The use of radar-based rainfall observations and forecasts to provide enhanced flood forecasts and warnings in Australia

Agathe Boronkay, Carlos Velasco-Forero

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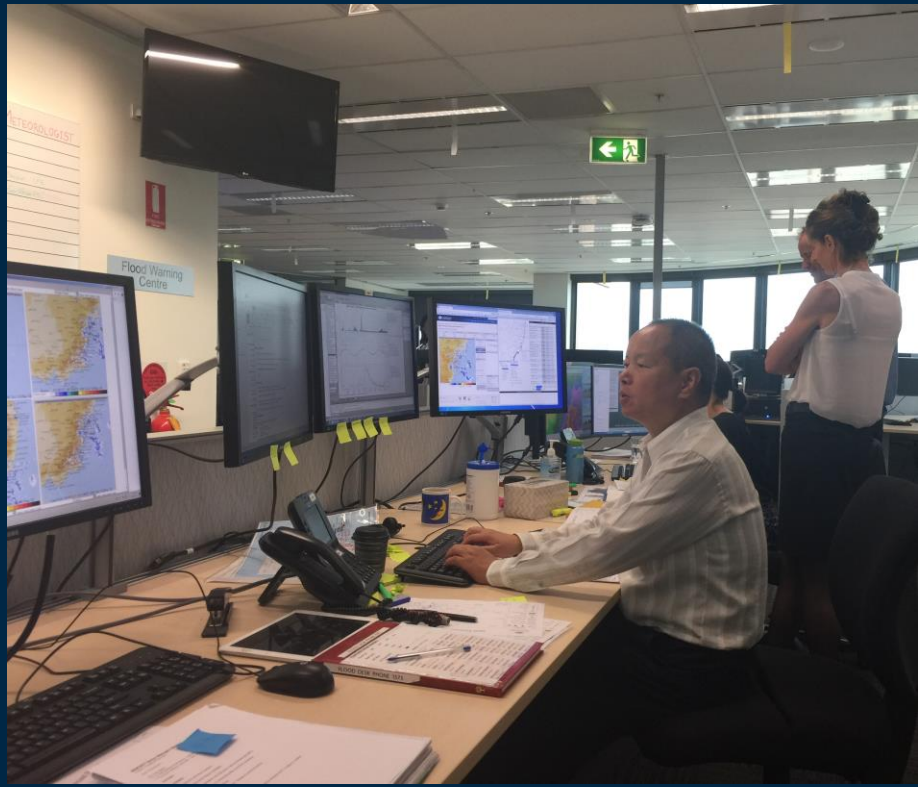
Australian Government
Bureau of Meteorology

Motivation

Emergency Services require warnings at longer lead times especially for small catchments that respond quickly to rainfall.

Forecasts and warnings must be defensible and based upon the latest observations and forecast rainfall guidance. They must highlight the potential for extreme flooding to develop.

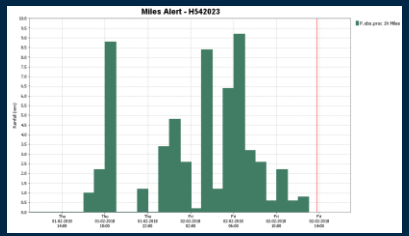


What is RAINFIELDS?

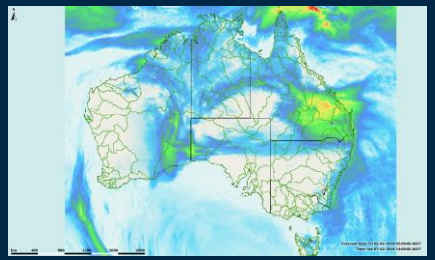
- *RAINFIELDS updates very rapidly, takes into account the latest observations and also provides ensemble rainfall forecasts that can identify a range of possible flood scenarios.*
- High spatial and temporal resolution grids derived from weather radar observations and produced in real-time. RAINFIELDS include:

1. Quantitative Precipitation Estimation (QPE): based on radar reflectivity and gauge observations.
2. Ensemble Quantitative Precipitation Forecast (QPF): based on radar QPE and Numerical Weather Prediction (NWP) rainfall forecast.

Radar



Rain gauge

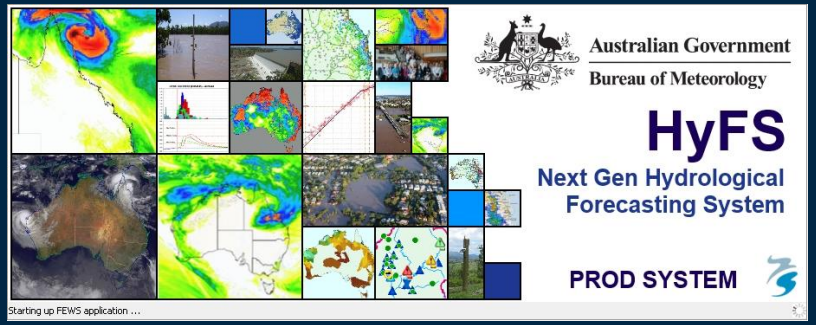


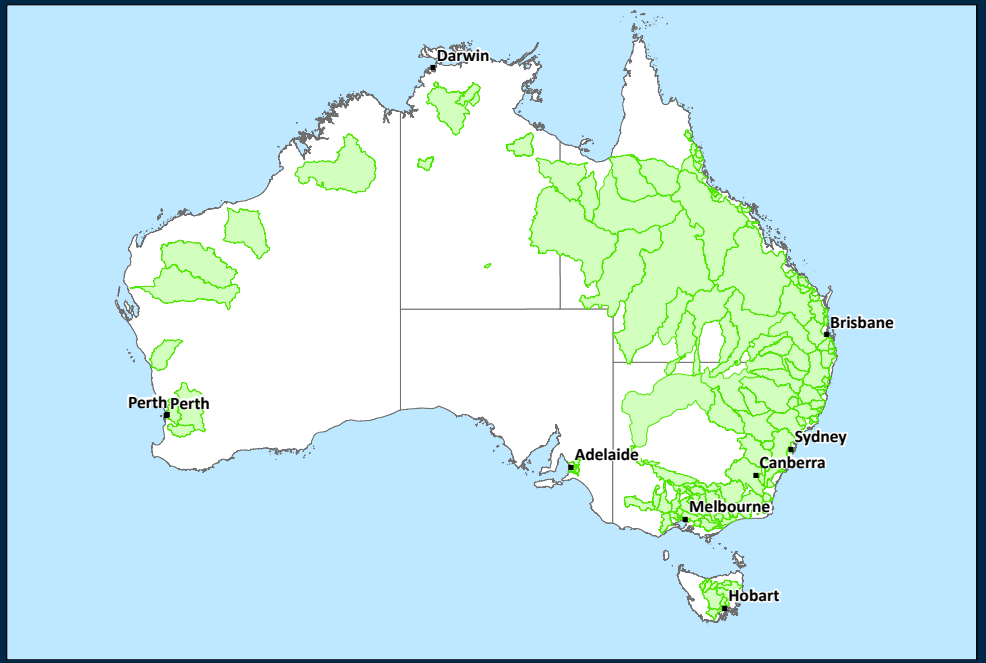
NWP

RAINFIELDS

Hydrological Forecasting System (HyFS)

- HyFS uses the Delft-FEWS forecasting framework and supports both event and continuous hydrological modelling.
- There are currently around ~150 flood forecasting models in HyFS.

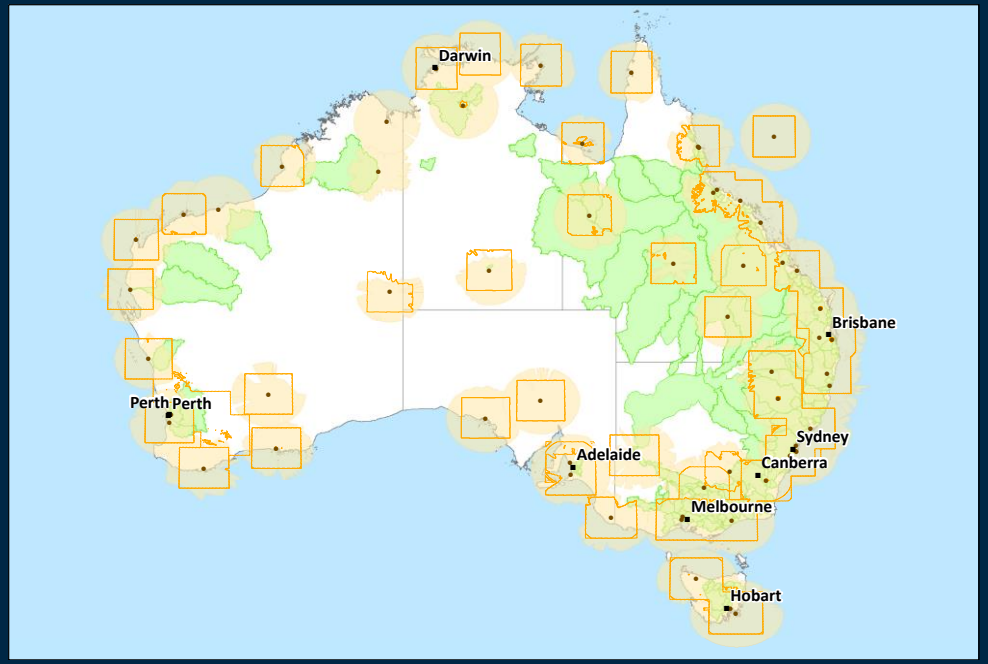




Operational flood forecasting catchment models (Dec 2017)

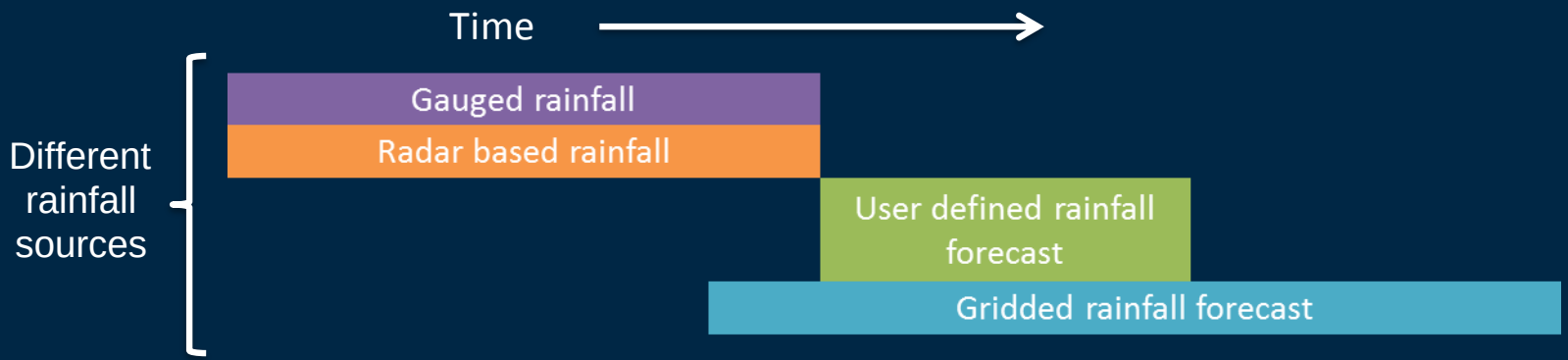
Methodology

- Identify past flooding events
- Modify HyFS to import, visualise and use in modelling the radar rainfall grids
- Run catchment models with RAINFIELDS data and other rainfall forecast guidance available during the flood events
- Qualitative and quantitative assessments of the modelled flows



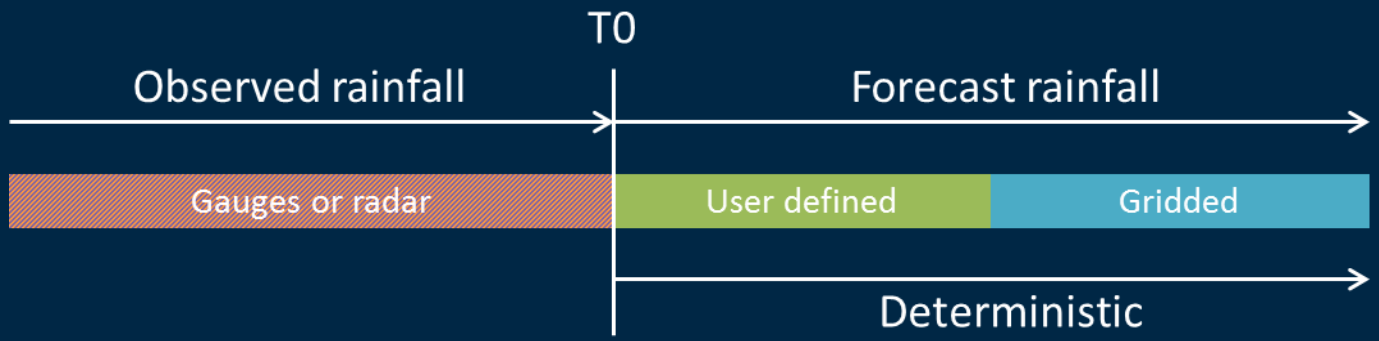
Operational flood forecasting catchment models and RAINFIELDS quantitative precipitation domains (Dec 2017)

Current Forecasting Process (1)



- Radar based rainfall: either based on radar observations only or blended with gauges (if available)
- Gridded: choice of BoM's official forecasts or NWP models (ACCESS C, R and G, ECMWF and OCF)

Current Forecasting Process (2)



- Radar based rainfall: either based on radar observations only or blended with gauges (if available)
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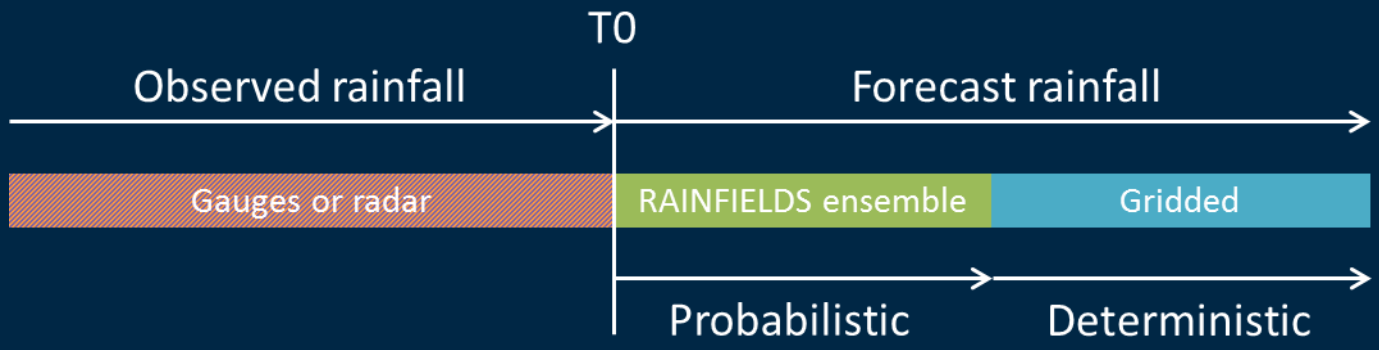
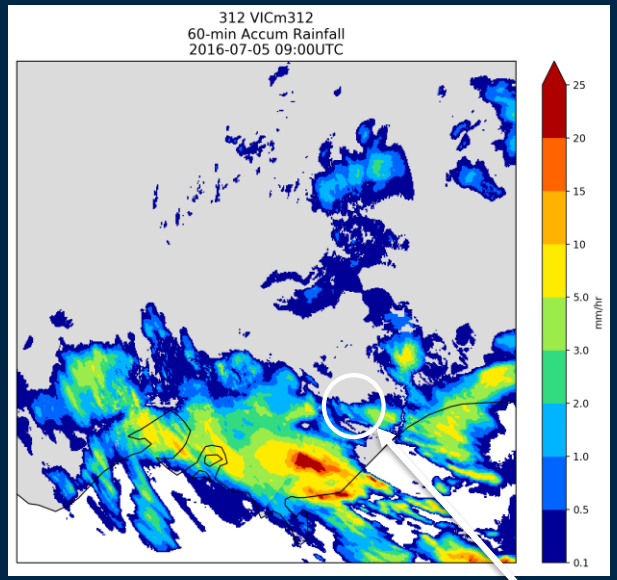
Modified Forecasting Process to include RAINFIELDS



- Radar based rainfall: either based on radar observations only or blended with gauges (if available)
- Gridded: choice of BoM's official forecasts or NWP models (ACCESS C, R and G, ECMWF and OCF)
- RAINFIELDS ensemble: 12-hr forecast with hourly time steps and 35 realisations

Victoria July 2016 – Observed and forecast rainfall



QPE + ensemble mean

QPE from 2016-07-05 0900UTC to 1500UTC

QPF from 2016-07-05 1600UTC to 2016-07-06 0300UTC (up to 12 hours ahead)

Avon catchment

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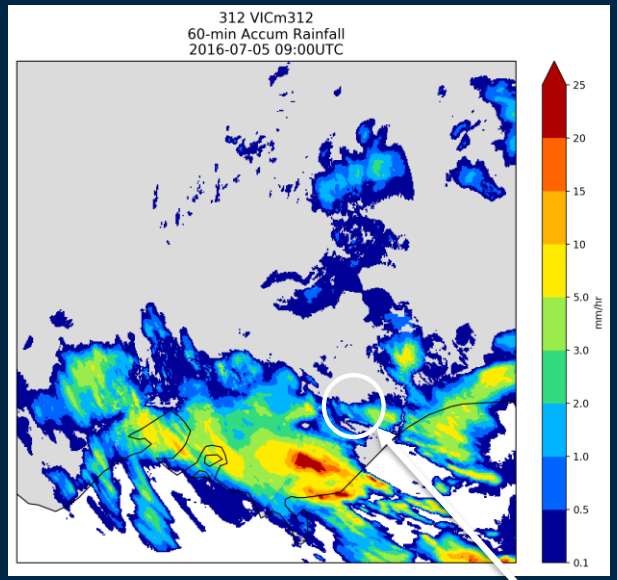
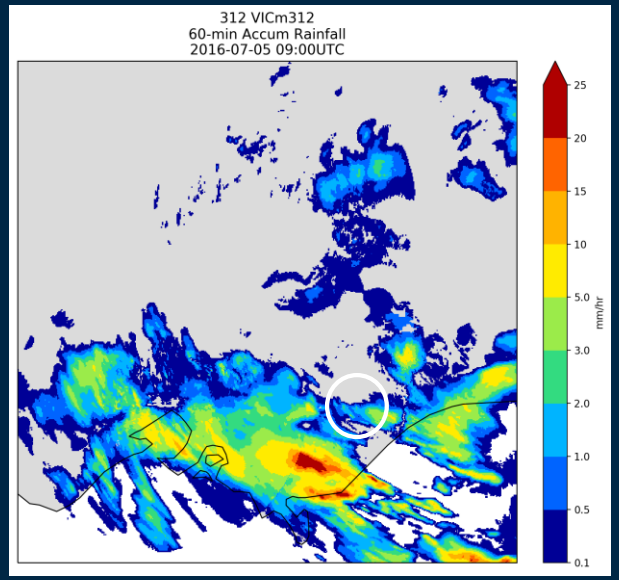
Victoria July 2016 – Observed and forecast rainfall



QPE + ensemble mean



QPE + ensemble member 14

Avon catchment

QPE from 2016-07-05 0900UTC to 1500UTC

QPF from 2016-07-05 1600UTC to 2016-07-06 0300UTC (up to 12 hours ahead)

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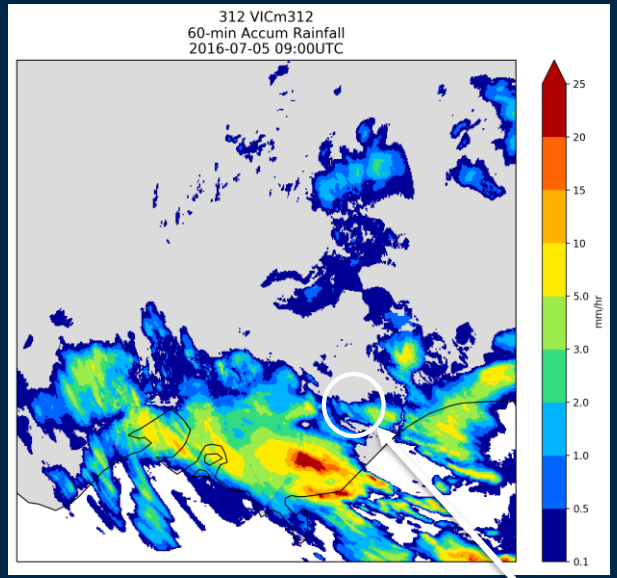
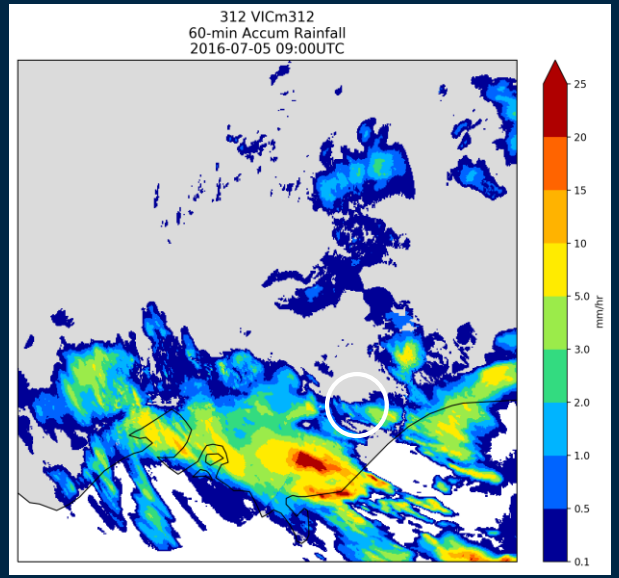
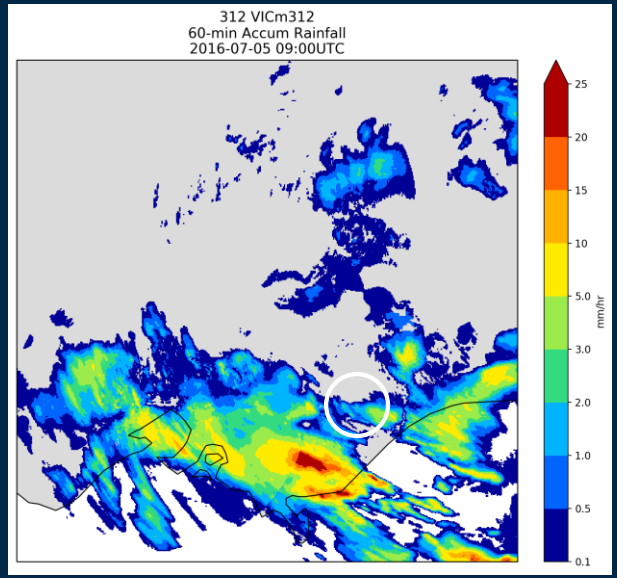


QPE + ensemble mean



QPE + ensemble member 14

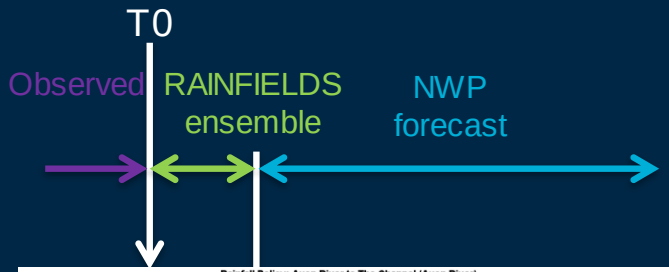


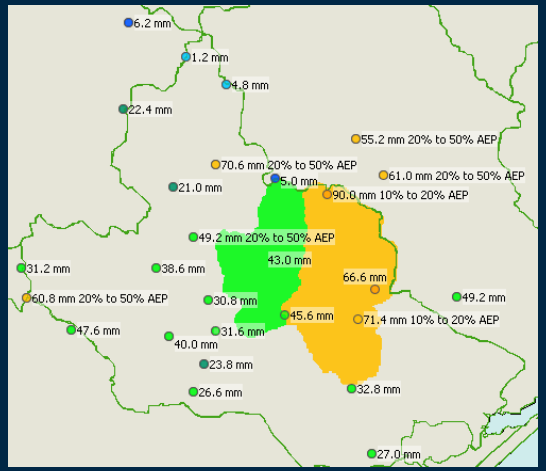
QPE + ensemble member 15

Avon catchment

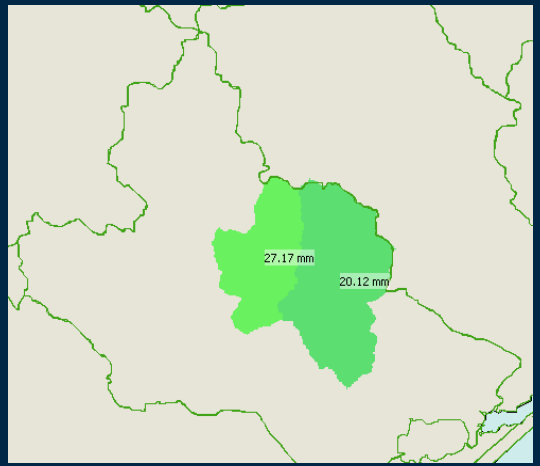
Avon catchment July 2016 event – Rainfall

Total catchment area	1830 km^2
Catchment area to The Channel (western subcatchment)	550 km^2

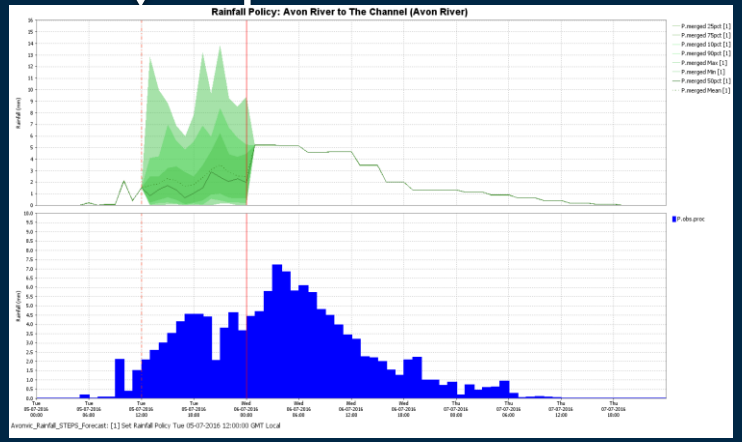




12-hr observed rainfall total

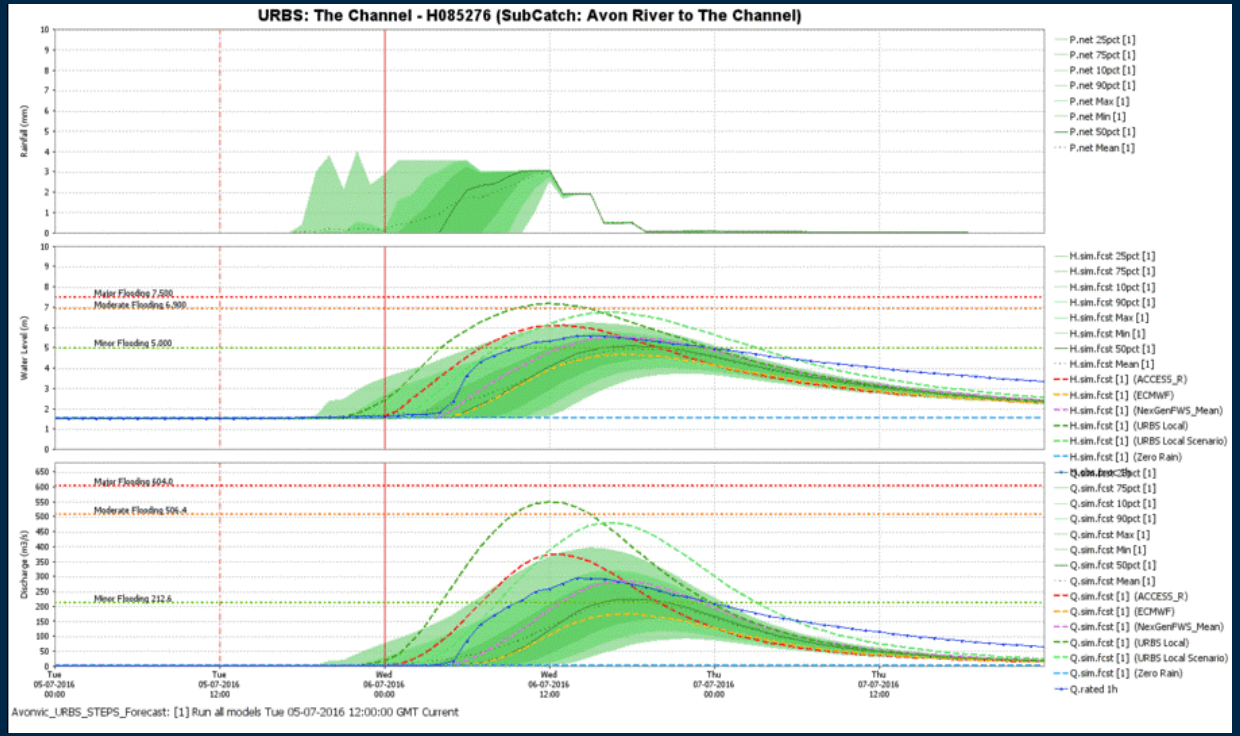


12-hr RAINFIELDS mean forecast total



Avon catchment July 2016 event – Flow and water level

- Flow and water level forecast at forecast location The Channel (~550 km^2)



Conclusions

- The key advantage of RAINFIELDS is its frequent updates and currency, it is able to adjust to new rainfall observations as the event unfolds.
- RAINFIELDS improves situational awareness for forecasts and highlights the potential for higher severity flooding to develop.
- The main benefit is for small fast responding catchments where long forecast lead times are difficult to achieve with the current rainfall forecasts available.
- The most challenging aspect of introducing RAINFIELDS is for flood and weather forecasters developing skills and experience in using it operationally.

Thank you

Questions?

Agathe Boronkay

agathe.boronkay@bom.gov.au

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