Modelling the interaction between climate change and chemical effects at different levels of biological organization - a PhD proposal

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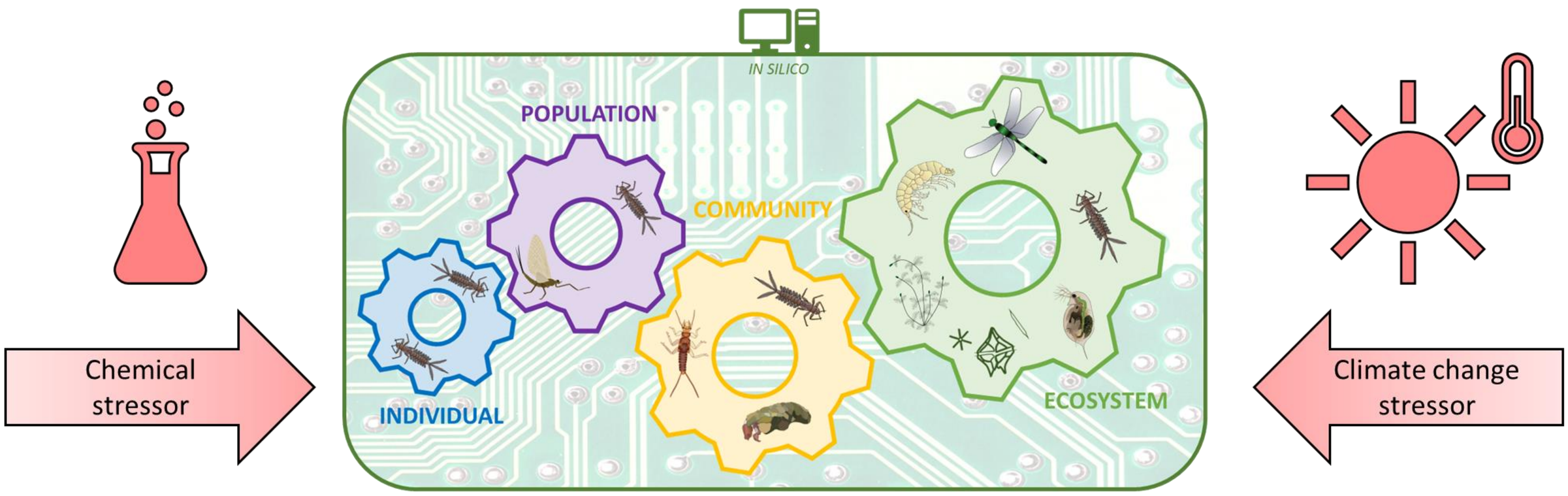
Background

- Chemical pollution continues to be a major threat to freshwater ecosystems
- In the phase of global climate change, temperature and CO_2 levels will rise in future ecosystems
- It is expected that the effects of chemicals will change due to these additional stressors as multiple stressors might act additively, antagonistically or synergistically and vary in their effects on different levels of biological organization
- Thus, to support future ecological risk assessment, there is an urgent need to understand (i) the combined effects of chemicals and climate change on freshwater ecosystems and (ii) how they affect different levels of biological organization, e.g., individual, population, community, and ecosystem

Objectives

- Extend existing modelling frameworks with the ability to assess combined effects of temperature and chemicals for individuals of freshwater invertebrates
- Translate individual response to higher levels of biological organization (population, community)
- Assessing combined effects of climate change and chemicals in freshwater food-webs (ecosystem)



PhD - Project outline

Chapter 1

Review on experimental and modelling assessments of combined effects of temperature and chemicals in freshwater systems

Searching for mechanisms of joint effects of temperature and chemicals on different levels of biological organization

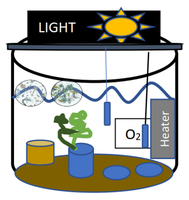
Chapter 2

Update toxicokinetic-toxicodynamic modelling frameworks (GUTS[1] and DEBtox[2]) for assessing combined effects of temperature and pesticides for individuals of freshwater invertebrates

Validation through exposures to flupyradifurone and imidacloprid to *Asellus aquaticus* under different temperatures

Chapter 3

Modelling interactive effects of temperature and chemicals in a bottom-up approach to propagate individual response to higher levels of biological organization (population, community, ecosystem) with IBMs[3] like ChimERA[4]



Validation through mesocosm experiments conducted by researchers from the ECORISK2050 project

Chapter 4

Using simple theoretical modelling approaches to improve understanding of vulnerability of populations and communities to chemical and climate change related stressors

Investigating the role of **intra-** and **inter-species** relationships in population and community response to environmental changes

Motivation

With the mechanistic understanding of the joint effects of chemicals and global climate change related stressors on different levels of biological organization, we improve assessments for future risks of freshwater ecosystems.

Literature

[1] Jager, T. et al. 2011. **General Unified Threshold Model of Survival** - a Toxicokinetic-Toxicodynamic Framework for Ecotoxicology. Environ. Sci. Technol. 45, 2529–2540.

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[3] Van den Brink, P. J. et al. 2007. An **individual-based approach** to model spatial population dynamics of invertebrates in aquatic ecosystems after pesticide contamination. Environmental Toxicology and Chemistry, 26, 2226–2236

[4] De Laender, F. et al 2014. **The ChimERA project**: coupling mechanistic exposure and effect models into an integrated platform for ecological risk assessment. Environ Sci Pollut Res 21, 6263–6267

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