

Comparison of flood forecasting approaches over High Atlas Mountains basins in Morocco

El Mahdi El Khalki¹, Yves Tramblay², Arnau Amengual³, Victor Homar³, Romualdo Romero³, Mohamed El Mehdi Saidi¹ and Meriem Alaouri⁴

1 Georesources, Geoenvironment and Civil Engineering Laboratory, Cadi Ayyad University, Marrakesh, 40000, Morocco

2 HydroSciences Montpellier (Univ. Montpellier, CNRS, IRD), 34000 Montpellier, France

3 Grup de Meteorologia, Departament de Fisica, Universtat de les Illes Balears, 07001 Palma de Mallorca, Spain

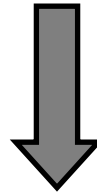
4 The Department of National Meteorology (DMN), 20000 Casablanca, Morocco

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■ Context

The rainfall events can be intense in the Moroccan High Atlas Mountains, generating flash flood events causing deaths and damages



Necessity to develop a forecasting system

Objectives:

Evaluation of three meteorological models (AROME, ALADIN and WRF)

Comparison between regression method and SCS-Clark model



■ Study Basins

Rheraya (225km²):

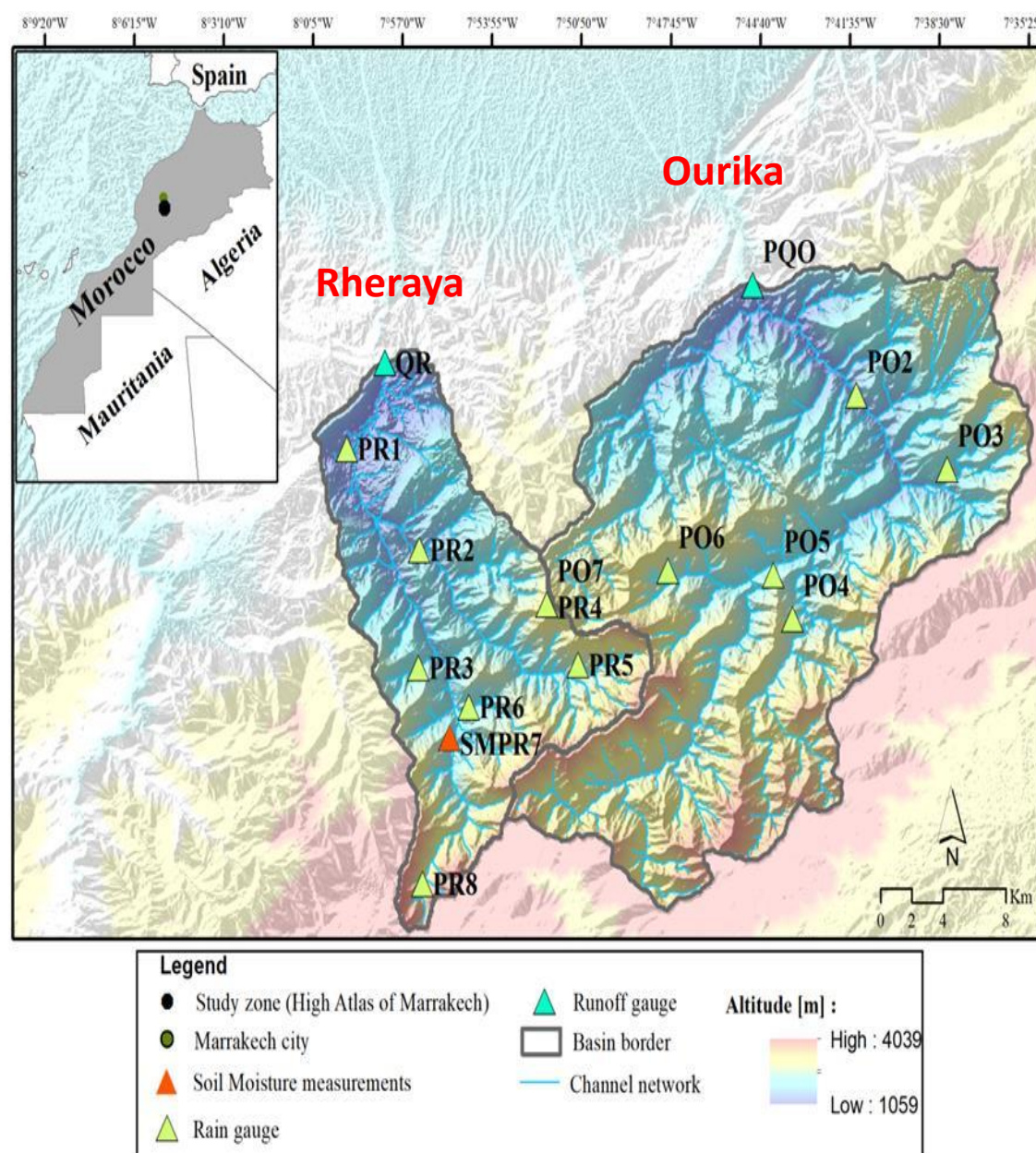
8 rain gauges
1 discharge station

13 flood events with Qmax between
7.64 & 103.4 m³/s

Ourika (503km²):

7 rain gauges
1 discharge station

7 flood events with Qmax between
22.3 & 424.3 m³/s



Methods

1. Evaluation of rainfall amounts between observed and forecasted precipitation using a contingency table with 3 thresholds (10, 20 and 30mm)
2. Calibration of SCS-Clark model in HEC-HMS
3. Correlation between observed rainfall amount, maximum discharge and soil moisture => multiple linear regression to estimate peak discharge (GLS Regression)

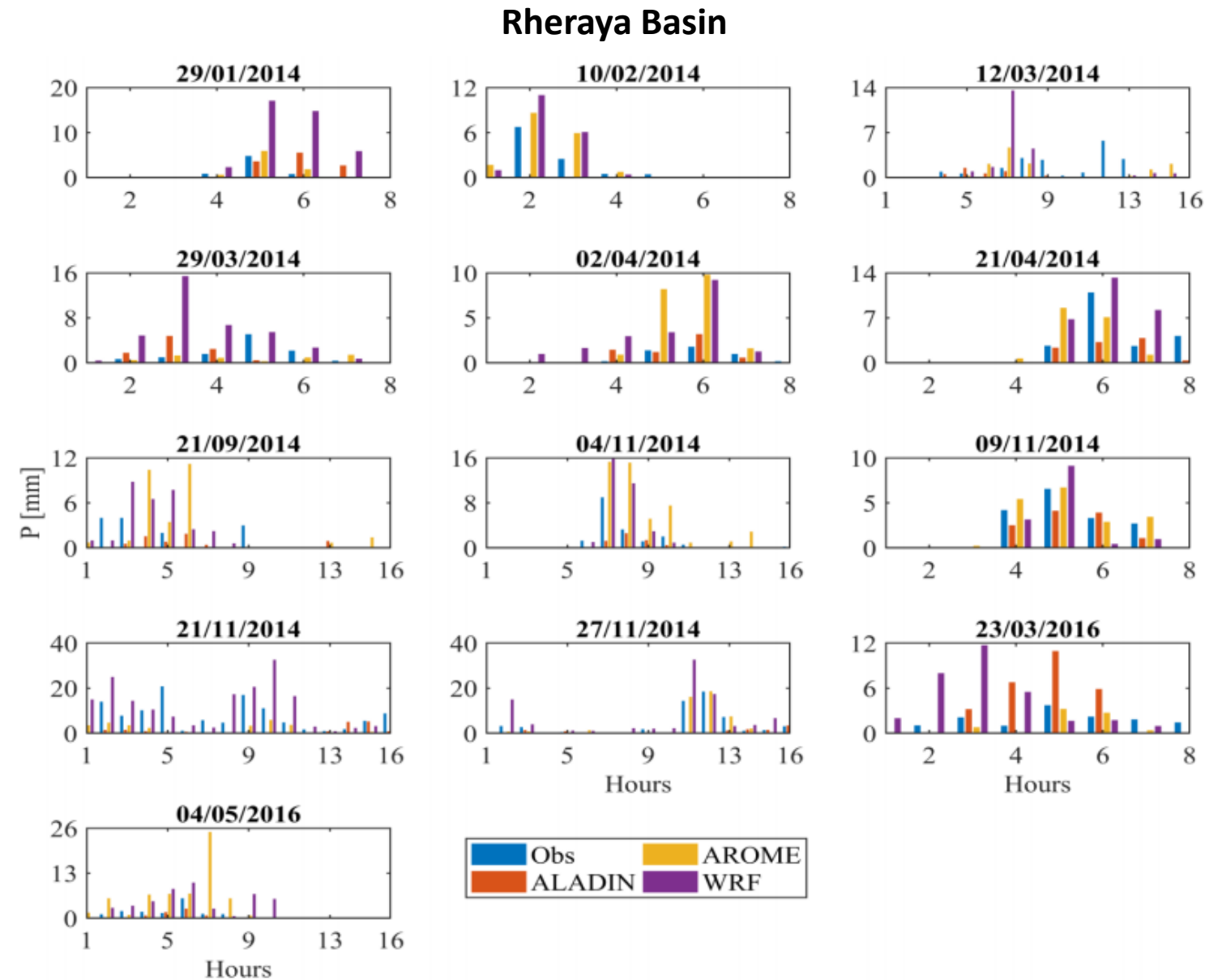
Three Soil moisture data for antecedent moisture conditions:

- In-Situ
- ESA-CCI
- ERA5

Each soil moisture data has its equation (3 equations/basin)

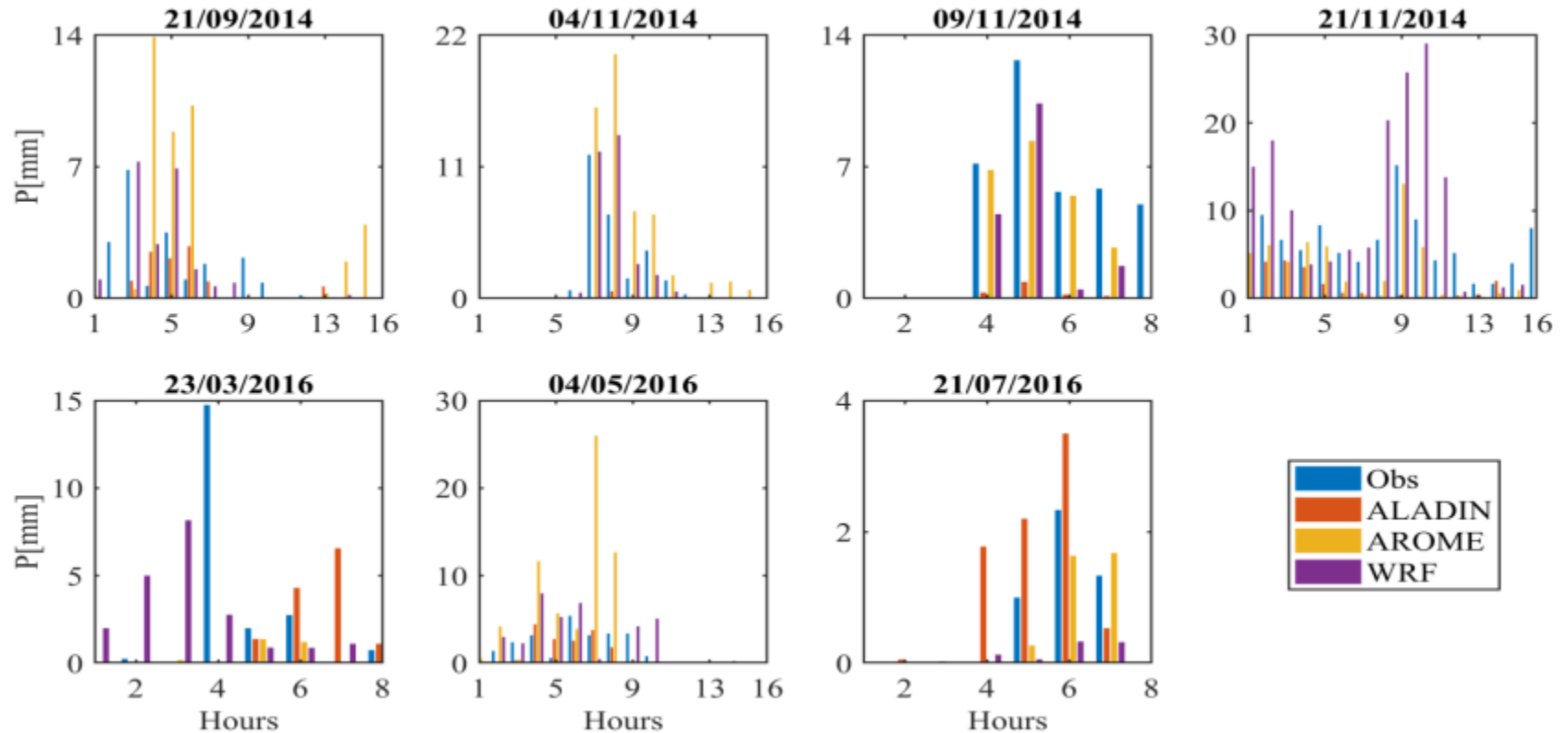
4. We replaced the observed rainfall with forecasted rainfall for the SCS-Clark and regression models
5. Comparison of the two approaches to flood forecasting (SCS-Clark and Regression)

■ **Results : Comparison between Observed/Forecasted precipitation**



- Results : Comparison between Observed/Forecasted precipitation

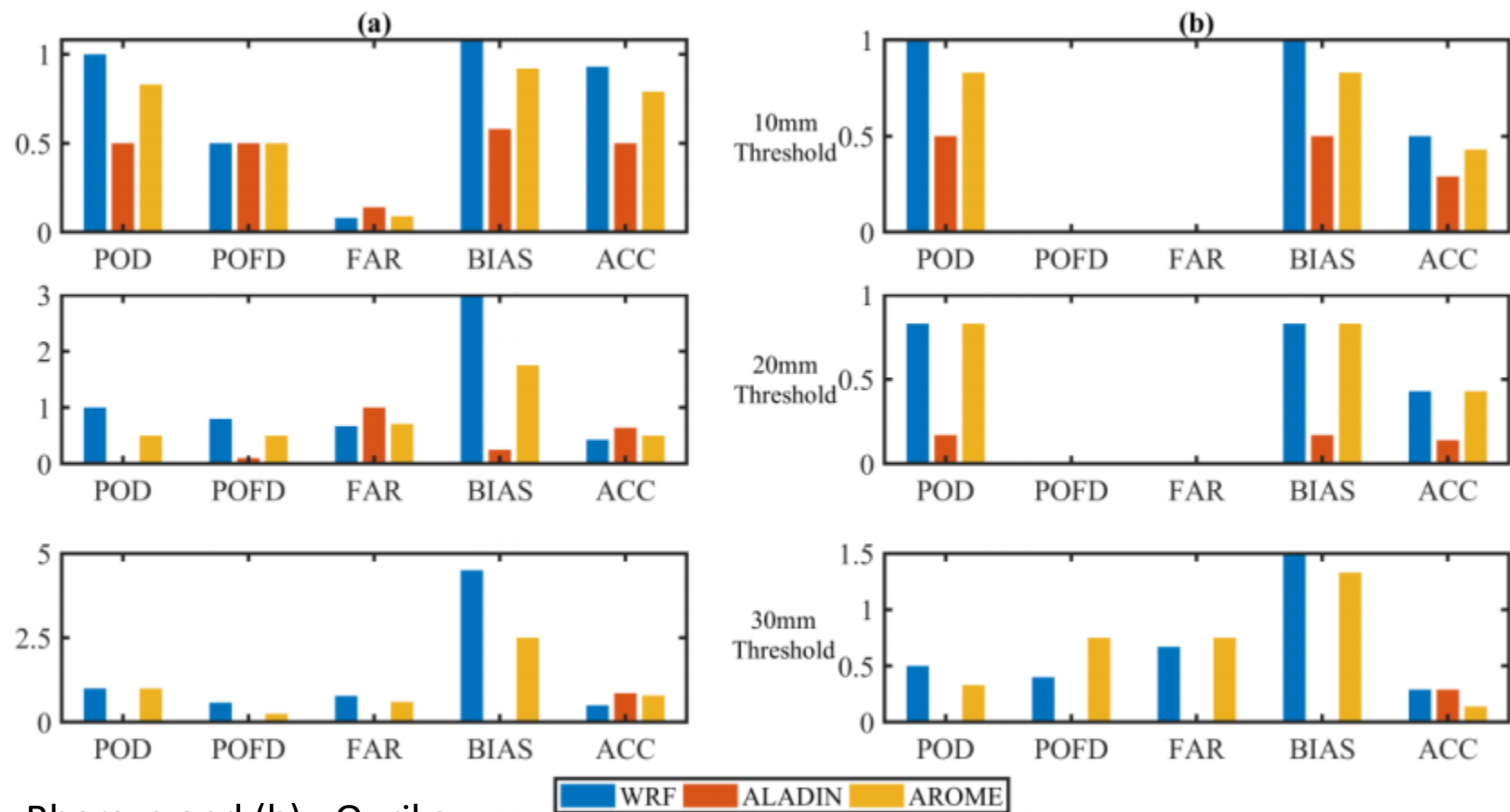
Ourika Basin



Comparison		
AROME	ALADIN	WRF
+24%	-64%	-2.6%

Meteorological models with high resolution allowing convection are best suited to the study area

■ Results : Comparison between Observed/Forecasted precipitation



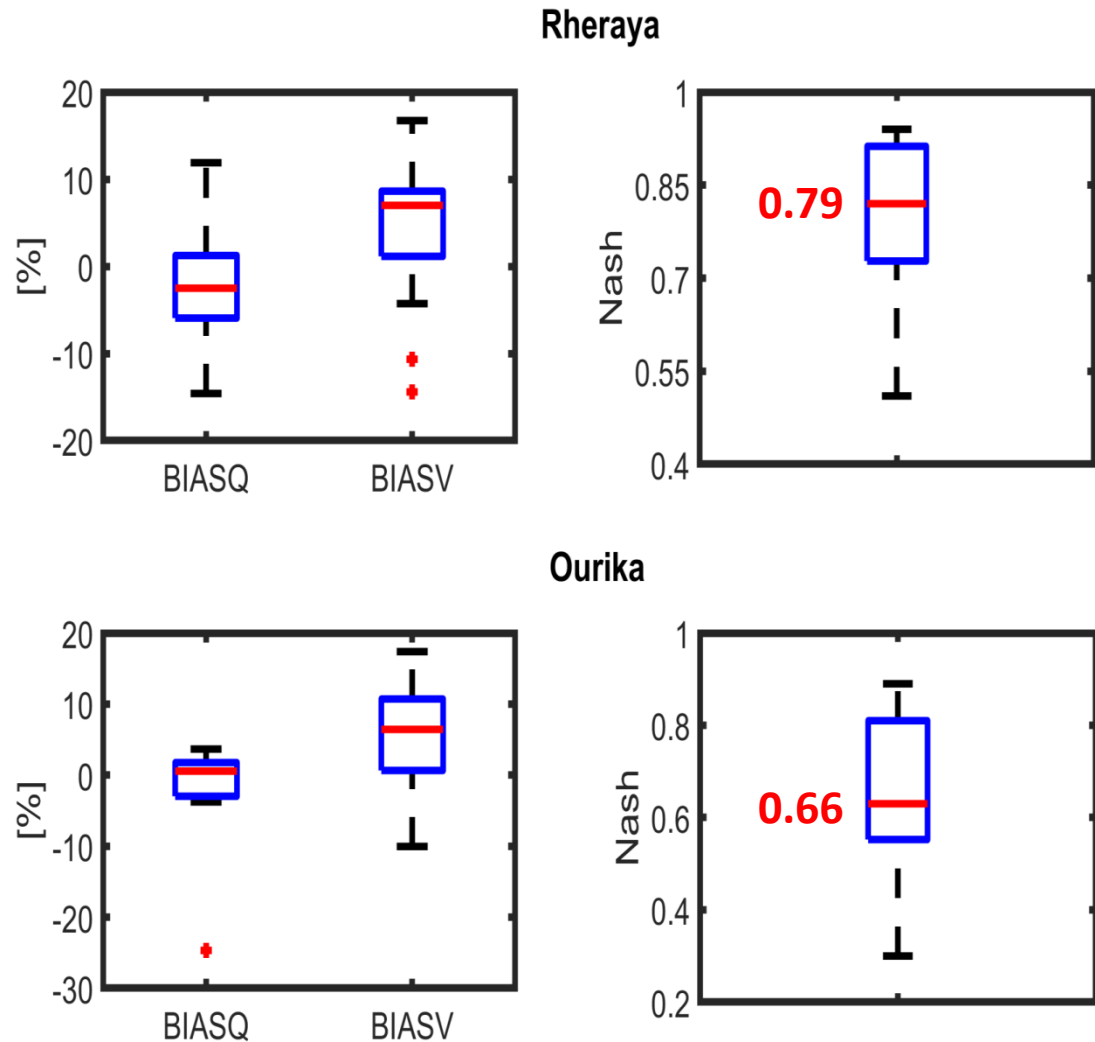
(a) : Rheraya and (b) : Ourika

- WRF and AROME have a $BIAS > 0$ which is due to the overestimation of rainfall. The ALADIN model generally under-estimates total rainfall amounts over the two basins.
- The ACC indicates that forecasts based on smaller thresholds are generally more in agreement with the observed amounts of rainfall.

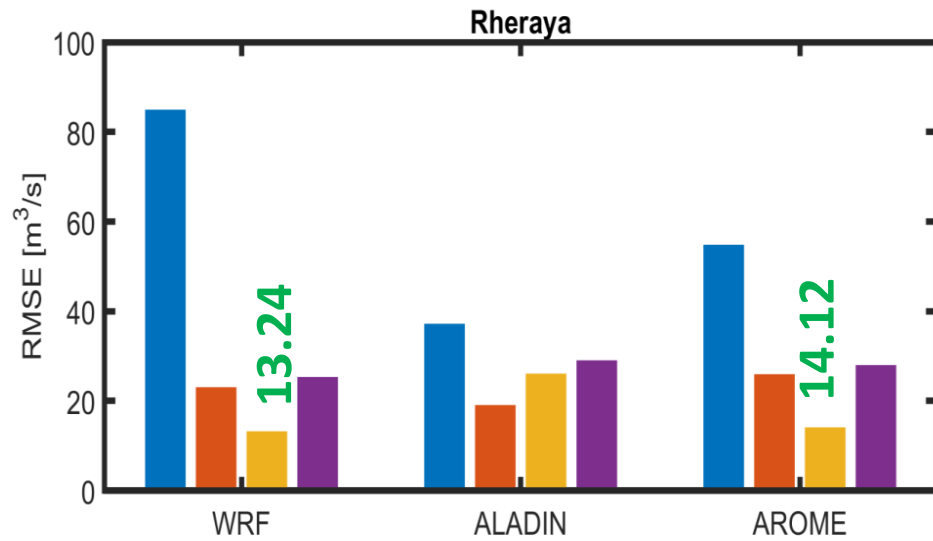
■ Results : Calibration of SCS-Clark model

The SCS-Clark model is
considered as a
benchmark

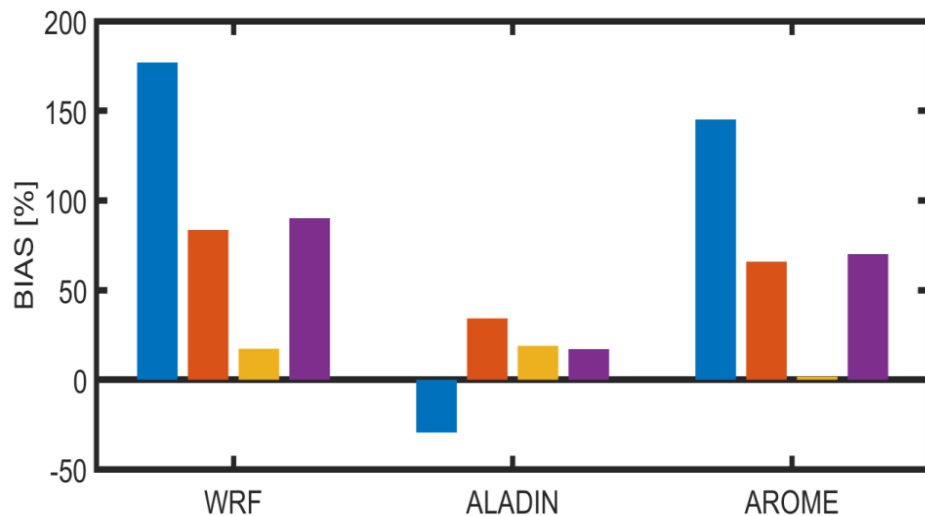
Forecasted rain replaces the
observed rain for the SCS-
Clark and regression
models.



■ Results : Comparison between SCS-Clark and regression models



SCS-Clark model
overestimate the
maximum discharge

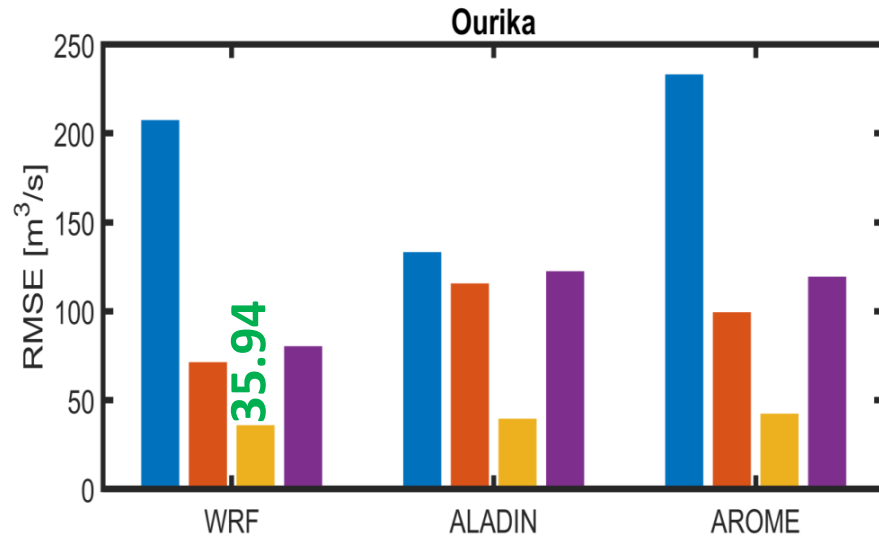


The combination **WRF-ERA5** &
AROME-ERA5 give good results in
terms of **RMSE**.

The combination **AROME-ERA5**
gives good results in terms of Bias
on **maximum discharge**

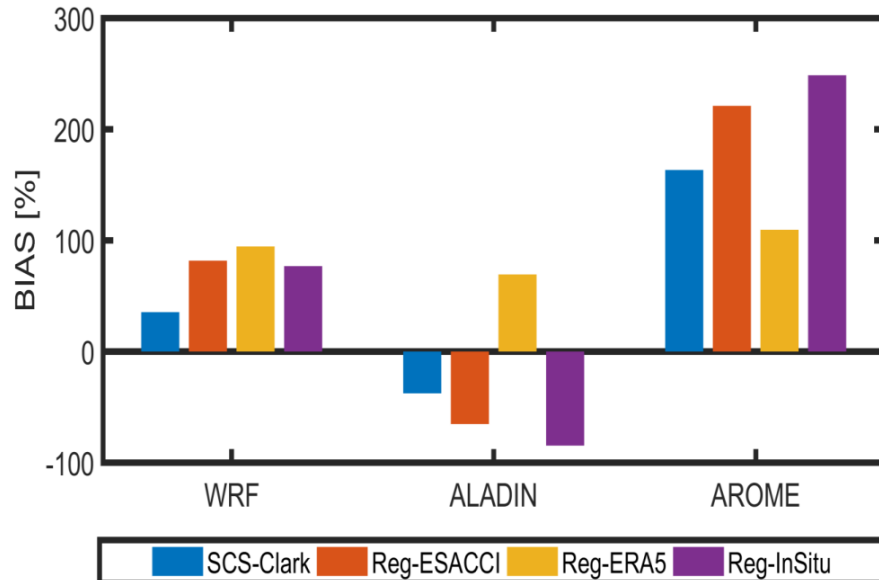


■ Results : Comparison between SCS-Clark and regression models



The two methods show an overestimation of maximum discharge

The combination **WRF-ERA5** gives low values of RMSE



The **regression** method gives better results than the hydrological model (**SCS-Clark**)

■ Conclusion

- ✓ AROME and WRF models overestimate the observed rainfall in the two basins, probably to the under catch of snow amounts by rain gauges
- ✓ The regression model performs better than the hydrological model in flood forecasting by using the combination WRF-ERA5 and AROME-ERA5.
- ✓ The forecast result is strongly by the choice of the soil moisture data source to estimate the antecedent soil moisture conditions before flood events

■ Recent publications:

El Khalki, E.M, Tramblay, Y., Amengual, A., Homar, V., Romero, R., Saidi, M.E.M., Alaouri, M., 2020. Validation of the AROME, ALADIN and WRF models for flood forecasting in Morocco, Water, 12(2), 437, <https://doi.org/10.3390/w12020437>

El Khalki, E.M, Tramblay, Y, Massari, C, Brocca, L, Simonneaux, V, Gascoin, S, and Saidi, M.E.M. (2020) , “Challenges in flood modeling over data-scarce regions: how to exploit globally available soil moisture products to estimate antecedent soil wetness conditions in Morocco”. Natural Hazards and Earth System Sciences, 20, 2591–2607, <https://doi.org/10.5194/nhess-20-2591-2020>