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Coupling of the global hydrodynamic CaMa-Flood model with the ECMWF land surface model HTESSEL.

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Rivers are a key component of the land hydrological cycle and are crucial in many societal activities and natural hazards. Historically, hydrological modeling has not been tightly associated with numerical weather prediction (NWP) due to the different communities involved, requirements and underlying processes. The increased skill of NWP has led to the uptake of weather forecasts in hydrological models, in particular for flood forecasting. At the same time, developments of Earth System Models (ESM), mainly driven by the climate community have lead to a tight integration of the land hydrological cycle. River discharge is a key quality indicator of the integrated water budget, and its use as a forecast skill metric of NWP has a large potential. Freshwater input to the ocean is also important for the ocean circulation, which becomes increasingly relevant with the current atmosphere-ocean coupling in NWP. Considering all these points, the representation of rivers and floodplains dynamics and their associated impact on inland water evolution is of interest for a wide range of applications currently addressed by global NWP.

In this study we present the key technical developments to achieve a 1-way and 2-way coupling between the global hydrodynamic CaMa-Flood model and the land surface component of the European Center for Medium-Range Weather Forecasts (ECMWF) HTESSEL. The models coupling followed a single executable strategy, i.e. avoiding external couplers. A coupling interface was developed for CaMa-Flood that is independent from the driving model, while keeping the stand-alone configuration. The coupling is flexible, allowing both models to run at different spatial resolutions. The implementation allows for a flexible integration of the models and independent development, and can be applied to other models.

The current representation of inland water bodies in HTESSEL (lakes) was driven by their impact in NWP, but without the representation of rivers it was not possible to have a consistent water budget. The coupling of CaMa-Flood allows for an integrated earth system model approach. Several options for the 2-way interaction between CaMa-Flood flooded areas in HTESSEL inland water bodies were investigated. Despite the consistent results, several challenges are identified in the representation of inland water bodies, their variability and impact on water cycle.