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Improving biomass burning pollution predictions in Singapore using AERONET and Lidar observations.

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Every year millions of people are affected by poor air quality from trans-boundary smoke haze emitted from large scale biomass burning in Asia. These fires are a particular problem in the Indonesian regions of Sumatra and Kalimantan where peat fires, lit to clear land for oil palm plantations and agriculture, typically result in high levels of particulate matter (PM) emissions. In June 2013 and from August-October 2015 the combination of widespread burning, meteorological and climatological conditions resulted in severe air pollution throughout Southeast Asia.

The Met Office of the United Kingdom (UKMO) and the Hazard and Risk Impact Assessment Unit of the Meteorological Service of Singapore (MSS) have developed a quantitative haze forecast to provide a reliable, routine warning of haze events in the Singapore region. The forecast system uses the UKMO's Lagrangian particle dispersion model NAME (Numerical Atmosphere-dispersion Modelling Environment) in combination with high resolution, satellite based emission data from the Global Fire Emissions System (GFAS).

The buoyancy of biomass burning smoke and it's rise through the atmosphere has a large impact on the amount of air pollution at the Earth's surface. This is important in Singapore, which is affected by pollution that has travelled long distances and that will have a vertical distribution influenced by meteorology. The vertical distribution of atmospheric aerosol can be observed by Lidar which provides information about haze plume structure. NAME output from two severe haze periods that occurred in June 2013 and from August-October 2015 was compared with observations of total column aerosol optical depth (AOD) from AERONET stations in Singapore and the surrounding region, as well as vertically resolved Lidar data from a station maintained by MSS and from MPLNET.

Comparing total column and vertically resolved AOD observations with NAME output indicates that the model underestimates PM concentrations throughout the column. This discrepancy may arise from i) too low emissions of PM, ii) uncertainties in the long range transport of PM or iii) the role of the boundary layer in NWP, all of which are being explored at UKMO and MSS. This study gives a more comprehensive evaluation of the model's performance and indicates that vertically resolved AOD data may be useful as a model input for the haze forecast system.