

1400 yr of extreme precipitation patterns over the Mediterranean French Alps and possible forcing mechanisms

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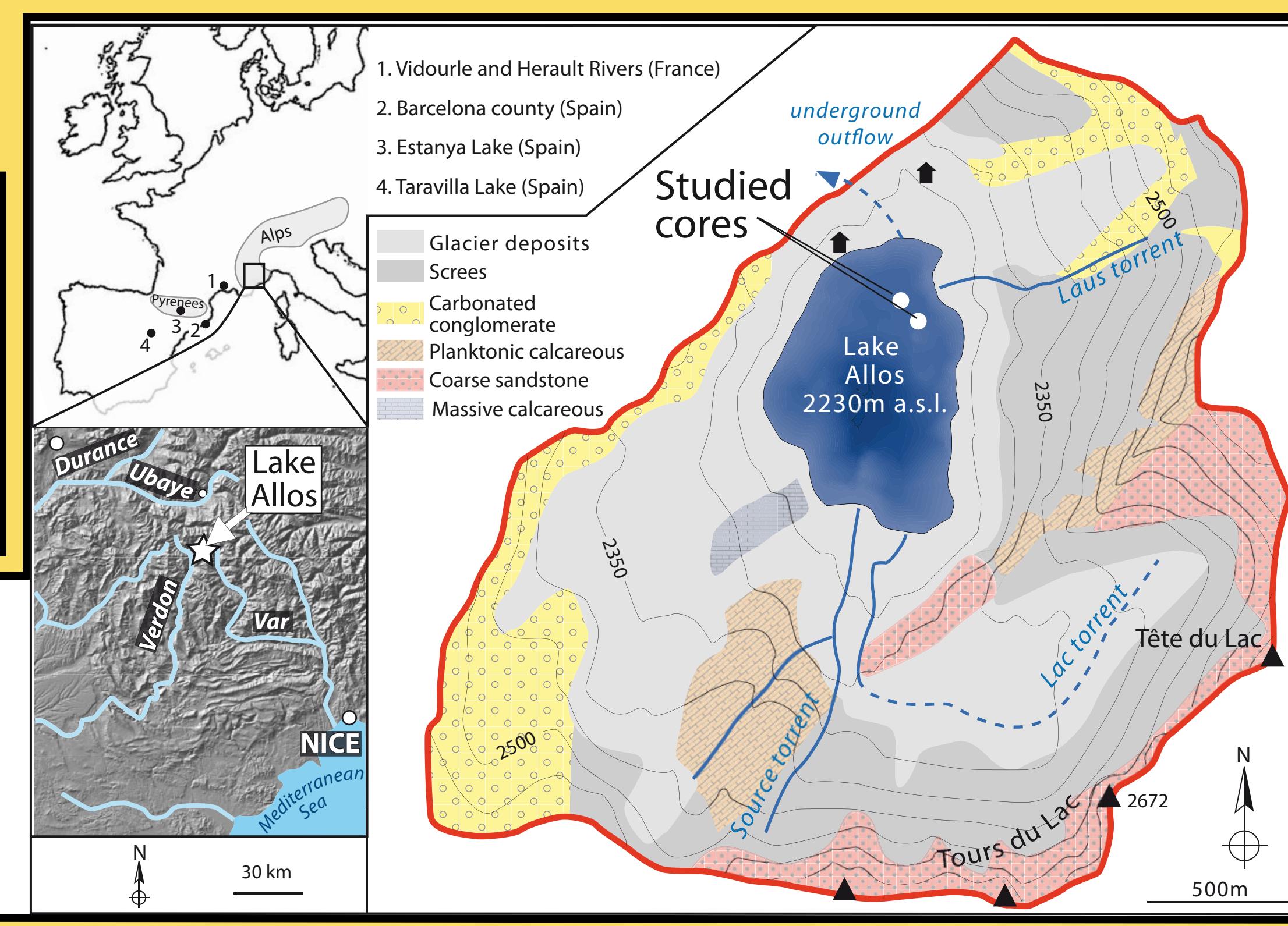
Context Global warming and impacts on flood hazard ?

Aim Assessment of **past flood frequency/intensity** in response to past climatic changes

Area Mediterranean french Alps

Study site High alpine catchment with thick erodible glacier deposits without vegetation cover

Climate Flood triggered by summer localized convective events or by **autumnal meso-scale convective events**



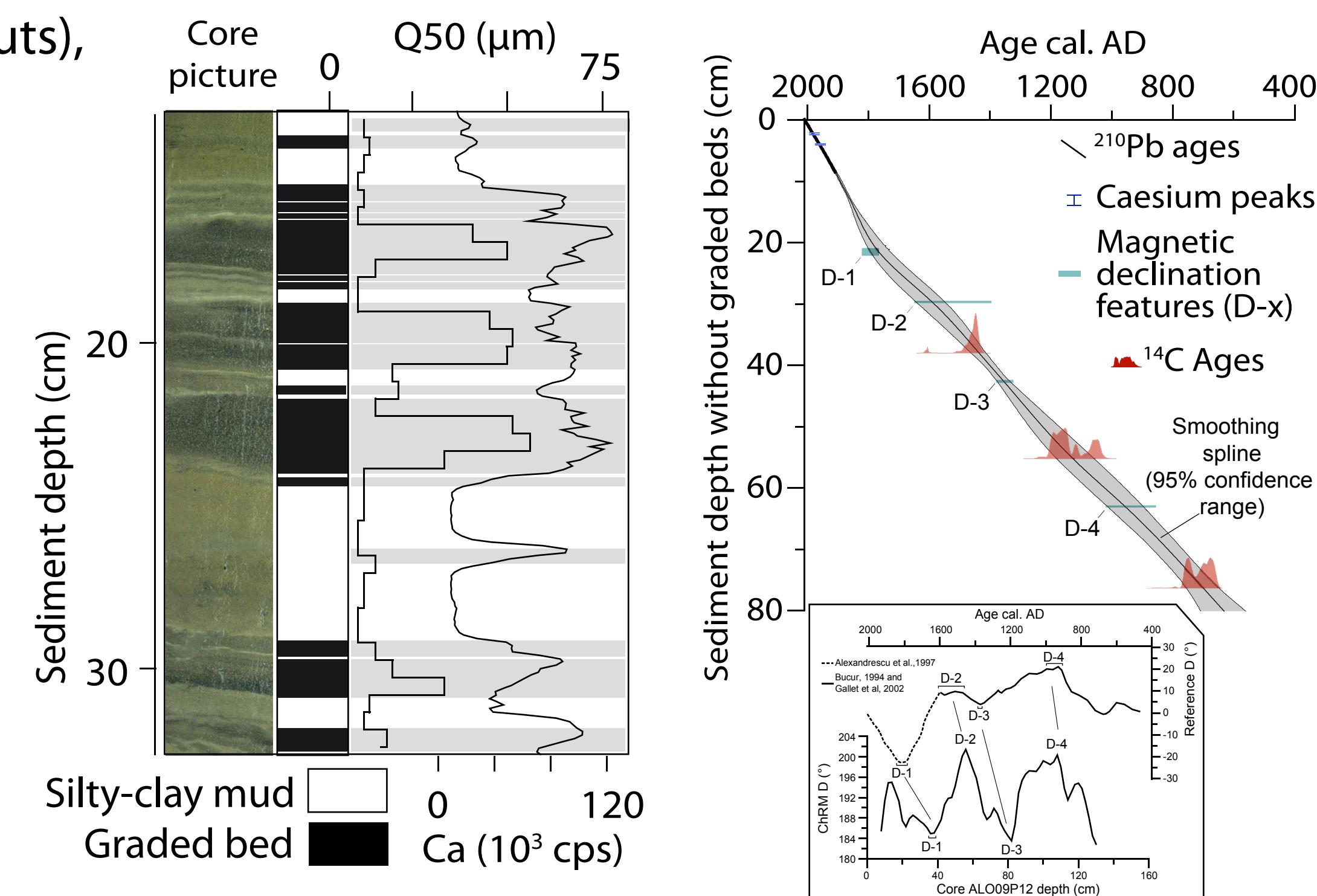
Characteristics of flood deposits Graded beds, punctual increase in Ca (associated to detrital carbonated inputs), decrease in organic matter content, presence of terrestrial vegetal matter

Proxy of flood intensity Flood deposit thickness (related to the coarsest grain size of each deposit)

Dating ^{210}Pb profile, 3 ^{14}C ages and 4 paleomagnetic (declination) features

Land-use history Pollen analyses suggest the absence of major disturbance in the erosion processes since 700 AD

Validation of the flood reconstruction Consistent with:
- major Allos historic flood dates and historic flood records of local torrents
- the historic flood record of the local large Ubaye River (catchment of 1000 km²) suggesting that **recorded flood in the Allos sequence are mostly triggered by autumnal meso-scale event**



Climatic trends of the Allos flood record

At a multi-secular trend:

Allos flood record

Low flood frequency during the MCA
High flood frequency during the LIA
High flood intensity during the LIA

Consistent with:
- Low/high lake levels in Spain
- Low/high hydrological activity in the French Mediterranean Alps (Miramont et al., 1998) and Spain (Benito et al., 2003)

At a multi-decennial trend:

Allos flood record

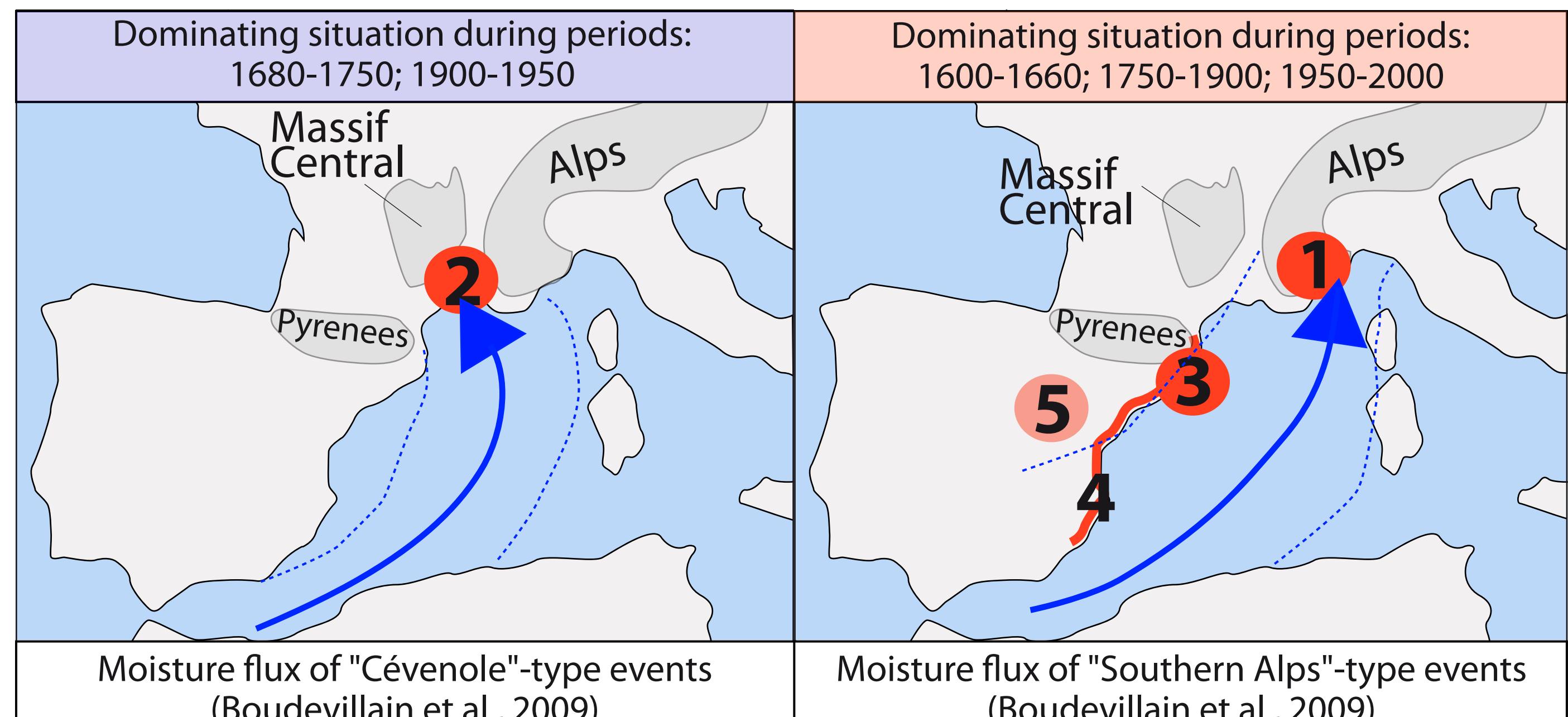
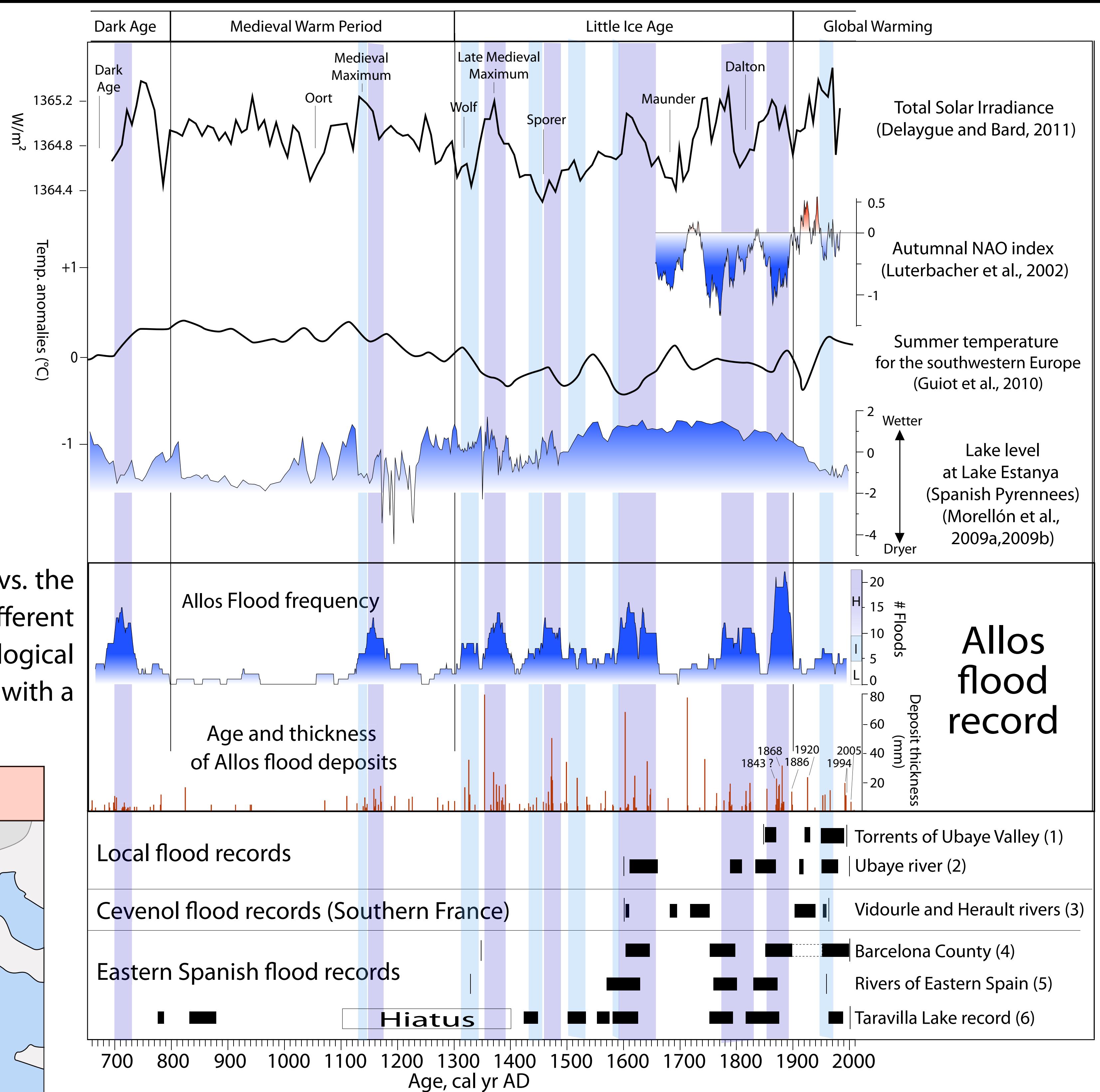
High flood variability within the LIA

Consistent with:

- Historic and sedimentary flood records from eastern Spain
- Almost with solar maxima
- Negative phases of the autumnal NAO

Over the last 400 years

Periods of high flood frequency appear in opposition in the Cévennes region vs. the French Mediterranean Alps and the eastern Spain. This suggests two different atmospheric circulation paths between these regions (supported by meteorological reanalyses, Boudevillain et al., 2009) and an oscillation between the two paths with a cyclicity of 100-300 years.



Our study shows that sediment sequences from high altitude lakes can provide reliable records of flood-frequency and intensity patterns related to extreme precipitation events. This opens up the possibility of using such records to investigate the evolution of extreme weather events during long-term periods of climate change.

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