

Integrated modelling

What can we achieve,
what can we believe?

Dresden

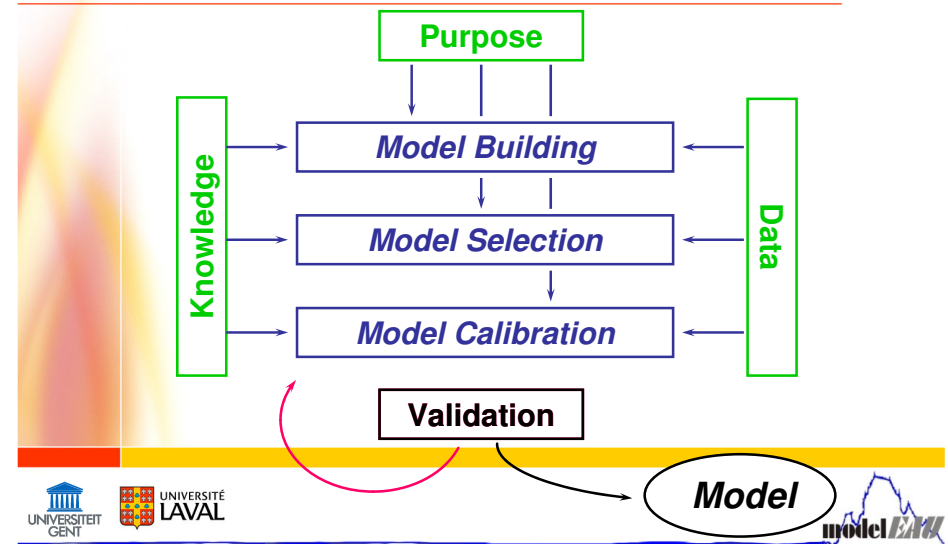
CD4WC: Integrated
urban wastewater
management

July 3-4 2006

Peter Vanrolleghem

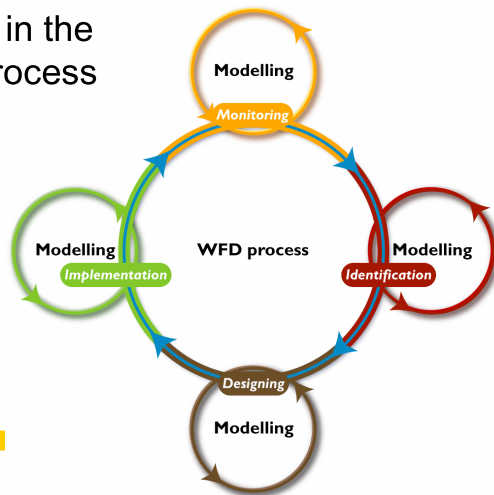


Modelling: Information sources



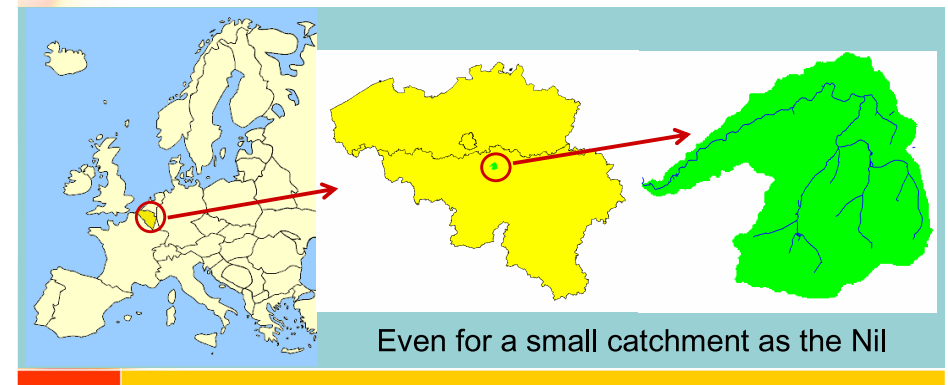
Integration of model purposes

- Models in the WFD process

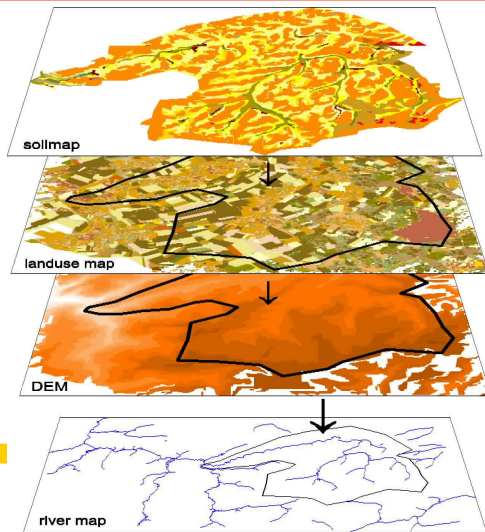


Integration of data sources

- River basin modelling requires a variety of data



Integration of data sources

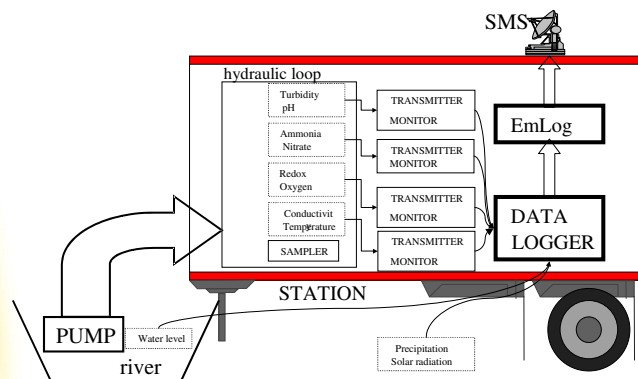


Integration of data sources

- 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 ?

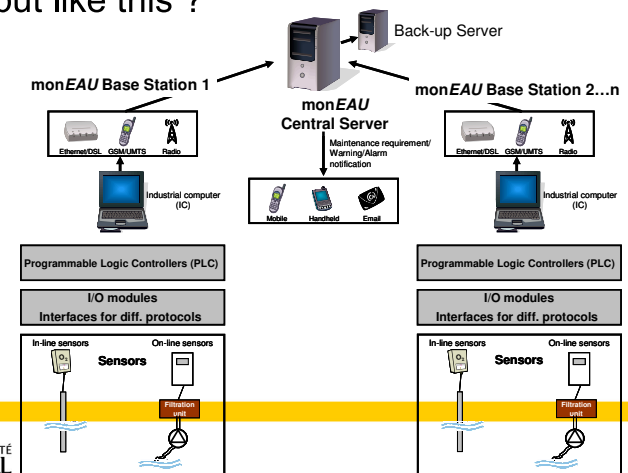
Integration of data sources

- Perhaps not like this ...



Integration of data sources

- ... but like this ?



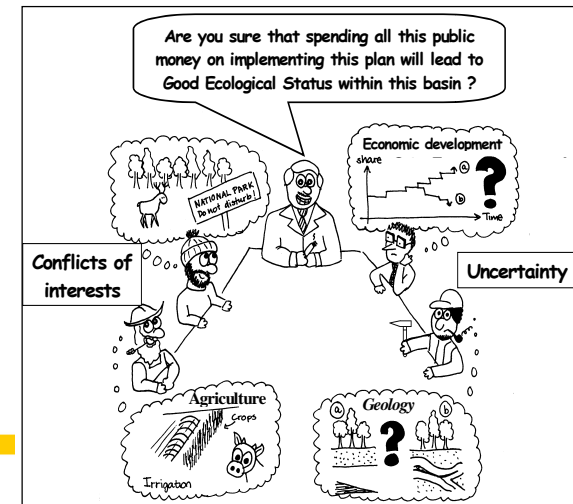
Integration of data sources

- Just be careful:



Data drowning...

Integration of knowledge

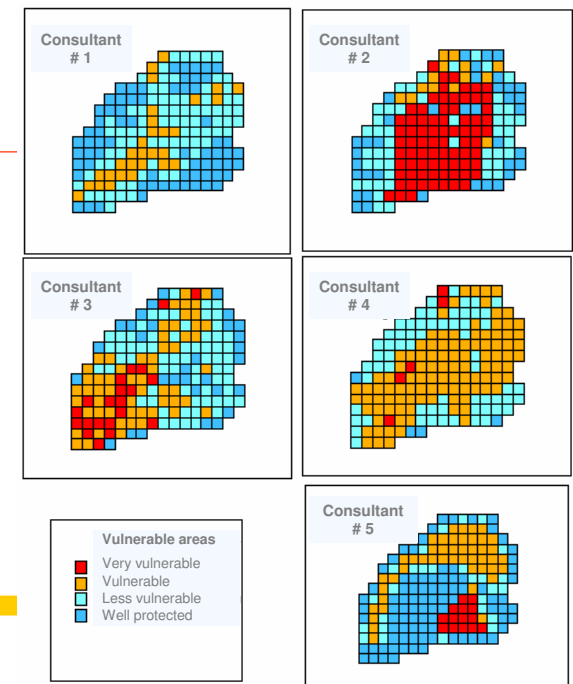


Integration of knowledge

- 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)

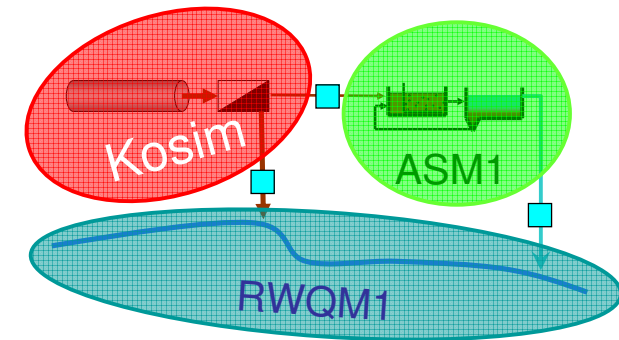
*Assessments from
five consultants
on areas vulnerable
to nitrate pollution
from diffuse sources*



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



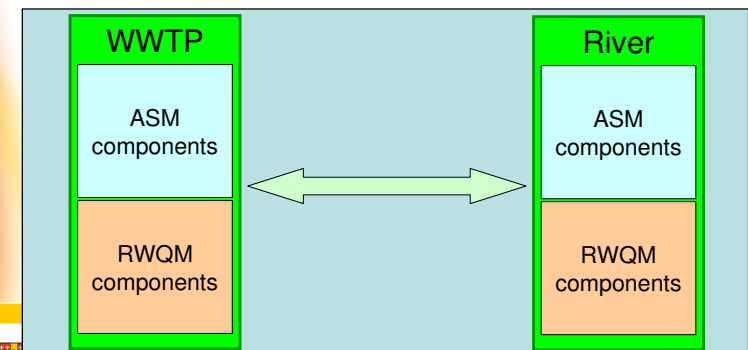
■ Model interfaces

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

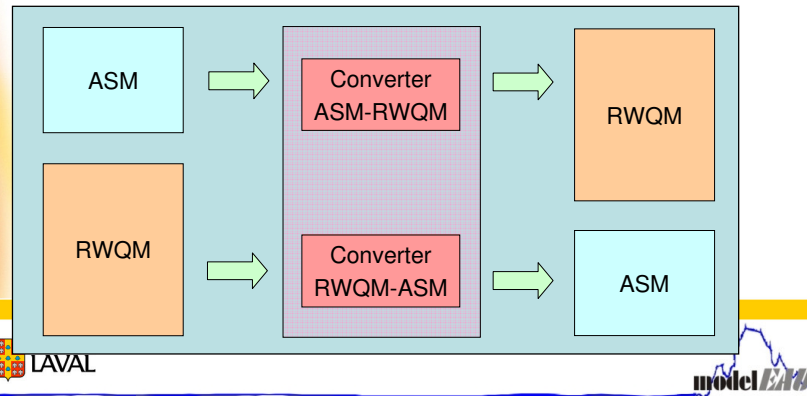
Supermodel approach

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



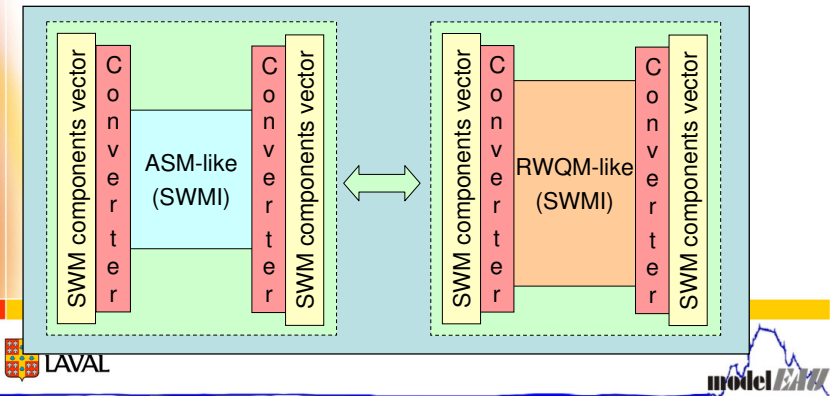
One-to-one interfaces

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



System-Wide Model Interface (SWMI)

- Bus: models have a “wrapper” to one interface vector
- $2 \times N$ 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”**

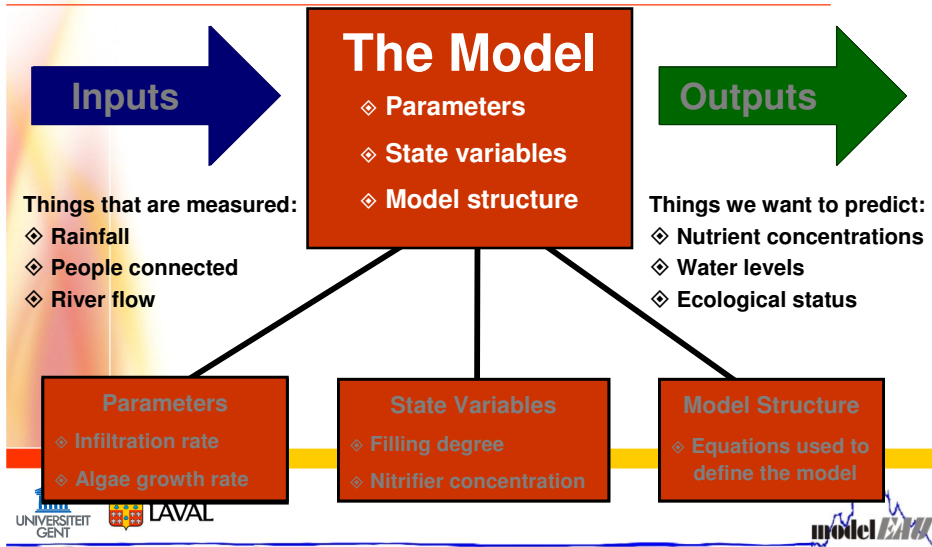
“Instead we want simple models that are reliable”

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

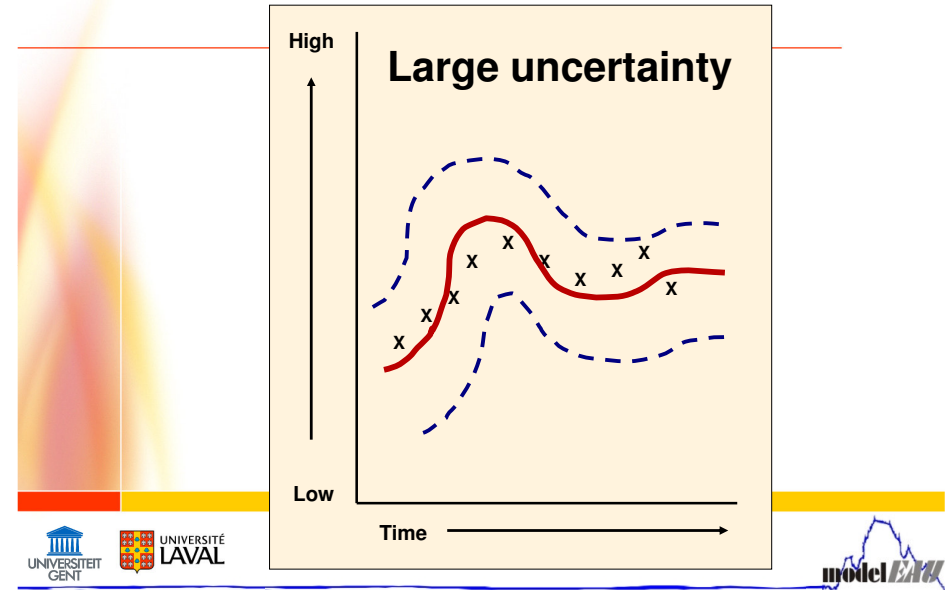
What do we believe ?

- 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

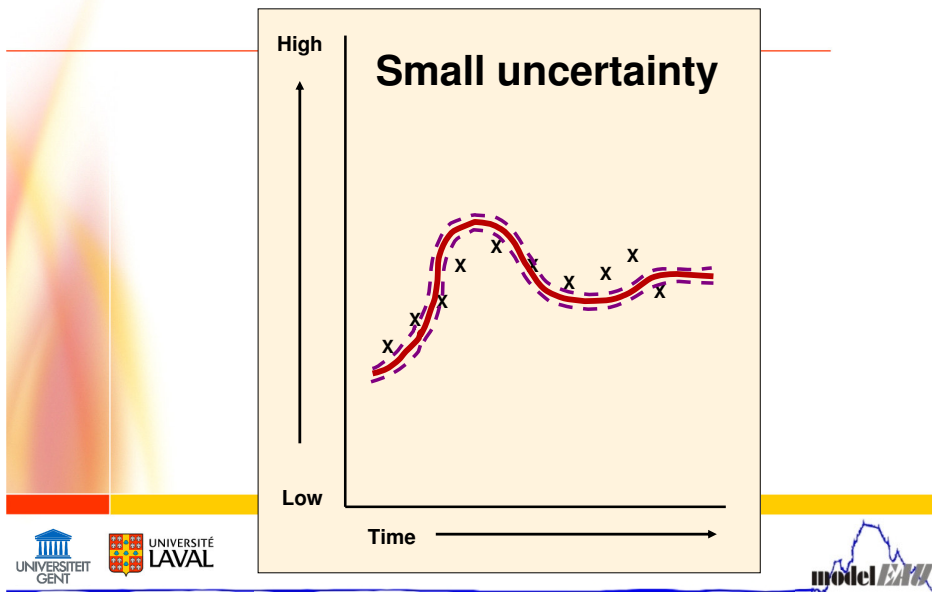
What is model uncertainty ?



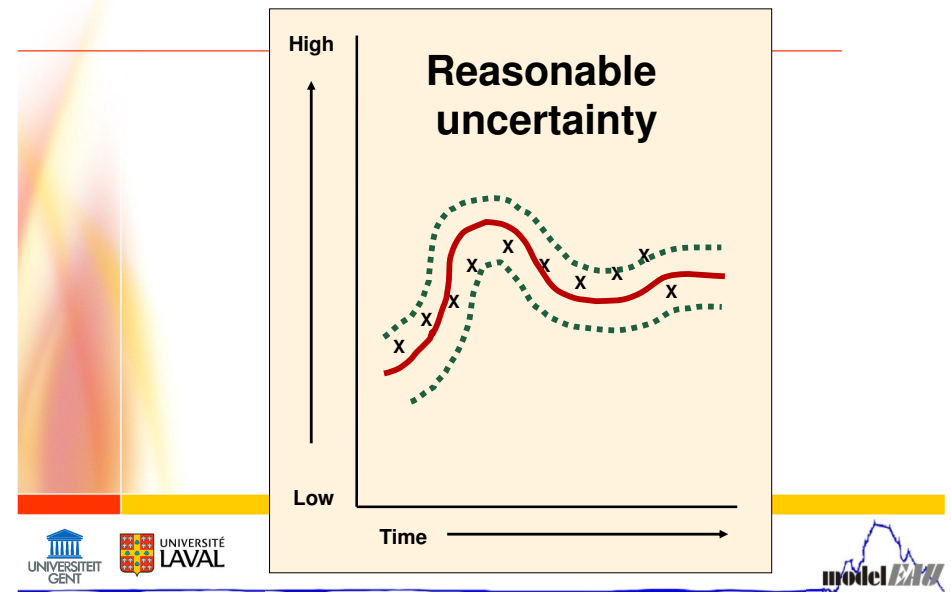
What is model uncertainty ?



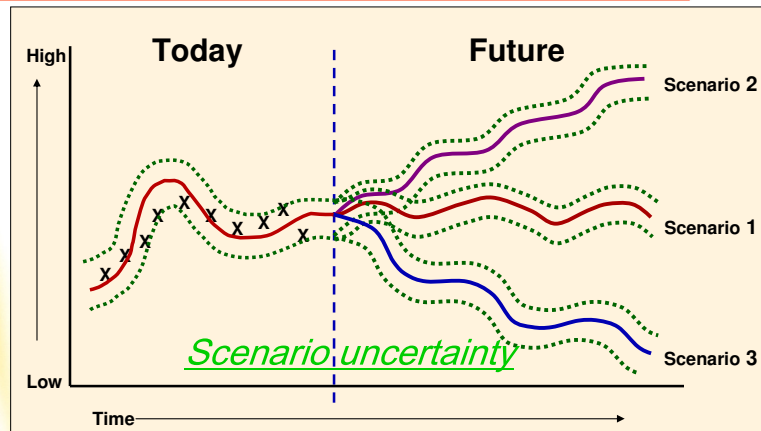
What is model uncertainty ?



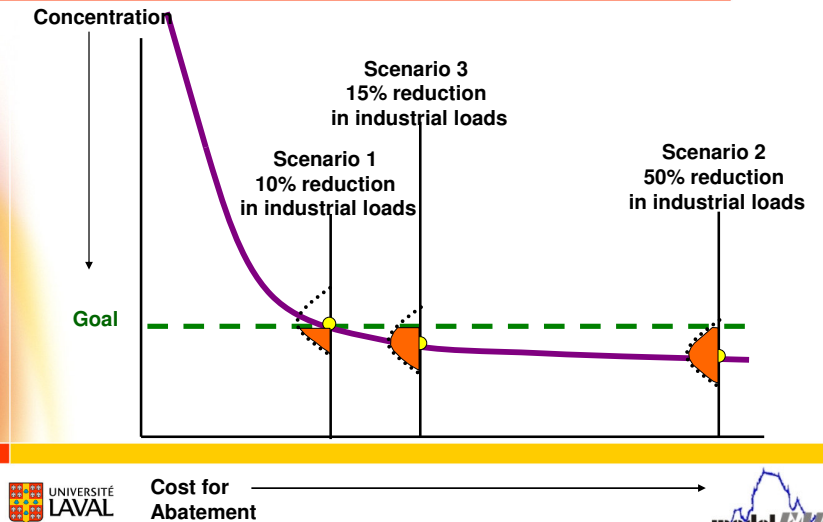
What is model uncertainty ?



What is model uncertainty ?



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

The screenshot shows the Netscape 6 browser displaying the 'River Basin Manager's Toolbox' website. The page includes a login form with fields for 'Login' (username: juha) and 'Password', and a 'Login' button. The website title is 'River Basin Manager's Toolbox'. The main content area describes the toolbox as a resource for implementing the Water Framework Directive (WFD) and provides information on how to use it. The footer mentions 'Contents: BMW Project Partners'.

Netscape 6 tiistai 14.09. 14:18:01

Model Catalogue

Logout Juha Kämäri

Home Search Help Feedback

River Basin Manager's Toolbox

Toolbox Entries

Other sortings

Domain	Entry name	Author	Created
Lake	BIOACCUMULATION	Tuomo Saloranta	21.1.2004
	CAEDYM	Tuomo Saloranta	21.1.2004
	Delete this	Tor Haakon Bakken	0.0.0000
	Delft3D-ECO	Leo Postma	0.0.0000
	Delft3D-FLOW	Leo Postma	0.0.0000
	Delft3D-MOR	Leo Postma	0.0.0000
	Delft3D-WAQ	Leo Postma	0.0.0000
	DYRESM	Tuomo Saloranta	21.1.2004
	EUTROMOD - relate water quality goals to allowable nutrient load	Olli Malve	21.1.2004
	Lake Package for MODFLOW-2000	Wolf von Igel	21.1.2004
	METABOLALAKE - Lake Metabolic Model	Olli Malve	21.1.2004
	SOBEK-1D2D	Simon Groot	21.1.2004
	SOBEK-CF	Simon Groot	21.1.2004
	SOBEK-RR	Simon Groot	21.1.2004
River	SOBEK-RTC	Simon Groot	21.1.2004
	SOBEK-WQ	Simon Groot	21.1.2004
	TELEMAC_2D/3D	Simon Groot	21.1.2004
	Delft3D-ECO	Leo Postma	0.0.0000
	Delft3D-FLOW	Leo Postma	0.0.0000
	Delft3D-MOR	Leo Postma	0.0.0000
	Delft3D-WAQ	Leo Postma	0.0.0000
	HERMES	Michael Hutchins	21.1.2004
	IAWQ River Water Quality Model No. 1	David Boorman	21.1.2004

Contents: BMW Project Partners

Netscape 6 tiistai 14.09. 14:09:00

Model Screening Tool

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River Basin Manager's Toolbox

User interface

- ☐ Windows
- ☐ Graphical
- ☐ Text-based
- ☐ Control file
- ☐ N/A

Sensitivity analysis options

Model preparations skills

- ☐ Expert
- ☐ Informed user
- ☐ Uninformed user
- ☒ N/A

Output interpretation skills

- ☐ Expert
- ☐ Informed user
- ☐ Uninformed user
- ☒ N/A

Cost basis

- ☐ Solid
- ☐ Free
- ☐ Nominal charge
- ☐ With consultancy
- ☐ Available under licence
- ☒ N/A

Peer acceptance

- ☐ Refereed paper
- ☐ Other open literature
- ☐ Gray literature
- ☒ N/A

Web information available

- ☐ Yes
- ☐ No
- ☒ N/A

Contents: BMW Project Partners

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Model Evaluation Tool

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River Basin Manager's Toolbox

Model Evaluation Tool

Selected model code

Model study application

Model applied to River Eurajoki. The river is discharged from the Lake Pyhäjärvi and polluted in many ways as its course to the Sea.

Update

Issue 1: Problem definition

1. What is the problem? Answered 0
2. What are the main causes of the problem? Answered 0
3. What are the measures that may be implemented to achieve the management objective stated in 2.2? Answered 0
- 4 GO - NO GO. Is any modelling approach appropriate? GO

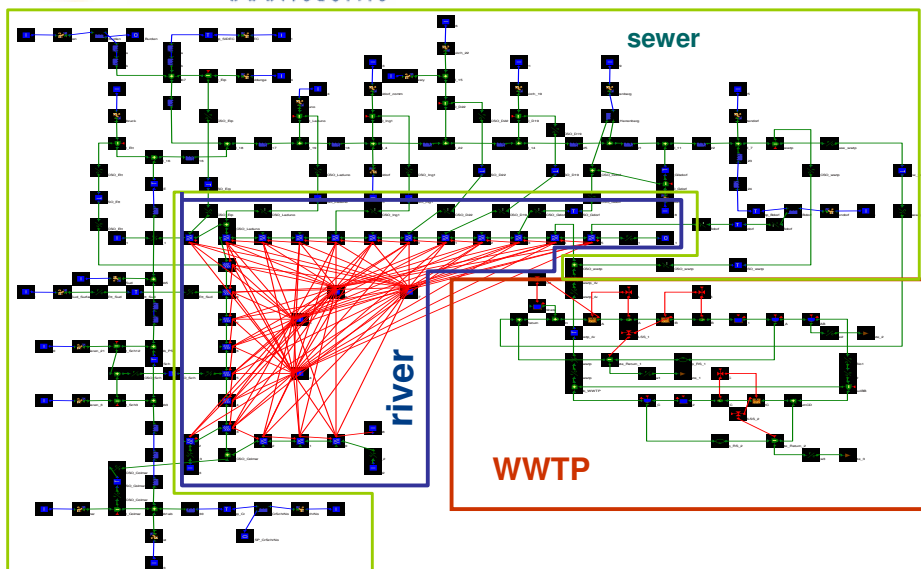
Issue 2: Model functionality and data

5. How well do the model output variables relate to the management task? Not given 0
6. Does the model include the key processes relevant to the management task? Not given 0
7. Does the model's temporal and spatial span and resolution correspond to the management task? Not given 0
8. Are all the necessary data required for the implementation of the model available? Not given 0

Contents: BMW Project Partners

What can we achieve ?

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

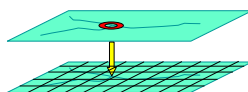
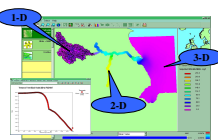
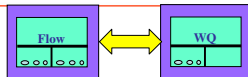


What can we achieve ?

- 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 linking issues

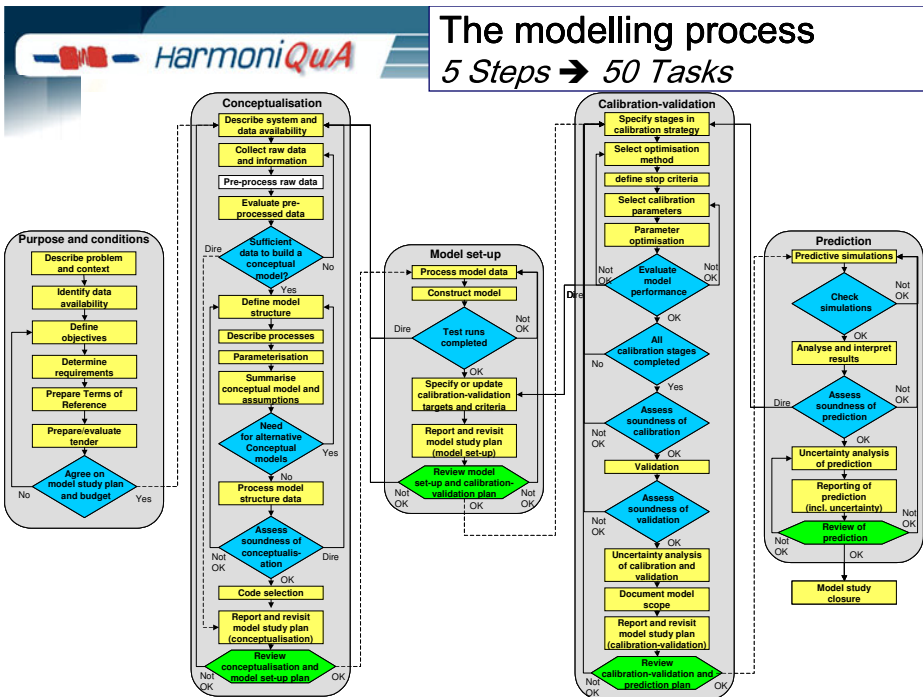
- Linking models of different processes
- Linking models based on different concepts
- Linking different spatial representations
- Linking models using different units
- Linking different temporal resolutions



=> *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)



Modelling Support Tool (MoST)

Guideline

1. Purpose and Conditions

1.1. Describe problem

1.2. Identify data availability

1.3. Define objectives

1.4. Determine requirements

1.5. Prepare Terms of Reference

1.6. Prepare / evaluate tender

1.7. Agree on model study plan and budget

2. Conceptualisation

2.1. Describe system

2.2. Collect raw data

2.3. Preprocess raw data

2.4. Evaluate preprocessed data

2.5. Sufficient data to build a conceptual model?

2.6. Define model structure

2.7. Describe processes

2.8. Parameterisation

2.9. Summarise conceptual model and assumptions

2.10. Need for alternative conceptual models?

2.11. Process model structure data

2.12. Assess soundness of conceptualisation

2.13. Code selection

2.14. Report and revisit model study plan (conceptualisation)

2.15. Review conceptualisation and model set-up plan

3. Model Set-up

3.1. Process model data

3.2. Construct model

3.3. Test runs completed

3.4. Specify or update calibration-validation targets and criteria

3.5. Report and revisit model study plan (model set-up)

3.6. Review model set-up and calibration-validation plan

3.7. Specify stages in calibration strategy

3.8. Select optimisation method

3.9. define stop criteria

3.10. Select calibration parameters

3.11. Parameter optimisation

3.12. Evaluate model performance

3.13. All calibration stages completed

3.14. Assess soundness of calibration

3.15. Validation

3.16. Assess soundness of validation

3.17. Uncertainty analysis of calibration and validation

3.18. Document model scope

3.19. Report and revisit model study plan (calibration-validation)

3.20. Review calibration-validation and prediction plan

3.21. Check simulations

3.22. Analyse and interpret results

3.23. Assess soundness of prediction

3.24. Uncertainty analysis of prediction

3.25. Reporting of prediction (incl. uncertainty)

3.26. Review of prediction

3.27. Model study closure

Task description: Activities information | Methods information | Full task information

Parametrisation

Name of activity: Determine which parameters can be estimated from field and laboratory data

Description of activity: Some model parameters may be held constant during model calibration. Typically, the values for these parameters are estimated from field or laboratory studies. It is necessary to determine which parameters will be held constant, what values will be assigned and the source of the parameter estimates.

Select an activity to work with: Determine which parameters can be estimated from field and laboratory data

What did you do?

1. Set trial infiltration rates in subcatchments to standard values based on soil map

2. Set channel roughness to standard Manning's n values of 0.04 in tributaries and 0.03 in main channel.

Start date: 1/05/20031

End date: 15/05/20

Time spent:

Select the methods you used: Determine which parameters can be estimated from field and laboratory data

What is the outcome?

Activity complete

Provide documents that you want attached to the model journal: C:\test\SOILMAP.DOC

Attach document

Remove document

What can we achieve ?

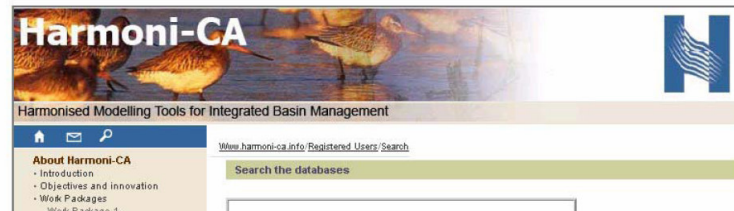
- Models are available
- Model experience is documented and can be used for selection of adequate models
- Models can be connected
- Softwares can be connected (OpenMI)
- Model building is supported by protocols (MoST)
- Data quantity and quality is improving
- We can get an idea of what we can believe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

Harmoni-CA

Harmonised Modelling Tools for Integrated River Basin Management

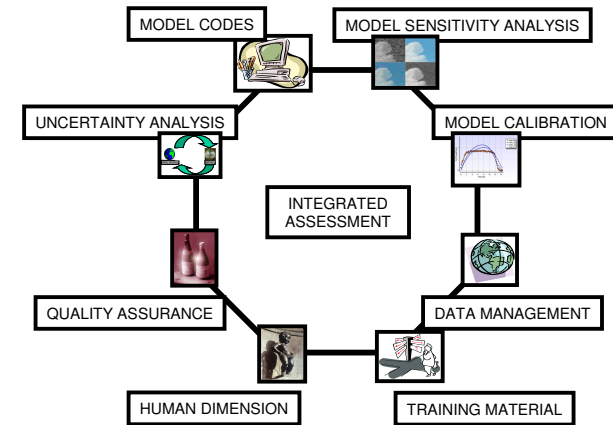
A Concerted Action "hovering" over the CatchMod cluster of projects

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

