Groundwater drought forecasting using lumped conceptual models

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

**Example simulation: Chilgrove House, Sussex**

**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

**Identify 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.

**References**

Mackay et al. (2014). Env. Mod. & Soft., 61, 229-245

**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).

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