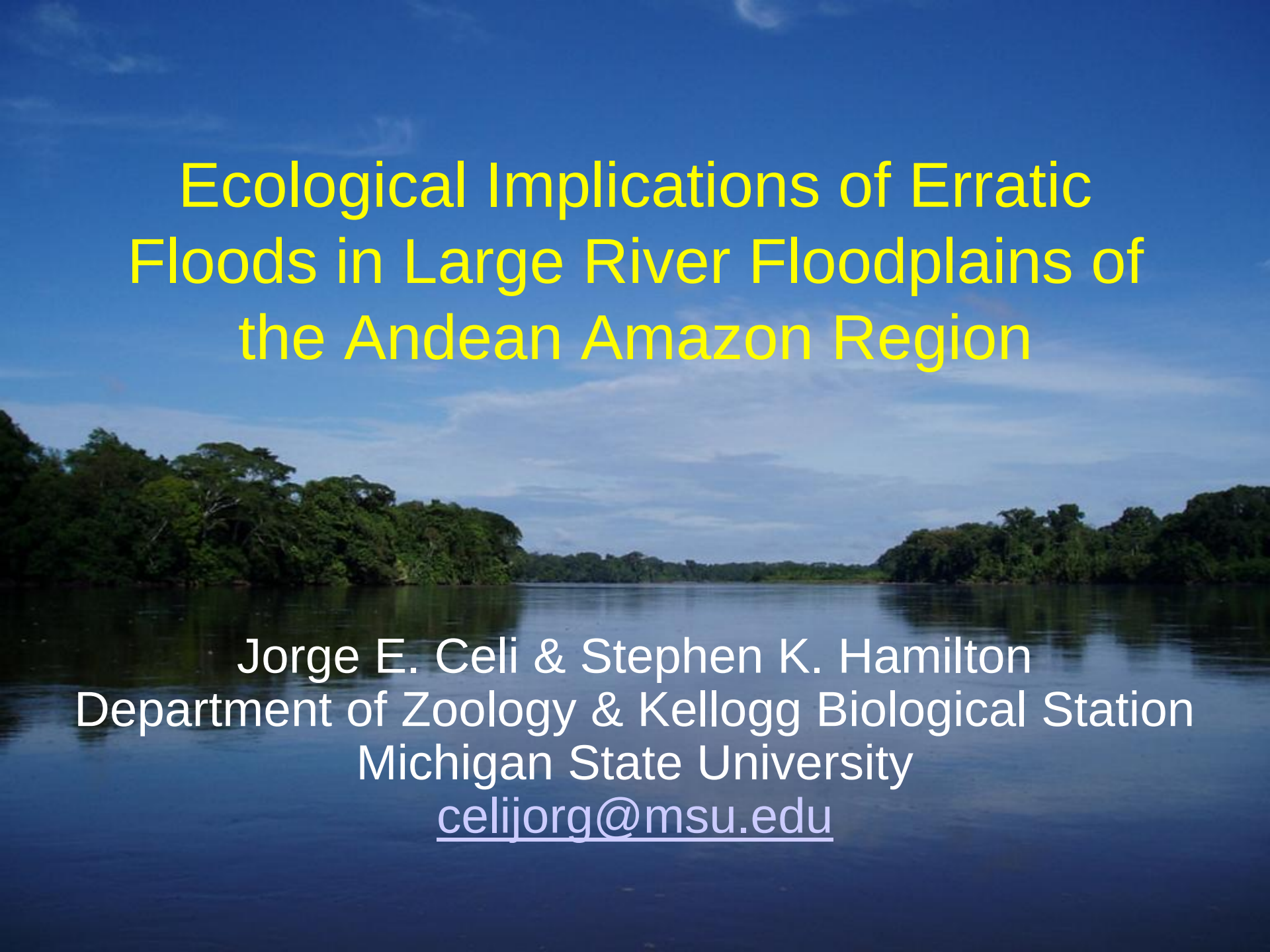

Ecological Implications of Erratic Floods in Large River Floodplains of the Andean Amazon Region

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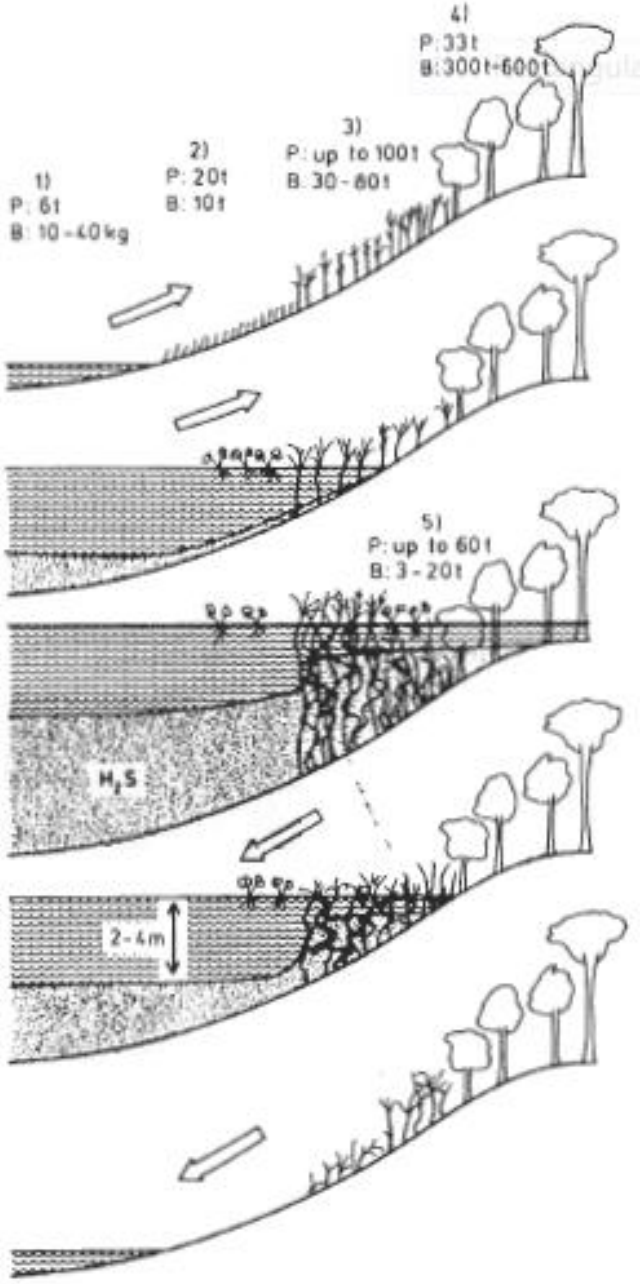
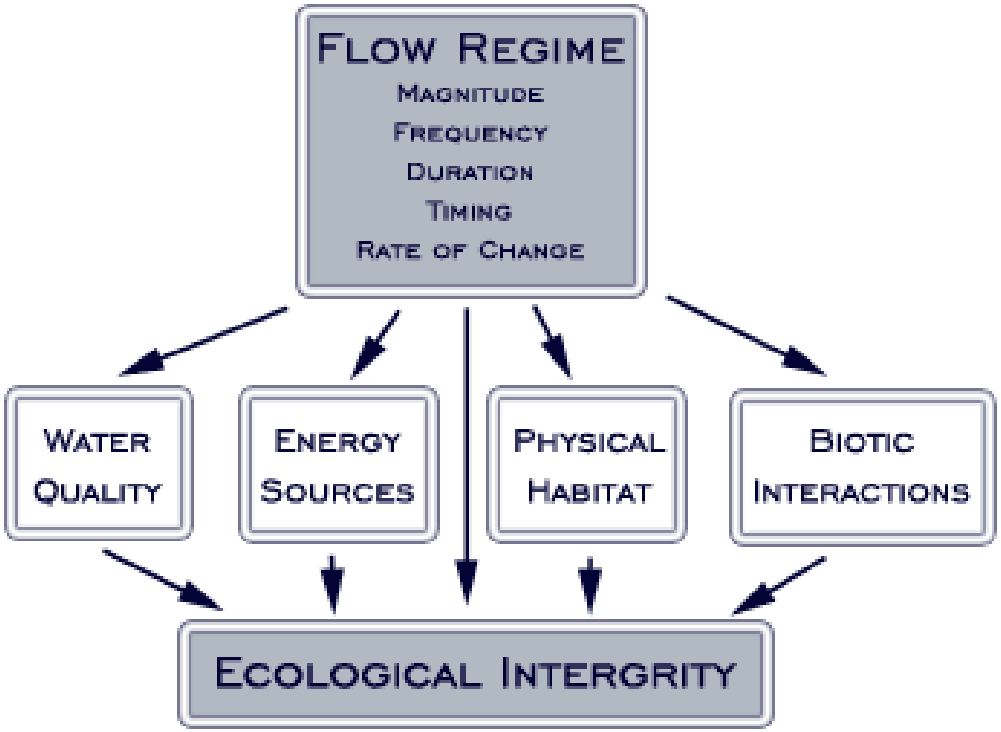
The Flood Pulse Concept (Junk et al. 1989)

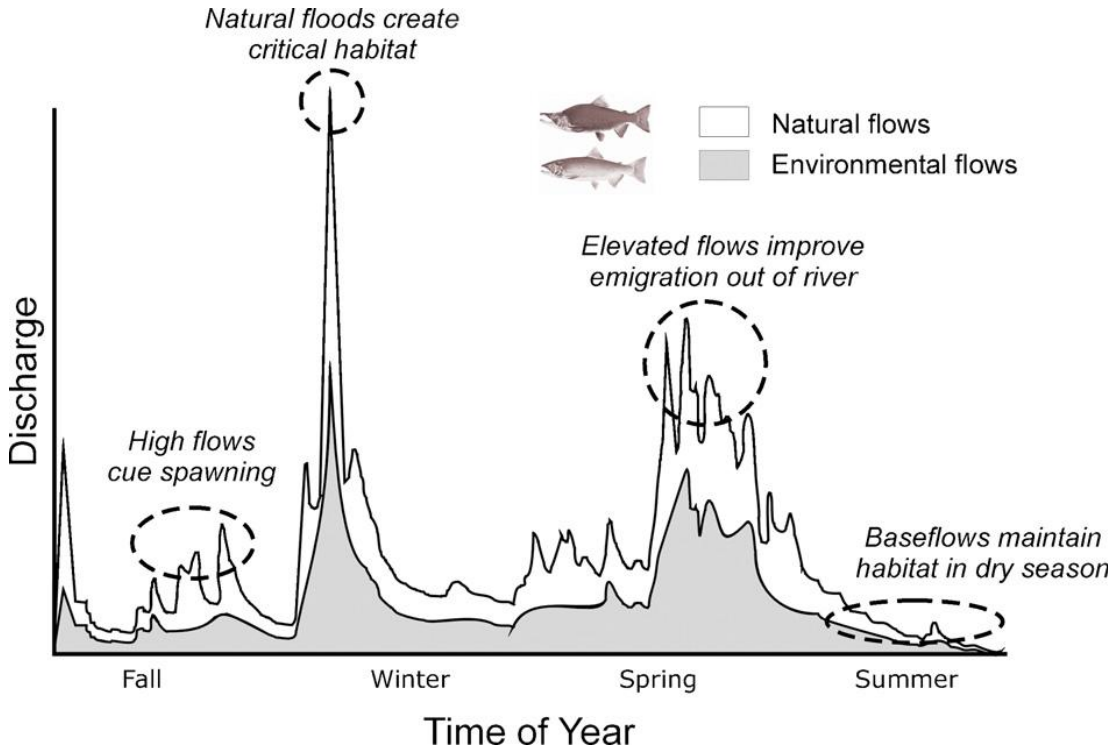
- Floodplains are **transitional** between aquatic and terrestrial zones.
- Large unmodified watersheds produce **flood pulses of long duration** and extensive seasonal floodplain inundation.
- Small or modified systems produce frequent **flood pulses of shorter duration.**
- **Predictable** pulses allow organisms to adapt to and benefit from inundation.
- **Unpredictable** pulses act as a disturbance and impede adaptation.





Poff et al. 1997. The Natural Flow Regime.

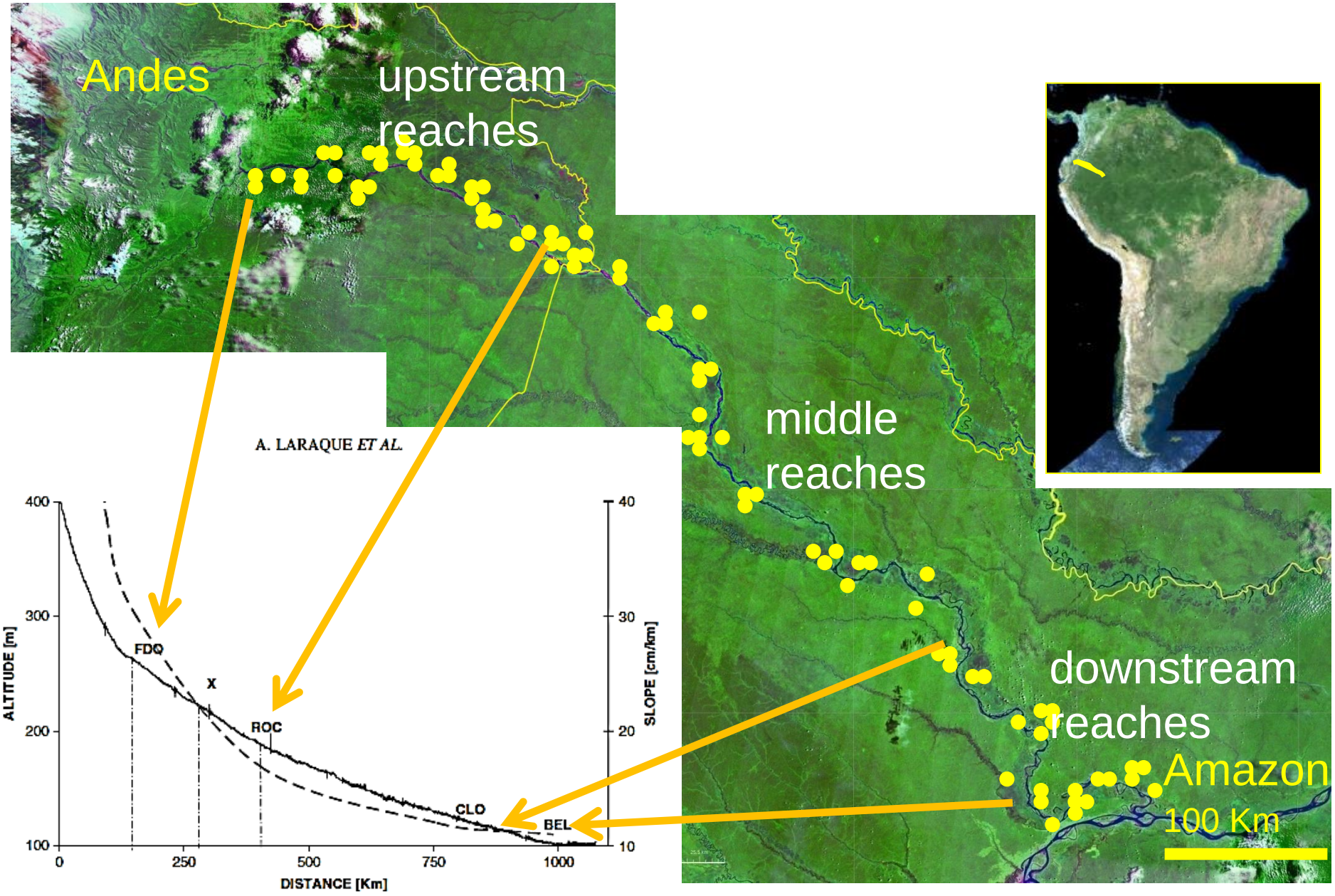
The Natural Flow Regime concept can be extended to Flood Regimes on floodplains



Naiman et al. 2008. Flow variability and the biophysical vitality of river systems.

The Napo River

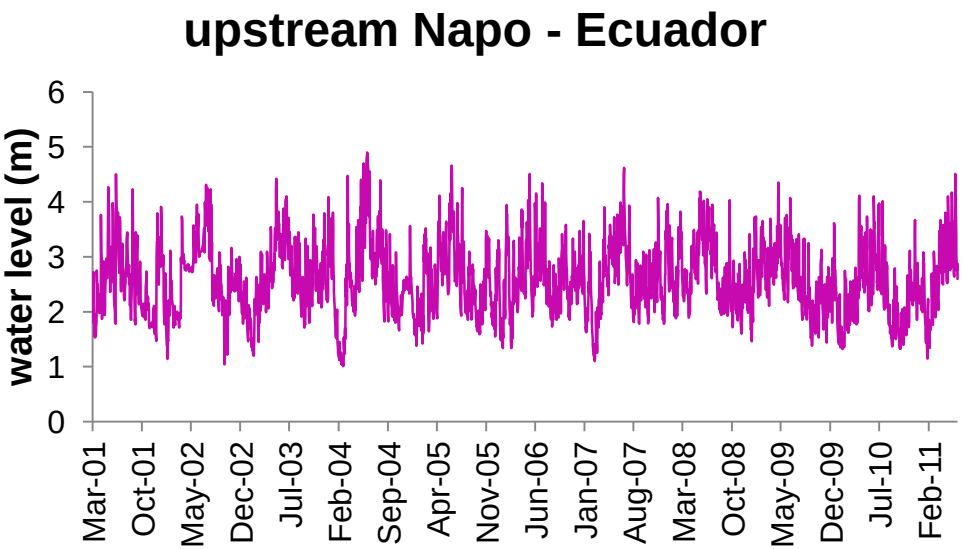
- Drains 10^5 km^2 of a highly diverse and largely undisturbed region of the western Amazon in Ecuador and Peru.
- Fringed with extensive floodplains along 800 km of lowland reaches.
- Exceptional levels of biodiversity may be related to flood regimes.
    - Intermediate disturbance hypothesis



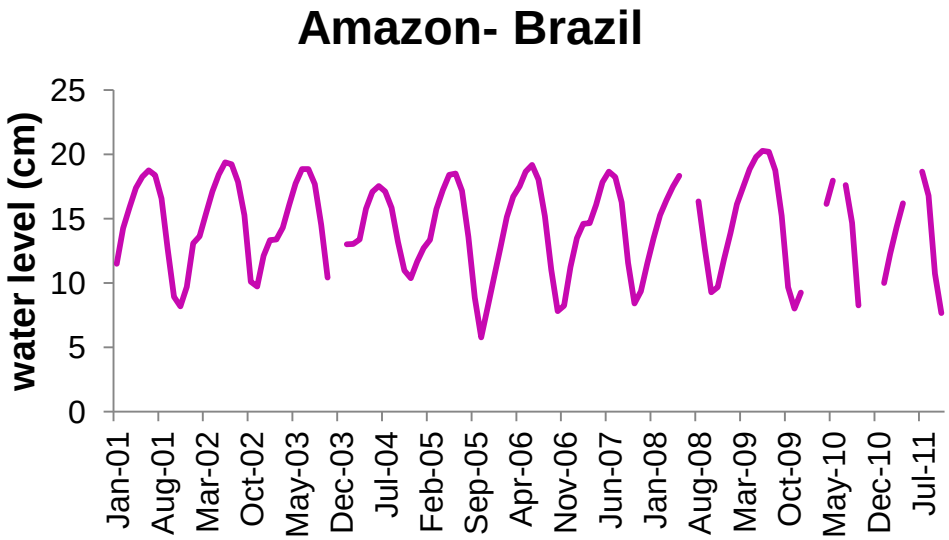
Laraque et al. 2009. Hydrol. Proc.

Water levels of the Napo River

- Highly variable and less predictable flow and flood regimes (multiple short pulses).
- Contrasts with more predictable, mono-modal regimes of the Amazon, Orinoco, Parana rivers.
- Stage fluctuations range from 4 m in upper reaches to 9 m in lower reaches, vs. 16 m in the central Amazon.



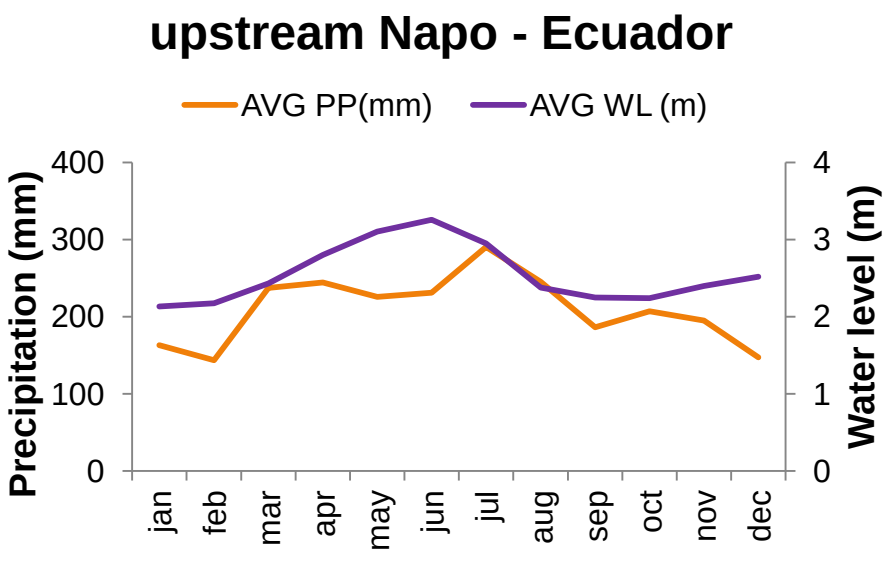
Source: INAMHI-SENAMHI, Hybam Project.



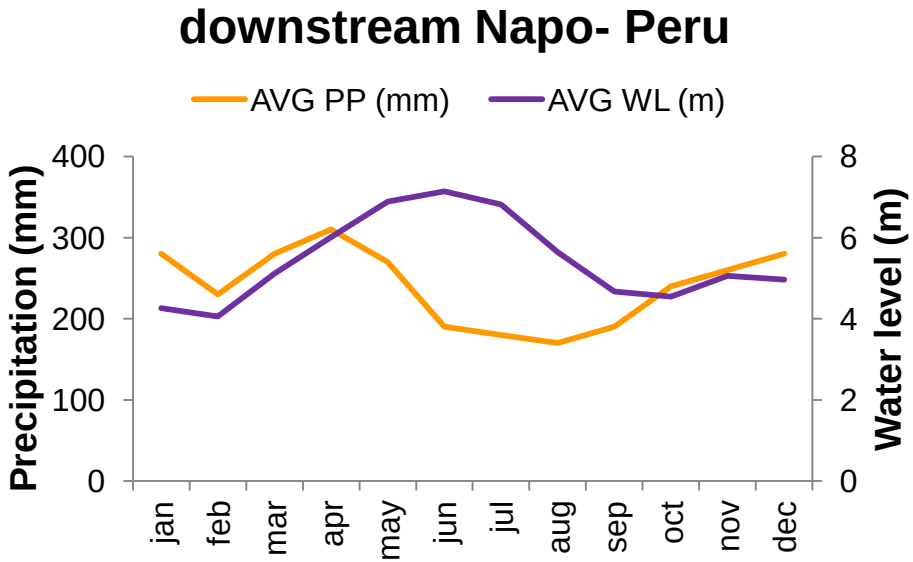
Source: ANA, Brazil.

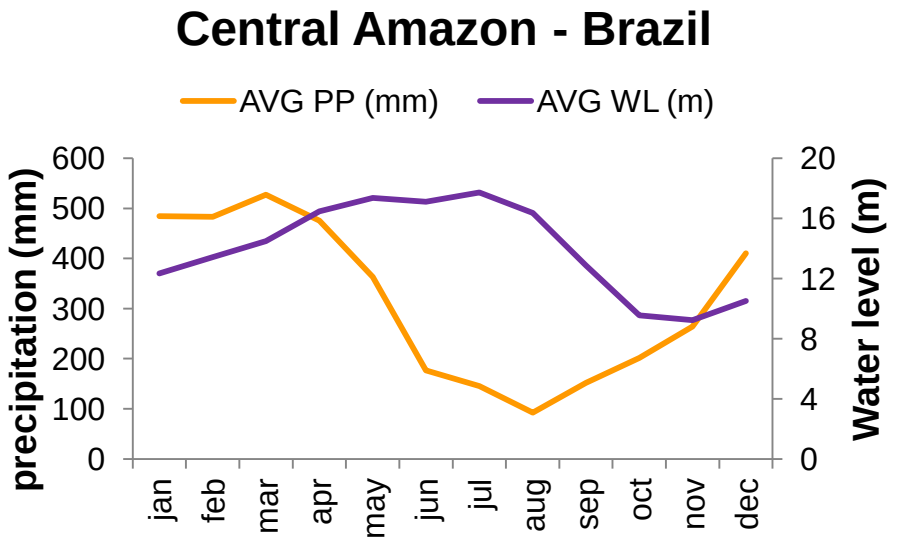
Water levels and precipitation

- Less pronounced seasonality in the Napo.
- Hydrograph coupled to precipitation events towards the upper reaches and decoupled (like the Amazon) towards the lower reaches.



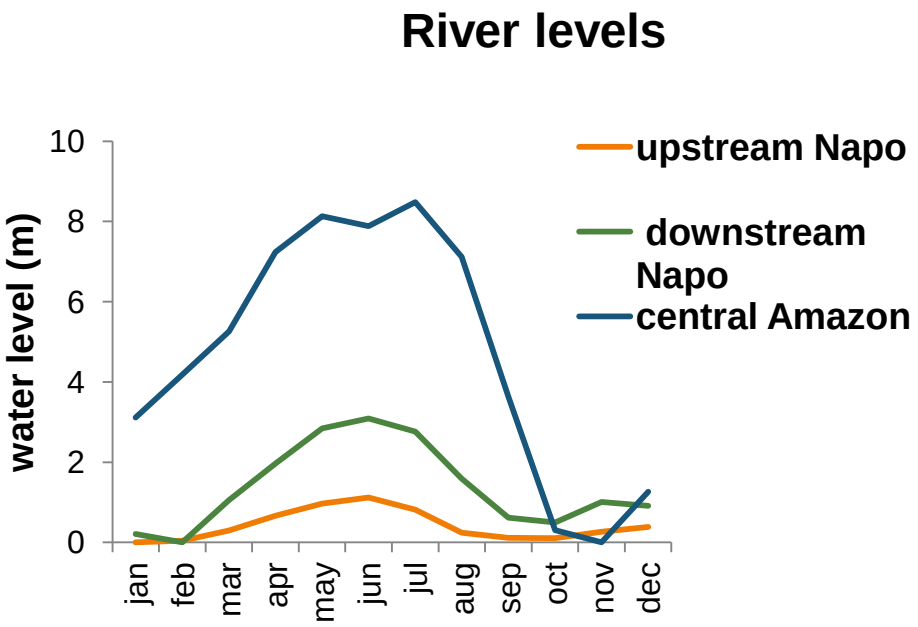
Source: INAMHI-SENAMHI, Hybam Project.

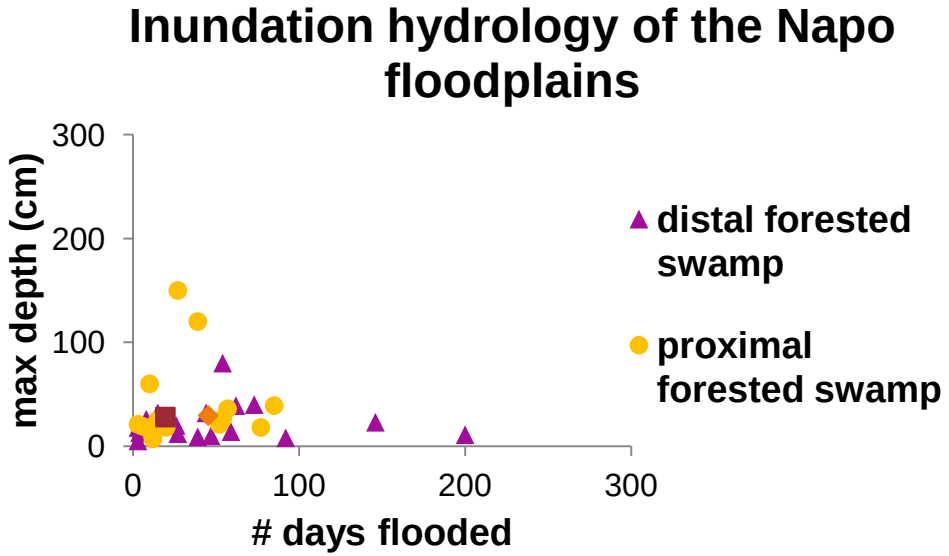




Source: ANA, Brazil.

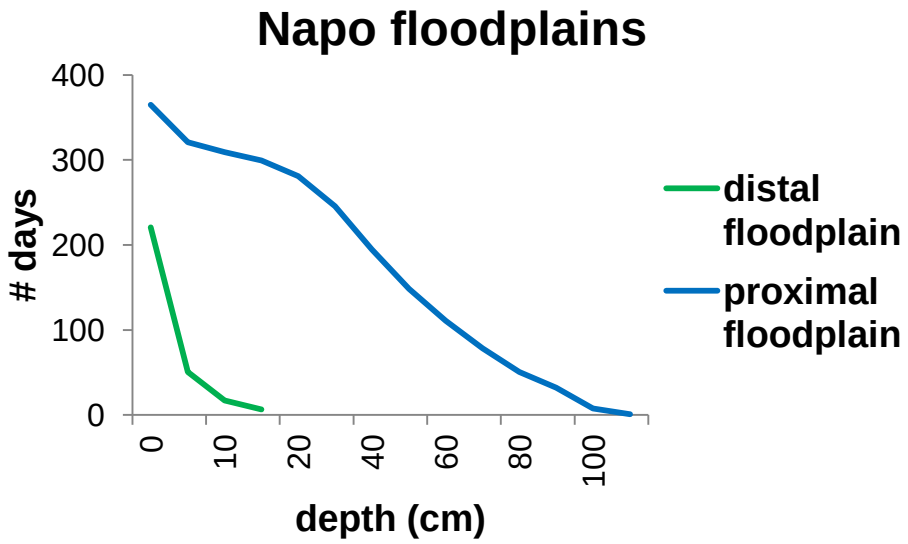
Magnitude: Depth of inundation

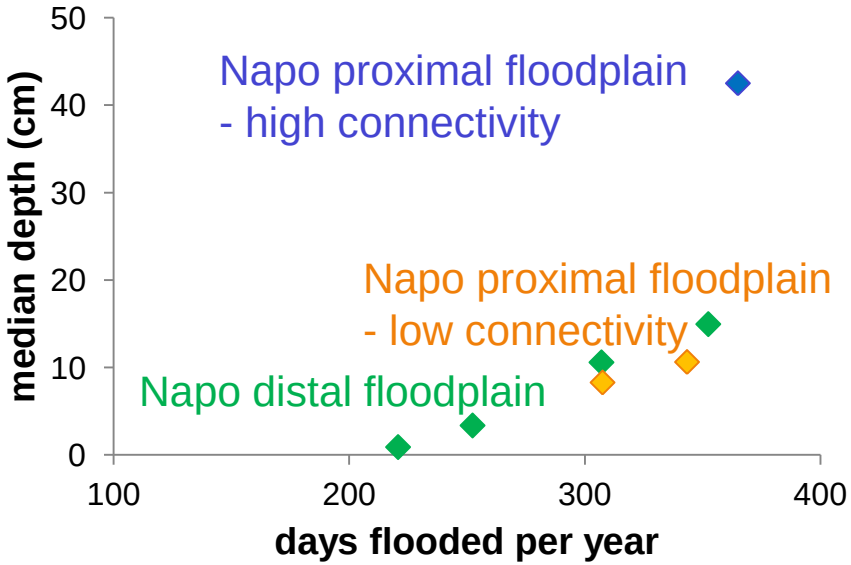




- Napo River has smaller amplitude of water levels than the Central Amazon.
  - Lower depth of flooding.
- Deepest flooding occurs at floodplain sites proximal to river.
- Floodplain biota less adapted to cope with deeper floods?

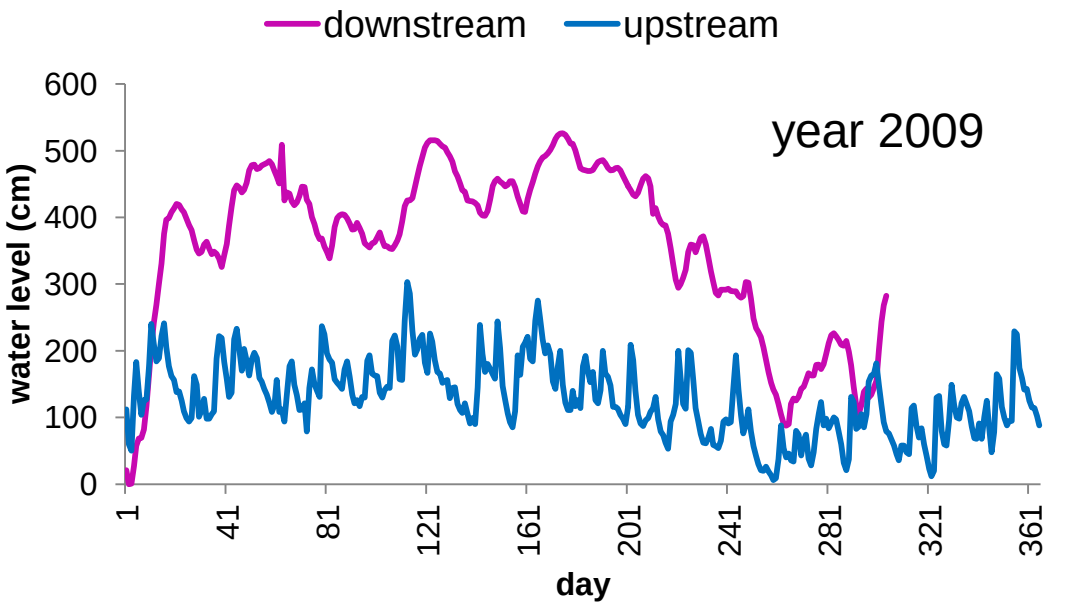
Duration: Floodplain Hydroperiod





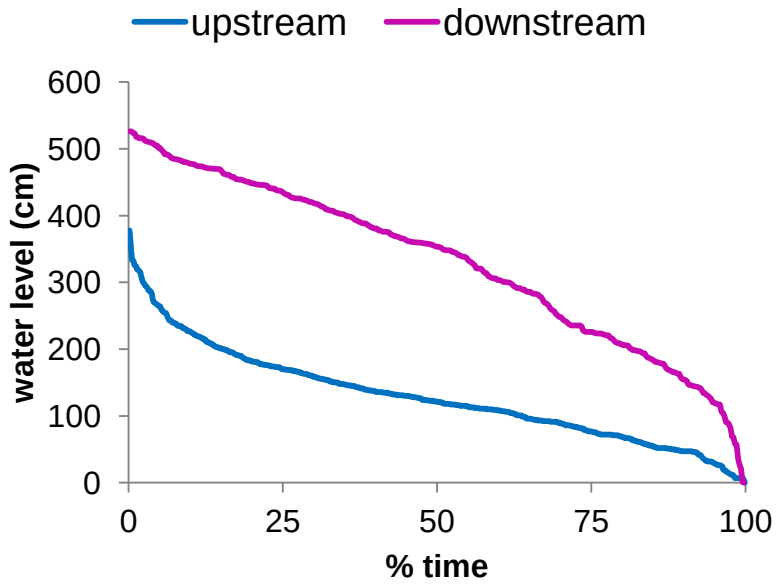
- Large variability in flood duration and depth.
- Proximity and hydrological connectivity to river explain depth and duration of flooding.
- Elevation of sampling sites relative to river unknown.
  - Some sites may be on perched terraces?

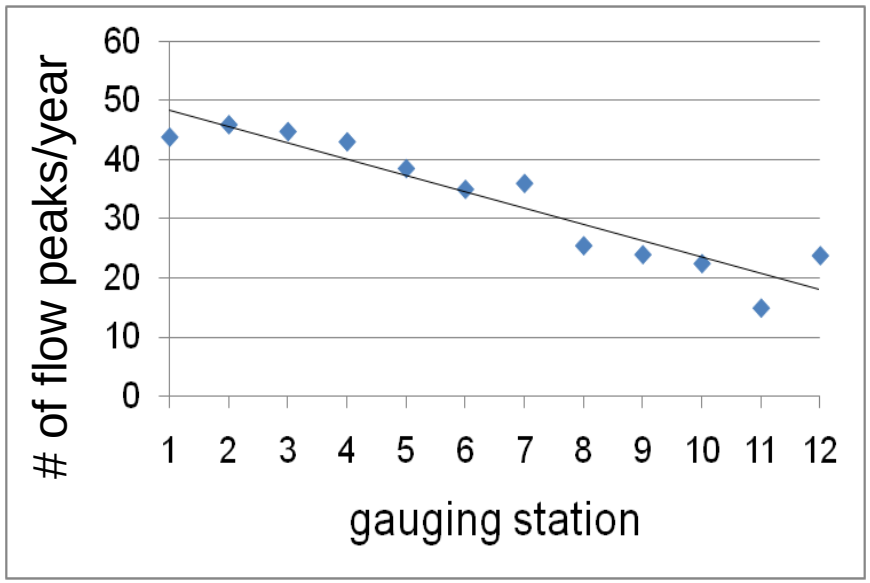
Frequency: Napo River hydrographs



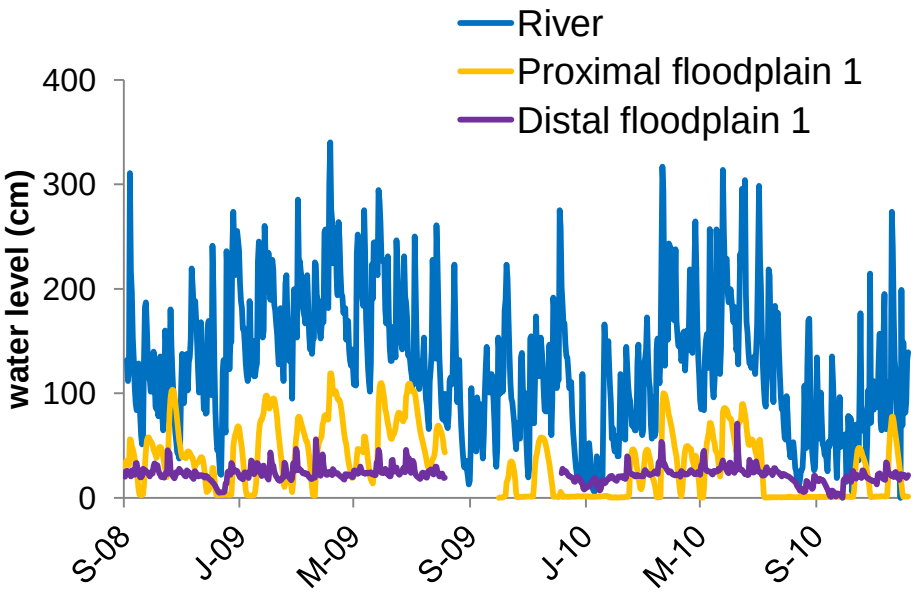
Source: INAMHI-SENAMHI, Hybam Project.

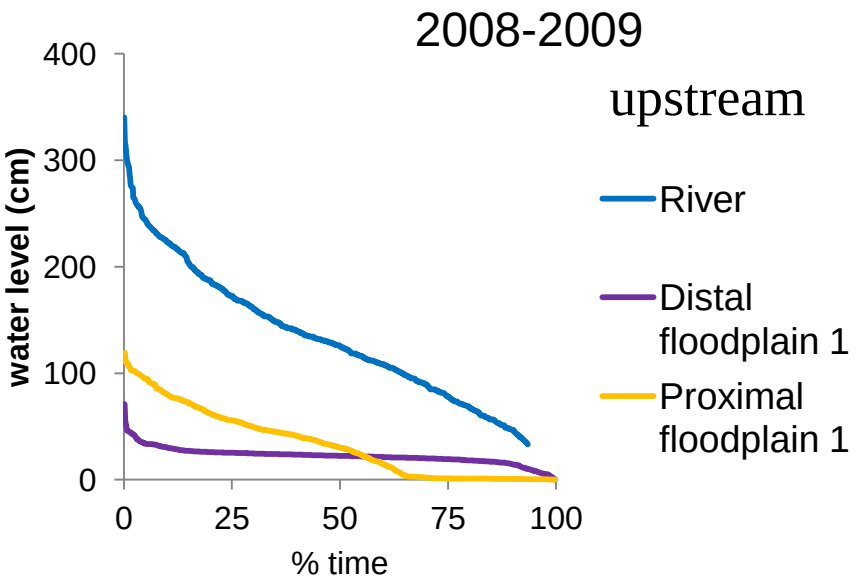
- Higher frequency of floods towards the Andes.
- Inundation may act more as an ecological disturbance towards the Andes.

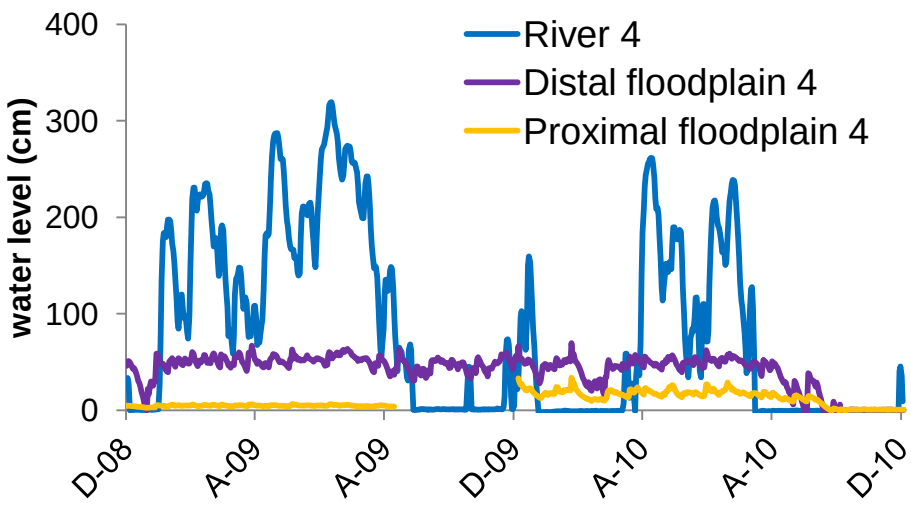


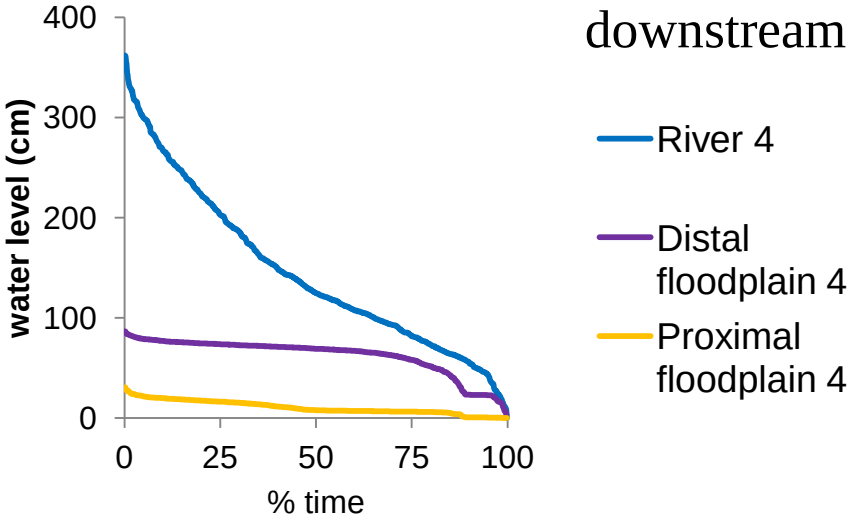


Frequency: Floodplain hydrographs



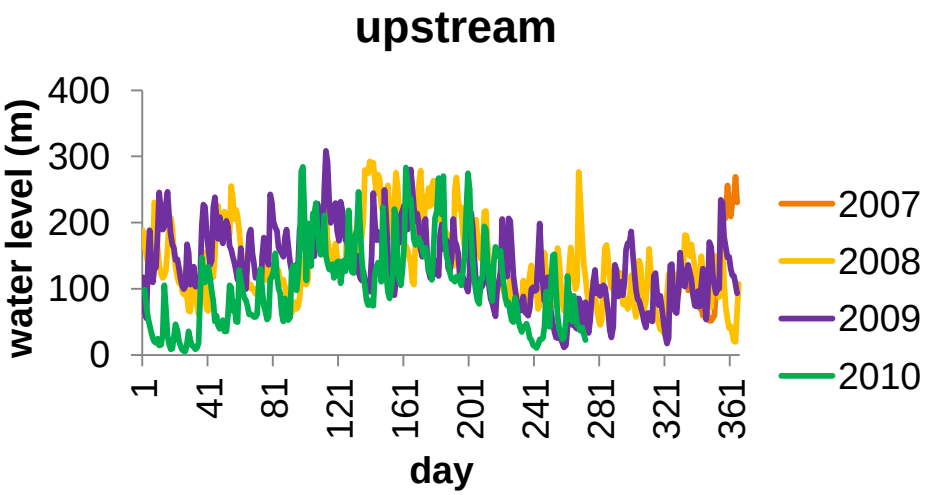


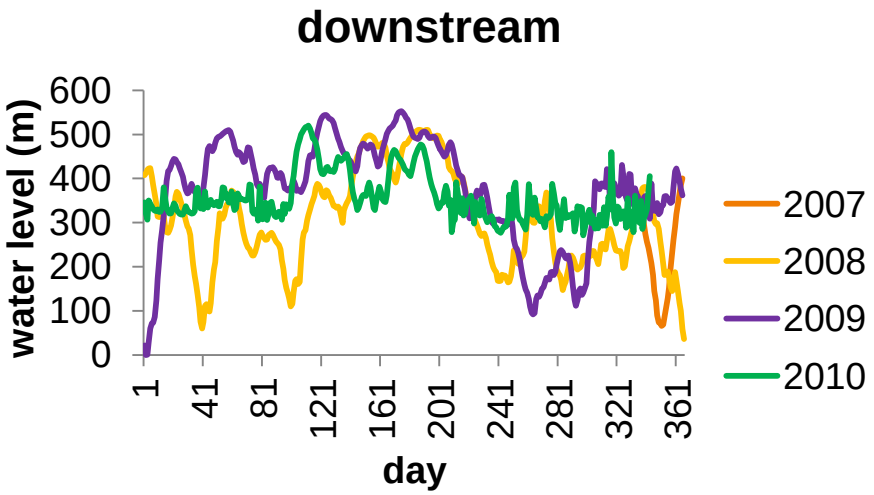


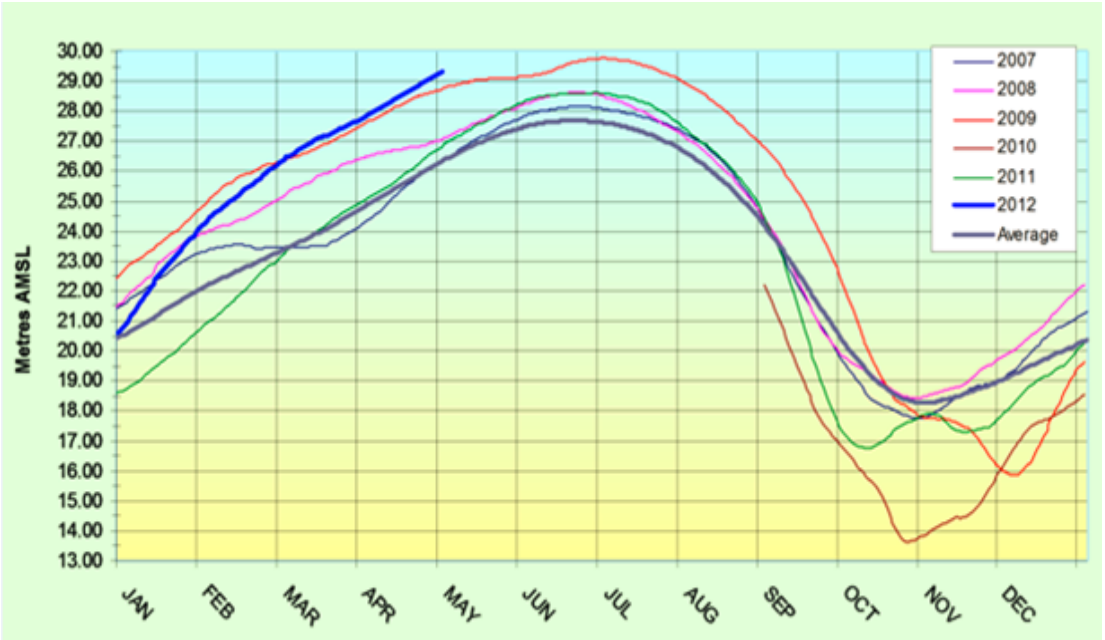


Most floodplain sites showed shallow, continuous inundation

Timing and flashiness: Predictability



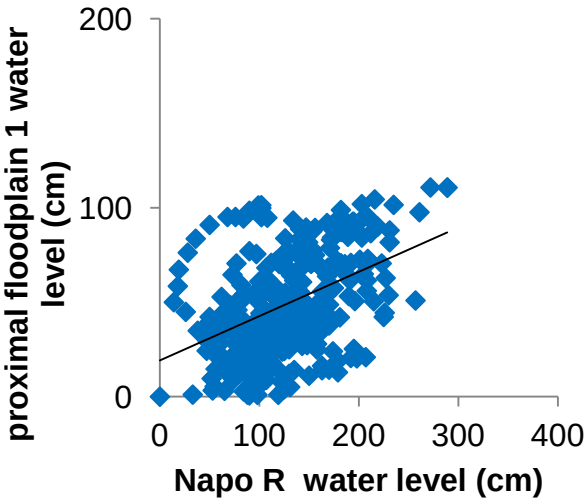


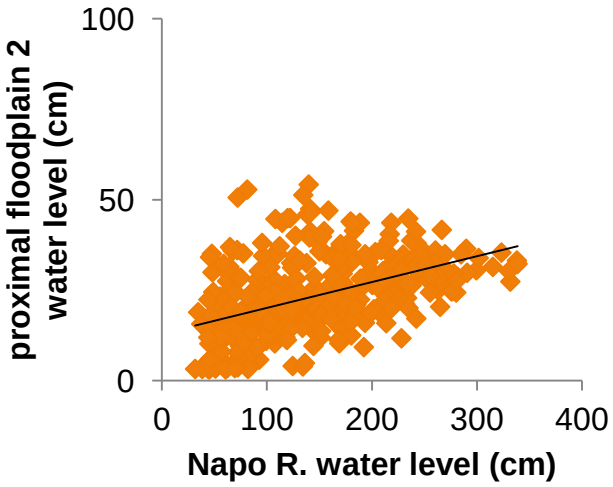


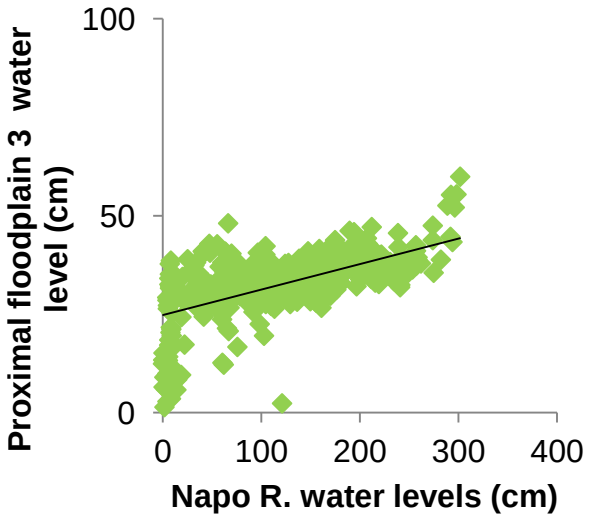
- Lower flood predictability in upstream reaches.
- Much flashier than Central Amazon!

River control of floodplain inundation?

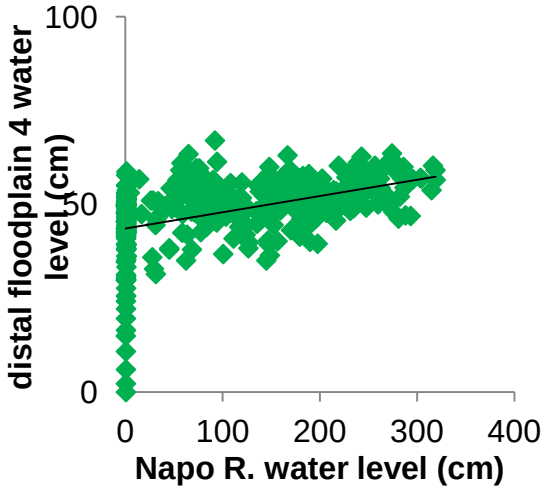
In some places it may to some extent:

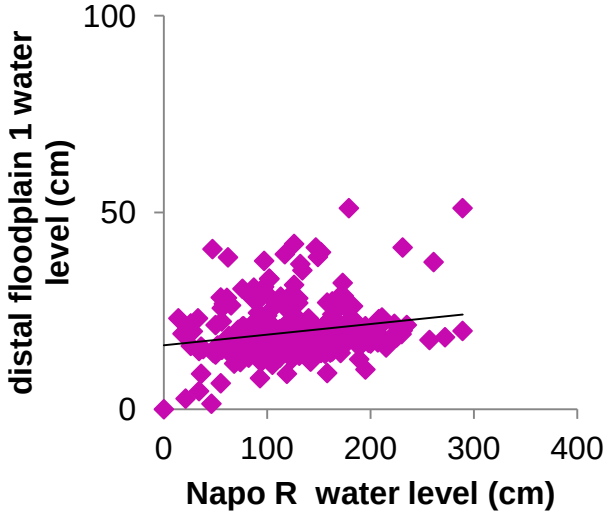


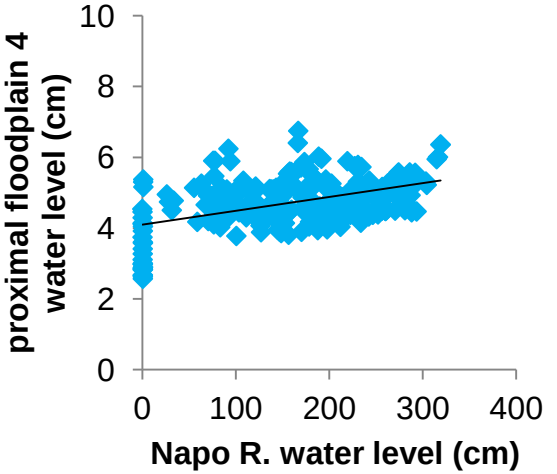




But often it doesn't:



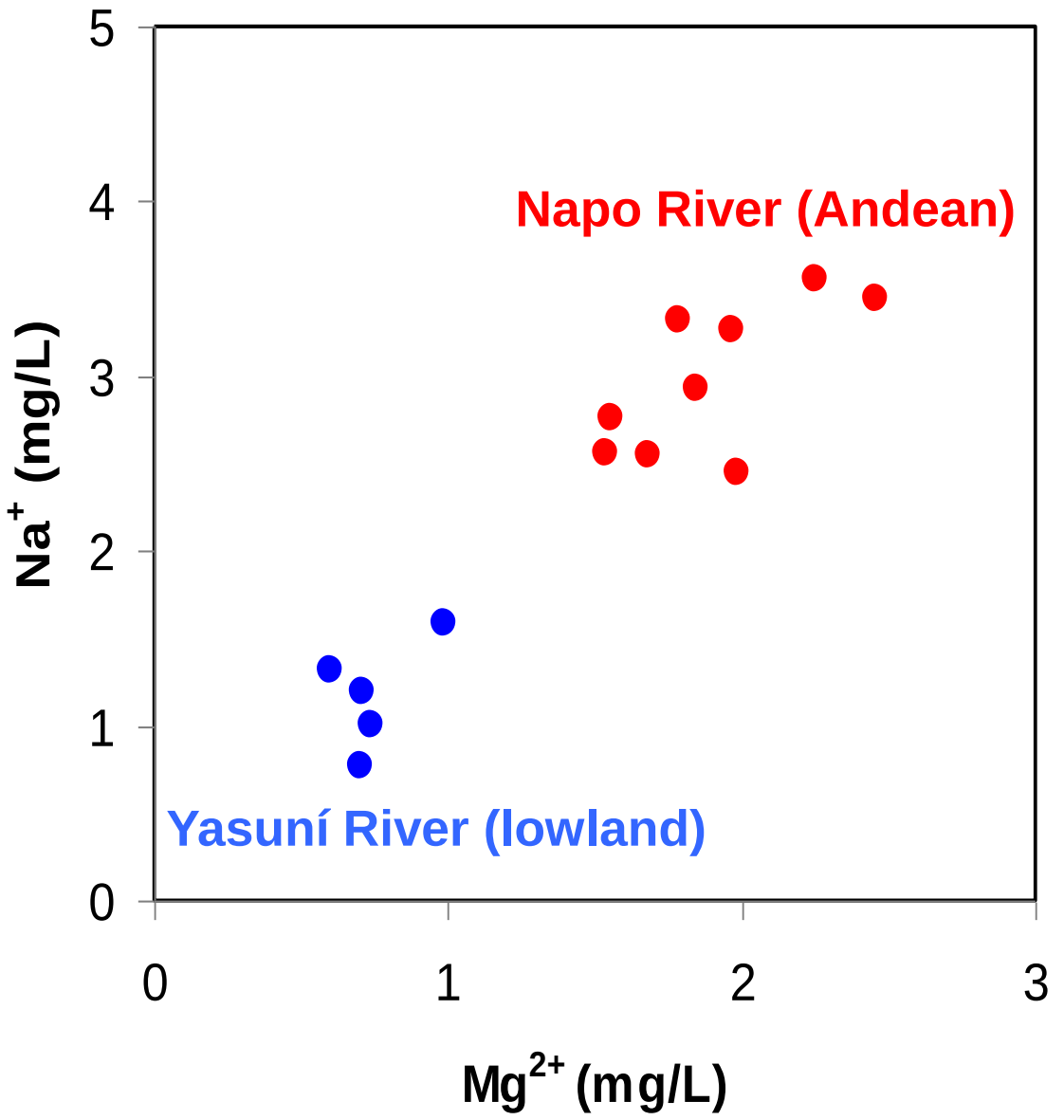




Caveat: only modest river floods occurred during the study

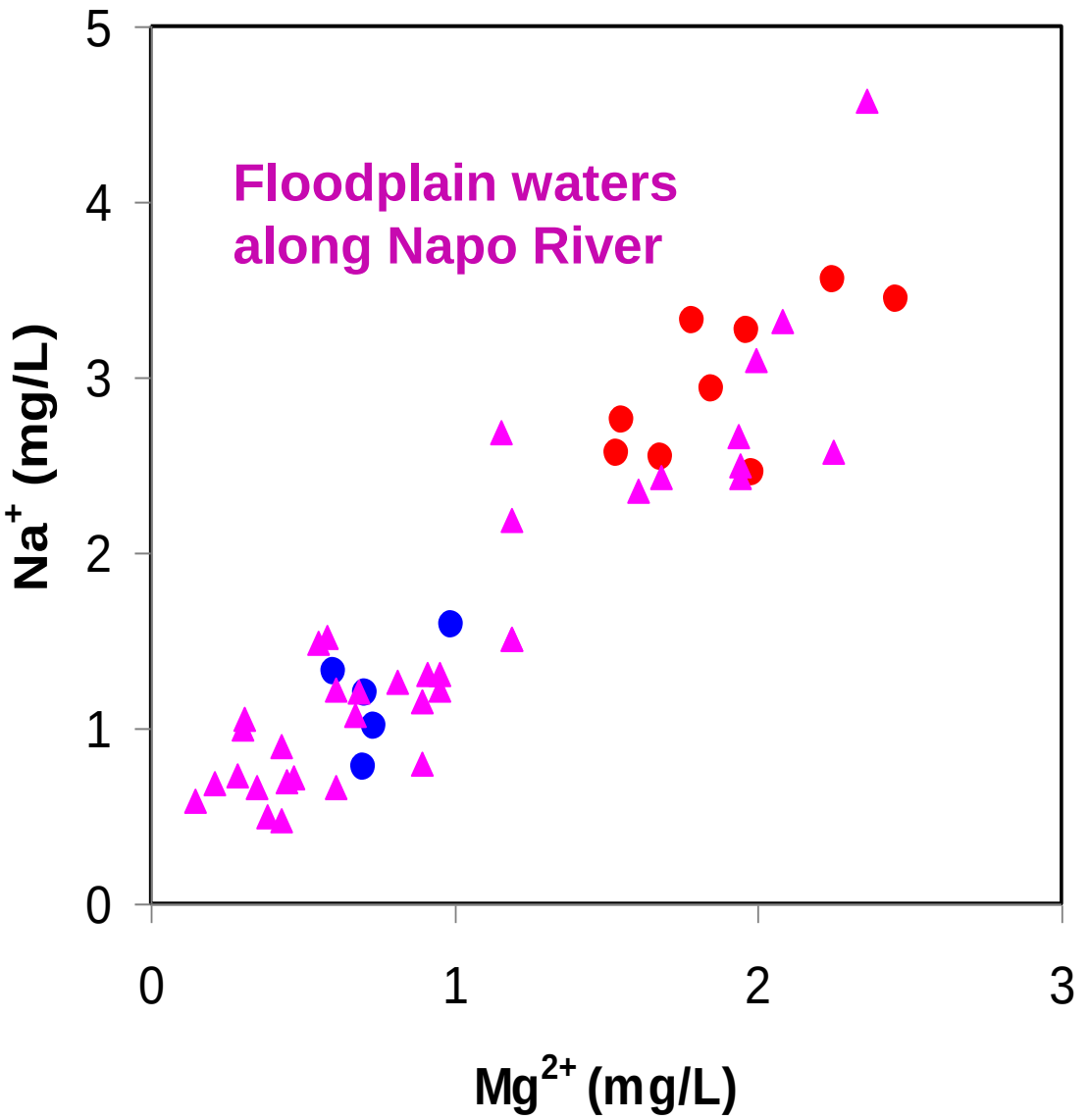
Sources of flood water

- Major ions as hydrological tracers
- Na^+ and Mg^{2+} highest in Andean rivers
- Lowland waters are more dilute in ions although similar in proportions

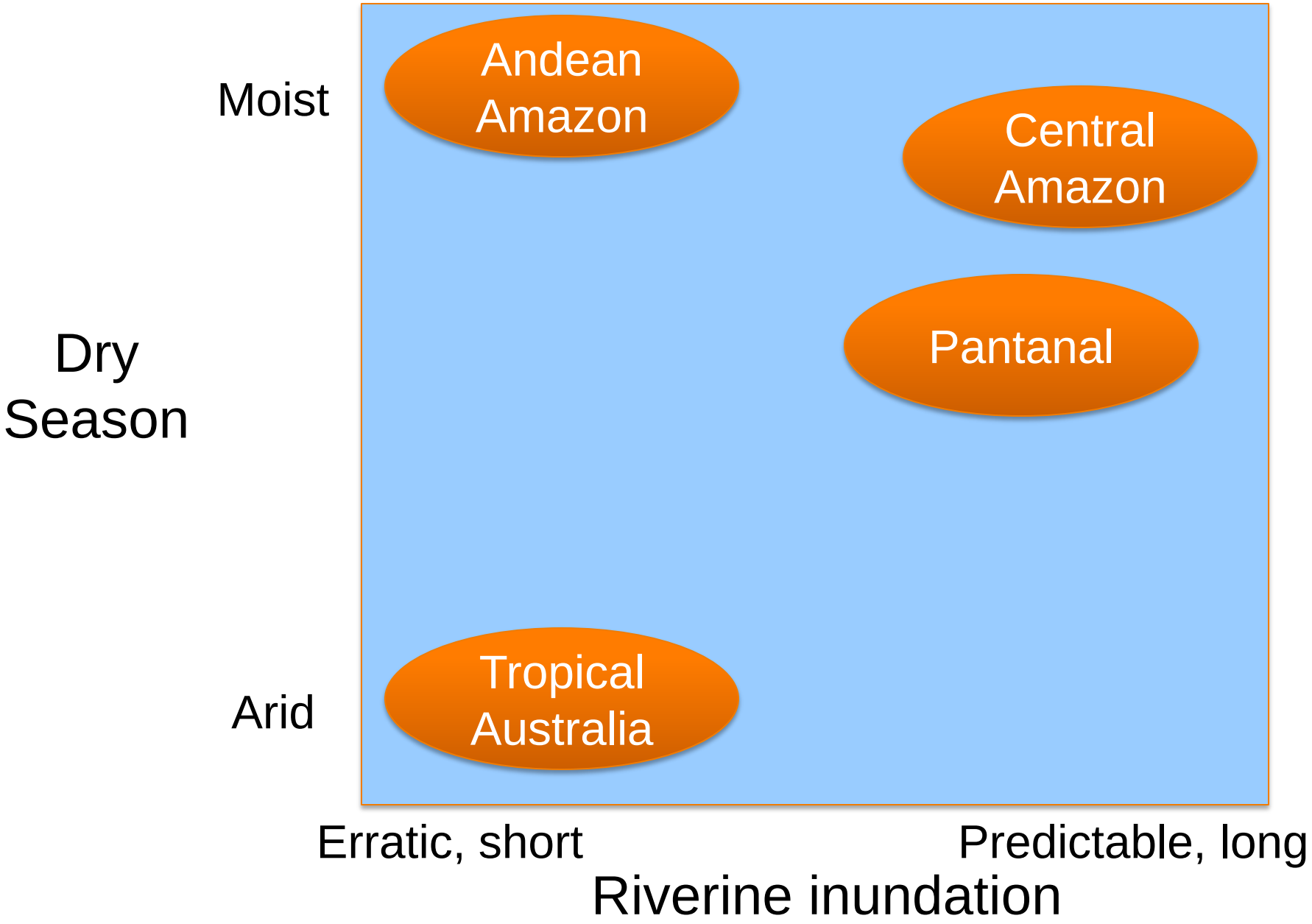


Sources of flood water

- Floodplain waters span the range from river water to local water
- Most are dominated by local water
- Diversity of water sources may increase floodplain biodiversity



Floodplain Hydrological Regimes Compared



Ecological implications: Do erratic floods matter?

Ecological phenomenon	Central Amazon	Andean Amazon
Aquatic macrophyte growth and coverage	Abundant	Sparse
Fish life cycles tied to flood pulse	Closely	Unknown – perhaps less?
Flooding resets vegetation succession	Sometimes	Often (channel migration)
Flooding as a filter for terrestrial biota	Severe	Lower
Dry season stress on aquatic biota	Modest	Lower
River-floodplain exchange of organic matter, nutrients	High	Modest

Acknowledgements

- Field assistants and local guides.
- Local communities and organizations
- Napo Wildlife Center & Sani Lodge
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