Dynamics of mixture effects and causative chemicals during rain events in rivers in agricultural and urban areas

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Background

- Rivers integrate pollutant emissions and processes of the whole catchment
- Rivers receive broad spectrum of pollutants via direct and indirect inputs
- During rain events, fast run-off components from agriculture and sealed surfaces of urban areas are additional input sources

Study site

- sampling site
- urban area
- forest
- agriculture

0 2 4 6 8 10 km
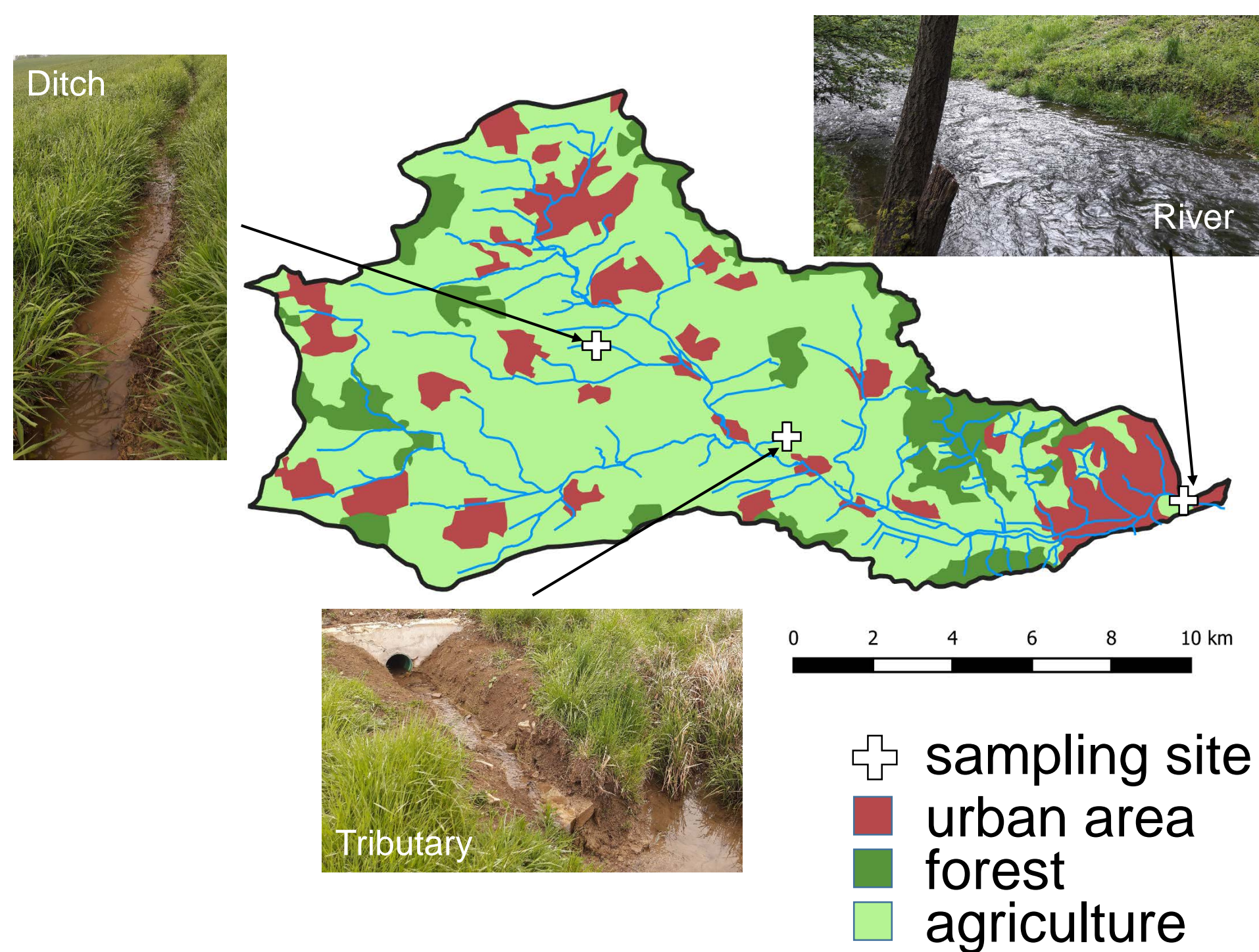
Approach

- Grab samples taken in the Ammer river basin, Germany, on four consecutive days ("rain 1" to "rain 4") following a moderate rain event, with a reference sample drawn after a longer dry spell (sample "dry")
- Samples enriched by solid phase extraction
- 51 Pesticides quantified with liquid chroma-tography and tandem mass spectrometry
- Bioassays: combined algae assay, oxidative stress response (AREc32), activation of estrogen receptor (ERa), arylhydrocarbon receptor (AhR) and PPARg expressed as effect concentrations EC10
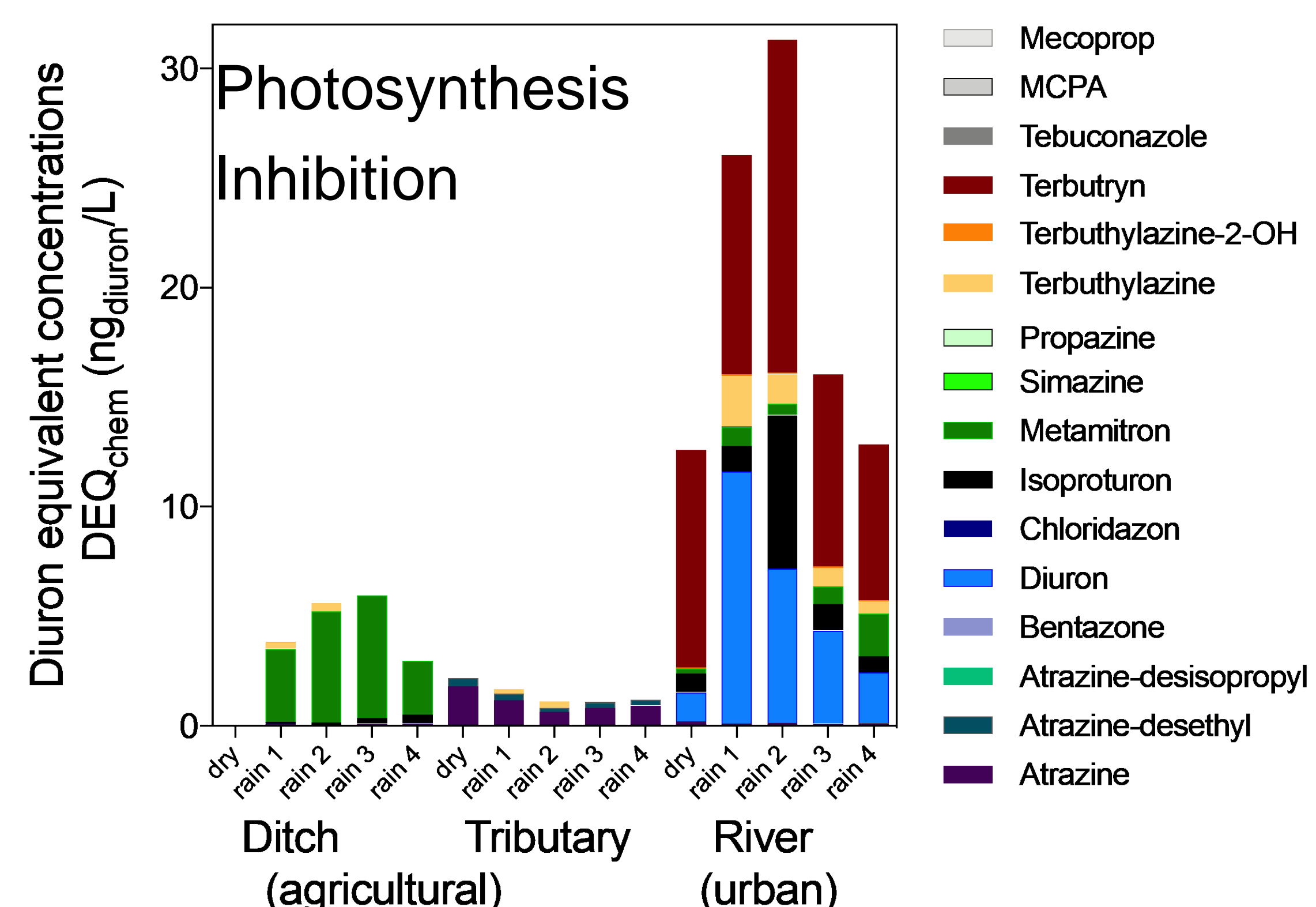
Pesticide dynamics

- Large dynamics in the ditch: Metamitron (lesser, carbendazim) introduced by rain
- Uneventful tributary: low levels and low dynamics; carbendazim same pattern as ditch
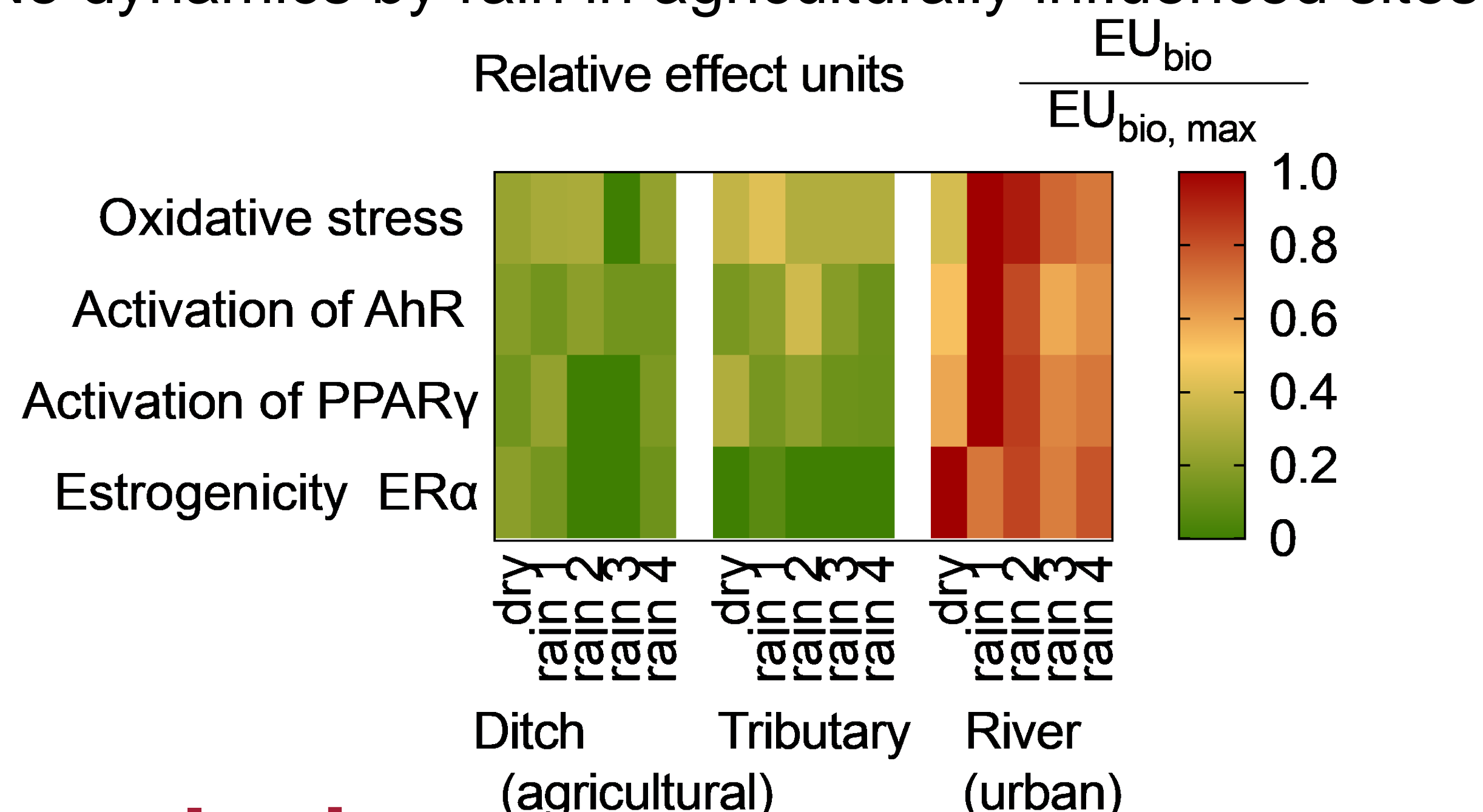- River shows footprint of upstream WWTP and urban impact (diuron, MCPA, mecoprop)
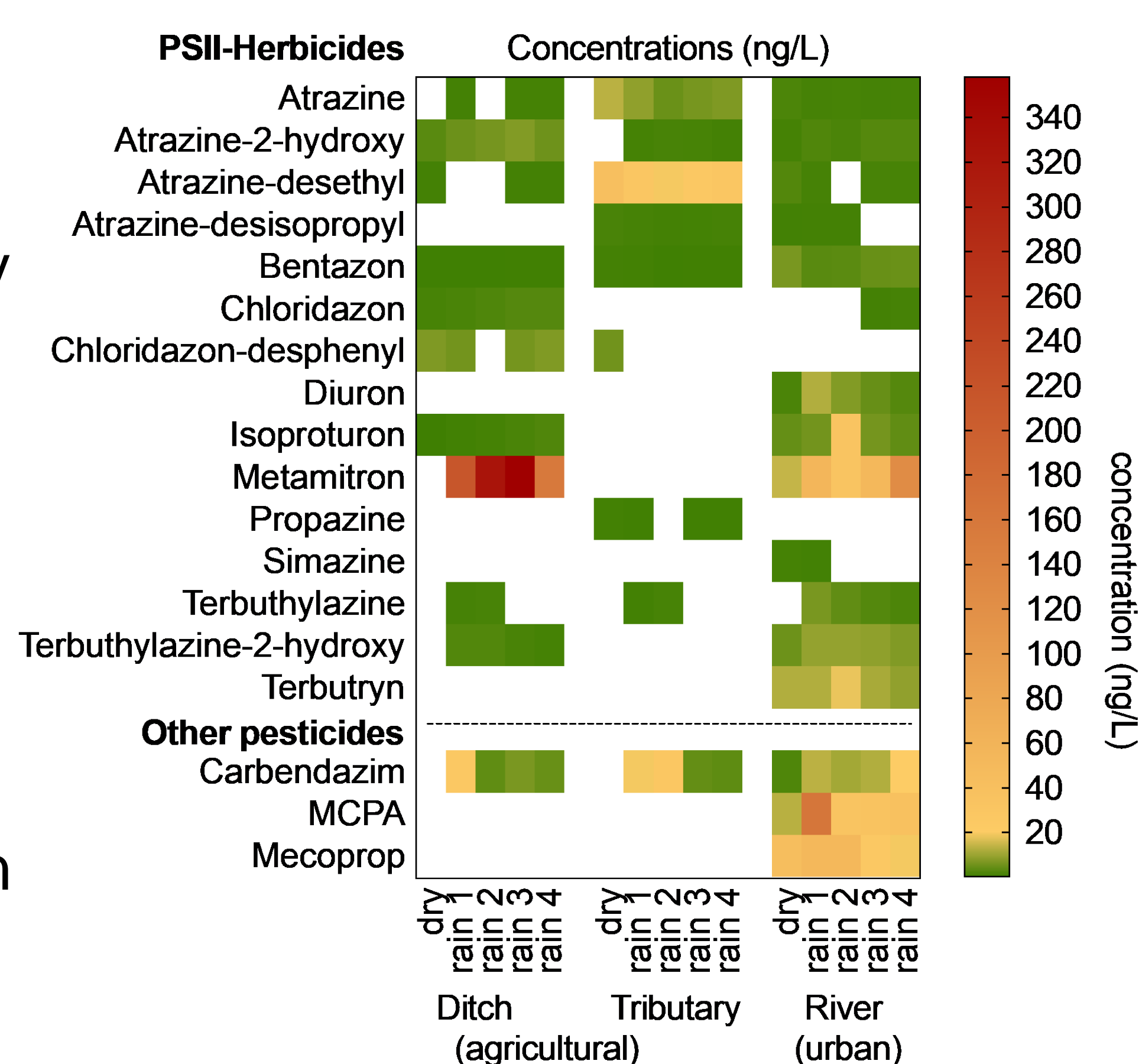
Algal toxicity

- Algal toxicity dominated by PSII herbicides

Other biological effects

- All biological endpoints were highest in river
  - Estrogenicity (mainly from WWTP) highest @ dry weather
  - All other endpoints impacted by rain event
- No dynamics by rain in agriculturally influenced sites

Relative effect units $\dfrac{EU_{bio}}{EU_{bio,\,max}}$

Effect Units

$$EU_{bio} = \frac{1}{EC10_{sample}}$$

$$EU_{chem} = \sum \frac{C_i}{EC_i}$$

Contribution of chemicals to effects

- Up to 30% of algal toxicity EU_{bio} explained by detected herbicides
- Detected pesticides contributed to a very small fraction (less than 0.1%) to EU_{bio} of AhR, ARE and PPARγ
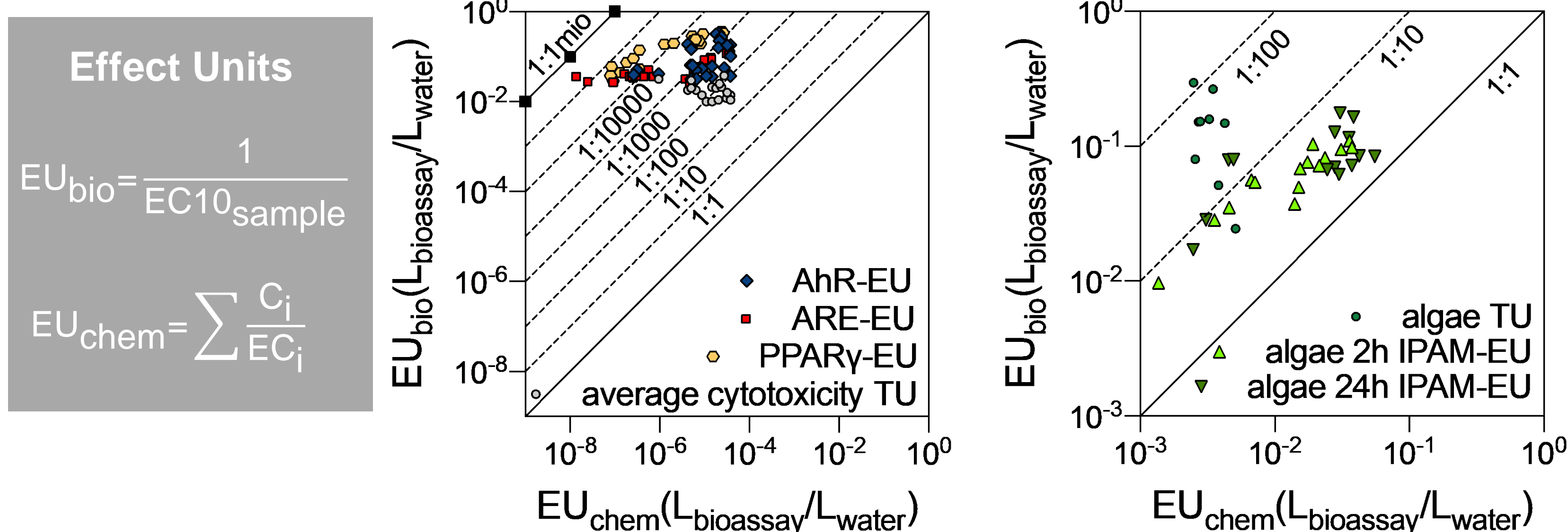
Conclusion

Moderate rain events led to substantial increase in individual pesticides' concentrations almost without changing the non-specific toxicity and modes of action that are not necessarily associated to pesticides (AhR, ER) but had a influence on algal toxicity when there was additional input of herbicides

Acknowledgements

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