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Evaluation of climate sensitivity to the representation of aerosols in a coupled ocean-atmosphere global model

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Aerosol radiative forcing is one of the greatest sources of uncertainty when projecting future climate change. Aerosols vary in time and in space and alter the Earth's radiative balance directly, by absorbing and scattering radiation, and indirectly, by interacting with clouds and altering cloud microphysics.

A series of sensitivity tests were performed using the coupled ocean-atmosphere general circulation model CNRM-CM in order to investigate how the representation of aerosols within the model can affect climate. These tests included looking at the difference between using constant emissions versus using emissions that evolve over a period of thirty years; examining the impacts of including indirect effects from sea salt and organics; altering the aerosol optical properties; altering the vertical distribution of aerosols, and using an interactive aerosol scheme versus using 2-D climatologies. The results of these sensitivity tests show how modifying certain aspects of the aerosol scheme can significantly affect radiative flux, the cloud radiative effect and global surface temperatures. Of particular note is the importance of the indirect effect of sea salt aerosols, which has more of a significant impact upon climate than the direct radiative forcing of sea salt aerosols; and the impact of using an interactive aerosol scheme instead of 2-D climatologies, which results in more net radiative flux at the top of the atmosphere and slightly warmer temperatures at land surfaces.