Practical 1:
High water levels

In this practical, you will analyse water levels of the Aare at a measuring station in Untersiggenthal, next to the Paul Scherrer Institute. The location is sensitive as it contains several experimental nuclear reactors, and a flood event could cause severe damage.

Figure 1: The Paul Scherrer Institute on the Aare, 2016. Source: `psi.ch/en/about`

The dataset provided by the Swiss Federal Office for the Environment (FOEN) includes daily maximum water levels (above sea level) as measured by the station (which is located at 325m above sea level). The range of the data is approximately 20 years (2000-2021). Your goal is to model the high water levels of the river at this point.

(a) Read in the data. Display a time series plot of the water level across the data range and try to identify times of highest levels.

(b) Now display a histogram of the water levels. What do you observe about the distribution?

The FOEN plans for several degrees of risk. In this assignment, we focus on two risk levels: 50-year events and 100-year events.

(c) Explain how you would model the high water levels using a peaks-over-threshold approach.

(d) Comment on the aspect of clustering of extremes. How do you propose to measure and deal with clustering of the daily water levels?

(e) Perform the analysis you suggest in c) and d) and compute the 50- and 100-year return levels. Explain your choice of threshold and provide an estimate of uncertainty for the return levels. *Note: take care to compute the return level in **yearly** terms.*

(f) Explain the drawbacks and advantages of using a block maxima method instead of the one used in c)-e).