What drives the decline in groundwater table?
A story of Edendale in New Zealand

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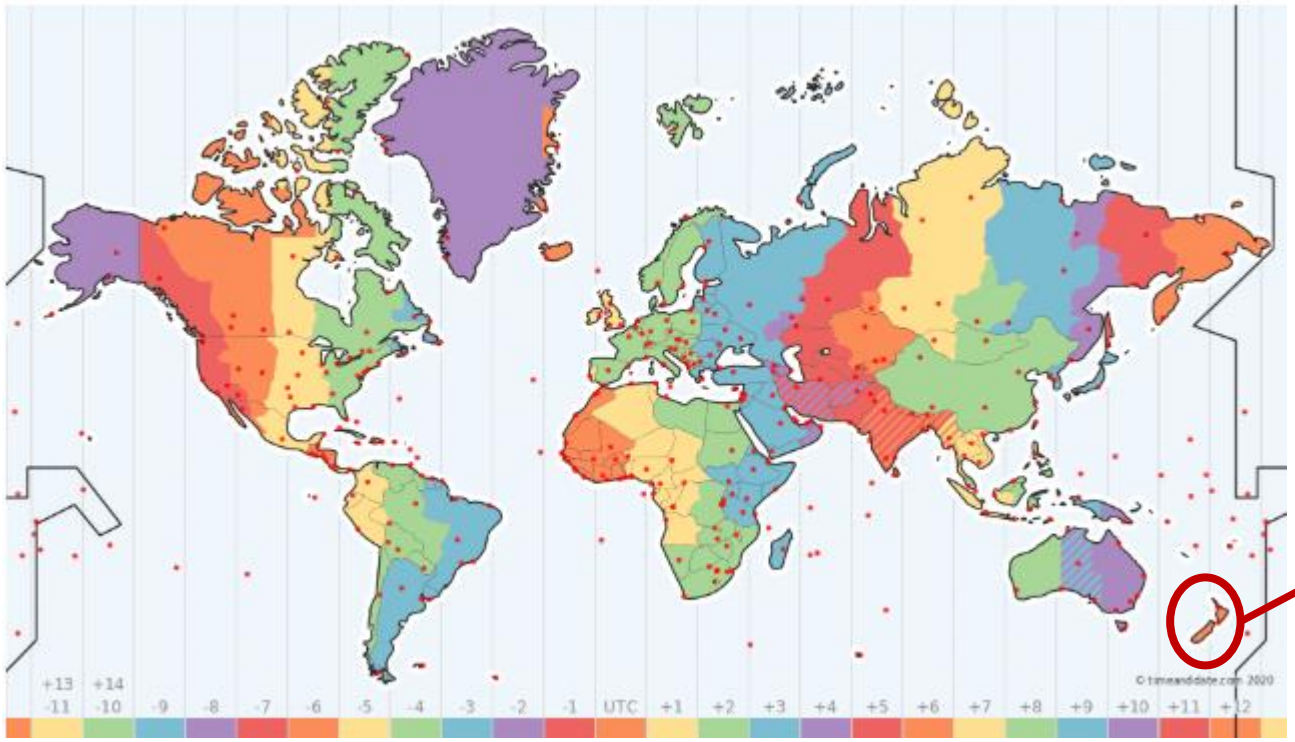
Background



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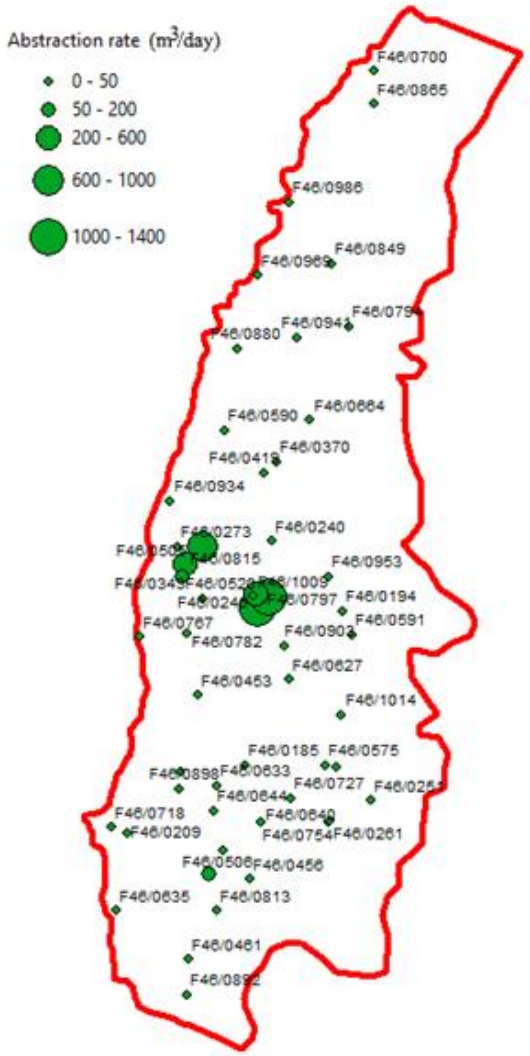
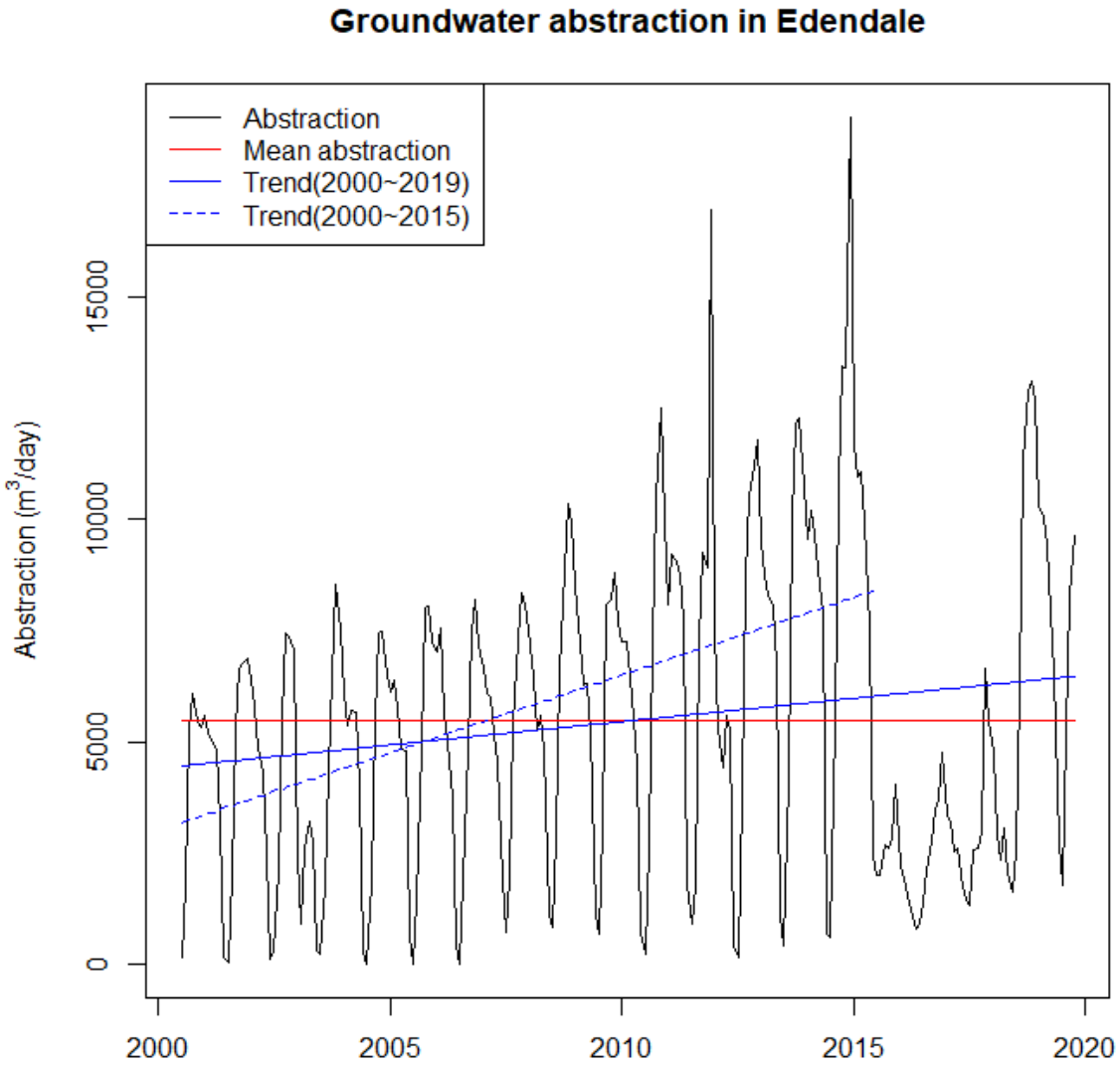
Metered groundwater abstraction





Note:
Sharp decrease in GW abstraction after 2015 is due to incomplete dataset

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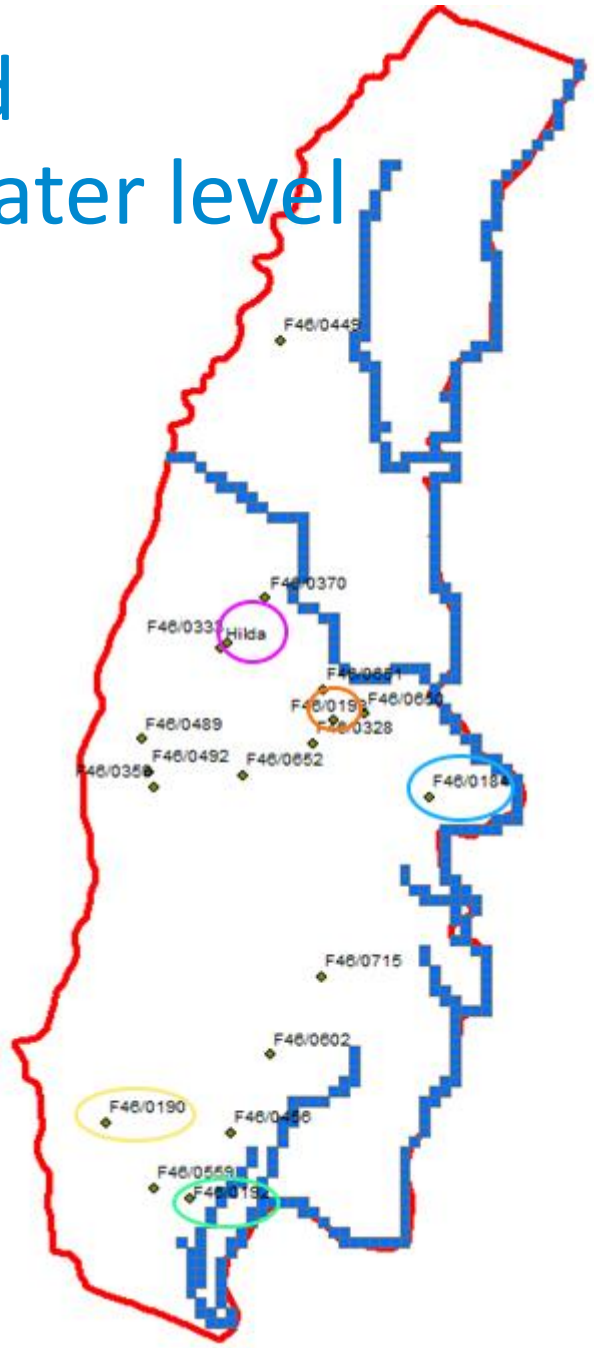
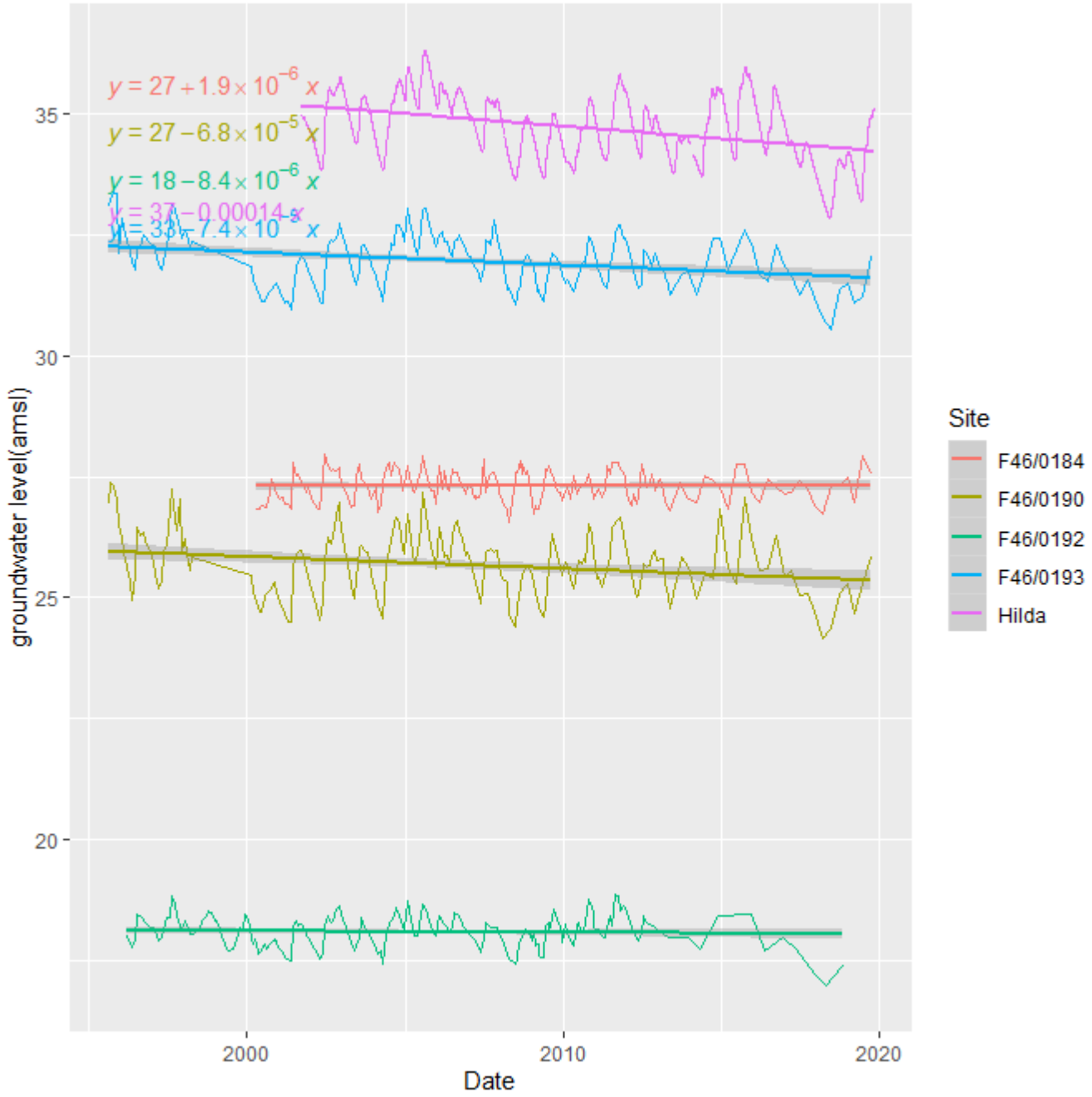
Observed groundwater level



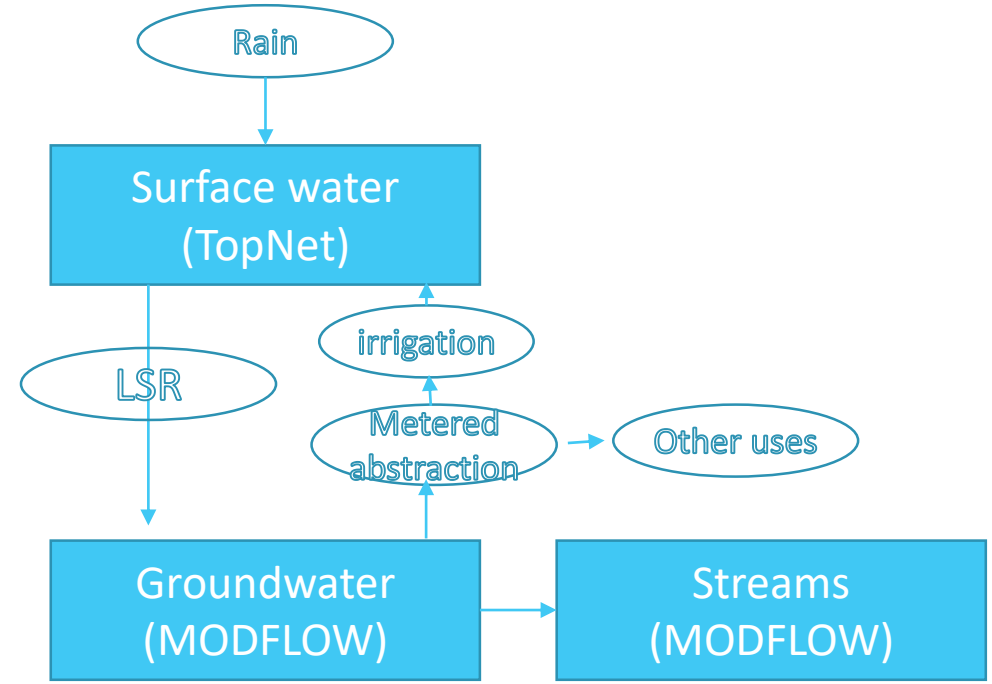


Questions from local water managers

- What is the main driving force to the declining groundwater level, climate variability or groundwater abstraction?
- Shall groundwater abstraction be strictly limited?
- What are the impacts on groundwater level and streamflow?
- …others… e.g. what are the impact on groundwater and stream ecology?

Combined statistical and hydrologic modelling

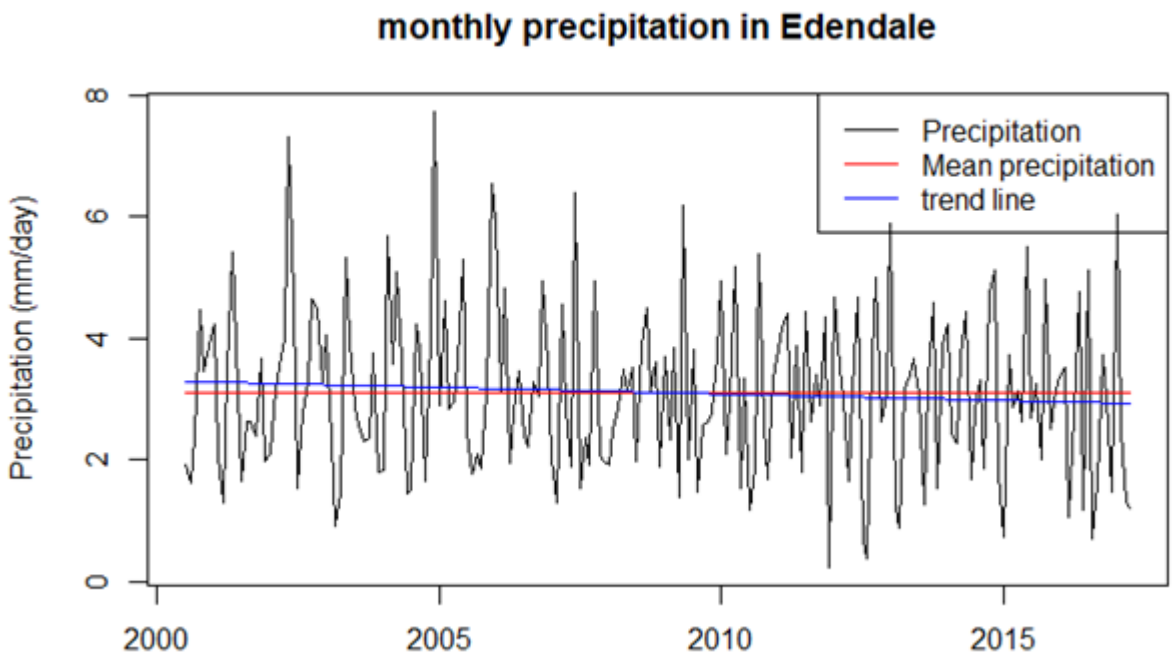
Time series trend and magnitude of rainfall and groundwater abstraction

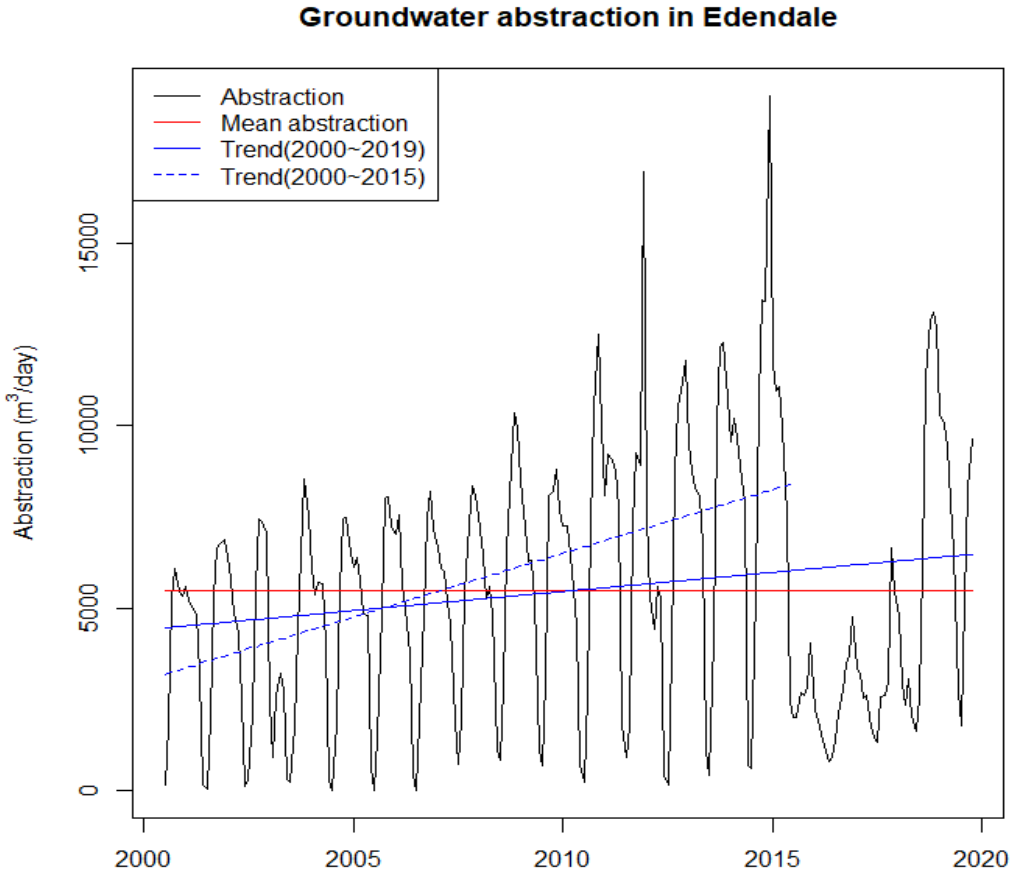


Statistical analysis

Hydrologic modelling

Statistical analysis





Annual precipitation: 1135 mm
Declining trend: 0.02 mm/a

Annual abstraction: 13 mm (5,500 m^3/day)
Increasing trend: 0.0007 mm/a (0.2865 m^3/day)

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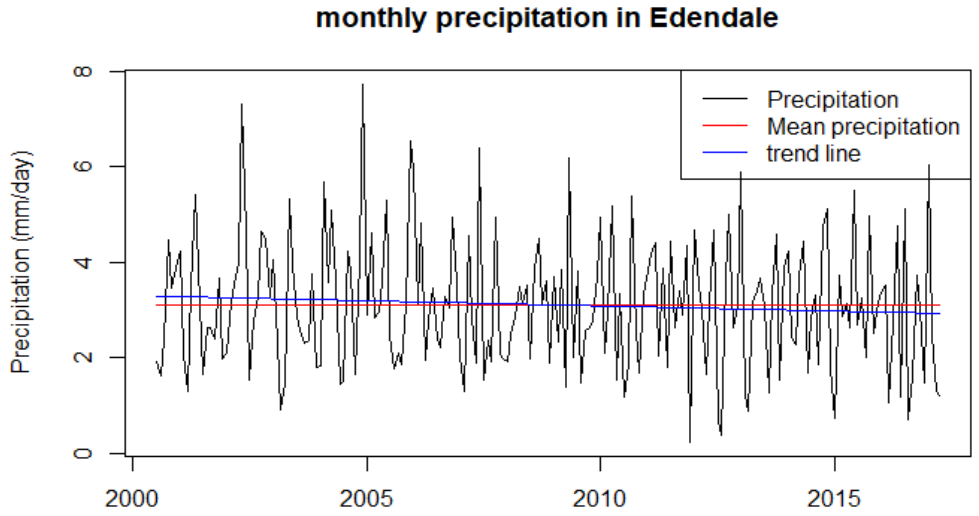
Hydrologic modelling (LSR: Land Surface Recharge)



Annual precipitation: 1135 mm
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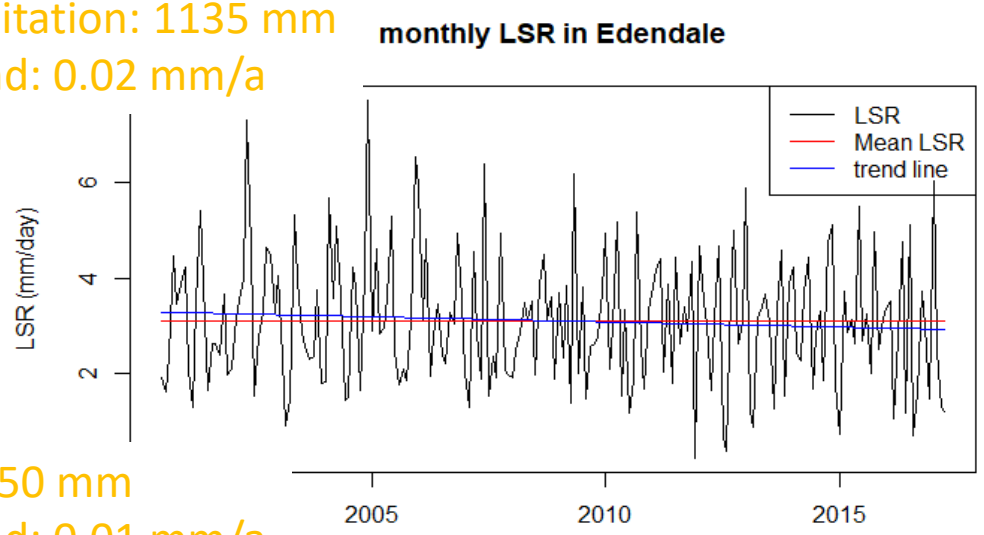
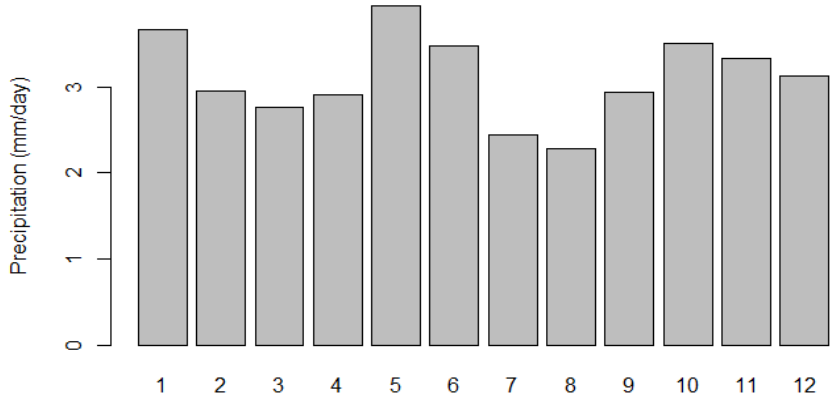
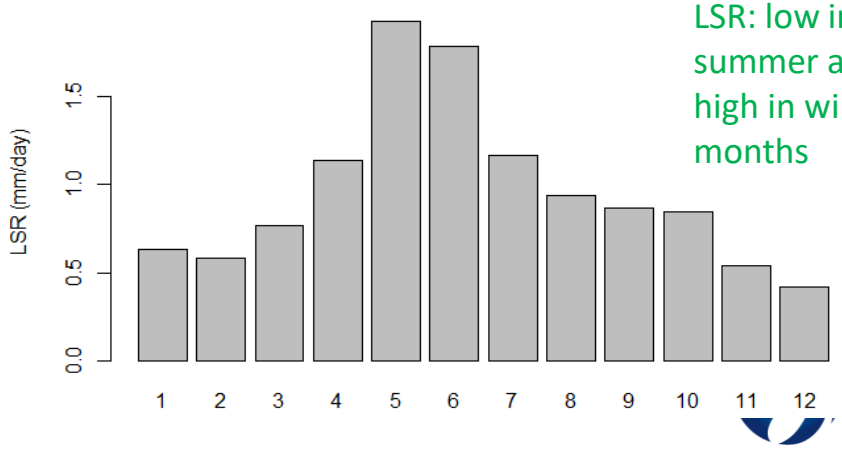


Annual LSR: 350 mm
Declining trend: 0.01 mm/a

Rainfall: evenly distributed into months



LSR: low in summer and high in winter months



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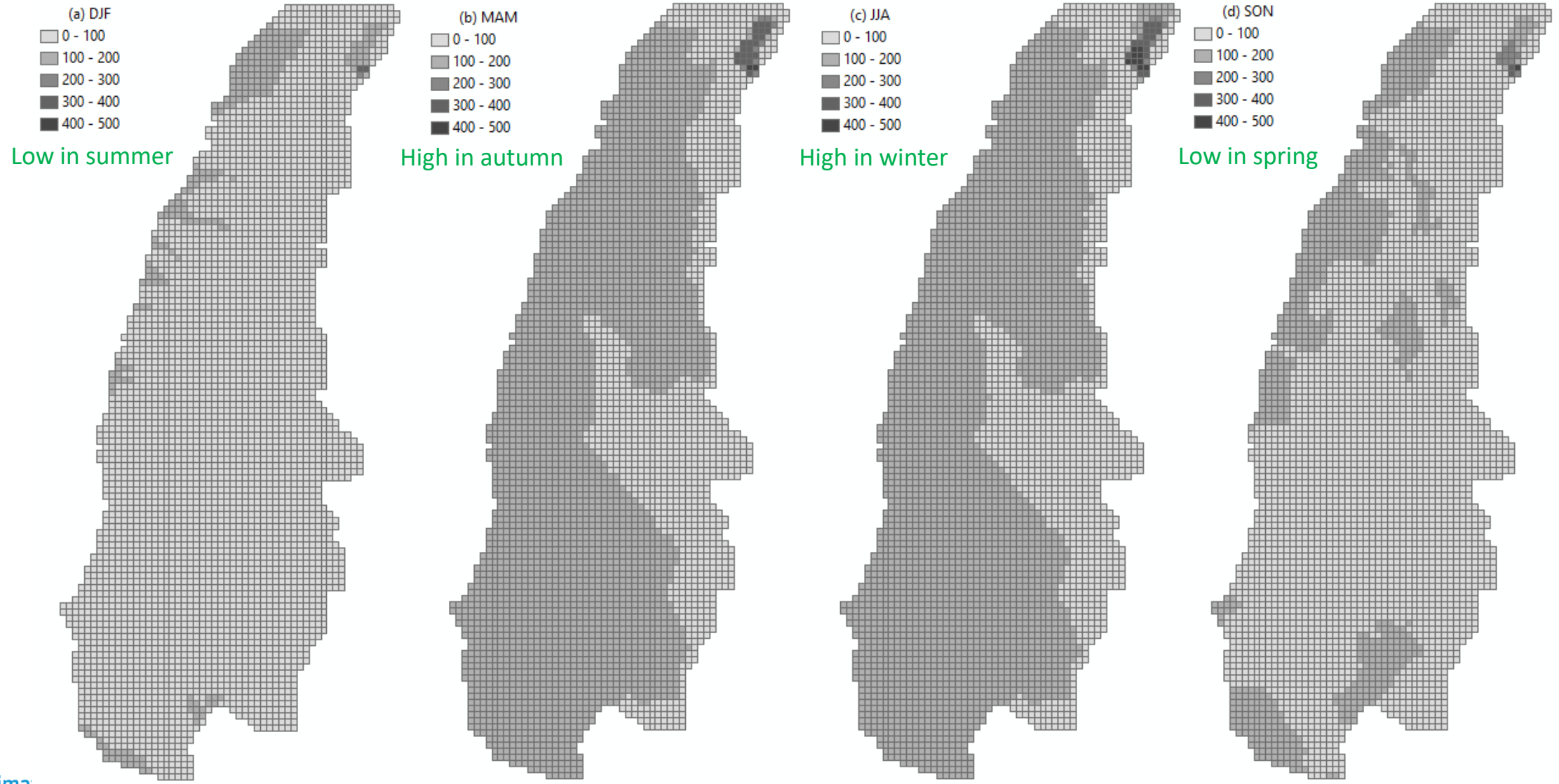
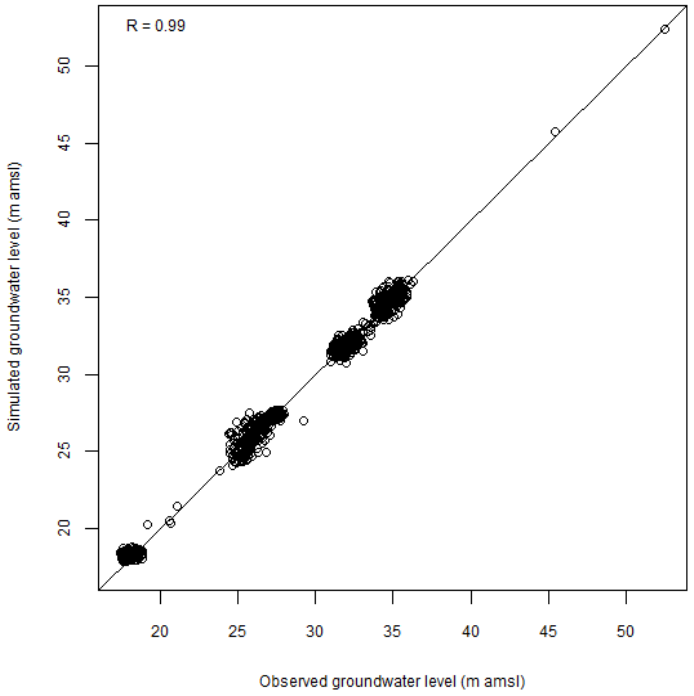
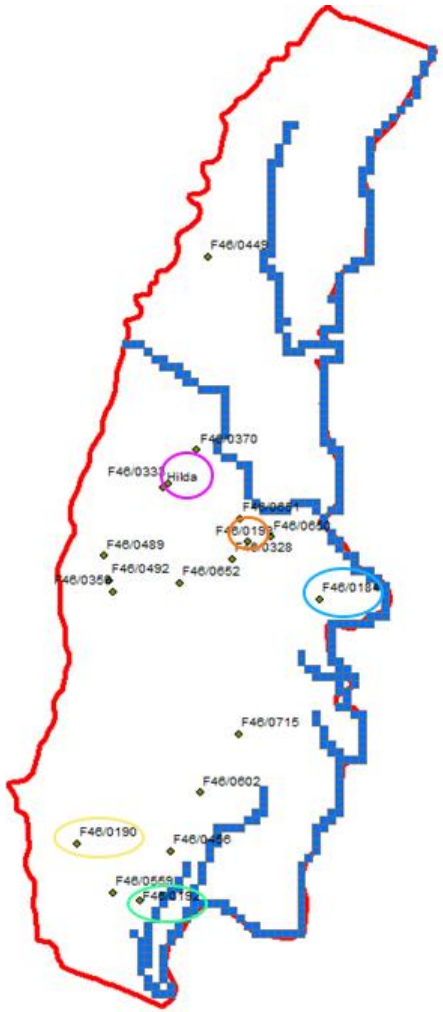
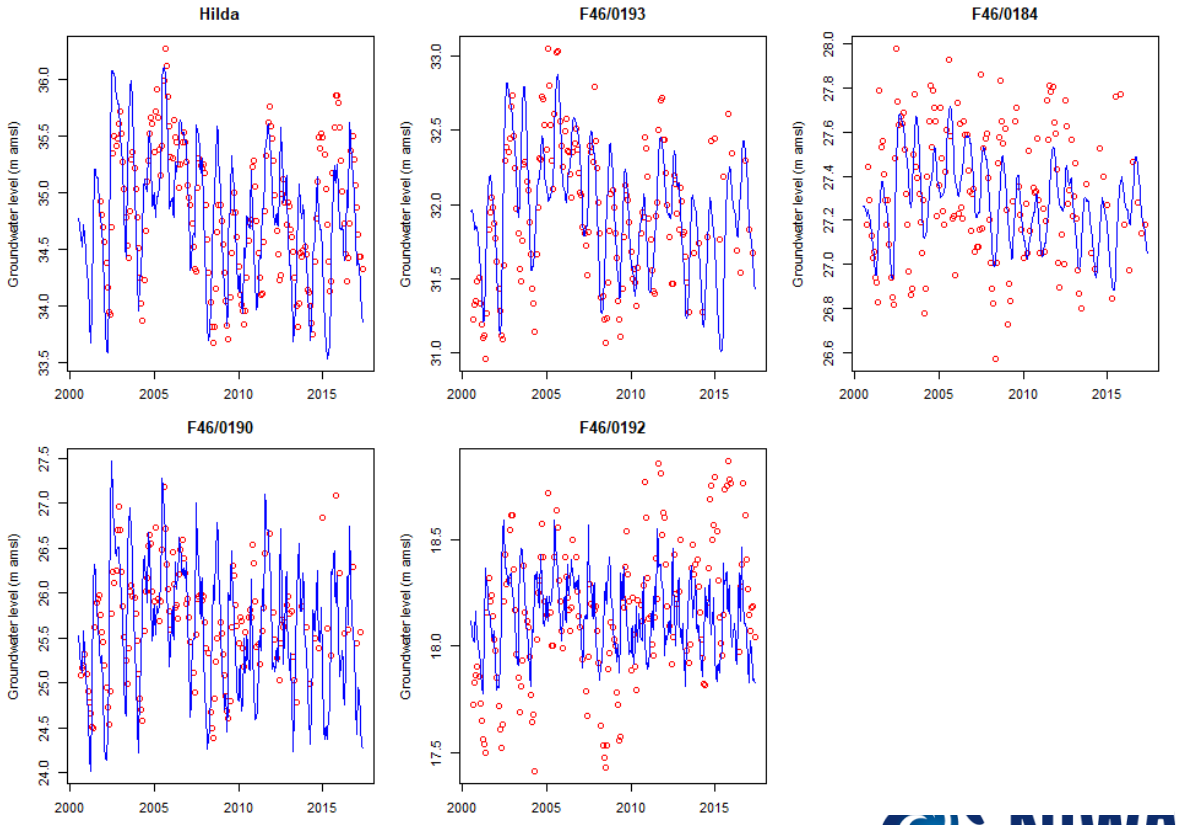
Seasonal LSR



MODFLOW calibration







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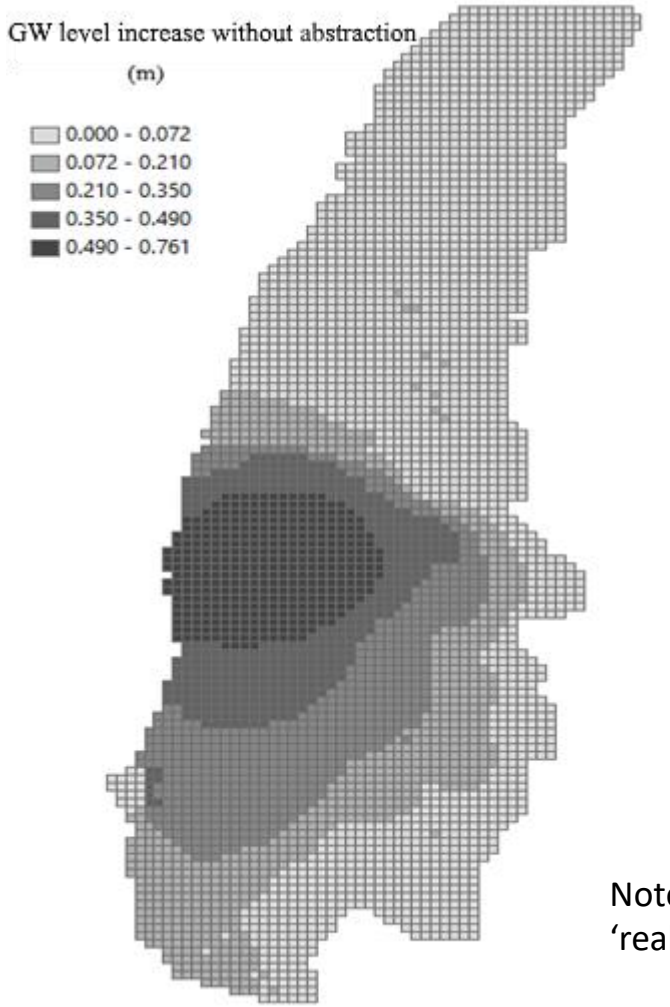
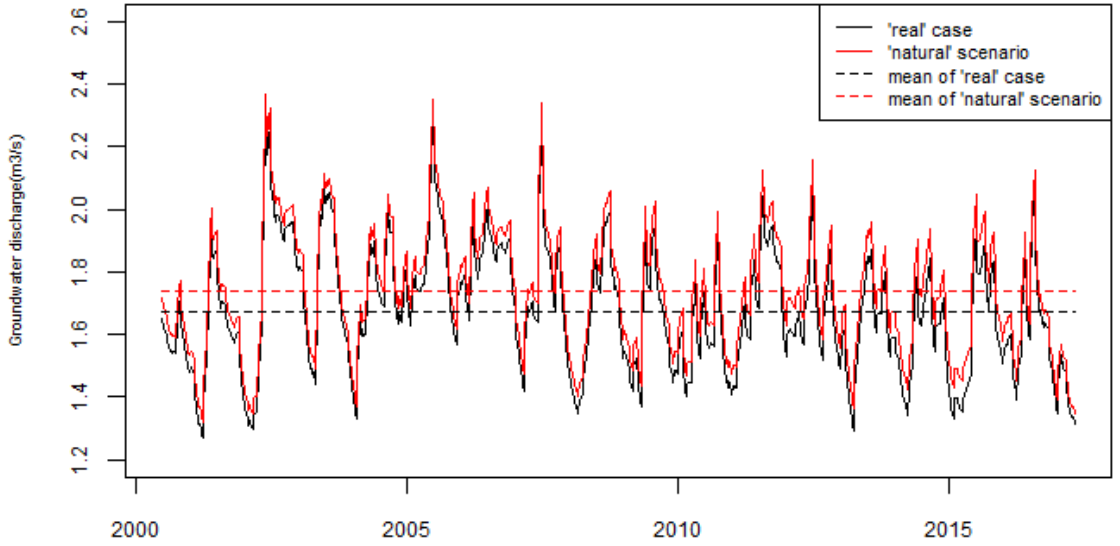
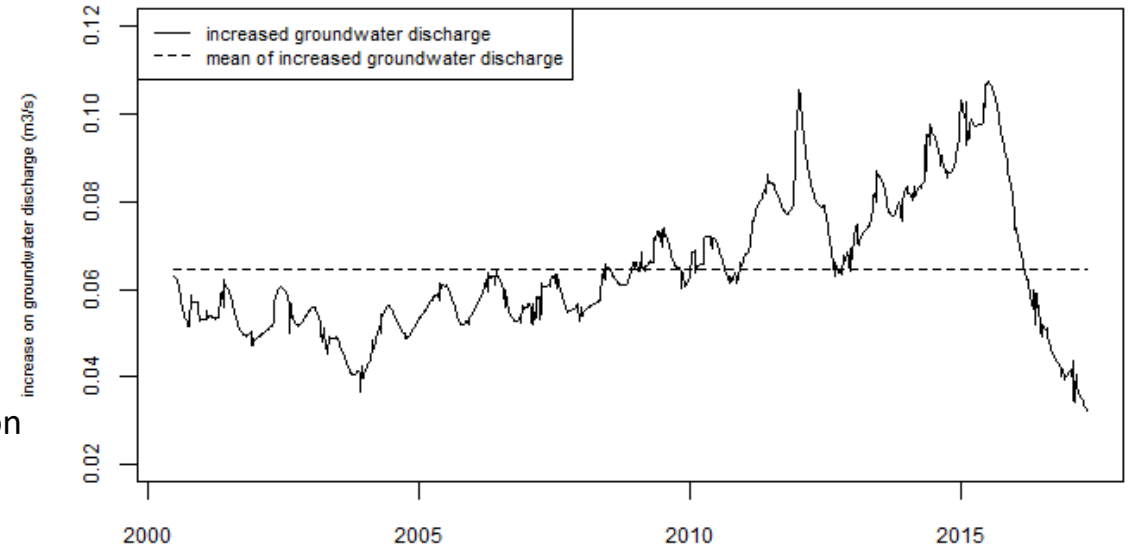
Groundwater level change without abstraction







Note:
'real' case:
current abstraction
'natural' scenario:
No abstraction

Conclusion

- From statistical analysis, at the catchment scale,

  - Annual groundwater abstraction is 3.7% of the annual rainfall

  - Decrease rate in rainfall (0.02 mm/a) is larger than increase rate in groundwater abstraction (0.0007mm/a), indicating rainfall decrease contribute more to groundwater level decline; but both rates are very small

- From hydrologic modelling

  - Spatial variability of GW level decline is contributed by both rainfall/LSR and groundwater abstraction

  - Area with large GW level decline was mainly influenced by large abstractions

Thank you

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