

Integrating Multiple Satellite Measurements with Decadal Surface Deposition Measurements to Classify and Model Asian Wet Deposition over Decadal Scales

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South East Asia and East Asia have been recognized as regions where rapid economic development contributes to a significant amount of urban and biomass burning emissions. However, the connections between emissions, deposition, and impacts on the Earth System are poorly understood and ill-constrained, especially so when the effects of a changing climate, via changes in precipitation, temperature, the distribution of the Monsoon, and aspects of long-range transport of nutrients are all considered.

This work shows the results of a new classification scheme based upon 16 years of wet deposition measurements throughout South East and East Asia. The results are combined with remotely sensed measurements of gasses and precipitation to better comprehend the underlying processes. The precision and chemical depth provided by the deposition measurements are integrated with the spatial and temporal advantages of the remotely sensed measurements to allow us to extrapolate over the entire Asian Continent.

We identify regions of urban change, long-range transport, enhancement of deposition with a decrease in precipitation, and other interesting and non-easily explained relationships. The known physical and chemical relationships are tested and found to not behave as simply as expected. To aid in further simulation and prediction, simple models and machine learning tools are adopted and their strengths and weakness are evaluated.

Finally, we compute the ecological impact of the wet deposition under the changing climate across the region, and determine that over the decadal scale, the impacts on the land surface ecosystem are quite significant, and presently underestimated. This is done within both the simplified modeling scheme, and within the CESM framework, so as to understand the impacts complexity and feedback when using such a combined numerical and basic physical modeling approach.