P-Transformation.8 ID:4391 10:30

Improving process understanding of transpacific transport with high-resolution models and observations

Meiyun Lin [1], *Tracey Holloway* [1], *Louisa Emmons* [2], *Arlene Fiore* [3], *Claus Moberg* [1], *Peter Hess* [4]
[1] Center for Sustainability and the Global Environment (SAGE), University of Wisconsin-Madison, USA
[2] National Center for Atmospheric Research, Boulder, Colorado, USA
[3] NOAA Geophysical Fluid Dynamics Laboratory, USA
[4] Cornell University, USA
Contact: mlin26@wisc.edu

Global chemical transport models are essential tools for estimating intercontinental transport of air pollution, but their ability to adequately resolve the relevant processes requires further study. Fine-scale processes affect both the export of pollution from Asia (e.g. deep convection, rapid frontal lifting, and topographic venting) and the import of Asian pollution to surface air over the North American west coast (e.g. mixing of free troposphere air into the boundary layer, orographic flow, and land-sea breezes). We conduct high-resolution simulations using the Weather Research and Forecasting model with fully coupled chemistry (WRF-Chem) for a hemispheric domain covering East Asia and North America (60x60km^2), and a nested domain (20x20km^2) over the North American west coast. The hemispheric WRF-Chem simulation is driven with boundary conditions from the global MOZART-4 model (2.8x2.8 degree). We evaluate the regional and global simulations with observations from EANET (Asia), AQS and CASTNet (United States) surface networks as well as TRACE-P (western Pacific, spring 2001) and INTEX-B (eastern Pacific, spring 2006) aircraft field campaigns. Analysis of WRF-Chem simulations and TRACE-P measurements indicate the venting of Asian pollution by deep convection that develops rapidly along the leading edge of frontal system convergence bands. This rapid venting is not adequately resolved in either of the two global models compared with the observations, suggesting a potential underestimate of Asian outflow. Further analysis for the INTEX-B period consistently suggests that the continental outflow of SO_2 and O_3 at a regionally representative EANET site (26.8N, 128.2E) is simulated more accurately in the regional WRF-Chem model than in the global MOZART model. We focus on a plume that was lifted from the coast of China, transported rapidly across the Pacific as indicated by daily CO maps from the AIRS instrument aboard the NASA Aqua satellite, and arrived ~3 days later above Seattle with sulfate > 5ug/m^3, CO > 300 ppbv, and O_3 > 100 ppbv as observed by the NCAR-C130 flight. This plume is absent in the global model simulation, and we intend to explore further with the hemispheric WRF-Chem simulation. The nested WRF-Chem analysis is designed to diagnose Asian O_3 influence in U.S. surface air with a focus on the high-altitude sites in spring where chances are best for detecting an influence.

P-Transformation.9 ID:4480 10:30

How much air-mass mixing occurs during long-range transport in the free troposphere?

Thomas Trickl, Hans-Eckhart Scheel, Hannes Vogelmann
Karlsruher Institut für Technologie, IMK-IFU
Contact: thomas.trickl@kit.edu

Lidar sounding of aerosol, ozone and water vapour as well as in-situ measurements at the Zugspitze summit (Germany, 2962 m a.s.l.) have been used for the characterization of atmospheric layers that have travelled over many thousand kilometres. In some cases contributions from rather different sources co-exist in such air masses. This is frequently the case if the air stream gets close to frontal systems. However, without convergence or stirring the composition of air masses may remain more or less unchanged even after travelling over very long distances. One example is stratospheric air intrusions. Measurements of water vapour in recent years with our differential-absorption lidar (DIAL) have repeatedly demonstrated relative

humidities between 0 and 2 % even in very thin intrusion layers. The corresponding mixing ratios are so low that we must assume that any mixing with surrounding air masses must have occurred in the upper troposphere, i.e., in the remote arctic source regions. Ozone in these air tongues, as observed at the Zugspitze, rarely reaches stratospheric values and also CO frequently does not decrease at all, a fact which is not easy to understand. Another example is air from the subtropical Atlantic that, e.g., reaches Central Europe in prefrontal air streams. These layers exhibit sharp edges in the ozone distribution and carry along ozone, nitric oxides and CO with low concentrations as found over the remote oceanic regions. All these observations induce a challenge for the model development since models have a tendency of overestimating atmospheric mixing due to the limited spatial resolution.

P-Transformation.10 ID:4546 **10:30**

Studying the effect of meteorology on calculations with the EMEP Unified model

Svetlana Tsyro, Michael Gauss, Haldis Berge, Hilde Fagerli, Anna Benedictow
Norwegian Meteorological Institute
Contact: svetlana.tsyro@met.no

The EMEP model is used operationally for assessment of the regional levels and the transboundary fluxes of acidifying compounds, ozone and particulate matter (PM) in Europe, and also pre-operationally for chemical weather forecasting. Accurate model calculations are essential for reliable assessment of the compliance with regulatory target values. Furthermore, correct description of the PM chemical composition is important for trustworthy modelling of PM source allocation and the impact of emission reductions. During the past decade, the PARLAM-PS (based on HIRLAM-v.3) weather prediction model was used to prepare meteorological input to the EMEP model. Using the same meteorological model is essential for consistent calculations of pollution trends. Recently, updating the meteorological driver has caused changes in EMEP model results. The most prominent is a considerable decrease of the surface concentrations of most pollutants, leading in several cases to model underestimation of observations. Here, we look at the effect of using different meteorological drivers, namely the HIRLAM-v.7 and ECMWF models, on EMEP model results, with a special focus on its performance for PM. We analyse the reasons for the significant discrepancy between model calculated PM concentrations when two versions of the HIRLAM meteorological model were employed. In particular, the seasonal variation and spatial distribution of precipitation, as well as the atmospheric stability and vertical mixing were found to be responsible for the decrease of surface concentrations, accompanied by their increase aloft. Also, the effect of meteorology on source-receptor calculations has been investigated, which may have implications for designing emission reduction strategies. Finally, we compare the effects due to using different meteorological drivers with those that are due to inter-annual meteorological variability.

P-Transformation.11 ID:4437 **10:30**

Modeling study of thunderstorm effects on the composition and chemistry of the upper troposphere during the 2006 North America Monsoon

Mary Barth [1], *Jeff Lee* [1], *Alma Hodzic* [1], *John Worden* [2], *John Wong* [3], *David Noone* [3], *William Skamarock* [1]
[1] NCAR
[2] NASA/JPL
[3] University of Colorado
Contact: barthm@ucar.edu

Recently the existence of an enhanced ozone region in the upper troposphere (UT) over the southern U.S. during July and August has been documented (Zhang et al., 2003; Li et al., 2005; Cooper et al., 2006, 2007,