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The impact of in-the-field organic fraction on the interpretation of sediment threshold values under the Water Framework Directive

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Environmental Quality Standards (EQS) purpose is to protect environmental stake, including benthic population. According to the Technical Guidance Document (E.C. ; 2011), the determination of QS_{sed} (quality standard for sediment) can be achieved by extrapolation from AA-QS_{water-eco} (quality standard in water) with the equilibrium partition method.

$$QS_{sed \text{ wet weight}} [\mu\text{g}/\text{kg}] = \frac{K_{sed-water}}{RHO_{sed}} \times AA-QS_{water-eco} [\mu\text{g}/\text{L}] \times 1000$$

With

$$K_{sed-water} = Fair_{sed} \times K_{air-water} + Fwater_{sed} + Fsolid_{sed} \times (Kp_{sed}/1000) \times RHO_{solid}$$

$$Kp_{sed} = Foc_{sed} \times Koc$$

This study is particularly interested in the relation between Foc, Koc and bioavailability in the equilibrium partition method when a local environment is assessed.

- The supposedly conservative method considers a 0.05 generic value for the fraction of organic carbon (Foc) in sediment. The TOC is the percentage of organic carbon in sediment and can be obtained by the relation: **Foc = TOC/100**. A bigger fraction of chemical is expected to bind with a sediment containing high quantity of organic matter (with high TOC).
- The organic carbon partition coefficient Koc is peculiar to every substance. It defines in equilibrium condition the ratio of bioavailable chemical in sediment media. Compound with high Koc are supposed to bind with solid matter, they are less bioavailable than chemical substance with low Koc.

National screening study

The National screening study in France surface water (2012) gave a precious opportunity to apply the equilibrium partition method on in-the-field context. 114 stations had been investigated and data in sediment (TOC and chemicals concentration in particular) had been collected.

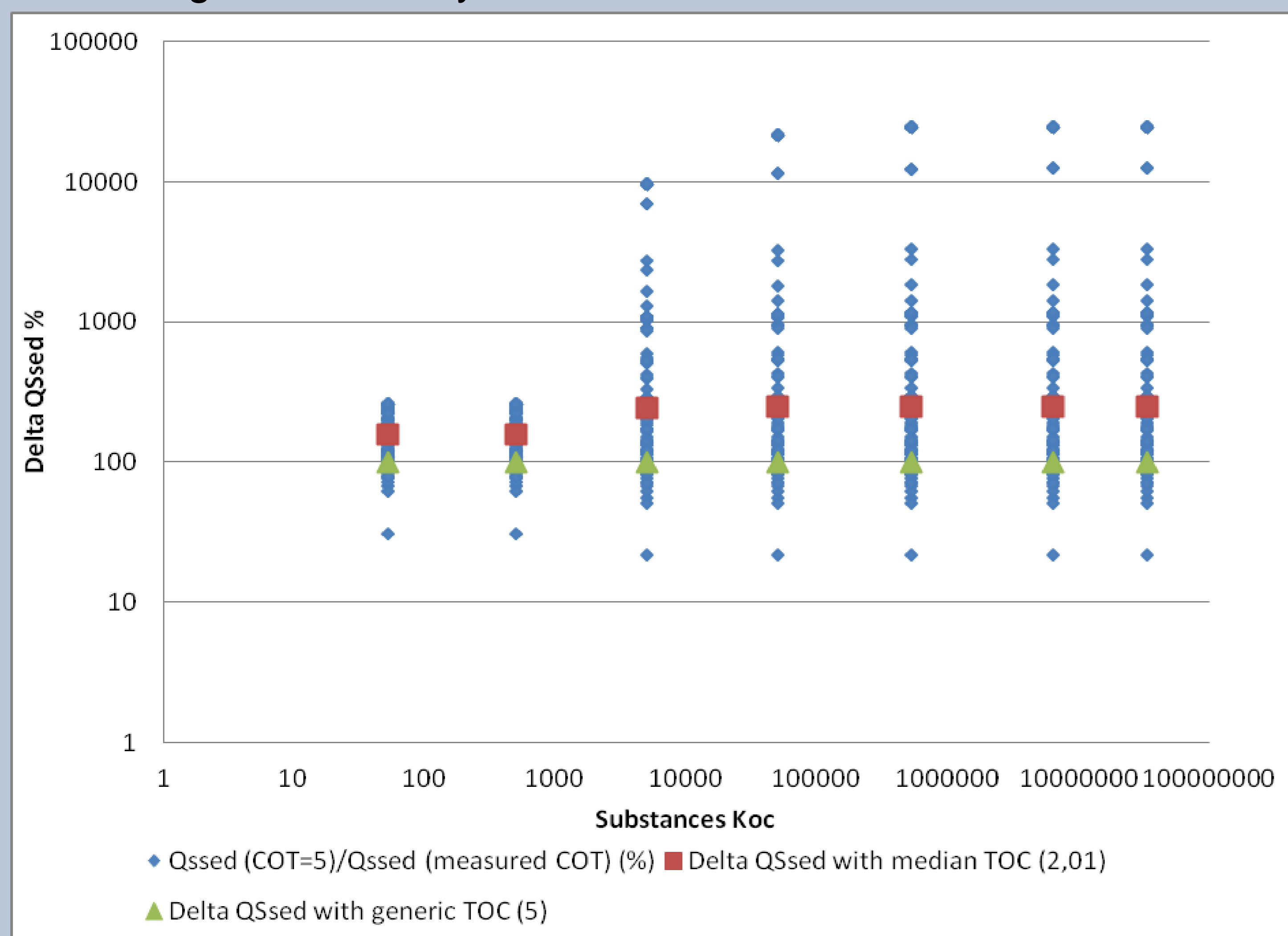
Observation proves **a generic 5 % of organic fraction in sediment is not as representative nor as protective as it is supposed to be:**

- only 17 out of the 114 stations have a TOC above 5.
- the TOC median is equal to 2,01%



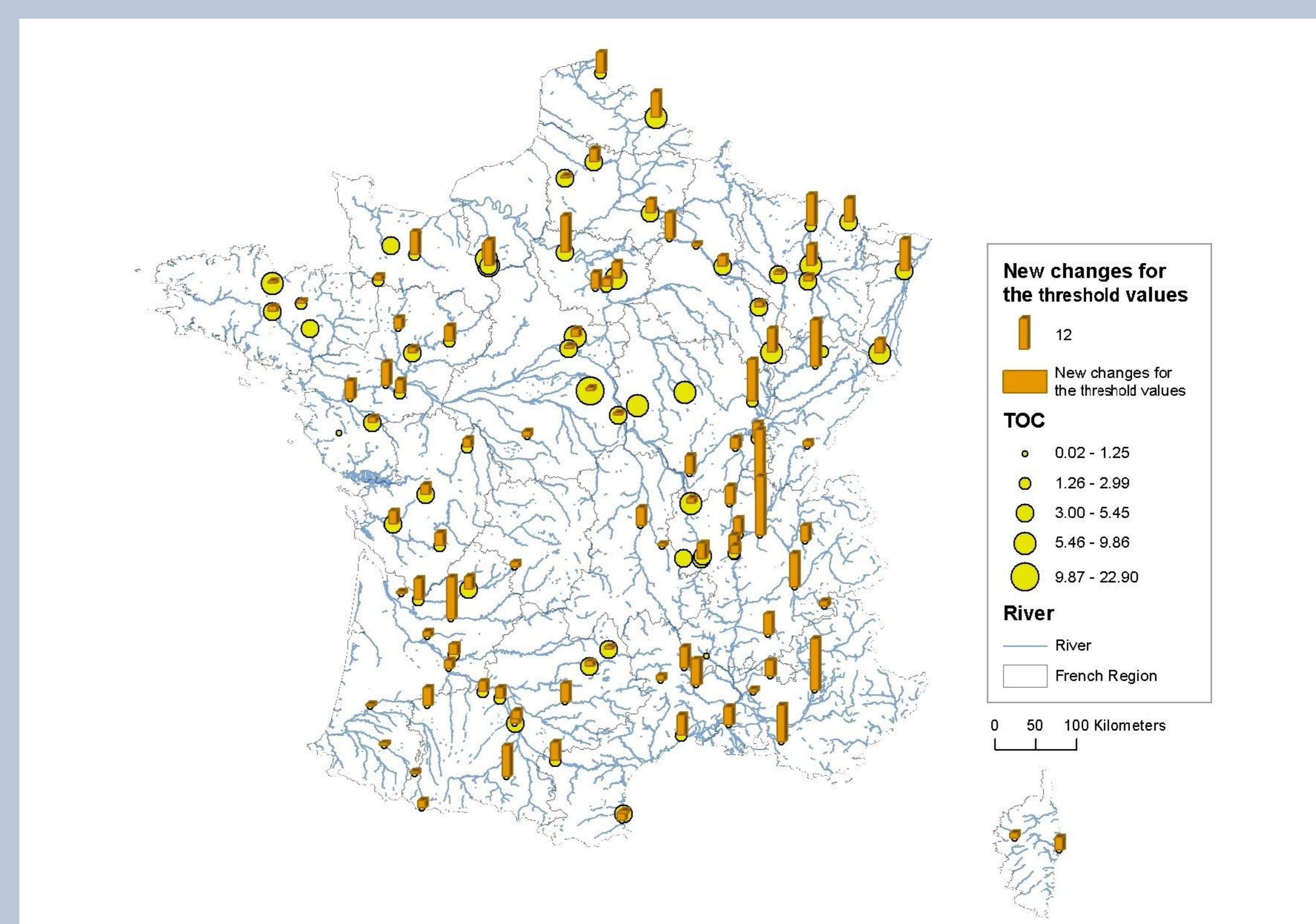
Moselle river by Axel Mauruszat (source Wikimedia Commons).

The figure below develops the relation between the bioavailability of a substance represented by its Koc and the effect of measured TOC on QS_{SED} extrapolation. Each blue spot represents the ratio of a QS_{SED} obtained with measured TOC and the default QS_{SED} (with TOC = 5%). The exercise was realized on seven compounds with an expected increasing bioavailability².



In-the-field TOCs have more impact on QS_{SED} calculation for chemicals with high Koc (less-bioavailable compounds).

Unexpectedly low in-the-field TOC suggests that all the bioavailable fraction of the substances had not been taken into account. QS_{SED} had been reevaluated for all the chemical substance with a formula containing appropriate measured TOC for each station. The figure presents **the number of substances that were not above the Quality Standard but are now that local bioavailable fraction is estimated.**



²: (Substance; Koc): (Iprodione; 52) (Prochloraz; 500) Pendiméthaline; 5012) (Tetrabromobisphénol A; 49730) (Acide perfluoro-décanoïque; 527600) (Coronene 6349000) (Penfluridol; 3400000).

Aknowledgements:



Reference :

- Water Framework Directive (2000/60/EC)
- Technical guide for deriving quality standards – Guidance Document No.27 – Technical Report 2011 - 055

Conclusions and Perspectives

- Bioavailability in sediment might be underestimated in the context of the WFD.
- Measured TOC has more influence on Quality Standard calculation for highly adsorbed chemical substances.
- To take account of the measured fraction of organic matter in France could lead to experience more over threshold situation.
- Further investigations: No correlation had been established between ecological status of stations and exceedance situation (with measured TOC and generic TOC). The impact of hydrographic parameters, such as suspended matter fraction and stream width, is supposed to be very high in understanding these non-correlations. To make categories of similar streams could contrast and enlighten relations between ecological status and bioavailability.