Modelling and data assimilation at ECMWF in support to land surface international projects: Lesson learnt from GSWP-2+ERA40 and perspectives offered by new reanalyses

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The representation of the global water cycle in the ECMWF Integrated Forecasting System (IFS) has been revised in the past few years leading to a substantial improvements in weather and seasonal predictions. A new convection and a new radiation scheme together with a revision of the land surface hydrology (in its soil, vegetation and snow components) have been key parametrisation elements. In particular, for what concerns the land surface, it can been shown that efforts devoted to the improvement of land surface physics can lead to a more accurate representation of the global water cycle on monthly time-scales and enhance the improvements obtained by the new convection in presence of extreme events.

In order to test and validate land surface revisions at the global scale the framework offered by the Global Soil Wetness Project II (GSWP2) has been of paramount importance. The relative contributions of the soil and snow hydrology revisions on atmospheric state, in particular for temperature, and the predicted river discharge are evaluated against independent datasets showing a significant incremental performance with the land surface updates.

In parallel, land surface data assimilation at ECMWF has moved towards the implementation of analysis schemes based on optimal estimation theory (Optimal Interpolation for snow and land surface temperatures and an Extended Kalman Filter for soil moisture) which makes a better use of the information produced by the model. The new assimilation schemes reduce the magnitude of correction on the land surface hydrological cycle mitigating conservation issues which are proper to any re-analysis.

With the perspectives of a renewed global land surface modelling initiative a new 3-hourly precipitation dataset extracted from the ECMWF Interim Reanalysis (ERA-Interim) has been validated against different precipitation datasets with focus over the conterminous U.S.A and Europe. The results show that, over U.S.A. and Europe, the ERA-Interim precipitation has comparable quality to recent datasets (e.g. GPCP v2.1, PRISM, NCEP-Stage-4, ELDAS) while providing high temporal and spatial resolution features. A scale-selective rescaling procedure that merges the ERA-Interim and the GPCPv2.1 product for reducing large-scale monthly biases while preserving ERA-Interim the fairly high temporal and spatial resolution is applied and it is shown to improve precipitation when validated against independent high resolution datasets.

Finally results of 20-year offline driven simulations with different versions of the ECMWF land surface scheme and ERA-Interim forcing are compared to river discharges World-wide at daily and monthly time-scales. This set of results is informative on the relative merits of the atmospheric forcing and land surface physical improvements in offline simulations of the water cycle. Perspectives offered by future re-analyses at ECMWF will be briefly presented.