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Atmospheric Chemistry and Physics Discussions

Interactive comment on "Evaluating the potential of IASI ozone observations to constrain simulated surface ozone concentrations" *by* G. Foret et al.

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This paper addresses the potential of IASI ozone observations for assimilation in an atmospheric chemistry transport model. Specifically, the question is how the free tropospheric sensitivity of IASI measurements propagates to the surface. The authors tackle this problem by initialization of model layers in the free troposphere and forward model simulations. The simulated surface concentrations are subsequently analyzed. The main conclusion is that tracers initialized at 800-700 hPa do reach the surface within 1-3 days, especially in the Mediterranean.

In my opinion this paper contains too few interesting findings. Although the presentation of the results is reasonable to good, the scientific method and the basic approach are far from sufficient. The set-up of the experiment (what model experiments should be performed to answer the question at hand) contains some basic flaws, some of which

will be discussed hereafter.

- The initialization of the tracers at different levels in only Europe may lead to the false suggestion (figure 4) that there is more subsidence in zone D compared to zone A

  Soon after initialization the western boundary of the model domain will be flushed with tracer free air. This air, when subsiding towards Western Europe thus contains low tracer concentrations. As a result the current set-up favors the tracing of subsidence over the SE part of the domain. Figure 3 clearly shows the replacement of air by zero-air from the NW. The conclusion of higher sensitivity in the SE may be true, but is not proven with the current setup.

- Vertical transport is not only governed by subsidence

  Subsidence might be a dominant effect over the Mediterranean in summer, but convection plays an important role as well, especially in frontal systems more to the north. Convection is not at all mentioned in the paper as a mechanism to mix the troposphere. In an analysis as presented here I would expect a selection of subsidence periods (high pressure systems), but the paper averages over entire summers masking effects of individual events. Clouds also play a role in the convective venting of the boundary layer. A much more useful analysis would be possible when specific events are selected (cloud free observations, and tracing the air back to the surface) and I recommend that the authors proceed along this way.

- The reverse process

  Related to the previous point: why would the reverse process (upward transport of ozone formed close to the surface by e.g. convection and subsequent detection by an IASA-like instrument) not be equally important? Probably the authors have in mind an assimilation of IASI observations, but the reverse process may be important when O_3-precursor emissions are optimized (variational data-assimilation of emission) by analyzing the amount of ozone that is vented upward from a polluted boundary layer and detected by an IASI-like instrument.

- The initialization of the tracers

  On a basic level: the current initialization of tracers in a varying grid at a fixed mixing ratio leads to the introduction of a certain amount of tracer (expressed in the total tracer mass added to the system). This mass varies, unless an equally spaced pressure grid is used. Thus the results from different layers (figure 2) cannot easily be compared. The thickness of the layers in figure 2 amount to 70, 100, 80, and 70 hPa for tracers 7, 8, 9, and 10, respectively (note the error in the caption). Close inspection reveals that tracer 8 indeed seems to be more abundant.

- Chemistry?

  Ozone chemistry is promised ("To simulate ozone as well as inert tracer concentrations .... we use the CHIMERE CTM"). I only find passive tracer experiments. Taking into account only deposition, but not chemical production and destruction, sounds to me as half work.

- PBL height

  The authors claim that in subsidence situations, the PBL is generally thick. This is not true, since subsidence tends to reduce PBL heights. Solar heating (as sensible heatflux) is competing with subsidence in determining the PBL height. Moist surface conditions in combination with subsidence can lead to a rather shallow boundary layer (low PBL height).

In conclusion, the authors should rethink the methodology and clearly define what they want to know and then come up with an improved strategy. My suggestion would be to

select a number of case studies in which IASI could potentially verify model calculations in terms of surface ozone.

Interactive comment on Atmos. Chem. Phys. Discuss., 9, 12829, 2009.