

A hemispheric extreme warm winter in 2019-20 enhanced by the highest sea surface temperature around mid-latitude

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In 2020 winter, most mid latitudes in the Northern Hemisphere was the historically warmest (Fig. 1a). The warmth was spreading zonally around all the mid latitudes throughout the season. Zonal-mean sea surface temperature in the mid latitudes was also unprecedentedly warm (Fig. 1b). It was substantially different from the recent localized extreme weathers, which were smaller both in temporal and spatial scales than 2020. The global warming might have turned into reality. Here we show that synchronized chain interaction between the warm seas and the warm atmosphere amplified the anomalousness of the warm winter using data analyses and simple numerical experiments. The chain is as follows; the warm seas built up in the previous autumn made overlying air warm, then the warmed air penetrated inland by westerlies, the warm air over the land further flew to the ocean, which again warms the seas. The zonal oceanic warming in mid-latitudes might shift the climate dynamics to a new state. This air-sea chain was responsible for unprecedentedly positive phase of Arctic Oscillation, which is a good measure of the zonal mean extreme warmth.

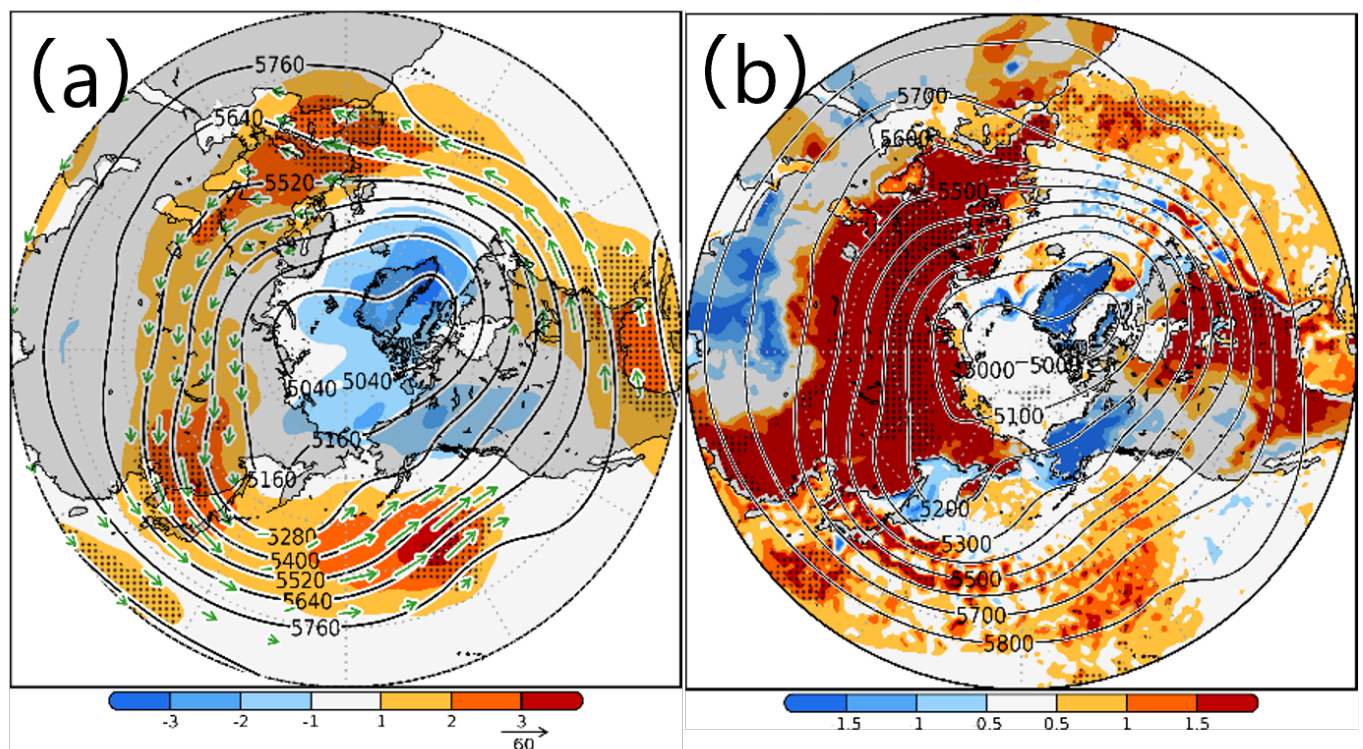


Figure 1 (a) Three-month mean air temperature anomalies (color shading [K], hatch: recorded the highest since 1979) at 500 hPa, and geopotential height (contours [m]) at 500hPa in winter 2020 between 1 January and 31 March. (b) same as Fig. 1a, but sea surface temperatures (ocean area) and ground temperature (land area).