



Trend of earlier spring in central Europe continued

Markus Ungersböck, Anita Jurkovic, Elisabeth Koch, Wolfgang Lipa, Helfried Scheifinger, and Susanne Zach-Hermann

Central Institute for Meteorology and Geodynamics, Vienna, Austria (m.ungersboeck@zamg.ac.at)

Modern phenology is the study of the timing of recurring biological events in the animal and plant world, the causes of their timing with regard to biotic and abiotic forces, and the interrelation among phases of the same or different species. The relationship between phenology and climate explains the importance of plant phenology for Climate Change studies. Plants require light, water, oxygen mineral nutrients and suitable temperature to grow. In temperate zones the seasonal life cycle of plants is primarily controlled by temperature and day length. Higher spring air temperatures are resulting in an earlier onset of the phenological spring in temperate and cool climate. On the other hand changes in phenology due to climate change do have impact on the climate system itself. Vegetation is a dynamic factor in the earth - climate system and has positive and negative feedback mechanisms to the biogeochemical and biogeophysical fluxes to the atmosphere

Since the mid of the 1980s spring springs earlier in Europe and autumn is shifting back to the end of the year resulting in a longer vegetation period. The advancement of spring can be clearly attributed to temperature increase in the months prior to leaf unfolding and flowering, the timing of autumn is more complex and cannot easily be attributed to one or some few parameters.

To demonstrate that the observed advancement of spring since the mid of 1980s is pro-longed in 2001 to 2010 and the delay of fall and the lengthening of the growing season is confirmed in the last decade we picked out several indicator plants from the PEP725 database www.pep725.eu. The PEP725 database collects data from different European network operators and thus offers a unique compilation of phenological observations; the database is regularly updated. The data follow the same classification scheme, the so called BBCH coding system so they can be compared.

Lilac *Syringa vulgaris*, birch *Betula pendula*, beech *Fagus* and horse chestnut *Aesculus hippocastanum* are well represented in the PEP725 database. Flowering of lilac *Syringa vulgaris* is also used in the US as spring indicator . The flowering and/or leaf unfolding dates of lilac, horse chestnut show a clear advance to an earlier entrance in the last two decades 1991 to 2000 and 2001 to 2010 compared with the reference period 1961 to 1990, being more pronounced in northwestern regions of Central Europe. The growing season defined here as time span between leaf unfolding and leaf coloration of birch and beech has been lengthening up to two weeks in 2001 to 2010 compared to 1961 to 1990 in northeastern parts of Central Europe.