A Comprehensive Investigation of Warm Season CO Lofting and Transport Episodes Utilizing In Situ Measurements, a Regional Scale Chemical Transport Model, and Satellite-Derived Data

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Abstract

Periods during INTEX-A will be selected when interesting spatial patterns were observed in the Atmospheric InfraRed Sounder (AIRS) carbon monoxide (CO) imagery. Examples of cases that will be selected include CO features downwind of major North American urban areas, warm conveyor belts, and biomass burning in Alaska. These cases likely will exhibit interesting temporal evolutions over a several day period.

Four dimensional fields of CO from the Sulfur Transport Eularian Model (STEM) are provided for the INTEX-A period. Output from MM5 runs used in STEM have also been provided. The STEM-derived CO vertical profiles in the areas of interest will be imported into forward radiative transfer code to calculate radiation spectra. The calculated spectra will be input to the AIRS CO retrieval code to create a synthetic version of AIRS CO imagery.

As a result of the above steps, synthetic AIRS imagery that is fully consistent with the underlying meteorology will be created. Thus, STEM and its known meteorology will provide a link between the synthetic imagery and the processes that produced it. An important point is that the synthetic AIRS CO imagery will be available at much shorter time intervals than provided by AIRS, thereby enabling the evolution of CO patterns to be examined in greater detail.

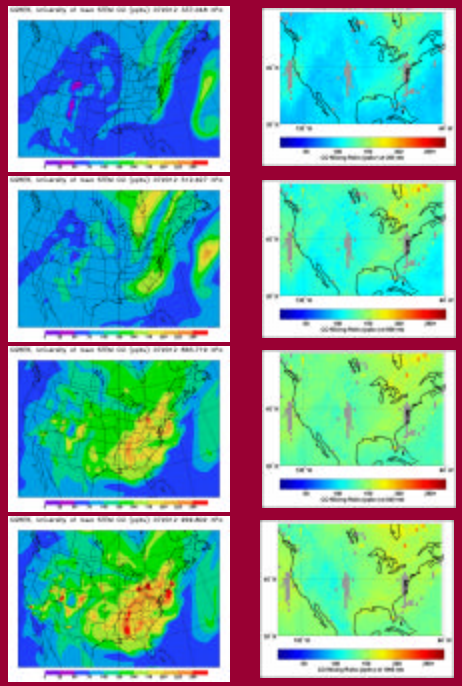
Objectives

- Understand the mechanisms that loft and transport pollution during the warm season
- Understand the magnitude of pollution export during the warm season
- Determine the usefulness of AIRS CO imagery to diagnose and understand pollution transport mechanisms

20 July 2004

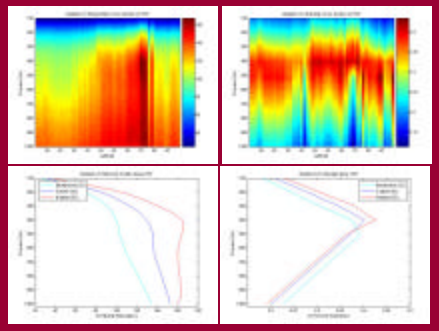
STEM CO

AIRS OBSERVED CO



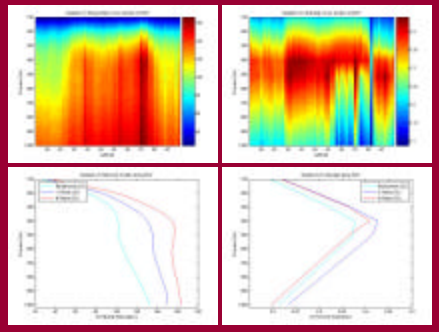
AIRS PLUMES

70 W



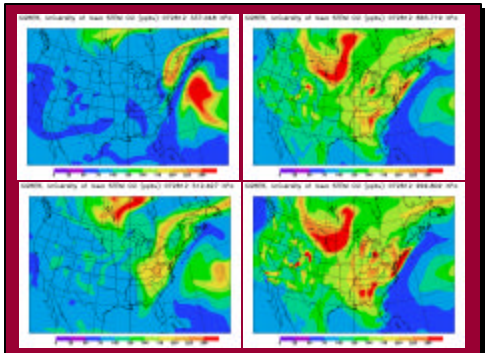
- Vertical cross sections through plumes of observed AIRS CO are plotted at 70 W (above) and 85 W (below)
- Due to the broad shape of the AIRS vertical sensitivity function, whenever a CO enhancement at a certain location is seen it is not known whether there is really more CO in that location or whether CO has been lifted to an altitude where AIRS has more sensitivity

85 W



- Horizontal plots of STEM CO and AIRS observed CO at 4 vertical levels (300, 500, 850, and 1000 hPa) are shown above
- However, as depicted by the vertical sensitivity function (right) the most reliable single piece of information from AIRS is the mean CO mixing ratio between 300 and 600 hPa, roughly where the sensitivity functions peak
- STEM and observed AIRS CO patterns are rather similar, however, the magnitudes are quite different
- Synthetic AIRS CO will be created and compared to the above plots

Alaskan Fires



- STEM CO at 4 vertical levels during this event
- Analyzed Alaskan Fires as indicated by NOAA NESDIS Hazard Mapping System (HMS) (right)
- We plan to study this event in further detail

Summary

A major goal of CO-sensing satellites is to track the evolution of pollution episodes. We will determine whether that goal was achieved by AIRS during INTEX-A. CO fluxes will be calculated to quantify the strength and magnitude of pollution export during the warm season. We will use a fine resolution CTM, with a detailed emissions inventory, to diagnose plumes downwind of major North American urban plumes.

This research will investigate the mechanisms that lofted and exported pollution during INTEX-A. We will examine the nature and magnitude of transport through WCBs. The meteorological processes and transport pathways of Alaskan burning episodes observed during INTEX-A also will be investigated.

The usefulness of AIRS CO imagery to diagnose pollution episodes and understand the transport mechanisms involved will be determined. We will show whether AIRS CO imagery can be used as a valuable tool to diagnose and understand episodes of pollution transport.