Predictability of North American summer circulation and precipitation at decadal timescale

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Evidence of the **regime** change in the continental scale circulation and precipitation (precipitation pattern and the circulation)

This change is consistent with the AMO, a result suggesting that the AMO may have influenced the multidecadal timescale circulation and precipitation change in the central U.S.

The figure showing the difference of precipitation between opposite phases of the AMO and the regression of the precipitation with the SST anomaly associated with the AMO, confirms that the AMO SST effects are essential in causing the precipitation anomalies in the central U.S.

The North Atlantic effects have been persist in the last few thousands of year (Holocene) although the Pacific SST anomalies also played nearly equally important role in causing the variations.

The **current issue** if what may have been the physical processes that connect the SST anomalies in the North Atlantic to the circulation and precipitation regime change in North America.

Some evidence of **regime** change in regional circulation and precipitation.

Precipitation distribution is organized in different ways in these different periods, a result suggesting different circulation processes responsible for the precipitation development (multidecadal variation of the circulation and precipitation regime in North America)

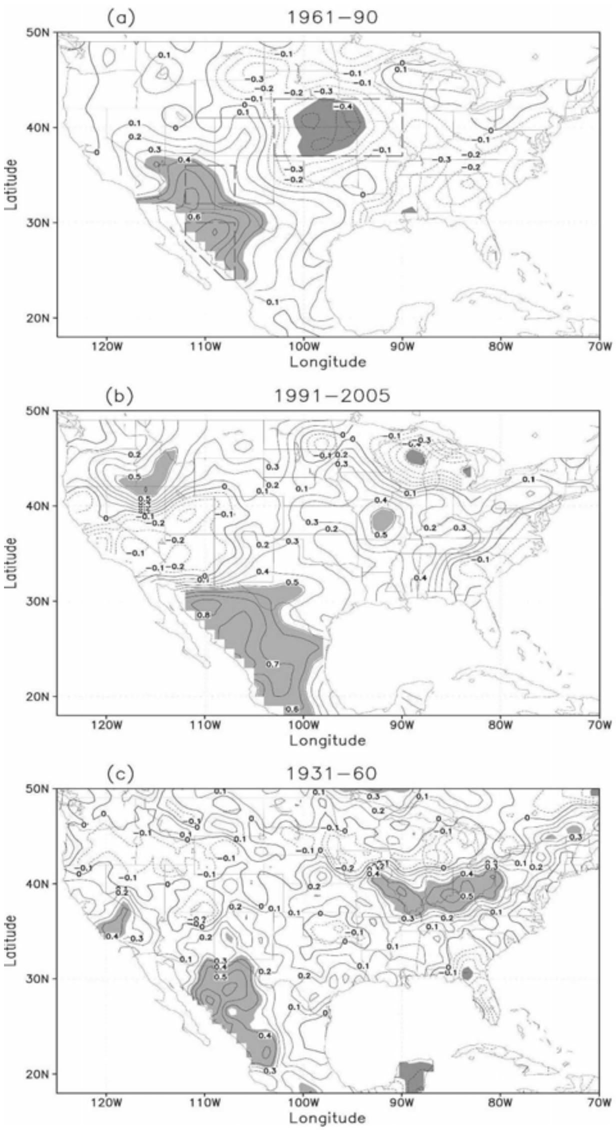

FIG. 2. Correlations between JAS rainfall in the west Mexico monsoon region and rainfall of individual grids across North America during (a) 1961–90, (b) 1991–2005, and (c) 1931–60. Here (a), (b) are based on NOAA CPC data and (c) is based on CRU data. Shading indicates correlations significant at the 95% confidence level. The dashed-line boxes mark the regions of west Mexico, the AZNM areas, and the central United States defined in this study.

Circulation anomalies for wet and dry summers in one regime

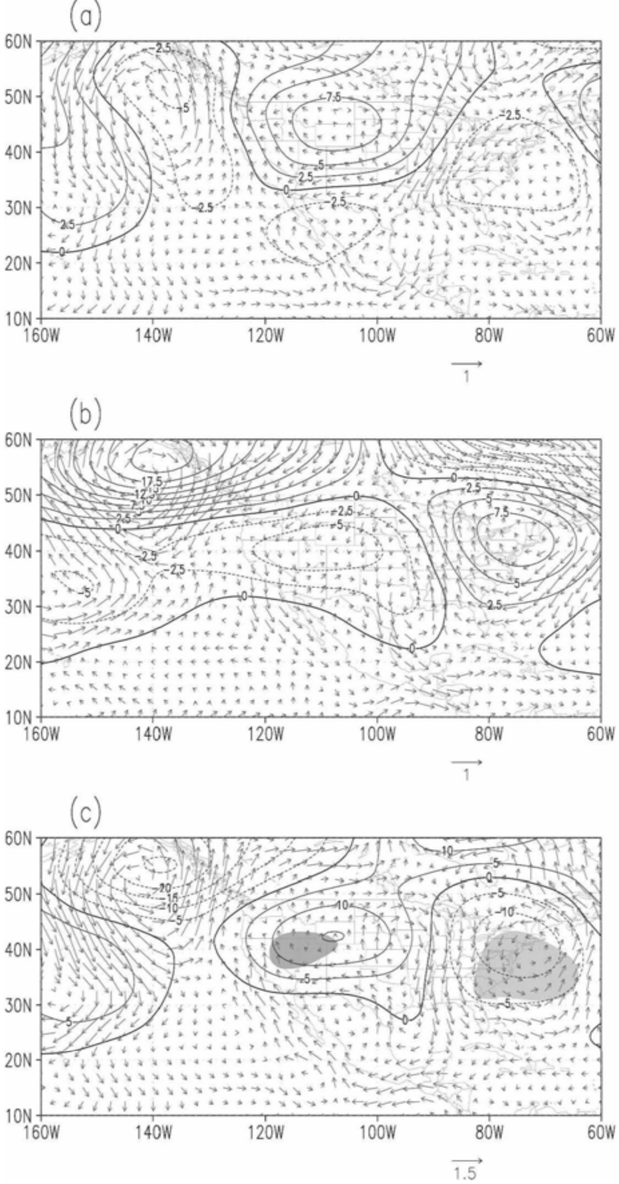

FIG. 3. Composites of 500-hPa geopotential heights (contour line; units: gpm) and 850-hPa wind (arrows; units: m s^{-1}) anomalies for (a) wet and (b) dry west Mexico monsoon years in the regime of 1961–90. The anomalies are based on the climatic means of the regime. (c) Difference between the wet and dry years. Shadings indicate that the differences of 500-hPa geopotential heights between wet and dry years are significant at the 95% confidence level.

Circulation anomalies for wet and dry summers in the other regime

The importance of these differences is that the interannual variations in summer precipitation in the North America, especially the North American monsoon, are caused by different mechanisms in different phases of the AMO. Understanding these differences is important for prediction of the summer monsoon.

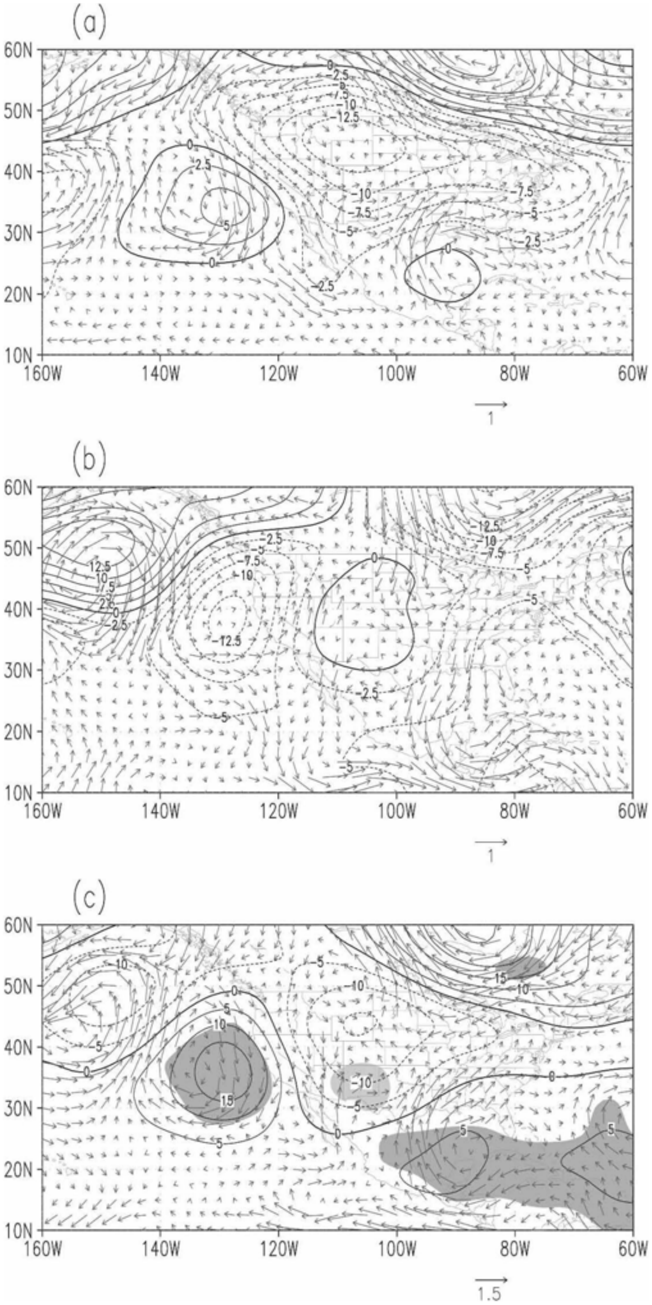

FIG. 4. Same as Fig. 3, but for 1991–2005.

The AMO effect on the North American summer monsoon, based on the instrumental data

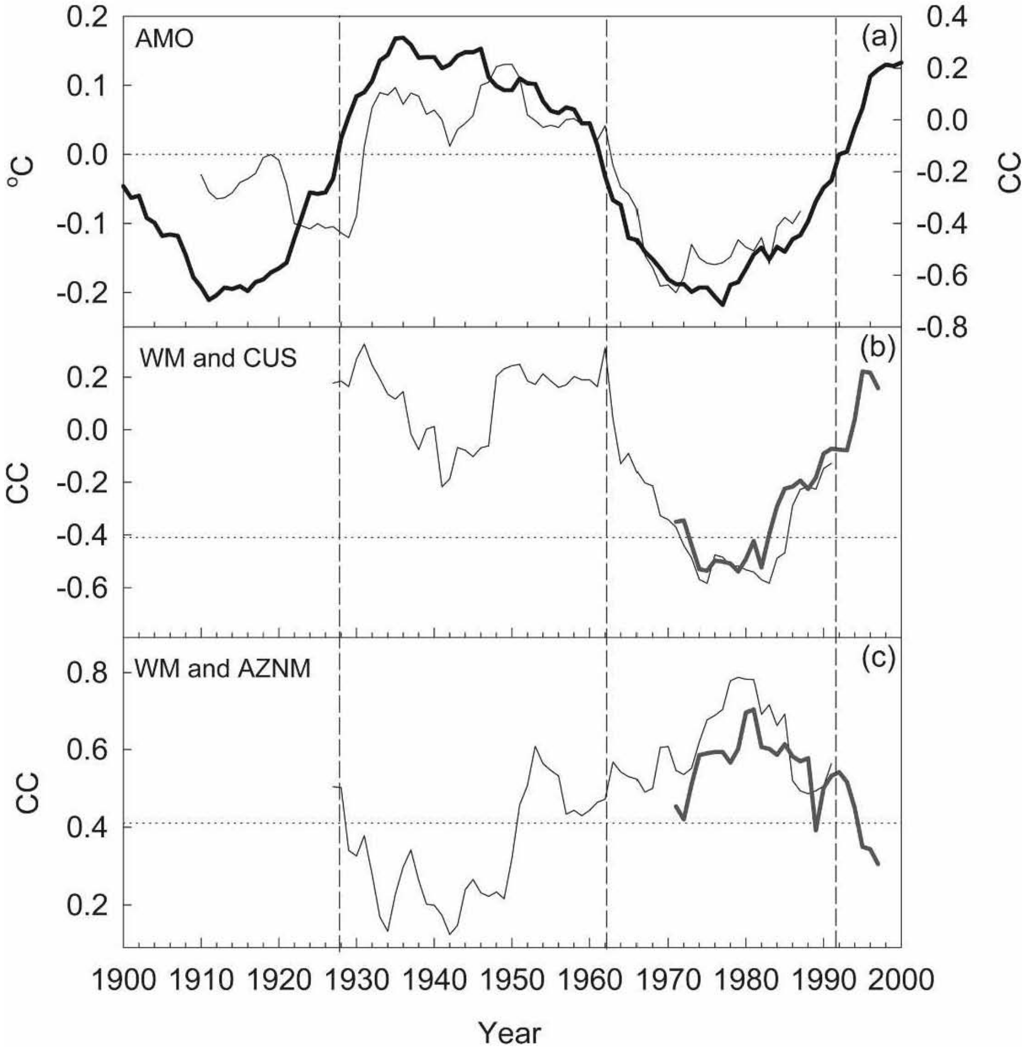

FIG. 6. (a) Thick line shows the time series of the AMO index and thin line shows the monsoon regime variation measured by the land memory (Hu and Feng 2002); (b) 21-point moving correlations of JAS rainfall between WM and CUS; and (c) same as (b) but between WM and AZNM. Thin lines in (b) and (c) are based on CRU data and thick lines are based on NOAA CPC data. Dotted lines show the 95% confidence level.

Another view of the AMO effect on the decadal timescale summer precipitation variation in the North America

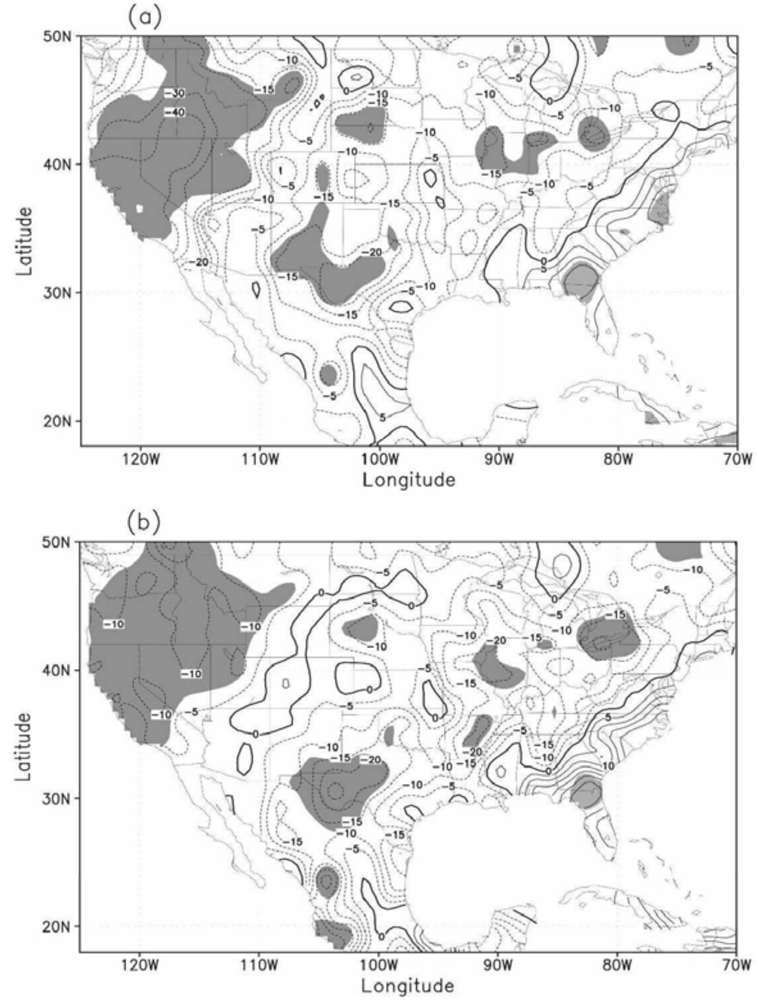

FIG. 8. (a) JAS rainfall differences (in percentage changes from the 1961–90 climatic mean) between 1931–60 and 1961–90. Shading shows rainfall changes between the two periods significant at the 95% confidence level. (b) Regression between JAS AMO and JAS rainfall in North America. Shading indicates significant correlations at the 95% confidence level. Data used are from CRU. Most of North America is wetter in the AMO cold phase than the warm phase.

SLP and surface wind and moisture flux anomalies corresponding to the AMO

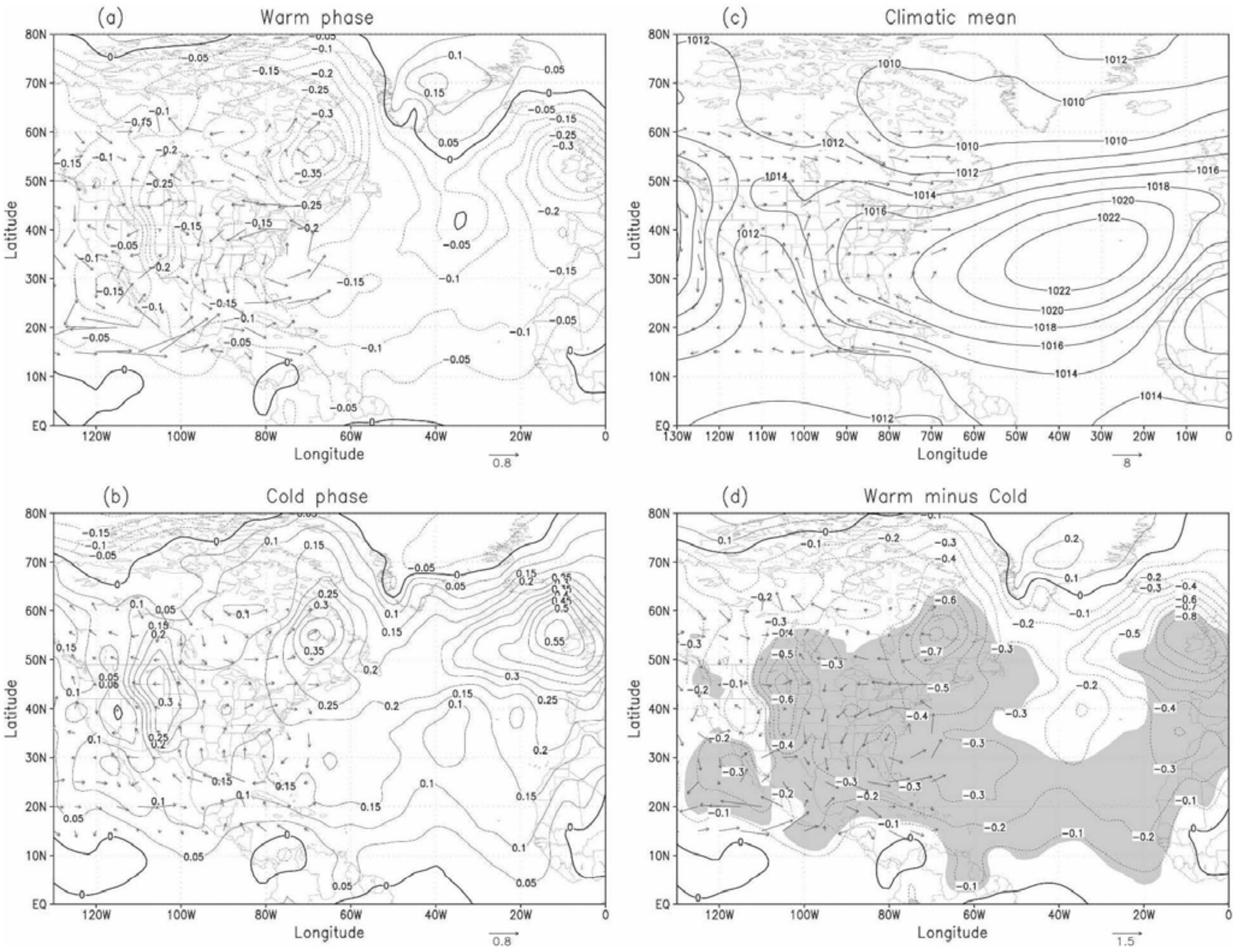

FIG. 7. Composite JAS SLP (contour lines) and 850-hPa wind anomalies (arrows) for AMO (a) warm and (b) cold phase. (c) Mean JAS SLP for 1900–2005. (d) Differences in JAS SLP anomalies between AMO warm and cold phase. Shading shows the significant (>95% confidence level) SLP changes between the warm and cold phases. The wind anomalies are based on data from 1948–60 and 1991–2005 for warm phase and 1961–90 for cold phase. The SLP anomalies are based on data from 1931–60 and 1991–2005 for warm phase and 1900–30 and 1961–90 for cold phase.

Based on proxy data and model result for the Holocene

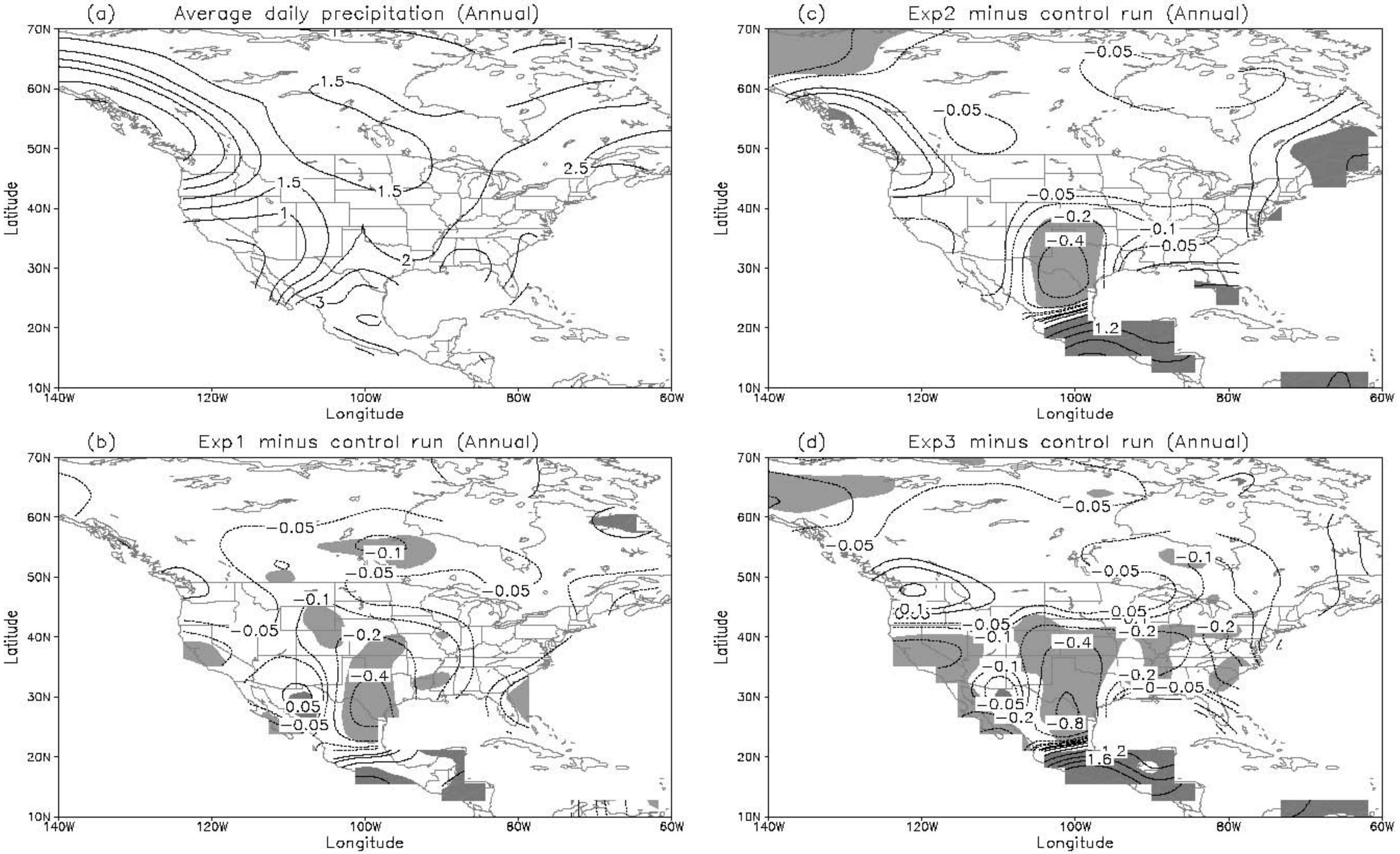

Figure 4. Simulated annual averaged daily precipitation (mm d^{-1}). (a) Control run and the differences between experiments (b) 1, (c) 2, and (d) 3 and the control run. Shadings indicate the differences are significant at 95% confidence level by two-tailed student-test. For clarity, only the precipitation over the land is shown.