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Parsimonious LAI-model development from long term MODIS data

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The spatio-temporal dynamics of land surface characteristics play an important role in controlling the exchange of momentum, energy , carbon and water fluxes between the land surface and the atmosphere. Therefore, the current generation of land surface models as implemented in global and regional scale climate and hydrological models require some description for plant growth and its dependency on water and nutrient availability as well as climate conditions. In general, such descriptions are based on some small scale physics or physiology (such as the Farquard approach for photosynthesis) but nevertheless implemented into larger scale applications. These model approaches require the determination of a large amount of effective process parameters, that will hardly been identifiable from available data.
In this paper we will focus on the development of a parsimonious description for the temporal evolution of leaf-area-index (LAI) as required in many regional/mesoscale hydrological models, controlling e.g. interception, through fall, and evapotranspiration. Rather than building on predefined "physically/biophysiologically – based " functional description, we here follow a more data-based approach in that "the data decide" what model complexity will be required and can be conditioned by the available information. This is done by using novel methods from nonlinear time series analysis, e.g. state dependent (SDP) and time variable (TVP) parameter estimation techniques. Data used in this study come from long term time series of MODIS satellite data for different meso-scal catchments in Germany, representing information at an aggregation level commensurable with the spatial discretisation of the mesoscale models. Derived simple dependencies of LAI dynamics on water availability and climate conditions will allow this approach to be implemented in not only meso-scale hydrological models, but into any description that is based on process descriptions requiring dynamic estimates of LAI.