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Transient response to aerosol radiative forcing and implications for hurricanes

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The air temperature beneath a dust aerosol layer comes into equilibrium with aerosol radiative forcing by adjusting to the forcing at the top of the atmosphere (TOA). However, the adjustment time of the circulation to aerosols is long compared to hurricane lifetime, raising the question of whether the initial effect of dust upon hurricanes might be augmented by the surface radiative forcing, whose magnitude is greater than the TOA value. The reduction of net radiation into the surface beneath the aerosol layer also causes a decrease in evaporation and a potential reduction in atmospheric moisture, which is an important determinant of hurricane development. Here, we calculate the transient response of boundary layer properties that influence hurricane formation, such as surface air temperature and moisture, to aerosol radiative forcing. We use a simple model of the coupled ocean and atmosphere to illustrate the time scales and mechanisms of the temperature response to dust radiative forcing, followed by a single column version of an AGCM that allows the boundary layer temperature and moisture to adjust through a wider array of physical processes.