Relationship between changes in land use and the magnitude of peak discharges in a tropical watershed

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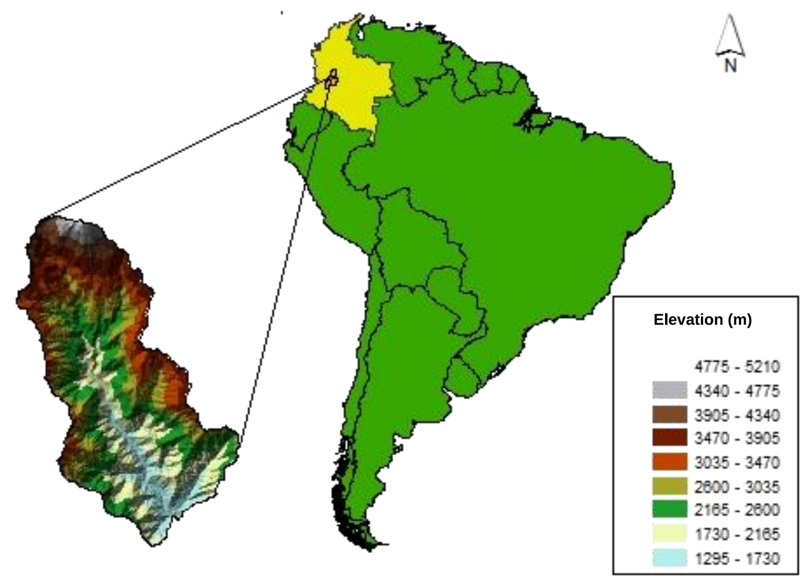
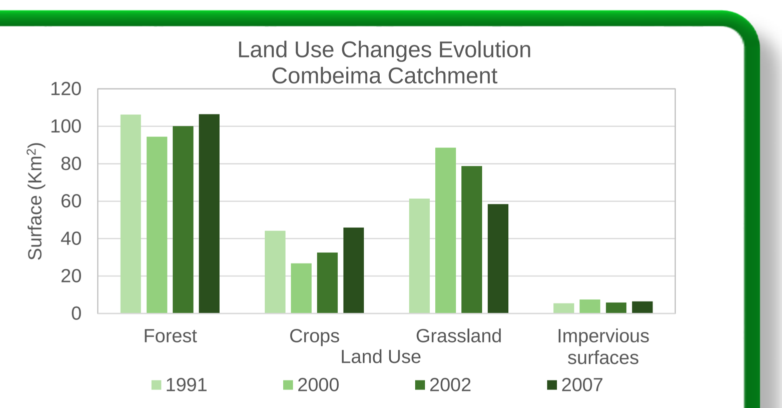
Introduction

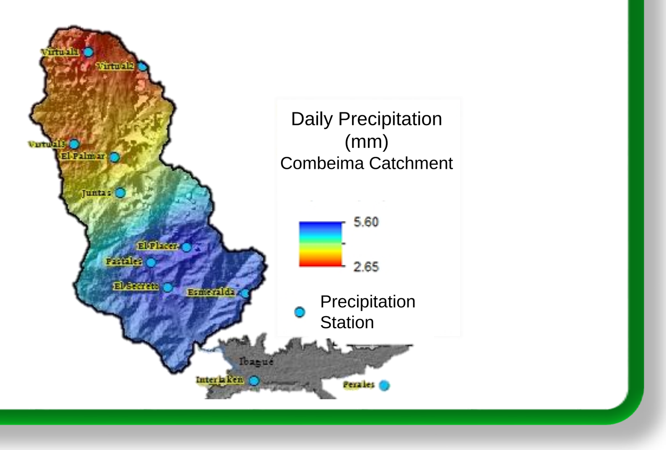
Land use/cover changes are a source of non-stationarity in time series (Hopmans *et al*, 2002) and generate changes in the hydrological response of the watersheds (Bronstert *et al*, 2007), because of the variations in the soil structure that modify its porosity and hydraulic properties (Kumar *et al*, 2008). This study focuses on incorporating the scaling theory to the relationship between the hydraulic properties of soil in the flood regime. To that end, tests were conducted to verify the scaling of flood quantiles with respect to **water storage in the soil root zone (*Hu*)** and the **saturated hydraulic conductivity (*Ks*)**. Furthermore, hydrological simulations of these changes were carried out involving scenarios varying the organizational structure of the soil hydraulic properties values. Obtained results show different effect on the magnitude of peak flows according to the type of land cover.

Study site

The study area is located in Colombia, in Los Andes of South America

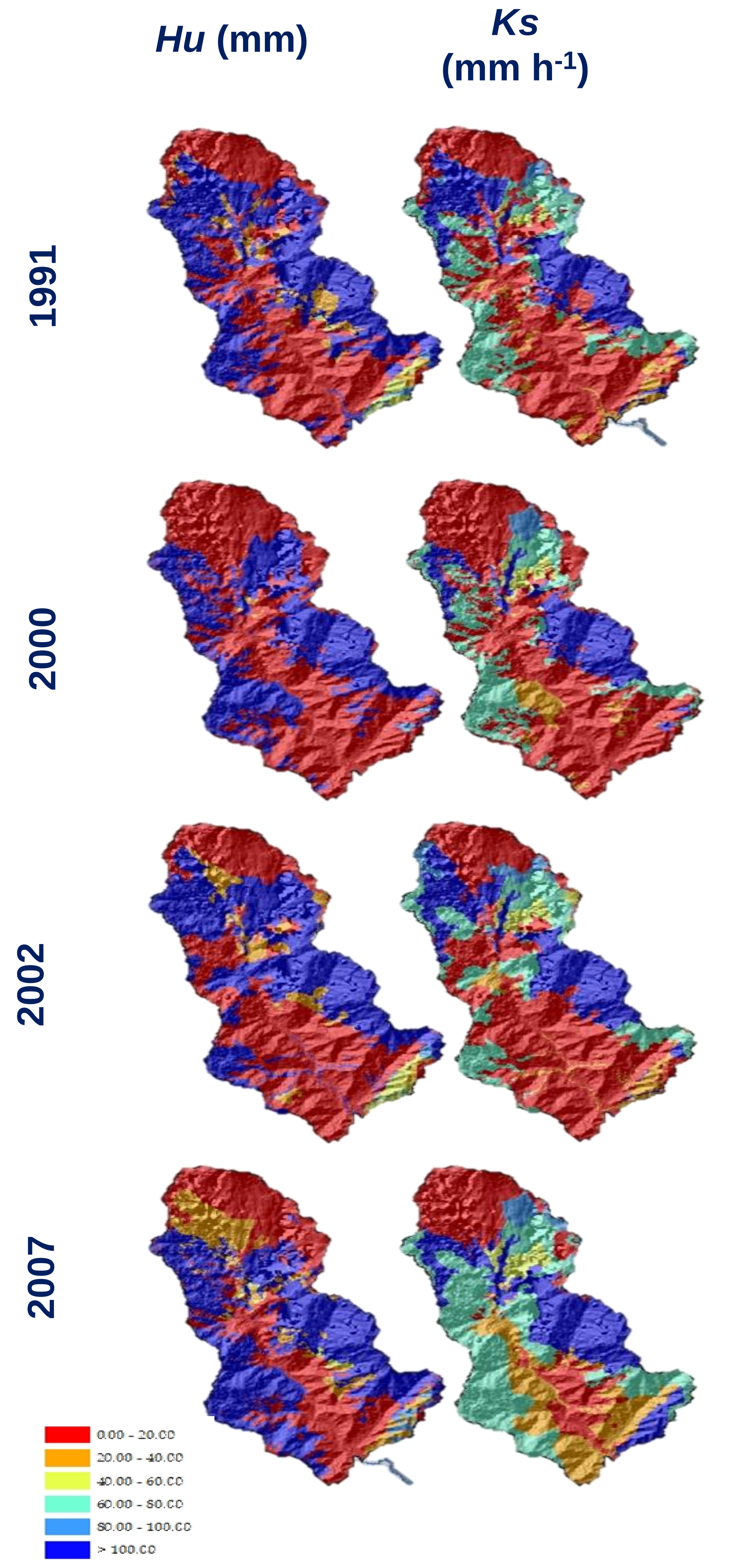




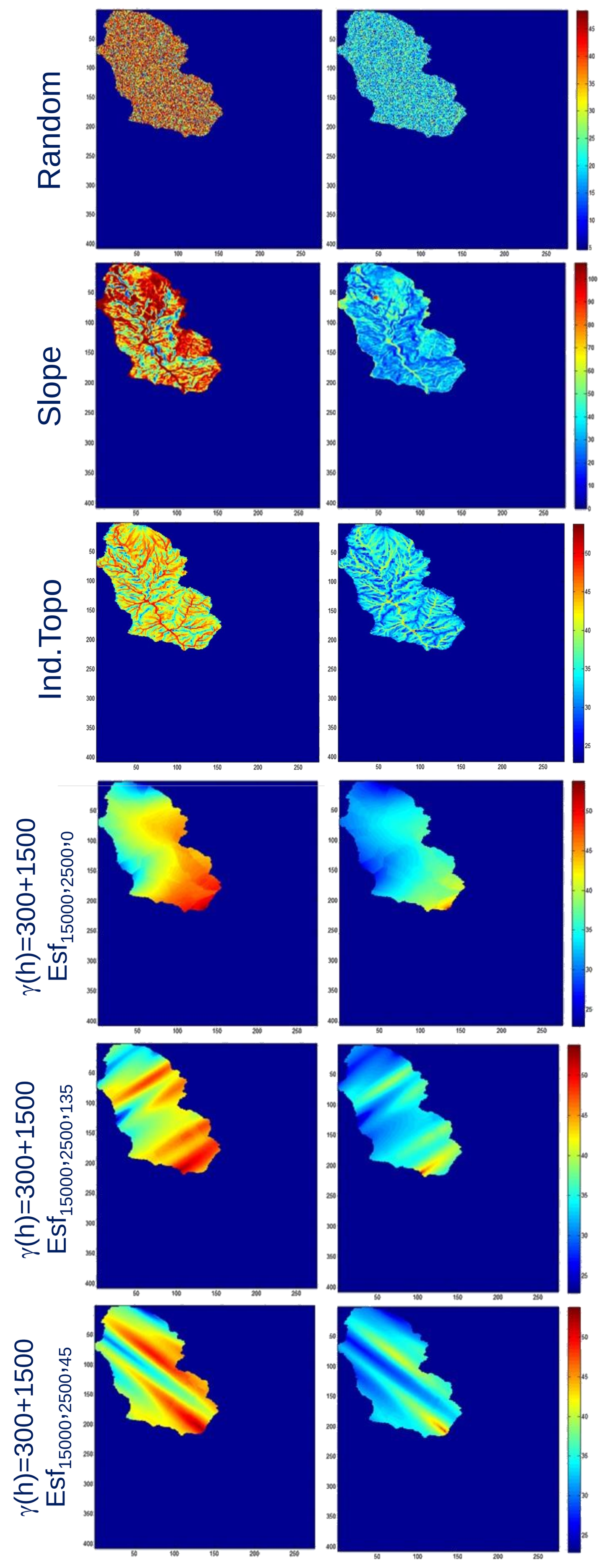


Methods

- ✓ Estimation of the soil hydraulic properties *Hu* and *Ks* using pedotransfer functions (Saxton *et al*, 1986).
- ✓ Modeling the hydrological response of the watershed to changes in land use with time with the distributed hydrological model TETIS (Francés *et al*., 2007).
- ✓ Calibration with present conditions and validation for each historical land use map.
- ✓ Verification of the scaling theory of the soil hydraulic properties on the flood regime.
- ✓ Tests on the effect of the spatial structure variation of *Hu* and *Ks* on the scaling of the flood regime.

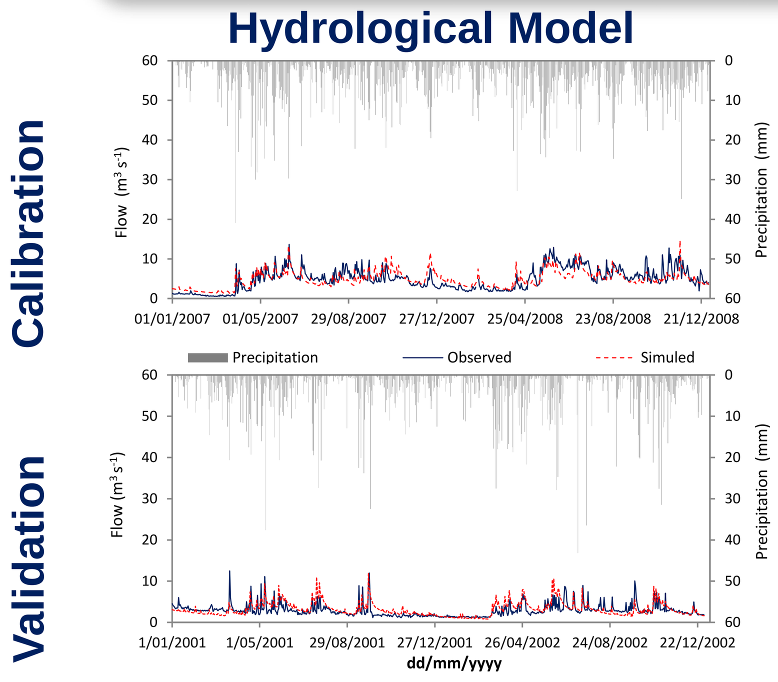


Artificial heterogeneity induced for Hu y Ks

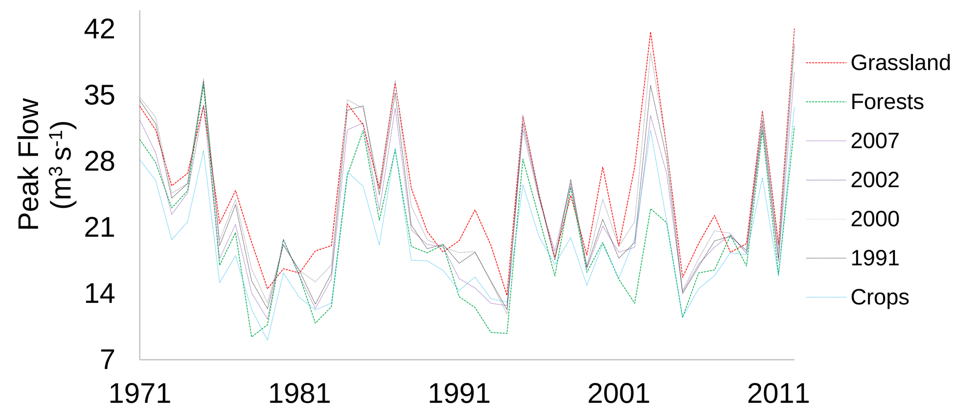


Results

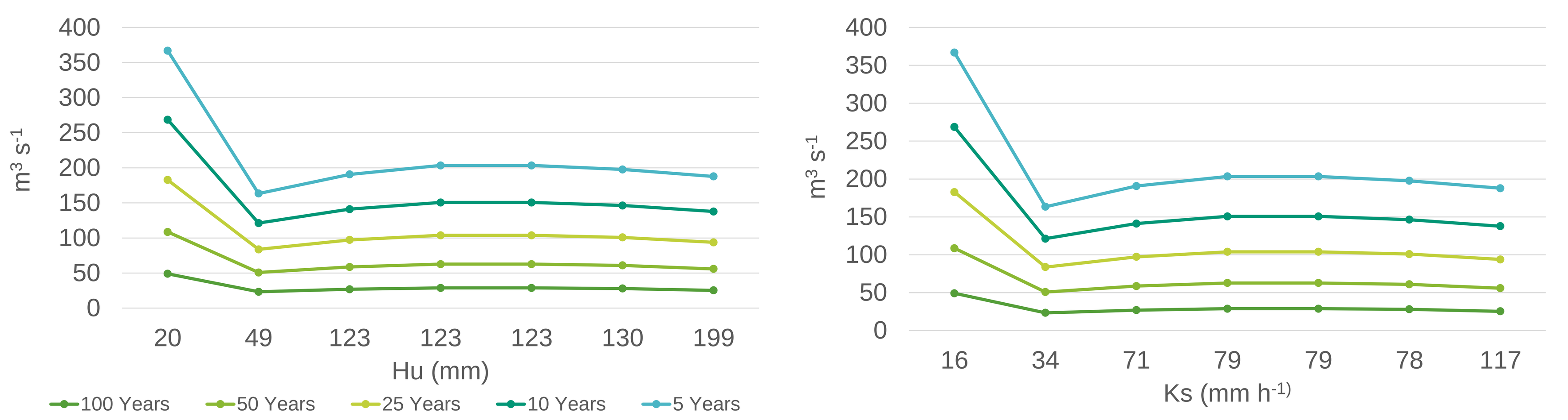
Hydrological Model



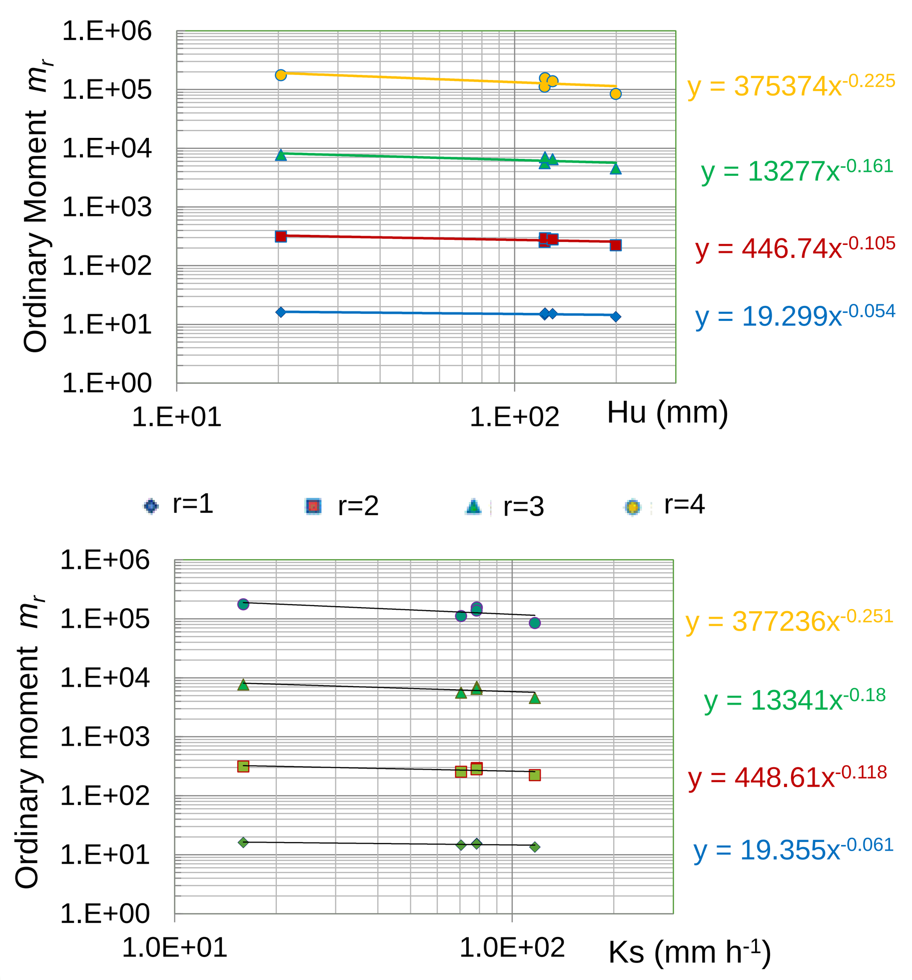
Anual maximun peak flow by land use/cover scenario



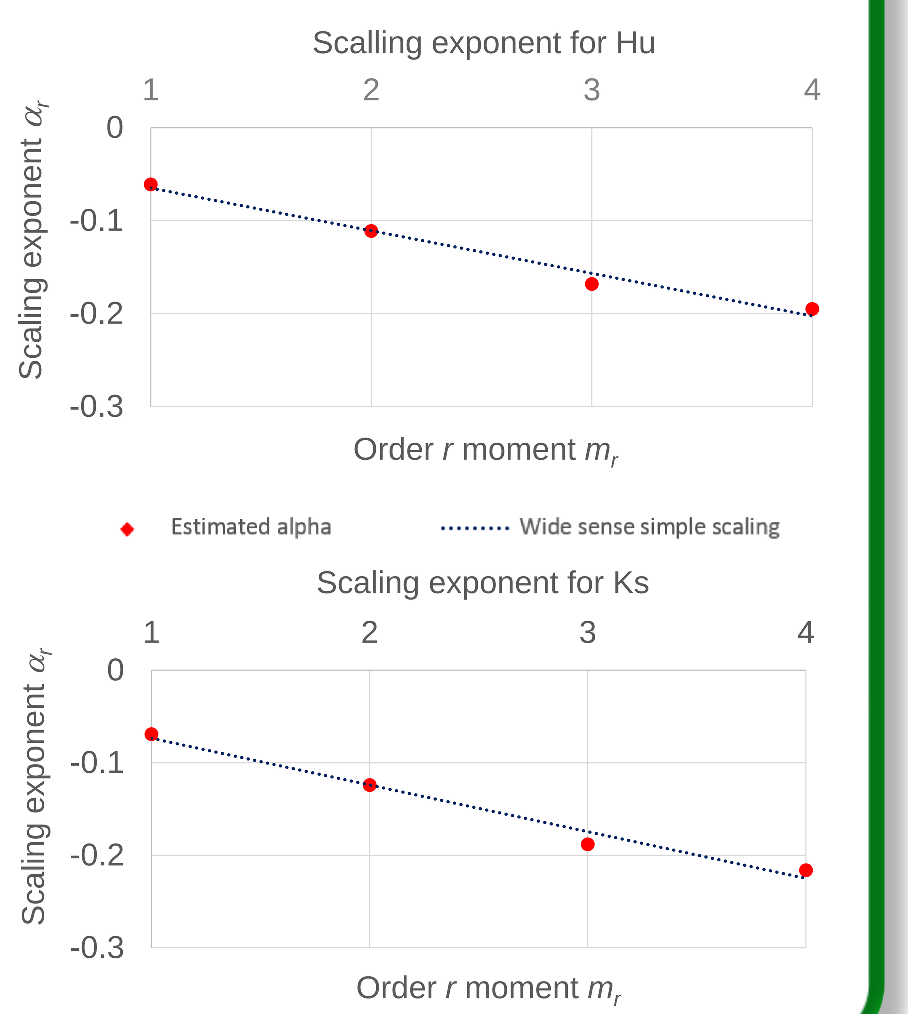
Peak flow variation for evolution parameters Hu y Ks - GEV distribution



Testing Scaling Behavior with Soil Hydraulic Properties



Scaling exponents α for different moment orders *r*



Conclusions

- ➢ The hydrological response of the watershed to different land cover results in different flood quantiles. For example, a full afforestation of the catchment results in decreased flood quantiles, whereas land covers with lower *Hu* and *Ks*, such as grassland, result in increased peak flows.
- ➢ Variation of the organizational spatial structure of *Hu* and *Ks* values does not significantly influence the scaling of the soil hydraulic properties on the flood regime.
- ➢ Flood regime has a wide sense simple scalable behavior with the scales *Hu (*water storage in the root zone) and *Ks* (hydraulic conductivity of soil).

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Acknowledgements

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