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Claire Granier, Avelino Arellano, Jenny Stavrakou

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# The new AMIGO project of IGAC

## Analysis of eMIssions usinG Observations

Claire Granier <sup>1,2,3</sup>, Avelino Arellano <sup>4</sup>, Jenny Stavrakou<sup>5</sup>  
And the participants to the April 2018 AMIGO scoping workshop

- 1: Observatoire Midi-Pyrénées, Toulouse
- 2: Laboratoire d'Aérodologie, Université de Toulouse, CNRS, UPS, Toulouse, France
- 3: NOAA/ESRL & CU/CIRES, Boulder, Colorado, USA
- 4: University of Arizona, Tucson, Arizona, USA
- 5: Royal Belgian Institute for Space Aeronomy, Brussels, Belgium

### ***1. Introduction***

An accurate knowledge of the emissions of atmospheric compounds is fundamental to many IGAC activities involving atmospheric modeling and analysis of observations. Years of extensive work to better quantify the emissions of gases and particles has led to improved determinations of the spatial distributions and temporal trends in these sources. Numerous emissions inventories have been developed at global and regional scales for specific periods and across years or even decades. For the past 25 years, the GEIA/IGAC (Global Emissions Initiative) project has coordinated these activities on surface emissions.

Many groups have analyzed inventories and obtained additional information about emissions of many species using a variety of observations and analysis techniques, including inverse models. However, comparing the findings from this array of approaches can be hampered because the studies focus on different time periods or different regions. There has been little systematic evaluation of the results to assess their consistency and to compare the methodologies and the various observations used in each study. Similarly, relatively little attention has been given to how observations-based emissions analyses of co-emitted species can build confidence in the inventories of the individual compounds.

The goals of the new AMIGO (Analysis of eMIssions usinG Observations) project of IGAC is to organize the international scientific community around a synthesis of research using observations-based analysis techniques that aim to better quantify emissions. The synthesis will consider chemically active compounds and greenhouse gases and will evaluate the consistency of their inferred emissions. AMIGO will assess the ability of different analysis techniques to provide consistent quantification of the emissions of multiple species across a range of spatial and temporal scales. Criteria to establish the accuracy of emissions data and their uncertainties will also be defined.

## ***2. Content of the AMIGO assessment***

The synthesis within AMIGO mainly consists of an assessment of publications in the past five years that report scientific and technical capabilities of observations-based emission analysis. This will include studies involving the use of different types of observations (ground-based, in-situ, and satellite) to quantify primary emissions from several source regions of the world, as well as their associated trends and variability.

Notably, there have been few inverse modeling studies on co-emitted species, as most inverse systems focus on a single species or two compounds at most. Inverse modeling aimed at improving inventories could consider co-emitted species to ensure consistency between the improved datasets.

The proposed assessment includes in particular the following topics:

- Suggested improvements in bottom-up emission inventories;
- Useful information from observations for optimizing emissions and their uncertainties;
- Successful methods for optimizing emissions, including top-down approaches;
- Analysis and evaluation of various emission datasets with emphasis on observational constraints in emission estimates;
- Suggested methods for improving emissions of co-emitted species.

The participants to AMIGO will include modelers, groups involved in the analysis of surface, aircraft and satellite observations, and scientists working on the quantification of emissions. The AMIGO project will establish links with other IGAC projects working either on modelling of the atmospheric composition (CCMI: Chemistry-Climate Model Initiative), on the development and analysis of emissions (GEIA), on fires (IBBI: Interdisciplinary Biomass Burning Initiative) and on the forecasting of air quality (MAP-AQ: Monitoring, Analysis and Prediction of Air Quality).

Links will also be established with several international organizations including the World Meteorological Organization (WMO) and the Global Atmosphere Watch (GAW), particularly with the Integrated Global Greenhouse Gas Information System (IG3IS), the LRTAP (Task Force on Hemispheric Transport of Air Pollution), and the Global Carbon Project (GCP). The Copernicus Atmosphere Monitoring Service (CAMS) in Europe will also participate in the project.

## ***3. AMIGO scoping meeting in April 2018***

The first meeting to discuss the AMIGO project took place at the end of the 2016 IGAC conference in Breckenridge, USA. The IGAC scientific steering committee approved AMIGO as a new IGAC project during its last meeting in September 2017. A scoping meeting was then organized last April 5-6 2018 in Toulouse, France. About 25 scientists from various institutions, including representatives from other IGAC activities, attended

the meeting. Several participants presented relevant work related to the AMIGO topics. This was followed by small group discussions with the aim of better defining these topics and identifying the first activities of the project.

During the scoping meeting, it was decided that the AMIGO assessment should be organized as a series of papers to be published in a particular scientific journal. The papers will represent a synthesis of emissions analyses using observations, models and inversion methods, and they will include recommendations for further research to characterize the methods and to increase the robustness of the analyses. It was decided that such assessment should first focus on a few species and then will extend to additional compounds after analyzing the interactions and synergies between them..

The availability of useful observations for the AMIGO synthesis was also discussed. It was recognized that a compilation of the data available from different measurement systems would be very useful, together with the definition of a common data format. The analysis of the trends in the concentrations and emissions of different species could bring very useful information, as well as the analysis of the ratios of different species and their trends. Moreover, the AMIGO community will provide recommendations about new measurement campaigns, especially in regions where observations are scarce or inexistent.

In addition to the synthesis assessments, innovative research activities were proposed during the meeting : (i) intercomparison studies between top-down emission estimates obtained from different models and inverse techniques, (ii) multi-model inversion experiments constrained by the same observation datasets, (iii) cross-evaluation between chemical mechanisms through box model experiments, (iv) evaluation of trends in bottom-up inventories using long-term spaceborne observations, and (v) merging of local scale emission information into global inventories. These activities, to be performed in collaboration with the CCMI/IGAC communities, will be beneficial in assessing the quality of top-down estimates and in improving our current knowledge of the emissions. AMIGO welcomes new ideas for further activities.

Model simulations using the results from various emission optimization studies from different numerical models could be beneficial in assessing the quality of these top-down estimation studies. Such work could be done in cooperation with the CCMI/IGAC project. AMIGO can help in narrowing down the uncertainties in emissions from the synthesis of model results using the top-down and bottom-up emission estimates.

#### ***4. How to participate***

The AMIGO project just started and welcomes new participants and ideas. You are invited to contact the AMIGO co-chairs, Claire Granier ([claire.granier@aero.obs-mip.fr](mailto:claire.granier@aero.obs-mip.fr)), Ave Arellano ([afarellano@email.arizona.edu](mailto:afarellano@email.arizona.edu)) and Jenny Stavrakou ([jenny@aeronomie.be](mailto:jenny@aeronomie.be)).

An AMIGO side meeting will take place during the IGAC 2018 conference in Takamatsu, where details of the project will be given, and all members of the IGAC community will be able to provide input to the scope of the project and its first activities.



Participants to the AMIGO scoping meeting in April 2018