Understanding the relationship between vegetation greenness and productivity across dryland ecosystems through the integration of PhenoCam, satellite, and eddy covariance data

Yan, D., *et. al., Remote Sensing of Envir.* 223 (2019) 50-62 https://doi.org/10.1016/j.rse.2018.12.029

Background:

- Drylands account for ~40% of the global land surface and play a dominant role in the trend and variability of terrestrial carbon cycle.
- Gross primary productivity (GPP), the major factor controlling terrestrial carbon uptake, is challenging to observe directly.
- Most GPP models use vegetation indices that largely capture changes in greenness; however, there is uncertainty in the spatiotemporal relationship between greenness indices and GPP, especially for dryland ecosystems.

Methods:

- This study compared vegetation greenness indices from PhenoCam and satellite (Landsat and MODIS) observations from 2013-2016 against GPP estimates from the eddy covariance technique across three representative ecosystem types (savanna, shrubland, and grassland) of the southwestern United States.

Results:

- Greenness-GPP relationships were independent of spatial scales when land cover type and composition remained relatively constant.
- Greenness-GPP relationships strengthened as the time interval increased; the strongest were observed at monthly resolution.
- This suggests that greenness-GPP relationship breaks down at short timescales because greenness changes more slowly than plant physiological function.

Significance:

- These findings provide insights into the potential for and limitations of modeling GPP using remotely-sensed greenness indices across dryland ecosystem types.
- The results highlight the needs for alternative remote sensing proxies of short-term GPP changes in drylands and the authors provide a short discussion of potential future alternatives.

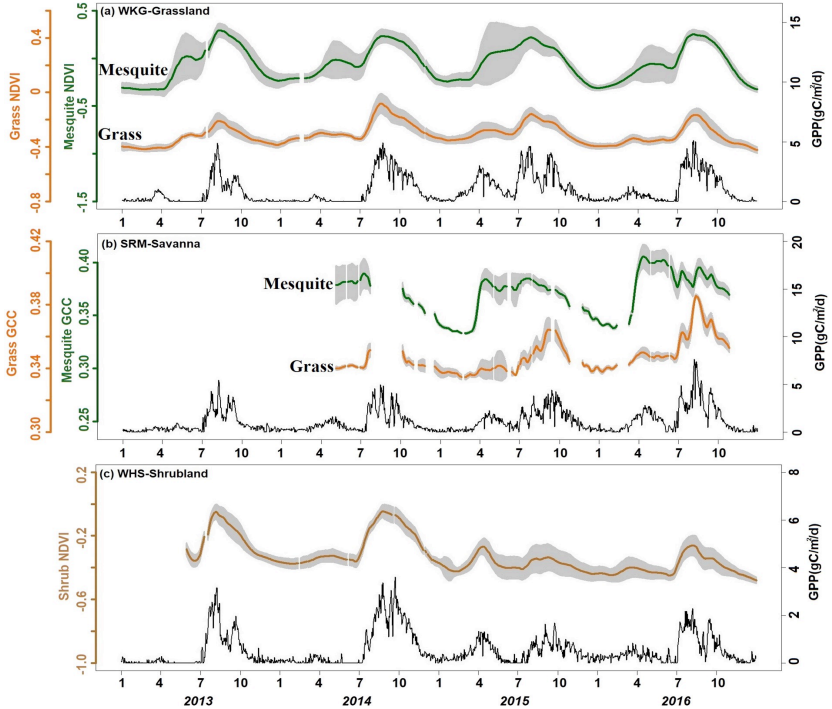

Figure: The time series of tower footprint scale VI (the three y-axes on the left), and GPP (right y-axis) during 2013–2016 at the study sites. PhenoCam, Landsat and MODIS VI are shown in blue, black and purple, respectively. Note that GCC was calculated for the SRM site while NDVI was calculated at the WKG and WHS sites. The gray shaded area (i.e., PhenoCam and MODIS) and error bars (i.e., Landsat) indicate one standard deviation above or below the footprint scale VI. GPP is shown as solid black lines. (For interpretation of the references to color in this figure legend, the reader is referred to the web version of this article.)