



PROcesses of Vertical Exchange in Shelf Seas (PROVESS)

MAST III contract # MAS3-CT97-0159

Cruise Report

ms. Mitra, 19 - 30 April 1999

SM Harvey and B de Jong



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1. PROVESS

PROVESS is a joint European funded project for an interdisciplinary study of the vertical fluxes of properties through the water column and the surface and bottom boundaries based on the integrated application of new measuring techniques, new advances in turbulence theory and new models.

1.1 General objectives

Improve understanding and quantification of vertical exchange processes in the water column, in the surface and benthic boundary layers and across the pycnocline.

Explore mechanisms of physical-biological coupling in which vertical exchanges and turbulence significantly affect the environmental conditions experienced by the biota.

Apply innovative technologies to the measurement of physical microstructure features and phenomena, in particular turbulence properties in the water column.

Provide a new, comprehensive and synoptic data set for validation of vertical fluxes of energy and matter calculated by physical and biological models.

Develop 1-D physical models for the computation of statistical moments of microstructure phenomena and integrated biological-physical models of the water column, including fluxes from the surface and the sediment.

Test and validate the models against measurements of mean and fluctuating properties in the water column.

Provide modules for vertical exchanges which can be implemented in state-of-the-art 3-D water quality and ecological models.

1.2 Specific cruise objectives

This cruise was the second of three forming the PROVESS southern North Sea experiment, and was principally concerned with making biological measurements. The cruise objectives were:

1. High temporal resolution CTD and nutrient sampling at the main site over 25 hour periods at different stages in the tidal cycle.
2. Four equally spaced CTD and nutrient sampling sections running parallel to the A-X mooring line to provide spatial coverage.
3. Collection of sediment cores for incubation experiments to measure sediment oxygen demand and nutrient fluxes, and for sectioning.
4. Deployment of the COM benthic chamber system for the in situ measurement of sediment oxygen demand.
5. Obtaining high vertical resolution water samples at the benthic boundary layer to determine near bed oxygen demand, and water samples from the CTD to determine oxygen demand higher in the water column.
6. Obtaining water column particulate profiles using the LISST profiler attached to the CTD frame.
7. Collecting water samples from the CTD and settling velocity tubes for particle size analysis using the Galai laser particle sizer.

2 Participants

2.1 Ship's Company

Martijn van Kolyk	Captain	(week 1)
Theo Maagdelijn	Captain	(week 2)
Ton Loomeyer	Mate	(week 1)
Bas van den Brand	Mate	(week 2)
Jacobus de Bruin	1 st Eng.	
Arie Oosterbaan	2 nd Eng.	(week 1)
Eric Stokebrook	2 nd Eng.	(week 2)
Willem Toet	Boatswain	
Cornelis L.M. Spaans	Sailor	
Thijs Zwart	Sailor	
Jan W. Jekel	Cook	
Vittorio F. Brizo Rozas	Steward	

2.2 Surveyors

Ben de Jong	(chief surveyor)
Jan W. van Bree	
Peter de Boer	
Michel Hofsteede	

2.3 Scientists

Martyn Harvey	DML (principal scientist)
Ken Jones	DML
Christian Grenz	COM
Pierre Harris	COM
Claude Jalong	COM (week 1)
Elizabeth Alliot	COM (week 2)
Rebecca Latter	UWB
Malcolm Hearn	UWB

DML Dunstaffnage Marine Laboratory, PO Box 3, Oban, Argyll, PA34 4AD, UK

COM Centre d' Océanologie de Marseille, Station Marine d'Endoume, 13007 Marseille, France

UWB School of Ocean Sciences, Menai Bridge, Gwynedd, LL59 5EY, UK

3 Narrative

3.1 English

NB all times are in UTC (Local Time – 2h).

More detailed meteorological information can be found in the Dutch section of the narrative.

19/4/99 The Mitra sailed from Scheveningen harbour at 1405Z, arriving on the main site, 400m south of mooring A, at 1530. The multicorer was deployed twice, on both occasions very short cores were obtained comprising coarse sandy sediment. It was decided to move the ship and try again at a different site. Accordingly the ship moved 200m to the east, where the multicorer was deployed again. On this occasion the sediment appeared more amenable to coring so this position was chosen as the main site. The corer was deployed 3 times altogether (in 17.2 – 17.5m water depth), with the cores being kept for incubation. The CTD was deployed to provide bottom water for the core incubations.

At 1610 the first 25 hour cycle (spring tides) was started. During this period CTD casts were made hourly, the interfacial sampler was deployed four times with six hours between deployments, and the settling velocity tubes were deployed every two hours over a 15 hour period.

20/4/99 During the 25 hour cycle wind speed increased from force 4 to 6, but remained south easterly, and had little effect on the wave height. The final CTD cast was taken at 1702, after which the Mitra took water samples (CTD bottles and surface water) as part of the regular RWS sampling programme. The ship returned to Scheveningen for offloading the samples, and then proceeded to the first CTD station on South Line 1.

21/4/99 South Line 1 was started at 0122Z. This line is 2 nm south of the A-X mooring line and parallel to it; 20 nm long, with stations every two nm. Stations were named SL1 – SL11. As the ship steamed along the line underway CTD data was collected using a fish which was towed 3.5m below the surface. The final station was reached at 0630, after which the ship returned to the main site, arriving at 0830. The COM benthic chamber system, mounted onto an RWS frame was deployed at 0935. This was attached to an 80m ground line and a toroid buoy, which went outboard at 0950, completing the deployment. After a CTD cast to collect water for core incubations, the multicorer was deployed successfully four times through the morning. During the afternoon the CTD and fish were checked, and the oxygen sensor on the CTD was replaced with a spare. Then the ship steamed to the start of North Line 1 (as South Line 1 but 2 nm north of the A-X mooring line and hence 4 nm north of South Line 1, stations NL1-NL11). The line was started at 2012. Over the next three hours the weather deteriorated considerably, the wind speed increased to force 7 and went round to the south west, wave height increased to about 2m. The CTD at the 7th station on the line was done at 2336, after which it was decided that conditions were too bad to continue. Accordingly the ship returned to the main site.

22/4/99 Because of the rough seas, and a problem with one of the COM incubators, it was decided to return briefly to Scheveningen to await an improvement. The ship docked at 0930. At 1400 a weather forecast indicated

the wind speed was going down to force 5 so the ship left the harbour and proceeded to the start of North Line 2 (4 nm north of North line 1, stations NL12-NL22). The line was started at 1643, but the promised improvement in the weather didn't materialise and after the third station work was once again abandoned and the ship returned to Scheveningen, arriving at 2030.

23/4/99 At 0600 three divers came on board, along with their gear and a decompression chamber, and the ship left the harbour at 0630. The wind had gone back to the south east and had dropped to force 3-4, with a concomitant decrease in wave height. The main site was reached at 0735 but it was necessary to wait for slack water before the diving operations could commence. The ship's boat proceeded to the chamber mooring at 1005, and after one dive on the chamber, returned to the ship at 1145. The divers reported that the chambers had penetrated into the sediment sufficiently to seal the enclosed overlying water, but the syringe system had not fired properly. The toroid was grappled at 1209 and by 1227 the chamber was back inboard. Since there was insufficient time remaining to redeploy the chamber and dive on it again before increasing tidal current speed would make this unsafe, the ship returned to Scheveningen where the divers left the ship. Claude Jalong (COM) also left, and was replaced by Elizabeth Alliot. After this the ship returned to the main site and a further 5 deployments of the multicorer were made, together with a CTD cast to collect bottom water. Following this the ship proceeded to the fourth station on North Line 2, the point at which the line had been abandoned on the previous night, and the remaining stations on the line were completed.

24/4/99 Having finished North Line 2, the ship went to the seventh station on North Line 1, and this line was completed similarly. Then the ship returned to the main site and at 0800 the second 25 hour cycle (neap tides) was started, with the same sampling regime as the first.

25/4/99 The final CTD cast of the second 25 hour cycle was carried out at 0904. Tests were then carried out on the benthic chamber datalogger housing. The housing was attached to the CTD frame and lowered to 20m water depth and retrieved, first immediately after lowering, and second after holding at 20m for 5 minutes. Once these tests were complete the ship left the main site to check mooring V. At 1200 the ship arrived at the recorded position of the mooring but it was not seen. On the ship's return to the main site the correct positions of moorings A, B, D and G were confirmed. There followed a test of the benthic chamber system to check the firing mechanism, this operated correctly. At 1430 the benthic chamber was deployed, and was recovered again at 1735. It was found that despite all efforts to prevent it, water was still gaining ingress to the datalogger housing. Although the datalogger had worked it was decided not to deploy the chambers again as it was felt that the ingress of water was likely to damage the electronics. The ship then steamed to the start of North Line 3, 4nm to the north of North Line 2 (stations NL23-NL33), and proceeded along it, deploying the CTD every 2nm.

26/4/99 The final station on North Line 3 was done at 0014, after which a series of calibrations were made on the CTD oxygen sensor. The ship then returned to Scheveningen, arriving at 0530. The captain, mate and second engineer left the ship and replacement personnel joined, and some provisions were also taken on board. The ship left the harbour at 0700, arriving back at the main site at 0830. There followed three deployments of the multicorer and

a CTD cast for bottom water. The ship then proceeded to the start of South Line 1 and a series of CTD casts were done at the stations along the line. When these were completed the ship set a course for the start of North Line 2, with the intention of passing by the positions of moorings U and T en route. Both of these moorings were seen at their recorded positions, but it was noted that the light on the toroid at mooring T was not working.

27/4/99 North Line 2 was started at 0010 and finished at 0543, when the ship returned to the main site where six deployments of the multicorer were made, followed by a CTD cast for bottom water. The third 25 hour cycle (mid way between springs and neaps) was started at 1205. During this cycle three deployments of the interfacial sampler were made at 8 hourly intervals, with water being also taken from the CTD bottles to determine the oxygen consumption rate higher in the water column. The Settling Velocity Tubes were not deployed.

28/4/99 The final CTD cast of the cycle was done at 1258. Four deployments of the multicorer were then made, the cores obtained were sliced for faunal analyses and other measurements so a CTD cast for bottom water was not necessary. The ship then started along North Line 1. Weather conditions had deteriorated somewhat, it was judged too rough to use the towed fish so no underway data was obtained on this transect.

29/4/99 North Line 1 was finished at 0328, after which the ship returned to the main site to take samples for the regular RWS sampling programme. Once this had been completed the ship proceeded to the start of North Line 3, starting along this line at 1355, again without using the towed fish. The line was finished at 1852, completing the scientific programme for this cruise. The Mitra accordingly returned to Scheveningen, docking there at 2115.

3.2 Dutch

Datum: Maandag 19-04-99,

Barograaf : 1016 Hpa
Zicht : goed
Zeegang : 5 dm
Wind : var 3
Temp : 10 °C

00:00 - 08:00 Gemeerd aan de Noordzeekade.
08:00 - 14:00 Buitenlandse onderzoekers aan boord, installatie apparatuur, C. Bijleveld en J. Suylen aan boord voor laatste informatie betreffende het project Provens.
14:00 - 15:00 Ontmeerd, stomen naar de Main location (A).
15:00 - 18:00 Testen de Multicore, Settling Tubes, Interfacial sampler en CTD. Alles in orde bevonden. Nemen monsters m.b.v. de Multicore, zie appendix 4.
18:00 - 24:00 Aanvang eerste 25 uurs cyclus , nemen per CTD 6 monsters, voor posities en labnummers zie appendix 1 en chronologisch verslag.

Datum: Dinsdag 20-04-1999

Barograaf : 1011 hPa
Zicht : goed
Zeegang : 8 - 17 dm
Wind : ZO- 3 -7
Temp : 8°C

00:00 - 20:00 Vervolgen eerste 25 uurs cyclus, zie appendix.
20:00 - 21:30 Bemeten en bemonsteren Noordwijk 10 in het kader van Mono 96, nemen extra zuurstof monsters t.b.v. ijking meetvis en sampler.
21:30 - 24:00 Gemeerd aan de Noordzeekade, plaatsen monsters Mono aan de wal, nemen materiaal t.b.v. Provens aan boord, vervolgen ijking van de sensoren.

Datum: Woensdag 21-04-1999

Barograaf : 1000 hPa
Zicht : goed
Zeegang : 10 dm.
Wind : ZW 4 Bft.
Temp : 12 °C

00:00 - 01:45 Gemeerd aan de Noordzeekade, vervolgen ijking. Tijdens het ijken breekt een snelkoppeling tussen CT sensoren en zuurstof sensor af, repareren dit.
01:45 - 03:00 Stomen naar lokatie 1 op de South line.
03:00 - 08:45 Bemeten en bemonsteren 11 lokaties op de South line, 4 monsters per CTD (2 mijl zuid van de meetopstellingen A tot X). De meting is

uitgevoerd tijdens opkomend water. Zie voor lokaties en tijden appendix 2.

- 08:45 - 11:35 Stomen naar de Main location voor plaatsen Benthic Chambers.
11:35 - 11:50 Plaatsen frame met instrumenten steen en boei, op lokatie X 588405 Y 5796200 (frame) en lokatie X 588365 Y 5796130 (steen). Afstand tussen frame en steen is 80 meter. Zie appendix 3.
11:50 - 14.25 Nemen bodem monsters m.b.v. de Multicorer, nemen tevens een CTD t.b.v. monsternamen bodem water voor de Incubation Chambers.
14.25 - 22.00 IJken zuurstof sensor sampler, sensor meet niet goed, vervangen membraan en electrolyt, zonder resultaat. Vervangen sensor 130375 voor sensor 130338. Vervangen membraan en electrolyt van sensor 130338 en laten de sensor circa 30 minuten in het water acclimatiseren. Nemen monsters voor zuurstof ijking.
22:00 - 24:00 Bemeten en bemonsteren 11 lokaties op de North line 1, 4 monsters per CTD (2 mijl noord van de meetopstellingen A tot X). De meting is uitgevoerd tijdens afgaand water. Zie voor lokaties en tijden appendix 2.

Datum: Donderdag 22-04-1999

Barograaf : 1002 hPa
Zicht : redelijk
Zeegang : 10 - 20 dm
Wind : ZW 4-7 Bft.
Temp : 12°C

- 00:00 - 01:50 Vervolgen North line 1.
01:50 - 10.00 Breken meting af i.v.m. toegenomen golfhoogte , lokatie NL1 t/m NL7 uitgevoerd. Stomen naar Main location, en houden schip gaande. Alle problemen rondom de zuurstof sensor van de sampler zijn opgelost.
10:00 - 11:40 Stomen naar Scheveningen, onwerkbaar weer.
11:40 - 16:25 Gemeerd aan de Noordzeekade.
16:25 - 18.00 Ontmeerd, stomen naar lokatie NL12, eerste punt op North line 2 (6 mijl noord van meetopstellingen A t/m X).
18:00 - 20.00 Bemeten en bemonsteren drie lokaties op de North line 2.
20:00 - 22:45 Ondanks het gunstige weerbericht van het HMR valt het zwaar tegen, golfhoogte was 1.9 meter in plaats van de voorspelde 1.0 meter. Breken de meting af en stomen naar Scheveningen.
22:45 - 24:00 Gemeerd langszij de Zirfaea, onwerkbaar weer.

Datum: Vrijdag 23-04-1999

Barograaf : 1011 hPa
Zicht : Goed
Zeegang : 15 - 5 dm
Wind : ZW 7 - var 3 Bft.
Temp : 15 °C

- 00:00 - 08:00 Gemeerd langszij de Zirfaea, onwerkbaar weer.
08:00 - 08:30 Nemen duikers en decompressie tank aan boord.

08:30 - 10:40 Ontmeerd, stomen naar Main location, voor bergen en plaatsen Benthic Chambers.
10:40 - 13:00 Op lokatie, wachten op afname stroomsterkte voor duik werkzaamheden.
13:00 - 14:00 Voeren duik werkzaamheden uit op Benthic Chambers, alles ziet er goed uit.
14:00 - 15:00 Bergen frame, de Benthic Chambers hebben goed gewerkt, er stond alleen water in de electronica pot, de data is correct binnen gekomen.
15:00 - 16:30 Stomen naar Scheveningen.
16:30 - 17:30 Gemeerd te Scheveningen, duikers aan de wal, Fransen verwisselen 1 onderzoeker.
17:30 - 18:45 Ontmeerd, stomen naar Main location.
18:45 - 20:05 Nemen monsters m.b.v. Multicores, zie appendix 4.
20:05 - 24:00 Bemonsteren en bemeten North line 2, zie appendix 2

Datum: Zaterdag 24-04-1999

Barograaf : 1012 hPa
Zicht : Goed
Zeegang : 5 dm
Wind : Var 3 Bft.
Temp : 15 °C

00:00 - 04:45 Vervolgen meting op North line 2, en North line 1, zie appendix 2.
04:45 - 08:00 Stomen naar Main location.
08:00 - 10:00 Geven assistentie aan onderzoekers op de meetpost, m.b.v. de Razende Bol.
10:00 - 24:00 Voeren tweede 25 uren meting uit, zie appendix 1.

Datum: Zondag 25-04-1999

Barograaf : 1017hPa
Zicht : Goed
Zeegang : < 5 dm
Wind : Var 2 Bft.
Temp : 16 °C

00:00 - 12:00 Vervolgen tweede 25 uren meting, zie appendix 1.
12:00 - 16:00 Voeren diverse testen uit met de waterdichtheid van de electronica pot van de Benthic Chambers en met het sluit mechaniek van de Benthic Chambers.
Varen langs meetopstelling V, zien geen boei.
16:00 - 17:00 Plaatsen meetopstelling. Waterdiepte 18.7 meter. Zie appendix 3.
18:30 - 18:45 Trekken aan het sluit mechaniek van de Benthic Chambers vanuit de Razende Bol.
18:45 - 19:34 Gaan op DP en halen het frame van de bodem.
De electronica pot was weer deels gevuld met water, maar de opname was wel door gegaan.
19:34 - 20:31 Stomen naar North line 3.
20:31 - 24:00 Bemeten en bemonsteren North line 3, zie appendix 2.

Datum: Maandag 26-04-1999

Barograaf : 1016hPa
Zicht : Goed
Zeegang : < 5 dm
Wind : NO 3-4 Bft.
Temp : 15 °C

00:00 - 03:00 Vervolgen North line 3, zie appendix 2.
03:00 - 07:50 Stomen naar Scheveningen, verwerken data en ijen pH en zuurstof sensoren.
07:50 - 08:50 Gemeerd te Scheveningen, vervangen kapitein, stuurman en tweede machinist. Nemen vers voedsel aan boord.
08:50 - 10:15 Stomen naar Main location, vervolgen met het verwerken van de meetdata.
10:15 - 13:50 Voeren bemonstering uit m.b.v. de Multicorer, zie appendix 4.
13:50 - 20:00 Bemeten en bemonsteren South line 1, zie appendix 2.
20:00 - 24:00 Stomen naar North line 2, maken gelijktijdig een inspectie tocht langs de moorings.

Datum: Dinsdag 27-04-1999

Barograaf : 1023 hPa
Zicht : goed
Zeegang : 10 15 dm
Wind : O 4-6 Bft.
Temp : 13°C

00:00 - 01:30 Stomen naar North line 2.
01:30 - 08:00 Bemeten en bemonsteren North line 2, zie appendix 2.
08:00 - 11:00 Stomen naar Main location.
11:00 - 14:00 Nemen bodemmonsters m.b.v. de Multicorer, zie appendix 5.
14:00 - 24:00 Voeren derde 25 uren meting uit, zie appendix 1.

Datum: Woensdag 28-04-1999

Barograaf : 1026 hPa
Zicht : goed
Zeegang : 17 dm
Wind : NO 3-6 Bft.
Temp : 15 °C

00:00 - 16:00 Vervolgen derde 25 uren meting, zie appendix 1.
16:00 - 19:00 Wachten op slack tide voor uitvoering bodembemonstering m.b.v. de Multicorer
19:00 - 20:00 Nemen bodemmonsters m.b.v. de Multicorer, zie appendix 5.
20:00 - 24:00 Wachten op volgend tij voor bemeten en bemonsteren North line 1.

Datum: Donderdag 29-04-1999

Barograaf : 1021 hPa
Zicht : goed
Zeegang : 10 - 15 dm
Wind : NO 4-6 Bft.
Temp : 15°C

00:00 - 06:00 Bemeten en bemonsteren North line 1, zie appendix 2.
06:00 - 10:00 Stomen naar Noordwijk 10. Inspecteren de moorings op lijn A t/m X, de boeien U en T zijn gesignaleerd.
10:00 - 12:00 Bemeten en bemonsteren Noordwijk 10 oppervlakte en bodem + 3 in het kader van de Mono.
12:00 - 15:30 Wachten op gunstig getij.
15:30 - 21:10 Bemeten en bemonsteren North line 3, zie appendix 2.
21:10 - 24:00 Stomen naar Scheveningen.

4 Individual Project Summaries

4.1 CCMS-DML (Ken Jones and Martyn Harvey)

This group used an interfacial sampling device to obtain water samples from close to the sea bed.

This instrument collects 10 water samples (approximately 4 litres each) at 20 cm height intervals above the sea bed, thus providing high resolution sampling in the benthic boundary layer.

The sampler was deployed at six hourly intervals during the first two 25 hour cycles (at spring and neap tides) four times. Samples were transferred into calibrated oxygen bottles, some of which were fixed immediately and some incubated for 24 hours prior to fixing. Incubations were carried out in the in a tank with a close fitting lid to exclude light. Water was continuously recirculated through the tank, initially from the ship's seawater supply. This however led to unacceptable variations in the incubation temperature, so for subsequent incubations the water was recirculated via a cooling unit which maintained the water temperature at 9-9.5°C, corresponding to ambient conditions. The fixed samples were Winkler titrated to measure their dissolved oxygen concentration, and hence the oxygen consumption rate of the water column at each depth interval could be calculated.

Samples were also filtered for chlorophyll (onto GF/F filters), particulate organic carbon (onto baked GF/F filters) and suspended particulates (onto Nucleopore filters). During the third 25 hour cycle the sampler was deployed three times at eight hourly intervals and samples taken for the incubations as described above. In addition samples were also taken from each of the six CTD bottles and either fixed immediately or incubated to provide a profile of water column oxygen consumption rate from the surface to the bed.

4.2 COM (Christian Grenz, Claude Jalong*, Pierre Harris and Elizabeth Alliot**)

* week 1

** week 2

The objectives of the COM group during the Proves Cruise was to measure oxygen and nutrient fluxes at the sediment water interface at the main station. Initially it was proposed to use two different techniques for flux measurements. First the incubation technique of sediment cores sampled by a multicorer, and second the use of an in situ benthic chamber system. Both sampling devices were deployed successfully during the cruise and a total of 5 onboard incubation cycles and 2 in situ cycles were obtained. After the two chamber cycles the benthic chambers were not used further because of a leakage in the container enclosing the data logger.

The following table shows the dates and times of onboard incubation start and durations:

Date	Local Time	Code	Core Id	Incubation duration*	N samples*
19/04/99	19h30	E1	C1 to C4	46h20	7
21/04/99	14h00	E2	C5 to C8	48h15	10
23/04/99	19h00	E3	C9 to C12	58h00	10
26/04/99	10h30	E4	C13 to C16	37h00	9
28/04/99	19h00	E5	C17 to C20	24h00	7

*depending on the oxygen results. From C13, due to a high fluff layer in the cores, the incubations were reduced in time because of an increase in O₂ consumption (as for syringe sampling inside the cores).

Concerning the benthic chambers, we got 2 complete cycles. The following table shows the sampling information:

Date start	Local Time	Date end	Local Time	Incubation duration	Sampling Freq. O ₂ probes
21/04/99	11h45	23/03/99	14h45	51h00*	5 min
25/04/99	16h30	25/04/99	19h30	3h00	1 min

*Bad weather conditions on the 22/04 prevented recovery of the chambers and explains the duration of the experiment.

Finally, the cores obtained on 28/04/99 at 19h00 were used for meiobenthos and other sediment analyses.

This sampling strategy provided a total of 20 individual fluxes of oxygen and nutrients at the sediment -water interface, separated into 5 blocks corresponding to 2 high tide slacks and 3 low tide slacks.

The in situ benthic chamber deployments are used to compare the onboard and in situ measured of oxygen consumption by the enclosed sediments and fluff layers.

Concerning the sediments, we sampled each of the 20 cores in order to get profiles of nutrients in the top 6 to 8cm of the sediments. Other sub-samples were taken from each core for porosity and granulometric analyses, for organic matter (CHN) and for algal pigment determination.

Sediment collected:

Individual 1cm-thick sediment samples : 108

The number of samples and analyses done on board are:

Oxygen : 203 microWinkler titrations

Ammonia : 311 Colorimetric analyses

Nutrients : 311 Technicon analyses

All nutrient samples were doubled and stored frozen for later lab analyses.

Individual samples of 20 ml GFF filtered samples : 622

Because of the environmental conditions, 85 % of the proposed work was achieved.

4.3 University of Wales, Bangor SPM group (Rebecca Latter and Malcolm Hearn)

CTD profiles indicate that the concentration of suspended material is predominantly greater at the bed than at the surface. Most of the material appears to be biological in origin when viewed on the laser particle sizer video-microscope. Compared to the earlier Pelagia cruise the particle size distribution is similar, being bimodal at the surface and the bed, with peaks in the 10-20 um and 100-200 um size classes. However, concentrations appear to be greater now.

Particle concentration

A total of 100 surface and near-bed water samples were taken from the CTD and filtered for gravimetric determination of SPM concentration. Regression analysis of SPM concentration against beam attenuation will yield an equation that will be used to convert beam attenuation measured by the CTD and moored transmissometers into SPM concentration.

Particle size and shape

Two instruments were used to measure particle size during the cruise. A LISST (Laser In Situ Scattering and Transmissometry) particle sizer was mounted on the

CTD frame to obtain *in situ* profiles of particle size (1-250 microns). The second instrument, Galai, was laboratory-based and required water samples from the CTD to be passed through it. A video-microscope on the instrument allows the particles to be viewed on a monitor and recorded onto video tape for shape analysis at a later date. A total of 161 profiles were obtained from the LISST. Surface and near-bed particle size distributions (5 - 600 microns) were obtained from the Galai every other hour over two 15hour sampling periods and one 25hour.

Particle settling velocity

A total of 30 QUISSET (Quasi *In-Situ* Settling Tubes) tubes were deployed for determination of particle settling velocity distributions at the surface and bed. The tubes are lowered horizontally into the water and when triggered closed take a horizontal slice of water. When back on deck the tubes are stood vertically and water samples removed from the bottom at specified intervals over a six hour period. samples are filtered for chlorophyll and gravimetric analysis at later date. The procedure will result in settling rates for SPM and chlorophyll. Surface and near-bed deployments were carried out every 2 hours over two 15 hour periods during the first and second 25 hour cycles.

5 Acknowledgements

The cruise on the Mitra provided the opportunity within the southern North Sea experiment to collect the biological data necessary for PROVESS. In this it has been very successful. Minor technical difficulties with the benthic chamber system prevented its full intended use, but apart from this we have achieved all our objectives.

Whilst the mostly clement weather we experienced on the cruise helped towards this outcome, by far the greatest contribution came from the captains, officers and crew, and also the surveyors. Without their help and cooperation things would have been very different. I (MH) would like to thank them for this, and also for their willingness to work the unsocial hours that were asked of them.

Organising this cruise was made much easier through the help I was given by Carel Bijleveld at RWS/DNZ and Jo Suijlen at RWS/RIKZ, and I would like to thank them both for the efforts they made in ensuring that we had everything we needed on the cruise, from the ship downwards.

And finally, for driving Ken and I, and our frozen samples, back to Schiphol airport on the Queen's birthday, I would like to say 'Thank you Fred'.

Appendix 1

1st 25 h cycle 19-04-99/20-04-99 CTD + Settling tubes + Interfacial sampler.

Freq (h)	Date	Time in UTC	Lat (N)	Long (E)	Depth (m)	Sample
00.00	19-04-99	16.10	52 18.59	4 18.24	19.5	cast1
00.30	19-04-99	16.45	52 18.65	4 18.17	19.8	IF 1
01.00	19-04-99	17.08	52 18.65	4 18.00	19.8	cast2
02.00	19-04-99	18.04	52 18.67	4 17.74	19.4	cast3
03.00	19-04-99	19.03	52 18.66	4 17.83	19.0	cast4
04.00	19-04-99	20.03	52 18.45	4 17.70	18.7	cast5
05.00	19-04-99	21.05	52 18.67	4 17.75	18.2	cast6
06.00	19-04-99	22.06	52 18.53	4 17.37	18.4	cast7
06.30	19-04-99	22.33	52 18.50	4 17.20	18.8	IF2
07.00	19-04-99	23.04	52 18.18	4 17.99	18.7	cast8
08.00	20-04-99	00.03	52 17.91	4 17.36	18.0	cast9
09.00	20-04-99	01.00	52 17.97	4 17.50	18.0	cast10
09.30	20-04-99	01.29	52 17.98	4 17.55	18.0	SV1+2
10.00	20-04-99	02.01	52 18.02	4 17.48	18.2	cast11
11.00	20-04-99	03.02	52 18.69	4 17.24	18.0	cast12
11.30	20-04-99	03.32	52 18.61	4 17.17	18.4	SV3+4
12.00	20-04-99	04.05	52 18.81	4 17.59	19.0	cast13
12.30	20-04-99	04.30	52 18.68	4 17.75	19.3	IF3
	20-04-99	04.44	52 18.71	4 17.72	19.5	IF4
13.00	20-04-99	05.06	52 19.13	4 17.81	19.9	cast14
13.30	20-04-99	05.33	52 19.30	4 17.53	19.9	SV5+6
15.00	20-04-99	07.06	52 19.08	4 18.11	19.3	cast15
15.30	20-04-99	07.35	52 19.99	4 18.07	19.3	SV7 +8
16.00	20-04-99	08.10	52 18.93	4 17.79	18.1	cast16
17.00	20-04-99	09.05	52 18.70	4 17.72	18.0	cast17
18.00	20-04-99	10.06	52 18.70	4 17.75	18.0	cast18
18.30	20-04-99	10.30	52 18.78	4 17.59	18.1	IF5
19.00	20-04-99	11.04	52 18.59	4 17.46	18.1	cast19
19.30	20-04-99	11.33	52 18.55	4 17.57	17.9	SV9+10
20.00	20-04-99	12.03	52 18.49	4 17.70	17.8	cast20
21.00	20-04-99	13.07	52 18.44	4 17.71	17.7	cast21
21.30	20-04-99	13.37	52 18.50	4 17.79	17.5	SV 11+12
22.00	20-04-99	14.07	52 18.71	4 17.55	17.5	cast22
23.00	20-04-99	15.10	52 18.73	4 17.66	17.8	cast23
23.30	20-04-99	15.40	52 18.70	4 17.70	18.0	SV 13+14
24.00	20-04-99	16.05	52 19.03	4 18.02	18.7	cast24
25.00	20-04-99	17.02	52 19.10	4 17.91	19.5	cast25

2nd 25 h cycle 24-04-99/25-04-99 CTD + Settling tubes + Interfacial sampler

Freq (h)	Date	Time in UTC	Lat (N)	Long (E)	Depth (m)	Sample
00.00	24-04-99	08.03	52 18.94	4 17.76	19.2	cast62
01.00	24-04-99	09.03	52 18.42	4 17.58	19.8	cast63
01.30	24-04-99	09.35	52 18.51	4 17.61	20.1	SV15+16
02.00	24-04-99	10.03	52 18.82	4 18.37	20.0	cast64
02.30	24-04-99	10.34	52 18.61	4 18.22	19.4	IF6+7
03.00	24-04-99	11.03	52 18.62	4 18.31	19.0	cast65
03.30	24-04-99	11.36	52 18.57	4 18.48	18.8	SV17+18
04.00	24-04-99	12.02	52 18.77	4 18.30	19.3	cast66
05.00	24-04-99	13.01	52 18.65	4 28.28	18.7	cast67
05.30	24-04-99	13.36	52 18.76	4 18.14	18.6	SV19+20
06.00	24-04-99	14.05	52 18.75	4 17.82	18.4	cast68
07.00	24-04-99	15.04	52 18.61	4 17.72	18.3	cast69
07.30	24-04-99	15.30	52 18.35	4 17.37	17.9	SV21+22
08.00	24-04-99	16.03	52 18.21	4 17.49	17.8	cast70
08.30	24-04-99	16.28	52.18.47	4 17.89	18.2	IF8+9
09.00	24-04-99	17.07	52 18.49	4 17.99	18.2	cast71
09.30	24-04-99	17.38	52 18.20	4 17.90	18.2	SV23+24
10.00	24-04-99	18.05	52 18.39	4 17.65	18.2	cast72
11.00	24-04-99	19.13	52 18.47	4 17.69	18.3	cast73
11.30	24-04-99	19.40	52 18.58	4 17.54	18.4	SV25+26
12.00	24-04-99	20.03	52 18.18	4 17.51	18.4	cast74
13.00	24-04-99	21.02	52 18.13	4 17.46	18.7	cast75
13.30	24-04-99	21.37	52 18.30	4 17.66	19.2	SV27+28
14.00	24-04-99	22.01	52 18.18	4 17.33	19.4	cast76
14.30	24-04-99	22.42	52 18.27	4 17.45	18.6	IF 10+11
15.00	24-04-99	23.04	52 18.82	4 17.95	19.1	cast77
15.30	24-04-99	23.40	52 18.25	4 17.44	18.7	SV29+30
16.00	25-04-99	00.02	52 18.54	4 17.52	18.9	cast78
17.00	25-04-99	01.05	52 15.56	4 17.53	18.5	cast79
18.00	25-04-99	02.02	52 18.65	4 17.73	18.3	cast80
19.00	25-04-99	03.03	52 18.75	4 17.86	18.2	cast81
20.00	25-04-99	04.03	52 18.51	4 17.73	18.2	cast82
20.30	25-04-99	04.33	52 18.54	4 18.02	18.3	IF 12+13
21.00	25-04-99	05.04	52 18.25	4 17.52	17.4	cast83
22.00	25-04-99	06.08	52 18.61	4 17.56	18.0	cast84
23.00	25-04-99	07.01	52 18.45	4 17.55	18.3	cast85
24.00	25-04-99	08.03	52 18.19	4 17.63	17.9	cast86
25.00	25-04-99	09.04	52 18.40	4 17.83	19.7	cast87

3rd 25 h cycle 27-04-99 / 28-04-99 CTD + Interfacial sampler

Freq (h)	Date	Time in UTC	Lat (N)	Long (E)	Depth (m)	Sample
00.00	27-04-99	12.05	52 18.27	4 17.60	19.9	cast 125
00.30	27-04-99	12.45	52 18.36	4 17.87	20.2	IF14+15
01.00	27-04-99	13.18	52 18.68	4 17.77	19.4	cast 126
02.00	27-04-99	14.00	52 18.54	4 17.65	19.4	cast 127
03.00	27-04-99	15.01	52 18.49	4 17.37	19.2	cast 128
04.00	27-04-99	16.01	52 18.47	4 17.38	18.8	cast 129
05.00	27-04-99	17.04	52 18.44	4 17.39	18.6	cast 130
06.00	27-04-99	18.02	52 18.57	4 17.37	18.3	cast 131
07.00	27-04-99	19.04	52 18.25	4 17.38	17.6	cast 132
08.00	27-04-99	20.03	52 18.41	4 17.37	18.0	cast 133
08.30	27-04-99	20.35	52 18.52	4 17.28	18.2	IF16+17
09.00	27-04-99	21.00	52 18.58	4 17.29	17.8	cast 134
10.00	27-04-99	22.03	52 18.39	4 17.19	17.4	cast 135
11.00	27-04-99	23.02	52 18.77	4 17.28	18.9	cast 136
12.00	28-04-99	00.02	52 18.92	4 18.48	19.0	cast 137
13.00	28-04-99	00.57	52 18.75	4 17.60	19.3	cast 138
14.00	28-04-99	02.00	52 18.89	4 17.61	19.4	cast 139
15.00	28-04-99	03.00	52 18.71	4 17.67	18.8	cast 140
16.00	28-04-99	04.03	52 18.73	4 17.55	18.6	cast 141
17.00	28-04-99	05.04	52 18.42	4 17.48	18.4	cast 142
18.00	28-04-99	06.02	52 18.23	4 17.34	19.9	cast 143
19.00	28-04-99	07.04	52 18.27	4 17.35	17.5	cast 144
20.00	28-04-99	08.04	52 18.35	4 17.26	17.4	cast 145
21.00	28-04-99	09.04	52 18.22	4 17.38	17.6	cast 146
22.00	28-04-99	10.03	52 18.11	4 17.17	18.4	cast 147
23.00	28-04-99	11.01	52 18.25	4 17.28	17.7	cast 148
24.00	28-04-99	12.07	52 18.49	4 17.35	18.9	cast 149
25.00	28-04-99	12.58	52 18.79	4 17.43	19.6	cast 150

Appendix 2**CTD Survey South Line 1.**

Station	Date	Time in UTC	Lat (N)	Long (E)	Depth (m)	CTD
SL1	21-04-99	01.22	52 15.04	4 20.45	16.3	cast26
SL2	21-04-99	01.56	52 15.68	4 17.28	17.1	cast27
SL3	21-04-99	02.24	52 16.27	4 14.19	17.9	cast28
SL4	21-04-99	02.54	52 16.78	4 11.00	20.5	cast29
SL5	21-04-99	03.29	52 17.45	4 07.81	21.1	cast30
SL6	21-04-99	03.55	52 17.81	4 04.76	22.0	cast31
SL7	21-04-99	04.29	52 18.35	4 01.59	24.5	cast32
SL8	21-04-99	05.04	52 18.97	3 58.62	24.1	cast33
SL9	21-04-99	05.38	52 19.20	3 55.28	27.2	cast34
SL10	21-04-99	06.05	52 20.12	3 52.28	27.6	cast35
SL11	21-04-99	06.31	52 20.56	3 48.93	26.1	cast36

CTD Survey South Line 1A.

Station	Date	Time in UTC	Lat (N)	Long (E)	Depth (m)	CTD
SL1	26-04-99	12.10	52 15.20	4 20.51	18.4	cast102
SL2	26-04-99	12.45	52 15.84	4 17.25	19.1	cast103
SL3	26-04-99	13.17	52 16.34	4 14.13	19.7	cast104
SL4	26-04-99	13.44	52 16.92	4 10.98	22.2	cast105
SL5	26-04-99	14.23	52 17.45	4 07.87	21.4	cast106
SL6	26-04-99	14.57	52 17.91	4 04.66	21.9	cast107
SL7	26-04-99	15.28	52 18.38	4 01.46	24.4	cast108
SL8	26-04-99	15.59	52 18.95	3 58.41	26.1	cast109
SL9	26-04-99	16.39	52 19.47	3 55.24	24.1	cast110
SL10	26-04-99	17.18	52 20.03	3 52.09	24.5	cast111
SL11	26-04-99	17.53	52 20.55	3 48.93	26.7	cast112

CTD Survey North Line 1 and 1A.

Station	Date	Time in UTC	Lat (N)	Long (E)	Depth (m)	CTD
NL1	21-04-99	20.12	52 18.91	4 22.21	17.5	cast 38
NL2	21-04-99	20.45	52 19.11	4 18.94	18.2	cast 39
NL3	21-04-99	21.16	52 19.84	4 15.72	19.1	cast 40
NL4	21-04-99	21.48	52 20.38	4 12.54	20.3	cast 41
NL5	21-04-99	22.22	52 20.96	4 06.68	20.5	cast 42
NL6	21-04-99	22.54	52 21.36	4 06.90	20.5	cast 43
NL7	21-04-99	23.36	52 22.04	4 03.02	23.8	cast 44 no data retrieved
NL7	24-04-99	00.27	52 21.98	4 03.28	23.5	cast 57
NL8	24-04-99	00.59	52 22.58	4 00.13	24.2	cast 58
NL9	24-04-99	01.29	52 23.06	3 56.97	21.4	cast 59
NL10	24-04-99	02.02	52 23.56	3 53.65	24.0	cast 60
NL11	24-04-99	02.34	52 24.13	3 50.50	24.0	cast 61

CTD Survey North Line 1B.

Station	Date	Time in UTC	Lat (N)	Long (E)	Depth (m)	CTD
NL1	28-04-99	22.03	52 19.02	04 22.03	16.60	cast 151
NL2	28-04-99	22.36	52 19.50	04 18.91	17.30	cast 152
NL3	28-04-99	23.06	52 20.01	04 15.61	17.90	cast 153
NL4	28-04-99	23.36	52 20.58	04 12.35	19.80	cast 154
NL5	29-04-99	00.09	52 21.10	04 09.40	20.50	cast 155
NL6	29-04-99	00.37	52 21.62	04 06.86	21.70	cast 156
NL7	29-04-99	01.14	52 22.28	04 03.20	23.20	cast 157
NL8	29-04-99	01.48	52 22.74	04 00.03	22.90	cast 158
NL9	29-04-99	02.19	52 23.31	03 56.88	25.00	cast 159
NL10	29-04-99	02.54	52 23.73	03 53.69	26.50	cast 160
NL11	29-04-99	03.28.	52 24.28	03 50.56	28.00	cast 161

CTD Survey North Line 2 + 2A.

Station	Date	Time in UTC	Lat (N)	Long (E)	Depth (m)	CTD
NL12	22-04-99	16.43	52 22.34	4 26.06	15.6	cast45
NL13	22-04-99	17.17	52 22.82	4 23.01	16.4	cast46
NL14	22-04-99	17.57	52 23.29	4 19.94	18.7	cast47
NL15	23-04-99	18.51	52 24.00	4 16.67	18.4	cast49
NL16	23-04-99	19.22	52 24.45	4 13.44	21.0	cast50
NL17	23-04-99	19.56	52 25.11	4 10.38	23.4	cast51
NL18	23-04-99	20.33	52 25.68	4 07.20	23.3	cast52
NL19	23-04-99	21.15	52 26.17	4 04.15	26.5	cast53
NL20	23-04-99	22.05	52 26.85	4 00.86	25.0	cast54
NL21	23-04-99	22.39	52 17.19	3 57.85	26.0	cast55
NL22	23-04-99	23.10	52 27.56	3 54.72	26.4	cast56

CTD Survey North Line 2B.

Station	Date	Time in UTC	Lat (N)	Long (E)	Depth (m)	CTD
NL12	27-04-99	00.10	52 22.32	04 26.19	16.7	cast113
NL13	27-04-99	00.44	52 22.87	04 23.03	16.9	cast114
NL14	27-04-99	01.16	52 23.41	04 19.85	18.3	cast115
NL15	27-04-99	01.48	52 23.94	04 16.75	19.1	cast116
NL16	27-04-99	02.20	52 24.68	04 13.53	21.0	cast117
NL17	27-04-99	02.53	52 25.05	04 10.42	21.8	cast118
NL18	27-04-99	03.25	52 25.57	04 07.33	23.3	cast119
NL19	27-04-99	03.56	52 26.12	04 04.16	24.0	cast120
NL20	27-04-99	04.30	52 26.67	04 00.93	24.7	cast121
NL21	27-04-99	05.06	52 27.20	03 57.81	26.1	cast122
NL22	27-04-99	05.43	52 27.74	03 54.63	27.7	cast123

CTD Survey North Line 3.

Station	Date	Time in UTC	Lat (N)	Long (E)	Depth (m)	CTD
NL23	25-04-99	18.57	52 25.81	4 28.80	14.9	cast90
NL24	25-04-99	19:27	52 26.59	4 26.12	15.9	cast91
NL25	25-04-99	19.59	52 27.11	4 22.73	16.7	cast92
NL26	25-04-99	20.28	52 27.67	4 19.48	18.0	cast93
NL27	25-04-99	20.56	52 28.27	4 16.20	19.0	cast94
NL28	25-04-99	21.23	52 28.80	4 13.18	22.0	cast95
NL29	25-04-99	21.59	52 29.11	4 10.14	24.4	cast96
NL30	25-04-99	22.36	52 29.64	4 07.11	24.5	cast97
NL31	25-04-99	23.11	52 30.19	4 03.82	25.5	cast98
NL32	25-04-99	23.43	52 30.73	4 00.66	25.0	cast99
NL33	26-04-99	00.14	52 31.27	3 57.51	25.0	cast100

CTD Survey North Line 3A.

Station	Date	Time in UTC	Lat (N)	Long (E)	Depth (m)	CTD
NL23	29-04-99	13.55	52 26.14	4 29.03	15.9	cast 163
NL24	29-04-99	14.27	52 26.65	4 25.87	17.0	cast 164
NL25	29-04-99	14.59	52 27.20	4 22.79	18.3	cast 165
NL26	29-04-99	15.33	52 27.83	4 19.61	19.5	cast 166
NL27	29-04-99	16.05	52 28.23	4 16.51	19.5	cast 167
NL28	29-04-99	16.35	52 28.93	4 13.30	22.8	cast 168
NL29	29-04-99	17.09	52 29.12	4 09.12	25.1	cast 169
NL30	29-04-99	17.34	52 29.75	4 06.89	24.6	cast 170
NL31	29-04-99	18.00	52 30.37	4 03.07	23.2	cast 171
NL32	29-04-99	18.25	52 30.84	4 00.60	24.1	cast 172
NL33	29-04-99	18.52	52 31.34	3 57.41	23.0	cast 173

Appendix 3**Benthic chambers**

Date	Time in UTC	Depth (m)	Lat (N)	Long (E)	Remarks
21-04-99	09.36	18.6	52 18.48	4 17.81	Lowering benthic chamber frame
21-04-99	09.45	18.5	52 18.45	4 17.77	Lowering anchor stone
21-04-99	09.50	18.5	52 18.45	4 17.77	Lowering toroid
23-04-99	12.27	19.3	52 18.48	4 17.81	Retrieving benthic chamber frame
25-04-99	14.31	19.0	52 18.44	4 17.84	Lowering benthic chamber frame
25-04-99	14.43	18.7	52 18.48	4 17.88	Lowering anchor stone
25-04-99	14.46	18.7	52 18.48	4 17.88	Lowering toroid
25-04-99	17.35	19.0	52 18.48	4 17.88	Retrieving benthic chamber frame

Appendix 4

Multicorer

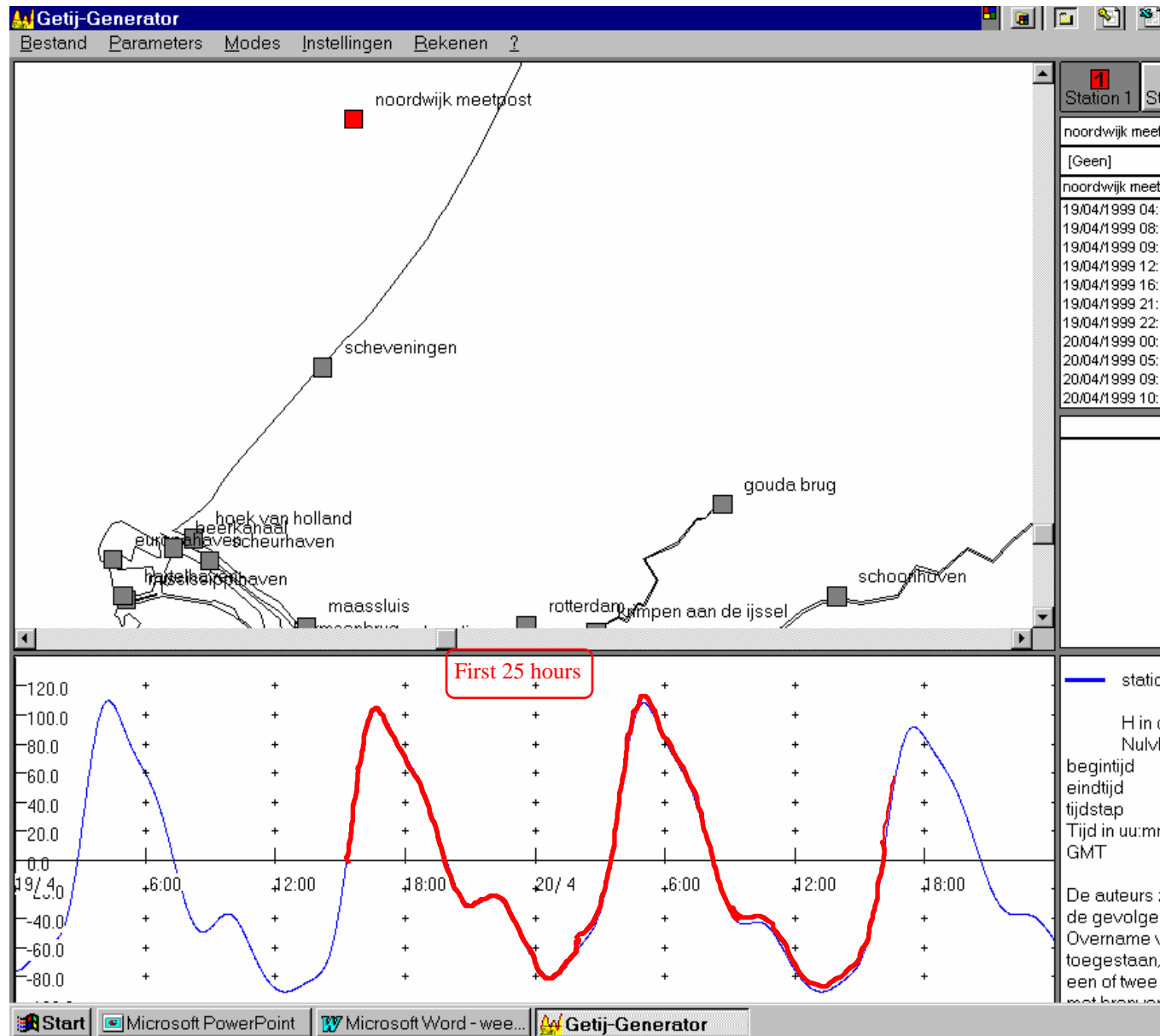
Multicorer	Date	Time in UTC	Depth (m)	Lat (N)	Long (E)	Remarks
MC1	19-04-99	14.00	17.1	52 18.15	4 17.92	No core
MC2	19-04-99	14.16	17.2	52 18.15	4 17.92	No core
MC3	19-04-99	14.44	17.2	52 18.14	4 18.08	1 core
MC4	19-04-99	14.54	17.3	52 18.15	4 18.08	2 core
MC5	19-04-99	15.06	17.5	52 18.14	4 18.09	2 core
Cast 37	21-04-99	11.29	18.4	52 18.14	4 18.07	Bottom water for incubation chambers
MC6	21-04-99	11.50	17.2	52 18.14	4 18.08	1 core
MC7	21-04-99	12.00	17.2	52 18.14	4 18.08	2 core
MC8	21-04-99	12.14	17.1	52 18.14	4 18.08	1 core
MC9	21-04-99	12.25	17.1	52 18.14	4 18.07	1 core
MC10	23-04-99	16.58	17.0	52 18.13	4 18.07	1 core
MC11	23-04-99	17.10	17.1	52 18.13	4 18.07	1 core
MC12	23-04-99	17.20	17.1	52 18.13	4 18.07	2 core
MC13	23-04-99	17.30	17.2	52 18.13	4 18.07	1 core
MC14	23-04-99	17.39	17.3	52 18.13	4 18.07	2 core
Cast 48	23-04-99	17.58	17.3	52 18.13	4 18.07	Bottom water for incubation chambers
MC15	26-04-99	08.30	17.5	52 18.14	4 18.08	1 core
MC16	26-04-99	08.41	17.5	52 18.14	4 18.08	2 core
MC17	26-04-99	09.00	17.5	52 18.14	4 18.08	2 core
Cast 101	26-04-99	09.23	17.5	52 18.14	4 18.08	Bottom water for Incubation chambers
MC 18	27-04-99	09.21	17.2	52 18.14	4 18.07	1 core
MC 19	27-04-99	09.36	17.2	52 18.14	4 18.07	1 core
MC 20	27-04-99	09.47	17.2	52 18.14	4 18.07	No core
MC21	27-04-99	09.53	17.2	52 18.14	4 18.07	1 core
MC22	27-04-99	10.07	17.3	52 18.14	4 18.07	No core
MC 23	27-04-99	10.16	17.3	52 18.14	4 18.07	1 core
Cast 124	27-04-99	10.33	17.3	52 18.42	4 17.80	Bottom water for Incubation chambers
MC24	28-04-99	17.04	17.5	52 18.14	4 18.07	1 core
MC25	28-04-99	17.15	17.5	52 18.14	4 18.07	1 core
MC26	28-04-99	17.27	17.4	52 18.14	4 18.07	1 core
MC27	28-04-99	17.35	17.4	52 18.14	4 18.07	1 core

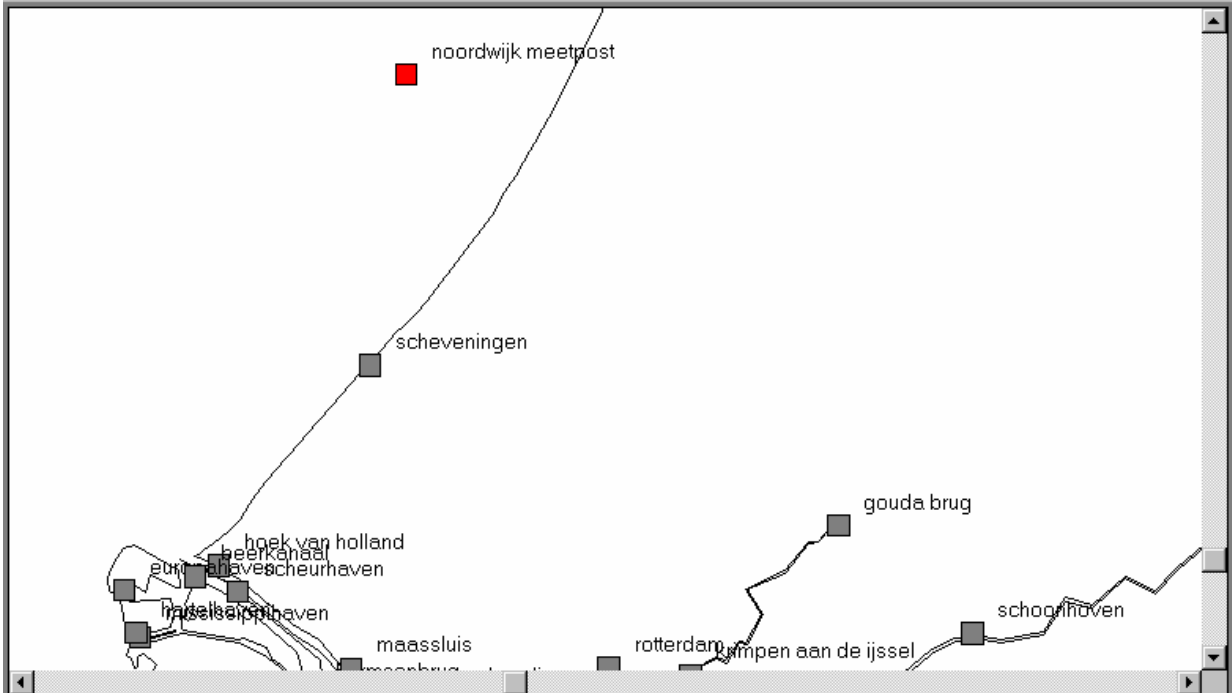
Appendix 5

Positions in UTM

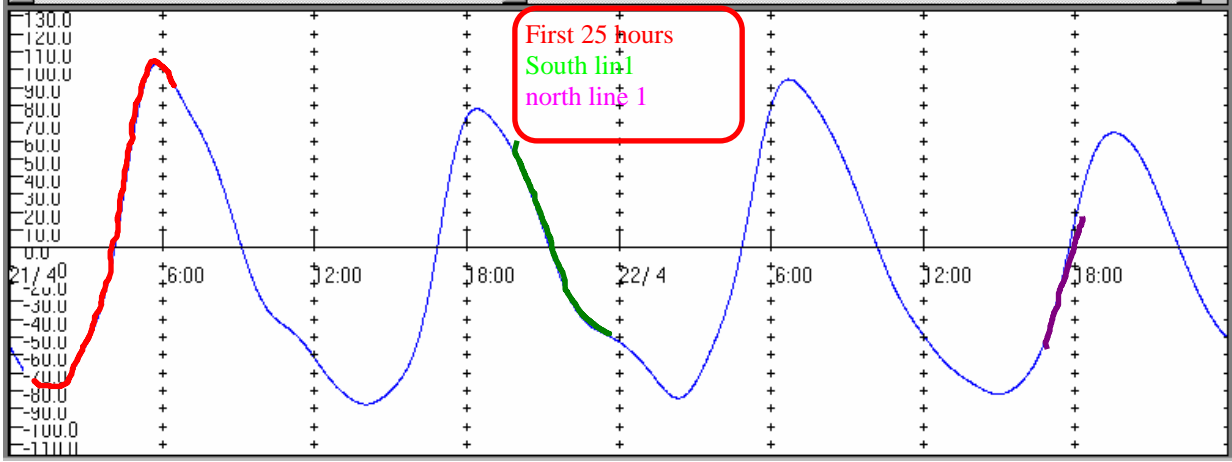
Station	X	Y	Station	X	Y	Station	X	Y
Scheveningen	586285.00	5772941.00	Main A	588662.68	5796002.89	NL19	572623.70	5810139.90
			T	581453.60	5797423.91	NL20	569042.60	5811086.00
multicore	588727.76	5795578.41	U	573931.00	5798974.24	NL21	565461.50	5812032.20
			V	591772.57	5810771.42	NL22	561881.50	5812976.80
NL1	593290.00	5797267.00	Site X	559016.53	5801925.19	NL23	600822.30	5810230.70
NL2	589696.20	5798163.08	Y	594891.01	5825295.73	NL24	597241.19	5811176.87
NL3	586102.04	5799059.16				NL25	593660.07	5812123.04
NL4	582508.00	5799955.00	SL1	591430.00	5790089.00	NL26	590078.96	5813069.21
NL5	578914.00	5800851.00	SL2	587849.00	5791035.00	NL27	586497.84	5814015.38
NL6	575932.00	5801747.00	SL3	584268.00	5791981.00	NL28	582916.73	5814961.55
NL7	571726.00	5802643.00	SL4	580687.00	5792927.00	NL29	579335.61	5815907.72
NL8	568132.00	5803539.00	SL5	577106.00	5793873.00	NL30	575754.50	5816853.89
NL9	564538.00	5804435.00	SL6	573525.00	5794819.00	NL31	572173.38	5817800.06
NL10	560944.00	5805331.00	SL7	569944.00	5795765.00	NL32	568592.27	5818746.23
NL11	557350.00	5806227.00	SL8	566363.00	5796711.00	NL33	565012.30	5819690.70
NL12	597691.50	5803516.80	SL9	562782.00	5797657.00			
NL13	594110.40	5804462.90	SL10	559201.00	5798603.00			
NL14	590529.30	5805409.10	SL11	555620.00	5799549.00			
NL15	586948.20	5806355.30						
NL16	583367.00	5807301.40						
NL17	579785.90	5808247.60						
NL18	576204.80	5809193.70						

Appendix 6



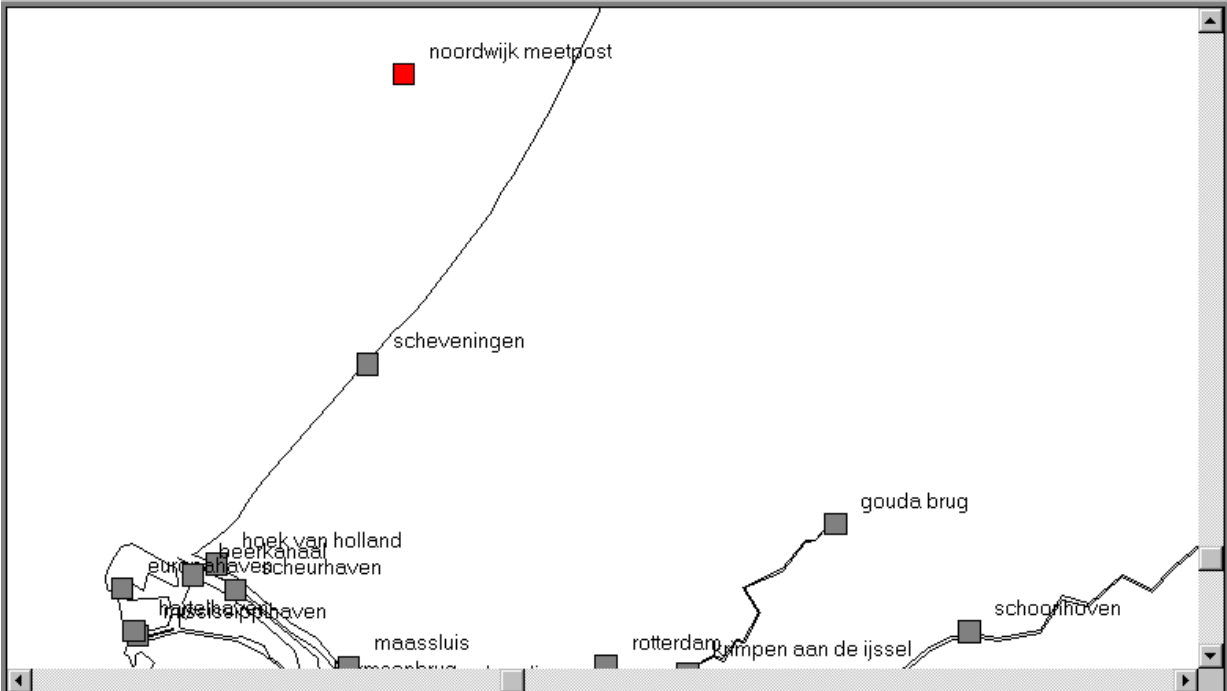


Station 1	St...
noordwijk meet	
[Geen]	
noordwijk meet	
21/04/1999 01:	
21/04/1999 05:	
21/04/1999 14:	
21/04/1999 18:	
22/04/1999 02:	
22/04/1999 06:	
22/04/1999 14:	
22/04/1999 19:	

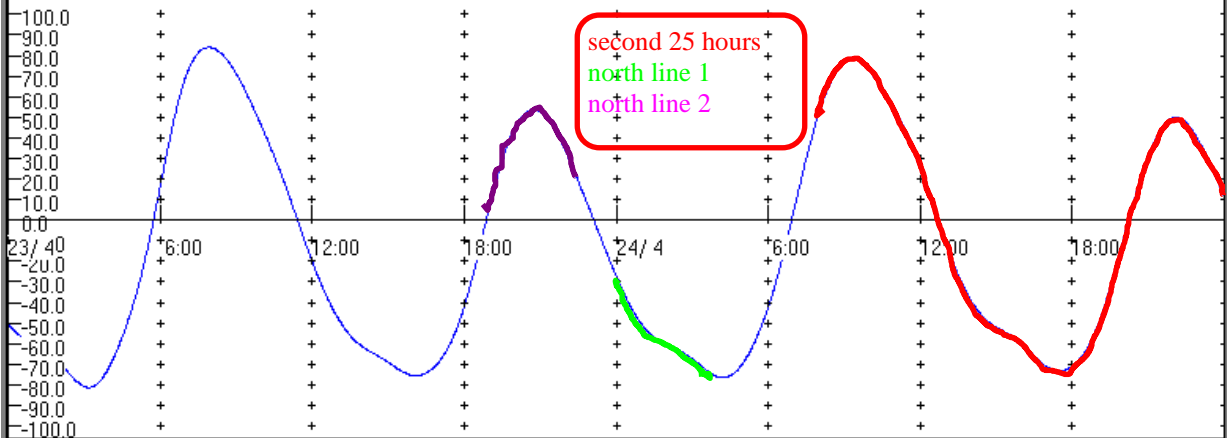


First 25 hours
South line
north line 1

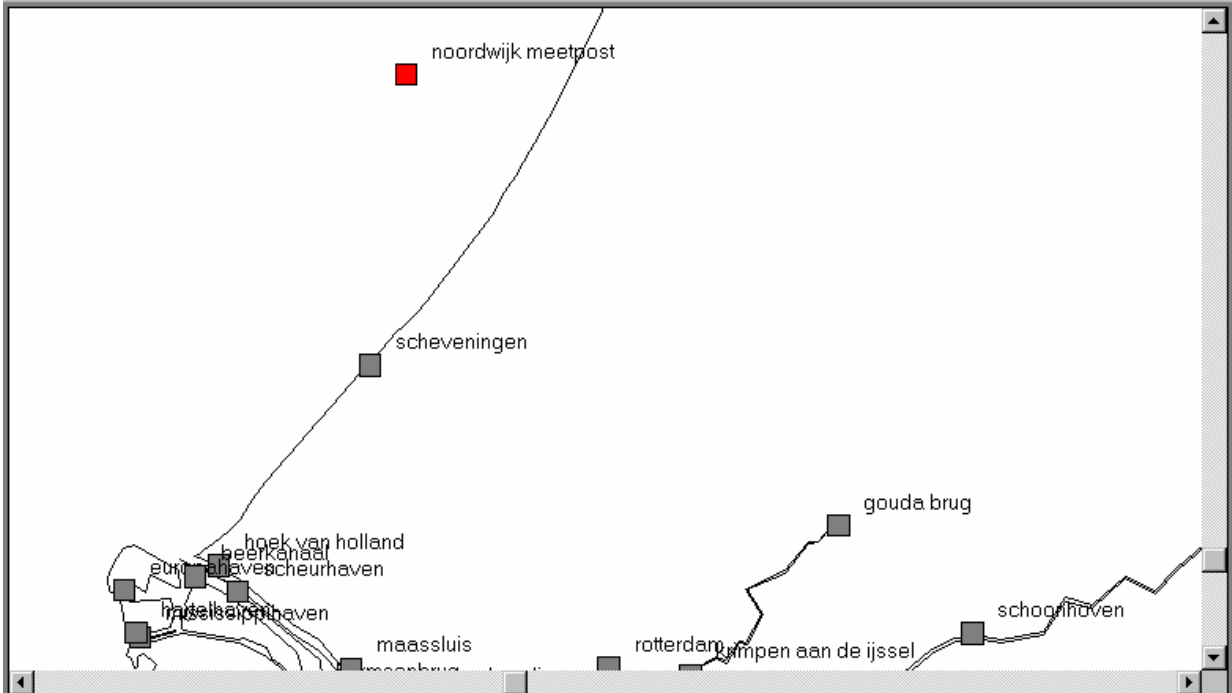
—	station
	H in
	Nulv
	begintijd
	eindtijd
	tijdstep
	Tijd in uur:m
	GMT
De auteurs	
de gevolge	
Overname v	
toegestaan	
een of twee	
met bronver	
Tevens ber	



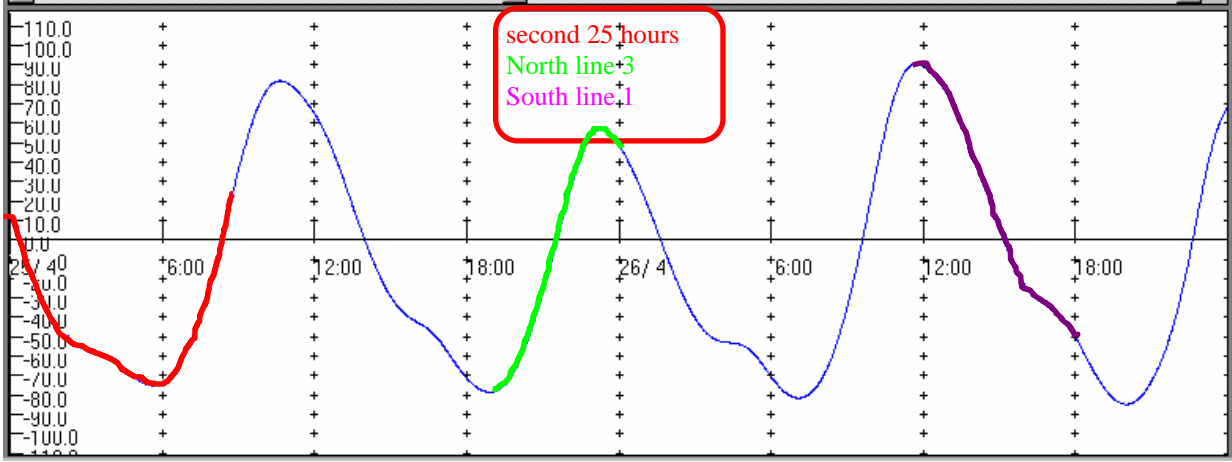
Station 1
noordwijk me
[Geen]
noordwijk me
23/04/1999 03
23/04/1999 07
23/04/1999 11
23/04/1999 20
24/04/1999 04
24/04/1999 08
24/04/1999 17
24/04/1999 22



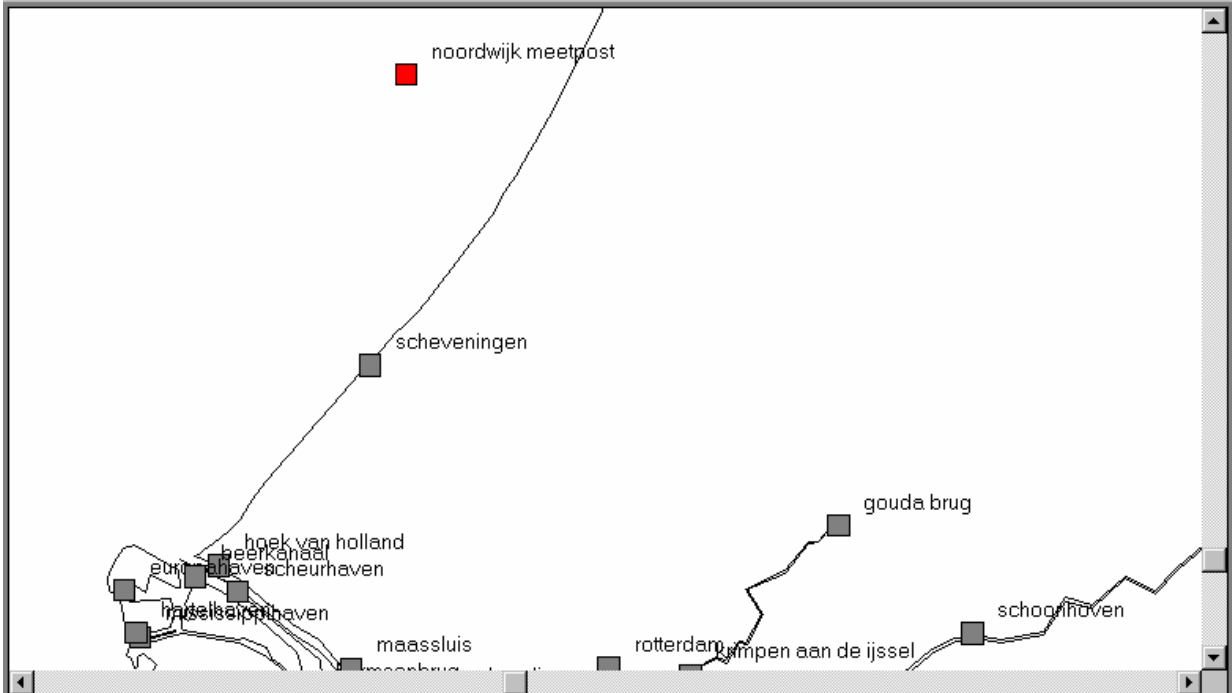
— stati
H in
Nuk
begintijd
eindtijd
tijdstep
Tijd in uur:
GMT
De auteurs
de gevolge
Overname
toegestaan
een of twee
met bronve
Tevens be



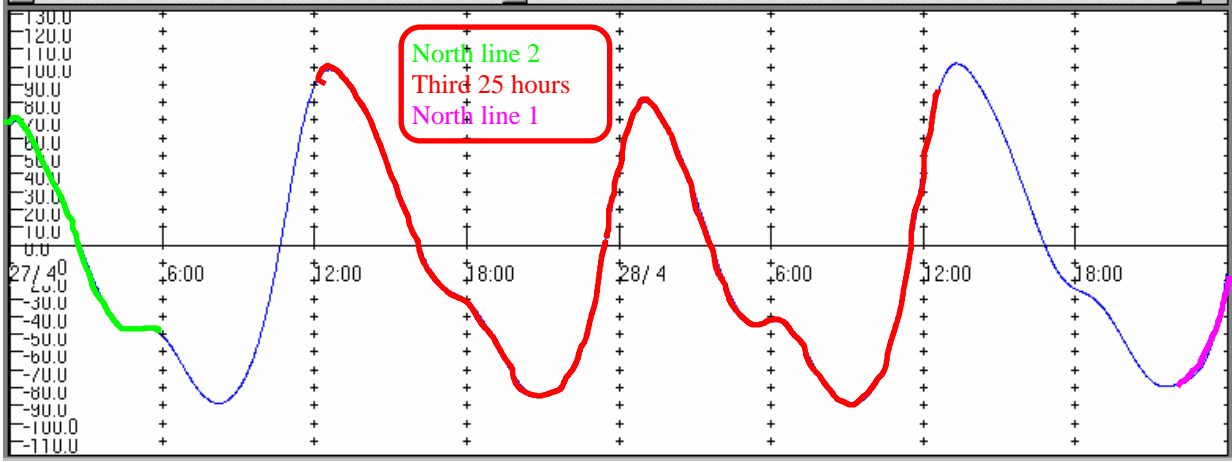
Station 1
noordwijk meet
[Geen]
noordwijk meet
25/04/1999 05:
25/04/1999 10:
25/04/1999 18:
25/04/1999 23:
26/04/1999 07:
26/04/1999 11:
26/04/1999 20:



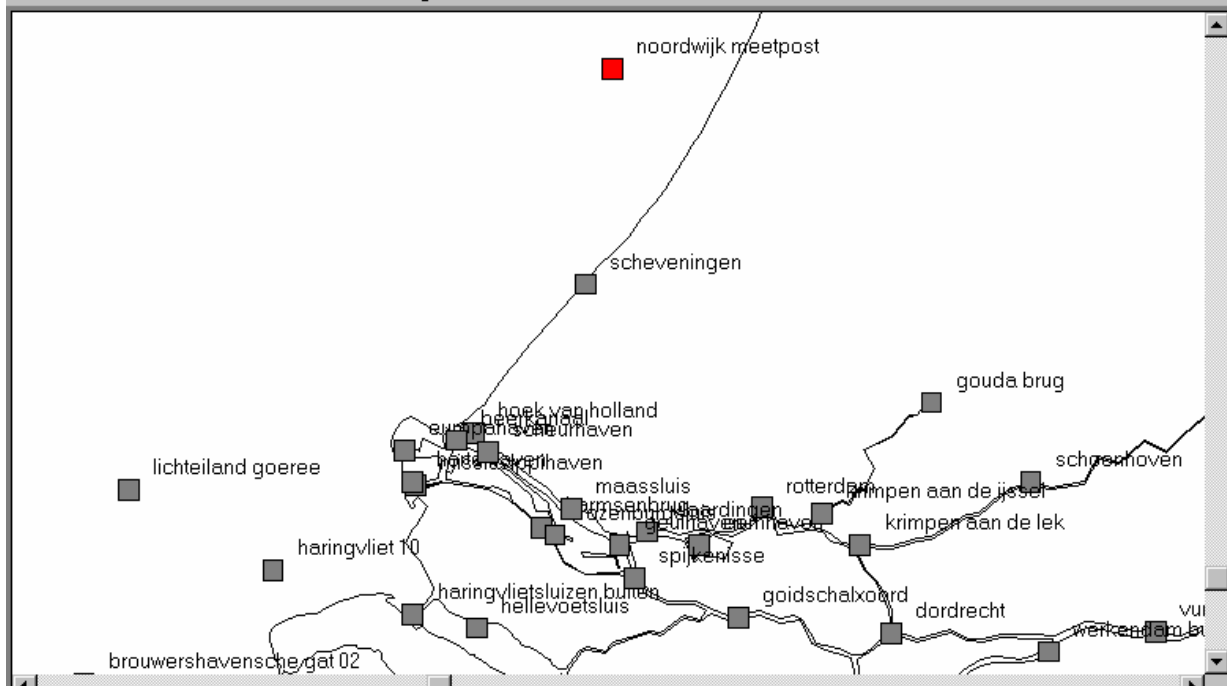
— station
H in
Nulv
begintijd
eindtijd
tijdstep
Tijd in uur:m
GMT
De auteurs
de gevolge
Overname v
toegestaan.
een of twee
met bronver
Tevens ber



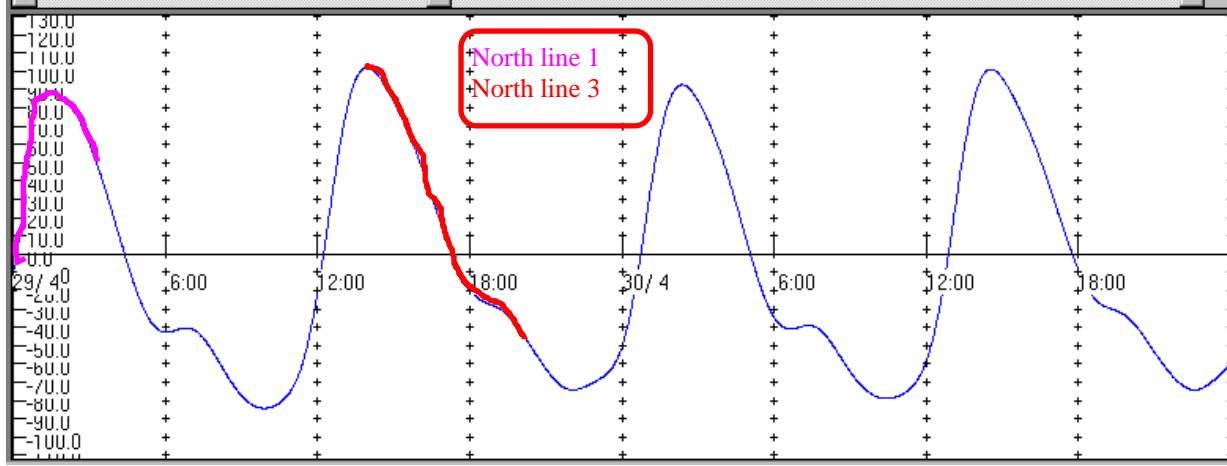
Station 1
noordwijk meet
[Geen]
noordwijk meet
27/04/1999 00:
27/04/1999 04:
27/04/1999 05:
27/04/1999 08:
27/04/1999 12:
27/04/1999 20:
28/04/1999 01:
28/04/1999 05:
28/04/1999 06:
28/04/1999 09:
28/04/1999 13:



—	station
	H in
	Nulv
	begintijd
	eindtijd
	tijdstap
	Tijd in uur:mn
	GMT
	De auteurs
	de gevolge
	Overname v
	toegestaan
	een of twee
	met bronver
	Tevens ber



Station 1	S
noordwijk meet	
[Geen]	
noordwijk meet	
29/04/1999 01:	
29/04/1999 06:	
29/04/1999 06:	
29/04/1999 09:	
29/04/1999 13:	
29/04/1999 22:	
30/04/1999 02:	
30/04/1999 06:	
30/04/1999 07:	
30/04/1999 10:	
30/04/1999 14:	



—	station
	H in
	Nulv
	begintijd
	eindtijd
	tijdstap
	Tijd in uur:m
	GMT
	De auteurs
	de gevolge
	Overname v
	toegestaan
	een of twee
	met bronver
	Tevens ber