

Supporting Material for “Stable climate simulations using a realistic GCM with neural network parameterizations for atmospheric moist physics and radiation processes”

List of Supplemental Materials:

Figure S1. Wave spectra of a) a stable NN parameterization and b) an unstable parameterization. The light blue background indicates where the phase speed is above 5m/s and the growth rate is positive. The stability diagrams are obtained by coupling linear responses of NN parametrizations to simplified 2D dynamics with a chosen base state, which is normal convection background in the long-term prognostic for a) and an initial state for unreal gravity wave in Movie S1 for b).

Figure S2. Latitude-pressure cross-section zonal and annual mean differences for temperature (top row) and specific humidity (bottom row) between (a & c) NNCAM and SPCAM and (b & d) CAM5 and SPCAM. The simulation period for all model is from 1999 to 2003.

Figure S4. Latitude-pressure cross-section zonal and annual mean for a) temperature and b) specific humidity in NNCAM simulated from 2004 to 2008 with their differences with the SPCAM simulation from 1999 to 2003.

Figure S5. Global distribution of temporal mean precipitation predicted by NNCAM from January 1st 2004 to December 31st 2008 for a) annual, b) boreal summer (JJA), and c) boreal winter (DJF).

Movie S1. Mid-level (500 hPa) convective moistening rate in a realistic configured NNCAM in which we use the chosen unstable NN parameterization to parametrize convection. This movie records the first unrealistic wave in maritime continent.

Movie S2. Similar movie as Movie S1 but for two gravity wave afterwards in the same simulation.

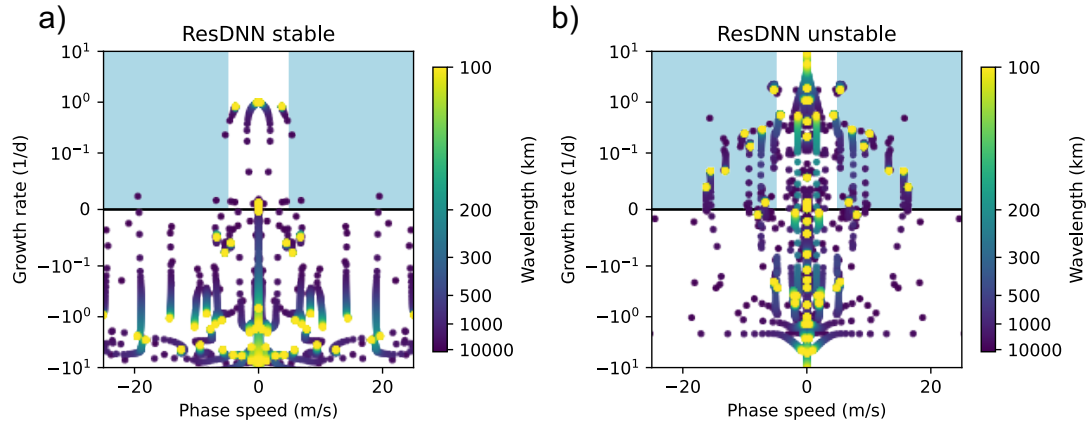


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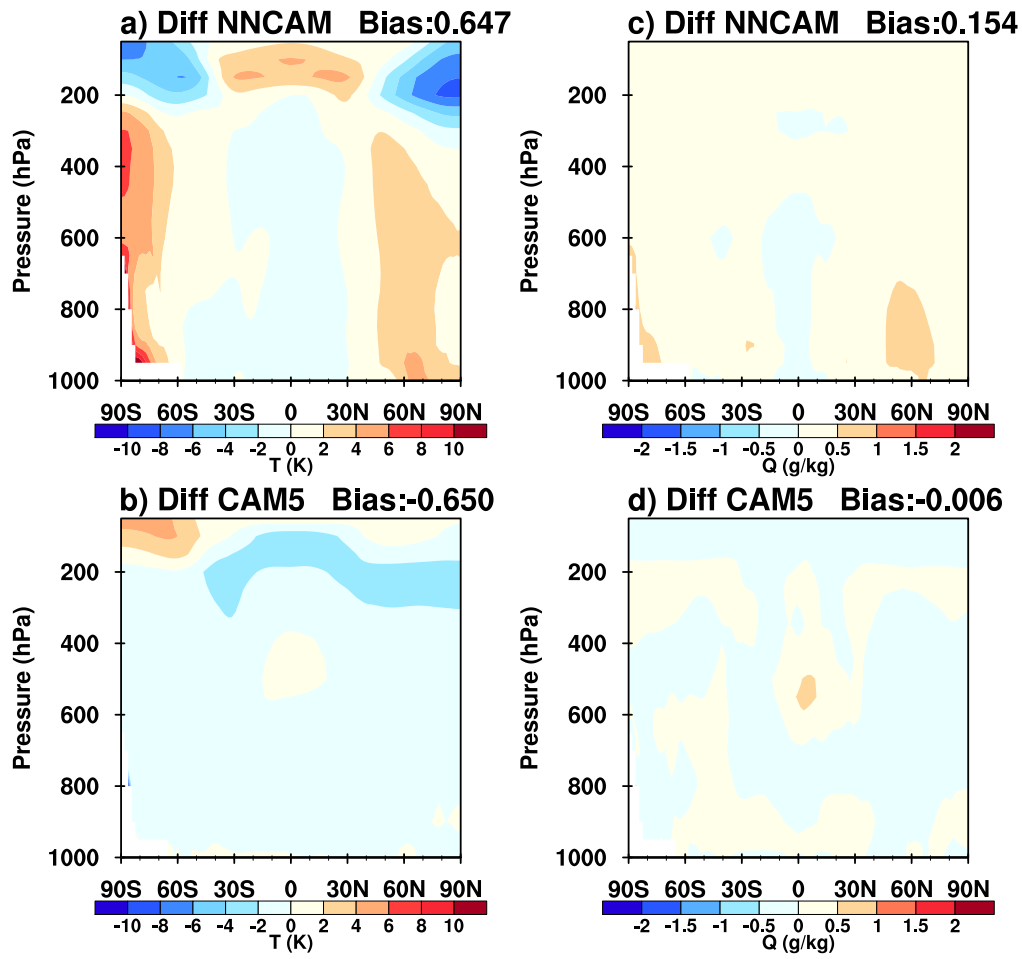


Figure S2. Latitude-pressure cross-section zonal and annual mean differences for temperature (top row) and specific humidity (bottom row) between (a & c) NNCAM and SPCAM and (b & d) CAM5 and SPCAM. The simulation period for all model is from 1999 to 2003.

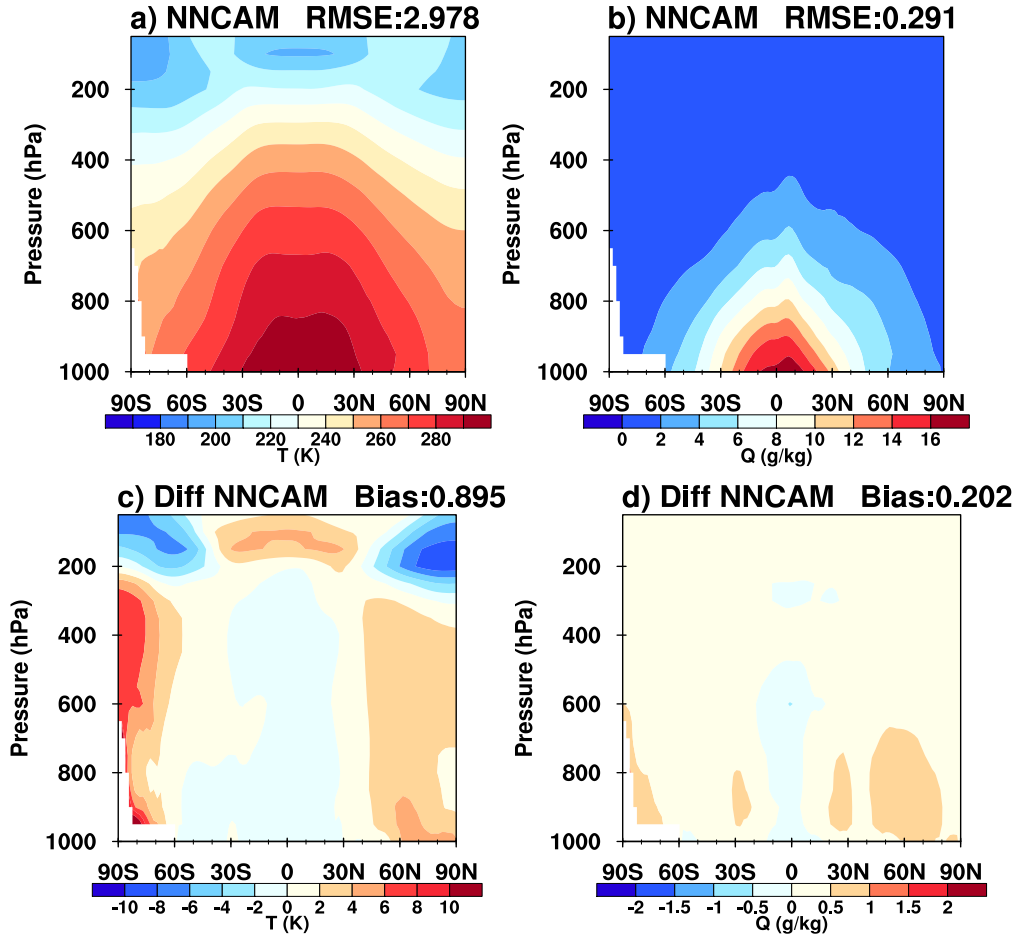


Figure S3. Latitude-pressure cross-section zonal and annual mean for a) temperature and b) specific humidity in NNCAM simulated from 2004 to 2008 with their differences with the SPCAM simulation from 1999 to 2003.

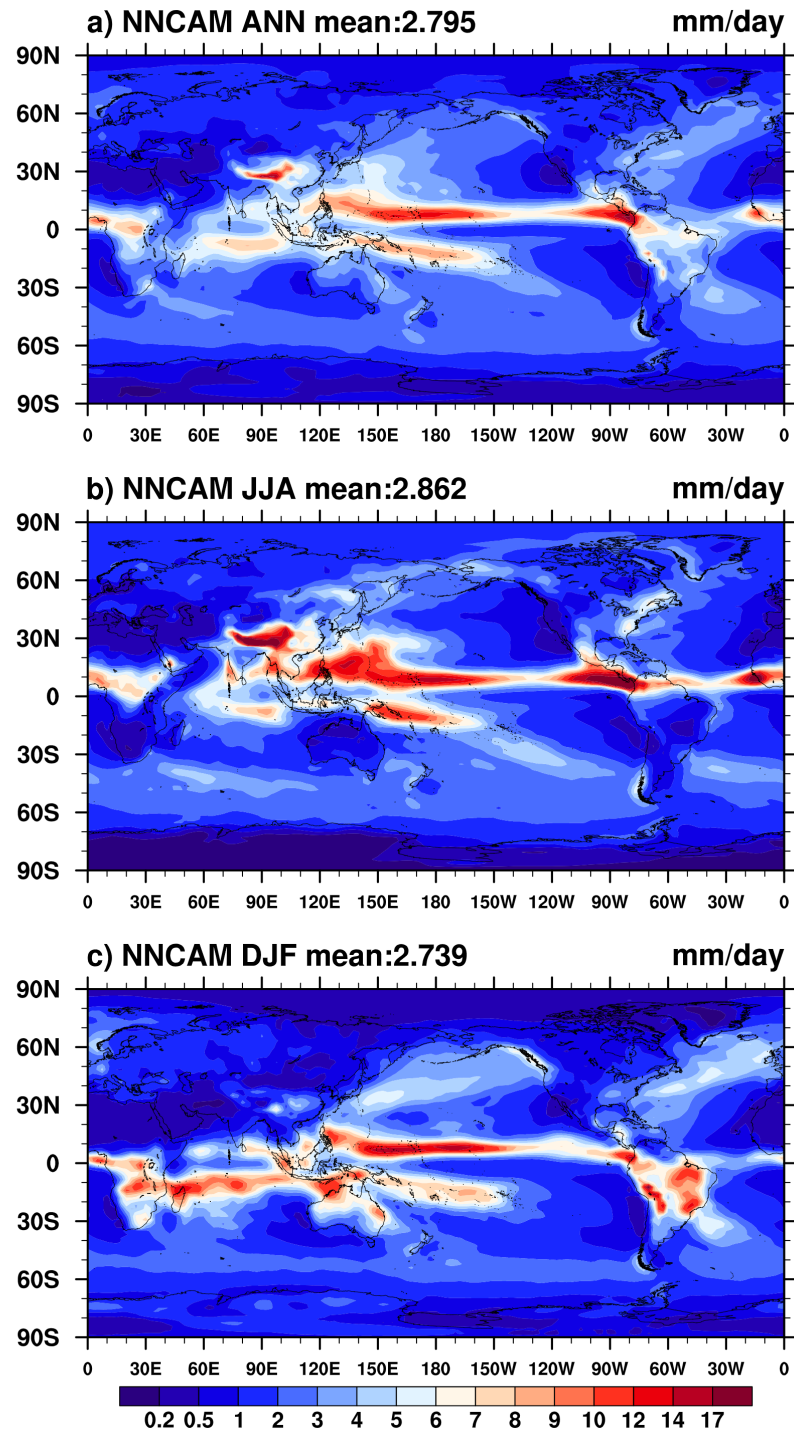


Figure S4. Global distribution of temporal mean precipitation predicted by NNCAM from January 1st 2004 to December 31st 2008 for a) annual, b) boreal summer (JJA), and c) boreal winter (DJF).