Uncertainty Assessment of Radar Rainfall Estimates on Streamflow Simulation - an Application in Southern Brazil

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INTRODUCTION

The performance of hydrological forecast models depends on the reliability and availability of real-time precipitation data. Due to its high spatial-temporal resolution, the availability of radar precipitation estimates is an option as an additional tool for monitoring and as input of hydrological forecast models. However, radar rainfall estimates have errors associated, for example: echoes from the local topography, conversion of reflectivity in precipitation rate (e.g., Z-R relationship), among others.

In this context, we evaluated the use of radar ensemble precipitation estimates generated through the errors associated with its measure, and as a tool in streamflow simulation. To achieve this goal, we calibrated the MHD-INPE hydrological model using raingauge data over upper Iguaçu Basin in Brazil. Then we used the Two Dimensional Satellite Rainfall Error Model (SREM2D), developed by Hossain and Anagnastou (2006), to simulate the error propagation of the radar precipitation estimation. This model quantified the error in space, time, and magnitude.

DATA AND METHODOLOGY

- Rain gauges
- Radar estimates of rainfall
- Hourly temporal resolution
- Spatial resolution 0,04º x 0,04º

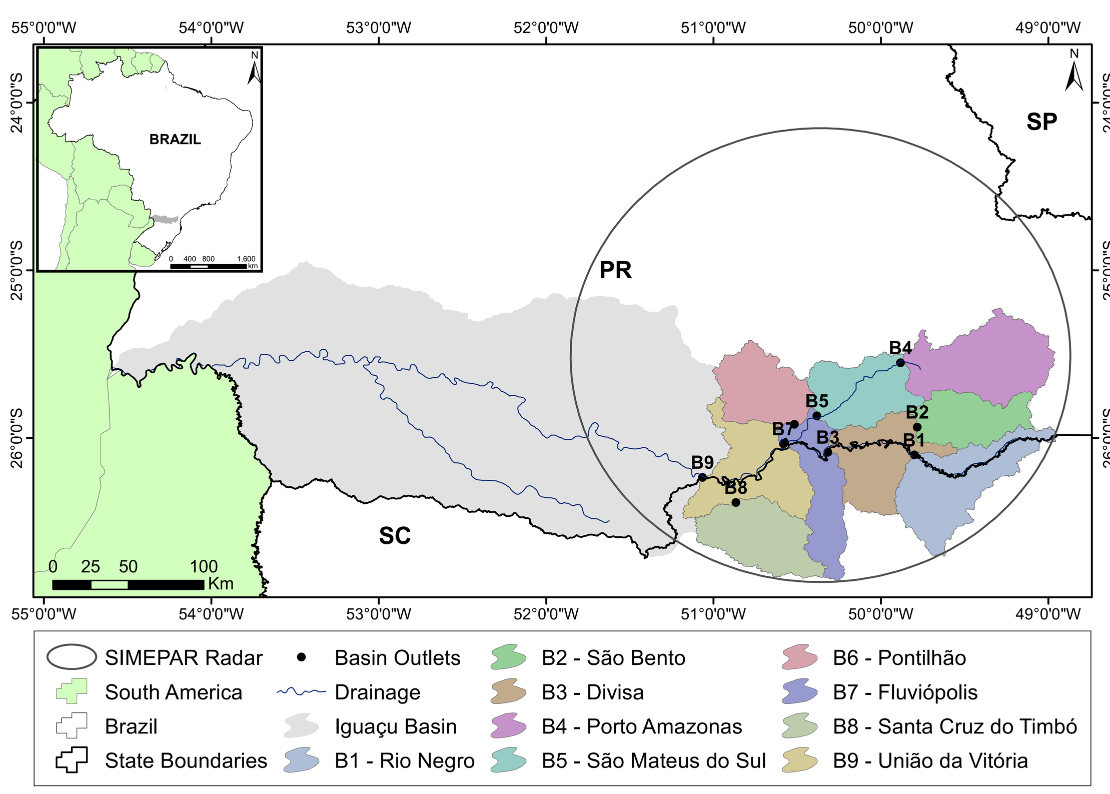

Fig. 1 - Localization of Iguaçu river basin.

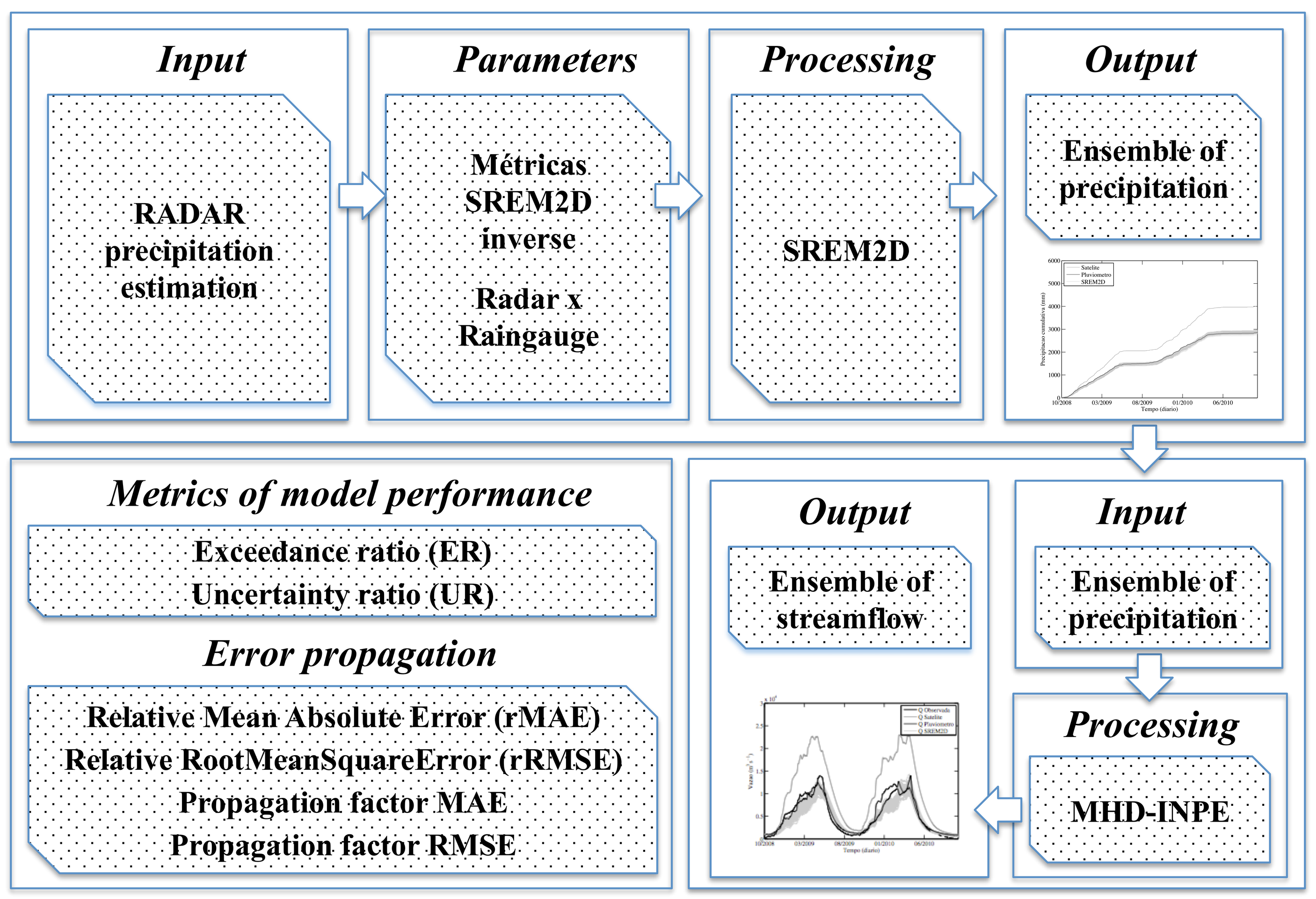

Fig. 2 - Implementation of Hydrological Model (MHD-INPE) and Stochastic Model (SREM2D).

CONCLUSIONS

Results show that the distributed hydrological model MHD-INPE applied to the Iguaçu river basin has a good performance in the streamflow simulation (Fig. 3). According to Fig. 5, we observe a reduction in the accumulation of precipitation of the ensemble SREM2D with respect to the radar cumulative precipitation, fitting the observed cumulative precipitation, thus significantly reducing the radar bias. However, it is noted that the radar overestimates not only the intense precipitation, but it presents weak precipitation when the raingauge presents no rain. This bias reduction of can also be observed in the streamflow simulation (Fig. 6).

Preliminary results show that SREM2D has the potential to create realistic precipitations ensembles according to the spatial and temporal error structure provided. However, in order to improve the performance of SREM2D is necessary to investigate an approach to represent better the seasonality of the rainfall along the year through the stochastic model parameters (e.g., a set of parameters for each season). It is also necessary to investigate the sensitivity increasing the calibration period and the number of members of the ensemble.

Acknowledgments
The research of A. S. Falck *et al.* was funded by the National Scientific and Technological Development (CNPq)

RESULTS

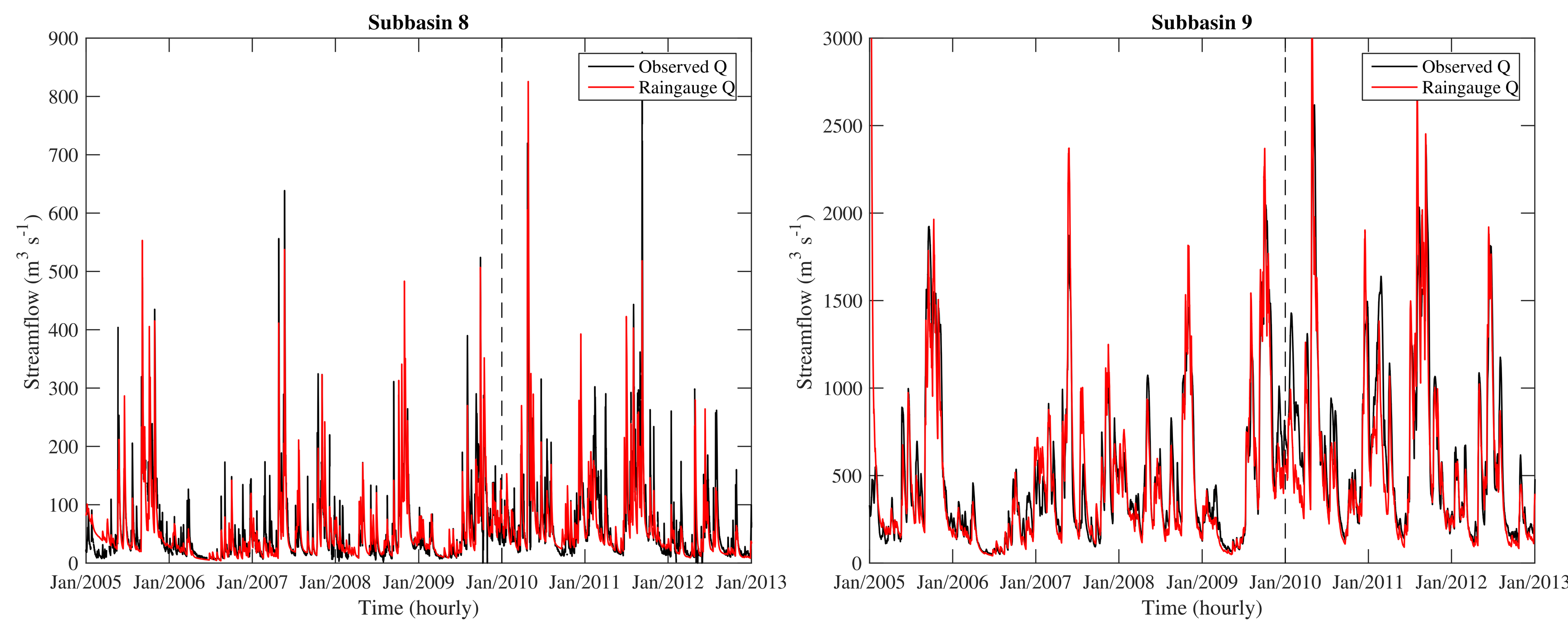

Fig. 3 - Hydrological Model calibration 2005-2010 and validation 2010-2013 for a small (B8) and large (B9) basin.

Table 1. Calibration and validation of Hydrological Model

Basin	Calibration		Validation	
	NASH	LNASH	NASH	LNASH
1	0.409	0.658	0.559	0.692
2	0.274	0.567	0.249	0.397
3	0.623	0.763	0.628	0.393
4	0.555	0.552	0.664	0.817
5	0.701	0.658	0.645	0.689
6	0.804	0.802	0.743	0.822
7	0.823	0.845	0.776	0.869
8	0.841	0.691	0.763	0.479
9	0.883	0.892	0.801	0.886

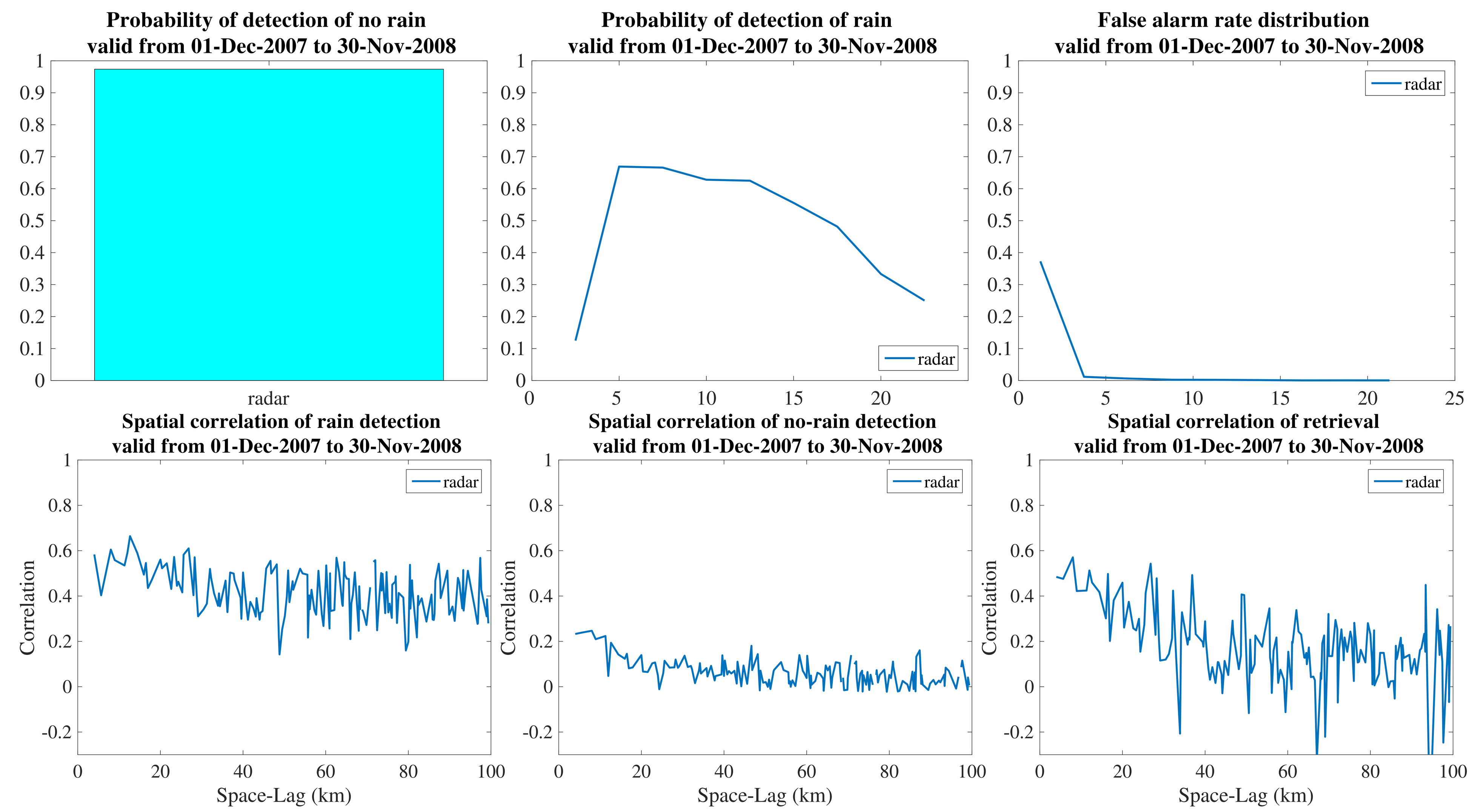

Fig. 4 - PODrain, PODnorain, False Alarm and spatial correlogram for December 2007 – November 2008.

Table 1. SREM2D error metrics calibrated for Teixeira Soares radar of SIMEPAR

Metrics	RADAR
POD parameters A	0.9142
POD parameters B	-0.134
False alarm (1/lambda)	1.17
Mean (mean gaus. log error)	-0.27
Sigma (std. dev. gaus. log error)	0.93
Correlation length rain det. (km)	30.00
Correlation length no rain det. (km)	0.00
Correlation length retrievel det. (km)	15.00
Lag-one correlation	0.31
PODnorain	0.97

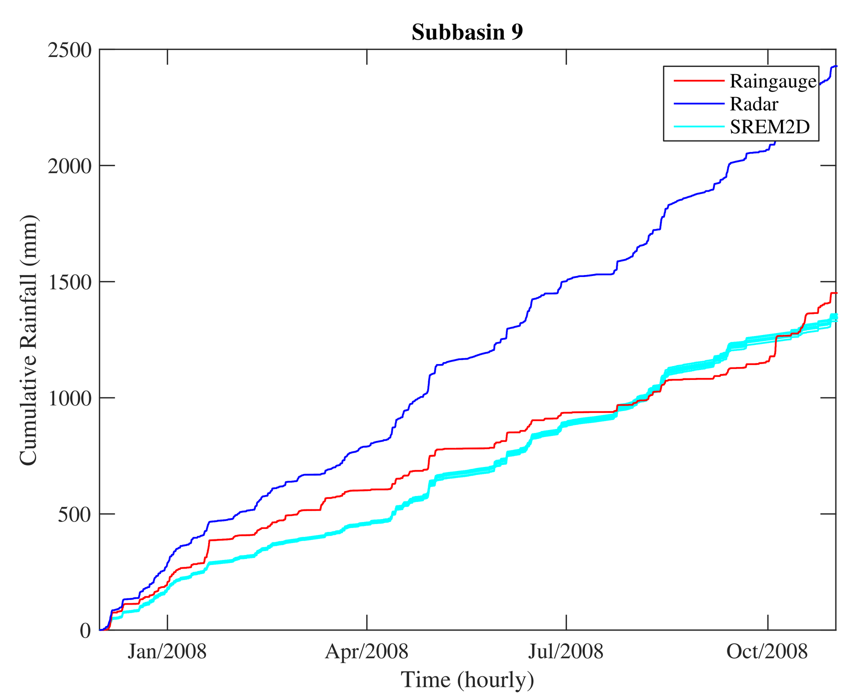

Fig. 5 - Time series of cumulative rainfall for a large (B9) basin.

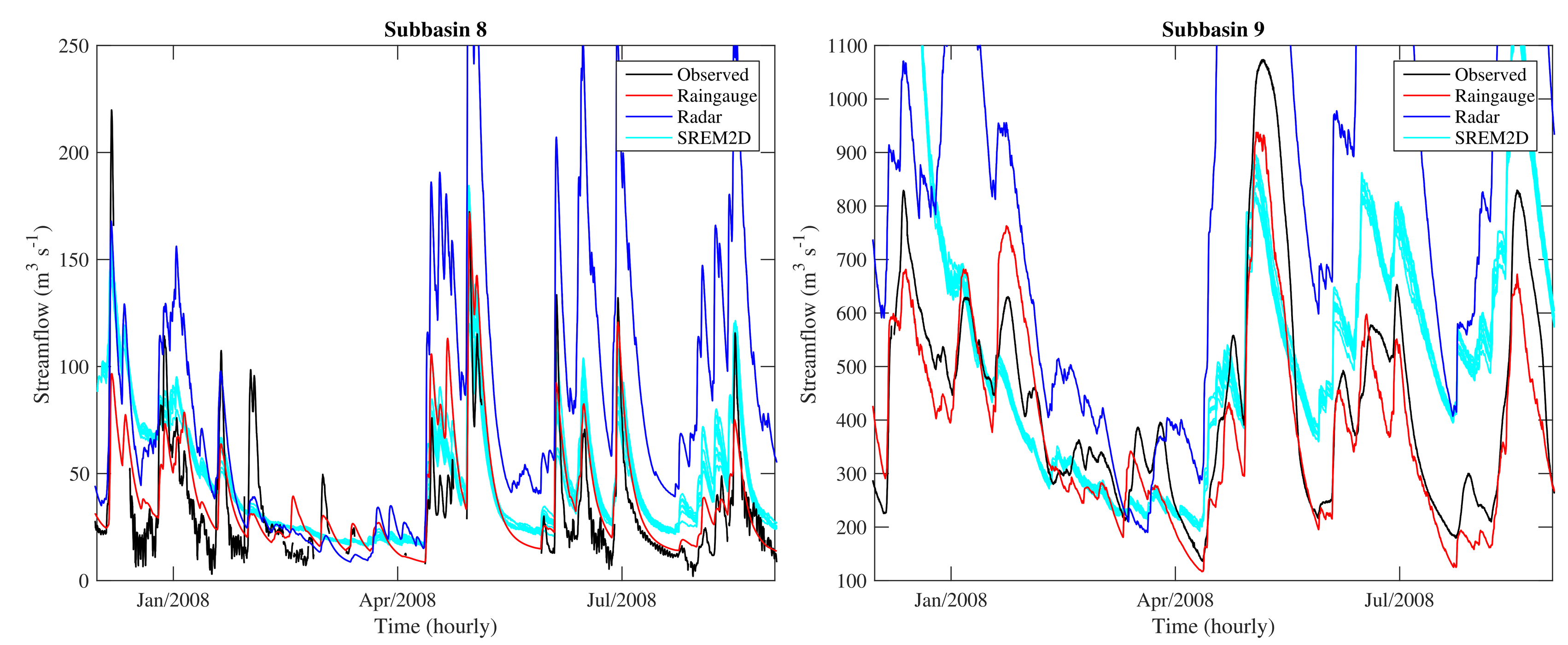

Fig. 6 - Time series of streamflow for a small (B8) and large (B9) basin.