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Tropical air intrusions over the eastern Mediterranean and Mesopotamia: An atmospheric river case study and role of the East Asian trough

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The high-elevation eastern Anatolian plateau, located in eastern Mediterranean basin, is cold and snowy in winter, and functions as a water tower in providing water to Mesopotamia through Euphrates and Tigris rivers. These rivers are snow-fed, as much of their discharges occurs in spring when the seasonal warming melts the snowpack. The anomalous warming over the eastern Anatolia in early March 2004 resulted in unprecedented snowmelt runoff in the Euphrates and Tigris basin together with the accompanying rainfall. This study explores an atmospheric river (AR) leading to the extreme hydrometeorological events in the headwaters regions of the Euphrates and Tigris basins in early March 2004, and its possible linkage to the strength of the East Asian trough (EAT). In the analyses, we used reanalysis data, gridded products of surface temperature and snow cover, river discharge data and satellite imagery. We employed an intensity index for the EAT and a trough displacement index for the Mediterranean trough (MedT) to explore the relationship between the strength of the EAT and the displacement of the MedT at pentad resolution. We show that there is a strong relationship between the strength of the EAT and the zonal displacements of the Mediterranean upper layer trough on the 13th pentad of the year, which corresponds to early days of March. In 2004, which appears to be an extreme year for this phenomenon, the MedT is positioned and deepened in the central Mediterranean (about10−15□E), and extended towards central Africa during the early days of March. This synoptic pattern provided favorable conditions for the development of AR with a southwest-northeast orientation, carrying warm tropical African air towards the eastern Mediterranean and Anatolian highlands resulting in rapid melting of the snowpack as well as severe precipitation, and thus, flooding events, in the eastern Anatolia. A key finding in our analysis is that the strengthening of the EAT was instrumental to the increased amplitude of the ridge-trough system over the Euro-Mediterranean region in the early days of 2004 late winter. A further analysis is ongoing to provide a basis to analyze past individual AR events over the region, especially those associated with extreme precipitation events and snowmelt.