

The Community Initiative for Emissions Research and Applications

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ABSTRACT

Emissions inventories at a variety of spatial and temporal scales are critical inputs to the understanding and prediction of air quality and climate. Systematic inventory evaluations, comparisons of different emission estimation methodologies, and quantification of emission uncertainties and their impacts are crucial to establish confidence in these datasets. We present the Community Initiative for Emissions Research and Applications (CIERA). CIERA is building an international community to catalyze emissions research by facilitating: the consistent, timely, and transparent development of emissions inventories at all scales; evaluations and analyses of emissions datasets; and the exchange and communication of emissions information. We discuss the motivation and vision for CIERA and illustrate its connections to existing efforts. We outline the developing CIERA distributed data system and demonstrate some examples of its applications. We encourage the emissions inventory development, research, and user communities at the local, national, and international levels to join the CIERA effort.

MOTIVATION

Emissions are crucial to effective scientific inquiry about the atmosphere. Quantitative emission information is needed to account for atmospheric composition in the past, to understand the

present state of the atmosphere, and to predict and project the future of the atmosphere. At the same time, taking actions and making decisions about atmospheric composition focus on emissions information. These data are used to analyze potential mitigation and adaptation actions, to define win-win climate/air quality strategies, and to make choices about what sources to control and by how much. Air quality and climate emission inventories are therefore essential tools in both research and regulation, leading to two overarching questions about the state of emissions knowledge:

- Are current emissions data meeting our needs?
- How can these data be improved while maximizing sparse resources?

To be useful tools for air quality and climate change science and policy, emissions inventories must be accurate, available for different time periods of interest, well documented, and address a wide array of species, sources, and temporal-spatial scales. The development of emissions information for research and regulatory purposes in the US and around the world has followed different paths. To make progress, air quality and climate researchers urgently need improvements in the accessibility, usefulness, and accuracy of emissions data.

A key need for emissions knowledge is consistent, timely, and transparent inventory development. Structural inconsistencies hinder comparisons of different inventories. Time lags and slow updates to inventories and their input data sets limit research studies that rely on emissions. Inventory development methodologies change over time, impacting analyses of emission trends and the understanding of evolving atmospheric composition. Traceable, well-documented inventory development is crucial but is not always practiced.

Equally important is the need for evaluations and analyses of emissions datasets. Establishing scientific confidence in inventories will require more systematic evaluations with observations and models. Comprehensive estimates of inventory uncertainties still do not exist in many cases. Emissions estimates can be constrained by sampling multiple inventory methodologies and input assumptions. However, most entities tasked with producing inventories have only enough resources to pursue specific development paths. More study is also needed on the impacts of using improved and evolving emissions data and on quantifying the level of emissions uncertainty that is acceptable in atmospheric predictions.

Finally, to be sure that effort is not wasted and resources are conserved, the research and regulatory communities would benefit from improved exchanges of emissions information. Making emissions datasets and tools more accessible and user-friendly will increase their usefulness to a broader community. Improved links between inventory, observation, and model data sources are a key step in this process. To improve emissions research and inventory development, better communication is also needed between those involved in producing, evaluating, and using emission information.

VISION

These considerations have informed our vision for a new emissions effort: the Community Initiative for Emissions Research and Applications. As shown schematically in Figure 1, we have begun to organize a multi-faceted international community activity that facilitates emissions

research through 1) the consistent, timely, and transparent development of emissions inventories at all scales; 2) evaluations and analyses of emissions datasets; and 3) the exchange and communication of emissions information.

Central to this vision is a web-based system for connecting and enhancing distributed emission data portals. Over the long term, we want this system to provide access to emission inventories, data from emission models, observational data sets, and output from atmospheric models. The planned system will incorporate tools that allow users to manipulate, visualize, and analyze these data sets. The intent with this system is not to replicate existing emission inventory web portals. Rather, we envision that CIERA provides the infrastructure that makes emissions data easier to use, and thereby enables comparisons between inventories employing different methodologies, facilitates evaluations of emissions data using observations and models, allows studies of the impacts of emissions changes and uncertainties, and supports emissions assessment activities.

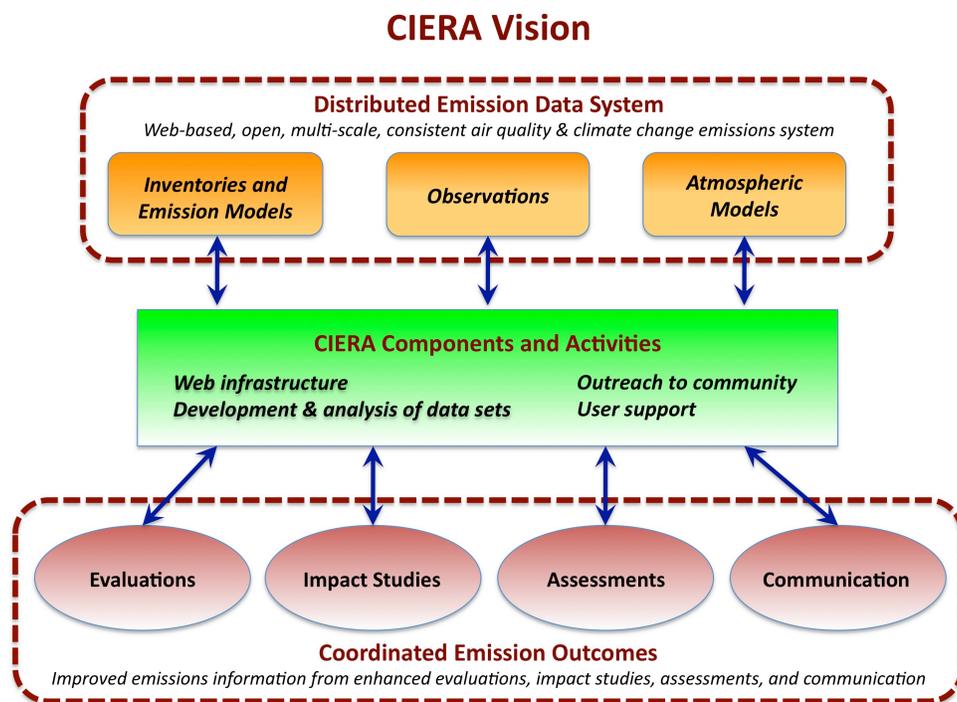


Figure 1. Schematic diagram describing the overall vision for CIERA.

We envision that the scope of CIERA will include emissions for air quality, climate, and their interconnections. The ideal CIERA system would provide information on emissions of criteria pollutants, greenhouse gases, toxics, and aerosols from anthropogenic, natural, and mixed sources. To be broadly useful for both air quality and climate, the system will need to provide information on past, present, and future emissions, address temporal variability on scales of hours to centuries, and span spatial scales from the global to the local level.

A key objective of CIERA is to build and strengthen the community that prepares, studies, and uses emissions data. CIERA will sponsor meetings and conference sessions designed to discuss current and future issues in emissions research, thereby providing venues for discussion and

collaboration between emission developers, researchers, and users that might not otherwise exist. The planned web system will also serve as a convenient venue to compile reports and articles discussing emissions data sets and research studies. Through these avenues, CIERA will help to widely disseminate the results of emission research studies that inform the community and perhaps avoid unnecessary duplications of effort. By strengthening ties across the emissions community, CIERA could assist in bringing together groups of experts to systematically assess emissions data. By providing conduits for meaningful exchanges of emissions knowledge, CIERA hopes to ultimately help improve the quantitative understanding of emissions.

RECENT PROGRESS AND FUTURE PLANS

The CIERA web site, <http://ciera-air.org/>, is now operational. The current site links inventory data sets from the existing NEISGEI (<http://www.neisgei.org/>) and GEIA (<http://geiacenter.org>, <http://ether.ipsl.fr>) emissions portals. In the near future, some applications for manipulation, visualization, and comparison of these inventory data sets will be brought online.

CIERA team members are already directly involved in the development, dissemination, evaluation, and analysis of emissions inventories. Examples of these connections include comparisons of the global and regional inventories used by the global chemical-transport modeling community used in the CMIP5/IPCC AR5 activity and evaluation of US fossil-fuel emissions using the EPA NEI and the Vulcan high-resolution CO₂ inventory. This work will be enhanced through the use of CIERA web applications.

CIERA efforts to promote information exchange and communication began with a workshop in Boulder, Colorado, in December 2009. Since then, CIERA team members have communicated their vision and encouraged the participation of the emissions community at a variety of venues, including presentations at the American Geophysical Union Meeting in December 2009, the US Air Quality Research Subcommittee meeting in February 2010, and the IGAC Meeting in July 2010. The CIERA team helped organize sessions at the 2010 EPA Emission Inventory Conference and at the American Geophysical Union Meeting in December 2010. The CIERA team is currently writing a New Directions column in the journal *Atmospheric Environment* that outlines the emissions needs of the scientific community and presents a vision for how CIERA can help to address these needs.

CIERA encourages participation from the emissions inventory development, research, and user communities at the local, national, and international levels. As representatives of these communities, we ask you to contribute datasets and tools to the CIERA web system and to employ the system to compare and evaluate emissions datasets. We invite you to participate in the CIERA-sponsored sessions at upcoming conferences. We want your help in shaping CIERA's vision through discussions, white papers, topic-specific working groups, and assessment panels. CIERA will succeed only if it is a truly community endeavor, so we need your participation to make CIERA a success.