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# Comparing net ecosystem exchange, satellite derived phenological measures and in-situ leaf observations in early spring in a temperate mixed forest

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Changes in the timing and duration of spring leaf development has implications for the start of the carbon uptake period and is therefore fundamental to facilitate the accurate calculation of carbon budgets and in determining the potential for forests to sequester $CO_2$. However, the rate at which $CO_2$ is absorbed and whether a forest acts as a carbon sink or source depends not only on the type of forest in question but on the time of day, the time of year and over the life-time of the forest. We propose to explore the relationship between the timing and duration of spring phenophases, continuous measurements of $CO_2$ exchange and satellite derived phenology. We will examine, over a 5-year period, (i) 3 field observed phenophase categories (bud-burst, leaf-out, full-leaf unfolded) from a suite of deciduous and coniferous tree species from a mixed forest in northern Wisconsin, USA, (ii) carbon flux data (Gross Primary Production (GPP), Ecosystem Respiration (ER) and net ecosystem exchange (NEE)) from a nearby AmeriFlux tall tower and (iii) satellite derived measures (Normalized Difference Vegetation Index (NDVI) and Enhanced Vegetation Index (EVI)) of the start of spring from the MODIS product MOD13Q1. We hypothesise that during warmer springs an early start to bud-burst coupled with a fast rate of phenological progression will be reflected in an earlier start to the carbon uptake period and a faster uptake rate. Furthermore, we hypothesize that both the observed phenophases and the flux data will be reflected in the satellite derived phenology.