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Timing and duration of autumn leaf development in Sweden, a 4-year citizen science study

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Phenology monitoring has traditionally focused on the start of phenological phases and the start of the growing season, especially when it comes to species-specific observations on the ground. The patterns of and the mechanisms behind the end of particular phases and the growing season itself are less studied and poorly understood. With a changing climate, the need to understand and predict effects on the length as well as on the end of phenological phases increase in importance, e.g. in relation to estimations of carbon budgets and validation of remote sensing data. Furthermore, different species may be affected in different ways by changing conditions.

In this 4-year-study, tens of thousands of pupils in ages from 6 to 19 years old were involved in observing autumn leaf development of common deciduous tree species. Their observations were made near schools all over Sweden (55-68°N). Observations were made weekly between late August and early November and followed an image-based observation protocol, classifying autumn leaf development into five levels, from a summer-green (level 0) to a 100% autumn-colored (level 4) canopy.

As expected, there was a general (negative) correlation between latitude and the start of leaf senescence (level 2; 1/3 autumn-colored canopy), but the correlation differed largely among years and between species. There was a week correlation between latitude and duration of the leaf senescence period, defined as the period between 1/3 (level 2) and 100% (level 4) of autumn-colored canopy. A delayed onset of the leaf senescence affected the duration of the leaf senescence period more strongly; One (1) day later start was correlated with a 5-day shorter period. Different species had different length of their senescence period, with oak (mainly Quercus robur) and birches (Betula pendula and B. pubescence) having on average a 50% longer period than trembling aspen (Populus tremula) and Norway maple (Acer platanoides).