

BACKGROUND

The past decades has seen remarkable changes in the Arctic. The decrease of sea-ice extent and sea-ice thickness is statistically significant, large physical and chemical variations in the upper and intermediate layers of the ocean are notable. Arctic organisms are adapted to extreme environmental conditions and the increasingly rapid rate of recent climate change poses new challenges to the resilience of arctic life. To detect and track the impact of environmental changes at a deep-sea site, the German Alfred Wegener Institute for Polar and Marine Research established HAUSGARTEN, representing the first, and by now only open-ocean long-term observatory in a polar region.

LOCATION

HAUSGARTEN was established in summer 1999 about 150 km west of Svalbard. It consists of 15 sampling sites along a depth transect between 1000 - 5500 m, and along a latitudinal transect following the 2500 m water depth isobath. Sampling sites are revisited yearly to analyse variations in biological, geochemical and sedimentological parameters. The use of autonomous systems anchored at the seafloor will help to assess seasonal variabilities. The development of benthic assemblages on larger scales are tracked via seafloor imagery. Two sites at 2500 m were chosen for biological long-term experiments to study causes and effects of gradients on deep-sea biodiversity.

HAUSGARTEN

THE ARCTIC DEEP-SEA OBSERVATORY

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Established by the *Alfred Wegener Institute for Polar and Marine Research, Bremerhaven, Germany. A key site of the proposed European Network of Excellence ESONET (European Seas Observatory Network)



FREE-FALLING SYSTEM, TYPE I

A bottom-lander carrying up to four respiration chambers is used to assess remineralisation rates by the sediment-inhabiting community.



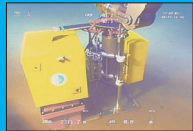
FREE-FALLING SYSTEM, TYPE II

A bottom-lander equipped with a scanning sonar, cameras and baited traps is used to study the spatial and temporal attraction of benthic scavengers by large food-falls.



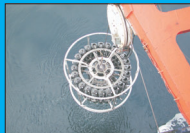
REMOTELY OPERATED VEHICLE

Within a cooperation with IFREMER, the French ROV "Victor 6000" is regularly used for video surveys, targeted sampling, and the installation and maintenance of in-situ experiments.



MICRO PROFILER

Micro-electrodes are used in-situ to assess gradients in oxygen and other solutes in upper sediment layers.



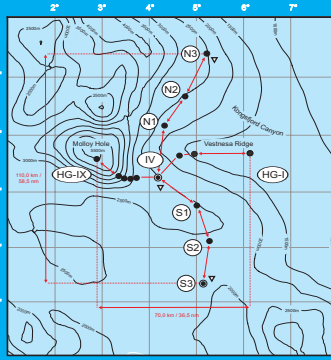
CTD-ROSETTE

To assess temperature and salinity profiles, and to take water samples we are using a combined CTD-Niskin Bottle-Rosette.



BOTTOM WATER SAMPLER

The BWS allows to sample near-bottom waters in order to quantify gradients in nutrients and oxygen, and interfacial solute fluxes in the benthic boundary layer.



● long-term sampling sites ● experimental areas ▼ sediment traps / current meters



AUTONOMOUS UNDERWATER VEHICLE

A 3000 m depth-rated AUV will be used for large-scale 3-dimensional CTD tasks, for high-resolution seafloor mapping, and visual observations at the deep seafloor.



OCEAN FLOOR OBSERVATION SYSTEM

A towed OFOS is used to assess large-scale distribution patterns of mega/epifauna at the deep seafloor.



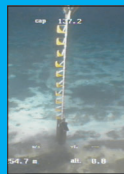
MULTIPLE CORER

A video-controlled MUC is used for semi-targeted sampling of virtually undisturbed surface sediments.



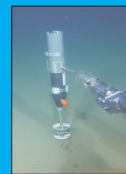
MOORINGS

Since summer 2000, we deploy moorings carrying sediment traps and current meters near the central "Hausgarten" station. Complementary current meter data are available from moorings deployed within the EU-projects VEINS and ASOF-N crossing the entire Fram Strait at 79°N.



CURRENT METERS, TYPES I, II

Arrays of current flags allow high vertical resolution short time measurements above the seafloor. Long-term measurements in the water column are performed by acoustic current meters.



CURRENT METERS, TYPE III

ROV-operated acoustical current meters are used to measure currents at small scales around different structures at the seafloor (e.g. biogenic structures, dropstones).

CORE MEASUREMENTS

Pelagic Zone: particle flux (biogenic, lithogenic), currents (speed, direction), phytoplankton

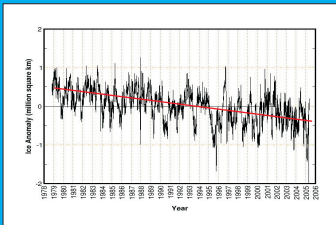
Near-Bottom Zone: oxygen concentrations, nutrients, bacterial densities, near-bottom currents in high-resolution

Sediment-Water-Interface: carbon remineralisation (oxygen microelectrodes, sediment community oxygen consumption), nutrient fluxes

Sediments: granulometry, porosity, organic carbon, carbonates, opal, C/N ratios, biomarker (e.g. alkenone, n-alkanes), organic matter input (phytodetrital pigments)

Benthic Organisms: bacteria (activities, densities, biomasses), meiofauna, macrofauna, megafauna (densities, biomass, dispersion, biodiversity)

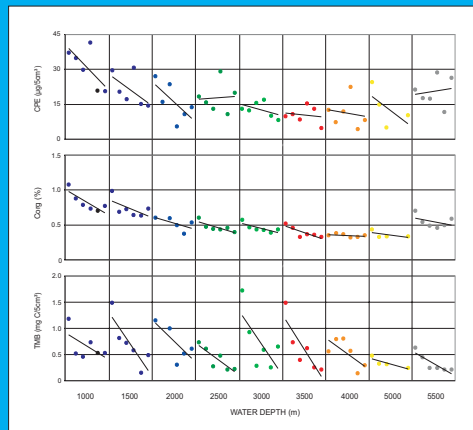
FIRST RESULTS



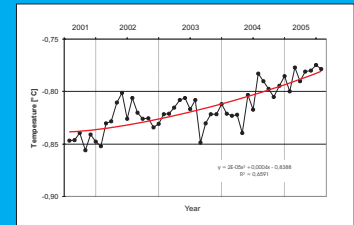
Sea-ice anomalies in the northern hemisphere between 1978 and 2005. (source: <http://arctic.atmos.uiuc.edu/cryosphere>)

TIME SERIES DATA, PART I

The decrease of sea-ice extent and thickness in the Arctic in the past decades is statistically significant. At the same time, water temperatures in Fram Strait constantly increased. Our temperature records covering the years 2001 through 2005 exhibited not only seasonal variations but also an overall slight temperature increase, even at 2500 m water depth at the central HAUSGARTEN site.



Temporal development (between 2000 and 2005) of concentrations in chloroplast pigment equivalents = phytodetrital input (top), organic carbon (center), and total microbial biomass (bottom) in sediments along HAUSGARTEN depth transect.



Temporal development of bottom temperatures at the central HAUSGARTEN site ($\Delta t = 0.06^\circ\text{C}$ over 4 years).

TIME SERIES DATA, PART II

Analyses of biogenic sediment compounds between the summers of 2000 and 2005 revealed a general decreasing input of phytodetrital matter to the seafloor, and subsequently, a decreasing trend in sediment-bound organic matter and total microbial biomass (TMB) in the sediments. An ongoing trend in decreasing organic matter fluxes will consequently affect the entire deep-sea ecosystem at HAUSGARTEN.