Effects of pump storage operations on reservoir turbidity (Grimselsee and Oberaarsee)

matteo bonalumi

6th Swiss Geoscience Meeting, Lugano

eawag
aquatic research

Outline

Introduction

Aims

Previous studies

Sampling and analytical methods

Results

Conclusions

Introduction

Why is the study of turbidity in a reservoir important?

- turbidity currents imply high sedimentation

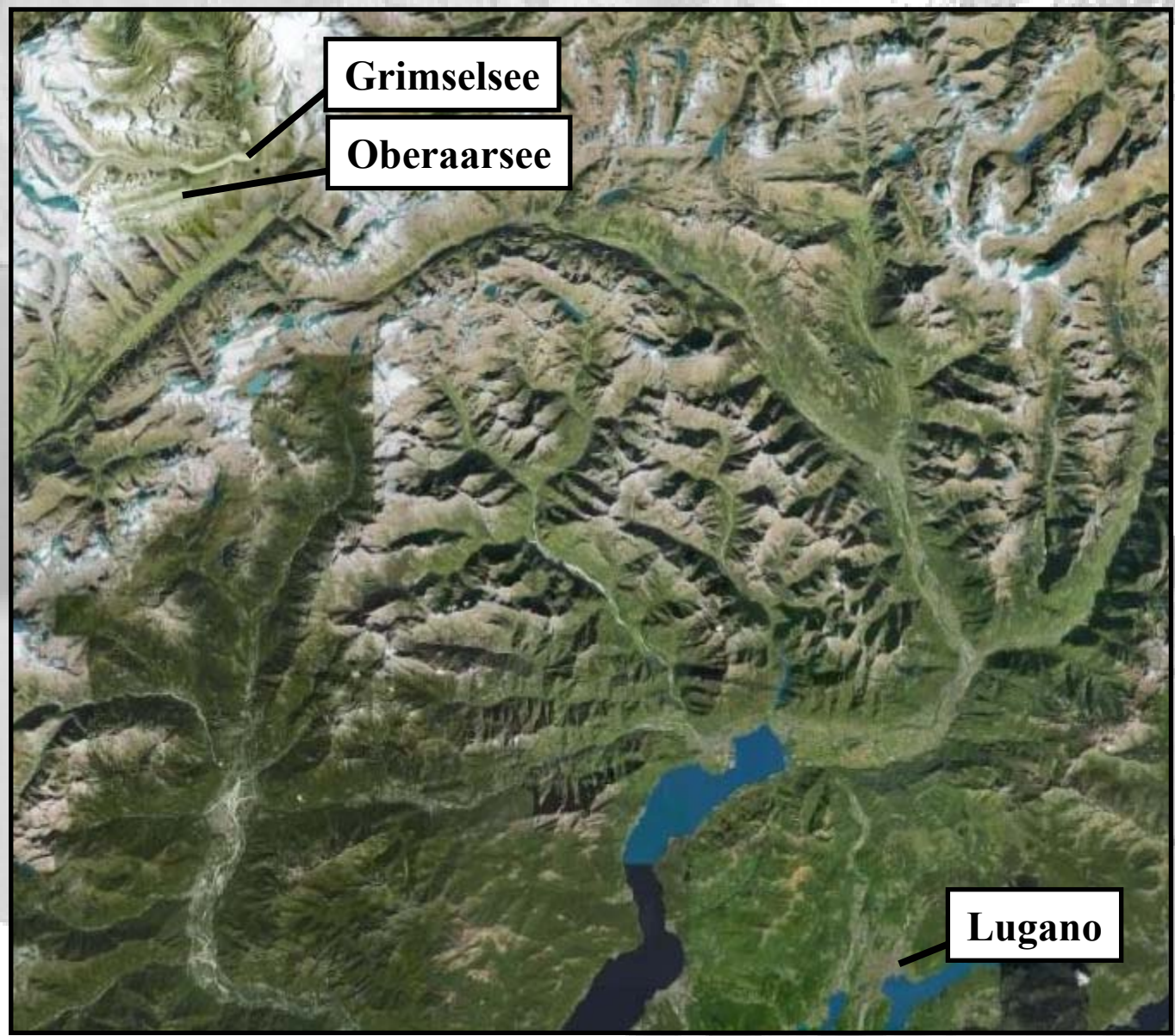
- suspended particles erode the turbines

- ecological effects downstream

- …

Introduction

Sampling locations

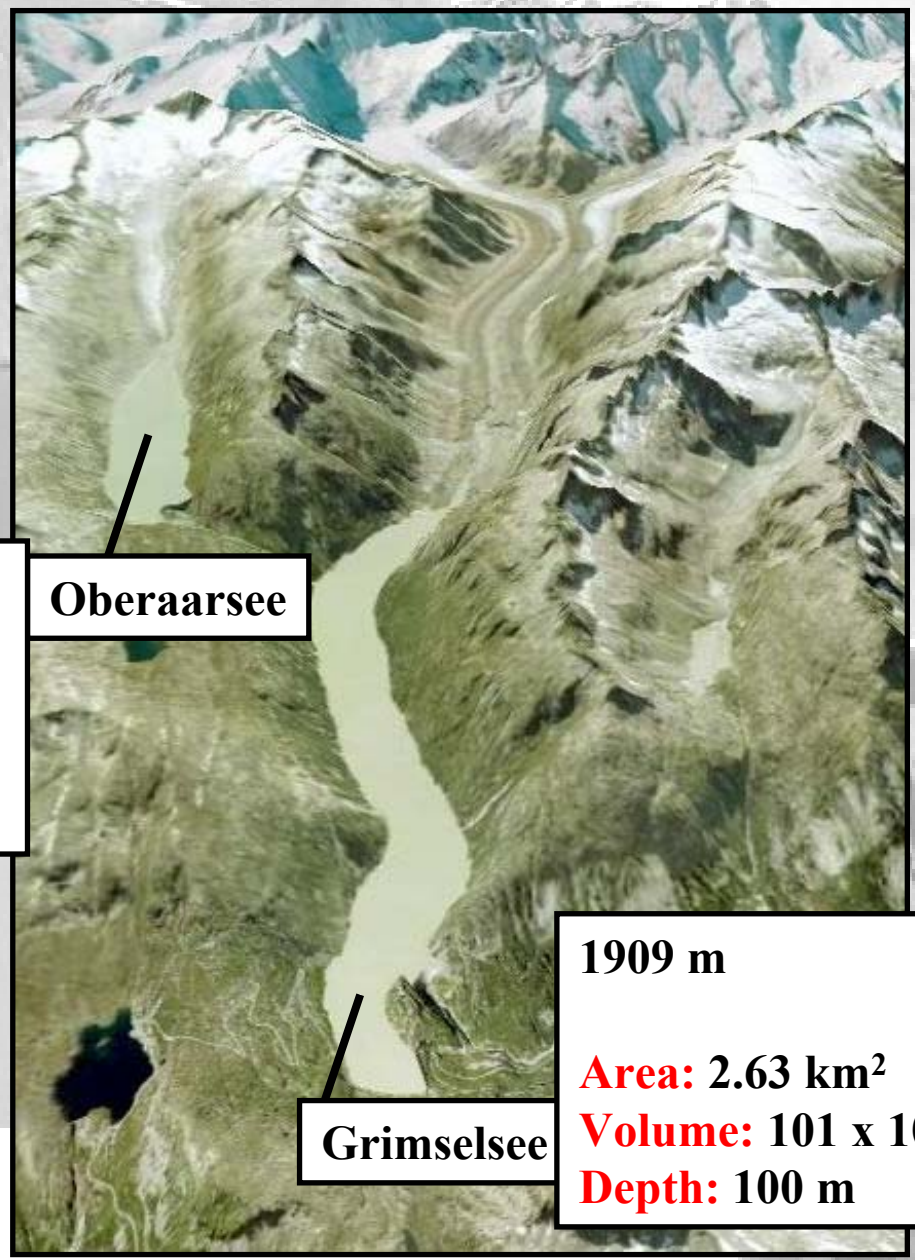


Introduction

Sampling locations

Introduction

Sampling locations



2303 m

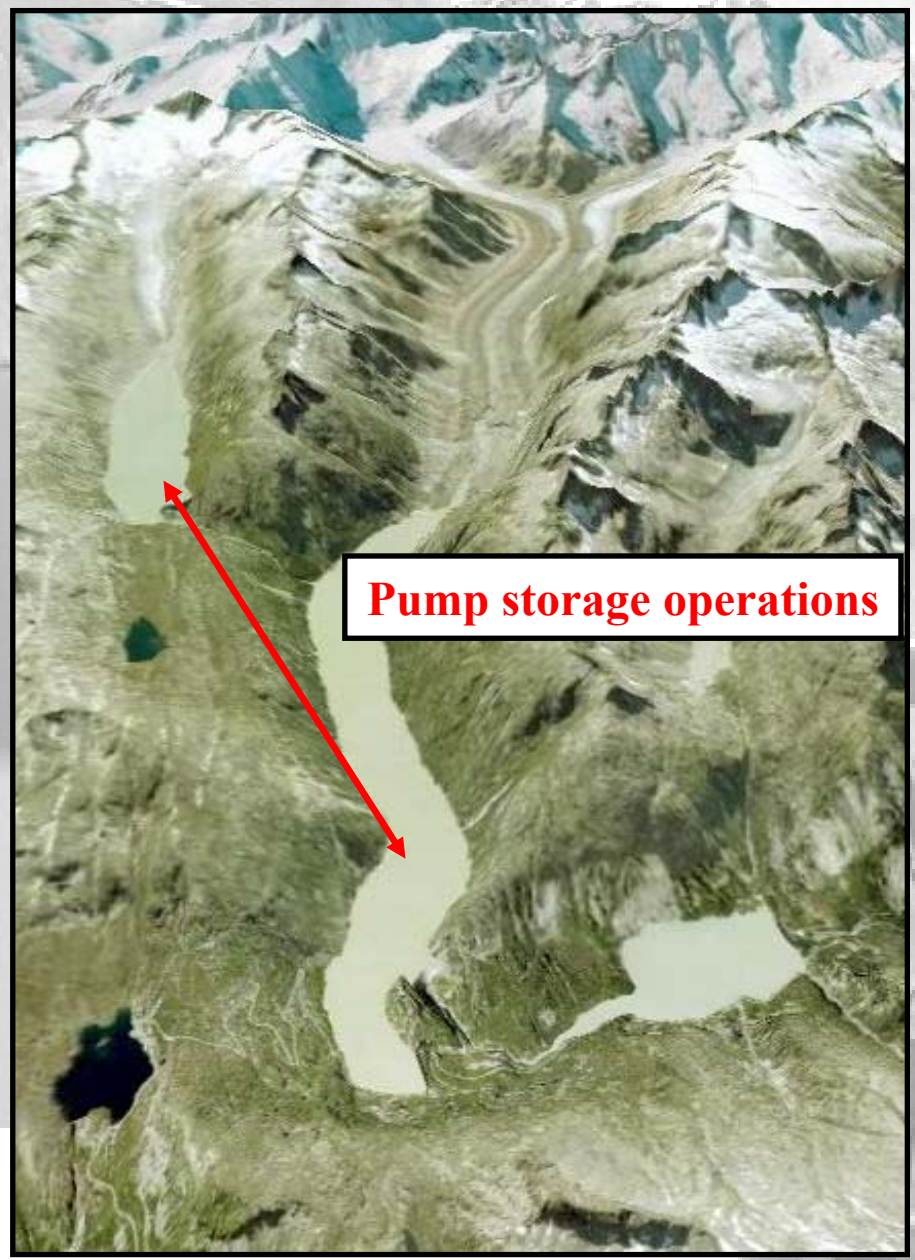
Area: 1,46 km^2
Volume: 58 x 10^6 m^3
Depth: 90 m

1909 m

Area: 2.63 km^2
Volume: 101 x 10^6 m^3
Depth: 100 m

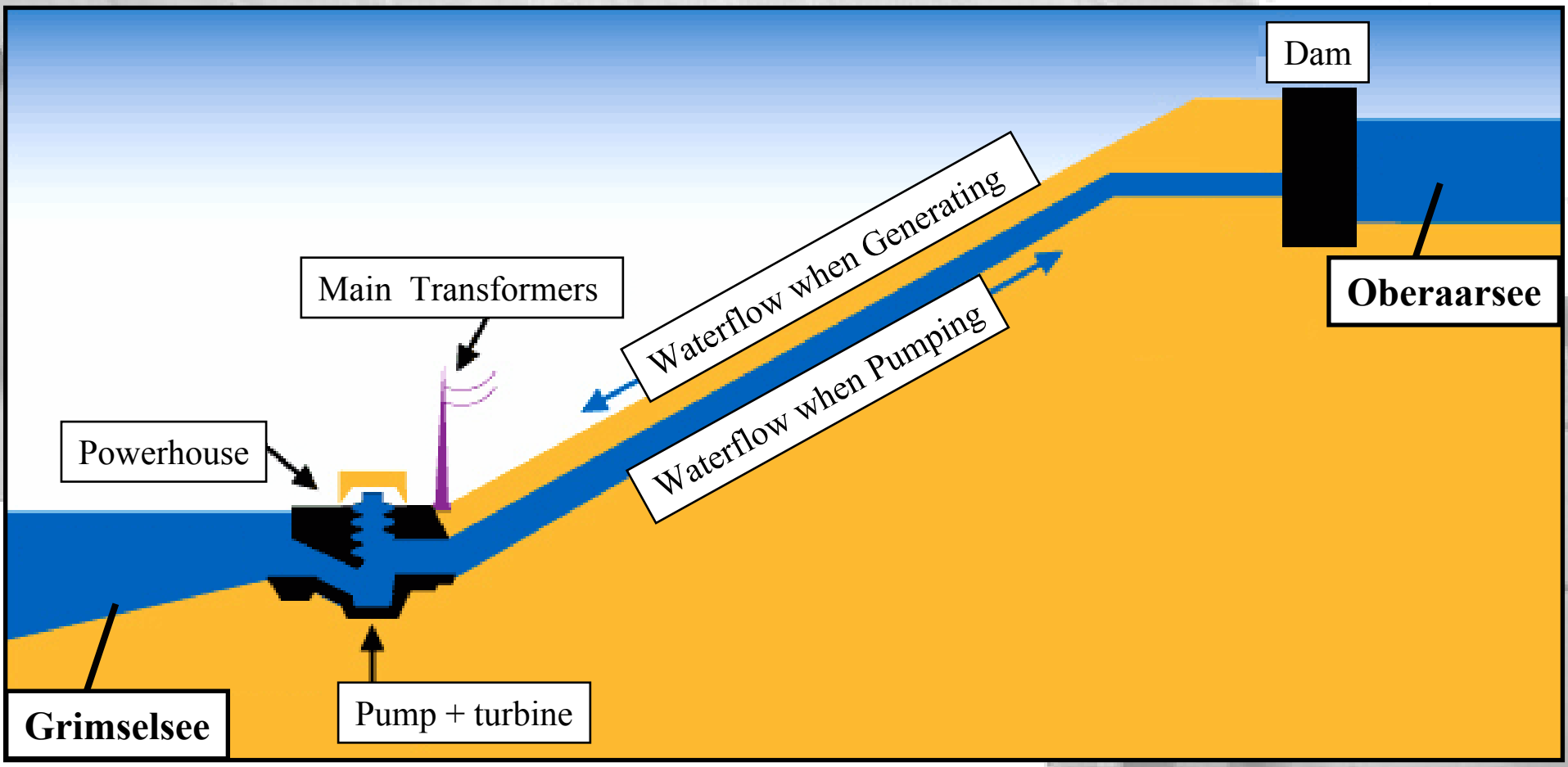
Introduction

Sampling locations



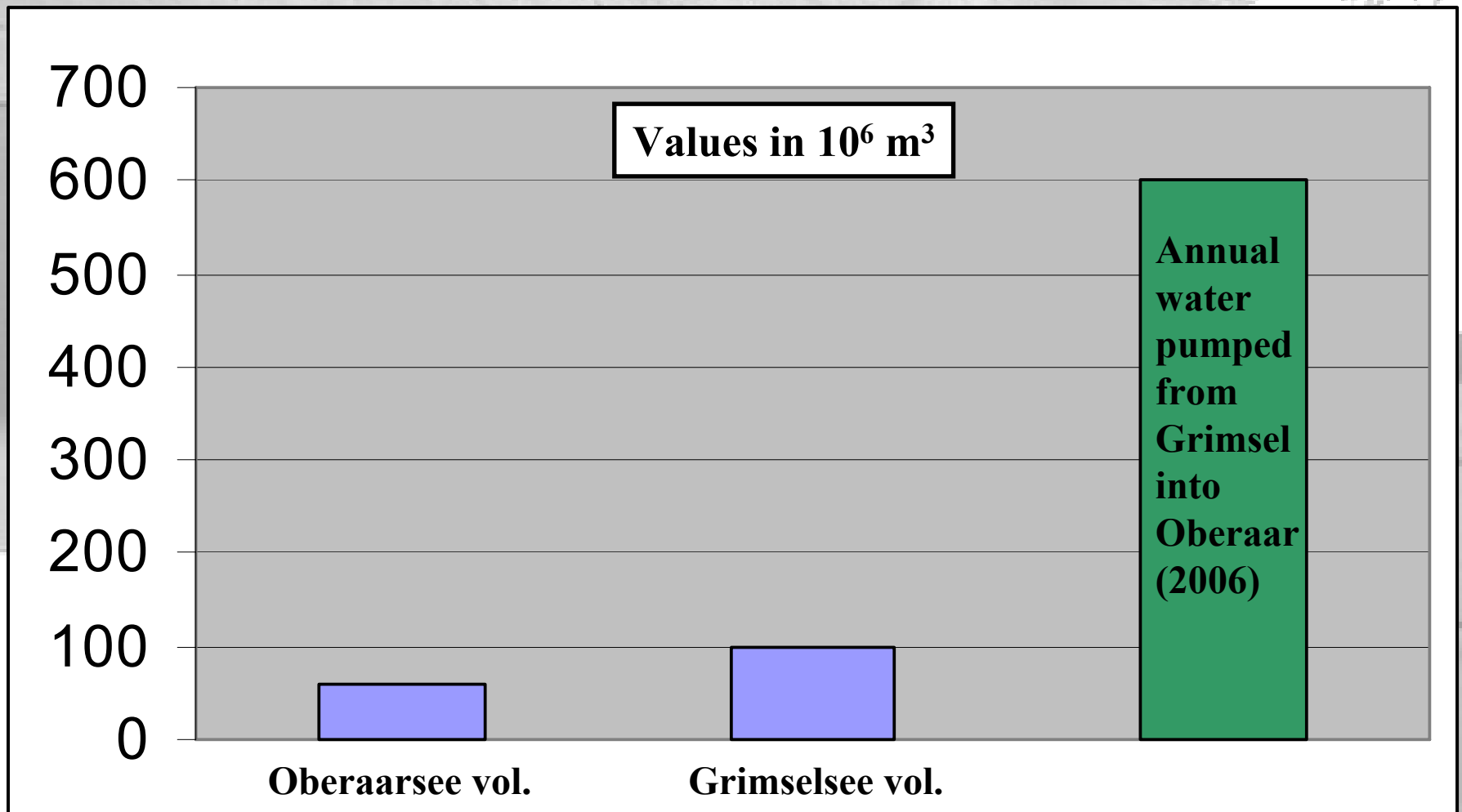
Introduction

Sampling locations – Pump storage operations



Introduction

Sampling locations – Pump storage operations

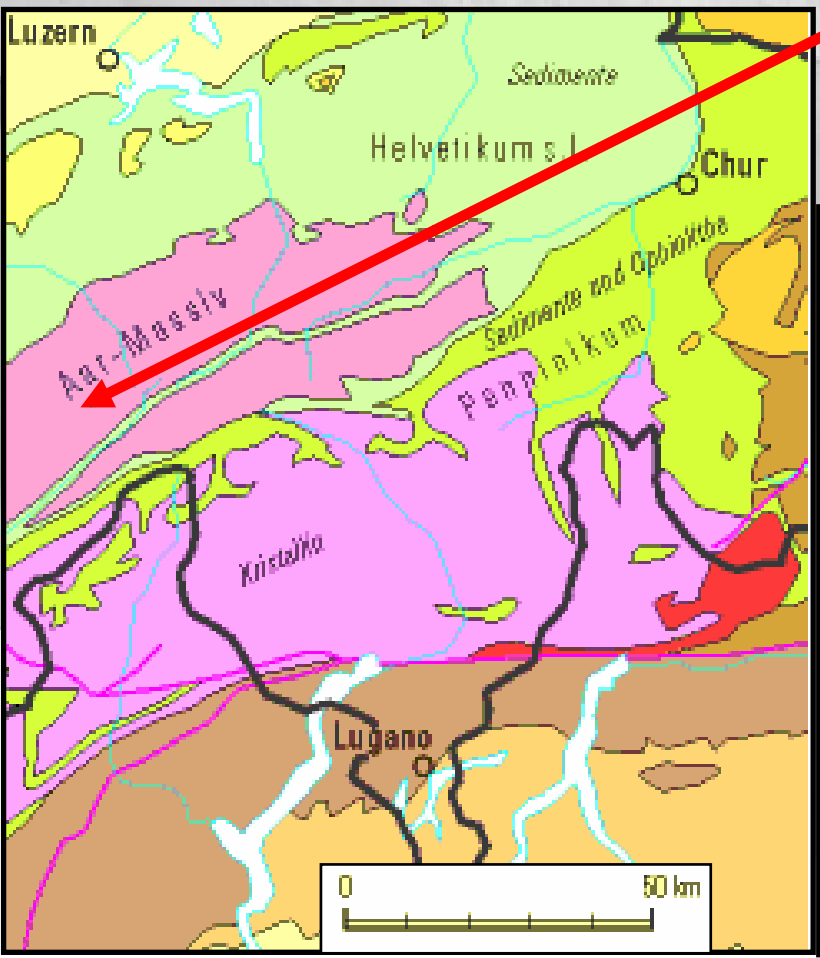


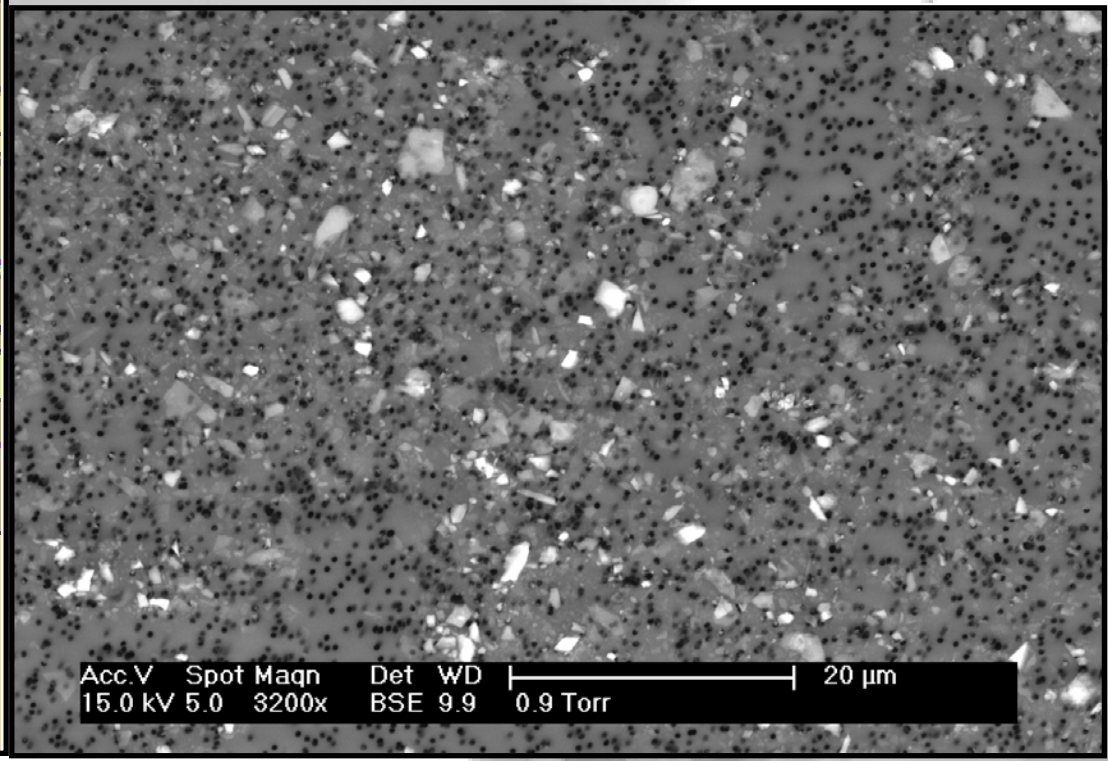
Introduction

Reservoirs are located in a partially glaciated catchment

Introduction

Reservoirs are located in a crystalline catchment





Aims

Characterize the turbidity in the two reservoirs in a seasonal resolution. Which factors are important?

Estimate the effect of the hydropower operations on the water column characteristics (e.g. thermal stratification)

Investigate the effect of hydropower operations on the sedimentation.

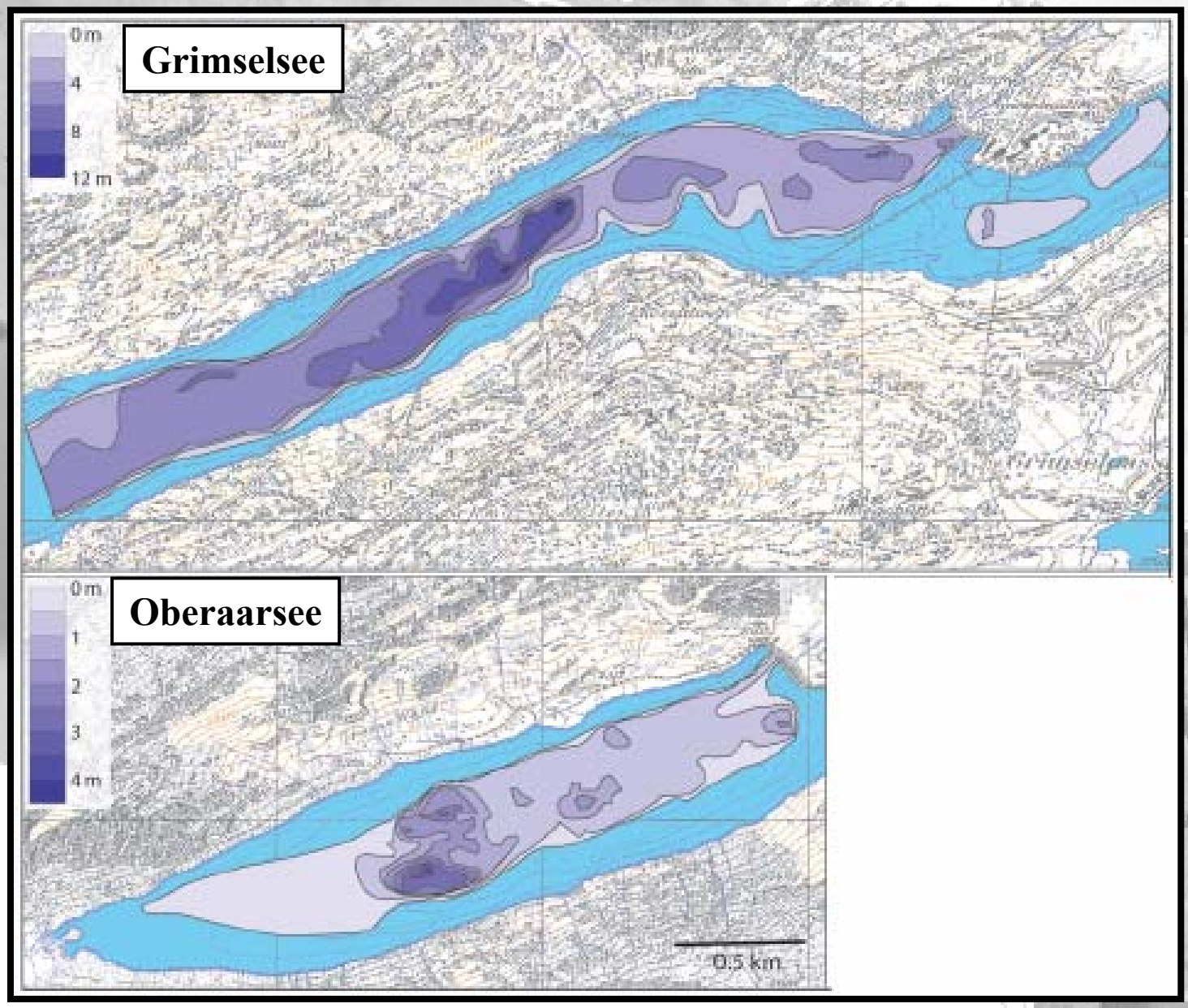
Previous studies

The reservoirs mean annual concentration is 50 mg/L (Bühler et al. 2003));

Grimselsee

Oberaarsee

Previous studies



The reservoirs act as important sediment trap (Anselmetti et al. 2007)

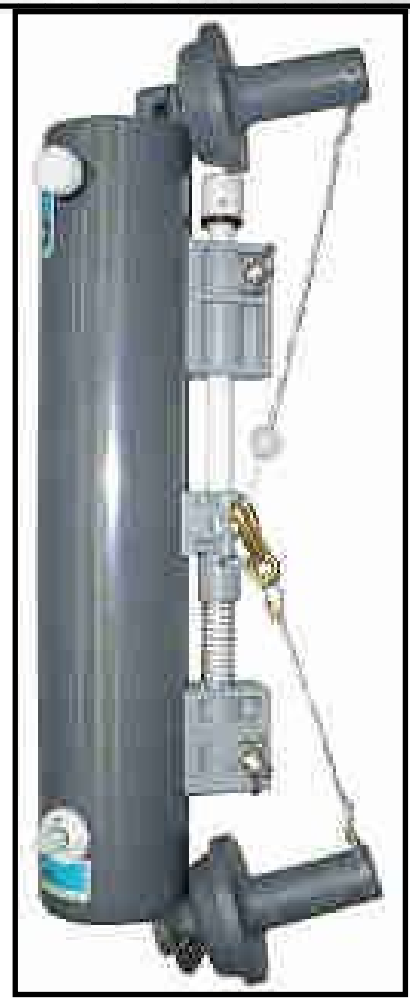
Sampling and analytical methods

CTD device

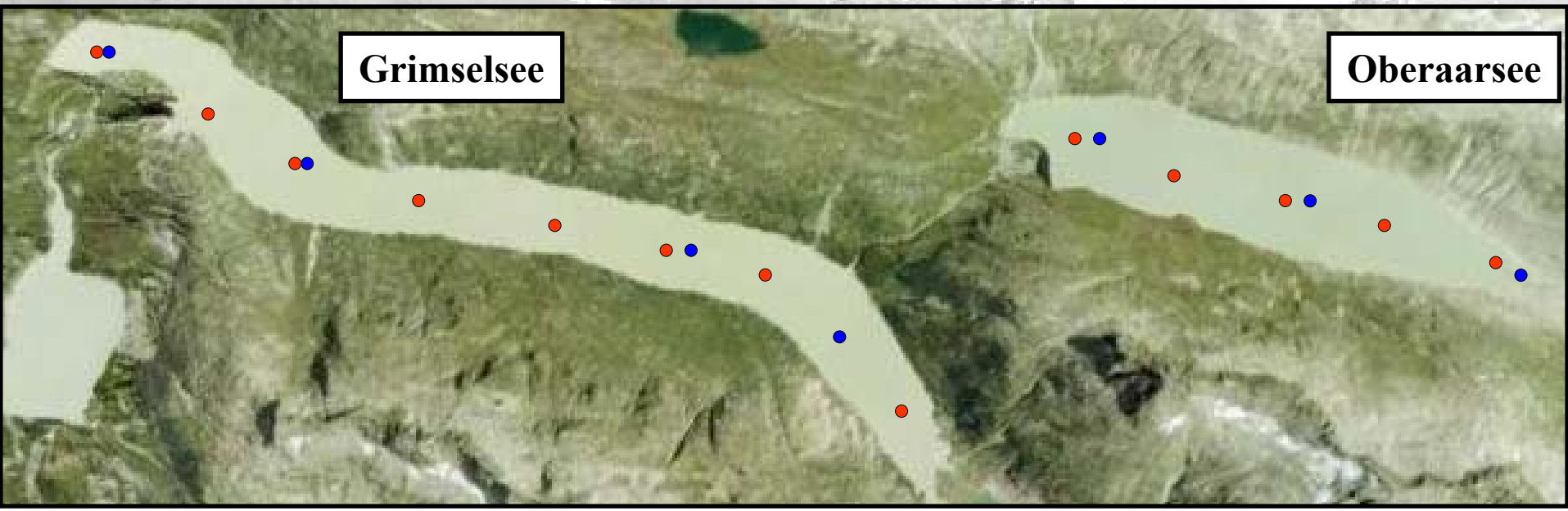
measuring Conductivity, Temperature, Pressure (Depth), Turbidity, ...

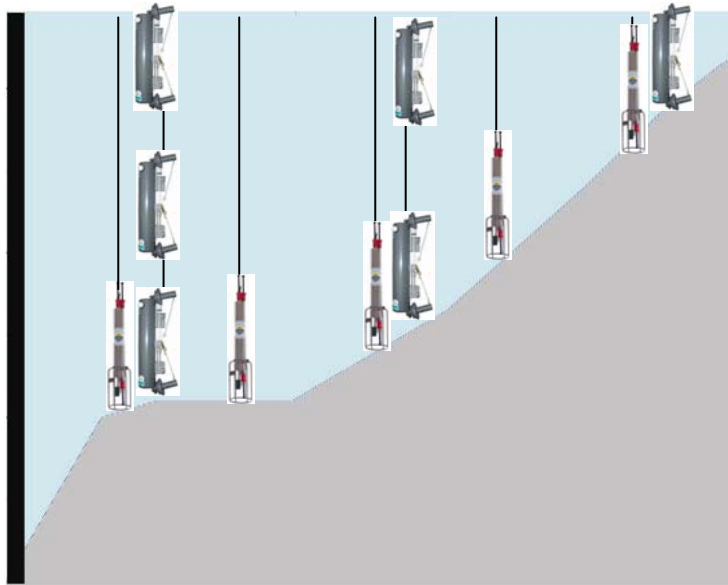
NISKIN bottle

for water sampling



Sampling and analytical methods





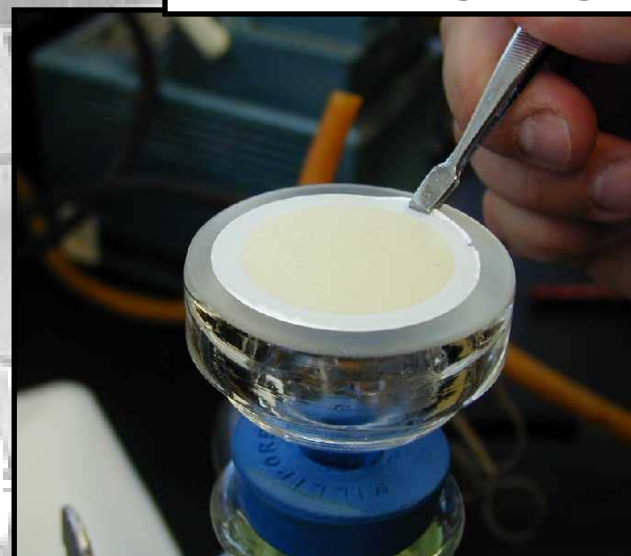
Sampling and analytical methods

Malvern Laser Grain sizer

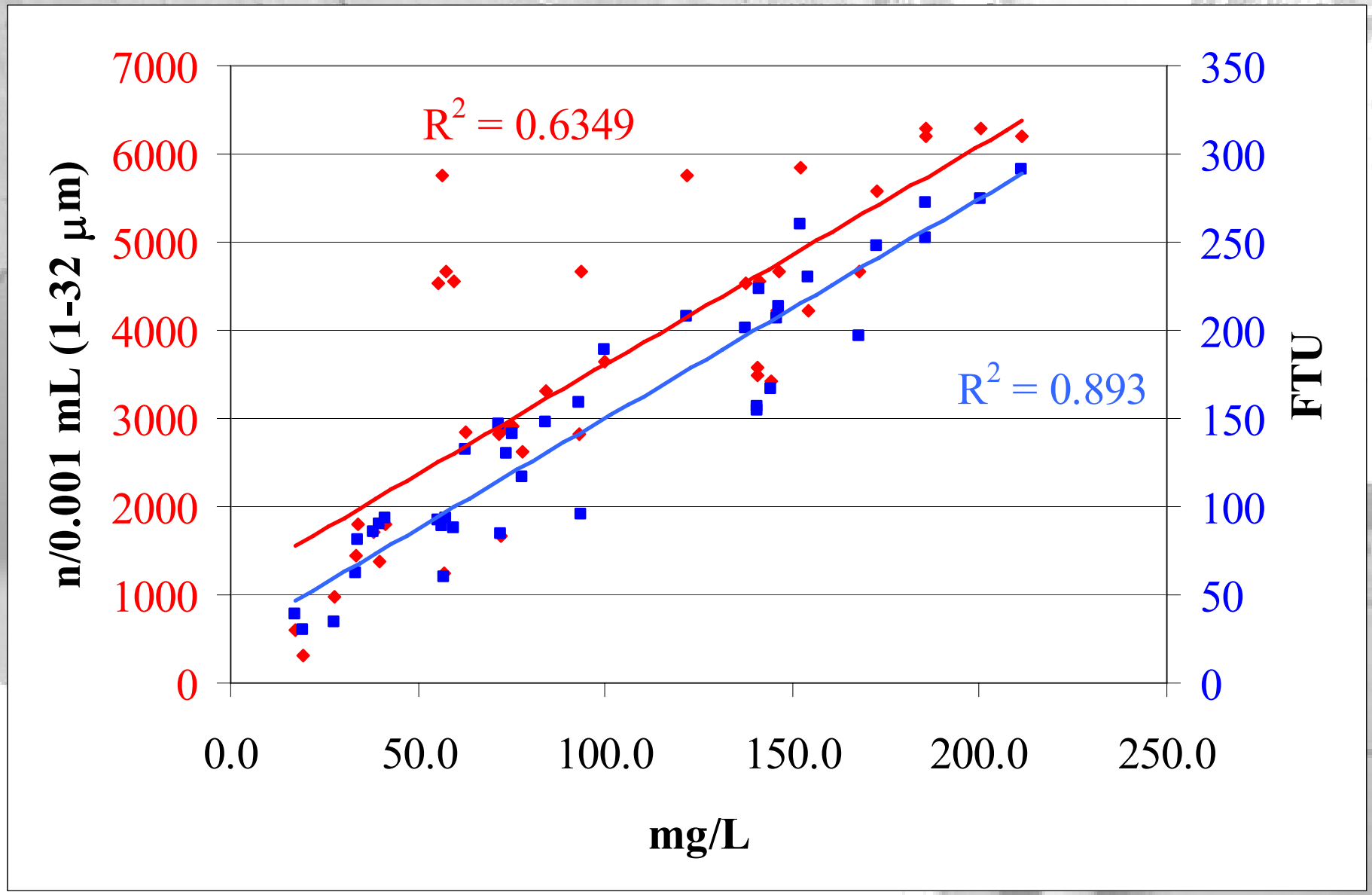
HACH Turbidimeter

Klotz Syringe Particle Counter

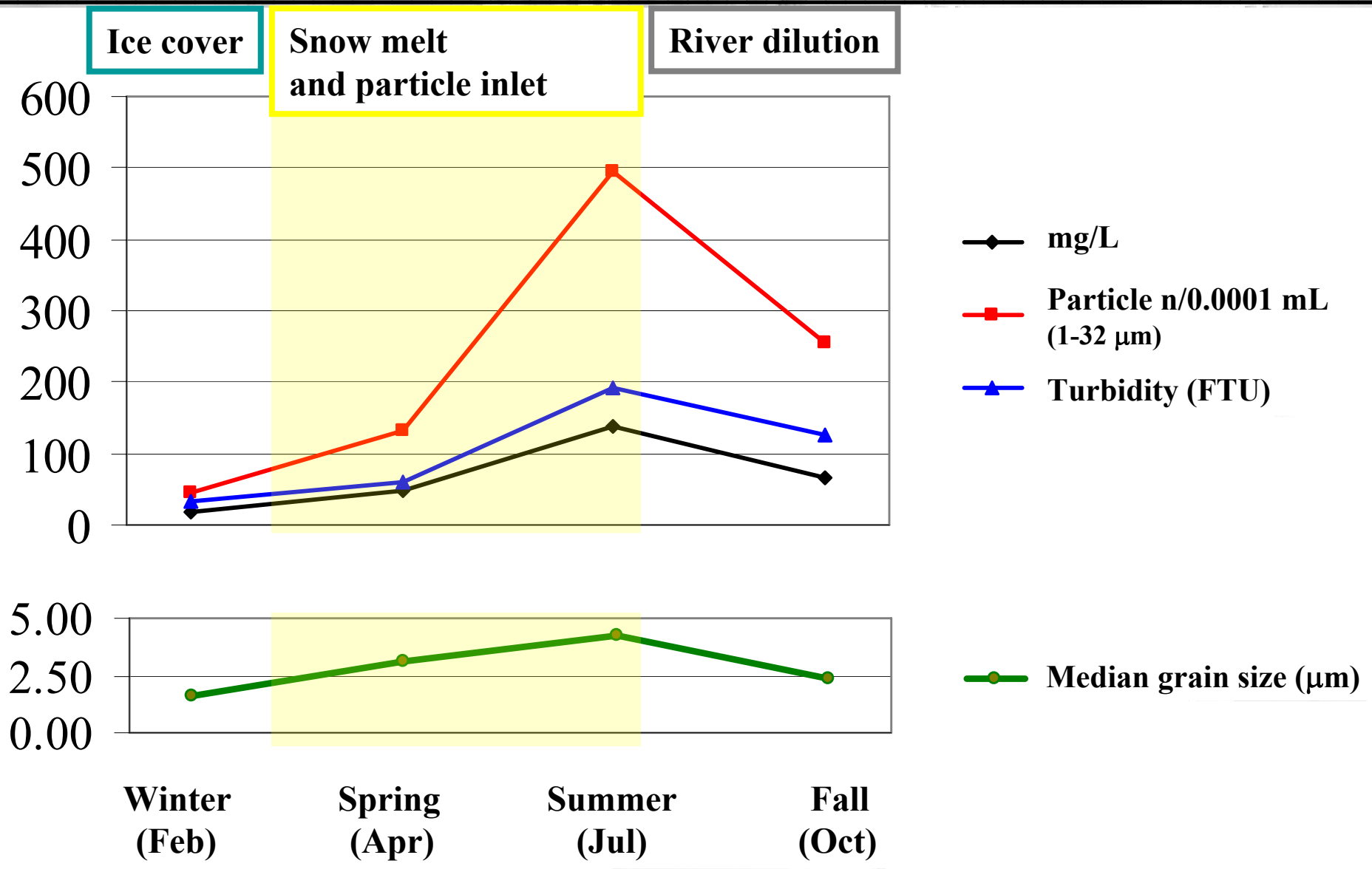
Filter weighing



Comparison between different methods

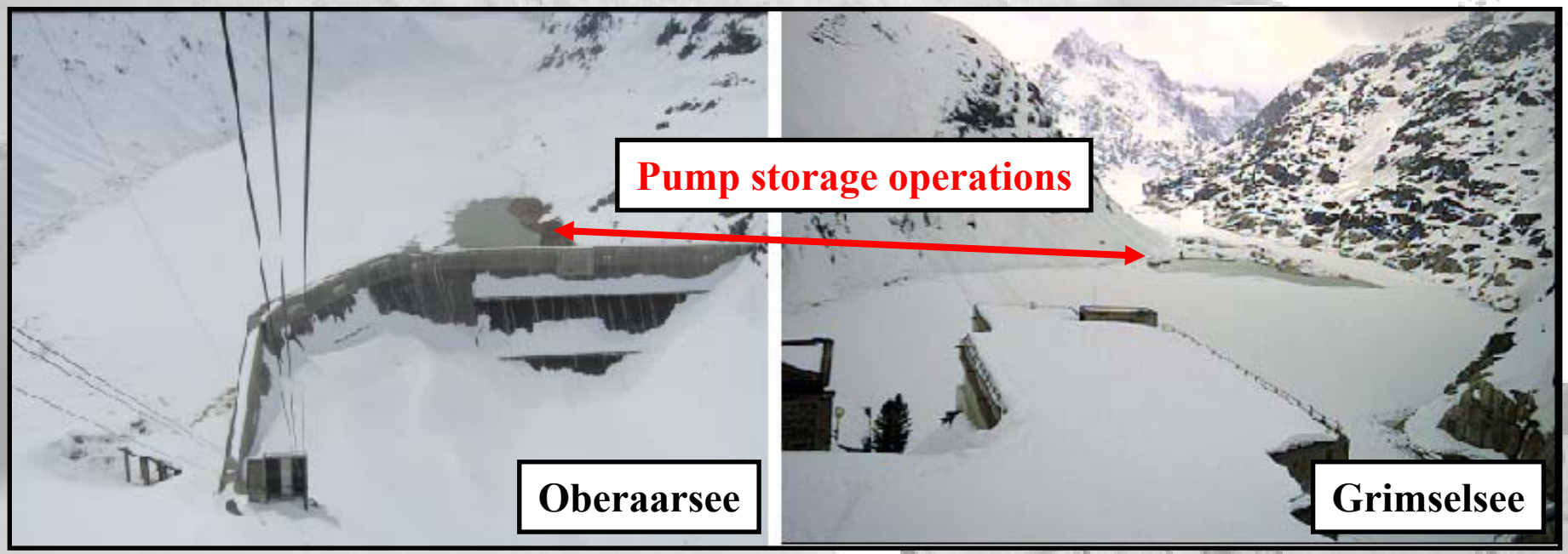


Turbidity and particle size

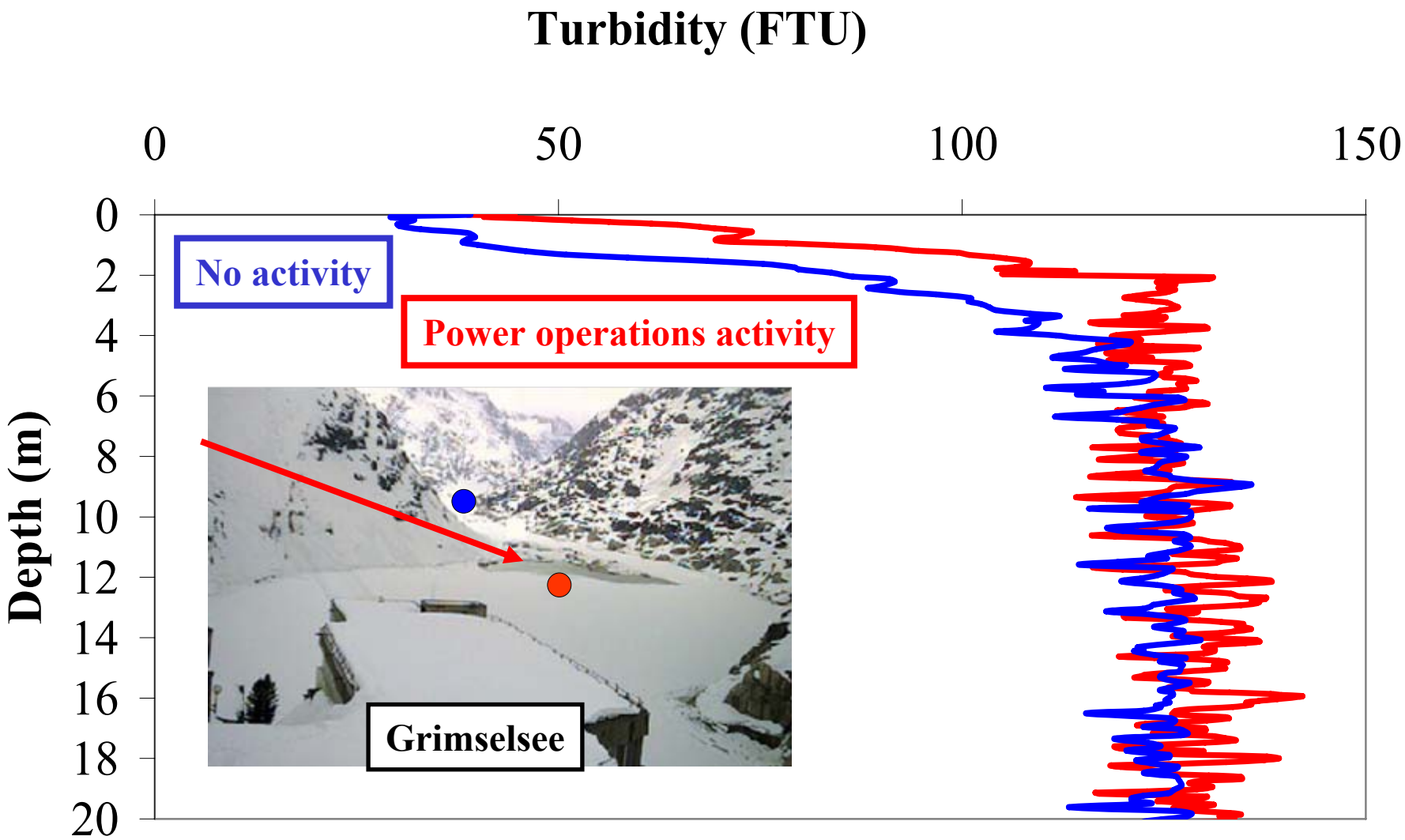


Results - Winter

Winter: no river inflow and low level in both reservoirs



Winter – Turbidity and power operation

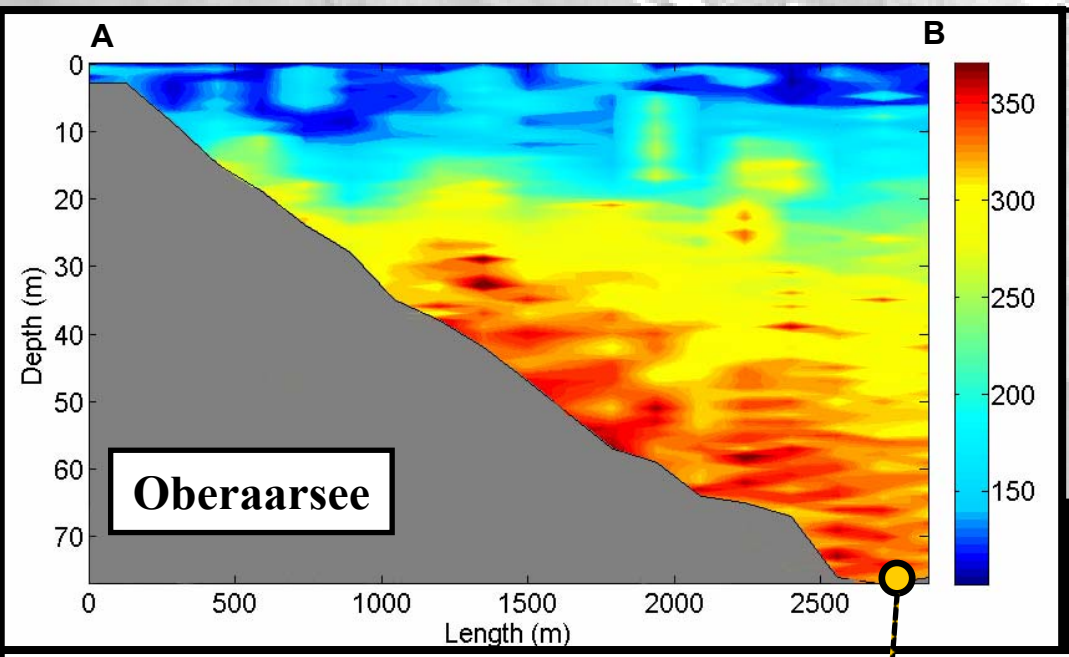


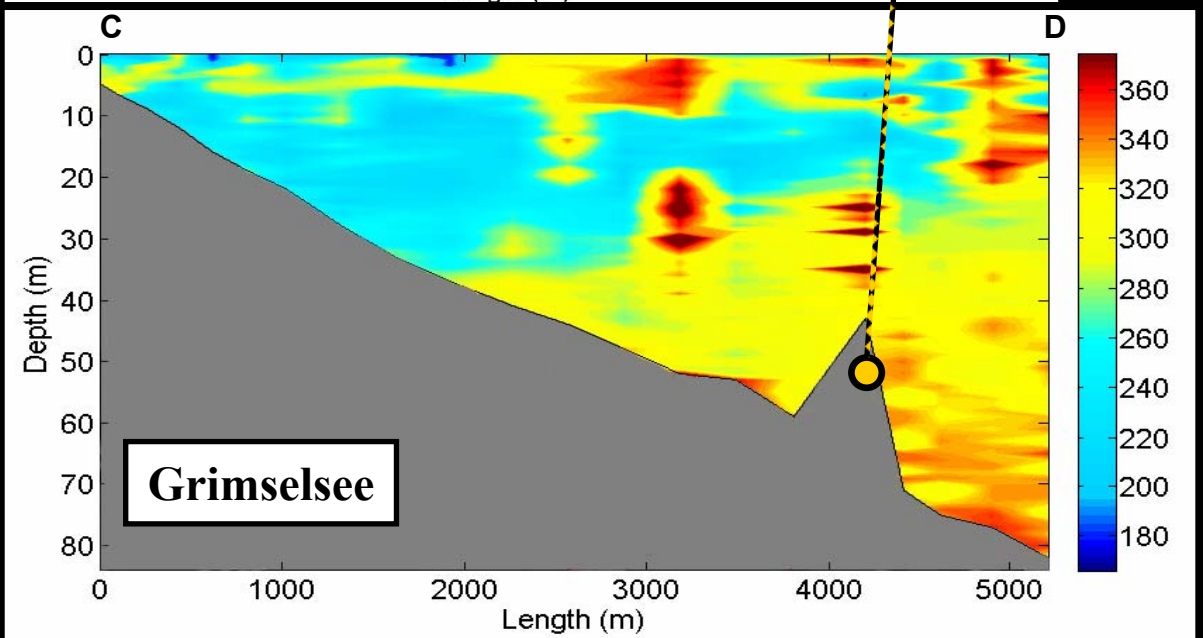
Results – Summer and Fall

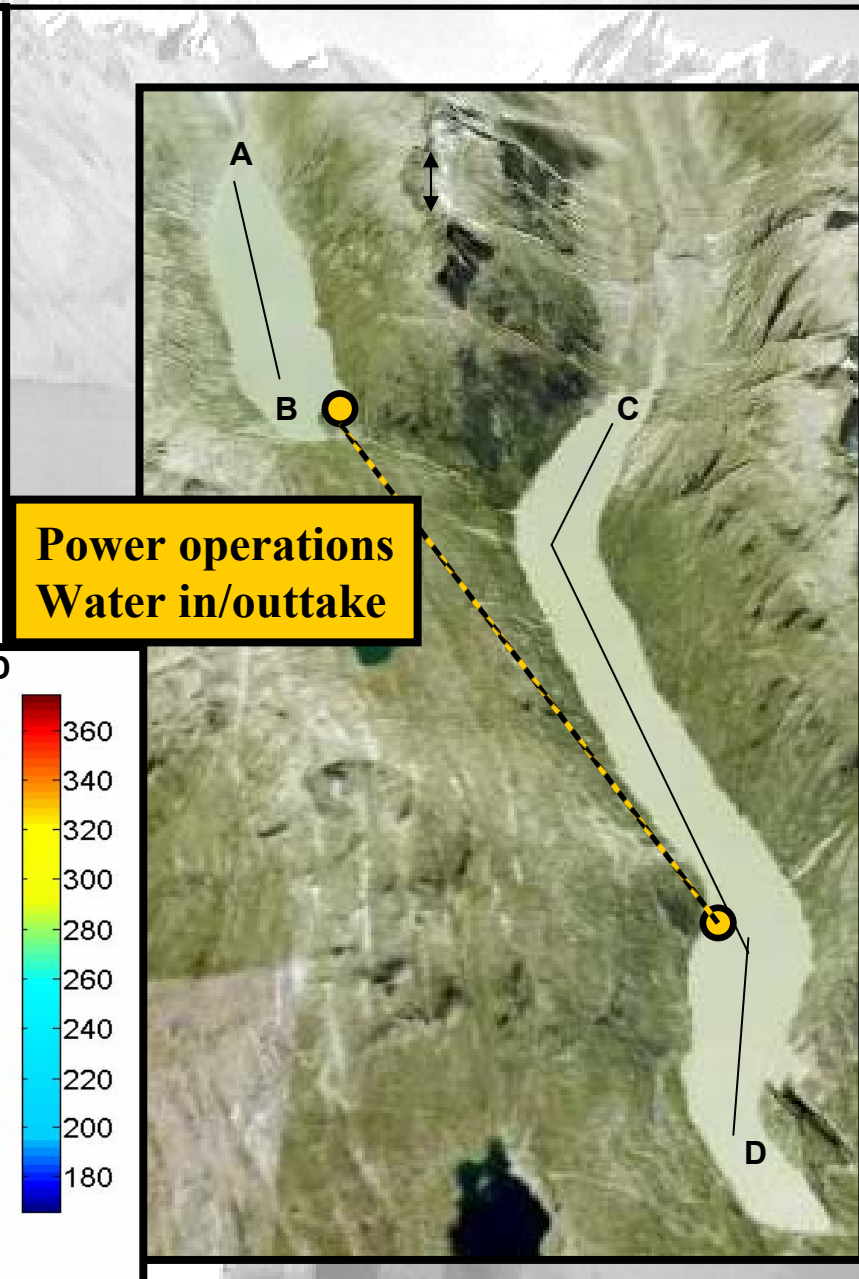
Summer and Fall: high level in both reservoirs

Grimselsee

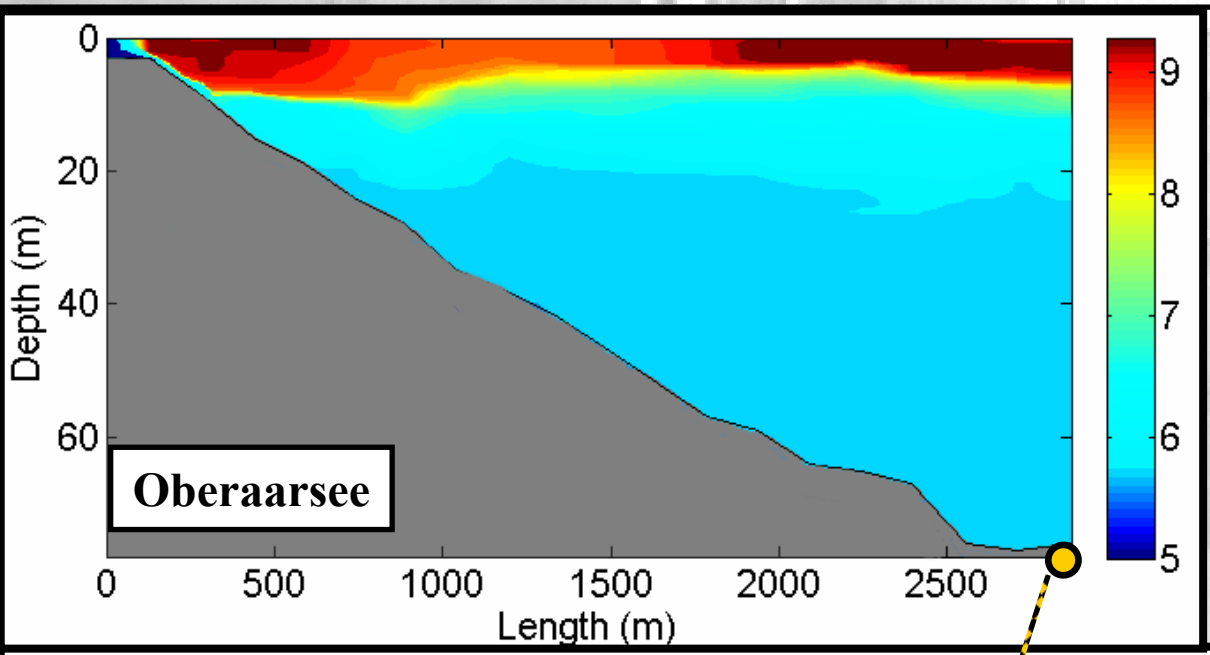
Different Turbidity (FTU) in the reservoirs

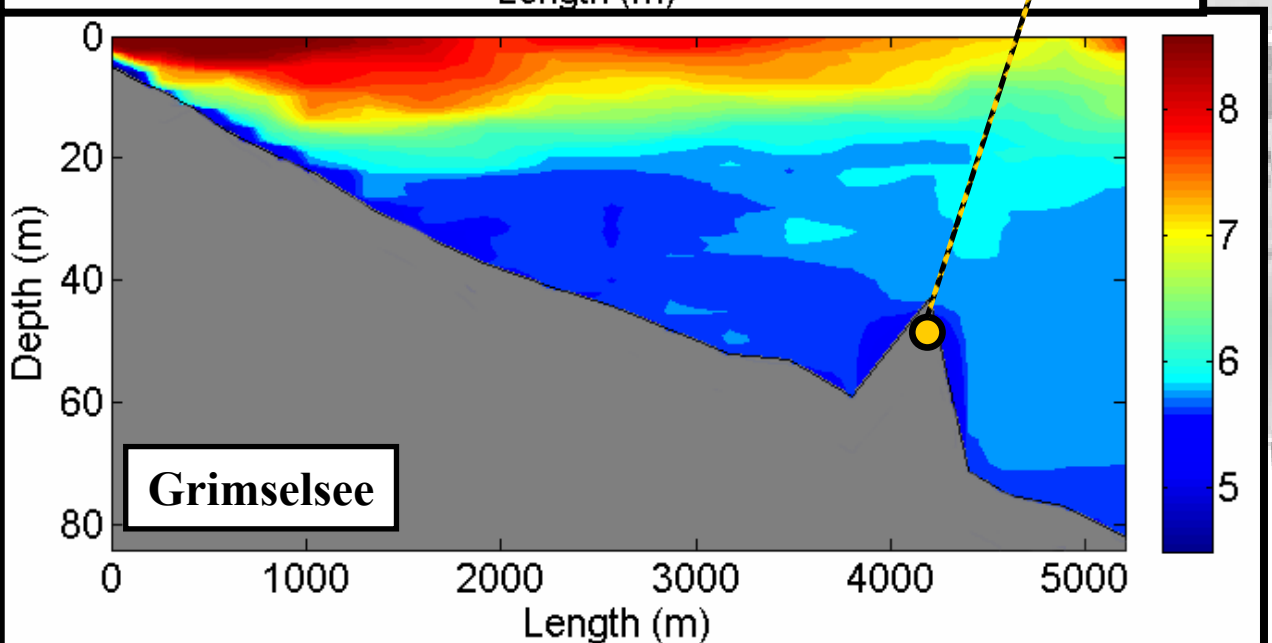






Summer - Different T (°C) in the reservoirs





Oberaarsee warmer than Grimselsee

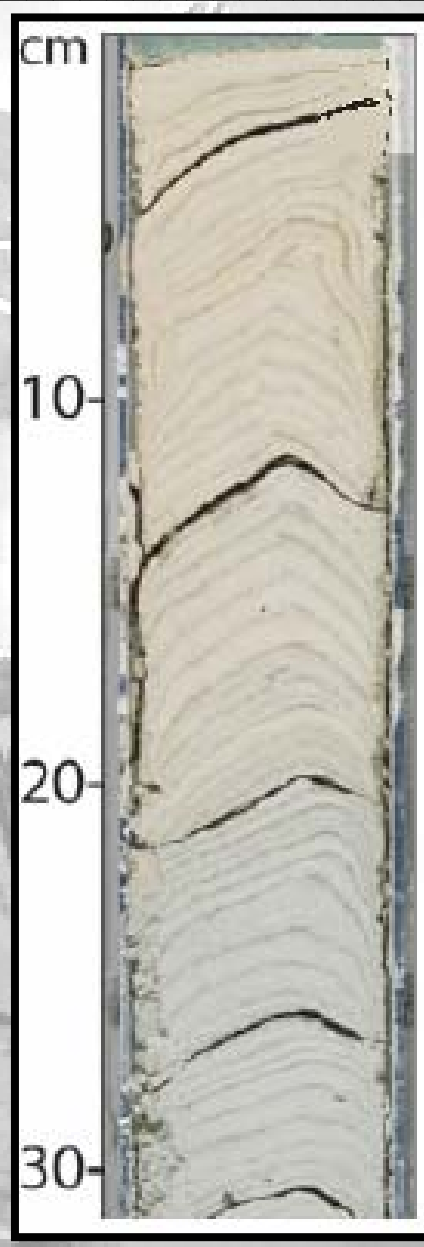
Conclusions

- Turbidity increases in spring when snow melts (in summer the rivers are diluting the reservoirs).

- Turbidity increases due to power operations.

- Turbidity seems to be strongly related with temperature in the water column (Grimselsee is more turbid and colder than Oberaarsee).

- Increasing water turbidity implies decreasing sedimentation and higher turbidity downstreams.




Thank you!