BALANCY FLUSHING EFFICIENCY AND DURATION: PROOF OF CONCEPTS

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Abstract

Sediment accumulation can shorten significantly the reservoirs' life. Sediment flushing is a common practice to slow down the ageing of a reservoir by restoring its original volume. However, it causes a periodic loss of energy production and a stress on the downstream ecosystem, whose resistance to a disturbance has been linked to the duration of the exposure. In this work, we compared numerically the drawdown flushing carried out in the Rio di Pusteria reservoir (Italy) in 2019 with alternative flushing scenarios. The results show that more frequent flushings with lower initial sediment filling in the reservoir can lead to a shorter flushing duration and to a minor consumption of stored water.

Keywords: sediment management, reservoirs, flushing, numerical simulation.

Methods

The Rio di Pusteria reservoir was flushed in May 2019, **5 years** after the previous time (2014).

- Original reservoir capacity = 1 690 000 m^3
- Sediments yield rate = 107 799 m^3/year
- During the 2019 flushing, 580 542 m^3 of sediments were removed (**V_{ref}**), completely restoring the original capacity

At the **current flushing frequency**, V_{ref} is the amount of sediment in the reservoir before the flushing. The drawdown flushing from 2019 was compared with 3 alternative scenarios at different initial sediments filling in the reservoir:

- **25%, 50%, 75%** of V_{ref}

At the current sedimentation rate

- 25% : the reservoir silts in ~1.5 years
- 50% : the reservoir silts in ~2.5 years
- 75%: the reservoir silts in ~4 years

The comparison was carried out through the 3D version of a semi-implicit numerical solver for the Navier-Stokes equations.

Table 1: Main features for the different drawdown flushing scenarios.

	Flushing frequency	Flushing Duration	Flushing in 10 years	Final water
V_{ref}	5 years	10 days	20 days	~ 0 m^3
25%	1 + 2 years	4.5 days	31.5 days	~ $5 \cdot 10^5$ m^3
50%	3 years	7 days	23 days	~ $4 \cdot 10^5$ m^3
75%	4 years	9.5 days	24	~ $2 \cdot 10^5$ m^3

Results

The end of the flushing was set as the moment in which 25%, 50%, 75% of V_{ref} is flushed.

- The relation between the lowering of the initial filling and the decrease in duration is **non-linear** (different inertia, outlet concentration threshold)
- In all the alternative scenarios, the **water level** at the end of the flushing is **higher**

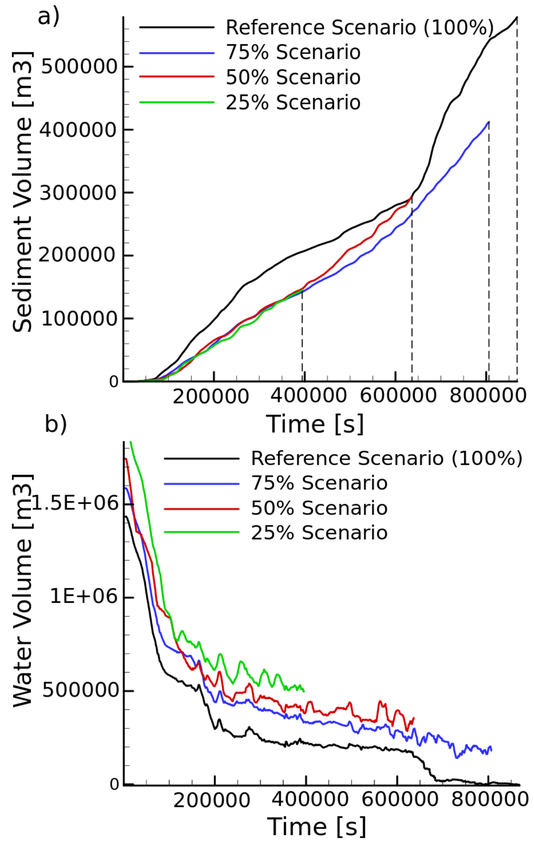

Figure 1: a) Volume of flushed sediments over time. b) Volume of stored water over time.

Conclusions

In 10 years, the reference scenario is the one that requires the least flushing days (2 flushings per decade, 10 days long each). However, the 50% scenario is close to it and it allows for a saving of about 25% of the stored water every time. Furthermore, being shorter, it is less stressful for the downstream ecosystem. Despite the common practice, more frequent flushings can be more convenient.

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