Hydropower under pressure: Mont d'Orb case study (France)

Paul Hazet

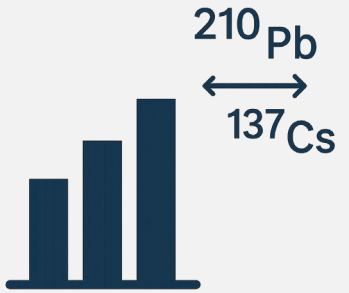
Context

Study area: Southern France

Extreme rainfall – Mediterranean episodes

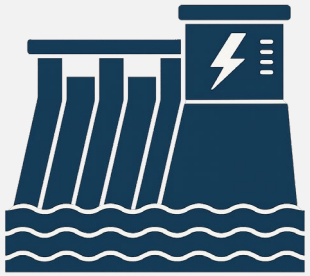
Methodology

Sediment core



Age modelling

Climate analysis



Operational analysis

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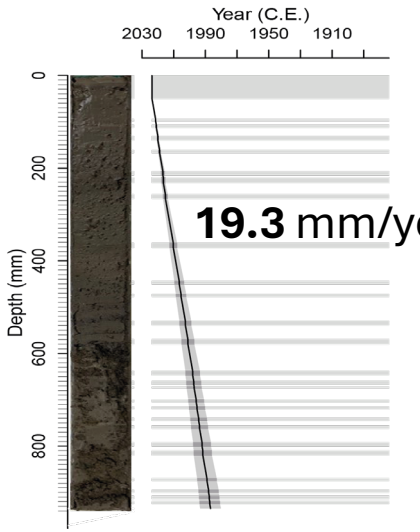
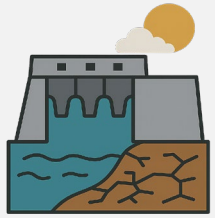
Key results



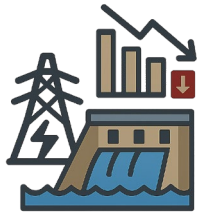
19.3 mm/year

1% of rainfall ~ **50%*** sediment yield



-20% winter rainfall

X2 - X4 more extrems
~30% more intense



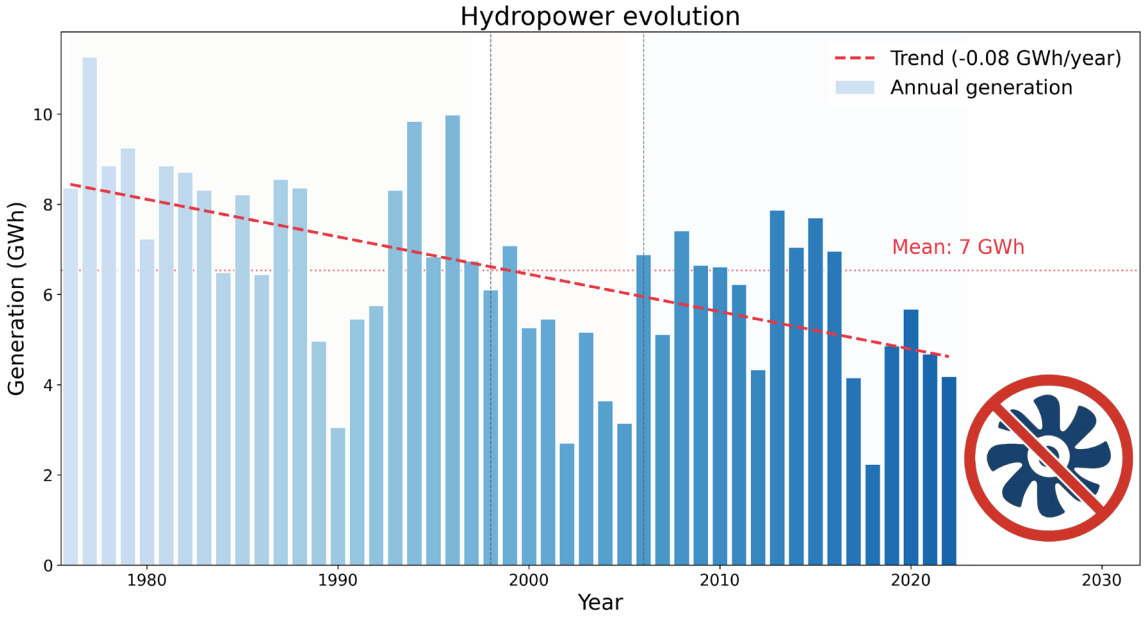
-25% hydropower

*Corrected after presentation (was 55 %)

Conclusion

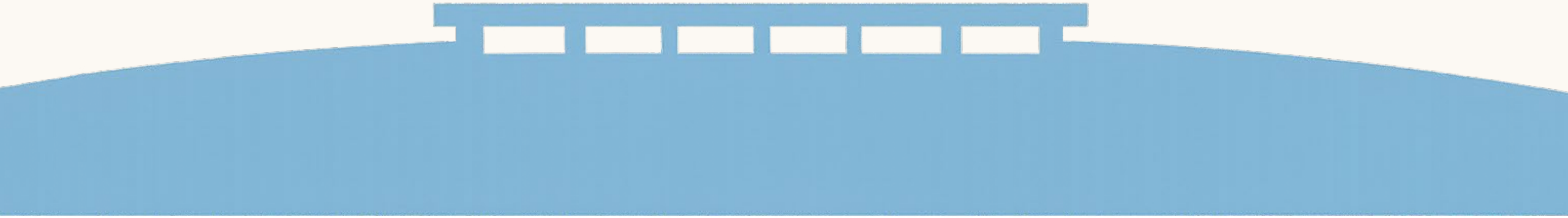
More droughts and extreme rainfalls expected

Combined risk with sediment accumulation

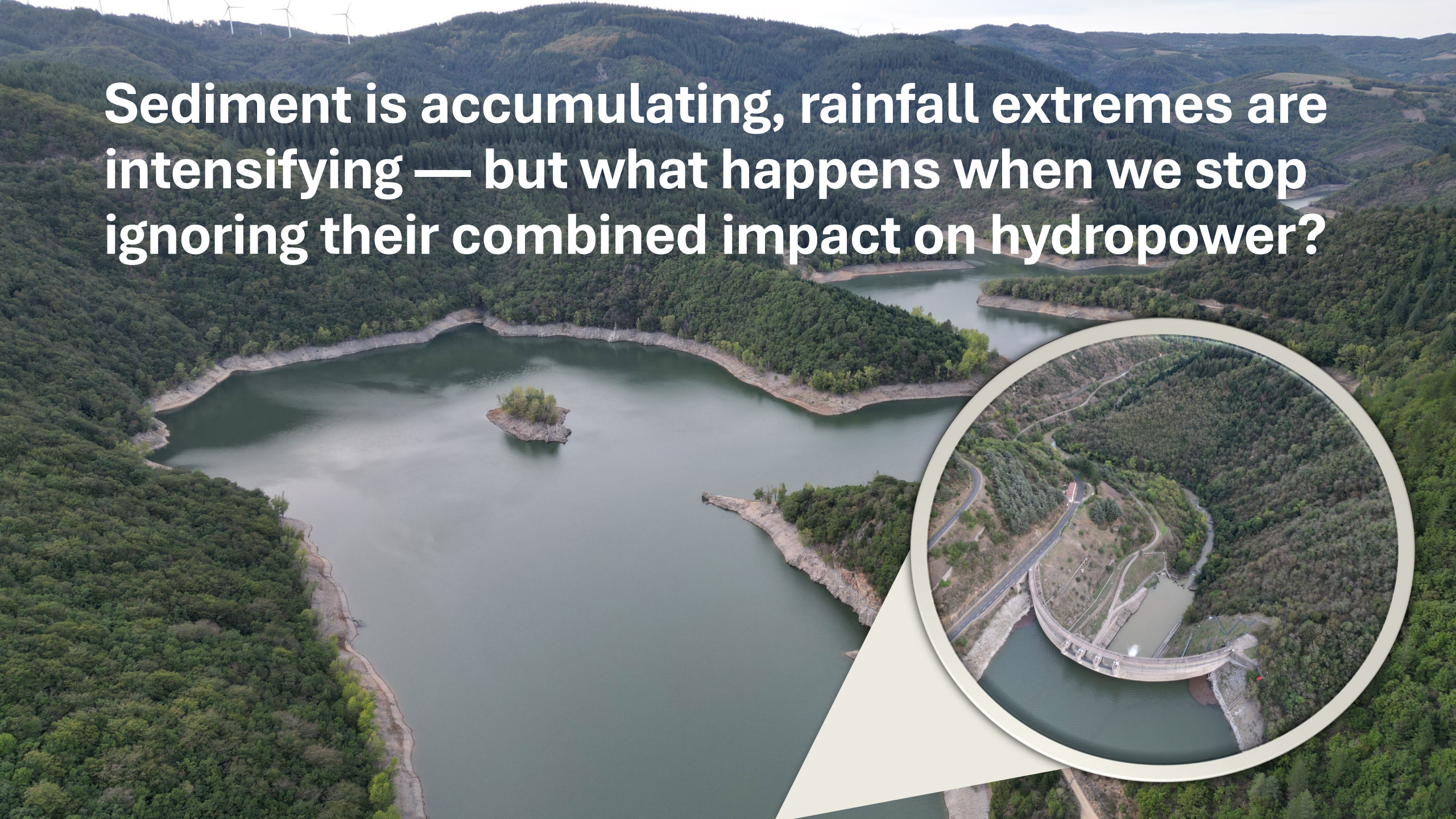


Impact of rainfall variability on sedimentary and hydropower dynamics in a dam reservoir of southern France

Case study Monts d'Orb dam



Sediment is accumulating, rainfall extremes are intensifying — but what happens when we stop ignoring their combined impact on hydropower?



Understanding combined climate and sediment impacts through a multiproxy approach

Why ?

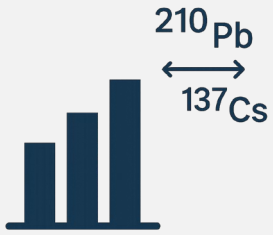
Rain and sediment: two forces converging on energy resilience

Context

Study area

Mediterranean events

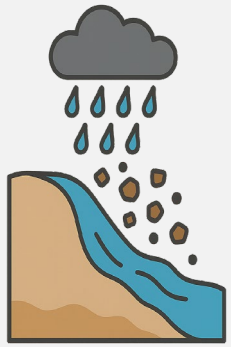
Methodology

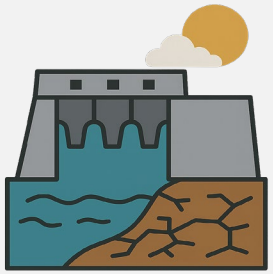


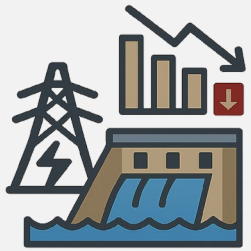
Conclusion

Future climate impact

Key results

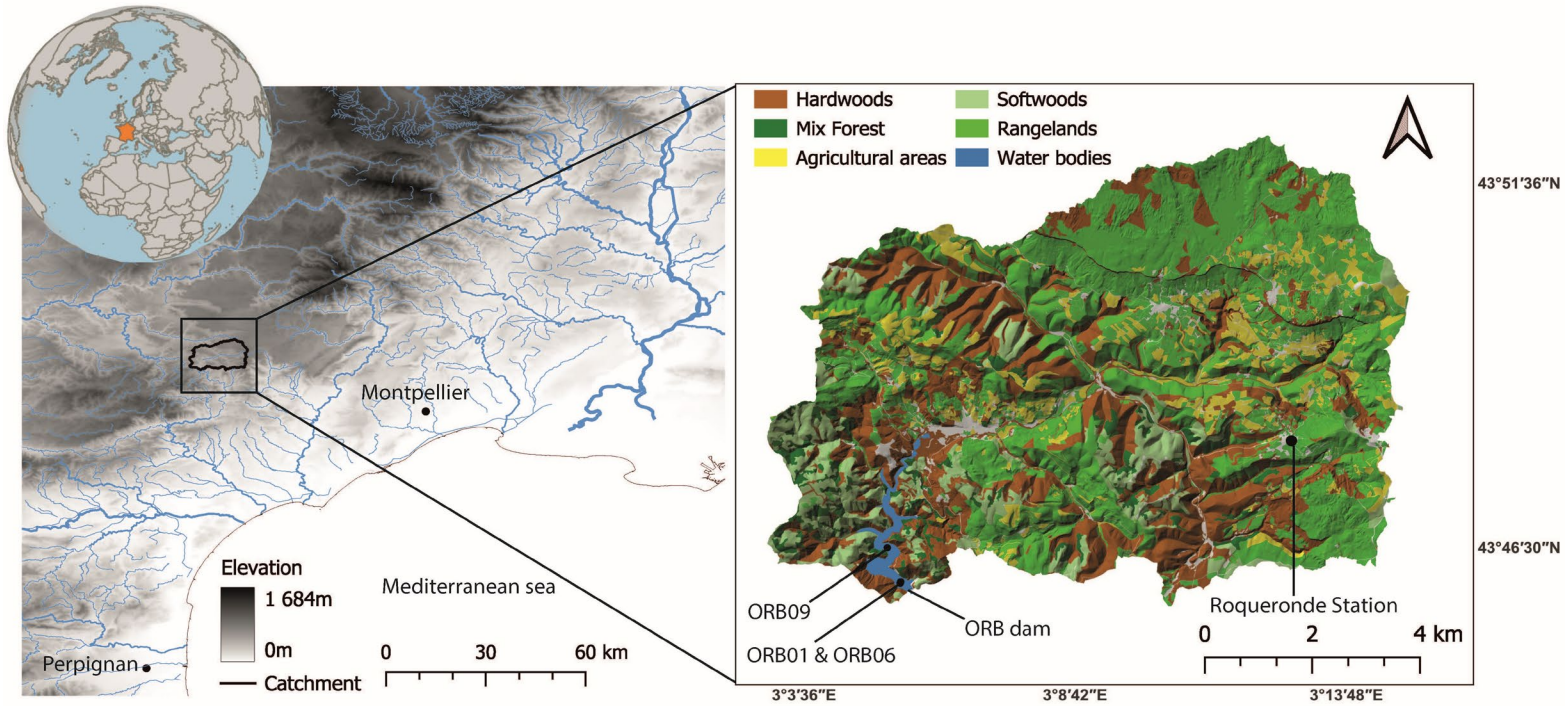




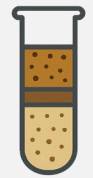


Context and objectives

In Mediterranean regions, water availability is shaped by both intense autumn rainfall and recurrent droughts. This variability is a great driver of sediment dynamics (ref)

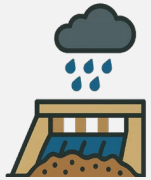


Hilgert et al.



Anjum et al.

Foucher et al.



This study

Few studies have assessed the combined long-term influence of precipitation variability, sediment dynamics (via core analysis), and water availability on hydropower production trends

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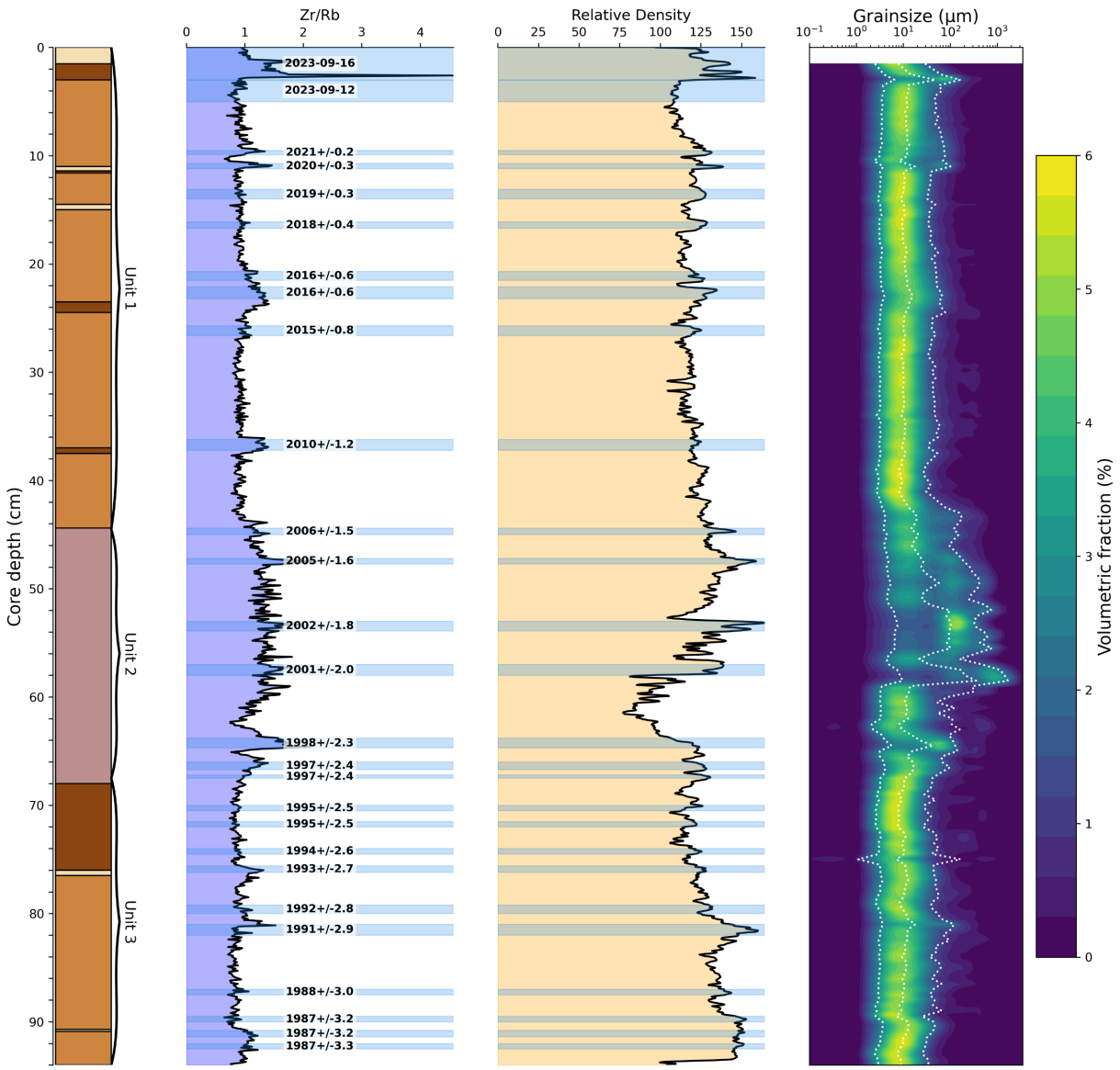
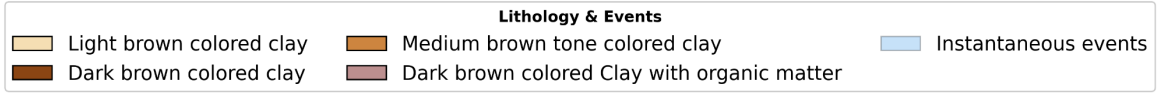
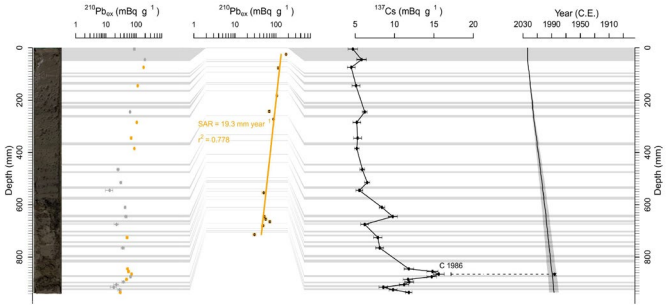
Methodology





Zr/Rb ratio interpreted as a proxy for sediment grain-size and energy conditions, following Croudace et al. (2015)



Click here for age modelling

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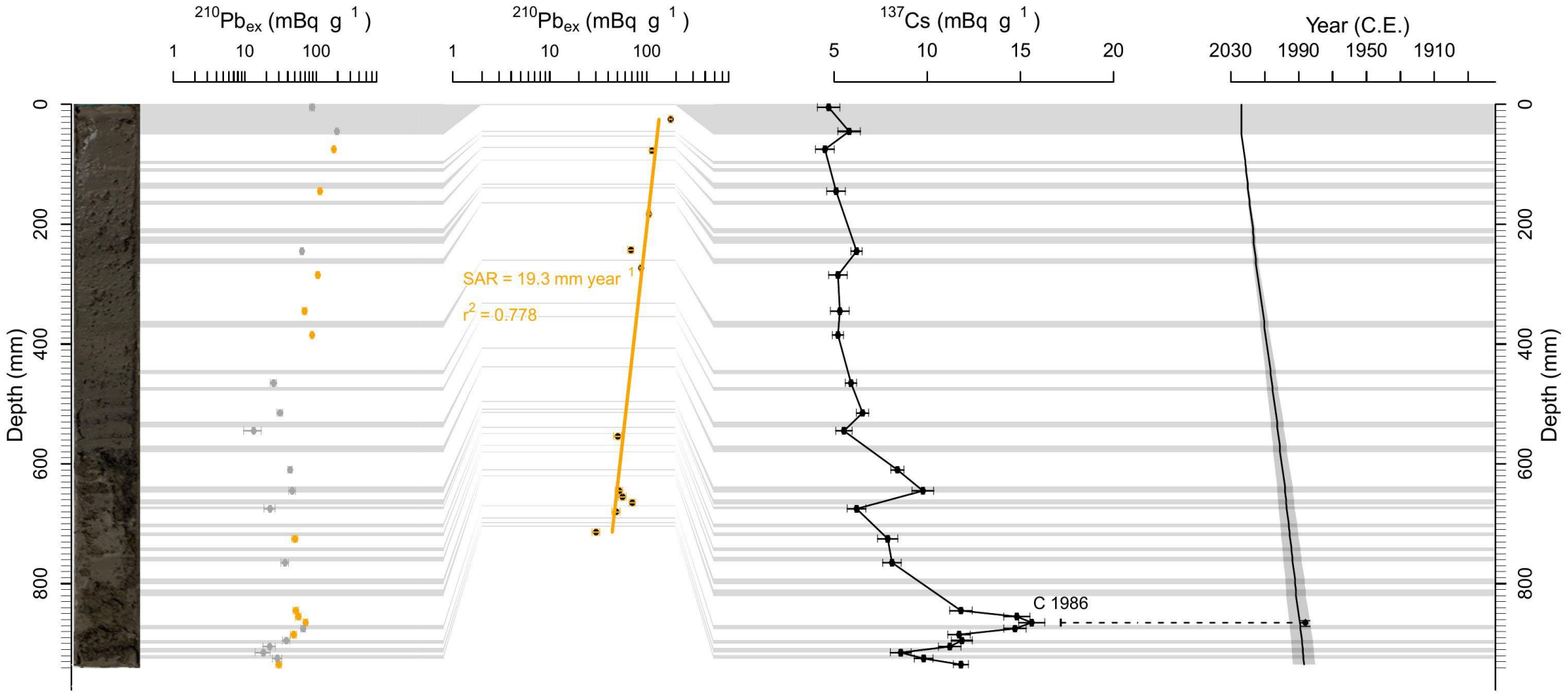
Minor correction: 3 of 27 uncertainty values updated after presentation (e.g. 4.7 → 2.4)

Age modelling



Chronology established using serac (Bruel et al., 2020), supported by excess ^{210}Pb dating.
A peak in ^{137}Cs detected around 1989, attributed to **Chernobyl fallout** (±3 years uncertainty).

Methods

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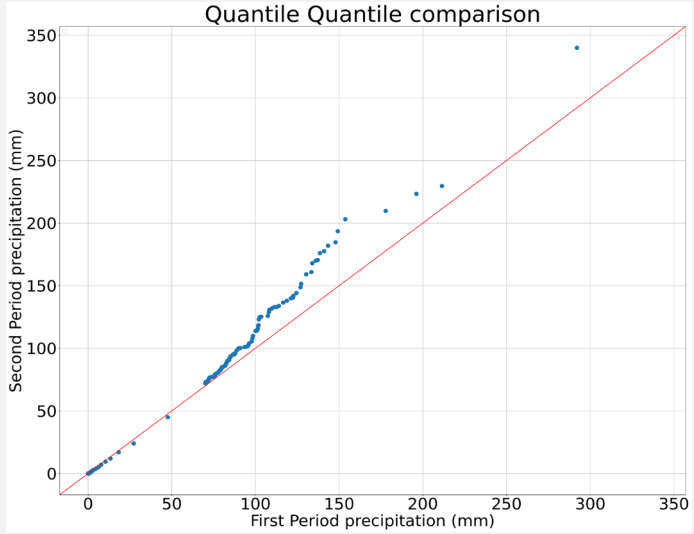
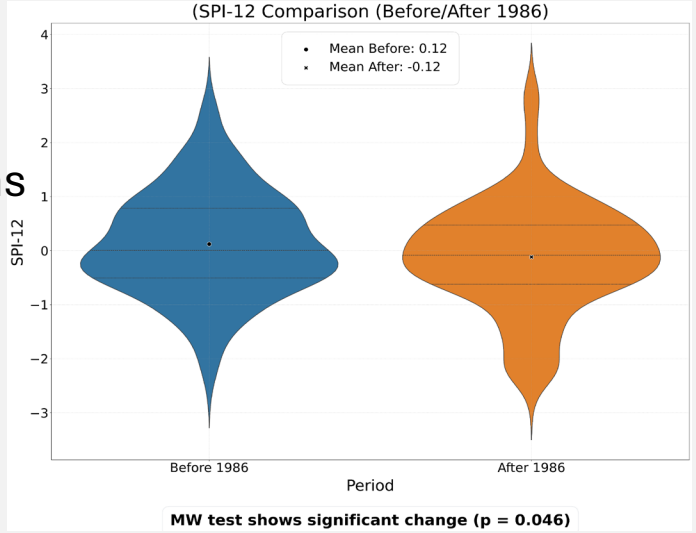
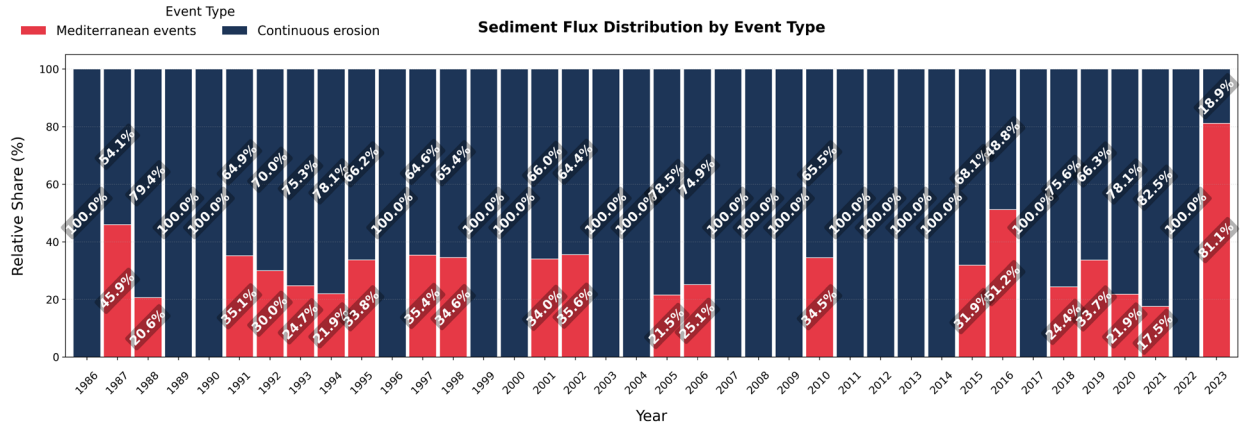
Key results

Observation of an increase in extreme value intensity before and after 1986



Dryest conditions observed after 1986





Key hydroclimatic signals after 1986

- **-19%** decline in winter precipitation
- **87% - 400%** increase in frequency in fall extremes
- **31%** increase in fall extremes intensity

Impacts on sediment delivery

1% of rainfall may bring up to **55%** of annual sediment yield

These post-1986 shifts suggest an **increased potential for sediment delivery**

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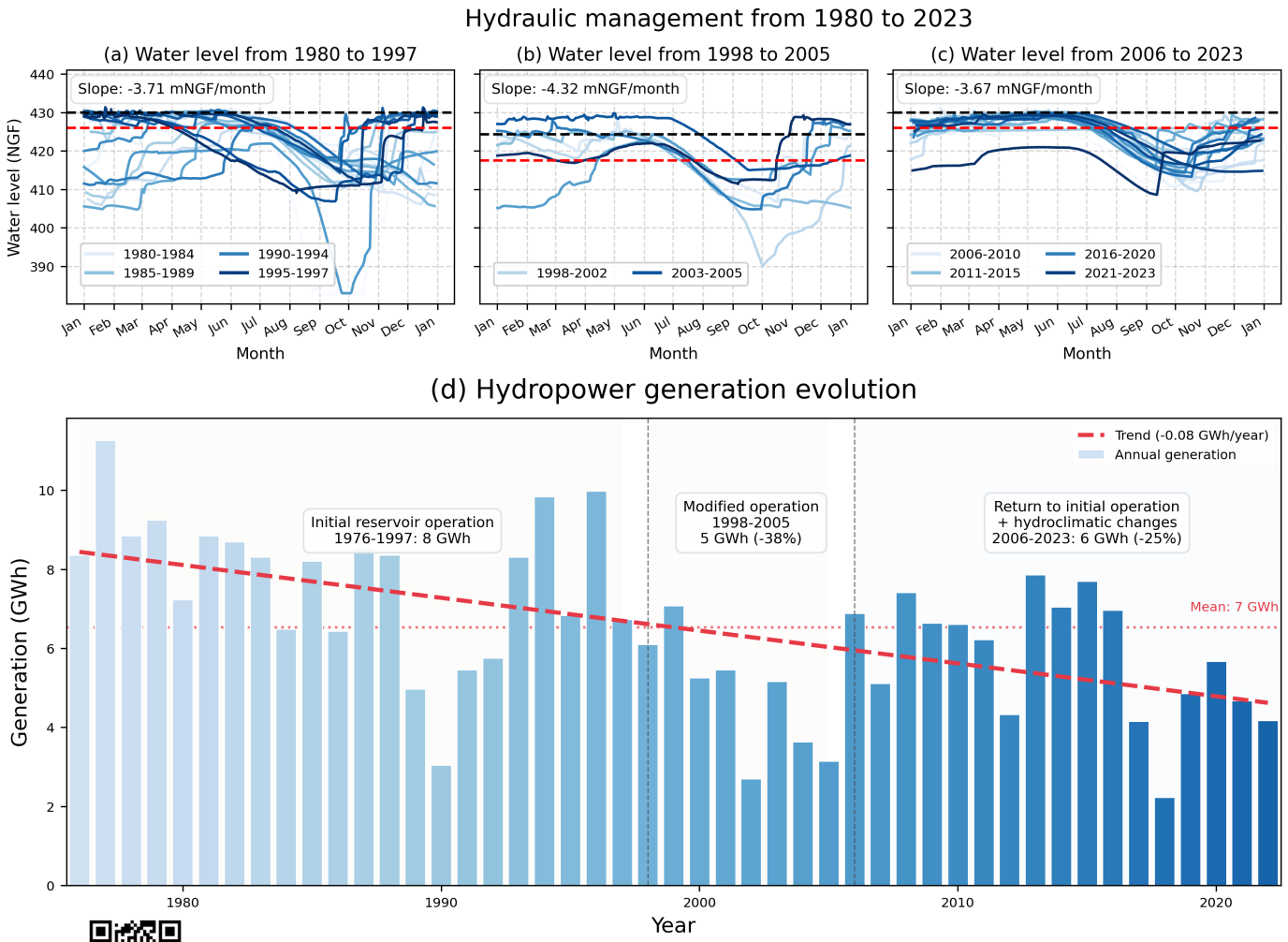
Conclusion



Despite a return to optimal operation, hydropower production declined by 25%, likely reflecting the increasing hydroclimatic stress. Sedimentation — currently not accounted for — could further exacerbate this decline if not anticipated

So far, sedimentation has not significantly impacted turbine operation — but with rising extremes and continuous accumulation, this could change rapidly

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