Relative contribution of remote influence from tropics and extra-tropical oceanic variability on the interannual-to-decadal variability of the midlatitude atmosphere

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Evidence is mounting that the interannual-to-decadal variability of midlatitude western boundary currents and associated mesoscale eddies can have discernible impacts on the variability of large-scale atmospheric circulations. However, it is still unclear how such extra-tropical oceanic influences are significant compared with the intense intrinsic variability in the midlatitude atmosphere and the dominant remote influences from tropics. This study aims at quantifying these different influences on the interannual-to-decadal variability of midlatitude atmosphere. To this end, we perform a series of 20-member ensemble AGCM experiments with a horizontal resolution about 100km for the period 1982-2013, forced with (1) global, time-varying, satellite-observed high-resolution sea ice concentration (SIC) and sea surface temperature (SST) (GOGA), (2) time-varying SST only in tropics and daily climatological mean SST and SIC elsewhere (TOGA), and (3) time-varying SST and SIC in extra-tropics and daily climatological mean SST in tropics (MOGA).

Focusing on the wintertime geopotential height at 500 hPa (Z500), the simulated total variance of Z500 across all ensemble members in GOGA represents the spatial pattern of observed variance well, although the amplitude is underestimated. Among the three geographical centers of large Z500 variance, the North Pacific is marked as a region of the largest forced variance of Z500 in the GOGA ensemble mean, largely due to the well-known atmospheric bridge from tropics. More interestingly, the forced variance of Z500 in GOGA is larger than that in TOGA, suggestive of a role of extra-tropical SST or SIC in enhancing the variance. Also, the atmospheric bridge from tropics into extra-tropics appears to be modulated by extra-tropical SST. Specifically, the Pacific North American pattern-like Z500 anomalies associated with Nino3.4 index is stronger (weaker) during the period when the Kuroshio Extension is stable (unstable). We will discuss to what extent the atmosphere responds to extratropical SST and SIC variability and how such extratropical effects interfere with the remote influence from tropics on the midlatitude atmosphere.

Keywords: Atmospheric bridge , Western boundary current, Pacific North American pattern , ensemble AGCM simulations

