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A global database of sap flow measurements (SAPFLUXNET) to link plant and ecosystem physiology

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Regional and global networks of ecosystem CO_2 and water flux monitoring have dramatically increased our understanding of ecosystem functioning in the last 20 years. More recently, analyses of ecosystem-level fluxes have successfully incorporated data streams at coarser (remote sensing) and finer (plant traits) organisational scales. However, there are few data sources that capture the diel to seasonal dynamics of whole-plant physiology and that can provide a link between organism- and ecosystem-level function. Sap flow measured in plant stems reveals the temporal patterns in plant water transport, as mediated by stomatal regulation and hydraulic architecture. The widespread use of thermometric methods of sap flow measurement since the 1990s has resulted in numerous data sets for hundreds of species and sites worldwide, but these data have remained fragmentary and generally unavailable for syntheses of regional to global scope. We are compiling the first global database of sub-daily sap flow measurements in individual plants (SAPFLUXNET), aimed at unravelling the environmental and biotic drivers of plant transpiration regulation globally. I will present the SAPFLUXNET data infrastructure and workflow, which is built upon flexible, open-source computing tools within the R environment (dedicated R packages and classes, interactive documents and apps with Rmarkdown and Shiny). Data collection started in mid-2016, we have already incorporated > 50 datasets representing > 40 species and > 350 individual plants, globally distributed, and the number of contributed data sets is increasing rapidly. I will provide a general overview of the distribution of available data sets according to climate, measurement method, species, functional groups and plant size attributes. In parallel to the sap flow data compilation, we have also collated published results from calibrations of sap flow methods, to provide a first quantification on the variability associated with different sap flow methods. The SAPFLUXNET database is not only a promising resource to investigate the physiological and environmental controls on transpiration by whole plants and stands, but also a tool to link ecosystem fluxes (FLUXNET) with plant functional traits (TRY). Finally, SAPFLUXNET will encourage data sharing and the adoption of common instrumental and analysis protocols among ecophysiologists.