IMPROVING FLOOD FORECASTING SKILL USING REMOTE SENSING DATA – *hydrological component*

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FLOOD FORECASTS SUFFER FROM VARIOUS SOURCES OF UNCERTAINTIES. THIS PROJECT INVESTIGATES THE BENEFIT OF USING REMOTELY SENSED SOIL MOISTURE DATA FOR HYDROLOGICAL MODEL CALIBRATION AND UPDATING. A REAL-TIME FORECASTING SYSTEM CONSTRAINED BY SOIL MOISTURE AND FLOW DATA IS BEING DEVELOPED.

INTRODUCTION

A timely and reliable forecast has great significance for warning delivery and emergency response. However, operational forecasting systems suffer from uncertainties in forcing data, initial conditions, model structure and parameters.

Flow measurements have been widely used to constrain the forecasting systems through calibration and data assimilation. Recent advances in remotely sensed soil moisture (RS-SM) products have a potential to further improve forecasting skills. This project aims to develop a real-time flood forecasting system constrained by RS-SM and discharge measurements.

MODEL

GR (Génie Rural) models have been chosen due to their satisfactory performance when applied in Australian catchments. The following three variants are compared initially.

- GR4H with a single soil moisture layer
- GRHUM with a surface and a bulk soil moisture layer
- GRKAL with a surface and a zoot-zone soil moisture layer

Fig. 1 shows the basic structure of the three models and the differences in soil moisture parameterization.

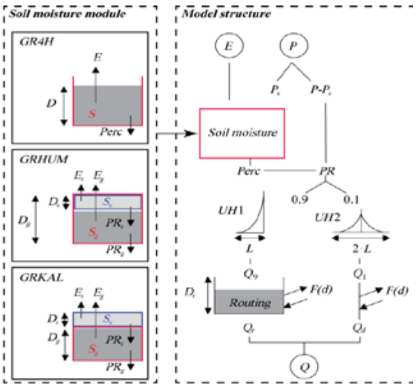

Fig. 1 The GR models

STUDY BASIN

The Clarence and Condamine-Culgoa-Balonne Basins have been selected for this study, as shown in Fig. 2.

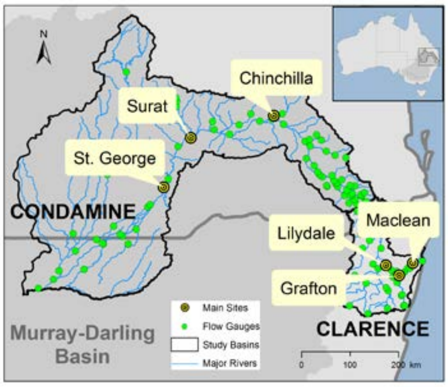

Fig. 2 Study basins

DATA

The following data have been used:

- Discharge from NSW and QLD Water,
- Gauge rainfall from BoM 2007-2014,
- PET from AWAP 5 km monthly archive,
- RS-SM from SMOS, AMSR-E/-2, ASCAT.

Fig. 3 illustrates the temporal coverages of the three RS-SM products.

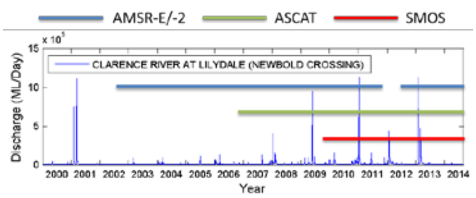

Fig. 3 Temporal coverage of SM products

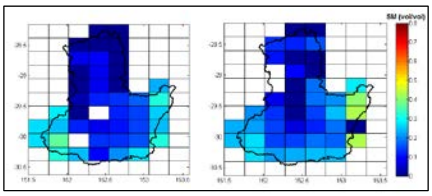

Fig. 4 SMOS soil moisture product

INITIAL ANALYSIS

The three models are calibrated from 1/1/2010 to 31/12/2012 using discharge data only. Then the models are evaluated from 1/1/2013-1/9/2014. The models exhibit similar forecasting skill in the calibration and validation periods (Table 1 and Fig. 5).

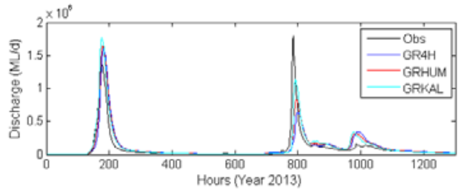

Fig. 5 Hindcasts based on discharge-only calibration (two events in 2013)

Table 1 Statistics of flow predictions

Statistics	NS	RMSE(m^3/s)	R^2
GR4H Cal.	0.78	2.3	0.79
GRHUM Cal.	0.79	2.2	0.83
GRKAL Cal.	**0.81**	**2.1**	**0.82**
GRKAL Cal-RS	**0.76**	**2.5**	**0.78**
GR4H Val.	0.70	3.5	0.77
GRHUM Val.	0.69	3.5	0.78
GRKAL Val.	**0.70**	**3.4**	**0.76**
GRKAL Val-RS	**0.71**	**3.2**	**0.76**

The GRKAL model is then calibrated through a multi-objective calibration scheme using SMOS RS-SM data (Fig. 4) and discharge. The result indicates that minimizing errors in SM degrades the accuracy of the flow prediction in the calibration period (Table 1). However, it leads to a slightly better forecast in forecasting periods (Table 1 and Fig. 6)

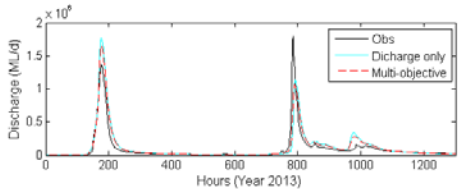

Fig. 6 Hindcasts based on two calibration schemes

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