5.065 Impacts of a New Multi-Satellite Constrained Aerosol Emissions Database: Missing Sources, Long-Range Transport, and In-Situ Chemical Processing.

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Abstract:

We have applied a variance maximization technique to simultaneous remotely sensed measurements of AOD, Aerosol Size, CO, and NO_2, from MISR, OMI and MOPITT. The resulting products are emissions at high frequency and global scale, containing different “annual average values” in space and time from existing emissions. These changes are significant in magnitude, spatial, and temporal distribution.

Some of the changes have been “relatively slow”, reflecting urbanization. Other are rapid and sharply peaked, associated with biomass burning. In addition there are strong linkages with El-Nino and other decadal scale phenomena, particularly in regions of biomass burning, where inter-annually and intra-annually variations are both important. In particular, many of these changes are located in South Asia, Southeast Asia, East Asia, Central Africa, Southern Africa, and South America.

These new emissions have then been used in a set of runs covering the period from 2000 to the present, using the CESM-AERO model, and in more detail over specific regions and times using WRF-CHEM. In addition to the standard aerosol routines, we introduce a core-shell trained MIE based aerosol algorithm, constrained by Asian AERONET measurements. Comparisons between the model results, MODIS and CALIOP find an improved aerosol connection between the emissions and both the mean and variability of the system. Also included in the findings is some amount of “chemical speciation” and vertical structure, although far more is still required.

This has led to a few conclusions. First, the emissions and impact of biomass burning are both currently underestimated. Second, that urban emissions are underestimated in some regions and overestimated in others, leading to large changes in the profiles and resulting radiative effects. Third, that the impact of long-range transport is more prevalent than previous thought.