## Dynamic modelling of Macrophytes in a large lowland river and Ecohydrological perspective.





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#### Study site







# Why Macrophytes?

- One of the Bio-indicator selected by the EWFD
- Biotopes for periphyton, invertebrates, fishes...exotic sp.
- Play a role in nutrient biochemical cycling
- Biomass seems to be controlled by river flow variability

#### Working hypothesis

- Cannot avoid hydrological stress
- No clear selectivity with substrates , local geomorphology
- Nutrient is not a limiting factor
- Integrate past habitat conditions



## Field data collection





## **Biomass indicator variability**





## Biotic memory (or response time)

Mean value of hydrological indicators (T, V, D, \*) were calculated on past days from each biotic sampling date

Selected past durations

(in days) :

1, 2, 4, 8, 16, 32, 64, 128, 192, 256, 365



(\*) : % scoured area = mechanic effect linked to floods defined here as the % of flow velocity exceeding 1m/s



## **Biotic memory**



a single or a combination of the abiotic factors!

## Biotic Growth Model (BGM)

## hypothesis

« the macrophyte population dynamics is a non linear growth process»



Can deviations from the model result from hydrological factors?

Cemagref

## Abiotic deviation model

Deviation model

$$\frac{d\omega H}{dt} = aV_1d + bV_2d + cV_3d \dots$$

(*d* is the memory length)

Model parameters fitted by a forward stepwise regression

*VH*: 1/D4, 1/exp(D4), 1/D2, D2, D16, D192, D256, V192, V128 R<sup>2</sup>: -0.35, +0.61, ......-0.97,.....+1.00

Water depth (D) is the main explicative physical variable

The deviation model mainly relies on short term memory variables!

The growth model and the deviation model were coupled to simulate the biomass dynamic along the five years of sampling



## Coupled model result



Magnitude and growth gradient are well simulated Shifts in time (re-colonisation not integrated in the model)

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# Summary of results

- Phanerogames biomass dynamic seems to depend both on :
  - (i) Cumulative effect (tennies to hundreths of days)
    - Water Temperature, Flow velocity which are integrated in the biotic growth model (biotic memory study)
  - (ii) Short term effect (several days)
    - Water depth (and combined variables) which controls rapid fluctuations of the growth
  - (iii) Initial hypothesis are broadly validated
- Perspective : test of scenarios based on flow regime manipulation to limit their development (keep biodiversity) but considering their nitrogen uptake efficiency in time and inside the whole river biota system.



# Merci de votre attention



## Macrophytes effect on bed roughness





Figure 25 Profil en travers des vitesses sur la section P1 (novembre 2005)

