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2011 年暖候期に中緯度北太平洋に現れた暖水偏差に対する大気応答の可能性
Possible Atmospheric Response to Prominent Warm SST Anomalies in the Midlatitude North Pacific during Summer/Autumn 2011

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Observational and modeling studies have recently shown that atmospheric response to SST anomalies in the North Pacific subarctic frontal zone (SAFZ) tends to become the strongest and most robust during in midwinter. Although possibility has recently been suggested that warm-season SST anomalies in SAFZ may also force atmospheric anomalies, specific mechanisms how the summertime atmospheric circulation can respond to midlatitude SST are still unsolved. In this study, we focus on prominent warm SST anomalies observed in the North Pacific during the warm season of 2011, to investigate whether and, if any, how the SST anomalies can force stationary atmospheric response through a set of Atmospheric Global Climate Model (AGCM) experiments.

Two types of experiments were conducted with AGCM for Earth Simulator (AFES) with T119 spectral truncation (equivalently ˜125-km grid intervals) and 56 vertical levels. One is what may be called *climatological run*, where the climatological-mean SST was assigned daily as the model lower-boundary condition. The climatological run is compared with *hindcast run*, where warm SST anomalies (stronger than 0.5 K) observed in the warm season 2011 (May through October) were added to the climatological-mean SST assigned to the model. This modification was applied only to the midlatitude North Pacific, so as to keep SST unchanged in any other regions over the globe. The NOAA OISST with a spatial resolution of $0.25^o * 0.25^o$ is used, and the SST climatology is defined for the period 1982-2011. Each of the two runs includes 10 ensemble members each of which was integrated to the end of October 2011 from the initial condition taken from the obsevations for a particular day in the period from 27 March to 5 June. The initial conditions were also used for the verification of our model simulation. Statistically significant differences in the ensemble means between the *hindcast run* and *climatological run* are regarded as a signal of the atmospheric response to the warm SST anomalies observed over the North Pacific in 2011.

AFES is found to well reproduce the tropospheric anticyclonic anomaly as observed over the North Pacific in October. The simulated anticyclonic anomaly should be regarded as a stationary barotropic response that can be attributed to the midlatitude warm SST anomaly over the western North Pacific imposed to the model lower boundary, since the anomalous surface heat flux simulated tends to be upward in September and October. Although the anomalous sensible heat flux changes its sign in late October, the anomalous latent heat flux is stronger and persistently upward. In the model, the barotropic response starts emerging in late September as the climatological westerlies migrating gradually southward come to the vicinity of the SST anomalies as observed. Our model experiments suggest that the anticyclonic anomaly observed in October over the North Pacific and a cyclonic anomaly to its north may be a response to the midlatitude SST anomaly but not merely a remote response to the La Nina event, since the cyclonic anomaly is not included in a canonical anomaly pattern to La Nina derived statistically for October.

Unlike in the observations, the model summertime response is found cyclonic, which may be attributable to the unrealistically weak westerlies over the North Pacific as a model bias. In fact, the westerly jet and the axis of the subtropical anticyclone over the summertime North Pacific tend to be displaced poleward in AFES, and the western portion of the observed SST anomaly is situated under the climatological-mean surface easterlies rather than under the westerlies as observed. Our results imply that the atmospheric responses to midlatitude SST anomalies can be sensitive to relative latitudinal position of the mean westerlies.

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