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The Leaf Area Index as a function of precipitation within a hydrological model

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The Leaf Area Index (LAI) is a key-component regarding the soil-atmosphere interaction within many evapotranspiration models. The parameter can be obtained by field measurements but also by remote sensors with a moderate to high spatiotemporal resolution. In many model applications, the LAI is assumed to have an annual phenology, but no inter-annual variation. Since the LAI highly influences the evapotranspiration, such a static LAI limits the possibility to assess the hydrological impact of climate extremes like drought, or a possible seasonal shift in future precipitation. This study focuses on the arid/semi-arid to sub-humid Jordan River region. The LAI is simulated as a function of precipitation and it is investigated how this dynamic LAI can improve the simulation of the regional water balance for time periods were no remotely sensed LAI data are available. The methods compromise the usage of ground collected precipitation as well as vegetation data received from remote sensing.
Monthly LAI was derived from the Normalized Difference Vegetation Index (NDVI) obtained by the Advanced Very High Resolution Radiometer (AVHRR). Thereafter, linear correlation analyses were conducted between LAI and spatial interpolated monthly precipitation. The analyses were conducted for each month of the year and for several land-uses. The regression parameters (slope and intercept) were obtained for the years 1982-1996. By applying these parameters, LAI was thereafter simulated as a function of precipitation for the validation period 1997-2002. As an objective function, the Spearman correlation coefficient was derived between the simulated and observed LAI. The results were compared to when a static LAI (no inter-annual variation) was assumed.
Within the correlation analyses, the slope and intercept differed between the months and land-uses. The dynamic LAI delivered higher correlation coefficients between the simulated and observed LAI values than the assumed static LAI did. This shows the value of implementing a dynamic LAI within the physically based hydrological model. With known regressions, the LAI can be simulated also for past conditions were remotely sensed LAI data are not available. The water balance has been simulated in the Jordan River region by using a static LAI. The simulations have been done on a 1x1 km scale for the years 1961-1990. Within next step, the same simulations will be conducted but by using the dynamic LAI. The results of both methods will be compared with special emphasis on the water balance components during drought.