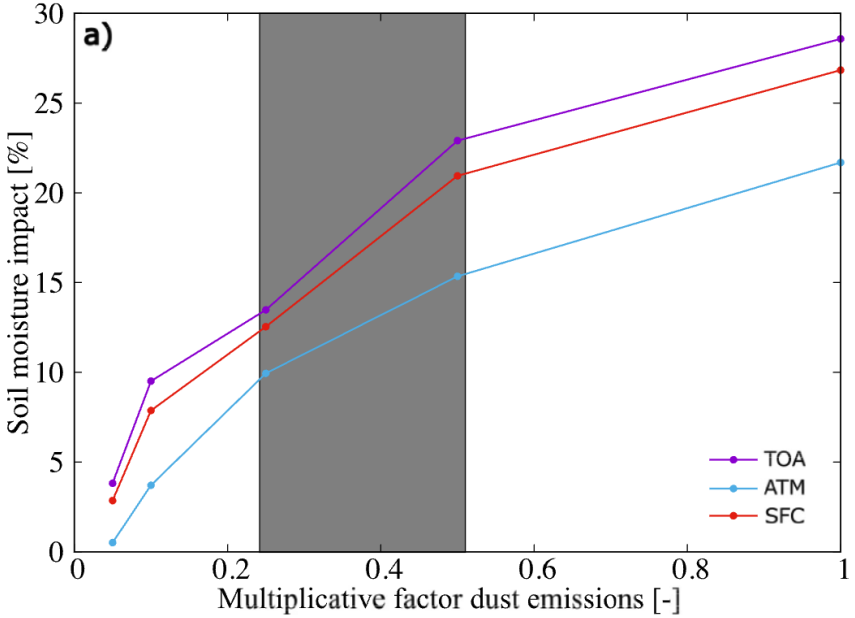
Soil moisture modulations introduce non-negligible impacts on the dust direct radiative effect

Problem: Soil moisture increases the cohesive forces of soil particles, making it more difficult to lift the particles by the wind. As a result, the soil moisture modulates the airborne dust abundance, which in turn modulates the Earth's radiative balance. The importance of these soil moisture modulations on the radiative balance is unknown, however.



Finding: We focus on the contiguous U.S. due to the presence of important dust sources and good observational networks. The soil moisture impacts, defined by comparing WRF-Chem simulations imposing the SMAP soil moisture retrievals with positive/negative soil moisture anomalies in the dust emissions, introduce an impact of around 15% in the net radiation at the top of the atmosphere and surface, and a smaller impact in the atmosphere.

Soil moisture impact on the direct radiative effect as a function of the level of dust emissions for the year of 2015 for the net radiation at the top of the atmosphere (TOA, purple), atmosphere (ATM, light blue), and surface (SFC, red). The gray shaded area corresponds to the most realistic range of emissions after comparison with observations.

Impact: The soil moisture modulations of the dust direct radiative effect are non-negligible, revealing a clear connection between the hydrological and energy cycles in the atmosphere.

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