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A new leaf phenology for the land surface scheme TERRA of the COSMO atmospheric model

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The terrestrial biosphere has a significant impact on near-surface atmospheric phenomena by modifying the energy and water balance of the land surface. In particular, it determines the evapotranspiration and therefore the latent and sensible heat fluxes over land, and thus influences atmosphere and land characteristics, such as temperature and humidity, the structure of the planetary boundary layer, and even cloud formation processes.

In soil-vegetation-atmosphere transfer (SVAT) schemes the role of vegetation in affecting the energy and water balance is considered by taking into account its physiological properties, in particular, leaf area index (LAI, the ratio of leaf to ground area), stomatal resistance, and rooting depth. However, many SVAT schemes do not describe the vegetation as a dynamic component. The seasonal evolution of its physiological properties is prescribed as a climatology, being the same for each year of a simulation.

This is also the case for the SVAT scheme TERRA of the COSMO atmospheric model. There are different options for specifying the seasonal cycle of LAI. In one method, a minimum and maximum value of LAI is specified, depending on land use, representing vegetation at rest and during the growing season, and the seasonal cycle is described by a sinusoidal fit through these values. In another method, climatological monthly mean values of LAI are specified which are based on satellite retrievals. A shortcoming of these methods is that the model can not account for inter-annual variations of the seasonal evolution of the vegetation. In some years the spring and growing season start earlier, in some years they are delayed. In these cases, the state of the vegetation is not accurately represented in the model when prescribing the leaf phenology by a climatology, leading to errors in for instance the evapotranspiration. A method is presented for allowing the phenology in the model to adapt to the simulated seasonal cycle of atmospheric or climatic conditions, respectively.