ALFRED-WEGENER-INSTITUT
HELMHOLTZ-ZENTRUM FÜR POLAR- UND MEERESFORSCHUNG

New Technology

One year alone in the deep sea of the Arctic

First long-term mission of the AWI underwater robot Tramper from the research vessel Polarstern has begun

[18. July 2016] Far from any controls, an underwater robot has been working for the past few days in 2,500 metres of water on the seabed of the Arctic, after the completion of a successful test run. Researchers and engineers of the Alfred Wegener Institute Helmholtz Centre for Polar and Marine Research (AWI) have deployed the deep-sea crawler Tramper for a year-round, fully autonomous mission for the first time. The mobile underwater robot, which has been developed within the Helmholtz Alliance Robotic Exploration of Extreme Environments (ROBEX), will now perform weekly oxygen measurements in the seabed.

Sleeping, driving, taking pictures, measuring – the job description for the AWI Tramper › sounds easy. Since this underwater robot is supposed to do all of this autonomously in the Arctic deep sea for a year at a water temperature near the freezing point, though, the engineers and scientists are a little nervous. Therefore, the program of the Polarstern expedition PS99.2 initially included a test run, which the AWI Tramper completed successfully: It was operating on the seabed for two days at a depth of 1,500 metres. Thereby Tramper travelled a total of 123 metres and performed seven measuring cycles, proving its operability.

Accordingly, the stage was set to deploy the underwater robot on the evening of 11 July 2016 for its long mission at the AWI deep-sea observatory 'Hausgarten' › at a water depth of 2,500 metres. A video-guided deployment system (the so-called launcher) brought the crawler safely to the seabed, where it is now to perform its measurements every week. It first moves 15 metres in order to reach an undisturbed area. An image recognition camera checks the surface there: If any stones or the like are recognised, Tramper travels on for another two metres. Then, a high-resolution photo of the measurement site is taken before the measurement begins. During this process, sensors are placed in the sediment in small increments of 0.1 millimetres, in order to measure the oxygen distribution in the seabed.

"After the measurement, Tramper goes to sleep for a week, to save energy. Ultimately, it should perform more than 52 such measurement cycles – and at a temperature of minus 1.8 degrees Celsius, which places a strong demand on the batteries," says Dr Frank Wenzhöfer, biologist at the Helmholtz Max Planck Joint Research Group for Deep-Sea Ecology and Technology › . The scientists want to use the Tramper measurements in order to investigate the activity of microorganisms on the seabed.

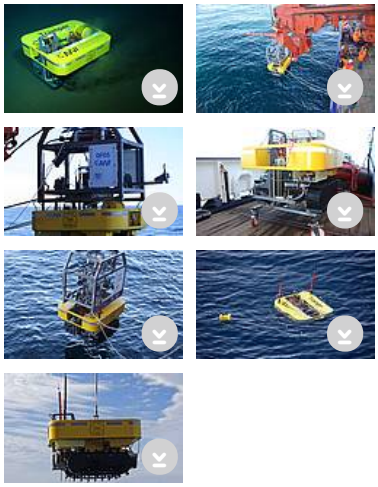
Microorganisms are particularly responsible for the degradation of organic material in the deep seabed. Bacteria convert the remains of dead algae and animals while consuming the oxygen in the seabed. Depending on how much dead algae arrive on the seabed, there will be more or less bacterial activity and, therefore, more or less oxygen consumption. "We want to use the measurements provided by Tramper to identify the natural variation over the course of the year," says Dr Frank Wenzhöfer in explaining the scientific objectives of the mission. "Statements can also be made about how the ecosystem of the Arctic seabed responds to environmental changes. Such data about the Arctic are still incomplete," the microbiologist adds.

"For studies by deep-sea ecologists, we have developed a new multi-sensor revolver-system, which is intended to guarantee the consistent quality of the measurements," says AWI engineer Dr Johannes Lemburg about the development work that is occurring in the context of the Helmholtz Alliance ROBEX › (Robotic Exploration of Extreme Environments). "It makes it possible to measure with three sensors at the same time and to exchange them after a certain number of measurements. Such an exchange of sensors can be performed six times with each of the three revolver, allowing a total of 18 sensors to be used," says Johannes Lemburg of the sophisticated system.

Engineers and scientists are already looking forward to their next expedition in the coming year: "In the summer of 2017, we are going to return with the RV Polarstern › to the AWI 'Hausgarten', and we hope to pick up the Tramper safe and sound and full of valuable data!"

Scientific Background

Downloads



Contact

Science

Frank Wenzhöfer
+49(471)4831-2182
Frank.Wenzhoefer@awi.de

Johannes Lemburg
+49(471)4831-2524
johannes.lemburg@awi.de

Press Office

Folke Mehrtens
+49(471)4831-2007
Folke.Mehrtens@awi.de

Abo/Share

Subscribe to AWI press release RSS feed

The Institute

The Alfred Wegener Institute pursues research in the polar regions and the oceans of mid and high latitudes. As one of the 18 centres of the Helmholtz Association it

Recent expeditions in the Arctic Ocean are limited to the ice-free summer months and therefore only represent a snapshot of the activity on the seabed. Continuous as well as long-term measurements are needed, however, in order to understand the carbon cycle of the oceans and to record the consequences of climate change. The measurement of oxygen consumption on the seafloor provides an estimate about the conversion of organic material there (benthic activity). The inhabitants of the deep seabed depend entirely on the supply of material from the sea surface.

Primary production at the sea surface is highly variable: It depends on the availability of nutrients, the sunlight and the sea ice coverage. It is therefore to be expected that such variability also influence the amount of the organic matter which is supplied to the deep sea. Time series analyses performed by the Alfred Wegener Institute for Polar and Marine Research at the 'Hausgarten' Deep-Sea Observatory by means of sediment trap measurements confirmed such a variable export of material from the surface to the deep sea. Until recently, though, direct measurements of related benthic activity could only be conducted during individual ship expeditions, and continuous measurements for the Arctic have not been available.

Temporal high-resolution measurements that record the variations in benthic activity are very important to model the carbon cycle in the Arctic and to document long-term influences. This input is essential to be able to evaluate the consequences of climate change and the long-term effects on the Arctic seabed.

Tramper now makes it possible to perform weekly measurements of the benthic oxygen consumption and to correlate the data with the incoming organic material. Scientists expect higher consumption rates in periods of increased surface primary production and export of material, i.e., higher rates in summer and lower rates in winter. Especially interesting is the influence of the ice coverage in this Arctic sea area, the transition from the winter to the summer phase and how the activity at the seafloor is associated with the surface activity from a temporal perspective.

Please find a press release on the endurance test of the Tramper here.

See also a press release on tracking marine litter from the air..

Video

coordinates polar research in Germany and provides ships like the research icebreaker Polarstern and stations for the international scientific community.

More information

Topic pages

» Research Vessel and Icebreaker Polarstern

Related pages

» Deep Sea Research
» LTER Observatory HAUSGARTEN
» Mobile benthic Systems

Related news

» Endurance test for AWI robot "Tramper" in the deep sea
» Tracking marine litter in the Arctic from the air