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Deriving 250m LAI time series by non-linear temporal regression

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The leaf area index (LAI) forms part of the 13 terrestrial essential climate variables and is key ingest to many vegetation productivity, hydrology and biogeochemistry models. LAI is modeled from satellite images including MODIS and SPOT VGT data in a consistent and operational manner that allows for time series generation. With approximately 1km spatial resolution these products are useful for global analysis but lack the necessary spatial detail for national and regional studies. This study aims at improving the spatial resolution of existing LAI data by relating their temporal course to time series of vegetation indices (VI). MODIS data are particular appropriate providing the LAI at 1km and VI at 1km and 250m spatial resolution. The study area (1100x500km) in central Mexico represents all major biomes and vegetation types of the country and a land surface heterogeneity beyond 1km cell size. Previous to model building LAI and VI time series are generated using appropriate tools (TiSeG) for filtering low-quality data and interpolation of data gaps. Plots show a good temporal correspondence between LAI and VI time series, and temporal cross-correlation indicates high coefficients with no or minor lag. For each pixel linear and non-linear regression models are built at the 1km resolution using the temporal domain and applied to 250m VI data. In addition, multiple regression models with spectral information will be tested. The resulting 250m LAI time series introduces the spatial detail of the 250m VI to the LAI and retains the high temporal consistency. To evaluate the modeled results 250m LAI time series are coarsened to 1km spatial resolution using an empirically-derived aggregation model that takes into account the MODIS-specific spatial point spread function. Error maps of the correlation coefficient and RMSE indicate regions of higher errors that correspond to specific biomes used in MODIS LAI retrieval. For instance, while the vast majority of the study site depicts mean correlation coefficients of 0.85 and an RMSE of 0.3 the mountainous regions that correspond to the evergreen broadleaf forest biome show higher errors (r=0.6, RMSE 0.7) that are also related remaining artifacts in the time series.