« Environmental copyrights » for a more efficient marine ecosystems protection

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Numerical oceanology as an opportunity to reinvent ocean conservancy's legal framework

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Ecological Integrity: A Relevant Concept for International Environmental Law in the Anthropocene?

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The concept of ecological integrity has been used repeatedly in various national and international legal texts over several decades. Its use has been to promote the conservation of the natural environment from human activities or the wise management of the natural environment by people. However, the meaning of ecological integrity is still insufficiently defined for its effective use in legal texts. The concept is replete with connotations of naturalness, wholeness, and changelessness and so not immediately compatible with the idea of the human-dominated Anthropocene, characterized by rapid and non-linear change. The

Sui generis intellectual property rights for Ocean protection

- IP regime for ecosystem services in relation to innovation

- Model-based environmental moral rights

The core legal concept / fiction : « environmental copyrights »

- Sticking together an upgraded idea of ecological integrity and an extended idea of « integrity » as understood through the legal concept of moral rights/copyrights over scientific models/representations

- Not any type of representation

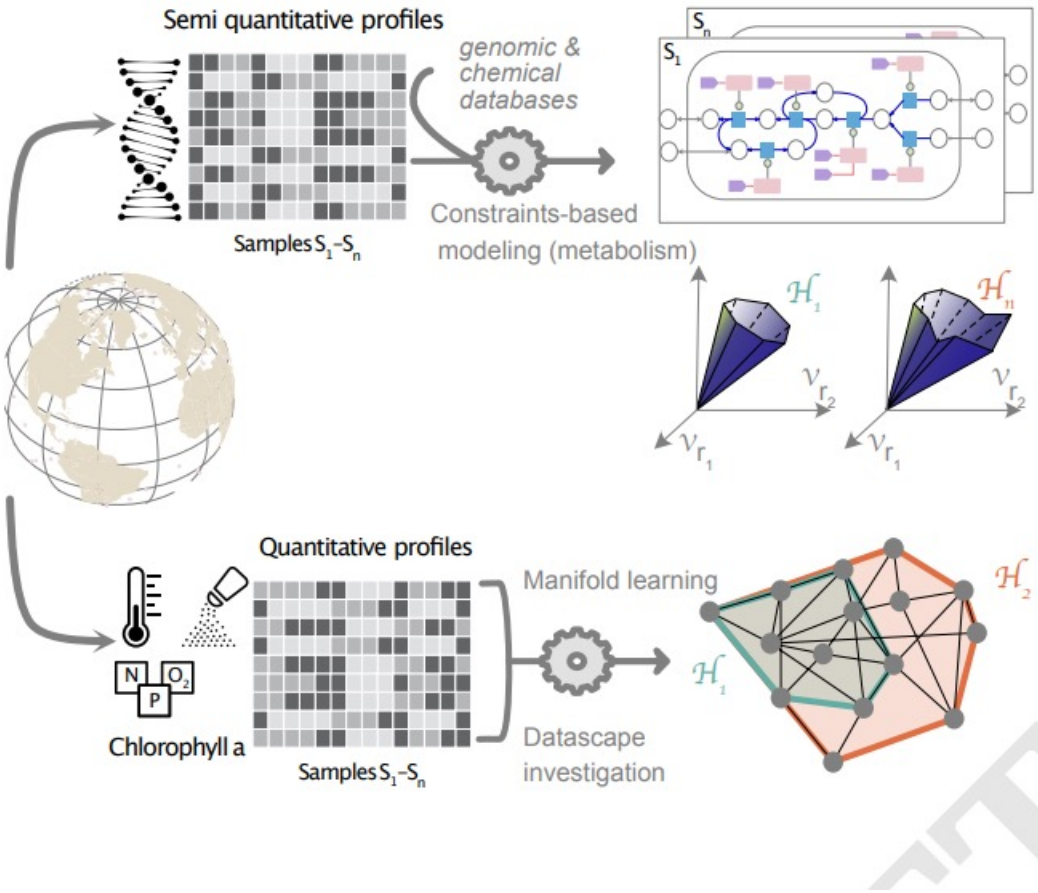

Fig. 1. Illustration of numerical modelings following the acquisition of massive data of different nature. On the one hand, from the global Ocean, meta-omics data (top panel) are semi-quantitative and describe the biological diversity of the ecosystem. The meta-omics description, combined with databases, allows, for each sample, the construction of a metabolic network. It assumes that the presence of a gene (purple arrows) – or better, its transcription – implies the presence of its encoding protein (pink rectangles) that drives a reaction when enzymatic (blue squares). Under quasi-stationary assumptions, the metabolic behaviors of the network of a given sample describe a solution space with an envelope (purple) that takes the shape of a convex hull. Comparing convex hulls allows the comparison of ecosystem phenotypes. On the other hand, environmental measurements are quantitative and describe the physic-ochemical status of the ecosystem. The application of manifold learning allows the data structure to be described as a graph (one node for each sample) on which one can compute a convex hull to encapsulate samples with a similar attribute (i.e., green for healthy conditions, orange after an environmental change).

- We consider the link between the models (convex hulls) and their underlying natural systems as the object of a particular legal protection.

=> viz. a disruption of the integrity/identity of the natural systems transposes as a violation of moral rights (integrity aspect) associated to the models.

What this protection does

- Does not offer systematic protective guarantees, but creates a new balance of power between stakeholders: polluters, scientists, and ecosystems themselves.

- And creates a legal alliance betwen scientists (and the public) and the environment against destructive actors.

An inherent weighing mechanism

- Compatible with many standard copyrights or non-copyrights regimes.

- Interestingly: the more open-source the access to the models => i.e., the heavier the human side of ‘environmental copyrights’ weighs => the stronger the environmental-moral rights violation in the judicial assessment.

How it works

Model-based judicial sanctions

Our proposed framework can articulate moral and economic dimensions. *Variable integrity thresholds* on the models, corresponding to fundamental modifications of the underlying natural systems, can be correlated to degrees of rights violations and determine graded penalties. Numerically speaking, an essential modification will result in a change of the hypervolume encapsulated by the hull (i.e., decrease or increase compared to a hull that one could qualify as wild). Relying on a formal definition, comparing two hulls (i.e., $\mathcal{H}_1$ and $\mathcal{H}_2$ after abiotic perturbation in Fig. 1) is computationally tractable and resumed by a distance such as Jaccard to become a foundation for a legal penalty score. For illustration, assuming $\mathcal{H}_1$ is associated with a healthy status and $\mathcal{H}_2$ characterizing the ecosystem after a perturbation, the hypervolume of $\mathcal{H}_2$ that is not covered by $\mathcal{H}_1$'s one is prejudice. This distance provides an objective model-based justification for determining torts and judicial sanctions.

What it solves

- Fragmented legal regimes
- Identification of bearers of rights
- A more precise and workable notion of ecological integrity
- A model-based assessment of harm and judicial sanctions