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Impacts of extraordinary warm and cold late-winter temperatures on observed and modelled plant phenology in Switzerland

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The impact of gradual change in the climate system during the second half of the 20th century left a strong imprint on the timing of seasonal events in biotic and biotic systems such as e.g. plant development stages and the greenness of the Earth's surface. Temporal trends in seasonal events largely correspond to the effects expected from the increases in temperature. The impact of extraordinary temperature and precipitation events on plant phenology in spring is less understood. For example a strong early-spring frost event in the USA in April 2007 lead to reduced greenness and freeze damage to leaves and fruits of natural and horticultural species whereas a winter warming event in northern Scandinavia in December 2007 caused considerable damage to sub-Arctic dwarf shrub vegetation and reduced vegetation activity (26% reduced maximum Normalized Difference Vegetation Index NDVI relative to the previous year) in the following summer. In Germany and Switzerland, the effects of the extraordinary warm temperature anomalies of autumn 2006, winter 2006/2007 and spring 2007 showed strong impacts on selected plant phenological phases back to 1951 and 1702. Common hazel and snowdrop flowered up to 35 days earlier in Germany and beech and fruits tree were two weeks earlier in Switzerland.

This contribution presents empirical evidence of extraordinary warm and cold late-winter temperatures on species-specific plant phenology and modelled landscape-scale phenology in Switzerland in the period 1958–2008. Species-specific observations were extracted from the Swiss Plant Phenological Network of MeteoSwiss for 23 low-altitude stations and 12 stations that report to the Global Climate Observation System (GCOS). Observations cover all climate regions and altitudes. For each GCOS station we also estimated daily Leaf Area Index with a prognostic phenology model. The model's empirical parameter space was constrained by assimilated Fraction of Photosynthetically Active Radiation absorbed by vegetation (FPAR) and Leaf Area Index (LAI) from the MODerate Resolution Imaging Spectroradiometer (MODIS). We present first results from an ongoing study that compares climate impacts of extraordinary characteristics on spring plant and vegetation development at the species and at the landscape level at different altitudes in the Swiss Alps.