Meteorological control of air pollution in a complex topography, high-altitude valley in the Tropical Andes

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About two-thirds of the Latin-American population lives on the Andes. In Colombia, 70% of the population lives at altitudes over 1 km above the sea level (ASL) on a complex topography 3 Andean mountain-chain system. Understanding and properly modeling air pollution in the Tropical Andes is thus a challenging task not just because of the complexity of horizontal and vertical transport in the Intertropical Convergence Zone but because of the strong influence of regional- and local-scale circulation phenomena. The Sogamoso Valley (5 degrees 43' N, 72 degrees 55' W, 2570 m ASL), located on the Colombian Andes Eastern Mountain Chain, is one of the most industrialized regions of Colombia. Air quality in this region is affected by a heterogeneous group of emission sources, which include truck traffic, heavy industry (including steelworks and cement), medium- and small-scale industry, and around 600 low-technology, highly polluting brick and quicklime production furnaces. 24-h average PM10 concentrations frequently double the Colombian standard (150 µg/m3). Measurements and analysis conducted in 2002 found that relatively rapid changes in the regional atmospheric circulation patterns strongly influence the Sogamoso Valley air quality, including drastic PM10 concentration variations observed during periods of fairly steady emissions. The strong linear dependence of the daily temperature variation amplitude and the maximum wind speed on the daily accumulated solar radiation suggests that air quality is ultimately determined by the synoptic activation of local and mesoscale circulation patterns and meteorological conditions, including mountain and valley winds, strong anabatic and katabatic winds from the lowlands (at both sides of the Colombian Andes Eastern Mountain Chain), channeling, and radiative cooling temperature inversion. During clear sky periods, katabatic advection of pollution from furnaces on the foothills resulted in recurrent nocturnal pollution episodes with elevated SO2 and CO concentrations. During the same periods, ground-level and tethered balloon O3 measurements indicate that local production of ozone (~6 ppbv/h) above the

background level (~30 ppbv) is regularly interrupted at around midday upon arrival of strong and clean katabatic winds from the Eastern Plains, which ventilate the Sogamoso Valley.

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