

Measurement and modelling of pesticide behaviour in on-line constructed wetlands

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Context and Aim

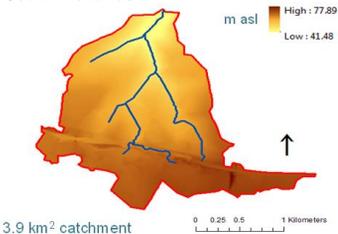
Pesticides make important contributions to modern agriculture but can create challenges for environmental management, particularly in catchments where surface waters are abstracted for drinking water supply. Here we evaluate the potential of small “on-line” free-surface constructed wetlands as a potential means of reducing pesticide fluxes in drainage ditches and headwater streams.

Study Sites

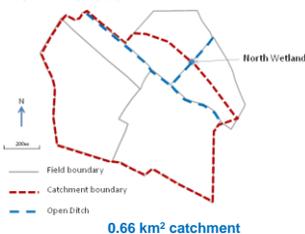
Two small free surface constructed wetland systems (North and South) in Cambridgeshire, UK, monitored over the 2014-2015 winter season.

- South wetland system: two small wetlands in series (large catchment).
- North wetland bunded with smaller catchment.
- Automatic water samplers used for sampling (typically 8h).
- Samples analysed using GC-MS-MS (Ramos et al., 2017).
- Flumes and v-notch weirs installed for flow monitoring.

South Wetlands



North Wetland

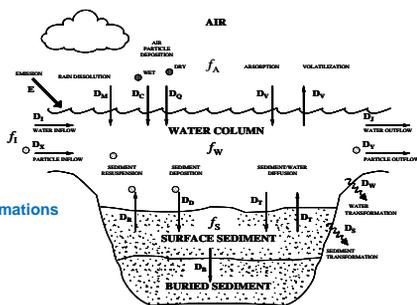


Model

- Dynamic version of fugacity-based QWASI model (Mackay et al., 1983).
- Measured input loads used for emission.
- Model equations solved numerically using Euler’s method with a time step of 0.1 hour.

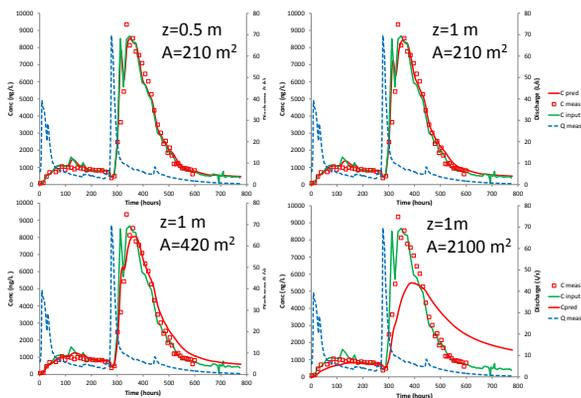
D values show fluxes & transformations

f is fugacity ($f = C/Z$)



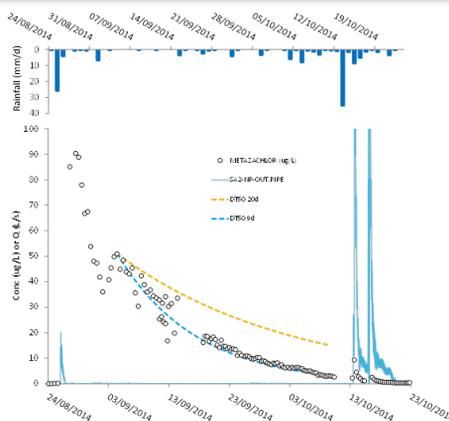
Results and simulations: South Wetland

There were no significant differences between inlet and outlet concentrations and loads (example shown for metaldehyde). Model fits for outlet concentrations were good. Model simulations suggest much larger surface area required for attenuation of pesticide concentrations but loads require longer residence times.



Results: North Wetland

Water and pesticide are occasionally retained in the north wetland between storm events and show removal for some pesticides. Example shown below for metazachlor.



Conclusions

Observed removal rates were relatively low – particularly during storm events, when pesticide loads are highest. Some losses were observed for limited periods with longer residence times suggesting some potential for removal when catchment area to wetland volume ratio is low.

References

- Mackay D. et al. (1983) *Chemosphere* **12**, 981-997.
 Ramos A.M. et al. (2017) *Water and Environment Journal*. In Press