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Solar-induced fluorescence: the best alternative to monitor global transpiration?

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Despite transpiration being a key variable in the global water cycle and the ecosystem energy budget, estimates of transpiration at large scales are associated with large uncertainties. This is due to the sparse nature of point measurements (e.g. sap flow or lysimeter measurements) and the incapability to sense this flux directly from space. Recent progress in remote sensing science may however substantially improve our skill to monitor this flux over large scales. In this study, we explore the use of satellite-based solar-induced chlorophyll fluorescence (SIF) for estimating transpiration. Up to date, SIF has mainly been linked to the photosynthesis process. However, as photosynthesis and transpiration are both mediated by the stomata, we expect a relationship between SIF and transpiration. Here, we show that SIF observations are as highly correlated to eddy-covariance measurements of latent heat flux as they are to photosynthesis. The seasonality of satellite-based SIF and field-scale transpiration are in phase with each other. We also show that at individual flux tower sites, satellite-based SIF retrievals are more highly correlated to transpiration than MODIS-based vegetation indices and optical products such as NDVI, EVI and fPAR, despite the much coarser resolution of the SIF data. Finally, we use the SCOPE model to prove that SIF and transpiration have a strong theoretical and almost linear relationship in both a dry and wet flux sites. The results show the clear potential of using satellite-based SIF data for routine monitoring of transpiration across the globe.