EMS Annual Meeting Abstracts
Vol. 10, EMS2013-541-1, 2013
13th EMS / 11th ECAM

Synoptic-scale patterns producing heat episodes in Central Europe

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Understanding the relationship between extreme weather and circulation is one of the main challenges of atmospheric sciences. There is a close relationship between air temperature extremes recorded by surface observations and synoptic-scale meteorological patterns in free atmosphere. A common feature of the patterns is obviously the occurrence of anomalies in relevant temperature characteristics. Nevertheless, the patterns also differ in some thermo-dynamic conditions determined particularly by the configuration of wind field (e.g., temperature gradient, thermal advection, heat flux). The presented study focuses on heat episodes in Central Europe and aims at distinguishing main variants of the patterns using a methodology which makes a quantitative comparison of the episodes possible.

First, we compile the most significant heat episodes in the Czech Republic from the last 50 years. We apply a selection criterion based on the maximum daily temperature measured by the official network of meteorological stations. The criterion takes into account the rarity of the occurrence using return periods and the objectively assessed affected area and duration. Second, we employ re-analysis data with the horizontal resolution of 2.5 deg to analyze synoptic-scale meteorological conditions in free atmosphere during the episodes. We prove that the episodes are characterized by the regular occurrence of meso-alpha scale anomalies in temperature characteristics and that these anomalies vary in terms of their strength (i.e. extent and rarity), location and duration. Finally, we carry out the cluster analysis of the episodes. We employ varying attributes of the anomalies and other thermo-dynamic conditions determined by the configuration of wind field as similarity criteria. Variants of synoptic-scale patterns belonging to individual main clusters are introduced and discussed.