

The OpenDA Association

Annual Report 2012



Annual report 2012 of the OpenDA Association

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0.1	January 2, 2013	NV	Concept	MR
0.2	May 29, 2013	NV	Added input from annual meeting	EB
0.3	June 10, 2013	EB	Added input from Deltares	NV
0.4	June 17, 2013	NV	Prepared final draft for all partners	MV,EB
0.5	June 26	MV	Added input from Deltares	Nv
0.6	June 27	NV	Finalize document	

1. Introduction

According to its charter, the OpenDA Association has the purpose to organize the product management, coordinate product development, and promote the OpenDA software toolbox for model calibration and data assimilation. This report gives an overview of the events and activities in 2012, gives the current status and provides an outlook on next year.

2. Overview of 2012

The year 2012 has been a successful year for the OpenDA association. We have seen many important activities. We have been able to release OpenDA 2.0 including many significant improvements. We had a number of courses, the first OpenDA webinar and many promotional activities. Comparing to previous years we now see a significant growth in the interest in and usage of OpenDA.

Product management

Meetings

The association has met on February 22 2012 (annual meeting 2011) and May 28 2013 (annual meeting 2012). These meetings serve to coordinate the various developments around OpenDA and to make plans for promotion.

Cooperation and projects

As in 2011, the OpenDA team is participating in SANGOMA, a European-funded project that aims at the development of advanced tools for oceanographic data-assimilation. This year we have worked together with the other SANGOMA partners to identify and specify the interface to tools we are going to share or develop together. Besides the shared tools a medium size NEMO ocean benchmark is defined which will be added to OpenDA.

The Flood Control 2015 subproject “Data Assimilation for Operational wave forecasting” uses OpenDA to develop an operational wave forecasting system for the North Sea. Within this project, we have extended the support for parallel computing in OpenDA.

In 2012 the MyWave EU-project started. The focus of Workpackage 2 of this project is on data-assimilation for wave models. The functionality of OpenDA for wave data-assimilation will be developed further. The first goals are to extend the application to bigger models and move from idealized to more realistic experiments.

In 2012 the development of the Kalman filter for the new operational storm-surge model in the Netherlands DCSM-v6 was finalized. It is expected that the system will become fully operational in the summer of 2013. During the development of the model several parameters such as friction at the seabed were calibrated with OpenDA. In total there were over 200 parameters and over 80 time series with observations. Each run was performed in parallel. There is a paper available about these developments [Zijl et. al. 2013]. The Kalman filter for the DCSM-v6 posed a significant challenge. An Ensemble Kalman Filter with 100 members resulted in a significant computation for this model with almost 1000000 gridcells. Several memory leaks were resolved and the parallel performance was investigated in great detail. The resulting Kalman filter uses a steady-state filter and combines a high efficiency with accurate results. The errors at small lead-times are reduced by almost 50% with an impact lasting up to 18 hours.

In addition, TU Delft participates in an OpenDA project with the engineering firm Witteveen&Bosch for modeling city waters.

The Dutch research institute TNO is actively cooperating with the three current OpenDA association members for further implementing OpenDA for their applications, such as air-pollution with Lotos-Euros and Eclipse for oil and gas reservoirs.

We have had various internships and MSc graduation projects in which OpenDA was involved. These projects included the coupling of OpenFOAM to OpenDA, calibration of the sewer system of the city of Delft, calibration of the morphological changes at the 'Sand-Engine' and data-assimilation on sewer systems.

Product development

Release version 2.0

On February 1st 2012 we have released OpenDA 2.0. The previous official release of OpenDA dated from April 2010. The 2.0 release contains a significant amount of improvements compared to the 1.0 release. The most noticeable is the improved installation of OpenDA. OpenDA now works out of the box on most platforms. During the preparation of the release much effort was put into setting up a server for nightly-builds and testing. This goal has been achieved for a large part, thus improving the testing of OpenDA and with that the quality of the release.

OpenDA applications

The following models are known to be coupled to OpenDA.

Model	Description	Calibration		Kalman Filtering		platforms
		Black box	In memory	Black box	In memory	
Lotos-Euros	Air quality model				X	Linux
Eclipse	Oil reservoir model			X		windows
OpenFOAM	Open source finite volume modeling system			X		Linux
Chimere	Air quality model				X	Linux
Delft3D Flow	2D and 3D hydrodynamics	X			X	windows and linux
Sobek RE & River/Rural	1D hydrodynamics	X	X ¹		X	windows
WAQUA/TRIWAQ in SIMONA	2D and 3D hydrodynamics	X			X	windows and linux
SWAN	spectral wave model	X		X		windows and linux
HBV	rainfall run-off	X				windows and linux
Modflow	groundwater flow			X		windows
HSPF	watershed hydrology and water quality	X ²				windows
EFDC	1D, 2D and 3D hydrodynamics and water quality	X ²			X	Windows, linux and IBM AIX

Delft3D-Delwaq	Water quality model				X	windows and linux
MSettle	soil consolidation				X	windows
PC-raster	PCRaster dll for GIS based (hydrological) models	X ²				windows and linux
OpenStreams	Open Source Distributed Deltares Hydrological Model Instrument		X		X	windows and linux
MCRM	Midlands Catchment Rainfall-Runoff Mode		X			windows and linux
Sacramento	Sacramento Soil Moisture Accounting Model		X			windows and linux
DFlow-FM	Finite-volume hydrodynamics for unstructured grids	X				
NEMO	Ocean circulation model			X		

- 1) .Net assembly.
- 2) Currently only for running models.

3. Current status

We see a significant growth of the use of OpenDA. There were 1277 downloads of OpenDA in 2012. During this year we also have had quite some contacts with potential users of OpenDA.

The last OpenDA release is stable and the number of installation issues has been reduced dramatically. OpenDA now includes sufficient basic functionality for most people to get started quickly.

Product management

Deltares has appointed a product manager. The task of the product manager is to have an overview of the various known OpenDA developments and to help coordinate the incorporation of new developments in OpenDA within Deltares. The partners are now able to free sufficient budget and resources to create one stable release a year.

Product development

Version 2.0 turned out to be a feature-rich and stable version. As the use of OpenDA increased in both volume and scope, more requests for expanded and new functionality were made. In part this concerned improvements and extensions of existing modules and wrappers. Several OpenDA wrappers have been written for new models. In support of this work, we have improved the testing and building facilities of OpenDA. These additions should become available to all users of OpenDA since they significantly improve OpenDA. Therefore we will work on organizing a new release in the coming year.

Promotion

The partners of OpenDA have been actively promoting OpenDA. Many of these activities are announced on the OpenDA website and by e-mail. The main activities of the past year were:

We have organized two one-day OpenDA courses and a webinar. The OpenDA courses were held at the Deltares Software Days at June 11 and Delft Software Days November 26. The existing course material has been improved and extended based on the experience of the previous courses.

The webinar was held on April 11. We had participants from all over the world. In all, more than one hundred people attended the webinar. This first webinar showed the use of OpenDA for calibration of a Delft3D model of an estuary.

There was an increasing number of presentations about OpenDA at workshops, conferences and institutions. Among others these workshops and presentations include:

- “Deltares Software Days 2012”, OpenDA basic course, an introductory course on OpenDA.
- “Delft Software Days 2012”, OpenDA basic course, an introductory course on OpenDA.
- Contributions to workshops and conferences:

- S. de Kleermaeker, M. Verlaan, J. Kroos, “A New Coastal Flood Forecasting System for the Netherlands”, HYDRO2012, 13-15 November 2012, Rotterdam
- M. Verlaan, J. Sumihar, “Ensemble-based observation sensitivity for forecasting of sea-level”, 7th International EnKF Workshop, June 18-20, 2012, Os (Bergen), Norway
- WJ van Verseveld, F Sperna-Weiland, D Meissner, HC Winsemius, AH Weerts, “Multi-purpose calibration of HBV models for the Rhine with OpenDA”, 2012, EGU General Assembly Conference Abstracts 14, 4039
- Ridler, M., Hummel, S., van Velzen, N., Katrine Falk, A., & Madsen, H. (2013, April). Open source data assimilation framework for hydrological modeling. In EGU General Assembly Conference Abstracts (Vol. 15, p. 7844).
- Garcia, M. (2013). Data Assimilation for Hydrodynamical Modeling of San Quintin Bay, BC, Mexico. FEMTEC 2013, 62.

Scientific publications in peer reviewed Journals:

- Y. Liu, A. H. Weerts, M. Clark, H.-J. Hendricks Franssen, S. Kumar, H. Moradkhani, D.-J. Seo, D. Schwanenberg, P. Smith, A. I. J. M. van Dijk, N. van Velzen, M. He, H. Lee, S. J. Noh, O. Rakovec, and P. Restrepo, *Hydro Earth Syst. Sci. Discuss.* 9, 3415-3415, 2012
- F. Zijl, M. Verlaan, H. Gerritsen, “Improved water level forecasting for the Northwest European Shelf and North Sea through direct modelling of tide, surge and non-linear interaction”, submitted to *Ocean Dynamics*
- M.U. Altaf, M. Verlaan and A.W. Heemink, “Efficient identification of uncertain parameters in a large-scale tidal model of the European continental shelf by proper orthogonal decomposition”, *International Journal for Numerical Methods in Fluids*, 2012, Vol. 68 Issue 4, p 422-450, Feb 2012, DOI: 10.1002/fld.2511

4. Outlook

Product development

The core of OpenDA is becoming more and more mature. Both calibration methods and Kalman filtering are now used on a routine basis for some applications. The product development will focus on making OpenDa even more user friendly, thus further improving this strength of OpenDa. Some examples are: an update of the documentation, improved filtering of output, and more noise models or uncertainty models. On the other hand further improvements to parallel processing will be made for high-end applications. Another important goal is to increase the number of applications. It is likely that in numbers many of these applications will be relatively simple to medium complexity, because this is where OpenDA excels.

Product management

The main goals for the product management in 2013 are:

- Try to attract more users of OpenDA. A wide scope of users is crucial for further development and growth of OpenDA. Also the core code of OpenDA is now stable, so end-users can add new applications reliably, both for calibration and for Kalman filtering.
- A new major release of OpenDA in spring 2013
- Improving the documentation of OpenDA. In particular on the black box wrapper, the available model couplings and the available methods.
- Attracting funds for development. Potential sources of funding are: support for new applications, subsidies for research or new technology, new OpenDA partners.
- Further improvement of product management.
- Set-up professional paid support for OpenDA.

Promotion

The main goals for the promotion of OpenDA in 2013 are:

- Attract more users of OpenDA, both in an academic context, for building operational systems and improving model performance for consultancy.
- Motivate existing users, who rely heavily on OpenDA to join the OpenDA association
- Organize a number of OpenDA courses
- Contribute to the summer-school for data-assimilation SSSA2013 (see <http://www.data-assimilation.com/sssa2013>)

- Present OpenDA at various international conferences
- Publish articles about OpenDA in scientific journals. In 2013 we want to contribute also more popular articles to a wider range of journals to reach a wider range of potential users.
- Support a number of Msc graduation projects with OpenDA.

5. Financial report

Assets		Liabilities & Equity	
31-12-12		31-12-12	
€	€	€	€
Fixed assets	-	Equity	8433
Current assets	16142	Current Liabilities	1533
Cash & bank balances ¹⁾	15918	Accounts payable	1533
Accounts receivable	224	Profit 2011	6176
	<u>16142</u>		<u>16142</u>

Income statement for the year ended on December 31, 2012

	Debit €	Credit €
Revenues		
Gross revenues ²⁾		9000
Expenses		
Professional services (internship OpenFOAM)	2142	
Accountant	330	
Bank fees/interest	91	
Office supplies (for flyers etc)	261	
<i>Total expenses</i>	<u>2824</u>	9000
Net income		<u>6176</u>

Notes on the accounts

1. Bank account 1138.79.792.

2. Contribution of three partners, based on an annual contribution of € 3000.