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Use of passive and active tracers in the biogeochemical-3D hydrodynamical ECO-MARS3D model to assess the role of river inputs on coastal zone of France, British Channel and southern North Sea

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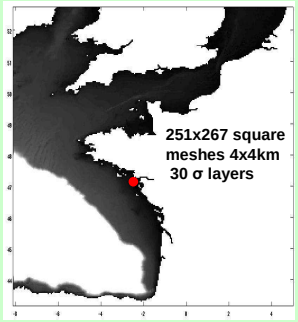
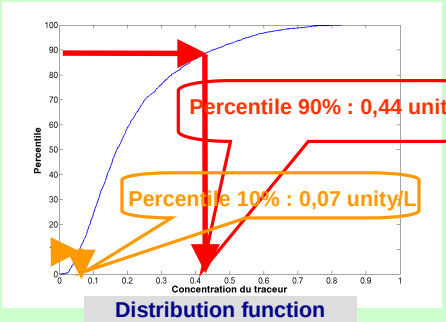
Passive tracking method (hydrodynamical model alone)

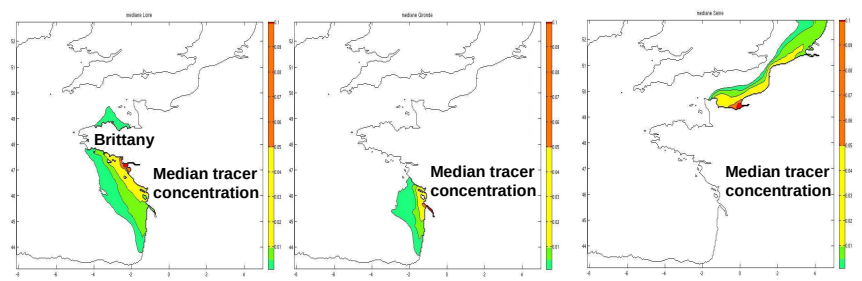




Distribution function

- **Conservative tracer (concentration 1) set only in the tracked river.**
- **The model ECO-MARS3D provides for each mesh of the domain daily values of tracer from 2000 to 2007.**
- **The distribution function of the 2920 values is calculated for each mesh of the surface layer.**
- **percentile 10, 50 and 90 are deduced.**

Examples of statistical marine (median) receiving area of some watersheds of the domain



Loire river | Gironde river | Seine river

Loire and Gironde rivers impact mainly the continental shelf of the bay of Biscay. Loire's marine area extends from the Gironde to the south of Brittany (dilution from 10 to 100 times) and can reach the north of Brittany. The Seine river impacts the Eastern English Channel (dilution from 10 to 100 times) and the Belgian and Dutch coasts of the southern North Sea (dilution between 100 and 200 times).

Active tracking method (biogeochemical model): Tracking any evolutive signature in a distributed trophic network

For the biogeochemical state variable B_i, having the signature $S(B_i)$:

• the current mass evolution equation is:

$dB_i/dt = sources(B_1,B_2,..B_n,t) - sinks(B_1,B_2,..B_n,t)$

• the new « signed mass » evolution equation is:

$dBs_i/dt = sources(B_1,B_2,..B_n,t) \times S(source) - sinks(B_1,B_2,..B_n,t) \times S(B_i)$

• the signature $S(B_i)$ is:

$S(B_i) = Bs_i / B_i$

Previous applications:
* age and birth place of diatoms (Ménesguen et al., 1997 MEPS)
* nitrogen origin in ulva mass accumulations (Ménesguen et al., 2005 Limnol. Oceanogr.)

If $A(Bs_i)$ is the mean age of the « signed mass » Bs_i:

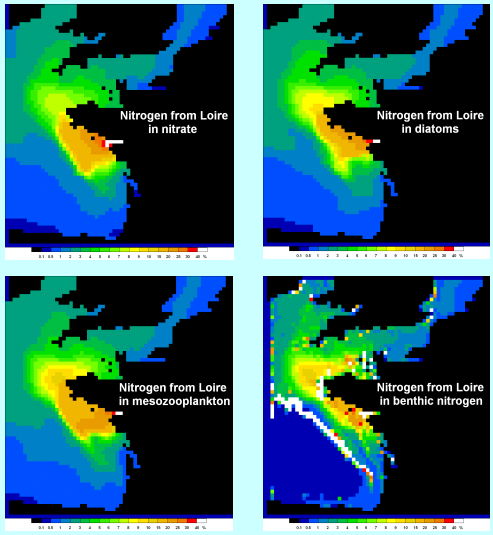
• The new « signed and aged mass » equation evolution is:

$dBsa_i/dt = sources(Bs_1,Bs_2,..Bs_n,t) \times A(source) - sinks(Bs_1,Bs_2,..Bs_n,t) \times A(Bs_i)$

• The age $A(Bs_i)$ is:

$A(Bs_i) = Bsa_i / Bs_i$

Examples of nitrogen tracking (for the Loire river)

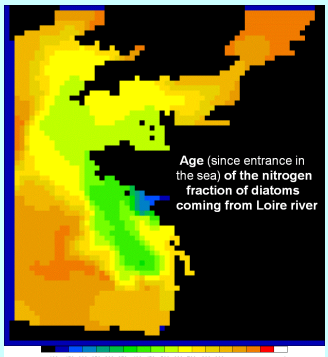


2003 annual mean of the percentage in 4 compartments of nitrogen coming from Loire river

The pattern of the percentage of nitrogen from Loire in each compartment is very similar to the statistical marine receiving area described above. The percentage of nitrogen coming from Loire river is :

- between 20 and 30% (aged of less than 1 year) in the area closed to the estuary
- around 5-10% (aged of about 1.5 year) in the Western Channel
- about 2 % (aged of about 3 years) in the entrance of the North Sea.

When going into more and more higher trophic levels (nitrate=>diatoms=>mesozooplankton=>benthic detritus), the percentage of nitrogen coming from the Loire river increases in the entrance of the Channel.



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