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Upscaling diurnal cycles of carbon fluxes

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Carbon fluxes like Gross Primary Production (GPP) and Net Ecosystem Exchange (NEE) are important variables for studying interactions between the atmosphere and the biosphere in different ecosystems. They are typically derived from measurements at Eddy covariance towers and the FLUXNET global network consists of hundreds of such sites. In order to diagnose global GPP and NEE patterns from FLUXNET, upscaling approaches have been used in the past to extrapolate the site measurements to continental and global scale. However, respective products have a daily or monthly temporal resolution and do not allow for analyzing patterns related to diurnal variations of GPP and NEE.

To raise these upscaling approaches to the next level, we present our first results on upscaling diurnal cycles of GPP and NEE with half-hourly resolution. We use random forest regression models to estimate the relationship between predictor variables and fluxes based on more than four million half-hourly observations from FLUXNET sites. We have developed and tested two approaches that overcome the mismatch in the temporal resolution between predictor variables at daily resolution and fluxes at half-hourly resolution. Based on thorough leave-one-site-out cross-validation we show that the approach works very well. Finally, we used the trained models for computing global products of half-hourly GPP and NEE that cover the years 2001 to 2014 and present global patterns of diurnal carbon flux variations derived from the upscaling approach.