



Supplement of

The key role of atmospheric absorption in the Asian summer monsoon response to dust emissions in CMIP6 models

Alcide Zhao et al.

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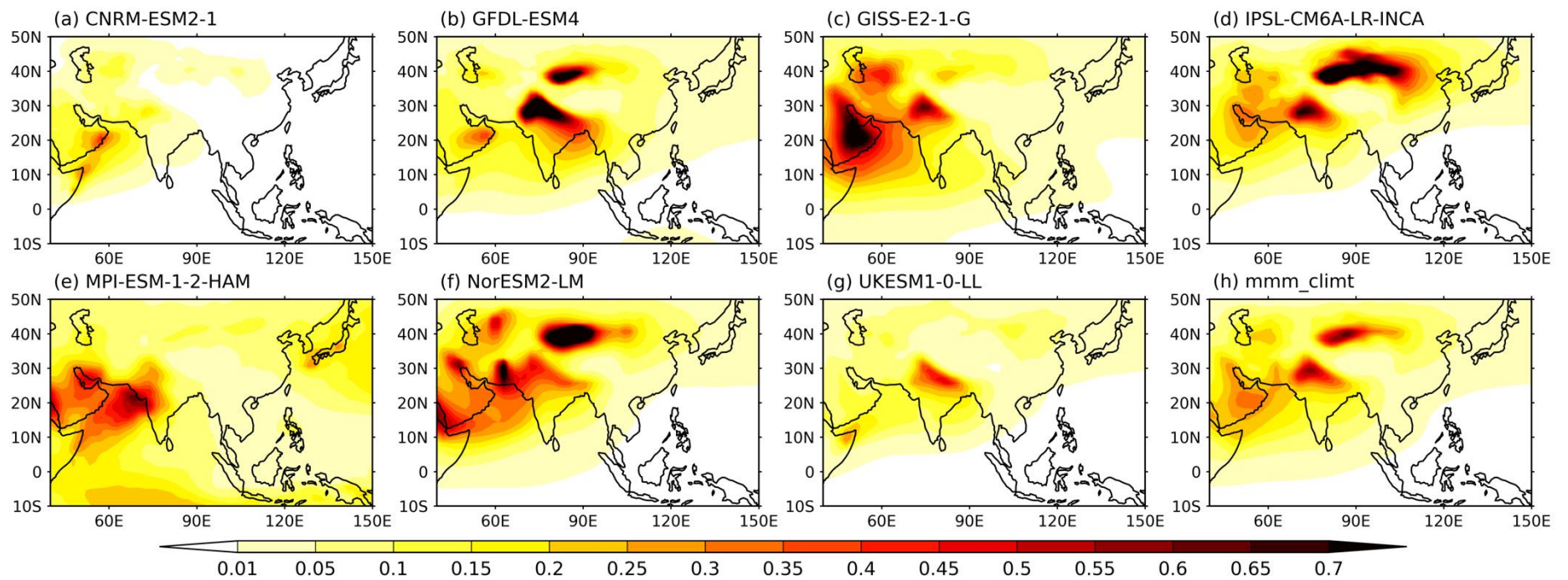


Figure S1. Models' simulated JJA climatology of dust aerosol optical depth (DOD) from the piClim-control.

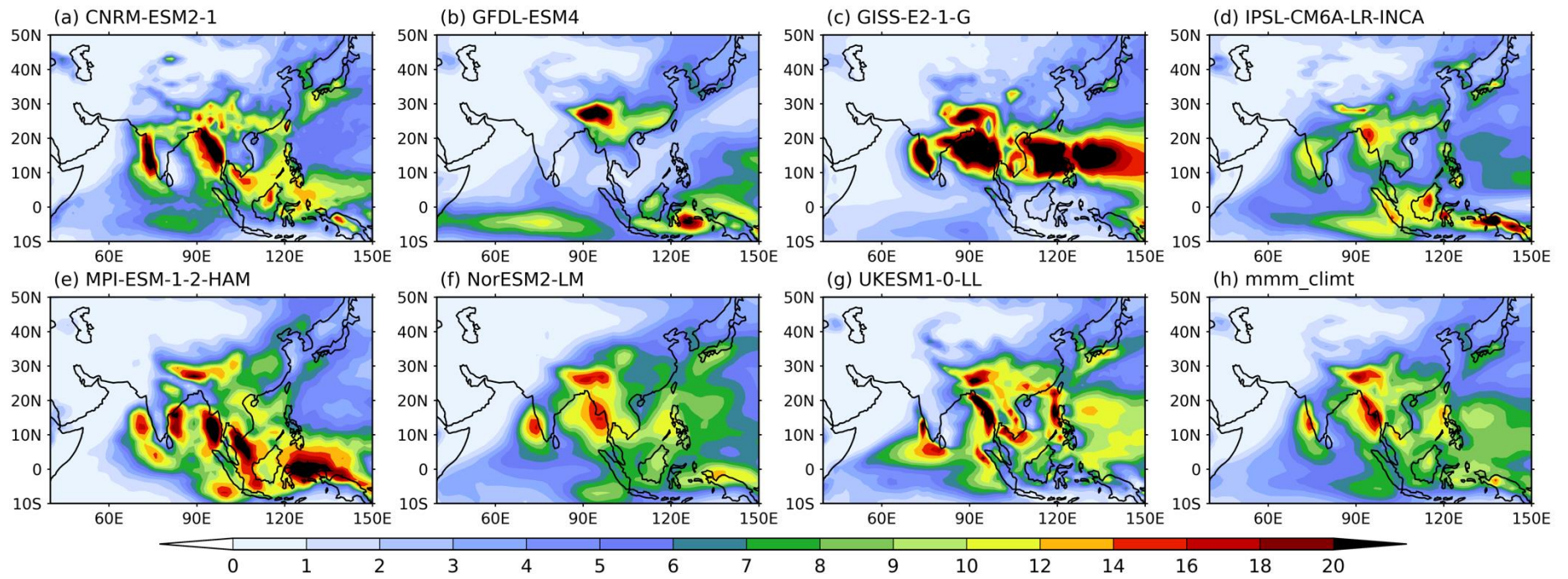


Figure S2. Models' simulated JJA climatology of precipitation (mm day⁻¹) derived from the piClim-control.

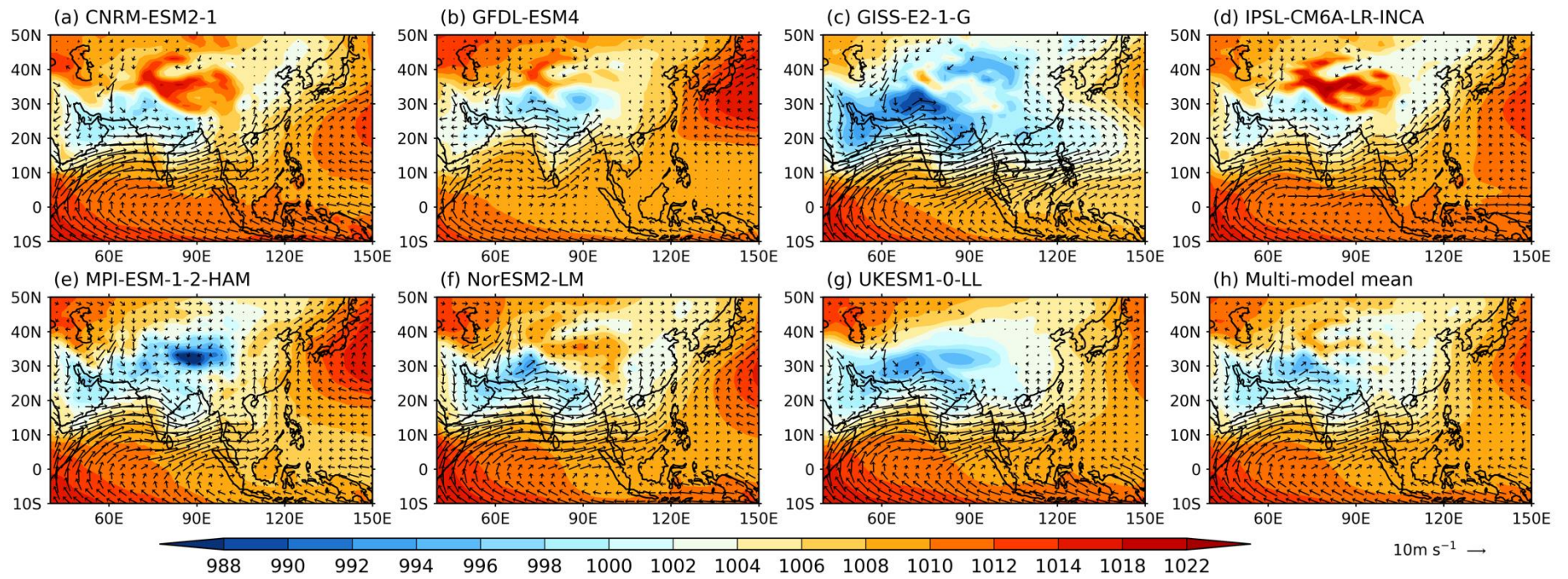


Figure S3. Models' simulated JJA climatology of sea level pressure (colours, hPa) and 850-hPa winds (vectors, m s^{-1}) derived from the piClim-control.

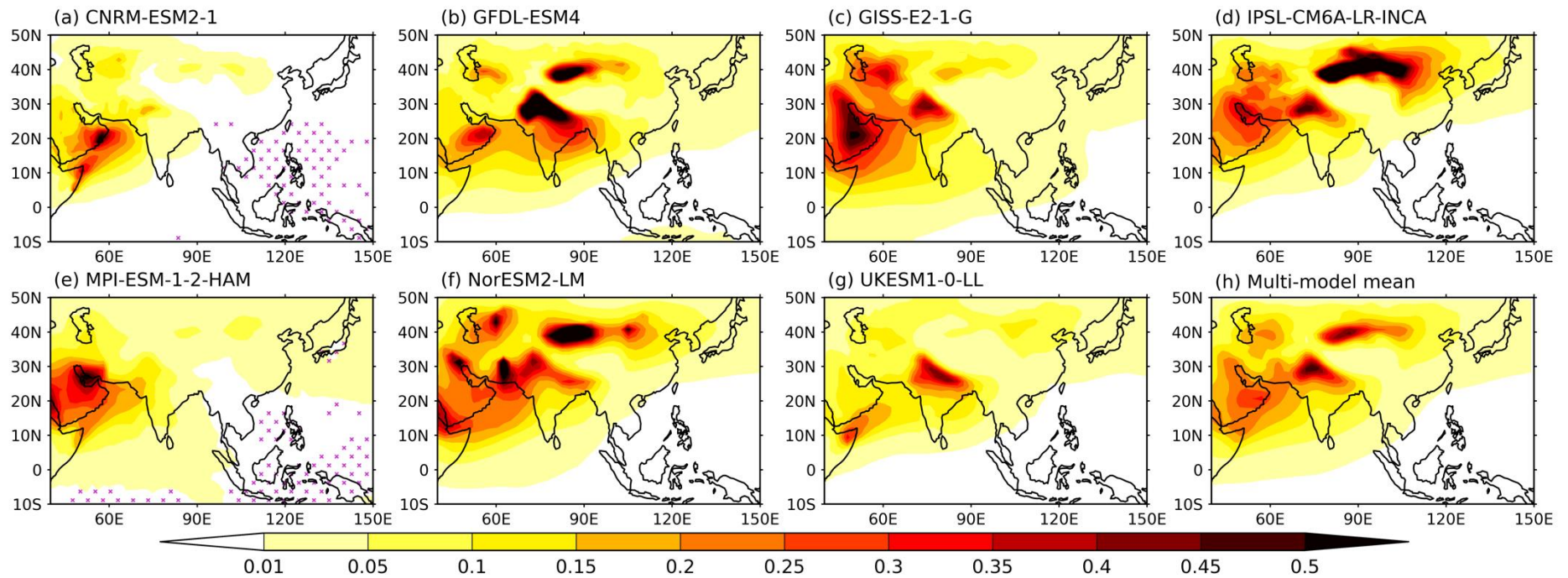


Figure S4. JJA mean changes in dust aerosol optical depth (DOD) due to doubled dust emissions in (a-g) individual models and (h) the multi-model mean. Purple hatches denote insignificant differences at the 10% level. Green hatches in (h) denote where ≤ 4 models have the same sign as the multi-model mean.

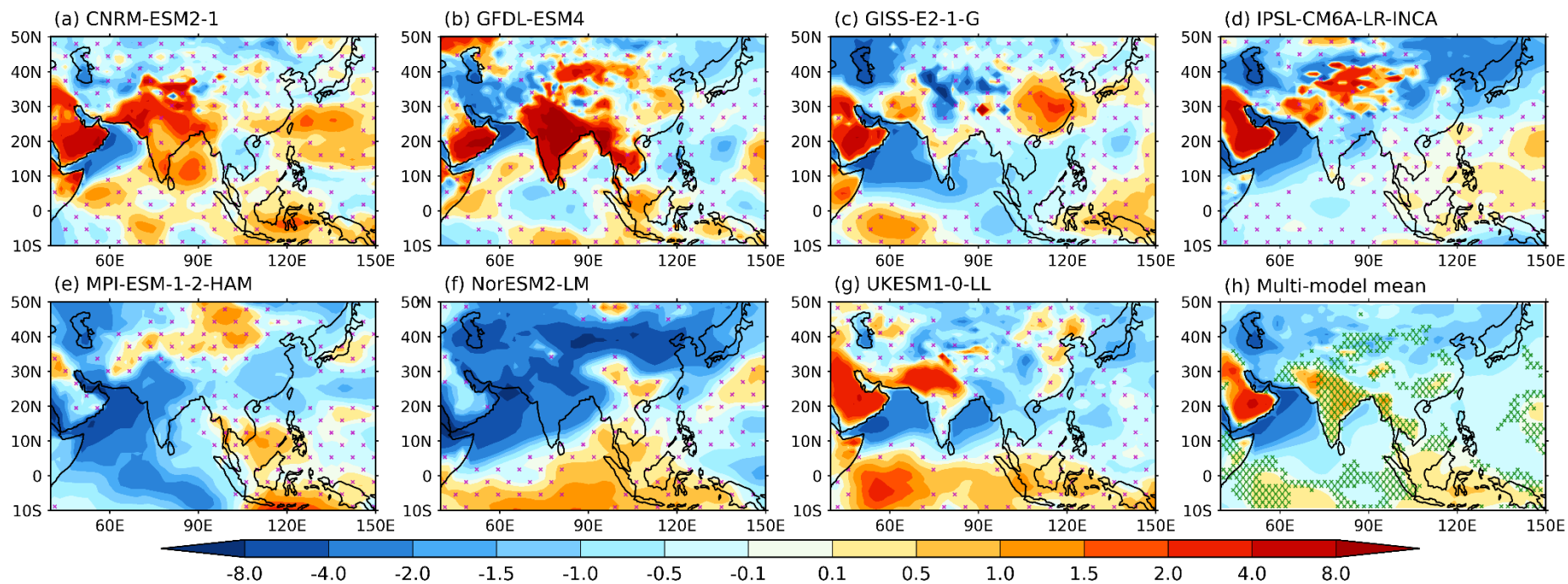


Figure S5. JJA mean changes in TOA clear-sky ERF ($W m^{-2}$) due to doubled dust emissions in (a-g) individual models and (h) the multi-model mean. Purple hatches denote insignificant differences at the 10% level. Green hatches in (h) denote where ≤ 4 models have the same sign as the multi-model mean.

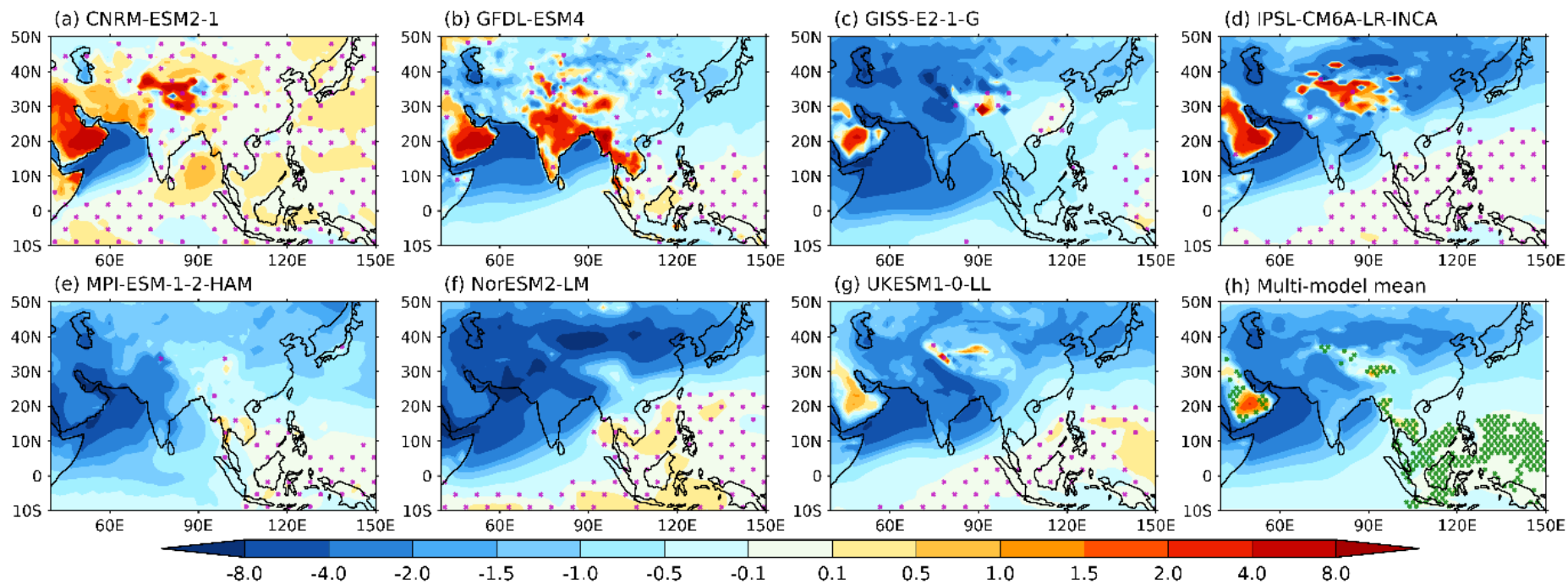


Figure S6. JJA mean changes in TOA clear-sky SW ERF (W m^{-2}) due to doubled dust emissions in (a-g) individual models and (h) the multi-model mean. Purple hatches denote insignificant differences at the 10% level. Green hatches in (h) denote where ≤ 4 models have the same sign as the multi-model mean.

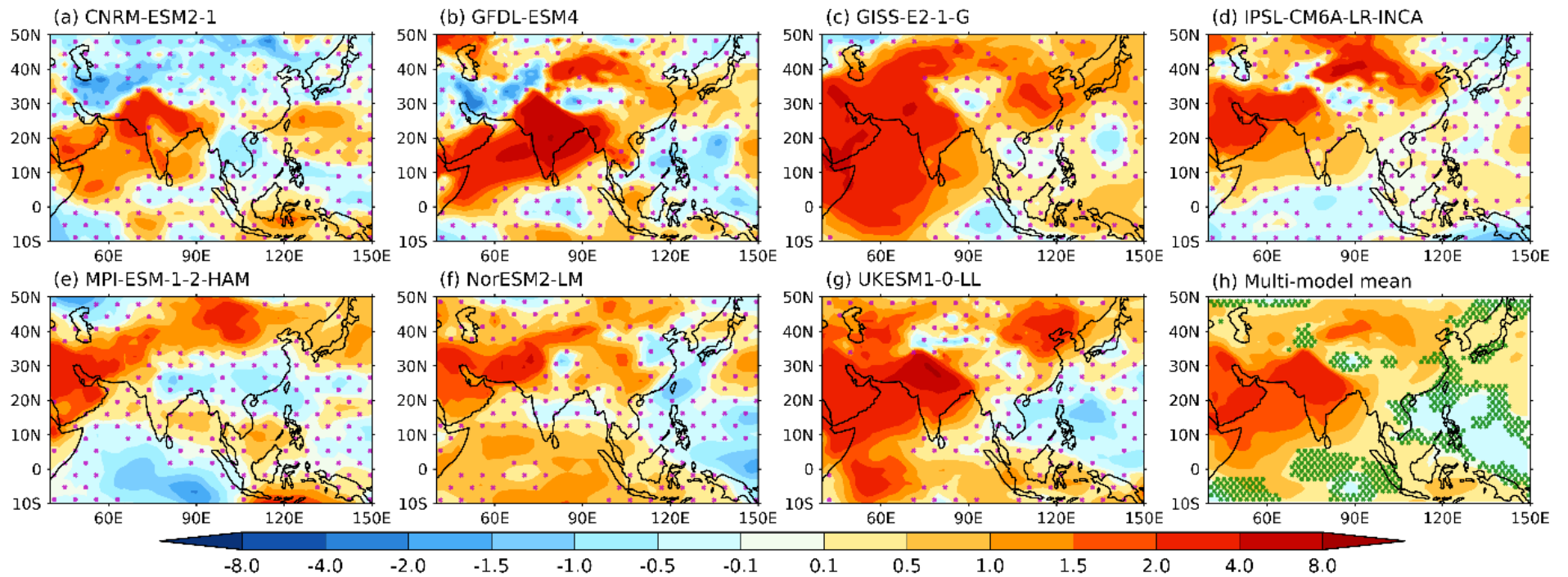


Figure S7. JJA mean changes in TOA clear-sky LW ERF (W m^{-2}) due to doubled dust emissions in (a-g) individual models and (h) the multi-model mean. Purple hatches denote insignificant differences at the 10% level. Green hatches in (h) denote where ≤ 4 models have the same sign as the multi-model mean.

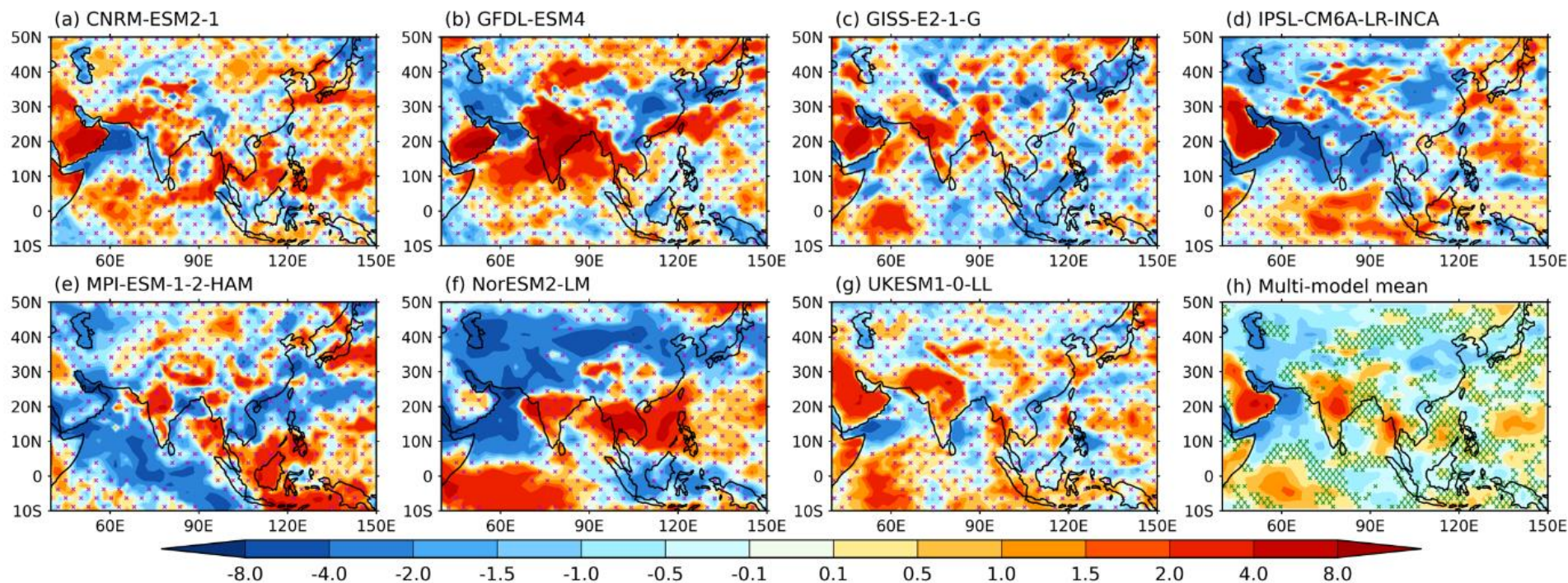


Figure S8. JJA mean changes in TOA all-sky net ERF (W m^{-2}) due to doubled dust emissions in (a-g) individual models and (h) the multi-model mean. Purple hatches denote insignificant differences at the 10% level. Green hatches in (h) denote where ≤ 4 models have the same sign as the multi-model mean.

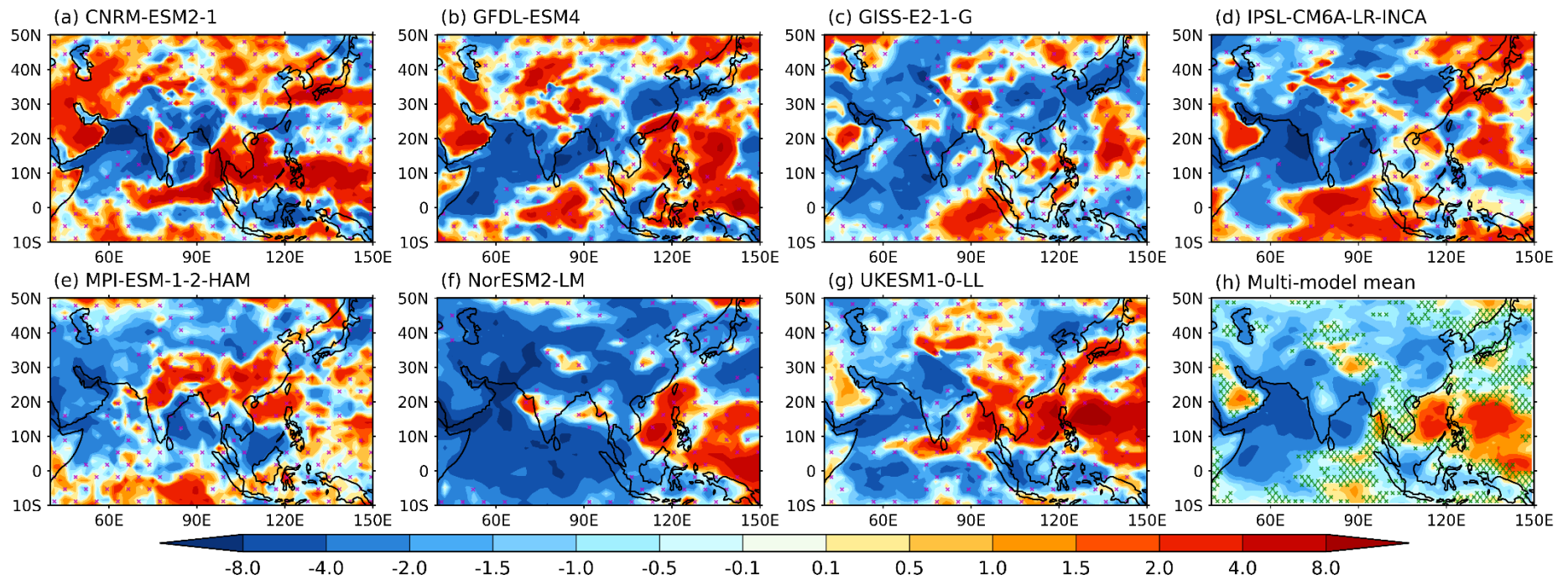


Figure S9: JJA mean TOA all-sky SW ERF (W m^{-2}) due to doubled dust emissions in (a-g) individual models and (h) the multi-model mean. Purple hatches denote insignificant differences at the 10% level. Green hatches in (h) denote where ≤ 4 models have the same sign as the multi-model mean.

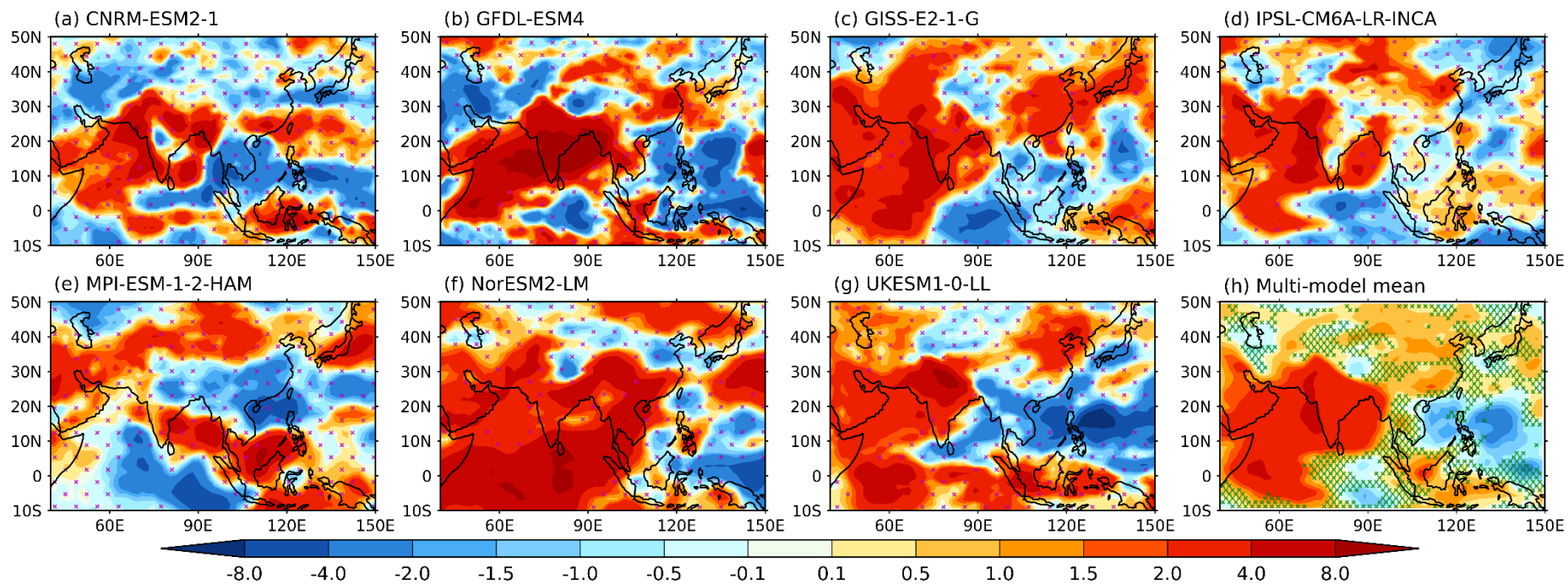


Figure S10: JJA mean TOA all-sky LW ERF ($W m^{-2}$) due to doubled dust emissions in (a-g) individual models and (h) the multi-model mean. Purple hatches denote insignificant differences at the 10% level. Green hatches in (h) denote where ≤ 4 models have the same sign as the multi-model mean.

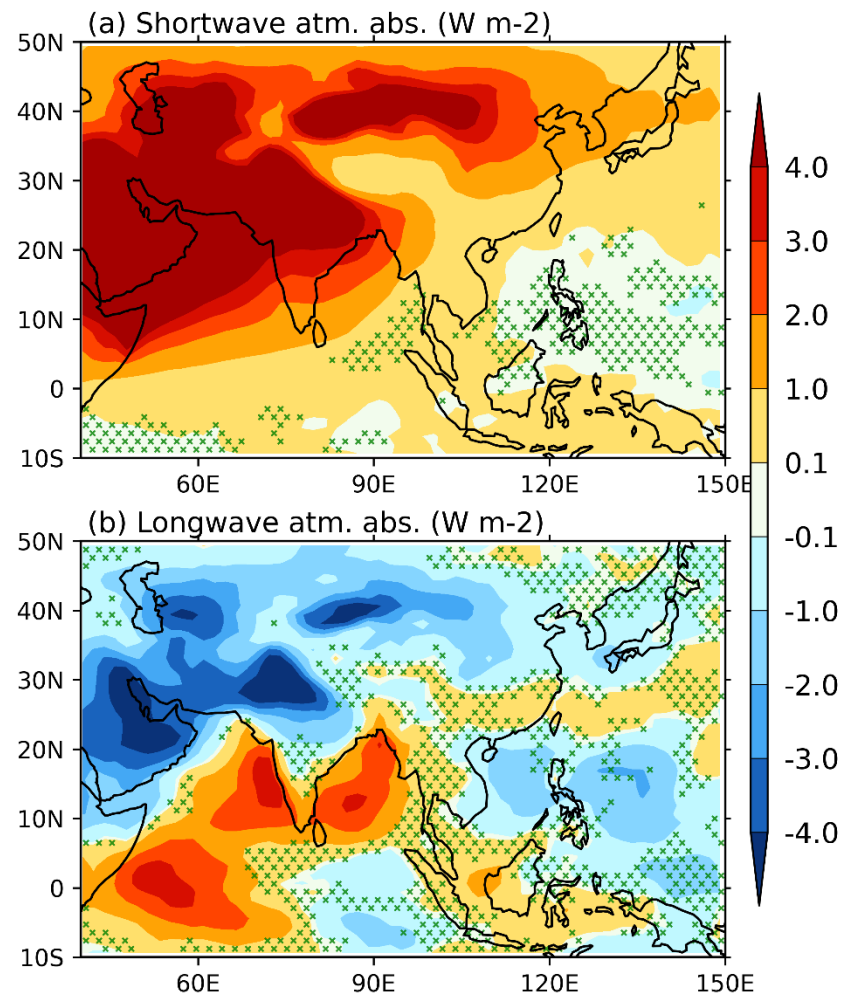


Figure S11. JJA multi-model mean changes in all-sky (a) shortwave and (b) longwave atmospheric absorption ($W m^{-2}$) due to doubled dust emissions. Green hatches denote where ≤ 4 models have the same sign as the multi-model mean.

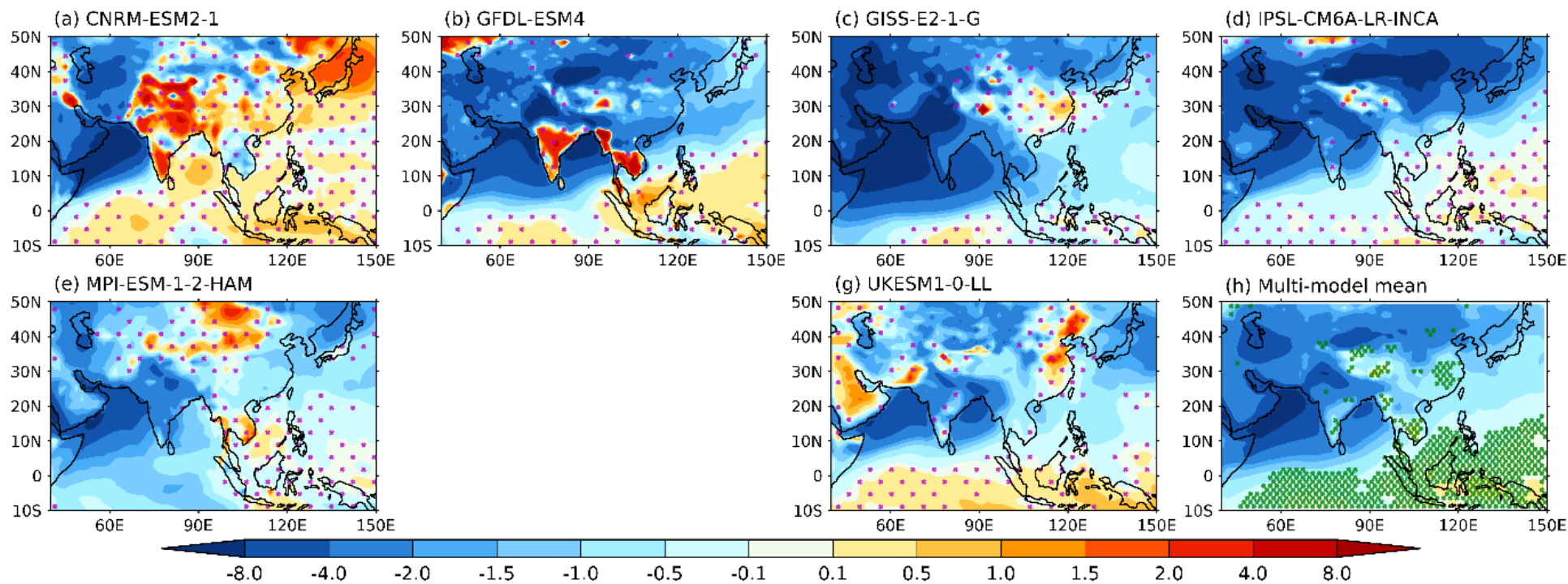


Figure S12. JJA mean changes in surface clear-sky net ERF ($W m^{-2}$) due to doubled dust emissions in (a-g) individual models and (h) the multi-model mean. Purple hatches denote insignificant differences at the 10% level. Green hatches in (h) denote where ≤ 4 models have the same sign as the multi-model mean. Data not available for all models.

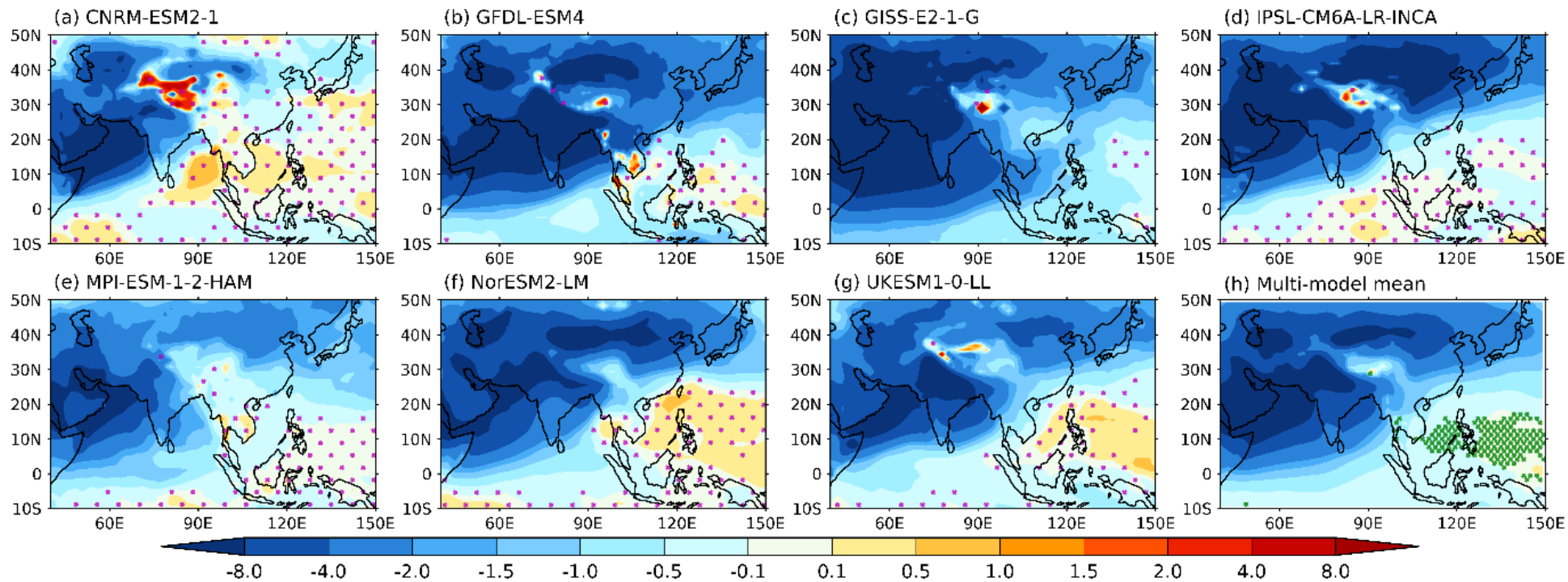


Figure S13. JJA mean changes in surface clear-sky SW ERF ($W m^{-2}$) due to doubled dust emissions in (a-g) individual models and (h) the multi-model mean. Purple hatches denote insignificant differences at the 10% level. Green hatches in (h) denote where ≤ 4 models have the same sign as the multi-model mean.

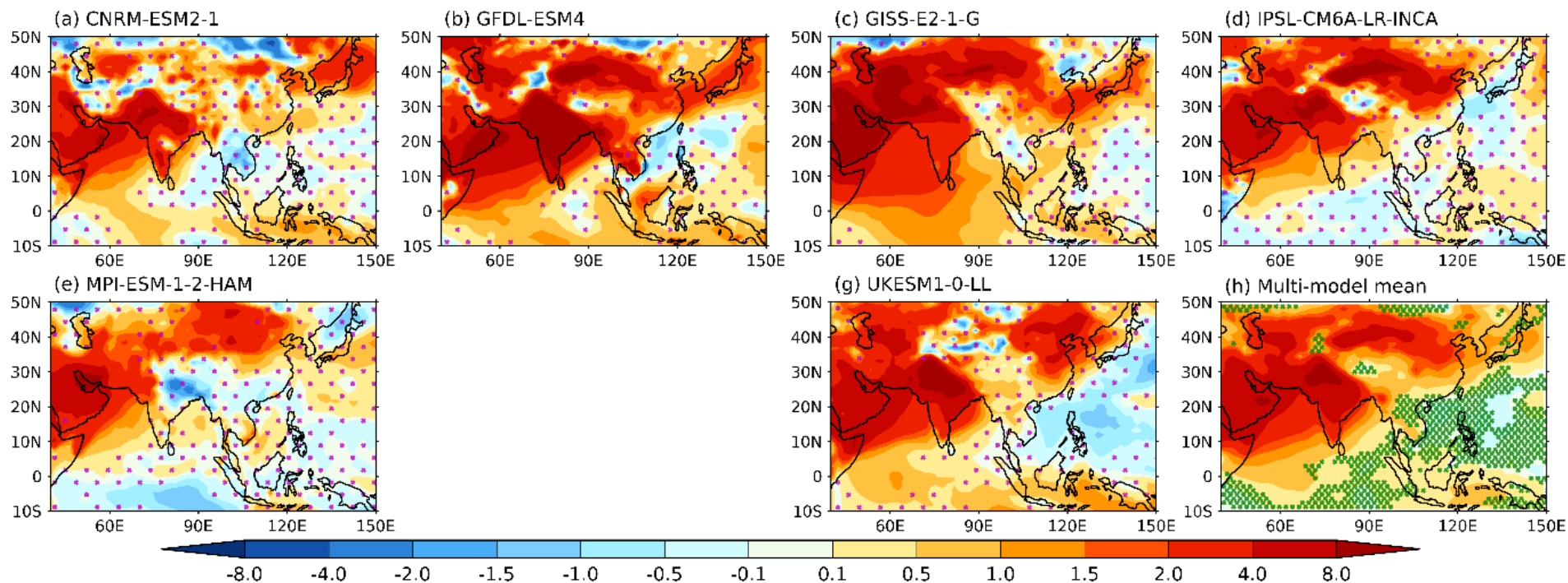


Figure S14. JJA mean changes in surface clear-sky LW ERF ($W m^{-2}$) due to doubled dust emissions in (a-g) individual models and (h) the multi-model mean. Purple hatches denote insignificant differences at the 10% level. Green hatches in (h) denote where ≤ 4 models have the same sign as the multi-model mean. Data not available for all models.

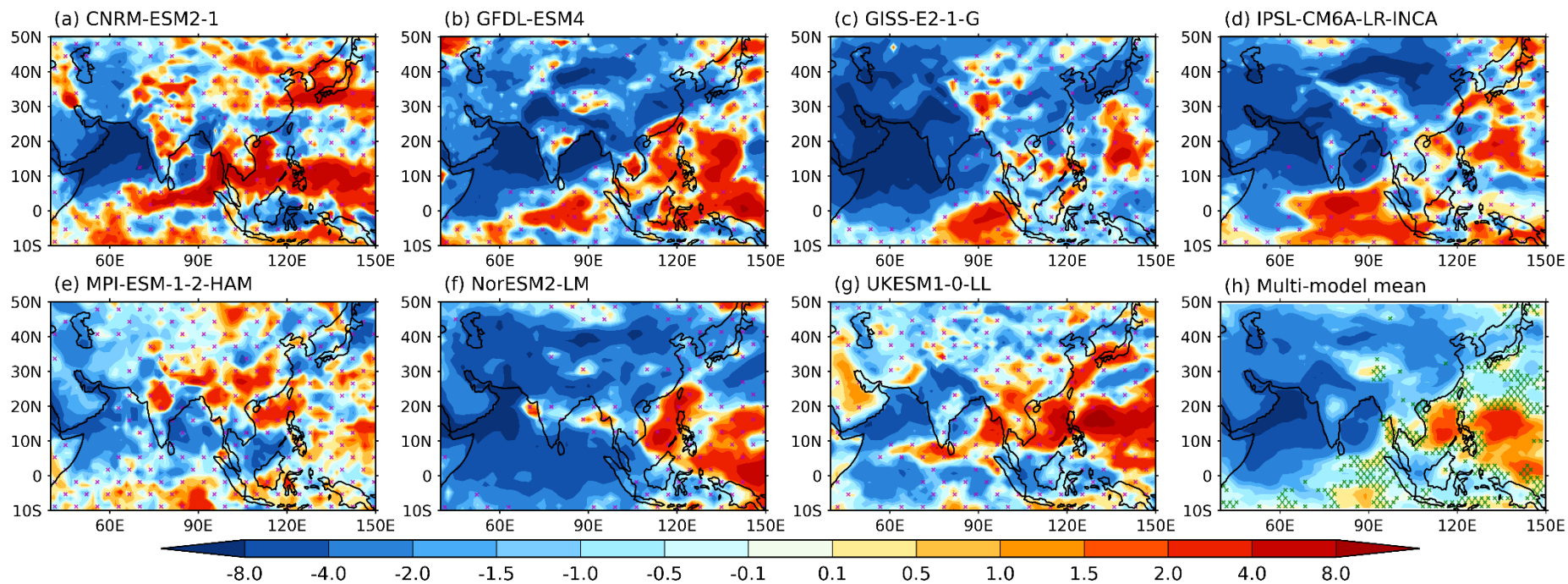


Figure S15. JJA mean changes in surface all-sky net ERF ($W m^{-2}$) due to doubled dust emissions in (a-g) individual models and (h) the multi-model mean. Purple hatches denote insignificant differences at the 10% level. Green hatches in (h) denote where ≤ 4 models have the same sign as the multi-model mean.

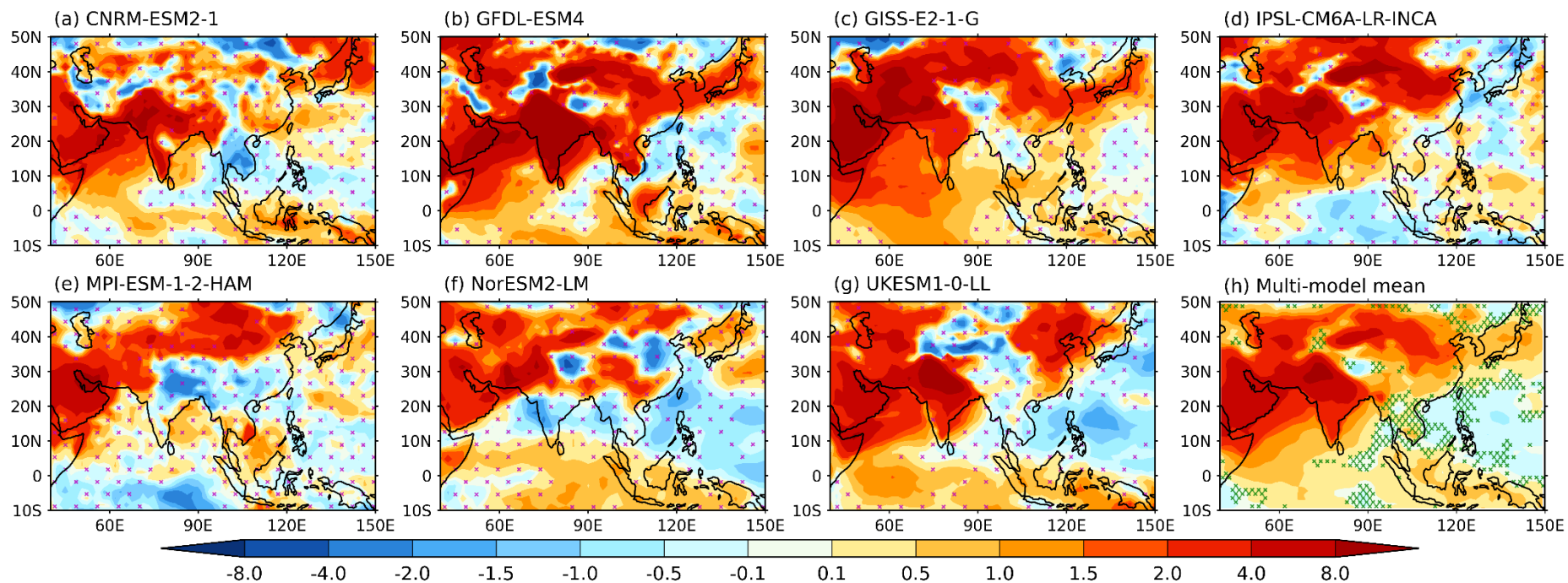


Figure S16: JJA mean surface all-sky SW ERF ($W m^{-2}$) due to doubled dust emissions in (a-g) individual models and (h) the multi-model mean. Purple hatches denote insignificant differences at the 10% level. Green hatches in (h) denote where ≤ 4 models have the same sign as the multi-model mean.

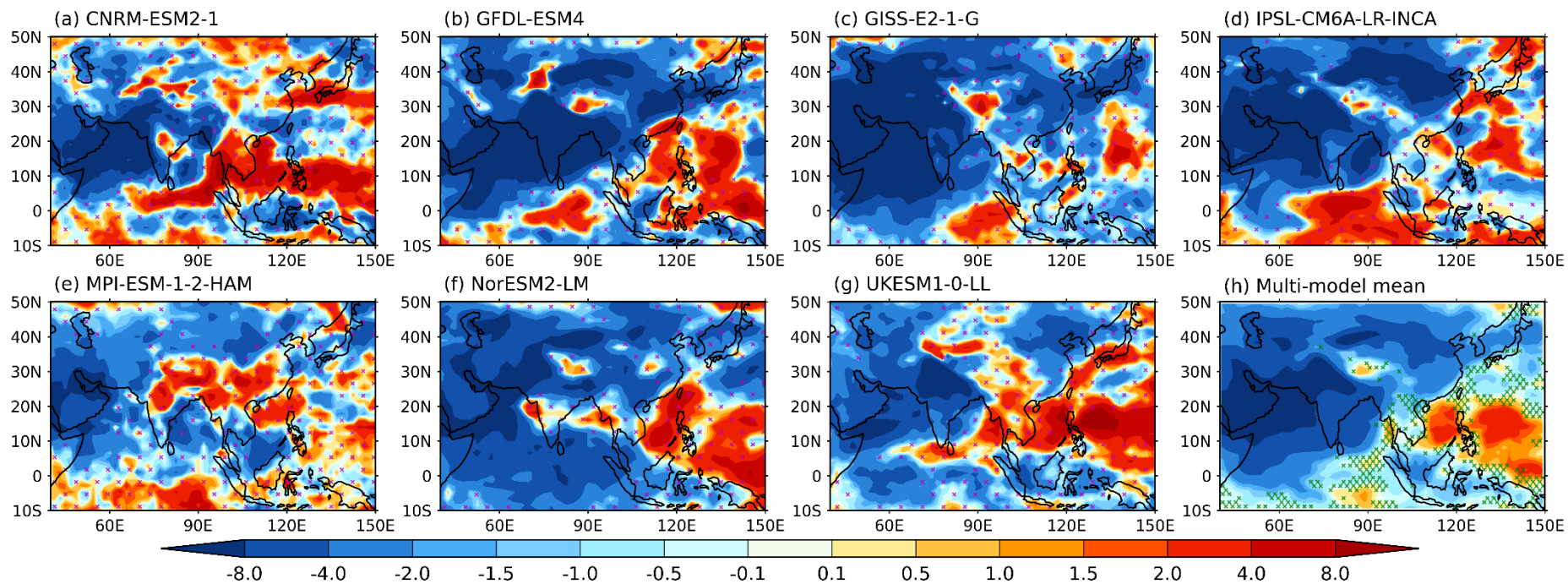


Figure S17: JJA mean surface all-sky LW ERF ($W m^{-2}$) due to doubled dust emissions in (a-g) individual models and (h) the multi-model mean. Purple hatches denote insignificant differences at the 10% level. Green hatches in (h) denote where ≤ 4 models have the same sign as the multi-model mean.

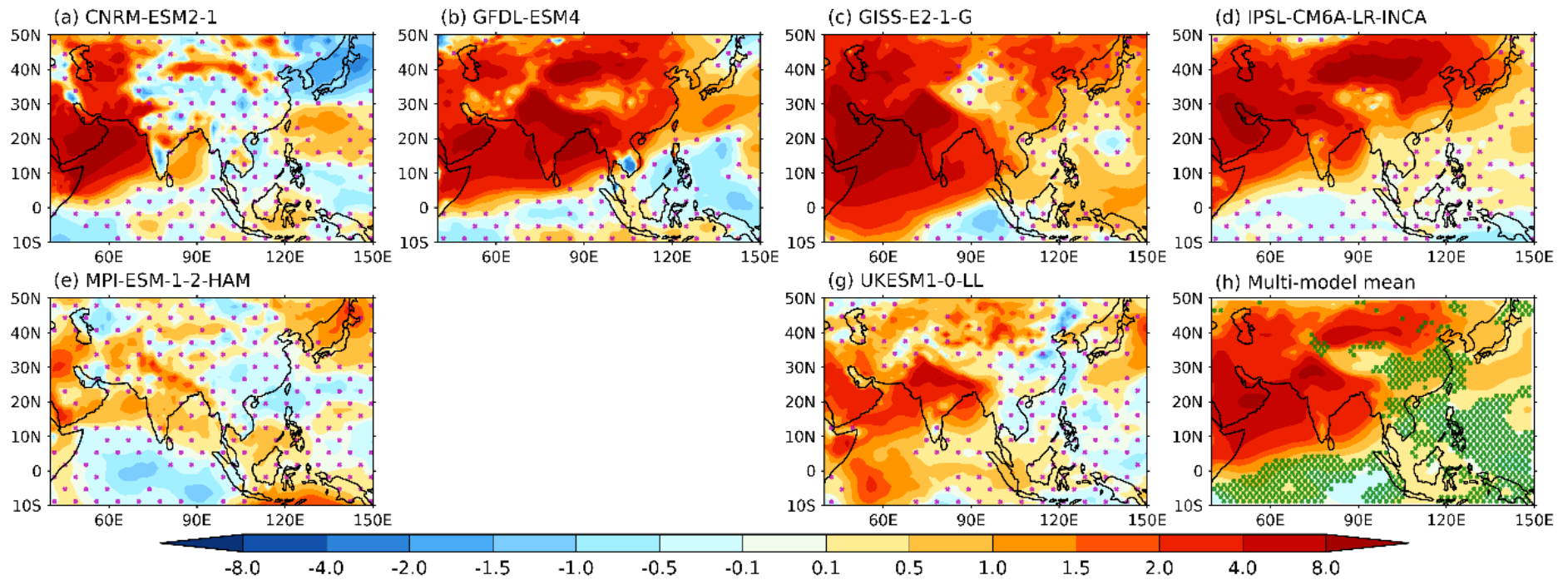


Figure S18 JJA mean changes in total clear-sky atmospheric absorption ($W m^{-2}$) due to doubled dust emissions in (a-g) individual models and (h) the multi-model mean. Purple hatches denote insignificant differences at the 10% level. Green hatches in (h) denote where ≤ 4 models have the same sign as the multi-model mean.

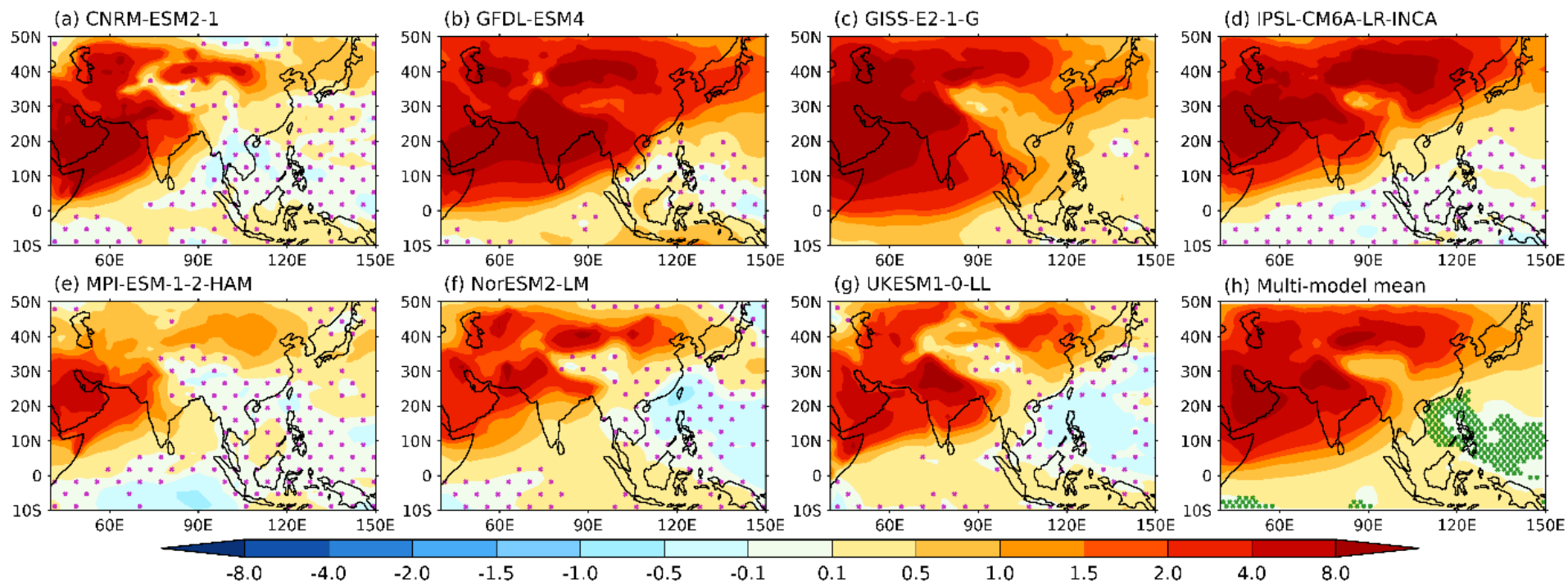


Figure S19 JJA mean changes in SW clear-sky atmospheric absorption ($W m^{-2}$) due to doubled dust emissions in (a-g) individual models and (h) the multi-model mean. Purple hatches denote insignificant differences at the 10% level. Green hatches in (h) denote where ≤ 4 models have the same sign as the multi-model mean.

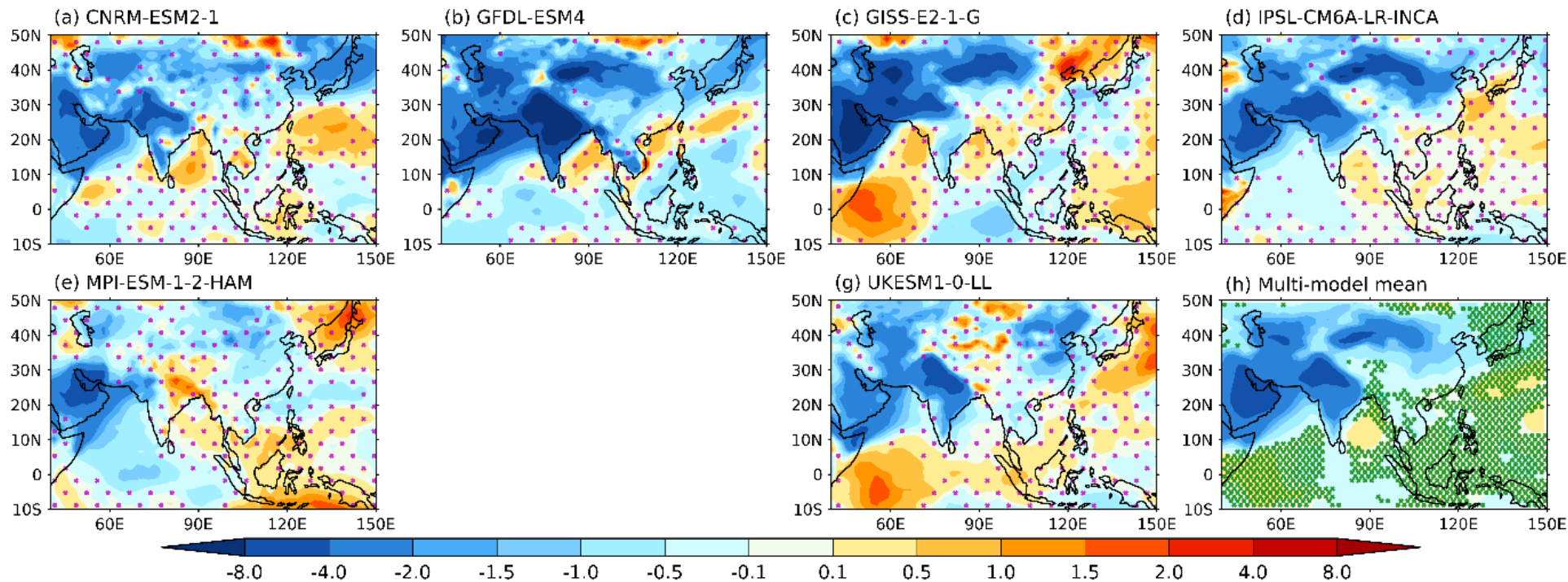


Figure S20 JJA mean changes in LW clear-sky atmospheric absorption ($W m^{-2}$) due to doubled dust emissions in (a-g) individual models and (h) the multi-model mean. Purple hatches denote insignificant differences at the 10% level. Green hatches in (h) denote where ≤ 4 models have the same sign as the multi-model mean.

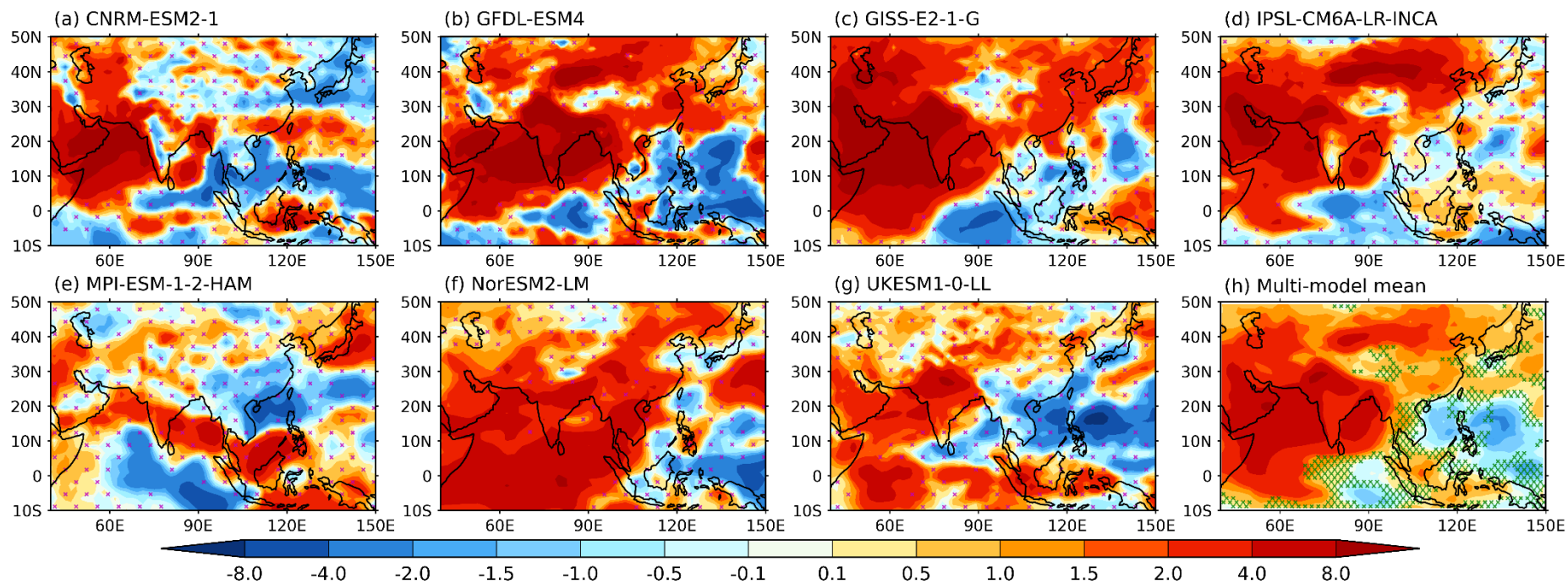


Figure S21 JJA mean changes in total atmospheric absorption (W m^{-2}) due to doubled dust emissions in (a-g) individual models and (h) the multi-model mean. Purple hatches denote insignificant differences at the 10% level. Green hatches in (h) denote where ≤ 4 models have the same sign as the multi-model mean.

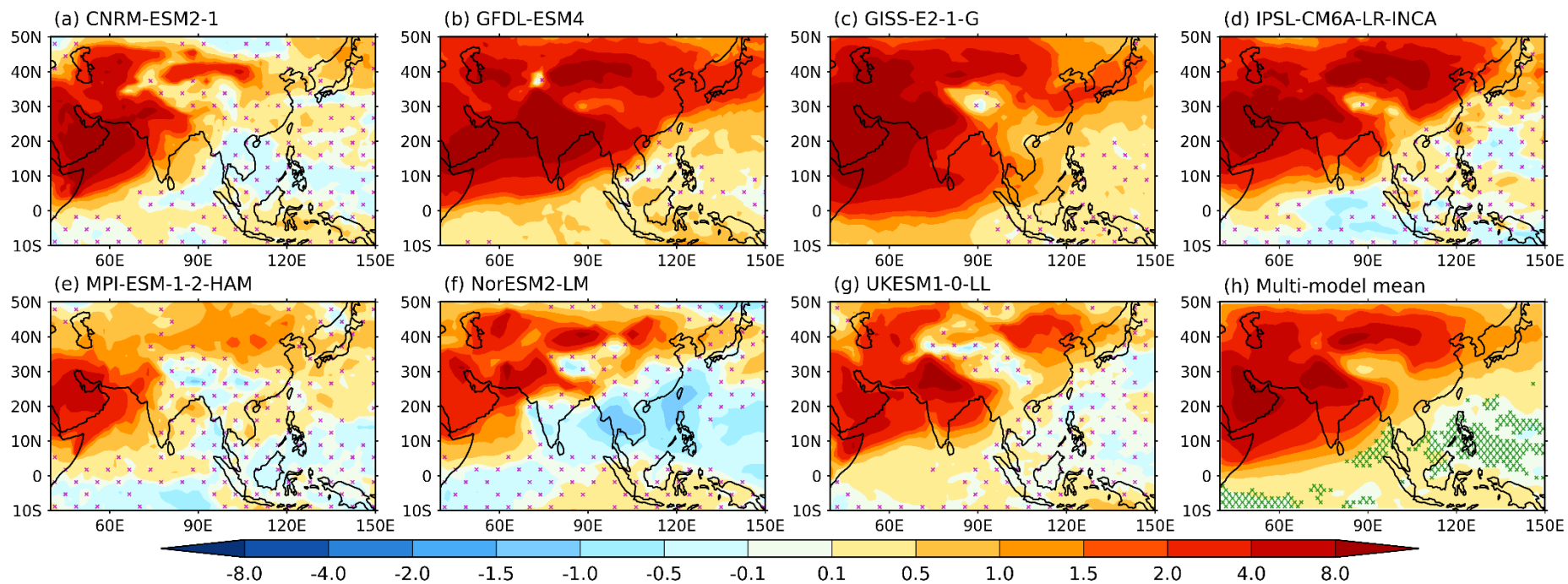


Figure S22: JJA mean changes in all-sky SW atmospheric absorption (W m^{-2}) due to doubled dust emissions in (a-g) individual models and (h) the multi-model mean. Purple hatches denote insignificant differences at the 10% level. Green hatches in (h) denote where ≤ 4 models have the same sign as the multi-model mean.

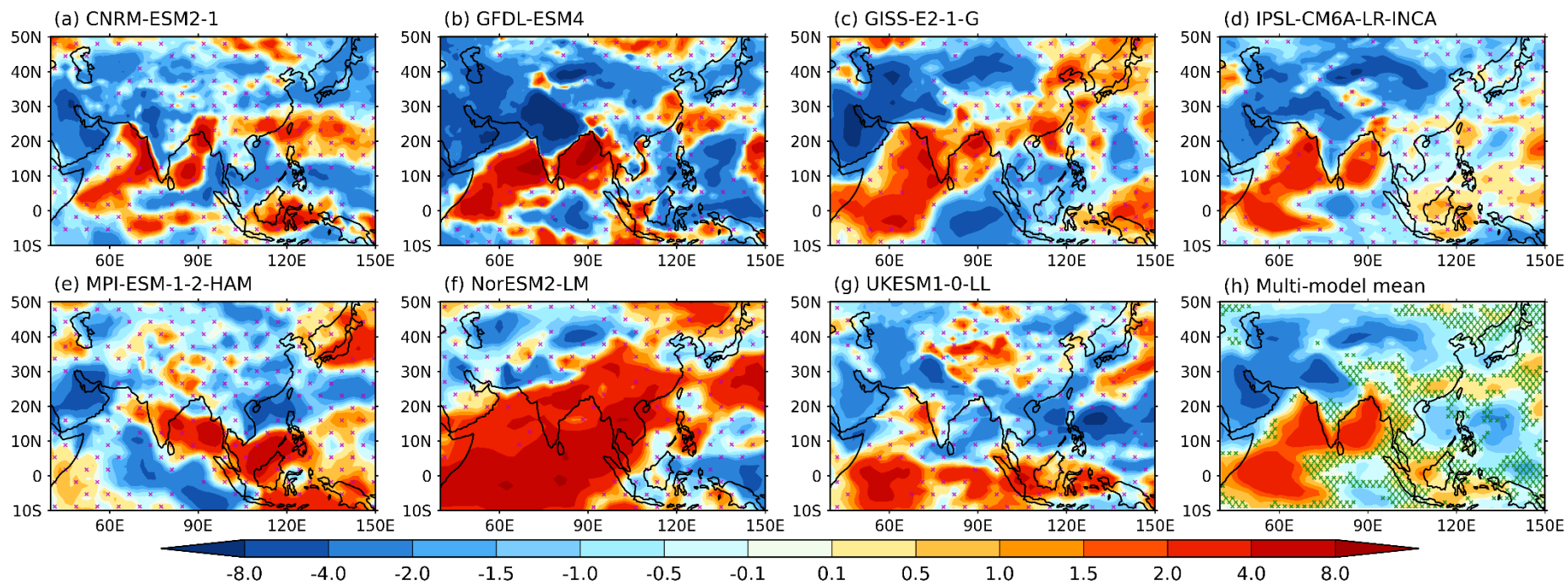


Figure S23: JJA mean changes in all-sky LW atmospheric absorption ($W m^{-2}$) due to doubled dust emissions in (a-g) individual models and (h) the multi-model mean. Purple hatches denote insignificant differences at the 10% level. Green hatches in (h) denote where ≤ 4 models have the same sign as the multi-model mean.

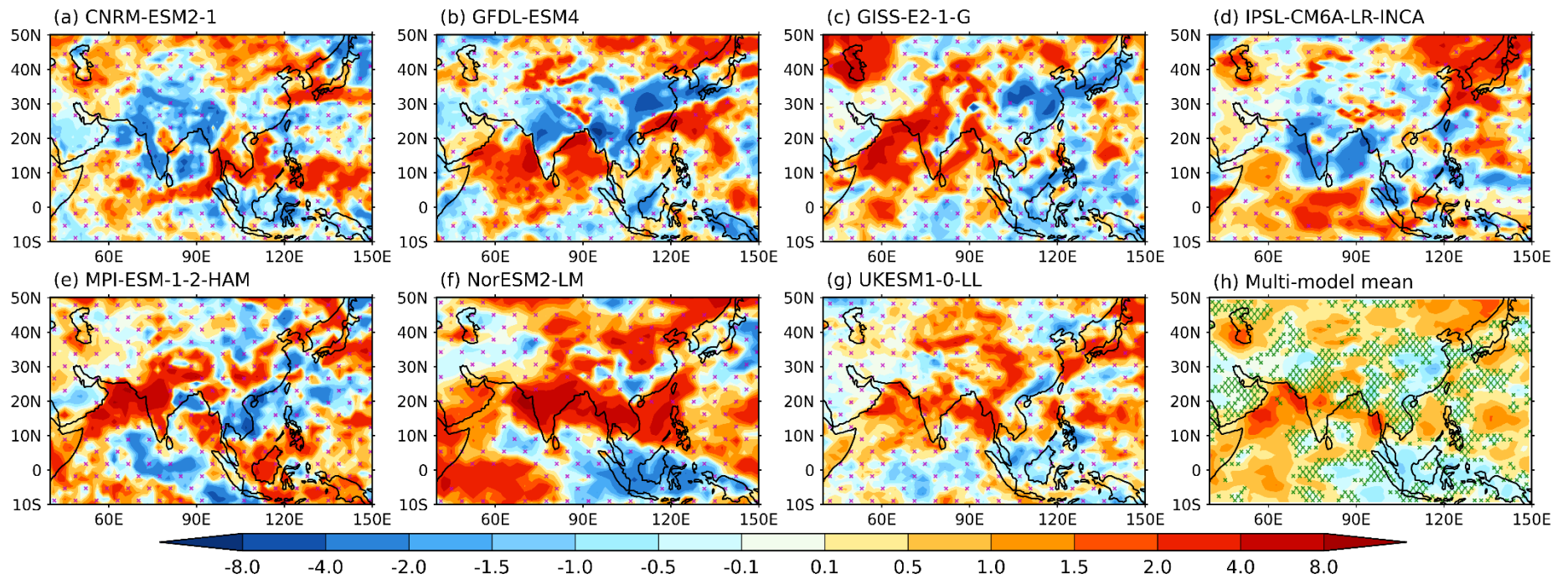


Figure S24: JJA mean TOA total (SW+LW) cloud radiative effect ($W m^{-2}$) due to doubled dust emissions in (a-g) individual models and (h) the multi-model mean. Purple hatches denote insignificant differences at the 10% level. Green hatches in (h) denote where ≤ 4 models have the same sign as the multi-model mean.

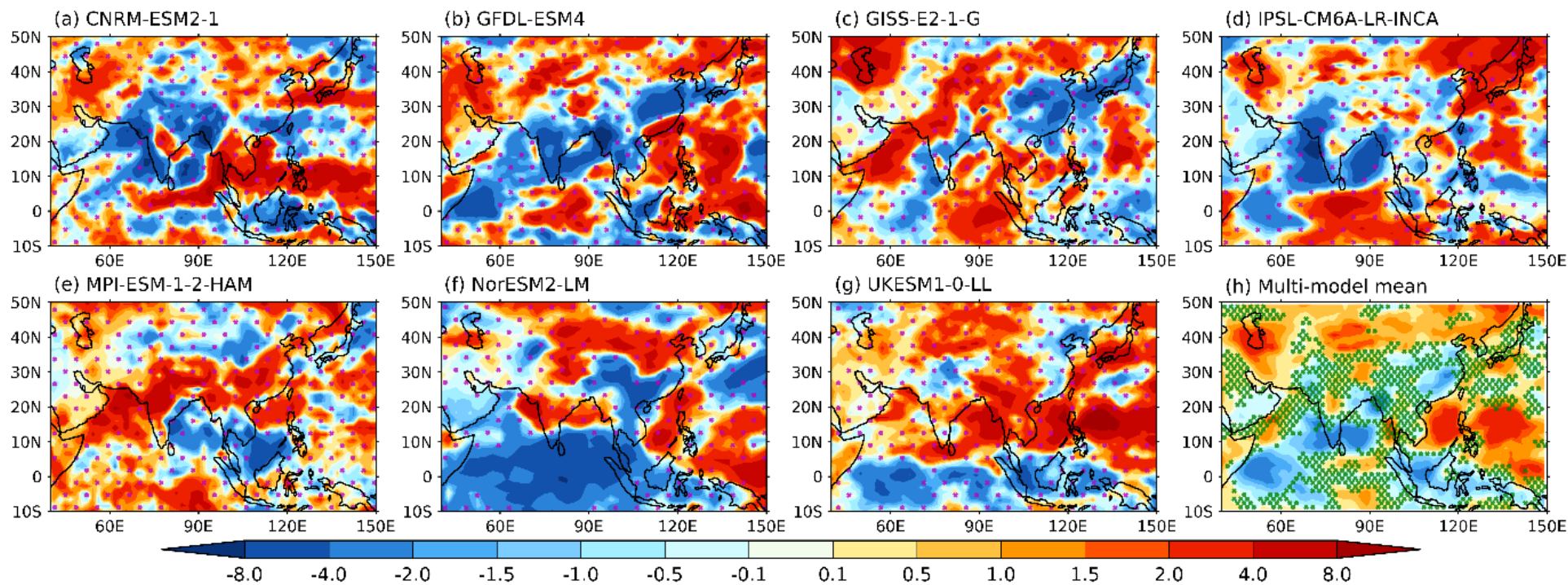


Figure S25: JJA mean TOA SW cloud radiative effect (W m^{-2}) due to doubled dust emissions in (a-g) individual models and (h) the multi-model mean. Purple hatches denote insignificant differences at the 10% level. Green hatches in (h) denote where ≤ 4 models have the same sign as the multi-model mean.

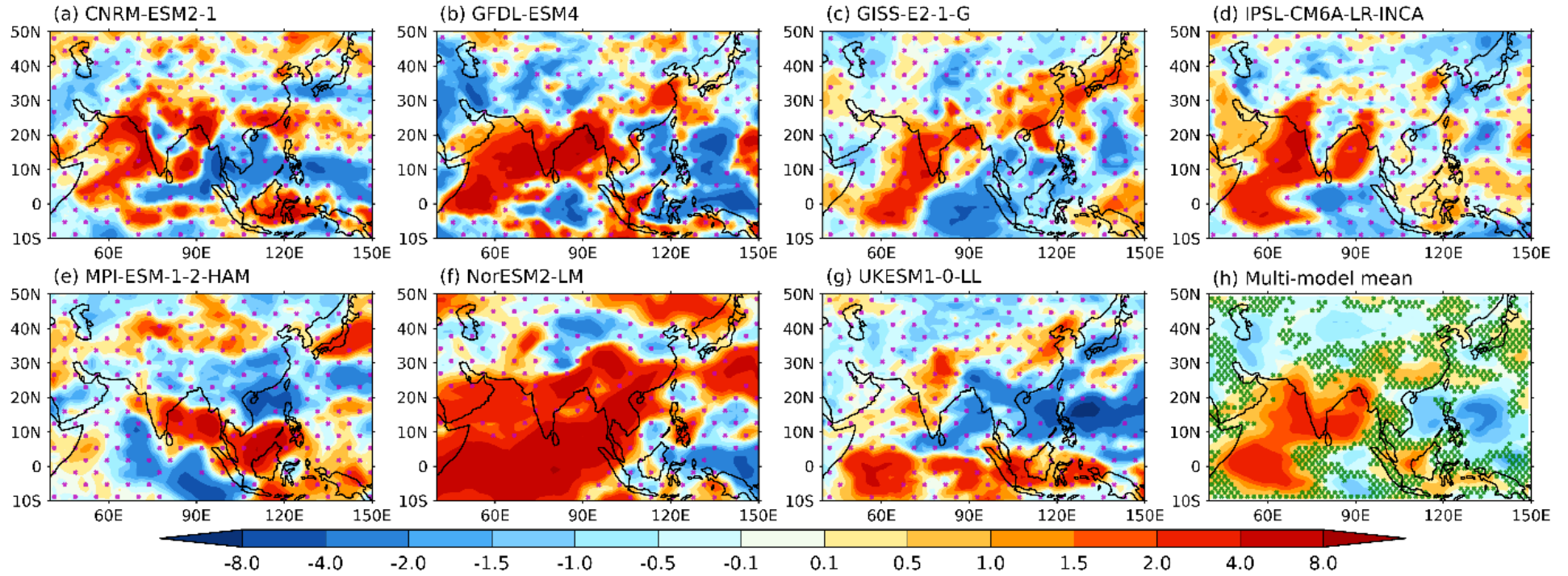


Figure S26: JJA mean TOA LW cloud radiative effect ($W m^{-2}$) due to doubled dust emissions in (a-g) individual models and (h) the multi-model mean. Purple hatches denote insignificant differences at the 10% level. Green hatches in (h) denote where ≤ 4 models have the same sign as the multi-model mean.

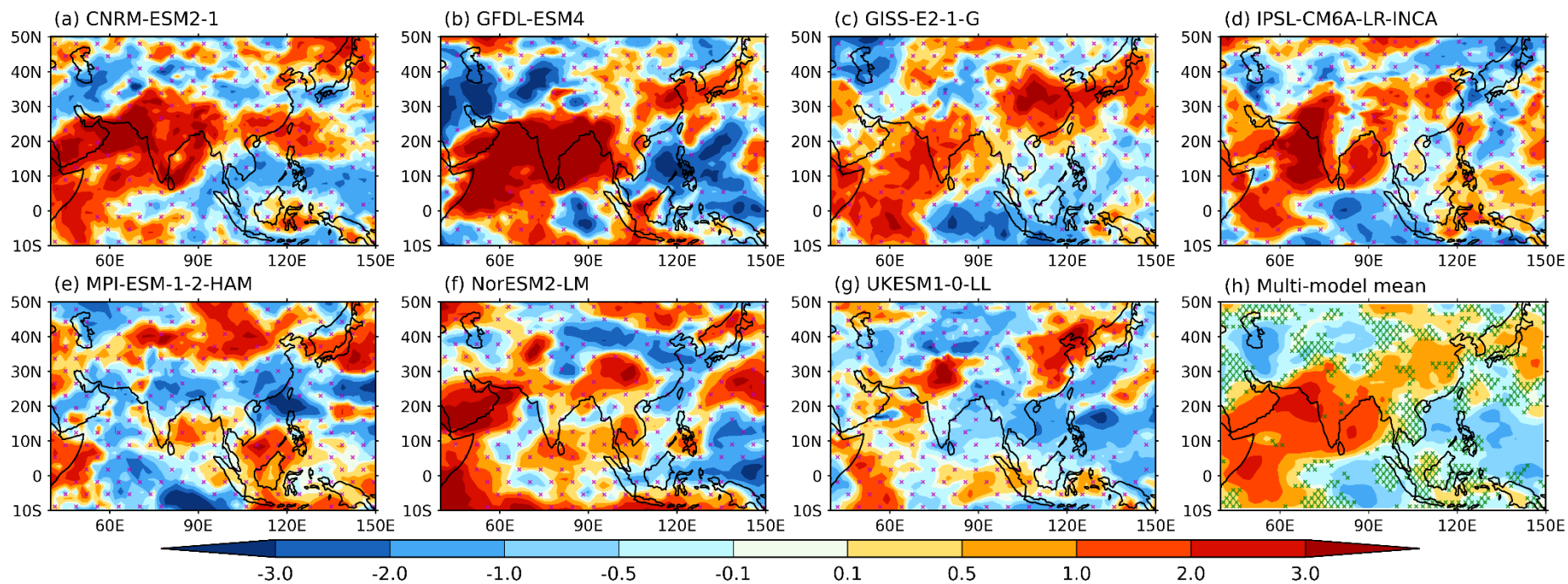


Figure S27. JJA mean changes in total cloud fraction (%) due to doubled dust emissions in (a-g) individual models and (h) the multi-model mean. Purple hatches denote insignificant differences at the 10% level. Green hatches in (h) denote where ≤ 4 models have the same sign as the multi-model mean.

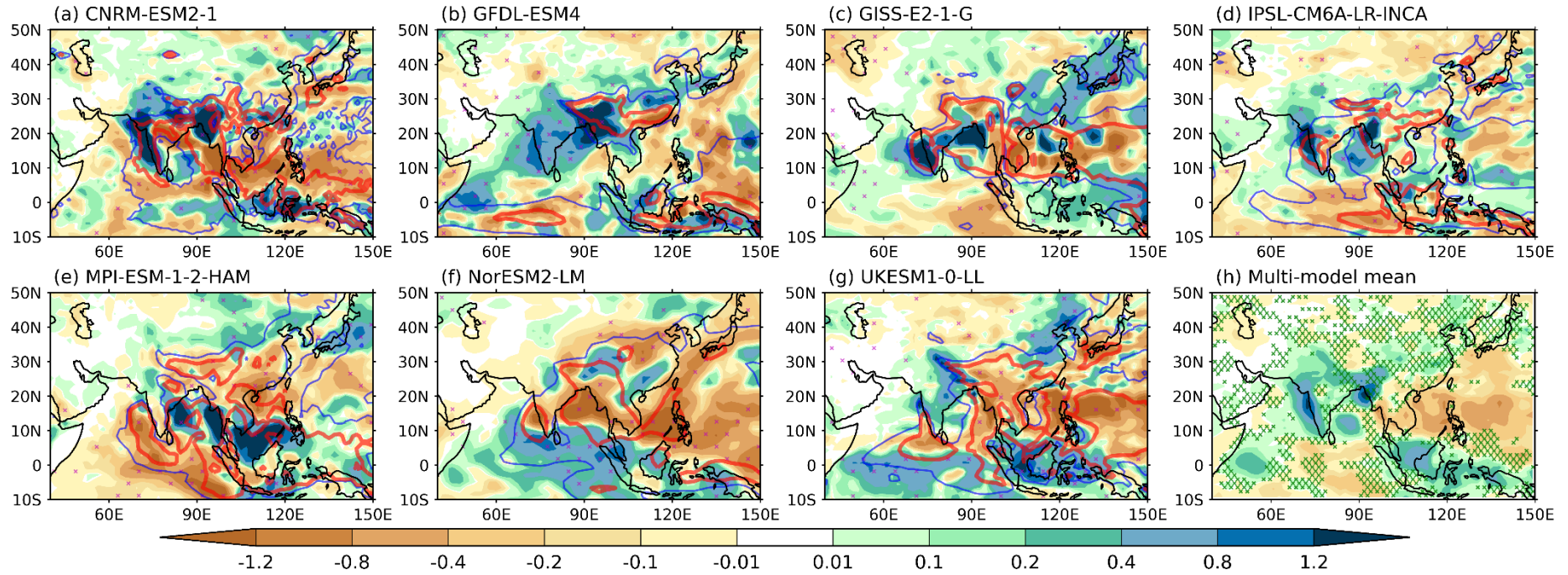


Figure S28. JJA mean changes in vertically integrated moisture flux convergence (mm day^{-1}) due to doubled dust emissions in (a-g) individual models and (h) the multi-model mean. Green hatches in (h) denote where ≤ 4 models have the same sign as the multi-model mean.

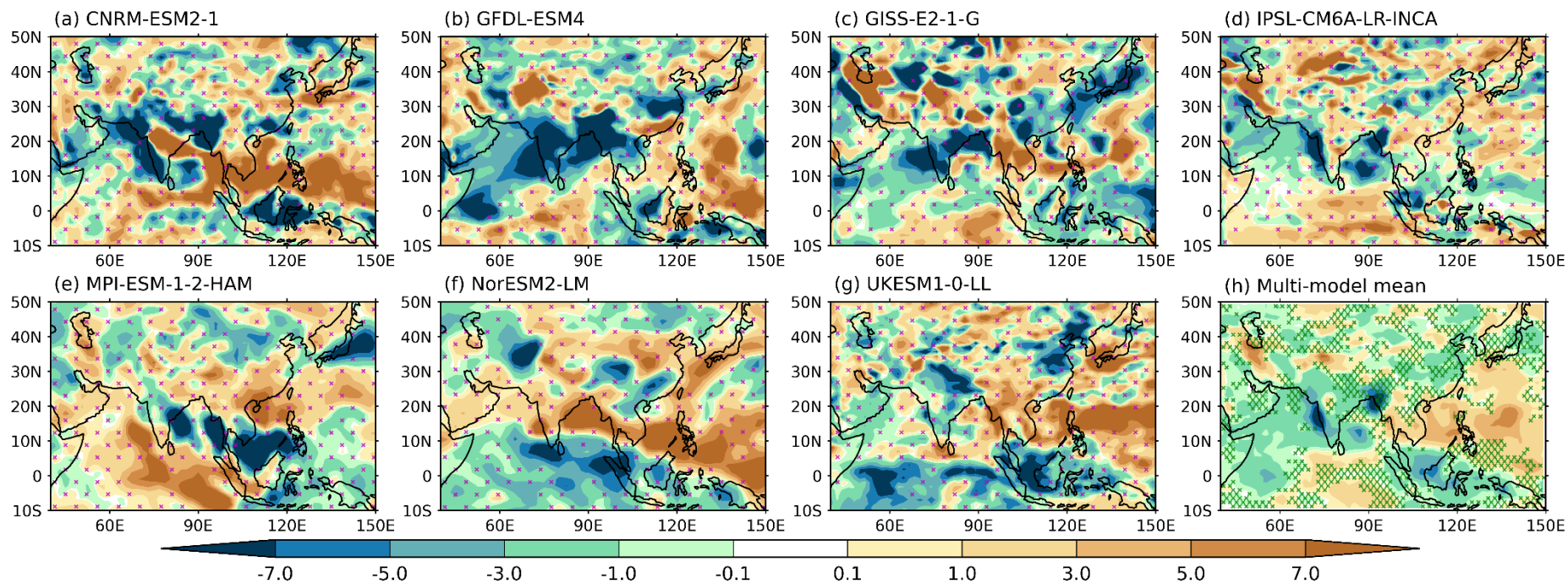


Figure S29. JJA mean changes in 500-hPa vertical velocity (hPa day^{-1}) due to doubled dust emissions in (a-g) individual models and (h) the multi-model mean. Purple hatches denote insignificant differences at the 10% level. Green hatches in (h) denote where ≤ 4 models have the same sign as the multi-model mean.

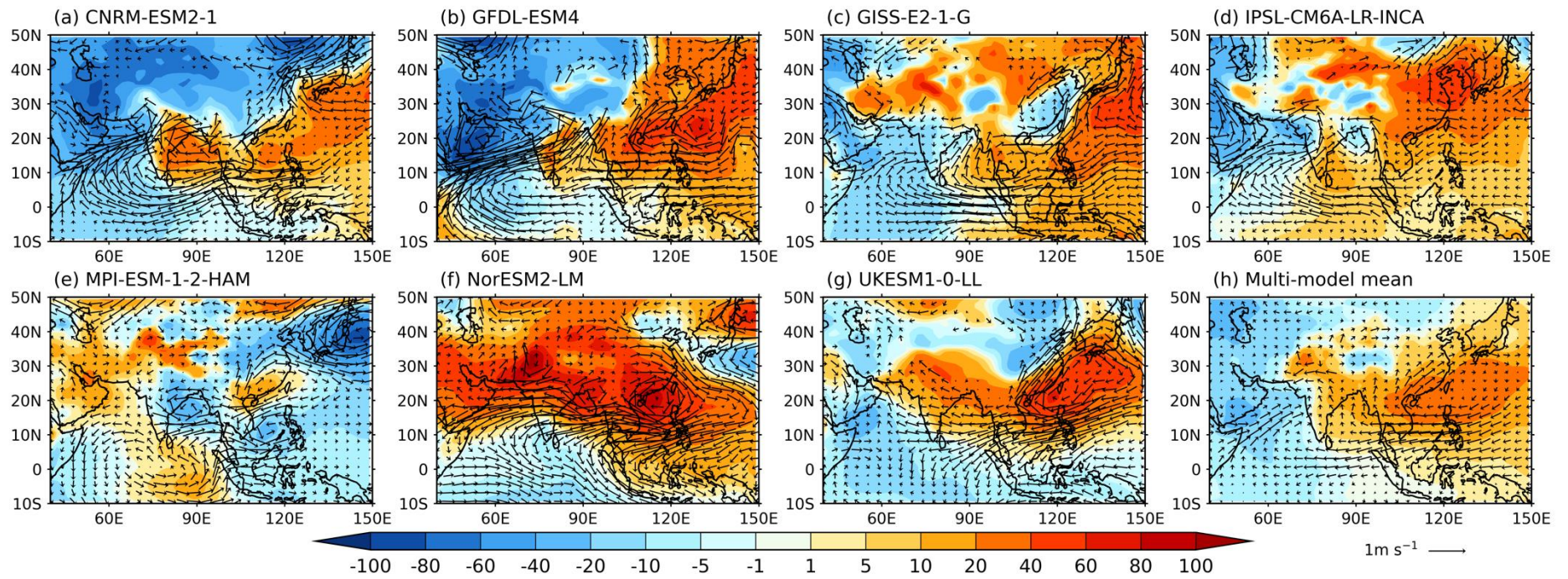


Figure S30. JJA mean changes in sea level pressure (colours, Pa) and in 850-hPa winds (vectors, m s^{-1}) due to doubled dust emissions in (a-g) individual models and (h) the multi-model mean.

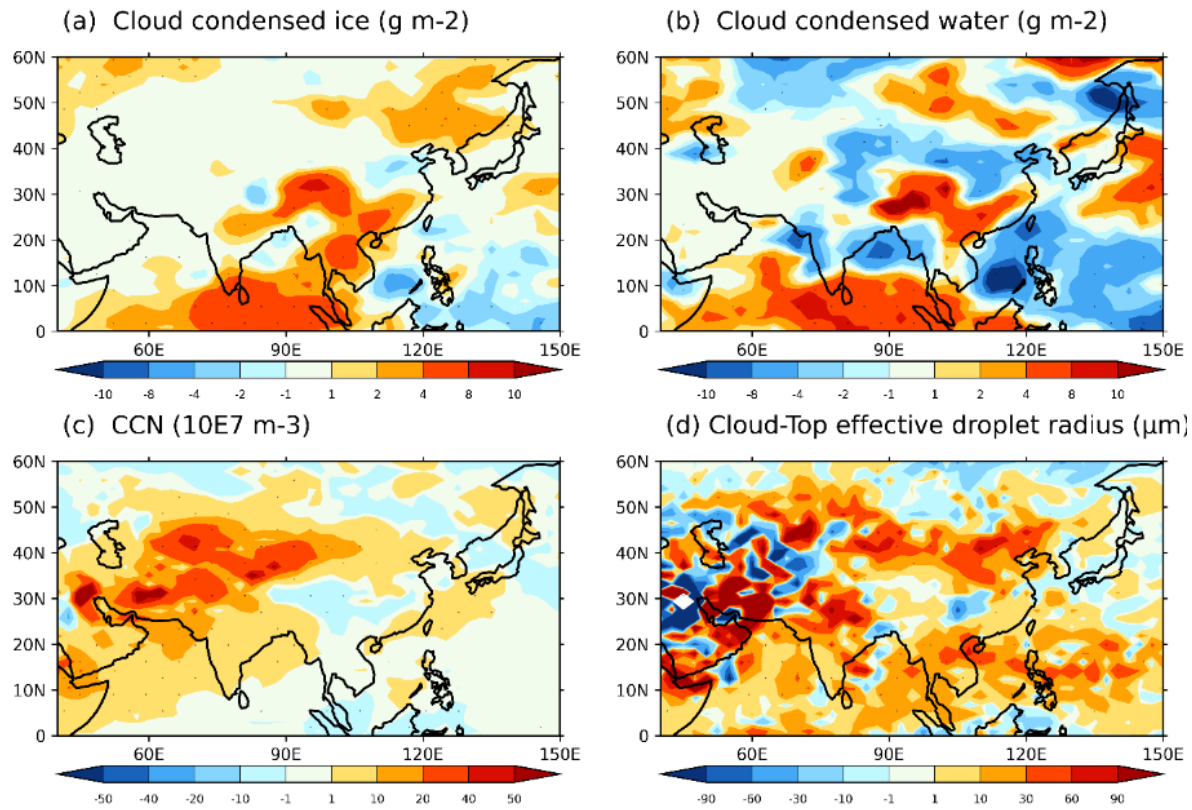


Figure S31: NorESM-LM changes in cloud microphysical properties due to doubled dust emissions. Hatches indicate locations where changes are significant.