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Using Variance Maximization with Multi-species Measurements to Pinpoint the Sources and Long Range Transport of Biomass Burning over the Past 15 Years

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Trace gases and aerosols in the troposphere exhibit significant variability, particularly so over regions where biomass burning occurs, and downwind of both biomass burning and large urban areas. Knowledge and quantification of the mean, trends, and most importantly variance over these source regions and their downwind plumes over climatological scales can therefore be used to retrieve information about both the source amounts as well as the amounts transported.

In this work, we pinpoint a way to separate these regions from one another by simultaneously employing a variance maximization approach to global weekly column measurements of OMI NO_2 (which has a very short atmospheric lifetime) and MOPITT CO (which has a relatively long atmospheric lifetime) from the past decade and a half. The variance maximization is done using the EOF/PCA approach, and yields important results in northern Australia, Indonesia, northern Southeast Asia, Siberia, central and southern Africa, Amazonia and California. We then compare and contrast the spatial and temporal results in terms of the difference in the atmospheric lifetime of the co-emitted species. We specifically look for an overlap between the two over the source regions, and a strong signal in CO exclusively over both the source and downwind transport regions.

This technique improves upon the current generation of bottom-up techniques detecting land-use change and hotspots, in terms of offering higher temporal resolution and better representations under cloud cover. However, to further improve the work, we hope to employ AOD measurements to refine our results, as co-emitted aerosols like BC are sensitive to precipitation, and thus able to pick up the source and transport under different precipitation conditions.