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Chemical composition of precipitation collected on a
weather ship in the North Atlantic: preliminary results:
a joint KNMI/ECN/IMOU/RIV project

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Chemical composition of precipitation
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North Atlantic.
Preliminary results

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Samenvatting

Vanaf 1979 worden aan boord van het Nederlandse weerschip Cumulus (positie 66°N , 2°E) neerslagmonsters verzameld om de chemische samenstelling ervan te bepalen. Van 12 reizen in de periode april 1979 tot en met oktober 1981 worden de voorlopige meetresultaten gepresenteerd van de volgende componenten: pH , H^+ , NH_4^+ , Na^+ , Ca^{2+} , Zn^{2+} , F^- , Cl^- , NO_3^- en SO_4^{2-} .

1. Introduction

Since 1979 rain water has been collected on a ship in the North Atlantic as a part of a joint project on precipitation chemistry. This project is being carried out by the Royal Netherlands Meteorological Institute (KNMI), the Netherlands Energy Research Foundation (ECN), the Institute for Meteorology and Oceanography of the State University of Utrecht (IMOU) and the National Institute of Public Health (RIV).

The KNMI is responsible for coordinating the experiment; the rain water samples are chemically analysed by RIV or ECN, while IMOU deals with the experimental set up and the interpretation of the results.

The rain water samples are collected on board the Netherlands weather ship "Cumulus". This experiment has been set up because very few (reliable) data exist on the chemical composition of rain water falling on the oceans. Besides there is a great need for chemical data which can be used for global deposition models and for the quantification of the intercontinental transport of air pollution across the Atlantic.

The components analysed from the samples of the journeys 124 up to and including 137 were pH, H^+ , NH_4^+ , Na^+ , Ca^{2+} , Zn^{2+} , F^- , Cl^- , NO_3^- and SO_4^{2-} . From journey 138 the samples were also analysed for K^+ and Mg^{2+} . The samples are sometimes analysed for a number of heavy metals, but this is not done on a regular basis. The results relating to heavy metals are not included in the tables because they have proved to be not always reliable.

The investigations are still in an experimental stage. The results presented therefore should be used with the utmost caution and should not be published in literature without written permission of the authors.

2. Collection of the precipitation samples.

The collection of rain water at sea is much more troublesome than it is on land. Precautions have to be taken to avoid contamination, for example by sea water and by the smoke from the ship's funnel. We used an adapted version of the original sampler designed and used by the Swedish Meteorological and Hydrological Institute (figure 1.). The outer shield serves as a wind shield and as a protection against the sea water. During dry periods the sampler was covered by a lid to avoid contamination. Before sampling the lid was removed and the funnel was thoroughly cleaned with distilled water.

Originally only one sampler was used (samples marked "A" in the tables). This sampler (and later on the other ones too) was placed on the port side of the ship, because this is the windward side when the ship is on station. The distance from the sampler to the rail was 50 cm. At a later stage we added first two, then three and four more samplers at different places aboard the ship. Some of the samplers were placed at different heights above the sea (figure 2). The four more samplers are marked "B", "C", "D", and "E". With samplers at different heights it was possible to investigate the influence of the sampling position on the chemical composition and to investigate differences between two samplers at almost the same height. During most sampling periods the collector was placed slanting to windward with a deviation of ca. 30° from the horizontal to increase the amount of rain collected. It should be pointed out that the primary purpose of our investigation is to determine as far as possible the concentration of the main components of the rain water and not to get a correct measure of the amount of rain.

The position of the weather ship "Cumulus", when on station, is 66°N and 2°E (corresponding to WMO-code: Mike). Under normal circumstances the ship does not drift more than 50 km from this position.

3. Remarks on the results presented in the tables.

- Every journey has its own registration number. The station period is also given. The symbols "A", "B", etc. refer to the different sampling positions on the ship (figure 2).
- When no result is given for a component, this means that the sample has not been analysed for that component. In most cases due to a small sample volume.
- The use of the sign "<" means that the sample has been analysed for that component, but that the result was below the detection limit of the analytical method.
- The windspeed ("ff") is given in knots* according to the meteorological code. The winddirection ("dd") is given in sectors of 10° , where $355^{\circ}-004^{\circ}$ is 01, $005^{\circ}-014^{\circ}$ is 02, etc.
- It is important to notice that one sample does not necessarily always represent one complete rain period. In some cases one rain period was split up into two samples. If at 0000, 0600, 1200, or 1800 GMT it was still raining the sample bottle was sometimes changed (see for example A1 and A3, voyage 124).

*1 knot \approx 0,5 meter per sec.

4. Method of analysis

Component	RIV	ECN
H/HCO ₃	Coulometry	Ion Specific Electrode
NH ₄	CFA	"
Na	AAS-flame	AAS-flame
K	"	"
Ca	"	"
Mg	"	"
Zn	"	"
F	Ion Specific Electrode	Ion Chromatography/Ion Specific
Cl	Potentiometry	Ion Chromatography Electrode
NO ₃	UV-method	"
SO ₄	CFA	"

5. Acknowledgements

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PRECIPITATION CHEMISTRY

Chemical data of rainwater collected on the Dutch weathership "Cumulus"

Voyage : 124 Period : 790409-790505

Position : Mike Analysis : RIV

sample	start sampling			end sampling			sample weight	amount of rain			concentrations																
	date		wind	date		wind		chem	off		µmol/l																
	no	day	GMT	ddff	day	GMT		ddff	g	mm	mm	pH	H	NH ₄	Na	K	Mg	Ca	Zn	F	Cl	NO ₃	SO ₄				
A1	0417	1245	2010	0418	0000	2117	23	0.8	0.6				748				30			1018	26	66					
A3	0418	0000	2117	0418	0530	2220	26	0.9	0.8				439				20			1159	34	54					
A4	0419	0000	2214	0419	0600	2015	62	2.2	0.5				130				5.0	0.31	0.53	152	3.2	16					
A6	0419	1700	1622	0420	0000	1916	24	0.8	0.7				657				35			818	23	64					
A9	0427	0600	1917	0427	1200	1928	46	1.6	1.0				431				15	0.76		559	19	29					

PRECIPITATION CHEMISTRY

Chemical data of rainwater collected on the Dutch weathership "Cumulus"

Voyage : 125 Period : 790604-790630

Position : Mike Analysis : RIV

sample	start sampling			end sampling			sample weight	amount of rain			concentrations																
	date		wind	date		wind		chem	off		µmol/l																
	no	day	GMT	ddff	day	GMT		ddff	g	mm	mm	pH	H	NH ₄	Na	K	Mg	Ca	Zn	F	Cl	NO ₃	SO ₄				
A1	0617	1915	2825	0618	0300	2920	34	1.2	0.1				83				10			73		6.2					
A2	0618	2250	1612	0619	0800	1318	138	4.9	0.1	5.1	7	8.9	974				23	0.15	0.56	1114		68					
A3	0623	0605	1327	0623	1000	1625	88	3.1	2	6.3	-27	5.0	2235				60	1.36	0.79	2697		168					
A4	0625	1830	3616	0626	0000	1413	249	8.8	5				113				6.5	0.45		127		71					

PRECIPITATION CHEMISTRY

Chemical data of rainwater collected on the Dutch weathership "Cumulus"

Voyage : 126 Period : 790730-790825

Position : Mike Analysis : RIV

sample	start sampling			end sampling			sample weight	amount of rain		concentrations													
	date		wind	date		wind		chem	off	µmol/l													
	no	day	GMT	ddff	day	GMT				ddff	g	mm	mm	pH	H	NH ₄	Na	K	Mg	Ca	Zn	F	Cl
A21	0730	2150	0718	0731	0000	0516	182	6.4	1.1	5.0	11	3.9	191				6.7	2.60	0.53	240	6.9	20	
A22	0731	0000	0516	0731	0600	0617	127	4.5	0.5	5.2	8	1.1	135				4.5	1.05	0.37	144	4.7	10	
A24	0806	1215	1121	0806	1800	1326	240	8.5	1.6	4.1	92	17	840				20	0.15	0.74	1000	32	94	
A25	0806	1800	1326	0807	0000	1229	251	8.9	1.6	3.8	166	61	1300				32	0.60	1.32	1560	68	161	
A26	0813	1100	1218	0813	1600	1916	166	5.9	1.4	4.9	15	5.6	340				9.0	0.45	0.42	410	10	29	
A27	0814	0200	1110	0814	0450	1120	27	1.0	6.7	5.5	-1	1.7	48				2.2	<0.15	0.37	31	2.6	3.1	
A28	0815	0900	1120	0815	1200	1617	62	2.2	2.3				350				11	0.30		380	10	39	
A29	0821	0600	0920	0821	1500	1406	141	5.0	1.5	6.3	-24	25						1.51	2.10				
A30	0822	0000	2607	0822	0600	2418	303	10.7	9.6	6.3	-34	32	240				9.0	1.51	0.63	260	6.8	26	
A32	0823	0600	2919	0823	1045	2815	283	10.0	3.3	5.5	1	7.8	460				11	0.45	0.47	560	7.4	36	

PRECIPITATION CHEMISTRY

Chemical data of rainwater collected on the Dutch weathership "Cumulus"

Voyage : 127 Period : 790924-791020

Position : Mike Analysis : RIV

sample	start sampling			end sampling			sample weight	amount of rain		concentrations													
	date		wind	date		wind		chem	off	µmol/l													
	no	day	GMT	ddff	day	GMT				ddff	g	mm	mm	pH	H	NH ₄	Na	K	Mg	Ca	Zn	F	Cl
A1	0924	1800	1733	0924	2300	1836	282	9.9	1	6.3	-22	8.3	5600				117	0.15	1.60	6300	36	360	
A2	1006	0600	2219	1006	1700	1921	108	3.8	1	4.6	35	14	8300				180	2.56	1.80	9200	71	560	
A3	1008	0500	1308	1008	1500	0906	110	3.9	0.8	4.3	62	28	360				13	1.66	1.05	410	27	67	
A4	1008	1610	0906	1009	0600	0216	107	3.8	0.5	4.3	57	8.3	27				2.5	0.60	1.52	34	8.1	30	
A5	1021	1700	0715	1012	2005	0620	53	1.9	0.5				1100				22	8.44		1290	11	96	
A6	1017	2125	1625	1017	2235	2715	50	1.8	0.5											1720	16	159	

PRECIPITATION CHEMISTRY

Chemical data of rainwater collected on the Dutch weathership "Cumulus"

Voyage : 128 Period : 791119-791215

Position : Mike Analysis : RIV

sample	start sampling			end sampling			sample weight	amount of rain		concentrations													
	date			date				chem	off	µmol/l													
	day	GMT	ddff	day	GMT	ddff				g	mm	mm	pH	H	NH ₄	Na	K	Mg	Ca	Zn	F	Cl	NO ₃
A21	125	1510	2017	1125	1700	2118	57	2.0	0.3	6.4	-34		540				35			600	9.7	61	
A22	1126	0710	0727	1126	1100	0722	250	8.8	<0.1	5.5	3	1.1	510			12	0.31	0.58	600	3.2	36		
A23	1126	1420	0521	1126	1700	0237	312	11.0	0.4	5.8	-7	1.1	2800			60	0.15	0.89	3260	24	197		
A24	1128	0720	1133	1128	1100	1238	136	4.8	1.8	6.0	-12	1.1	3400			62	0.15	0.84	3260	24	190		
A25	1129	0835	2417	1129	1400	2828	294	10.4	0.9	5.7	-5	1.1	730			15	0.76	0.47	850	6.5	51		
A26	1201	1915	1623	1201	2300	1834	323	11.4	3.5	5.7	-6	1.1	420			7.2	<0.15	0.47	480	3.2	28		
A27	1204	1500	1513	1204	1900	0827	233	8.3	0.9	5.7	3	1.1	2130			48	0.31	0.68	2500	16	143		

PRECIPITATION CHEMISTRY

Chemical data of rainwater collected on the Dutch weathership "Cumulus"

Voyage : 130 Period : 800309-8000404

Position : Mike Analysis : RIV

sample	start sampling			end sampling			sample weight	amount of rain		concentrations													
	date			date				chem	off	µmol/l													
	day	GMT	ddff	day	GMT	ddff				g	mm	mm	pH	H	NH ₄	Na	K	Mg	Ca	Zn	F	Cl	NO ₃
A1	0313	0900	1514	0313	1200	1409	39	1.4	0.5				704			58			793	39	94		
A2	0325	0945	1508	0325	1300	1207	33	1.2	0.4				574			16			628	42	92		

PRECIPITATION CHEMISTRY

Chemical data of rainwater collected on the Dutch weathership "Cumulus"

Voyage : 132 Period : 800630-800726

Position : Mike Analysis : RIV

sample no	start sampling			end sampling			sample weight	amount of rain		concentrations																
	date			date				g	mm	mm	pH	H	NH ₄	Na	K	Mg	Ca	Zn	F	Cl	NO ₃	SO ₄				
	day	GMT	ddff	day	GMT	ddff																	µmol/l			
A2	0701	0600	0118	0701	1220	3618	53	1.9	1				182			8	0.70		228	5	22					
A4	0720	1420	0212	0720	2118	0417	228	8.0	1.8	4.7	28	<0.6	791			18	0.53	0.3	913	11	66					
A5	0722	1720	1524	0722	2050	1721	98	3.5	0.4	4.3	66		463			15	0.42	1.0	531	18	69					
A6	0722	2300	1819	0723	0730	1908	46	1.6	0.2				518			50			575	20	81					

PRECIPITATION CHEMISTRY

Chemical data of rainwater collected on the Dutch weathership "Cumulus"

Voyage : 133 Period : 800825-800920

Position : Mike Analysis : RIV

sample no	start sampling			end sampling			sample weight	amount of rain		concentrations																
	date			date				g	mm	mm	pH	H	NH ₄	Na	K	Mg	Ca	Zn	F	Cl	NO ₃	SO ₄				
	day	GMT	ddff	day	GMT	ddff																	µmol/l			
A3	0902	0820	1707	0902	1130	2107	135	4.8		6.1	-14	<0.6	509			19	2.82	<0.1	572	20	45					
A7	0905	0000	1419	0905	0630	2206	124	4.4		5.2	6	<0.6	350			8	0.60	<0.1	400	17	30					
A1	0905	2030	1213	0906	0410	2013	254	9.0	1	4.9	14	<0.6	217			5	0.85	<0.1	251	6	25					
A8	0906	2320	1521	0907	0530	2118	231	8.1	3.2	6.0	-10	1.7	332			5	1.71	<0.1	370	6	24					
A9	0916	1400	1334	0916	1800	1730	292	10.3	2.2	6.0	-7	7.8	1407			27	6.15	<0.1	1622	28	100					
A10	0916	1800	1725	0916	2130	2175	73	2.6					1204			22	3.63		1302	26	85					
A11	0917	1545	0316	0917	1845	3235	260	9.2	2.5	5.6	-1	<0.6	491			8	1.67	<0.1	542	15	37					

PRECIPITATION CHEMISTRY

Chemical data of rainwater collected on the Dutch weathership "Cumulus"

Voyage :137 Period :810406-810502

Position :Mike Analysis :RIV

sample	start sampling			end sampling			sample weight	amount of rain		concentrations																		
	date		wind	date		wind		chem	off	µmol/l																		
	no	day	GMT	ddff	day	GMT		ddff	g	mm	mm	pH	H	NH ₄	Na	K	Mg	Ca	Zn	F	Cl	NO ₃	SO ₄					
A1	0409	0910	2021	0409	1620	2329	193	6.9	5			<0.6	370				22	0.34	0.3	745								
A2	0411	1730	1520	0411	2310	1623	131	4.7	4			42	554				35	1.55	0.82	1100								
A3	0411	3210	1623	0412	0400	1831	300	10.7	5.5			64	1400				30	1.10	0.59	1650								
A4	0413	1645	2314	0413	2025	2321	64	2.3	2			54	27800				589		13.9	31600								
A5	0417	0700	2521	0417	0835	2621	41	1.5	1.5			33							1.00	3280								
A6	0429	0650	1929	0429	0845	2914	129	4.6				<0.6	401				32	0.76	0.43	751								

PRECIPITATION CHEMISTRY

Chemical data of rainwater collected on the Dutch weathership "Cumulus"

Voyage :138 Period :810601-810627

Position :Mike Analysis :ECN

sample	start sampling			end sampling			sample weight	amount of rain		concentrations																		
	date		wind	date		wind		chem	off	µmol/l																		
	no	day	GMT	ddff	day	GMT		ddff	g	mm	mm	pH	H	NH ₄	Na	K	Mg	Ca	Zn	F	Cl	NO ₃	SO ₄					
A1	0607	0730	0818	0607	1530	0618	118	4.2	5	5.6			322	9.5	37.8	20.0	1.53			347	9.7	26.0						
B2							129	4.6		6.5			2.2	731	21.2	98.7	29.9	0.23			973	29.0	57.3					
C3							37	3.4		6.5			1.1	174	4.6	19.7	12.7	0.15			197	4.8	16.7					
A4	0609	0230	0427	0609	1045	0323	45	1.6	2.5	6.5			1.7	413	10.2	49.4	19.0	1.07			468	12.9	31.3					
B5							50	1.8		6.5			3.3	748	21.5	103	28.9	0.54			1040	60.4	60.4					
C6							29	1.0		6.0			4.4	487	14.3	53.5	14.7	0.08			564	17.7	37.5					
A7	0613	2300	1119	0614	0845	1016	89	3.1	3.2	4.9	20		178	5.1	20.6	5.5	0.84			212	16.1	18.8						
B8							83	2.9		5.3			2.8	2870	71.6	350	67.4	0.23			3440	111	192					
C9							50	1.8		5.2			11.1	113	6.7	12.3	7.0	0.69			135	14.5	13.5					
A10	0618	2215	2322	0619	0200	3120	73	2.6	2	4.9			3.3	174	7.2	20.6	8.5	4.05			189	4.8	16.7					
B11							68	2.4		5.8			2.8	261	10.0	28.4	9.5	0.23			291	8.1	18.8					
C12							57	2.0		6.4			2.2	183	13.6	17.7	8.0	0.38			200	4.8	13.5					
A13	0621	1430	1924	0622	0145	2019	215	7.6		5.6	20		2.8	457	11.5	53.5	11.2	2.60			496	14.5	31.3					
B14							174	6.1		5.5			6.7	731	19.7	98.7	20.0	0.08			979	25.8	53.1					
C15							89	3.2		5.4			10.0	283	7.4	31.7	9.7	0.23			319	9.7	20.8					

PRECIPITATION CHEMISTRY

Chemical data of rainwater collected on the Dutch weathership "Cumulus"

Voyage : 139

Period : 810727-810822

Position : Mike

Analysis : ECN

sample	start sampling			end sampling			sample weight	amount of rain			concentrations															
	date			date				chem	off	µmol/l																
	no	day	GMT	ddff	day	GMT				ddff	g	mm	mm	pH	H	NH ₄	Na	K	Mg	Ca	Zn	F	Cl	NO ₃	SO ₄	
A1	0730	1500	1624	0730	1800	2312	15	0.5	<0.1	6.2	11	8.9	1460	42.7	74	61.4	5.97	<0.1	1880	11.3	14					
A5	0804	2020	2118	0805	0610	2121	53	1.9	0.9	6.6		0.6	313	10.0	35.4	16.2	0.54	<0.1	463	2.3	20.8					
B6	'	'	'	'	'	'	27	1.0	'	6.8		0.6	1580	37.6	81	50.4	0.84	<0.1	2040	8.1	102					
D8	'	'	'	'	'	'	25	0.9	'	6.7		3.9	1280	30.9	150	39.7	0.92	<0.1	1580	8.9	85.4					
A13	0811	1245	1524	0811	1530	1618	33	1.2	0.4	6.3		1.1	513	12.5	57.6	22.7	2.29	<0.1	592	8.9	36.5					
D16	'	'	'	'	'	'	8	0.3	'			1.1	696	15.9	80.6	62.4		<0.1	936	7.6	54.2					
A17	0814	2100	0316	0815	0030	0114	204	7.2	9	5.7		1.1	54	15.6	6.2	4.4	0.69	<0.1	67	5.7	4.4					
B18	'	'	'	'	'	'	207	7.3	'	5.7		0.6	53	1.8	6.2	4.3		<0.1	65	5.0	4.2					
C19	'	'	'	'	'	'	144	5.1	'	6.4		0.6	37	1.8	3.7	4.8		<0.1	42	4.8	3.2					
D20	'	'	'	'	'	'	156	5.5	'	5.8		1.7	40	2.1	4.5	4.1		<0.1	47	6.9	5.7					
A21	0817	2100	1819	0818	0605	2511	72	2.5	7	6.7		1.1	172	6.2	16.0	9.2	3.98	<0.1	170	6.9	16.4					
B22	'	'	'	'	'	'	110	3.9	'	4.9		2.2	147	4.2	16.9	4.4	1.38	<0.1	185	5.8	13.8					
C23	'	'	'	'	'	'	22	0.8	'	4.8		4.4	65	4.8	4.9	3.9	0.31	<0.1	61	4.2	8.5					
D24	'	'	'	'	'	'	19	0.7	'	5.4		5.6	102	6.1	9.5	6.1	0.46	<0.1	104	6.9	12.0					

PRECIPITATION CHEMISTRY

Chemical data of rainwater collected on the Dutch weathership "Cumulus"

Voyage : 140

Period : 810921-811017

Position : Mike

Analysis : ECN

sample	start sampling			end sampling			sample weight	amount of rain			concentrations															
	date			date				chem	off	µmol/l																
	no	day	GMT	ddff	day	GMT				ddff	g	mm	mm	pH	H	NH ₄	Na	K	Mg	Ca	Zn	F	Cl	NO ₃	SO ₄	
A1	0924	1400	0918	0924	1700	0815	40	1.4	1.5	5.3	13		84	2.3	10	2.7	1.40	0.53	97	3.8	8.9					
B2	'	'	'	'	'	'	14	0.5	'	5.7	5	5.0	106	0.4	12	5.0			127	3.6	9.6					
C3	'	'	'	'	'	'	22	0.8	'	5.3	8	2.8	60	1.9	7.2	2.4	0.08	0.05	67	3.3	5.9					
D4	'	'	'	'	'	'	18	0.6	'	5.3	9	3.3	42	0.3	5.1	4.6		0.21	47	2.9	4.8					
E5	'	'	'	'	'	'	16	0.6	'	5.4	5	4.4	41	1.8	4.9	2.9		0.37	47	4.1	5.8					
A6	0925	1745	0818	0925	1130	0917	323	11.4	10	5.3	7	2.2	190	4.9	22	4.2	2.40	0.11	190	3.1	17					
B7	'	'	'	'	'	'	168	5.9	'	5.4	7	3.6	116	2.8	14	2.6	0.92	0.11	138	3.4	12					
C8	'	'	'	'	'	'	252	8.9	'	5.1	4	2.8	50	1.4	5.6	14	0.31	0.16	58	2.3	7.3					
D9	'	'	'	'	'	'	222	7.8	'	5.1	5	6.8	46	1.5	5.1	1.9	0.08	0.26	55	2.5	7.3					
E10	'	'	'	'	'	'	247	8.7	'	5.0	4	2.8	43	1.7	4.9	1.2	0.38	0.11	53	2.4	7.0					
A11	0925	1130	0916	0926	0110	0815	123	4.3	7	5.6	1		67	1.8	7.8	1.9	0.84	0.32	79	1.8	6.1					
B12	'	'	'	'	'	'	70	2.5	'	5.7	2	1.7	55	1.8	6.8	1.6		0.05	57	1.1	4.1					
C13	'	'	'	'	'	'	91	3.2	'	5.6	2	2.2	32	1.2	3.7	1.0	0.08	0.05	34	1.3	3.1					
D14	'	'	'	'	'	'	82	2.9	'	5.7	1	2.8	32	1.9	3.3	1.5	0.38	0.05	33	1.5	3.2					
E15	'	'	'	'	'	'	87	3.1	'	5.9	3	3.3	38	3.5	3.7	1.6	0.31	0.42	40	1.2	3.5					

continued

PRECIPITATION CHEMISTRY

Chemical data of rainwater collected on the Dutch weathership "Cumulus"

Voyage : 140 Period : 810921-811017

Position : Mike Analysis : ECN

sample no	start sampling			end sampling			sample weight	amount of rain		concentrations																		
	date		wind	date		wind		chem	off	µmol/l																		
	day	GMT	ddff	day	GMT	ddff		g	mm	mm	pH	H	NH ₄	Na	K	Mg	Ca	Zn	F	Cl	NO ₃	SO ₄						
A16	1006	1500	3424	1006	1700	3521	121	4.2	3	6.3	10	2.2	4110	85	465	81	0.31	0.05	3526	23	214							
A21	1010	0830	0734	1010	1045	0735	159	5.6		6.7	8	2.2	10222	228	1172	230	1.40	0.05	10437	55	576							
B22							13	0.4		6.6	12	6.1	10439	217	1193	220	0.08	0.21	8801	86	503							
C23							192	6.8		5.5	8	2.2	693	16	80	1.5	0.08	0.63	697	4.5	51							
D24							82	2.9		6.1	15	2.8	4785	118	539	111	1.10	0.47	4147	29	263							
E25							54	1.9		5.6	8	3.3	848	29	131	26	0.46	0.37	1106	6.1	78							
A26	1012	2000	3318	1013	0300	3326	103	3.6	3	6.4	13	2.2	3145	67	370	64	0.15	0.16	2821	19	201							
B27							34	1.2		6.5	12	2.2	3314	68	387	69	0.76	0.16	2764	17	200							
C28							82	2.9		5.8	5	1.1	182	4.2	21	4.7	0.23	0.05	192	1.0	13							
D29							68	2.4		6.0	8	1.1	711	16	81	20	0.08	0.21	657	4.1	46							
E30							49	1.7		6.3	3	1.1	141	3.2	17	4.2	0.08	0.05	153	1.0	10							
A31	1016	0800	0625	1016	1300	1021	51	1.8	2	5.9	7	2.8	280	6.4	32	7.2	1.10	0.05	277	1.9	21							

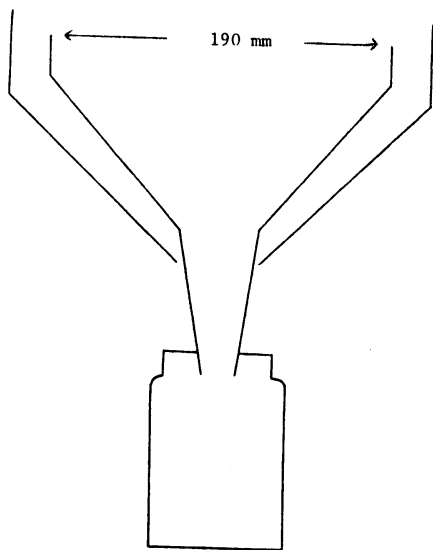


Figure 1 : Sampler

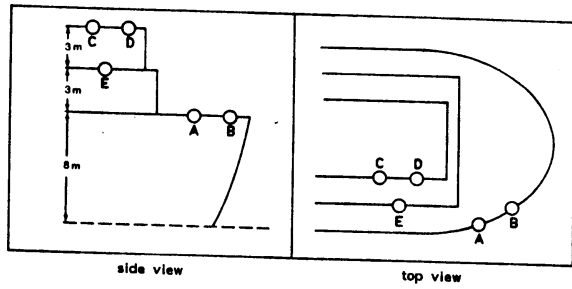


Figure 2 : Position of the samplers

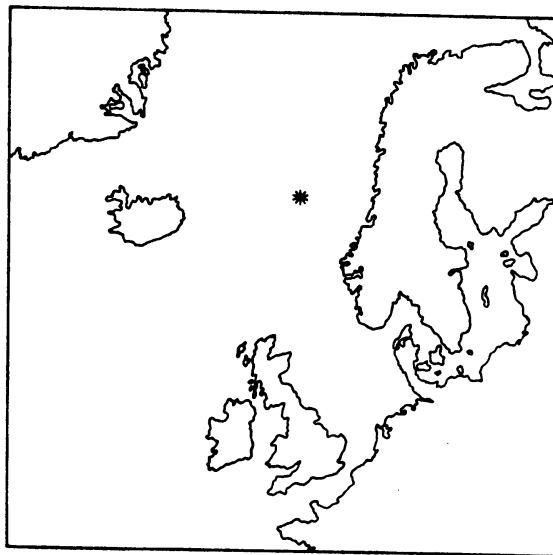


Figure 3 : Position of the weather ship