

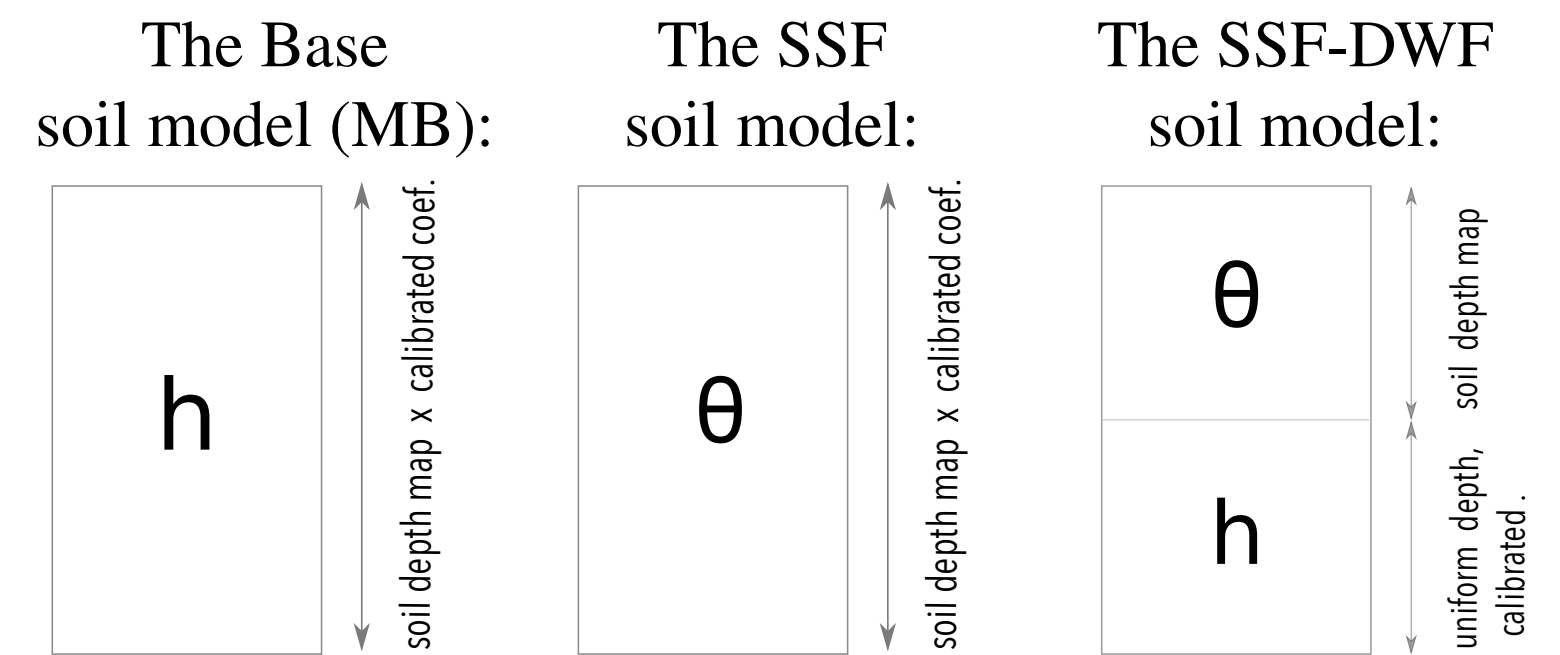
A multi-sourced assessment of the spatio-temporal dynamic of soil saturation in the MARINE flash flood model

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Introduction

The MARINE hydrological model [8] is a distributed model dedicated to flash flood simulation. Recent developments of the MARINE model are presented by [4]: on the one hand, the transfers through the subsurface take place in a homogeneous soil column based on the volumetric soil water content θ instead of the water height h (**SSF model**). On the other hand, the soil column is divided into two layers, which represent respectively the upper soil layer and the deep weathered rocks (**SSF-DWF model**). **The aim of this work is to assess the performances of these new representations for the simulation of soil saturation during flash flood events.**



Data and methods

The performances of the model are estimated with respect to several soil moisture products, either at the local scale or spatially extended:

1. The gridded soil moisture product provided by the operational modeling chain **SAFRAN-ISBA-MODCOU (SIM)** [6] at the daily time step and at the 8-km resolution.
2. The gridded soil moisture product provided by the **LDAS-Monde assimilation chain** [1], based on the ISBA-a-gs land surface model and assimilating high resolution spatial remote sensing data. LDAS-Monde is available at the hourly time step and at the 2.5-km resolution.
3. The upper soil moisture hourly measurements taken from the **SMOSMANIA observation network** [2];
4. The **Soil Water Index (SWI)** provided by the **Copernicus Global Land Service (CGLS)**, derived from Sentinel1/C-band SAR and ASCAT satellite data, at the daily time step and at the 1-km resolution.

The case study is led over two french Mediterranean basins impacted by flash flood events over the 2017-2019 period and where one SMOSMANIA station is available. The ANTILOPE QPE [7], a fusion between radar data and pluviometric measurements, is used for the model precipitation input. The calibrations of MARINE proposed by [5] and [3] are used. Soil moisture is initialized with the SIM data.

Results

The local comparison of the MARINE outputs with the SMOSMANIA measurements, as well as the comparison at the basin scale of the MARINE outputs with the gridded LDAS-Monde and CGLS data lead to the same conclusions: the dynamics as well as the amplitudes of the soil moisture simulated with the SSF and SSF-DWF models are better correlated with both the SMOSMANIA measurements and the LDAS-Monde data than the outputs of the base model. The emptying of the soil column in the base model is faster than in the SSF and SSF-DWF models. For the SSF-DWF model, the simulation of the deep layer moisture content strongly relies on the deep layer calibration. The two-layers model calibration could then be further investigated.

Figure 2: Local comparison of the MARINE simulated soil moisture with the SMOSMANIA measurements.

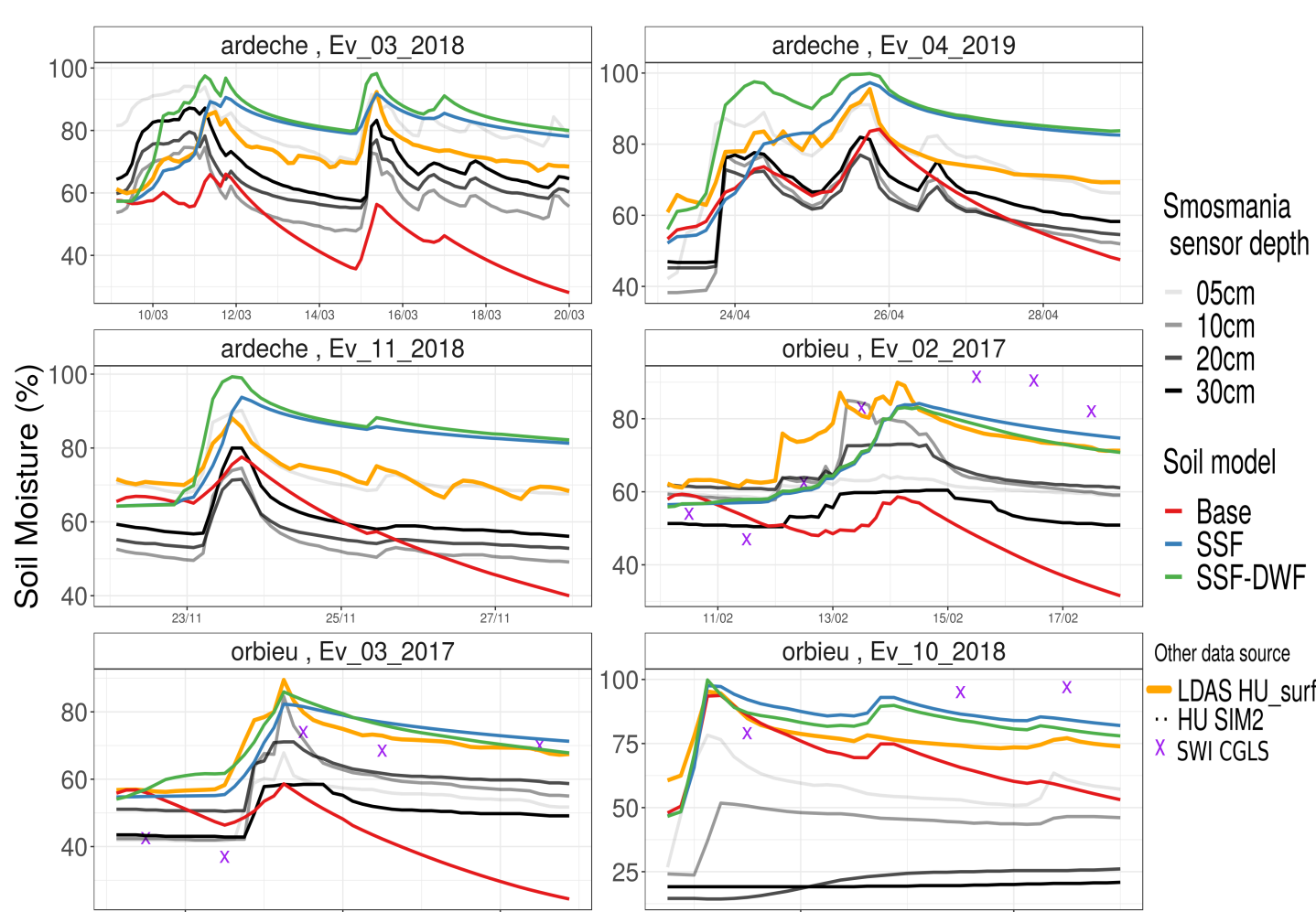


Figure 3: Comparison at the basin scale of the MARINE simulated soil moisture with LDAS-Monde and CGLS gridded products.

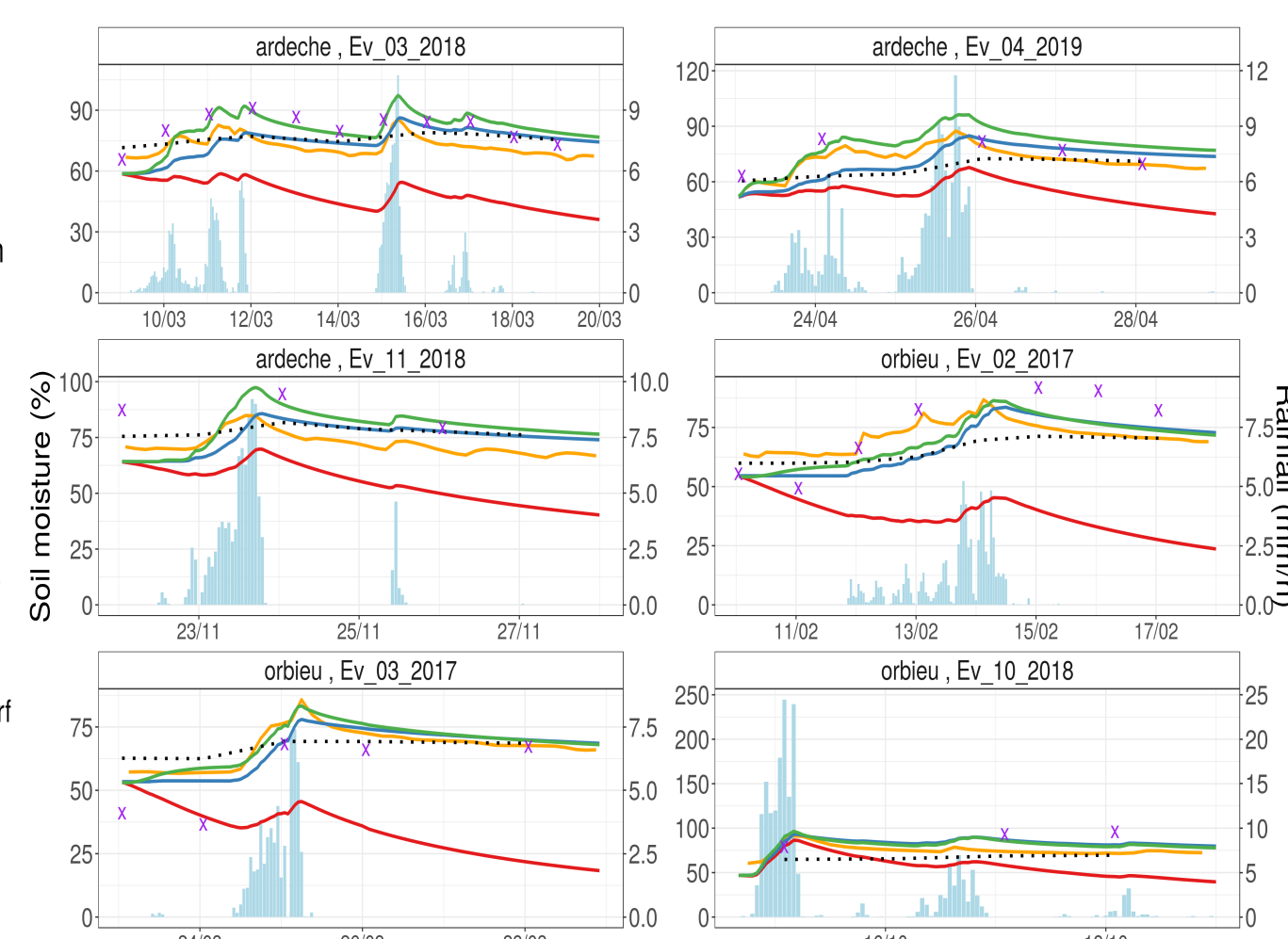
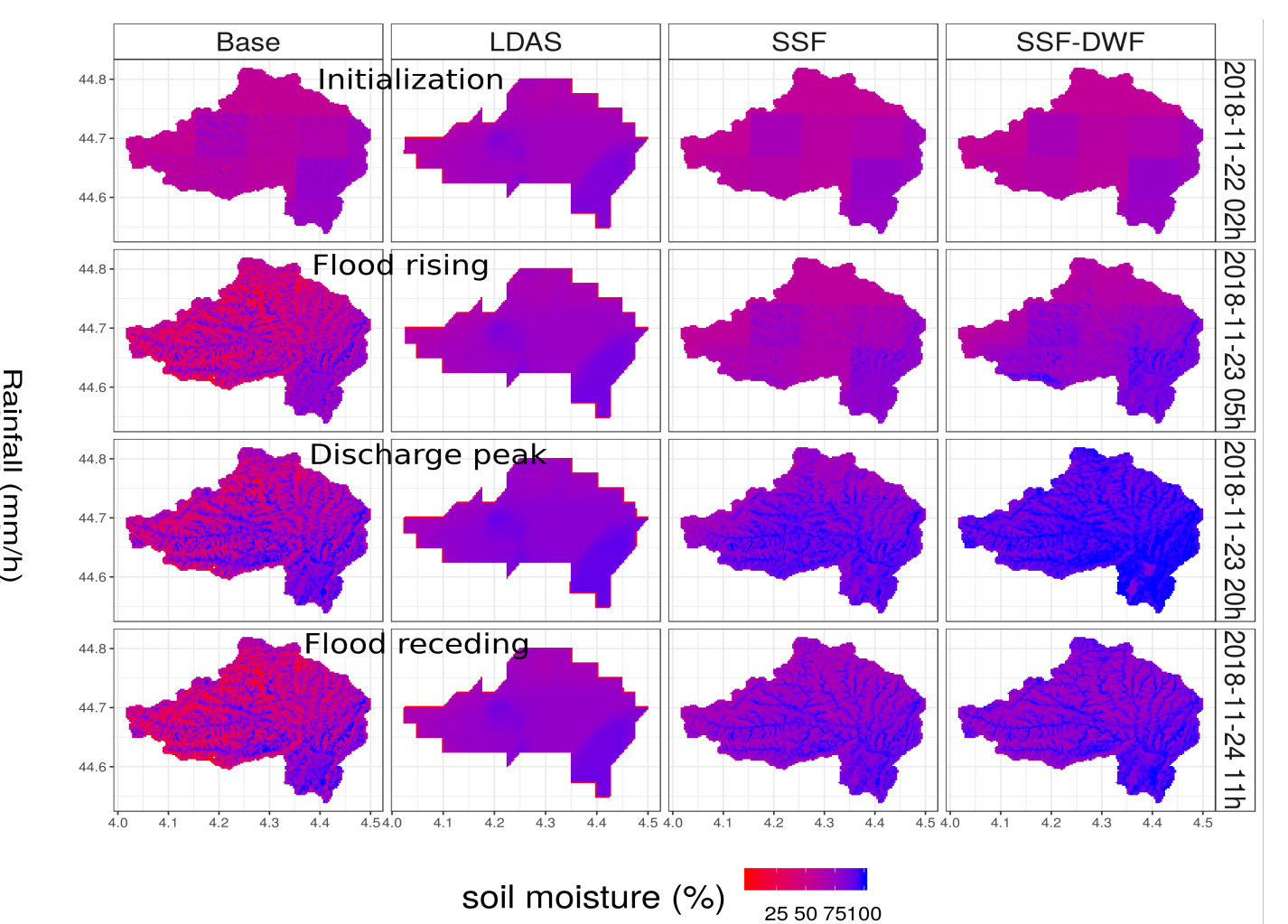


Figure 4: Soil moisture maps for all of the studied data sources. Case of the November, 2018 event over the Ardeche basin.



Conclusions and forthcoming research

- The SSF and the SSF-DWF models allow to improve the soil moisture simulation for surface layers, at the local scale (comparison with Smosmania), as well as at the basin scale (comparison with gridded products: LDAS-Monde and CLGS data).
- Additional data about underground water would be necessary to validate the simulated moisture of the deep layer in the SSF-DWF model.
- The opportunity of improving the SSF-DWF model calibration for discharge simulation is investigated, in particular by considering the geomorphological characteristics of the basins.

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