

### **Innovation Challenge 3**

*To advance understanding of ecological feedbacks in the Earth System*

#### **Perspective piece on Ecological Feedbacks**

The planned Perspective paper is now close to submission. We have a complete draft that is in the final stages of editing, checking and finalising for submission. As part of the development of the paper we have commissioned a series of figures.

The paper has developed to encompass both marine and terrestrial ecosystems. The authorship includes a number of IMBeR community scientists, and also specialists in aspects of terrestrial and freshwater ecosystem science, modelling and climate change impacts.

*Current draft abstract*

#### ***Ecological Feedbacks in the Earth System***

Ecological feedbacks are fundamental features of the Earth system, affecting physical processes and biogeochemical cycles. Our understanding of the interactions between ecological, physical, and chemical processes at different spatial and temporal scales and the extent to which feedbacks can affect Earth system functioning remains limited. The effects of accelerated anthropogenically-driven climate change are already negatively affecting ecological processes in marine, freshwater, and terrestrial ecosystems. These will most likely be amplified in the coming decades under our current warming pathway. The impacts on ecological feedbacks have the potential to cause rapid perturbations to the Earth system, and combined with other human-driven stressors (e.g., deforestation, pollution), may significantly impact the structure and functioning of ecosystems. However, the role of our planet's diverse ecological feedbacks in Earth system processes and the impacts of perturbations are major knowledge gaps. Here, we first examine what is known about ecological feedbacks in ecosystems and how they affect physical and chemical processes. Second, we consider the implications of ecological feedbacks for analyses of anthropogenically-driven change, development of scientific understanding and models, and provision of scientific advice for policy makers. Third, we highlight major knowledge gaps and research needs for the rapid assessment and integration of ecological feedbacks in Earth system science. Finally, we propose the development of a systematic approach to improve the understanding of ecological feedbacks at different spatial and temporal scales. This perspective piece is an urgent call to the scientific community for the rapid development of integrated ecosystem – Earth system research.

We are grateful to IMBeR and ICED for the support in the generation of the manuscript and in the publication process. Once the publication process is complete, we will consider the next stage in the development of this activity. The paper makes a number of recommendations that could form the basis for future discussions within the IMBeR community on the development of approaches to improve understanding of ecological feedbacks in the ocean and their role in the Earth system.

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