

PM₁₀ Emission from Agricultural Soils on the Columbia Plateau: Comparison of Dynamic and Time Integrated Field Scale Measurements and Entrainment Mechanisms

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Emission of particles less than 10 μm mean diameter (PM₁₀) from agricultural sources is an environmental issue due to health concerns and potential effects on local and global climate. The Columbia Plateau region of Washington and Oregon contains vast deposits of fine loess soils and is an active PM₁₀ emission source. An instrumented field site was established to continuously monitor meteorological conditions and PM₁₀ concentrations at 10 min intervals during periods of high winds (defined as sustained wind speeds $>5 \text{ m s}^{-1}$ at 2 m height) during the 2001 and 2002 field seasons. Time-integrated measurements of PM₁₀ and total soil movement were made using high volume air samplers (HiVols) and BSNE sediment traps, respectively. Particle impact sensors (Sensits[®]) monitored particle movement (i.e. saltation) close to the surface. Tapered element oscillating microbalances (TEOMs) and wind velocity profiles were utilized to examine short-time-interval dust emission dynamics of fallow, dryland fields. TEOM data clearly identified periods of active PM₁₀ emission. TEOM and HiVol PM₁₀ concentrations integrated during high wind events (HWE) showed excellent agreement. Time-integrated PM₁₀ concentrations were well-correlated with horizontal soil mass transport. However, few saltator impacts were recorded during high wind events. Analysis of wind velocity profiles and friction velocities indicated little saltation was occurring. In general, for continuous emission of PM₁₀ from fallow fields with dust mulch conditions, threshold friction velocity was approximately 0.4 m s^{-1} and threshold velocity was approximately 8 m s^{-1} . Several wind events showed evidence where PM₁₀ concentration gradients were extremely small, the PM₁₀ being well-mixed between 1 and 3 m heights.