Project: **1118**

Project title: **DyKliLand**

Principal investigator: **Merja Toelle**

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

Within our project MAPPY funded by JPI Climate sensitivity studies were conducted with the regional climate model COSMO-CLM (v5.16) at convection-permitting scale using different land cover data sets (Globcover, GLC, ESACCI, ECOCLIMAP) for 1999 to 2011 over Germany and adjacent regions using ERA5 Reanalysis as driving data. Here, the simulation with the Globcover land cover data set served as a reference run to which the other simulations with GLC, ESACCI and ECOCLIMAP land cover data sets were compared to. Differences in the spatiotemporal heterogeneity in the different surface characteristics was explored. We investigated land cover changes due to the retrieval year, number, fraction and spatial distribution of land cover classes. The bias of the annual temperature cycle of all the simulations compared to observations is larger than the differences between simulations. The latter is well within the uncertainty of the observations. The land cover class fractional differences are small among the land cover maps. Greatest changes in temperature can be seen due to differences in croplands or urban areas and during spring to autumn. The results are published in Tölle and Churiulin 2021 Frontiers in Earth Science.

For MAPPY hindcast simulations at convection-permitting scale were performed over Central Europe and the Iberian Peninsula with the regional climate model COSMO-CLM (v5.16) for the period 1979 to 2020 with ERA 5 Reanalysis as driving data. The results were evaluated with different observational data sets (Zhang and Tölle 2020) and presented in a couple of conferences. After that historical simulations based on RCP8.5 and RCP2.6 scenario from MPI-M-MPI-ESM-LR were performed over Central Europe and the Iberian Peninsula from 1979 to 2006. 1979 was regarded for each simulation as a spin-up year. Future simulations over the same domains covering the period from 2006 to 2070 are currently running. All simulations are preformed as a direct downscaling experiment as results of direct downscalings are within the range of other regional climate simulations results or even superior compared to observations (see Coppola et al. 2018 and Ban et al. 2021). The historical and future simulations are further bias-corrected using a quantile-mapping approach. Our project partners for their vegetation impact models then use these bias-corrected data.

Some examples of our results are seen in the Figures below.

Publications

Tölle, M. H. and E. Churiulin (2021): Sensitivity of convection-permitting regional climate simulations to changes in land cover input data: role of land surface characteristics for temperature and climate extremes, Front. Earth Sci. - Atmospheric Science, DOI: 10.3389/feart.2021.722244

Ban, N., Caillaud, C., Coppola, E., Pichelli, E., Sobolowski, S., Adinolfi, M., Ahrens, B., Alias, A., Anders, I., Bastin, S., Belušic, D., Berthou, S., Brisson, E., Cardoso, R. M., Chan, S. C., Christensen, O. B., Fernández, J., Fita, L., Frisius, T., Gašparac, G., Giorgi, F., Goergen, K., Haugen, J. E., Hodnebrog, Ø., Kartsios, S., Katragkou, E., Kendon, E. J., Keuler, K., Lavin-Gullon, A., Lenderik, G., Leutwyler, D., Lorenz, T., Maraun, D., Mercogliano, P., Milovac, J., Panitz, H.-J., Raffa, M., Remedio, A. R., Schär, C., Soares, P. M. M., Srnec, L., Steensen, B. M., Stocchi, P., Tölle, M. H., Truhetz, H., Vergara Temprado, J., de Vries, H., Warrach-Sagi, K., Wulfmeyer, V., Zander, M. J. (2021): The first multi-model ensemble of regional climate simulations at the kilometer-scale resolution, Part I: Evaluation of precipitation. Climate Dynamics, DOI: 10.1007/s00382-021-05708-w

Zhang, H., M. H. Tölle: Evaluation of agricultural related extreme events in hindcast COSMO-CLM simulations over Central Europe, ECAS, November 2020, https://doi.org/10.3390/ecas2020-08464

Coppola, E., S. Sobolowski, E. Pichelli, F. Raffaele, B. Ahrens, N. Ban, M. Belda, D. Belusic, U. van Bert, R. M. Cardoso, S. Davolio, A. Dobler, J. Fernandez, L. Fita Borrell, Q. Fumiere, K. Goergen, I. Güttler, S. Kartsios, E. Katragkou, L. Kendon, S. Khodayar, S. Knist, A. Lavin, T. Lorenz, D. Maraun, L. Marelle-Sebrechts, J. Milovac, H.-J. Panitz, M. Piazza, T. Raub, C. Schär, K. Sieck, P. M. M. Soares, S. Somot, P. Stocchi, C. Teichmann, M. H. Tölle, L. Torge, H. Truhetz, R. Vautard, H. de Vries, K. Warrach-Sagi, F. Giorgi, 2018: The CORDEX FPS on convective phenomena at high resolution over Europe and the Mediterranean: work plan description and preliminary results, Climate Dynamics, DOI: 10.1007/s00382-018-4521-8

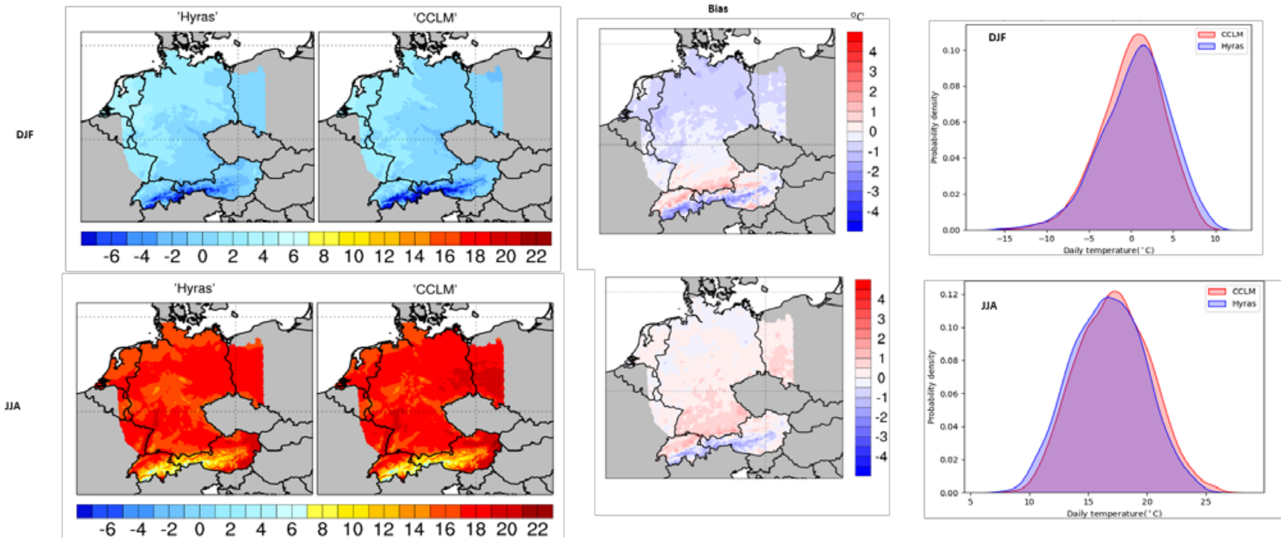

Figure 1: The spatial pattern of mean seasonal temperature for the observation and the simulation and mean seasonal temperature bias (°C) for the period 1980–2015. Upper rows: winter (DJF), lower rows: summer (JJA). In most regions the temperature bias ranges from -1 to +1 °C.

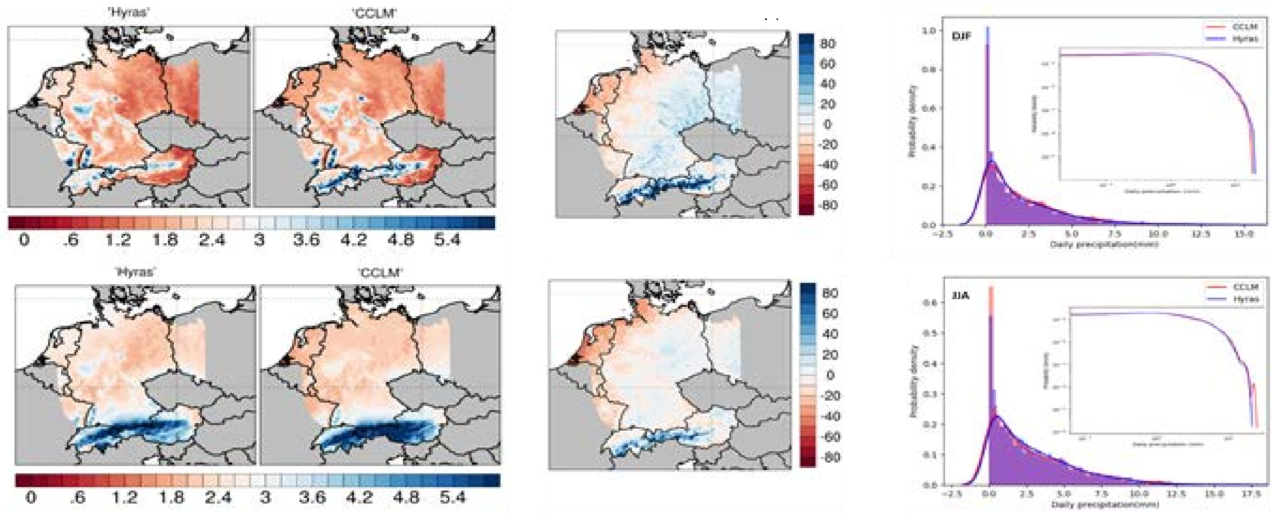

Figure 2: As previous figure but for spatial pattern of daily precipitation and the mean relative seasonal precipitation bias (%). In most regions the precipitation bias ranges from -20 to +20%.

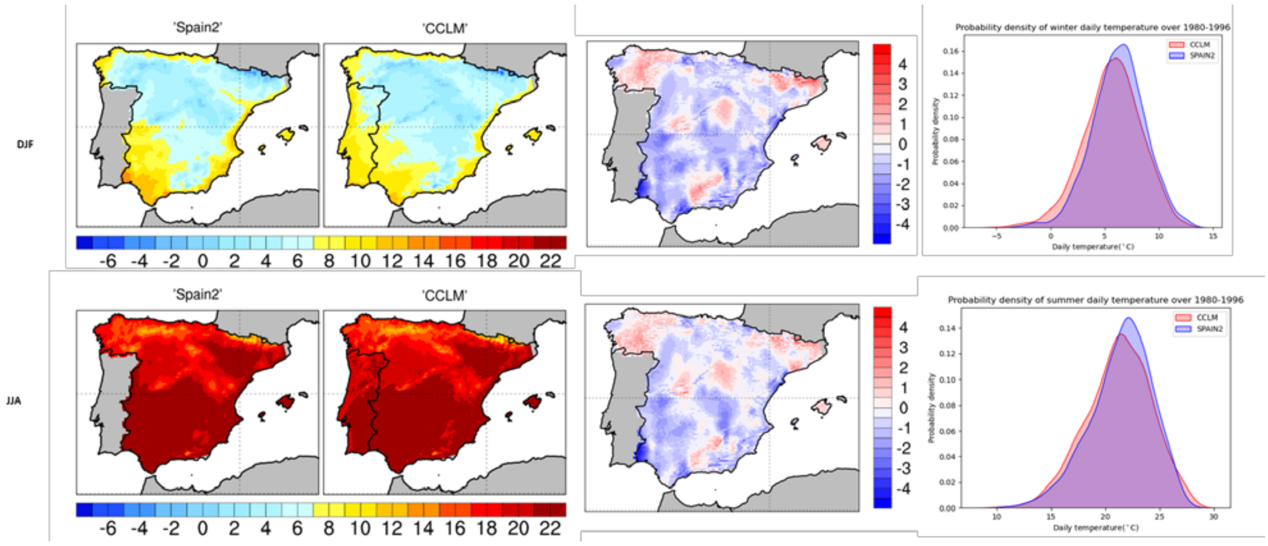

Figure 3: The spatial pattern of mean seasonal temperature for the observation and the simulation and mean seasonal temperature bias (°C) for the period 1980–1996. Upper rows: winter (DJF), lower rows: summer (JJA). In most regions the temperature bias ranges from -2 to +2 °C.

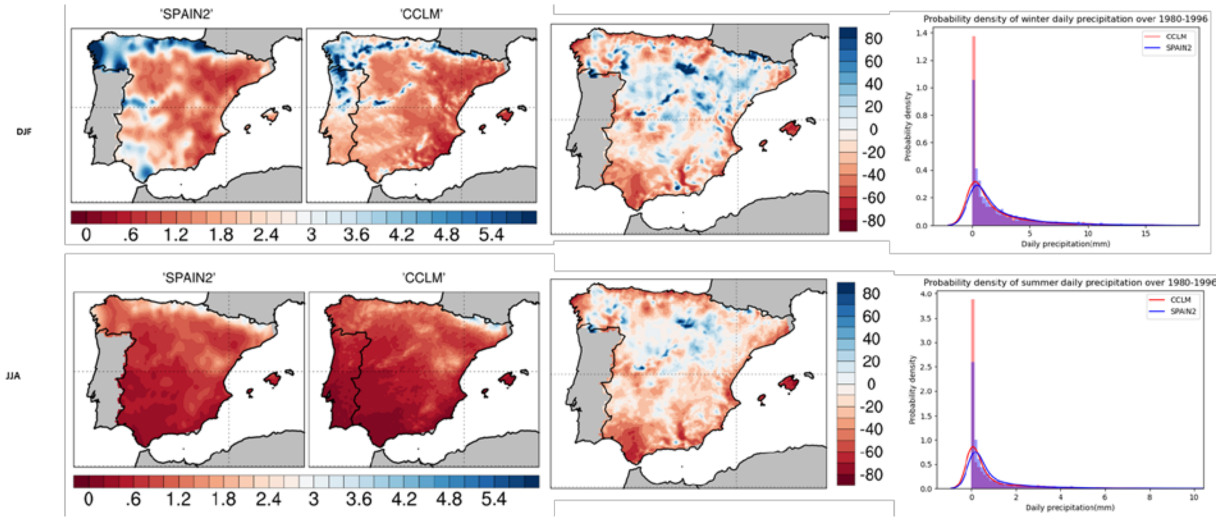

Figure 4: As previous figure but for spatial pattern of daily precipitation and the mean relative seasonal precipitation bias (%). In most regions the precipitation bias ranges from -40 to +20 %.