vERSO

Ecosystem Responses to global change : a multiscale approach in the Southern Ocean

DURATION
01/12/2013 – 28/02/2018

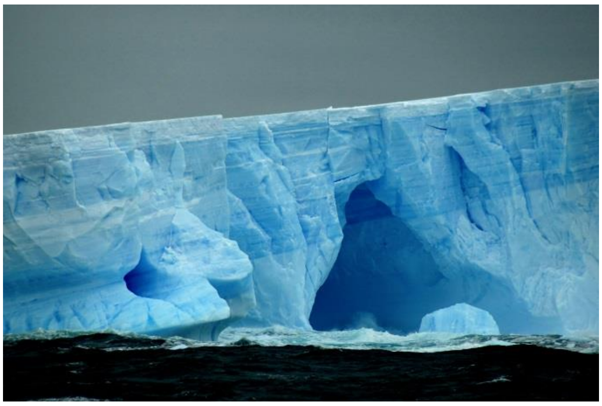
BUDGET
1 239 038 €

PROJECT DESCRIPTION

The Southern Ocean covers about 34.8 million km² and the Antarctic contains roughly 11% of the world's continental-shelf area, harbouring a major part of the global marine diversity. The region is experiencing environmental changes across broad temporal and spatial scales that may fundamentally change the biology of the Southern Ocean, inducing massive, far-reaching modifications that ecosystems have never experienced before. Global change affects Antarctic ecosystems through numerous interacting stressors, the most important ones being temperature increase, acidification, increased sedimentation rates and changes in nutrients and food resources. The latter is linked to glacier melting, reduced seasonal ice cover and ice shelf collapses, and will result in modified bentho-pelagic coupling. All Antarctic regions are not affected to the same extent: for example, the western Antarctic Peninsula (WAP) is the most rapidly warming region in the Southern hemisphere and the only area of the Antarctic where sea ice coverage actually decreased with time. In contrast, the Ross Sea area has been marked by the largest increase of sea ice extent over the past 30 years and this also holds for the Western Pacific sector of Antarctica.

Sustained environmental stress is causing a cascade of effects, yet, comprehensive studies on how these stressors will impact marine ecosystems and their different components are sparse. If major changes in coastal and shelf pelagic systems have already been documented, very little information is available on benthic systems. The response of organisms to a changing environment depends on their capacity to cope with the physiological cost imposed by the new conditions and the outcome of change is determined by the ability of the populations to sustain themselves. Individuals may be able to cope physiologically or to adapt their trophic ecology, but reduced genetic connectivity between populations caused by hydrodynamic changes, environmental shifts changing the boundaries of physiological sustenance, and biological alterations may change species distributions and/or reduce or eliminate populations. In turn, it may enhance speciation. At the community level, biological interactions play a crucial role. Therefore, addressing potential effects of climate change requires an integration of macro-ecological concepts, experimental evidence and modeling approaches at multiple scales (from gene to ecosystem, and including various geographical scales).

The goal of the vERSO project is to assess the impact of the main stressors driven by global change on benthic Antarctic ecosystems using an integrated multiscale approach including representative taxa from different size classes of the benthos. Two principal regions with current contrasting impacts of global change will be considered, namely the Western Antarctic Peninsula and Terre Adélie. To reach this goal, research on connectivity and adaptation, trophic ecology and sensitivity and resilience will be conducted and integrated using ground-proofed predictive models. The vERSO research will be distributed among four interactive work packages.



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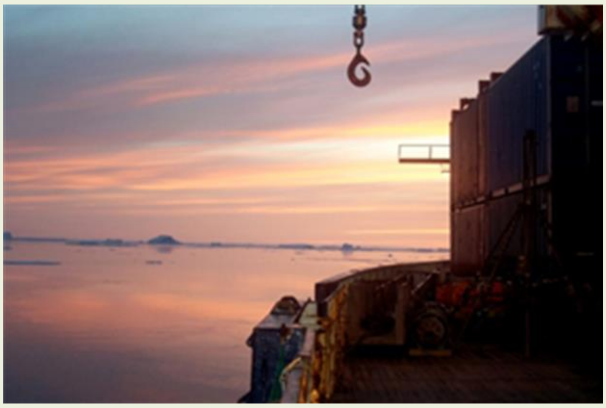
In the first work package (WP1 – Connectivity and Adaptation) vERSO will identify the contemporaneous and past connectivities in a range of widespread and common benthic taxa (nematods, amphipods, echinoderms and fishes) along the continental shelf of the Antarctic continent. The main aim is to identify and understand the dispersal-related processes that explain the distribution patterns and biodiversity of Southern-Ocean taxa in a community perspective. The relative importance of environmental and dispersal-related explanatory variables in determining distribution and biodiversity patterns will be assessed. Microsatellites and mitochondrial DNA markers will be the principal tools. The specific spatio-temporal molecular patterns will be used to expand the predictive power and resolution of the models used in WP4.

In the second work package (WP2 – Trophic Ecology) vERSO will delineate general trophic web structure and carbon pathways in contrasting coastal habitats and assess trophic variability (i.e., specific plasticity, ontogenic shifts, degree of specific and individual trophic specialisation) in order to estimate the adaptative potential of communities to future trophic changes. For that purpose, primary production and fluxes to the sea floor, energy flow through the benthic food web and trophic niches will be characterized using either stable isotope tracing experiments or natural isotopic ratios and fatty acid compositions.

In the third work package (WP3 – Sensitivity and Resilience) vERSO will characterize the sensitivity of key benthic taxa and communities by running integrated experiments to assess the combined effects of temperature, acidification, and food quality and quantity on nutrient fluxes, metabolism and functional structure of significant components of sediment communities (prokaryotes, nematodes, amphipods and echinoids) in contrasting regions. Food sources enriched in heavy stable isotopes of C and N will be used to trace their fate in the trophic web. Both energy metabolism and acid-base balance will be characterized. The output of these experiments will be used in the interpretation of WP2 and in models of WP4. Resilience analysis will be based both on available, yet poorly exploited long-term data and on modeling using sensitivity, connectivity and trophic ecology data.

The fourth work package (WP4 – Integrative modeling) will run predictive models (array of Species Distribution Models and dynamic models) and will attempt integrating biogeographical, connectivity, trophic, sensitivity and environmental data to assess the severity of potential ecological shifts. Fine scale data will be used to validate predictive species distribution models. WP4 will play a dual role in vERSO, both as a science driver and as an integrator.

vERSO integrates into the new SCAR Scientific Research Programs (SRPs – AntERA and AntECO) and will contribute data, models and advises to science policy interfaces, committees, treaties and protocols to which Belgium is committed, such as the Antarctic Treaty Committee on Environment Protection (ATCM CEP), the Convention for the Conservation of Antarctic Marine Living Resources (CCAMLR), or the Convention on Biodiversity (CBD) together with direct contributions to the new Antarctic Environments Portal initiative.



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LINKS

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