Dust Storm Events in Northeast China by Ground Based, Satellite and GEOS-Chem Modeling Data

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Abstract

We present the results of an analysis of dust storm events in Northeast China using a multi-platform, model-based approach covering 2015-2025. The study integrates data from ground-based sensors (AERONET, low-cost PM monitors), satellite observations, and model simulations (GEOS-Chem). Key findings reveal that dust aerosols are mainly transported from the Gobi and Taklimakan deserts and significantly impact air quality in the region. The western part of Northeast China is experiencing the highest dust concentrations. Analysis of aerosol optical properties during dust events shows sharp increases in AOD and decreases in the Ångström exponent, indicating a dominance of coarse-mode particles. Cluster analysis effectively reveals the dust events from other aerosol types produced by smoke outbreaks. GEOS-Chem simulations and back-trajectory analysis confirm the prevailing northwest origin of dust transport. The study also identifies seasonal patterns in dust distribution and transport pathways across five sub-areas of the Northeast China region. The dust fractional distribution, averaged over sub-areas and 2015–2023, shows a greater proportion of larger dust particles in the western part of the region than in the northern part (22% versus 6%). We compared dust aerosol concentrations simulated by GEOS-Chem with observed PM_{10} concentrations. Both results show increasing dust/PM_{10} concentrations up to 300 μg m^{-3} during the most significant dust storm events.

Keywords

AERONET, Back-trajectory, Cluster Analysis, Dust Aerosol, PM_{10}, Seasonal Pattern