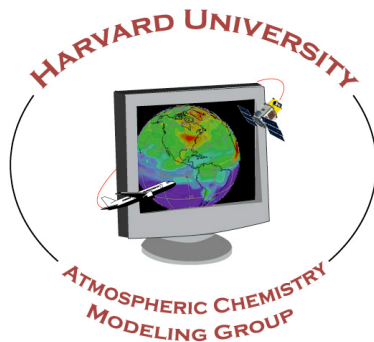


Joint Assimilation of Ozone and CO Geostationary Observations to Improve Constraints on Ozone Air Quality



Peter Zoogman

with Daniel J. Jacob, Kelly Chance, Lin Zhang, Annemarie
Eldering, Xiong Liu, Vijay Natraj, Susan S. Kulawik, Mary Barth,
David Edwards, Helen Worden

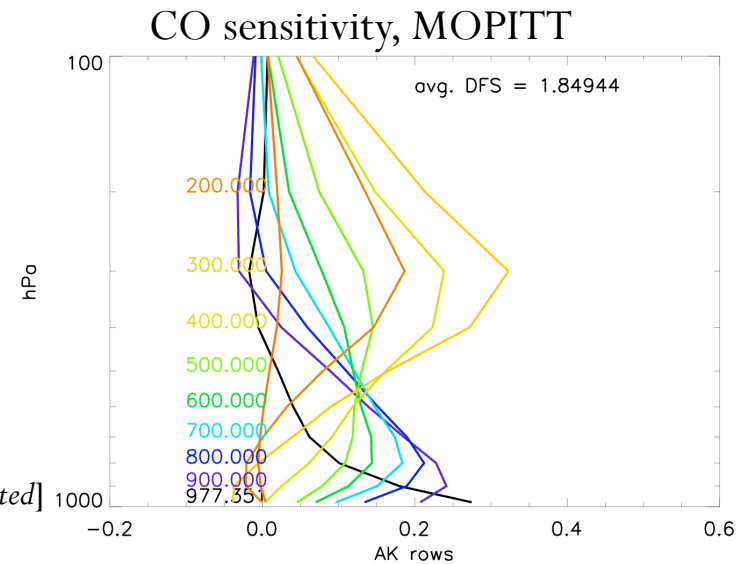
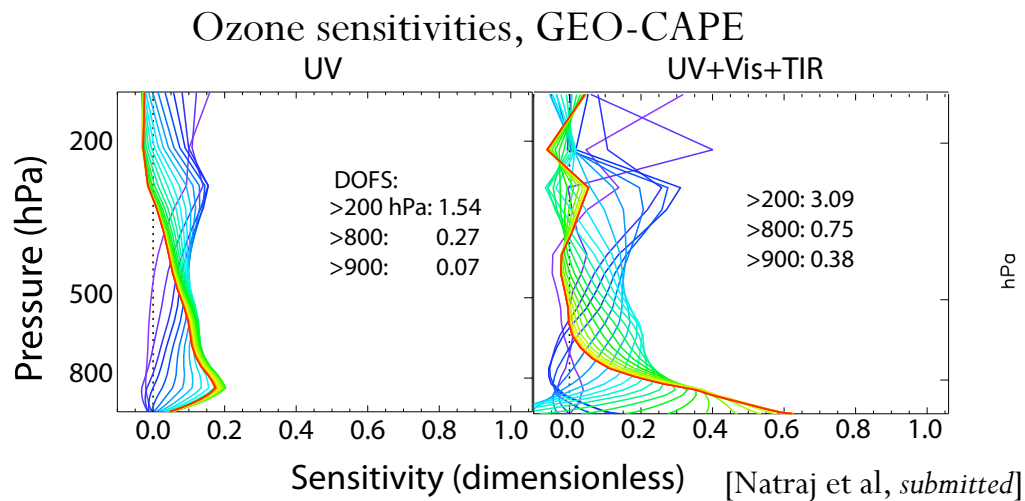
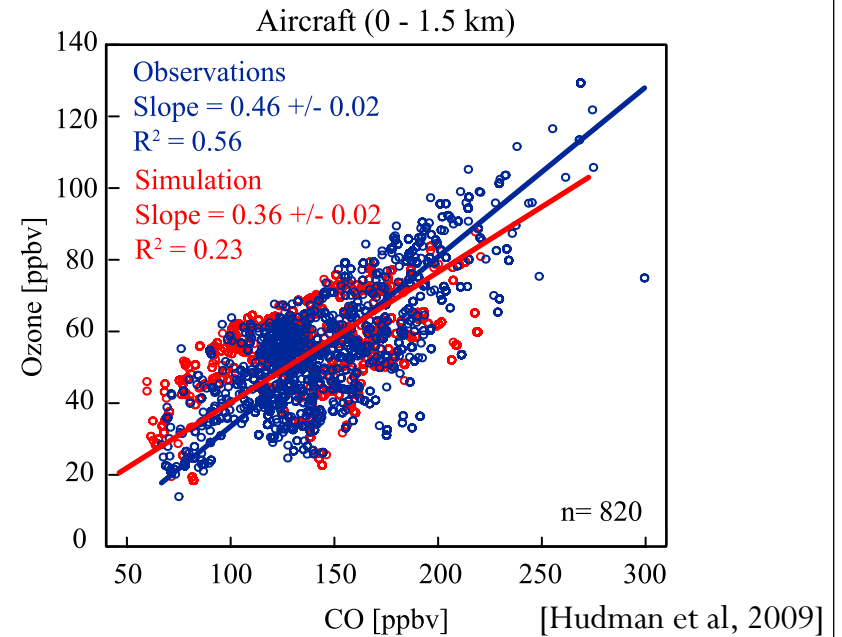
GEO-CAPE Meeting

May 12, 2011



Usefulness of CO Observations

- O_3 :CO correlations are well known
- GEO-CAPE boundary layer sensitivity may be greater for CO than for ozone
 - Model errors correlated \Rightarrow CO observations could add information for ozone air quality

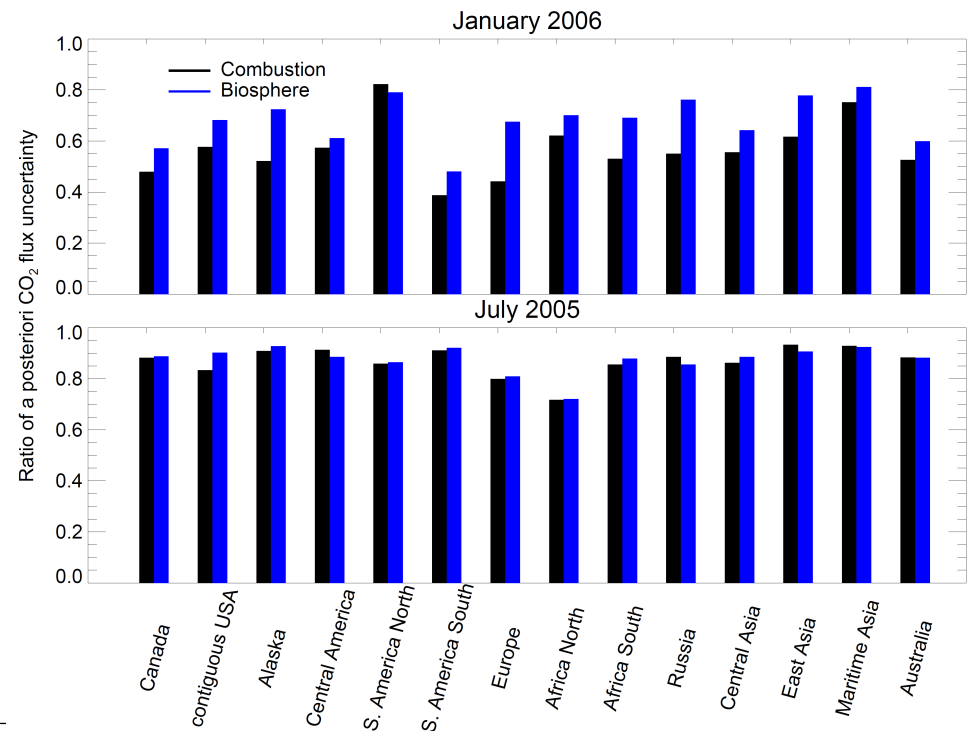


Error Correlation Methodology

- Data assimilation depends on constraining model error
 - CO observations can be used to constrain model transport error

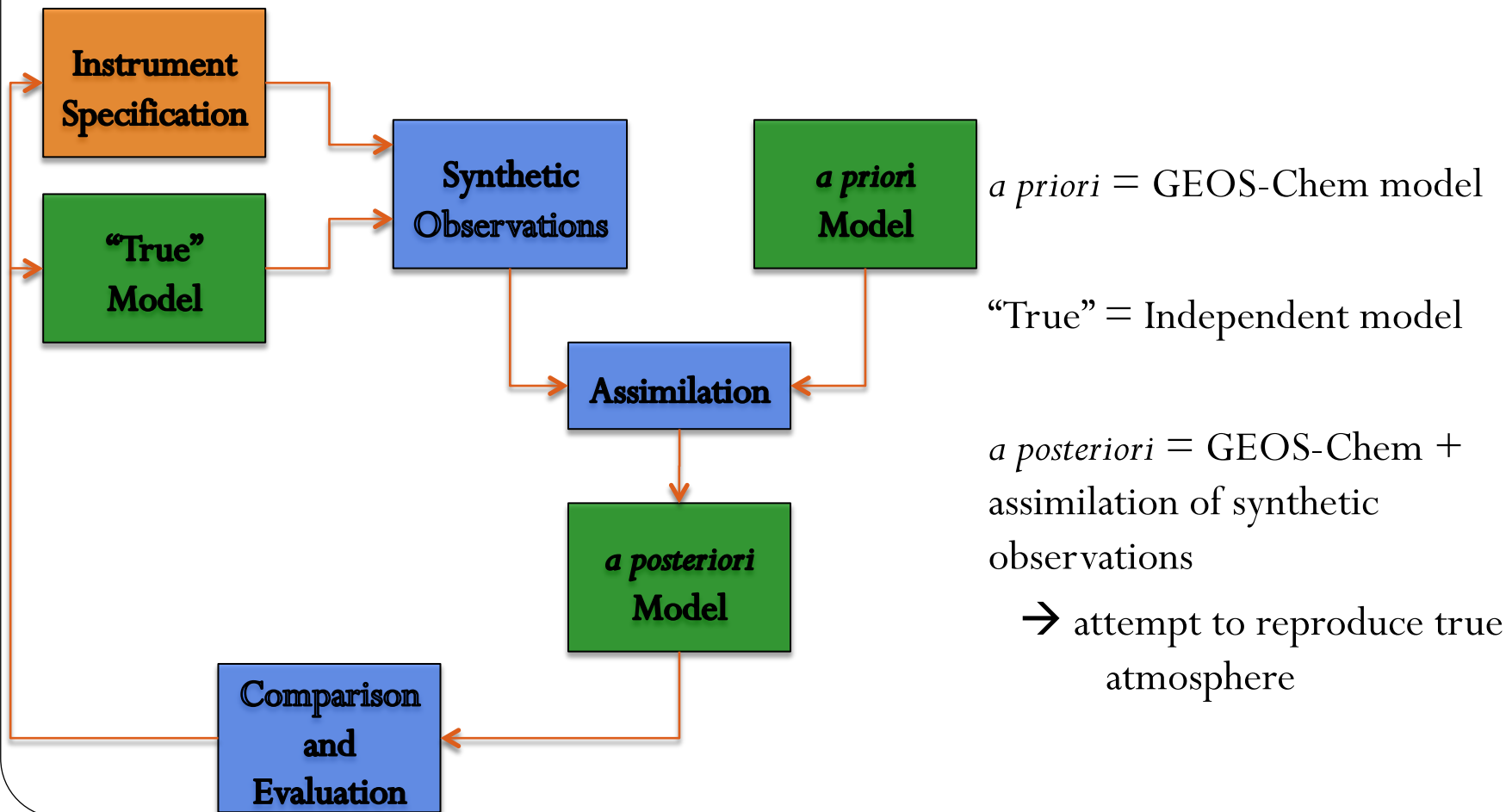
$$S = \begin{pmatrix} S_{O_3} & E(\varepsilon_{O_3} \varepsilon_{CO}^T) \\ E(\varepsilon_{CO} \varepsilon_{O_3}^T) & S_{CO} \end{pmatrix}$$

- Previous work by Wang et al. (2009) demonstrated the use of CO:CO₂ error correlations to improve CO₂ flux estimates



Observing System Simulation Experiment

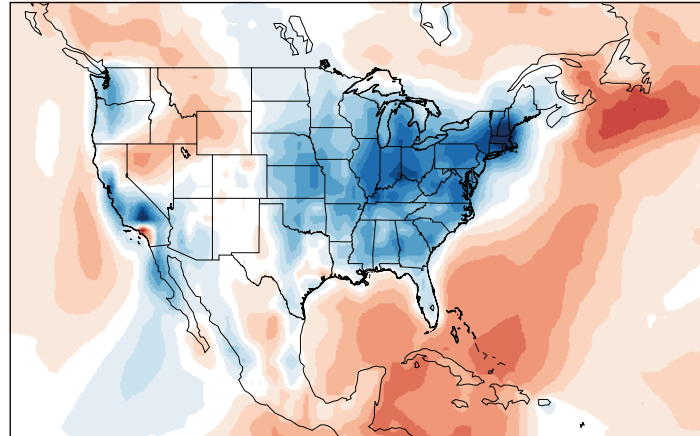
- To what degree can geostationary measurements in different spectral regions/combinations resolve ozone near the surface?
- What information can we gain about ozone from CO measurements from error correlations?



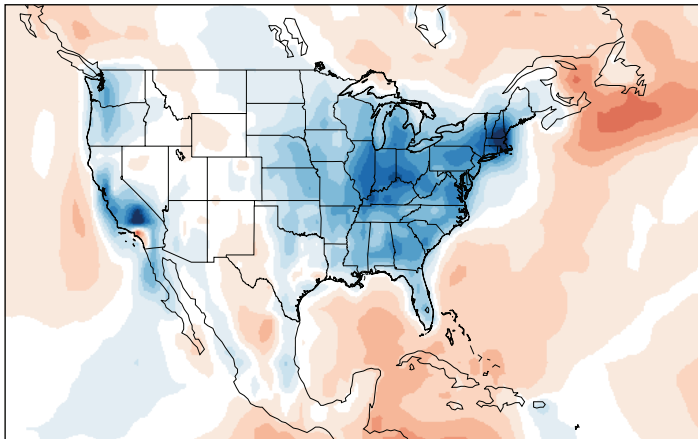
Air Quality Information from GEO-CAPE

Error in Surface MDA8 Ozone averaged for July 2001

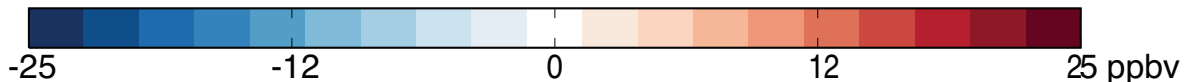
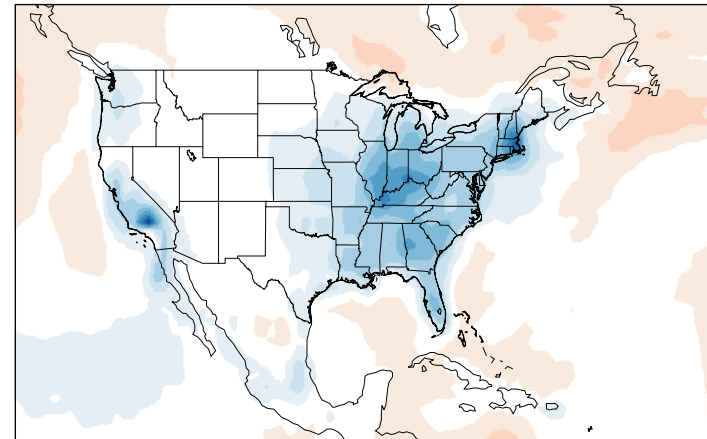
a priori RMSE: 8.0 ppbv



LEO UV+Vis+TIR RMSE: 6.5 ppbv



Geo UV+Vis+TIR RMSE: 3.7 ppbv

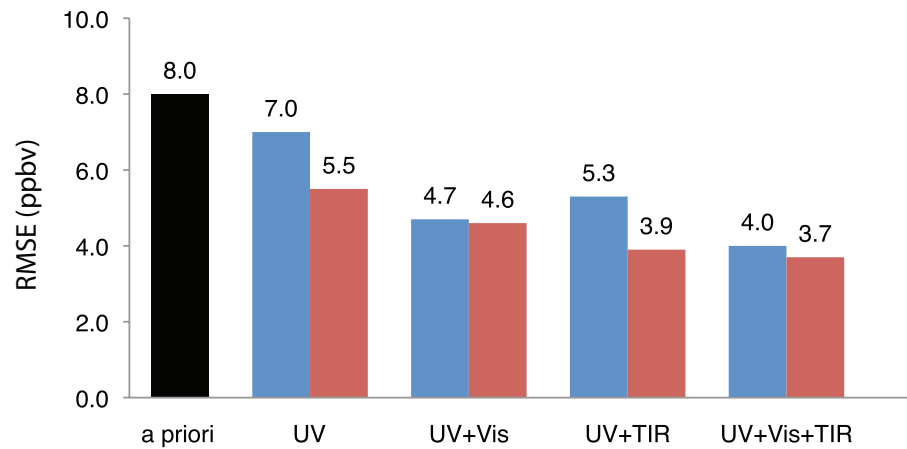


Need to combine observations in multiple spectral regions at high temporal resolution to constrain ozone air quality

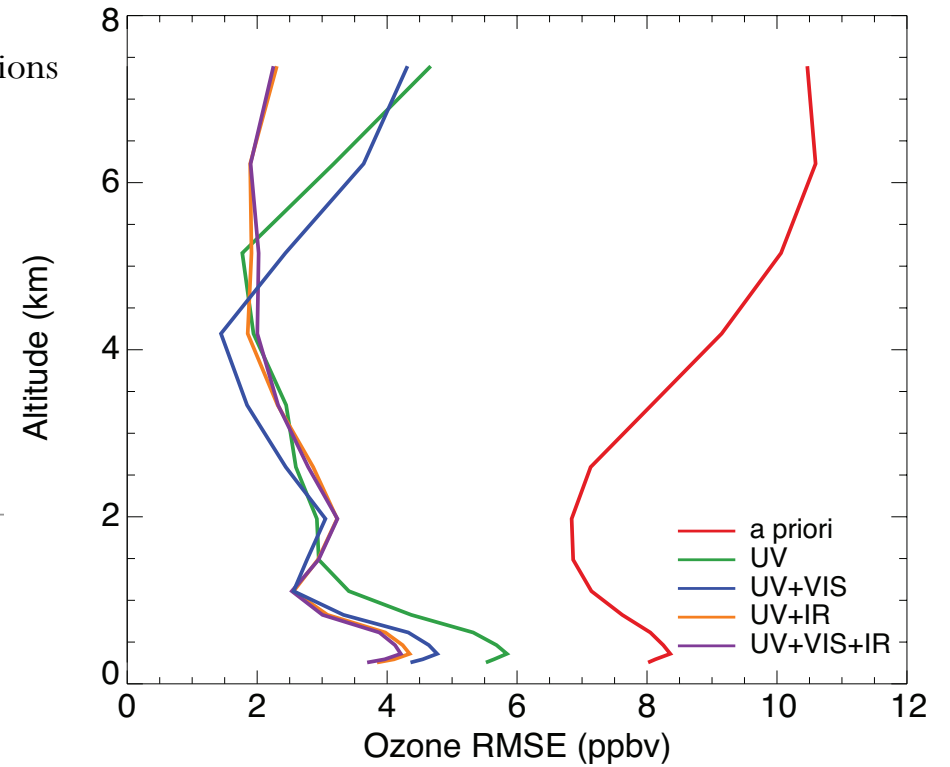
[Zoogman et al,
in review]

Comparison of Spectral Combinations

Error in ozone surface air concentration over the US after assimilation of observations in different spectral combinations



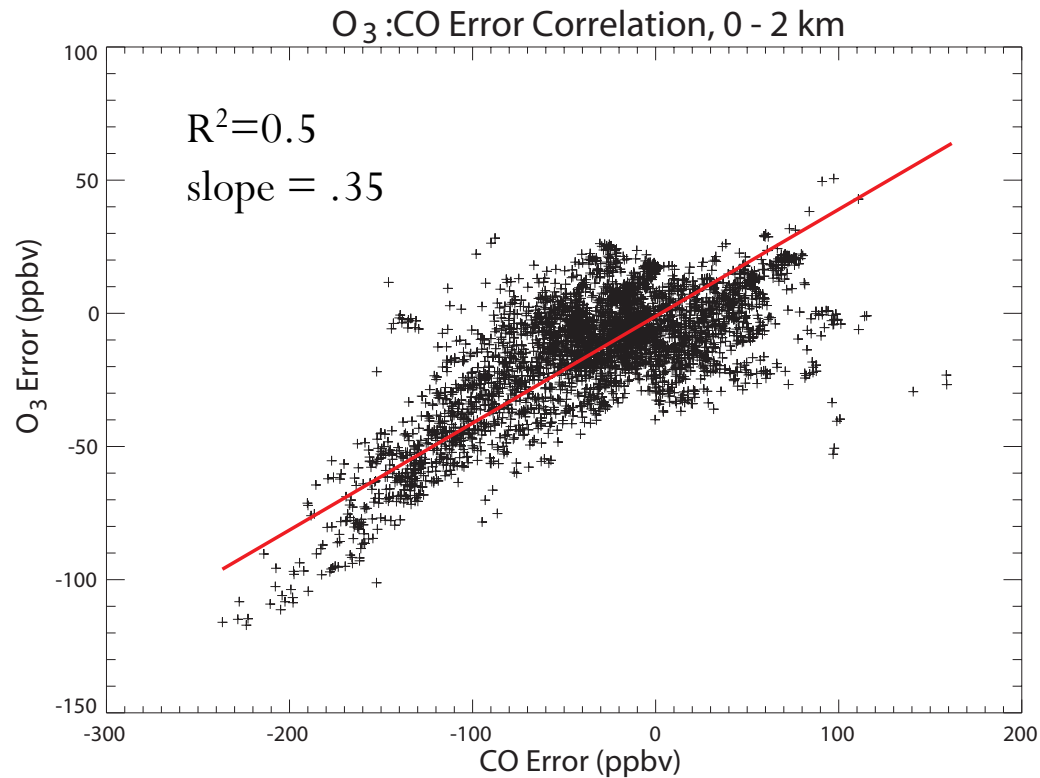
Vertical profile of *a posteriori* error in ozone concentrations



[Zoogman et al,
in review]

GEOS-Chem Error Correlation

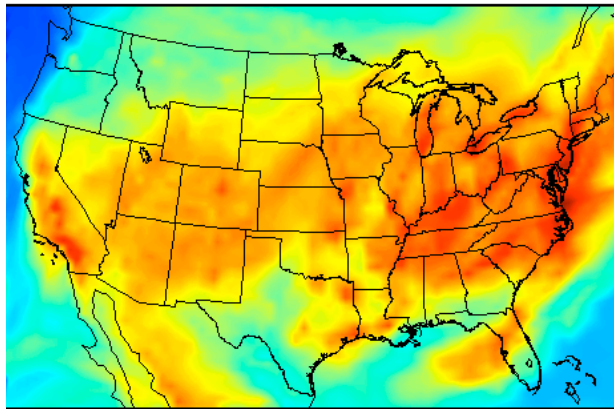
- To quantify model error correlation we compared Nested NA GEOS-Chem to INTEX-NA below 2 km
 - July 1 – August 15, 2004
 - Below 2 km



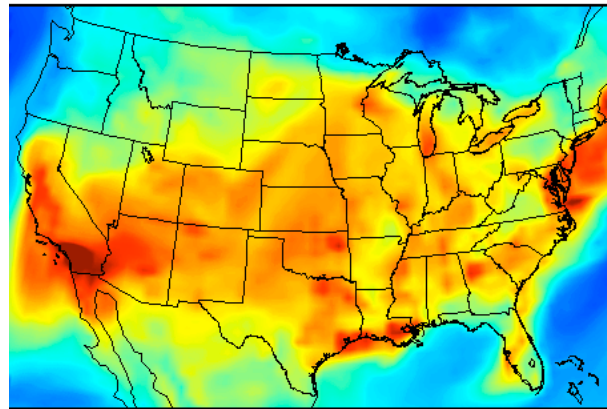
Model Comparison

- WRF-Chem and GEOS-Chem are completely different
 - Meteorology, Chemistry, Emissions

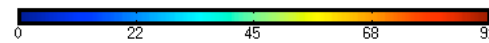
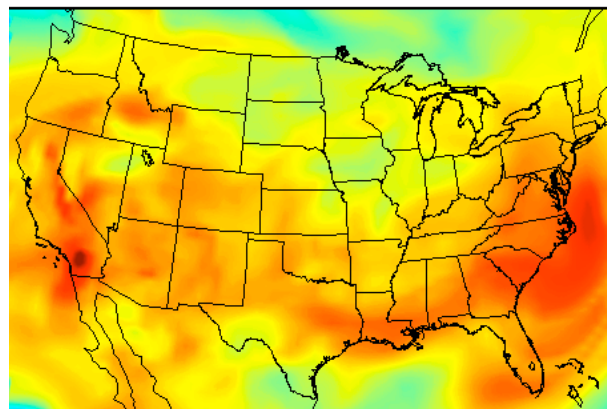
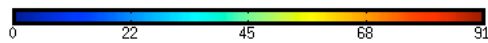
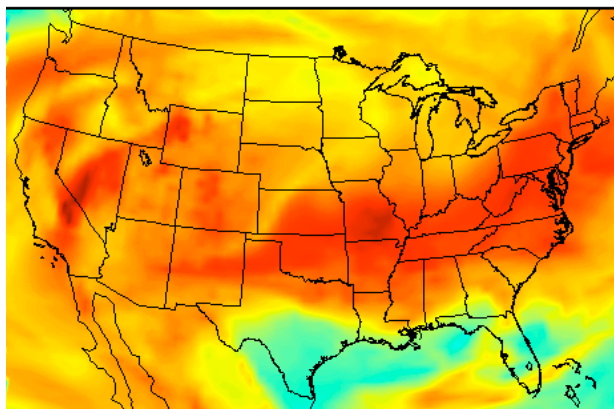
“Truth” -- WRF-Chem



a priori -- GEOS-Chem



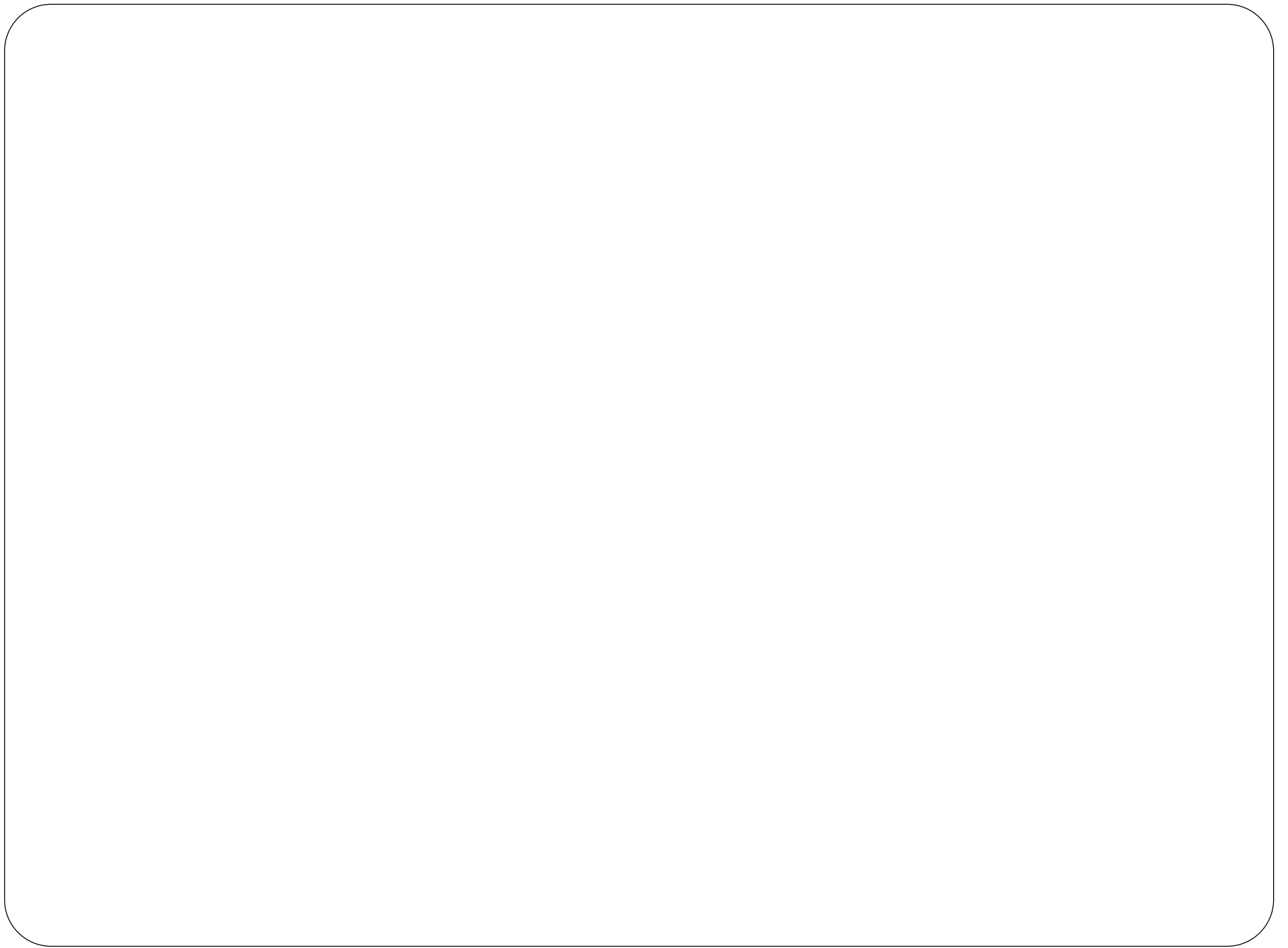
Surface



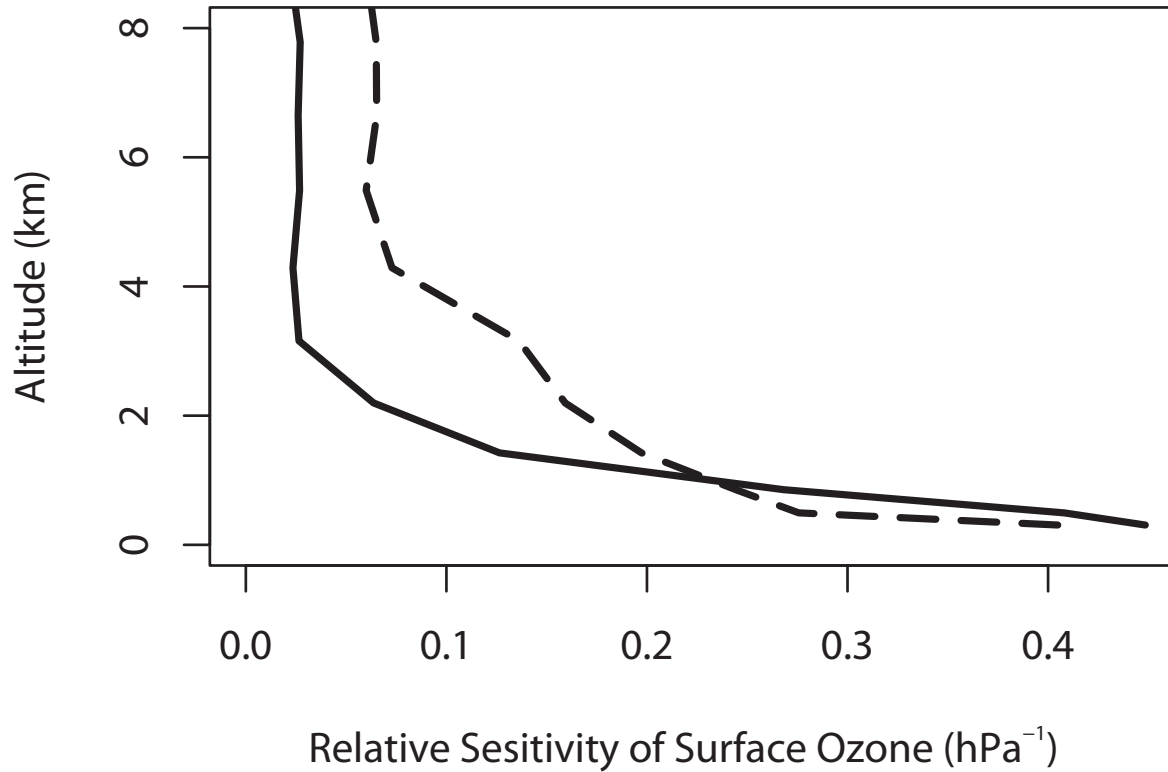
700 hPa

Future Work

- Quantify added information from joint assimilation for different spectral combinations
- Account for variability in retrievals based on atmospheric conditions
- Incorporate other related species (NO_x , formaldehyde)
- Apply full assimilation framework to current observations to test realism of OSSEs



Surface Ozone Sensitivity



Surface ozone primarily sensitive to ozone produced below 2 km.