



**British  
Geological Survey**

NATURAL ENVIRONMENT RESEARCH COUNCIL

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# Evidence for hydrogeological controls on spatio-temporal variations in groundwater droughts in the UK

**John Bloomfield, Andrew McKenzie,  
Murray Lark and Rob Ward**

Groundwater Systems Analysis and Management Team,  
British Geological Survey, Wallingford

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# Context



As a precursor to assessing how useful the Index Borehole network is for drought monitoring and warning

How do groundwater levels vary spatially and temporally during a drought at the national to regional scale?

Can we identify hydrogeological controls on groundwater response to drought?

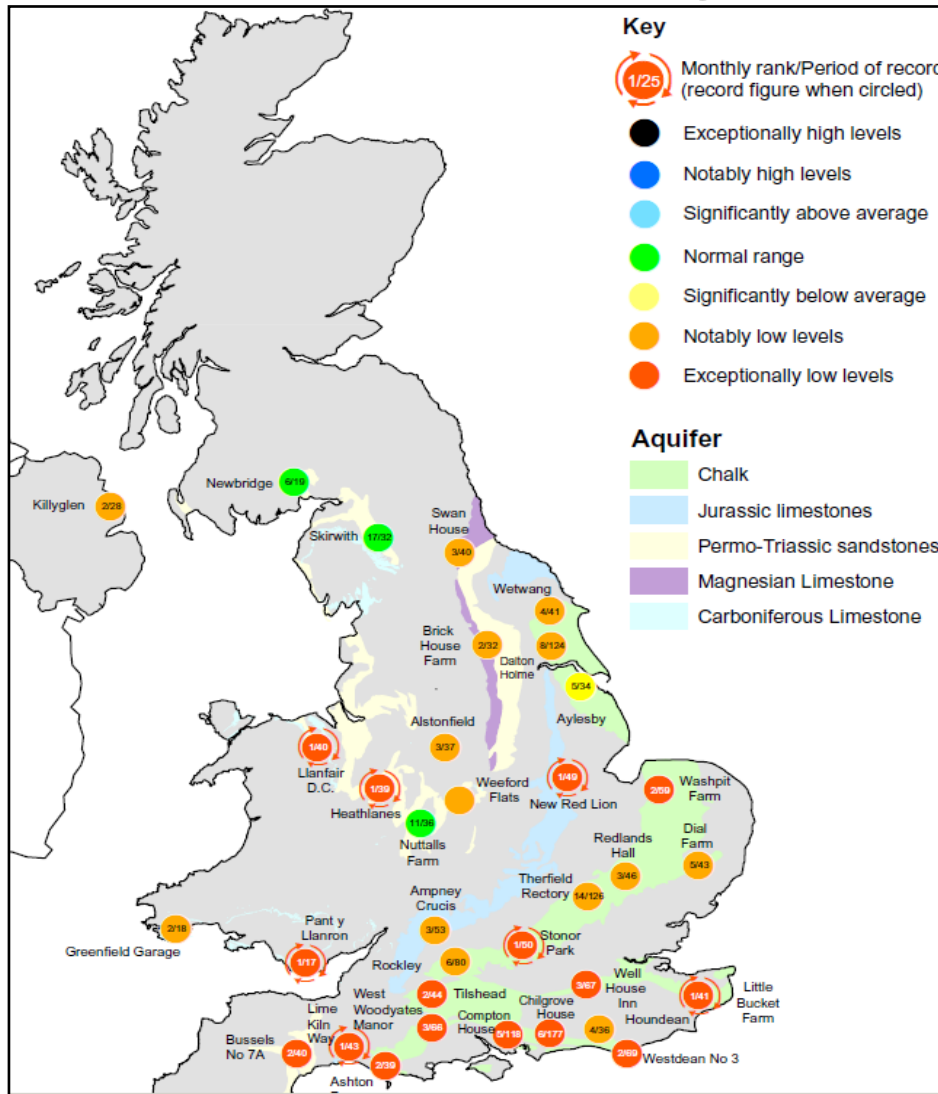
# Overview

- Characterising groundwater drought (GWD)
- A new, quantitative measure of groundwater drought - Groundwater level Index (GLI)
- Spatio-temporal coherence in GW droughts
- Evidence for hydrogeological controls on groundwater response to drought
- Summary and (groundwater) research needs

## Drought is:

a 'sustained and regionally extensive occurrence of below average **[ground]**water availability' associated with significant precipitation deficits (Tallaksen and van Lanen, 2004)

# Characterising GWD



Graphic representation (monthly rank / period of observation) as used in the Monthly Hydrometric Summaries

[http://www.ceh.ac.uk/data/nrfa/nhmp/monthly\\_hs.html](http://www.ceh.ac.uk/data/nrfa/nhmp/monthly_hs.html)

# Spatio-temporal coherence in GWD

- Monthly fluctuations in GLI may contain similarities between sites over a range of spatial and temporal scales
- Estimate temporal correlations of GLI for 7 timescales
  - (2-4, 4-8, 8-16, 16-32, 32-64, 64-128, 128-256 months)
- Search for significant spatial variations using two approaches
  - Cluster trees
  - Pairs of individual OBHs as a fn of separation distance of OBHs

# Controls on response to drought

- Tested the hypothesis that drought response for GWLs is a function of:
  - Distance to nearest river
  - Catchment area (upstream surface water catchment area)
  - Saturated OBH depth
  - Mean unsaturated zone thickness
  - Aquifer parameters based on 'representative' values taken from Aquifer Properties Manual
- 26 sites, mainly Chalk, but also P-T Sandstones, Carboniferous Limestone, Jurassic limestones, Lincs Limestone and Upper Greensand sites
- Regression model used (backward, step-wise least squares)
- **Only found a correlation with aquifer parameters**

# Summary

- The Groundwater Level Index (GLI) performs well as an index for groundwater drought
- Using GLI, major and minor drought episodes in England and Wales back to 1900 can be quantified and can be shown to be consistent with the documented history
- Aquifer parameters are a significant factor in controlling groundwater level response to drought episodes and hence the response of groundwater to drought
- Local catchment and borehole factors may have a secondary influence on drought response at an observation borehole