"Alternative uses of data from satellite monitoring of fishing vessel activity in Fisheries management"

EC Project 98/023:

Interim Report

Authors:

E. Vanderperren
Dr. G.J. Piet
B. Jooris
Dr. R. De Clerck

RIVO

Netherlands institute for fisheries research

Haringkade 1
1976 CP IJmuiden, (The Netherlands)
Tel.: +31.255.564646
Fax: +31.255.564644

DvZ-CLO

Ministry of Small Enterprises, Traders and Agriculture
Agriculturale Research Centre – Ghent
Sea Fisheries Department
Ankerstraat 1
B-8400 Oostende (Belgium)
Tel: +32 59 342250
Fax: +32 59 330629

"Alternative uses of data from satellite monitoring of fishing vessel activity in Fisheries management"

EC Project 98/023:

Interim Report

Authors:

E. Vanderperren
Dr. G.J. Piet
B. Jooris
Dr. R. De Clerck

Table of content

"Alternative uses of data from satellite monitoring of fishing vessel activity in Fisheries management"

EC Project 98/023:

Interim Rapport: Draft I

1. INTRODUCTION

In 1998, the EU began a satellite based vessel monitoring system (VMS) for certain categories of community fishing vessels fishing in 3rd country waters, which will be extended to community waters for all vessels exceeding 24 m overall length from the year 2000. These programmes will generate a large amount of information on the distribution and activity of fishing vessels in Community and third country waters. Although the schemes are aimed primarily at monitoring the activity of the vessels in relation to licence arrangements and enforcement, they provide a unique opportunity to use the data in fisheries assessment and management. The aims of this project will be to evaluate alternative uses of satellite monitoring data in fisheries assessment and management and to develop the basic data handling and modelling techniques:

(a) describe the activity of the fleets in detail using graphical and statistical outputs
(b) test environmental and engine sensors as a means of validating fishing activity
(c) develop algorithms to identify fishing activity based on the speed and direction of the vessel
(d) develop and test improved cpue and effort indices
(e) analyse multi-species aspects of the fishery
(f) evaluate the use of accurate fishing effort data in modelling fleet behaviour and to provide estimates of catches fleet and where possible on member state level.
(g) assess the frequency of trawling over the seabed in the western North Sea to compliment the and extend the coverage obtained by RIVO in the eastern North Sea
(h) evaluate the use of environmental sensors, engine sensors and log book data to model spatial and seasonal variability in catch and effort

This interim report gives an overview of the progress and the accomplishments by each country during the first year of EU-project 98/023. Participating countries are The Netherlands (RIVO) and Belgium (DvZ-CLO, co-ordinator).

2. OVERVIEW OF THE BEAM TRAWLER FLEETS OPERATING IN THE NORTH SEA

2.1 The Netherlands

The Dutch fishing fleet consists of 736 vessels registered in 46 harbours. The main harbours are Bruinisse, Den Helder, Goedereede, Harlingen, Urk, Yerseke and Zoutkamp in which more than half of the vessels are registered. Two segments of the Dutch fleet should be distinguished when considering their fishing positions: vessels with engine power below or above 300 Hp. Only vessels with engine power less than 300 Hp (the so-called "eurocutters") are allowed to fish within the 12-miles zone and "plaice-box". These vessels mainly fish in the

coastal zone. The Dutch fishing fleet consists of about 400 Eurocutters. The remaining "large" vessels generally fish further offshore.

2.2 Belgium

The Belgian fleet consists of 125 vessels of which the major part is registered in Zeebrugge (75) and Oostende (32). It is not possible to define the North Sea Fishing fleet because fishing grounds often changes during the year. Southern and Central North Sea (IVb, c) is the main fishing ground, but a major part of the fleet shift during the year from one fishing ground to another. The motives for such change depend mainly on the current catch rates on each fishing ground.

3 STATUS OFFICIAL V.M.S-CONTROL

3.1 The Netherlands

At present there are about 237 Dutch fishing vessels larger than 24 m. Part of these vessels is applying for exemption from the regulation that EU regulation that position registration is mandatory because these vessels:

- Fish only within the 12-miles zone
- Are at sea for periods shorter than 24 hours

Whether or not these vessels will be exempted is still being investigated. Of the remaining vessels, 186 are set up with approved equipment and are being monitored at a frequency of once every two hours. Standard procedure is to register only vessel identifier, time and position. Occasionally it can be decided to register at a higher frequency (if in the vicinity of sensitive areas like the 12-miles zone or the plaice box) and/or to register also speed and direction.

3.2 Belgium

Before 1st of January 2000 Belgium had not implemented a satellite based vessel monitoring system (VMS), because the EU regulations enforced before 2000 did not apply on the categories of fishing vessels registered in Belgium. From 1st of January 2000 the number of fishing vessels categories falling under the EU regulations was extended and a hundred Belgian fishing vessels have to be monitored with a satellite based vessel monitoring system.

The "Dienst voor Zeevisserij"— part of the Ministry of Small Enterprises, Traders and Agriculture— responsible for the enforcement of EU and national legislation involving fishing activities had to set up a satellite based control centre. However due to logistic and technical problems this centre is not operational yet. The "Dienst voor Zeevisserij" expects to put the system into operation any day now. The control system is designed to poll each vessel —that is 'call' the vessel and ask for position information— every two hours and register the vessel identifier, time and position. If necessary the frequency of polling can be raised.

According to EU regulations 96 Belgian fishing vessels have to be monitored. National regulations extend this number with 7 vessels, because they practice the same activities. Until now 45 vessels are equipped with the approved positioning system, but only 25 of them are presently monitored by the control centre.

4 PROGRESS BY EACH COUNTRY

4.1 The Netherlands

Progress

In the description of the current status of the VMS project in the Netherlands three actors are involved:

- Inspectorate of the ministry of Agriculture Nature conservation and Fisheries (AID)
- Fish board (PV)
- Netherlands Institute of Fisheries Research (RIVO)

At the onset of the project it was decided the best and most cost-efficient approach for the Netherlands to set up a system capable of monitoring the fishing activities of the national fleet was to use the equipment and expertise already available at the AID. The AID is responsible for the enforcement of EU and national legislation pertaining to a.o. fishing activities. The data acquired are for enforcement purposes only and confidential. Therefore in order to be able to use the AID data, RIVO needed an authorisation from each individual vessel that would allow AID to make the data available to RIVO.

Table 1: Vessels equipped to be tracked by VMS and allowing the use of their position registration data by RIVO. Above the vessels with engine power > 300 Hp, below the Eurocutters. The vessels that register their catch on a haul-by-haul basis and allow the use of that data are indicate with *.

Ship	Engine power (Hp)	Length (m)	Logbook
GO 20	2000	39.45	
GO 22	3900	45.60	*
GO 4	1995	40.11	*
GO 40	1400	33.86	*
GO 44	2025	39.02	*
GO 56	1995	41.20	*
GO 59	1999	45.98	*
IJM 11	2000	38.92	*
IJM 44	2400	39.54	*
KW 45	2000	42.85	
OD 50	1800	34.54	
SL 27	2000	40.20	*
SL 3	1230	30.55	
TH 43	2720	39.38	
TX 14	1996	40.90	
UK 177	900	30.05	
UK 184	1986	37.46	
UK 224	1036	33.55	*
UK 45	1900	38.76	*
UK 87	1800	40.40	
UK 88	1800	39.38	
VLI 28	2140	39.00	*
	Euro cutters		
KG 6	300	24.45	
KG 7	300	24.45	
WR 108	300	26.02	
WR 244	300	24.45	
WR 34	300	24.45	
YE 139	300	25.09	

All Dutch fishing vessels received a request for authorisation but at present only 42 vessels actually signed it. Of these 42 vessels only 28 vessels are longer than 24 m and therefore equipped for VMS. Hence the sample size is considerably smaller than the potential size of 186. Reason for the poor willingness to co-operate is among others a negative advice from the fish board on co-operation with the VMS project. This negative advice was based on the fact that at that time there was no understanding between AID and PV as to the exact contents, timing and enforcement of the EU legislation. Other reasons were dissatisfaction with TAC advice and the continued closure of the "plaice box". Apart from the vessels for which tracking by VMS is mandatory, a number of vessels have volunteered to co-operate although they are not equipped for VMS tracking (table 2).

Table 2: Vessels willing to co-operate but not equipped for VMS tracking

Ship	Engine power (Hp)	Length (m)
BR 29	229	19.68
KW 72	300	21.70
OD 5	300	20.57
OL 12	300	19.15
TH 5	300	22.97
UK 158	300	23.97
WL 27	250	23.38
WL 7	256	23.95
WR 17	300	22.47
WR 18	300	22.47
WR 21	300	23.92
WR 52	300	23.96
ZK 49	229	21.06
ZK 87	299	23.88

Recently AID and PV have reached an understanding and PV is willing to give a positive advice so a new request for authorisation will be issued shortly. The planning for the collection of position registration data presented below, however, will be based on the sample of vessels that have already signed the authorisation. Later this planning may be adjusted if more vessels are willing to co-operate in the VMS project.

The VMS project is an extension of earlier work by RIVO on the monitoring of fishing activities of the Dutch beam trawl fleet. In 1993 a project "A study of the microdistribution of beam-trawling using an automated position recording system" was started funded by EU, Dutch Ministry of Agriculture, Nature conservation and Fisheries together with the Dutch Fish board.

In this project data on the spatial distribution of beam trawlers was available from two sources: a) EC-logbooks of the total Dutch fleet (VIRIS data base); b) automated position recordings from a sample of on average 25 Dutch beam trawlers (APR data base).

In the VIRIS database, the fishing effort of the total fleet is registered on a spatial scale of 30 x 30 mile (ICES rectangles) based on the EC-logbook forms. The form contains information on the time of the start and end of the fishing trip, the gear used, the ICES rectangle fished and the landings by fish species. The database is designed for quota management purposes under responsibility of the Ministry of Agriculture, Nature management and Fisheries, but is available for research purposes.

The APR data set consists of positions that were recorded in a sample of the Dutch beam trawl fleet with an automated position recording system (APR) that was connected to the navigator (Decca, GPS, DGPS). The APR device has a separate power supply (24 Volts) and internal clock. The position information from the navigator is stored in a buffer and, after a fixed time interval, decoded and recorded on a removable memory card with an accuracy of 0.1 minutes (±180 m). The accuracy of the recorded position is less than that of the navigator (± 12 to 100 m). Each position fix is based on one reading from the navigator. All APR devices and memory cards had a distinct identity number. At the start of each fishing trip, the skipper inserted a new memory card in the device and returned the card to RIVO at the end of the trip. When a memory card is inserted, software specifying for instance the registration interval is loaded and the time and first position are recorded. The internal clock was set at installation and checked at least every year. After receiving the memory card at the laboratory, the position recordings were added to the computer database after data control.

For each position, the speed of the vessel (S) was calculated from the distance covered between subsequent positions. The speed during fishing (FS = ± 6 knots) is related to the engine power of the vessel and differed from the speed during steaming (± 12 knots). Position recordings were classified in one of three classes (fishing, steaming, floating) based on the speed of the vessel.

The sample of beam trawlers participating in this project comprised on average about 25 vessels (±10% of the Dutch fleet) stratified by fishing harbour and engine power. In the course of the sampling period a number of vessels were replaced and the section of so-called Eurocutters (vessels with engine power ≤ 300 Hp) was expanded (table 3). Since the start of the project 4362040 valid position registrations were collected or on average 623149 per year.

Originally it was planned to continue for three years but because of the interest of both policy makers and fishing industry it was continued until this date. The intention is that the long-term dataset on the spatial distribution of the Dutch beam trawl fleet is continued using the data from the VMS project. To assure uninterrupted and consistent dates it is essential that a certain degree of overlap exist between the two detests. This will enable the researchers to verify and validate the data collected in these two projects against one another thereby ascertaining the consistency of the dataset. Because verification of the usefulness and reliability of the data collected in the VMS project is considered an important issue it was decided to continue the collection of data using the APR system until at least a three-month overlap with position recordings using VMS was achieved. This could only be accomplished by continuing the registrations using APR as part of the VMS project. Probably the main added value of the merging of the APR and VMS data is that a markedly longer time period is covered allowing comparison between years of, for example, distribution patterns, CPUE indices beam trawl intensities etc.

Table 3: Total number of APR registrations per year and quarter for the two segments of the fleet

Eurocutter	1993				1994				1995				1996				1997				1998				1999			
	1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4
62													1991	9001	3916	2007	7652	10786	5412	9314								
71																					3593	10527	8569	9457	13072	14609	10391	2110
72													1400	2777	6441	5691	2580	8825	5732	6811	5743	8047	4991	6125	7166	8892	2498	
73													827	8066	7290	6737	7697	9713	5727	6233	501	6531	2796				2952	
74														4737	5256	8323	9153	11473	8579	353	10062	1710			5232			
76																	737	2409	5976	6050	1503		6271	1491				
81	1	7057	7144	4905	1567	4124	6498	5488	5930	5115	2245	8505		5059	7476	5526	955	9569										
Total	1	7057	7144	4905	1567	4124	6498	5488	5930	5115	2245	8505	4218	29640	30379	26284	28774	52775	31526	28761	21402	26815	22627	17073	25470	23501	15841	2110

> 300 Hp	1993				1994				1995				1996				1997				1998				1999			
	1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4
6	484	8325	12404	10081	13053	9787	11517	9646	6701	4412	3116	8946	4886	7656	1412													
11		2235	6185	1573	6353	7253	6186	6942	4120	8280	5828	7853	3979	8694	3779	9978	2747		5806	7084	8651	6177	7762	7253	8673	8364	8517	
21	444	5310	5771	5120	7749	5380	9057	8097	7382	8871	7025	5671	5469	6187	1599													
22		1960	8673	8400	9266	8612	8209	8265	9553	6748	6830	9445	10223	12411	9539	1463	12127	10493	14328	14230	11572	14120	5768					
31		1487	7599	8649	9759	6349	3691																					
41	1981	4483	3725	8360	4854	7405		4875	8607	7900	6713	10132	6287	6949	7996	7857	7628	5495	6149	11070	8339	3210	7008	10281	8835	9250	6764	1856
42	1914	5466	7041	7282	8862	6676	7290	7818	3074	1186		1420	1542	3522														
43	1861	10151	6453	8468	7608	6109	5324	4137	10526	9093	6641	9875	9720	4102	6254	10399	10017	7124			2896	6290	2356	7663	10165	9422	7174	1704
44		6096	3680	7249	7023	7827	5872	8829	9479	7328	5741	8691	6300	5095	6794	9720	7267	11125	8695	9738	10094	9725	6114	4407	687			
45		1300	6833	5158	5005	5870	9743	7366	6628	7115	9057	8620	7415	6994	8650	7813	7739	9068	7708	8415	8410	10430	9196					
46		557	7231	8096	9353	4893	5605	6994	8343	1253	5514	9774	8142	5287	7058	7186	7845	10958	6833	4289	6309	8127	3180	8468	10528	10253	7364	407
47		530	7190	6464	7005	5144			4476	8655	7613	8982	7004	4236	6825	8659	7518	10168	8910	8520	6059	7751	3451	7767	9139	5547	8857	774
48			3640	4884	1114	5126	6072	5962	5799	5910	5046	2751	3475				2455	2177										
49			2156	8313	7682	5534	8122	9233	11482	5918	4523	9481	8729	3039	6491	8602	6930	7828	10271	8386	6967	10020	2520	7137	9702	9210	7206	765
50						6311	4498	8102	7454	5785	4511	9310	6633	3415	4114	10214	7785	9361	6268	8594	9919	9002	5428	9457	10125	7379	7656	847
51								1385	9801	10333	5717	9436	3674	3689	7739	9540	7706	11254	7739	10325	9815	10520	7308	4577	9662	9376	7620	728
52														6220	7159	1450												
61		4879	5341	4710																								
82		5671	7135	7457	1161	5273	6531	5823	8077	7132	8589	7448	7756						4744	3631		8305	10202	6474	9414	14178	5107	
83		8260	8808	8626		6544	8920	10077	8656	9284	10804	8370	8220	6864	7589	9544	7688	11335	10647	10990	9626	10874	4436	8331	10442	10700	5532	
84		4375	8457	8201	5184	6113	7193	2167	5644	5488	7338		7615	7742	9032	5360	7095	8882	8919	1587								
85		5356	9391	9366	9638	5701	6818	8943	7838	7688	4046	8750	5274	9229	5596	10344	8574	6696	5622	10991	7858	9386	8707	9445	9633	8982	4381	1353
86		1847	7207	6912	5761	1510																						
87		4388	6693	8431	7580	7346	3885	9629	6489	8815	5252	8870	1526	3972	5502	3263	6038	5973	4581		6191	7274						
88		1670	7472	2087	6969	6270	7679	5007	644	3663	6123	5842	4905	7196	9665	7283	6166	10907	8152	8759	8130	10190	9318	7650	7916	3541		
89		2868	6269	1601	7953	8911	6385	2490	4989	9631	3379	1822	5376	5639	5666		3201	10760	4487	560	3814	216	5540	5221	7423	7961	4854	
90		584	6938	7968	9131	7530	4342	9711	6554	6604	3259	4827	8487	8326	7209	10790	8953	10921	7163	9225	6286	11110	8262	9938	10657	1844		
91								2856	4125	3904	5945	5786	7385	6624	6095	9925	6764	6628	9769	9075	8705	9355	6516	7231		3023	10511	882
92																	3042	9595	9564	5836	9022	5849	9164	8912	9449	9428	8862	848
93																			10283	5771	12045	12012	10948	10845	5920	10573	9079	1697
Total	6684	88698	158000	161000	158000	153000	141000	155000	166000	161000	139000	172000	150000	143000	142000	149000	145000	177000	167000	157000	161000	180000	133000	141000	148000	139000	109000	11861

Results

Using position registration data from the micro distribution project, analyses were performed that were relevant for the planning and tuning of the VMS project. These analyses focussed on two topics: (a) determination of fishing speed, (b) effect of position registration frequency on the perceived distribution of fishing activities.

Because the fishing speed is known to depend on the engine power of the vessels two classes were distinguished: Vessels with engine power ≤ 300 Hp (HP1) and vessels with engine power > 300 Hp (HP2). For each engine class the frequency of occurrence of the speed at the position registrations was calculated and based on these data a range of speeds was determined within which a vessels was considered to be fishing. For HP1 vessels the range was 2-6 knots, for HP2 vessels the range was 4-8 knots (figure 1,2,3,4). When speed was below that range it is characterised as "floating" (hauling the nets or inside the harbour), when above that range it is characterised as "steaming". Only the fishing positions are considered relevant for the VMS project.

From the whole dataset of all position registrations (not only fishing positions) collected within the microdistribution project several subsets were derived depending on the interval between registrations. The following intervals were applied: 6, 12, 18, 24, 30, 60, 90 and 120 minutes. Distributions of the different subsets were compared with each other and with the distribution of the dataset of fishing position registrations with a 6-minute interval. As can be expected the total number of registrations decreased inverse proportional to the interval chosen. The total area covered however, decreased markedly less than can be expected with increasing interval (Table 4). There was hardly any difference between the subsets that only differed in interval time, the main differences were observed between the subsets consisting of all registrations and the dataset of only fishing registrations. Notably in closed areas such as the 12 miles zone and the plaice box where this segment of the fleet was not allowed to fish, the first three subsets do show registrations whereas the latter dataset does not. The minor differences between the different interval subsets were confirmed by the comparison of the proportion of the area covered by a specific number of (normalised) registrations. It was shown that with an increasing interval the relative area with a low number of registrations decreased in favour of area with higher numbers of registrations (Table 5).

Table 4: Total number of registrations and total number of 3x3 Nm squares depending on the interval chosen

Interval	Registrations	3x3 Nm squares
6	6948766	36003
12	3777065	35028
18	2519765	34165
24	1891165	33270
30	1514088	32523
60	759904	29625
90	508524	27616
120	382880	26159

Table 5: Proportion (%) of the area with normalised number of registrations at different intervals

Number of registrations	Interval (minutes)		
	120	60	6
0-500	60	62	67
500-2000	28	27	23
2000-4000	7	7	6
4000-10000	4	4	4
> 10000	0	0	0

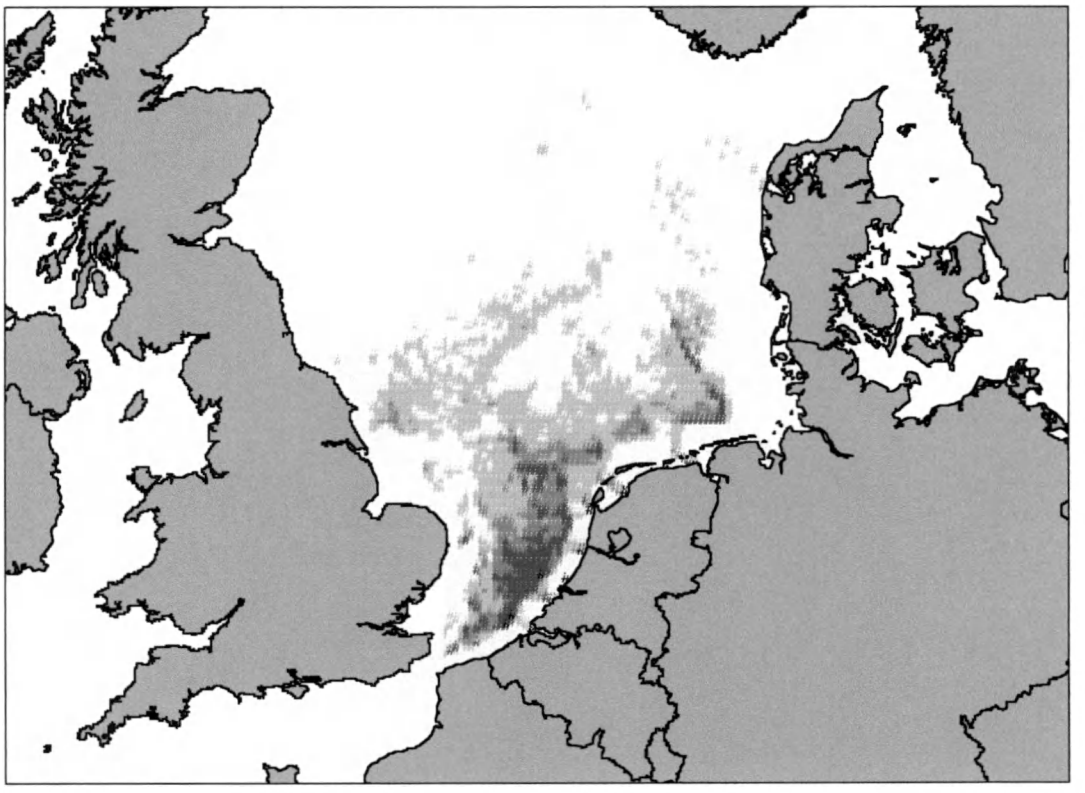

Figure 1: Distributions of all position registration at intervals of 120 minutes

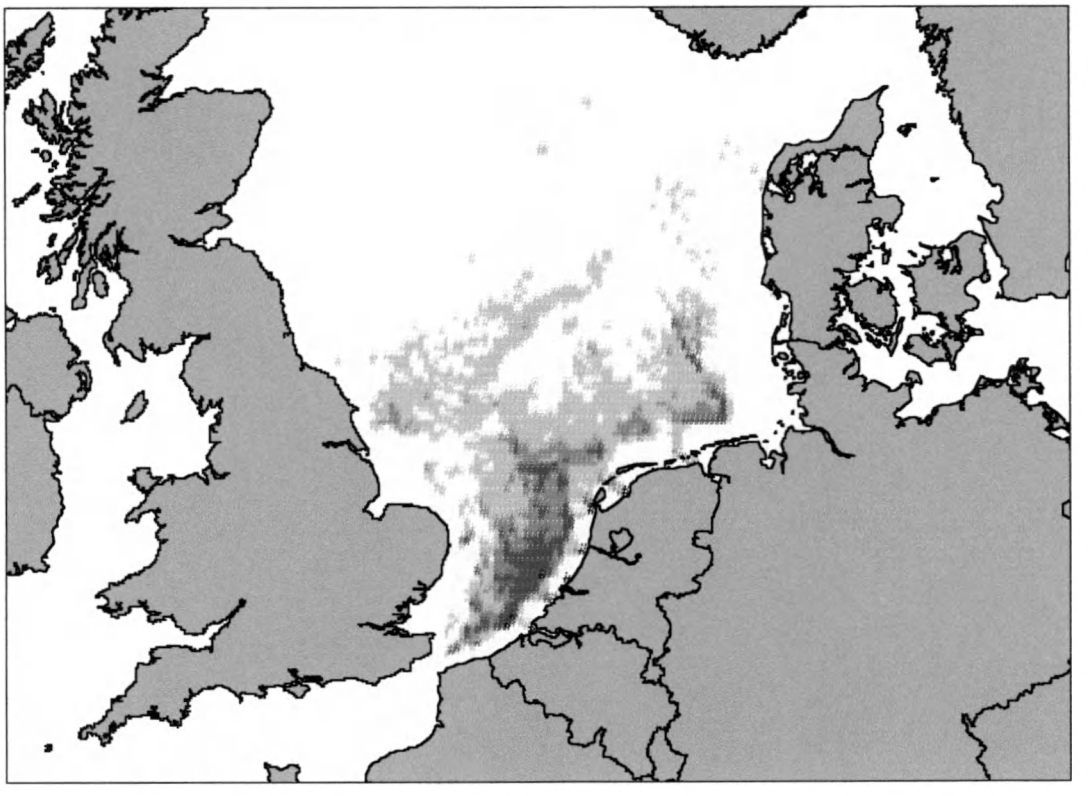

Figure 2: Distributions of all position registration at intervals of 60 minutes

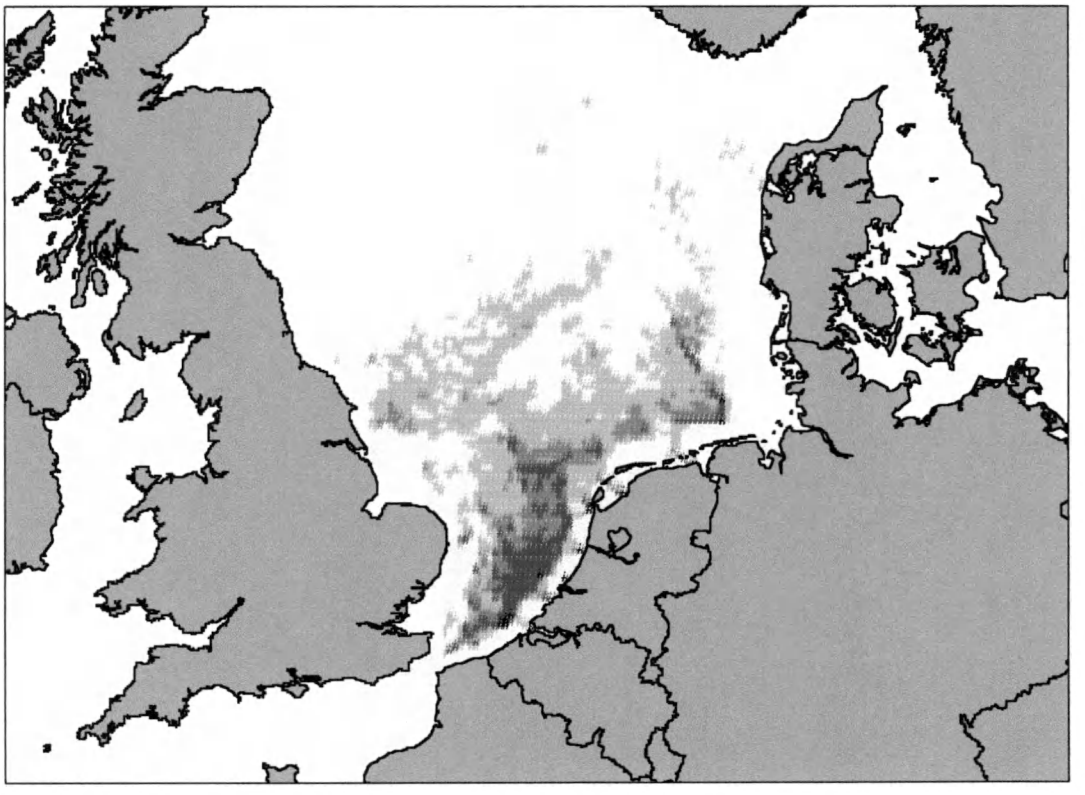

Figure 3: Distributions of all position registration at intervals of 6 minutes

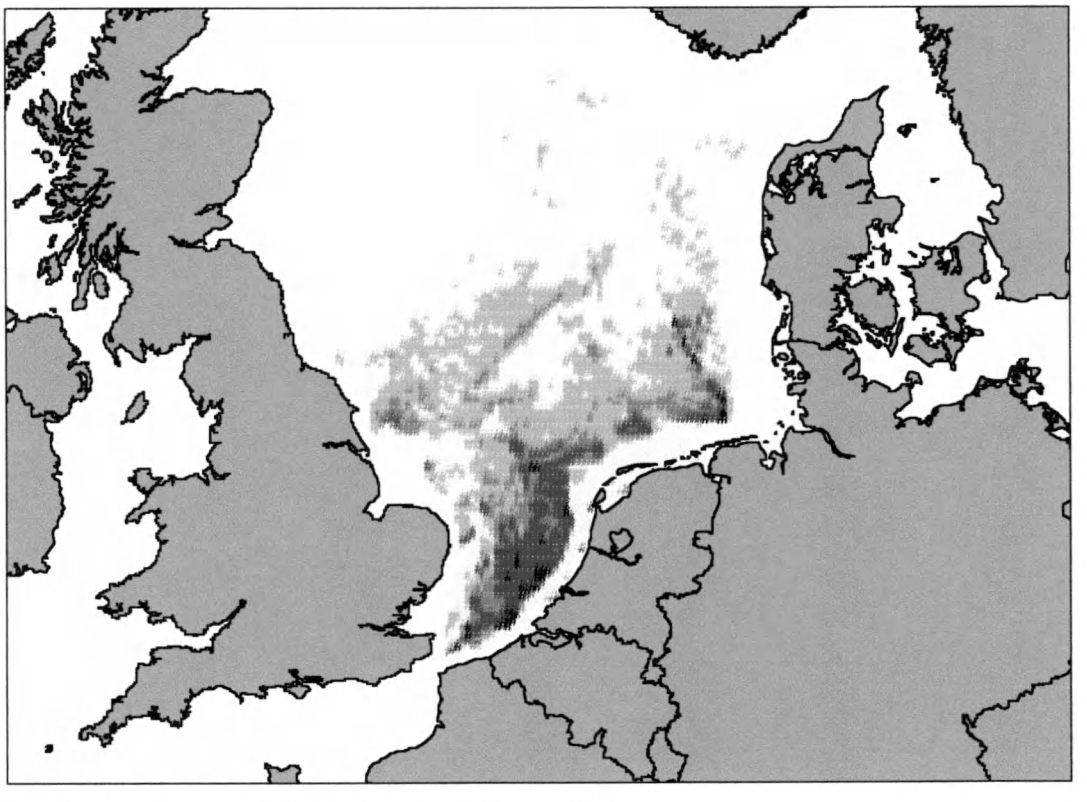

Figure 4: Distribution of the fishing position registrations at 6-minute interval.

4.2 Belgium

Progress

At the onset of the project it was decided to co-operate with the official authority responsible for satellite based vessel monitoring "Dienst voor Zeevisserij" (see 3.2). So the data collection by Belgium and the Netherlands would be analogous. Due to a series of delays during the start-up of the official control centre —the system is still not fully operational— we had to alter our approach several times.

Our first intention was to involve fishing vessels that participated in a previous project (1995) using satellite position data. These vessels were in connection with this previous project equipped with the necessary hardware (laptop, blue- or black box, receiver-transmitter). In 1999 however only a few of them were still equipped and willing to participate. We started to write the necessary software to combine the position data with the logbook and sensor data, still planning to corporate with the official control centre for retrieval of the data during the test period of their system. Finally we were forced to write software which was capable of operating without any involvement of the official control centre. This means that the data collection, retrieval and processing had to be integrated in our software package.

Figure 5 gives a schematic overview of the DvZ-system. Via the navigation satellite and the Inmarsat-C/GPS the position data are registered and combined with the data of the electronic logbook and the data of environmental and engine data. These data are compressed into data packages, which are subsequently transmitted via a satellite link (communication satellite) to the ground station. From the ground station the data are sending to a computerised mailbox and afterwards collected via E-mail, so that the data processing at the institute can start. This system allows recording different kind of data on a haul by haul basis, and provides very detailed information. Once the system is installed on board of the participating vessels and operative, valuable data are collected without the input of a lot of additional effort by the fisherman nor the scientist.

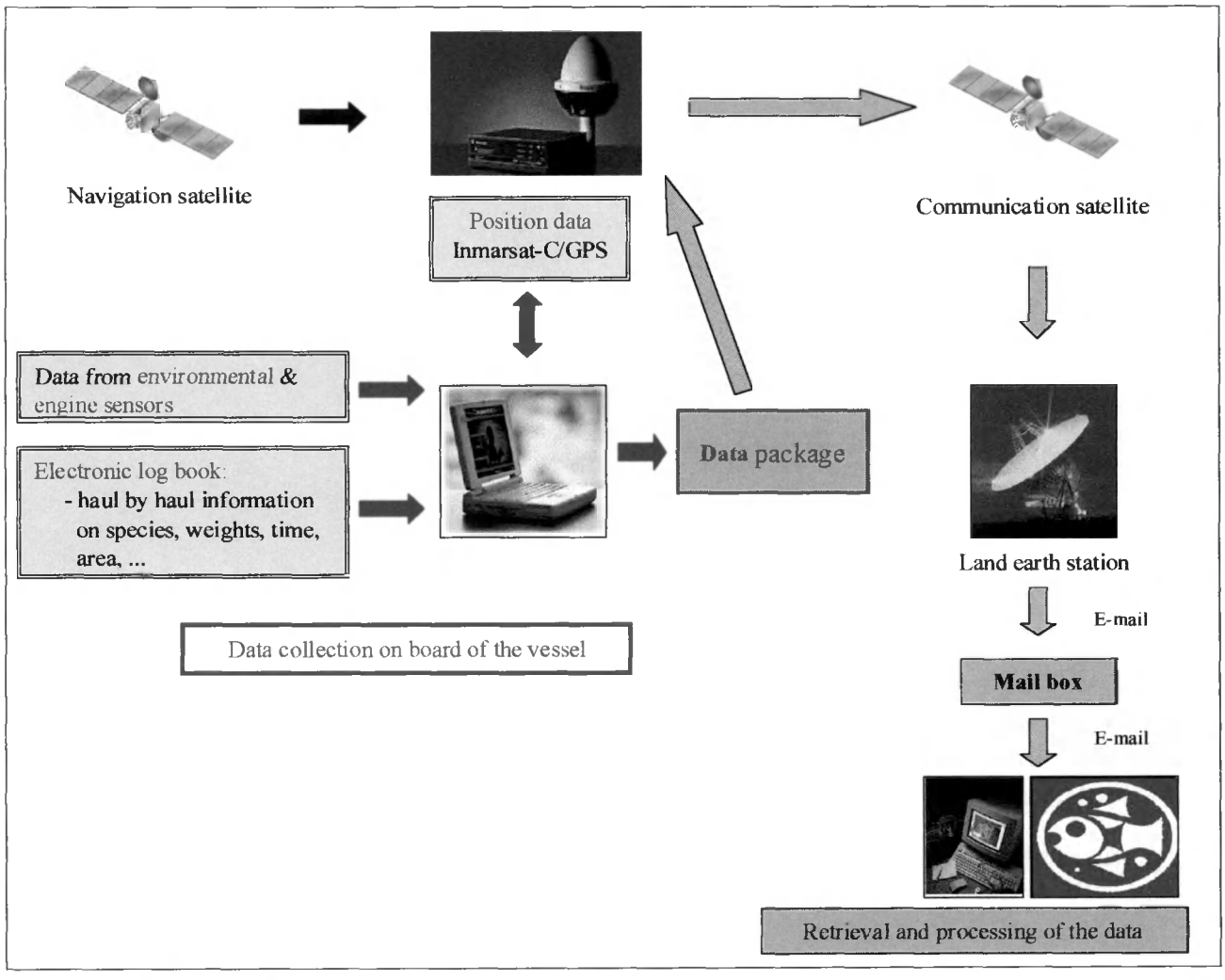

Figure 5: Schematic overview DvZ-system

Technology used for data collection, retrieval and processing

General

Because there was no suitable software available we were obliged to write our own software package. DvZ-CLO decided it was appropriate to develop a flexible and adaptable system, rather than a system with a limited usefulness and only one specific application. Developing and writing this software appeared to be a very complicated and time-consuming job, especially because there were so many factors to take in account.

The ability to collect all kinds of data and compatibility with different kinds and types of devices (blue- and black boxes, sensors,...) were a primary concern. The format of the collected data was also important, because the smaller the data package that had to be send the cheaper the transmission via the communication satellite. As land earth station 'Station 12' situated in Burum-the Netherlands, was the best option. The information send through them is always send per 32 bytes, so even when you want to send only 33 bytes you are charged for 64 bytes. That is why we choose to compress the data before sending them via the satellite, and decompress them afterwards. But the system is able to send the data in any desired format.

The system had to be user-friendly as well, and be able to collect valuable data without a lot of additional effort and inconvenience for neither the fisherman, nor the scientist. Also the users interface had to be easy and relatively straightforward thereby minimising confusion and the possibility to make errors.

In the whole DvZ-system two sub units can be distinguished (see figure X), each with a specific approach in writing the software:

- data collection on board of the vessel
- retrieval and processing of these collected data

To meet al these demands and to be able to write and test the adaptable and flexible software a virtual class was created, which can communicate with a simulator (see further) and different kinds and types of devices. The class created is "equipped" with the following virtual functions (figure 6):

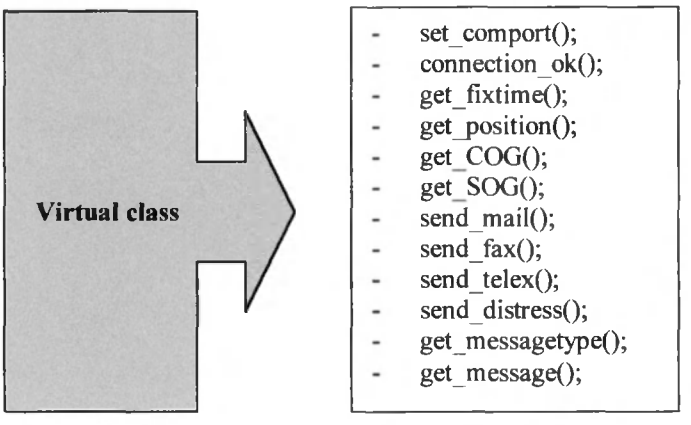

Figure 6: Virtual class with virtual functions

The different steps in writing the DvZ-software

➢ *Starting point*

As mentioned before we could depend upon the corporation of a few vessels, which participated in an earlier project and were equipped with:

- Trimble Galaxy TNL7001 (GPS)
- Laptop 486 DX 33

Combined these hardware forms a master-slave configuration (figure 7). The software already installed on this hardware was not useful in this project, but was a starting point to write our own software.

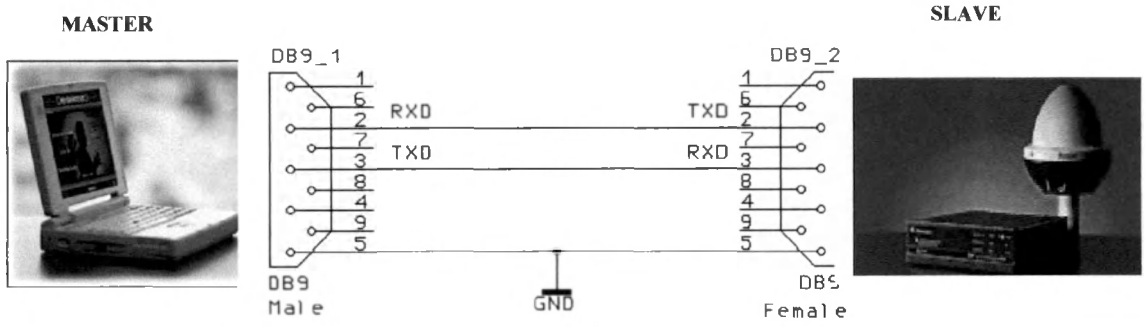

Figure 7: Master-slave configuattion

➢ *Spy Configuration*

In order to understand the communication between the original software and the Inmarsat-C/GPS a spy configuration was assembled (figure 8). Combined with the information available on the protocol of the Galaxy Inmarsat-C/GPS DCE (Data Communications Equipment) the necessary technical insight was acquired to write a simulator.
(ftp://ftp.trimble.com/pub/mpc/galaxy/gxy-DCE-InterfaceSpec30.pdf)

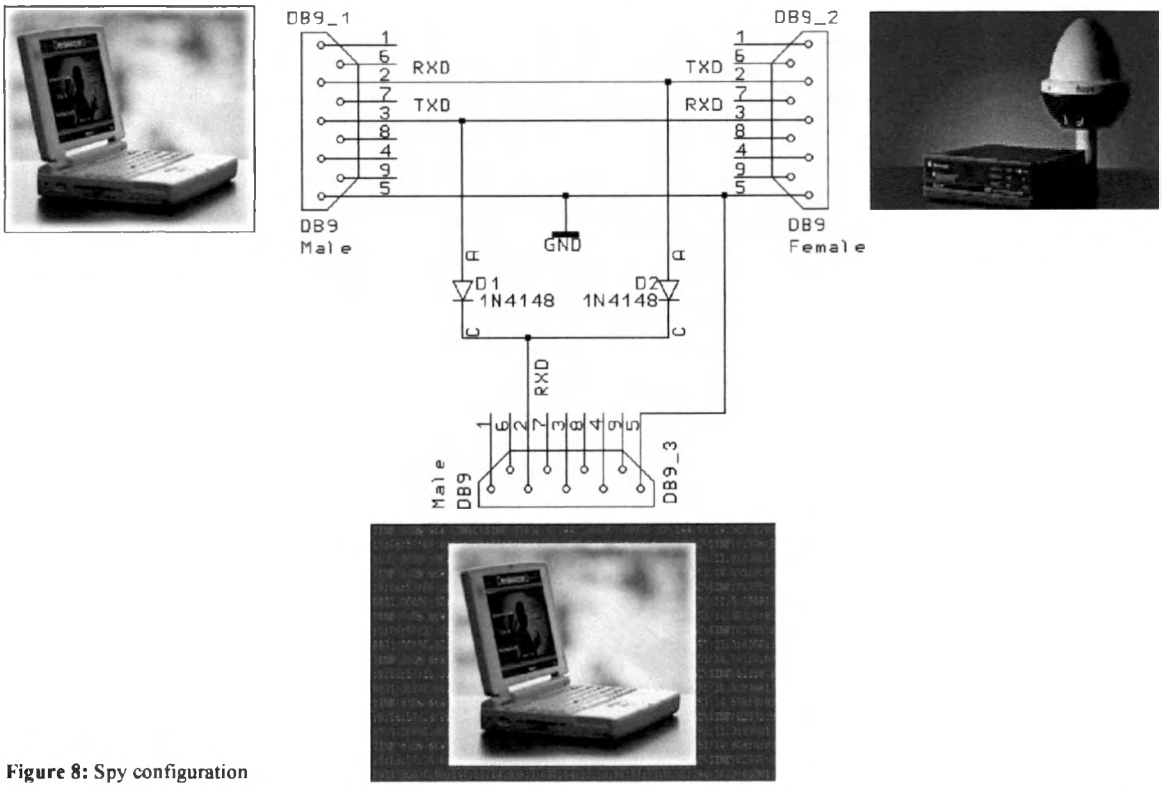

Figure 8: Spy configuration

➢ *Creating a simulator*

The simulator provides position information, in the same way as a real Inmarsat-C device and was indispensable to create a stable environment to work out a virtual class (see general). Now we are able to work on a higher level, we are no longer dependent of the kind of Inmarsat-C/GPS-device we are working on or the environment we are working in. We can use the class as any other component (figure 9).

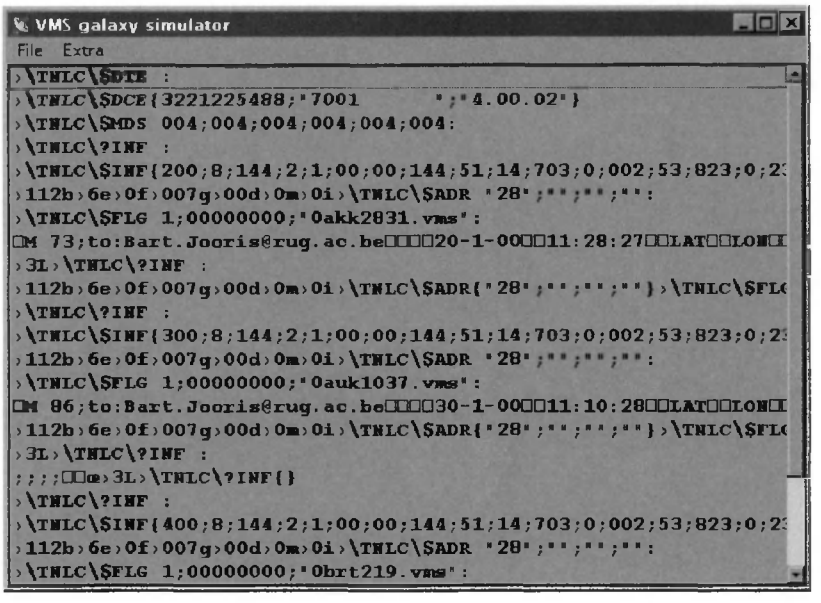

Figure 9: Simulator

➢ *Hard ware add*

Because most laptops have only one serial port, and we want to collect data from different devices (blue box, sensors, … and the like), we have to add additional hardware. Figure 10 shows a simple schematic overview for a possible hardware-add.

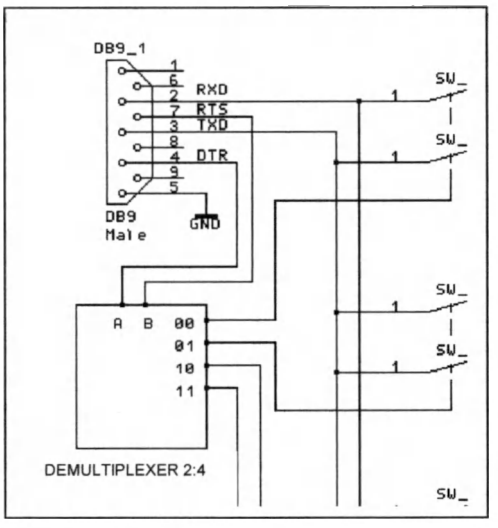

Figure 10: Schematic overview for a possible hardware-add

➢ *The User-interface.*

The user interface had to meet many demands (see general). A similar appearance and working method as outlook express was chosen, to increase the user friendliness (figure 11).

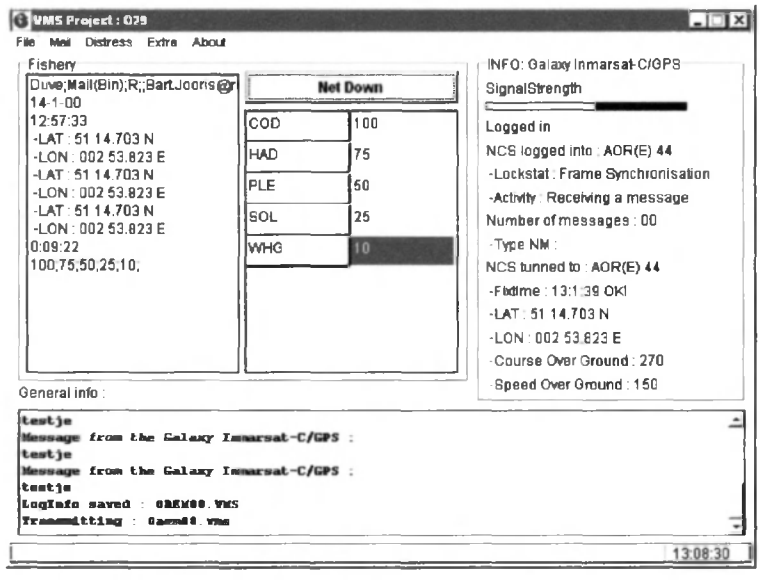

Figure 11: Users interface

When the system is operative the fishermen only have to perform the following steps:

1. When the vessel starts fishing they have to do is push the button "Net Down". The program automatically records date, time and position. From that moment on the program automatically registers the position with a by the scientists set time interval. If necessary this time interval can be altered via satellite communication with out interference of the fishermen them self.
2. When the vessels stops fishing the fishermen have to push the button "Net Up", and the time, position and duration of the haul are automatically recorded.
3. Finally the fishermen have to fill in the catch data into the electronic logbook and push the button "Fishery Data!" and the programme will be ready to register the next haul.

If there are sensors installed, their measurements will be automatically recorded and combined with the fishery data and compressed to a data package. Subsequently this data package is send in binary format to a predefined email-address and stored in a mailbox. From this mailbox the data are forwarded to the E-mail address of scientist at DvZ. Next step is automatic decompressed and storage of the data into a database. The basic output of the received data is as follows, but any other format can be chosen.

```
029                          //ships info
14-1-00                      //date
12:57:33                     //time
-LAT : 51 14.703 N           //GPS...
-LON : 002 53.823 E
-LAT : 51 14.703 N
-LON : 002 53.823 E
-LAT : 51 14.703 N
-LON : 002 53.823 E
0:09:22                      //How long the job took...
100;75;50;25;10;             //Fishery Data...
```

5 EXTENSION OF THIS PROJECT WITH UK BEAM TRAWLERS OPERATING IN THE NORTH SEA

Originally this project (98/023) had the intention to look at beam trawl activity in the whole North Sea, based on vessels from Belgium, The Netherlands and England. However due to administrative reasons the UK had to withdraw and this left a gap in the coverage of beam trawl activity particularly in the western North Sea. Thanks to a recent EU-project (99/002) which commenced on the 1st of February 2000 and is directly linked to this project, the UK beam trawl fleet can be included. Participating countries are the UK (CEFAS) and Belgium (DvZ-CLO, co-ordinator). EU project (99/002) is in fact an extension to this EU project (98/023) enabling the three main beam trawl fleets operating in the North Sea to be fully covered. Considering the objectives and the linkage of both projects it seems only logical to consider the data collection, data processing and the data evaluation as a whole.

6 FURTHER PLANNING

6.1 The Netherlands

The approach using AID to collect the data allows a different strategy with regard to the sample of vessels to be used for this project. Initially it was planned to imitate the microdistribution project and sample about 10% of the fleet, which would come down to about 20 vessels for the Netherlands. However, the design, potential number of co-operating vessels and the budget of this project allows us to take our goals one step further and aim at addressing questions that could not be resolved within the microdistribution project. Although the microdistribution project has shown to be representative for the area covered by the sample, questions remain as to the area unfished by the sample. Was this area not fished by the entire fleet because it is not suitable for trawling or was it not fished by our sample and would a larger sample have shown otherwise?

In the VMS project potentially the entire fleet can be monitored. At this point 28 vessels have volunteered to participate in the project and probably considerably more will follow in the near future. This allows a design aimed at including a maximum number of vessels in the sample while retaining the 6 minutes interval. This 6 minutes interval is considered the maximum interval allowed to be able to calculate the speed between two subsequent position registrations. With the current sample all vessels will be monitored with a 6 minutes interval. As more vessels allow transfer of their position registrations the design can be revised so that as many different vessels as possible are sampled per year. Because the different vessels may show different seasonal patterns the sampling design should ensure that each vessel is tracked for a specific amount of time (e.g. one month) at least every quarter.
The following criteria will give vessels a higher priority for being continuously tracked by VMS at a 6-minute frequency interval.

Vessels that register their catches in a logbook on a haul-by-haul basis and are willing to make that information available for the VMS project are preferred. In order to be able to associate the catch data with the relevant fishing position it is essential to have the high-frequency position registrations for the "logbook-vessels". Because the logbook data have to be computerised at the institute from the original logbooks the proportion of "logbook-vessels" are limited by the budget available for input of logbooks.

A limited amount of vessels also participating in the microdistribution project are preferred. This will be useful for the validation of each of the position registrations of the two projects against the one another and will therefore be beneficial for the continuation of the position-registration data set that started in 1993 with the microdistribution project.

Depending on the size of the sample in terms of vessels that can be potentially tracked by VMS and the budget available for these registrations there is a balance between the number of vessels and the interval between registrations; more vessels means the interval should increase. A larger interval eliminates the possibility of establishing the fishing speed, which is necessary to determine whether or not a vessel was fishing. But for each position registration the speed can be requested at additional costs together with the vessels position. The above results from the microdistribution project show that the distinction between fishing and not fishing is important when trying to establish the spatial patterns in the fleets activity the interval had little impact. Thus, when having to decide between number of vessels and size of the interval the preference will be towards a higher number of vessels, a larger interval (up to two hours) and additional costs for requesting the speed together with the position of the vessel.

Probably the transfer of VMS position registration data to RIVO will commence in the second quarter of 2000. All vessels that authorised the transfer of data will be monitored with a 6-minute interval. Should in the course of the second quarter more vessels enter the sample then part of the vessels that do not apply to the priority-criteria above may be changed for a new batch of vessels. Any new vessels that do apply to notably the first priority-criterion will become part of the group of vessels that are monitored year-round at the highest frequency (6 minutes) until this group exceeds the maximum of 20 vessels.
To extend the fishing position registrations in the Dutch inshore coastal zone and increase the number of vessels in the sample it may be considered to install VMS equipment in some of the vessels that volunteered to co-operate with the project but were not equipped for VMS tracking (Table 2).

In addition to the high-frequency (6-minute) tracking of the selected vessels, a database exists at AID of all Dutch vessels tracked at a 2-hour interval. Although the latter database only contains position registrations and therefore it cannot be decided whether or not the vessel was actually fishing it may be valuable to compare this dataset with that of the high-frequency database of only fishing registrations and see to what extent they differ. In case these differences are negligible it may be considered to use the low-frequency data which are available at minimum expense. Also both datasets should be compared to the effort registrations in the VIRIS database described above.

6.2 Belgium

The extension of automatically collection and retrieval of satellite position data in combination with precise logbook data is the main objective. DvZ-CLO will equip more fishing vessels with the earlier described DvZ-system. Additionally some fishing vessels will be equipped with different kinds of sensors allowing the synchronised collection of engine and/or environmental data and the satellite and logbook data. The DvZ-software will be further evaluated and improved.

As land earth station 'Station 12' situated in Burum, was the best option. They charge 0.5 US $ per 32 bytes send. They promised that the system using a 'green code' would be operational on the 1st of January 2000, however this is not the case. This individual 'green code' assigned to each participating vessel, would allows DvZ to distinguish the costs made for sending the

data packages via satellite communication to the DvZ predefined E-mail and the other communications cost made by sending private messages to other E-mail addresses. A cost-reducing factor of the green code is a smaller and consequently cheaper data package. In fact the 'green code' would make the system cheaper and less vulnerable for misuse, and DvZ will implement the 'green code' in its system as soon as it is available.

Additional to the approach using the DvZ-software on different vessels to collect data, DvZ is also trying to have access to the position data collected by the official control centre. The official authorities are willing to co-operate, and provide us with the data once their control centre is operative. Because the data acquired are for enforcement purposes only and confidential, there is one condition. A written authorisation from each individual vessel to access their position data is needed. Currently the ship owners are contacted. Due to constant delay and misunderstandings during the set up of the EU enforced VMS control; the ship owners are rather reluctant to participate in the official VMS control. So problems in convincing them to give DvZ access to their position data, can be expected. We are now negotiating with the organisations representing the fishery industry, but they can not force their members to co-operate.

As mentioned in section 5 this EU project (98/023) is extended with EU project (99/002) with Belgium and the UK as participating countries. This means that UK beam trawl fleet is finally included, enabling the three main beam trawl fleets operating in the North Sea to be fully covered. Currently DvZ-CLO is co-ordinating and practically linking both projects, and will keep on doing this until the end of both projects.

Due to unforeseen delays at the start of this project (see section 4) the participants (The Netherlands – RIVO; Belgium – DvZ-CLO) agreed to apply for an extension of the project with another six months. This extra time, not extra funding would allow to us to complete the one-year coverage of the fishing position registrations using VMS that this project originally intended. Considering the seasonal changes in the spatial distribution of fishing activities this is essential for a proper interpretation and evaluation of the results. Moreover, the extension also permits to synchronise with project (99/002) which would end in the third quarter of 2001. Hence, this extension allows the monitoring of the three major beam trawl fleets operating in the North Sea during a longer overlapping time period, allowing a more accurate and complete overview of the fishing activities in the North Sea.

Considering the objectives and the linkage of both projects it seems only logical to consider the data collection, data processing and the data evaluation as a whole. Accordingly the tree participating countries decided to ask the EU permission to write one final report that evaluates the alternative uses of data from satellite monitoring of fishing vessel activity in fisheries management. Financially the two projects remain independent.

7 SUMMERY

The evaluation of alternative uses of satellite monitoring data in fisheries assessment and management and the development of the basic data handling and modelling techniques are the objectives of this project. In the VMS project potentially the entire fleet can be monitored. Different approaches are use by each country. RIVO co-operates with the AID to collect position data, and with the fishermen to collect logbook data on a haul-by-haul-basis. RIVO uses their experience obtained through their microdistribution project for the planning and the tuning of this V.M.S.-project. DvZ-CLO developed a flexible and independent-working system with specialised software to collect, retrieve and process position, logbook and sensor data. DvZ-CLO will equip more fishing vessels with the DvZ-system, and will intensify data

collection. RIVO and DvZ-CLO aim to increase the number of ship owners giving the authorisation to use the official V.M.S. data for this project.

The participants of this project (The Netherlands – RIVO; Belgium – DvZ-CLO) have applied, with a particular letter, for an extension of the project with another six months. This extra time, not extra funding would allow to us to complete the one-year coverage of the fishing position registrations using VMS that this project originally intended. Moreover, the extension also permits to synchronise with project (99/002, participants: UK – CEFAS; Belgium – DvZ-CLO) which would end in the third quarter of 2001. Hence, this extension allows the monitoring of the three major beam trawl fleets operating in the North Sea. Considering the objectives and the linkage of both projects, the three participating countries asked the EU permission to condense all available data for three countries involved into one final report that evaluates the alternative uses of data from satellite monitoring of fishing vessel activity in fisheries management.