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Vertical transport of air pollution in the Himalaya

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The vertical component of winds in mountain areas plays a crucial role in transporting gases and aerosols to higher elevations. Accurate simulation of pollutant transport in mountain areas requires very fine resolution in order to correctly capture surface properties and winds that vary rapidly in space. We present results of two studies of air pollution transport in the Himalaya.

First, we used tracer simulations driven by the meso-scale meteorological model MM5, and more recently the newer model WRF, to examine the pathways traveled by air pollutants emitted within the Kathmandu Valley, Nepal. We found that pollutants emitted in the morning traveled up mountain slopes to elevations higher than the peaks, while those emitted in the afternoon traveled out of the valley through mountain passes without ever rising to the height of the peaks. Vertical mixing over the Kathmandu Valley was suppressed during the afternoon because of the arrival through upwind mountain passes of air with a lower potential temperature that originated over regions of lower elevation. Pollutants emitted at night were unable to leave the Kathmandu Valley's air mass, but they were lifted slightly by arriving katabatic winds that pushed underneath the air already in the valley. These pollutants were mixed back down to the surface once a mixed layer started growing the next morning.

Second, we present preliminary results of an ongoing modeling study to quantify the topographic venting of Ganges Valley air by wind systems in the Himalaya. We hypothesize that during winter months, when the Ganges Valley is covered by fog or thick haze which suppresses vertical mixing, the up-valley and up-slope winds in the nearby Himalaya play a crucial role in transporting pollutants emitted within the

Ganges Plains to elevations at which the jet stream can transport them long distances.