Improving flood forecast skill using remote sensing data

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This project investigates the use of remotely sensed soil moisture and inundation extent to improve the accuracy of operational flood forecast.

Worldwide, floods are considered to be one of the most devastating natural hazards.

Coupled hydrologic-hydraulic forecasting models are essential tools for real-time management of floods. Hydrologic models predict the volume of water in the river system; hydraulic models translate this volume into inundation extents and levels.

Uncertainties due to model structure, parameterization, and input data limit the effectiveness of model forecasts. Fortunately satellite remotely sensed (RS) soil moisture (SM) and flood extent/level can be used to skillfully improve hydrologic and hydraulic model forecasts.

STUDY SITES

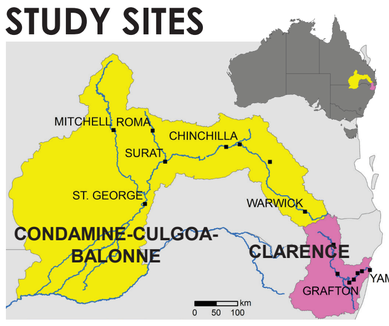

Fig 1. The catchments of the Clarence and Condamine-Culgoa-Balonne rivers which were affected by floods in 2011,2012, and 2013 are used as case studies

IMPROVING REMOTELY SENSED DERIVATIONS OF INUNDATION EXTENT

SAR data allow 24h, all-weather flood monitoring in any catchment.

An algorithm for the mapping of floods in areas with emerging vegetation is being developed.

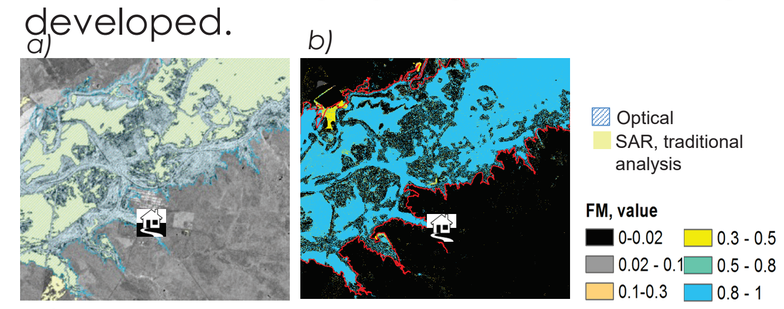

Fig 2 - a) SAR data, Surat area on Jan. 4th 2011. b) SAR-derived flood extent; FM: fuzzy membership to the flooded area. c) Performance metrics.

HYDROLOGIC MODELLING WITH GRKAL

MODEL CALIBRATION USING RS SM AND DISCHARGE MEASUREMENTS

In operational settings observation and model error structures are unknown and can limit the effectiveness of data assimilation routines.

A set of case studies were conducted in the study sites to determine the affect of joint calibration on streamflow simulations.

RESULTS

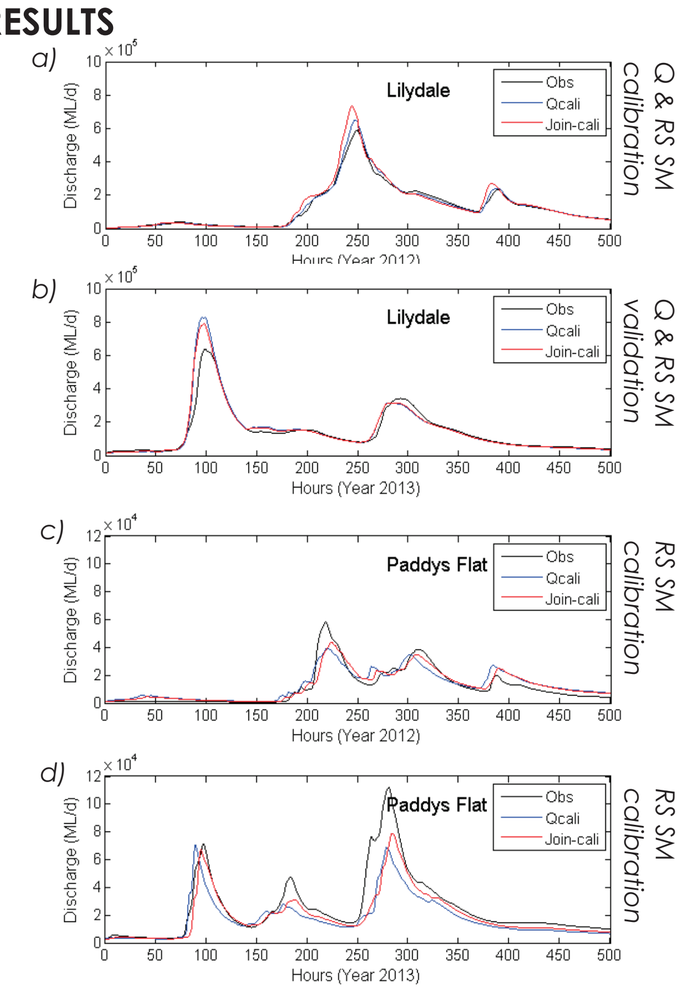

Fig 3 a) and b) Simulated catchment streamflow and c) and d) internal streamflow simulations

Both simulation of peak flow and simulation timing of discharge improves.

CONCLUSION FOR HYDROLOGICAL MODELLING

Joint calibration improves forecast skill at ungauged locations and does not significantly reduce skill at gauged locations

HYDRAULIC MODELLING WITH LISFLOOD-FP

USE OF RS-DERIVED OBSERVATIONS FOR MODEL VERIFICATION

The 2011 flood in the Clarence catchment was used as a case study to test the effectiveness of:

1) RS-derived flood extent, and
2) RS-derived wet/dry boundary points

for model constraint. Water level gauged data were used as benchmark dataset.

RESULTS

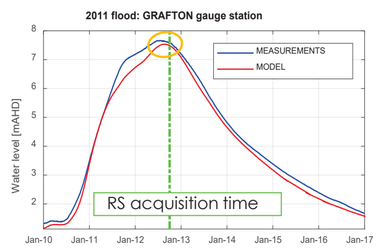

Fig 4 – Grafton: modelled and measured water level.

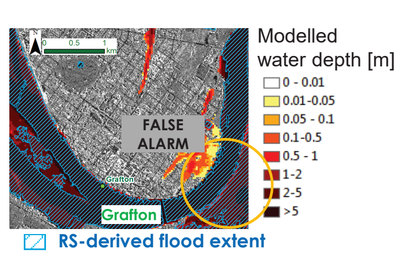

Fig 5 – Grafton: modelled and RS-derived flood extent.

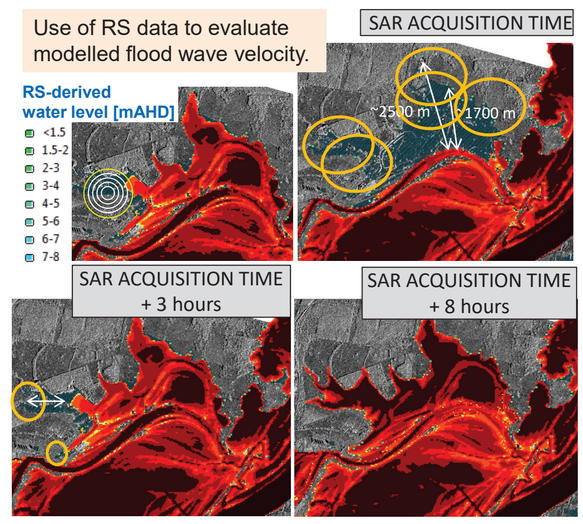

Fig 6 – RS-derived wet/dry boundary points at overpass time and modelled flood extent and depth at different times.

Despite a good agreement between modelled and gauged time series, comparison with RS-derived data revealed false alarm errors and delays in modelled flood wave arrival time

CONCLUSION FOR HYDRAULIC MODELLING

RS-derived information enable more comprehensive ways to constrain floodplain inundation models.

END-USERS STATEMENTS

"Recent flood events have shown the importance of flood forecasting to reducing damages to the community, and this research shows the potential of remote sensing to improve flood forecasting across Australia." – *Chris Leahy (Australian Bureau of Meteorology)*

"This project has developed an automated method to map flooded vegetation using single synthetic aperture radar acquisition and data products available for the whole of Australia. This is a valuable step towards routine use of all-weather satellite observation for flood monitoring in Australia." – *Fang Yuan (Geoscience Australia)*