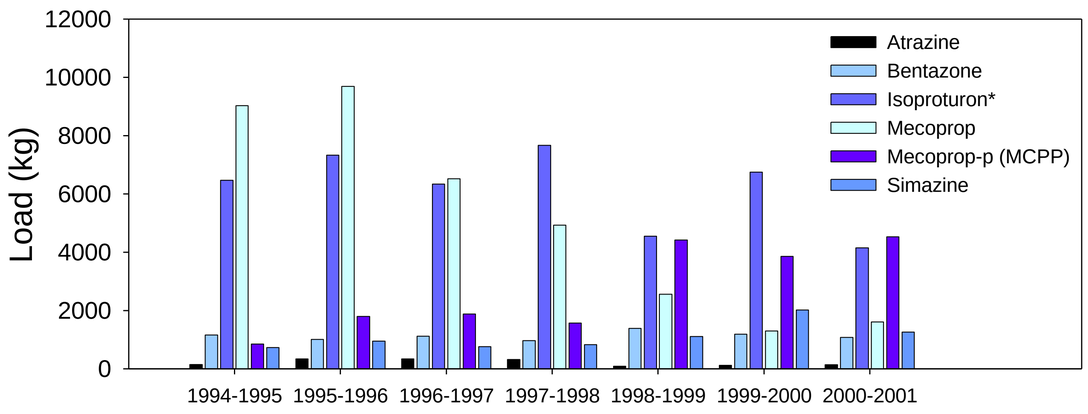
Pesticides and metabolites in groundwater: examples from two major UK aquifers

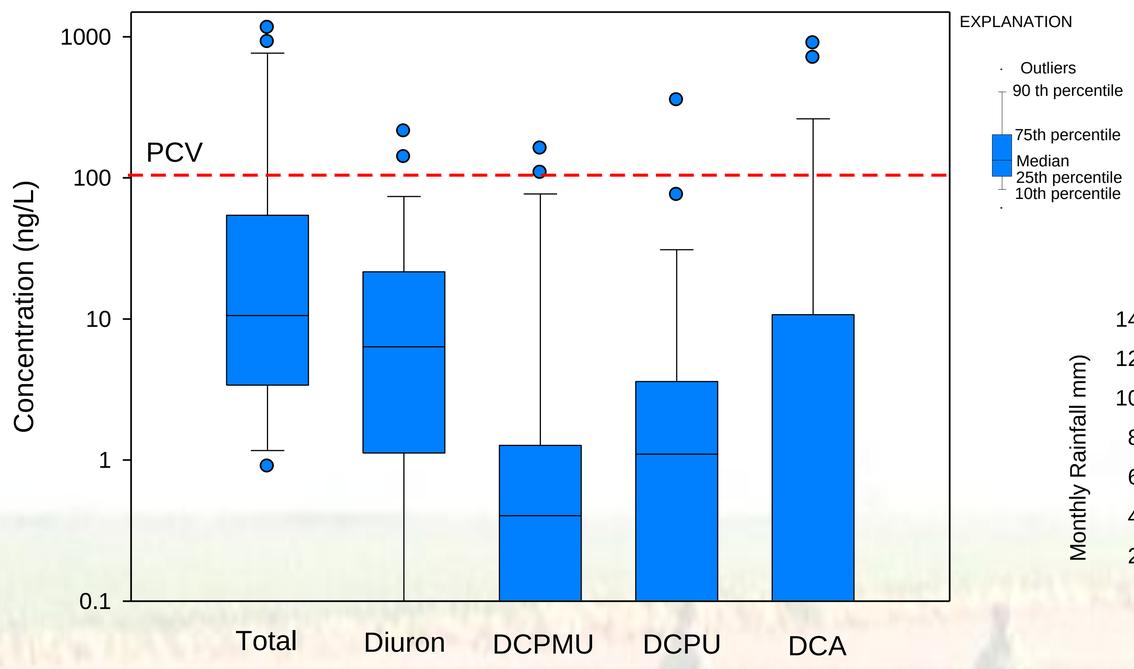
Lapworth D J [1], Gooddy D C [1], Stuart M E [1], Harrison I [2] and Chilton P J [1]*

Introduction

Reducing the impact of anthropogenic pollution on groundwater bodies and ameliorating any deterioration of water quality is central to key legislative drivers such as the EU Water Framework Directive and the proposed daughter Directive relating to the protection of groundwater. Pesticide pollution has a direct impact on groundwater quality and an indirect impact on the associated aquatic ecosystems supported by groundwater. There is currently no legislative requirement to monitor pesticide metabolite concentrations in groundwater.



Historical pesticide loading in the Doncaster area
*/5 for Isoproturon



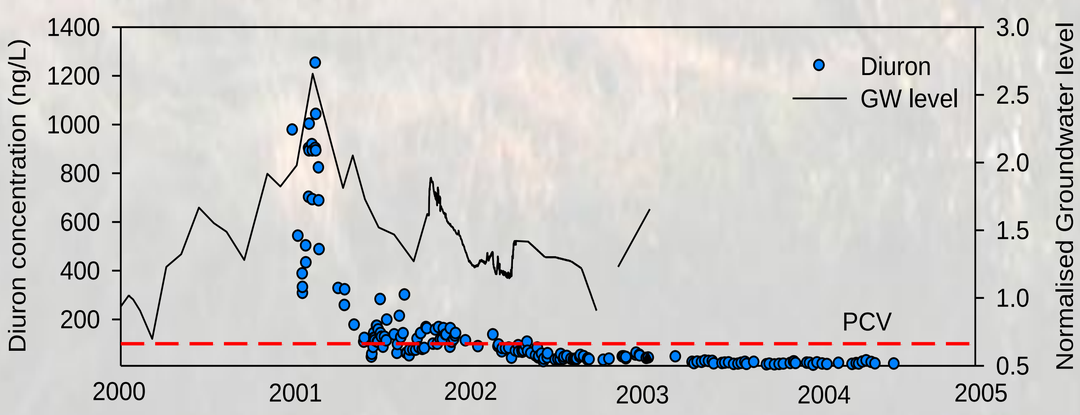
Box plot of diuron and metabolite compounds from a groundwater survey of 15 boreholes in the chalk aquifer

Metabolites in groundwater

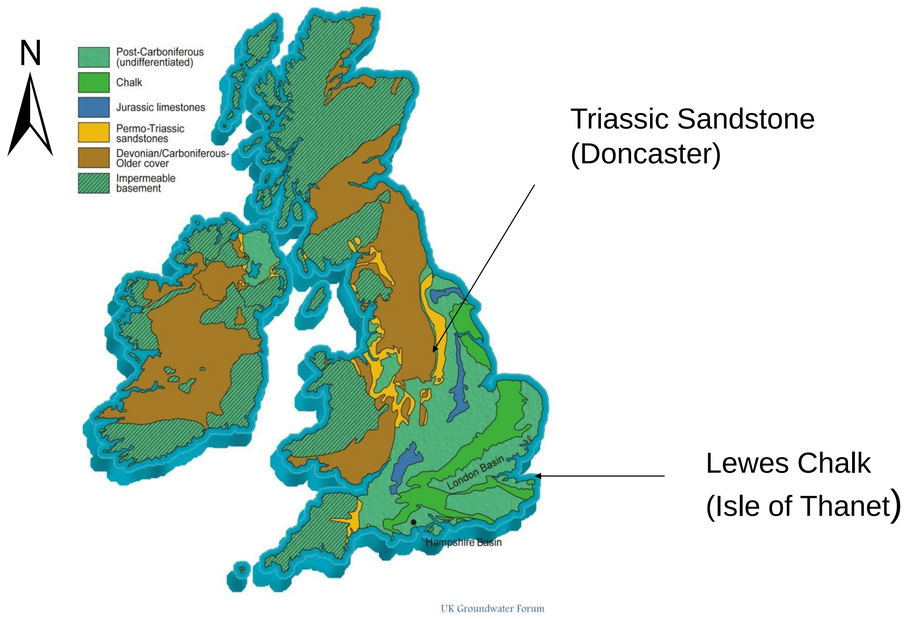
Aerobic microbial degradation of diuron in the soil can lead to the formation of three compounds; dichlorophenylmethyl urea (DCPMU), dichlorophenyl urea (DCPU) and dichloroanaline (DCA).

- Median diuron concentrations were significantly higher than each of the metabolites with outliers exceeding the PVC on at least one occasion

- At nine sites (60%) metabolites were more prevalent than diuron



Changes in diuron concentration and normalised groundwater level in the Chalk aquifer of southeast England



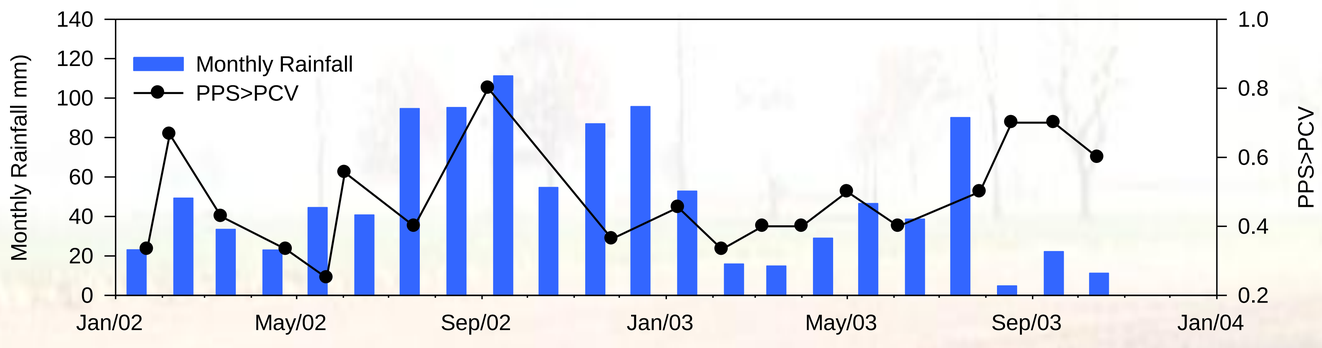
Site locations: Doncaster and Isle of Thanet

Potential sources of pesticides

- Both aquifers are an important source of water, locally supplying up to 80% of public drinking water

- The sandstone site has a predominantly arable landuse with a potential diffuse source of pesticides although soakaways are possible point sources

- The chalk site has a mixture of arable and industrial/urban landuse. A significant source has been from excessive applications of diuron (“over-spray”) on a number of public amenities



Changes in positive detections per sampling (PPS)>PCV (0.1μg/L) in 14 shallow groundwaters of the Triassic sandstone aquifer

Temporal changes in groundwater pesticide concentrations

- Data from both aquifers show that pesticide concentrations have a high degree of temporal variability

- Elevated pesticide concentrations are associated with recharge events in both aquifer systems regardless of pesticide source terms

Conclusions

- Pesticides from *amenity* use and *diffuse agricultural* sources both pose a threat to groundwater quality

- Pesticide metabolites are present in significant concentrations in groundwaters

- Systematic, long-term monitoring (5-10 years) is required to understand trends in groundwater quality

British Geological Survey
NATURAL ENVIRONMENT RESEARCH COUNCIL

1 British Geological Survey
Wallingford
UK OX10 8BB
* Corresponding author: djla@bgs.ac.uk

2 British Geological Survey
Keyworth
NG12 5GG