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Regional validation and refinement of the global hydrological model LSDM in the Nile catchment

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Data of global continental water mass redistribution is widely used for studies of Earth rotation excitation and gravity field simulations. They could be also useful for de-aliasing purposes of the GRACE gravity mission. The global hydrological land surface discharge model (LSDM) is oriented towards the simulation of a closed hydrological cycle conserving the total water masses in a consistent integrated Earth system model. In contrast to regional models, LSDM is optimized for globally distributed near real-time input data from the European Centre for Medium-Range Weather Forecasts (ECMWF) generating the influence on integrated geodetic parameters like polar motion, length of day variations, and low degree gravity field changes on a routinely basis. To be independent of the restricted availability of a detailed local parameterization and time variable calibration LSDM works without regional or local tuning. This approach has also the advantage that the model processes remain physically interpretable. Regional results from LSDM, like river discharges, have been analyzed in detail to locate error sources coming along with this global focussing and associated simplifications. Especially for the Nile catchment we identify three necessary refinements. Since the hydrological discharge depends strongly on the precipitation input the overestimated tropical rain in Middle-East Africa of the ECMWF meteorological data has to be corrected before any further analysis. Even the improved ERA-Interim data has to be scaled to the monthly mean level provided by the Global Precipitation Climate Centre (GPCC), to obtain comparable river discharges. Evaporation estimates from the ECMWF have to be enhanced according to local effects from swamps and flooded regions like the Sudd. Anthropogenic influences such as dams and irrigation were incorporated to realistically absorb the high seasonal variability in rainfall. The regionally improved LSDM still keeps a global operational model generating now comparable river discharges for the Nile basin. The regional improvements lead also to noticeable variations in the global geodetic parameters, mainly due to the corrected precipitation-evaporation budget. Furthermore the results provide indirectly clear indications for deficiencies of the ECMWF precipitation/evaporation estimates in the tropical and sub-tropical Africa region.