Bringing the OpenMI to LIFE

Progress Report No. 4 - 31st March 2008 – 30th September 2008

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PROGRESS REPORT No. 4

Covering the project activities from 31-03-2008 to 30-09-2008

Reporting Date
31/10/2008

LIFE Project Name
Bringing the OpenMI to LIFE

Data Project

Project location	Europe
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Project end date:	31/01/2010 **Extension date:** -
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Total budget	€ 4002 656
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(%) of total costs	49.68%
(%) of eligible costs	50%

Data Beneficiary

Name Beneficiary	Natural Environment Research Council
Contact person	Mr Roger Moore
Postal address	Centre for Ecology and Hydrology, Crowmarsh Gifford, Wallingford, Oxon. OX10 8BB. UK
Visit address	Centre for Ecology and Hydrology, Crowmarsh Gifford, Wallingford, Oxon. OX10 8BB. UK
Telephone	Switch board: +44 1491 838800 Direct no. +44 1491 692235
Fax:	+44 1491 692424
E-mail	rvm@ceh.ac.uk
Project Website	http://www.OpenMI-Life.org/

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KEYWORDS

Integrated modelling
Integrated water management
Model linking
Open Modelling Interface and Environment
OpenMI
OpenMI Association
Water Framework Directive

ABBREVIATIONS

AGU	American Geophysical Union
BaW	Bundesanstalt fuer Wasserbau, Germany
CEH	Centre for Ecology and Hydrology, a component body of NERC
CHy	Commission for Hydrology
CSDMS	Community Surface Dynamics Modelling System

[1] This does not include sub-contractors.

CUAHSI	Consortium of Universities for the Advancement of Hydrologic Science, Inc, USA
Deltares	The new partner following the merger of WL|Delft and RIKZ
DELTA	The short name for Deltares
DHI	DHI – Water, Environment and Health
EPA	Environment Protection Agency, USA
EC	European Commission
FH	Flanders Hydraulic Research
HarmonIT	The short name for the Framework 5 project called IT Frameworks
iEMSs	International Environmental Modelling and Software Society
NCAR	National Centre for Atmospheric Research, USA
NERC	National Environmental Research Council, UK
NSF	National Science Foundation, USA
OA	OpenMI Association
OADC	OpenMI Association Dissemination Committee
OAEC	OpenMI Association Executive Committee
OATC	OpenMI Association Technical Committee
OO	Object Orientated
OpenMI	Open Modelling Interface
PEER	Partnership for European Environmental Research
RIKZ	National Institute for Coastal and Marine Management now Deltares
SEAMLESS	Shortname for the EC FP6 project: System for Environmental and Agricultural Modelling; Linking European Science and Society
SDK	Software Development Kit
ULg	University of Liège
US ACE	US Army Corps of Engineers
USGS	US Geological Survey
UTH	University of Thessaly
VMM	Vlaamse Milieumaatschappij
VMM-AWA	Intern Verzelfstandigd Agentschap Vlaamse Milieumaatschappij – afdeling Water
WFD	Water Framework Directive
WL|Delft	Delft Hydraulics now Deltares
WSL	Wallingford Software Ltd

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SECTION 1. EXECUTIVE SUMMARY

1.1. PROJECT OBJECTIVES[2]

The Water Framework Directive demands an integrated approach to water management. This requires the ability to predict how catchment processes will interact. In most contexts, it is not feasible to build a single predictive model that adequately represents all the processes; therefore a means of linking models of individual processes is required. This is met by the FP5 HarmonIT project's Open Modelling Interface and Environment (the OpenMI).

The purpose of this project is to transform the OpenMI from research output to sustainable operational product. It will build the capacity to use the OpenMI and will demonstrate it in real-life situations. It will also develop, test and demonstrate the future support organisation for the OpenMI. Finally, information about the OpenMI will be disseminated to users.

1.2. LIST OF KEY DELIVERABLES AND OUTPUTS

The key deliverables and outputs for the reporting period are:

- Interim Report (April 2008)
- Continued work on the Scheldt and Pinios demonstrations:
    - Making models compliant
    - Testing
    - Preparing for the Operational and Evaluation Phases
- Continued work on user support and development
- OpenMI Association poster and leaflets
- Continued promotion of the OpenMI especially in the US
- Conference presentations at Modflow and More, iEMSs 2008 and FloodRisk2008.

Appendix 2 provides a detailed list of the task deliverables, dates of delivery and their current status.

1.3. SUMMARY OF THE FOLLOWING SECTIONS

The sections below report on the project's management, progress with the tasks, problems encountered, dissemination activities, work for the next period, financial issues and a review of progress. Appendices give an overview of the project, the deliverables, partner information and publications and meetings.

In brief, the project's management and tasks continue to proceed as planned. No unexpected problems have arisen. Task A has prepared the second set of training courses to be delivered in Belgium and Greece during the next period. Task B has now made all its required models OpenMI compliant including PEGASE. As expected, during testing a number of technical problems were identified and are being worked upon. Discovering and dealing with such problems is an import part of

[2] Readers who are not familiar with the OpenMI-Life project may like to read Appendix 1 where they will find an overview of the project.

moving the OpenMI from being a research output to being an operational standard. The University of Liege has appointed a new and very effective member of staff. As a result some of the lost time has been recovered. Like Task B, Task C is ready to move to the operational demonstration phase. For reasons of resources and to give time for further thought on some of the technical issues, there will be a staggered start to the seven operational demonstrations. Task D has developed a forward strategy for the OpenMI Association and is now implementing it. Release 1.4 of the OpenMI Standard has been made and work on Version 2.0 is well underway. The OpenMI Association has continued to develop our contacts with the US. NSF sent seven US scientists from NCAR and CUASHI to Europe to review the OpenMI. Subject to EC permission, the US EPA has invited the OpenMI to contribute to its plans for incorporating integrated modelling into its operational work. Task E has continued to develop the project's two websites, with the focus being on www.openMI.org . The aim is that this should become a two way communication channel with users and enable the OpenMI Association to harness the huge resources of creativity in the outside world. .Expenditure remains broadly on track. Overall, the project is on target. The challenges at the moment are technical and they are being addressed.

SECTION 2. PROJECT MANAGEMENT

2.1. PROJECT CO-ORDINATION

The Table in Appendix 6 shows the formal Meetings and Workshops held to manage and co-ordinate the work of the project during the reporting period (earlier and future planned meetings are shown in grey). All meetings were run and minuted in accordance with the Collaboration Agreement. Where appropriate, the minutes were distributed to all partners and the European Commission and will be published on the website.

2.2. CHANGES TO PROJECT MANAGEMENT STRUCTURE

There have been no changes in the project management structure during the reporting period. No partners have withdrawn or been replaced. However, following the formation of the new Dutch organisation Deltares, a contract amendment has been submitted to the Commission. It requests that, WL|Delft and RIKZ (Partners 3 and 12) be replaced by Deltares (Acronym: DELTA and partner ID: 13). Appendix 4 lists, for each partner, the staff members involved in the OpenMI-Life project and their contact details.

2.3. PROJECT ORGANOGRAM

Figure 1 shows the project's management structure and reporting lines. These follow the proposal except that responsibility for quality now lies with the task leaders, who are all Steering Committee members. Ultimate responsibility for quality rests with the chairman. By this change, it is hoped to propagate a culture of appropriate quality throughout the project.

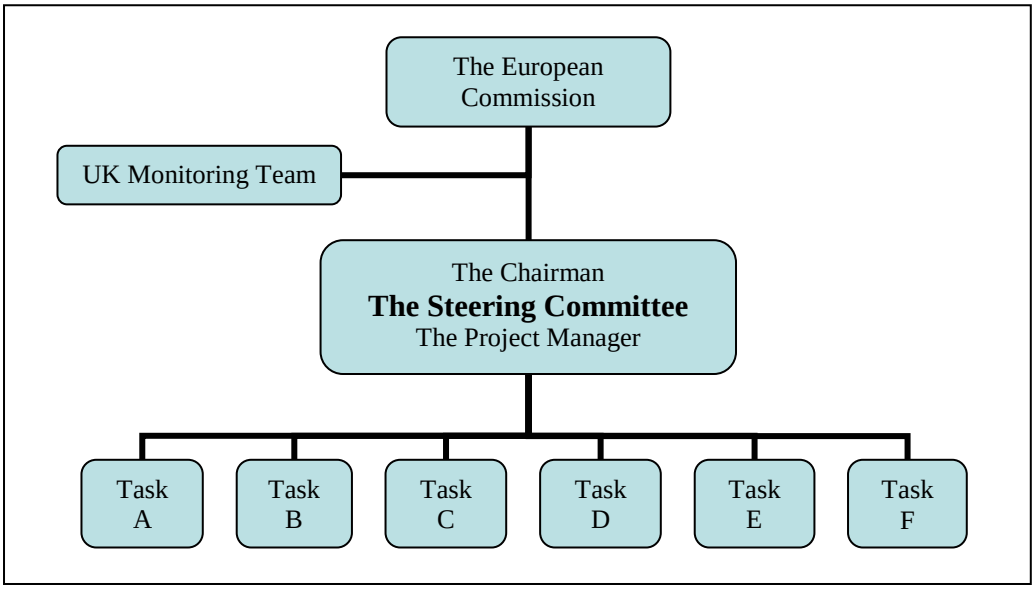


Figure 1 The structure and reporting lines of OpenMI-Life

It is an objective of the project to leave in place an operational support organisation to manage the continued development and support of the OpenMI. Over the duration of the project, all activities relating to the support organisation are being mapped onto the new organisation's structure and run as though the new organisation is in place.

The formal inception of the OpenMI Association occurred in June 2007, and the transfer of management responsibility from the OpenMI-Life management structure to the Association structure is now going forward. The Association's structure is shown in Figure 2. Whilst the OpenMI-Life Steering Committee still overseas the LIFE project and the Scheldt and Pinios case studies, responsibility for Task D has transferred to the Association's Technical Committee and Tasks A and E to the Association's Dissemination Committee, with both being overseen by the Association's Executive Committee.

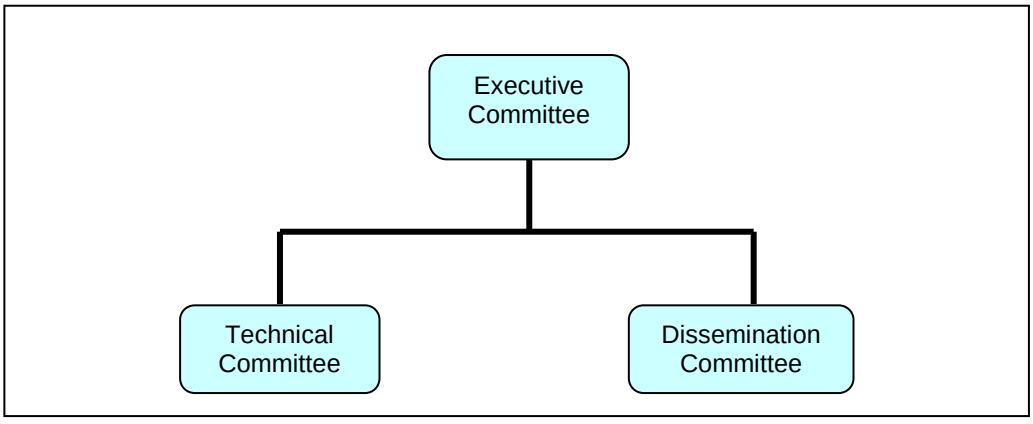


Figure 2 Organogram for the OpenMI Association

2.4. PROJECT REPORTS

The following reports have been delivered during the reporting period:

2.5. PROJECT EXTENSION

At the time of writing, no extension of the project duration is needed or envisaged.

SECTION 3. TECHNICAL DEVELOPMENT

3.1. INTRODUCTION

The sections below describe the progress on each task during the reporting period.

3.2. TASK A – BUILD CAPACITY

3.2.1. Objective

The main objective for Task A in this period was to continue the detailed planning of the second training sessions, started at the end of the previous period.

3.2.2. Progress

For both the Pinios and the Scheldt partners, firm plans for the second set of training sessions have now been proposed, agreed and scheduled.

Training for the Pinios partners will take place in October 2008 in Volos and Athens, Greece. Sessions will range from an introductory course for the competent authorities (not necessarily modelling practitioners) to basic and advanced developers' training courses for programmers from the project partners and neighbouring universities.

Training for the Scheldt partners will take place in November 2008 in Antwerp, Belgium during the OpenMI-Life Scheldt workshop. These training sessions will be end user oriented and will comprise of both beginner and advanced level exercises. Both sessions will be open to non-project participants, if places are available.

3.2.3. Issues

At the March 2008 Steering Committee meeting, it was reported that ULg was undergoing a major reorganisation that would cause delays to Task B, Use Case c. A new action plan was agreed. Part of the plan was to recruit a new member of staff to ULg. The Steering Committee recognised the need to help with training and supporting the new member as soon as he/she was in post and assigned appropriate resources, mainly through the good offices of Deltares. Pol Magnermans was the successful candidate and, since his appointment, Deltares have provided him with individual developer training and support to help speed up the migration of the Pegase model. Although further training and support is available, Pol Magermans has mastered the OpenMI so quickly that the extra session is not felt necessary at present.

3.2.4. Plan and objectives for next period

As described in 3.2.2., the plan for the next period is to run the training sessions in Greece and Belgium.

3.3. TASK B – DEMONSTRATE THE OPENMI IN THE SCHELDT BASIN

3.3.1. Objectives

The objectives for the fourth period (April 2008 – September 2008) were:

- to make any necessary adjustments to the OpenMI compliant versions of the models in order to obtain operational stand alone models;
- to link the required models and to test them in linked mode;
- to adjust the OpenMI compliant versions of the models in order to obtain stable runs and resolve any technical issues;
- to perform the trial runs of the linked models.

As stated in the previous progress report, there has been some delay in Use case ‘c’, and so for this Use Case, the objectives have been as follows:

- to make the conceptual modifications to the models in order for them to become linkable to be linkable : conceptual modifications;
- to make the models required for OpenMI-Life OpenMI compliant;
- to perform the first runs with the OpenMI compliant versions of each model in order to validate them when running independently.

3.3.2. Progress

Four use cases have been proposed for the Scheldt and detailed descriptions are available on the website in the members only area at www.openmi-life.org. Progress on the use cases is as follows:

- Use Case ‘a’ - ‘Linking a sewer flow model to a river flow model’: definition report completed, required models made OpenMI compliant, testing phase completed.
- Use Case ‘b’ - ‘Linking two (different) river flow models’: definition report completed, required models made OpenMI compliant, testing phase completed.
- Use Case ‘c’ -‘Linking two river flow models to a river quality model’: definition report completed, required models made OpenMI compliant, first runs in stand-alone mode performed.
- Use Case ‘d’ - ‘Linking a 1D river flow model to a 2D estuary model’: definition report completed, required models made OpenMI compliant, testing phase completed.

Six models are required for the Scheldt use cases.

- InfoWorks CS, which is already OpenMI compliant,
- InfoWorks RS, which is already OpenMI compliant,
- MIKE11, which is already OpenMI compliant,
- PEGASE, which has been made OpenMI compliant during this fourth period,
- Waqua, which was made OpenMI compliant during the second period,

- Delft3D, which was already OpenMI compliant but which has been upgraded during the second period for OpenMI-Life project to enable it to exchange a greater range of quantities (modelled variables).

The partners Aquafin, VMM-AWA, Flanders Hydraulics and Deltares have completed the testing phase. They have linked the required models and have tested the runs in linked mode. As expected, a number of modifications have been necessary to eliminate instabilities arising during linked running. The cause of this problem is believed to lie in one of the models rather than the OpenMI. However, it is not yet fully understood and the need for further work in this area can be expected. Other modifications have been made to reduce the memory use and run-times. Several tests to establish the optimal location of the 'trigger' have also been performed.

Since the last progress report significant progress has been made on Use Case c. A new member of staff has been recruited and given one to one training on the use of the OpenMI. This has enabled him to make the PEGASE model OpenMI compliant during this fourth period. ULG has now started installing OpenMI compliant versions of the associated models required, and performing the first runs in stand-alone mode. In these runs, data, that later will come from linked models, are read from files.

3.3.3. Issues

As explained in the last progress report, reorganisation at ULg and a number of particularly complex technical issues have delayed Use Case c. A revised schedule was therefore prepared and agreed- see Appendix 7. In the reporting period, good progress has been made and some of the delay has been recovered.

A number of technical issues have arisen with the linked models including problems with model stability, memory consumption issues and increased run times. These are exactly the problems that OpenMI-Life was designed to uncover and resolve, mitigate or avoid. The issues are being investigated with the model providers and solutions are being found. Further refinements will be undertaken during the operational phase.

A very productive joint task technical meeting was held on 9th September 2008, in which such issues were addressed and further such meetings are planned.

3.3.4. Plan and objectives for next period

The key objectives for the next period (October 2008 – March 2009) are to complete the testing phase and commence the operational demonstration phase. To assist with the final evaluation phase, all Scheldt partners will be asked to keep a diary recording details of the types of runs undertaken, any issues occurring and steps taken to resolve issues. For Use Case c, there will some overlap between the testing phase (B2), and the operational demonstration phase (B3). This will enable the Use Case to catch up and complete the project on time.

A set of common guidelines has been drafted and agreed by the Steering Committee for the evaluation in the last phase (B4) of the operational demonstration in (B3). These can be seen in Appendix 10. The key issue to be evaluated through the Scheldt use cases is how integrated modelling and the OpenMI will improve collaborative working between the competent authorities.

Use case specific points for investigation are described below.

Use Case a will link a sewer flow model to a river flow model. Aquafin will evaluate the results with respect: to optimising the design and operation of trunk sewers and wastewater treatment plants with respect to minimising flood risk. VMM-AWA will be evaluating the benefits of integrated modelling with respect to being able to take account of sewer inputs when designing urban and rural river channel improvements. During the operation demonstration, data from historical events will form the input to the combined models and will be used to test different structural designs and operating methodologies.

Use Case b will link two (different) river flow models. The aims of both participants, Flanders Hydraulics and VMM-AWA, are to improve the quality of flood frequency maps and flood forecasts by using linked as opposed to separate models. Flanders Hydraulics is also interested to see whether the combined models allow the derivation of better operating rules for flood storage ponds.

Use Case c will link two river flow models to a river quality model. The University of Liege and VMM have research and operational reasons for being interested in effects of high and low flows on river quality. The OpenMI provides the opportunity to replace the hydraulic component of the PEGASE model by more powerful commercial models. The demonstration will involve assessing whether or not the improved hydraulic model leads to better estimates of physical and chemical water quality determinands such as dissolved oxygen, biological oxygen demand, chemical oxygen demand, nitrate and phosphate. These are important indicators of the health of the river. High nitrate and phosphate levels lead to eutrophication and the growth of weeds and algae. During the demonstration both high and low flows will be routed through the hydraulic model as both can create pollution. High flows by stirring up bed material and low flows through lack of dilution.

Use Case d will link a 1D river flow model to a 2D estuary model. The aims of both the Flanders Hydraulics and RIKZ river managers are to improve the boundary conditions of the models, to improve flood forecasting during storm surges or high inland discharges and to obtain a better understanding of the accessibility of harbour areas. The demonstration will involve modelling the response of the estuary during periods of high river flows for different tidal situations. Integrated modelling should be able to represent the interaction between the river and the estuary better than separately run models as the flow out of the river is dependent on the water levels in the estuary

For Use Case c, the following tasks will be completed prior to starting the main activities for the operational demonstration period, which are:

- to complete the installation of the OpenMI compliant models on a single PC and to validate them running independently against simple use cases;
- to make any necessary modifications to the OpenMI compliant versions of the models in order to obtain operational models;
- to link the required models,
- to make test runs in linked mode.

3.4. TASK C - DEMONSTRATE THE OPENMI IN THE PINIOS BASIN

3.4.1. Objective

The sustainability of the Thessaly area natural and built environments depends greatly on quantity and quality of water in the Pinios. All three scenarios included in the OpenMI-Life Pinios study use the OpenMI technology to facilitate the integration of in-house developed models with suitable models from other developers in order to successfully represent the different processes that interact in the basin. The three case studies focus on different water management issues.

The objectives for the fourth period were to set the basis to support the operational demonstration phase of OpenMI-Life, Activity C3, which is due start in October 2008. Task C comprises the following three use cases:

- Use Case a involves the linking of two NTUA models, a hydraulic model (RISH-1D) and a water quality model (R-Qual) with a MIKE-11 (the Rainfall-Runoff Module) to evaluate water quality upstream of the Pinios junction with tributary, the Enippeas.
- Use Case b links a MIKE-11 model with an NTUA reservoir water management model (RMM-NTUA) to assess the impact of climate change on the reliability of the Smokovo reservoir (SW area of the Thessaly plain)**.**
- Use Case c demonstrates the capabilities of the OpenMI by coupling the UTHBAL monthly conceptual water balance model [Loukas et al., 2008] with the Visual Modflow© groundwater model for the simulation of the overexploited Lake Karla aquifer in the hydro ecologically sensitive region of eastern Thessaly, Greece.

3.4.2. Progress

During the last six months, the following progress was achieved in the Pinios case studies. For Use Case A, all models have been made OpenMI compliant. The R-Qual model was initially migrated to the OpenMI version 1.2. During the last three months, it was upgraded to version 1.4. The models are now linked and set up to exchange information at 26 nodes along the main Pinios channel. Historical data has been used to calibrate the models, and further testing has been undertaken to ensure the linked models behave as anticipated under storm and forecasted drought conditions.

For Use Case B, the migration and testing of the two linked models has been completed. The trial of integrated modelling phase involved a detailed examination of the linked model system behaviour under stress, using various climate change scenarios.

For Use Case C, the UTHBAL model has proved to be a valuable hydrological tool for enabling the estimation of water balance components and to study the impact of land-use and climate change on water resources. In such case studies, the choice of an appropriate spatial discretisation is a crucial issue. It is obviously linked to the available data, their spatial resolution and the dominant hydrological processes. Three spatial discretisations were adopted in the Lake Karla watershed for assessing surface water resources and groundwater recharge:

- Lumped UTHBAL application
- Semi-distributed UTHBAL application
- Distributed UTHBAL application

The implementation of the groundwater model is by default fully distributed. However, three different spatial discretization schemes have been investigated with different pixel sizes of 100m, 200m and 400m, respectively. All three scenarios have been tested in the implementation environment and the stand alone simulations have been run. There are still a number of issues that will be further refined as part of the operational demonstration phase.

3.4.3. Issues

Use Case c still has a number of problems regarding the linking of UTHBAL to Visual Modflow, using OpenMI 1.2 compliant models. Visual Modflow had already been made OpenMI compliant and the .omi files were supplied by the model developers. These issues are currently being addressed with the developers and the OpenMI Association Technical Committee. It is hoped that these remaining issues will soon be resolved; the planned Pinios (end users & developers) training session in October 2008 will be used to address the more complex issues encountered.

3.4.4. Plan and objectives for next period

The key objective for the next period (October 2008 – March 2009) is to commence and complete the operational demonstration phase (C3). It is expected that the learning process will continue and that further modifications will be made to some models.

To assist with the final evaluation phase, as in the Scheldt, all Pinios partners will be asked to keep a diary recording details of the types of runs undertaken, any issues occurring and steps taken to resolve issues.

A set of common guidelines has been drafted and agreed by the Steering Committee for the evaluation of the operational demonstration in the last phase (C4). These can be seen in Appendix 10. However, five specific issues to be evaluated through the Pinios use cases of special interest to the Greek competent authorities are:

1. The feasibility of migrating in-house models.
2. The value of linked model results at various nodes during extreme events
3. The added value of integrated modelling
4. The possible complications/pitfalls
5. The usefulness of the scenarios to the end user

Use case specific points for investigation are described below.

Use Case a will use the initial part of the period to, further investigate optimum time-step sizes, to identify critical nodes, to evaluate the results at those nodes (both their physical and quantitative interpretation), and to check the linked models' behaviour during extreme events. The behaviour of uni-directional and bidirectional links will

also be checked (bi-directional links are used when the value to be exchanged between two models has to be reached by an iterative process).

Use Case b, linking the MIKE-11 and RMM models in the Smokovo reservoir area, will evaluate integrated modelling as means of assessing the benefits of the conjunctive use of several sources, here reservoirs, over managing each as a separate independent entity. The current and future needs of the area will be assessed. The yield of the system will then be computed for current and conjunctive management strategies using current and integrated modelling approaches.

Use Case c will use an integrated modelling approach utilising the OpenMI to enable the European Water Framework Directive's concepts of sustainable water management to be applied. The aim will be to simulate both the present surface water and groundwater resources, and to predict the future response of the aquifer under various management schemes. The UTHBAL and Visual Modflow models will be coupled to enable a number of possible future scenarios to be modelled and, hence, the response of the aquifer to the scheduled partial restoration of Lake Karla to be understood. The management scenarios used will be based on the expected surface reservoir operation and the likely subsequent decrease in pumping from groundwater water. This set up will enable a number scenarios dealing with water saving in the agricultural sector to be analysed. The improvements predicted by this pumping decrease (concerning both the pumping rate and number of wells) will be evaluated with respect to the aquifer's rehabilitation. The study should allow the competent authorities to evaluate both integrated modelling and the OpenMI.

3.5. TASK D – DEMONSTRATE THE OPENMI TECHNICAL SUPPORT, MAINTENANCE AND CO-ORDINATION

3.5.1. Objective

The success of the OpenMI as a standard depends upon its widespread adoption across European and then the world. However, its use requires a small but significant degree of investment by developers. Therefore, it will only be taken up if there is confidence that it will be supported and maintained into the future. This task will identify and test a sustainable support and co-ordination organisation. The specific objectives of Task D for the reporting period have been:

- To formalise the procedures for supporting, maintaining and co-ordinating the OpenMI.
- To trial and demonstrate these procedures by receiving requests for changes to the OpenMI and the support mechanism, responding to these requests and, where appropriate, making changes to the OpenMI or the support mechanism and issuing periodic open source releases.

3.5.2. Progress

3.5.2.1. Working procedures and protocols

The following procedures and protocols have been completed or are under development:

- The OpenMI Association Charter: completed
- The OpenMI Association Standing Orders: completed
- Procedure for source code version control and Quality Assurance: completed
- Procedure for updating www.OpenMI.org: completed
- OpenMI Association Technical Committee management protocol: draft version completed
- Procedure for OpenMI standard releases: draft version completed (see Appendix 9)
- Procedure for membership administration: To be done in the next period
- Procedure for test and component acceptance: To be done in the next period

Procedure for OpenMI standard releases

Changing the OpenMI Standard has major implications for both OpenMI developers and users, because it is impossible to make such changes backwards compatible. Consequently, when a new OpenMI Standard is released, all model providers must upgrade their models to stay compliant with the latest OpenMI version. The pace at which this happens varies from model provider to model provider, since many model providers only make new releases of their software products on a six month or yearly basis. Hence, after an OpenMI Standard release it can possibly take a year before the bulk of compliant models are upgraded to the new version. This has implications for OpenMI users, as they may find that the models they want to use for linked configurations are not compliant to the same OpenMI versions. It is therefore important that the procedure for OpenMI Standard releases ensures that new releases meet the current and future demands from both the OpenMI users and developers.

The OpenMI Association Technical Committee has developed a new proposed procedure for OpenMI standard releases; see Appendix 9 for the procedure details. This procedure has been submitted to the OpenMI Association Executive Committee for refinement and approval. The release procedure describes how the estimated two year release cycle has been divided into four periods:

i. A change request period, when anyone can submit change requests and/or comment on change requests that have already been submitted.
ii. A proposal period when anyone or any group can develop and submit a proposal for the next OpenMI standard.
iii. A commenting period, during which anyone can submit comments to the proposed standards.
iv. And finally a test and documentation period, where the winning standard proposal is refined. The idea behind the proposed procedure is to allow public interaction throughout the entire release cycle in order to ensure that new OpenMI standard, to the maximum possible extent, meets the demands from current and future users and developers. The procedure also facilitates the involvement of groups outside the OpenMI Association in the development of the next version of the OpenMI.

3.5.2.2. Building the support organisation for the OpenMI

The OpenMI Association was formally established in June 2007 and is now operating as a fully functional support organisation for the OpenMI. There have been no changes to the Association and its organisation during this reporting period.

3.5.2.3. OpenMI Association Executive Committee (OAEC)

The OpenMI Executive Committee had one meeting during the reporting period on 11th July 2008 in Barcelona, Spain. It was held in conjunction with the International Environmental Modelling and Software Society (iEMSs) 2008 conference.

3.5.2.4. OpenMI Association Dissemination Committee

The OpenMI Association Dissemination Committee is responsible for the development and maintenance of the official OpenMI web site, www.openmi.org. A full mirror of the official web site has been created on the OpenMI wiki. In this way all information can be edited and quality ensured in a convenient way prior to publishing on the official web site. The second OpenMI newsletter was sent out in July 2008. It is planned to release newsletters at regular intervals.

3.5.2.5. OpenMI Association Technical Committee (OATC)

During the reporting period the OpenMI Association Technical Committee held three meetings. Agendas and minutes from these meetings are available on: http://public.deltares.nl/display/OPENMI/OpenMI+AssociationTechnical+Committe.
OpenMI Association Technical Committee activities for the current reporting period are detailed below:

a Support and feature requests

OATC is supporting the users from the OpenMI-Life use cases and the now world wide OpenMI user community, through the discussion forum on source forge. See: https://sourceforge.net/forum/?group_id=136874 for more information. The OATC maintains a wiki page with contact information, calendar, procedures, agendas and minutes relating to the OATC meetings, and a Getting Started page http://public.deltares.nl/display/OPENMI/OpenMI+AssociationTechnical+Committe.
The Getting Started page consists of a number of 'How To …' pages targeting specific model migration issues, general conceptual issues and hands-on examples for end-uses.

b OpenMI Developments

The main purpose of the OpenMI 1.4 Standard, SDK, and tools release was to allow asynchronous releases of the OpenMI Standard and the supporting software (the SDK and the configuration editor). OpenMI Standard releases cannot be made compliant to previous versions, which means that such releases have greater implications for developers and end users, whereas the SDK and tools can be made fully backward compliant and released without such inconveniences. The OATC has therefore decided to develop the OpenMI along two tracks; the OpenMI Standard, which will be released every other year and the SDK and tools which will be released more frequently.

c OpenMI 1.4.0.0 development

The OATC is continuously correcting errors and adding features based on bug reports and feature requests submitted via the OpenMI source development site (www.sf.net/projects/OpenMI). So far, the bugs and features added during the last six months can all be categorized as minor. Consequently, they did not justify creating a formal release.

All source code undergoes semiautomatic unit testing. All source code is open source, which means that users can safely download and use the software at any time between official releases. However, for convenience, at certain intervals, a zipped version of the SDK source code with the full installers for the configuration editor is released. Providing no severe bugs are reported in the meantime, version 1.4.1 of the SDK and tools will be released on 20th December 2008.

d OpenMI 2.0 Standard development

During the last six months, the main features of the OpenMI 2.0 Standard have been decided and the corresponding draft software architecture has been defined. The challenge has been to ensure that the powerful pull driven approach for model to model linkage is retained, and that new features are added without sacrificing the simplicity of the Standard. Additionally, the new standard must be easy to explain. Specific issues and features are described below:

1. **Less model focused:** The OpenMI 1.x Standard was developed specifically with the linkage between numerical time stepping models in mind. However, in systems for integrated modelling other components such as data providers, data bases, viewers, etc. are also used. Some of the change to facilitate the linking of such components has been simple, for example, the renaming of various methods and properties e.g. Model ID has been renamed to Instance ID. However, some more significant changes have been made regarding how time is handled and how the possible connection points (exchange items) are exposed.

2. **More logical for small components:** It is reasonable that the OpenMI migration process for complex numerical models requires significant skill and time. However, the OpenMI Standard contained within version 1.x for creating simple components, such as a basic data provider, is also relatively complicated. One reason for this is that a large number of properties and methods must be implemented even though they are irrelevant to such simple components. Examples of this are methods such as GetEarliestInputTime(), or the property TimeHorizon, which make little sense with a component providing so few numerical values. In version 2 all time related methods and properties have been separated into an optional time dedicated interface. In this way, simple components that do not have a time dimension can ignore this optional interface. A key aim of version 2 is to make it easy for developers to implement simple components, possibly without even using the SDK.

3. **Decorator design pattern:** Using and understanding the concepts of data operations as defined within version 1 is difficult. Also, the invocation of the GetValues method can be problematic, since a reference to the receiving linkable component is also required in the method arguments list. This means that only components that are themselves linkable components can retrieve

data from other linkable components. This can cause problems when testing and when linkable components are used e.g. as parts of decision support systems. In the decorator design pattern applied in version 2, all data available from outside is exposed as a simple list of output items. These output items consist of metadata regarding where, and possibly when the data applies and a simple get property to retrieve the data. Data retrieved by this mechanism is not converted in any way (when running systems of linked models data typically needs to be converted from the time and location of the provider to match the time and locations of the acceptor). In such case, the decorator object is requested from the providing component for a given time and location (imbedded as an input item). This mechanism is similar to the way GetValues worked within version 1.x. However, with the decorator design pattern access to both simple and the more advanced components can be achieved in a logical and straightforward way.

4. **More suitable for calibration, data assimilation:** Development of calibration, optimization and data assimilation tools for OpenMI compliant models is possible with version 1.x of the Standard. However, the pull-driven architecture has made this very complicated. However, the data exposed for exchange in version 2 is a precise reflection of the data inside the component, so the implementation of set values methods is possible. Hence, version 2 will be able to support both *pull driven* systems, typically used for model to model linkages, and *push driven* systems, typically used for calibration, optimization, data assimilation and decision support systems.

5. **Support of complex data types:** With version 1.x of the OpenMI Standard, the only possible data type that can be exchanged are arrays of doubles between compliant components. Generally, this is satisfactory for the usual number crunching type of numerical models. However, for many decisions support systems, it is necessary to be able to exchange other data types as well. In OpenMI version 2, the existing numerical data type (quantities) will be supplemented with categorized data (qualities). Examples of qualities can be “high”, “medium”, “low” or “grass”, “wheat”, “corn”. Creating a mechanism to exchange such data is straightforward, but the challenge over the next period for the OATC is to ensure that such data is interpreted correctly by the receiving component.

3.5.3. Issues

There were no significant issues during the reporting period.

3.5.4. Plan and objectives for next period

Goals for the next period are:

- To release version 1.4.1.0 of the OpenMI SDK and configuration editor.
- To continue development of version 2.0.
- To provide support for users.
- Further develop US links leading to further joint workshops and collaboration projects.

The OpenMI version 2 development plan is as follows:

From	To	Action
11/09/2008	02/11/2008	Finish the configuration architecture (the decorator pattern) and update SDK and GUI.
03/11/2008	05/11/2008	OATC meeting in The Netherlands: special focus on return types and geometry (ElementSet)
06/11/2008	12/01/2009	Implementation of new geometry interfaces and return types. Update SDK and GUI.
13/01/2009	15/01/2009	OATC meeting in UK. Final decision for the version 2 standard interfaces. This also implies deciding which requested feature that will not be included in version 2.
16/01/2009	09/03/2009	Complete implementation and unit testing of the version 2 standard, SDK and GUI.
10/03/2009	12/03/2009	OATC meeting, Denmark. OpenMI 2 standard, SDK and GUI beta release.
13/03/2009	20/04/2009	Migrate and test selected commercial models and components for version 2.
21/04/2009	23/04/2009	OATC Meeting in The Netherlands. Evaluate real models test and further refinements.
24/04/2009	23/04/2009	Continue real models testing, write documentation.
10/06/2009	12/06/2009	OATC meeting in Denmark. Final evaluation, submission of version 2 to the OpenMI Association Executive Committee for acceptance.
13/06/2009	13/08/2009	The Standard is reviewed by external reviewers.
14/08/2009	19/09/2009	Adjustments based on comments from the reviewers. Finalization of the OpenMI version 2 release.
20/09/2009		Final release of OpenMI version 2 Standard, SDK and GUI release.

SECTION 4. PROBLEMS ENCOUNTERED

Problems in OpenMI-Life fall into two classes: problems concerning the delivery of the project and integrated modelling problems, which the project is designed to identify, solve, mitigate or avoid.

So far, the main problem concerning delivery has been the effect of the reorganisation at the University of Liege. This was picked up quickly and a revised plan produced for the delivery of Use Case c in Task B. Since then good progress has been reported.

Other reorganisations in the project, for example, the merger of WL|Delft and RIKZ have not had a significant impact, other than to generate additional management tasks. In Task B Use Case a, a technical problem has been encountered in a model. The developers have been contacted and they are seeking a solution. Two aspects of the problem, memory use and run times when large numbers of nodes are involved have been addressed. A third aspect is still being investigated. At present, when the model in question is linked, it runs up to a point and crashes. In unlinked mode, it runs without error.

In a different Task A, model linkage instability occurs when the two models are run together. Instability is an expected problem and it is an important aim to find out what causes it and then how to avoid it.

In Use Case a, Task B, the InfoWorks sewer model is linked bi-directionally to the Mike 11 river model. After simulating about 20 days with no instabilities, both models starts to oscillate and eventually Mike 11, crashes. The model providers are cooperating with Flanders Hydraulics to find a solution to this problem. Both models are physically based, distributed, fully dynamic numerical models operating on the same time scale; a case where the risk of numerical instabilities is very high.

SECTION 5. DISSEMINATION (TASK E)

5.1. OBJECTIVE

The objectives of the OpenMI-Life dissemination activities are to plan and implement a dissemination programme that will include: a). reviewing the OpenMI user community identified in HarmonIT; b). maintaining and extending awareness of the OpenMI in its potential European and global user communities; c). identifying the most effective media for communication with each group within the community; d). planning a dissemination programme together with opportunities for external evaluation and feed back; and e). implementing the programme. The dissemination deliverables are a best practice manual, papers and journals, press articles, conference presentations, OpenMI-Life and OpenMI Association websites, workshops, leaflets, posters, and a layman's report. The dissemination task is split into two parts. One covers the dissemination of information about the OpenMI-Life project (guided by the OpenMI-Life Steering Committee), while the other has a broader scope and covers the overall dissemination of the Open Modelling Interface. During the last six months, the dissemination task has made use of the new OpenMI Association Strategy to direct its work. This has resulted in the promotion of OpenMI-Life scientific work at relevant conferences and meetings, both within Europe and the US.

5.2. PROGRESS

Significant effort has been applied to dissemination activities over the last period, and it has been an exciting time for the team in terms of the level of interest shown in the OpenMI, particularly from outside Europe. The new website has enabled interested parties to view details of events, both via the latest news section and the events calendar. As a result a number of new enquiries have been received and followed up, and the team is currently in the position that our limited resources are struggling to meet the demand for more information about the OpenMI.

5.2.1. US Collaboration

During this reporting period, a significant focus has been the promotion of collaboration opportunities with the USA. In April 2008, a very successful joint workshop was held with US NSF scientists including members of CUAHSI, CSDMS and NCAR. For more information regarding this workshop, please see: http://www.openmi.org/reloaded/events/archive/eu-nsf-2008-04.php. As a direct result of this workshop the OpenMI Association have been invited to take part in a joint session at the December 2008 Fall AGU meeting being held in San Francisco,

USA entitled H65 - Integrated Modeling in Hydrology: Advances in Model Interoperability, Architectures, and Cyberinfrastructure. For more information, see: http://www.agu.org/meetings/fm08.old/index.php/Program/SessionSearch/?show=detail&sessid=549. Roger Moore and Bert Jagers will be attending as invited speakers on behalf of the OpenMI Association and will be presenting aspects of the OpenMI. Following the workshop, the Community Surface Dynamics Modelling System (CSDMS), who were represented by Scott Peckham and Bert Jagers, has formally decided to adopt the OpenMI as their programmes' standard. CUAHSI is now a member of the OpenMI Association and the OATC are looking at ways to involve Dr Jon Goodall in their work. Other resulting actions are the submission of an NSF proposal making significant use of the OpenMI by Dr Jon Goodall, a CUAHSI member. Dr Goodall will also be leading in the planning of a US summer school covering the use of the OpenMI in integrated modelling to be held in 2009.

There has been much communication between the US EPA and the Association. This resulted in a web meeting between a number of EPA sites, members of the OpenMI Association and the European Commission on the 15th May 2008. The meeting was followed up with a face to face meeting with the EPA's Dr Noha Gaber in Barcelona following iEMSs on 10th July 2008. As a direct result, under the EC-EPA Collaboration Agreement, the EPA Chief Scientist has invitationed the OpenMI Association to contribute to the EPA's planning process for incorporating integrated modelling within its integrated approach to water management. The OA will also explain how it is attempting to build a *community of integrated modelling practice*[3] in Europe. The meeting is to be held 10– 12 December 2008. A request to visit the OpenMI team in Europe during November has also been received from the EPA's Dr Gene Whelan. The purpose of the meeting will be to advance the detailed planning of the December meeting.

Dr Peter Gijsbers was invited by Mary Hill of the USGS to present the OpenMI to the Modflow and More 2008 conference, held at Golden, Colorado, US, in May 2008. His talk attracted an audience of over 100 people, comprising USGS staff, representatives from US agencies, universities and consultancies, with around 25 non-US attendees. The paper (see Appendix 7) was well received Four other papers made specific references to the OpenMI. Personal discussions were undertaken with a number of software suppliers, members of USGS and CSDMS (which has resulted in the CSDMS decision to adopt the OpenMI in their work). Dr Gijsbers was also invited to give an OpenMI training course as part of the "JUPITER API for Calibration, Sensitivity Analysis, and Uncertainty Evaluation, and OpenMI for Linking Process Models at the Grid and Time-Step Scale", post event course. The course was attended by nine people (5 from USGS, 2 consultants and 2 from universities), who are now aware of the OpenMI and its benefits in integrated modelling. More details on the course can be found at http://typhoon.mines.edu/short-course/JUPITER_08.htm.

The US Army Corps of Engineers (US ACE) is continuing its exploration of the OpenMI and has received further funding for its work on linking HECRAS to

[3] 'Community of practice' is the US term for a collaborative group of individuals and organisations with a common purpose.

MODFLOW. The Corps is also expressing interest in linking ecological and hydraulic models.

5.2.2. Workshops & Conferences

CEH hosted a workshop entitled, Integrated Modelling for Integrated Science – The role of the OpenMI in June 2008, which was attended by 40 UK Natural Environment Research Council researchers, many of whom had no prior knowledge of the OpenMI. In July 2008, a number of project partners attended iEMSs 2008 (International Congress on Environmental Modelling and Software Integrating Sciences and Information Technology for Environmental Assessment and Decision Making), held in Barcelona, Catalonia. The OpenMI session was entitled, OpenMI applications and innovations. Three papers were presented to an international audience of 50 people, including papers on the Scheldt use cases, and the Pinios Use Case c. This was followed by a workshop entitled, Taking the OpenMI forward, in which the OpenMI Association Strategy was presented and valuable feedback was received. CEH received a post conference visit from Dr Rob Argent, Project Director of the Australian Water Information System. In September 2008, David Fortune led a session at the FloodRisk2008 conference, held in Oxford, UK.

5.2.3. Publicity Material

To assist with the OpenMI-Life project and OpenMI Association promotional work, the following material has been developed:

- An OpenMI Association leaflet
- An English version of the Scheldt partners poster
- A draft version of the Pinios OpenMI-Life use cases poster
- The 2nd OpenMI Newsletter distributed in July 2008

5.2.4. Communication (website)

Before reporting progress it is useful to provide some background information. The way in which businesses will be run in the future is being changed dramatically by the ability to communicate afforded by the internet. Standards such as the OpenMI are enabling individuals and organisations to collaborate in ways not previously possible. There will always be more resources, ideas and creativity outside an organisation than within it. To succeed in the future, organisations especially those involved in research and information must learn how to harness those external resources, some of which are offered for free. The OpenMI Association is therefore feeling its way toward a business model that will allow it draw on the hugely creative body that lies outside its immediate membership.

With respect to progress in the last period, the OpenMI-Life project has supported the development and ongoing maintenance of two websites: the OpenMI-Life website, www.openmi-life.org (English and Greek versions) and the OpenMI Association website, www.openmi.org. At the beginning of 2008 a new updated OpenMI Association website was released, and a key focus of the remainder of the year has been the completion of this website. Additional features in this new website have been the introduction of separate end user and developer areas, enabling the very different needs to be met. For the developers, a link has been created to the OpenMI wiki. This has been the subject of much discussion as the site moves from being simply a notice board to being a means of two way conversation with the outside

world. The website also contains a dynamic updatable calendar, and future and past events areas to enable OpenMI events to be publicised. Feedback received so far indicates that these pages are well read by those interested in finding out more about the OpenMI, and requests to attend events have been received as a result of the website from those not previously known to the OpenMI Association.

5.3. ISSUES

No special concerns exist regarding dissemination at this point.

5.4. PLAN AND OBJECTIVES FOR NEXT PERIOD

The next six months will be very busy for the Dissemination Task. On the 25th November 2008, the first Scheldt OpenMI Workshop will be held. This workshop will be aimed at end users, modellers and members of the competent authorities from within the Scheldt region. The workshop will cover a basic introduction to the OpenMI, and comprehensive presentations from each of the four Scheldt use cases detailing the progress and findings to date. A Scheldt OpenMI-Life trilingual leaflet will be finalised for use at this workshop. Planning has also been started for the Pinios Workshop, to be held in Volos, Thessaly, Greece, planned for May 2009, and an associated bilingual leaflet will be produced ready for this workshop. Two OpenMI abstracts are currently under preparation, to be submitted as part of a Special Issue for Integrated Modelling. The OpenMI Association Website Latest News will be re-created to become easily updatable by all OpenMI Association Committee members. The 3rd OpenMI Newsletter will be compiled and published.

The OpenMI Association has received a request to present the OpenMI at a workshop being organised by Peter Schade (member of the OATC) of BaW, Hamburg, Germany on 31st October 2008 They are hoping to start a German OpenMI local interest group. Roger Moore has also received requests to speak at the Thirteenth Session for the Commission for Hydrology (CHy), in Geneva, Switzerland in November 2008, the forthcoming PEER workshop being hosted by CEH in January 2009 and the SEAMLESS conference being organised by Alterra in March 2009. The OpenMI will be well represented at the AGU Fall meeting in San Francisco in December 2008.

SECTION 6. PROGRESS UP TO 31ST MARCH 2009

This section provides a summary of envisioned progress up to 31/03/2009. For full details of progress in each task see sections 5 and 7 above.

Task A will be ensuring that the second sets of end user and developer training are completed successfully. For the Pinios partners, these sessions are planned for 20-24th October, and for the Scheldt partners, the 26-27th November 2008.

Tasks B and C, the Scheldt and Pinios demonstrations, will both be preparing to start the operational phases of the project and assessing how the project can be effectively evaluated.

Task D will be defining the final architecture for version 2.0, and present this to the next OpenMI Association Executive Committee meeting in November 2008. Once

this has been accepted release dates will be set for 2009. At present, the proposed final release date is September 2009.

Task E will complete the publicity material required to promote the work of the OpenMI, and encourage project partners to submit their work to relevant conferences. It will mount the first Scheldt workshop in November 2008 and plan for the Pinios workshop to be held in May 2009. Representation will be made to the US Environmental Protection Agency's meeting aimed at forming a community of practice in integrated modelling, and to a joint session with CUAHSI on integrated modelling at the US Fall AGU meeting, both in December 2008. Confirmation is awaited to attend a US Army Corps of Engineers meeting on the linking of ecological and hydraulic models.

SECTION 7. FINANCIAL ISSUES

Table 1 shows the project costs for all partners incurred since the start of the project up until 12/09/2008.

Table 1 Project costs incurred

	Cost category	Total cost according to the Commision's decision*	Costs incurred from the start date to 12/09/2008	%**
1	Personnel	2,660,632	1,331,542.79	50.05
2	Travel	544,450	134,310.64	24.67
3	Outside assistance	422,080	75,744.49	17.95
4	Durables: total non-depreciated cost			
	- *Infrastructure sub-tot.*	-	-	
	- *Equipment sub-tot.*	50,800	10,231.54	20.14
	- *Prototypes sub-tot.*	-	-	
5.	Consumables	10,000	1,788.93	17.89
6.	Other costs	54,500	11,532.91	21.16
7.	Overheads	260,194	109,202.49	41.97
	SUM TOTAL	**4,002,656**	**1,674,353.79**	**41.83**

The major item in the project costs is staff time and the expenditure here is in line with the expected rate of spend. Overall, the project is slightly under spent at this point. There are a number of reasons for this. Firstly, in the original proposal a number of partners bid for equipment that has not subsequently been required. Secondly, there is generally a delay between expenditure and invoicing, particularly in relation to External Assistance; hence the true expenditure is higher than currently shown. Thirdly, the partners have deliberately ensured funds are available for the dissemination activities that are weighted towards the end of the project, when more tangible results can be demonstrated. Lastly, for the UK partners the decline in the GB £ rate against the Euro has resulted in a lower than expected expenditure.

SECTION 8. PROGRESS AND PLANNED ACTIVITIES

At present, the project is, overall, on schedule. The Scheldt and Pinios partners are currently commencing the operational demonstration phase, during which time further refinement of the models and the scenarios to which they will be applied will be undertaken. The current plan is shown in the Gantt chart in Figure 3. An expanded version of the plan can be found in the Proposal.

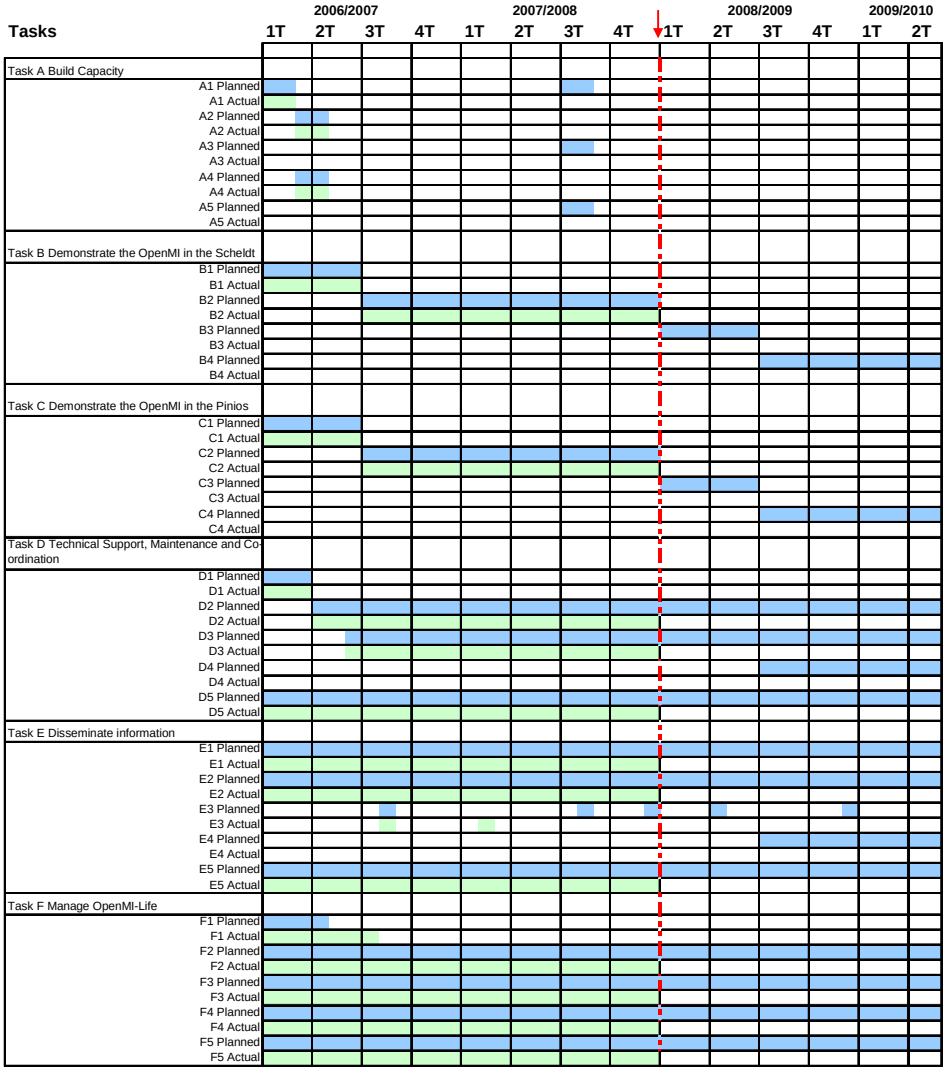


Figure 3 Overview of the OpenMI-Life Work plan

SECTION 9. APPENDICES

Appendices are provided below giving information on the following topics:

1. Project Summary for OpenMI-Life
2. Task Deliverables and their Status
3. OpenMI Compliant Models
4. Partner Information
5. Publications
6. Meetings
7. Examples of dissemination material developed
8. New Planning & Timing for the Scheldt Use Case c
9. Draft OpenMI Standard release Procedure
10. Evaluation Reports

APPENDIX 1 PROJECT SUMMARY FOR OPENMI-LIFE

The goal of OpenMI-Life is to support the implementation of the Water Framework Directive (WFD) and, more particularly, make integrated water management feasible. This requires an ability to predict not only how individual catchment processes will respond to 'programmes of measures' but also to foresee how those processes will interact with each other. Prediction is achieved through the use of models but until the development of the OpenMI, no generic open practical mechanism existed that could link together models of different processes from different suppliers running on different machines – see State-of-the-Art section. HarmonIT, funded by FP5, has developed and proved the highly innovative concept of the Open Modelling Interface, which solves this complex problem. OpenMI-Life will demonstrate how it can be deployed, used, supported and funded at the operational level on real world scale problems. This demonstration will be conducted in co-operation with Competent Authorities in two Pilot River Basins, the Scheldt and the Pinios. It will also show how requests by users for changes to the interface will be handled and implemented. It is the intention that the procedures and systems demonstrated and refined in this project will continue after the project. The long term aim is that the OpenMI should become the European and global standard for model linking in the environmental domain.

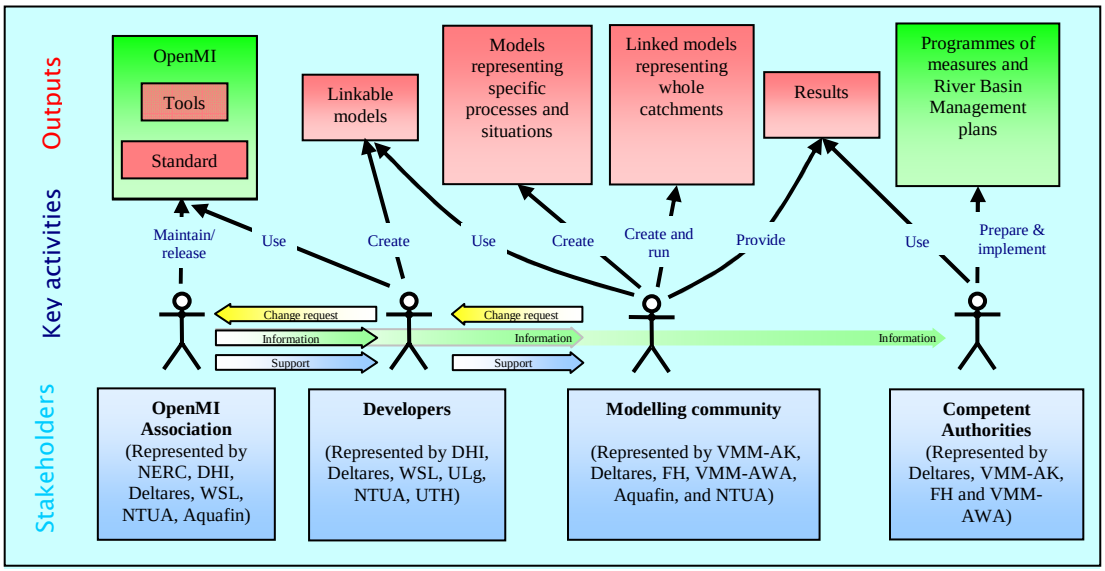


Figure 4 Simplified view of stakeholders and their involvement in the use, maintenance and dissemination of the OpenMI

Figure 4 illustrates the key stakeholders, procedures and products involved in the use, evolution and maintenance of the OpenMI. The tasks listed below are designed to demonstrate the OpenMI and these procedures working at an operational level. It is anticipated that the project will identify the need for change both in the OpenMI and the support procedures. The demonstration will show that both types of request can be handled in a sustainable way. Listed below are the main tasks involved in staging the demonstration:

A) Build capacity: For the OpenMI to become widely adopted there must be a core of knowledgeable modellers. This task will create and deliver training courses to developers, modellers and users in the Competent Authorities of the Scheldt and Pinios and the wider modelling community if resources permit.

B) Demonstrate the OpenMI in the Scheldt and C) the Pinios river basins: The Scheldt and Pinios are Pilot River Basins where implementation of the WFD is being trialled. Both basins contain problems whose management requires an integrated approach and hence the use of linked models. The Competent Authorities of these basins will identify a range of problems. The modelling community will use models linked by the OpenMI to perform an integrated analysis of the problems and indicate the likely outcomes of different policies to the Competent Authorities. Model providers will upgrade the relevant models to be OpenMI-compliant so that they can be linked. The OpenMI Association will maintain and support the OpenMI making new releases in response to requests for change. An evaluation report will assess the value of a) integrated modelling and b) the OpenMI and its support organisation.

D) Demonstrate the OpenMI technical support, maintenance and co-ordination: The success of the OpenMI as a standard depends upon its widespread adoption at the European level. However, its use requires a small but significant degree of investment by developers. Therefore, it will only be taken up if there is confidence that it will be supported and maintained into the future. This task will identify and test a sustainable support and co-ordination organisation. The demonstration will begin using the current open source version of the OpenMI, the research output of HarmonIT. It is expected that this will not satisfy all the user needs. The resulting change requests will be used to exercise all aspects of the support organisation including the periodic release of new open source versions of the OpenMI standard and its supporting software and documentation.

E) Disseminate information: Global awareness of the OpenMI has been achieved in the water modelling community. If the OpenMI is to be widely adopted, it is essential that this is maintained and, ideally, extended into other domains. This task will confirm the target community and the best media for communication. It will then use those media to deliver appropriate information about the OpenMI and the benefits of integrated modelling.

F) Manage OpenMI-Life: The transformation of an IT product is a complex task involving risk. Substantial time will be allocated for active monitoring and management. A risk management plan is in place.

Figure 4 shows the OpenMI-Life participants and the stakeholder roles they will represent in the demonstration. The '**Competent Authorities**' responsible for implementing the WFD and IWM are represented by VMM-AK, FH, VMM-AWA and DELTA who are, in their domains, the competent authorities for the Scheldt Basin. They are actively involved in the preparation of programmes of measures and the development of River Basin Management Plans. VMM-AK and DELTA are leading members of the International Scheldt Commission. They have also been members of the Interreg III Scaldit project, which tested the implementation of the WFD. VMM-AK, DELTA, FH, VMM-AWA, Aquafin, and NTUA represent the **modelling community**. VMM-AK, DELTA, FH, VMM-AWA are regulators and

Aquafin is the company responsible for waste water treatment for the whole of Flanders. All actively own and use models to analyse water management problems and *are anxious to know if integrated modelling will lead to better, more integrated solutions to water management problems*. DHI, DELTA, and WSL represent the major commercial **model developers** in Europe and probably the world. ULg, NTUA and UTH are academic developers, many of whose models have been taken up commercially. In the demonstration, the developers will interact with the modelling community and the OpenMI Association as they would in a real world context. Their motivation is to understand the opportunities and the threats that the OpenMI creates together with the costs and savings. They will receive requests for change to their models from the modelling community. If these requests require a change to the OpenMI, they will pass them to the **OpenMI Association** represented by NERC, DHI, DELTA, WSL, AQUAFIN and NTUA. These organisations have been responsible for leading the €6M FP5 HarmonIT project that created the OpenMI and have planned the support organisation. NERC, DHI, DELTA and WSL all have experience of maintaining standards and software on a national and international basis. All have a long term interest in and understanding of water management. NTUA managed the global dissemination programme for HarmonIT. Their collective interest is to be sure that the proposed support organisation is viable.

The OpenMI-Life project will be led by **the UK Natural Environment Research Council (Centre for Ecology and Hydrology) (NERC),** a world class research organisation with over 2500 staff and turnover in excess of €420M. Its science programme covers most aspects of the natural environment and related technologies; of particular relevance to OpenMI-Life are: hydrology, ecology, integrated management (especially of water resources), sustainable economies, modelling, data management, database design and environmental informatics. NERC works with both the public, private and academic sectors and has extensive experience of managing large national and international projects. It is committed to the delivery of its science to the user community and the market place. NERC has successfully led and managed the 14 partners from 7 countries, who developed the OpenMI over 4 years through the €6M FP5 HarmonIT project (Contract No EVK1-CT-2001-00090), delivering it on time and to budget.

Of the participants, NERC, VMM-AK, FH, VMM-AWA and DELTA are publicly funded national bodies. NTUA, ULg and UTH are Universities and Aquafin, DHI and WSL are non profit companies. All the partners have participated in many past and current EC projects. Much of their recent contribution has been underpinning research for the Water Framework Directive. VMM-AK and NTUA are representing the Pilot River Basins where the WFD is being trialled. The two most relevant projects are the FP5 HarmonIT and Interreg III Scaldit.

APPENDIX 2 TASK DELIVERABLES AND THEIR STATUS

The table below shows a detailed list of the Task deliverables and their status.

Task Deliverables and their status

Deliverable No	Deliverable title	Delivery date	Status
TaskA/1	Training material	**September 2009**	**Ongoing**
TaskA/2	Training course 1 on OpenMI concepts for end users	**December 2006**	**Completed**
TaskA/3	Training course 2 on OpenMI concepts for end users	**November 2008**	**Started**
TaskA/4	Training course 1 on OpenMI upgrades for developers	**December 2006**	**Completed**
TaskA/5	Training course 2 on OpenMI upgrades for developers	**October 2008**	**Started**
Task B/1	Defined Use Cases	**February 2007**	**Completed**
Task B/2	Models migrated to use the OpenMI Interface	**February 2007**	**Completed**
Task B/3	Evaluation report on integrated modelling using the OpenMI (from user and developer perspectives)	**September 2009**	**Started**
Task B/4	Evaluation report on the OpenMI from a user perspective	**September 2009**	**Started**
Task B/5	Evaluation report on the OpenMI support organisation from user perspective	**September 2009**	**Started**
Task C/1	Defined Use Cases	**February 2007**	**Completed**
Task C/2	Models migrated to use the OpenMI Interface	**February 2007**	**Completed**
Task C/3	Evaluation report on integrated modelling using the OpenMI (from user and developer perspectives)	**September 2009**	**Started**
Task C/4	Evaluation report on the OpenMI from a user perspective	**September 2009**	**Started**
Task C/5	Evaluation report on the OpenMI support organisation from user perspective	**September 2009**	**Started**
Task D/1	Management protocol report	**November 2006**	**Completed**
Task D/2	6-Monthly software releases of OpenMI upgrades	**Approx 6 monthly intervals**	**Ongoing**
Task D/3	6-Monthly document addenda	**Approx 6 monthly intervals**	**Ongoing**
Task D/4	Final documentation release of the updated OpenMI	**September 2009**	**Not started**
Task D/5	Evaluation report from OpenMI coordination perspective	**September 2009**	**Not started**
Task D/6	Maintained OpenMI website	**September 2009**	**Ongoing**
Task D/7	Business plan (Including After LIFE Communication report)	**September 2009**	**Started**
Task E/1	Best practice manual	**December 2009**	**Started**
Task E/2	Papers and Journals (6), e.g. Journal of HydroInformatics.	**2 completed, June 2008 (3), June 2009(1)**	**Ongoing**
Task E/3	Press articles (8)	**2008 (2), 2009 (6)**	**Not Started**
Task E/4	Conference presentations (6), e.g. HydroInformatics and iEMSs	**4 completed. September 2008(1), June 2009 (1),**	**Ongoing**
Task E/5	OpenMI-Life web site (multi-lingual)	**Operational / continuous updates**	**Ongoing**
Task E/6	Workshops(5)	**2 completed. November 2008 (1), May 2009 (1), November 2009(1)**	**Ongoing**
Task E/7	Associate with existing newsletters (3),e.g. Rivers List, IAHS, etc.	**2 completed 2009 (1)**	**Ongoing**
Task E/8	Leaflets (4, multi-lingual)	**1 completed, December 2009 (2)**	**Started**
Task E/9	Posters (4)	**3 completed. May 2009 (1)**	**Ongoing**
Task E/10	Layman's report	**December 2009**	**Not started**
TaskF/1	The Collaboration Agreement	**December 2006**	**Completed**
TaskF/1	1st Progress Report to EC	**April 2007**	**Completed**
TaskF/2	2nd Progress Report to EC	**October 2007**	**Completed**
TaskF/3	3rd Progress Report to EC ('Mid-term Report')	**April 2008**	**Completed**
TaskF/4	4th Progress Report to EC	**October 2008**	**Completed**
TaskF/5	5th Progress Report to EC	**April 2009**	**Not started**
TaskF/6	6th Progress Report to EC ('Final Report')	**January 2010**	**Not started**
TaskF/7	Miscellaneous reports required by the EC	**As required**	**Ongoing**

APPENDIX 3 OPENMI COMPLIANT MODELS

Below is a table detailing all reported OpenMI compliant models.

Company	Compliant Models & Components	OpenMI version	.NET	Java	General description/ Compliance
British Geological Survey & University of Birmingham	ZOOMQ3D	1.4	X		Finite-difference groundwater flow model
Alterra	Capri	1.2		X	Agricultural policy impact model
	FSSIM	1.2		X	Bio-economic model
	Apes	1.2		X	Biophysical model
	MetaSwap en Simgro	1.2		X	Hydrological model
BAW	GEI Wrapper	1.2	X		Access to propriatary data for Delft 3D flow
CEH	Classic	1.2	X		Hydrological model
CRWR	ArcHydro	1.2	X		Hydrological model
Delft Hydraulics Software	Sobek 1DFlow	1.2	X		Urban/Rural/River model
	Delft3D	1.2	X		2D/3D flow model
	DelftFEWS	1.2	X		Flood forecasting model
DHI software	MIKE 11	1.2	X		Hydraulic model
	MIKE SHE	1.2	X		Hydrological model
	MIKE URBAN	1.2	X		Urban drainage model
Hydrologic Engineering Center	HEC-RAS	1.2	X		Hydraulic model
NTUA	RMM - NTUA	1.2	X		Reservoir watershed management model
	RiSH-1D	1.2	X		Hydraulic model
Utrecht University	PCRaster	1.2	X		Data interface component
RIZA	DM	1.2	X		Surface water transport model component
	Mozart	1.2	X		Unsaturated zone model component
	Agricom	1.2	X		Agricultural model
	NwSim	1.2	X		
	DemNat	1.2	X		Ecohydrological model
	DistrConnector	1.2	X		
Wallingford Software	Info Works RS	1.2	X		Hydraulic model
	Isis	1.2	X		Hydrological model
	Info Works CS	1.2	X		Sewer model
	SULIS	1.2	X		3D lake and estuary model
Schlumberger Water Services	Visual Modflow	1.2	X		Groundwater model
University of Liege	PEGASE	1.2	X		River quality model
University of Thessaly	UTHBAL	1.2	X		Hydrological model
WRc Plc	STOAT	1.2	X		Wastewater treatment model

APPENDIX 4 PARTNER INFORMATION

This Appendix provides names, addresses and contact details for all the personnel working in the partner organisations.

			TASKS A-F	CONTRACT	STEERING COMMITTEE	TECHNICAL COMMITTEE
Chairman CEH Wallingford, UK	Mr. Roger V. Moore CEH Wallingford Wallingford Oxon OX10 8BB. UK	Tel: +44 (0)1491 692235 Mobile: +44 7834 184334 Fax: +44 (0)1491 692424 Email: rvm@ceh.ac.uk	A, B, C, D, E, F	✓	✓	
Secretary CEH Wallingford, UK	Miss Hazel Murphy CEH Wallingford Wallingford OX10 8BB. UK	Tel: +44 (0)1491 692205 Fax: +44 (0)1491 692424 Email: harp@ceh.ac.uk	A, B, C, D, E, F	✓	✓	
DHI Water and Environment, Denmark	Dr. Jan Gregersen LicTek Tingstedet 8, 4070 Kirke Hyllinge, Denmark	Tel: +45 46 40 36 26 Mobile: +45 41 58 80 26 Email: Gregersen@LicTek.dk	A, B, C, D, E, F	✓	✓	✓
Wallingford Software Limited, HR Wallingford Group, UK	Ms Susan Anderson Wallingford Software Ltd. Howbery Park Wallingford OX10 8BA. UK	Tel: +44 (0)1491 822322 Fax: +44 (0)1491 826392 Email: susan.anderson@wallingfordsoftware.com	A,			
Wallingford Software Limited, HR Wallingford Group, UK	Mr. David Fortune Wallingford Software Ltd. Howbery Park Wallingford OX10 8BA. UK	Tel: +44 (0)1491 822297 Fax: +44 (0)1491 826392 Email: david.fortune@wallingfordsoftware.com	A, B, C, D, E, F		✓	
Wallingford Software Limited, HR Wallingford Group, UK	Mr. Adrian Harper Wallingford Software Ltd. Howbery Park Wallingford OX10 8BA. UK	Tel: +44 (0)1491 824777 Fax: +44 (0)1491 822221 Email: adrian.harper@wallingfordsoftware.com	A, D			✓
Wallingford Software Limited, HR Wallingford Group, UK	Mr. Rob Millington Wallingford Software Ltd. Howbery Park Wallingford OX10 8BA. UK	Tel: +44 (0)1491 822417 Fax: +44 (0)1491 826392 Email: rob.millington@wallingfordsoftware.com	A, B, C, D, E, F	✓	✓	

			TASKS A-F	CONTRACT	STEERING COMMITTEE	TECHNICAL COMMITTEE
NTUA National Technical University of Athens, Greece *Pinios partner*	Prof. Maria Mimikou NTUA Iroon Polytechniou 5 157 80 Athens, Greece	Tel: +30 210 772 2880 Fax: +30 210 772 2879 Email: mmimik@chi.civil.ntua.gr	A, C, D, E		✓	
NTUA National Technical University of Athens, Greece *Pinios partner*	Dr. Ria Safiolea (Contact person) NTUA Iroon Polytechniou 5 157 80 Athens, Greece	Tel: +30 210 772 2885 Fax: +30 210 772 2879 Email: safiolea@chi.civil.ntua.gr	A, C, D, E	Send to Maria Kalliampakou (financial & admin) mkalli@chi.civil.ntua.gr	✓	
NTUA National Technical University of Athens, Greece *Pinios partner*	Dr. Christos Makropoulos NTUA Iroon Polytechniou 5 157 80 Athens, Greece	Tel: +30 210 772 2886 Fax: +30 210 772 2879 Email: cmakro@chi.civil.ntua.gr	A, C, D, E			
UTH University of Thessaly, Greece *Pinios partner*	Mr. Lampros Vasiliades Department of Civil Engineering University of Thessaly 38334 Volos, Greece	Tel: +30 24210 74115 Fax: +30 24210 74169 Email: lvassil@uth.gr	C	✓	✓	
UTH University of Thessaly, Greece *Pinios partner*	Dr. Konstantinos Kokkinos Department of Civil Engineering University of Thessaly 38334 Volos, Greece	Tel: +30 24210 74115 Fax: +30 24210 74169 Email: k_kokkinos@teilar.gr	C			
UTH University of Thessaly, Greece *Pinios partner*	Prof. Antonis Liakopoulos University of Thessaly Pedion Areos, 383 34 Volos, Greece	Tel. +30 2421 074111 Fax +30 2421 074169 Email: aliakop@uth.gr	C	✓	✓	
UTH University of Thessaly, Greece *Pinios partner*	Prof. Athanasios Loukas Department of Civil Engineering University of Thessaly 38334 Volos Greece	Tel: +30 24210 74168 Fax: +30 24210 74169 Email: aloukas@civ.uth.gr	C			

			TASKS A-F	CONTRACT	STEERING COMMITTEE	TECHNICAL COMMITTEE
Aquafin Belgium	Mr. Johan Van Assel Aquafin Dijkstraat 8 2630 Aartselaar Belgium	Tel: +32 3 450 4082 Fax: +32 3 450 4444 Email: johan.vanassel @aquafin.be	A, B, C, D, E, F	✓	✓	
Aquafin Belgium	Mr. Chris Thoeye Aquafin Dijkstraat 8 2630 Aartselaar Belgium	Tel: +32 3 450 40 72 Fax: +32 3 450 4444 Email: chris.thoeye@aquafin.be	A, B, C, D, E, F			
Aquafin Belgium	Gunther Waterschoot Aquafin Dijkstraat 8 2630 Aartselaar Belgium	Tel. +32/3 4504088 Fax +32/3 4504185 Email : gunther.waterschoot@aquafin.be	B			
VMM-AK Vlaamse Milieumaatschappij Belgium *Scheldt partner*	Ir. Yves Ronse DVP Waterkwaliteitsmodellering VMM - Afdeling Kwaliteitsbeheer Werkadres : Gasthuisstraat 42, 9300 Aalst Postadres : A. Van de Maelestraat 96, 9320 Erembodegem	Tel : +32 53 72 66 31 Fax : +32 53 72 66 30 E-mail : y.ronse@vmm.be	A, B, D, E, F	✓	✓	
VMM-AK Vlaamse Milieumaatschappij Belgium *Scheldt partner*	Mr. Tom D'Heygere DVP Waterkwaliteitsmodellering VMM - Afdeling Kwaliteitsbeheer Werkadres : Gasthuisstraat 42, 9300 Aalst Postadres : A. Van de Maelestraat 96, 9320 Erembodegem	Tel : + 32 53 726578 Fax : +32 53 72 66 30 E-mail: t.dheygere@vmm.be	A, B			

			TASKS A-F	CONTRACT	STEERING COMMITTEE	TECHNICAL COMMITTEE
VMM-AK Vlaamse Milieumaatschappij Belgium *Scheldt partner*	Mr. Gunther De Mey VMM - Afdeling Kwaliteitsbeheer Werkadres : Gasthuisstraat 42, 9300 Aalst Postadres : A. Van de Maelestraat 96, 9320 Erembodegem	Tel : + 32 53 72.63.26. Fax : + 32 53 72.62.31. Email : g.demey@vmm.be	B, E, F	✓	✓	
FH Flanders Hydraulic Research Belgium *Scheldt partner*	Mr. Hans Vereecken Vlaamse Overheid - Departement Mobiliteit en Openbare Werken Afdeling Waterbouwkundig Laboratorium Berchemlei 115 | B-2140 Borgerhout	Tel: + 32 3 224 61 89 Fax: + 32 3 224 60 36 Email: hans.vereecken@mow.vlaanderen.be	A3, B2, B3, B4, E	✓	✓	
FH Flanders Hydraulic Research Belgium *Scheldt partner*	Ms Isabelle Neyskens Vlaamse Overheid - Departement Mobiliteit en Openbare Werken Afdeling Waterbouwkundig Laboratorium Berchemlei 115 | B-2140 Borgerhout	Tel: + 32 3 224 61 92 Fax: + 32 3 224 60 36 Email: isabelle.neyskens@mow.vlaanderen.be	A3, B2, B3, B4, E			
FH Flanders Hydraulic Research Belgium *Scheldt partner*	Ms. Katrijn Holvoet Vlaamse Overheid - Departement Mobiliteit en Openbare Werken Afdeling Waterbouwkundig Laboratorium Berchemlei 115 | B-2140 Borgerhout	Tel: + 32 3 224 61 92 Fax: + 32 3 224 60 36 Email: katrijn.holvoet@mow.vlaanderen.be	A3, B2, B3, B4, E			
VMM-AWA Vlaamse Milieumaatschappij Afdeling Water Belgium *Scheldt partner*	Dhr. Kris Cauwenberghs Vlaamse Milieumaatschappij Afdeling Water Graaf de Ferraris-gebouw Koning Albert-II laan 20 1000 Brussel	Tel: +02 553 21 29 Fax: +02 553 21 05 Email: k.cauwenberghs@vmm.be	A, B, E	✓	✓	

			TASKS A-F	CONTRACT	STEERING COMMITTEE	TECHNICAL COMMITTEE
VMM-AWA Vlaamse Milieumaatschappij Afdeling Water Belgium *Scheldt partner*	Ms. Neel Devroede Vlaamse Milieumaatschappij Afdeling Water Waaistraat 1 bus2 3000 Leuven	Tel: + 32 16 21 12 60 Fax: + 32 16 211270 Email: n.devroede@vmm.be	A, B, E			
ULG University of Liege Belgium *Scheldt partner*	Ir. Jean-Francois Deliege Universite de Liege Aquapole Sart-Tilman B5 4000 Liege – Belgium	Tel: +32 (0) 4 366.23.56 Fax: +32(0) 4 366.23.55 Email: jfdeliege@ulg.ac.be	A3, A5, B1, B2, B3, B4, E1, E3, F1, F4	✓	✓	
ULG University of Liege Belgium *Scheldt partner*	Ir Etienne Everbecq Universite de Liege Aquapôle : Sart Tilman B53 B - 4000 Liège (Belgium)	Tel : + 32 4 366.23.52 Email : e.everbecq@ulg.ac.be	A3, A5, B1, B2, B3, B4, E1, E3, F1, F4			
ULG University of Liege Belgium *Scheldt partner*	Mr Tayeb Bourouag Universite de Liege Aquapôle : Sart Tilman B53 B - 4000 Liège (Belgium)	Tel : + 32 4 366.23.56. Email : mbourouag@ulg.ac.be	A3, A5, B1, B2, B3, B4, E1, E3, F1, F4			
ULG University of Liege Belgium *Scheldt partner*	Ir Pol Magermans Universite de Liege Aquapôle : Sart Tilman B53 B - 4000 Liège (Belgium)	Tel : + 32 4 366.4874. Email : p.magermans@ulg.ac.be	B2, B3, B4, E1, E3			

			TASKS A-F	CONTRACT	STEERING COMMITTEE	TECHNICAL COMMITTEE
ULG University of Liege Belgium *Scheldt partner*	Mr Laurent Rousseau Universite de Liege Aquapôle : Sart Tilman B53 B - 4000 Liège (Belgium)	Tel: + 32 4 366.4865. Email : l.rousseau@ulg.ac.be	B2, B3, B4, E1, E3			
Deltares, The Netherlands	Dr. Peter Gijsbers Deltares P.O. Box 177 2600 MH Delft The Netherlands	Tel: +31 15 285 89 28 Fax: +31 15 285 85 82 Email: peter.gijsbers@deltares.nl	D			✓
Deltares, The Netherlands	Mr. Jaco Stout Deltares P.O. Box 177 2600 MH Delft The Netherlands	Tel: +31 15 285 87 63 Fax: +31 15 285 87 11 Email: jaco.stout@deltares.nl	A, B, D, F	✓	✓	
Deltares, The Netherlands	Mr Stef Hummel Deltares P.O. Box 177 2600 MH Delft The Netherlands	Tel: +31 15 285 85 09 Fax: +31 15 285 85 82 Email: stef.hummel@deltares.nl	D			✓
Deltares The Netherlands *Scheldt partner*	Mr. Edwin Spee Deltares P.O. Box 177 2600 MH Delft The Netherlands	Tel: +31 15 285 88 29 Fax: +31 15 285 87 11 Email: Edwin.Spee@deltares.nl	A, B, E			
Deltares The Netherlands	Mr Michiel Blind Deltares P.O. Box 177 2600 MH Delft The Netherlands	Tel: +31 15 285 78 16 Fax: +31 15 285 85 82 Email: michiel.blind@deltares.nl	E			
Deltares The Netherlands *Scheldt partner*	Mr. David Kerkhoven Deltares P.O. Box 177 2600 MH Delft The Netherlands	Tel: + 31 15 285 87 45 Fax: + 31 15 285 87 85 Email: david.kerkhoven@deltares.nl	A, B, E			

APPENDIX 5 PUBLICATIONS

This Appendix lists scientific papers, conference papers, presentations, posters, leaflets and articles in the popular scientific press

Authors	Date	Title	Event	Reference	Type
Fortune, D	17-19/4/2007	The relevance of the OpenMI to the Yangtze River Forum	Yangtze River Forum		Oral presentations
Moore, R. V., Tindall, C. I.	30/04/2007	OpenMI Progress Report. October 2006 – March 2007.			Customer Report to the European Commission. April 2007.
Moore, R. V., Tindall, C. I.	30/04/2007	Collaboration agreement for LIFE Project No LIFE06 ENV/UK.000409			Collaboration agreement
Vits, S. (VMM-AWA)	03/05/2007	Interaction between models: OpenMI-Life Project	Congress: Conference on Water Systems Symposium: Modelling for integrated water management in Flanders		Oral presentation
Van Assel, J	22/05/2007	OpenMI- Linking of InfoWorks CS and RS, applied in the Scheldt basin (in Dutch)	InfoWorks Benelux User meeting in Hoeven, The Netherlands.		Oral presentation
Safiolea E. (NTUA)	03/07/2007	Bringing the OpenMI to Life	Floodmed Workshop, Sofia, Bulgariaa		Poster Presentation
Aquafin	15/07/2007	Models co-operate better with OpenMI-Life (in Dutch)		Aqua Magazine 2007/02, Aquafin, Belgium	Promotional article
National Technical University of Athens and Centre for Ecology and Hydrology	31/07/2007	OpenMI-Life poster		Imprint: Athens, Greece: National Technical University of Athens, July 2002	Poster
Mylopoulos N. and P. Sidiropoulos (University of Thessaly)	9-13/09/2007	Uncertainty analysis and management in an overexploited aquifer	ModelCARE 2007 Calibration and Reliability in Groundwater Modelling, Credibility of Modelling, Copenhagen, Denmark		Poster presentation
Van Assel, J	12/09/2007	Integrated modelling in the Scheldt River Basin	InfoWorks International User Conference, Wallingford, UK		Oral presentation
Moore, R. V.	27/09/2007	Tools and technologies for river basin management, HarmonIT - OpenMI-Life	Harmoni-CA Final Conference, Brussels, Belgium		Oral presentation
Gregersen, J.B., Gijsbers, P.J.A., and Westen, S.J.P.	2007	OpenMI: Open modelling interface		Journal of Hydroinformatics, 9(3), 175-191.	Refereed paper
Hummel, S	03/10/2007	Presentation of OpenMI for IDSW" (IDSW is the InformationDesk for Standards in the Water domain, the Netherlands)	IDsW-informative meeting on external developments.		Oral presentation.

Authors	Date	Title	Event	Reference	Type
National Technical University of Athens and Centre for Ecology and Hydrology		OpenMI leaflet		Imprint: Athens, Greece: National Technical University of Athens, July 2007	Leaflet
Moore, R. V., Tindall, C. I.	31/10/2007	OpenMI second Progress Report. April 2007 – September 2007.			Customer Report to the European Commission. October 2007.
Devroede, N., Vits, S.		Interacties tussen modellen: het OpenMI-LIFE project	Article for a Flemish magazine reporting on a presentation given by Vits S. on 03/05/2007. It describes the OpenMI-LIFE project and TaskB-the Scheldt in particular.		Article
Moore, R. V., Murphy, H. M.	3-4 December 2007	OpenMI Association poster	CEH Annual Staff Conference		Poster
Holvoet, K., Vereecken, H., Devroede, N., Ronse, Y., Cauwenberghs, K., Van Assel, J., and Waterschoot, G.	6-7 December 2007	OpenMI helps water managers in the future with integrated water management	Knowledge of Water Systems Conference, Antwerp, Belgium		Poster presentation in Dutch
Gregersen, J., Gijsbers, P.	March 2008	OpenMI Standard poster			Poster
Moore, R. V., Murphy, H. M.	28/02/2008	OpenMI Association Annual Report			Association Annual Report
Moore, R. V., Murphy, H. M.	30/04/2008	OpenMI Interim Report. October 2006 – March 2008			Customer Report to the European Commission. April 2008
Moore, R. V., Murphy, H. M., Sotiropoulos, E.	April 2008	OpenMI Association poster			Poster
Gijsbers, P.J.A., J.B. Gregersen, P.Sinding, S.Hummel	19-21 May 2008	OpenMI design patterns for river-groundwater interaction	Modflow and More 2008 Conference, organised by IGWMC, Golden, CO		paper accepted for publication in conference proceedings
Gijsbers, P.J.A.	22 May 2008	OpenMI training course	post-event Modflow and More 2008 Conference, organised by IGWMC, Golden, CO		course
Holvoet, K., Vereecken, H., Devroede, N., Ronse, Y., Cauwenberghs, K., Van Assel, J., Waterschoot, G. Sotiropoulos, E	June 2008	Demonstration of Integrated Modelling in the Scheldt River Basin using the OpenMI			Poster
Loukas, A., K. Kokkinos, L. Vasiliades, and A. Liakopoulos (University of Thessaly)	6-10/07/2008	The migration of the UTHBAL hydrologic model into OpenMI	iEMSs 2008: International Congress on Environmental Modelling and Software, Integrating Sciences and Information Technology for Environmental Assessment and Decision Making, 4th Biennial Meeting of iEMSs, Barcelona, Spain		paper accepted for publication in conference proceedings

Authors	Date	Title	Event	Reference	Type
N. Devroede, Y. Ronse, J. Van Assel and H. Vereecken	6-10/07/2008	Demonstration of Integrated Modelling using the OpenMI in the Scheldt River Basin	iEMSs 2008: International Congress on Environmental Modelling and Software, Integrating Sciences and Information Technology for Environmental Assessment and Decision Making, 4th Biennial Meeting of iEMSs, Barcelona, Spain		paper accepted for publication in conference proceedings
Gijsbers, P., Moore, R.V.	6-10/07/2008	Taking the OpenMI Forward	iEMSs 2008: International Congress on Environmental Modelling and Software, Integrating Sciences and Information Technology for Environmental Assessment and Decision Making, 4th Biennial Meeting of iEMSs, Barcelona, Spain		paper accepted for publication in conference proceedings
OpenMI Association & Sotiropoulos, E	July 2008	2nd OpenMI Newsletter			Newsletter
Moore, R. V., Murphy, H. M., Sotiropoulos, E., Safiolea, R., Van Assel, J., Blind, M.	August 2008	OpenMI Association leaflet			Leaflet
Smolders, S., Neyskens, I., Willems P., Vaes G., Van Assel J.	31/08/2008 - 05/09/2008	Bi-directional sewer-river linking through the OpenMI software	ICUD 2008 : 11th International Conference on Urban Drainage, Edinburgh, Scotland		paper accepted for publication in conference proceedings
Fortune, D	October 2008	The OpenMI-LIFE Project - putting integrated modelling into practice in flood management	FloodRisk2008		Oral presentation
Moore, R.V.	07/10/2008	The OpenMI - Planning for success	NERC IT Awareness, Warwick University, UK		Oral presentation
Moore, R. V., Murphy, H. M.	31/10/2008	OpenMI fourth Progress Report. April 2008 – September 2008.			Customer Report to the European Commission. October 2008.
Moore, R.V.	31/10/2008	The potential of Integrated Modelling (with the OpenMI)	Integrated Modelling with the OpenMI, Workshop at the Bundesanstalt Fur Wassenbrau, Hamburg, Germany.		Oral presentation
Moore, R.V.	10/11/2008	An introduction to the OpenMI	Thirteenth Session of the Commission for Hydrology, WMO, Geneva, Switzerland.		Oral presentation
Moore, R.V.	12/12/2008	Title to be decided	The US EPA Office of Environmental Information Annual Symposium, Phoenix, Arizona, USA		
Moore, R.V.	17/12/2008	The OpenMI – its transformation from research output to global integrated modelling community standard	AGU Fall Meeting, San Francisco, USA		Abstract submitted
Moore, R.V.	29/01/2009	To be decided	PEER Workshop, CEH, Wallingford, UK.		Oral presentation
Moore, R.V	10/03/2009		Integrated Assessment of Agriculture and Sustainable Development, Hotel Zuiderduin, Egmond ann Zee, The Netherlands		Keynote speech

Note: Publications in grey are in the process of being prepared.

APPENDIX 6 MEETINGS

This Appendix lists all the formal Meetings and Workshops held to manage and co-ordinate the work of the OpenMI-Life project.

Meeting	Date	Host / Venue	Attendees
OpenMI-Life kick-off meetings	03-05/10/2006	VMM-AK, Belgium	All partners
OpenMI Association Executive Committee meeting 2	03/10/2006	VMM-AK, Belgium	CEH, RIZA, WSL, NTUA, WL|Delft, DHI, NTUA, Aguafin,
Steering Committee meeting 1	05/10/2006	VMM-AK, Belgium	CEH, DHI, WL|Delft, WSL, NTUA, Aquafin, VMM-AK
Task B, Use case 'c' Technical meeting 1	6/11/2006	VMM-AWA Leuven, Belgium	Aquafin, VMM-AK, FH, VMM-AWA, ULG
Task B, Use case 'd' Technical meeting 1	14/11/2006	RIKZ Middelburg, The Netherlands	FH, RIKZ, WL|Delft
Task B, Use case 'c' Technical meeting 2	23/11/2006	VMM-AWA, Belgium	VMM-AK, ULG, VMM-AWA
Task A developers and end users training for Pinios	30/10-01/11/2006	NTUA, Greece	NTUA, UTH, DHI
Task A developers training for Scheldt	29/11-01/12/2006	ULG, Belgium	ULG, RIKZ, WL|Delft
Task B Technical meeting Use case 'b' and 'c'	06/12/2006	VMM-AWA, Belgium	VMM (+ULG), VMM-AWA, FH
Task B, Use case 'c' Technical meeting 3	11/12/2006	University of Liège, Belgium	VMM-AK, FH, ULG
OpenMI Association Technical Committee meeting 2	13-14/12/2006	WL | Delft, Delft, The Netherlands	DHI, WSL, WL|Delft, Alterra, RIZA
Task B Technical meeting ' b'	17/01/2007	VMM-AWA, Belgium	VMM-AWA, FH
Task A end users training for Scheldt	17-19/01/2007	VMM-AK, Belgium	VMM-AK, VMM-AWA, FH, ULG, Aquafin, WSL
OpenMI Association Technical Committee meeting 3	22–23/01/2007	WSL, Wallingford, UK	DHI, WSL, WL|Delft, Alterra
Steering Committee meeting 2	25/01/2007	CEH, Wallingford, UK	CEH, DHI, WL|Delft, WSL, NTUA, Aquafin, VMM-AK, HTSPE Ltd
OpenMI Association Dissemination Committee meeting 1	16/02/2007	NTUA, Athens, Greece	NTUA, CEH
Task B, Use case 'd' Technical meeting 2	16/02/2007	FH Borgerhout, Belgium	FH, RIKZ, WL|Delft
OpenMI Association Technical Committee meeting 4	05-07/03/2007	DHI, Hørsholm, Denmark	DHI, WSL, WL|Delft
Task B Technical meeting Use case 'a'	05/03/2007	VMM-AWA, Belgium	VMM-AWA, Aquafin
Task C Technical Group Meeting Pinios: All Use Cases	05/03/2007	University of Thessaly, Volos, Greece	NTUA, UTH
Task B, Use case 'c' Technical meeting 4	6/03/2007	University of Liège, Belgium	VMM-AK, ULG
Task C Technical Group Meeting Pinios : Use Case 3	20/03/2007	University of Thessaly, Volos, Greece	UTH
Task C Technical Group Meeting Pinios: Use Case 1	28/03/2007	NTUA, Athens, Greece	NTUA
Task C Technical Group Meeting Pinios: Use Case 2	29/03/2007	NTUA, Athens, Greece	NTUA
Task B, Use case 'c' Technical meeting 5	29/03/2007	University of Liège, Belgium	VMM-AK, ULG
Task C Technical Group Meeting Pinios: Use Case 3	03/04/2007	University of Thessaly, Greece	UTH
Task C Technical Group Meeting Pinios: Use Case 1	12/04/2007	NTUA, Athens, Greece	NTUA
Task C Technical Group Meeting Pinios: Use Case 2	13/04/2007	NTUA, Athens, Greece	NTUA
OpenMI Association Dissemination Committee meeting 2	16/04/2007	Aquafin, Aartselar, Belgium	NTUA, Aquafin, WL | Delft
Task B Technical meeting Use case 'a'	17/04/2007	Aquafin, Aartselar, Belgium	VMM-AWA, Aquafin, Wallingford Software
OpenMI Association Executive Committee meeting 3	17/04/2007	Aquafin, Aartselar, Belgium	CEH, RIZA, WL| Delft, DHI, WSL, NTUA, Aquafin, Alterra
OpenMI-Life Workshop	18-19/04/2007	Aquafin, Aartselar, Belgium	CEH, DHI, WL|Delft, HRWG, NTUA, UTH, Aquafin, VMM-AK, FH, VMM-AWA, ULG, RIKZ
OpenMI-Life Steering Committee meeting 3	19/04/2007	Aquafin, Aartselar, Belgium	CEH, DHI, WL|Delft, WSL, NTUA, Aquafin, VMM

Meeting	Date	Host / Venue	Attendees
OpenMI Association Technical Committee meeting 5	07-09/05/2007	WL | Delft, Delft, The Netherlands	DHI, WSL, WL|Delft
Task E Training and assistance on the OpenMI	07-11/05/2007	HEC, Davis, CA, USA	WL Delft, HEC
Task B, Use case 'd' Technical meeting 4	08/05/2007	WL | Delft, Delft, The Netherlands	FH, WL|Delft
Task C Technical Group Meeting Pinios: Use Case 3	15/05/2007	University of Thessaly, Volos, Greece	UTH
OpenMI Association Technical Committee meeting 6	18-20/06/2007	WSL, Wallingford, UK	DHI, WSL, WL|Delft
Task C Technical Group Meeting Pinios: Use Case 3	04/07/2007	University of Thessaly, Volos, Greece	UTH
Task C Technical Group Meeting Pinios: Use Case 2	18/07/2007	NTUA, Athens, Greece	NTUA
Task B Technical meeting Use case 'a'	31/07/2007	Aquafin, Aartselaar, Belgium	Aquafin, VMM-AWA
Task C Technical Group Meeting Pinios: Use Case 3	30/08/2007	University of Thessaly, Volos, Greece	UTH
OpenMI Association Technical committee meeting 7	03-05/09/2007	DHI, Hørsholm, Denmark	DHI, WSL, WL|Delft
OpenMI Association Executive Committee meeting 4	06/09/2007	DHI, Hørsholm, Denmark	CEH, RIZA, WL|Delft, DHI, WSL, NTUA, Aquafin, Alterra
OpenMI-Life Steering Committee meeting 4	07/09/2007	DHI, Hørsholm, Denmark	CEH, DHI, WL|Delft, WSL, NTUA, Aquafin, VMM
Task C Technical Group Meeting Pinios: Use Case 1	19/09/2007	NTUA, Athens, Greece	NTUA
Task B Technical meeting Use case 'a'	24/09/2007	Aquafin, Aartselaar, Belgium	Aquafin, VMM-AWA
Task B Technical meeting Use case 'b'	24/09/2007	FH, Borgerhout, Belgium	FH, VMM-AWA
OpenMI Association Executive Committee meeting 5	03/10/2007	WL | Delft, Delft, The Netherlands	RIZA, WL| Delft, DHI, WSL, NTUA, Aquafin, Alterra
OpenMI Association General Meeting 1	04/10/2007	WL | Delft, Delft, The Netherlands	CEH, RIZA, WL| Delft, DHI, WSL, NTUA, Aquafin
Task C Technical Group Meeting Pinios: Use Case 1	10/10/2007	NTUA, Athens, Greece	NTUA
Task B, Use case 'd' Technical meeting 5	11/10/2007	FH Borgerhout, Belgium	FH, RIKZ, WL|Delft
OpenMI Association Technical Committee meeting 8	22-24/10/2007	WL | Delft, Delft, The Netherlands	DHI, WSL, WL|Delft
Task C Technical Group Meeting Pinios: Use Case 1	24/10/2007	NTUA, Athens, Greece	NTUA
Task C Technical Group Meeting Pinios: Use Case 2	25/10/2007	NTUA, Athens, Greece	NTUA
OpenMI Association Documentation Meeting 1	25/10/2007	WL | Delft, Delft, The Netherlands	CEH, WL| Delft, DHI, WSL, Butford Technical Publishing
OpenMI Association Strategy meeting 1	30-31/10/2007	Brussels, Belgium	CEH, WL| Delft, DHI, WSL, Aquafin, NTUA, EC DG RTD
OpenMI Association Technical Committee meeting 9	07/11/2007	Web meeting	DHI, WSL, WL|Delft
Task C Technical Group Meeting Pinios: Use Case 3	13/11/2007	University of Thessaly, Volos, Greece	UTH
OpenMI Association Technical Committee meeting 10	14/11/2007	Web meeting	DHI, WSL, WL|Delft
OpenMI Association Dissemination Committee meeting 3	19/11/2007	CEH, Wallingford, UK	CEH, NTUA, Aquafin, WL|Delft
2nd OpenMI-LIFE Workshop	20/11/2007	HRW, Wallingford, UK	All partners plus outside invited guests
OpenMI Association Workshop	21/11/2007	CEH, Wallingford, UK	All partners plus outside invited guests
OpenMI Association Strategy and Funding meeting 2	21/11/2007	CEH, Wallingford, UK	Partners plus outside invited guests
OpenMI Association Technical Committee meeting 11	22/11/2007	CEH, Wallingford, UK	DHI, WSL, WL|Delft, partners plus outside invited guests
OpenMI-Life Steering Committee meeting 5	23/11/2007	CEH, Wallingford, UK	CEH, DHI, WL|Delft, WSL, NTUA, Aquafin, VMM
OpenMI Association Executive Committee meeting 6	22-23/11/2007	CEH, Wallingford, UK	CEH, RIZA, WL| Delft, DHI, WSL, NTUA, Aquafin, Alterra
OpenMI Association Technical committee meeting 12	10–12/12/2007	Wallingford Software, Wallingford, UK	DHI, WSL, WL|Delft
Task C Technical Group Meeting Pinios: Use Case 2	12/12/2007	NTUA, Athens, Greece	NTUA
Task B Technical meeting Use case 'a'	20/12/2007	Aquafin, Aartselaar, Belgium	Aquafin, VMM-AWA, WSL
OpenMI Association Dissemination Committee meeting 4	09/01/2008	Aquafin, Aartselaar, Belgium	CEH, NTUA, Aquafin, Deltares
Task B, Use case 'd' Technical meeting 6	10/01/2008	Deltares, Delft, The Netherlands	FH, Deltares
OpenMI Association Technical committee meeting 13	16/01/2008	Web meeting	DHI, WSL, Deltares
OpenMI Association Technical committee meeting 14	23/01/2008	Web meeting	DHI, WSL, Deltares
Task B Technical meeting Use case 'a'	01/02/2008	Aquafin, Aartselaar, Belgium	Aquafin, VMM-AWA, WSL
OpenMI Association Technical committee meeting 15	04-06/02/2008	DHI, Hørsholm, Denmark	DHI, WSL, Deltares

Meeting	Date	Host / Venue	Attendees
Task C Technical Group Meeting Pinios: Use Case 3	14/02/2008	University of Thessaly, Volos, Greece	UTH
Task B, Use case 'd' Technical meeting 7	21/02/2008	FH Borgerhout, Belgium	FH, Deltares
Task C Technical Group Meeting Pinios: Use Case 1	22/02/2008	NTUA, Athens, Greece	NTUA
Task B Technical meeting Use case 'a'	03/03/2008	Aquafin, Aartselaar, Belgium	Aquafin, VMM-AWA, WSL
Task C Technical Group Meeting Pinios: Use Case 1	03/03/2008	NTUA, Athens, Greece	NTUA
OpenMI Association Documentation Meeting 2	11/03/2008	Deltares, Delft, The Netherlands	CEH, Deltares, DHI, WSL, Butford Technical Publishing
OpenMI Association Dissemination Committee meeting 5	12/03/2008	Deltares, Delft, The Netherlands	CEH, NTUA, Aquafin, Deltares
OpenMI Association General Meeting 2	13/03/2008	Deltares, Delft, The Netherlands	CEH, Deltares, DHI, WSL, NTUA, Aquafin
OpenMI Association Executive Committee meeting 7	13/03/2008	Deltares, Delft, The Netherlands	CEH, Deltares, DHI, WSL, NTUA, Aquafin, Alterra
OpenMI-Life Steering Committee meeting 6	14/03/2008	Deltares, Delft, The Netherlands	CEH, DHI, Deltares, WSL, NTUA, Aquafin, VMM
Task C Technical Group Meeting Pinios: Use Case 3	03/04/2008	University of Thessaly, Volos, Greece	UTH
OpenMI Association Technical committee meeting 16	14-16/04/2008	Deltares, Delft, The Netherlands	DHI, WSL, Deltares
Task B Technical meeting Use case 'a'	30/04/2008	Aquafin, Aartselaar, Belgium	Aquafin, VMM-AWA, WSL
EU-EPA OpenMI Video Conference	15/05/2008	Video Conference	CEH, DHI, WSL, Deltares, Aquafin, NTUA, EC, EPA
OpenMI Association Technical committee meeting 17	02-04/06/2008	WSL, Wallingford, UK	DHI, WSL, Deltares
OpenMI Association EU-NSF Workshop	07-10/04/2008	CEH/WSL, Wallingford, UK	CEH, DHI, WSL, Deltares
Task B, Use case 'd' Technical meeting 8	15/05/2008	Deltares Delft, The Netherlands	FH, Deltares
Task B Technical meeting Use case 'a'	20/05/2008	Aquafin, Aartselaar, Belgium	Aquafin, VMM-AWA, WSL
OpenMI Association Diss Comm working visit	29/05/2008	NTUA, Athens, Greece	NTUA, Aquafin
CEH Workshop on the OpenMI	05/06/2008	CEH Wallingford, UK	CEH, DHI, WSL
OpenMI Association Technical committee meeting 18	17/06/2008	Web Meeting	DHI, WSL, Deltares
Task C Technical Group Meeting Pinios Use Case a	17/06/2008	NTUA, Athens, Greece	NTUA
Task C Technical Group Meeting Pinios Use Case b	17/06/2008	NTUA, Athens, Greece	NTUA
Task C Technical Group Meeting Pinios: Use Case 3	19/06/2008	University of Thessaly, Volos, Greece	UTH
OpenMI Association Dissemination Committee meeting 6	25/06/2008	NTUA, Athens, Greece	CEH, NTUA, Aquafin, Deltares, UTH
OpenMI-Life Steering Committee meeting 7	26/06/2008	NTUA, Athens, Greece	CEH, DHI, Deltares, WSL, NTUA, Aquafin, VMM, UTH
Task B, Use case 'd' Technical meeting 9	03/07/2008	FH Borgerhout, Belgium	FH, Deltares
EU-EPA OpenMI Meeting	10/07/2008	Barcelona, Spain	CEH, Deltares, DHI, WSL, Aquafin, Alterra, EPA
OpenMI Association Executive Committee meeting 8	11/07/2008	Barcelona, Spain	CEH, Deltares, DHI, WSL, Aquafin
Task C Technical Group Meeting Pinios Use Case a	15/07/2008	NTUA, Athens, Greece	NTUA
Task B, Use case 'd' Technical meeting 10	27/07/2008	FH Borgerhout, Belgium	FH, Deltares
Task C Technical Group Meeting Pinios Use Case b	05/08/2008	NTUA, Athens, Greece	NTUA
Task B Technical meeting Use case 'b'	14/08/2008	VMM-AWA Leuven, Belgium	FH, VMM-AWA
Task B Technical meeting Use case 'b'	29/08/2008	VMM-AWA Leuven, Belgium	FH, VMM-AWA
Task C Technical Group Meeting Pinios Use Case a	09/09/2008	NTUA, Athens, Greece	NTUA
Task B Combined Technical meeting	09/09/2008	VMM, Aalst, Belgium	Aquafin, Deltares, VMM, VMM-AWA, ULG, FH
Task C Technical Group Meeting Pinios Use Case a	06/10/2008	NTUA, Athens, Greece	NTUA
Task C Technical Group Meeting Pinios Use Case b	09/10/2008	NTUA, Athens, Greece	NTUA
OpenMI Association Technical committee meeting 19	08-10/09/2008	WSL, Wallingford, UK	DHI, WSL, Deltares
Task C Technical Group Meeting Pinios Use Case a	16/10/2008	NTUA, Athens, Greece	NTUA
OpenMI-Life Steering Committee meeting 8	29-30/09/2008	CEH, Wallingford, UK	CEH, DHI, Deltares, WSL, NTUA, Aquafin, VMM
Task C Technical Group Meeting Pinios Use Case b	20/10/2008	NTUA, Athens, Greece	NTUA
Task C Technical Group Meeting Pinios All Use Cases	22/10/2008	NTUA, Athens, Greece	NTUA

Meeting	Date	Host / Venue	Attendees
Task A training for Pinios End Users & Developers	20-24/10/2008	NTUA, Athens /UTH, Volos, Greece	DHI, WSL, UTH, NTUA, Aquafin
BaW OpenMI Workshop	31/10/2008	BaW, Hamburg, Germany	DHI, CEH, Deltares.
OpenMI Association Technical committee meeting 8	03-05/11/2008	Deltares, Delft, The Netherlands	DHI, WSL, Deltares
1st Scheldt OpenMI-Life Workshop	25/11/2008	Antwerp, Belgium	Scheldt partners plus outside invited guests
Task A training for Scheldt End Users & Developers	26/27/11/2008	Aquafin, Aartselaar, Belgium	Aquafin, VMM, ULG, VMM-AWA, WSL, FH, ULG, WSL, DHI
OpenMI Association Dissemination Committee meeting 7	26/11/2008	Aquafin, Aartselaar, Belgium	CEH, NTUA, Aquafin, Deltares
OpenMI Association Executive Committee meeting 9	27/11/2008	Aquafin, Aartselaar, Belgium	CEH, Deltares, DHI, WSL, Aquafin, NTUA
OpenMI-Life Steering Committee meeting 9	28/11/2008	Aquafin, Aartselaar, Belgium	CEH, Deltares, DHI, WSL, Aquafin, NTUA
OpenMI Association Technical committee meeting 20	13-15/01/2009	WSL, Wallingford, UK	DHI, WSL, Deltares
OpenMI Association Dissemination Committee meeting 7	04/03/2009	Deltares, Delft, The Netherlands	CEH, NTUA, Aquafin, Deltares
OpenMI Association Executive Committee meeting 10	05/03/2009	Deltares, Delft, The Netherlands	CEH, Deltares, DHI, WSL, Aquafin, NTUA
OpenMI Association General meeting 3	05/03/2009	Deltares, Delft, The Netherlands	CEH, Deltares, DHI, WSL, Aquafin, NTUA
OpenMI-Life Steering Committee meeting 10	06/03/2009	Deltares, Delft, The Netherlands	CEH, Deltares, DHI, WSL, Aquafin, NTUA
OpenMI Association Technical committee meeting 21	10-12/03/2009	DHI, Hørsholm, Denmark	DHI, WSL, Deltares
OpenMI Association Technical committee meeting 22	21-23/04/2009	Deltares, Delft, The Netherlands	DHI, WSL, Deltares
OpenMI-Life Steering Committee meeting 11	05/2009	University of Thessaly, Volos, Greece	CEH, Deltares, DHI, WSL, Aquafin, NTUA, UTH
Pinios OpenMI-Life Workshop	05/2009	University of Thessaly, Volos, Greece	UTH, NTUA, CEH, WSL, Deltares, WSL, DHI
OpenMI Association Technical committee meeting 23	09-11/06/2009	WSL, Wallingford, UK	DHI, WSL, Deltares
OpenMI-Life Steering Committee meeting 12	03/07/2009	DHI, Hørsholm, Denmark	CEH, Deltares, DHI, WSL, Aquafin, NTUA
OpenMI-Life Steering Committee meeting 13	17-18/09/2009	WSL, Wallingford, UK	CEH, Deltares, DHI, WSL, Aquafin, NTUA

APPENDIX 7 EXAMPLES OF DISSEMINATION MATERIAL DEVELOPED

Please find attached a selection of the dissemination material that has been developed as part of the project. Included is the paper Peter Gijsbers presented at Modflow and MORE, the paper Johan Van Assel presented at iEMSs 2008 about the Scheldt use cases, the new English version of the Scheldt partners poster and the new OpenMI Association leaflet.

OpenMI design patterns for river-groundwater interaction

Gijsbers, P.J.A. [1], J.B. Gregersen[2], P.Sinding[2], S.Hummel[1]
[1] *Deltares-Delft Hydraulics, peter.gijsbers@deltares.nl, Delft, The Netherlands*
[2] *DHI Water, Environment and Health, jbg@dhigroup.com, Hørsholm, Denmark*

ABSTRACT

Modelling process interaction between groundwater systems and surface water systems typically requires frequent bi-directional exchange of information such as levels and fluxes. Such linkages are often tailor made between specific model codes. To increase the usability of the effort put in developing linkages between hydrological, a standard interface has been developed. Adopting such standard increases the ability to link your groundwater-code to a variety of hydraulic codes (e.g. Mike-11, HEC-RAS, SOBEK) without extra effort. The standardized interface, the OpenMI, allows run-time data exchange between (model) components that run simultaneously. The OpenMI standard utilizes a request-reply concept, where a (model) component performs a GetValues-call to retrieve data at the time and in the spatial representation needed. The OpenMI has been launched in 2005 and is available as an interface implemented in .Net and Java, with an open source software development kit to ease software migration. This paper will provide example OpenMI design patterns that could be applied for river-groundwater interactions.

THE OPENMI

The bio-physical processes involved in catchment hydrology are complex in nature. Typically these processes are encapsulated in domain specific numerical codes. Widely applied codes for groundwater modeling are Modflow and Feflow, while well known model codes for river hydraulics are e.g. HEC-RAS, Mike11, SOBEK, Infoworks RS. No single numerical code combining both groundwater and rivers has reached a similar level of widespread application. Integrated catchment management however demands for solutions that allow us to understand the process interaction between these domains. Typically such interaction is bi-directional as the flux between rivers and aquifers is determined by the water levels in the respective water bodies. In the past, many organizations have developed tailored solutions to address the required process interaction for integrating their own codes. While the effort put in those linkages is substantial, their application range used to be limited as they were not based on an interface protocol shared by a wide range of organizations. Such shared protocol can provide a stimulus for research collaboration as it allows organizations to focus on scientific issues regarding integrated modeling and integrated water management. The European Commission therefore supported a group of European research institutes to setup the HarmonIT project, co-funded in the Fifth Framework Programme, with the objective to develop a generic software interface definition for model linking in the water domain [Graham et al. 2003]. The result of their project is called the OpenMI (Open Modelling Interface).

The OpenMI Standard is a namespace which provides a standardized interface to define, describe and transfer data on a time basis between software components that run simultaneously, thus supporting systems where feedback between the modelled processes is necessary in order to achieve physically sound results. The OpenMI Standard is based on a request-reply based data exchange mechanism, where the delivering component has the responsibility to hand over data in the format requested. The OpenMI allows the linking of models with different spatial and temporal representations, therefore accommodating process interaction between river models and groundwater models, where the river model typically uses a one-dimensional grid and a short time step and the groundwater model uses a two- or three-dimensional grid and a longer time step.

Since the service oriented character of the standardized interfaces do not easily fit with traditional modeling codes, a software development kit (SDK) has been developed which utilizes an internal interface that is much more suitable for numerical engines. Application of the SDK is not required to support the OpenMI Standard interfaces, but it eases the migration of existing modelling codes.

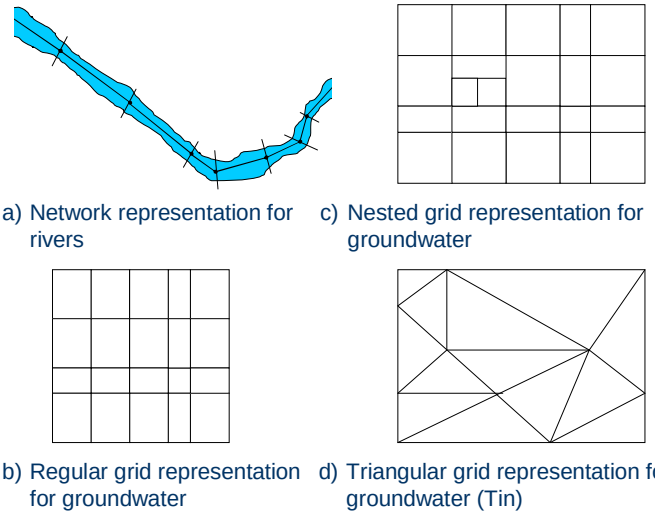
Various publications describe the OpenMI in more detail, with Gregersen et al. [2005] and Gregersen et al. [2007] being the most complete journal publications to the interfaces. More detailed documents on the scope of the OpenMI [Moore et al. 2005], the Interface specification [Gijsbers et al. 2005], the Software Development Kit [Sinding et al. 2005] and Guidelines for application [Tindall et al. 2005] are available at http://www.openmi.org. The OpenMI is available as open source in C# and Java.

In order to maintain the OpenMI for the water and environmental community an association has been created in 2007 as part of a follow up demonstration project (OpenMI-Life). This body, The OpenMI Association, is open for membership by organizations and individuals, and has already welcomed various other organizations from governmental, academic and commercial background. The primary task of the Association will be to maintain and develop the OpenMI Standard interfaces. While anyone is welcome to offer a software development kit, the Association will take responsibility to offer at least one open source SDK. Due to funding constraints and partners preference, the current focus is on maintenance and development of the C#-implementation. More information on the OpenMI Association is available at www.openmi.org.

One of the design criteria for OpenMI was, and is, to maximize the freedom for the code developer to adapt its code in order to implement the interfaces. Utilization of the software development kit is not required, but its application provides a good starting point for design patterns on model linking. The next sections address the conceptual, spatial and temporal design patterns that may be applied to interface groundwater and river models using the OpenMI. The design patterns have been based on OpenMI migration projects dedicated to river – groundwater coupling of Mike11-HD (DHI), Mike She (DHI), Visual Modflow (WHI/Schlumberger), SOBEK-CF (Deltares-Delft Hydraulics), Modflow (TNO version) and Triwaco (finite element model by Royal Haskoning).

CONCEPTUAL PATTERNS FOR LINKING RIVER AND GROUNDWATER MODELS

Before starting to migrate a model to become OpenMI compliant some considerations about how this model is intended to be used within OpenMI linked systems should be taken. This is especially evident for complex distributed physically based models. Within OpenMI, the receiving component should request for the data in the spatial and temporal representation as required by this component. It is up to the delivering component to provide the data in the correct format. At configuration time, spatial or temporal data operations, if available, may be specified to ensure that the data is delivered correctly.



a) Network representation for rivers
c) Nested grid representation for groundwater
b) Regular grid representation for groundwater
d) Triangular grid representation for groundwater (Tin)

Figure 5 Spatial representations for rivers and groundwater models

A distributed physically based river model normally represents the river geometry by a poly line which is the longitudinal centerline of the river and number of cross-sections perpendicular to the centerline (see figure 1a, upper left). Distributed physically based groundwater models normally represent the three-dimensional subsurface geometry by a number of layers, where each layer shares the same lateral geometry. The lateral geometry may be a regular geometry consisting of rectangles or irregular geometries using triangles (for finite element type of models) or nested grids (see figure 1b, c and d). Whether the lateral geometry is regular or irregular does not affect the principles of the OpenMI migration design pattern described.

In systems with coupled groundwater and river models there are actually three models in play; the groundwater model the river model and a model for the flow between groundwater and the river. A fully distributed physically based model for model-river interaction is very difficult to achieve as this requires a description of the full three-dimensional complex physical phenomenon. Consequently, conceptual interaction models are often preferred.

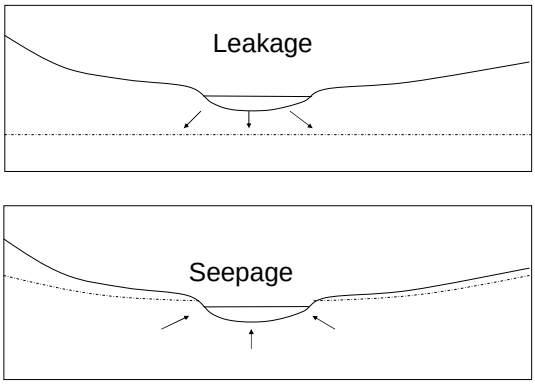


Figure 6 River groundwater interaction

An example of such conceptual model could be based on the assumption that for one particular river section water is flowing into the river (seepage) if the ground water level at the position of the river section is above the water level in the river and flowing out of the river (leakage) if the ground water level at the position of the river section is below the water level in the river. The actual flow rate is a function of the water level in the river, the ground water level, the wetted perimeter, and a leakage coefficient. When water leaves the river the leakage is positive and when water enters the river the leakage is negative. The leakage coefficient can be considered as a lumped characterization of the hydraulic soil properties of the river bed and the soil under the river bed.

Such conceptual groundwater – river interaction model could be a separate model in an OpenMI configuration. However, this would require that information about leakage coefficients, ground water levels and water levels in the river to be transferred to this model.

Two other alternatives are available: either embed the interaction model in the river model, or embed the knowledge in the groundwater model.

The OpenMI concept of exchange items reflects the alternative supported by the code. An exchange Items describes the quantity and the element set (i.e. the spatial context) where data can be exchanged, where available supported by data operations for spatial and temporal mapping.

Knowledge Encapsulation Pattern 1: Embed Interaction Model In The River Model

DHI and WHI have chosen to embed the knowledge in the river model, with leakage coefficients specified for each river segment in the Mike 11 user interface. Mike 11 computes the leakage based on the groundwater level received and the leakage coefficients at the river segments [Graham et al. 2006]. The river model has an output exchange item called e.g. leakage and an input exchange item called e.g. ground water level. The ground water model has an input exchange item called e.g. leakage and an output exchange item called e.g. ground water level.

Knowledge Encapsulation Pattern 2: Embed Interaction Model In the Groundwater Model

Deltares and Royal Haskoning have chosen a concept where the groundwater model receives a surface water level and determines the exchange flux (see Figure 7) [Vergroesen & Zaadnoordijk 2005].

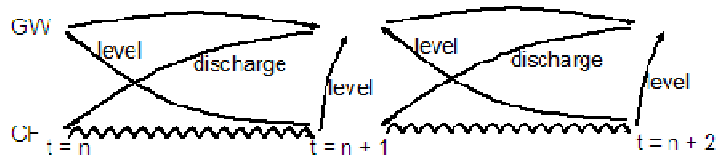


Figure 7 Explicit coupling scheme between SOBEK-CF and the Triwaco [Vergroesen 2005]

In case the leakage flux is not available in the river, a correcting demand flux is enforced at the next time step. Since Mike11 and Triwaco both encapsulate the interaction knowledge, a new model combination can be setup where the system configurator can decide where the flux computation is undertaken.

Most OpenMI couplings developed so far are based on an explicit scheme, although the interface protocol accommodates state management, allowing iterative coupling schemes if necessary.

SPATIAL OPENMI DESIGN PATTERN FOR THE RIVER GROUNDWATER COUPLING

OpenMI uses the concept of an ElementSet to represent the computational elements. An ElementSet can be id-based or geo-referenced, using one of the following spatial data types: point, line, polyline, polygon.

Spatial Pattern 1: Apply Geo-referenced ElementSets

In this pattern, the river network will typically be represented on an OpenMI polyline ElementSet or an OpenMI line ElementSets, while the groundwater model grid (regular, nested or triangular) will be represented on an OpenMI polygon ElementSet. If proper spatial mapping algorithms are included (e.g. by use of the SDK), the groundwater model may expose itself for outputs by one polygon of the entire modeled area. However, for better computational performance, the size of the mapping matrix might be reduced by exposing groundwater levels only in the areas near to the river. Because the ground water model consists of multiple layers, the ground water model must, when it is asked for ground water level, internally detect from which layer to extract this information and when the ground water model receives leakage also internally detect to which layer the water should be added.

This design pattern is applied by Mike11 and Visual Modflow. The links can be specified at a meta-level as 'connect leakage output on river network to leakage input on groundwater model grid' and 'connect groundwater level in groundwater model grid to groundwater level input to river network'. A more elaborate description of this design pattern, including its spatial mapping concepts and the bi-directional interaction between ground water model and river model is given in [Gregersen et al. 2007]. The OpenMI release available for download contains an example with dummy models using this design pattern.

Spatial Pattern 2: Use id-based mapping

Alternatively, an id-based mapping can be established to connect the two models. This mapping is typically conducted as a first step towards full implementation of spatial pattern 1. In this design pattern, both the river model and groundwater model expose their computational elements by Id. Connection takes is less straightforward, as it basically listing each individual connection point.

OPENMI DESIGN PATTERN TO RE-ENGINEER THE TIME LOOP

OpenMI allows model algorithms to compute at their own time step, requesting data when needed and providing data when requested Figure 7 illustrates that data is exchanged at the heartbeat of the groundwater model while the river model runs at a much smaller time step.

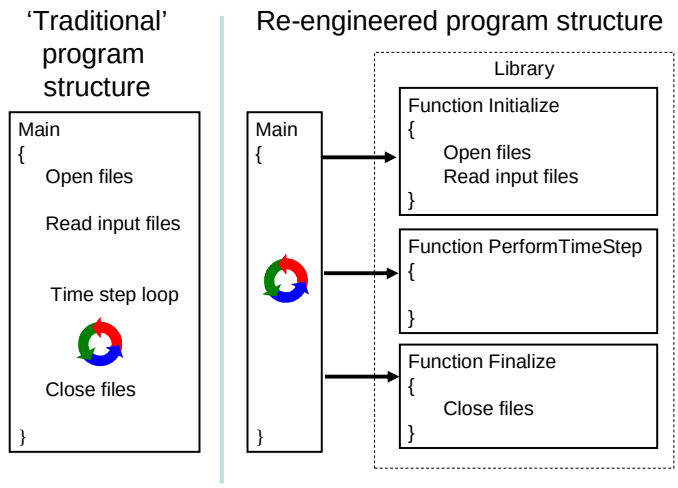


Figure 8 Re-engineering of the time loop

To accommodate this time based data exchange, an engines core typically needs to be turned into a library where the outside world (e.g. the OpenMI wrapper) can dictate the time stepping. Figure 8 illustrates the re-engineering recommended. Three functional elements in the main code should be placed in separate callable functions: Initialize, PerformTimestep and Finalize. While the Initialize function may still read all boundary conditions, the re-engineered code should allow these values to be replaced by data acquired (by the wrapper) during time stepping. To replace these values, one may introduce a SetValues-function to accommodate values to be set into the calculation matrix.

Alternatively, an internal buffer may be used which is accessed by both the calculation algorithm as the wrapper. When re-engineering the code according to these functions, one easily can implement the internal IEngine interface as utilized by the wrapper provided in the OpenMI SDK (see [Gregersen et al. 2007] for the details).

LESSONS LEARNED

OpenMI accommodates time based data exchange for models that run simultaneously. OpenMI is designed to act as a standard for model integration in the water domain. OpenMI is maintained and developed by the OpenMI Association. The OpenMI interfaces are available as open source at the website www.openmi.org. Code developers have been given much freedom to develop their own solutions. Legacy code needs to be modified to become

OpenMI compliant. To ease the migration a software development kit (SDK) is available, as well as various design patterns. For many numerical codes, the main re-engineering effort will be required for re-arranging the time loop, accommodate the acceptance of new inputs data at run-time. OpenMI allows individual algorithms to run at their own time step, and exchange data only when required. OpenMI supports both id-based and geo-referenced design patterns for mapping river models to groundwater models. Various alternatives can be chosen to embed the interaction model computing the exchange flux based on the water level difference and the resistance at the bio-physical interface. Well known codes such as Mike11, Visual Modflow, Mike She, Triwaco, SOBEK-CF and HEC-RAS have been made OpenMI compliant and are being applied to simulate river-groundwater interaction.

ACKNOWLEDGEMENT

The activities of the OpenMI Association, including a demonstration under operational conditions with several competent authorities, are supported by EC DG Environment as part of the Life Environment programme (grant LIFE06 ENV/UK/000409). More information is available at www.openmi-life.org.

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Demonstration of Integrated Modelling using the OpenMI in the Scheldt River Basin

Neel Devroede[a], Yves Ronse[a], Johan Van Assel[b] and Hans Vereecken[c]
[a] *Vlaamse Milieumaatschappij (VMM), A. Van de Maelestraat 96, 9320 Erembodegem, Belgium (n.devroede@vmm.be, y.ronse@vmm.be)*

[b] *Aquafin, Dijkstraat 8, 2630 Aartselaar, Belgium (johan.vanassel@aquafin.be)*

[c] *Flanders Hydraulics Research, Berchemlei 115, 2140 Antwerpen, Belgium (hans.vereecken@mow.vlaanderen.be)*

Abstract: Water management in the transnational Scheldt River Basin (Belgium, France, the Netherlands) is scattered among many different authorities and operators. For several years, most of them have adopted modelling as a technology for optimising investment and operation strategies for the part of the water system that is under their responsibility. As the European Water Framework Directive imposes water management to be integrated across both authorities and water domains, there is a clear need to streamline and integrate the various modelling efforts. However, many of those models have been developed completely independently from each other, with inconsistent spatial boundaries, and using different approaches and objectives. Hence, integrating these models is far from straightforward. The development and release of the OpenMI (Open Modelling Interface) standard in 2005 offered a potential solution to linking models of various origins and concepts, and the challenge was taken up to try and apply this new standard at full scale on real operational models. In the frame of the demonstration project OpenMI-Life, four use cases were defined within the Scheldt basin, in which various aspects of model linking will be tested. By the end of the project, it is hoped that water managers will be advised with better insights of how interactions between water systems may affect strategic decisions.

Keywords: OpenMI, model linking, integrated water management

1. INTRODUCTION

Due to its transnational character and its geographic location in the heart of one of the most densely populated areas in Europe, the Scheldt River Basin is a good example of how complex and challenging integrated water management is in practice.
From an institutional point of view, the International Scheldt Commission co-ordinates the policies of no less than six member states/regions (France, the federal state and three regions of Belgium, and the Netherlands). But even within these six entities, there is a variety of authorities and operators involved in the different water domains and water industry sectors.
From a water management point of view, there are important issues about flood protection and water quality. Furthermore, the economic role of the river basin, which contains the Antwerp, Ghent and Zeebrugge ports along with many heavily used canals, is not to be underestimated.

During the preparation of the OpenMI-Life project, four use cases were identified (Vits and Devroede [2007]), which were thought to give a good picture of the possible interactions between the main large scale modelling programs that have been running for the last ten years.
These use cases are :

linking a sewer model with a hydraulic river model
linking two different hydraulic river models for navigable and non-navigable water courses
linking a river quality model with two hydraulic river models

linking a 1D-river model with a 2D-estuary and coast model.

Details of the four use cases are described further.

The aim of the OpenMI-Life project is to demonstrate that the OpenMI standard (Gregersen et al. [2007]) and its implementations can provide a technical solution for the different linking problems in the four use cases, and that the OpenMI Association as a support organisation can come up with solutions for those areas where further improvement and development to the Standard would still be required. Besides the use cases in the Scheldt River Basin, there is a second pilot area in the Greek Pinios River Basin.
The project is supported by the European Life Programme and is co-ordinated by the UK Centre for Ecology and Hydrology (CEH). It started in October 2006 and lasts until January 2010. More information on the project can be found at www.openmi-life.org.

2. DESCRIPTION OF THE USE CASES

2.1 Use case A : sewer-river interactions in the drainage area of Leuven

In the first use case a (hydraulic) sewer model is linked to a hydraulic river model. The models respectively describe the urban drainage area around the town of Leuven (appr. pop. 120000, appr. area 120 km²) and the river Dijle with its main tributaries between the Walloon/Flemish regional border and the confluence with the river Demer (appr. length 40 km, appr. area 300 km²) (Figure 1). Partners involved in this use case are Aquafin (the company responsible for building and operating the wastewater treatment plants and main trunk sewers in Flanders) and the Division Operational Water Management of VMM (Vlaamse Milieumaatschappij – Flemish Environmental Agency), responsible for the non-navigable watercourses in Flanders. The models have been built in InfoWorks CS (sewers) and InfoWorks RS (rivers) (Wallingford Software, UK).

Simulating the models in linked mode is expected to lead to an improved forecast of flooding, both in the sewer system and in the river, and will provide new insights and opportunities for optimising the investment schemes and operational management for both the sewer and the river system.

Under normal conditions two types of interactions can be defined. Firstly, the sewer system discharges into the river system at various locations, such as permanent outfalls, overflows and at the waste water treatment plant. Secondly, high water levels in the river system can prevent free discharging from the sewer system. Flows may occasionally revert in these cases where outfalls are not protected by a flap valve.
Under flood conditions additional exchange of water can occur between sewer and river system, as the river may flood certain sewer manholes, causing the river water to enter the sewer system, or flooded manholes may spill (diluted) sewage into river flood areas.

In OpenMI terminology this means that the quantities exchanged are flows (from sewer to river model) and water levels (from river to sewer model). Although this does not look particularly complicated, it is the high number of links (more than 100 in normal conditions and probably an even higher number for flood conditions) and the fact that all links are bidirectional, which makes up the technical challenge for this use case. All these exchanges will lead to a continuous and dynamic flow redistribution between both models, which would never be achievable using predefined boundary conditions.

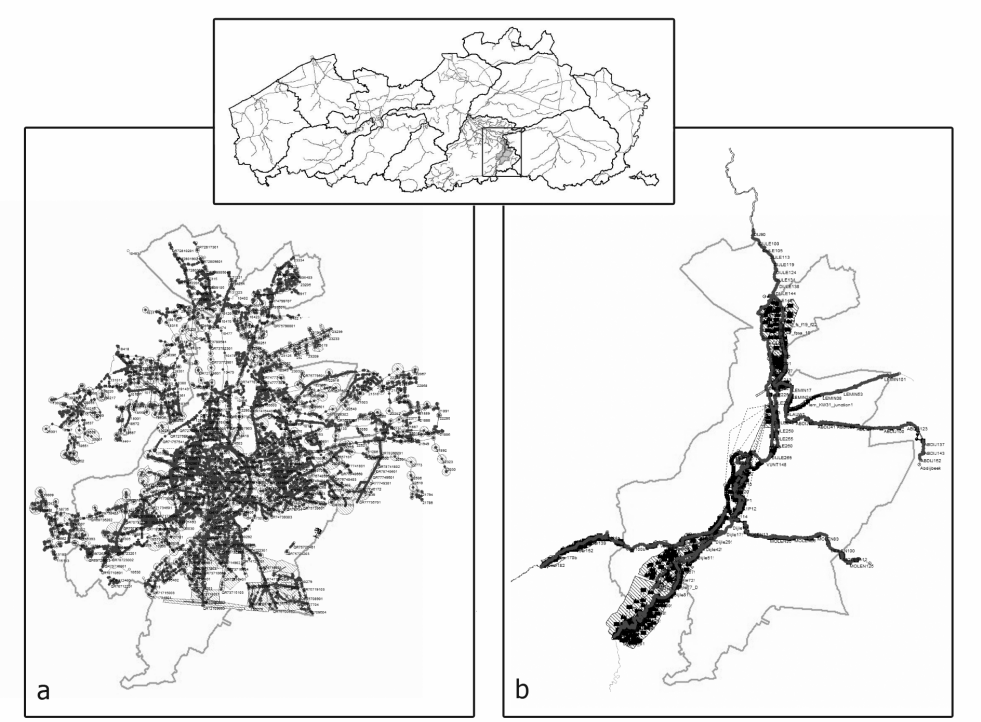

Figure 9. Geographic setting (top) and models for use case A : InfoWorks CS sewer model of Leuven (left, a) and InfoWorks RS Dijle river model (right, b)

2.2 Use case B : linking Scheldt and Dijle river sub-basins using two different hydraulic river models

The second use case comprises the linking of two independently built hydraulic river models. The first one describes the subbasin of the river Dijle and its tributaries, upstream from the confluence with the river Demer (the same model as used in use case A). The second one describes the tidal part of the Scheldt river and its tributaries, including the river Dijle downstream from the confluence with the river Demer (Figure 2).
The end of the tidal and navigable zone, which forms the split point between the two models, also delineates the competence area of both partners in this use case : on the one hand the Division Operational Water Management of VMM; on the other hand the Divison Flanders Hydraulics Research of the Flemish Ministry of Mobility and Public Works. The models have been built in InfoWorks RS (Wallingford Software, UK) and Mike11 (Danish Hydraulic Institute, Denmark).

Simulating the models in linked mode, thus avoiding the need for setting up appropriate and reliable upstream and donwstream boundary conditions, is expected to improve the accuracy of flood forecasting in both models. By linking the models both competent authorities can take into account the impact of operational flood management (such as the use of retention basins) in each other's parts of the river basin.

As for use case A, the quantities exchanged are flows (from Dijle model to Scheldt model) and levels (from Scheldt model to Dijle model), again defined as bidirectional links. The number of exchange points however is very limited, even with the occurrence of mazed tributaries in the boundary area between the two models. As both original models have an overlapping zone (in order to dempen the immediate impact of boundary conditions), alternative scenarios for the definition of the links will be investigated (e.g. with the flow exchange not necessarily occuring at the same location as the water level exchange).
When looking at the models in flood conditions, flow and level exchange will be applied not only on the main river channel, but also in the flood zones.

Finally, a clearly different technical challenge, as opposed to use case A is the fact that use case B deals with models from different suppliers.

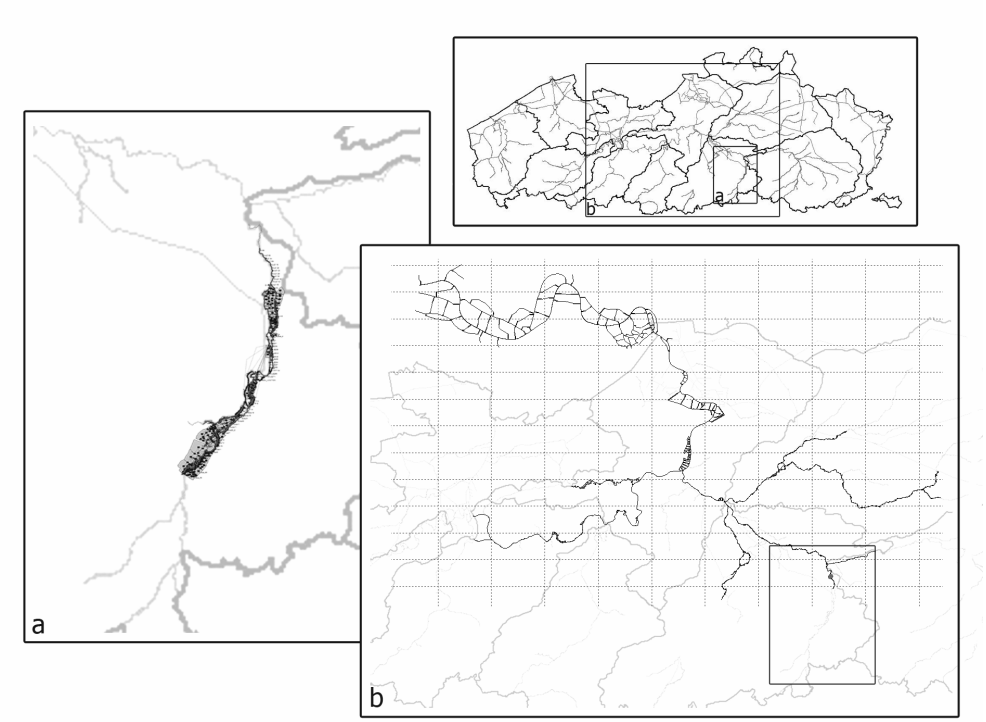

Figure 10. Geographic setting (top) and models for use case B : InfoWorks RS model of the river Dijle (left, a) and Mike11-HD model of the river Scheldt and tributaries (right, b)

2.3 Use case C : linking a river quality model with two different hydraulic river models in the Dijle and Demer sub-basins

In use case C parts of the two aforementioned hydraulic river models will be linked (one at a time) with a river quality model, which describes the whole of the river Dijle and river Demer basins (including the Walloon part of the river Dijle) (Figure 3).
The river quality model PEGASE was developed by the University of Liege, Belgium and is used by the Division Water Quality Management of VMM in view of developing its surface water quality management plans. It has a built-in hydrological module, which –based upon flow observations from river gauges- can produce flow patterns for the river branches. By linking the PEGASE model with the hydraulic river models InfoWorks RS and Mike11, it is expected that the flow calculations will become much more accurate compared to the ones produced by the built-in hydrological module. This in turn will improve the accuracy of the river quality calculations, as these are obviously very dependent from the velocities. In those areas where there is no InfoWorks or Mike11 feed, PEGASE will continue to use its own flow calculations. Point inflows to the river (waste water treatment plants, industries) will continue to be taken from the PEGASE input database.

Besides the expected improvement of the water quality calculations, the linking of the models will enable water quality and river managers to take the expected quality of the flood water into account in the decision process of the construction and operation of flood zones.

The technical aspect of the linking is different from the two aforementioned use cases in so far that the models are sharing the same geographical area. This means that the linking is to be seen as a global overlay rather than as a point-to-point link as in use cases A and B.. Inconsistencies in the details of the river schematisations in both models form a specific point of attention when applying this.
Quantities exchanged are water depths, flows and velocities (all from the hydraulic river models to the river quality models).

Contrary to the other use cases, it is also to be mentioned that the PEGASE model was not yet OpenMI compliant before the start of the OpenMI-Life project. Hence, the process of migrating a model is another element in demonstrating the application of the OpenMI standard in this case.

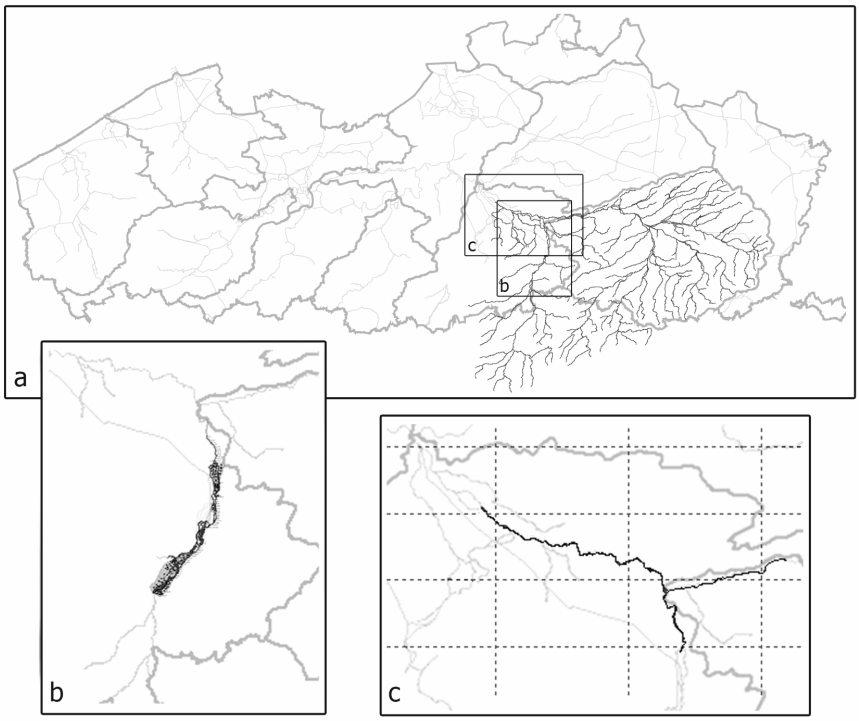

Figure 11. Geographic setting (top, a) and models used for use case C : PEGASE river quality model for Dijle and Demer (top, a), InfoWorks RS hydraulic river model for Dijle (left, b) and Mike11-HD hydraulic river model for Demer (right, c)

2.4 Use case D : linking 1D-river model to 2D-estuary models in the Dender sub-basin and main Scheldt basin.

The fourth and final use case describes the linking of a 1-dimensional hydraulic river model to a 2-dimensional estuary and coastal model. The first one is the model of the Flemish part of the river Dender basin (built by Flanders Hydraulics Research). In a later stage of the project it is hoped that this could be replaced by the full tidal Scheldt model. For the second one, two different options will be investigated : on the one hand the "Kustzuid" model, on the other hand the "Zeekennis" model (Figure 4).
"Kustzuid" is an operational model from the former Dutch authority Rijkswaterstaat (currently part of Deltares), built with the WAQUA software. It covers the whole Scheldt estuary and a large part of the North Sea. For the purpose of the OpenMI-Life project it was extended to the confluence of the Dender and Scheldt rivers. "Zeekennis" is a morphology oriented model, built in Delft3D. It covers a slightly smaller area than the "Kustzuid" model.

Linking the 1- and 2-D models is expected to increase the accuracy of flood prediction (especially in a later phase when the Dender model would be replaced with the full 1D tidal Scheldt model), and to improve the forecasting of the accessibility for large vessels of the port of Antwerp.

As for use cases A and B, quantities exchanged are flow (from Dender model to estuary models) and water level (from estuary models to Dender model) in a bidirectional link. Special attention is required in this use case to the transformation of the quantities. Not only do the models have different dimensions (1D to 2D), but due to the different national altitude references, a linear conversion in the water level has to be applied as well.

Waqua and Delft3D were also not yet OpenMI-compliant at the start of the project. And as for use case B and C, this use case also deals with models from different suppliers.

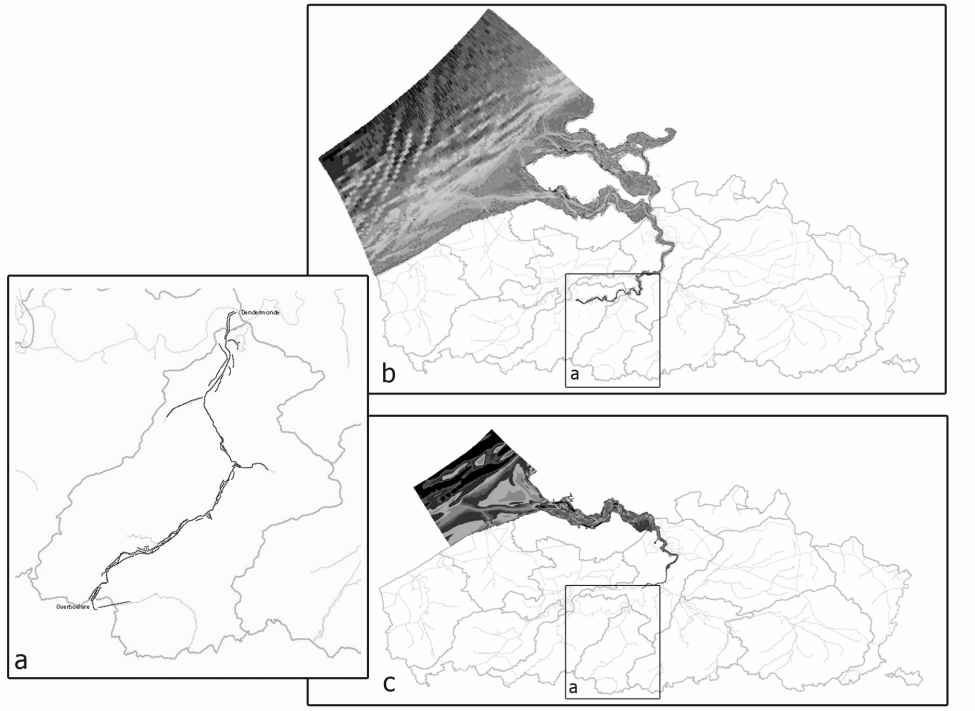

Figure 12. Geographic setting (top, b) and models used for use case D : Mike11-HD model for the Dender sub-basin (left, a), Waqua-model "Kustzuid" (top, b) and Delft3D model "Zeekennis" (right, c).

3. CURRENT PROGRESS

3.1 General

The timing of the OpenMI-Life project foresaw four major phases in the elaboration of the use cases :

Definition phase describing the objectives, technical details and expected problems of each use case (October 2006 – March 2007)
Trial phase, during which all aspects of the linking are being tested and problems identified and solved. This phase includes migration for those models that were not yet OpenMI-compliant (April 2007 – September 2008)
Operational phase, during which the models will be run in linked mode on a full operational scale, i.e. performing all the types of simulations they would normally be used for in stand alone mode (October 2008 – March 2009)
Evaluation phase. In this latest phase the use cases will evaluate the results of the operational phase (benefits compared to stand alone modelling, benefits in view of water management policy) (March 2009 – September 2009).

All use cases have produced a definition report, from which it appeared that the current version of the OpenMI standard was not a limiting factor with a view to the linking operations that were envisaged. In some cases however, there was a need for revising certain elements of the way OpenMI had been implemented in the then already compliant softwares.

3.2 Use case A

The linking of sewer and river model under normal conditions seems to work fine, even with many bidirectional links. The exchange of flows under flood conditions is currently still being tested. Other items that need resolving are the simulation of predefined series of events in linked mode, and further decisions need to be made about inconsistencies in rainfall used in both models.
None of these is expected to endanger the timing of the use case.

3.3 Use case B

Linking the upstream RS river model to the downstream Mike11 river model at a single exchange point proved to be very straightforward. In the near future it will be tested if linking at multiple exchange points is workable. Afterwards coupling at an overlapping set of exchange points will be tried out and it will be looked at how this can be applied to overlapping flooding areas.

3.4 Use case C

The main present technical achievement in this use case is the migration of the river quality model PEGASE from the UNIX environment into the Windows environment. The migration to make this model OpenMI compliant is ongoing. Several stand alone simulations have been performed with the river flow models InfoWorks RS and MIKE11 on the river Dijle in order to feed the PEGASE model after the links between the models have been defined. Appointments for defining the links have also been made.

3.5 Use case D

Waqua and Delft3D are now both OpenMI compliant. The river Dender model was coupled to the "Zeekennis" model and a correct data exchange between the two models was achieved. Due to the fact that the "Zeekennis" model was originally built for a smaller area not reaching Dendermonde, it would take too much time to extend and calibrate the "Zeekennis" model. But it was shown that the linking between the two models from a technical perspective worked correctly. The coupling between the river Dender model and "Kustzuid" is currently being tested.
The progress of the use case is in agreement with the foreseen planning.

4. FUTURE ISSUES

From the case studies, the largest concern about OpenMI is not its technical implementation, but its user-friendliness. If OpenMI based modelling is really to tear down the barriers for practical co-operation between authorities, then the use cases will have to prove that it is possible to conceive, set up and run linked simulations with little more technical and organisational effort than what authorities are experiencing now in their normal modelling practice.
One of the key expectations that were raised by all partners involved in the use cases was the possibility of remote linking. Local linking means that all models have to run simultaneously on one machine and often requires additional licenses for software that would otherwise not be necessary. Creating links between models running at different locations and under each user's own licence, would improve the perception of complexity and practicability of integrated modelling. Although recent developments (Curn [2007]) seem promising, it cannot be guaranteed that all models will have implemented this option by the end of the operational phase.
Linked modelling will also introduce additional problems of quality assurance procedures. The risk of wrong sets of models being linked to one another is a real concern, and could lead to a deterioration of the quality of the calculations, which would be dramatic for the credibility of linked modelling.
All these issues will have to be carefully considered during the last phase of the project so as to produce a well funded evaluation of the use of OpenMI in integrated water management.

5. CONCLUSIONS

The first trials of the application of the OpenMI on real scale models in the Scheldt River Basin indicate that there is a clear potential for its use in integrated water management. So far there were no real technical obstacles that could not be handled with the current version of the OpenMI. Improved implementations for specific applications may be necessary however.
It is expected that the use cases will continue to make good progress and that operational simulations can be run at the time foreseen in the OpenMI-Life project schedule. At that time (end of 2009) it will become clear if the expected technical benefits of linked modelling and the improved way of co-

operating between the different authorities will stimulate real integrated water management within Europe and beyond.

ACKNOWLEDGEMENTS

The OpenMI-Life project is made possible through the financial funding of the Life Programme of DG Environment of the European Commission (contract n° LIFE06 ENV/UK/000409).
Acknowledgement also goes to the town of Leuven for making their sewer model available for the project.

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OpenMI

OpenMI Association
Membership Application Form

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Applicant Signature

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More information

www.openmi.org

The OpenMI Association is currently funded under the EC LIFE Environment Programme.

OpenMI Association

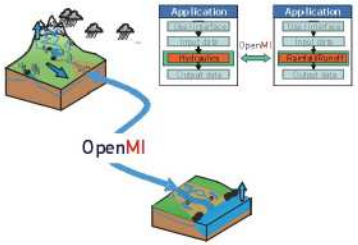
OpenMI

Enabling Integrated Modelling for Integrated Environmental Management

What is the OpenMI?

Model integration helps the understanding and prediction of process interactions and is an essential capability for the achievement of the integrated approach to environmental management including integrated water management called for in the Water Framework Directive.

The Open Modelling Interface (OpenMI) standard defines an interface that allows time-dependent models to exchange data at run-time. When the standard is implemented, existing models can be run simultaneously and share information at each time step. It is the key to making model integration feasible at the operational level.



Why was the OpenMI developed?

The European Commission realised that a generic solution to model linking was important to the implementation of the Water Framework Directive. The European Commission have funded a four year €6 million research project, HarmonIT, which developed the OpenMI. Now a three year €4 million follow up project, the OpenMI-Life, is transforming it from a research output to an operational standard.

As part of the OpenMI-Life project, the OpenMI Association has been set up to become the long term support organisation for the OpenMI.

Purpose of the OpenMI Association

The objectives of the Association are to promote the development, use, management and maintenance of the OpenMI.

The Association seeks to achieve this goal by:

- Disseminating information on the OpenMI standard through the websites, newsletters, conferences and other suitable methods.
- Undertaking the maintenance and development of the OpenMI Standard and its supporting software.
- Stimulating the provision of information and promoting discussion on the OpenMI in Europe and across the world by organising and participating in events.

How does it work?

The OpenMI Association is an entirely open international group of organizations and people.

It provides a small core team that supports, responds to and is guided by a growing active worldwide user community.

It is a not for profit organisation and therefore depends on the willingness of its members to contribute.

To fulfil its objectives, a simple organisational structure has been put in place, which currently includes three committees/working groups, the Technical Committee and the Dissemination Committee overseen by the Executive Committee.

Why join the OpenMI Association?

The OpenMI Association is open to all organizations and individuals with an interest in the OpenMI. It is run by and for its members.

OpenMI Association members can:

- Actively influence the direction and activities of the Association and the development of OpenMI.
- Gain access to a multidisciplinary network of Agencies, Software Developers, Consultants and Research Centres working on integrated modelling.
- Facilitate their own work by using OpenMI and having direct access to knowledge, training and special interest groups.
- Promote their OpenMI work, products and services on the OpenMI website and find new partners and clients.

What does it cost?

The membership fee for 2008/2009 is €100 per annum.

How to join?

New members are welcome at anytime. Members can join either as organisational or individual members.

The steps are:

1. Download an application form or complete the form on the back of this leaflet
2. Send the completed form to:
   The OpenMI Secretariat - Mr Michiel Blind, c/o Deltares
   PO Box 85467, 3508 AL Utrecht, The Netherlands

Alternatively, scan the signed document and email it to secretary@openmi.org

An invoice will be sent when the signed application form has been received.

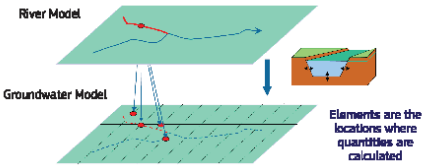
OpenMI

Demonstration of integrated modelling in the Scheldt River Basin, using the OpenMI

Katrijn Holvoet, Hans Vereecken - Flanders Hydraulics Research, Belgium • Neel Devroede, Yves Ronse, Kris Cauwenberghs - Flemish Environment Agency (VMM), Belgium • Johan Van Assel, Gunther Waterschoot - Aquafin NV, Belgium

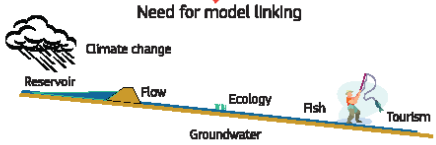
What is the OpenMI?

OpenMI = Open Modelling Interface
An interface standard for run time data exchange between models, databases & tools (no matter what dimension / domain), through links defined by the modeller, **whose purpose is to improve the** ability to model complex scenarios.

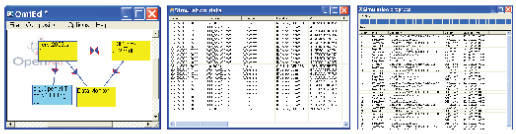


Why apply the OpenMI?

Competition for scarce resources
↓
Need for integrated water management - WFD
↓
Complexity leads to need for decision support
↓
Need for whole catchment models
↓
Need for model linking



The OpenMI an example of linking



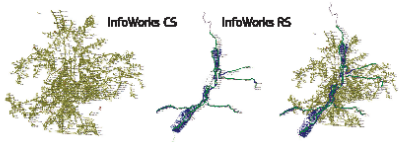
OmlEd | Simulation data | Simulation progress

More information

- **Concerning the LIFE project:** http://www.openmi-life.org
- **Concerning the OpenMI:** http://www.openmi.org
- Gregersen J.B., Gijsbers P.J.A., Westen S.J.P., 2007. OpenMI: Open Modelling Interface. J. Hydroinf., 9 (3), 175-191.

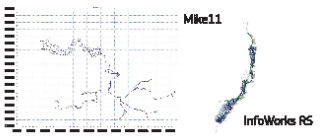
OpenMI-LIFE demonstration: The River Scheldt

Use case A: linking a sewer model & a river model



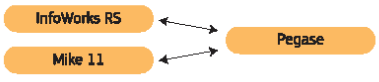
Objective: optimise investments & operational strategies for water managers
Study case: the City of Leuven & the River Dijle
Partners: Aquafin and VMM

Use case B: linking a tidal model & a river model



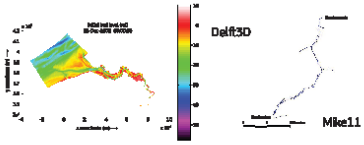
Objective: Improved flood maps & predictions
Study case: the River Dijle & the River Scheldt
Partners: FH and VMM

Use case C: linking a river model & a water quality model



Objective: Improve interaction between water quantity and water quality
Study case: the River Dijle & the River Demer
Partners: FH, VMM and ULG

Use case D: linking a 1D-river model & a 2D-tidal model



Objective: Improved flood maps & accessibility for Antwerp Harbour
Study area: the River Scheldt & the River Dender
Partners: FH and Deltares

This project has been made possible with the contribution of the LIFE financial instrument of the European Community. Contract no: LIFE06 ENV/UK/000409

APPENDIX 8 NEW PLANNING & TIMING FOR SCHELDT USE CASE C

Resumption of the activities of the ULG for this OpenMI LIFE project: on September 9th 2008

Task B1 (migration and installation): completed
Task B2 (trial of integrated modelling): is ongoing

There are several sub use cases foreseen:
1. an unidirectional link in some nodes between the PEGASE model of the river Dijle catchment and the Infoworks RS model of the river Dijle ; limited to the part upstream the city of Leuven,
2. an unidirectional link in some nodes between the PEGASE model of the river Dijle catchment and the MIKE11 model of the river Dijle,
3. an unidirectional link in all nodes between the PEGASE model of the river Dijle catchment and the MIKE11 model of the river Dijle,
4. a bidirectional link in all nodes between the PEGASE model of the river Dijle catchment and the MIKE11 model of the river Dijle.

For each sub use case, the following steps have to be achieved:
- to assess the links between the models,
- to perform runs in stand alone mode,
- to use the results of the associated model as input data for runs in stand alone mode,
- to link the models and to perform runs in linked mode,
- to solve the problems, encountered during the tests,
- to validate the models, running in linked mode.

The next planning and timing are proposed for task B2:

- to perform sub use case 1 (an unidirectional link in some nodes between the PEGASE model of the river Dijle catchment and the Infoworks RS model of the river Dijle ; limited to the part upstream the city of Leuven) : to be completed on October 31st 2008 ,
- to perform sub use case 2 (an unidirectional link in some nodes between the PEGASE model of the river Dijle catchment and the MIKE11 model of the river Dijle) : to be completed on December 31st 2008,
- to perform sub use case 3 (an unidirectional link in all nodes between the PEGASE model of the river Dijle catchment and the MIKE11 model of the river Dijle) : to be completed on February 28th 2009,
- to perform sub use case 4 (a bidirectional link in all nodes between the PEGASE model of the river Dijle catchment and the MIKE11 model of the river Dijle) : to be completed on March 31st 2009.

Task B3 (Demonstrate under operational conditions): still to do

There are two management / policy issues defined for this use case:
1. the river flow regulation on the river quality,

- simulations of high flow situations,
- simulations of low flow situations.

2. the impact of the river quality at flooding.

For each management / policy issue, the following steps have to be achieved:
- to carry out runs in operational mode,
- to evaluate the performance and stability in operational mode,
- to perform the required changes to the models and to the information environment,
- to repeat the operational runs after changes in place.

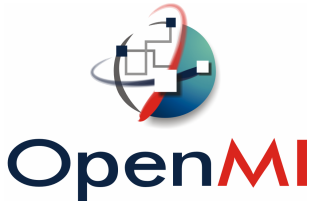
The next planning and timing are proposed for task B3:
- to perform the simulations for solving the first management / policy issue (the river flow regulation on the river quality) : to be completed on July 31st 2009,
- to perform the simulations for solving the second management / policy issue (the impact of the river quality at flooding) : to be completed on September 30th 2009.

Task B4 (Evaluate operational use): still to do

- to evaluate the results of integrated simulations in terms of objectives, questions answered, improved insight in process interactions,
- to evaluate the added value of integrated modelling as compared to the use of several solely models, in view of better integrated water management,
- to evaluate the OpenMI technological issues in view of performance and stability,
- to evaluate the working of the OpenMI support structure in view of flexibility, time of response etc.

To be completed by January 31st 2010.

APPENDIX 9 DRAFT OPENMI STANDARD RELEASE PROCEDURE



Summary:

This procedure describes the rules to follow for OpenMI standard releases.

Contact:

secretary@openmi.org
www.openmi.org

Version:

V0.1

Date:

18/09/2008

Status:

Proposed, draft

OpenMI Standard release procedure

Introduction

Changing the OpenMI Standard has major implications for both OpenMI developers and users. Unfortunately, it is impossible to make such changes backwards compatible. Consequently, when a new OpenMI Standard is released, all model providers must upgrade their models to stay compliant with the latest OpenMI version. The pace at which this happens varies from model provider to model provider, since many model providers only make new releases of their software products on a six month or yearly basis. Hence, after an OpenMI Standard release it can often take a year before the bulk of compliant models are upgraded to the new version. This has implications for the OpenMI users, as they may find that the models they want to use for linked configurations are not compliant to the same OpenMI versions. For this reason a very conservative release strategy for the OpenMI Standard must be adopted. Of course this has to be balanced against the need to implement the change requests from developers and users. If the Standard stays unchanged for too long, variants of the standard will emerge. It is then unlikely that models compliant with such variants will be linkable to models that comply to the official OpenMI Standard, with the result that end users may find that there are supposedly OpenMI compliant models that cannot be linked.

Given all the considerations above, a time period of about two years between OpenMI standard releases seems appropriate. Such a long period between releases puts huge demands on getting the release right both with respect to quality and contents. Rigid procedures must be applied in order to ensure that releases are absolutely bug free and that the content - the functionality the standard provides - meets both current and future demands.

It is important that the procedure of upgrading the OpenMI standard is as open as practically possible. At all stages during the release all documents should be public available and it should be possible for anyone to comment and influence the decisions.

The new OpenMI Standard release is formally not developed by the OpenMI association. Anyone can provide proposals for OpenMI Standard version x+1. However, it is the right and responsibility of the OpenMI Association Executive Committee to select the best proposal.

Scope

These procedures apply only to the OpenMI Standard. Other items, such as the OpenMI software development kit, the configuration editor, guidelines and so on, are not required to follow this procedure (the SDK and the GUI can be made backward compatible, so this is a different story).

The standard is only source code and documentation released under the OpenMI.Standard namespace.

Who may make changes to this procedure

Any changes to this procedure must be approved by the OpenMI Association Executive Committee.

Release procedure

The OpenMI Standard release schedule is divided into four periods:

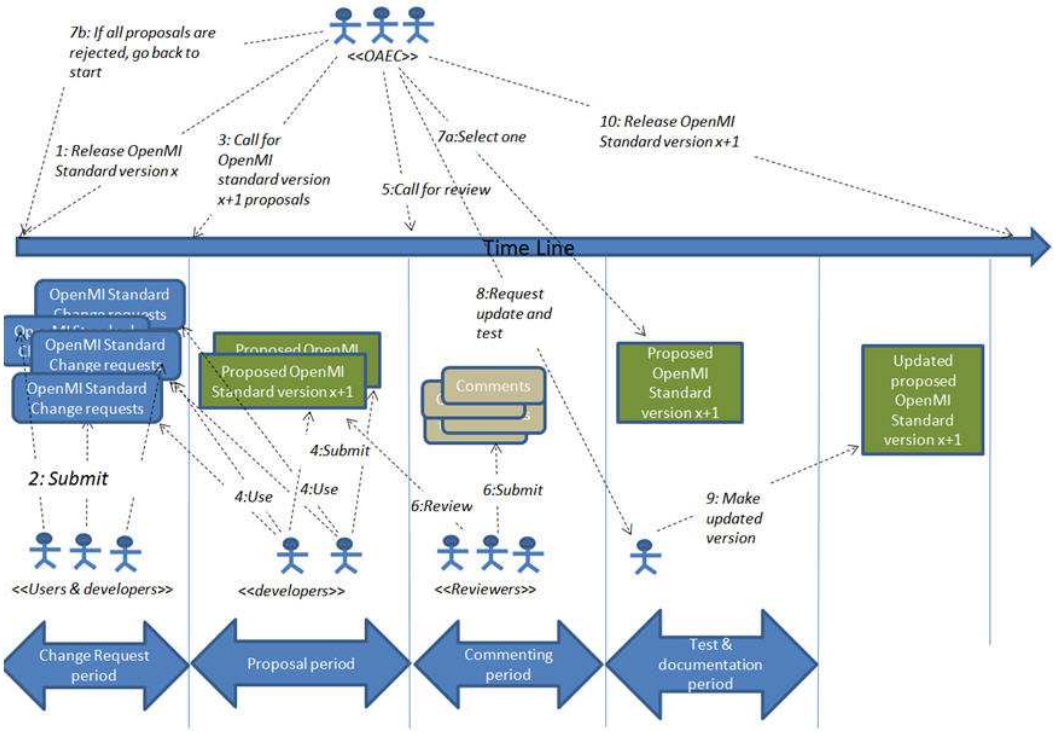


Figure 1 OpenMI Standard release phases

OpenMI Standard x+1 change requests period

The change request period starts immediately after the release of OpenMI standard version x. During this period anyone can submit change requests to the standard. Change requests are submitted electronically on the OpenMI web and made public available. Change requests must follow the rules described below in the change request section. The OpenMI Association will within five days after submission of a change request accept or reject a change request. Acceptance at this stage only means that the request follows the rules for change requests and that the request relates to the OpenMI Standard (many people are confused about the distinction between e.g. the standard and the SDK). So accepted change requests are not guaranteed to be included in the next OpenMI Standard. Acceptance of change requests will be (somehow) marked on the request on the web. If a request is rejected is will be marked on the web as rejected and the reasoning for rejection is given. If the person

submitting a rejected request does not agree on the rejection, the rejection can then be appealed and a final decision will be made at the next OAEC meeting. The collection of incoming change requests will be discussed at every OAEC meeting and when appropriate the end date for submission of change requests (the end of the change request period) will be decided and announced on the OpenMI web. There must be at least a period of three months from the announcement of this date until the date actually occurs. After the end of the change request period the possibilities for on-line submission of change requests on the web is closed. The OpenMI web will also feature a facility for posting comments to change requests.

OpenMI Standard x+1 proposal period

This period starts with a call for OpenMI Standard version x+1 proposals. The deadline for submission of proposals is also announced. The proposal period must be at least 4 months. Anyone can submit proposals (it can easily happen that OATC is the only one submitting such proposals, but to make the procedure as open as possible it should be allowed for anyone to provide proposals). As opposed to the change requests, that typically are aimed at one particular feature, proposals must describe the whole Standard. Proposals must be based on the change requests, but there is no limit to how many change requests that will be taken into account or to which extend the proposed standard reflects these change requests. The OpenMI Standard proposals must follow the requirement for such proposals (see Rules for OpenMI Standard proposal requirement below). Proposals are submitted online and will be public available.

OpenMI Standard x+1 commenting period

When the deadline for submitting proposals is passed a call for comments to the submitted proposals can be posted on the OpenMI web. Comments can be submitted by anyone and must follow the rules for comments to OpenMI standard proposals (see below). Also the deadline for submission of comments is announced. The commenting period must be at least three months. It should also be possible to submit comments to comments.

OpenMI Standard x+1 test and documentation period

When the commenting period has expired the OpenMI Executive Committee will decide which proposal is favorable. The executive committee will take into account the submitted change requests, the Standard proposal and the comments to this proposal. The evaluation will be carried out according to the OpenMI standard proposal guidelines, which also are publicly available. The OAEC will announce on the web which proposal is selected and reference selected comments from the commenting period that should be taken into account. (The OAEC is not allowed to give new comments at this stage). The authors of the winning proposal will then respond whether they, under those conditions, will elaborate the final release candidate. If they accept then this will be announced and the test and documentation starts. (Test and

documentation is carried out by those who submitted the winning proposal). The authors of the winning proposal will then make modifications to the proposed standard according to the comments, write documentation and test according the requirements for documentation and testing (see below). Finally the release is submitted and the OAEC can, if the everything is OK, release the OpenMI Standard version x+1.

If the submitters of the winning proposal decline to complete the OpenMI Standard release under the given conditions, the OAEC can decide to select another candidate or decide to delay the release. In case of the latter the whole release procedure starts from the beginning again (with a new change request submission period). Previous accepted change requests will still be valid.

Rules for OpenMI standard requests

- Anyone can submit change requests
- All change requests are made public available
- Change requests are submitted online on the OpenMI web using the predefined form
- The following must be provided with the change request:
    - Full name, affiliation, city, country, and e-mail address must be provided.
    - List of OpenMI standard interfaces affected by the change request.
    - List of OpenMI standard schemas affected by the change request.
    - Free text area, where the reasoning for the change request is described.
    - Free text area, where the actual change request is described.
    - Full source code for any changed interface or new interface, including source code xml comments.
    - Full xml schemas for any changed schema or new schema.

Rules for comments to OpenMI standard change requests or OpenMI Standard proposals.

- Anyone can submit comments to OpenMI Standard change requests.
- All comments are made public available
- Change requests are submitted online on the OpenMI web using the predefined form
- The following must be provided with the change request:
    - Full name, affiliation, city, country, and e-mail address.
    - Free text area where the comment is given.

Rules for OpenMI standard proposals

- Anyone can submit a OpenMI Standard proposal
- OpenMI standard proposals are made public available.

- The following must be provided with an OpenMI Standard proposal:
  - Full name, affiliation, city, country, and e-mail address.
  - List of OpenMI standard interfaces changed.
  - List of OpenMI standard schemas change.
  - Free text area conceptual changes, and the reasoning for those changes are given.
  - Documentation for tests carried out.
  - Zip file containing the full OpenMI standard release. (This means that if no further comments are provided and the OAEX accepts the proposal as is, this zip file can be directly released.)

Test requirements

Since the OpenMI standard simply is implemented interfaces, real unit test cannot be applied to the interfaces themselves. Hence, the purpose of the test is to ensure that things possible with the previous release also are possible with the new release (and in case not, make a sufficient argumentations for why that is). Make sure that features anticipated for the new release actually can be realized.

Specifically the test must involve the following:

- Ensure that the OpenMI standard can be compiled without any errors or warnings.

- Ensure that each and every interface and method is described if sufficient details in the source code comments. Ensure that there are no ambiguities and room for misunderstanding in the source code comments.

- Upgrade the OATC SDK and GUI or equivalent open source software packages and make sure that these compiles without any errors or warnings and that every unit tests runs without any errors.

- Demonstrate that the proposed standard works with different types of models and components.

Documentation requirements

Only in-code xml comments are required.

APPENDIX 10 EVALUATION REPORTS

1. Evaluation report - user and developer perspectives on integrated modelling using the OpenMI for water management issues

Introduction

Outline of the OpenMI-Life project – will be written by SC.

Aim of the demonstration Scheldt/Pinios evaluation of integrated modelling and the OpenMI, specific aims to the Scheldt and the Pinios

Bigger picture – what overall policy level problem is being looked at e.g. impact of flooding on sewer systems, managing water resources between 2 reservoirs. Can be taken from use case definitions.

Use Case Title e.g. Tides and upstream flood risk (can be taken from the use case definitions)

What are you trying to do –use case problem definition?

How has this been done to date?

Why was integrated modelling considered?

Have earlier attempts been made to apply integrated modelling to the problem?

Could the problem be solved by other means?

Are there efficiency benefits, science or commercial?

Are the results better/more reliable? If not, why is this?

Project Methodology

Outline integrated modelling process followed.

Give brief outlines of the results under the following headings.

Project Results

Project Discussion

Project Conclusion

Evaluation

Application of the concept of integrated modelling

How easy was it to apply integrated modelling to this problem?

What indicators were applied?

What models are required and what data

How easy was this?

What concerns were there regarding the process

Issues that arose during the process?

List any problems encountered and how they were resolved.

List any general issues arising out of integrated. Some suggestions are listed below:

- Sensitivity analysis by exchanging models
- Calibration and validation of integrated models
- Harmonizing evaluation criteria
- Avoiding instability

- Matching and converting units and categorizations, and projections
- The building of decision support systems
- Linking models representing different scales (geographical and temporal)
- Agent based models (where agents (which can be thought of as models) and their links are created and destroyed in the course of a run).
- Linking across disciplines
- Linking models based on different modelling concepts
- Linking models with different extents (usually geographical but also temporal)
- Linking models running at different temporal and spatial resolutions
- Error propagation and uncertainty
- Matching semantics
- Ensuring mass balance

Communication/Collaboration

Did integrated modelling facilitate good cooperation between the competent authorities?

What problems occurred and how were they resolved?

What has been learnt?

What have you learnt during the project?

What would you change in your approach?

If you started now what you do differently?

Can you think of other problems where you would like to apply integrated modelling?

Recommendations for improvement.

Results of integrated modelling

How useful were the results?

Are they better than what could have been achieved before? If so on what basis?

Does your organisation have confidence in the results achieved?

Did we get a significant improvement of the quality of the model calculations for the main model?

Conclusion/Recommendations

Was the project successful?

Would you recommend integrated modelling to others?

Have you enjoyed the project?

Will your organisation use integrated modelling for future projects?

2. Evaluation report on the OpenMI from a user perspective

The OpenMI concept

- Is the OpenMI concept a good / appropriate concept for linking models?

The OpenMI standard

- Is the OpenMI standard interface a good/appropriate approach for linking models?
- Is the OpenMI standard functionally adequate?
    - Ability to exchange data time step by time step
    - Ability to handle most modelling concepts
    - Ability link models at different scales
    - Ability to convert units
    - Ability to cross reference terminology (i.e. no need for a standard terminology)
    - Ability link models running different spatial and temporal resolutions – ability to interpolate and extrapolate in space and time
    - Ability to handle iteration
    - Ability to revert to a previous state
    - Ability to run under external control
    - Deadlocking should not be possible
    - Platform independence
    - Minimum change to existing code
    - No framework
    - Minimum impact on performance
    - Minimum constraints on modeller's freedom
- Does it meet our linking requirements?

The migration process

- Is it clear?
- Is it simple enough?
- Does it not require exceptional skills?
- Was it necessary?
- Did we have success with making our model / application OpenMI-compliant?
- If so, how many man-weeks did it take?

The linking / configuration process

- Is it clear?
- Was it easy to make the spatial links?
- Was it easy to define the quantity links?
- Did we have success with spatial and temporal aggregation/disaggregation?
- Did we have success with unit conversions?
-

The run process

- Is it clear?
- Was it easy to make the configuration for the runs?
- Was it easy to start the runs?
- Were there trigger problems?
- Have the trigger problems been solved?

Transferability from one problem to another

To evaluate the OpenMI technological issues in view of performance and stability,

- Did we have success with linking the associated model to the main model?
- Did we have success with linking the associated model to the main model under the use of a discrete number of nodes in one-directional links?
- Did we have success with linking the associated model to the main model under the use of all available nodes in one-directional links?
- Did we have success with linking the associated model to the main model under the use of bidirectional links?
- Are the simulated runs not too long?
- Did we reduce the run time?
- Did we get stable runs with linking the associated model to the main model?
- Did we get stable runs while using the link between the associated model to the main model during limited periods in a year (regarding the fact that main model runs an entire year and thus the associated model should start its calculation on the main models initial condition)?
- Did we get reliable results with linking the associated model to the main model?
- Did we get more sensitive results with linking the associated model to the main model?
- Did we get a higher quality of model calculation using a few discrete link nodes rather than using all the available nodes?
- Did we get a higher quality of model calculation with bidirectional links rather than with unidirectional links?
- Have simulations been performed in remote linking?
- Have simulations been performed in multi threading mode?

Conclusions/ recommendations

3. Evaluation report on the OpenMI support organisation from user perspective

To evaluate the OpenMI support structure in view of delivering information, documentation on the OpenMI

- Could we find information, documentation on the OpenMI?
- Where did we find it?
- Did it provide the info we wanted?
- Was it delivered in a helpful and friendly manner?
- Did we understand it?
- Was it sufficient?
- Was it timely?

To evaluate the OpenMI support structure in view of delivering tools

- Did the OpenMI Association (the participating model suppliers) deliver us the wanted tools (OpenMI compliant made associated models or other tools)?
- Was it delivered in a helpful and friendly manner?
- Was it timely?

To evaluate the OpenMI support structure in view of giving trainings

- Did the OpenMI Association give us trainings about the OpenMI?
- Did we attend a training course?
- Did we study the examples provided by the OpenMI Association?
- Was the trainer capable / experienced enough on OpenMI, modelling?
- Was the training material adequate?
- Was the training capacity/quality right?
- After training, did we manage with success on your own, using the items learned on the training?

To evaluate the working of the OpenMI support structure in view of flexibility, time of response etc.

- Did we feel we could make a request for change to the OpenMI support structure?
- Was it easy to do so?
- Did we get a positive response of the OpenMI support structure to our requests?
- Did we get a quick response of the OpenMI support structure to our requests?
- Did we get an adapted response of the OpenMI support structure to our requests?
- Was that reasonable?

Conclusion/Recommendations

4. Evaluation report from OpenMI coordination perspective - OATC to write

Demonstration of feasibility / Added value of OpenMI

- What lessons were learned?
- What was successful?
- What seeds were sown for future cooperation?
- Roadmap for integrating models in a new field/domain

Training

- Is there a need for separate trainings for users, developers and on integrated modelling?
- Should the OpenMI Association provide for all of these?
- Are the training materials adequate?
- Is there a list of trainers?
- Was training capacity/quality right?

Technical issues

Evaluate the effectiveness of the following services provided

- User support
- Bugs
- Enhancements
- OpenMI Association Technical Committee

Communication

How effective was the communication?

Which communication methods were most effective?

- Web site
- Wiki
- Source Forge
- Conferences
- Newsletters
- Conference/web site

Conclusion/Recommendations

5. Business plan (Including After LIFE Communication report) - to be written by the OAEC

Introduction

OpenMI Association Strategy

Implementation to date

Plan going forward