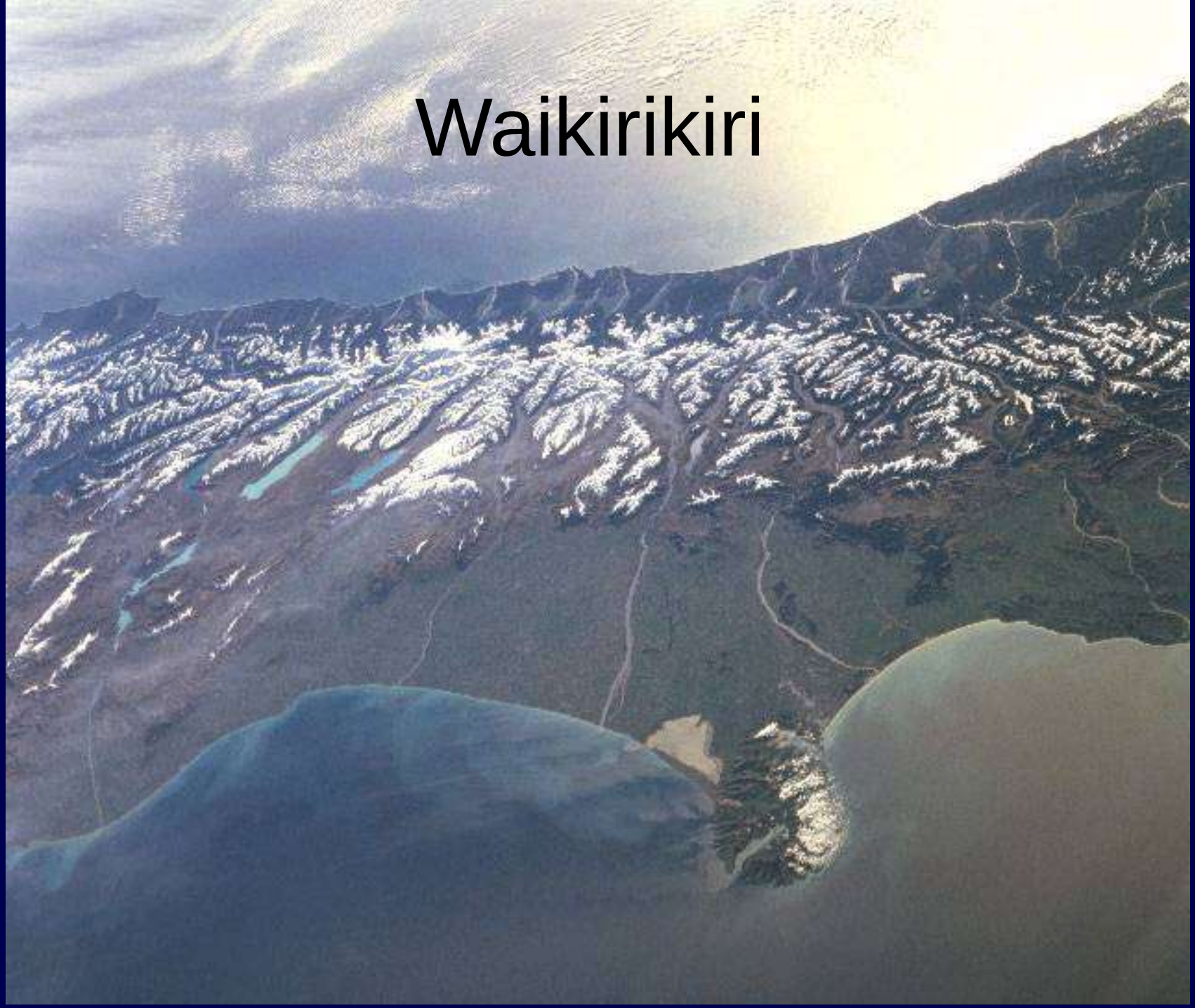
The Selwyn River/Waikirikiri

Living Lake Symposium

Scott Larned &
NIWA research team

NIWA
Taihoro Nukurangi


Waikirikiri


Waikirikiri

Overarching question:
What are the ecological effects of flow variability?

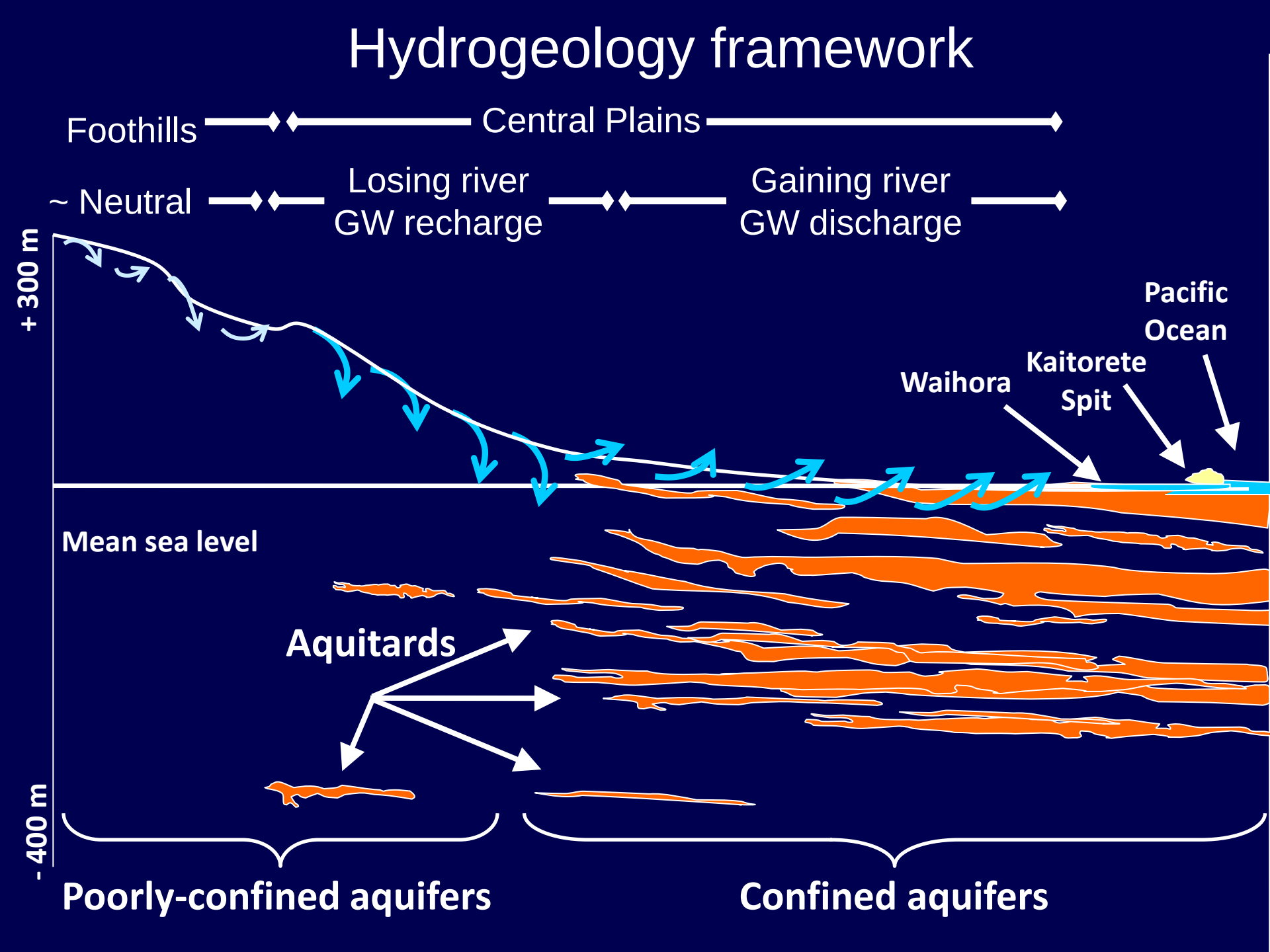
Flow variability:

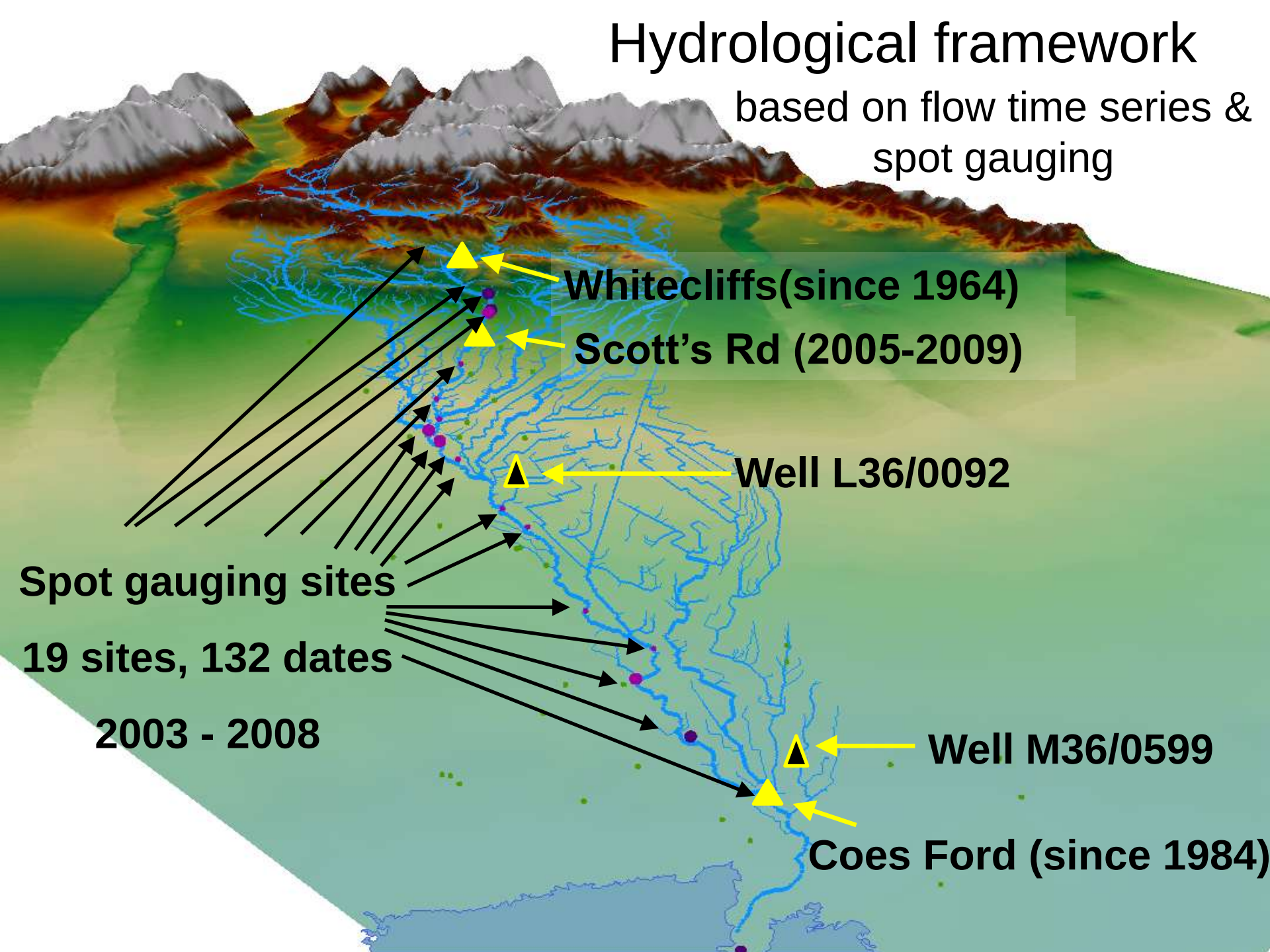
- Intermittence
- Mid-range flow pulses
- Longitudinal flow variability
- Bed-moving floods
- Groundwater-surface exchange
- Connection & disconnection
- Historical trends
- Variable aquifer & runoff input

Complex hydrology:

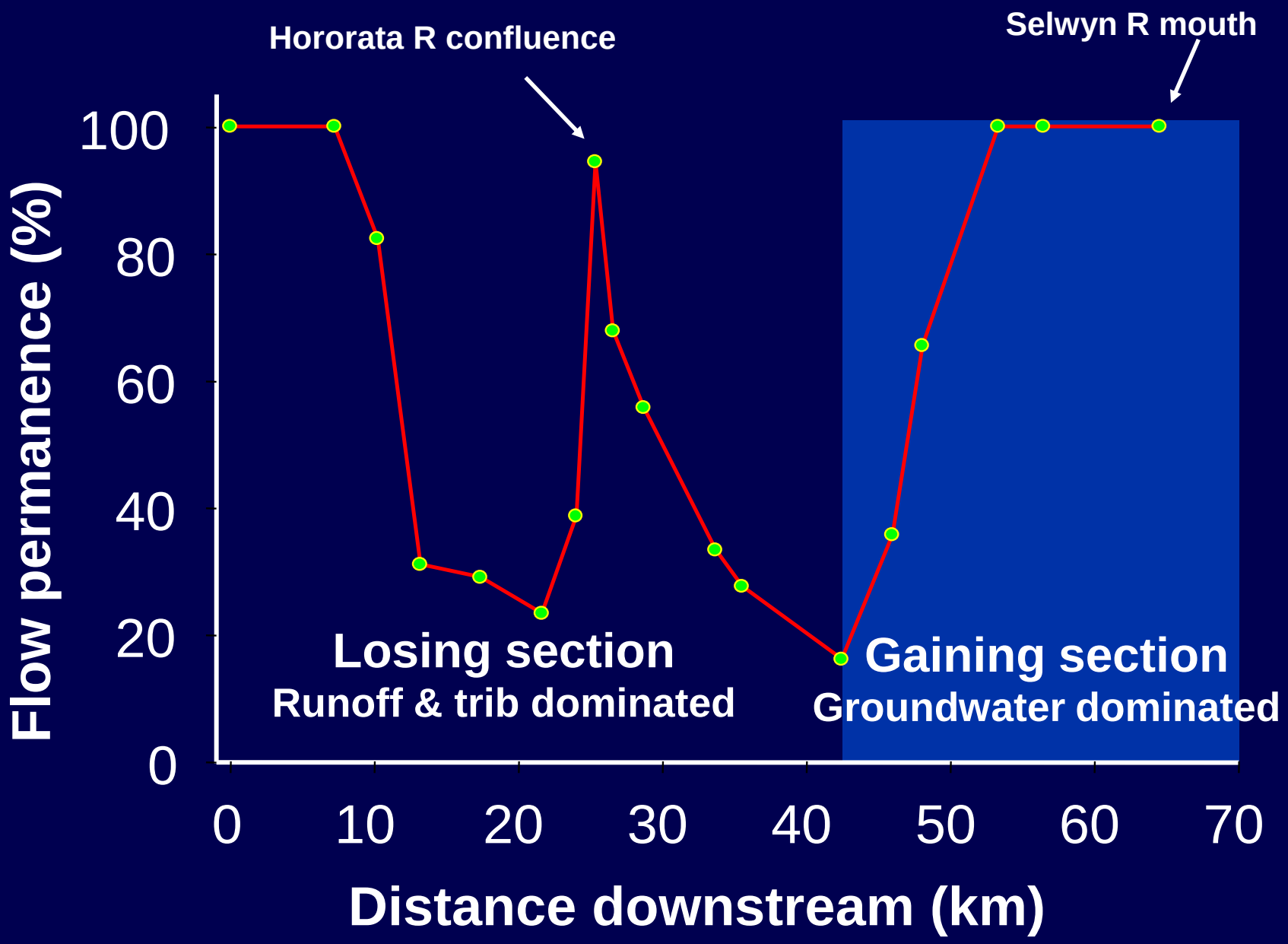
- Perennial, intermittent, ephemeral reaches
- Run-off dominated, groundwater-dominated reaches
- Floods & droughts
- Effects of long-term water use

Hydrogeology framework

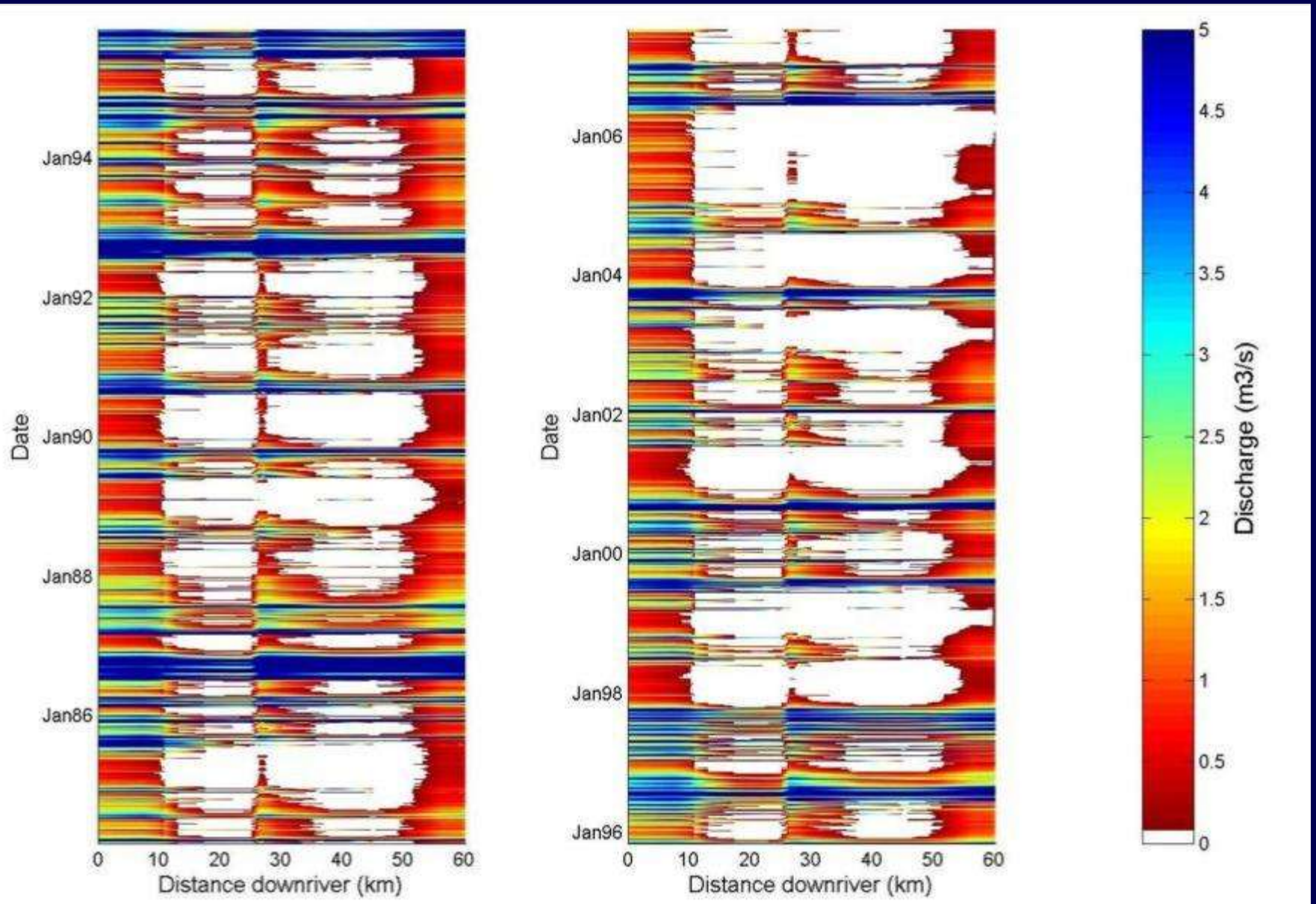



Hydrological framework
based on flow time series & spot gauging
Whitecliffs(since 1964)
Scott's Rd (2005-2009)
Well L36/0092
Spot gauging sites
19 sites, 132 dates
2003 - 2008
Well M36/0599
Coes Ford (since 1984)

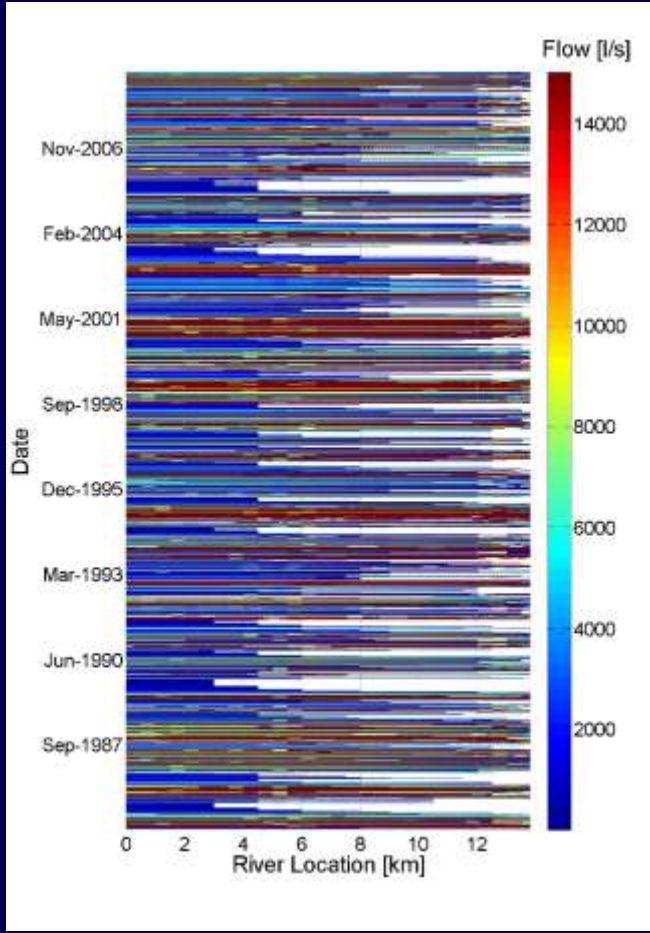
Flow permanence



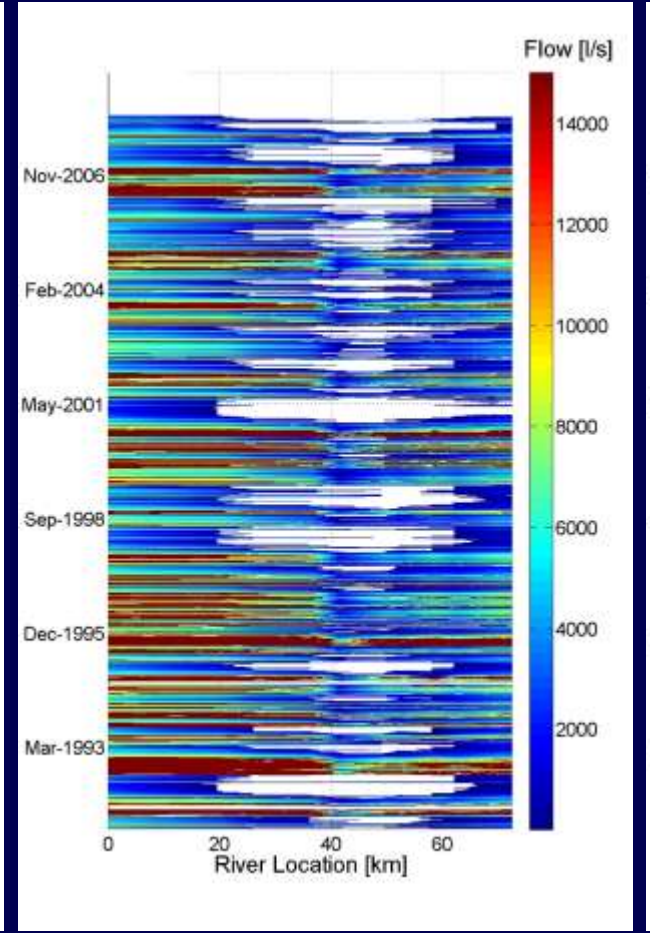
Hydrological framework – ELFMOD



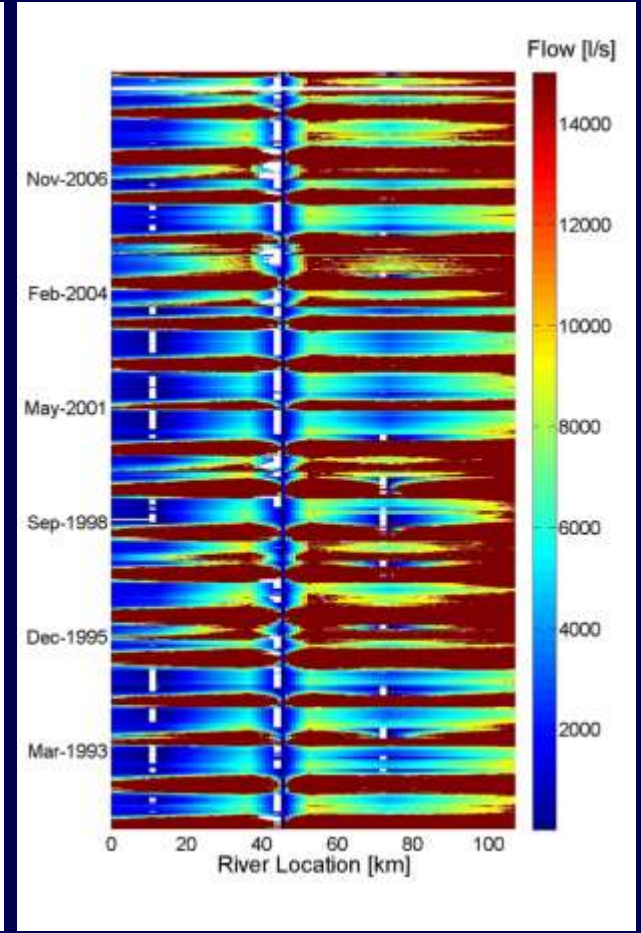
ELFMOD for predicting flow time series at all points on rivers



Albarine River, France

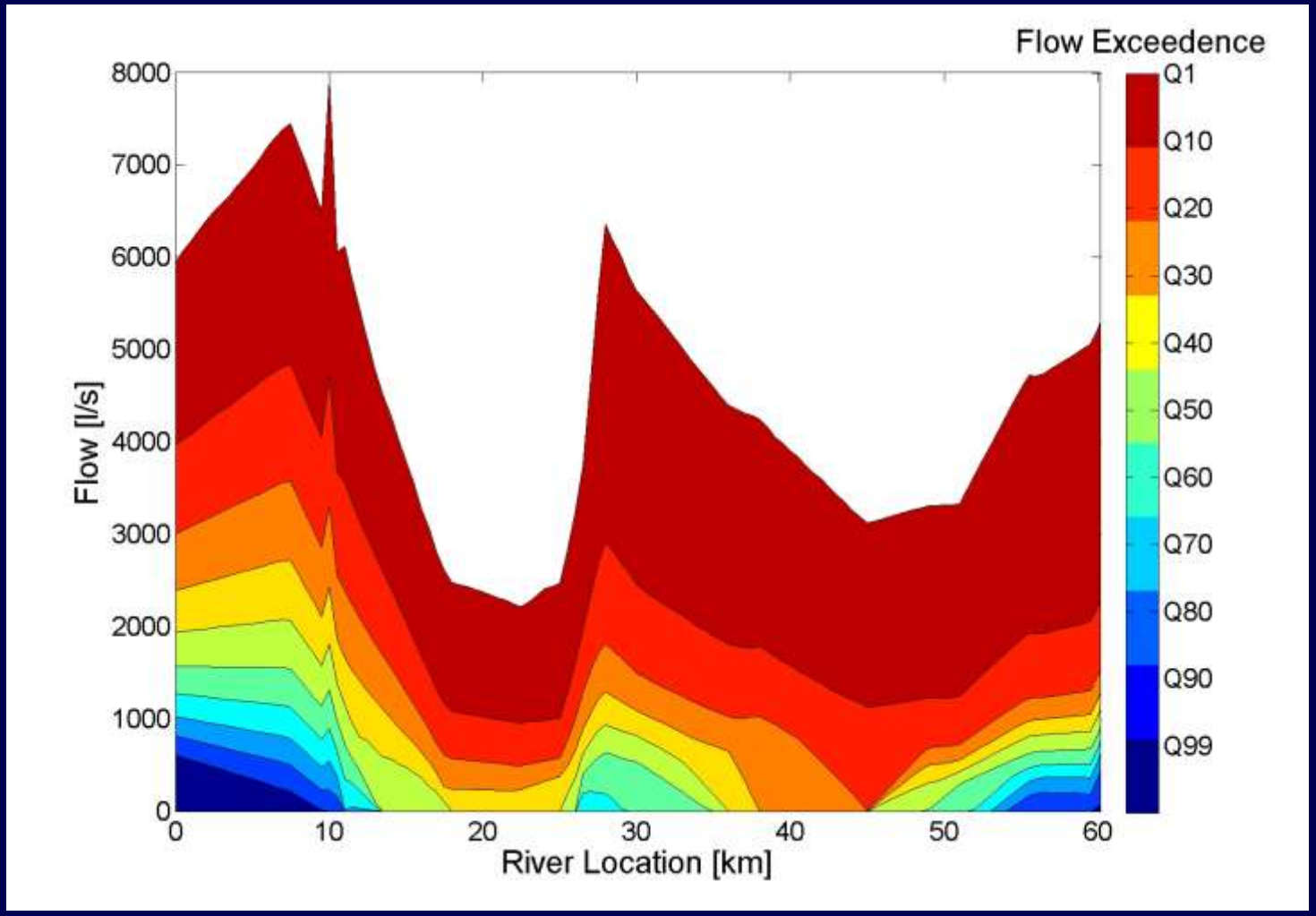


Orari River, New Zealand



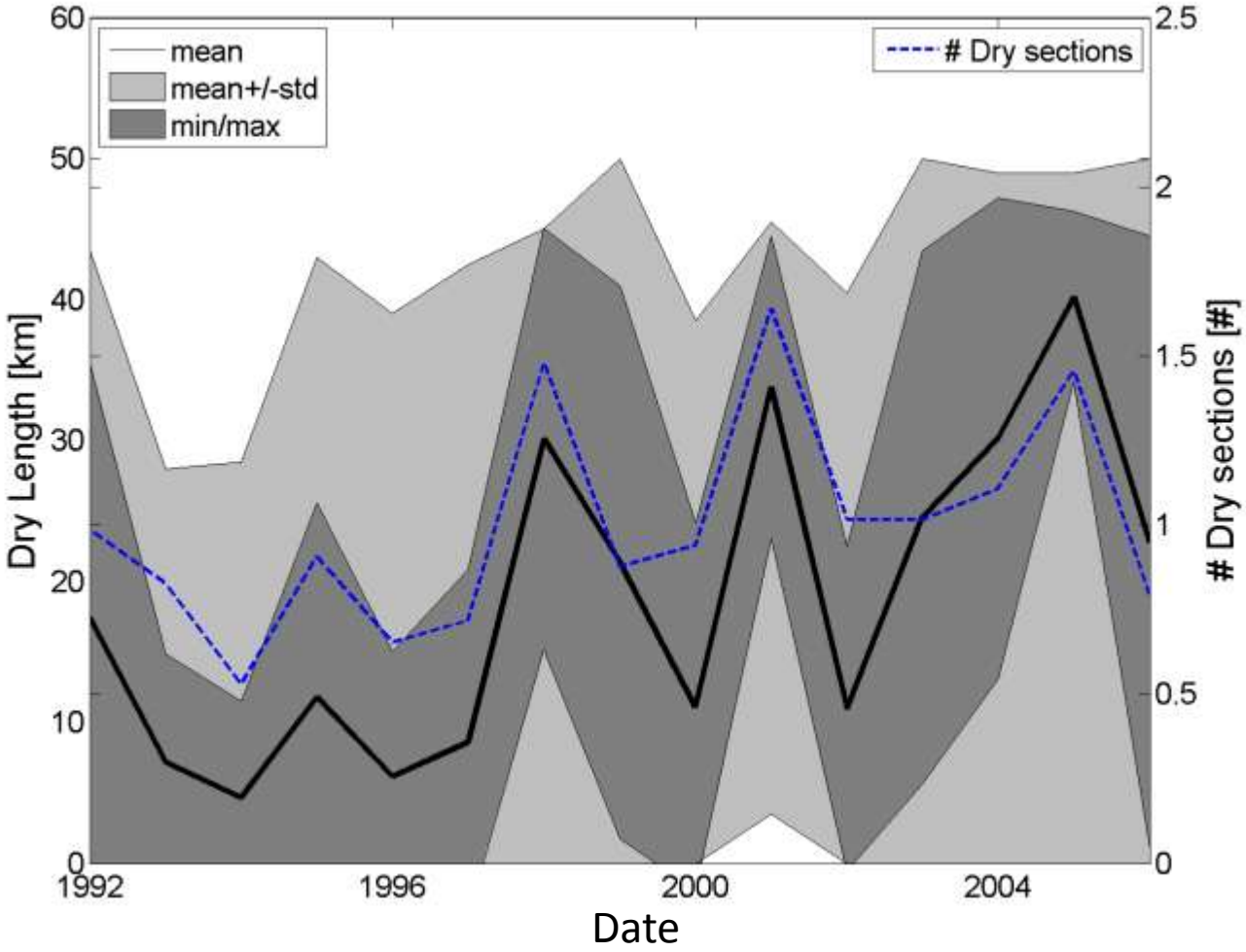
Methow River, USA

ELFMOD



Longitudinal flow frequency profile

Longitudinal flow variability



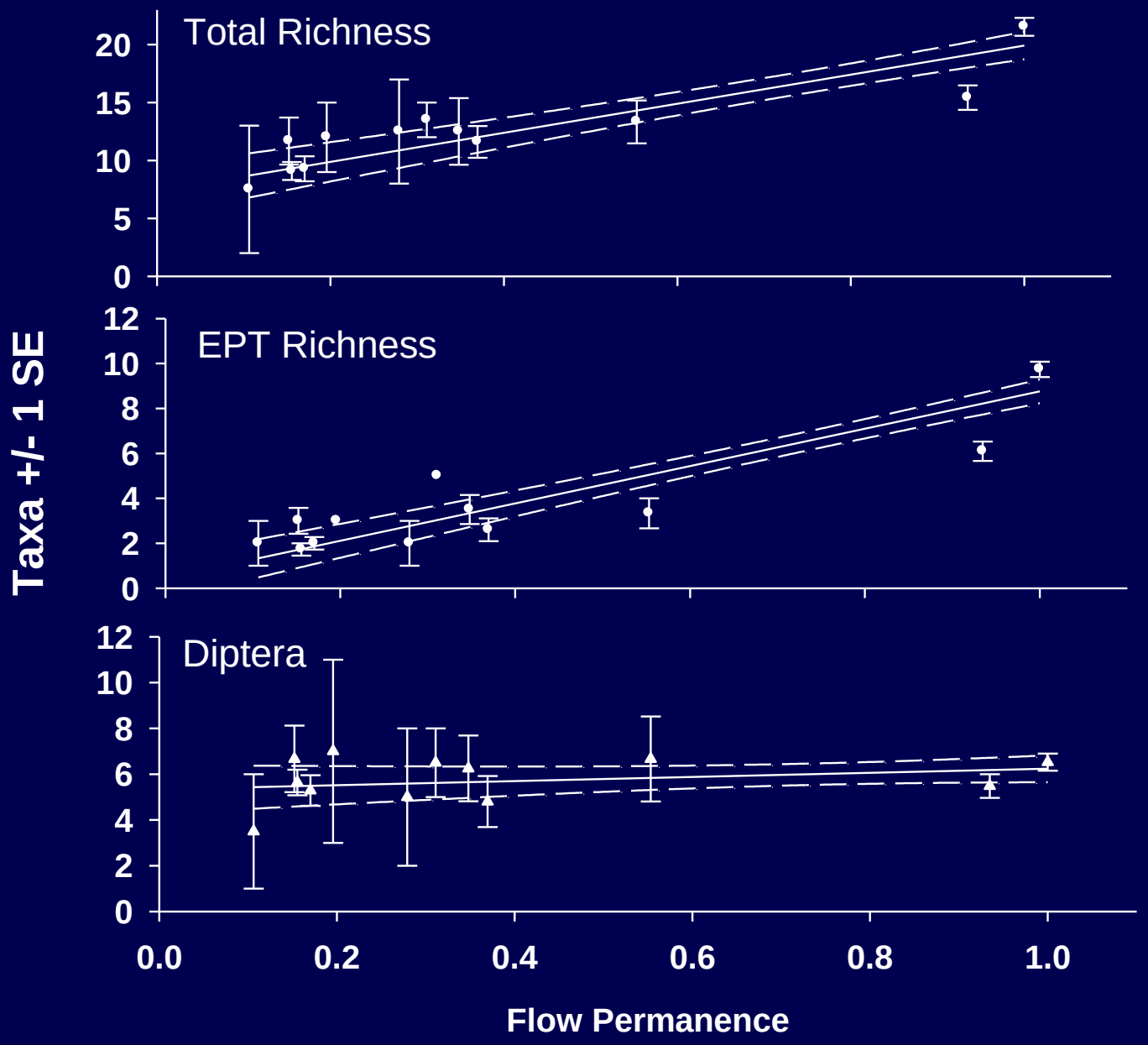
Temporal variation in intermittence

Flow-ecology relationships: hydrological variables

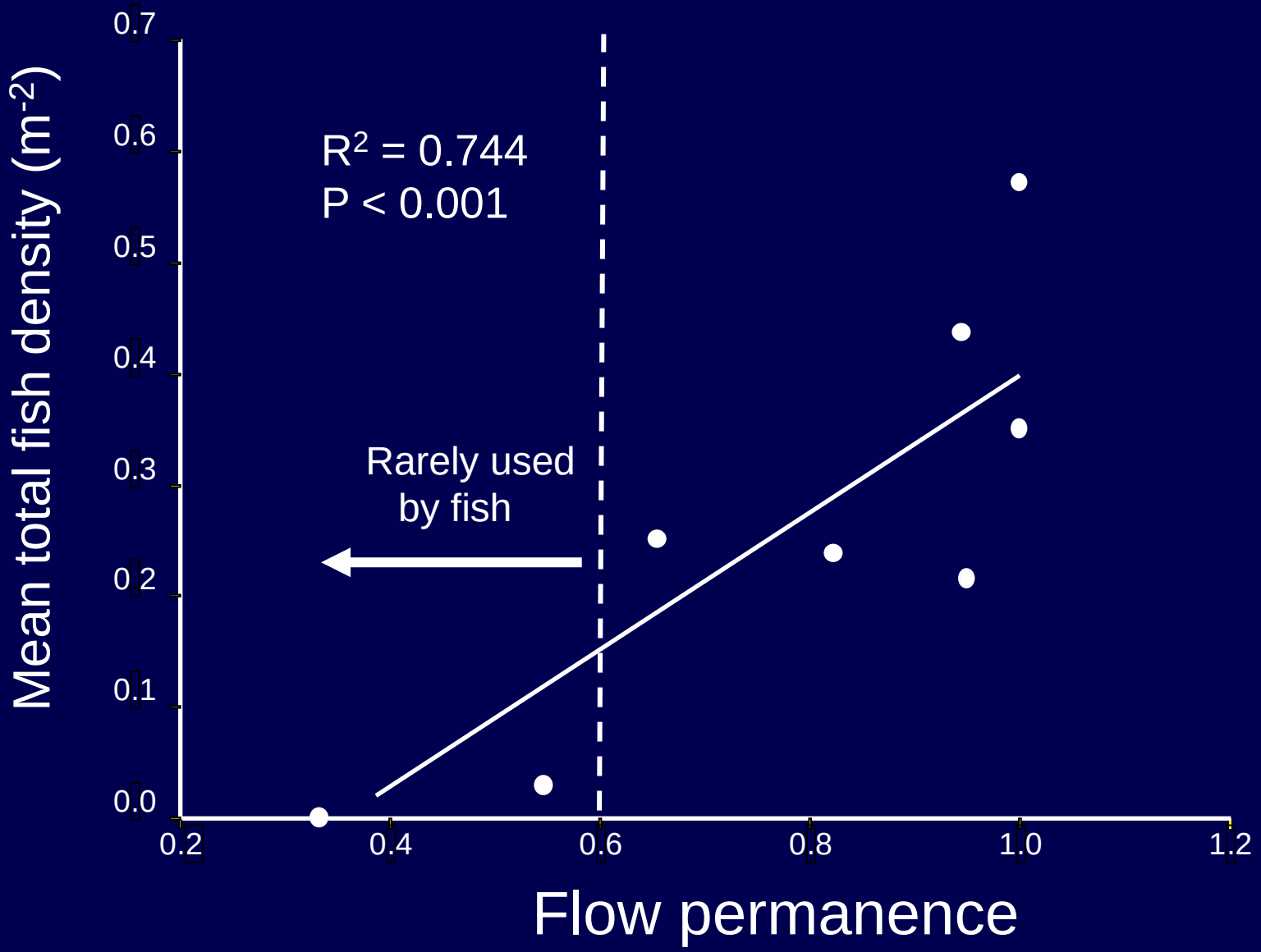
- Flow & flow state at any point (m^3 s^{-1})
- Long-term flow permanence at any point (%)
- Distance to flowing reach or perennial reach (km)
- Rate of flow loss or gain (m^3 s^{-1} km^{-1})
- Hydroperiod at any point (d)
- Historical trends in intermittence
  - Temporal, e.g., trends in hydroperiod (d)
  - Spatial, e.g., trends in dry length (d)
- Predicted onset of intermittence in perennial rivers
- Standard hydro statistics & flow duration curves for any point (e.g., MALF-7, FRE-3)

Flow-ecology relationships: ecological variables

Flow ecology relationships



Flow - ecology relationships



Flow-ecology relationships (a sample)

Hydrological variable	Ecological response	Reference
Dry duration (d)	Aquatic invertebrate richness	Larned et al. 2007.
Dry duration (d)	Aquatic invertebrate density	Aq Sci 69: 554.
Dry duration (d)	Sediment respiration	
Dry duration (d)	Esterase activity	
Flow permanence (%)	Hyporheic invertebrate density	Datry et al. 2007.
Flow permanence (%)	Hyporheic taxon richness	Freshwat Bio 52:1452.
Flow permanence (%)	% Hypogean taxa	
Flow duration (d)	Fish species densities	Davey & Kelly 2007.
Flow permanence (%)	Fish species richness	Freshwat Bio 52:1719.
Flow permanence (%)	Total fish density	
Dry reach length (m)	N & P retention	Datry & Larned 2008
Flow rate (m^3s^{-1})	N & P retention	CJFAS 65:1532.
Flow duration (d)	Aquatic invertebrate richness	Arscott et al. 2010
Flow duration (d)	Aquatic invertebrate density	JNABS 29:530
Flow permanence (%)	Aquatic invertebrate richness	
Flow permanence (%)	Aquatic invertebrate density	

Surface-groundwater interactions

Surface-subsurface interactions

- Roles of shallow groundwater systems in water purification and other ecosystem services

- Effects of river flow and river management on groundwater ecosystems and their services

- Flow requirements for groundwater ecosystems and their services

Experimental river ecology

Nutrient additions to experimental gravel bars

Experimental river ecology

Invertebrate & fish responses to river drying

For more information

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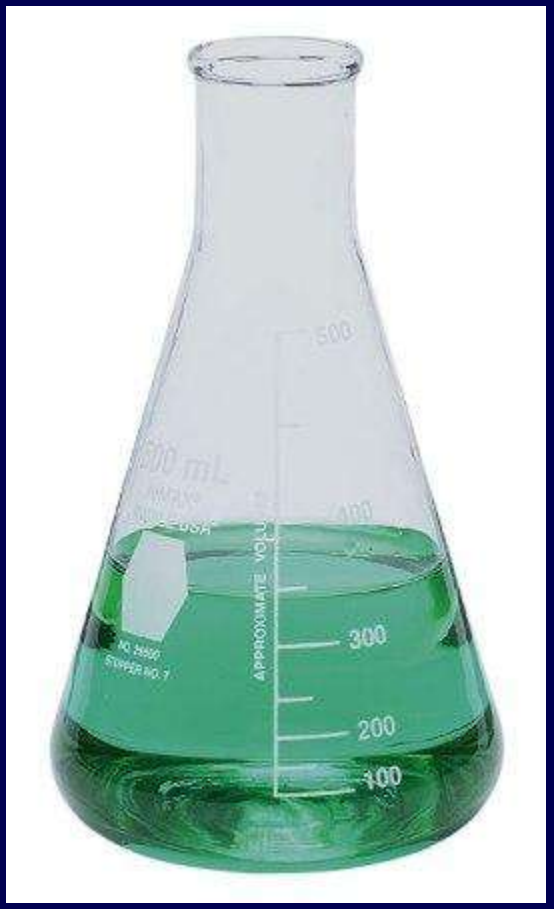
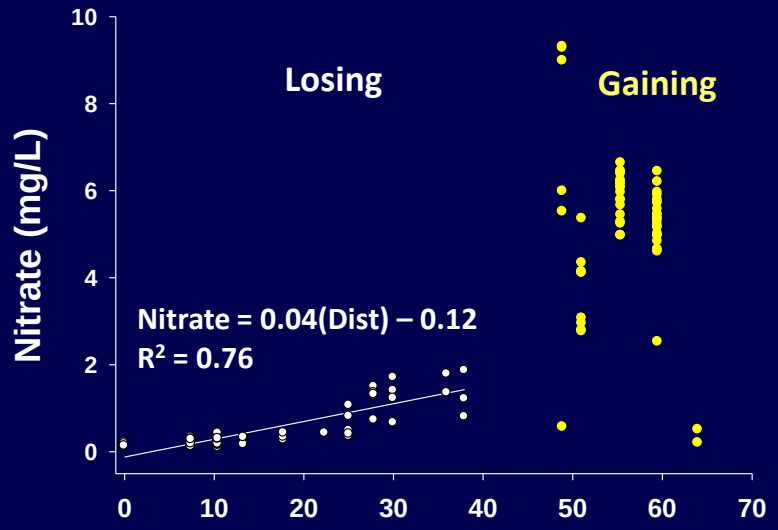
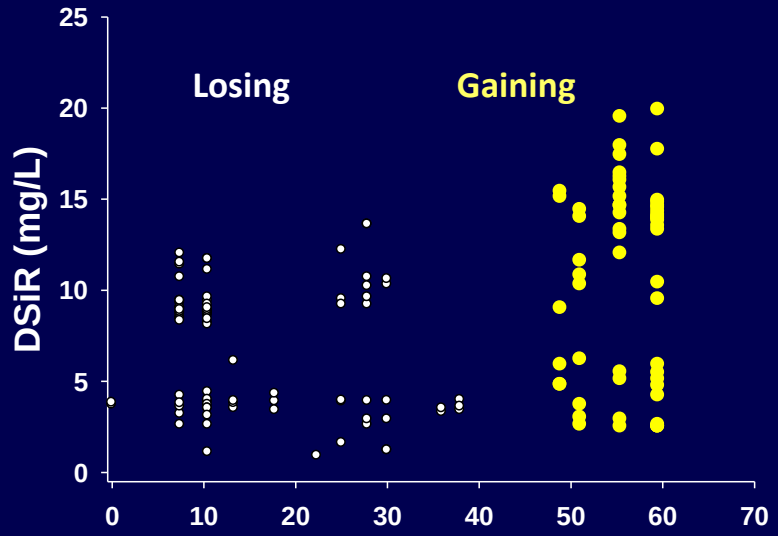
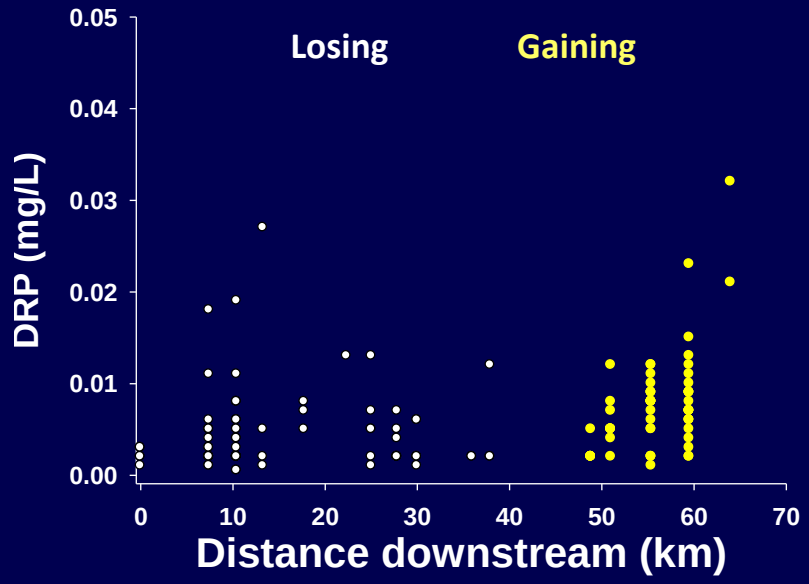
Water quality & periphyton

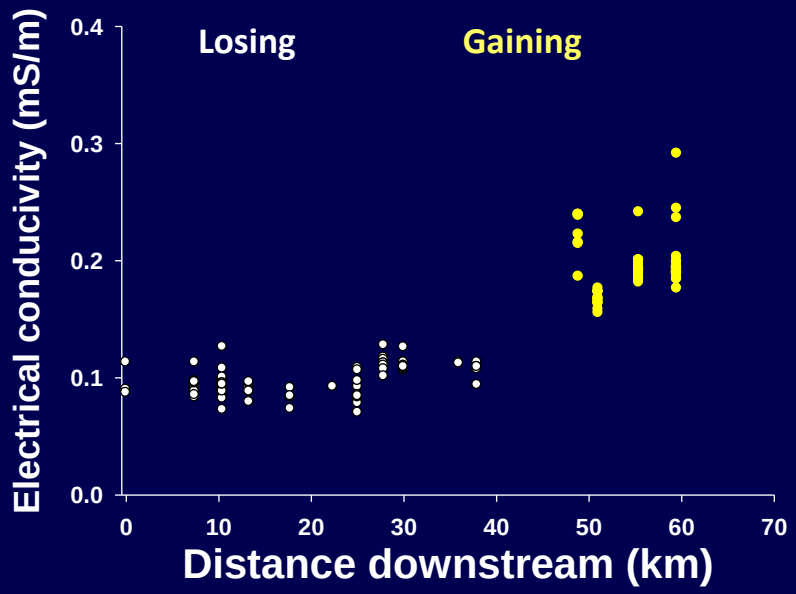


Water quality changes with distance downstream

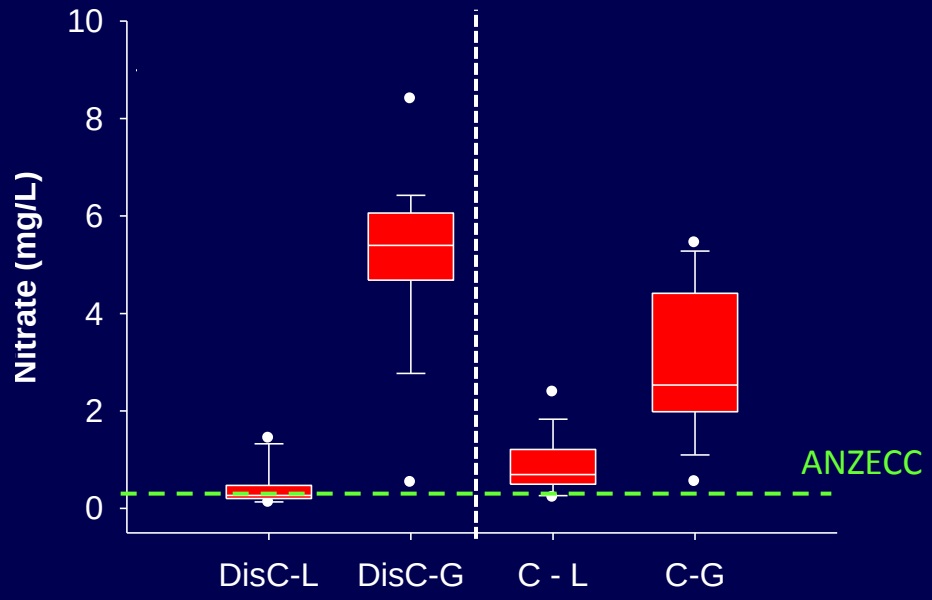


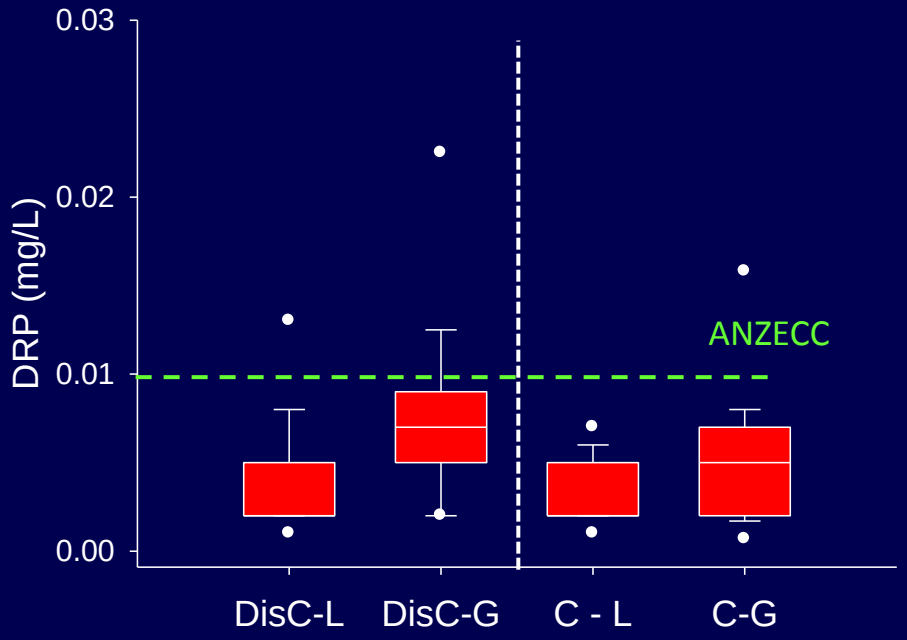






Differences betw. Selwyn sections & flow states



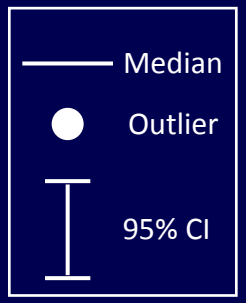


DisC-L = disconnected, losing (u/s)

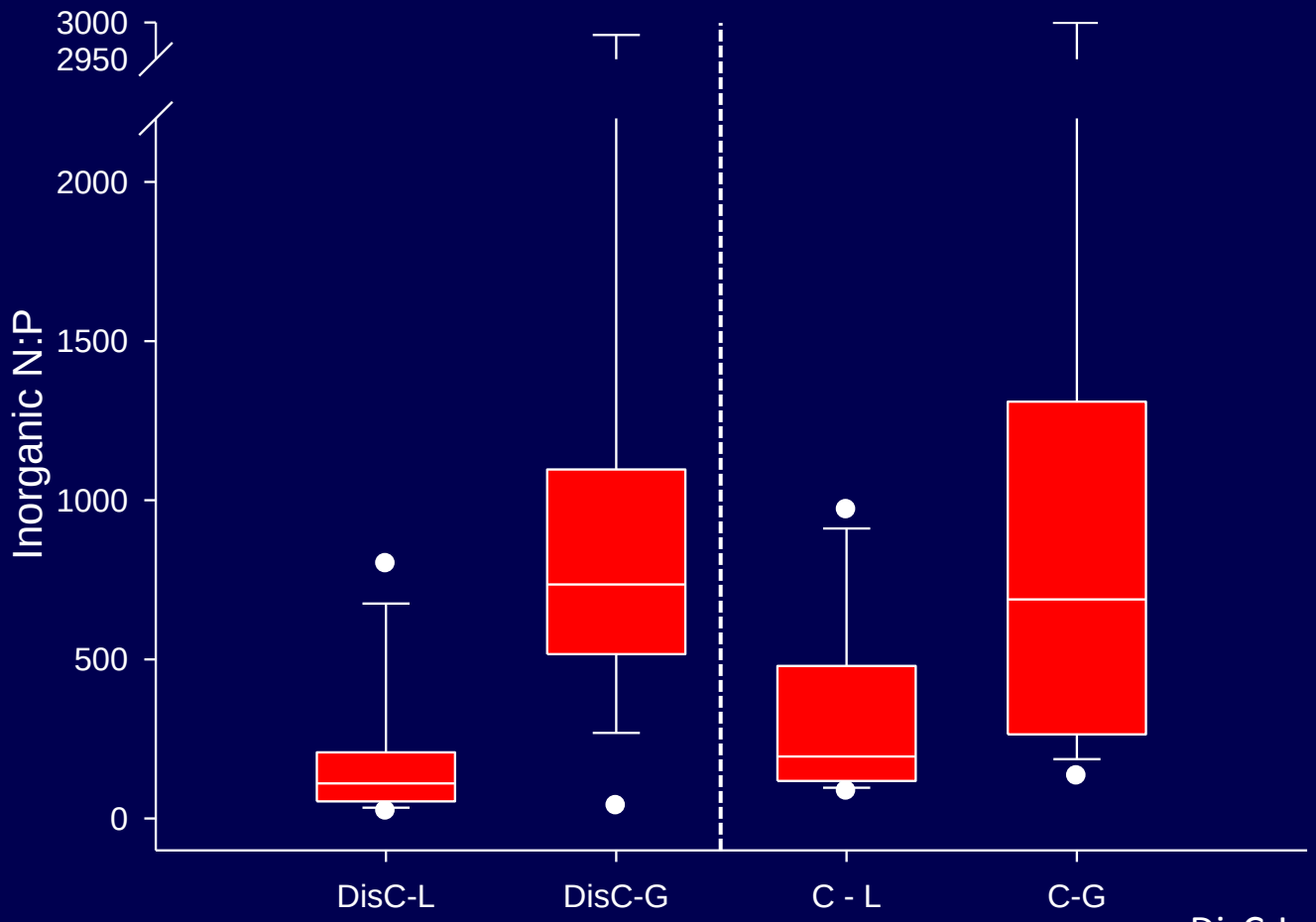
DisC-G = disconnected, gaining (d/s)

C-L = connected, losing (u/s)

C-G = connected, gaining (d/s)



Differences betw. Selwyn sections & flow states



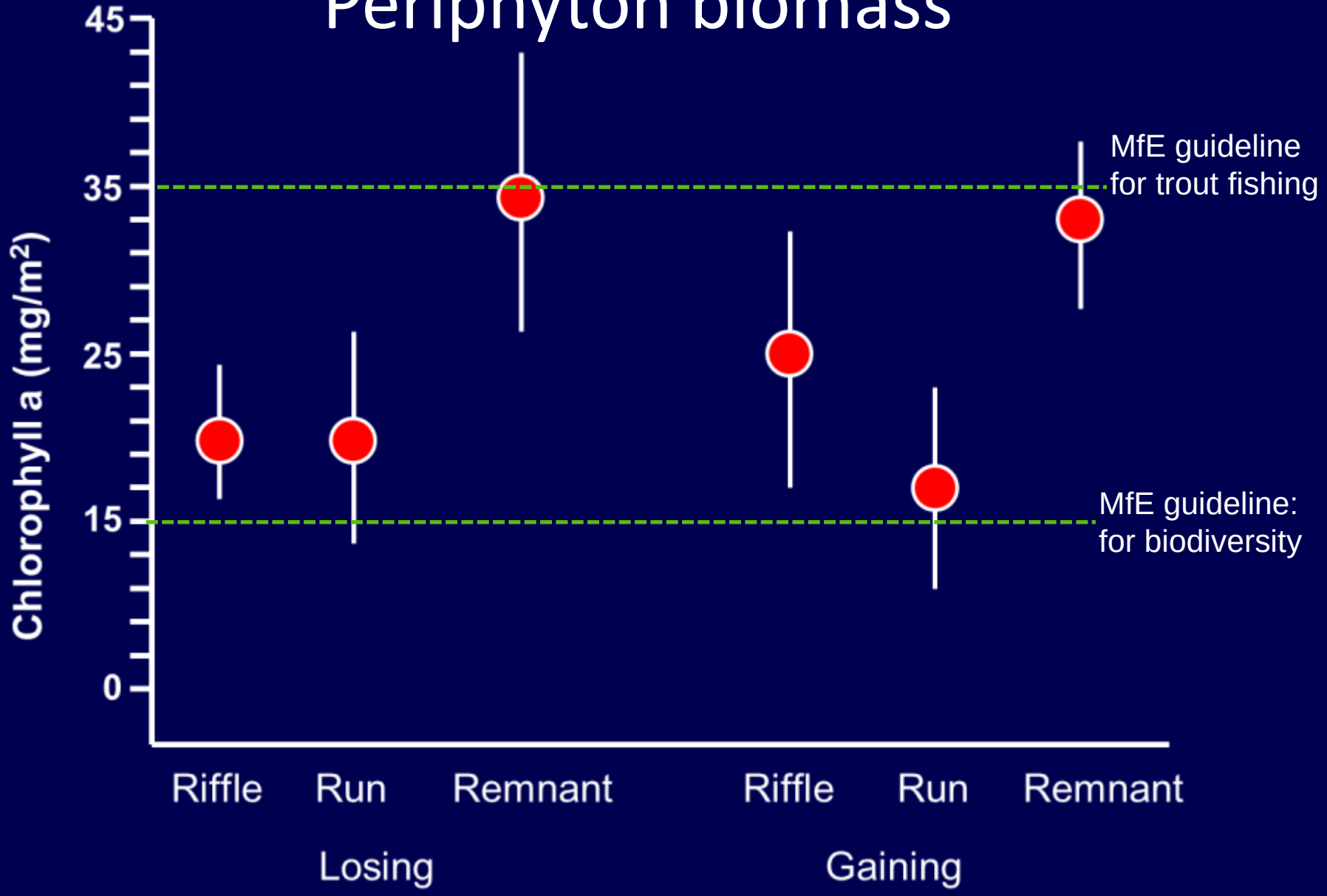
DisC-L = disconnected, losing (u/s)

DisC-G = disconnected, gaining (d/s)

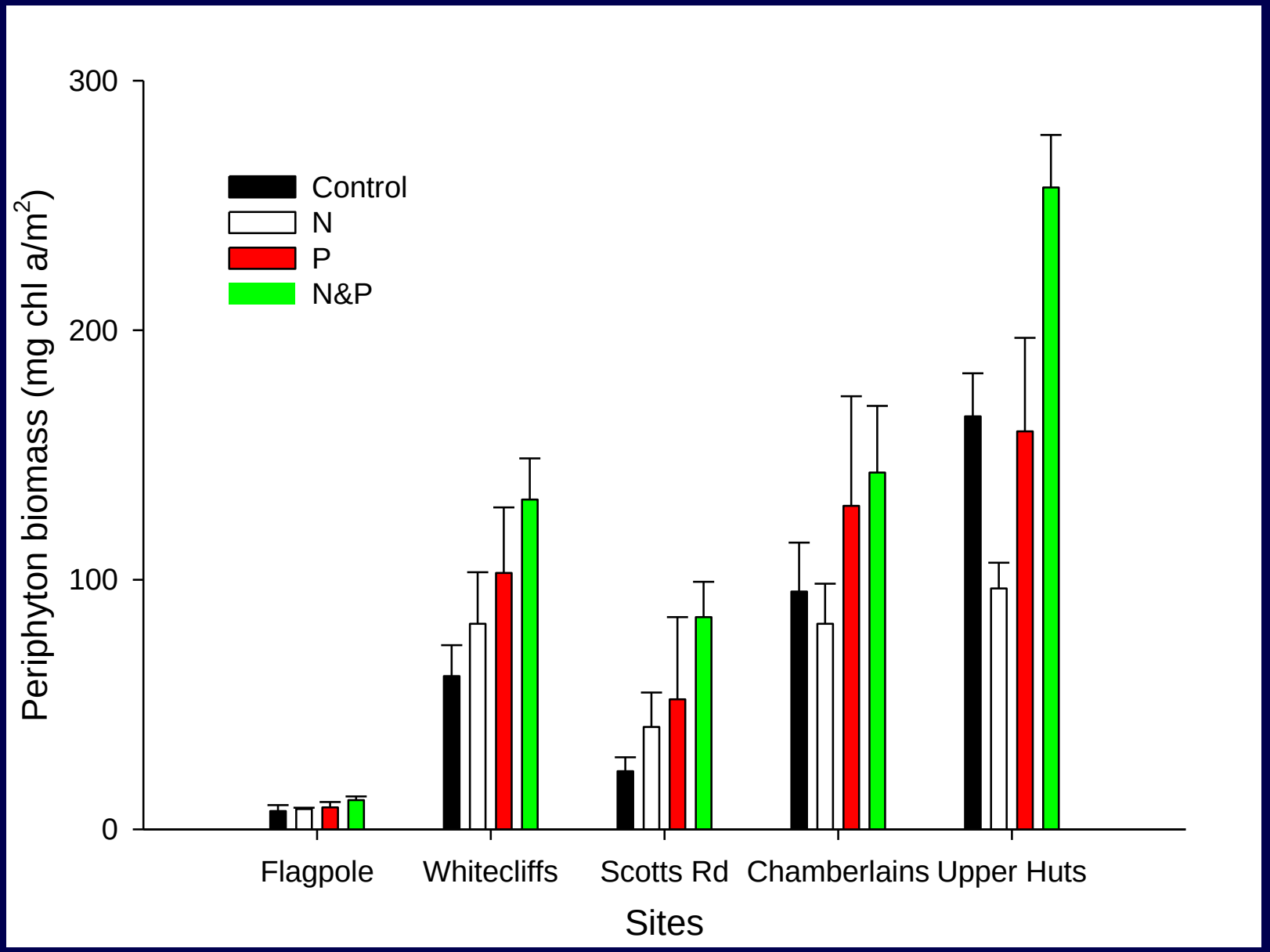
C-L = connected, losing (u/s)

C-G = connected, gaining (d/s)

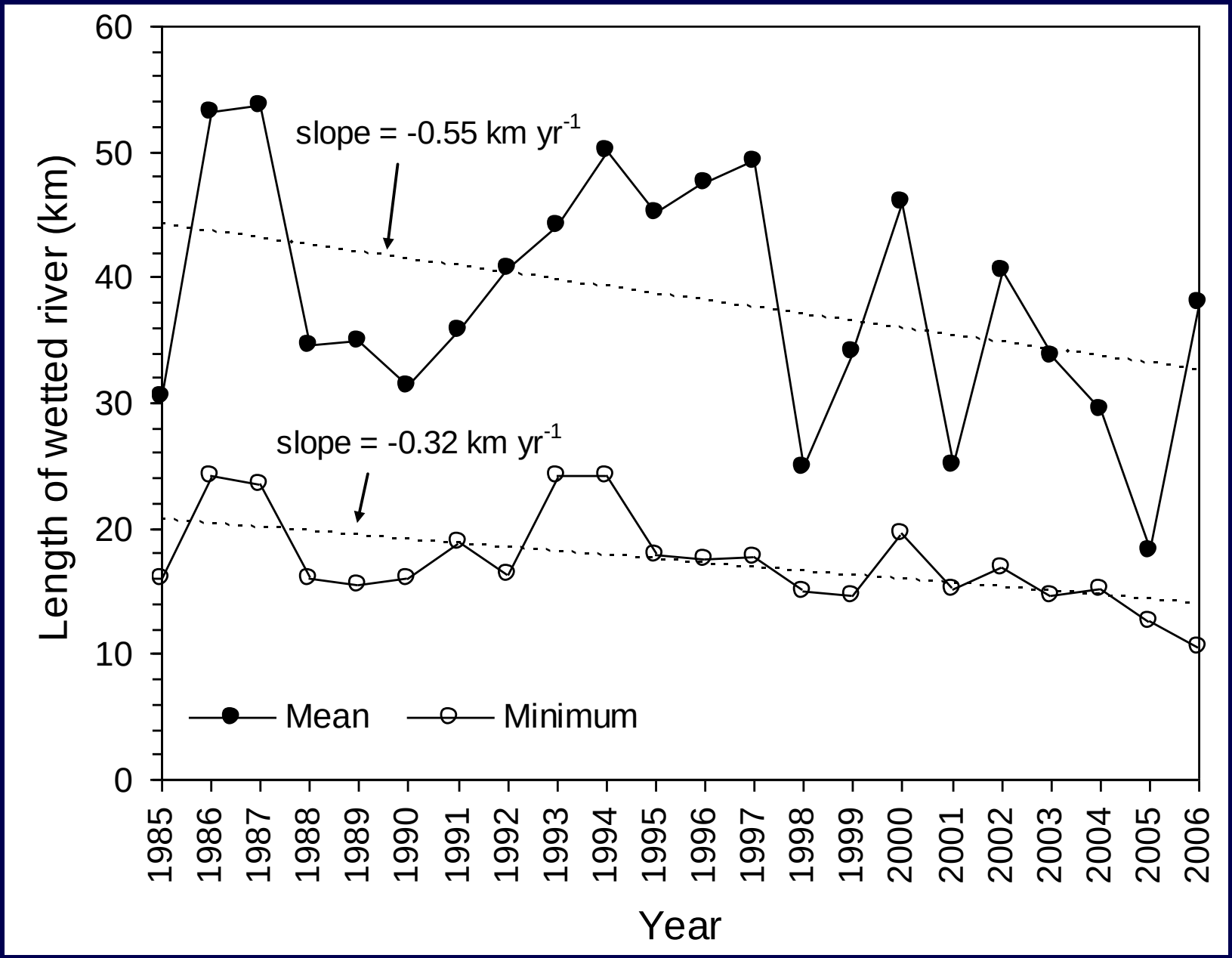
Periphyton biomass



Nutrient-limited periphyton



Intermittence trends



Experimental river ecology

Invertebrate dispersal and colonisation