MASTER TOPICS CHEMICAL OCEANOGRAPHY

Ocean carbon sink/source for 2 degrees warming target
Supervisor: Jerry Tjiputra, jetj@norceresearch.no (plus someone from UiB).
Topic/Goal: Quantify reduction in ocean carbon sink and feedback in reaching the 2°C target. Determine the re-emergence of anthropogenic carbon by identifying hotspots and mechanisms where the ocean reverses role from an uptake to a source of carbon to the atmosphere.
Methodology: Analyse an ensemble of Earth system model projections from the IPCC/CMIP5 database under the RCP2.6 scenario. Link changes in air-sea CO2fluxes to (1) trend in atmospheric CO_2, (2) ventilation dynamics, and (3) biological processes.

Adding aragonite to a biogeochemical ocean model for ocean acidification studies
Supervisor: Christoph.Heinze@uib.no
Topic/goal: Our biogeochemical global ocean iHAMOCCC model includes only calcite. Goals of the study is to add semi-labile $CaCO_3$ (as used by some zooplankton and corals) as a further particulate and solid sediment tracer. This addition is important for making realistic estimates on ocean acidification under high CO_2/global warming.
Methodology: Add aragonite production at the surface, aragonite re-dissolution in the water column, and aragonite burial/re-dissolution in the sediment within iHAMOCC.

Effect of declining sea ice on marine primary production in the Arctic
Supervisor: Annette Samuelsen Annette.Samuelsen@nersc.no and Caglar Yumruktepe (Nansen Centre) (supervisor from UiB Are Olsen: are.olsen@uib.no):
Topic/goal: To understand how historically (past 20-30 years) changing sea ice coverage has affected primary production and the lower trophic levels in the Arctic Ocean and how sensitive the model estimates of primary production are to the choice of sea-ice model parameterization.
Methodology: HYCOM-CICE-ECOSMO is a coupled model system simulating the ocean, sea ice and nutrients and the lower trophic levels of the marine ecosystem. Task (1) to run a hindcast of HYCOM-CICE-ECOSMO and analysing the resulting primary production with respect to sea-ice variables. Task (2) change how light penetrates the sea ice in the sea-ice model and analyse how this changes the primary production estimates with respect to the results from task (1).

Trends and variation in surface ocean carbon cycle
Supervisors: Siv Lauvset (UiB and NORCE), siv.lauvset@norceresearch.no, and Ingunn Skjelvan (NORCE), ingunn.skjelvan@norceresearch.no
Topic/Goal: Determine temporal and spatial variation in surface pCO2 based on 10 years of data from the research vessel G.O. Sars sailing in the Nordic Seas. Further, suggest drivers for the observed variations.
Methodology: Use developed software routines and theory to study gradients in marine carbon system between open ocean and coast/fjords, from south to north, over an annual cycles and over years.

Nordic Seas ^{13}C Suess effect in marine sedimentary records
Supervisor: Are.Olsen@uib.no plus several people working on paleoceanography at GEO and NORCE (Ulysses Ninnemann, Hans Petter Sejrup, Carin Anderson Dahl, Fabian Bonitz, Margit Simon)
Goal/Topic: Understand how the decline in the atmospheric fraction of the stable carbon isotope ^{13}C, a result of human emissions of CO_2 penetrates the ocean and imprints itself on $\delta^{13}C$ in sediment- and shell-based records of past ocean conditions.
Methodology: Synthesise Nordic Seas marine sediment and shell-based based records covering the past few hundred years and determine the magnitude and characteristics of the

^{13}C Suess effect in these, and propose a unified framework for correcting for this effect in the various types of records, for use in current and future paleoceanographic investigations.

Climate change risk metrics for marine ecosystems
Supervisor: Christoph.Heinze@uib.no
Topic/goal: Evolving climate change induces risks for the marine environment due to warming, ocean acidification, deoxygenation, and other stressors. Vulnerabilities of ecosystems and exposure to driving factors lead to risk. The goal is to design simple risk metrics for the marine environment (in analogy to terrestrial risk frameworks) and apply them to output data from Earth system models under different climate change scenarios.
Methodology: Suitable model data sub-sets need to be accessed/downloaded from the CMIP archive. Climate risk indices will be derived from the literature, and were needed designed anew based on methods for the land-biosphere, which need redesigning for the marine realm. The risk indices/metrics will then be applied to the data sets and risk maps as well as time series will be produced.