GEOPEARL-UK

A fully spatially-distributed, higher-tier modelling approach for refining UK groundwater risk

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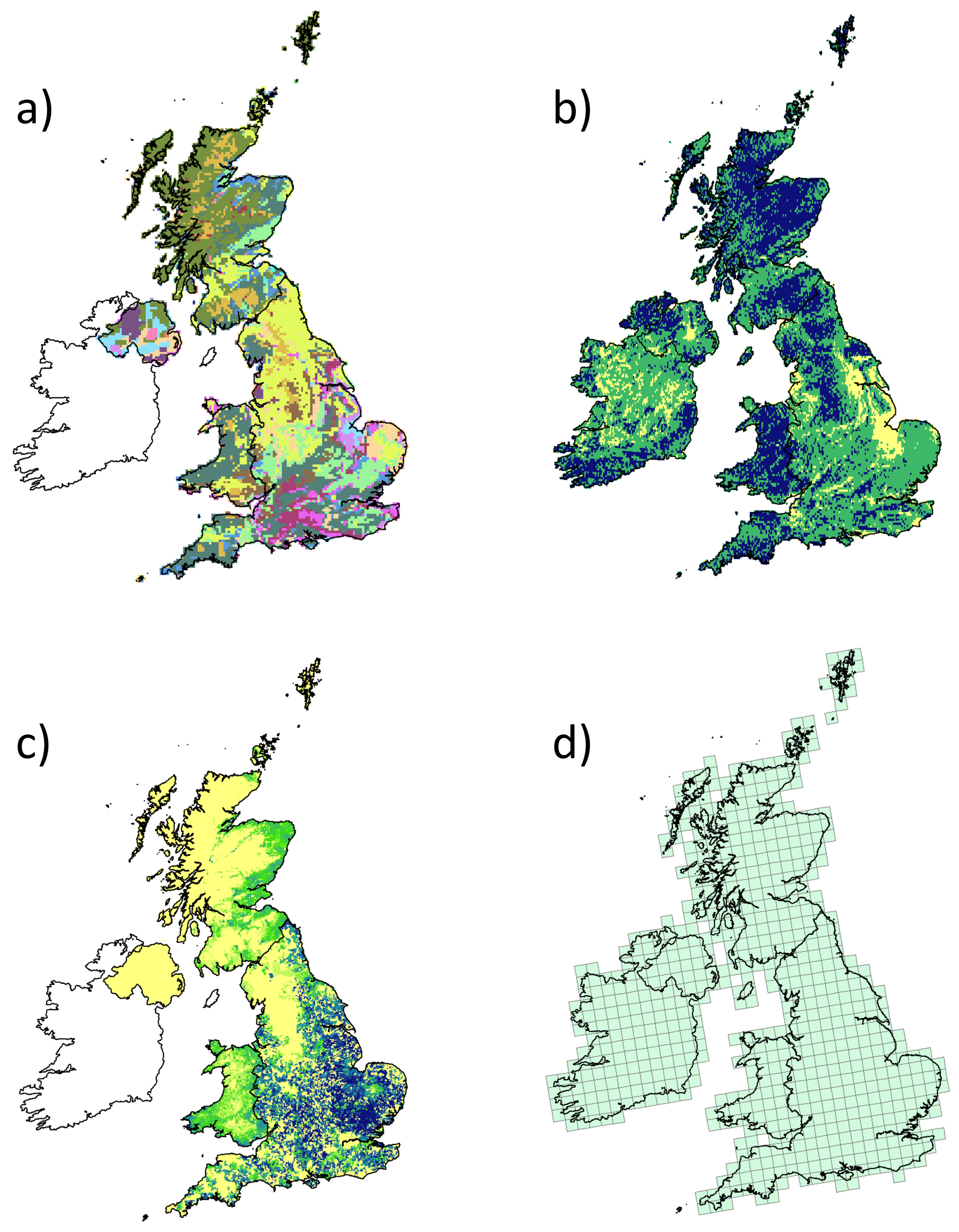
At present there are limited options outlined within the UK regulatory process for higher tier refinement of exposure estimates for pesticides leaching to groundwater (GW). This poster describes the development of a spatially-distributed, higher tier modelling approach at Tier 3b, drawing on the example of the UK higher tier drainflow framework, as well as the NL GeoPEARL and FR FROGS modelling approaches.



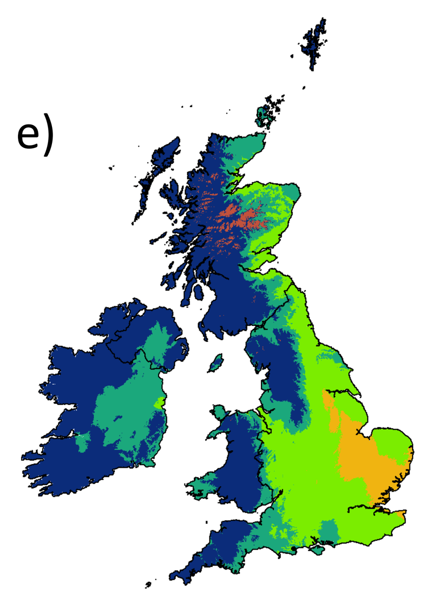


Figure 1: a) Distribution of defined soils classes; b) depth to groundwater (yellow – shallow; blue – very deep); c) example crop distribution for field beans (yellow – low density; dark blue – high density); d) MARS25 grid squares; e) FOCUSgw zones used to define crop parameters

Methodology

The approach presented in this poster draws on guidance from the CRD (e.g. Beulke et al., 1998 and 2002) and the FOCUS groundwater work group (FOCUS, 2014), and is in keeping with recent guidelines for the design and contextualisation of groundwater monitoring studies (Gimsing *et al.*, 2019). It is underpinned by a 5 km resolution environmental dataset describing soils, land use, depth to groundwater and weather.

Soils: Soils series in England and Wales (NATMAP5000), Scotland (1:250K soils) and Northern Ireland (1:50K/1:1M) were assigned to one of 15 soil classes:

- 7 soil classes that are free draining and would contribute to groundwater;
- 4 soil classes that contribute to groundwater at 1 m depth, but would ordinarily have agricultural drains and largely impermeable lower boundaries;
- 2 soil classes that are peaty, for which the leaching of plant protection products (PPPs) to groundwater would not be expected due to the high organic carbon contents;
- 2 soil classes overlying substrates that are largely impermeable, for which the leaching of PPPs to groundwater would not be expected.

Depth to groundwater: Depth to groundwater was set using the median value calculated for each 5 km grid square from the 30-arc second resolution Fan *et al*. 2013 depth-to-groundwater raster dataset. The bottom boundary condition was defined based on the soil class and depth to groundwater.

Land use: An RSK ADAS land use database at 1 km resolution was used to identify the extent of crop production on the defined soil classes.

Weather: Daily weather data were sourced from the MARS 25 km gridded meteorological dataset, and missing data were patched using appropriate techniques. In the case study below, the period 1975-2000 was simulated.

Cropping: Crop parameters were utilised for the FOCUSgw zone in which the 5 km grid square was located. While the current version does not include crop rotation, this module is currently being developed.

Modelling: The amount of active ingredient leaching to groundwater was simulated using the MACRO v4.4.2 and PEARL v4.4.4 models for drained and undrained soils, respectively.

Case study

The results of a preliminary groundwater risk assessment for a mobile herbicide, sometimes detected in groundwater in England, are presented in Table 1 and Figure 2. A single, pre-emergent application to field beans was simulated.

The standard FOCUSgw scenarios suggest a potential risk to groundwater for this use, with the Okehampton scenario failing the risk assessment, and the Hamburg scenario passing by only a very narrow margin (Table 1). When combined with the detection of this compound in ground and drinking water sources, these results make the registration of this compound uncertain.

Scenario	PECgw (µg/L)
Hamburg	0.099
Kremsmünster	0.046
Okehampton	0.112
GeoPEARL-UK	**0.067**

Table 1: Calculated PECgw for case study

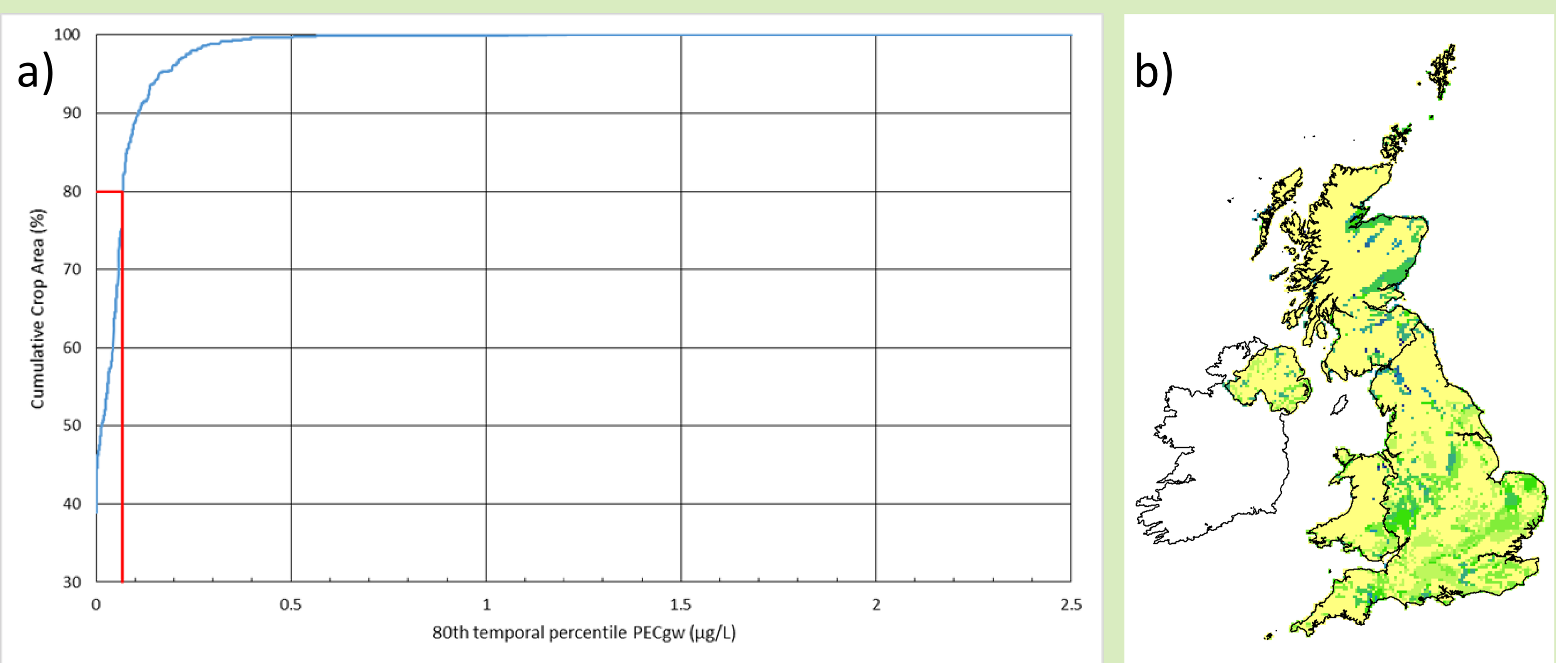


Figure 2: a) Cumulative frequency distribution of PECgw for a pre-emergent application of a mobile herbicide to field beans; b) example PECgw map for dominant soil class

The 80th spatial percentile PECgw predicted by GeoPEARL-UK is **0.067 µg/L**, suggesting that safety would be demonstrated using this approach. In addition, it should be noted that this case study was based on a series of worst-case assumptions, e.g. no agricultural drains were included.

Key risk factors identified by the modelling allow for sensible risk mitigation options to be proposed, should these be required.

Conclusions

The modelling framework presented here allows a range of refinement options to be explored, for example the impact of agricultural drains, different simulation time periods, and withdrawal from individual soil classes. This framework was designed to use a limited number of soil classes in order to limit data licensing costs, and future work will explore the cost-benefit of expanding this number to provide more risk mitigation options.

This modelling framework introduces much more complexity into the risk assessment, and further exploration will provide a better understanding of its performance as a refinement option across a broader range of compound types, and a more diverse range of crops. The regulatory acceptance of this higher tier GW risk assessment by CRD is currently unknown.

References:

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