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Evaluation of hydrological cycle in the major European midlatitude river basins in the frame of the CORDEX project

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Water supply and its potential to increase social, economic and environmental risks are among the most critical challenges for the upcoming decades. Therefore, the assessment of the reliability of regional climate models (RCMs) to represent present-day hydrological balance of river basins is one of the most challenging tasks with high priority for climate modelling in order to estimate range of possible socio-economic impacts of the climate change.

However, previous work in the frame of 4th IPCC AR and corresponding regional downscaling experiments (with focus on Europe and Danube river basin) showed that even the meteorological re-analyses provide unreliable data set for evaluations of climate model performance. Furthermore, large discrepancies among the RCMs are caused by internal model deficiencies (for example: systematic errors in dynamics, land-soil parameterizations, large-scale condensation and convection schemes), and in spite of higher resolution RCMs do not always improve much the results from GCMs, but even deteriorate it in some cases. All that has a consequence that capturing impact of climate change on hydrological cycle is not an easy task.

Here we present state of the art of RCMs in the frame of the CORDEX project for Europe. First analysis shows again that even the up to date ERA-INTERIM re-analysis is not reliable for evaluation of hydrological cycle in major European midlatitude river basins (Seine, Rhine, Elbe, Oder, Vistula, Danube, Po, Rhone, Garonne and Ebro). Therefore, terrestrial water storage, a quasi observed parameter which is a combination of river discharge (from Global River Discharge Centre data set) and atmospheric moisture fluxes from ERA-INTERIM re-analysis, is used for verification. It shows qualitatively good agreement with COSMO-CLM (CCLM) regional climate simulation (abbreviated CCLM_eval) at 0.11 degrees horizontal resolution forced by ERA-INTERIM re-analysis. Furthermore, intercomparison of terrestrial water storage seasonal cycle averaged in Danube river basin for the ten years (1990-1999) overlapping period between CCLM historical experiment (abbreviated CCLM_hist), its forcing GCM (MPI-ESM-LR, here abbreviated MPI_hist) and CCLM_eval is performed. It reveals that CCLM_hist simulation is in better agreement with quasi observed terrestrial water storage than MPI_hist and CCLM_eval. This result seems promising for the assessment of impact of climate change on hydrological cycle. However, evaluation of the whole ensemble of regional climate downscaling experiments participated in CORDEX-Europe project would provide a more robust estimate.