5.034 Understanding and Quantifying the Missing Free Tropospheric Aerosol Loading Over Monsoon Asia.

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Abstract:

Black Carbon (BC) is a short-lived, heterogeneously distributed, species impacting radiative forcing and the atmospheric energy balance. Over Southeast Asia, its dominant sources are rapid and growing urbanization and massive forest and agricultural fires. A recent pair of papers used a time-varying Kalman Filter method and multiple ground and remotely sensed measurements to show both sources contribute to the underestimation. However, the weekly and monthly scale changes in the spatial, temporal, and vertical distribution are still not well quantified. In addition, there is considerable in-situ dynamical and chemical processing contributing to the underestimation. It is known that the BC in this region is heavily chemically aged/mixed and heterogeneously distributed in space and time, due to urban-scale chemistry, heat from fires, intense convection, and high atmospheric water loadings.

This work uses a combination of chemical and optical measurements from both surface and remotely sensed platforms, in combination with fundamental physical and atmospheric chemical models, to quantify the timing and amount of emissions, aging, and method of the transport of the aerosols. Measurements are taken from multiple platforms, and look at multiple species, directly and indirectly related to BC, including: fires, extinction, AOD, and trace gasses.

Comparisons of the inverse-modeled results are shown to match well under both El Nino (2006) and typical (2010) years. Furthermore, the signal can be observed by more precise instruments far away from the source regions.

A sensitivity analysis is performed and used to quantify the drivers behind the underestimate in the free tropospheric loading. It is found that a combination of underestimated fires, convective feedback, underestimated emissions, and insufficient aging are all responsible. Applications of these results to other Monsoon regions will be discussed.