Improving and Applying Lagrangian Models of the Atmosphere

AGI Chapman Conference on Advances in Lagrangian Modeling of the Atmosphere; Grindelwald, Switzerland, 10–14 October 2011

Under the majestic gaze of the Eiger north face in Switzerland, an international group of researchers met as part of a Chapman Conference to discuss advances in Lagrangian modeling of the atmosphere. Lagrangian models track the movement of air parcels, using tracer fields, source/sink information, and source/receptor linkages that have become increasingly popular as tools used by geoscientists. The conference provided an opportunity for a diverse group of researchers developing and applying Lagrangian models to congregate and discuss the use of such models to understand geophysical phenomena and to identify how to improve the models. The 98 participants (of which 17 were graduate students) hailed from 19 countries around the world.

Appropriately for a Chapman Conference, the Chapman-Kolmogorov equation was introduced in the first session of the conference, which focused on the fundamental formulation of turbulence within Lagrangian models. The next session, which examined the coupling between Lagrangian models and their Einstein counterparts’ stationary grid cells, followed by sessions examining uncertainties in Lagrangian models and the use of field experiments and tracer observations to test such models.

The conference then moved to more specific topics, in which Lagrangian models are used in wide-ranging areas in the atmospheric sciences, including understanding the influence of sinks and sinks of greenhouse gas, atmospheric chemistry and air quality, source regions of moisture in precipitation, processes in the upper troposphere–lower stratosphere, and the risk of radionuclides released from nuclear reactors or volcanic ash, for example, from Fukushima in Japan in 2011 or from Eyjafjallajökull in Iceland in 2010, respectively. These papers featured the rich variety of topics to which Lagrangian models are applied and illustrated their great potential as an essential tool for modeling if the models can be further improved.

During discussion periods, participants probed the following questions:

1. How can model uncertainties be communicated to users of Lagrangian models, particularly in cases requiring difficult decisions by stakeholders? Clear examples included emergency responses to nuclear fallout or flight cancellations due to presence of volcanic ash.

2. How can model uncertainties and correlations within such uncertainties be accounted for in inversion studies?

3. What is the accuracy of kinematic versus diagnostic descriptions of vertical velocities in stratospheric trajectory modeling?

4. How can new ideas in plume modeling and nonlinear interactions between transport and mixing processes and chemical reactions be incorporated into regional or global-scale models of air quality and atmosphere chemistry?

5. How can an intercomparison study between different Lagrangian models be properly carried out?

6. Are the meteorological fields provided by numerical weather prediction models (NWP) centers sufficient and appropriate for driving Lagrangian models?

7. Of the discussion topics above, questions 3 and 6 led to breakout groups that engaged in further post-discussion conversations that persisted late into the night. The breakout groups identified concrete steps that may lead to a formal Lagrangian model intercomparison effort and a white paper outlining the needs of offline atmospheric modeling using meteorological fields output from NWP centers. Some suggestions to prevent information loss in the NWP-generated fields identified during the conference include higher output frequency (e.g., hourly or 6-hourly), inclusion within the output files of sub-grid-scale variables, the use of native model coordinates instead of pressure levels, and temporally averaged rather than instantaneous fields.

Among the many highlights of the conference were two field trips to Jungfraujoch that included tours of the Global Atmosphere Watch observatories there, situated at 3500 meters above sea level in the Swiss Alps. The participants were able to bask in sunny weather during the field trips, despite severe snowfall in the beginning of the conference that resulted in multiple power outages, among other disturbances.

Most talks and posters presented during the conference are available online at http://www.agi.org/lagrangan. Furthermore, the conference will give rise to an AGU Geophysical Measurement Technologies conference that will introduce the theory and applications of Lagrangian modeling to graduate students and new researchers entering the field.

The organizers gratefully acknowledge the support of the International Science Foundation’s TOSTORE Research Network, AGU Geophysical Technology Program, the Swiss Academy of Sciences, and the Center for Climate Systems Modeling at Switzerland Federal Institute of Technology (ETH Zurich) and the International Foundation High Altitude Research Stations Jungfraujoch and Gøttingen.

Bringing Together Users and Developers of Forest Biomass Maps

NASA Carbon Monitoring System Briefing: Steps Towards Improved Measurements of Biomass and Resources for the Future;

Washington, D. C., 9 September 2011

Measurements of Biomass and Resources for the Future; NASA Carbon Monitoring System Briefing: Steps Towards Improved of Forest Biomass Maps

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Carbon cycle scientists. Understanding the needs and requirements of these data users is helpful not just to the NASA CMS program, but also to the entire community working on carbon-based activities.

To that end, this meeting brought together a small group of national resource managers and policy makers who use information on forests with their work with NASA scientists who are working to create aboveground and belowground biomass maps. These maps, derived from combining remote sensing and ground plots, aim to be more accurate than current inventory efforts not only to provide basic data for carbon or biomass measurements but also to provide data to help serve a broad range of goals, such as forest watershed management, habitat protection for biodiversity, and assessment of carbon markets for ecosystem services. CMS leadership should engage users of these products should also be relevant to other biomass measurements for forest woodland management, habitat protection for biodiversity, and assessment of carbon markets for ecosystem services. (3) CMS leadership should communicate with the stakeholders to better understand the needs for forest inventory and the requirements of sub-grid-scale variables, the use of native model coordinates instead of pressure levels, and temporally averaged rather than instantaneous fields.

By the conclusion of the conference, participants expressed enthusiasm about the progress made and the potential for future work. Most talks and posters presented during the conference are available online at www.agu.org/lagrangan conferences. Furthermore, the conference will give rise to an AGU Geophysical Measurement Technologies conference that will introduce the theory and applications of Lagrangian modeling to graduate students and new researchers entering the field.

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