

## Replies on 4 BioGeoScapes questions from Finland BioGeoScapes discussion group held on 11<sup>th</sup> May 2023.

Invitation to join discussion was sent out by David N. Thomas to whole FINMARI membership in February 2023. The resulting discussion group was David N. Thomas & Nicolas-Xavier Geilfus (University of Helsinki), Shane Hogle (University of Turku), Eero Asmala (GTK), Hermanni Kaartokallio & Eeva Eronen-Rasimus (Syke)

*1) Thoughts on preliminary BioGeoScapes Mission statement this? How could this be improved? "To improve our understanding of the functioning and regulation of ocean metabolism and its interaction with nutrient cycling within the context of a hierarchical seascape perspective".*

What is "Ocean" is it just open ocean or includes coastal and inland waters.... should it be "ocean & seas"

Ocean, here, is a somewhat exclusive term and for the benefit of inclusivity there is a need to explicitly include shelf, coastal, inland waters and estuaries.

"Ocean metabolism" is an ambiguous term for many, especially in terms of scale (virus to whales?) "Hierarchical seascape" could be defined better?

*2) How would your nation best contribute to BioGeoscapess efforts? – e.g. fieldwork, laboratory work, modelling, intercalibration efforts, project coordination, data management, bioinformatics*

**Fieldwork:** Ship and coastal station infrastructure for coastal and inland sea research

**Laboratory work:** Experimental facilities and accredited analytical facilities across several Government and higher education institutions (Finnish Environment Institute (Syke), Geological Survey of Finland (GTK), Finnish Meteorological Institute (FMI), Natural Resources Institute Finland (LUKE), Universities of Helsinki (UH), Turku & Åbo Akademi.

**Modelling:** Climate, oceanographic, biogeochemical and spatial modelling (FMI, Syke, GTK & UH)

**Project coordination:** Already a well established Finnish Marine Research Infrastructure (FINMARI) coordination of national marine infrastructure. Actual project management from a pool of government-funded institutes: Syke, LUKE, FMI, GTK who have appropriate national responsibilities and capabilities.

**Data Management:** Unique long-term history of easily accessible monitoring data (coastal and inland seas). E.g. FairData (<https://www.fairdata.fi/en/>) offer products to support data management, metadata description, safe storage as well as digital preservation over decades, technology cycles and research projects" FairData is a Finnish service but it is intimately linked to the European Research Data Alliance (RDA) network. Finland was one of the first countries participating in building the RDA network (<https://www.rd-alliance.org/rda-europe>) since 2012. It hosts the high-capacity storage nodes in Europe along with the Netherlands, Greece, Ireland, UK, Germany, France and Italy.

**Bioinformatics:** Rapidly developing community (multiple new TT hires in microbiome science across Finland) & highly accessible computational infrastructure (CSC – IT Center for Science)

nationally & as part of European networks. For example, the Finnish Center for Supercomputing (CSC) is a non-profit state enterprise with an official mandate to keep Finland at the cutting edge of technology by e.g. being a partner in national and international projects providing services in supercomputing, information technology, and data management.

*3) What science questions are most important to your nation within the broad scope of BioGeoScapes on a 10-year timeframe?*

**1) Role of microbes in coastal carbon sinks:** Investigate the contribution of microbial processes to carbon sequestration in coastal environments, including the role of sediments, coastal wetlands, salt marshes and mangroves. Study the microbial mediation of carbon burial, greenhouse gas emissions and the resilience of coastal carbon sinks to environmental change.

**2) Identifying molecular biomarkers to diagnose the status of ocean biogeochemical cycles.** What are the biological determinants (genomic/transcriptomic/proteomic) that structure the concentrations and chemical forms of nutrients in the sea? How can we leverage the wealth of current and emerging marine microbiome and oceanographic datasets to identify microbial biomarkers for nutrient metabolism in the ocean? How can we convert “omics” information at the level of genes/proteins into currencies that can be practically and usefully leveraged by global biogeochemical models?

**3) Mechanistic understanding of microbial community structure and function:** Using synthetic assemblages in laboratory experiments (‘omics’, physiology and metabolism) to better understand microbial physiology and metabolism in the ocean.

**3) Mechanistic understanding of microbial community structure and function that links the molecular to biogeochemical processes** Can we functionally characterize sets of microbial biomarkers (i.e., species, genes or gene networks) identified through data-driven omics approaches (e.g., question 2) to gain a mechanistic understanding of microbial community structure/function/metabolism. Both using pure microbial cultures and synthetic microbial assemblages in laboratory experiments from the perspective of microbial omics, physiology and metabolism.

**4) Linking particle properties to microbial processes:** Investigate the relationship between particle properties (e.g., surface characteristics, composition) and their influence on microbial colonization, activity, and gene expression. Explore how particle characteristics affect the structure and function of microbial communities involved in particle degradation.

**5) Anthropogenic impacts on coastal microbial biogeochemistry:** Assess the effects of climate and human activities, including pollution, coastal development as well as nutrient inputs, on microbial biogeochemical processes in estuarine and coastal environments. Investigate how these impacts alter microbial community composition, functional gene expression, and ecosystem functioning.

**6) Microbial biodiversity and functional change resulting from climate change processes:** Does changes in microbial community composition affect to microbially mediated processes? What are effects of the habitat losses (e.g. sea ice, wetlands, coastal macrophytes) to microbial diversity and functions?

4) Are there any impediments that the international community could seek to mitigate via training or collaboration?

Targeted workshops/events/schools/exchanges to disseminate omics literacy.

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