

# Climate Change and the Impact on Water Resources

What can we expect and what can we do?

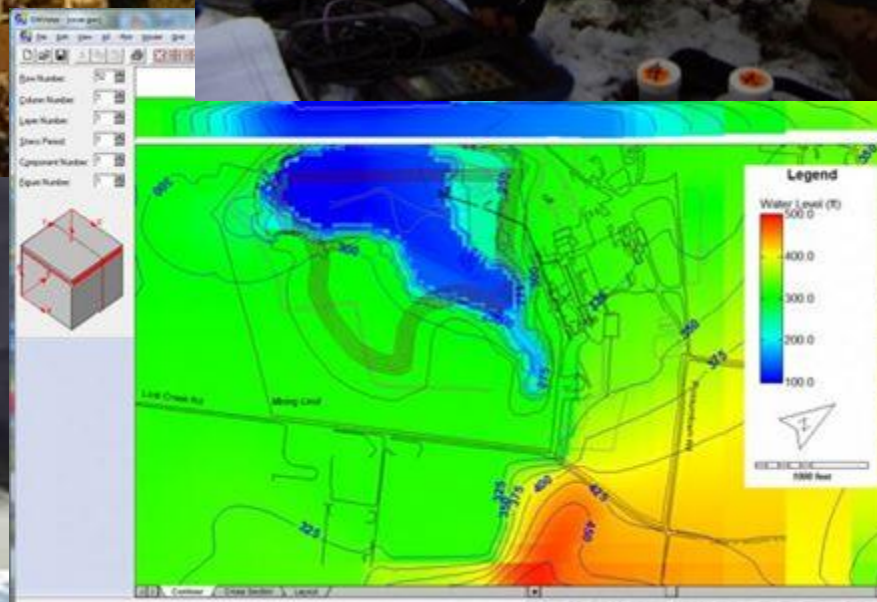
Elizabeth Sharpe

Big Green Week  
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# Overview

- .Introduction to hydrogeology
- .Climate Change influences on the water cycle
- .Current research on Climate Change impact on Groundwater
- .What can we do?
- .Q&A

# Work as a Hydrogeologist

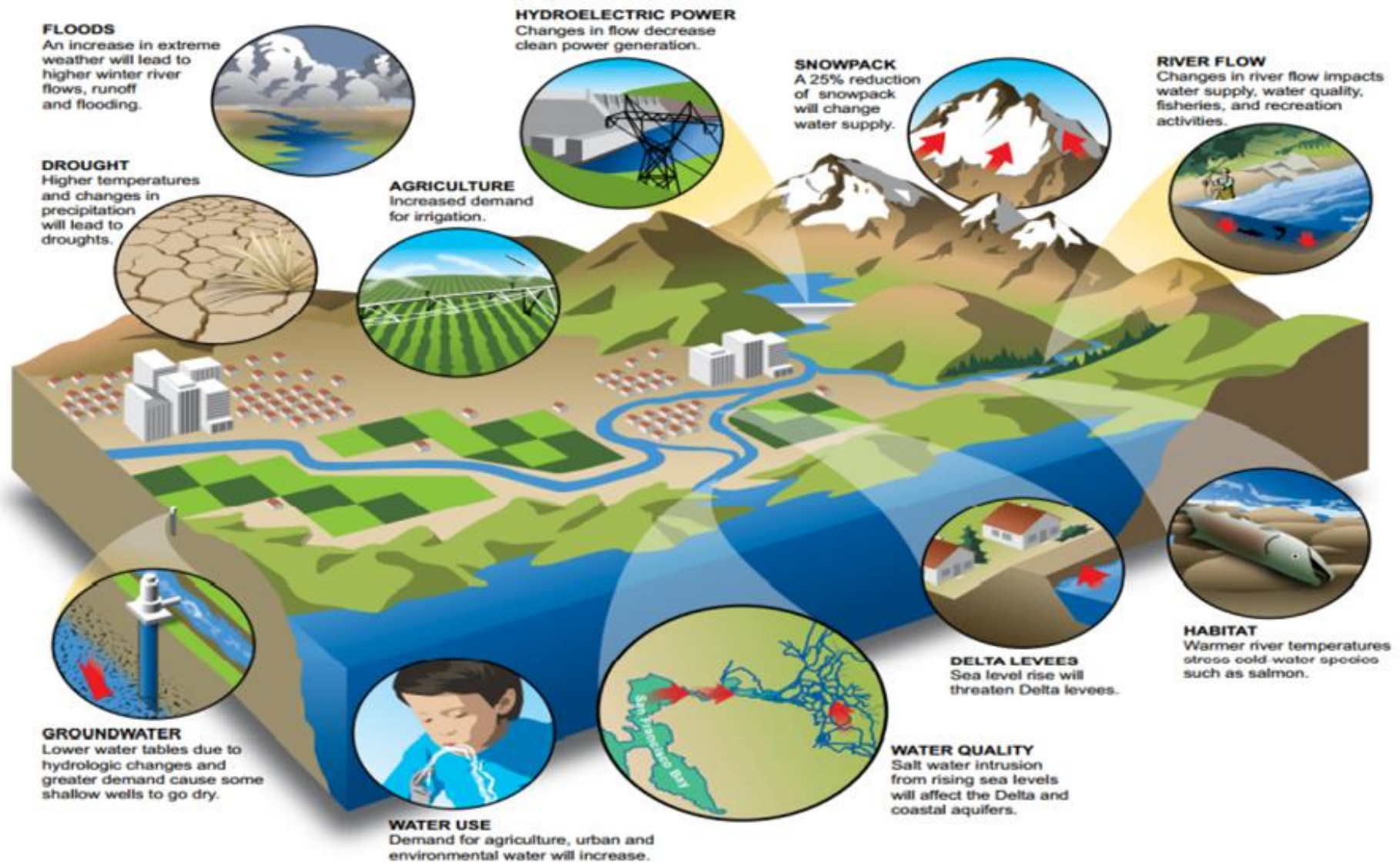


# Climate Impacts on Water

*“Water is the primary medium through which climate change influences Earth’s ecosystem and thus the livelihood and well-being of societies. Higher temperatures and changes in extreme weather conditions are projected to affect availability and distribution of rainfall, snowmelt, river flows and groundwater, and further deteriorate water quality. The poor, who are the most vulnerable, are likely to be adversely affected.”*

*UN Climate Change Adaptation: The Pivotal Role  
of Water May 2010*

# Climate Change impacts in a basin



# Potential CC Impacts on Water

## •Water levels –

- Long term trends and annual fluctuations
- Primary response to precipitation changes and secondary response due to anthropogenic response to CC

## •Water Temperature

- Long term trends and annual fluctuations due to global T changes

## •Water Quality

- Contamination
- Changes due to Water Level and Temperature change
- Anthropogenic changes

# GW Conceptual Model

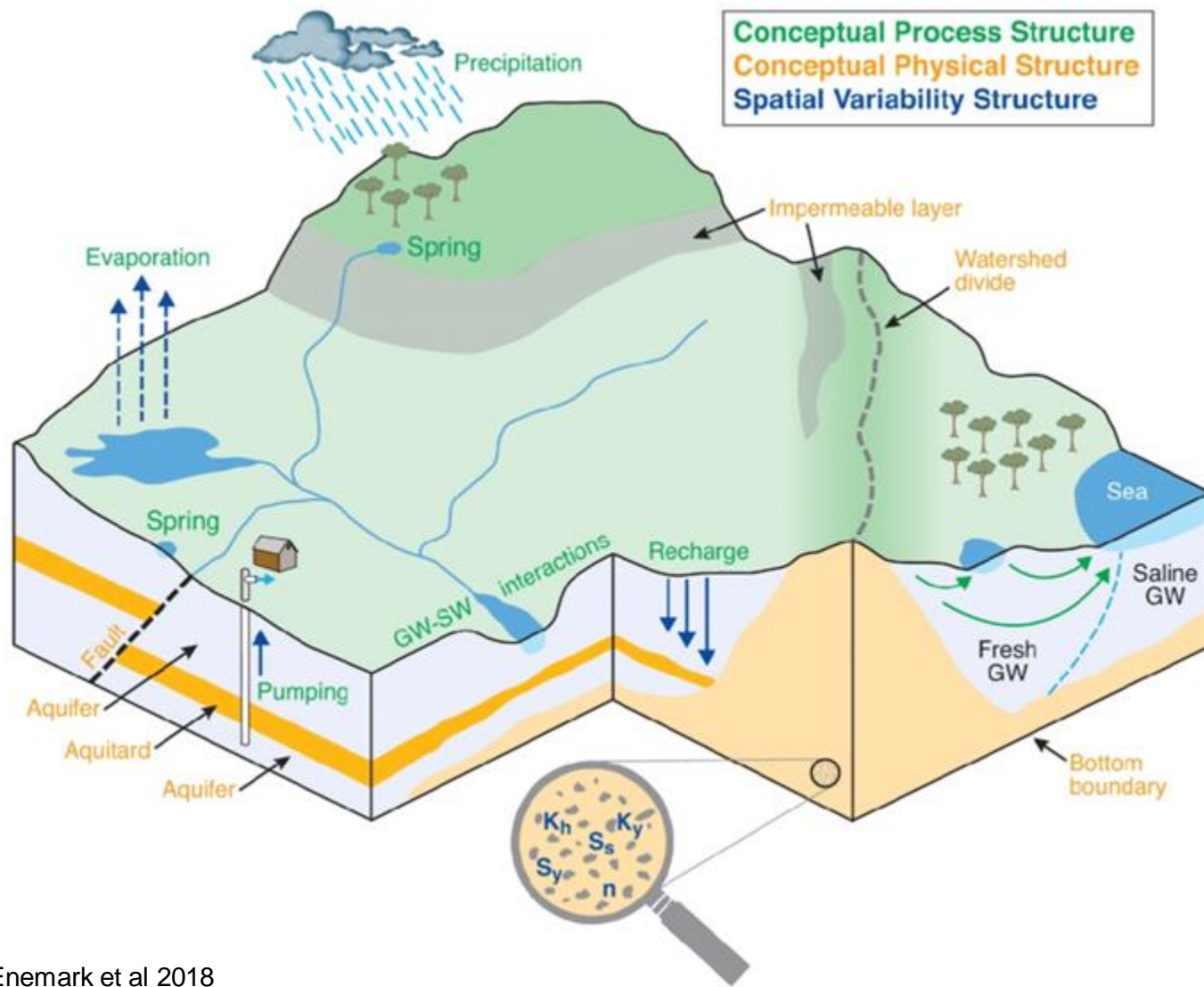


Image from Enemark et al 2018

[https://www.researchgate.net/publication/329412924\\_Hydrogeological\\_conceptual\\_model\\_building\\_and\\_testing\\_A\\_review](https://www.researchgate.net/publication/329412924_Hydrogeological_conceptual_model_building_and_testing_A_review)

# Groundwater Cycle

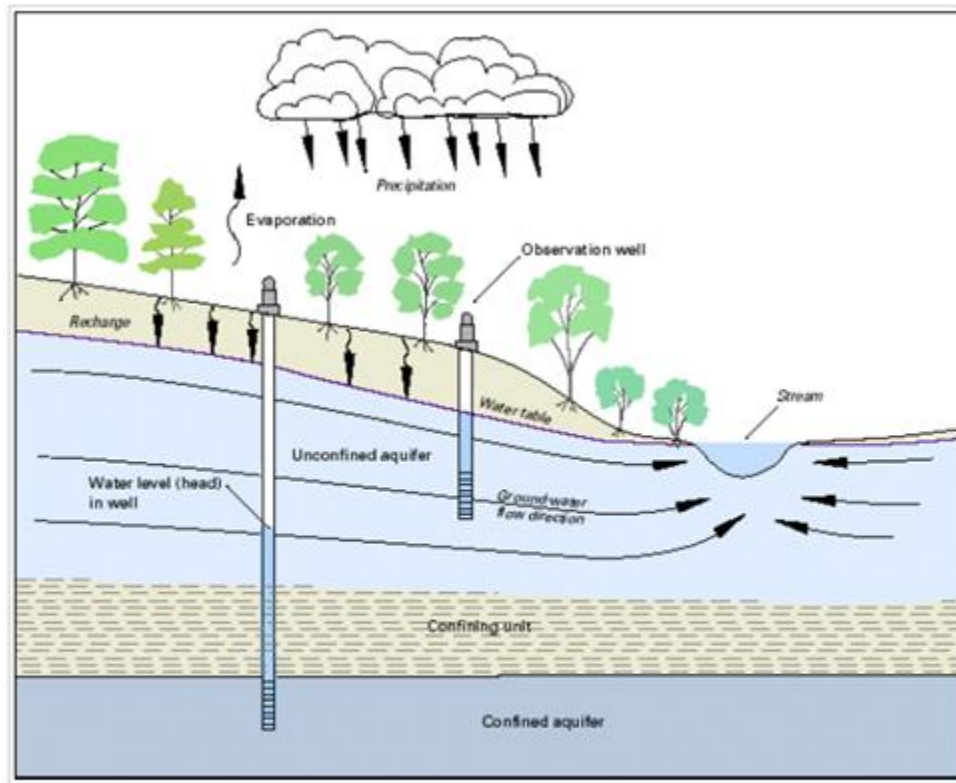
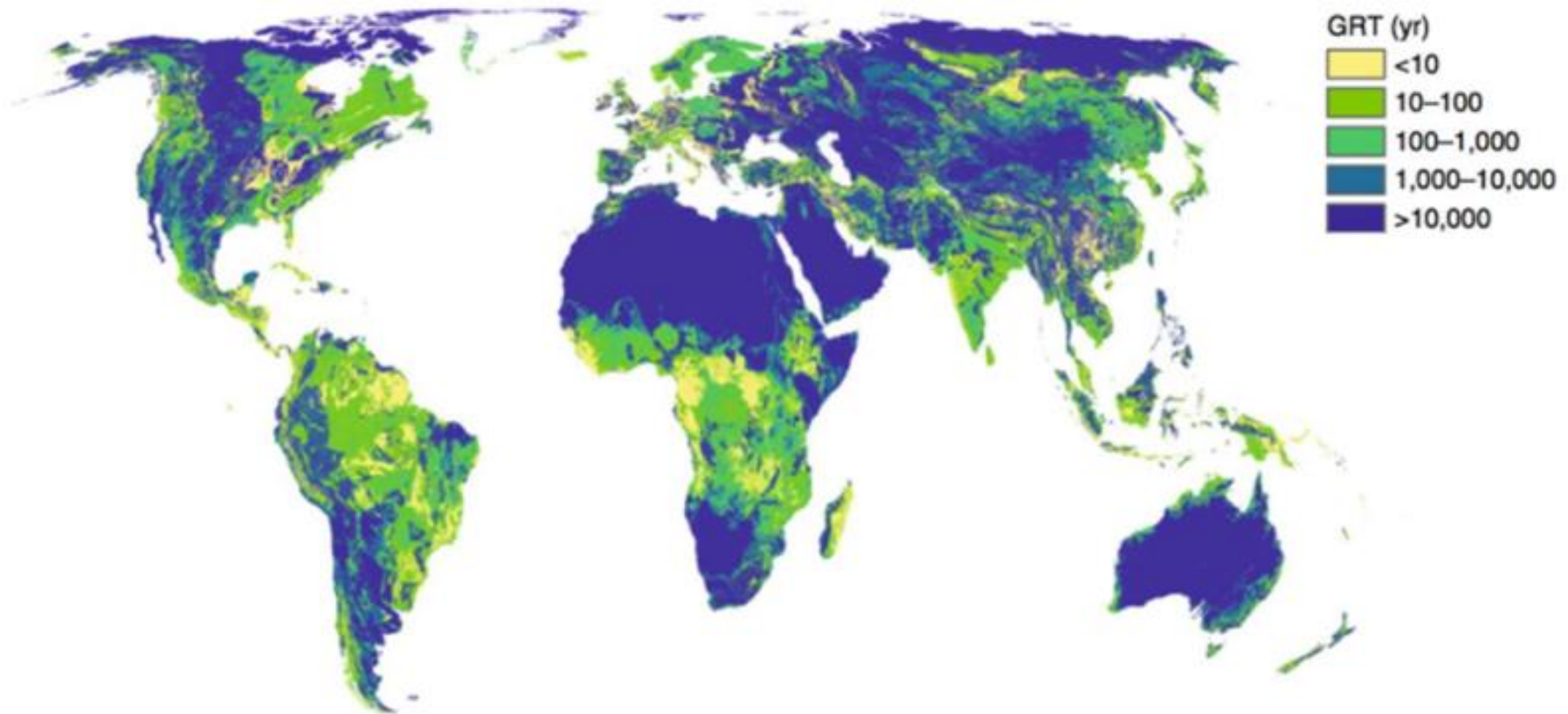


Figure 6. Schematic cross sectional diagram showing layered system with an upper unconfined aquifer above a confining unit, and underlain by a confined aquifer. Note the water level in the two wells: In the unconfined aquifer the water level in the well is the same as the height of the water table. In the confined aquifer, the water level is higher than the top of the aquifer - indicating that the aquifer is fully saturated and that the water is under pressure.

Source: [USGS Water Science Photo Gallery](#)

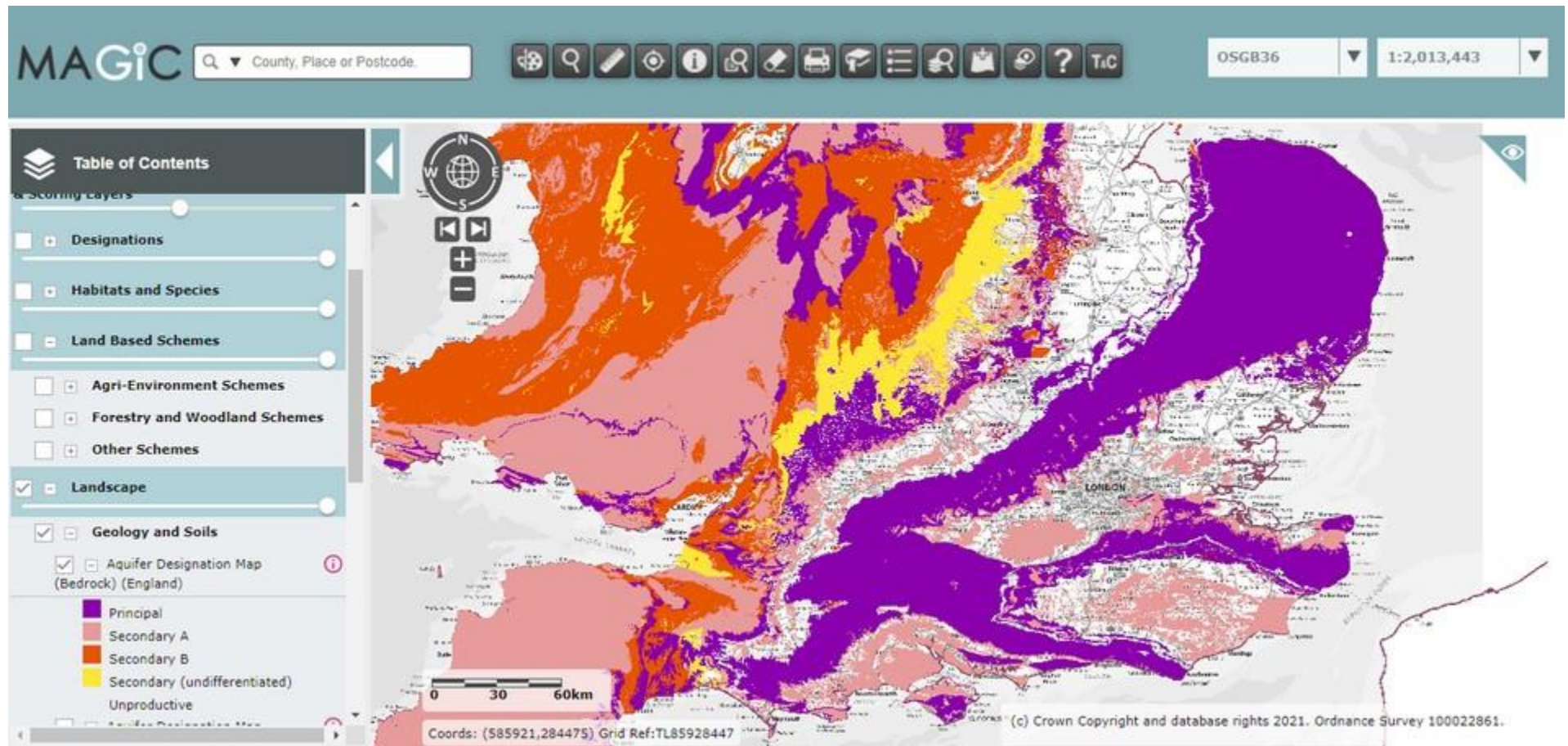


# Groundwater Response Times



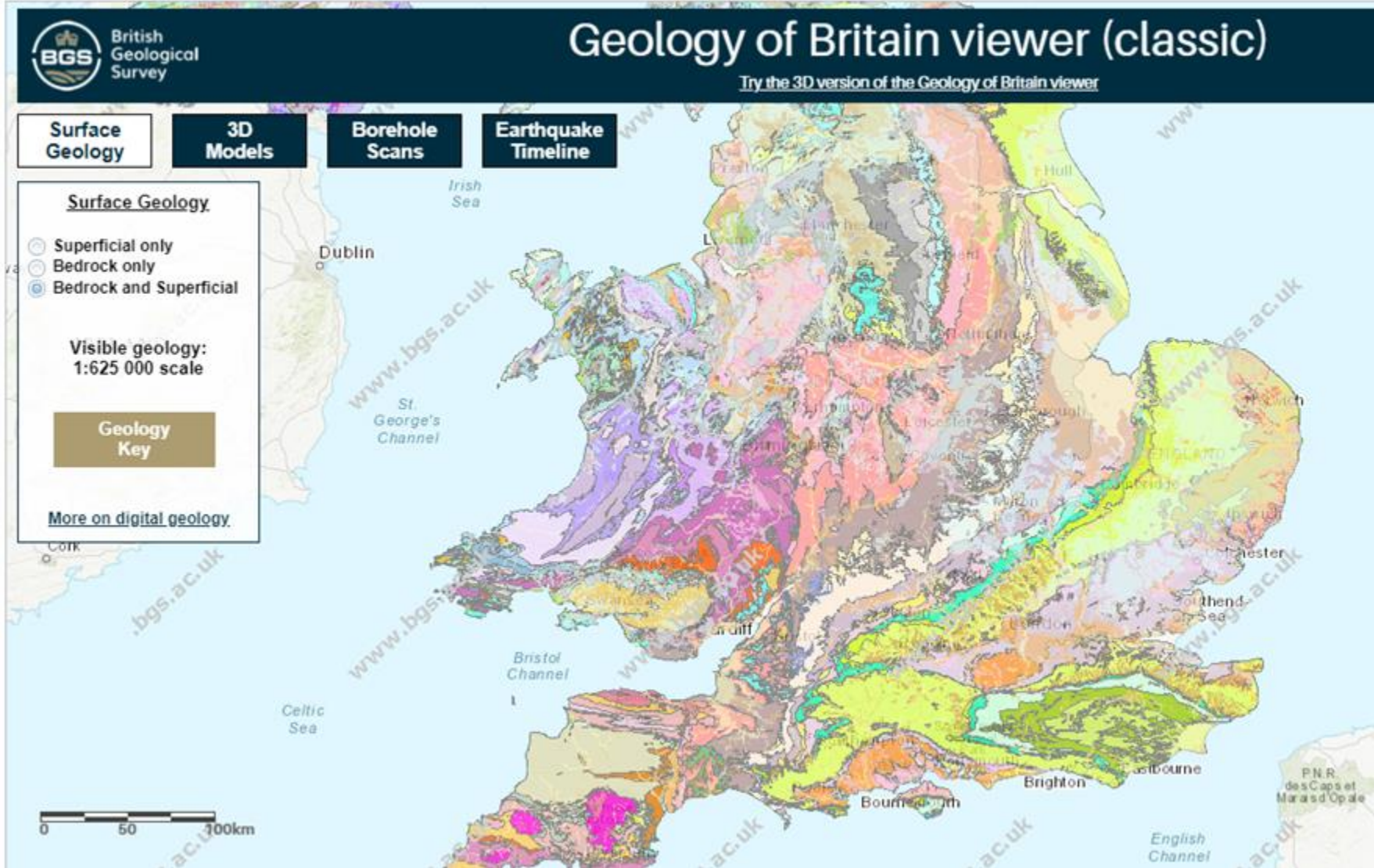
Global distribution of “groundwater response times” (GRT). Yellow shows areas where groundwater is likely to respond to stresses in less than 10 years, light green shows where the response time is 10-100 years, while dark green and blue indicate response times of 100 to more than 10,000 years. Source: Cuthbert et al. (2019)

# Southern UK Aquifers

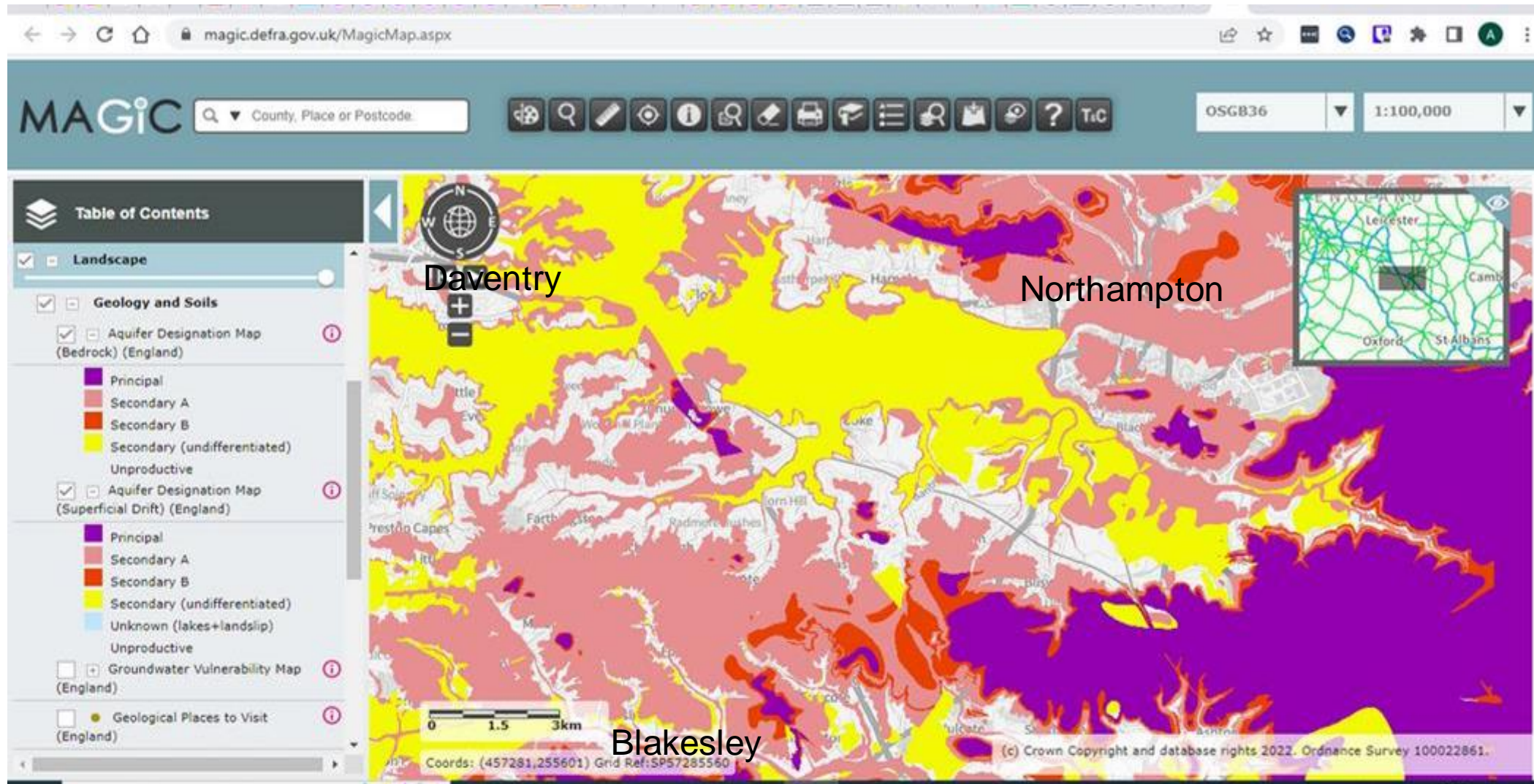


# Geology of the Southern UK

mapapps.bgs.ac.uk/geologyofbritain/home.html?&\_ga=2.124719690.1938988202.1632225601-554489845.1632225601



# West Northamptonshire Aquifer Designations



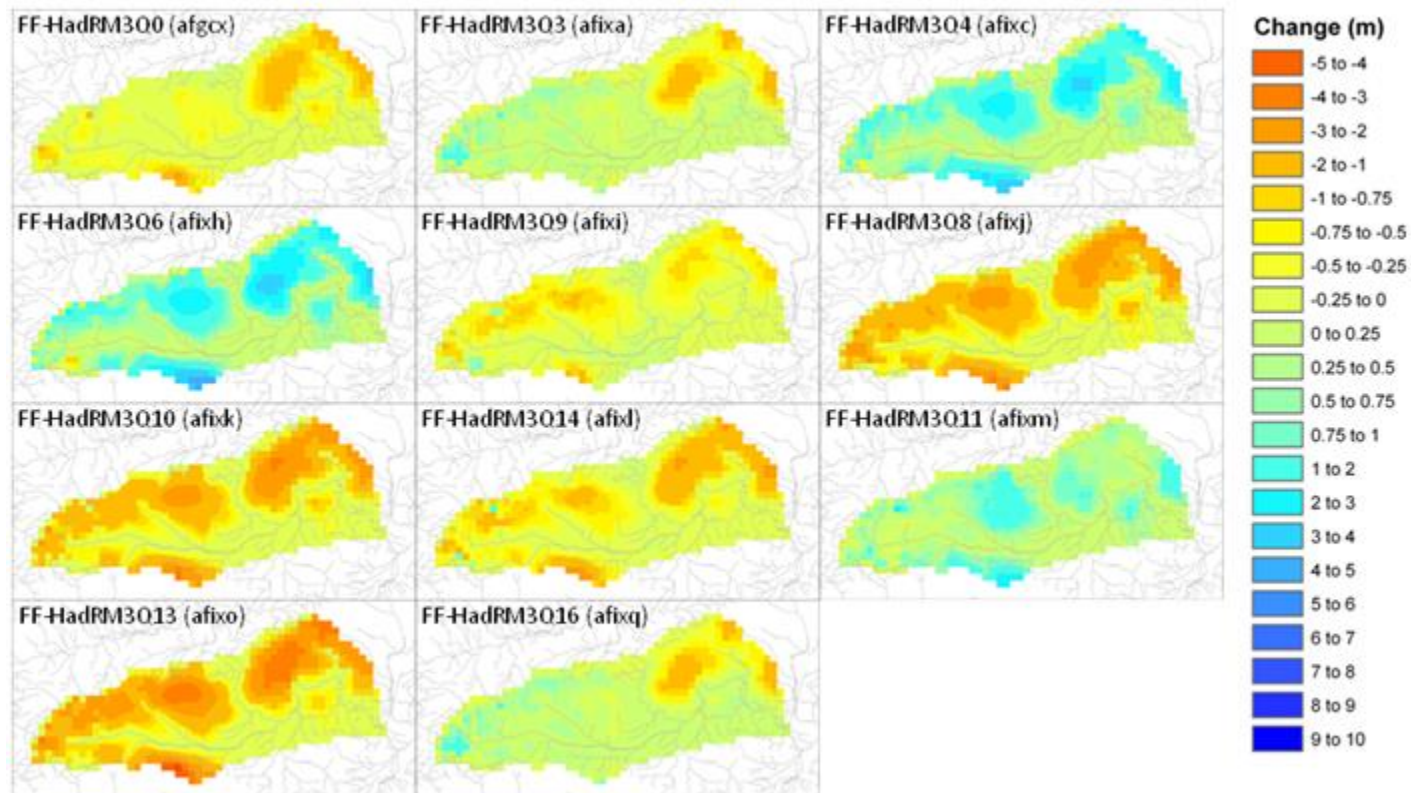
# Impact on GW Levels

- Influenced by recharge and abstraction/discharge
  - Increase in global T = decrease in recharge season
    - Jackson 2011 – higher recharge in shorter period
  - Increase in T = increase in abstraction/discharge
- Current evidence is that there's no observable statistically significant pattern.

# Modelled GWL predictions

Malborough and Berkshire Downs ZOOMQ3D  
Jackson C R, Meister R & Prudhomme C. 2011

Change in groundwater level for the 2050s: end of December



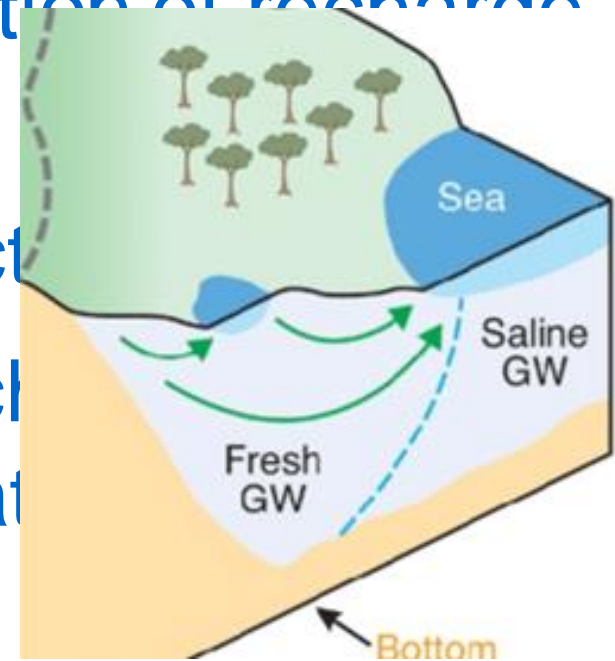
# Impact on GW Temperatures

↓

- Naturally varies with depth (10C)
- Increase in Air T = increase in GW T
- Slow response to changes for deeper aquifers- it may be a long time before we see the results
- Evidence of a median increase of 0.0102 C/yr in a 1990-2008 based on EA dataset
  - could lead to WQ change due to decrease in DO and increase in photosynthesis of aquatic plants

# Impact on GW Quality

- Increase in Global T = concentration of recharge and photosynthesis of algae
- Saltwater incursion – local impact
- Other environmental and social changes (e.g. bigger influences particularly nitrate  $\text{NO}_3^-$  in last 50 years)
  - These could be secondary impacts from adaptations and mitigations.





# What can we do?

- Individual Changes.
- Hidden water resources of our purchases e.g. cotton and almonds.
- Maximise recharge
  - SUDs
- Educate

# Purpose of SUDs

- .Diverting water away from storm drains and sewers
- .Removing contaminants
- .Slowing down water flow
- .Supporting existing habitats and creating biodiversity

# SUDs



# Domestic Rainwater Harvesting

- .5000l tank, filled over 3 days from 170m<sup>2</sup> roof
- .Lasts a family of 6 approx 1 month
- .But is dry for most of the summer
- .Retrofitting



# Education



# Conclusions

- Climate Change impacts on water are complex and many.
- Impacts on Groundwater are uncertain and highly dependent on land use (and subsequent changes)
- High variation in GW response times to CC may be acting as a buffer at the moment but may also be a ticking time bomb for the future.
- There are small things that we can do as individuals but really we need to be calling local, national and global governments to act on mitigation and adaptation measures.
- Education is a key part of this.

# Sea Level Rise + Extreme events

