European-wide ecological scenarios for the exposure assessment of chemicals in aquatic systems

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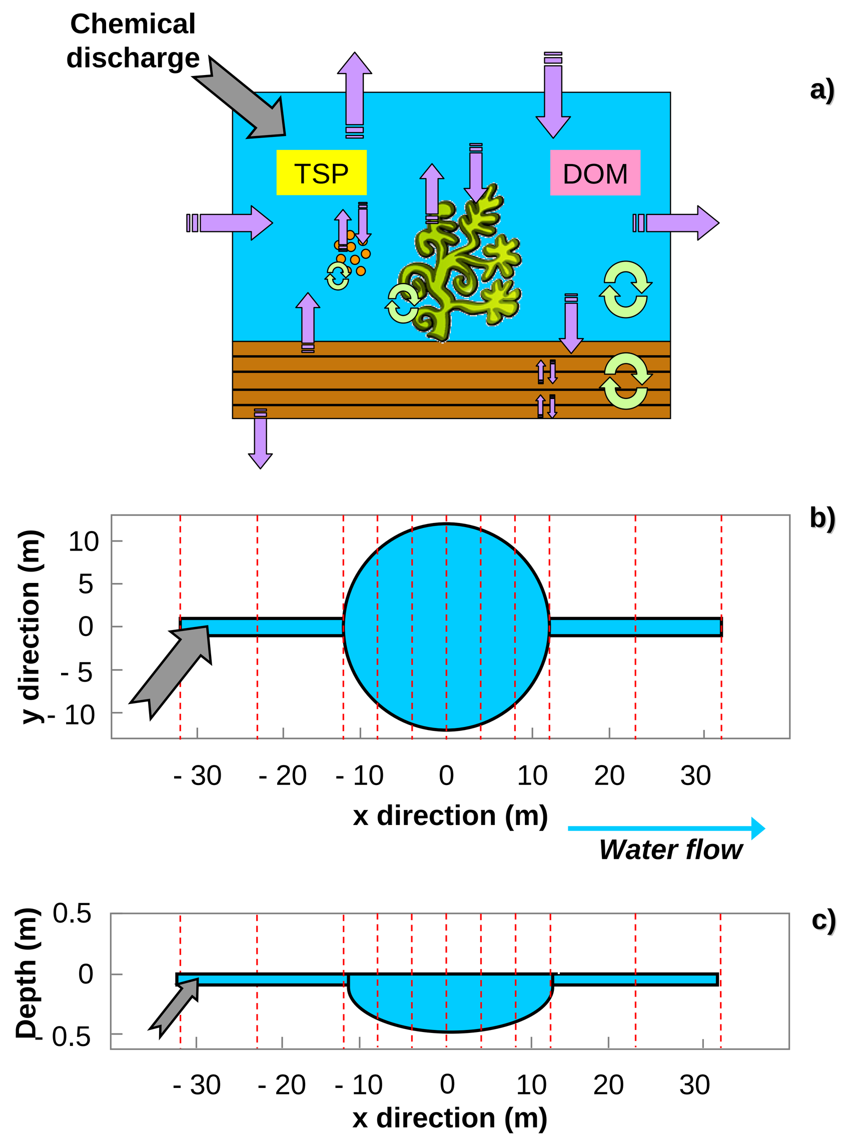

Figure 1. (a) ChimERA fate model unit; (b) top view and (c) side view of the environmental system simulated in the model illustration.

1. Introduction

❖ Growing need of enhancing **ecological risk assessment** (ERA) → more ecological realism in both exposure and effect assessment

❖ **Exposure assessment in aquatic environments**: development of models (e.g., **ChimERA fate**, **Fig. 1**) accounting for primary producers and particulate/dissolved organic carbon (POC/DOC) dynamics

❖ Need for data and **dynamic scenarios** to parameterize and apply such models

2. Objectives

❖ Development of **5 scenarios** (water temperature, phytoplankton biomass, POC/DOC concentrations) representative of European lentic shallow water bodies

❖ **Model application** using the 5 scenarios → influence of environmental and ecological conditions on exposure levels

Figure 2. (a) Lake Candia location (Piedmont Region, Northern Italy) and (b) Lake Candia top view.

3. Materials and Methods

3.1 Scenario development

❖ Starting point: **Lake Candia** (**Fig. 2**), small shallow lake (1.26 km^2, average depth 4.7 m) for which monthly limnological observations were available for 25 years

❖ Water temperature + phytoplankton biomass + POC/DOC concentrations during the year 2000 in Lake Candia → **"Northern Italy" scenario**

❖ Parameters adapted according to a climatic gradient to derive datasets for 4 other scenarios: **"Scandinavian"**, **"Central Europe"**, **"UK"**, **"Mediterranean"**

❖ Comparison of obtained datasets with **literature data** for about 200 European ponds and small lakes

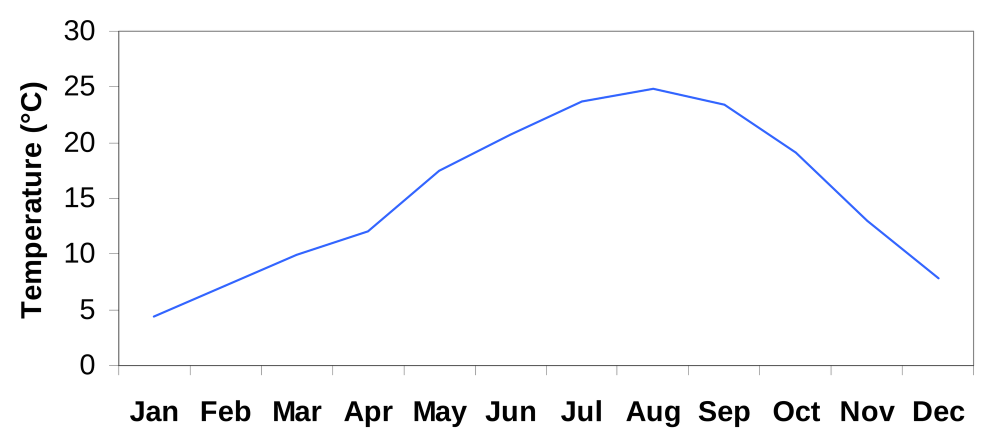

Figure 3. Water temperature (°C) during the simulation period in the "Northern Italy" scenario.

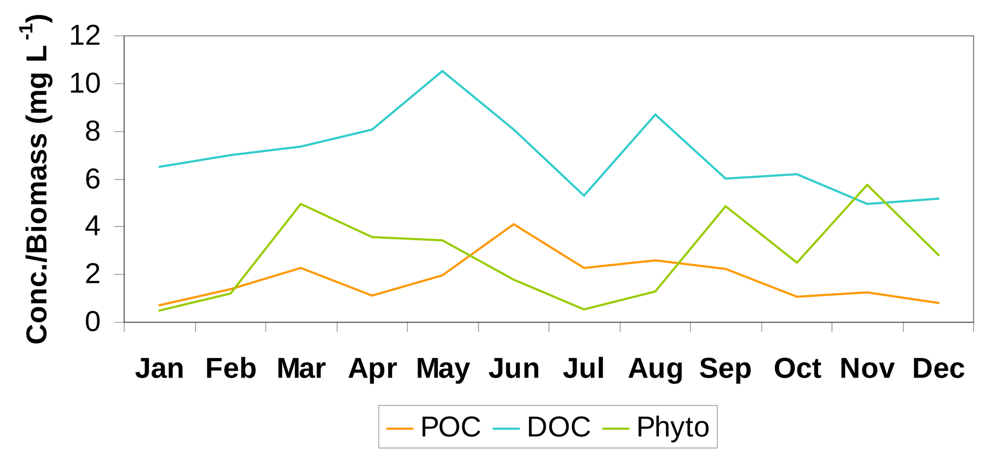

Figure 4. POC/DOC concentrations (mg/L) and total phytoplankton biomass (mg w.w./L) during the simulation period in the "Northern Italy" scenario.

3.2 Modelling approach and parameterization

❖ **ChimERA fate model** (**Fig. 1**, see poster **MO348**)[1]

❖ Preliminary simulations run with a simplified spatial system: one model unit (**Fig. 1a**) representing a pond, constant water flux

❖ One year simulations for 2 chemicals: **atrazine** (log K_{OW} = 2.5) and **lambda-cyhalothrin** (log K_{OW} = 7) emitted directly to the pond (3 chemical pulses)

❖ For simplicity, **phytoplankton-dominated systems** (no macrophytes)

❖ Water temperature, phytoplankton biomass, POC and DOC concentrations as in **Figures 3** and **4** for the "Northern Italy" scenario; for the other scenarios, the datasets built as explained in **3.1** were used

4. Results and discussion

4.1 Scenarios

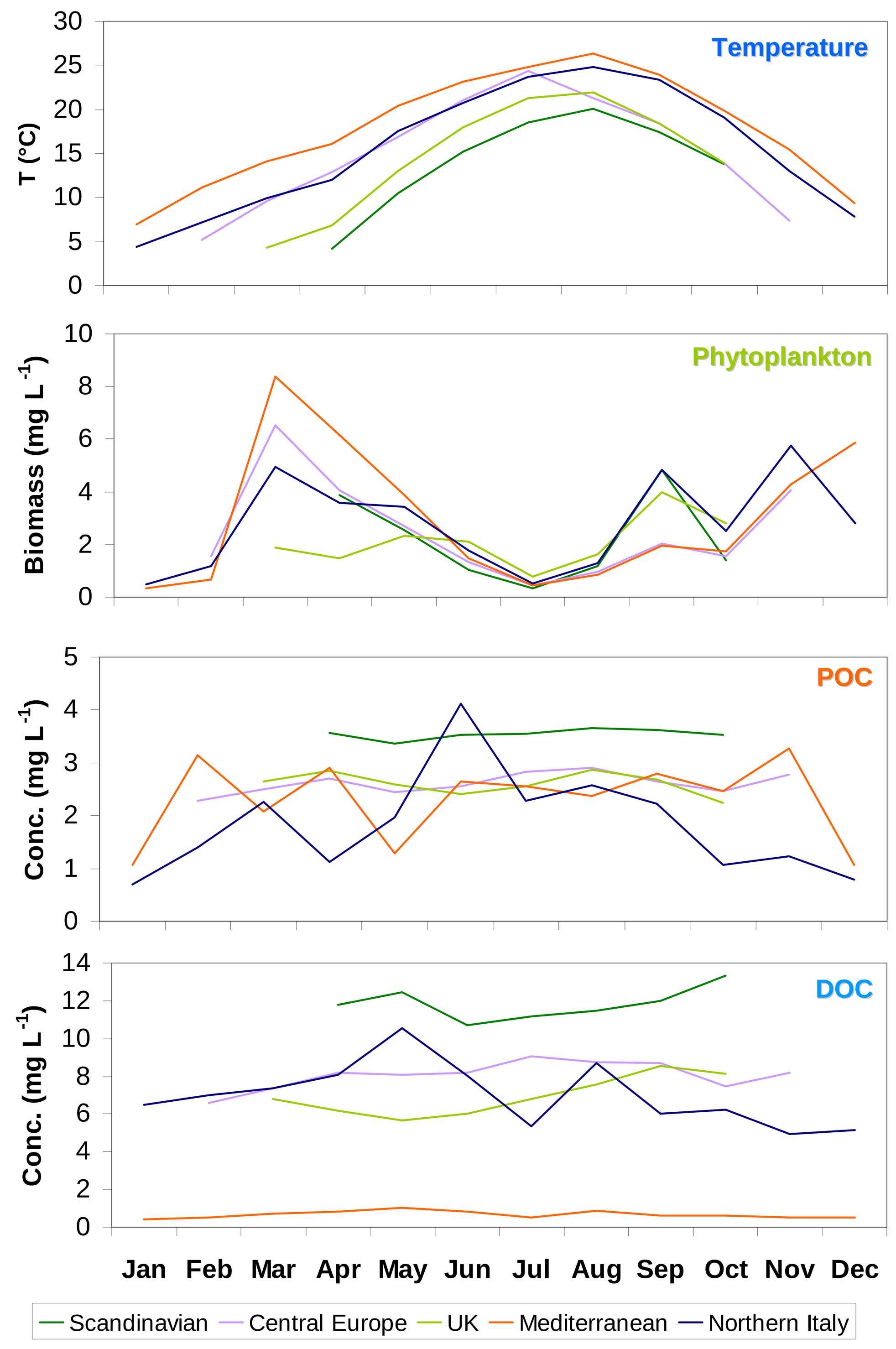

Figure 5. Water temperature, total phytoplankton biomass and POC/DOC concentrations in the 5 scenarios.

4.2 Illustrative simulations

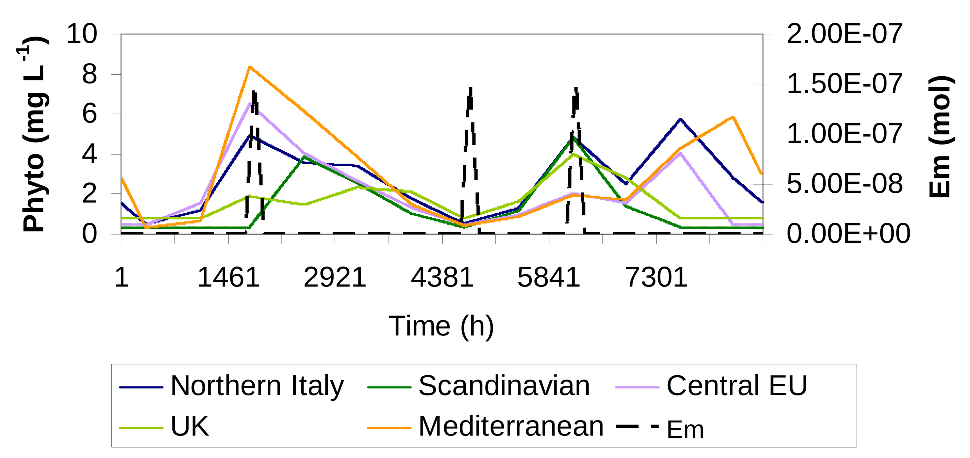

Figure 6. Emission ("Em") timing compared to phytoplankton abundance (mg w.w./L) in the 5 scenarios.

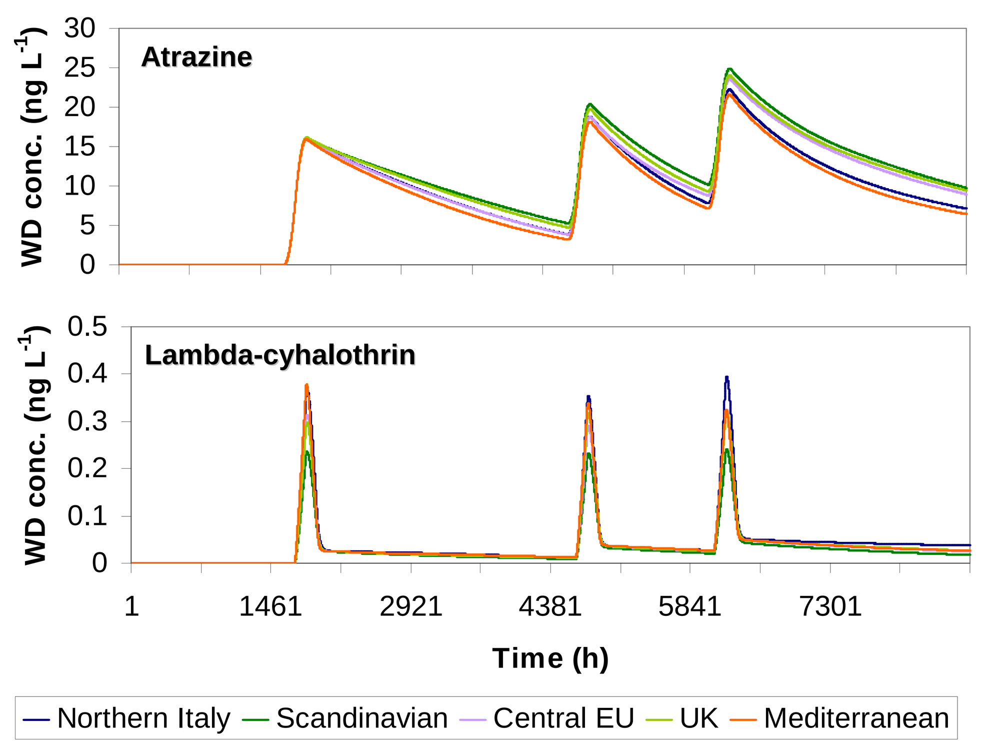

Figure 7. Water-dissolved concentrations (ng/L) of the modelled chemicals in the 5 scenarios.

❖ Yearly profiles of water temperature, total phytoplankton biomass, POC and DOC concentrations for all **scenarios** are depicted in **Figure 5**

❖ The obtained profiles were generally in line with literature findings concerning shallow water bodies in the considered European areas

❖ **Emission timing** (3 pulses) for illustrative simulations was set according to the 2 most relevant phytoplankton peaks and the summer low biomass period (**Fig. 6**)

❖ Water dissolved concentrations of the modelled chemicals are reported in **Figure 7**

❖ **Atrazine** was less affected by changes in phytoplankton biomass and POC/DOC levels with respect to **lambda-cyhalothrin** due to its low hydrophobicity

❖ → Changes in exposure levels from one scenario to another were low for atrazine and up to a factor of 2 for lambda cyhalothrin

5. Conclusions

❖ **5 scenarios** to be used in dynamic exposure simulations were assembled as representative of different European conditions

❖ Illustrative simulations with the **ChimERA fate model** → importance of **scenario-specific dynamics** in driving bioavailable concentrations

❖ Need for scenario refinement (with more literature data and datasets)

❖ Need for thorough validation of the phytoplankton accumulation model (now 1 compartment model)

[1]Morselli et al. (2015) In press in *Sci Total Environ*

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