How to use global soil moisture products to estimate antecedent soil wetness conditions for flood modelling in a semi-arid region?

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Intense rainfall events lead up to devastating floods in the Mediterranean region. In Maghreb countries such as Morocco, there is a severe need to flood forecasting systems to mitigate their effects. It is challenging to develop such a system for ungauged catchments. However, remote-sensing products could compensate for the lack of observed data. The soil moisture content can significantly modify the magnitude of flood events and is, therefore, an essential component for flood modelling. In this study, different soil moisture products (ESA-CCI, SMOS, SMOS-IC, ASCAT, and ERA5 reanalysis) are evaluated against in situ measurements and one continuous soil-moisture-accounting. The results indicate that the SMOS-IC satellite product and the ERA5 reanalysis have the strongest correlations with observed soil moisture and SMA model outputs. Comparing the various soil moisture datasets allowed the estimation of the initial soil moisture condition for an event-based hydrological model using the Soil Conservation Service Curve Number (SCS-CN). The ASCAT, SMOS-IC, and ERA5 products behaved equally well in validation to simulate floods, outperforming daily in-situ soil moisture data that may not be truly representative of catchment soil moisture conditions. Due to the faster depletion of soil moisture after precipitation in these semi-arid areas, the daily time step may not properly reflect the saturation condition immediately before a flood occurrence. ERA5 and in situ data were found to better represent the initial soil moisture conditions of the SCS-CN model at the hourly time step compared to the daily time step. This research could be employed to construct effective flood modelling and forecasting systems in semi-arid countries where soil moisture observations are unavailable. The ASCAT, SMOS-IC, and ERA5 products performed equally well in validation to simulate floods, outperforming daily in situ soil moisture measurements that may not be representative of the whole catchment soil moisture conditions.