

Diverging phenology change in the European mountains in a warming world.

Global warming lengthens the potential thermal growing season, strongly influencing vegetation phenology in temperature-constrained ecosystems. The spatial resolution of phenological studies usually ranges from 1 km to 50 km and may hinder elevation patterns in areas with complex topography and the response of different vegetation types in fragmented landscapes, which are therefore still poorly understood. To fill this gap, we investigated phenological trends in broadleaved forests and natural grasslands in the Alps, in the Carpathians, and in the Pyrenees from 2001 to 2021 using MODIS satellite imagery at 500 m resolution. We observed a more evident change in autumn rather than in spring phenology, with different patterns along elevation gradients, mountain regions, and vegetation types. Moreover, we assessed the existence of a general uniformization of phenology across elevations, and we explored changes in the sensitivity of spring phenology to temperature.

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