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Fluxes across scales in Alpine Landscape: From Towers to Pixels

Recent advances in ecosystem monitoring increasingly emphasize flux measurements at larger spatial scales, enabling better integration with satellite remote sensing products and Earth system models. However, alpine ecosystems remained undersampled globally, limiting the ground validation of these model results and satellite-derived carbon estimates. Despite being in one of the most extreme environmental conditions on Earth, these ecosystems play a vital role in the exchange of water, energy, and carbon. Here, we present continuous carbon and energy flux estimates measured at 19 m in an alpine steppe ecosystem on the Tibetan Plateau (TP) from July 2018 to June 2019. The measured fluxes were compared with the fluxes obtained at 3 m over the same ecosystem, and the measured gross primary productivity (GPP) was additionally compared with the MODIS global GPP product. While the 3 m flux footprint represents a relatively homogeneous patch, the 19 m integrates fluxes across a broader, more heterogeneous area, better matching the spatial resolution of MODIS, enabling landscape-scale comparisons. By capturing variability across microtopographic and ecological gradients, these observations provide new opportunities to assess flux variability at spatial scales directly relevant to satellite remote sensing and ecosystem modelling.

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