Direct Radiative Effects of Dust Events Over Limassol, Cyprus in 2024 using Ground-Based Measurements and Modelling

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Dust plays a significant role in the atmospheric radiative balance by altering both shortwave and longwave radiation fluxes. While deserts are the primary sources of dust emissions, atmospheric circulation can transport dust over long distances, impacting air quality and climate in remote regions. These transport episodes, commonly known as dust events, vary in intensity and effects. Despite extensive research, uncertainties persist regarding their precise radiative impacts.

This study examines the direct radiative effects of dust events in 2024 (a year marked by heightened dust activity) over Limassol, Cyprus. A comprehensive approach is employed, integrating radiative transfer modelling, ground-based solar radiation measurements, and dust optical property analysis. The LibRadtran radiative transfer package is used to simulate atmospheric radiative transfer under dust-laden conditions, incorporating key dust optical properties such as Aerosol Optical Depth, Single Scattering Albedo, and the Asymmetry Parameter retrieved from the Limassol's AERONET station. Observations from solar radiation station at the Cyprus University of Technology (including global, direct, and diffuse irradiance measurements) serve as validation for the model.

The study quantifies the radiative impact of dust by evaluating changes in surface irradiance and radiative forcing efficiencies, providing valuable insights into the role of dust in atmospheric energy balance.

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