Three-dimensional numerical modelling of the Arabian Gulf with the Gulf Community Model

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Aim of this presentation

To introduce to you the new **Gulf Model Community** in which we can share knowledge and models to provide a good and continuously developing basis for marine projects and research in this region.

And to show you the open models that this community contains.
Reasons to model the Gulf

- Metocean and design conditions for project development and offshore operations
- Power and desalination industry – development and environmental effects
- Marine spatial planning
- Environmental Impact Assessments (water quality, habitats)
- Coastal developments – design and impacts
- Effects of Climate Change – floods, increase in salinity etc.
- Oil spills
- Harmful algal blooms
- Etc. etc…
Delft3D Modelling suite – open source

The Delft3D-FLOW and Delft3D-FM software suite can be used to model the following processes:

- 2D and 3D hydrodynamics
- Extreme ambient conditions (storms, cyclones, flooding, etc.)
- Industrial outfalls and river discharges
- Sediment transport and morphology (e.g. erosion)
- Water quality (Delft3D-WAQ)
- Habitat impacts
- Etc.

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The Delft3D Gulf Models
Modelling the hydrodynamics of the Gulf

2D tides

Tidal constituent M2
Runid: r14

Tidal constituent K1
Runid: r14
Modelling the hydrodynamics of the Gulf

2D tides

Abu Dhabi water levels and currents

Qatar current velocities and directions
Modelling the hydrodynamics of the Gulf

3D circulations – Typical Gulf characteristics covered by the Delft3D model:

Reynolds, 1993
Current status of the models

**Delft3D-FLOW**

- 2D calibrated tidal model
- 3D tidal and circulation model available and under further development and calibration

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Current status of the models

Delft3D-FM

Delft3D-Flexible Mesh (2D and 3D)
- Initial versions and under further development
- Flexible mesh generation
- Increased computational efficiency
Assessment of long-term impact of desalination and climate change on Gulf hydrodynamics, water quality and ecological impacts
A well-validated numerical model could be used to provide guidance for plant siting, construction and operation, reducing operational risks and facilitating planning and permitting procedures.
Fields of application

Forecasting spreading of harmful algae blooms / oil spills

- Operational HAB or oil spill forecasting system
- Detection of present HABs/spills using satellite observations
Fields of application
Forecasting water levels and currents

Water levels and flow field during peak of the extreme Shamal storm of January 1964

- Operational forecasts hydrodynamics (water levels, currents, waves, etc.)
- Analysis of extreme conditions (e.g. storm surge during Shamal storms)
Outlook

Next to 2D and 3D hydrodynamics:
- Flexible mesh 2D and 3D
- Water quality models
- Wave models
- Ecology
- Interactive modelling tools
- ...?
Aim of the community

To share knowledge and models to provide a good and continuously developing basis for marine projects and research in this region.

To enable different parties:
- to use and develop the models
- jointly increase the knowledge about the Gulf for the region
- new research projects to start from a more developed basis instead of reinventing the wheel
- contribute to the further development of the model and make publications about these developments

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The Gulf Model Community develops and provides modelling tools that:

- can provide a **better understanding** of the physical processes that determine the basin-wide and more regional circulations in the Gulf

- can assess the short- and long-term **impacts of climate change**

- can assess the **accumulative effects** of anthropogenic loadings
The Gulf Model Community develops and provides modelling tools that:

- can assist in designing optimal long-term hydrodynamic and water quality monitoring systems in the Gulf

- form an efficient basis for hydrodynamic and water quality research studies in the Gulf region

- teach students and researchers the basis of hydrodynamic and water quality modelling for the Gulf
Present contributing community members

KISR
Kuwait Institute for Scientific Research

MIT
Massachusetts Institute of Technology

Deltanet
Enabling Delta Life

Deltanet
This is the website of the Gulf Model Community. This community consists of a growing number of members that use and develop the open source models for the Gulf region. The aim of this community is to share knowledge and models to provide a good and continuously developing basis for marine projects and research in this region.

This website provides a platform for availability and continuous development of the process-based, hydrodynamic flow model describing the Gulf system as well as for related (future) wave, water quality and ecological models. The models from this community are free to download and use. The community and the knowledge in this field grow when improvements to the models and knowledge base made by members are fed back to the community. Interested parties are very welcome to join and contribute to this community and can contact us here.

http://www.agmcommunity.org
You are welcome to join the Gulf Model Community!

http://www.agmcommunity.org

Universities
Research institutes
Governments and authorities
Regional organisations
Project developers

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