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Sensing nitrogen and phosphorous concentrations in vegetation across different scales

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Nitrogen (N) and Phosphorus (P) are essential nutrients for plant growth and have been linked to physiological processes at the leaf and canopy scales. At the global scale, N and P are also strongly linked to carbon assimilation by vegetation. Vegetation models predicting terrestrial carbon uptake have therefore integrated the N cycle, and some of the models include the P cycle as well. Accessing information about the N- and P- cycles is thus essential but plant trait data for these cycles, e.g. canopy N and P concentrations are often lacking. Remote sensing methods offer the possibility to estimate canopy N and P concentrations at different scales. Our research focuses on sensing these traits across different scales, from in situ experiments (N and P measurements) up to regional (N measurements) and continental (N measurements) scale using vegetation indices (VIs). At the local scale, we tested and developed VIs for canopy N and canopy N to P ratio (N:P) detection on a grass species, *Holcus lanatus*, grown under three ratios and two levels of N:P supply. Canopy N concentration and canopy N:P were highly correlated (R2 = 0.5 – 0.7) with VIs calculated using both the narrow band spectra and the spectra resampled to the spectral properties of six satellites sensors (Sentinel 2 - MSI, Sentinel 3 - OLCI, MODIS, Landsat 8 - OLI, RapidEye and Worldview 4). At the regional scale, we used the MERIS Terrestrial chlorophyll Index (MTCI) Level 3 product from MERIS aboard ENVISAT (ESA) to study the relationship with canopy N. We analyzed 846 Mediterranean forest plots located in Catalonia (north eastern Iberian Peninsula). Canopy N concentration was correlated with MTCI (R2 = 0.32). The results suggested a strong influence of the plant functional type (PFT) of the plots and the relationship for the deciduous broadleaf forest (DBF) plots was stronger than for any other PFTs. We will expand this research to the continental scale of Europe using more than 700 temperate forest plots from the ICP forests database. As these plots were measured repeatedly over 20 years, this will allow us to study the temporal variation of canopy N.