Cruise Report HE-425, 23. May – 07. June 2014

Chief Scientist: Sara Billerbeck, ICBM, University of Oldenburg

Aim

The aim of this cruise was to assess the abundance, diversity and physiological activity of various members of the *Roseobacter* clade in the water column during a late spring phytoplankton bloom in the northern or central North Sea.

Cruise track, stations, sampling and parameters studied.

As outlined in Fig. 1, the cruise track went from Bremerhaven to 58 °N and back south, the way north further west than the southward return. In total 47 stations were visited. Satellite images indicated several regions with pronounced phytoplankton blooms, in the southern and eastern North Sea near the German and Danish coast, in the Skagerrak and southwest of the Norwegian coast (Fig. 2). In the latter coccolithophores were abundant, the phytoplankton group of the major interest of this cruise. Therefore, two 24 hour-time series were investigated in this area (stations 21-29, 31-39) and one as a control outside the bloom closer to the Norwegian coast (stations 12-19).

Results

The phytoplankton in the entire study area was composed of mainly of diatoms and dinoflagellates, but coccolithophores were also present, mainly in the northern region. The measured chlorophyll *a* data verified the three areas of enhanced concentrations and thus of phytoplankton blooms, one southwest of the Norwegian coast, one west of Denmark and the southernmost one in the German Bight (Fig. 3). The zooplankton was always dominated by copepods but other taxonomic groups such as echinoderm larvae, appendicularians and chaetognaths were also present. Bacterial abundance in near surface waters varied from 0.4 to 6.0 x 10^6 ml^{-1} with highest numbers in the German Bight and enhanced numbers also in the other bloom areas (Fig. 4). Bacterial biomass production ranged from 90 to ~1000 ng protein l^{-1} h^{-1} with highest rates in the southern areas near the German and Danish coast (Fig. 5). The phytoplankton bloom area southwest of the Norwegian coast exhibited also enhanced rates, indicating that the bacterioplankton generally responded to the enhanced input of organic matter in the phytoplankton bloom areas. The data on the composition of the bacterial communities and the DOM are not yet available because these analyses need much more time.

Conclusions and outlook

The field and experimental work on shipboard was very successful and we were able to achieve the aims of this research cruise. The data on phytoplankton, chlorophyll, bacterial abundance and production indicate that the various water masses and phytoplankton blooms exhibited distinct differences with respect to the biological productivity and activity, being a promising feature to also expect such differences in the community composition of the bacterioplankton.

Acknowledgements:

We are most grateful to the captain and crew of RV Heincke for their excellent support on shipboard, to the Deutsche Forschungsgemeinschaft for financial support and to the responsible authorities of Denmark and Norway for giving us the permission to do research in the exclusive economic zones of their countries.

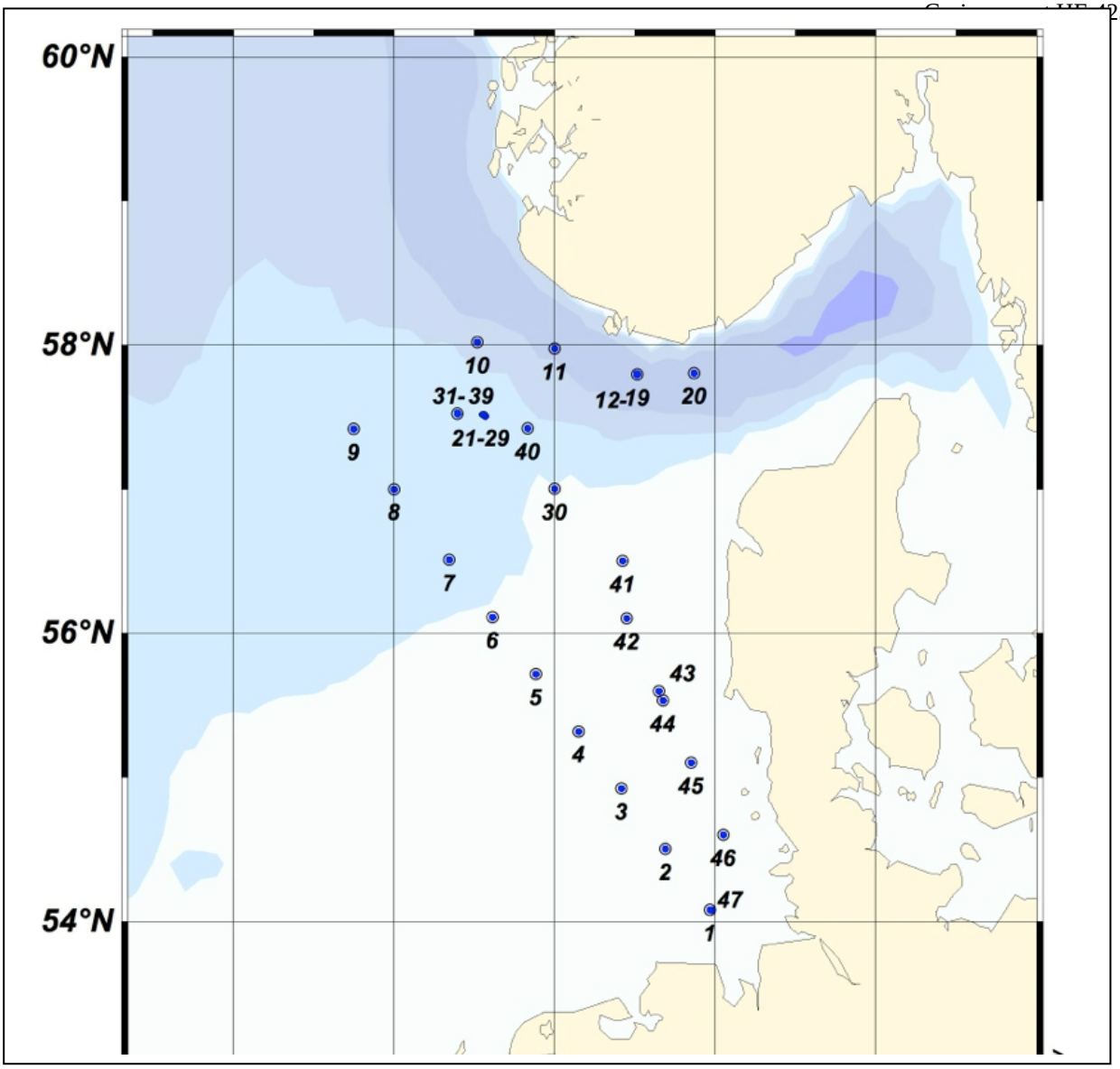

Fig. 1: Cruise track and stations of cruise HE-425. For exact location of the stations see Table 1.

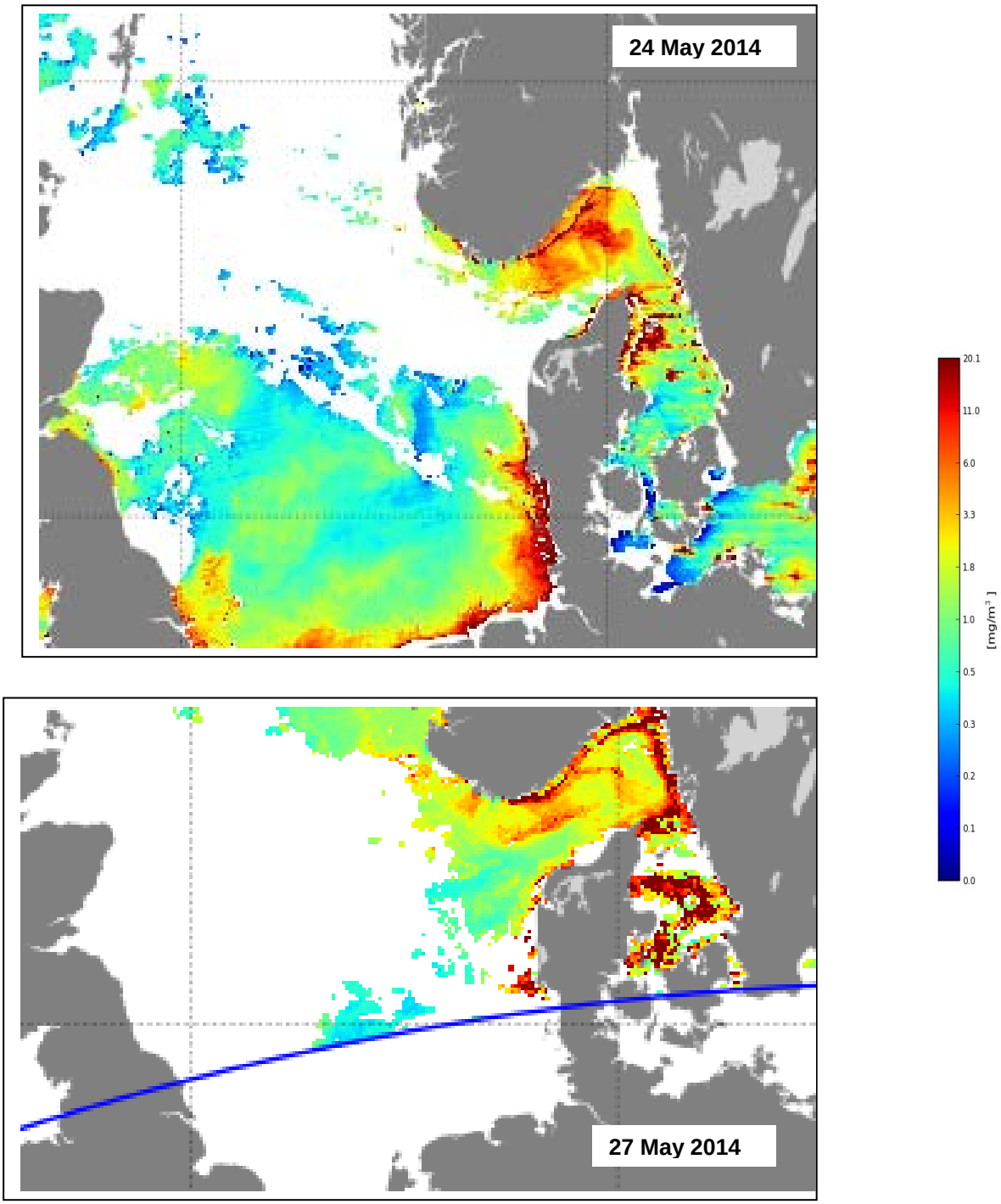

Fig. 2: Satellite image (NASA MODIS) of chlorophyll *a* distribution on May 24 and May 27, 2014, in the North Sea (courtesy of HZG Geesthacht).

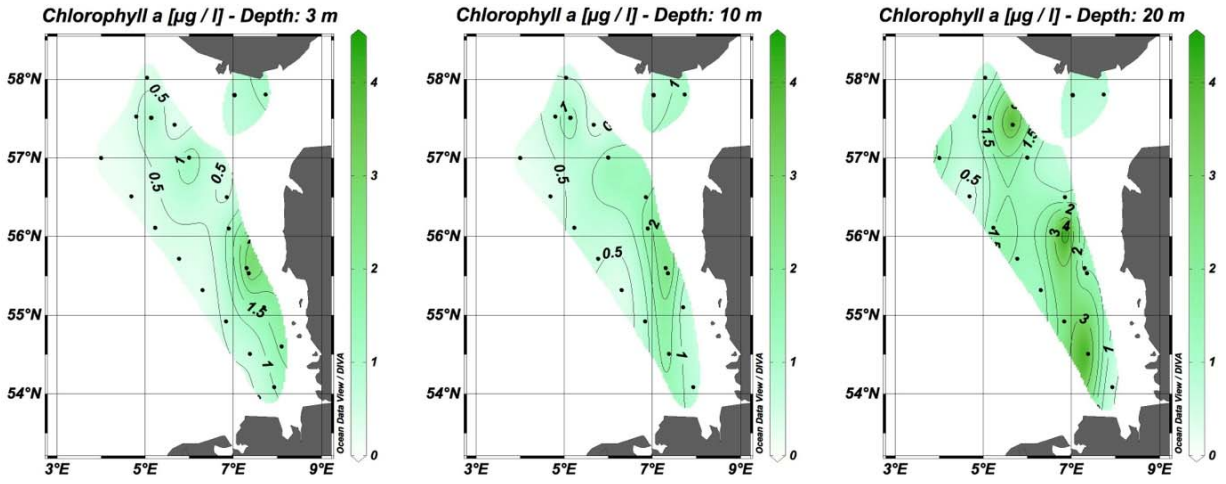

Fig. 3: Chlorophyll *a* at 3 m (left), 10 m (center) and 20 m depth (right) in the North Sea between 23 May and 7 June 2014 during cruise HE-425.

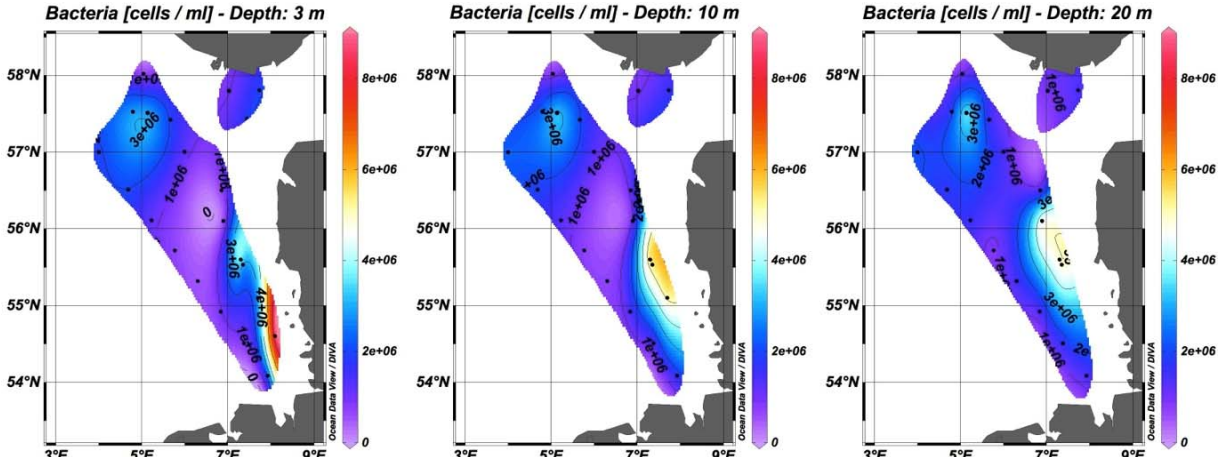

Fig. 4: Bacterial cell numbers at 3 m (left), 10 m (center) and 20 m depth (right) in the North Sea between 23 May and 7 June 2014 during cruise HE-425.

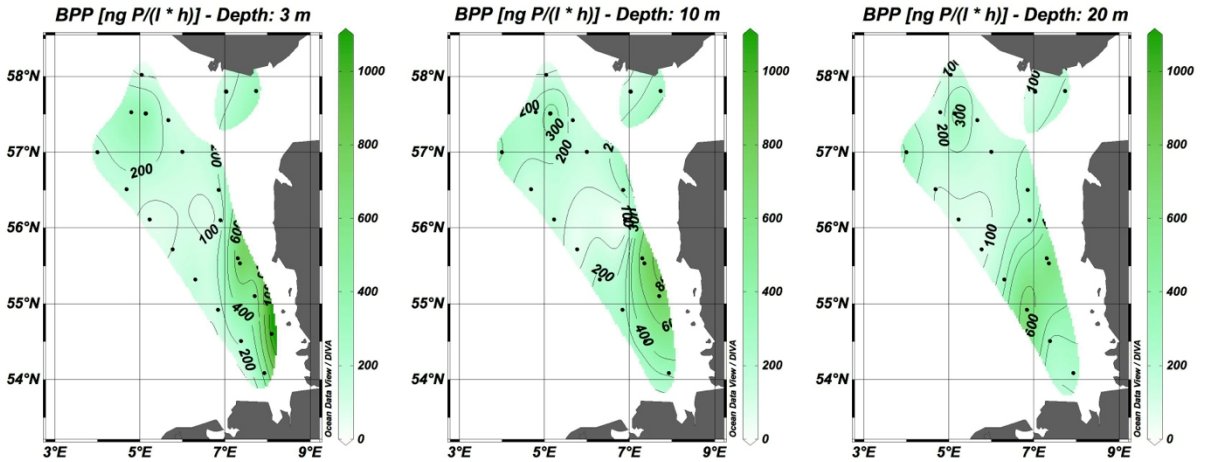

Fig. 5: Bacterioplankton biomass production (BPP) at 3 m (left), 10 m (center) and 20 m depth (right) in the North Sea between 23 May and 7 June 2014 during cruise HE-425.

Cruise Heincke-425, 23. May - 07. June 2014
Table 1: Station overview, gray: diel cycle

Station	Date	Time (UTC)	Position °N	Position °E	Temp 0 m (°C)	Depth (max) (m)
1	23.5.	13:08	54.081	7.9313	13.76	33
2	24.5.	06:09	54.504	7.3817	13.12	26
3	24.5.	10:59	54.9207	6.8323	13.97	30
4	25.5.	06:29	55.3187	6.302	13.16	46
5	25.5.	10:25	55.7152	5.7695	12.80	47
6	25.5.	13:45	56.1103	5.2308	12.82	41
7	26.5.	06:26	56.5088	4.684	12.54	59
8	26.5.	11:19	56.9997	4.0027	11.96	57
9	26.5.	17:23	57.5002	3.432	12.34	85
10	27.5.	06:30	58.02	5.0373	13.09	139
11	27.5.	12:00	57.955	6.000	12.45	409
12	28.5.	17:59	57.8015	7.0298	11.50	409
13	28.5.	21:00	57.7972	7.0293	11.46	403
14	29.5.	00:02	57.7972	7.0293	11.46	403
15	29.5.	03:02	57.7972	7.0293	11.54	403
16	29.5.	06:01	57.7972	7.0293	11.68	403
17	29.5.	11:57	57.7972	7.0293	12.99	403
18	29.5.	15:02	57.7972	7.0293	12.99	403
19	29.5.	18:01	57.7972	7.0293	13.23	403
20	30.5.	10:11	57.8062	7.7377	14.00	500
21	31.5.	06:59	57.5087	5.1387	10.96	83
22	31.5.	09:04	57.5085	5.1387	10.86	81
23	31.5.	11:56	57.5085	5.1387	10.86	83
24	31.5.	15:01	57.5085	5.1387	11.21	83
25	31.5.	17:59	57.5085	5.1387	11.63	83
26	31.5.	21:02	57.5085	5.1387	10.74	83
27	31.5.	23:57	57.5085	5.1387	10.61	83
28	31.5.	03:02	57.5085	5.1387	10.76	83
29	01.6	05:57	57.5085	5.1387	11.00	83
30	01.6	11:53	57.0012	5.9968	10.97	47
31	02.6	06:35	57.5247	4.7928	11.59	78
32	02.6	09:09	57.5247	4.7928	11.59	78
33	02.6	11:59	57.5247	4.7928	11.69	78
34	02.6	15:01	57.5247	4.7928	12.12	78
35	02.6	17:57	57.5247	4.7928	12.48	78
36	02.6	20:58	57.5247	4.7928	12.21	78
37	02.6	23:56	57.5247	4.7928	12.08	78
38	03.6	03:02	57.5247	4.7928	12.08	78
39	03.6	05:59	57.5247	4.7928	12.08	78
40	03.6	10:29	57.4197	5.667	12.84	79
41	04.6	06:28	56.5013	6.8487	13.71	36
42	04.6	10:26	56.1027	6.8987	13.96	34
43	04.6	13.54	55.5992	7.3012	15.19	30
44	04.6	16:28	55.5313	7.3522	15.81	28
45	05.6	06:27	55.101	7.7028	14.57	18
46	05.6	10:23	54.5992	8.0997	14.90	9

Station overview, sampling depths
Heincke 425, 23. May -7. June 2014

Station	Date	Time (UTC)	Position °N	°E	Sampling depths (m)
1	23.5.	13:08	54.081	7.9313	3, 10, 20
2	24.5.	06:09	54.504	7.3817	3, 10, 20
3	24.5.	10:59	54.9207	6.8323	3, 10, 20
4	25.5.	06:29	55.3187	6.302	3, 10, 25, 35
5	25.5.	10:25	55.7152	5.7695	3, 10, 30
6	25.5.	13:45	56.1103	5.2308	3, 10, 20, 30
7	26.5.	06:26	56.5088	4.684	3, 10, 25, 35 45
8	26.5.	11:19	56.9997	4.0027	3, 10, 30, 45
9	26.5.	17:23	57.5002	3.432	3, 20, 40, 60
10	27.5.	06:30	58.02	5.0373	3, 10, 40, 100
11	27.5.	12:00	57.955	6.000	3, 10, 40, 100
12	28.5.	17:59	57.8015	7.0298	3, 10, 20, 50, 150, 250
13	28.5.	21:00	57.7972	7.0293	3, 20, 40
14	29.5.	00:02	57.7972	7.0293	3, 20, 40
15	29.5.	03:02	57.7972	7.0293	3, 20, 40
16	29.5.	06:01	57.7972	7.0293	3, 20, 40
17	29.5.	11:57	57.7972	7.0293	3, 20, 40
18	29.5.	15:02	57.7972	7.0293	3, 20, 40
19	29.5.	18:01	57.7972	7.0293	3, 20, 40
20	30.5.	10:11	57.8062	7.7377	3, 10, 40, 150
21	31.5.	06:59	57.5087	5.1387	3, 20, 50
22	31.5.	09:04	57.5085	5.1387	3, 20, 50
23	31.5.	11:56	57.5085	5.1387	3, 20, 50
24	31.5.	15:01	57.5085	5.1387	3, 20, 50
25	31.5.	17:59	57.5085	5.1387	3, 20, 50
26	31.5.	21:02	57.5085	5.1387	3, 20, 50
27	31.5.	23:57	57.5085	5.1387	3, 20, 50
28	31.5.	03:02	57.5085	5.1387	3, 20, 50
29	01.6	05:57	57.5085	5.1387	3, 20, 50
30	01.6	11:53	57.0012	5.9968	3, 20, 40
31	02.6	06:35	57.5247	4.7928	3, 20, 50
32	02.6	09:09	57.5247	4.7928	3, 20, 50
33	02.6	11:59	57.5247	4.7928	3, 20, 50
34	02.6	15:01	57.5247	4.7928	3, 20, 50
35	02.6	17:57	57.5247	4.7928	3, 20, 50
36	02.6	20:58	57.5247	4.7928	3, 20, 50
37	02.6	23:56	57.5247	4.7928	3, 20, 50
38	03.6	03:02	57.5247	4.7928	3, 20, 50
39	03.6	05:59	57.5247	4.7928	3, 20, 50
40	03.6	10:29	57.4197	5.667	3, 10, 25, 55
41	04.6	06:28	56.5013	6.8487	3, 10, 25, 35
42	04.6	10:26	56.1027	6.8987	3, 14, 24
43	04.6	13.54	55.5992	7.3012	3, 8, 12, 20
44	04.6	16:28	55.5313	7.3522	3, 12, 20
45	05.6	06:27	55.101	7.7028	3, 15
46	05.6	10:23	54.5992	8.0997	3

Parameter overview water column

Station	Date	POC	Chl	DNA	FISH	BP	Bact	Phyto	DOC	DAA/ DCHO	inorg. nutr	FT-ICR-MS
1	23.5.	+	+	+	+	+	+	+	+	+	+	+
2	24.5.	+	+	+	+	+	+	+	+	+	+	+
3	24.5.	+	+	+	+	+	+	+	+	+	+	+
5	25.5.	+	+	+	+	+	+	+	+	+	+	+
6	25.5.	+	+	+	+	+	+	+	+	+	+	+
7	25.5.	+	+	+	+	+	+	+	+	+	+	+
8	26.5.	+	+	+	+	+	+	+	+	+	+	+
10	26.5.	+	+	+	+	+	+	+	+	+	+	+
11	26.5.	+	+	+	+	+	+	+	+	+	+	+
12	27.5.	+	+	+	+	+	+	+	+	+	+	+
13	27.5.	-	-	-	-	-	+	-	-	-	-	-
14	28.5.	+	+	+	+	+	+	+	+	+	+	+
15	28.5.	-	-	-	-	-	+	-	-	-	-	-
16	29.5.	+	+	+	+	+	+	+	+	+	+	+
17	29.5.	-	-	-	-	-	+	-	-	-	-	-
18	29.5.	+	+	+	+	+	+	+	+	+	+	+
19	29.5.	-	-	-	-	-	+	-	-	-	-	-
20	29.5.	+	+	+	-	+	-	-	+	+	-	+
21	29.5.	+	+	+	+	+	+	+	+	+	+	+
22	30.5.	-	-	-	-	-	-	-	-	-	-	-
23	31.5.	+	+	+	+	+	+	+	+	+	+	+
24	31.5.	-	-	-	-	-	-	-	-	-	-	-
25	31.5.	+	+	+	+	+	+	+	+	+	+	+
26	31.5.	-	-	-	-	-	-	-	-	-	-	-
27	31.5.	+	+	+	+	+	+	+	+	+	+	+
28	31.5.	-	-	-	-	-	-	-	-	-	-	-
29	31.5.	+	+	+	+	+	+	+	+	+	+	+
30	31.5.	+	+	+	+	+	+	+	+	+	+	+
31	01.6	+	+	+	+	+	+	+	+	+	+	+
32	02.6	-	-	-	-	-	-	-	-	-	-	-
33	02.6	+	+	+	+	+	+	+	+	+	+	+
35	02.6	-	-	-	-	-	-	-	-	-	-	-
36	02.6	+	+	+	+	+	+	+	+	+	+	+
37	02.6	-	-	-	-	-	-	-	-	-	-	-
38	02.6	+	+	+	+	+	+	+	+	+	+	+
39	03.6	-	-	-	-	-	-	-	-	-	-	-
40	03.6	+	+	+								
41	03.6	+	+	+								
42	04.6	+	+	+								
43	04.6	+	+	+								
44	04.6	+	+	+								
45	04.6	+	+	+								
46	05.6	+	+	+								

CRUISE SUMMARY REPORT	*FOR COLLATIMG CENTRE USE* **Centre: DOD** **Ref. No.:** Is data exchange restricted ☐ Yes ☐ In part ☐ No

SHIP enter the full name and international radio call sign of the ship from which the data were collected. and indicate the type of ship. for example. research ship; ship of opportunity. naval survey vessel; etc.

Name: Heincke **Call Sign: HE**

Type of ship: Research Vessel

CRUISE NO. / NAME425

enter the unique number, name or acronym assigned to the cruise (or cruise leg, if appropriate).

CRUISE PERIOD start **23/5/14** to **07/6/14** end
(set sail) **day/ month/ year** **day/ month/ year** **(return to port)**

PORT OF DEPARTURE (enter name and country) **Bremerhaven. Germany**

PORT OF RETURN (enter name and country) **Bremerhaven. Germany**

RESPONSIBLE LABORATORY enter name and address of the laboratory responsible for coodinating the scientific planning of the cruise

Name: ICBM. University of Oldenburg

Address: POBox 2503. D-26111 Oldenburg

Country: Germany

CHIEF SCIENTIST(S) enter name and laboratory of the person(s) in charge of the scientific work (chief of mission) during the cruise.

Sara Billerbeck, ICBM, University of Oldenburg

OBJECTIVES AND BRIEF NARRATIVE OF CRUISE enter sufficient information about the purpose and nature of the cruise so as to provide the context in which the report data were collected.

The Roseobacter clade during phytoplankton blooms in the North Sea

PROJECT (IF APPLICABLE) if the cruise is designated as part of a larger scale cooperative project (or expedition). then enter the name of the project. and of organisation responsible for co-ordinating the project.

Project name: Collaborative Research Center (CRC. SFB) TRR 51 Roseobacter

Coordinating body: University of Oldenburg

PRINCIPAL INVESTIGATORS: Enter the name and address of the Principal Investigators responsible for the data collected on the cruise and who may be contacted for further information about the data. (The letter assigned below against each Principal Investigator is used on pages 2 and 3. under the column heading 'PI'. to identify the data sets for which he/she is responsible)

Prof. Dr. Meinhard Simon

MOORINGS. BOTTOM MOUNTED GEAR AND DRIFTING SYSTEMS

This section should be used for reporting moorings. bottom mounted gear and drifting systems (both surface and deep) deployed and/or recovered during the cruise. Separate entries should be made for each location (only deployment positions need be given for drifting systems). This section may also be used to report data collected at fixed locations which are returned to routinely in order to construct 'long time series'.

PI See top of page.	APPROXIMATE POSITION LATITUDE deg	min	N/S	LONGITUDE deg	min	E/W	DATA TYPE enter code(s) from list on cover page.	DESCRIPTION Identify. as appropriate. the nature of the instrumentation the parameters (to be) measured. the number of instruments and their depths. whether deployed and/or recovered. dates of deployments and/or recovery. and any identifiers given to the site.
								Please continue on separate sheet if necessary

SUMMARY OF MEASUREMENTS AND SAMPLES TAKEN

Except for the data already described on page 2 under 'Moorings. Bottom Mounted Gear and Drifting Systems'. this section should include a summary of all data collected on the cruise. whether they be measurements (e.g. temperature. salinity values) or samples (e.g. cores. net hauls).

Separate entries should be made for each distinct and coherent set of measurements or samples. Different modes of data collection (e.g. vertical profiles as opposed to underway measurements) should be clearly distinguished. as should measurements/sampling techniques that imply distinctly different accuracy's or spatial/temporal resolutions. Thus. for example. separate entries would be created for i) BT drops. ii) water bottle stations. iii) CTD casts. iv) towed CTD. v) towed undulating CTD profiler. vi) surface water intake measurements. etc.

Each data set entry should start on a new line – it's description may extend over several lines if necessary.

NO. UNITS : for each data set. enter the estimated amount of data collected expressed in terms of the number of 'stations'; miles' of track; 'days' of recording; 'cores' taken; net 'hauls'; balloon 'ascents'; or whatever unit is most appropriate to the data. The amount should be entered under 'NO' and the counting unit should be identified in plain text under 'UNITS'.

PI	NO	UNITS	DATA TYPE	DESCRIPTION
see page 2	see above	see above	Enter code(s) from list on cover page	Identify. as appropriate. the nature of the data and of the instrumentation/sampling gear and list the parameters measured. Include any supplementary information that may be appropriate. e. g. vertical or horizontal profiles. depth horizons. continuous recording or discrete samples. etc. For samples taken for later analysis on shore. an indication should be given of the type of analysis planned. i.e. the purpose for which the samples were taken.
A	**35**	**35**	**H10**	**see cruise track**
A	**35**	**35**	**H24**	**see cruise track**
A	**35**	**35**	**B02**	**see cruise track**
A	**35**	**35**	**B71**	**see cruise track**
A	**35**	**35**	**B03**	**see cruise track**
A	**35**	**35**	**B08**	**see cruise track**
A	**35**	**35**	**B07**	**see cruise track**
A	**35**	**35**	**B72**	**amino acids. see cruise track**
A	**35**	**35**	**B07**	**see cruise track**
				Please continue on separate sheet if necessary

TRACK CHART: You are strongly encouraged to submit. with the completed report. an annotated track chart illustrating the route followed and the points where measurements were taken.	**Insert a tick(✔) in this box if a track chart is supplied**	☒

GENERAL OCEAN AREA(S): Enter the names of the oceans and/or seas in which data were collected during the cruise – please use commonly recognised names (see. for example. International Hydrographic Bureau Special Publication No. 23. 'Limits of Oceans and Seas').

North Sea

SPECIFIC AREAS: If the cruise activities were concentrated in a specific area(s) of an ocean or sea. then enter a description of the area(s). Such descriptions may include references to local geographic areas. to sea floor features. or to geographic coordinates.
Please insert here the number of each square in which data were collected from the below given chart

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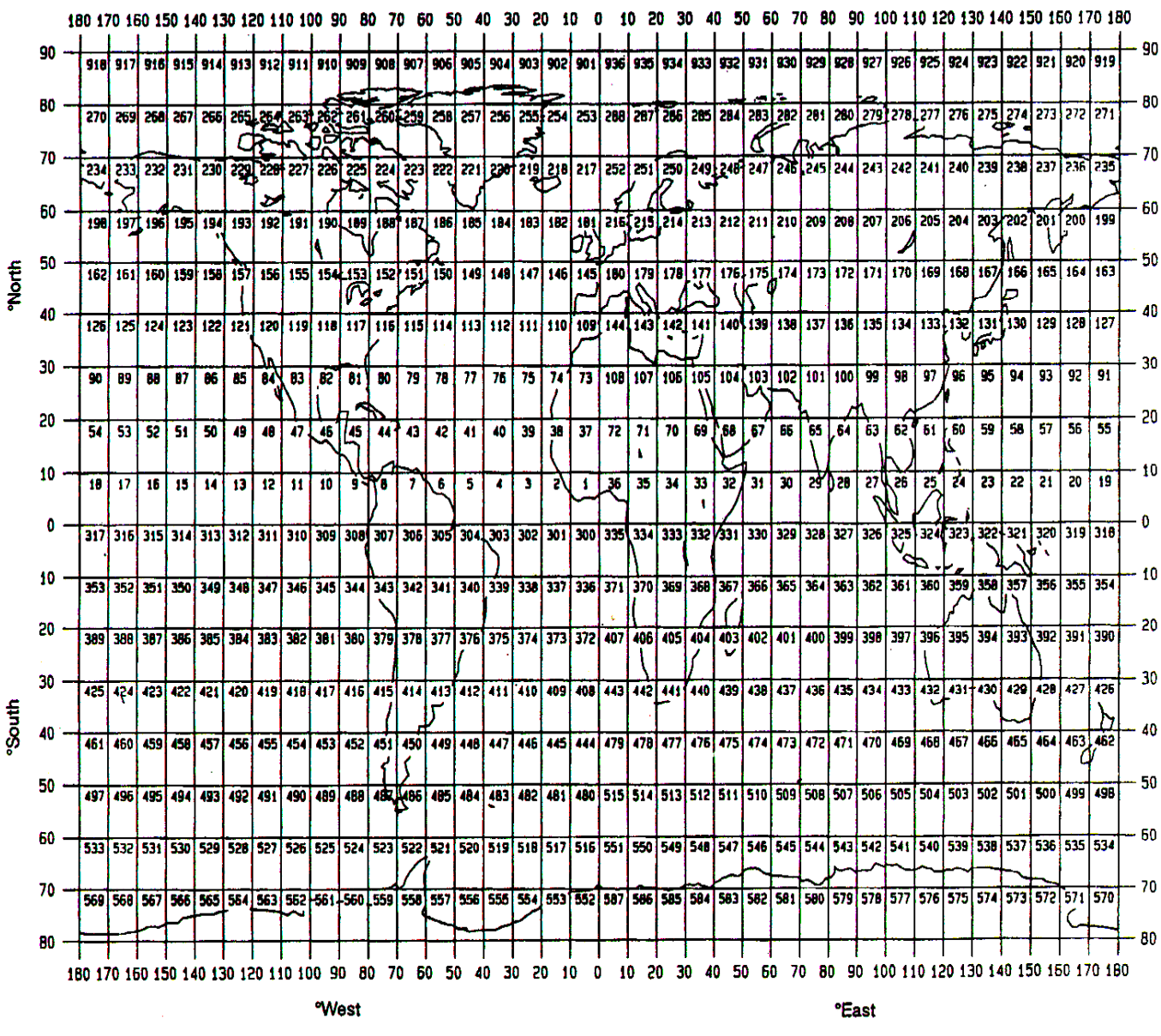
GEOGRAPHIC COVERAGE - INSERT 'X' IN EACH SQUARE IN WHICH DATA WERE COLLECTED

see above



THANK YOU FOR YOUR COOPERATION