Abstract (English)

RNDr. Monika Cahynová: The influence of long-term changes of atmospheric circulation on observed trends of surface climatic elements in the Czech Republic and Europe

The aim of this thesis is to quantify the links between recent atmospheric circulation changes over Europe and local surface climatic trends. We employ several parallel classifications of circulation types that were collected and developed within the COST733 Action "Harmonisation and Applications of Weather Types Classifications for European Regions". To our knowledge, such a comparative approach has not been used so far.

Atmospheric circulation changes over Europe were studied in terms of changing seasonal frequency and persistence of daily circulation types in the second half of the 20th century. The extensive collection of both subjective and objective catalogues of circulation types in European regions from the COST733 Action served as a platform for comparison of different classification methods, varying numbers of circulation types, and spatial scale of circulation processes. The most prominent trend – winter increase in the number of days with westerly flow – clearly stems from the strengthening of the North Atlantic Oscillation. The objective classifications did not show any systematic change of persistence of synoptic situations in the study period, whereas in the subjective catalogues (Brádka's Czech–Czechoslovak, German Hess–Brezowsky, and Hungarian Péczely) we have detected inhomogeneities – sudden shifts in the persistence.

We have studied the influence of changes in the frequency of circulation types on seasonal climatic trends of eleven surface climatic variables on the territory of the Czech Republic in the period 1961–1998. The selected circulation classifications were created using eight methods, each applied on sea level pressure fields in three variants with fixed numbers of types (9, 18, and 27). Additionally, three subjective catalogues of circulation types were used. There is large variability within the results obtained with different circulation classifications and also within the 21 individual stations (despite the relatively small spatial scale of the Czech territory). We only found substantial influence of circulation changes on winter temperature trends, which suggests that it is rather the change of climatic properties of individual circulation types (within-type change) that drives most of the observed climatic trends.

At the scale of Europe, the influence of circulation changes on seasonal climatic trends in the period 1961–2000 was studied using daily maximum and minimum temperature and precipitation at 29 stations. To study the effect of spatial scale of atmospheric processes on local climatic trends, we have used the 24 selected circulation classifications computed at the scale of the whole Europe and at smaller European regions. Circulation changes in the small domains are usually more tightly connected with climatic trends than those in the large domain except for Icelandic and Scandinavian stations where circulation over the whole Europe explains a larger part of the observed trends. Seasonal climatic trends in the period 1961–2000 can be only partly explained by the changing frequency of circulation types, the link being again the strongest in winter. In the other seasons, within-type climatic trends are responsible for a major part of the observed trends, which confirms the previously reported instationarities in the relations between atmospheric circulation and local climate. The attribution of European climatic trends again showed marked differences within the results obtained using 24 parallel, fully comparable objective circulation classifications. We therefore think such a comparative approach is highly desirable in synoptic-climatological studies.