

Report on the cruise
of
ORV Sagar Kanya (SK 267)

Equatorial Indian Ocean cruise during
15 January - 13 February 2010

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Appendix - I. Table 1

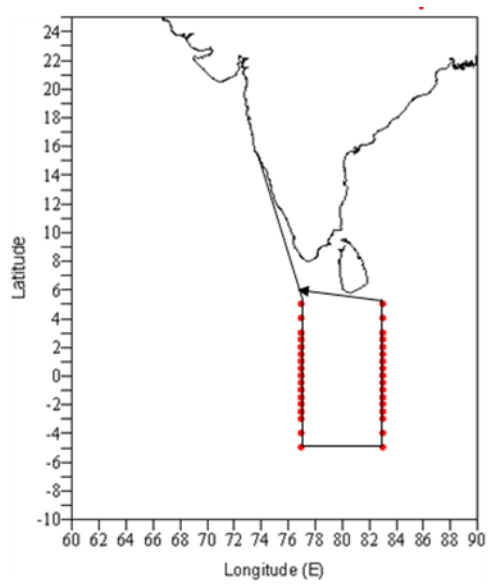
Appendix – II Table 2

1. SUMMARY

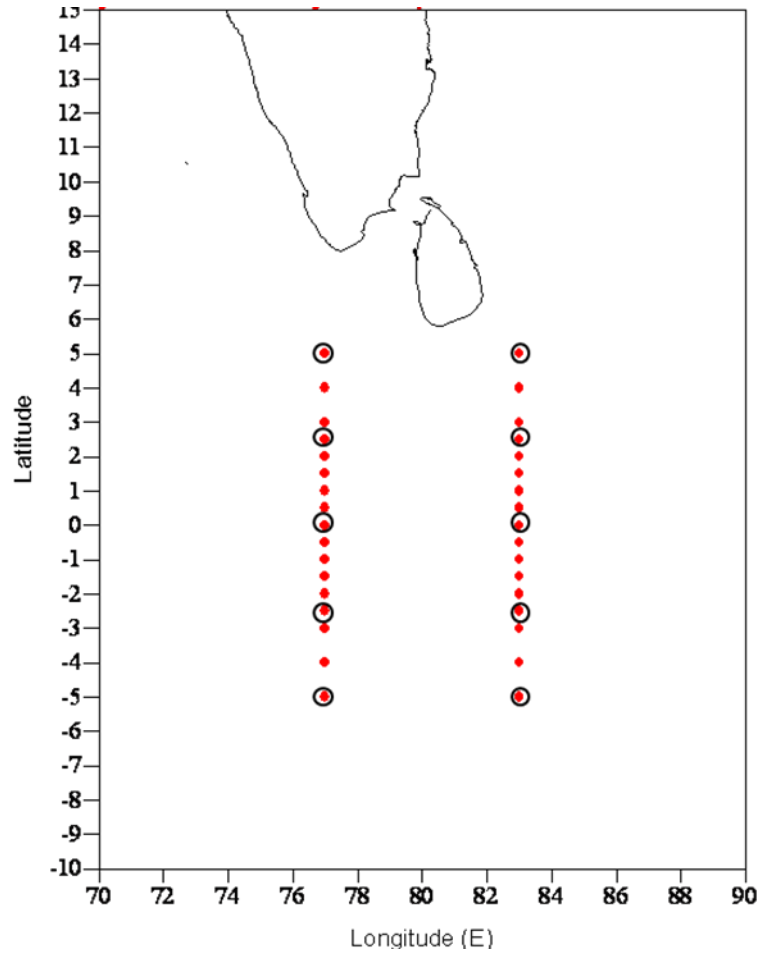
The 267th cruise of ORV *Sagar Kanya* forms a part of the water column measurement planned under the national programme “Equatorial Indian Ocean Process Studies – Dynamics and biogeochemistry (EIOPS)” funded by Ministry of Earth Sciences (MoES) and also forms a part of the National Institute of Oceanography's supra Institutional programme SIP-1306. The objective of the programme is to address the seasonal variability of the upper ocean in response to atmospheric forcing and its implication to overall biogeochemistry. The *in situ* measurements in the present cruise were designed to capture the signature of winter monsoon. For *in situ* measurements, the CTD was operated at half-a-degree interval from 3°N to 3°S and at one-degree-interval in the rest of the stations (See Fig.1) along two transects along 77°E and 83°E from 5°N to 5°S with 5L Niskin bottles. In all 34 CTD stations were occupied. Water samples were collected for the analysis of chemical (surface, 10m, 20m, 40m, 60m, 80m, 100m, 120m, 150m, 200m, 300m, 400m, 500m, 600m, 800m and 1000m) and biological parameters (surface, 10m, 20m, 40m, 60m, 80m, 100m and 120m) by operating the CTD twice (usually 1200 - 80 m and 60 - 1 m). Similarly there was separate cast for Primary Productivity (PP, up to 120 m). Plankton Net with closing mechanism was operated at each of the PP stations to get the stratified biomass in the depth range 1000-500, 500-300, 300-base of the mixed layer, and from base of the mixed layer to surface. To achieve *in situ* conditions for PP measurements, the PP mooring assembly with samples from 8 different depths (surface, 10m, 20m, 40m, 60m, 80m, 100m and 120m) after adding tracer substrates was deployed before day-break and recovered after sun set from 9 pre-decided stations (5 along 77°E and 4 along 83°E). Surface meteorological parameters were measured at CTD as well as XBT locations while ADCP data were collected along the track.

In addition to the above waters samples were collected at all the CTD stations from all depths (surface, 10m, 20m, 40m, 60m, 80m, 100m, 120m, 150m, 200m, 300m, 400m, 500m, 600m, 800m and 1000m) for isotope analysis under IWIN programme. A total of 34 XBTs and 4 surface drifting buoys were deployed at pre-determined locations.

2. CRUISE TRACK



- CTD Station
- PP Station



3. INTRODUCTION

The 267th cruise of ORV *Sagar Kanya* forms a part of the water column measurement planned under the national programme “Equatorial Indian Ocean Process Studies – Dynamics and biogeochemistry (EIOPS)” funded by Ministry of Earth Sciences (MoES) and also forms a part of the National Institute of Oceanography’s supra Institutional programme SIP-1306. The objective of the programme is to address the seasonal variability of the upper ocean in response to atmospheric forcing and its implication to overall biogeochemistry. The *in situ* measurements in the present cruise was designed to capture the signature of winter monsoon. For *in situ* measurements, the CTD was operated at half-a-degree interval from 3°N to 3°S and at one-degree-interval in the rest of the stations (See Fig.1) along two transects along 77°E and 83°E from 5°N to 5°S with 5L Niskin bottles. In all 34 CTD stations were occupied. Water samples were collected for the analysis of (surface, 10m, 20m, 40m, 60m, 80m, 100m, 120m, 150m, 200m, 300m, 400m, 500m, 600m, 800m and 1000m) and biological parameters (surface, 10m, 20m, 40m, 60m, 80m, 100m and 120m) by operating the CTD twice (usually 1200 - 80 m and 60 - 1 m). Similarly there was separate cast for Primary Productivity (PP, up to 120 m). Plankton Net with closing mechanism was operated at each of the PP stations to get the stratified biomass in the depth range 1000-500, 500-300, 300-base of the mixed layer, and from base of the mixed layer to surface. To achieve *in situ* conditions for PP measurements, the PP mooring assembly with samples from 8 different depths (surface, 10m, 20m, 40m, 60m, 80m, 100m and 120m) after adding tracer substrates was deployed before day-break and recovered after sun set from 9 pre-decided stations (5 along 77°E and 4 along 83°E).

4. ITINERARY

Departure: Marmugoa, 15 January 2010
Arrival: Marmugoa, 13 February 2010

5. CRUISE PARTICIPANTS

5.1 Scientific component

1. Dr. S. Prasanna Kumar, Chief Scientist	National Inst. of Oceanography
2. Mr. Ashok Kankonkar,	-do-
3. Dr. Jayu Narvekar	-do-
4. Ms. T. Divya David	-do-
5. Mr. P. Byju	-do-
6. Mr. Joshua D' Mello	-do-
7. Ms. K.R. Mangala	-do-
8. Mr. Muthukumar	-do-
9. Mr. Subha Anand	-do-
10. Ms. Aarti Verenkar	-do-
11. Mr. M.M. Muhammed Rafeeq	-do-
12. Mr. R. Prasad	Cochin University of Science and technology
13. Dr. S.C. Sujatha	-do-
14. Mr. M. Nayeem	-do-
15. Ms. R. Shruthi Thalayappim	-do-
16. Mr. P.M. Salas	-do-
17. Dr. N. Manoharan	Bharathidasan University
18. Mr. S. Vinoth Kumar	-do-
19. Mr. N. Jeyraj	-do-
20. Mr. S. Ananth	-do-
21. Mr. S. Ganesan	-do-
22. Mr. J.S. John Wilson	-do-
23. Ms. Shruti V. Chari	-do-
24. Ms. S.Sujitha	-do-
25. Mr. R.S. Nandagopal	-do-
26. Mr. Biju Vikraman Nair	NORINCO
27. Mr. Manivannan Dayalan	-do-
28. Mr. Parshuram Durgappa Madar	-do-
29. Mr. A.C. Luis	-do-
30. Mr. Rajapandian Karthickraja	-do-

5.2 Ship's complement

1. CAPT. Laljee Ram Meena	Master
2. Mr. Imran Ahmed	Chief Officer
3. Mr. A.H.Y. Kazi	2 nd Officer
4. Mr. Sudhir Kumar	3 rd Officer
5. Dr. Kamal K. Gupta	Medical Officer
6. Mr. Rex Horwood	RO
7. Mr. Alex Inas Fernandes	Purs. Officer
8. Mr. Minhajur R. Kazi	CEO
9. Mr. Vijay S. Telgote	2 nd EO
10. Mr. Rakesh Raj S.	4 th EO
11. Mr. S.V. Dicholkar	4 th EO
12. Mr. Arun Singh	EL/O
13. Mr. Subhas Chandra Ganguli	EL/O
14. Mr. S. Karunakaran	Catg. Officer
15. Mr. N.J. Dias	A/Catg. Officer

6. OBJECTIVES

1. To obtain a high-resolution biogeochemical measurements along two trans-equatorial sections along 77°E and 83°E from 5°N to 5°S to decipher spatial variations in physical, chemical and biological properties as a part of the seasonal cycle and the various forcing that are responsible for such variability in the equatorial Indian Ocean.
2. Collection of two sediment cores, one from 5°N and 77°E, and the other from 5°N and 83°E.
3. Deploy 34 numbers of XBTs and 4 surface drifters at pre-determined locations.
4. Collect water samples for IWIN project for isotope analysis.
5. Inter comparison of Idronaut CTD with SBE CTD

7. WORK ACCOMPLISHED

7.1 Parameters measured

1. Temperature profile
2. Salinity profile
3. Sea surface temperature (SST)
4. Wind speed and direction
5. Air temperature and wet bulb temperature
6. Atmospheric pressure
7. Chlorophyll *a*
8. ¹⁴C based Primary production rate
9. Phytoplankton
10. Zooplankton
11. TCO₂
12. pH
13. Alkalinity
14. Nutrients (Nitrate, Phosphate)
15. TOC

7.2 Instrument and machinery used onboard

1. CTD with Rosette (Sea-Bird)
2. 5L Niskin samplers
3. ADCP
4. Micro Salinometer
5. Echo sounder
6. XBT launcher
7. Milli Q water purification system
8. Jib boom
9. Atlas crane
10. CTD winch
11. Deep sea winch
12. Gravity corer

7.3 NIO equipment used onboard

1. Coulometer
2. pH meter
3. Spectrophotometer
4. Gas Chromatograph
5. Filtration units and pumps
6. Bucket thermometer
7. PP Mooring system
8. Fluorometer
9. Dynalab met kit
10. Plankton Net with closing mechanism

7.4 ADCP operation

Ship-borne ADCP was used to collect current data en-route along the track as well as at stations.

7.5 Surface met observations

Surface met observations were carried out at each of the CTD stations using hand-held met kit.

In addition surface met observations were also carried out at all the XBT location mentioned under 7.11

7.6 CTD operations

Sea-Bird CTD was operated at half-a-degree interval from 3°N to 3°S and at one-degree-interval from north and south of 3° and up to 5°. CTD was operated up to 1200 m depths to collect temperature and salinity profiles along 77°E and 83°E (see cruise track). In addition to the above, data on oxygen, fluorescence and photosynthetically available radiation (PAR) were also collected. Data was collected during down cast while water samples were collected during up cast. At each of the CTD stations water samples were collected using CTD Rosette using 2 casts. During the deep cast CTD was lowered up to 1200m and water samples were collected from 1000m up to 80m. In the shallow cast water samples were collected from 60m to surface. These water samples were used for the analysis of nutrients, TCO₂, alkalinity, oxygen (surface, 10m, 20m, 40m, 60m, 80m, 100m, 120m, 150m, 200m, 300m, 400m, 500m, 600m, 800m and 1000m) and chlorophyll (surface, 10m, 20m, 40m, 60m, 80m, 100m and 120m). In all 34 CTD stations were occupied, 17 along each track. In addition, a total of 9 PP stations, 5 along 77°E and 4 along 83°E, were also occupied where PP mooring was deployed for *in situ* incubation experiment from before sunrise to after sunset.

Water samples were also collected at all the CTD station from all the depths (surface, 10m, 20m, 40m, 60m, 80m, 100m, 120m, 150m, 200m, 300m, 400m, 500m, 600m, 800m and 1000m) for isotopic analysis under IWIN project.

7.7 Plankton Net operations

Plankton Net with closing mechanism and single net was operated with flow meter sensor in all the PP stations (5 along 77°E and 4 along 83°E). Wire paid out using meter wheel was used to determine the closing depth of the net. In all 4 times the net was operated to make stratified collection up to 1000 m. Plankton Net was hauled up using the following depth intervals – from 1000-500, 500-300, 300-bottom of the mixed layer and from bottom of the mixed layer to surface.

7.8 In situ primary production measurements

In situ primary production measurements were carried out by inoculating the samples drawn from CTD rosette from 8 depths (surface, 10m, 20m, 40m, 60m, 80m, 100m, 120m) by ¹⁴C and deploying it in situ with the help of PP mooring. In all 9 PP stations were occupied, 5 along 77°E and 4 along 83°E.

7.9 Gravity core operation

Gravity core was operated at 5°N and 77°E on 28th January 2010. The first attempt failed as no sediment sample was collected. In the 2nd attempt on 29th January 2010 a core of length 5.5m was collected.

On 30 January 2010 gravity core was operated at 5°S and 83°E.No core sediment core was collected, but a few rounded black nodule type of material was collected. Since the bathymetry showed sharp gradient it was decided to move to north and east where the bathymetry was gentler. Accordingly, gravity corer was operated at 4°S and 83° 45'E on 1 February 2010. A core of length ~ 250cm was collected from this location.

7.10 Deployment of XBT

In all 34 XBTs were deployed during the cruise at pre-determined locations and the details are given below:

XBT	Date	Time (IST)	Latitude N/S	Longitude E
T7_0002(CTD_01)	19-01-2010	2254 hrs	4° 55.97' N	77° 00.00'E
T7_0004(CTD_02)	20-01-2010	1205 hrs	3° 59.87' N	76° 59.99'E
T7_0006(CTD_03)	22-01-2010	0505 hrs	2° 59.75' N	76° 59.59'E
T7_0008(CTD_05)	22-01-2010	1425 hrs	2° 04.25' N	76° 58.95'E
T7_0010(CTD_07)	23-01-2010	0248 hrs	0° 58.33' N	76° 57.98'E
T7_0012(CTD_09)	23-01-2010	2313 hrs	0° 00.20' S	76° 59.84'E
T7_0014(CTD_11)	25-01-2010	0349 hrs	1° 01.43' S	76° 59.00'E
T7_0016(CTD_13)	25-01-2010	1500 hrs	2° 00.06' S	77° 00.24'E
T7_0018(CTD_15)	26-01-2010	2355 hrs	2° 59.74' S	77° 00.08'E
T7_0020(CTD_16)	27-01-2010	0849 hrs	3° 59.99' S	77° 00.00'E
T7_0022(CTD_17)	27-01-2010	1735 hrs	4° 59.86' S	76° 59.95'E
T7_0024(along 5°S)	29-01-2010	1100 hrs	5° 03.75' S	78° 00.51'E
T7_0026(along 5°S)	29-01-2010	1630 hrs	5° 06.00' S	78° 59.10'E
T7_0028(along 5°S)	29-01-2010	2222 hrs	5° 04.36' S	79° 58.39'E
T7_0030(along 5°S)	30-01-2010	0449 hrs	5° 03.18' S	80° 59.15'E
T7_0032(along 5°S)	30-01-2010	1045 hrs	5° 01.29' S	81° 59.12'E
T7_0034(CTD_18)	30-01-2010	2203 hrs	4° 59.78' S	81° 59.99'E
T7_0036(CTD_18)	30-01-2010	2209 hrs	4° 59.78' S	81° 59.99'E
T7_0038(CTD_19)	01-02-2010	1346 hrs	3° 59.71' S	83° 02.32'E
T7_0041(CTD_20)	03-02-2010	0502 hrs	2° 59.01' S	83° 00.04'E
T7_0043(CTD_22)	03-02-2010	1402 hrs	1° 59.93' S	82° 59.94'E
T7_0045(CTD_24)	04-02-2010	0325 hrs	1° 00.20' S	83° 00.02'E
T7_0047(CTD_26)	05-02-2010	0500 hrs	0° 00.02' S	82° 59.79'E
T7_0050(CTD_28)	06-02-2010	0505 hrs	0° 59.65' N	82° 59.56'E
T7_0052(CTD_30)	06-02-2010	1630 hrs	1° 59.92' N	83° 00.20'E
T7_0054(CTD_32)	07-02-2010	0546 hrs	2° 59.47' N	82° 59.47'E
T7_0056(CTD_33)	07-02-2010	1554 hrs	3° 59.92' N	83° 00.42'E
T7_0058(CTD_34)	08-02-2010	0610 hrs	4° 54.40' N	82° 56.29'E
T7_0059(En-route to Goa)	08-02-2010	2230 hrs	4° 51.21' N	82° 03.00'E
T7_0061(En-route to Goa)	09-02-2010	0430 hrs	5° 05.12' N	81° 03.67'E
T7_0063(En-route to Goa)	09-02-2010	1054 hrs	5° 21.71' N	80° 02.80'E
T7_0066(En-route to Goa)	09-02-2010	1740 hrs	5° 47.39' N	79° 02.79'E
T7_0068(En-route to Goa)	10-02-2010	0040 hrs	6° 08.72' N	77° 55.75'E
T7_0070(En-route to Goa)	10-02-2010	0700 hrs	6° 26.18' N	76° 57.31'E

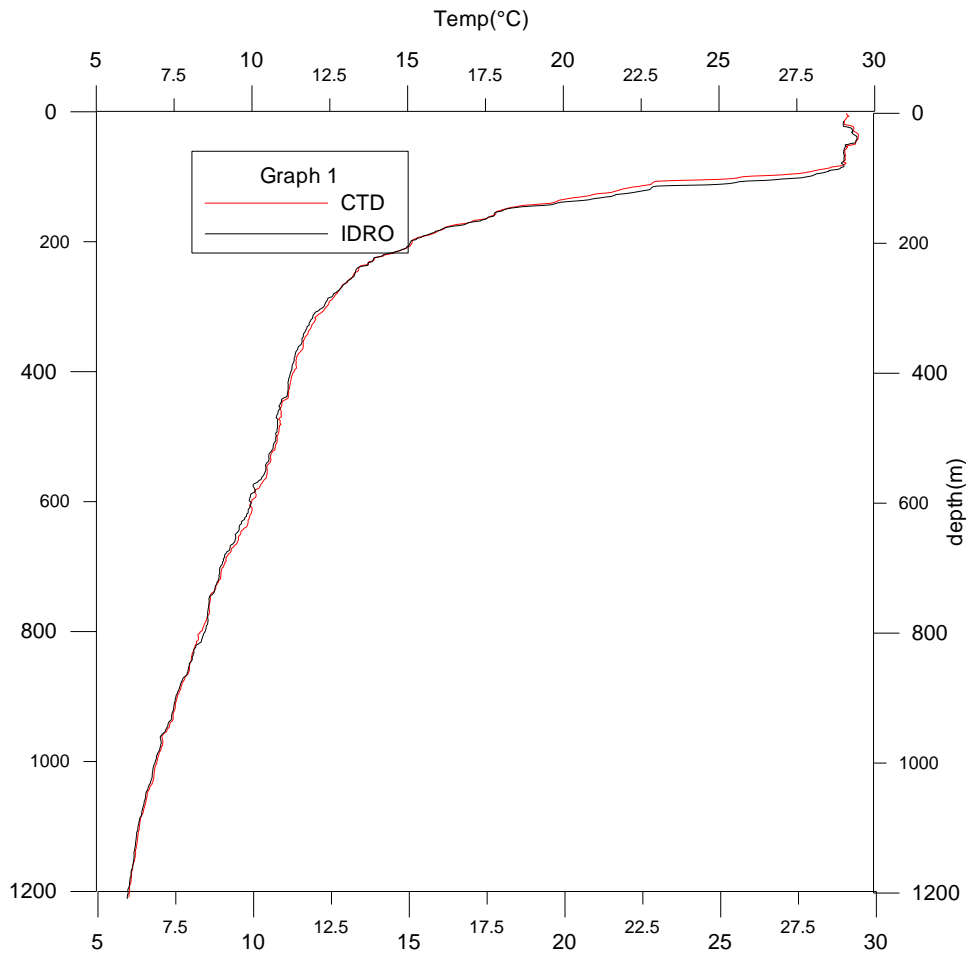
7.11 Deployment of drifting buoys

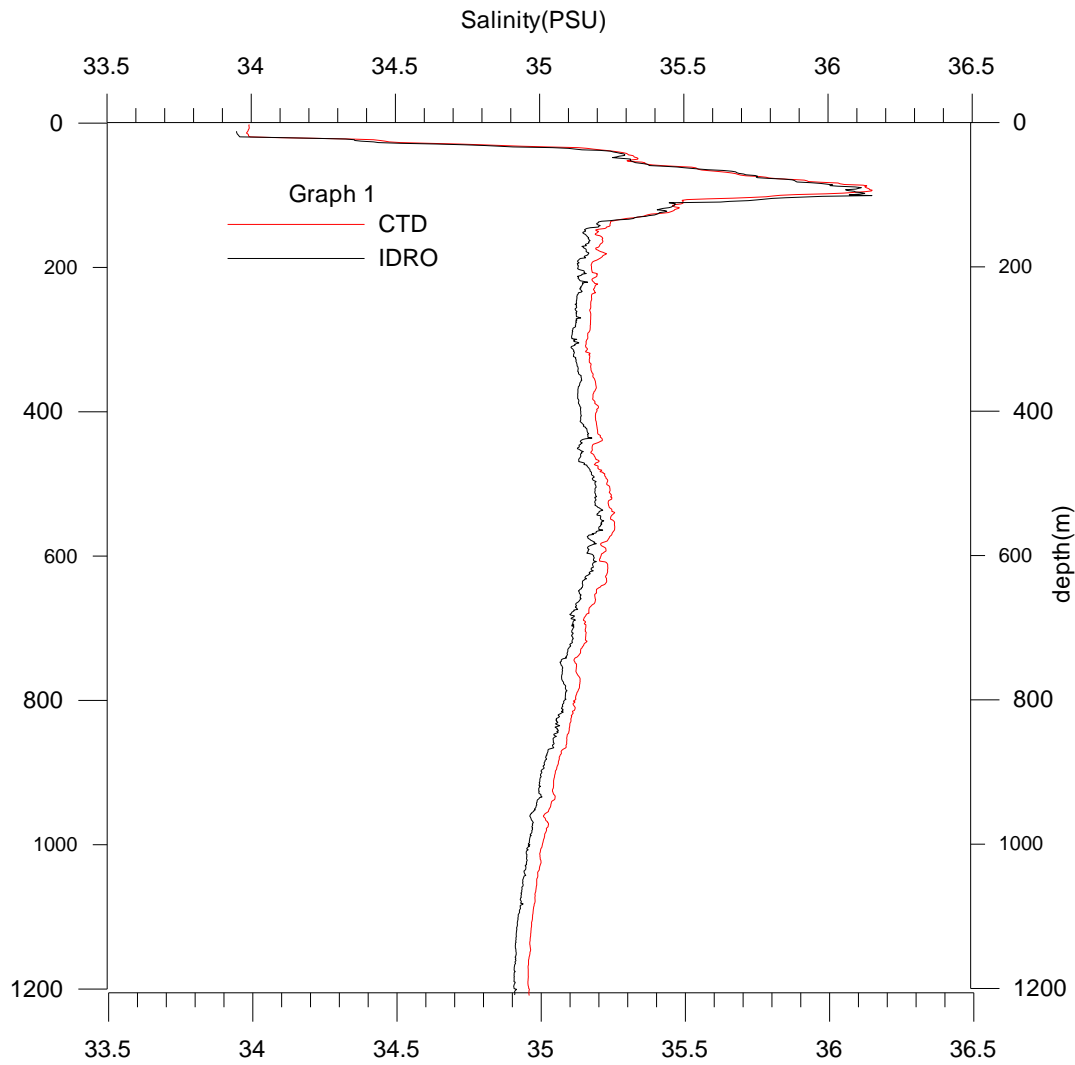
In all 4 surface drifting buoys were deployed during the cruise at pre-determined locations and the details are given below:

Float ID	Date	Time (IST)	Latitude N/S	Longitude E
98679	19 th January 2010	0430 hrs	4° 55.12' N	76° 56.66' E
98665	24 th January 2010	1953 hrs	0° 05.36' S	76° 41.71' E
98680	5 th February 2010	1945 hrs	0° 05.49' S	82° 35.36' E
98666	8 th February 2010	1845 hrs	4° 43.46' N	82° 39.15' E

7.12 Inter comparison of Idronaut CTD with Sea-Bird (SBE) CTD

Both Idronaut CTD and SBE CTD were lowered at 10° 03.28'N and 75° 15.75'E for (1) testing the rosette unit of Idronaut for triggering of bottles and (2) for inter comparison.





In the top 150m Idronaut CTD Temperature was colder than Sea-Bird CTD, while in the deeper layers in was slightly warmer.

The Salinity of Idronaut CTD was fresher than the Sea-Bird CTD below 200m

See Table 2 in Appendix II for digital values of the profile and their difference in the top 500m.

8. PERFORMANCE OF THE EQUIPMENT USED

Sea-Bird CTD - calibration of CTD salinity with Micro Salinometer

In order to calibrate the salinity from the conductivity sensor of onboard Sea-Bird CTD, water samples were collected from 600 m, 800 m and 1000 m depth and salinity estimated with the help of onboard Micro Salinometer. In all 9 samples from 3 stations (CTD_04, CTD_05, CTD_10) along 77°E were used. In addition surface water sample at CTD_21 were also used for the analysis.

The first attempt to calibrate the Micro Salinometer using standard sea water, according to the procedure laid down in the manual, was made on 29th January 2010 at Echo sounder lab during 11:00 to 12:00 hrs and later again 16:00 to 18:30 hrs. In both the times Micro Salinometer did not reproduce the salinity value that has been indicated on the standard seawater bottles. It was suspected that the temperature variation at the Echo sounder lab (23-24°C) might be the reason. Hence the instrument and samples were shifted to multibeam lab on 30th January 2010.

The calibration was attempted 3 times more during 31st January 1st and 5th February 2010. Each time the calibration was tempted thrice following the procedure given in the manual. But Micro Salinometer did not give the value of salinity displayed in the standard sea water bottle.

The closest salinity value as that of the standard seawater was obtained during the calibration exercise was on 5th February 2010. In this case the calibration was attempted 3 times (20 minutes each time). With this calibration the salinity samples were analyzed with Micro salinometer and compared with CTD salinity and the values are given below.

Water sample no	Time taken for analysis using Micro Salinometer (MS)	Minimum Standard deviation attained by MS	Salinity determined by MS (PSU)	Salinity from Sea-Bird CTD (PSU)	MS salinity minus CTD salinity
CTD_04 (600m)	10:36 to 10:57	0.00058	35.1678	35.0507	0.1171
CTD_04 (800m)	11:55 to 12:16	0.00045	34.9494	35.0304	-0.0810
CTD_04 (1000m)	14:22 to 14:42	0.00032	34.8910	34.9385	-0.0475
CTD_05 (800m)	13:12 to 13:32	0.00033	35.0269	35.0333	-0.0064
CTD_05 (1000m)	15:34 to 15:55	0.00029	33.8501	34.9588	-1.1087
CTD_10 (600m)	11:17 to 11:37	0.00019	34.2530	35.0067	-0.7537
CTD_10 (800m)	14:57 to 15:20	0.00021	33.0482	35.0209	-1.9807
CTD_10 (1000m)	16:13 to 16:33	0.00043	34.1376	34.9361	-0.7985
CTD_21 (2m)	17:20 to 17:40	0.00032	34.2274	34.2442	-0.0168

From the above table it is clear that the salinity from the Micro Salinometer was very much different from the CTD salinity, which is not expected. Since the CTD salinity sensor is recent one as the CTD system is new it is expected to perform within the stipulated accuracy of the sensor calibration sheet provided by Sea-Bird. Hence it is suspected that the Micro Salinometer may not be functioning well. Also note that the time taken for each sample analysis is several fold higher than that compared to AUTOSAL.

In the light of the above, it is recommended that a new AUTOSAL may be procured at the earliest as this instrument is crucial to ensure data quality of salinity measurement.

CTD Rosette

The CTD Rosette was used with 12 numbers of 5L Niskin bottles for water sampling purposes. Rosette and Niskin sampling bottles worked well in all operations without any problems.

Hydrographic winch

Hydrographic winch was used for lowering the CTD as well as Plankton Net. Winch worked well with out any problem while operation.

Multiple Plankton Net

Multiple Plankton et was not available onboard ORV Sagar Kanya during the cruise. In spite of requesting specifically for the Multiple Plankton Net during the proposal for the cruise onboard ORV Sagar Kanya as well as during the presentation at NIOT for cruise planning, it was not available onboard as it was taken for Southern Ocean cruise by NCAOR onboard Sagar Nidhi.

Auto analyzer

The auto analyzer was tested with the standards on 18 January 2010 to check for its calibration and subsequent use for the analysis of Nitrate, Phosphate and Silicate concentrations in seawater samples. The calibration of auto analyzer did not give the expected values. Negative values were encountered for the lower concentrations of the standard. The same standard was used in the spectrophotometer method, which gave exact calibration. Hence it was concluded that though the instrument is working and operational it is unable to give good calibration with standards. This calibration was repeated several times (18th, 19th, 27th, 30th, 31st January and 4th February 2010.) using standards of different concentrations but in all those tests results from auto analyzer was not satisfactory. The rest results are appended below.

Type1	Identity1	NITRATE Micromoles/litre	SILICATE Micromoles/litre	PHOSPHATE Micromoles/litre
IW	Initial Wash	-4.406	-37.890	0.000
T	Tracer	36.660	84.993	0.000
W	Wash	-4.406	-37.890	
S1	Standard 1	-2.607	-20.929	
S2	Standard 2	4.106	26.933	

S3	Standard 3	11.899	70.347
S4	Standard 4	25.750	84.390
S5	Standard 5	36.852	84.259
D	Drift	20.959	84.114
W	Wash	-4.406	-37.890
U	Distilled W 1	-4.202	-37.686
U	Distilled W 2	-4.157	-37.801
W	End Run	-4.406	-37.890
E	End Run	0.000	0.000

It appears that though the machine is technically working it is not suitable for performing the analysis of nutrient concentration in the seawater sample. The reason could be in the way the machine needs to be maintained chemically as per the manual. Please refer manual which describes the routine maintenance. For example to de-contaminate the system it is necessary to rinse with recommended chemical (for example, 1% hypochlorite for nitrate system) periodically (preferably once in a week), changing the tubing at regular intervals.

9. PERFORMANCE OF THE SHIP

In general, the shipboard machinery and equipment worked satisfactorily. The need for a deep sea Echo sounder was felt during the cruise, specially at location where core sample was needed.

10. LOSS REPORT

No loss during the cruise

11. CONCLUSIONS

Data was collected at all the planned station, except the PP mooring at 2.5°N at 83°E due to time constraint.

1. All 34 stations were covered for various observations and data collection.
2. CTD was operated at half-a-degree interval up to 1200 m depth along 77°E and 83°E.
3. Nutrients and chlorophyll a measurements were carried out at one-degree interval along 77°E and 88°E. However, near the equator the sampling was carried out at half-a-degree spatial interval.
4. ¹⁴C based primary production measurement were carried in-situ at 9 stations, 5 along 77°E and 4 along 88°E.
5. Four surface drifter and 34 XBTs were deployed at pre-determined positions.
6. Two sediment cores were collected one at 5°N, 77°E and the other at 4°N, 84° 45'E.

12. RECOMMENDATIONS

- (1) Unable to get digital depth measurement at station location as depth of operation of echo sounder available onboard was limited to 3000m. This put a constraint on the coring operation as the depth was obtained approximately from the chart depth from Navigation Bridge.
- (2) Auto analyzed needs urgent attention to see that acceptable calibration values are obtained which is not the case presently and hence was not useful in the present cruise.
- (3) Micro Salinometer available onboard was not useful as it did not reproduce the salinity values of the standard seawater even after calibration several times. As a result calibration of CTD salinity from water sample could not be carried out. It is recommended that the existing old Guildline AUTOSAL which is not usable (as it does to reproduce the conductivity of the standard sea water) needs to be replaced by procuring a new one.
- (4) MPN is a must for any multi-disciplinary measurement programme. Hence it should be ensured that MPN is available for all multi-disciplinary cruises. If needed a second unit may also be procured.
- (5) The titration unit available at Chemistry lab is the instrument is very old (came along with ship). It is good to procure one new unit as the present one may stop functioning at any time.
- (6) Presently there is no automatic weather unit available onboard and hence hand held met kit is being used by each cruise participants. Due to this continuous met data is not being collected which is a loss. Hence an automatic weather station may be procured and installed at the earliest.
- (7) The salinity data from the thermosalinograph showed large difference compared to CTD salinity. The problem appears to be due to the bubble trapped along with the water that is being pumped. Hence it is suggested that the existing pump may be checked for rectifying this problem. Alternately a bubble free waters supply mechanism for the conductivity cell may be arranged.
- (8) An LCD projector and a PC may be made available permanently at the conference room to facilitate talks, seminars and discussions.

13. ACKNOWLEDGEMENTS

Master, Chief Engineer, Chief Officer, all other Officers as well as the entire shipboard personnel from deck, engine and catering departments cooperated very well to make this cruise a great success. The Chief Scientist and the entire team record their appreciation for this co-operation.

Similarly, the NORINCO engineers extended their technical support whenever required.

The constant encouragement by the Director, NIO and the excellent logistical support extended by Mr. Subramanian and NCAOR team is greatly acknowledged. Dr. Rasik Ravindra, Director NCAOR was instrumental in getting this cruise allotted for equatorial measurements.

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Appendix I

Table 1 - Station locations and operations

Sl. No	Station number	Latitude	Longitude	Date	Time IST	Operations
1	CTD_01	4° 59.99'N	76° 59.99'E	19-1-10	0225 0445 1855	Transect along 77°E CTD cast up to 120 m for PP PP mooring deployment PP mooring recovery CTD deep cast up to 1200 m. XBT 760m. CTD shallow cast upto 60m. Plankton net 1000m – 0m. Plankton net 500m – 0m. Plankton net 40m – 0m. Plankton net 300m – 40m. Deployment of drifting buoy ID 98679
		5° 00.06'N	77° 0.172'E		2155 2257	
		4° 58.60'N	76° 58.93'E	20-1-10	0005 0052	
		4° 55.12'N	76° 56.66'E		0225 0330 0350 0430	
2	CTD_02	3° 59.85'N	76° 59.98'E	20-1-10	1050 1200 1210 1212 1315	CTD deep cast up to 1200 m XBT 760m (File lost) Secchi disc operation XBT 760m CTD shallow cast upto 60m
3	CTD_03	2° 59.97'N	76° 59.95'E	22-1-10	0355	CTD deep cast up to 1200 m XBT 760m CTD shallow cast upto 40m
		2° 57.42'N	76° 57.42'E		0507 0612	
4	CTD_04	2° 29.90'N	77° 00.02'E	20-1-10	2325	CTD Deep cast up to 1200 m CTD shallow cast 40 m Plankton net 1000m – 500m. Plankton net 500m – 300m. CTD cast upto 120 m for PP Plankton net 40m – 0m Plankton net 300m – 40m PP mooring deployment PP mooring pulled out as it got entangled with the fishing line PP mooring redeployment Secchi disc operation PP mooring recovery CTD cast upto 200m for bacterial respiration
				21-1-10	0135 0210	
		2° 26.39'N	76° 54.28'E		0305 0337 0407 0424 0540 0900	
		2° 30.00'N	76° 59.95'E		0940 1330 1825 2315	
5	CTD_05	2° 00.12'N	76° 59.99'E	22-1-10	1310 1428 1435	CTD deep cast up to 1200 m XBT 760m Secchi disc operation CTD shallow cast up to 600 m
		1° 57.63'N	76° 56.47'E		1526	
6	CTD_06	1° 30.42'N	76° 59.74'E	22-1-10	1950	CTD deep cast up to 1200 m CTD shallow cast up to 40 m
		1° 28.33'N	76° 56.58'E		2147	

7	CTD_07	0° 59.95'N 0° 57.43'N	77° 00.24'E 76° 56.53'E	23-1-10	0125 0250 0343	CTD deep cast up to 1200 m XBT 760m CTD shallow cast up to 40 m
8	CTD_08	0° 30.10'N 0° 27.72'N	76° 59.87'E 76° 57.87'E	23-1-10	0706 0905	CTD deep cast up to 1200m CTD shallow cast up to 40m
9	CTD_09	0° 00.16'S 0° 02.11'S 0° 03.53'S 0° 05.36'S	77° 00.08'E 76° 58.70'E 76° 55.71'E 76° 41.71'E	23-1-10 24-1-10	2313 0021 0120 0145 0245 0318 0329 0343 0405 0535 1905 1953	CTD deep cast up to 1200 m XBT 760m CTD shallow cast up to 40 m Plankton net 1000m – 0m Plankton net 500m – 300m Plankton net 60m – 0m (closed before reaching the surface) Plankton net 60m – 0m CTD up to 200m for PP and bacterial respiration. Plankton net 300m – 60m PP mooring deployment PP mooring recovery Deployment of drifting buoy ID 98665
10	CTD_10	0° 29.86'S 0° 33.43'S	77° 00.09'E 76° 56.76'E	23-1-10	1553 1822	CTD Deep cast up to 1200m CTD shallow cast up to 40m
11	CTD_11	1° 00.33'S 1° 02.32'S	76° 59.86'E 76° 58.27'E	25-1-10	0235 0347 0440	CTD deep cast up to 1200 m XBT 760m CTD shallow cast up to 40 m
12	CTD_12	1° 30.00'S 1° 31.38'S	76° 59.74'E 76° 58.87'E	25-1-10	0800 0947	CTD deep cast up to 1200 m CTD shallow cast up to 40 m
13	CTD_13	2° 00.20'S 2° 00.60'S	77° 00.33'E 77° 00.39'E	25-1-10	1405 1500 1505 1548	CTD deep cast up to 1200 m XBT 760m Secchi disc operation CTD shallow cast up to 40 m
14	CTD_14	2° 30.04'S 2° 30.00'S 2° 29.99'S	77° 00.08'E 77° 00.00'E 77° 00.00'E	25-1-10 26-1-10	1945 2128 2154 2255 2350 0022 0042 0330 0525 1330 1910	CTD deep cast up to 1200 m CTD shallow cast up to 40 m Plankton net 1000m – 0m (Failed) Plankton net 1000m – 500m Plankton net 500m – 300m Plankton net 300m – 60m Plankton net 60m – 0m CTD shallow cast up to 120m for PP PP mooring deployment Secchi disc operation PP mooring recovery
15	CTD_15	2° 59.73'S 2° 59.74'S	77° 00.07'E 77° 00.03'E	26-1-10 27-1-10	2300 2358 0035	CTD deep cast up to 1200 m XBT 760m CTD shallow cast up to 40 m
16	CTD_16	3° 59.92'S 4° 00.00'S	77° 00.06'E 77° 00.00'E	27-1-10	0755 0849 0945	CTD deep cast up to 1200 m XBT 760m CTD shallow cast up to 40 m
17	CTD_17	4° 59.89'S	76° 59.96'E	27-1-10	1734	CTD deep cast up to 1200 m

		4° 58.43' S	76° 59.63' E		1832 1943 2009 2106 2139 2206	XBT 760m CTD shallow cast up to 105m Plankton net 1000m – 500m Plankton net 500m – 300m Plankton net 300m – 40m Plankton net 40m – 0m
		4° 58.87' S	76° 59.54' E	28-1-10	0427 0538 1325 1915 2153	CTD cast up to 120m for PP PP mooring deployment Secchi disc operation PP mooring recovery
		4° 59.93' S	76° 59.97' E		2153	Gravity coring operation (corer came out without sample)
				29-1-10	0100	Second lowering of gravity corer
						XBT operations along 5° S from 77°E to 83°E
		5° 03.75' S	78° 00.51' E	29-1-10	1047	XBT 760m
		5° 06.00' S	78° 59.10' E	29-1-10	1629	XBT 760m
		5° 04.36' S	79° 58.39' E	29-1-10	2222	XBT 760m
		5° 03.18' S	80° 59.15' E	30-1-10	0449	XBT 760m
		5° 01.21' S	81° 59.12' E	30-1-10	1048	XBT 760m
						Transect along 83°E
18	CTD_18	4° 59.67' S	82° 59.99' E	30-1-10	1730	Gravity coring operation. No sample collected.
		4° 59.70' S	82° 59.99' E	30-1-10	2056 2203 2209 2242	CTD deep cast up to 1200 m XBT 285 m XBT 760 m CTD shallow cast up to 40 m
				31-1-10	2346 0053 0135 0200	Plankton net 1000- 500 m Plankton net 500- 300 m Plankton net 300- 40 m Plankton net 40- 0 m
		5° 00.19' S	82° 59.89' E	31-1-10	0355 0456 1915	CTD cast up to 120 m for PP PP mooring deployment PP mooring recovery
19	CTD_19	3° 59.85' S	83° 45.18' E	01-2-10	0300 0637	Gravity coring operation. 250 cm of core collected. Rock fragments are collected. Idronaut CTD lowered upto 1500 m for testing self mode triggering. Failed.

		3° 59.87' S	83° 00.12' E		1250	CTD deep cast up to 1200 m Bottle at 200 m did not close.
					1348	XBT 760 m
					1423	CTD shallow cast up to 200 m
20	CTD_20	2° 59.85' S	82° 59.98' E	03-2-10	0400 0500 0502 0535	CTD deep cast up to 1200 m XBT 760 m. Probe did not work. XBT 760 m CTD shallow cast up to 60 m
21	CTD_21	2° 30.00' S	83° 00.08' E	02-2-10	0123	CTD deep cast up to 1200 m
		2° 29.24' S	83° 01.90' E		0300	CTD shallow and PP cast upto 120 m.
					0357	Plankton net 1000- 500 m
					0512	PP mooring deployment. (Overcast sky and rain)
					1905	PP mooring recovery
		2° 30.02' S	83° 00.22' E		2200	Plankton net 1000- 500 m
					2255	Plankton net 500- 300 m
					2333	Plankton net 300- 40 m
					2356	Plankton net 40- 0 m
22	CTD_22	1° 59.94' S	82° 59.93' E	03-2-10	1304	CTD deep cast up to 1200 m
					1405	XBT 760 m
					1443	CTD shallow cast up to 40 m
					1418	Secchi disc operation
					1500	Idronaut CTD lowered upto 1500 m. Triggering unit was non operational in water.
23	CTD_23	1° 30.04' S	82° 59.91' E	03-2-10	2057 2217	CTD deep cast up to 1200 m CTD shallow cast up to 60 m
24	CTD_24	1° 00.20' S	83° 00.02' E	04-2-10	0224 0325	CTD deep cast up to 1200 m XBT 760 m
		1° 01.71' S	82° 59.56' E		0404	CTD shallow cast up to 40 m
25	CTD_25	0° 30.19' S	83° 00.01' E	04-2-10	0905 1032	CTD deep cast up to 1200m CTD shallow cast up to 45m
26	CTD_26	0° 00.01' S	82° 59.80' E	04-2-10 05-2-10	2350 0015 0117	Plankton net upto 90 m Plankton net 1000- 500 m Plankton net 500- 300 m. (Failed)

		0° 02.22' S	82° 55.24' E		0147 0225 0245	to close) Plankton net 500- 300 m Plankton net 300- 30 m Plankton net 30- 0 m
		0° 02.81' S	82° 54.06' E		0254	CTD shallow and PP cast up to 120 m XBT 760 m
		0° 03.36' S	82° 51.59' E		0355	CTD deep cast up to 1200m
		0° 05.49' S	82° 35.36' E		0508 1315 1902 1945	PP mooring deployment Secchi disc operation PP mooring recovery Deployment of drifting buoy ID 98680
27	CTD_27	0° 29.66' N 0° 27.74' N	82° 59.75' E 82° 57.78' E	04-2-10	1824 2010	CTD deep cast up to 1200 m CTD shallow cast up to 40 m
28	CTD_28	0° 59.78' N	82° 59.88' E	06-2-10	0355 0505 0545	CTD deep cast up to 1200 m XBT 760 m CTD shallow cast up to 40 m
29	CTD_29	1° 29.86' N	82° 59.91' E	06-2-10	0947 1211	CTD deep cast up to 1200 m CTD shallow cast up to 40 m
30	CTD_30	1° 59.94' N	83° 00.19' E	06-2-10	1629 1746 1813	CTD deep cast up to 1200 m XBT 760 m CTD Shallow cast up to 40 m
31	CTD_31	2° 29.81' N 2° 29.60' N	82° 59.97' E 82° 57.44' E	06-2-10 07-2-10	2245 0019	CTD deep cast up to 1200 m CTD Shallow cast up to 40 m
32	CTD_32	2° 59.86' N	82° 59.81' E	07-2-10	0427 0546 0619	CTD deep cast up to 1200 m XBT 760 m CTD Shallow cast up to 40 m
33	CTD_33	3° 59.92' N 3° 57.70' N	83° 00.42' E 82° 58.99' E	07-2-10	1439 1554 1624	CTD deep cast up to 1200 m XBT 760 m CTD shallow cast up to 40 m
34	CTD_34	4° 59.48' N	82° 59.95' E	08-2-10	0100 0110 0137 0207 0229 0305	Plankton net 40- 0 m Plankton net 300- 40 m. (Failed to close) Plankton net 300- 40 m. (Failed to close) Plankton net 300- 40 m. Plankton net 500- 300 m Plankton net 1000- 500 m

		4° 55.71' N 4° 54.71' N 4° 54.40' N	82° 57.31' E 82° 56.52' E 82° 56.29' E		0403 0452 0507 0610 0626 1815 1845	CTD shallow and PP cast up to 120 m CTD shallow cast up to 40 m CTD deep cast up to 1200 m XBT 760 m PP mooring deployment PP mooring recovery Deployment of drifting buoy ID 98666 End of all water column-profiling operations.
	TESTING OF IDRONAUT CTD	4° 51.21' N 5° 05.12' N 5° 21.71' N 5° 47.39' N 6° 08.72' N 6° 26.18' N 10°03.28' N	82° 03.00' E 81° 03.67' E 80° 02.80' E 79° 02.79' E 77° 55.75' E 76° 57.31' E 75° 15.75' E	08-2-10 09-2-10 09-2-10 09-2-10 10-2-10 10-2-10 11-2-10	2230 0430 1054 1740 0040 0700 1325 1409 1508	XBT operations en-route to Goa 83°E to 7°E XBT 760 m XBT 760 m XBT 760 m XBT 760 m XBT 760 m XBT 760 m End of all planned observations. Idronaut CTD operation upto 60 m. (For testing rosette unit for triggering bottles and found non-operational under water). Idronaut CTD operation upto 1200 m. (For testing triggering of bottles and water sample collection was found to be not according to the sequence of firing.) Temperature and salinity data was collected. Seabird CTD upto 1200 m for inter-comparison with Idronaut CTD.

Appendix II

Table 2 – Inter-comparison of Idronaut CTD with Sea-Bird CTD

PrDM	T090C	DepSM	Sal00	Depth. idro	Pressure idro	Temp. Idro	Salinity. idro	Depth. diff	Temp. diff	Sal. diff
2.011	29.052	2	33.988							
3.017	29.051	3	33.9861							
4.023	29.054	4	33.9868							
5.029	29.055	5	33.9869							
6.034	29.075	6	33.9873							
7.04	29.119	7	33.9873							
8.046	29.069	8	33.9863							
9.051	29.045	9	33.9846							
10.06	29.034	10	33.984							
11.06	29.026	11	33.9828							
12.07	29.011	12	33.9813	11.91	12	29.0173	33.9495	0.09	-0.006	0.0318
13.07	28.987	13	33.9792	12.9	13	28.9981	33.9492	0.1	-0.011	0.03
14.08	28.97	14	33.9784	13.89	14	28.9916	33.9496	0.11	-0.0215	0.0288
15.09	28.968	15	33.9823	14.88	15	28.9905	33.9506	0.12	-0.0221	0.0317
16.09	28.97	16	33.9845	15.88	16	28.9896	33.9515	0.12	-0.0195	0.033
17.1	28.966	17	33.9852	16.87	17	28.9922	33.9541	0.13	-0.0258	0.0311
18.1	28.962	18	33.9856	17.86	18	28.9928	33.956	0.14	-0.0305	0.0296
19.11	28.964	19	33.9913	18.85	19	28.9937	33.9579	0.15	-0.0293	0.0334
20.12	29.018	20	34.069	19.85	20	28.997	33.9606	0.15	0.0211	0.1084
21.12	29.125	21	34.2108	20.84	21	29.0928	34.0886	0.16	0.0318	0.1222
22.13	29.215	22	34.3382	21.83	22	29.1791	34.2111	0.17	0.0357	0.1271
23.13	29.264	23	34.4183	22.82	23	29.2519	34.3277	0.18	0.0125	0.0906
24.14	29.272	24	34.4412	23.81	24	29.2688	34.3576	0.19	0.0033	0.0836
25.14	29.278	25	34.4587	24.81	25	29.2765	34.3589	0.19	0.0015	0.0998
26.15	29.279	26	34.473	25.8	26	29.2846	34.3812	0.2	-0.0058	0.0918
27.16	29.267	27	34.511	26.79	27	29.3004	34.4244	0.21	-0.0334	0.0866
28.16	29.237	28	34.6101	27.78	28	29.3012	34.4405	0.22	-0.0642	0.1696
29.17	29.258	29	34.7158	28.78	29	29.2593	34.5185	0.22	-0.0013	0.1973
30.17	29.279	30	34.795	29.77	30	29.2824	34.6474	0.23	-0.0034	0.1476
31.18	29.313	31	34.8629	30.76	31	29.279	34.7383	0.24	0.0342	0.1246
32.18	29.356	32	34.9309	31.75	32	29.3051	34.8089	0.25	0.051	0.122
33.19	29.381	33	35.0233	32.74	33	29.3393	34.8589	0.26	0.0416	0.1644
34.2	29.408	34	35.1269	33.74	34	29.3662	34.9079	0.26	0.0416	0.219
35.2	29.416	35	35.1588	34.73	35	29.4009	35.0442	0.27	0.0149	0.1146
36.21	29.423	36	35.1804	35.72	36	29.4282	35.1002	0.28	-0.0055	0.0802
37.21	29.425	37	35.203	36.71	37	29.4297	35.1245	0.29	-0.0045	0.0785
38.22	29.416	38	35.2295	37.71	38	29.4335	35.1472	0.29	-0.0176	0.0823
39.23	29.417	39	35.2502	38.7	39	29.4366	35.2086	0.3	-0.0198	0.0416
40.23	29.418	40	35.269	39.69	40	29.4235	35.2455	0.31	-0.0055	0.0235
41.24	29.415	41	35.2846	40.68	41	29.4152	35.2547	0.32	0.0002	0.0299
42.24	29.407	42	35.2958	41.67	42	29.4017	35.2677	0.33	0.0051	0.0281
43.25	29.396	43	35.2998	42.67	43	29.397	35.2792	0.33	-0.0009	0.0206

44.26	29.378	44	35.3029	43.66	44	29.3956	35.2922	0.34	-0.0177	0.0107
45.26	29.357	45	35.318	44.65	45	29.3837	35.2955	0.35	-0.0268	0.0225
46.27	29.34	46	35.3212	45.64	46	29.3579	35.2944	0.36	-0.0183	0.0268
47.27	29.333	47	35.3225	46.63	47	29.2266	35.276	0.37	0.1067	0.0465
48.28	29.328	48	35.3319	47.63	48	29.1632	35.2667	0.37	0.1647	0.0652
49.28	29.329	49	35.3361	48.62	49	29.0511	35.2532	0.38	0.2778	0.0829
50.29	29.314	50	35.3345	49.61	50	29.0669	35.284	0.39	0.247	0.0505
51.3	29.221	51	35.3141	50.6	51	29.073	35.3151	0.4	0.1475	-0.001
52.3	29.103	52	35.2975	51.6	52	29.0573	35.3144	0.4	0.0454	-0.0169
53.31	29.033	53	35.3009	52.59	53	29.0455	35.3139	0.41	-0.0124	-0.013
54.31	29.072	54	35.3491	53.58	54	29.0341	35.3188	0.42	0.0381	0.0303
55.32	29.068	55	35.36	54.57	55	29.0267	35.3266	0.43	0.0408	0.0334
56.33	29.041	56	35.3589	55.56	56	29.0218	35.3322	0.44	0.019	0.0267
57.33	29.034	57	35.3673	56.56	57	29.0141	35.3518	0.44	0.0202	0.0155
58.34	29.012	58	35.3862	57.55	58	29.0089	35.3722	0.45	0.0033	0.014
59.34	28.987	59	35.4223	58.54	59	29.0076	35.3776	0.46	-0.0206	0.0447
60.35	28.97	60	35.471	59.53	60	29.0075	35.3802	0.47	-0.0375	0.0908
61.36	28.987	61	35.5214	60.52	61	28.9955	35.4332	0.48	-0.0084	0.0882
62.36	28.987	62	35.5366	61.52	62	29.0095	35.4766	0.48	-0.0228	0.06
63.37	28.986	63	35.5407	62.51	63	29.0086	35.5001	0.49	-0.0228	0.0406
64.37	28.987	64	35.5451	64.49	65	29.0179	35.5525	-0.49	-0.0307	-0.0074
65.38	28.992	65	35.5572	65.48	66	29.036	35.5843	-0.48	-0.0438	-0.0271
66.39	29.005	66	35.5854	66.48	67	29.0226	35.6358	-0.48	-0.0178	-0.0504
67.39	29.016	67	35.6131	67.47	68	29.015	35.666	-0.47	0.0013	-0.0529
68.4	29.002	68	35.6389	68.46	69	29.0137	35.6799	-0.46	-0.0118	-0.041
69.4	28.993	69	35.6595	69.45	70	29.0145	35.6831	-0.45	-0.0211	-0.0236
70.41	28.994	70	35.6734	70.44	71	29.0157	35.6912	-0.44	-0.0217	-0.0178
71.42	28.996	71	35.682	71.44	72	29.0182	35.708	-0.44	-0.0222	-0.026
72.42	28.998	72	35.691	72.43	73	29.0213	35.715	-0.43	-0.023	-0.024
73.43	29.003	73	35.7102	73.42	74	29.0169	35.7473	-0.42	-0.014	-0.0371
74.43	29.007	74	35.7559	74.41	75	28.988	35.7555	-0.41	0.0188	0.0004
75.44	28.985	75	35.7795	75.4	76	28.9573	35.7509	-0.4	0.0277	0.0286
76.45	28.936	76	35.7893	76.4	77	28.9278	35.7552	-0.4	0.0084	0.0341
77.45	28.932	77	35.821	77.39	78	28.9408	35.7959	-0.39	-0.0084	0.0251
78.46	28.975	78	35.869	78.38	79	28.9826	35.8469	-0.38	-0.0073	0.0221
79.46	29.024	79	35.9118	79.37	80	29.0082	35.8753	-0.37	0.0161	0.0365
80.47	29.018	80	35.9222	80.36	81	29.0149	35.8838	-0.36	0.0031	0.0384
81.48	28.972	81	35.9264	81.36	82	29.0155	35.8876	-0.36	-0.044	0.0388
82.48	28.908	82	35.9704	82.35	83	28.9971	35.8926	-0.35	-0.0892	0.0778
83.49	28.879	83	36.0297	83.34	84	28.9167	35.9411	-0.34	-0.0376	0.0886
84.5	28.731	84	36.0358	84.33	85	28.9042	35.9751	-0.33	-0.1733	0.0607
85.5	28.562	85	36.0508	85.32	86	28.8757	35.9968	-0.32	-0.3137	0.054
86.51	28.539	86	36.1162	86.32	87	28.7996	36.0161	-0.32	-0.2606	0.1001
87.51	28.445	87	36.1292	87.31	88	28.6043	36.0065	-0.31	-0.159	0.1227
88.52	28.323	88	36.1222	88.3	89	28.5256	36.0337	-0.3	-0.2025	0.0885
89.53	28.185	89	36.1247	89.29	90	28.5277	36.0939	-0.29	-0.343	0.0308
90.53	28.093	90	36.1304	90.28	91	28.4368	36.1157	-0.28	-0.3434	0.0147
91.54	27.982	91	36.1369	91.27	92	28.3717	36.1058	-0.27	-0.3901	0.0311
92.54	27.93	92	36.1379	92.27	93	28.2558	36.0964	-0.27	-0.3263	0.0415
93.55	27.781	93	36.1477	93.26	94	28.1253	36.0612	-0.26	-0.3442	0.0865
94.56	27.678	94	36.145	94.25	95	28.0927	36.0682	-0.25	-0.4144	0.0768

95.56	27.52	95	36.1237	95.24	96	28.0293	36.0912	-0.24	-0.509	0.0325
96.57	27.226	96	36.0841	96.23	97	27.9974	36.0955	-0.23	-0.7719	-0.0114
97.57	26.986	97	36.0464	97.23	98	27.884	36.1179	-0.23	-0.8979	-0.0715
98.58	26.63	98	35.9863	98.22	99	27.7581	36.1276	-0.22	-1.1279	-0.1413
99.59	26.021	99	35.8849	99.21	100	27.6574	36.1086	-0.21	-1.6363	-0.2237
100.6	25.712	100	35.8292	100.2	101	27.352	36.0735	-0.2	-1.64	-0.2443
101.6	25.603	101	35.8019	101.19	102	26.9979	36.1524	-0.19	-1.3954	-0.3505
102.6	25.517	102	35.7793	102.19	103	26.7977	35.9803	-0.19	-1.2806	-0.201
103.6	25.312	103	35.7283	103.18	104	26.4836	35.9203	-0.18	-1.1714	-0.192
104.6	24.94	104	35.664	104.17	105	25.8993	35.8529	-0.17	-0.9597	-0.1889
105.6	24.224	105	35.5777	105.16	106	25.6543	35.8059	-0.16	-1.4307	-0.2282
106.6	23.376	106	35.5055	106.15	107	25.5719	35.7796	-0.15	-2.1957	-0.2741
107.6	22.927	107	35.4885	107.14	108	25.4584	35.7531	-0.14	-2.5317	-0.2646
108.6	22.858	108	35.4924	108.14	109	25.3126	35.7236	-0.14	-2.4549	-0.2312
109.6	22.82	109	35.4912	109.13	110	25.0284	35.6596	-0.13	-2.2086	-0.1684
110.7	22.801	110	35.4915	110.12	111	24.6198	35.6272	-0.12	-1.8185	-0.1357
111.7	22.786	111	35.4913	111.11	112	23.5387	35.4488	-0.11	-0.7531	0.0425
112.7	22.74	112	35.4846	112.1	113	22.9941	35.4661	-0.1	-0.2546	0.0185
113.7	22.607	113	35.4636	113.1	114	22.8868	35.4711	-0.1	-0.2803	-0.0075
114.7	22.455	114	35.4549	114.09	115	22.8507	35.4682	-0.09	-0.3954	-0.0133
115.7	22.361	115	35.4572	115.08	116	22.8246	35.4664	-0.08	-0.4635	-0.0092
116.7	22.151	116	35.4627	116.07	117	22.8066	35.4606	-0.07	-0.6554	0.0021
117.7	22.067	117	35.4783	117.06	118	22.7933	35.4569	-0.06	-0.7264	0.0214
118.7	21.946	118	35.4777	118.05	119	22.7265	35.4486	-0.05	-0.7805	0.0291
119.7	21.846	119	35.4691	119.05	120	22.5785	35.428	-0.05	-0.7322	0.0411
120.7	21.772	120	35.462	120.04	121	22.4674	35.4165	-0.04	-0.6957	0.0455
121.7	21.727	121	35.461	121.03	122	22.3491	35.4073	-0.03	-0.6223	0.0537
122.7	21.638	122	35.4551	122.02	123	22.2306	35.4346	-0.02	-0.593	0.0205
123.7	21.564	123	35.448	123.01	124	22.0797	35.4408	-0.01	-0.5155	0.0072
124.7	21.501	124	35.4407	124	125	21.9045	35.4296	0	-0.4032	0.0111
125.7	21.329	125	35.4168	125	126	21.6868	35.4147	0	-0.3582	0.0021
126.8	21.048	126	35.3819	125.99	127	21.6565	35.4136	0.01	-0.609	-0.0317
127.8	20.949	127	35.3693	126.98	128	21.5997	35.4067	0.02	-0.6503	-0.0374
128.8	20.854	128	35.3614	127.97	129	21.5284	35.399	0.03	-0.6746	-0.0376
129.8	20.796	129	35.3552	128.96	130	21.3425	35.3785	0.04	-0.5462	-0.0233
130.8	20.659	130	35.341	129.96	131	21.2018	35.3681	0.04	-0.5432	-0.0271
131.8	20.524	131	35.3246	130.95	132	21.0351	35.3392	0.05	-0.5111	-0.0146
132.8	20.318	132	35.297	131.94	133	20.9004	35.3284	0.06	-0.5825	-0.0314
133.8	20.186	133	35.2825	132.93	134	20.8316	35.3253	0.07	-0.646	-0.0428
134.8	20.063	134	35.2675	133.92	135	20.6468	35.3091	0.08	-0.5837	-0.0416
135.8	19.949	135	35.2558	134.91	136	20.3885	35.2647	0.09	-0.4396	-0.0089
136.8	19.826	136	35.2425	135.91	137	20.1119	35.2438	0.09	-0.2859	-0.0013
137.8	19.765	137	35.24	136.9	138	19.9255	35.2152	0.1	-0.1604	0.0248
138.8	19.737	138	35.2404	137.89	139	19.8234	35.2041	0.11	-0.0862	0.0363
139.8	19.679	139	35.2397	138.88	140	19.7555	35.2033	0.12	-0.0767	0.0364
140.8	19.608	140	35.2385	139.87	141	19.6884	35.198	0.13	-0.0803	0.0405
141.9	19.513	141	35.2385	140.86	142	19.5963	35.1978	0.14	-0.083	0.0407
142.9	19.231	142	35.2391	141.86	143	19.3357	35.2023	0.14	-0.1051	0.0368
143.9	18.972	143	35.2358	142.85	144	18.9831	35.21	0.15	-0.0109	0.0258
144.9	18.683	144	35.2264	143.84	145	18.678	35.2043	0.16	0.0048	0.0221
145.9	18.545	145	35.2256	144.83	146	18.4962	35.2037	0.17	0.0489	0.0219

146.9	18.445	146	35.2209	145.82	147	18.3397	35.1757	0.18	0.1051	0.0452
147.9	18.298	147	35.2012	146.81	148	18.2187	35.1633	0.19	0.0793	0.0379
148.9	18.197	148	35.1892	147.81	149	18.1284	35.1585	0.19	0.069	0.0307
149.9	18.126	149	35.1903	148.8	150	18.0658	35.1555	0.2	0.0604	0.0348
150.9	18.057	150	35.1986	149.79	151	18.0555	35.1589	0.21	0.0019	0.0397
151.9	17.965	151	35.1967	150.78	152	17.9849	35.1583	0.22	-0.0203	0.0384
152.9	17.923	152	35.1942	151.77	153	17.8565	35.1508	0.23	0.0667	0.0434
153.9	17.836	153	35.1889	152.76	154	17.8045	35.1496	0.24	0.0318	0.0393
154.9	17.792	154	35.1871	153.75	155	17.7886	35.1523	0.25	0.0032	0.0348
155.9	17.781	155	35.1909	154.75	156	17.7801	35.1576	0.25	0.001	0.0333
156.9	17.778	156	35.203	155.74	157	17.7787	35.1608	0.26	-0.0009	0.0422
158	17.774	157	35.2073	156.73	158	17.778	35.1622	0.27	-0.0036	0.0451
159	17.77	158	35.2105	157.72	159	17.7706	35.1654	0.28	-0.001	0.0451
160	17.739	159	35.2124	158.71	160	17.7335	35.167	0.29	0.0057	0.0454
161	17.671	160	35.2135	159.7	161	17.6178	35.1701	0.3	0.0529	0.0434
162	17.598	161	35.2109	160.7	162	17.5637	35.1682	0.3	0.0339	0.0427
163	17.546	162	35.212	161.69	163	17.547	35.171	0.31	-0.0007	0.041
164	17.532	163	35.2136	162.68	164	17.5243	35.171	0.32	0.0075	0.0426
165	17.493	164	35.214	163.67	165	17.4509	35.1751	0.33	0.0421	0.0389
166	17.396	165	35.2124	164.66	166	17.368	35.1722	0.34	0.0278	0.0402
167	17.293	166	35.2112	165.65	167	17.3329	35.1694	0.35	-0.0396	0.0418
168	17.096	167	35.2069	166.64	168	17.1781	35.1715	0.36	-0.0826	0.0354
169	17.042	168	35.2047	167.64	169	17.0159	35.1672	0.36	0.0259	0.0375
170	17.018	169	35.2032	168.63	170	16.9416	35.16	0.37	0.0765	0.0432
171	16.978	170	35.2025	169.62	171	16.9043	35.1587	0.38	0.0733	0.0438
172	16.88	171	35.2003	170.61	172	16.8576	35.1621	0.39	0.0228	0.0382
173.1	16.79	172	35.1982	171.6	173	16.7985	35.1463	0.4	-0.0085	0.0519
174.1	16.605	173	35.1897	172.59	174	16.669	35.1517	0.41	-0.0645	0.038
175.1	16.463	174	35.1892	173.59	175	16.4766	35.1527	0.41	-0.0135	0.0365
176.1	16.378	175	35.1903	174.58	176	16.3504	35.1574	0.42	0.0277	0.0329
177.1	16.296	176	35.1963	175.57	177	16.2569	35.1612	0.43	0.0395	0.0351
178.1	16.195	177	35.2003	176.56	178	16.1782	35.1616	0.44	0.017	0.0387
179.1	16.151	178	35.2062	177.55	179	16.1205	35.1617	0.45	0.0303	0.0445
180.1	16.118	179	35.2146	178.54	180	16.0912	35.1608	0.46	0.0272	0.0538
181.1	16.107	180	35.2196	179.53	181	16.0537	35.1638	0.47	0.0532	0.0558
182.1	16.09	181	35.2267	180.53	182	15.987	35.1706	0.47	0.1027	0.0561
183.1	16.011	182	35.2232	181.52	183	15.8942	35.17	0.48	0.1172	0.0532
184.1	15.948	183	35.2168	182.51	184	15.8688	35.1676	0.49	0.079	0.0492
185.1	15.909	184	35.213	183.5	185	15.8464	35.1677	0.5	0.0623	0.0453
186.1	15.884	185	35.2121	185.48	187	15.7162	35.1547	-0.48	0.1676	0.0574
187.1	15.834	186	35.2086	186.47	188	15.6803	35.1563	-0.47	0.1538	0.0523
188.1	15.789	187	35.2053	187.47	189	15.6148	35.1597	-0.47	0.1746	0.0456
189.2	15.742	188	35.2009	188.46	190	15.5165	35.1415	-0.46	0.2256	0.0594
190.2	15.683	189	35.1965	189.45	191	15.4726	35.1374	-0.45	0.2106	0.0591
191.2	15.609	190	35.1916	190.44	192	15.4526	35.1357	-0.44	0.1564	0.0559
192.2	15.498	191	35.1844	191.43	193	15.4019	35.1327	-0.43	0.0956	0.0517
193.2	15.433	192	35.1797	192.42	194	15.3051	35.1314	-0.42	0.128	0.0483
194.2	15.31	193	35.1768	193.41	195	15.2898	35.1337	-0.41	0.0199	0.0431
195.2	15.256	194	35.1757	194.41	196	15.2719	35.1371	-0.41	-0.0157	0.0386
196.2	15.226	195	35.175	195.4	197	15.1553	35.1303	-0.4	0.071	0.0447
197.2	15.159	196	35.1735	196.39	198	15.11	35.1326	-0.39	0.0485	0.0409

198.2	15.122	197	35.1732	197.38	199	15.1059	35.1317	-0.38	0.0163	0.0415
199.2	15.107	198	35.1741	198.37	200	15.0887	35.1346	-0.37	0.0182	0.0395
200.2	15.1	199	35.1746	199.36	201	15.079	35.134	-0.36	0.0208	0.0406
201.2	15.094	200	35.1744	200.35	202	15.0711	35.133	-0.35	0.023	0.0414
202.2	15.09	201	35.1743	201.35	203	15.0627	35.133	-0.35	0.0271	0.0413
203.2	15.085	202	35.1743	202.34	204	15.0555	35.1316	-0.34	0.0296	0.0427
204.3	15.072	203	35.1748	203.33	205	15.0371	35.1351	-0.33	0.0347	0.0397
205.3	15.06	204	35.1753	204.32	206	15.0215	35.1429	-0.32	0.0384	0.0324
206.3	15.049	205	35.1756	205.31	207	14.9751	35.1537	-0.31	0.074	0.0219
207.3	15.037	206	35.1768	206.3	208	14.9605	35.1545	-0.3	0.0769	0.0223
208.3	15.011	207	35.1772	207.29	209	14.9494	35.1552	-0.29	0.0615	0.022
209.3	14.964	208	35.1888	208.29	210	14.9386	35.1533	-0.29	0.025	0.0355
210.3	14.939	209	35.1948	209.28	211	14.8428	35.1617	-0.28	0.0961	0.0331
211.3	14.898	210	35.1926	210.27	212	14.7907	35.1466	-0.27	0.1075	0.046
212.3	14.86	211	35.1934	211.26	213	14.7642	35.1467	-0.26	0.0953	0.0467
213.3	14.777	212	35.193	212.25	214	14.6872	35.1403	-0.25	0.0899	0.0527
214.3	14.738	213	35.1907	213.24	215	14.5872	35.1312	-0.24	0.1503	0.0595
215.3	14.676	214	35.1862	214.23	216	14.5474	35.1352	-0.23	0.129	0.051
216.3	14.592	215	35.18	215.22	217	14.4142	35.1337	-0.22	0.1781	0.0463
217.3	14.559	216	35.177	216.22	218	14.3432	35.1336	-0.22	0.2157	0.0434
218.3	14.507	217	35.1754	217.21	219	14.239	35.137	-0.21	0.2683	0.0384
219.4	14.47	218	35.1771	218.2	220	14.2102	35.1385	-0.2	0.2601	0.0386
220.4	14.347	219	35.1785	219.19	221	14.1991	35.1401	-0.19	0.1477	0.0384
221.4	14.241	220	35.1816	220.18	222	14.1322	35.1535	-0.18	0.1083	0.0281
222.4	14.185	221	35.184	221.17	223	14.0611	35.1666	-0.17	0.1236	0.0174
223.4	14.165	222	35.1851	222.16	224	13.93	35.1479	-0.16	0.2347	0.0372
224.4	14.065	223	35.1961	223.15	225	13.909	35.1509	-0.15	0.1558	0.0452
225.4	13.916	224	35.1904	224.15	226	13.904	35.1489	-0.15	0.0121	0.0415
226.4	13.893	225	35.1877	225.14	227	13.8954	35.1477	-0.14	-0.0024	0.04
227.4	13.887	226	35.187	226.13	228	13.89	35.146	-0.13	-0.003	0.041
228.4	13.878	227	35.1861	227.12	229	13.8784	35.1444	-0.12	-0.0003	0.0417
229.4	13.863	228	35.1851	228.11	230	13.8567	35.141	-0.11	0.0065	0.0441
230.4	13.84	229	35.184	229.1	231	13.8111	35.1439	-0.1	0.0286	0.0401
231.4	13.788	230	35.1813	230.09	232	13.7265	35.1391	-0.09	0.0612	0.0422
232.4	13.697	231	35.1817	231.08	233	13.7219	35.14	-0.08	-0.0252	0.0417
233.5	13.686	232	35.1838	232.08	234	13.7239	35.1432	-0.08	-0.0375	0.0406
234.5	13.688	233	35.1848	233.07	235	13.7271	35.1452	-0.07	-0.0396	0.0396
235.5	13.687	234	35.1857	234.06	236	13.7226	35.1475	-0.06	-0.036	0.0382
236.5	13.688	235	35.1884	235.05	237	13.5744	35.1444	-0.05	0.1134	0.044
237.5	13.551	236	35.1807	236.04	238	13.4721	35.1342	-0.04	0.0792	0.0465
238.5	13.446	237	35.1762	237.03	239	13.428	35.1339	-0.03	0.0179	0.0423
239.5	13.414	238	35.1749	238.02	240	13.387	35.1332	-0.02	0.0272	0.0417
240.5	13.387	239	35.1743	239.01	241	13.3756	35.1302	-0.01	0.0115	0.0441
241.5	13.378	240	35.1744	240.01	242	13.3595	35.1304	-0.01	0.0189	0.044
242.5	13.376	241	35.1745	241	243	13.3374	35.1292	0	0.039	0.0453
243.5	13.375	242	35.1747	241.99	244	13.3337	35.1288	0.01	0.0416	0.0459
244.5	13.373	243	35.1749	242.98	245	13.3285	35.1299	0.02	0.0446	0.045
245.5	13.368	244	35.1749	243.97	246	13.328	35.1288	0.03	0.04	0.0461
246.5	13.354	245	35.1747	244.96	247	13.3276	35.1284	0.04	0.0264	0.0463
247.5	13.329	246	35.1737	245.95	248	13.3093	35.1292	0.05	0.0194	0.0445
248.6	13.263	247	35.1724	246.94	249	13.301	35.1274	0.06	-0.0384	0.045

249.6	13.236	248	35.172	247.93	250	13.2998	35.1277	0.07	-0.0643	0.0443
250.6	13.224	249	35.1718	248.93	251	13.2869	35.1277	0.07	-0.0626	0.0441
251.6	13.216	250	35.1719	249.92	252	13.2834	35.1279	0.08	-0.0674	0.044
252.6	13.207	251	35.1717	250.91	253	13.2702	35.128	0.09	-0.0633	0.0437
253.6	13.193	252	35.1717	251.9	254	13.2456	35.1229	0.1	-0.0523	0.0488
254.6	13.182	253	35.1719	252.89	255	13.2153	35.1278	0.11	-0.0333	0.0441
255.6	13.175	254	35.172	253.88	256	13.1925	35.1272	0.12	-0.0177	0.0448
256.6	13.169	255	35.172	254.87	257	13.1847	35.1269	0.13	-0.0157	0.0451
257.6	13.139	256	35.1717	255.86	258	13.1462	35.129	0.14	-0.007	0.0427
258.6	13.101	257	35.1708	256.85	259	13.1175	35.1276	0.15	-0.0161	0.0432
259.6	13.067	258	35.1693	257.85	260	13.0834	35.1234	0.15	-0.0166	0.0459
260.6	13.047	259	35.1679	258.84	261	13.058	35.1228	0.16	-0.0114	0.0451
261.6	13.021	260	35.1685	259.83	262	13.0315	35.1246	0.17	-0.0108	0.0439
262.7	13.021	261	35.1694	260.82	263	13.0159	35.1258	0.18	0.0055	0.0436
263.7	13.021	262	35.1704	261.81	264	13.0059	35.1293	0.19	0.0148	0.0411
264.7	13.009	263	35.1709	262.8	265	12.9656	35.1278	0.2	0.0434	0.0431
265.7	12.951	264	35.1719	263.79	266	12.9389	35.1255	0.21	0.012	0.0464
266.7	12.903	265	35.1722	264.78	267	12.9231	35.1281	0.22	-0.0198	0.0441
267.7	12.871	266	35.1721	265.77	268	12.9092	35.1268	0.23	-0.0378	0.0453
268.7	12.844	267	35.172	266.77	269	12.8915	35.1268	0.23	-0.0471	0.0452
269.7	12.834	268	35.1717	267.76	270	12.8815	35.1275	0.24	-0.0479	0.0442
270.7	12.827	269	35.1717	268.75	271	12.8638	35.1275	0.25	-0.0373	0.0442
271.7	12.815	270	35.1716	269.74	272	12.8366	35.1348	0.26	-0.0212	0.0368
272.7	12.802	271	35.1715	270.73	273	12.8227	35.1423	0.27	-0.0208	0.0292
273.7	12.787	272	35.1713	271.72	274	12.7993	35.1271	0.28	-0.012	0.0442
274.7	12.772	273	35.1712	272.71	275	12.7878	35.1264	0.29	-0.0157	0.0448
275.7	12.758	274	35.171	273.7	276	12.752	35.1293	0.3	0.0058	0.0417
276.7	12.741	275	35.1709	274.69	277	12.7245	35.1254	0.31	0.0167	0.0455
277.8	12.729	276	35.1709	275.68	278	12.7123	35.1255	0.32	0.0169	0.0454
278.8	12.708	277	35.1709	276.68	279	12.663	35.1279	0.32	0.0454	0.043
279.8	12.697	278	35.1707	277.67	280	12.6248	35.1249	0.33	0.0721	0.0458
280.8	12.691	279	35.1708	278.66	281	12.6143	35.1253	0.34	0.077	0.0455
281.8	12.674	280	35.1701	279.65	282	12.6076	35.1252	0.35	0.0663	0.0449
282.8	12.634	281	35.1702	280.64	283	12.5986	35.1249	0.36	0.0354	0.0453
283.8	12.621	282	35.17	281.63	284	12.5809	35.1235	0.37	0.0403	0.0465
284.8	12.61	283	35.17	282.62	285	12.5523	35.1249	0.38	0.0577	0.0451
285.8	12.596	284	35.1698	283.61	286	12.4899	35.1226	0.39	0.106	0.0472
286.8	12.582	285	35.1697	284.6	287	12.4422	35.1172	0.4	0.1399	0.0525
287.8	12.564	286	35.1694	285.59	288	12.4345	35.1152	0.41	0.1299	0.0542
288.8	12.548	287	35.1688	286.59	289	12.4278	35.1155	0.41	0.12	0.0533
289.8	12.535	288	35.1682	287.58	290	12.4212	35.1146	0.42	0.1139	0.0536
290.8	12.517	289	35.1667	288.57	291	12.4034	35.1128	0.43	0.1133	0.0539
291.9	12.486	290	35.165	289.56	292	12.3902	35.1148	0.44	0.096	0.0502
292.9	12.453	291	35.1618	290.55	293	12.374	35.1128	0.45	0.0788	0.049
293.9	12.43	292	35.161	291.54	294	12.3616	35.1133	0.46	0.0681	0.0477
294.9	12.427	293	35.1614	292.53	295	12.3559	35.1128	0.47	0.0706	0.0486
295.9	12.423	294	35.1612	293.52	296	12.3462	35.1129	0.48	0.0763	0.0483
296.9	12.418	295	35.1612	294.51	297	12.3344	35.1119	0.49	0.0838	0.0493
297.9	12.41	296	35.1613	295.5	298	12.3277	35.1116	0.5	0.0819	0.0497
298.9	12.4	297	35.1614	297.49	300	12.3111	35.1103	-0.49	0.089	0.0511
299.9	12.376	298	35.1616	298.48	301	12.2895	35.1118	-0.48	0.0869	0.0498

300.9	12.364	299	35.1606	299.47	302	12.2619	35.1116	-0.47	0.1016	0.049
301.9	12.338	300	35.1584	300.46	303	12.2271	35.129	-0.46	0.1113	0.0294
302.9	12.322	301	35.1572	301.45	304	12.187	35.1182	-0.45	0.1353	0.039
303.9	12.306	302	35.1564	302.44	305	12.1668	35.1212	-0.44	0.1395	0.0352
304.9	12.29	303	35.1552	303.43	306	12.1525	35.1185	-0.43	0.1378	0.0367
306	12.27	304	35.1558	304.42	307	12.1167	35.1307	-0.42	0.1537	0.0251
307	12.257	305	35.1556	305.41	308	12.0679	35.1361	-0.41	0.189	0.0195
308	12.251	306	35.1559	306.4	309	12.0288	35.1272	-0.4	0.2217	0.0287
309	12.223	307	35.1552	307.39	310	12.0193	35.1214	-0.39	0.204	0.0338
310	12.196	308	35.154	308.39	311	12.0039	35.123	-0.39	0.192	0.031
311	12.187	309	35.1536	309.38	312	11.9816	35.1172	-0.38	0.2057	0.0364
312	12.147	310	35.1552	310.37	313	11.9637	35.1106	-0.37	0.1833	0.0446
313	12.113	311	35.1553	311.36	314	11.9613	35.1083	-0.36	0.1517	0.047
314	12.079	312	35.1589	312.35	315	11.9594	35.11	-0.35	0.1199	0.0489
315	12.06	313	35.1606	313.34	316	11.9516	35.1134	-0.34	0.1082	0.0472
316	12.047	314	35.1593	314.33	317	11.9511	35.1162	-0.33	0.096	0.0431
317	12.007	315	35.1571	315.32	318	11.9384	35.1173	-0.32	0.0681	0.0398
318	11.978	316	35.1543	316.31	319	11.9275	35.1188	-0.31	0.0507	0.0355
319	11.964	317	35.1542	317.3	320	11.9061	35.1175	-0.3	0.0581	0.0367
320.1	11.982	318	35.1626	318.29	321	11.8877	35.1205	-0.29	0.0941	0.0421
321.1	12	319	35.1697	319.28	322	11.8805	35.1203	-0.28	0.1198	0.0494
322.1	11.991	320	35.1686	320.27	323	11.8741	35.1191	-0.27	0.117	0.0495
323.1	11.97	321	35.1648	321.27	324	11.8568	35.118	-0.27	0.1132	0.0468
324.1	11.963	322	35.1678	322.26	325	11.8436	35.118	-0.26	0.1196	0.0498
325.1	11.956	323	35.1686	323.25	326	11.8378	35.1173	-0.25	0.118	0.0513
326.1	11.941	324	35.1683	324.24	327	11.8315	35.117	-0.24	0.1093	0.0513
327.1	11.924	325	35.1677	325.23	328	11.8396	35.1226	-0.23	0.084	0.0451
328.1	11.902	326	35.1678	326.22	329	11.8282	35.1261	-0.22	0.0737	0.0417
329.1	11.882	327	35.1668	327.21	330	11.7998	35.1239	-0.21	0.0819	0.0429
330.1	11.869	328	35.1666	328.2	331	11.775	35.1262	-0.2	0.0941	0.0404
331.1	11.865	329	35.167	329.19	332	11.7667	35.127	-0.19	0.0985	0.04
332.1	11.862	330	35.1669	330.18	333	11.7633	35.1261	-0.18	0.0985	0.0408
333.2	11.856	331	35.1666	331.17	334	11.7599	35.126	-0.17	0.0963	0.0406
334.2	11.847	332	35.1681	332.16	335	11.7511	35.1275	-0.16	0.0955	0.0406
335.2	11.837	333	35.1717	333.15	336	11.7313	35.1285	-0.15	0.1052	0.0432
336.2	11.823	334	35.1728	334.15	337	11.7225	35.1289	-0.15	0.1	0.0439
337.2	11.808	335	35.1723	335.14	338	11.7133	35.1293	-0.14	0.0945	0.043
338.2	11.783	336	35.1719	336.13	339	11.7047	35.1301	-0.13	0.0781	0.0418
339.2	11.769	337	35.1716	337.12	340	11.6928	35.1294	-0.12	0.0765	0.0422
340.2	11.76	338	35.1716	338.11	341	11.676	35.1319	-0.11	0.084	0.0397
341.2	11.753	339	35.1718	339.1	342	11.6601	35.1329	-0.1	0.0931	0.0389
342.2	11.748	340	35.1726	340.09	343	11.6574	35.1332	-0.09	0.0908	0.0394
343.2	11.748	341	35.1725	341.08	344	11.6543	35.1339	-0.08	0.0934	0.0386
344.2	11.74	342	35.1723	342.07	345	11.6503	35.1335	-0.07	0.0895	0.0388
345.2	11.72	343	35.1734	343.06	346	11.6495	35.1327	-0.06	0.0703	0.0407
346.2	11.707	344	35.1744	344.05	347	11.6477	35.133	-0.05	0.059	0.0414
347.3	11.684	345	35.1753	345.04	348	11.639	35.132	-0.04	0.0449	0.0433
348.3	11.669	346	35.1764	346.03	349	11.6109	35.1349	-0.03	0.0585	0.0415
349.3	11.652	347	35.1791	347.02	350	11.6062	35.1347	-0.02	0.0457	0.0444
350.3	11.646	348	35.18	348.02	351	11.6048	35.1352	-0.02	0.041	0.0448
351.3	11.636	349	35.1799	349.01	352	11.6064	35.1368	-0.01	0.0296	0.0431

352.3	11.627	350	35.1788	350	353	11.6136	35.1412	0	0.0137	0.0376
353.3	11.616	351	35.1788	350.99	354	11.6077	35.1443	0.01	0.0078	0.0345
354.3	11.601	352	35.1802	351.98	355	11.6022	35.1435	0.02	-0.0009	0.0367
355.3	11.6	353	35.1818	352.97	356	11.598	35.1436	0.03	0.0019	0.0382
356.3	11.596	354	35.1839	353.96	357	11.5924	35.145	0.04	0.004	0.0389
357.3	11.593	355	35.185	354.95	358	11.5869	35.1451	0.05	0.0059	0.0399
358.3	11.593	356	35.1861	355.94	359	11.5733	35.1445	0.06	0.0194	0.0416
359.3	11.592	357	35.187	356.93	360	11.548	35.1463	0.07	0.0443	0.0407
360.3	11.591	358	35.1881	357.92	361	11.524	35.1435	0.08	0.0667	0.0446
361.4	11.59	359	35.1882	358.91	362	11.4921	35.1431	0.09	0.0978	0.0451
362.4	11.591	360	35.1884	359.9	363	11.485	35.1408	0.1	0.1055	0.0476
363.4	11.591	361	35.1888	360.89	364	11.4801	35.1396	0.11	0.1104	0.0492
364.4	11.589	362	35.189	361.88	365	11.4726	35.1389	0.12	0.1166	0.0501
365.4	11.588	363	35.1897	362.87	366	11.4689	35.1392	0.13	0.1186	0.0505
366.4	11.585	364	35.1901	363.87	367	11.4638	35.1378	0.13	0.1215	0.0523
367.4	11.581	365	35.1905	364.86	368	11.4507	35.1382	0.14	0.1298	0.0523
368.4	11.56	366	35.191	365.85	369	11.427	35.1346	0.15	0.1332	0.0564
369.4	11.537	367	35.1911	366.84	370	11.411	35.1341	0.16	0.126	0.057
370.4	11.519	368	35.1899	367.83	371	11.4043	35.134	0.17	0.1149	0.0559
371.4	11.5	369	35.1885	368.82	372	11.4019	35.1333	0.18	0.0976	0.0552
372.4	11.488	370	35.1875	369.81	373	11.3988	35.1325	0.19	0.0891	0.055
373.4	11.477	371	35.1863	370.8	374	11.3926	35.1331	0.2	0.0842	0.0532
374.5	11.447	372	35.1837	371.79	375	11.3826	35.1327	0.21	0.0644	0.051
375.5	11.429	373	35.1823	372.78	376	11.382	35.1328	0.22	0.0465	0.0495
376.5	11.424	374	35.1821	373.77	377	11.3817	35.1326	0.23	0.0424	0.0495
377.5	11.407	375	35.1804	374.76	378	11.3787	35.1329	0.24	0.028	0.0475
378.5	11.394	376	35.1796	375.75	379	11.3645	35.1322	0.25	0.0291	0.0474
379.5	11.389	377	35.1795	376.74	380	11.3582	35.1322	0.26	0.0305	0.0473
380.5	11.384	378	35.1793	377.73	381	11.3571	35.132	0.27	0.0269	0.0473
381.5	11.379	379	35.1795	378.72	382	11.3561	35.1324	0.28	0.0232	0.0471
382.5	11.375	380	35.1793	379.71	383	11.3545	35.1318	0.29	0.0201	0.0475
383.5	11.37	381	35.179	380.7	384	11.3514	35.1318	0.3	0.0182	0.0472
384.5	11.36	382	35.1783	381.69	385	11.3484	35.132	0.31	0.0116	0.0463
385.5	11.354	383	35.1792	382.69	386	11.3472	35.1322	0.31	0.0069	0.047
386.5	11.361	384	35.1819	383.68	387	11.3325	35.1345	0.32	0.0284	0.0474
387.6	11.368	385	35.1843	384.67	388	11.3215	35.1356	0.33	0.0461	0.0487
388.6	11.373	386	35.1866	385.66	389	11.3131	35.1359	0.34	0.0597	0.0507
389.6	11.368	387	35.1863	386.65	390	11.3028	35.1353	0.35	0.065	0.051
390.6	11.353	388	35.185	387.64	391	11.2959	35.1346	0.36	0.0571	0.0504
391.6	11.354	389	35.1879	388.63	392	11.2918	35.1344	0.37	0.0622	0.0535
392.6	11.36	390	35.1908	389.62	393	11.2858	35.1348	0.38	0.0741	0.056
393.6	11.369	391	35.1946	390.61	394	11.2828	35.1373	0.39	0.0859	0.0573
394.6	11.374	392	35.1974	391.6	395	11.286	35.138	0.4	0.0878	0.0594
395.6	11.375	393	35.1984	392.59	396	11.2834	35.1396	0.41	0.0915	0.0588
396.6	11.376	394	35.1985	393.58	397	11.2772	35.1402	0.42	0.0986	0.0583
397.6	11.367	395	35.1974	394.57	398	11.281	35.1424	0.43	0.0856	0.055
398.6	11.342	396	35.1942	395.56	399	11.275	35.1432	0.44	0.0665	0.051
399.6	11.318	397	35.192	396.55	400	11.2572	35.1413	0.45	0.0603	0.0507
400.7	11.312	398	35.1938	397.54	401	11.2449	35.1422	0.46	0.0672	0.0516
401.7	11.307	399	35.1931	398.53	402	11.2417	35.1422	0.47	0.0649	0.0509
402.7	11.297	400	35.192	399.52	403	11.2336	35.142	0.48	0.0632	0.05

403.7	11.281	401	35.1907	400.51	404	11.2277	35.1429	0.49	0.053	0.0478
404.7	11.263	402	35.189	401.5	405	11.2236	35.1423	0.5	0.0396	0.0467
405.7	11.255	403	35.1886	403.48	407	11.2147	35.1425	-0.48	0.0407	0.0461
406.7	11.251	404	35.1885	404.47	408	11.2097	35.1429	-0.47	0.0411	0.0456
407.7	11.242	405	35.1882	405.47	409	11.2084	35.1434	-0.47	0.0336	0.0448
408.7	11.233	406	35.1881	406.46	410	11.1939	35.1451	-0.46	0.0388	0.043
409.7	11.223	407	35.188	407.45	411	11.1864	35.1425	-0.45	0.0364	0.0455
410.7	11.218	408	35.1882	408.44	412	11.1802	35.1424	-0.44	0.0373	0.0458
411.7	11.212	409	35.1885	409.43	413	11.1767	35.1418	-0.43	0.0356	0.0467
412.7	11.21	410	35.1885	410.42	414	11.1765	35.1423	-0.42	0.0336	0.0462
413.8	11.207	411	35.1885	411.41	415	11.177	35.1426	-0.41	0.0302	0.0459
414.8	11.201	412	35.189	412.4	416	11.1684	35.1426	-0.4	0.0325	0.0464
415.8	11.195	413	35.1901	413.39	417	11.1591	35.1411	-0.39	0.036	0.049
416.8	11.19	414	35.1908	414.38	418	11.1556	35.1407	-0.38	0.0341	0.0501
417.8	11.188	415	35.1911	415.37	419	11.1563	35.1437	-0.37	0.0317	0.0474
418.8	11.184	416	35.1914	416.36	420	11.1593	35.1464	-0.36	0.0251	0.045
419.8	11.179	417	35.1914	417.35	421	11.1679	35.148	-0.35	0.0107	0.0434
420.8	11.177	418	35.1918	418.34	422	11.1682	35.1521	-0.34	0.0085	0.0397
421.8	11.174	419	35.1924	419.33	423	11.1594	35.1533	-0.33	0.0141	0.0391
422.8	11.171	420	35.1928	420.32	424	11.1603	35.1517	-0.32	0.0102	0.0411
423.8	11.165	421	35.1931	421.31	425	11.1637	35.1534	-0.31	0.0009	0.0397
424.8	11.158	422	35.1939	422.3	426	11.1649	35.1597	-0.3	-0.0067	0.0342
425.8	11.158	423	35.1941	423.29	427	11.16	35.1594	-0.29	-0.0024	0.0347
426.9	11.154	424	35.1946	424.28	428	11.1571	35.1635	-0.28	-0.0029	0.0311
427.9	11.149	425	35.1951	425.27	429	11.1599	35.1636	-0.27	-0.0111	0.0315
428.9	11.146	426	35.1955	426.26	430	11.1573	35.1646	-0.26	-0.0118	0.0309
429.9	11.13	427	35.1955	427.25	431	11.1531	35.1645	-0.25	-0.0228	0.031
430.9	11.126	428	35.1958	428.24	432	11.1504	35.1651	-0.24	-0.0243	0.0307
431.9	11.124	429	35.1957	429.23	433	11.1479	35.1662	-0.23	-0.0236	0.0295
432.9	11.122	430	35.196	430.22	434	11.1454	35.1674	-0.22	-0.0237	0.0286
433.9	11.12	431	35.1975	431.21	435	11.1408	35.1702	-0.21	-0.0206	0.0273
434.9	11.124	432	35.2013	432.2	436	11.1392	35.1661	-0.2	-0.0151	0.0352
435.9	11.129	433	35.2055	433.19	437	11.1352	35.1669	-0.19	-0.0065	0.0386
436.9	11.122	434	35.2048	434.18	438	11.1305	35.1679	-0.18	-0.0083	0.0369
437.9	11.109	435	35.2046	435.17	439	11.1271	35.167	-0.17	-0.0185	0.0376
438.9	11.113	436	35.2082	436.16	440	11.1265	35.1673	-0.16	-0.0134	0.0409
440	11.115	437	35.2105	437.15	441	11.0586	35.1815	-0.15	0.0566	0.029
441	11.116	438	35.2117	438.15	442	11.0115	35.1597	-0.15	0.1046	0.052
442	11.116	439	35.2118	439.14	443	10.9753	35.1498	-0.14	0.1405	0.062
443	11.114	440	35.2114	440.13	444	10.9539	35.1448	-0.13	0.1604	0.0666
444	11.087	441	35.2056	441.12	445	10.9489	35.1419	-0.12	0.1378	0.0637
445	11.066	442	35.2011	442.11	446	10.9445	35.1408	-0.11	0.1211	0.0603
446	11.028	443	35.1949	443.1	447	10.9579	35.1431	-0.1	0.0702	0.0518
447	10.981	444	35.188	444.09	448	10.9404	35.1478	-0.09	0.0406	0.0402
448	10.943	445	35.1811	445.08	449	10.9359	35.1428	-0.08	0.007	0.0383
449	10.925	446	35.1784	446.07	450	10.9182	35.142	-0.07	0.0066	0.0364
450	10.915	447	35.1774	447.06	451	10.9076	35.1363	-0.06	0.0075	0.0411
451	10.907	448	35.1768	448.05	452	10.9022	35.1371	-0.05	0.0043	0.0397
452	10.905	449	35.1766	449.04	453	10.8839	35.1377	-0.04	0.021	0.0389
453.1	10.904	450	35.1765	450.03	454	10.8732	35.1361	-0.03	0.0306	0.0404
454.1	10.902	451	35.1764	451.02	455	10.862	35.131	-0.02	0.0395	0.0454

455.1	10.901	452	35.1769	452.01	456	10.8891	35.1309	-0.01	0.0121	0.046
456.1	10.9	453	35.1773	453	457	10.903	35.1373	0	-0.0032	0.04
457.1	10.886	454	35.1759	453.99	458	10.9079	35.141	0.01	-0.0217	0.0349
458.1	10.869	455	35.1743	454.98	459	10.8957	35.1444	0.02	-0.0267	0.0299
459.1	10.849	456	35.1721	455.97	460	10.8721	35.1516	0.03	-0.0234	0.0205
460.1	10.846	457	35.1725	456.96	461	10.8584	35.1446	0.04	-0.0125	0.0279
461.1	10.86	458	35.1769	457.95	462	10.8447	35.1467	0.05	0.0149	0.0302
462.1	10.871	459	35.1804	458.94	463	10.8389	35.1427	0.06	0.0325	0.0377
463.1	10.88	460	35.1828	459.93	464	10.8395	35.142	0.07	0.0408	0.0408
464.1	10.882	461	35.1835	460.92	465	10.8395	35.1419	0.08	0.0427	0.0416
465.1	10.887	462	35.185	461.91	466	10.8298	35.1431	0.09	0.0575	0.0419
466.2	10.892	463	35.1872	462.9	467	10.8201	35.1425	0.1	0.0718	0.0447
467.2	10.878	464	35.1875	463.89	468	10.8102	35.1409	0.11	0.068	0.0466
468.2	10.88	465	35.1893	464.88	469	10.7982	35.139	0.12	0.0822	0.0503
469.2	10.877	466	35.1897	465.87	470	10.7873	35.1369	0.13	0.0893	0.0528
470.2	10.887	467	35.197	466.86	471	10.7836	35.1356	0.14	0.1034	0.0614
471.2	10.894	468	35.2005	467.85	472	10.7823	35.1357	0.15	0.1113	0.0648
472.2	10.894	469	35.2007	468.84	473	10.7811	35.1358	0.16	0.1132	0.0649
473.2	10.875	470	35.1965	469.83	474	10.8103	35.1356	0.17	0.0643	0.0609
474.2	10.833	471	35.1891	470.82	475	10.8309	35.1455	0.18	0.002	0.0436
475.2	10.827	472	35.1874	471.81	476	10.8338	35.1546	0.19	-0.0072	0.0328
476.2	10.81	473	35.1838	472.8	477	10.8179	35.1562	0.2	-0.0084	0.0276
477.2	10.82	474	35.1877	473.79	478	10.8161	35.1533	0.21	0.0041	0.0344
478.3	10.85	475	35.1965	474.78	479	10.82	35.1638	0.22	0.03	0.0327
479.3	10.853	476	35.1974	475.77	480	10.8157	35.164	0.23	0.0374	0.0334
480.3	10.849	477	35.197	476.76	481	10.82	35.1662	0.24	0.0293	0.0308
481.3	10.843	478	35.1962	477.75	482	10.8224	35.1678	0.25	0.0208	0.0284
482.3	10.849	479	35.1985	478.74	483	10.8231	35.1709	0.26	0.0254	0.0276
483.3	10.854	480	35.2009	479.73	484	10.8226	35.172	0.27	0.0316	0.0289
484.3	10.879	481	35.2102	480.72	485	10.8221	35.1744	0.28	0.0572	0.0358
485.3	10.864	482	35.2077	481.71	486	10.8197	35.1748	0.29	0.0447	0.0329
486.3	10.823	483	35.2038	482.7	487	10.818	35.1743	0.3	0.005	0.0295
487.3	10.827	484	35.2147	483.69	488	10.8218	35.1767	0.31	0.0054	0.038
488.3	10.822	485	35.2144	484.68	489	10.8136	35.1801	0.32	0.0082	0.0343
489.3	10.829	486	35.2204	485.67	490	10.8072	35.1796	0.33	0.0213	0.0408
490.3	10.817	487	35.2199	486.66	491	10.8047	35.1797	0.34	0.0119	0.0402
491.4	10.815	488	35.22	487.65	492	10.8042	35.1797	0.35	0.0107	0.0403
492.4	10.813	489	35.2204	488.64	493	10.8051	35.1816	0.36	0.0075	0.0388
493.4	10.815	490	35.2228	489.63	494	10.8064	35.1854	0.37	0.0082	0.0374
494.4	10.812	491	35.2243	490.62	495	10.8013	35.1884	0.38	0.0111	0.0359
495.4	10.811	492	35.2247	491.61	496	10.7733	35.1891	0.39	0.0373	0.0356
496.4	10.807	493	35.2268	492.6	497	10.7585	35.1839	0.4	0.0484	0.0429
497.4	10.806	494	35.2294	493.59	498	10.7617	35.1823	0.41	0.044	0.0471
498.4	10.797	495	35.2304	494.58	499	10.7659	35.1841	0.42	0.0315	0.0463
499.4	10.789	496	35.2303	495.57	500	10.7798	35.1856	0.43	0.0089	0.0447
500.4	10.779	497	35.2297	496.56	501	10.7872	35.1906	0.44	-0.0079	0.0391