SCCER SoE

SWISS COMPETENCE CENTER for ENERGY RESEARCH
SUPPLY of ELECTRICITY

WP5 Pilot & Demonstration Projects
SMALL FLEX

In cooperation with the CTI

Energy
Swiss Competence Centers for Energy Research

Schweizerische Eidgenossenschaft
Confédération suisse
Confederazione Svizzera
Confederaziun svizra

Swiss Confederation

Commission for Technology and Innovation CTI

C. Münch & all the project partners

September 14th , 2018

Revision of Energy Ordinance – 01.01.2018

Feed-in tariff at cost (KEV) has been changed to encourage small producers to produce electricity according to the demand or in other words to **follow the energy market**.

Even small hydropower plants have to be **more flexible** ! What can be the degree of freedom for small run-of-river HPP ?

SMALL FLEX Project : a demonstrator to show how small hydropower plants can be **flexible** and provide winter peak energy as well as ancillary services, whilst remaining **eco-compatible.**

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Schweizerische Eidgenossenschaft
Confédération suisse
Confederazione Svizzera
Confederaziun svizra

Bundesamt für Energie BFE
Office fédéral de l'énergie OFEN

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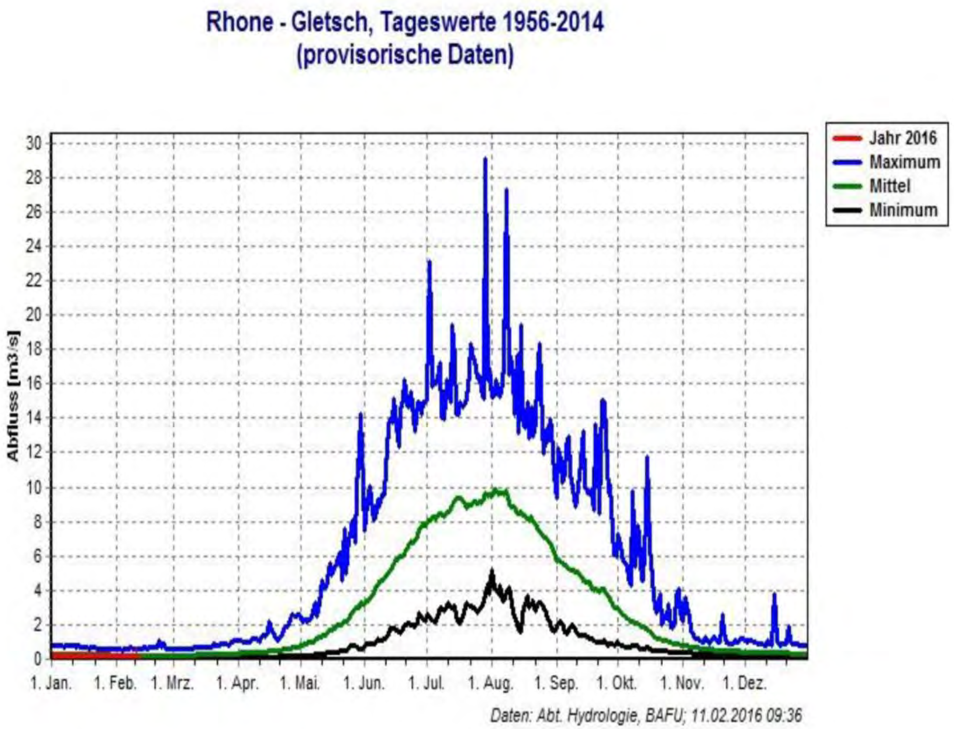
Small Flex Case study : KW Gletsch-Oberwald

Run-of- the-river power plant

Net head :	288 mCE
Installed discharge :	5.7 m^3/s
Installed capacity :	14 MW
Expected production :	41 GWh/year
Mean gross capacity :	4.68 MW

Commissioned in 2018



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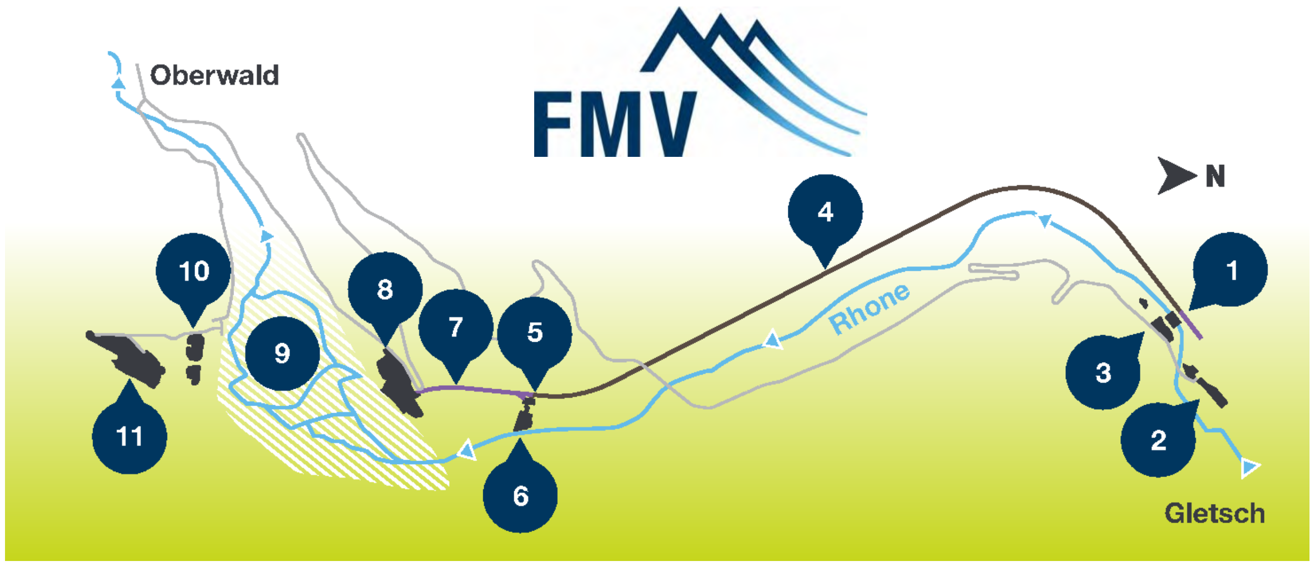
Small Flex Case study : KW Gletsch-Oberwald



1. **Zugangstollen Fassung**
   Galerie d'accès à la prise d'eau
2. **Installastionsplätze Gletsch**
   Place de chantier de Gletsch
3. **Wasserfassung**
   Prise d'eau
4. **Triebwasserstollen**
   Centrale souterraine
5. **Zentrale unterirdisch**
   Centrale souterraine
6. **Rückgabestollen**
   Galerie en charge
7. **Zugangsstollen Zentrale**
   Galerie d'accès à la centrale
8. **Installationsplatz St. Niklaus**
   Place de chantier de St. Niklaus
9. **Umweltmassnahmen**
   Mesures de compensation environnementale

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Project organisation

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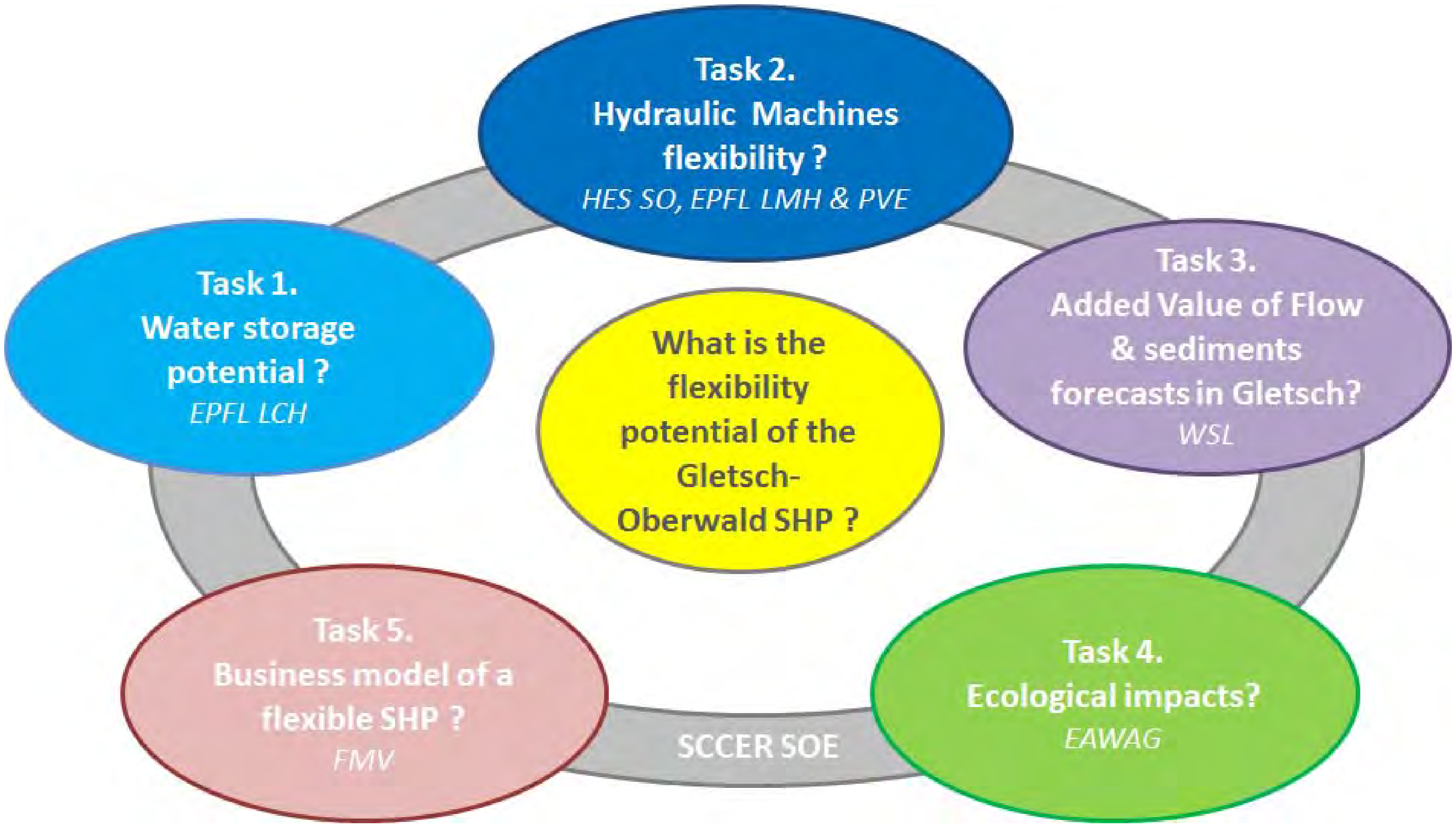

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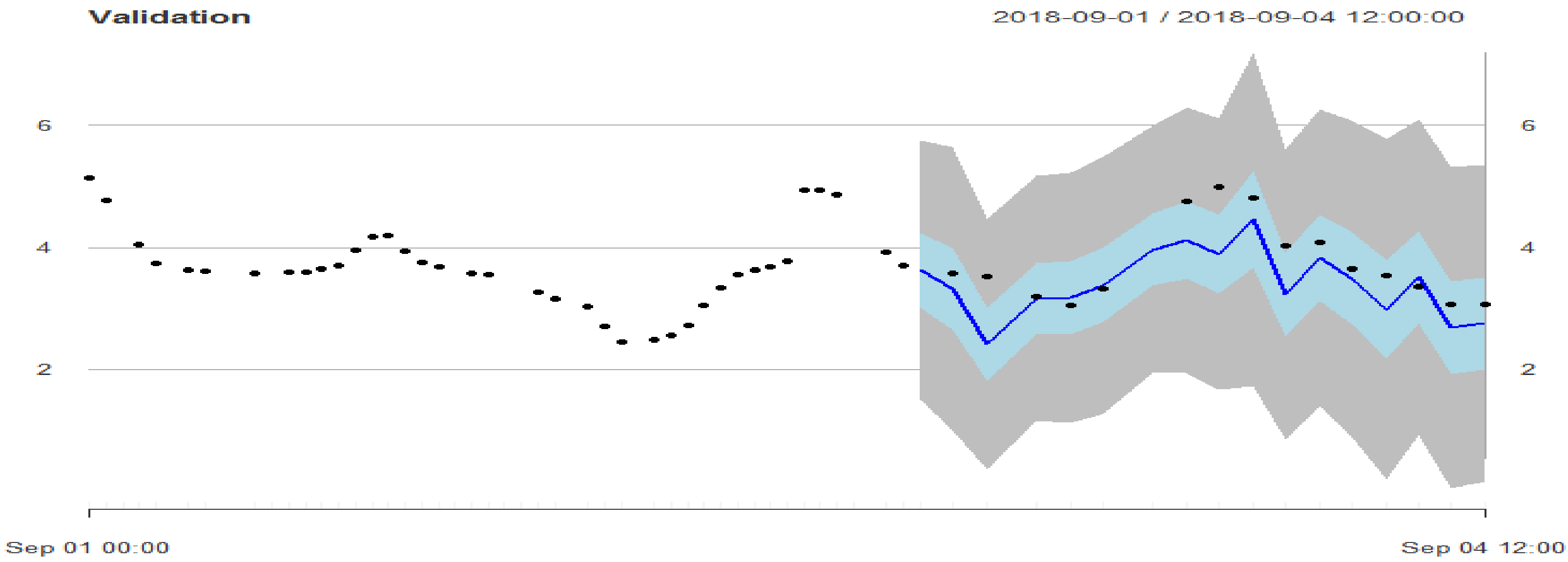
Task 3. Added Value of Flow & sediments forecasts

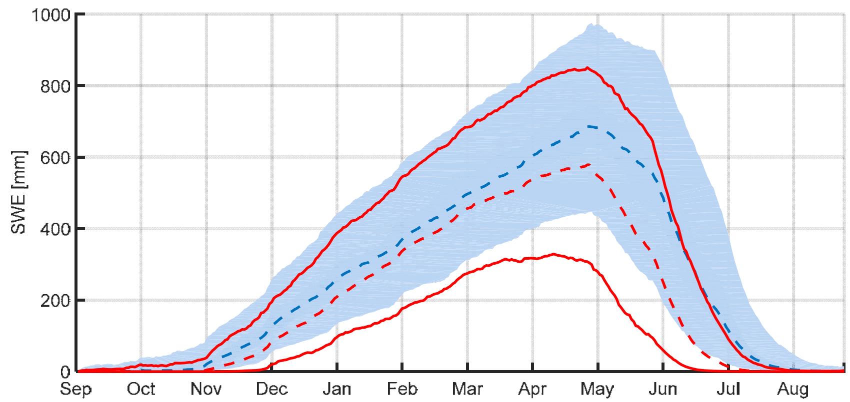


Operational forecast for the inflow at Gletsch:

- INCA-CH forecast 6h
- Seamless extension combining INCA-CH + COSMO-1 forecast 33h
- First results of post-processing the forecast (bottom) showing the observations (dots) and the median forecast including predictive uncertainty

Task 3. Added Value of Flow & sediments forecasts

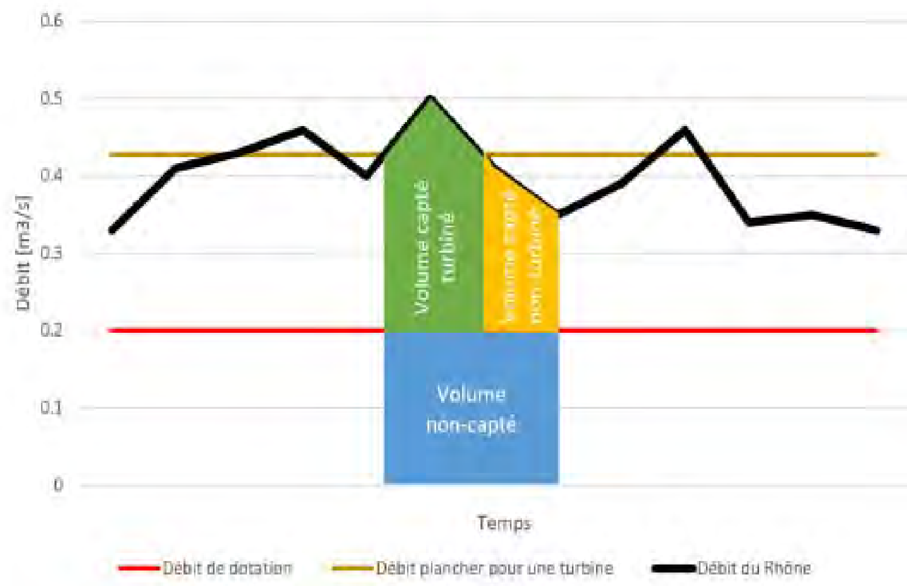
- Simulated Snow Water Equivalent (5, 50,95 percentiles)
- Current climate (blue), 900 years
- Future climate (red), 5 climate models (RCP8.5) x 300 years, mid of century
- The spread between dry and wet years is substantially larger than the effect of climate change.
- This spread evolves mainly from natural variability.
- A relevant change between current and future climate can be observed during melt season, while the amount of SWE is not changing relevantly.
- Changes are more evident in lower elevation bands, however, in the shown band most of SWE is stored.



Task 1. Water storage potential

Smart storage definition: increasing storage in order to concentrate production in periods with higher remuneration

- use of available space underground such as existing galleries, headrace tunnel and penstock pipe, **settling basin** and forebay chamber
- activate turbines at a discharge close to their optimum to have the best efficiency



MAIN PROBLEM DURING WINTER:

Q_{IN} is higher than the environmental flow **+** Q_{IN} is less than the minimum discharge required by the turbines **=** LOSS OF WATER

Task 1. Water storage potential

Characteristics of the settling basin in Gletsch-Oberwald:

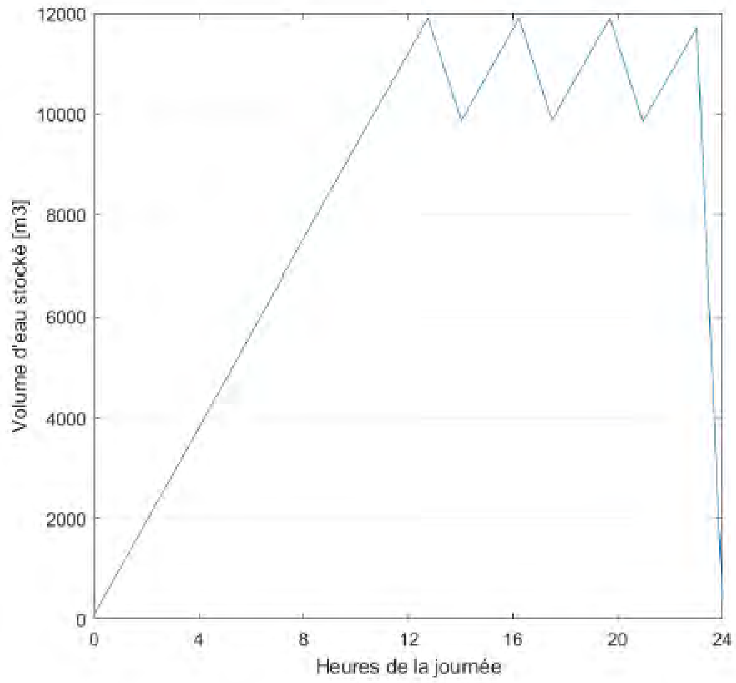
Net volume of water	V_{flex}	2050 m^3
Max water level	N_{MAX}	1747.45 msm
Min water level	N_{MIN}	1742.70 msm

$V_{IN} \rightarrow V_{flex}(N_{MAX})$

↗ $V_{OUT} = V_{IN} - V_{flex}(N_{MAX})$

↘ $V_{turb} \rightarrow V_{flex}(N_{MIN})$

ENERGY PRODUCTION



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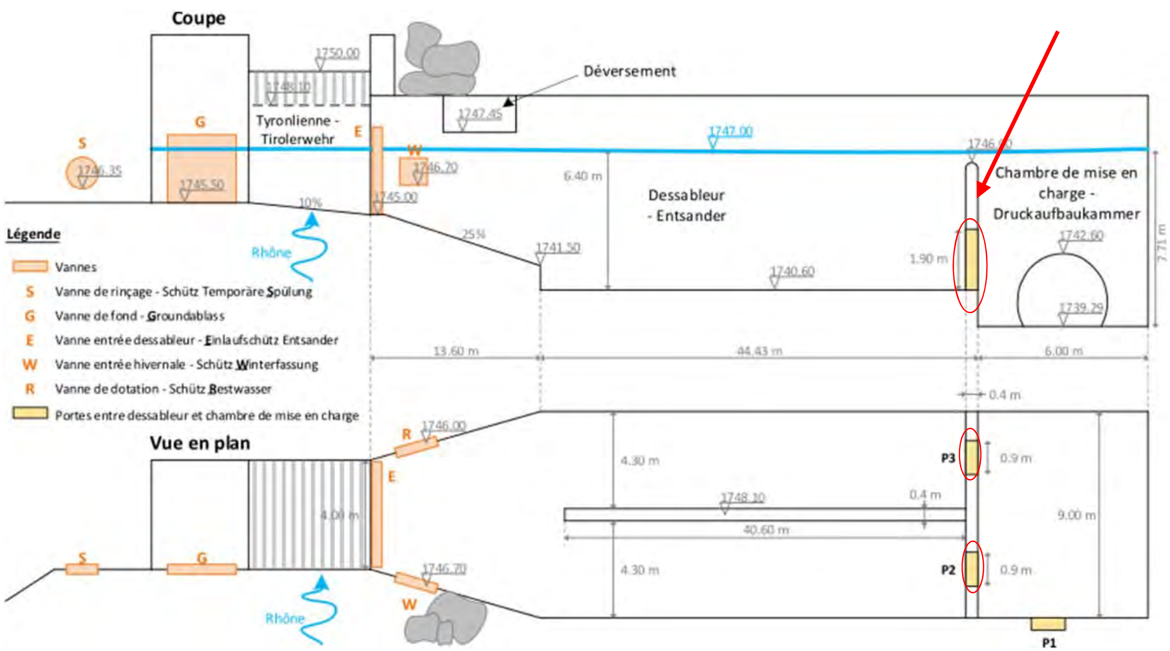
Task 1. Water storage potential

First results:



1. **ADAPTED GEOMETRY OF THE SETTLING BASIN**
   → two bottom outlets connect the settling basin to the forebay tank

2. The **SMART** use of the storage has already been appreciated and empirically applied by the **practitioners** in Gletsch-Oberwald
   → Now we need a systematic concept!

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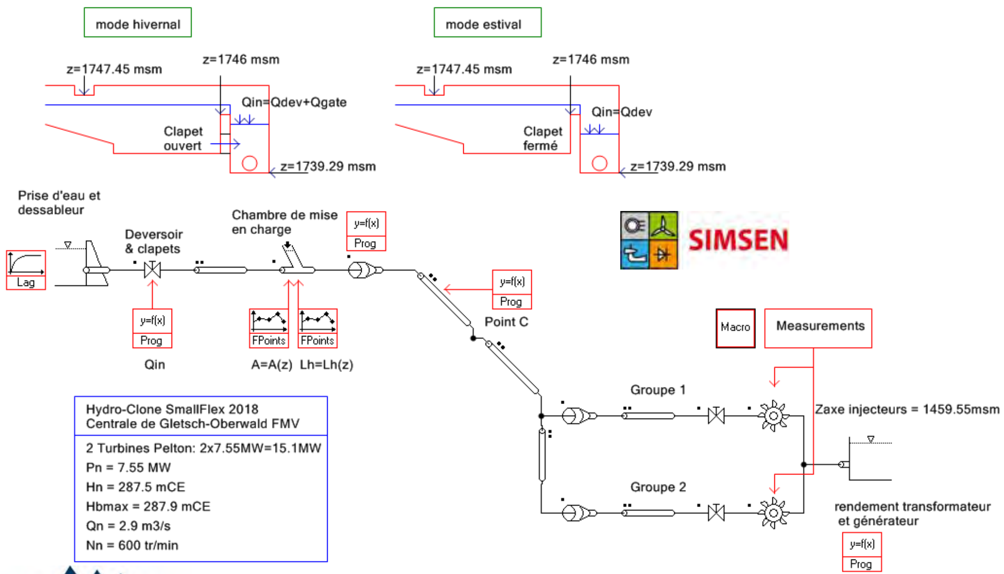
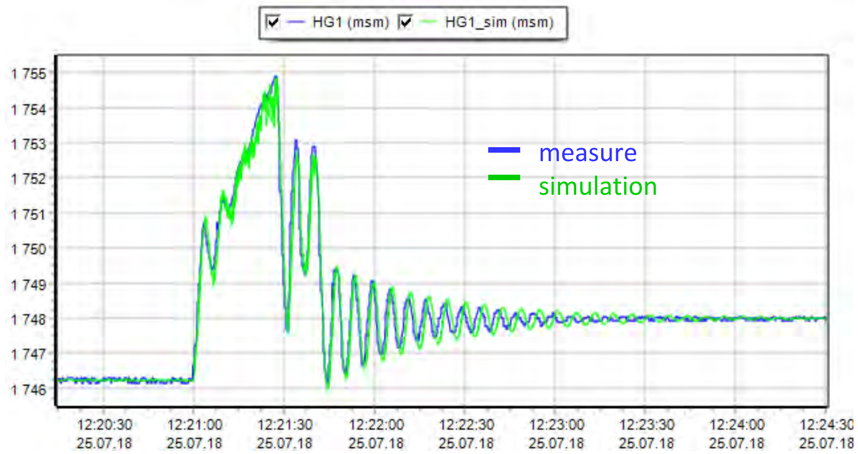
Task 2. Hydraulic Machines Flexibility

- Complete *SIMSEN* 1D-Model of the power plant available for flexibility assessment
- Model calibration and validation based on commissioning transient tests





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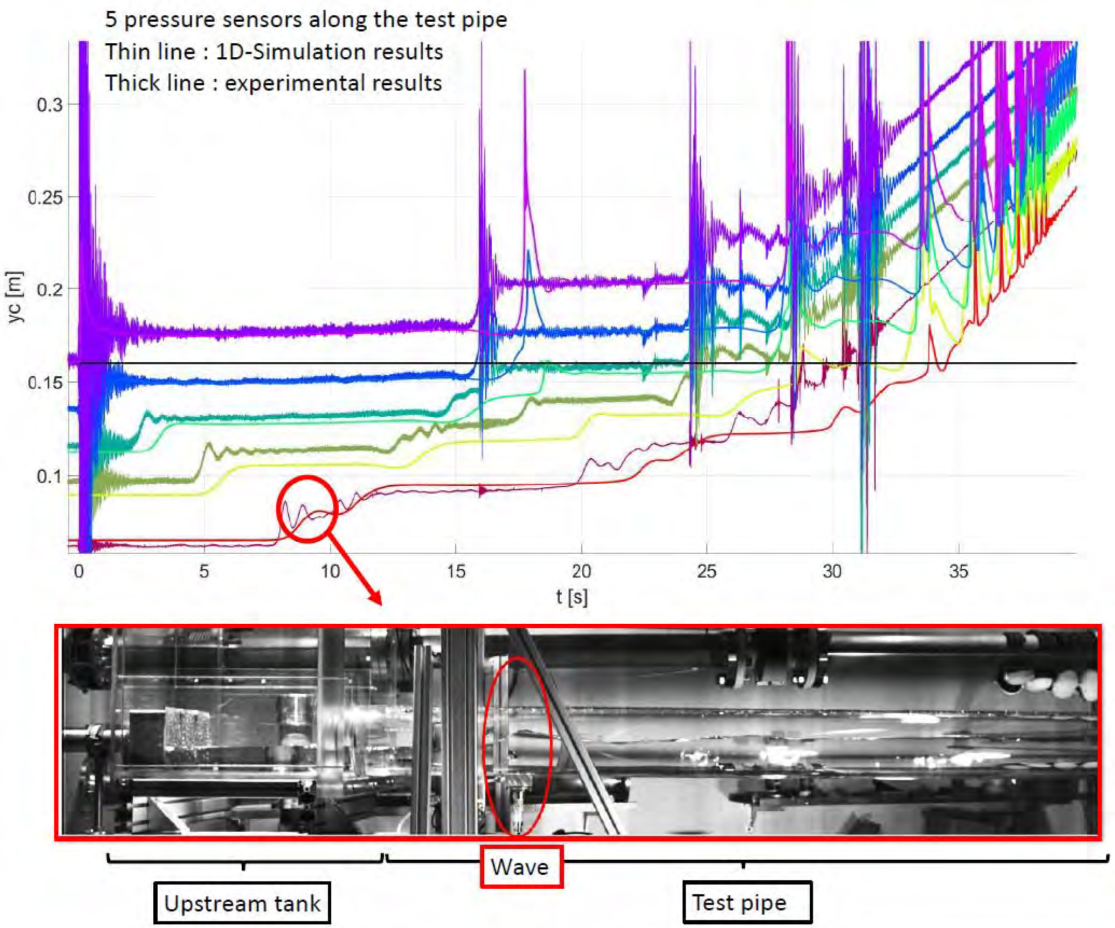
Task 2. Hydraulic Machines Flexibility

First experimental investigations



A. Gaspoz,
Master thesis

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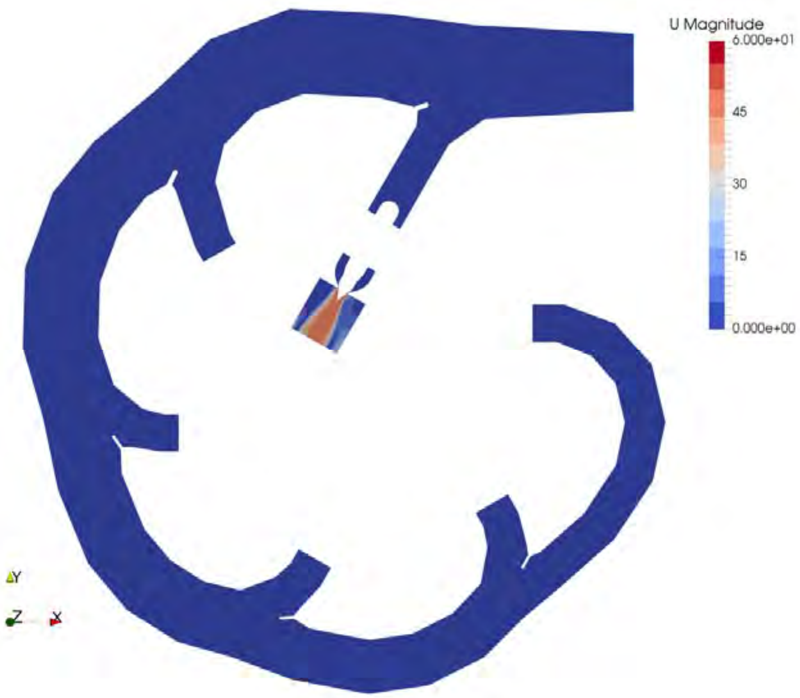
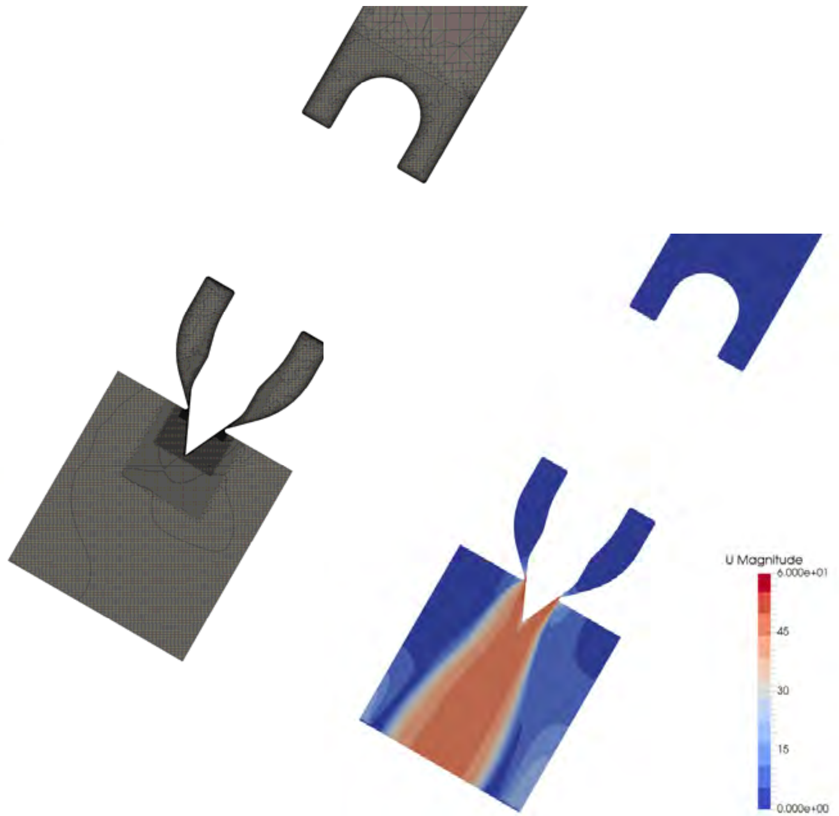
Task 2. Hydraulic Machines Flexibility

Preliminary CFD simulations





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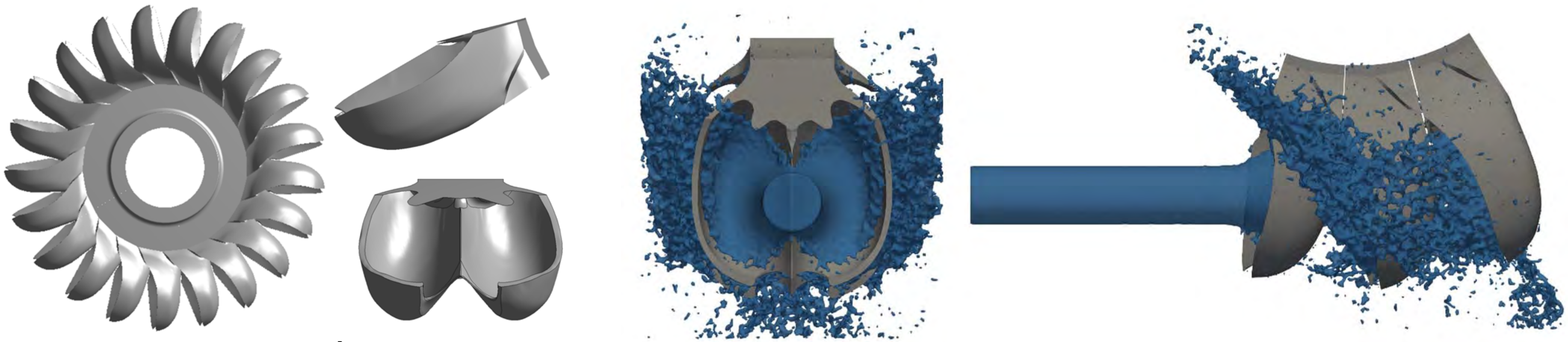
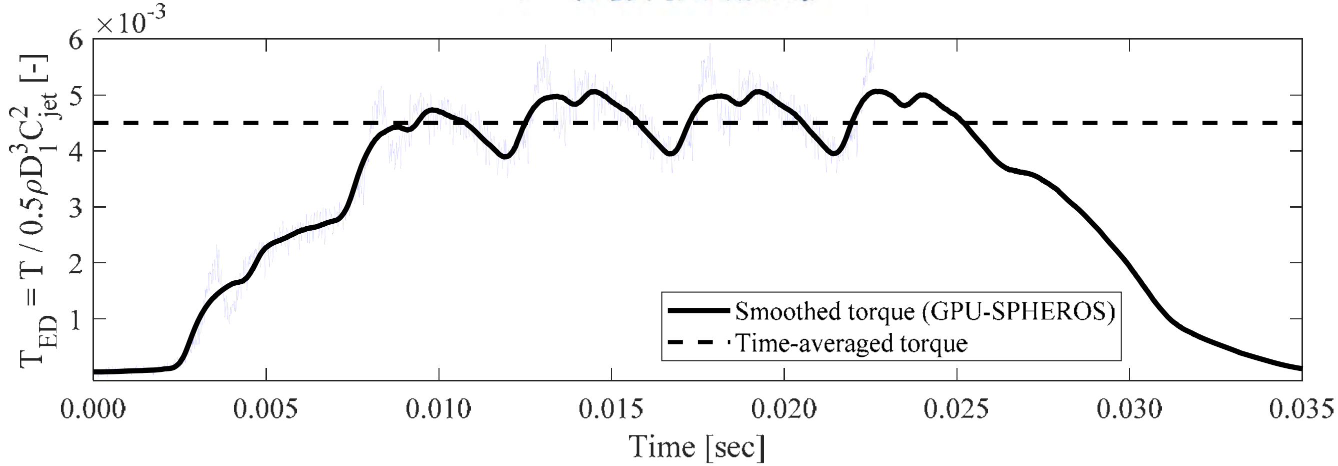
Task 2. Hydraulic Machines Flexibility

Preliminary simulation of the jet by GPU-SPHEROS for BEP





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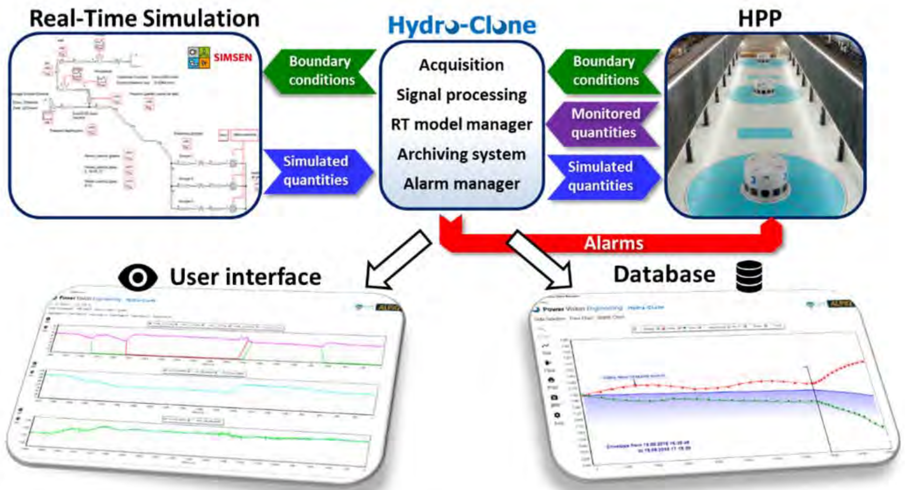
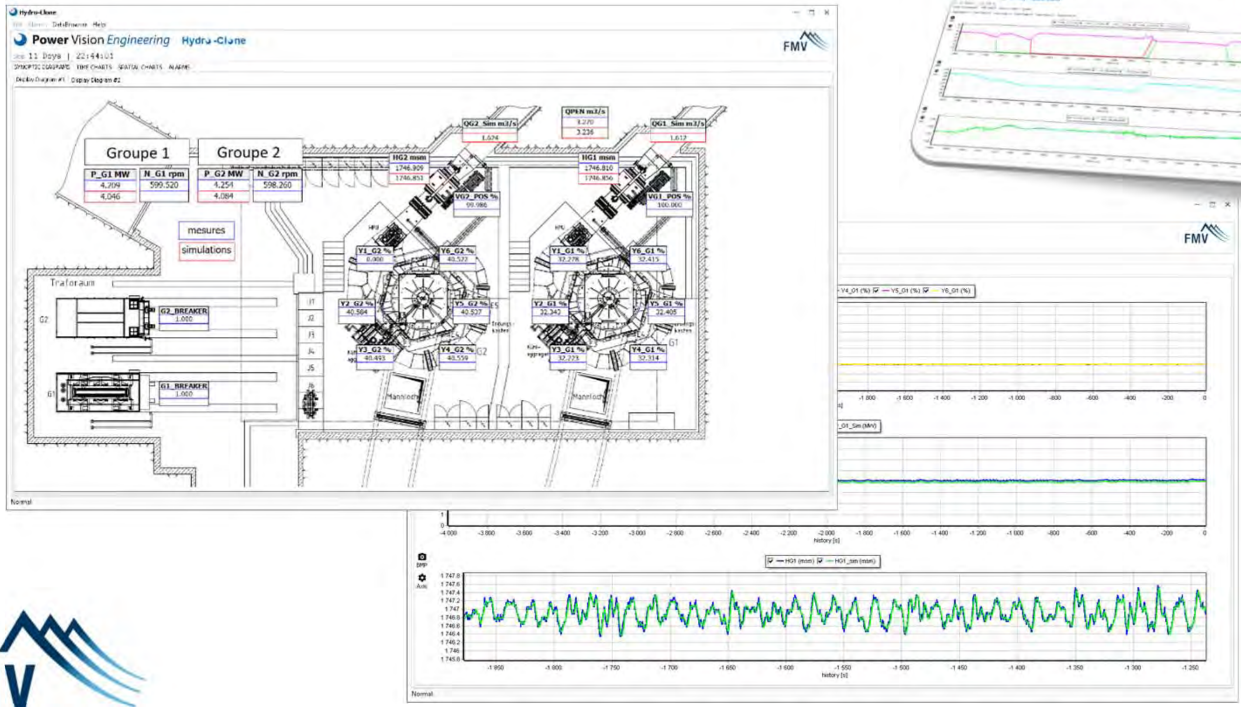
Task 2. Hydraulic Machines Flexibility

- **Hydro-Clone** system deployed
- Real-time monitoring of the power plant since 13.06.2018





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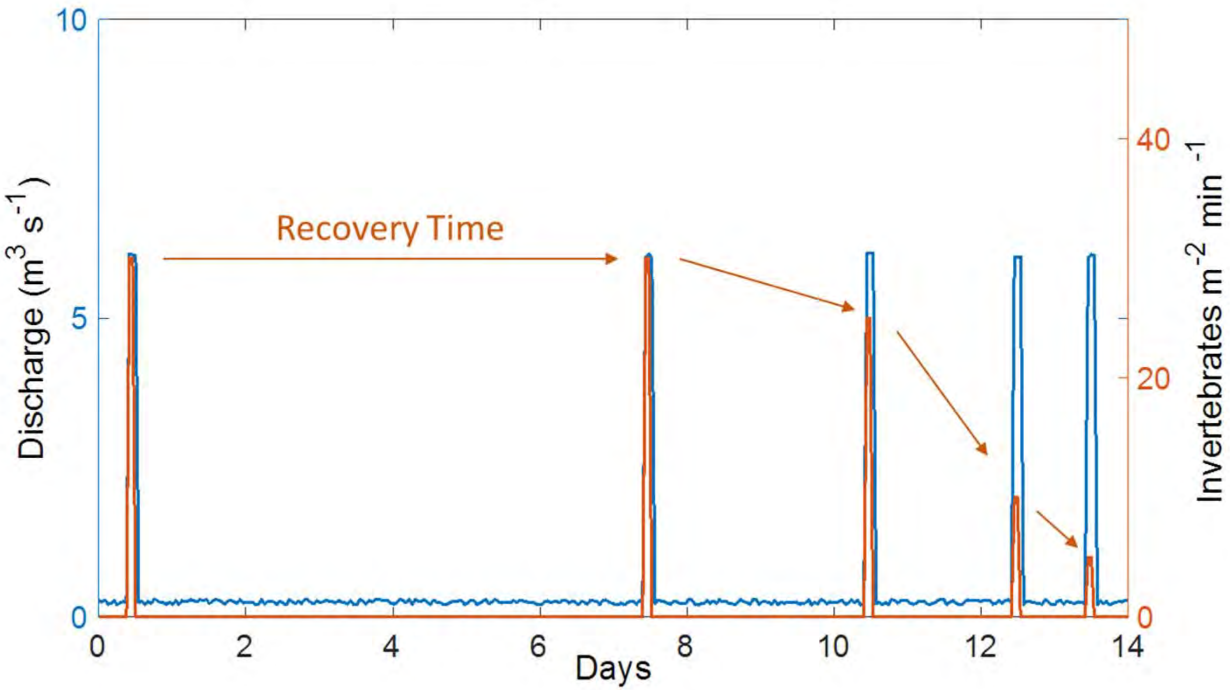
Task 4. Ecological impacts

Focus: Recovery of macroinvertebrates after hydropeaking events

Hypothesis: Recovery will depend on available recovery time between hydropeaking events



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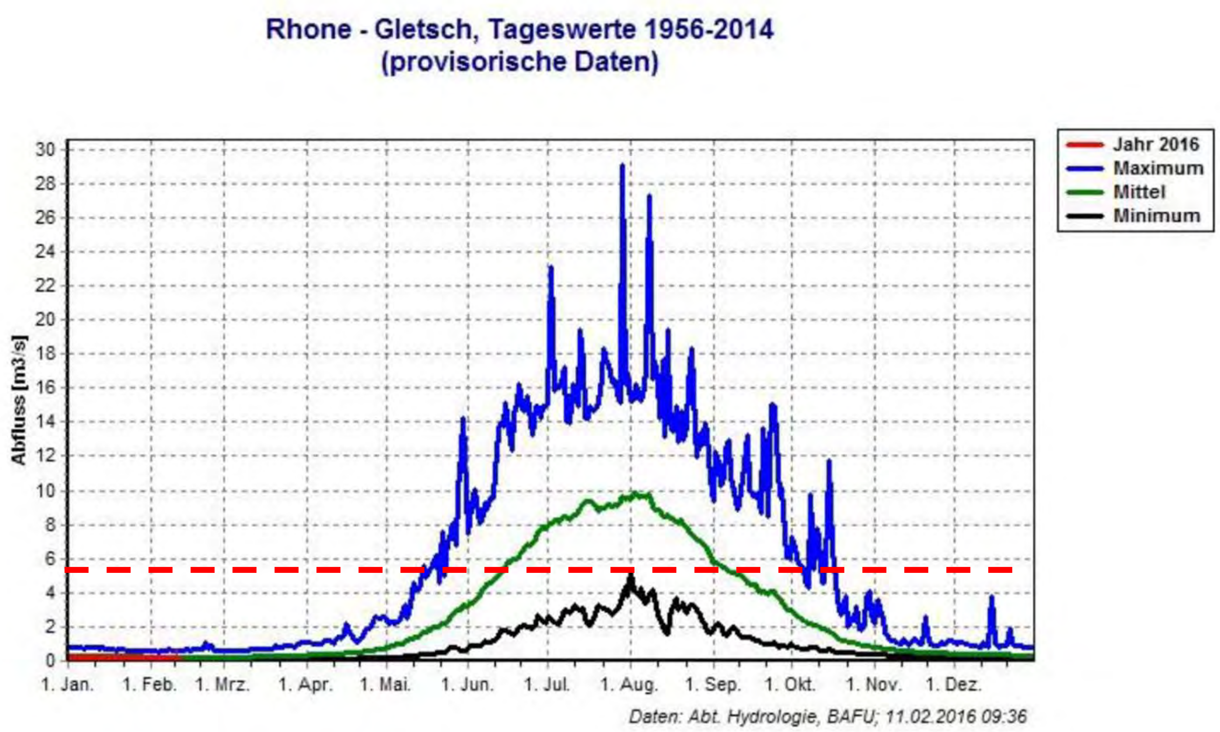
Next steps

- First campaign in November 2018 during three weeks gathering the competences of the research team to explore flexibility !



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Posters 2018

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- *Mise à profit hivernale d'un dessableur souterrain en milieu alpin pour l'exploitation hydroélectrique flexible*. J. Zordan, P. Manso, C. Münch-Alligné.
- *Investigation of transient mixed flow at hydropower plant intake***.** A. Gaspoz, V. Hasmatuchi, C. Nicolet, C. Münch-Alligné.
- *Implementation of an operational seamless nowcast to short range forecast system for the small hydropower plant at Gletsch.* K. Bogner, M. Buzzi, M. Schirmer, M. Zappa.
- *High resolution climate scenarios for snowmelt modelling in small alpine catchments*. M. Schirmer, N. Peleg