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The importance of sea spray in the heat and freshwater budgets of storms

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A summer storm south of Iceland in June, 1998 was characterized by strong upper ocean fluxes of heat and freshwater that resulted in dramatic perturbations of near-surface temperature and salinity. The underway temperature and salinity time series were assimilated into a series of nine upper ocean boundary layer models to deduce the probable air-sea fluxes during the storm. The freshwater input from this inverse procedure was much higher from estimates based on bulk parameterization of the latent heat flux. The magnitude of the implied surface freshwater loss was consistent with enhanced evaporation from wind-generated sea spray. The inferred freshwater loss during the high wind event suggests that the magnitude of the sea spray volume production function may be 2 - 3 times higher than the best available parameterization with a significant reduction in the order of magnitude uncertainty of the previous work. Although rain-generated surface freshwater lenses have previously been reported, this is the first report of wind-generated surface salt lens. The technique shows promise of being able to more accurately predict sea spray latent heat fluxes during wind speeds higher than 20 m/s when direct flux measurements are dangerous and unreliable. The inferred surface heat fluxes from the data-assimilation procedure were more difficult than for the freshwater fluxes because of strong vertical advection of heat within the oceanic boundary layer. Of the seven bulk, diffusion, and transilient models tested, a recent diffusion model incorporating surface wave effects predicted the correct relationship between the strongest surface heat and freshwater fluxes during the height of the storm.