Modelling nutrient emissions in freshwater at different scales and for different objectives

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1. Agrohydrological modelling

- **Heuristic perspective**, large variability of model structure depending on objectives
  - To estimate the distribution of the transit time, or the retention for example.
- **Operational perspective**, as decision support tools
  - To test innovative scenarios of agricultural changes and contribute to defining a strategic vision for a catchment.
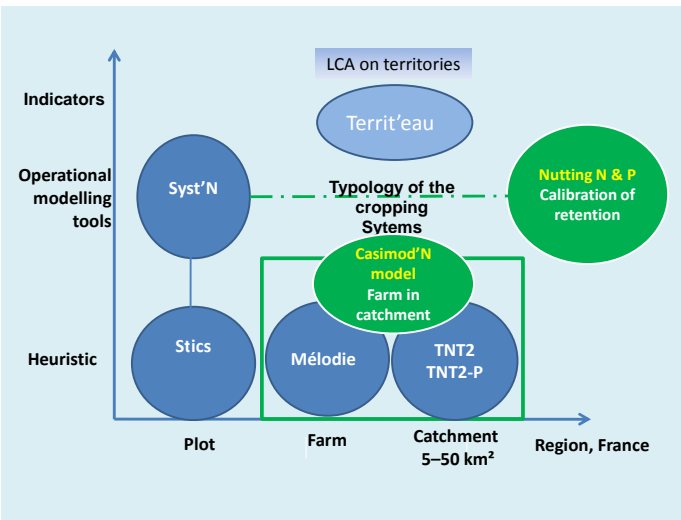

2. Casimod'N, a model to test changes in farming systems in a consistent way

- Feeding the cows to sustain milk production (main income)
- Being able to manage animal waste according to regulations
- Sustain the economic margin by compensating every loss of income by a decrease in charges

CASIMOD'N
grass R² = 0.82
silage maize R² = 0.72
grain R² = 0.91
straw R² = 0.87
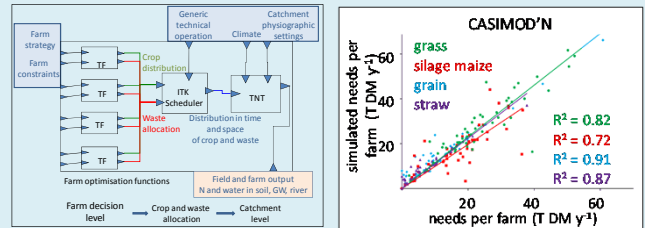
- Design simple indicators to set objectives and guide the changes
  - Explain the rationale and the feasability of the objectives
  - Find voluntary farmers to implement changes in real farms
- Assess, with the model, what would be the impact of generalising the changes to all the farms in the catchment (« what if » scenario).
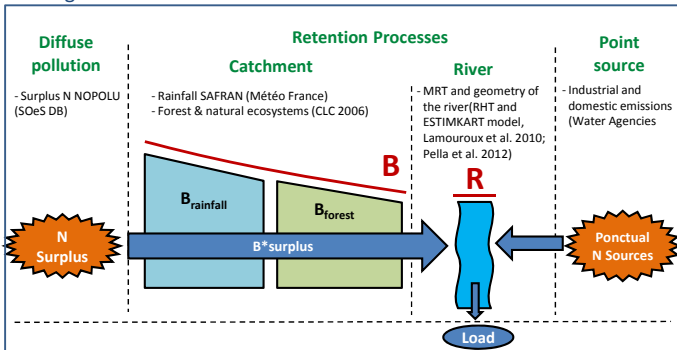 - Next iteration…
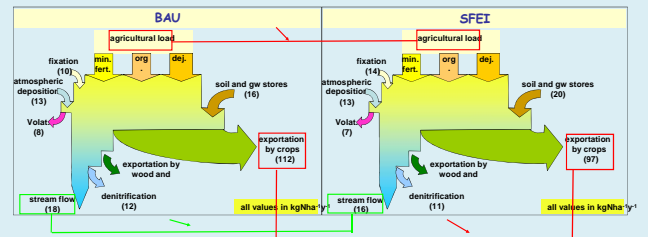
The model outputs suggest a 20% reduction in stream nitrate fluxes without affecting milk production.

## 3. Nutting-N and P models at regional and national scale for defining areas at risk

$$TP\ Load = (B * Ptopsoil + Ppoint) - retention_{benthic}$$

$$TN\ Load = (B * Nsurplus + Npoint) * R - denit_{benthic}$$

Nutting'N model

Diffuse pollution
- Surplus N NOPOLU (SOeS DB)

Retention Processes
Catchment
- Rainfall SAFRAN (Météo France)
- Forest & natural ecosystems (CLC 2006)

River
- MRT and geometry of the river(RHT and ESTIMKART model, Lamouroux et al. 2010; Pella et al. 2012)

Point source
- Industrial and domestic emissions (Water Agencies)

- A database of 160 headwater catchments and their attributes
- Attributes characterize N & P agricultural pressures and transfer variables (climate, soil, IDPR connectivity index, river geometry)
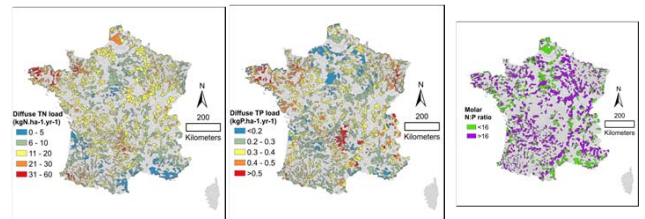
N Loads   **P Loads**

- Model fit (leave-one-out cross validation)
- Total-N: R²=0,59 (specific load) & 0,85 (global load)
- Total-P: R²=0,40 (specific load) & 0,70 (global load)

Agriculture contributes to 97% total-N load and 46% total-P load (national mean)

Perspectives
- A typology of agricultural systems, as input
- Ratio of types of systems per catchment
- Assess, with the model, what would be the impact of generalising the changes in farming systems (« what if » scenario).
- Next iteration…

Thanks to Onema (national water agency)and French water Agencies

The challenge of such models is to take into account a typology of agricultural and environmental systems so that scenarios can be easily and relevantly tested.

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