Evaluation of Hydrogeophysical Data to Constrain a 3D Variable Density Numerical Groundwater Model of a Freshwater Lens in a Multi-layered, Island Aquifer System

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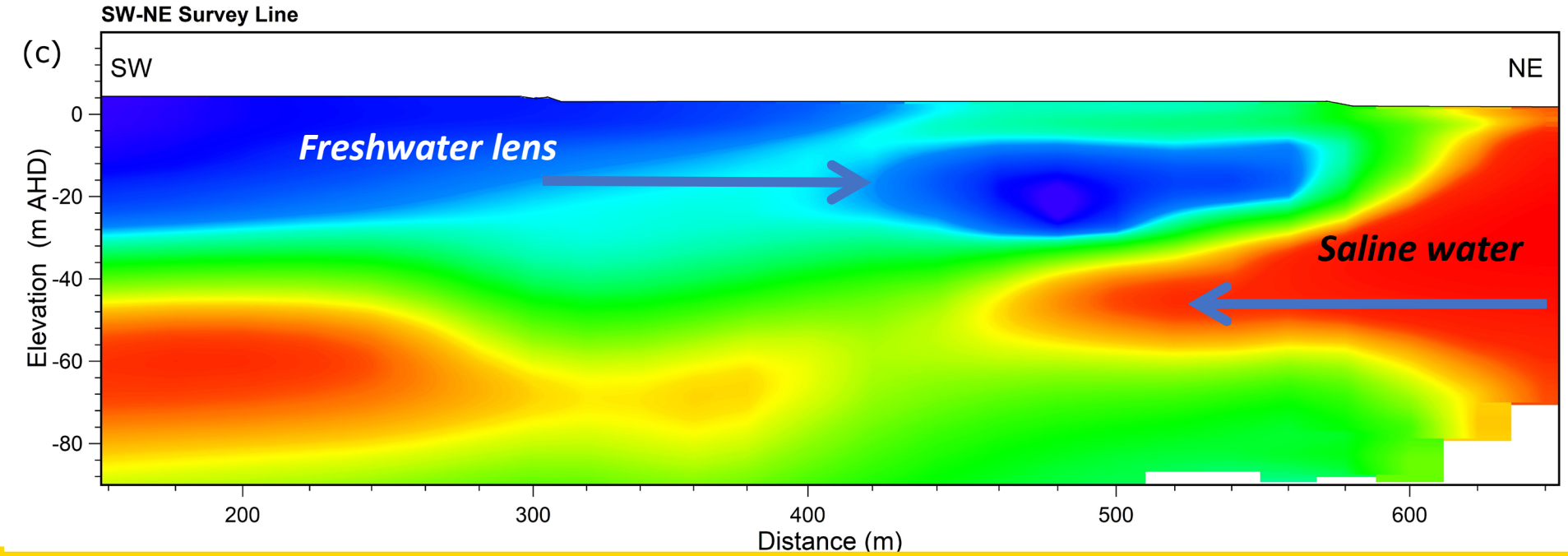
EGU 2020 Online Discussion HS8.2.1

Island hydrogeology

- Fresh groundwater lens volume
- Geometry and thickness of the fresh groundwater/saltwater transition zone
- Dynamic behaviour of the lens to variable climatic and groundwater pumping conditions



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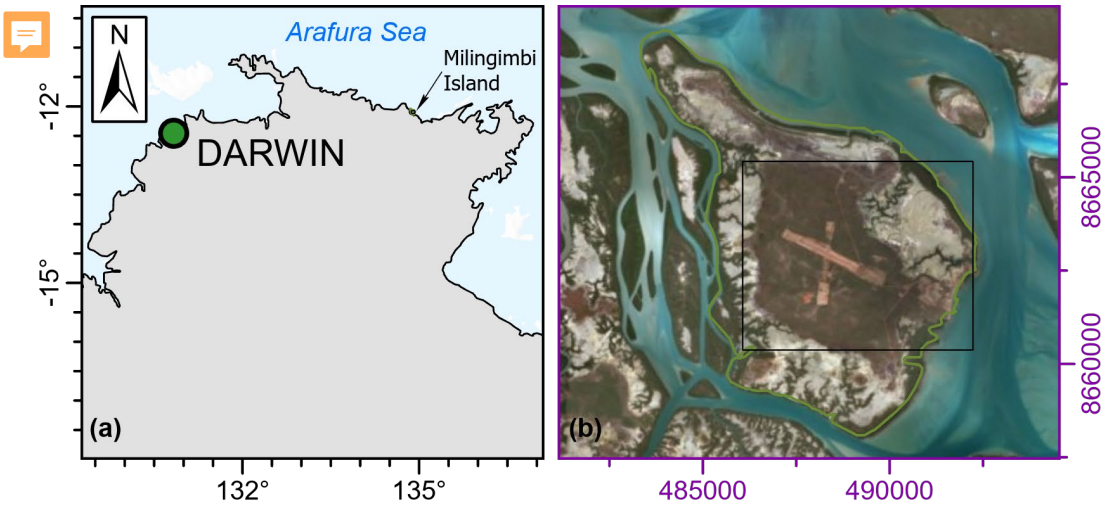
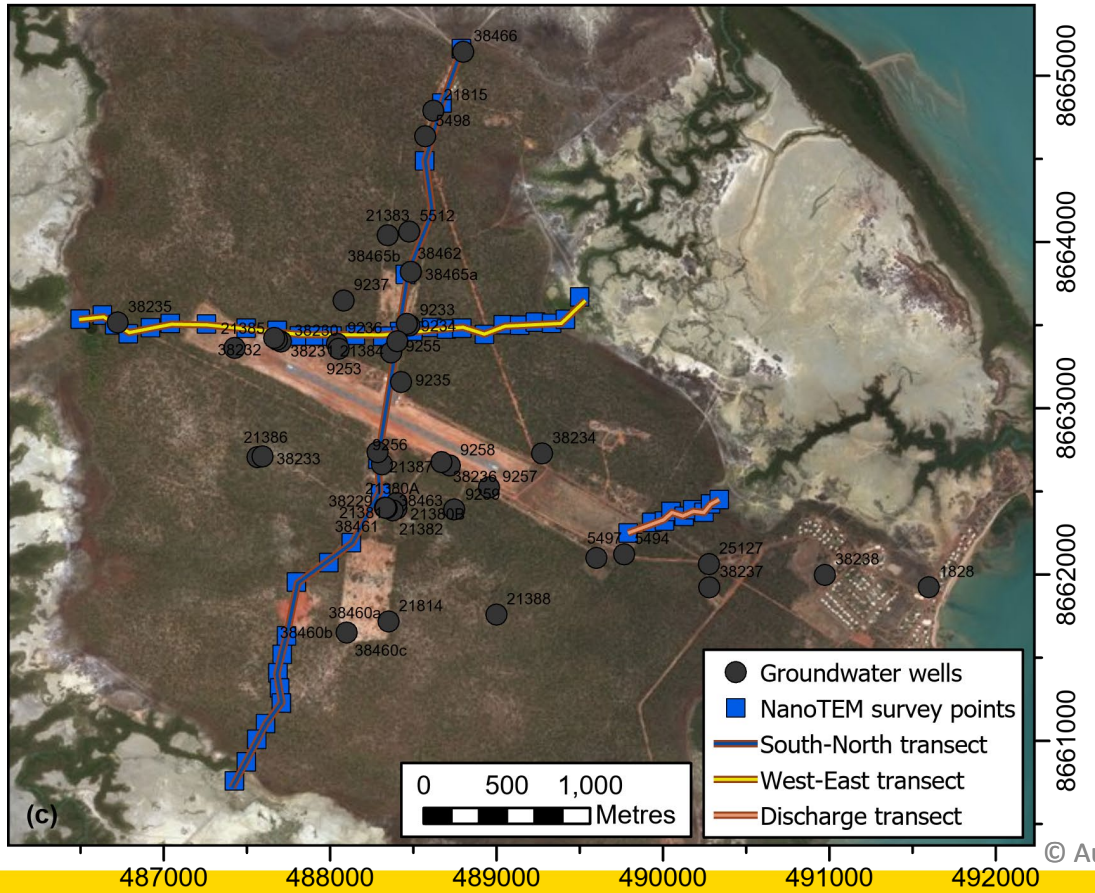
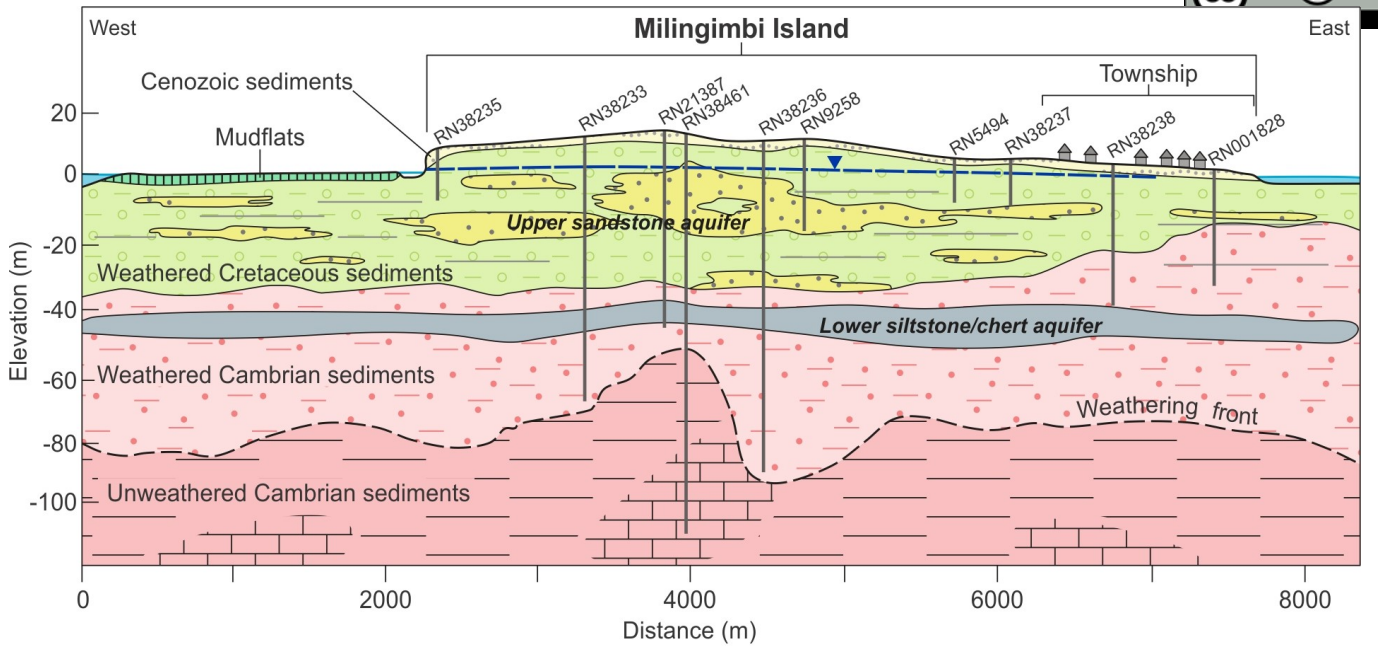
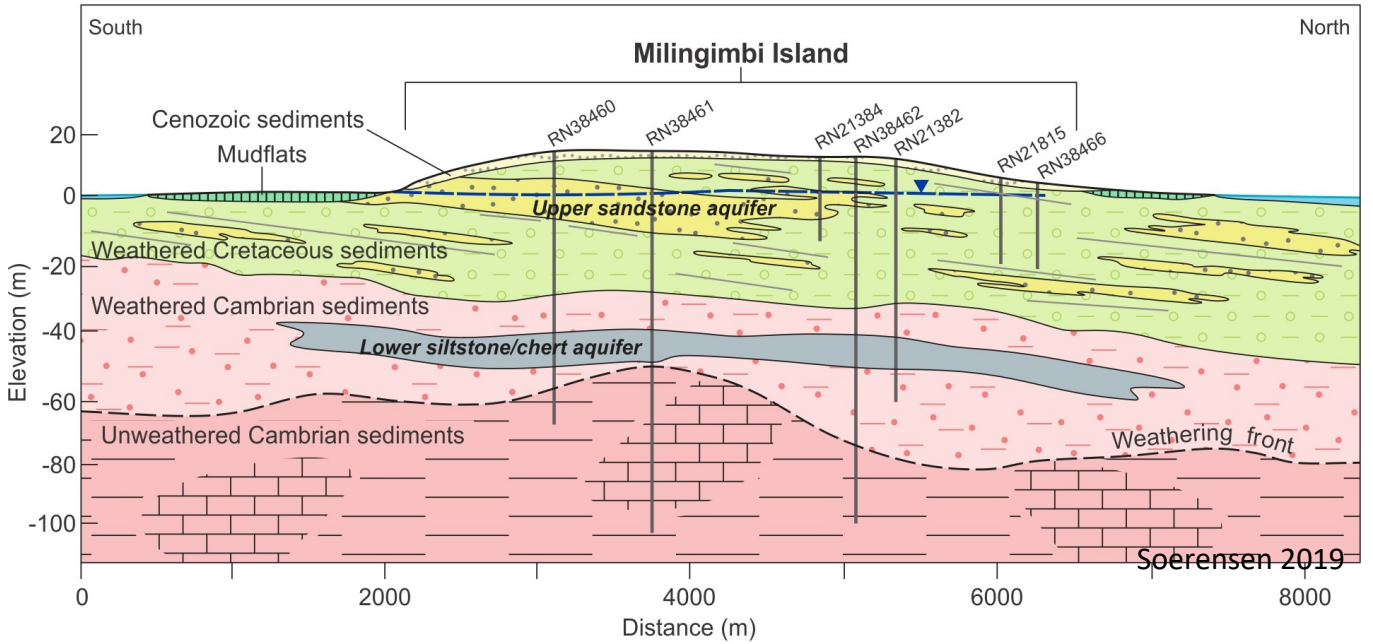


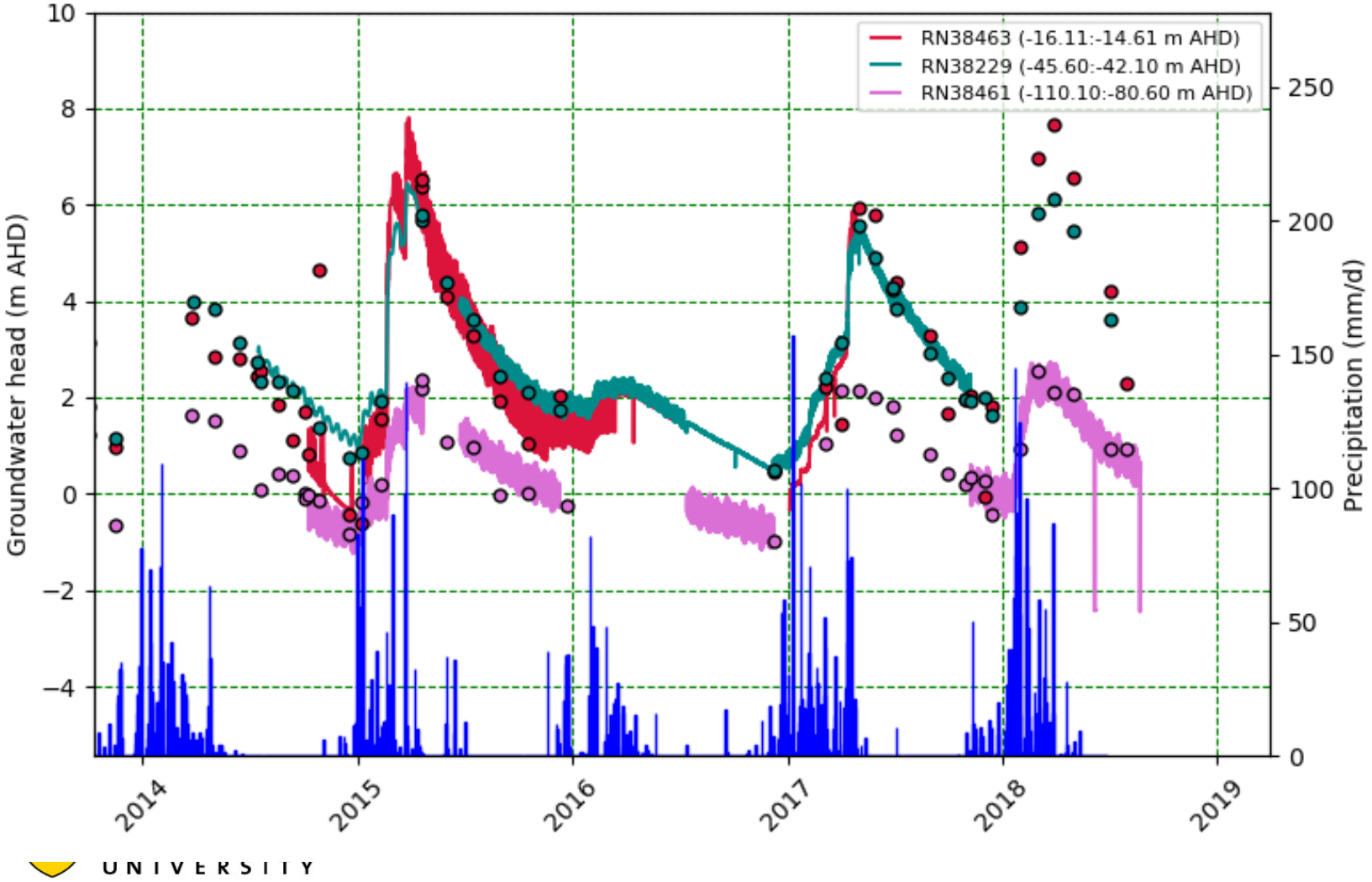


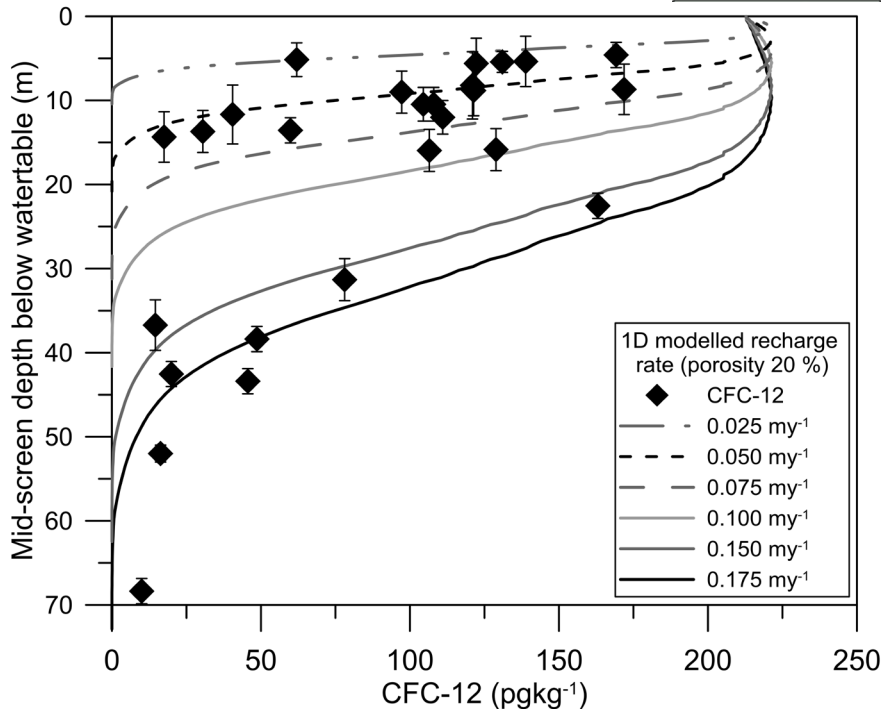


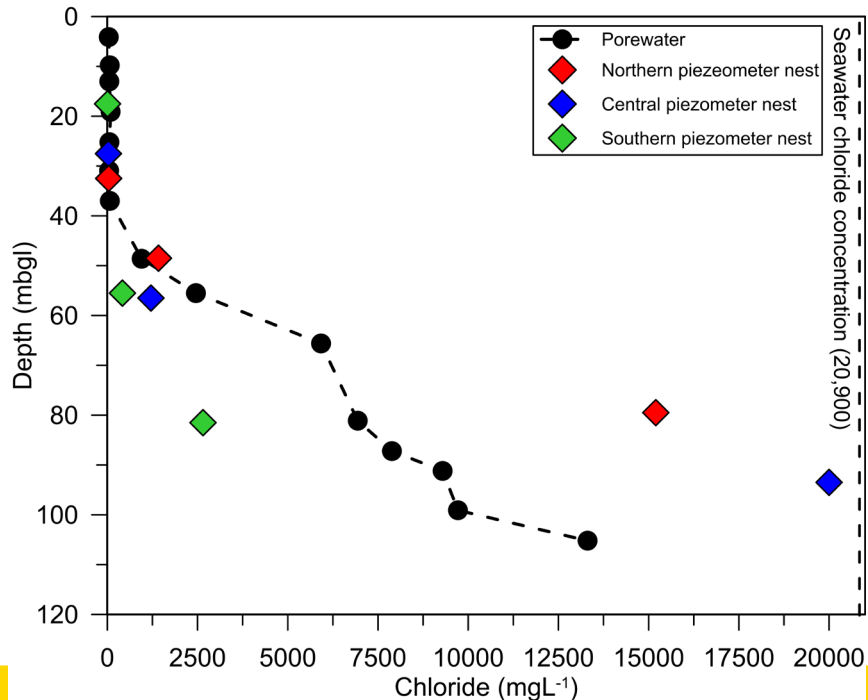


Local knowledge

Data & Conceptualisation

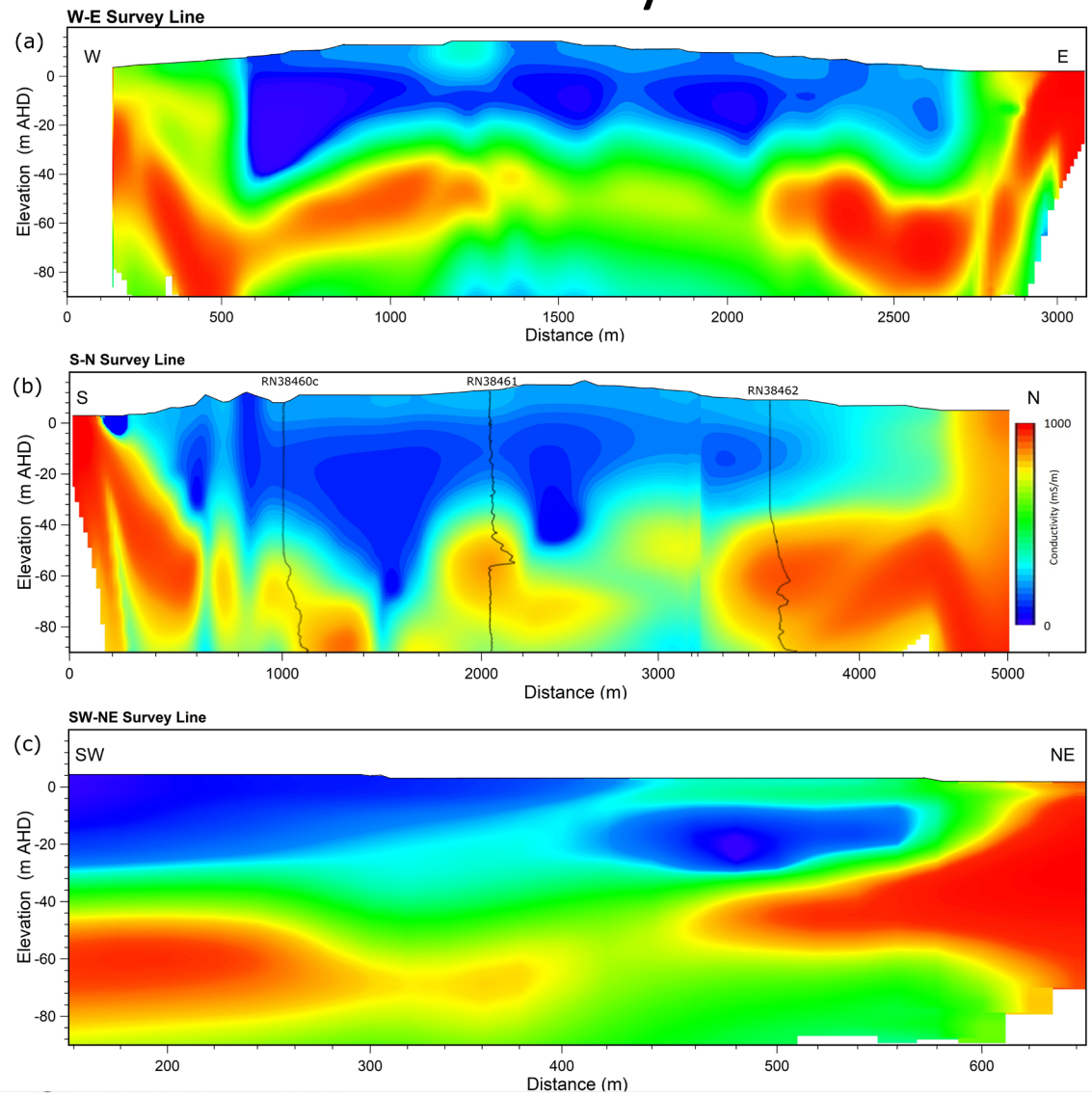




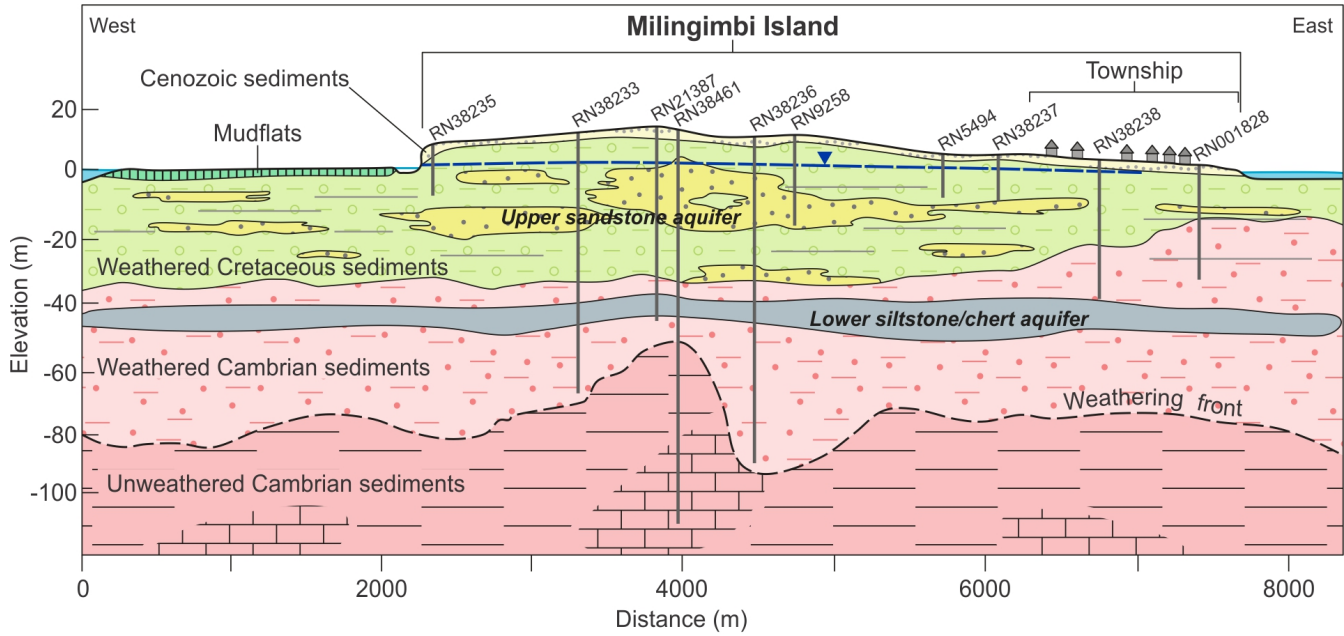


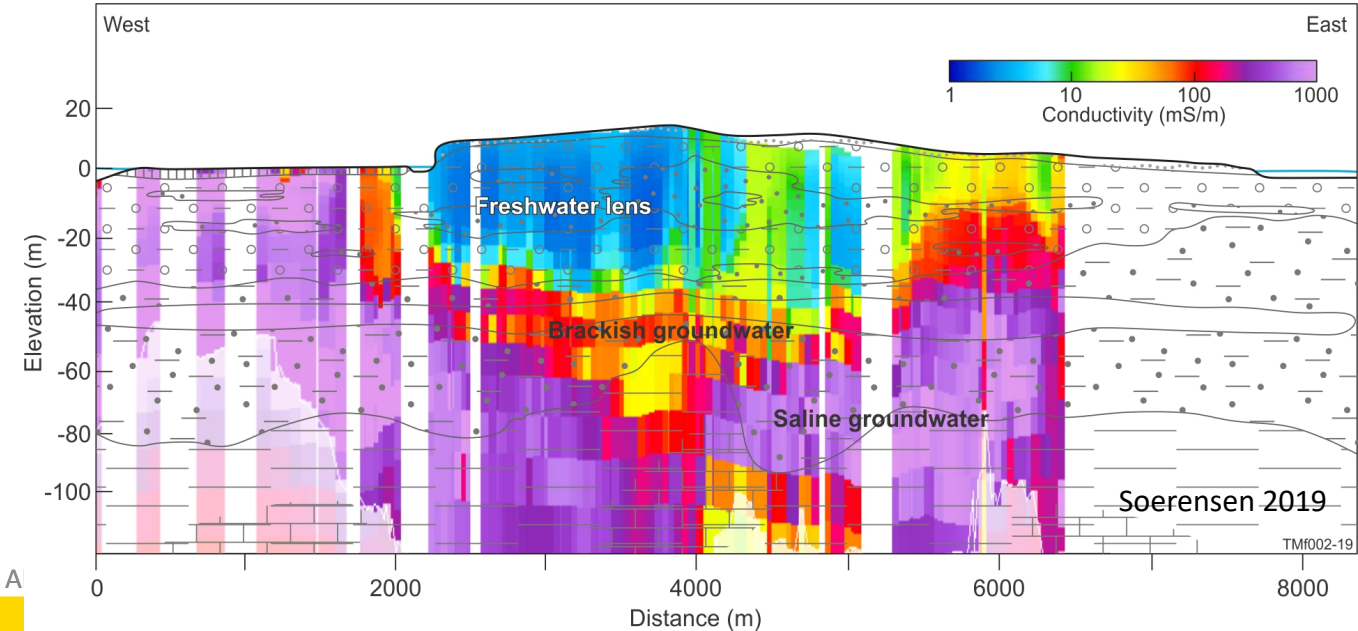
Conceptualisation

TEM surveys



AEM West-East cross section

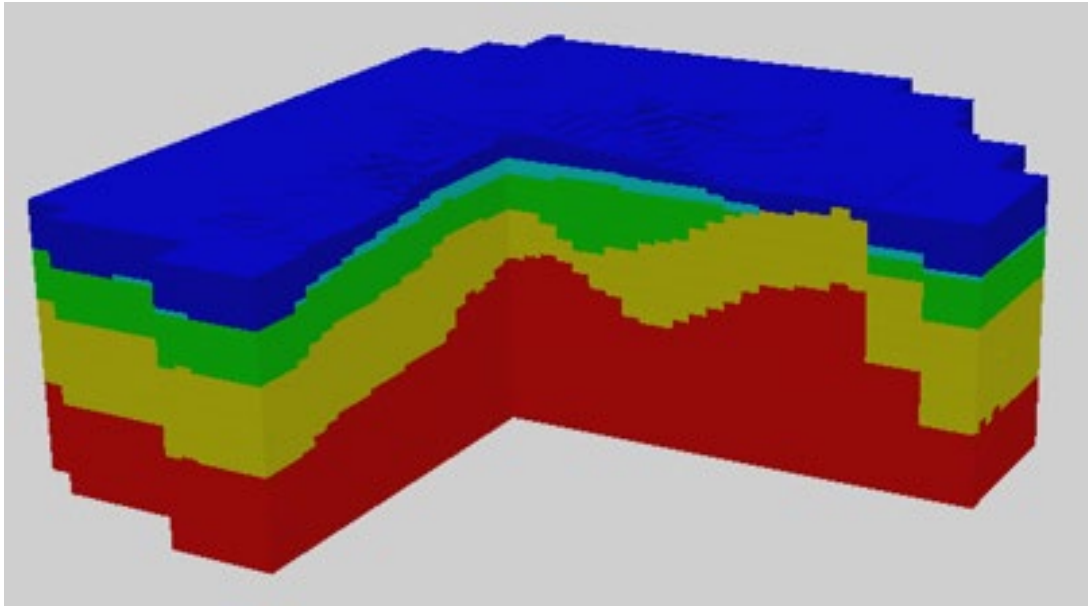




Numerical model

- 3D SEAWAT Version 4.
- 5 geological layers
- Grid 500 x 500 m (49 layers, active cells= 15,483
- Boundary conditions included:

sea boundary, recharge, ET

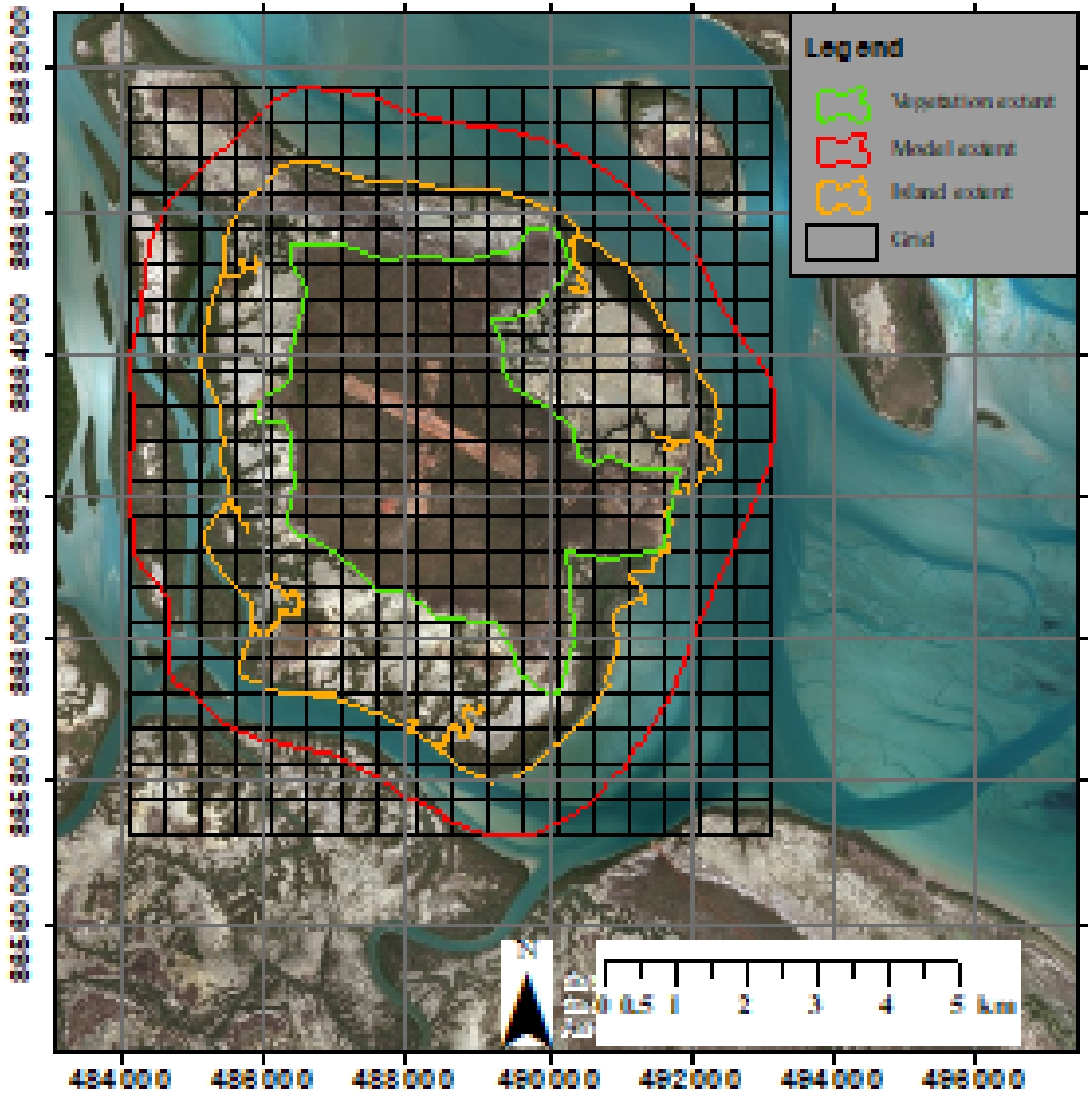


- Layer 1: variable thickness from 0.5 m to 15.4 m, based on the mean DEM elevation within each cell
- Layer 2: 1.0 m thick, from 0.5 to -0.5 m a.s.l
- Layer 3: 0.5 m thick, from -0.5 to -1 m a.s.l.
- Layers 4-43: 2.5 m thick, from -1 to -98.5 m a.s.l.
- Layer 44: 1.5 m thick, from -98.5 to -100 m a.s.l.
- Layers 44-48: 5 m thick, from -100 to -125 m a.s.l.
- Layer 49: 25 m thick, from -125 to -150 m a.s.l

Model framework

Three phases

- Steady state model
- Transient model
- Scenario testing



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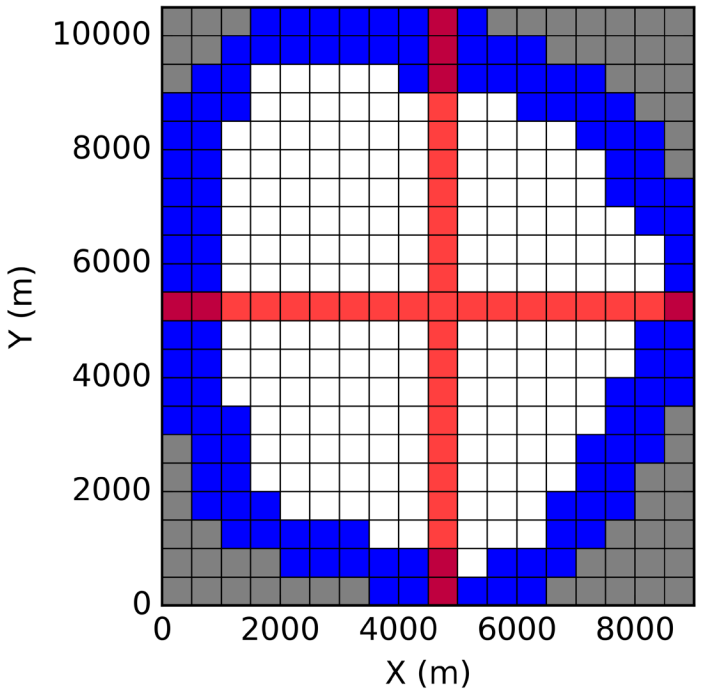
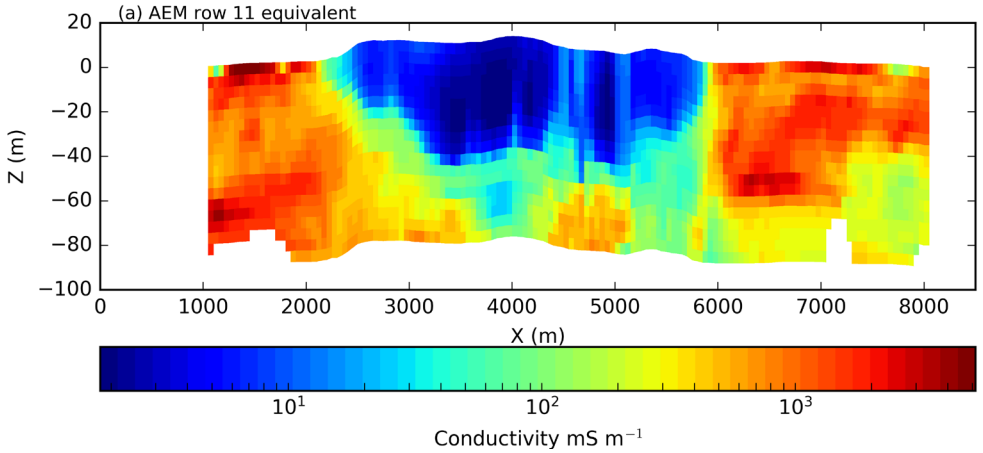
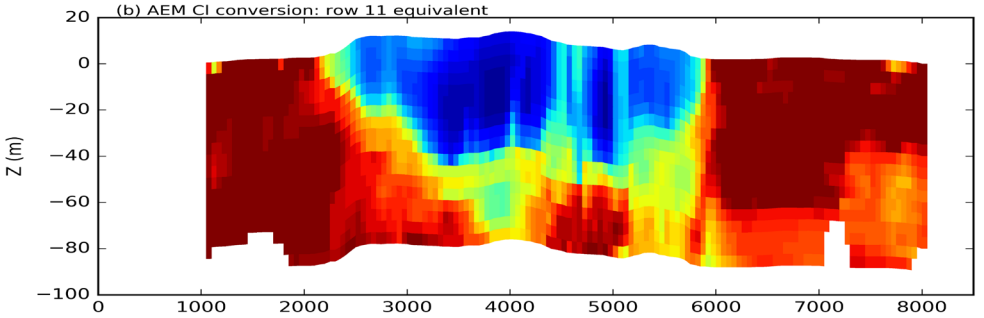
Steady state model



AEM

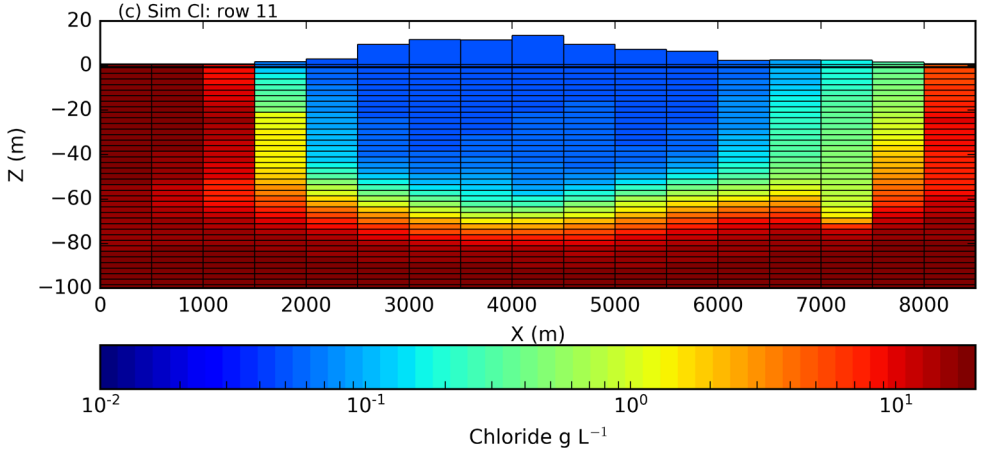


AEM-chloride conversion

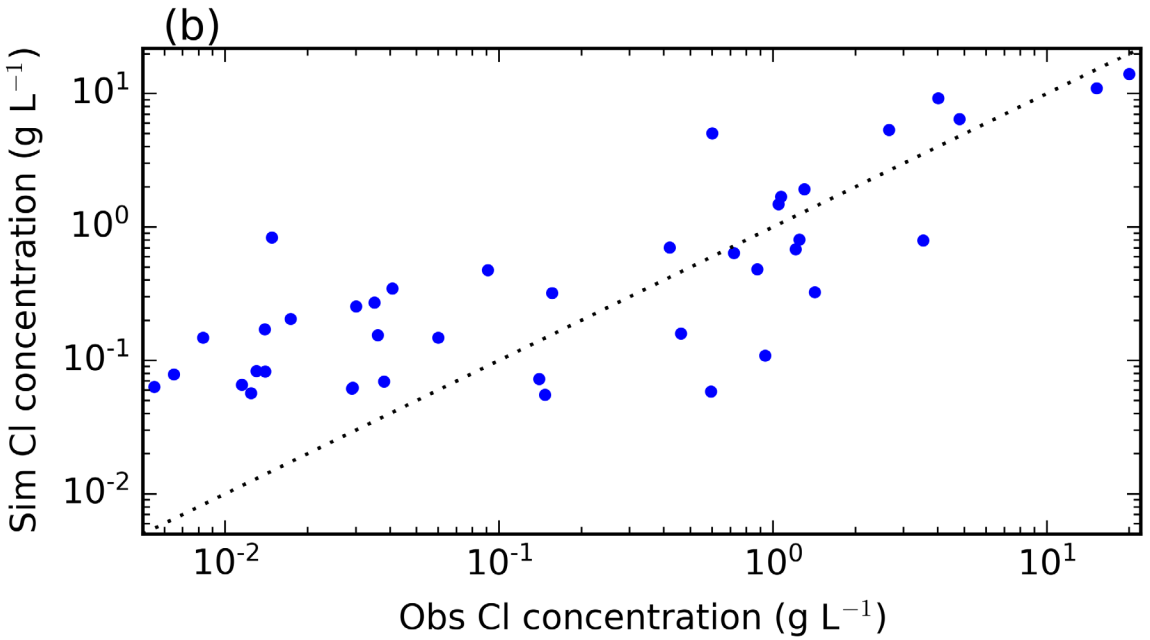


West-East cross section

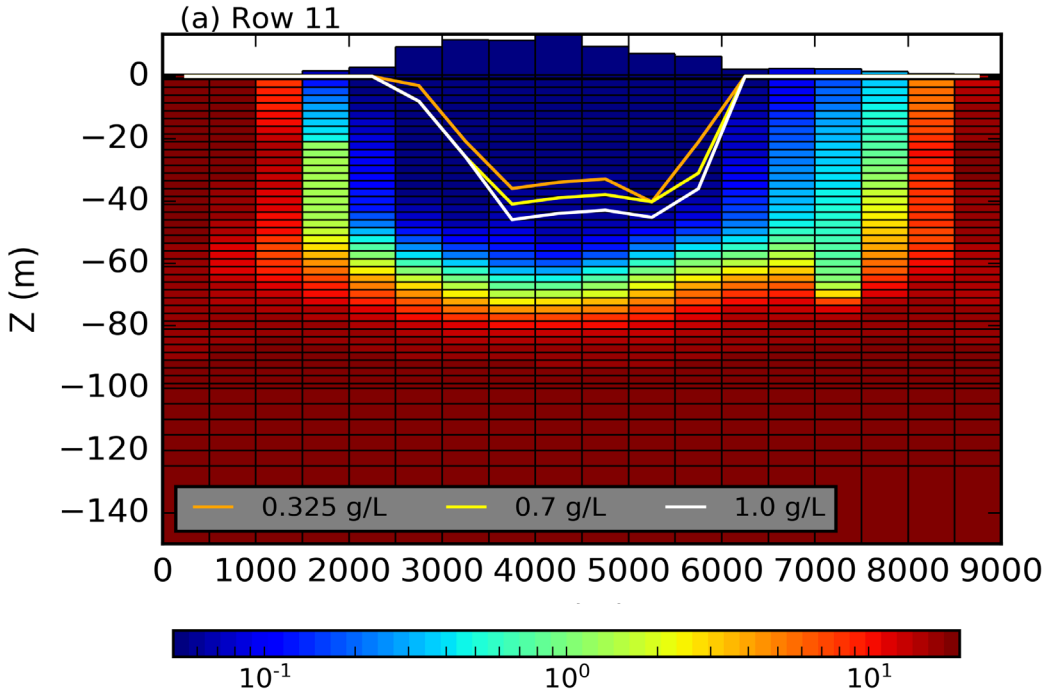
Simulated chloride

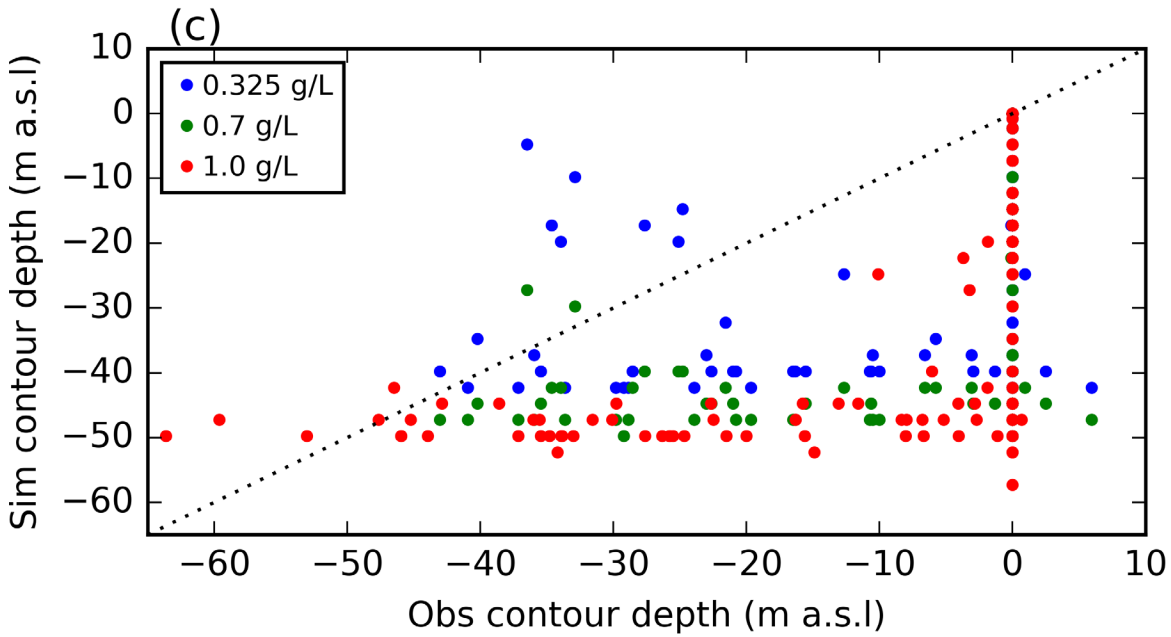


Steady state model

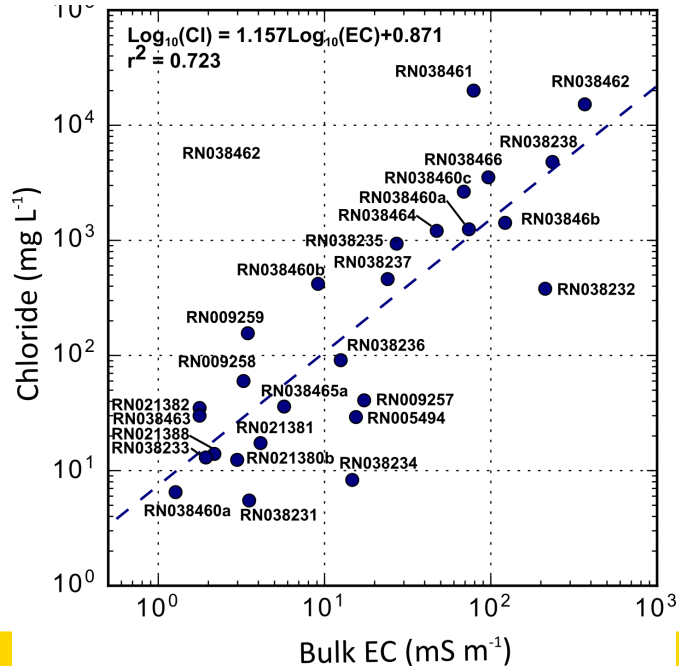


4 orders magnitude

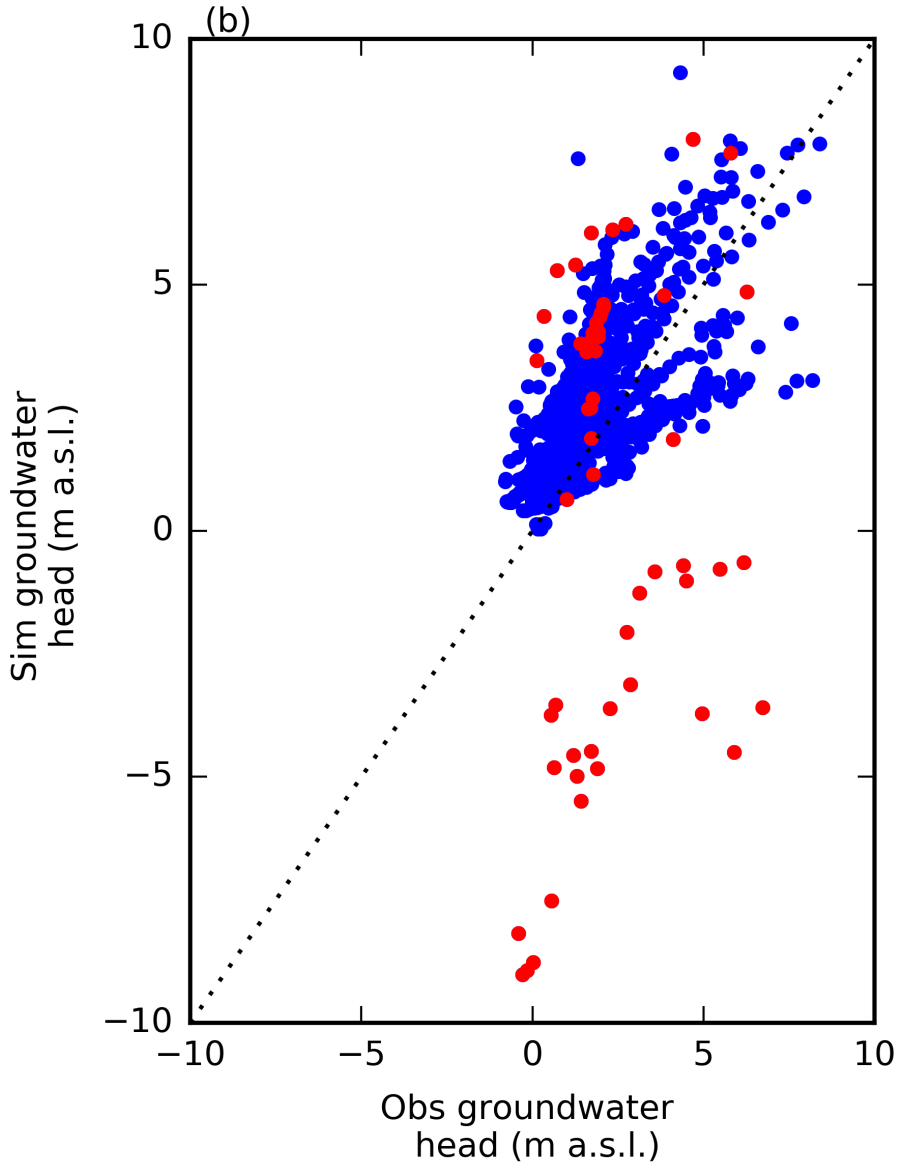




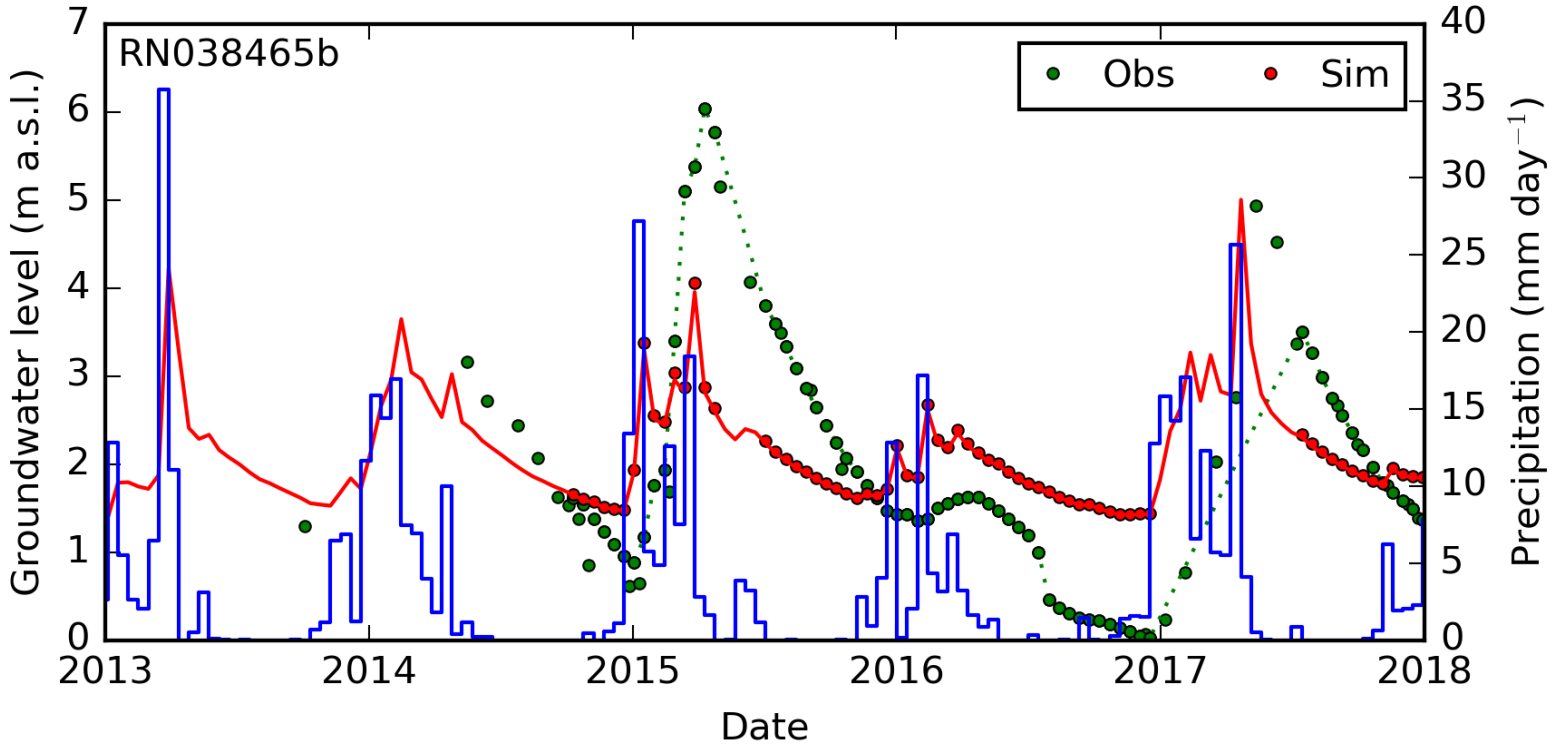
Chloride vs bulk EC



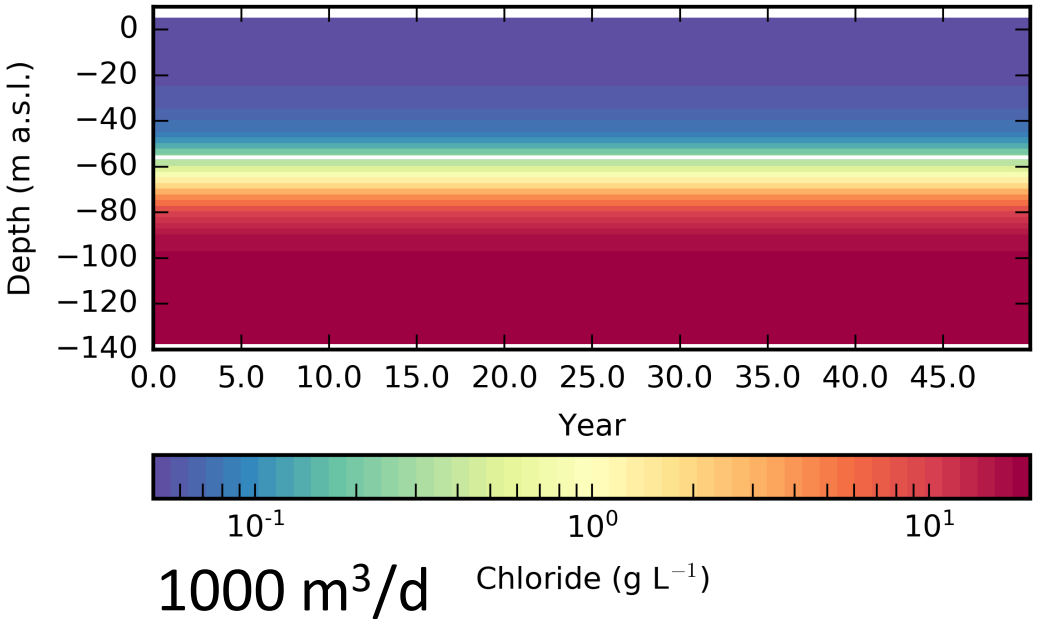
Transient model



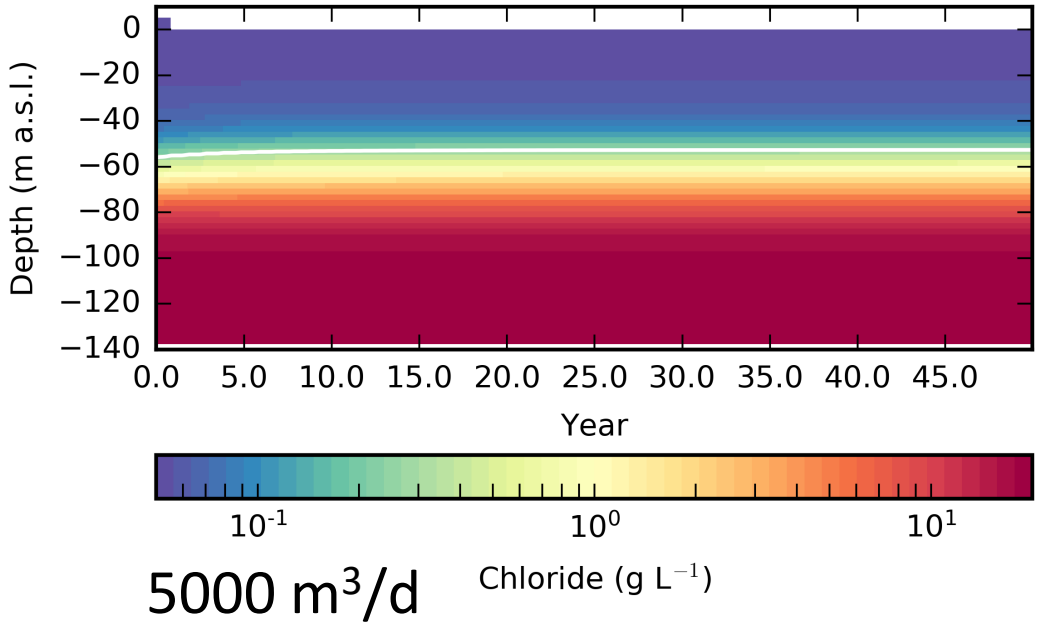
- Seasonal GW response; up to 6 m
- Calibrated to aquifer storage properties and recharge



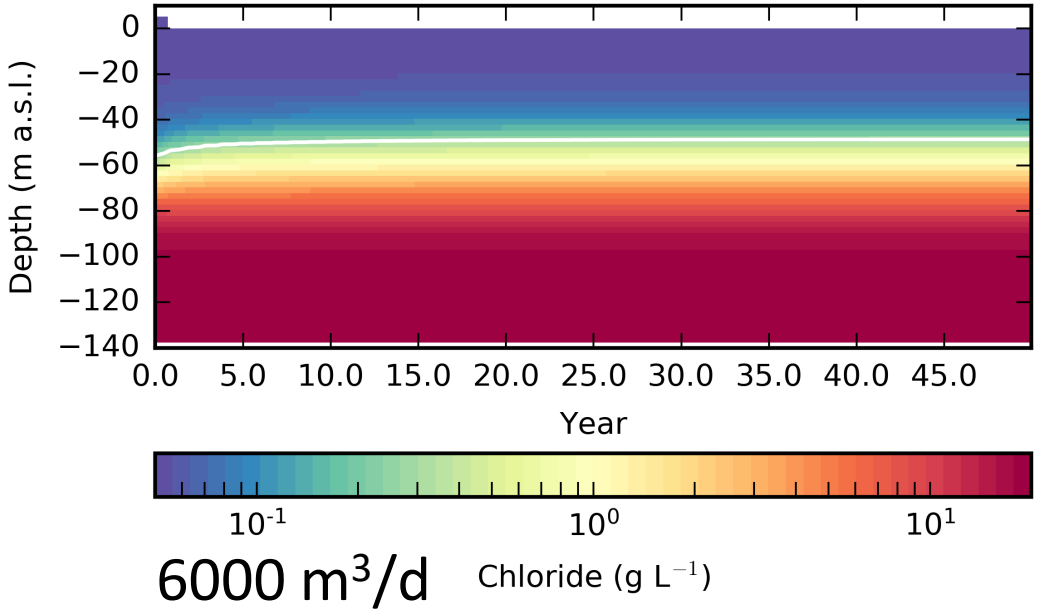
Scenarios



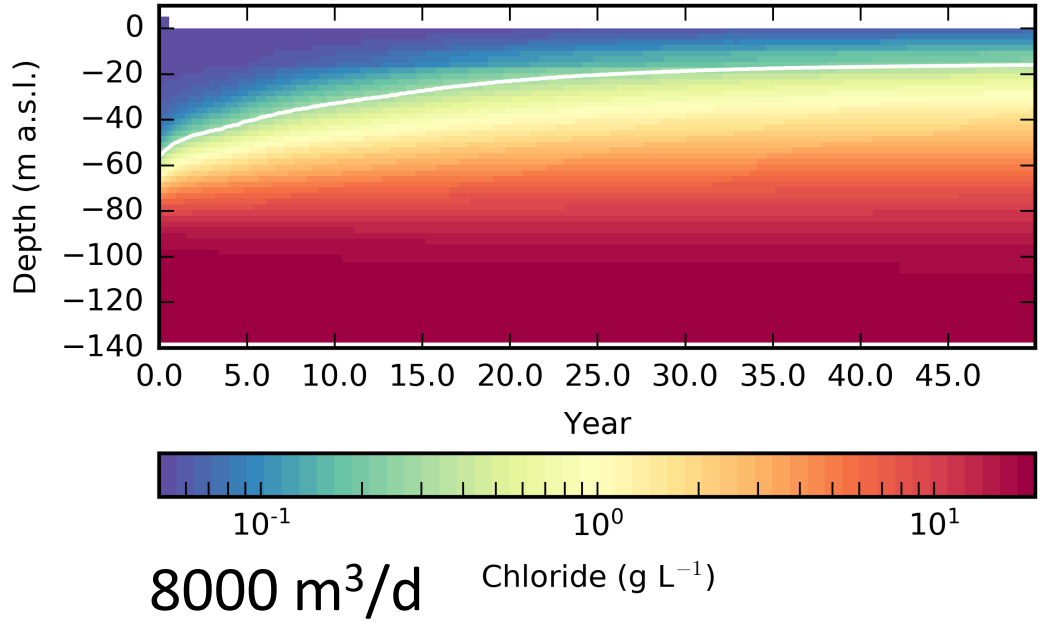
1000 m^3/d



5000 m^3/d



6000 m^3/d



8000 m^3/d

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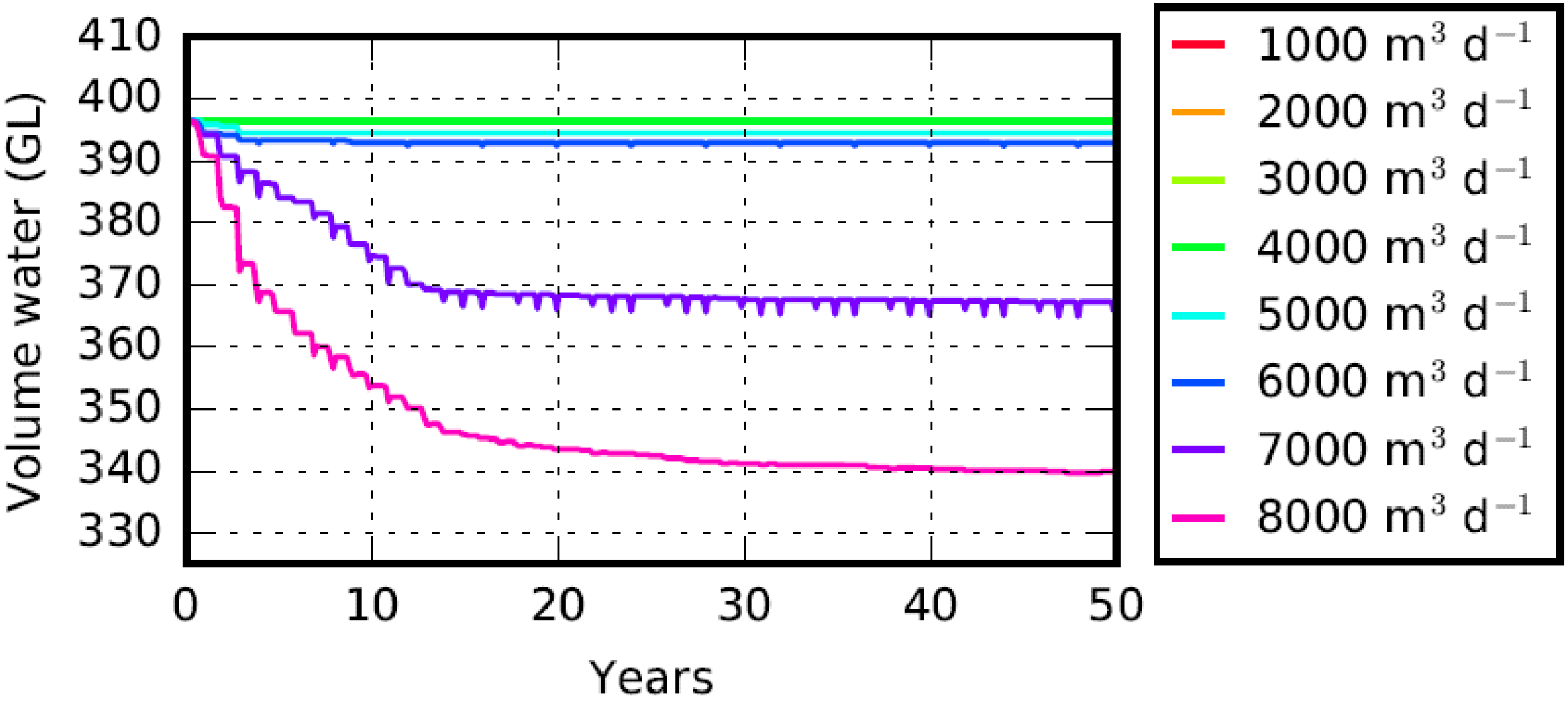
Available freshwater resource

GW pumping 3,000m^3/d (only ~15% of recharge volume)



Summary

- Multiple methods can improve both spatial and temporal information of the conceptual model.
- Near surface and AEM geophysical techniques add value to numerical models in data poor areas.
- 3D numerical model beneficial in exploring the dynamic behaviour of the lens and to determine the available water volume under different groundwater pumping scenarios.

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