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Flood modelling and forecasting in the High-Atlas of Morocco

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In Southern Mediterranean countries, there is a growing interest to develop flood forecasting methods to reduce the impacts of floods. In Morocco, some basins have recently been equipped with real-time monitoring and alert systems, such as those located upstream of the city of Marrakech in the High-Atlas mountains. This region is characterized by very steep slopes, altitudes up to 4167 m and strong rainfall variability. The purpose of this work is first to simulate floods with event-based rainfall-runoff models and then to validate quantitative precipitation forecasts provided by the AROME and ALADIN-ALBACHIR meteorological models, with different lead times from 24h to 72h. The ALADIN-ALBACHIR model provides forecasts since 1996 with a 10 km spatial resolution, while the AROME model is in service since 2014 and has a horizontal resolution of 2.5 km. Both models have been re-run in reanalysis mode for the sample of floods events considered. The evaluation is based on a set of 20 floods events with hourly precipitation and discharge for three catchments with different size and altitude: the Rheraya (225 km^2) and Ourika (500 km^2) catchments with maximum altitude above 4000 m and the Issyl catchment (125 km^2), near Marrakech, with altitudes lower than 2000 m. Hydrological modelling results with different model structures indicated that lumped and distributed approaches provided similar results and reproduced well the sample of flood events. However, the distributed model provided the best estimation of the initial soil moisture conditions, estimated from the ESA-CCI satellite soil moisture product and the Antecedent Precipitation Index. Then, the simulations of the AROME and ALADIN-ALBACHIR models have been compared with observed precipitation over the basins. The newest AROME model is outperforming ALADIN-ALBACHIR, with respectively an average bias of -5% and -38.5%. These results open valuable perspectives for the implementation of flood forecasting models in these vulnerable basins.