

Methods

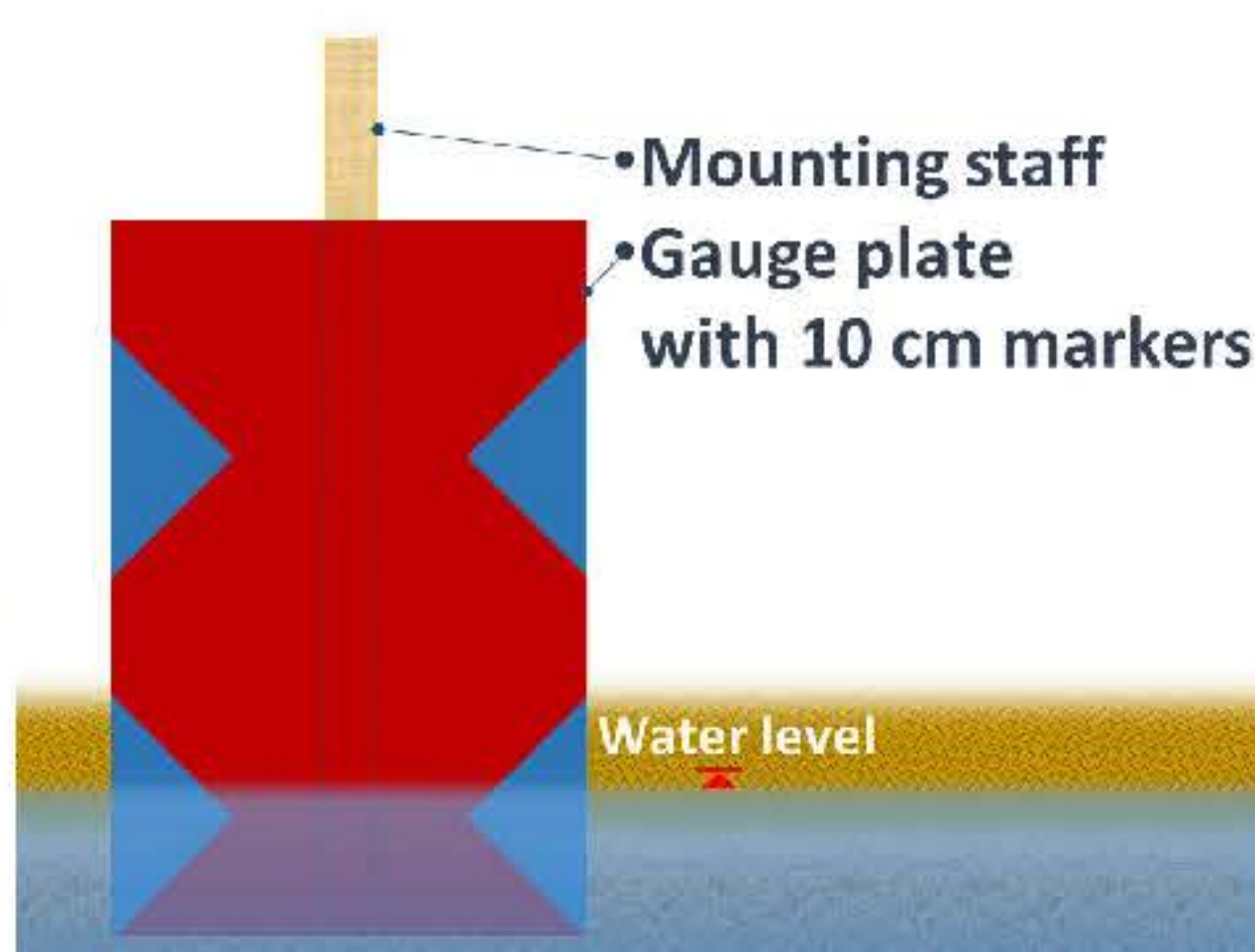
Sensor Setup

- Wildlife camera Dörr Snapshot Mini 5.0 5 MP, RGB (day) & IR (night)
- Locks & mounting belt
- External battery pack FIAMM FG 10451
- Gauging plate system
- (Carbon fiber stick in wooden foundation)
- (Mechanical/optical saturation sensor system)

- Images are taken at 15 min interval
- intervals between 5s and 8h are possible
- Battery and SD-card capacity last for ~ 2 month
- 71 locations installed (finalized)

Water Level Measurement

Water level is measured on a wooden plate (40 cm x 60 cm). The scale bar is painted with spar varnish. The design of the scale bar is triangular due to performance issues of the Hough - transformation algorithm during processing.



Water Velocity Measurement

Water velocity is obtained from the relation of water velocity and water pressure. A carbon-fiber stick (2 mm Ø) with a floating body is used that bends due to water pressure. The bending angle α of the carbon fiber stick can then be related to the water velocity & level.

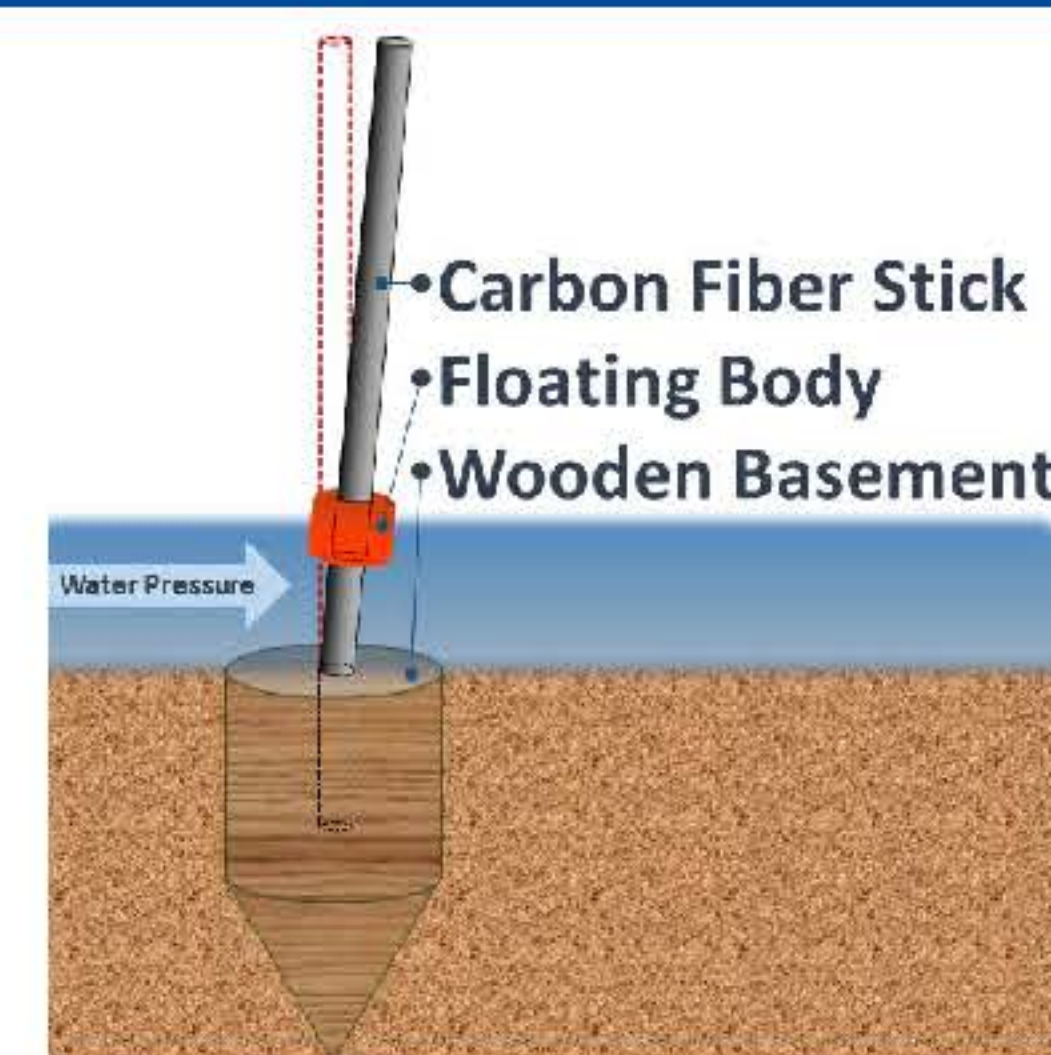
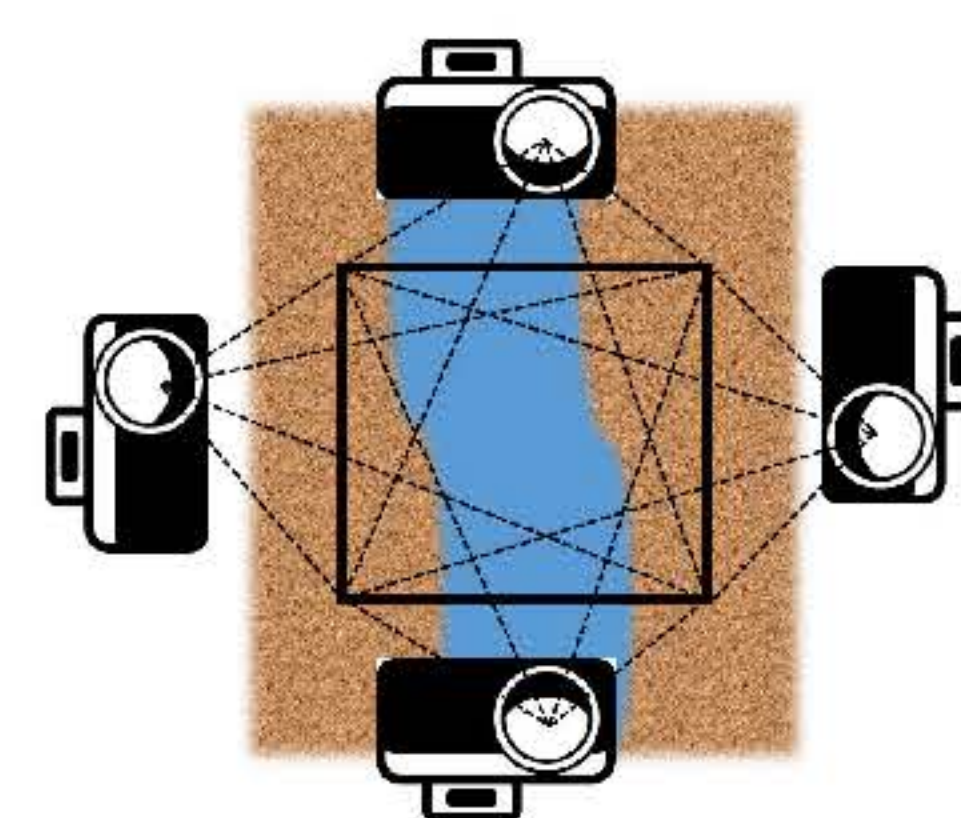


Image Processing

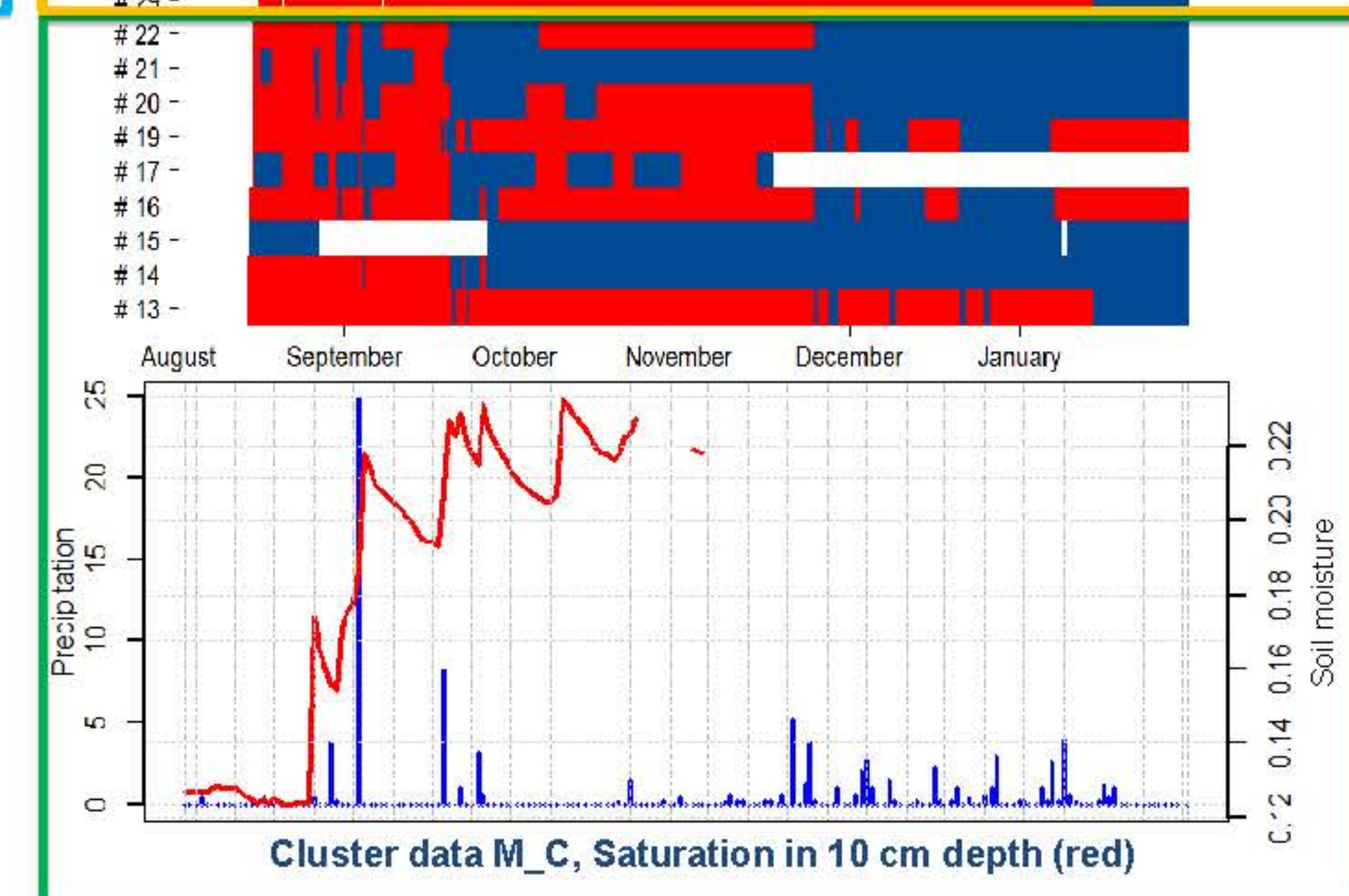
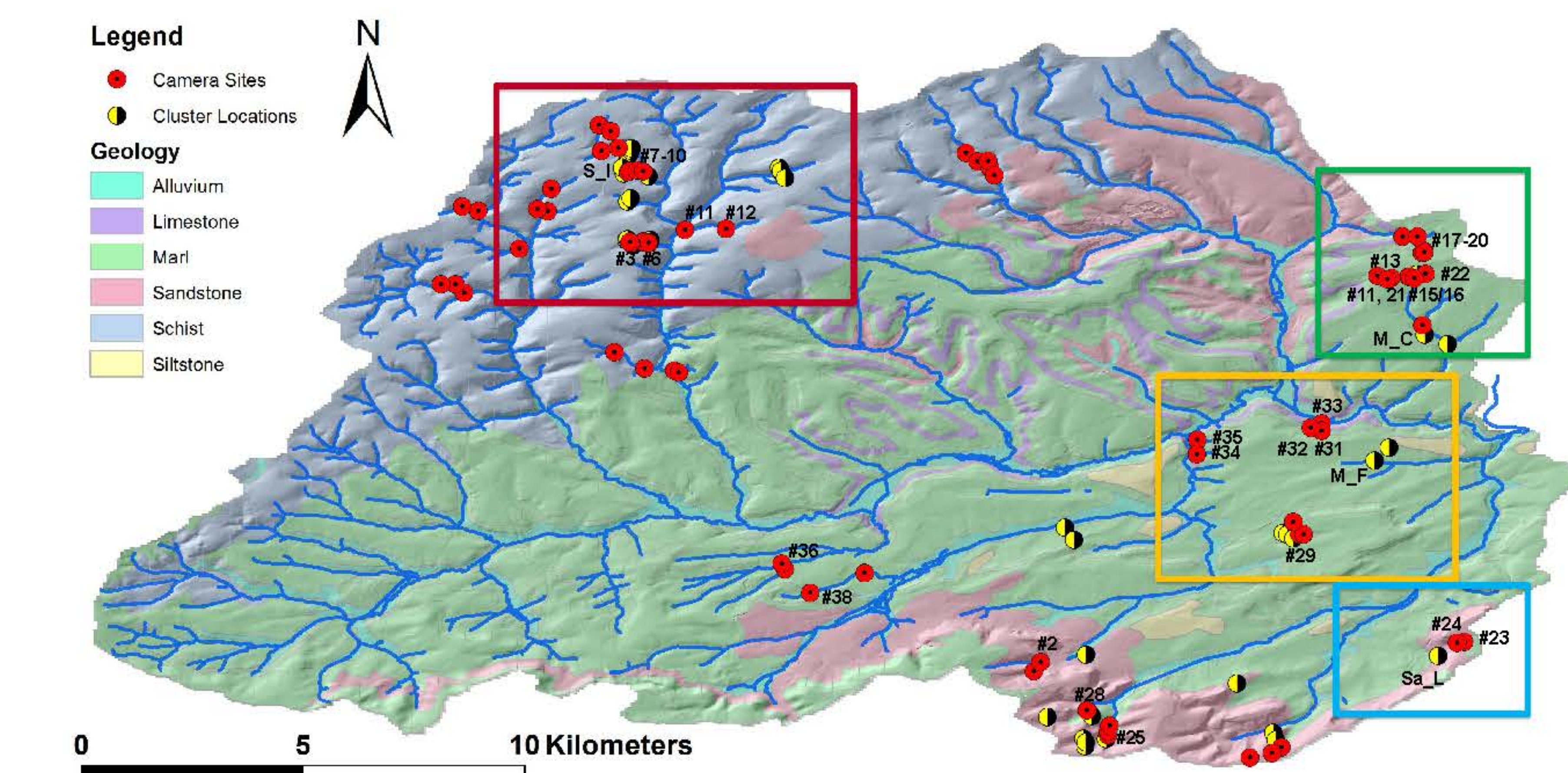
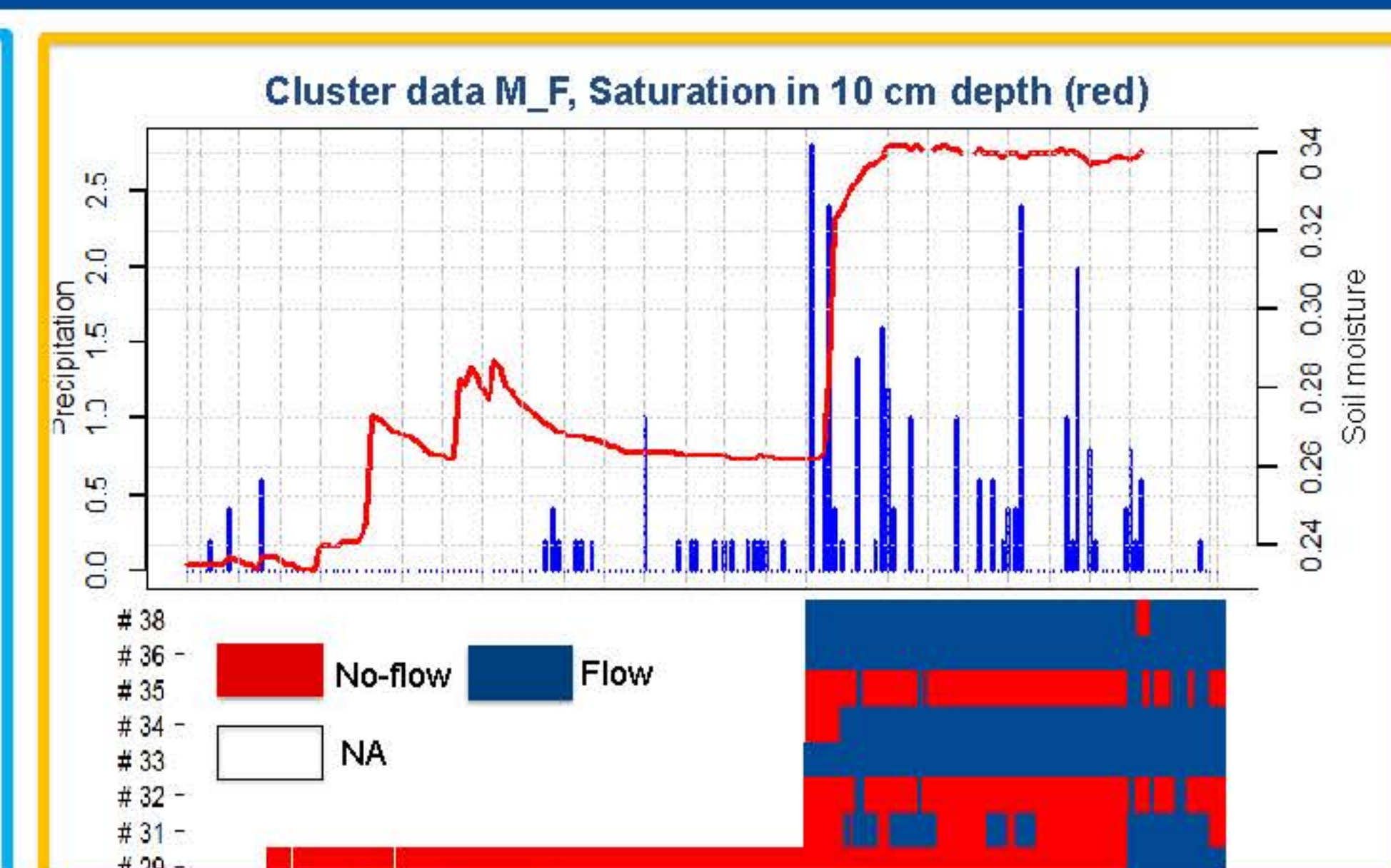
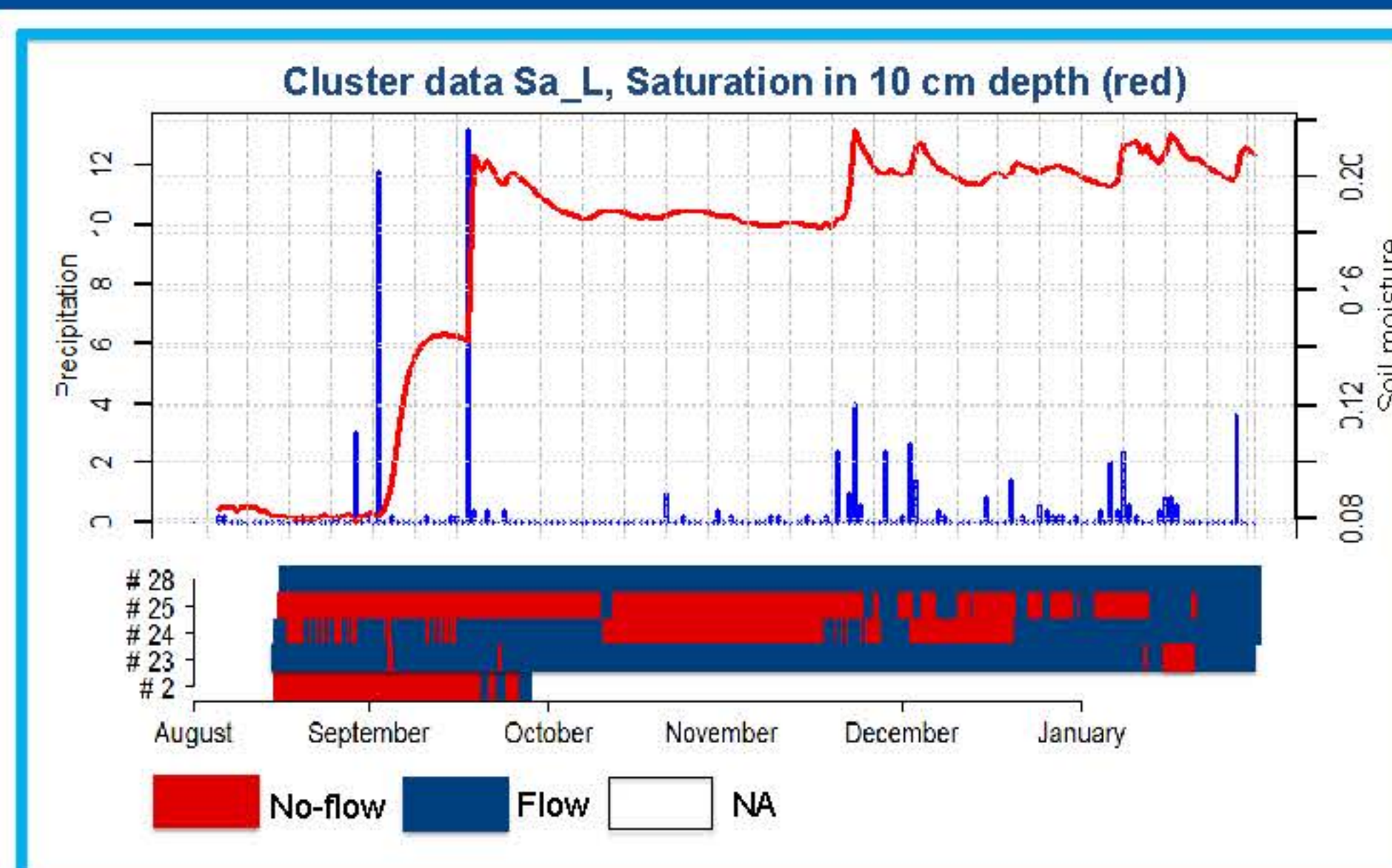
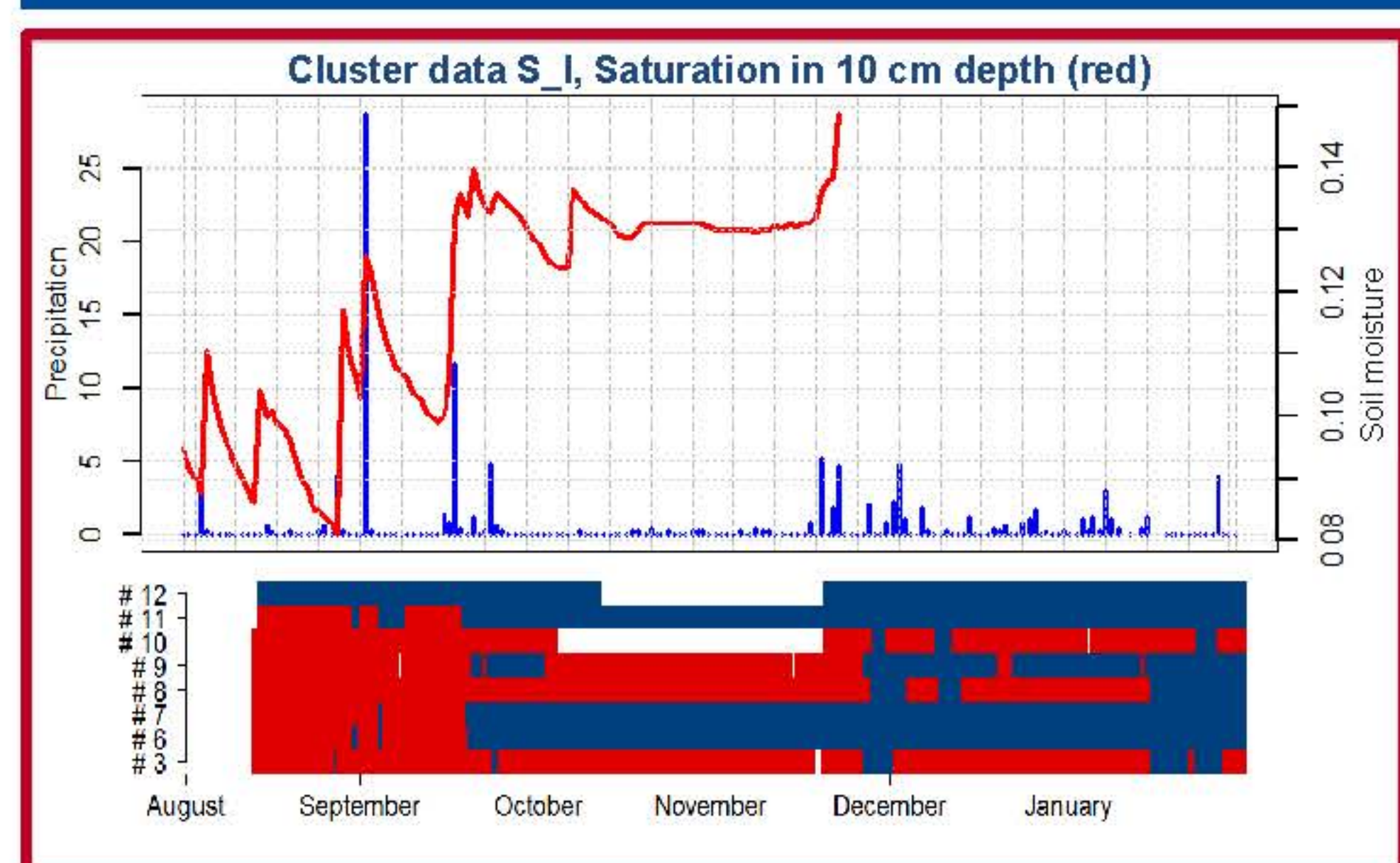
The Images are processed in Fiji ImageJ using filters, image registration, referencing, thresholding and Hough-transformation. An automatic version is in development.

Channel geometry

Channel geometry was measured under low flow or dry conditions in one temporal stream. A photogrammetric method from Haas et. al (2015) was used to obtain a micro DEM of the river bed. Images from four positions around the riverbed were taken using a frame with markers. In addition manual measurements with a yardstick were taken and the Manning-Strickler value was estimated.



Preliminary Results



Conclusions

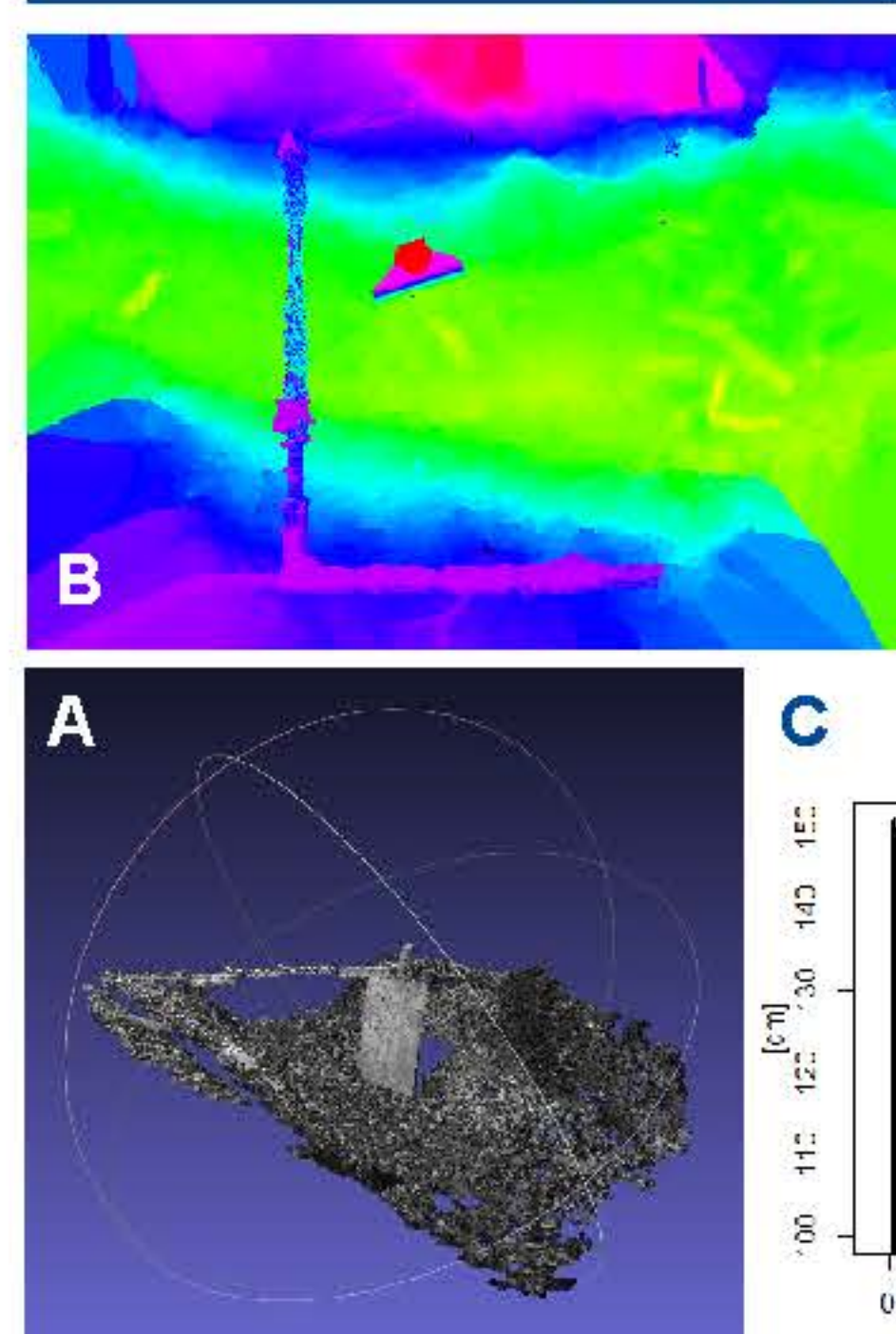
A) Image analysis

Currently the only information from the image analysis are the binary categories of flow and no-flow. Nonetheless differences between geological units and the influence of watershed area become obvious in discharge patterns. In addition local phenomena are visible e.g. at sites 23/24 were intraday evapotranspiration patterns. In general it seems that in schist and marl the activation of the stream network is driven by soil saturation whereas in sandstone areas either constant outflow/connection or short response to heavy rainfall are the dominating processes.

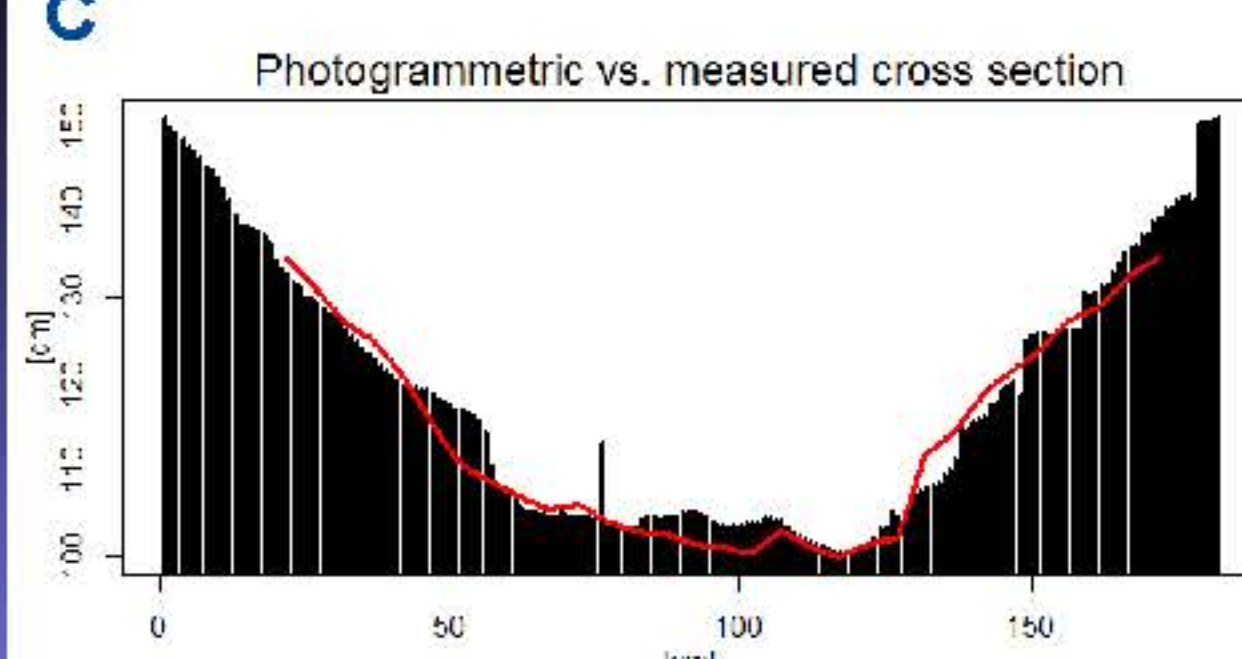
B) Photogrammetry

Photogrammetry provides high resolution cross section information of the natural stream channel. Due to technical limitations the method has so far only been used for one measurement.

Photogrammetry



- 3D-Reconstruction of stream channel
- DEM of the stream channel ranging from 50 cm height (purple) to 0 cm (green)
- Photogrammetry provides a high resolution cross section (black) compared to the manually measured cross section (red)



Outlook

A) Image analysis

The aim of the image analysis is to obtain flow information. With improved image analysis the water level can be extracted. When ever applicable flow velocity measurements with carbon fiber sticks will be installed. Otherwise Manning-Strickler values and cross section of the streambed will be used to calculate flow velocity

B) Photogrammetry

Besides the calculation of cross sections photogrammetry can may be help to define Manning-Strickler Values using terrain roughness as indicator