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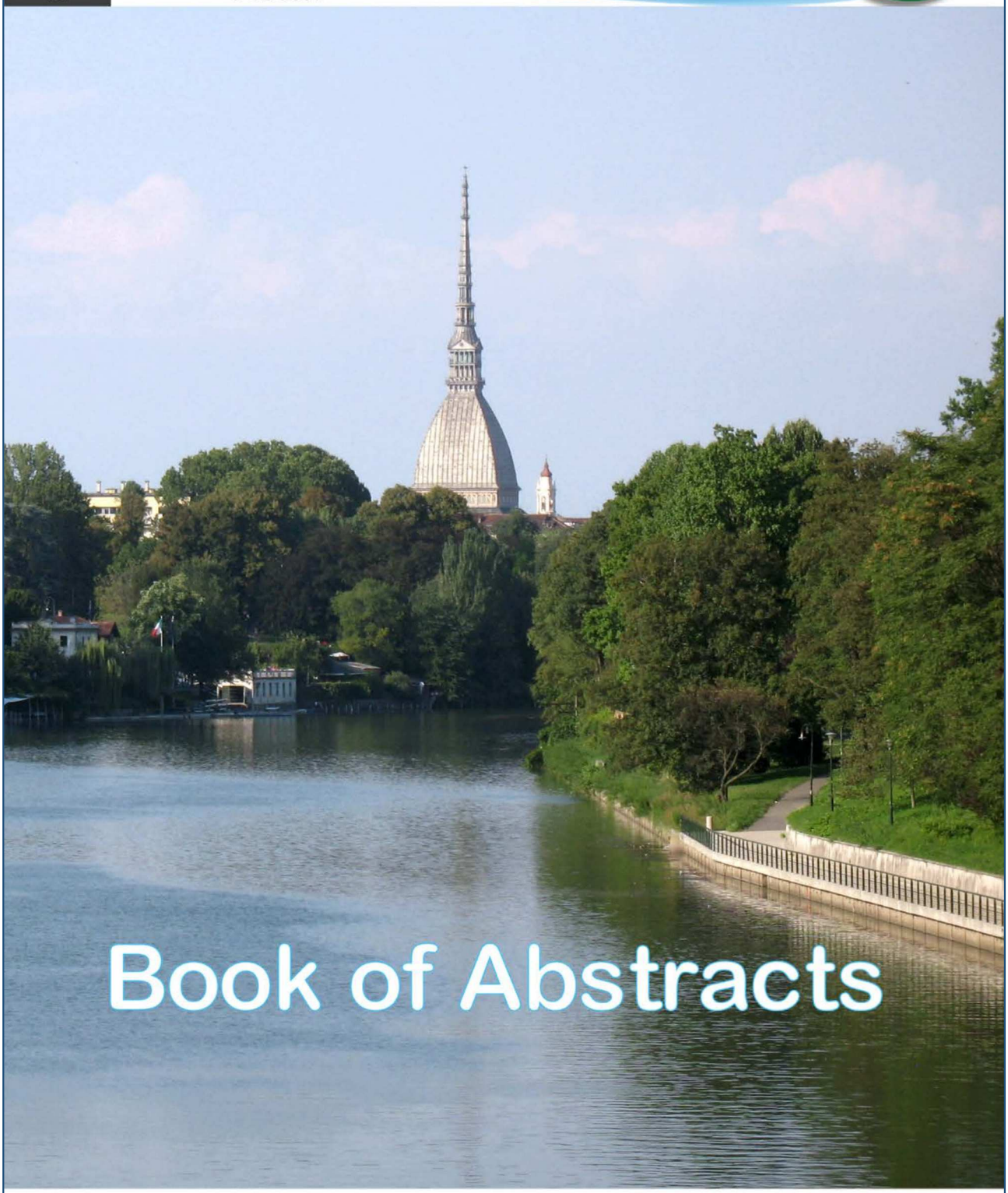

Book of Abstracts

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adaptation to pharmaceuticals, to heavy metals, or to other chemicals or ecological constrains. For this reasons, once an ARG spreads within a microbial community is not surprising that its presence becomes constitutive for a long time.
We are presenting the results from our long-term (2013-today) study of the resistome of Lake Maggiore, the sixth largest Western European lake, and the most important Italian reservoir of freshwater.
We could assess at least two ARGs (against sulphonamides and tetracyclines) as constitutive within the microbial community of the lake, and other three genes against beta-lactams, macrolides, and aminoglycosides as occasionally present, sometimes even in very high concentrations. We therefore also measured the concentrations of those ARGs in other, less impacted, high mountain lakes and springs in the Lake Maggiore catchment area, in the six main tributaries and in two wastewater treatment plants discharging their effluxes directly into the lake.
Our results, coupled with a number of concomitant measures of the main limnological and microbiological variables for each sampling date and station, allows a depiction of the routes of antibiotic determinants contamination in the catchment area of Lake Maggiore, distinguishing between inputs of agricultural or urban origin and the related temporal variations.
The catchment area of Lake Maggiore represents the first geographically defined territory where such integrated monitoring is being performed, providing fundamental insights for the management of antibiotic release in anthropized environments.

39-O Incorporating greenhouse gas emissions into ecosystem models with application to Lake Iseo.

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Management-oriented ecosystem models were originally developed in the early 1970's to assess the impact of nutrient loadings on lake eutrophication. As a consequence, their characterization of water chemistry was rudimentary at best. In the mid-1980s, stimulated by concern with acid rain, two principle modeling advances provided the theoretical basis for upgrading the chemistry in lake ecosystem models. First, the methodology for coupling fast equilibrium reactions with slow nutrient/phytoplankton kinetics was developed. Second, the modeling of sediment-water fluxes of solutes and gases was rigorously established. Although most currently available, open-source lake water-quality frameworks still focus primarily on nutrients and phytoplankton dynamics, the theoretical advances now make it possible to incorporate equilibrium chemistry into these frameworks. One benefit is that such expanded frameworks can be used to examine interesting questions beyond the traditional nutrient overenrichment problem.
In the present talk we focus on one such question: the determination of changes in greenhouse gas emissions as a lake becomes eutrophic. We do this using LAKE2K, an open-source, seasonal, 1D coupled hydrodynamic-ecological-chemistry model. The hydrodynamic model simulates the lake as a one-dimensional system consisting of three vertical layers and computes the interlayer mixing based on wind speed and water density. As is commonplace, the ecological model includes the simulation of plant photosynthesis/respiration, organic carbon decomposition, nitrification, denitrification, sediment nutrient and oxygen fluxes. However, several novel features are incorporated including new chemical state variables and algorithms to simulate alkalinity, inorganic carbon (and hence pH and CO_2), methane, sulfate, hydrogen sulfide, and nitrous oxide. Post processing provides lake managers with results in a decision-support format. This includes typical time series of nutrients, phytoplankton and oxygen, but additionally with time series and annual totals of greenhouse gas fluxes across the air-water interface as well as key optical variables (Secchi depth, turbidity, light extinction). An application to the Italian pre-Alpine Lake Iseo illustrates how the model can provide information supportive of management and decision making for lake systems that are experiencing watershed and climate modifications.

39-O Chemical profiling of the bioactive metabolites produced by invasive cyanobacteria in perialpine lakes.

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Cyanobacteria are known to produce toxic metabolites, such as microcystins, nodularins, anatoxins, and saxitoxins. Cyanobacteria proliferation represents, therefore, a serious risk in natural and artificial water bodies. Besides the ones

mentioned above, cyanobacteria produce many other bioactive compounds, which are less investigated but are equally important because they can be also toxic. The full determination of the chemical profile can be therefore very useful for a correct determination of the toxic potential inside a cyanobacteria population. Moreover, the chemical profile can have very important applications from an ecological point of view, since secondary metabolites play an important role in determining the cyanobacteria success over other organisms. The chemical profile (and consequently the toxic potential) is specific for any single species, and, within one species, can be subject to changes in response to environmental (biotic and abiotic) factors. We have started a detailed investigation aimed at defining the chemical profiling inside the cyanobacteria populations typical of the perialpine lakes. These lakes are experiencing the colonization of new algal species (i.e. *Dolichospermum lemmermannii* and *Tychonema bourrellyi*) and therefore we focused our attention on these species. We used LC-MS techniques for the determination of a wide panel of secondary metabolites classified in two major classes: *i)* alkaloids (anatoxins, cylindrospermopsins, saxitoxins) and *ii)* peptides (microcystins, nodularins, anabaenopeptins, aeruginosins, micropeptins, microviridins). We analyzed cultures of selected species as well as field samples. Analysis carried out on cultures allowed to identify molecules produced in lower concentrations. We found considerable differences among species in terms of nature and amount of secondary metabolites. For example, *T. bourrellyi* resulted to produce two neurotoxic alkaloids (anatoxin-a and homoanatoxin-a), while *D. lemmermannii* and *Planktothrix rubescens* did not; *P. rubescens*, instead, resulted to produce five different epatotoxic peptides (microcystins). A number of peptides in the mass range between 400 and 1100 dalton were also identified. The investigation allowed us to determine that the investigated cyanobacteria produce and release in the water many different compounds belonging to different chemical classes (anatoxins, microcystins, cyanopeptolins, aeruginosins, anabaenopeptins) and that each species has a specific chemical finger print.

39-O Phytoplankton community response to extreme meteorological events in a deep alpine lake.

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In the course of climate change, extreme meteorological events (EMEs) like heat waves or heavy rainfall are expected to increase in frequency in central Europe within the next decades. These events can significantly alter nutrient, light and temperature levels in lake ecosystems. Protist communities are known to react immediately to abiotic changes and hence community composition may shift due to EMEs. Here, we show the response of protist communities, especially phytoplankton, to a summer heat wave in 2015 and heavy rainfall events in 2015 and 2016. In each case we sampled 9 stations across a deep meso-oligotrophic Austrian lake, Lake Mondsee. Water samples were taken from several depths of the upper 20 m or from 0-20 m using an integrating water sampler and nutrients as well as temperature, conductivity and pH were analysed. Nutrient inflows of the three main tributaries of Lake Mondsee were also monitored. Phytoplankton identification and biomass calculations were estimated using three complementary methods: FlowCAM, flow cytometry and light microscopy (Utermöhl technique). During the heat wave, we found relatively low horizontal variation but significant changes in phytoplankton community composition at the central station of the lake with increasing water temperature. Changes were not restricted to the epilimnion; for instance we observed a vertical shift in the *Planktothrix* peak at 12-16 m depth according to PE-levels and microscopic counts. During the heavy rainfall events we found significant variations of plankton community compositions at sampling stations across the lake, indicating a high horizontal variation. Our results show, that EMEs significantly alter phytoplankton community composition. As these communities constitute a fundamental part of limnetic food webs, EMEs have the potential to change the trophic structure of lake ecosystems.

39-O Long-term ecosystem responses to multiple stressors in a large lake: a functional principal components analysis.

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In this study we describe from a Functional Data Analysis perspective the long-term (1981-2008) dynamics of Lake Maggiore, the second largest Italian lake, located in the subalpine lake district. Several physical (i.e. water temperature,