



Supplement of

Inverse modeling of the 2021 spring super dust storms in East Asia

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Figure S1. Snapshots of the bias-corrected PM_{10} measurements for assimilation during severe dust event 1 (SD1) at March 15, 12:00. a.1: the non-dust PM_{10} simulation simulated by LOTOS-EUROS, b.1: the bias-corrected PM_{10} measurements, c.1 and d.1: the instrument uncertainty and integrated uncertainty of the PM_{10} observations.



Figure S2. Snapshots of the bias-corrected dust AOD measurements for assimilation during severe dust event 1 (SD1) in March 15. a.1: the non-dust AOD simulation simulated by LOTOS-EUROS, b.1: the bias-corrected AOD measurements, c.1 and d.1: the instrument uncertainty and integrated uncertainty of the AOD observations at 10:00 CST. Similar, a.2-d.2 show the non-dust AOD simulation, the bias-corrected AOD and the AOD uncertainties at 12:00.



Figure S3. Snapshots of the bias-corrected PM_{10} measurements for assimilation during severe dust event 2 (SD2) at March 28, 11:00 CST. a: the non-dust PM_{10} simulation simulated by LOTOS-EUROS, b: the bias-corrected PM_{10} measurements, c and d: the instrument uncertainty and integrated uncertainty of the PM_{10} observations.



Figure S4. Snapshots of the bias-corrected dust AOD measurements for assimilation during severe dust event 2 (SD2) at March 28, 11:00 CST. a: the non-dust AOD simulation simulated by LOTOS-EUROS, b: the bias-corrected AOD measurements, c and d: the instrument uncertainty and integrated uncertainty of the AOD observations.



Figure S5. Snapshots of the bias-corrected PM_{10} measurements for assimilation during severe dust event 3 (SD3) at April 15, 11:00 CST. a: the non-dust PM_{10} simulation simulated by LOTOS-EUROS, b: the bias-corrected PM_{10} measurements, c and d: the instrument uncertainty and integrated uncertainty of the PM_{10} observations.



Figure S6. Snapshots of the bias-corrected dust AOD measurements for assimilation during severe dust event 3 (SD3) at April 15, 11:00 CST. a: the non-dust AOD simulation simulated by LOTOS-EUROS, b: the bias-corrected AOD measurements, c and d: the instrument uncertainty and integrated uncertainty of the AOD observations.



Figure S7. The posterior dust AOD and surface dust concentration simulation either driven by the AOD-only or driven by the PM_{10} -only assimilation emission result during SD1. Column 1: the dust AOD and surface dust concentration simulation driven by the posterior emission from AOD-only assimilation; column 2: the dust AOD and surface concentration driven by the posterior emission from PM_{10} -only assimilation at 10:00 (panel a and c) and 12:00 (panel b), March 28.



Figure S8. The posterior dust AOD and surface dust concentration simulation either driven by the AOD-only or driven by the PM_{10} -only assimilation emission result during SD3. Column 1: the dust AOD and surface dust concentration simulation driven by the posterior emission from AOD-only assimilation; column 2: the dust AOD and surface concentration driven by the posterior emission from PM_{10} -only assimilation at 11:00, April 15.