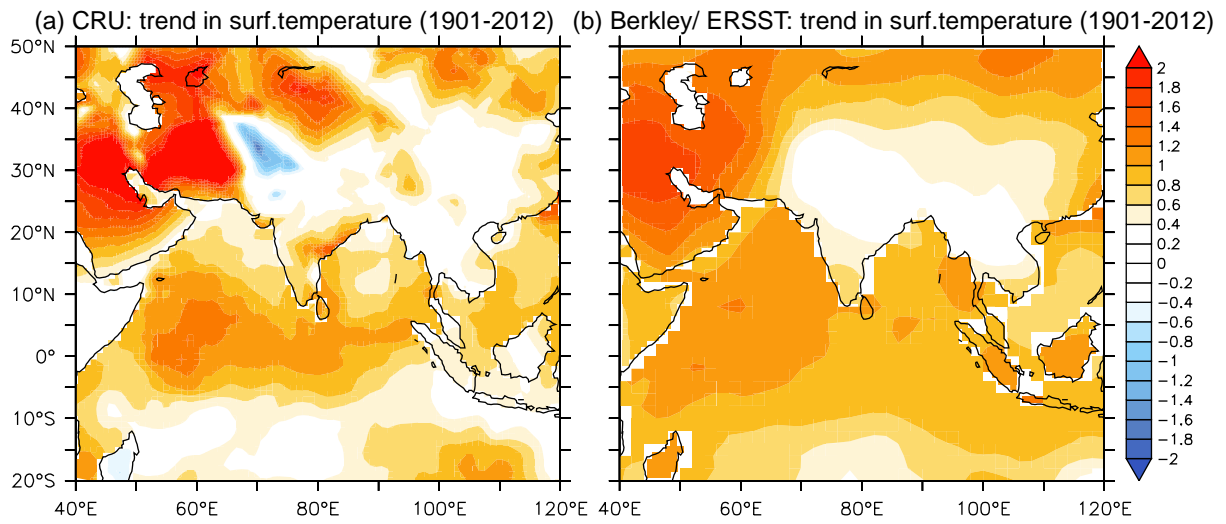
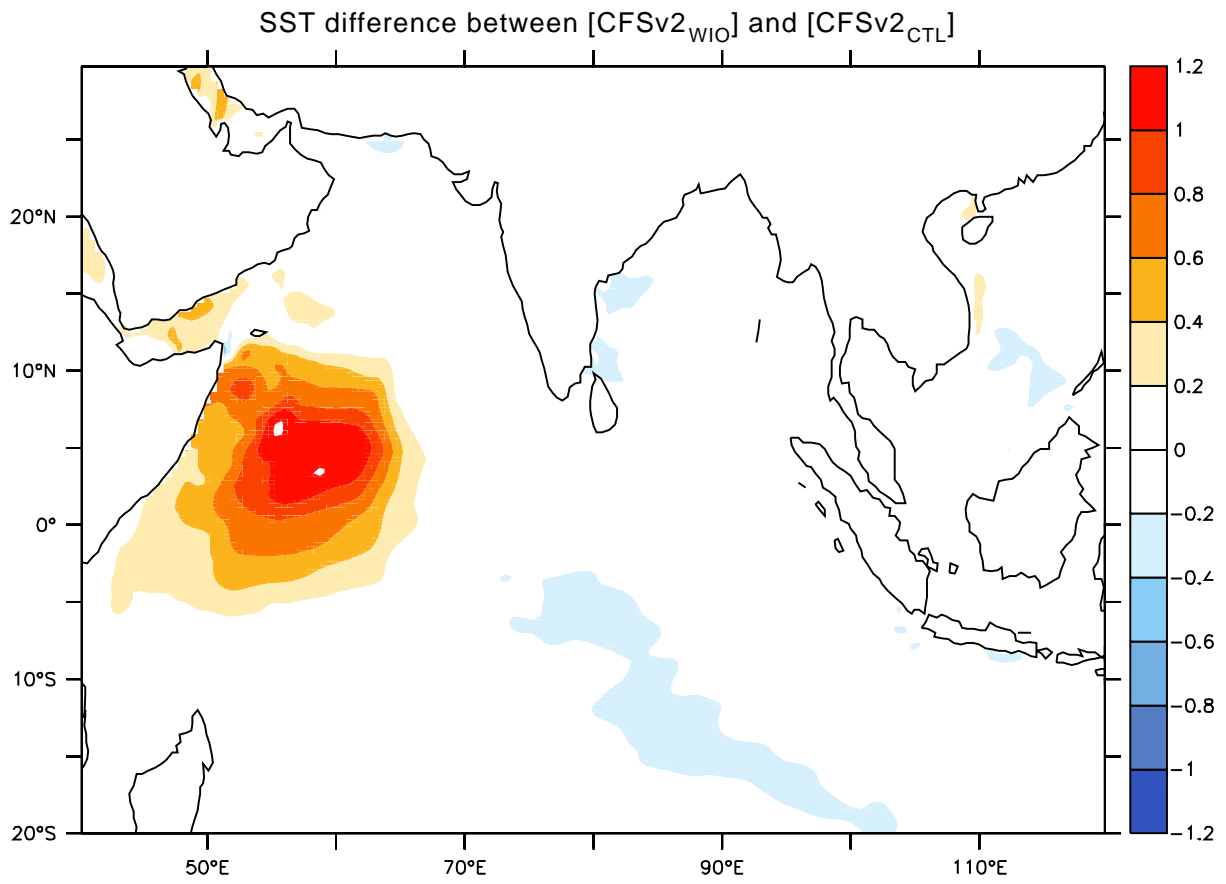


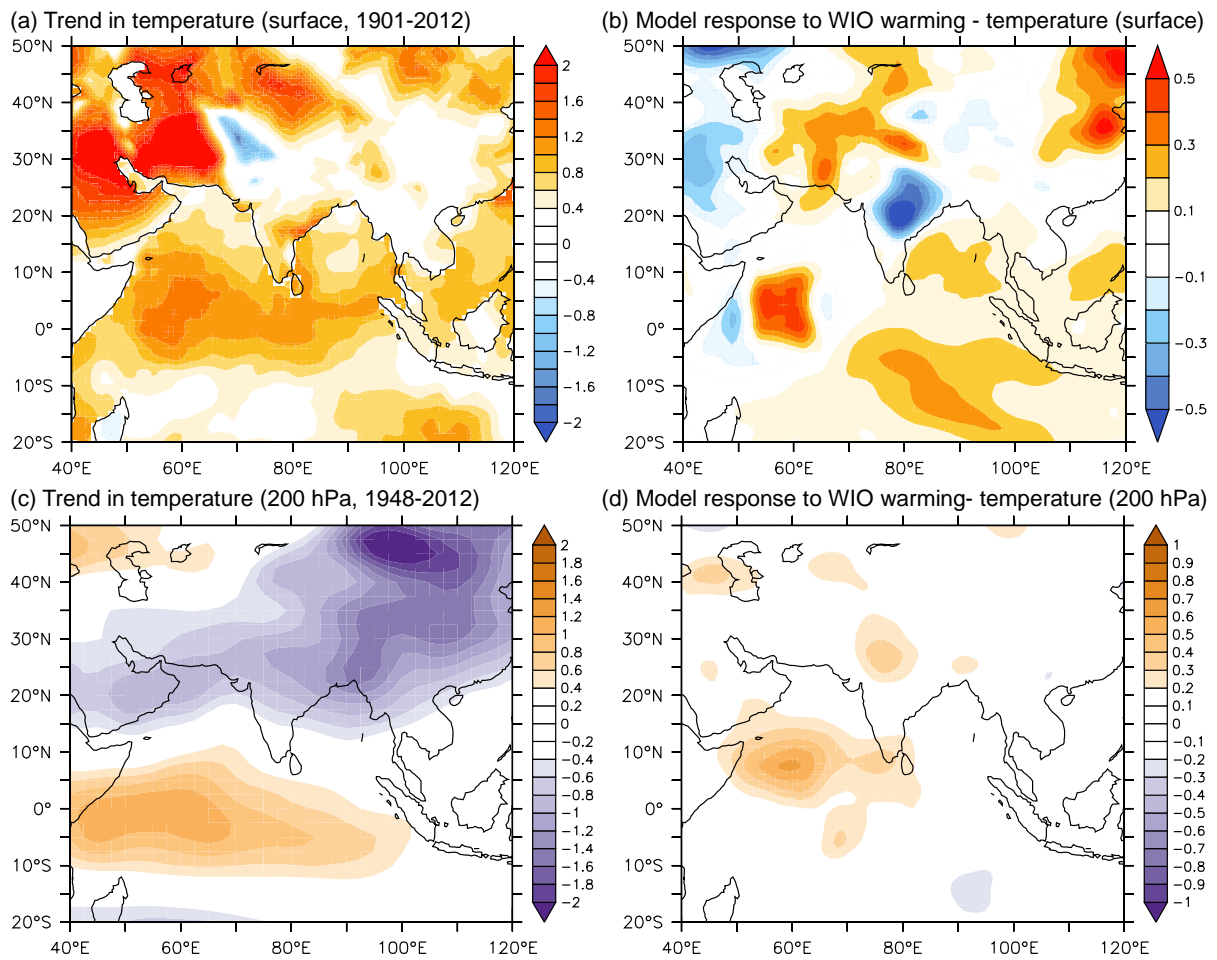
Supplementary Figure 1. Correlation between detrended anomalies of SST over the western Indian Ocean (WIO, 50-65°E, 5°S-10°N) and precipitation over the Indian subcontinent, for ERSST and CRU precipitation during June-September, for the years 1901-2012. Contours denote regions significant at the 95% confidence level. The inset box refers to the region under consideration in Figure 3.



Supplementary Figure 2. Trend ( $^{\circ}\text{C } 112 \text{ year}^{-1}$ ) of surface temperatures during June-September, 1901-2012 in (a) CRU surface temperature and (b) Berkley land surface temperature/NOAA ERSST. The color shades represent regions significant at the 95% confidence level.



Supplementary Figure 3. Simulated difference in SST between the sensitivity (CFSv2<sub>WIO</sub>) and reference (CFSv2<sub>CTL</sub>) experiments.



Supplementary Figure 4. Observed trends along with model response to WIO warming in (a, b) near-surface temperature and (c, d) temperature at 200 hPa. The model response is estimated from the simulated difference between the sensitivity (CFSv2<sub>WIO</sub>) and reference (CFSv2<sub>CTL</sub>) experiments.