Upscaling plant traits to ecosystem level: blending local biodiversity, global traits databases, and remote sensing data.

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Plant functional traits have great influence in how terrestrial ecosystems function. This key information is however generally oversimplified in most Earth system models (ESMs) and is typically represented by a number of static, empirically fixed values assigned to a selection of plant functional types (PFTs). This leads to reducing the diversity of plant communities into a relatively low number of categories and key variability within individual PFTs is lost. Subgrid processes are thus underrepresented and accuracy compromised.

The TRY global traits database contains the largest set of in-situ trait observations for numerous species around the globe. Despite the large number of species and samples included in trait databases, such as TRY, they are sparse compared to the overall richness and diversity of species globally. We propose the use of the massive geolocated plant occurrence data from the Global Biodiversity Information Facility (GBIF) as ancillary source of information to better capture species distributions, especially in locations where TRY data are missing.

As a first order approach, GBIF was used to estimate species abundances for a given study area (contiguous United States), and they were further corrected with high resolution, subpixel maps of PFT derived via remote sensing and machine learning upscaling. This information was used to provide ecosystem level trait estimates for a selection of plant traits (specific leaf area and leaf nitrogen concentration). The proposed approach allows us to link local biodiversity composition from GBIF with a more precise and realistic representation of plant community composition coming from remote sensing information for ecosystem-level trait estimation. Among many possible applications of these data, the addition of the produced trait estimates to improve ESMs estimations could be very valuable to improve the understanding and monitoring of the biosphere.