Application of OMI Ozone Profiles in CMAQ

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Abstract

Using OMI ozone profiles as the boundary conditions for CMAQ calculations significantly improves the agreement of the model with ozonesonde observations during IONS06. This improvement results from both representing the free-tropospheric ozone amounts more accurately and also from representing recirculating air masses more accurately. A simultaneous assessment of the OMI ozone profiles directly with the sondes indicates agreement to better than 10% throughout the free troposphere with 10-20% differences in the PBL.

Experiment Description

In this study, 4 CMAQ runs are made:

(1) ***cntrl***: uses static profiles as the lateral boundary conditions;

(2) ***raqms_bc***: obtains lateral boundary conditions from global chemical model output (RAQMS);

(3) ***sat_bc***: uses OMI/O_3 as lateral boundary conditions;

(4) ***sat_icbc***: uses OMI/O_3 as lateral boundary conditions, and once a model-day, modifies simulated O_3 with OMI O_3.

OMI/O_3 Data Processing

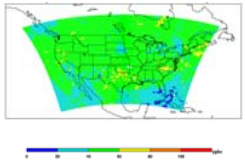


Fig. 1 OMI O_3 retrievals between 1013-701mb during Aug. 21, 2006, are gridded to CMAQ horizontal domain.

•Ozone Monitoring Instrument (OMI) onboard NASA's AURA satellite provides mapping of O_3 profiles at a nominal ground footprint of 13x48 km^2 at nadir.

• OMI O_3 profiles during each day are gridded to CMAQ domain (36km x 36km resolution) using a "**drop-in-the-box**" method.

•Interpolate gridded OMI O_3 profiles (24 layers) onto 39 sigma layers of CMAQ.

Evaluation with IONS06 ozonesondes

Fig. 2 IONS06 Ozonesonde network. (http://croc.gsfc.nasa.gov/intexb/ions06.html).

IONS06 provides the best set of free tropospheric ozone measurements ever gathered across the continent in a single season data.

Of the IONS06 ozonesondes, 252 are chosen for evaluation of CMAQ results. Criteria include:

- Within CMAQ domain;
- Launched during UTC1500 ~ 2300, Aug 2006.

Model Evaluations

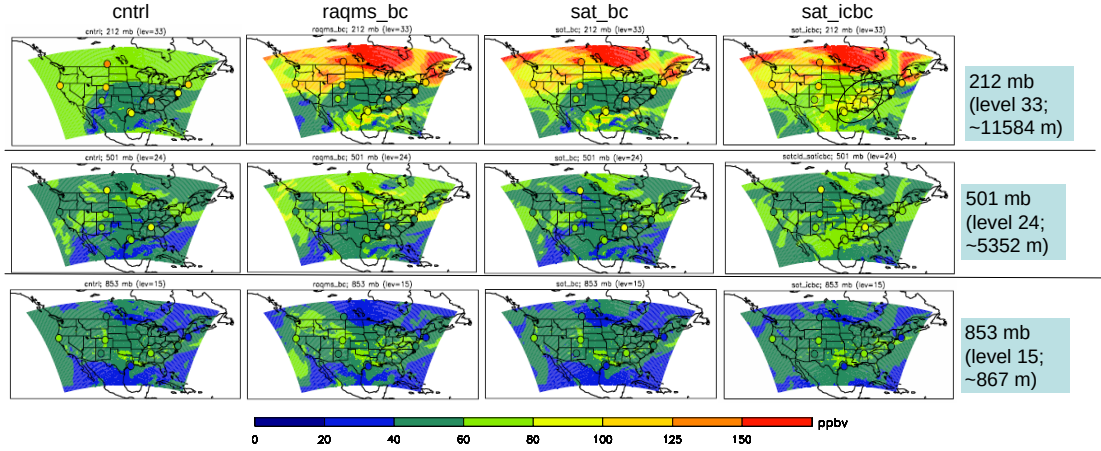


Fig 3. O_3 (ppbv) 1900 UTC, 8/21/2006 simulated by 4 CMAQ runs; over plotted with 9 ozonesondes found within 1500~2300 UTC.

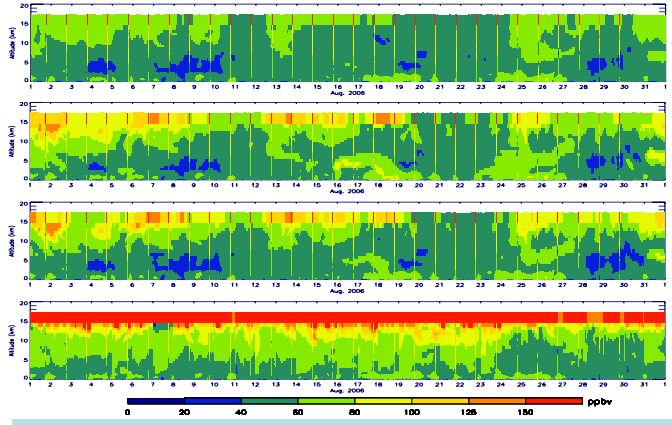
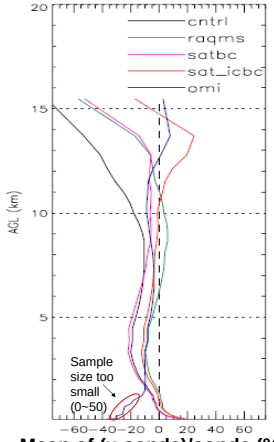


Fig 4. CMAQ simulated ozone variations at Huntsville, AL, during August 2006. Ozonesonde measurements are re-sampled onto CMAQ vertical resolution and over-plotted.



Mean of (x-sonde)/sonde (%)
Sample size = 252 (varies with altitude)

Fig 5. Differences calculated between model simulated O_3(ppbv) and ozonesondes, as well as between level-2 OMI/O_3 profiles and ozonesondes, during August 2006.

Using OMI boundary (bc) or bc+initial conditions, results in significantly better agreement between CMAQ and the sondes in the middle and upper troposphere (**Figure 3**).

The temporal evolution seen at Huntsville is also significantly improved throughout the troposphere by using OMI ic/bc information (**Figure 4**).

The monthly mean difference over 252 sonde stations likewise shows the vertical profile of the improvement in CMAQ with increasing amounts of OMI ozone information, including the direct comparison of OMI ozone profiles and ozonesondes in CMAQ space (**Figure 5**).

Conclusions

Using OMI ozone profiles as lateral BCs for CMAQ, improves the middle and upper-tropospheric ozone calculations.

By modifying modeled O_3 with OMI O_3 throughout model domain once a model-day, further improvement can be made, especially in interior region.

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