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Phenological responses to climate change and their trait-induced differences

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On the basis of an extensive plant phenological dataset which involves phenological stations distributed all over Europe (from Spain to Russia, from the Alps to the Scandinavian Peninsula), we assess those differences in temporal trends related to Plant Functional Types (PFTs, i.e. woodiness), ecological traits (i.e. dates of flowering) and functional traits (i.e. pollination mode). We analyze differences in the sensitivity of different flowering stages to these traits. We focus on different substages such as beginning of flowering, full flowering, end of flowering because flowering seems to be so far one of the stages most affected by climate change.

An increasing risk of pollinosis is one of the most likely expected consequences of climate change, and the detection of differences in responses of wind-pollinated plants with respect to other vegetation categories is important also to understand the impact of increasing temperatures on the behavior of allergenic plants. Wind-pollinated plants can be considered as representative of allergenic species because anemophilous species include those ones with the highest capability of causing allergy-related diseases in human subjects (e.g. the birch family, some cultivated and spontaneous grasses).

Our main results indicate that, during the last three decades, wind-pollinated plants are advancing more than insect-pollinated ones, moreover showing a significant linear dependence of trends on phenodates.

The tendency towards an earlier onset of flowering of anemophilous species could be explained due to the fact that all the considered species are angiosperms. For this plant division, anemophily is a condition derived from entomophily, and likely developed as a response to adverse or changing environmental conditions. So, it could be possible to look at them as species somehow predisposed to a more rapid adaptation process. On the other hand, this behavior could also be caused by the direct dependence on temperature of these species, that can hence more easily react to a warming not being tied to other factors. Insect-pollinated plants depend on temperature as well, but in a more indirect way, with a dependence filtered through the life cycle of their pollinators.

A further study is necessary to understand which interpretation could be more reliable, e.g. a comparative study with gymnosperms, for which anemophily is the primary condition.