



*Supplement of*

## **Exploring the mechanisms of dust emission and transport based on observations and GEOS-Chem simulations**

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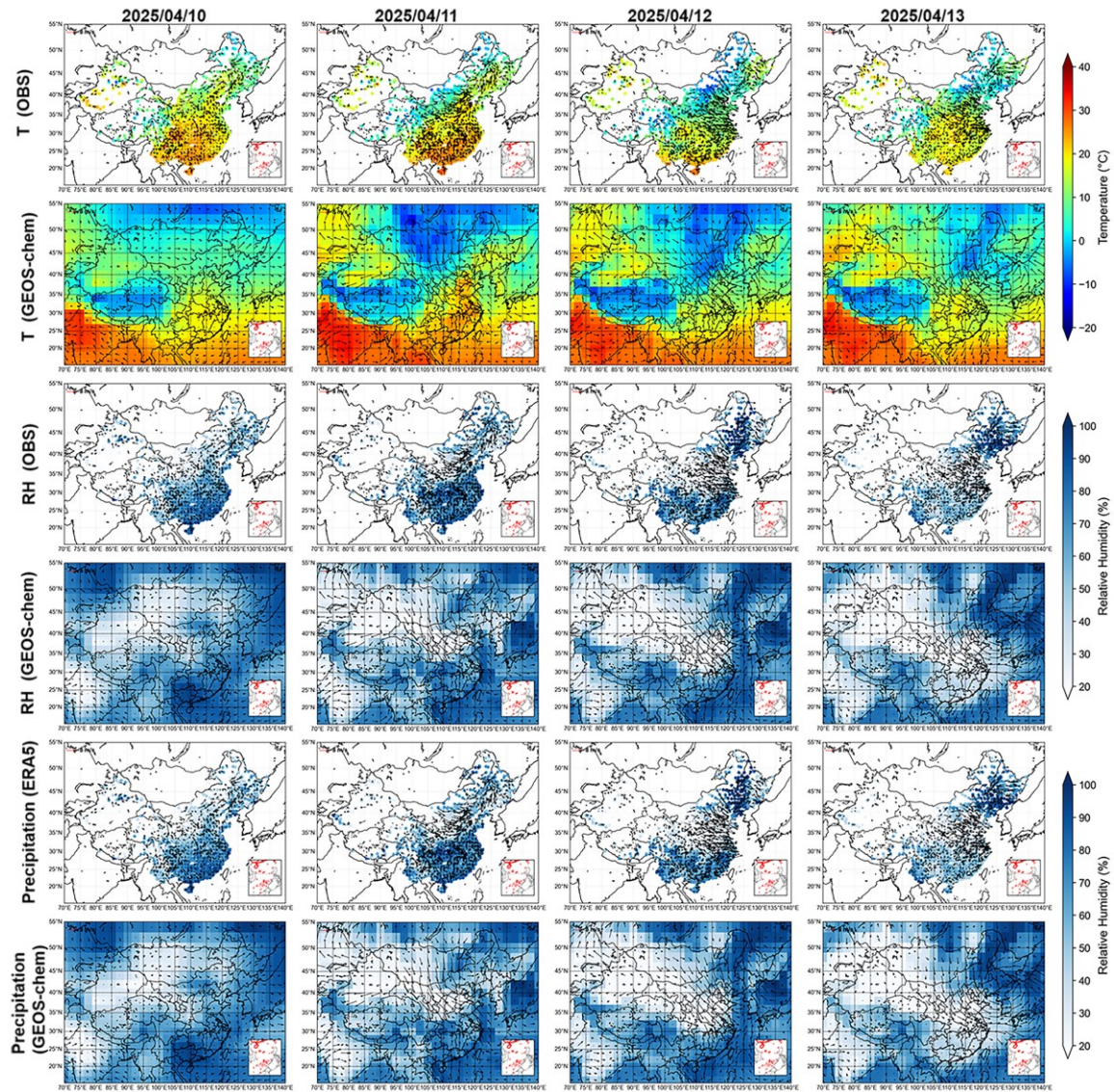


Figure S1. Comparative analysis of meteorological conditions between observations and model simulations over China during the dust event in April 2025, including daily mean temperature (T, unit: °C), daily mean relative humidity (RH, unit: %), hourly total precipitation (Precipitation, unit: mm) and surface wind fields during 10-13 April 2025 BJT. Due to the lack of station-based precipitation observations, ERA5 reanalysis data are used for comparison in precipitation.

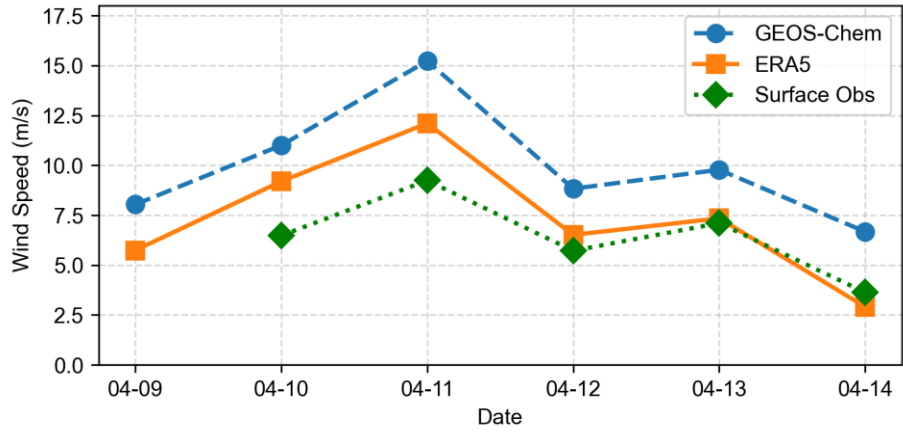


Figure S2. Time series of daily maximum surface wind speeds in the WIM region from GEOS-Chem, ERA5, and observational data, during the period April 9–14, 2025.

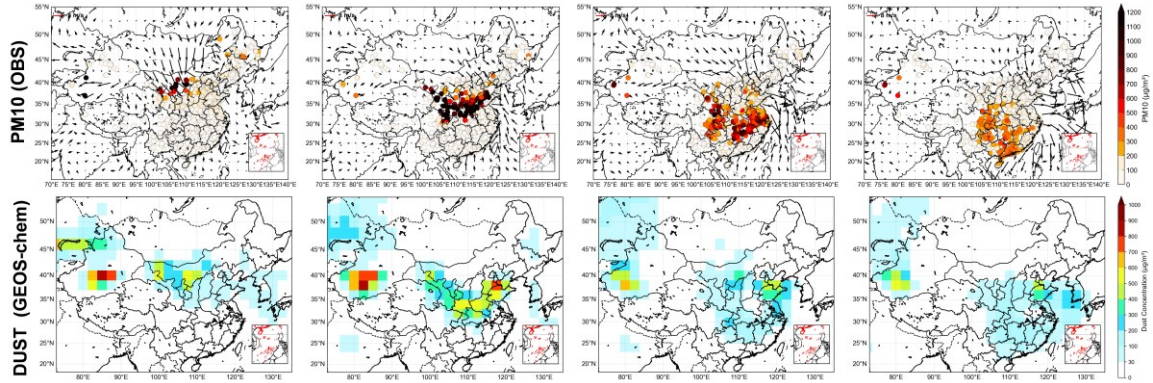


Figure S3. comparisons of simulated dust aerosol concentration ( $\mu\text{g}/\text{m}^3$ ) with observed  $\text{PM}_{10}$  concentration ( $\mu\text{g}/\text{m}^3$ ) during 11-13 April 2025 BJT. Surface wind fields data are sourced from ERA5, while  $\text{PM}_{10}$  concentration data are sourced from air quality monitoring stations.

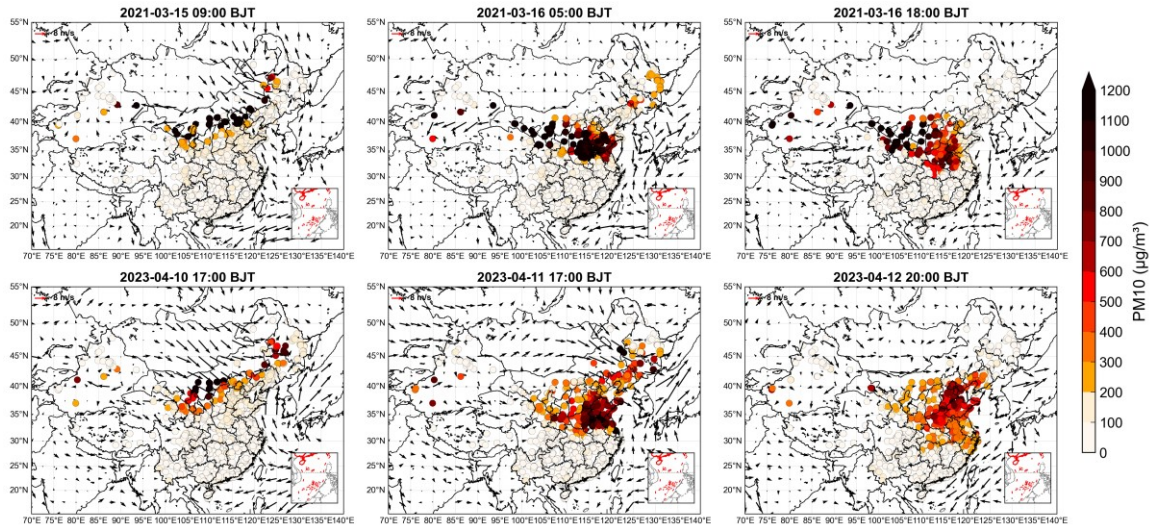


Figure S4.  $PM_{10}$  concentration ( $\mu g/m^3$ ) variations during the severe dust storm event over China in March 2021 and during the severe dust storm event in April 2023. Surface wind fields data are sourced from ERA5, while hourly  $PM_{10}$  concentration data are obtained from surface monitoring stations.

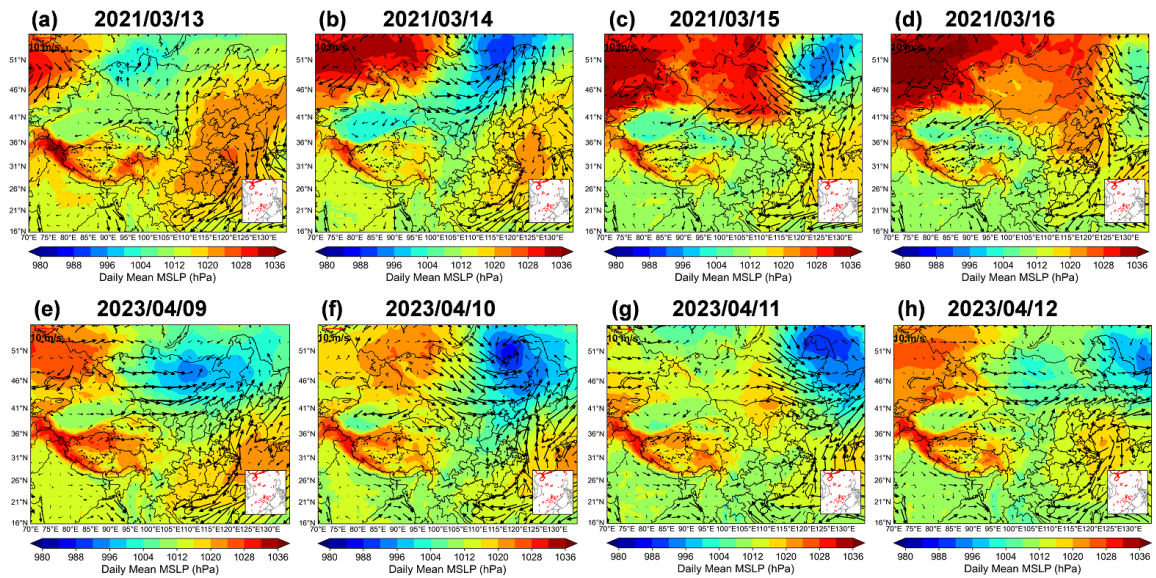


Figure S5. Spatiotemporal variations of mean sea level pressure (unite: hPa) and surface wind fields over China from ERA5 during 10-13 April 2025 (BJT) in March 2021 (a-d) and in April 2023 (e-h).