Assessment of the influence of the rainfall structure on hydrograph simulation:

Comparison of radar and interpolated methods in a tropical catchment

N. Velásquez.[1,2], S. Castillo.[1], J. Sepulveda.[1], M.A. Ochoa.[1], C.D. Hoyos.[1,2]

1. Sistema de Alerta Temprana de Medellín y Valle de Aburrá

2. Universidad Nacional de Colombia, sede Medellín

Introduction

River discharge simulation using hydrological models strongly depends on the quality and spatiotemporal representativeness of precipitation during storm events. All precipitation measurement strategies have different strengths and weaknesses that translate into discharge simulation uncertainty: In general, rainfall measurements from a dense and well-maintained rain gauge network provide an acceptable estimation of the total water volume during rainfall events. However, spatial interpolation introduces uncertainty to the simulation. On the other hand, rainfall derived from radar provide a better spatial structure representation, but with higher uncertainty regarding the magnitude of the event. In the present work, we explore:

- Spatio-temporal differences between **interpolated** fields and **radar** data.
- The influence of interpolated and radar data on the **performance** and **behavior** of a **distributed hydrological model**.

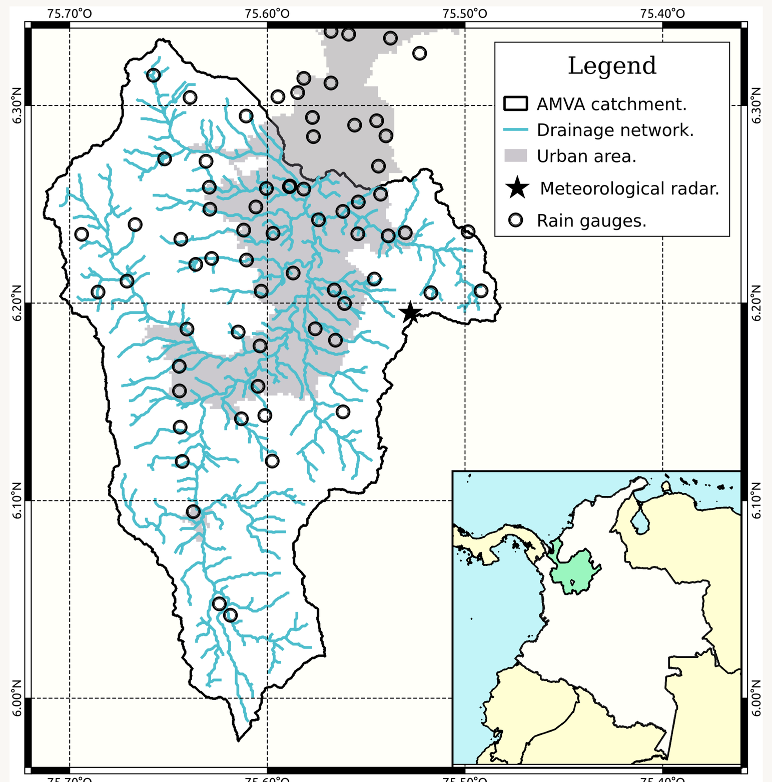

Figure 1. Watershed localization

Materials and Methods

Region: Aburrá Valley basin, a mountainous tropical catchment located in Colombia with an area of 470 km². About 24% of its territory is urban.

Data: The interpolation methods use 54 raingauge stations. A polarimetric C-band radar combined with a QPE technique provides rainfall information every 5min. We analyze 84 storm events.

Methods: We compare spatiotemporal features of IDW, TIN interpolated gauges and radar fields. For the hydrological simulation we use the WMF model (https://github.com/nicolas998/WMF).

Model

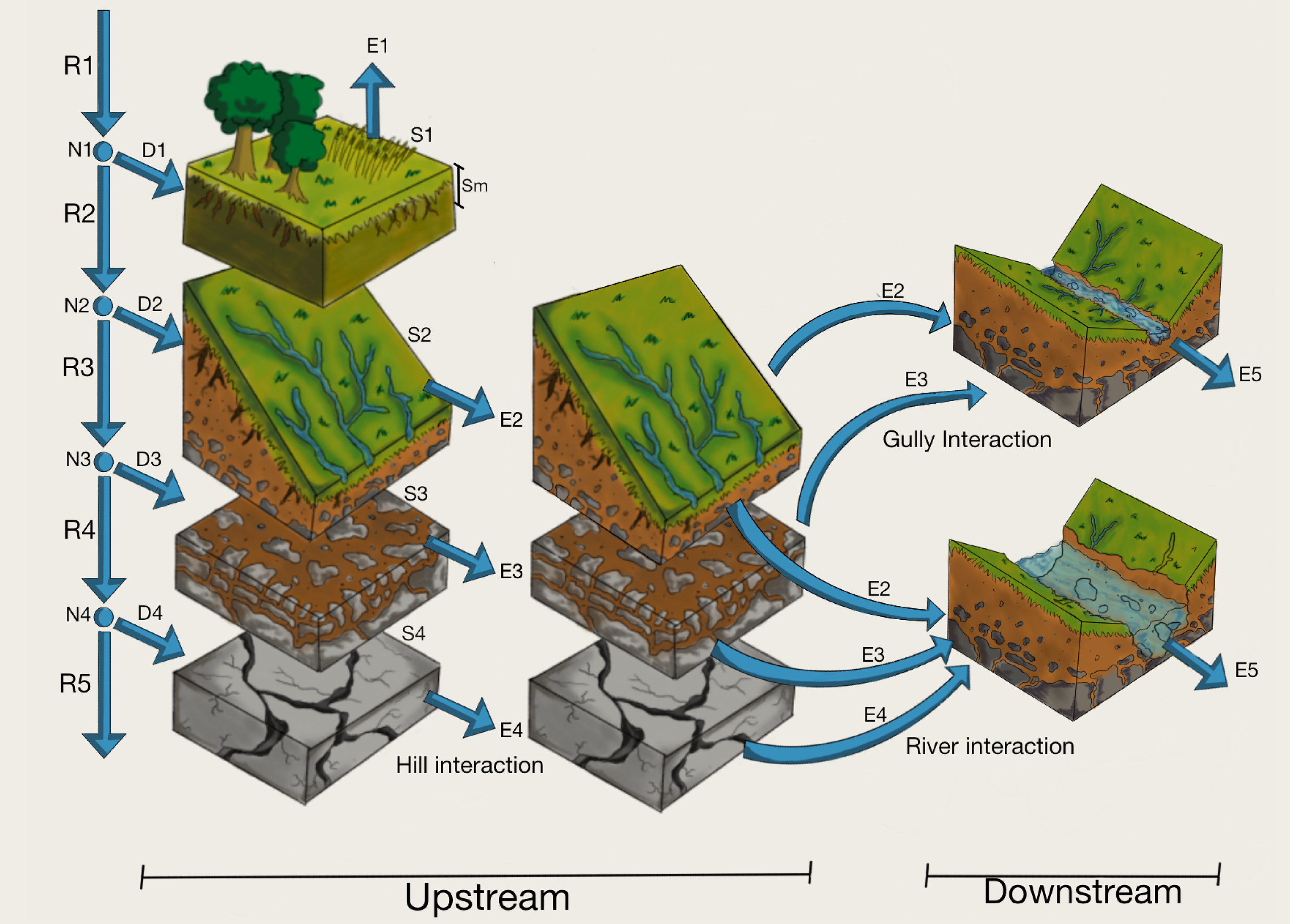

Figure 2. Model description

$$U_{run} = \frac{\xi}{n} A_{2,x,t}^{(2/3)_{e1}} S_0^{1/2} \quad (1)$$

$$U_{sub} = \frac{K_s S_0^2}{3H^2_{x,g}} S_{3,x,t} \quad (2)$$

$$A_{i,x,t} = \frac{S_{3,x,t}}{\Delta X_x + v_{x,t}\Delta_t} \quad (3)$$

Results and analysis

The temporal analysis shows differences at I_{max} and I_{mean}. Despite these differenes, **IDW** tends to behave similar to radar.

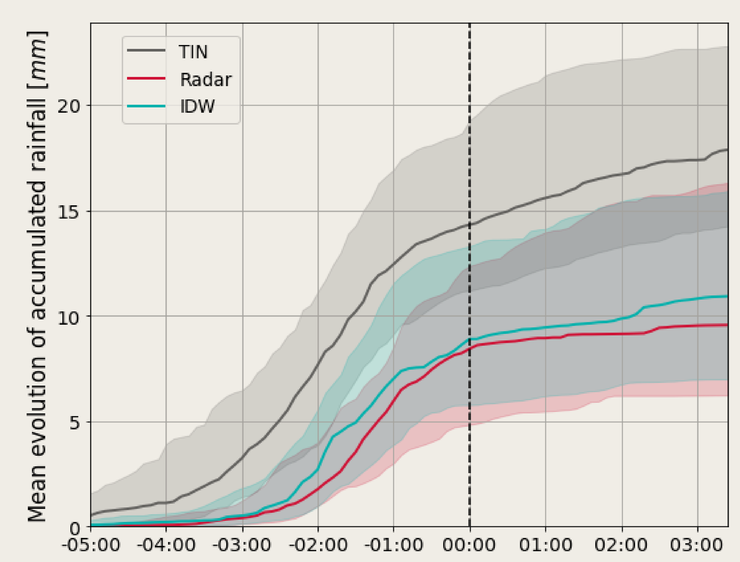

Figure 3. Distribution of accumulated rainfall for 84 events.

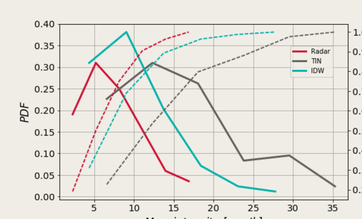

Figure 4. I_{max} distribution

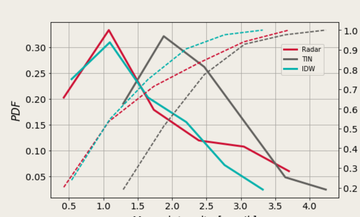

Figure 5.1 I_{mean} distribution

Regarding I_{max}: **TIN**-based interpolation estimates are greater than Radar-derived intensity and **IDW.** For I_{mean}, Radar and IDW histograms are similar.

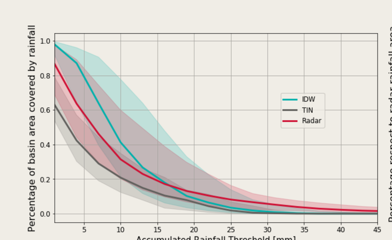

Figure 6. Percentage of basin coverage

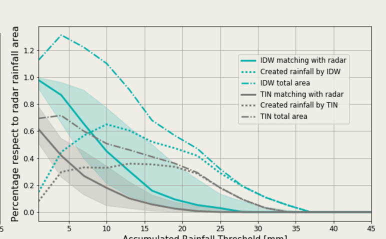

Figure 7. Match percentage re- garding radar

Percentage of basin coverage by storm event is similarly for high rainfall thresholds. However, the case is the opposite when we assess spatial match relative to radar fields.

Spatial differences

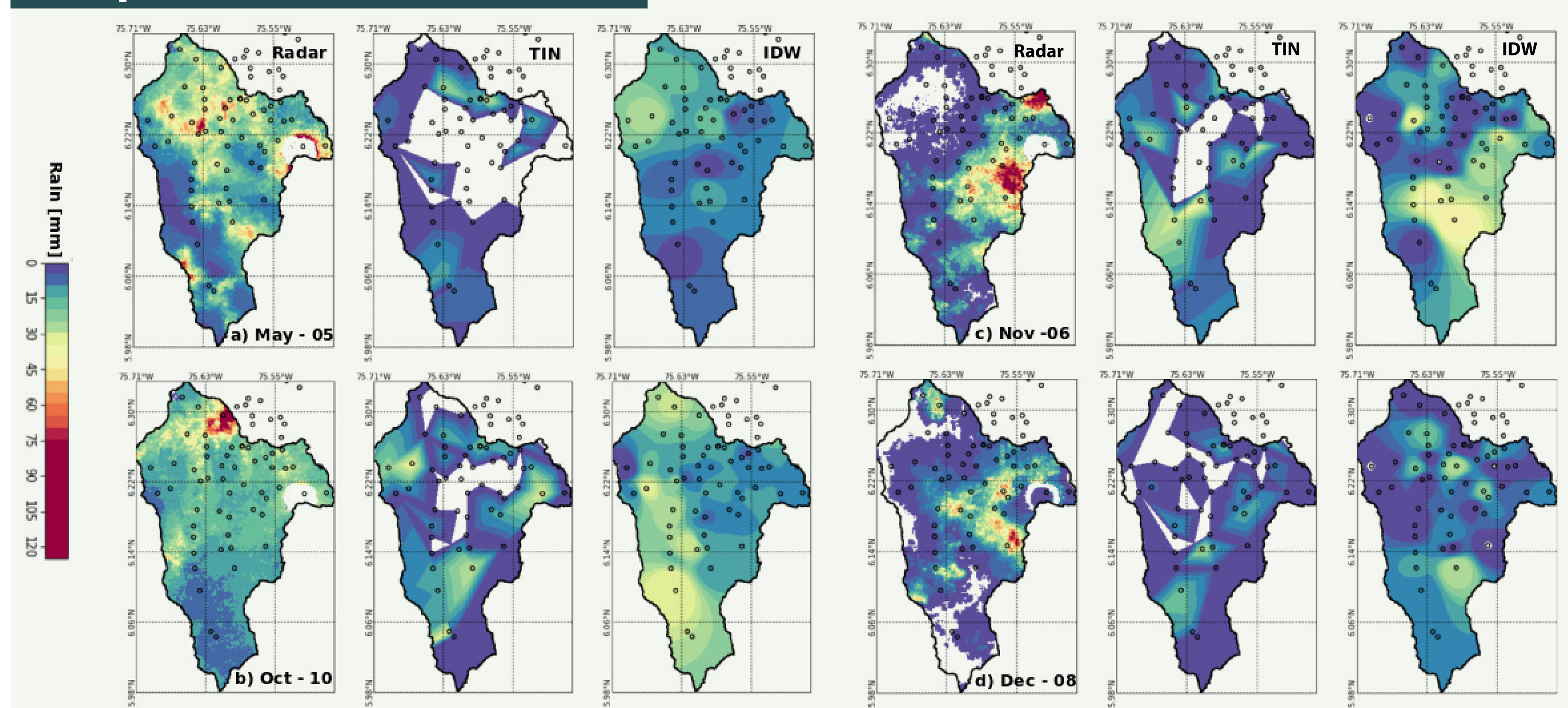

Figure 8. Accumulated rain fileds for four events.

Hydrological results

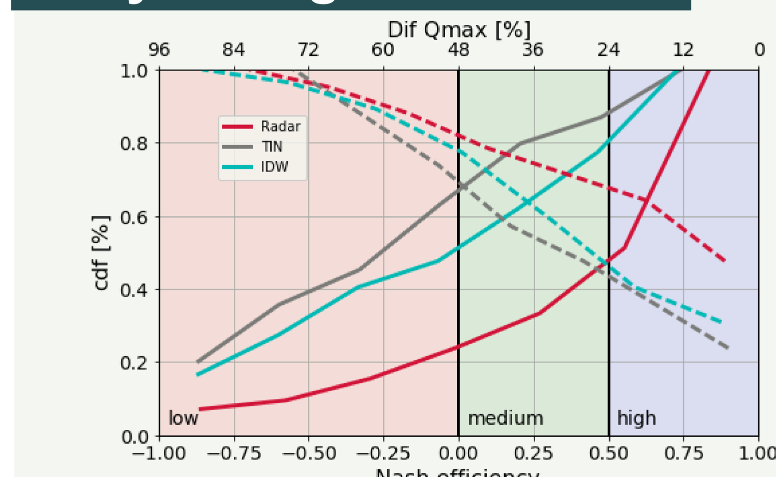

Figure 9. Model performance

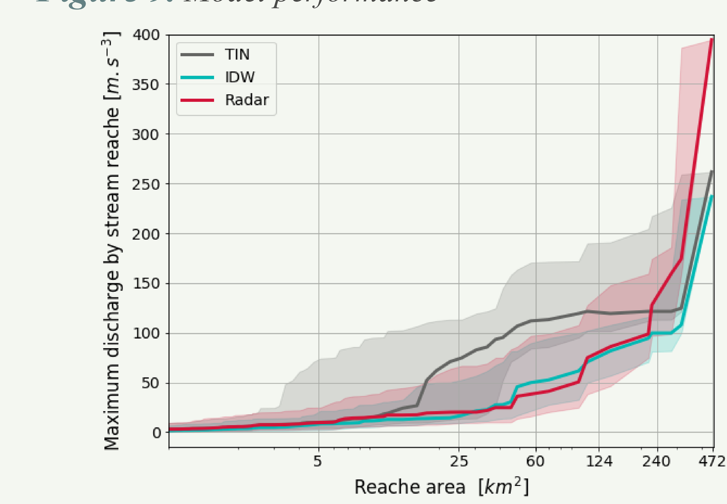

Figure 11. Simulated peak streamflow at sub-catchments.

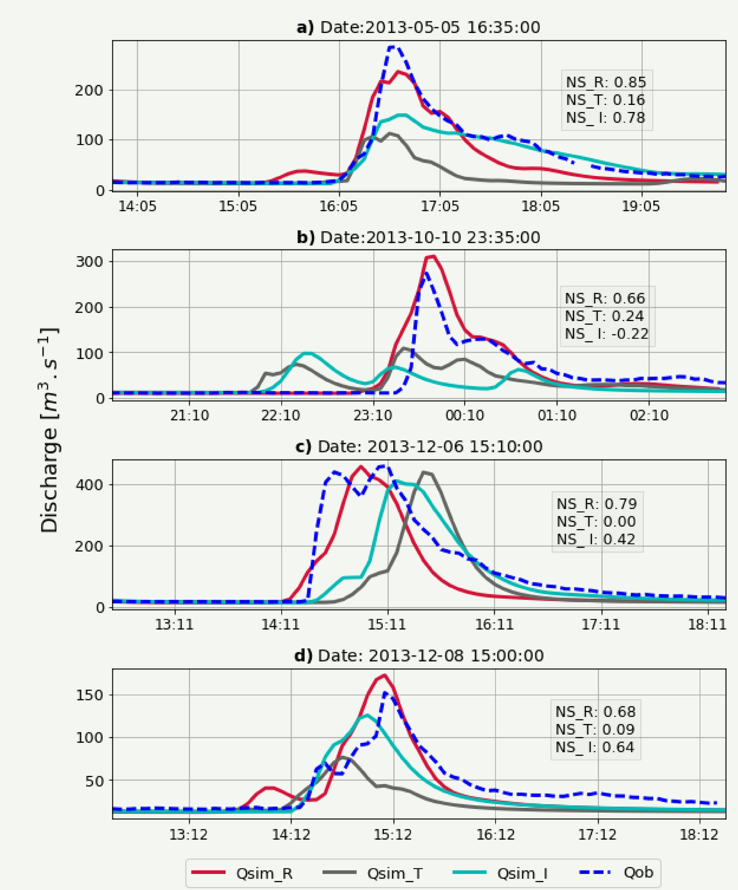

Figure 10. Model realizations at four cases.

Radar data increase the performance of the model.

Conclusions

We analyze the differences between gauge-based interpolated and radar rainfall fields as well as their impact on hydrological simulations for 84 rainfall events. Interpolated methods do not represent essential features of observed radar fields. These differences influence model performance and behavior at multiple scales. Despite the differences, IDW tends to behave similarly to radar data. However, radar fields data increase the performance of the model, including a better representation of the hydrograph.

Acknowledgements

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Contact

Nicolás Velásquez
nvelasqg@unal.edu.co

Alcaldía de Medellín