At the University of Hohenheim, the Weather Research and Forecasting (WRF) model with the Advanced Research WRF (ARW) numerical core is applied for weather and climate simulations from the regional scale (0.44° and 0.11° km resolution) to the convection permitting (CP) scale (down to 1.5 km resolution). In some limited domains, turbulence permitting (TP) simulations with a resolution down to 100 m are performed. The data project WRFSIM covers model simulation data from case studies on the TP and CP scale, seasonal simulations on the CP scale, and climate simulations on the convection permitting to regional scale for Europe.

The first data set contains high-resolution case study simulations for two projects with multi-scale simulations from the CP down to the TP scale: 1) the Land Atmosphere Feedback Experiment (LAFE) experiment performed at the Atmospheric radiation measurement (ARM) site in Oklahoma during August 2017, and 2) the Stuttgart metropolitan area. The aims are a better understanding of the evolution of the planetary boundary layer (PBL) and land-atmosphere feedback in a realistic mesoscale environment and the improvement of its representation in the model.

The second data set deals with the quantification of the regional terrestrial and atmospheric energy and water budgets in different weather situations in Southwest Germany from the CP to the TP scales. It contains simulations of regional terrestrial budgets of energy and water as well as the budgets of sensible and latent heat in the PBL including simulations down to the TP scale for different weather situations. Three different case studies have been conducted at an agricultural dominated site and a forest site. With this approach, the influence of soil moisture, weather conditions, and land cover on budgets can be investigated.

The third data set of WRFSIM contains an evaluation of a small multi-physics ensemble to investigate the potential to simulate summertime convection over the Arabian Peninsula on the CP scale. Several simulations were performed for a case study in July 2015 by varying the PBL parametrizations and the cloud microphysics scheme additionally and their dependence on aerosol climatologies. A TP simulation to further investigate the complex interaction between the desert and mountainous areas will extend this data set. Over this area, an additional one-year simulation in weather prediction mode was carried out on the CP scale to further investigate the model performance over the United Arab Emirates with respect to extreme temperature, storm, and fog events.

For weather forecasting, an accurate initial state especially of water vapor and temperature in the PBL determines the forecast quality on the nowcasting to short-range time scale. The initial fields can be improved by applying data assimilation (DA) methods to ingest data from high-resolution remote sensing observing systems from the University of Hohenheim temperature Raman lidar (TRRL) and water vapor DIAL (WV DIAL). The fourth data set of WRFSIM includes the results from two experiments. One experiment applied a 3DVAR rapid update cycle (RUC) approach. In order to incorporate flow-dependent forecast error covariance in the model, in a second experiment, an Ensemble DA technique is being tested a European domain. A hybrid 3DVAR-ensemble transform Kalman filter (ETKF) consisting of 10-20 ensemble members will be used for this purpose.

The fifth data set of WRFSIM is the result of four latitude-belt simulations at regional and CP resolution to investigate the added value of a high resolution on longer time scales without lateral boundaries. As limited area model (LAM) simulations are disturbed by applying lateral boundary conditions especially in the meridional direction, latitude-belt simulations are assumed to be less affected by boundary conditions. The data set contains two different experiments: One simulation was performed on a latitude-belt between 20°N-65°N for a two-month period in summer 2013. The second experiment contains a data set covering the region 57°S-65°N for five months starting in February 2015.

Food security at the Horn of Africa depends on high-resolution seasonal forecasts of temperature and precipitation extremes. The sixth data set of WRFSIM covers an investigation to what extent a regional downscaling of the ECMWF seasonal forecast ensemble (SEAS5) to the CP scale improves the regional forecasts. A combination of different ECMWF SEAS5 members for initial and boundary conditions and a multi-physics ensemble s being used to evaluate the downscaling and provide uncertainty measures. This project also includes a study of the added value of the high-resolution downscaling effort to enhance farmers agricultural practice optimization, risk assessment, and early warning systems.

The seventh data set of WRFSIM is from a case study on the impact of crop development stages on L-A feedback. Though the characteristics of croplands depend on the crops themselves, sowing dates, and weather, so far cropland parameters like the leaf area index show a static annual cycle. In a project, a crop model was implemented into WRF. The land atmosphere coupling strength is studied for the growing season 2005 in Germany in comparison with a WRF baseline simulation at CP resolution.

The University of Hohenheim contributes to the regional climate model ensembles of two flagship pilot studies (FPS) of the Coordinated Regional Climate Downscaling Experiment (CORDEX, http://www.cordex.org/) with WRF. One is the FPS „Convective phenomena at high resolution over Europe and the Mediterranean“ (e.g., https://www.hymex.org/cordexfps-convection/wiki/doku.php?id=objectives). The evaluation climate simulation forced with ERA-Interim reanalyses data from 1999-2012 for Central Europe was performed on regional and CP resolution. Hourly data are subject of international data analyses and publications of an ensemble of climate simulations and need to be long term archived and form the eighth data set within WRFSIM.

The ninth set contains data of University of Hohenheim contribution to the FPS “Land-Use and Climate Across Scales” (LUCAS https://www.hzg.de/ms/cordex_fps_lucas). The overarching goal is to implement (transient) land cover changes in an ensemble of regional climate models and assess their bio-geophysical impacts on European climate. This data set contains two idealized land cover change experiments and a baseline run on the regional scale (0.44° resolution) from 1986 to 2016 to test the sensitivity of the model to extreme land cover changes.