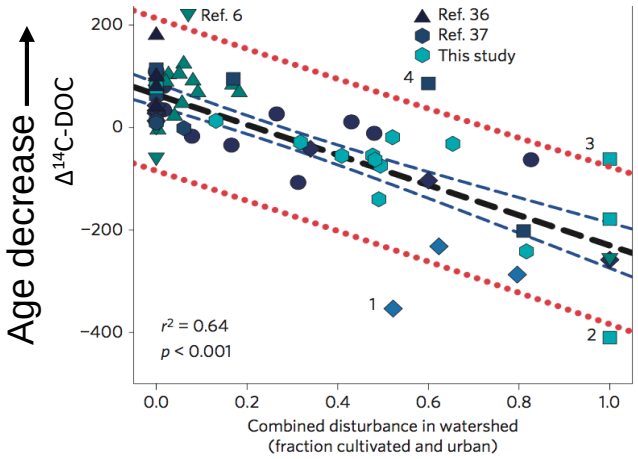
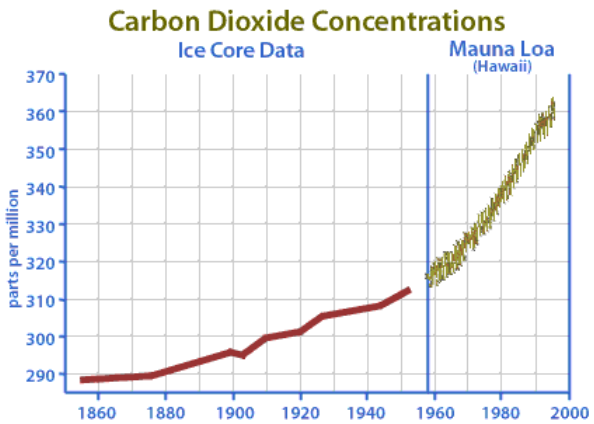
Rivers want to break free

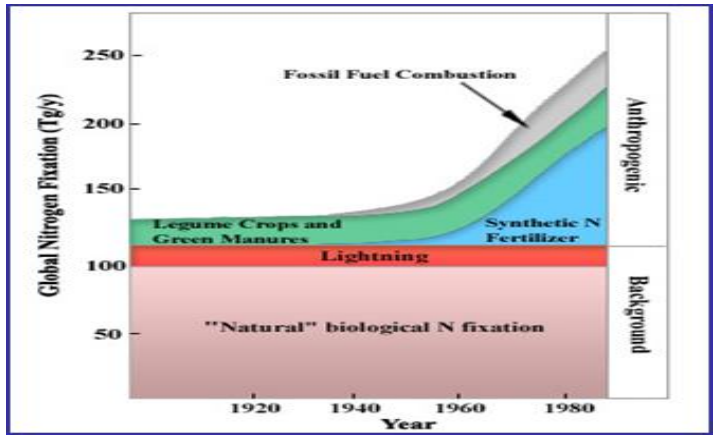
Vjosa River © *Gregory Egger*

Context: Human alteration of C,N,P cycles



Butman et al. 2014

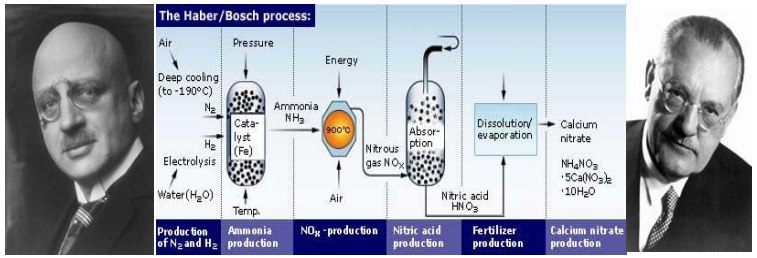


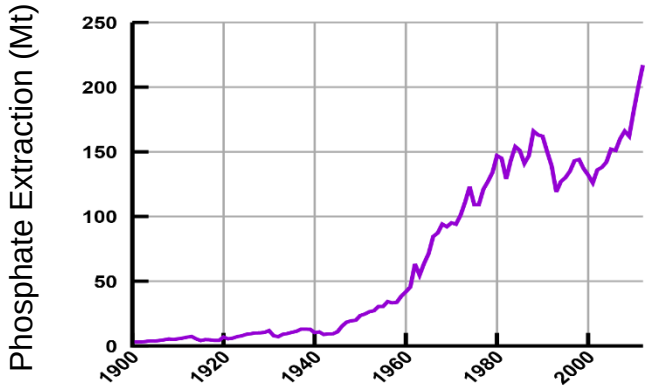


Vituosek et al. 1997

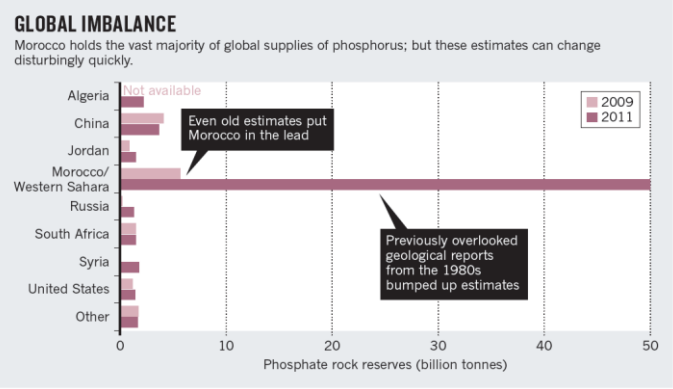
Fritz Haber

Carl Bosch



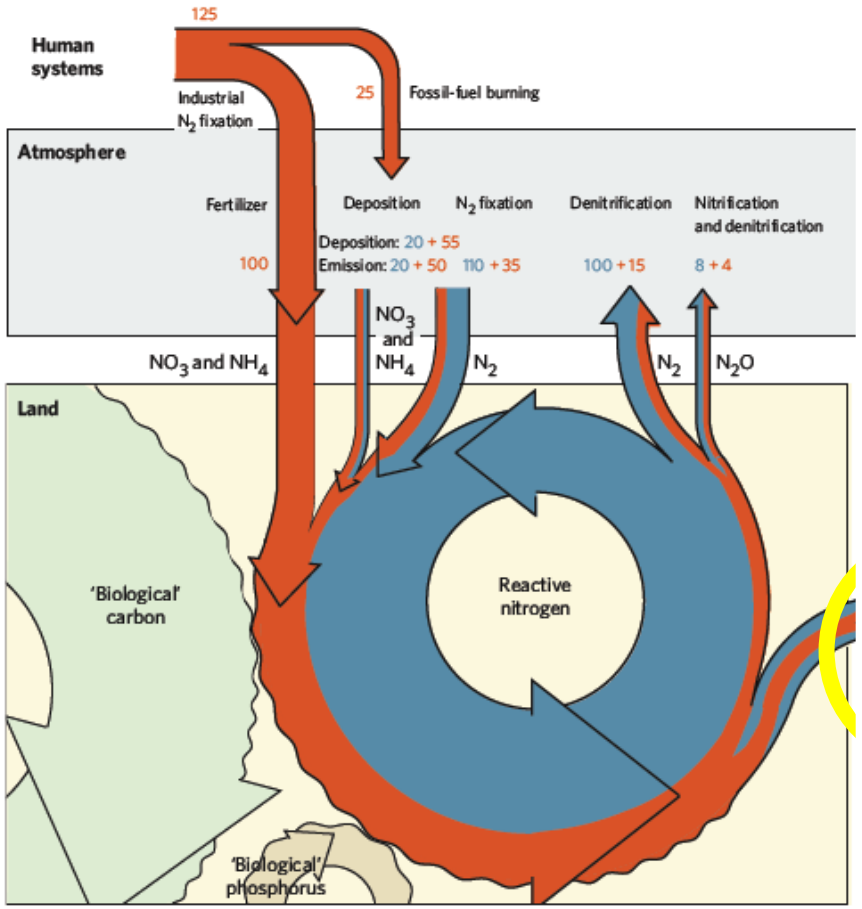


USGS 2015



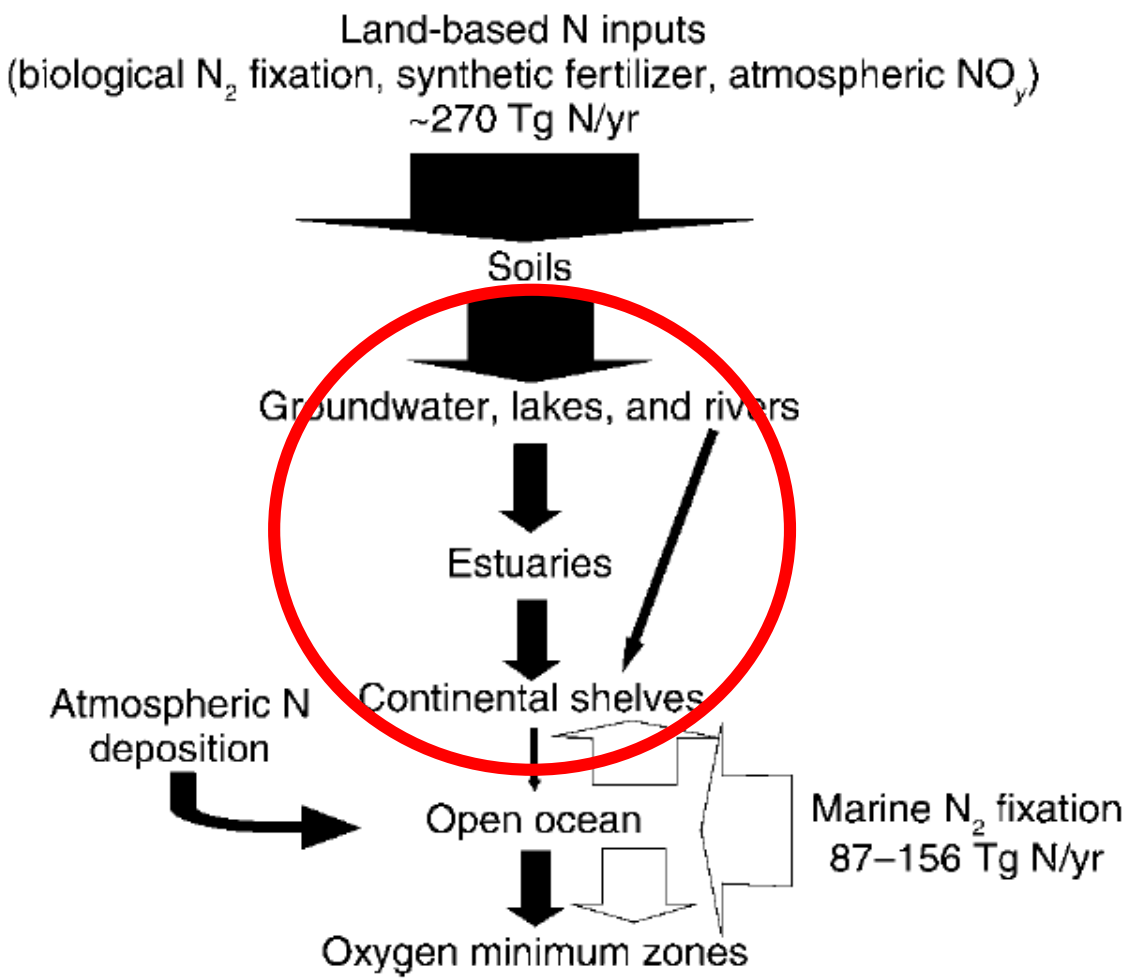
Elser and Bennett 2011

Consequences

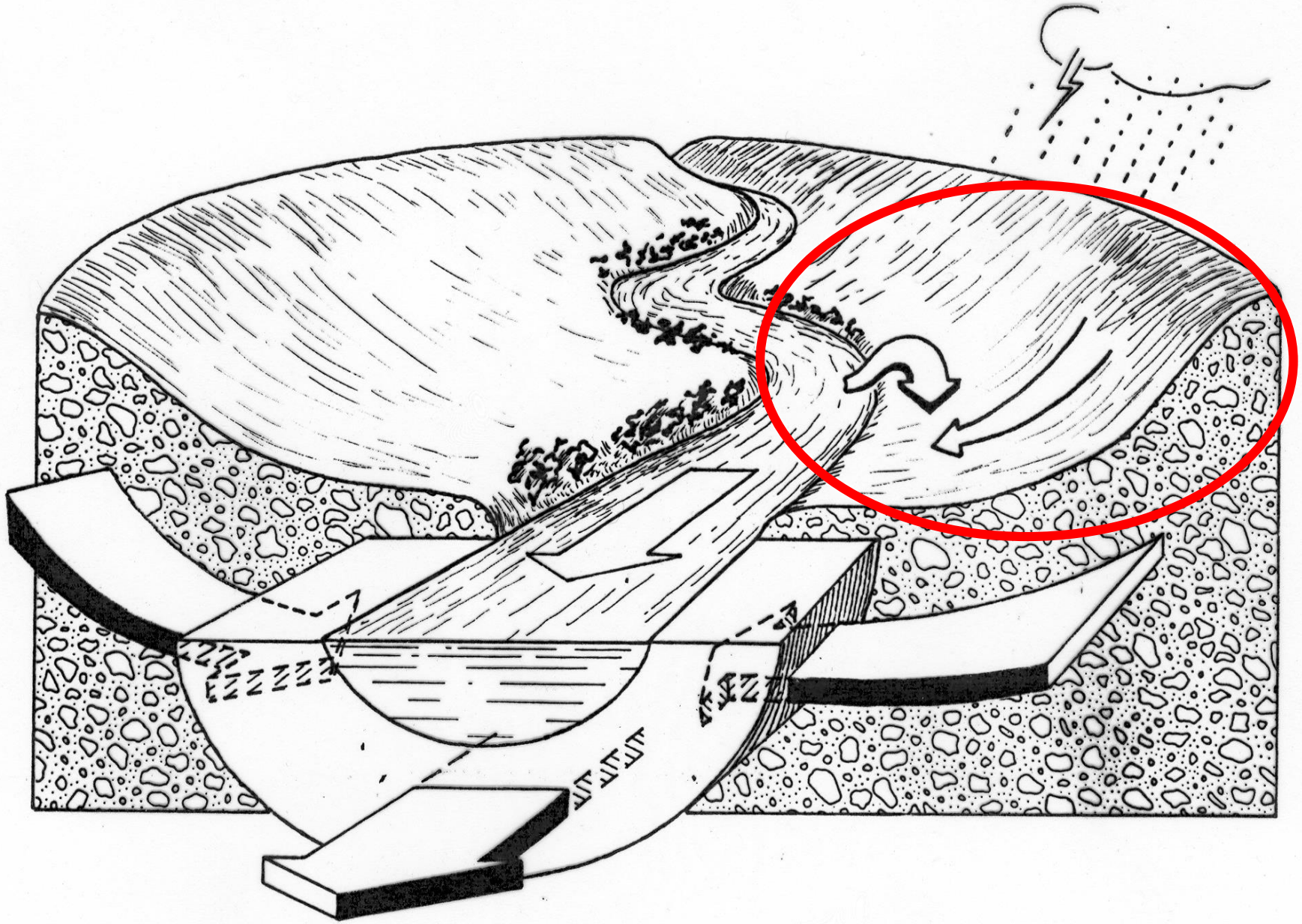


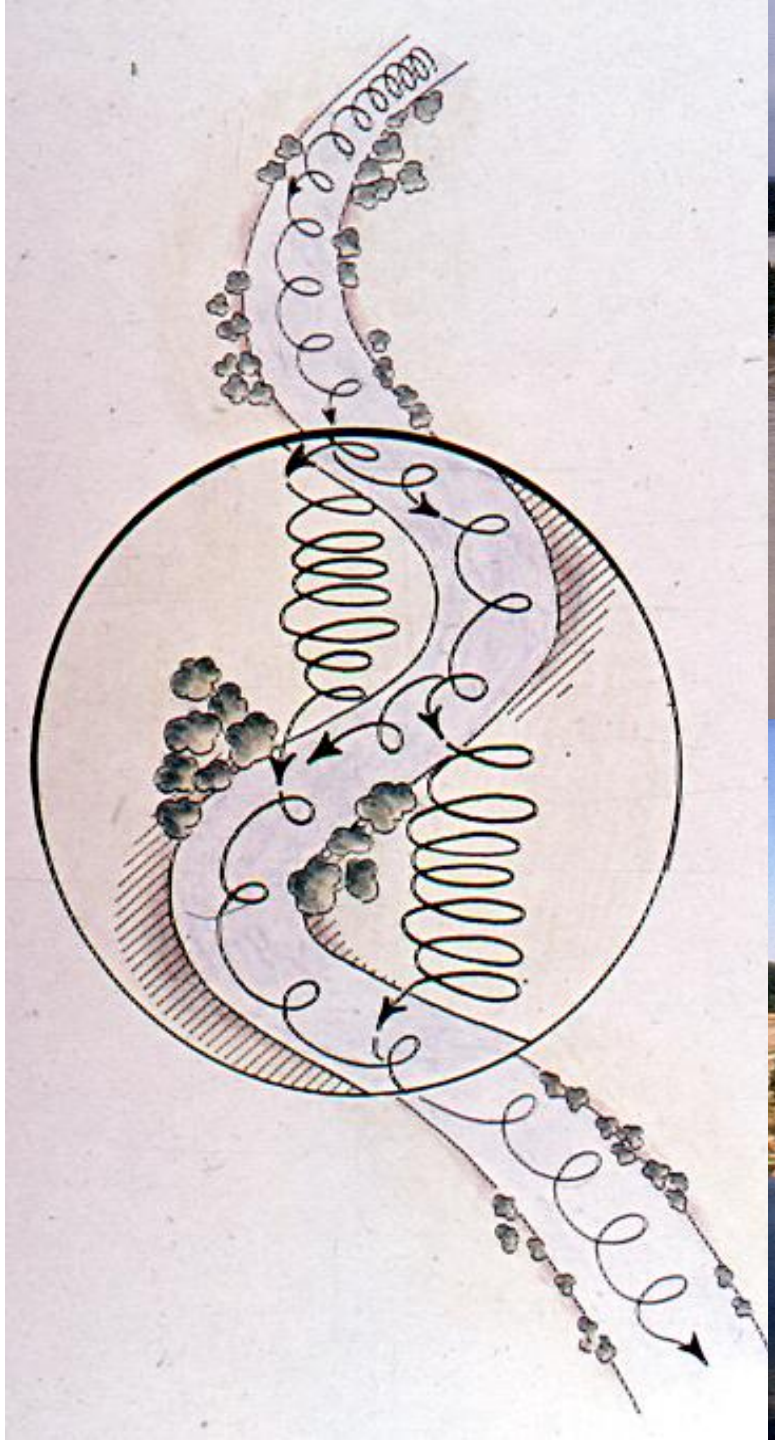
Gruber & Galloway , *Nature 2008*

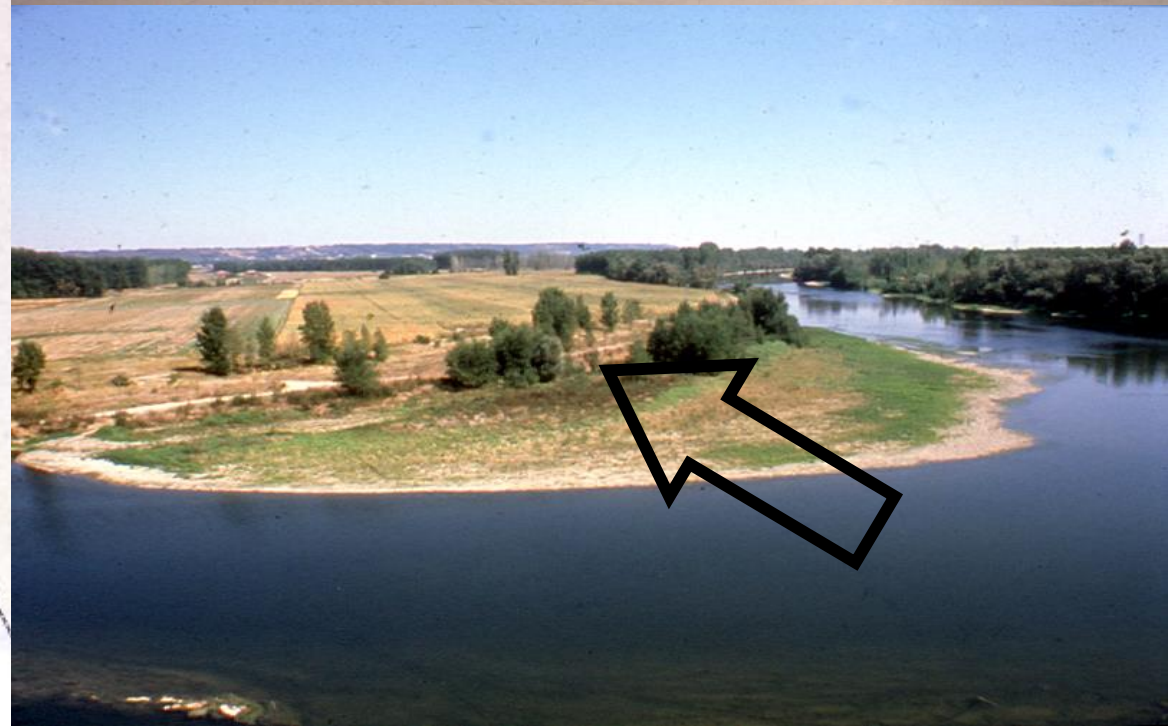
Nitrogen processing and retention

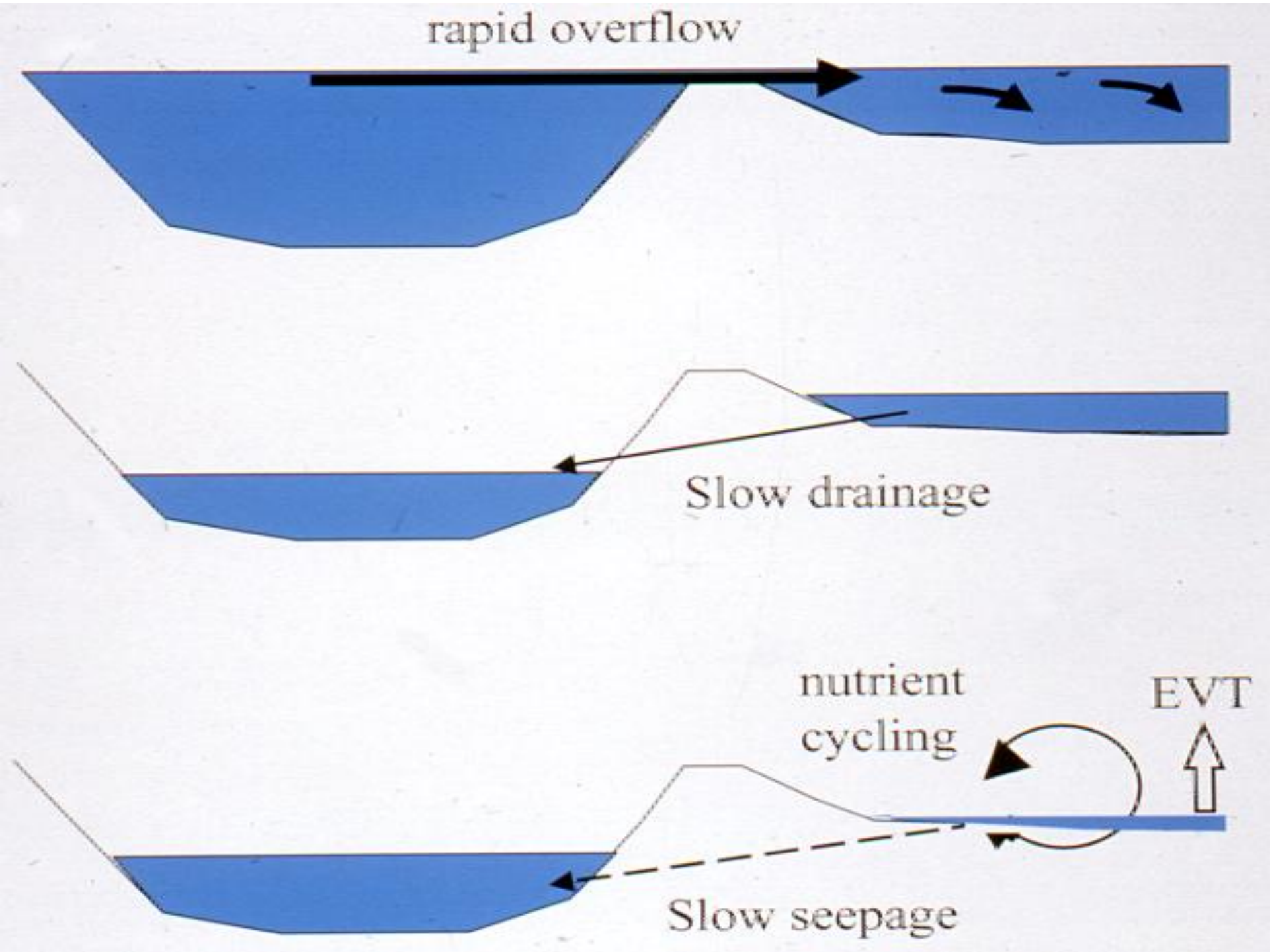


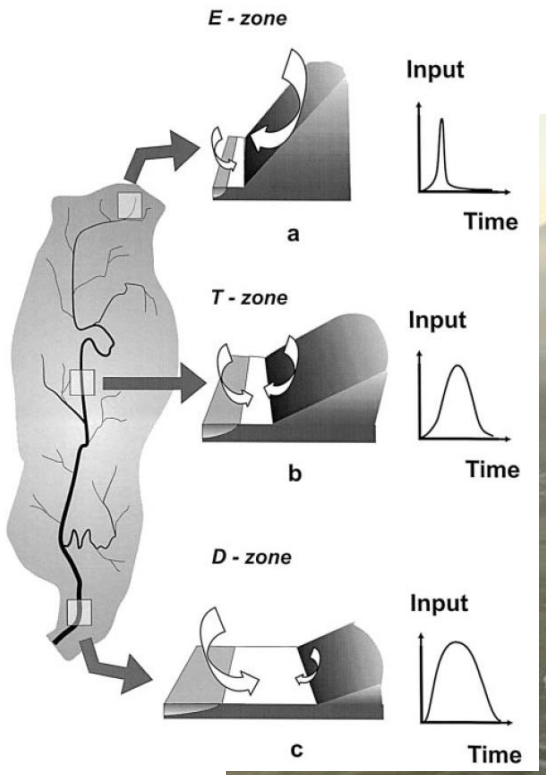
Seitzinger et al. 2006



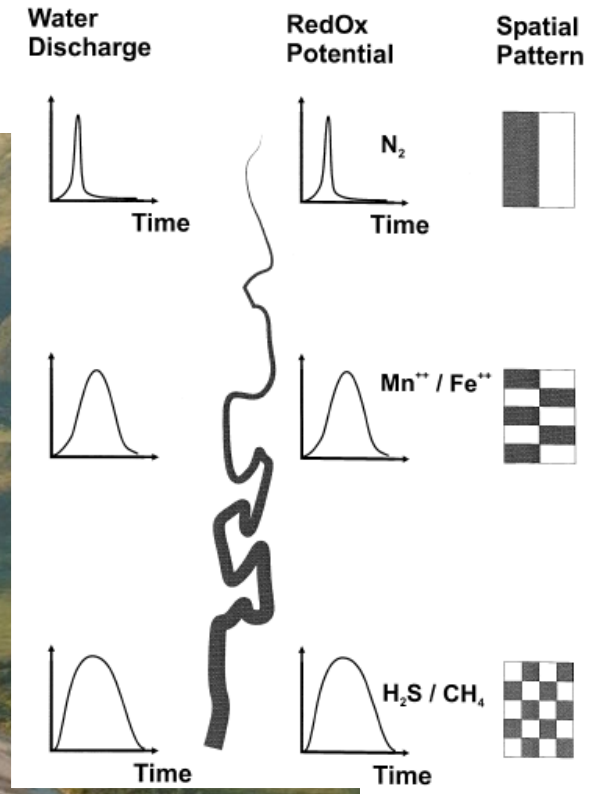




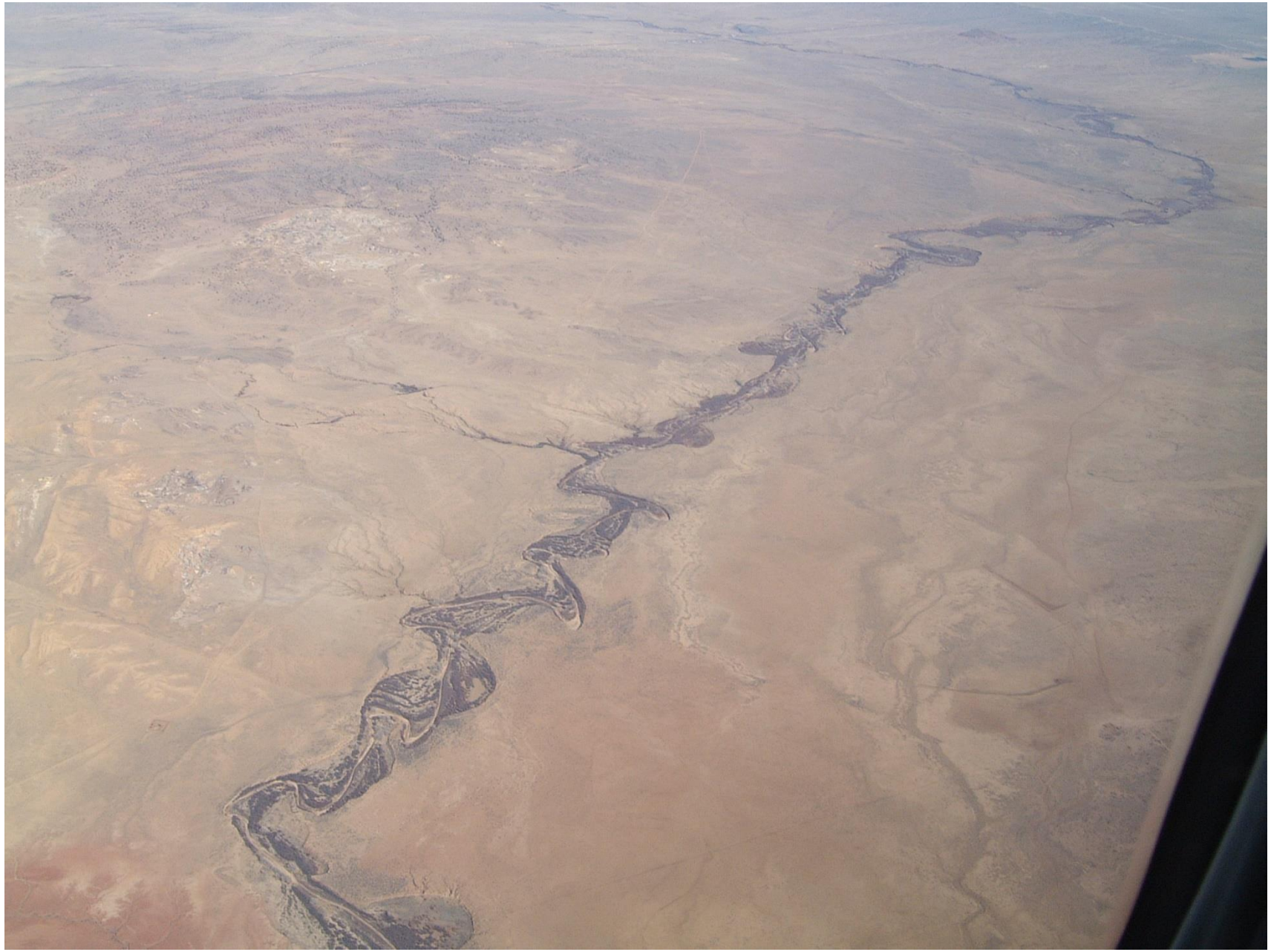

rapid overflow
Slow drainage
nutrient
cycling
EVT
Slow seepage

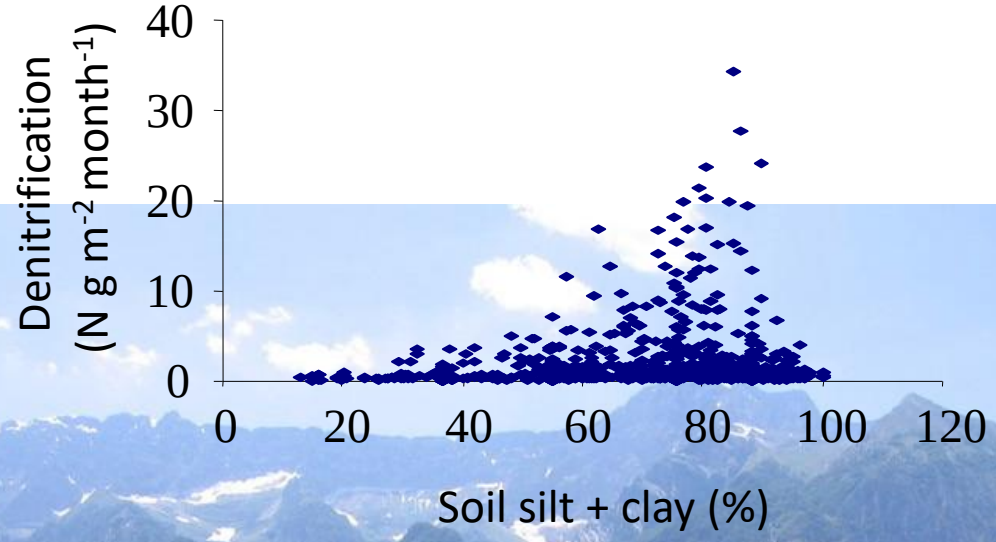


Tabacchi et al. 1998



Tabacchi et al. 1998





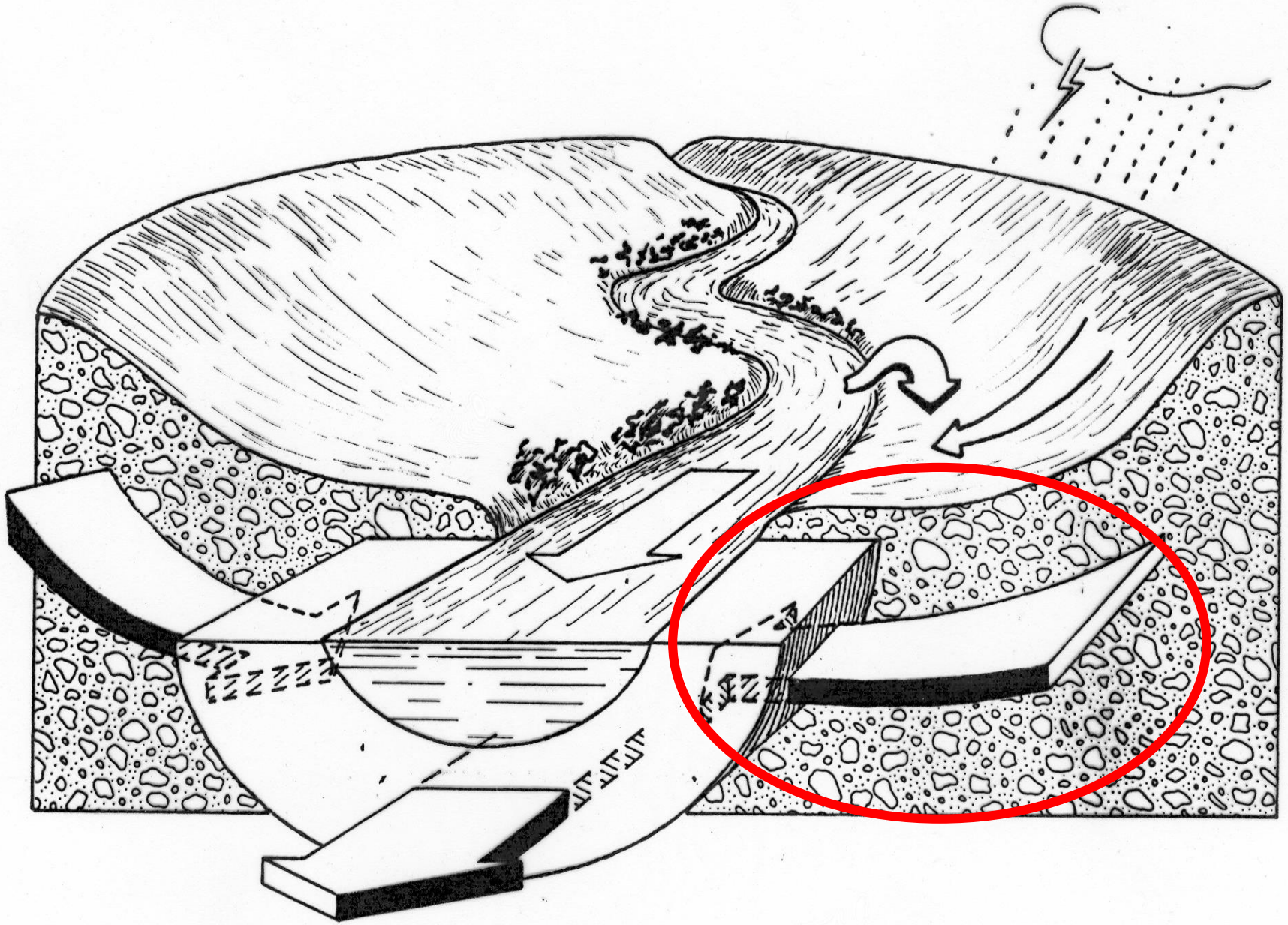
Pinay et al., Biogeochemistry, 1995 & 2000

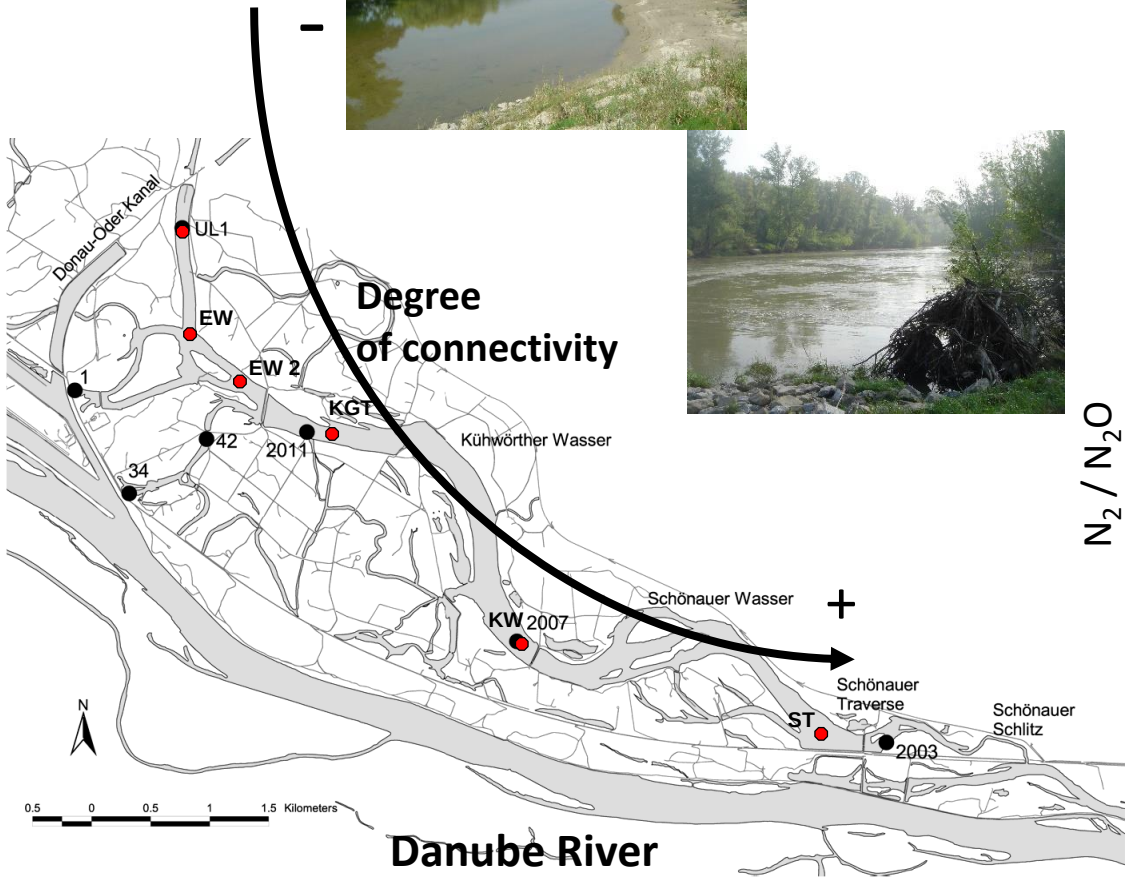
« *no river needs more than one bed* »

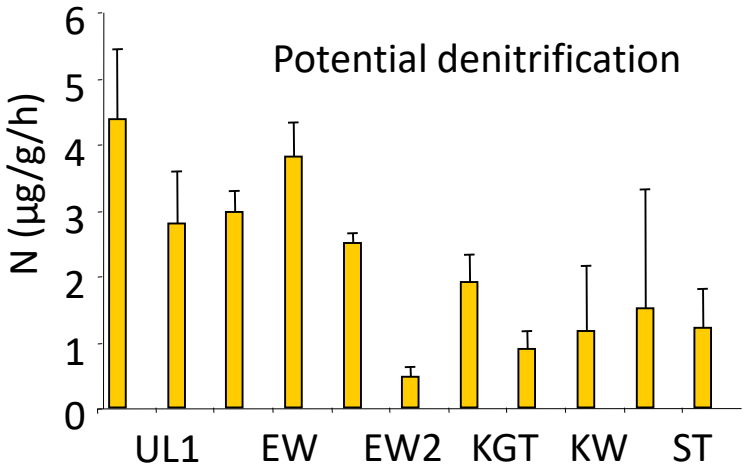
Johann Gottfried Tulla

Rhine River transformation 1842-1876

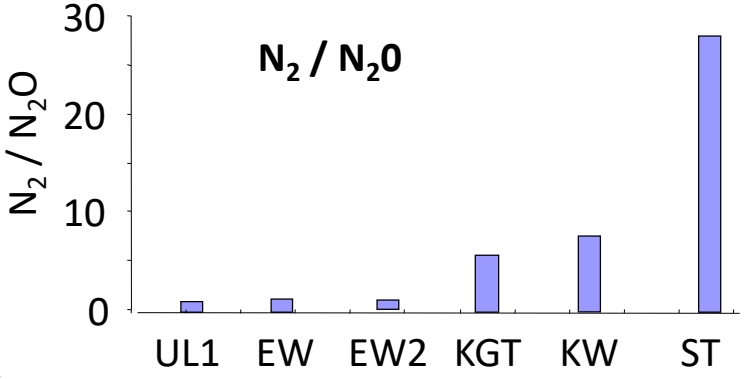
151 AMIENS. — Le Chemin de Halage - LL
POSTES
RÉPUBLIQUE FRANÇAISE
AMIENS



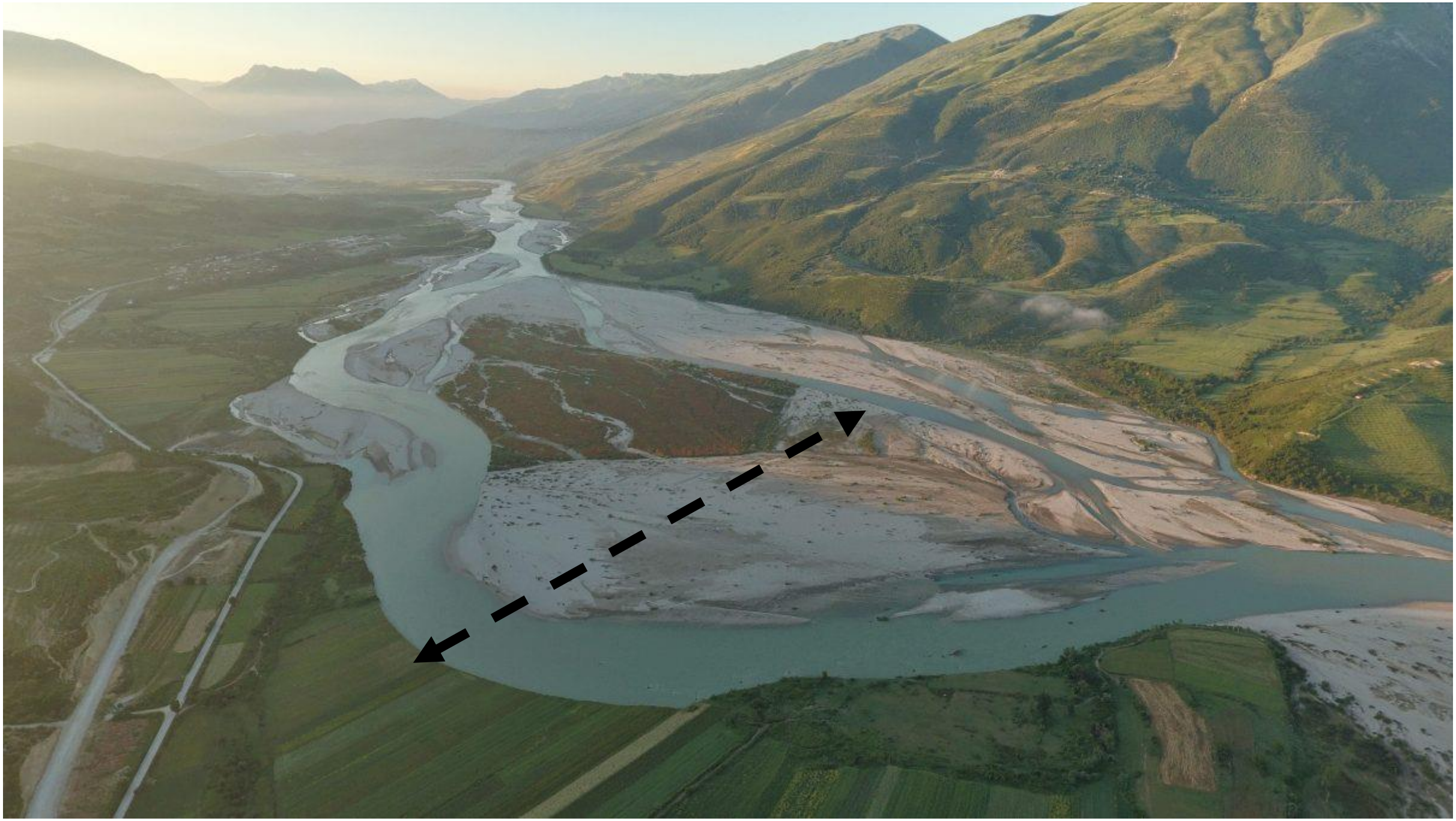


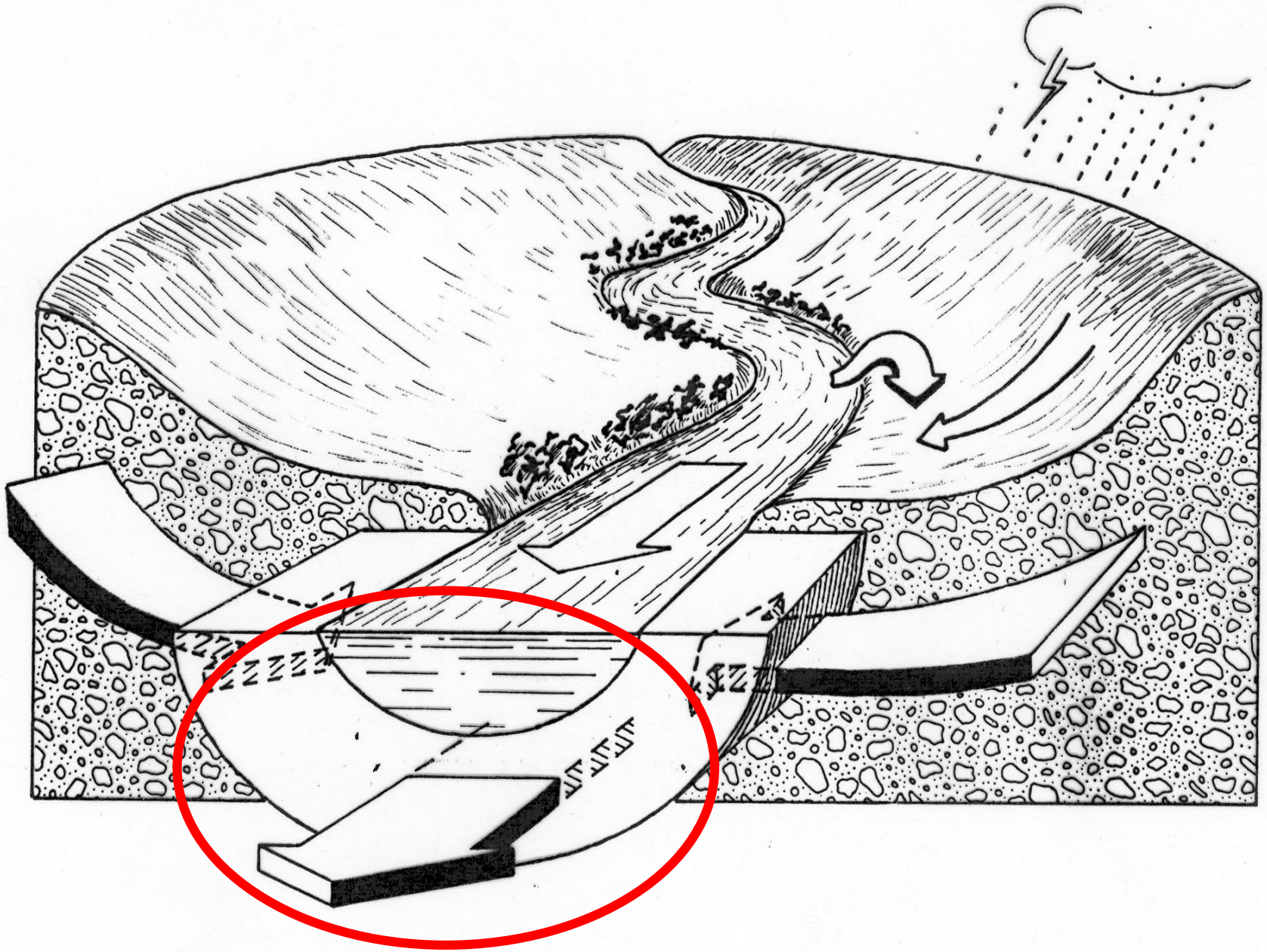


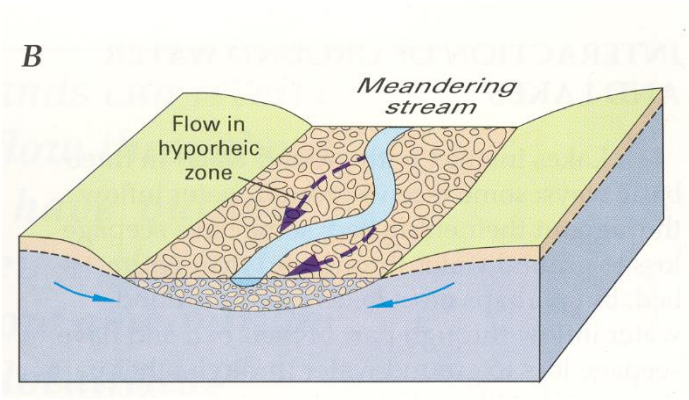
– Degree of connectivity +

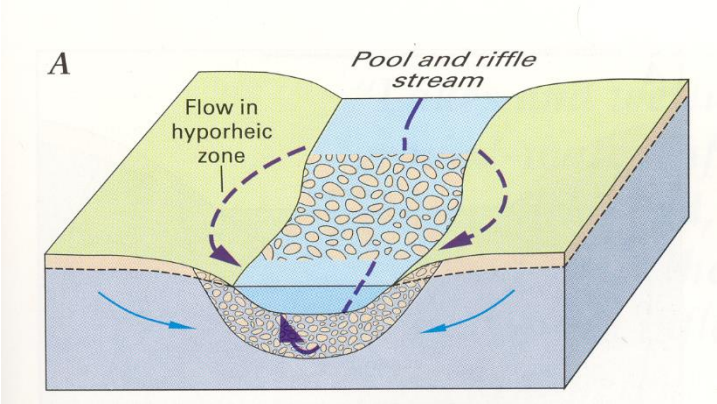


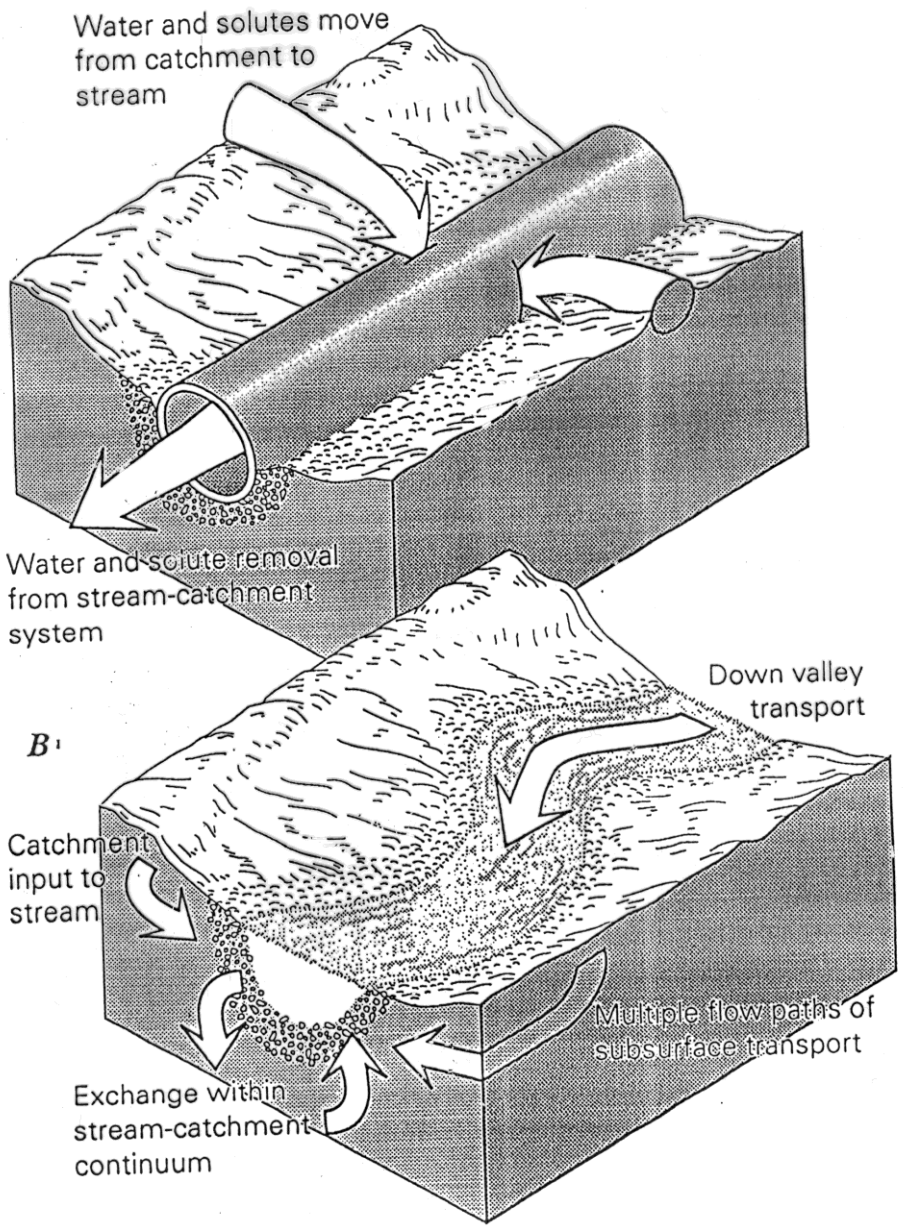
Welti et al. *Ecological Engineering*, 2012
Tritthart et al. *Environmental Modelling & Software*, 2011

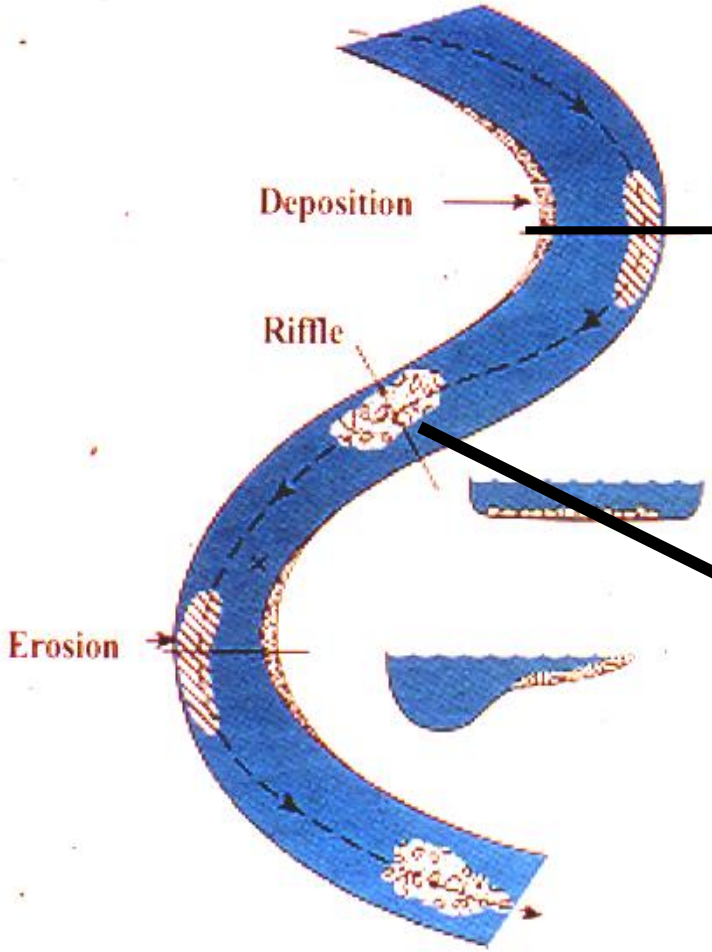




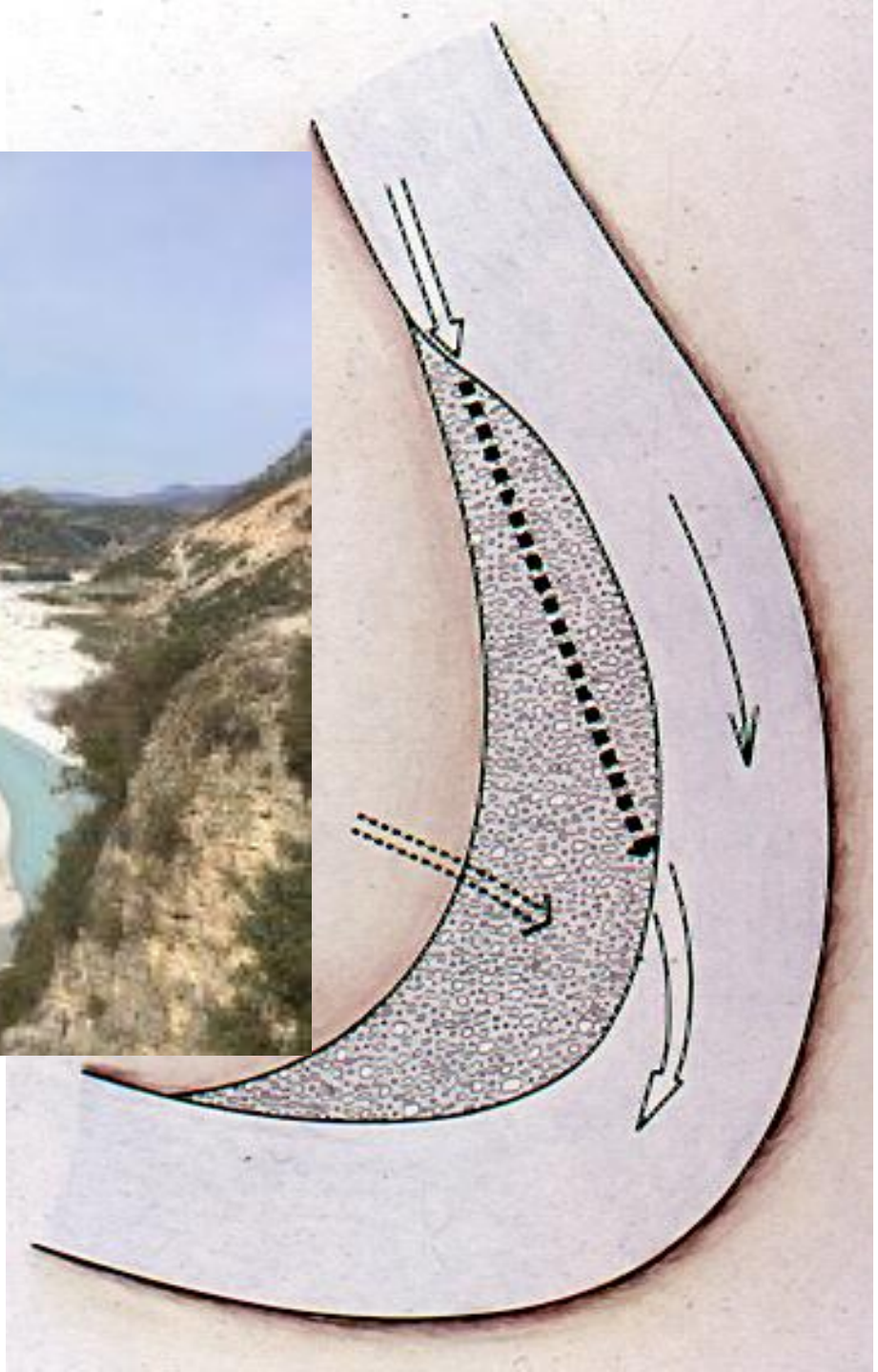

B
Meandering stream
Flow in hyporheic zone

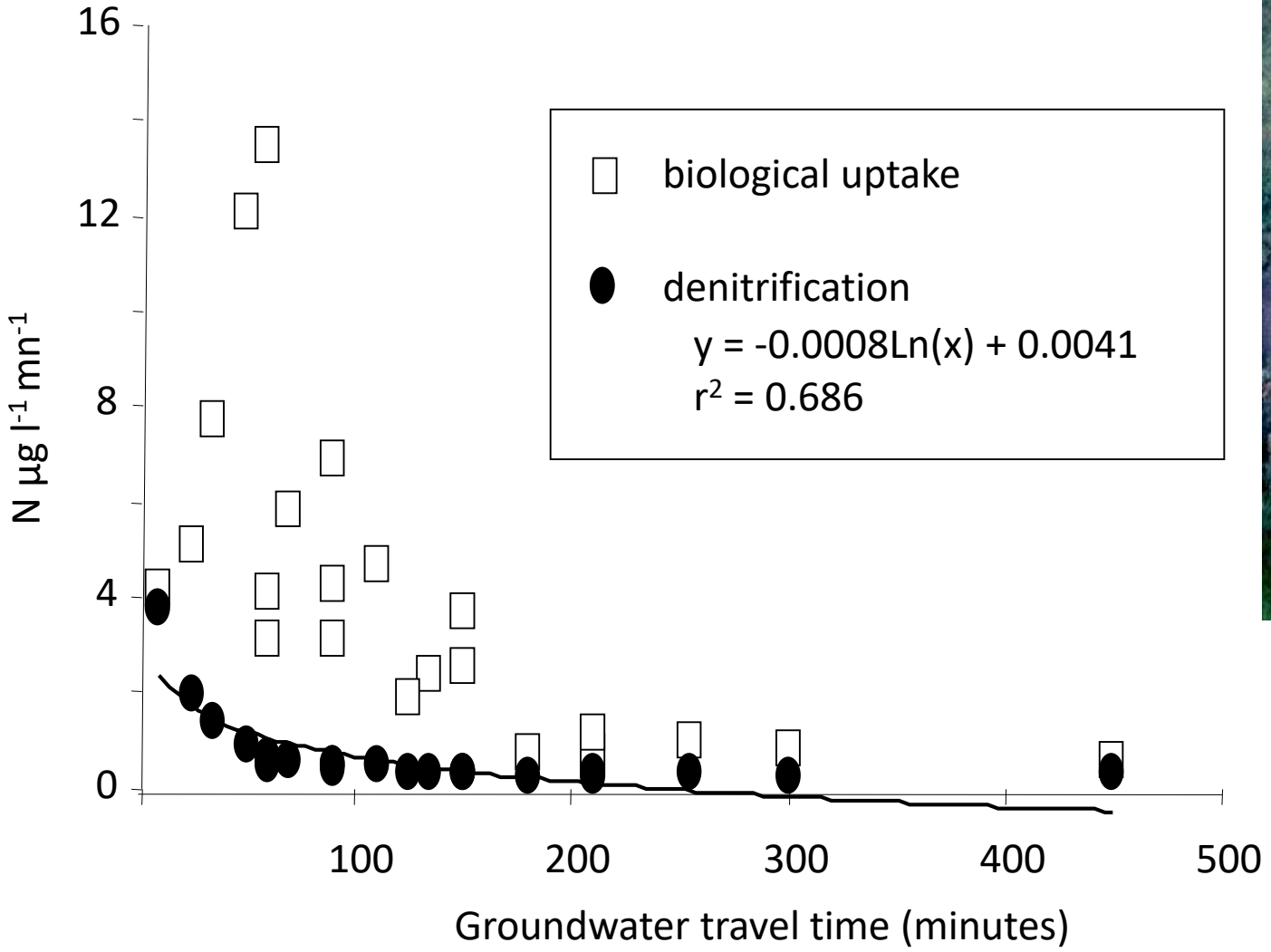

A
Pool and riffle stream
Flow in hyporheic zone

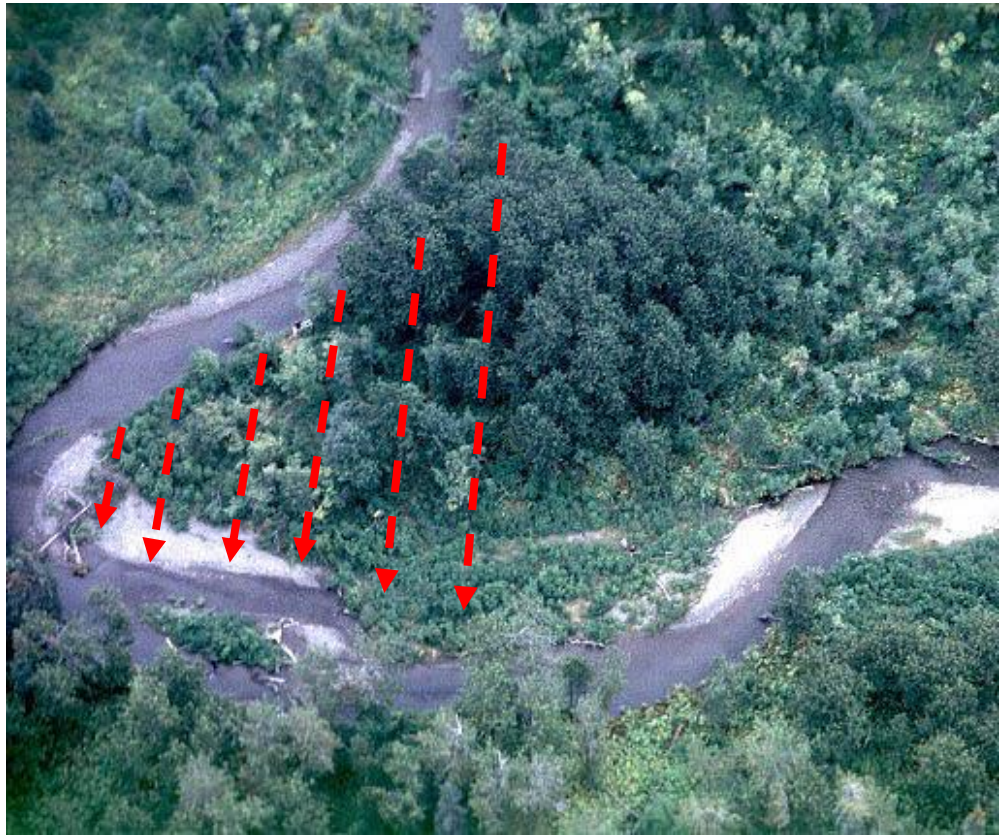

Water and solutes move from catchment to stream
Water and solute removal from stream-catchment system
Down valley transport
B'
Catchment input to stream
Multiple flow paths of subsurface transport
Exchange within stream-catchment continuum



A clean watercourse with a varying morphology can provide good habitats for a variety of species.

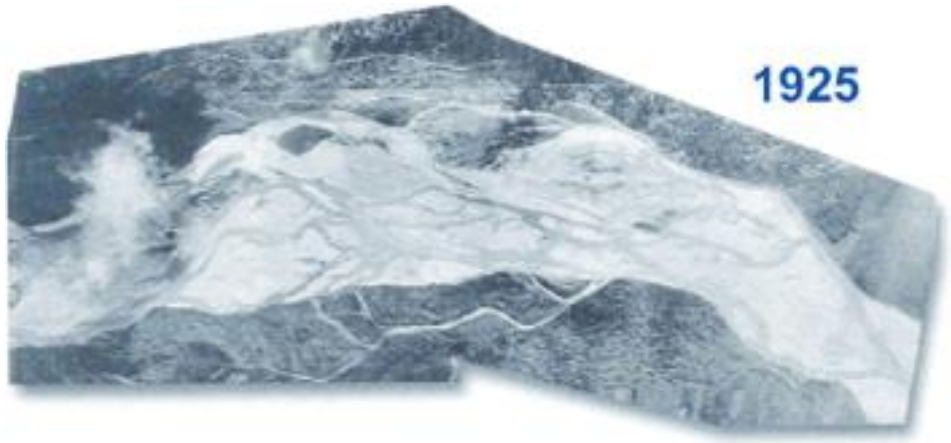






Pinay et al. *River Research and Application*, 2009

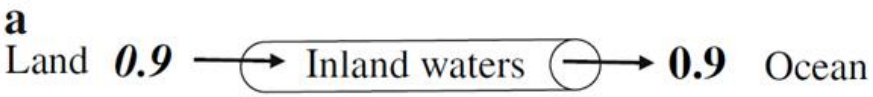
Serre-Ponçon, France


1925

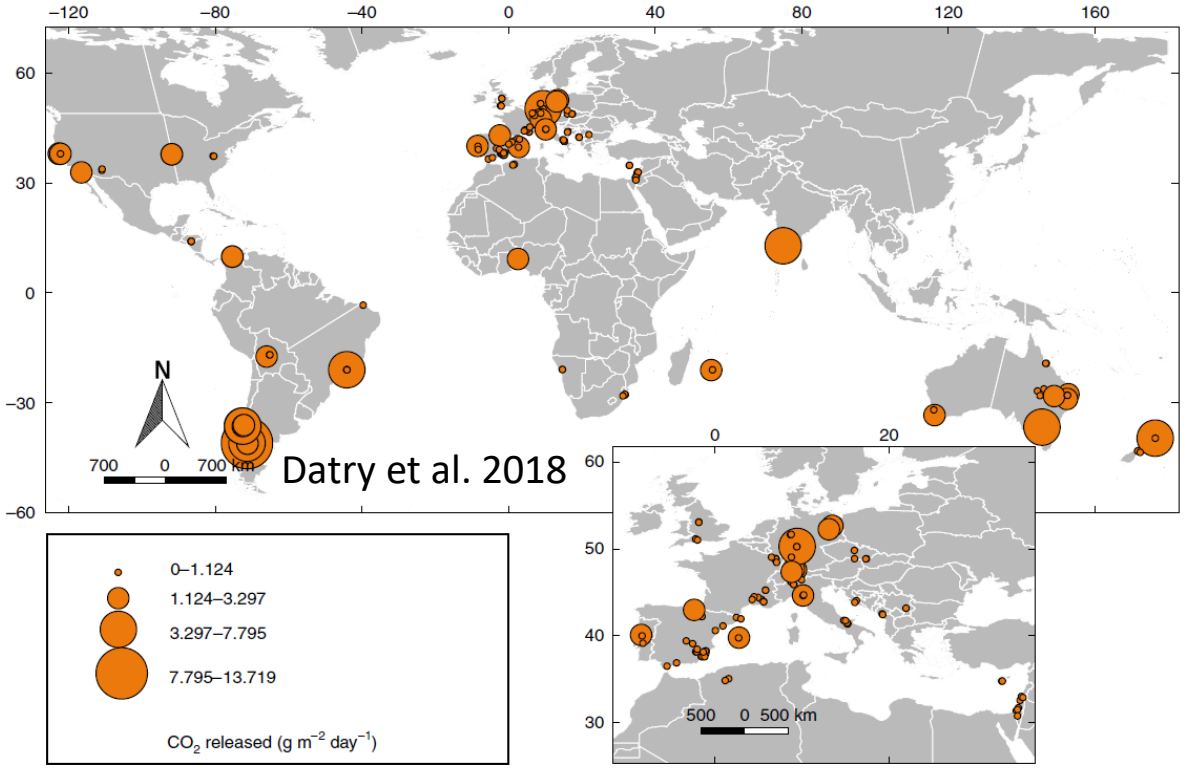
1971

1982

Carbon processing and retention

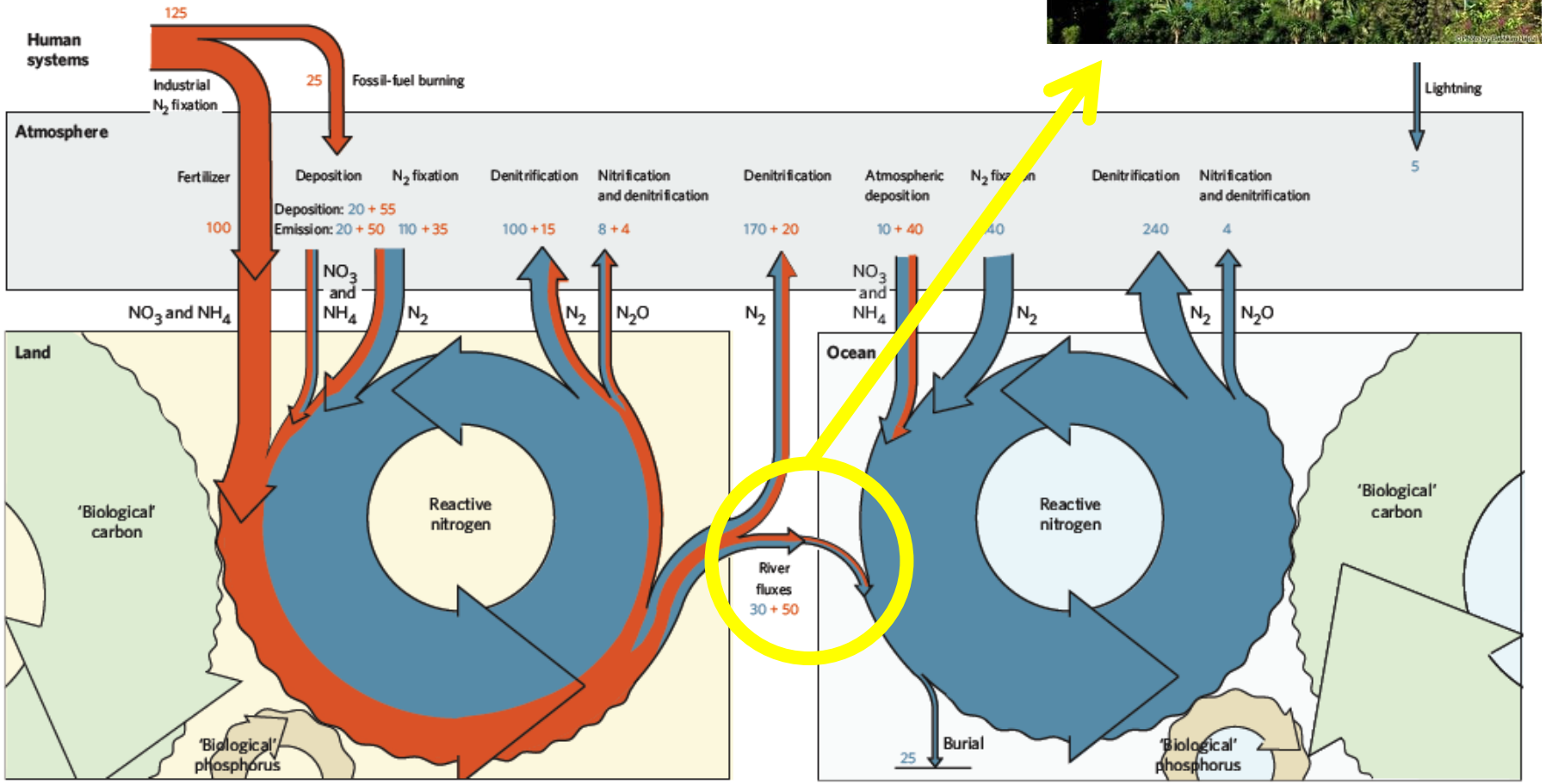


Cole et al. 2007



Datry et al. 2018

Conclusion



Gruber & Galloway , *Nature 2008*

Thank you
for your attention

gilles.pinay@irstea.fr