Analysis of simplified HRU configurations for the evaluation of water yield improvement projects in mountain ecosystems

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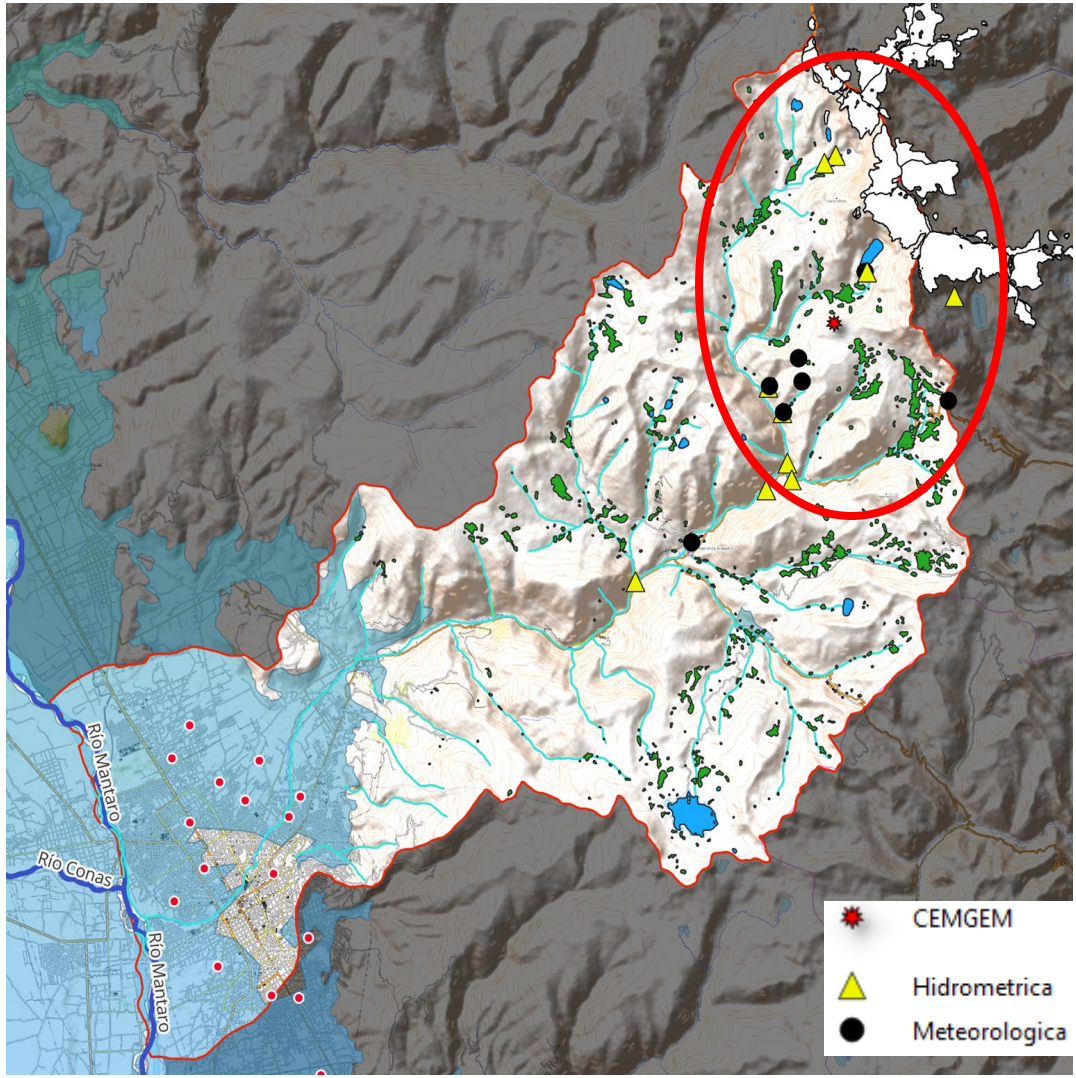
Shullcas watershed

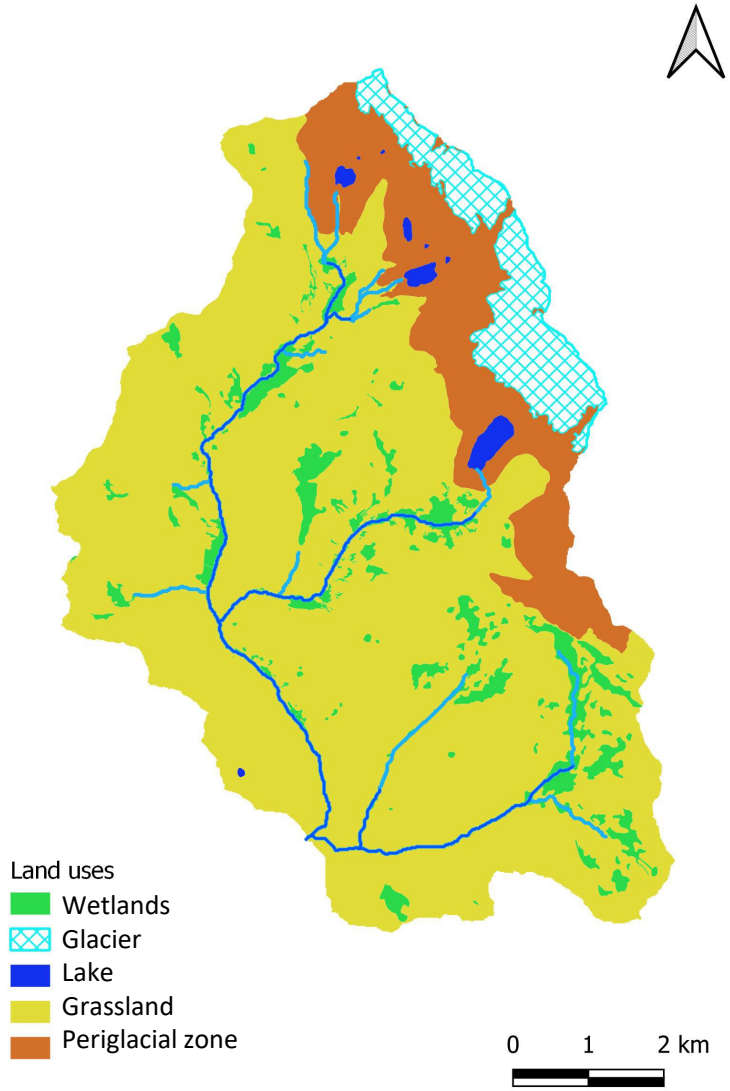
Shullcas area	250.4km2
Study area	59.49 km2
Elevation	3193 – 5475 m s.n.m.
Glacier area	3.7 km2
Lake area	1.6 km2
Wetland area	27.9 km2
river length	35.2 km
Discharge	2.41 m3/s
Precipitation	1060 mm/year

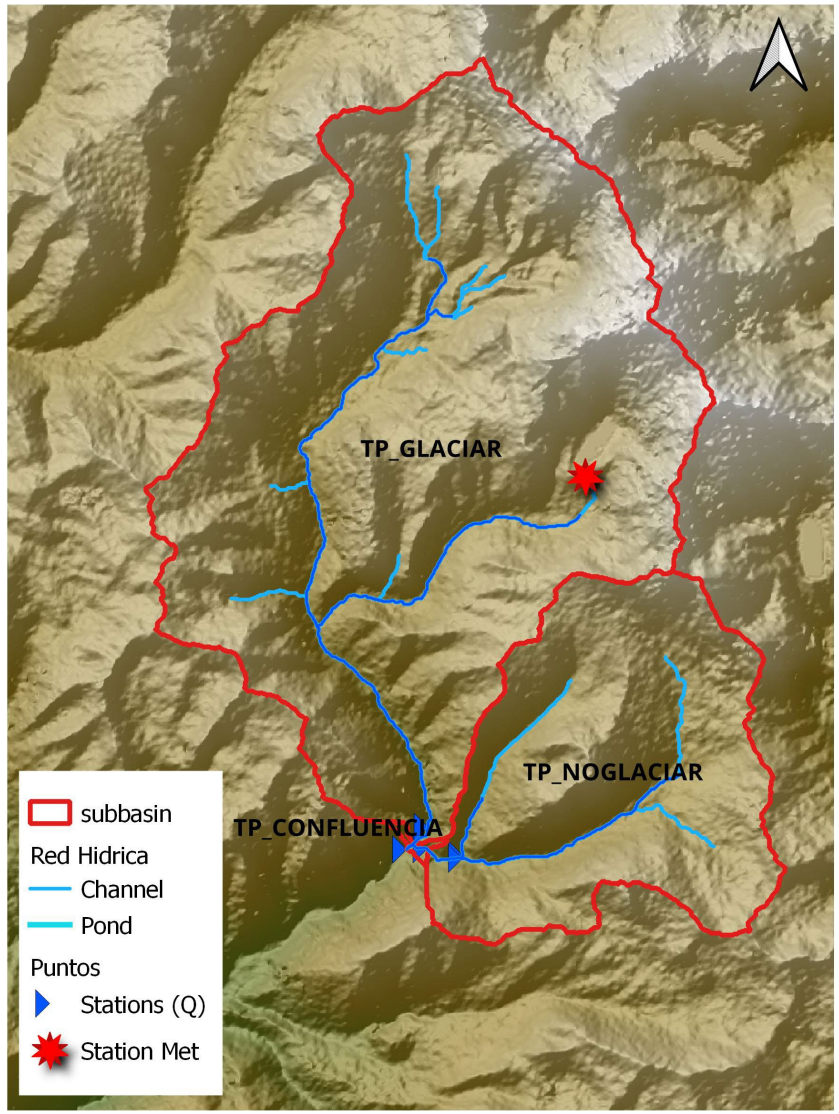


Study Area

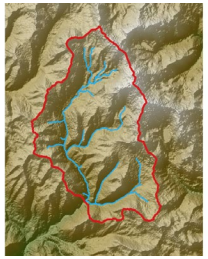
Vegetation parameters assigned based in previous Peruvian studies: LAI_MIN, BLAI, T_OPT.

WATR	Lake, Glacier
BSVG	Periglacial zone
GRAS	Grassland
WETN	High Andean wetlands

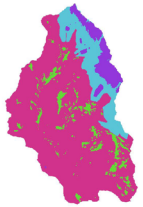




Methodology

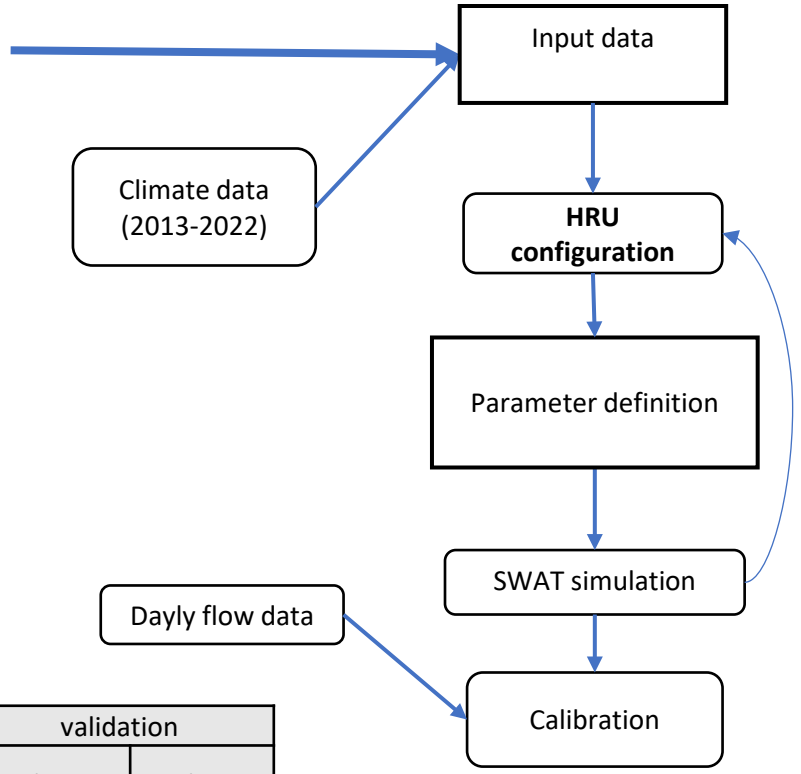


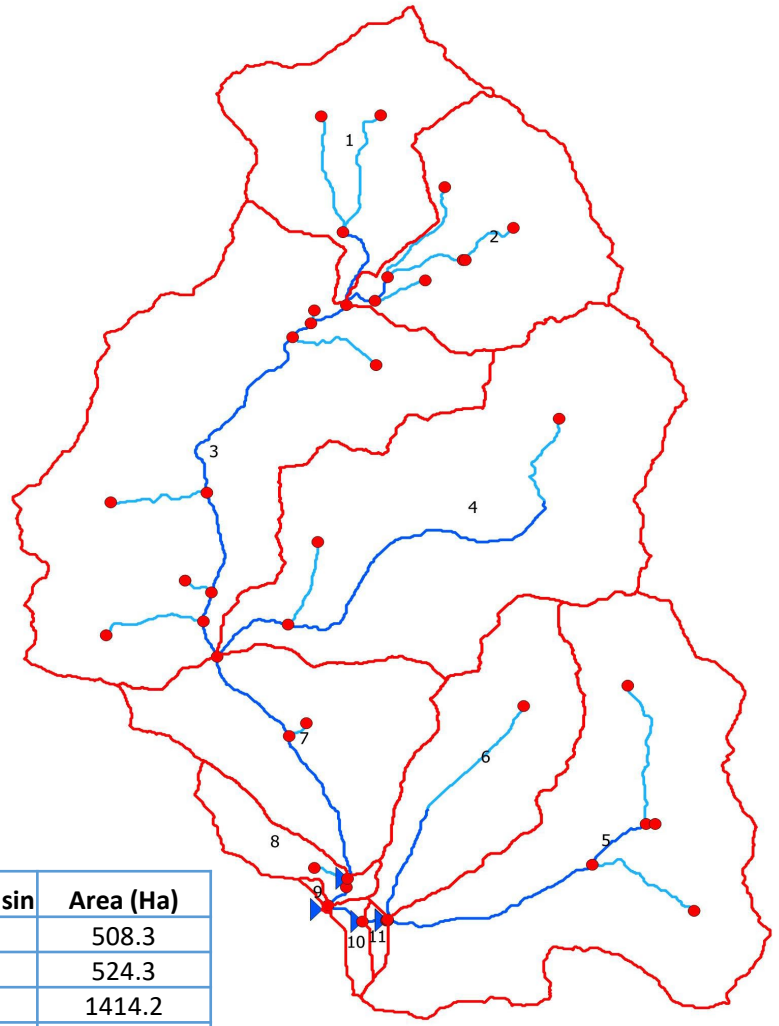
DEM 12.5m_Alos Palsar



Ecosystem map (INAIGEM)

ZEE Junin soil map

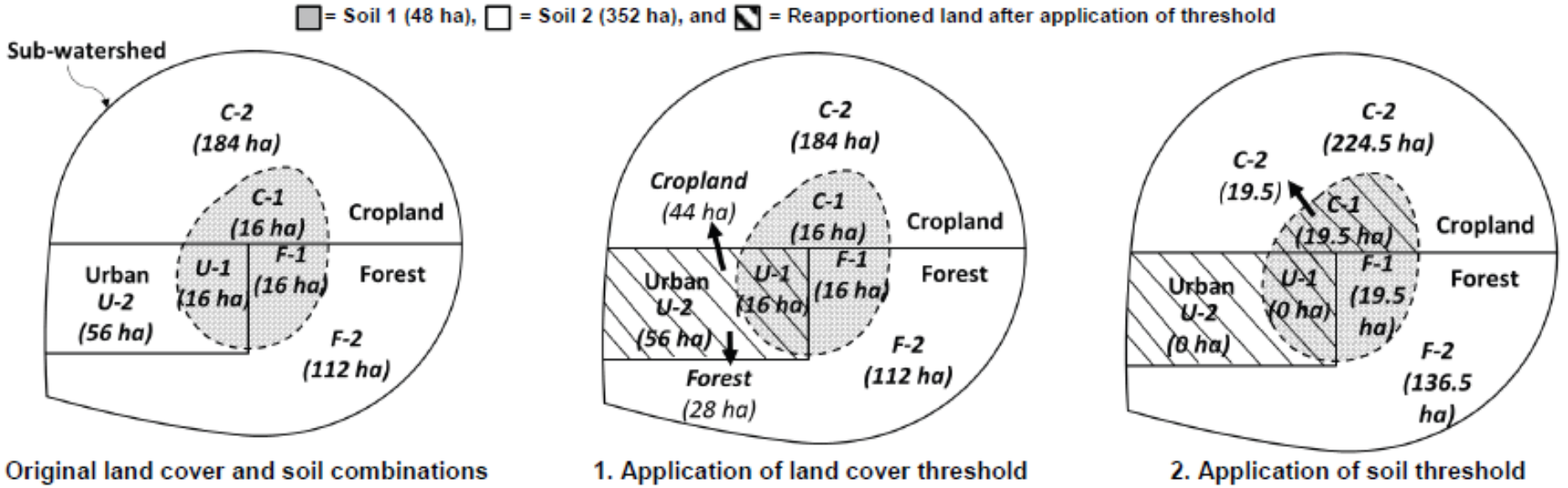




	time	calibration		validation	
Glacier influence	1year2month	08/2015	04/2016	05/2016	10/2016
Non glacier influence	10 month	03/2016	08/2016	01/2017	06/2017
confluence	2 years	06/2016	04/2017	05/2017	06/2018

Subbasin	Area (Ha)
1	508.3
2	524.3
3	1414.2
4	1232.7
5	1121.8
6	459.3
7	528.5
8	109.7
9	4.7
10	30.3
11	14.9

HRUs configuration



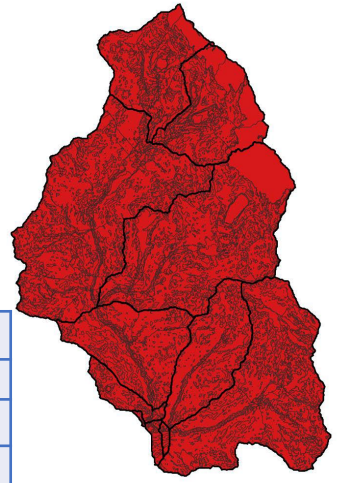
1. Application of Land Cover Threshold (20%)					2. Application of Soil Threshold (10%)				
Land Cover	Area (ha)	Percentage of Sub-Watershed	Qualifies as HRU?	Result (ha)	Soil	Area after Land Cover Threshold (ha)	Percentage of Land Cover	Qualifies as HRU?	Result (ha)
Cropland	200	50%	Yes	244	Soil 1 (C-1)	19.5	8.0%	No	0
					Soil 2 (C-2)	224.5	92.0%	Yes	244.0
Forest	128	32%	Yes	156	Soil 1 (F-1)	19.5	12.5%	Yes	19.5
					Soil 2 (F-2)	136.5	87.5%	Yes	136.5
Urban	72	18%	No	0	Urban land reapportioned to cropland and forest				

Y. Her et al (2015)

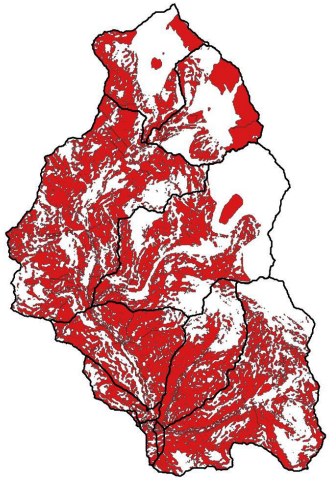
Subbasins	11
FULL HRU	444

Names	Representation	Landuse	Soil	Slope	HRUs
FULL	Complete	34%	90%	40%	444
18L_0S_13P	No wetlands	18%	0%	13%	279
DOMINANCIA	Dominace				78
0L_0S_40P	No slope	0%	0%	40%	208
Land_Soil_Slope	Dominance land, soil or slope				78
34L_0S_0P	No Landuses	34%	0%	0%	314
0L_90S_0P	No soil	0%	90%	0%	388
2L_90S_40P	**Best configuration**	**2%**	**90%**	**40%**	**153**

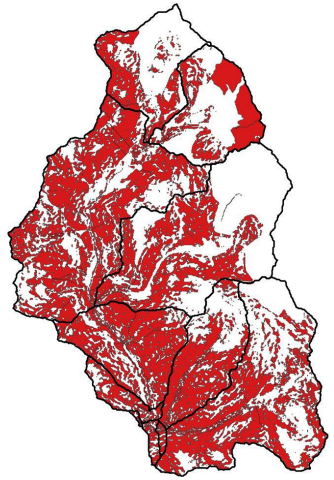
Full HRU



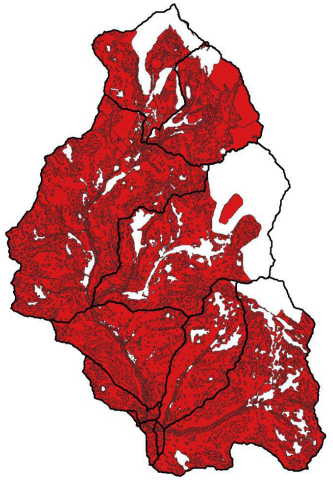
Dominance



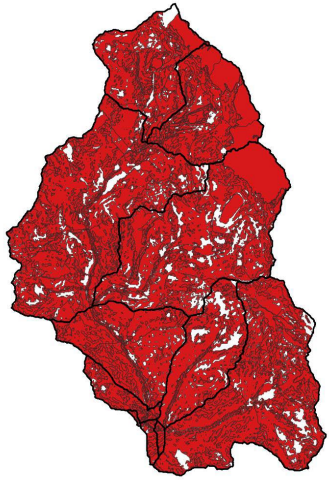
Land_soil_slope



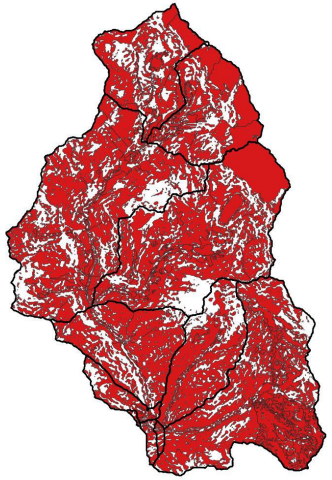
34L_0S_0P



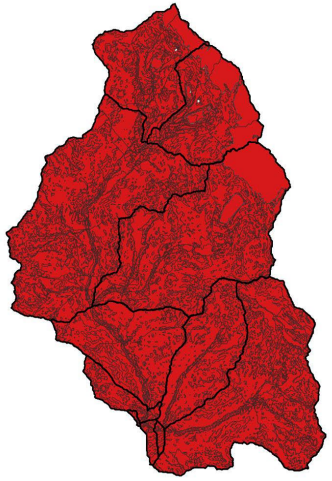
18L_0S_13P



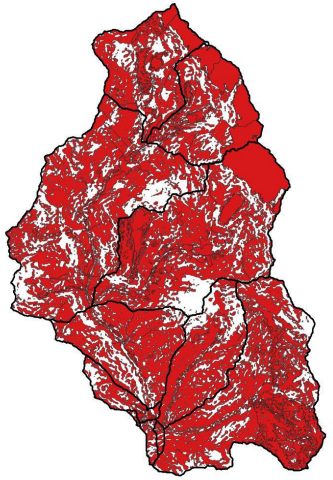
2L_90S_40P



0L_90S_0P



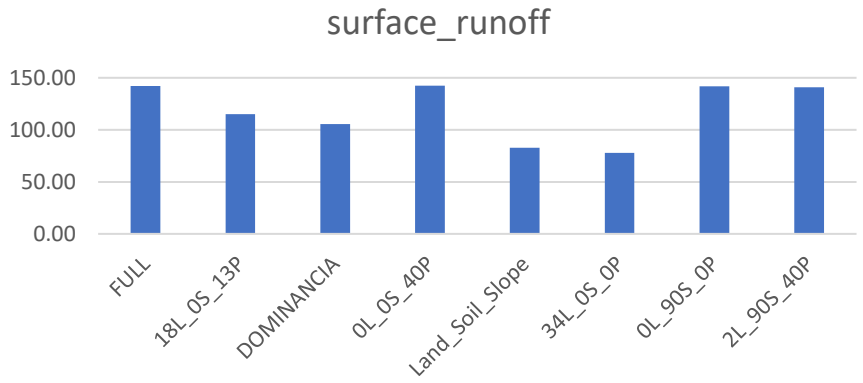
0L_0S_40P

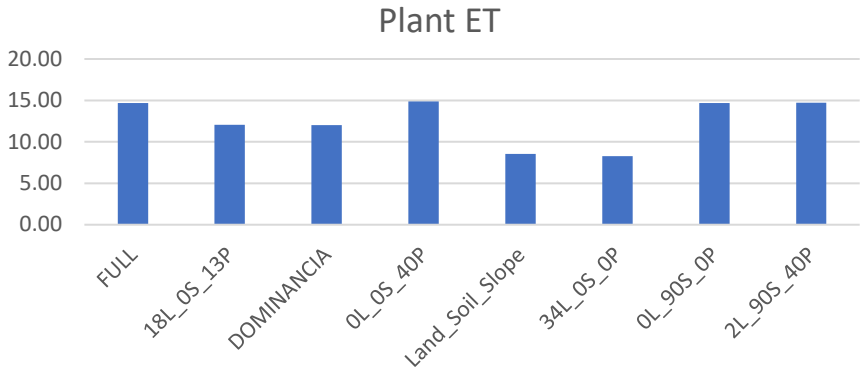


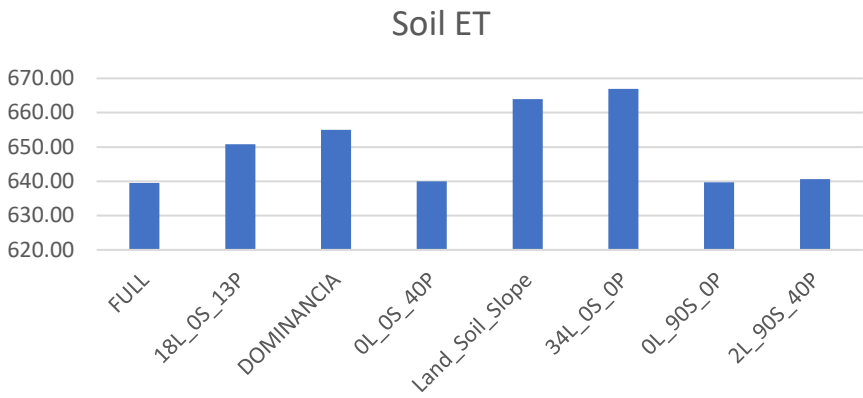
Results

Main diferences of flows by HRU configuration

HRU configuration	Surface runoff mm/year	Plant ET mm/year	Soil ET mm/year
FULL	142.1	14.7	639.5
18L_0S_13P	114.9	12.0	650.8
DOMINANCIA	105.6	12.0	655.0
0L_0S_40P	142.3	14.8	639.9
Land_Soil_Slope	82.8	8.5	663.9
34L_0S_0P	77.7	8.2	666.9
0L_90S_0P	141.8	14.6	639.6
2L_90S_40P	140.7	14.7	640.5

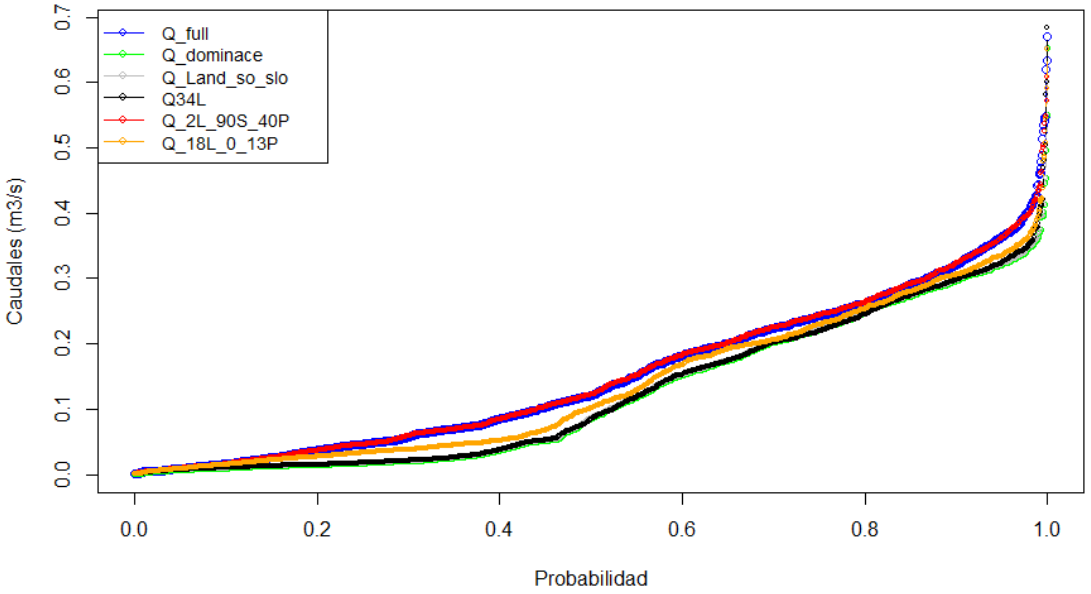




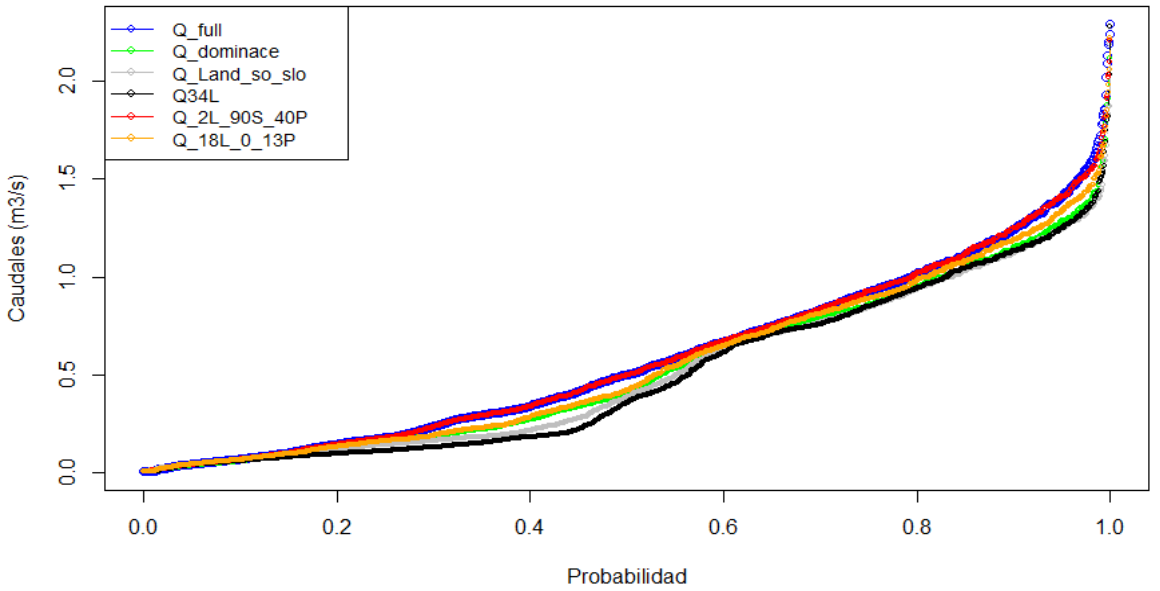


Results

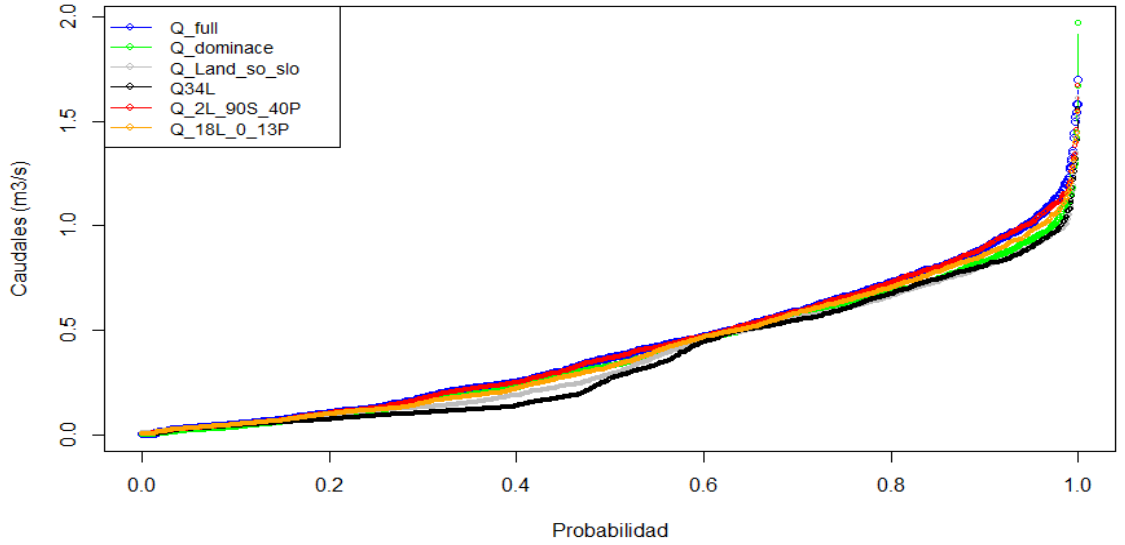
Non glacier influence



Confluence

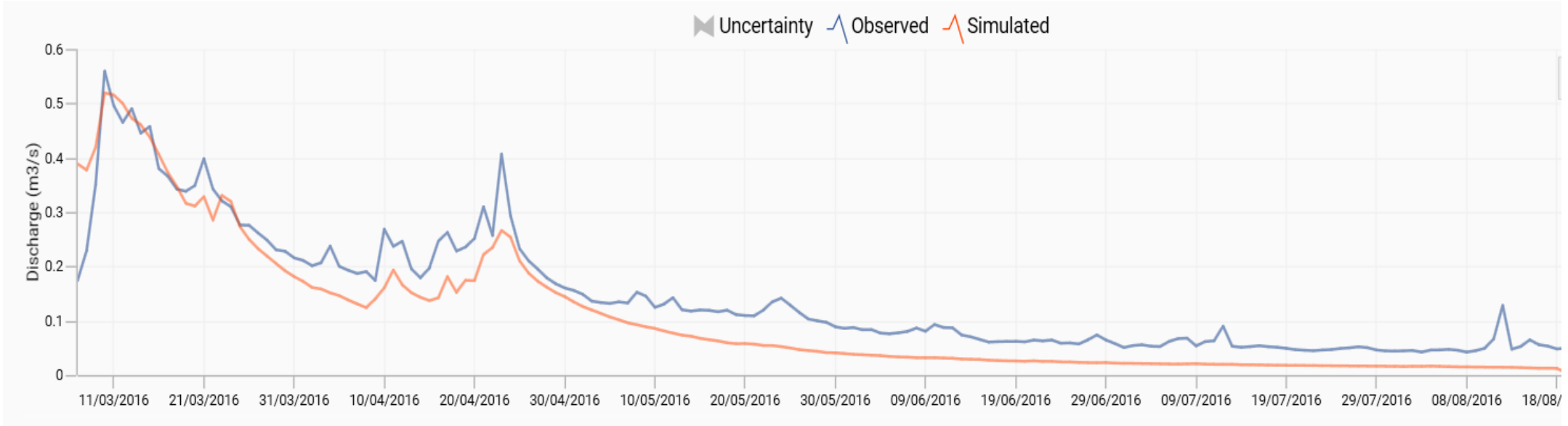


Glacier influence



Calibration

Non glacier influence



Conclusions and next steps

- Properly representation of landuse allows a better evaluation of investment projects based on interventions on ecosystems.
- The best configuration identified in this work is 2L_95S_40P, because it reduces the number of HRUs necessary for the evaluation of the interventions.
- The fluxes with the significant variation due to the different HRU configurations are Surface runoff, plant ET and soil ET.
- A good calibration was obtained in the area without glacial contribution (NSE=0.79). However, the area with glacial contribution requires further analysis.

- Add the glacier and reservoir components to improve model calibration.
- Improve the soil map with field measurements.
- Link model results to a decision support system.

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