

Intercontinental Source Attribution of Ozone Pollution at Western U.S. Sites Using an Adjoint Method

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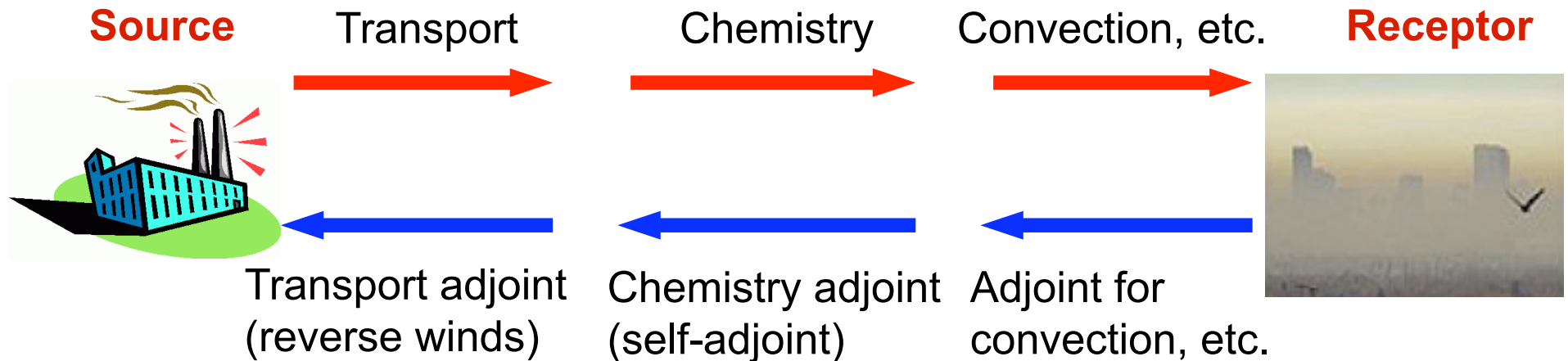
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Forward versus adjoint sensitivity analysis

Forward analysis (source-oriented)



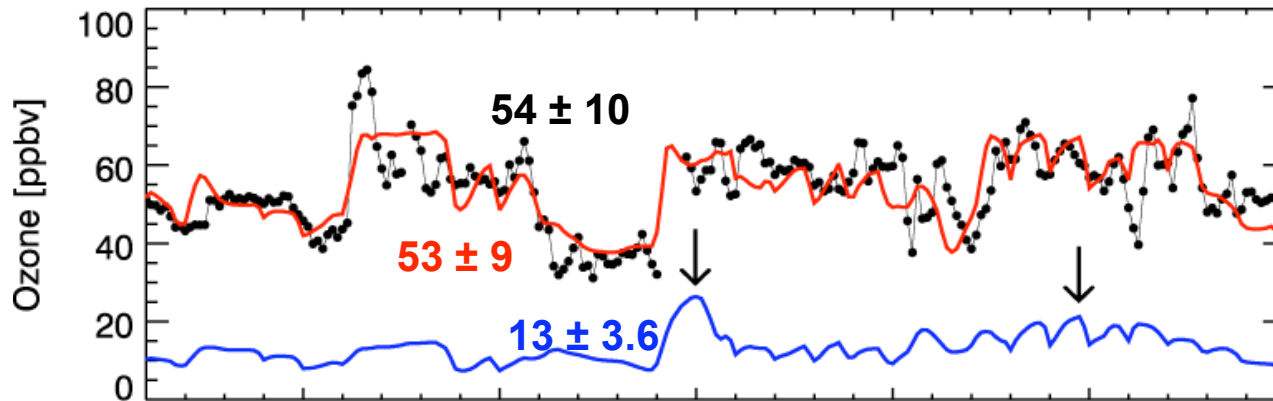
Adjoint analysis (receptor-oriented)

This study uses GEOS-Chem adjoint (v6-02-05, GEOS-4, $2^\circ \times 2.5^\circ$ resolution) for tagged ozone simulation driven by ozone production rates and loss frequencies saved from the full chemistry.

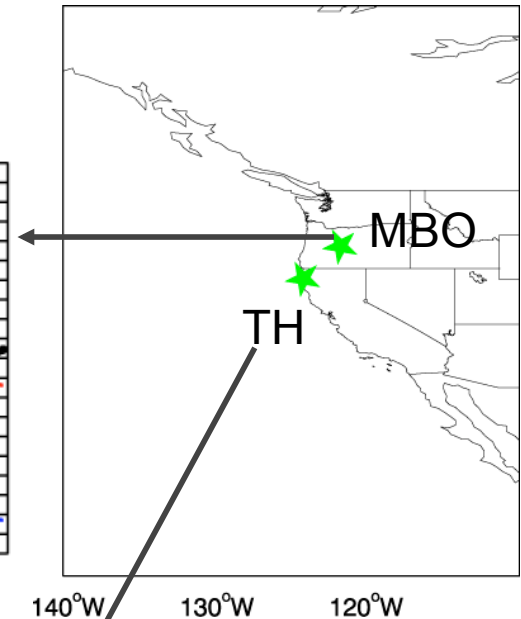
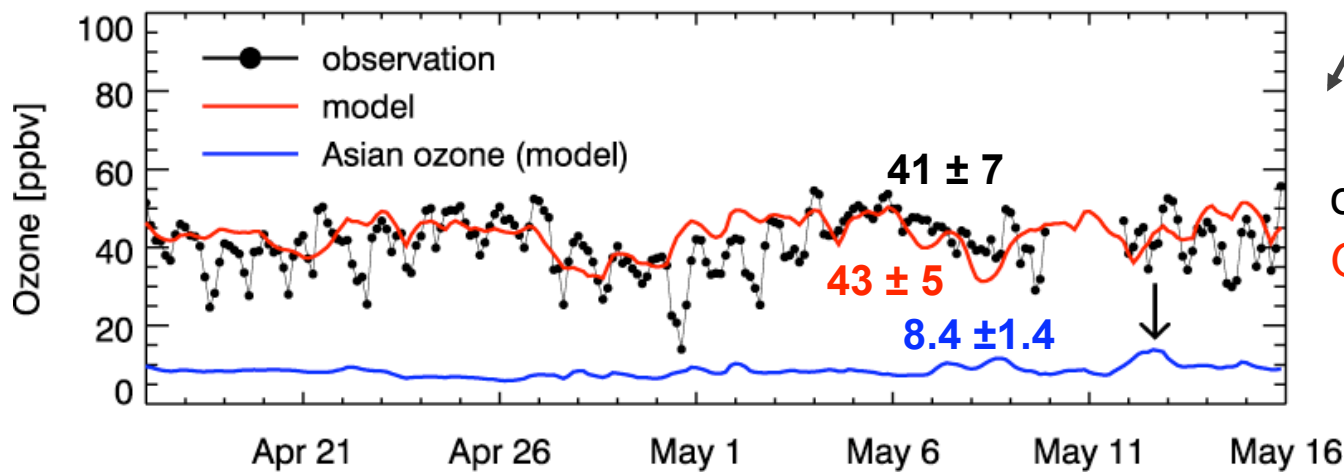
Ozone observations at the western U.S sites

For the INTEX-B period (April 17 - May 15, 2006)

Mt. Bachelor Observatory (44.0N, 121.7W, 2700m)



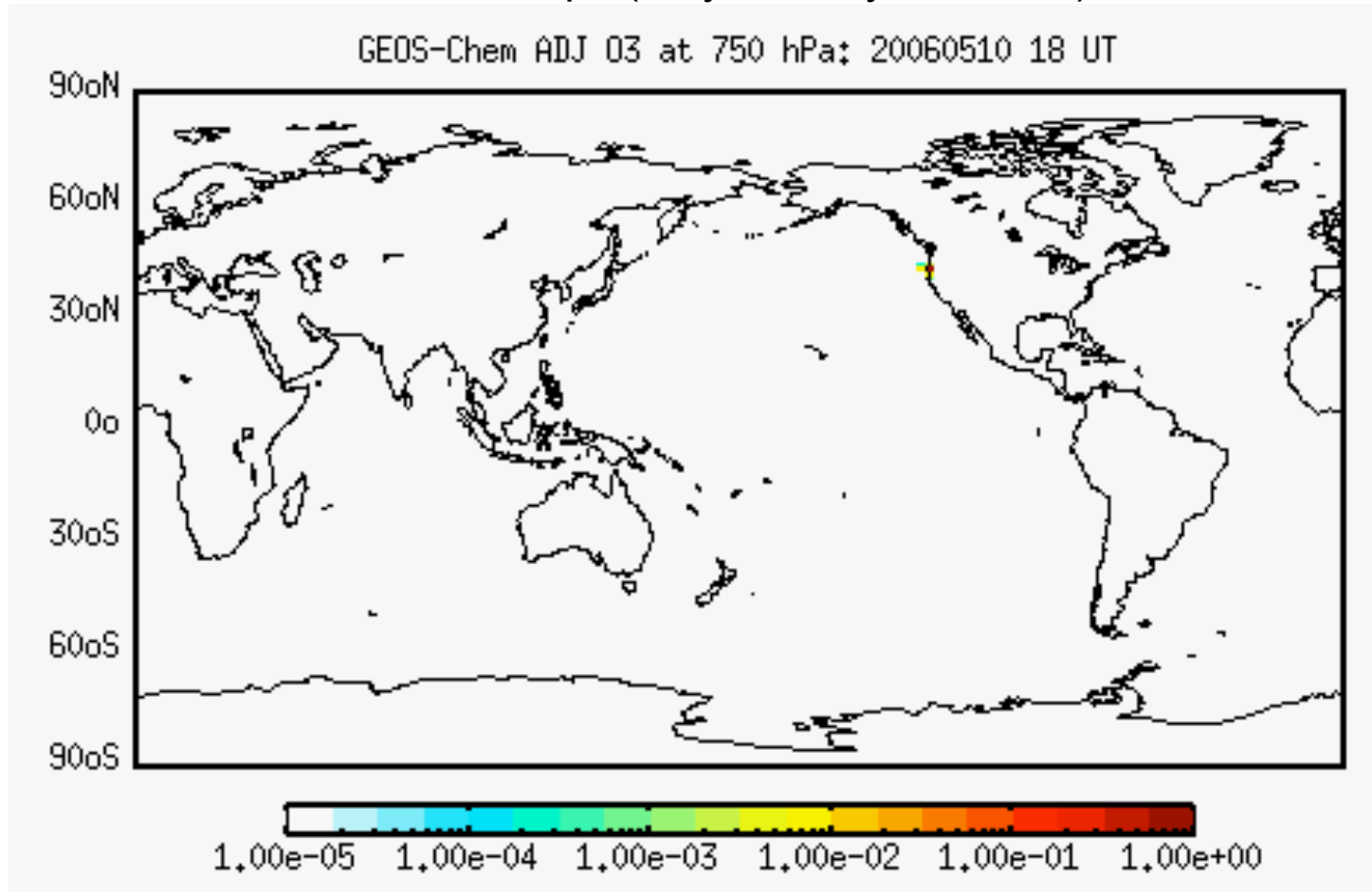
Trinidad Head (41.1N, 124.2W, 107m)



observation
GEOS-Chem
Tagged ozone produced over Asia

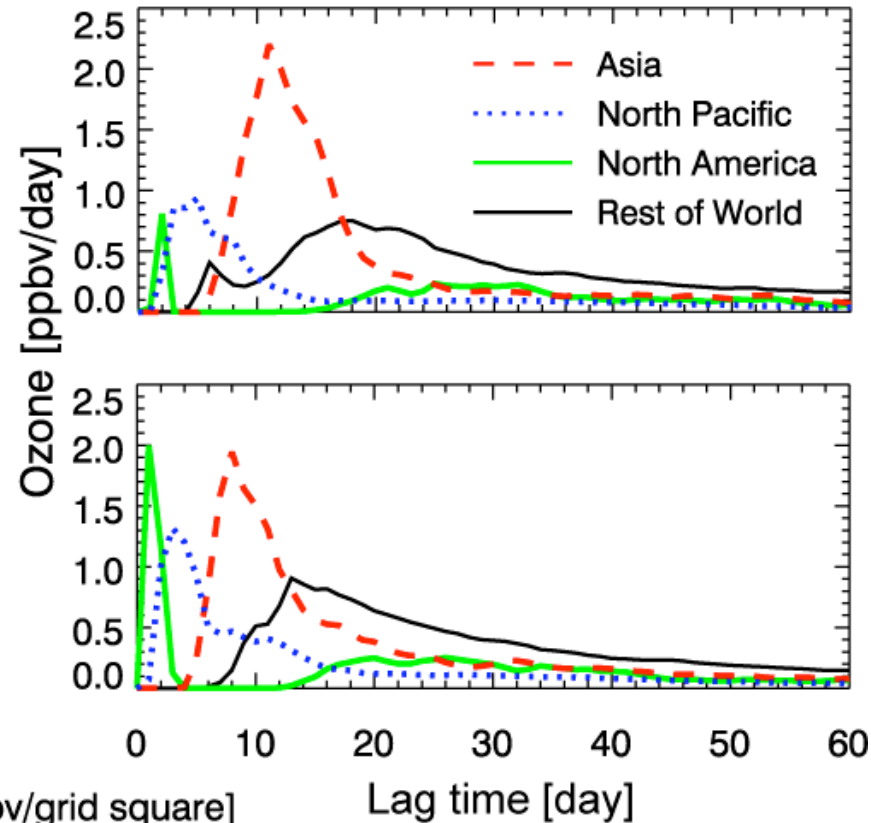
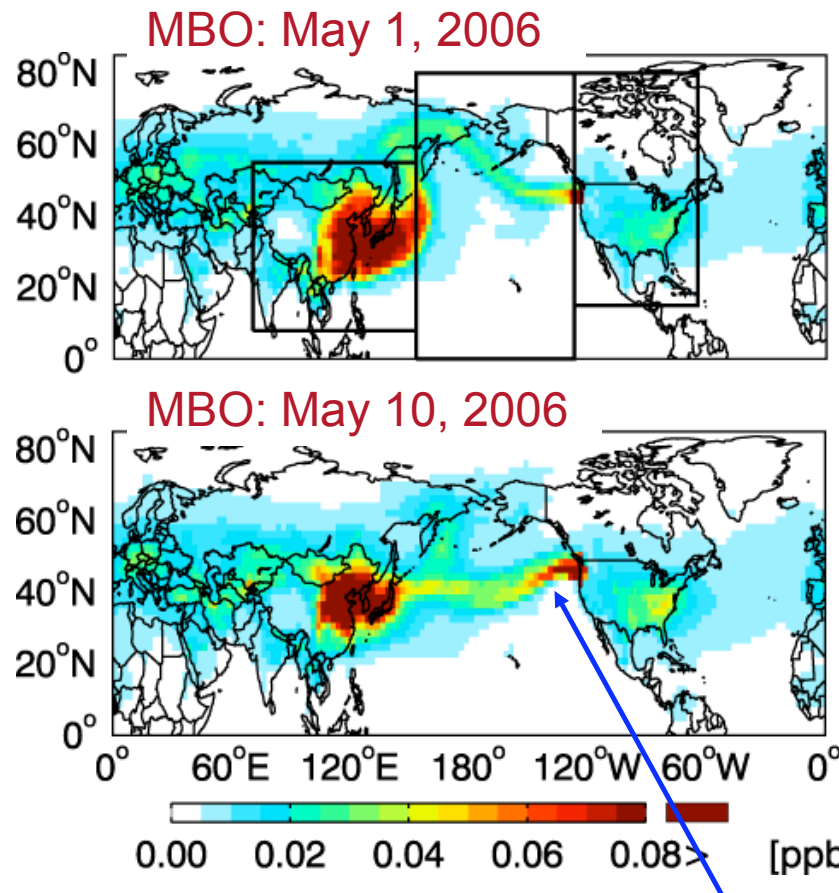
Adjoint sensitivity for ozone at MBO on May 10

Sensitivity of ozone concentration at MBO on May 10, 2006 at 18 UT to ozone fields at earlier time steps (May 3 - May 10, 2006)



Adjoint computes the sensitivity at $2^\circ \times 2.5^\circ$ resolution over the history of air parcels reaching the site.

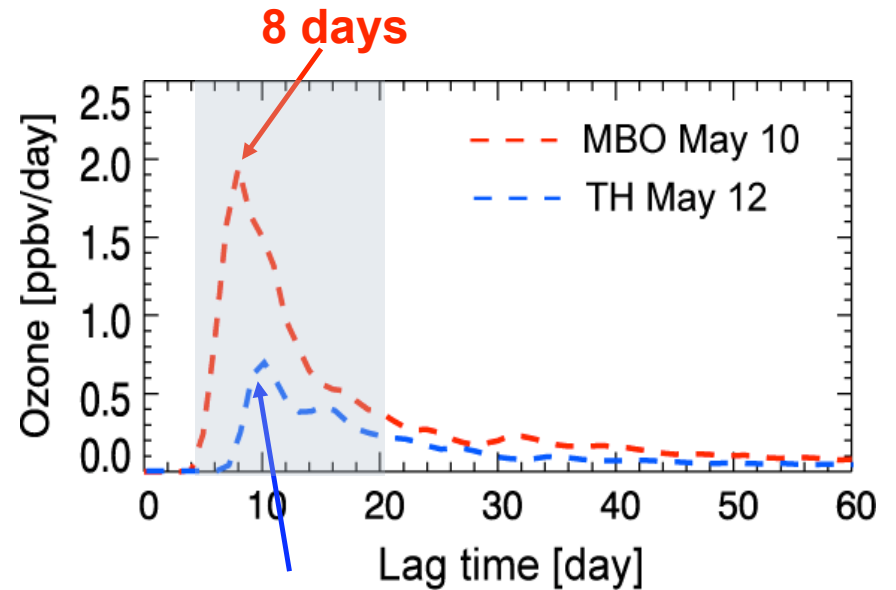
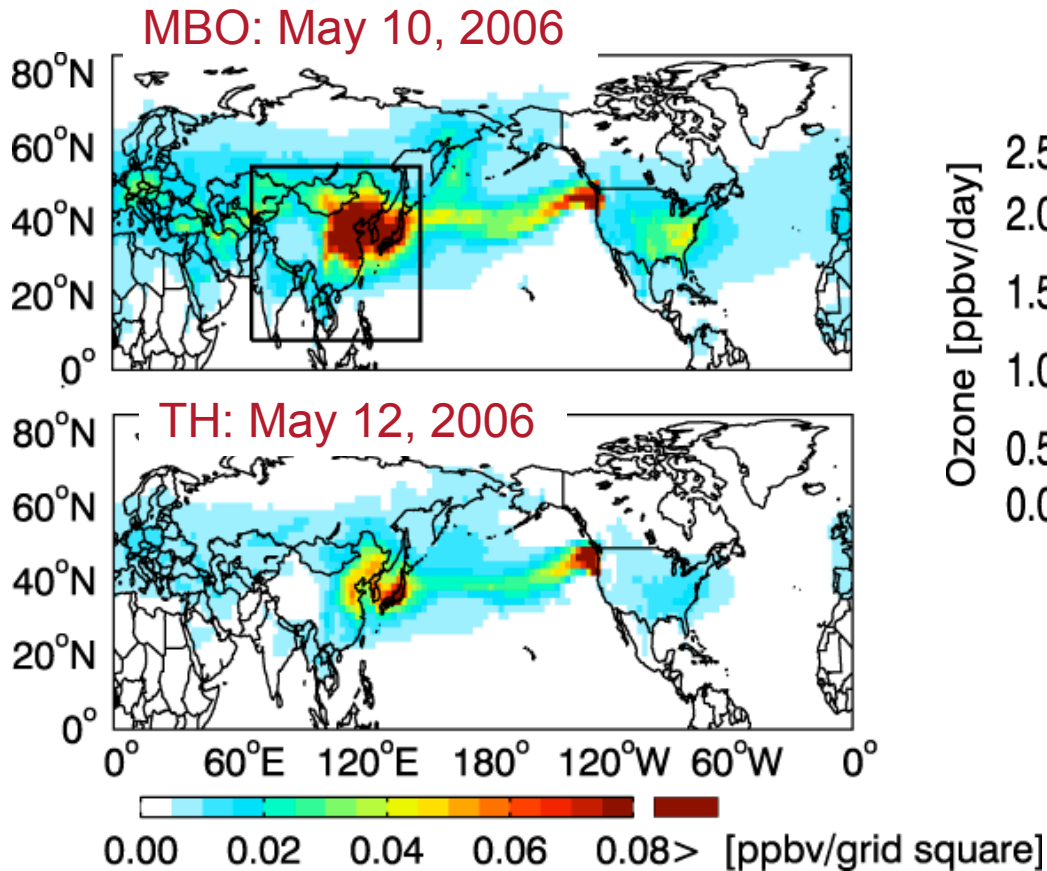
Source attribution of ozone pollution episodes



Decomposition of Asian PAN

- The May 1 plume took a more northerly and higher-altitude route than the May 10 plume, and thus had less production over the Pacific.
- Maximum Asian influence for the two events occurs at time lags of 8-11 days

Dilution of Asian ozone plume during entrainment

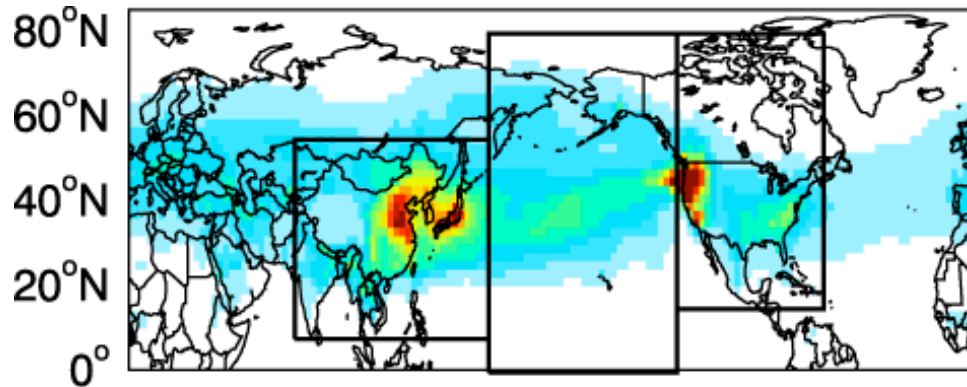


15 ppbv vs. 5 ppbv
integrated over time lags of
5-20 days

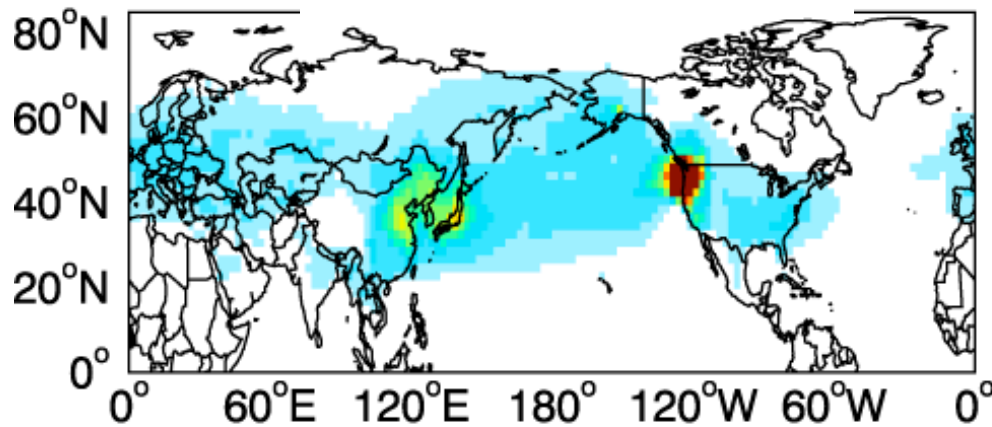
A factor of 3 dilution effect as
the Asian plume mixes down
to the surface.

Mean conditions at MBO and TH

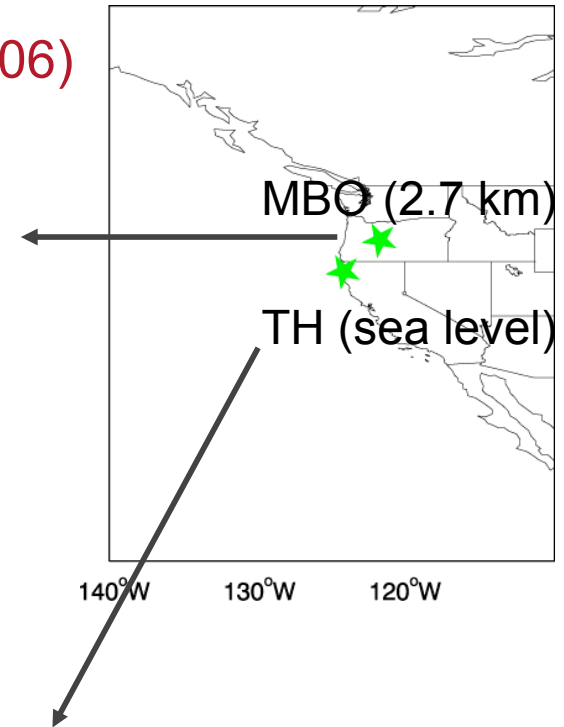
MBO: INTEX-B mean (Apr 17-May 15, 2006)



TH: INTEX-B mean



0.00 0.02 0.04 0.06 0.08 > [ppbv/grid square]



This study attributes ozone pollution sources based on production regions. Sensitivity to ozone precursor emissions can be quantified with the adjoint for full chemistry.



Thank you!