The H SAF H64 soil moisture-precipitation integrated product: development and preliminary results

Luca Ciabatta[1], Christian Massari[1], Giulia Panegrossi[2], Anna Cinzia Mara[2], Paolo Filippucci[1], Daniele Casella[2], Paolo Sanò[2], Stefano Dietrich[2], Davide Melfi[3], Luca Brocca[1]

[1] Research Institute for Geo-hydrological Protection, National Research Council, Perugia, Italy; [2] Institute of Atmospheric Sciences and Climate, National Research Council, Rome, Italy; [3] COMET, Italian Air Force, Pratica di Mare, Italy

1. Introduction

State-of-the-art satellite rainfall products are often the only way for estimating precipitation in remote areas of the world. However, it is well known that they may fail in properly reproducing the amount of precipitation reaching the ground, which is of paramount importance for hydrological applications (natural hazards forecast and mitigation, water management). With the purpose of improving the accuracy of satellite rainfall products, an approach using satellite soil moisture (SM) data, called SM2RAIN was recently developed. Through the EUMETSAT Satellite Application Facility on Support to Operational Hydrology and Water Management (H SAF), the SM2RAIN approach together with the MW-based rainfall product H23 are the scientific background for the development of the H64 rainfall-soil moisture integrated product. The integration of rainfall estimates derived from MW-based precipitation-SM products is expected to be highly beneficial for increasing the accuracy of satellite precipitation estimates by overcoming intrinsic limitations of precursors SM-only and PMW-only rainfall estimates.

2. The datasets

The datasets used are:

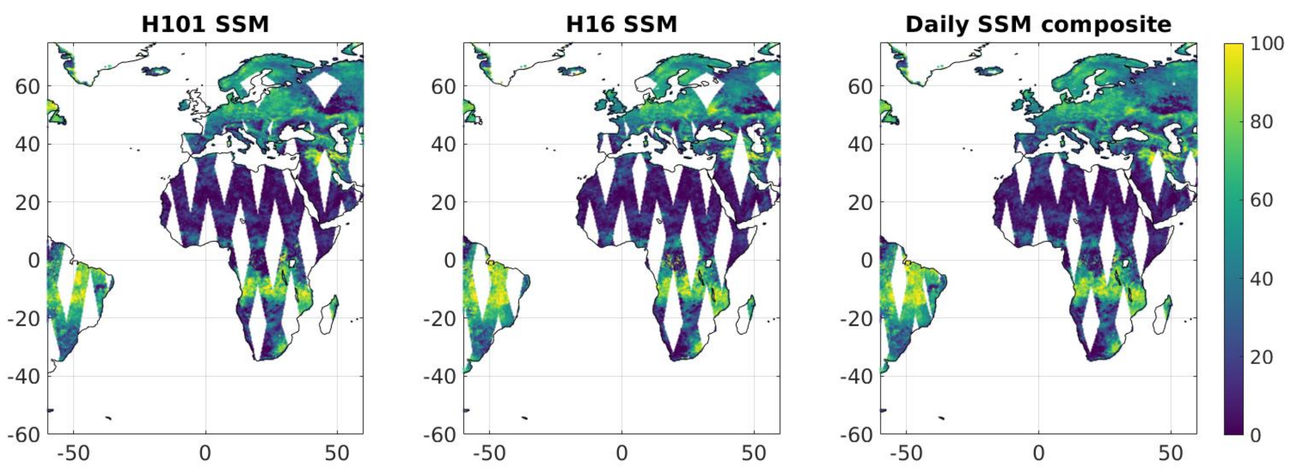
- **H23 MW-based rainfall product** at 0.25°-daily spatial/temporal resolution developed by ISAC-CNR and provided within the H SAF project. The product is based on the merging of PMW rainfall rates derived from conical and cross-track scanning radiometers.
- **H101 and H16 SM products** at 12.5 km of spatial sampling developed by TU WIEN and provided within the H SAF project. In order to estimate rainfall, all the available data within one day are considered.

The H64 rainfall dataset will be provided over the MSG full disk.

3. Methodology

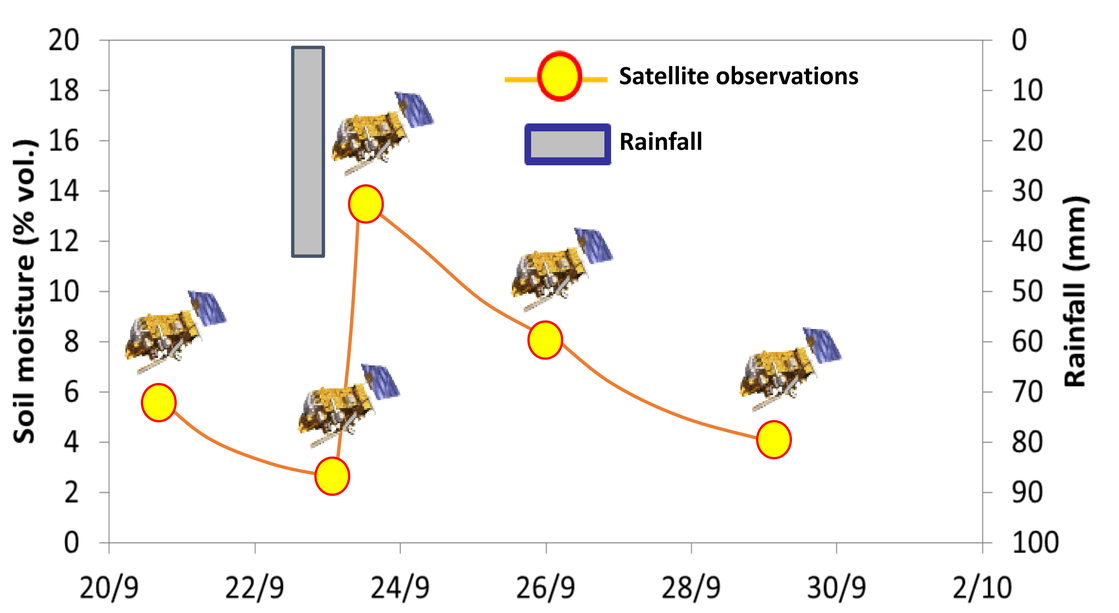
STEP 1 – SM data preprocessing:

All the available SM data are remapped over a common grid in order to obtain a daily SM composite over the study area.



STEP 2 – SM2RAIN application:

The SM2RAIN algorithm (Brocca et al., 2014) is applied to the SSM observations in order to obtain rainfall through the following equation:



The SM2RAIN parameters are obtained through calibration during the period 2013-2018 against ERA5 reanalysis dataset. In this phase a remapping over the H23 grid (0.25°) is performed.

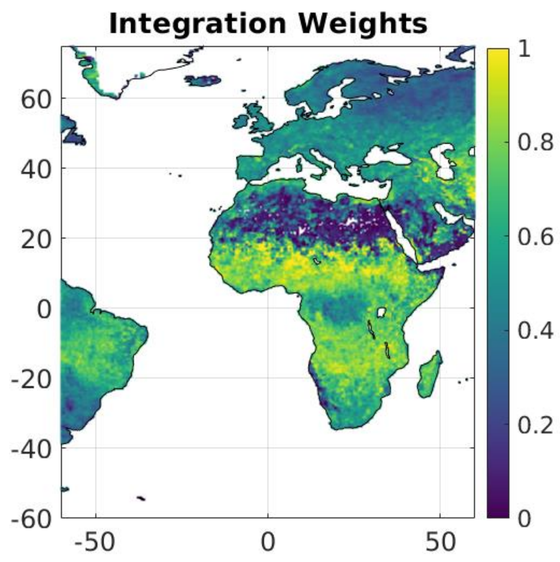
STEP 3 – integration scheme:

The integration between SM2RAIN-derived rainfall and H23 estimates is carried out by a simple nudging scheme, described by the following equation:

$$P_{H64} = P_{SM2RAIN} + W(P_{H23} - P_{SM2RAIN})$$

The integration weights (W) are computed after a Triple Collocation analysis (Massari et al., 2017) applied to the parent products and a benchmark, ERA5 in this case. W are estimated through the following equation:

$$W = \frac{\rho_{1R} - \rho_{12}\rho_{2R}}{\rho_{2R} - \rho_{12}\rho_{1R} + \rho_{1R} - \rho_{12}\rho_{2R}}$$



4. Preliminary results

Tropical Cyclone Idai started as an intense tropical depression off the coast of Mozambique at the beginning of March, 2019. After making landfall over Mozambique it turned back over the Mozambiqua Chanel and strengthened to become a tropical cyclone on the 10th of March