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# A meteo-hydrological modeling study for flood events in the Ofanto river catchment

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The aim of this study is to evaluate the capability of our meteo-hydrological modeling system to simulate the local water cycle of the Ofanto river catchment.

The basin of the Ofanto River, flowing through the Southern Italy and ending into the Adriatic Sea, is chosen as a challenging case study to test the modeling chain since the Southern Italy is known to be a region subject to flash flood events (Delrieu et al, 2005; Davolio et al, 2008; Miglietta et al., 2008). Moreover the Ofanto River is a semi-perennial river, its annual averaged discharge is low (15 $m^3s^{-1}$following Raicich, 1996) but may significantly increase when heavy rain events occur.

We select the first 3 months of 2011 as model time window since 4 heavy rain events characterized this period with flooding of the Ofanto River during two of them.

The meteo-hydrological chain consists of: WRF-ARW model (Skamarock et al., 2008) for the atmospheric modeling, NOAH-MP Land Surface Model (Niu et al., 2011) which describes the vertical physics of the soil column up to 1m below the ground-level, and WRF-Hydro model (Gochis D., et al., 2013) which enables to model the lateral soil surface and subsurface water fluxes and is coupled in 1-way mode with WRF and 2way-mode with NOAH-MP.

We have assessed which model tunable parameters, numerical choices and forcing data most impact the performance of our integrated modeling system and have determined an optimal set-up of our meteo-hydrological modeling chain that fully captures the observed heavy rain events and the related river floods. The skill was assessed with respect to available observations of precipitation and river runoff relying on more than 100 raingauge stations and 2 hydrological stations along the river network.

The sensitivity results show positive impacts of higher resolution and upgraded land use categories, soil types and topography data on hindcast simulations. It is also found that the tunable parameters of soil infiltration, conductivity and deep drainage as well as the coefficients of aquifer recharge-discharge law play an important role on the capability to reproduce the river streamflow discharge. Additionally we examined how a more detailed description of overland and subsurface waterflow carried out by WRF-Hydro impacts the representation of surface water and energy fluxes with respect to the standard column-only soil modeling approach of NOAH LSM.

Regarding the atmospheric model performance not surprisingly it is found to be strongly sensitive to the details of mesoscale initialization and that the model skill deteriorates when the severe weather systems show patterns on very local scales.

Overall, the integrated modeling system shows promise for skilled prediction of rainfall and discharge peaks in terms of timing, amount and localization, for the warning purpose.