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Comparison of flood modeling approaches in semi-arid Mountainous catchments (High-Atlas, Morocco)

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Abstract: In semi-arid regions such as the Mediterranean basin, floods usually represent a large contribution to water resources. In addition, climate scenarios indicate a possible increase in extreme events in the Mediterranean region. Therefore, it is necessary to model floods to better understand the processes involved and predict these risks. The Moroccan catchments flowing downstream of the High-Atlas Mountains are among the areas most vulnerable to flooding. The Issyl catchment (170km²) is located at the foothills of the High Atlas Mountains, with altitudes ranging from 632 to 2295m, and producing floods that directly affect the city of Marrakech. The Rheraya catchment is a mountainous basin with altitudes ranging from 1000m to 4165m, and affected by violent floods that constitute a threat for the villages located in low elevation areas. This paper compares the efficiency of two model structures, based either on the Soil Conservation Service - Curve Number (SCS-CN) method or the Green and Ampt model. In addition, the comparison is also performed using global and semi-distributed model structures to account for the spatial variability of rainfall. A total of 21 flood events that occurred between 2008 and 2014 were tested for the two watersheds. The results of the global approach show a good reproduction of the maximum discharge with both models, but the flood volume are not adequately reproduced for the Rheraya catchment. The results of the semi-distributed approach show a clear improvement for several events, with better Nash criterion values on average with the SCS-CN model. In conclusion, we found that the Green and Ampt model outperforms the SCS-CN model in global mode, and it is the opposite in semi-distributed mode. Since the parameters of the Green-Ampt model can be successfully approximated using soil information, this model appears adequate for climate changes studies or real time flood forecasting.

Keywords: Flood modeling, SCS-CN, Green and Ampt, High-Atlas