3.024 Kuwait’s Vision for Environmental Data Management 2010-2030.

Early Career Scientist

Presenting Author:
Marwan AlDimashki, Environment Public Authority (EPA), Environmental Monitoring Information System of Kuwait (eMISK), State of Kuwait, marwan@emisk.org

Co-Authors:
Mohammad AlAhmad, Environment Public Authority (EPA), Environmental Monitoring Information System of Kuwait (eMISK), State of Kuwait

Abstract:

Issues ranging from reduced availability of fresh water, contamination of natural systems, waste management, sustainable use of resources, population growth, air pollution and climate changes and land degradation to remediation of oil spills and land mines have all remained hot topics of discussion at public forums and media conferences in Kuwait.
The Environment Public Authority in Kuwait (KEPA) is the authoritative regulatory body responsible for monitoring the quality of the environment in the State of Kuwait in collaboration with other relevant ministries and authorities. KEPA holds a wealth of environmental monitoring data which goes back as early as 1980 generated through many environmental monitoring programmes covering all environmental domains. KEPA realized that the provision and the rapid access to authentic environmental information and geospatial analysis of environmental data are fast becoming necessary tools for the evaluation of impacts on human health and the environment and are very essential for environmental management and decision making.
To enhance Kuwait EPA capabilities in the monitoring and dissemination of environmental data and knowledge related to environmental issues and activities in Kuwait using Geographic Information Systems (GIS) and other relevant technologies such as remote sensing, GPS and web-GIS based services, Kuwait EPA took the initiative in 2010 by establishing the ‘Environmental Monitoring Information System of Kuwait (eMISK), as a unique repository of geo-environmental information relating to Kuwait that is shared commonly with people over the internet. eMISK employs state-of-art hardware and software, based on the latest technology and networking infrastructure. A customized GIS-based information system called “eMISK-Enterprise System (www.emisk.org)” and a public website “Kuwait Official Environmental Portal (www.beatona.net)” are being used for the dissemination of environmental knowledge and provides authoritative strategic and timely information for the government, companies, researchers and the Kuwaiti public for development and implementation of policies and decisions for a sustainable environment.

3.018 Analysis of Criteria pollutant and weather conditions. Case study: Highest record of temperature in Bogota, Colombia..

Early Career Scientist

Presenting Author:
Juan Aragon, Universidad Libre Colombia, juan.aragon@unilibrebog.edu.co

Co-Authors:
Alejandra Catacoli, Universidad Libre

Abstract:

The present work is aimed to explain the behavior of the criteria pollutants under extreme weather condition as in this case highest record of temperature in Bogota, Colombia. The city is located at 2600 MASL, and has an average temperature of 18˚C. On february eight of 2017 the temperature reported was 25,1 ˚C, and the next day was observed a concerning dense cloud of pollution. Reasons why the authors decided analyse the relationship between the weather extreme condition and the concentration of pollutants, first in a statistical sense, describing the parameters. Second in a spacial sense, ploting the concentration of pollutants and the main weather conditions during the study period. And third with the analysis of the rawinsonde to determine the inversion levels and the possible height of the pollutants. The findings pointed out the more respresentative positive lineal correlation between ozone and temperature, reaching 0,81 in r Pearson correlation. The use of GIS was helpful for solving the focus areas of pollution in the city, interpolated with IDW, and the response to weather conditions over study period. The temperature inversion zones can be asociated with the main concentration of pollutants in proportion with the molecular weight.

2.018 Confronting Recent Chemical Reanalyses with Satellite Data on Combustion Characteristics Over Megacities .

Presenting Author:
Avelino Arellano, Dept. of Hydrology and Atmospheric Sciences, University of Arizona, Tucson, AZ, USA, afarellano@email.arizona.edu

Abstract:

Recently, five independent chemical reanalyses spanning across the recent decade have been reported from leading data assimilation and inverse modeling groups like Copernicus Atmospheric Monitoring Service, Laboratoire des Sciences du Climat et de l'Environnement, Japan Agency for Marine-Earth Science and Technology, National Center for Atmospheric Research, and NASA Jet Propulsion Laboratory. These represent a range of modeling and assimilation approaches, assimilating different sets of chemical observations, and updating emission estimates from various bottom-up inventories. Yet all these studies mainly suffer from the following issues: a) mismatch in scales representing emissions in the model versus what is observed, b) validity of an assumption that the transformation of emission inventories to concentrations is well-known, and c) consistency in emission estimates across species. Representativeness and model (transport, mixing, removal, chemistry) errors are difficult to address with a single modeling system and traditional methods/approximations. There is a strong need therefore to initiate research efforts towards reconciling bottom-up and top-down estimates in a systematic manner, as has already been suggested by numerous studies. This is an opportunity to do so given the relative maturity in our understanding of the issues of retrievals, models, and inverse methods. Here, we introduce preliminary evaluation of these five reanalyses to better understand and characterize uncertainties and elucidate key factors contributing to the errors in top-down estimates. This serves as a step towards an inter-comparison project on current chemical data assimilation/inverse modeling systems (CDAs) similar to TransCom Experiment for CO_2 and CH^4. We introduce a project called **CH**emical **I**nverse **M**odeling system **E**xperiments (CHIME), which begins by evaluating these five reanalyses on their ability to capture emergent patterns in reasonably observed trace gases such as CO (MOPITT, IASI), NO_X (OMI), and SO_2 (OMI, IASI)). Our evaluation will focus on analysis of the joint probability distributions of combustion products from major megacities.

1.047 Influence of canopy reduction on biogenic NO emission patterns in northern Europe.

Early Career Scientist

Presenting Author:
Jan Alexander Arndt, Helmholtz-Zentrum Geesthacht, Institute of Coastal Research, Max-Planck-Str.1, D-21502 Geesthacht, Germany, jan.arndt@hzg.de

Co-Authors:
Volker Matthias, Helmholtz-Zentrum Geesthacht, Institute of Coastal Research, Max-Planck-Str.1, D-21502 Geesthacht, Germany
Armin Aulinger, Helmholtz-Zentrum Geesthacht, Institute of Coastal Research, Max-Planck-Str.1, D-21502 Geesthacht, Germany
Johannes Bieser, Helmholtz-Zentrum Geesthacht, Institute of Coastal Research, Max-Planck-Str.1, D-21502 Geesthacht, Germany

Abstract:

Microorganisms in soil perform nitrification and denitrification processes. As an intermediate compound nitrogen monoxide (NO) is produced and partly emitted to the atmosphere. On a global scale this contributes to 15% of the total NO emissions. Modeling approaches often use above-soil parameterizations to estimate the NO flux to the atmosphere. However, in the lowest part of the atmosphere, NO reacts to nitrogen dioxide (NO2) and is partly absorbed by leaves in the canopy layer of crops and woods. To take this effective emission reduction into account, canopy reduction functions are used.
In this study we examine the impact of canopy reduction schemes on NO emissions and subsequently on air concentration and deposition patterns in Northern Europe. We tested two different canopy reduction functions. For the first one after Wang et al. (1998), we found an overall reduction of oxidized reactive nitrogen air concentrations of about 5%, with a maximum reduction of about 30% in rural areas. Nitrogen deposition is reduced by about 2.5% on average and up to 15% in extreme cases. This nonlinear response of dry deposition to emission reduction is explained by a shift in the chemical composition of nitrogen species due to the removal of nitrogen oxides which leads to faster dry deposition.
The second parameterization after Yienger and Levy (1995) uses a much simpler canopy reduction scheme. For example, much more simplified and therefore unrealistic time profiles for the diurnal and annual cycle are used. In total, it gives approximately two times the reduction effect of the Wang parameterization.

1.027 A line-point source model for ship emissions in ports.

Presenting Author:

Armin Aulinger, Helmholtz-Zentrum Geesthacht, Institute of Coastal Research, 21505 Geesthacht, Germany, armin.aulinger@hzg.de

Co-Authors:

Volker Matthias, Helmholtz-Zentrum Geesthacht, Institute of Coastal Research, 21505 Geesthacht, Germany

Abstract:

Ships emit considerable amounts of pollutants, not only when sailing, but also during their stay at berth. This is of particular importance for port cities hosting large vessels that contribute notably to nitrogen oxide and particle concentration levels.
To estimate the emissions from ships in ports both the technical specifications of the ships and their emission factors specific to the different ship activities, sailing, maneuvering and berthing need to be known. At our institute, we combined a line source model approach for moving ships and a point source model for ships at berth following an approach by Hulskotte and Denier van der Gon. For moving ships, emission factors depend on the ship size and type and the load of the engines during sailing. For berthing ships, functional relationships between ship size and fuel use per hour at berth for different ship types have been derived. These functions have been combined with ship activities derived from AIS data and tables of port calls to calculate the energy use, fuel consumption and emissions of the most important gaseous and particulate pollutants.
As a first example, annual ship emissions for 2013 for the port of Hamburg were calculated with this model. Due to the strict regulations for the fuel sulfur content in ports the sulfur dioxide and sulfate emissions are low compared to the emissions of nitrogen oxides. In 2013, the total NOx emissions from ships amounted to more than 5000 tons while SO2 emissions were about 650 tons. Primary aerosol emissions comprising sulfates, black carbon and other primary organic aerosols were about 280 tons according to the model results.

2.029 SO2 EMISSIONS OVER CHINA; EVALUATION OF NEW TOP-DOWN INVENTORIES .

Presenting Author:

Dimitriosq Balis, Laboratory of Atmospheric Physics, Aristotle University of Thessaloniki, Greece., balis@auth.gr

Co-Authors:

MariLiza Koukouli, Laboratory of Atmospheric Physics, Aristotle University of Thessaloniki, Greece.

Ronald van der A, Royal Netherlands Meteorological Institute (KNMI), De Bilt, The Netherlands & Nanjing University of Information Science & Technology (NUIST), China.

Jieying Ding, Royal Netherlands Meteorological Institute (KNMI), De Bilt, The Netherlands

Fei Liu, Royal Netherlands Meteorological Institute (KNMI), De Bilt, The Netherlands

Konstantinos Kourtidis, Department of Environmental Engineering, Democritus University of Thrace (DUTH), Greece.

Aristeidis Georgoulias, Department of Environmental Engineering, Democritus University of Thrace (DUTH), Greece.

Abstract:

Within the aims of the EU FP7 *Monitoring and Assessment of Regional air quality in China using space Observations Project Of Long-term sino-european co-Operation*, MarcoPolo, project was to improve Sulphur Dioxide, SO_2, air quality monitoring, modelling and forecasting over China using satellite data. As such, three different techniques were employed to attempt at updating the existing bottom-up SO_2 estimates: a combination with existing emission inventory-type technique developed by LAP/Auth, a linearity between NOx and SO_2 levels-type technique developed by DUTH and a technique weighing existing emissions inventories with satellite-derived trends developed by KNMI. In the following, these three emission inventories will be presented, discussed and compared to existing bottom-up emissions such as the MEIC v1.2 and the EDGAR v4.3.1 databases. Furthermore, the effect of utilizing these emissions on the output field of the CHIMERE CTM model will also be presented and evaluated against other modelling outputs.

1.049 Effect of climate change and CO2 inhibition on isoprene emissions in Europe calculated using the ALARO-0 regional climate model .

Presenting Author:
Maite Bauwens, BIRA-IASB, Tropospheric Chemistry Modelling Team, Brussels, 1180, Belgium, maiteb@oma.be

Co-Authors:
T. Stavrakou , Royal Belgian Institute for Space Aeronomy, Brussels, Belgium
J.-F. Müller , Royal Belgian Institute for Space Aeronomy, Brussels, Belgium
L. De Cruz , Royal Meteorological Institute, Brussels, Belgium
R. De Troch , Royal Meteorological Institute, Brussels, Belgium
B. Schaeybroeck , Royal Meteorological Institute, Brussels, Belgium
R. Hamdi , Royal Meteorological Institute, Brussels, Belgium
P. Termonia , Royal Meteorological Institute, Brussels, Belgium
O. Giot , Royal Meteorological Institute, Brussels, Belgium
A. Sanchez-Lorenzo, Spanish National Research Council (CSIC), Zaragoza, Spain

Abstract:

Isoprene is the dominant biogenic hydrocarbon emitted in the atmosphere, with global annual emissions estimated at ca. 400-600 Tg (Guenther et al. 2006). It plays a key role in the atmospheric composition because of its influence on tropospheric ozone formation in polluted environments and its contribution to particulate matter. Its emissions are modulated by meteorological parameters. Climate changes therefore affect the spatiotemporal and interannual variation of these emissions. In this study we estimate the isoprene fluxes emitted by vegetation in past and future climate over the European (EURO-CORDEX) domain using the MEGAN-MOHYCAN model (Müller et al. 2008, Stavrakou et al. 2014).We first calculate isoprene emissions over 1979-2014 based on the ECMWF ERA-Interim reanalysis data, we compare with available isoprene flux measurements, and we investigate the sensitivity to solar radiation changes observed at European stations. The interannual variability and emission trends on regional and country level are derived and discussed.
Next, we perform simulations using the output of the ALARO-0 regional climate model (Giot et al., 2015) forced by the RCP2.6, RCP4.5 and RCP8.5 scenarios over 2071-2099, and compare with the historical emissions over 1976-2005 derived by the same model. Furthermore, we incorporate the inhibition of isoprene emissions to the enhanced CO2 levels of the climate projections through two different parameterizations. The future climate scenarios result in higher isoprene emissions over the European domain increased by 6%, 33% and 82% for the RCP2.6, RCP4.5 and RCP8.5 scenario respectively. However, the CO2 inhibition effect results in an overall decrease of isoprene emissions relative to the standard future simulation, even though this decrease is strongly sensitive to the parameterization used. The different CO2 inhibition simulations in this study show that future isoprene emission are between 11% lower and 26% higher than the present

isoprene emissions over Europe.

3.012 Effect of different emission inventories on modeled trace gas and aerosol distribution in China.

Presenting Author:
IDIR BOUARAR, Max Planck Institute for Meteorology, Hamburg, Germany, idir.bouarar@gmail.com

Co-Authors:
Guy Brasseur, Max Planck Institute for Meteorology, Hamburg, Germany
Katinka Petersen, Max Planck Institute for Meteorology, Hamburg, Germany
Claire Granier, NOAA ESRL/CSD and CIRES, University Colorado, Boulder USA
Qi Fan, Sun Yat-Sen University, School of Environmental Sciences and Engineering (SESE-SYSU), Guangzhou, China
Xuemei Wang, Sun Yat-Sen University, School of Environmental Sciences and Engineering (SESE-SYSU), Guangzhou, China
Lili Wang, Institue of Atmospheric Physics, Chinese Academy of Sciences (IAPCAS), China
Ying Xie, The Shanghai Center for Urban Environmental Meteorology (SCUEM), China

Abstract:

The WRF-Chem weather and forecast model coupled with chemistry is used to predict air quality in China for January and July 2010 and to investigate the sensitivity of the model predictions to anthropogenic emissions. The focus is particularly put on three city clusters where surface observations are available: the Hebei-Beijing-Tianjin (HBT), the Yangtze River Delta (YRD) and the Pearl River Delta (PRD) regions. Three anthropogenic emission inventories with different spatial resolution are used in this study: MACCity, REASv2 and HTAPv2. Large differences between these inventories are found in the magnitude of their emissions (e.g. 98%, 35% and 85% respectively for CO, NOx and OC between HTAP and MACCity in HBT region in January), spatial distribution as well as seasonal variability. Such differences have significant impacts on model predictions which show clear regional and temporal differences. This is confirmed with comparison of model simulations performed with the different emission inventories with satellite measurements of CO total columns from MOPITTv6 and NO2 tropospheric columns from GOME2 and suface observations of NOx, O3, SO2, CO, PM2.5 and PM10. This study shows that a considerable part of the discrepancies in model predictions of air quality in China is related to uncertainties and differences in current emission inventories. The results highlight the need for improved and high-resolved anthropogenic emissions in order to improve the performance of air quality model predictions in China.

1.058 Quantifying sources contributing to ambient particulate matter in low income areas of South Africa.

Presenting Author:
Roelof Burger, North-West University, Potchefstroom, South Africa, roelof.burger@nwu.ac.za

Co-Authors:
Stuart Piketh, North-West University, Potchefstroom, South Africa
Brigitte Language, North-West University, Potchefstroom, South Africa
Nicola Walton, North-West University, Potchefstroom, South Africa
Luckson Muyemeki, North-West University, Potchefstroom, South Africa

Abstract:

People living in low-income areas in Southern Africa are exposed to the poorest ambient air quality in the region. Sources contributing include human influences like solid fuel burning, power generation, motor vehicles and industrial, as well as natural, like wind-blown dust and biomass burning. The interplay between the human and natural drivers are complex. Socioeconomic conditions of communities determine the quantity, amount, and type of fuels used for domestic purposes; the level of vehicle activity; and the impact on local land cover which in turn controls wind-blown dust emissions. This talk will present efforts to quantify the contribution of different sources to the ambient levels of particulate matter in three different low-income areas in Southern Africa using a source and a receptor-based approach. Source apportionment performed in different seasons using coarse and fine nucleopore filters in stacked filter unit samplers, analyzed with energy dispersive X-Ray Fluorescence (XRF) and Ion Chromatography (IC), and modeled using chemical mass balanced (CMB) and positive matrix factorization (PMF). These results are compared with source based dispersion modelling. Solid fuel burning is the dominant source contributing to ambient levels of particulate matter. Regional sources like biomass burning and wind-blown dust are important to short term events of very high levels of ambient levels. Results show the importance of quantifying sources at high spatial and temporal scales. This is especially relevant for areas that have a variety of different local, low-level sources of particulate matter, such as dense, low-income communities.

3.029 First Experiences of Mexico Ctiy Air Quality Forecast System.

Presenting Author:

Beatriz Cardenas, Air Quality Management General Direction, Mexico City Ministry of Environment, Mexico City, Mexico, bcardenagz@gmail.com

Co-Authors:

Monica Jaimes-P, Air Quality Management General Direction, Mexico City Ministry of Environment, Mexico City, Mexico

Armando Retama , Independent consultant, Mexico City, Mexico

Guevara Marc, Earth Sciences Division, Barcelona Supercomputing Center, Barcelona, Spain

Aguilar Alberto, Air Quality Management General Direction, Mexico City Ministry of Environment, Mexico City, Mexico

Camacho Patricia, Air Quality Management General Direction, Mexico City Ministry of Environment, Mexico City, Mexico

Juan M. Arriaga, Air Quality Management General Direction, Mexico City Ministry of Environment, Mexico City, Mexico

Mauricio Hernández, Air Quality Management General Direction, Mexico City Ministry of Environment, Mexico City, Mexico

Kim Serradell, Earth Sciences Division, Barcelona Supercomputing Center, Barcelona, Spain

Carlos Tena, Earth Sciences Division, Barcelona Supercomputing Center, Barcelona, Spain

Olivia Rivera, Air Quality Management General Direction, Mexico City Ministry of Environment, Mexico City, Mexico

Abstract:

The Mexico City Metropolitan Area (MCMA) is especially susceptible to the formation of photochemical smog, due to amount and type of precursors emitted as well as its physiographic and meteorological characteristics. MCMA´s air quality has been improved over the last two decades, however ozone (O_3) levels are still exceeding the limit value of the Mexican air quality standard for more than 34% of days per year (2016). Evaluation of the MCMA population health impacts have been evaluated.

The Atmospheric Contingency Program, implemented in 1999, it is activated when O_3or PM10 concentration reach certain levels which over the years have been continuously reduced... The program considers alerts to population and requires the application of different actions to reduce atmospheric emissions of the main sources in order to avoid the worsening of the episode. In February 2017, Mexico City implemented an operational Air Quality Forecasting System, that present information at (http://www.aire.cdmx.gob.mx/pronostico-aire/) and through a mobile application. The system is composed by the WRF meteorological model, the CMAQ photochemistry model and an in-house emission model, which uses Mexico City local emission inventory as input

data. The results of the system are continuously evaluated with the Automatic Air Quality Monitoring Network. Analyses of the first three month suggests a good performance of the system, with a high probability of O_3 event-detection (70%) and a deviation of 15 ppb in O_3 peaks. The data provided by the system will help to create knowledge bases to contribute to the development of emergency plans (high ozone levels), to decision making and to emission reduction programs. It will also make quantitative information on air pollution available to society, the health sector and environmental authorities.An evaluation of the first 8 months of this forecast will be presented .

2.026 Verifying the UK agricultural N2O emission inventory with tall tower measurements.

Early Career Scientist

Presenting Author:
Edward Carnell, Centre for Ecology & Hydrology Edinburgh, Bush Estate, Penicuik, Midlothian EH26 0QB, UK, edcarn@ceh.ac.uk

Co-Authors:
Elena Meneguz, Met Office, Fitzroy Road, Exeter, Devon, EX1 3PB, UK
Ute Skiba, Centre for Ecology & Hydrology Edinburgh, Bush Estate, Penicuik, Midlothian EH26 0QB, UK
Tom Misselbrook, Rothamsted Research, North Wyke, Okehampton, Exeter, EX20 2SB, UK
Laura Cardenas, Rothamsted Research, North Wyke, Okehampton, Exeter, EX20 2SB, UK
Tim Arnold, Met Office, Fitzroy Road, Exeter, Devon, EX1 3PB, UK
Alistair Manning, Met Office, Fitzroy Road, Exeter, Devon, EX1 3PB, UK
Ulrike Dragosits, Centre for Ecology & Hydrology Edinburgh, Bush Estate, Penicuik, Midlothian EH26 0QB, UK

Abstract:

Nitrous oxide (N_2O) is a key greenhouse gas (GHG), with a global warming potential ~300 times greater than that of CO_2. N_2O is predominantly emitted from agricultural sources. Annual UK emission estimates are reported, to comply with government commitments under the United Nations Framework Convention on Climate Change (UNFCCC). The UK N_2O inventory follows internationally agreed protocols and emission estimates are derived by applying emission factors to estimates of (anthropogenic) emission sources. This approach is useful for comparing anthropogenic emissions from different countries, but does not capture regional differences and inter-annual variability associated with environmental factors and agricultural management. In recent years, the UK inventory approach has been refined to include regional information into its emissions estimates, in an attempt to reduce uncertainty.
This study attempts to assess the difference between current published inventory methodology (default IPCC methodology) and an alternative approach, which incorporates the latest thinking, using data from recent work. For 2013, emission estimates made using the alternative approach were 30 % lower than those made using default IPCC methodology, due to the use of lower emission factors suggested by recent projects (Defra projects: AC0116, AC0213 and MinNO). Annual emission estimates were disaggregated on a monthly basis using agricultural management (e.g. sowing dates), climate data and soil properties. The temporally disaggregated emission maps were used as input to the Met Office atmospheric dispersion model NAME, for comparison with measured N_2O concentrations, at three observation stations in the UK DECC network (Deriving Emissions linked to Climate Change). The trends in the modelled data were

found to correspond with the observational data trends, with concentration peaks coinciding with periods of land spreading of manures and fertiliser application. The model run using the default IPCC methodology was found to correspond with the observed data more closely than the alternative approach.

2.030 Gas flaring detection, characterisation and emissions assessment from Sentinel-3 SLSTR.

Presenting Author:
Alexandre Caseiro, Max-Planck-Institute for Chemistry, Mainz, Germany, alexandre.caseiro@mpic.de

Co-Authors:
Johannes W. Kaiser, Max-Planck-Institute for Chemistry, Mainz, Germany
Gernot Ruecker, Zebris GbR, Munich, Germany
Eckehard Lorenz, DLR, Berlin, Germany

Abstract:

Gas flaring (GF) is a disposal process widely used in the upstream oil industry, which consists of burning unwanted associated gas at the tip of a stack. Since this process mostly consists of oxidizing methane to carbon dioxide prior to releasing it into the atmosphere, it is a source of greenhouse gases and black carbon (BC). At higher latitudes, GF has been estimated as the main input of atmospheric BC, alongside vegetation fires.
Being a high temperature process, GF can be detected from space using measurements in the infrared spectral domain. Indeed, remote sensing has the ability to overcome the technical difficulties that have hindered routine in-situ measurements and a systematic reporting framework. The SLSTR instrument on board ESA's Sentinel-3A features a suitable channel setting for the night-time detection and characterisation of GFs in terms of temperature, area and fire radiative power (FRP). Once the characterisation has been performed, the estimation of emissions can be conducted by applying published emission factors to estimated FRP.
In this work, we present a detailed methodology for the detection and characterisation of GFs using night-time radiances sampled by SLSTR. The methodology is applied to a year long SLSTR radiances dataset over known flaring regions. FRP retrievals are cross-validated by comparison with the results obtained from the higher resolution German FireBIRD small satellite mission and with the Nightfire product based on VIIRS on-board Suomi NPP satellite. The corresponding emissions will be computed and presented.

1.023 Ammonia emissions from agriculture activities in Argentina (2000-2012) under increasing soybean expansion and changes in livestock production.

Early Career Scientist

Presenting Author:
Paula Castesana, (a) Instituto de Investigación e Ingeniería Ambiental, Universidad Nacional de San Martín (3iA-UNSAM), Buenos Aires, Argentina; (b) Facultad Regional Buenos Aires, Universidad Tecnológica Nacional (FRBA-UTN), Ciudad Autónoma de Buenos Aires, Argentina., pcastesana@unsam.edu.ar

Co-Authors:
Laura Dawidowski, (c) Comisión Nacional de Energía Atómica (CNEA), Buenos Aires, Argentina; (a) Instituto de Investigación e Ingeniería Ambiental, Universidad Nacional de San Martín (3iA-UNSAM), Buenos Aires, Argentina.
Laura Finster, (d) Instituto Nacional de Tecnología Agropecuaria (INTA), Argentina.
Darío Gómez, (c) Comisión Nacional de Energía Atómica (CNEA), Buenos Aires, Argentina.
Miguel Taboada, (d) Instituto Nacional de Tecnología Agropecuaria (INTA), Argentina; (e) Consejo Nacional de Investigaciones Científicas y Técnicas (CONICET), Argentina.

Abstract:

Agriculture has a significant participation in the Argentinean economy and, in the last decades, the increase in prices and competitiveness of some grains has imposed important changes. In this process, many millions of hectares historically devoted to livestock farming have been switched to crop cultivation, while cattle farming (historically based on pastoral production systems) has evolved towards (*i*) geographical relocation in lower-performance agricultural areas, and (*ii*) intensification of activity through feeding modifications and the increased implementation of feedlot systems. The agriculture sector accounts most likely for the largest share of NH_3 emissions in Argentina, however no inventory developed locally has been thus far available. To bridge this gap and particularly to have accurate input information for coupled atmospheric chemistry models for secondary inorganic aerosols, we estimated 2000-2012 NH_3 emissions, both at national and spatially disaggregated levels. Of particular interest for us was also to improve the consistency of the time series and evaluate the impact of changes in agricultural practices and technologies during this period in Argentina. National NH_3 emissions in 2012 amounted for 302.1 Gg, use of fertilizers accounted for 44.5%, manure management 20.3%, manure in pasture 33.6% and agricultural waste burning 1.5%. These results do not include prescribed burning of savannas because there are major disagreements regarding the allocation of emissions from this category. NH_3 estimates in the EDGAR database for 2008 are 88.1% higher than ours for this year, and exhibit more

significant differences per category, namely 112.7% higher for use of fertilizers, 102.4% higher for manure in pasture, about 500% higher for agricultural waste burning, but 25.6% lower for manure management. Urea dominates national NH_3 emissions, accounting for 34.2% of the total in 2012 and its use for wheat and corn crops dominates the trend.

1.053 Determination of the Emission Factors of Jeepneys and Tricycles in the Philippines.

Presenting Author:

Mylene Cayetano, Institute of Environmental Science and Meteorology, University of the Philippines, Diliman, 1101, Quezon City Philippines, mcayetano@iesm.upd.edu.ph

Co-Authors:

Enrique Mikhael Cosep, Institute of Environmental Science and Meteorology, University of the Philippines, Diliman, 1101, Quezon City Philippines

Abstract:

At present, the Philippines does not have an established emission factor database for estimating the annual emission of different sources despite the huge pollution contributions of sources like motorized vehicles. Local agencies still rely on emission factors taken from the US EPA or other international agencies. The aim of this research is to establish an emission factor for two specific vehicles: namely the Jeepney (PUV) and the Tricycle (MC/TC). These two vehicles are the most common public transportation medium used in the Philippines and can be found nearly all throughout the country. In addition, PUVs and MC/TCs are significant source of outdoor air pollution. In this research, fine particulate matter ($PM_{2.5}$)a nd elemental emission factors, and the estimated annual emissions from both PUVs and MC/TCs were determined. Samples were collected employing a wind tunnel setup and an active filter based sampling device. The emission samples were subsequently analyzed by gravimetric analysis to determine its mass, and Inductively Coupled Plasma-Mass Spectrometry to determine its elemental composition. The $PM_{2.5}$ emission factors generated for the PUVs and MC/TCs are 0.7 g(*1000)/km and 0.2 g(*1000)/km respectively. The generated values, with the statistical data received from the Land Transportation Office, were used to estimate the annual emission per vehicle type for the year 2012 and 2013. The determined values can be used to assess the current local, regional and national air quality as well as the variations observed compared to previous years. Environmental agencies can also benefit by being able to ascertain the applicability of existing policies, and if needed, accordingly change and improve dated procedures as well as develop new control systems and programs.

3.037 Household solid fuel use for space heating: Updating emissions estimates to better understand air pollution, health, and climate change implications.

Early Career Scientist

Presenting Author:
Zoe Chafe, Cornell University, Atkinson Center for a Sustainable Future, Ithaca, NY, USA, zoe.chafe@cornell.edu

Co-Authors:
Zbigniew Klimont, International Institute for Applied Systems Analysis (IIASA), Laxenburg, Austria
Nicholas Lam, University of Illinois at Urbana-Champaign, Department of Civil & Environmental Engineering, Urbana, IL, USA
Pallav Purohit, International Institute for Applied Systems Analysis (IIASA), Laxenburg, Austria

Abstract:

Use of solid fuels (wood, dung, coal, charcoal etc.) for household heating is a major source of fine particulate air pollution and ill-health in many areas where space heating is required. Initial estimates indicate that household heating with sold fuels may account for about 3% of total PM2.5 emissions, resulting in approximately 100,000 premature deaths per year. Household heating with solid fuels is practiced in countries of all income levels—unlike cooking with solid fuels, which is generally restricted to low and middle income countries. However, the manner in which solid fuels are combusted for space heating vary greatly both within and between countries, presenting challenges to the broad-scale assessment of emissions and impacts.
This presentation will describe efforts to improve understanding of both emissions and impacts related to combustion of solid fuels for household space heating, including integration of model estimations and national-level emission inventories; estimation of climate-relevant pollutants from household combustion for heating; and efforts to quantify health impacts from household solid fuel heating on a global scale.

3.026 Air quality and health impact with mitigation measures in changing climate over Global, Asian and Regional scales.

Presenting Author:
DILIP CHATE, Indian Institute of Tropical Meteorology, Pune India,
chate@tropmet.res.in

Co-Authors:
Sachin Ghude, Indian Institute of Tropical Meteorology, Pune India

Abstract:

Short-lived greenhouse gas and aerosol pollutants emitted from anthropogenic sources account directly or indirectly for extreme pollutant episodes leads to the direct damage to human health from energy use all over the developed and developing region of the world. Significant portion of human population is believed to be regularly exposed to higher surface ozone (O_3) levels with recent upward trend in industrialization and urbanization. Focus of presentation will be on total, cardiovascular and respiratory mortalities, and hospitalizations (COPD) caused by population exposure to surface O_3. We will show results of estimated exposure attributable to surface O_3 concentration using population distribution in recent decade in conjunction with finer spatial scale (0.5°x0.5°) regional chemical transport model (WRF-Chem) simulations that resolve surface O_3 levels over rural, urban, suburban, and industrial hotspots regions. Further focus will be on quantified attributable mortalities using health impact function of long-term relative risk estimates (population attributable-risk proportion) for O_3 from epidemiology literature. Results will be presented for total mortality and mortality caused by cardiovascular deceases and by respiratory deceases and COPD cases by O_3 exposure to population. The focus of talk will be on groups of vulnerable public, including those suffering from cardiovascular and respiratory diseases, people with reactive airways and airway allergies. We will present estimated economic loss which will be useful to policymakers, researchers and planners. Based on our scientific discussion, we can address how patterns of emissions depend on anthropogenic sources over global to regional scales in relation to changing world.
Keywords: COPD, mortality, WRF-Chem, population exposure, air quality, ozone

2.014 Agricultural NH3 emissions regional variability and trends as observed by IASI.

Presenting Author:
Audrey CHEINEY, LISA, CNRS/INSU, UMR 7583, Université Paris-Est Créteil, Créteil, France, audrey.cheiney@lisa.u-pec.fr

Co-Authors:
Gaelle DUFOUR, LISA, CNRS/INSU, UMR 7583, Université Paris-Est Créteil, Créteil, France
Gilles FORET, LISA, CNRS/INSU, UMR 7583, Université Paris-Est Créteil, Créteil, France
Guillaule SIOUR, LISA, CNRS/INSU, UMR 7583, Université Paris-Est Créteil, Créteil, France
Matthias BEEKMANN, LISA, CNRS/INSU, UMR 7583, Université Paris-Est Créteil, Créteil, France
Cathy CLERBAUX, LATMOS/IPSL, UPMC Univeristé Paris06, UVSQ, CNRS, Paris, France
Pierre COHEUR, Spectroscopie de l'atmosphère, Chimie quantique et photophysique, Univeristé LIbre de Bruxelles, Brussels, Belgium
Martin VAN DAMME, Spectroscopie de l'atmosphère, Chimie quantique et photophysique, Univeristé LIbre de Bruxelles, Brussels, Belgium
Lieven CLARISSE, Spectroscopie de l'atmosphère, Chimie quantique et photophysique, Univeristé LIbre de Bruxelles, Brussels, Belgium

Abstract:

Ammonia (NH_3), which main source is agriculture, is an important precursor gas for particulate matter concentrations. We have analyzed the temporal variability of ammonia at different scale. First, we derived ammonia emissions from space, using NH_3 total columns from the IASI instrument onboard Metop-A, at a high resolution (grid-cell of 0.5° x 0.5°, at a daily scale), for the European spring haze episode of March 2014, 8th to 15th. During this period, IASI reveals higher NH_3 emissions than in the European reference EMEP inventory over Central Europe (especially over Germany, Czech Republic and eastern France), exhibiting in addition a large day-to-day variability. This suggests emissions due to punctual spreading practices, that are difficult to anticipate with an inventory-based approach, drive the ammonia variability in springtime. The increase of NH_3 emissions, that could reach +300% locally, leads both to an increase of simulated NH_3 and PM_{25} surface concentrations and conducts to a better comparison with independent measurements (in terms of bias, root mean square error and correlation).

Second, we described interannual variability (IAV) and trends of IASI total columns for several regions of the world. We showed positive trend over China and over USA for the 2008-2015 period, whereas a negative trend is observed over India. Finally, IASI showed very high NH_3 values in 2015 all around the world and an investigation is performed to understand such feature.
These preliminary studies are promising for future quantification of NH_3 emission estimates by atmospheric inversions, at a daily scale during pollutions peaks or at a monthly scale for decadal analysis.

3.033 Uncertainties of Estimated PM2.5- and O3-Related Health Impacts in China due to Emissions.

Presenting Author:
Futu Chen, Boston Medical Center, Boston, Massachusetts, USA, futuchen0704@gmail.com

Co-Authors:
Min Zhong, Department of Environmental Sciences, Emory University, Atlanta, Geogia, USA
Eri Saikawa, Department of Environmental Sciences, Emory University, Atlanta, Geogia, USA

Abstract:

Background: Exposure to fine particulate matter ($PM_{2.5}$) as well as ground-level ozone (O_3) is associated with a variety of adverse health effects. Particularly in China, these air pollutants are anticipated to continuously affect large populations in the coming decades. Simulation of the levels of these pollutants largely depends on emissions inputs, which are highly uncertain in magnitude and spatial distribution. Few studies have quantified how the uncertainty in emissions estimates affects adverse health impacts calculations, such as premature mortality and hospital visits. Our goal was to provide quantitative analysis of how emissions and other model parameters influence $PM_{2.5}$ and O_3-related health impacts calculations in China.
Methods: We simulated $PM_{2.5}$ and O_3 concentrations using the Weather Research and Forecasting model coupled with Chemistry (WRF-Chem) for 2008 and 2050. We used three different emission inventories in 2008 and four emissions scenarios in 2050. Each of the resulting air pollutant concentrations were combined with one of the eight population projections and with one of multiple existing concentration-response functions to estimate future $PM_{2.5}$- and O_3- related health effects in China. An analysis of variance was used to apportion the uncertainty due to different parameters.
Findings: Different combinations of model parameters produced a wide range of national $PM_{2.5}$- and O_3-related mortality and morbidity. Present emissions are the largest source of uncertainty for $PM_{2.5}$-related health estimates (74% of total sum squares), while future emissions are the greatest source of uncertainty for estimated O_3-related health outcomes (52% of total sum squares). Other parameters are much less influential, compared with emissions.
Interpretation: Our results highlight the importance of reducing uncertainty in emissions estimates for quantifying potential $PM_{2.5}$ and O_3-related human health impacts. It is particularly essential to have a better understanding of present emissions to reduce uncertainty in $PM_{2.5}$-related health impacts calculations for the future.

1.042 Emissions from cooking and other sources in West Africa.

Presenting Author:
Evan Coffey, University of Colorado Mechanical Engineering, Boulder Colorado USA, coffeye@colorado.edu

Co-Authors:
Didier Muvandimwe, University of Colorado Mechanical Engineering, Boulder Colorado USA
Ricardo Piedrahita, University of Colorado Mechanical Engineering, Boulder Colorado USA
David Pfotenhauer, University of Colorado Mechanical Engineering, Boulder Colorado USA
Forrest Lacey, University of Colorado Mechanical Engineering, Boulder Colorado USA
Michael Hannigan, University of Colorado Mechanical Engineering, Boulder Colorado USA
Mingjie Xie, University of Colorado Mechanical Engineering, Boulder Colorado USA
Christine Wiedinmyer, National Center for Atmospheric Research, Atmospheric Chemical Observations & Modeling Laboratory, Boulder Colorado USA
Ernest Kanyomse, Navrongo Health Research Center, Upper East Region Ghana
Abraham Oduro, Navrongo Health Research Center, Upper East Region Ghana

Abstract:

Anthropogenic emissions of pollutants in Africa still remain highly uncertain, and the contribution of residential emissions from cooking with biomass is large. As part of the Research Of Emissions, Air Quality, Climate, And Cooking Technologies In Northern Ghana (REACCTING) project, in-field emission measurements from 75 UCTs (Uncontrolled Cooking Tests) of trace gases and particulate matter (PM) were made on traditional and two improved stoves. Emission factors of carbon dioxide, carbon monoxide and carbonaceous (both organic and elemental) PM were calculated from the measurements for a variety of fuel, stove and meal type combinations. The differences between the traditional and improved stove emissions were quantified with mixed effects models. The results are used as inputs to residential emission inventories in West Africa. We also assess the sensitivity of the overall inventory to the way in which the emissions are calculated: per person, food produced and energy delivered. Moreover, emission factors from a wide range of common biomass burning activities (commercial cooking, charcoal making, kerosene lighting, trash burning etc.) were calculated and compared to existing inventory values.

2.006 Integrating remotely sensed AOD and trace gasses to quantify the 3-dimensional emissions of Asian aerosols.

Presenting Author:
Jason Blake Cohen, Sun Yat-Sen University, School of Atmospheric Sciences, Guangzhou, Guangdong, China, jasonbc@alum.mit.edu

Abstract:

We use a new methodology with 3 simultaneously remotely sensed products from MODIS, OMI, and MOPITT to produce a new and more robust analysis of Asian aerosol. Our results are capable of reproducing inter-annual, and intra-annual variations in the emissions of Asian Aerosols over the large scale, for the decade from 2006-2016. In particular, the results are quite good over Eastern and Southeastern Asia, matching well against various external measurements, without the need for scaling factors to be applied. One reason for this new finding is that the measurements underlying the emissions estimations span different spectral, spatial, temporal, and size ranges.

The results of this inversion display the fact that urban regions play a significant role in this region. However, it is also found that there is a slow by important change in the emissions from urban areas, associated with new-urbanization as well as other underlying economic and technological factors. Frequently these are occurring in areas which are otherwise not know to be urbanizing or rapidly changing. Furthermore, we find that there are regions of large-scale change due to emissions from biomass burning. Again, many of these regions are not previously known or accounted for, even in datasets such as FINN. Additionally, due to the use of different measurements with different properties, additional insights are made in terms of quantifying the amounts from primary emissions versus secondary in-situ production, which is still hard to measure on the ground in this part of the world.

1.024 Anthropogenic Carbon Dioxide Emissions in Tokyo Metropolis Estimated with a Combination of Top-down and Bottom-up Approach.

Early Career Scientist

Presenting Author:
Richao Cong, Center for Global Environmental Research, National Institute for Environmental Studies, Tsukuba, Ibaraki, Japan, cong189@126.com

Co-Authors:
Makoto Saito, Center for Global Environmental Research, National Institute for Environmental Studies, Tsukuba, Ibaraki, Japan
Ryuichi Hirata, Center for Global Environmental Research, National Institute for Environmental Studies, Tsukuba, Ibaraki, Japan
Akihiko Ito, Center for Global Environmental Research, National Institute for Environmental Studies, Tsukuba, Ibaraki, Japan
Shamil Maksyutov, Center for Global Environmental Research, National Institute for Environmental Studies, Tsukuba, Ibaraki, Japan
Tomohiro Oda, Global Modeling and Assimilation Office, NASA Goddard Space Flight Center, Greenbelt, Maryland, USA

Abstract:

Anthropogenic greenhouse gas (GHG) emissions are considered as the main sources of the global carbon cycle. Of which Carbon dioxide (CO_2) is a major GHG source. Therefore, visible analysis on CO_2 emission sources and trend is meaningful for the data validation when combing the atmospheric and satellite observations with atmospheric transport models. In this paper, we focus on developing a visible CO_2 emissions inventory by using Geography Information System (GIS) to make CO_2 emissions distribution map of Tokyo Metropolis with high spatial resolution.
The emission sources are divided into three categories: point, line and continuum. For point source, detailed information of Tokyo on the power plants, waste disposal plants, and airport are gathered. The line source refers to the roads for which the traffic volume statistics data is available. And the continuum source is related to energy consumption in the rest of roads, residential area, commercial area, industrial area, and other sectors. The bottom-up approach is used for estimating the CO_2 emissions from the point source and line source (roads that with larger traffic volume). The activity volumes with geographical attributes are multiplied by the emission factors to gain the annual total emissions. In addition, top-down approach is applied for counting the annual emissions from continuum source. Hence, we use the energy consumption data and emission factors to calculate the total emissions of each sector and then allocating it by population indictor which own geographical distribution information. After allocating these emissions data into the map by GIS, a high spatial resolution map is obtained. In addition, the inventory of EAGrid2010-Japan is used for resolution comparison. Due to our achievement, CO_2 emissions inventory is more visible at local scale and precise for data

validation in global carbon cycle.

1.016 Global Modeling of Oceanic Carbon Monoxide Emissions.

Early Career Scientist

Presenting Author:
Ludivine CONTE, Laboratoire des Sciences du Climat et de l'Environnement CEA-CNRS-UVSQ, Orme des Merisiers, 91191, Gif sur Yvette, France, ludivine.conte@lsce.ipsl.fr

Co-Authors:
Sophie SZOPA, Laboratoire des Sciences du Climat et de l'Environnement CEA-CNRS-UVSQ, Orme des Merisiers, 91191, Gif sur Yvette, France
Laurent BOPP, Laboratoire de Météorologie Dynamique, rue d'Ulm, 75005, Paris, France

Abstract:

Carbon monoxide (CO) is an important compound for tropospheric chemistry. It is the dominant sink for hydroxyl radicals and is involved in ozone chemistry. Hence, atmospheric CO concentrations indirectly affect the lifetime of greenhouse gases like methane and have impacts on air quality. The ocean has long been recognized as a source of atmospheric CO. Even if in minority at the global scale, it plays a key role far from continental anthropized zones. Its marine production is linked to both photooxidation of organic matter and phytoplanktonic activity and can thus have a large interannual variability. Several campaigns have been carried out to characterize these emissions and were used to assess the global oceanic source but due to their scarcity and to large heterogeneities in phytoplankton and organic matter distributions, the extrapolation is rather imprecise. Our study aims to quantify the CO oceanic emissions at the global scale and to characterize their interannual variability and trends considering multidecadal global changes. The marine biogeochemical model PISCES, coupled to the ocean general circulation model NEMO, explicitly represents CO source and sink terms in the ocean. These terms include photoproduction, which is related to the action of UV on colored dissolved organic matter, phytoplankton production, bacterial consumption and fluxes at the ocean-atmosphere interface. Simulated oceanic CO concentrations have been compared to literature reported surface data as well as vertical profiles collected around the world during the last 30 years. First results show a global emission of a few tens of TgC per year, with large spatial and seasonal variabilities in both oceanic concentrations and emissions.

1.066 An optimized NOx emission inventory over East Asia, from PYVAR-CHIMERE inverse modeling tool constrained by OMI satellite observations.

Presenting Author:
Lorenzo Costantino, Laboratoire Interuniversitaire des Systèmes Atmosphériques (LISA), CNRS UMR7583, Université Paris Est Créteil, Université Paris Diderot, Créteil, France, lore.costantino@gmail.com

Co-Authors:
Gaëlle Dufour, Laboratoire Interuniversitaire des Systèmes Atmosphériques (LISA), CNRS UMR7583, Université Paris Est Créteil, Université Paris Diderot, Créteil, France
Audrey Cheiney, Laboratoire Interuniversitaire des Systèmes Atmosphériques (LISA), CNRS UMR7583, Université Paris Est Créteil, Université Paris Diderot, Créteil, France
Isabelle Pison, Laboratoire des Sciences du Climat et de l'Environnement (LSCE), CEA-CNRS-UVSQ, Gif-sur-Yvette, France

Abstract:

Anthropogenic pollutant emissions over China have largely increased in the last decades, because of the rapid economic development, demographic growth, urbanization, and energy consumption. Measurements of ambient concentration of ozone, $PM_{2.5}$ and PM_{10} exceed by far the recommended threshold from WHO for the main Chinese megacities, causing sever health problems. Several studies show that improved knowledge on photo-oxidant (O_3) and PM precursor (NO_x, SO_2, NH_3, VOCs) emissions are crucial to better understand, simulate, forecast and then mitigate pollution over China. Efforts have been made by Chinese authorities during the last 10 years to implement control measures in SO_2 and NO_x emissions.
The first effects of NOx reductions are still not clearly visible. Satellite based observations show a decrease in NO2 stratospheric column density above North China Plain starting from 2011, but high photochemical ozone formation remains in many Chinese regions such as Beijing.
In the framework of the PolEASIA project (Pollution in Eastern ASIA: toward better air quality prevision and impacts evaluation) that involves different French (LISA, LSCE, ARIA Technologies) and Chinese partners (CRAES, IAP, PKU), we propose to better quantify pollution precursor emissions (mainly NO_x and NMHCs), their spatio-temporal variability from the interannual to the sub-seasonal scale for the 2008-2017 period, and to evaluate the impact on pollutant variability and trends. To achieve this, we use the PYVAR-CHIMERE inverse modeling tool, based on the CHIMERE chemical transport model and a 4D variational assimilation scheme, to derive optimized temporally resolved NO_X gridded emission inventories at continental scale, with a fine spatial resolution of 0.25 and 0.5 degrees, from OMI satellite observations of NO_2 tropospheric columns. First results covering one year of simulations will be presented and discussed.

3.040 Canadian Air Quality Modelling Platform for Policy Emission Reduction scenarios.

Presenting Author:

Sophie Cousineau, Air Quality Modelling Applications Section, Meteorological Service of Canada, Environment and Climate Change Canada, Montreal, Québec, Canada, sophie.cousineau@canada.ca

Co-Authors:

Cassandra Bolduc, Air Quality Modelling Applications Section, Meteorological Service of Canada, Environment and Climate Change Canada, Montreal, Québec, Canada

Annie Duhamel, Air Quality Modelling Applications Section, Meteorological Service of Canada, Environment and Climate Change Canada, Montreal, Québec, Canada

Rabab Mashayekhi, Air Quality Modelling Applications Section, Meteorological Service of Canada, Environment and Climate Change Canada, Montreal, Québec, Canada

Philippe Lucas-Picher, Air Quality Modelling Applications Section, Meteorological Service of Canada, Environment and Climate Change Canada, Montreal, Québec, Canada

Jacinthe Racine, Air Quality Modelling Applications Section, Meteorological Service of Canada, Environment and Climate Change Canada, Montreal, Québec, Canada

Mourad Sassi, Air Quality Modelling Applications Section, Meteorological Service of Canada, Environment and Climate Change Canada, Montreal, Québec, Canada

Calin Zaganescu, Air Quality Modelling Applications Section, Meteorological Service of Canada, Environment and Climate Change Canada, Montreal, Québec, Canada

Abstract:

The Meteorological Service of Canada within Environment and Climate Change Canada (ECCC) updated his air quality (AQ) modeling platform for regulatory guidance to policy-makers. This AQ modelling platform uses the MSC AQ forecasting model, GEM-MACH, which is an on-line chemical transport model and in operation since 2009. This update makes use of the latest scientific improvements provided by ECCC AQ research division, the latest Air Pollution Emission Inventory (APEI) for base years and projections. Application of the AQ modelling platform includes: support the development or amendment of Canadian regulations targeting emission reductions of air pollutant or co-benefits of GHG regulation, assess health, environmental and science impact of diverse emissions changes for national and international purposes. In order to provide such guidance, air-quality model scenarios analysis are the most common means used to

estimate the impact of emission changes on atmospheric pollutant concentrations. This presentation will give an overview of the modelling platform and methodologies used in air quality emission scenario analysis, as well as the impact of different emission scenario changes on modelled ambient concentrations for both baselines and projected years and finally an overview of recent published Canadian regulations and on-going projects.

1.010 IMPACTS OF EMISSIONS FROM CUBA´ STATIONARY SOURCES .

Presenting Author:

Osvaldo Cuesta -Santos, Cuban Meteorological Institute, Havana, Cuba., osvaldo.cuesta@insmet.cu

Co-Authors:

Carlos Sosa-Pérez, Cuban Meteorological Institute, Havana, Cuba.

Yosdany González-Jaime , Cuban Meteorological Institute, Havana, Cuba.

Javier Bolufé-Torres, Cuban Meteorological Institute, Havana, Cuba.

Abstract:

The determination quantitative of air pollutant emission and dispersion in the atmosphere from main stationary sources in Cuba and its effects on healthy environment, is an urgent and necessary study, taking into the account that a number considerable of emission sources. The knowledge of these emissions is a useful tool to know for mitigating climate change and environmental management. The first emissions inventory from the country's stationary sources is showed. The methodologies corresponding to USEPA and the European Environmental Agency are used. In-situ emission measurements are also one of the tools used. The results showed atmospheric emissions rate of SO_2 is upper than 273 thousand ton/year while NO_2 emission rate is about 98 thousand ton/year. Furthermore, particulate matter (PM_{10} and $PM_{2.5}$) reach 88 000 ton/year, which are known for its potential damage for human health and atmospheric chemistry. Artemisa, Camagüey and Cienfuegos are the provinces to emit more SO_2 to the atmosphere. The oil refinery and power plant are present in these provinces. The municipalities: Mariel and Nuevitas are major emitters of air pollutants gaseous species (SO_2, NO_2, CO and NMVOC). Also Cienfuegos, Matanzas and Regla are great emitters and coinciding with urban areas with bad air quality. Environmental control and regulation measures should therefore be maintained to mitigate emissions. In addition to implementing reduction plans with technological improvements. This inventory using the bottom-up methodology can verify the calculations obtained in Greenhouse Gas Emissions Inventories by reducing uncertainties and thus achieving more accurate mitigation scenarios for climate change.

Key words: emissions inventory, pollution sources, air quality management.

1.026 Geographical distribution of the atmospheric short living Hg species releases: concerns for local effects due to Anthropogenic and Biomass Burning emissions.

Early Career Scientist

Presenting Author:
Francesco De Simone, CNR-Institute of Atmospheric Pollution Research, Division of Rende, UNICAL-Polifunzionale, 87036 Rende, Italy, f.desimone@iia.cnr.it

Co-Authors:
Sergio Cinnirella, CNR-Institute of Atmospheric Pollution Research, Division of Rende, UNICAL-Polifunzionale, 87036 Rende, Italy
Ian M. Hedgecock, CNR-Institute of Atmospheric Pollution Research, Division of Rende, UNICAL-Polifunzionale, 87036 Rende, Italy
Francesca Sprovieri, CNR-Institute of Atmospheric Pollution Research, Division of Rende, UNICAL-Polifunzionale, 87036 Rende, Italy
Nicola Pirrone, CNR-Institute of Atmospheric Pollution Research, Area della Ricerca di Roma 1, Via Salaria km 29,300, Monterotondo, 00015 Rome, Italy

Abstract:

Mankind’s activities have perturbed the natural biogeochemical cycle of mercury (Hg) since ancient times, contributing to legacy Hg, now present in different environmental compartments.
This Hg can be mobilised and released to the atmosphere by several naturally and anthropogenically driven mechanisms. Biomass Burning (BB) is an important factor in recycling legacy Hg over land, and is itself a major source of atmospheric Hg, amounting to roughly one third of the Hg released by anthropogenic activities each year.
The Hg atmospheric residence time depends strongly on the emissions speciation. The presence of reactive Hg species, that is Hg(II) compounds and Hg bound to particulate matter, having a short residence time of days to a few weeks, determines the fluxes to environments close to emission locations.
Hg emissions from BB have generally been considered to be only Hg(0) , which due to its long residence time has little local impact.
However, there are some studies which suggest that a fraction of Hg from BB is released as bound to particulate matter (HgP).
Although the Hg, and thus HgP, emissions from BB show high inter-annual variability due to the underlying variation in BB activity, these emissions can be comparable to, and in some regions higher than, those from anthropogenic activities. Consequently, similar amounts of HgP from both these sources are deposited to local ecosystems, however their geo-graphical and seasonal distributions are markedly different. Using the latest versions of the Global Fire Emissions Database (GFEDv4.1s) and of the EDGAR anthropogenic Hg emission inventory, the emissions of HgP from both BB and anthropogenic activities are calculated and compared over a 12 year period, to identify

regions affected by the two sources. The potential role that climatic changes and the objectives of the Minamata Convention to reduce anthropogenic Hg emissions may have, have also been investigate.

2.027 Measurement-based methane emission quantification from Europe’s largest on-shore gas field.

Presenting Author:

Hugo Denier van der Gon, TNO, dept. Climate, Air and Sustainability, Utrecht, The Netherlands, hugo.deniervandergon@tno.nl

Co-Authors:

Scott C. Herndon, Aerodyne Research, Inc. 45 Manning Road, Billerica, Massachusetts, USA

Jan Hulskotte, TNO, dept. Climate, Air and Sustainability, Utrecht, The Netherlands

Sander Jonkers, TNO, dept. Climate, Air and Sustainability, Utrecht, The Netherlands

Tara I. Yacovitch, Aerodyne Research, Inc. 45 Manning Road, Billerica, Massachusetts, USA

Bruno Neininger, METAIR AG, Airfield LSZN, Hausen a. A., Switzerland

Daniel Zavala-Araiza , Climate and Energy Program, Environmental Defense Fund Austin, Texas, USA

Abstract:

Methane (CH_4), is a powerful greenhouse gas and if not properly controlled, can leak from all stages of the Oil & Gas production and supply chain. If CH_4 emissions are larger than 3% of the natural gas produced, the climate benefits of a natural gas power plant vs. a coal power plant will be completely eroded. A large range in leakage-production ratios (0.25% - 8%) was found in recent U.S. studies. The Netherlands represents 44% of the EU's gas production, but reports negligible upstream methane emissions. Therefore Environmental Defense Fund (EDF) initiated a pilot campaign to collect measurement data from the Groningen gas field in the Netherlands, the largest on-shore gas field in Europe. During a week in August 2016, a multi-scale study of the Groningen gas field was undertaken, including aircraft measurements (regional and facility-level) and ground-based measurements (facility-level). We used an instrumented mobile laboratory (mini Aerodyne Mobile Laboratory, minAML) to collect concentration data downwind of facilities (including production cluster sites and existing midstream facilities). Emissions are quantified using these ground measurements and an inverse Gaussian plume model calculation. We use ethane/methane ratios to distinguish oil and gas emissions from nearby biogenic sources. Mass-balance flights using Metair's DIMO aircraft were performed to quantify the local and regional methane flux by flying upwind and downwind of the Groningen field. We will compare the overall results from the campaigns with official reported emissions, downscaled to the measurement days. The data will give a good indication if the mismatch in reported and actual emissions seen in the U.S. is present in the Groningen field as well and highlight the importance of the attribution efforts (separating CH_4 fossil emissions from biogenic emissions) and the use of several multi-scalar methodologies to constrain Oil & Gas CH_4 emissions in production regions outside of the US.

2.004 Space-based NOx shipping emissions near the Chinese coasts.

Early Career Scientist

Presenting Author:
Jieying Ding, Royal Netherlands Meteorological Institute, De Bilt, The Netherlands, ding@knmi.nl

Co-Authors:
Ronald van der A, Royal Netherlands Meteorological Institute, De Bilt, The Netherlands
Pieternel Levelt, Royal Netherlands Meteorological Institute, De Bilt, The Netherlands

Abstract:

With the emission estimate algorithm DECSO we have derived NOx emissions from 10 years of satellite observations from GOME2a and OMI over different regions (such as Europe, Middle East, East Asia etc.). The latest version of DECSO is able to better detect NO_X emissions over remote regions. For example, the derived NO_X emissions reveal ship tracks near the Chinese coasts that are otherwise hidden by the outflow of NO_2 from the Chinese mainland. The temporal evaluation of shipping emissions near the Chinese coasts will be presented.

3.020 First analysis of anthropogenic VOC distribution and emission fingerprints in Abidjan, West Africa.

Early Career Scientist

Presenting Author:
PAMELA DOMINUTTI, Laboratoire de Météorologie Physique LaMP/ CNRS, Université Clermont Auvergne, Clermont-Ferrand, France, p.dominutti@opgc.univ-bpclermont.fr

Co-Authors:
Agnès Borbon, Laboratoire de Météorologie Physique LaMP/ CNRS, Université Clermont Auvergne, Clermont-Ferrand, France
Aurélie Colomb, Laboratoire de Météorologie Physique LaMP/ CNRS, Université Clermont Auvergne, Clermont-Ferrand, France
Julien Bahino, Laboratoire de Physique de l'Atmosphère (LAPA)- Université Félix Houphoët-Boigny, Abidjan, Côte D'Ivoire
Keita Sekou, Laboratoire de Physique de l'Atmosphère (LAPA)- Université Félix Houphoët-Boigny, Abidjan, Côte D'Ivoire
Laëtitia Bouvier, Laboratoire de Météorologie Physique LaMP/ CNRS, Université Clermont Auvergne, Clermont-Ferrand, France
Thierry Leonardis, IMT Lille Douai, Département Sciences de l'Atmosphère et Génie de l'Environnement (SAGE), 59000 Lille, France
Stéphane Sauvage, IMT Lille Douai, Département Sciences de l'Atmosphère et Génie de l'Environnement (SAGE), 59000 Lille, France
Veronique Yoboué, Laboratoire de Physique de l'Atmosphère (LAPA)- Université Félix Houphoët-Boigny, Abidjan, Côte D'Ivoire
Corinne Galy-Lacaux, Laboratoire d'Aérologie de Toulouse-Université t de Toulouse 3, France
Cathy Liousse, Laboratoire d'Aérologie de Toulouse-Université t de Toulouse 3, France

Abstract:

Volatile Organic Compounds (VOCs) are important pollutants present in the urban atmospheres which can affect air quality by producing secondary pollutants. In-situ VOC observations are therefore necessary to provide direct implications on air pollution exposure and to improve the prediction of secondary products formation. Meanwhile, VOCs field-observations have been deeply used over the last years as constraints for the development of reliable emission inventories. Related studies pointed out large discrepancies between inventory estimations and emission ratios derived from ambient measurements, implying limitations in the accurate modeling of VOC impact. In addition, there are still missing VOC observations in sensitive places like West Africa. The unplanned growth of urban conglomerations is the main issue in West Africa, aggravating

health problems due to unregulated emissions and producing effects on atmospheric chemistry. Therefore, the characterization and quantification of these emissions, is a key input to improve the comprehension of sources contribution over West Africa and to assess their impact on human and air quality conditions.
Intensive VOC field-campaigns have been performed in the framework of the WP2 (Air pollution and Health) DACCIWA project during two years. Different sites have been sampled in Abidjan, Ivory Coast for ambient and source measurements. Results for three intensive campaigns representative of the wet and dry seasons are available over the period 2015-2016. Speciated VOCs were collected off-line by absorbent tubes and then analyzed and quantified by GC-MS techniques. Anthropogenic VOC profiles (traffic, industrial, domestic and waste fires) have been evaluated and the levels and distribution of VOCs have been analyzed. VOC data were also compared with those from other cities worldwide to discuss discrepancies and commonalities. These data provide the first constraints for the construction of regional emission inventory and for the understanding of the role of VOC emissions in the urban atmospheric chemistry, in West Africa.

1.051 The Community Emissions Data System (CEDS): an open source system for global anthropogenic emissions inventories.

Early Career Scientist

Presenting Author:

Leyang Feng, Joint Global Change Research Institute, Pacific Northwest National Laboratory, College Park, MD, USA, leyang.feng@pnnl.gov

Co-Authors:

Rachel M. Hoesly, Joint Global Change Research Institute, Pacific Northwest National Laboratory, College Park, MD, USA

Steven J. Smith, Joint Global Change Research Institute, Pacific Northwest National Laboratory, College Park, MD, USA

Abstract:

We describe the code and operation of the Community Emissions Database System (CEDS). CEDS is an open source data system scheduled for public release in Summer 2017 that produces global, historical (1750 - present) estimates of anthropogenic chemically reactive gases (CO, CH_4, NH_3, NO_X, SO_2, NMVOC), carbonaceous aerosols (BC and OC), and CO_2.

The data system is based in R, an open-source software system, and its download includes all system code and input data files other than IEA energy statistics, as well as comprehensive documentation, tutorials, and user guides. It is designed to allow for easy addition or replacement of data and assumptions, so changes to energy data, emission factors or fuel properties do not require coding. Comprehensive meta-data functionality tracks all data files used to create final system outputs and value meta-data tracks whether a specific estimate was scaled to an existing inventory. The data system requires the purchase of the IEA energy statistics to create the complete historical data set, but a fully open source option from 1990 – 2015 using publically available UN energy data is being explored.

This system provides a transparent, reproducible, and consistent methodology for producing emissions trends and allows researchers and policy makers to access emissions and emissions factor data by country, sector, and fuel as well as produce new estimates with updated country-specific data or alternative assumptions in general.

1.017 A global inventory of anthropogenic and volcanic SO2 emissions derived from the Ozone Monitoring Instrument (OMI).

Presenting Author:
Vitali Fioletov, Environment and Climate Change Canada, Toronto, ON, Canada , vitali.fioletov@outlook.com

Co-Authors:
Chris McLinden, Environment and Climate Change Canada, Toronto, ON, Canada
Simon Carn, Department of Geological and Mining Engineering and Sciences, Michigan Technological University, Houghton, MI, USA
Nickolay Krotkov, Atmospheric Chemistry and Dynamics Laboratory, NASA Goddard Space Flight Center, Greenbelt , MD USA
Can Li, Atmospheric Chemistry and Dynamics Laboratory, NASA Goddard Space Flight Center, Greenbelt , MD USA

Abstract:

The presentation introduces the first satellite-based sulfur dioxide (SO_2) emission inventory for 2005-2016. SO_2 measurements from OMI satellite sensor are used to detect large point emission sources and estimate emissions from them. A total of about 500 continuously emitting point sources releasing from about 30 kT y^{-1} to more than 4000 kT y^{-1} of SO_2 per year have been identified and grouped by the country and the source type. The annual emissions from these sources were estimated using a new algorithm that combines satellite measurements with wind data.

Global cumulative emissions from power plants and smelters are declining, while emissions from oil and gas industry have remained nearly constant. In 2005-2016, anthropogenic emissions from the USA, China, and Europe declined by up to 80%, while emissions from India nearly doubled, and emissions from other dominant SO_2-emitting regions (South Africa, Russia, Mexico, and the Middle East) remained fairly constant. In total, OMI-based estimates account for about half of total reported anthropogenic SO_2 emissions; the remaining half is likely related to sources emitting less than 30 kT y^{-1} and not detected by OMI. However, for some regions (e.g., Mexico) OMI-based estimates are up to 4 times higher than the reported emissions.

The inventory includes annual emission data for 90 volcanoes. Emissions from passively degassing volcanic sources account for about 30% of total emissions, but that fraction has increased in recent years due to the steady decline of anthropogenic emissions. Annual emissions from passive volcanic degassing significantly exceeded eruptive emissions in the last 10 years except during one year (2014), when they were at approximately the same level.

The obtained emission information can be used to improve available emissions inventories, since about 40 sources seen by OMI are not included in the inventories. They account for about 6-12% of total global SO_2 emissions.

2.037 Direct measurements of atmospheric isoprene from satellite observations .

Presenting Author:

Dejian Fu, Science Division, Jet Propulsion Laboratory, Pasadena, California, United State of America, 91109, dejian.fu@jpl.nasa.gov

Co-Authors:

Vivienne Payne, Science Division, Jet Propulsion Laboratory, Pasadena, California, United State of America, 91109

Dylan Millet, University Of Minnesota, Minnesota, Saint Paul, Minnesota, United State of America,55455

Abstract:

Isoprene (C_5H_8), the most important of the non-methane biogenic volatile organic compounds (NMBVOCs), plays a crucial role in atmospheric chemistry and carbon cycle – affecting the oxidative capacity of the atmosphere through reaction with OH, and as an important precursor of O_3 and secondary organic aerosols. Its annual emission is about 400–600 TgC (90% emitted by terrestrial plants), equivalent to the size of the annual biogenic CH_4 source. Accurate isoprene measurements from airplane and surface sites are sparse. Its global distribution is relied on an indirect approach and estimated using its chemistry product, formaldehyde (HCHO) measurements. However, these HCHO-derived isoprene estimates have large errors mainly due to the high uncertainty of HCHO level 2 data products (mostly ~100%), in addition to any imperfect assumptions of HCHO-C_5H_8 models. It leads to the ambiguous understanding of differences among various chemical/dynamical processes on controlling isoprene spatial/temporal distributions. Direct measurements of global atmospheric isoprene are highly needed in order to allow improved quantification of isoprene's roles in atmospheric chemistry and carbon cycle under past and future climate states. Recently, we estimated spectral signals of atmospheric isoprene for its strongest spectral band centered at ~900 cm^{-1} region with the environmental conditions over Amazonian forest. It was found that the estimated signal level is 0.2 K (brightness temperature), three times larger than the noise level of CrIS single footprint measurements and similar to that of AIRS, which indicates the high feasibility of directly retrieving global isoprene distribution from CrIS/AIRS measurements. We would present prototype retrievals of atmospheric isoprene directly from existing satellite observations of CrIS/AIRS over Southeast USA.

1.021 Network for Observation of Volcanic and Atmospheric Change (NOVAC).

Presenting Author:
Bo Galle, Chalmers University of Technology, Department of Earth and Space Sciences, Gothenburg, Sweden, bo.galle@chalmers.se

Co-Authors:
Santiago Arellano , Chalmers University of Technology, Department of Earth and Space Sciences, Gothenburg, Sweden
Johan Mellqvist, Chalmers University of Technology, Department of Earth and Space Sciences, Gothenburg, Sweden
Ulrich Platt, University of Heidelberg, Germany
Michel Van Roozendael, Belgian Institute for Space Aeronomy, Belgium
Thor Hansteen, Leibniz-Institut für Meereswissenschaften, IFM-GEOMAR, Germany
Andrea Di Muro, Institut de Physique du Globe de Paris, France
Mike Burton, Istituto Nazionale di Geofisica e Vulcanologia, Italy
Hugo Delgado, Universidad Nacional Autónoma de México, Mexico
Angelica Muños, Instituto Nicaragüense de Estudios Territoriales, Nicaragua
Maarten DeMoor, Observatorio Volcanológico y Sismológico de Costa Rica, Costa Rica
Gustavo Garzón, Servicio Geológico Colombiano, Colombia
Demitrio Escobar, Servicio Nacional de Estudios Territoriales, El Salvador
Katcho Karumbe, Observatoire Volcanologique de Goma, D.R. Congo
Silvana Hidalgo, Escuela Politécnica Nacional, Ecuador
Eddy Sanchez, Instituto Nacional de Sismología, Vulcanología, Metrología e Hidrología, Guatemala
Salvatore Inguaggiato, Istituto Nazionale di Geofisica e Vulcanologia, Italy
Kristín Vogfjörd, Icelandic Meteorological Office, Iceland
Chris Newhall, Earth Observatory of Singapore, Singapore
Kila Mulina, Rabaul Volcano Observatory, Papua New Guinea
Pablo Masias, Instituto Geológico Meteorológico Metalúrgico, Peru

Abstract:

NOVAC, the Network for Observation of Volcanic and Atmospheric Change, was initiated in 2005 as a 5-years-long project financed by the European Union. Its main purpose is to create a global network for the study of volcanic atmospheric plumes and related geophysical phenomena by using state-of-the-art spectroscopic remote sensing technology. Up to 2014, more then 100 instruments have been installed at 40 volcanoes in Chile, Peru, Ecuador, Colombia, Nicaragua, Costa Rica, El Salvador, Guatemala, Mexico, Italy, Democratic Republic of Congo, Reunion Island, Iceland, Papua New Guinea and Philippines, and efforts are being done to expand the network to other active volcanic

zones. NOVAC has been a pioneer initiative in the community of volcanologists and embraces the objectives of the Word Organization of Volcano Observatories (WOVO) and the Global Earth Observation System of Systems (GEOSS).
In this contribution, we present the results of the measurements of SO_2 gas fluxes carried out within NOVAC, which for some volcanoes represent a record of more than 10 years of semi-continuous monitoring The network comprises some of the most strongly degassing volcanoes in the world, covering a broad range of tectonic settings, levels of unrest, and potential risk. . Examples of correlations with seismicity and other geophysical phenomena, environmental impact studies and comparisons with previous global estimates will be discussed as well as the significance of the database for further studies in volcanology and other geosciences.

2.016 Stratospheric Ozone data quality in form of long term variability and trend study on comparison of Indian Ozonesonde and Satellite data over three sites at different latitudes of India.

Early Career Scientist

Presenting Author:
Rohtash Singh Garhwal, CSIR-National Physical Laboratory, New Delhi, India, rosiga.vansh86@gmail.com

Co-Authors:
Tuhin Kumar Mandal, CSIR-National Physical Laboratory, New Delhi, India
Sudhir Kumar Sharma, CSIR-National Physical Laboratory, New Delhi, India
S. K. Peshin, India Meteorological Department, New Delhi, India

Abstract:

The present paper assesses the quality of ozone data of modified Brewer Mast balloonborne ozonesonde and its comparison with satellite based BUV/SBUV, UARS MLS and EOS Aura MLS data covering three different timeframe (1972-2014, 1992-98 & 2005-2014). To analysis the variability and long-term trend in ozone data over three Indian stations at different latitudes namely Delhi, Pune and Trivandrum, India. According the WHO Criteria (1982) the reasonable amount of ozonesonde data analysis shows the good quality as 70–80 % of data within the normalization factor of 1.3–0.8 ± (0.05–0.1) over all three stations. A multiple regression modal has been used to find the long term trend in the stratospheric ozone delineating the effect of quasi-biennial oscillation (QBO), the eleven year solar cycle and the Eliassen-Palm (EP) Flux. Trends in the ozonesonde data for the three different periods are quite different even within the same and different dataset. An agreement among two data set (SBUV and MLS) is seen in the period of 1992-1998 showing maximum negative trends of different magnitude in the upper stratosphere, but considerably lower in the stratosphere (between 2 and 15 hPa). The trend in the period of 2005-2014 has varied -3.04 - 1.72% per yr and shifted from negative to positive in the upper stratosphere. As compared to BUV/SBUV dataset, the MLS data shows insignificant trend. Trend in stratospheric ozone over the tropical sites are satisfactorily insignificant for the period of 1998-2014. The percentage difference between ozonesonde and UARS MLS data at Delhi, Pune and Trivandrum show variation of ±15 % and ozonesonde data, EOS Aura MLS and SBUV data at Delhi, Pune and Trivandrum show variation of ±45 % in the vertical range of 46 to 10 hPa, whereas MLS data show highest accuracy.

3.036 Estimating the Tipping Point of Urban NOx Control in major US cities.

Early Career Scientist

Presenting Author:
Angele Genereux, Department of Civil and Environmental Engineering, Carleton University, Canada, angelegenereux@cmail.carleton.ca

Co-Authors:
Amanda Pappin, Department of Civil and Environmental Engineering, Carleton University, Canada
Amir Hakami, Department of Civil and Environmental Engineering, Carleton University, Canada

Abstract:

Previous studies have shown that although nation-wide ozone concentrations in the U.S. have consistently declined over the past decade, increased concentrations of ozone appear in urban and suburban areas. The health impacts associated to the increase in ozone concentrations with NO_X control in these locations are termed “dis-benefits” (or “marginal damages”). These dis-benefits have been quantified in recent publications at current emission levels, and have shown that increasing NO_X emission control would eventually turn these dis-benefits into benefits as the region shifts from NO_X-inhibited to NO_X-limited.

We quantify the societal monetary health benefits of NO_X control through the adaptation of the U.S. EPA’s Air Quality model [CMAQ]. We supply the model with the derivative of an exposure-based cost function, which utilizes respiratory mortality rates due to chronic 1-hour ozone exposure. With this, we estimate both national and local monetized health damages from chronic exposure to ozone with respect to NO_X emissions in the U.S. on a benefit-per-ton [BPT] basis. We investigate how compounding benefits of NO_X control compare to dis-benefits in two major urban areas: New York, NY and Los Angeles, CA. We identify the tipping point of NO_X control beyond which negative BPTs become positive along the abatement pathway. We estimate the break-even point where cumulative benefits compensate these immediate dis-benefits in urban areas. We examine the impact of applying nationalized vs. localized emission control policies in NY and LA. For surface-level emissions in NY and LA, we show how the compounding nature of these marginal damages calls for more aggressive emission control policies. For example, BPTs in NY start at -$27,000/ton NO_X and increase until the tipping point is reached at ~40% abatement. At ~70%, the cumulative benefits compensate immediate dis-benefits from the previous abatement levels, reaching a maximum of $157,000/ton NO_X at 100% abatement.

2.033 Inter-comparison of different NOX emission inventories and associated variation in simulated surface ozone in Indian region.

Presenting Author:
Sachin Ghude, Indian Institute of Tropical Meteorology, Pune, India, sachinghude@gmail.com

Co-Authors:
Chinmay Jena, Indian Institute of Tropical Meteorology, Pune, India

Abstract:

In this work, we compare for the first time different anthropogenic NO_X emission inventories and examine the associate variation in simulated surface ozone (O_3) in India. Six anthropogenic NO_X emission inventories namely Emission Database for Global Atmospheric Research (EDGAR), Intercontinental Chemical Transport Experiment-Phase B (INTEX-B), Regional Emission Inventory in Asia (REAS), MACCity, Indian National Emission Inventory (India_NOx), and Top-Down NO_X emission inventory for India (Top-Down) are included in the comparison. We include these emission inventories in regional chemical transport model WRF-Chem to simulate tropospheric column NO2 and surface O3 mixing ratios for the month of summer (15-March to 15-April) and winter (December) in 2005. Predicted tropospheric column NO_2 using different NO_X emission inventory are evaluated with the OMI satellite observations. All emission inventories show similar spatial features, however uncertainty in NO_X emissions distribution is about 20-50% over rural regions and about 60-160% over the major point sources. Compared to OMI, the largest bias in simulated tropospheric NO_2 columns is seen in the REAS (-243.0 ± 338.8 $\times 10^{13}$ molecules cm^{-2}) emission inventory, followed by EDGAR (-199.1 ± 272.2 x 10^{13} molecules cm^{-2}), MACCity (-150.5 ± 236.3 $\times 10^{13}$ molecules cm^{-2}), INTEX-B (-96.8 ± 199.5 $\times 10^{13}$ molecules cm^{-2}), India_NOx (-87.7 ± 159.9 $\times 10^{13}$ molecules cm^{-2}) and Top- Down (-30.8 ± 69.6 × 10^{13} molecules cm^{-2}) inventories during winter. Simulations using different NO_X emission inventories produces maximum deviation in daytime 8-h averaged O3 of the order of 9-17 ppb (15-40%) in summer and 3e12 ppb (5-25%) in winter over most of the land area. The simulation suggests that choice of NO_X emission inventories have significant effect on surface O_3 concentration for air quality studies over India.

1.002 Surface emissions from the RCPs scenarios: are they consistent with the most recent inventories?.

Presenting Author:
Claire GRANIER, Laboratoire d'Aerologie and NOAA/CIRES, claire.granier@noaa.gov

Co-Authors:
Catherine LIOUSSE, Laboratoire d'Aerologie, Toulouse, France
Thierno DOUMBIA, Meteo-France, Toulouse, France
Idir BOUARAR, Max-Planck Isntitute for Meteorology, Hamburg, Germany
Sabine DARRAS, Observatoire Midi-Pyrenees, Toulouse, France
Gregory J. FROST, NOAA ESRL/CSD, Boulder, USA
Louise GRANIER, LATMOS/IPSL, Paris, France
Rachel HOESLY, PNNL - Joint Global Change Research Institute, College Park, USA
Greet MAENHOUT, Joint Research Center, Ispra, Italy
Katerina SINDELAROVA, Charles University, Prague, Czech Republic
Steven SMITH, PNNL - Joint Global Change Research Institute, College Park, USA
Jenny STAVRAKOU, Belgian Institute for Space Aeronomy, Brussels, Belgium

Abstract:

The simulations performed in support of the 2013 report of the Intergovernmental Panel on Climate Change (IPCC) used surface emissions from the so-called Representative Concentration Pathways (RCPs) scenarios. These scenarios provide emissions of greenhouse gases and atmospheric pollutants from 2000 to 2100. Four scenarios are available, representing different radiative forcings for 2100. These scenarios are currently widely used by the climate and atmospheric community.
We will compare the emissions provided by the four RCPs emissions scenarios from 2000 to 2015 with the most recent information on emissions during the past fifteen years. From these comparisons, we will assess if the RCPs emissions can be used for forecasting the distribution of atmospheric pollutants in the recent past and near future.
This assessment, which will focus on the emissions of nitrogen oxides, sulfur dioxide and volatile organic compounds, will include recent determinations of surface emissions from global and regional inventories, as well as the estimations of emissions using inverse modeling techniques and satellite observations.

1.034 Consistency between recent trends in emissions and satellite observations in different world cities.

Early Career Scientist

Presenting Author:
Louise GRANIER, LATMOS/IPSL, Paris, France, louise.granier.lg@gmail.com

Co-Authors:
Thierno DOUMBIA, Meteo-France, Toulouse, France
Idir BOUARAR, Max-Planck Institute for Meteorology, Hamburg, Germany
Sabine DARRAS, Observatoire Midi-Pyrenees, Toulouse, France
Hugo DENIER VON DER GON, TNO, Utrecht, The Netherlands
Gregory FROST, NOAA ESRL/CSD, Boulder, USAS
Claire GRANIER, Laboratoire d'Aerologie, Toulouse, France, NOAA ESRL/CSD and CIRES/University of Colorado, Boulder, USA
Sekou KEITA, Laboratoire d'Aerologie, Toulouse, France
Jeroen KUENEN, TNO, Utrecht, The Netherlands
Cathy LIOUSSE, Laboratoire d'Aerologie, Toulouse, France
Brian McDONALD, NOAA ESRL/CSD and CIRES/University of Colorado, Boulder, USA
Katerina SINDELAROVA, Charles University, Prague, Czech Republic
Jenny STAVRAKOU, Belgian Institute for Space Aeronomy, Brussels, Belgium

Abstract:

We will review the datasets providing anthropogenic emissions at the global scale and at the regional scale, for the 1990-2015 period, and discuss a comparison of these datasets. The analysis will include different gaseous and particulate compounds, i.e. carbon monoxide, nitrogen oxides, volatile organic compounds, sulfur dioxide, ammonia, black and organic carbon, and particulate matter (PM10 and PM2.5). This work will help quantifying the uncertainties on anthropogenic emissions in the different regions.
The spatial and temporal distributions of several of these compounds has been measured by different satellite instruments since the late 1990s. Trends in the distributions of nitrogen oxides, sulfur dioxide and volatile organic compounds have been detected from these satellite observations in several regions and cities.
We will compare the trends in the anthropogenic emissions of NOx, SO2 and VOCs in different world cities and megacities provided by different global and regional inventories and by the satellite observations. Surface emissions optimized by inverse modeling techniques will also be included in this analysis. It will be shown that the trends in emissions and in satellite observations display a very good consistency in some regions and cities, while no consistency can be found in other regions.

2.025 Optimal estimation of Sulfuryl Fluoride emissions on regional scale using advanced 3D inverse modeling and AGAGE observations.

Early Career Scientist

Presenting Author:
Alicia Gressent, Massachusetts Institute of Technology, Center for Global Change Science, Cambridge, Massachusetts, USA., agressen@mit.edu

Co-Authors:
Ronald G. Prinn, Massachusetts Institute of Technology, Center for Global Change Science, Cambridge, Massachusetts, USA.
Mark Lunt, School of Chemistry, University of Bristol, Bristol, UK.
Matthew Rigby, School of Chemistry, University of Bristol, Bristol, UK.
Anita Ganesan, School of Geographical Sciences, University of Bristol, Bristol, UK.
Jens Mühle, University of California, San Diego Scripps Institution of Oceanography, La Jolla, California, USA.
Paul B. Krummel, CSIRO Oceans and Atmosphere, Aspendale, Victoria, Australia.
Paul Fraser, CSIRO Oceans and Atmosphere, Aspendale, Victoria, Australia.
Paul Steele, CSIRO Oceans and Atmosphere, Aspendale, Victoria, Australia.
Ray F. Weiss, University of California, San Diego Scripps Institution of Oceanography, La Jolla, California, USA.
Chris. M. Harth, University of California, San Diego Scripps Institution of Oceanography, La Jolla, California, USA.
Simon O'Doherty, School of Chemistry, University of Bristol, Bristol, UK.
Dickon Young, School of Chemistry, University of Bristol, Bristol, UK.
Sunyoung Park, Department of Oceanography, College of Natural Science, Kyungpook National University, Daegu, South Korea.
Shanlan Li, Department of Oceanography, College of Natural Science, Kyungpook National University, Daegu, South Korea.
Bo Yao, Chinese Academy of Meteorological Sciences, China Meteorological Administration, Beijing, China.
Stefan Reimann, Laboratory for Air Pollution and Environmental Technology, Empa, Swiss Federal Laboratories for Materials Sciences and Technology, Dübendorf, Switzerland.
Martin K. Vollmer, Laboratory for Air Pollution and Environmental Technology, Empa, Swiss Federal Laboratories for Materials Sciences and Technology, Dübendorf, Switzerland.

Michela K. Maione, Università di Urbino, Department of Pure and Applied Sciences, Urbino, Italy.
Jgor Arduini, Università di Urbino, Department of Pure and Applied Sciences, Urbino, Italy.
Chris R. Lunder, Norwegian Institute for Air Research, Kjeller, Norway.

Abstract:

Sulfuryl fluoride (SO_2F_2) is used increasingly as a fumigant to replace methyl bromide (CH_3Br), which was regulated under the Montreal Protocol (1986). Mühle et al., 2009, showed that SO_2F_2 had been accumulating in the global atmosphere with a growth rate of 5±1% per year from 1978 to 2007. In addition, the global warming potential of SO_2F_2 has been estimated to be ≈4780 for a 100-year time horizon [Papadimitriou, 2008], which is similar to the CFC-11 (CCl_3F) GWP. Thus it is a potent greenhouse gas and its emissions are expected to continue to increase in the future. Here we report the first estimation of the SO_2F_2 emissions on regional scale (for North West America, Europe, South East Asia and South Australia) from 2008 to 2015. Emissions are constrained by AGAGE observations and they are derived using a 3D Lagrangian dispersion model (NAME) via the reversible-jump trans-dimensional MCMC approach [Lunt, 2016] along with a 3D Eulerian CTM (MOZART-4) for boundary conditions calculation. Over the inversion window, results show that South East Asia is responsible for the highest emissions with a continuous increase of +18% and +38% in China and Japan respectively. In North West America, emissions are mainly distributed in Mexico and California with the highest rise of +223% and they are associated with house and building fumigation. In Europe, SO_2F_2 is primarily used and released in Poland and Spain, with +4% rise, for both structural fumigation and crop treatment. Finally, South Australia is characterized by lower emissions with a continuous increase of +8%. They are found in limited inland areas potentially related to bulk grain treatment. This work provides a unique quantitative understanding of the SO_2F_2 industrial emissions and initiates future work for improving our knowledge on its atmospheric sinks with the aim of performing similar estimation on global scale.

2.034 Efficient high-resolution constraints for primary aerosol emissions during biomass burning events.

Early Career Scientist

Presenting Author:
Jonathan Guerrette, NOAA, CSD, Boulder, Colorado, U.S.A., jonathan.guerrette@noaa.gov

Co-Authors:
Pablo Saide, National Center for Atmospheric Research, Boulder, Colorado, U.S.A.
Nicolas Bousserez, University of Colorado, Department of Mechanical Engineering, Boulder, Colorado, U.S.A.
Gregory Carmichael, University of Iowa, Department of Chemical and Biochemical Engineering, Iowa City, Iowa, U.S.A.
Daven Henze, University of Colorado, Department of Mechanical Engineering, Boulder, Colorado, U.S.A.
Stuart McKeen, NOAA/CIRES, CSD, Boulder, Colorado, U.S.A.

Abstract:

Aerosols from open burning contribute to regional haze events globally and have been shown to have a non-negligible influence on severe storms. Wild fires are potentially becoming more commonplace due to climate change. Those aerosol emissions are highly uncertain, with global annual and monthly continental total estimates varying by a factor of 2 to 3 and a factor of 10, respectively. The multi-scale variation stifles high resolution forecasting required for incident prediction of $PM_{2.5}$ exposure and extreme weather. The only widespread observations of aerosols available globally every day are from satellites, which has motivated their application to past top-down emission constraint at coarser resolution.

This work combines three related efforts in order to effectively utilize optical observations of aerosols from existing polar-orbiting and future geosynchronous satellites to enable fast inverse modeling of high-resolution biomass burning sources. (1) An efficient adjoint-free inversion method has been used in WRF-AAM, a limited-area meteorological model with aerosol-aware microphysics, to remove inventory bias in ~4 to 6 aggregated geographic regions on hourly time scales, and to inform daily flight paths during recent air quality campaigns. (2) An efficient parallelized stochastic method was proven to approximate a reduced basis set of high-resolution surface fluxes associated with maximum observational constraint. This optimal basis defines optimally aggregated regions and time periods that can be adjusted for daily fluctuations in fire locations, meteorology, and observation availability, acting as a preprocessing step for part (1). (3) WRFDA (WRF data assimilation) has been extended to carry out 4D variational source inversion using the stochastic method from part (2). We will present progress toward merging these three projects, including adjoint descriptions of the simplified aerosol microphysics and optical measurements and estimates of computational requirements.

The final product could be used operationally to improve daily regional air quality forecasts during fire events.

1.009 An emission processing system for the Mexico City metropolitan area: Evaluation and comparison of the MOBILE6.2-Mexico and MOVES-Mexico traffic emissions .

Presenting Author:

MARC GUEVARA VILARDELL, Barcelona Supercomputing Center - Centro Nacional de Supercomputación, Earth Sciences Department, Barcelona, Spain., marc.guevara@bsc.es

Co-Authors:

CARLES TENA MEDINA, Barcelona Supercomputing Center - Centro Nacional de Supercomputación, Earth Sciences Department, Barcelona, Spain.

ALBERT SORET MIRAVET, Barcelona Supercomputing Center - Centro Nacional de Supercomputación, Earth Sciences Department, Barcelona, Spain.

KIM SERRADELL MARONDA, Barcelona Supercomputing Center - Centro Nacional de Supercomputación, Earth Sciences Department, Barcelona, Spain.

DIANA GUZMÁN, Secretaría del Medio Ambiente de la Ciudad de México, Dirección General de Gestión de la Calidad del Aire, Ciudad de México, México.

ARMANDO RETAMA, Secretaría del Medio Ambiente de la Ciudad de México, Dirección General de Gestión de la Calidad del Aire, Ciudad de México, México.

PATRICIA CAMACHO, Secretaría del Medio Ambiente de la Ciudad de México, Dirección General de Gestión de la Calidad del Aire, Ciudad de México, México.

MÓNICA JAIMES-PALOMERA, Secretaría del Medio Ambiente de la Ciudad de México, Dirección General de Gestión de la Calidad del Aire, Ciudad de México, México.

Abstract:

The High-Elective Resolution Modelling Emission System for Mexico (HERMES-Mex) model is an emission processing tool developed to transform the official Mexico City Metropolitan Area (MCMA) emission inventory into hourly, gridded (up to 1km2) and speciated emissions used to drive mesoscale air quality simulations. HERMES-Mex constitutes the emission core of the Air Quality Forecast System for the City of Mexico, developed by the Barcelona Supercomputing Center (BSC) and the Mexico City's Secretariat of the Environment (SEDEMA). In this work the resulting traffic emissions from the Mobile Source Emission Factor Model for Mexico (MOBILE6.2-Mexico) and the MOtor Vehicle Emission Simulator for Mexico (MOVES-Mexico) models are integrated in the tool to assess and compare their performance. NOx, CO and VOC total emissions modelled are reduced by 37%, 52% and 26% in the MCMA when replacing MOBILE6.2-Mexico for MOVES-Mexico traffic emissions, while PM10 and PM2.5 are slightly increased (6% and 8%, respectively). In terms of air quality, the system composed by the Weather Research and Forecasting model (WRF) coupled with HERMES-Mex and the Community Multi-scale Air Quality (CMAQ) model properly reproduces the pollutant levels and patterns measured in the MCMA. The system's performance clearly improves in urban stations with a strong influence of traffic sources when applying MOVES-Mexico emissions. These results

reinforce the conclusions reached by previous works that stated that MOBILE6.2-Mexico NOx and CO emission factors were overestimated. Despite reducing estimations of modelled precursor emissions, O3 peak averages are increased in the MCMA core urban area (up to 30ppb) when using MOVES-Mexico mobile emissions due to its VOC-limited regime.

3.028 Assessing the influence of regional transport from Mainland China over the Korean Peninsula during the 2016 KORUS-AQ Field Campaign .

Early Career Scientist

Presenting Author:
Hannah Halliday, NASA Langley, Chemistry and Dynamics, Hampton, VA, USA, hannah.s.halliday@nasa.gov

Co-Authors:
Josh DiGangi, NASA Langley, Chemistry and Dynamics, Hampton, VA, USA
Glenn Diskin, NASA Langley, Chemistry and Dynamics, Hampton, VA, USA
Yonghoon Choi, NASA Langley, Chemistry and Dynamics, Hampton, VA, USA
Sally Pusede, University of Virginia, Department of Environmental Science, Charlottesville, VA, USA
Mario Rana, NASA Langley, Chemistry and Dynamics, Hampton, VA, USA
John Nowak, NASA Langley, Chemistry and Dynamics, Hampton, VA, USA

Abstract:

The industrial growth in East Asia has resulted in widespread growth and prosperity, but has been accompanied by degraded air quality. These poor air quality events have both local and regional effects, and long range transportation of pollution can greatly increase the affected populations. South Korea has a technologically oriented economy with vibrant urban regions, but suffers from poor air quality arising from both local emissions on the Korean peninsula and from the transport of pollution from Mainland China. The KORUS-AQ field campaign was an international collaboration to measure the air quality over the Korean peninsula in the spring of 2016. We use the aircraft in situ data from the DC-8 aircraft to examine trace gas ratios over three major regions: the Seoul Metropolitan region, the South Korean western coast, and the Yellow/West Sea. We look specifically at the correlations between CO and CO_2 as an indicator of emissions type, with low ratios generally indicative of more efficient combustion and high emissions indicating low efficiency combustion. At low altitudes, higher incidences of low CO/CO_2 ratios were observed in the Seoul and western coastal regions, compared to higher ratios of CO/CO_2 over the West Sea. We examine the meteorological dependence of these carbon species ratios, their relationships to VOC tracers, and their vertical behavior to evaluate the air mass contributions from Mainland China and assess the percentage contributions of these regional emissions to the measurements over the Korean Peninsula.

1.029 Fire Activity in Northern Eurasia from 2002 to 2015.

Presenting Author:

Wei Min Hao, US Forest Service, RMRS Fire Sciences Laboratory, Missoula, MT 59803, whao@fs.fed.us

Co-Authors:

Bryce Nordgren, US Forest Service, RMRS Fire Sciences Laboratory, Missoula, MT 59803

Alex Petkov, US Forest Service, RMRS Fire Sciences Laboratory, Missoula, MT 59803

Rachel Corley, US Forest Service, RMRS Fire Sciences Laboratory, Missoula, MT 59803

Shawn Urbanski, US Forest Service, RMRS Fire Sciences Laboratory, Missoula, MT 59803

Yves Balkanski, Laboratoire des Sciences du Climat et de l'Environnement (LSCE), CEA-UVSQ-CNRS UMR 8212, Institut Pierre et Simon Laplace, L'Orme des Merisiers, F-91191 Gif sur Yvette Cedex, France

Philippe Ciais, Laboratoire des Sciences du Climat et de l'Environnement (LSCE), CEA-UVSQ-CNRS UMR 8212, Institut Pierre et Simon Laplace, L'Orme des Merisiers, F-91191 Gif sur Yvette Cedex, France

Florent Mouillot, Centre d'Ecologie Fonctionnelle et Evolutive, CNRS, 34293 Montpellier 5, France

Abstract:

Wildfire is a disturbance to the ecosystem and most of the fires are caused by human activity. The trace gases, aerosol particles, and black carbon emitted from fires can affect air quality, climate, and public health. Black carbon emitted from wildfires in high latitudes can also accelerate ice and snow melting in the Arctic. As the climate becomes warmer and drier, more wildfires are predicted to occur in high-latitude ecosystems, a region highly sensitive to climate change. We studied the trends of the area burned daily in various ecosystems of Northern Eurasia at a 500m × 500m resolution during a 14-year period from 2002 to 2015 using the MODIS products. The total area burned decreased by 40% from 3.2×10^5 km^2 in 2002 to 1.9×10^5 km^2 in 2015. There is no apparent trend of the forested area burned, which is contrary to conventional assumptions. However, the area burned in grassland fires in Central and Western Asia decreased by 63% from 2.1×10^5 km^2 in 2002 to 0.8×10^5 km^2 in 2015, accounting for all the decline of the total area burned in Northern Eurasia. The decrease is correlated with (1) the decrease of MODIS Drought Severity Index (DSI), and (2) the increase of the number of grazers: goats, sheep and cattle. The DSI decreased substantially from 1.0 in 2002 to -0.4 in 2011. The numbers of grazers in this region decreased drastically in the mid-1990s because of economic collapse of the Soviet Union. However, the number of grazers has recovered and increased steadily since 2000. Grazing on grassland reduces fuel loadings and thus emissions from biomass burning. The interactions of climate, economy, grazing, the extent of biomass burning, emissions of atmospheric pollutants and black carbon in

Central and Western Asia in the past 14 years will be summarized.

1.004 Estimation the Green house gases emissions from transport sector in Azerbaijan..

Presenting Author:

Sadig Hasanov, Institute of Radiation problems, National Academy of Sciences of Azerbaijan ,Baku, Azerbaijan, h_sadiq@mail.ru

Co-Authors:

Mustafayev İslam İsrafil, Institute of Radiation problems, National Academy of Sciences of Azerbaijan , Baku,Azerbaijan

Mahmudov Hokman Movajjat, Institute of Radiation problems, National Academy of Sciences of Azerbaijan ,Baku, Azerbaijan

Abstract:

The contribution and modeling the Green House Gases(GHG) from transport sector in total pollution into the atmosphere air in Azerbaijan has been evaluated. As a result of conducted surveys, it is ascertained that car wastes are the main pollution sources of worsening air quality. Thus, over 80% (1 mln ton) the total emissions has been exhausted by vehicles. In the frame of survey, COPERT 4 software evaluation program has been applied to calculate Carbon-dioxide (CO2), nitrous oxides(N2O) and methane (CH4) which is one of main source of Global Warming and Climate Changes. The methodology has been based on IPCC/CORINAIR air pollutant emissions inventory guidebook. The key results of the study show that calculating vehicles emission using the COPERT-4 methodology can improve the estimation methods and could help to modeling the pollution for next years.

The method based on fuel consumption, average emission factors, road infrastructure, motion of vehicles at different condition included in the guidelines of İPCC. Methodology require the collection of all the considered activity data by using the respective guidelines, calculate the total emissions from each source and pollutants of interest. Currently, gradual growth at fuel consumption is irrational for economical and air quality aspects

Using the methodology proposed in this work is able to start from certification data to define modal emission rates of fuel consumption and NOx emission according to COPERT-4 software. This data and methodology can be further used in any other driving cycle, using the correspondent vehicle time distribution, to estimate and modeling fuel use and emission outcome in a given vehicle ore fleet of vehicles.

1.064 Inter-comparison of Global Satellite Burned Area Maps derived from MODIS, MERIS and SPOT-VGT.

Presenting Author:
Angelika Heil, Max Planck Institute for Chemistry, Mainz, Germany, a.heil@mpic.de

Co-Authors:
Kaiser Johannes W., Max Planck Institute for Chemistry, Mainz, Germany

Abstract:

Inter-comparison of Global Satellite Burned Area Maps derived from MODIS, MERIS and SPOT-VGT

Vegetation fires are a major disturbance in the Earth System. Fire emissions exert a significant climate forcing and are source of widespread air pollution. Most fire emission inventories rely on satellite burned area information as input. Therefore, the accuracy of the burned area maps is one important determinant for the quality of the emission estimates. Over the last decade, several satellite-derived burned area products have been released. The products differ in terms of satellite sensor and/or algorithm used. Each of them has different strengths and weaknesses.

Here, we inter-compare six global burned area products from MODIS (collection 5: GFED4 aka "MCD64 C5", GFED4s and MCD45 and collection 6: MCD64 C6), MERIS (Fire_cci) and SPOT-VGT (C-GLOPS). We show that Fire_cci, MCD64 C5, GFED4s, MCD64 C6 and MCD45 largely agree in localising the regions with most intense fire activity in the tropical belts of Africa and Australia. The Copernicus Land product C-GLOPS shows the least inter-product agreement of all burned area products. Pronounced inter-product differences emerge for specific regions or fire events. Burned area mapped by Fire_cci, for example, tends to be notably higher in regions where small agricultural fires predominate.

Users generally do not take into account the variability of observational gaps in the underlying burned area mapping. Under unfavourable conditions, these variations may introduce distinct artificial regional and temporal trends. Burned area may be low or absent in certain regions because there is little fire activity. Burned area may equally be low or absent because of poor observational coverage (e.g. missing satellite input data, cloud cover). We demonstrate that correctly discriminating between both is essential for unflawed applications and interpretations of burned area products.

2.035 Top-down Validation of Swiss non-CO2 Greenhouse Gas Emissions.

Presenting Author:
Stephan Henne, Empa, Laboratory for Air Pollution/Environmental Technology, Dübendorf, Switzerland, stephan.henne@empa.ch

Co-Authors:
Joachim Mohn, Empa, Laboratory for Air Pollution/Environmental Technology, Dübendorf, Switzerland
Markus Leuenberger, Univ. of Bern, Physics Institute and Oeschger Centre for Climate Change Research, Bern, Switzerland
Frank Meinhardt, Umweltbundesamt (UBA), Kirchzarten, Germany
Martin Steinbacher, Empa, Laboratory for Air Pollution/Environmental Technology, Dübendorf, Switzerland
Martin K. Vollmer, Empa, Laboratory for Air Pollution/Environmental Technology, Dübendorf, Switzerland
Stefan Reimann, Empa, Laboratory for Air Pollution/Environmental Technology, Dübendorf, Switzerland
Lukas Emmenegger, Empa, Laboratory for Air Pollution/Environmental Technology, Dübendorf, Switzerland
Dominik Brunner, Empa, Laboratory for Air Pollution/Environmental Technology, Dübendorf, Switzerland

Abstract:

Globally, emissions of long-lived non-CO_2 greenhouse gases (GHG) account for approximately 30 % of the radiative forcing of all anthropogenic GHG emissions. However, on the country level 'bottom-up' estimates of anthropogenic non-CO_2 GHGs are often connected with relatively large uncertainties compared with those of anthropogenic CO_2. The latter can be fairly well established from fuel statistics, whereas the former originate from rather diffuse sources for which both activity data and emission factors may carry substantial uncertainties. In order to validate national inventories and ascertain that target emission reductions can be reached with a given set of reduction measures, it is indispensable to apply independent 'top-down' methods on the country scale.
Here, we present country-scale atmospheric inversion studies for non-CO_2 GHG emission estimates in Switzerland, making use of the recently established CarboCount-CH network (est. 2013) of four stations on the Swiss Plateau as well as the neighbouring mountain-top sites Jungfraujoch (JFJ) and Schauinsland (SSL, Germany). Continuous observations of N_2O started at the tall tower site Beromünster in January 2017. The mountain-top sites have been providing continuous CH_4, N_2O, and halocarbon (JFJ) observations for several years. We use a high-resolution (7 x 7 km^2) Lagrangian model (FLEXPART-COSMO) in connection with two different inversion systems to estimate spatially and temporally resolved emissions for the Swiss domain. Extensive sensitivity inversions are used to assess the

overall uncertainty. In general, we find good agreement of the total Swiss CH_4 emissions between our ‘top-down’ estimate and the NIR ‘bottom-up’ reporting. Reduced winter time emissions were evident in all years. Uncertainties in the model’s boundary conditions can induce large offsets in national total emissions. We present first preliminary estimates of N_2O emissions and discuss emission estimates for the most important hydrofluorocarbons (HFCs) on the European and Swiss scale.

1.045 Progress towards comprehensive uncertainty estimates and emissions ensembles with the Community Emissions Data System (CEDS).

Early Career Scientist

Presenting Author:
Rachel Hoesly, Pacific Northwest National Lab - Joint Global Change Research Institute, rachel.hoesly@pnnl.gov

Co-Authors:
Steven J Smith, Pacific Northwest National Lab - Joint Global Change Research Institute

Abstract:

The Community Emissions Database System (CEDS) is an open source data system scheduled for public release in Summer 2017 that produces global, historical (1750 - present) estimates of anthropogenic acidifying gases (NH_3, NO_X, SO_2), carbonaceous gases (CO_2 and CO, CH_4) and carbonaceous aerosols (BC and OC). Emissions are estimated annually and resolved by the country, sector, and fuel, and then gridded by year and sector with monthly seasonality. CEDS estimates rely on existing energy consumption data sets and regional and country-specific inventories to produce emission trends over recent decades. The system provides a reproducible, consistent, and transparent means of quantifying uncertainty around emissions inventories.
We examine uncertainty involved in estimating recent year emissions, which includes uncertainty from the preliminary nature and lack of sectoral detail for energy data and the lack of detailed emission factor and emission control information for recent years. We estimate this uncertainty by comparing emissions estimates resulting from applying estimation methodologies to data released in pervious years, to estimates resulting from data released at later dates. We are working toward more comprehensive uncertainty estimates, considering correlations in uncertainties across sectors and countries and taking into account the relative uncertainties across emission species (within a group of countries). These estimates will lead to ensembles of historical emissions, which will be used in modeling experiments to more comprehensively examine uncertainties.

1.040 Drying lakes as emerging sources of dust: Case of Urmia Lake, Iran.

Presenting Author:

Ali Hoshyaripour, Institute for Meteorology and Climate Research, Karlsruhe Institute of Technology (KIT), Germany, gholamali.hoshyaripour@uni-hamburg.com

Co-Authors:

Klemen Zaksek, Zentrum für Telematik e.V., Würzburg, Germany

Abstract:

The drying up of the Urmia Lake in Iran's northwestern corner is considered as one of the most staggering environmental disasters in the country. Over the last 20 years up to 90% of the former seabed of this salt lake have been exposed, creating a potentially significant dust source with very high salt content. It is widely believed, but little researched, that this has increased the dust emissions in the region posing major hazards to human health and agriculture.

This study aims to quantify the changes in dust emissions from the dried seabed and also to identify the main physical mechanisms that modulate these changes. We investigate the trend of Aerosol Optical Depth (AOD) as a measure of dust emission over Urmia lake and its surroundings from 2000 to 2014. The changes of the wind speed and land surface properties are also explored as the key physical drivers of dust emission.

The AOD trends show that the dust emission in the region is doubled during 2010-2014 compare to the decade before. This escalation is mainly fueled by increase in the wind speed and also erodibility of the surface. The implications of the results for dust emission schemes in numerical models are explained.

1.048 Improving emission and air quality analyses via better representing the land surface states.

Presenting Author:
Min Huang, George Mason University, Fairfax, VA, mhuang10@gmu.edu

Abstract:

In several case studies over different regions of the world, we show that emission and air quality analyses can be improved by alternating the representation of the land surface states (e.g., surface types, soil moisture and temperature, vegetation dynamics), which redefines the sources of emissions and modifies the modeling analyses on process level. We first assess the impact of weather model inputs on the calculation of US biogenic isoprene emissions during the SEAC^{4}RS and DISCOVER-AQ airborne campaigns. By using a different method to initialize the surface states of the Weather Research and Forecasting (WRF) model than the conventional method, biases in the WRF simulated surface air temperature and latent/sensible heat fluxes with respect to in-situ and satellite observations were effectively reduced. The isoprene emissions in the eastern US estimated by the Model of Emissions of Gases and Aerosols from Nature (MEGAN) based on the improved WRF weather fields are closer to the aircraft-derived emissions. We then show initial results of assimilating the Soil Moisture Active-Passive (SMAP) soil moisture, the Moderate Resolution Imaging Spectroradiometer (MODIS) greenness vegetation fraction and the MODIS/Visible Infrared Imaging Radiometer Suite (VIIRS) surface types data to benefit the coupled WRF modeling over the US, east Asia and Australia during recent spring-summer seasons. Over the erodible lands, the interannual variability of meteorology from the best WRF simulations is connected with that of the dust events frequency indicated by the MODIS deep blue aerosol product and in-situ particulate matter measurements, as well as the dynamic dust source regions determined by the MODIS vegetation index products along with the MODIS/VIIRS surface types data.
*with acknowledgements to many in SMAP, NCA and field campaign science teams.

1.015 Towards a harmonized emission inventory in South America for air quality and climate modelling.

Presenting Author:
Nicolas Huneeus, Department of Geophysics and Centre for Climate and Resilience Research, University of Chile, Santiago, Chile, nhuneeus@dgf.uchile.cl

Co-Authors:
Laura Dawidowski, National Atomic Energy Commission, Buenos Aires, Argentina
Hugo Denier van der Gon, TNO, Utrecht, The Netherlands
Marcelo Alonso, Universidad Federal de Pelotas, Brazil
Paula Castesana, National University of San Martín (UNSAM), San Martin, Buenos Aires, Argentina
Melisa Diaz, National Atomic Energy Commission, Buenos Aires, Argentina
Laura Gallardo, Department of Geophysics and Centre for Climate and Resilience Research, University of Chile, Santiago, Chile
Dario Gomez, National Atomic Energy Commission, Buenos Aires, Argentina
Claire Granier, CNRS (National Center for Scientific Research), LATMOS, Paris, France
Rachel Hoesly, Pacific Northwest National Laboratory, College Park, MD, USA
Maria de Fatima Andrade, University of São Paulo, Sao Paulo, Brazil
Mauricio Osses, Technical University Federico Santa Maria, Santiago, Chile
Nestor Rojas, National University of Colombia, Bogota, Colombia
Sebastian Tolvett, Metropolitan Technical University, Santiago, Chile
Odon Sanchez-Ccoyllo, Servicio Nacional de Meteorologia e Hidrologia del Perú-SENAMHI, Lima, Peru
Steven Smith, Pacific Northwest National Laboratory, College Park, MD, USA

Abstract:

National emission inventories in South America are prepared as part of the obligations of the Parties to the United Nations Framework Convention on Climate Change within the framework of their national communications. These inventories include the emissions of greenhouse gases (GHG) as well as non-GHG subject to complementary reporting under the Convention. However, several pollutants with important impact on climate change and air quality are not included in these estimates. Emission inventories developed in different South American (SA) countries are typically prepared at national level, providing an annual total, not necessarily for all criteria pollutants and without information on spatial and temporal emission patterns. There are also inventories for a number of SA cities, particularly large urban conglomerates, but these are not necessarily consistent with the corresponding national inventories. There is need to harmonize these estimates, and to fill the gap associated with the knowledge of spatially distributed and temporally disaggregated emissions. A network was established between members of the Latin America (LA) Emissions Inventory Group (LAEIG) from five countries (Argentina, Brazil,

Chile, Colombia and Peru) and international researchers with the aim to build a consistent and shared emission inventory in the near future for these five countries. As a first step a workshop was held in Chile in March 2017. Compiled information already generated in the region was presented and summarized in a document that will be used to seek international funding to generate the emission inventories. The main conclusion of this meeting and examples of the most pressing issues will be presented.

2.019 Satellite-based methane emissions estimation from the natural gas industry in Northeast British Columbia, Canada.

Early Career Scientist

Presenting Author:

SM Nazrul Islam, PhD student, Natural Resources and Environmental Studies, University of Northern British Columbia (UNBC), Prince George, BC, Canada, sislam0@unbc.ca

Co-Authors:

Peter Jackson, Professor, Natural Resources and Environmental Studies Institute, UNBC, Prince George, BC, Canada

Chris McLinden, Research Scientist, Air Quality Research Division, Environment and Climate Change Canada, Toronto, Ontario, Canada

Abstract:

Although British Columbia's (BC's) natural gas resource is an economic boon, improper handling during its production, distribution and use can result in increased emissions of methane to the atmosphere. In 2014 it was estimated that 21% of BC's total methane emissions (10,633 kt CO_2e) were from mining and upstream oil and gas production, as well as fugitive oil and natural gas sources. In this research, satellite-based methane concentrations (XCH_4) will be used to detect positive methane anomalies in spatial maps of regions associated with oil and gas industries. We will compute XCH_4 anomalies for the selected target regions by subtracting the monthly mean values of SCIAMACHY XCH_4 for the respective entire region from the individual satellite observations. By doing so, signals from large-scale seasonal variations and global trends will be filtered out, yielding regional enhancements relative to varying background concentrations. Next, the computed satellite anomalies are averaged over the time periods of 2004-2006 (before the rapid expansion of natural gas extraction) and 2007-2009 (after the rapid expansion). The differences in anomalies between these time periods are used to see the changes in atmospheric methane in Northeast BC before and after the rapid development of natural gas. The XCH_4 anomalies will be used to determine the emission change as an average mass flux per unit of time, following the mass balance approach. Finally, the emission estimation will be compared with other available estimations. This study will allow us to improve the provincial methane emission inventory and consequently serve the needs of Provincial and National climate policy.

1.008 Now you see me, now you don’t. Lessons learnt from the construction of ship emission inventories ranging from local to global scale..

Presenting Author:
Jukka-Pekka Jalkanen, Atmospheric Composition Research, Finnish Meteorological Institute, P.O. Box 503, FI-00101 Helsinki, Finland, jukka-pekka.jalkanen@fmi.fi

Co-Authors:
Lasse Johansson, Atmospheric Composition Research, Finnish Meteorological Institute, P.O. Box 503, FI-00101 Helsinki, Finland
Jaakko Kukkonen, Atmospheric Composition Research, Finnish Meteorological Institute, P.O. Box 503, FI-00101 Helsinki, Finland

Abstract:

The knowledge of ship activity has increased tremendously during the last decade. Introduction of mandatory vessel transponder equipment, like the Automatic Identification System (AIS), has facilitated the birth of a new generation of emission inventories which are based on actual ship traffic patterns. The amount of data available from one year of ship activities from a busy, relatively small sea area like the Baltic Sea surpasses the amount of data that was collected globally in the last 250 years. With this wealth of data come certain drawbacks, which need to be considered. These can range from challenges arising from sheer volume of data, but may include several other issues which may not be that evident, like sparse reporting intervals and target swapping. These features may have a big impact on the quality of ship emission inventories.
This paper summarizes recent advances in global ship emission modelling based on real vessel activity during the year 2015. Based on this data, a global inventory for ships will be presented with fully dynamic features, at 10 km resolution and retaining the temporal variation of emission maps. This inventory is in line with both the methodology and the overall emission totals of the Third IMO GHG study, which links ship emission modeling to policymaking. General applicability of this inventory for use in chemical transport modelling and future development needs will be discussed.

1.007 The 1970-2012 emissions atlas of EDGARv4.3.2.

Presenting Author:
Greet Janssens-Maenhout, European Commission, Joint Research Centre, Ispra (Varese), Italy, greet.maenhout@jrc.ec.europa.eu

Co-Authors:
Marilena Muntean, European Commission, Joint Research Centre, Ispra (Varese), Italy
Monica Crippa, European Commission, Joint Research Centre, Ispra (Varese), Italy
Diego Guizzardi, Didesk, Verbania, Italy
Edwin Schaaf, European Commission, Joint Research Centre, Ispra (Varese), Italy
Jos Olivier, European Commission, Joint Research Centre, Ispra (Varese), Italy
Frank Dentener, European Commission, Joint Research Centre, Ispra (Varese), Italy

Abstract:

The Emissions Database for Global Atmospheric Research (EDGAR) estimates anthropogenic emissions and emission trends for each world country, based on international statistics, for the use in atmospheric models and for policy evaluation. The new version EDGARv4.3.2 provides global emission gridmaps at source-sector level, for a historic period from 1970 to 2012. The global geo-coverage, long time-series and multipollutant calculations are important for tracking emissions of greenhouse gases as well as gaseous and particulate air pollutants.

The trends of the world's largest emitters are analysed in more depth, so that insights on the temporal increases and decreases of each pollutant can be retrieved in a historic perspective. We also discuss the geospatial distribution and change in spatial patterns of hot spots making use of emission gridmaps. For hot spot emissions (e.g. megacities) EDGARv4.3.2 gridmaps can provide input to the community of atmospheric observations with a mapping of multipollutant sources at gridcell level, taking into account the shares of the different sectors for different substances (CO2, CO, CH4, NOx, PM). This mapping is qualitatively evaluated because of the relative large uncertainty, depending on the spatial and temporal representativeness of the emissions for the gridcell at a given time period.

The uncertainty for industrialised countries, countries with economy in transition and developing countries is addressed per sector and substance. Even though large progress is made on emission inventory compilation, the uncertainty on the global emission totals did not decrease, because of the increased share of emitting countries with weaker statistical infrastructure, and the decreased share of the well-known sectors where emissions reductions took place. EDGARv4.3.2 improved compared to v4.2, by the use of more recent international statistics providing timeseries till 2012, a considerably extended set of subsector specific spatial proxies and revised emission factors taking into account inverse modeling results using independent measurements

2.031 Report from 2017 IBBI workshop on improving operational fire emission estimates with current field campaigns.

Presenting Author:
Johannes W. Kaiser, Max Planck Institute for Chemistry, Mainz, Germany, j.kaiser@mpic.de

Co-Authors:
Melita Keywood, CSIRO, Melbourne, Australia
Melamed Megan L., University of Colorado/CIRES, Boulder, CO, USA

Abstract:

The Interdisciplinary Biomass Burning Initiative (IBBI) is jointly sponsored by the International Global Atmospheric Chemistry (IGAC) Project, the Integrated Land-Atmosphere Processes Study (iLEAPS), and the World Meteorological Organization's (WMO). The primary goal of IBBI is to improve atmospheric composition and air quality monitoring and forecasting through better scientific understanding of the various processes around biomass burning.
Various satellite-based fire observations are currently being used for estimating smoke emissions from vegetation fires for operational air quality forecasting and climate studies. In this setup, the emission estimation is a bottom-up methodology. It is, however, associated with large uncertainties. Therefore, there is a need for complementary constraints from atmospheric observations, i.e. a top-down approach.
Currently multiple research studies are underway within the US to study the impact of fires on climate and air quality through integrated laboratory, field and modelling activities, with major field activities taking place the summer of 2018 funded by NOAA (Fire Influence on Regional and Global Environments Experiment, FIREX), NASA (FIREChem) and NSF (Western wildfire Experiment for Cloud chemistry, Aerosol absorption and Nitrogen, WE-CAN). These campaigns can provide some of the mentioned top-down constraints.
In order to capitalize on these research projects, IBBI bringing representatives from these projects together with the international biomass burning research community with the ultimate goal of discussing how to leverage the efforts in the US and Europe to improve scientific research and understanding around biomass burning globally. The workshop is being held on 10-12 July 2017 in Boulder, Colorado, with financial support by ESA, NOAA, NASA and NSF. In this presentation, we will give an overview of its main findings.

3.031 Electric vehicles – emission scenarios for Poland and air quality modelling results.

Presenting Author:
Jacek Kaminski, Institute of Geophysics, Polish Academy of Sciences, jwk@wxprime.com

Co-Authors:
Joanna Struzewska, Warsaw University of Technology, Poland
Pawel Durka, Institute of Environmental Protection, Warsaw, Poland
Grzegorz Jeleniewicz, Institute of Environmental Protection, Warsaw, Poland
Ewelina Sulej, Warsaw University of Technology, Poland

Abstract:

Every year the number of electric cars on European roads is increasing. The electric cars are becoming affordable and more practical as batteries more efficient and travel range is increasing. The increase in numbers of charging points for electrical cars and shorter recharging time is an important factor in the overall electromobility trends. The number of electrical cars in Poland is increasing due to environmental awareness, new investments and government incentives.
We will present concepts of a possible electromobility evolution in Poland for three time horizons 2020, 2025 and 2030. For each of the year, three scenarios of high, low and medium expansion will be considered. For these assumptions, we will apply adequate changes for road transport (SNAP7) and energy sector (SNAP1) emission levels and trends for each of the time horizons. Available emission databases such as MACCity, EMEP, ECLIPSE as well as RCPs scenarios from the AR5 IPCCC report will be used.
We will carry out air quality simulations using the GEM-AQ model for the defined emission scenarios. The base simulation will be done for 2015. Model simulations will use base meteorology for 2015 in order to reflect changes that can be attributed to emissions scenarios only.
Air quality modelling results for primary and secondary pollutants for each of the years and three activity levels will be presented.

1.028 Mobile monitoring of ultrafine and fine particle at the street level in a Southeast Asian City: finding the source locations and the health risk assessment.

Presenting Author:
Md Firoz Khan, Centre for Tropical Climate Change System, Institute of Climate Change, Universiti Kebangsaan Malaysia, 43600 Bangi, Selangor, Malaysia, mdfiroz.khan@gmail.com

Abstract:

Aerosol pollution is a deep concern in the tropical regions of Southeast Asia as these particles can pose a deleterious impact on human health. The concentration of the particles is greatly influenced by the anthropogenic activities e.g. pristine management of agricultural waste, wildfires, burning of peat soil, combustion of fossil fuel and local monsoonal circulation. These particles influence on the climate change via the scattering and absorbing radiation, alter cloud albedo and decrease visibility. Furthermore, particle pollution can cause the severe level of exposure to the population at the street levels. However, this crucial fact was not fully investigated in this city. Therefore, the particle number concentration (PNC) was recorded through the use of Nanoscan and Optical particle sizer (OPS) for the wide ranges of 10 nm to 420 nm and 0.300 µm to 10 µm, respectively. Additionally, ozone (O_3) at the surface level, meteorological parameters, and the GPS coordinates were recorded at 1 min resolution. The equipment and other devices were accommodated to a four wheeler vehicle and the inlets were kept on the roof of the vehicle. This campaign was designed for a period of 4 January 2017 to 11 January 2017 on the main streets of Kuala Lumpur and the nearby areas during the daytime. The campaign was operated at the city centre, residence, industrial and the palm oil plantation areas. The main objectives of the campaign were a) to study the trend analysis of PNC; b) relate to the source regions; c) to estimate the possible risk on human health. Briefly, the results showed that the sharp peaks of PNC were observed in the range of ultrafine and fine mode at the city centre areas as compared to the residential and palm oil plantation areas.

3.038 Linked Analysis of Baseline Emissions and Reduction Pathways for China and Korea .

Presenting Author:
Younha Kim, Department of Advanced Technology Fusion, Konkuk University, Seoul, Korea , pinktokkya@naver.com

Co-Authors:
Junghun Woo, Division of Interdisciplinary Studies, Konkuk University, Seoul, Korea
Jinsu Kim, Department of Advanced Technology Fusion, Konkuk University, Seoul, Korea
Chanjong Bu, Department of Advanced Technology Fusion, Konkuk University, Seoul, Korea
Jinseok Kim, Department of Advanced Technology Fusion, Konkuk University, Seoul, Korea

Abstract:

Air pollution and its impacts over the Northeast Asia are very severe because of the massive pollutant emissions and high population. Korea has been trying to improve air quality with the enhanced environmental legislation. The air quality over Korea, however, does not entirely dependent on its local emissions. Transboundary air pollution from China highly affects Korean atmosphere. The purpose of this research is to understand role of local and transbounday efforts to improve air quality changes over Korea.
In this research, we have tried to set up the multiple emission scenario pathways for Korea and China using IIASA's GAINS (Greenhouse gas – Air pollution Interactions aNd Synergies) modeling framework. More up-to-date growth factors and control policy packets were made using regional socio-economic data and control policy information from local governments and international statistics. Four major scenario pathways, 1) Base (Baseline: current legislation), 2) OTB/OTB(On the book/On the way : existing control measure/planed control measure), 3) BOTW_GHG(Beyond on the way : OTW with GHG reduction plan), 4) BOTW_NH3 (OTW with additional NH3 reduction measure) were developed to represent air quality improvement pathways in consideration of both Korean and Chinese efforts.
Strict ambient PM2.5 standards from Seoul metropolitan Air quality Improvement Plan(SAIP) seems too enthusiastic without linking air quality control efforts of China. Step-by-step emission controls and following air quality, control cost, health impact from each scenario will be presented at the conference.
Acknowledgements
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3.022 Aerosol transport and the links to black carbon concentrations measured at a site on the west coast of southern Africa.

Early Career Scientist

Presenting Author:
Danitza Klopper, School of Geo- and Spatial Science, Unit for Env. Sc. and Management, North-West University, Potchefstroom, South Africa, danitzaklopper@gmail.com

Co-Authors:
Paola Formenti, LISA, UMR CNRS 7583, Université Paris Est Créteil et Université Paris Diderot, Institut Pierre Simon Laplace, Créteil, France
Stuart J. Piketh, School of Geo- and Spatial Science, Unit for Env. Sc. and Management, North-West University, Potchefstroom, South Africa

Abstract:

Back trajectories are used to determine the source regions of light-absorbing black carbon (BC) aerosols measured at a ground based site on the west coast of southern Africa over a 4-year period. 72 hour back-trajectories are run for days with excess (above pristine) BC loads and the seasonal maximum for measured BC concentrations is observed during the austral wintertime (May to August). The back trajectories are visually analysed and grouped into 12 envelopes of different source regions from around the southern African subcontinent which include the southeastern Atlantic and Indian oceans, South Africa, Mozambique, Zimbabwe, Botswana, Namibia, Zambia and Angola. The 12 envelopes are grouped into 3 larger envelopes which divide the regions up into an Atlantic flow pathway, a southerly continental pathway and a south-easterly continental pathway. The differences in the contributions of BC from the source regions is spatially representative of biomass and fossil fuel emissions from those regions. 90% of the values for BC originating from the Atlantic flow pathways are smaller than 250 $ng.m^{-3}$ and mean concentrations are significantly lower (0.01 confidence level) than that of the continental flow pathways. Possible sources include ship tracks along the southern African west coast, local sources, biomass burning and industrial plants along the west coast. The continental flow pathways are significantly different from one another at the 0.05 confidence level and 90% of the values range between 250 and 450 ng m^{-3}. Possible sources include biomass burning and anthropogenic sources from central and southern Africa.

2.011 Constraining black carbon emissions from Siberian wildfires using remote sensing aerosol measurements.

Presenting Author:
Igor Konovalov, Institute of Applied Physics of the Russian Academy of Sciences, Nizhny Novgorod, Russia, konov@appl.sci-nnov.ru

Co-Authors:
Daria Lvova, Institute of Applied Physics of the Russian Academy of Sciences, Nizhny Novgorod, Russia
Matthias Beekmann, LISA, CNRS, Université Paris-Est and Université Paris 7, Créteil, France

Abstract:

Siberian vegetation fires are known to provide an important natural source of absorbing aerosol species such as black carbon (BC) and brown carbon (BrC) that can perturb the Earth's radiation budget in many ways, including the direct radiative forcing in the atmosphere and accelerating sea ice melting in the Arctic. Therefore, accurate characterization of this source is needed in order to ensure that climate model results isolating anthropogenic and natural contributions to the radiation budget are sufficiently accurate. However, BC emission data that are provided for the Siberia region by fire emission inventories and are widely used in models have practically not been evaluated against atmospheric measurements. Furthermore, the inventories usually do not provide any information on BrC as a fraction of organic carbon (OC) emissions.
We combined retrievals of aerosol optical properties from multiwavelength measurements performed at AERONET stations and by the OMI satellite instrument with corresponding data from a chemistry transport model, in which a robust empirical parameterization was used to relate the BC / OC ratio with the single-scattering albedo of biomass burning aerosol. An original algorithm, based on the wavelength dependence of BC and BrC absorption, allowed us to separate the contributions of BC and BrC into the observed absorption aerosol optical depth. As a result, we obtained observation-based monthly estimates of the BC emissions from Siberian fires in 2012. Furthermore, we found that, in line with results of our other recent study (Konovalov et al., ACPD, 2016), the atmospheric evolution of BrC is substantially different from that of BC (or other passive primary aerosol species). The results are discussed in the context of assessments of the impact of emissions from Siberian fires on the Arctic warming.
This study was supported by the Russian Science Foundation (grant no. 15-17-10024), and by the French CNRS PARCS project.

1.055 A NEW EMISSION INVENTORY FOR CHINA BASED ON THE MONITORING AND ASSESSMENT OF REGIONAL AIR QUALITY IN CHINA USING SPACE OBSERVATIONS, MARCOPOLO, PROJECT..

Presenting Author:
MariLiza Koukouli, Laboratory of Atmospheric Physics, Aristotle University of Thessaloniki, Greece., mariliza@auth.gr

Co-Authors:
Dimitris Balis, Laboratory of Atmospheric Physics, Aristotle University of Thessaloniki, Greece.
Ronald van der A, Royal Netherlands Meteorological Institute (KNMI), De Bilt, The Netherlands & Nanjing University of Information Science & Technology (NUIST), China.
Jieying Ding, Royal Netherlands Meteorological Institute (KNMI), De Bilt, The Netherlands
Fei Liu, Royal Netherlands Meteorological Institute (KNMI), De Bilt, The Netherlands
Tzenny Stavrakou, Royal Belgian Institute for Space Aeronomy (BIRA-IASB), Brussels, Belgium.
Maite Bauwens, Royal Belgian Institute for Space Aeronomy (BIRA-IASB), Brussels, Belgium.
Jean-François Mueller, Royal Belgian Institute for Space Aeronomy (BIRA-IASB), Brussels, Belgium.
Gerrit de Leeuwe, Finnish Meteorological Institute, FMI, Helsinki, Finland.
Vassilis Amiridis, Institute for Astronomy, Astrophysics, Space Applications and Remote Sensing, National Observatory of Athens, Greece.
Manolis Proestakis, Institute for Astronomy, Astrophysics, Space Applications and Remote Sensing, National Observatory of Athens, Greece.
Konstantinos Kourtidis, Department of Environmental Engineering, Democritus University of Thrace, Greece.
Aristeidis Georgoulias, Department of Environmental Engineering, Democritus University of Thrace, Greece.
Hans Hooyberghs, Flemish Institute for Technological Research (VITO), Belgium
Nele Veldeman, Netherlands Organization for Applied Scientific Research (TNO), Netherlands
Renske Timmmermans, Netherlands Organization for Applied Scientific Research (TNO), Netherlands
Qiang Zhang, Center for Earth System Science, Tsinghua University, China

Abstract:

The main objective of the EU FP7 MarcoPolo project, 2014-2017, is to improve air quality

monitoring, modelling and forecasting capabilities over China using satellite data by combining Chinese and European expertise. Due to the strong economic growth in China, emissions of main air pollutants like NO_2, SO_2, VOCs, aerosols, and CO are rapidly growing. Recently, however, the implementation of cleaner technology (e.g. desulfurization in coal-fired power plants) proved to be successful in reducing the emissions in many regions around the country.

Within the MarcoPolo project we combined atmospheric observations from satellite with state-of-the-art inverse modeling techniques in order to monitor and quantify the emissions of main air pollutants (SO_2, NO_2, VOCs, and PM) from space over the last 10 years, and study the effect of rapid economic growth and emission regulations on the current air quality. In a second step, we combined the space-based emission estimates with sector information from bottom-up emission inventories (MEIC) to generate a new emission database for the Chinese domain for year 2014. Due to the immediate access of satellite observations, often within 3h of measurement, updates to the emission inventories may be performed much more frequently than the traditional compilation of the bottom-up fields.

The MarcoPolo inventory is used as input to chemistry-transport models, such as LOTOS-EUROS and CHIMERE, and is thence assessed against ground-based observations. Space-based emission inventories will undoubtedly help improve air quality modeling and forecast skills, guide decision-making and help face the challenge of improving air quality in this rapidly changing region.

3.027 Characteristics of emission particles over Indo-Gangetic Basin: health and climatic implications.

Presenting Author:

Ranjit Kumar, Department of Chemistry, Faculty of science, Dayalbagh Educational Institute (Deemed University), Dayalbagh, Agra-5 (India), rkschem@rediffmail.com

Co-Authors:

Pratima Gupta, Department of Chemistry, Faculty of science, Dayalbagh Educational Institute (Deemed University), Dayalbagh, Agra-5 (India)

Ashok Jangid, Department of Physics and Computer Science, Faculty of science, Dayalbagh Educational Institute (Deemed University), Dayalbagh, Agra-5 (India)

Abstract:

The Indo-Gangetic Basin has attracted attention of scientific community in last few years due to high air pollution load; drastic change in climatic pattern and increase in epidemic and endemic diseases. Emitted aerosol particles affects climate directly and indirectly and pose threats to human health. The effects of emitted particles depend upon the physical and chemical properties of aerosol, which depends upon nature of source. The present study reports the level of PM_{10}, $PM_{2.5}$ and BC concentration at Agra over Indo-Gangetic Basin, possible sources and role in deteriorating human health. The concentration of PM_{10} and $PM_{2.5}$ are much higher than NAAQS level set by Indian Government. It is many times higher than WHO, USEPA and EUPAQ values. The high concentration of PM_{10} and $PM_{2.5}$ are throughout the year. It may probably due to fast growth in construction and industrial sectors. The chemical analysis reveals alkaline nature of aerosols. The BC concentration was in the range of 5-15 µg m^{-3}. The high load of black carbon in Agra and over Indo-Gangetic basin may be due to vehicular emissions and biomass combustions. BC exhibits seasonal variation with the maximum concentration during the winter followed by post-monsoon, summer and monsoon. Back air trajectory study reveals long range transported pollutant over this region. Wind patterns are such that European countries influence this region. The ratio of BC_{880}/UVPM $_{370}$is found to be less than one during the entire study period except in winter (December). This may be due to the fact that biomass combustion and diesel exhaust are more contributory over this region while a higher ratio in winter may be probably due to increase in consumption of fossil fuel and wood for heating purposes. Correlation analysis hints and found high load of aerosol particles are responsible for asthmatic and cardiovascular diseases over this region.

1.018 Evaluation of historical emission inventory in Asia.

Presenting Author:
Jun-ichi Kurokawa, Asia Center for Air Pollution Research, Niigata, Japan, kurokawa@acap.asia

Co-Authors:
Keiya Yumimoto, Kyushu University, Fukuoka, Japan
Syuichi Itahashi, Central Research Institute of Electric Power Industry, Chiba, Japan
Tatsuya Nagashima, National Institute for Environmental Studies, Tsukuba, Japan
Takashi Maki, Meteorological Research Institute, Tsukuba, Japan
Toshimasa Ohara, National Institute for Environmental Studies, Tsukuba, Japan

Abstract:

Recently, emissions of air pollutants and greenhouse gases from Asian region are considered to bring not only serious urban and regional air pollution, but also raises concerns about serious impact on global climate change. To tackle this problem, we need to understand the current status and past trend and effectiveness of mitigation measures. In order to provide fundamental information for this issue, we are developing a historical emission inventory in Asia based on Regional Emission inventory in ASia (REAS) version 2. Currently, target year is from 1950 to 2013, but the latest year will be extended using both bottom-up and top-down approaches. In this study, we preliminary evaluated effectiveness of abatement measures on emissions of air pollutants in Japan and China. For example, in 2013, NOx emissions were reduced by about 80% and 35% in Japan and China, respectively from those assuming no control measures. The largest effective mitigation measure in Japan is regulation for motor vehicles. For China, recently, denitrification equipment to power plants are becoming major emission control measures. For BC, most emission in current Japan were from diesel vehicles which are decreasing due to automobile low for PM. Emission from industry and residential sectors in Japan were largely reduced by abetment equipment and shifting to clean fuels such as natural gas. In China, about 50% of BC emissions were reduced in 2013 by mitigation measures for industry and road transport sectors. Shifting to clean fuels in residential sectors and introducing abetment equipment to such as cokes and brick plants expect to reduce BC emissions more in China. For improvement of bottom-up emissions, evaluation using model simulations is essential. We plan to perform historical model runs in Asian region and inverse modeling for NOx and BC. The preliminary results will be also reported.

1.020 Using STEAM and SILAM to model hydrocarbon emissions and dispersion from compression-ignition ship engines.

Early Career Scientist

Presenting Author:
Jaakko Laakia, Finnish Meteorological Institute, jaakkola@windowslive.com

Co-Authors:
Jukka-Pekka Jalkanen, Finnish Meteorological Institute
Hanna Hannuniemi, Finnish Meteorological Institute
Lasse Johansson, Finnish Meteorological Institute
Marje Prank, Finnish Meteorological Institute
Mikhael Sofiev, Finnish Meteorological Institute
Ari Karppinen, Finnish Meteorological Institute

Abstract:

Ocean-going vessels (OGVs) are significant sources of anthropogenic pollution. The Ship Traffic Emissions Assesment Model (STEAM2) includes emissions of CO, CO_2, NO_x, SO_x and PM [1]. The model was further developed in this study to include the combustion emissions of volatile organic compounds (VOC), which consist of various alkanes, aldehydes and aromatic molecules. As the number of different kinds of VOCs in the emissions was too large, the simplification was carried out according to the VOCs response to the engine loads. This information was transferred into STEAM2 where ship emissions were calculated on a global scale covering nearly 400 000 vessels. These results were further processed using Carbon Bond Mechanics IV (CB4), in which the chemicals were classified into specific blocks according to their functional groups. In addition, the compounds were distributed within the blocks according to their mass-equivalent effective saturation concentration. Subsequently this and the CB4 classifications were introduced into the SILAM chemical transport model (http://silam.fmi.fi/) in order to calculate the concentration distributions for VOCs.

Reference

[1] J.P. Jalkanen, L. Johansson, J. Kukkonen, A. Brink, J. Kalli, T. Stipa, Extension of an assessment model of ship traffic exhaust emissions for particulate matter and carbon monoxide, Atmos. Chem. Phys. 12 (2012) 2641–2659. doi:10.5194/acp-12-2641-2012.

2.032 City-scale top-down verifications of NOX emissions in South Korea using satellite observations.

Presenting Author:
Jae Hyeong Lee, Department of Atmospheric Science, Kongju National University, Gongju, South Korea, ljh0226@kongju.ac.kr

Abstract:

A quantitative evaluation of anthropogenic emissions is a prerequisite for accurate modeling of air quality using a chemical transport model. South Korea is suffering from poor air quality due to the influence of strong local emissions and trans-boundary emissions of China. In the study, a top-down verification method is applied to assess NOX emissions over local urbanized areas in South Korea using OMI/KNMI (Ozone Monitoring Instrument/Royal Netherlands Meteorological Institute) NO2 columns. The WRF-Chem (Weather Research and Forecasting-Chemistry) is configured over the East Asia domain (DX = 32.4 km) and nested down to South Korea domain (DX = 3.6 km) using a one-way nesting technique. The model simulation was conducted for 6 months (from April to September) 2010 with the MICS-ASIA 2010 (Model Inter-Comparison Study for ASIA 2010) emissions which includes both the local and trans-boundary emissions in the model domain. Ten sector areas with high emission intensities in South Korea were defined and the NOX emission of each sector was assessed. The satellite-observed NO2 columns range from 3.9×1015 molec. cm-2-13.5×1015 molec. cm-2 with a highest value in Seoul. The model simulated NO2 columns of a range of 6.2×1015 molec. cm-2-15.7×1015 molec. cm-2 compare well within the estimated model-observation errors. Appling OMI averaging kernels to modeled NO2 column increased ~24% on average, and the magnitude changed seasonally by a combined influence of monthly variations in vertical distributions of the modeled NO2 mixing ratios and the OMI averaging kernels. Further details are discussed including the influence of a sector-size and a OMI NO2 column down-scaling.

1.060 Portuguese emissions trends under the NEC Directives.

Presenting Author:
Joana Leitão, CESAM & Dep. of Environment and Planning, University of Aveiro, 3810-193 Aveiro, Portugal, jleitao@ua.pt

Co-Authors:
Joana Ferreira, CESAM & Dep. of Environment and Planning, University of Aveiro, 3810-193 Aveiro, Portugal
Ana Isabel Miranda, CESAM & Dep. of Environment and Planning, University of Aveiro, 3810-193 Aveiro, Portugal
Alexandra Monteiro, CESAM & Dep. of Environment and Planning, University of Aveiro, 3810-193 Aveiro, Portugal
Carlos Silveira, CESAM & Dep. of Environment and Planning, University of Aveiro, 3810-193 Aveiro, Portugal
Hélder Relvas, CESAM & Dep. of Environment and Planning, University of Aveiro, 3810-193 Aveiro, Portugal
Myriam Lopes, CESAM & Dep. of Environment and Planning, University of Aveiro, 3810-193 Aveiro, Portugal
Peter Roebeling, CESAM & Dep. of Environment and Planning, University of Aveiro, 3810-193 Aveiro, Portugal

Abstract:

The first National Emission Ceilings (NEC) Directive (2001/81/EC) was adopted in 2001 establishing emission ceilings for several pollutants (SO_2, NOx, NMVOC and NH_3) to be accomplished in 2010 by each European Member State (MS). Recently, this legal document was revised leading to the publication of a new NEC Directive (2016/2284/EU) to ensure further reduction of air pollution negative impacts. The MS committed to new stricter targets for 2020 and 2030 for the pollutants included in the previous regulation, adding now also a ceiling for PM2.5.
Portuguese emissions have shown a decreasing trend and targets defined for 2010 were achieved. Emission trends and corresponding contributions from activity sectors have been assessed showing a clear reduction of the energy production contribution to NOx and SO_2 emissions and of transport to NMVOC. Nevertheless, current legislation scenarios from the GAINS model and the national environment agency show exceedances for all pollutants in 2030. This analysis shows that to reach those targets additional measures as the ones considered in optimized scenarios will have to be implemented to assure compliance with the legislated ceilings.
Within the FUTURAR project the air quality impacts of 2030 Portuguese emission projections are being analysed, not just at a national level but investigating as well optimal regional implementation of emission reduction measures. By analysing the spatial distribution of emissions it is possible to identify local/regional problems and appropriated emission control strategies. A methodology to account with spatial variability that allows for spatial disaggregation of national values will be presented. In this way key sectors are identified together with regions that should be the focus of

future emission reduction strategies. Additionally, this analysis identifies several factors that can be used as proxy for this purpose, such as population projections at regional/municipal levels, future trends of energy consumption, planning strategies, among others.

2.005 Emission rate estimates determined for VOCs using airborne measurements for the oil sands facilities in Alberta, Canada.

Early Career Scientist

Presenting Author:
Shao-Meng Li, Air Quality Research Division, Environment and Climate Change Canada, 4905 Dufferin Street, Toronto, Ontario M3H 5T4, Canada, shao-meng.li@canada.ca

Co-Authors:
Amy Leithead, Air Quality Research Division, Environment and Climate Change Canada, 4905 Dufferin Street, Toronto, Ontario M3H 5T4, Canada
Samar Moussa, Air Quality Research Division, Environment and Climate Change Canada, 4905 Dufferin Street, Toronto, Ontario M3H 5T4, Canada
John Liggio, Air Quality Research Division, Environment and Climate Change Canada, 4905 Dufferin Street, Toronto, Ontario M3H 5T4, Canada
Michael Moran, Air Quality Research Division, Environment and Climate Change Canada, 4905 Dufferin Street, Toronto, Ontario M3H 5T4, Canada
Daniel Wang, Air Quality Research Division, Environment and Climate Change Canada, 4905 Dufferin Street, Toronto, Ontario M3H 5T4, Canada
Katherine Hayden, Air Quality Research Division, Environment and Climate Change Canada, 4905 Dufferin Street, Toronto, Ontario M3H 5T4, Canada
Andrea Darlington, Air Quality Research Division, Environment and Climate Change Canada, 4905 Dufferin Street, Toronto, Ontario M3H 5T4, Canada
Mark Gordon, York University, 4700 Keele Street, Toronto, Ontario, M3J 1P3, Canada
Ralf Staebler, Air Quality Research Division, Environment and Climate Change Canada, 4905 Dufferin Street, Toronto, Ontario M3H 5T4, Canada
Paul Makar, Air Quality Research Division, Environment and Climate Change Canada, 4905 Dufferin Street, Toronto, Ontario M3H 5T4, Canada
Craig Stroud, Air Quality Research Division, Environment and Climate Change Canada, 4905 Dufferin Street, Toronto, Ontario M3H 5T4, Canada
Robert McLaren, York University, 4700 Keele Street, Toronto, Ontario, M3J 1P3, Canada
Peter Liu, Air Quality Research Division, Environment and Climate Change Canada, 4905 Dufferin Street, Toronto, Ontario M3H 5T4, Canada
Jason O'Brien, Air Quality Research Division, Environment and Climate Change Canada, 4905 Dufferin Street, Toronto, Ontario M3H 5T4, Canada
Richard Mittermeier, Air Quality Research Division, Environment and Climate Change Canada, 4905 Dufferin Street, Toronto, Ontario M3H 5T4, Canada

Junhua Zhang, Air Quality Research Division, Environment and Climate Change Canada, 4905 Dufferin Street, Toronto, Ontario M3H 5T4, Canada
George Marson, Air Quality Research Division, Environment and Climate Change Canada, 4905 Dufferin Street, Toronto, Ontario M3H 5T4, Canada
Stewart Cober, Air Quality Research Division, Environment and Climate Change Canada, 4905 Dufferin Street, Toronto, Ontario M3H 5T4, Canada
Mengistu Wolde, National Research Council Canada, Flight Research Laboratory, Ottawa, Canada K1A 0R6
Jeremy Wentzell, Air Quality Research Division, Environment and Climate Change Canada, 4905 Dufferin Street, Toronto, Ontario M3H 5T4, Canada

Abstract:

In Summer of 2013, aircraft-based measurements of air pollutants were made during a field campaign in support of the Joint Implementation Plan on Oil Sands Monitoring in Alberta, Canada. Volatile organic compounds (VOCs) were determined using a proton-transfer-reaction time-of-flight mass spectrometer (PTR-ToF-MS) continuously at 2-5 sec resolution during the flights, and from 680 canisters collected during flights followed by offline GC-MS and GC-FID analyses for four large oil sands surface mining facilities. The Top-down Emission Rate Retrieval Algorithm (TERRA), developed at Environment and Climate Change Canada (ECCC), was applied to the aromatics and oxygenated VOC results from the PTR-ToF-MS to determine their emission rates. Additional VOC species, determined in the canisters, were compared with the PTR-ToF-MS VOC species to determine their emission ratios. Using these emission ratios and the emission rates for the aromatics and oxygenated VOCs, the individual emission rates for 73-90 VOCs were determined for each of the four major oil sands facilities. The results are the first independently determined emission rates for a large number of VOCs simultaneously for the oil sands mining facilities, that can be used to strengthen VOC emission reporting.

3.019 Emissions, Air pollution and Health in southern west Africa in the frame of DACCIWA-WP2 program..

Presenting Author:
Cathy LIOUSSE, Laboratoire d'Aérologie, Université Paul Sabatier Toulouse III-CNRS, France, lioc@aero.obs-mip.fr

Co-Authors:
Jacques Adon, Laboratoire d'Aérologie, Université Paul Sabatier Toulouse III-CNRS, France
Aristide Akpo, Université d'Abomey-Calavi, Cotonou, Bénin
Isabella Annesi-Maesano , EPAR, Université Pierre et Marie Curie-INSERM, Paris, France
Eric Assamoi , Université Félix Houphoët-Boigny, LAPA, VPV34, Abidjan 01, Côte D'Ivoire
Armelle Baeza , RMCX, Université Paris Diderot, Paris, France.
Julien Bahino, Université Félix Houphoët-Boigny, LAPA, VPV34, Abidjan 01, Côte D'Ivoire
Sylvia Becerra, Laboratoire Géosciences Environnement,Toulouse. France
Mouhamadou Bedou, Université Félix Houphoët-Boigny, LAPA, VPV34, Abidjan 01, Côte D'Ivoire
Marie Belland, Laboratoire d'Aérologie, Université Paul Sabatier Toulouse III-CNRS, France; Laboratoire Géosciences Environnement,Toulouse. France
Agnes Borbon, Université Clermont Auvergne, CNRS, LaMP, F-63000 Clermont-Ferrand, France
Christelle Chiron, Laboratoire d'Aérologie, Université Paul Sabatier Toulouse III-CNRS, France
Julien Djossou, Université d'Abomey-Calavi, Cotonou, Bénin
Benjamin Fayomi, Faculté des Sciences de la Sante (FSS), Cotonou, Bénin.
Corinne Galy-Lacaux, Laboratoire d'Aérologie, Université Paul Sabatier Toulouse III-CNRS, France
Eric Gardrat, Laboratoire d'Aérologie, Université Paul Sabatier Toulouse III-CNRS, France
Marius Kedote, Institut Régional de Santé Publique, University of Abomey-Calavi, Ouidah, Bénin.
Sekou Keita, Université Félix Houphoët-Boigny, LAPA, VPV34, Abidjan 01, Côte D'Ivoire
Abdourahamane Konare, Université Félix Houphoët-Boigny, LAPA, VPV34, Abidjan 01, Côte D'Ivoire
Kouame Kouadio, Institut Pasteur, Abidjan, Côte d'Ivoire.
Jean-Francois Leon, Laboratoire d'Aérologie, Université Paul Sabatier Toulouse III-CNRS, France
Guillaume Money, Université Félix Houphoët-Boigny, LAPA, VPV34, Abidjan 01,

Côte D’Ivoire
Evelyne N’Datchoh Touré, Laboratoire d’Aérologie, Université Paul Sabatier Toulouse III-CNRS, France;Université Félix Houphoët-Boigny, LAPA, VPV34, Abidjan 01, Côte D’Ivoire
Laurent Roblou, Laboratoire d’Aérologie, Université Paul Sabatier Toulouse III-CNRS, France
Mai-Lan Tran, RMCX, Université Paris Diderot, Paris, France.
Veronique Yoboue, Université Félix Houphoët-Boigny, LAPA, VPV34, Abidjan 01, Côte D’Ivoire

Abstract:

Urbanisation is a strongly emerging issue in West Africa, for a number of factors: explosive population growth in sub-Saharan countries, urban concentrations of activities, lack of regulations... This has resulted in the rapid development of "urban ecosystems". In this context, the main West African emission sources are anthropogenic, such as domestic fires, fossil fuel sources with unregulated traffic and industries, savannah fires, waste burning... This results in an inordinate surge in particle and gas emissions into the atmosphere within cities with unexpected high pollution levels extremely harmful to health with various clinical manifestations, changing following the type of sources emissions. Quantification of these anthropogenic emissions and the consecutive air pollution and health impacts have received very little attention in Africa unlike Europe, North America and Asia,
The EU-funded project DACCIWA (Dynamics-Aerosol-Chemistry-Cloud Interactions in West Africa) and especially the workpackage 2 is investigating such quantifications in southern West Africa. The main final objective is to produce spatial and temporal distribution maps of health impact due to particles and gases using numerical modeling, updated and revised combustion emission inventories and scenarios and dose-response functions measured during the project. For that purpose, four urban sites were selected in Abidjan (Cote d’Ivoire) and Cotonou (Benin) focusing on main specific regional combustion sources (domestic fires, traffic and waste burning). Long-term measurements occurred from January 2015 to March 2017 to determine dose response functions in terms of respiratory diseases and mortalities by linking gas and particulate mass measurements and census in hospitals. Intensive measurements took place during the dry and wet seasons 2016 and 2017 to characterize toxicological effects of size-speciated aerosol chemical composition and dose response functions in terms of lung inflammations.

1.006 Regional, national and port level shipping emission inventories in East Asia.

Presenting Author:
Huan Liu, School of Environment, Tsinghua University, Beijing, 100084, China, liu_env@tsinghua.edu.cn

Co-Authors:
Xinxin Jin, School of Environment, Tsinghua University, Beijing, 100084, China
Mingliang Fu, School of Environment, Tsinghua University, Beijing, 100084, China

Abstract:

Increased air pollution from shipping emissions in East Asia have contributed to tens of thousands of premature deaths each year in the region, and could have significant local and global climatic impacts. We use an advanced method based on detailed dynamic ship activity data to build the regional and national level shipping emission inventories. Currently, share of emissions in East Asia to global shipping total has increased to 16%, which is much higher than previous estimation. In addition, the national level and 24 port-level emission inventories were build up for the first time. The port-level inventories provide important data for global port emissions. All these 24 ports are ranked as top ports for world throughput league table. The total emissions of CO, NMVOC, NOx, PM, SO_2, CO_2 in China were 0.0741 ± 0.0004 Tg•yr^{-1}, 0.0691 ± 0.0004 Tg•yr^{-1}, 1.91 ± 0.01 Tg•yr-1, 0.164 ± 0.001 Tg•yr-1, 1.30 ± 0.01 Tg•yr-1, 86.3 ± 0.3 Tg•yr-1, respectively. Bohai Rim Area, Yangtze River delta and Pearl River Delta totally accounted for 8% of whole ocean area, but contributed about 37% of total shipping emissions. Compared with road transportation, NOx and PM emission from maritime transportation are about 32% and 29% in China, respectively. Compared with diesel vehicle emissions, NOx and PM from shipping emissions account for 47% and 29%, respectively.

2.010 Evaluation of the BC / OC ratios for aerosol emissions from biomass burning in Siberia using AERONET retrievals.

Early Career Scientist

Presenting Author:
Daria Lvova, Institute of Applied Physics of the Russian Academy of Sciences, Nizhny Novgorod, Russia, daria@lvov.in

Co-Authors:
Igor Konovalov, Institute of Applied Physics of the Russian Academy of Sciences, Nizhny Novgorod, Russia
Matthias Beekmann, LISA, CNRS, Université Paris-Est and Université Paris 7, Créteil, France

Abstract:

Biomass burning (BB) aerosol is known to have a considerable direct impact on the radiation budget of the atmosphere as a result of both scattering and absorbing solar shortwave radiation and increasing the downward longwave radiation. A balance between the cooling and warming effects of aerosol critically depends on the ratio of the major absorbing and scattering components in particles, such as black carbon (BC) and organic carbon (OC), respectively. To specify the BC / OC emission ratios for BB aerosol, the climate and chemistry transport models rely on fire emission inventory data which, however, have not been sufficiently validated, especially in the case of biomass burning in such remote regions as Siberia.
We propose a simple method to estimate the BC / OC ratio in BB aerosol by using retrievals of aerosol optical properties from AERONET measurements along with an empirical relationship between the BC / OC ratio and the single-scattering albedo. A chemistry transport model is used to relate the BC / OC ratio in aerosol with the ratio of the corresponding emission factors and to estimate the “photochemical” age of BB plumes. The BC / OC ratios in BB plumes are found to exhibit strong variability, although, on average, our estimates of the BC / OC emission ratios are consistent with a range of values assumed in different fire emission inventories in the case of temporal and boreal forests. It is also found that the BC / OC ratio in BB aerosol demonstrates a strong dependence on its photochemical age; this finding is consistent with the results of our previous modeling analysis (Konovalov et al., ACP, 2015; ACPD, 2016) of the BB aerosol evolution.
This study was supported by the Russian Science Foundation (grant no. 15-17-10024), and the French CNRS PARCS project.

2.022 Modelling the temporal and spatial allocation of emission data.

Presenting Author:
Volker Matthias, Helmholtz-Zentrum Geesthacht, Institute of Coastal Research, Chemistry Transport Modeling Department, Max-Planck-Straße 1, 21502 Geesthacht, Germany, volker.matthias@hzg.de

Co-Authors:
Johannes Bieser, Helmholtz-Zentrum Geesthacht, Institute of Coastal Research, Chemistry Transport Modeling Department, Max-Planck-Straße 1, 21502 Geesthacht, Germany
Jan A. Arndt, Helmholtz-Zentrum Geesthacht, Institute of Coastal Research, Chemistry Transport Modeling Department, Max-Planck-Straße 1, 21502 Geesthacht, Germany
Armin Aulinger, Helmholtz-Zentrum Geesthacht, Institute of Coastal Research, Chemistry Transport Modeling Department, Max-Planck-Straße 1, 21502 Geesthacht, Germany
Christiane Gackenholz, Helmholtz-Zentrum Geesthacht, Institute of Coastal Research, Chemistry Transport Modeling Department, Max-Planck-Straße 1, 21502 Geesthacht, Germany
Markus Quante, Helmholtz-Zentrum Geesthacht, Institute of Coastal Research, Chemistry Transport Modeling Department, Max-Planck-Straße 1, 21502 Geesthacht, Germany
Matthias Karl, Helmholtz-Zentrum Geesthacht, Institute of Coastal Research, Chemistry Transport Modeling Department, Max-Planck-Straße 1, 21502 Geesthacht, Germany
Rosa Schultes, Helmholtz-Zentrum Geesthacht, Institute of Coastal Research, Chemistry Transport Modeling Department, Max-Planck-Straße 1, 21502 Geesthacht, Germany

Abstract:

Atmospheric chemistry transport models need spatially and temporally resolved emission data as input. Atmospheric concentrations of pollutants as well as their deposition depend not only on the emitted amount but also on place and time of the emissions used in the model calculations. Emission inventories typically provide annual emissions of specific substances on a predefined grid. In many cases this grid is of coarser resolution than the model grid and a high temporal resolution that varies at least hourly is not available.
Emission models like US EPA's SMOKE or its European spinoff SMOKE for Europe have been developed with the purpose to create "model-ready" emissions, i.e. the emission data gathered from the inventories is distributed in time and space in order to provide the chemistry transport models with sufficiently resolved data. This is done with a number of different methods that depend on the emission sector and the additional data available for the disaggregation of the inventory data, e.g. land use and population

density data. In addition, new methods for specific sectors have been developed in the scientific community in order to provide temporally and spatially highly resolved data at the same time.

This contribution reviews the most commonly used global and regional emission inventories and provides an overview of the different methods to spatially and temporally disaggregate the emission inventory data. Particular emphasis is laid on the temporal disaggregation by presenting methods that allow the creation of individual time profiles for each grid cell. This includes emissions from residential heating that are distributed according to the ambient temperature as well as ammonia emissions from agriculture that use temperature, wind speed, animal densities and legal restrictions to improve the commonly used fixed temporal profiles.

1.063 Volatile Chemical Products Emerging as Largest Fossil-Source of Organics over U.S. Cities.

Early Career Scientist

Presenting Author:
Brian McDonald, University of Colorado, Cooperative Institute for Research in Environmental Science, Boulder, CO, USA; NOAA ESRL, Chemical Sciences Division, Boulder, CO, USA, brian.mcdonald@noaa.gov

Co-Authors:
Joost de Gouw, University of Colorado, Cooperative Institute for Research in Environmental Science, Boulder, CO, USA
Jessica Gilman, NOAA ESRL, Chemical Sciences Division, Boulder, CO, USA
Shantanu Jathar, Colorado State University, Mechanical Engineering, Fort Collins, CO, USA
Ali Akherati, Colorado State University, Mechanical Engineering, Fort Collins, CO, USA
Christopher Cappa, University of California, Civil & Environmental Engineering, Davis, CA, USA
Yuyan Cui, University of Colorado, Cooperative Institute for Research in Environmental Science, Boulder, CO, USA; NOAA ESRL, Chemical Sciences Division, Boulder, CO, USA
Drew Gentner, Yale University, Chemical & Environmental Engineering, Forestry & Environmental Studies, New Haven, CT, USA
Allen Goldstein, University of California, Environmental Science & Policy Management, Civil & Environmental Engineering, Berkeley, CA, USA
Robert Harley, University of California, Civil & Environmental Engineering, Berkeley, CA, USA
Jose Jimenez, University of Colorado, Chemistry & Biochemistry, Boulder, CO, USA
Si-Wan Kim, University of Colorado, Cooperative Institute for Research in Environmental Science, Boulder, CO, USA; NOAA ESRL, Chemical Sciences Division, Boulder, CO, USA
Julia Lee-Taylor, University of Colorado, Cooperative Institute for Research in Environmental Science, Boulder, CO, USA; National Center for Atmospheric Research, Boulder, CO, USA
Stuart McKeen, University of Colorado, Cooperative Institute for Research in Environmental Science, Boulder, CO, USA; NOAA ESRL, Chemical Sciences Division, Boulder, CO, USA
James Roberts, NOAA ESRL, Chemical Sciences Division, Boulder, CO, USA
Michael Trainer, NOAA ESRL, Chemical Sciences Division, Boulder, CO, USA

Gregory Frost, NOAA ESRL, Chemical Sciences Division, Boulder, CO, USA

Abstract:

There are current gaps in the understanding of urban emissions of volatile organic compounds (VOCs), which contribute to regional ozone (O3) and aerosol burdens. We expand a previously developed fuel-based inventory of mobile source emissions to include speciated VOCs. We also construct a new inventory of chemical product emissions (also known as solvents) from bottom-up principles. The new inventories are evaluated using extensive VOC measurements made in the Los Angeles basin during the California Nexus Study in 2010. We show that in order to bring closure to missing hydroxyl radical (OH) reactivity and secondary organic aerosol (SOA) formation in cities, emission inventories and models need to properly account for the influence of volatile chemical products (e.g., personal care products, paints, surface cleaners, etc.). These sources now account for half of urban VOCs in a U.S. megacity, and are a larger source of air pollution than previously thought. We find that current emission inventories underestimate VOC emissions from chemical products by a factor of 2.

1.056 Discrepancies in industrial VOC emissions: impact on tropospheric ozone .

Presenting Author:
Johan Mellqvist, Chalmers University of Technology, Göteborg, Sweden, johan.mellqvist@chalmers.se

Co-Authors:
John Johansson , Chalmers University of Technology, Göteborg, Sweden
David Simpson, Norwegian Meteorological Institute (met.no)
Jerker Samuelsson, FluxSense AB, Gothenburg. Sweden
Erika von Schneidemesser, Institute for Advanced Sustainability Studies (IASS), Potsdam, Germany
Kathleen Mar, Institute for Advanced Sustainability Studies (IASS), Potsdam, Germany
Tim Butler, Institute for Advanced Sustainability Studies (IASS), Potsdam, Germany
Hugo Denier van der Gon, TNO, Utrecht, the Netherlands
Antoon Visschedijk, TNO, Utrecht, the Netherlands
Arjo Segers, TNO, Utrecht, the Netherlands

Abstract:

The Solar Occultation Flux (SOF) method is a mobile remote sensing technique that is used to quantify emissions of volatile organic compounds (VOCs) from large industrial complexes and/or individual facilities, such as refineries and petrochemical industries. SOF is best available technology (BAT) in Europe for such measurements. It has been applied at various locations worldwide during the last 10 years such as: Canada, China, Europe (Antwerp, Le Havre, Rotterdam) and the US (Texas, California). In Sweden the results from the method are used for the official reporting of NMVOC from refineries. It is generally found that the measured VOC gas fluxes obtained with the SOF method are 5 to 10 times higher than reported in inventories. Other studies carried out by Differential Absorption LIDAR and airborne measurements show similar results.
In order to investigate the potential impact of the observed VOC emission discrepancies on air quality, we have carried out several sensitivity studies using three different atmospheric chemical transport models, i.e. EMEP MSC-W(met.no/Chalmers), LOTOS-EUROS(TNO) and WRF-Chem (IASS). In the sensitivity studies the emissions of the industrial sectors for industrial point and area sources were changed by various factors (5-10) to reflect the correction needed compared to official reporting. Next, the effects on ozone were analyzed on differential temporal and spatial scales.
In this paper we will present SOF measurements carried out at various sites worldwide, including a recent study in the LA basin. We will also present the modelling results from the sensitivity study and discuss the general impact of the observed VOC emission discrepancies on tropospheric ozone.

2.003 Decadal changes in global surface NOx emissions from multi-constituent satellite data assimilation.

Presenting Author:
Kazuyuki Miyazaki, Japan Agency for Marine-Earth Science and Technology, Yokohama, 236-0001, Japan, kmiyazaki@jamstec.go.jp

Co-Authors:
Henk Eskes, Royal Netherlands Meteorological Institute (KNMI), Wilhelminalaan 10, 3732 GK De Bilt, the Netherlands
Folkert Boersma, Wageningen University, Meteorological and Air Quality department, Wageningen, the Netherlands
Kevin Bowman, Jet Propulsion Laboratory, California Institute of Technology, Pasadena, CA, USA
Yugo Kanaya, Japan Agency for Marine-Earth Science and Technology, Yokohama, 236-0001, Japan
Takashi Sekiya, Japan Agency for Marine-Earth Science and Technology, Yokohama, 236-0001, Japan

Abstract:

Global surface emissions of nitrogen oxides (NOx) over a 10-year period (2005–2014) are estimated from an assimilation of multiple satellite data sets: tropospheric NO2 columns from OMI, GOME-2, and SCIAMACHY, O3 profiles from TES, CO profiles from MOPITT, and O3 and HNO3 profiles from MLS using an ensemble Kalman filter technique. Chemical concentrations of various species and emission sources of several precursors are simultaneously optimized. This is expected to improve the emission inversion because the emission estimates are influenced by biases in the modelled tropospheric chemistry, which can be partly corrected by also optimizing the concentrations. We present detailed distributions of the estimated emission distributions for all major regions, the diurnal and seasonal variability, and the evolution of these emissions over the 10-year period. The estimated regional total emissions show a strong positive trend over India (+29 % decade−1), China (+26 % decade−1), and the Middle East (+20 % decade−1), and a negative trend over the USA (−38 % decade−1), southern Africa (−8.2 % decade−1), and western Europe (−8.8 % decade−1). The negative trends in the USA and western Europe are larger during 2005–2010 relative to 2011–2014, whereas the trend in China becomes negative after 2011. The data assimilation also suggests a large uncertainty in anthropogenic and fire-related emission factors and an important underestimation of soil NOx sources in the emission inventories. Despite the large trends observed for individual regions, the global total emission is almost constant between 2005 (47.9 Tg N yr−1) and 2014 (47.5 Tg N yr−1).

3.005 Climatology (2003-2015) analysis of Remotely-Sensed and Surface Data of Aerosols and Meteorology for the Mexico Central Megalopolis Area..

Early Career Scientist

Presenting Author:
Marco Mora, Physico-Mathematics, Benemérita Universidad Autónoma de Puebla, Puebla, Mexico., marco.x.mora@gmail.com

Co-Authors:
Armin Sorooshian, Department of Chemical and Environmental Engineering, University of Arizona, Tucson
Rachel Barun, Department of Chemical and Environmental Engineering, University of Arizona, Tucson, USA
Taylor Shingler, NASA Langley Research Center, Hampton, VA, USA.

Abstract:

This work presents an aerosol climatology study from 2003-2015 for the Mexico City Metropolitan Area (MCMA) using remotely sensed aerosol data, ground-based measurements, air mass trajectory modeling, aerosol chemical composition modeling, and reanalysis data for the broader Megalopolis of Central Mexico region. The most extensive biomass burning emissions occur during the dry hot season (March-May) coincident with the highest aerosol optical depth, ultraviolet aerosol index, and surface particulate matter (PM) values. A clear anthropogenic effect is observed in the day-of-week and diurnal profiles of PM, with a notable enhancement in coarse PM levels during vehicular rush hour periods on weekdays versus weekends. Among different species modeled using GOCART, sulfate accounted for most of the optical depth (highest in May-June), followed by organics. Among wet deposition species measured, $PM_{2.5}$, PM_{10}, and PM_{10}-$PM_{2.5}$ were best correlated with NH_4^+, SO_4^{2-}, and Ca^{2+}, suggesting these three constituents are important components of the aerosol seeding the hydrometeors that eventually fall as wet deposition in the study region. Inter-annual trend analysis of measured parameters is presented with a key result being a statistically significant increase in wind speed and ambient temperature from 2003 to 2015 in the study region.

2.023 Emissions of VOCs over India and the Middle East estimated using OMI HCHO observations and the MAGRITTE regional model.

Presenting Author:
Jean-François Müller, Royal Belgian Institute for Space Aeronomy, Brussels, Belgium, jfm@aeronomie.be

Co-Authors:
Trisevgeni Stavrakou, Royal Belgian Institute for Space Aeronomy, Brussels, Belgium
Maite Bauwens, Royal Belgian Institute for Space Aeronomy, Brussels, Belgium
Isabelle De Smedt, Royal Belgian Institute for Space Aeronomy, Brussels, Belgium
Michel Van Roozendael, Royal Belgian Institute for Space Aeronomy, Brussels, Belgium

Abstract:

The air quality in India has considerably deteriorated in the last decades due to growing industrialization, coal-fired power plants and the lack of regulations. In the Middle East, tropospheric ozone reaches very high levels during summer due to the combination of high solar irradiances with often very high anthropogenic emissions of NOx and VOCs associated to oil/gas exploitation and fast urbanisation. High biogenic VOC emissions are expected in non-desert areas, in particular during summer due to scorching temperatures and high solar irradiances. Both anthropogenic and biogenic VOC emissions are poorly known in these regions. Here we use spaceborne (OMI) observations of formaldehyde, a known product of anthropogenic and biogenic VOC oxidation, as constraint in an inversion framework built on a regional model, MAGRITTE (Model of Atmospheric composition at Global and Regional scales using Inversion Techniques for Trace Gas Emissions). MAGRITTE is run at 0.5x0.5 degree resolution, with lateral boundary conditions provided by the global CTM IMAGESv2 (Bauwens et al., 2016). The global and regional models share essentially the same chemistry and physical parameterizations. Emission inversion with MAGRITTE is performed using an adjoint-based iterative procedure, similar to previous inversions using IMAGES. Biogenic VOC emissions are calculated using MEGAN (Muller et al., 2008; Stavrakou et al., 2014), whereas the HTAPv2 emission dataset is used for anthropogenic emissions, with several adjustments for oil/gas exploitation and traffic emissions. The OMI data, obtained from recently released QA4ECV EU project, are averaged over 2005-2010 in order to reduce noise and then regridded onto the model resolution. Preliminary results indicate that biogenic isoprene emissions are a major VOC source in summertime throughout the "Fertile Crescent" from the Nile Valley to Iraq. Anthropogenic emissions from many large cities (e.g. Bagdad, Cairo, Tehran, Kolkata, Mecca) as well as from known oil extraction/refining/handling sites are well detected.

3.009 Benzo[a]pyrene and CO2 emissions trade-off between biomass combustion and fossil fuel used in the residential sector: an insight on climate and air quality/health co-benefits..

Presenting Author:
Marilena Muntean, European Commission, Joint Research Centre (JRC), Directorate for Energy, Transport and Climate, Air and Climate Unit, Via E. Fermi 2749, I-21027 Ispra (VA), Italy, marilena.muntean@jrc.ec.europa.eu

Co-Authors:
Greet Janssens-Maenhout, European Commission, Joint Research Centre (JRC), Directorate for Energy, Transport and Climate, Air and Climate Unit, Via E. Fermi 2749, I-21027 Ispra (VA), Italy
Monica Crippa, European Commission, Joint Research Centre (JRC), Directorate for Energy, Transport and Climate, Air and Climate Unit, Via E. Fermi 2749, I-21027 Ispra (VA), Italy
Diego Guizzardi, Didesk Informatica, Verbania (VB), Italy
Edwin Schaaf, European Commission, Joint Research Centre (JRC), Directorate for Energy, Transport and Climate, Air and Climate Unit, Via E. Fermi 2749, I-21027 Ispra (VA), Italy
Jos Olivier, PBL Netherlands Environment Assessment Agency, Bilthoven, the Netherlands
Frank Dentener, European Commission, Joint Research Centre (JRC), Directorate for Sustainable Resources, Food Security Unit, Via E. Fermi 2749, I-21027 Ispra (VA), Italy

Abstract:

Polycyclic aromatic hydrocarbons (PAHs) are known to be carcinogenic. The residential sector is one of the most important sources of PAHs emissions, and global population growth is one of the drivers of a substantial increase in fuel consumption in households. Globally, the energy demand from this sector in 2012 was 39% higher than in 1970 and by fuel, there were increases of 64% in biomass and 158% in gas combustion and decreases of 5% in oil and 46% in coal combustion. Biomass combustion, which is considered a renewable energy source, can contribute to GHG emissions reduction while the sustainable development goals (SDGs) of the United Nations warn us about possible air pollution and health problems.
This research gives an insight on climate and air quality/health co-benefits by evaluating the trends of two substances emitted from fuel combustion in residential sector: CO_2 as an indicator for climate and benzo[a]pyrene (BaP), which is part of PAHs group, as an indicator for carcinogenic effects. First, the CO_2 and BaP emissions in the Emissions Database for Global Atmospheric Research (EDGARv4.3.2 and tox3 versions) over more than forty years are analysed. Afterwards, backward-looking emission scenarios are developed for both old and modern combustion technologies and fuel mixes; CO_2 and BaP emissions are evaluated for different country-specific fuel mixes. Focusing on the

regions/countries with fast growing population and high shares in global biomass consumption in residential sector such as China, India, Nigeria and Indonesia, we will provide an analysis of the variations of CO_2 and BaP emissions for each scenario. We discuss the implications of the findings on changing emissions patterns globally as well as for countries with fast growing population, which rely on biomass for their cooking and heating needs, identifying both the health and climate mitigation related benefits of potential technological and fuel-mix changes.

3.016 Simulation of current and future surface ozone concentrations over the South African Waterberg region.

Early Career Scientist

Presenting Author:
Mogesh Naidoo, Climate Studies Modeling and Environmental Health Group, CSIR-NRE, Pretoria, South Africa., mnaidoo4@csir.co.za

Co-Authors:
Rebecca, M Garland, Climate Studies Modeling and Environmental Health Group, CSIR-NRE, Pretoria, South Africa.
Francois, A Engelbrecht, Climate Studies Modeling and Environmental Health Group, CSIR-NRE, Pretoria, South Africa.

Abstract:

The developing landscape of South Africa has led to the deterioration of air quality within and outside of urban centres. In an attempt to understand the various factors involved, studies involving air quality modeling have been conducted. The South African Waterberg region (which includes the border between Botswana and South Africa) is undergoing intensive industrialization. The area is also characterized by smaller urban centres, largely vegetated land cover, heavy seasonal biomass burning and coal-fired power stations; providing a range of emission sources to consider. Air quality modeling (CAMx) was used to investigate source attribution and transboundary impacts on ozone concentrations. The impact of a changing climate on simulated ozone concentrations were also investigated through the forcing of the air quality model with land surface and atmospheric fields from a coupled land-atmosphere climate model (CCAM-CABLE). The non-anthropogenic emissions used are based on offline MEGAN biogenic VOC and FINN biomass burning. Anthropogenic area source emissions (including domestic fuel use and on-road vehicles) were derived from top down methodologies, while industrial emissions data necessitated gathering through unofficial channels.. Model validation illustrates the impact that sparse industrial emissions information can have on simulations. Results of annual average surface ozone indicate that intense NOx emissions from power stations and the Johannesburg region present areas of ozone titration, while these same areas are shown to exhibit high daily maximum concentrations. This presentation will describe the modeling study, results and challenges in developing appropriate emissions inventories in a data scarce environment.

3.011 The Impact of Climate Change and the Coastal Settlement in Nigeria..

Early Career Scientist

Presenting Author:
Adedotun Oke, Michael, Michael Adedotun Oke Foundation, International Development , Federal Capital Territory, Abuja, Nigeria , maof2020@gmail.com

Abstract:

.Climate change affect the agricultural practices in which makes the Cattle herdsmen to look for pasture during the dry seasons, adaptation of farm animals, increase in the search of water intake, non- availability of food, re-settlement of cattle's herdsmen's in Nigeria and the effect is noted in the pattern of grazing and communal clashes between the farmers resulting into destructions of farms and the untimely harvesting of crops and insecurity challenges, posting harvest losses of all Agricultural product and the fighting for land between the farmers and herdsmen know as Fulani. While the coastal zone of Nigeria is with many resources of food, energy, and minerals, not only are composed of various fragile ecosystems, but are scenes of a variety of often conflicting uses. At present, the uncontrolled development of the coastal zone and the almost haphazard exploitation of their natural resources threaten to turn the promise of economic prosperity into an environmental nightmare that portends great dangers for present and future generations (Ibe A.C. 1987). This paper identifies the need to for the cattle herdsmen to engaged in feed formulation, pastures development , high breeds of development of animals for productivities and Nigeria citizens needs to developed the coastal regions interms of bring in Infrastructes that will better the living standard of the citizens.

3.007 Bioavailability of the Metal Bounded to Ultrafine Fraction of Airborne Particles and Appraisal of Exposure Risk in an Urban Atmosphere of Southwestern Nigeria.

Presenting Author:
Gbenga Olumayede, Department of Industrial Chemistry, Federal University Oye - Ekiti, Oye - Ekiti. Ekiti State, Nigeria, emmanuel.olumayede@fuoye.edu.ng

Abstract:

The assumption that biotoxic effect of metals depends not only on the concentration as expressed by their total amount but also on their bioavailability, origin and properties was investigated in this study. Therefore, the focus of study is to collect, analyse and quantify the metals bound to ultrafine fractions of particulate matters. Airborne particulates from within Akure were collected using SKC Air Check XR 5000 high volume Sampler at human breathing height of between 1.5 and 2.0 metres during the dry season period (November, 2014 to March, 2015). The modified BCR sequential extraction procedure was used to fractionate the samples and heavy metals (Cd, Cu, Cr, Ni, Pb, Zn and Mn) were determined using Atomic Absorption Spectrophotometer. The results showed metals concentration of order Pb >Cr > Cd>Zn > Ni>Cu>Mn. However, most metals in the samples exist in non-mobile fractions range: exchangeable (6.43 – 16.2%), reduced (32.58 – 47.39%), organic (4.73 – 9.88%), and residual (18.28 – 27.53 %). The pollution indices showed that ingestion as the leading route of metal exposure with non-carcinogenic (HQ) and cancer risk (HI) for humans in the area higher than one, indicating health threat.

3.035 Assessing the air quality health benefits of phasing out coal-fire power plant in Ontario and Alberta: An adjoint sensitivity analysis.

Early Career Scientist

Presenting Author:
Yasar Burak OZTANER, Department of Civil and Environmental Engineering, Carleton University, Ottawa, burakoztaner@cmail.carleton.ca

Co-Authors:
Marjan Soltan zadeh, Department of Civil and Environmental Engineering, Carleton University, Ottawa
Amir Hakami, Department of Civil and Environmental Engineering, Carleton University, Ottawa

Abstract:

Numerous studies have examined the health and environmental impacts of traditional Coal-Fired power plants (CFPP) in Canada and the US. Based on such studies, the Ontario government implemented a policy to phase out its CFPPs by the end of 2013 and now Alberta, which has more CFPP emissions than other provinces, is committed to phasing out its coal plants by 2030. We conduct a retrospective analysis on Ontario's coal phase-out and evaluate the predicted benefits from Alberta's proposed plan for moving away from coal.

Previous studies that investigated the CFPP phase-out resulting in the reduction of mortality rate were all scenario-based. In this study, we present a backward/adjoint analysis to provide source-specificity analysis to quantify the marginal health benefits of phasing out the CF power plants in Ontario and Alberta considering the impact of trans-border emission from the US.

We apply U.S. EPA's (CMAQ) and its adjoint to quantify the health benefits of emission reduction of NO_X, and $PM_{2.5}$. Meteorological inputs are from the (WRF) model, and emissions for Canada and the US are taken from National Pollutant Release Inventory (NPRI) and National Emission Inventory (NEI), respectively. Subsequently, these emissions are processed in (SMOKE) model to get hourly emissions. The simulation is done over a 36 km and 12 km resolution for 2011. Marginal benefits due to the reduced NO_X and $PM_{2.5}$ and the subsequent impact on long-term mortality are calculated and compared to those found previously in scenario-based studies. Our primarily results show that in 2011, health benefits for specific plants in Ontario were as high as 3.5 $/KWh, i.e. much greater than the price of electricity, and more significant than previous estimates. The findings of marginal health benefit analysis and an evaluation matrix for control policy options for Alberta and Ontario will be discussed.

1.031 Global emissions in the Copernicus Atmosphere Monitoring Service.

Presenting Author:
Mark Parrington, European Centre for Medium-range Weather Forecasts (ECMWF), Reading, UK, mark.parrington@ecmwf.int

Co-Authors:
Johannes Flemming, ECMWF, Reading, UK
Anna Agusti-Panareda, ECMWF, Reading, UK
Vincent Huijnen, Royal Netherlands Meteorological Institute (KNMI), De Bilt, Netherlands
Richard Engelen, ECMWF, Reading, UK
Vincent-Henri Peuch, ECMWF, Reading, UK

Abstract:

The Copernicus Atmosphere Monitoring Service (CAMS), implemented by the European Centre for Medium-range Weather Forecasts (ECMWF) on behalf of the European Commission, brings together state-of-the-art numerical models and observing systems to provide forecasts and analyses of global atmospheric composition and European regional air quality. The CAMS global production system uses a version of the ECMWF Integrated Forecast System including atmospheric chemistry (C-IFS) to provide twice daily (at 0z and 12z UTC) 5-day forecasts of reactive gases, aerosols and greenhouse gases with a horizontal resolution of approximately 40km (16km for greenhouse gases). Lateral boundary conditions, derived from the global model output, are used to initialize a suite of 7 regional air quality models for European domain. Surface boundary conditions are critical to the operational delivery of CAMS and are provided by a combination of surface flux calculations (GFAS for biomass burning, biospheric flux adjustment) and emissions inventories (MACCity, EDGAR, MEGAN). We will present an overview of the emissions implemented in C-IFS to provide the CAMS atmospheric composition forecasts. We will also highlight current issues with using these emissions in an operational service and give examples where future developments to emissions in CAMS are expected to improve the quality of the forecast and analysis products.

1.012 Development of spatial disaggregation models for the Waste Sector Emission Inventory in Argentina.

Early Career Scientist

Presenting Author:

Romina María Pascual Flores, Atmospheric and Environmental Studies Group (GEAA) - National Technological University, Mendoza Regional Faculty, rominapascual@gmail.com

Co-Authors:

David Gabriel Allende, Centro de Investigaciones y Desarrollo de CEAMSE (CIDEC) - Complejo Ambiental de Villa Domínico

Gabriel Caballero, Atmospheric and Environmental Studies Group (GEAA) - National Technological University, Mendoza Regional Faculty

Salvador Enrique Puliafito, Atmospheric and Environmental Studies Group (GEAA) - National Technological University, Mendoza Regional Faculty - Buenos Aires Regional Faculty

Abstract:

Detailed estimates of pollutant emissions at fine spatial scales are critical to both modelers and decision makers dealing with global warming and climate change. In that sense, Waste Sector has lately received special attention since it was acknowledged to be significant source of air pollutants and GHGs. Nevertheless, emission inventories for this sector are characterized by methodological limitations, lack of data or low reliability of existing data, leading to high uncertainty. Therefore, simple, but also accurate methods for assessing the spatial distribution of waste sector emissions are needed for the environmental management in Argentina and most South American cities.
With the aid of a geographic information system (GIS) platform combined with a variations of an Analytic Hierarchy Process (AHP) we identified source-specific spatial distribution proxies in order to provide inventories with higher level of detail and realistic representation of emission scenarios. Spatial patterns of MSW open burning were explicitly ranked using infrastructural and socio-economic intra urban differences. Field burning of agricultural waste was spatially disaggregated combining LULC data, MODIS thermal anomalies information and a night lights map. Industrial waste incineration, clinical waste incineration and cremation emissions were spatially distributed with a 2-stage process: an initial GIS-based screening based on population, LULC data and economic factors; and an expert judgement stage to rank the weight of the sites found in the first phase.

As a result of this process, we obtained an atmospheric emission inventory gridded with cells of 0.025° longitude × 0.025° latitude for the Waste Sector, including the continental sector of Argentina. A comparison with EDGAR emission data shows that despite having a good resolution of approximately 10 km x 10 km, EDGAR’s spatial distribution of emissions is not fully adequate for Argentina, probably because the source of original data is from statistical data of very large geographical units.

1.022 Emission inventories for domestic heating: a bottom-up model for the city of Hamburg .

Early Career Scientist

Presenting Author:
Martin Otto Paul Ramacher, Helmholtz Zentrum Geesthacht, Chemistry Transport Modeling, Geesthacht, Germany, martin.ramacher@hzg.de

Co-Authors:
Johannes Bieser, Helmholtz Zentrum Geesthacht, Chemistry Transport Modeling, Geesthacht, Germany

Abstract:

A major part of the total air pollution in cities is the urban background pollution, which is mainly a result of emissions from industry, traffic and residential plants for domestic heating. While most of the industrial sources are captured by legal reporting obligations and traffic emissions are often based on established bottom-up models, the methods to determine emissions from domestic heating are repeatedly top-down approaches, lack spatial information or require expensive field studies. Thus, it is necessary to develop more accessible and simpler approaches to create emission inventories for this sector.
The presented approach to model the domestic heating emissions in Hamburg uses publicly available data from different (governmental) sources to create a spatially referenced inventory. The main input for the spatial distribution in Hamburg is the population density on a 100x100 m² grid as raised by the latest available census data. The resulting raster is combined with data for living area per capita on a urban quarter level. In connection with information on heating consumption per district it is possible to create a 100x100 m² raster with the heating demand per grid cell. This raster is again combined with information for the different types of heating per statistical zone and adjusted by the share of electrically driven night storage heating. Considering the fuels for different heating types, losses due to conversion and distribution and fuel based emission factors for the pollutants of interest, the emission maps for residential heating are determined.
The results have been compared to several top-down approaches and a bottom-up approach to evaluate the annual total emissions as well as their spatial distribution. While the spatial distribution of the newly developed approach leads to very robust results, the total annual emissions show a strong dependence on the used emission factors and are more difficult to evaluate.

3.013 Air Quality and Health Impacts from Control Policies on Coal-fired Power Plants in China from 2005 to 2015.

Presenting Author:

wu ruili, Ministry of Education Key Laboratory for Earth System Modeling, Department of Earth System Science, Tsinghua University, Beijing 100084, People's Republic of China, wurl15@mails.tsinghua.edu.cn

Co-Authors:

Zhang Qiang, Ministry of Education Key Laboratory for Earth System Modeling, Department of Earth System Science, Tsinghua University, Beijing 100084, People's Republic of China

Abstract:

Air Quality and Health Impacts from Control Policies on Coal-fired Power Plants in China from 2005 to 2015

To achieve the national emission reduction target and curb the air pollution in China, two policies focused on coal-fired power plants including restructuring of unit fleet and end-of-pipe measures are implemented during 11th and 12th Five-year Plan(FYP). However, the extent to which control policies on power plants can improve the air quality and protect health still remains unknown. In addition, the control efficiency of each policy also need to be quantify to guide further management of power sector.

Here, we designed two retrospective power emission scenarios based on China Coal-fired Power plant Emissions Database（CPED）to assess the environmental and health impact of changes in the structure of unit capacity and end-of-pipe control measures of coal-fired power plants. The WRF-CMAQ simulation was conducted to quantify the change of air quality and then the premature mortality caused by fine particulate matter pollution was calculated using exposure-response model.

The preliminary results show that in 2010, the restructuring of unit fleet during 11^{th} FYP resulted in the reduction of 4.76Tg of SO_2, 2.45Tg of NO_x and 0.47Tg of $PM_{2.5}$ emissions. The FGD installation prevented 12.79Tg of SO_2, a value that is 1.6 higher than the actual emissions. The upgrade of dust removal and co-benefit of wet FGD aided in the reduction of $PM_{2.5}$ emissions by 0.91Tg. In summary, these two policies have significant effect on emission reduction and air quality improvement in china, especially, the progress of end-of-pipe measures rather than restructuring of unit fleet is the leading factor to decrease $PM_{2.5}$ concentrations caused by power generation.

2.017 SHIPPING EMISSIONS OVER EUROPE: A STATE-OF-THE-ART AND COMPARATIVE ANALYSIS.

Early Career Scientist

Presenting Author:
Michael Russo, University of Aveiro, CESAM & Department of Environment and Planning, Aveiro, Portugal, michaelarusso@ua.pt

Co-Authors:
Joana Leitão, University of Aveiro, CESAM & Department of Environment and Planning, Aveiro, Portugal
Carla Gama, University of Aveiro, CESAM & Department of Environment and Planning, Aveiro, Portugal
Joana Ferreira, University of Aveiro, CESAM & Department of Environment and Planning, Aveiro, Portugal
Carlos Borrego, University of Aveiro, CESAM & Department of Environment and Planning, Aveiro, Portugal
Alexandra Monteiro, University of Aveiro, CESAM & Department of Environment and Planning, Aveiro, Portugal

Abstract:

Due to its dependence on fossil fuel combustion and the fact that it is one of the least regulated anthropogenic emission sources, emissions from the shipping sector can contribute significantly to air pollution and climate change. A reliable and up-to-date ship emission inventory is essential for atmospheric scientists quantifying the impact of shipping and policy makers implementing regulations and incentives for emission reduction. Several emission inventories exist for Europe, which include emissions originating from ship traffic in European sea areas.
However, few comparisons of these inventories, in particular focusing on specific emission sectors like shipping, exist in literature. Therefore, the aim of this paper is to study the emissions, specifically for shipping and its main pollutants (NOx, SOx and PM10), of four inventories developed, and available, for the European domain: 1) the 2008 EMEP (European Monitoring and Evaluation Programme) inventory; 2) the 2008 emission inventory developed by the TNO (Netherlands Organisation for Applied Scientific Research); 3) the 2008 E-PRTR (European Pollutant Release and Transfer Register) inventory and 4) the 2010 EDGAR (Emission Database for Global Atmospheric Research) inventory.
The inventories were initially compared in terms of total emission values and their spatial distribution. In addition, the contribution of shipping emissions to the totals was analysed, together with their geographical representation. After this, they were converted into an identical grid to spatially compare the emission datasets, evaluate the differences and calculate the associated delta/range. Analysing the data, the total emission values are largely in agreement, however, the spatial representation shows significant differences in the emission distribution over Europe. As for shipping contribution, emissions from this

sector represent approximately 16%, 11% and 5% of total NOx, SOx and PM10 emissions, respectively. These variances can mainly be attributed to the different methods used by each inventory to estimate the emissions for each sector.

3.010 Influence of Brick kilns emissions in the atmosphere pollution in Dhaka, Bangladesh.

Presenting Author:
Abdus Salam, Department of Chemistry, University of Dhaka, Dhaka 1000, Bangladesh, asalam@gmail.com

Abstract:

Atmospheric pollution has significant impact on human health, climate and ecosystem. It is a serious problem in Bangladesh. Bangladesh is one of the top ranking countries of the World for $PM_{2.5}$ exposure and mortality due to air pollution. Verities of sources (e.g., brick and other industries, traffic, construction, biomass burning, etc.) are contributing to the worst air quality in Bangladesh. Emission of brick industries has a major share of air pollution in Dhaka. About six thousand brick industries are in Bangladesh, and about one fourth of them are in Dhaka mega city. The combustion efficiency of kilns depends on the types of kilns (e.g., FCK, Ziz-Zag, Tunnel, etc.). Coal is the main fuel of the brick industries. Particulate matters (BC, OC, and Hg) and gases (CO, CO_2, NOx, and SO_2) are the main emission from brick kilns. BC and CO are producing due to the incomplete combustion, whereas SO_2 is producing due to the sulfur content in the fuel. About 38% of $PM_{2.5}$ emission is from brick industries in Dhaka.
Black carbon is the significant contributor to the $PM_{2.5}$. Therefore we are also focusing on BC emission from brick industries in Bangladesh. $PM_{2.5}$ on quartz filters with stack sampling instrument (AMMEX, USA) and gases (CO, NOx, and SO_2) with Aeroqual (NZ) has been collecting inside the chimney of brick kilns in and around Dhaka mega city (by dividing the city into eight clusters - at least three kilns from each clusters and covered all types of kilns). $PM_{2.5}$ loaded filters will be analyzed for BC with a soot scanner (Magee OT21, USA). The emission of BC, CO, NOx, and SO_2 from different types of brick kilns in and around Dhaka mega city will be presented. The contribution of brick kilns emission in the Dhaka air pollution will also be assessed.

2.012 The global methane budget 2000-2012: budget and trends.

Presenting Author:
Marielle SAUNOIS, LSCE, CEA-UVSQ-CNRS, Université Paris Saclay France, marielle.saunois@lsce.ipsl.fr

Co-Authors:
Philippe Bousquet, LSCE, CEA-UVSQ-CNRS, Université Paris Saclay France
Ben Poulter , NASA Goddard Spice flight Center, Biospheric Science Laboratory, Greenbelt, MD 20771, USA
Philippe CIAIS, LSCE, CEA-UVSQ-CNRS, Université Paris Saclay France
Josep G. Canadell, Global Carbon Project, CSIRO Marine and Atmospheric Research, Australia
Edward J. Dlugokencky, NOAA ESRL, Bouler, Colorado, USA

Abstract:

Atmospheric methane is the second anthropogenic greenhouse gas after carbon dioxide. Its 10-year lifetime and the wide diversity of its sources make methane a key element in climate change mitigation. There are now various atmospheric methane observations: in-situ and remote-sensed observations from the surface or from space. Such data can be assimilated in atmospheric inversion to infer methane emissions and sinks (top-down approaches). In parallel, a large international effort is conducted to model emitting processes at the surface (e.g. wetland emissions) or destroying methane in the atmosphere (e.g. OH radicals), but also to compile inventories of anthropogenic emissions (bottom-up approaches). Despite such effort, large uncertainties remain in the spatio-temporal quantification of methane sources and sinks.
Here, we present a synthesis of global and regional methane emissions and sinks for the period 2000-2012, using an integrated approach that combines atmospheric measurements, chemistry-transport models, ecosystem models, emission inventories, and climate-chemistry models. Emission estimates are extracted for global to regional scales and presented from an ensemble of atmospheric inversions and of process-based models in order to highlight what is known as robust and what is still uncertain. We discuss scenarios of methane emissions and sinks (process-based and region-based) possibly explaining the sustained atmospheric increase since 2007. We show in particular that US methane emissions are not likely to contribute to the positive atmospheric trend, that none of the IPCC scenarios of methane emissions represents the recent trajectory of emissions, and that natural wetlands are probably not the dominant factor to explain the sustained increase over more than 9 years now, which has even accelerated in 2014 and in 2015.

3.034 High-Frequency Box-Modelling of Airborne Data from KORUS-AQ: Spatiotemporal Analysis of O3 and its Precursors, and Evaluation of Emissions Sector Contributions to O3 in the Seoul Metropolitan Area.

Early Career Scientist

Presenting Author:
Jason Schroeder, NASA Langley Research Center, schroede.jaso@gmail.com

Co-Authors:
James Crawford, NASA Langley Research Center
Alan Fried, University of Colorado
Armin Wisthaler, University of Oslo
Andrew Weinheimer, NCAR

Abstract:

The NASA Langley 0-D photochemical box model was used to calculate abundances of short-lived radical species and chemical reaction rates, including O_3 production rates, at high frequency (1 Hz) along the flight track of the NASA DC-8 during the Korea United States Air Quality Study (KORUS-AQ). Because the model is constrained by measurements of meteorological parameters, photolysis rates, and concentrations of speciated trace gases, analysis of model outputs allows for disentangling the contributions of individual species on O_3 production. Results show that the urban core of Seoul is VOC-limited, anthropogenic VOC emissions dominate local VOC reactivity, and that emissions of C_{7+} aromatics from solvent usage are the primary driver of variability in O_3 production. At downwind sites, however, O_3 production was mixed between NO_x- and VOC-limited regimes, suggesting that a strategy to control regional O_3 should include reductions in both NO_x and VOCs.

Additionally, episodic transport of emissions from large, upwind point sources along South Korea's west coast can further degrade air quality in the Seoul Metropolitan Area (SMA). Airborne measurements collected over these point sources will be used in conjunction with measurements in Seoul on relevant transport days to understand the effect of these upwind point sources on atmospheric composition in the SMA. Lastly, we will compare O_3 production rates along the DC-8 flight track for the observed conditions to conditions extracted from regional and global models. By comparing observed (box-modeled) and predicted (3-D model-predicted) values for radicals, formaldehyde, peroxides, nitrogen dioxide, etc., we can begin to understand how well the emission inventories used in models translate to real-world chemical processes.

2.009 High-resolution global surface NOx emissions from multi-constituent satellite data assimilation.

Early Career Scientist

Presenting Author:
Takashi Sekiya, Japan Agency for Marine-Earth Science and Technology, Yokohama, Japan, tsekiya@jamstec.go.jp

Co-Authors:
Kazuyuki Miyazaki, Japan Agency for Marine-Earth Science and Technology, Yokohama, Japan
Koji Ogochi, Japan Agency for Marine-Earth Science and Technology, Yokohama, Japan
Kengo Sudo, Graduate School of Environmental Studies, Nagoya University, Nagoya, Japan
Masayuki Takigawa, Japan Agency for Marine-Earth Science and Technology, Yokohama, Japan

Abstract:

Nitrogen oxides (NO_X) emitted from anthropogenic, biomass burning, and natural sources are a precursor of ozone (O_3) and nitrate aerosols, which are important for human health, ecosystems, and climate. We have developed a global chemical data assimilation system based on an ensemble Kalman filter to combine multiple-species observations from multiple-satellite sensors, including OMI, GOME-2, SCIAMACHY, TES, MOPITT, and MLS, with a global CTM (CHASER), and this system has been applied to estimate global surface NO_X emissions at 2.8°x2.8° horizontal resolution (Miyazaki et al., 2012, 2017). Emission estimations at higher resolutions can be expected to provide better estimates of NO_X emissions, especially for strong local source regions such as megacities and power plants, through reductions in the spatial gaps between observations and simulations and improvements in small-scale chemical and transport processes.

In this study, we demonstrate global NO_X emissions derived from multi-constituent satellite data assimilation from OMI, GOME-2, MOPITT, and MLS at three different horizontal resolutions (0.5°x0.5°, 1.1°x1.1°, and 2.8°x2.8°) during the NASA's aircraft campaign, KORUS-AQ, in May 2016. The global total NO_X emission at 1.1° resolution is 4.37 Tg N $month^{-1}$, which is about 5 % higher than that at 2.8° resolution. The regional emissions differed largely between the two estimates: by -36% over South America and by +12% over the western U.S. at 1.1° resolution. The peak emissions over megacities in East Asia, such as Beijing and Hong Kong, became 2-8 times larger by using the 1.1° resolution through better representation of urban-rural contrasts. We will further discuss the benefit of using a 0.5° resolution data assimilation for NO_X emission estimates from local point source to regional to global scales.

1.043 African Anthropogenic Emissions Inventories for gases and particles from 1990 to 2016.

Early Career Scientist

Presenting Author:
Keita Sekou, Université Félix Houphoët-Boigny, LAPA-MF, BPV34, Abidjan 01, Côte D'Ivoire, sekkeith@yahoo.fr

Co-Authors:
Liousse Cathy, Laboratoire d'Aérologie, Université Paul Sabatier Toulouse III-CNRS, France
Doumbia Thierno, LATMOS, Université Pierre et Marie Curie, Paris, France
Touré N'Datchoch , Université Félix Houphoët-Boigny, LAPA-MF, BPV34, Abidjan 01, Côte D'Ivoire
Roblou Laurent, Laboratoire d'Aérologie, Université Paul Sabatier Toulouse III-CNRS, France
Yoboue Véronique, Université Félix Houphoët-Boigny, LAPA-MF, BPV34, Abidjan 01, Côte D'Ivoire
Assamoi Eric-Michelle, Université Félix Houphoët-Boigny, LAPA-MF, BPV34, Abidjan 01, Côte D'Ivoire
Borbon Agnes, Université Clermont Auvergne, CNRS, LaMP, F-63000 Clermont-Ferrand, France
Dominutti Pamella, Université Clermont Auvergne, CNRS, LaMP, F-63000 Clermont-Ferrand, France
Colomb Aurelli, Université Clermont Auvergne, CNRS, LaMP, F-63000 Clermont-Ferrand, France
Sauvage Stéphane, IMT Lille Douai, Univ. Lille, SAGE - Département Sciences de l'Atmosphère et Génie de l'Environnement, 59000 Lille, France
Akpo Aristide, Université d'Abomey-Calavi, Cotonou, Bénin
Gardrat Eric, Laboratoire d'Aérologie, Université Paul Sabatier Toulouse III-CNRS, France
Galy-Lacaux Corinne , Laboratoire d'Aérologie, Université Paul Sabatier Toulouse III-CNRS, France
Léon Jean François, Laboratoire d'Aérologie, Université Paul Sabatier Toulouse III-CNRS, France

Abstract:

Presently, there is one African regional inventory dealing with biofuel and fossil fuel emissions (Liousse et al., 2014) and only global emission inventories including Africa. Developing a regional inventory for gases and particles is not an easy task: the DACCIWA project has allowed to organize a framework suitable for this development through

regrouping several investigators. The aim is to set an African database on fuel consumption and new emission factor measurements and to include other sources of pollution than biofuel and fossil fuel such as flaring and waste burning yet not negligible in Africa. The inclusion of these sources in the new inventory and also new emissions factor measurements will reduce the uncertainties on anthropogenic emissions in Africa. This work will present the first version of African fossil fuel (FF), biofuel (BF), gas flaring and waste burning emission inventories for the 1990-2016 period for the major atmospheric compounds (gases and particles) providing up to date emission fields at 0.125° x 0.125° spatial resolution and yearly temporal resolution. Temporal variability of emissions from 1990 to 2016 will be scrutinized.
Tests on these inventories in Regional Climate Model (RegCM) at African scale will be presented for different years. Finally, uncertainties will be discussed.

1.036 Evaluation of Tehran air pollution changes in the last decade based on emission inventory and air quality data.

Early Career Scientist

Presenting Author:
Hossein Shahbazi, Mechanical Engineering Department, Sharif University of Technology, Tehran, Iran, hshahbazi@mech.sharif.ir

Co-Authors:
Vahid Hosseini, Mechanical Engineering Department, Sharif University of Technology, Tehran, Iran
Gholamali Houshyaripour, Institute of Meteorology and Climate, Karlsruhe Institute of Technology / Max Planck Institute for Meteorology, Germany

Abstract:

Tehran, the capital of Iran, has been facing severe air quality degradation in the last three decades with significant damages to the public health and socio-economic systems. To mitigate the air pollution, various emission reduction policies have been implemented with focus on mobile sources. About 6%, 46%, 98%, 87%, and 70% of total primary SOx, NOx, CO, VOC and PM emission are from mobile sources, respectively. This study investigates the change in Tehran's air pollution over the last decade by comparing concentration of various pollutants as well as the emission inventory in 1997 and 2015. The result shows that the emission of SOx, NOx, CO, and VOCs are reduced by 86%, 36%, 42%, and 28%, respectively, despite of increased number of population from 6.6 to 8.5 million and increased number of vehicles from around 1.3 to more than 4.2 million. The concentrations of the major pollutants show very different trends over time. The Annual average concentration for CO decreased significantly from more than 8 ppm to below 3 ppm in the last 13 years. The same trend is observed for SO2 and NO2 with annual average of more than 58 and 85 ppb in 2006-2007, which dropped to below 20 and 51 ppb in 2015-2016, respectively.
This can be due to several factors such as switching house heating fuel from heavy oil and diesel to natural gas, changing vehicle technology from carburetor to injector and improving the quality of gasoline and diesel fuel.
The concentration for PM10 and O3 has remained relatively constant by varying around 80±10 µg/m3 and 22±2 ppb respectively.
This study reveals the impact of various mitigation policies on air quality trends in Tehran. Moreover, it lays the ground for the future investigation on emission analysis and air quality modeling in the region.

1.003 Seasonal variations of aerosols in Pakistan: Contributions of domestic anthropogenic emissions and transboundary transport.

Early Career Scientist

Presenting Author:
Muhammad Zeeshaan Shahid, King Abdullah University of Science and Technology (KAUST), Thuwal, Saudi Arabia, mzeeshanshahid@gmail.com

Co-Authors:
Imran Shahid, Institute of Space Technology, Islamabad Pakistan
Liao Hong, Institute of Atmospheric Physics, Chinese Academy of Sciences, Beijing China

Abstract:

Air pollution has become a serious challenge for developing countries like Pakistan. Very scarce information is available regarding pollution levels in this geographic region. This study presents the first modelling work to simulate the spatial distribution and temporal variation of aerosol concentrations over Pakistan by using the Weather Research and Forecasting Model coupled with chemistry (WRF-Chem). Simulated aerosols species include sulfate, nitrate, ammonium, organic carbon, black carbon, and $PM_{2.5}$ (particles with a diameter of 2.5 mm or less), which are evaluated against ground-based observations and satellite measurements. In year 2006, simulated $PM_{2.5}$ concentrations averaged over northeastern Pakistan (71-74.5°E, 28-34°N) are 55, 48.5, 31.5, and 98 μg m^{-3} in January, April, July, and October, respectively. The simulated highest $PM_{2.5}$ concentration in October results from the relatively low temperatures that favor nitrate formation as well as the lowest precipitation that leads to the smallest wet deposition of all aerosol species. The simulated lowest concentration of $PM_{2.5}$ in July can be attributed to the largest precipitation associated with the South Asian summer monsoon. Sensitivity studies show that transboundary transport contributes to $PM_{2.5}$ aerosol levels in northeastern Pakistan by 10-20% in January and April and by 10-40% in July and October of year 2006. Wind over India and Pakistan is found to be the major meteorological parameter that determines the transboundary aerosol transport.

1.061 Agriculture gridded emissions for air quality modelling purposes – the Portuguese case.

Presenting Author:
Sara Silva, CESAM & Dept of Environment and Planning, University of Aveiro, 3810-193 Aveiro, Portugal, sasilva20@ua.pt

Co-Authors:
Joana Leitão, CESAM & Dept of Environment and Planning, University of Aveiro, 3810-193 Aveiro, Portugal
Joana Ferreira, CESAM & Dept of Environment and Planning, University of Aveiro, 3810-193 Aveiro, Portugal
Carlos Silveira, CESAM & Dept of Environment and Planning, University of Aveiro, 3810-193 Aveiro, Portugal
Myriam Lopes, CESAM & Dept of Environment and Planning, University of Aveiro, 3810-193 Aveiro, Portugal

Abstract:

The agriculture sector is the main source of ammonia (NH_3) emissions. According to emission trends and projections for Europe, emissions of NH_3 have been increasing and intensive and industrial agriculture practices are the main cause of this rise. As a precursor of secondary particles in the atmosphere, the NH_3 emissions will have significant impacts on air pollution and should, therefore, be monitored and assessed. Furthermore, new emission ceilings have been enforced for European Member States by the NEC Directive 2016/2284/EU. Accurate emission inventories with high spatial resolution will not only be essential for the evaluation of progress in achieving such goals but also serve as basis for better air quality modelling exercises that evaluate the compliance with air quality standards across Europe, particularly on urban regions and surrounding rural areas.

For Portugal, the official national emission inventory accounting for the spatial variability of emissions is available at municipal level which is not always adequate for air quality modelling. Moreover, in some Portuguese regions, such as the Aveiro Region, agriculture is one of the main activities and thus, air quality impact studies require a highly-resolved emission inventory for this sector. In this context, we are developing a combined bottom-up/top-down methodology to improve and update the agriculture emissions based on a very detailed Portuguese land use database and on statistical activity data on cattle categories, number and type of animals per administrative area. In addition, we have performed a comparative analysis between the national emission inventory for agriculture and other gridded emission inventories available for Europe such as EDGAR and TNO.

This work has been developed under the project ClairCity. This project has received funding from the European Union’s Horizon 2020 research and innovation programme under grant agreement No. 689289.

1.032 Extention of a long-term BVOC emission dataset and its comparison with other emission studies.

Early Career Scientist

Presenting Author:
Katerina Sindelarova, Charles University in Prague, Faculty of Mathematics and Physics, Dept. of Atmospheric Physics, Prague, Czech Republic; Laboratoire Atmosphères, Milieux, Observations Spatiales, LATMOS-IPSL, Paris, France, katerina.sindelarova@mff.cuni.cz

Co-Authors:
Claire Granier, Laboratoire d'Aérologie, CNRS-Université de Toulouse, Toulouse, France; Laboratoire Atmosphères, Milieux, Observations Spatiales, LATMOS-IPSL, Paris, France
Palmira Messina, Laboratoire des Sciences du Climat et de l'Environnement, LSCE-IPSL, Gif-sur-Yvette, France
Juliette Lathière, Laboratoire des Sciences du Climat et de l'Environnement, LSCE-IPSL, Gif-sur-Yvette, France

Abstract:

We will present an update to the global dataset of biogenic volatile organic compounds calculated by the Model of Emissions of Gases and Aerosols from Nature (MEGANv2.1) called MEGAN-MACC. The dataset now covers a period of 1980-2015 and is available as monthly mean values on a 0.5 x 0.5 degree grid for a whole range of compounds, such as isoprene, speciated monoterpenes, sesquiterpenes, methanol, acetone and other. The dataset is based on MERRA reanalyzed meteorological fields (NASA Goddard Space Flight Center) and leaf area index values derived from observations by the MODIS satellite instrument.
The MEGAN-MACC data have recently been compared with simulations of the global vegetation model ORCHIDEE. We will present results of the comparison focusing on different geographical regions as well as outcomes of the sensitivity studies of both MEGANv2.1 and ORCHIDEE to some of the key parameters such as leaf area index.

1.065 Impact of landuse change from forest to oil palm plantation on direct and indirect greenhouse gas emissions..

Presenting Author:
Ute Skiba, Centre for Ecology and Hydrology, NERC, Penicuik, Midlothian, EH26 0QB, UK, ums@ceh.ac.uk

Co-Authors:
Julia Drewer, Centre for Ecology and Hydrology, NERC, Penicuik, Midlothian, EH26 0QB, UK

Abstract:

In the last 40 years oil palm production has expanded almost 10 fold, with 85% of the production occurring in Malaysia and Indonesia. This expansion of a highly efficient crop, providing 35% of the global vegetable oil consumption is likely to increase, especially in the tropical regions of Africa and South America. But, this expansion requires land use change, which up to now has been at the expense of tropical forests. Replacing forests with oil palm plantations does have large environmental consequences, including increased greenhouse gas emissions, especially nitrous oxide, carbon dioxide and volatile organic carbons, more wild fires and changes in the local climates.
This presentation will summarise the latest knowledge of the magnitude of greenhouse gas emissions and other pollutants from oil palm plantations relative to natural forests, grown on peat or mineral soils and under different management practices. Measured emissions factors will be assessed against the IPCC Tier 1 approach and brought into context of total anthropogenic emissions in the oil palm growing countries and globally.

1.052 Next Steps For Improving Emission Estimates (With The Community Emissions Data System-CEDS).

Presenting Author:
Steven Smith, Joint Global Change Research Institute, Pacific Northwest National Laboratory, College Park, MD USA, ssmith@pnnl.gov

Co-Authors:
Rachel Hoesly, Joint Global Change Research Institute, Pacific Northwest National Laboratory, College Park, MD USA

Abstract:

Inventory data is a key component of scientific and regulatory efforts focused on air pollution, climate and global change and also a key compliment to observational efforts to better constrain emissions. The Community Emissions Data System (CEDS) released a historical emissions dataset in 2016 for use in research, including CMIP6. As this work continues, in collaboration with the emissions data and atmospheric research community, we aim to improve historical data, improve our understanding of uncertainties, and to make this data more useful for the modeling community. This presentation is intended as the start of a community conversation toward these ends.

One key improvement mechanism is already in the CEDS methodology. As new country-level inventory and activity data becomes available, this data can easily be incorporated into new estimates. There are many cases, outside of the formal release of country inventory data, however, where we can, and we argue should, improve the data used for research. As an open-source research system, the main criteria for improvements to CEDS is scientific justification. For example, where observations or other analysis show that formal inventory data are inaccurate, or where countries lack up to date inventories. In many cases it may be at least as important, or even more important, to update uncertainty estimates, and not just central emission estimates. For many emission species observational data will be critical to better understand uncertainties and, ultimately, to better constrain emission estimates.

Finally, as emissions data and models improve, it will also be useful to provide additional spatial and temporal information in addition to emission fluxes, such as weekly and diurnal emissions patterns and emission height (or effective height). This information is often lacking global inventories, although often present in higher resolution country and regional inventories.

www.globalchange.umd.edu/CEDS

3.032 Source-specific estimation of air quality co-benefits of CO2 reduction in Europe, Canada and the United States using backward sensitivity analysis.

Early Career Scientist

Presenting Author:
Marjan Soltanzadeh, Department of Civil and Environmental Engineering, Carleton University, Ottawa, marjansoltanzadeh@cmail.carleton.ca

Co-Authors:
Burak Oztaner, Department of Civil and Environmental Engineering, Carleton University, Ottawa
Amanda Pappin, Department of Civil and Environmental Engineering, Carleton University, Ottawa
Amir Hakami, Department of Civil and Environmental Engineering, Carleton University, Ottawa

Abstract:

Reducing combustion-based CO_2 emissions often entails significant ancillary benefits for public health by reducing emissions of criteria co-pollutants and precursors. These co-benefits' location and sector dependencies, captured in an adjoint or backward sensitivity analysis, are important factors that can change the overall source and sector neutrality of GHG reduction benefits. The present study aims to quantify how the co-benefits of reducing criteria co-pollutants vary spatially and by sector.

The adjoint of USEPA's CMAQ 4.7.1 was applied to quantify the health benefits associated with emission reduction of NO_X as an O_3 precursor and $PM_{2.5}$ primary and precursor emissions in on-road mobile, Electric Generation Units (EGUs), and Upstream Oil and Gas, on a location-by-location basis across the US, Canada and Europe. These health benefits are then converted to CO_2 emission reduction co-benefits by accounting for source-specific emission rates of criteria pollutants in comparison to CO_2. We integrate the results from the adjoint of CMAQ with emission estimates from 2011 NEI at the county level, and point source data from EPA's Air Markets Program Data and National Pollutant Release Inventory (NPRI) for Canada, and Emissions Database for Global Atmospheric Research (EDGAR) for Europe.
Our preliminary results show that the monetized health benefits (due to averted chronic mortality) associated with reductions of 1 ton of CO_2 emissions is up to $65/ton in Canada and $200/ton in US for mobile on-road sector. For EGU sources, co-benefits are estimated at up to $100/ton and $10/ton for the US and Canada, respectively. Calculated co-benefits show a great deal of spatial variability across emission locations for different sectors and sub-sectors. Implications of such spatial variability in devising control policy options that effectively address both climate and air quality objectives will be discussed.

2.024 Estimating CO emissions using IASI data and hemispheric constraints on OH concentrations.

Presenting Author:
TRISEVGENI STAVRAKOU, Royal Belgian Institute for Space Aeronomy, Brussels, Belgium, jenny@aeronomie.be

Co-Authors:
Jean-François Müller, Royal Belgian Institute for Space Aeronomy, Brussels, Belgium
Maite Bauwens, Royal Belgian Institute for Space Aeronomy, Brussels, Belgium
Cathy Clerbaux, Université Libre de Bruxelles (ULB) and LATMOS/IPSL, UPMC Univ. Paris 06 Sorbonne Universités, UVSQ, CNRS, Paris, France
Maya George, LATMOS/IPSL, UPMC Univ. Paris 06 Sorbonne Universités, UVSQ, CNRS, Paris, France
Martine De Mazière, Royal Belgian Institute for Space Aeronomy, Brussels, Belgium
Bavo Langerock, Royal Belgian Institute for Space Aeronomy, Brussels, Belgium

Abstract:

The purpose of this work is to use atmospheric measurements of carbon monoxide (CO) to provide constraints on the budget (sources and sinks) of this compound. The sources of CO are either direct, due to incomplete combustion, or indirect, due to secondary chemical production resulting from the oxidation of hydrocarbons. The dominant CO sink is its reaction with the hydroxyl radical (OH), and therefore CO plays a key role in the oxidative capacity of the atmosphere. Previous modelling studies used ground-based measurements and/or satellite data in combination with chemistry-transport models (CTMs) to provide top-down constraints on the surface emissions and (in some cases) also the photochemical production of CO. The resulting updated emissions proved to be sensitive not only to the choice of atmospheric dataset and inversion setup, but they are also greatly influenced by the representation of the chemical sink of CO, i.e. the abundance of hydroxyl radicals (OH). Indeed, because average OH levels are overestimated by most models in the Northern Hemisphere, the total hemispheric top-down CO emissions are likely too high. A recent study (Patra et al., 2014) reported an annual ratio of Northern Hemispheric to Southern Hemispheric (NH/SH) OH concentration very close to 1, and much lower than a multi-model mean (NH/SH) OH ratio estimated at 1.28 (Naik et al. 2012). Here we propose to take advantage of the above studies to assess the global CO budget based on inverse modeling using the IMAGES CTM (Bauwens et al. 2016) constrained by IASI CO observations. Vertical CO profiles by ground-based FTIR instruments are used to evaluate the results, together with in situ (GAW, GMD) and aircraft measurements. The ultimate goal is to provide a modeling framework that reconciles CO measurements from different platforms on the global scale.

2.028 Spatial and temporal distribution of emissions from on-road transport activity in Chile.

Early Career Scientist

Presenting Author:

Ignacio Andrés Suárez Laengle, Centre for Climate and Resilience Research and Departamento de Ingeniería Mecánica - Universidad Técnica Federico Santa María - Santiago, Chile, ignacio.suarez@alumnos.usm.cl

Co-Authors:

Laura Gallardo Klenner, Centre for Climate and Resilience Research and Department of Geophysics - Universidad de Chile

Mauricio Osses Alvarado, Centre for Climate and Resilience Research and Departamento de Ingeniería Mecánica - Universidad Técnica Federico Santa María

Nicolás Huneeus Lagos, Centre for Climate and Resilience Research and Department of Geophysics - Universidad de Chile

Abstract:

Spatial and temporal distribution of emissions from on-road transport activity in Chile

Ignacio Suárez[1], Mauricio Osses[1,2], Nicolás Huneeus[2,3], Laura Gallardo[2,3]

[1] Departamento de Ingeniería Mecánica - Universidad Técnica Federico Santa María

[2] Centre for Climate and Resilience Research - Universidad de Chile

[3] Department of Geophysics - Universidad de Chile

A database with estimates of historic and future emissions produced by on-road vehicles in Chile between 1998 until 2050 is spatially distribute in a 1x1km grid across the whole country, using cities and roads as principal objects of spatial distribution. The database contains information separated into urban and interurban transport activity. Urban desegregation is distributed using population density and fleet distribution for each city. Interurban activity is distributed using toll barrier data of vehicle counts in highways, complemented by information from origin-destiny surveys for interurban transport. Temporal resolution goes from monthly to hourly desegregation, extrapolating toll barrier data. Emissions are classified by type of vehicle and by pollutant: PM2.5, NOx, HC, CO, CO2, CH4, N2O and black carbon. GIS open source software is used to distribute the data, in particular, QGIS and Python. This will provide an approximation of pollution distribution across the country highways and main cities of Chile. Future work includes distribution of pollutants from other means of transport like railways, maritime, aerial and industrial activities in the country.

3.003 Implication of Rural Residential Energy Transition in China.

Presenting Author:
Shu Tao, Peking University, Beijing, China, taos@pku.edu.cn

Co-Authors:
Ru Muye, Peking University, Beijing, China
Du Wei, Peking University, Beijing, China
Zhu Xi, Peking University, Beijing, China
Zhong Qirui, Peking University, Beijing, China

Abstract:

Solid fuels are extensively used for cooking and heating in rural China, contributing significantly to the emissions of various air pollutants. However, a rapid transition towards clean energy is occurring in China, which was not well recorded in mainstream literature. To fill the data gap, we conducted a nationwide survey to collect energy mix data from 34,489 households and a fuel weighing campaign to weigh daily fuel consumption from 1670 households. A rural residential energy consumption database was compiled for China with detailed fuel (crop residues, corncob, fuel wood, brushwood, coal, honeycomb briquette, charcoal, LPG, biogas, electricity), activity (rice cooking, dish preparation, water boiling, animal feed heating, and space heating), spatial (347 out of 350 municipalities in China), and temporal (1992, 2002, 2007, and 2012) information. Based on these data, as well as a series of high-resolution emission inventories (PKU series), the contributions of rural residential energy consumption to total emissions of various air pollutants, ambient air $PM_{2.5}$ exposure associated premature deaths, and climate forcing in China were modeled and assessed.

1.005 Spatio-temporal distribution and correlation between NO2 and aerosols over South Asia .

Early Career Scientist

Presenting Author:
Salman Tariq, Remote Sensing and GIS Group, Department of Space Science, University of the Punjab, New-Campus, Lahore, Pakistan., salmantariq_pu@yahoo.com

Co-Authors:
Zia Ul-Haq, Remote Sensing and GIS Group, Department of Space Science, University of the Punjab, New-Campus, Lahore, Pakistan.

Abstract:

Understanding of trace gases–aerosols–climate interaction is required for modeling the climate change and air quality. In this study, we have analyzed the spatio-temporal distribution of NO_2 and aerosols, and correlation between them over South Asia. For this purpose we have used tropospheric nitrogen dioxide (NO_2) retrieved from Ozone Monitoring Instrument (OMI), and aerosol optical depth at 550 nm (AOD) and Angstrom exponent (0.412–0.47 nm) (AE) obtained from Aqua-MODIS during 2005–2015. We observed significant variability of NO_2 and AOD with higher values over Indo-Gangatic Plain (IGP) and eastern mining region. Mean annual values of NO_2 and AOD were found to be 1.10 ± 0.05 (x 10^{15} mol cm^{-2}) and 0.29 ± 0.01 with increasing trend of 14.9% and 10.1% respectively over the study region. A significant correlation of r=0.49 was observed between NO_2 and AOD over the South Asia. Higher values of spatial correlations were noted over IGP and eastern mining region with a strong seasonality. Higher correlations were observed during monsoon (r = 0.50) and post-monsoon (r = 0.61) and lower during winter (r = -0.09) and pre-monsoon (r = -0.13). In order to understand the cause of correlations and sources of NO_2 and aerosols we have also mapped GPW3 population density, anthropogenic emissions of MACCity-NOx, ECLIPSE fine-mode PM (PM2.5) and coarse-mode PM (PM10-PM2.5) from sum sectors in South Asia. Overall correlation was found to be increasing (1.2% /year) over the study region during 2005-2015.

1.062 New methods to bridge differences between regional and local emission inventories.

Presenting Author:
Leonor Tarrason, NILU, Urban Environment and Industry, Kjeller, Norway, lta@nilu.no

Co-Authors:
Marc Guevara, Barcelona Supercomputer Center, Barcelona, Spain
Susana Lopez Aparicio, NILU, Kjeller, Norway
Philippe Thunis, JRC, Ispra, Italy

Abstract:

As atmospheric emissions in urban areas become increasingly important to determine the extent of air quality impacts in human health, the requirements on refined spatial distribution also increase. Fine scale emission inventories are compiled either from process-based local information or by downscaling regional emission data. In most cases, the results from the two different approaches are significantly different, a fact that may has implications for the type of measures selected to mitigate air pollution problems in urban areas. A new benchmarking methodology designed to support the evaluation and comparison of different types of emission inventories in regional and local areas has been developed and tested under the Forum for air quality modelling in Europe (FAIRMODE). Results from the comparison of different emission inventories carried out in several European cities (Thunis et al, 2016; Guevara et al, 2016 and Lopez Aparicio et al, 2017) will be presented, with special attention to the identification of gaps, the importance of differences in activity data in particular for the traffic and residential sectors. Initial results from the evaluation of the overarching new European EMEP 0.1x0.1 will be presented also. The results show the capabilities of this new benchmarking emission methodology to identify inconsistencies between inventories, and to evaluate the reason behind discrepancies as a mean to improve both local bottom-up and downscaled regional emission inventories.

3.008 How current and proposed thermal power plants affect the global carbon budget?.

Presenting Author:

DAN TONG, Ministry of Education Key Laboratory for Earth System Modeling, Department for Earth System Science, Tsinghua University, Beijing 100084, People's Republic of China, td13@mails.tsinghua.edu.cn

Abstract:

In the past decade, rapid economic development has witnessed tremendous new-built power units, especially in developing countries, like China and India. Therefore, present operating units will substantially continue to produce CO_2 emissions in future, in addition, proposed thermal power units will become new sources and also contribute to future CO_2 emissions. Quantifying committed CO_2 emissions of current and proposed power units is significant to explore how probably CO_2 emissions in power sector affect carbon budget and further mitigating climate change. Here, we present the Global current and proposed Power CO_2 Emissions Database, a coupled database of global thermal power-generating units and their CO_2 emissions as of 2016, and the results of an analysis that identifies the room for other sectors of the main four regions (China, India, EU28 and the U.S.).
If the remaining proposed plants (Announced, Pre-permit development, and Permitted) follow each commissioning rate of 75%, 50%, and 25%, they would add another 99 (Permitted: 50; Pre-permit development: 29; Announced: 20) Gt of committed CO_2, and units of shelved status would add additional 7 Gt of committed CO_2, totally 178 Gt committed CO_2. From the fuel perspective, coal type plays a dominant role in proposal committed emissions, accounting for ~71% (127 Gt) committed CO_2, next is gas type, accounting for ~26% (47 Gt) committed CO_2, and proposed oil-fired units contributes less for future committed CO_2 emissions (4 Gt).
In total, unless the commissioning rate of proposed projects can be substantially lower, currently proposed capacity will add 178 Gt of additional CO_2 to the atmosphere. The 178 Gt combined with the 735 Gt of emissions from existing infrastructure and up to 913 Gt, pushing emissions dangerously is over the lower end of the IPCC 2 carbon budget (870 Gt).

1.068 Histrical Trend of Air Pollutants Emissions in Japan.

Presenting Author:
Yutaka Tonooka, Emeritus Professor Saitama Univeristy , ytonooka@gmail.com

Co-Authors:
Toshimasa Ohara , Research Director NIES Fukushima Branch Planning department Tsukuba-city Ibaragi-pref. Japan
Junich Kurokawa , Researcher Asia Center for Polution research ACAP Niigata-city Niigata-Pref. Japan

Abstract:

Air pollutants, SO2,NOx,TSP and NMVOCs emissions and energy consumptions (secondary energy converted) in Japan from 1972 to recent year by emission source types are estimated. Emission sources are covering all the anthropogenic sources. In addition longer historical trend of emissions from 1906 by fuel types are roughly estimated as well. Trend analysis with the GDP and demographic population shows shape of environmental Kuznets curves. Data reliability of our emission inventory would be best quality level in Japan and may be best in the world, which quality is realized by our estimation system and survey methodology of Air pollutants Emission Inventory by Ministry of Environment of Japan mainly developed by Y.Tonooka in the age of 1980’s.

1.050 Biomass burning emissions inventories over Africa: How to explain the differences observed between GFED and AMMABB inventories? .

Early Career Scientist

Presenting Author:
N'Datchoh Evelyne TOURE, Laboratoire d'Aerologie,UMR 5560, Toulouse, France / Universite Felix Houphouet Boigny, Abidjan, Cote d'Ivoire, ndatchoheve@yahoo.fr

Co-Authors:
Cathy Liousse, Laboratoire d'Aerologie,UMR 5560, Toulouse, France
Laurent Roblou, Laboratoire d'Aerologie,UMR 5560, Toulouse, France
Abdourahamane Konaré, Universite Felix Houphouet Boigny, Abidjan, Cote d'Ivoire
Guido van der Werf, Department of Hydrology and Geo-Environment Sciences, Faculty of Earth and life Sciences, VU University, Amsterdam, The Netherlands
Aya Brigitte N'Dri, UFR des Sciences de la Nature, Unité de Recherche Ecologie et Biodiversité, Pôle Environnement et Développement Durable, Universite Nangui Abrogoua, Abidjan, Cote d'Ivoire.
Johannes W. Kaiser, King's College London, London, UK / European Centre for Medium-range Weather Forecasts, Reading, UK / Max-Planck-Institut für Chemie, Mainz, Germany.

Abstract:

Over the past 20 years, several studies have estimated biomass burning emissions both at global and regional scales. However, large discrepancies still exist in the biomass burning emission inventories particularly over Africa. These discrepancies exist both on gas and particulate emissions. They can be related to methodology applied and /or input data such as fire products, land cover, emission factors. This work aims to investigate the differences between two bottom-up inventories namely African Monsoon Multidisciplinary Analysis Biomass Burning (AMMABB) and Global Fire Emissions Data version (GFED). To achieve this purpose, the same "bottom-up" methodology was applied to derive biomass burning emission inventories with the same MODIS burned areas, Global Land Cover (GLC) map and emission factor values and their respective Biomass Density (BD) and burning Efficiency (BE) values allowing to focus investigations on vegetation parameters only. Two emission inventories were then generated: the "AMMABB-like" and the "GFED-like" emissions inventories with respective AMMABB and GFED values. Results show that relative errors related to the contribution of vegetation class emissions to total emissions varies between 25% for GLC 17 (Mosaic: Cropland/Tree Cover/Other Natural Vegetation) and 94% for GLC3 (Tree cover Broadleaf Deciduous open). Vegetation classes GLC3, GLC12, GLC13 and GLC18 have been identified as the main vegetation classes that explain discrepancies of a factor of 2.4 between AMMABB and GFED inventories.

Hemispheric-correlated discrepancies can also be noticed from this comparison. New BE and BD measurement would help decreasing such discrepancies.

1.035 Forecasting wildfires' impact on air quality.

Presenting Author:

Solene Turquety, 1Sorbonne Universités, Université Pierre et Marie Curie – Paris 6; CNRS/INSU; Ecole Polytechnique, Laboratoire de Météorologie Dynamique (LMD) – IPSL, Paris, France., solene.turquety@lmd.polytechnique.fr

Co-Authors:

Laurent MENUT, 1Sorbonne Universités, Université Pierre et Marie Curie – Paris 6; CNRS/INSU; Ecole Polytechnique, Laboratoire de Météorologie Dynamique (LMD) – IPSL, Paris, France.

Melanie ROCHOUX , CERFACS, France

Abstract:

Wildfires are a significant source of atmospheric pollutants, which alters air quality at local to regional scales. Fire activity being highly variable both temporally and spatially, including this source into air quality forecasting systems requires daily reanalysis of emissions. The availability of near-real time observations from geostationary satellites for several regions (GOES, SEVIRI) now allows integration of emissions as soon as fires are detected. However, evolution during the forecast integration time, typically up to 5 days, has to be estimated.

In this paper, we propose a methodology for the near-real time calculation of the emissions and their evolution in an air quality forecasting context. It combines near-real time fire detection from satellite (MODIS, SEVIRI) with large fire risk modelling and the APIFLAME emissions' calculation model. Fire risk is simulated using a probabilistic approach and meteorological simulations from the WRF regional model. The forecasting spread of fire emissions and of their impact on air quality during a 5 days forecasting period is estimated using simulations with the chemistry-transport model CHIMERE. Results will be discussed based on different fire events in South-Western Europe.

1.039 Evaluating updated light alkane emissions from the oil and natural gas industry in the U.S. .

Early Career Scientist

Presenting Author:
Zitely Tzompa, Colorado State University, Department of Atmospheric Science, Fort Collins, Colorado, USA, zitely@atmos.colostate.edu

Co-Authors:
Barron Henderson, U.S. Environmental Protection Agency, Office of Air Quality Planning and Standards, Air Quality Modeling Group
Katie Travis, Harvard University, Atmospheric Chemistry Modeling Group, Cambridge, Massachusetts, USA.
Emily Fischer, Colorado State University, Department of Atmospheric Science, Fort Collins, Colorado, USA

Abstract:

New efficient drilling techniques triggered a massive growth of unconventional oil and natural gas production in North America starting in 2005. Emissions of a variety of volatile organic compounds (VOCs) from the oil and gas sector occur during well development and production phases, and emissions to the atmosphere also continue when wells are abandoned. The leakage flux and gas composition of oil and natural gas wells depends on their production stages, the emission controls in place, and the type of reservoir (e.g., tight gas vs. shale gas). Determining VOC emission fluxes in the context of rapid growth of the oil and natural gas industry presents a big challenge for emission inventories. The U.S. 2011 National Emission Inventory has undergo numerous revisions, where emissions from the oil and natural gas industry had been updated using the recent local and regional data. The latest version of the 2011 National Emission Inventory (NEI 2011v6.3) includes updates over important oil and natural gas basins and speciation profiles based on the Western Regional Air Partnership. In this study, we incorporate the NEI 2011v6.3 into the GEOS-Chem chemical transport model to simulate the atmospheric abundances of C_2-C_5 alkanes over the U.S. attributed to the updated emissions from the oil and gas sector. We evaluate our simulation by comparing it to a suite of surface in situ observations, column measurements, and aircraft profiles. Finally, we estimate the contribution over the contiguous U.S. that C_2-C_5 alkanes make to the abundances of important secondary species including ozone, peroxy acetyl nitrate, and several ketones.

3.023 Measurement of Particulate Matter and its Risk Assessment in an Urban Environment of Niger Delta Region of Nigeria..

Presenting Author:

STEPHEN UZOEKWE, Department of Chemistry, Federal University, Otuoke, P.M.B 126, Yenagoa, Bayrlsa State, Nigeria, uzoekwe_steve@yahoo.com

Co-Authors:

DAVID AJAYI, Department of Chemistry, Niger-Delta University, Bayelsa State, Nigeria

Abstract:

Abstract:

This study reports the ambient concentrations of total suspended particulate matter (respirable and non-respirable) measured in Yenagoa and its environs as means of assessing the ambient air quality of a fast growing urban town in Niger Delta region of Nigeria. Air particulate matter was collected gravimetrically at five stations (using a high volume portable SKC air check MTX Sidekick air sampler (Model: 224-52MTX). The particulate matter range of 662.00 ±162.68 – 1623.00 ± 95.67

1.011 Intercomparison of NOx emission inventories over East Asia.

Presenting Author:
Ronald van der A, KNMI, De Bilt, The Netherlands, avander@knmi.nl

Co-Authors:
Jieying Ding, KNMI, De Bilt, The Netherlands
Bas Mijling, KNMI, De Bilt, The Netherlands
Kazuyuki Miyazaki, Japan Agency for Marine-Earth Science and Technology, Yokohama, Japan
Jun-ichi Kurokawa, Asia Center for Air Pollution Research, Niigata, Japan
SeogYeon Cho, Inha University, Inchon, South Korea
Qiang Zhang, Tsinghua University, Beijing, China
Greet Janssens-Maenhout, Joint Research Centre, Ispra, Italy
Pieternel Levelt, KNMI, De Bilt, The Netherlands

Abstract:

We compare 9 emission inventories of nitrogen oxides including four satellite-derived NO_x inventories and five bottom-up inventories for East Asia: REAS (Regional Emission inventory in ASia) version 2.1 and 2.2, MEIC (Multi-resolution Emission Inventory for China), CAPSS (Clean Air Policy Support System) and EDGAR (Emissions Database for Global Atmospheric Research). Two of the satellite-derived inventories are estimated by using the DECSO (Daily Emission derived Constrained by Satellite Observations) algorithm, which is based on an extended Kalman filter applied to observations from OMI or from GOME-2. The other two are derived with the EnKF algorithm, which is based on an ensemble Kalman Filter applied to observations of multiple species using either the chemical transport model CHASER and MIROC-chem. The temporal behaviour and spatial distribution of the inventories are compared on a national and regional scale.

2.015 High spatial resolution mapping of urban emissions at neighborhood scale.

Presenting Author:
Erik Velasco, Singapore-MIT Alliance for Research and Technology, Singapore, evelasco@smart.mit.edu

Abstract:

Increasingly eddy covariance (EC) flux towers are placed in urban areas to evaluate the accuracy of gridded emission inventories of pollutant and greenhouse gases. The EC method is a direct measure that includes all major and minor natural and anthropogenic emission sources and sinks. With a proper design and location of the flux tower, the observed footprint can represent a large upwind extent similar to the size of a complete neighborhood, and cover one or a few square grids (10^2 – 10^3 m) of a spatially distributed emissions inventory. To investigate the spatial distribution of emissions at even a finer resolution (20 - 50 m) we propose the application of the aerodynamic resistance approach in combination with high frequency mixing ratio data collected by mobile measurements along defined paths at street level across the monitored footprint. Based on the Monin-Obukhov similarity theory and Reynolds analogy, the aerodynamic resistance of sensible heat can be used as a proxy to estimate the exchange rate of any scalar between the surface and the atmosphere. As a probe of concept, we instrumented a bicycle with an infrared gas analyzer, a meteorological sensor and a GPS to log georeferenced mixing ratios of carbon dioxide (CO_2) across the low-rise residential neighborhood of Telok Kurau in Singapore where we have measured fluxes of energy and CO_2 for seven years. This paper will introduce the results of these measurements and discuss the strengths and weaknesses of the approach to map CO_2 emissions at high spatial resolution at neighborhood scale.

3.030 Estimates of spatially and temporally resolved gridded optimised black carbon emission over Indian region and its population exposure assessment using a strategic integrated modelling approach.

Presenting Author:

Shubha Verma, Department of Civil Engineering, Indian Institute of Technology Kharagpur, West Bengal, India, shubhaverm@gmail.com

Co-Authors:

Sanhita Ghosh, Department of Civil Engineering, Indian Institute of Technology Kharagpur, West Bengal, India

Kasa Vara Prasad, Department of Civil Engineering, Indian Institute of Technology Kharagpur, West Bengal, India

Abstract:

We estimated the latest spatially and temporally resolved gridded optimised black carbon (BC) emissions over Indian region using a strategic integrated modelling approach; this was done extracting information on initial bottom-up emissions and atmospheric BC concentration from a general circulation model (GCM) simulation in conjunction with the receptor modelling approach. Monthly BC emission (83–364 Gg) obtained from the present study exhibited a spatial and temporal variability with this being the highest (lowest) during February (July). Monthly BC emission flux was considerably high (> 100 $kg.km^{-2}$) over the entire Indo-Gangetic plain (IGP), east and west coast during winter months. This was relatively higher over the central and western India than over the IGP during summer months. Annual BC emission rate was 2534 Gg y^{-1} with that over the IGP and central India respectively amounting to 50% and 40% of the total annual BC emissions over India. The relative predominance of monthly BC emission flux over a region (as depicted from z-score distribution maps) was inferred being consistent with the prevalence of region- and season-specific anthropogenic activity. Simulation of atmospheric BC concentration in a chemical transport model using the optimised BC emissions indicated a good agreement between model estimates and observations, unlike the available bottom-up BC emissions over the Indian region. It was estimated that more than 85% of the population over the IGP was exposed to a BC concentration of 20 µg m^{-3} . Relative risk of BC exposure was greater than one over the IGP, thereby implying population exposed to BC being under health risks associated with combustion derived toxic chemical constituents.

2.020 Carbonyl Sulfide Serves as Tattletale for Biosphere Signal.

Presenting Author:
Gara Villalba, Universitat Autònoma de Barcelona, gara.villalba@uab.cat

Co-Authors:
Xavier Gabarrell, Universitat Autònoma de Barcelona

Abstract:

Currently, anthropogenic CO_2 emissions over a geographic region can be calculated in several ways: 1) based on energy consumption using emission factors within city limits, 2) using $^{14}CO2$ as tracer for fossil CO_2, and 3) subtracting the biosphere signal from observation (measured) CO_2 data. In order to calculate the ecosystem CO_2 emissions (respiration and photosynthesis), ecosystem models such as SiB, CASA, or others are used. However, it is not clear which is the best one to determine the ecosystem signal because they all give different results in terms of GPP.
We first show simulations of biosphere CO_2 given by SiB, CASA, and CAN-IBIS over central California. Each model gives different values of CO_2 GPP. Using these values to determine fossil fuel CO_2 contribution can give very different results. We suggest that COS can be used to determine which ecosystem model best represents the biosphere signal. Just like CO_2, COS is taken up by photosynthesis but is not given off in respiration and can thus be used as a trace gas to estimate GPP. We begin with COS surface fluxes provided by SiB, CASA and CAN-IBIS for a 9km-resolution domain over the Bay Area of San Francisco and part of the San Joaquin Valley. Simulations using the atmospheric model WRF provide the meteorological data, which along with the COS fluxes, are used to run the transport model STEM over a 10-day period in March 2015. Simulations of COS mixing ratio based on the various surface flux models are compared to observed data available from several locations. The model that best represents COS uptake consequently also provides the most accurate simulation of CO_2 biosphere signal, and is used to estimate fossil fuel CO_2 emissions.

1.067 Comparing measurements and emission inventory data for NMVOCs in urban areas.

Presenting Author:
Erika von Schneidemesser, IASS, Potsdam, Germany, evonsch@gmail.com

Co-Authors:
Monica Crippa, Joint Research Center, Ispra, Italy
Hugo Denier van der Gon, TNO, Utrecht, the Netherlands
Leyang Feng, Pacific Northwest National Laboratory-Joint Global Change Research Institute, College Park, MD, USA
Gregory Frost, NOAA, Boulder, CO, USA
Ganlin Huang, University of Stuttgart, Stuttgart, Germany
Greet Janssens-Maenhout, Joint Research Center, Ispra, Italy
Brian McDonald, NOAA, Boulder, CO, USA
Steven Smith, Pacific Northwest National Laboratory-Joint Global Change Research Institute, College Park, MD, USA
- GEIA NMVOC WG Members, various

Abstract:

Common relationships among non-methane volatile organic compounds (NMVOCs) across urban areas globally have indicated a substantial similarity in the dominant emission source, specifically motor vehicles. Furthermore, the use of NMVOC measurements in urban areas has been used to provide a check on the primary emissions for NMVOCs in reported inventories, as in Warneke et al., 2007, Borbon et al., 2013. These studies typically compare measured atmospheric enhancement ratios of individual NMVOCs to carbon monoxide (CO) or acetylene to parallel ratios in emission inventories (EI). In many cases these studies have shown significant measurement-inventory discrepancies by factors of 2 or more for individual species. Such discrepancies have implications for air quality modeling and the accurate simulation and prediction of not only NMVOCs, but other species such as ozone or secondary organic aerosol. This study is an effort of the GEIA Working Group on NMVOCs and brings together measurements of NMVOCs from urban areas globally in conjunction with two global emission inventories (EDGARv4.3.2 and CEDS) to provide a synthesis of such comparisons against the same baseline (global inventory). Initial comparisons have shown large differences in the agreement/disagreement between the ratios in the emission inventories compared to those in the measurements that vary depending on the specific NMVOC. There are a number of challenges associated with such comparisons: the resolution of such inventories is often rather coarse and the observational data come from ambient measurements in urban areas, which are not necessarily spatially representative, and therefore not an ideal match. Furthermore, spatial proxies used to distribute emissions, as well as atmospheric chemistry processes can add a confounding factor. However, there are also benefits in that the use of a global EI allows for comparability across different urban regions worldwide, as well as a possible check via inter-comparison on the reported inventory data.

3.015 The Effect of Meteorological Variabilities on Atmospheric Sulfate Aerosols over East China and the United States: The Analyses of NCAR-CESM Simulations.

Early Career Scientist

Presenting Author:
Chi-Yun Wang, Department of Atmospheric Sciences, National Taiwan University and Atmospheric Sciences Research Center, State University of New York at Albany, agilen.wang@gmail.com

Co-Authors:
Wei-Chyung Wang, Atmospheric Sciences Research Center, State University of New York at Albany
Jen-Ping Chen, Department of Atmospheric Sciences, National Taiwan University

Abstract:

Air quality depends on surface emission and meteorology; however, current policy emphasizes on the emission (i.e. abatement of total pollutant emissions), while the role of meteorology is inadequately considered. This study illustrates the important role of meteorological variabilities in air quality from the regional perspective. Sulfate aerosols have been one of major air pollutants over China and the United States, and their chemical and physical properties have been studied rather thoroughly. This investigation further evaluates the meteorological controls of air pollution by analyzing 100-year mean and variability of atmospheric sulfate concentrations simulated from the National Center Atmospheric Research' Community Earth System Model (NCAR-CESM) using identical annual aerosol emission for each year during the 1980s. The NCAR-CESM is a coupled atmosphere-ocean general circulation model considering fully the aerosol-meteorology and air-sea interactions. The relationships between variabilities in sulfate concentration and the meteorological factors (i.e. surface temperature, specific humidity, precipitation, and the wind at 850 hPa) exhibit significant seasonal and inter-annual variations. For instance, during September-October-November: the sulfate variabilities over South China is ± 30 % due to large precipitation fluctuation; over the Upper Midwest US, they are ± 40 % due to the combined effect of temperature, specific humidity, and wind direction. Climate phenomena, such as El Niño, also lead to strong variation. Under the future climate change scenarios, the meteorological variability may change, and it could result in different impacts on air quality and therefore on public health. Understanding the effect of meteorology on local air quality could help gain knowledge about the uncertainty in air pollution conditions and relevant policy.

2.036 Managing the mean or the tail: sensitivity of surface PM2.5 to emissions changes in China.

Presenting Author:

Yuxuan Wang, 1. Department of Earth and Atmospheric Sciences, University of Houston; 2. Department of Earth System Sciences, Tsinghua University, Beijing, China, ywang246@central.uh.edu

Co-Authors:

Beixi Jia, Department of Earth System Sciences, Tsinghua University, Beijing, China

Yuanyu Xie, Department of Earth System Sciences, Tsinghua University, Beijing, China

Abstract:

Both satellite remote sensing and bottom-up inventories have provided evidence of a recent decrease of Chinese emissions of SO_2 and NOx, which are precursors of inorganic aerosol in the atmosphere. Despite of such progresses, episodes of severe PM2.5 pollution occur frequently, especially over North China during the winter season, giving rises to public concerns about the effectiveness of the government in controlling air pollution. Here we employ both atmospheric observations and 3-D chemical transport modeling exercises to estimate the sensitivity of severe $PM_{2.5}$ episodes to emissions reductions and contrast this sensitivity to that of annual and seasonal average $PM_{2.5}$. Implications of the different sensitivities for air quality management in China will be discussed.

1.054 Mobile measurements reveal high ammonia concentrations in German inner cities.

Presenting Author:
Robert Wegener, Institute of Energy and Climate Research, IEK-8: Troposphere, Forschungszentrum Jülich GmbH, Jülich, Germany, r.wegener@fz-juelich.de

Co-Authors:
Dieter Klemp, Institute of Energy and Climate Research, IEK-8: Troposphere, Forschungszentrum Jülich GmbH, Jülich, Germany
Franz Rohrer, Institute of Energy and Climate Research, IEK-8: Troposphere, Forschungszentrum Jülich GmbH, Jülich, Germany
Christian Ehlers, State Agency for Nature, Environment and Consumer Protection (LANUV), Essen, Germany
Andreas Wahner, Institute of Energy and Climate Research, IEK-8: Troposphere, Forschungszentrum Jülich GmbH, Jülich, Germany

Abstract:

Despite a number of regulatory measures by the European Union, the air quality in German inner cities is only slowly improving. Especially the concentration of nitrogen dioxide (NO_2) remains hazardously elevated. As cars have been identified as main NO_2 sources in German cities[1], an increasing number of Diesel engines are equipped with selective reduction catalysts (SCR) to diminish NO_2 emissions. These catalysts are fueled with urea solution which splits off ammonia to reduce NO_2. However, if NH_3 is added in excess, then the spillover is released into the atmosphere.
MOBILAB, the mobile laboratory of Forschungszentrum Jülich, has been equipped with two NH_3 detectors to measure NH_3 emissions of vehicles while driving. Both instruments, an off-axis integrated cavity output spectrometer and a cavity ring-down spectrometer, agree well in field measurements. Together with the fast measurements of CO_2, other trace gases and particles, it is possible to determine emissions ratios of vehicles running ahead. In 2016 and 2017 MOBILAB measurements were part of the joint research programs ‘Urban Climate Under Change – [UC]²’ and ‘ALASKA’ founded by the Federal Ministry of Education and Research and the German Ministry for Economic Affairs and Energy. Mobile measurements in Stuttgart 2016 and 2017 revealed high concentration of ammonia in the inner city with values up to 1 ppm. Taking account the increasing number of cars with selective reduction catalysts (SCR), the importance of ammonia as pollutant in German inner cities is expected to increase.
[1]C. Ehlers, D. Klemp, F. Rohrer, D. Mihelcic, R. Wegener, A. Kiendler-Scharr, and A. Wahner, 'Twenty Years of Ambient Observations of Nitrogen Oxides and Specified Hydrocarbons in Air Masses Dominated by Traffic Emissions in Germany', *Faraday Discussions,* 189 (2016), 407-37.

1.037 DICE-Africa: Diffuse and Inefficient Combustion Emissions in Africa, today and in the future.

Presenting Author:
Christine Wiedinmyer, National Center for Atmospheric Research, Boulder, CO, USA, christin@ucar.edu

Co-Authors:
Eloise Marais, University of Birmingham, Birmingham, UK
Forrest Lacey, University of Colorado, Boulder, CO, USA
Mat Evans, University of York, York, UK
Yanko Davila, University of Colorado, Boulder, CO, USA
Daven Henze, University of Colorado, Boulder, CO, USA

Abstract:

Diffuse and inefficient combustion sources, including transportation, back-up generators, and cooking with biomass, significantly contribute to pollutant emissions and the resulting ambient air quality in Africa. The Diffuse and Inefficient Combustion Emissions in Africa (DICE-Africa) is a recently published inventory of pollutant emissions for continental Africa for 2006 and 2013. DICE-Africa emissions are spatially aggregated to the 0.1 by 0.1 degree resolution for use in various atmospheric model applications. The DICE-Africa emissions have been used in conjunction with existing global inventories, specifically the EDGAR-HTAP inventory, to assess the air quality impacts from both sector-specific anthropogenic emissions along with the impacts from DICE-Africa sources across the African continent. Updates to this emissions inventory have been made based on in-field measurements taken during field campaigns to more accurately represent the speciation and magnitude of emissions from inefficient combustion. As Africa moves into the future, emissions from particular sources such as residential cooking, transportation, and power may change due to technological advances, policy actions, and cultural shifts. We explore potential, realistic future emission scenarios based on changes specific to the residential, power, and transportation sectors. Three emissions mitigation scenarios representing 2030 populations will be shown. The results of the current and future emissions estimates are run with the GEOS-Chem chemical transport model to assess their impacts on air quality, and ultimately on human health.

1.046 Current and Future Primary Particle Number Size Distribution Emission Inventory of On-road Vehicles in Southeast Asia.

Early Career Scientist

Presenting Author:
Ekbordin Winijkul, Asian Institute of Technology (AIT), ekbordinw@ait.asia

Abstract:

Anthropogenic particles, originated from different sources, are emitted in different size ranges. These particles have different impacts on health and atmospheric processes due to their mass/number characteristics and size specific properties. While aerosol number concentration are dominated mostly by particles in ultrafine particle size range (diameter < 0.1 μm), the mass concentration dominates mostly on the larger size particle range. The particle number concentrations and particle mass concentrations are both important for health and atmospheric research.

Researches and regulations in the past 30 years have been developed based on mass-based emission inventories since the mass concentration have been intensively linked with health and climate effects. However, more and more recent studies have showed that number-based emission have direct effects to the health and atmospheric process such as particle number and respiratory health effects and cloud interactions. Although the relationship between particle number distribution can be converted from particle mass distribution data, uncertainties in the conversion will be large considering that most of the mass are dominated by small number of particles while only small mass will be accounted for large number of particle in the ultra-size ranges.

In this study, we will develop the on-road particle number distribution emission inventory for Southeast Asia from 2010 to 2030 with five year interval based on vehicle population model that will be tuned with vehicle usage patterns and particle number emission factors measured with the vehicle technologies used in Southeast Asia. The engine population model is selected in this study because it can provide the estimation of yearly in-use vehicle population based on technologies and ages according to regional owner usage pattern data. This inventory will be the first particle number distribution emission inventory developed by using vehicle population model for Southeast Asia.

1.059 The KORUS2015 Emissions Inventory – Initial Findings and Future Perspectives.

Presenting Author:
Jung-Hun Woo, Division of Interdisciplinary Studies/Dept. of Advanced Technology Fusion, Konkuk University, Seoul, Korea, woojh21@gmail.com

Co-Authors:
Younha Kim, Dept. of Advanced Technology Fusion, Konkuk University, Seoul, Korea
Chanjong Bu, Dept. of Advanced Technology Fusion, Konkuk University, Seoul, Korea
Yungu Lee, Dept. of Advanced Technology Fusion, Konkuk University, Seoul, Korea
Jinseok Kim, Dept. of Advanced Technology Fusion, Konkuk University, Seoul, Korea
Jinsu Kim, Dept. of Advanced Technology Fusion, Konkuk University, Seoul, Korea
Youjung Jang, Dept. of Advanced Technology Fusion, Konkuk University, Seoul, Korea
Minwoo Park, Division of Interdisciplinary Studies, Konkuk University, Seoul, Korea
Jifeng Lu, Argonne National Laboratory, Chicago, USA
David G. Streets, Argonne National Laboratory, Chicago, USA

Abstract:

The needs of more scientific understanding of inter-relationship among emissions, transport, chemistry over East Asia are much higher to effectively protect public health and ecosystems. Two aircraft filed campaigns targeting year 2016, MAPS-Seoul and KORUS-AQ, have been organized to study the air quality of over Korea and East Asia relating to chemical evolution, emission inventories, trans-boundary contribution, and satellite application. We developed a new East-Asia emissions inventory, named KORUS2015, based on NIER/KU-CREATE (Comprehensive Regional Emissions inventory for Atmospheric Transport Experiment), in support of the filed campaigns. For anthropogenic emissions, it has 54 fuel classes, 201 sub-sectors and 13 pollutants, including CO_2, SO_2, NO_x, CO, NMVOC, NH_3, PM_{10}, and $PM_{2.5}$. Since the KORUS2015 emissions framework was developed using the integrated climate and air quality assessment modeling framework (i.e. GAINS) and is fully connected with the comprehensive emission processing/modeling systems (i.e. SMOKE, KU-EPS, and MEGAN), it can be effectively used to support atmospheric field campaigns for science and policy. During the field campaigns, we are providing modeling emissions inventory to participating air quality models, such as CMAQ, WRF-Chem, CAMx, GEOS-Chem, MOZART, for forecasting and post-analysis modes. Based on initial assessment of those results, we are improving our emissions, such as VOC speciation, biogenic VOCs modeling. From the 2^{nd} iteration

between emissions and modeling/measurement, further analysis results will be presented at the conference.

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1.025 Overview of Korean National Air Pollutants Emissions Inventory .

Early Career Scientist

Presenting Author:
So-young Yeo, National Institute of Environmental Research, Global Environment Research Division, Incheon, Republic of Korea, chwh80@korea.kr

Co-Authors:
Kim Daigon , National Institute of Environmental Research, Global Environment Research Division, Incheon, Republic of Korea
Lee Hyangkyeong, National Institute of Environmental Research, Global Environment Research Division, Incheon, Republic of Korea
Seol Sung-hee , National Institute of Environmental Research, Global Environment Research Division, Incheon, Republic of Korea
Lee Kyung-mi , National Institute of Environmental Research, Global Environment Research Division, Incheon, Republic of Korea
Kim SangKyun, National Institute of Environmental Research, Global Environment Research Division, Incheon, Republic of Korea

Abstract:

An air pollutant emissions inventory is one of essential data set, which policymakers use to understand the current status of air pollution level, to establish policies for air quality management, and to evaluate the feasibilty and effect of such policies. It is also fundamental and valuable for the field of air quality studies.
In order to accurately and systematically estimate the emissions of air pollutant in South Korea, we have developed the Korean Emissions Inventory System named the Clean Air Policy Support System (CAPSS). This inventory encompasses all the three types of emission sources: (1) point sources including fuel combustion, production processes, and waste treatments, (2) area sources, such as solvent use, storage and distribution of fuels, agriculture, and biomass burning, and (3) mobile sources including road transport and other mobile machinery. Emission factors for each type of sources are collected from a number of domestic and international research reports. For the sake of reflecting Korean conditions, basically, those obtained from domestic one are preferentially used. However, the international data are also applied in the case there are no available domestic data. For activity data, the CAPSS utilizes national, regional, and local level of statistical data, compiled by approximately 120 Korean organizations.

1.044 Aerosol and VOC emission factor measurements for African anthropogenic sources.

Presenting Author:
Veronique Yoboué, Université Félix Houphoët-Boigny, LAPA-MF, BPV34, Abidjan 01, Côte D'Ivoire, yobouev@hotmail.com

Co-Authors:
Sekou Keita, Université Félix Houphoët-Boigny, LAPA-MF, BPV34, Abidjan 01, Côte D'Ivoire
Catherine Liousse, Laboratoire d'Aérologie, Université Paul Sabatier Toulouse III-CNRS, France
Eric Assamoi, Université Félix Houphoët-Boigny, LAPA-MF, BPV34, Abidjan 01, Côte D'Ivoire
Sophie Haslett, Centre for Atmospheric Science, University of Manchester, Manchester, M13 9PL, United Kingdom
Agnes Borbon, Université Clermont Auvergne, CNRS, LaMP, F-63000 Clermont-Ferrand, France
Pamela Dominutti, Université Clermont Auvergne, CNRS, LaMP, F-63000 Clermont-Ferrand, France
Aurelie Colomb, Université Clermont Auvergne, CNRS, LaMP, F-63000 Clermont-Ferrand, France
Laetitia Bouvierr, Université Clermont Auvergne, CNRS, LaMP, F-63000 Clermont-Ferrand, France
Stephane Sauvage, IMT Lille Douai, Univ. Lille, SAGE - Département Sciences de l'Atmosphère et Génie de l'Environnement, 59000 Lille, France
Thierry Léonardis, IMT Lille Douai, Univ. Lille, SAGE - Département Sciences de l'Atmosphère et Génie de l'Environnement, 59000 Lille, France
Aristide Akpo, Université d'Abomey-Calavi, Cotonou, Bénin
Hugh Coe, Centre for Atmospheric Science, University of Manchester, Manchester, M13 9PL, United Kingdom
Eric Gardrat, Laboratoire d'Aérologie, Université Paul Sabatier Toulouse III-CNRS, France
Corinne Galy-Lacaux, Laboratoire d'Aérologie, Université Paul Sabatier Toulouse III-CNRS, France
Jean-Francois Leon, Laboratoire d'Aérologie, Université Paul Sabatier Toulouse III-CNRS, France

Abstract:

Anthropogenic pollution in Africa is dominated by combustion sources, mainly by domestic fires for cooking and heating and traffic. But these sources are not yet well characterized. Also, there are some sources of pollution specific to Africa, that are poorly

documented such as two-wheel two-stroke vehicles using a mixture of oil and gasoline (Assamoi and Liousse, 2010) or open solid waste burning (Wiedinmyer et al., 2014). These sources are not taken into account in most of emission inventories, although they are very emitting. Due to the lack of data, emission factors (EFs) used in emission inventories for these sources of pollution are derived from the literature, from norther hemisphere values. Therefore, uncertainties on emission factors contribute significantly to uncertainties in emission inventories (Zhang and Tao, 2009; Zhao et al., 2011).
In the frame of workpackage 2 of the Dacciwa European project many campaigns of EF measurements were organized with ground field (GF) and combustion chamber (CC) experiments. Main African anthropogenic sources (wood and charcoal burning, charcoal making, truck, car, buses, two wheels vehicles, open waste burning) have been scrutinized. Total Particulate Matter (TPM), black carbon (BC), primary organic carbon (OC) and Non-methane volatile organic compounds (NMVOC) species were specially studied.
In this work, a new set of EF for African anthropogenic sources will be presented and compared with literature data. Comparison between GF and CC experiments will be conducted.

2.013 Geostatistics for local emission inventories.

Early Career Scientist

Presenting Author:
Damian Zasina, Institute of Environmental Protection - NRI, The National Centre for Emissions Management, Warsaw, Poland, damian.zasina@kobize.pl

Co-Authors:
Jaroslaw Zawadzki, Warsaw University of Technology, Warsaw, Poland

Abstract:

The study presents selected dependencies connected with spatial disaggregation of the top-down emission inventory. Analysed case concerns the area with the district heating network supplying with the heat and hot water considerable part of dwellers.
Compiling the top-down emission inventories for purposes of local policies or air quality modelling can be very demanding considering small, scattered emission sources such as coal based residential combustion: small boilers and stoves (very popular in Poland, causing mainly the low emission phenomenon). The disaggregation of estimated emissions to a fine grid (~ 2×2 km2) can be hidered by occurrence of the district heating infrastructure. Without detailed map of the heating network, indicating places where residential emission must be reduced, the only possibility is to disaggregate estimated emission using simplified approach based on weighted averages of living areas or population data.
Presented analysis, carried out for Silesian Metropolis, (southern part of Poland) used available spatial data on urbanized areas (derived from the Corine Land Cover), also population density, and selected geostatistical techniques to determine of the heating infrastructure occurrence, also emission disaggregations based on geostatistical approach.

1.041 The Status of the first Atmospheric Sentinel Mission S-5 Precursor and its possible Exploitation for Emission Monitoring.

Presenting Author:
Claus Zehner, ESA/ESRIN, Via Galileo Galilei CP64, 00044 Frascati, Italy,
claus.zehner@esa.int

Abstract:

Sentinel-5 Precursor (S-5P) will be the first of a series of atmospheric chemistry missions to be launched within the European Commission's Copernicus (former GMES) Programme. With the current launch window of June 2017 and a nominal lifetime of 7 years, S-5P is expected to provide continuity in the availability of global atmospheric data products between its predecessor missions SCIAMACHY (Envisat) and OMI (AURA) and the future Sentinel-4 and -5 series. S-5P will deliver unique data regarding the sources and sinks of trace gases with a focus on the lower Troposphere including the planet boundary layer due to its enhanced spatial, temporal and spectral sampling capabilities as compared to its predecessors. The S-5P satellite will carry a single payload, TROPOMI (TROPOspheric Monitoring Instrument) which is jointly developed by The Netherlands and ESA. Covering spectral channels in the UV, visible, near- and short-wave infrared, it will measure various key species including tropospheric/stratospheric ozone, NO2, SO2, CO, CH4, CH2O as well as cloud and aerosol parameters. The actual status of the S-5P mission will be presented herewith together with results obtained within the ESA GlobEmission project - http://www.globemission.eu/ - demonstrating the potential future usage of S-5P measurements for the generation of top-down emission inventories.

1.033 Ship Emissions from All Vessels with AIS Activity Data in Pearl River Delta.

Early Career Scientist

Presenting Author:
Yiqi Zhang, Division of Environment, Hong Kong University of Science and Technology, Hong Kong, PRC, yzhangen@ust.hk

Co-Authors:
Jimmy W.M. Chan, Division of Environment, Hong Kong University of Science and Technology, Hong Kong, PRC
Alexis K.H. Lau, Division of Environment, Hong Kong University of Science and Technology, Hong Kong, PRC; Civil and Environmental Department, Hong Kong University of Science and Technology, Hong Kong, PRC

Abstract:

Ship emissions inventory has been fast developed in the recent years with the advancement of Automatic Identification System (AIS). However, while the AIS data can provide high-resolution spatial and temporal information of ship activities (i.e. real-time speed), its derivation of emissions inventory also require pertinent vessel specifications, which are mostly only available for international registered vessels. Thus, AIS-based emissions inventory in earlier studies are restricted to the vessels that can be identified in the given vessel parameter database, while emissions from non-identified vessels (mailnly for domestic navigations) are neglected.
In this study, we improved the traditional approach of AIS-based estimation and used the AIS activity data to derive the emissions from all the vessels with AIS installed in Hong Kong and the Pearl River Delta (PRD) region in southern China, where inland waterway transport has been fast developing. Our results show that the non-identified vessels may contribute 30% to 50% of the SO_X emission in the region in 2015. Moreover, our results clearly show the importance of ship activities in the inland waterways, as the associated emission maps show much more distinct and significant emission tracks and hot spots in the inland water channels of the PRD region.

1.030 An AIS-based 2013 ship emission inventory and estimated trends from 2004 to 2040 in China.

Early Career Scientist

Presenting Author:
Junyu Zheng, School of Environment and Energy, South China University of Technology, Guangzhou, China, zhengjunyu_work@hotmail.com

Co-Authors:
Cheng Li, School of Environment and Energy, South China University of Technology, Guangzhou, China
Yuanqian Xu, School of Environment and Energy, South China University of Technology, Guangzhou, China
Guanglin Jia, School of Environment and Energy, South China University of Technology, Guangzhou, China
Zhijiong Huang, School of Environment and Energy, South China University of Technology, Guangzhou, China
Yanlong Wang, School of Environment and Energy, South China University of Technology, Guangzhou, China

Abstract:

Driven by the rapid domestic and international trade growth, ship has become one of important air pollutants emissions source, especially in coastal areas of China. Accurate ship emission inventories are fundamental for formulating pollution control policies and effective air quality management under the proposed Domestic Emission Control Areas (DECAs) policy in China. In this study, we presented a bottom-up Chinese national ship emission inventory by using the Automatic Identification System (AIS) data of ships for the year of 2013. The results show that for the domain within 200 nautical miles (Nm), the ship source contributes about 10% to the total SO_2 and NOx emissions from all sectors in the coastal provinces of China. The three port regions of the Yangtze River Delta (YRD), the Pearl River Delta (PRD) and the Bohai region accounted for almost 88% of the marine heavy oil (MHO) consumption of the total ship sector in China, which contributed about 85% and 86% of SO_2 and NOx to the total ship emissions in China within 200 Nm. The emissions from the proposed Domestic Emission Control Areas (DECAs) within 12 Nm constitute approximately 40% of the total ship emissions. Ship emissions in the top ten ports contributed almost 80% of the total emissions from all ports and accounted for 24% of the total ship emissions within 200 Nm. The historic emissions trends in ship sources from 2004 to 2013 were analyzed and future ship emissions changes under different emissions control scenarios were discussed. We also attempted to use Ozone Monitoring Instrument (OMI) satellite NO_2 observations to validate the amount and spatial distributions of the 2013-based inventory in order to understand its potential uncertainty.

3.004 An Operational Numerical Air Quality Forecasting over Eastern China.

Presenting Author:

Guangqiang Zhou, 1. Yangtze River Delta Center for Environmental Meteorology Prediction and Warning, Shanghai 200030, P. R. China; 2. Shanghai Key Laboratory of Meteorology and Health, Shanghai Meteorological Service, Shanghai 200030, P. R. China, zhougq21@163.com

Co-Authors:

Jianming Xu, 1. Yangtze River Delta Center for Environmental Meteorology Prediction and Warning, Shanghai 200030, P. R. China; 2. Shanghai Key Laboratory of Meteorology and Health, Shanghai Meteorological Service, Shanghai 200030, P. R. China

Ying Xie, 1. Yangtze River Delta Center for Environmental Meteorology Prediction and Warning, Shanghai 200030, P. R. China; 2. Shanghai Key Laboratory of Meteorology and Health, Shanghai Meteorological Service, Shanghai 200030, P. R. China

Abstract:

The Regional Atmospheric Environmental Modeling System for eastern China (RAEMS) is an operational numerical system to forecast near surface atmospheric pollutants such as $PM_{2.5}$ and O_3 over the eastern China region. This system is based on the fully online coupled weather research and forecasting/chemistry (WRF-Chem) model. Anthropogenic emissions are based on MEIC and INTEX-B inventories, and biogenic emissions are calculated online using MEGAN2. Authorized by the China Meteorological Administration (CMA), this system started to provide operational forecast in 2013. With a large domain covering eastern China, the system produces daily 72-hr forecast. In this work, a comprehensive evaluation was carried out against measurements for two full years (2014-2015). Evaluation results show that the RAEMS is skillful in forecasting temporal variation and spatial distribution of major air pollutants over the eastern China region. The performance is consistent in different forecast length of 24h, 48h, and 72h. About half of cities have correlation coefficients greater than 0.6 for $PM_{2.5}$ and 0.7 for daily maximum 8-hour averaged (DM8H) ozone. The forecasted $PM_{2.5}$ is generally in good agreement with observed concentrations, and ozone diurnal variation is very similar to that of observed. The modeling system also exhibits acceptable performance for PM_{10}, NO_2, SO_2, and CO. Meanwhile, degraded performance for $PM_{2.5}$ is found under heavily polluted conditions, and there is a general over estimation in ozone concentrations. Detailed results will be presented in the coming conference.

1.019 Emission Characteristics of VOCs for Automobile Surface Coating Operations.

Early Career Scientist

Presenting Author:
Zhien Zhou, Chongqing Research Academy of Environmental Sciences, cqzhouze@126.com

Co-Authors:
Weikai Fang, Chongqing Research Academy of Environmental Sciences
Qian Luo, Chongqing Research Academy of Environmental Sciences
Lei Qiao, Chongqing Research Academy of Environmental Sciences
Liping Wu, Chongqing Research Academy of Environmental Sciences

Abstract:

The emissions of VOCs by automobile industry in Chongqing was approximately 20□000 tons with 83 percent emissions arising from surface coating□The emissions of VOCs are almost arising from the usage of coatings□diluents and curing agent□and from the process of spraying□drying□paint□waxing and repair□The VOCs composition of typical vehicle manufacturer in Chongqing□was identified as toluene□xylene□toluene□cumene□ethyl acetate□butyl acetate□n-butanol□isobutanol□formaldehyde□methyl ethyl ketone□acetone□cyclohexanone□methyl ethyl ketone□the mixture of aromatic and the mixture of naphtha□For accessing the environmental impact of VOCs□according to the concentration of the compounds above□the ozone formation potential□OFP□was calculated between 900~1300 mg/m^3□Furthermore□according to the amount of partly compounds above which was researched by determining the fractional aersol coefficient and fraction of VOC reacted□the amount of SOA was calculated between 3636~11073 ton/a□This report provides absolute foundation to the emission standard of VOCs in automobile surface coating operations□