# IMPROVING FLOOD FORECAST SKILL USING REMOTE SENSING DATA


**V. Pauwels[1], J. Walker[1], Y. Li[1], A. Wright[1], S. Grimaldi[1]**

[1]Monash University, Department of Civil Engineering, Clayton, VIC 3800


**THE USE OF REMOTE SENSING DATA IN OPERATIONAL FLOOD FORECASTING IS CURRENTLY RECEIVING INCREASING ATTENTION. THIS PROJECT INVESTIGATES THE USE OF REMOTELY SENSED SOIL MOISTURE AND FLOOD EXTENT/LEVEL TO IMPROVE HYDROLOGIC AND HYDRAULIC MODELLING, RESPECTIVELY. A SYSTEMATIC APPROACH WILL BE DEVELOPED TO OPTIMALLY USE THESE DATA FOR OPERATIONAL FLOOD FORECASTING.**

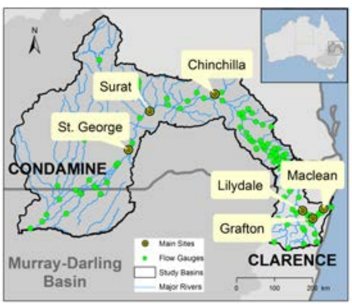
Floods are among the most common natural disasters in Australia, and cost the economy on average $377M per year. 1859 people have died in floods between 1900 and 2015 (*Haynes et al., 2016[1]*). In early June 2016, floods in East Australia and Tasmania claimed the lives of 5 people.

- Flood forecasting models are an essential tool in managing floods. They consist of a hydrologic model, forecasting the flow volume in the river system, and a hydraulic model, converting this flow volume into water levels and flood extents.
- Forecast inaccuracies are mainly due to errors and uncertainties in the rainfall data and the model structure and parameters.
- Satellite remote sensing (RS) can provide excellent data sets that should be used to constrain these models.
- In this project, RS soil moisture values will be used to constrain the hydrologic model; RS water levels and flood extents will be used to constrain the hydraulic model.

## STUDY SITES

The Clarence and the Condamine-Culgoa-Balonne (Fig. below) have been selected based on:

- the relevance of historical flood events;
- the availability of RS data of flood extent/water levels.

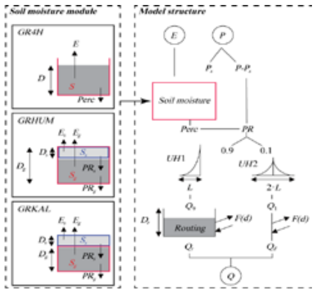



## HYDROLOGIC MODELLING (*GR MODELS)*

### Model comparison

The following three variants of GR (Génie Rural) models were initially investigated:

- GR4H with a bulk soil moisture (SM) layer;
- GRHUM with a bulk SM layer and a surface layer embedded;
- GRKAL with separated surface and root-zone SM layers.

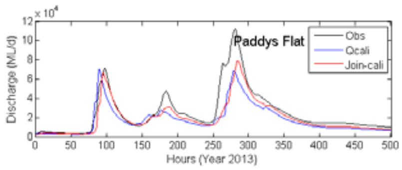



Due to the relatively good performance and ability to accept RS data, the GRKAL model has been chosen.

### Joint calibration

A semi-distributed forecasting system based on GRKAL and linear Muskingum routing is calibrated using either only discharge or both discharge and RS-SM in Clarence. The results indicate that:

- RS-SM can improve flow prediction in forecasting period (Fig. below);
- RS-SM has stronger impact in ungauged areas (Table below).

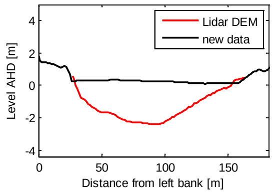


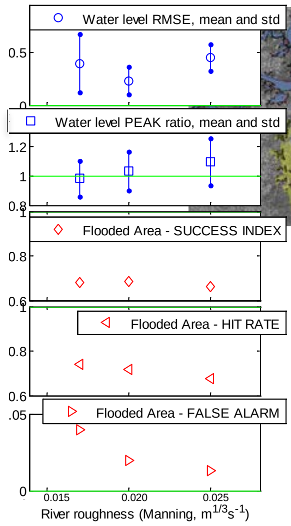

| NS | Sub1 | Sub2 | Sub3 | Sub4 | Sub5 | Out |
|---|---|---|---|---|---|---|
| Cal-Q | 0.57 | 0.41 | 0.43 | 0.59 | 0.65 | 0.83 |
| Cal-Joint | 0.64 | 0.43 | 0.61 | 0.54 | 0.67 | 0.80 |
| Val-Q | 0.55 | 0.45 | 0.49 | 0.58 | 0.63 | 0.74 |
| Val-Joint | 0.61 | 0.45 | 0.55 | 0.51 | 0.67 | 0.76 |

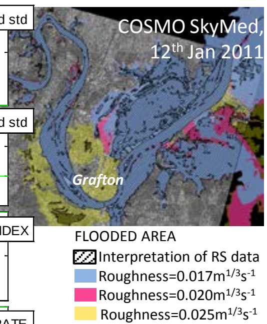
## HYDRAULIC MODELLING (*LISFLOOD – FP)*

### Clarence catchment

A field campaign was organized to complete the existing bathymetric dataset (20km).




***IN PROGRESS:***

Multi-objective calibration using gauged water levels, remote sensing data of flooded area (Fig. on the left, above).

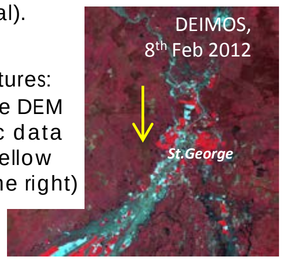
### Condamine-Balonne catchment

A field campaign was organized to measure the bathymetry of river reaches in strategic locations (13km in total).

***IN PROGRESS***

Analysis of critical features:

- Low accuracy of the DEM
- Lack of bathymetric data
- Levee breaches (yellow arrow in the Fig. on the right)





***REFERENCE:*** *[1]Haynes, K., Coates, L., Dimer de Oliveira, F., Gissing, A., Bird, D., van den Honert, R., Radford, D., D'Arcy, R, Smith, C. (2016). An analysis of human fatalities from floods in Australia 1900-2015. Report for the Bushfire and Natural Hazards CRC*