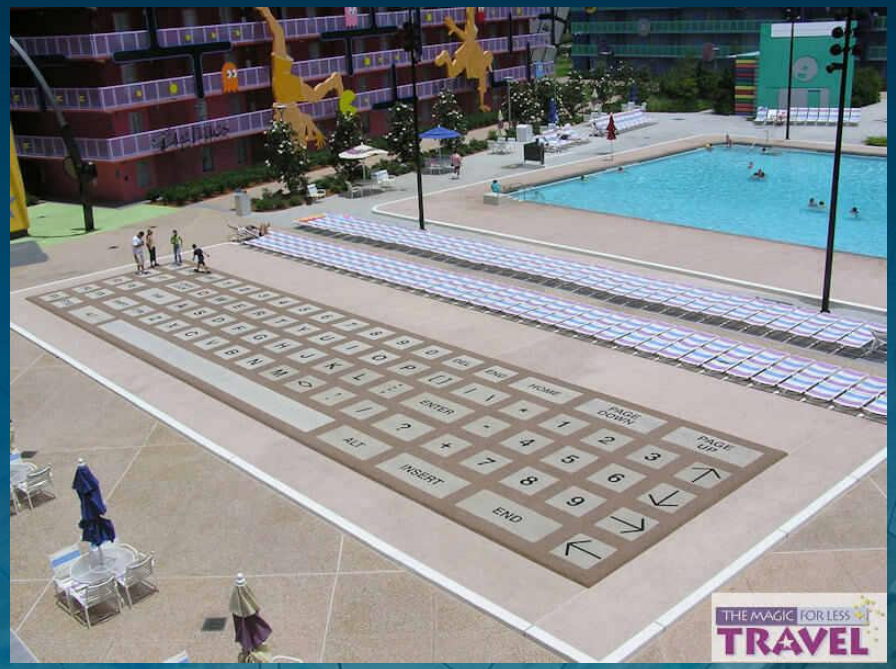
TUFLOW
Into the Future

BMT WBM Software Business Unit

- More autonomy on resourcing and financial reporting
- Delivery of software and support less influenced by consulting deadlines
- Greater resourcing directed to market research and marketing
- Focus on developing technical "geeky" tools unchanged – that's what we're about!
- Better prioritisation of tasks
- Facilitate branching into new areas
- Nearly all technical staff will still be involved in consulting projects
  - Essential to software being useful!



Staff

- Bill Syme – Manager
- Chris Huxley – market research/strategy, branding, web delivery
- Phil Ryan and Mitchel Smith – TUFLOW Classic
- Ian Teakle and Matt Barnes – TUFLOW FV
- Mat Roberts and Stephanie Dufour to lead UK Sales/Support
- ~ 6 other engineers/scientists coding and support services
- Sandy Thompson and others for licensing, accounts and admin

Integration of Products

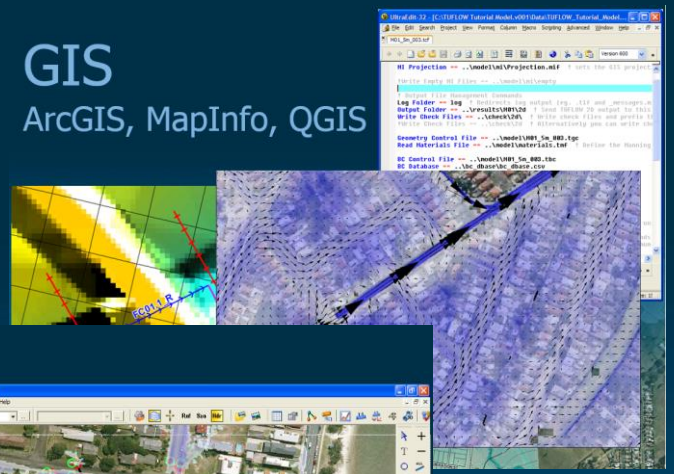
- Greater integration of engines
- TUFLOW Classic's 1D Solver (ESTRY) linked with GPU Solver
  - High resolution modelling of urban areas with pipe networks
  - Virtual Pipes feature stepping stone to achieve this
- 1D Solver also to be linked into TUFLOW FV
  - Flexible mesh modelling of fluvial and surface water
- TUFLOW FV engine on to GPU
- One TUFLOW.exe for all

Other Major R&D

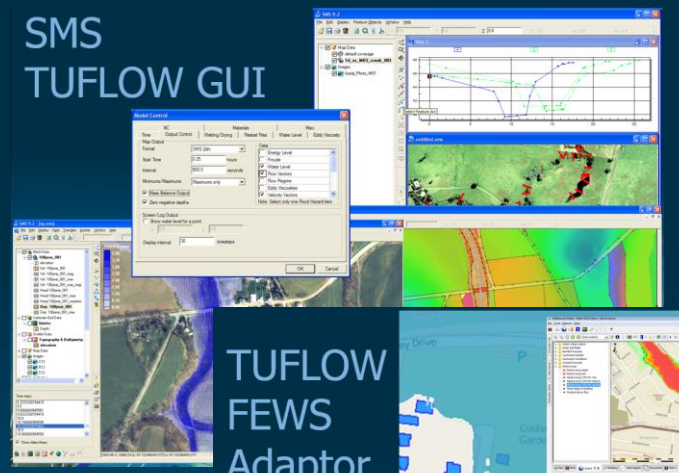
- TUFLOW GPU 2nd Order Solver
- FV Morphologic Module into Classic
- TUFLOW Classic parallelisation and on Linux
- Continued development of miTools, QGIS Plugins and ArcGIS tools
- Incorporation of GDAL GIS libraries
  - Support wide range of GIS formats and on-the-fly projection transformations
- 1D Bridge Losses
- Plus 100+ minor R&D tasks on The List!

TUFLOW Wrappers

GIS
ArcGIS, MapInfo, QGIS

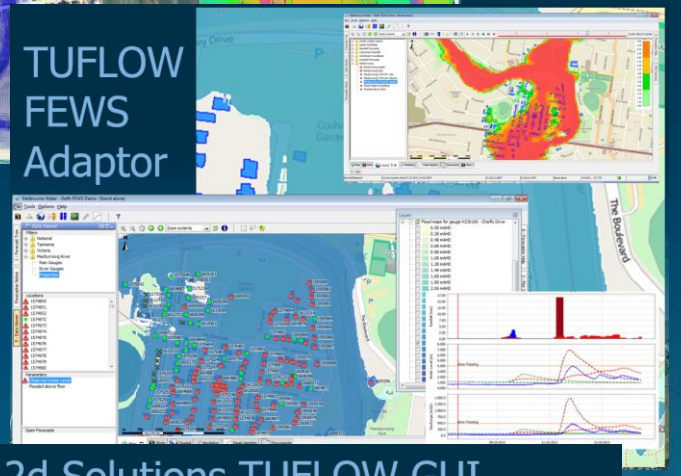


SMS
TUFLOW GUI

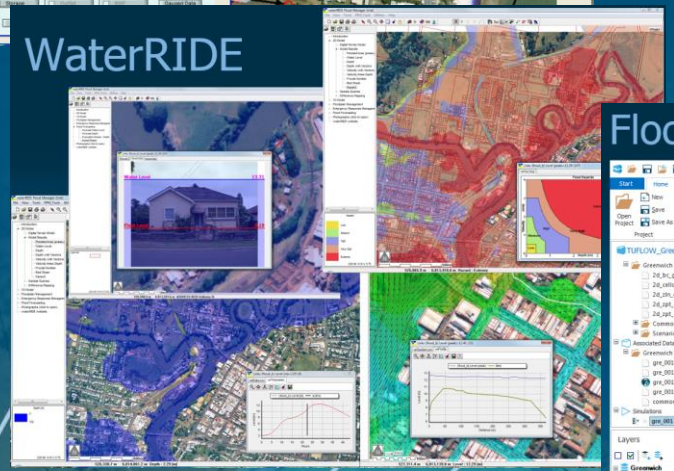


XP-2D GUI

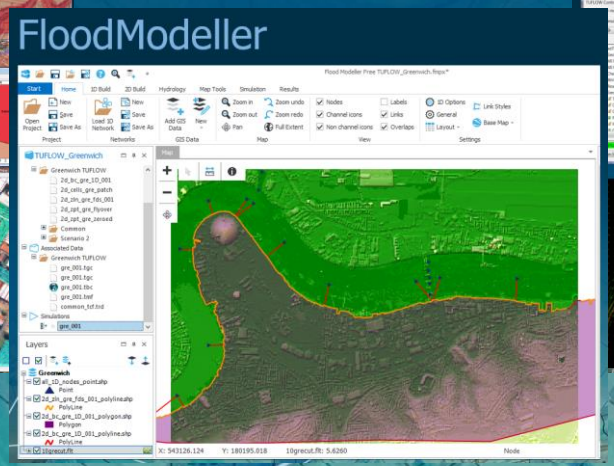
TUFLOW FEWS Adaptor



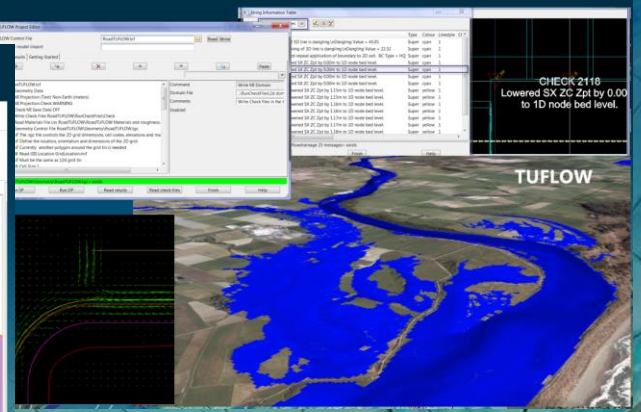
WaterRIDE



FloodModeller



12d Solutions TUFLOW GUI

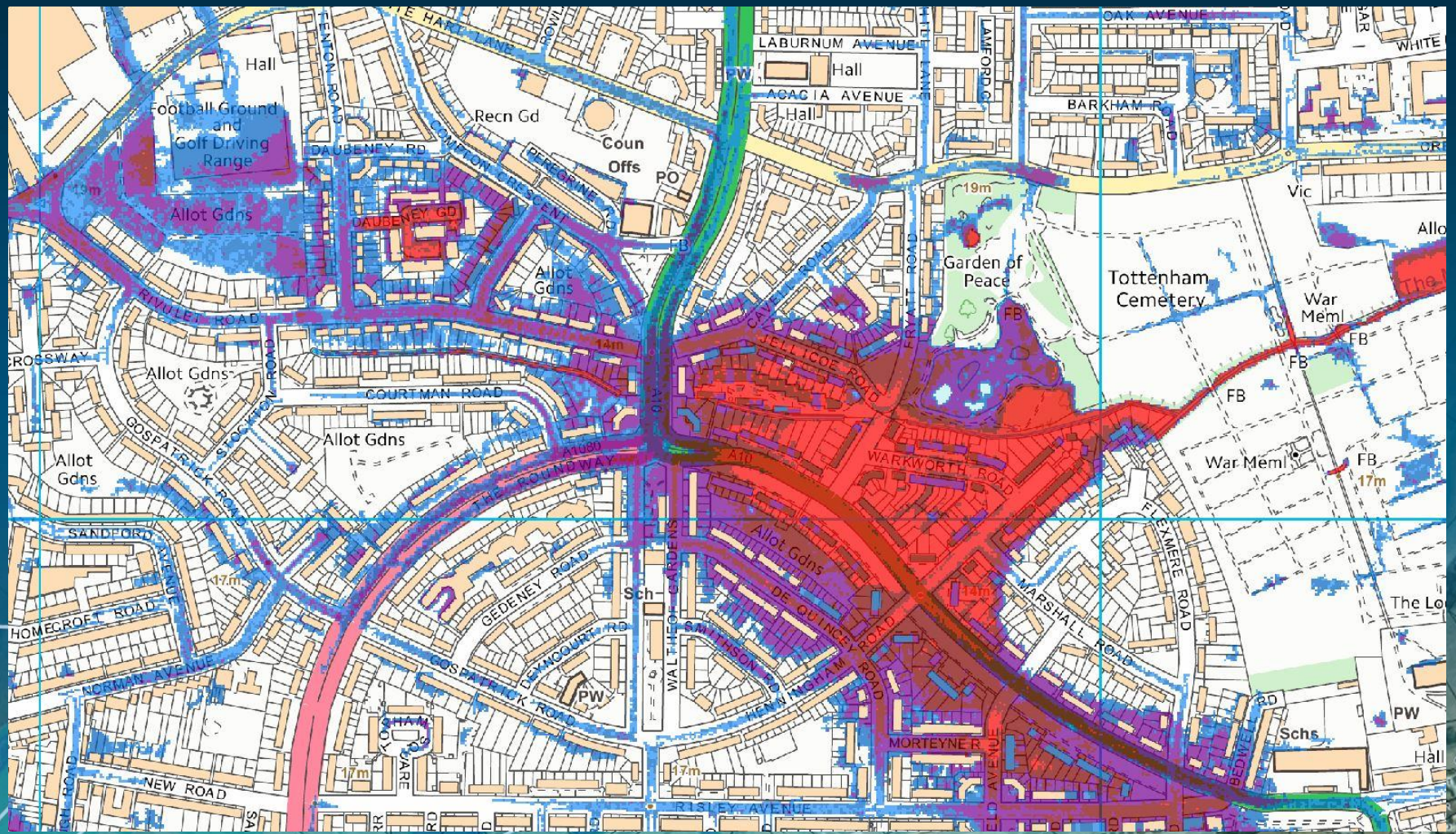


Licensing and SaaS

- Subscription (annual) service
- Cloud licensing
- Software as a Service (Cloud simulations)
- Looking into making 2015 Classic Release free for small models

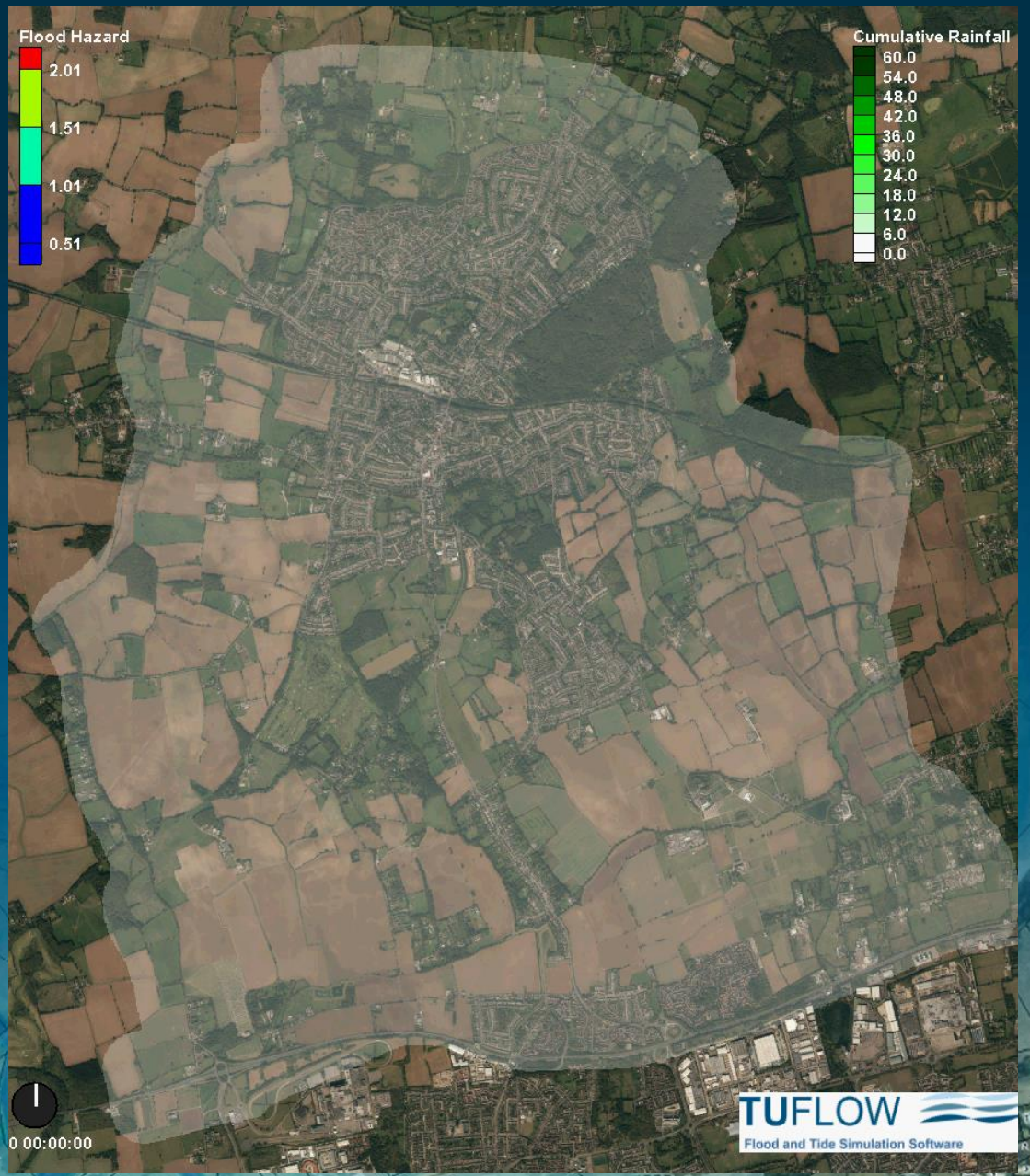
TUFLOW GPU Urban Pipe Modelling

- Heading towards cell sizes of 0.1 to 0.5m
- Suits shallow urbanised areas
- Virtual pipes or full pipe networks
- Needs high quality DEM



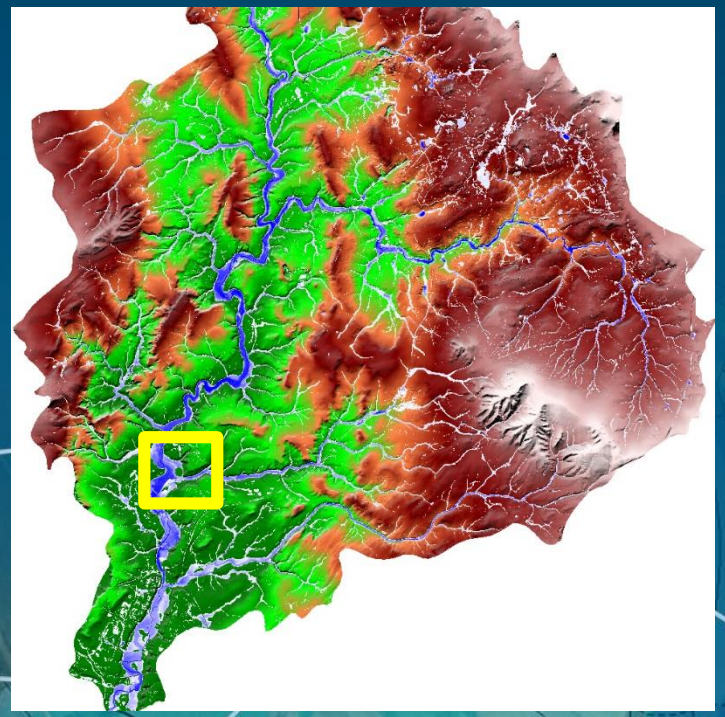
Flood Forecasting

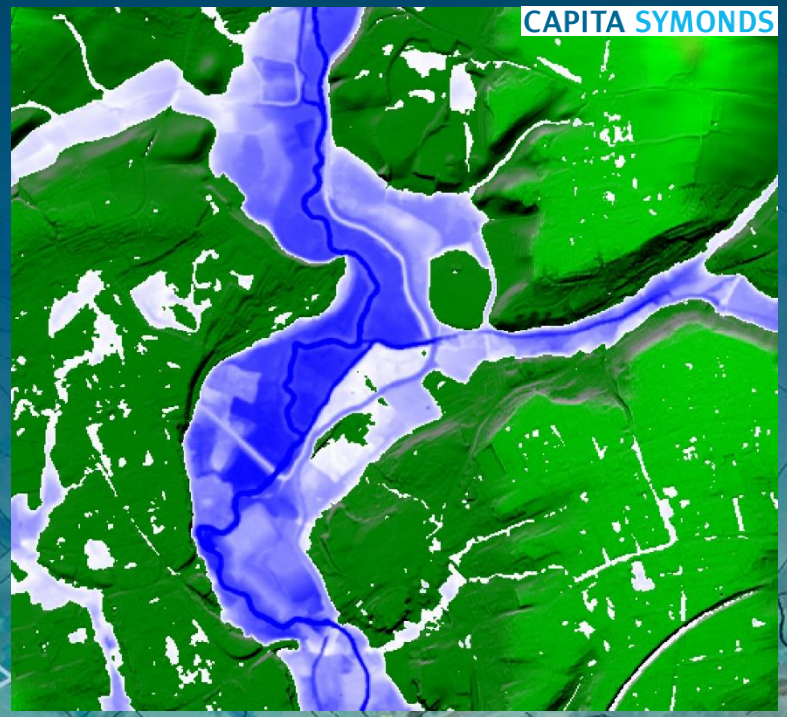
- Time varying rainfall grids
  - Interpolated from gauges
  - Radar imagery
  - Meteorological Forecasts
- Together with GPU solver opportunities for 2D flood forecasting



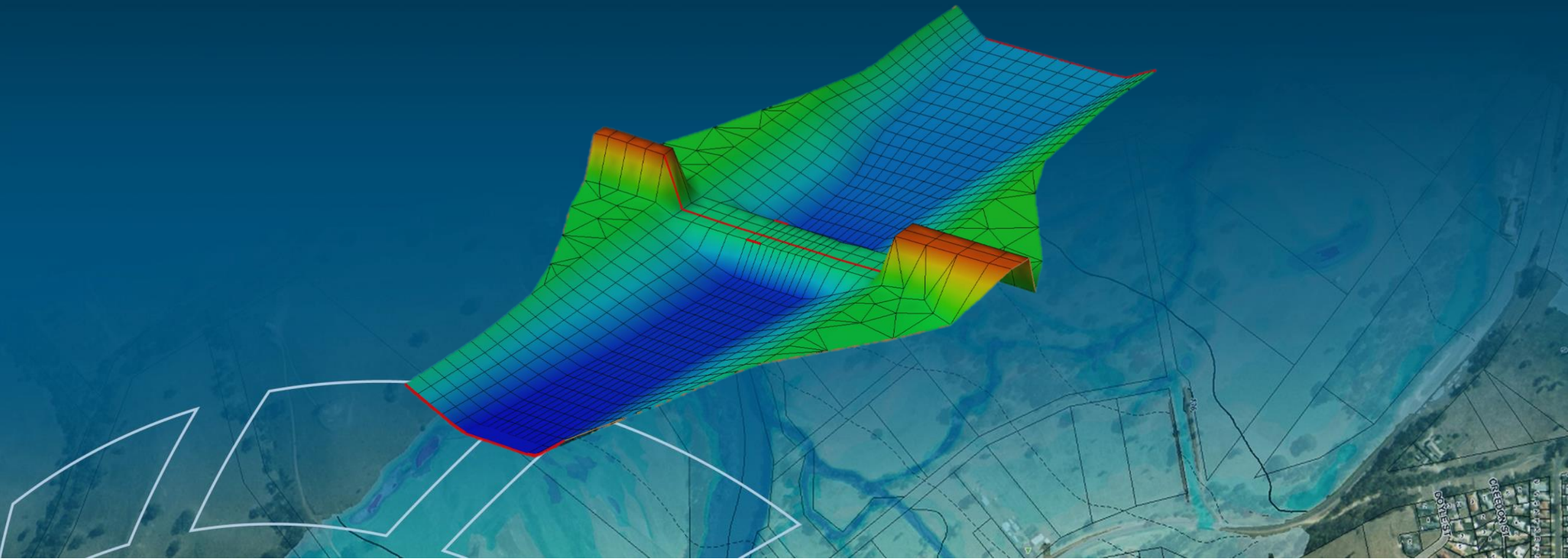
Is 2D Direct Rainfall Modelling the Next Approach to Hydrologic Modelling?

- DEM + Rain + Land-use + Soils = Pretty Flood Map, but is it representative of reality!
- Is the rate of runoff, the timing of the hydrographs, realistic?
- Is infiltration well represented?
- TUFLOW Classic/GPU can do all of the above, but don't treat it as a "black box"
- Need research, real-world calibrations, benchmarking, guidelines…





TUFLOW FV
Flexible Mesh Solver



BMT WBM

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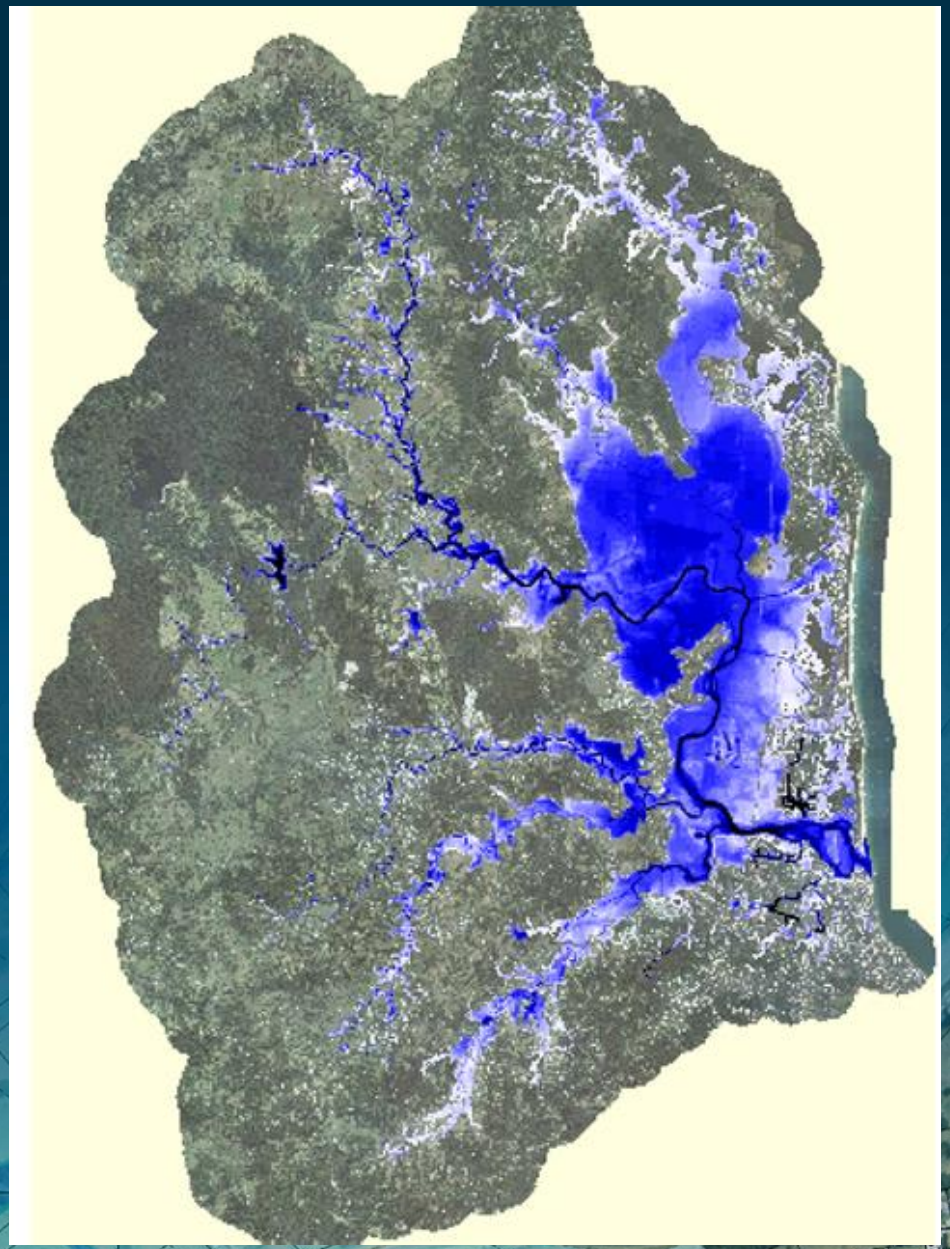
TUFLOW FV

- 2D/3D NLSWE solver
- Finite Volume Scheme
- Flexible Mesh
  (Triangles and Quads)
- Adaptive time stepping
- Parallelised Scheme
- 1st and 2nd order schemes

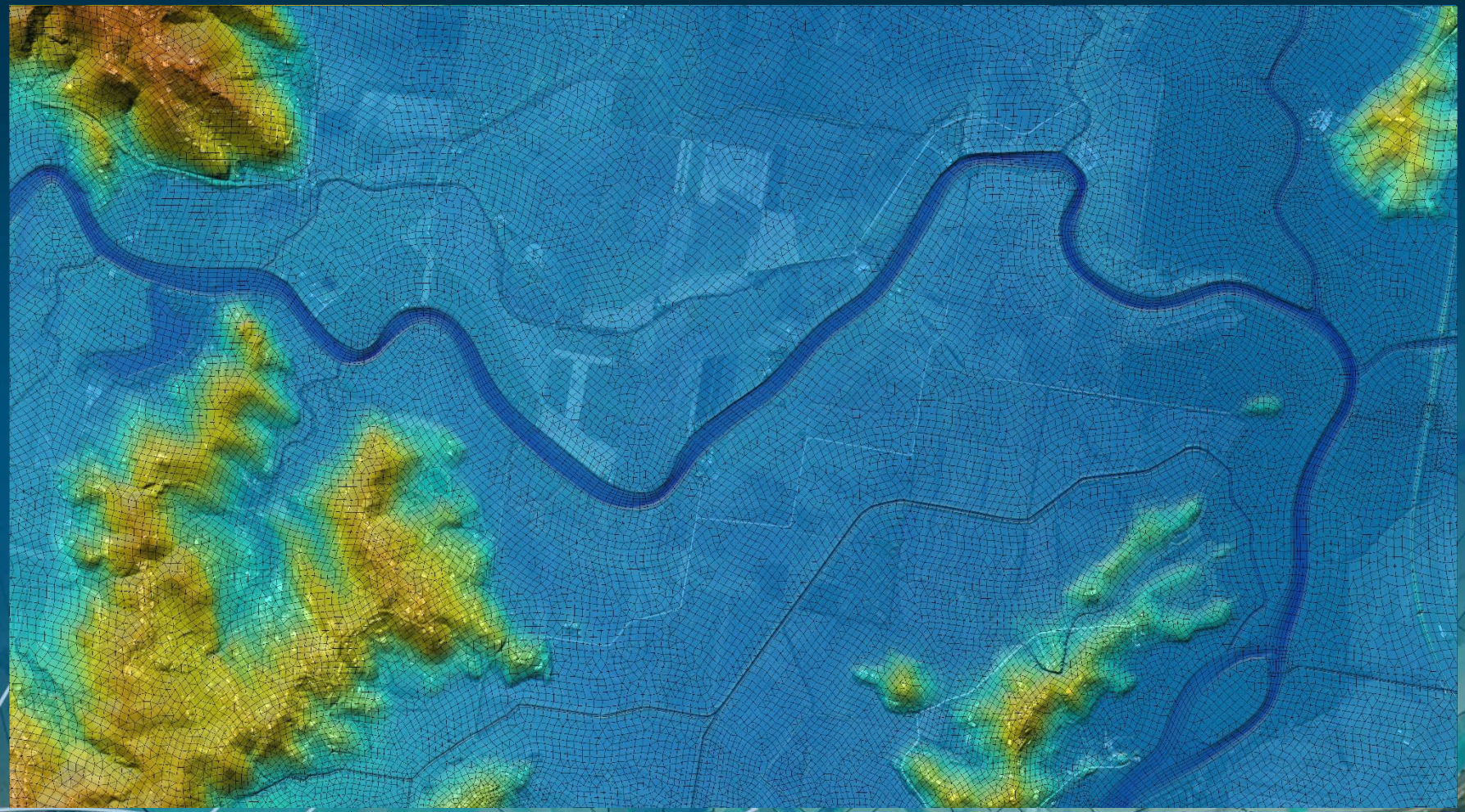
- Advection-Diffusion Module
- 3D Baroclinic Module
- Integrated Atmospheric Heat Module
- Sediment and Morphology Module
- Water Quality Module
- Similar interface to TUFLOW Classic

TUFLOW FV
Maroochy River – Australia

- Modelling Overview
  - 630 km^2 catchment area
  - Single model consolidating 10 past fixed grid hydraulic models
  - 2 model versions:
    - Coarse = 900,000 cells
    - Refined = 2,300,000 cells
  - Calibrated to four historic events
    - 17 Time series height gauges
    - 40 Maximum height gauges
  - 300 Structures (bridges, culverts)

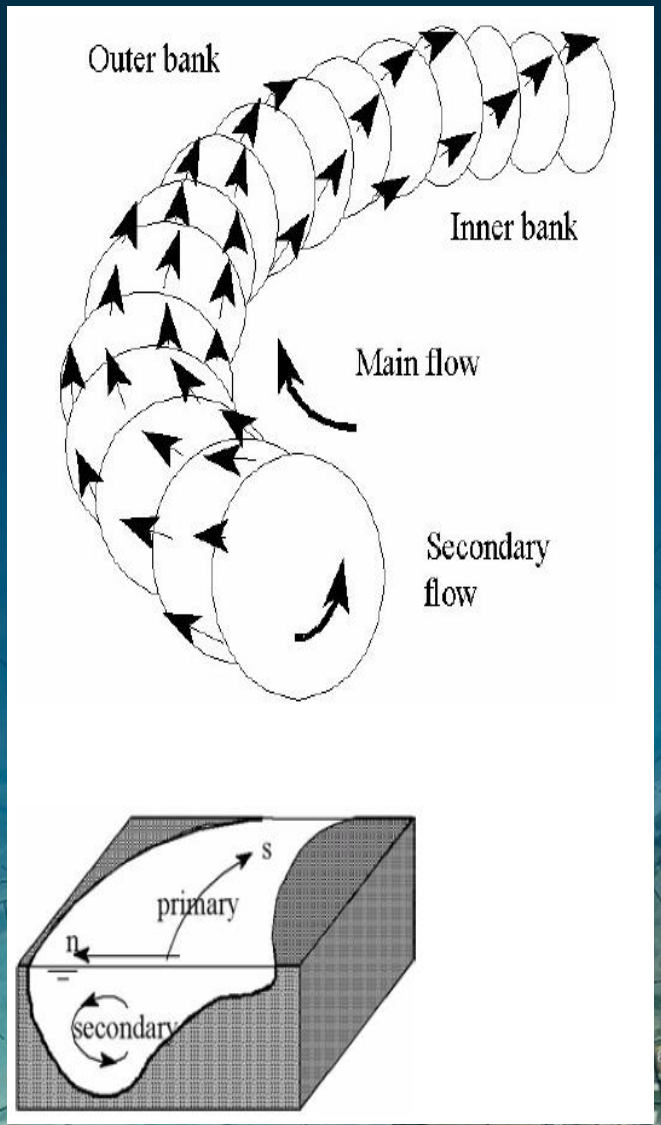


TUFLOW FV
Maroochy River Coarse Model Mesh

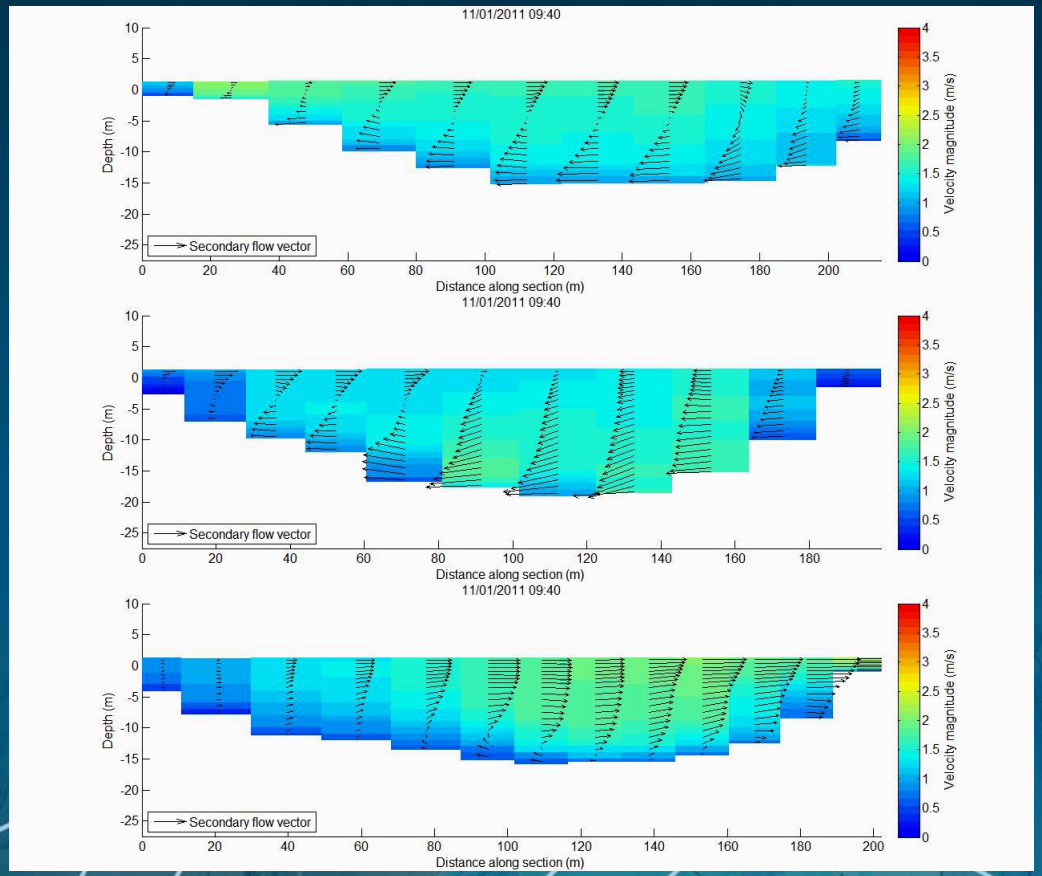


3D River Applications

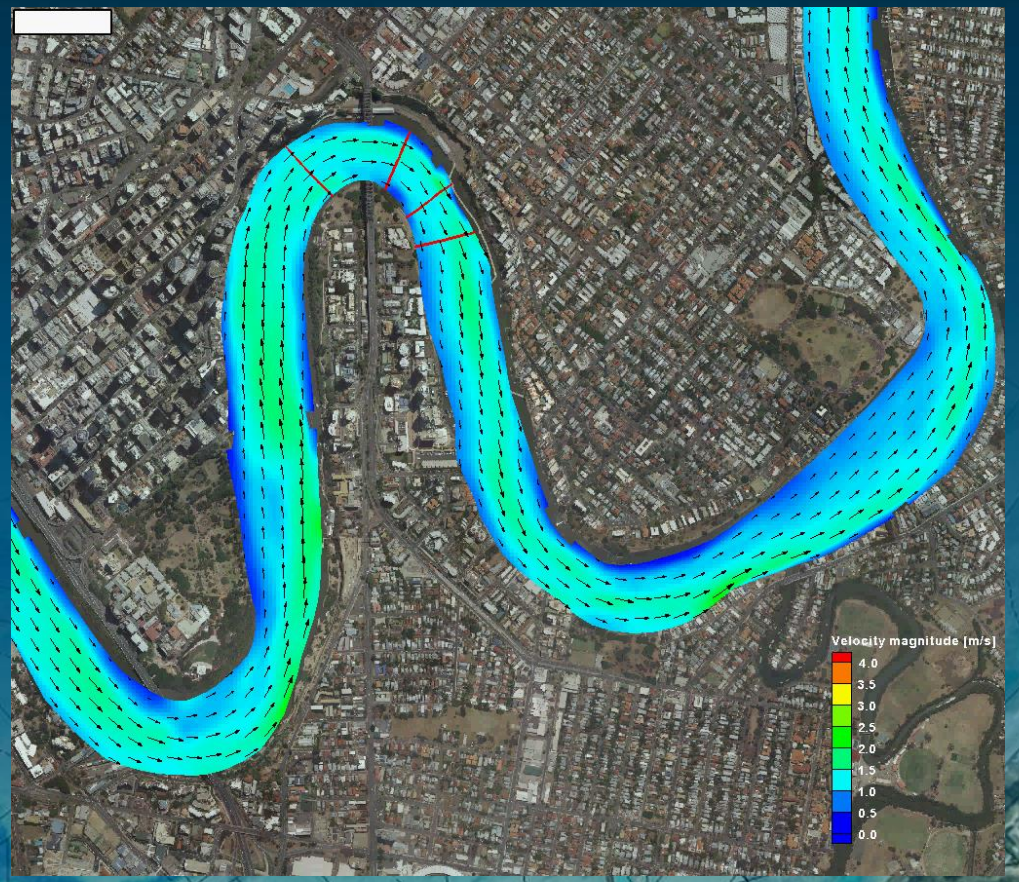
- **When might a 3D river model be required?**
- To resolve some secondary flow characteristics (e.g. helical flow through a river meander)
- To resolve vertical mixing of water constituents



TUFLOW FV - 3D Modelling



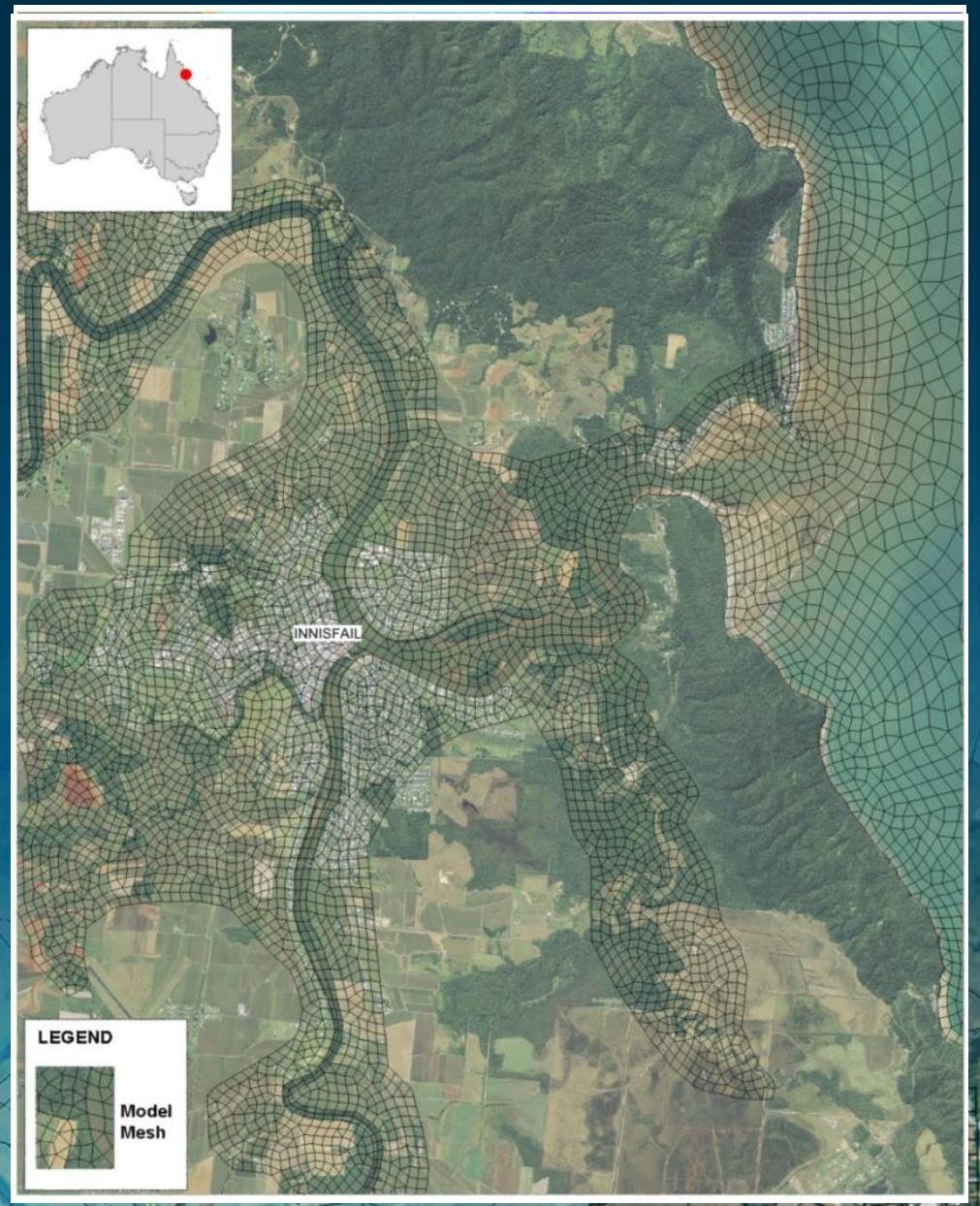
Transverse Velocity Direction



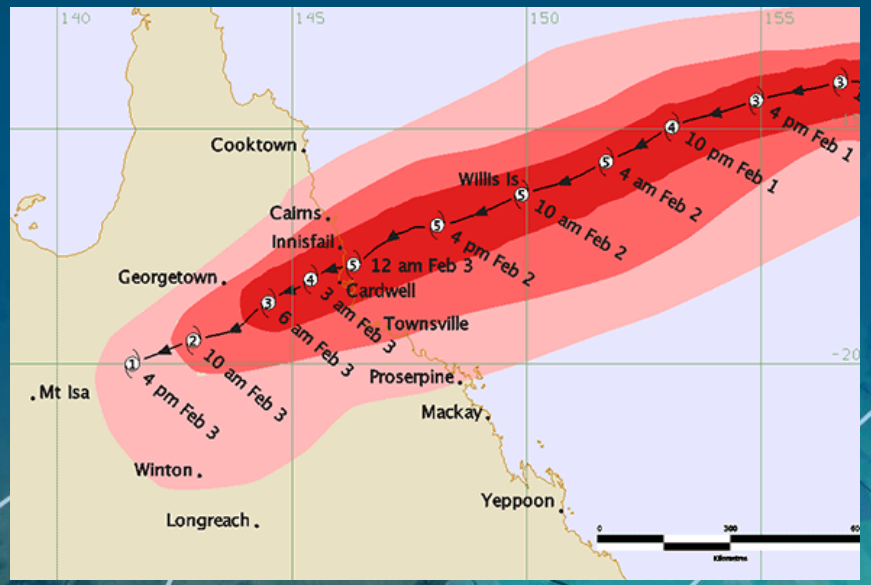
Depth Averaged Velocity

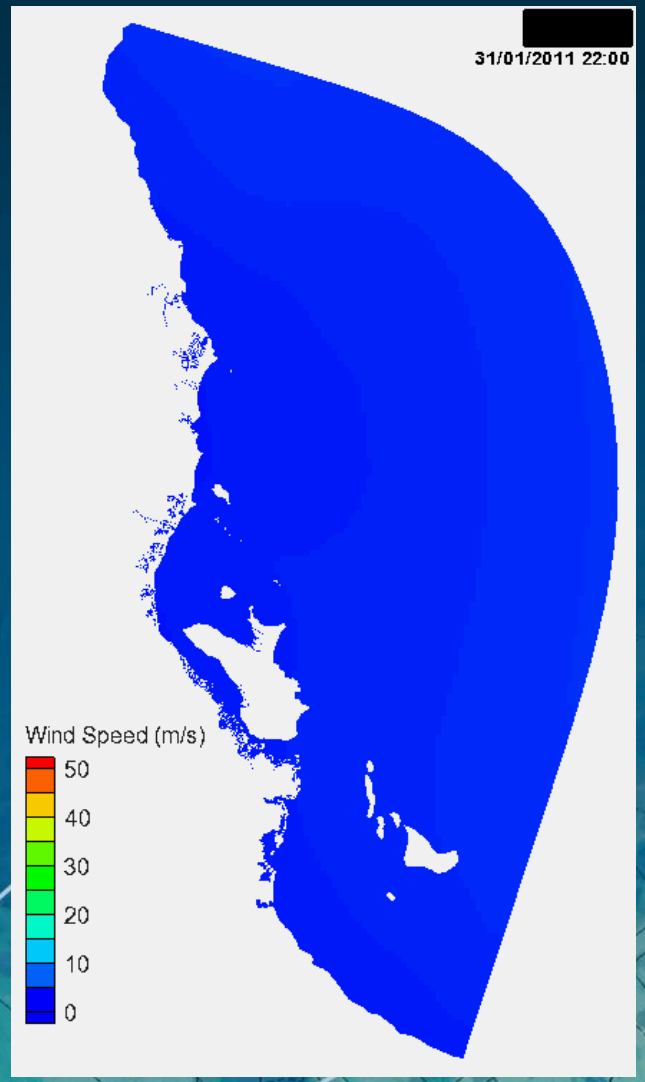
Tide & Surge Modelling

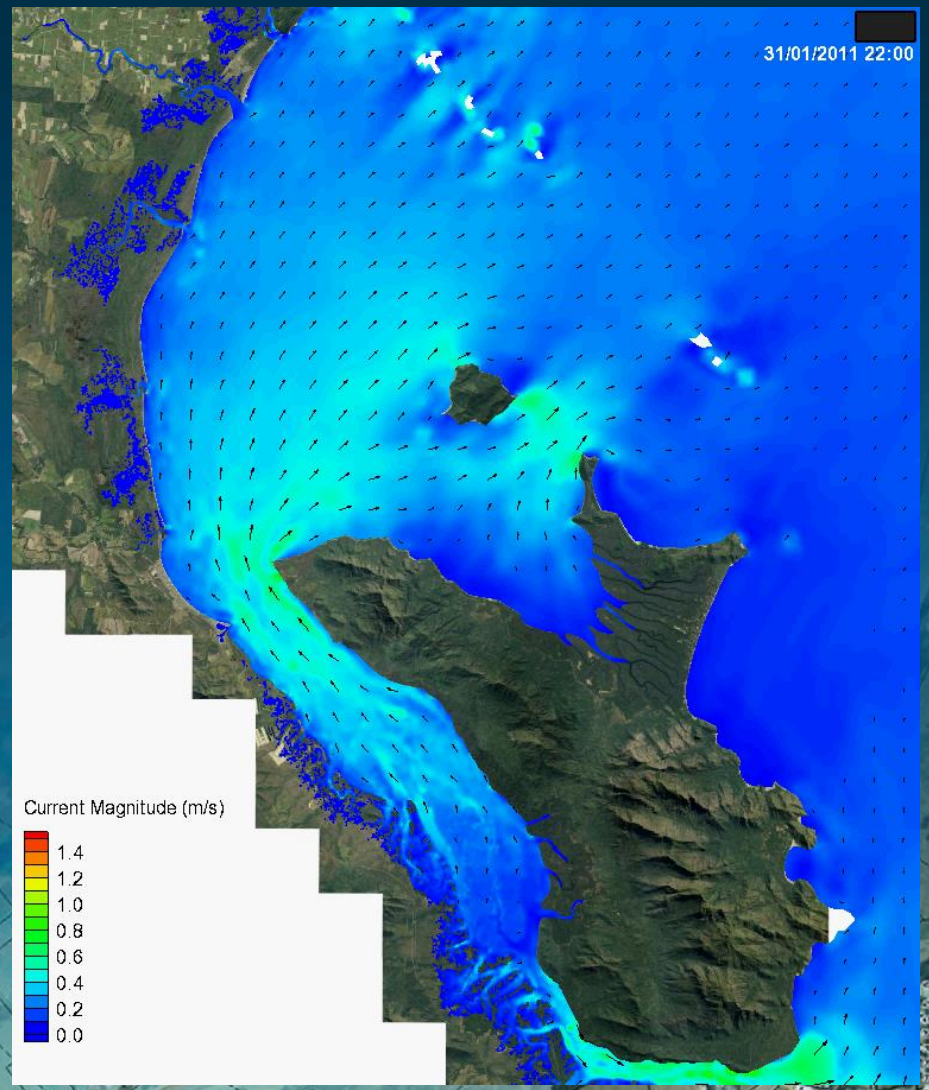
- Cassowary Coast (North Queensland)
- Coastal Inundation Hazard Study
- Tropical Cyclone Region
- TUFLOW FV Model of offshore waters, coastal floodplain, rivers and creeks
- Mesh size on floodplain <100m
- Forced by tide, wind and atmospheric pressure



Tropical Cyclone Yasi, February 2011

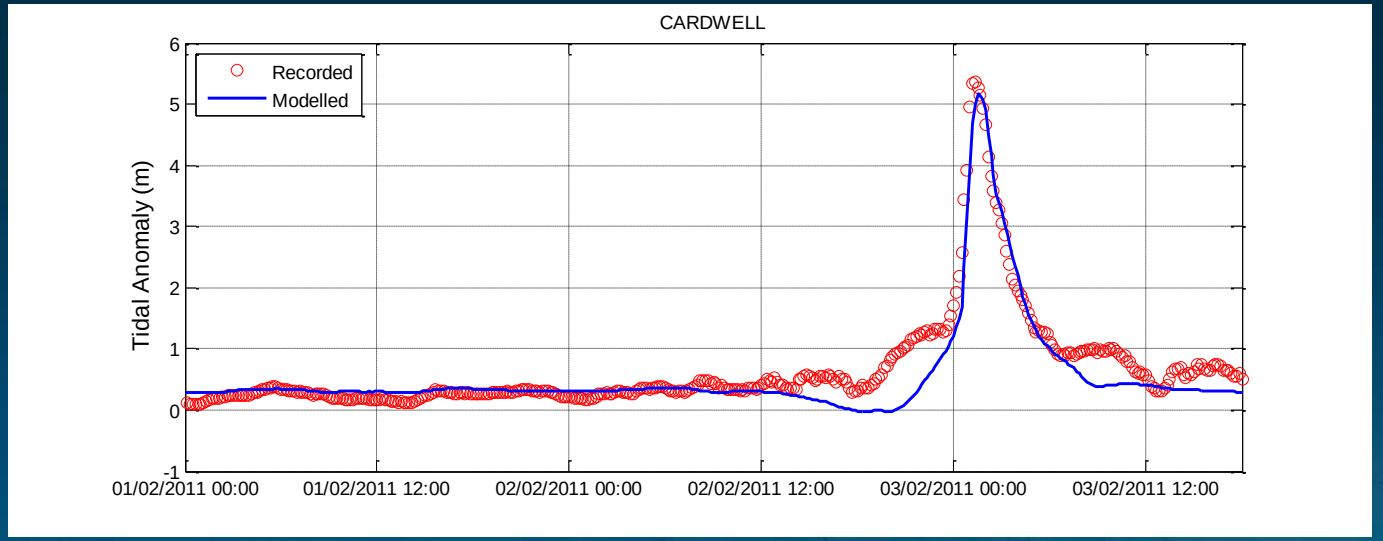




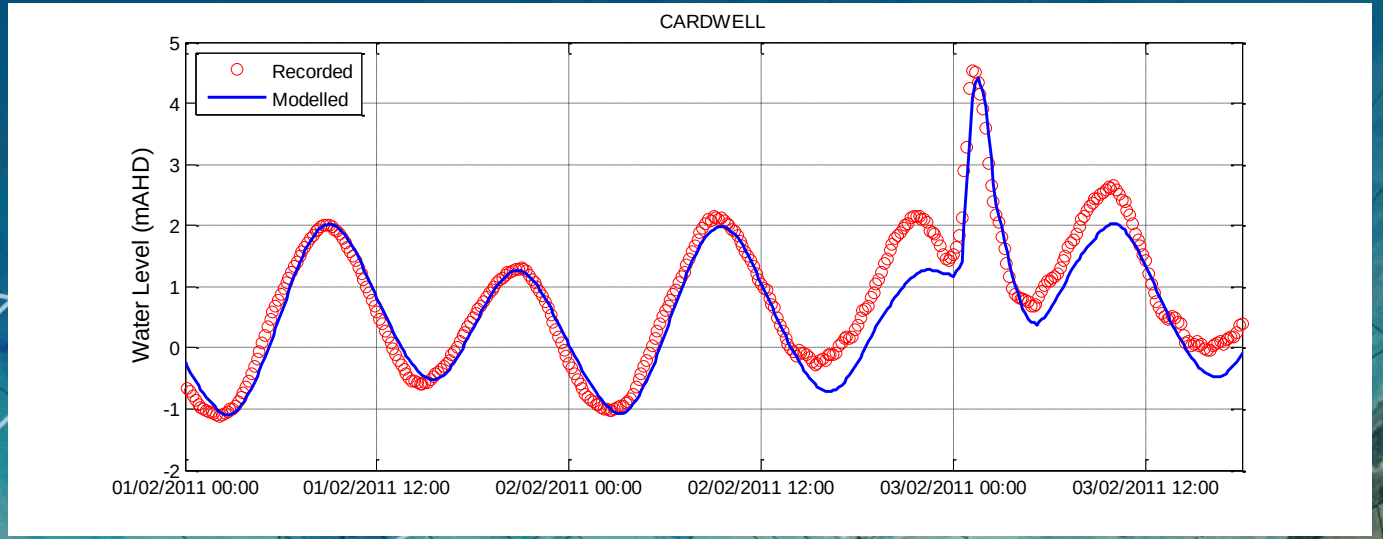


Tropical Cyclone Yasi, February 2011

- Tidal anomaly validation

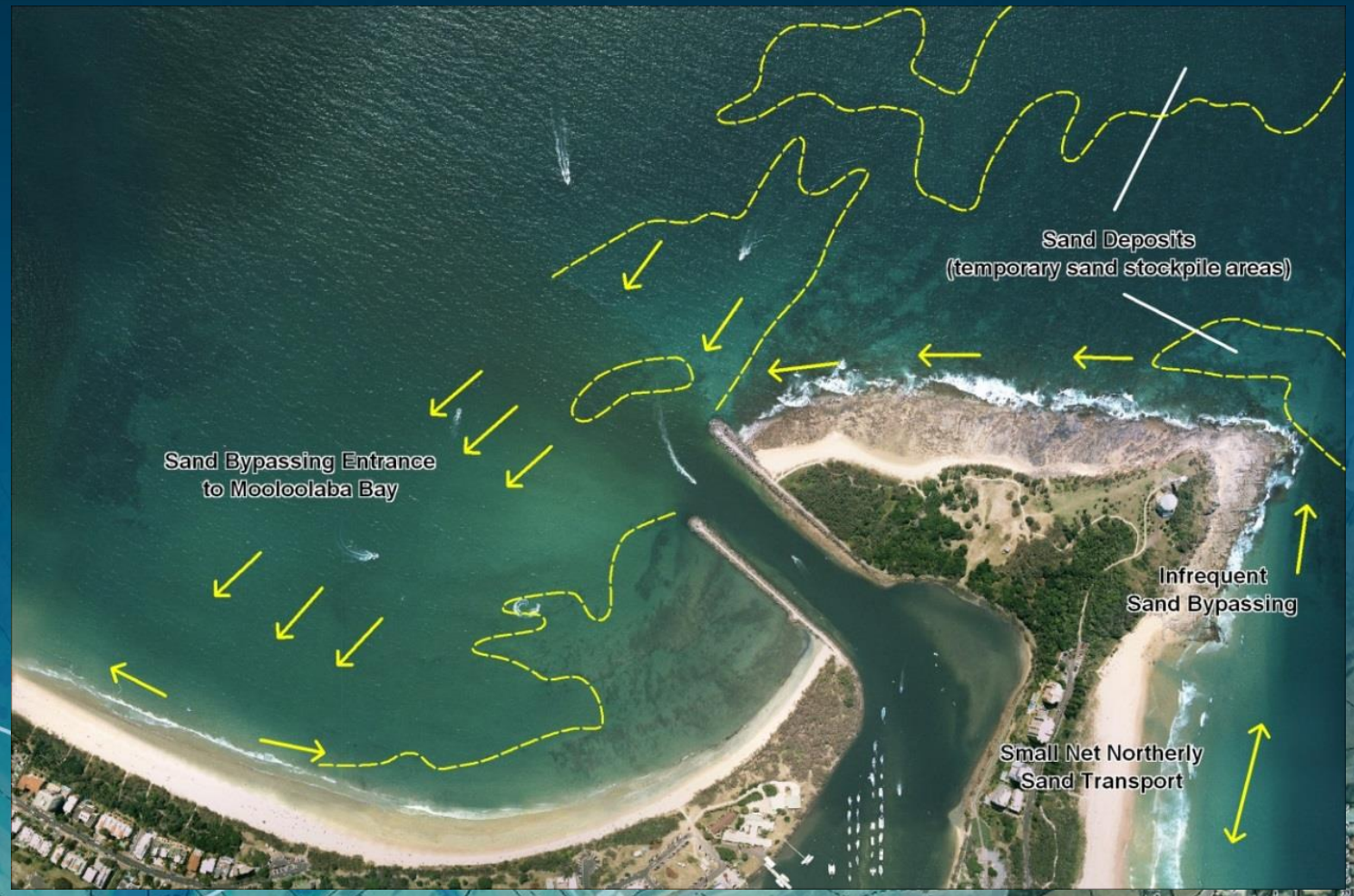


- Surge plus tide validation



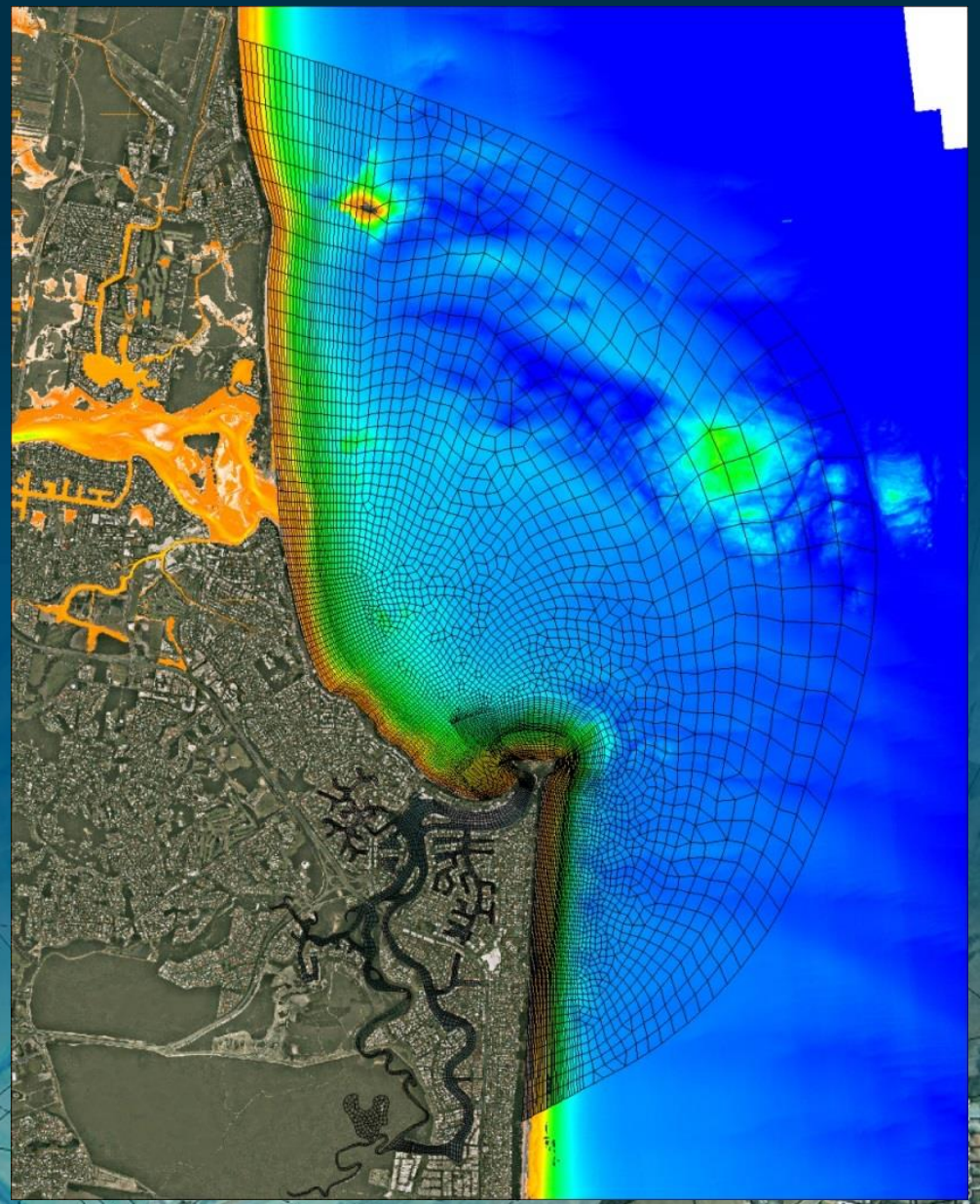
Mooloolaba Harbour Entrance

- Management of the entrance aims to maintain a channel to 3m below LAT
- At times, this objective is not met due to episodic shoaling events
- DTMR commissioned study to assess options to mitigate shoaling using TUFLOW FV



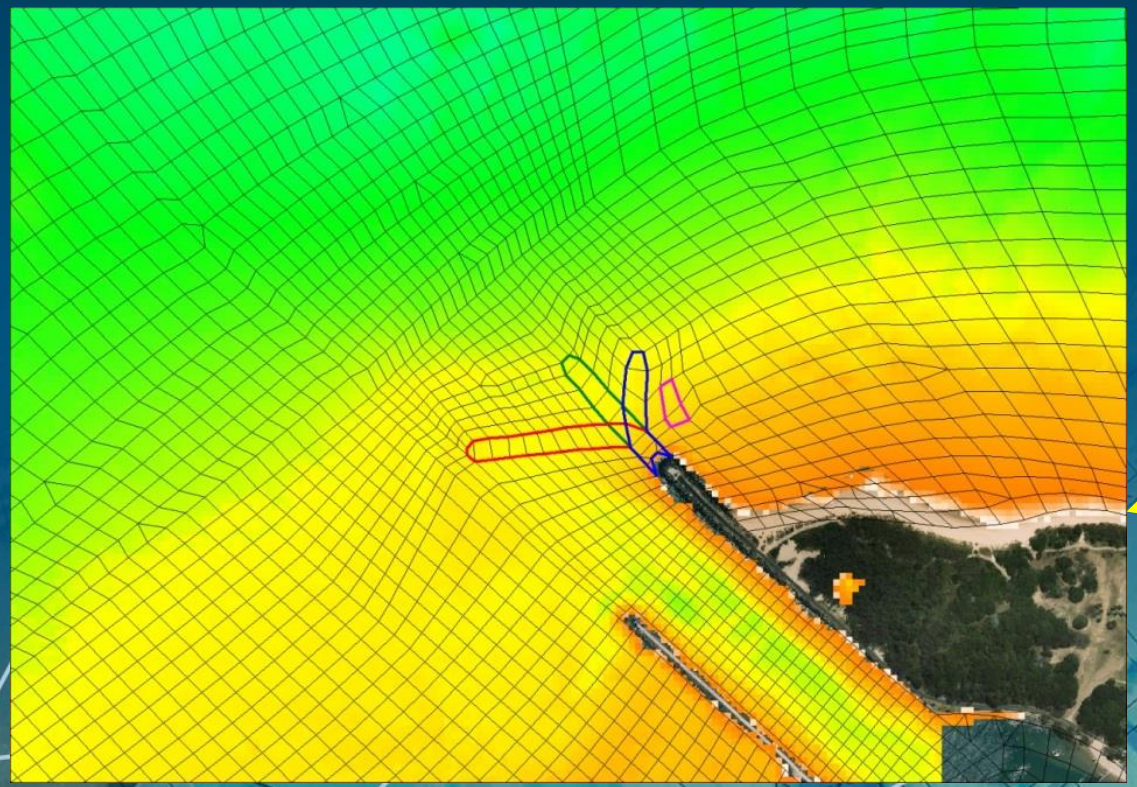
TUFLOW FV Model

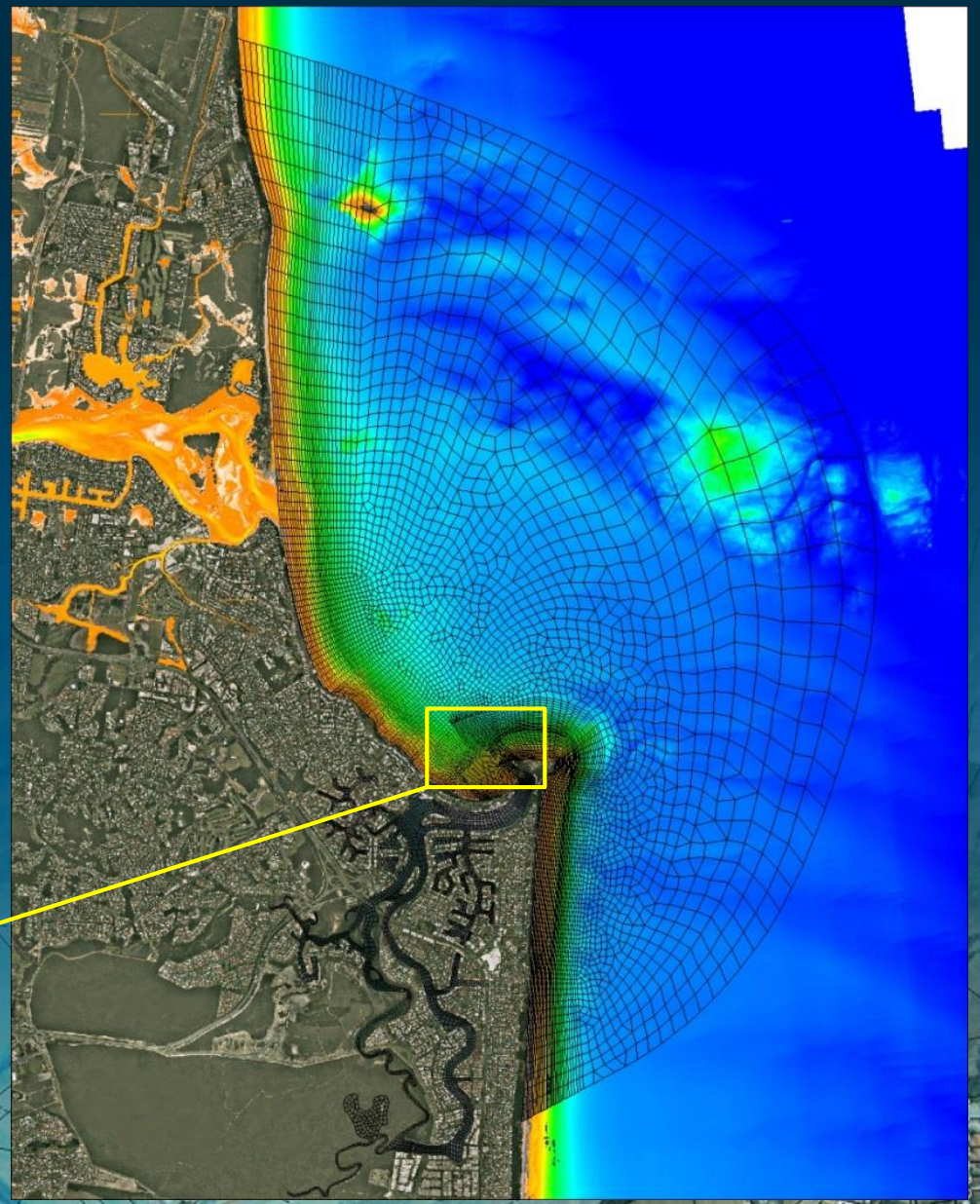
- Mesh details
  - 13,850 mesh elements
  - 500m^2 element size offshore
  - 10-15m^2 element size at entrance
- Boundary conditions:
  - Bathymetric LiDAR (Nov 2011)
  - Mooloolaba tide gauge offshore (15min lag applied)
  - Interpolated BOM winds
  - SWAN Sunshine Coast 100m grid
  - 2-way TUFLOW FV/SWAN coupling within 25m SWAN grid



TUFLOW FV Mesh

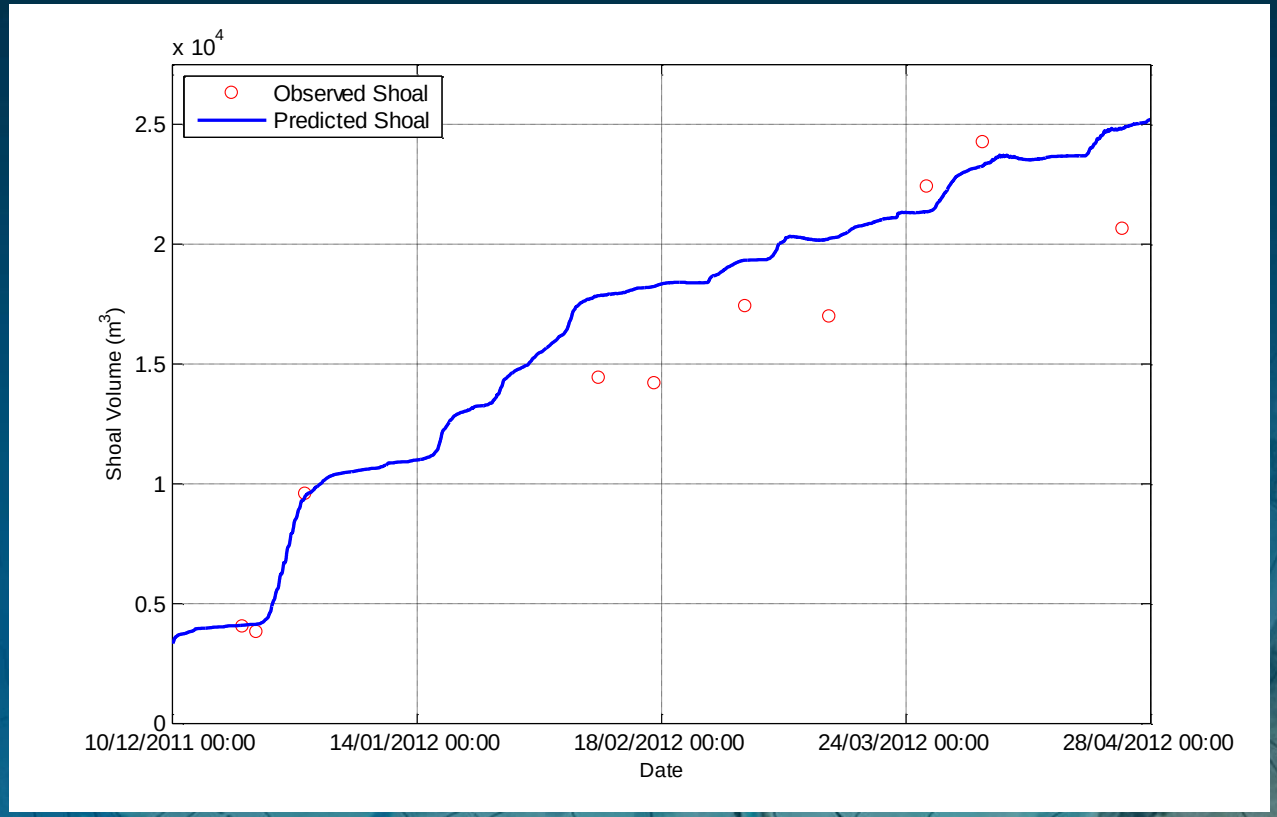
- 10-15m^2 elements in shoaling zone
- Incorporation of capital works options

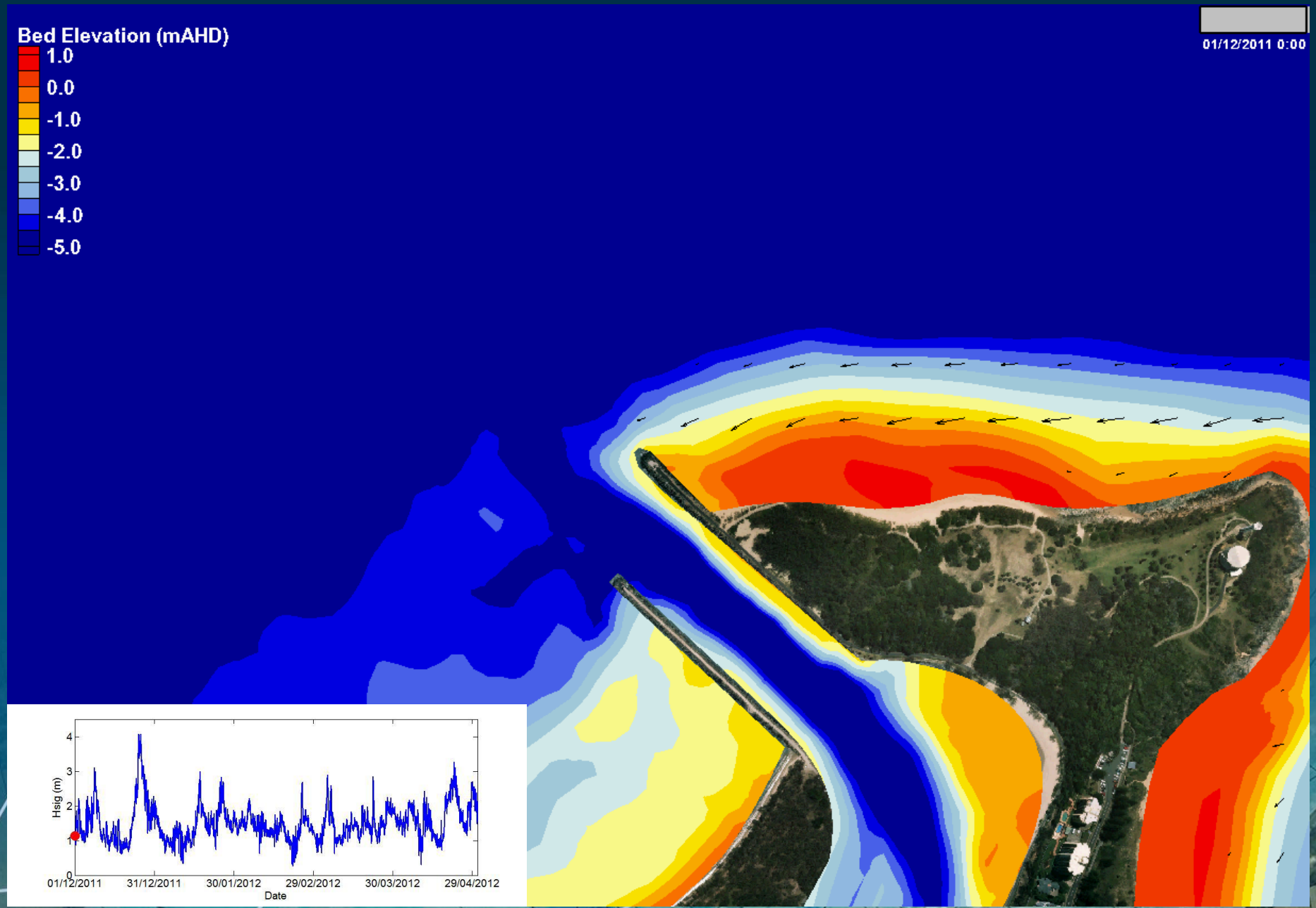




Shoal Event Model Validation

- Morphology modelling scenario
  - Period: 01/11/2011 – 01/05/2012 (key wave/shoal event late December 2011)
  - 2-way coupled wave forcing within vicinity of entrance
  - Wave boundary condition applied in far-field areas
  - Limited sand volume available (0.5m layer of sand above bedrock)
  - van Rijn sand transport scale parameters adjusted as part of the calibration process

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-2.0
-3.0
-4.0
-5.0
01/12/2011 0:00
Hsig (m)
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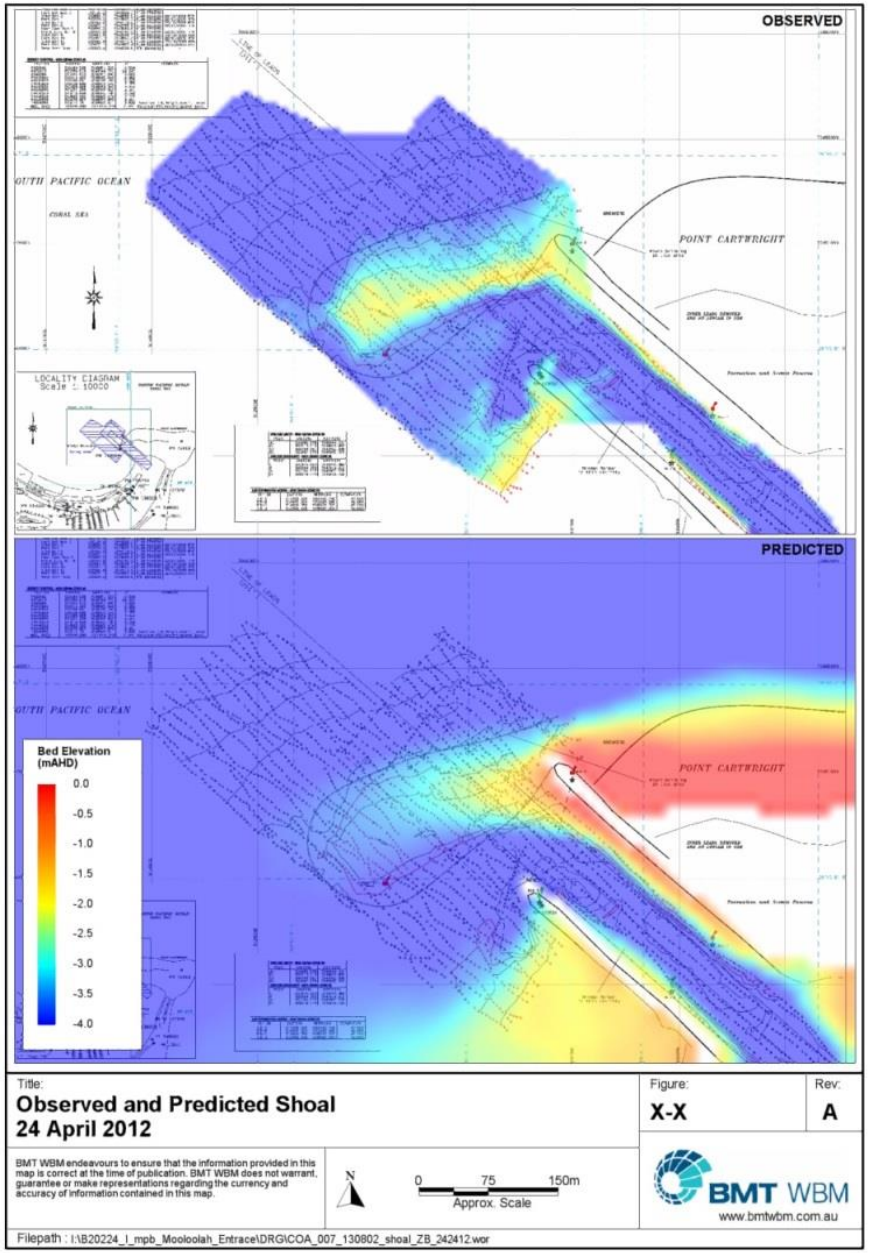
Date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POINT CARTWRIGHT
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Observed and Predicted Shoal 24 April 2012
Figure:
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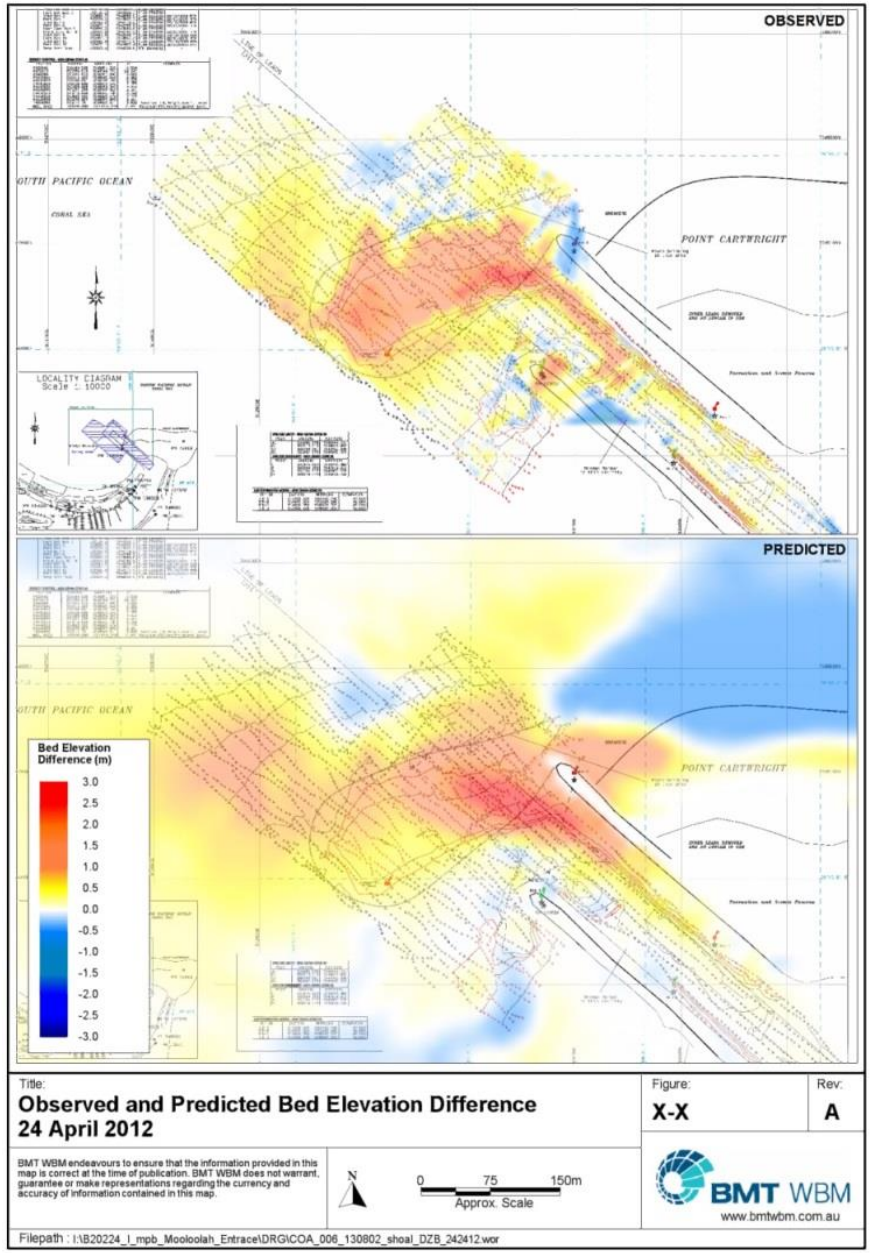
OBSERVED
PREDICTED
POINT CARTWRIGHT
Bed Elevation Difference (m)
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-3.0
Title:
Observed and Predicted Bed Elevation Difference 24 April 2012
Figure:
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Rev:
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BMT WBM endeavours to ensure that the information provided in this map is correct at the time of publication. BMT WBM does not warrant, guarantee or make representations regarding the currency and accuracy of information contained in this map.
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Wrapping-Up

- Continue to make bigger and better
- Focus on the engines, modules and interfacing with GIS and GUIs
- Software Business Unit is a plus, especially in terms of accessing resources

- Please keep sending those ideas through!

thank you