



Integration

The Global Emissions Inventory Activity (GEIA) was created in 1990 as an activity of the International Global Atmospheric Chemistry Project (IGAC) – a core project of IGBP. Since 1990 GEIA has been developing and distributing inventories of global gas and aerosol emissions from natural and anthropogenic sources, under the guidance of activity conveners and a Coordinating Committee. The GEIA network includes over 300 people around the globe.

Where is GEIA Going?

The GEIA database includes emissions for the major atmospheric compounds, including gases important for aerosol formation and a number of trace species [1] (e.g. Figure 1). Separate inventories have been developed for different groups of chemical compounds, and these datasets are only accepted into the GEIA database after substantial peer review and agreement amongst GEIA project teams. Most datasets were developed for a 1985 base year, and all are at a 1x1 degree spatial resolution. The database thus has sufficient accuracy and spatial and temporal resolution to be widely used in global chemistry-transport models, and hence is considered as a standard for Earth science studies. The inventories provide a scientific foundation for assessments dealing with global pollution, global warming, stratospheric ozone depletion, acid precipitation and biological damage. In addition to the inventories, GEIA has summarised the state of the science for each inventory constituent. The list of species, data sets and their documentation, state of science summaries, workshop overviews, planning documents, and a list of the people involved can be obtained from www.geiacenter.org.

As a result of the fast development of chemistry-transport models and Earth System models, and the large amount of new observational data becoming available, GEIA is entering a new phase. In 2003 the IGBP Steering Committee formed a working group to define the future of GEIA as an IGBP Fast-Track Initiative, to identify scientific priorities, and to propose a new organisation for the activity. The working group (WG) first met in June 2003 in Boulder, Colorado, USA.

The WG refined the goal of GEIA to that of “*quantifying the anthropogenic emissions and natural exchanges of trace gases and aerosols that drive Earth System changes*”, and recommended that GEIA establish strong links and co-sponsored activities with the new IGAC project, with the IGBP projects of iLEAPS (land-

atmosphere), SOLAS (ocean-atmosphere) and GAIM, as well as with external programs such as IPCC and ICSU. The WG proposed seven themes for GEIA (below), within which activities will be identified that are related to integrated or international projects, and/or are driven by scientific or societal issues.

- 1. New Inventories:** incorporate new, quality-assured datasets, such as regional/global inventories and time-dependent inventories (e.g. historical and future), that will follow the rapid evolution and development of chemistry-transport and Earth System models used for long simulations.
- 2. Inter-comparisons and Evaluations:** identify the main uncertainties and problems remaining in the inventories, so as to improve emission and deposition estimates.
- 3. Prioritise Observations:** identify and prioritise the measurements needed to improve emission and deposition estimates, in collaboration with other IGBP projects.
- 4. Databases of Driving Variables:** provide the evaluation and compilation of emission factors, emission algorithms and other driving variables used for emission estimation. This will improve consistency between inventories, and provide recommendations on the use of variables which could help in developing new inventories (e.g. gridded population data, fire pixels, burned scars, leaf area index).
- 5. Temporal Variations:** improve predictions of short-term (i.e. diurnal, weekly, seasonal) emission variations, to allow detailed analysis at the local or regional scale, and to allow more detailed analysis of global datasets.
- 6. Chemical Exchange Models:** develop stand-alone models for evaluating parameterisations of chemical-exchange processes and incorporate

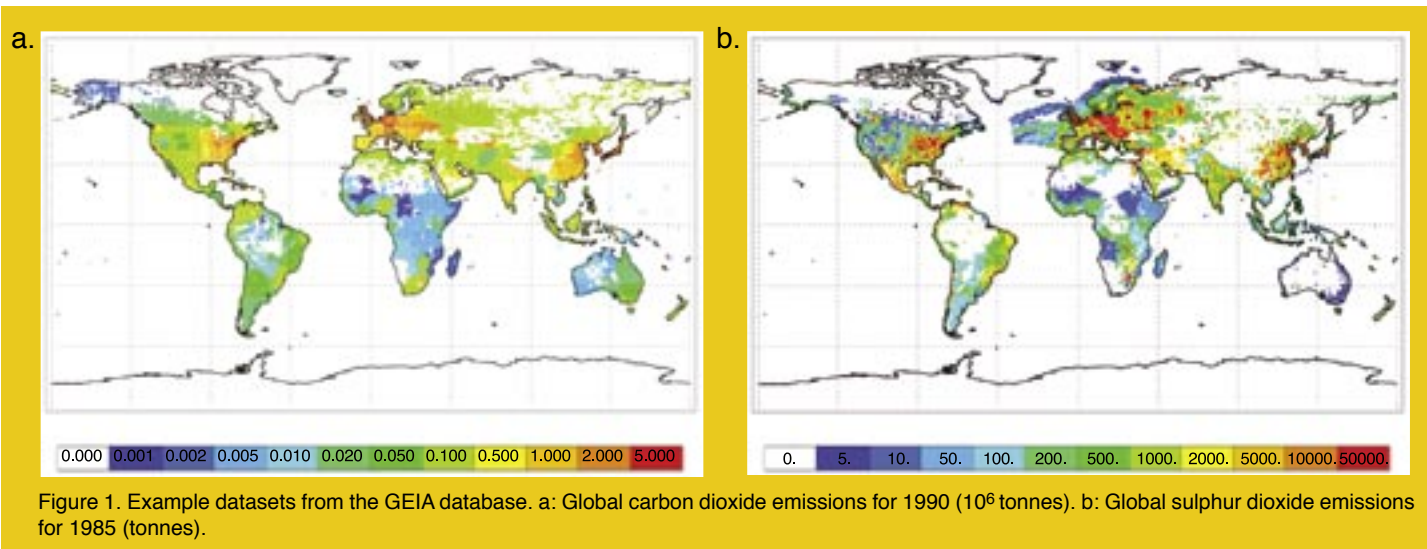


Figure 1. Example datasets from the GEIA database. a: Global carbon dioxide emissions for 1990 (10^6 tonnes). b: Global sulphur dioxide emissions for 1985 (tonnes).

these into chemistry-transport and Earth System models. This activity will (in collaboration with other IGBP projects) help couple mechanistic or comprehensive emission models.

7. Validation Using Observations and Global/Regional Chemistry-transport Models: develop and apply (in collaboration with scientists performing measurements) forward and inverse modeling methods, using observations from surface networks, in-situ (aircraft or balloon) or satellite observations.

GEIA will build on focus group experiences to compile emission inventory (flux estimates, driving variables, algorithms) and model information, and to provide guidance for inventory and model evaluation and improvement. Some high priority issues that could be promoted within GEIA are:

- improvement, development and comparison of existing global anthropogenic emission inventories with regionally specific data and quantified uncertainties;
- emission estimates from mega-cities;
- improvement of global biomass burning emission estimates: comparison of emission inventories and evaluation by comparison with observations;
- compilation of gas and aerosol (including black and organic carbon) emission estimates for the past 100 years and extension of Special Report Emissions Scenarios of IPCC to detailed chemical species and regional scales.

Collaborative activities with other IGBP projects could focus evaluation or development of models for:

- climate-driven global dust emissions;
- global terrestrial ecosystem emissions (nitrogen compounds, methane, individual volatile organic compounds) and depositions;
- global natural sulphur emissions (dimethylsulphide, sulphur dioxide, hydrogen sulphide, carbonysulphide);

- climate-driven global lightning nitric oxide emissions.
- The WG recommended that GEIA be reorganised to be led by a steering committee of high disciplinary and geographical diversity consisting of two co-chairs and about 12 members (serving one or two 3-year terms). The steering committee would approve and monitor GEIA activities and suggest new activities. The recommended reorganisation also included the establishment of a secretariat and a web portal to improve internal and external GEIA communication. Scientific meetings should be organised jointly with IGBP projects and other international projects, and specific workshops held to coordinate ongoing activities and to initiate new activities. The GEIA data center will be directed by a scientist and with computer support, using the latest data distribution and information exchange technology. Opportunities for improved integration and consistency of data storage and exchange will be discussed with other IGBP data centers.

A close collaboration will be established with the activity on emissions within the European Network of Excellence ACCENT (Atmospheric Composition Change: a European Network). The first open scientific meeting of the new GEIA will take place during the ACCENT emissions database meeting in Paris, June 23-25, 2004. This will be followed by an open meeting associated with the 8th Conference of the IGAC Project, in Christchurch, New Zealand. (See page 21).

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