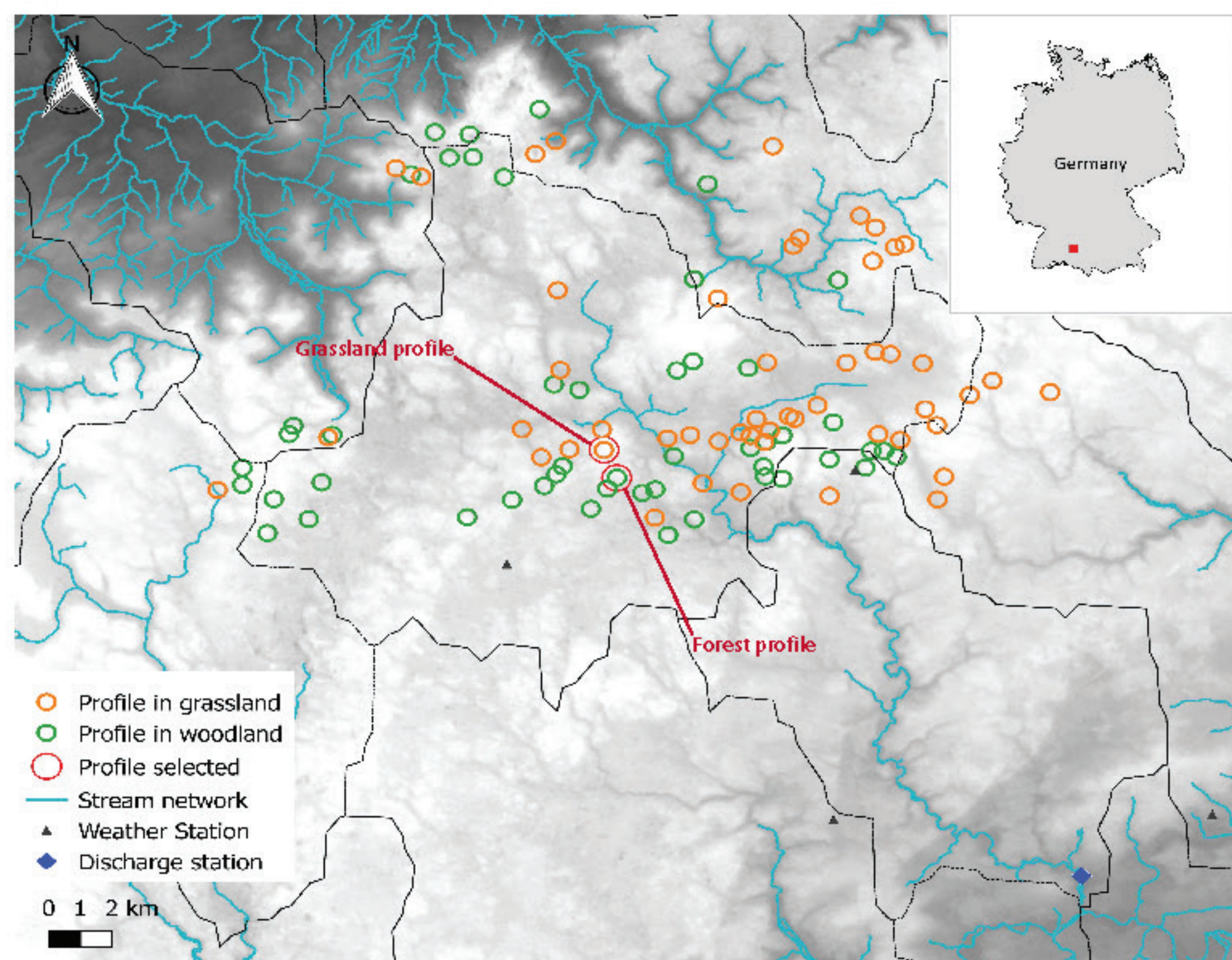


## Motivation

- The most typical approach to characterize a karst system: the disintegration of its output signal measured at the karst spring which includes discharge observations, the hydrochemical signal or tracer information
- In this ongoing study: elaboration on the value of soil moisture observations to characterize the karstic groundwater recharge dynamics
- Storage-discharge relationship in catchment can be hysteretic and can reveal different hydrological processes \*
- Hysteresis analysis can help developing more realistic models for karst systems \*\*

## Study area, Experimental setup & Data



### Study area

Location: Swabian Alb - Baden-Württemberg - Southwest Germany

Geology: Upper Jurassic carbonate rocks - Karstified

Soil: Rendzina soil

### Data

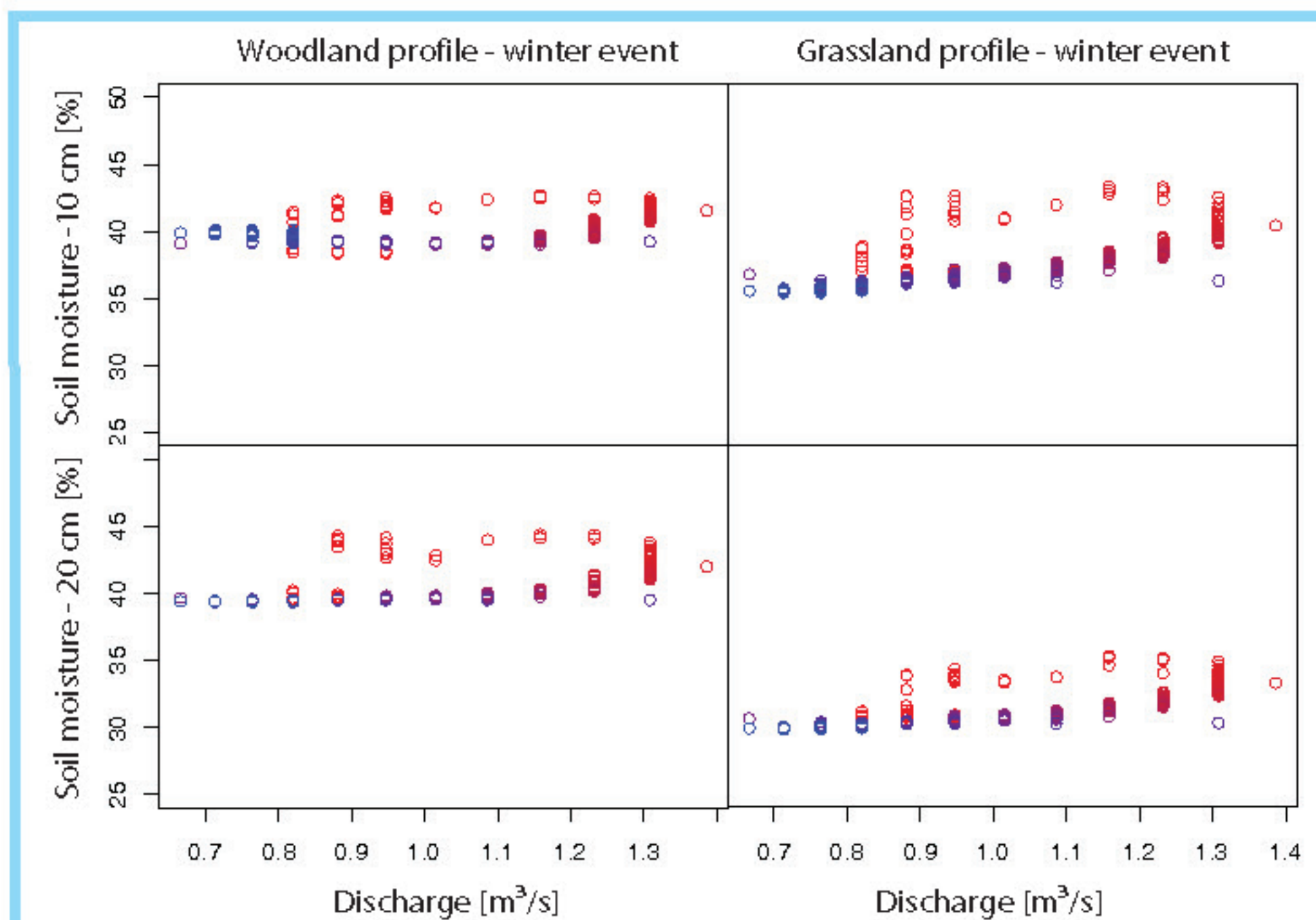
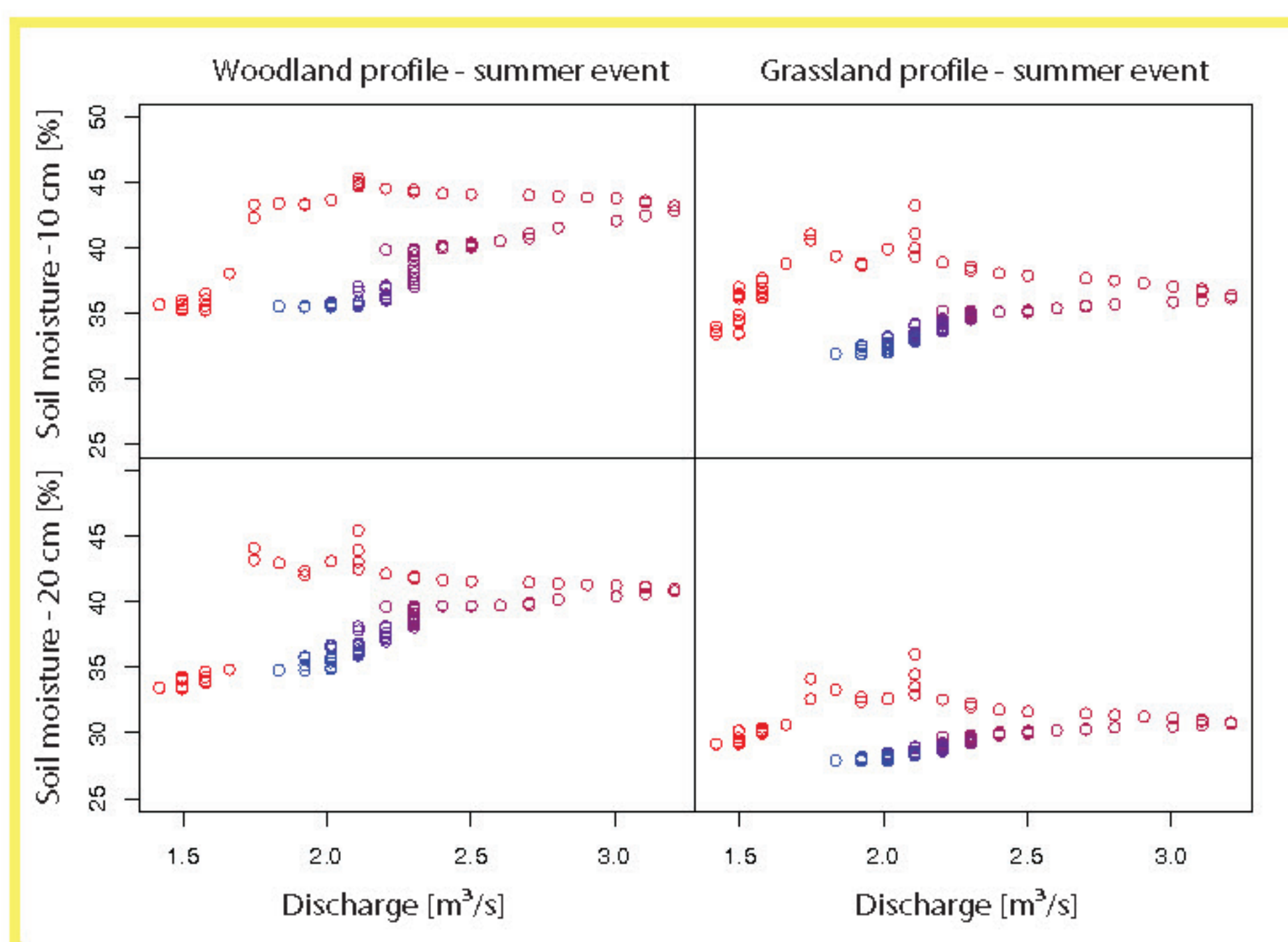
Soil moisture data: 50 soil moisture profiles measurement in grassland  
49 soil moisture profiles measurement in woodland  
Soil moisture probe at 10 and 20 cm depth  
Measurements from 2009 to 2017 - 1h resolution



Discharge data: GrosseLauter river - 1h resolution

Rainfall data: 1h resolution

## Results



Clockwise reaction observed: it seems that the soil storage has first to be refilled before the water is infiltrated to the saturated zone.

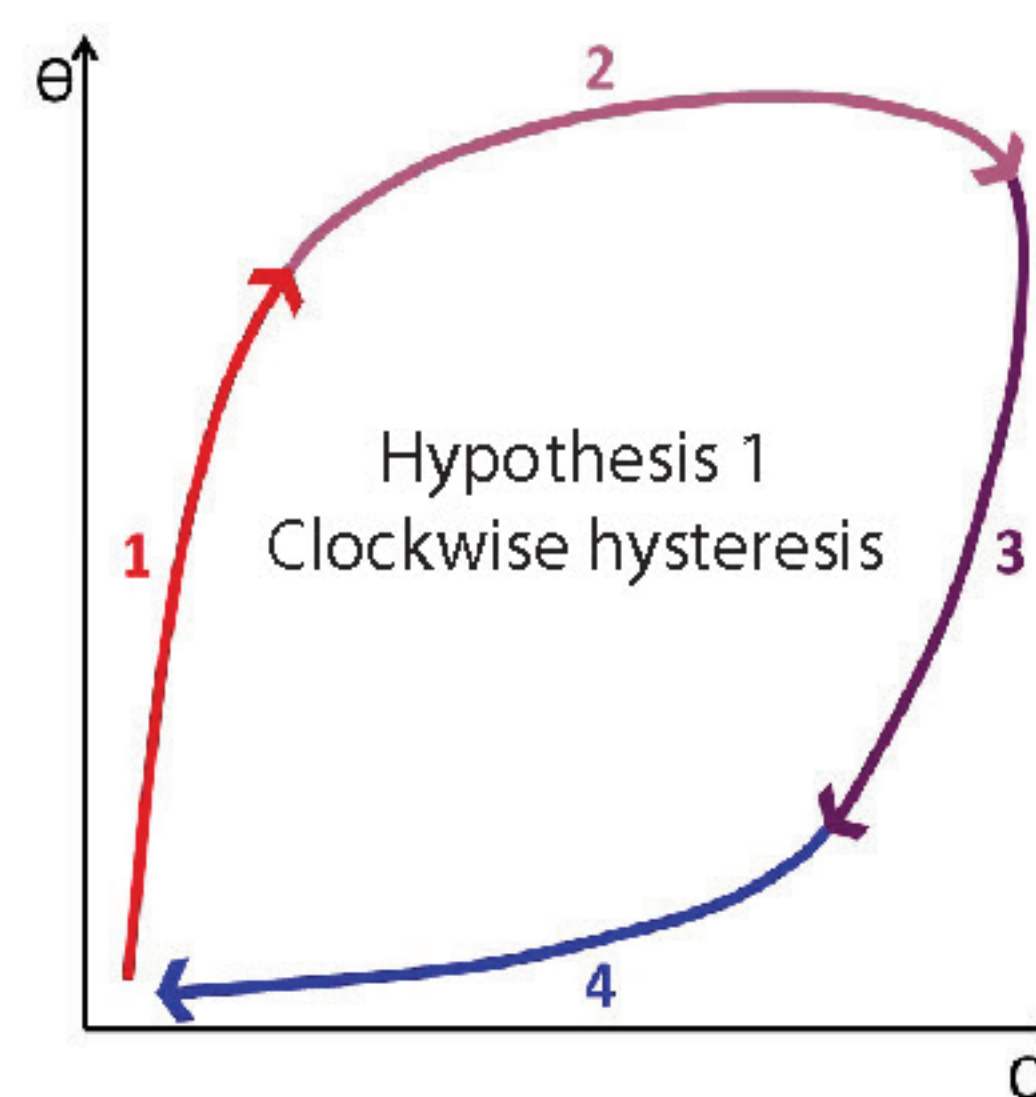
The woodland soil moisture increases faster than in the grassland: it can be interpreted as the presence of preferential flow

Start of the event      End of the event

Clockwise reaction and the faster increase of soil moisture in woodland still observed during the winter event.

The hysteretic curve is less wide compared to the curve during the summer event, the soil moisture thinly increases compare to the discharge. The field capacity seems to be reached faster than during the summer event.

## Hypotheses & approach

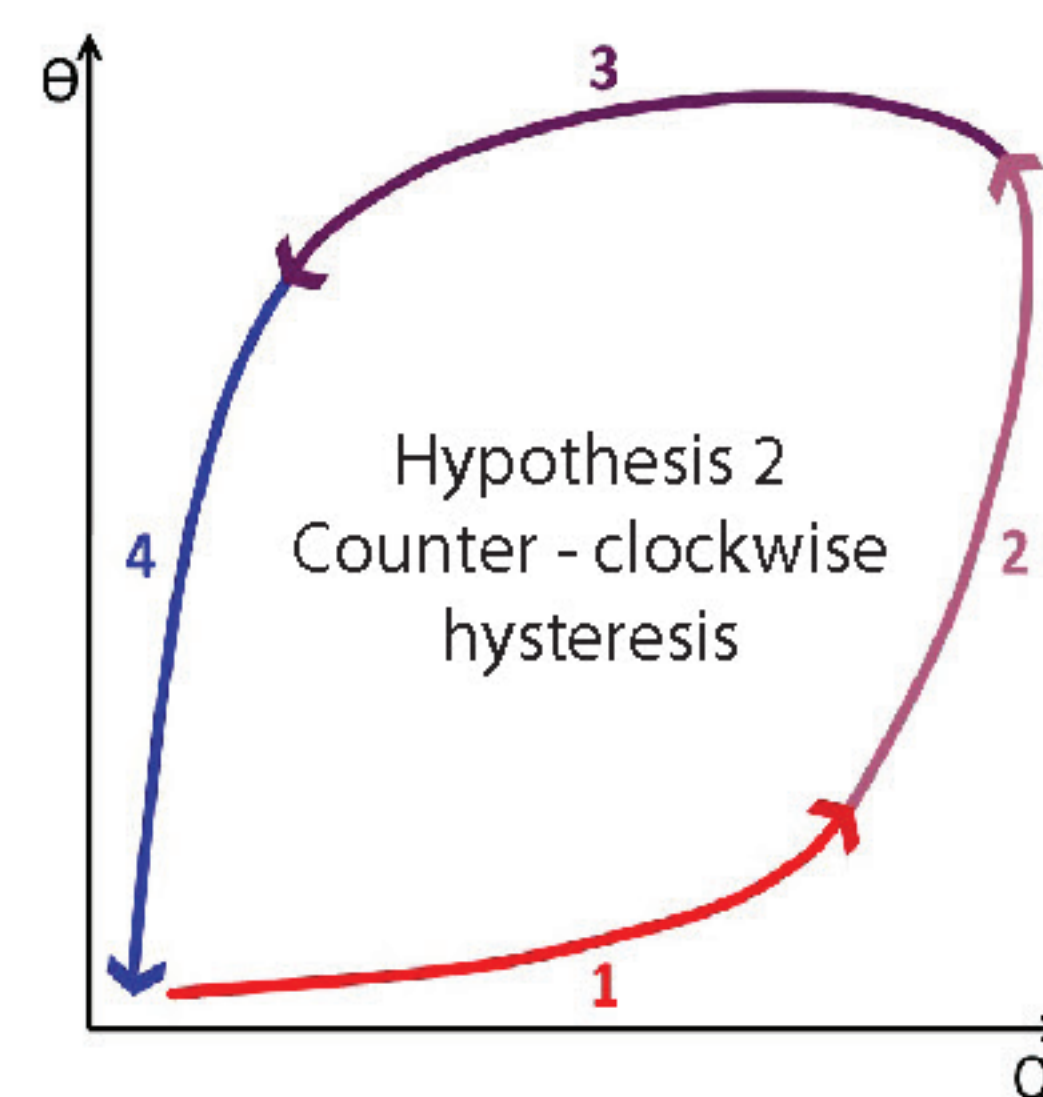


1- The discharge does not react immediately to the rainfall event - the soil moisture increases

2- The discharge increases while the soil saturation is reached

3- The soil moisture decreases but the discharge continue to increase because of infiltration

4- The discharge decreases



1- The discharge reacts quickly after the rainfall event while the soil moisture does not react

2- The soil moisture increases but it doesn't affect directly the discharge reaction that it is still increasing

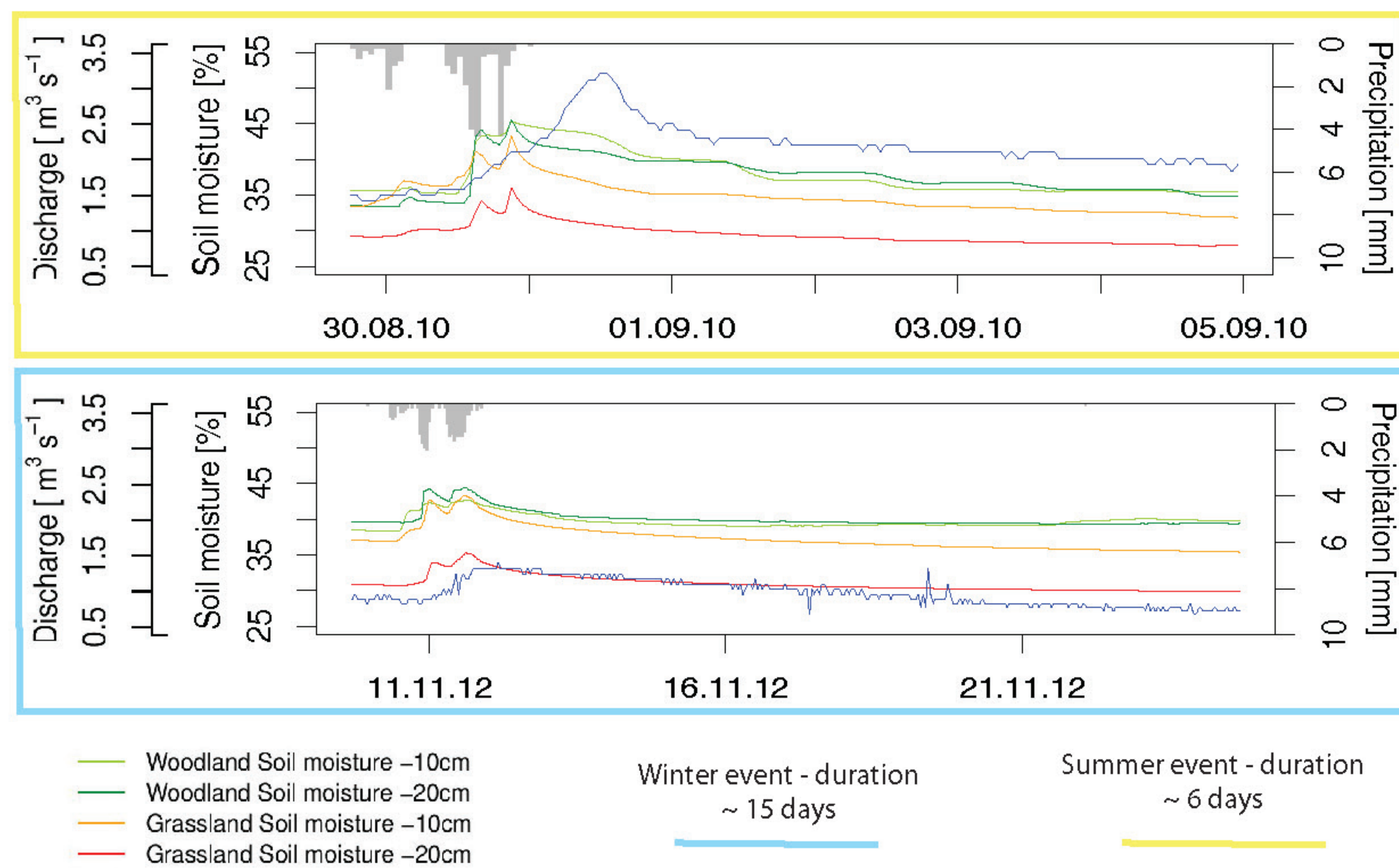
3- The discharge decreases and soil moisture begins to decrease

4- The soil moisture decreases

### First qualitative analysis

- > Selection of 1 profile in the grassland, 1 profile in the woodland equipped with soil moisture probes at 10 cm and 20 cm depth
- > Selection of 1 soil moisture - discharge event during summer (dry conditions) and 1 soil moisture - discharge event during winter (wet conditions)

## Selected events



## Conclusions

- Hysteresis reaction observed, with only the clockwise direction in this study
- New possibility to identify karst hydrological processes in a qualitative way
- Different behaviors observed between land uses and antecedent hydrological conditions

## Perspectives

This approach has been conducted on 2 profiles and 2 events. It will be applied to a larger number of profile and events in a systematic way. Other measurements and analyses will be included to improve processes characterization. For instance, independent estimates of evapotranspiration will help to separate unsaturated percolation in the soil from the reduction of soil moisture due to vaporization.

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