FASTWATER

Freely Available Simulation Toolset for WAves, Tides and Eddy Replication

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Supergen Offshore Renewable Energy

EPSRC Engineering and Physical Sciences Research Council

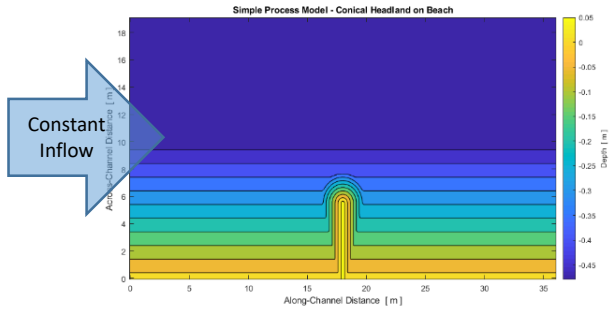
CATAPULT Offshore Renewable Energy

EMEC THE EUROPEAN MARINE ENERGY CENTRE LTD

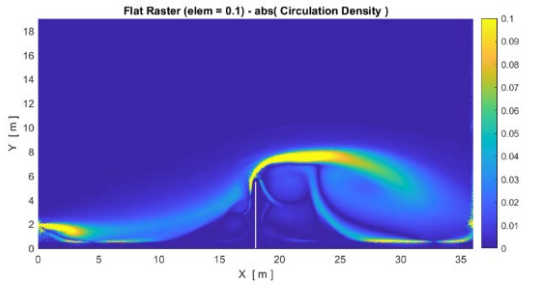
THE UNIVERSITY of EDINBURGH

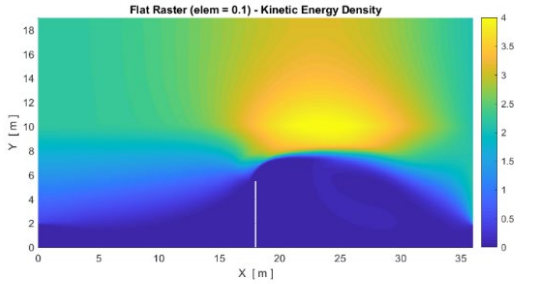
Advanced Methods Development: Mesh Design & Model Uncertainty Estimation

Simple Process Model



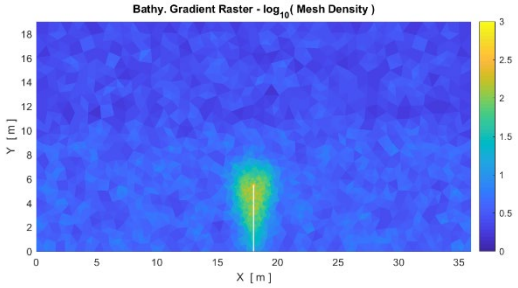
High Res. "Truth"

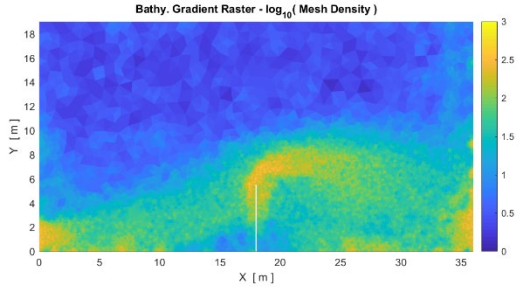


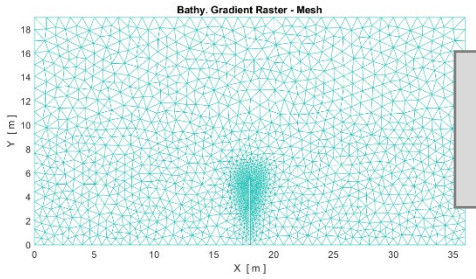


Mesh Design Based on Dynamics

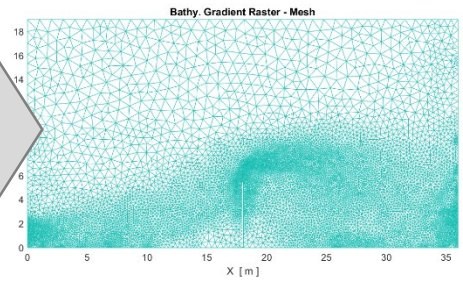
Mesh density raster used for mesh refinement, mesh density based on dynamics derived from model run based on a given mesh, iterate to convergence.

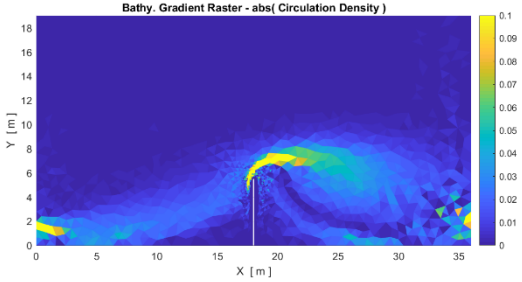


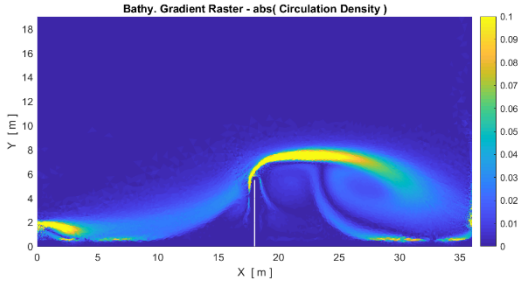




Multiple Iterations





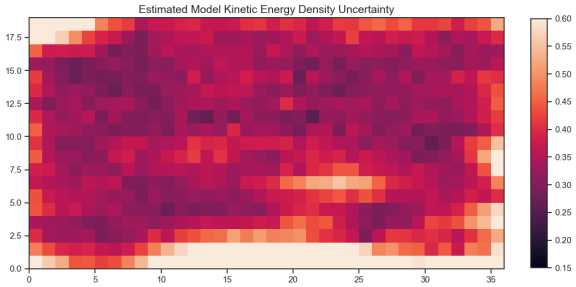


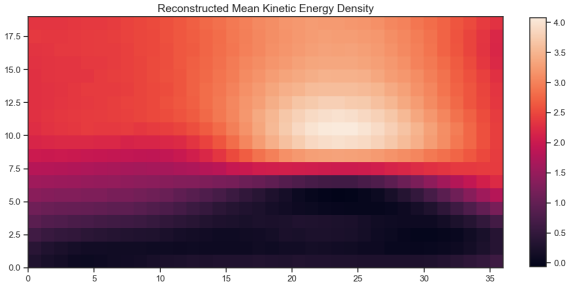
Bayesian Model Uncertainty Estimation

Truth: $f(x) = g(x) + u(x)$

Model: $g(x) = \sum_{i=1}^{p} \beta_i \, h_i(x) + \epsilon(x)$

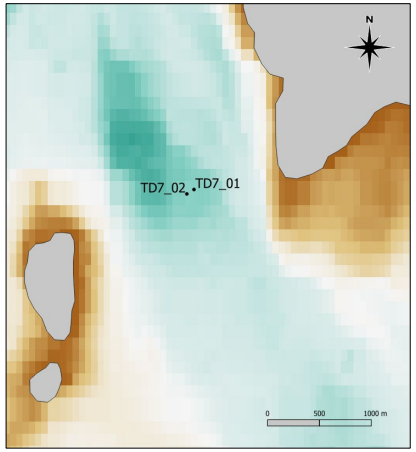
SEPIA python package used to generate solution.

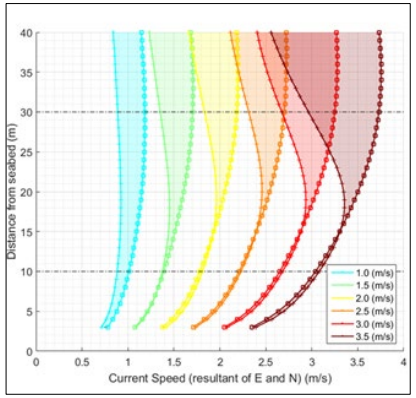




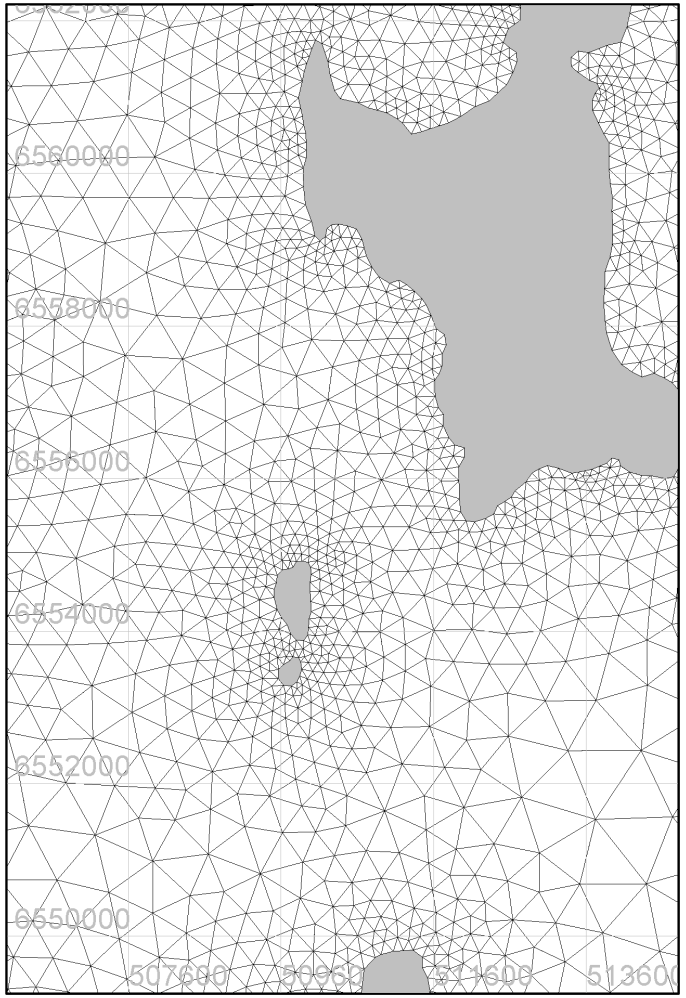
Case Study 1: EMEC Tidal Energy Site, Falls of Warness

Motivation:
ReDAPT data from twin deployment shows high spatial variability over 80m separation.

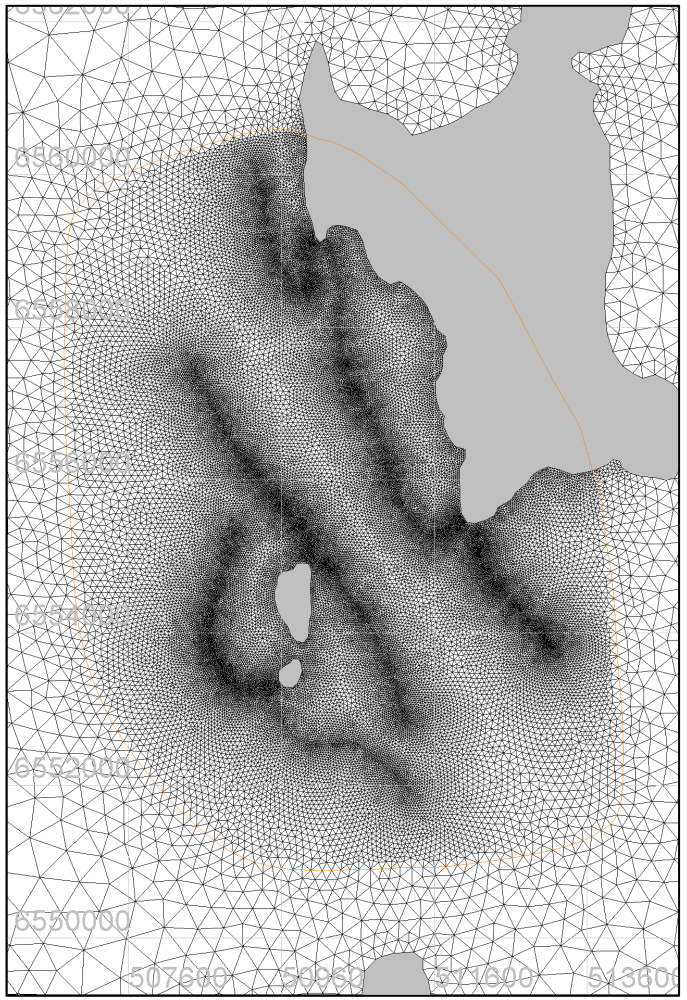




FASTWATER Base Model Mesh

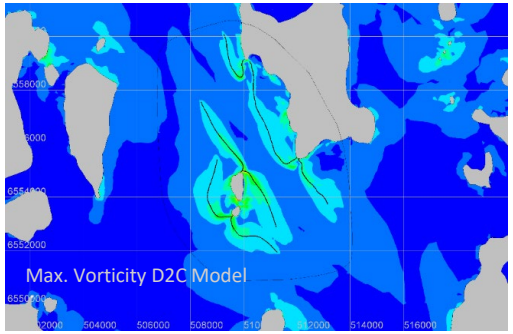


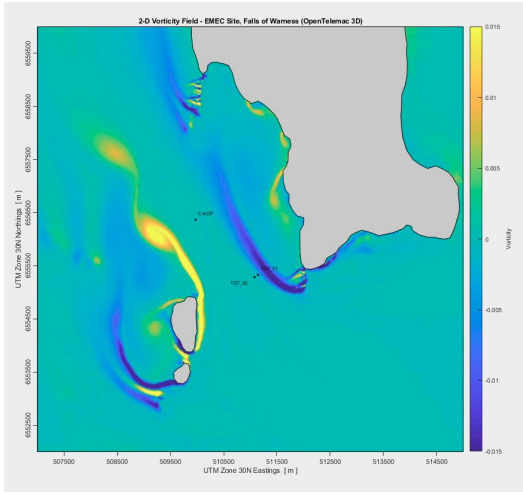
Falls of Warness Refined Mesh



Mesh refinement steps:

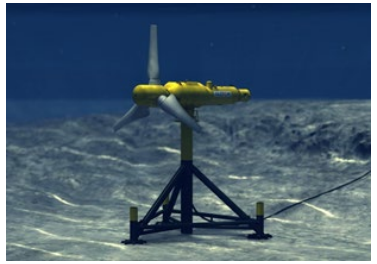
1. Distance-to-coast refinement
2. Spin-up and run for 14 days
3. Extract horizontal vorticity field
4. Vorticity refinement
5. Spin-up and run for 7 days

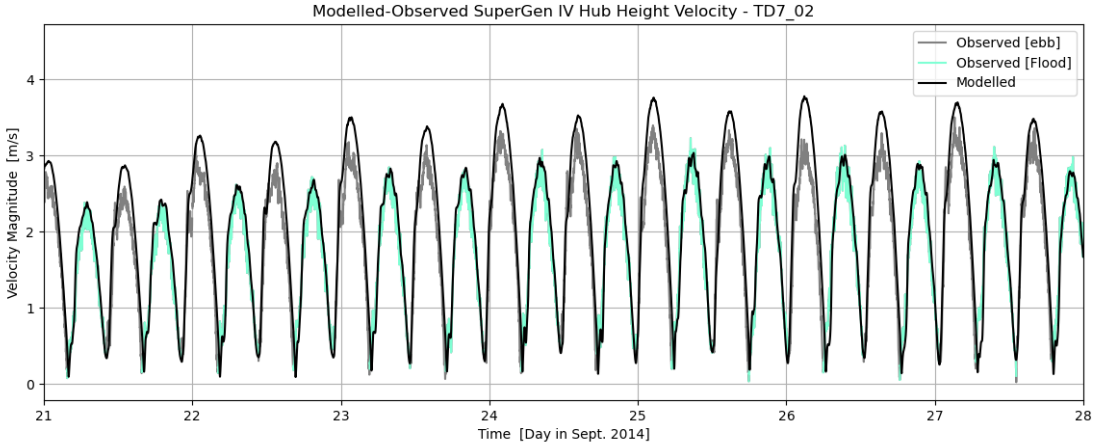


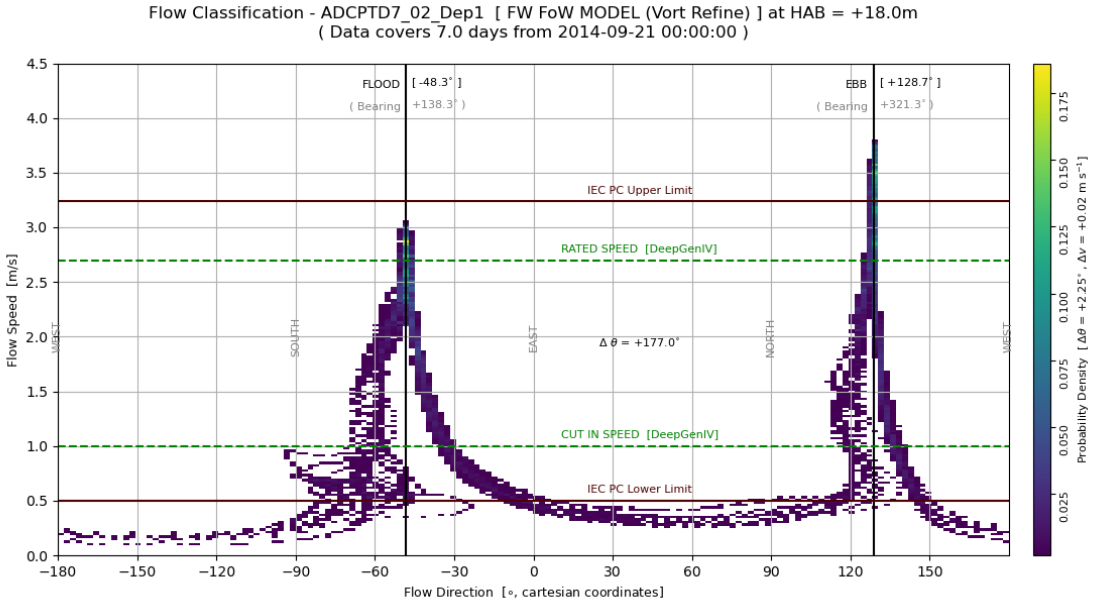


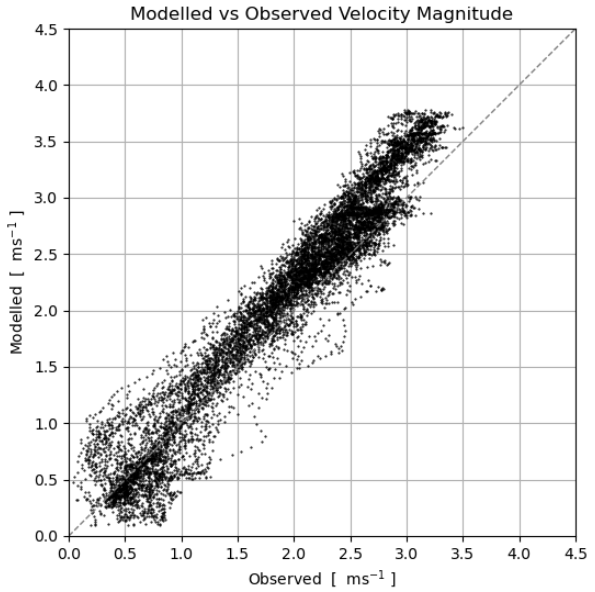
Case Study 1: Analysis Using FASTWATER Tools

Analysis based on turbine design

Alstrom DeepGen IV		
	**Rotor Dia.**	**20 m**
	Hub Height	**18 m (above bed)**
	Cut-in Speed	**1.0 m/s**
	Rated Speed	**2.7 m/s**







Validation Statistics

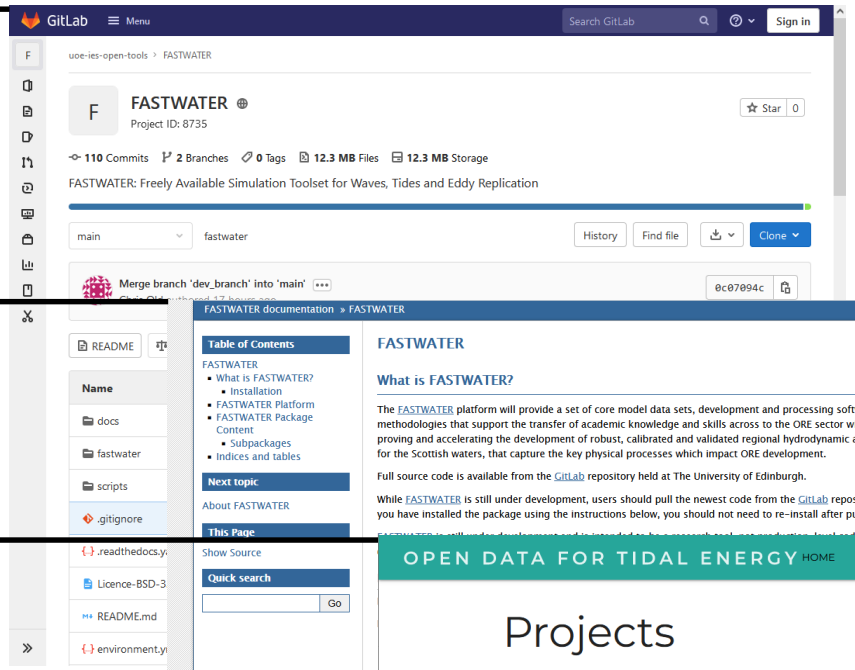
Correlation	= +0.966
Goodness-of-fit	= +0.888
Mean Bias	= +0.193 ms^{-1}
Normalised MB	= +10.21%
Mean Absolute Error	= +0.274 ms^{-1}
Normalised MAE	= +14.53%
RMS Error	= +0.332 ms^{-1}
Normalised RMSE	= +16.05%
Scatter Index	= +13.07%
Number of Samples	= 10059

Data Description

Observation Data Source: ReDAPT
Deployment ID: ADCPTD7_02_Dep1
Model Data Source: FW FoW MODEL (Vort Refine)
Data Geo Location: [511078. 6555286.]
Data CRS: WGS84 UTM Zone 30N (EPSG:32630)
Data Height Above Bed: 18.0 m
Coverage: 7.0 days from 2014-09-21 00:00:00
Tidal State: All phases

FASTWATER Open Platform

Public
GitLab
Repository



https://git.ecdf.ed.ac.uk/uoe-ies-open-tools/fastwater

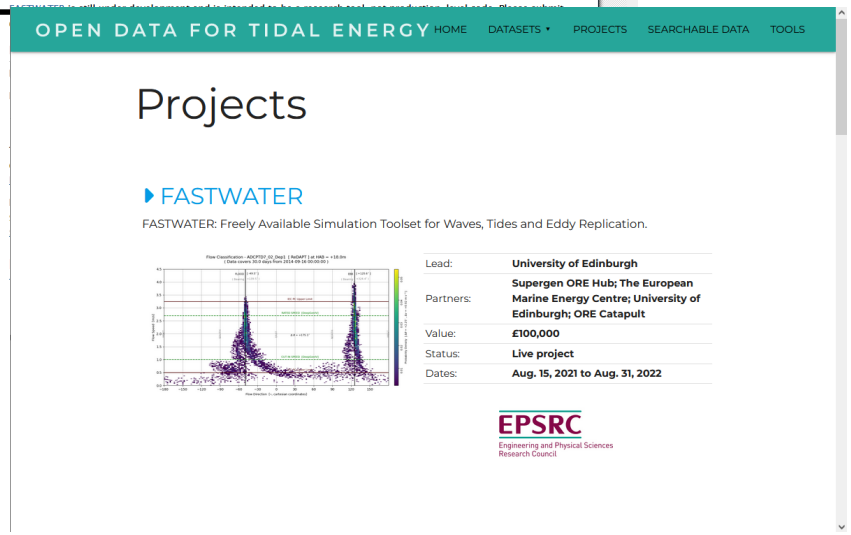
- Installation methods
- Python software modules
- Example processing scripts
- Example validation scripts

On-line
Documentation

https://fastwater.readthedocs.io/en/latest/

- Background to tools
- Description of methodology
- Base model
- Case studies
- Information on data sets

Archived
Open-Access
Data Sets



https://tidalenergydata.org/

- Coastline data
- Derived bathymetry data
- Derived friction coefficients
- Distance-to-coast data
- OpenTelemac model files
- Base model 2-D & 3-D output data
- EMEC model 2-D & 3-D output data
- Extracted model data