

PEGASE, A Software Dedicated to Surface Water Quality Assessment And European Database Reporting

Towards eEnvironment 2009

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Pôle de recherche
et d'expertise en sciences de l'eau

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Introduction

Aquapôle = **research centre** → expertise in water domain



- Public Admin.
- Industry

- Integrated water analysis & manag^t → sustainable development:
 - manag^t tools improv^t → ecological, economic and social stakes
 - Predictive models (e.g. **PEGASE** model)
 - support public and private operators in implementation of WFD
- Treatment and management of sewage effluents
- Analytic measurements of water quality
- Cooperation with Southern countries
- Knowledge of aquatic ecosystems & impacts related to pollution

Introduction (cont^d)



Pôle de recherche
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Software → characterisation of environmental
state of surface water

Main Partners → Public Authorities
of some European
countries
(authorities in charge
of surface water
management)



Development of **PEGASE**



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L'eau nous fait progresser. Faisons progresser l'eau

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PEGASE Model

Planification Et Gestion de l'ASsainissement des Eaux Planning and Management of Water Purification



Developed for 20 years, initiated by 3 Belgian universities

- OBJECTIVES:**
- Better understand the mechanisms of the hydro-system
 - Structure knowledge (including “Input Data”)
 - Quantify “pressure-impact” relationships and ease decision making

USAGE: 1) Simulation model of surface water

- watershed / rivers (→ extending “river” models)
- pollutants loads and discharges (→ data structuring)
- aquatic ecosystem and water quality (O₂, C, N, P, ...)

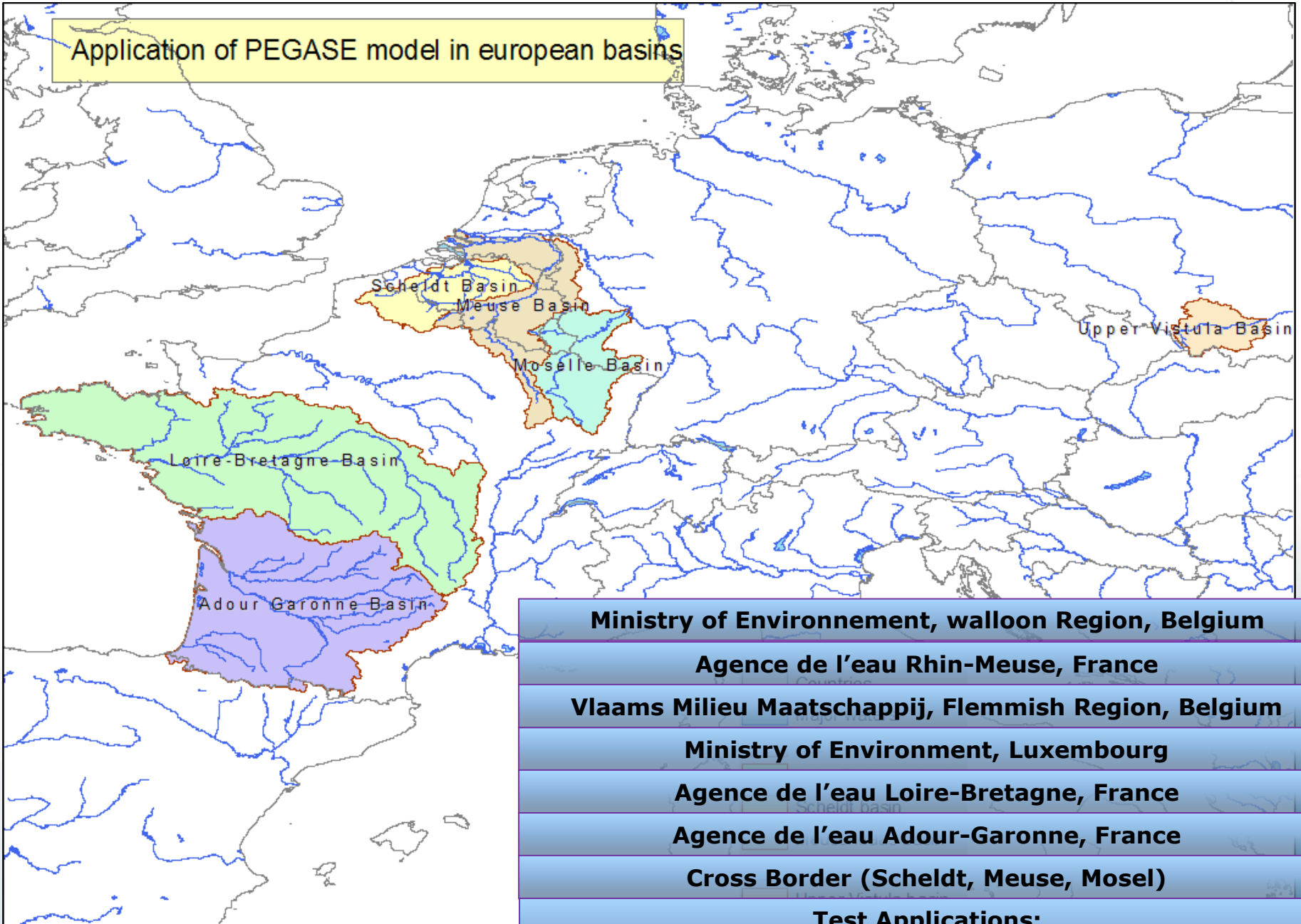
→ Deterministic model and physically based

2) Operational Decision Making Tool for

- purification and depollution
- management of aquatic environment quality

→ Continuous interaction with users

Application of PEGASE model in european basins



Ministry of Environnement, walloon Region, Belgium

Agence de l'eau Rhin-Meuse, France

Vlaams Milieu Maatschappij, Flemish Region, Belgium

Ministry of Environment, Luxembourg

Agence de l'eau Loire-Bretagne, France

Agence de l'eau Adour-Garonne, France

Cross Border (Scheldt, Meuse, Mosel)

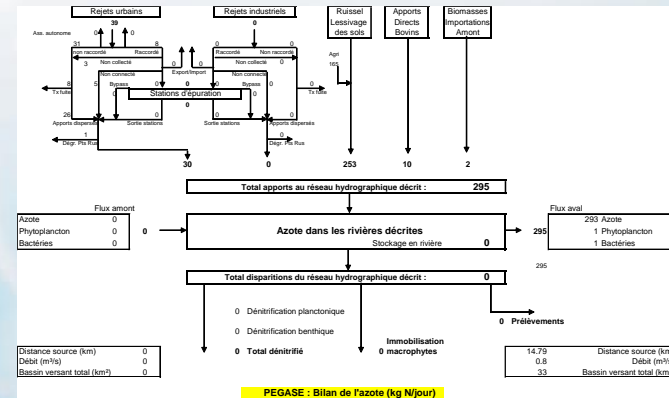
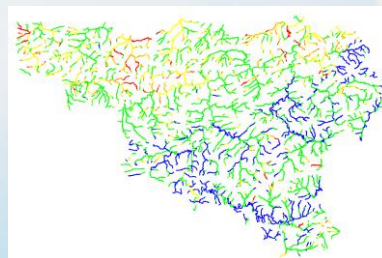
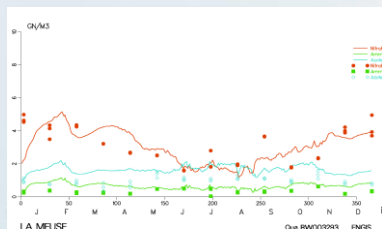
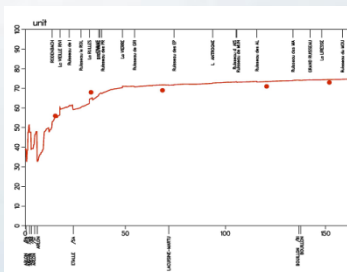
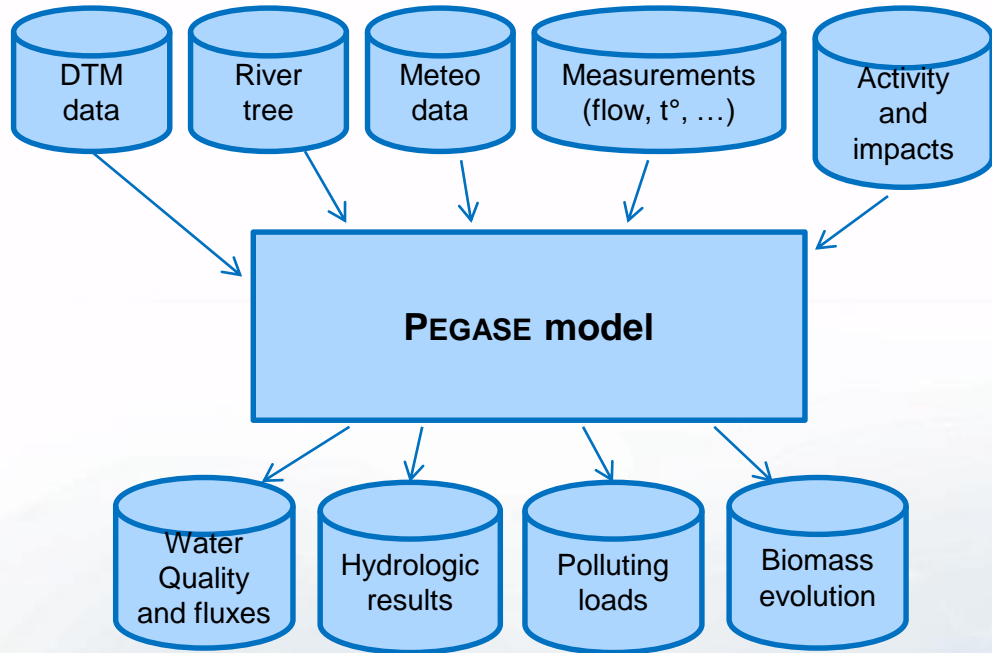
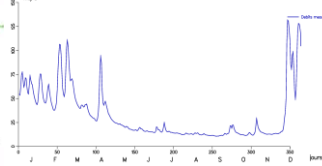
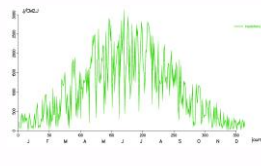
Test Applications:

Upper Wisla (Poland), Itajai (Brasil), Nicolet (Canada)

PEGASE Working Scheme



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L'eau nous fait progresser. Faisons progresser l'eau

PEGASE Model Features



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- Integrated model for rivers & watershed
- Simulation a few km² → several 100 000 km²
- “Refined” Description of river tree (actually ~3000 rivers)
- Developed in collaboration with end users
- Complete Description of ecosystems (phytoplankton, bacteria...)
- “Coherent and complete” modelling of loads and discharges
- Stationary or non-stationary Simulations (several CPU hours for the latter)
- Globalisation of results per water bodies, ...
- Calculation of statistics for comparison (p90, mean,...)
- Complementary Modules → WFD (cost/efficiency, ..)

The Water Quality Model

Processes

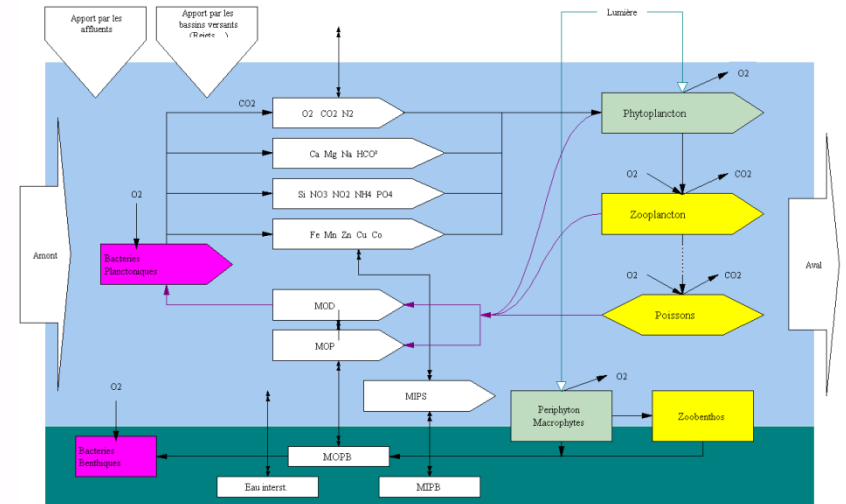
- primary production
- mortality, biomasses respiration
- degradation organic matter
- nitrification, de-nitrification
- re-aeration

Variables

- flows, velocities, transfer time in the hydrographical network
- temperature
- concentrations : **OM, DOC, POC, COD, BOD, NH₄, NO₂, NO₃, N_{Kj}, P_{tot}, PO₄, dissolved O₂ (hourly) biomasses**

Results

- longitudinal results, temporal evolutions, maps & charts:
calculation of statistics (p90, ...), quality indices SEQ-Eau (French index)
- globalisation of results per river, per water body, per basin, ... :
flux, balances



Loads and Discharges

Estimates of loads and discharges (C, N, P)

Urban Releases

Equivalent-inhabitant

Consideration of abatements in treatment plants (measures or estimates)



Industrial releases

Inventory of discharges (fees, ...)



Cattle

“Accidental” direct discharge of Livestock (tanks, ...)



Diffuse Loads

Semi-statistical functions, region specific

= run-off x leaching concentrations

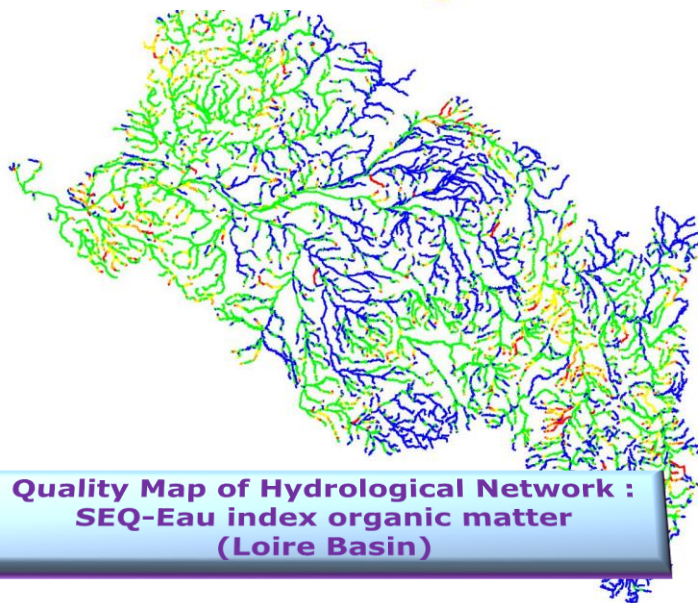
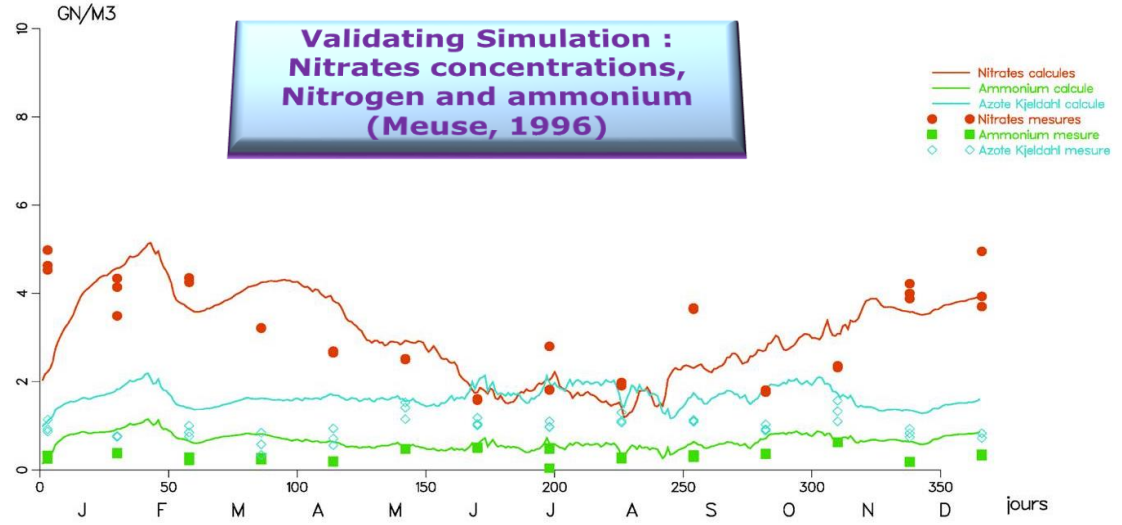
possibility of coupling with soils models



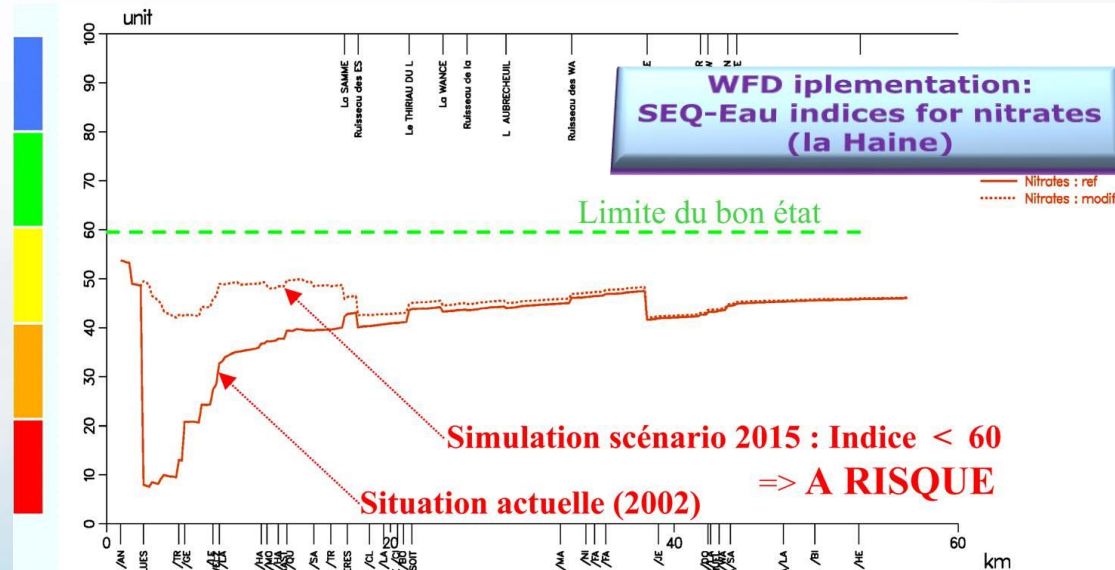
Example of Results



**Transnational Application :
DHI of the Meuse
(F, B, Lux, D, NL)**



**Quality Map of Hydrological Network :
SEQ-Eau index organic matter
(Loire Basin)**



Example of Results



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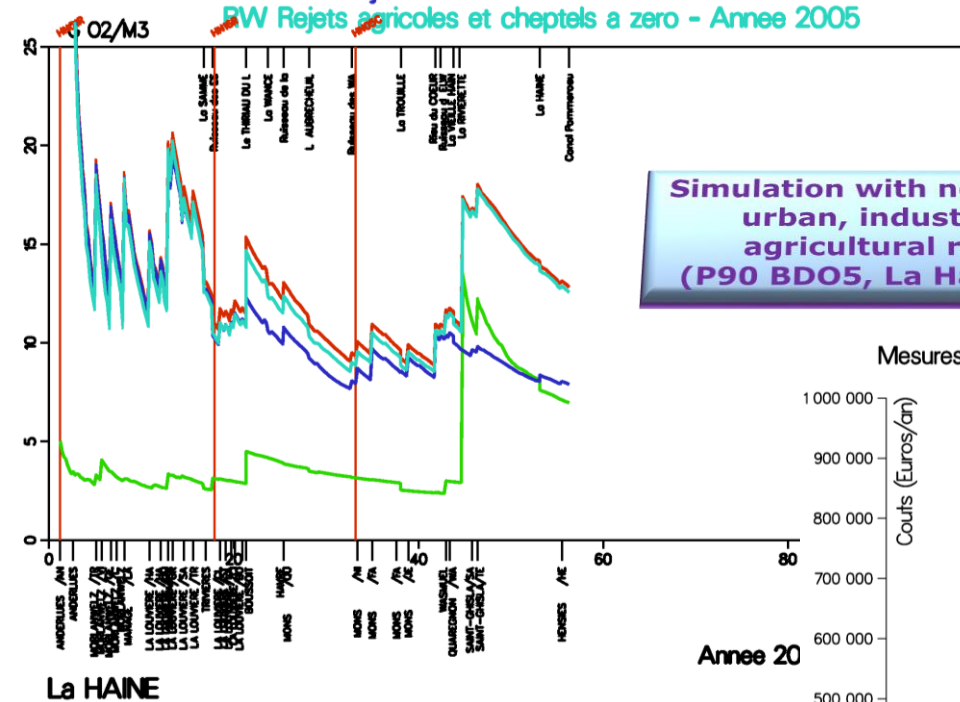
CONCENTRATIONS DANS LE RESEAU HYDROGRAPHIQUE "DBO5" CARBONE (GO2/M3)

RW Simulation de reference - Region Wallone

RW Rejets urbains a zero - Annee 2005

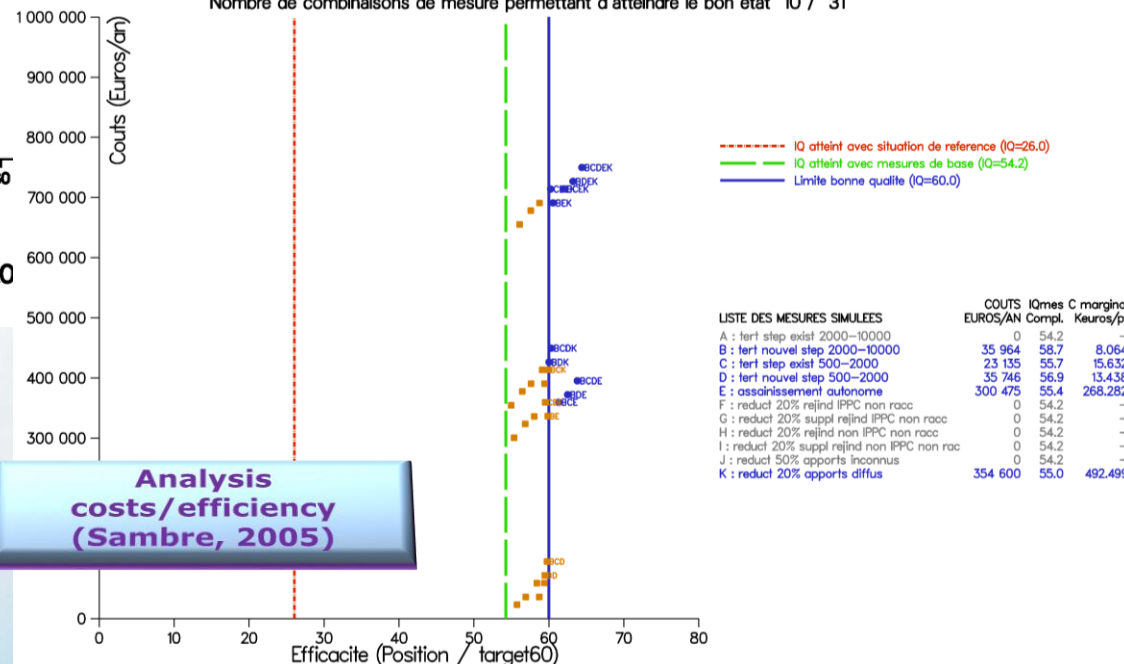
RW Rejets industriels a zero - Annee 2005

RW Rejets agricoles et cheptels a zero - Annee 2005



Simulation with no discharge: urban, industrial and agricultural releases (P90 BDO5, La Haine, 2005)

Mesures de base : Indice qualite minimum : 54.2 - parametre declassant : IMP_PO4
 Nombre de combinaisons de mesure permettant d'atteindre le bon etat 10 / 31



Analysis costs/efficiency (Sambre, 2005)

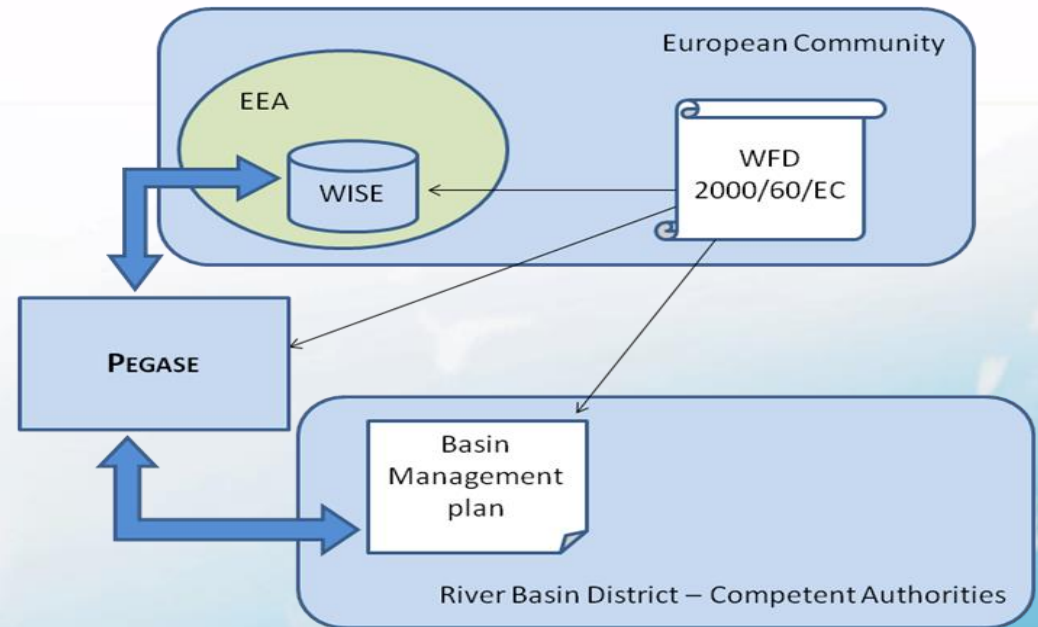
PEGASE ↔ EIONET



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Bring Pegase to Operational level for

- WFD compliance
- WISE databases usage/populating



PEGASE ↔ EIONET



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Extension of the **PEGASE** model:

- Add WFD compliance
- Export to WISE databases

Some competent authorities already use Pegase results for European reporting

→ to generate output data directly exploitable by WISE

→ to simplify water related reporting to EU

- Import from WISE databases

Data needed by Pegase are in WISE data set (e.g. EPER db)

→ read directly data from EU databases

→ “generic” import tool for EU countries

→ avoid manipulation mistakes

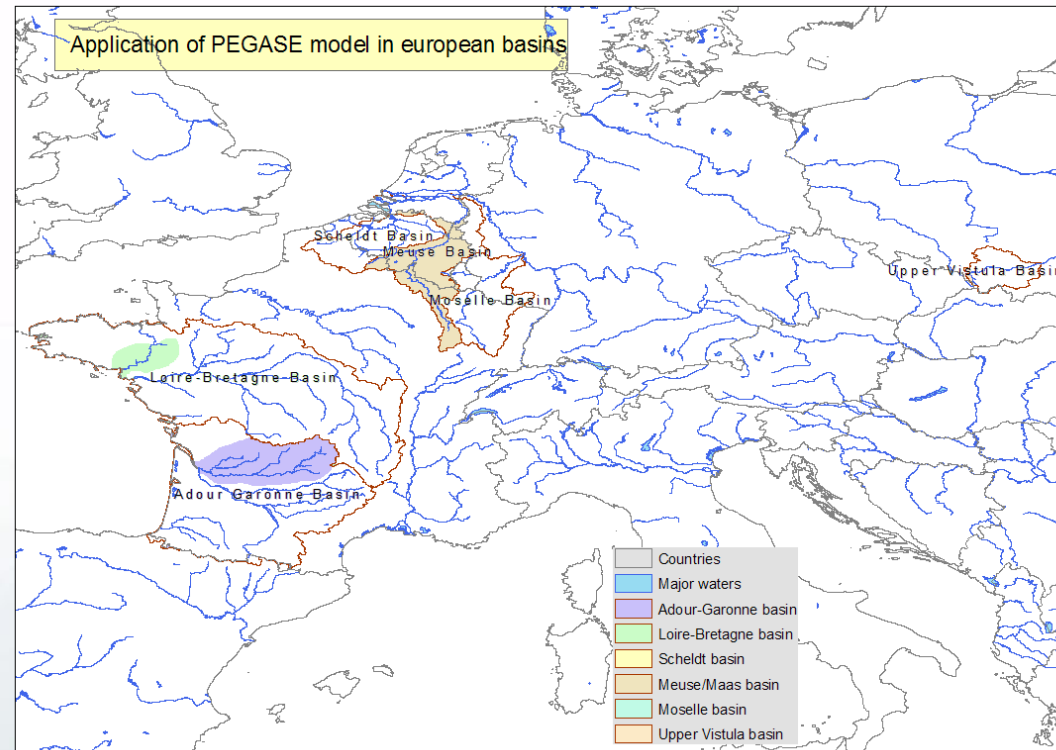
PEGASE ↔ EIONET



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LIFE+ Project proposed:

- Extension of the model
- Validation on use cases:
 - Vilaine/Dordogne national basin
1 country,
1 Comp. Auth. Each
 - Meuse international basin
5 countries,
9 Comp. Auth.
 - *TBD* basin in Eastern Europe (candidates?)



Conclusion: Value Added by Modelling



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- ✓ **Contribution to the implementation of the Water Frame Directive (2000/60/CE)**
 - Diagnostic of river and channel water bodies before and after considering various scenarios of measures
 - Extrapolation of locally sampled data to the whole set of water bodies
 - Analysis cost/efficiency of various combinations of possible measures
 - Support to programs of measures elaboration

- ✓ **Contribution of balances and diagnostics to interventions and specific valuations**
 - Establishment of intervention priorities (e.g. In the field of purification)
 - Technical support to administrations for local actions
 - Impact studies of treatment plant, industrial or urban releases
 - Geographical modulation of subventions and fees
 - Support to definition of actions at international level (cross-border basins)

Conclusion: Value added by Pegase



- **New way to manipulate the assessment of river quality, thanks to a precise, non stationary and physically based calculation, up to the level of a whole basin.**
 - **More precise knowledge of river network quality**
- **New way to assess the impact of measures taken to enhance the quality of targeted rivers, by performing simulations of scenarios on the basin, before physically building anything, and thus assess the cost/efficiency ratio of each solution.**
- **New operational way to help planning of measures several years before they are needed, allowing optimised lifecycle and cost in the realisation of these measures.**
- **New way to ensure the consistency of the data at international level.**
- **New tool to handle data from some WISE databases.**
- **New way to extrapolate discrete measurements (in time and space) to each water body by a sophisticated physically based calculation.**
- **A computer tool adapted to the new requirements imposed by the issue of the WFD and WISE, providing directly usable results to the decision makers.**



Thanks for your attention