From Alaska to Amazonia—first global maps of traits that drive vegetation growth

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Credit: University of Minnesota

Detailed global maps of key traits in higher plants have been made available for the first time, thanks to work led by researchers from the University of Minnesota's (UMN) College of Food, Agriculture and Natural Resource Sciences (CFANS).

Based on measurements of 45,000 individual plants from 3,680 species, and using high-tech statistical mapping protocols, the team created global maps of plant traits including leaf nitrogen concentration, leaf phosphorus concentration, and specific leaf area (a measure of area displayed to intercept light per unit investment in leaf biomass). These maps, with more than 50,000 pixels, show surprisingly large local variation in trait values that could significantly impact future carbon cycle calculations produced by Earth System models (ESMs). The plant traits mapped in the study are critical for photosynthesis and foliar respiration and serve as input to the ESMs. Incorporating this local variability of plant traits in the ESMs will lead to more accurate modeling of carbon cycle feedbacks.

"The scarcity of field measurements presents a major roadblock in creating high resolution global maps of plant traits," said Ethan Butler, co-lead author and postdoctoral associate in the Department of Forest Resources at UMN's College of Food, Agricultural and Natural Resource Sciences (CFANS). "This work advances previous trait mapping endeavors by leveraging the largest to-date global plant trait database, TRY (www.try-db.org), which is three-fold larger than any used before."

According to Peter Reich, the project leader, "Current ESMs represent variation in plant life using crude averages of trait values of plants; a model might be as simplistic as assuming all leaves in Amazonia or Alaska are identical. The new maps reveal that local diversity is substantial; ignoring this fact is problematic. Incorporating data from these maps into the EMSs will lead to improved carbon cycle models."

"Despite having an enhanced number of field measurements, the geographical coverage of TRY is still limited with little or no data for much of the tropics, large swaths of Central Asia, Russia, South Asia and much of the Arctic," said co-lead author Abhi Datta, formerly a PhD student in the Division of Biostatistics at UMN. "Subsequently,

sophisticated statistical approaches were used to extrapolate plant trait values using a combination of climate, soil and spatial information. The resulting maps provide a complete characterization of how traits vary within and among over 50,000 50 km x 50-km cells across the entire vegetated land surface."

The new findings were published in the *Proceedings of the National Academy of Sciences*.

More information: Ethan E. Butler et al, Mapping local and global variability in plant trait distributions, *Proceedings of the National Academy of Sciences* (2017). DOI: 10.1073/pnas.1708984114 , dx.doi.org/10.1073/pnas.1708984114

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