## Project: 1112

## Project title: Improve processes on regional and local climate induced by land-atmosphere feedbacks

## Principal investigator: Merja Toelle

Report period: 2021-07-01 to 2022-06-30

According to the research, we have proposed in our project funded by the DFG, we continued our model development as such. A new stomatal resistance, leaf photosynthesis and "two-big leaf" formulation for the vegetation type grass was implemented into the regional climate model COSMO-CLM in its latest version v5.16. The formulations were adapted from the Community Land Model (CLM). After several tests for the implementation, a sensitivity study was conducted based on three different formulations of the stomatal resistance according to the equations used in CLM version 3.5 and 4.5. For the latter case, an additional term for dry leave transpiration was implemented. Three cases with the new implementations have been tested for a climatological relevant time scale in the regional climate model to derive the feedback mechanisms of stomatal resistance and climate from 2010 to 2015. For this purpose, a reference run with the recommended setting was needed as well as simulations with the new included stomatal resistance formulation over the same period. One column simulations were performed accounting for grassland only over three different TERENO observational sites (Lindenberg, Linden, and Selhausen). Here the external land cover data set was consistently changed to grass type only. The simulation results were evaluated with observational data from Lindenberg, Linden, and Selhausen, stomatal resistance data, and freely available gridded data sets (GLEAM, HYRAS, etc.). The results revealed major differences in the annual cycle of stomatal resistance compared to the original algorithm for the reference simulation. Especially, more dynamics are shown for dry and hot periods with the new stomatal resistance formulation as exemplified for the year 2013 in Figure 1. The results are in the process to be published in a peer-reviewed article.



Results are presented for 1 pm of each day during summer 2013

*Results:* As stomatal resistance increases, latent heat decreases at the same time and sensible heat increases.



Figure 1: Impact of stomatal resistance on turbulent fluxes.

As computation time was not enough in project bb1118 for the production runs for the future at convection-permitting scale with the regional climate model COSMO-CLM, future simulations were conducted over Central Europe from 1980 to 2070 with the resources of bb1112 to accommodate the needs of the research partners waiting for our simulations.