

Regional Measurements and Modeling of Windblown Agricultural Dust: The Columbia Plateau PM₁₀ program

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ABSTRACT

The Columbia Plateau PM₁₀ Program (CP³) is a multi-investigator study of windblown dust in the Pacific Northwest with an emphasis upon the role of agricultural lands in regional dust storms. Ambient measurements of PM₁₀ within the source areas of the central basin of Washington during several fall dust periods show that typical background concentrations (non-wind event periods) decrease from an average of 34 $\mu\text{g m}^{-3}$ in early fall to 10 $\mu\text{g m}^{-3}$ in late fall. During wind events, ambient concentrations at downwind urban receptors can exceed 500 $\mu\text{g m}^{-3}$ on an hourly basis with 24 hr averaged values as high as 300 $\mu\text{g m}^{-3}$. Particle counts during wind events are enhanced by as much as a factor of five for particle sizes greater than 5 μm , and particle counts are also increased for sizes between 1 and 5 μm compared to non-windy periods. Analysis of the synoptic conditions which exist during these dust storms showed a common situation where a surface low is moving rapidly across British Columbia while a surface high is positioned in the Great Basin of Nevada. A regional windblown dust air quality model, developed for the CP³ study, predicts large dust plumes stretching across eastern Washington with maximum concentrations in the source regions exceeding 10000 $\mu\text{g m}^{-3}$. Total mass emissions during a storm are estimated to equal 100 Gg day⁻¹ which represents about 1% of recent estimates of the global annual dust emission rate. In the initial applications of the model, available PM₁₀ observations are used to calibrate the dust emission algorithm. Changes in the dust constant for two modeled events are consistent with changes in soil cover and accumulated precipitation between an early fall event and a late fall event. The estimated fluxes are in a range similar to those in the literature, but appear to be much less than estimated from global modeling of recently disturbed soils.