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New frontiers in plant phenological research

H. Scheifinger (1), E. Koch (1), C. Matulla(2) and P. Cate (3)

(1) Central Institute for Meteorology and Geodynamics, Hohe Warte 38, A – 1190 Vienna, Austria, (2) Climate Research Branch (CCRM), Meteorological Service of Canada, 4905 Dufferin Street, Downsview, Toronto, Ontario, M3H 5T4, Canada (3) AGES, Institut für Pflanzengesundheit, Spargelfeldstr. 191, A – 1220 Vienna, Austria
(Helfried.Scheifinger@zamg.ac.at / Tel.: +43 1 36026 2410 / Fax.: +43 1 36026 74)

In recent years phenology has emerged as highly valuable source of information in the field of climate impact assessment. An increasing number of studies report that plants and animals of the mid- and higher latitudes of the northern hemisphere have been responding to the temperature increase of the last decades.

This poster presents a few selected results of an analysis (project named CLIMPHEN) of the Austrian phenological data set, which has been collected by the Austrian national weather service (ZAMG) from 1951 onwards. The Austrian phenological data set has features, which make it unique. There is for instance a large number of phases (244, of which about 50 to 100 can be used for analysis, depending on the time section), which have been observed continuously since 1951 in Austria including the Alps, where the station elevation ranges from 150 to 1400 m MSL. The Alps are specifically sensitive to climate variability.

One of the topics was the spatial gradients of the phenological phases and their relationship with the spatial temperature gradients. As summary of this relationship the spatial gradient law is proposed. It says that the spatial gradient of the phenological phases is the product of the spatial gradient of the temperature corresponding to the phenological phase and the spatial sensitivity of the phenological phase. The basis of the spatial gradient law of phenology is the observation that a specific temperature sensitivity can be attributed to each phase. The spatial gradient law of phenology stresses the strong relationship between phenological occurrence dates and temperature as the main atmospheric factor governing the spatial variability of the phenological occurrence dates. The validity and significance of this relationship has to be explored with spatially more extended data sets.

Another topic concerns the spatial variation of the long term mean occurrence dates of a phenological phase as function of station longitude, latitude and elevation, which can be described by a multiple regression model to a great degree ($>$ 70% for many phases), but not completely. Long term phenological occurrence dates reveal in fact residual patterns of spatial variation not described by the multiple linear regression model. These residual patterns display a great similarity among different phases. They seem to be related with climatic deviations of a greater region. This unexpected result warrants a deeper look into the physical background governing the spatial variations of the phenological occurrence dates and their related temperature sums.