Model based characterization of alpine water springs

Proposed: December 2022 **Valid until:** December 2023

Background

The BAFU funded project WABEsense [1] has sensorize alpine water springs and produced data of their water production (discharge and water temperature). The detailed water production data allow municipalities to enhance their general water supply planning (Generelle Wasserversorgungsplanung) and it can also be used by researchers to model the behavior of alpine water springs and the water table in the alps.

Because it is difficult to measure many important processes influencing springs, such as groundwater recharge, flow time, and flow path of groundwater; indirect characterization using models is needed. Characterization of the spring behavior leads to a better understanding of their hydrogeology, their effect in the local ecology, and (by long-term tracking of the spring's characteristics) allow us to assess how climate change and land use is affecting them. The characterization of the spring can be purely based on data analysis (data-driven models) involving temporal (e.g. correlations) and frequency analysis (e.g. Fourier spectrum) of the measured signals; or it can be based on the identification of hydrological spring models, with parameters that have a direct physical interpretation.

Objectives of the suggested topic

1. To enhance the validation of the measurement systems installed, and data processing used by WABEsense. In particular the validation of local peaks in the discharge data that are caused by "flush" events following rain, see Fig 1. The student will manually measure spring discharge on site during one or more rain events (see Fig. 2).
2. To determine what spring models published in the scientific literature could be calibrated using the available data (discharge, temperature, meteorological data, hydrogeological maps, etc.)
    a. To perform the calibration of hydrogeological models using available data: using the data from the WABEsense project, the student will calibrate spring models to characterize the springs.
3. To identify data-driven spring parameters (e.g. flushiness, retention time, stability, transfer function, etc) that are relevant for the characterization and long term monitoring of the spring.
    a. To compute these parameters using available data: using the data from the WABEsense project, the student will evaluate different types of correlations to identify spring characteristics, e.g. retention time, flushiness.

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References

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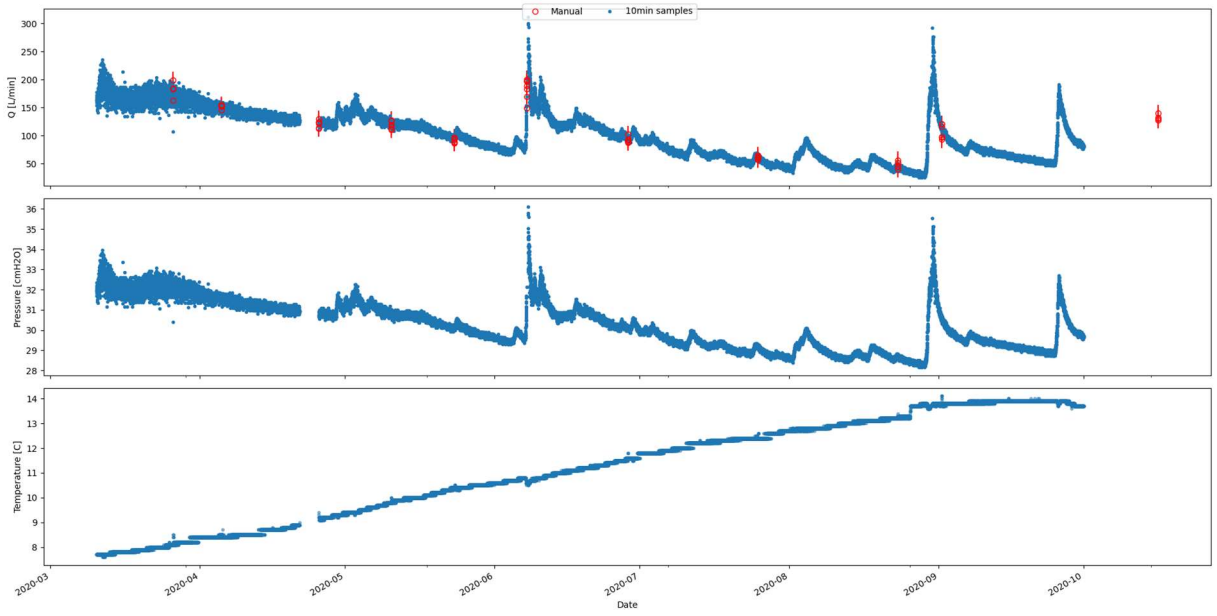

Figure 1. WABEsense data for Paliu Fravi spring in Bonaduz: temperature (bottom) and pressure (middle). The discharge (top) is then calculated using a CFD-based model. Red dots are on-site manual measurements of the spring discharge.

Figure 2. Paliu Fravi spring tapping at Bonaduz, 46°48'06.3"N 9°22'15.3"E