Use of 2D Flood Models for Flood Forecasting and Flood Intelligence

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Project summary

- Investigate use of 1D/2D and fully 2D hydrodynamic models for flood forecasting
- Develop a model adapter to run TUFlow models within Delft-FEWS
- Modify TUFlow to be able to run in a real-time environment and make the necessary adjustments to model parameters based on real-time data

```map
Map Output Format  ==  xmdf  nc
NetCDF Output Format  ==  FEWS
```

- Test the system on actual catchments
Why?

- Because its interesting!
- Fast hydrodynamic models have the potential for improving flood forecasts
- Spatial output from such models can assist with flood response operations (flood intelligence)
- Prior to now, use of 2D models for flood forecasting has had limited application, primarily due to simulation times and model stability
- Application of rainfall directly onto the 2D model area (direct rainfall modelling) is showing encouraging signs for operational use
Really fast hydraulic models…

- TUFLOW GPU is an engine for very high speed and stable floodplain simulations, it has been extensively benchmarked and is now being used to model large areas at high resolution

- Direct rainfall (DR) modelling eliminates the need for separate hydrologic models and also facilitates the application of gridded rainfall data for flood forecasting

- Ongoing research is required into use of appropriate surface roughness values for DR modelling. Use of depth varying surface roughness is likely to be more appropriate when using direct rainfall modelling
Time management in TUFLOW

- FEWS operates in UCT
- TUFLOW based on model time
- The TUFLOW pre adapter creates a ‘TUFLOW Read File’ containing model start time

```
Read file == ..\enoggera.trd
```

- TRD used by TUFLOW to assign UCT time to NetCDF outputs
- TRD used by TUFLOW post adapter to assign UCT time to scalar outputs

NetCDF Output Start Date == 2013-01-27 00:00:00
Workflow options

- **URBS**
  - Hydrology for all sub-catchments

- **TUFLLOW**
  - Observed runoff
  - Routed sub-catchment flows onto hydraulic model

- **URBS**
  - Hydrology for upstream inflows

- **TUFLLOW**
  - Routed flows into upstream extents of model
  - Rain-on-grid for hydraulic model extent

- **TUFLLOW**
  - Rain-on-grid hydraulic model of catchment
Pilot project – Enoggera Creek, Brisbane

- Brisbane urban creek, headwaters at Mount Nebo
- Steep upper reaches, flattening into floodplain passing Brisbane CBD
- Discharging into Brisbane River via Breakfast Creek
Pilot project – Enoggera Creek, Brisbane

- 9km² floodplain
- Reservoir for upstream boundary
- 15m grid resolution
- GPU hydraulic model – 13 mins to simulate 48 hour event

Feb 2015
Pilot project – Enoggera Creek, Brisbane

- 2008 event flash flood in upper catchment suburbs
  - no warning time
  - mostly road affected by flooding
- 2013 event modelled (TC Oswald) due to large outflow from Enoggera Reservoir
Comparison of hydrology and hydraulics
School Road, The Gap
Comparison of hydrology and hydraulics
Bennett Road, The Gap
Comparison of hydrology and hydraulics
Gresham Street, Ashgrove
Comparison of hydrology and hydraulics
Kelvin Grove Road, Kelvin Grove
Comparison of hydrology and hydraulics
Bowen Hills Road, Bowen Hills
Comparison of hydraulics and gauges
Mapping peak depths
Mapping depth time series
Mapping depth time series
Peak levels and level time series
Peak velocities and velocity time series
Max hazard and hazard time series
Time to peak / time of peak

- Provide a time component to the flood forecasts
- Allows responders to plan their response
- Improved efficiency for deployment of resources to where they are needed first
- Intelligence around when evacuation routes may close and re-open
Long section profile
Properties
Properties
What next?

- Further calibration and operational testing
- Modifications to the TUFLOW engine to enable:
  - Data assimilation
  - Error prediction
  - State and parameter updating
  - Ensemble forecasting
  - Communication of uncertainty
Thank you