AGU Eos Meeting Report:
Chapman Conference: Advances in Lagrangian Modelling of the Atmosphere
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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, giving rise to trajectory information and source/receptor linkages that have become increasingly popular as tools used by geoscientists. The Conference was 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 further improve the models. The 98 participants (out of which 17 were graduate students) hailed from 19 different countries around the world.

Appropriately for a "Chapman" Conference, the Chapman-Kolmogorov equation was introduced in the very first session of the Conference, which focussed on the fundamental formulation of turbulence within Lagrangian models. The next session examined the coupling between Eulerian and Lagrangian models, which was 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 topics that are more applied in nature, in which Lagrangian models are used in wide-ranging areas in the atmospheric sciences, ranging from understanding sources/sinks of greenhouse gases, 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—e.g., from Fukushima or the 2010 Eyjafjallajökull eruption, 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 geoscientists 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 these uncertainties be accounted for in inversion studies?

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3) What is the accuracy of kinematic versus diabatic descriptions of vertical velocities in stratospheric trajectory modeling?
4) How can new ideas in plume modeling and nonlinear interactions between transport/mixing processes and chemical reactions be incorporated within regional or global scale models of air quality and atmospheric 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 (NWP) centers sufficient and appropriate for driving Lagrangian models?

Out of the discussion topics above, 5) and 6) led to breakout groups that engaged in further post-dinner 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 in off-line atmospheric modeling using outputted meteorological fields 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 instead of 6-hourly), inclusion within the output files of sub-gridscale variables, the use of native model coordinates instead of interpolation to pressure levels, and temporally averaged rather than instantaneous fields.

One of the (many) highlights of the Conference were two field trips to Jungfraujoch that included tours of the Global Atmospheric Watch observatory there, situated at 3500 m above sea level in the Swiss Alps. The participants were able to bask in sunny weather during the field trips, despite severe flooding in the beginning of the Conference that resulted in multiple power outages, entailing creative reshuffling of the schedule!

Most talks and posters presented during the Conference are available in electronic format from: http:// www.agu.org/lagrangian. Furthermore, the Conference will give rise to an AGU Geophysical Monograph which will introduce the theory and applications of Lagrangian modeling to graduate students and new researchers entering the field.

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