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Temporal and spatial variability of frost free period in Central Europe and its circulation background

Agnieszka Wypych (1), Agnieszka Sulikowska (1), Malgorzata Sliwinska (1), Zbigniew Ustrnul (1), and Frank-M. Chmielewski (2)

(1) Jagiellonian University, Cracow, Poland, (2) Humboldt-University of Berlin, Germany

The lengths of frost free and growing season are very important factors in natural ecosystems as well as for human activities. The shifts in last spring and first fall freezes leading to increasing length of frost free period have already been detected in many European and non-European regions.

The aim of the study is to investigate the temporal and spatial variability of the dates of last spring and first autumn frosts followed by the length of frost free period in Central Europe in relation to atmospheric circulation.

The analyses were conducted for the period 1951-2010 using gridded data of daily minimum air temperature from the E-OBS dataset at 0.25° spatial resolution. To assess the impact of temperature variability on plant vegetation also events of late spring freezes and severe frosts were examined in respect of the beginning of growing season. The role of atmospheric circulation was estimated for both spatial and temporal scale using Grosswetterlagen circulation types classification. For long-term impact circulation indices: zonal and meridional were implemented while the events of late spring freezes were associated with particular circulation types and air mass advection.

The results confirm so-far proved significant increase of the length of frost free period. Although the tendency is significant over the whole area under investigation, trend intensity differs regionally reflecting oceanic and continental climatic conditions of respectively western and eastern part of the area. Moreover late spring freezes occurrence is still a burning issue as most damage to perennial plants in midlatitude locations occurs during spring bloom when below-freezing temperatures may harm flower buds following the loss of cold hardiness.
The relationship between atmospheric circulation and freezes occurrence provides an alternative approach for investigating past and future trends in spring freeze risk for perennial crops, under the assumption that only a small number of airflow patterns are associated with late spring freeze events and that changes in the frequency of these airflow patterns will result in changes in the risk of freeze damage.