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Education and Research experience

- Postdoctoral Research Assistant, Imperial College London, August 2006 to present date
- Research assistant/PhD student, Delft University of Technology, 2002 to 2006
- MSc Theoretical Physics, University of Utrecht, 1994-2001
- MSc Mathematics, University of Utrecht, 1994-2001

Consultancy work

- Consultancy for Alstom TGL (tidal computations for marine renewable projects)
- Consultancy for London Computational Solution (LCS) (aerodynamics)

Research interests

Coastal ocean modelling. I am one of the lead developers of a new coastal ocean modelling framework, called **Thetis** (http://thetisproject.org/). I am funded as a Research Co-Investigator on EPSRC project *A new simulation and optimisation platform for marine technology* (EP/M011054/1). This project builds on our experience in developing Fluidity and OpenTidalFarm/FEniCS to combine their various capabilities, such as multi-scale hydrodynamic modelling, mesh adaptivity, high performance computing and optimisation through adjoint methods, in a unified framework. The numerical core has been rewritten using Firedrake, an automated system for the solution of differential equations using finite elements, in close collaboration with its developers at Imperial College. The two main target applications are: renewable energy generation via tidal turbine arrays and dense water discharge from desalination plants.

Previously, under the SuperGen project "Large Scale Interactive Coupled Modelling of Environmental Impacts of Marine Renewable Energy Farms" (LINC) funded by EPSRC (EP/J010065/1), a collaboration of Imperial College London (IC), Queen's University Belfast and Cefas, I looked at the reliability of large scale hydrodynamic models for marine renewable projects with a focus on environmental impact studies, in particular, comparing the capabilities of Fluidity, developed at IC, and MIKE 21 a commercial, industry standard hydrodynamic model.

Tidal farm optimisation Developed in collaboration with Simon Funke (IC/Simula), Patrick Farrell (Oxford) and Matthew Piggott (IC), **OpenTidalFarm**, http://opentidalfarm.org, is a tool for the optimisation of the layout of tidal turbine farms . This tool uses advanced adjoint techniques coupled with a shallow water solver to automatically compute the optimal positioning of individual turbines that yields the maximum power output (whilst potentially minimising costs and environmental impacts).

Mantle convection modelling Together with Rhodri Davies (ANU, Australia) and Cian Wilson (Carnegie Institution for Science, US): the development of Fluidity as a new, state of the art, mesh–adaptive geodynamics model for the modelling of mantle convection.

Fluidity As one of the main developers of Fluidity (`http://amcg.ese.ic.ac.uk/fluidity`), an open source, general purpose modelling frame work, I am and have been involved in a number of the very many applications of Fluidity.

- Introduced a shallow water capability
- Free surface algorithms.
- Modelling of tides and tidal energy resource assessments.
- Modelling of tsunamis.
- Developing efficient solver algorithms for large aspect ratio, non-hydrostatic ocean simulations.
- Various contributions to the excellent parallel scaling (MPI) properties of Fluidity. Threading of the Fluidity code, and parts of PETSc, to enable hybrid MPI/OpenMP parallelism — in collaboration with STFC Daresbury, EPCC Edinburgh, and Fujitsu Laboratories of Europe.
- Using the PETSc library, to greatly improve solver efficiency and parallel performance.
- Various improvements to the adaptivity functionality of Fluidity: a new algorithm that maintains vertical alignment, important in large aspect ratio domains; adaptivity in periodic domains.
- Shock capturing capabilities (project funded by AWE).

Publications

[1] T. D. Jones et al. "The concurrent emergence and causes of double volcanic hotspot tracks on the Pacific plate". In: *Nature* 545 (2017), pp. 472–476. DOI: 10.1038/nature22054.

[2] R. J. du Feu et al. "The trade-off between tidal-turbine array yield and impact on flow: A multi-objective optimisation problem". In: *Renewable Energy* 114 (2017), pp. 1247–1257. DOI: 10.1016/j.renene.2017.07.081.

[3] D. M. Culley et al. "A surrogate-model assisted approach for optimising the size of tidal turbine arrays". In: *International Journal of Marine Energy* 19 (2017), pp. 357–373. DOI: 10.1016/j.ijome.2017.05.001.

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[5] Rebecca C. Smith et al. "Comparing approaches for numerical modelling of tsunami generation by deformable submarine slides". In: *Ocean Modelling* 100 (2016), pp. 125–140. DOI: 10.1016/j.ocemod.2016.02.007.

[6] Simon W. Funke, Stephan C. Kramer, and Matthew D. Piggott. "Design optimisation and resource assessment for tidal-stream renewable energy farms using a new continuous turbine approach". In: *Renewable Energy* 99 (2016), pp. 1046–1061. DOI: 10.1016/j.renene.2016.07.039.

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[13] Robert Martin-Short et al. "Tidal resource extraction in the Pentland Firth, UK: potential impacts on flow regime and sediment transport in the Inner Sound of Stroma". In: *Renewable Energy* 76 (2015), pp. 596–607. DOI: 10.1016/j.renene.2014.11.079.

[14] Christian T. Jacobs et al. "An improved quantitative measure of the tendency for volcanic ash plumes to form in water: implications for the deposition of marine ash beds". In: *Journal of Volcanology and Geothermal Research* 290 (2015), pp. 114–224. DOI: 10.1016/j.jvolgeores.2014.10.015.

[15] Jon Hill et al. "How does multiscale modelling and inclusion of realistic palaeobathymetry affect numerical simulation of the Storegga Slide tsunami?" In: *Ocean Modelling* 83 (2014), pp. 11–25. DOI: 10.1016/j.ocemod.2014.08.007.

[16] Fanny Garel et al. "Interaction of subducted slabs with the mantle transition-zone: A regime diagram from 2-D thermo-mechanical models with a mobile trench and an overriding plate". In: *Geochemistry, Geophysics, Geosystems* 15 (2014). DOI: 10.1002/2014GC005257.

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Conferences and workshops

Presented at a large number of international conferences, a.o. the European Geophysical Union (EGU) and American Geophysical Union (AGU) conferences, the European Wave and Tidal Energy Conference (EWTEC), Society for Industrial and Applied Maths (SIAM), etc. I am a regular contributor to the yearly International workshop on Multi-scale (Un)-structured mesh numerical Modeling (IMUM)

workshops. I have been a visiting fellow at the Newton Institute, Cambridge, participating in the "Multiscale Numerics for the Atmosphere and Ocean" program.