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INTERNAL DOCUMENT No. 22

Near real time ATSR data support for Cruises D213 and D214

T N Forrester & G D Quartly

1995

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Institute of
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ABSTRACT This report describes the process of obtaining infrared satellite imagery data in near real time for the support of two cruises which took place on the RRS *Discovery* between January and March 1995. It details the reasons for this type of support and the use to which the data were put, as well as giving an overview of the prevailing surface currents in the region.	
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CHAPTER 1. INTRODUCTION

In the autumn of 1994 detailed planning began for two research cruises, which James Rennell Centre for Ocean Circulation (JRCOC) ran between 7 January and 10 March 1995. The cruises were to be in the south west Indian Ocean, which is a region of high surface variability (Quartly and Srokosz, 1993). Although each cruise had separate aims they both required a synoptic view of the prevailing surface current conditions in Near Real Time (NRT). Through contact with Dr Mutlow of the Along Track Scanning Radiometer (ATSR) team at the Rutherford Appleton Laboratory (RAL) it was revealed that the Tromsø Satellite Station (TSS) in Norway were scheduled to receive high resolution ATSR data in NRT on an operational basis by the end of 1994. It was felt that this would be a good opportunity to test out this service on behalf of TSS, as well as satisfying the requirements of JRCOC. The European Remote sensing Satellite (ERS) help desk was approached as the first point of contact. They were sent details of both cruise proposals and a request for NRT ATSR sea surface temperature (SST) data to cover the period of the cruises. The ERS help desk promptly replied, and also sent back details of the scheduled ERS-1 ground tracks for the designated period and region. In additon to this they forwarded on the cruise plans to Rolf Enoksen of TSS who then contacted the JRCOC, so that discussions over the details of the request then ensued.

CHAPTER 2. OVERVIEW OF OCEAN CIRCULATION IN THE REGION OF INTEREST

2.1 Surface Current Systems

The major currents in the region of interest are illustrated in Fig. 1. The Agulhas Current flowing south-westward along the east coast of South Africa is the Western Boundary current for the Indian Ocean basin. It is typically 90km across between 0.5ms^{-1} isotachs, with a flow rate in the core exceeding 1ms^{-1} (Pearce, 1977). After it has passed off Durban, the current continues south-westwards taking it offshore. On reaching a region some 500km south of South Africa, the current undergoes a sharp "Retroflection" in a region of deep and nearly constant bathymetry. The Agulhas Return Current (ARC) heads due east, except for northward excursions around the Agulhas Plateau and over the Southwest Indian Ridge. In this area, the Antarctic Circumpolar Current lies much further south (around 50°S).

2.2 Thermal Signatures

The Agulhas Current carries warm salty water, and is typically characterised by surface temperatures of around 22°C on the edge of the current (Pearce, 1977), rising to around 25°C in the core. The narrow strip of water inshore of the current is usually cooler. The ARC provides the re-circulation path in the southern Indian Ocean, and as such marks the southern limit of Indian Ocean surface water. The southern edge of the ARC is marked by a strong thermal gradient, with a change of 5K in 100km (Lutjeharms and Valentine, 1984); this may occur as part of the Subtropical Convergence (STC), separating the Sub Antarctic Surface Water from the lighter waters to the north, or as a separate Agulhas Front.

2.3 Variability in the Flow

Although the description of the current system given above is broadly correct, none of the currents should be thought of as constant and unchanging. An important part of investigations in this area is to ascertain both the mean and the variability of the various features. The position of the Retroflection moves zonally by some 10° of latitude, with the shedding of Agulhas Rings (warm core eddies). The meanders of the ARC are not constant (see (Harris et al., 1978) for example) and the instabilities engendered in its flow may lead to the formation of warm eddies to the south and cold eddies to the north of the mean flow. The formation of such eddies is an important process enabling the transfer of different water types across the STC.

Finally, but critically, the flow of the Agulhas Current itself may be subject to significant changes in the forcing of the currents that feed it (Pearce and Grundlingh, 1982) A particularly striking and poorly understood phenomenon is that called the Natal Pulse. This is a large (~170km) off-shore meander of the current, which progresses south-westwards at ~18km day^{-1} (Lutjeharms and Roberts, 1988). Estimates of the flow of the Agulhas Current could be greatly in error if a Natal Pulse is passing through unrecognised.

CHAPTER 3. DATA ACQUISITION AND PROCESSING

3.1. Data processing at TSS

The cruises took place on the Royal Research Ship (RRS) *Discovery*, and were designated cruises D213 and D214. A summary of the cruise proposals giving the main aims and intended positions with dates was given to TSS and a data capture area between 29 to 46°S and 25 to 55°E was established to cover both cruises. The NRT ATSR data acquisition system at TSS used the SADIST (Synthesis of ATSR Data Into Sea-surface Temperatures) processing system (Bailey, 1994) which was developed at the Rutherford Appleton Laboratory (RAL). TSS provided the data in SADIST version 600 format with an extra header of 176 bytes added to the beginning to make it European Space Agency (ESA) compatible. Once TSS had processed the SADIST Sea Surface Temperature (SST) product, it was compressed and transferred to an anonymous File Transfer Protocol (FTP) site at JRCOC via the Internet.

3.2. Data processing at JRCOC

At JRCOC the data were then decompressed for further processing. Details consisting of file name, percentage of bad data, SST range, and latitude/longitude range were archived to a log file. Percentage of bad data was the relative amounts of pixels flagged as containing land or cloud. If there was more than one percent good data then the image was plotted to hard copy. Images were then inspected for SST features (i.e. fronts and eddies) which were likely to be important in the day to day planning of the cruise. These were printed in grey scale and the appropriate SST features were highlighted by hand before the image was sent to the ship by facsimile. It was felt that sending the images by facsimile was a cheaper method than sending compressed image data via INMARSAT.

CHAPTER 4. THE CRUISES

4.1. Cruise D213

The cruise began when the RRS Darwin sailed from Durban in South Africa on Saturday 7 January 1995 and finished in Durban Tuesday 21 February 1995, the track of the ship during this period is shown in figure 2.

4.1.2. Overview

In April 1993 eight moorings were deployed in the South West Indian Ocean (Pollard and Read, 1993) to monitor the flow across the Mozambique Basin and Crozet Plateau. Nearly two years later, the primary objective of RRS *Discovery* cruise D213 was to recover these moorings. Additional objectives were to survey the Agulhas, Subtropical and Sub Antarctic Fronts and the Sub Antarctic Zone between 30°E and 50°E and to occupy a complementary section across the Agulhas Current with CTD plus tracers, SeaSoar and acoustic Doppler current profiler.

The start of the cruise was delayed for a week by the break down of the ship's VHF radio. A special dispensation allowed us to leave Durban and work in coastal waters, and the opportunity was taken to do a much more detailed survey of the Agulhas Current than originally planned. All equipment worked well from the very beginning of the cruise and one CTD and three SeaSoar transects were completed across the core of the Agulhas Current. After this work began on the primary objective. No trace could be found of the first mooring. In summary three of the eight moorings were lost and three were recovered fully intact. Of the other two, one had lost the upper two current meters and after extensive dragging operations, the bottom two current meters were abandoned on the last mooring. In between recovering the moorings the same line of CTD stations as done during the first cruise was repeated. The mooring section was followed by four north-south sections (Fig. 2). The first followed a TOPEX-POSEIDON track to the north-east, and was occupied first with SeaSoar and then repeated with full-depth CTD casts. This combination provided detailed information about the surface structure as well as the full depth geostrophic shear. Next, a CTD section along the deepest part of the Indomed Fracture Zone was carried out. The northern part could not be completed with CTDs because of bad weather conditions so T5 eXpendable BathyThermographs (XBTs) were used instead. CTDs and tracers were then used for a detailed survey of the break between the Madagascar and S. W. Indian Ridges. This gap is the only place deep enough for deep water exchange to occur between the Madagascar and Mozambique Basins. CTD and tracer work continued back down the S. W. Indian Ridge to the mooring. This transect also followed a TOPEX-POSEIDON track and was repeated and extended with full depth CTD stations back across the Madagascar Basin towards Durban, where the ship finally docked after 46 days at sea.

4.1.3. NRT ATSR data support

A total of 268 SST products were acquired between 4 January 1995 and 21 February 1995 (see Appendix A). Data acquisition was reduced for the first week of the cruise due to the late departure of the ship. It was soon discovered that the data were uncharacteristically noisy. This was investigated to make certain that it was being read correctly. The problem was identified by RAL as being due to the ATSR instrument overheating because the onboard cooler was approaching the end of its mission life. The noisiness of the data was exaggerated because generation of the SST product involved combining the 11μm and 12μm infrared channels in the forward and nadir view, which multiplied the noise. A solution was to obtain Brightness Temperature (BT) images from one channel and a single view. From 14 January 1995 TSS provided BT 11μm nadir view data, and the corresponding SST products were used to provide navigation, and various auxiliary data, such as land and cloud flags etc.. A total of 230 BT products were received and 10 images were sent to the ship (see Appendix B).

4.1.4. Description of data transmitted to the ship

Satellite images were used whenever they were available. They helped to clarify the interpretation of features seen in the sub-surface hydrographic data. They were used to help determine the location of the survey track, especially in locating SeaSoar sections. In particular the last SeaSoar deployment was made several degrees further south than it might otherwise have been thus ensuring that it crossed the Sub Antarctic Zone and Subtropical Front as intended. The images were also instrumental in changing sampling strategy. For example, during bad weather CTD work had to be abandoned at the northern end of the Indomed Fracture Zone. A satellite image received 11 days earlier showed an eddy-like feature, so instead of abandoning the site completely, work continued with the deployment of XBTs and logging of ADCP data. Otherwise the opportunity to study the internal dynamics of this feature would have been missed.

The image of the 7 January 1995 (page 25) which was transmitted to the ship as a facsuimile showed that the proposed cruise track crossed a frontal region within the ARC. The position of the feature was able to be clearly marked by hand. The frontal gradient was about 1°C higher on the ARC side which had a SST of ~22.0°C. The other image on the same page is a composite of two consecutive ATSR SST images, it demonstrated that the proposed ship track was not parallel with the sub satellite track. This was important if the principle scientific officer on the cruise wanted to run the ships track parallel with the ERS-1 altimeter track. The images on page 26 are both SST composites, the of the 11 January 1995 is an ascending pass and the of the 12 January 1995 is a descending pass. There is overlap in the lower half of these two composites. It can be seen that the front marked by the 1°C gradient between the 16.5°C and 17.5°C isotherms is persistent on both days and the degree of horizontal addvection of the frontal feature can be estimated to the first order. Note how the "balloon" like feature at 41°S 39°E changed shape and appeared to move south-eastward along the front in the shape of a "bubble", this feature was bisected by the proposed cruise track. The image of 15 January 1995 (page 27) shows a large bend in the ARC at the south west corner of the survey close to the first CTD station (see figure 2). The high degree of thermal variability in the region is shown in the facsimile composite image of 24 January 1995 (page 28), it is in a region which lies between the cruise tracks (see figure 2). The large cyclonic eddy in the south-eastern corner is a cold eddy (with a core surface temperature of 16°C), which is being drawn into the warmer (~20°C) main stream of the ARC. This feature is seen much more clearly in the BT image shown in figure 3. which corresponds to the lower portion of the composite in the facsimile. It also shows the warmer central ARC water being drawn south, to the west of the eddy and begining to form into an anticyclonic eddie. There are other smaller eddies shown to the north of these and the fine scale filament structure is much more evident than either in the facsimile or the corresponding SST image shown in figure 5. The facsimile on page 30 (1 February 1995) shows how the cloud may separate features within the image and by inspecting the BT images it is possible to highlight these features on the facsimile. The facsimile on page 31 (12 February 1995) shows a broad frontal region lying across the ships projected track just before she was to start her northward leg back to Durban. Another large anti-cyclonic eddy is shown in the facsimile on page 32 (13 February 1995).

4.2. Cruise D214

The cruise began when the RRS Darwin sailed from Durban in South Africa on Sunday 26 February 1995 and ended in Cape Town on Thursday 9 March 1995, the track of the ship during this period is shown in figure 5.

4.2.1. Overview

The Agulhas Current is the western boundary current for the South Indian Ocean and has long been considered to be the strongest of the Southern Hemisphere western boundary currents. The is uncertainty over its size and temporal variability, and arguments over the appropriate choice of reference level for geostrophic transport estimates from hydrographic sections have led to a range of transport values from 35 to 95 Sv for the region where it closely follows the African continental slope. An accurate estimate of the transport of the Agulhas Current represents a key for defining the large-scale circulation of the Indian Ocean including its heat and fresh-water fluxes and the size of its meridional overturning circulation.

A plan to deploy an array of moored current meters across the Agulhas Current in order to measure the transport of the Agulhas Current and its temporal variability over a year-long period was developed. Thus, the primary objective for *Discovery* Cruise 214 was to deploy this array of moored current meters. Six moorings with a total of 26 current meters were deployed in the Agulhas Current as it flows south-westward along the continental slope off South Africa. The moorings were specifically designed to maintain their integrity in strong currents with fared wire, large (rather than distributed) buoyancy elements and heavy, fluked anchors. These moorings are planned to be recovered in Spring, 1996, after a full year-long deployment period. Two of the moorings in the strongest parts of the Current included Acoustic Doppler Current Profilers (ADCP's) at approximately 400m depth to profile upward the currents at 8m intervals throughout the upper 400m of the water column.

The second objective of the cruise was to make a hydrographic section across the Agulhas Current in order to determine the geostrophic transport of the Current. To avoid the problems of choosing a reference level that have confounded previous synoptic estimates of the Agulhas Current transport, an effort was made to utilise new and developing acoustic profiling methods to measure directly the velocity structure of the Agulhas Current during the cruise. A closely spaced CTD section consisting of 14 stations (plus one test station) within 220 km of the African coast was taken in order to determine the geostrophic transport of the Agulhas Current. A novel aspect of the CTD stations was the mounting of an ADCP on the CTD frame so that the velocities at each station could be measured directly from surface to bottom and back to the surface. This technique, called Lowered ADCP or LADCP, resulted in full-depth velocity profiles for each of the 14 CTD stations. The new method that provided the fundamental velocity measurements is underway ADCP profiling utilising GPS navigation, which (Saunders and King, 1995) used to such advantage on the transatlantic section A11. After the cruise, data from nearby land stations are to be used to post process the GPS measurements using differential GPS (DGPS) techniques to increase the accuracy of the underway ADCP measurements by an order of magnitude to less than 1 cm s^{-1} for 10-minute average velocities, following the methods pioneered by (King et al., 1995). Thus, with these underway ADCP measurements and DGPS navigation techniques, this should provide accurate enough measurements of the velocity structure in the upper 300m of the water column to give an accurate estimate of the synoptic geostrophic transport of the Agulhas Current for the first time.

Finally, a developmental acoustic profiling technique was prepared to help define the velocity structure of the Agulhas Current. In a collaborative effort with RD Instruments of San Diego, just prior to the cruise a pre-production instrument called an Acoustic Correlation Current Profiler (ACCP) was installed in *Discovery's* hull. The specifications for the ACCP indicate that it may be able to profile continuously down from the surface to a depth of approximately 1200m. Testing and inter-comparing the three new and developing acoustic profiling techniques made up the third objective for *Discovery* Cruise 214.

4.2.2. NRT ATSR data support

A total of 64 SST and BT products were acquired between 22 February 1995 and 12 March 1995 for the cruise (see Appendix C). Another 26 products covering the same region were acquired during the support of D213 (see Appendix A.) One image was sent to the ship.

4.2.3. Description of data transmitted to the ship

The main requirement for NRT ATSR data support during cruise D214 was to detect any occurrence of a Natal Pulse during and just prior to the cruise, none were detected, although the ubiquitous amount of cloud contamination in the images made this task difficult. A sharp frontal feature across the Agulhas Current was identified on 26 February 1995 and this image was sent by facsimile to the ship. (see appendix D).

DISCUSSION

This was the first time that high resolution ATSR NRT data had been used to support research cruises. The main concern was to provide the principle scientists with information about the prevailing surface conditions, so that they may be taken into account when it was necessary to change the ship's survey plans for operational or scientific reasons. This was the case for cruise D213 where the cruise was delayed for a week due to ship's radio problems.

Although the ship was supplied with facsimiles giving information of the gross SST structure within the 512 km^2 region of the images, a finer resolution image was required in order for the data to be interpreted properly. This was due to the problems with the SST data as discussed in section 4.1.3 The difference in identifiable features between the BT image in figure 3 and its corresponding SST image is clearly shown in figure 4. For example in the SST image it isn't clear if the large dark structure in the bottom right of the image is an eddy or a meander of a front, but fine scale structure of the BT image clearly shows this feature to be an eddy.

The spatial sampling characteristics resulting from the 512km^2 swath width of the ATSR and the 35 day repeat orbit of ERS-1 gave a near 3 day repeat coverage over the region. However the receiving station at TSS was not able to "see" all the orbits of ERS-1. It was "hit and miss" as to whether images covering the required area on any particular day were actually received from TSS. To avoid TSS having to process all the ATSR data in the data capture region every day, an attempt was made to reduce the amount of work by providing TSS with an updated forecast of the ships position every 3 or 4 days. To help in this the ships daily position information was extracted from the Research Vessel Services (RVS) bulletin service and regular communications were made with the principle scientific officer on the ship via e-mail.

From the total of 332 SST products that JRCOC received, only 3% were sent to the ship, and 25% contained more than 99% cloud cover. Thus 72% either contained too many cloudy pixels or did not provide enough useful information in the required area. Generally most of the images were too cloudy to be useful. Although the turnover in terms of number of products processed was high compared to the number of images sent to the ship, the operation was very successful. This is indicated by the fact that there was an Automatic Picture transmission (APT) receiving station (MacSat) on board the RRS Discovery which was able to directly receive low resolution data SST from the NOAA series of satellites, but was not able to provide any useful images to the scientists.

Another advantage of this exercise was that JRCOC possessed much of the ATSR data required for post cruise analysis, whereas in the past delays of up to a year or more in obtaining the data off-line have been experienced.

ACKNOWLEDGEMENTS

Many people have helped in various ways in this support programme. The biggest thanks must go to the Tromsø Satellite Station, especially Jens Skoglund and Rolf Enoksen, for providing the data and expertise free of charge as a test bed exercise. Thanks must also go to the ERS Help Desk, who helped persuade TSS of the usefulness of our request as a test of there service and especially to Gabriella Scarpino, who provided the ERS-1 orbit data. Thanks also to the ATSR team at the Rutherford Appleton Laboratory, especially Paul Bailey who gave advice on the data quality and Chris Mutlow who helped in our request to ESA. Finally thanks to Jane Read, Harry Bryden and Raymond Pollard of JRCOC for their contributions to the report.

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Figure 1. An image of surface potential temperature from the OCCAM fine resolution general circulation model clearly showing the Agulhas current, the Agulhas Retroflection and the Agulhas Return Current which flows eastward.

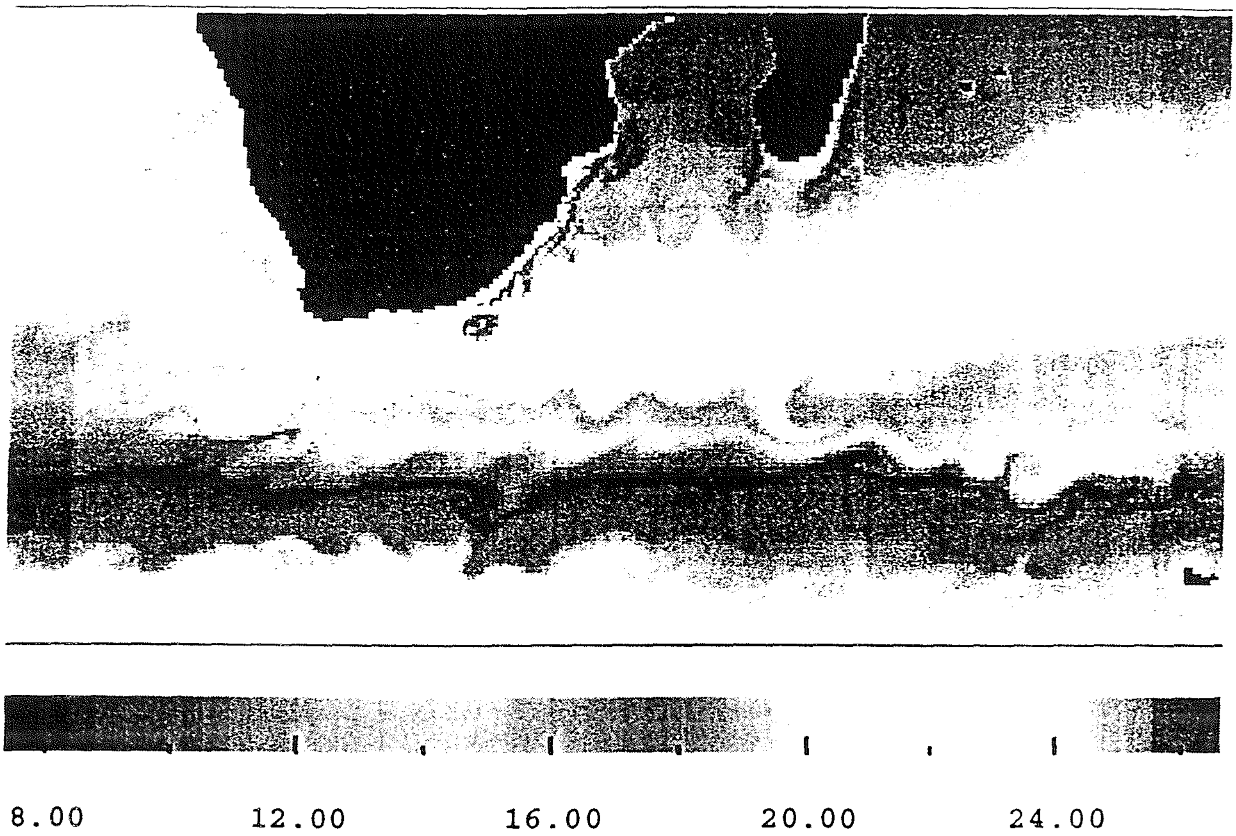
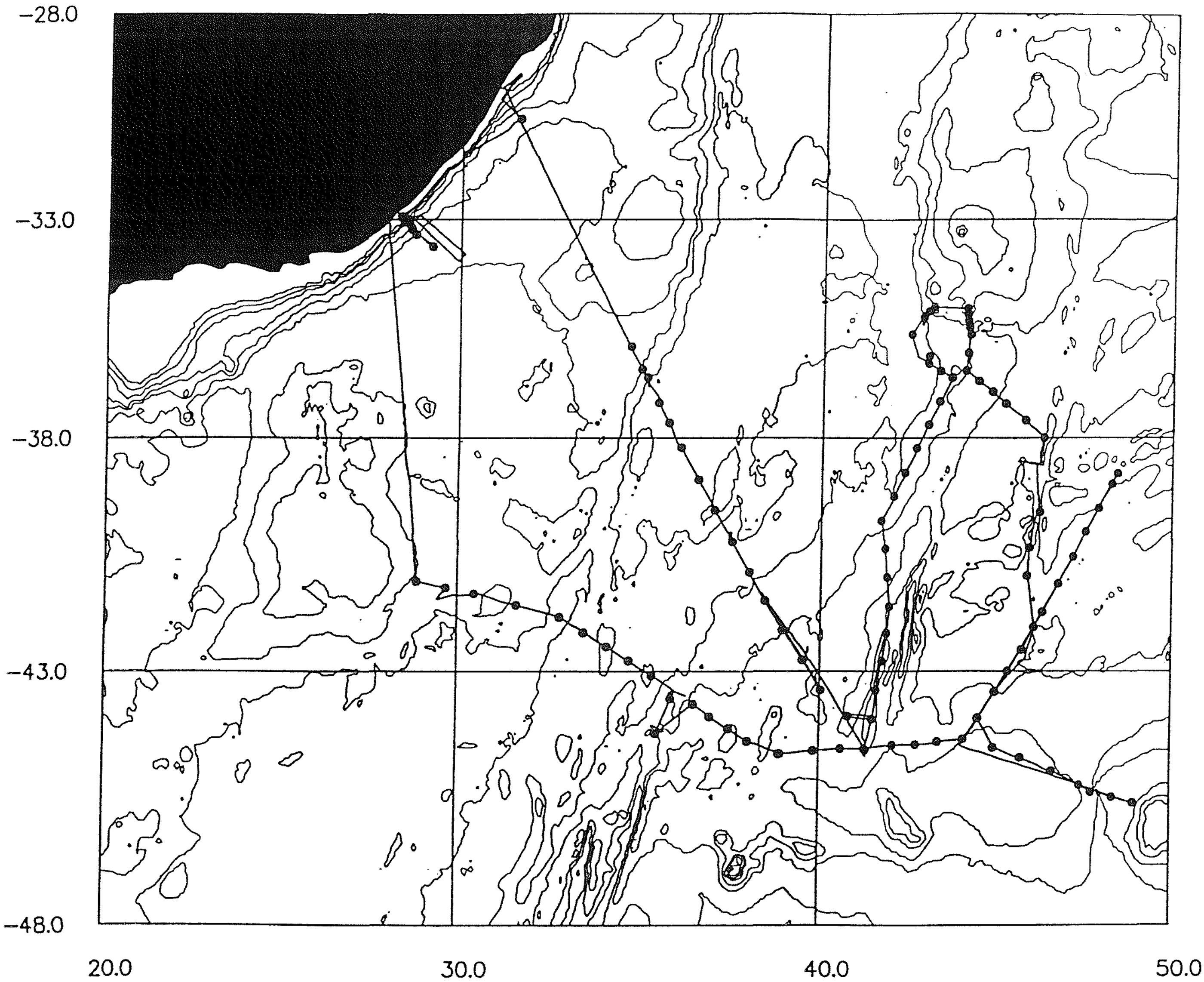


Figure 2. Track chart of RRS *Discovery* cruise 213, 6 Jan. - 21 Feb. 1995, with CTD station positions superimposed.



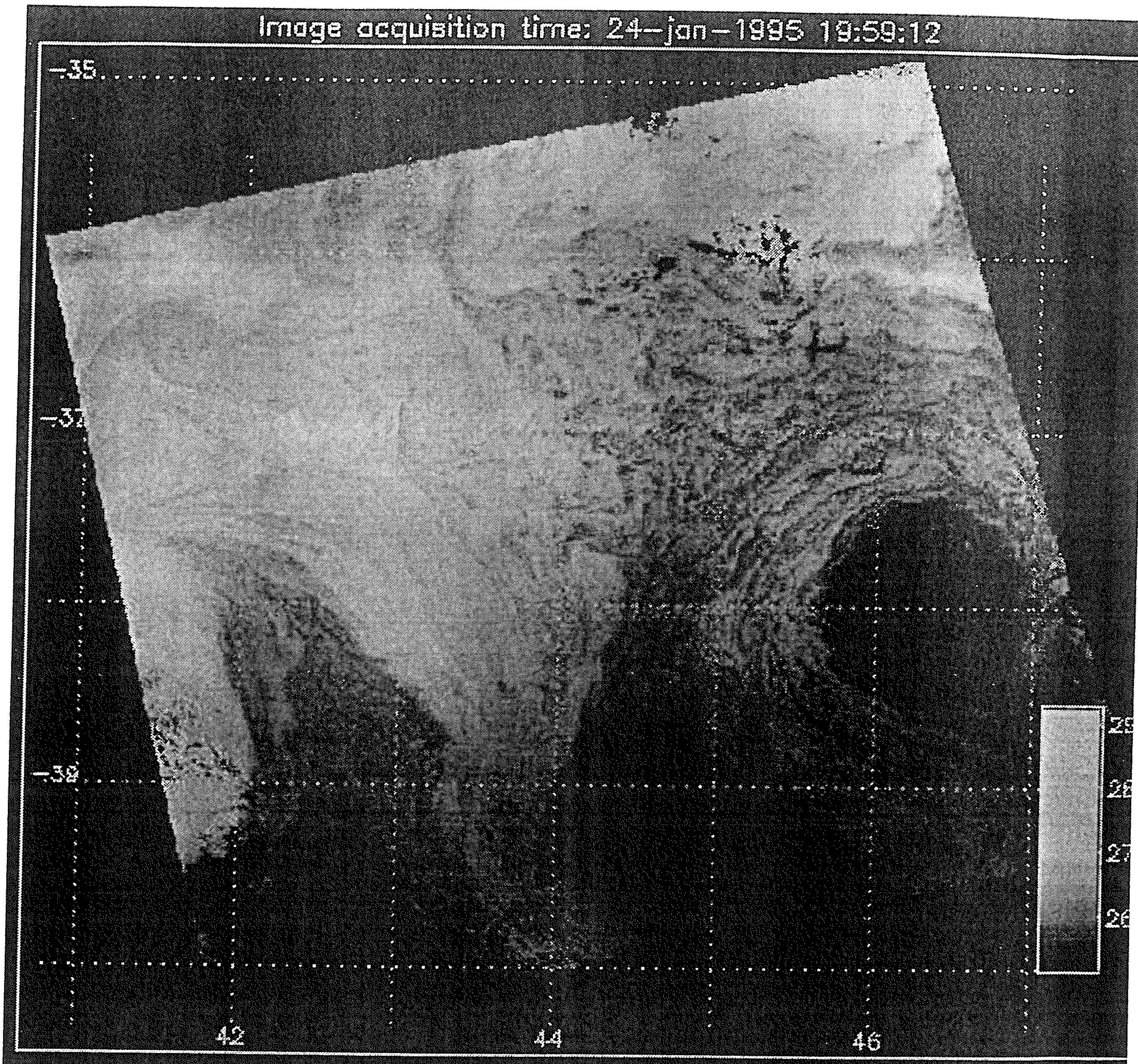


Image acquisition time: 24-jan-1995 19:59:12
-35
42
44
46

Figure 4. A SST image for 24 January 1995 which corresponds to the BT image in figure 3.

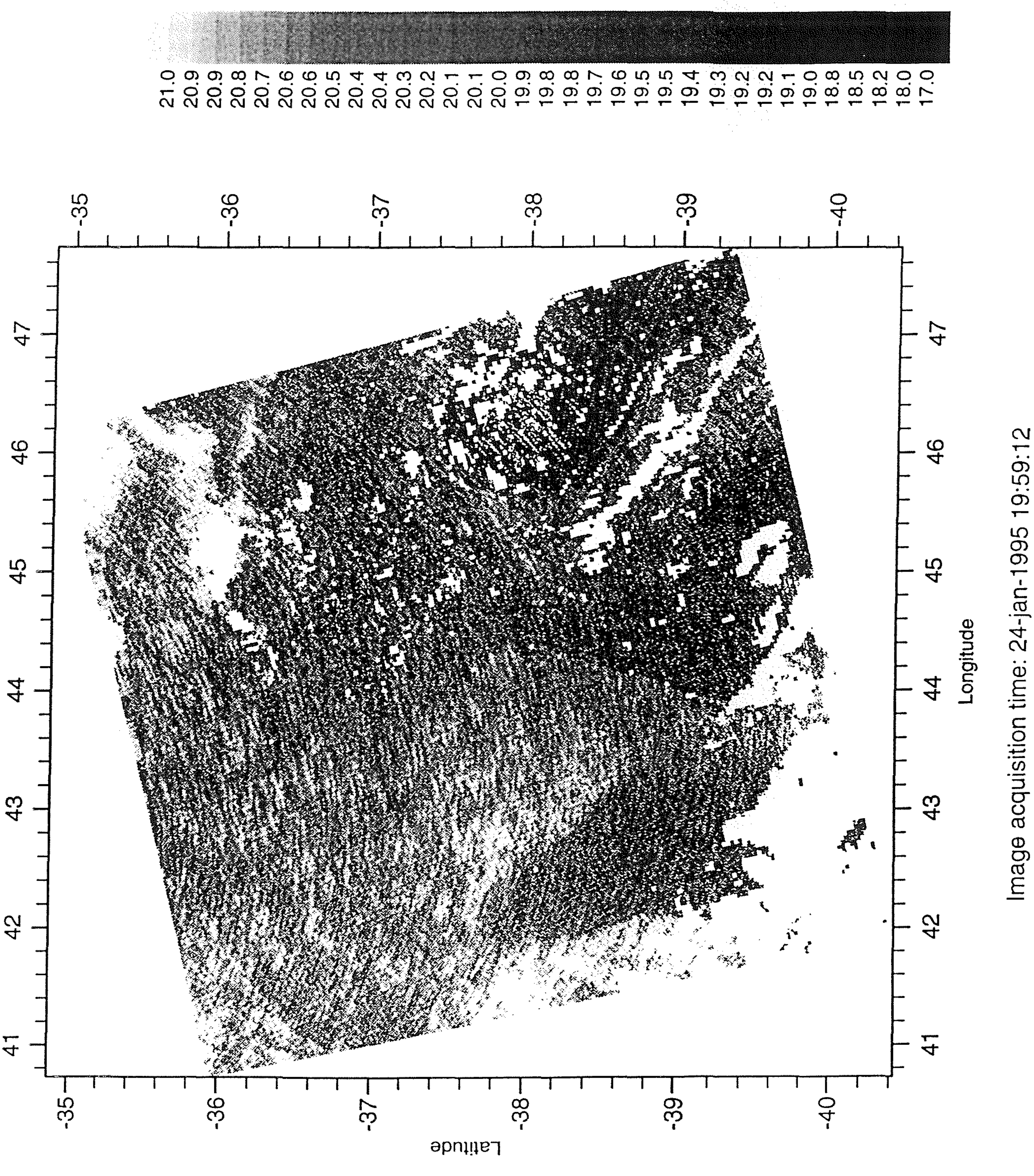


Figure 5. Track chart of RRS *Discovery* cruise 213, 26 Feb. - 09 Mar. 1995.

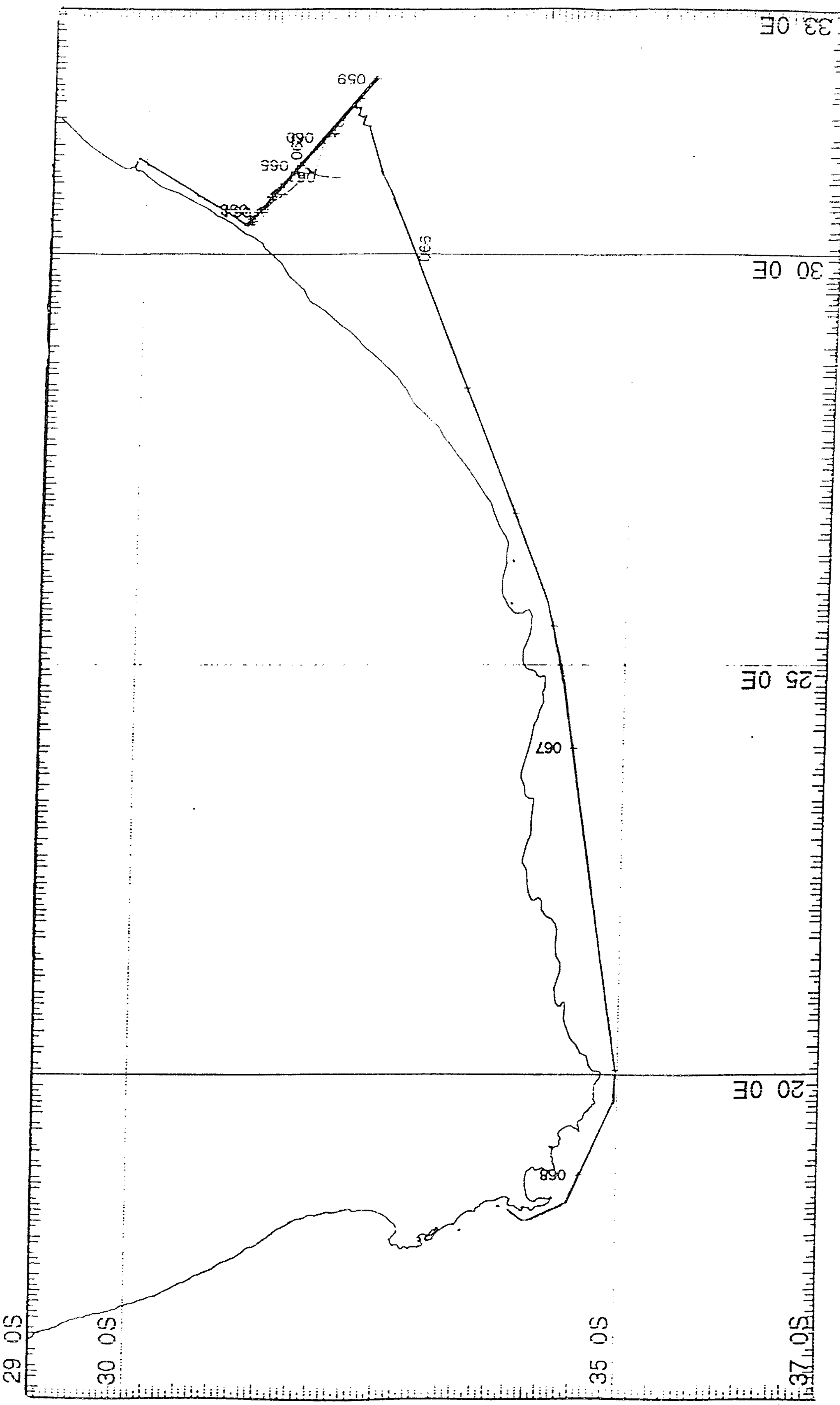


Figure 3. Track chart of RRS *Discovery* cruise 213, 26 Feb. - 09 Mar. 1995.

APPENDIX A

D213 ATSR data list

A listing of the near real time ATSR data acquired to cover cruise D213. Those beginning with an "*" coincide the same region as the follow on cruise D214.

	No.	SADIST File name	% Bad Data	SST Range		Longitude Range		Latitude Range	
*	1	9501040649_23500_A600.SST	77.4	20.0	26.0	32.0	38.4	-33.5	-28.0
*	2	9501040649_24000_A600.SST	55.4	17.0	24.0	30.6	37.3	-37.9	-32.3
	3	9501040649_24500_A600.SST	97.4	12.4	21.6	29.0	36.2	-42.2	-36.7
	4	9501041832_35500_A600.SST	100.0						
	5	9501041832_36000_A600.SST	77.1	12.0	21.0	40.1	47.1	-40.4	-34.9
	6	9501051757_35500_A600.SST	100.0						
	7	9501051757_36000_A600.SST	32.0	11.0	22.0	48.9	55.9	-40.4	-34.9
	8	9501051757_36500_A600.SST	69.3	17.0	24.0	47.8	54.4	-36.0	-30.5
	9	9501051937_35500_A600.SST	100.0						
	10	9501051937_36000_A600.SST	100.0						
	11	9501051937_36500_A600.SST	100.0						
*	12	9501060719_23700_A600.SST	99.4	19.2	27.0	24.0	30.5	-35.2	-29.7
	13	9501060719_24200_A600.SST	68.7	18.0	25.0	22.5	29.4	-39.6	-34.1
	14	9501060719_24700_A600.SST	100.0						
	15	9501061902_35500_A600.SST	100.0						
	16	9501061902_36000_A600.SST	75.7	11.0	22.0	32.7	39.7	-40.4	-34.9
	17	9501061902_36500_A600.SST	100.0						
	18	9501070644_23700_A600.SST	48.0	19.8	25.0	32.8	39.3	-35.2	-29.7
	19	9501070644_24200_A600.SST	93.3	18.6	23.3	31.3	38.2	-39.6	-34.1
	20	9501070644_24700_A600.SST	99.8	11.2	17.2	29.6	37.0	-44.0	-38.4
	21	9501071826_35500_A600.SST	98.4	9.5	19.6	42.7	50.2	-44.8	-39.2
	22	9501071826_36000_A600.SST	66.7	8.0	22.0	41.5	48.5	-40.4	-34.9
	23	9501071826_36500_A600.SST	61.8	17.0	24.0	40.3	47.0	-36.0	-30.5
	24	9501081751_35500_A600.SST	99.3						
	25	9501081751_36000_A600.SST	96.1	9.1	20.0	50.3	57.3	-40.4	-34.9
	26	9501081751_36500_A600.SST	98.8	16.6	22.0	49.2	55.8	-36.0	-30.5
*	27	9501090714_23700_A600.SST	92.3	17.2	24.0	25.3	31.9	-35.2	-29.7
	28	9501090714_24200_A600.SST	75.1	15.0	23.0	23.8	30.7	-39.6	-34.1
	29	9501090714_24700_A600.SST	81.8	12.0	23.0	22.2	29.6	-44.0	-38.4
	30	9501091856_35500_A600.SST	81.0	7.4	18.0	35.2	42.7	-44.8	-39.2
	31	9501091856_36000_A600.SST	97.7	13.7	21.0	34.0	41.0	-40.4	-34.9
	32	9501091856_36500_A600.SST	92.8	17.3	24.0	32.9	39.5	-36.0	-30.5
	33	9501091856_35500_A600.SST	81.0						
	34	9501091856_36000_A600.SST	97.7						
	35	9501091856_36500_A600.SST	92.8						
	36	9501101821_36500_A600.SST	98.4	3.2	25.0	41.7	48.3	-36.0	-30.5
	37	9501101821_36000_A600.SST	97.0	5.6	20.0	42.8	49.8	-40.4	-34.9
	38	9501101821_35500_A600.SST	68.8	0.8	18.0	44.0	51.5	-44.8	-39.2
*	39	9501040649_23500_A600.SST	71.5	20.0	26.0	32.0	38.4	-33.5	-28.0
	40	9501111746_35500_A600.SST	71.6	0.0	18.0	52.8	60.3	-44.8	-39.2
	41	9501111746_36000_A600.SST	80.7	8.0	20.0	51.6	58.6	-40.4	-34.9
	42	9501111746_36500_A600.SST	61.1	6.3	12.0	50.5	57.1	-36.0	-30.5
	43	9501111926_35500_A600.SST	37.6	4.0	20.0	27.7	35.2	-44.8	-39.2
	44	9501111926_36000_A600.SST	70.8	6.0	23.0	26.5	33.5	-40.4	-34.9
	45	9501111926_36500_A600.SST	100.0						
*	46	9501120709_23700_A600.SST	90.9	17.2	25.0	26.7	33.2	-35.2	-29.7
	47	9501120709_24200_A600.SST	93.3	17.5	24.0	25.2	32.1	-39.6	-34.1

	48	9501120709_24700_A600.SST	35.7	11.0	21.0	23.5	30.9	-44.0	-38.4
	49	9501121851_35500_A600.SST	100.0						
	50	9501121851_36000_A600.SST	46.4	16.0	21.0	35.3	42.4	-40.4	-34.9
	51	9501121851_36500_A600.SST	62.5	17.0	23.0	34.2	40.8	-36.0	-30.5
	52	9501130633_23700_A600.SST	69.0	17.4	25.0	35.5	42.0	-35.2	-29.7
	53	9501130633_24200_A600.SST	49.2	17.4	22.0	34.0	40.9	-39.6	-34.1
	54	9501130633_24700_A600.SST	91.2	12.6	21.0	32.3	39.7	-44.0	-38.4
	55	9501131816_35500_A600.SST	100.0						
	56	9501131816_36000_A600.SST	34.5	13.1	21.0	44.2	51.2	-40.4	-34.9
	57	9501131816_36500_A600.SST	85.5	6.2	23.0	43.0	49.7	-36.0	-30.5
	58	9501150703_23700_A600.SST	100.0						
	59	9501150703_24200_A600.SST	99.7						
	60	9501150703_24700_A600.SST	93.6	13.1	23.0	24.9	32.3	-44.0	-38.4
	61	9501160628_23700_A600.SST	84.5	18.0	25.0	36.8	43.4	-35.2	-29.7
	62	9501160628_24200_A600.SST	99.5						
	63	9501160628_24700_A600.SST	97.0	16.1	21.7	33.7	41.1	-44.0	-38.4
	64	9501161810_35500_A600.SST	100.0						
	65	9501161810_36000_A600.SST	83.4	15.1	21.9	45.5	52.5	-40.4	-34.9
	66	9501161810_36500_A600.SST	100.0						
	67	9501141921_35500_A600.SST	100.0						
	68	9501141921_36000_A600.SST	98.6	14.3	23.8	27.9	34.9	-40.4	-34.9
	69	9501141921_36500_A600.SST	100.0						
	70	9501171915_35500_A600.SST	100.0						
	71	9501171915_36000_A600.SST	96.2	13.1	23.0	29.2	36.2	-40.4	-34.9
*	72	9501171915_36500_A600.SST	67.5	14.0	26.0	28.1	34.7	-36.0	-30.5
*	73	9501180658_23700_A600.SST	56.9	20.4	26.9	29.3	35.9	-35.2	-29.7
	74	9501180658_24200_A600.SST	94.7	19.6	23.0	27.9	34.8	-39.6	-34.1
	75	9501180658_24700_A600.SST	97.4	12.0	17.0	26.2	33.6	-44.0	-38.4
	76	9501181840_35500_A600.SST	100.0						
	77	9501181840_36000_A600.SST	68.9	4.0	21.0	38.0	45.0	-40.4	-34.9
	78	9501181840_36500_A600.SST	45.0	15.4	25.9	36.9	43.5	-36.0	-30.5
	79	9501190623_23700_A600.SST	64.8	19.2	27.0	38.2	44.7	-35.2	-29.7
	80	9501190623_24200_A600.SST	98.2	17.5	21.4	36.7	43.6	-39.6	-34.1
	81	9501190623_24700_A600.SST	100.0						
	82	9501190623_24700_A600.SST	98.4	9.0	19.7	35.0	42.4	-44.0	-38.4
	83	9501191805_35500_A600.SST	92.6	5.4	17.0	48.0	55.5	-44.8	-39.2
	84	9501191805_36000_A600.SST	100.0						
	85	9501191805_36500_A600.SST	100.0						
	86	9501191945_35500_A600.SST	100.0						
	87	9501191945_36000_A600.SST	73.6	16.0	24.0	21.8	28.8	-40.4	-34.9
*	88	9501191945_36500_A600.SST	78.3	15.1	24.0	20.7	27.3	-36.0	-30.5
	89	9501201910_35500_A600.SST	96.4	7.0	18.0	31.8	39.3	-44.8	-39.2
	90	9501201910_36000_A600.SST	95.5	16.2	23.0	30.6	37.6	-40.4	-34.9
*	91	9501201910_36500_A600.SST	74.4	19.0	26.0	29.5	36.1	-36.0	-30.5
*	92	9501210652_23700_A600.SST	83.1	19.2	26.0	30.7	37.2	-35.2	-29.7
	93	9501210652_24200_A600.SST	69.2	17.0	23.0	29.2	36.1	-39.6	-34.1
	94	9501210652_24700_A600.SST	72.5	10.0	21.0	27.6	35.0	-44.0	-38.4
	95	9501211835_35500_A600.SST	96.6	5.6	16.0	40.6	48.1	-44.8	-39.2
	96	9501211835_36000_A600.SST	100.0						
	97	9501211835_36500_A600.SST	93.8	18.0	25.7	38.3	44.9	-36.0	-30.5
	98	9501221800_35500_A600.SST	100.0						
	99	9501221800_36000_A600.SST	86.2	15.4	20.0	48.2	55.2	-40.4	-34.9
	100	9501221800_36500_A600.SST	97.6	18.3	24.0	47.1	53.7	-36.0	-30.5
	101	9501221940_35500_A600.SST	91.2	2.5	15.0	24.3	31.8	-44.8	-39.2
	102	9501221940_36000_A600.SST	100.0						
*	103	9501221940_36500_A600.SST	92.6	15.2	26.0	22.0	28.6	-36.0	-30.5
*	104	9501230722_23700_A600.SST	96.6	18.2	26.0	23.2	29.8	-35.2	-29.7
	105	9501230722_24200_A600.SST	66.6	18.0	24.0	21.7	28.7	-39.6	-34.1
	106	9501230722_24700_A600.SST	91.1	9.1	21.0	20.1	27.5	-44.0	-38.4

107	9501231905_35500_A600.SST	100.0						
108	9501231905_36000_A600.SST	57.4	14.0	23.0	31.9	38.9	-40.4	-34.9
109	9501231905_36500_A600.SST	46.6	17.0	25.9	30.8	37.4	-36.0	-30.5
110	9501240647_23700_A600.SST	85.6	20.4	25.7	32.0	38.6	-35.2	-29.7
111	9501240647_24200_A600.SST	83.6	16.4	23.0	30.6	37.5	-39.6	-34.1
112	9501240647_24700_A600.SST	96.0	16.0	22.9	28.9	36.3	-44.0	-38.4
113	9501241829_35500_A600.SST	100.0						
114	9501241829_36000_A600.SST	14.6	15.0	22.0	40.7	47.7	-40.4	-34.9
115	9501241829_36500_A600.SST	45.8	14.0	24.0	39.6	46.2	-36.0	-30.5
116	9501251754_35500_A600.SST	100.0						
117	9501251754_36000_A600.SST	89.8	14.2	21.0	49.5	56.5	-40.4	-34.9
118	9501251754_36500_A600.SST	97.4	17.0	23.8	48.4	55.0	-36.0	-30.5
119	9501251935_35500_A600.SST	63.6	9.0	19.0	25.6	33.1	-44.8	-39.2
120	9501251935_36000_A600.SST	99.0						
121	9501251935_36500_A600.SST	100.0						
122	9501260717_23700_A600.SST	100.0						
123	9501260717_24200_A600.SST	80.5	18.2	24.0	23.1	30.0	-39.6	-34.1
124	9501260717_24700_A600.SST	79.2	11.2	23.0	21.4	28.8	-44.0	-38.4
125	9501270642_23700_A600.SST	91.7	21.4	26.0	33.4	39.9	-35.2	-29.7
126	9501270642_24200_A600.SST	47.8	17.3	24.0	31.9	38.8	-39.6	-34.1
127	9501270642_24700_A600.SST	76.3	9.3	22.0	30.2	37.6	-44.0	-38.4
128	9501281749_35500_A600.SST	100.0						
129	9501281749_36000_A600.SST	78.4	15.4	21.0	50.9	57.9	-40.4	-34.9
130	9501281749_36500_A600.SST	100.0						
*131	9501290712_23700_A600.SST	98.6	19.4	25.0	25.9	32.5	-35.2	-29.7
132	9501290712_24200_A600.SST	78.5	17.3	24.0	24.4	31.4	-39.6	-34.1
133	9501290712_24700_A600.SST	93.1	11.1	21.0	22.8	30.2	-44.0	-38.4
134	9501291854_35500_A600.SST	76.4	8.1	21.0	35.8	43.3	-44.8	-39.2
135	9501291854_36000_A600.SST	86.6	16.5	22.9	34.6	41.6	-40.4	-34.9
136	9501291854_36500_A600.SST	85.8	18.0	26.0	33.5	40.1	-36.0	-30.5
137	9501300636_23700_A600.SST	97.2	20.9	27.0	34.7	41.3	-35.2	-29.7
138	9501300636_24200_A600.SST	98.2	18.2	23.5	33.2	40.2	-39.6	-34.1
139	9501300636_24700_A600.SST	98.1	12.3	22.0	31.6	39.0	-44.0	-38.4
140	9501301819_35500_A600.SST	100.0						
141	9501301819_36000_A600.SST	98.5	18.5	23.0	43.4	50.4	-40.4	-34.9
142	9501301819_36500_A600.SST	92.8	19.2	25.0	42.3	48.9	-36.0	-30.5
143	9501311924_35500_A600.SST	100.0						
144	9501311924_36000_A600.SST	98.3	20.0	24.0	27.1	34.1	-40.4	-34.9
*145	9501311924_36500_A600.SST	78.6	16.0	26.0	26.0	32.6	-36.0	-30.5
*146	9502010706_23700_A600.SST	91.7	20.3	27.0	27.3	33.8	-35.2	-29.7
147	9502010706_24200_A600.SST	97.9	19.7	24.0	25.8	32.7	-39.6	-34.1
148	9502010706_24700_A600.SST	98.1	10.1	19.9	24.1	31.5	-44.0	-38.4
149	9502011849_35500_A600.SST	67.5	7.7	19.0	37.1	44.6	-44.8	-39.2
150	9502011849_36000_A600.SST	88.8	17.1	23.0	35.9	42.9	-40.4	-34.9
151	9502011849_36500_A600.SST	67.6	19.1	26.0	34.8	41.4	-36.0	-30.5
152	9502020631_23700_A600.SST	79.4	20.0	27.0	36.1	42.6	-35.2	-29.7
153	9502020631_24200_A600.SST	80.7	18.0	24.0	34.6	41.5	-39.6	-34.1
154	9502020631_24700_A600.SST	96.7	9.1	18.9	32.9	40.3	-44.0	-38.4
155	9502021813_35500_A600.SST	83.4	5.3	19.0	45.9	53.4	-44.8	-39.2
156	9502021813_36000_A600.SST	85.9	16.4	22.9	44.7	51.8	-40.4	-34.9
157	9502021813_36500_A600.SST	89.7	15.1	25.0	43.6	50.2	-36.0	-30.5
158	9502031918_35500_A600.SST	100.0						
159	9502031918_36000_A600.SST	89.6	16.2	24.0	28.5	35.5	-40.4	-34.9
160	9502031918_36500_A600.SST	100.0						
*161	9502040701_23700_A600.SST	81.0	20.7	27.0	28.6	35.1	-35.2	-29.7
162	9502040701_24200_A600.SST	62.6	18.1	25.0	27.1	34.0	-39.6	-34.1
163	9502040701_24700_A600.SST	99.2						
164	9502041843_35500_A600.SST	98.4	6.1	13.7	38.5	46.0	-44.8	-39.2
165	9502041843_36000_A600.SST	98.3	16.8	22.8	37.3	44.3	-40.4	-34.9

166	9502041843_36500_A600.SST	74.1	18.3	26.0	36.2	42.8	-36.0	-30.5
167	9502050626_23700_A600.SST	79.7	19.7	26.0	37.4	43.9	-35.2	-29.7
168	9502050626_24200_A600.SST	93.9	18.2	24.9	35.9	42.8	-39.6	-34.1
169	9502050626_24700_A600.SST	100.0						
170	9502051808_35500_A600.SST	99.6						
171	9502051808_36000_A600.SST	97.6	16.3	21.0	46.1	53.1	-40.4	-34.9
172	9502051808_36500_A600.SST	98.1	19.1	25.9	45.0	51.6	-36.0	-30.5
173	9502061913_35500_A600.SST	100.0						
174	9502061913_36000_A600.SST	98.3	17.0	24.9	29.8	36.8	-40.4	-34.9
175	9502061913_36500_A600.SST	99.3						
*176	9502070655_23700_A600.SST	72.2	20.2	28.0	29.9	36.5	-35.2	-29.7
177	9502070655_24200_A600.SST	91.4	20.3	24.8	28.5	35.4	-39.6	-34.1
178	9502070655_24700_A600.SST	100.0						
179	9502071838_35500_A600.SST	100.0						
180	9502071838_36000_A600.SST	87.1	10.0	22.8	38.6	45.6	-40.4	-34.9
181	9502071838_36500_A600.SST	51.3	19.0	26.0	37.5	44.1	-36.0	-30.5
182	9502081803_35500_A600.SST	100.0						
183	9502081803_36000_A600.SST	100.0						
184	9502081803_36500_A600.SST	84.7	16.0	25.0	46.3	52.9	-36.0	-30.5
185	9502081943_35500_A600.SST	95.8	5.1	21.0	23.5	31.0	-44.8	-39.2
186	9502081943_36000_A600.SST	79.1	13.4	25.9	22.4	29.4	-40.4	-34.9
187	9502081943_36500_A600.SST	81.7	16.0	25.6	21.2	27.8	-36.0	-30.5
*188	9502090725_23700_A600.SST	93.4	19.2	27.0	22.5	29.0	-35.2	-29.7
189	9502090725_24200_A600.SST	51.8	14.2	26.0	21.0	27.9	-39.6	-34.1
190	9502090725_24700_A600.SST	66.6	11.2	24.0	19.3	26.7	-44.0	-38.4
191	9502091908_35500_A600.SST	74.8	1.0	17.9	32.3	39.8	-44.8	-39.2
192	9502091908_36000_A600.SST	94.8	4.2	23.0	31.2	38.2	-40.4	-34.9
193	9502091908_36500_A600.SST	83.5	19.2	26.0	30.0	36.7	-36.0	-30.5
194	9501150703_23700_A600.SST	100.0						
195	9501150703_24200_A600.SST	99.7						
196	9501150703_23700_A600.SST	100.0						
197	9501150703_24200_A600.SST	99.9						
198	9501150703_24700_A600.SST	95.4	13.1	23.0	24.9	32.3	-44.0	-38.4
199	9501161810_35500_A600.SST	100.0						
200	9501161810_36000_A600.SST	87.4	15.1	21.9	45.5	52.5	-40.4	-34.9
201	9501161810_36500_A600.SST	100.0						
202	9502100650_23700_A600.SST	90.5	20.2	26.0	31.3	37.8	-35.2	-29.7
203	9502100650_24200_A600.SST	95.5	17.4	24.8	29.8	36.7	-39.6	-34.1
204	9502100650_24700_A600.SST	97.5	10.3	21.0	28.2	35.6	-44.0	-38.4
205	9502101832_35500_A600.SST	84.0	4.0	19.0	41.2	48.7	-44.8	-39.2
206	9502101832_36000_A600.SST	100.0						
207	9502101832_36500_A600.SST	100.0						
208	9502111757_35500_A600.SST	81.1	6.1	18.0	50.0	57.5	-44.8	-39.2
209	9502111757_36000_A600.SST	100.0						
210	9502111757_36500_A600.SST	91.8	16.4	24.9	47.7	54.3	-36.0	-30.5
211	9502111938_35500_A600.SST	84.1	7.6	22.0	24.9	32.4	-44.8	-39.2
212	9502111938_36000_A600.SST	64.7	15.0	25.0	23.7	30.7	-40.4	-34.9
*213	9502111938_36500_A600.SST	94.6	17.0	26.0	22.6	29.2	-36.0	-30.5
214	9502120720_23700_A600.SST	100.0						
*215	9502120720_24200_A600.SST	74.0	16.1	26.0	22.3	29.3	-39.6	-34.1
216	9502120720_24700_A600.SST	92.5	11.5	20.9	20.7	28.1	-44.0	-38.4
217	9502121902_35500_A600.SST	64.4	7.0	21.0	33.7	41.2	-44.8	-39.2
218	9502121902_36000_A600.SST	100.0						
219	9502121902_36500_A600.SST	75.7	20.0	26.0	31.4	38.0	-36.0	-30.5
220	9502130645_23700_A600.SST	39.2	19.9	26.0	32.6	39.2	-35.2	-29.7
221	9502130645_24200_A600.SST	67.4	16.1	24.0	31.1	38.1	-39.6	-34.1
222	9502130645_24700_A600.SST	70.2	10.0	23.0	29.5	36.9	-44.0	-38.4
223	9502131827_35500_A600.SST	100.0						
224	9502131827_36000_A600.SST	43.1	12.0	22.0	41.3	48.3	-40.4	-34.9

225	9502131827_36500_A600.SST	88.4	17.7	24.0	40.2	46.8	-36.0	-30.5
226	9502141752_35500_A600.SST	100.0						
227	9502141752_36000_A600.SST	99.8						
228	9502141752_36500_A600.SST	80.1	17.2	23.0	49.0	55.6	-36.0	-30.5
229	9502141932_35500_A600.SST	91.0	8.7	21.0	26.2	33.7	-44.8	-39.2
230	9502141932_36000_A600.SST	79.5	16.1	24.9	25.0	32.0	-40.4	-34.9
231	9502141932_36500_A600.SST	99.3						
232	9502150715_23700_A600.SST	0.0	-273.1*****		25.2	31.7	-35.2	-29.7
*233	9502150715_24200_A600.SST	90.1	17.1	25.0	23.7	30.6	-39.6	-34.1
234	9502151857_35500_A600.SST	86.5	2.1	19.0	35.0	42.5	-44.8	-39.2
235	9502151857_36000_A600.SST	100.0						
236	9502151857_36500_A600.SST	58.6	19.1	25.0	32.7	39.3	-36.0	-30.5
237	9502160639_23700_A600.SST	67.4	19.9	26.0	34.0	40.5	-35.2	-29.7
238	9502160639_24200_A600.SST	85.1	20.2	24.7	32.5	39.4	-39.6	-34.1
239	9502160639_24700_A600.SST	100.0						
240	9502161822_36000_A600.SST	93.2	16.8	22.0	42.7	49.7	-40.4	-34.9
241	9502161822_36500_A600.SST	89.7	18.8	25.0	41.5	48.2	-36.0	-30.5
242	9502171746_35500_A600.SST	100.0						
243	9502171746_36000_A600.SST	98.5	17.7	21.0	51.5	58.5	-40.4	-34.9
244	9502171746_36500_A600.SST	93.6	17.1	24.0	50.4	57.0	-36.0	-30.5
245	9502171927_35500_A600.SST	93.8	8.4	21.8	27.6	35.1	-44.8	-39.2
246	9502171927_36000_A600.SST	74.9	17.1	24.0	26.4	33.4	-40.4	-34.9
*247	9502171927_36500_A600.SST	98.8	21.3	27.9	25.3	31.9	-36.0	-30.5
*248	9502180709_23700_A600.SST	97.5	20.5	27.5	26.5	33.0	-35.2	-29.7
249	9502180709_24200_A600.SST	91.4	16.8	23.0	25.0	31.9	-39.6	-34.1
250	9502180709_24700_A600.SST	79.5	13.7	22.0	23.4	30.8	-44.0	-38.4
251	9502181852_35500_A600.SST	91.7	8.9	20.0	36.4	43.9	-44.8	-39.2
252	9502181852_36000_A600.SST	86.6	14.4	23.0	35.2	42.2	-40.4	-34.9
253	9502181852_36500_A600.SST	100.0						
254	9502190634_23700_A600.SST	100.0						
255	9502190634_24200_A600.SST	100.0						
256	9502190634_24700_A600.SST	100.0						
257	9502191816_35500_A600.SST	100.0						
258	9502191816_36000_A600.SST	99.5	16.1	22.0	44.0	51.0	-40.4	-34.9
259	9502191816_36500_A600.SST	93.1	18.2	25.0	42.9	49.5	-36.0	-30.5
260	9502201921_35500_A600.SST	100.0						
261	9502201921_36000_A600.SST	90.5	18.0	25.0	27.7	34.7	-40.4	-34.9
262	9502201921_36500_A600.SST	100.0						
*263	9502210704_23700_A600.SST	97.1	22.6	26.7	27.9	34.4	-35.2	-29.7
264	9502210704_24200_A600.SST	99.8	16.9	23.7	26.4	33.3	-39.6	-34.1
265	9502210704_24700_A600.SST	99.3	12.4	20.2	24.7	32.1	-44.0	-38.4
266	9502211846_35500_A600.SST	70.5	7.1	19.0	37.7	45.2	-44.8	-39.2
267	9502211846_36000_A600.SST	92.3	15.4	23.9	36.5	43.5	-40.4	-34.9
*268	9502211846_36500_A600.SST	96.8	19.6	25.0	35.4	42.0	-36.0	-30.5

APPENDIX B

D213 Images

Greyscale brightness temperature images that were sent to the RRS *Discovery* by facsimile during cruise D213

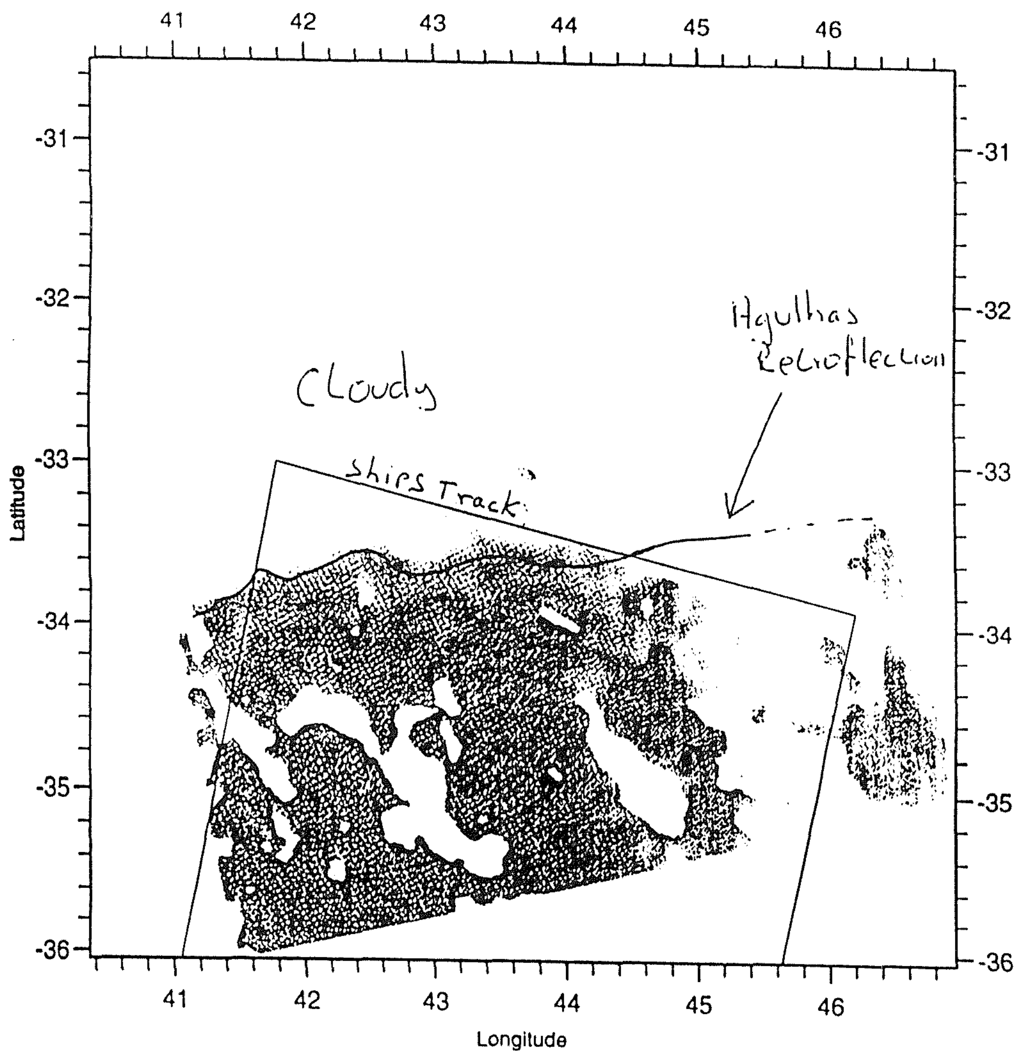
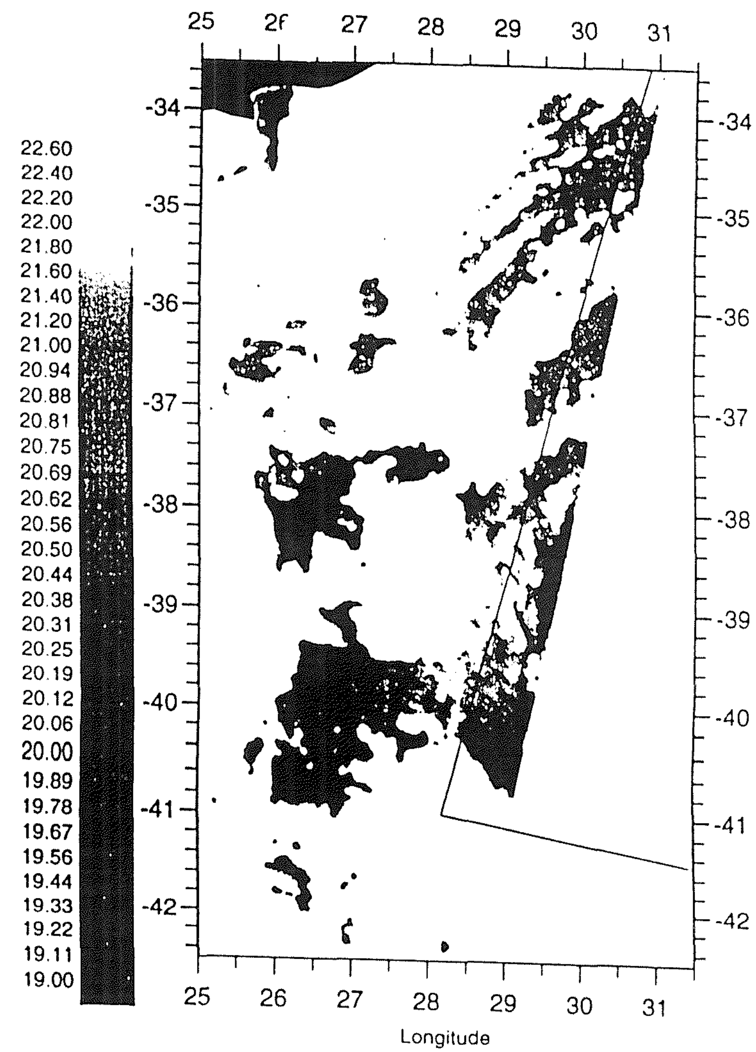


Image acquisition time: 07-jan-1995 19:57:27

JRCOCx501071826_36500_50107_a600.sst

Image 1

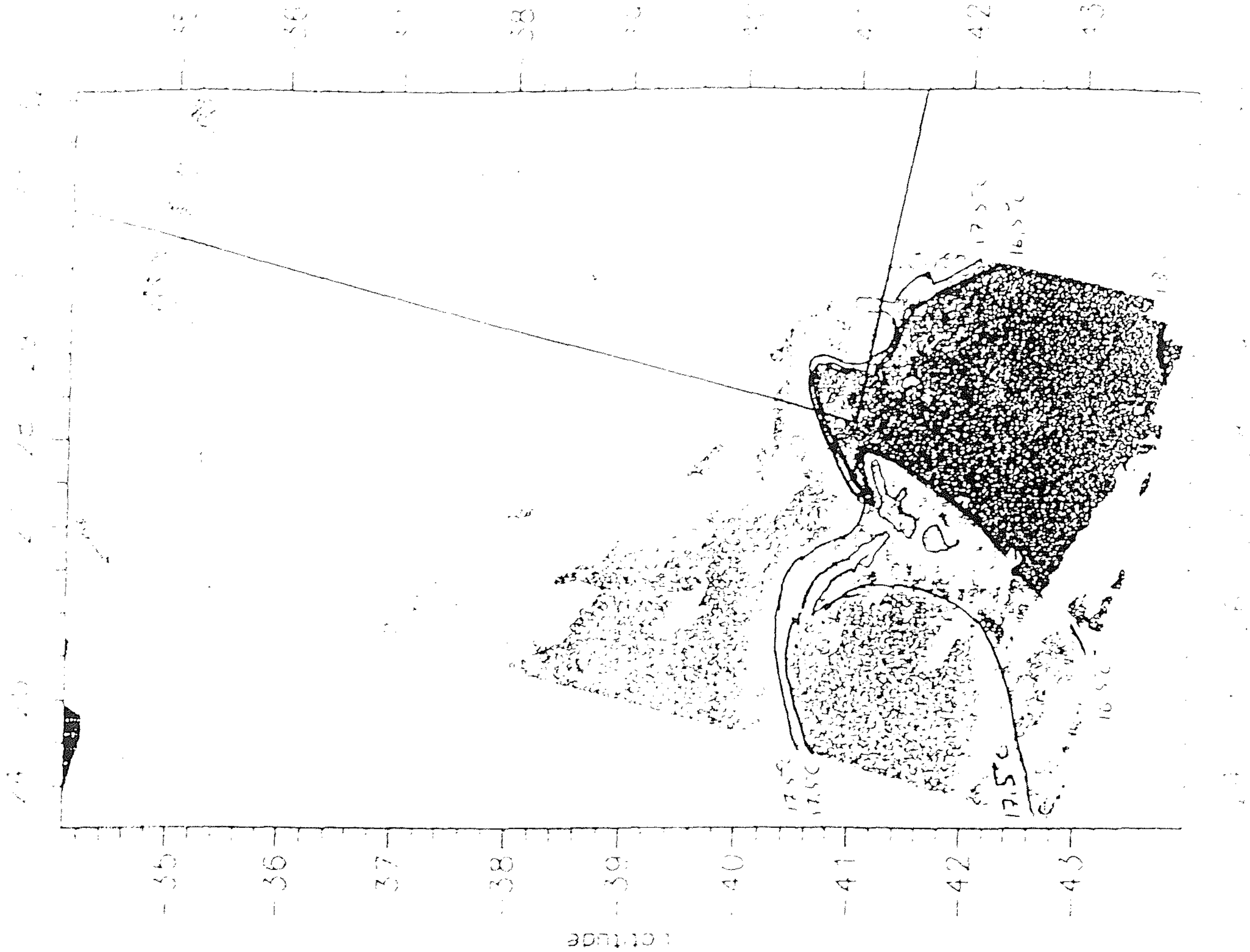


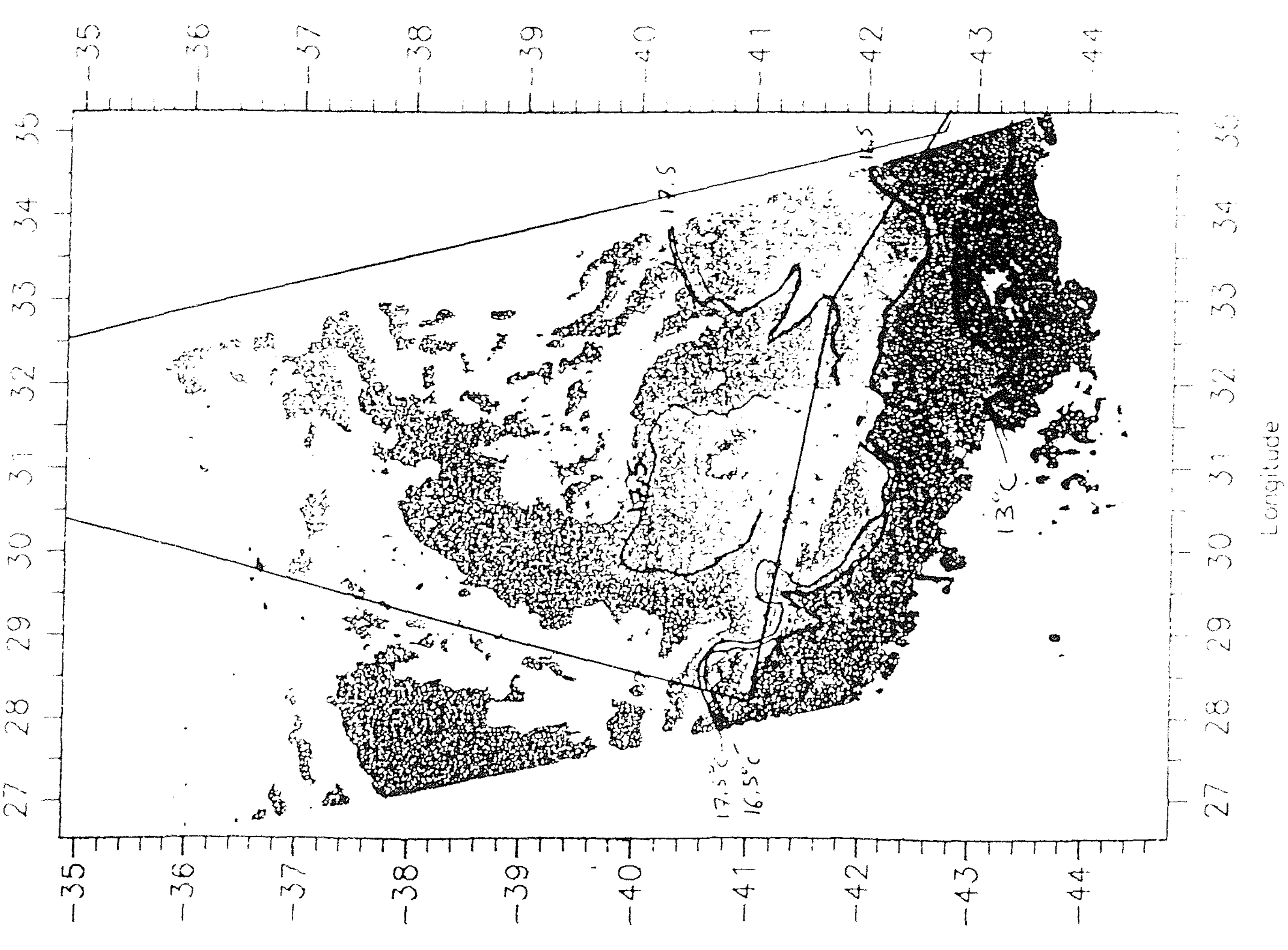
57.1% cloud cover

Image acquisition time: 09-jan-1995 08:15:39

JRCOCx501090714_24700_50109_a600.sst

Image 2


Latitude
17.5°C
16.5°C


Longitude
17.5
16.5
13°C
17.5°C
16.5°C

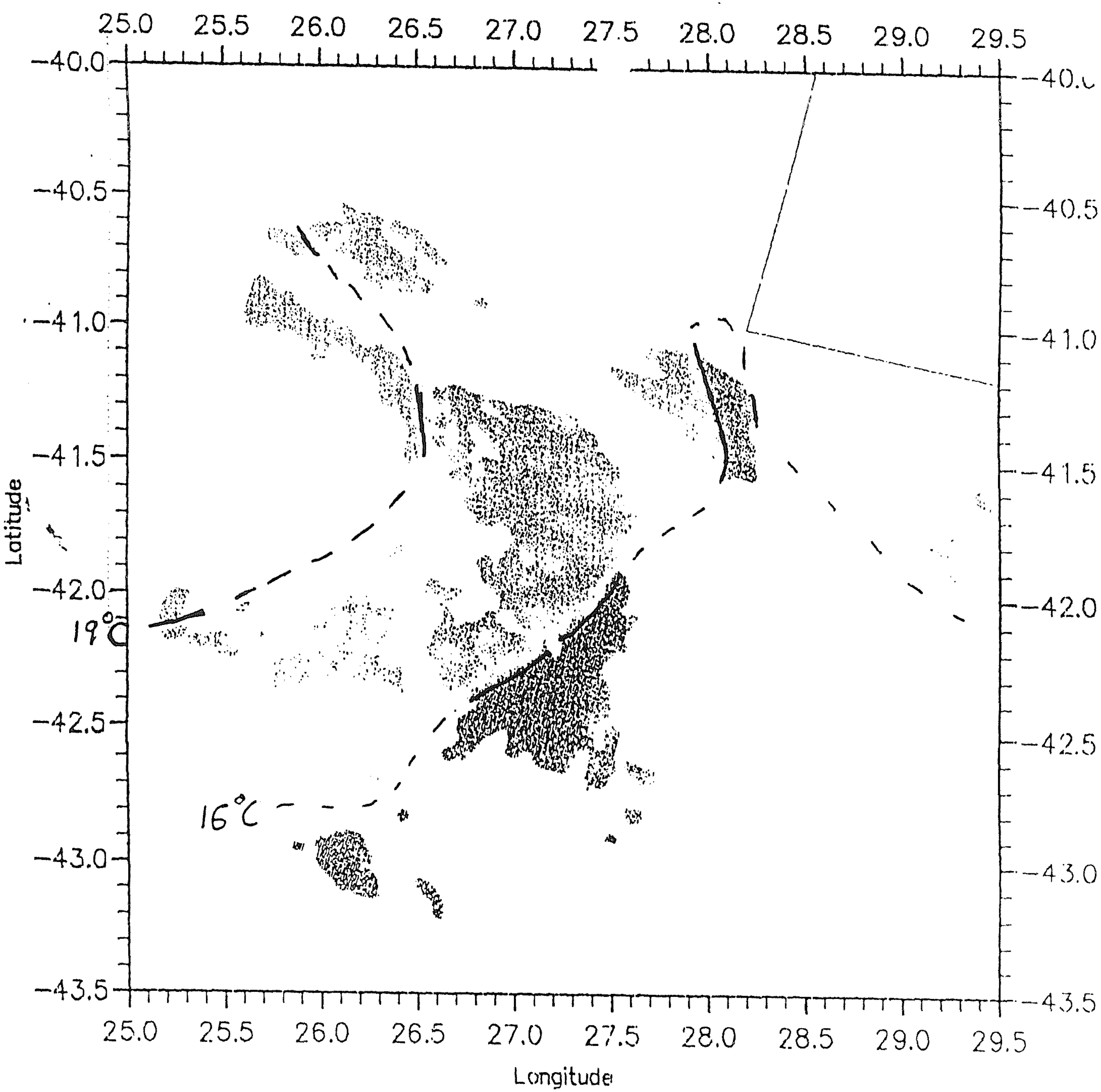


Image acquisition time: 15-[illegible]-19[illegible] 08[illegible]54

FACSIMILE

To: Raymond Pollard
c/o RRS Discovery

From: Graham Quartly
Rennell Centre

Date: 17th Jan 95

Text: Of today's batch, only one good image of relevance (nr. Mooring H)

Is planned itinerary for next 2 weeks doing Moorings H to A i.e. only ATSR images between 40° & 45°S needed?

98

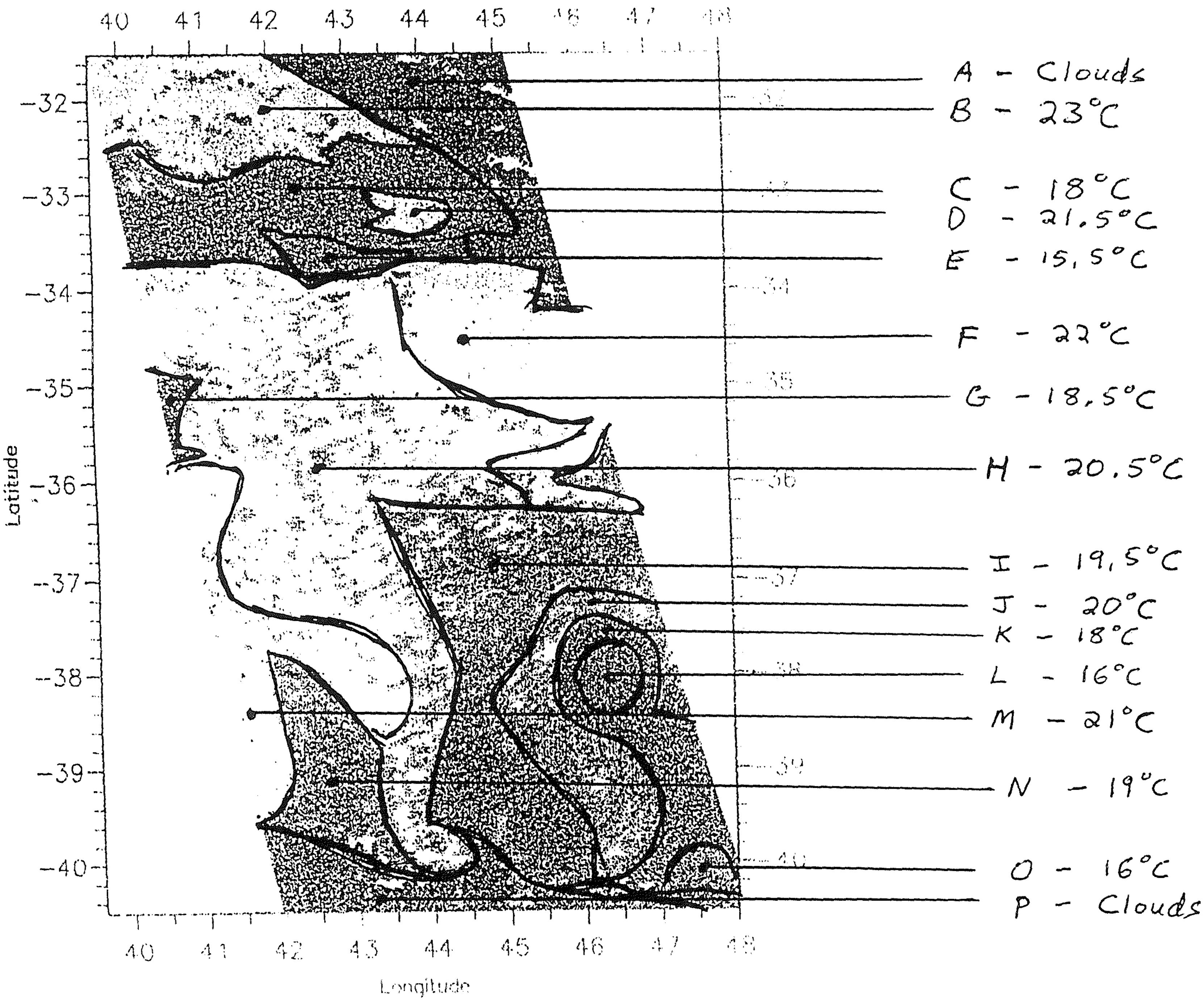


Image acquisition time: 24 - jan [illegible]

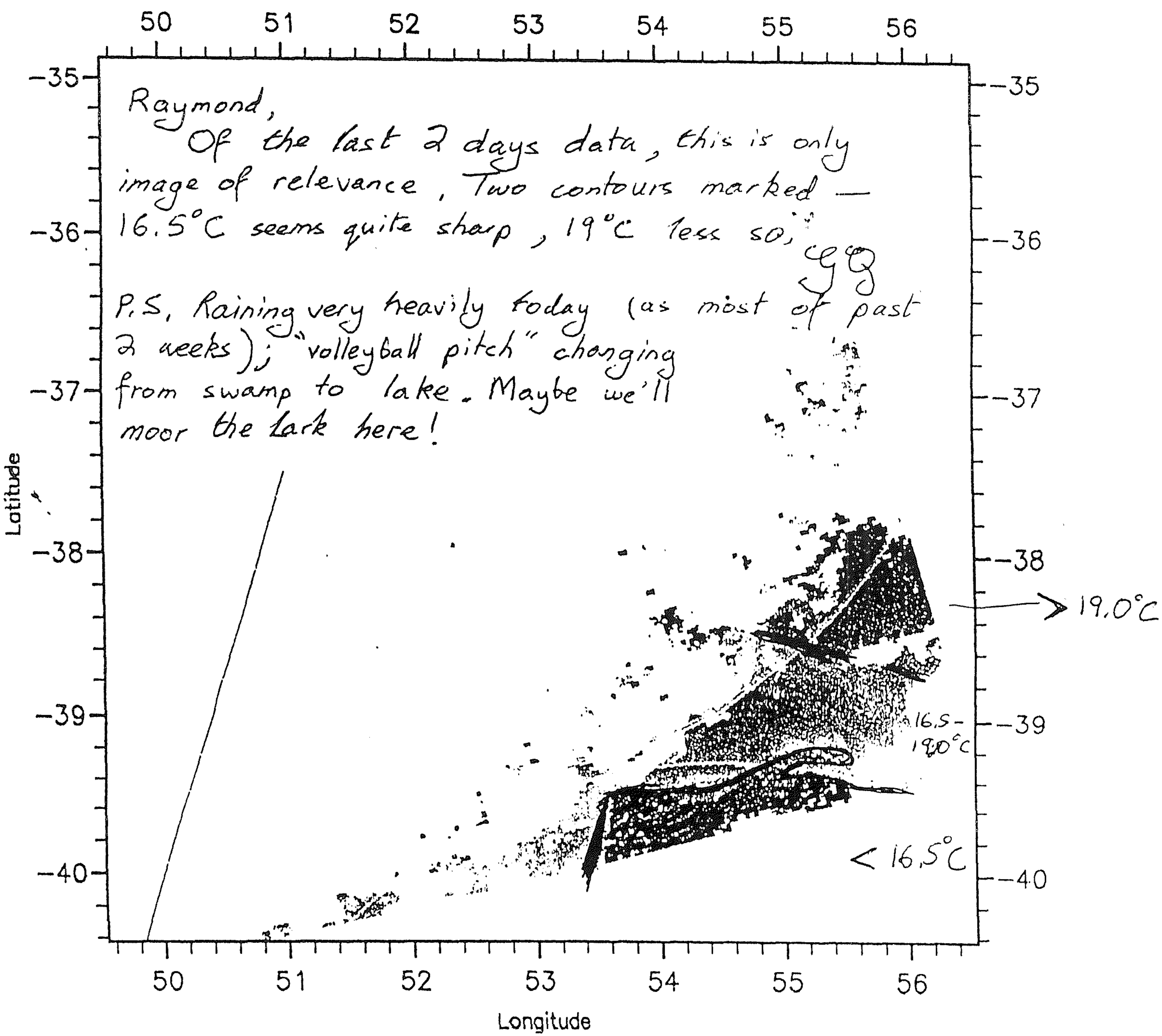
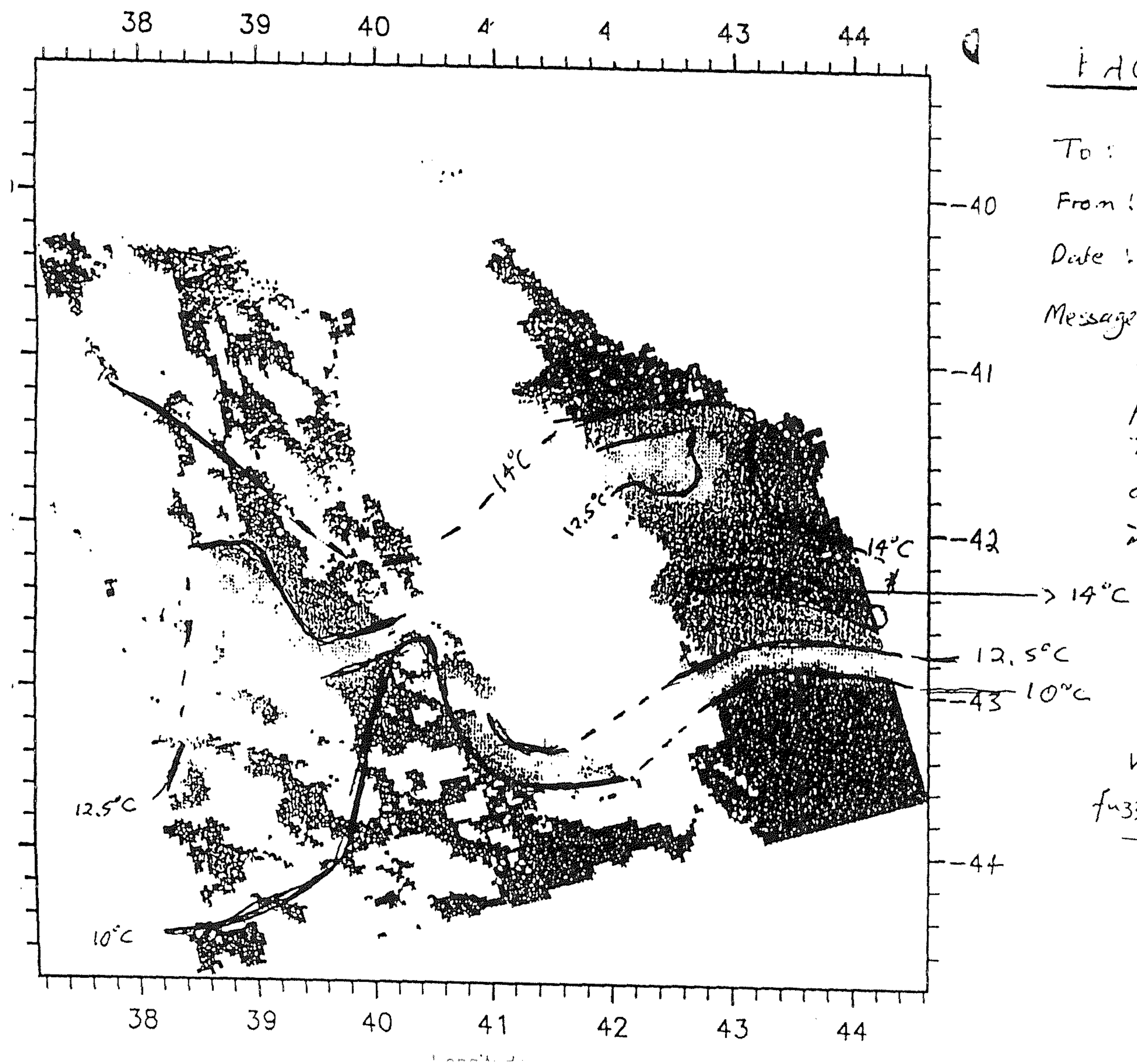


Image acquisition time: 25 Jan- 1995

(14)



FACSIMILE

To: Raymond Pollard c/o RRS Discovery

From: Graham Quartly

Date: 02 Feb 95

Message: This is the best of last few days' data. I know it's west of present plans; however, may prove of interest. Thermal features sharpest on RHS of picture. On LHS, 10°C contour is hard to guess due to patchy data and noise. Cool loop (< 12.5°C) centred on 42°E, 41.5°S appears real. Probably has been/is connected to other 12.5°C contours. Warm streak at 43°E, 42.5°S has fuzzy (smeared) edge — probably real.

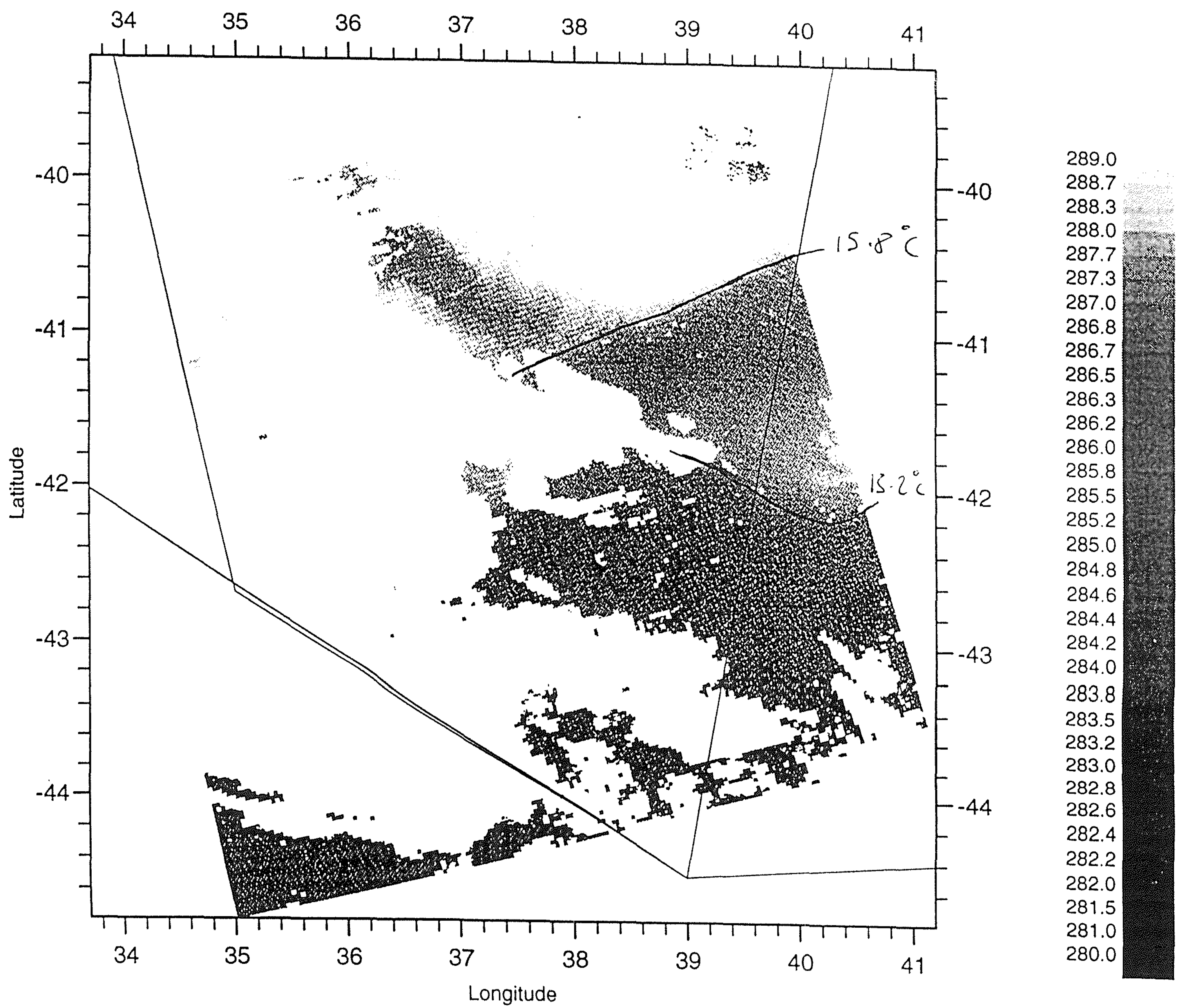


Image acquisition time: 12-feb-1995 20:30:50

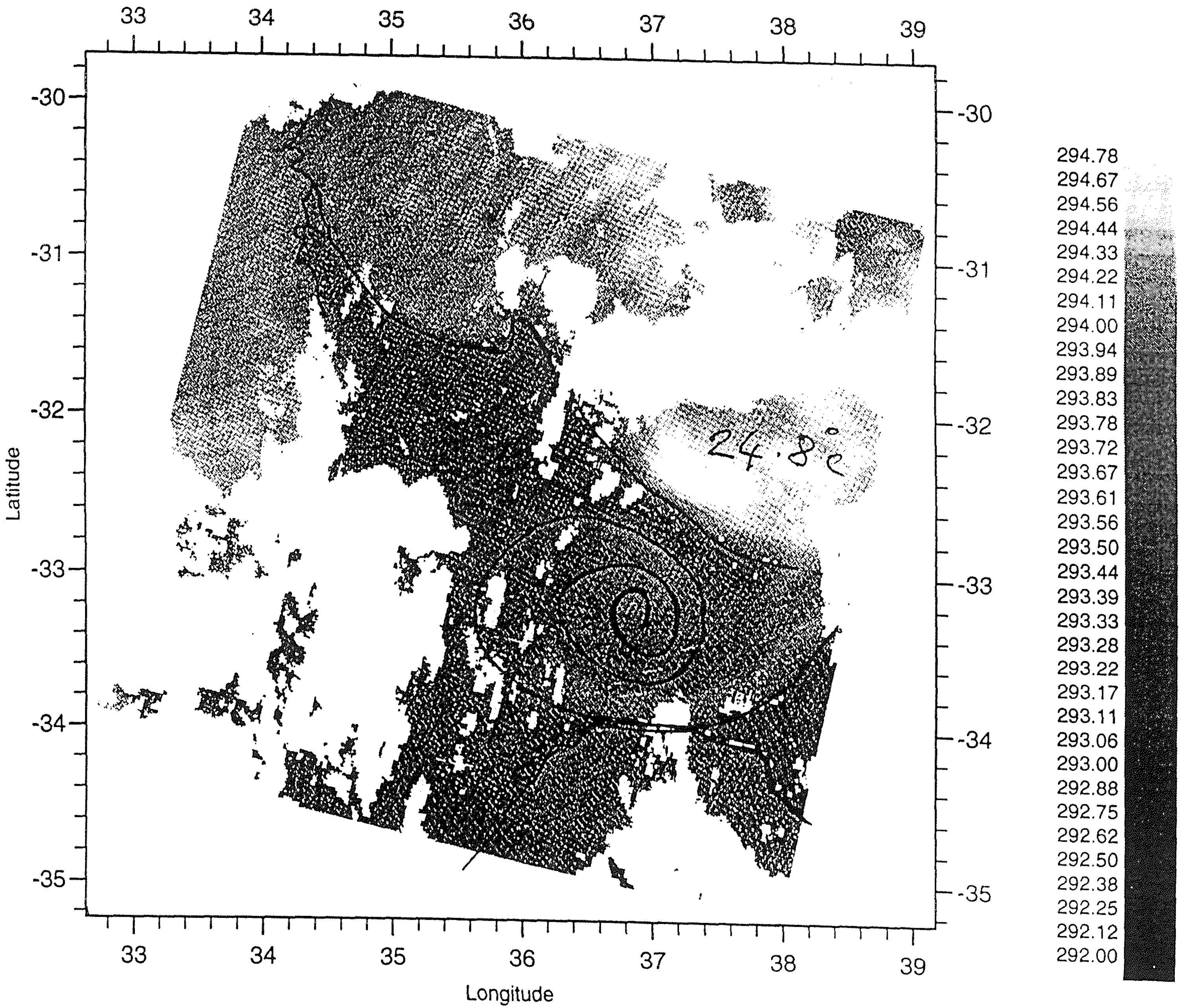


Image acquisition time: 13-feb-1995 07:43:57

APPENDIX C

D214 data list

A listing of the near real time ATSR data acquired to cover cruise D214.

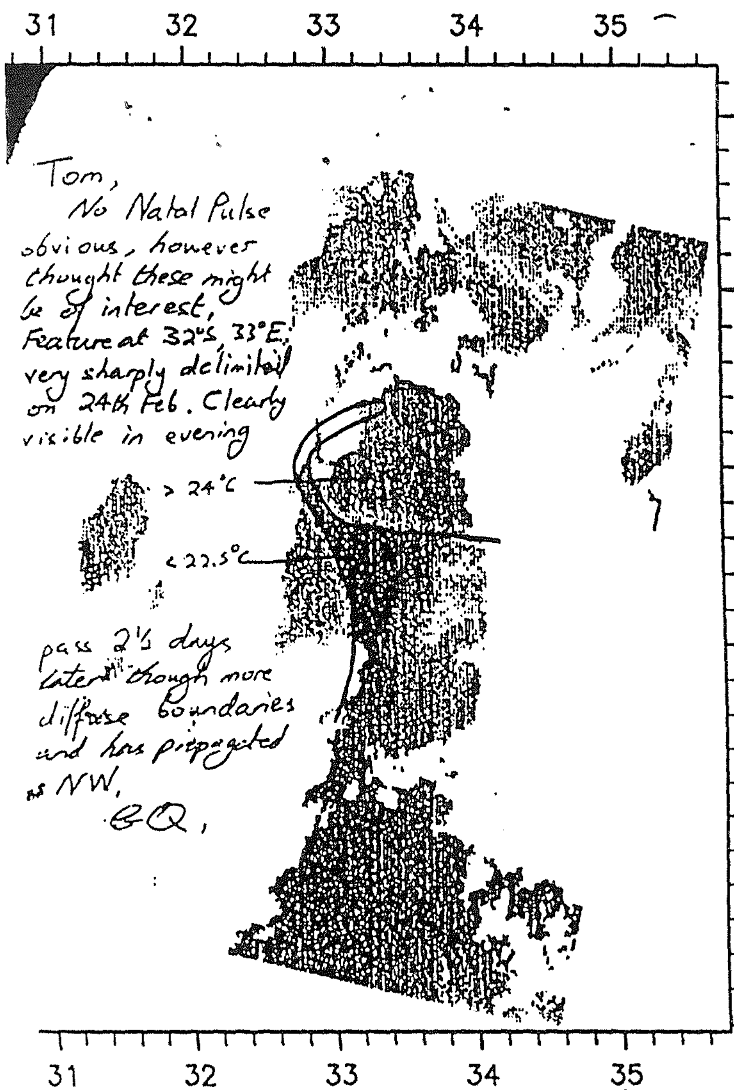
No.	SADIST File name	% Bad Data	SST Range		Longitude Range		Latitude Range	
1	9502220629_23700_A600.SST	100.0						
2	9502220629_24200_A600.SST	99.9	19.0	23.0	35.2	42.1	-39.6	-34.1
3	9502220629_24700_A600.SST	83.5	9.6	20.0	33.5	40.9	-44.0	-38.4
4	9502231916_36200_A600.SST	70.3	17.1	25.0	28.6	35.5	-38.7	-33.1
5	9502231916_36700_A600.SST	94.7	20.0	27.0	27.5	34.0	-34.3	-28.8
6	9502231916_37200_A600.SST	100.0						
7	9502240658_23700_A600.SST	76.4	20.5	26.0	29.2	35.7	-35.2	-29.7
8	9502240658_23700_A600.SST	76.4	20.5	26.0	29.2	35.7	-35.2	-29.7
9	9502240658_24200_A600.SST	71.5	18.4	25.0	27.7	34.6	-39.6	-34.1
10	9502240658_23200_A600.SST	0.0	-273.1*****		30.5	36.8	-30.9	-25.3
11	9502240658_23200_A600.SST	82.7	21.8	28.0	30.5	36.8	-30.9	-25.3
12	9502240658_23700_A600.SST	76.4	20.5	26.0	29.2	35.7	-35.2	-29.7
13	9502240658_24200_A600.SST	71.5	18.4	25.0	27.7	34.6	-39.6	-34.1
14	9502250623_23200_A600.SST	79.7	22.5	28.0	39.4	45.6	-30.9	-25.3
15	9502250623_23700_A600.SST	80.0	18.6	26.0	38.0	44.6	-35.2	-29.7
16	9502250623_24200_A600.SST	63.5	18.4	24.0	36.5	43.5	-39.6	-34.1
17	9502261911_36200_A600.SST	78.3	18.1	24.0	30.0	36.8	-38.7	-33.1
18	9502261911_36700_A600.SST	73.1	21.2	28.0	28.9	35.3	-34.3	-28.8
19	9502261911_37200_A600.SST	91.8	20.5	28.9	27.8	34.0	-29.9	-24.4
20	9502270653_23200_A600.SST	67.2	22.3	29.0	31.9	38.1	-30.9	-25.3
21	9502270653_23700_A600.SST	41.8	21.1	27.0	30.5	37.1	-35.2	-29.7
22	9502270653_24200_A600.SST	58.6	19.1	25.0	29.1	36.0	-39.6	-34.1
23	9502281940_36200_A600.SST	100.0						
24	9502281940_36700_A600.SST	100.0						
25	9502281940_37200_A600.SST	100.0						
26	9503010723_23200_A600.SST	100.0						
27	9503010723_23700_A600.SST	100.0						
28	9503010723_24200_A600.SST	85.5	15.5	25.0	21.6	28.5	-39.6	-34.1
29	9503011905_36200_A600.SST	98.8	18.6	24.0	31.3	38.1	-38.7	-33.1
30	9503011905_36700_A600.SST	95.6	22.1	28.0	30.2	36.7	-34.3	-28.8
31	9503011905_37200_A600.SST	83.1	23.1	29.0	29.2	35.4	-29.9	-24.4
32	9503020648_23200_A600.SST	71.7	23.2	29.0	33.2	39.5	-30.9	-25.3
33	9503020648_23700_A600.SST	100.0						
34	9503020648_24200_A600.SST	73.4	18.1	24.0	30.4	37.3	-39.6	-34.1
35	9503031935_36200_A600.SST	68.3	12.2	27.0	23.8	30.7	-38.7	-33.1
36	9503031935_36700_A600.SST	100.0						
37	9503031935_37200_A600.SST	100.0						
38	9503050642_23200_A600.SST	81.7	23.0	29.0	34.6	40.8	-30.9	-25.3
39	9503050642_23700_A600.SST	60.4	20.0	26.0	33.2	39.8	-35.2	-29.7
40	9503050642_24200_A600.SST	75.2	18.9	24.0	31.8	38.7	-39.6	-34.1
41	9503061930_36200_A600.SST	93.6	18.2	24.0	25.2	32.0	-38.7	-33.1
42	9503061930_36700_A600.SST	100.0						
43	9503061930_37200_A600.SST	100.0						
44	9503070712_23200_A600.SST	100.0						
45	9503070712_23700_A600.SST	98.7	19.1	27.8	25.8	32.3	-35.2	-29.7
46	9503070712_24200_A600.SST	98.2	20.4	23.9	24.3	31.2	-39.6	-34.1
47	9503071854_36200_A600.SST	100.0						

48	9503071854_36700_A600.SST	100.0						
49	9503071854_37200_A600.SST	100.0						
50	9503091924_36200_A600.SST	100.0						
51	9503091924_36700_A600.SST	98.8	22.5	27.0	25.4	31.9	-34.3	-28.8
52	9503091924_37200_A600.SST	100.0						
53	9503100707_23200_A600.SST	100.0						
54	9503100707_23700_A600.SST	92.7	20.0	26.0	27.1	33.7	-35.2	-29.7
55	9503100707_24200_A600.SST	98.2	20.0	24.5	25.6	32.6	-39.6	-34.1
56	9503101849_36200_A600.SST	100.0						
57	9503101849_36700_A600.SST	93.4	19.9	27.0	34.2	40.7	-34.3	-28.8
58	9503101849_37200_A600.SST	87.5	23.6	28.9	33.2	39.4	-29.9	-24.4
59	9503110631_23200_A600.SST	82.7	23.1	29.0	37.3	43.5	-30.9	-25.3
60	9503110631_23700_A600.SST	86.7	19.1	27.0	35.9	42.5	-35.2	-29.7
61	9503110631_24200_A600.SST	98.3	18.1	24.6	34.4	41.4	-39.6	-34.1
62	9503121919_36200_A600.SST	94.0	15.0	25.0	27.9	34.7	-38.7	-33.1
63	9503121919_36700_A600.SST	97.3	19.3	25.9	26.8	33.3	-34.3	-28.8
64	9503121919_37200_A600.SST	100.0						

APPENDIX D

D214 Images

Greyscale brightness temperature images that were sent to the RRS *Discovery* by facsimile during cruise D213



acquisition time: 24-feb-1995 07:57:39

FAO Tom Forrester
c/o RRS Discovery

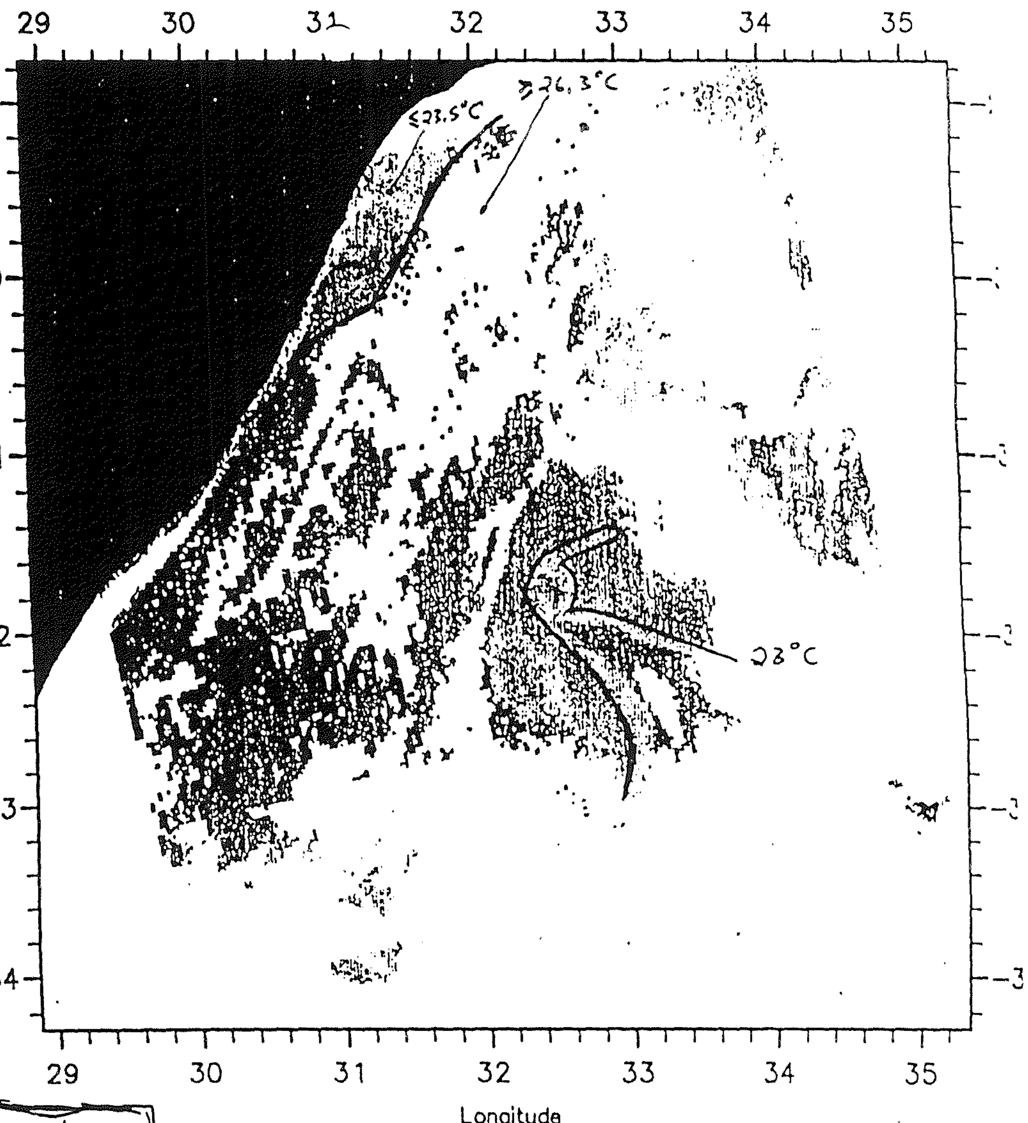


Image acquisition time: 26-feb-1995 20:42:09