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Modeling of Wind-blown Dust Emissions at Owens (dry) Lake, CA

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Abstract

A method for estimating F_a, the vertical flux of wind erosion resuspension particles smaller than 10 micrometers (PM10), was developed for Owens Lake, a large dust-source area in California. Owing to the size of the potentially dust-emitting dry lake bed (about 130 km^2) and the large effort and expense to rigorously measure vertical mass fluxes using micometeorological methods, an alternate method was developed to use cheaper and more easily accomplished measurements. The method used the model of Shao that expresses the vertical particle flux of suspended particles produced by impact of saltating particles

$$\frac{F_a}{q} = K' \frac{m_d}{\Psi} \qquad (1)$$

where □ is binding energy, K' is a constant, q is the integrated horizontal flux of airborne particle mass from the ground to 1 meter height and m_d is the mass per particle. We assumed that the ratio F_a/q [equivalent to K' m_d/□] could be taken as a constant for scales of a few hundred square meters of the lake-bed and could be evaluated by using field-scale experimental data. Our method required detailed large scale measurements of q, high quality measurements of PM10 at several locations near the shoreline of Owens Lake and use of a transport model for emitted dust from the lake surface. We estimated F_a/q values for the most active areas of dust emissions at Owens Lake as follows:

(1) Sand fluxes (q) were measured in a grid of 130 sand flux samplers. The grid has a separation distances of 1 km.

(2) Concentration of PM10 were measured at several locations along the shoreline of Owens

(3) Concentrations were modeled using CALPUFF. Initially, a "first guess" value for F_a/q was used with the 130 q values to give the F_a (vertical fluxes of PM10) for each 1km^2 area of Owens Lake. These F_a values were used in the model and the concentration field is calculated.

(4) The ratios of the calculated concentrations at the locations of the TEOM instruments to the actual concentrations are found. Using the mean of these ratios the "first guess" F_a/q value is adjusted so that the predicted and measured concentrations agree–one F_a/q value is found for each hour of a dust storm.

(5) Owens Lake was divided into three areas having similar surface characteristics. Using appropriate data selection, one-hour F_a /q values that apply to the three distinct source areas of the lake were calculated.