MATHEMATICS IN WATERLAND

7-10 FEBRUARY 2011

COSSE Workshop
Delft University of Technology - Netherlands

- KTH Royal Institute of Technology, Sweden
- Technical University of Berlin, Germany
- Technical University of Delft, the Netherlands
- Friedrich-Alexander University of Erlangen-Nürnberg, Germany

European Commission
ERASMUS
MUNDUS

Programme

Monday 7 February, 2011		
08:50		transport from hotel to University
09:15	09:30	arrival/opening in Snijderszaal
09:30	10:15	Karen Aardal / Arnold Heemink *TU Delft*
10:15	10:30	break
10:30	11:15	Eric Deleersnijder - invited speaker *"Introduction"*
11:15	11:30	Break
11:30	12:15	Reinhard Nabben *TU Berlin*
12:15	13:30	lunch Elektron
13:30	17:30	Group Project (GP) - coffee/tea
17:30	18:30	drinks/bite
18:30	19:30	diner in Aula Univ.
19.30		transport to hotel

Tuesday 8 February, 2011		
08:50		transport from hotel to University
09:15	10:00	Dietmar Fey *Uni-Erlangen*
10:00	10:15	break
10:15	11:00	Katarina Gustavsson - invited speaker *"Introduction"*
11:00	11:15	break
11:15	12:00	Michael Hanke *KTH*
12:00	13:45	lunch Elektron
13:45	16:00	visit Deltares (Delft Hydraulics)
16:00	18:30	GP - coffee/tea
18:30		transport to Restaurant in Delft - Banquet
		Guest: Jan Verwer

Programme

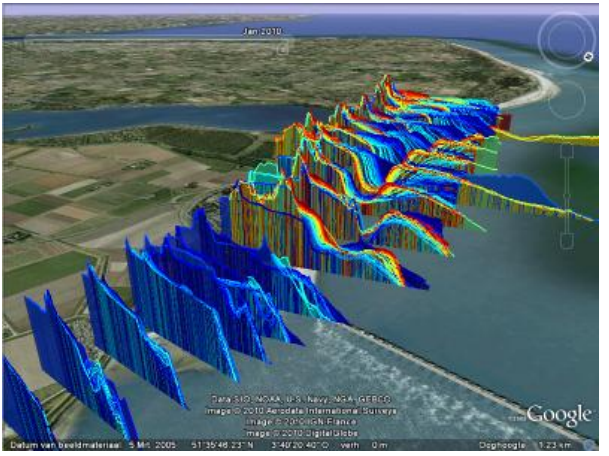
Wednesday 9 February, 2011		
08:50		transport from hotel to University
09:15	10:00	Volker Mehrmann *TU Berlin*
10:00	10:15	break
10:15	11:00	Katarina Gustavsson - invited speaker *"Large scale simulations of gravity induced sedimentation of slender fibers"*
11:00	11:15	break
11:15	12:00	Lennart Edsberg *KTH*
12:00	12:45	Martin van Gijzen *TU Delft*
12:45	13:45	lunch Elektron
13:45	16:30	visit museum Lambert van Meerten and museum Het Prinsenhof
16:30	18.00	GP - coffee/tea
18:00	19:00	diner in Aula Univ.
19:00		transport to hotel
19:00	*21:00*	*PAG Mobility Decision meeting: room 7.060*

Thursday 10 February, 2011		
08:50		transport from hotel to University
09:15	10:00	Ulrich Rühde *Uni-Erlangen*
10:00	10:15	Michael Hanke *"Announcement mobility track"*
10:15	11:00	Eric Deleersnijder - invited speaker *"Beyond ocean modelling: Multi-scale/physics numerical simulation of the hydrosphere"*
11:00	11:15	break
11:15	11:45	Jana Štetková-Fiorito *EACEA*
11:45	12:15	Karin Knutsson *KTH administration*
12:15	13:15	GP presentation
13:15	14:00	lunch Elektron
14:00		departure

Friday 11 Feb. 08:00-17:30 PAG meeting in Lipkenszaal
12:00-14:00 lunch in Elektron

Tuesday 8 February, 2011
13:45-16:00 VISIT DELTARES

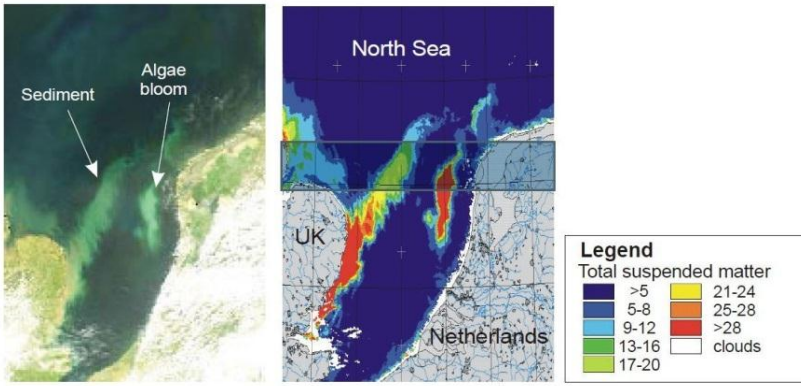
Deltares is a leading, independent, Dutch-based research institute and specialist consultancy for matters relating to water, soil and the subsurface. We apply our advanced expertise to help people live safely and sustainably in delta areas, coastal zones and river basins. We conduct research and provide specialist advisory services for government authorities and the corporate sector in The Netherlands and globally. The essence of our work is the development, application and sharing of knowledge. We develop knowledge in partnerships with universities, other knowledge institutions and the business sector, not only in government research programmes but also in contract research. Deltares has more than 800 employees, and we are based in Delft and Utrecht.



Delta technology Economic activity, rising populations, falling land levels and the impact of climate change are generating increasing pressure on habitable space in deltas, river basins and coastal areas throughout the world. Deltares has the knowledge and the resources needed to tackle water and subsurface issues in a new, integrated way.

When water, soil and the subsurface are critical factors, the debate will be about more than just technological issues. For example, we take spatial planning into account, together with the range of policy agendas and interests, and legal and economic processes. Nature also plays an important role. So issues must be approached from various angles. Deltares applies the relevant knowledge in integrated ways. Sophisticated combinations of

measures result in more sustainable, liveable, and often more economic solutions. We call this integrated approach 'delta technology'.



Our goal is the sustainable shaping of the living environment, using high-grade technological solutions that have the support of society in general.

Wednesday 9 February, 2011
10:15-11:00 LECTURE INVITED SPEAKER

Large scale simulations of gravity induced sedimentation of slender fibers

Katarina Gustavsson
CSC/Numerical Analysis//Linné Flow Center
Royal Institute of Technology, KTH, Stockholm, Sweden

Gravity induced sedimentation of slender rigid fibers in a highly viscous fluid is investigated by large scale numerical simulations. The fiber suspension is considered at a microscopic level and the flow is described by the Stokes equations in a three dimensional periodic domain/box.

For this specific problem, it is suitable to work with a boundary integral formulation. Since the fibers are slender, a non-local slender body approximation can be used to accurately capture the dynamics of the fibers. A great advantage of such formulation is that it leads to a reduction in dimensionality of the problem. Instead of solving the full three dimensional problem, a system of one dimensional boundary integrals is solved to determine the dynamical behavior of the fibers.

Using numerical simulations we will demonstrate that a suspension with an initial homogeneous and random distribution of fibers will form large scale inhomogeneities in the fiber distribution during sedimentation. Elongated fiber-dense streamers will form, surrounded by regions of clear fluid. Within these streamers smaller clusters of fibers are created and dispersed in a repetitive fashion. We observe a strong correlation between the creation and dispersion of clusters and the fluctuations in the sedimentation velocity of the suspension.

We have also studied the effect of the micro-structure of the suspension on averaged quantities such as the mean sedimentation velocity. Our results show that two simulations with the same macroscopic properties (fiber concentration and periodic box geometry) but with different random initial distribution of fibers, can exhibit very different dynamical behavior at the fiber level, causing large differences in e.g. the mean sedimentation speed. Hence, in order to obtain reliable data of such quantities, the results need to be averaged over a number of simulations. We will present ensemble averages of the sedimentation velocity and fiber orientation for different values of the effective concentration of fibers and the results are compared to existing experimental data.

Wednesday 9 February, 2011

13:45-16:30 VISIT MUSEUM LAMBERT VAN MEERTEN /MUSEUM HET PRINSENHOF

Museum Lambert van Meerten is situated in a beautiful building alongside the canals on the street called 'Oude Delft'. The museum shows a collection of artefacts that was brought together by the rich industrial and art collector Lambert van Meerten. Several antique building fragments have been integrated into the Neo-renaissance interior of the house.

Museum Het Prinsenhof tells the story of William of Orange and his role in the creation of the Dutch Republic. You meet the most important figures of the Netherlands Revolt (80 Years War) and gain more information concerning the major events of this turbulent period. By way of a collection of 17th century art and handicrafts you can discover the typically Dutch city Delft in the Golden Age

Thursday 10 February, 2011
10:15-11:00 LECTURE INVITED SPEAKER

Beyond Ocean Modelling:
Multi-Scale/Physics Numerical Simulation of the Hydrosphere

Eric Deleersnijder
Delft Institute of Applied Mathematics
(on leave from the Université catholique de Louvain, Louvain-la-Neuve, Belgium)
www.ericd.be

The hydrosphere is made up of a number media, such as the oceans, the shelf seas, the estuaries, the rivers, the sea ice — which, for the sake of simplicity, is considered herein to be part of the hydrosphere. The processes taking place in these domains are vastly different in nature and are characterised by a wide range of space- and time-scales.

The components of the hydrosphere interact with each other. For instance, the shallow marine and estuarine regions, though accounting for less than 1% of the volume of the oceans, have a biomass far from negligible as compared to that of the oceans, implying that they play a significant role in global biogeochemical cycles. This is one of the reasons why models are now needed that deal with most, if not all, of the components of the hydrospheric system.

Numerical models of each of the components of the

hydrosphere already exist. However, an integrated model of the whole hydrosphere has yet to developed. Building such a model is a daunting task, requiring the development of multi-scale/physics simulation tools.

Numerical methods for dealing with multi-scale problems are developing rapidly. Unstructured meshes offer an almost infinite geometrical flexibility, allowing the space resolution to be increased when and where necessary. In addition, time steppings for dealing with a wide spectrum of timescales while retaining a high order of accuracy have been developed over recent years (e.g. multi-rate schemes).

Taking advantage of the abovementioned progress in numerical methods, various teams over the world have started developing models for simulating in an integrated manner a significant number of components of the hydrosphere. One of these groups is building the Second-generation Louvain-la-Neuve Ice-ocean Model (SLIM, www.climate.be/slim). The latter solves the equations governing geophysical, environmental and groundwater phenomena by means of the finite element method on 2D or 3D unstructured meshes.

The current status of SLIM will be presented, as well as developments planned in the near future. It will be seen that space-time mesh adaptivity pays off. Applications will be reported on, in particular those pertaining to the land-sea continuum of the Scheldt River (France, Belgium, The Netherlands), the Great Barrier Reef (Australia) and the Mahakam River (Indonesia).