Supplement

S1 Comparisons between original water substances and the sum of corresponding tagged water substances in each physical process

In this section, we investigate the differences between the tendencies of original water substances (water vapour, cloud droplets and ice) and the sum of the tendencies of tagged water substances originated from 25 moisture source regions in deep convection, shallow convection, cloud processes (macrophysics and microphysics), advection and vertical diffusion, respectively. Note that the adjustment criteria in the Sect. 2.7 of the manuscript are not done here. The simulation is started in 01 January 1997 and then we investigate the results in January 1998.

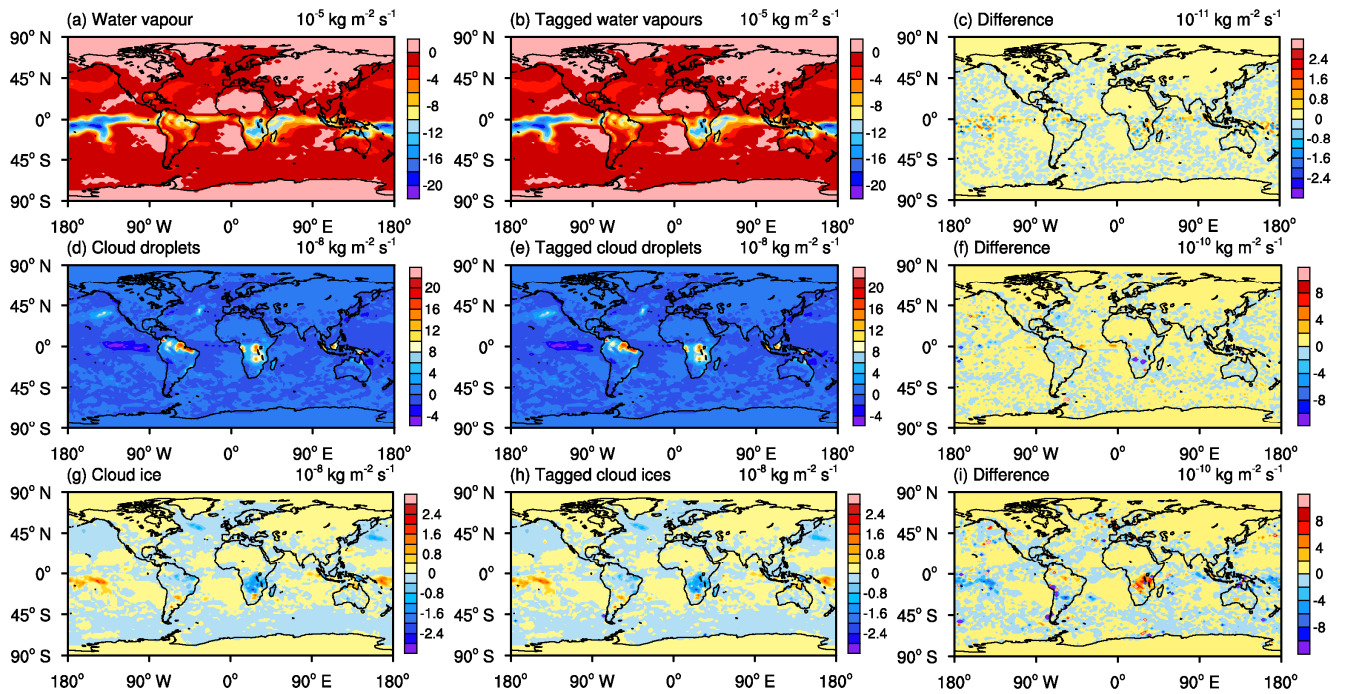
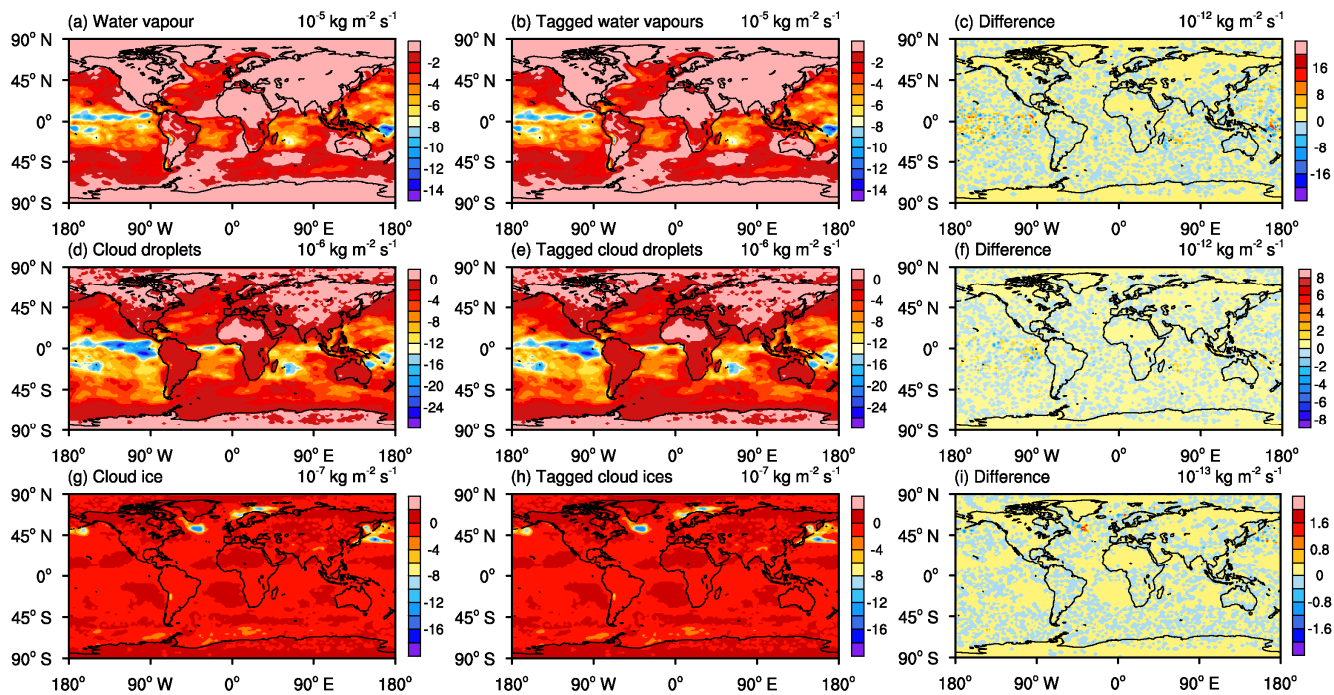



Figure S1. The distributions of the tendencies of (a) water vapour, (d) cloud droplets, and (g) ice and the distributions of the sum of the tendencies of (b) 25 tagged water vapours, (e) 25 tagged cloud droplets, and (h) 25 tagged cloud ices in deep convection in January 1998. The differences between tagged quantities and corresponding original quantities are shown in (c), (f) and (i), respectively. All these quantities are vertical integrated values from the surface to the tropopause.

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16 **Figure S2.** Same as **Fig. S1**, but for quantities in shallow convection.

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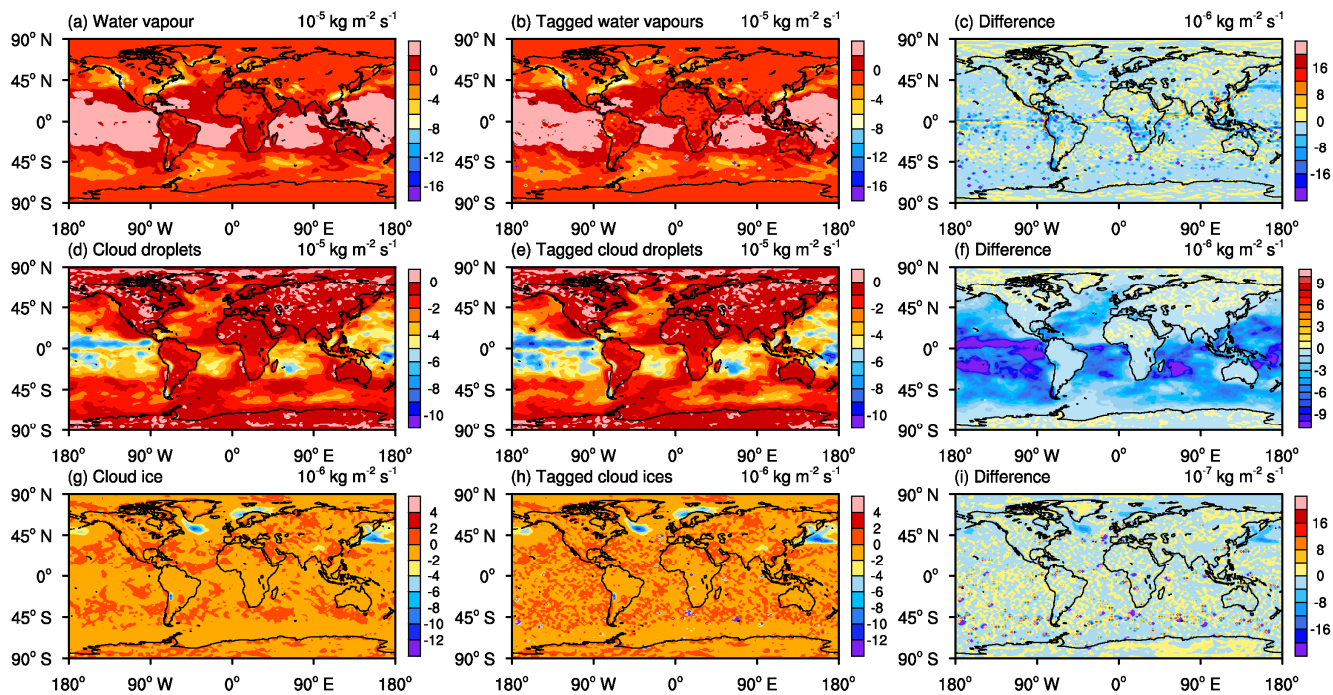
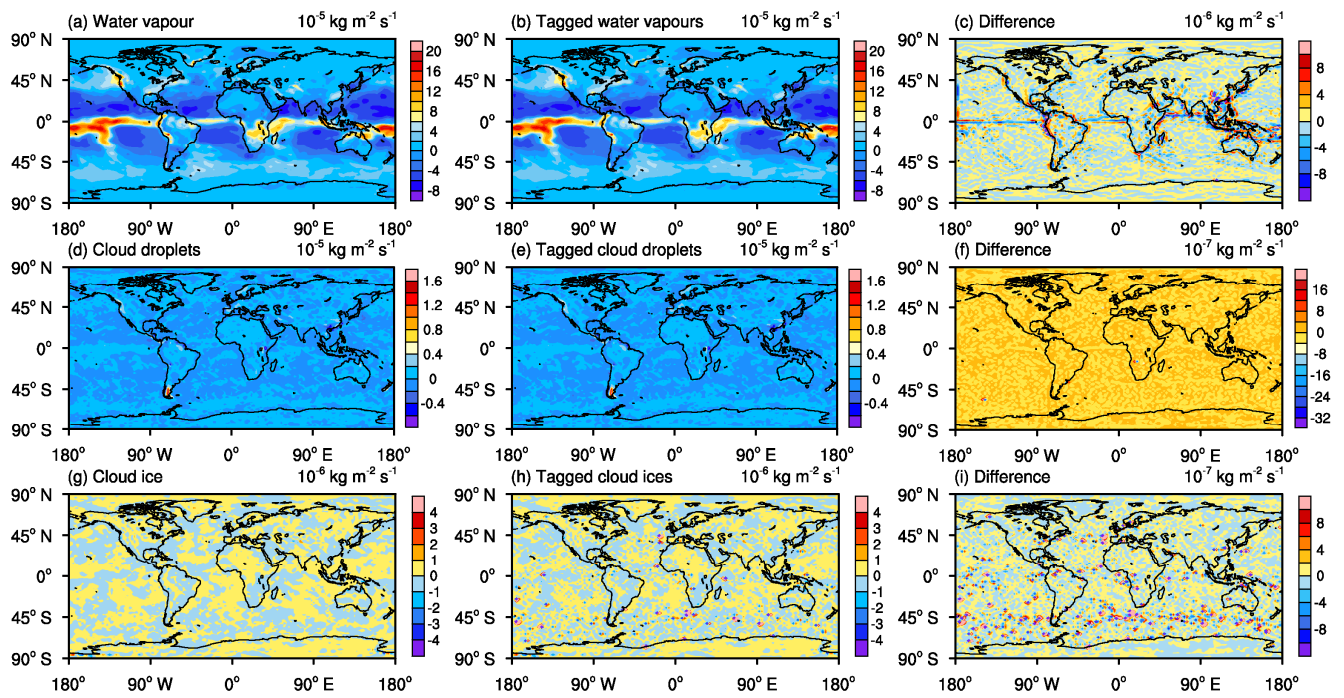


Figure S3. Same as **Fig. S1**, but for quantities in cloud processes.

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20 **Figure S4.** Same as **Fig. S1**, but for quantities in advection.

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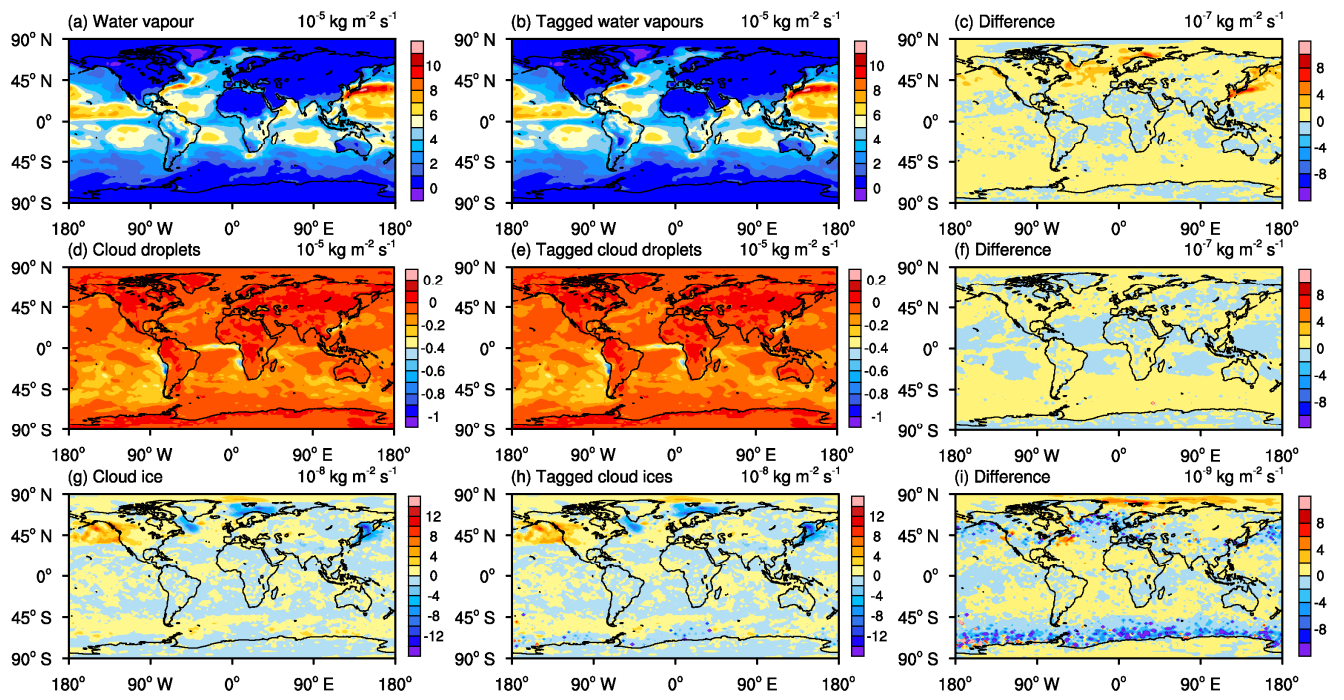
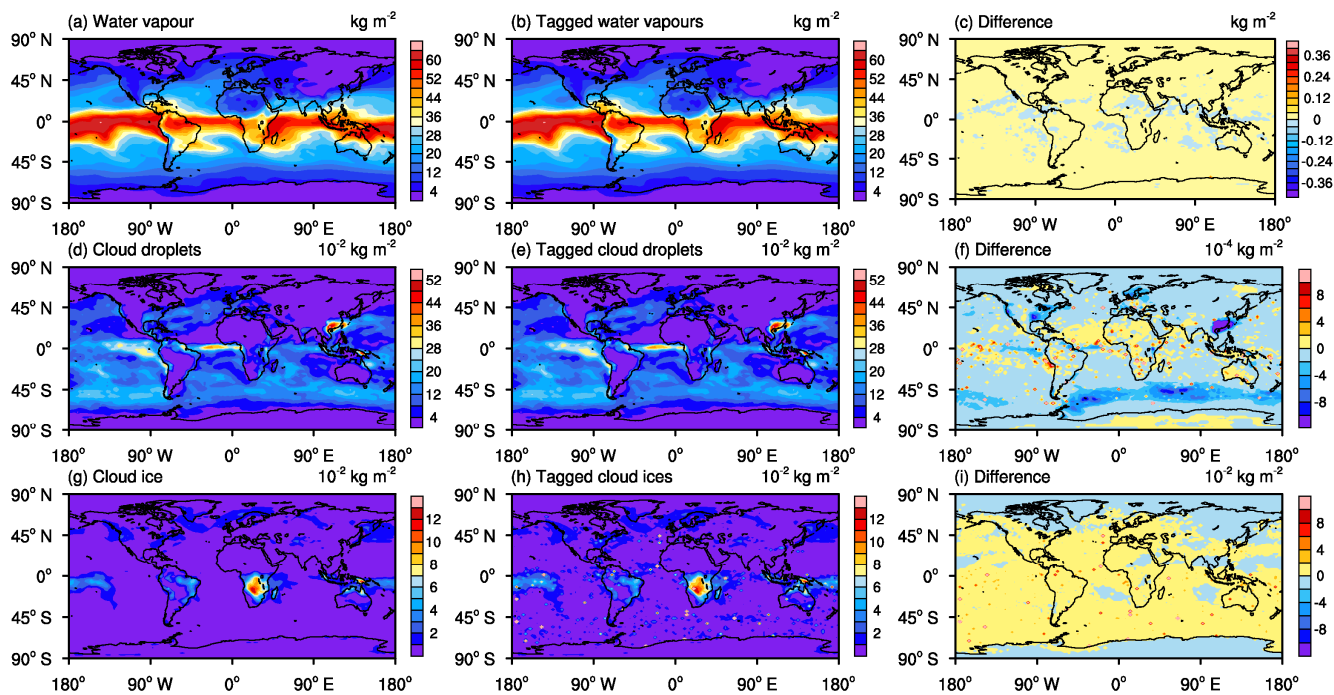


Figure S5. Same as **Fig. S1**, but for quantities in vertical diffusion.

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24 **Figure S6.** Same as **Fig. S1**, but for the distributions of the concentrations of (left) original water substances, (middle) the sum of the

25 concentrations of tagged original water substances, and (right) their differences.

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29   **Figure S7.** The distributions of tagged water vapour tracers supplied from the 25 source regions defined in **Fig. 1** in winter. Here, all the

30   contents (units: kg m^{-2}) of tagged water vapour tracers are ten-year averaged values from 1998 to 2007.

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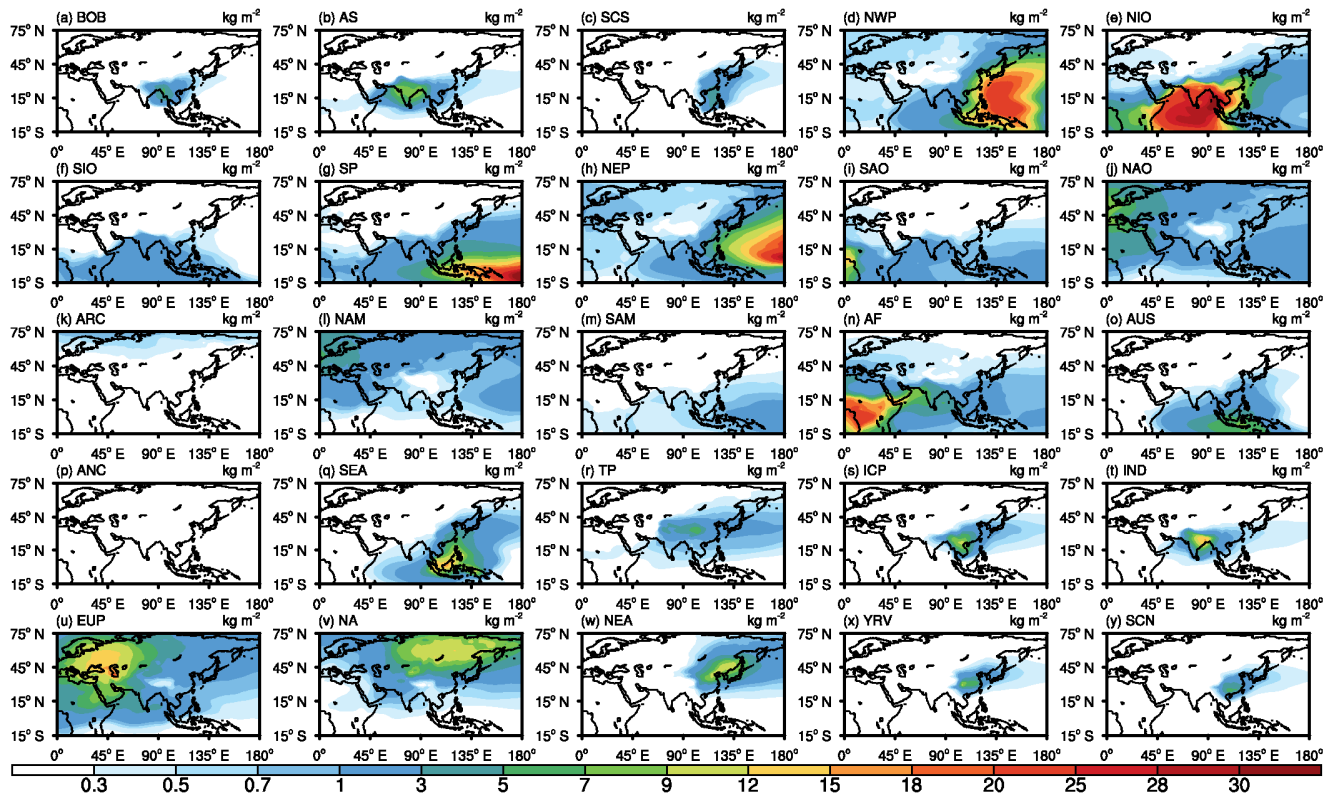
Figure S8. Same as **Fig. S7**, but for the contents (units: kg m^{-2}) of water vapour tracers in summer.
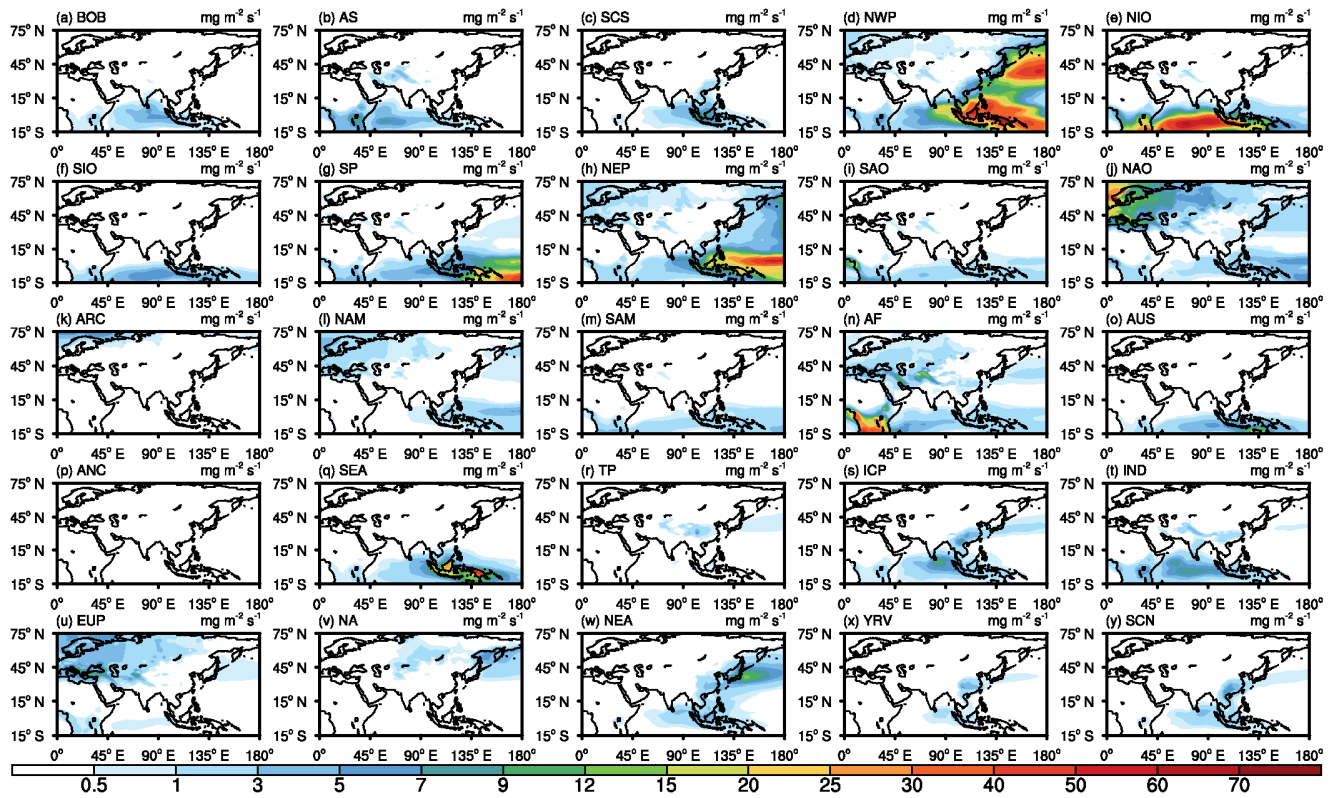
Figure S9. Same as Fig. S7, but for the tagged winter precipitations (units: mg m⁻² s⁻¹) supplied from the 25 source regions defined in Fig.
1.
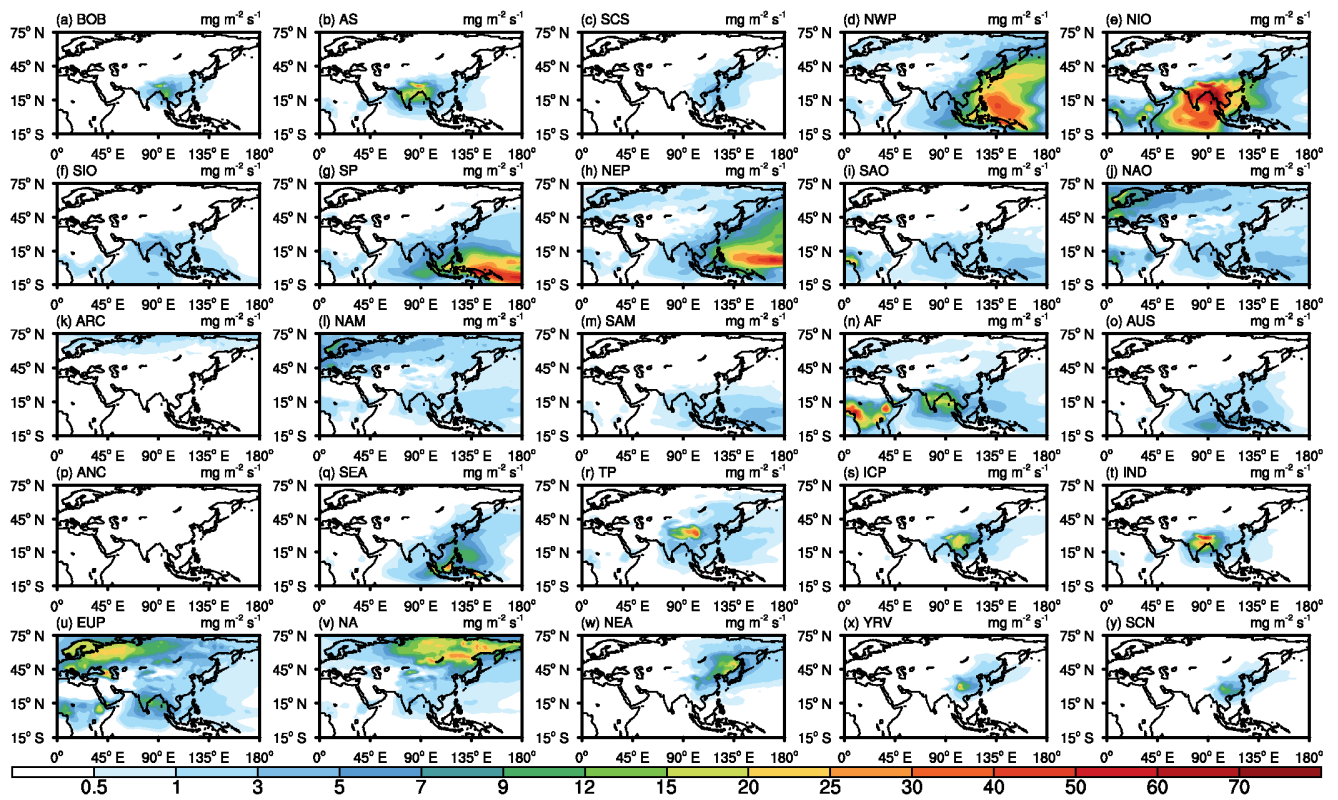
Figure S10. Same as **Fig. S7**, but for the tagged summer precipitations (units: mg m^{-2} s^{-1}) supplied from the 25 source regions defined in **Fig. 1**.