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Proposal summary:

Current satellite-derived estimates of carbon uptake, termed gross primary productivity (GPP) can not accurately capture the high intra- and inter-annual variability of eddy covariance based GPP, in particular, for the highly heterogeneous dryland ecosystems. To close this critical knowledge gap, I propose to develop a novel, multi-scale model of dryland carbon uptake dynamics through integrating vegetation physiological, functional, and structural information derived from three remote sensing techniques: solar-induced fluorescence (SIF), hyperspectral, and Light detection and ranging (LiDAR) data. Firstly, at three representative eddy covariance flux tower sites in the southwestern US: the Walnut Gulch Experimental Watershed Kendall grassland site (US-Wkg), the Santa Rita experimental range woody savanna site (US-SRM), and the Santa Catalina Mountains Critical Zone Observatory Mt. Bigelow subalpine conifer forest site (US-MtB), I will integrate tower-based remote sensing (i.e., SIF, Hyperspectral, and LiDAR) to yield the most robust and accurate estimates of tower-based GPP. Secondly, with several incoming satellite missions such as Europe Space Agency TROPOspheric Monitoring Instrument ESA TROPOMI, NASA the Orbiting Carbon Observatory-3 (OCO-3), German Space Agency Earth Sensing Imaging Spectrometer (DLR DESIS), NASA/ Japan Aerospace Exploration Agency the Hyperspectral Imager Suite (JAXA HISUI), and NASA Global Ecosystem Dynamics Investigation (NASA GEDI), the proposed integration of SIF, hyperspectral, and LiDAR data at the tower level will be applied to the new synthesis of data from eddy covariance flux sites distributed across southwestern North America, thus will yield the most robust and accurate estimates of GPP across the diverse subregions of the US southwest. This research fills the gap of exceptionally high intra- and inter-annual variability of GPP that is not accurately captured in existing satellite-based models. Meanwhile, it will provide added value such as evaluation and validation for the incoming satellite missions, including: NASA OCO-3, and ESA TROPOMI, DLR DESIS, NASA/JAXA HISUI, and NASA GEDI.