Air-Sea Gas Exchange, Nutrient Levels and Primary Production in the North Sea

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Contents

CRUISE OBJECTIVES

1. To obtain field determinations of the air-sea gas exchange rate over short time scales (approx 12 - 72 hours) and hence obtain relatively high resolution data to evaluate the dependence of the exchange rate on windspeed.

2. To measure the spatial variations in levels of the major nutrients in the North Sea, together with rates of phytoplankton production, nitrogen assimilation and bacterial production with particular regard to the major estuaries in the region.

INTRODUCTION

Knowledge of air-sea gas exchange rates are fundamental in understanding the role of the global oceans in the uptake of anthropogenic carbon dioxide from the atmosphere. Little field data on the variation of the exchange rate with windspeed is available. However, a dual tracer technique developed jointly by the Plymouth Marine Laboratory (PML) and the University of East Anglia (UEA), to measure gas exchange rates at sea enables accurate measurements to be made over both short time periods (24 - 72 hrs) and spatial scales of about 10 Km^2 (see Upstill-Goddard et al. 1991). The method, described later, enables the relationship between gas exchange and locally prevailing conditions of wind and sea state to be investigated. The technique can be used to test in detail the degree to which measurements made in wind/wave tunnels can be used to parameterise air/sea gas exchange in the real ocean. It represents a significant advance over the "radon deficit" method which only gives accurate gas exchange rates when integrated over periods of several weeks, or preferably months, and cannot, therefore, be used to adequately test parameterisations, such as those proposed by Liss and Merlivat (1986).

The technique involves measuring the rate of change over time in the ratio of the concentrations of two purposefully added tracers in seawater. In brief, seawater containing sulphur hexafluoride (SF_6) and helium-3 (^3He) is released over a period of several hours and drifting buoys deployed to act as aids in tracking the movement of the patch. Surveys of the tracer patch are then conducted using continuous-flow measurement techniques at periodic intervals throughout the remainder of the cruise. Once the centre of the patch has been found, seawater is collected and analysed immediately for SF_6 and samples stored in sealed copper tubes for the later determination of ^3He. Wind data was to be collected from several sources. Firstly a windvane and anemometer were fixed to the main mast of the RRS Challenger and logging equipment recorded the output from these devices. As the nature of the cruise ensured

that the ship was away from the tracer patch for long periods of time a second windvane, anemometer and data-logger was fixed to a mooring close to the study area. Finally, although of lesser value, data was to be obtained from nearby Dutch monitoring sites.

In addition to the gas exchange work, five discrete tracks were made over the period of the cruise in order to measure the concentrations, and map the distributions, of the major nutrient species in the North Sea using a nutrient analyser and a continuous-flow over-side submersible pump. These tracks incorporated transects close to the Thames, Scheldt and Firth of Forth Estuaries, the Ems, Weser, Tyne and Tees Rivers and Europort, and are described overleaf;

1. From the eastern English Channel to the tracer patch.
2. From the tracer patch to the inshore region of the German Bight.
3. From the tracer patch to the offshore region of the German Bight
4. From the tracer patch to Great Yarmouth.
5. From Great Yarmouth to Dundee.

This data was obtained during a period when nutrient concentrations would be expected to be at a maximum and would form part of a larger data set to address the status of eutrophication in the North Sea.

METHODS

1. The determination of air-sea gas exchange rates.

In order to minimise potential contamination of the ship, an airtight tank holding about one ton of seawater was pre-saturated with SF_6 and ^3He prior to the start of the cruise. These gases are used because they are both sparingly soluble, inert, gases measurable in very low concentrations, and because there is a large difference in their gas exchange rates. They are also non-toxic and non-radioactive. The tank remained sealed while the ship sailed to the release site. After ensuring that no stratification of the water column was present the tracer was deployed by pumping water into the tank via a header tank. The output was released via a flowmeter through a sub-surface hose.The flowrate was increased throughout the deployment to compensate for the dilution of the tracer remaining in the tank. Five, drogued. surface drifting buoys were successfully deployed, at intervals of approximately 90 minutes, throughout the tracer release to act as aids in tracking the movement of the patch. As previous releases of SF_6 had shown that these buoys do not stay with the patch but instead drift downwind, buoy 4 was fitted with a new design of drogue and released concomitantly with

buoy 5, drogued with a standard design, in order to test its effectiveness. The tank that had contained the tracer was then moored on the sea-floor, approximately ten miles from the release site, to eliminate the possibility of any tracer contamination from the tank interfering with on-board determinations of SF_6.

Surveys of the tracer patch were then made using a system capable of automatic, rapid online analysis of SF_6. This apparatus was used to map the tracer patch and a picture of the patch obtained in near-real time by interfacing the output with the ship's movement relative to the water mass. Near the centre of the patch, as identified by this survey, seawater was collected from three depths (at the surface, middle and bottom of the water column) using Niskin sampling bottles sprung with stainless steel and multiple subsamples drawn from these. Electron capture gas chromatography was used to detemine the levels of SF_6 on-board, while samples were stored in sealed copper tubes for the later determination of ^3He using isotopic mass spectrometry in collaboration with Prof R. K. O'Nions at the Dept. of Earth Sciences at Cambridge University. The $^3He/SF_6$ ratio in each bottle can be determined to about 2% accuracy.

It is expected from both theory and observations in wind-tunnels that, whereas the absolute values of gas transfer coefficient of both gases will vary with wind speed and sea state, the ratio of the two will remain approximately constant. If the two tracers are released into a vertically well-mixed water body of constant depth, then it can be shown that their ratio $R = {}^3He/SF_6$ will change according to;

$$[1/R]dR/dt = -(V_{He}-V_{SF6})/H$$

where V_{He}, V_{SF6} are the gas exchange piston velocities for the two gases and H is the water column depth. For the ratio V_{He}/V_{SF6} to be constant irrespective of windspeed and sea state, it follows that;

$$V_{He} = V_{He}^{*}.F(\text{wind, waves}) \quad \text{and} \quad V_{SF6} = V_{SF6}^{*}.F(\text{wind,waves})$$

where the * signifies the piston velocity at some reference windspeed, and F(wind, waves) is a function containing all the windspeed and sea state dependence. The rate of decline of R, plotted as a function of windspeed, can then be used to determine the form of F(wind, waves).

The crucial assumption that the ratio of the two transfer velocities remains constant needs to be investigated further, for example in wind/wave tunnels. Data as yet unpublished (Wanninkhof and Jahne, personal communication) support this assumption but leave open the

possibility that there is some decline in the ratio at high windspeeds.

2. The determination of nutrient levels

All data were obtained by adopting a surface survey mode. Water was obtained via the PML overside pumping system and fed continuously to a six channel nutrient analyser. Species measured were: nitrate, nitrite, ammonium, urea, phosphate and silicate. Data were logged using the RVS ABC system at 30s sampling intervals.

Primary production, nitrogen assimilation and bacterial production were measured on sub-samples at 3-4 hourly intervals over the entire track. Primary production was measured using 14C techniques, and nitrogen assimilation by 15N techniques, using ammonium, nitrate and urea as tracers. Phytoplankton was fractionated into <5um and >5um fractions after incubation.

Continuous surface measurements were also made of chlorophyll, fluorescence, temperature, salinity and turbidity using the RVS suite of surface measurements.

EQUIPMENT DEPLOYED, RECOVERED AND LOST.

1. Five "I.B.D." surface drifting buoys, tracked by Argos satellite and direction locating radio transmitters were deployed on 10/2/92 as follows;

Buoy 1	52 15.0 N	03 30.4 E	07-18
Buoy 2	52 18.0 N	03 33.4 E	08-41
Buoy 3	52 20.8 N	03 36.4 E	10-08
Buoy 4	52 22.7 N	03 38.8 E	11-22
Buoy 5	52 22.7 N	03 38.8 E	11-24

Four of the argos drifting buoys were recovered towards the end of the tracer experiment, but the remaining buoy (No. 5) was tracked to the Dutch mainland close to Den Helder and had presumably been picked up by another vessel. Unfortunately it was not possible to retrieve this buoy. Information on the movement of these buoys was also hampered by a lack of communication from RVS concerning the Argos positions.

2. The tank that contained the tracer was moored on the seabed as a precaution against possible contamination of the on-board SF_6 analyses.

Mooring	52 26.6 N 03 30.8 E	14-22

Unfortunately one of the mooring lines parted during the deployment of the rig and the wind monitoring set that had been attached to the toroid buoy marking the tank was lost along with the radar reflector. This was regrettable. Although the remainder of the toroid buoy and the data-logger were successfully retrieved towards the end of the tracer work by dragging for the mooring with a Gifford hook, the tank and chain weight could not be recovered as the cable parted.

PRELIMINARY ASSESSMENT OF RESULTS

1. Measurement of air-sea gas exchange rates

Seven surveys of the tracer patch were made during the cruise which would give a possible total of six rate determinations, double that expected from the cruise, although there is little doubt that a cruise dedicated purely to this work would yield considerably more data and would result in less time being spent searching for the tracer patch. No values for the exchange rate will be available until the helium analyses have been completed in some months time. However, the results for the SF_6 determinations are available and fully corrected and calibrated data are given in Appendix A. These initial results are encouraging and the values that will be obtained for the exchange rate should span a range of windspeeds. No further information can be given as a considerable amount of data work-up remains. A plot of the tracer patch as observed on the 11 February is shown in Figure 1.

2. Nutrient survey work

A notable achievement was that all nutrient data were corrected and calibrated by the end of the cruise. In general, nutrient concentrations were measurable throughout; this was to be expected because of the low phytoplankton activity. Chlorophyll concentrations were low, although there were indications of higher concentrations offshore from the Rhine outflow. This may be an indication that the spring bloom was about to commence. These data will prove to be invaluable in the wider context of the eutrophication aspects of the work.

Nutrient concentrations were highest in the estuarine plume regions. All the major

estuaries were examined with good coverage, with the exception of the Wash, which had to be abandoned because of bad weather.

A totally unexpected finding was the levels of nitrite in the in the offshore Danish waters. Concentrations up to almost 4 micromole l^{-1} were found. These are extremely unusual for open sea waters, but were not associated with any riverine inputs. A preliminary interpretation of these distributions (from examination of the complete data set) is that the nitrite may be due to nitrification, with the high concentrations due to the high riverine ammonium concentrations. Such concentrations could only be observed during winter because phytoplankton activity during the summer would compete for the ammonium substrate. Unfortunately due to the reduced level of this cruise for the nutrient work we were not able to examine this aspect thoroughly. All remaining aspects of the work require analysis in the laboratory.

Given that this work was carried out on an opportunistic basis, because of the cancellation of a dedicated cruise, the nutrient aspects were highly successful. The data will be an essential complement to the developing data set on eutrophication in the North Sea. All major objectives were achieved with the exception of the analysis of the Wash system. A secondary objective, to examine the Dogger Bank was also not accomplished.

CONDENSED SCIENTIFIC LOG

Prior to cruise departure

Sun 2 Feb: Arrival at RVS Barry. Preparation of tank prior to addition of SF_6 and ^3He.

Mon 3 Feb: Commenced bubbling of SF_6 in tank at 11-50. Dissolution of SF_6 completed by 18-30. Tank isolated and left overnight.

Tues 4 Feb: No loss of headspace observed overnight. Approximately 2400 mls of ^3He dissolved into the tank.

Wed 5 Feb: Loading equipment onto Challenger. Windset fixed to main mast of Challenger. Another windset, data logger and battery pack attached to the toroid marker buoy.

Thurs 6 Feb: Loading of equipment continued. Argos buoys, drogues, toroid buoy and tank all loaded. Equipment secured. Gas chromatographs up and running.

Cruise departure

Fri 7 Feb: Depart Barry approx 09-00. Discrete SF_6 sampling system up and running. Trouble-shooting SF_6 continuous measuring system. Nutrient analyser up and running. Unable to deploy overside pump as run made to Land's End to avoid the onset of bad weather. Proceeding to tracer deployment site.

Sat 8 Feb: Overside-pump deployed at 08-45. Continuous-flow SF_6 GC communicating with the Sun workstation. Header tank for the tracer tank prepared and readied for deployment. Both windsets and logging equipment up and running. Proceeding to deployment site.
Nutrient system on-line at 19-50 off Greenwich buoy.

Sun 9 Feb: Proceeding to deployment site. Arrival at site put back until 18-00. Earliest suitable tracer release time at 7-00 Mon due to need for deployment to begin at slack water.
Transect made into and out of Europort for nutrient and associated measurements.
Hove to at tracer release site from 20- 00 (52 14.5N : 03 30.0E)

Mon 10 Feb:	06-56	(52 14.6N; 03 30.0E)	CTD ensuring that there is no stratification of the water column at the release site.
	07-18	(52 15.0; 03 30.4)	Argos buoy 1 deployed.
	07-20		Start deployment of tracer.
	08-41	(52 18.0; 03 33.4)	Argos buoy 2 deployed.
	10-08	(52 20.8; 03 36.4)	Argos buoy 3 deployed.
	11-22	(52 22.7; 03 38.8)	Argos buoy 4 deployed with cylindrical drogue.
	11-24	(52 22.7; 03 38.8)	Argos buoy 5 deployed.
	12-38	(52 25.3; 03 41.3)	Ceased tracer deployment.
	13-58	(52 27.1; 03 31.1)	Deploying tank mooring.
	14-22	(52 26.6; 03 30.8)	Broken rig. Mooring line parted. Windset and radar reflector sheared from toroid buoy and lost.
	15-28	(52 23.9; 03 40.9)	Commence initial survey of tracer patch.
	17-00	(52 19.4; 03 36.3)	Argos buoys 4 and 5 spotted.
	19-00	(52 16.6; 03 34.3)	Close to buoy 3. Areas of very high SF_6 concentrations. Patch extremely narrow.
	21-15	(52 20.9; 03 36.6)	CTD, samples for SF_6 and ^3He collected.
	22-40	(52 22.9; 03 40.7)	Buoys 2 and 3 observed on direction finding equipment. Surveying tracer patch.

Tues 11 Feb:	02-06	(52 18.6; 03 35.2)	CTD , samples collected for SF_6 and ^3He analysis.
	08-00	(52 14.5; 03 30.4)	Surveying tracer patch,
	13-33	(52 15.9; 03 32.2)	CTD, samples collected for SF_6 and ^3He analysis.
	16-29	(52 18.6; 03 35.3)	CTD, samples collected for SF_6 and ^3He analysis.
	19-30	(52 27.3; 03 43.8)	Completed work at tracer site. Started nutrient survey work on leg to German Bight.
	22-00	(52 38.4; 04 11.2)	Nutrient survey work.
Wed 12 Feb:	04-05	(53 19.9; 04 51.6)	Nutrient survey work.
	09-00	(53 34.7; 05 46.8)	Nutrient survey work.
	11-00	DB1 Off Ems	Nutrient survey work.
	15-00	DB17 Off Elbe	Nutrient survey work.
	16-30	Schlusseltonne buoy.	Nutrient survey work.
	20-27	(54 12.3; 07 34.0)	CTD, Background samples taken for ^3He.
	22-00	(54 12.5; 07 34.0)	Nutrient survey work.
Thurs 13 Feb:	02-00	(54 31.0; 06 43.3)	Nutrient survey work.
	06-00	(54 18.3; 06 12.1)	Nutrient survey work.
	11-00	(54 04.5; 04 54.7)	Nutrient survey work.
	16-09	(53 18.2; 04 28.5)	Nutrient survey work.
	23-15		Entering tracer deployment area. Heading for Argos buoy 3. Searching for patch. No tracer encountered.
Fri 14 Feb:	00-55	(52 25.0; 03 41.6)	Searching for patch.
	03-55	(52 22.0; 03 38.3)	Searching for patch.
	06-28	(52 20.2; 03 38.0)	Surveying patch.
	08-00	(52 20.6; 03 41.9)	CTD, samples collected for SF_6 and ^3He analysis.
	12-00	(52 23.0; 03 48.4)	Surveying patch.
	16-00	(52 22.6; 03 42.8)	CTD, Samples collected for SF_6 and ^3He analysis.
	19-00	(52 40.8; 04 04.7)	Finish survey and proceed on offshore German Bight survey of nutrients and associated parameters.
Sat 15 Feb:	01-30	(53 40.2; 04 54.9)	Over-side pump faulty and brought in board.
	02-35	(53 40.8; 04 55.5)	Over-side pump replaced and survey continued.
	06-00	(53 58.7; 05 51.8)	Nutrient survey cont.
	10-00	(54 29.9; 06 33.5)	Nutrient survey cont.
	15-00	(55 15.7; 07 11.3)	Stopped for calibration. Unable to do CTD due to

			rough weather.
	18-00	(55 13.6; 06 58.7)	Nutrient survey cont.
	22-00	(55 10.6; 06 37.8)	Nutrient survey cont.
	23-00	(55 11.0; 06 33.2)	Hove to due to rough weather.
Sun 16 Feb:	04-00	(55 15.2; 06 13.4)	Hove to.
	08-00	(55 12.3; 05 54.5)	Nutrient survey cont.
	12-00	(54 43.1; 05 16.1)	Nutrient survey cont.
	16-00	(54 12.6; 04 34.8)	Nutrient survey cont.
	19-00	(53 52.7; 04 00.9)	Nutrient survey cont.
	20-15		Near-loss of pump due to heavy weather. Weld to pole made during cruise turn-around gave way. Too rough to redeploy pump. Nutrient survey therefore cut short and headed for tracer patch.
Mon 17 Feb:	06-54	(52 22.2; 03 32.0)	Approaching area containing tracer patch.
	07-00		Commencing search for tracer.
	09-00		Searching for tracer.
	12-34	(52 21.3; 03 44.4)	Surveying tracer patch.
	12-53	(52 21.6; 03 44.5)	CTD, samples taken for SF_6 and ^3He analysis.
	15-00	(52 24.0; 03 46.0)	Commencing survey grid over patch.
	16-50	(52 25.0; 03 48.6)	New pump pole deployed over-side.
	18-00	(52 24.8; 03 46.9)	Continuing survey of tracer grid.
	21-32	(52 20.1; 03 41.2)	CTD, samples collected for SF_6 and ^3He analysis.
	21-42	(52 20.1; 03 41.0)	Continuing along survey grid.
	23-12	(52 20.0; 03 47.2)	Continuing along survey grid.
Tues 18 Feb:	00-40	(52 21.1; 03 47.9)	Continuing along survey grid.
	04-00	(52 25.1; 03 45.0)	Continuing along survey grid.
	07-23	(52 25.0; 03 44.5)	CTD, samples taken for SF_6 and ^3He analysis.
	07-33	(52 24.7; 03 44.4)	Heading for tank mooring.
	08-30	(52 26.6; 03 30.6)	Dragging for mooring with Gifford hook.
	09-34	(52 26.6; 03 30.9)	Toroid buoy in board. Remainder of mooring, tracer tank, fittings and chain lost. Heading for Argos buoys.
	11-55	(52 23.3; 03 51.7)	Argos buoy 4 found.
	12-40	(52 23.3; 03 51.8)	Drogue and rig recovered.
	13-01	(52 22.5; 03 50.9)	Approaching Argos buoy 3.
	13-39	(52 23.6; 03 52.0)	Drogue and rig recovered.

	14-41	(52 21.7; 03 50.8)	Approaching Argos buoy 1.
	14-43	(52 21.7; 03 50.8)	Buoy and drogue recovered.
	15-17	(52 22.3; 03 48.0)	Approaching Argos buoy 2.
	15-33	(52 22.4; 03 48.1)	Buoy and light recovered, drogue cut adrift. Proceeding to tracer patch.
	16-20	(52 24.7; 03 44.4)	Starting survey grid.
	20-10	(52 22.1; 03 43.6)	CTD, samples collected for SF_6 and ^3He analysis.
	22-40	(52 20.1; 03 47.1)	Hove to.
Wed 19 Feb:	07-00	(52 22.3; 03 48.5)	Starting survey grid.
	08-00	(52 21.4; 03 49.5)	Searching for tracer. Levels very low.
	10-22	(52 21.2; 03 49.5)	CTD, samples taken for SF_6 and ^3He analysis, but no SF_6 in samples, had drifted away from patch.
	11-12	(52 19.7; 03 46.6)	CTD, samples taken from 3 depths. None contained measurable SF_6.
	12-03	(52 19.0; 03 44.5)	CTD, samples taken from 3 depths, none contained SF_6.
	13-24	(52 18.5; 03 52.8)	Abandon tracer survey and start on nutrient survey around Scheldt and Thames estuaries.
	14-35	(52 08.7; 03 54.6)	Pump defective, brought in-board and stripped down.
	15-40	(52 12.9; 03 54.2)	Pump out-board.
	18-00	Goeree Lt.	Nutrient survey work
	22-00	S.W. Akkaert	Nutrient survey work
Thurs 20 Feb.	02-42	S. Falls Lt buoy.	Nutrient survey work
	09-11	(51 50.0; 01 53.3)	CTD, Helium and background SF_6 samples collected from surface and mid-depth.
	13-00	(52 15.5; 01 44.6)	Nutrient survey work
	16-00	(52 30.0; 02 31.8)	Nutrient survey work
	18-00	(52 42.7; 02 05.1)	Awaiting pilot
	23-00		Yarmouth port call for water.
Fri 21 Feb:	20-00		Leave Yarmouth.
	20-30		Pump over-board and calibration of auto-analyser.
Sat 22 Feb:	01-30	(52 43.6; 02 27.6)	Nutrient survey work
	05-00	(53 08.2; 02 50.7)	Nutrient survey work
	08-00	(53 40.1; 02 37.2)	Nutrient survey work

	12-00	(53 48.6; 02 10.3)	Nutrient survey work
	17-00	(53 45.3; 01 31.4)	Nutrient survey work
	19-00	(53 46.4; 01 13.0)	Nutrient survey work
Sun 23 Feb:	02-00	(53 48.2; 00 16.9)	Nutrient survey work
	06-00	(54 24.5; 00 10.7)	Nutrient survey work
	10-10	(53 40.4; 00 12.1)	Nutrient survey work
	14-00	(54 19.5; 00 03.1)	Nutrient survey work
	18-11	(54 38.1; 00 58.9)	Nutrient survey work
	20-08	(54 53.0; 00 53.8)	CTD, Helium background samples collected from surface
	23-00	(54 58.7; 01 12.1)	Nutrient survey work
Mon 24 Feb:	01-50	(55 05.8; 00 42.8W)	Nutrient survey work
	05-00	(55 13.6; 01 25.6W)	Nutrient survey work
	08-00	(55 36.4; 00 56.4W)	Nutrient survey work
	12-00	(55 56.4; 01 45.2W)	Nutrient survey work
	15-00	(56 12.7; 02 27.9W)	Nutrient survey work
	17-30	(56 27.7; 02 32.6W)	Hove to recovering pump pole
	18-30		Moored at Dundee

CTD STATION LIST

Measurements of temperature, pressure and salinity were obtained from the CTD. Determinations of sulphur hexafluoride were made on samples collected from the depths shown below. Samples for helium-3 analysis were also collected from the same bottles.

Date	Time	Lat.	Lon.	Stn.	Depths
10/2	06-56	52 14.6	03 33.0	501	-
10/2	21-15	52 20.4	03 36.6	502	3,9,15,21,27
11/2	02-06	52 18.6	03 35.2	503	3,14,25
11/2	13-33	52 15.9	03 32.2	504	3,14,25
11/2	16-29	52 18.6	03 35.3	505	3,13,25
12/2	20-27	54 12.3	07 34.0	506	3
14/2	08-00	52 20.6	03 41.9	507	3,14,25
14/2	16-00	52 22.6	03 42.8	508	5,10,19
17/2	12-53	52 21.6	03 44.5	509	3,14,25
17/2	21-32	52 20.1	03 41.2	510	3,14,25
18/2	7-32	52 25.0	03 44.5	511	3,11,20
18/2	20-10	52 22.1	03 43.6	512	3,14,25
20/2	09-11	51 50.0	01 53.3	516	3,10
23/2	20-08	54 53.0	00 53.8	517	4

POINTS FOR THE ATTENTION OF RVS

Staff at RVS are to be commended for their co-operation and help in providing facilities for us to prepare the tracer tank prior to the arrival of the Challenger in Barry, for constructing fixings to enable the windset, data-logger and battery pack to be attach to the toroid buoy, and finally for similarly attaching another windset to the main mast of the Challenger. All RVS equipment on-board the ship worked well, with excellent support.

A welding failure on a pump pole resulted in serious damage to a PML pump. A second failure, to the pump bracket could have resulted in a loss of equipment; fortunately, however, this was noticed before any loss occurred. No data on the positions of the Argos buoys was received from RVS until after their retrieval, limiting their effectiveness as markers of the tracer patch.

ACKNOWLEDGEMENTS

We would like to thank Robin Powell, Allan Taylor, Paul Duncan and Gary White together with the Master, officers and crew of the RRS Challenger for excellent service; it is always a pleasure to sail on the Challenger.

Legends

Figure 1: Contour plot of the SF_6 tracer on 10/11 Feb.

Figure 2: Cruise Track of Challenger 88.

Appendix A: Sulphur hexafluoride and CTD data.

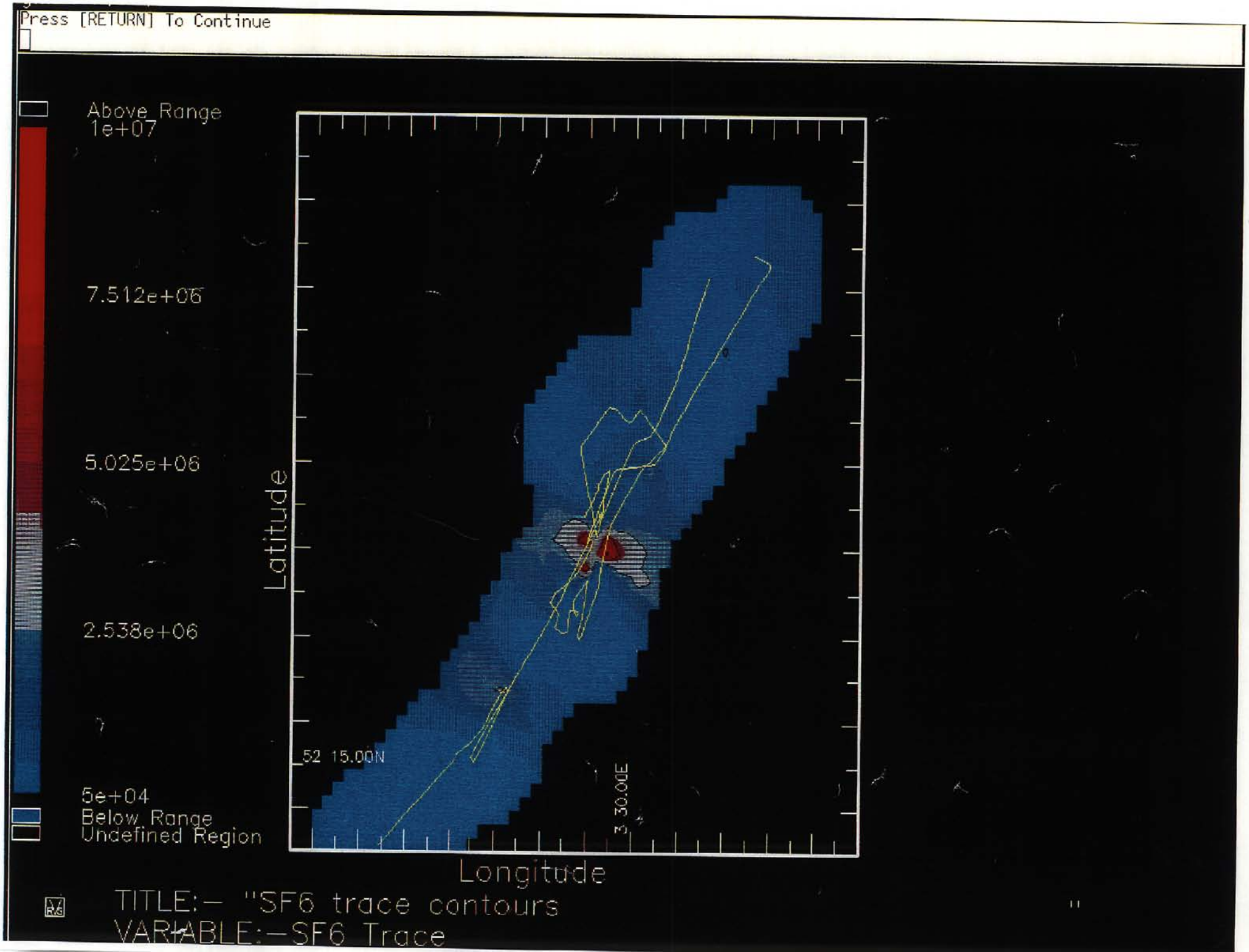
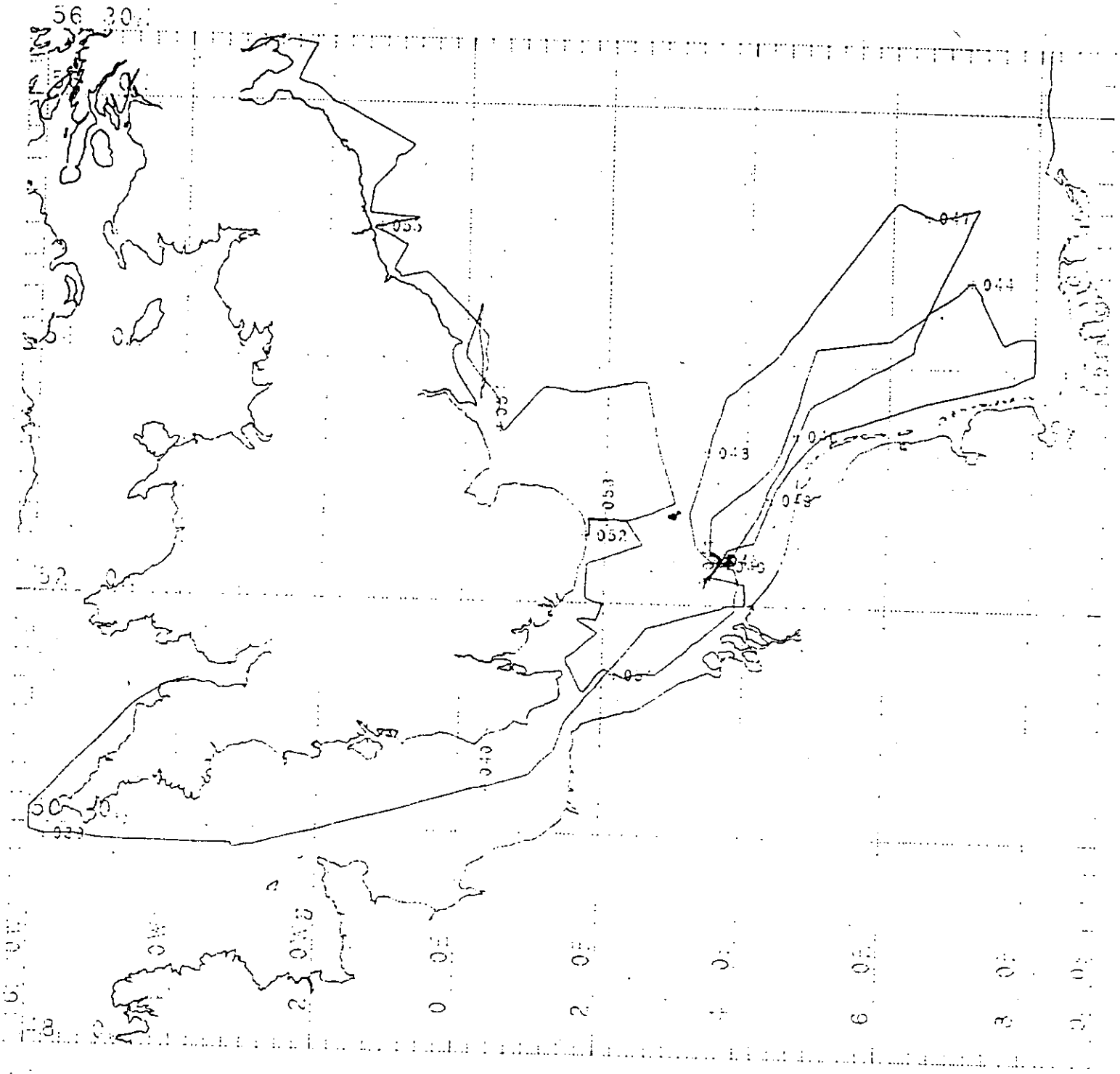

Press [RETURN] To Continue
Above Range
1e+07
7.512e+06
5.025e+06
2.538e+06
5e+04
Below Range
Undefined Region
Latitude
52 15.00N
3 30.00E
Longitude
TITLE:- "SF6 trace contours
VARIABLE:-SF6 Trace

Fig 1

FIG 2.



MERCATOR PROJECTION

SCALE 1 TO 3233778 (NATURAL SCALE AT LAT. 32)

INTERNATIONAL SPHEROID PROJECTED AT LATITUDE 0

Challenger 88 — Cruise track

APPENDIX A.

DATE	TIME	CTD No.	DEPTH Metres	SALIN per mil	TEMP. Celsius	SF6 pM Samp.	SF6 pM Mean	SF6 dev	SF6 dev%
10-Feb	21:15	502.spk	3.26	35.276	6.39	1.8376	1.84965	0.040773	2.204345
10-Feb	21:15	502.spk	3.26	35.276	6.39	1.8186			
10-Feb	21:15	502.spk	3.26	35.276	6.39	1.9096			
10-Feb	21:15	502.spk	3.26	35.276	6.39	1.8328			
10-Feb	21:15	502.spk	9.06	35.279	6.39	1.8295	1.82116	0.056246	3.088464
10-Feb	21:15	502.spk	9.06	35.279	6.39	1.8215			
10-Feb	21:15	502.spk	9.06	35.279	6.39	1.7989			
10-Feb	21:15	502.spk	9.06	35.279	6.39	1.9054			
10-Feb	21:15	502.spk	9.06	35.279	6.39	1.7505			
10-Feb	21:15	502.spk	15.35	35.284	6.391	1.9064			
10-Feb	21:15	502.spk	15.35	35.284	6.391	1.791	1.79588	0.030677	1.708168
10-Feb	21:15	502.spk	15.35	35.284	6.391	1.7651			
10-Feb	21:15	502.spk	15.35	35.284	6.391	1.8065			
10-Feb	21:15	502.spk	15.35	35.284	6.391	1.8428			
10-Feb	21:15	502.spk	15.35	35.284	6.391	1.774			
10-Feb	21:15	502.spk	21.55	35.283	6.392	1.7504	1.79968	0.058677	3.260392
10-Feb	21:15	502.spk	21.55	35.283	6.392	1.7474			
10-Feb	21:15	502.spk	21.55	35.283	6.392	1.888			
10-Feb	21:15	502.spk	21.55	35.283	6.392	1.8253			
10-Feb	21:15	502.spk	21.55	35.283	6.392	1.7873			
10-Feb	21:15	502.spk	26.88	35.283	6.392	1.6669	1.7191	0.035988	2.09342
10-Feb	21:15	502.spk	26.88	35.283	6.392	1.7518			
10-Feb	21:15	502.spk	26.88	35.283	6.392	1.7093			
10-Feb	21:15	502.spk	26.88	35.283	6.392	1.7545			
10-Feb	21:15	502.spk	26.88	35.283	6.392	1.713			
11-Feb	2:06	503.spk	24.82	35.284	6.382	0.6204	0.6281	0.010889	1.733712
11-Feb	2:06	503.spk	24.82	35.284	6.382	0.6358			
11-Feb	2:06	503.spk	13.89	35.283	6.383	0.4914	0.48698	0.018278	3.753375
11-Feb	2:06	503.spk	13.89	35.283	6.383	0.4902			
11-Feb	2:06	503.spk	13.89	35.283	6.383	0.4602			
11-Feb	2:06	503.spk	13.89	35.283	6.383	0.5108			
11-Feb	2:06	503.spk	13.89	35.283	6.383	0.4823			
11-Feb	2:06	503.spk	3.05	35.281	6.383	0.3901	0.38574	0.014363	3.723468
11-Feb	2:06	503.spk	3.05	35.281	6.383	0.3613			
11-Feb	2:06	503.spk	3.05	35.281	6.383	0.3923			
11-Feb	2:06	503.spk	3.05	35.281	6.383	0.3864			
11-Feb	2:06	503.spk	3.05	35.281	6.383	0.3986			
11-Feb	2:06	503.sp	24.82	35.284	6.382	0.6195	0.62725	0.01096	1.747334
11-Feb	2:06	503.sp	24.82	35.284	6.382	0.635			
11-Feb	2:06	503.sp	13.89	35.283	6.383	0.4905	0.48628	0.018213	3.745337
11-Feb	2:06	503.sp	13.89	35.283	6.383	0.4894			
11-Feb	2:06	503.sp	13.89	35.283	6.383	0.4596			
11-Feb	2:06	503.sp	13.89	35.283	6.383	0.5101			
11-Feb	2:06	503.sp	13.89	35.283	6.383	0.4818			
11-Feb	2:06	503.sp	3.05	35.281	6.383	0.3894	0.38518	0.014391	3.73605
11-Feb	2:06	503.sp	3.05	35.281	6.383	0.3607			
11-Feb	2:06	503.sp	3.05	35.281	6.383	0.3918			
11-Feb	2:06	503.sp	3.05	35.281	6.383	0.3859			
11-Feb	2:06	503.sp	3.05	35.281	6.383	0.3981			

11-Feb	13:33	504.spk	2.89	35.252	6.383	0.3917	0.397683	0.009365	2.354922
11-Feb	13:33	504.spk	2.89	35.252	6.383	0.4022			
11-Feb	13:33	504.spk	2.89	35.252	6.383	0.395			
11-Feb	13:33	504.spk	2.89	35.252	6.383	0.4104			
11-Feb	13:33	504.spk	2.89	35.252	6.383	0.384			
11-Feb	13:33	504.spk	2.89	35.252	6.383	0.4028			
11-Feb	13:33	504.spk	14.06	35.255	6.384	0.4289	0.421813	0.008287	1.964675
11-Feb	13:33	504.spk	14.06	35.255	6.384	0.4279			
11-Feb	13:33	504.spk	14.06	35.255	6.384	0.4259			
11-Feb	13:33	504.spk	14.06	35.255	6.384	0.4243			
11-Feb	13:33	504.spk	14.06	35.255	6.384	0.4053			
11-Feb	13:33	504.spk	14.06	35.255	6.384	0.4281			
11-Feb	13:33	504.spk	14.06	35.255	6.384	0.4145			
11-Feb	13:33	504.spk	14.06	35.255	6.384	0.4196			
11-Feb	13:33	504.spk	24.84	35.254	6.383	0.4042	0.400633	0.006007	1.499264
11-Feb	13:33	504.spk	24.84	35.254	6.383	0.3937			
11-Feb	13:33	504.spk	24.84	35.254	6.383	0.3999			
11-Feb	13:33	504.spk	24.84	35.254	6.383	0.4084			
11-Feb	13:33	504.spk	24.84	35.254	6.383	0.3937			
11-Feb	13:33	504.spk	24.84	35.254	6.383	0.4039			
11-Feb	13:33	504.sp	2.89	35.252	6.383	0.3943	0.400517	0.009465	2.363085
11-Feb	13:33	504.sp	2.89	35.252	6.383	0.4048			
11-Feb	13:33	504.sp	2.89	35.252	6.383	0.3977			
11-Feb	13:33	504.sp	2.89	35.252	6.383	0.4135			
11-Feb	13:33	504.sp	2.89	35.252	6.383	0.3869			
11-Feb	13:33	504.sp	2.89	35.252	6.383	0.4059			
11-Feb	13:33	504.sp	14.06	35.255	6.384	0.4314	0.4247	0.008242	1.940595
11-Feb	13:33	504.sp	14.06	35.255	6.384	0.4306			
11-Feb	13:33	504.sp	14.06	35.255	6.384	0.4287			
11-Feb	13:33	504.sp	14.06	35.255	6.384	0.4272			
11-Feb	13:33	504.sp	14.06	35.255	6.384	0.4081			
11-Feb	13:33	504.sp	14.06	35.255	6.384	0.4313			
11-Feb	13:33	504.sp	14.06	35.255	6.384	0.4176			
11-Feb	13:33	504.sp	14.06	35.255	6.384	0.4227			
11-Feb	13:33	504.sp	24.84	35.254	6.383	0.4066	0.403267	0.006066	1.504099
11-Feb	13:33	504.sp	24.84	35.254	6.383	0.3961			
11-Feb	13:33	504.sp	24.84	35.254	6.383	0.4025			
11-Feb	13:33	504.sp	24.84	35.254	6.383	0.411			
11-Feb	13:33	504.sp	24.84	35.254	6.383	0.3964			
11-Feb	13:33	504.sp	24.84	35.254	6.383	0.407			
11-Feb	16:29	505.spk	3	35.28	6.398	0.2539	0.25558	0.001517	0.593644
11-Feb	16:29	505.spk	3	35.28	6.398	0.2568			
11-Feb	16:29	505.spk	3	35.28	6.398	0.257			
11-Feb	16:29	505.spk	3	35.28	6.398	0.254			
11-Feb	16:29	505.spk	3	35.28	6.398	0.2562			
11-Feb	16:29	505.spk	13.48	35.278	6.401	0.2617	0.26248	0.001831	0.697519
11-Feb	16:29	505.spk	13.48	35.278	6.401	0.2654			
11-Feb	16:29	505.spk	13.48	35.278	6.401	0.2613			
11-Feb	16:29	505.spk	13.48	35.278	6.401	0.2631			
11-Feb	16:29	505.spk	13.48	35.278	6.401	0.2609			
11-Feb	16:29	505.spk	24.72	35.279	6.402	0.2283	0.2271	0.005789	2.549001
11-Feb	16:29	505.spk	24.72	35.279	6.402	0.2334			
11-Feb	16:29	505.spk	24.72	35.279	6.402	0.2312			

11-Feb	16:29	505.spk	24.72	35.279	6.402	0.2192			
11-Feb	16:29	505.spk	24.72	35.279	6.402	0.2234			
11-Feb	16:29	505.sp	3	35.28	6.398	0.2539	0.25558	0.001517	0.593644
11-Feb	16:29	505.sp	3	35.28	6.398	0.2568			
11-Feb	16:29	505.sp	3	35.28	6.398	0.257			
11-Feb	16:29	505.sp	3	35.28	6.398	0.254			
11-Feb	16:29	505.sp	3	35.28	6.398	0.2562			
11-Feb	16:29	505.sp	13.48	35.278	6.401	0.2617	0.26244	0.001869	0.712146
11-Feb	16:29	505.sp	13.48	35.278	6.401	0.2654			
11-Feb	16:29	505.sp	13.48	35.278	6.401	0.2612			
11-Feb	16:29	505.sp	13.48	35.278	6.401	0.2631			
11-Feb	16:29	505.sp	13.48	35.278	6.401	0.2608			
11-Feb	16:29	505.sp	24.72	35.279	6.402	0.2283	0.22708	0.005771	2.541493
11-Feb	16:29	505.sp	24.72	35.279	6.402	0.2334			
11-Feb	16:29	505.sp	24.72	35.279	6.402	0.2311			
11-Feb	16:29	505.sp	24.72	35.279	6.402	0.2192			
11-Feb	16:29	505.sp	24.72	35.279	6.402	0.2234			
14-Feb	8:00	507.spk	3.39	35.276	6.409	0.0517	0.05095	0.000593	1.163521
14-Feb	8:00	507.spk	3.39	35.276	6.409	0.0513			
14-Feb	8:00	507.spk	3.39	35.276	6.409	0.0515			
14-Feb	8:00	507.spk	3.39	35.276	6.409	0.0501			
14-Feb	8:00	507.spk	3.39	35.276	6.409	0.0502			
14-Feb	8:00	507.spk	3.39	35.276	6.409	0.051			
14-Feb	8:00	507.spk	3.39	35.276	6.409	0.0506			
14-Feb	8:00	507.spk	3.39	35.276	6.409	0.0512			
14-Feb	8:00	507.spk	13.98	35.275	6.411	0.052	0.050929	0.001077	2.113923
14-Feb	8:00	507.spk	13.98	35.275	6.411	0.0516			
14-Feb	8:00	507.spk	13.98	35.275	6.411	0.0503			
14-Feb	8:00	507.spk	13.98	35.275	6.411	0.0502			
14-Feb	8:00	507.spk	13.98	35.275	6.411	0.0498			
14-Feb	8:00	507.spk	13.98	35.275	6.411	0.0525			
14-Feb	8:00	507.spk	13.98	35.275	6.411	0.0501			
14-Feb	8:00	507.spk	24.93	35.277	6.414	0.0515	0.049857	0.000907	1.819428
14-Feb	8:00	507.spk	24.93	35.277	6.414	0.0501			
14-Feb	8:00	507.spk	24.93	35.277	6.414	0.0501			
14-Feb	8:00	507.spk	24.93	35.277	6.414	0.0494			
14-Feb	8:00	507.spk	24.93	35.277	6.414	0.05			
14-Feb	8:00	507.spk	24.93	35.277	6.414	0.0486			
14-Feb	8:00	507.spk	24.93	35.277	6.414	0.0493			
14-Feb	8:00	507.sp	3.39	35.276	6.409	0.0521	0.051238	0.000619	1.207339
14-Feb	8:00	507.sp	3.39	35.276	6.409	0.0517			
14-Feb	8:00	507.sp	3.39	35.276	6.409	0.0518			
14-Feb	8:00	507.sp	3.39	35.276	6.409	0.0505			
14-Feb	8:00	507.sp	3.39	35.276	6.409	0.0505			
14-Feb	8:00	507.sp	3.39	35.276	6.409	0.0512			
14-Feb	8:00	507.sp	3.39	35.276	6.409	0.0507			
14-Feb	8:00	507.sp	3.39	35.276	6.409	0.0514			
14-Feb	8:00	507.sp	13.98	35.276	6.409	0.0523	0.051143	0.001118	2.185684
14-Feb	8:00	507.sp	13.98	35.275	6.411	0.0519			
14-Feb	8:00	507.sp	13.98	35.275	6.411	0.0505			
14-Feb	8:00	507.sp	13.98	35.275	6.411	0.0504			
14-Feb	8:00	507.sp	13.98	35.275	6.411	0.05			
14-Feb	8:00	507.sp	13.98	35.275	6.411	0.0527			

14-Feb	8:00	507.sp	13.98	35.275	6.411	0.0502			
14-Feb	8:00	507.sp	24.93	35.277	6.414	0.0519	0.050157	0.000952	1.897916
14-Feb	8:00	507.sp	24.93	35.277	6.414	0.0505			
14-Feb	8:00	507.sp	24.93	35.277	6.414	0.0504			
14-Feb	8:00	507.sp	24.93	35.277	6.414	0.0497			
14-Feb	8:00	507.sp	24.93	35.277	6.414	0.0502			
14-Feb	8:00	507.sp	24.93	35.277	6.414	0.0489			
14-Feb	8:00	507.sp	24.93	35.277	6.414	0.0495			
14-Feb	16:00	508.spk	5.05	35.278	6.456	0.1616	0.159933	0.001127	0.704818
14-Feb	16:00	508.spk	5.05	35.278	6.456	0.1584			
14-Feb	16:00	508.spk	5.05	35.278	6.456	0.1595			
14-Feb	16:00	508.spk	5.05	35.278	6.456	0.1608			
14-Feb	16:00	508.spk	5.05	35.278	6.456	0.1594			
14-Feb	16:00	508.spk	5.05	35.278	6.456	0.1599			
14-Feb	16:00	508.spk	10.07	35.278	6.453	0.1617	0.161188	0.002012	1.248054
14-Feb	16:00	508.spk	10.07	35.278	6.453	0.1607			
14-Feb	16:00	508.spk	10.07	35.278	6.453	0.158			
14-Feb	16:00	508.spk	10.07	35.278	6.453	0.1611			
14-Feb	16:00	508.spk	10.07	35.278	6.453	0.1641			
14-Feb	16:00	508.spk	10.07	35.278	6.453	0.1606			
14-Feb	16:00	508.spk	10.07	35.278	6.453	0.1637			
14-Feb	16:00	508.spk	10.07	35.278	6.453	0.1596			
14-Feb	16:00	508.spk	19.24	35.276	6.453	0.173			
14-Feb	16:00	508.spk	19.24	35.276	6.454	0.1718	0.1673	0.003196	1.910395
14-Feb	16:00	508.spk	19.24	35.276	6.454	0.1693			
14-Feb	16:00	508.spk	19.24	35.276	6.454	0.1639			
14-Feb	16:00	508.spk	19.24	35.276	6.454	0.1654			
14-Feb	16:00	508.spk	19.24	35.276	6.454	0.1661			
14-Feb	16:00	508.sp	5.05	35.278	6.456	0.1619	0.160183	0.001141	0.71225
14-Feb	16:00	508.sp	5.05	35.278	6.456	0.1587			
14-Feb	16:00	508.sp	5.05	35.278	6.456	0.1598			
14-Feb	16:00	508.sp	5.05	35.278	6.456	0.1611			
14-Feb	16:00	508.sp	5.05	35.278	6.456	0.1596			
14-Feb	16:00	508.sp	5.05	35.278	6.456	0.16			
14-Feb	16:00	508.sp	10.07	35.278	6.453	0.162	0.162756	0.004353	2.674857
14-Feb	16:00	508.sp	10.07	35.278	6.453	0.1611			
14-Feb	16:00	508.sp	10.07	35.278	6.453	0.1583			
14-Feb	16:00	508.sp	10.07	35.278	6.453	0.1614			
14-Feb	16:00	508.sp	10.07	35.278	6.453	0.1645			
14-Feb	16:00	508.sp	10.07	35.278	6.453	0.1609			
14-Feb	16:00	508.sp	10.07	35.278	6.453	0.1638			
14-Feb	16:00	508.sp	10.07	35.278	6.453	0.1596			
14-Feb	16:00	508.sp	19.24	35.276	6.454	0.1732			
14-Feb	16:00	508.sp	19.24	35.276	6.454	0.1721	0.16748	0.003278	1.957405
14-Feb	16:00	508.sp	19.24	35.276	6.454	0.1696			
14-Feb	16:00	508.sp	19.24	35.276	6.454	0.1641			
14-Feb	16:00	508.sp	19.24	35.276	6.454	0.1656			
14-Feb	16:00	508.sp	19.24	35.276	6.454	0.166			
17-Feb	12:53	509.spk	3.28	35.277	6.224	0.0276	0.02735	0.000481	1.757311
17-Feb	12:53	509.spk	3.28	35.277	6.224	0.0273			
17-Feb	12:53	509.spk	3.28	35.277	6.224	0.028			
17-Feb	12:53	509.spk	3.28	35.277	6.224	0.0268			
17-Feb	12:53	509.spk	3.28	35.277	6.224	0.0276			

17-Feb	12:53	509.spk	3.28	35.277	6.224	0.0268			
17-Feb	12:53	509.spk	13.84	35.277	6.219	0.0266	0.026688	0.000638	2.390398
17-Feb	12:53	509.spk	13.84	35.277	6.219	0.0272			
17-Feb	12:53	509.spk	13.84	35.277	6.219	0.0262			
17-Feb	12:53	509.spk	13.84	35.277	6.219	0.0279			
17-Feb	12:53	509.spk	13.84	35.277	6.219	0.0266			
17-Feb	12:53	509.spk	13.84	35.277	6.219	0.0269			
17-Feb	12:53	509.spk	13.84	35.277	6.219	0.0261			
17-Feb	12:53	509.spk	13.84	35.277	6.219	0.026			
17-Feb	12:53	509.spk	25.08	35.276	6.219	0.0259	0.025629	0.000454	1.769733
17-Feb	12:53	509.spk	25.08	35.276	6.219	0.0265			
17-Feb	12:53	509.spk	25.08	35.276	6.219	0.0254			
17-Feb	12:53	509.spk	25.08	35.276	6.219	0.0254			
17-Feb	12:53	509.spk	25.08	35.276	6.219	0.0253			
17-Feb	12:53	509.spk	25.08	35.276	6.219	0.0252			
17-Feb	12:53	509.spk	25.08	35.276	6.219	0.0257			
17-Feb	21:32	510.spk	2.89	35.281	6.212	0.1045	0.1103	0.004163	3.773827
17-Feb	21:32	510.spk	2.89	35.281	6.212	0.1045			
17-Feb	21:32	510.spk	2.89	35.281	6.212	0.1118			
17-Feb	21:32	510.spk	2.89	35.281	6.212	0.1152			
17-Feb	21:32	510.spk	2.89	35.281	6.212	0.1115			
17-Feb	21:32	510.spk	2.89	35.281	6.212	0.113			
17-Feb	21:32	510.spk	2.89	35.281	6.212	0.1116			
17-Feb	21:32	510.spk	14.1	35.281	6.215	0.1077	0.112938	0.003189	2.823898
17-Feb	21:32	510.spk	14.1	35.281	6.215	0.1169			
17-Feb	21:32	510.spk	14.1	35.281	6.215	0.1162			
17-Feb	21:32	510.spk	14.1	35.281	6.215	0.113			
17-Feb	21:32	510.spk	14.1	35.281	6.215	0.1148			
17-Feb	21:32	510.spk	14.1	35.281	6.215	0.1115			
17-Feb	21:32	510.spk	14.1	35.281	6.215	0.1096			
17-Feb	21:32	510.spk	14.1	35.281	6.215	0.1138			
17-Feb	21:32	510.spk	24.91	35.28	6.218	0.1194	0.116125	0.003317	2.856731
17-Feb	21:32	510.spk	24.91	35.28	6.218	0.1199			
17-Feb	21:32	510.spk	24.91	35.28	6.218	0.1187			
17-Feb	21:32	510.spk	24.91	35.28	6.218	0.1113			
17-Feb	21:32	510.spk	24.91	35.28	6.218	0.115			
17-Feb	21:32	510.spk	24.91	35.28	6.218	0.1116			
17-Feb	21:32	510.spk	24.91	35.28	6.218	0.1164			
17-Feb	21:32	510.spk	24.91	35.28	6.218	0.1167			
18-Feb	7:32	511.spk	2.56	35.285	6.187	0.0128	0.012888	0.000236	1.828595
18-Feb	7:32	511.spk	2.56	35.285	6.187	0.013			
18-Feb	7:32	511.spk	2.56	35.285	6.187	0.0134			
18-Feb	7:32	511.spk	2.56	35.285	6.187	0.0129			
18-Feb	7:32	511.spk	2.56	35.285	6.187	0.0129			
18-Feb	7:32	511.spk	2.56	35.285	6.187	0.0127			
18-Feb	7:32	511.spk	2.56	35.285	6.187	0.0127			
18-Feb	7:32	511.spk	2.56	35.285	6.187	0.0127			
18-Feb	7:32	511.spk	11.28	35.285	6.196	0.0131	0.01324	0.000483	3.645776
18-Feb	7:32	511.spk	11.28	35.285	6.196	0.013			
18-Feb	7:32	511.spk	11.28	35.285	6.196	0.013			
18-Feb	7:32	511.spk	11.28	35.285	6.196	0.0141			
18-Feb	7:32	511.spk	11.28	35.285	6.196	0.013			
18-Feb	7:32	511.spk	19.79	35.284	6.201	0.0165	0.01612	0.000512	3.175306

18-Feb	7:32	511.spk	19.79	35.284	6.201	0.0157			
18-Feb	7:32	511.spk	19.79	35.284	6.201	0.0155			
18-Feb	7:32	511.spk	19.79	35.284	6.201	0.0167			
18-Feb	7:32	511.spk	19.79	35.284	6.201	0.0162			
18-Feb	20:10	512.spk	2.99	35.276	6.16	0.1119	0.1158	0.002305	1.990559
18-Feb	20:10	512.spk	2.99	35.276	6.16	0.1144			
18-Feb	20:10	512.spk	2.99	35.276	6.16	0.1187			
18-Feb	20:10	512.spk	2.99	35.276	6.16	0.1176			
18-Feb	20:10	512.spk	2.99	35.276	6.16	0.1167			
18-Feb	20:10	512.spk	2.99	35.276	6.16	0.1146			
18-Feb	20:10	512.spk	2.99	35.276	6.16	0.1167			
18-Feb	20:10	512.spk	14.1	35.278	6.166	0.115	0.1171	0.004102	3.503155
18-Feb	20:10	512.spk	14.1	35.278	6.166	0.1131			
18-Feb	20:10	512.spk	14.1	35.278	6.166	0.1203			
18-Feb	20:10	512.spk	14.1	35.278	6.166	0.1223			
18-Feb	20:10	512.spk	14.1	35.278	6.166	0.1125			
18-Feb	20:10	512.spk	14.1	35.278	6.166	0.1194			
18-Feb	20:10	512.spk	24.81	35.274	6.17	0.1146	0.116086	0.001621	1.396503
18-Feb	20:10	512.spk	24.81	35.274	6.17	0.1146			
18-Feb	20:10	512.spk	24.81	35.274	6.17	0.1189			
18-Feb	20:10	512.spk	24.81	35.274	6.17	0.1166			
18-Feb	20:10	512.spk	24.81	35.274	6.17	0.1172			
18-Feb	20:10	512.spk	24.81	35.274	6.17	0.1147			
18-Feb	20:10	512.spk	24.81	35.274	6.17	0.116			