Integrated modelling

What can we achieve,
what can we believe?

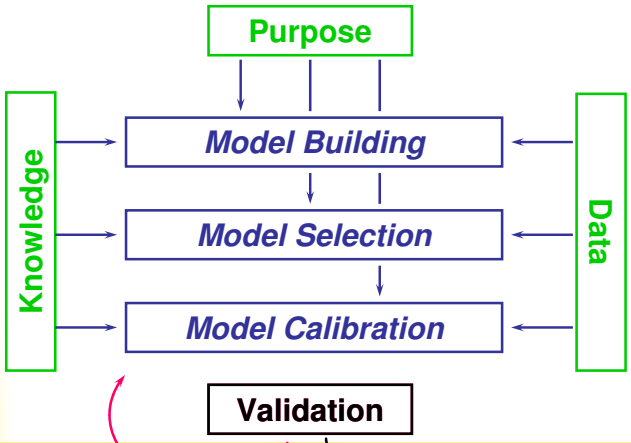
Dresden

CD4WC: Integrated urban wastewater management

July 3-4 2006

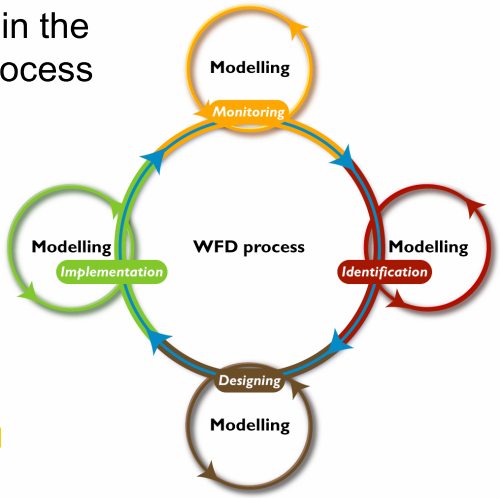
Peter Vanrolleghem

Modelling: Information sources



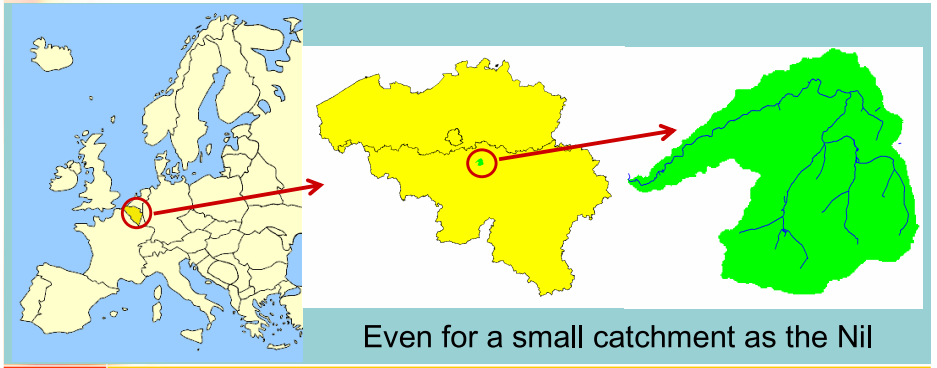
Integration of model purposes

- Models in the WFD process



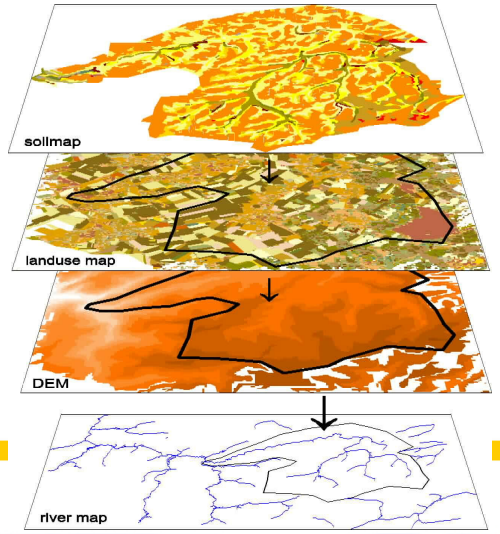
Integration of data sources

- River basin modelling requires a variety of data



Even for a small catchment as the Nil

Integration of data sources

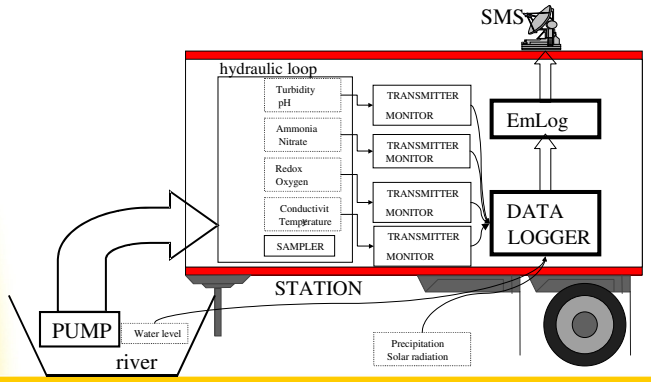


Integration of data sources

- Thanks to the WFD monitoring obligation, data quantity (and quality ?) is improving !
- What we need (for monitoring/modelling) is:
  - high frequency -
  - high quality data
  - over long monitoring periods
  - at low cost
- Automatic monitoring stations ?

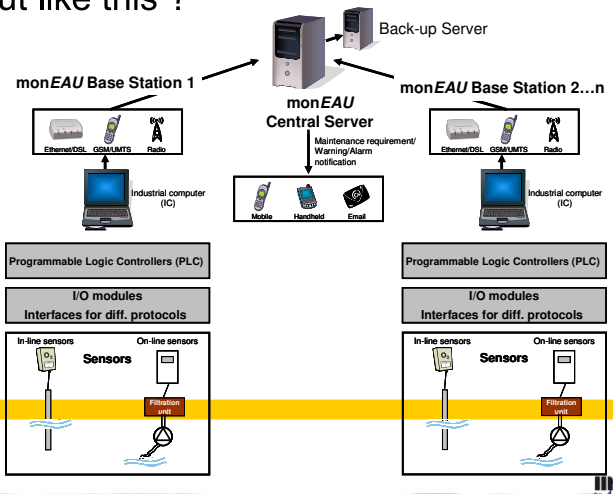
Integration of data sources

- Perhaps not like this …



Integration of data sources

- … but like this ?

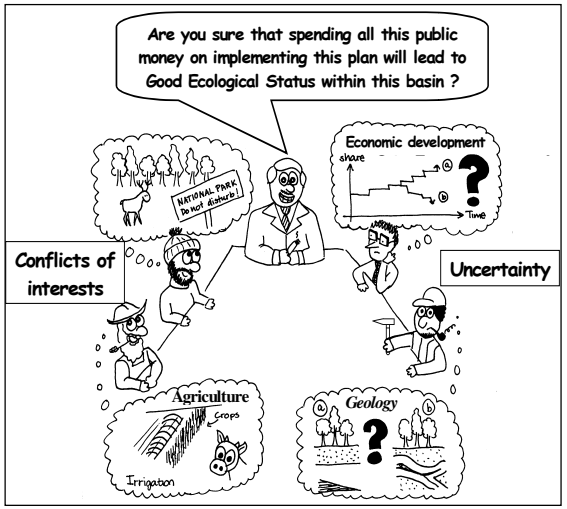


Integration of data sources

- Just be careful:

Data drowning…

Integration of knowledge

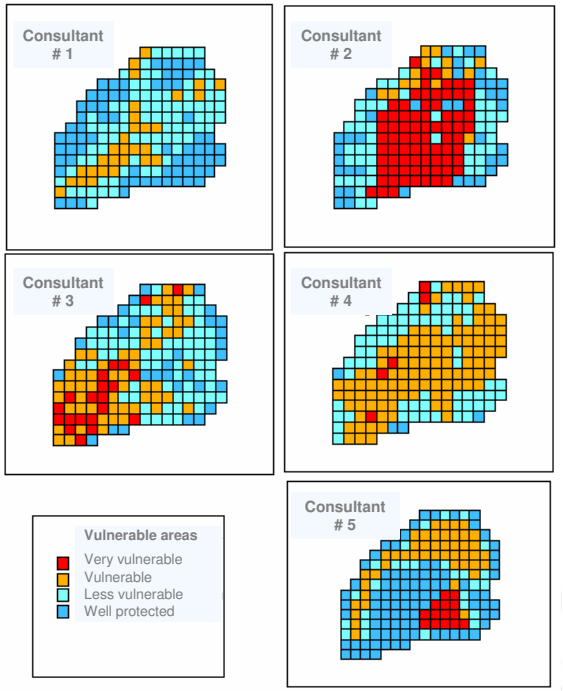


Integration of knowledge

- An example from a groundwater case study
  - provided by Jens Christian Refsgaard (GEUS)
  - illustrates the state of knowledge/expertise
- Good illustration of what we believe

Copenhagen County project on identification of methods to assess groundwater vulnerability (2000)

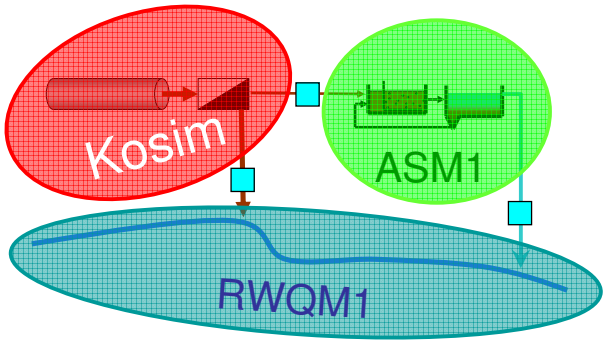
Assessments from five consultants on areas vulnerable to nitrate pollution from diffuse sources



Integration of knowledge

- An example from groundwater case study
  - provided by Jens Christian Refsgaard (GEUS)
  - illustrates the state of knowledge/expertise
- Good illustration of what we (think we can, but probably shouldn't) believe
- Good illustration of diversity in 'expert' opinions
- Anybody knows of such an exercise in urban wastewater systems ?

Integration of knowledge



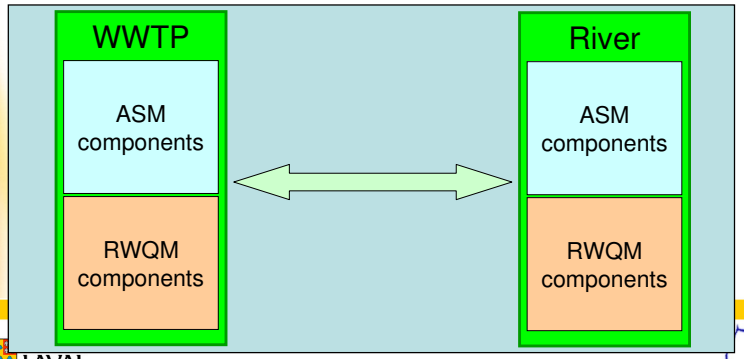
Model interfaces

Model interfacing

- Principles
  - Mass continuity (C, H, O, N, P, COD, charge…)
  - System-specific behaviour of components must be carefully considered (e.g. nitrifiers in effluent/river)
- Three approaches:
  - Supermodel
  - One-to-one interfaces
  - System Wide Model Interface

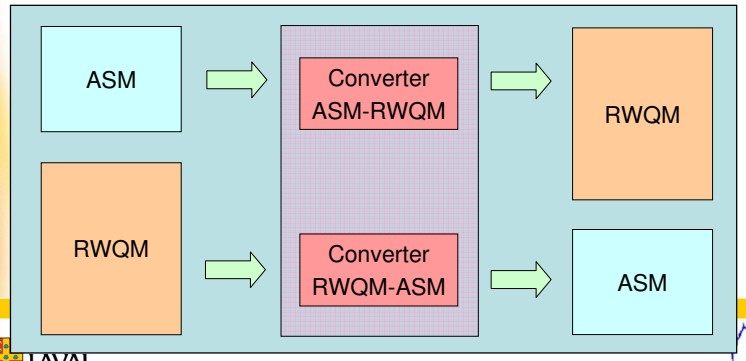
Supermodel approach

- All components are considered in each subsystem
- Behaviour must be described in each subsystem
- Not scalable when more subsystems are considered



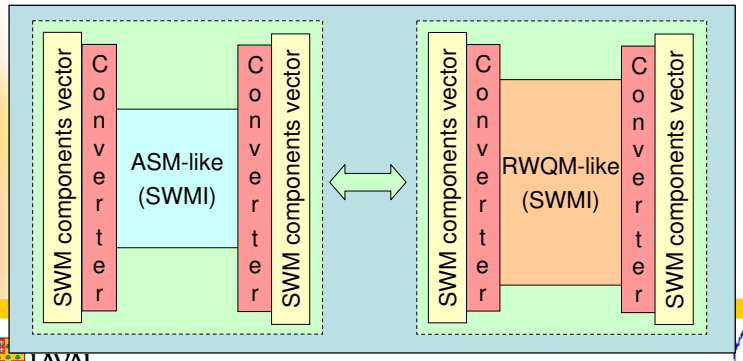
One-to-one interfaces

- For each model combination, 2 interfaces needed
- Nx(N-1)/2 interfaces for N models
- Generalized method to create interfaces exists



System-Wide Model Interface (SWMI)

- Bus: models have a "wrapper" to one interface vector
- 2xN interfaces, but if a new model: work to be redone
- Generalized method to create interfaces proposed



What do we believe ?

"We do not need complex hydrological models
which we do not understand and
where the output is known to be uncertain"

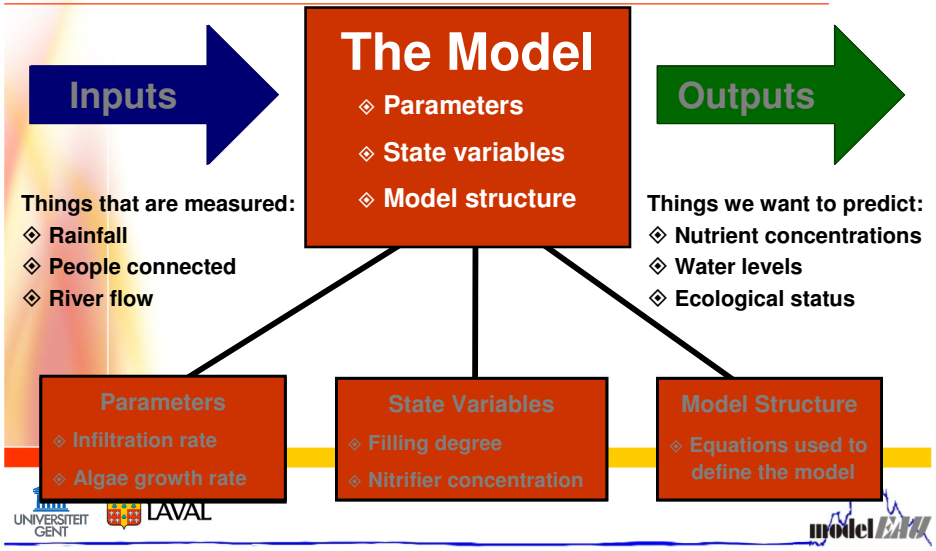
"Instead we want simple models that are reliable"

Statement from a water manager
responsible for implementation of the Water Framework Directive
(Harmoni-CA conference, Brussels February 2004)

What do we believe ?

- Before WFD, answers were given by scientists:
  - They spoke the truth,
  - the whole truth, and
  - nothing but the truth
- WFD has imposed the concept of uncertainty (which was already in EU risk assessment)
- We need to deal with it and learn about it

What is model uncertainty ?



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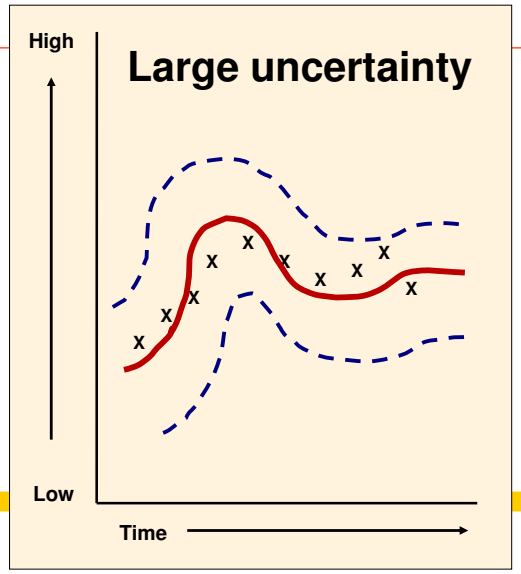

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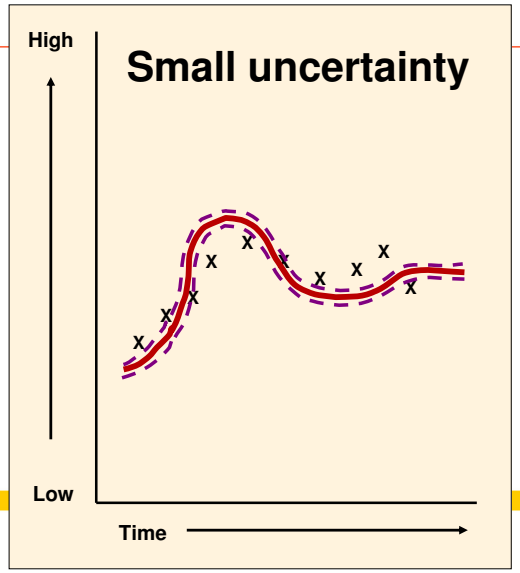

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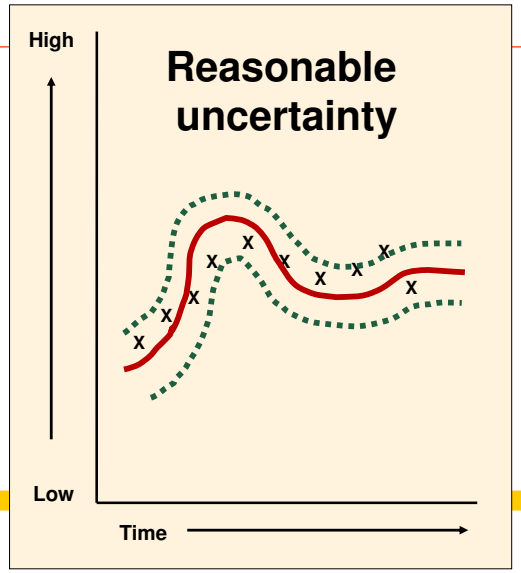

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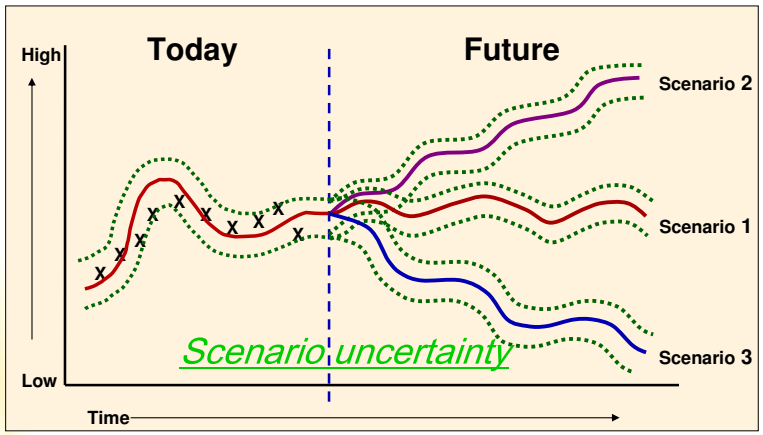
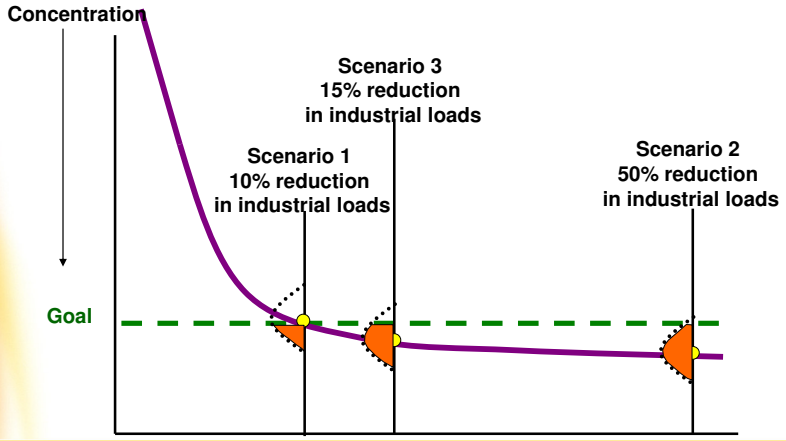
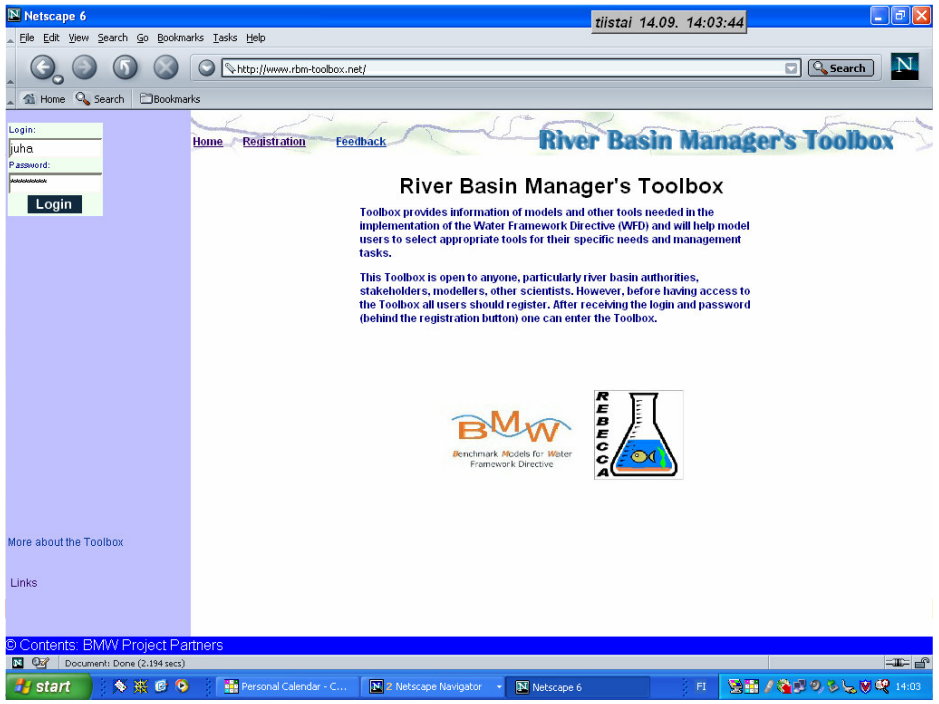


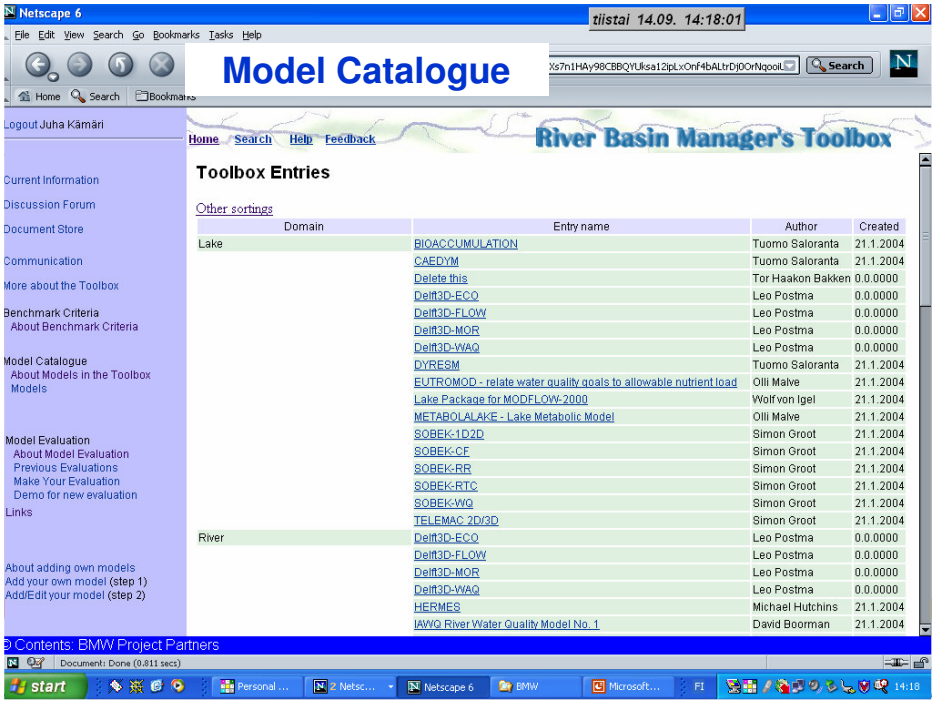
The cost of model uncertainty ?

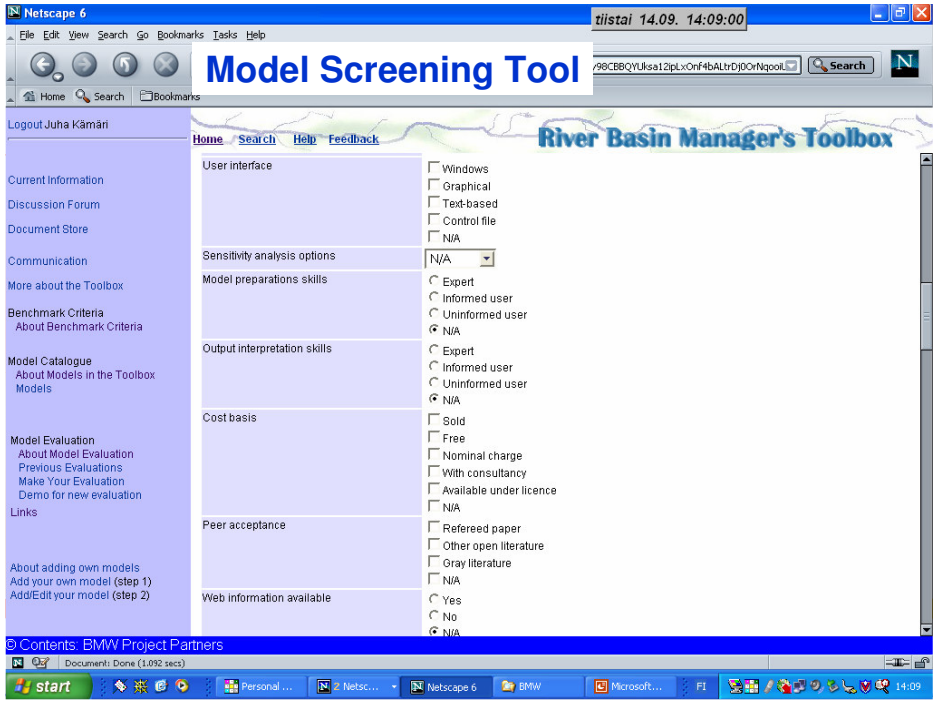


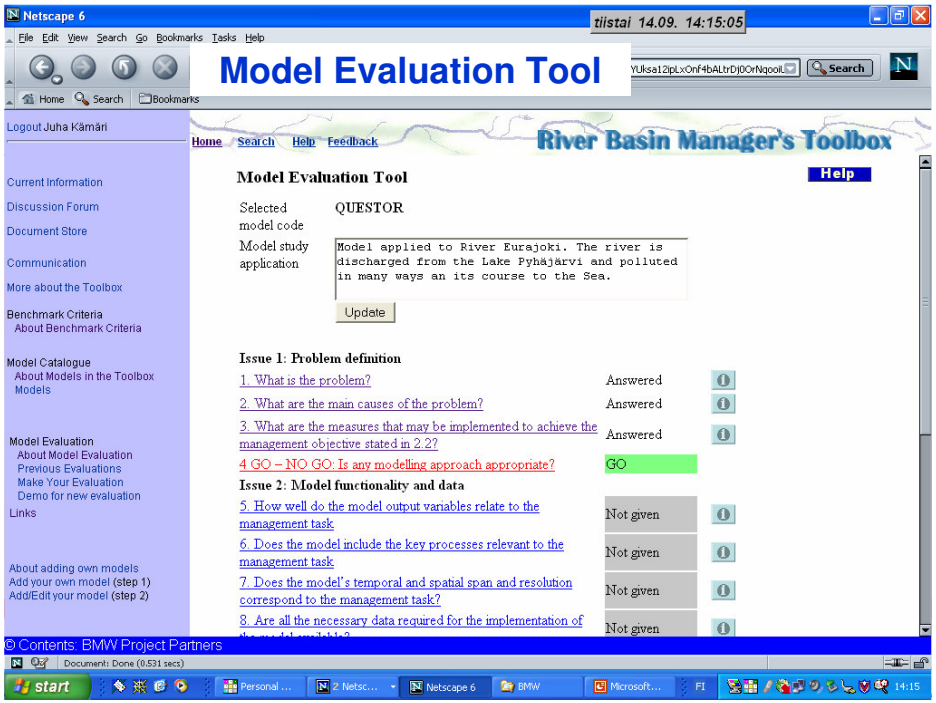
What can we achieve ?

- Models are available
- Model experience is documented and can be used for selection of adequate models









What can we achieve ?

- Models are available
- Model experience is documented and can be used for selection of adequate models
- Models can be connected

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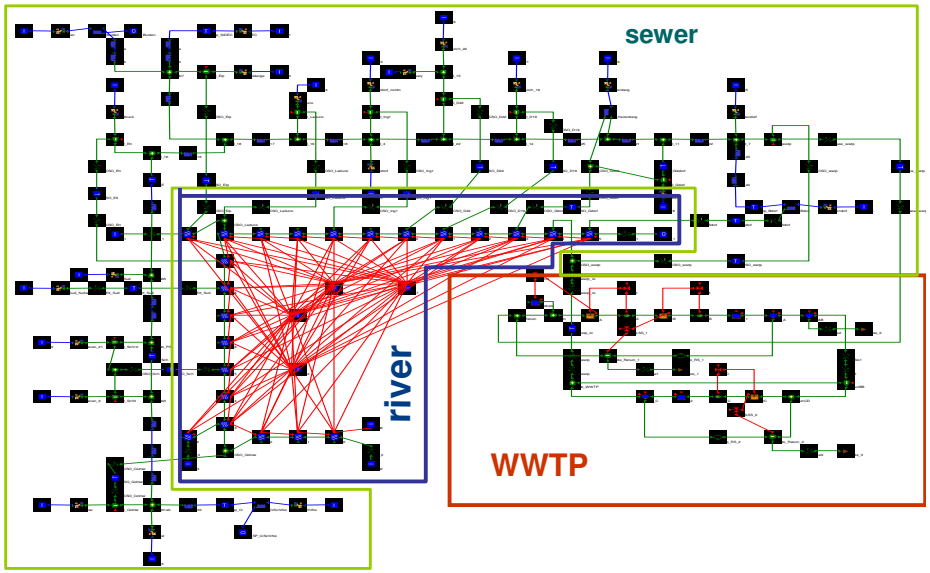
Bleesbruck case

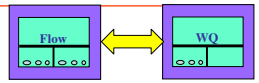


What can we achieve ?

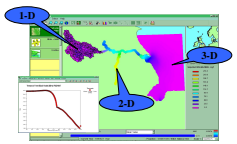
- Models are available
- Model experience is documented and can be used for selection of adequate models
- Models can be connected
- Softwares can be connected (OpenMI)

HarmoniT — Model linking issues

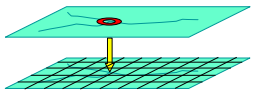
- Linking models of different processes



- Linking models based on different concepts



- Linking different spatial representations
- Linking models using different units



- Linking different temporal resolutions

=> OpenMI standard

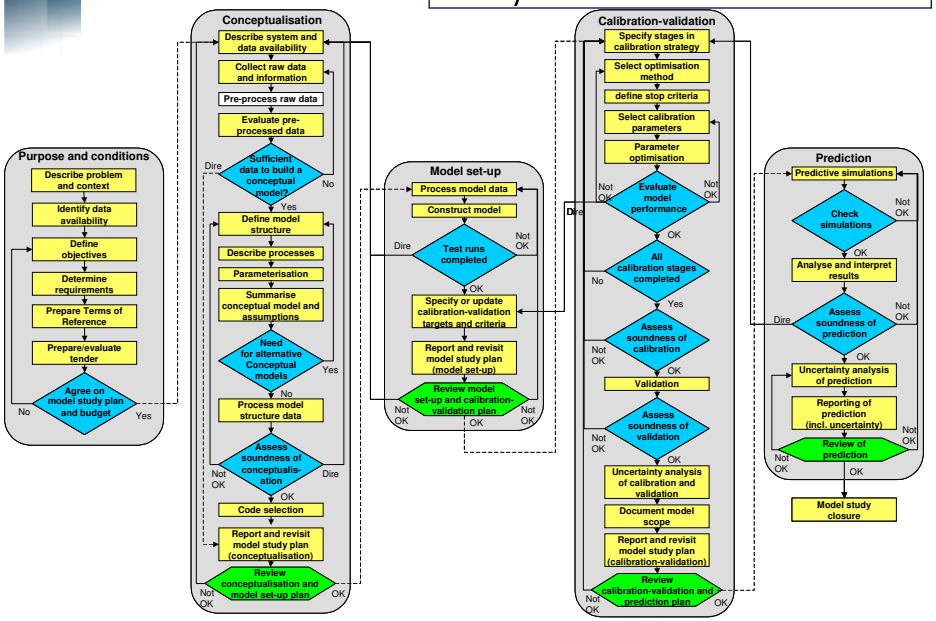
What can we achieve ?

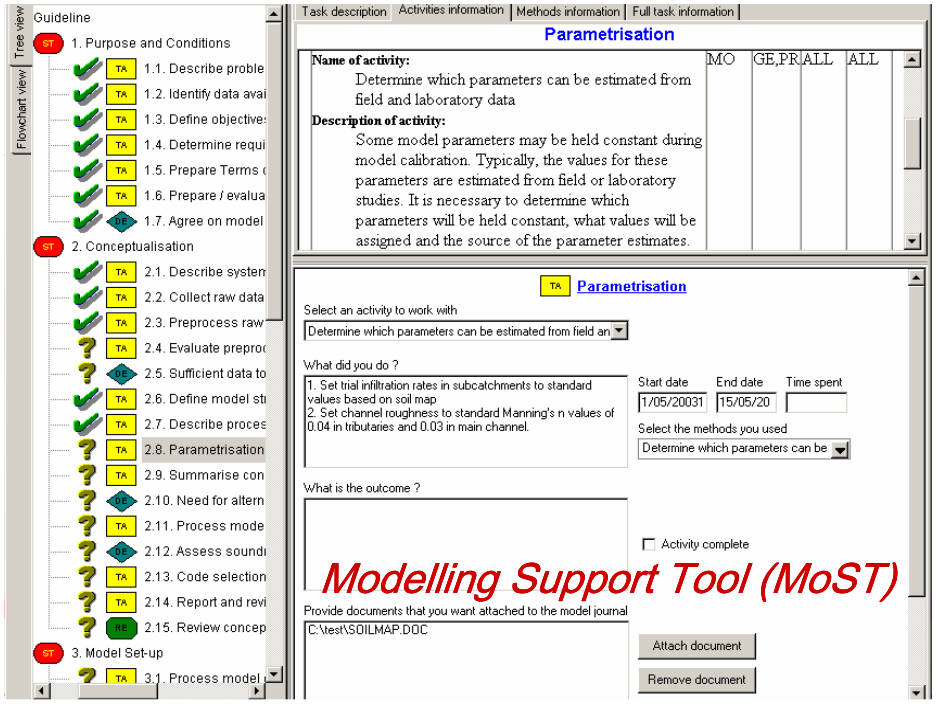
- Models are available
- Model experience is documented and can be used for selection of adequate models
- Models can be connected
- Softwares can be connected (OpenMI)
- Model building is supported by protocols (MoST)

HarmoniQuA

The modelling process

5 Steps ➔ 50 Tasks





Modelling Support Tool (MoST)

What can we achieve ?

- Models are available
- Model experience is documented and can be used for selection of adequate models
- Models can be connected
- Softwares can be connected (OpenMI)
- Model building is supported by protocols (MoST)
- Data quantity and quality is improving
- We can get an idea of what we can believe (UA)

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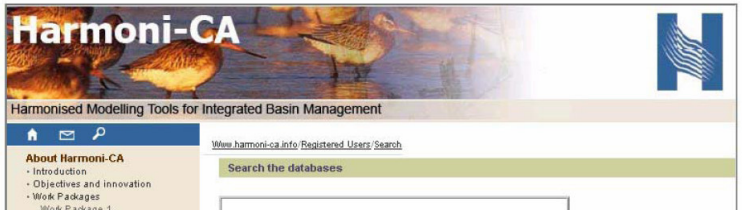
Harmoni-CA

Harmonised Modelling Tools for Integrated River Basin Management

A Concerted Action "hovering" over the CatchMod cluster of projects

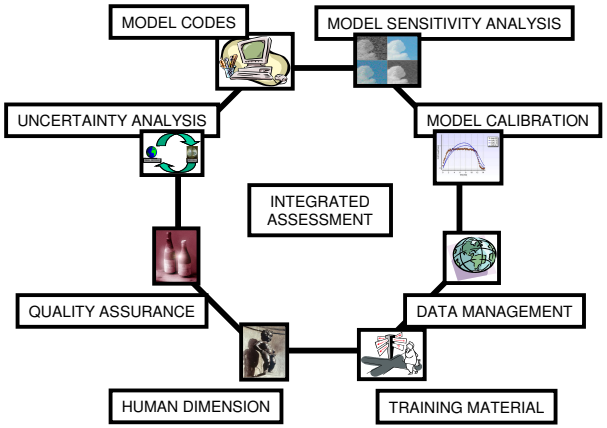
RIZA · UNIVERSITEIT GENT · PIK · GEUS · UNIVERSITÄT OSNABRÜCK

Harmoni-CA links to RBM-projects



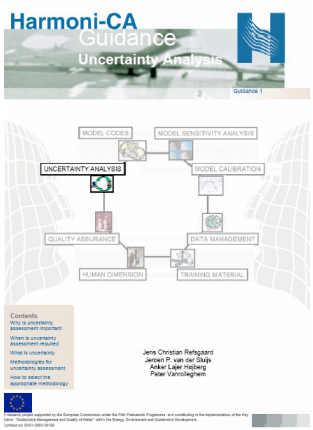
http://www.Harmoni-CA.info

Harmoni-CA Modelling Toolbox



Harmoni-CA guidance documents

- IWA Publishing series:
  - Uncertainty analysis
  - Sensitivity analysis
  - Model codes
  - Model calibration
  - Human dimension
  - Data management
  - Quality assurance
  - …



CD4WC fits in the Citynet cluster

http://citynet.unife.it