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Characterizing fAPAR variability and complexity on multiple scales

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Remote sensing of the activity of vegetation in relation to environmental conditions provides an invaluable basis for investigating the spatiotemporal dynamics and patterns of variability for ecosystem processes. We investigate the fraction of Absorbed Photosynthetically Active Radiation (fAPAR) using SeaWiFS satellite observations from 1998 to 2005 and ancillary meteorological variables from the CRU-PIK dataset with a global coverage at a spatial resolution of 0.5° x 0.5°. A pixel-by-pixel spectral decomposition using Singular System Analysis leads to a global “classification” of the terrestrial biosphere according to prevalent time-scale dependent dynamics of fAPAR and its relation to meteorology. A complexity analysis and a combined subsignal extraction and dimensionality reduction reveals a series of dominant geographical gradients, separately for different time scales. At the annual scale, which explains around 50% of the fAPAR variability as a global average, patterns largely resemble the biomes of the world as mapped by biogeographical methods, and are driven by temperature and by pronounced rain seasons in the tropics. On shorter time scales, fAPAR fluctuations are exclusively driven by water supply, inducing, e.g., semi-annual cycles in the equatorial belt of Africa or the Indo-Gangetic Plain. For some regions however, in particular South America, altitude, mean temperature, drought probability and fire occurrences are parameters that seem to shape the spatial patterns of fAPAR across time scales. Overall, we provide a first global multiscale characterization of fAPAR and highlight different mechanisms in land-surface-climate couplings.