Plastic pollution in the Mediterranean
An ecosystem risk assessment

Guerrini F.*, Mari L., Casagrandi R.

DEIB – Dipartimento di Elettronica, Informazione e Bioingegneria,
Politecnico di Milano, Via Ponzio 34/5, 20133 Milan (Italy), +39 02 2399 3471,
https://www.deib.polimi.it
*Presenter. Email: federica.guerrini@polimi.it

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Introduction and context

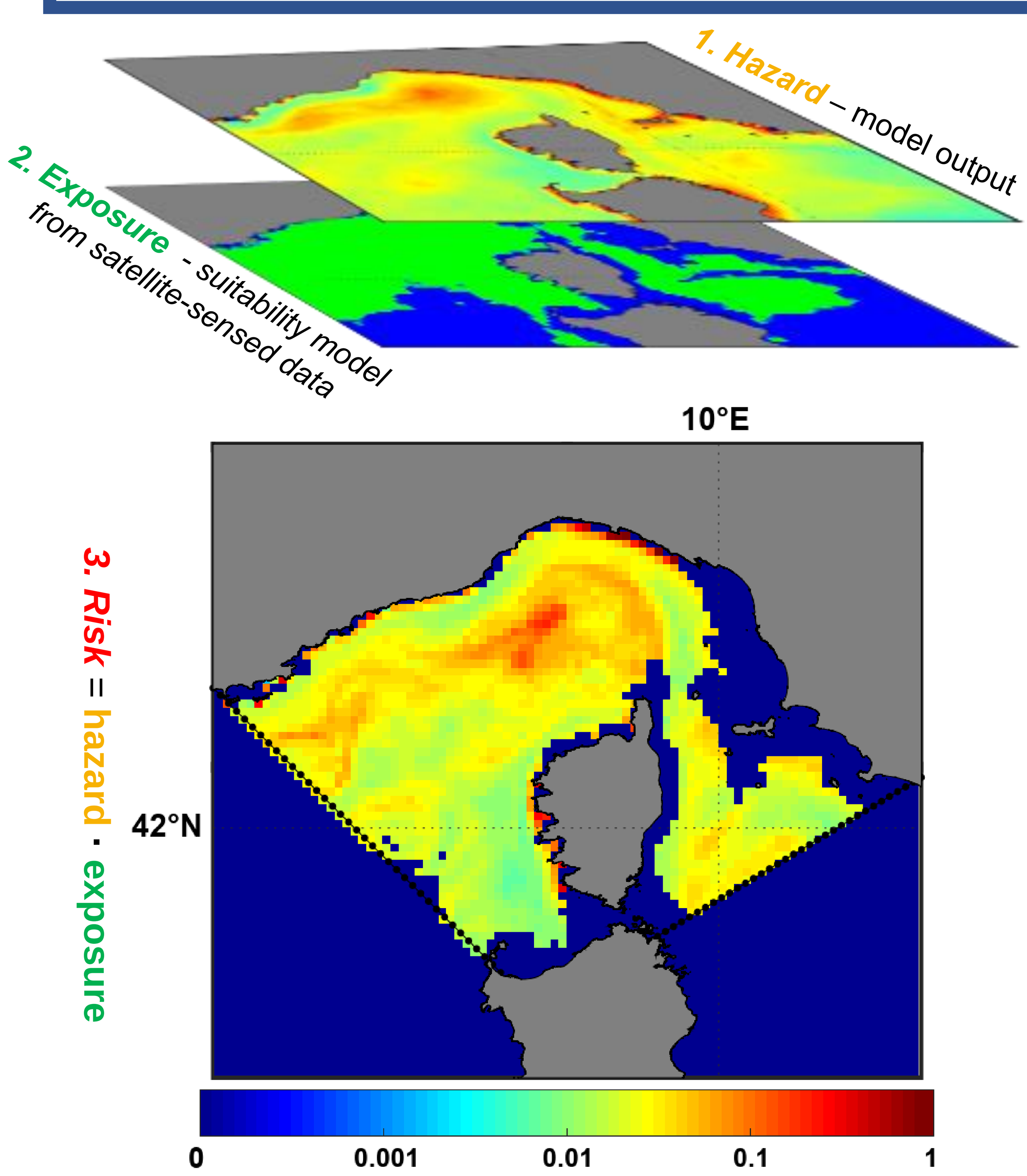
Marine ecosystems in *a plastic soup*

Plastic pollution is cause of increasing concern in the scientific community and in the general population due to its pervasiveness, in particular in the marine environment. It globally threatens the ecosystems and all populations relying on the many ecosystem services provided by nature.

The Mediterranean Sea (MedSea), one of the ecoregions most impacted by human activities in the world, is no stranger to marine litter, with measured plastic concentrations comparable to the ones found in oceanic gyres [1]. For this reason, marine plastic litter in the MedSea has been defined as *a plastic soup* [1], and its impacts have already been documented on several species [2].

Here we show how numerical modelling can be applied to evaluate the risk caused by plastic pollution in Southern European seas. We combined modelled plastic densities with an ecosystem approach, with the aim to inform policies for protection of Marine Protected Areas (such as *Pelagos*).

The International Sanctuary for Mediterranean Marine Mammals (Pelagos Sanctuary)



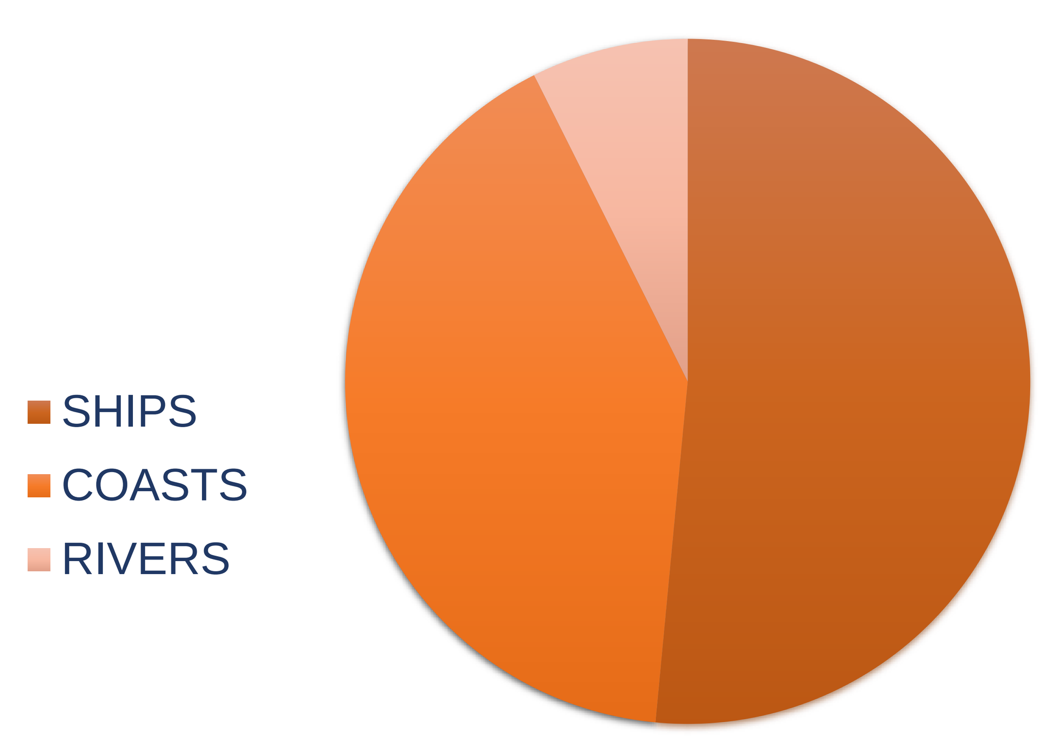
Material and approaches

An ecotoxicology-driven approach:
Risk = hazard · exposure

1. **Hazard: maps of plastic density**
   Numerical modelling of particle transport is forced by EU Copernicus reanalyses of surface ocean currents (https://marine.copernicus.eu). Plastic sources embedded in the model include coasts, rivers and maritime routes.

2. **Exposure: habitat suitability maps**
   Habitat suitability can be determined for several species by correlating environmental variables to species sightings. In this work, a species-specific habitat suitability model has been applied for the fin whale *Balaenoptera physalus*, for which remote-sensed chlorophyll-a concentration and bathymetry are used as a predictor of potential habitat (after [3]).

3. **Risk: interlacing hazard and exposure**



Apportionment of ***plastic sources contribution*** *in the Pelagos Sanctuary*

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Outcomes

- **Providing risk maps**
  A relevant, space-varying plastic risk indicator can be obtained and mapped targeting focal species and/or ecosystem services

- **Apportioning sources contribution**
  The modelling approach is based on keeping track of the origin of each plastic particle, thus allowing to compute how much does each source contribute to the overall plastic pollution (and the associated risk for marine ecosystem)

THUS

- **Giving the opportunity to inform policies for prioritising intervention on most impacting sources**

Transferability

The present methodology can be applied to:

- **Other regions** of the MedSea or the Black Sea
- **Other ecosystem services of interest**, in particular:
  - ***Supporting services*** (e.g. monitoring overlapping between plastic and high primary production areas)
  - ***Provisioning services*** (e.g. risk for commercial species)
  - ***Cultural services*** (e.g. tourism)

[1] Suaria, G. et al. (2016), The Mediterranean plastic soup: Synthetic polymers in Mediterranean surface waters, Scientific Reports 6, 37551
[2] Secretariat of the Convention on Biological Diversity and the Scientific and Technical Advisory Panel—GEF (2012). *Impacts of Marine Debris on Biodiversity: Current Status and Potential Solutions*, Montreal, Technical Series No. 67, 61 pages
[3] Druon, J. et al. (2012), Potential feeding habitat of fin whales in the Western Mediterranean sea: an environmental niche model, Mar. Ecol. Prog. Ser., 464. 289-306. 10.3354/meps09810.