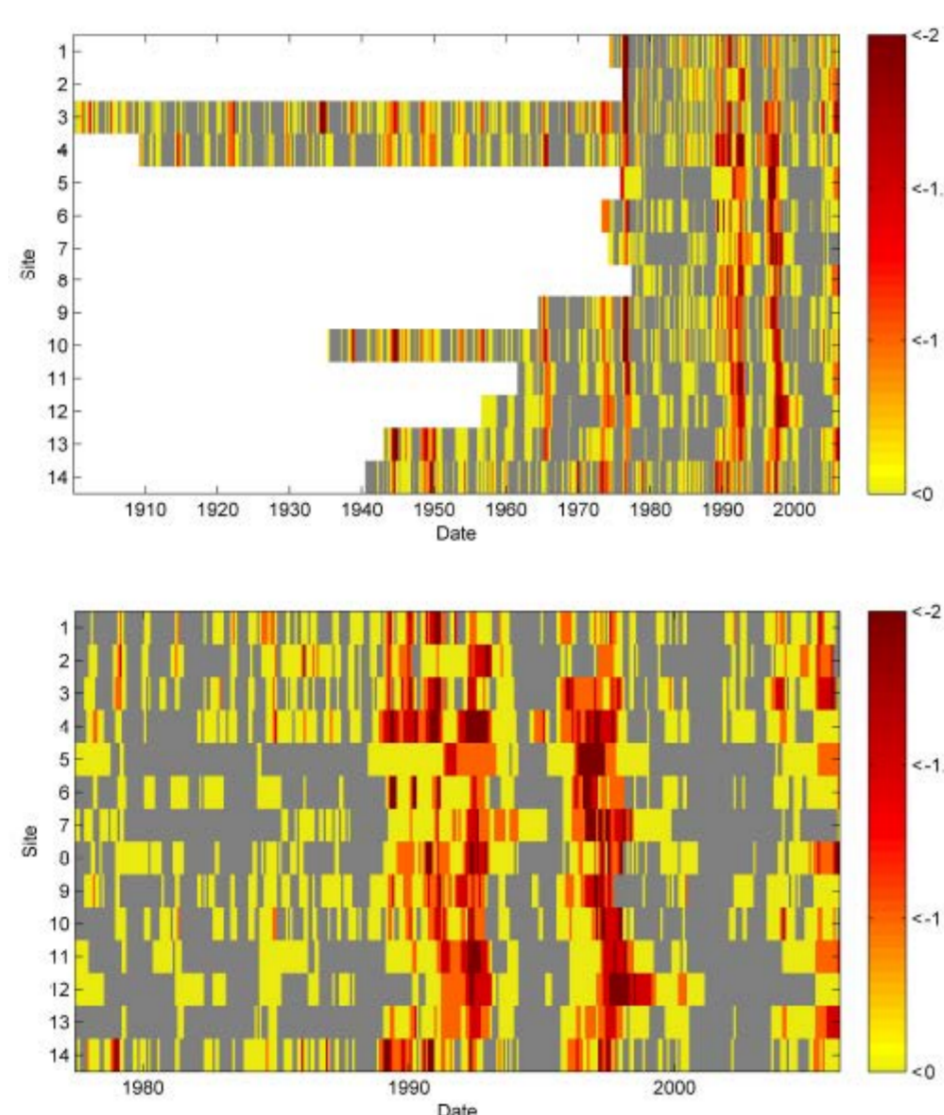
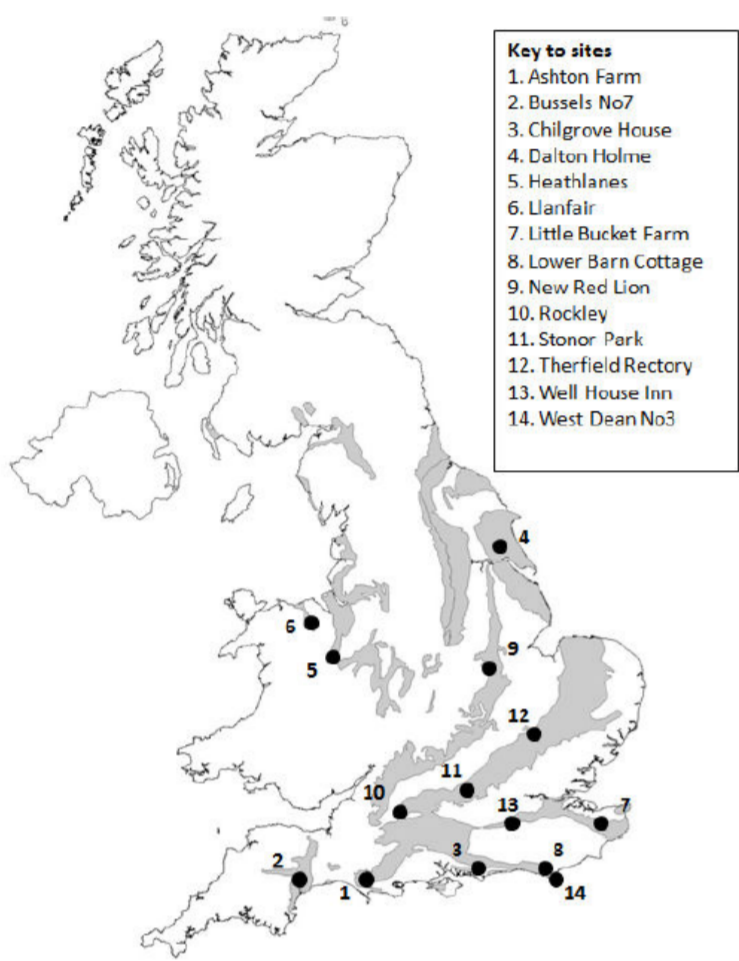


Groundwater drought forecasting using lumped conceptual models

C.R. Jackson, V. Christelis, M Mansour, L Wang, J.P. Bloomfield

Characterisation of groundwater drought using Standardised Groundwater level Index (SGI)

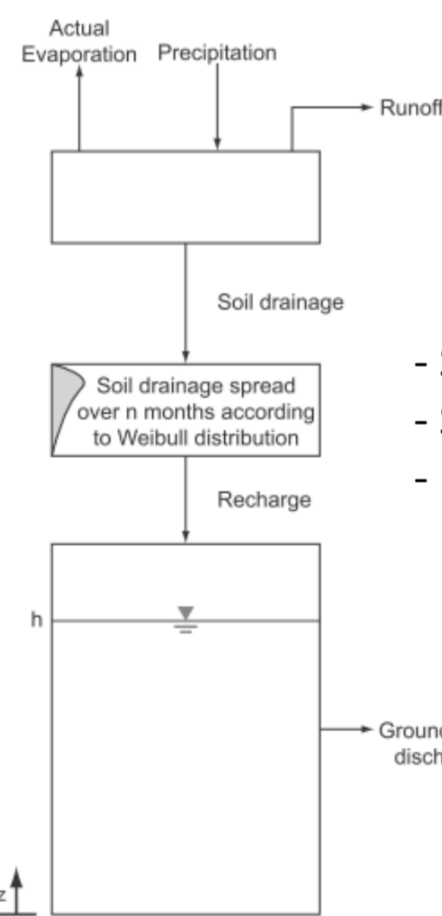
For fractured aquifers, such as the Cretaceous Chalk, autocorrelation in SGI (Bloomfield & Marchant, 2013) has been inferred to be primarily related to autocorrelation in the recharge time series, while in granular aquifers, such as the Permo–Triassic sandstones, autocorrelation in SGI is inferred to be primarily a function of intrinsic saturated flow and storage properties of aquifer.



Application of Aquimod

Application of lumped conceptual model, Aquimod (Mackay et al., 2014), and multiple representations of soil, unsaturated zone and saturated aquifer to simulate groundwater level time-series

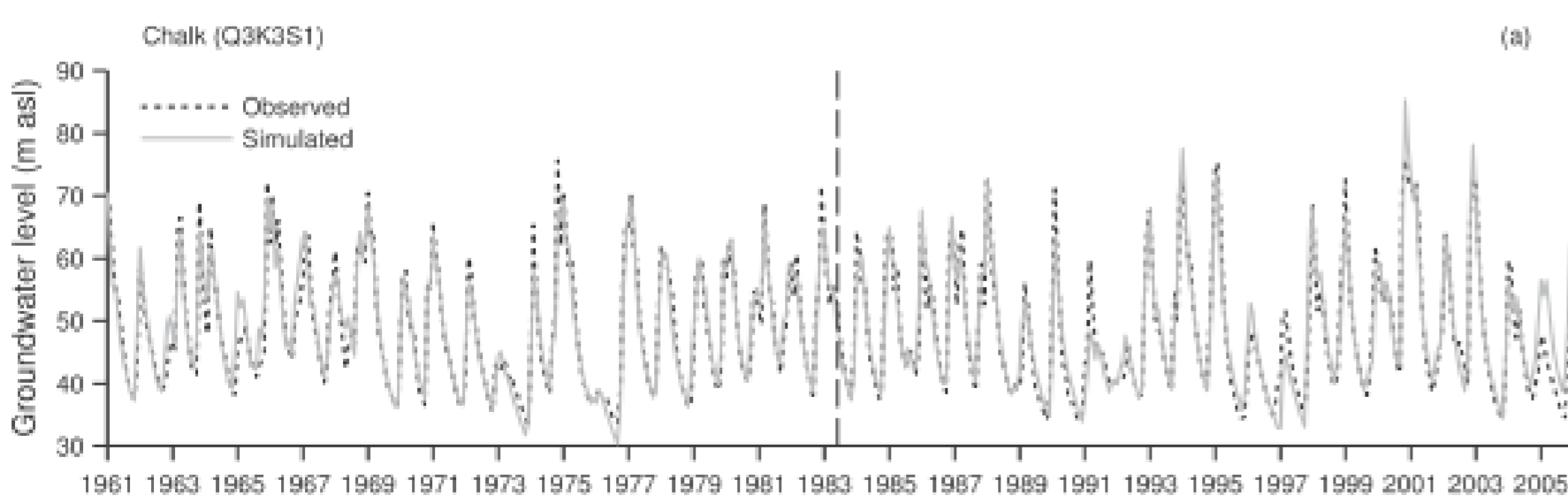
- SMD: Penman-Grindley
- SMD: FAO56
- SMAP: Mathias et al. 2015



- Simple transfer function
- Simple matrix-fracture flow
- Dual permeability unsaturated

- 5 linear/non-linear reservoirs
- Semi-analytical solution (Park & Parker, 2008)
- Impulse Response Function (von Asmuth et al., 2008)

Example simulation: Chilgrove House, Sussex



References

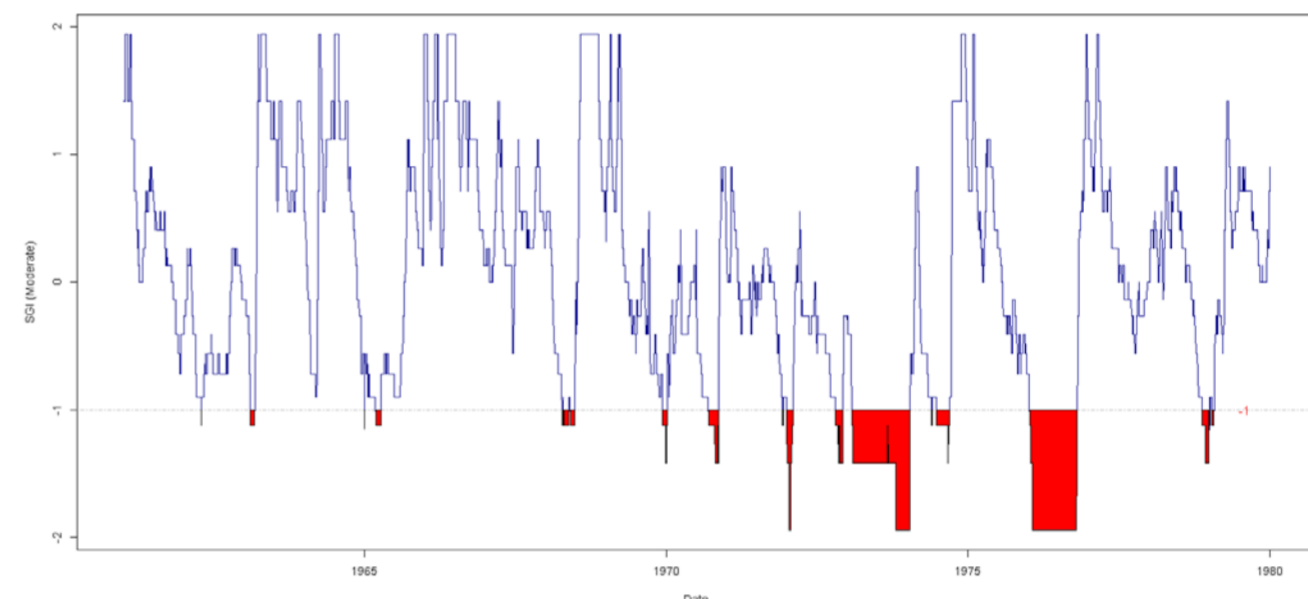
Barker et al. (In press). Improved seasonal prediction of UK regional precipitation using atmospheric circulation. *Q. J. R. Meteorol. Soc.*
 Bloomfield and Marchant. (2013). *HESS*, 17, 4769-4787.
 Mackay et al. (2014). *Env. Mod. & Soft.*, 61, 229-245
 Mackay et al. (2015). *J. Hydrology*, 530, 815-828.
 Mathias et al. (2015). *Water Resour. Res.*, 51, 506–523.

Reproduction of drought events

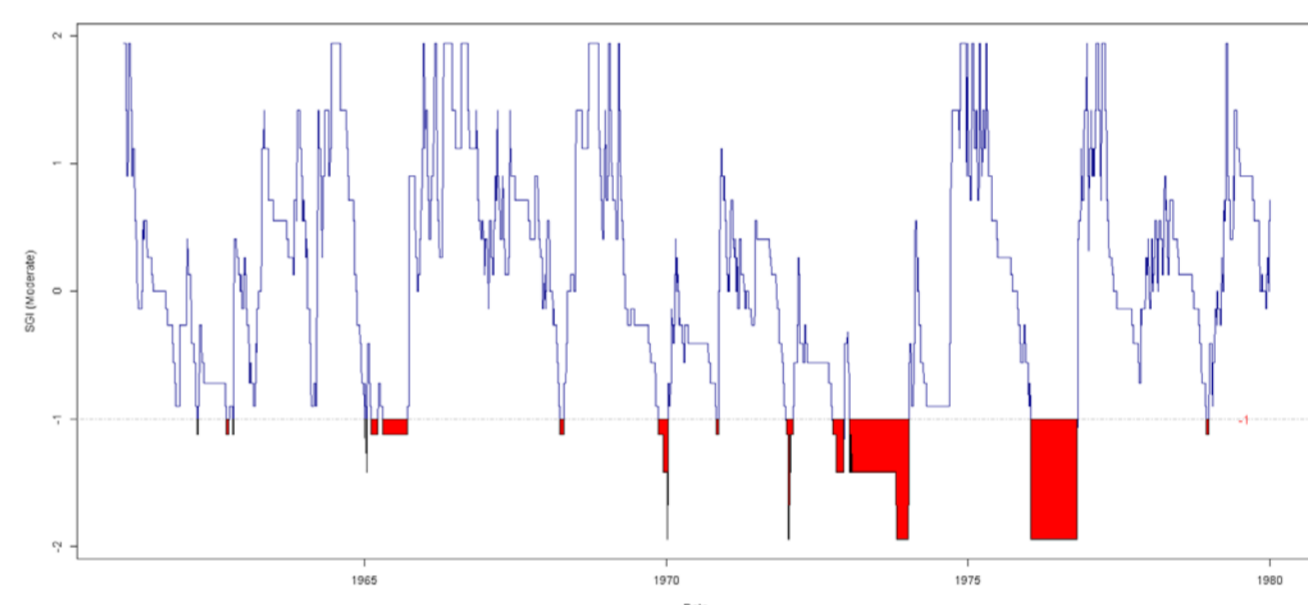
Identification of droughts using SGI thresholds:

- SGI = -1: “moderate” groundwater drought
- SGI = -1.5: “severe” groundwater drought
- SGI = -2: “extreme” groundwater drought

Observed SGI and moderate droughts

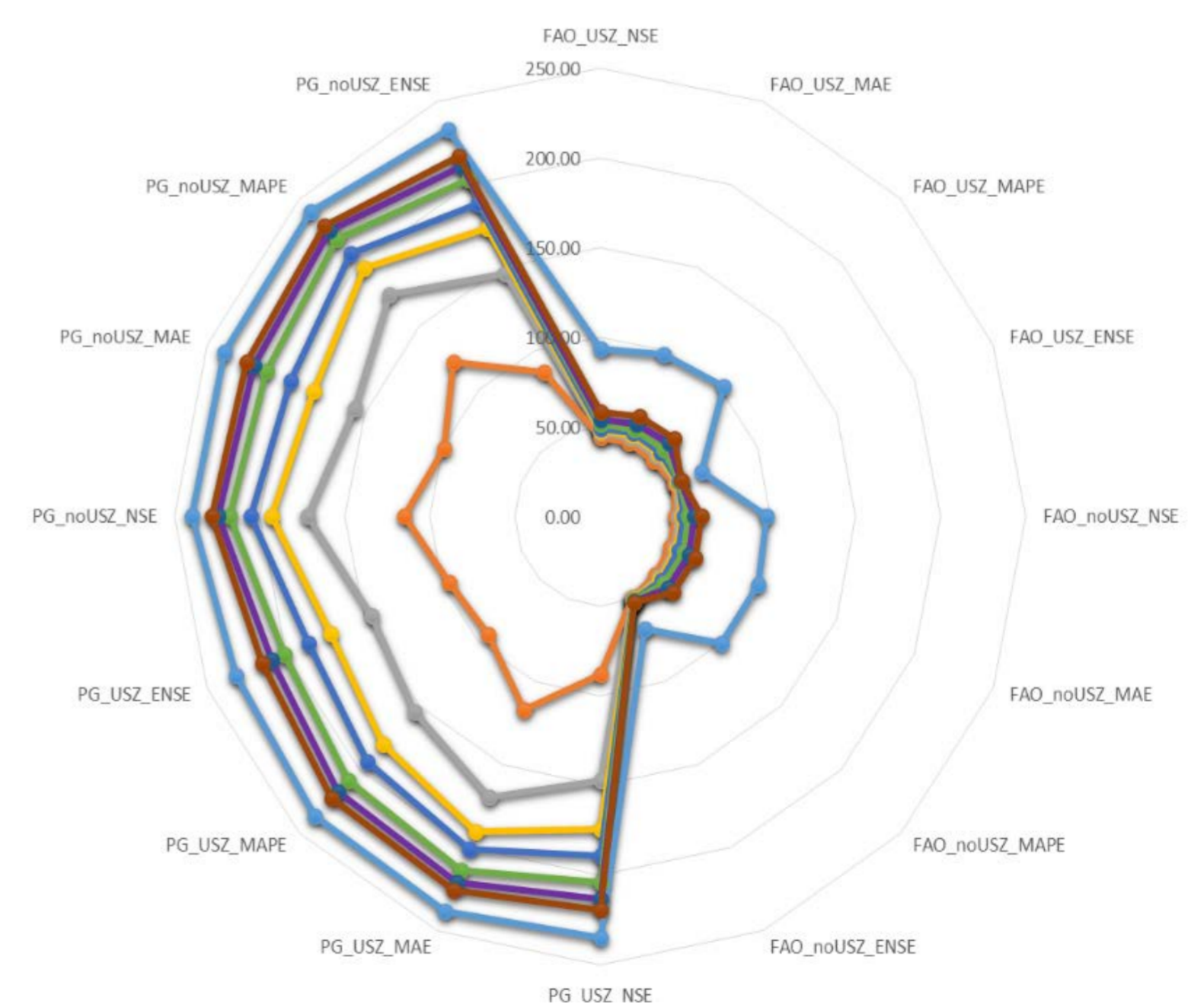


Example model simulation



Identification of better performing model structures and calibration measures across multiple hydrogeological settings

- Importance of slow drainage through the unsaturated zone in controlling drought response?
- Drought level minima bounded due to vertical heterogeneity?
- Use of extended-NSE, which incorporates error in magnitude and timing of groundwater level, improves model performance.



Immediate next steps

- Complete model structure experiments across UK sites.
- Integrate improved models and new regionalised seasonal rainfall forecasts from GloSea5 (Barker et al, In press) into groundwater seasonal forecasts (Mackay et al., 2015).