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Regional Pollutant Dispersion from Sumatra Forest Fires

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In Sumatra and Kalimantan, fire is commonly used to clear plantation land and logging debris. During dry spells, the fires readily burn out of control and spread over large areas. Dense smoke generated by the fires envelops the region for months. This problem was especially severe in 1997-1998 as maritime Southeast Asia experienced an extended drought, brought on by an intense El Niño event. This work is our attempt at simulating the dispersion of smoke haze in Southeast Asia, with the aim of understanding the relative importance of the effects of advection by the mean winds and the strong diurnal variations of the turbulent transports within the planetary boundary layer.

We used the atmospheric module of the Coupled Ocean / Atmosphere Mesoscale Prediction System (COAMPS^{TM})[1] to predict the weather and pollutant dispersion over the Sumatra-Malaya-Borneo region in the period 2 - 5 Sep 1999 during the southwest monsoon season. Satellite pictures show that there were a number of hot spots in Sumatra during this period. To represent the injection of smoke into the atmosphere by a forest fire in Sumatra, a hypothetical source is placed at location (102.5ºE, 0ºN) and 55m above the surface. The source emits smoke continuously starting from 00 UTC 2 Sep 1999. The emitted smoke is idealized as a neutrally buoyant and chemically inert tracer. It is carried by winds and mixed through the boundary layer by turbulent eddies.

Our results show that smoke is first lifted out of the planetary boundary layer (PBL) by confluent low-level sea breezes over Sumatra, and subsequently transported eastwards above the PBL by westerly winds over South China Sea to Borneo. During daytime, the PBL over Borneo deepens and atmospheric turbulence entrains smoke from the upper air to the surface in west Borneo. At night, the PBL is shallow so that turbulent transport of smoke to the surface is much reduced. The importance of a realistic simulation of the turbulent transports within the PBL, including their diurnal variation is highlighted, as these processes have strong influences on the surface pollutant density.

[1] *COAMPS is a registered trademark of US Naval Research Laboratory.*

Keywords: haze; forest fire; tracer transport; planetary boundary layer.