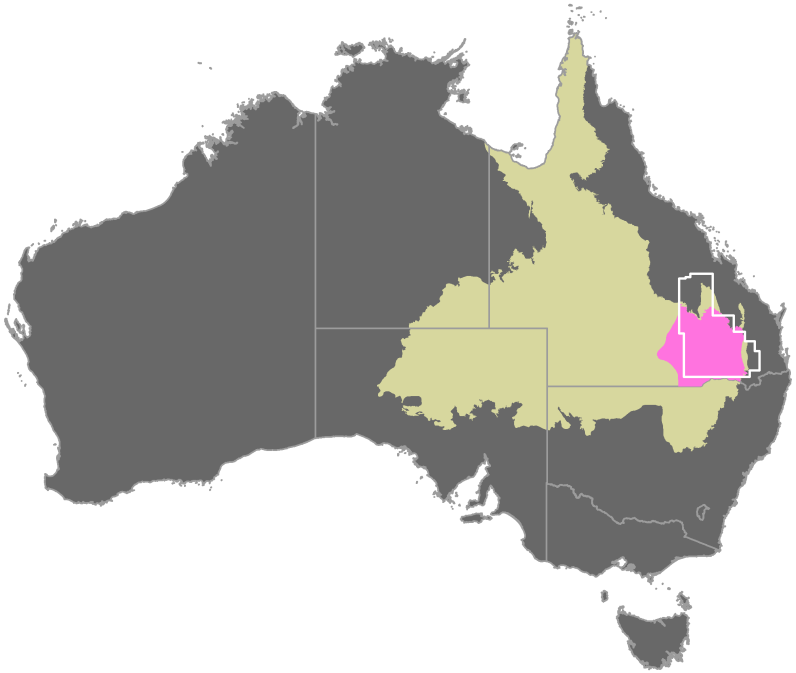
THE UNIVERSITY OF QUEENSLAND
AUSTRALIA

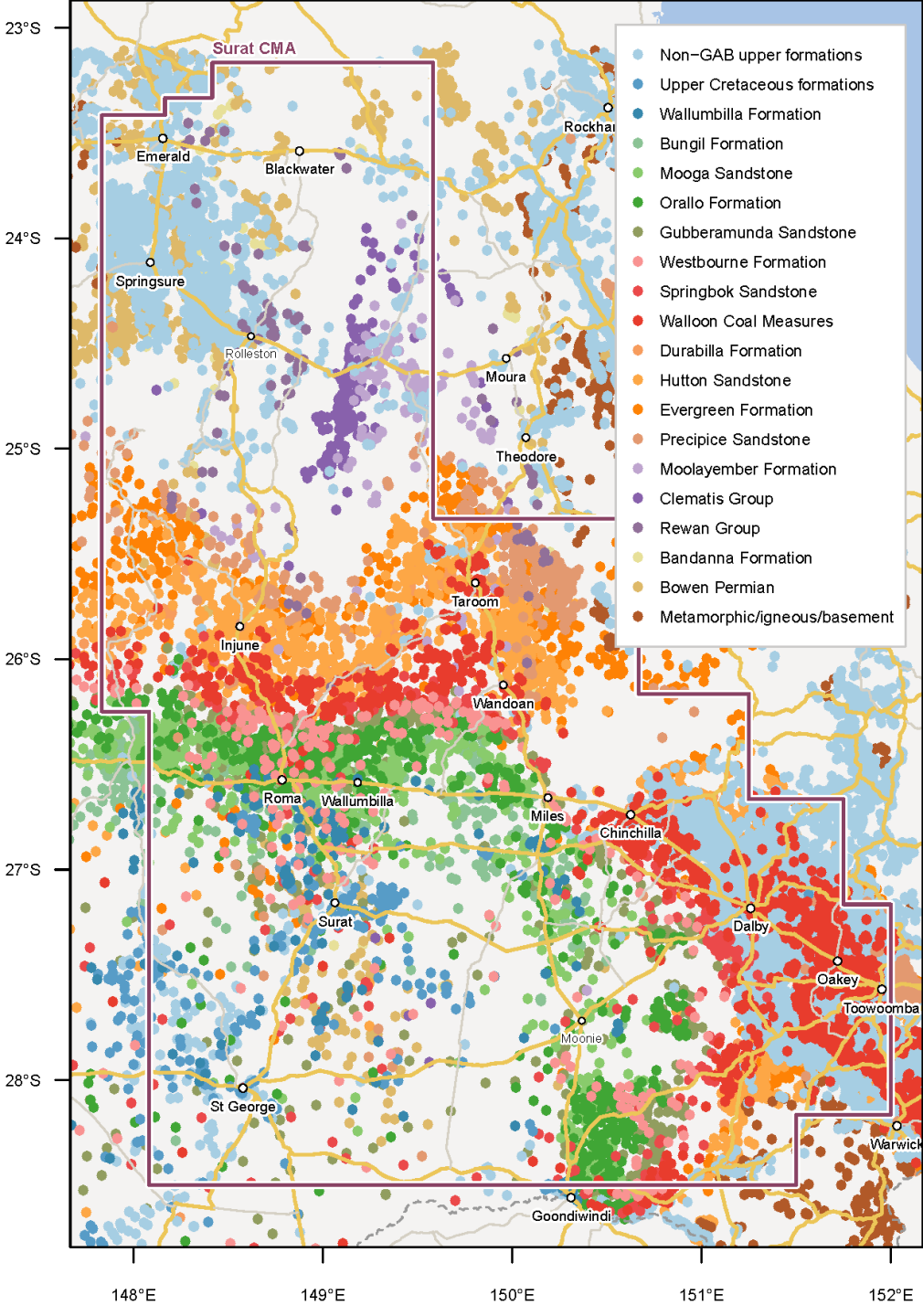
Monitoring and modelling groundwater extractions over a data-sparse region of Australia

Greg Keir, Nevenka Bulovic, Neil McIntyre

The Surat Basin

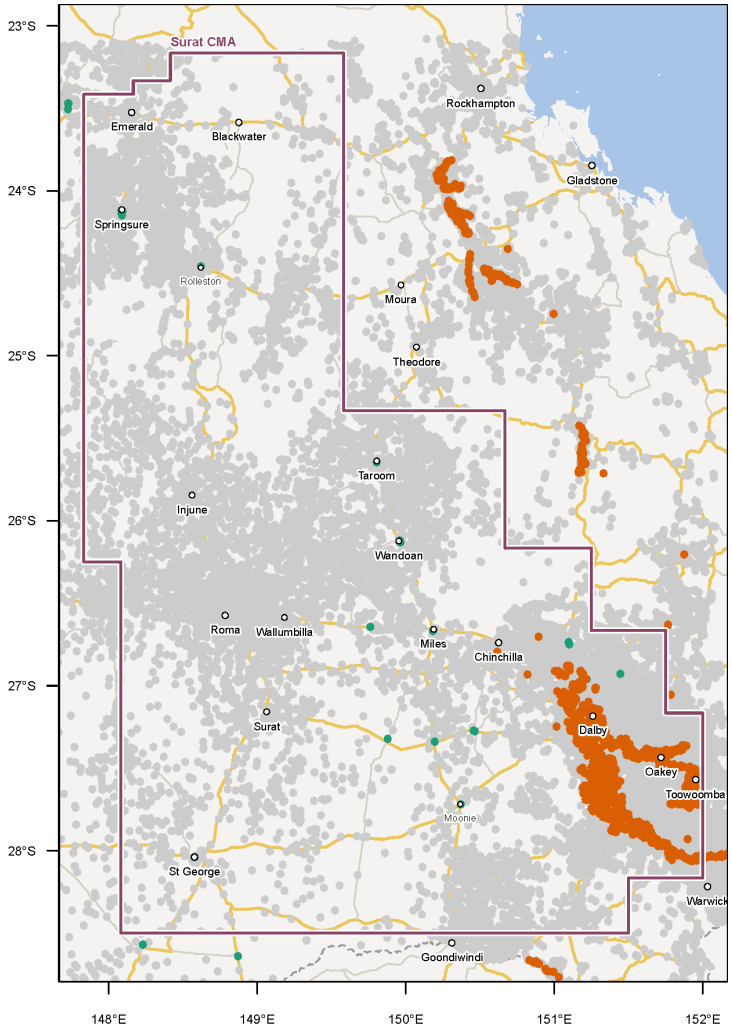


Area – 160,000 km^2
Average rainfall –
400 to 800 mm/year



Data availability – Groundwater extraction metering

- Region has 30,000+ bores
- **< 5000 bores** metered, and metering limited to:
  - Irrigation bores
  - Municipal bores
  - Other larger users
- Most bores are used for stock watering and domestic purposes (S & D)



Data availability – Stock and domestic bores

- 'Direct' estimates of extraction with different levels of uncertainty
  - Small-scale metering program across 43 bores
  - Anecdotal baseline estimates
  - Long-term analytical and empirical estimates (e.g. OGIA)

- Other supporting (explanatory) datasets that can influence extraction
  - Bore characteristics
  - Hydrogeology and hydrology
  - Climate
  - Rural property characteristics

Modelling overview

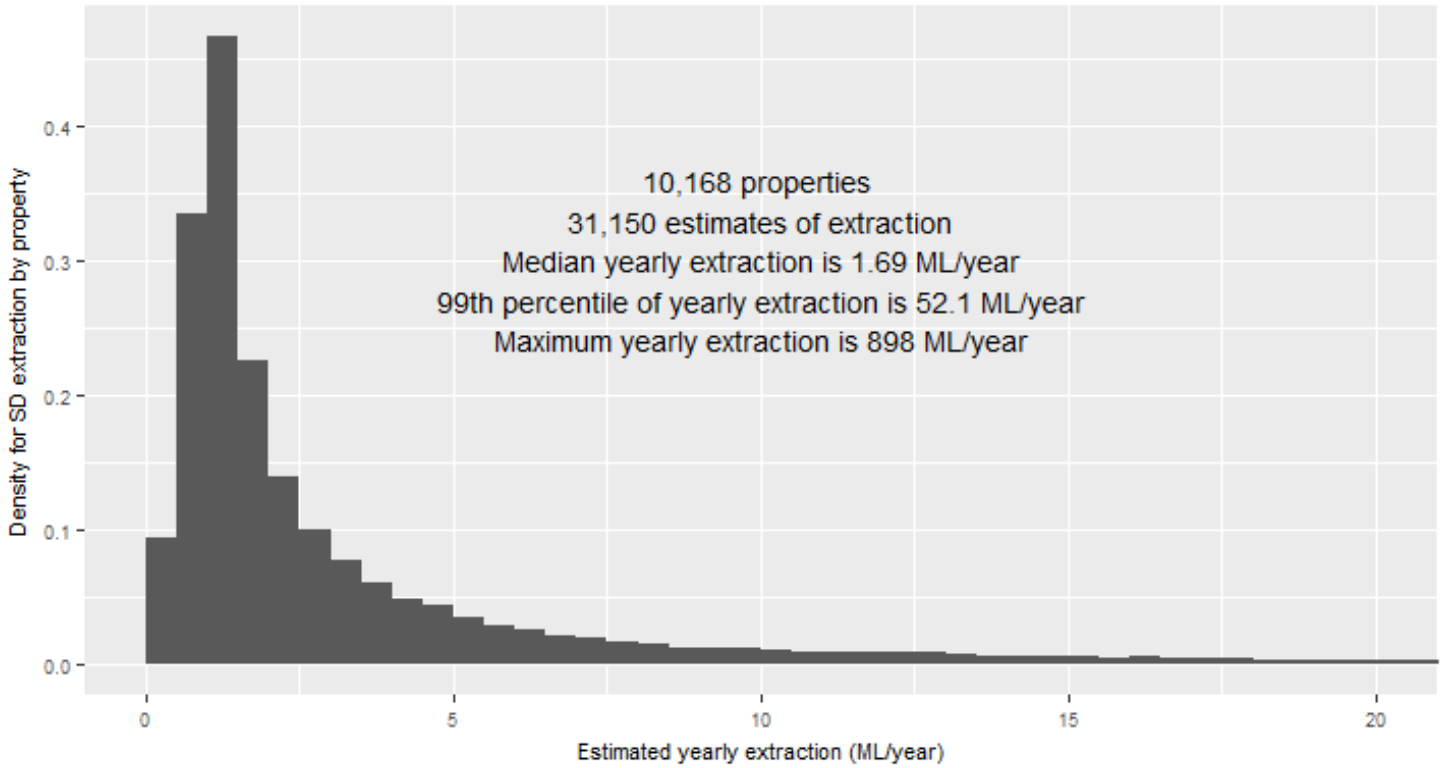
- A three-step modelling approach used to get bore scale estimates
  1. Magnitude model at property scale
  2. Occurrence model at bore scale
  3. Proportional distribution model within properties

$$g(\mu) = \eta = \sum d\beta$$

Property magnitude model

- Response variable: Gamma distribution
- Inverse link function: $\boldsymbol{g(\mu_i)} = \frac{\mathbf{1}}{\boldsymbol{\mu_i}} = \sum_{j=1}^{p} d_{i,j}\beta_j$

```
extraction  ~  rain + temp_max + temp_min + solar + ndvi +
               surf_water + Persons + Area + Pasture + GIS_LNG +
               GIS_LAT + nBores
```

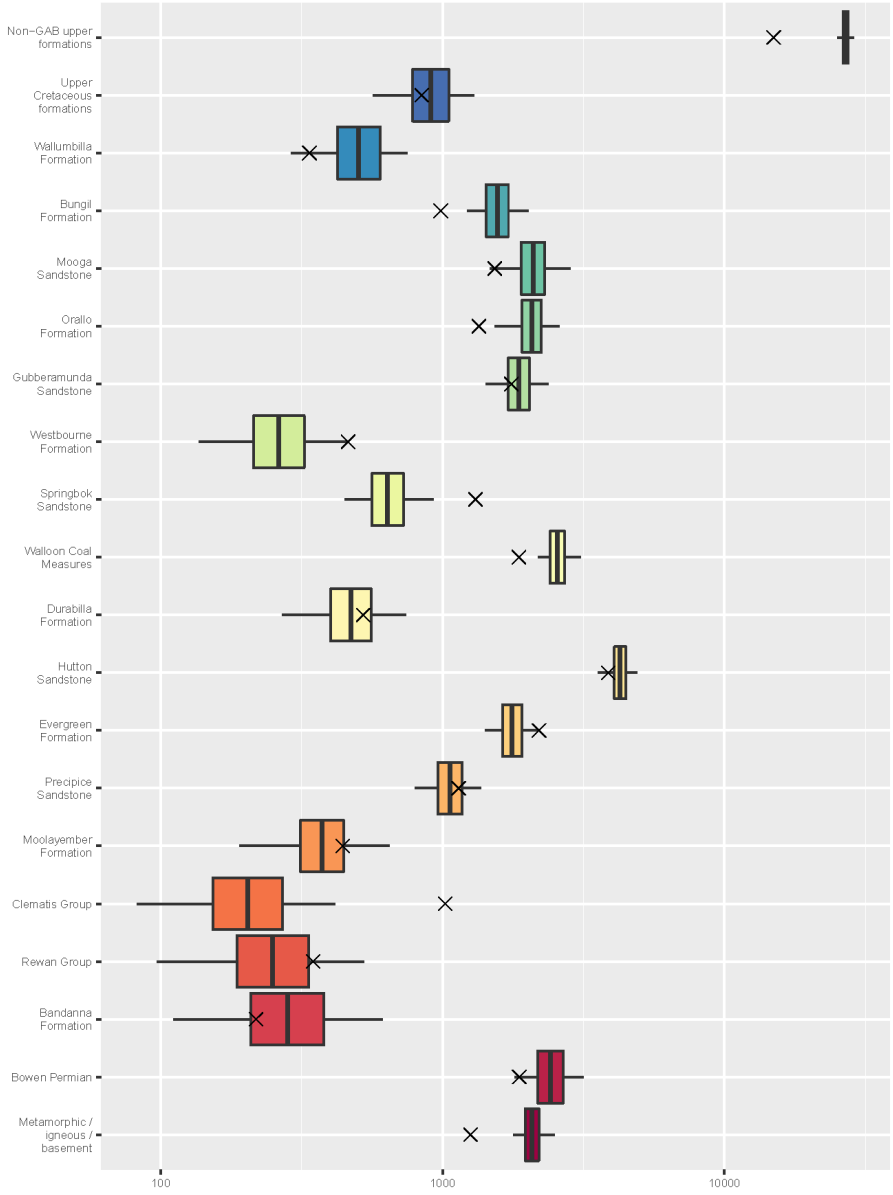


Occurrence model

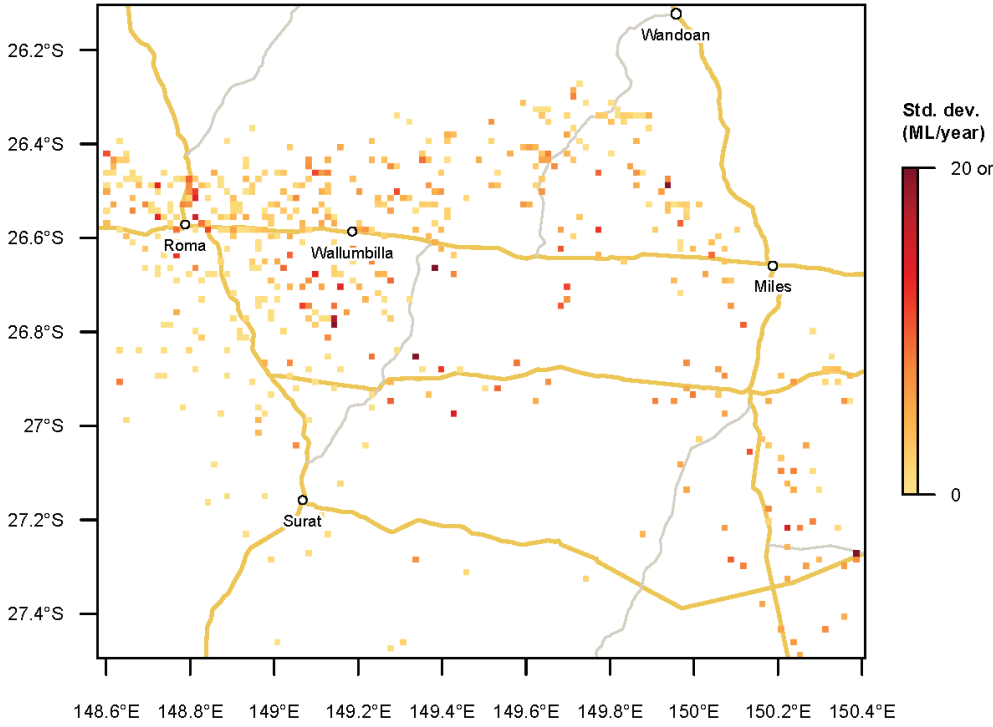
- Response variable: Bernoulli distribution
- Logit link function: $g(\pi_i) = \log\left(\frac{\pi_i}{1-\pi_i}\right) = \sum_{j=1}^{p} d_{i,j}\beta_i$

```
Used ~ FACILITY_TYPE + DN + Well + Age + GIS_LNG + GIS_LAT +
       EC + Deep_Aqui + Thickness + t + tb +
       rain + temp_max + temp_min + solar + ndvi +
       surf_water + Persons + Area + Pasture
```

Example outputs



Total extraction by aquifer



Spatial distribution of extraction

Contact details

Greg Keir
E: greg.keir@gmail.com

Nena Bulovic
E: n.bulovic@uq.edu.au

Neil McIntyre
E: n.mcintyre@uq.edu.au

Sustainable Minerals Institute
The University of Queensland
St Lucia QLD 4072
W: http://www.cwimi.uq.edu.au

Acknowledgements

Thanks to representatives for APLNG, Arrow Energy, QGC, Santos and OGIA for their advice and assistance.

Disclosure

This research was funded by the Centre for Coal Seam Gas, which is currently funded by The University of Queensland 22% ($5 million) and the Industry members 78% ($17.5 million) over five years. Industry members also contribute an extra $3 million to fund the purchase of research infrastructure. The Centre's industry members are APLNG, Arrow Energy, QGC and Santos. For more information about the Centre's activities and governance see http://www.ccsg.uq.edu.au/.

Disclaimer