MOXXI Measurements & Observations in the 21st Century

Working Group - International Association of Hydrological Sciences

FEDERAL UNIVERSITY OF FRONTEIRA SUL

CAMPUS CHAPECÓ, BRAZIL

COMBINING SOIL WATER TENSION AND TEMPERATURE MEASUREMENT TO INFER RUNOFF PROCESSES IN A HEADWATER CATCHMENT

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Environmental and Sanitary Engineering

1. MOTIVATION

The determination of the **mechanisms** that control **source areas of runoff generation** and the active drainage network in headwater basins remains a challenge in hydrology.

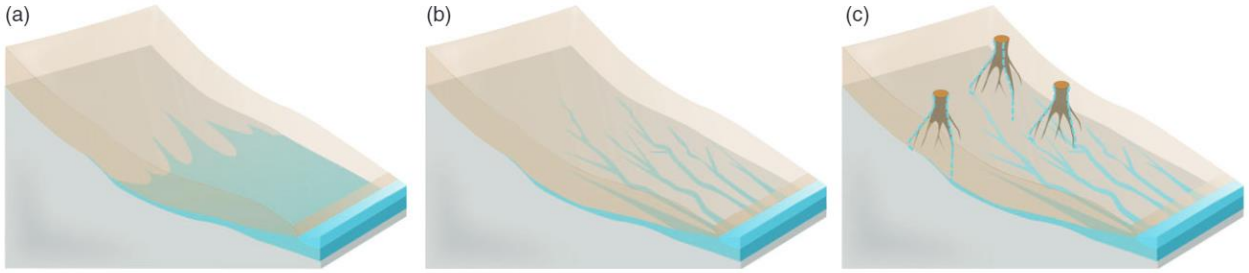


FIGURE 1 | Diffuse hillslope–stream connectivity (a), focused hillslope–stream connectivity due to concentrated flow at the soil–bedrock interface (b), and concentrated flow in macropores (c).

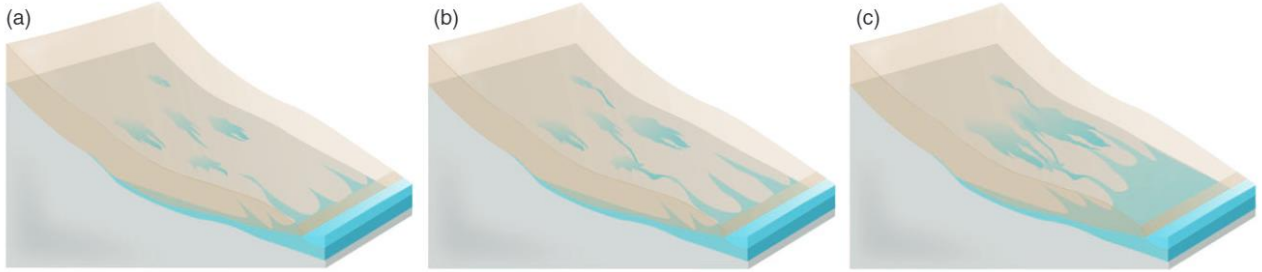
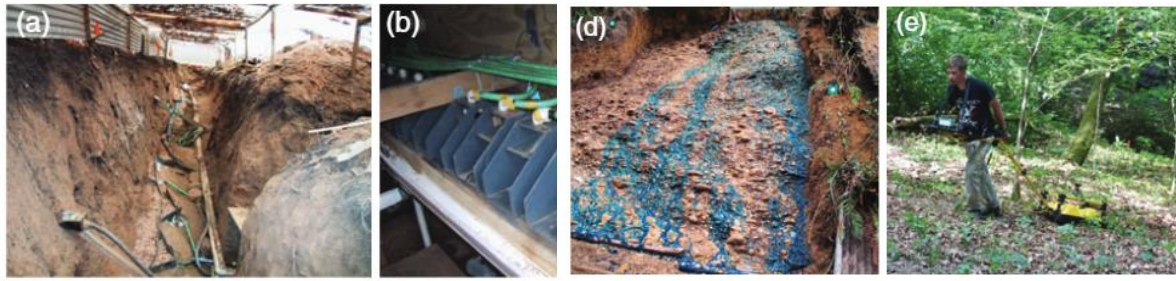
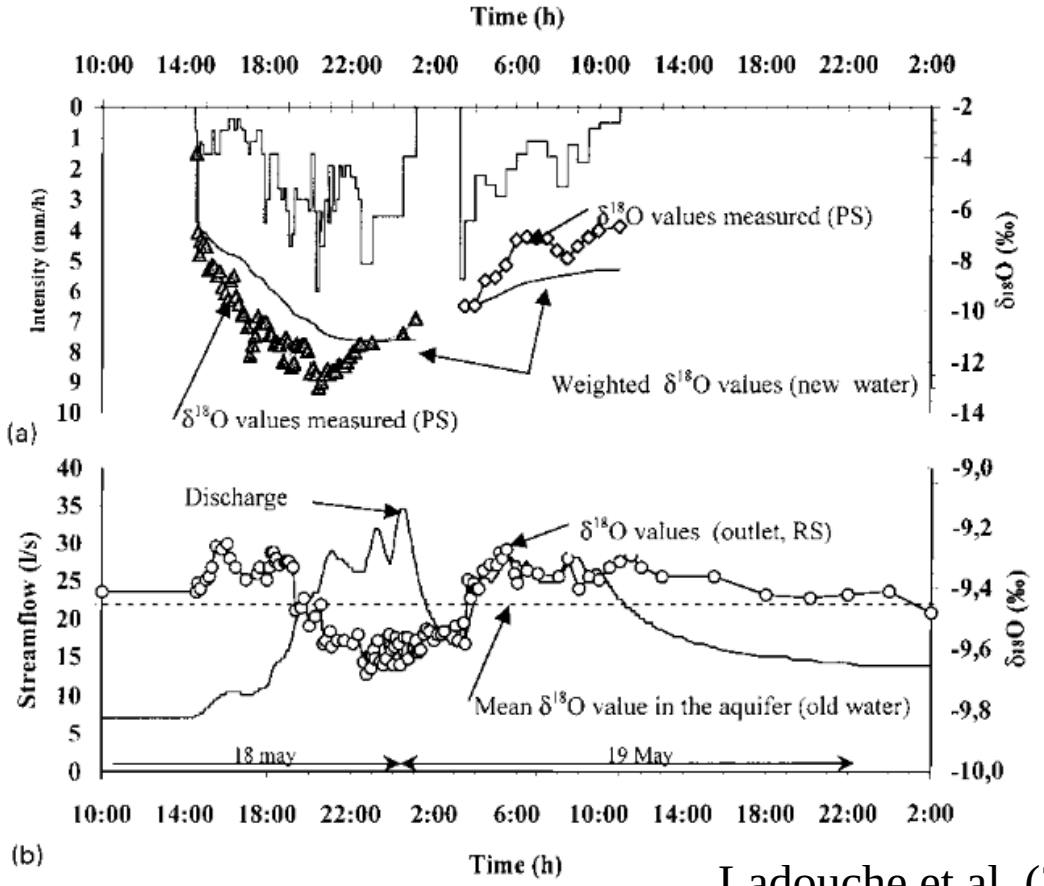


FIGURE 4 | Establishment of subsurface connectivity across a hillslope during events.

A lot of parameters to monitor/measure →

Expensive and possible errors





Ladouche et al. (2001)

1. MOTIVATION

THE USE OF **TEMPERATURE AS A TRACER** IS PROMISING

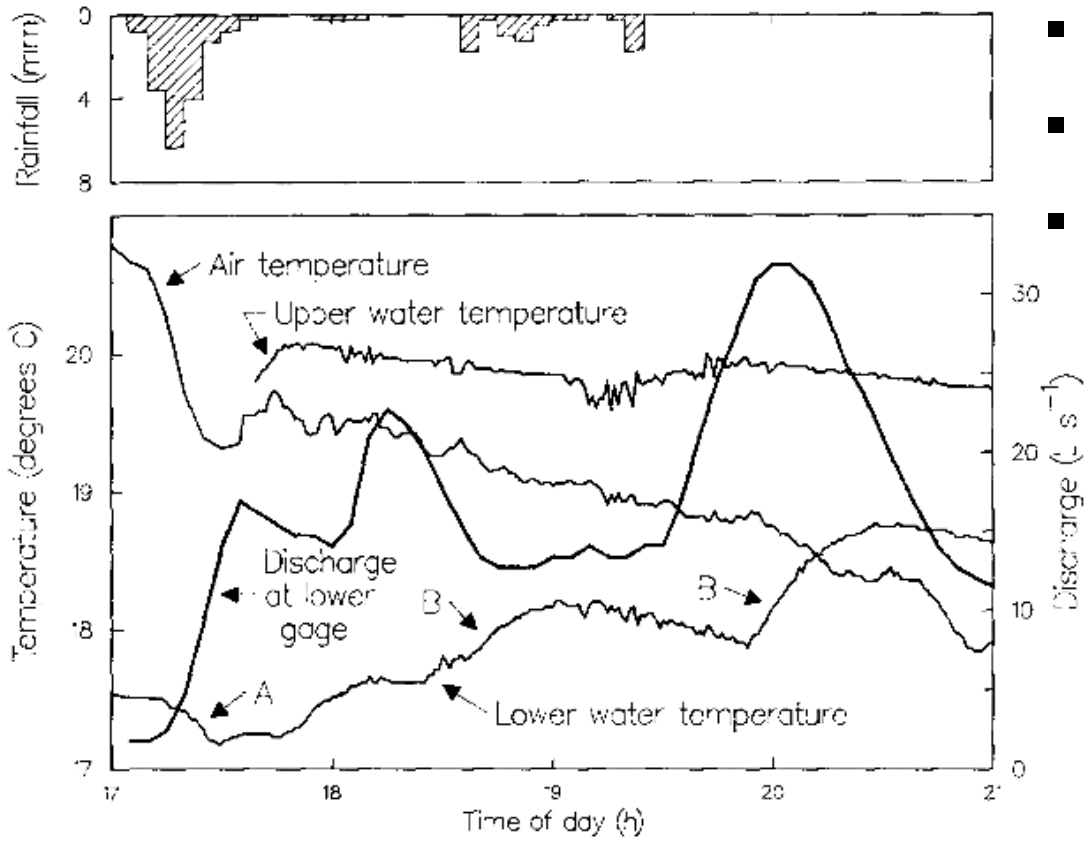


Fig. 4. Air temperature and streamwater temperature response to rainstorm of May 19, 1986. Each rainfall bar represents rain amount in 5-min interval. A = temperature decrease during initial rise in discharge; B = temperature increase as event water arrives at lower gage.

SHANLEY e PETERS (1988)

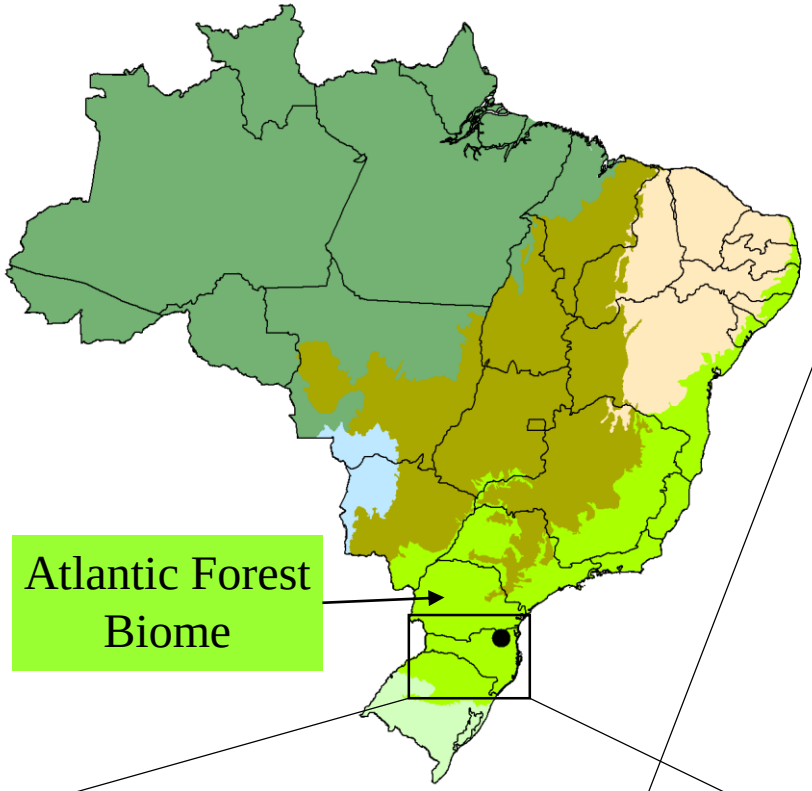
- Study area: Panola Mountain
- Rain water: 17.5°C
- Groundwater: 15.9°C

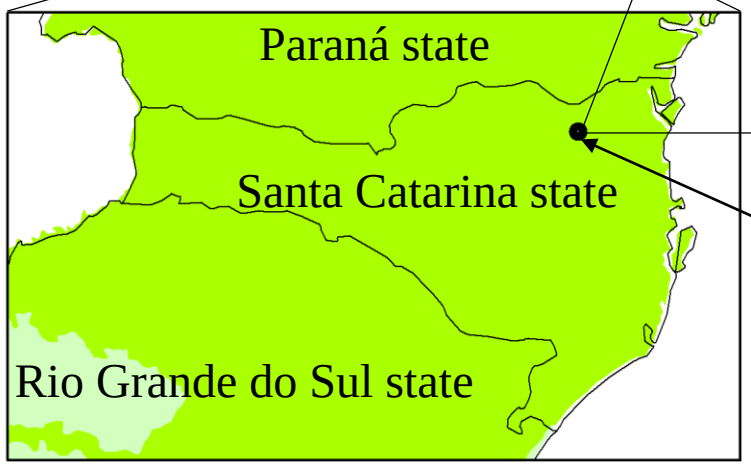
It can be measured with **good accuracy**, at **high frequency** and at **low cost**;

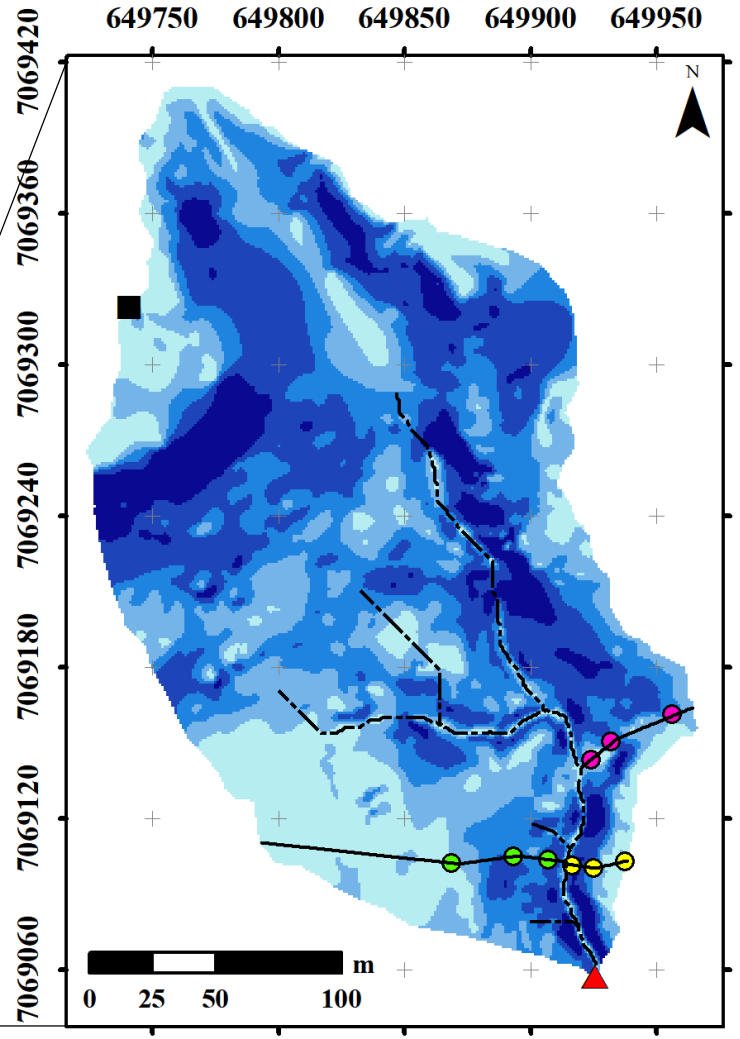
It has **great ecological importance**.

What could be inferred about runoff processes if we combine temperature and soil water tension??

2. STUDY AREA



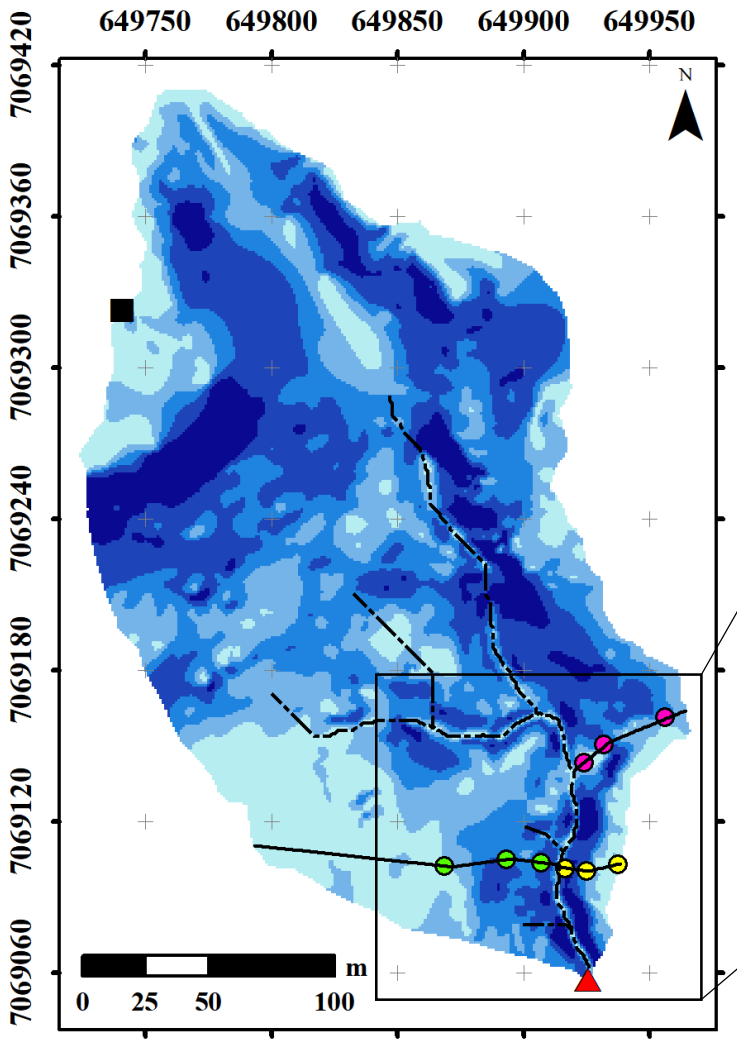


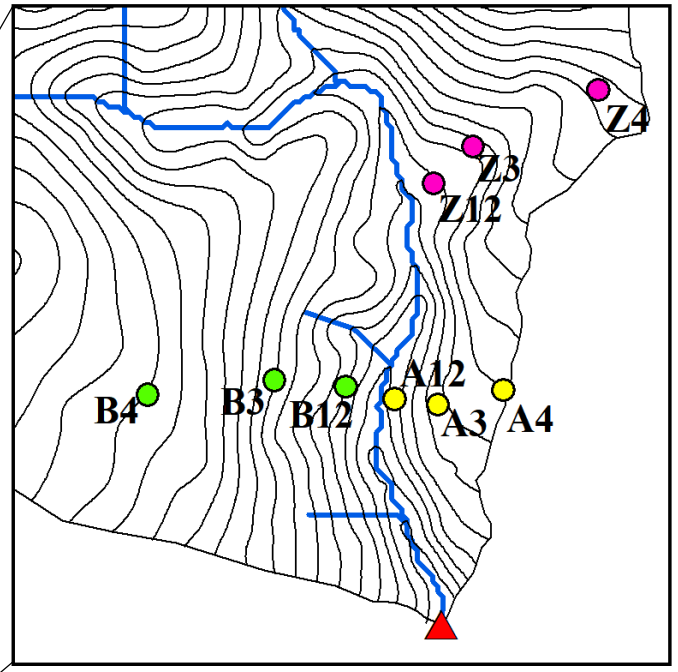


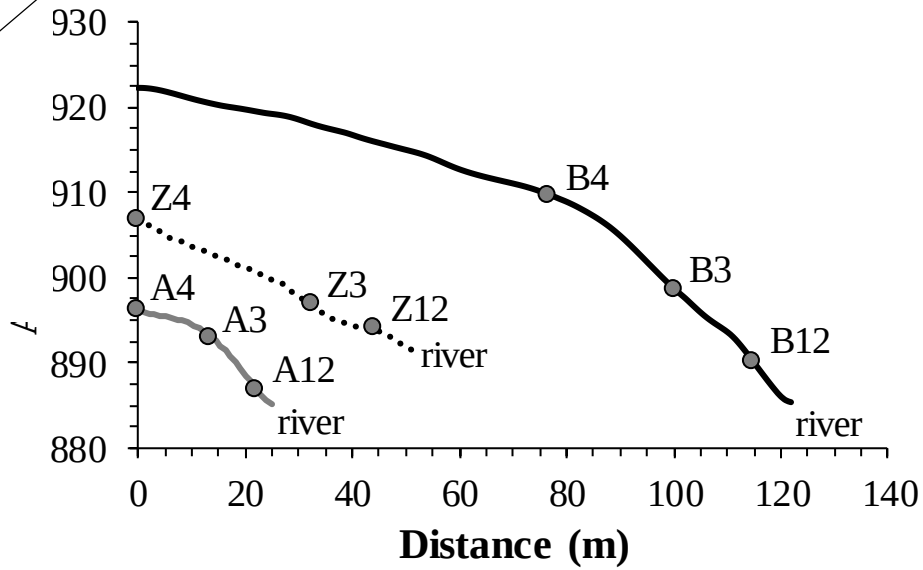
Araponga River Basin

- Area: 5.3 ha;
- Covered by secondary vegetation of the Ombrophilous Mixed Forest.

3. MONITORING SYSTEM

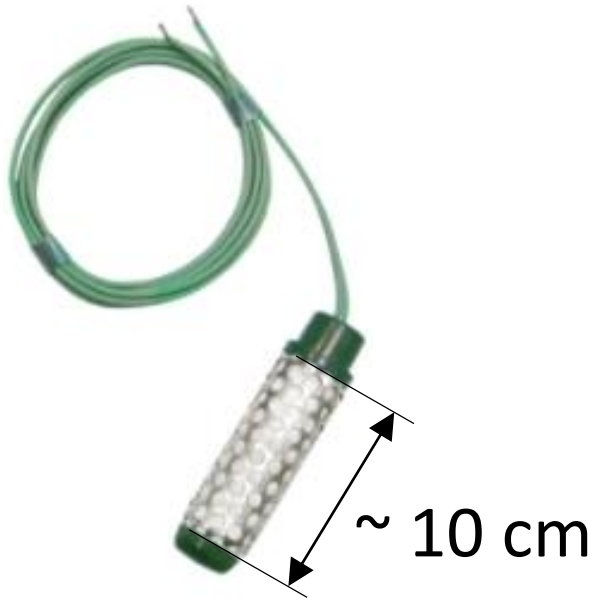






Tensiometry:

- Every 10 min;
- Model 200SS by Irrometer Watermark;
- Range is from 0 to 239 kPa.



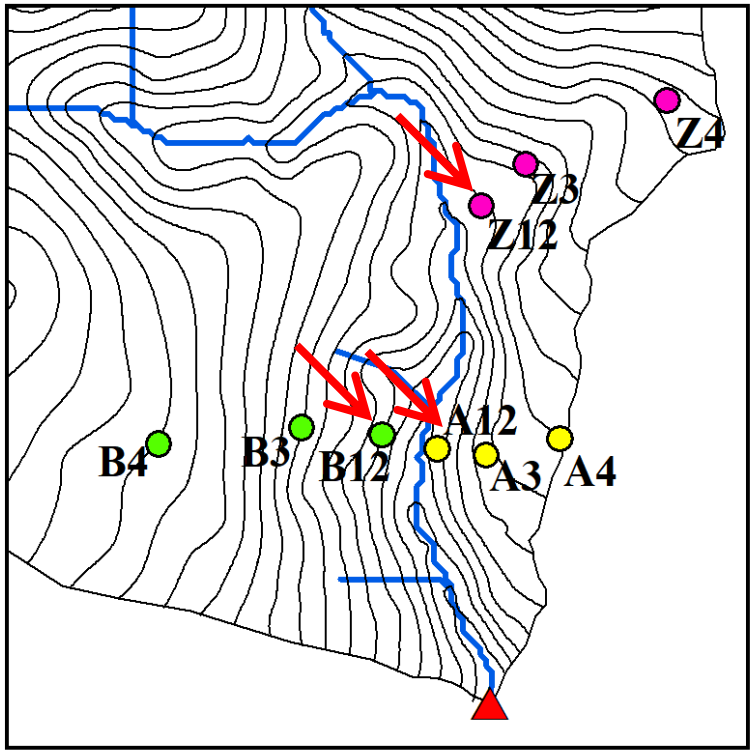
3. MONITORING SYSTEM

Tensiometry:

Sensor insertion

Downloading data and programming the data logger

3. MONITORING SYSTEM



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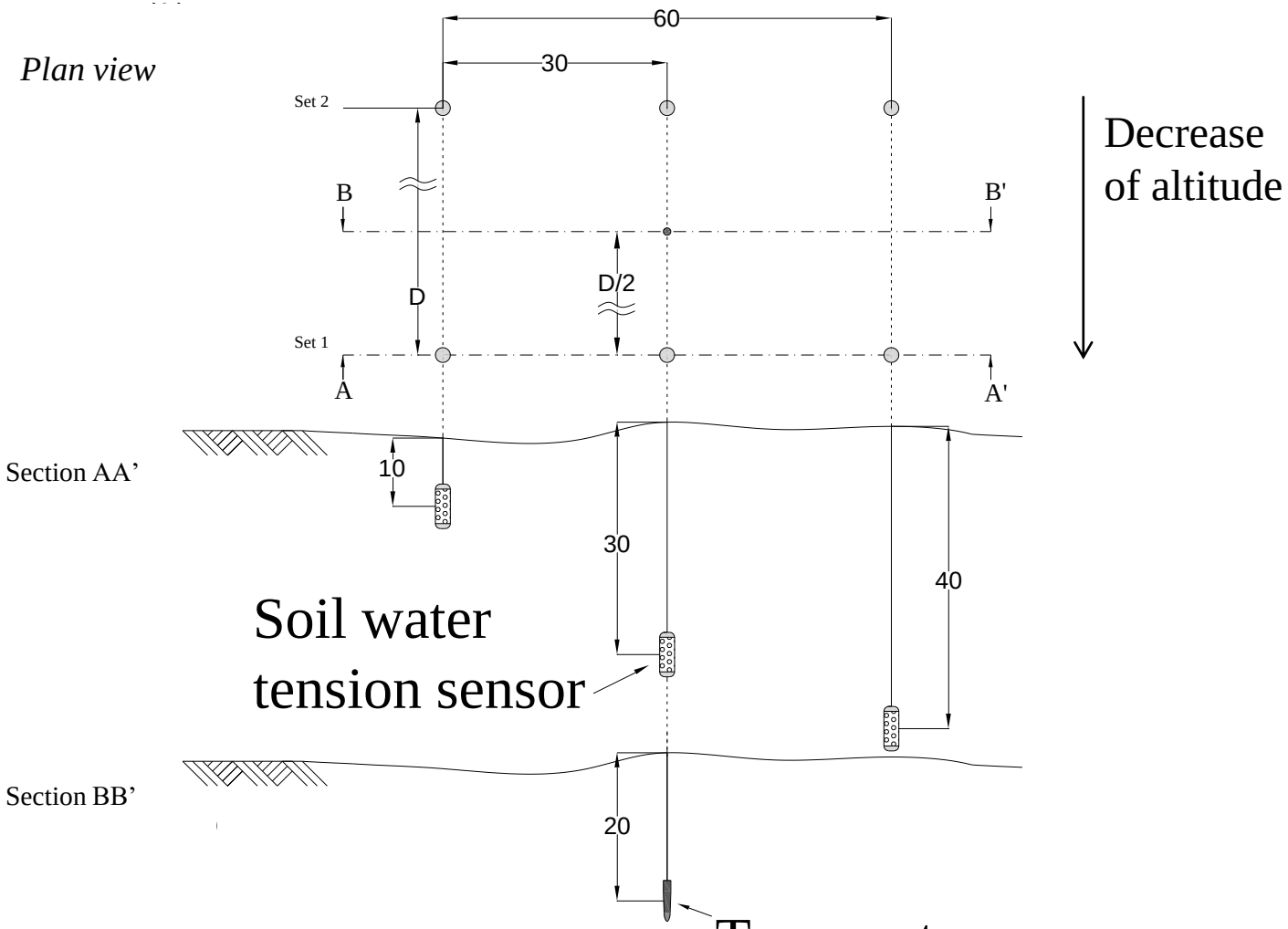


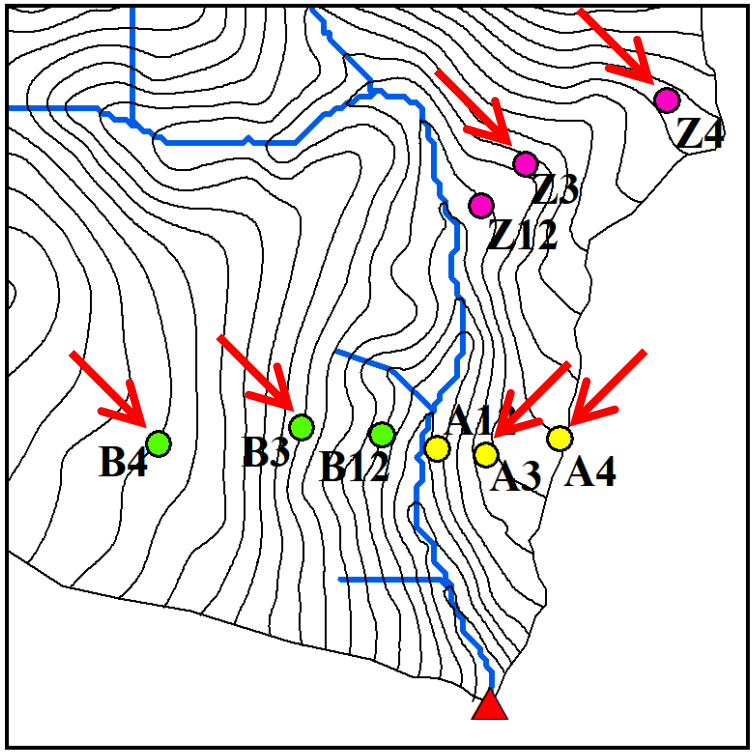
* Dimensions in cm.

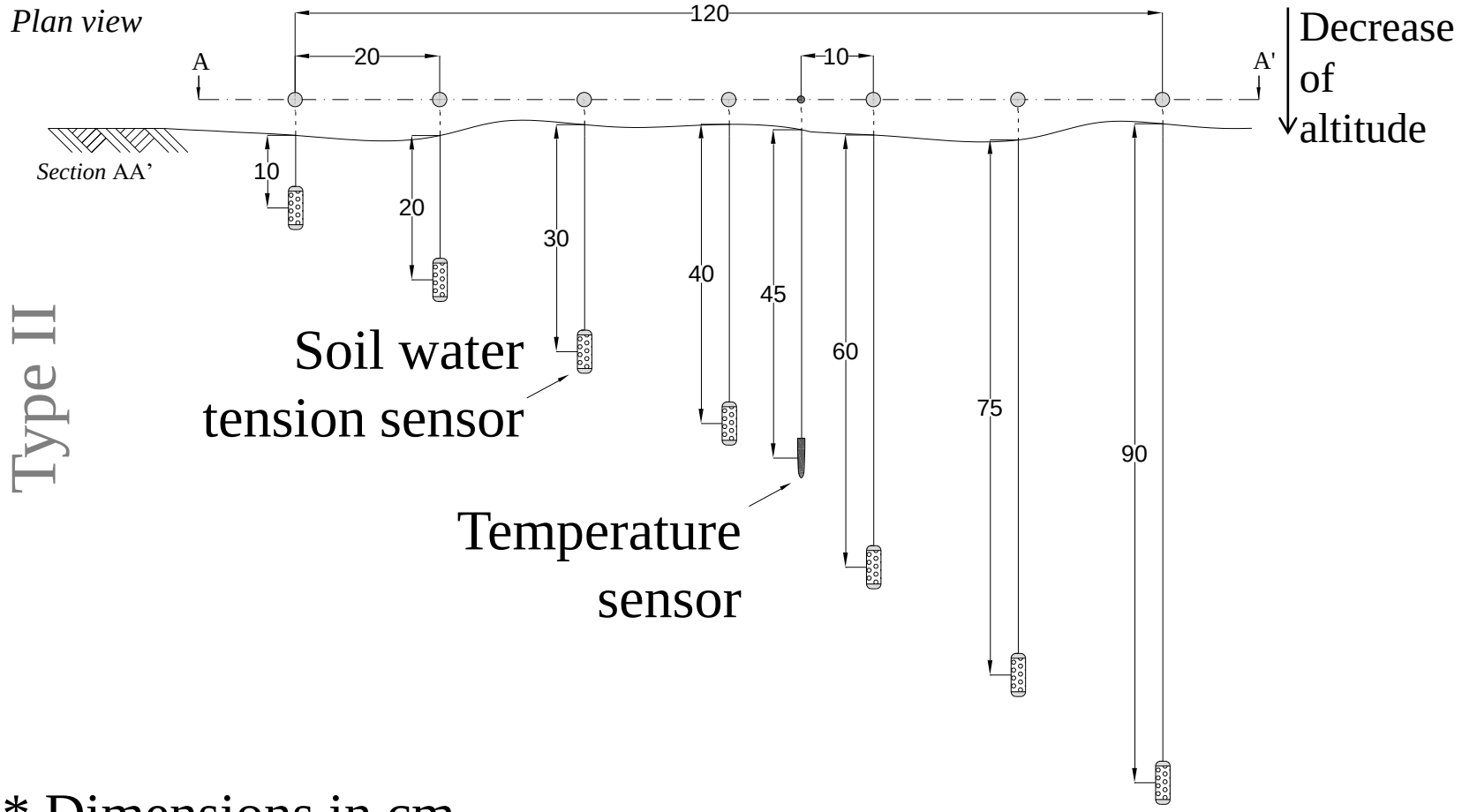
Depth:

Soil water tension: 10 to 40 cm

Temperature: 20 cm

3. MONITORING SYSTEM





* Dimensions in cm.

Depth:

Soil water tension: 10 to 90 cm

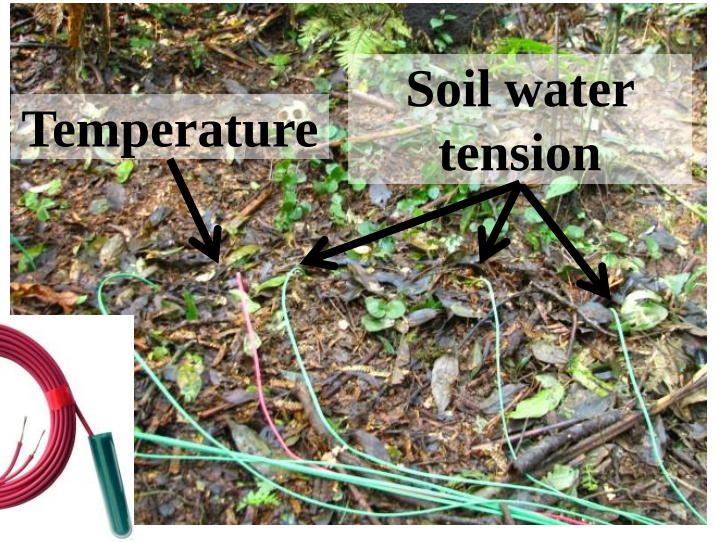
Temperature: 45 cm

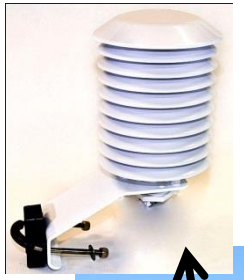
3. MONITORING SYSTEM

Temperature:

River water (outlet)

Soil (20 and 45 cm)

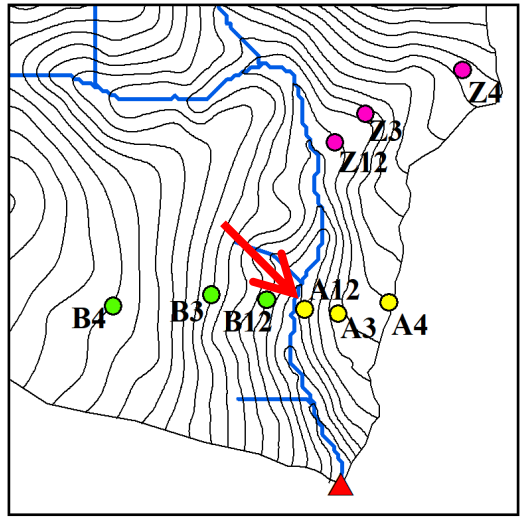


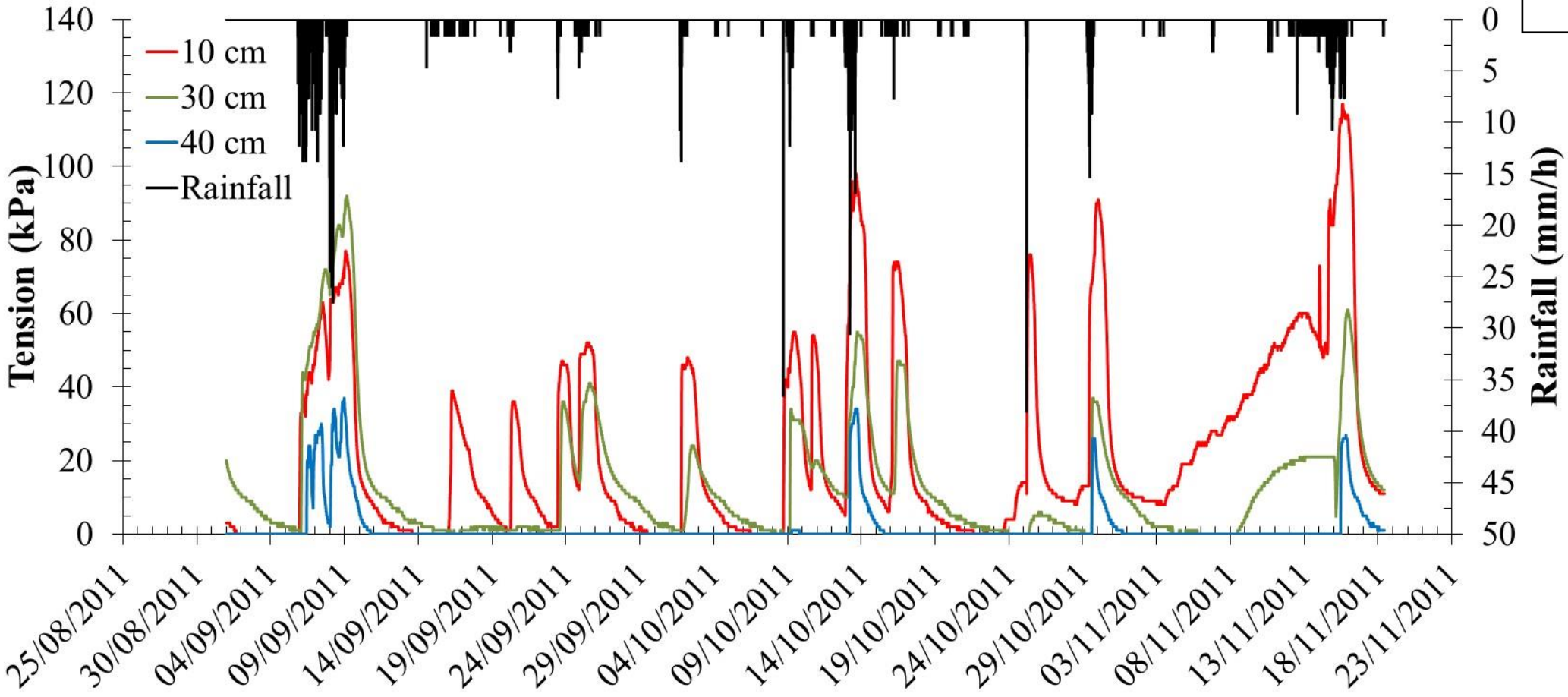


Atmospheric

4. RESULTS AND DISCUSSION

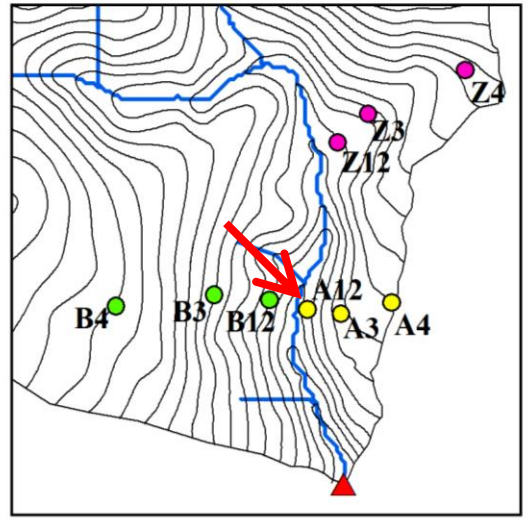
In the first 2 to 12 months of monitoring:
soil water tension presented an **anomalous behavior!!**

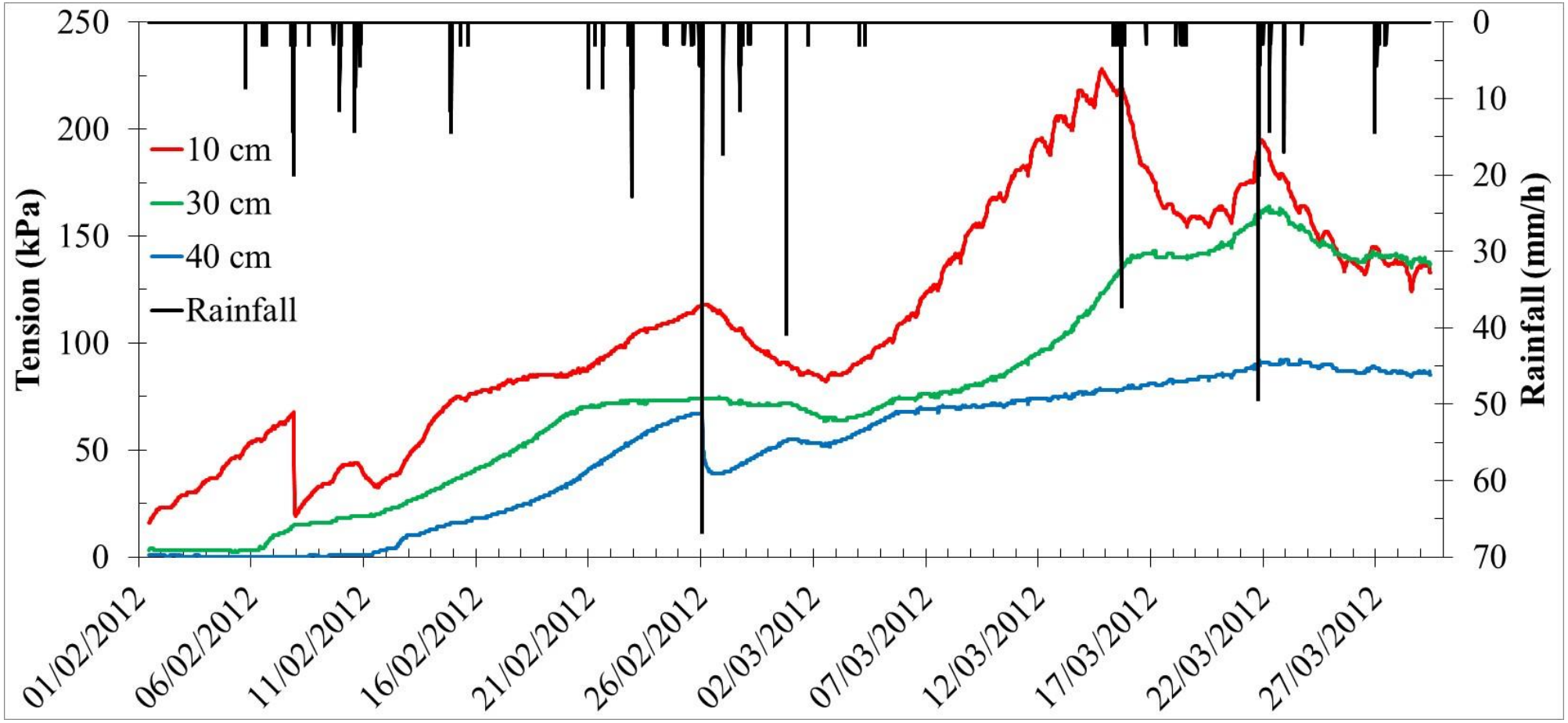




4. RESULTS AND DISCUSSION

5 months after the start of monitoring:
Most of the sensors started to presented an **expected behavior!!**





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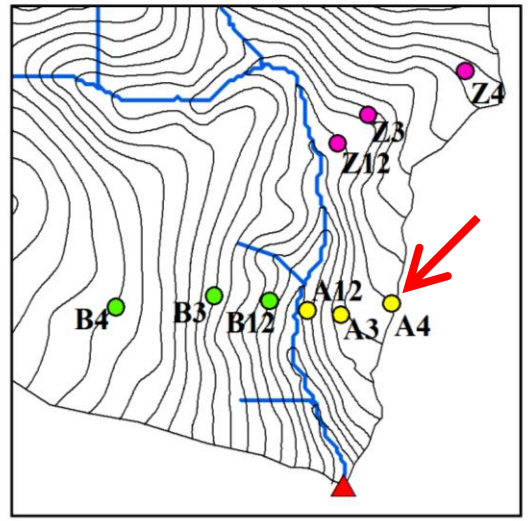

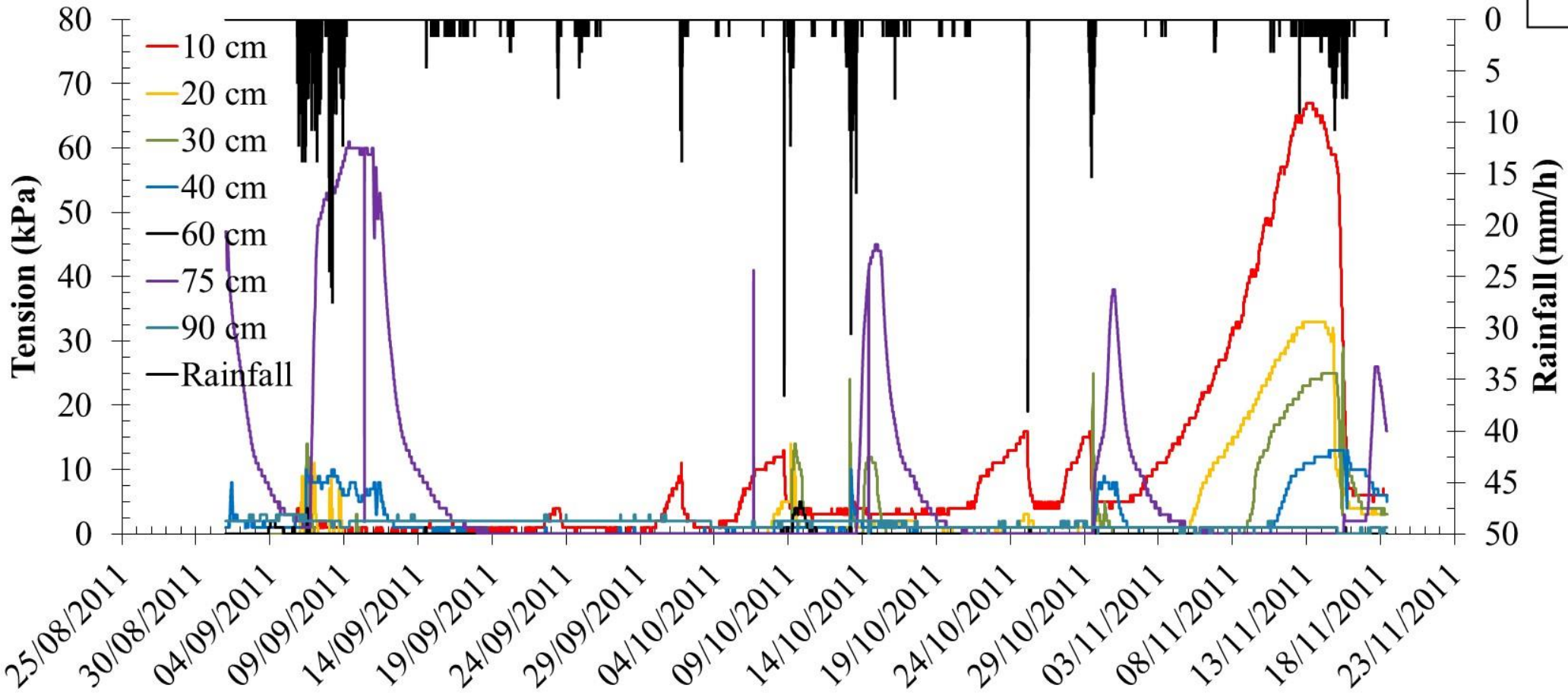

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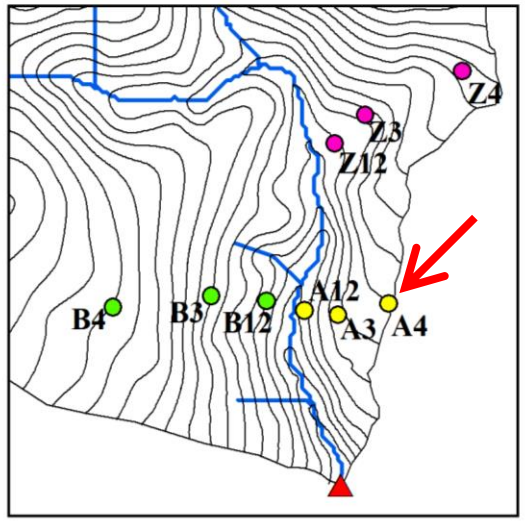
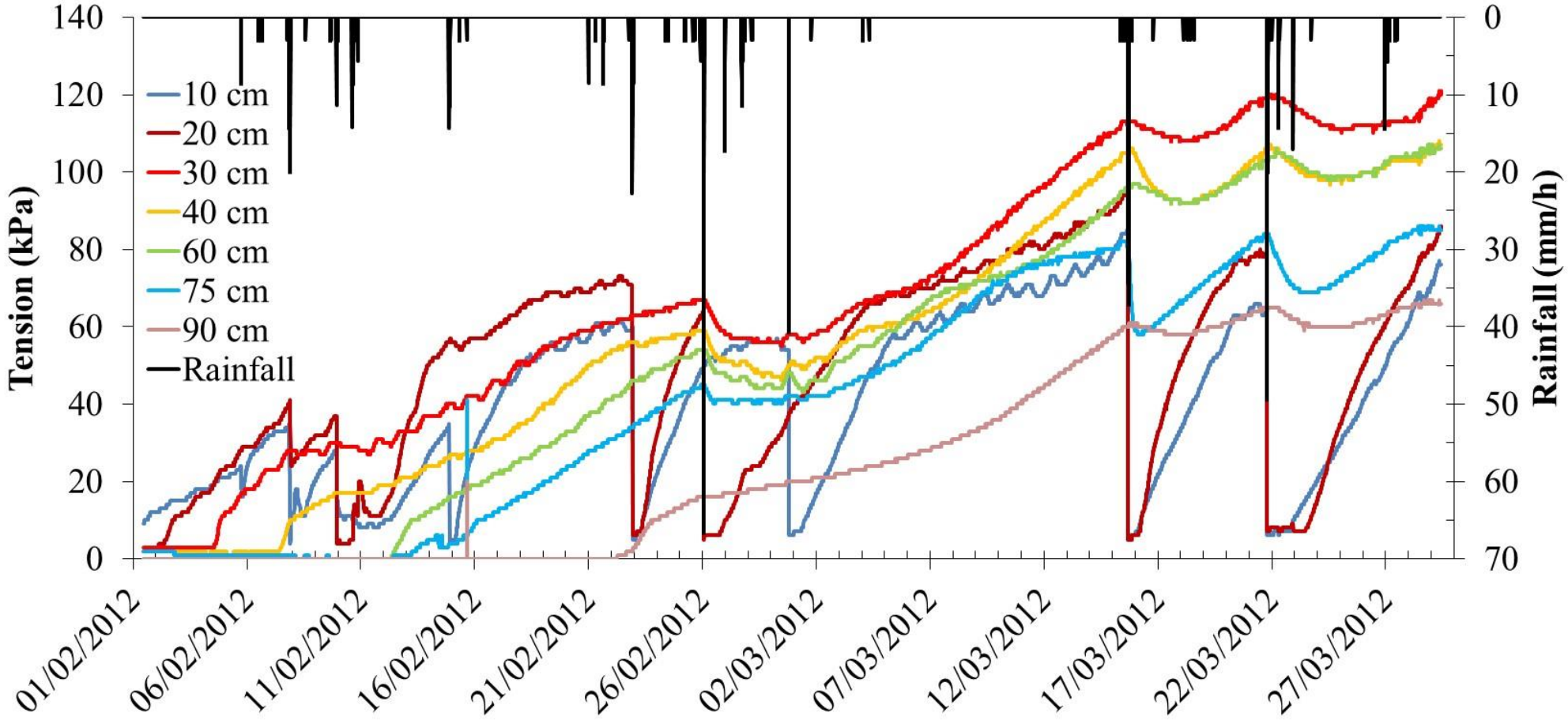




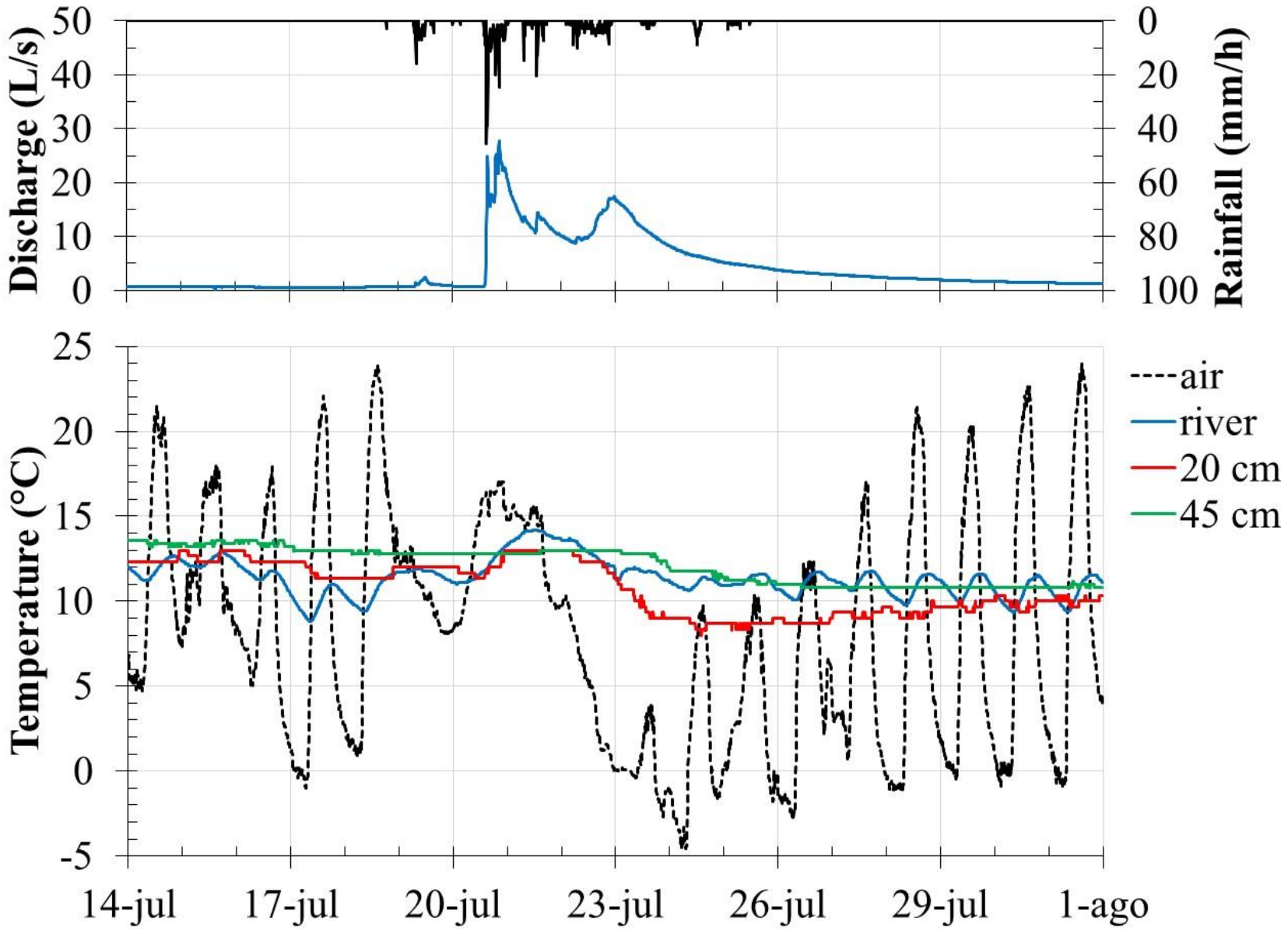
After that period, the consistency analysis had to be quite detailed.

4. RESULTS AND DISCUSSION

During the winter:

- The air temperature steeply decreases;
- The river water temperature was similar to the soil temperature at the depth 45 cm.

- Soil water tension measurements (HYDRUS 2D) & temperature measurements: during the winter, the water arriving in the river comes mainly from the soil layer close to 45 cm.



4. CONCLUSIONS

- Despite that some of the soil water tension measurements were not consistent, by combining it with temperature measurements we were able to infer that during the winter, the **water arriving in the river comes mainly from the soil layer close to 45 cm**.

- The main objective of **monitoring-based researches** should be to discover something new. But monitoring procedures are normally accompanied with **failures, mistakes**, etc. that are very important for all the scientists in the long run.

TO FURTHER **DEVELOP** HYDROLOGY, **MONITORING-BASED RESEARCH** SHOULD BE **ENCOURAGED**.

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Thank you for your attention!!





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