Community Emissions Data System (CEDS) - New Historical Emissions for Aerosol and Chemistry Research

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17th GEIA Conference
Tsinghua University, Beijing, China

November 18, 2015

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PREVIOUS
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PNNL-SA-112479
This effort grew out of experience producing historical emissions for the RCP/CMIP5 process several years ago.

Steering Committee

Laura Dawidowski (NAEC, Buenos Aires)
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Collaborators

Liu Liang, Tami Bond (U Illinois), Bob Andres (ORNL), Others

**Funding for this project**
Provided by the
US Department of Energy
Office of Science
and the
National Aeronautics and
Space Administration

CEDS Goals:

Emissions with the same standards of timeliness, openness, and uncertainty quantification as other key model inputs.
Community Emissions Data System

Timely “research” estimates for emissions of aerosol (BC, OC) and aerosol precursor compounds (SO$_2$, NO$_x$, NH$_3$, CH$_4$, CO, NMVOC) are key inputs for aerosol research and Earth System Models

Needed for historical and future simulations, validation/comparisons with observations, historical attribution, uncertainty quantification, IAM calibration and validation, and economic/policy analysis.

Produced using an open-source data system to increase data transparency and facilitate research advancements.
Methodology

Approach: Hybrid of bottom-up emissions & inventory

- Develop a default dataset (GAINS emission factors, EDGAR, etc.)
- Calibrate to country-level inventories at the sectoral level where available and reliable (e.g., most policy-relevant). Similar to approach for RCP/CMIP5 data and EDGAR-HTAP.
- Most of the effort is in gathering input data
  - Driver data (historical energy, agricultural output, other sectors)
  - Default emissions factors. Sectoral emissions for calibration.
- Methodologies similar to Smith et al. (2011) & Klimont et al. (2013)

Produce “a” best estimate, not a fully independent estimate

- In most OECD countries much effort goes into estimating emissions, so use those. Important when control levels are changing over time.
- Emissions factors are changing less rapidly in many developing countries (but are less well known in many cases).
- Some countries (e.g. China, SE Asia) – changes are also rapid –are also more uncertain. Challenging. Wider community involvement can improve results.
Overall Project Timeline

Phase I: 2015

- Build emissions data system
- Updated dataset for CMIP6 focusing on recent decades (Winter 2015)

Community input and review in both phases.

Phase II: 2016 – 2017

- Consistently estimate uncertainty over time and region
- Expand sub-regional detail for large countries and extend emissions estimates over entire industrial era
- Improve gridding, add seasonality and other characteristics

Implementation

- Modular, data-driven system, in the R open-source platform
- Flexible, automated system
- Consistent with country-level inventories (where desired/appropriate)
- Open source code and input data (where possible)
- Tool for emissions research more broadly
Interim CEDS Emissions Dataset for CMIP6

Interim emissions data product that updates the Lamarque et al. (2010) dataset in time for CMIP6.

- Recent emissions consistent with country inventory data over approximately ~1970 – 2014
- Early Winter 2015 Data: $SO_2$, $NO_x$, CO, NMVOC, $NH_3$, $CH_4$, BC, OC, $CO_2$
- EDGAR 4.3 (0.1°) basis for gridding and default emissions
- Extrapolate to earlier years using RCP data (e.g. HYDE)
- Future scenario will be harmonized to depart from this starting point
- Additional features will be added in Phase II

**Calculation Status (Oct 1, 2015)**

**Emission Data Used**
- Gains (Default EF)
- US Emission Trends
- Canada Emission Trends
- UNFCCC Reporting
- EDGAR, REAS, Adl Results
- Asia, US NEI, EMEP

**Emissions of SO2 by Country, Sector, Fuel**
(1960/1971 – 2014)
Uncertainty Estimates

Uncertainty For Most Recent Years (Phase I)

*It is critical that emissions for recent years are coupled with uncertainty estimates*

- The additional uncertainty in the most recent years can be rigorously assessed by applying the extension methodologies to past data
  - Although “past uncertainty does not guarantee future uncertainty”

Comprehensive Uncertainty Estimates (Phase II)

*All bottom-up emission uncertainty estimates contain a substantial element of expert judgment*

- Guide assumptions with literature, comparisons between inventories, and comparisons between within CEDS
- Reduce dimensionality by a “tiered” approach to group assumptions
  - Otherwise: ~40 sectors × 200+ countries × 5 fuels × ~10 emissions
- Consider correlations across sectors and countries (spatially)
- Result: consistent uncertainty estimates across species and regions
Engagement

Your input is encouraged

- **ssmith@pnnl.gov**
- We have a web site
  - [http://www.globalchange.umd.edu/CEDS/](http://www.globalchange.umd.edu/CEDS/)
- And a listserv for updates
  - Send an email to listserv@listserv.umd.edu with the email body: “subscribe cedsinfo”. (You will get a return e-mail asking you to verify your subscription.)

The data system and input data will be released as open source software

- Including capability of producing gridded emission datasets
  
  *You will have to purchase a license for the IEA energy data*

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**DEMO session Thursday 17:45**

- *Learn about system structure and operation*
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