Supplementary Information for

Two mega sand and dust storm events over northern China in March 2021: transport processes, historical ranking and meteorological drivers

Ke Gui[1], Wenrui Yao[1, 2], Huizheng Che[1, *], Linchang An[3], Lei Li[1], Yu Zheng[1], Hujia Zhao[4], Lei Zhang[1], Junting Zhong[1], Yaqiang Wang[1], Xiaoye Zhang[1]

[1] State Key Laboratory of Severe Weather & Key Laboratory of Atmospheric Chemistry of CMA, Chinese Academy of Meteorological Sciences, Beijing, 100081, China
[2] Department of Atmospheric and Oceanic Sciences & Institute of Atmospheric Sciences, Fudan University, Shanghai, 200438, China
[3] National Meteorological Center, CMA, Beijing 100081, China
[4]Institute of Atmospheric Environment, China Meteorological Administration, Shenyang, 110166, China

Correspondence to: Huizheng Che (chehz@cma.gov.cn)

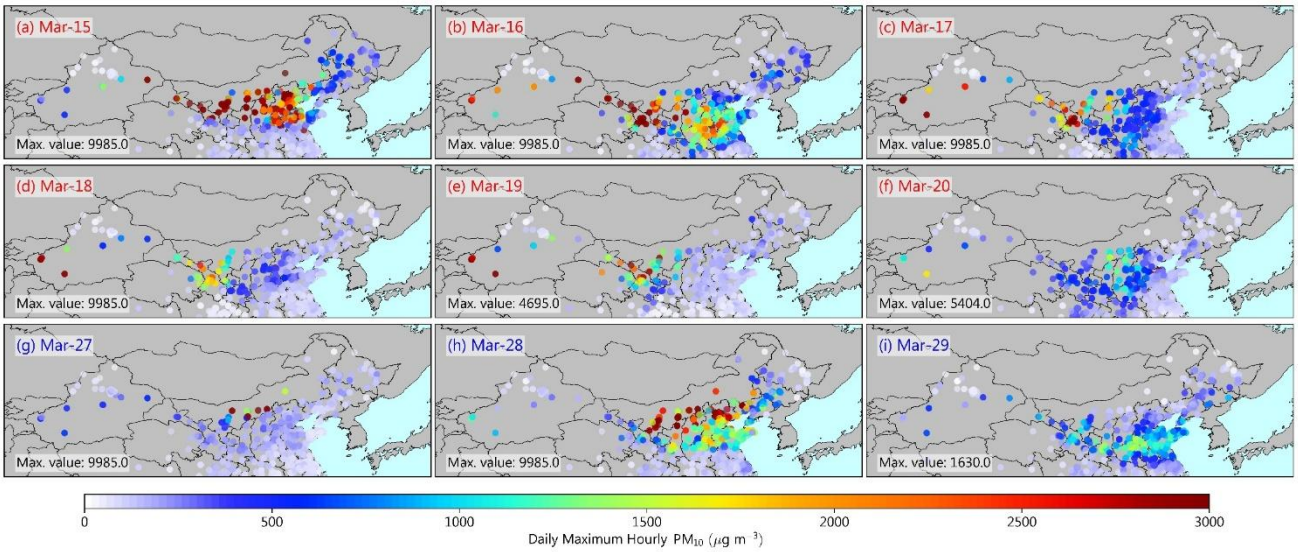

Figure S1: Evolution of observed daily maximum hourly PM_{10} concentrations during (a–f) the 3.15 event (March 15–20, 2021) and (g–i) the 3.27 event (March 27–29, 2021). The single-site maximum values of daily maximum hourly PM_{10} concentrations in northern China are marked in the lower-left of each panel.

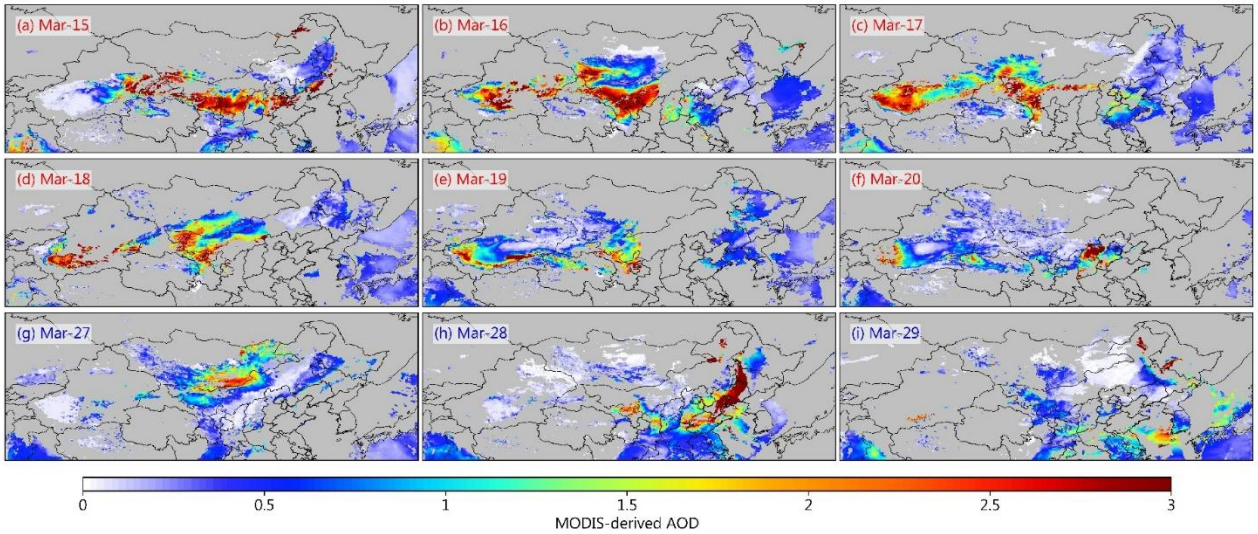

Figure S2: Evolution of Aqua and Terra combined daily mean AOD during (a–f) the 3.15 event and (g–i) the 3.27 event. Gray areas indicate MODIS-derived AOD gaps due to the presence of clouds or other unfavorable conditions that are not conducive to retrieval.

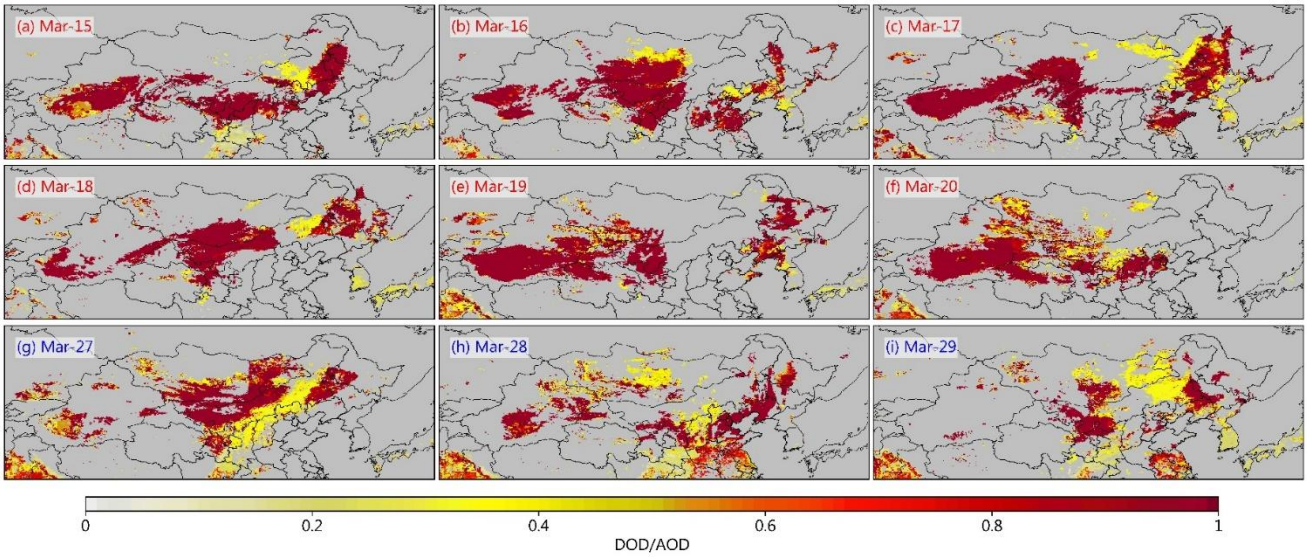

Figure S3: As in Fig. S2 but for the daily mean DOD as a proportion of total AOD.

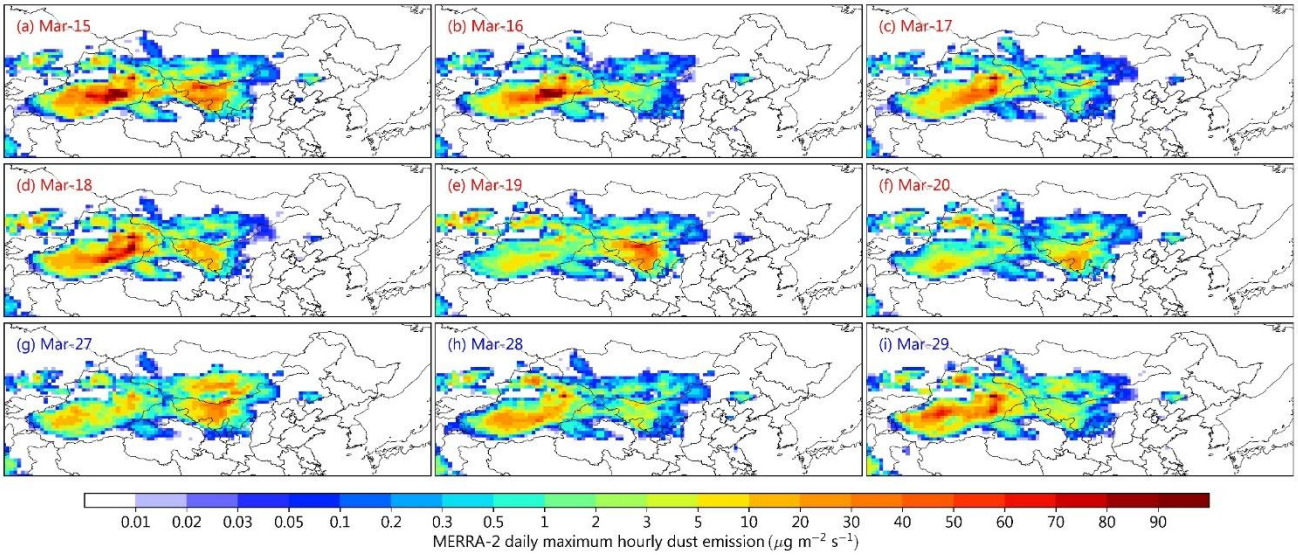

Figure S4: Evolution of MERRA-2 daily maximum hourly dust emissions for all size bins during (a–f) the 3.15 event and (g–i) the 3.27 event.

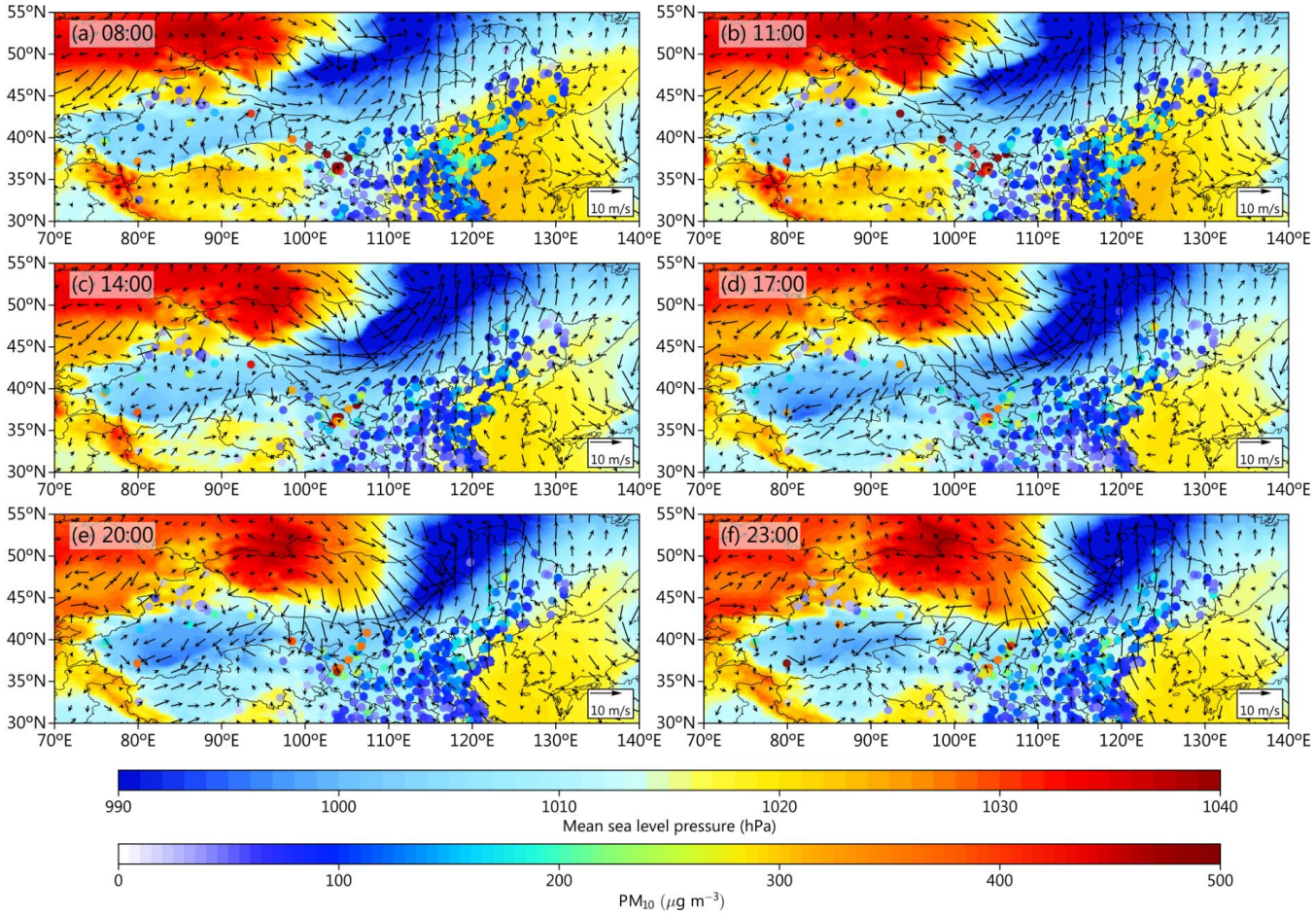

Figure S5: The 3-h pattern evolutions of ERA5 mean sea level pressure (SLP) and 10 m wind vectors at (a) 08:00 CST (China standard time), (b) 11:00, (c) 14:00, (d) 17:00, (e) 20:00, (f) 23:00 on March 14, 2021. Overlaid on the SLP is the observed 3-h PM_{10} concentrations from the CNEMC network.

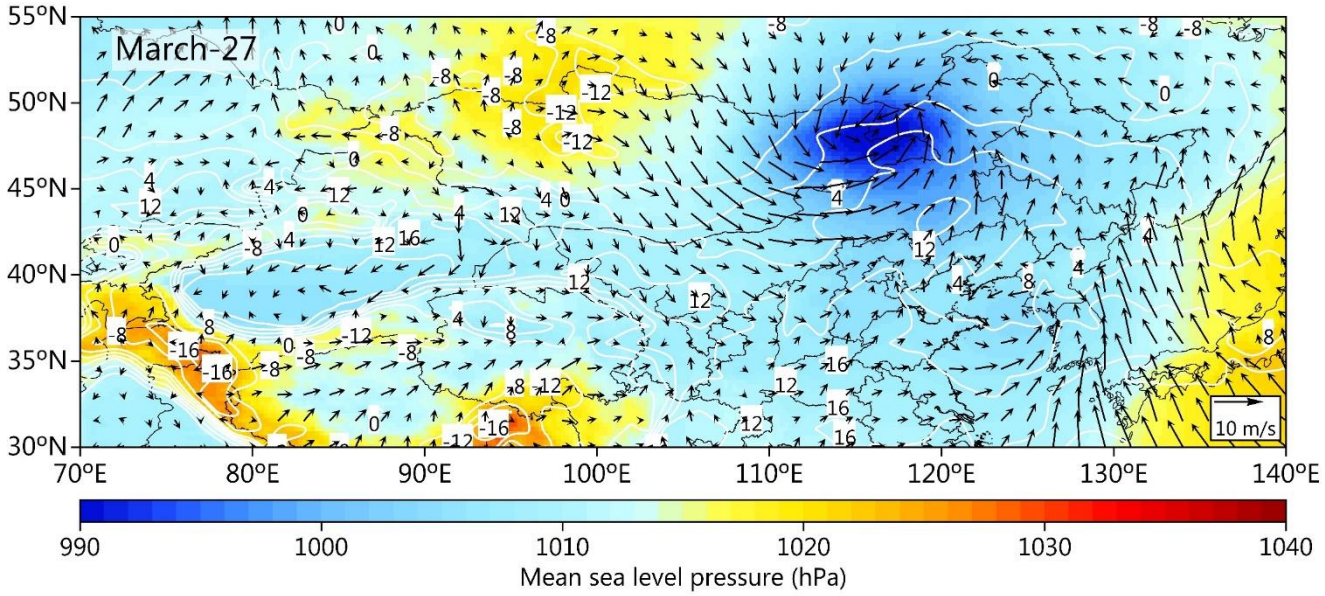

Figure S6: Daily mean SLP (shading; hPa) and temperature at 2 m (contour; ℃) on March 27, 2021. Overlaid on the map are the ERA5 wind vectors at 10 m.

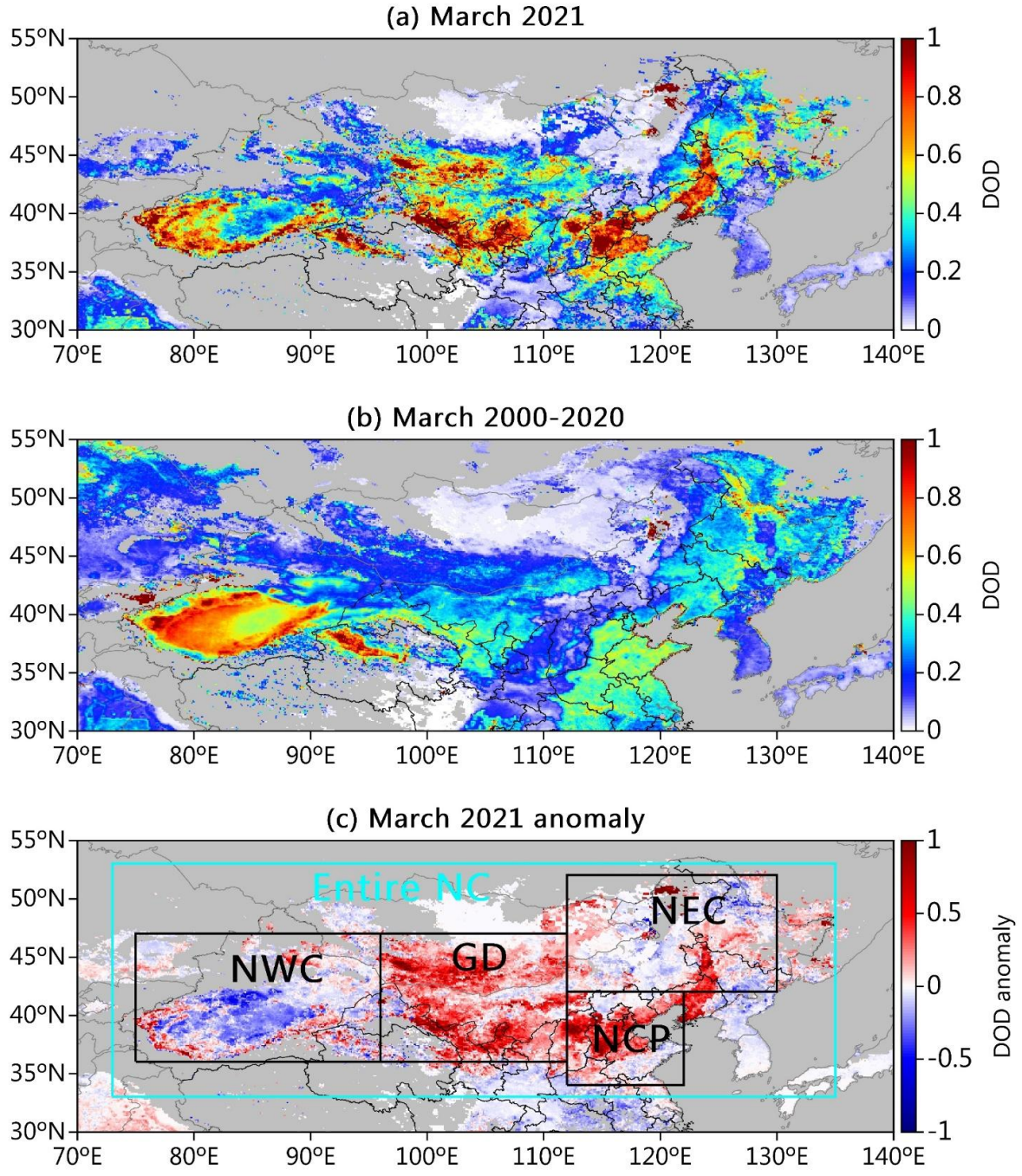

Figure S7: DOD retrieved from MODIS/Terra: (a) March 2021; (b) March climatology (2000–2020); (c) March 2021 anomaly. Cyan and black boxes denote the averaging areas for the DOD time series.

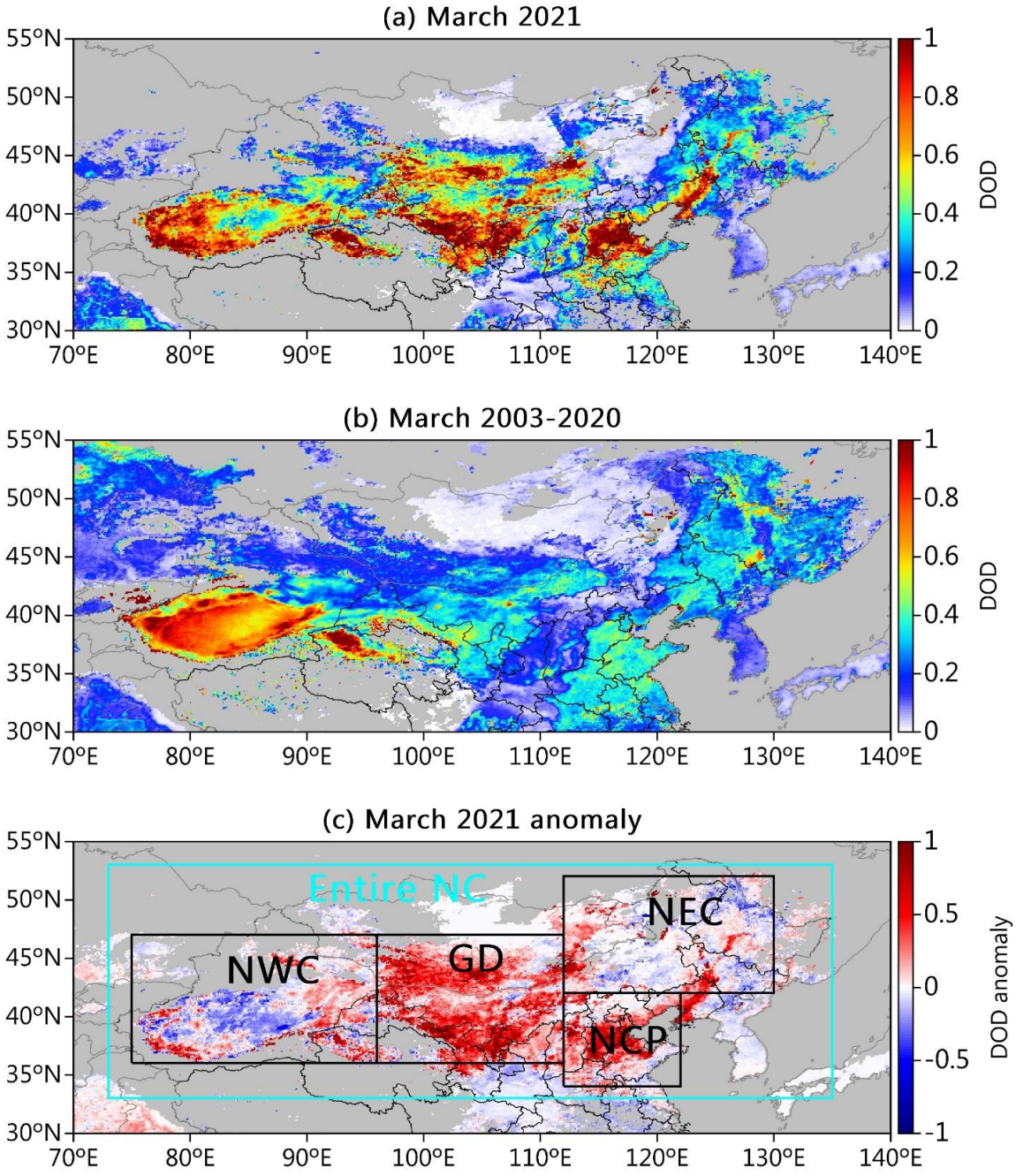

Figure S8: DOD retrieved from MODIS/Aqua: (a) March 2021; (b) March climatology (2003–2020); (c) March 2021 anomaly.

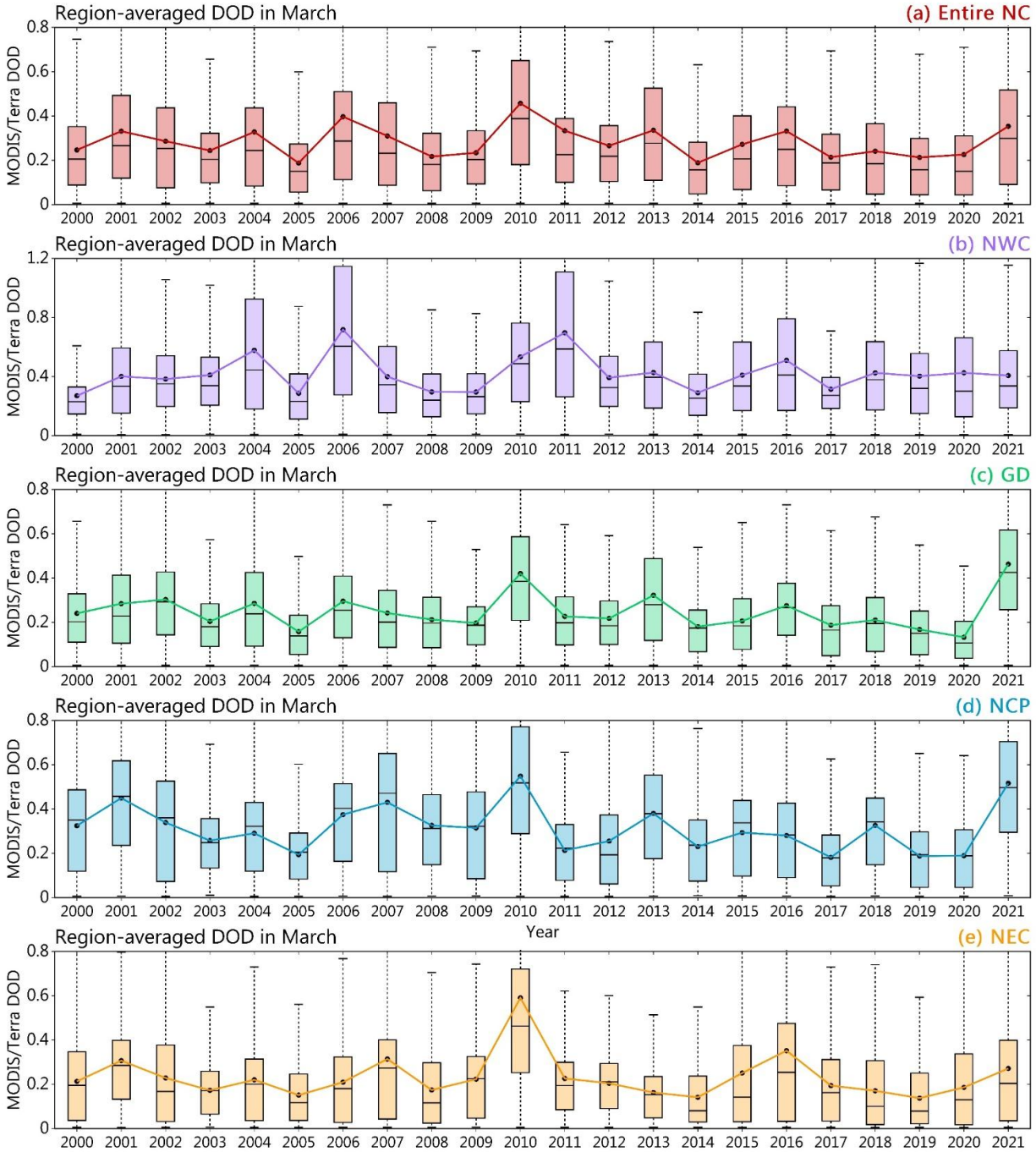

Figure S9: Time-series boxplots of the regional-averaged DOD retrieved from MODIS/Terra over (a) the entire NC region, (b) NWC, (c) the GD, (d) the NCP, and (e) NEC in March from 2000 to 2021.

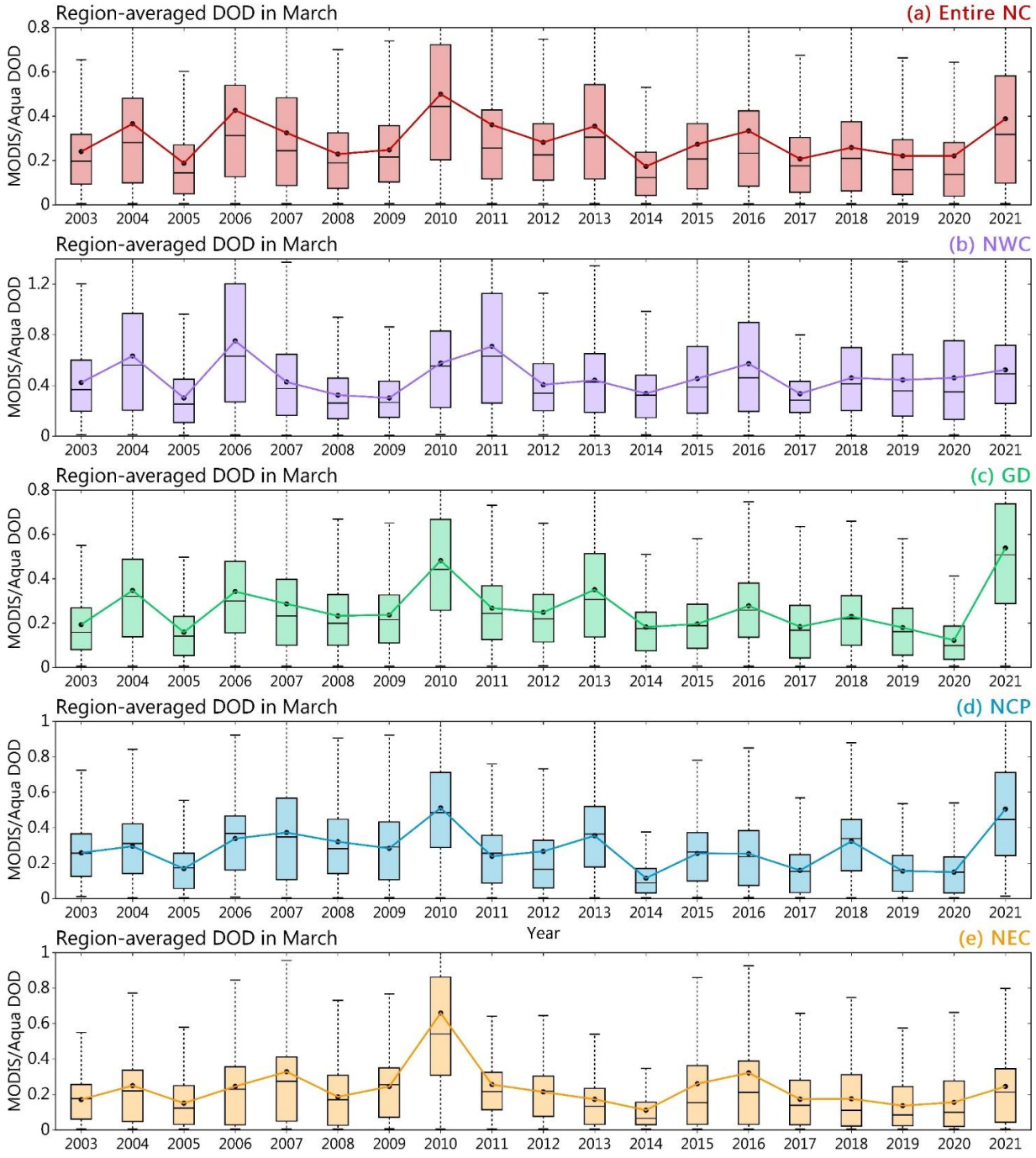

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Figure S10: Time-series boxplots of the regional-averaged DOD retrieved from MODIS/Aqua over (a) the entire NC region, (b) NWC, (c) the GD, (d) the NCP, and (e) NEC in March from 2003 to 2021.

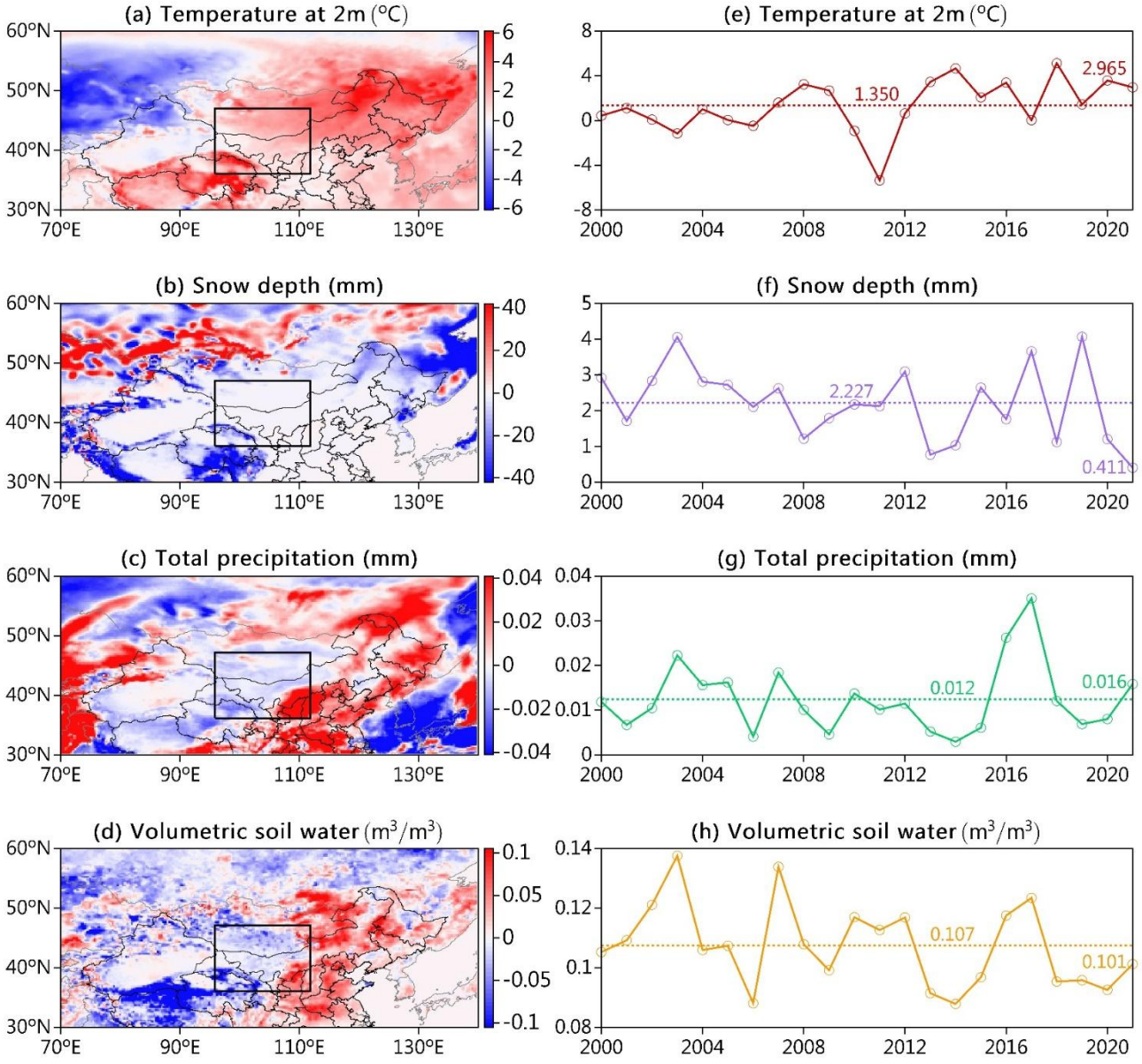

Figure S11: ERA5 meteorological anomalies two weeks before the 3.27 SDS event (March 27–29, 2021): (a–d) anomalies of temperature at 2m (℃), and snow depth (mm), total precipitation (mm), and volumetric soil water (m^3 m^{-3}) with reference to the 2000–2020 climatology. Black boxes in (a–d) denote the averaging areas (i.e., the GD; 36 °–47 °N; 96 °–112 °W) for the meteorological time series. (e–h) Time series of ERA5 meteorological factors two weeks before the 3.27 event averaged over the GD. The numbers and dashed lines represent the multi-year averages and their locations, respectively. Also, the magnitude for 2021 is labeled.