

Database of the JGOFS expedition ANT X/6 aboard R.V. *Polarstern*

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U.V. Bathmann† and V. Smetacek†.

INTRODUCTION

The enclosed CD-ROM contains the actual database of measured variables as well as various background information on the expedition and the methods and other descriptions directly related to each reported variable. The CD-ROM was mastered in a format that can be read by both Macintosh and PC computers. It is organised in a hierarchical structure by folders containing both text files in MS-Word for Windows 2 format and datafiles in either Excel 4.0 or ACCESS format. Software with such formats is not included but available from Microsoft. In addition the textfiles have been converted to PostScript format and the datafiles have been converted to simple ASCII formats and placed on the CD-ROM as well.

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BACKGROUND INFORMATION

Textfiles

- Participating scientists (affiliations, phone, fax, internet).
- Participating institutes (postal addresses).
- JGOFS core activities (responsible scientists).
- Other activities (with scientists).
- Shipboard experiments (with scientists).
- Description of methods.
- Structure CD-ROM / MS ACCESS relational database.

Tabulations

- Listing of 123 stations (with geartype deployment).
- Listing of 211 measured variables in rosette bottles (units, description).

DATABASE

- CTD sensors downcasts records of 229 CTD casts.
- Rosette bottles from 229 hydrocasts of 24 samplers each (station, cast, bottle number).
- Natural radioisotopes from Gerard barrel casts.
- Trace metals and nutrient data from Kevlar wire Go Flo sampling.
- Metal-biota interaction experiments.

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Incubations primary productivity and ^{15}N ammonia uptake.
Net sampling results: mesozoo-, phytoplankton and mesozooplankton grazing.
 CO_2 system, meteorology, chlorophyll: underway in surface waters.
Ice cover observations.
Wind velocities.
Benthic observations.
Ice biology.

ELECTRONIC MAIL UPDATES

Further updates of the ANT X/6 database will become available by electronic mail through ftp-servers at the Alfred Wegener Institute (<ftp://ftp.awi-bremerhaven.de/pub>).

ENQUIRIES

Queries about certain parts of the data can be addressed directly to the relevant scientist(s). For this purpose a listing of names and addresses including internet identities is provided in the file STAFF.DOC. Enquiries relating to the CD-ROM are to be made to Joop Rommets at NIOZ (rommets@nioz.nl) and all questions related to the electronic updates are to be made to Ulrich Bathmann at AWI (ubathmann@awi-bremerhaven.de).

DATA POLICY

The data contained in this CD-ROM have been produced jointly by the participants of the JGOFS expedition ANT X/6 and the data management staff of the Netherlands Institute for Sea Research (NIOZ). Users of the data are free to process these as deemed useful, provided that in any report or publication arising from such use the source of the data is acknowledged by referring either to the relevant individual research article(s) in this issue of *Deep Sea Research II* or to:

Rommets, J.W., M.H.C. Stoll, R.X. de Koster, T.F. de Bruin, H.J.W. de Baar, U.V. Bathmann and V. Smetacek (1997) Database of the JGOFS expedition ANT X/6 aboard RV 'Polarstern'. *Deep-Sea Research II*, **44** (1-2), and CD-ROM Appendix.

When in such case the used ANT X/6 data is a substantial part of the report or publication, one is expected to extend the courtesy of informing the respective investigators, or on their behalf one of the guest editors (Smetacek, de Baar, Bathmann, Lochte or Rutgers van der Loeff) of this issue or the editor Rommets of the CD-ROM. This allows the option of consideration of joint authorship.

Acknowledgements—Production of the database and the CD-ROM were supported by the Netherlands Institute for Sea Research (NIOZ) and a grant for JGOFS Southern Ocean of the Netherlands Committee for Antarctic Research (NAAP), a subsidiary of the Netherlands Organization for Scientific Research (NWO), coordinating Antarctic subsidies by 7 government departments. The excellent support of Anne Vindenes Allen, Kevin Ruston, Justinia Seaman and Catherine Shaw of Elsevier Science at Oxford in facilitating the production are gratefully acknowledged.

REFERENCES

Bathmann, U.V., V. Smetacek, H.J.W. de Baar, E. Fahrbach and G. Krause (1994). The expeditions ANTARKTIS X/6-8 of the Research Vessel *Polarstern* in 1992/1993. *Berichte zur Polarforschung*, **135**, 4-126.

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analyze the samples in their laboratory

* In collaboration with H. Gieshagen (IFM, Dept. Microbiology)

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| DWDS | Deutscher Wetterdienst, Seewetteramt Bernhard-Nocht-strasse 76 2000 Hamburg 4, Deutschland | |
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JGOFS CORE ACTIVITIES

1. Meteorology and positioning

Herbert Köhler (DWDS), Heinz Hill (DWDS), Cees Veth (NIOZ)

2. CTD, O₂-probe, fluorometry, turbidity

Cees Veth (NIOZ), Sven Ober (NIOZ), Ronald de Koster (NIOZ)

Underway salinity, temperature, fluorometry

Uli Bathmann (AWI)

3. Dissolved Oxygen

Rinus Manuels (NIOZ).

4. Nutrients

Karel Bakker (NIOZ), Peter Fritsche (IFM). Ammonia by Jacques Poncin (IEM)

5. Optics

Sylvie Mathot (ULB), Cees Veth (NIOZ), Bernard Queguiner (IEM), Laetitia Teissier (IEM).

6. Carbondioxide system

Dorothee Bakker (NIOZ), Joop Rommets (NIOZ), Michel Stoll (NIOZ), Hein de Baar (NIOZ).

7. POC and PON

Uli Bathmann (AWI), Bernard Queguiner (IEM)

8. DOC and DON by HTCO methods

Avan Antia (SFB), Paul KŠhler (SFB)

9. Chlorophyll and Pigments

Uli Bathmann (AWI), Bärbel Bolt (FBB), Doris Meyerdierks (FBB), Bernard Queguiner (IEM), Ilka Peeken (SFB), Maria van Leeuwe (NIOZ).

10. Bacteria biomass and production

Karin Lochte (AWI), Peter Bj rnsen (MBL), Alexandra Nielsen (MBL), Anke Weber (UOS/IFM), Sylvie Becquevort (ULB), Thierry de Henau

11. Mesozooplankton (incl. egg production)

Santiago Gonzalez (NIOZ), Bouwe Kuipers (NIOZ).

12. Microplankton abundance; autotrophs, heterotrophs; incl. nanoplankton

Dick Crawford (AWI), Friedel Hinz (AWI) Renate Scharek (AWI), Christine Klaas (AWI), Andrea Detmer (IFM), Sylvie Becquevort (ULB), Sylvie Mathot (ULB), Frank Jochem (IFM), Peter Bj rnsen (MBL).

13. Primary production by 14C

Sylvie Mathot (ULB), Bernard Queguiner (IEM), Frank Jochem (IFM)

14. Primary production by O₂

Frank Jochem (IFM) with Rinus Manuels (NIOZ)

15. New Production by 15N and Export Production by 234Th

Marita Wunsch (SFB), Wolfgang Koeve (SFB), Frank Dehairs (VUB), Leo Goeyens (VUB), Michiel van der Loeff, Jana Friedrich, Heike H lzen (all AWI).

16. Autotrophic pico/nano-plankton (including cyanobacteria)

Andrea Detmer (IFM)

17. Grazing by Mesozooplankton

Corinna Dubischar (AWI), Uli Bathmann (AWI).

18. Grazing by Microzooplankton and Nanozooplankton

Christine Klaas (AWI), Sven Reitmeier (SFB), Sylvie Becquevort (ULB), Thierry de Henau (ULB)

19&20.Sediment traps

Uli Bathmann (AWI)

SOUTHERN OCEAN JGOFS CORE ACTIVITIES

- 21. Ice coverage.**
Jan van Franeker (IBN)
- 22. Ice physics**
Cees Veth (NIOZ)
- 23. Ice biology**
Uli Bathmann (AWI), Renate Scharek (AWI), Sylvie Becquevort (ULB),
Sylvie Mathot (ULB), Ilka Peeken (SFB), Frank Jochem (IFM)
- 24. Silica biogeochemical cycling (incl. mathematical modeling)**
Bernard QuŽguiner (IEM), Laetitia Teissier (IEM), Pascal David (CNRS)
- 25. Iron-plankton interactions (incl. trace element distributions)**
Maria van Leeuwe (NIOZ), Renate Scharek (AWI), Jeroen de Jong (NIOZ),
Bettina Lšscher (NIOZ), Hein de Baar (NIOZ).

OTHER ACTIVITIES

- 26. Top predators (birds, marine mammals)**
Jan van Franeker (IBN)
- 27. Ecophysiology of ice algae: DMSP**
Doris Meyerdierks (FBB), BŠrbel Bolt (FBB)
- 28. Biogeochemistry of Barium**
Frank Dehairs (VUB)
- 29. ^{13}C in surface water particulate organic matter**
Frank Dehairs (VUB)
- 30. Benthic processes**
Michiel Rutgers van der Loeff, Ola Holby, Jana Friedrich, Heike Hölzen, Karin Lochte (all AWI)

ANT X/6: SHIPBOARD EXPERIMENTS

9. Effect of declining light conditions on phytoplankton, pigments and bacteria. (Peeken, Lochte, Crawford). Data available upon request.
10. Experiments for calibration of bacterial production measurements and for assessment of bacterial consumption of DOC (Kähler, BjørnSEN, Manuels, and others). Data available upon request.
10. Effect of temperature on bacterial production and primary production. (Lochte, BjørnSEN, Mathot). Data available upon request.
12. Growth potential of heterotrophic dinoflagellates (< 20µm). (BjørnSEN). Data available upon request.
12. Phytoplankton cultures isolation, electron microscope fixation and shipboard experiments. (Crawford, Scharek)
12. Growth and grazing experiments with natural microplankton populations (Klaas). Data available upon request.
17. Mesozooplankton grazing other than "in" the field. (Dubischar, Bathmann, Peeken). Data available upon request.
24. Silica dissolution experiments (Quéguiner and others). Data available upon request. Related data in this bottle casts report.
25. Fe/biota experiments (vanLeeuwe, Scharek and others). Data available upon request.

SCIENTIFIC COMMITTEE ON OCEANIC RESEARCH



JOINT GLOBAL OCEAN FLUX STUDY

A Core Project of the International Geosphere-Biosphere Programme

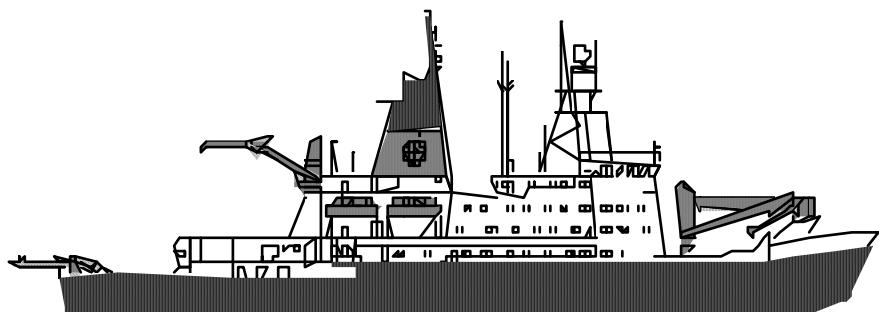
Frühling im Eis

R.V. Polarstern Cruise ANT X/6

Punta Arenas to Capetown

29 September - 29 November 1992

V. Smetacek, chief scientist



Bottle Casts Databases
(CTD/Rosette - Gerard Barrels - KevlarWireGoFlo)

edited by

J.W. Rommets, M.H.C Stoll, R. Dapper

H.J.W. de Baar and C. Veth

METHODS

Investigators (brackets for those not actually taking part in the cruise)
{Acronyms of variables as in Rosette database}

1. Meteorology and positioning

Herbert Köhler (DWDS), Heinz Hill (DWDS), Cees Veth (NIOZ)
{Data will appear in other report.} Automated INDAS system aboard R.V. 'Polarstern'

For positioning of the research vessel use is made of the Global Positioning System (GPS).

Standard meteorological observations according to World Meteorological Organization (WMO) recommendations have been done at 3 hour intervals as prescribed by JGOFS. Parameters measured every 3 hours are:

Position; Speed; Heading; Air temperature; Dew point, humidity; Wind velocity; Wind direction; Air pressure; Tendency of air pressure; Visibility ; Cloud base; Cloud type; Water temperature; Wave height; Wave period; ice concentration

Automatic recording takes place of the following parameters (Every 5 minutes): Position; Speed; Heading; Air temperature; Dew point; Wind velocity; Wind direction; Air pressure; Tendency of air pressure; Global radiation; Visibility; Cloud base; Water temperature; Salinity.

2a. CTD, O₂-probe, fluorometry

Cees Veth, Sven Ober, Ronald de Koster (all NIOZ)
{CTD.press, CTD.temp, CTD.sal, CTD.O2.sens, CTD.Fluor, CTD.Trans}

At each station CTD-casts have been done. Standard cast depths were 1500 m and regularly to 200 m for incubation purposes. At a number of stations casts to the bottom were performed.

CTD-type

Seabird SBE 9 plus. with deckunit SBE 11plus (sample freq. 24 Hz)

T-sensor: type Seabird SBE 3

C-sensor: type Seabird SBE 4

Pressure sensor: Paroscientific high resolution pressure sensor

DO₂ (dissolved oxygen): Seabird SBE 13

Submersible Pump Seabird SBE

Accuracy and precision

Accuracy temperature: 0.001 degrees C and precision 0.0005 deg C

Accuracy salinity: 0.002 PSU and precision 0.001 PSU (deep)

0.004 PSU and precision 0.001 PSU (surface)

Accuracy pressure: 2 dbar and precision 0.5 dbar

DO₂-sensor is calibrated with bottle analysis (see 3. Dissolved oxygen)

Accuracy and precision "better than 1%"

Calibrations procedures

Temperature

Pre cruise calibration by Sea-Bird Electronics Inc.

In situ calibration with SIS electronic reversing thermometers
(calibrated against triple point of water)

Post cruise calibration by Sea-Bird Electronics Inc.

Salinity / Conductivity

Pre cruise calibration by Sea-Bird Electronics Inc.

Calibrated with bottle analysis, with a Guildline 8400 Salinometer using standard sea water ampoules.

Post cruise calibration by Sea-Bird Electronics Inc.

Pressure

Pre cruise calibration by Paroscientific Inc.

In-situ calibration with SIS electronic reversing pressure meter

Post cruise calibration by Paroscientific Inc.

Fluorometer

Chelsea Instruments Aquatracka (deep sea version).

Transmissometer

type Sea-Tech 25 cm beamlength, (wavelength: 660 nm)

Accuracy better than 1%, precision 0.1 %.

Rosette

General Oceanics 24 positions steppermotor

Rosette sample bottles:

NOEX and NISKIN for standard sampling

GoFlo for ultra clean sampling

Rosette frame: Teflon coated stainless steel for ultra clean sampling.

2b. Underway salinity, temperature, fluorometry

Uli Bathmann (AWI)

{No data in this report}

3. Dissolved Oxygen

Rinus Manuels (NIOZ)

{Oxy1, Oxy2, Oxy, OxyT}

Oxygen samples have been collected and analyzed in duplicate according to the Winkler method, following recommendations of the Woce Hydrographic Program (WHP) except for the calibration of the sodiumthiosulphate solution which was done gravimetrically (rather than with pipettes) for better accuracy. The photometric high precision oxygen titrator provides reproducibility better than 0.1 percent, well exceeding the 0.5 % WHP requirements. Because of the very cold seawater in the Antarctic region gas bubbles were seen to escape from the samples after having been acidified under normal laboratory conditions. In order to avoid this outgassing all samples were stored and analyzed at 4.5 °C in a thermostatted waterbath.

Abbreviations:

Oxy1 = 1st replicate

Oxy2 = 2nd replicate

Oxy = Mean (excluding possible outliers)

OxyT = Sample temperature on closing bottle

Culberson, C.H. (1991) Dissolved Oxygen, chapter in: WHP Operations and methods - July 1991.

4. Nutrients

Karel Bakker (NIOZ), Peter Fritzsche (IFM), Jacques Poncin (IEM)

Nitrate, nitrite, phosphoric acid, orthosilicic acid

Karel Bakker, Peter Fritzsche

{Silicate, Nitrate, Nitrite, Phosphate}

Samples were collected by Niskin, NOEX or Go Flo bottles and as soon as possible taken for nutrients in polyethylene bottles. Measurements were carried out within 12 hours after collection;

meanwhile samples were kept cool at 2 °C and dark in a refrigerator. Volumetric flasks for dilution of nutrients stocks were precalibrated giving linearity with correlation coefficients of at least 0.999 for 4 calibration points. Baseline water obtained by dissolving 34g NaCl / 1 demineralized water (18 MΩ) is used as washwater between the samples and as a carrier for the diluted stocks in order to avoid matrix problems on an autoanalyzer. Blank measurements of this water obtained values of zero µM for phosphate, nitrate, nitrite and silicate. For the CTD samples the maximum sample value is compared with the full scale standard value so to obtain the best resolution of the system. With every run of CTD samples we put in a stable nutrient-cocktail containing all the parameters as an independent check standard.

The samples were measured on a Technicon AA-II autoanalyzer with a sample rate of 30 hr⁻¹ using 80 seconds sample-time and 40 seconds washing-time to reach a steady state level. Calculations were done with an attached PC correcting for baseline and gain drift.

The chemical methods used for the various nutrients were:

Silicate: Measured as the reduced molybdenum blue complex at 660 nm, with ascorbic acid as reductant; using oxalic acid to eliminate the phosphate interference.

Ortho-phosphate: Formation of the reduced molybdo-phosphate complex at pH 0.9-1.1 whereby potassium-antimonyl tartrate is used as a catalyst and ascorbic acid as the reductant. The developed color is measured at 880 nm. Method described first by Murphy and Riley (1962). At the end of the cruise all hydrographic data were corrected upwards by multiplication with a factor 1.04 based on the overall offset observed through two months versus the absolute standard. Data provided for several shipboard experiments is to be corrected accordingly.

Nitrate and nitrite:

Method described by Grasshoff (1983). Nitrate is first reduced into nitrite using a copperized cadmium coil (reduction > 95%) with imidazole as buffer agent. Used are two channels, one for nitrate plus nitrite with the cadmium coil in the first stage sample line, and the other for nitrite alone using the same color reagent for both. The pink colour formed after diazotization with sulphanylamide and naphtylethylenediamine is measured at 550 nm for both channels nitrate is obtained by subtracting the nitrite values from the first channel.

The overall statistics for this cruise were:

| | detection limit [µM] | accuracy at typical value [µM] |
|-------------|-------------------------|-----------------------------------|
| silicate | 0.4 | 0.8 at 100 |
| o-phosphate | 0.02 | 0.05 at 2 |
| nitrite | 0.005 | 0.01 at 0.5 |
| nitrate | 0.3 | 0.6 at 30 |

N.B. see also project 24. for separate measurements of orthosilicic acid.

Ammonia

Jacques Poncin
{NH4}

Ammonia is determined by the manual method of Koroleff (1976). Standards are realized with freshly prepared deionized water. Blanks are determined by using seawater samples taken at 1000-1500 m depth.

Koroleff (1976). Determination of ammonia. In: Grashoff, K. (ed.) Methods of seawater analysis. Verlag Chemie, Weinheim, 126-133.

5. Optics

Sylvie Mathot (ULB), Cees Veth (NIOZ), Bernard Quéguiner (IEM), Laetitia Teissier (IEM)

Incident Photosynthetically Active Radiation (PAR) was continuously recorded (one value every two minutes) by means of a cosine Li-Cor sensor set up on the upper deck of the ship.

6. Carbon dioxide system

Dorothee Bakker , Joop Rommets, Michel Stoll, Hein de Baar (all NIOZ)

Partial pressure of CO₂ in atmosphere and ocean

Dorothee Bakker
{pCO₂.GC-cm}

The partial pressure of CO₂ of discrete samples.

Discrete samples of 600 ml were taken in glass bottles with a screw cap containing a rubber septum from 1500, 1000, 500, 300, 200, 150, 100, 80, 60, 40, 20 and 10 meter from the CTD at all whole degree stations. Also all depths in deep casts to the bottom were sampled. Samples were poisoned by adding 0.1 ml of a saturated mercury chloride solution and put in a waterbath of 4.5 to 5°C for a minimum of one hour. 20 ml of water in each bottle was replaced by calibration gas of 473 ppmv CO₂ in artificial dry air. After at least another hour in the waterbath the headspace of the sample was injected into the gaschromatograph. A GC-run typically consisted of one discrete sample and calibration gas of 473 ppmv CO₂ by volume. The temperature of the waterbath was registered continuously. The temperature correction of Copin-Montegut (1988, 1989) was applied. Results were checked by comparing them with measurements of alkalinity and total CO₂.

Copin-Montegut, C., 1988. A new formula for the effect of temperature on the partial pressure of CO₂ in seawater. *Marine Chemistry*, **25**, 29-37.

Copin-Montegut, C., 1989. Corrigendum. *Marine Chemistry*, **27**, 143-144.

Continuous measurements of the partial pressure of CO₂ in surface water and marine air.

Seawater was pumped continuously from 12 meters below sealevel to an equilibrator. The temperature difference between water at the intake and in the equilibrator was typically less than a degree. Every 10 minutes the CO₂ content of the headspace of the equilibrator was measured by a gaschromatograph. Marine air was pumped from 22 meter above sea level. Calibration gases of 259, 361 and 473 ppmv in artificial dry air by BOC, UK were used. Each GC-run consisted of two calibration gases, an equilibrator sample, followed by marine air and a second equilibrator sample. CO₂ was converted to methane by a nickel catalyst and detected by an FID-detector. The temperature correction of Copin-Montegut (1988, 1989) was used.

Files are per day with nomenclature CO2Dmmdd.XLS and CO2Smmdd.XLS

- Files containing the suffix D contain ONLINE data per 10 minute interval
- Files containing the suffix S contain ONLINE data and air-sea fluxes computed with different methods.
- mm stands for the month
- dd stand for the day

| CO2D???? | Explanation | Unit | Parameterisation | Skin temperature difference | Length wind interval | Length atmospheric pressure |
|--------------|-----------------------|--------------------|------------------|-----------------------------|----------------------|-----------------------------|
| Date | Date | m/d/yr | - | - | - | - |
| Time | Time | hh:mm | - | - | - | - |
| Wvel | wind velocity | m·s ⁻¹ | - | - | - | - |
| AirTemp | air temperature | °C | - | - | - | - |
| Humidity | humidity | % | - | - | - | - |
| Latitude | Latitude | N+, S- | - | - | - | - |
| Longitude | Longitude | E+, W- | - | - | - | - |
| SpeedAh | speed ahead | m·s ⁻¹ | - | - | - | - |
| Air pressure | atmospheric pressure | hPa | - | - | - | - |
| Glob rad | global radiation | W·m ⁻² | - | - | - | - |
| Visibility | visibility | m | - | - | - | - |
| Cloud base | cloud base | m | - | - | - | - |
| Depth | water depth | m | - | - | - | - |
| DewPoint | dew point | °C | - | - | - | - |
| Wdir | wind direction | ° | - | - | - | - |
| Chlorophyll | chlorophyll a content | mg·m ⁻³ | - | - | - | - |

| CO2S???? | Explanation | Unit | Parameterisation | Skin temperature difference | Length wind interval | Length atmospheric pressure |
|----------------|--|---|-------------------------------------|---|----------------------|-----------------------------|
| Date | Date | m/d/yr | - | - | - | - |
| Wanted time | Time | hh:mm | - | - | - | - |
| xCO2DryAir | dry volume fraction of CO2 in dry air | $\mu\text{mol}\cdot\text{mol}^{-1}$ | - | - | - | - |
| fCO2Air | fugacity of CO2 in with water saturated air | μatm | - | - | - | - |
| fCO2Eq | fugacity of CO2 in the equilibrator | μatm | - | - | - | - |
| fCO2w | fugacity of CO2 in water | μatm | - | - | - | - |
| Gamma eq | fugacity coefficient of CO2 for the equilibrator | - | - | - | - | - |
| K0_Air | solubility of CO2 at the sea surface | $\text{mol}\cdot\text{kg}^{-1}\cdot\text{atm}^{-1}$ | - | - | - | - |
| K0_H2O | solubility of CO2 in bulk water | $\text{mol}\cdot\text{kg}^{-1}\cdot\text{atm}^{-1}$ | - | - | - | - |
| Cair | concentration of CO2 at the sea surface | $\mu\text{mol}\cdot\text{kg}^{-1}$ | - | - | - | - |
| Cwater | concentration of CO2 in bulk water | $\mu\text{mol}\cdot\text{kg}^{-1}$ | - | - | - | - |
| Tempeq | temperature of the equilibrator | °C | - | - | - | - |
| TskTemp | Water temperature bow salinometer | °C | Bow salinometer | | | |
| TPyro | Uncorrected Pyrometer signal | °C | Detected signal (before correction) | | | |
| TPyroCorr 40° | Corrected pyrometer temperature 40° | °C | Detected and corrected to 40° | | | |
| TskSal | Salinity bow salinometer | - | - | - | - | - |
| Density | Density of seawater | $\text{kg}\cdot\text{m}^{-3}$ | - | - | - | - |
| TWVel | wind velocity | $\text{m}\cdot\text{s}^{-1}$ | - | - | - | - |
| AirTemp | air temperature | °C | - | - | - | - |
| Humidity | humidity | % | - | - | - | - |
| PosLat | Latitude | N+, S- | - | - | - | - |
| PosLon | Longitude | E+, W- | - | - | - | - |
| SpeedAh | speed ahead | $\text{m}\cdot\text{s}^{-1}$ | - | - | - | - |
| SpeedAc | speed across | $\text{m}\cdot\text{s}^{-1}$ | - | - | - | - |
| Airpressure | atmospheric pressure | hPa | - | - | - | - |
| GlRad | global radiation | $\text{W}\cdot\text{m}^{-2}$ | - | - | - | - |
| Vis | visibility | m | - | - | - | - |
| CloudBase | cloud base | m | - | - | - | - |
| SysDepth | water depth | m | - | - | - | - |
| DewPoint | dew point | °C | - | - | - | - |
| WDir | wind direction | ° | - | - | - | - |
| Chloro | chlorophyll a content | $\text{mg}\cdot\text{m}^{-3}$ | - | - | - | - |
| Flux LMno skin | CO2 air-sea flux | $\text{mmol}/(\text{m}^2\cdot\text{d})$ | Liss-Merlivat | none | 10 min | 10 min |
| Flux LM meas | CO2 air-sea flux | $\text{mmol}/(\text{m}^2\cdot\text{d})$ | Liss-Merlivat | detected | 10 min | 10 min |
| Flux LMskin02 | CO2 air-sea flux | $\text{mmol}/(\text{m}^2\cdot\text{d})$ | Liss-Merlivat | 0.2°C | 10 min | 10 min |
| Flux LM1002 | CO2 air-sea flux | $\text{mmol}/(\text{m}^2\cdot\text{d})$ | Liss-Merlivat | none | 10 min | 6 weeks |
| Flux LMwind | CO2 air-sea flux | $\text{mmol}/(\text{m}^2\cdot\text{d})$ | Liss-Merlivat | none | 6 weeks | 10 min |
| Flux Wno skin | CO2 air-sea flux | $\text{mmol}/(\text{m}^2\cdot\text{d})$ | Wanninkhof | none | 10 min | 10 min |
| Flux W meas | CO2 air-sea flux | $\text{mmol}/(\text{m}^2\cdot\text{d})$ | Wanninkhof | detected (40°) | 10 min | 10 min |
| Flux Wskin02 | CO2 air-sea flux | $\text{mmol}/(\text{m}^2\cdot\text{d})$ | Wanninkhof | 0.2°C | 10 min | 10 min |
| Flux W1002 | CO2 air-sea flux | $\text{mmol}/(\text{m}^2\cdot\text{d})$ | Wanninkhof | none | 10 min | 6 weeks |
| Flux Wwind | CO2 air-sea flux | $\text{mmol}/(\text{m}^2\cdot\text{d})$ | Wanninkhof | none | 6 weeks | 10 min |
| Flux Hasse | CO2 air-sea flux | $\text{mmol}/(\text{m}^2\cdot\text{d})$ | Wanninkhof | Skin effect, Hasse | 10 min | 10 min |
| Flux Saun8 | CO2 air-sea flux | $\text{mmol}/(\text{m}^2\cdot\text{d})$ | Wanninkhof | Skin effect, Saunders, l=8 | 10 min | 10 min |
| Flux Saun var | CO2 air-sea flux | $\text{mmol}/(\text{m}^2\cdot\text{d})$ | Wanninkhof | Skin effect, Saunders, l=variable | 10 min | 10 min |
| Flux Schnacht | CO2 air-sea flux | $\text{mmol}/(\text{m}^2\cdot\text{d})$ | Wanninkhof | Skin effect, Schlüssel et al, night | 10 min | 10 min |
| Flux Schtot | CO2 air-sea flux | $\text{mmol}/(\text{m}^2\cdot\text{d})$ | Wanninkhof | Skin effect, Schlüssel et al, day+night | 10 min | 10 min |

| Flux Soloviev | CO2 air-sea flux | mmol/(m ² ·d) | Wanninkhof | Skin effect, Soloviev and Schlüssel | 10 min | 10 min |
|---------------|-----------------------------|--------------------------|----------------------------------|---|--------|--------|
| dTsch-D | Skin temperature difference | °C | Model Schlüssel et al, day | - | - | - |
| dTsch-N2 | Skin temperature difference | °C | Model Schlüssel et al, night | - | - | - |
| dTsch-tot | Skin temperature difference | °C | Model Schlüssel et al, day+night | - | - | - |
| dTsa, l=8 | Skin temperature difference | °C | Model Saunders, labda =8 | - | - | - |
| dTsa, l=var | Skin temperature difference | °C | Model Saunders, variable labda | - | - | - |
| dThasse | Skin temperature difference | °C | Model Hasse | - | - | - |
| dTso-tot | Skin temperature difference | °C | Model Soloviev and Schlüssel | - | - | - |

Total Carbondioxide

Michel Stoll
{TCO₂.C}

Total carbon dioxide in discrete samples was determined by the Coulometric method (Johnson et al., 1987). Samples were poisoned with 0.05 - 0.1 mol l⁻¹ of saturated mercuric(II) chloride solution to prevent changes due to biological activity. They were then analyzed with an automated extraction line. A subsample is acidified with 8.5% phosphoric acid and bubbled through with CO₂-free nitrogen gas. The released CO₂ gas is captured in ethanol-ammonia solution with an indicator which is photometrically backtitrated. Standards reference seawater as supplied by Dickson were determined regularly as a quality control check. Accuracy and precision amounts to ± 1.5 µmol/kg.

Johnson K.M., P.J. LeB. Williams, L. Brändström and J. McN Sieburth (1987). Coulometric total carbon dioxide analysis for marine studies: Automatization and calibration. *Marine Chemistry*, **21**, 117-133.

Alkalinity

Joop Rommets
{Alk.A}

For the determination of the alkalinity 125 ml sea water samples were titrated at 20 °C with 0.1 M hydrochloric acid in a closed cell modified after Bradshaw and Brewer (1988). A Gran plot was made of the data points after the second equivalent point. For the calculation the constants of Goyet and Poisson (1989) were used. About five samples could be analysed in one hour with an accuracy of 1 micro-equivalent per kg seawater. Most of the samples were taken at the full degree mesostations at 20, 40, 60, 80, 100, 150, 200, 300, 500, 1000 and 1500 metres, occasionally until the bottom.

Bradshaw, A.L. and P.G. Brewer (1988) *Marine Chemistry*, **34**, 155-162.
Goyet, C. and A. Poisson (1989) *Deep-Sea Research*, **36**(11), 1635-1654.

7. POC and PON

Uli Bathmann (AWI), Bernard Quéguiner (IEM), Laetitia Teissier (IEM), Jacques Poncin (IEM), Pascal David (CNRS)

Particulate Organic Carbon and Nitrogen

U. Bathmann
{POC, PON}

Shortly after taken water samples from CTD-rosette, 1 to 4 L of seawater were filtered through a precombusted (550 °C, 12 hours) Whatman GF/F glassfibre filter and shortly rinsed with distilled water. Filters were stored frozen (-25°C) until measurement at the laboratory at AWI. Before measurements filters were exposed to fumed HCl for 24 hours, then rinsed shortly with distilled water and dried (60 °C, 2 hours). Measurements were done by means of a Perkin-Elmer CHN Analyzer. Values are given in mg POC / m³ or mg PON / m³.

Particulate Organic Carbon and Nitrogen (in relation to project 24.)

Bernard Quéguiner, Laetitia Teissier, Jacques Poncin, Pascal David.
{Biog.Si.POC, Biog.Si.PON}

2.5-l seawater were filtered through 25m m Whatman GF/F filters (precom busted at 450 °C) using Pyrex filter towers (Millipore). Filters were stored frozen in closed glass pill-boxes. POC and PON analyses were performed in the laboratory. After elimination of inorganic carbon remaining on the GF/F filters by fum инг with concentrated HCl, POC and PON were measured by a combustion method (Strickland and Parsons, 1972), using a modified Carlo Erba model N 1500 analyser.

Strickland J.D.H. & Parsons T.R. 1972. A practical handbook of seawater analysis, 2nd edition. Bull. Fish. Res. Bd. Canada, 167 : 310 pp.

8. Dissolved Organic Carbon and Dissolved Organic Nitrogen

Avan Antia (SFB), Paul Kähler (SFB)
{DOC, DON}

The contents of dissolved organic carbon (DOC) and nitrogen (DON) are measured by High Temperature Catalytic Combustion similar to the method presented by Sugimura and Suzuki (1988). 10 ml of sample are filled into glass ampoules from the Niskin bottle, acidified with 60 µl concentrated phosphoric acid, and the ampoules sealed. Acidified samples may be stored for prolonged periods (months). Before measurement the water is sparged of (inorganic) CO₂ (i.e. all carbonates at the low pH) by bubbling with argon in the opened ampoules for 10 to 20 minutes. 100 µl of the sample is injected into a quartz tube containing 20 g of platinized alum inum oxide beads (5% Pt content) covered with 2 g of Pt gauze and kept at a temperature of 900 °C. A stream of oxygen (or 10% oxygen in argon for combined DOC/DON measurements) carries the water vapor and combustion gases through several water traps (5 °C.-trap, ice bath, Mg-perchlorate tube) and adsorption traps for sulphur-and chlorine-containing gases (tin, zinc and bronze) to an infrared adsorption CO₂-detector. In one of three such set-ups a chemoluminescence detector for the measurement of NO (to measure total dissolved nitrogen compounds) is in line after the infrared detector. Calibration is against glucose and urea dissolved in seawater at appropriate concentrations. The obtained values of total organic carbon (TOC) and total dissolved nitrogen (TDN) are converted to DOC and DON by the subtraction of particulate C, particulate N and inorganic dissolved N-compounds respectively. We measure water column values of odd stations on board, even-numbered stations at home. Additionally, we measure DOC and DON in ice, porewater, and water from various experiments.

Values are given in µmol C and N per litre.

Sugimura, Y. and Suzuki, Y. (1988) A high temperature catalytic oxidation method of non-volatile dissolved organic carbon in seawater by direct injection of a liquid sample. *Marine Chemistry*, **16**, 83-97.

9. Chlorophyll and Pigments

Uli Bathmann (AWI), Bärbel Bolt (FBB), Doris Meyerdierks (FBB), Bernard Quéguiner (IEM), Laetitia Teissier (IEM), Jacques Poncin (IEM), Pascal David (CNRS), Sylvie Mathot (ULB), Ilka Peeken (SFB), Maria van Leeuwe (NIOZ)

Determination of chlorophyll *a* and phaeopigments by fluorometric technique

U. Bathmann
{Chlorophyll}

Shortly after taken water samples from CTD-rosette, 0.5 to 2 L of seawater water was filtered through a Whatman GF/F glassfibre filter. Filters were stored frozen (-25 °C) until extraction which was normally performed within one day by adding 10 ml of 90% aceton/water (v/v) and grinding (plankton and filters) with glass beads. The extract was measured for chlorophyll *a* and phaeopigments (the latter

after adding two drops of 1M HCl) with a Turner Design fluorometer according to the method described by Evans et al. 1982. The fluorometer was calibrated by using pure chlorophyll extract obtained from Sigma Chemical Company and checked by the photometric method described by Strickland and Parsons (1972). Values are given in mg chl. a / meter³ or µg chl.a / l.

Chlorophyll a and phaeopigments (in relation to project 24).
Bernard Quéguiner, Laetitia Teissier, Jacques Poncin, Pascal David
{Biog.Si.Chla}

1-l samples are filtered through 25m m Whatman GF/F filters. Filters are placed in Pyrex tubes and kept frozen until analysis in the laboratory. An alysis is performed using the fluorometric method (Neveux, 1976).

Neveux J. 1976. Dosage de la chlorophylle a et de la phéophytine par fluorométrie. *Ann. Inst. Océanogr.*, **52**, 165-174.

Chlorophyll a (in relation to project 27.)

Doris Meyerdierks, Bärbel Bolt
{DMSP.Chla}

After prefiltration through a 200 µm nylon net to remove larger zooplankton, phytoplankton was concentrated by filtration (< 150 m bar) of 1 - 4 L seawater onto glass fibre filters (Whatman GF/F, 47 mm diameter). For chlorophyll a analysis, filters were stored frozen (-25 °C) in polyethylene tubes until extraction within the next two days. They were then homogenized in 5 ml of 90 % acetone, centrifuged and the supernatant was determined fluorometrically using a Chlorophyll-Fluorometer (biosens Hannover, Germany) calibrated against chlorophyll a standard (Sigma Chemicals) which was checked photometrically according to Jeffrey and Humphrey (1975).

Chlorophyll a (in relation to projects 12. and 13.)

Sylvie Mathot
{Data available upon request}

For below study on "Phytoplankton: chlorophyll, proteins, lipids, carbohydrates" (see section 12.) a small dataset of Chl a values was produced. This is not in the database but available upon request.

Pigments

Ilka Peeken
{Pigments, 19-but, 19-hex, allox, chla, chla/allo, chla/epi, chlb, chlc1+2, chlc3, chllida, diadino, fuco, lut/zeax, peridin, phorba, phphyta, prasinox, pyrophorb, pyrphphyta}

Seawater samples (2-8 l) were filtered onto 25 mm Whatman GF/F filters with a pressure of less than 120 m bar. After filtration, the filters were folded and stored in 2 ml micro centrifuge tubes (Eppendorf cups) at -30 °C until analysis.

Samples from transects 2, 3, 5, 6 and 7 were measured on board by means of a HPLC-system, equipped with a Perkin Elmer pump (series 400), an LS1 fluorescence detector, a spectroflow 757 UV-Vis detector and a Waters integration system. Samples from transect 11 were measured in the laboratory 4 months after the cruise, where the UV-Vis detector was replaced by a diode array spectrophotometric detector (Waters 995).

For analytical preparation, 50 µl internal standard (canthaxanthin) and 2 ml acetone were added to each filter sample and then homogenised for 3 minutes in a cell mill. After centrifugation, the supernatant liquid was placed in Eppendorf cups and stored at -30 °C until analysis within the next 12

hours. Just prior to analysis, an aliquot (100-200 µl) of the sample was premixed with water (HPLC-grade) in the ratio 1:1 (v/v) and injected onto the HPLC-system. The pigments were analysed by reverse-phase HPLC, using a C₁₈ spherisorb ODS 3 µm (4.0x125mm) Pharmacia column and HPLC-grade solvents (Biomol). Solvent A consisted of 80% methanol and 20% 0.5 M ammonium acetate and solvent B contained 80% methanol and 20% acetone. The gradient was run from A to B in 30 minutes and then held for 10 minutes at B, with a continuous flowrate of 1.5 ml min⁻¹. Eluting pigments were detected by absorbance (436 nm) and fluorescence (Ex: 410 nm, Em: > 600 nm).

Pigments were identified by comparing their retention times with those of pure standards and algal extracts. Additional confirmation for each pigment was done with the remaining extracts of representative samples from all transects using on-line diode array absorbance spectra between 390-750 nm. Pigment concentrations were quantified based on peak areas of external standards, which were spectrophotometrically calibrated using extinction coefficients published by BIDIGARE (1991). For correction of experimental losses and volume changes, the concentrations of the pigments were normalised to the internal standard canthaxanthin.

Bidigare, R. R. (1991). Analysis of algal chlorophylls and carotenoids. In *Marine particles: Analysis and Characterisation*, vol. Geophysical Monograph (ed. D. C. Hurd und D. W. Spencer), pp. 119-123: American Geophysical Union.

Pigments (in relation to project 25.)

Maria van Leeuwe

{Var3.Pigments}

Seawater was collected typically at 80m and 40m depths as to coincide with the sampling depths for particulate trace metals (see below 25). At least 10 l of sea water was filtered over glass fibre filters (Whatman GF/F). Filters were immediately placed into a dewar-container holding liquid nitrogen, in which they will be stored until HPLC-analysis at home.

10. Bacteria biomass and production

Karin Lochte (AWI), Peter Bjørnsen (MBL), Anke Weber (UOS/IFM), (Hanna Giesenhausen, IFM), Alexandra Nielsen (MBL), Sylvie Becquevort (ULB).

Bacterial abundance

Anke Weber (Hanna Giesenhausen)

{Bact.CellNum.AO}

5-10 ml of formalin fixed sample filtered onto Irgalanblack pre-stained 0.2 µm Nuclepore filters, a second membrane filter was placed underneath to facilitate dispersion of the bacteria over the filter. After four minutes of staining by acridine orange, the counts were made under blue-light excitation using a Zeiss epifluorescence microscope (1000x) with ICS-optics. The shipboard dataset will be written up in collaboration with H. Giesenhausen (IFM).

Bacterial Biomass

Anke Weber (Hanna Giesenhausen)

{Bact.BM.AO}

Mean bacterial cellular biomass was estimated by measuring 50 randomly selected cells (from filters prepared as described above) and calculating mean bacterial biovolume by comparison to a New Portion grid which was calibrated by comparison with standard size fluorescent beads. Calculation of the mean bacterial cellular carbon content was done according to Simon & Azam, Mar. Ecol. Prog. Ser. 51, 201-213, 1989. Bacterial biomass was calculated by multiplying cell numbers and mean cellular carbon

content. No correction was made for possible shrinkage as a result of sample preparation. The shipboard dataset will be written up in collaboration with H. Giesenhenagen (IFM).

Bacterial biomass

S. Becquevort, Th. De Henau

{Bact.CellNum.DAPI, Bact.BM.DAPI}

Bacteria were enumerated by epifluorescence microscopy after 4',6-diamidino-2-phenylindole (DAPI) staining (Porter & Feig, 1980) and by flow cytometry after DAPI staining (De Henau, 1992). Biovolumes were estimated on enlargements of microphotographs. Conversion into carbon biomass was done using the biovolume dependent C/biovolume ratio proposed by Simon & Azam (1989).

Bacterial production

Peter K. Bjørnson, Karin Lochte

{Bact.TTI, Bact.LEU}

Production of bacterial biomass is determined by incorporation of [³H]-labelled thymidine and leucine into macromolecules which are precipitated by cold trichloroacetic acid (TCA) as described below. The dependence of substrate incorporation on incubation time and concentration of the respective substrate was investigated in different water bodies throughout the cruise. The data in the database are the basic (and most reliable) data of substrate incorporation given in pmol thymidine l⁻¹ day⁻¹ or in pmol leucine l⁻¹ day⁻¹, respectively. The conversion factors to convert these incorporation rates to production of bacterial cells or biomass carbon are established in experiments with 0.8 µm filtered water samples, in which the production of new cells is monitored parallel to [³H]-thymidine and [³H]-leucine incorporation.

In order to convert the substrate incorporation into bacterial production the following conversion factors were determined in the experiments: 1 pmol of tritiated thymidine incorporation (TTI) corresponds to a bacterial production of 1×10^6 cells; for leucine (LEU) 1 pmol leucine incorporated corresponds to a net carbon production of 3 ngC. Carbon content of the bacterial cells was determined as 1.87×10^{-5} ngC cell⁻¹. Carbon conversion efficiency of bacteria was assumed as 30%.

Incubations were carried out at a fixed temperature of 0 °C. Experiments showed that temperature has an effect of up to 15 % per degree C on incorporation rates. Corrected incorporation rates which take into account in situ temperatures will be supplied later.

Thymidine:

Four 10 ml aliquots of water sample are dispensed into plastic vials; one of these subsamples is fixed by addition of 100 µl 39% formalin amended with cold thymidine and serves as a blank. Each sample receives 1 µl ethyl-[³H]-thymidine, specific activity 3.11 TBq/mmol (Amersham), to a final concentration of 2 nM. The samples are incubated for 2 to 3 hours at 0 °C and the incubation is stopped by addition of 100 µl 39% formalin amended with cold thymidine. The samples are filtered through 0.22 µm poresize cellulose acetate filters, pre-soaked in a cold thymidine solution, and rinsed 10 times with 2 ml 5% ice cold TCA. The filters are placed in 5 ml plastic scintillation vials and 4.5 ml scintillation cocktail (Lumagel SB, Baker Chemicals) are added. The radioactivity incorporated in the cold TCA precipitable material on the filter is measured on board by a Packard Liquid Scintillation Counter.

Leucine:

The procedure is identical to the thymidine incorporation method described above except for the following differences: The samples receive a final concentration of 10 nM L-[4,5-³H]-leucine (Amersham), specific activity 0.522 TBq/mmol. After incubation the samples are filtered through 0.2 µm poresize polycarbonate filters (Nuclepore).

11. Mesozooplankton (incl. egg production)

Santiago Gonzalez, Bouwe Kuipers (all NIOZ)
{ } NETSTR??.XLS

Zooplankton samples were collected with two Hydro Bios Multinet, mounted with five nets of 64 and 200 µm mesh-size respectively.

The Multinets were lowered vertically and covered with the five successive nets the next depths strata:

| Net nr | Depth stratum | approx. volume filtered |
|--------|---------------|-------------------------|
| 1 | 500-200 m | 75 m ³ |
| 2 | 200-100 m | 25 m ³ |
| 3 | 100-50 m | 12.5 m ³ |
| 4 | 50-25 m | 6.25 m ³ |
| 5 | 25-0 m | 6.25 m ³ |

Treatment of samples

The contents of the nets were washed into the FOLSOM plankton splitter and splits into two equal halves.

From the 64 micron mesh size net one halve was concentrated on 50 µm sieve and preserved in 4% formalin for counting and species determination. In accordance with the JGOFS core measurement recommendations the other half was screened into two size fractions (0.2-1 and 1-20 mm) which were rinsed with distilled water and sucked dry on tared Whatman GF/C filters. The filters were stored at -27°C and weighted after 18 h at 60 °C and 2 h at 550 °C subsequently to estimate ashfree dry weight (AFDW).

Counting and species determination was made for Transect 2, 5 and 11. AFDW for the JGOFS protocol was determined for Transect 1, 2, 3, 4, 5, 6, 11 and 12.

Some remarks:

- S Species index and name
- D Density per M³
- B Dry weight per M³ in milligram
- G Mean dry weight in microgram
- L Mean length in 100 µ

12. Microplankton abundance; autotrophs, heterotrophs; incl. nanoplankton

Dick Crawford (AWI), Friedel Hinz (AWI), Renate Scharek (AWI), Christine Klaas (AWI), Andrea Detmer (IFM), Sylvie Becquevort (ULB), Sylvie Mathot (ULB), Thierry de Henau (ULB), Frank Jochem (IFM), Peter Bjørnsen (MBL), Alexandra Nielsen (MBL), Santiago Gonzalez (NIOZ), Bouwe Kuipers (NIOZ)

Microplankton & nanoplankton, mostly flagellates

S. Becquevort, Th. De Henau
{Auto.Flag.}

Nanoplanktonic auto- as well as heteroflagellates were enumerated by epifluorescence microscopy after DAPI staining (Porter & Feig, 1980). The lengths and widths of 100 flagellates were determinated visually by comparison with an ocular micrometer. Cell volumes were estimated using the equation of a prolate spheroid. Nanoplankton biomass was calculated assuming a carbon density of 0.11 pgC μm^{-3} (Edler 1979).

Phytoplankton and protozoa enumeration

Sylvie Mathot

{muPhyt.CellNum, muPhyt.BM} (no data)

Several water sub-samples were taken for microscopic examination of the planktonic communities and preserved with appropriate (i.e. for reliable identification and abundance determination) fixatives immediately after collection. Thus samples for phytoplankton (mainly diatoms and dinoflagellates) and protozoan (ciliates and dinoflagellates) carbon biomass calculation were preserved either with glutaraldehyde-25% (final conc. 0.5%) or with a glutaraldehyde-lugol cocktail (35 o/oo, v/v; final conc. 1%). Carbon biomass was calculated from cell counts and cellular biovolume measurements under an inverted microscope (Utermöhl technique), by using appropriate carbon/cell biovolume conversion factors of 0.11 pgC. μm^{-3} (Edler, 1979) for dinoflagellates (auto- and heterotrophic) and diatoms, and 0.08 pgC. μm^{-3} (Beers and Steewart, 1970) for ciliates. Autotrophs were discriminated from heterotrophs by their red chlorophyll autofluorescence. Details concerning this procedure are extensively described in Becquevort et al. (1992).

Becquevort, S., Mathot, S. and Lancelot, C. (1992) Interactions in the microbial community of the marginal ice zone of the northwestern Weddell Sea through size distribution analysis. Polar Biol., 12: 211-218.

Phytoplankton: chlorophyll, proteins, lipids, carbohydrates

Sylvie Mathot

{Cell.Const.Proteins, CellConst.Lipids, Cell.Const.CarbHydr.RES, Cell.Const.CarbHydr.TOT}

These measurements were done in conjunction with the project on photosynthetic assimilation rates (see below 13.), only at selected stations. Water samples were collected for chlorophyll a measurements, for phytoplankton biochemical determination (i.e. proteins, total and reserve carbohydrates, lipids) and for cell enumeration. All these variables will be measured in the home laboratory.

Chlorophyll a measurement:

1 to 2 liters of water were filtered onto 47 mm diameter Whatman GF/F glass-fiber filters. Filters are kept frozen in the dark until analysis. Chlorophyll a will be determined following either the spectrophotometric method of Lorenzen (1967) or the fluorometric method of Yentsch & Menzel (1963). The dataset is quite small and not part of the database, yet available upon request.

Phytoplankton biochemical composition:

For stocks determination, 1 to 2 liters of water were filtered on pre-ashed (512 °C) 47 mm diameter Whatman GF/F glass-fiber filters. Phytoplankton cellular constituents were estimated by regression analysis of measurements of particulate proteins, carbohydrates and lipids on Chl-a concentrations as proposed by Lancelot-Van Beveren (1980). Thus quantitative measurements of proteins in solution were performed with the Folin-Ciocalteu reagent (Lowry et al, 1951) following the experimental procedure developed by Hewitt (1958). For total carbohydrates, a modified form of the

phenol-sulphuric acid method of Dubois et al (1956) was used. Total lipids were extracted with a chloroform-methanol solution, carbonized with concentrated sulphuric acid, and the amount of carbon was spectrophotometrically measured (Marsh & Weinstein, 1966). Experimental procedures are extensively described in Lancelot-Van Beveren (1982).

Lancelot-Van Beveren, C. (1982) Etude ecophysiologique du phytoplankton de la zone côtière belge. These de doctorat, Université Libre de Bruxelles, 221p.

Autotrophic Pico- and Nanoplankton Abundance

Andrea Detmer

{PPML.ANP.C, PPML.UNID.C, PPML.ANP.M, PPML.APP.M.}

Autotrophic pico- and nanoplankton cell numbers (ANP.C) and numbers of unidentified cells/particles (UNID.C) as estimated by flow cytometry under blue-light excitation (430-490 nm) on a Fluovo II cytometer, triggered for red autofluorescence normally characteristic for chlorophyll. Chlorophyll-containing as well as phycoerythrin-containing particles were observed. Also 50-100 ml of sample fixed with glutaraldehyde (1%) were filtered onto Irgalanblack pre-stained 0.2 µm Nuclepore filters, stained by Proflavine and stored frozen (-28 °C) for counting with epifluorescence microscopy (ANP.M, APP.M). These methods also apply to observation of cyanobacteria (JGOFS activity 16.).

Heterotrophic Pico- and Nanoflagellate Abundance

Frank Jochem

{PPML.HNF10-20, PPML.HNF<10, PPML.HPF, PPML.HPP}

Cell numbers of heterotrophic nanoflagellates 10-20 µm (HNF10-20) and less than 10 µm (HNF<10) in size, and heterotrophic picoflagellates (HPF) less than 2 µm. 50-100 ml of sample filtered onto Irgalanblack pre-stained 0.2 µm Nuclepore filters, stained by Proflavine and Hoechst 33342, counted under blue-light excitation on a Zeiss epifluorescence microscope (200x and 1000x) with ICS-optics; suspect cells checked for nucleus presence under UV-excitation using Hoechst stain. Relying on these methods cyanobacteria were also observed (JGOFS activity 16.).

Abundance and biomass of heterotrophic dinoflagellates smaller than 20 µ

(in relation to experiments on growth potential)

Peter K. Bjørnsen and Alexandra C. Nielsen

{Bact.SHD.Cellnum and Bact.SHD.BM}

Ten ml samples were fixed by 150 µl of 25% glutaraldehyde, stained with proflavin hemisulphate (10 ppm final concentration) and filtered onto black polycarbonate filters of 0.2 µm pore size. More than 50 sm all heterotrophic dinoflagellates (SHD) were counted and sized under an epifluorescence microscope at 600 x magnification and blue excitation. Only dinoflagellates smaller than 20 µm were included in these counts. Biovolume was converted into biomass assuming a carbon density of 0.12 pg C per µm³.

Diatoms

Dick Crawford, Friedel Hinz

{Diatoms}

Apstein net (20µm mesh) from surface 20m and Multinet (64µm mesh) from 5 depths down to 300m were examined live for floristic assessment. Samples were preserved and prepared for a permanent slide collection to provide a detailed taxonomic account and relative frequency figures for the floral composition.

Microplankton and nanoplankton

Renate Scharek, Christine Klaas

{muPhyt.Prot.CellNum, muPhyt.Prot.Phyto, muPhyt.Protzoa, muPhyt.Protists}

Species composition and biomass of the mikroplankton assemblage are obtained by counting fixed material with the Utermöhl technique on:

- a) Water bottle 200ml samples.
- b) 10 l water bottle samples concentrated to 200ml by reverse filtration through 2.0 µm filters.
- c) Multinet samples (64 µm mesh).

Abundances will be given in cells/l. Biomass are given in nanogram s/l for protistan carbon (PRC), and comprises a phytoplankton carbon fraction (PPC) and protozooplankton carbon (PZC).

Video recordings were taken for identification of living heterotrophic protozoans.

Microzooplankton

Bouwe Kuipers, Santiago Gonzalez

{Microzoo}

At all meso- and most microstations samples were taken from 20, 40, 80, 200 and 300 m. Niskin or NOEX bottles (three stations above and two under the usual thermocline) and preserved immediately in 2 % Lugol-A solution. At NIOZ numbers per ml. of tintinnids, other ciliates, large heterotrophic flagellates, rotifers and other groups will be counted by settlement inverted microscopy for size-categories <20, 20-60, 60-100 and >100 µm. The purpose is to check whether there are -similar to recent North Sea observations -significant numerical responses in these small grazers at the onset of bloom. Diatom numbers counted in the same samples could illustrate how because of microzooplankton size selective grazing larger algae can become dominating during blooms notwithstanding the much higher µ-max of the smaller microzooplankton algal prey-species.

13. Primary production by ^{14}C

Sylvie Mathot (ULB), Frank Jochem (IFM), Bernard Quéguiner (IEM)

Primary Production

Frank Jochem

{PPML.TOTPP, PPML.PP>20, PPML.PP5-20, PPML.PP2-5, PPML.PP<2}

Size-fractionated primary production from 12 hrs. in-situ incubation (stn 885 only) or 24 hrs. in-situ simulated deck incubation using neutral density filters in a seawater-cooled deck incubator (see below description by S. Mathot, ULB Bruxelles). Added activity = 50 µCi per 250 ml polycarbonate bottle; subsamples of 45 ml for measurements in size fractions of "total" (untreated), "<20" (net gauze), "<5" and "<2" (by 5.0 µm and 2.0 µm Nuclepore filters, respectively), fractionated subsamples filtered onto 0.2 µm membrane filters, dissolved in Lumagel SB and measured in a Beckman LS-1800 liquid scintillation counter. Two bottles treated with 1.5 x 10-5 nM DCMU were used as «dark bottles» and subtracted from the light bottle values. The unfractionated value {PPML.TOTPP} is the JGOFS variable and compatible with below {PP.Prim.Prod}.

Primary production

Sylvie Mathot

{PP.Prim.Prod}

Assessments according to JGOFS protocols with the exception of using deck incubators rather than in situ incubation. 250 ml samples were collected from depths closer to 100%, 70%, 45%, 22%, 10%, 4.5%, 1.5%, and 0.5% (neutral density screens) of incoming PAR. An additional sample was taken and kept in the dark as «dark bottle» for which then the value was subtracted from the values of the light bottles. Samples were incubated for 24 hours in the " *in-situ* simulated deck-incubator", in polycarbonate bottles with NaH $^{14}\text{CO}_3$ at a rate of 10 μCi per 100 ml 1 sample (Amersham, specific activity = 56 mCi.mmol $^{-1}$).

Samples were filtered on Whatman GF/F filters at the end of incubation time. Two drops of HCl 0.5N were added to the filters to release unassimilated $^{14}\text{CO}_2$. Scintillation cocktail was added to the filters prior to their radioactivity assaying in a Packard 1900CA Tri-Carb Liquid Scintillation Counter. Occasionally, size-fractionation was also performed onto 10 μm and 0.8 μm Poretics filters.

Photosynthetic assimilation rate, phytoplankton growth and respiration.

Sylvie Mathot

{PP.AssimRT, Phyto.GrowthRT}

This project was done in relation with above "Phytoplankton: chlorophyll, proteins, lipids, carbohydrates", see section 12. The experimental determination of physiological parameters characteristic of phytoplankton involved two kind of tracer experiments conducted in parallel under simulated *in-situ* conditions. For all these incubations, 100 to 250 ml 1 seawater sample, which amount was chosen according to phytoplankton biomass, were incubated in polycarbonate bottles with NaH $^{14}\text{CO}_3$ at a rate of 10 μCi per 100 ml sample (Amersham, specific activity = 56 mCi.mmol $^{-1}$).

Experimental determination of photosynthetic parameters involved short-term (4 hours) ^{14}C incubations (based on the Steemann-Nielsen standard method), performed at various fractions of light intensity, either in an " *in-situ* simulated inside incubator" (0, 1, 4, 6, 10, 15, 20, 30, 40, 60, 80, 100%; Philips 500W halogen lamps) or in an " *in-situ* simulated deck-incubator" (0, 0.5, 1.5, 4.5, 10, 22, 45, 70, 100% of incoming PAR), both cooled by running seawater. Filters were treated as described above. Photosynthetic parameters K_{max} , a, and b were calculated by mathematical fitting of the data relative to the photosynthesis-light relationship using Platt et al.'s equation (1980).

Experimental determination of phytoplankton growth (net primary production) and respiration parameters was performed through long-term (24 hours) light-dark kinetics of ^{14}C assimilation into 4 pools of cellular constituents easily separable by biochemical procedure: small metabolites (composed of monomeric precursors for the synthesis of macromolecular compounds), lipids and polysaccharides (constituting together the reserve products of the phytoplankton cell), and proteins. Incubations were conducted at *in-situ* temperature under saturating illumination (100-170 $\mu\text{E.m}^{-2}.s^{-1}$). The light-dark cycle was fixed at 14:10 to simulate environmental conditions. Two drops of HCl 0.5N were added to the filters to release unassimilated $^{14}\text{CO}_2$. Scintillation cocktail was added to the filters prior to their radioactivity assaying in a Packard 1900CA Tri-Carb Liquid Scintillation Counter. Occasionally, size-fractionation was also performed onto 10 μm and 0.8 μm Poretics filters. Filters for biochemical fractionations were kept frozen until analysis in the home laboratory. Details on experimental procedure and biochemical fractionation are described in Lancelot and Mathot (1985). Phytoplankton growth and respiration parameters were estimated by mathematical fitting of the data relative to the kinetics of assimilation of ^{14}C into proteins and storage products, using the equations described in Lancelot et al. (1991).

Lancelot, C. and Mathot, S. (1985) Biochemical fractionation of primary production by phytoplankton in Belgian coastal waters during short- and long-term incubation with ^{14}C -bicarbonate. I. Mixed diatom population. Mar.Biol., 86(3): 219-226.

Lancelot, C., Veth, C., and Mathot, S. (1991) Modelling ice edge phytoplankton bloom in the Scotia-Weddell Sea sector of the Southern Ocean during spring 1988. J.Mar.Syst., 2: 333-346.

Carbon primary production (in relation to project 24.)

Bernard Quéguiner
{Biog.Si.PP}

250-ml samples were collected from depths closer to 100%, 25%, 10%, 3%, 1% and 0,1% incident PAR. Samples were spiked with $10\mu\text{Ci}$ (370 kBq) $\text{NaH}^{14}\text{CO}_3$ and incubated during 24-h in a deck incubator maintained at sea surface temperature. Just after spiking, 100 ml is removed and immediately counted by liquid scintillation to determine the specific activity of each sample. After incubation samples were filtered onto $0.4 \mu\text{m}$ Nuclepore filters. Non-incorporated $\text{NaH}^{14}\text{CO}_3$ remaining on the filter is eliminated by adding a few ml of 0.01 N HCl in $0.4 \mu\text{m}$ -filtered seawater. Filters were then counted by liquid scintillation method.

14. Primary production by O_2

Frank Jochem (IFM), Rinus Manuels (NIOZ)

Except for one in situ incubation at drift station no data.

15. New Production by ^{15}N and Export Production by ^{234}Th

Marita Wunsch (SFB), (Wolfgang Koeve, SFB), Frank Dehairs (VUB), (Leo Goeyens, VUB), Michiel van der Looff (AWI)

Nitrate assimilation

Marita Wunsch, (Wolfgang Koeve)
{ $^{15}\text{NO}_3$.Uptake}, no data.

New Production here is defined as phytoplankton growth based on the assimilation of nitrogen in the form of NO_3 as opposed to Regenerated Production, which is based on ammonia uptake (EPPELY etc. 19..). We measure NO_3 uptake with $^{15}\text{NO}_3$ as a tracer.

4.5-litre samples of seawater from various depths (corresponding to 66, 52, 13 and 1% light levels) are filled into transparent polycarbonate bottles, spiked with $^{15}\text{NO}_3$ at a concentration of about 10% of the ambient nitrate concentration and incubated on deck at surface water temperature for 24 hours. The respective light levels are attained by covering the bottles with appropriate light absorbing foils. After this incubation two to four litres (depending on Chl-a content) of the water are filtered over GF/F-filters (200 bar suction) which are stored frozen then dried at 60°C and later analyzed for particulate ^{15}N by mass spectrometry.

NO_3 uptake of various size classes is determined by additional sequential filtration over 20, 5, and $2 \mu\text{m}$ pore-size filters respectively. In these cases, sample depths and incubation light levels are 100, 30, and 1% of the surface light level

Values are given in $\mu\text{mol NO}_3$ uptake per day and m^2 .

New Production by ^{15}N

Frank Dehairs, (Leo Goeyens)
{ $^{15}\text{NH}_4$.Uptake, $^{15}\text{NO}_2$.Uptake, $^{15}\text{NH}_4$.Mineralisation}

Uptake of ammonium

Sampling and spiking:

4.5 l seawater was sampled in a Nalgene bottle. Spike solution ($1.7 \text{ ml } ^{15}\text{N}-\text{NH}_4\text{Cl}$ solution: 11.6 mg l^{-1} ; 99% ^{15}N) was added. The bottle was gently shaken and subsampled for the initial ammonium content. The spike addition was calculated to increase an original ammonium content of $1 \mu\text{mol l}^{-1}$ by

about 10%. Since during ANT X/6 natural ammonium concentrations never reached that level, spike additions were generally >> 10% of the original content.

Incubations: During the transects samples from -10 and -30m were incubated for 24 hours in the on-deck incubator, respectively at 100% and 30% of incoming radiation using a neutral density screen.

During the drift station (from October 22 to 24), day incubations (06.00 to 18.00) and night incubations (18.00 to 06.00) were done. Day incubations concerned samples from -7, -20, -40, -60 and -80 m depth. The first day of the drift station experiment these samples were set out *in-situ*. On day 2 and day 3 the samples were incubated in the on-deck incubator, respectively at 100%, 66%, 30%, 13% and 1% of incoming light, using neutral density screens.

Night incubations were done on samples from -10 and -60m. These samples were incubated in the dark in the cold room at 1 °C or in the on-deck incubator.

At the end of the incubation period, subsamples were taken for determination of the final ammonium content. Another subsample is taken for assessment of the ammonium mineralisation rate (see point 2 below).

For cases where Chl-a content $\geq 0.3 \mu\text{g l}^{-1}$, one fraction of the seawater sample was passed over a 20 µm screen to assess ammonium uptake by the $\leq 20 \mu\text{m}$ sized phytoplankton. The other fraction was directly filtered (approx. 0.2 bar underpressure) on precombusted (450 °C) Whatman GF/F filters to assess ammonium uptake by the total phytoplankton population.

For situations with low Chl-a content ($< 0.3 \mu\text{g l}^{-1}$) no size fractionation was performed.

GF/F filters are oven dried (50 °C) and sealed in plastic petri dishes for later analysis in the home laboratory.

Mineralisation of ammonium

Mineralisation of ammonium is assessed during the same experiment as ammonium uptake. After the incubation and before the filtration (see point 1 above), 10 ml of the sample are transferred to a serum vial, and spiked with 500 µl of an unlabeled ammonium carrier solution (NH₄Cl: 54.15 mg l⁻¹) for the entrainment of ¹⁵N-ammonium. Ammonium from this solution is extracted by adding 500 µl of strong base (KOH: 50%) and the produced ammonia is captured on aluminium oxide beads coated with sulphuric acid (0.25 M) and suspended in a tin cup above the solution. After ≥ 48 hours the tin cup is retrieved and sealed in a plastic envelope for later analysis in the home laboratory.

Uptake of nitrite

Sampling and spiking:

Sampling of the seawater from -10 m, in a 4.5 l Nalgene bottle. Addition of 2 ml spike solution (¹⁵N-KNO₂: 4.8 mg l⁻¹; 99% ¹⁵N). The bottle is gently shaken and subsampled for the initial nitrite concentration.

Incubation:

The sample is incubated for 24 hours in the on-deck incubator at 100% of incoming light. After the incubation a subsample is taken for the determination of the final nitrite concentration. The remaining solution is filtered on precombusted Whatman GF/F and oven dried at 50 °C. Samples are sealed in plastic petri dishes for later analysis in the home laboratory.

Determination of ¹⁵N abundance (home laboratory)

The ¹⁵N abundance is determined by emission spectrometry (JASCO NIA-¹⁵N analyzer) after conversion of particulate nitrogen and extracted ammonia into dinitrogen by means of an oxidation with CuO. This conversion is performed in quartz discharge tubes at 750 °C. Specific and absolute uptake

rates are computed using mathematical expressions based on the isotope dilution law and on a constant transport model (the latter assumes no significant biomass build up during the incubation)

Export Production by ^{234}Th , including ^{210}Po and ^{210}Pb

Michiel Rutgers van der Loeff, Heike Höltzen, Jana Friedrich

{S, 234Th.diss, 234Th.part, 234/238.diss, 234/238.part, 234/238.removed, Si, NO₂, NO₃, PO₄}

RADIOISO.XLS

(Michiel Rutgers van der Loeff, Heike Höltzen, Jana Friedrich)

Samples were taken with 270-l Gerard bottles. On shallow casts samples were collected at 6 depths, usually 20m, 60m, 100m, 200m, 400m and 600m. Some samples from deep casts had to be discarded because silicate analyses, compared with the silicate profile obtained from CTD-Rosette casts, indicated leakage during retrieval due to insufficient closure of the covers. The water was pumped by a centrifugal pump through a 142m m 1μ nucleopore filter. Filtered volume was measured with a KENT flow meter. A 20-kg aliquot of filtrate was weighed, acidified with 20 m l of HNO₃, and spiked with ^{230}Th , ^{208}Po and stable Pb yield tracers. 250 m g of Fe was added, and after 1 day isotope equilibration, NH₃ was added to a pH of 8.5, thus coprecipitating Th, Po and Pb with Fe(OH)₃. The hydroxide was collected by settling and centrifugation, and dissolved in a minimum amount of 9M HCl. After complexing Fe with ascorbic acid, Po was plated on silver planchets according to Fleer and Bacon (1984) based on the procedure of LYNN (1968). After evaporation with some HNO₃ to decompose the ascorbic acid, Th was isolated by ion exchange and electroplated according to Anderson and Fleer (1982). ^{234}Th was counted by anticoincidence low-level beta counting (background 0.15 dpm) on-board ship, whereas the ^{230}Th and Po was counted in the home laboratory.

The filter samples were decomposed by microwave acid digestion in a mixture of 10 ml HNO₃, 0.5 ml HF and 2 m l H₂O₂. Organic residues were destroyed by adding 2 m l HClO₄ after spiking with ^{230}Th , ^{208}Po and stable Pb yield tracers. Radionuclide analysis of the filter samples was performed following the same procedures as for the water samples.

^{210}Pb of water and filter samples was determined through the ingrowth of ^{210}Po . The solution remaining after the first Po plating, which still contained the Pb fraction, was stored for about one year to allow new ^{210}Po to grow from decay of ^{210}Pb . Then Po was extracted again by the method mentioned above. The silver planchets with the Po fraction were measured by alpha counting on silicon surface barrier detectors (EG&G Ortec). ^{210}Pb and ^{210}Po activities are decay-corrected to the time of sampling according to FLEER & BACON (1984). Error estimates (1-sigma) include counting errors and uncertainties in blanks, spike activities and sample volume.

The ^{226}Ra activity was calculated from the silica concentration of the water from the relationship of KU & LIN (1976). Salinity is obtained from corresponding CTD casts, and used to calculate ^{238}U from the relationship given by Chen et al. (1986).

Anderson, R. F., and A. P. Fleer (1982) Determination of natural actinides and plutonium in marine particulate material. *Anal. Chem.*, **54**, 1142-1147.

Chen, J. H., L. R. Edwards, and G. J. W. Asserburg (1986) ^{238}U , ^{234}U and ^{232}Th in seawater. *Earth Planet. Sci. Lett.*, **80**, 241- 251.

Fleer, A. P., and M. P. Bacon (1984) Determination of ^{210}Pb and ^{210}Po in seawater and marine particulate matter. *Nuclear Instruments and methods in Physics Research*, **223**, 243-249.

Flynn, W. W. (1968) The determination of low levels of Polonium-210 in environmental materials. *Anal. Chim. Acta*, **43**, 221- 227.

Gardner, W. D., I. D. Walsh, and M. J. Richardson (1993) Biophysical forcing of particle production and distribution during a spring bloom in the North Atlantic. *Deep-Sea Res. II*, **40**, 171-195.

Ku, T. L., and M. C. Lin (1976) ^{226}Ra distribution in the Antarctic Ocean. *Earth Planet. Sci. Lett.*, **32**, 236.

16. Autotrophic pico/nano-plankton (including cyanobacteria)

Andrea Detmer, Frank Jochem (both IFM)
{PPML.SYN}

See above core activity 12., for our methods for autotrophic and heterotrophic pico- and nanoplankton.

17. Grazing by Mesozooplankton

Corina Dubischar (AWI), Uli Bathmann (AWI)
{No samples from bottle casts. Data will appear in other report.}

Mesozooplankton grazing experiments with copepods were carried out at several stations in order to assess the *in situ* grazing rates of the dominant species. Following the suggestions of the JGOFS protocol for the core parameters, the gut fluorescence technique was applied. Immediately after capture of the species with a Bongo net (sealed cod end), lots of 10 to 15 individuals each, of the dominant species (*Rhincalanus gigas*, *Calanus propinquus*, *Calanoides acutus*) were placed in buckets (1 liter) containing filtered sea water. One lot was deep frozen (-25 °C) at once, the others in time intervals of 20, 40, 60, 120, 150 minutes. Three to five replicas were taken for each time step. After each series of such gut evacuation experiment, chlorophyll *a* and phaeopigment content were determined by means of a Turner Design Fluorometer. Data are given in chlorophyll *a* equivalents as the sum of chlorophyll *a* and phaeopigments. According to theory, the initial slope should represent the gut evacuation rate *in situ*; the reverse representing the gut passage time (minutes).

18. Grazing by Microplankton

Christine Klaas (AWI), Sven Reitmeier (SFB), Sylvie Becquevort (ULB), Thierry de Henau (ULB)

Grazing by microplankton & nanoplankton

S. Becquevort, Th. De Henau
{NanoZoo.Grazing}

Protozoan grazing on phytoplankton and bacteria specifically were measured by the method proposed by Sherr et al (1987) based on the uptake of fluorescent - labelled prey (FLA *fluorescent - labelled algae*, Rublee & Gallegos 1989; FLB *fluorescent - labelled bacteria*, Sherr et al 1987).

Grazing

Christine Klaas
{Dinoflag}

From abundance's of dinoflagellates (see above 12.) it is conceivable to derive an estimate of grazing rates, in which case these rates will also be brought into the database.

Microzooplankton Grazing

Sven Reitmeier
{Var2.k, Var2.g, Var2.Regr, Var2.Init.Chla, Var2.PICG, Var2.ChlADoubl, Var2.CG}

Microzooplankton Grazing (MZP-grazing) is measured by a procedure similar to that described by LANDRY and HASSETT (1982). Diluting a water sample with filtered seawater will also reduce the grazing pressure on planktonic algae, while the phytoplankton growth rate is not affected. Water from the Niskin bottle (or Gerard Water Sampler) is pre-screened over a 100 µm gauze and then diluted to 20,

40, and 70% with 0.2 µm-filtered seawater. 2.5 litres of each of these dilutions, and of undiluted seawater, are incubated in transparent polycarbonate flasks in triplicate at ambient temperature on deck for 24 hours, the light level of the sampling depth being attained by a cover with an appropriate light absorbing foil.

Chlorophyll-a is determined fluorimetrically before and after incubation for each dilution after filtration of 1-2 litres onto a GF/F filter, and acetone extraction. Before and after incubations there are also samples taken for phytoplankton and microzooplankton microscopic analysis. These samples are fixed with Lugol's solution and analysed by the Utermöhl technique. The natural logarithms (\ln) of the quotient between initial and final Chl-a values (Phytoplankton apparent growth rate, AGR) are plotted against the dilution (fractions of 1), the grazing coefficient ("g") is read from the slope of the line and "k" (y-axis intercept) is the phytoplankton growth coefficient.

Values of "g" and "k" are given (dimensionless), describing the function of the linear regression like: $y=k+gx$. Once the C/Chl. ratio is established from the analysis of POM, the grazing rates can also be expressed in carbon units.

Additionally, samples were taken for later pigment analysis by HPLC in order to obtain information on the selectivity of MZP-grazing.

19/20. Sediment traps

Uli Bathmann (AWI)

{No data in this report.}

21. Ice coverage.

Jan van Franeker (IBN)

Icecover is an important parameter in JGOFS studies because of its influence on the light regime, stability and salinity of the underlying water, all strongly affecting growth conditions for phytoplankton. Furthermore, the ice contains important communities of ice algae. Methods for ice observations have been developed in the "Protocol for ship- and airborne observations on the structure, physical properties and coverage of sea ice in the framework of Southern Ocean (SO) JGOFS activities. (Ackley S.F, Eicken H., van Franeker J.A., and Wadhams P. 1992). Following these methods ice observations during SO-JGOFS were conducted at every station position, and when thought useful, in between station positions. Results have been summarized in an ice database (ICESUM_ANTX/6. available in MAC Excel3, and MS_DOS Lotus3 or ASCII file).

Parameters listed in the database are:

- SO-JGOFS stationnumber and transectnumber. Observations at intended but cancelled station positions have station number 0, and underway observations have no number. Positions of ice edge crossings have been included as "edge". Edge positions given are for the outer ice edge, that is the most northern border of loose bands or fields of ice.
- date, time and position (minutes of latitude/longitude expressed in decimals!)
- Range (in km) around position for which observations are considered valid. It was attempted to give a description of icecover in a larger (5 to 10 km) area, but visibility or other circumstances sometimes reduced the area of observation.
- Percentages of open water and total icecover. Within total icecover a subsequent distinction is made between coverage by:
- Floes: relatively flat pieces of first-year or older ice, covered by snow. - New ice: new ice types (grease/slush; pancake ice; dark nilas; light nilas; and grey/greywhite ice) were recorded separately when possible but have been combined in one figure in the database. New ice generally has no or little snowcover.
- Brash ice: defined as small fragments of the wreckage forms of other forms of ice.
- Floediameter lists the estimated average diameter of floes dominating in icecover (in meters).

- Additional to the sea ice cover the total number of icebergs in a 12 nautical mile range around the ship was counted from the ships radar.
- For each station, the distance in km's from the ice edge was calculated (latitudinal difference between ship position and edge position).
- Finally the database lists temperature and salinity of the surface water, and air temperature (10 minute average from Polarstern INDAS datasystem).

Filenames have the following convention:

- ICE10-?.XLS: These contain 10 minute observations of the various parameters. Some files are combined which are designated by both transect numbers (e.g. ICE10-78.XLS, has the data of transect 7 and 8). Exceptions are ICE10-11.XLS and ICE10-12.XLS, respectively transect 11 and 12.
- ICEJGOFS.XLS: Ice observation data according to JGOFS protocol.

Some further parameters were recorded during JGOFS observations, such as thickness of iceflocs and snowcover, different types of young ice, frequency of rafted floes and frequency of brown ice. These have not been included because they were considered too specific, hardly variable or of low reliability.

In addition to the standard JGOFS observations, ice conditions were estimated on a much finer scale during each ten-minute period of top predator observations in a narrow transect band (including minimum-maximum figures for icecover and floesize). Part of these observations will be included in the database of the surface registration group.

If such data are required please obtain further information from Jan van Franeker, see address list.

22. Ice physics

Cees Veth (NIOZ)

{No data in this report.}

23. Ice biology

Uli Bathmann (AWI), Renate Scharek (AWI), Sylvie Becquevort (ULB), Sylvie Mathot (ULB), Frank Jochem (IFM)

{No data in this report.}

24. Silica biogeochemical cycling

Bernard Quéguiner (IEM), Laetitia Teissier (IEM), Jacques Poncin (IEM), Pascal David (CNRS)
{Biog.Si.BM, Biog.Si.Prod, Biog.Si.Silicate}

Biogenic silica biomass

1-l seawater is filtered onto 47 μm Nuclepore membranes (0.4 μm at each depth and size-fractionation : 0.4-10 μm at selected depths). Filters are dried for at least 24h at 60 °C and stored in plastic Petri dishes. Biogenic silicate [μmol Si.m⁻³] analyses are performed in the laboratory using the NaOH digestion method of Paasche (1973) as modified by Nelson et al. (1989).

Nelson D.M., Smith W.O., Muench R.D., Gordon L.I., Sullivan C.W. & Husby D.M. 1989. Particulate matter and nutrient distributions in the ice-edge zone of the Weddell Sea : relationship to hydrography during late summer. *Deep-Sea Res.*, **36**, 191-209.

Paasche E. 1973. Silicon and the ecology of marine plankton diatoms. 1. *Thalassiosira pseudonana* (*Cyclotella nana*) grown in a chemostat with silicate as the limiting nutrient. *Mar. Biol.*, **19**, 117-126.

Biogenic silica production

PSi is determined by the ^{30}Si stable isotope method of Nelson and Goering (1977). The tracer solutions had been passed through Chelex resin before the cruise to limit possible trace metal contamination. 1-l samples are collected from depths closer to 100%, 25%, 10%, 3%, 1% and 0,1% incident PAR. Samples are then drawn in 1-l acid (HCl 0.1 N)-cleaned polycarbonate bottles that had been previously covered with neutral-density nickel screens. Under a laminar flow hood, samples are spiked with 20 μm oles of $\text{Na}_2^{30}\text{SiO}_3$ and placed in a plexiglas incubator maintained at sea surface temperature by constant flow of surface water. After a 24-h incubation the samples are filtered under a laminar flow hood through 47mm Nuclepore membranes (0.4 μm at each depth and size-fractionation : 0.4-10 μm at 100% and 0.1% depths). Filters are dried for at least 24h at 60 °C and stored in plastic Petri dishes. The determination of the rates of orthosilicic acid uptake (PSi) is performed in the laboratory by mass spectrometry.

Nelson D.M. & Goering J.J. 1977. A stable isotope tracer method to measure silicic acid uptake by marine phytoplankton. *Anal. Biochem.*, **78**, 139-147.

Biogenic silica dissolution

At some stations, Diss Si is determined in parallel to PSi by the ^{30}Si stable isotope method of Nelson et al. (1991). 1.6-l samples are collected from depths closest to 100%, 25%, 10%, 3%, 1% and 0,1% incident PAR. Under a laminar flow hood, samples are spiked with 32 μm oles of $\text{Na}_2^{30}\text{SiO}_3$. 1-l of each sample is immediately transferred into acid-cleaned polycarbonate bottles and allowed to incubate during 24-h in a deck incubator maintained at sea surface temperature. 0.6-l remaining are immediately filtered through 0.4 μm Nuclepore filter. The filter is retained for BSi analysis and the filtrate treated to collect the dissolved silicic acid for isotopic analysis. 37.5 ml of Sephadex-cleaned ammonium molybdate/hydrochloric acid reagent are added to the filtrate. The silicon molybdate complex is then extracted on a Sephadex column. After 24-h incubation the 1-l sample is filtered onto 0.4 μm Nuclepore filter. The filter is retained for PSi analysis and the filtrate is treated as described above. $^{28}\text{Si}/^{30}\text{Si}$ ratios are determined in the laboratory by mass spectrometry. The difference between $^{28}\text{Si}/^{30}\text{Si}$ ratios in the dissolved phase before and after incubation allows to calculate the rate of dissolution of biogenic silica.

Nelson D.M., Ahern J.A. & Herlihy L.J. 1991. Cycling of biogenic silica within the upper water column of the Ross Sea. *Mar. Chem.*, **35** : 461-476.

Orthosilicic acid concentrations

$\text{Si}(\text{OH})_4$ concentrations are determined using a Technicon autoanalyzer. The analytical procedure is based on the reduction of silicon molybdate in acid solution to molybdenum blue by a methyaminophenol sulfate (Metol) and sodium sulfite solution (Mullin & Riley, 1975 ; Strickland & Parsons, 1972).

Mullin J.B. & Riley J.P. 1955. The spectrophotometric determination of silicate-silicon in natural waters with special reference to sea water. *Anal. Chim. Acta*, **12**, 162-170.

Strickland J.D.H. & Parsons T.R. 1972. A practical handbook of seawater analysis, 2nd edition. Bull. Fish. Res. Bd. Canada, **167** : 310 pp.

N.B. This is independent from the orthosilicic acid measurements done for the hydrographic work (core activity 4).

25. Iron-plankton interactions (incl. trace element distributions)

Maria van Leeuwe (NIOZ), Renate Scharek (AWI), Jeroen de Jong (NIOZ),
Bettina Löscher (NIOZ), Hein de Baar (NIOZ)

Iron as growth limiting factor

Maria van Leeuwe, Renate Scharek, Jeroen de Jong, Hein de Baar

At several stations large batches of seawater were collected with precleaned, modified GoFlo samplers mounted either on the all-teflon coated CTD/Rosette frame or on a 10mm kevlar hydrowire. Immediately upon recovery the samplers were attached to the outside of the thermostated clean air incubation van. Then teflon tubing was connected as to lead the seawater inside the clean environment where it was collected into acid cleaned, seawater preconditioned, polycarbonate culture vessels of various sizes ranging from 1 to 20 liters.

The data presented in the files BIOMETA?.XLS hold the results of the chlorophyll a and nutrient analyses belonging to the experiments described in the paper by van Leeuwe et al. on “Iron enrichment experiments in the Southern Ocean ... “ These date we re used to calculate nutrient uptake rates and rates of chlorophyll a synthesis.

Some remarks:

- “control” stands for the unamended control bottles, “Fe” stands for the bottles enriched with 2 nM Fe.
- Chlorophyll a data are expressed in $\mu\text{g} \cdot \text{dm}^{-3}$.
- Nutrient date are expressed in $\mu\text{mol} \cdot \text{dm}^{-3}$.
- Phosphate data have to be corrected by multiplication with a factor of 1.04

Uptake rates and rates of synthesis were calculated by linear regression of a semi-log plot of chlorophyll a concentrations and nutrient consumption during exponential growth versus time. The slope of the semi-log regression provides the desired rate (d^{-1}) of chlorophyll a synthesis and nutrient uptake respectively.

Distributions of dissolved and particulate trace metals

Bettina Löscher, Jeroen de Jong, Hein de Baar

{Trace.Met} METALS.XLS

{Nom.Depth, Diss.Met., Part.Met., Si, NO3, PO4} METALS.XLS

Seawater samples were taken with precleaned GoFlo samplers (12 L) mounted either on a 10 mm kevlar hydrowire (40 - 400 m), or on an all-Teflon coated CTD/Rosette frame (> 400 m). At each full degree, six samples were collected with kevlar wire at standard depths (40-60-100-150-200-400 m), corrected afterwards for wire angle, using an SIS pressure sensor at the deepest (400 m) sampler. Water deeper than 400 m was collected with the CTD/Rosette frame. Surface water samples (~10 m; unfiltered) were taken from a walking bridge extending 10 m beyond the bow of the slowly upwind steaming ship, using a 2 l GoFlo sampler on a small winch with 6 mm kevlar wire. Upon recovery, the sampler was wrapped in plastic bags, transferred into a Class-100 clean air laboratory van, and drained into a precleaned storage bottle. Particulate matter was collected by filtering 30 to 60 l of seawater through 142 mm NUCLEPORE filters with a pore size of 0.2 μm . The seawater had been taken with a suite of 3-6 12L GoFlo samplers on the CTD/Rosette frame.

Immediately upon recovery, the large 12 L GoFlo samplers were attached to the outside of the clean air laboratory van. Teflon tubes were connected to lead the seawater into the clean laboratory. Pressure lines, with high purity nitrogen gas passing over fine particle arrestance filters, were attached to the top of the samplers, to allow for filtration by an overpressure of < 1 bar. Inside the clean laboratory, seawater was filtered over acid-cleaned NUCLEPOR E or PORETICS membrane filters (47 mm, 0.4 μm), mounted in all-Teflon (PTFE) filter holders. In addition, seawater samples were taken without filtering. The filtered or unfiltered seawater was collected into 1 or 2 l hot-acid-cleaned PE bottles, acidified to pH 2 with quartz distilled HNO₃ and stored. ZHUANG et al. (1990) reported an increasing

dissolution of Fe in marine aerosols with decreasing pH of seawater. Hence, for the unfiltered samples it is assumed that the approximately one year storage at pH 2 would allow dissolution of at least some, if not most biogenic fractions and surface oxyhydroxides coatings. Only the most refractory component of land-derived minerals (clays, sand, etc.) would still be excluded from the analysis.

At the ice stations, surface snow, ice and brine samples were collected using acid-cleaned plastic ware. The samples were placed in a laminar flow clean air bench for melting, then acidified, and transferred into PE bottles and stored.

In the clean laboratory onshore, the samples were pre-concentrated (167x) by an APDC/DDDC chloroform extraction in Teflon separatory funnels, according to BRULAND and FRANKS (1979). The back extraction step was omitted. The extract was evaporated to dryness and the residue dissolved in diluted HNO₃. The reagents used were cleaned by four-fold subboiling distillation in quartz stills. The final analyte was measured using a Perkin Elmer 5100 PC Graphite Furnace Atomic Absorption Spectrophotometer with Zeeman background correction.

In the home laboratory the trace metals Fe, Cd, Cu, Ni, Zn, (Co), (Pb), (Ag) have been analyzed. The first step is a twohundredfold preconcentration and purification by selective complexation with APDC/DDDC followed by solvent extraction into chloroform. The extract is then evaporated to dryness and the residue dissolved in dilute HNO₃. The final analyte was measured using a Perkin Elmer 5100PC Graphite Furnace Atomic Absorption Spectrophotometer (GFAAS) with Zeeman background correction.

26. Top predators (birds, marine mammals)

Jan van Franeker (IBN)

27. Ecophysiology of ice algae: Dimethylsulfoniumpionate (DMSP) content during ice melt

Doris Meyerdierks and Bärbel Bolt (FBB)

{DMSP,DMSP,Chla}

After prefiltration through a 200 µm nylon net to remove larger zooplankton, phytoplankton was concentrated by filtration (< 150 m bar) of 1 - 4 L seawater onto glass fibre filters (Whatman GF/F, 47 mm diameter). The particulate DMSP was determined as gaseous Dimethylsulfide (DMS) using the specific reaction that cleaves DMSP 1:1 into DMS and acrylic acid upon the addition of a strong base. After base (25 % NaOH) was added the filters were incubated in gastight vials and headspace gas analysis was performed at least 4 hours later, after complete liberation of DMS, using a gas chromatograph (Shimadzu 8A) with flame photometric detector. For calibration, DMSP standards (Research Plus, Bayonne, NJ, USA) were treated and analysed in the same way.

28. Biogeochemistry of Barium

Frank Dehairs (VUB)

{diss.Ba, Part.Ba, Part.Ba, Part.Ba, Part.Ca, Part.Ba, Part.Al, Part.Ba, Part.Si, Part.Ba, Part.Sr}

Particulate Barium

During the north-south transects along 6° W total suspended matter samples were taken at every 2 degrees of latitude for particulate Ba-barite determination. The upper 600m of water column were sampled to document the mesopelagic accumulation of Ba-barite.

Sampling

Depths were -10, -50, -100, -150, -200, -250, -300, -350, -425, -500 and -600m. Between 10 and 20 l seawater were filtered under pressure on Nuclepore membranes of 0.4 µm porosity. After filtration

filters were rinsed with about 10 ml of Milli-Q type water and dried at 50 °C. They were then stored in plastic petri dishes at room temperature for further analysis in the home laboratory.

Determination of Barium

Filter samples are transferred to platinum crucibles. After careful combustion of the Nuclepore substrate and of the organic matter at ~ 400 °C, the remaining particulate matter is fused for 1 hour at 1100 °C with LiBO₂ as the flux. The fused pearl is redissolved in 4% hot nitric acid. This solution is brought to 10 ml volume. The analysis is carried out by inductively coupled plasma optical emission spectrometry (ICP-OES). Other elements such as Ca, Sr, Si and Al are analysed simultaneously.

29. ¹³C in surface water particulate organic matter

Frank Dehairs (VUB)

{Part.Ba.13C}

When sampling for particulate barium, during the north-south transects along 6° W, the -10 and -50m depths were sampled for ¹³C determination in POM. Occasionally samples were also taken from 20m and 60m depths sampled with the Gerard bottles. About 20 l of seawater are filtered under pressure on precombusted (450 °C) Whatman GF/F filters. Filters are dried at 50 °C and stored at room temperature till later analysis in the home laboratory.

Analysis of ¹³C natural abundance

Filters are left for 1 hour in HCl vapour for elimination of carbonates. Subsamples are combusted in a CN analyzer (Carlo Erba NA 1500) and the produced CO₂ is automatically trapped in a trapping-box (Finnigan-Mat) for preconditioning the gas sample before introduction into the on-line mass spectrometer (Delta-E, Finnigan Mat). CO₂ mass measurements are relative to that of CO₂ reference gas (from marble standards, standardized relative to NBS CaCO₃ standards). Final results are expressed as ¹³C abundance (¹³C) relative to the PDB reference.

30. Benthic processes

Michiel Rutgers van der Loeff, Jana Friedrichs, Haiske Hölscher, Ola Holby, Karin Lochte (all AWI), Bettina Löscher (NIOZ)

Sediment data

The sediment data were determined in undisturbed sediment cores obtained by multiple corer at the stations indicated.

Microbiological data are given in the file **Bentbact.xls**

Variables:

1. station = station numbers following the ship's protocol
2. bottom depth = depth of water column (m)
3. sediment layer = sediment horizon sampled (cm)
4. bact.numb. = bacterial numbers (10^8 cells/ml)
5. phospholipids = concentration of phospholipids (nmol/ml)
6. FDA = hydrolysis rate of fluorescein diacetate (micromol/l/hr)

Variables 3)-6) were provided by

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Methods (Karin Lochte):

1. See ships protocol
2. See ships protocol
3. Sediment layer: Sediment cores were segmented into 0.5 cm layers from 0 to 2 cm sediment depth; from 2 to 6 cm they were segmented into 1 cm layers; from 6 to 10 cm they were segmented into 2 cm layers. The sediment layer depth gives the mean depth of the sample.
4. Bacterial numbers: Bacteria were counted microscopically in the sediment samples which had been stored fixed in 2% formaldehyde solution and kept refrigerated at 4 °C. The samples are diluted 1:10000 with filtered seawater, homogenized briefly by ultrasonication, stained 5 min with acridine orange (0.01%), washed with citrate buffer (pH 4) and filtered onto black 0.2 μm micrometer poresize polycarbonate filters (Nucleopore). The filters are mounted on microscopic slides in Cargille immersion oil and viewed at 1000x magnification (Zeiss Axioscope20, filter system BP450-490/FT510/LP520, oil immersion objective Plan-Neoflar 100). At least 200 cells per sample were counted.
5. Phospholipids: Phospholipids were extracted from the sediments and analysed as described in: Boetius, A., Lochte, K. (1994) Regulation of microbial enzymatic degradation of organic matter in deep-sea sediments. Mar.Ecol.Prog.Ser. 104, 299-307.
6. Hydrolysis rate of fluorescein diacetate: The rate of hydrolysis of fluorescein diacetate was determined in the sediment samples as described in: Meyer-Reil,L.-A., Köster, M. (1992) Microbial life in pelagic sediments: the impact of environmental parameters on enzymatic degradation of organic material. Mar.Ecol.Prog.Ser. 81, 65-72.

Pore water data are given in the file **Bentpore.xls**

Variables

- A) Station, station numbers following the ships protocol
- B) AWI, AWI core number
- C) Sediment layer, mean depth of sediment horizon sampled (cm)
- D) Concentration of nitrite in porewater (μM)
- E) Concentration of nitrate in porewater (μM)
- F) Concentration of ammonium in porewater (μM)
- G) Concentration of phosphate in porewater (μM)
- H) Concentration of reactive silicate in porewater (μM)

I) Flux of oxygen into the sediment (mmol/m² d)

Variables C)-I) provided by

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Methods (Ola Holby)

C) Sediment layer: Sediment cores were segmented into layers from 0-0.5, 0.5-1, 1-2, 2-3, 3-5, 5-7 and 7-10 cm. Below 10 cm the cores were segmented into 5 cm layers. The sediment layer depth gives the mean depth of the sample.

D)-H) The porewater concentrations of NO₂, NO₃, NH₄, PO₄ and Si, were analysed directly on board with an auto analyser according to Grasshoff et al. (Methods of Seawater Analysis, Verlag Chemie, Weinheim, 419 pp, 1983). No precaution was taken to avoid contact with air.

I) The flux of oxygen into the sediment was calculated with Fick's first law, using oxygen profiles obtained in the ship's refrigerated lab with home-built Clark style electrodes (Revbsch, N. P., In situ measurements of oxygen profiles of sediments by use of oxygen microelectrodes. in *Polarographic Oxygen Sensors: Aquatic and Physiological Applications*, edited by E. Gnaiger, and H. Forstner, pp. 265-273, Springer, 1983)

Further pore water data (alkalinity and pH) as well as data of porosity and sediment composition (Th-234 excess activity, organic carbon and biogenic silica content) and fluxes between sediment and overlying water are available upon request.

Metals concentration in sediments

Bettina Löscher (NIOZ)
BENTMETA.XLS

The particulate matter samples on 142 μm filters were subjected to a sequential chemical leaching treatment in the clean laboratory. They were immersed in 4.5 M Q-acetic acid for 4 h at room temperature, to dissolve adsorbed cations, carbonate phases and reactive oxyhydroxides (LANDING and BRULAND, 1980; 1987). This was followed by a digestion in 2 M Q-HCl/1 M Q-HNO₃ for again 4 h at room temperature to dissolve the more resistant Fe (III) oxyhydroxides (LEWIS and LANDING, 1991). The residual refractory material was taken in clean digestion vessels and totally digested with 3 ml Q-HCl, 1 ml Q-HNO₃ and 1 ml ultra clean HF. After digestion in a microwave oven they were diluted with 5 ml saturated H₃BO₃ to neutralise the strong acid HF (Merck). The last digestion step was tested for total destruction with the reference material calcareous loam (BCR No. 141) and light sandy soil (BCR No. 142) for the metals Cu and Ni. The obtained values agreed with the certified values within the 95% confidence interval. The blanks of Fe ranged between 0.43 and 5.67 pM, and between 0.07 and 1.07 nM for the acetic acid leaching step and the total destruction step, respectively. The blanks for the second leaching step were smaller than 0.01 nM. The detection limits, based on three times the standard deviation of the blanks, ranged between 1.57 and 3.15 pM, 0.6 and 7.8 pM, and 20 pM and 0.88 nM for the acetic acid leaching step, the second leaching step and the total destruction, respectively.

For the total particulate Al data, the seawater samples were collected independently by F. Dehairs in the upper 600 m using an all-Teflon coated CTD/Rosette frame with NOEX samplers. Typical depths were 10, 50, 100, 150, 200, 250, 300, 350, 425, 500 and 600 m. The seawater was transferred to 30-l acrylic (perspex) filtration units for filtration on Nuclepore membranes (47 mm, 0.4 µm porosity) using pressure of filtered air. In general between 5 and 24 litres seawater were filtered per sample. After filtration, membranes were dried at 50°C and stored frozen in Millipore petri dishes until later analysis. At every station one blank membrane was dried and stored as done for the sample membranes. In the home laboratory filter samples were mineralised using a lithium metaborate (LiBO_2 ; Suprapure, Johnson & Matthey) fusion technique described in detail in DE HAIRS et al. (1990, 1991). Prior to the fusion of the samples in platinum crucibles at 1100°C, the polycarbonate matrix of the membrane filters was gently combusted at 400°C. After fusion the samples were redissolved in hot (80°C) HNO_3 (Merck, Suprapure) under constant stirring. Final sample solution (10 ml) was 8 % in HNO_3 and 5 % in LiBO_2 . Al was analysed by simultaneous inductively coupled plasma optical emission spectrometry (Jobin-Yvon 48). Standards were prepared in a similar $\text{HNO}_3/\text{LiBO}_2$ matrix as the samples.

Appendix: All variables present in ROSETTE.XLS listed in the following table.

| Variables | Unit | Availabi lity after ... | INSTIT | INVESTIGATOR | Description | JGOFS |
|-----------------------|------------------|-------------------------------|-------------|--------------------------|---|-------|
| | | Months | | | | |
| Station | Identification | | NIOZ | J. Rommets | | |
| Cast | Identification | | NIOZ | J. Rommets | | |
| Bottle | Identification | | NIOZ | J. Rommets | | |
| Depth (Nominal) | m | | NIOZ | J. Rommets | | |
| CTD.press | dbar | | NIOZ | S. Ober | CTD pressure | 2 |
| CTD.temp | deg. C | | NIOZ | S. Ober | CTD temperature | 2 |
| CTD.sal | no dimension | | NIOZ | S. Ober | CTD Salinity (PSU, dimensionless) | 2 |
| CTD.O2.sens | cm3.dm-3 | | NIOZ | S. Ober | CTD Oxygen sensor | 2 |
| CTD.Fluor | ug chloroph.dm-3 | | NIOZ | S. Ober | CTD Fluorescence | 2 |
| CTD.Trans | % | | NIOZ | S. Ober | CTD Transmissometer | 2 |
| 15NH4.Mineralisation | nmol.dm-3.d-1 | 8 | VUB | F. Dehairs | 15N Ammonia mineralization rate | 15 |
| 15NH4.Uptake | nmol.dm-3.d-1 | 6 | VUB | F. Dehairs | 15N Ammonia uptake rate | 15 |
| 15NO2.Uptake | nmol.dm-3.d-1 | 6 | VUB | F. Dehairs | 15N Nitrite uptake rate | 15 |
| 15NO3.Uptake | nmol.dm-3.d-1 | 6/12 | SFB313 | M. Wunsch/N. Koeve | 15N Nitrate uptake rate | 15 |
| 19-but | ng.dm-3 | | SFB313 | I. Peeken | 19'-butanoyloxyfucoxanthin | 9 |
| 19-hex | ng.dm-3 | | SFB313 | I. Peeken | 19'-hexanoyloxyfucoxanthin | 9 |
| %PPCflag | % | | AWI | Scharek | % Phytoplankton Carbon flagellates | 12 |
| %PPCidia | % | | AWI | Scharek | % Phytoplankton Carbon sea-ice diatoms | 12 |
| %PPCpdia | % | | AWI | Scharek | % Phytoplankton Carbon pelagic diatoms | 12 |
| %PPCtdia | % | | AWI | Scharek | % Phytoplankton Carbon total diatoms | 12 |
| Al Hac | pmol.dm-3 | | NIOZ | B. Loscher | particulate aluminium, soluble in Hac | 25 |
| Al HCl | pmol.dm-3 | | NIOZ | B. Loscher | particulate aluminium, soluble in HCl | 25 |
| Al ref | nmol.dm-3 | | NIOZ | B. Loscher | particulate aluminium, digested HCl/HNO3/HF | 25 |
| Alk.A | μeq.kg-1 | | NIOZ | J. Rommets | Alkalinity | 6 |
| allox | ng.dm-3 | | SFB313 | I. Peeken | Alloxanthin | 9 |
| AOU | μmol.kg-1 | | NIOZ | M.W. Manuels | Apparent Oxygen Utilisation | 3 |
| Auto.Flag.BM | μg C.dm-3 | 0/2 | ULB | S. Becquevort | Autotrophic Flagellates, Biomass | 12 |
| Auto.Flag.CellNum | cells.dm-3 | | ULB | S. Becquevort | Autotrophic Flagellates, Cell number | 12 |
| Ba.UptakeRT | pmol.dm-3.d-1 | 6 | VUB | F. Dehairs | 135Ba uptake rate | 27 |
| Bact.BM.AO | ng C.dm-3 | | IFM | A. Weber | Bacteria Biomass (by Acridine orange) | 10 |
| Bact.BM.DAPI | μg C.dm-3 | | ULB | S. Becquevort | Bacteria biomass (by D.A.P.I. staining) | 10 |
| Bact.CellNum.AO | cells.cm-3 | | IFM | A. Weber | Bacteria cell number (by Acridine orange) | 10 |
| Bact.CellNum.DAPI | cells.dm-3 | | ULB | S. Becquevort | Bacteria cell number (by D.A.P.I. staining) | 10 |
| Bact.LEU | pmol.dm-3.d-1 | | AWI/M BL | K. Lochte/P. Bjornsen | Leucine incorporation | 10 |
| Bact.SHD.BM | μg C.dm-3 | 0 | MBL | P. Bjornsen | Small Heterotrophic Dinoflagellates Biomass | 10 |
| Bact.SHD.CellNum | cells.cm-3 | 0 | MBL | P. Bjornsen | Small Heterotrophic Dinoflagellates cell number | 10 |
| Bact.TTI | pmol.dm-3.d-1 | | MBL/A WI | P. Bjornsen/K. Lochte | Thymidine incorporation | 10 |
| Biog.Si.BSi | μmol.dm-3 | 6 | IEM | B. Queguiner | Biogenic Silica Biomass | 24 |
| Biog.Si.Chla | μg Chla.dm-3 | | IEM | B. Queguiner | Chlorophyll a | 9 |
| Biog.Si.Phae | μg .phaeo.dm-3 | | IEM | B. Queguiner | Phaeophytin | 9 |
| Biog.Si.POC | μmol.dm-3 | | IEM | B. Queguiner | POC | 7 |
| Biog.Si.PON | μmol.dm-3 | | IEM | B. Queguiner | PON | 7 |
| Biog.Si.PP | μg C.dm-3.d-1 | | IEM | B. Queguiner | Primary production (deck incubation) | 13 |
| Biog.Si.PSi | μmol.dm-3.d-1 | 12 | IEM | B. Queguiner | Biogenic Silica Production | 24 |
| Biog.Si.Silicate | μmol.dm-3 | | IEM | B. Queguiner | Silicate | 24 |
| Cd dis | pmol.dm-3 | | NIOZ | B. Loscher | Dissolved cadmium | 25 |
| Cd Hac | pmol.dm-3 | | NIOZ | B. Loscher | Particulate cadmium, soluble in Hac | 25 |
| Cd HCl | pmol.dm-3 | | NIOZ | B. Loscher | Particulate cadmium, soluble in HCl | 25 |
| Cd ref | pmol.dm-3 | | NIOZ | B. Loscher | Particulate cadmium, digested HCl/HNO3/HF | 25 |
| Cd tot | pmol.dm-3 | | NIOZ | B. Loscher | Total cadmium | 25 |
| Chaet.bulb/dich | cells.dm-3 | | AWI | Scharek | Chaetoceros bulbosum/dichaeta | 12 |
| Cell.Const.CarbHydr.R | μg C.dm-3 | 6 | ULB | S. Mathot | Cell constituents, Carbohydrates, reserve | 13 |
| ES | | | | | | |

| | | | | | | |
|-----------------------|-----------------------------------|--------|--------|---------------------------|--|----|
| Cell.Const.CarbHydr.T | $\mu\text{g C}.\text{dm}^{-3}$ | 6 | ULB | S. Mathot | Cell constituents, Carbohydrates, total | 13 |
| OT | | | | | | |
| Cell.Const.Lipids | $\mu\text{g C}.\text{dm}^{-3}$ | 6 | ULB | S. Mathot | Cell constituents, Lipids | 13 |
| Cell.Const.Proteins | $\mu\text{g C}.\text{dm}^{-3}$ | 6 | ULB | S. Mathot | Cell constituents, Proteins | 13 |
| chl a | $\mu\text{g}.\text{dm}^{-3}$ | | SFB313 | I. Peeken | Chlorophyll a | 9 |
| chl a/allo | $\mu\text{g}.\text{dm}^{-3}$ | | SFB313 | I. Peeken | Chlorophyll a allomer | 9 |
| chl a/epi | $\mu\text{g}.\text{dm}^{-3}$ | | SFB313 | I. Peeken | Chlorophyll a epimer | 9 |
| chl b | $\text{ng}.\text{dm}^{-3}$ | | SFB313 | I. Peeken | Chlorophyll b | 9 |
| chl c1+c2 | $\text{ng}.\text{dm}^{-3}$ | | SFB313 | I. Peeken | Chlorophyll c1+c2 | 9 |
| chl c3 | $\text{ng}.\text{dm}^{-3}$ | | SFB313 | I. Peeken | Chlorophyll c3 | 9 |
| chl lida | $\text{ng}.\text{dm}^{-3}$ | | SFB313 | I. Peeken | Chlorophilide a | 9 |
| Chlorophyll | $\mu\text{g Chla}.\text{dm}^{-3}$ | | AWI | U. Bathmann | Chlorophyll a | 9 |
| Coccoli | $\text{cells}.\text{dm}^{-3}$ | | AWI | Scharek | Coccolithophorideae | 12 |
| Cor.crioph | $\text{cells}.\text{dm}^{-3}$ | | AWI | Scharek | Corethron criophilum | 12 |
| Cor.crioph e | $\text{cells}.\text{dm}^{-3}$ | | AWI | Scharek | Corethron criophilum, empty | 12 |
| Cor.c.f.in | $\text{cells}.\text{dm}^{-3}$ | | AWI | Scharek | Corethron criophilum forma inerme | 12 |
| Cor.c.f.in e | $\text{cells}.\text{dm}^{-3}$ | | AWI | Scharek | Corethron criophilum forma inerme, empty | 12 |
| Cu dis | $\text{nmol}.\text{dm}^{-3}$ | | NIOZ | B. Loscher | Dissolved copper | 25 |
| Cu Hac | $\text{pmol}.\text{dm}^{-3}$ | | NIOZ | B. Loscher | Particulate copper, soluble in Hac | 25 |
| Cu HCl | $\text{pmol}.\text{dm}^{-3}$ | | NIOZ | B. Loscher | Particulate copper, soluble in HCl | 25 |
| Cu ref | $\text{pmol}.\text{dm}^{-3}$ | | NIOZ | B. Loscher | Particulate copper, digested HCl/HNO3/HF | 25 |
| Cu tot | $\text{nmol}.\text{dm}^{-3}$ | | NIOZ | B. Loscher | Total copper | 25 |
| Cyano | $\text{cells}.\text{dm}^{-3}$ | | AWI | Scharek | Cyano's | 12 |
| Density | $\text{kg}.\text{m}^{-3}$ | | NIOZ | S. Ober | density | 2 |
| Density20 | $\text{kg}.\text{dm}^{-3}$ | | NIOZ | S. Ober | density at 20 C | 2 |
| diadino | $\text{ng}.\text{dm}^{-3}$ | | SFB313 | I. Peeken | Diadinoxanthin | 9 |
| diat t e | $\text{cells}.\text{dm}^{-3}$ | | AWI | Scharek | numbers of total empty diatoms | 12 |
| diat t f | $\text{cells}.\text{dm}^{-3}$ | | AWI | Scharek | numbers of total full diatoms | 12 |
| Diatoms | % | '12/24 | AWI | R. Crawford | % Composition of diatom flora by species | 12 |
| Dinoflag | $\mu\text{g C}.\text{dm}^{-3}$ | 12 | AWI | C. Klaas | Dinoflagellates | 12 |
| diss.Ba | $\text{nmol}.\text{dm}^{-3}$ | | VUB | F. Dehairs | Dissolved Barium | 28 |
| DMSP.Chla | $\mu\text{g Chla}.\text{dm}^{-3}$ | | FBB | B. Bolt/D. Meyerdierks | Chlorophyll a | 27 |
| DMSP.DMSP | $\text{nmol}.\text{dm}^{-3}$ | | FBB | B. Bolt/D. Meyerdierks | DMSP | 27 |
| DOC | $\mu\text{mol C}.\text{dm}^{-3}$ | | SFB313 | A. Antia/P. Kahler | Dissolved Organic Carbon | 8 |
| DON | $\mu\text{mol N}.\text{dm}^{-3}$ | | SFB313 | A. Antia/P. Kahler | Dissolved Organic Nitrogen | 8 |
| F ker | $\text{cells}.\text{dm}^{-3}$ | | AWI | Scharek | Fragilariopsis kerguelensis | 12 |
| F ker e | $\text{cells}.\text{dm}^{-3}$ | | AWI | Scharek | Fragilariopsis kerguelensis, empty | 12 |
| Fe dis | $\text{nmol}.\text{dm}^{-3}$ | | NIOZ | B. Loscher | Dissolved iron | 25 |
| Fe Hac | $\text{pmol}.\text{dm}^{-3}$ | | NIOZ | B. Loscher | Particulate iron, soluble in Hac | 25 |
| Fe HCl | $\text{nmol}.\text{dm}^{-3}$ | | NIOZ | B. Loscher | Particulate iron, soluble in HCl | 25 |
| Fe ref | $\text{nmol}.\text{dm}^{-3}$ | | NIOZ | B. Loscher | Particulate iron, digested HCl/HNO3/HF | 25 |
| Fe tot | $\text{nmol}.\text{dm}^{-3}$ | | NIOZ | B. Loscher | Total iron | 25 |
| fuco | $\text{ng}.\text{dm}^{-3}$ | | SFB313 | I. Peeken | Fucoxanthin | 9 |
| isp.CO2 | $\mu\text{mol}.\text{kg}^{-1}$ | | NIOZ | J. Rommets | H2CO3 in situ T and p | 6 |
| isp.CO32 | $\mu\text{mol}.\text{kg}^{-1}$ | | NIOZ | J. Rommets | CO3-- in situ T and p | 6 |
| isp.HCO3 | $\mu\text{mol}.\text{kg}^{-1}$ | | NIOZ | J. Rommets | HCO3- in situ T and p | 6 |
| isp.pCO2 | μatm | | NIOZ | J. Rommets | pCO2 in situ T and p | 6 |
| isp.pH | | | NIOZ | J. Rommets | pH in situ T and p | 6 |
| kg.Ammonium | $\mu\text{mol}.\text{kg}^{-1}$ | | NIOZ | J. Poncin | Ammonium per kg | 4 |
| kg.Nitrate | $\mu\text{mol}.\text{kg}^{-1}$ | | NIOZ | K. Bakker/P. Fritsche | Nitrate per kg | 4 |
| kg.Nitrite | $\mu\text{mol}.\text{kg}^{-1}$ | | NIOZ | K. Bakker/P. Fritsche | Nitrite per kg | 4 |
| kg.Phosphate | $\mu\text{mol}.\text{kg}^{-1}$ | | NIOZ | K. Bakker/P. Fritsche | Phosphate per kg | 4 |
| kg.Silicate | $\mu\text{mol}.\text{kg}^{-1}$ | | NIOZ | K. Bakker/P. Fritsche | Silicate per kg | 4 |
| lut/zeax | $\text{ng}.\text{dm}^{-3}$ | | SFB313 | I. Peeken | Lutein + Zeaxanthin | 9 |
| Mesdi | $\text{cells}.\text{dm}^{-3}$ | | AWI | Scharek | Mesodinium | 12 |
| Microzoo | individuals cm^{-3} | 24 | NIOZ | B. Kuipers | Microzooplankton | 12 |
| Mn Hac | $\text{pmol}.\text{dm}^{-3}$ | | NIOZ | B. Loscher | Particulate manganese, soluble in Hac | 25 |

| | | | | | | |
|---------------------|---------------|--------------|--------------------------|---|------------------------------|----|
| Mn HCl | pmol.dm-3 | NIOZ | B. Loscher | Particulate manganese, soluble in HCl | 25 | |
| Mn ref | pmol.dm-3 | NIOZ | B. Loscher | Particulate manganese, digested HCl/HNO3/HF | 25 | |
| muPhyt.BM | µg C.dm-3 | 12 | ULB | microphytoplankton, Biomass | 12 | |
| muPhyt.CellNum | cells.dm-3 | 12 | ULB | microphytoplankton, Cell number | 12 | |
| muPhyt.Prot.CellNum | cells.dm-3 | 6 | AWI | Scharek,Crawford, Protists species composition, cell number Klaas | 12 | |
| muPhyt.Prot.Phyto | ng C.dm-3 | 6 | AWI | Scharek,Crawford, Protists species composition, phytoplankton Klaas Carbon | 12 | |
| muPhyt.Protists | ng C.dm-3 | 6 | AWI | Scharek,Crawford, Protists species composition, Protists Carbon Klaas | 12 | |
| muPhytProtozoa | ng C.dm-3 | 6 | AWI | Scharek,Crawford, Protists species composition, Protozoa Carbon Klaas | 12 | |
| N prol | cells.dm-3 | AWI | Scharek | Nitzschia prolongatoides, cell number | 12 | |
| N prol e | cells.dm-3 | AWI | Scharek | Nitzschia prolongatoides empty, cell number | 12 | |
| NanoflaC | ng.dm-3 | AWI | Scharek | Phytoplankton Carbon ot total nanoflagellates | 12 | |
| Nanoflag | cells.dm-3 | AWI | Scharek | number of total nanoflagellates | 12 | |
| NanoZoo.BM | µg C.dm-3 | 2 | ULB | S. Becquevort | Nanozooplankton, Biomass | 12 |
| NanoZoo.CellNum | cells.dm-3 | | ULB | S. Becquevort | Nanozooplankton, Cell number | 12 |
| NanoZoo.Graz | µg C.dm-3.h-1 | 2 | ULB | S. Becquevort | Nanozooplankton grazing rate | 18 |
| NH4 | µmol.dm-3 | IEM | J. Poncin | Ammonia | 4 | |
| Ni dis | nml.dm-3 | NIOZ | B. Loscher | Dissolved nickel | 25 | |
| Ni tot | nmol.dm-3 | NIOZ | B. Loscher | Total nickel | 25 | |
| Ni.turg/Lin.hei. | cells.dm-3 | AWI | Scharek | Nitzschia turgidula/Lineola heimii | 12 | |
| Nitrate | µmol.dm-3 | NIOZ/IF M | K. Bakker/P. Fritsche | Nutrient | 4 | |
| Nitrite | µmol.dm-3 | NIOZ/IF M | K. Bakker/P. Fritsche | Nutrient | 4 | |
| Nitz clos | cells.dm-3 | AWI | Scharek | Nitzschia closterium | 12 | |
| Nitz clos e | cells.dm-3 | AWI | Scharek | Nitzschia closterium, empty | 12 | |
| O2.proc | 0/0 | NIOZ | R. Manuels | Oxygen saturation in procent | 3 | |
| O2.sat | µmol.kg-1 | NIOZ | R. Manuels | Oxygen saturation | 3 | |
| Oxy | µmol.dm-3 | NIOZ | R. Manuels | Oxygen mean | 3 | |
| Oxy.kg | µmol.kg-1 | NIOZ | R. Manuels | Oxygen per kg | 3 | |
| Oxy1 | µmol.dm-3 | NIOZ | R. Manuels | Oxygen | 3 | |
| Oxy2 | µmol.dm-3 | NIOZ | R. Manuels | Oxygen | 3 | |
| OxyT | deg. C | NIOZ | R. Manuels | Closing temperature of oxygen bottles | 3 | |
| p1.CO2 | µmol.kg-1 | NIOZ | J. Rommets | H2CO3 in situ T and p=1 | 6 | |
| p1.CO32 | µmol.kg-1 | NIOZ | J. Rommets | CO3-- in situ T and p=1 | 6 | |
| p1.HCO3 | µmol.kg-1 | NIOZ | J. Rommets | HCO3- in situ T and p=1 | 6 | |
| p1.pCO2 | µatm | NIOZ | J. Rommets | pCO2 in situ T and p=1 | 6 | |
| p1.pH | | NIOZ | J. Rommets | pH in situ T and p=1 | 6 | |
| PAR | µE.m-2.s-1 | | | Mean incident PAR | | |
| Part.Ba.13C | 0/0 vs PDB | VUB | F. Dehairs | Particulate organic delta 13C vs PDB | 29 | |
| Part.Ba.Part.Al | nmol.dm-3 | VUB | F. Dehairs | Particulate Aluminium | 28 | |
| Part.Ba.Part.Ba | pmol.dm-3 | VUB | F. Dehairs | Particulate Barium | 28 | |
| Part.Ba.Part.Ca | nmol.dm-3 | VUB | F. Dehairs | Particulate Calcium | 28 | |
| Part.Ba.Part.Si | µmol.dm-3 | VUB | F. Dehairs | Particulate Silicon | 28 | |
| Part.Ba.Part.Sr | pmol.dm-3 | VUB | F. Dehairs | Particulate Strontium | 28 | |
| pCO2.GC-cm | µatm | NIOZ | D. Bakker | Partial pressure of CO2, t in situ, P=1 | 6 | |
| pCO2.GC-tp | µatm | NIOZ | D. Bakker | Partial pressure of CO2, t in situ, P in situ | 6 | |
| peridin | ng.dm-3 | SFB313 | I. Peeken | Peridinin | 9 | |
| phorba | ng.dm-3 | SFB313 | I. Peeken | Phaeophorbide a | 9 | |
| Phosphate | µmol.dm-3 | NIOZ/IF M | K. Bakker/P. Fritsche | Nutrient | 4 | |
| phphyta | ng.dm-3 | SFB313 | I. Peeken | Phaeophytin a | 9 | |
| Phyto.GrowthRT | d-1 | ULB | S. Mathot | Phytoplankton Growth rate from model | 13 | |
| Pigments | ng.dm-3 | SFB313 | I. Peeken | Pigments, HPLC | 9 | |
| POC | µmol C.dm-3 | AWI | U. Bathmann | Particulate Organic Carbon | 7 | |
| PON | µmol N.dm-3 | AWI | U. Bathmann | Particulate Organic Nitrogen | 7 | |
| Pot.Temp | deg. C | NIOZ | S. Ober | Potential temperature | 2 | |
| PPC tot | ng.dm-3 | AWI | Scharek | Total phytoplankton Carbon | 12 | |
| PPCflag | ng.dm-3 | AWI | Scharek | Phytoplankton Carbon flagellates | 12 | |
| PPCcidia | ng.dm-3 | AWI | Scharek | Phytoplankton Carbon sea-ice diatoms | 12 | |

| | | | | | | |
|----------------|------------------|----|-----------|------------------------|---|----|
| PPCpdia | ng.dm-3 | | AWI | Scharek | Phytoplankton Carbon pelagic diatoms | 12 |
| PP.AssimRT | µg C.µg Chla.h-1 | 0 | ULB | S. Mathot | Photosynthetic assimilation rate | 13 |
| PP.PrimProd | mg C.m-2.d-1 | | ULB | S. Mathot/B. Queguiner | Primary production (deck incubation) | 13 |
| PPML.ANF<10 | cells.cm-3 | | IFM | F. Jochem | Autotroph. Nanoflagellates <10 µm cell number | 12 |
| PPML.ANF10-20 | cells.cm-3 | | IFM | F. Jochem | Autotroph. Nanoflagellates 10-20 µm cell number | 12 |
| PPML.ANP.C | cells.cm-3 | | IFM | A. Detmer | Autotrophic Nanoplankton cell number by cytometry | 12 |
| PPML.ANP.M | cells.cm-3 | | IFM | A. Detmer | Autotrophic Nanoplankton cell number by microscopy | 12 |
| PPML.APP | cells.cm-3 | | IFM | F. Jochem | Autotroph. Pico Plankton | 12 |
| PPML.APP.M | cells.cm-3 | | IFM | A. Detmer | Autotrophic Picoplankton cell number by microscopy | 12 |
| PPML.CENTR | cells.cm-3 | | IFM | F. Jochem | Centrics cell number | 12 |
| PPML.CRYP | cells.cm-3 | | IFM | F. Jochem | Cryptos cell number | 12 |
| PPML.DIATOMS | cells.cm-3 | | IFM | F. Jochem | Diatoms cell number | 12 |
| PPML.HNF<10 | cells.cm-3 | | IFM | F. Jochem | Heterotr. Nanoflagellates <10 µm cell number | 12 |
| PPML.HNF10-20 | cells.cm-3 | | IFM | F. Jochem | Heterotr. Nanoflagellates 10-20 µm cell number | 12 |
| PPML.HPF | | | | | | |
| PPML.HPP | cells.cm-3 | | IFM | F. Jochem | Heterotr. PicoPlankton(<2 µm) cell number | 12 |
| PPML.NITZ | cells.cm-3 | | IFM | F. Jochem | Nitzschia cell number | 12 |
| PPML.PP<2 | µg C.dm-3.d-1 | | IFM | F. Jochem | Primary production in size class < 2 um = pico | 13 |
| PPML.PP>20 | µg C.dm-3.d-1 | | IFM | F. Jochem | Primary production in size class > 20 µm = micro | 13 |
| PPML.PP2-5 | µg C.dm-3.d-1 | | IFM | F. Jochem | Primary production in size class 2-5 µm = small nano | 13 |
| PPML.PP5-20 | µg C.dm-3.d-1 | | IFM | F. Jochem | Primary production in size class 5-20 µm = large nano | 13 |
| PPML.SYN | cells.cm-3 | | IFM | F. Jochem | Synechococcus abundance (cell number) | 16 |
| PPML.TOT.PP | µg C.dm-3.d-1 | | IFM | F. Jochem | Total particulate Primary production (C_14) | 13 |
| PPML.UNID.C | cells.cm-3 | | IFM | A. Detmer | Unidentfied cells/particle number by cytometry | 12 |
| prasinox | ng.dm-3 | | SFB313 | I. Peeken | Prasinoxanthin | 9 |
| pyrophorb | ng.dm-3 | | SFB313 | I. Peeken | Pyrophaeophorbide a | 9 |
| pyrphphyta | ng.dm-3 | | SFB313 | I. Peeken | Pyrophaeophytin a | 9 |
| Rare.Elem | nmol.dm-3 | 12 | NIOZ | B. Loscher | Rare Earth Elements | 25 |
| Salinity | no dimension | | NIOZ | C. Veth | Practical Salinity Unit (dimensionless) | 2 |
| SigmaT | | | NIOZ | S. Ober | at in situ temp | 2 |
| SigmaTheta | kg.m-3 | | NIOZ | S. Ober | at potential temp | 2 |
| Silicate | µmol.dm-3 | | NIOZ/IF M | K. Bakker/P. Fritsche | Nutrient | 4 |
| TCO2.C | µmol.kg-1 | | NIOZ | M. Stoll | Total Carbon Dioxide | 6 |
| Thal nitz | cells.dm-3 | | AWI | Scharek | Thalassionema nitzschioides | 12 |
| Thal nitz e | cells.dm-3 | | AWI | Scharek | Thalassionema nitzschioides, empty | 12 |
| Tha spp | cells.dm-3 | | AWI | Scharek | Thalassionema others | 12 |
| Trace.Met | nmol.dm-3 | | NIOZ | B. Loscher | Trace Elements | 25 |
| Var2.CG | µg Chla.dm-3.d-1 | | SFB313 | S. Reitmeier | Chla grazed | 18 |
| Var2.ChlADoubl | d-1 | | SFB313 | S. Reitmeier | Chla Doublings | 18 |
| Var2.g | no dimension | | SFB313 | S. Reitmeier | g= MicroZoo grazing coefficient | 18 |
| Var2.InitChla | µg Chla.dm-3 | | SFB313 | S. Reitmeier | Initial Chla concentration in 100% FUW | 18 |
| Var2.k | no dimension | | SFB313 | S. Reitmeier | k= Phytoplankton growth coefficient | 18 |
| Var2.PICG | d-1 | | SFB313 | S. Reitmeier | Percent Initial Chla Concentration Grazed | 18 |
| Var2.Regr | no dimension | | SFB313 | S. Reitmeier | Regression Coefficient | 18 |
| Var3.Pigments | ng.dm-3 | 12 | NIOZ | M. van Leeuwe | Pigments | 9 |
| Var4.Chla<20um | µg Chla.dm-3 | | AWI | U. Bathmann | Chlorophyll a fractionated < 20 um | 9 |
| Var4.Chla<2um | µg Chla.dm-3 | | AWI | U. Bathmann | Chlorophyll a fractionated < 2 um | 9 |
| Var4.Chla<5um | µg Chla.dm-3 | | AWI | U. Bathmann | Chlorophyll a fractionated < 5 um | 9 |
| Zn dis | nmol.dm-3 | | NIOZ | B. Loscher | Dissolved zinc | 25 |
| Zn tot | nmol.dm-3 | | NIOZ | B. Loscher | Total zinc | 25 |

DATA POLICY STATEMENT.

The data contained in this CD-ROM have been produced jointly by the participants of the JGOFS expedition ANT X/6 and the data management staff of the Netherlands Institute for Sea Research (NIOZ). This database is freely available for the general use by the scientific community. Further updates of the ANT X/6 database will become accessible by electronic mail through ftp-servers at the Alfred Wegener Institute (<ftp://ftp.awi-bremerhaven.de/pub>). Queries about certain parts of the data can be addressed directly to the relevant scientist(s), for the overall CD-ROM contents to J. Rommets at NIOZ, and for the further updates to U. Bathmann at AWI, Germany. For this purpose a listing of names and addresses including internet identities is provided in the file STAFF.DOC.

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Rommets, J.W., M.H.C. Stoll, R.X. de Koster, T.F. de Bruin, H.J.W. de Baar, U.V. Bathmann and V. Smetacek (1997) Database of the JGOFS expedition ANT X/6 aboard RV 'Polarstern'. *Deep-Sea Research II*, **44** (1-2), and CD-ROM Appendix.

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Overview and structure of the MS ACCESS database

Preface

This text provides you with

- an overview of required hard and software
- a description of the database
- an explanation of the included example queries

Requirements.

For ACCESS for Windows 95:

PC 80486 or higher
MS Windows 95
MS ACCESS for Windows 95

For ACCESS version 1.1:

PC 80386 or higher
MS Windows 3.1 or higher
MS ACCESS 3.1

Data is also accessible by:

- MS WORD most versions
- MS EXCEL most versions

Description of the database

Data set.

CTD data and CTD sample data

Not included in the database are the following parameters:

| INVESTIGATOR | variable_id |
|------------------------|-----------------|
| B. Kuipers | Microzoo |
| B. Loscher | Rare.Elem |
| B. Queguiner | Biog.Si.BSi |
| B. Queguiner | Biog.Si.PSi |
| C. Klaas | Dinoflag |
| D. Bakker | pCO2.GC-tp |
| F. Dehairs | 15NH4.Uptake |
| F. Dehairs | 15NO2.Uptake |
| F. Dehairs | Ba.UptakeRT |
| F. Dehairs | 15NH4.Minerali |
| F. Dehairs | diss.Ba |
| M. van Leeuwe | Var3.Pigments |
| M. Wunsch/N. Koeve | 15NO3.Uptake |
| P. Bjornsen | Bact.SHD.BM |
| P. Bjornsen | Bact.SHD.Cell |
| R. Crawford | Diatoms |
| S. Becquevort | Auto.Flag.BM |
| S. Becquevort | NanoZoo.BM |
| S. Becquevort | NanoZoo.Graz |
| S. Mathot | muPhyt.BM |
| S. Mathot | Cell.Const.Lipi |
| S. Mathot | Cell.Const.Car |
| S. Mathot | Cell.Const.Car |
| S. Mathot | muPhyt.CellNu |
| S. Mathot | PP.AssimRT |
| S. Mathot | Cell.Const.Prot |
| Scharek,Crawford,Klaas | muPhyt.Prot.C |
| Scharek,Crawford,Klaas | muPhyt.Prot.P |
| Scharek,Crawford,Klaas | muPhyt.Protist |
| Scharek,Crawford,Klaas | muPhytProtoz |

Tables.

Parameter

contains the parameters that reside in the database.

- variable_id Identity field for the parameter, acronym of the parameter
- Unit The unit in which the parameter value is stored
- INSTITUTE The institute or organisation of the principal investigator/data owner
- INVESTIGATOR The principal investigator(s)
- Description Describes the parameter
- JGOFS JGOFS code
- Occurrences Number of occurrences of the parameter in the database

Primary key on variable_id

Indexes on -INSTITUTE
 -INVESTIGATOR

Cast

contains the metadata of the CTD casts

- | | |
|-------------------|---|
| • station_id | Identity field |
| • cast_id | Identity field |
| • date_start | Date of start of cast (GMT) |
| • date_end | Date of end of cast (GMT) |
| • time_start | Time of start of cast (GMT) |
| • time_end | Time of end of cast (GMT) |
| • latitude_start | Latitude at start of cast (“dd:mm.m”) |
| • longitude_start | Longitude at start of cast (“ddd:mm.m”) |
| • lat_dec_start | Latitude at start of cast (decimal number) |
| • lon_dec_start | Longitude at start of cast (decimal number) |
| • latitude_end | Latitude at end of cast (“dd:mm.m”) |
| • longitude_end | Longitude at end of cast (“ddd:mm.m”) |
| • lat_dec_end | Latitude at end of cast (decimal number) |
| • lon_dec_end | Longitude at end of cast (decimal number) |
| • depth_start | Echo depth at start of cast (m) |
| • depth_end | Echo depth at end of cast (m) |

Primary key on station_id, cast_id

Indexes on -date_start, time_start
 -lat_dec_start, lon_dec_start

Sample

contains the metadata of the bottles

this table can join the table Cast with the table Values in case of queries that want both measured data values and cast metadata.

- | | |
|--------------|--|
| • station_id | Identity field (see table Cast) |
| • cast_id | Identity field (see table Cast) |
| • sample_id | Identity field (see table Values) |
| • bottle_nr | bottle number |
| • CTD_pres | pressure measured by CTD in dbar (redundant: also resides in table Values) |

Primary key on sample_id

Values

contains the measured values

links to table Parameter through field ‘variable_id’

links to table Cast through field ‘sample_id’ (first 4 positions)

- sample_id Identity field (see table Sample)
composed out of station_id (3 positions) cast_id (1 position) and
BottleNumber (2 positions)
- variable_id Identity field (see table Parameter)
- value Measured value

Indexes on -sample_ID
 -variable_ID

Explanation of example queries.

The database contains some example queries.

Example All pressures

Provides an overview of all the bottles present in the database.

*Column ‘sample_id’ shows the bottle identification: the first three positions represents the station, the fourth position the cast and the last 2 positions the bottle number.
(875103= station 875, cast 1, bottlenumber 3)*

Column ‘CTD_pres’ (‘value’) shows the measured CTD pressure in dbar.

```
SELECT DISTINCTROW sample_id, value as CTD_pres  
FROM [VALUES]  
WHERE variable_id like "CTD.Pres*";
```

Example All parameters of station 945

selects all the parameters measured at all the casts of station 945.

*Column ‘sample_id’ identifies the station, the cast and the bottle number
Column ‘variable_id’ identifies the parameter
Column ‘value’ shows the measured value*

*Since the ‘sample_id’ is constructed out of station_id followed by successively cast_id and bottle_number (sample_id = station_id * 1000 + cast_id *100 + bottle_number) in this example we include all casts and bottles of station 945 by selecting all sample_id’s in between 945000 and 946000.*

```
SELECT DISTINCTROW VALUES.sample_id, VALUES.variable_id, VALUES.value  
FROM [VALUES]  
WHERE (((VALUES.sample_id)>945000)) and (((VALUES.sample_id)<946000));
```

Example **Poc1 and Poc2**

these two examples show how to extract two parameters from the data set derived from the same bottles. In this example we query for the parameter 'POC' and the related 'Depth'

'Poc1' queries for all the bottles that contain the parameter 'POC' and results in one column with the desired sample_id's (wich is station, cast, bottle number) and one column with the measured values.

```
SELECT sample_id, value as POC
FROM [VALUES]
WHERE variable_id = "POC";
```

You can easily limit the result of 'poc1' to one or several casts by specifying the casts in the WHERE clause. The station and cast are identified by 'sample_id' (sample_id= station_id * 1000 + cast_id * 100 + bottle_number). So the sample_id's of all the bottles of station 878 cast 1 are in between 878100 and 878200. Which would look like this:

```
SELECT sample_id, value as POC
FROM [VALUES]
WHERE (variable_id = "POC")
AND ((sample_id > 878100) AND (sample_id < 878200));
```

You can query like this for any parameter by substituting the variable_id in the WHERE clause with the desired variable_id and the label 'as POC' by a more appropriate one..

'Poc2' joins the result of 'poc1' with the table 'values' to add a third column with the Depth's of the same bottles.

```
SELECT DISTINCTROW    poc1.*,
                           VALUES.value AS Depth
FROM [VALUES]
INNER JOIN poc1 ON VALUES.sample_id = poc1.sample_id
WHERE      VALUES.variable_id = "Depth"
ORDER BY poc1.sample_id;
```

You can use these examples as a base to query more than two parameters as well.
To add a third parameter you

1. copy 'poc2'
2. edit it to query the results of 'poc2' and the third parameter from table Values

'Poc3' is an example of this and adds a column containing the values of the PON parameter:

```
SELECT DISTINCTROW      poc2.*,
                  VALUES.value AS PON
  FROM [VALUES]
 INNER JOIN poc2 ON VALUES.sample_id = poc2.sample_id
 WHERE      VALUES.variable_id = "PON"
 ORDER BY poc2.sample_id;
```

In this way you can expand the query with as many parameters as you want.

NOTE: YOU ONLY HAVE TO RUN THE LAST QUERY the preceding queries will be triggered by the last one.

A more complete query also retrieves the cast metadata from the table Cast together with the measured data.

Example **Full1 and Full2**

'Full1' is the more complex equivalent of 'poc1' and contains some metadata of the cast and the bottle, in this example the query is limited for all casts of stations 878 until 911:

```
SELECT DISTINCTROW    CAST.cast_id,  
                      SAMPLE.bottle_nr,  
                      SAMPLE.sample_id,  
                      CAST.latitude_start,  
                      CAST.longitude_start,  
                      CAST.station_id,  
                      SAMPLE.CTDpressure,  
                      VALUES.value as POC  
FROM      (CAST INNER JOIN SAMPLE ON (CAST.cast_id = SAMPLE.cast_id)  
          AND (CAST.station_id = SAMPLE.station_id))  
          INNER JOIN [VALUES] ON SAMPLE.sample_id = VALUES.sample_id  
WHERE     ((CAST.station_id >= 878) AND (CAST.station_id <= 911)  
          AND (VALUES.variable_id="POC"))  
ORDER BY CAST.cast_id, SAMPLE.bottle_nr;
```

'Full2' is identical to 'poc2' except that it accesses 'full1' in stead of 'poc1' and it expands the query with another parameter column (parameter Depth in this example).

```
SELECT DISTINCTROW    full1.*,  
                      VALUES.value AS Depth  
FROM [VALUES] INNER JOIN full1 ON VALUES.sample_id = full1.sample_id  
WHERE VALUES.variable_id = "Depth"  
ORDER BY full1.sample_id;
```

You can also extend this query with more columns in a way equivalent as explained in example 'poc3'

The CD-ROM Database of the JGOFS expedition ANT X/6 aboard RV ‘Polarstern’

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INTRODUCTION

The enclosed CD-ROM contains the actual database of measured variables as well as various background information on the expedition and the methods and other descriptions directly related to each reported variable, as well as a statement on data policy, citation and copyright. The CD-ROM was mastered in a format that can be read by both Macintosh and PC computers. It is organised in a hierarchical structure by folders containing both text files in MS-Word for Windows 2 format and datafiles in either Excel 4.0 or ACCESS format. Software with such formats is not included but available from Microsoft. In addition datafiles have also been converted to simple ASCII formats and placed on the CD-ROM as well.

CONTENTS OF THE FOLDERS

| <i>Description</i> | <i>File Name</i> |
|---|--|
| README | README.DOC |
| REGULAR JGOFS ANTX/6 FOLDERS | JGOFSX6 |
| <u>Background information</u> | GENERAL |
| Structure of the CD-ROM contents | README.DOC |
| Data policy statement | POLICY.DOC |
| Participating scientists (affiliations, phone, fax, internet) | STAFF.DOC |
| Participating institutes (postal addresses) | INSTIT.DOC |
| Listing JGOFS Core and other activities (with scientists) | CORE.DOC |
| Listing shipboard experiments (with scientists) | EXPS.DOC |
| Methods description | METHODS.DOC |
| <u>Stations Database</u> | STATDATA |
| Listing of stations (with deployment of gear) | STSLIST.XLS |
| Benthic observations | BENTIC |
| Methods benthic observations text | BENTIC.DOC |
| Benthic data | BENTBACT.XLS BENTMETA.XLS BENTPORE.XLS |
| CTD/Rosette sampling | CTDROS |
| CTD sensors | CTD |
| CTD sensors text | CTD.DOC |
| CTD sensors downcasts records of 229 CTD casts | |

| | |
|---|--------------|
| Rosette with 24 samplers | ROSETTE |
| Methods text | ROSETTE.DOC |
| Listing of measured variables (units, description) | VARIABL.XLS |
| Structure relational database for ACCESS | STRUCT.DOC |
| Data from 229 hydrocasts of 24 samplers at 123 stations (station, cast, bottle number) | ROSETTE.ACC |
| Trace Metals | METALS |
| Kevlar wire GoFlo sampling | KEVLARGF |
| Methods trace metals and biota | METALS.DOC |
| Kevlar wire/GoFlo metals, Ba and nutrients | METALS.XLS |
| Metal-Biota interactions | BIOMETAL |
| Methods Metal-Biota text | BIOMETAL.DOC |
| Incubations data | BIOMETAL.XLS |
| Net sampling results | NETS |
| Net collection text | NETS.DOC |
| Mesozooplankton, phytoplankton and Mesozoo grazing | NETS.XLS |
| Incubations primary productivity and 15N uptake | PRODUCT |
| Ammonia uptake rates | NH3PRPR |
| Ammonia uptake rates text | NH3PRPR.DOC |
| Ammonia uptake rates | NH3PRPR.XLS |
| Primary productivity | PRIMARY |
| Primary production methods text | PRIMARY.DOC |
| Primary production at stations | PRPROD.XLS |
| Size fractionated prim productivity | PRODINT.XLS |
| SIZEFRPP.XLS | |
| Natural Radioisotopes from Gerard samplers | RADIOISO |
| Methods radioisotopes text | RADIOISO.DOC |
| Radioisotopes data | RADIOISO.XLS |
| <u>Underway Database</u> | WAYDATA |
| Wind | WIND |
| Windtext | WIND.DOC |
| Wind velocities (INDAS) over 10 minute intervals | WIND10.XLS |
| Ice and Top Predators | ICEPRED |
| Icetext | ICE.DOC |
| Ice cover, chlorophyll, top predators, one value every 10 minutes | ICE10.XLS |
| Ice cover in JGOFS protocol format | ICEJGOFS.XLS |
| CO2 surface waters | CO2SURF |
| CO2 surface waters text | CO2SURF.DOC |
| CO2 and ancillary data, fluxes, etc. | |
| Excel files for every day | CO2S????.XLS |
| | CO2D????.XLS |

JGOFSASC DIRECTORY(Contents as above)

ELECTRONIC UPDATES

Further updates of the ANTX/6 database will become available by electronic mail through ftp-servers at the Alfred Wegener Institute (<ftp://ftp.awi-bremerhaven.de/pub>).

ENQUIRIES

All enquiries relating to the CD-ROM are to be made to Joop Rommets, NIOZ, (rommets@nioz.nl) and all questions related to the electronic updates are to be made to Ulrich Bathmann, AWI, (ubathmann@awi-bremerhaven.de).

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REFERENCES

Bathmann, U.V., V. Smetacek, H.J.W. de Baar, E. Fahrbach and G. Krause (1994). The expeditions ANTARKTIS X/6-8 of the Research Vessel "POLARSTERN" in 1992/1993. Berichte zur Polarforschung, 135:4-126.

ENCLOSED in BACKCOVER

CD-ROM containing Database of the JGOFS expedition ANTX/6 aboard RV 'Polarstern'