

**Ph.D. in Information Technology
Thesis Defense**

April 21st, 2022

at 14:15

Room Alpha and online by Zoom

Federica GUERRINI – XXXIV Cycle

Data-informed models for the coupled dispersal of microplastics and plastic-related pollutants applied to the Mediterranean Sea

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Abstract:

Microplastic pollution is a global emerging environmental threat, particularly for marine ecosystems. Mounting evidence highlights that floating microplastics in the sea are not just passively transported by wind and surface currents, but are often contaminated with organic pollutants and colonized by marine organisms, that are processes occurring at microplastic scale. These interactions with abiotic and biotic components of the seascape affect the dynamics of microplastics at sea and exacerbate their toxicity to marine biota; on the other hand, these phenomena are inherently hard to observe on field.

The thesis proposes and analyzes novel models based on oceanographic reanalyses to simulate realistic patterns of release and transport of plastics in the marine environment, as well as their consequent interactions with the seascape. Crucial to the realism of our models is identifying drivers of plastic pollution and exploiting the wide variety of data linked with them, ranging from national censuses to satellite data of surface water runoff and GPS ship tracking. Here we present the conceptual design, methodological settings, and modelling results of a novel 2D Lagrangian-Eulerian modelling framework that simultaneously describes (i) the Lagrangian dispersal of microplastic on the sea surface, (ii) the Eulerian advection-diffusion of selected organic contaminants, and (iii) the gradient-driven chemical exchanges between microplastic particles and chemical pollutants in the marine environment in a simple, yet comprehensive way.

While providing further understanding of the distribution of microplastics in the Mediterranean, the results of our method applied to a multi-year simulation contribute to a first basin-wide assessment of the role of microplastics as a vehicle of other pollutants of concern in the marine environment. Although far from providing a complete picture of the complex phenomenon of plastic-related pollution at sea, the framework proposed here is intended as a flexible tool to help advance knowledge towards a comprehensive description of the multifaceted threat of marine plastic pollution and an informed support to targeted mitigation policies.

PhD Committee

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