6.151 Formaldehyde column density measurements as a suitable pathway to estimate near-surface ozone tendencies from space.

Early Career Scientist

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Abstract:

In support of future satellite missions, NASA's DISCOVER-AQ field campaign was designed to enable exploration of relationships between column measurements of trace species relevant to air quality at high spatial and temporal resolution. Because CH_2O has a very short lifetime, its vertical distribution is heavily weighted towards the surface and any correlation between CH_2O and O_3 has the potential to be useful in estimating near-surface O_3 tendencies from space. Initial analysis of DISCOVER-AQ data showed a modest correlation between column measurements of CH_2O and O_3, and further analysis revealed distinct behavioral differences in the O_3-CH_2O relationship between data collected in Maryland and Houston. In Maryland, we found that the O_3-CH_2O relationship was strongest when there was high temporal variability in CH_2O column densities. In Houston, on the other hand, approaching the dataset from a spatial perspective revealed interesting behavior and suggested that time-dependent transport of emissions from the ship channel area obfuscated the observed O_3-CH_2O relationship. In Maryland, a strong diurnal pattern in biogenic emissions caused CH_2O to, in general, increase monotonically throughout the day. In Houston, however, anthropogenic emissions from the ship channel dominated the local hydrocarbon environment, and no discernable diurnal trend in CH_2O was observed. Box model simulations suggest that ambient CH_2O mixing ratios have a weak diurnal trend unless concurrent changes in the local hydrocarbon oxidation environment occur. When a diurnal trend in isoprene was introduced to model simulations, co-variance between O_3 and CH_2O was predicted, which is in agreement with our observations. While additional measurements and studies involving 3D models would be necessary to validate these results and determine the regional applicability of the O_3-CH_2O relationship, the results presented here provide compelling insight into the ability of future satellite missions to aid in monitoring near-surface air quality.