



The VERSEAU – TRACKSED - DRASTIC Project: Quantification of sediment fluxes in the Loire hydrographic basin

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Géosciences pour une Terre durable
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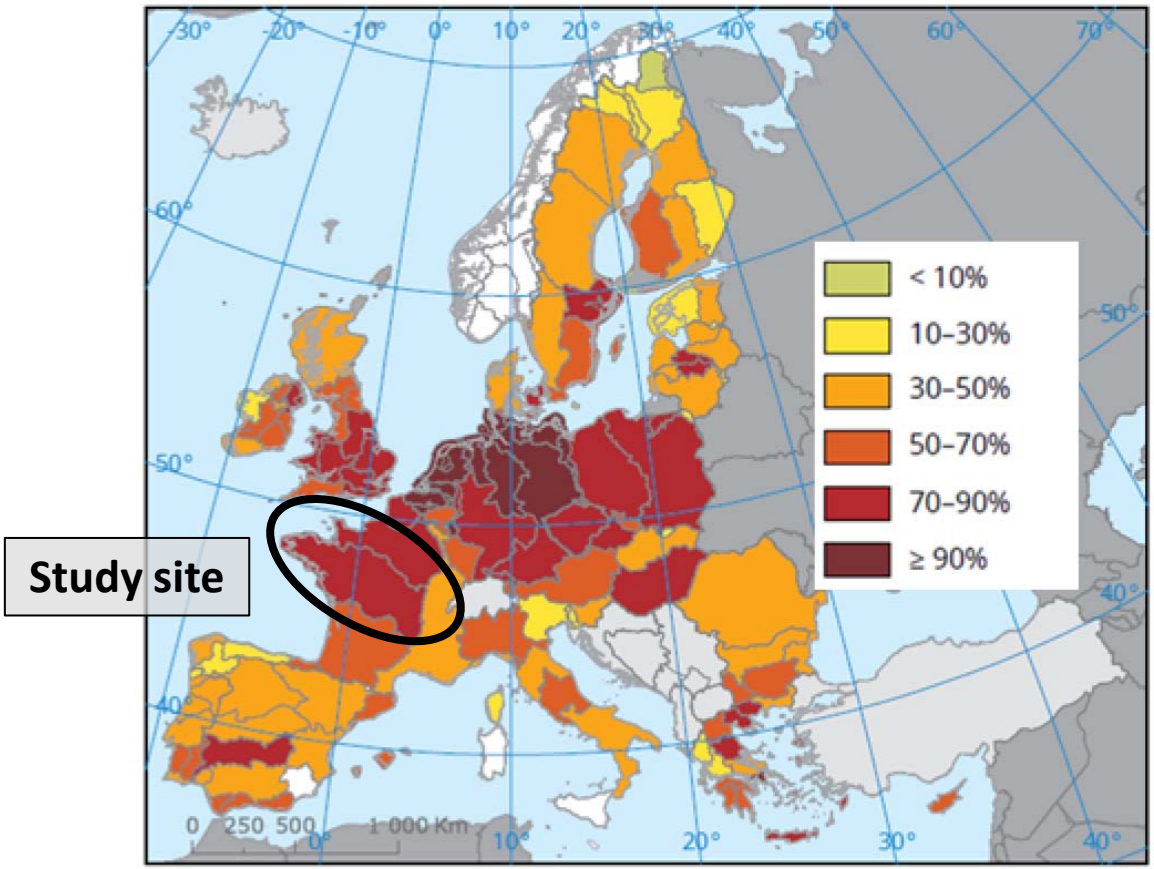
Starting point: the good ecological status of water bodies

The Loire Brittany water agency meets problems with stream siltation

Percentage of water bodies in less than good ecological status or potential in rivers and lakes



European Environment Agency, 2015

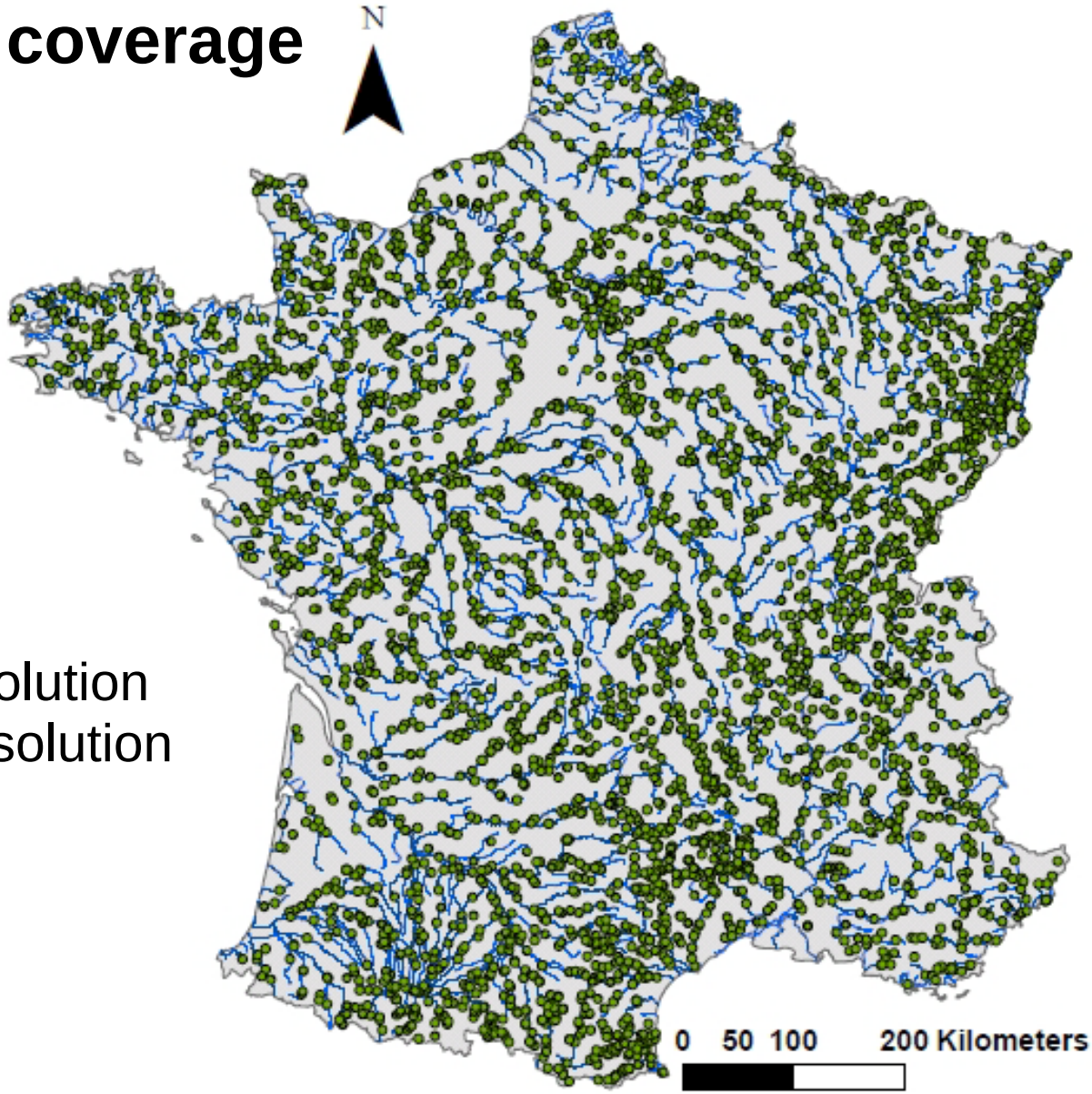
Characterise the present-day sediment fluxes in the Brittany Loire river Basin

Is the basin eroding? Where is the sediment coming from?

2 steps :

- **The suspended sediment loads**
- **The sources**

Good spatial coverage

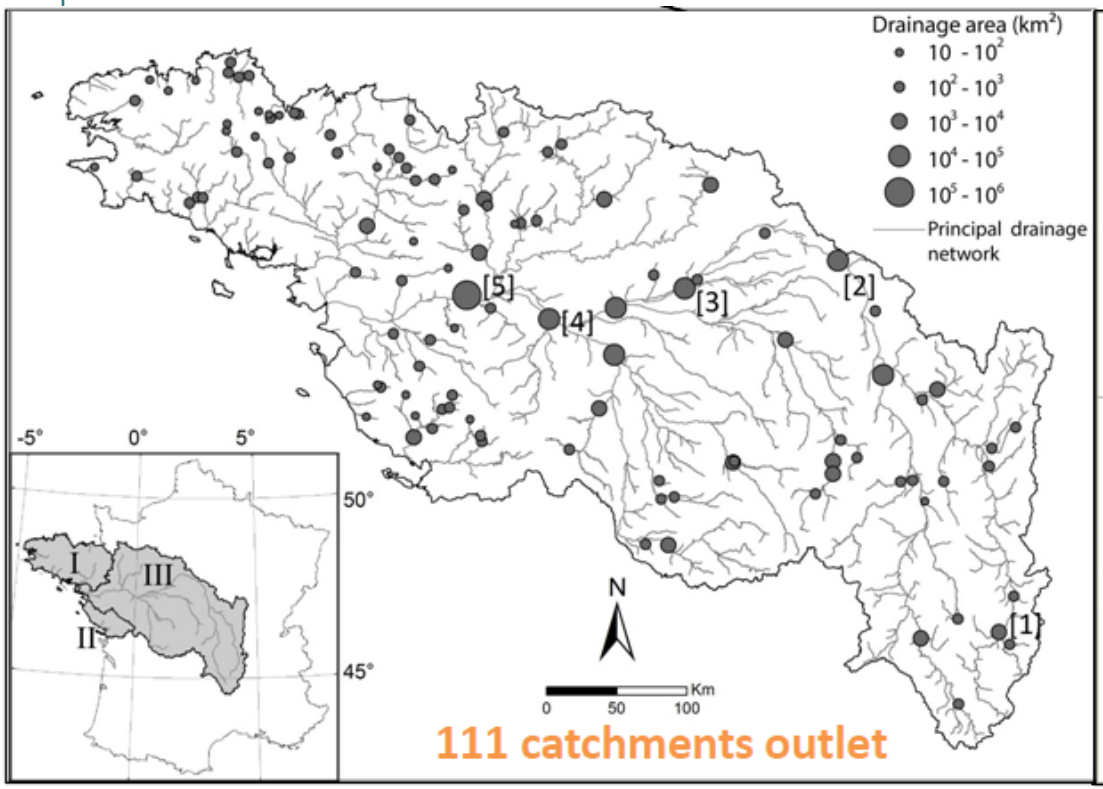


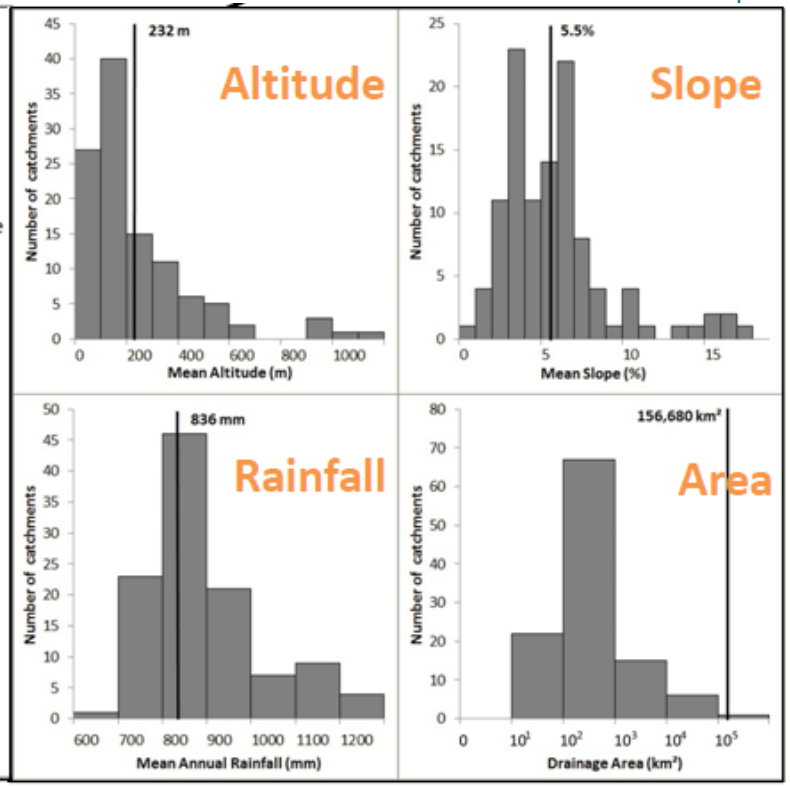
3500 stations :

- daily flow data
- High spatial resolution
- low temporal resolution for SS

Study site: the Loire and Brittany river basin

- A lowland area in France
- Loire – Brittany river basin ~155 000 km² (28% of French metropolitan territory)
- 111 small to large scale catchments (10^1 - 10^5 km²) chosen ~78% of the whole basin





Area specific suspended sediment yield calculation

National databases

Suspended sediment concentration (C)
Once in a month sampling over more than 7 years

Flow discharge (Q)
Daily measurements

2 calculation methods ***(Delmas et al. 2011)[1]***

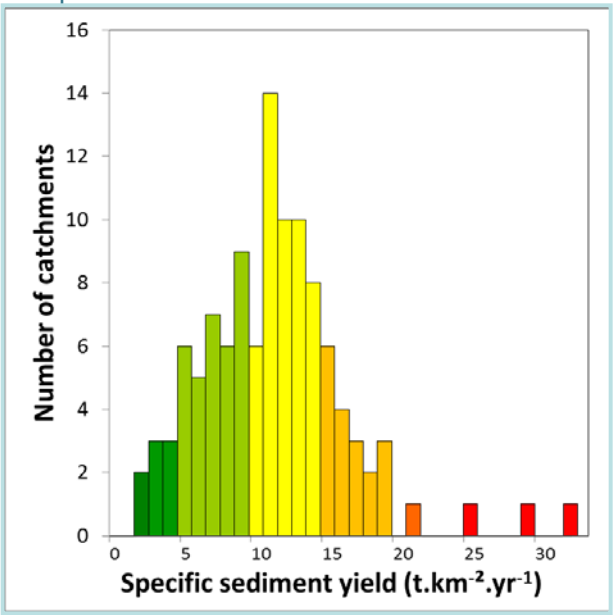
$$C = a\,Q^{b} + a5\,\delta S$$

- Rising discharge
- Falling discharge

Variations of sediment stock

➡ **Long term mean SY values with a maximum uncertainty of 30%**
➡ **Analysis of yields at annual time scale**

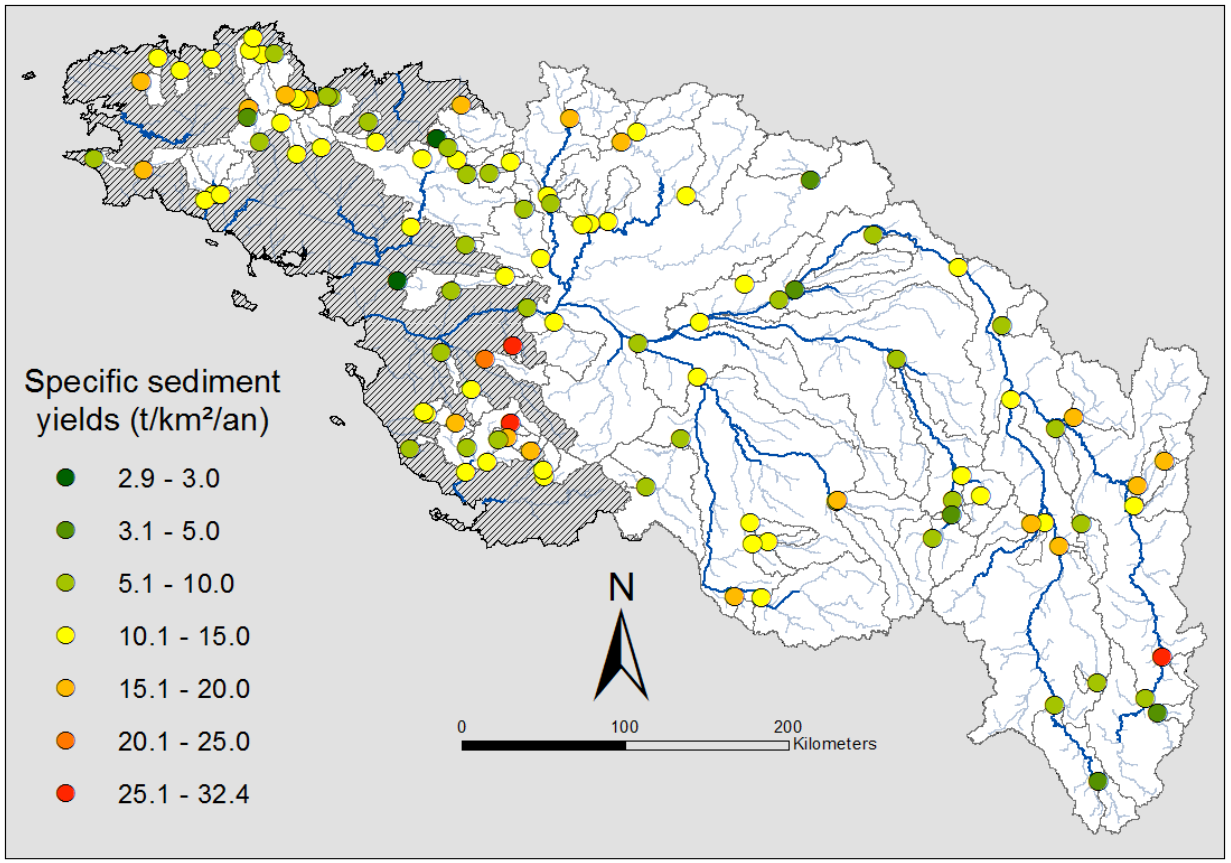
Suspended SY values and spatial distribution



Some values :

$SY \sim 10^{-4} – 10^{1}$ Mt. yr^{-1}

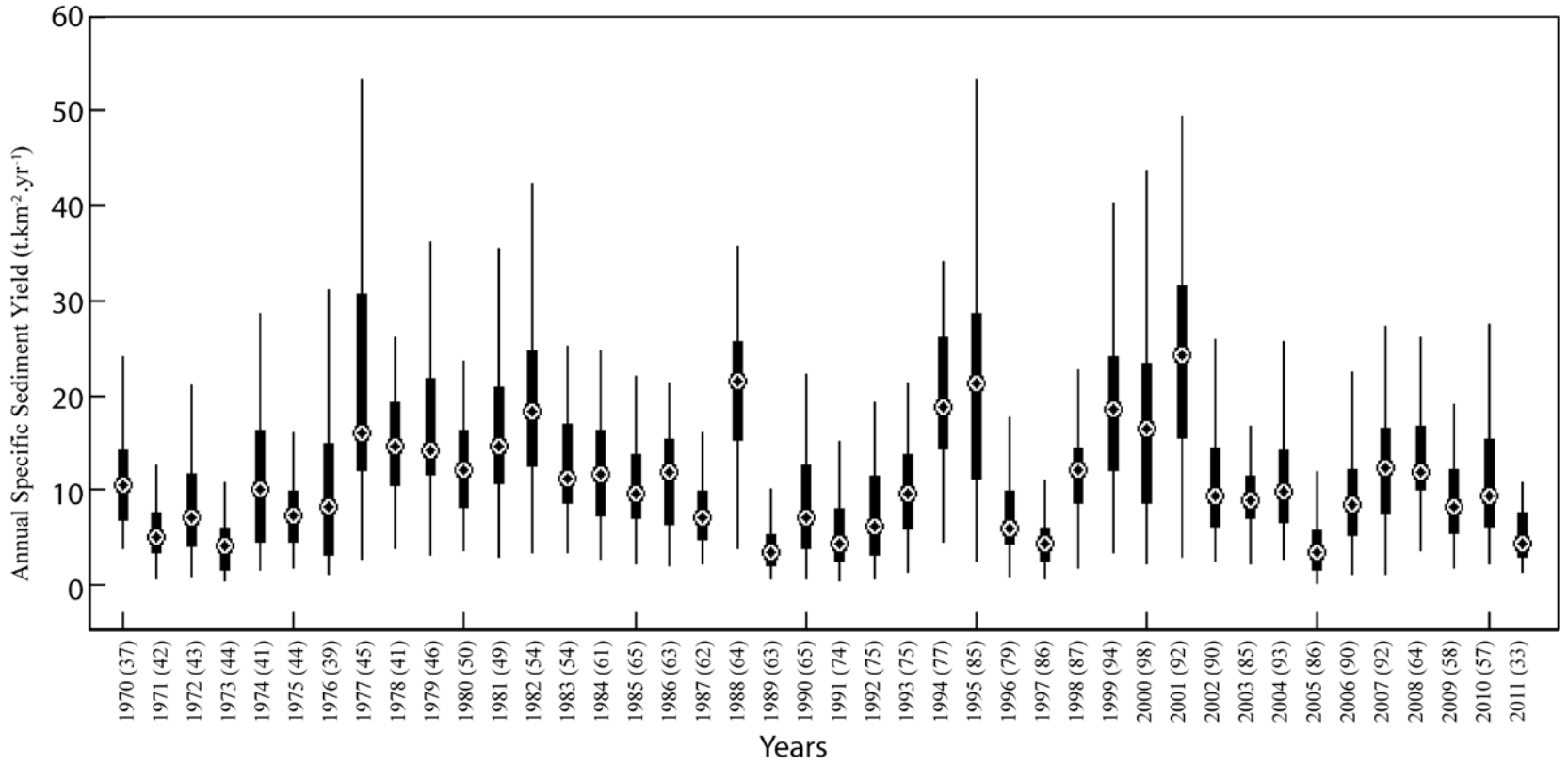
$SSY \sim 2.9 – 32.4$ t.km^{-2}.yr^{-1}



- **Large SSY database obtained from homogeneous data and calculation methods**
  Comparison with literature data: low values
- **No spatial pattern of SSY distribution**

Gay *et al.* 2014

Suspended SY temporal variability



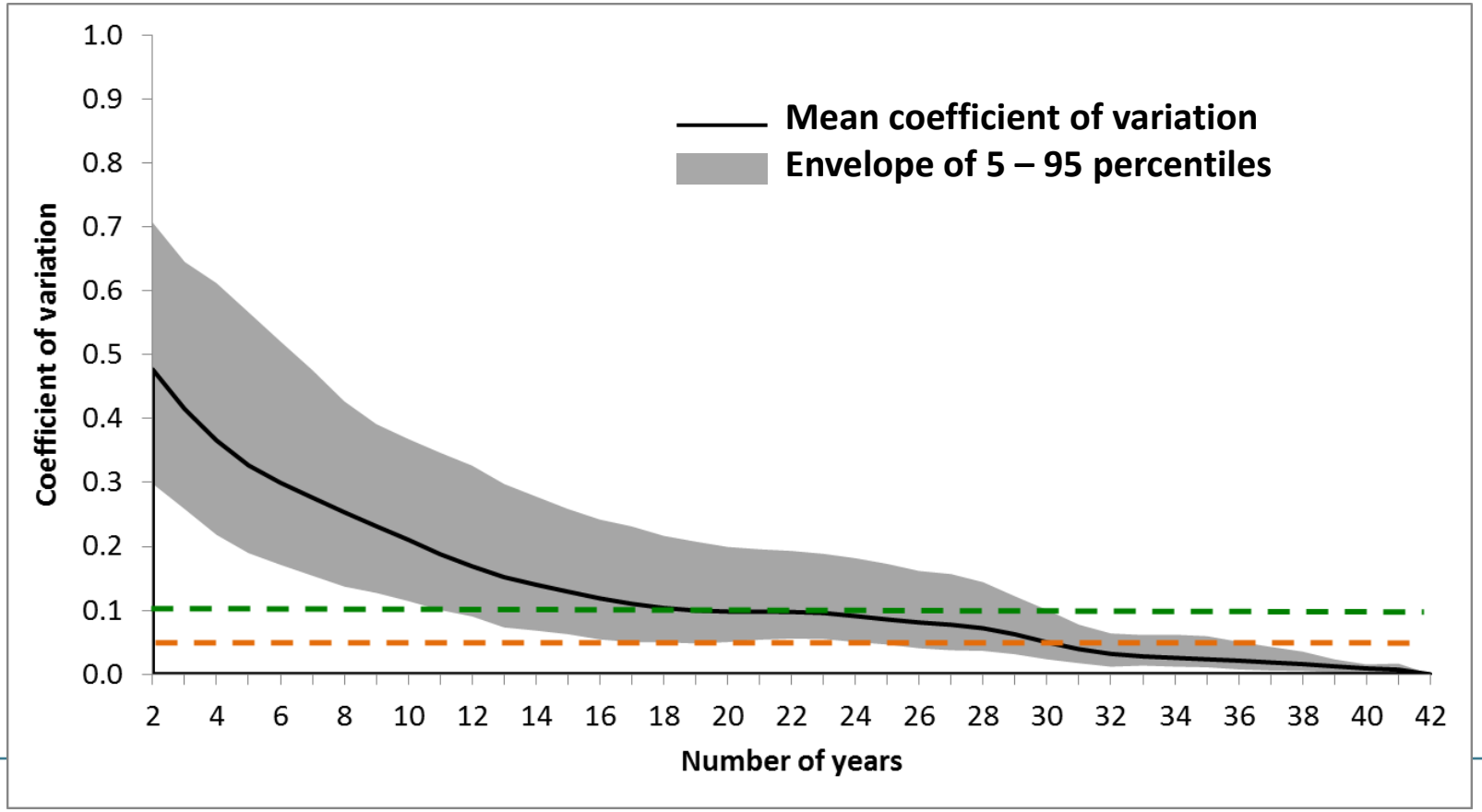
Large discrepancies between years

but…

Homogeneous trend of catchments within the Loire and Brittany river basin

Giving reliable mean SSY values…

- 41 catchments with more than 30 years data
- Calculation of moving average of SSY using different type steps : 2 – 42 years
- Comparison of coefficient of variation for each time step
- 18 years of annual data are needed to provide a mean value of SSY with less than 10 % of potential variation



Characterise the present-day rates of erosion of the Loire river Basin

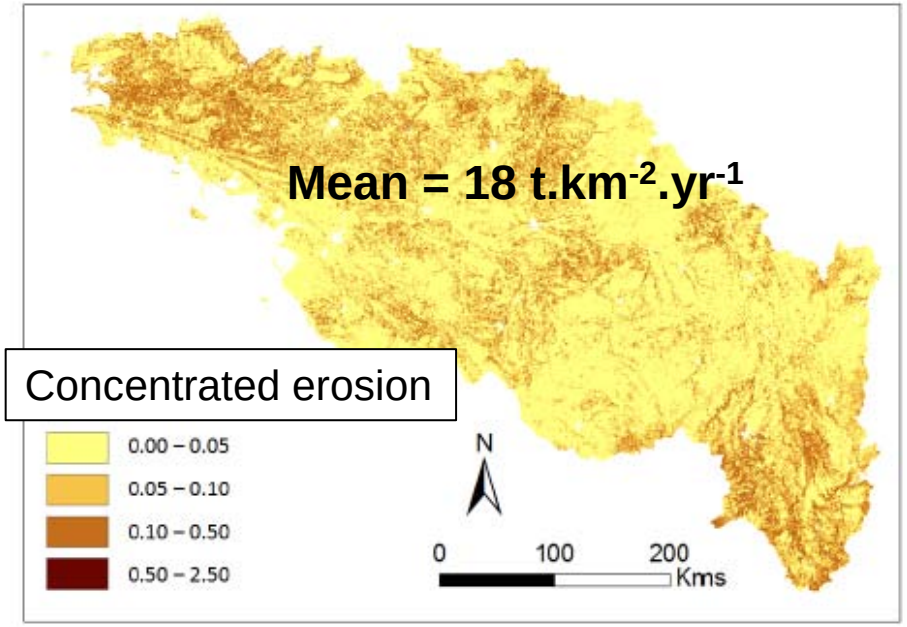
Is the basin eroding? Where is the sediment coming from?

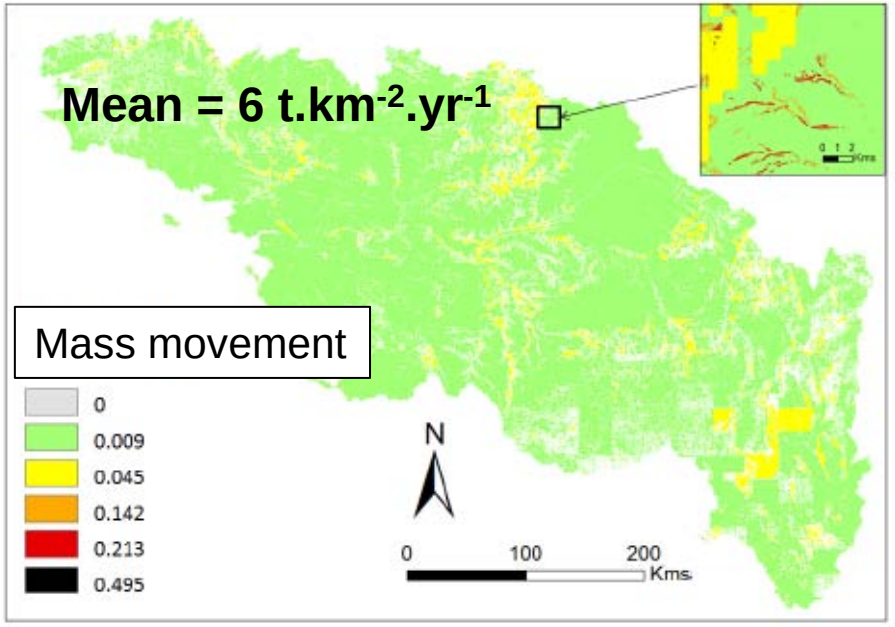
2 steps :

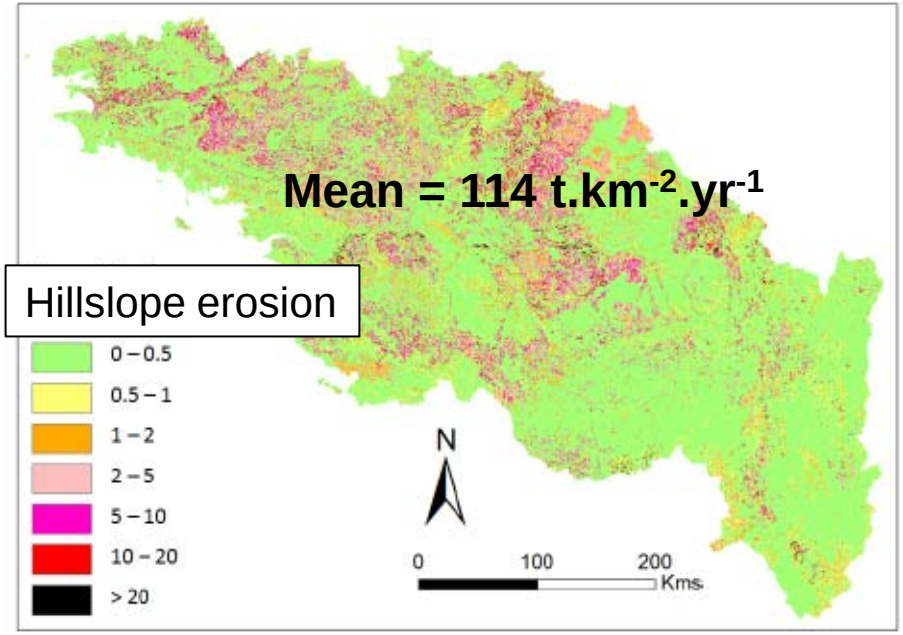
> The suspended sediment loads

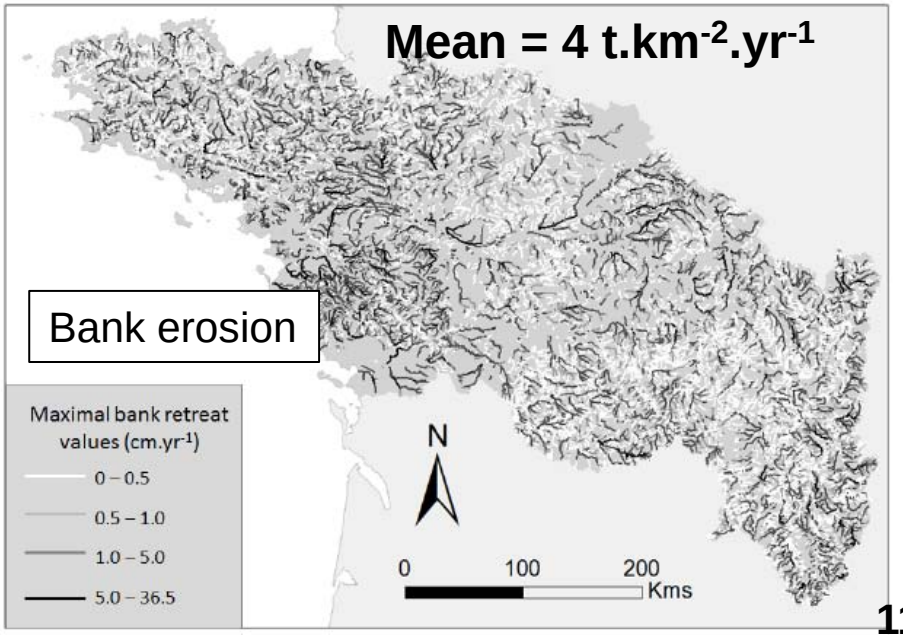
> **The sources**

The local sources



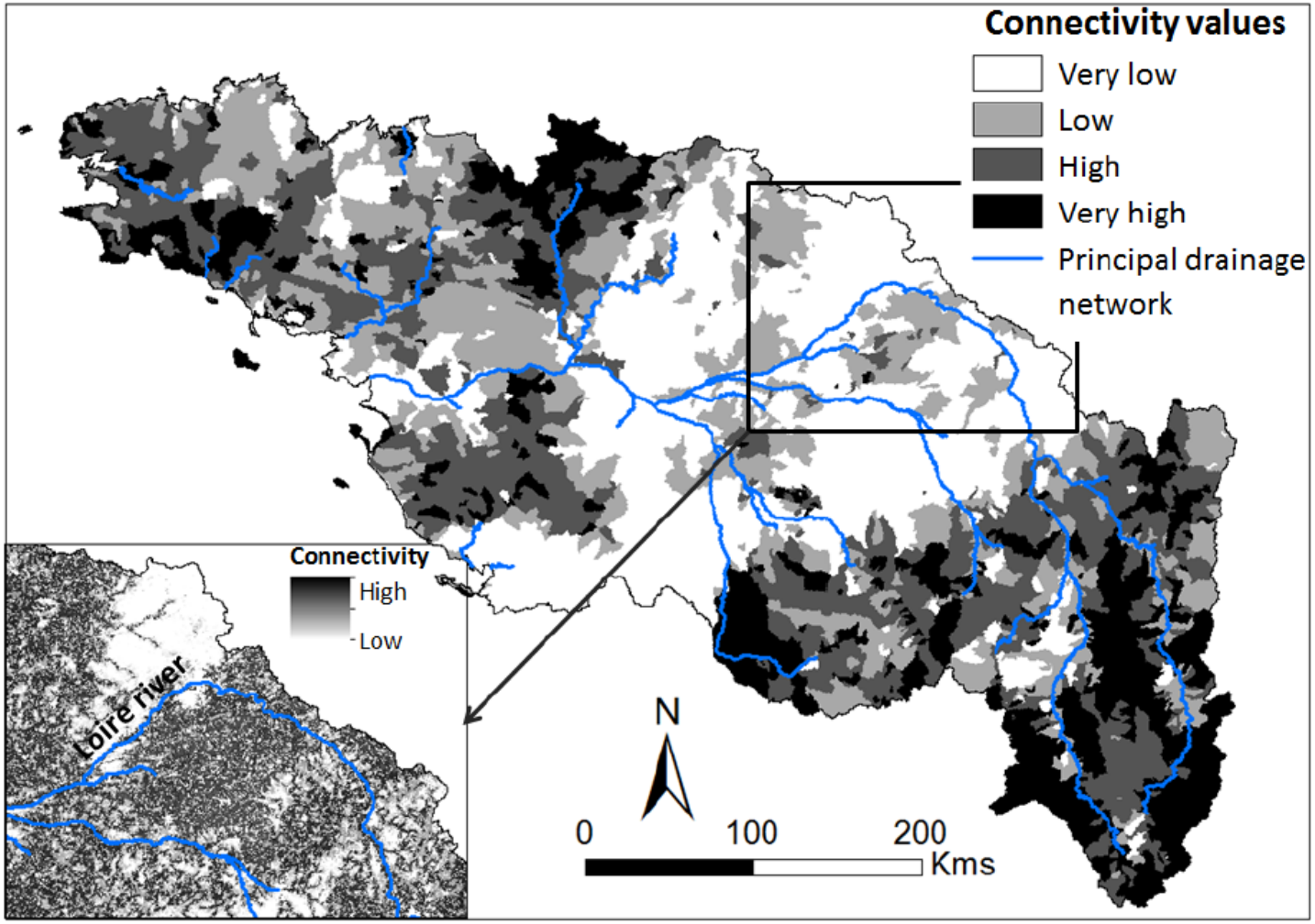




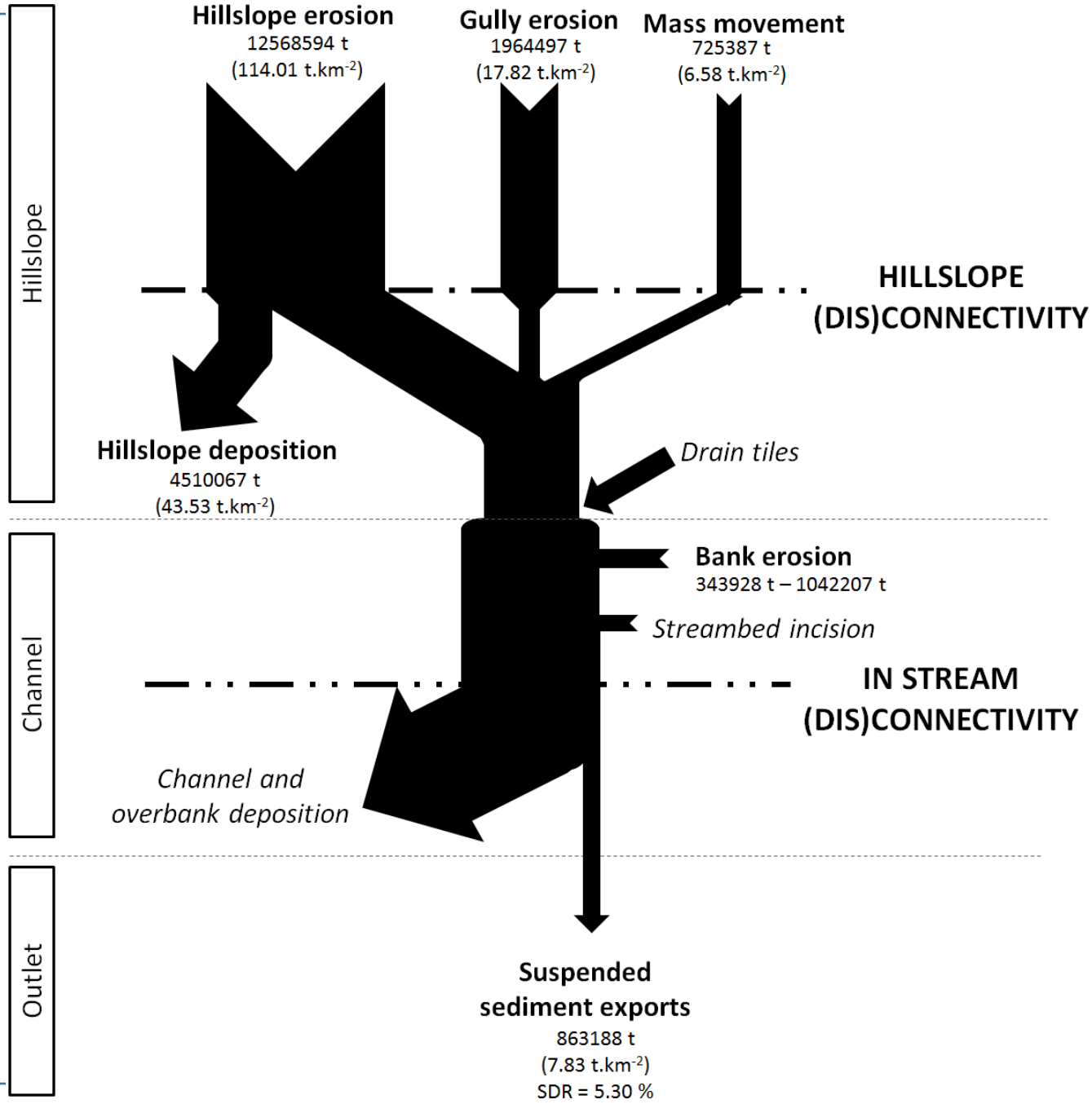


Need of connectivity

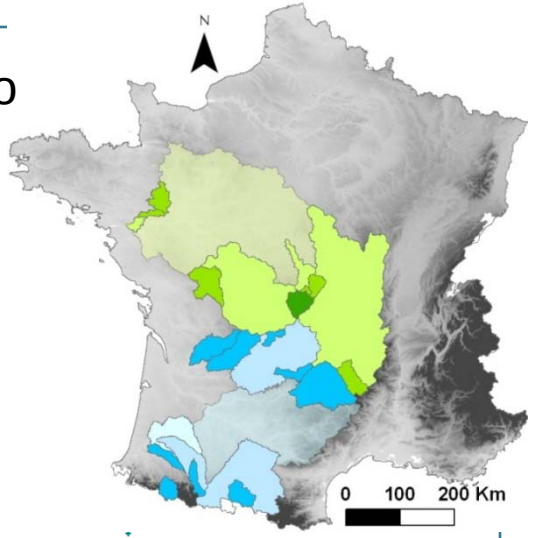
=> To explain the difference between hillslopes and rivers

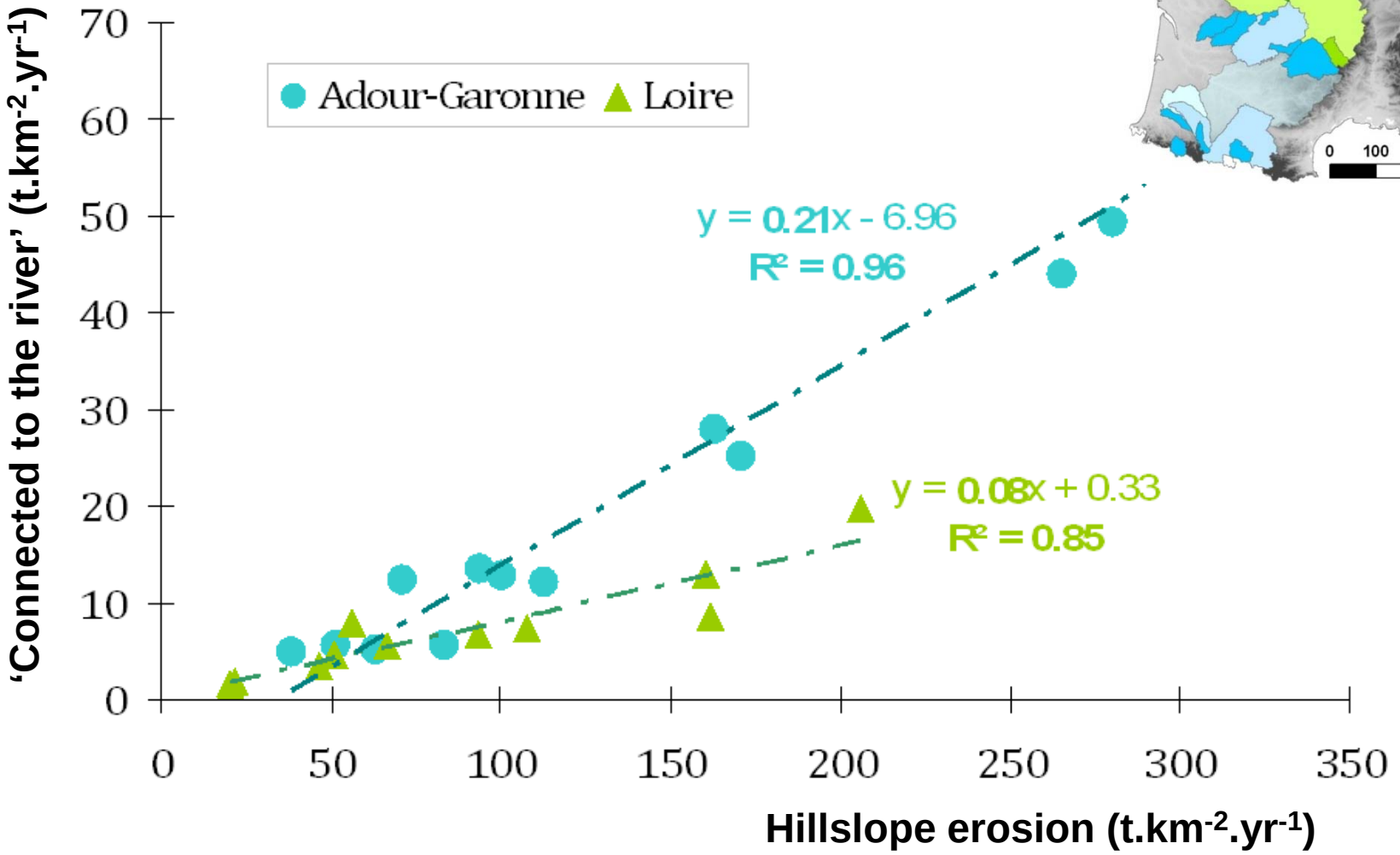


Borselli *et al*. (2008), Gay *et al*. (2016) *Journal of Soil and Sediments*


Hillslope
Channel
Outlet
Hillslope erosion
12568594 t
(114.01 t.km-2)
Gully erosion
1964497 t
(17.82 t.km-2)
Mass movement
725387 t
(6.58 t.km-2)
HILLSLOPE
(DIS)CONNECTIVITY
Hillslope deposition
4510067 t
(43.53 t.km-2)
Drain tiles
Bank erosion
343928 t – 1042207 t
Streambed incision
IN STREAM
(DIS)CONNECTIVITY
Channel and
overbank deposition
Suspended
sediment exports
863188 t
(7.83 t.km-2)
SDR = 5.30 %

The Loire basin has a low connected erosion comparing to other French basins





Conclusion: A large homogeneous database

Low values of SSY (2.9 – 32.4 $t.km^{-2}.yr^{-1}$)

- Strong interannual variability but homogeneous trend in this variability (with a major influence of rainfall, min = 18 years of data)
- Hillslope erosion, transfer limited (SDR 5%)

Perspectives: Towards a distributive approach…

- Soil production map for the river basin
- Quantification of drain tiles erosion

Thank you for your attention