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Supplement of

Dust impacts on the Indian summer monsoon: chaotic or physical effect?

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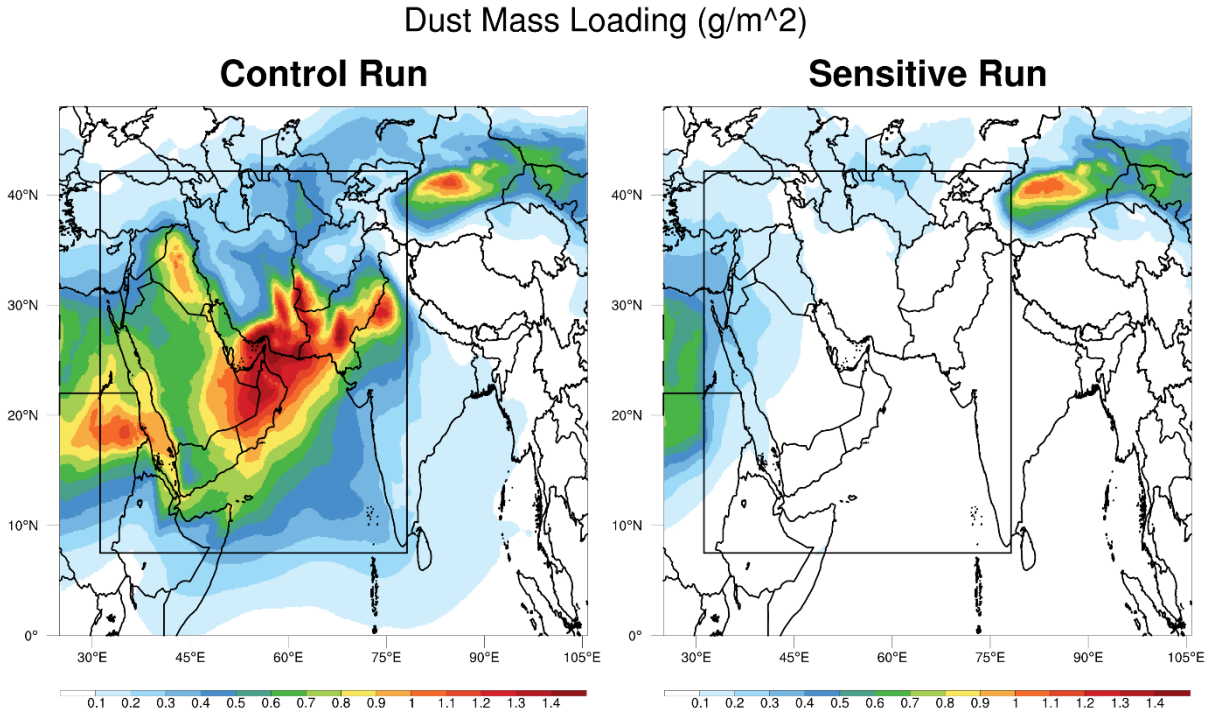

Figure S1. The ensemble-mean results of dust mass loading simulated from Control and Sensitive experiments. The black solid line represents the region where the dust emissions are removed in "Sensitive" experiments.

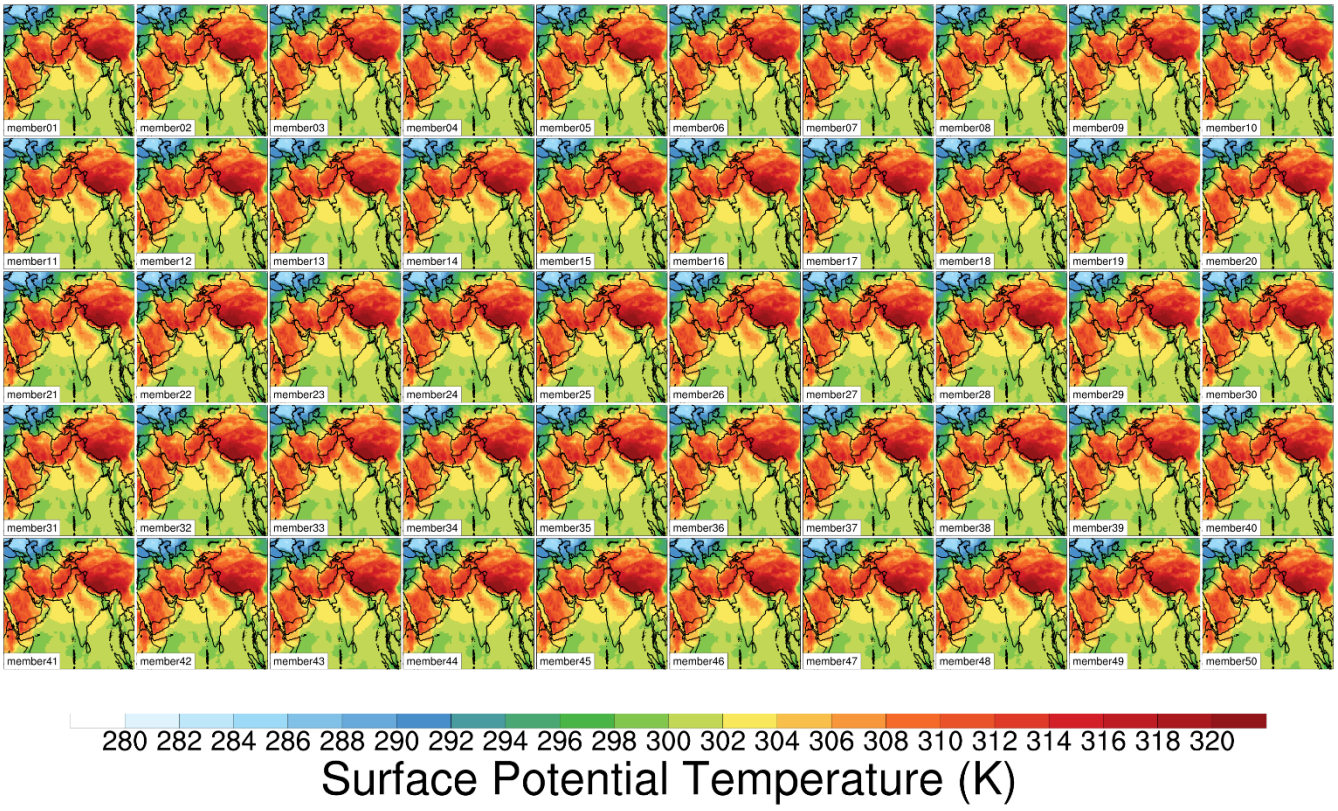

Figure S2. The spatial distributions of surface potential temperature derived from the perturbed initial conditions of the 50 ensemble members over the Indian monsoon region.

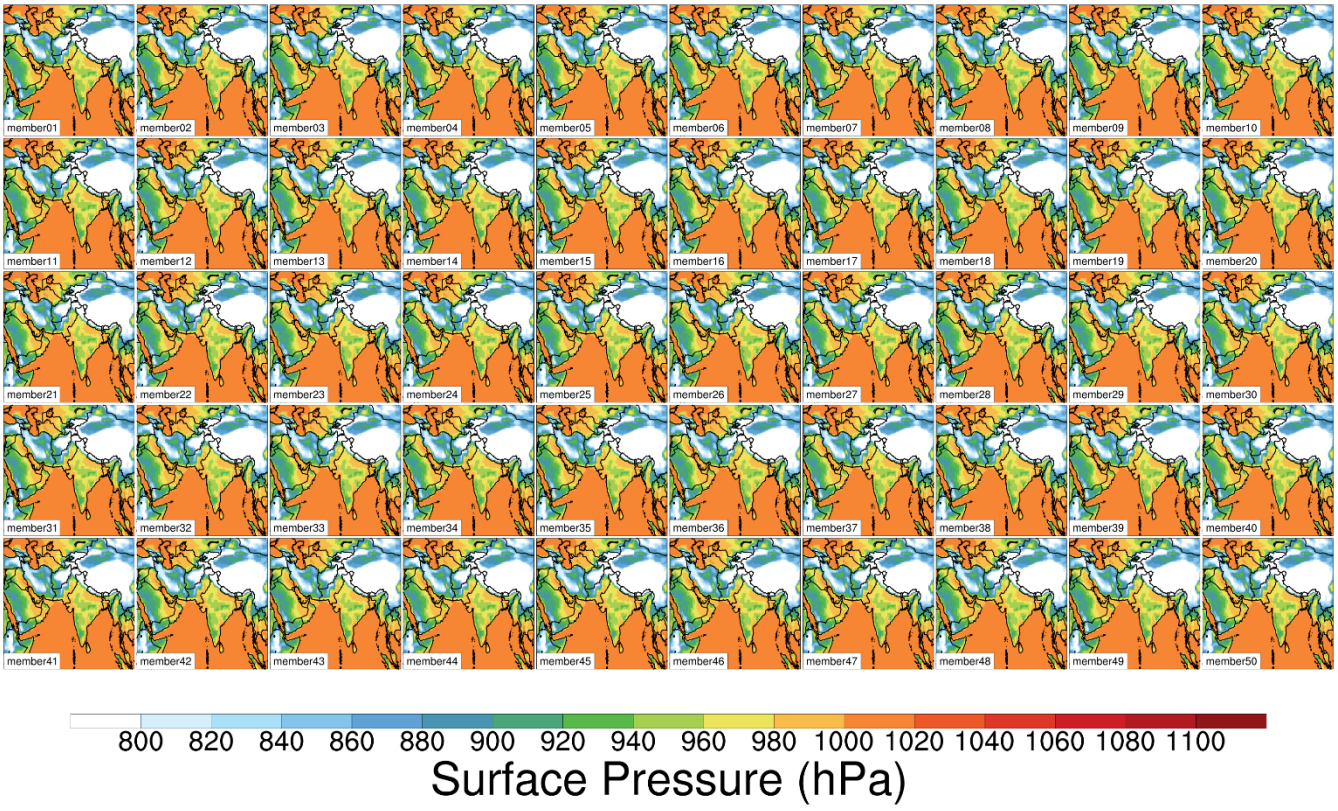

Figure S3. Same as Figure S2 but for surface pressure.

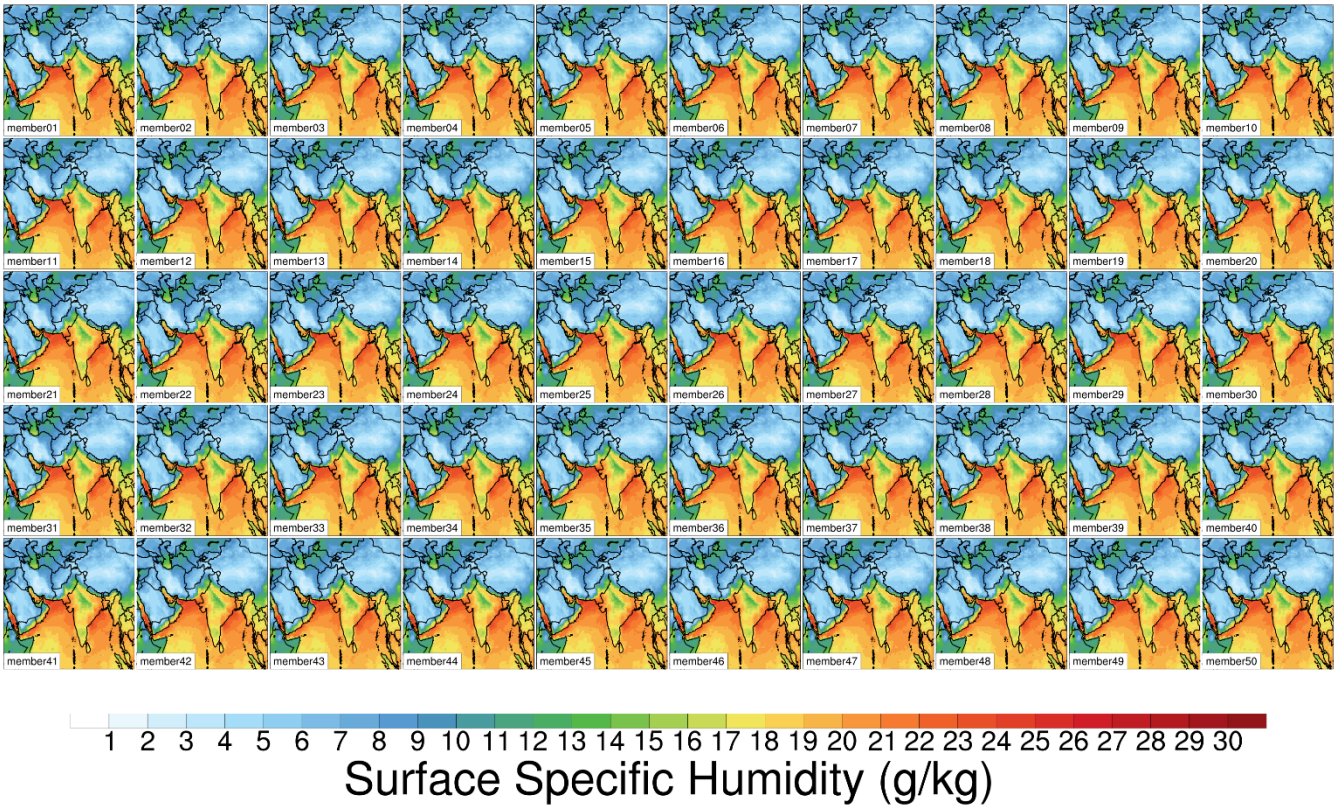

Figure S4. Same as Figure S2 but for surface specific humidity.

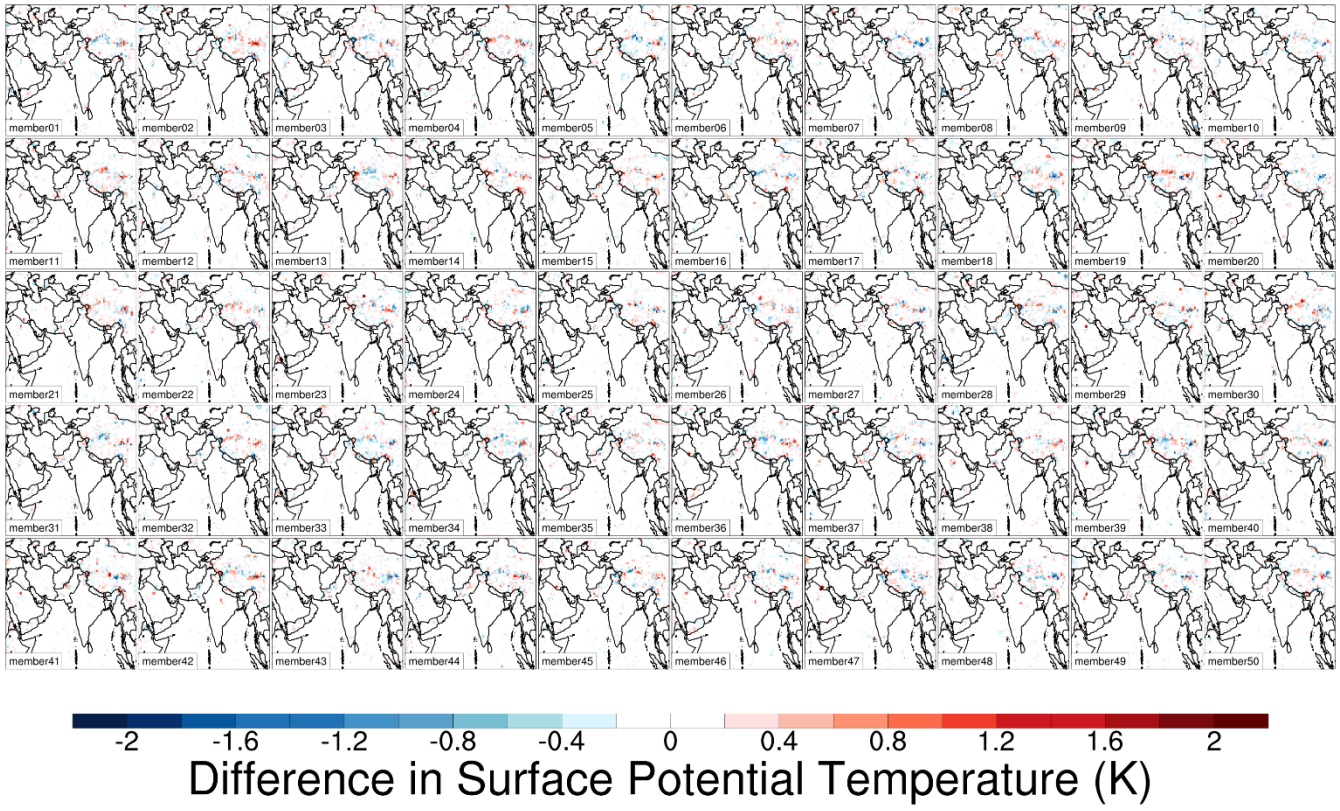

Figure S5. The spatial distributions of difference in surface potential temperature derived from the perturbed initial conditions of the 50 ensemble members between the ensemble mean results.

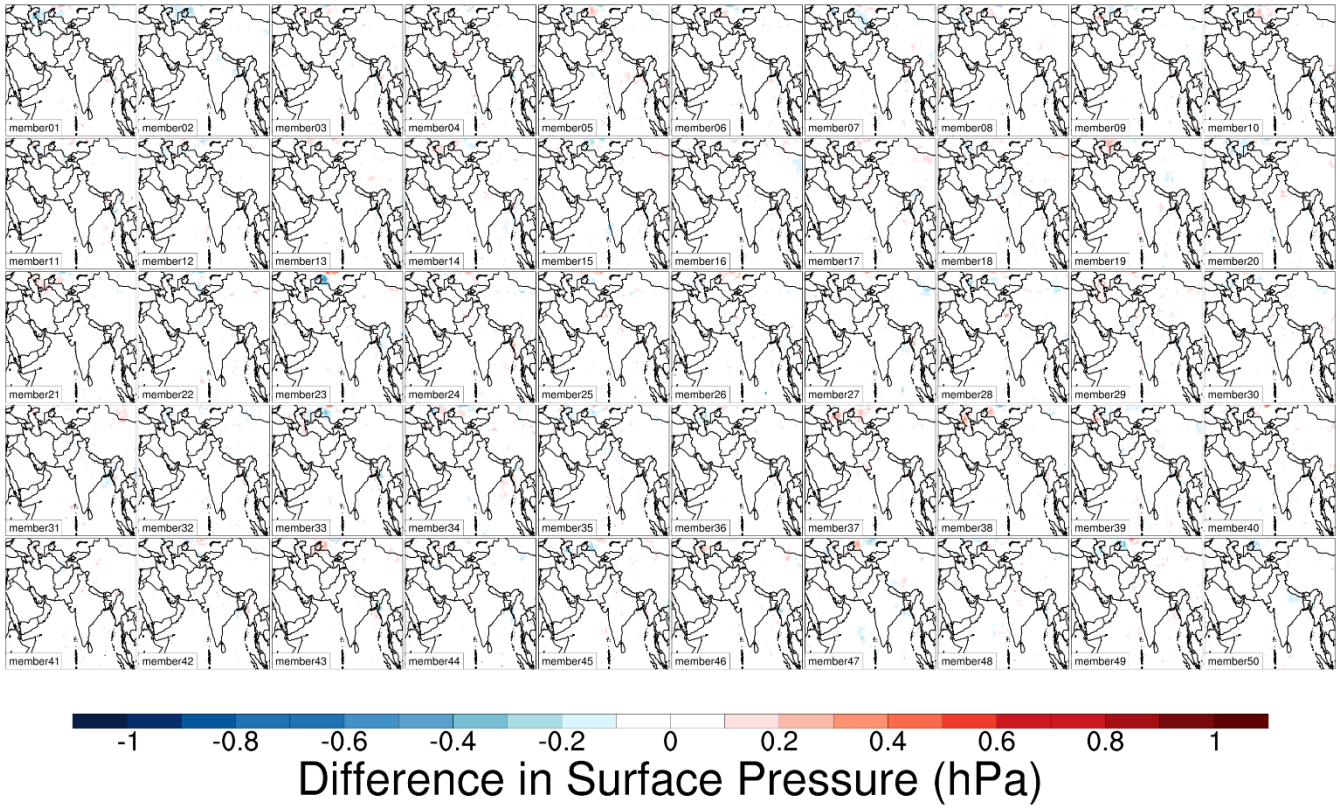

Figure S6. Same as Figure S5 but for difference in surface pressure.

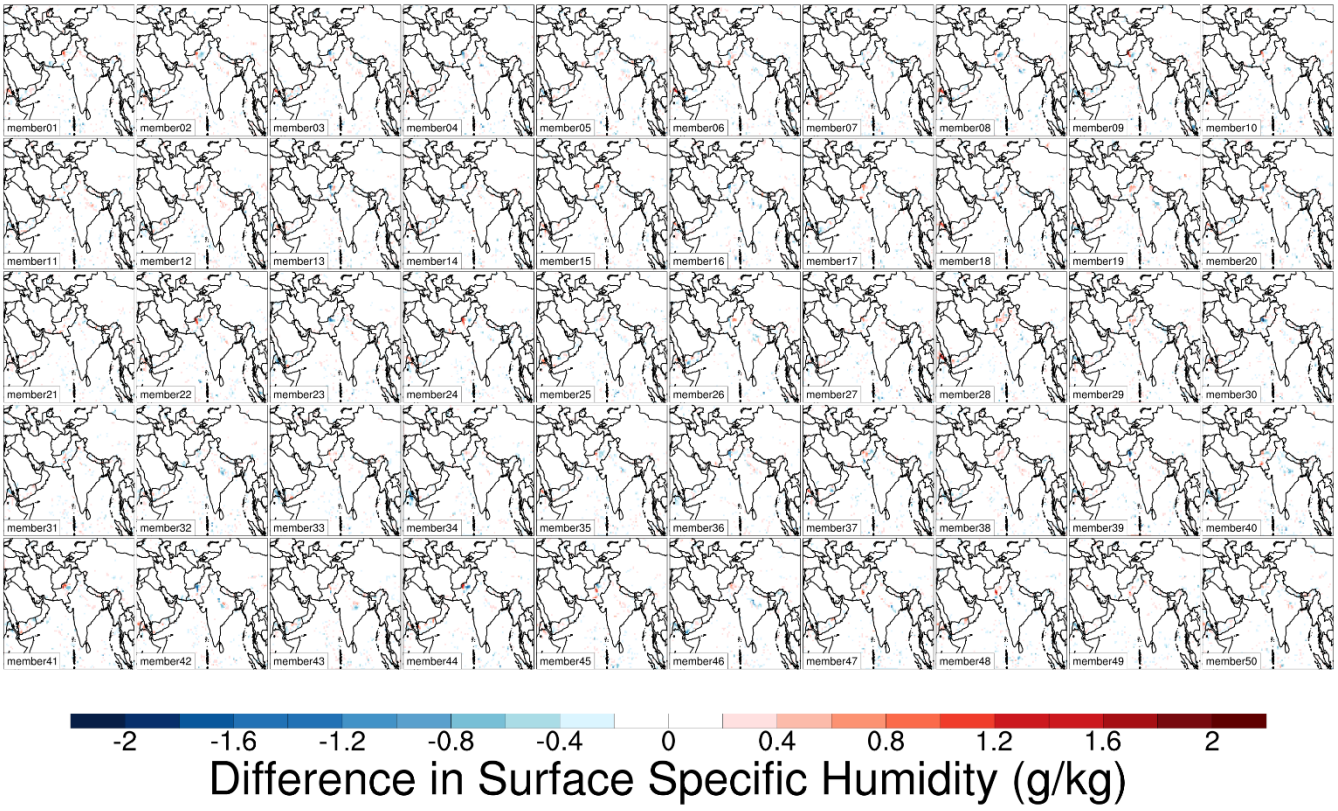

Figure S7. Same as Figure S5 but for difference in surface specific humidity.

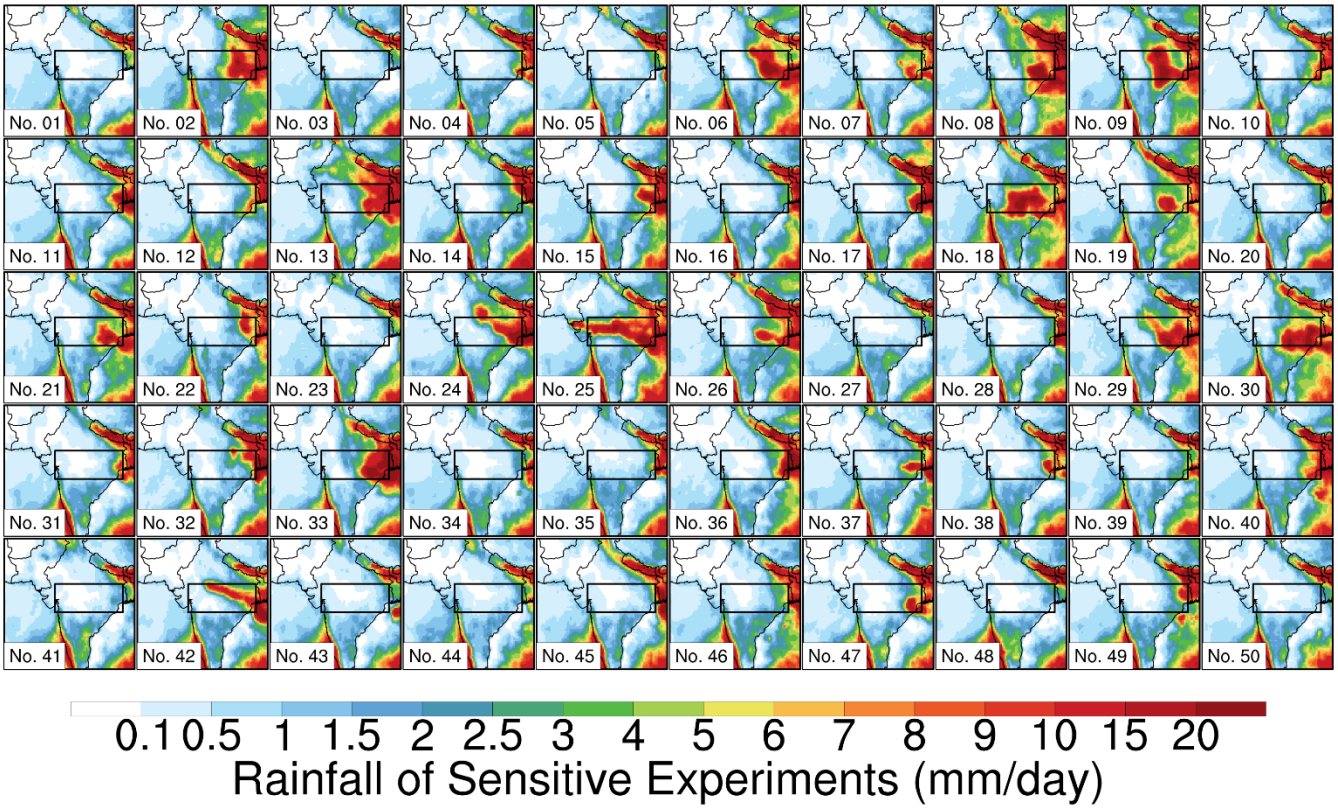

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Figure S8: The spatial distributions of precipitation derived from 50 ensemble members of "Sensitive" experiments over the Indian monsoon region. The results are averaged from June 10, 2016, to June 30, 2016. The monsoon depression region is delineated by the black box.

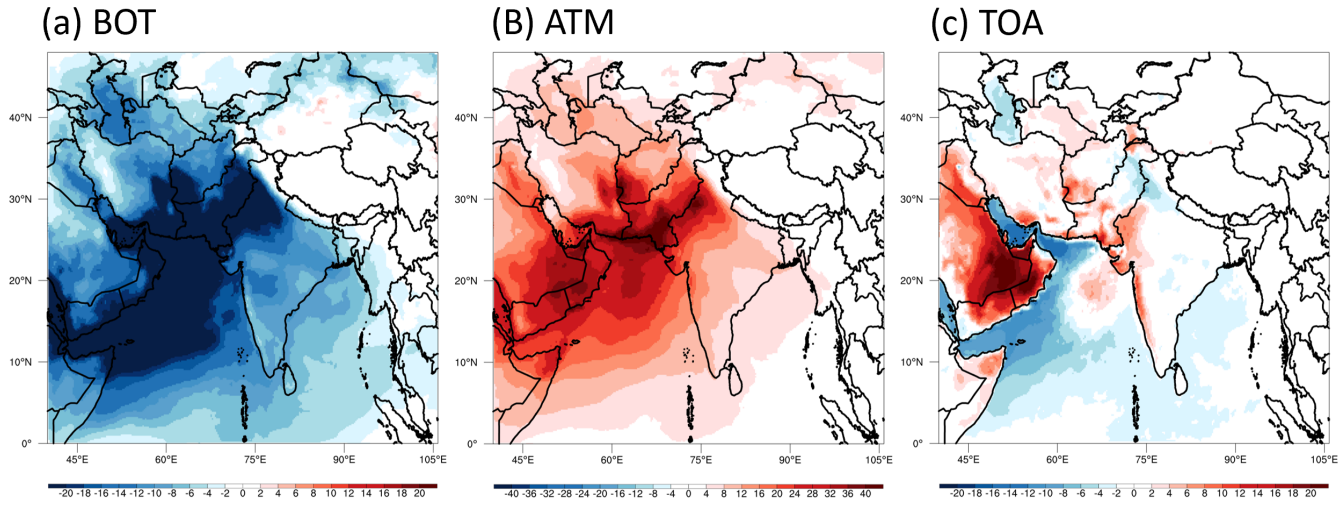

Figure S9: The difference between "Control" and "Sensitive" experiments in dust aerosols' direct radiative forcing (a) at the bottom of atmosphere (BOT); (b) in atmosphere (ATM); (c) at the top of atmosphere (TOA). The net downward radiative flux at TOA and BOT is considered positive, while upward flux is considered negative; the heating effect of radiative flux within the ATM is considered positive, while the cooling effect is considered negative.

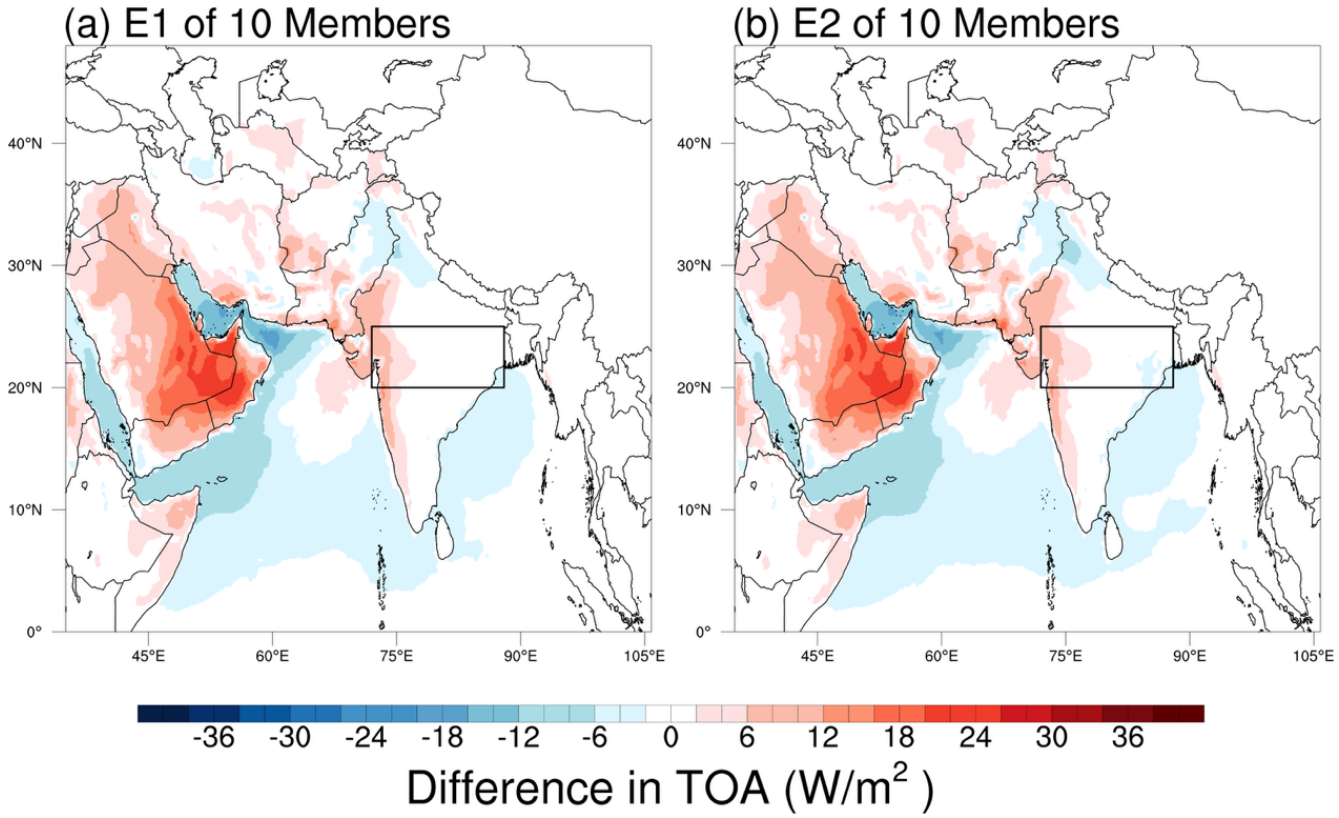

Figure S10: Difference in TOA results for two extreme cases selected from 10,000 possible combinations of 10-member ensembles, representing the maximum (panel a) and minimum (panel b) area-averaged responses.

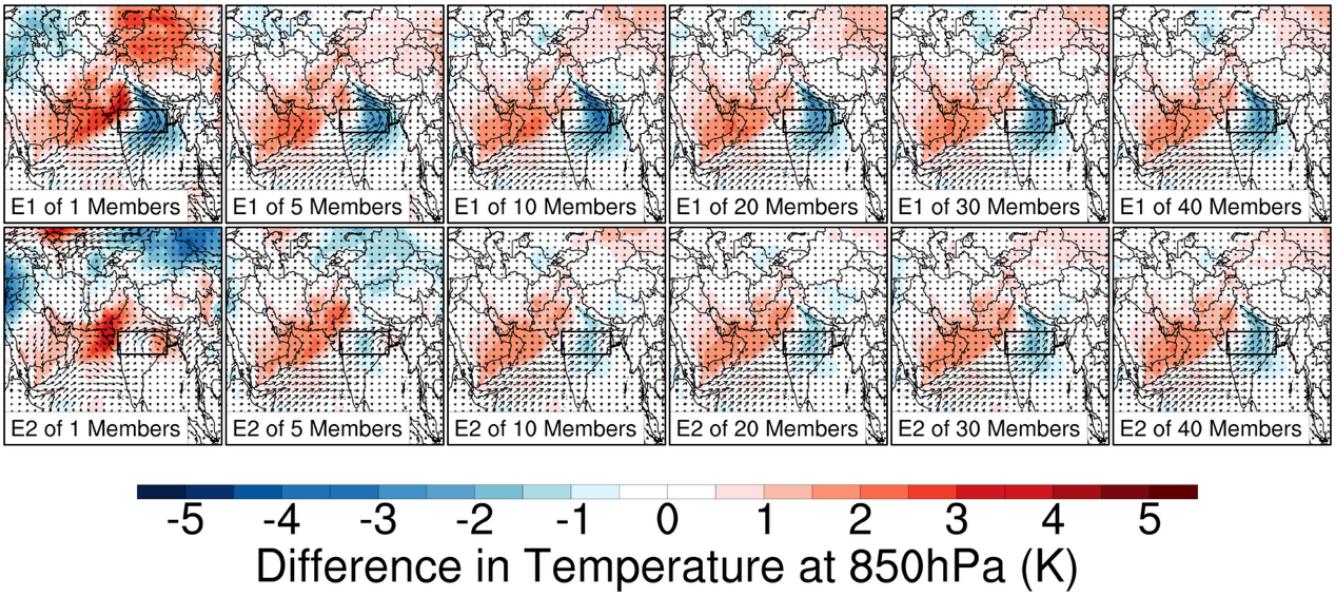

Figure S11. The spatial distribution of dust-induced temperature at 850hPa impacts for two extreme cases selected from possible combinations of 1, 5, 10, 20, 30, and 40-member ensembles, representing the maximum (E1 in top panels) and minimum (E2 in bottom panels) area-averaged responses.