Applicability of the North Sea Caspian Pattern as an indicator of the Euro-Mediterranean Climate Variability

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Abstract

Climate variability related to trough locations in the Euro-Mediterranean region is determined by various semi-permanent pressure centers of teleconnections and synoptic features. These features are resulted from the interactions between mesoscale and global-scale patterns from sub-seasonal to decadal scales. The North Atlantic Oscillation (NAO) and the Arctic Oscillation (AO) are the most common teleconnection patterns for depicting climate anomalies in this region. However, their skills for predicting climate anomalies gradually decays towards Eastern Europe and the Mediterranean.The North Sea Caspian Pattern (NCP) is a middle troposphere teleconnection between the North Sea and the Caspian Sea. The skill of the suggested NCP index was tested for temperature and precipitation fields in the Eastern Mediterranean, and significant correlations were found particularly with temperature fields. The index had limited utilization because it was believed that the index could not represent precipitation anomalies well in the region.We aimed to assess the competence of the NCP on indicating climate variability in a broader region. For this purpose, a high resolution, spatially continuous, and homogeneous data was needed. The European Center for Middle-Range Weather Forecasts (ECMWF) ERA5 reanalysis data was chosen for investigating monthly total precipitation, mean air temperature at 2-m height and 500 hPa mean geopotential fields for the period of 1950-2019. We produced correlation and composite maps of temperature, precipitation, and geopotential for the NCP and other common indices in the region. There were significant differences between the negative and positive phases of the NCP in Western Europe and the Caucasus regions. These areas coincided with the edges of the Mediterranean Trough. To understand the working mechanism of the index, cross-correlations between other indices were calculated. The Mediterranean Trough Displacement index showed significant positive correlations with the NCP, which indicates that the east-west migration of the through might have a significant effect on the strength of the NCP. Composite maps of mean geopotential height differences also provided support for this finding. Since the identified poles of the NCP are along both latitudinal and longitudinal directions, the NCP is sensitive to zonal and meridional circulation features. For the areas with significant composite differences of temperature and precipitation, the skill of the NCP for predicting climate anomalies is comparable to the skills of the AO and the NAO.We found strong evidence that the NCP is adequate for indicating not only monthly temperature but also precipitation anomalies particularly in Northwestern Europe and the Caucasus regions. This study is supported by the 2232 International Fellowship for Outstanding Researchers Program of the Scientific and Technological Research Council of Turkey (TUBITAK) under grant 118C329. The financial support from TUBITAK does not mean that the content of the publication reflects the approved scientific view of TUBITAK.