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

CRUISE-REPORT

FS Heincke – Cruise 462

German Bight, Norwegian trench, Sognefjorden

Chief Scientist: Dr. Sören Krägefsky

29.04– 08.05.2016

Scientific Participants

Dr. Sören Krägefsky (AWI)

Prof. Dr. Astrid Bracher (AWI, not on board)

Maria Falla (AWI)

Franziska Frank (University Oldenburg)

Dr. Torben Gentz (AWI)

Sebastian Hellmann (AWI, University Bremen)

Yangyang Liu (AWI, University Bremen)

Sonja Wiegmann (AWI)

Zusammenfassung

Hauptziel der Heincke-Expediton HE462 war der Test einer Reihe von Sensoren, die zukünftig in einen undulierenden, geschleppten Geräteträger integriert werden sollen. Das geschleppte Messsystem soll eine räumlich und zeitlich hochauflösende Untersuchung physikalischer, chemischer und biologischer Parameter im oberen Ozean ermöglichen.

Die optischen Messparameter, die durch kontinuierliche und diskrete Beprobung in der Deutschen Bucht, der Norwegischen Rinne und dem Sognefjord erhoben worden sind, sollen ferner der Validierung der Satelliten-Messdaten des Sentinel-3 OLCI (Ocean Land Colour Imager) dienen. CTD und Nährsalz-Messungen, die durchgeführt wurden, adressieren die Wachstumsbedingungen des Phytoplanktons.

Im kontinuierlichen Messbetrieb und mit einer Kalibrierung wurde das schiffs-gebundene neu entwickelte Breitband-Echolotsystem (Simrad EK80) getestet, ebenso wie eine mobile Variante des EK80 (Simrad EK80 WBT tube für geschlepptes Messsystem), die an zwei Stationen für mehrere Stunden ausführlich getestet wurde.

Methan und CO_2-Messungen dienten dem Test und der Optimierung eines Cavity-Ring-Down-Spektrometers (LosGatos) aus Oberflächenwasser.

Introduction and objective

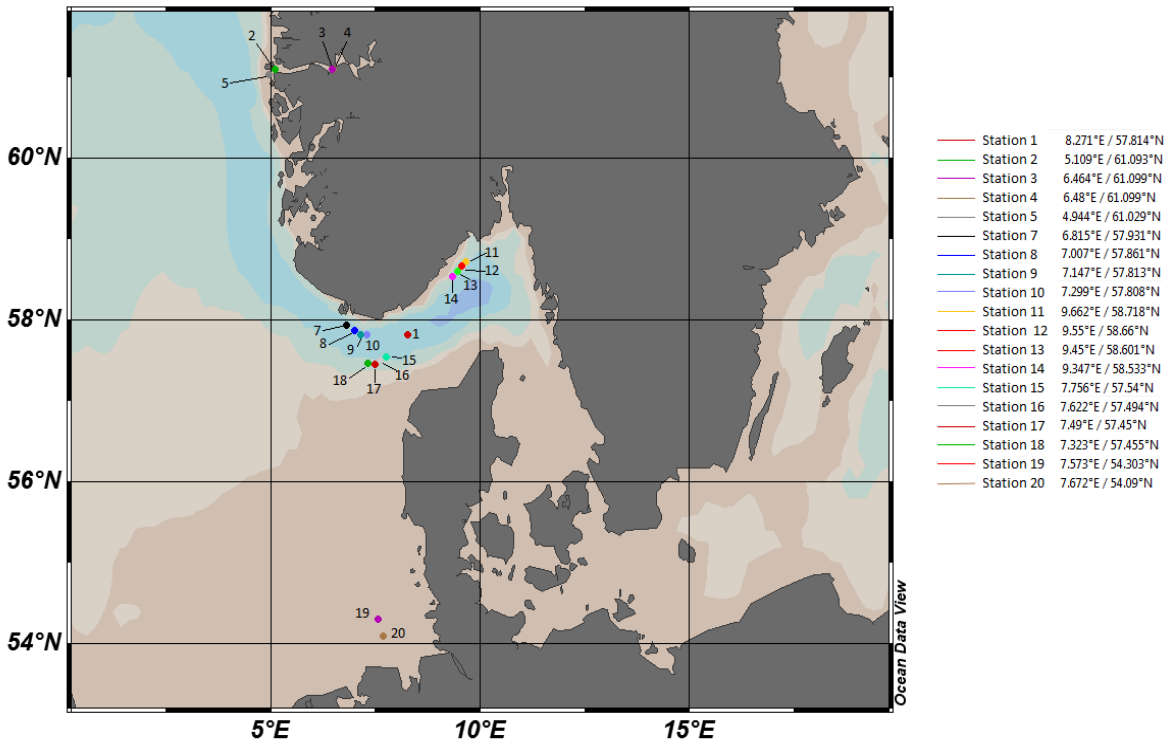
Primary objective of the cruise was testing a set of sensors for later integration in a towed undulating vehicle for surveying physical, chemical and biological properties of the upper ocean with high temporal and spatial resolution.

Apparent and inherent optical properties of the surface seawater derived from the different discrete as well as continuous bio-optical measurements conducted during the cruise shall be used as validation measurements for the Sentinel-3 OLCI (Ocean Land Colour Imager) satellite data. CTD measurements and nutrient sampling at discrete depths addressed phytoplankton growth conditions.

Extensive measurements using a standard target (calibration sphere) served testing and validation of a new developed wide-band echosounder (Simrad EK80 WBT Tube and Simrad EK80 WBT).

Study area

Measurements were conducted in three different investigation areas and during transects to this areas in Norwegian and German waters. All three areas are within Case-2 waters with high or even extremely high concentrations of chlorophyll, inorganic particles and coloured dissolved organic matter (CDOM). In particular we collected data in the Sognefjorden of Norway (5 Stations), in the Skagerrak at the southernmost tip of Norway (13 Stations) as well as in the German Bight around Helgoland (2 Stations). Calibrations of the Simrad EK80 WBT Tube (towed vehicle) and Simrad EK80 WBT (hull-mounted) were performed in the shelter of the Sognefjorden.



Methods

Bio-optical measurements

A hyperspectral spectrophotometer (AC-s; Wetlabs) was used for continuous underway surface sampling, operating in flow-through mode to obtain hyperspectral inherent optical properties (IOPs; total and particulate scattering and absorption) of surface water. A second AC-s instrument was mounted on a steel frame together with a depth sensor as well a set of TRIOS Ramses radiometers measuring hyperspectral IOPs upwelling radiance (Lu) and downwelling irradiance (Ed) down to a maximum of approximately 120 m with a winch speed of 0.1 m/s. and operated during 19 CTD stations and one extra station. Additionally, solar irradiance was measured continuously during the cruise on the ship's monkeydeck. Samples for discrete measurements of CDOM, total particulate and phytoplankton absorption as well as phytoplankton pigment concentrations and composition were taken at a 3-hourly interval from the underway-sampling system, and from 5-7 depths at 19 CTD-stations. Water samples were filtered on board immediately after sampling and the filters for pigment determination were thermally shocked in liquid nitrogen and then stored in the -80°C freezer. The samples are brought back to AWI directly at the end of cruise and then will be analyzed within the next three months by High Performance Liquid Chromatography Technique (HPLC) at AWI following Taylor et al. (2011). Water samples for CDOM absorption analysis were filtered through 0.2 µm filters and analyzed onboard with a 2 m path length liquid waveguide capillary cell system (LWCC, WPI). Total particulate and phytoplankton absorption coefficients were determined with the quantitative filter techniques using samples filtered onto glass-fiber filters and measured in a portable QFT Integrating Cavity Absorption Meter (QFT-ICAM) following Röttgers et al. 2016.

CTD measurements and discrete sampling

CTD measurements were performed down to 100 m or at least 10 m above the ocean floor in shallower areas. Nutrients were sampled at discrete depths during the CTD-Casts. The discrete water samples were stored in 4°C freezer and analyzed directly after return to Bremerhaven in the laboratory of the section "marine geochemistry". A "Quaddro30" nutrient analyzer from Seal Analytical was used to analyze 19 CTD profiles for silicate, nitrite, nitrate, phosphate and ammonia. Beside the nutrients, discrete water samples for the measurements of methane were taken at one sample of each CTD-cast. The samples will be analyzed by head space technique and subsequent gas chromatography at the facilities of the AWI.

Hydroacoustic measurements

Extensive measurements were made with the hull-mounted Simrad EK80 WBT (centre frequencies 38, 70, 120 and 200 kHz) including calibration measurements using different pulse form settings. Calibration measurements were made in drifting (unanchored) mode. A Simrad EK80 WBT (centre frequencies 120 and 333 kHz) was deployed during 2 stations for 5 hours in total. Measurements were made in passive mode and with calibration spheres with lines attached to the frame and introduced in sound beam of the transducers, using as well different pulse form settings.

Preliminary results

Measuring performance and stability of newly developed Simrad EK80 wideband echosounder were tested. Calibrations of a hull-mounted and a mobile EK80 WBT were performed.

Continuous measurements of solar irradiance and inherent optical properties of surface water were made in German and Norwegian waters. 164 measurements of total absorption, of phytoplankton absorption, and of CDOM absorption were directly measured on board. Additionally, samples were taken for later HPLC analysis of pigment concentrations. Apparent and inherent optical properties were measured with different sensors installed on a vertical towed frame at 19 stations. These measurements will allow validating Sentinel-3 OLCI data, helping to identify changes in phytoplankton community and its degradation products and elucidate its link to biogeochemical fluxes. CTD- and nutrient measurements allow assessment of the growth environment of the phytoplankton.