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An assessment of soil moisture in the MARINE flash flood model using in situ measurements, reanalysis and satellite derived estimates

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The representation of soil moisture is a key factor for the simulation of flash flood in the Mediterranean region. The MARINE hydrological model is a distributed model dedicaded to flash flood simulation. Recent developments of the MARINE model lead to an improvement of the subsurface flow representation : on the one hand, the transfers through the subsurface take place in a homogeneous soil column based on the volumic soil water content instead of the water height. On the other hand, the soil column is divided into two layers, which represent respectively the upper soil layer and the deep weathered rocks. The aim of this work is to assess the performances of these new representations of the subsurface flow with respect to the soil saturation dynamics during flash flood events. The performances of the model are estimated with respect to three soil moisture products: i) the gridded soil moisture product provided by the LDAS-Monde assimilation chain. LDAS-Monde is based on the ISBA-a-gs land surface model and integrates high resolution spatial remote sensing data from the Copernicus Global Land Service for vegetation through data assimilation; ii) the upper soil moisture measurements taken from the SMOSMANIA observation network ; iii) The satellite derived surface soil moisture data from Sentinel1. The case study is led over two french mediterranean catchments impacted by flash flood events over the 2017-2019 period and where one SMOSMANIA station is available. Additionnal tests for the initialisation of MARINE water content for the two soil layers are assessed. Results show first that the dynamic of the soil moisture both provided by LDAS-Monde and simulated for the upper soil layer in MARINE are locally consistent with the SMOSMANIA observations. Secondly, the use of soil water content instead of water height to describe lateral flows in MARINE is cleary more relevant with respect to both LDAS-Monde simulations and SMOSMANIA stations. The dynamic of the deep layer moisture content also appears to be consistent with the LDAS-Monde product for deeper layers. However, the bias on these values strongly rely on the calibration of the new two-layers model. The opportunity of improving the two-layers model calibration is then discussed. Finally, the impact of the soil water content initialisation is shown to be significant mainly during the flood rising, and also to be dependent on the model calibration. In conclusion, the new developments presented for the representation of subsurface flow in the MARINE model appear to enhance the soil moisture simulation during flash floods, with

respect to both the LDAS-Monde product and the SMOSMANIA observation network.