FINDINGS

Remotely sensed data can improve flood forecasting capability in poorly gauged catchments

Improving flood forecast skill using remote sensing data

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Floods cause considerable socioeconomic damage worldwide. In the past 40 years the average annual cost of floods is estimated to be $377 million dollars. The Insurance Council of Australia have declared 823,560 Queensland homes to be unprepared for flooding. Water and emergency agencies use flood forecasting systems to limit the socio-economic exposure to floods.

Introduction

This project explored novel ways to combine remote sensing data and models to improve flood forecasting capability and skill. Flood forecast capability was improved by:

- Using remotely sensed soil moisture in a multi-objective calibration scheme for the hydrologic model,
- Using remote sensing-derived flood extent and waterline to calibrate the hydraulic model.

Methods

Hydrologic model: To assess flood forecast skill at internal sub-catchment locations, a traditional semi-distributed hydrologic model which is calibrated to the downstream flow gauges at Chinchilla and Lilydale respectively, is compared to a model which additionally calibrates internal sub-catchments to remotely sensed soil moisture observations.

Hydraulic model: The calibration framework aims at minimizing the discrepancies between modelled and remote sensing-derived flood extents and waterlines. Performance metrics that provide a quantitative evaluation of the accuracy of the modelled floodplain inundation dynamics were used. The 2011 and 2013 floods in the Clarence catchment were used as test cases.

Results

Hydrologic model: The results from Li et al. (2018) demonstrate that semi-distributed hydrologic models which use remotely sensed soil moisture observations are significantly more able to forecast streamflow at internal sub-catchment locations.

Hydraulic model: The remote sensing-based calibration framework determined a spatially distributed parameter set for both the flood events. Gauged data were used as an independent validation dataset and the remote sensing-derived spatially distributed parameters led to Nash Sutcliffe values consistently higher than 0.75.

Discussion

Hydrologic model: It is not uncommon for significant flooding to occur upstream of in-situ streamflow gauges. Further, installing additional gauges at these locations is not always feasible. The ability to use remotely sensed soil moisture to improve streamflow forecast skill at these locations had wide-reaching impacts.

Hydraulic model: The accuracy, timing, and spatial coverage of the remote sensing observations largely impacted the effectiveness of the calibration exercise. Further improvements to the framework are required when using remote sensing observations acquired after the flood peak in valley filling events. Further testing of the calibration framework on catchments with different hydrological and morphological features is strongly recommended.

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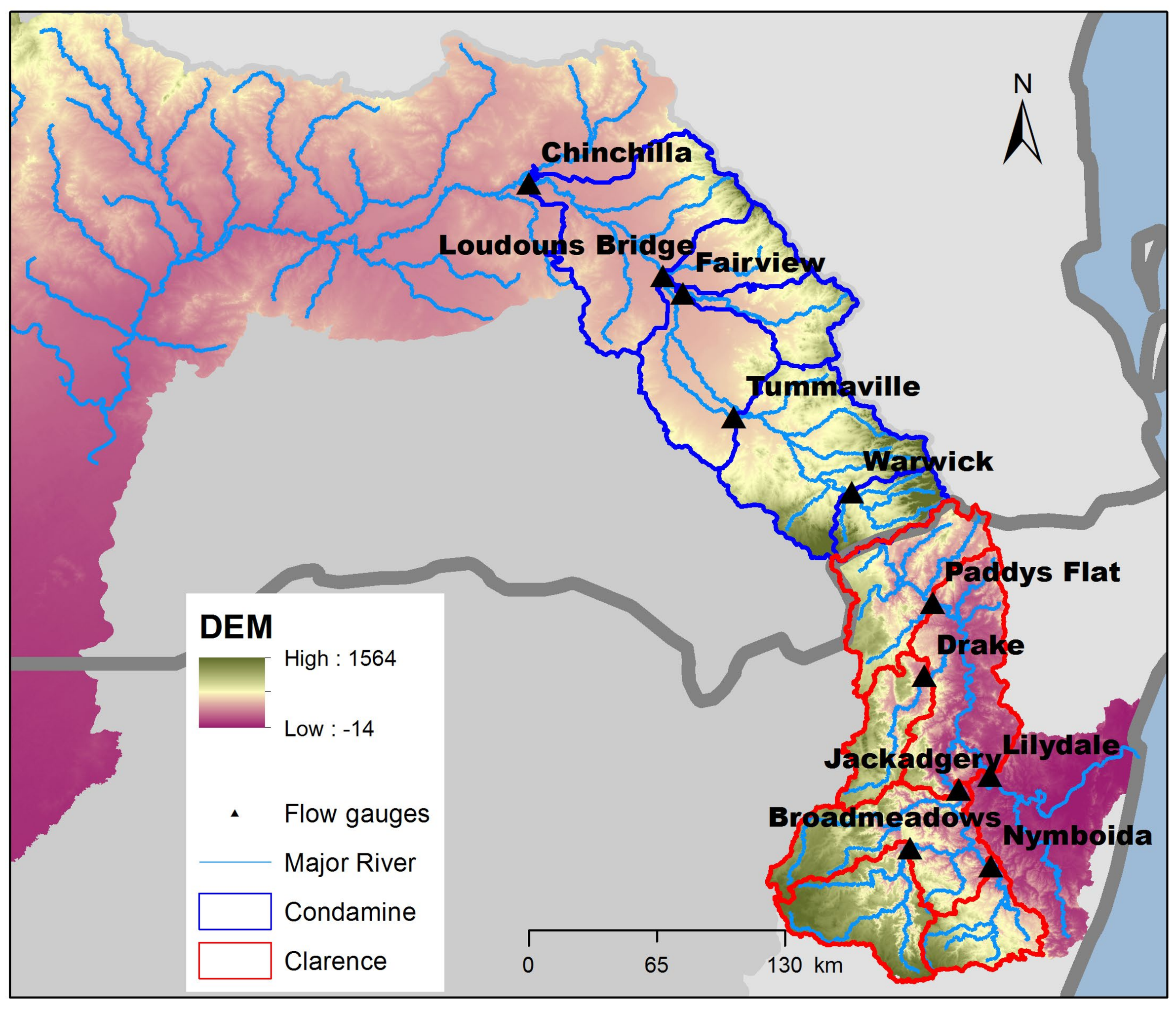

Figure 1: By using remotely sensed soil moisture streamflow simulation skill was improved at internal locations.

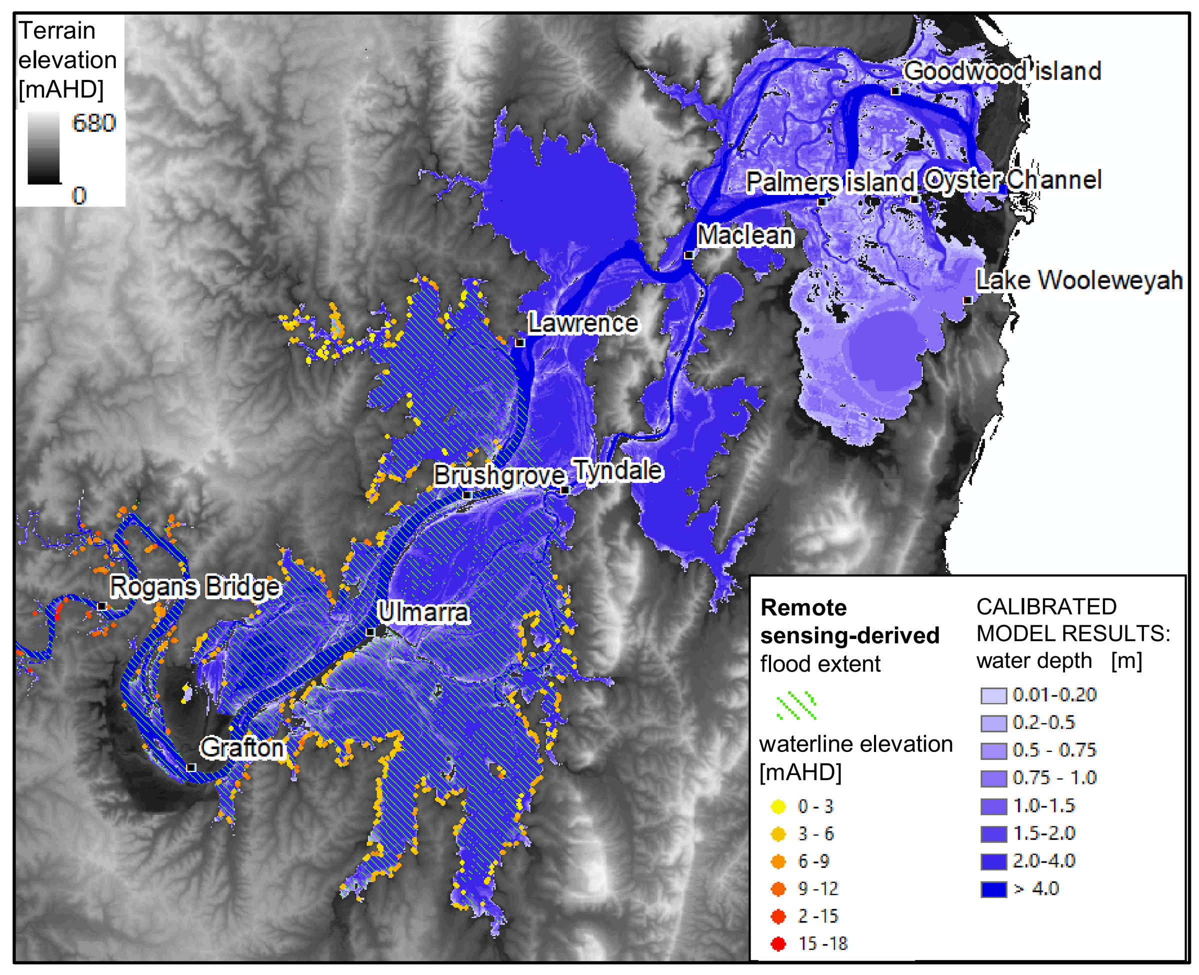

Figure 2: Clarence catchment, 2011 flood event – remote sensing-derived observations compared with model results.

References

Li, Y., Grimaldi, S., Pauwels, V. R., & Walker, J. P. (2018). Hydrologic model calibration using remotely sensed soil moisture and discharge measurements: The impact on predictions at gauged and ungauged locations. https://doi.org/10.1016/j.jhydrol.2018.01.013

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