Northern mid-latitude warming prolonged for more than 6 months in 2018 well-predicted by the JMA's operational seasonal prediction system

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In Japan, record-breaking heavy rains were observed in various places, mainly in western Japan in early July 2018 (Tsuguchi et al, 2018). Thereafter, an extremely high temperature continued mainly in eastern and western Japan (JMA, 2018). East Japan's summer average temperature recorded the highest since the statistical records began in 1946 (JMA, 2018). One of the background factors that brought such a hot summer is that the zonally averaged tropospheric temperature anomaly was high in the northern mid-latitudes (JMA, 2018). Here, we conduct re-forecast and sensitivity experiments by the JMA Seasonal Prediction System (JMA/MRI-CPS2; Takaya et al., 2018) and discuss factors of the formation of the prolonged high temperature anomaly in the Northern mid-latitude.
The seasonal mean 200 hPa height shows positive anomaly in almost all areas of the northern mid-latitudes. This indicates tropospheric warming in the northern mid-latitudes. In particular, the positive anomalies were large in the area from Mongolia to northern China, the vicinity of Alaska Bay, the vicinity of the Labrador Peninsula and in the southern part of the Scandinavian Peninsula. The positive anomalies of the northern mid-latitudes were remarkable in the zonally averaged field, and in the time series, the positive anomalies of the northern mid-latitudes had been continuing from around autumn of 2017.
This prolonged northern mid-latitude positive anomalies were well predicted in re-forecast experiments using a coupled model with initial date at October 28, 2017, despite the fact that the initial date is more than six months ago.
From the end of 2017 to the spring of 2018, the sea surface temperature in the Pacific equator shows anomaly pattern of the La Niña type, then ENSO became neutral during the summer of 2018. From spring to summer, the SSTs over the northern side of the equator showed positive anomalies and the SSTs over the southern side of the equator showed negative anomalies. This SST anomaly pattern continued during spring and summer 2018. This pattern was also well predicted by the model.
In order to investigate the influence of this SST anomaly pattern on the atmospheric anomaly field, we conducted an experiment in which the SST of the tropical Pacific region was nudged to climate SST. The northern mid-latitude height in this experiment (referred to as 'sensitivity experiment' hereafter) was lower than that of re-forecast experiment during the period from the end of 2017 to the summer of 2018. The positive anomalies of convective activity on the north side of the equator were well predicted in the re-forecast experiment, but in the sensitivity experiment, the convective activity anomalies in the same region were weak. This suggests that the SST anomalies in the tropical Pacific has played an important role through the anomalies of convective activity to the formation of the prolonged Northern midlatitude positive height anomalies.

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