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SUPPLY of ELECTRICITY

Controlled fine sediment release from a reservoir by a hydrodynamic mixing device Demonstrator SEDMIX

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In cooperation with the CTI

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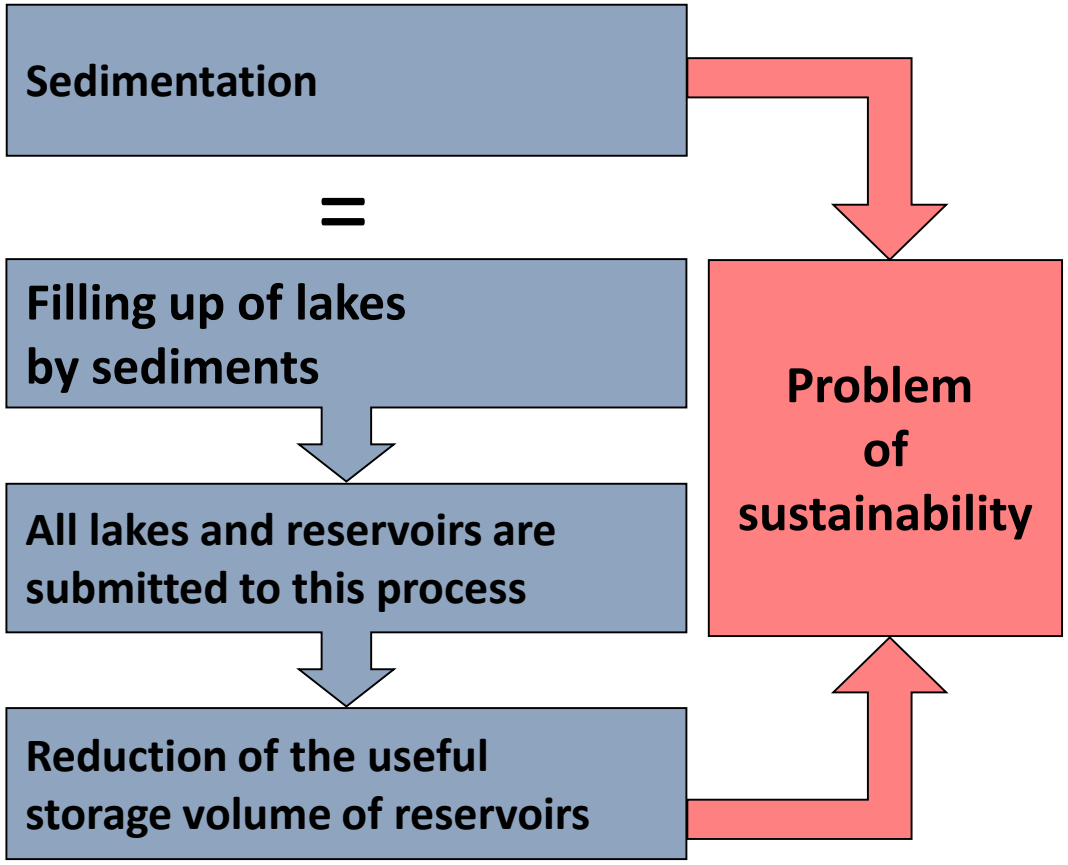
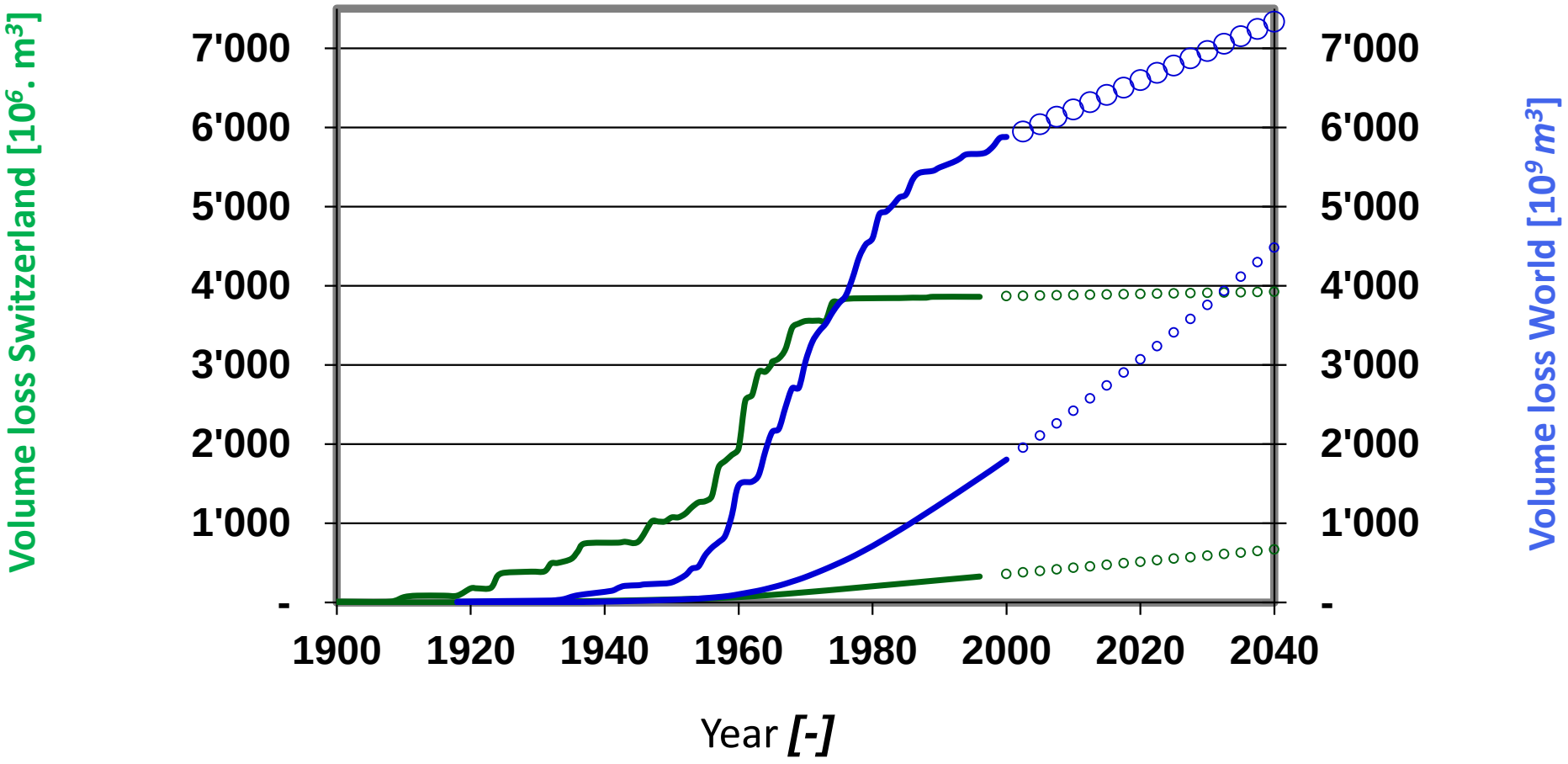
Problem of reservoir sedimentation



Mauvoisin arch dam in Canton Wallis

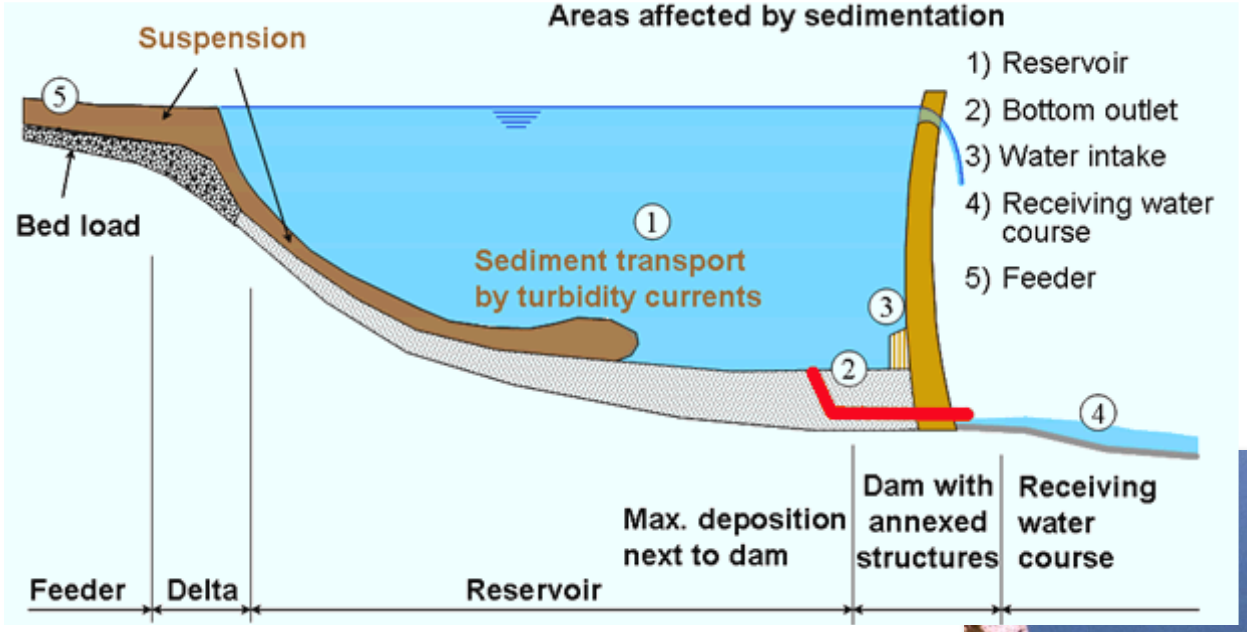
Sediments in front of the bottom outlet during emptying in May 1985

Problem of reservoir sedimentation

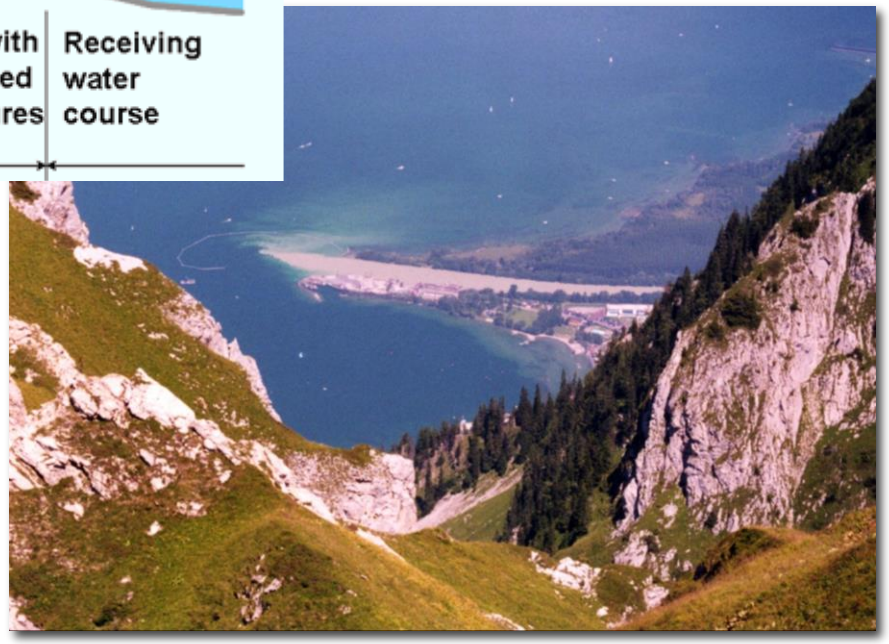


Comparison of increase due to construction and loss due to reservoir sedimentation

Turbidity currents as the main sedimentation process in deep reservoirs

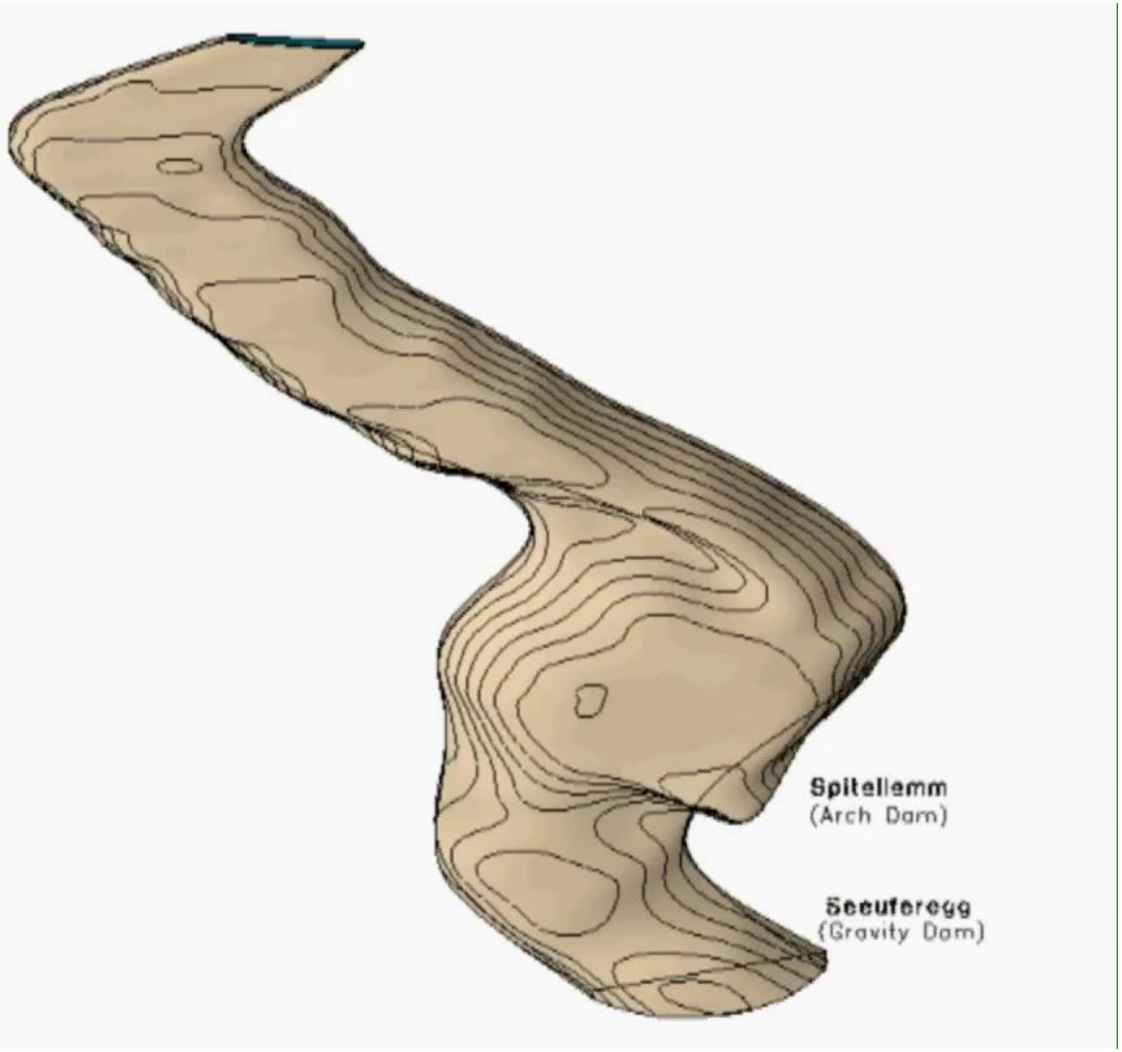


Turbidity current in a reservoir

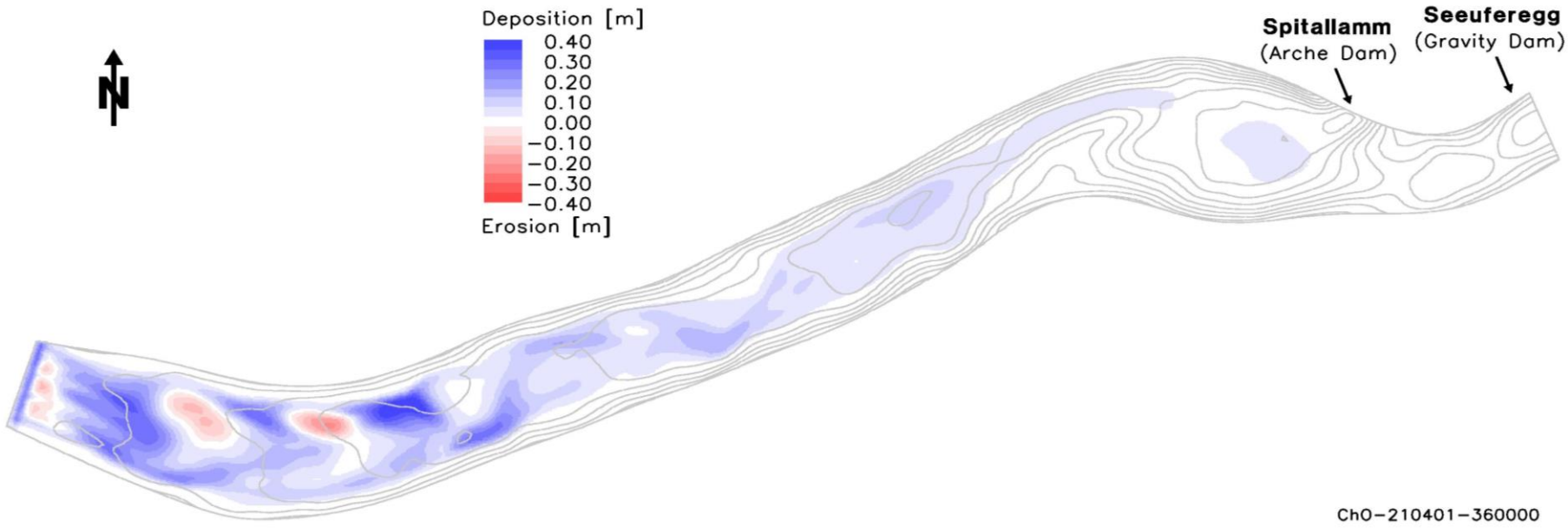


Plunging of a turbity current in lake of Geneva

Example of turbidity current simulation in Grimsel reservoir (flood 2000)

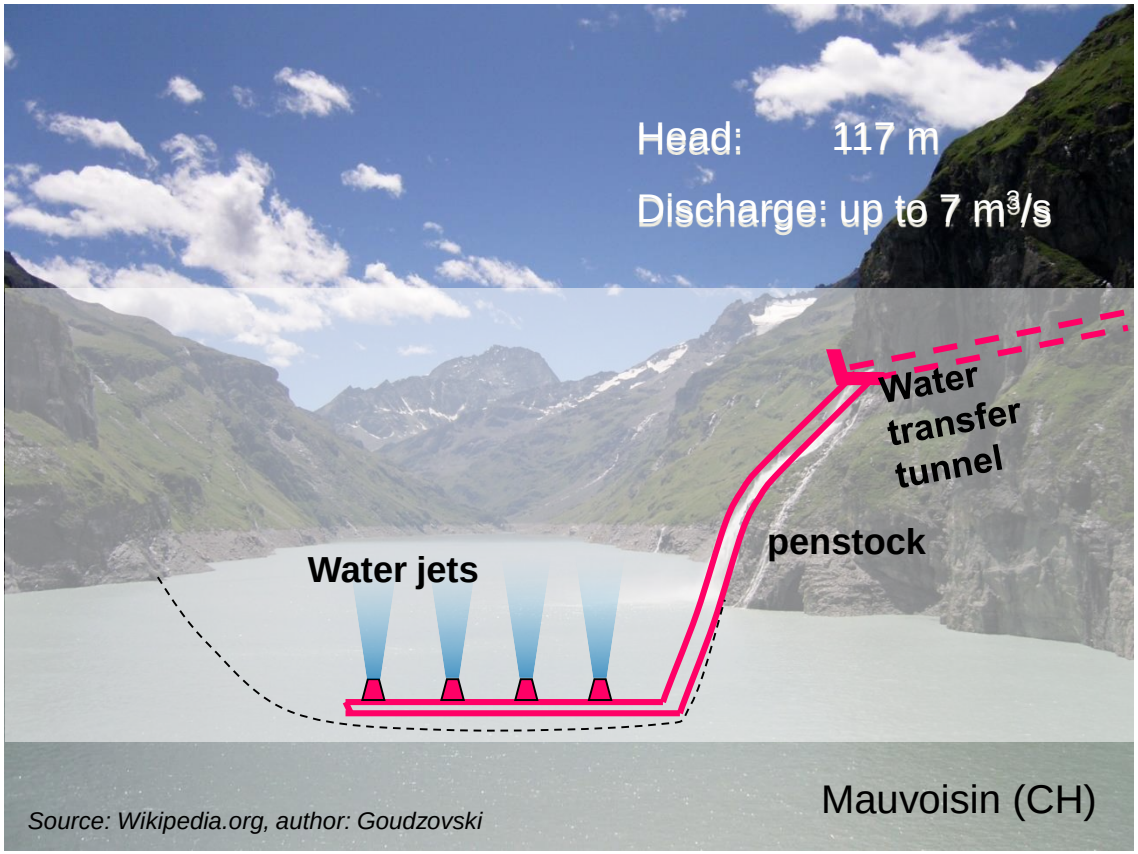


Example of turbidity current simulation in Grimsel reservoir (flood 2000)



SEDMIX
Controlled fine sediment release from a reservoir by a hydrodynamic mixing device

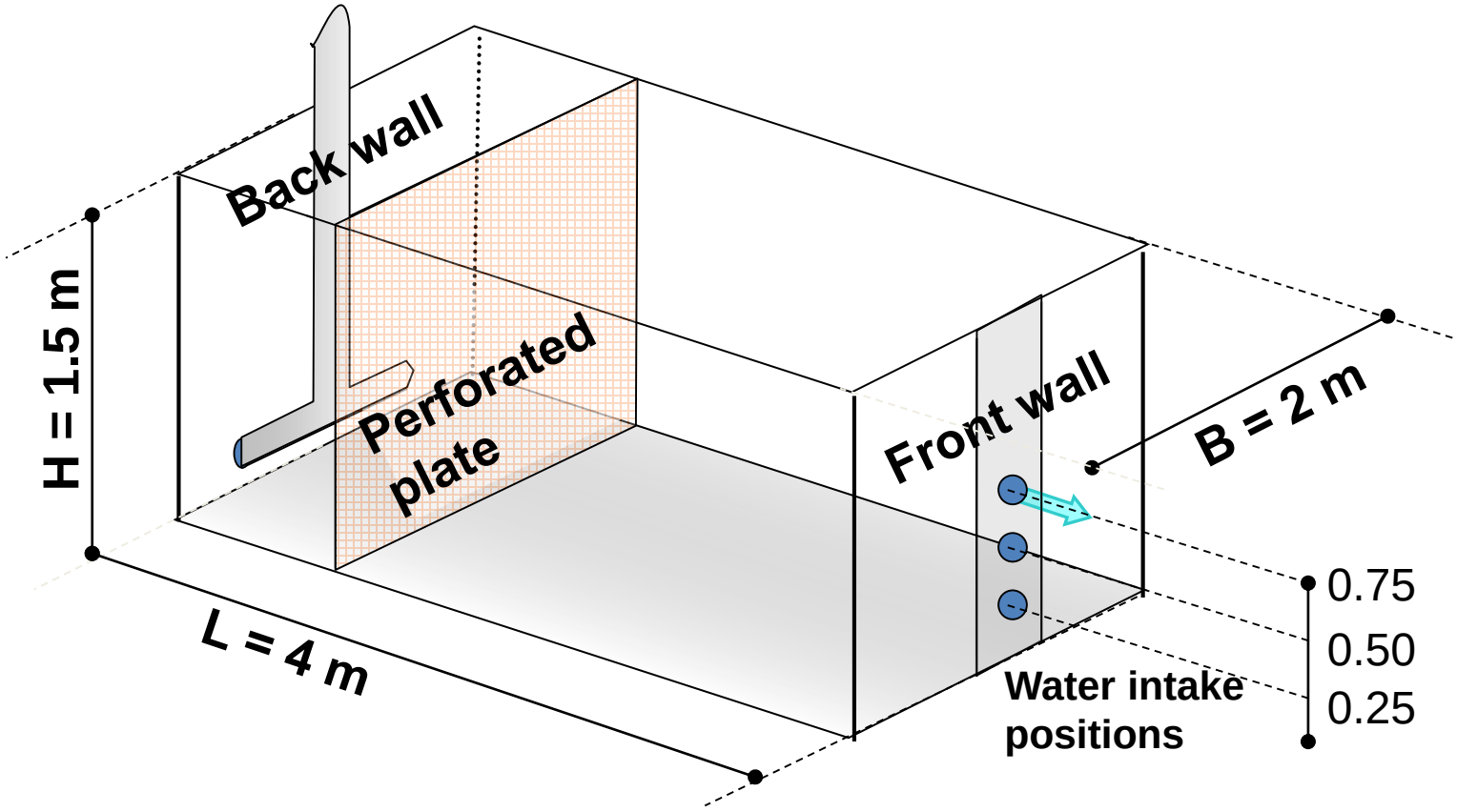
Idea illustrated at Mauvoisin reservoir



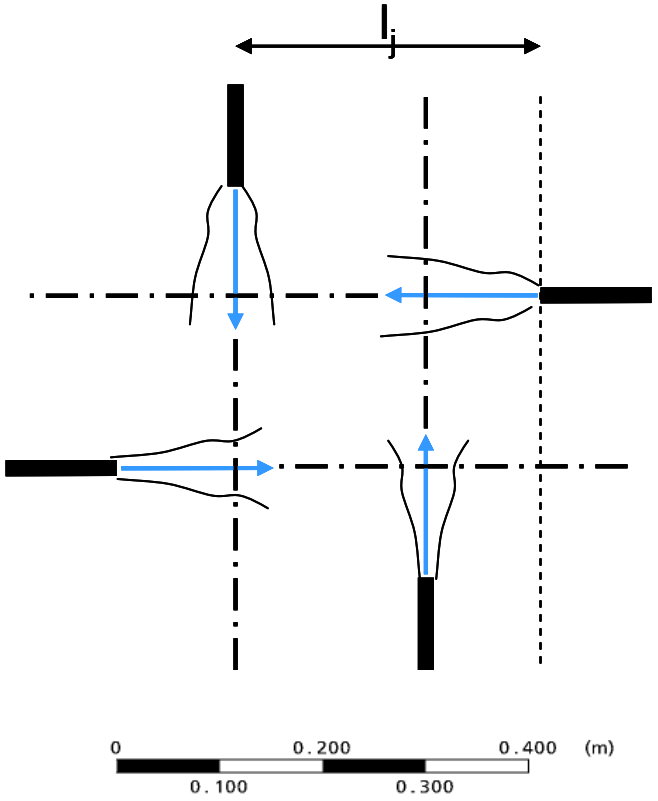
Concept proof with experimental set-up

Thesis Jolanda Jenzer-Althaus

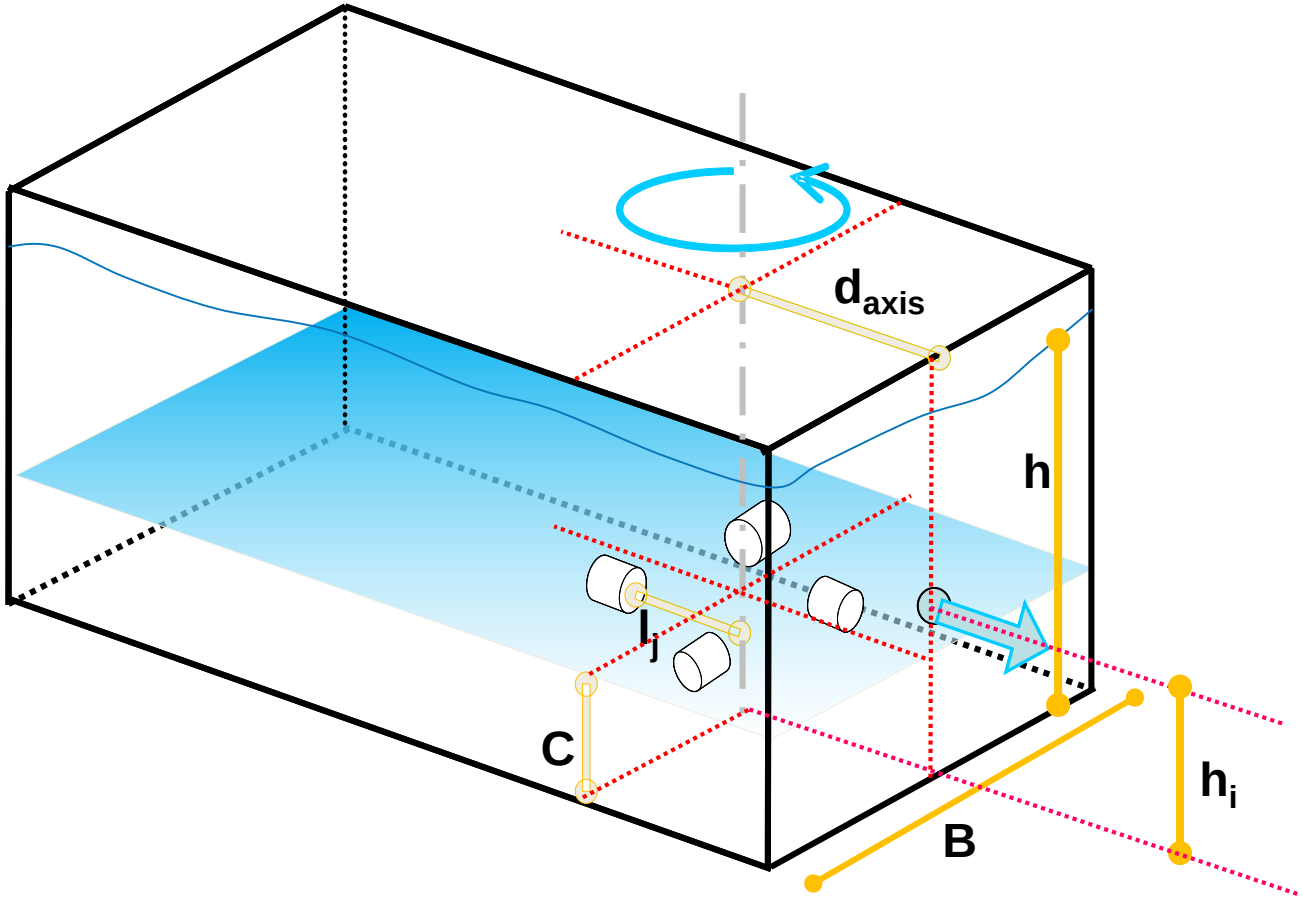
Jenzer-Althaus J., De Cesare G., & Schleiss A. J. (2014). Sediment evacuation from reservoirs through intakes by jet-induced flow. Journal of Hydraulic Engineering, 141 (2),
Jenzer-Althaus J., De Cesare G., & Schleiss A. J. (2016). Release of suspension particles from a prismatic tank by multiple jet arrangements. Chemical Engineering Science, 144, 153–164.



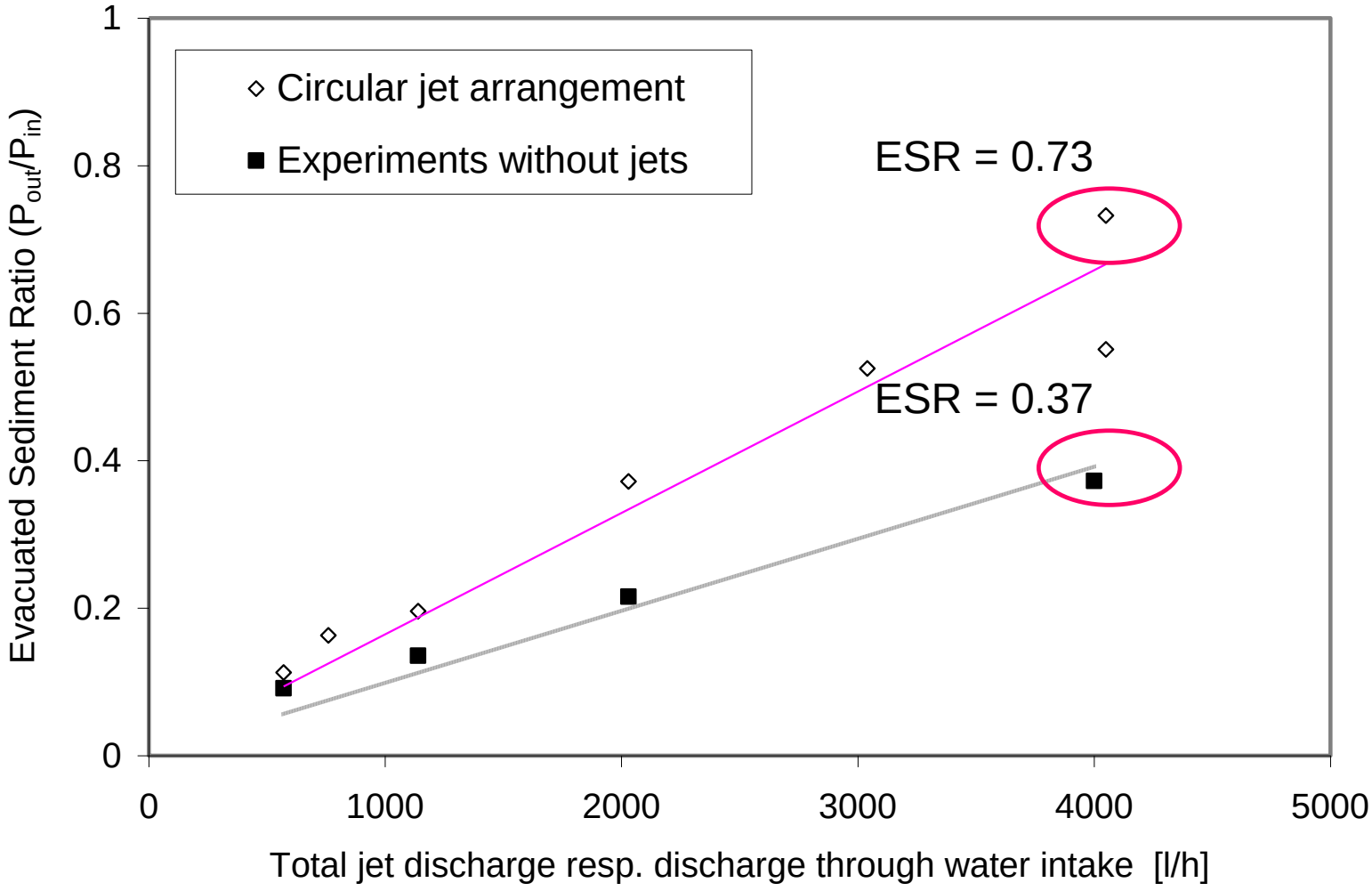
Circular jet arrangement producing a mixer-like upflow



Discharge and geometrical parameters

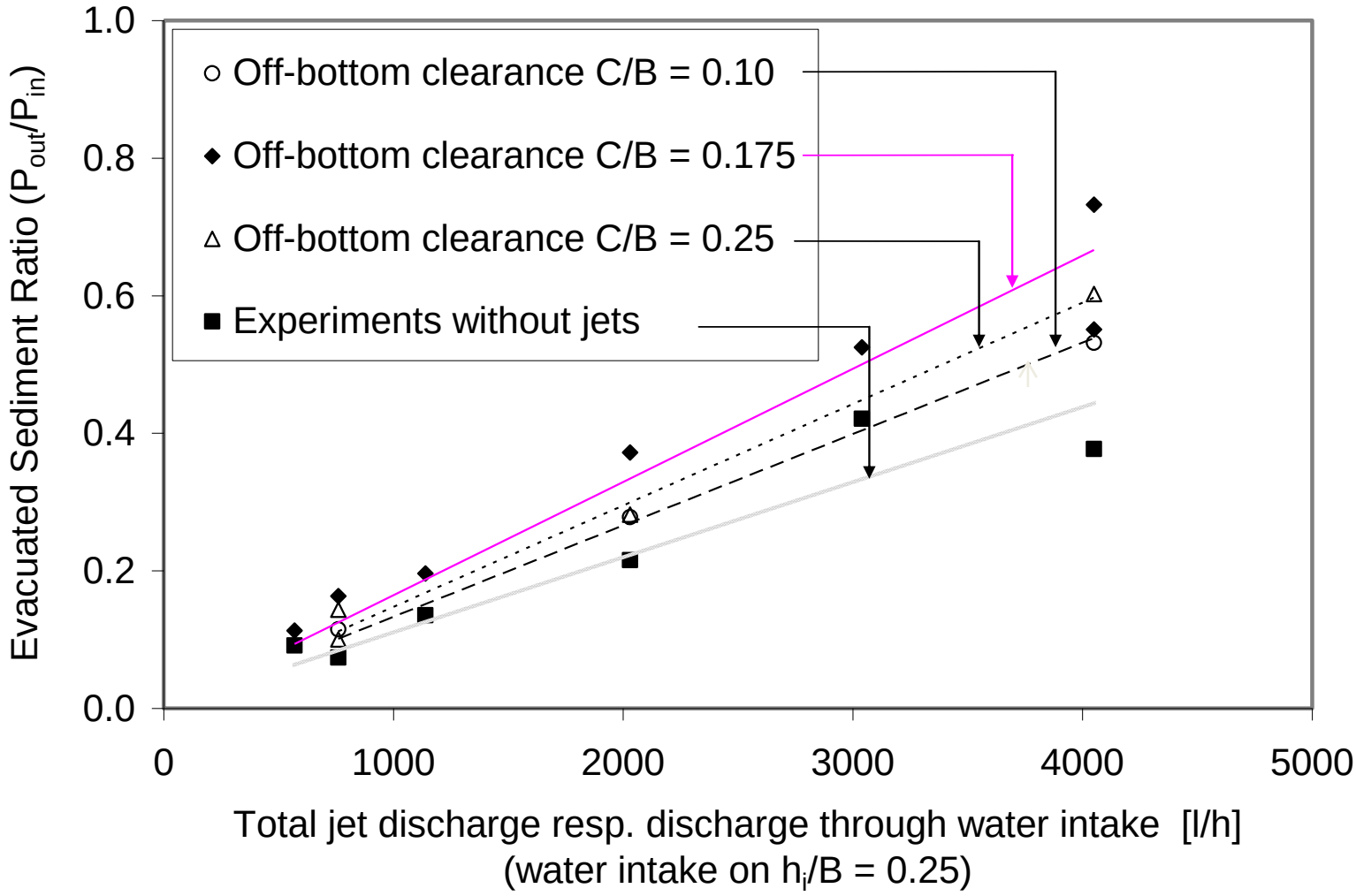


Sediment release - circular jet arrangements



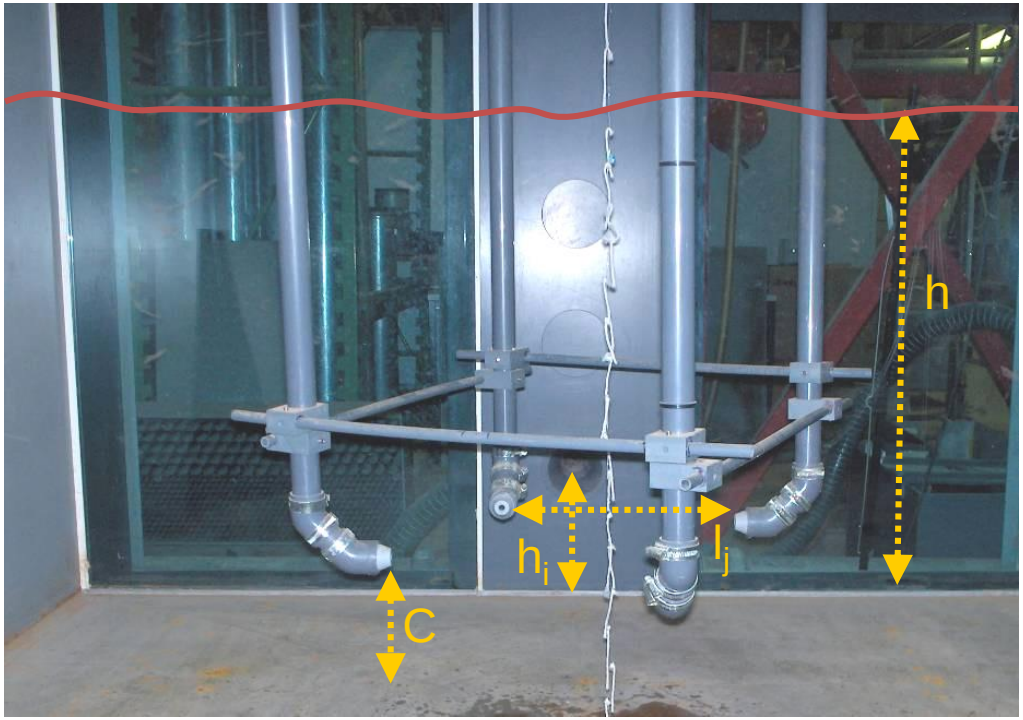
Sediment release - circular jet arrangements

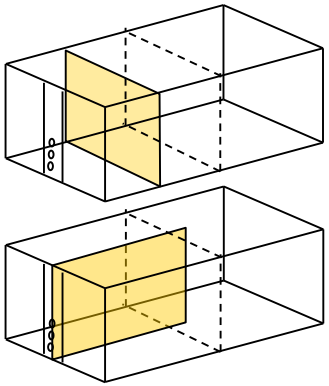
Off-bottom clearance



Optimal jet configuration

C/B	= 0.175
h_i/B	= 0.25
h/B	= 0.6
d_{axis}/B	= 0.525
l_j/B	= 0.15
φ	= 0°





Axial

Axial/Radial

SEDMIX

Controlled fine sediment release from a reservoir by a hydrodynamic mixing device

From experiments to prototype

- The sediment mixer is a circular pipe arrangement that is installed near the dam reservoir bottom at the vicinity of the power intake.
- The facility is equipped with a four nozzles releasing pressurized water jets and inducing sufficient upwind turbulence to maintain fine sediments in suspension, thus preventing them from settling near the dam
- Fine sediment are then continuously released downstream the power waterways (without water and energy loss) with a small concentration.
- The operation of the sediment mixer can be operated following a turbidity current flood-driven event or be scheduled for periodical sediment release operations.
- The demonstrator mixer operates with a pump needing electrical power supply
- The mobile mixing devise (demonstrator) will be tested at several dams to show his efficiency

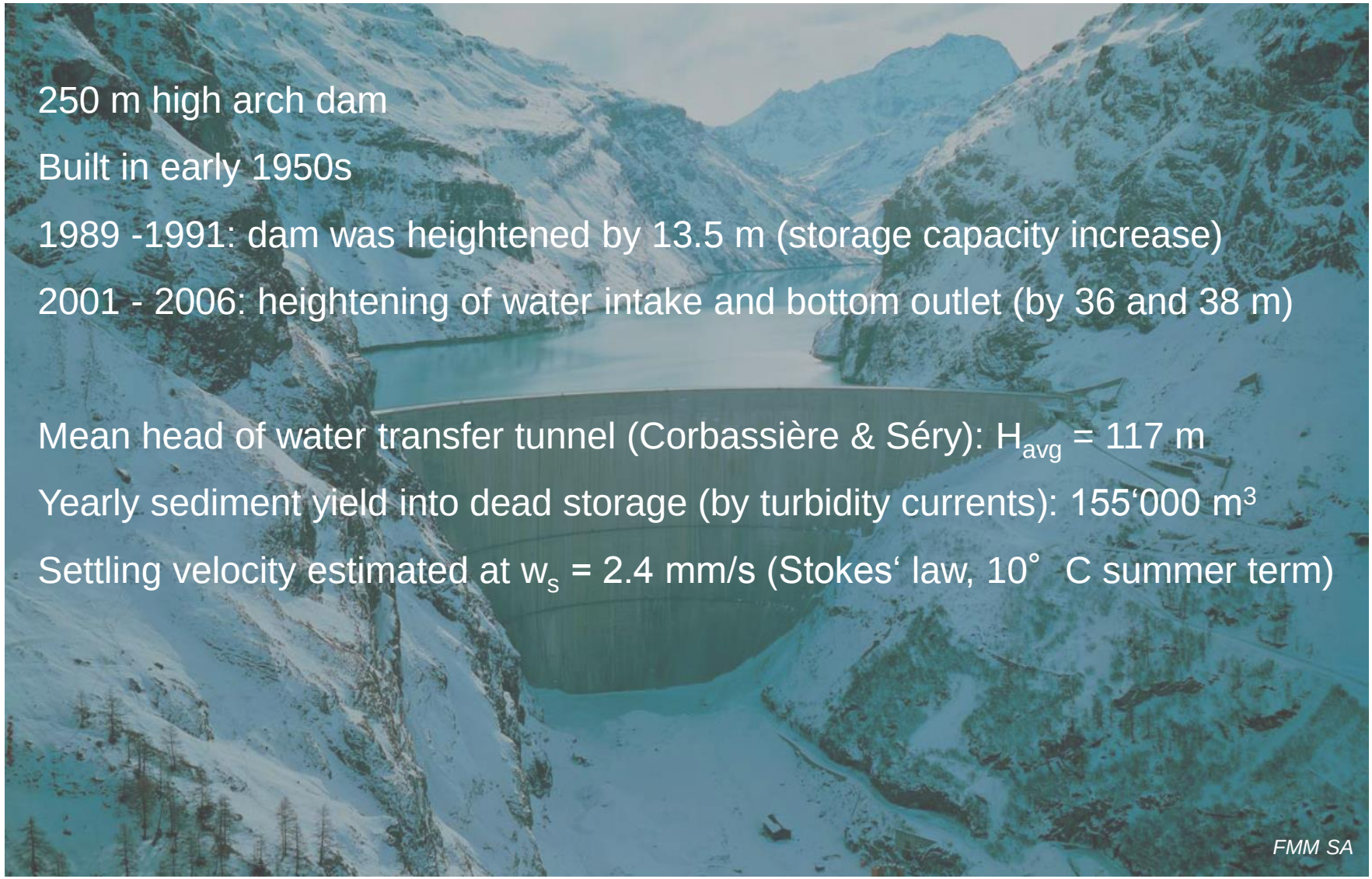
DEMONSTRATOR B

Controlled fine sediment release from a reservoir by a hydrodynamic mixing device

Demonstrator concept and experimental set-up requirements

- The demonstrator is composed of two main parts in steel construction: a water supply pipeline and a multi-nozzle manifold frame.
- It will be conceived for max. 200 m water depth and internal/external water pressure of 25 bar.
- The supply pipeline is mostly anchored onshore and the remainder lies on the reservoir bottom;
- The manifold circular frame is assembled onshore, then positioned with a system of water/air floaters/ballast;
- The facility can be installed on a given dam reservoir then disassembled & moved to another

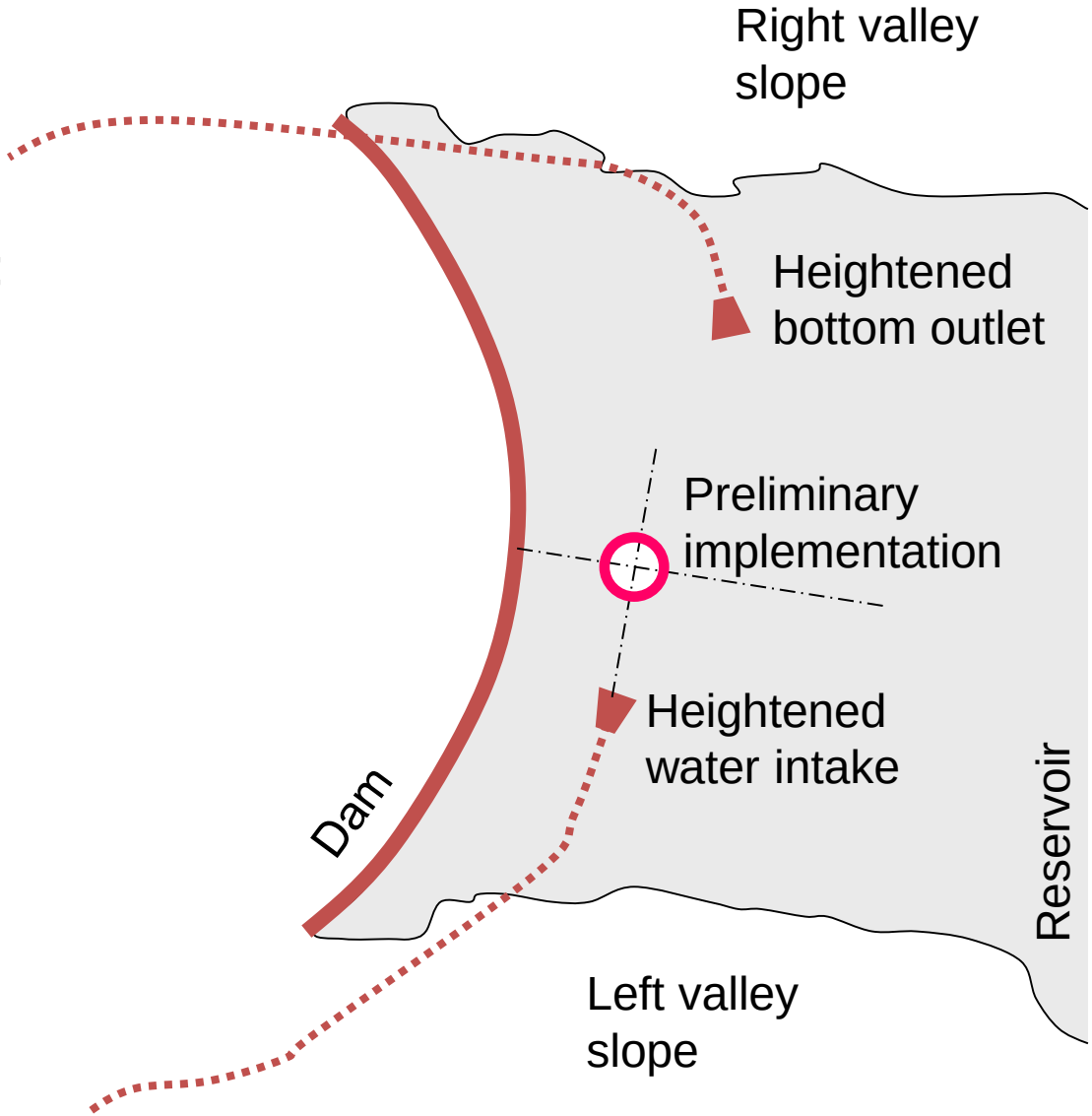
Mauvoisin - Preliminary implementation



Mauvoisin

Two confinements: valley slope, dam

Not obvious flow prediction, asymmetric flow pattern



Mauvoisin – Economic analysis

Jet construction costs estimated at 924‘000 CHF

	Without jets	With jets
Annual costs [10^6 CHF]	1.4 – 4.6 (conventional removal)	0.08 (20 years payback period)
	1.27 (bottom outlet and water intake heightening with 20 years payback period)	

Even if only 7 % of the yearly incoming sediment would be released by means of jets a circular jet installation the latter is economical and recommended in view of a sustainable reservoir operation


Thank you for your attention
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