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Comparative Analysis of Lumped and Semi-distributed Hydrological Models in Humid Mediterranean Environments

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Abstract

We inter-compare four hydrological models in terms of their surface water response simulations and their ability to capture the particular features of humid Mediterranean climates. We selected the Maule River basin (central Chile), in particular the Longaví basin as the paradigm of humid Mediterranean climate to run the study. The area is under intensive irrigated agricultural exploitation, which jeopardizes groundwater recharge and may be further pressurized by precipitation changes due to global warming. The Longaví basin in the south of the Maule, was studied and its hydrological cycle was simulated using four simulation tools: GR4J, HBV-light, HEC-HMS and WEAP, hence including lumped as well as a semi-distributed approaches. For model performance assessment, the Longaví was sub-divided into three zones with comparable characteristics in terms of climate, physical soil properties and altitude classes. Daily hydro-meteorological forcing time series were provided by official institutions of Chile for the 1979 to 2015 period. The individual model efficiency was evaluated through usual deterministic performance indicators. The models exhibit different strengths in terms of hydrologic response simulations. The results obtained with GR4J, HEC-HMS and WEAP perform better during southern hemisphere Winter between June and October, while HBV-light produces stronger results during the November to May Summer season. The more heavily parameterized WEAP model tends to better represent the stream flow variability observed during the rainy season with respect to the dry season.

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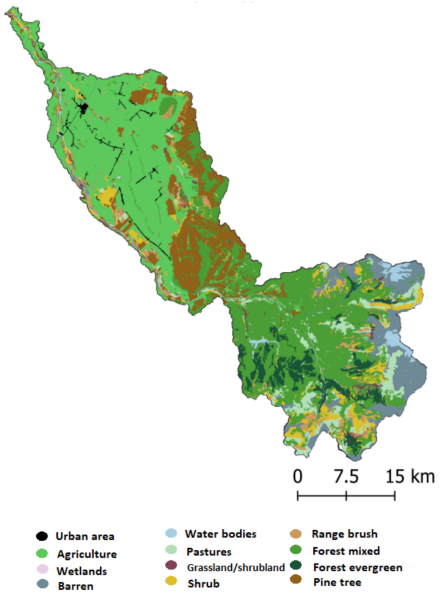

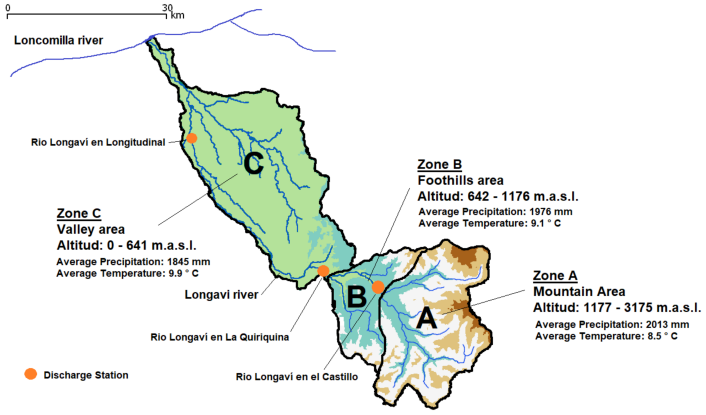

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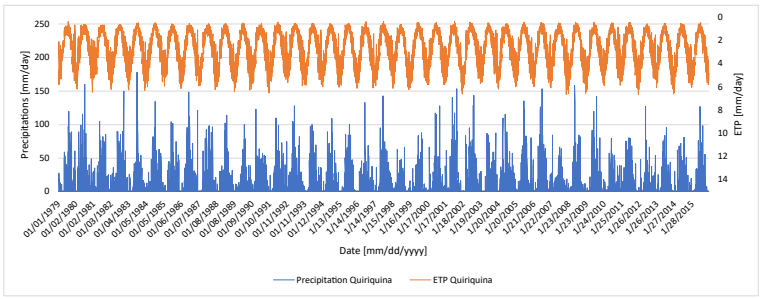

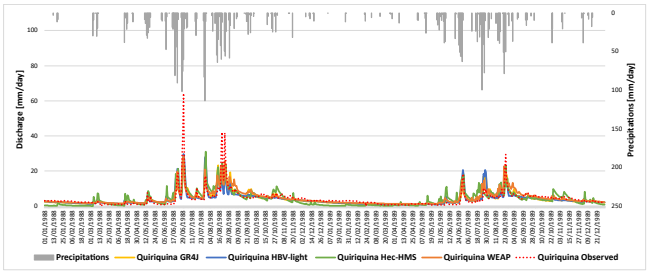

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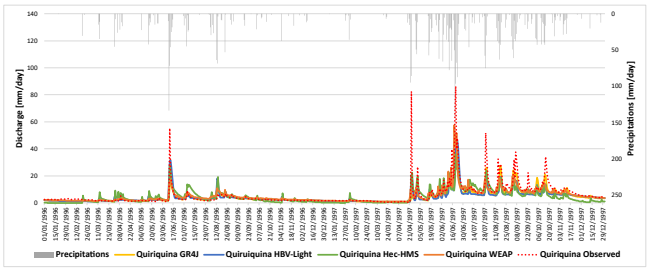

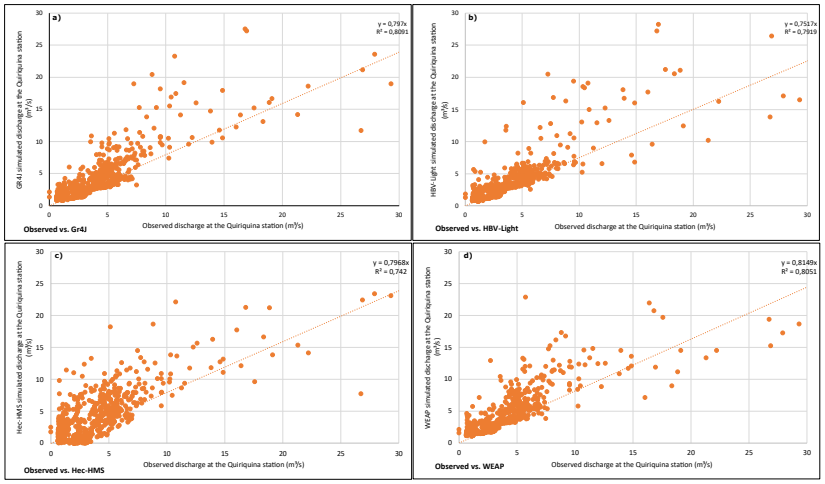

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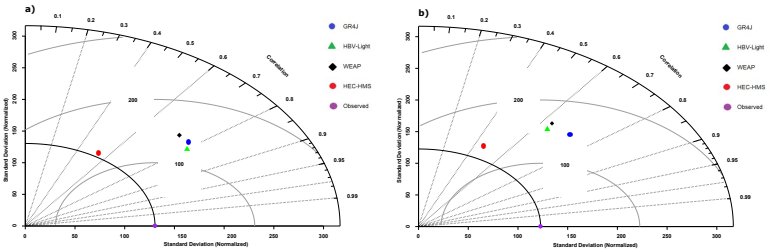


	GR4J	HBV-Light	WEAP	HEC-HMS
Adaptation to Observed				
Low flows				
Peaks and High flows				
Rain season				
Dry season				
Performance nash				
Performance nash ln				
Performance R^2				
Behaviour in High Altitud Areas				
Behaviour in Medium Altitud Areas				
Behaviour in Low Altitud Areas				
Snow treatment				
Land use / soil types				
Irrigation Performance				

Rainfall - Runoff

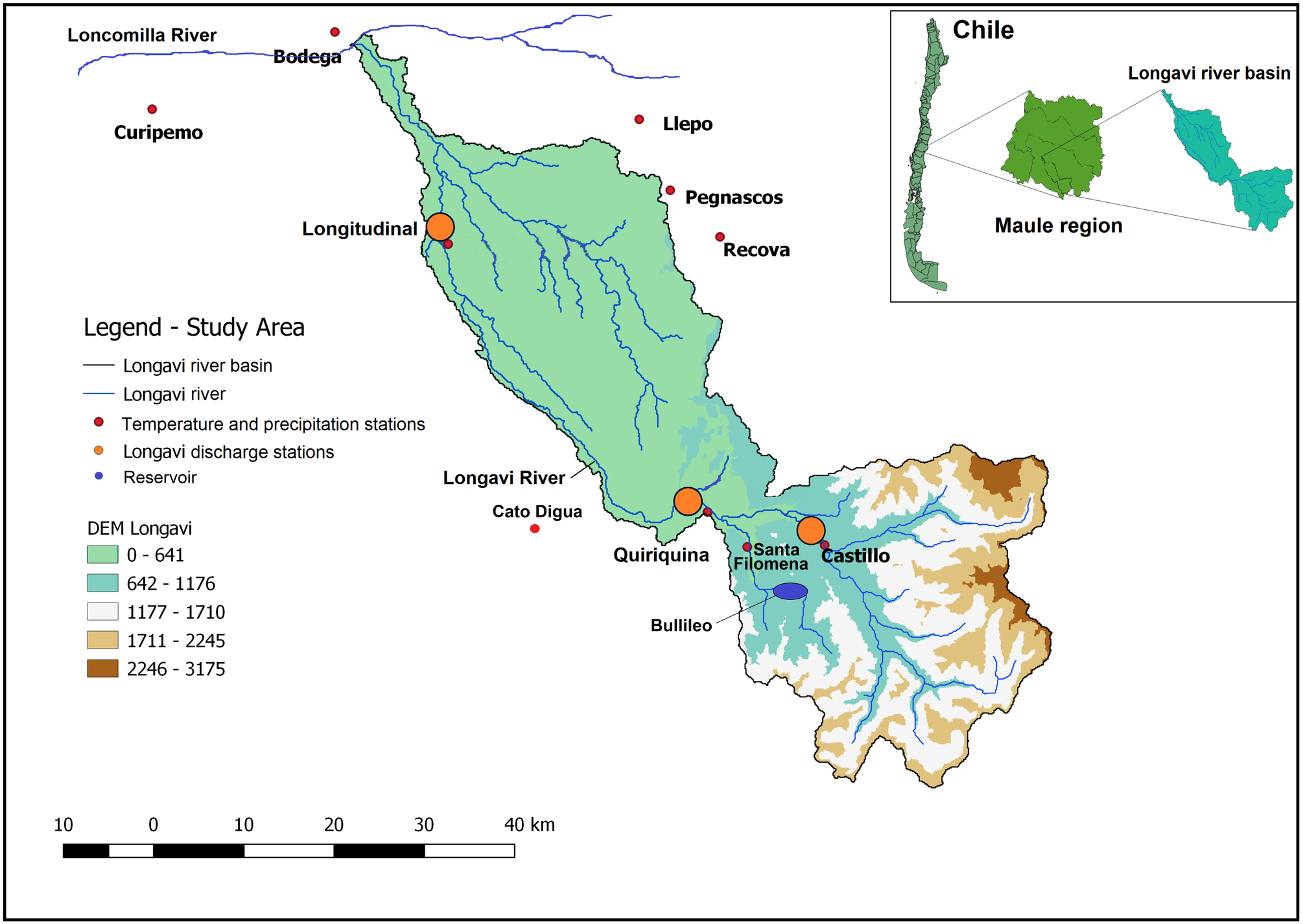
Rainfall – Runoff + Snow package

Rainfall – Runoff + Snow package + Land use / soil types parameters

Effectiveness ≥ 60%

30% ≤ Effectiveness ≤ 59%

0% ≤ Effectiveness ≤ 29%


Loncomilla River
Bodega
Curipemo
Llepo
Pegnascos
Recova
Longitudinal
Chile
Longavi river basin
Maule region
Legend - Study Area
Longavi river basin
Longavi river
Temperature and precipitation stations
Longavi discharge stations
Reservoir
DEM Longavi
0 - 641
642 - 1176
1177 - 1710
1711 - 2245
2246 - 3175
Longavi River
Cato Digua
Quiriquina
Santa Filomena
Castillo
Bullileo
10 0 10 20 30 40 km