Millennium-long flood record (French Alps)

Bruno Wilhelm
LTHE - University Grenoble Alpes
France
http://www.lthe.fr/LTHE/pageperso/wilhelm/

Introduction

Are these violent flood events due to the global warming?

In theory:

Temperature increase may lead to an increase of flood frequency and intensity

IPCC, 2013

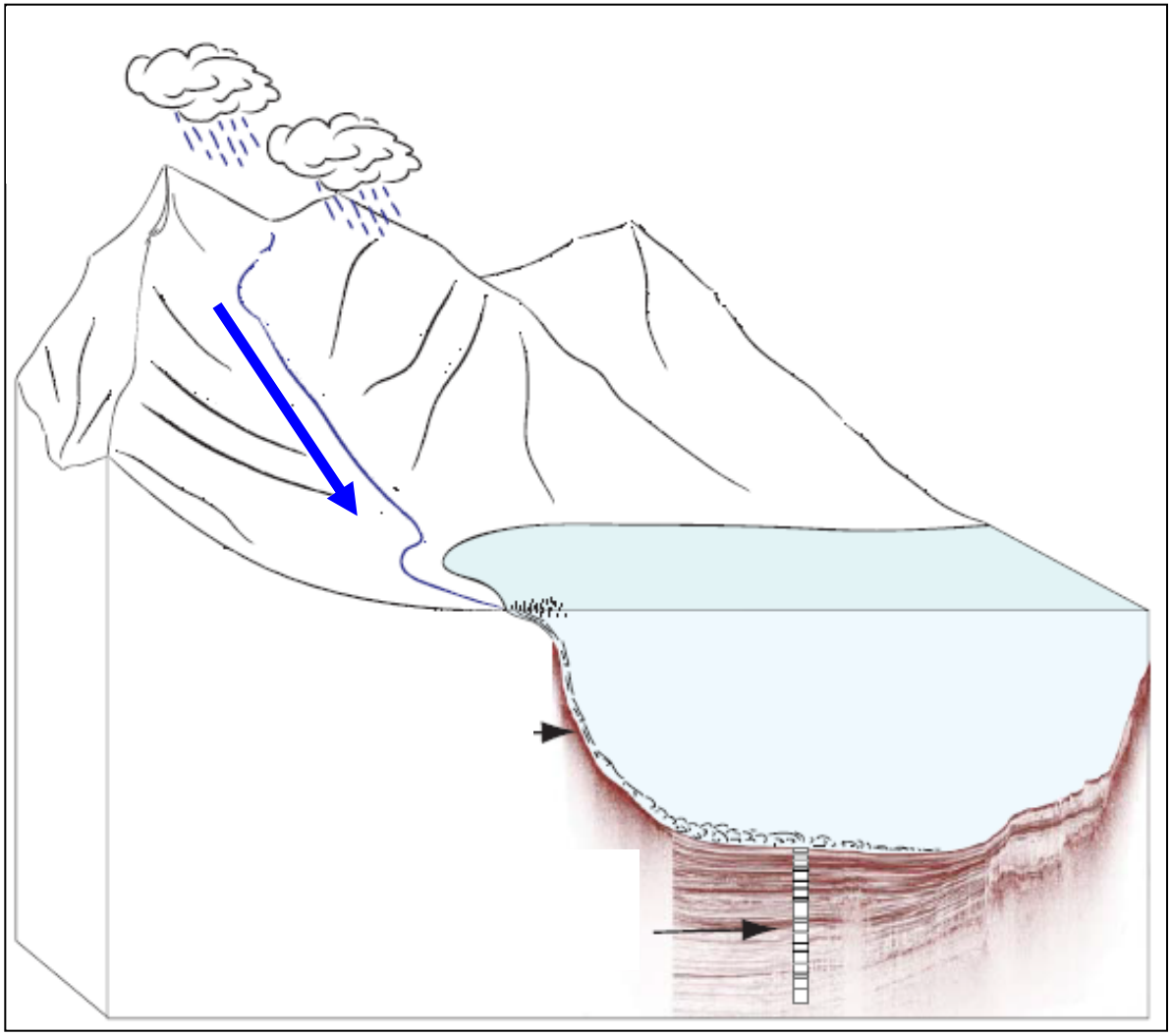
Observations:

Difficult to establish a robust link between the warming and the flood variability

Lack of long-term series

Our approach: Extending the 'flood' records

Lake sediments as natural archive of past floods

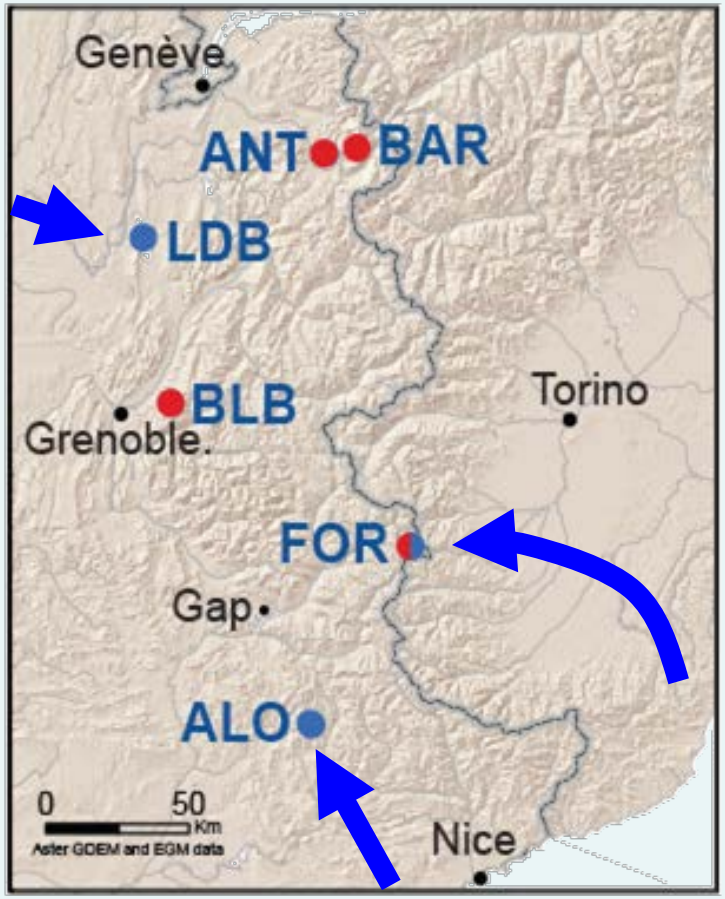


Glur et al., 2013

Approach

In Space…

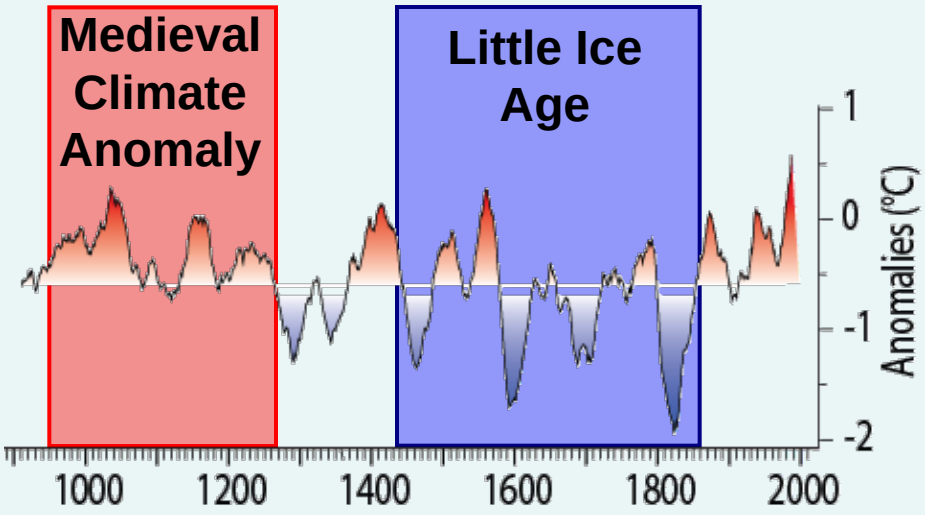
French Alps



- Sensitive to '**thunderstorms**'
- Sensitive to '**frontal systems'**

… and Time

The last millennium



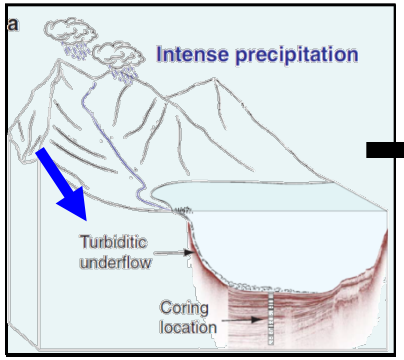
AD 950-1250 **AD 1450-1850**

-0.3°C **-0.8°C**

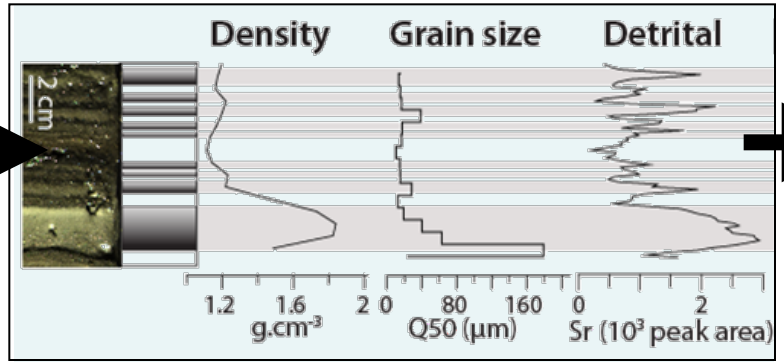
Büngten *et al*., 2011

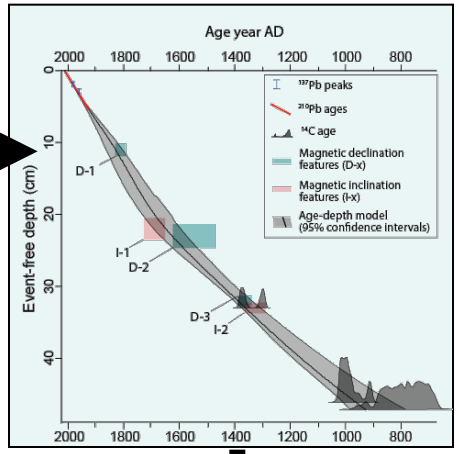
Lake sediments as natural archive of past floods

Coring… **Flood deposit identification…** **and dating**

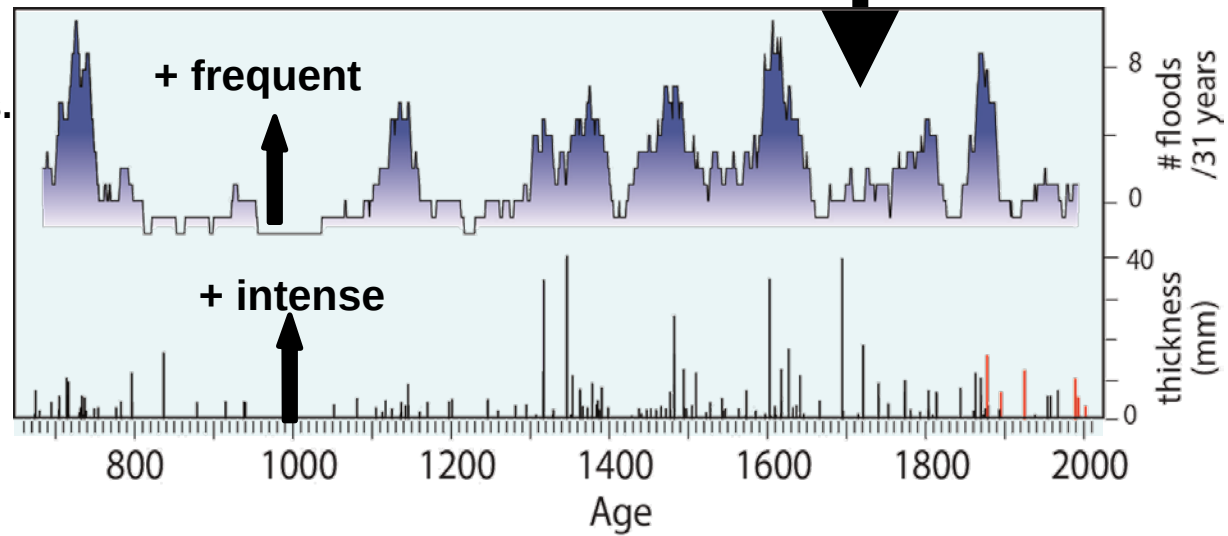


Glur et al., 2013



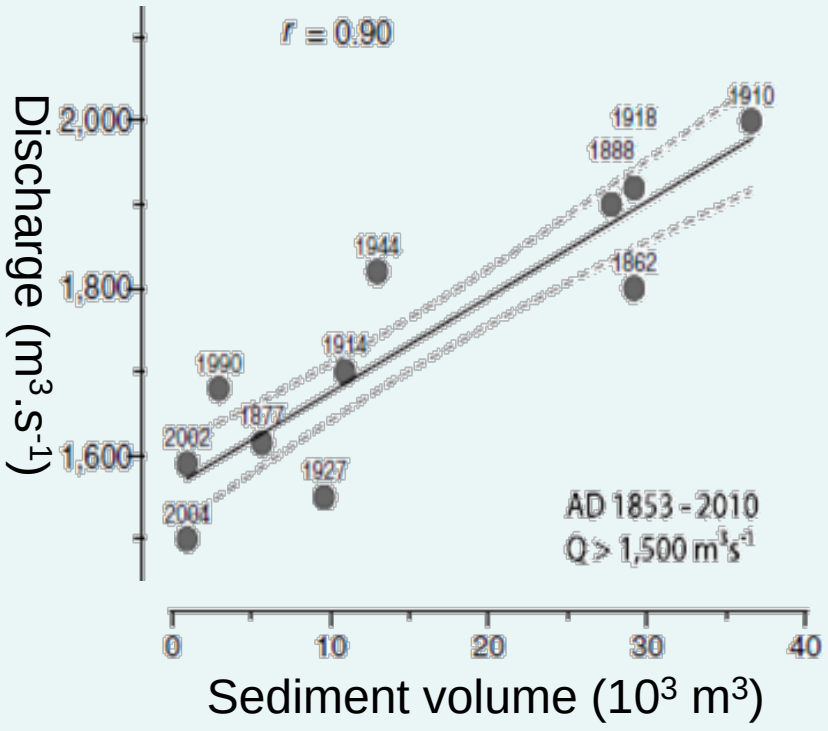


Arnaud et al., 2012, QSR
Giguet-Covex et al., 2012, Quat. Res.
Wilhelm et al., 2012a, Clim. Ch.
Wilhelm et al., 2012b, Quat. Res.
Wilhelm et al., 2013, J. Quat. Res.
Jenny et al., 2014, J. Paleolim
Wilhelm et al., 2015, Sedim.
Wilhelm et al., 2016, Clim. Past



Record calibration

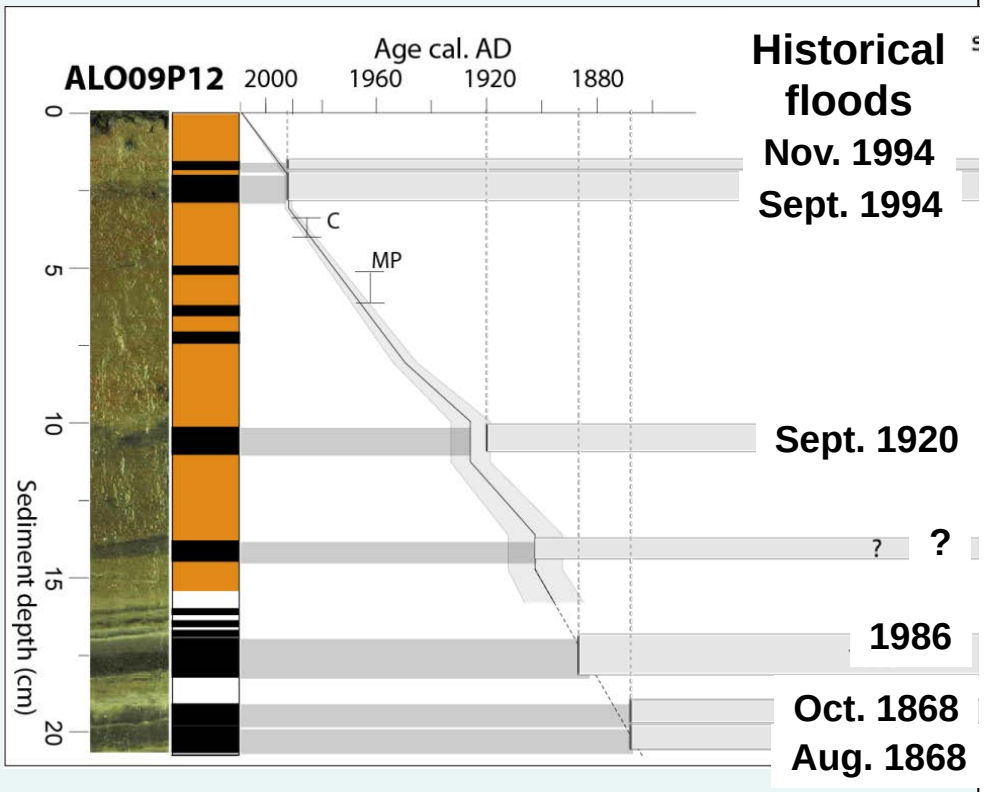
Instrumental data



-90% flood recorded
-Intensity well reconstructed

Jenny et al., 2014, JoPl

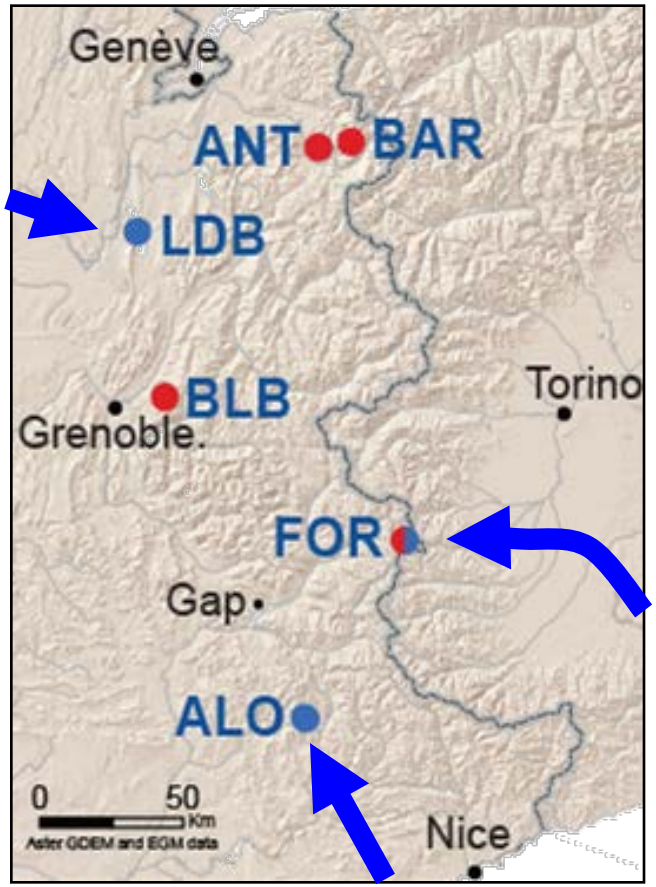
Historical data

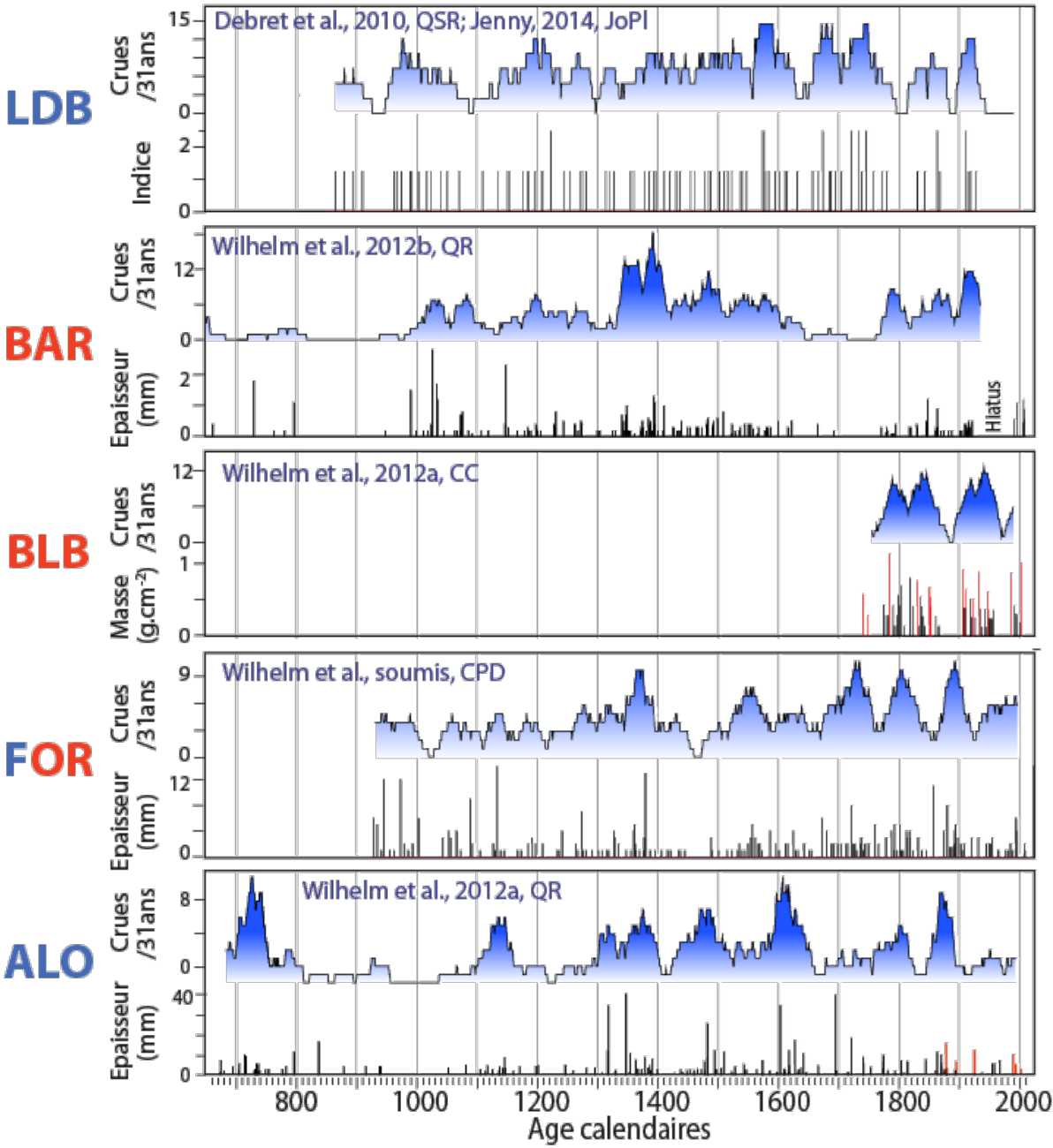


-100% historical flood recorded
-Flood intensity proxy validated

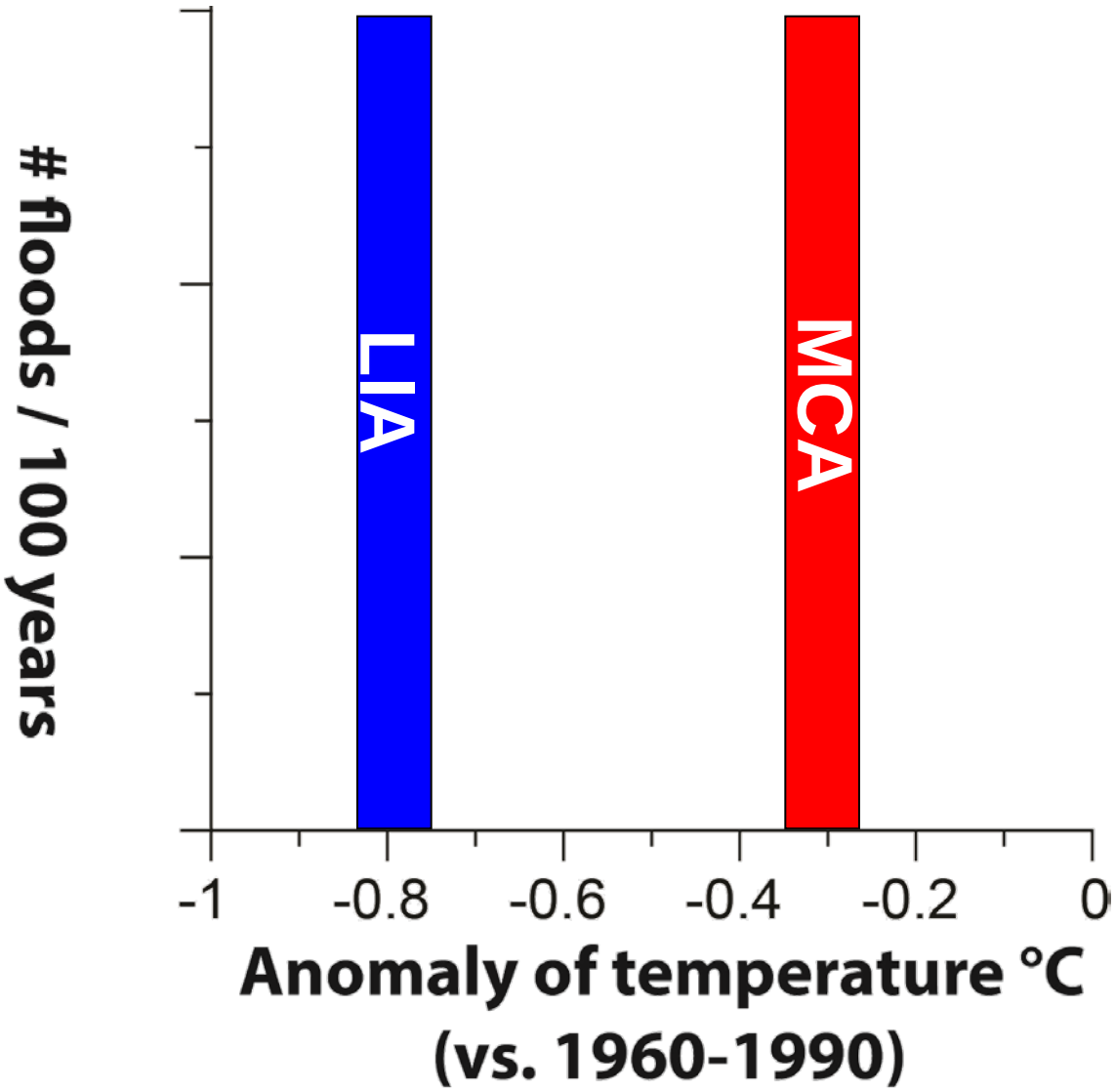
Wilhelm et al., 2012 & 2015

Flood records

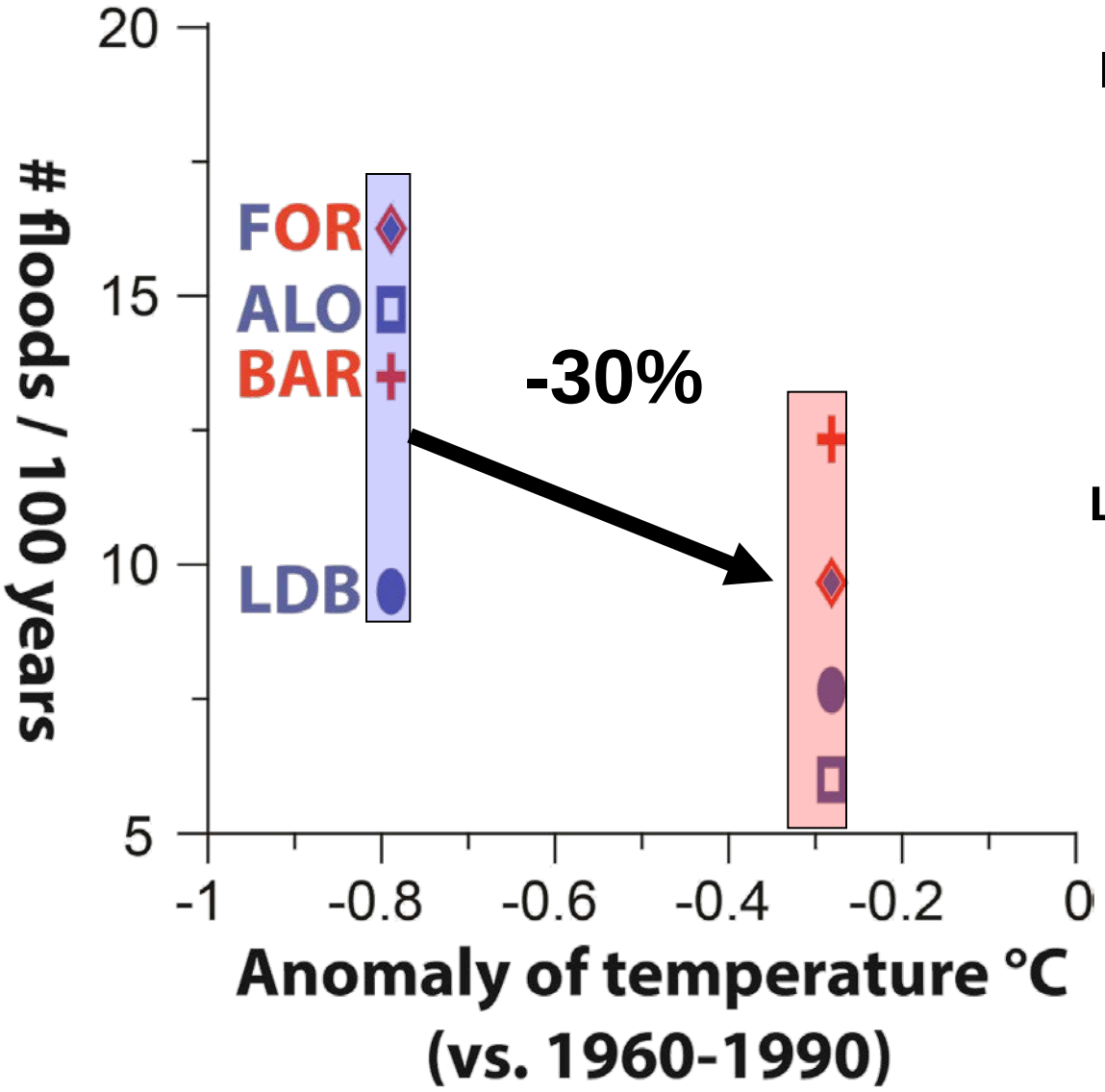




Flood frequency: LIA vs. MCA



Flood frequency: LIA vs. MCA



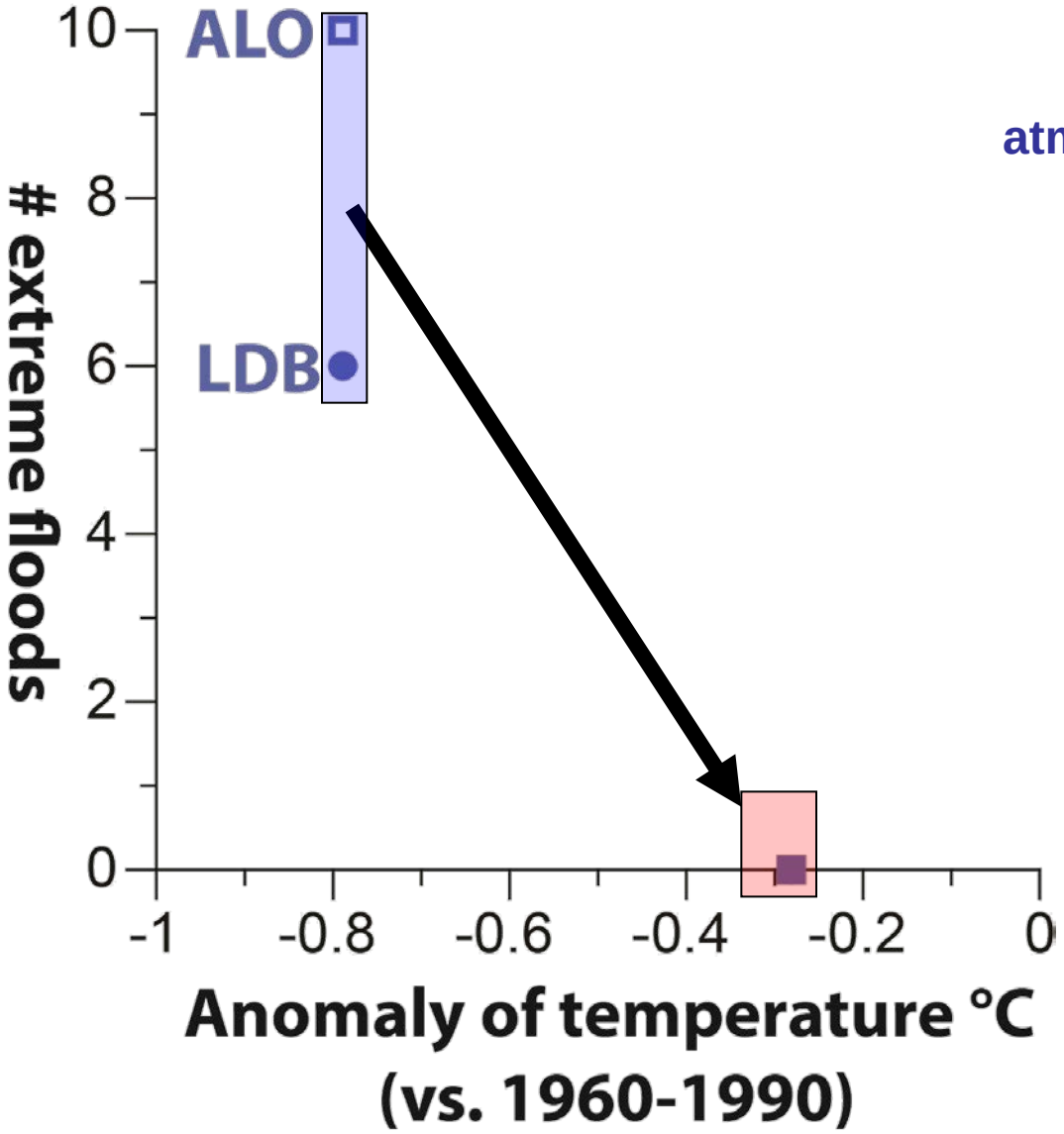
In agreement with other studies in Europe

(Czymzik et al., 2012; Swierczynski et al., 2012; Vannière et al., 2013; Witrh et al., 2013; Glur et al., 2014; etc.)

Linked to an intensification of atmosph. circulations during cold perdiods?

Trigo and Davies, 2000
Raible et al., 2007

Flood intensity: LIA vs. MCA



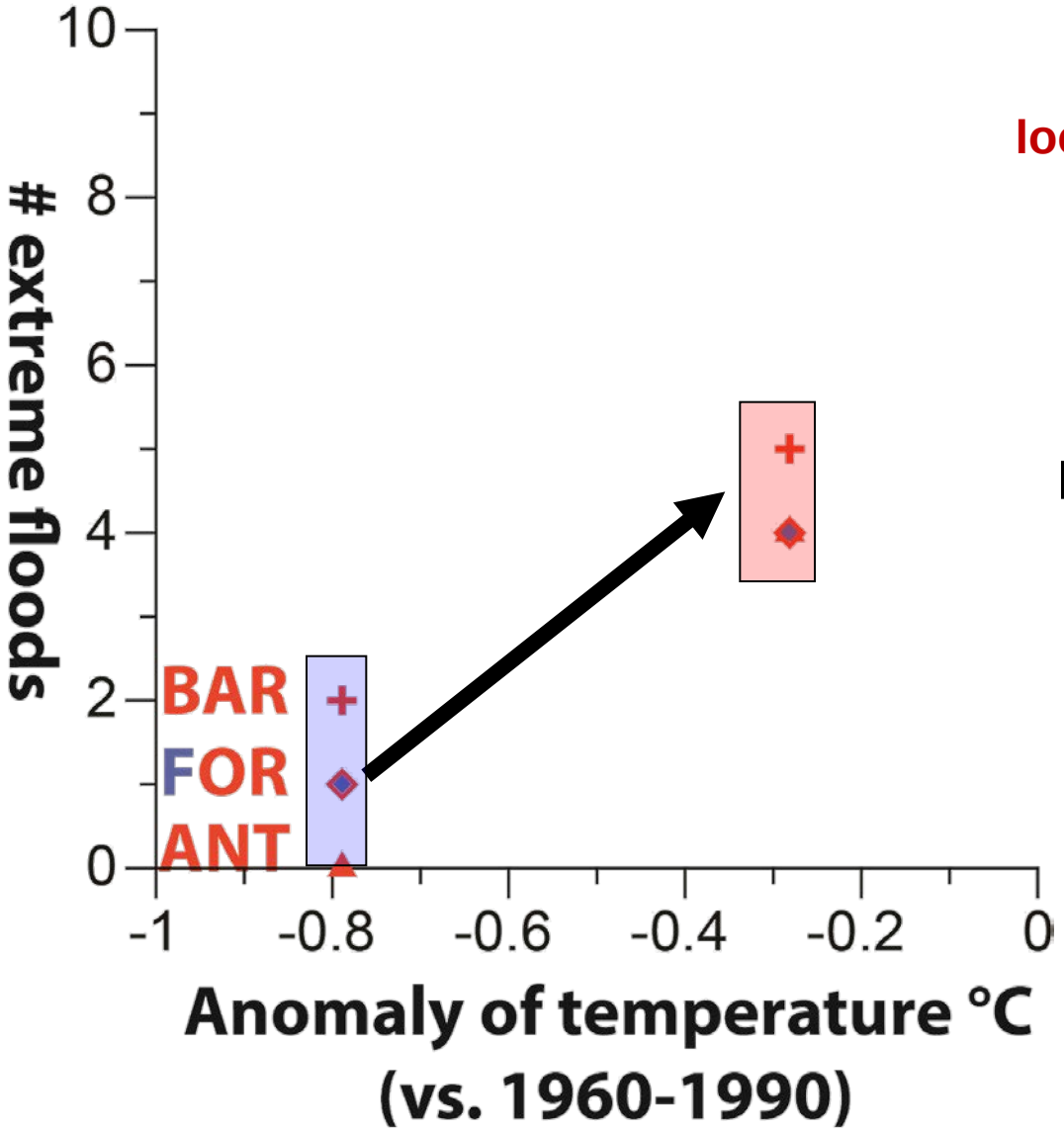
Site sensitive to floods strongly linked to atmospheric circulation patterns

« Disappearance » of extremes

Linked to an intensification of atmosph. circulations during cold perdiods?

Trigo and Davies, 2000
Raible et al., 2007

Flood intensity: LIA vs. MCA

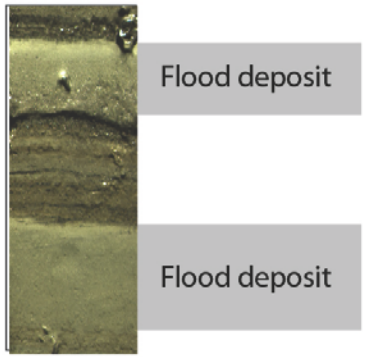


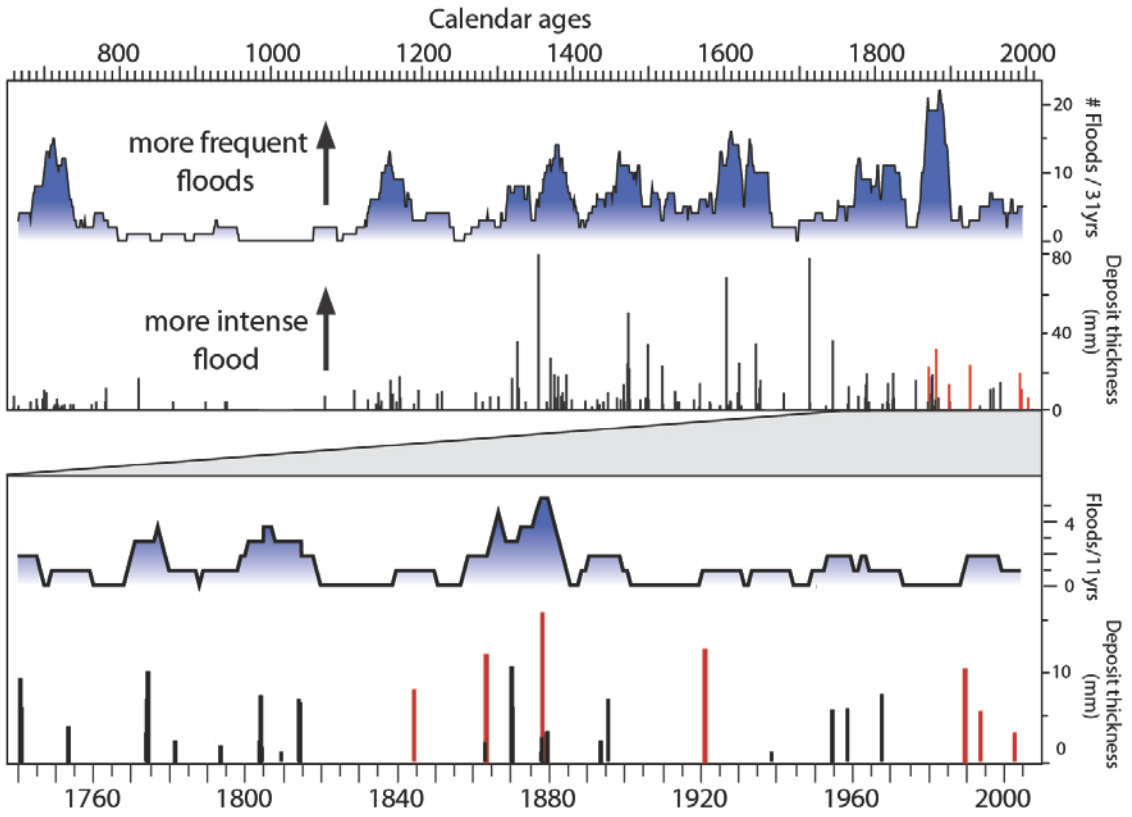
Site sensitive to floods strongly linked to localized convective processes (e.g. thunderstorms)

Linked to an increase of convective processes with the warming?

Long record of past floods

geological records





Historical flood impacts on socities

1 Nov. 1843	16 Aug. 1868	in 1886	23 Sept. 1920	24 Sept. 1994	5 Nov. 1994	19 June 2005
Crops flooded, road cut and a bridge destroyed	Bridge destroyed	Notre-Dame de Valvert church scoured	Aggradation of 50 cm of the river bed	Exceptional increase of water level	Embankment destroyed, 2 houses and crops flooded, road cut	Traffic on the road interrupted

Conclusion

Flood variability with temperature

		Frequency	Intensity
Northern French Alps	**Large River** ‘frontal sys.’	-	-
	Mountain stream Convective	-	+
Southern French Alps	**Mountain stream** ‘meso-scale convect. sys.’	-	-

Floods Working Group

http://www.pages-igbp.org/ini/wg/floods

Contacts:
Stefanie Wirth (Uni Neuchâtel)
Bruno Wilhelm (Uni Grenoble)

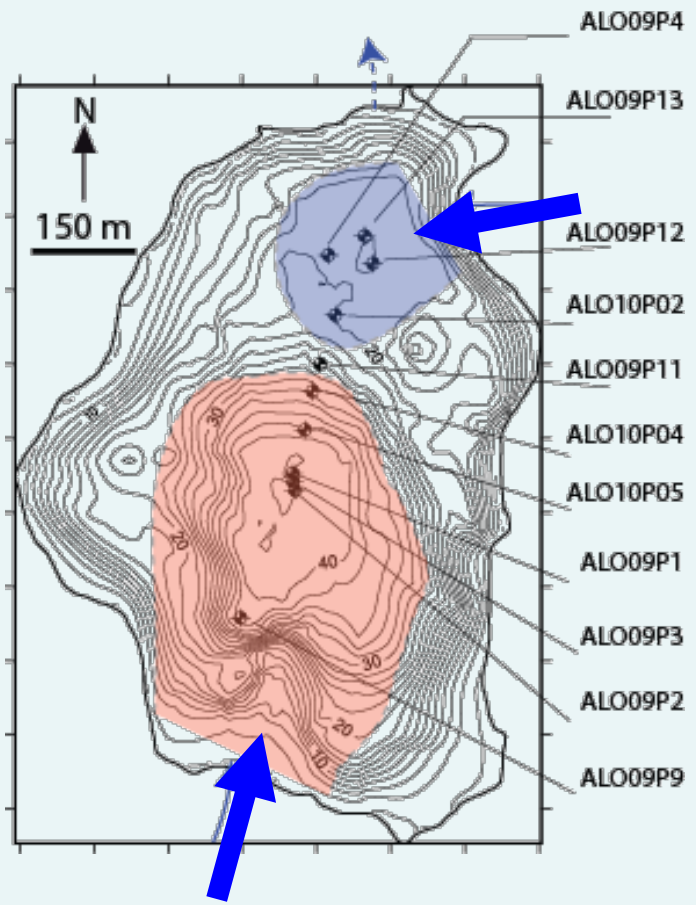
- **Gathering scientists from all flood-archive communities**
  - **For collaborations and compilation of all existing data on past floods**

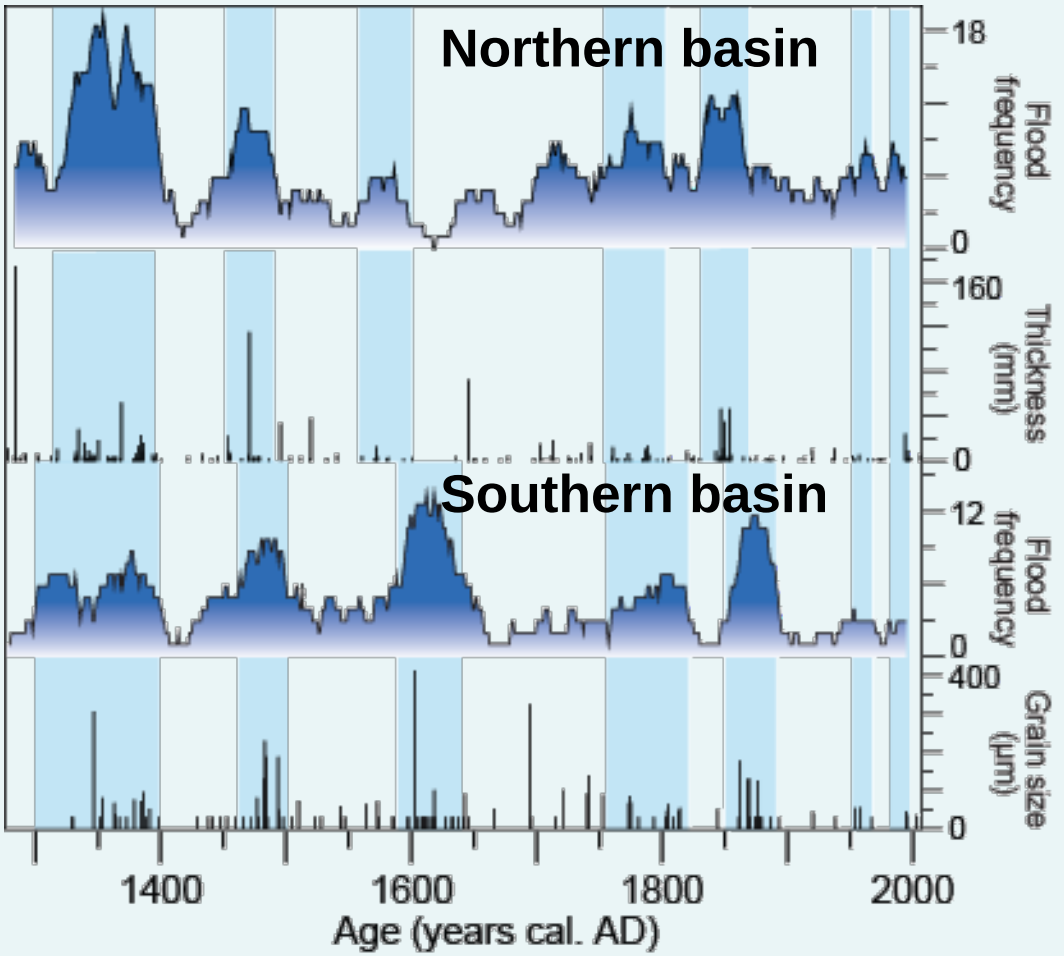
- **Gathering also scientists from other flood-hydrology communities**
  - **To proceed to e.g. statistical analysis, hydro-climate modelling, flood-hazard assessment, etc.**

Cross community workshop on past flood variability
June 27-30, 2016 – Grenoble (France)

Open call (deadline March 15th)

Reproductibility of a reconstructed flood signal?



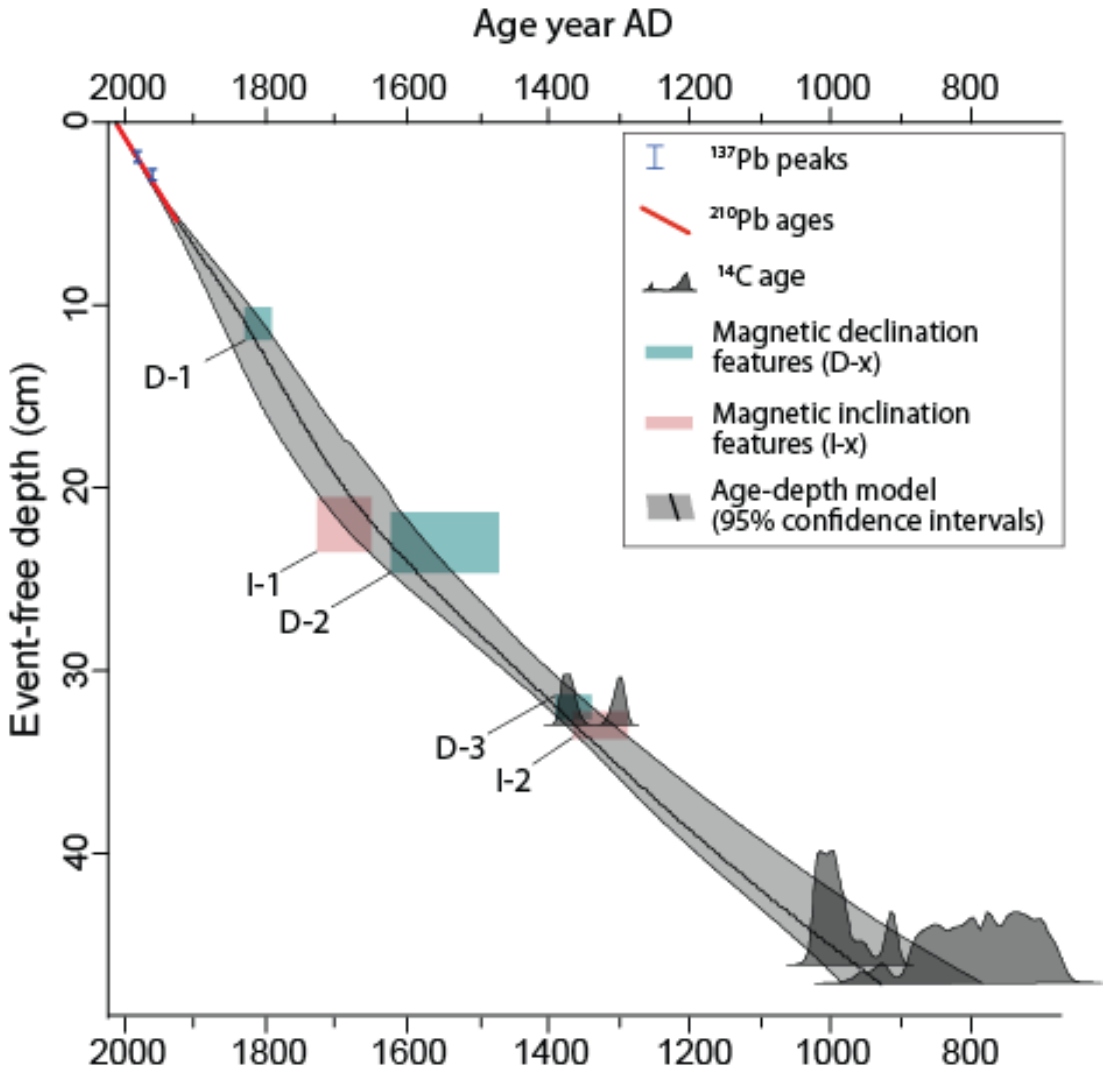


Wilhelm et al., 2012, Quat. Res.

Wilhelm et al., 2015,Sedimentology

Chronology of the records

- $^{210}Pb/^{137}Cs$
- **Historical events**
- **Radiocarbone**
- **Paleomagnetism**

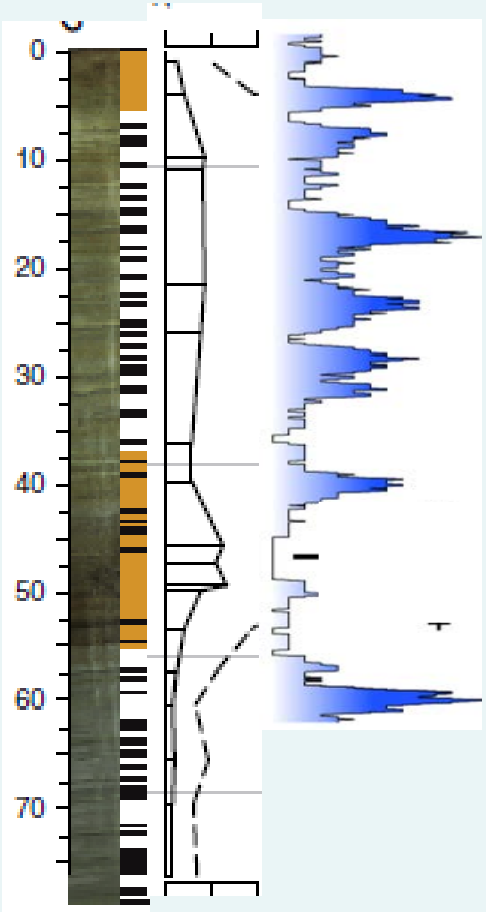


Wilhelm et al., 2016, Climate of the Past

Human impact?

Pollens

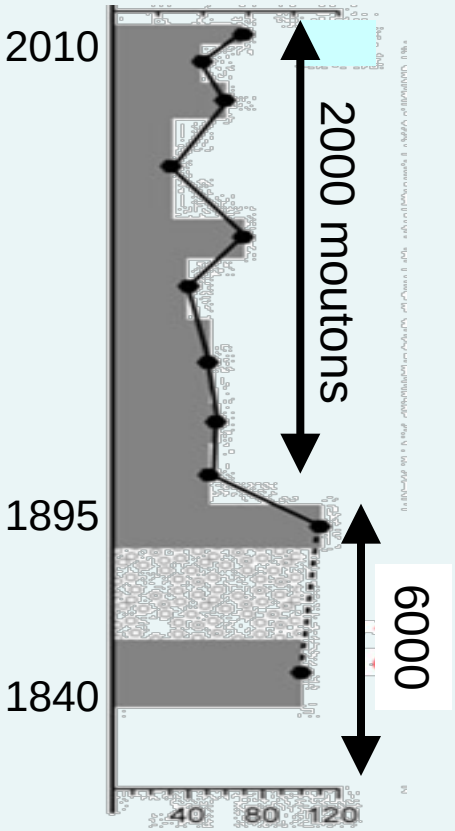
Proxy of grazing



Wilhelm et al., 2012, Quat. Res.

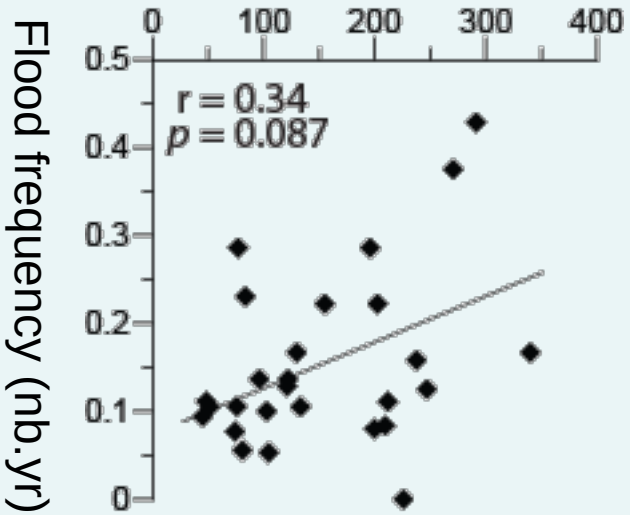
Coprophilous fungies

Flux
Sporomiella



Etienne et al., 2014, JoPl

Flux
Sporomiella



Wilhelm et al., 2016,
Clim. Past