Understanding the Representativeness of FLUXNET for upscaling carbon fluxes

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Introduction

- *Hargrove et al.* (2003) first produced a map of AmeriFlux representativeness in 2003.
- Quantitative method is based on climatic, physiographic, and edaphic variables.
- Enables similarity analysis (e.g., maps of Smokies-ness) and provides a quantitative basis for upscaling fluxes.

FLUXNET Sites

- Similar analysis can be performed for FLUXNET sites through time or for the subset of sites contained in the FLUXNET2015 data collection.
- The quantitative variables used for representativeness, ecoregions delineation, and upscaling are shown in Table 1.

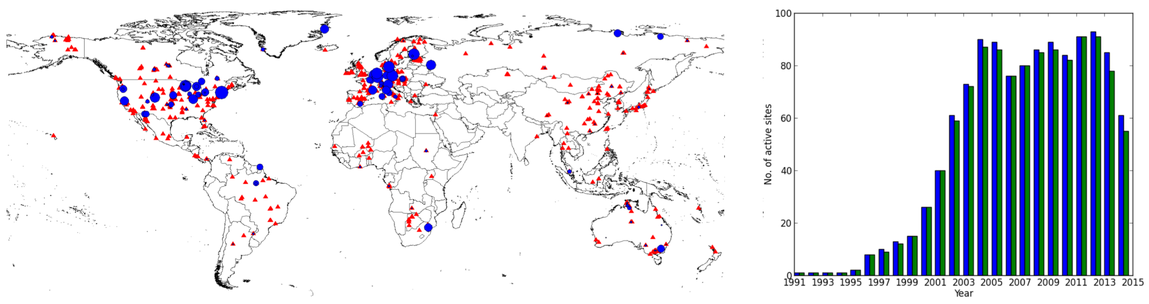

Figure 1: *(Left) This maps shows the spatial locations of all FLUXNET sites. Red triangles indicate the location of all sites (~750) registered in the FLUXNET network. Blue circles indicate sites (164) contained in the FLUXNET2015 data set. The size of the blue circles quantifies the time period of data availability. (Right) Active FLUXNET2015 sites each year (1991–2014). Blue bars indicate active sites; green bars indicate active sites with* `GPP_DT_CUT_REF` *available.*

Table 1: *Environment variables (raster grids at ~4 km^2) used for ecoregion delineation, representativeness analysis and upscaling.*

Variable Description	Units	Source
Bioclimatic Variables		
Annual mean temperature	°C	*Hijmans et al.* (2005)
Mean diurnal range	°C	*Hijmans et al.* (2005)
Isothermality	–	*Hijmans et al.* (2005)
Temperature seasonality	°C	*Hijmans et al.* (2005)
Temperature annual range	°C	*Hijmans et al.* (2005)
Mean temperature of wettest quarter	°C	*Hijmans et al.* (2005)
Mean temperature of driest quarter	°C	*Hijmans et al.* (2005)
Mean temperature of warmest quarter	°C	*Hijmans et al.* (2005)
Mean temperature of coldest quarter	°C	*Hijmans et al.* (2005)
Annual precipitation	mm	*Hijmans et al.* (2005)
Precipitation during the wettest quarter	mm	*Hijmans et al.* (2005)
Precipitation during the driest quarter	mm	*Hijmans et al.* (2005)
Precipitation during the warmest quarter	mm	*Hijmans et al.* (2005)
Precipitation during the coldest quarter	mm	*Hijmans et al.* (2005)
Edaphic Variables		
Available water holding capacity of soil	mm	*Global Soil Data Task Group* (2000), *Saxon et al.* (2005)
Bulk density of soil	g cm^{-3}	*Global Soil Data Task Group* (2000), *Saxon et al.* (2005)
Soil carbon density	g m^{-2}	*Global Soil Data Task Group* (2000), *Saxon et al.* (2005)
Total nitrogen density	g m^{-2}	*Global Soil Data Task Group* (2000), *Saxon et al.* (2005)
Topographic Variables		
Compound topographic index (relative wetness)	–	*Saxon et al.* (2005)

FLUXNET Representativeness

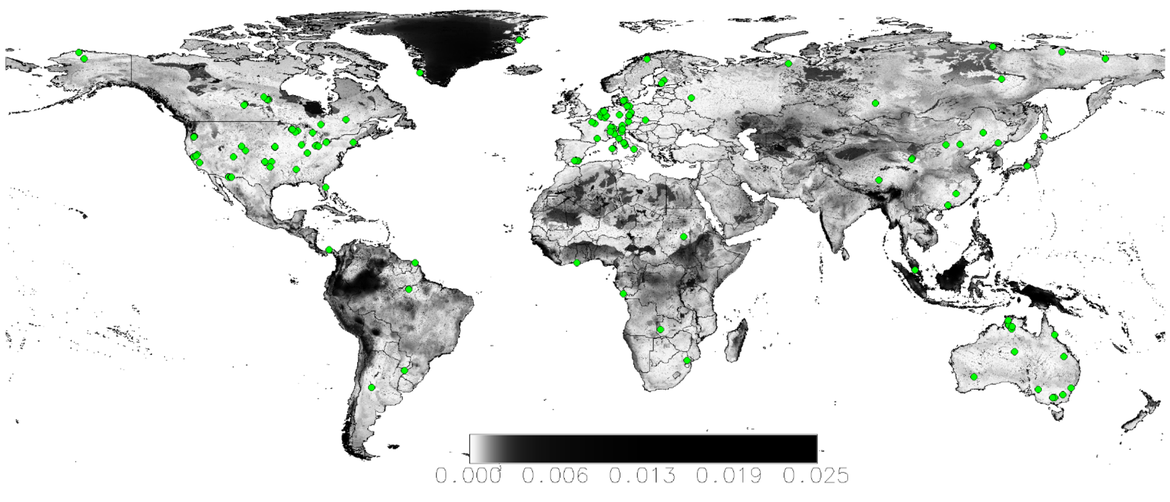

Figure 2: *This map shows the network representativeness of all 164 FLUXNET2015 sites. Darker regions are poorly represented by this network of sites.*

Quantitative Ecoregions

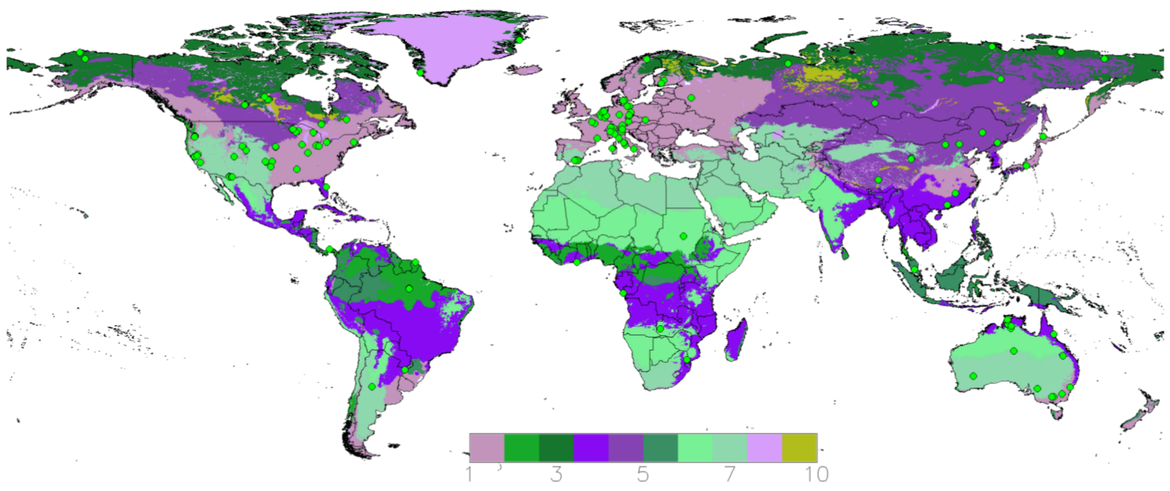

Figure 3: *This map shows the 164 FLUXNET2015 sites overlying the 10 ecoregions quantitatively determined by multivariate cluster analysis for $k = 10$ from the co-registered variables shown in Table 1.*

Upscaled Annual Gross Primary Production Estimates

Inverse distance weighted nonlinear interpolation, constrained within ecoregions, was used to scale up gross primary production (GPP) estimates from FLUXNET2015 sites.

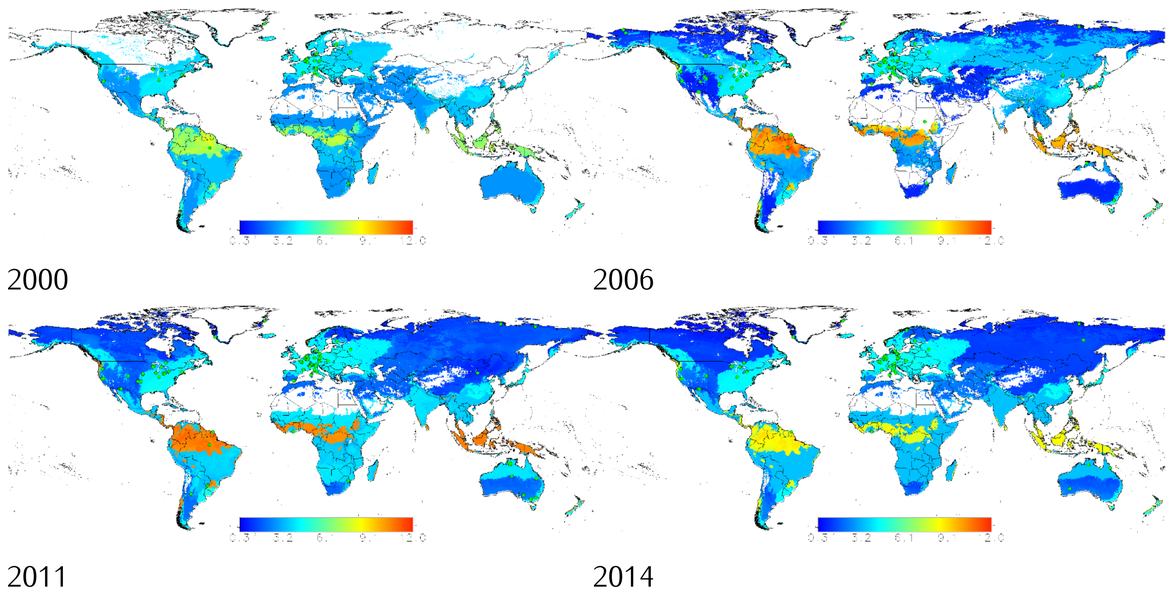

Figure 4: *These maps show the spatial distribution of the time integrated annual mean estimates of gross primary production (GPP) fluxes (g C m^{-2} d^{-1}) for years 2000, 2006, 2011, and 2014.*

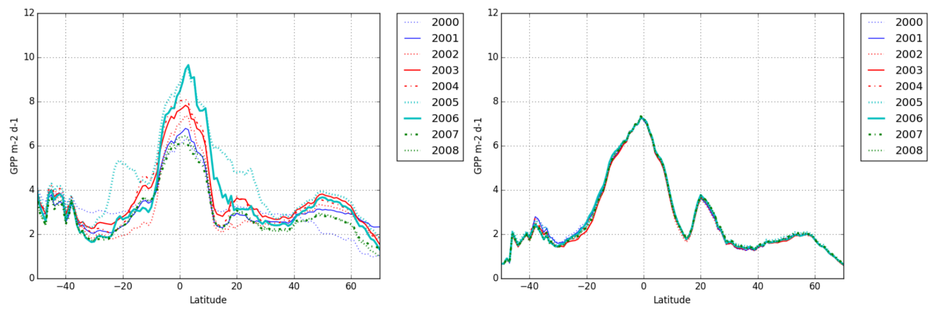

Figure 5: *Zonal interannual variability in GPP fluxes from upscaled FLUXNET2015 (left) and the FLUXNET-MTE product (right) (g C m^{-2} d^{-1}) for years 2000–2008. Upscaled FLUXNET2015 may overestimate GPP in some regions, but it captures zonal interannual variability much better than the FLUXNET-MTE product.*

References

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Acknowledgments

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