



**Interuniversity Programme in
Water Resources Engineering**

Quantification of rainfall interception in the páramo

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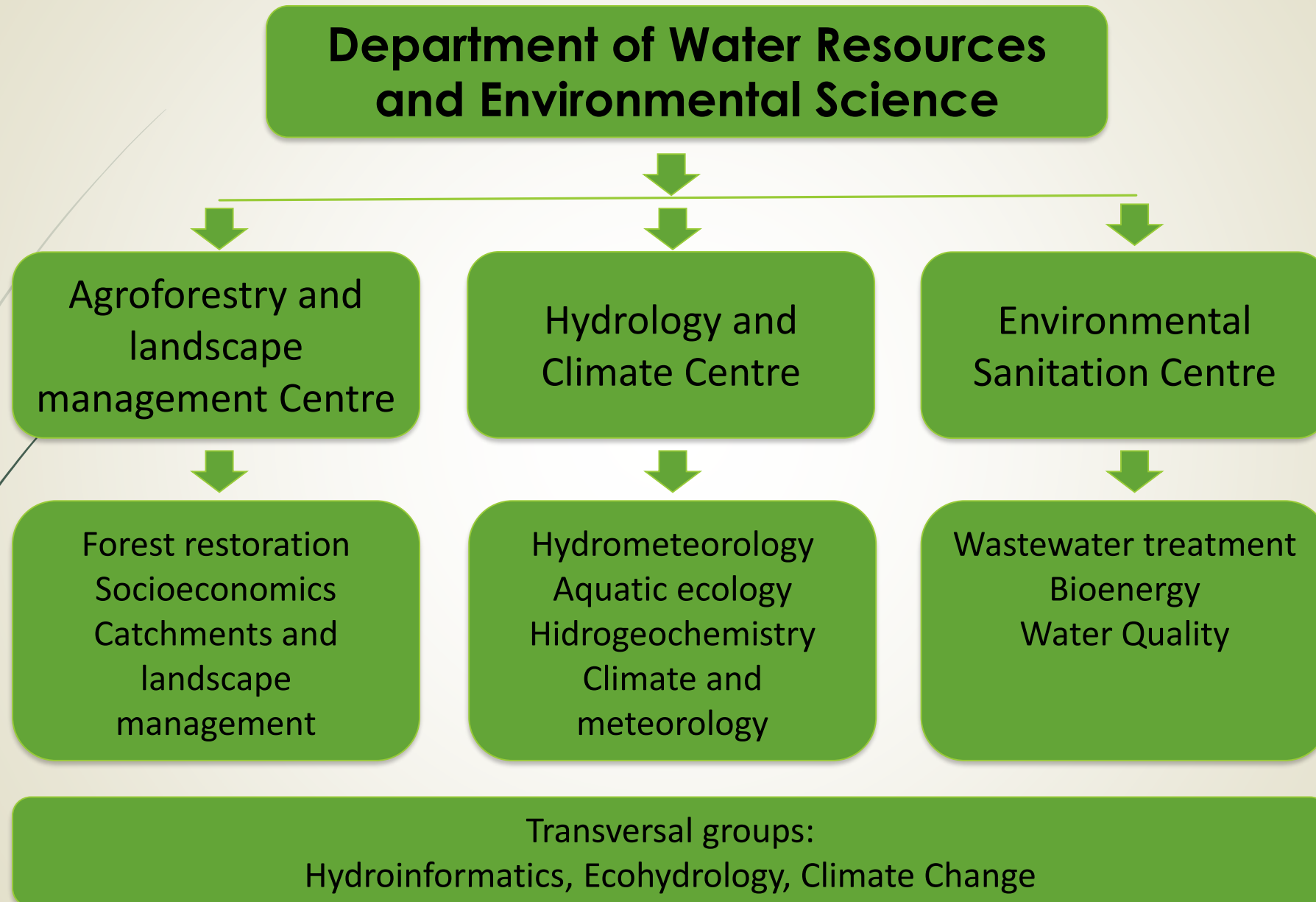
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Importance of the páramo

- Mountain regions produce more than a half of world fresh water
- The páramo ecosystem provides water for:
 - Highlands in Venezuela, Colombia, Ecuador
 - Nearby lowlands
 - Desert zones in Peru
- Impact on its hydrological services
 - Land use change
 - Climate change



Scientific challenge



- Difficulties to study hydrology in the paramo
- Lack of knowledge hinders management of the ecosystem services.
- Studies have been made:
 - Microcatchment scale
 - A single component of the hydrological cycle
 - Subcatchment studies at extreme events

Rainfall-runoff without quantifying the processes in between

Quantifying ETa and partitioning


- ETa explains the interchange of water and energy between the soil and the atmosphere
- Evaporation from soil, plants, and transpiration separately to:
 - Process conceptualization
 - Interception is a large part of evaporation: rarely quantified in grasslands

Interception process (IL)

 
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RESEARCH ARTICLE


Quantification of rainfall interception in the high Andean tussock grasslands

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Abstract

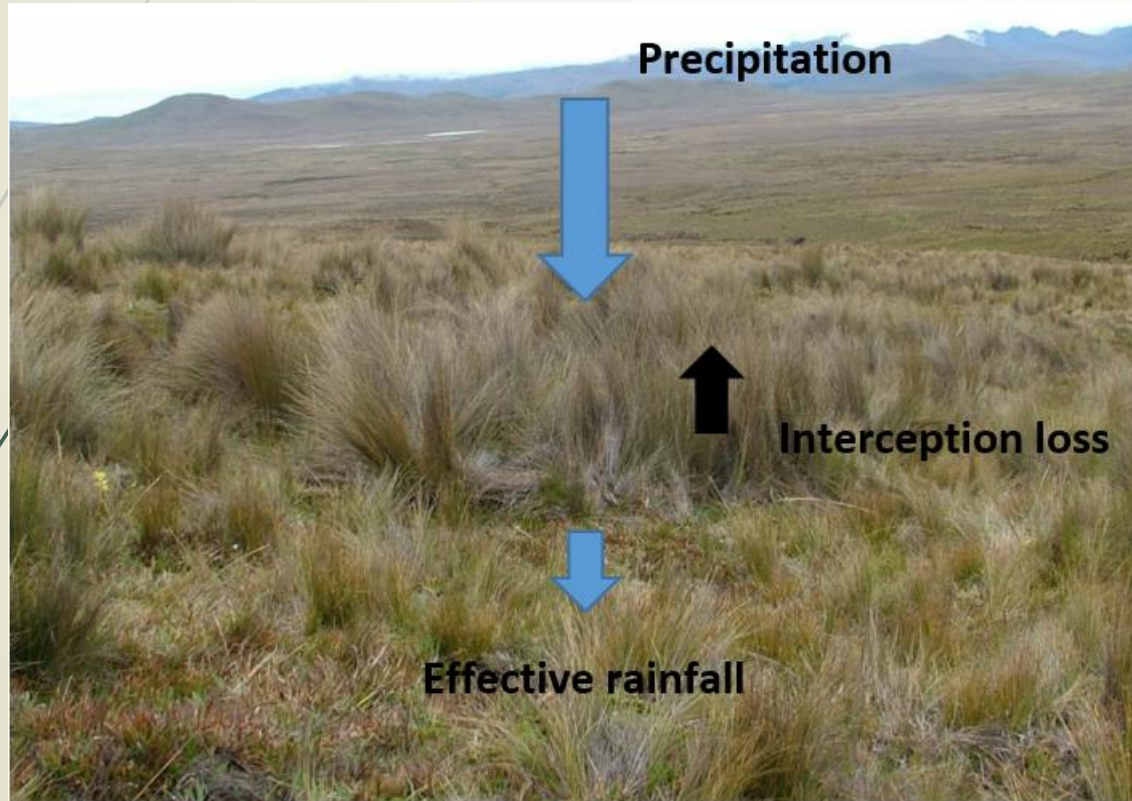
The páramo ecosystem provides most of the water for the tropical Andean highlands in South America. While the comprehension of this environment has increased lately, there remains an urgent

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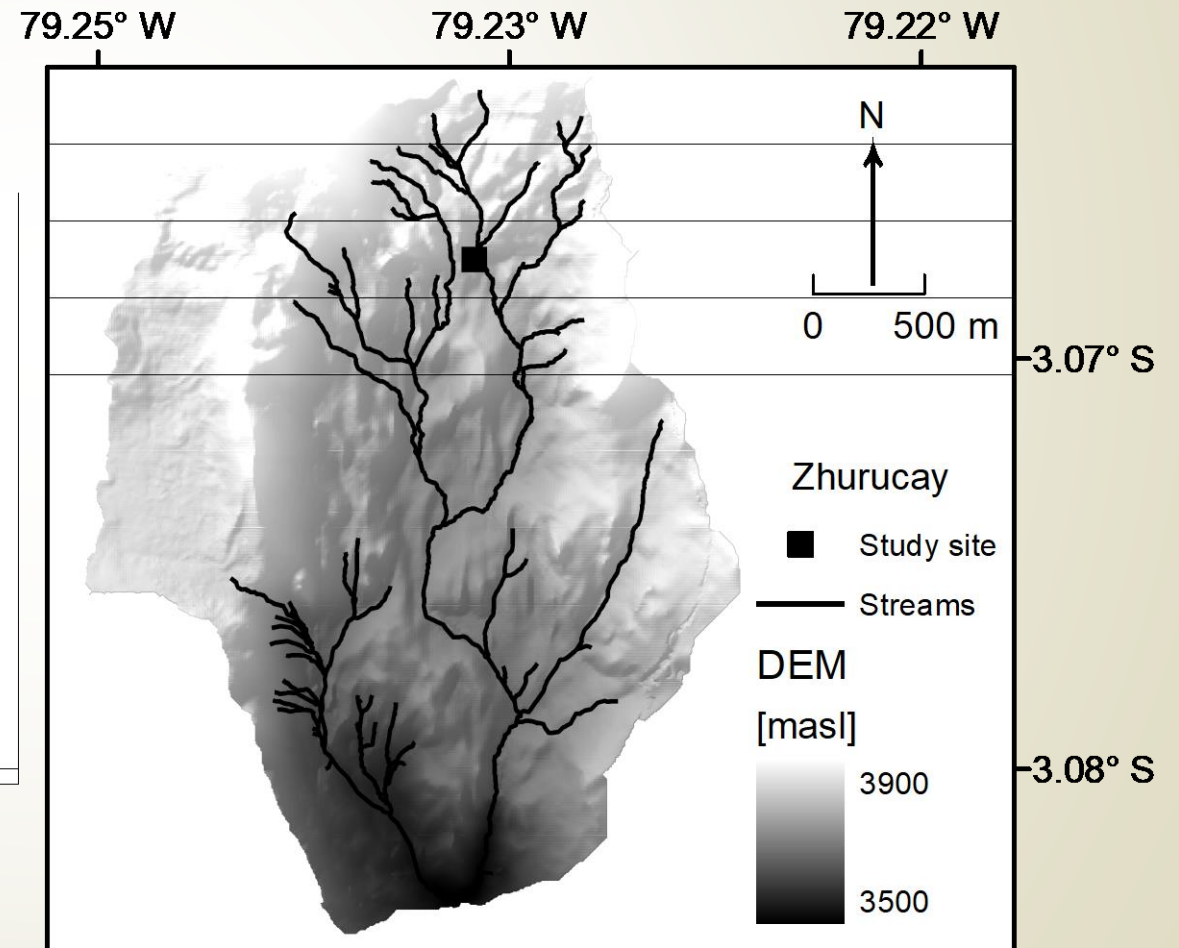
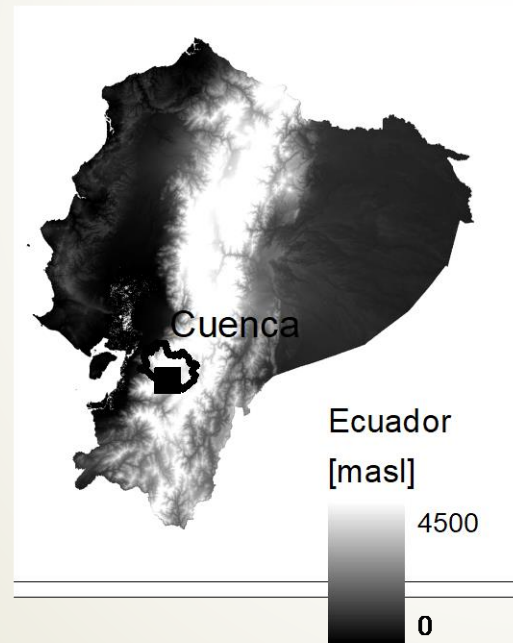
Interception process (IL)



Scientific questions on IL process

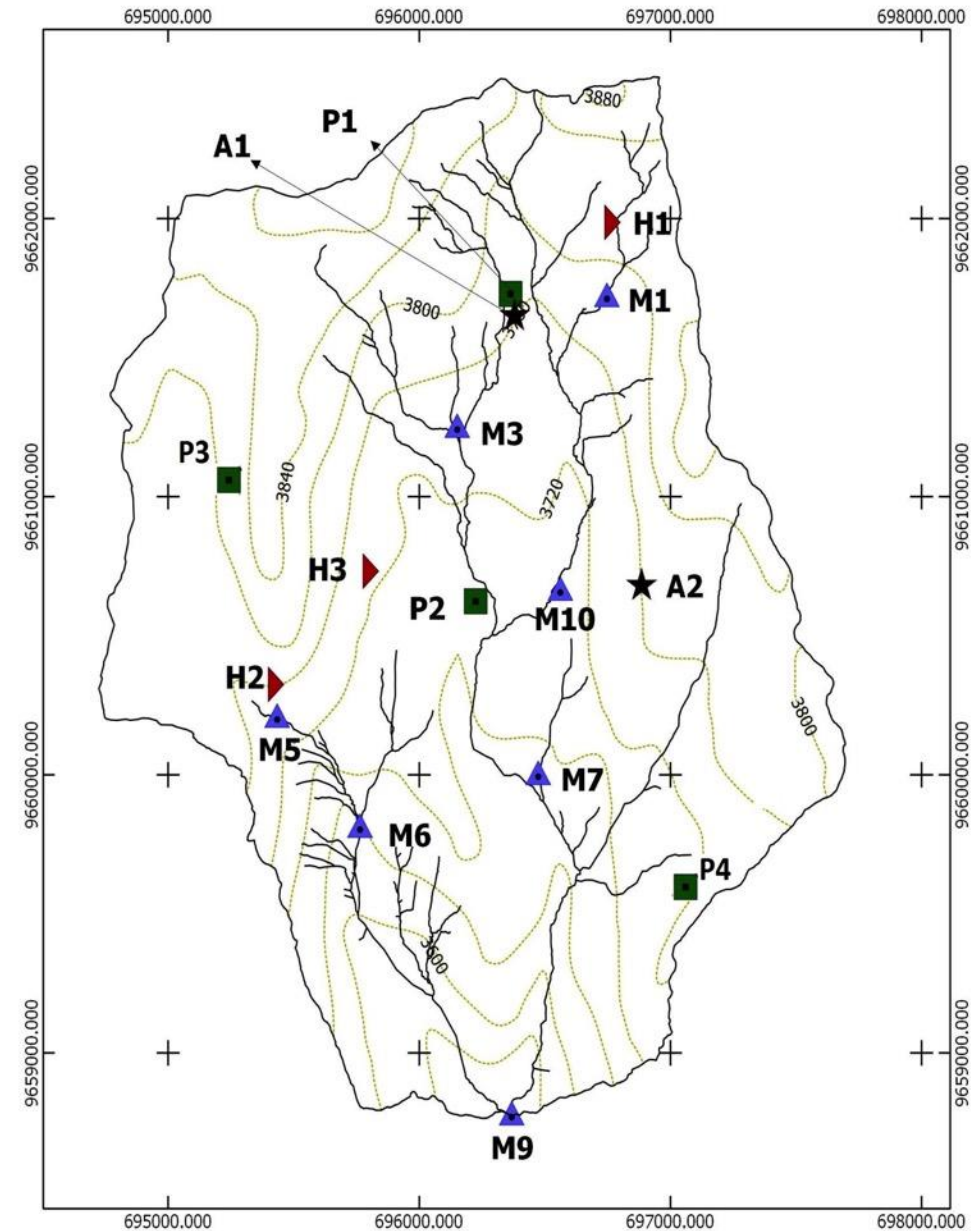
1. How much of precipitation becomes effective rainfall (ER) and how much interception (IL)?
2. What is the impact on IL calculations of using a raingauge instead of a disdrometer?
3. Which meteorological variables are related to the IL process?
4. Is it possible to estimate IL from meteorological variables?

Zhurucay Ecohydrological Observatory



Zhurucay Ecohydrological Observatory

- 3 meteorological stations
- 12 raingauges, 2 disdrometers
- 1 Eddy-covariance station
- 2 energy flux systems
- 1 experimental hillslope
- Tracers and ecological monitoring



Materials



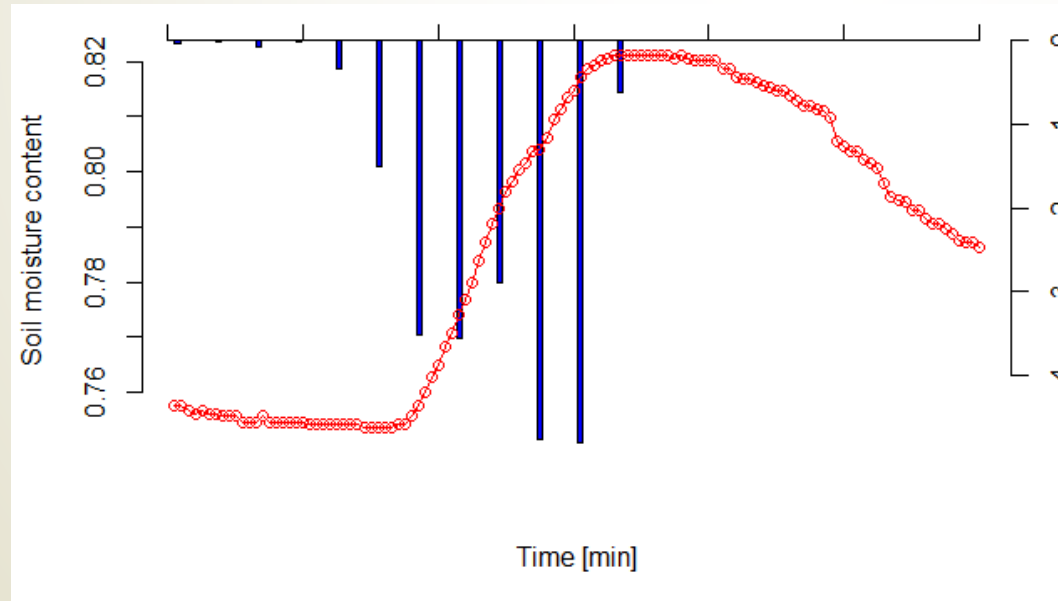
- Disdrometer and rain gauge
- Meteorological station
- WCRs

4-year time series with a 5-min time resolution

- Precipitation
- Soil water content at 10 cm depth
- Meteorological variables (RH, Rn, Eto, Ws, WI, etc)

Methods: IL quantification per event

1. Event selection
2. Calculation of P , ER \rightarrow IL
3. Disdrometer vs. rain gauge



$$IL = P - ER \quad [\text{mm}]$$

P = cumulative
precipitation

$$ER = \Delta \text{ soil moisture} * 100$$

Methods: IL related to meteo variables

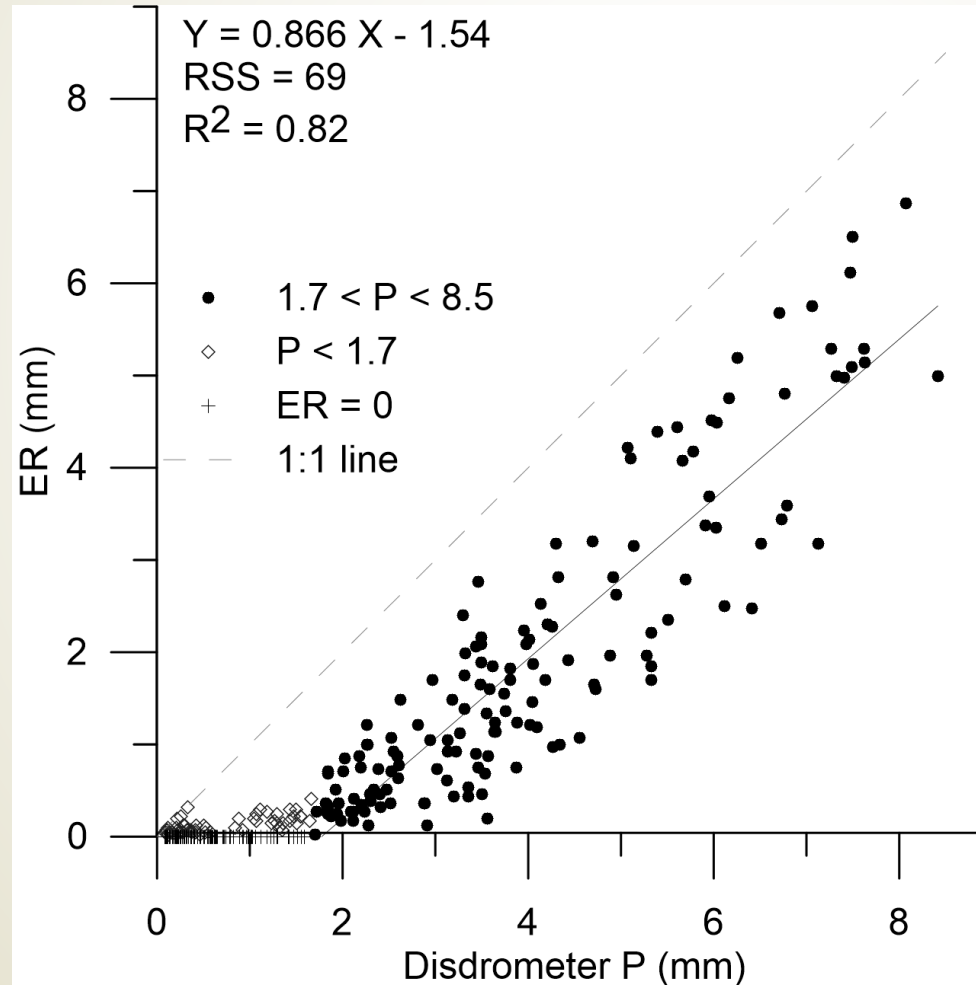
1. Random forest

- Which meteo variables are the most important to IL process?
- Reduces number of variables

2. Regression trees

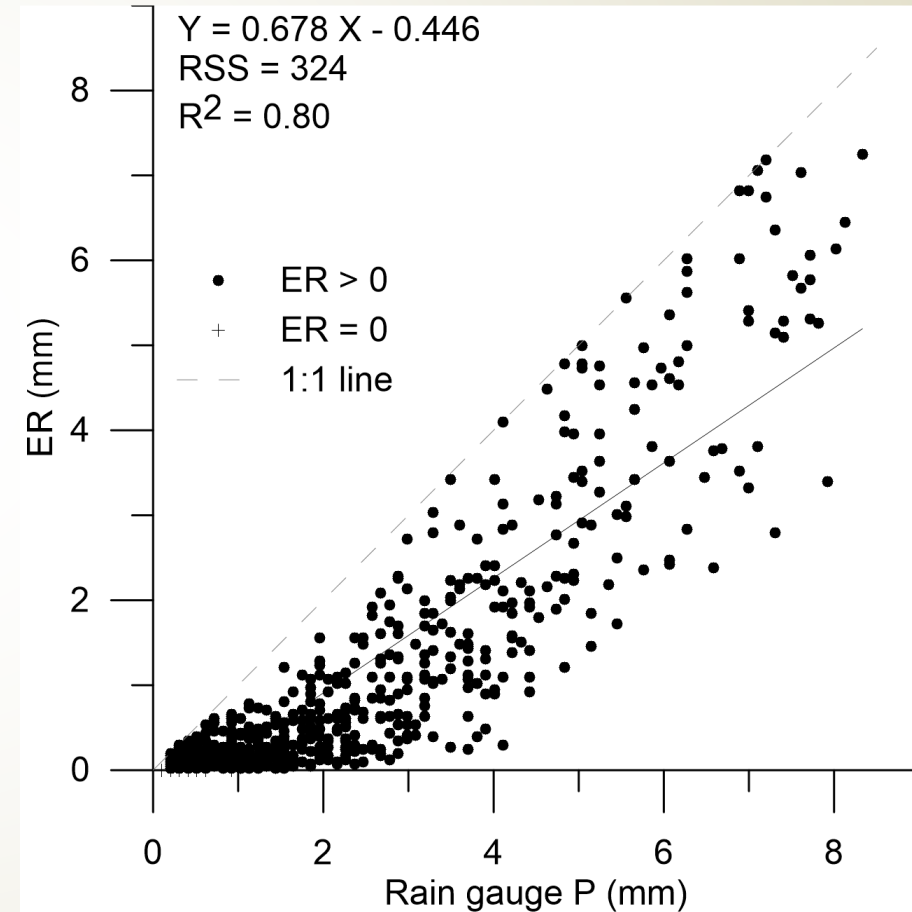
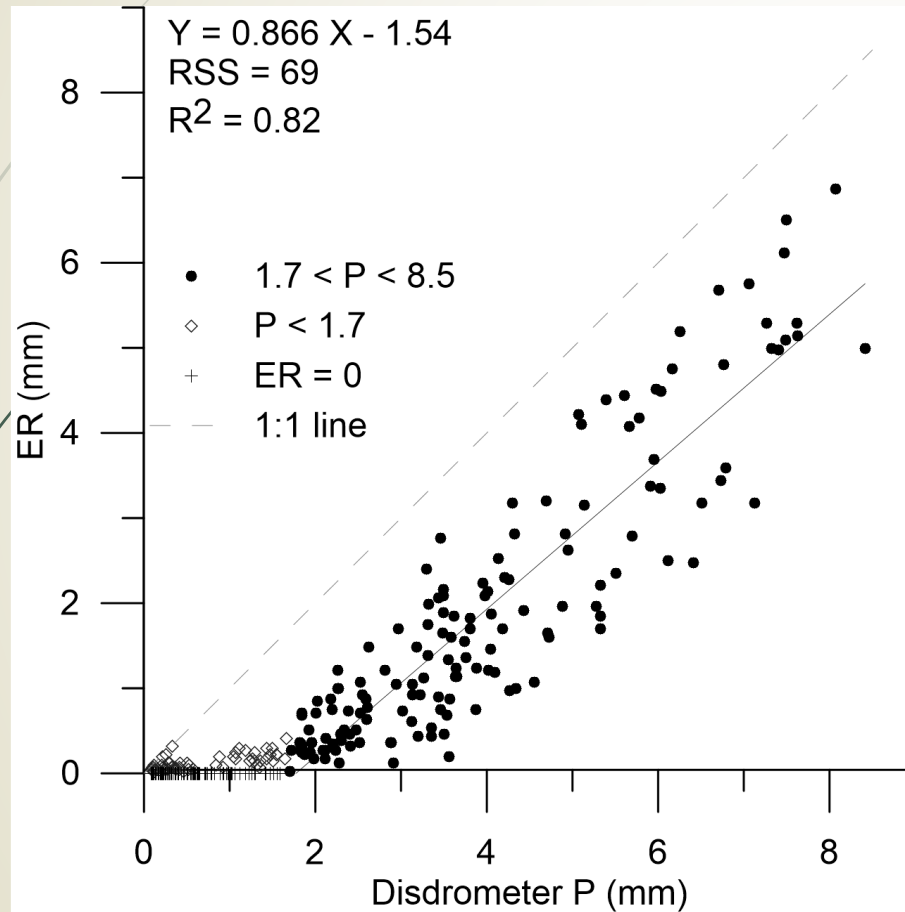
- Tree includes variables related to IL
- Threshold values for each variable

How much of precipitation becomes effective rainfall (ER)?

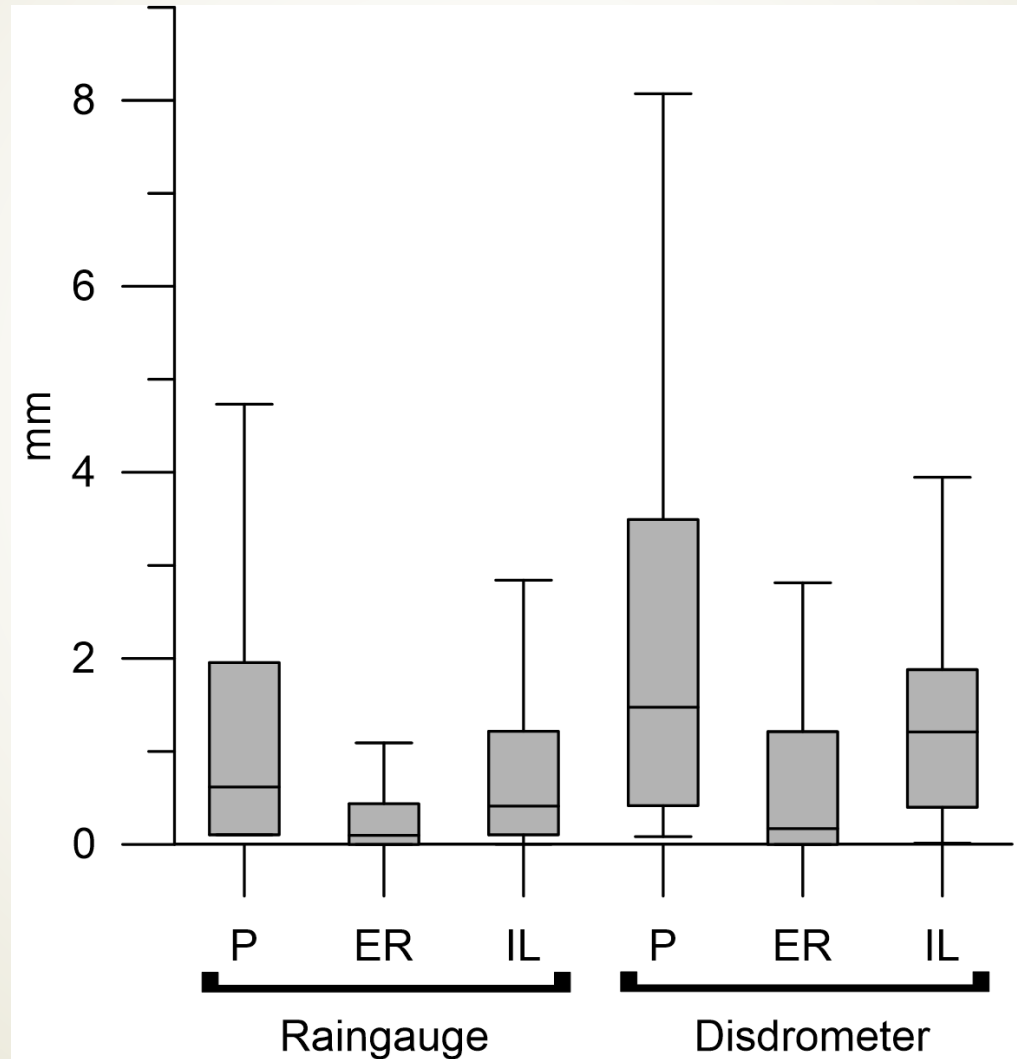


Max canopy storage
 $S = 2 \text{ mm}$

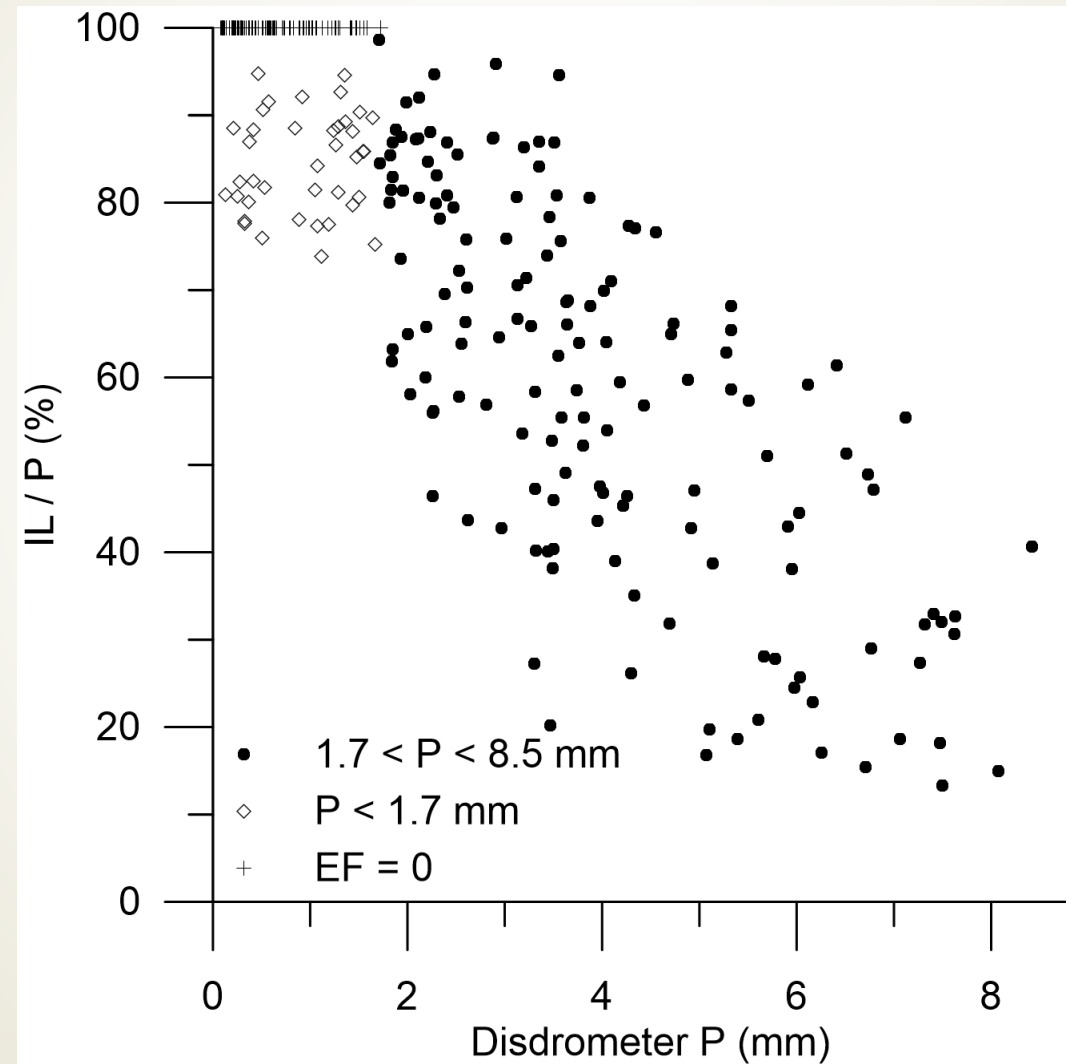
Disdrometer or rain gauge?



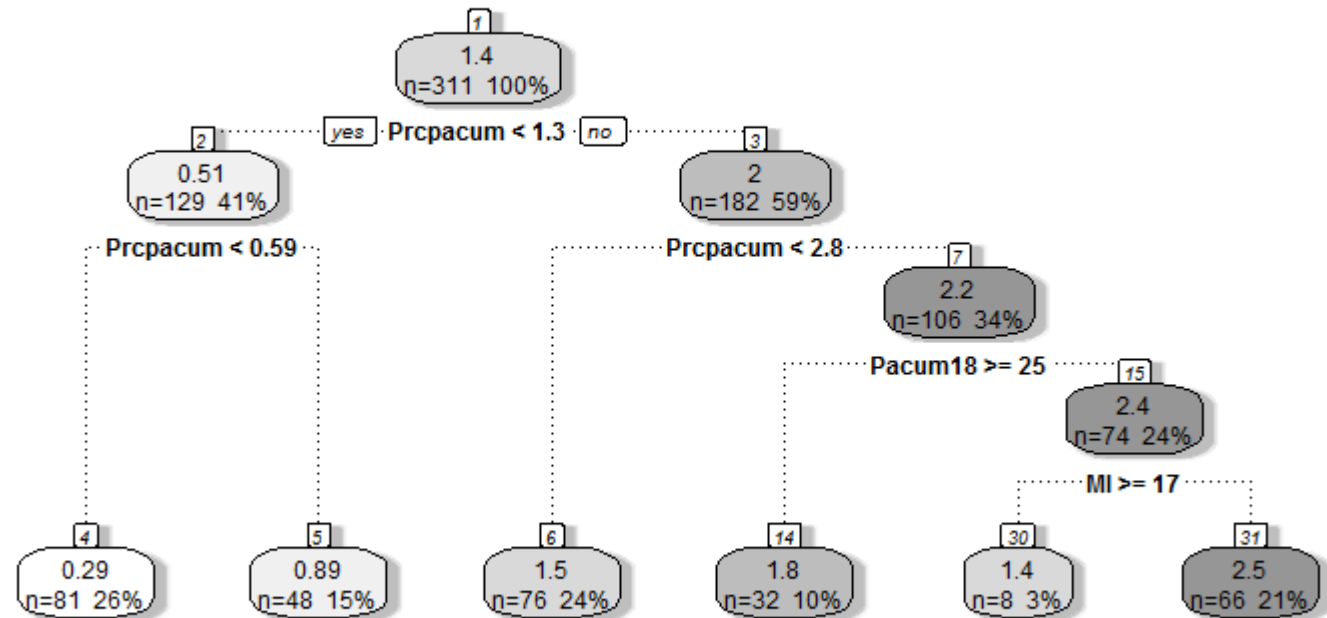
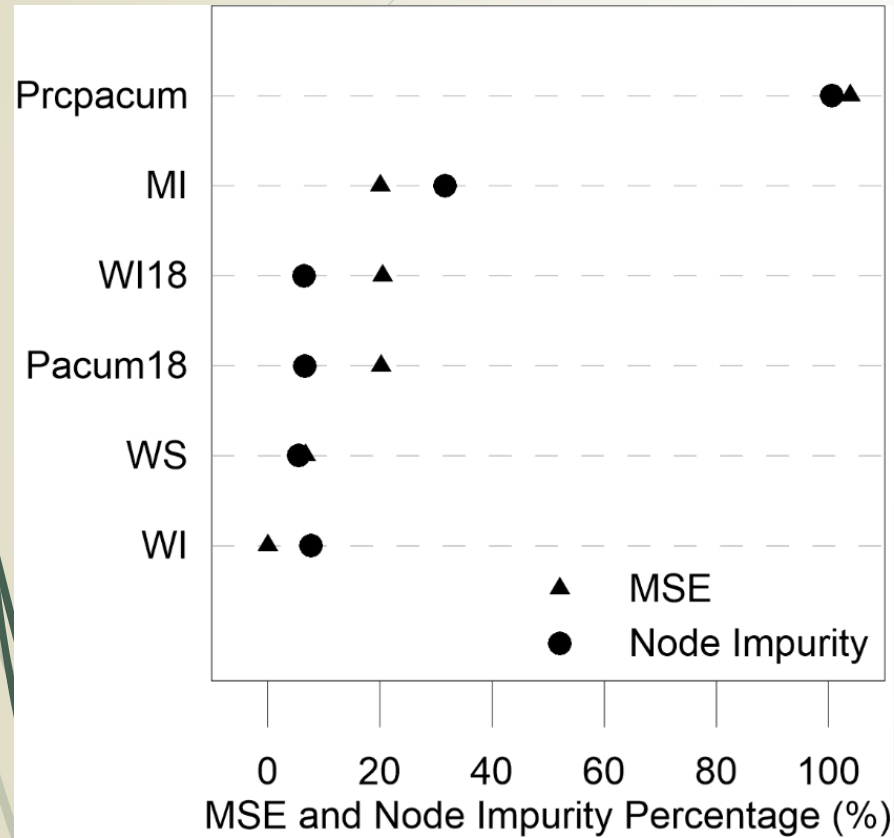
Disdrometer or raingauge?



How much is IL?

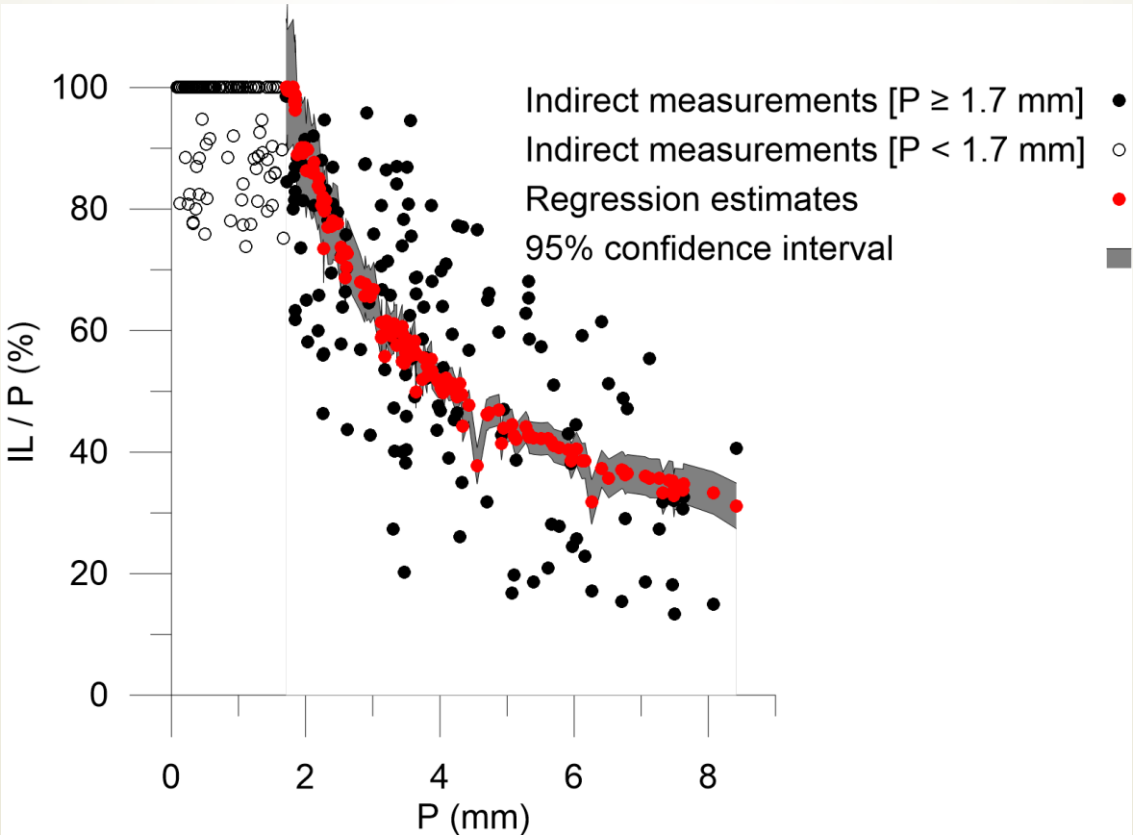


Which variables are related to IL?



Is it possible to estimate IL?

Dependent variable	Model [@]	RSE (mm)	R ²
Interception loss (mm)	$IL = 0.140 P^{***} + 0.016 RH^{**}$	0.67	0.9



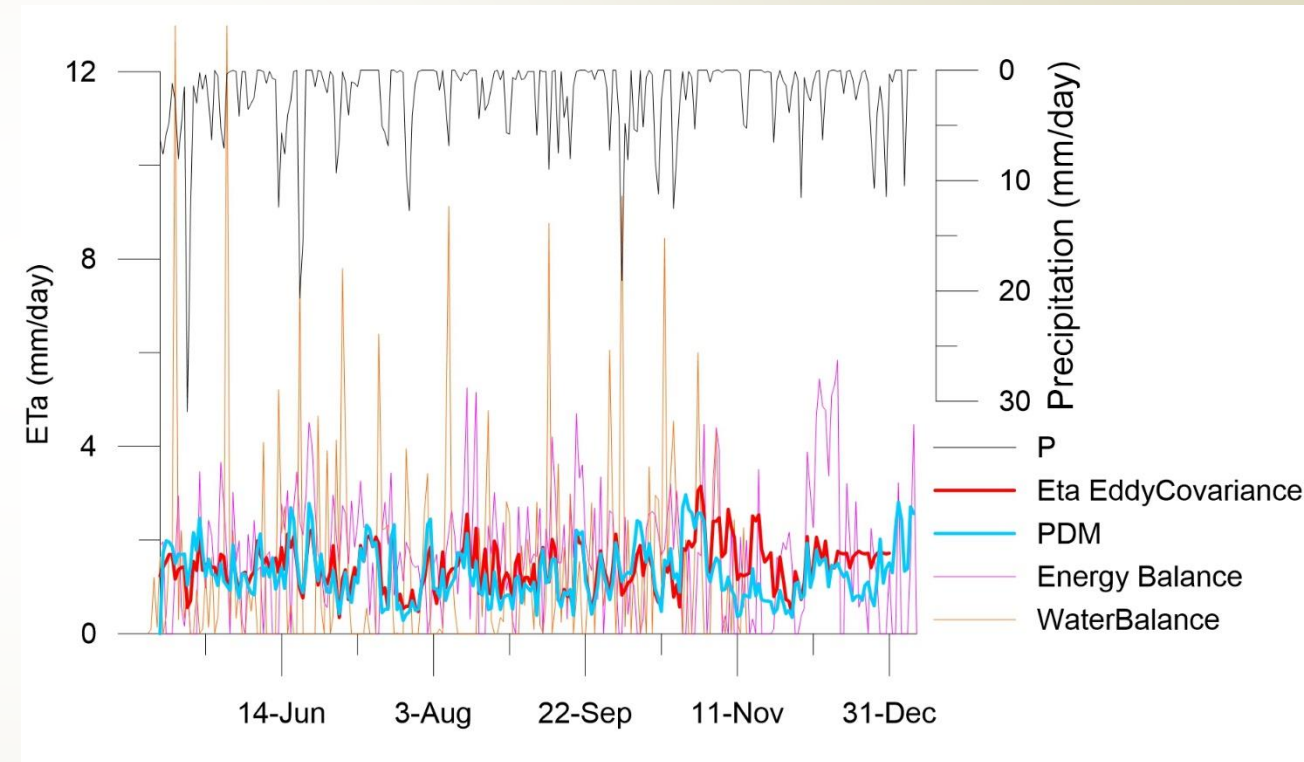
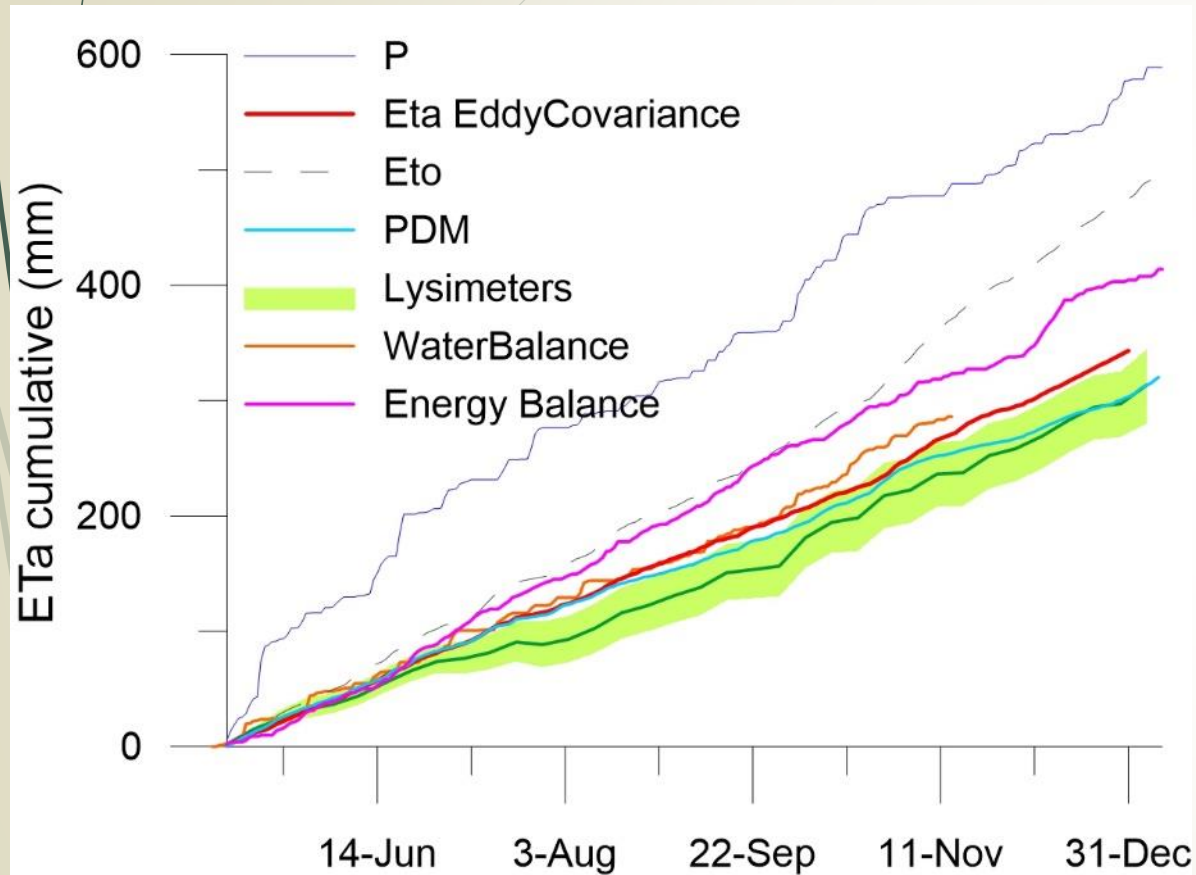
Conclusions

- IL was quantified for the first time in the páramo
- Drizzle quantified with the disdrometer needs to be taken into account for more accurate calculations of IL
- Maximum water storage capacity of the tussock grassland is 2 mm

Conclusions

- IL expressed as a percentage of cumulative precipitation goes from 100 to 10 %
- IL is mainly related to P
- IL can be estimated from P and RH with a multiple linear regression when $1.7 < P < 8.5$ mm

Future work





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Thanks for your attention

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Literature review

Reference	IL/P (%)	S (mm)	P (mm)	RH (%)	D (h)	WS (m/s)	WI (mm/h)	Vegetation coverage (%)
1. Ochoa-Sánchez et al., 2018	30-100	2	+	+	No cor	No cor	No cor	
2. Genxu et al., 2012	5-20		+		+		+	+
3. Baloutsos et al., 2009	26-40		+		+	+	No cor	
4. Domingo et al., 1998	20-40	0.25-0.75	+					
5. Lockwood & Sellers, 1982						No cor		+
6. Campbell & Murray, 1990	10-100	0.6-0.7	+					
7. Crouse et al., 1966	30	0.127	+					+
8. Beard, 1956	10		+				-	