What's going into the air?
Developing and evaluating new emissions scenarios for climate simulations

Gases and particles are emitted into the atmosphere as a result of both human and natural activities. The knowledge of emissions and how they change over time is essential for climate studies. This knowledge is crucial to our ability to understand the role of anthropogenic behavior in causing past climate change as well to our ability to project future climate. Inventories of emissions are also necessary for assessing mitigation options. CSD scientists are playing a key role in the understanding of climate through the development and evaluation of emissions information.

Most of the climate simulations for the future have been performed using scenarios from the Special Report on Emission Scenarios (SRES), published in 2000. The SRES scenarios considered a variety of future emissions pathways based on different assumptions about socio-economic changes, but the scenarios did not take into account specific policies to mitigate climate change. The results from climate simulations based on SRES scenarios that were assessed in the Intergovernmental Panel on Climate Change (IPCC) 4th Assessment Report report, and work performed during the last few years have spurred increasing interest in developing scenarios that explicitly explore the impact of different climate policies. The need for these new scenarios prompted the IPCC to request that the scientific community develop a new set of scenarios to facilitate future research into climate change issues.

In response to these requests, four new key scenarios were developed, known as the Representative Concentration Pathways (RCPs). The RCPs were developed within a cooperative process across various disciplines involved in climate research. They cover a range from very high emission futures to a stringent climate control scenario that aims to limit the increase of global mean temperatures to less than 2^{o}C.

The RCP scenarios break new ground in several ways:

- They include some of the highest and lowest scenarios of greenhouse gas emissions examined by the climate modeling community. They also include scenarios with explicit climate mitigation.
- They include information on emissions changes resulting from land-use changes, available on a spatial grid appropriate for climate models;
- They include gridded information on emissions of short-lived climate forcers (such as particulate matter and tropospheric ozone and its precursors) consistent with the emissions of long-lived greenhouse gases (such as carbon dioxide and methane);
- They include four very long-term extensions of emissions to the year 2300 to explore longer-term climate impacts;

These scenarios are designed to allow researchers to explore the long-term consequences of decisions made today, while taking into account the inertia in both the socio-economic and physical system. As such, scenarios help to explore the costs and benefits of climate policies. The RCPs will be used directly in experiments run by chemistry-climate models and Earth system models.

CSD scientists were part of this international working group. Claire Granier and Gregory Frost led an assessment of a variety of historical emissions data used to define a common starting point for the future trajectories of the RCPs. This evaluation of emissions included regional emissions provided by regulatory agencies such as EPA in the US and EMEP in Europe. Anthropogenic as well as biomass burning emissions are included in this assessment. John Daniel also helped to integrate emissions of ozone-depleting substances that are based past observations and future projections into the RCP scenarios.

A special issue was just released in the journal Climatic Change that describes the process for developing the RCPs, the details of each individual RCP, and the various integrative and evaluation activities that were necessary to develop and assess the RCPs.

The RCP emissions are available for download at http://www.iiasa.ac.at/web-apps/tnt/RcpDb/. They are also available on the ECCAD database (http://ether.ipsl.jussieu.fr/eccad), together with tools that allow users to easily visualize and analyze these data.

For futher information, please contact:
Claire Granier: Claire.granier@noaa.gov
Gregory Frost: Gregory.J.Frost@noaa.gov>
John Daniel: John.S.Daniel@noaa.gov>

Table of contents of the Climatic Change special issue:

7. Granier et al. Evolution of anthropogenic and biomass burning emissions of air pollutants at global and regional scales during the 1980–2010 period.
http://www.springerlink.com/content/m72616127617wht3/fulltext.pdf

8. Lamarque et al. Global and regional evolution of short-lived radiatively-active gases and aerosols in the Representative Concentration Pathways.
http://www.springerlink.com/content/231207127112k026/fulltext.pdf

9. Hurtt et al. Harmonization of land-use scenarios for the period 1500–2100: 600 years of global gridded annual land-use transitions, wood harvest, and resulting secondary lands.
http://www.springerlink.com/content/y1n5n86570r356q5/fulltext.pdf

10. Meinshausen et al. The RCP greenhouse gas concentrations and their extensions from 1765 to 2300. http://www.springerlink.com/content/96n71712n613752g/fulltext.pdf

Proposed figure for illustration: