Using a global tree sap flow database as ground-truth for transpiration products validation

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Transpiration (T) is a key driver of ecosystem energy, water and carbon flows and is tightly linked to climate and land-use change. While global models rely extensively on remotely sensed transpiration products to evaluate land-surface processes, ground-truth validation for these products does not exist. At best, data from eddy-covariance evapotranspiration is used, but the T component is partitioned based-on a set of complex assumptions, which are in themselves poorly validated for many parts of the world. Sapflow (SF) measurements allow direct quantification of tree-level T which can be used as ground-truth for T-products in forested areas. A recent global network of sapflux data, (SapFluxNet – SFN) has provided the first quality-controlled sapflow dataset at a global scale, opening up new opportunities to evaluate global T products. Using the SFN-SF and Global Land Evaporation Amsterdam Model (GLEAM) T product, we address i) how the time course of the two products scale with one another, and ii) whether this scaling is different between days with low, median or high T/ SF within months; in addition, iii) we evaluate errors patterns of GLEAM-T in relation to SFN-SF and test whether these errors are biased by site climate or by model inputs. Our results shows GLEAM-T scales with SFN-SF, especially for days with median transpiration, but this scaling, rather than 1:1, has a slope of 0.9, which causes underestimation of SFN-SF at high GLEAM-T values. The scaling is shallower for low and high transpiration days leading to a higher bias in those days. In addition, GLEAM-T scales from SFN-SF with an offset, which compensate the shallower scaling at median values at the expense of increasing bias at extremes. Our results also show errors of GLEAM-T in relation to SFN-SF are not random but depend on the location’s climate and on the soil moisture stress factor used within GLEAM transpiration model. Our work bridges, for the first time, the scale difference between trees and pixels and shows the potential of using ground-truth SF measurements for evaluating biases and patterns in global products.