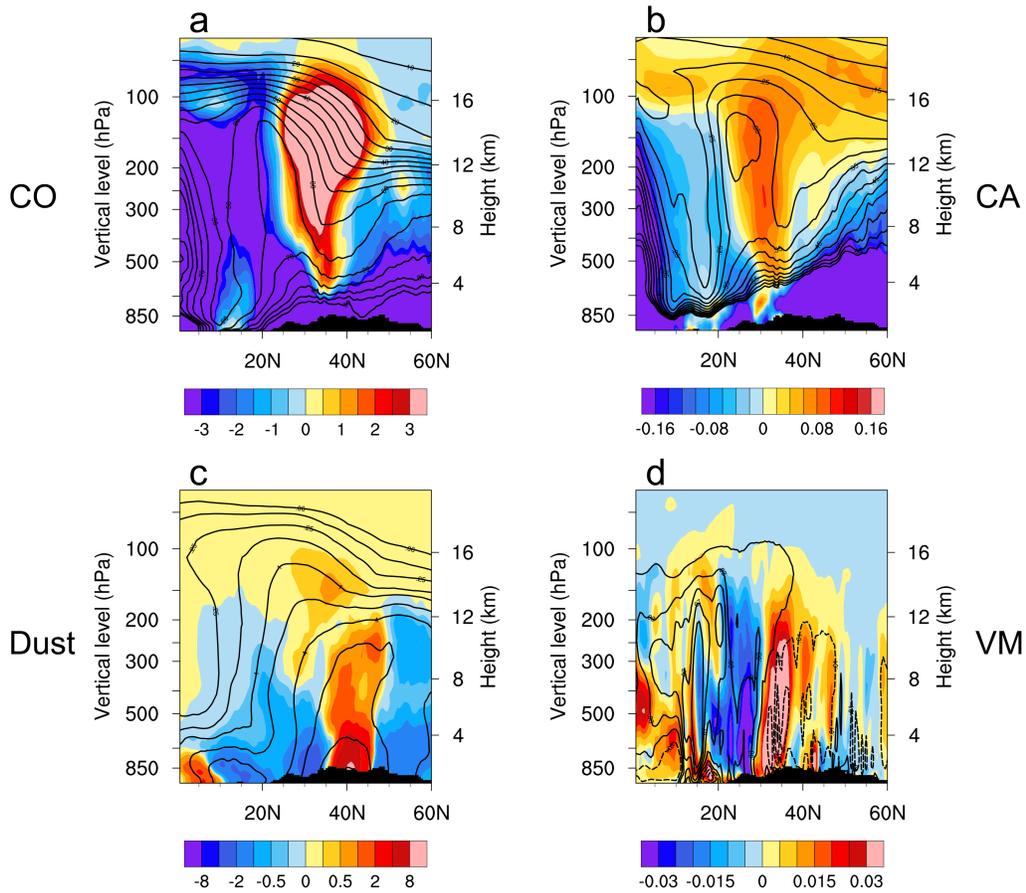


**Figure S1. Spatial distributions of climatological (left panels) and anomalous ('strong' minus 'weak', right panels) mass concentrations of CO (ppbv), CA, (ppbm), and dust (ppbm). The climatological 850-hPa wind field and wind field anomalies (arrows, in  $\text{m s}^{-1}$ ) are superimposed on (a, c, e) and (b, d, f), respectively.**

5

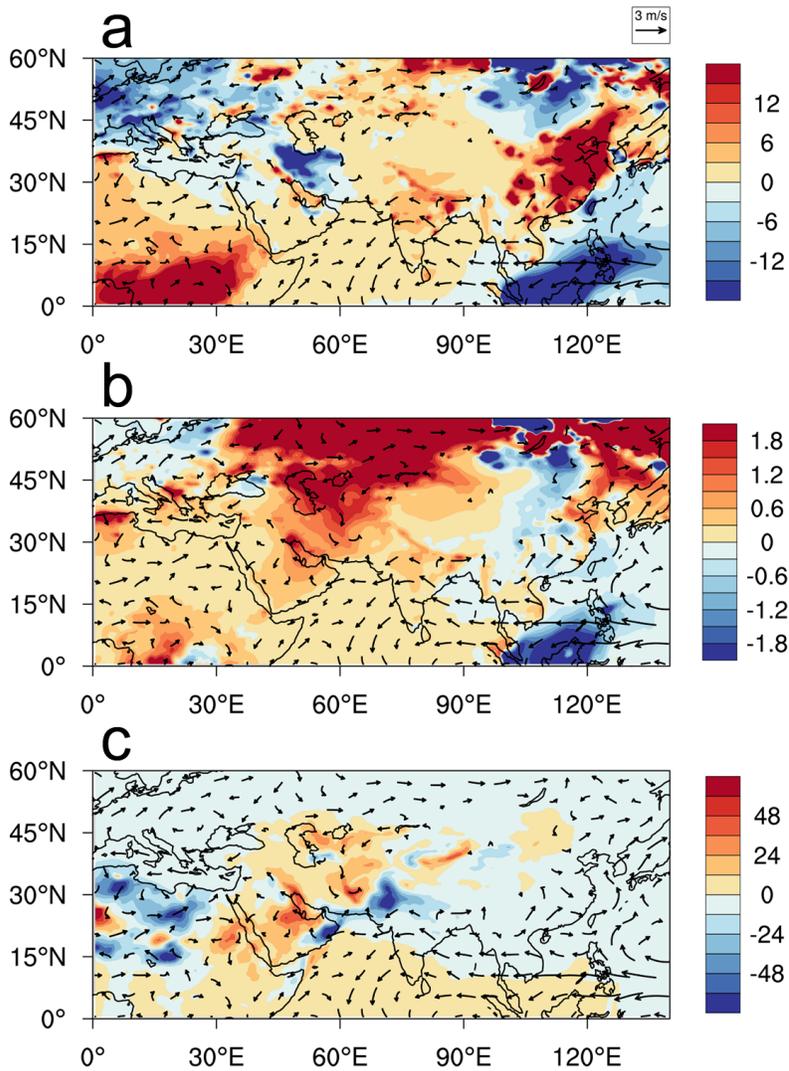
10



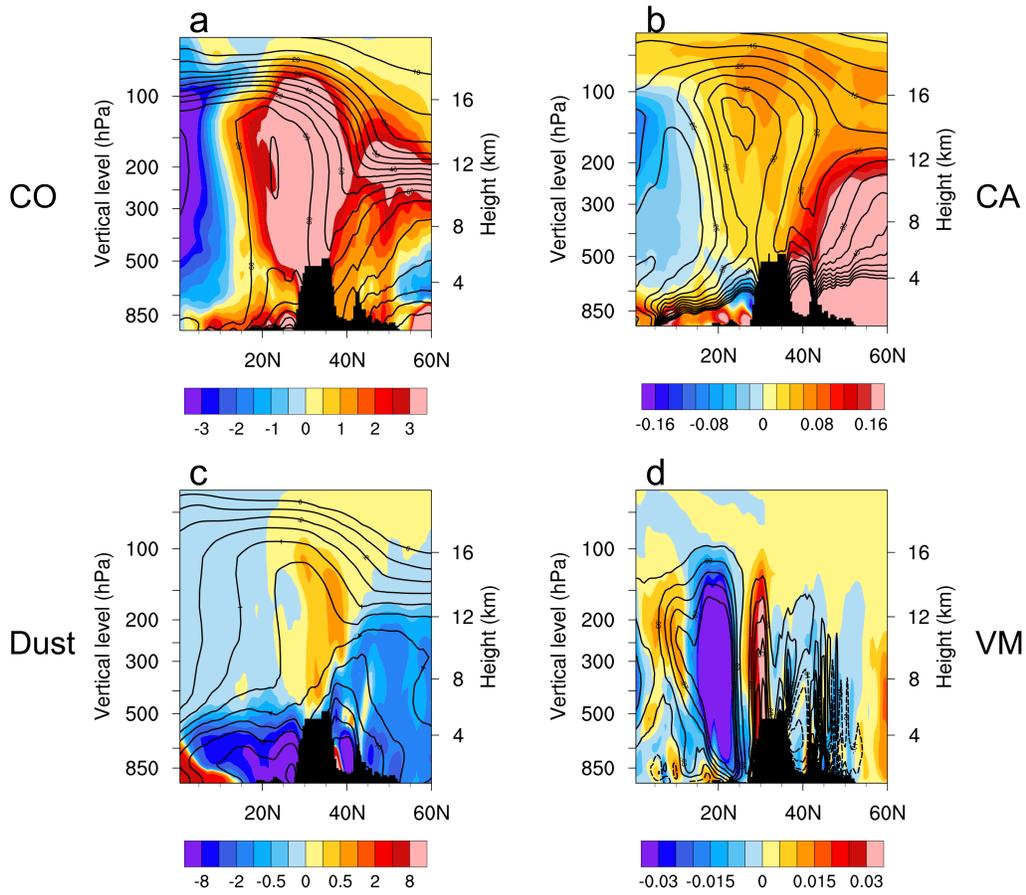
15 **Figure S2.** Latitude-height cross-sections ( $0^{\circ}\text{N}$ - $60^{\circ}\text{N}$ ) of (a) CO (ppbv), (b) CA (ppbm), (c) dust (ppbm), and (d) vertical motion ( $\text{Pa s}^{-1}$ ) anomalies between strong and weak monsoon years ('strong' minus 'weak') averaged over the SB region ( $100^{\circ}\text{E}$ - $105^{\circ}\text{E}$ ) during July-August, superimposed with the climatological mean of weak monsoon years (black contours). For vertical motions in (d), solid (dashed) contours indicating ascent (descent).

20

25

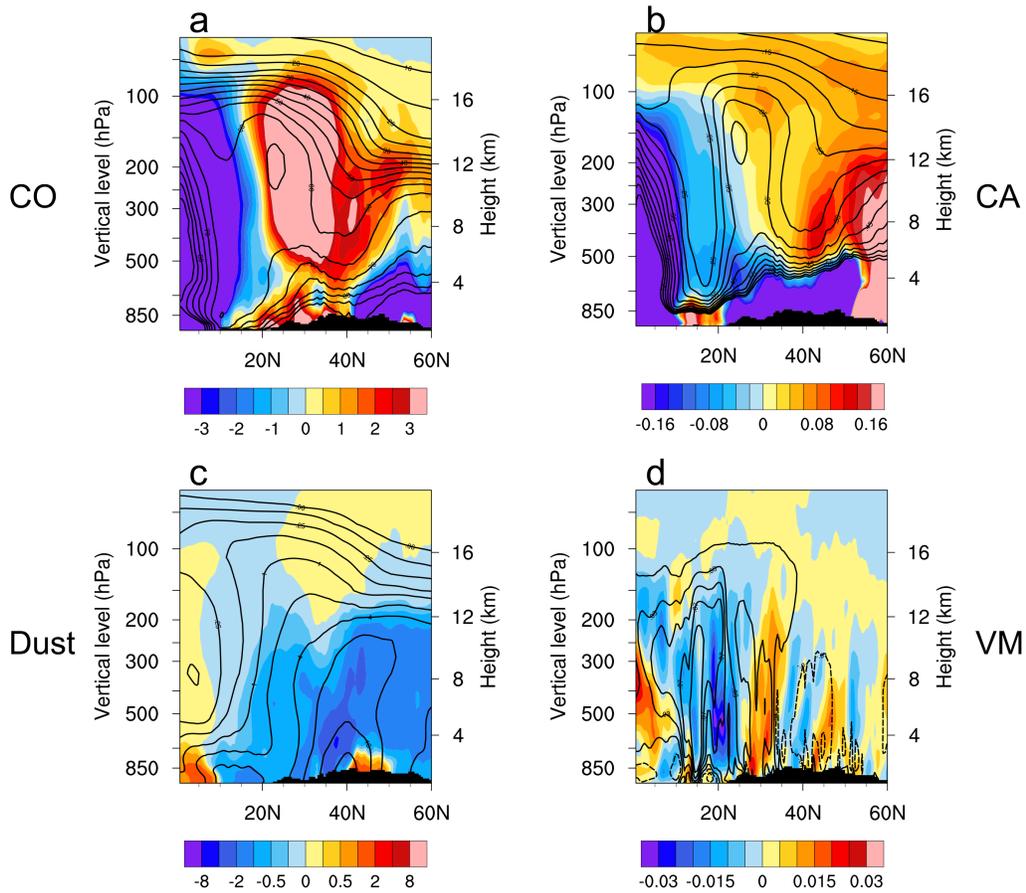


**Figure S3. Anomalous 850 hPa wind (arrows, in  $\text{m s}^{-1}$ ) and surface loading of (a) CO (ppbv), (b) CA (ppbm), (c) dust (ppbm) between Late Part years and Early Part years ('Late' minus 'Early') during July to August.**



35

**Figure S4. Latitude-height cross-sections ( $0^{\circ}\text{N}$ - $60^{\circ}\text{N}$ ) of (a) CO (ppbv), (b) CA (ppbm), (c) dust (ppbm), and (d) vertical motion ( $\text{Pa s}^{-1}$ ) anomalies between Late Part years and Early Part years ('Late' minus 'Early') averaged over the HGP region ( $80^{\circ}\text{E}$ - $85^{\circ}\text{E}$ ) during July-August, superimposed with the climatological mean of Early Part years (black contours). For vertical motions in (d), solid (dashed) contours indicating ascent (descent).**



40

**Figure S5. Latitude-height cross-sections (0°N-60°N) of (a) CO (ppbv), (b) CA (ppbm), (c) dust (ppbm), and (d) vertical motion ( $\text{Pa s}^{-1}$ ) anomalies between Late Part years and Early Part years ('Late' minus 'Early') averaged over the SB region (100°E-105°E) during July-August, superimposed with the climatological mean of Early Part years (black contours). For vertical motions in (d), solid (dashed) contours indicating ascent (descent).**