1.068 Volatile organic compound emissions in the South China Sea during the 2011 VASCO Cruise: sources, emission rates, and ozone formation potential.

Early Career Scientist

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Abstract:

As part of the Seven Southeast Asian Studies (7SEAS) program, air sampling was conducted on the M/Y Vasco over a two-week research cruise in late September 2011 in the Northern Palawan region of the South China Sea (SCS) to observe the temporal behavior of atmospheric aerosol properties and their relationships to meteorology during the Southwest monsoon. Whole air samples from the cruise, with over 60 identified trace gases, were analyzed to identify potential sources, emissions and ozone formation potentials (OFPs). Based on HYSPLIT ensemble back-trajectories and MODIS Active Fire satellite data, the two periods of enhanced VOC concentrations observed are dominated by contributions from biomass burning. However, because the air masses were transported over long distances, this paper further discusses the influence of photochemical aging and other regional sources mixed into the plume. To identify the sources, positive matrix factorization (PMF) is applied. Six factors are identified with the following contributions: biomass burning (19.2%), urban emissions (48.4%), industrial emissions (8.5%), ships (7.9%), marine emissions (10.6%), and a mixed source (5.3%). Normalized excess mixing ratios (NEMRs) are calculated with respect to CO to isolate

combustion-related emissions. NEMRs for three VOCs (ethyne, benzene, 3-Methyl-2-$BuONO_2$) showed high correlation (R^2>0.8) and eight (CH_3I, ethane, CH_3Cl, 2-$BuONO_2$, 3-$PenONO_2$, 2-$PenONO_2$, $CHCl_3$, $EtONO_2$) showed moderately high correlation (0.8>R^2 >0.5) with CO. These calculations were robust, consistent using both linear regression and source-tracer-ratio (STR) methods. These NEMRs represent the integrated regional emissions attributed to combustion-related sources. Finally, the OFPs of individual VOCs and of each source are quantified using the maximum incremental reactivity (MIR) scale. Within the plumes, OFP is 2-3 times above background, even at a receptor point distant from large emission sources. This characterization of emissions, particularly combustion-related ones, offers insight into the long-range impact of biomass burning and other sources within the SCS region.