

Expanding the simulation of East Asian super dust storm: physical 2 transport mechanism impacting the western pacific

ABSTRACT

Dust models are widely applied over the East Asian region for the simulation of dust 15 emission, transport and deposition. However, due to the uncertainties in estimates of dust flux, these 16 methods still lack the necessary precision to capture the complexity of transboundary dust events. This 17 study demonstrates an improvement in the Community Multiscale Air Quality (CMAQ) model dust 18 treatment during long-range transport of dust from northwest China to the South China Sea (SCS). To 19 accomplish this, we considered a super dust storm (SDS) event in March 2010, and evaluated the dust 20 scheme by including adjustments to the recent calibration (Dust_Refined_1) and bulk density 21 (Dust_Refined_2) refinements individually and in combination (Dust_Refined_3). The Dust_Refined_3 22 normalized mean bias of PM10 was -30.73 % for the 2010 SDS event, which was lower compared to 23 Dust_Refined_1 (-41.34 %) and Dust_Refined_2 (-50.09 %). Indeed, the Dust_Refined_3 improved the 24 simulated AOD value during significant dust cases, for instance, in March 2005, March 2006 and April 25 2009. Dust_Refined_3 also showed more clearly that in March 2010, a 'double plume' (i.e., one plume 26 originated from the Taiwan Strait and the other from the Western Pacific) separated by the Central 27 Mountain Range (CMR) of Taiwan Island affected dust transport on Dongsha Island in the SCS. On 15- 21 April 2021, both CMAQ simulations and satellite data highlighted the influence of typhoon 'Surigae' 29 on dust transport to downwind Taiwan and the Western Pacific Ocean (WPO). The CMAQ Dust_Refined_3 simulations further revealed a large fraction of dust aerosols were removed over WPO 31 due to typhoon 'Surigae'. Hence, the model indicated near-zero dust particle concentration over the 32 WPO, which was significantly different from previous dust transport episodes over the Taiwan region. 33 Therefore, our study suggested an effective method to improve dust management of CMAQ under 34 unique topographical and meteorological conditions.