

Virtual ACOM/CISL Joint Seminar

Data Assimilation for Atmospheric Chemistry

Peter Jan van Leeuwen

Department of Atmospheric Science, Colorado
State University

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Links: <https://operations.ucar.edu/live-acom>

ABSTRACT

Atmospheric chemistry poses special problems for the standard data-assimilation techniques, both in terms of problem size and in terms of complexities specific to this application field. It is crucial that strong progress is made given the importance of atmospheric chemistry for e.g. air quality, interactions with cloud microphysics, and radiative effects, against a background of a changing climate. This pertains to both prediction as well as quantifying and understanding sources and sinks of the different species and the connections to the biosphere.

This talk will start with a short general overview of what data assimilation is and how it can be useful. I then introduce Bayes Theorem and show how present-day work horses such as variational methods like 3DVar and 4DVar and Ensemble Kalman filters can be derived from that. This is needed to understand the next topic, the specific data assimilation issues related to atmospheric chemistry, and ways these have been attacked in the past. Examples from e.g. GEOS-CHEM and TOMCAT will be discussed. This is followed by illustrations of the special nonlinearities of the atmospheric-chemistry data-assimilation problem related to both the nonlinear reaction equations and the uncertainties in transport of the different species. We then discuss nonlinear data-assimilation methods that could be of use, and close with a view towards the future.

The emphasis will be on concepts instead of mathematical details, with many examples to illustrate these concepts.