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Understanding complex pressures on the Wadden Sea and options for action

The Wadden Sea is a unique tidal wetland and World Heritage Site. This German-Dutch research programme charts the complex pressures and (cumulative) effects for the ecosystem, the options for action and their consequences for human life in this coastal region.

Purpose and objectives



This call for proposals aims to fund interdisciplinary, international research projects that strengthen our knowledge on the impact of human-induced pressures, especially those related to the triple ecological crisis of climate change, rapid changes in biodiversity, and pollution, on the Wadden Sea ecosystem, options for action to address these pressures, and the consequences of measures for socio-economic aspects of local communities.

← Dutch Research Agenda (NWA)

[Research along Routes by Consortia \(NWA-ORC\)](#) ▾

[Thematic Programming](#) ▾

[Innovation and Networks](#) ▾

[Science Communication and Outreach](#) ▾

Characteristics

Status

[In progress](#)

Start

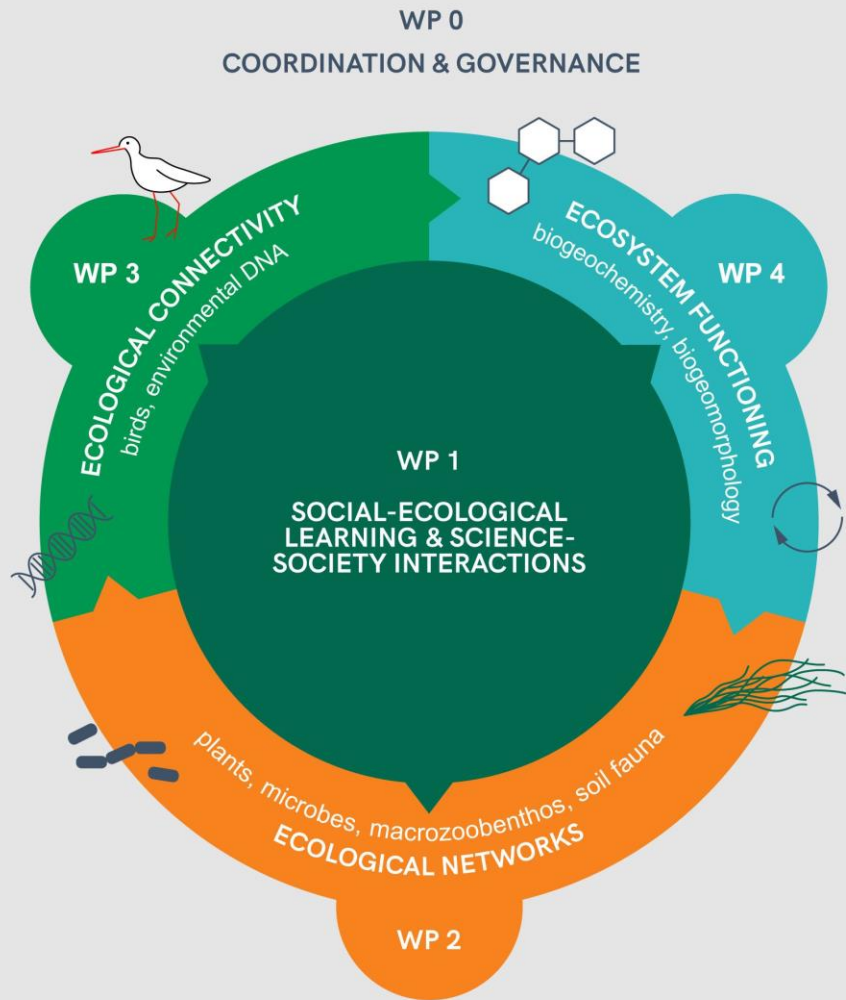
2023

TRICMA² - Triple crisis meets trilateral cooperation

Overarching goal: Develop guiding principles for future salt-marsh management



Tightly connected work packages & transdisciplinary team

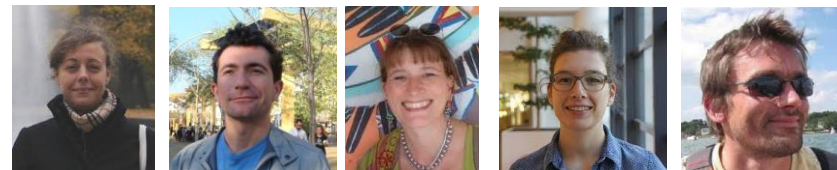


Primary stakeholders
(NL, SH, LS, HH, DK)



Trilateral,
interdisciplinary
consortium

+ jointly supervised PhD students
+ PostDoc, expert/staff & project manager



Advisory Board
UK, Spain, Sweden,
NL, France

Different forms of knowledge - starting point for TRICMA²

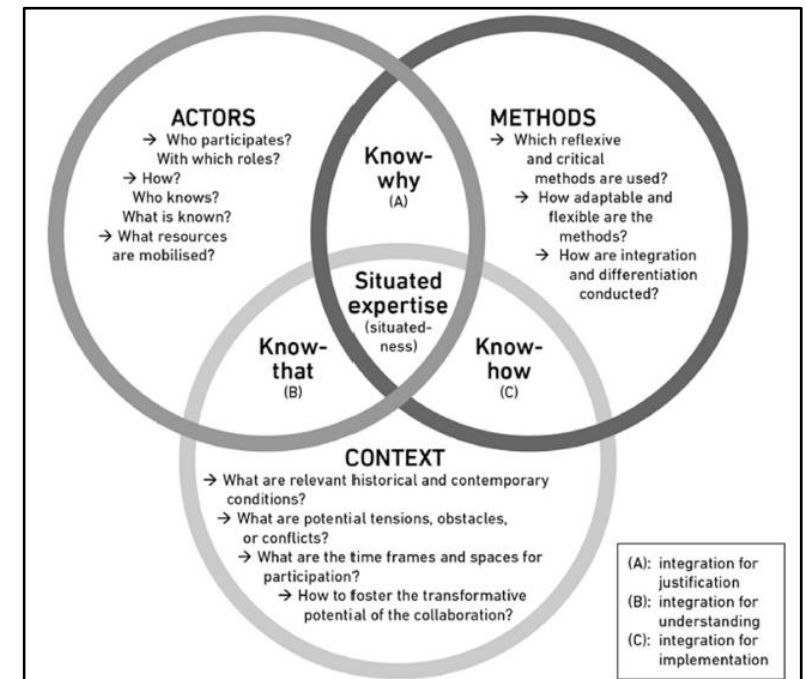
Situated knowledge: From theory to practice...

- Listening and talking to each other instead of informing the public
- Co-design in proposal & exploratory phase; co-production of novel knowledge in experimental & synthesis phase

With our focus on joint knowledge co-creation instead of one-directional science dissemination, we will be on the forefront of science-society interactions



Bregje van Wesenbeeck, Nature based Solutions;
Associate Professor, Deltares



Regular science-stakeholder interactions

Outputs - achieved results to be used by stakeholders

- Novel knowledge about effects of triple crisis
- Dedicated attention and understanding in future generations
- Fostered valuation of trilateral exchange and harmonization



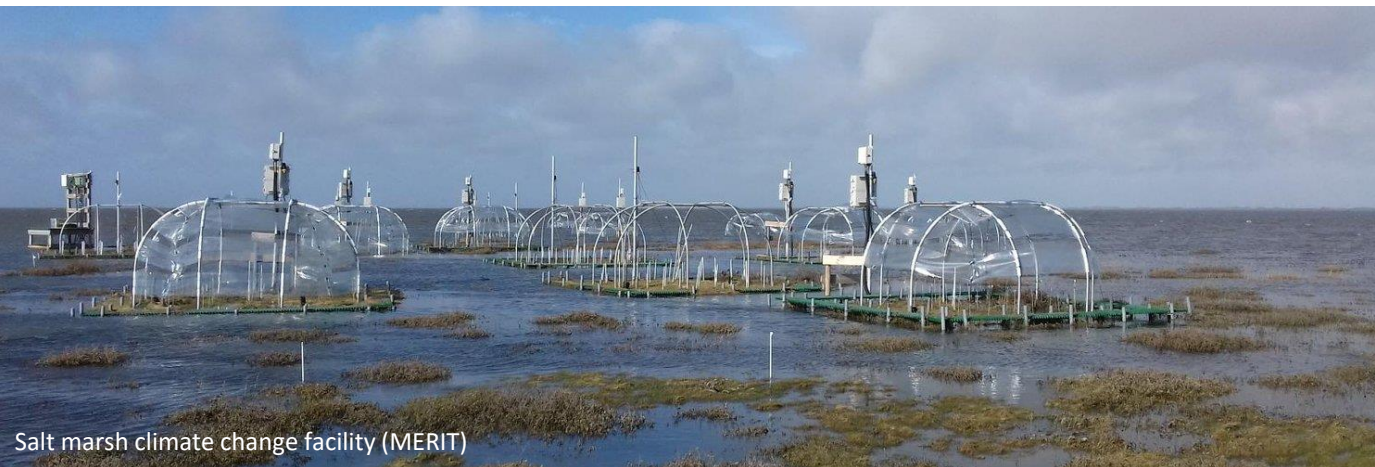
Trilateral expert group during active exchange

Foto: John Frikke ©

A common vision for the future of salt marshes (...) would be a great achievement of the project, combined with passing on this knowledge to future generations



Gregor Scheiffarth, primary stakeholder;
Wadden Sea National Park LS, Wilhelmshaven



Salt marsh climate change facility (MERIT)

What is the meaning of future in TRICMA²

- Raising attention of future generations'
- Analyzing effects of future climate change

- Addressing future trilateral challenges together
- Principles for future salt-marsh management



JGR Biogeosciences

METHOD
10.5194/2022/202207550

Key Points:

- Novel Ecosystem Response to Increased Temperatures (MERIT) is a novel ecosystem warming experiment in a high-energy coastal salt marsh
- MERIT addresses passive aboveground and active belowground warming in 1 m depth
- MERIT tests warming effects on ecosystem functioning along a marine-terrestrial ecotone

Supporting Information:
Supporting Information may be found in the online version of this article.

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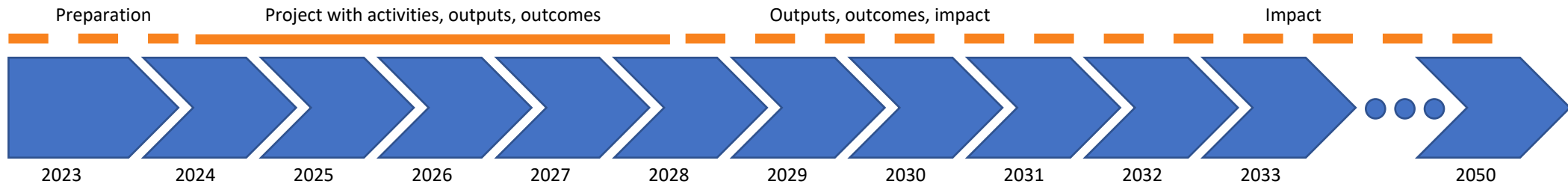
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Data curation: R. L. Kirk, Stefan Thomsen

Design and Assessment of a Novel Approach for Ecosystem Warming Experiments in High-Energy Tidal Wetlands
R. L. Kirk¹, Peter Müller^{2,3}, Miriam Fink⁴, Sabine Gossens⁵, Eva Osting⁶, Sverre Risse⁷, Han Tang⁸, Aligra Tangjaru⁹, Stefan Thomsen¹⁰, Kai Jensen¹¹, and Stefan Müller¹²

Abstract: Coastal salt marshes have an important role in climate change adaptation and mitigation. Direct and indirect responses to warming are expected to vary along the marine-terrestrial ecotone, making ecosystem responses to warming at this marine-terrestrial ecotone complex. The MERIT Ecosystem Response to Increased Temperatures (MERIT) experiment was established in 2020 on the North Sea coast of Germany. Experimental plots are evenly distributed over three elevational marsh zones (low, mid, and high marsh) and include three temperature treatments (ambient, +2°C, +4°C). MERIT's novel design combines active warming (horizontal surface warming cables and embedded warming panel) with passive, partially covered domes. For performance assessment, temperature data between ambient and warmed plots were calculated and evaluated at seasonal, daily, and diurnal scales. Linear Mixed Models with Random Maximum Likelihood evaluated warming treatment effects and constraining environmental factors. MERIT was effective at ecosystem warming in this high-energy environment both above- and belowground. Mixed models show that warming treatment dominates differences belowground and at the soil surface, along with factors such as wind speed, flooding duration, and solar radiation. Aboveground warming was lower than belowground warming, but the degree of warming was similar in other open-air chamber experiments. The combination of passive aboveground warming with feedback-controlled active surface and belowground heating provides a setup for understanding warming effects on tidal ecosystems without altering the natural impacts of wind, radiation, and high tides at high-energy ecotones. Our design creates opportunities to expand future warming experiments to remote locations and technically challenging environments.

Plain Language Summary: Coastal vegetated ecosystems such as salt marshes have been highlighted for their important role in climate change adaptation and mitigation, especially in storing carbon. However, some of ecosystem functioning and biogeochemistry to warming are largely unknown and



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