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Project Report: Global Temperature and Salinity Profile Programme (GTSPP)

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Summary of the document

The document summarizes the Global Temperature and Salinity Profile Programme (GTSPP) progress made covering the past two year period 2007 – 2008 and provides the GTSPP work plans in 2009 and 2010. A summary meeting report for the most recent ad hoc session on the GTSPP is also attached in the Appendix.

DRAFT TEXT FOR INCLUSION IN THE SUMMARY REPORT

The Global Temperature and Salinity Profile Programme (GTSPP) is a joint program of the International Oceanographic Data and Information Exchange committee (IODE) and the Joint Commission on Oceanography and Marine Meteorology (JCOMM). IODE and JCOMM are technical committees of the Intergovernmental Oceanographic Commission and the World Meteorological Organization.

Over past two year period 2007–2008, GTSPP continued to deal in greater volumes of data. The Integrated Science Data Management (ISDM) of Canada managed Real-time data. The number of BATHYs reported steadily increased from 24,855 in 2007 to 27,775 in 2008, while the number of TESACs was 1,630,360 to the end of 2008, dramatically increased from 821,321 in 2007. A new data set of 6,869 CTD profiles derived from marine mammals was made available the first time since July 2008. The data are useful because they get high data return from areas far to south between 60° S and 70°S where data are very little.

The U.S. National Oceanographic Data Center (NODC) provided data processing services for delayed mode data and maintenance of the Continuously Managed Database (also known as the GTSPP archive). Delayed mode data include the full resolution data from XBTs or CTDs from the ships, or fully processed and quality controlled data from the organizations that provided the real time low resolution data to the GTS (Global Telecommunication System). The numbers of the delayed-mode measurements added to the archive were 12,737 and 62,252 in 2007 and 2008, respectively.

GTSPP continued to improve its capabilities of serving the GTSPP data for operations and climate research. The GTSPP data sets were available at GTSPP's Web site at http://www.nodc.noaa.gov/GTSPP/. The usage statistics of the GTSPP data transferred for 2008 increased to 1,557.33GB from 927.409GB in 2007; while the average number of distinct hosts served was 20,238 per year in 2007and 2008.

GTSPP collaborated with a number of international programs. In particular, it managed the XBT data collected by the operators of the Ship-of-Opportunity Programme (SOOP), which is a subprogram of the Ship Observations Team (SOT) of JCOMM. GTSPP developed a strategy for linking XBT profiles to the SOOP XBT survey lines that were sampled and has been working closely with SOOP to assist in proper documentation of the XBT fall rate in the CMD. GTSPP produced monthly real-time maps including data density maps. GTSPP published a catalog of the data collected, statistics of data on the GTS from various sources and monitoring reports for each ocean basin. In addition, GTSPP also publishes a monthly ship report that contains errors found. This is then sent to the operators for corrections

GTSPP also collaborated with the Argo program to fix GTS reports from Argo floats that were reporting pressure instead of depth to the GTS. GTS also worked with the World Ocean Database project and the CLIVAR-Carbon Hydrographic Office (CCHDO) to pull CCHDO data from the Internet quarterly for providing the fully quality controlled high quality CTD data to the Argo CTD Reference Database used for delayed-mode quality control of Argo salinity data.

In May 2007, Mr. Bob Keeley resigned from the GTSPP Chair position. Dr. Charles Sun, NODC, assumed Mr. Keeley's responsibility of managing GTSPP. The GTSPP Steering Group met twice in conjunction with the Argo Data Management Team meetings over the last intersessional period. The most recent meeting of GTSPP took place at the East-West Center, Honolulu, Hawaii, USA on 27 October 2008. Topics discussed at the meeting included, but were not limited to, the XBT fall rate issue, GTSPP data formats, evaluation of a Cyclical Redundancy Check (CRC) in identification of real-time and delayed mode duplicates,, identifying GTSPP data product centres and delayed-mode data assembly centres, cooperation with other programs, and the future of GTSPP. A summary report of the meeting is attached in the Appendix of this document so readers can become familiar with GTSPP.

DRAFT ITEMS FOR THE 2009-2011 WORK PLAN AND BUDGET

GTSPP will continue its operations in 2009 – 2011. The following table shows the highlights of the activities planed for the period from 2009 to 2011. The tasks listed for completion in 2009 may spill into 2010 or 2011 depending on competing work pressures. Tasks listed as continuing are activities that are expected to continue into the future.

Action item description	*To be implemented by [name]*	*Deadline date*	*Requested from UNESCO RP*	*Requested from other sources*
2009				
Continue to acquire profiles and make real-time & delayed mode profile data available.	*ISDM and NODC*	*continuing*	*None*	*ISDM and NODC*
Continue production of metrics in support of JCOMM OPA and SOT	*ISDM*	*continuing*	*None*	*ISDM*
Evaluation of the use of a CRC in real-time and delayed mode duplicates identification	*NODC*	*continuing*	*None*	*NODC*
Continue discussions to find data product centres & delayed-mode data assembly centres	*GTSPP Steering Group*	*Continue*	*Assist in identifying candidates*	*None*
Complete bi-annual report for 2007 - 2008	*NODC and ISDM*	*April 2009*	*None*	*NODC and ISDM*
Prepare a paper on the CRC tag implementation	*GTSPP Steering Group*	*September 2009*	*None*	*NODC*
Update the GTSPP RT QC Manual	*NODC and ISDM*	*March 2009*	*None*	*NODC and ISDM*
Update the GTSPP NetCDF format in compliance with the Climate Forecast NetCDF conventions	*NODC*	*June 2009*	*None*	*NODC*
Collaborate with Argo in making profile data from other instruments available in Argo format	*NODC*	*November 2009*	*None*	*NODC*

Action item description	*To be implemented by [name]*	*Deadline date*	*Requested from UNESCO RP*	*Requested from other sources*
2010				
Convene a two-day workshop for design and requirements of adapting objective analysis (OA)-like tests and serving the GTSPP data via the WMO Integrated Global Observing Systems (WIGOS)	*ISDM, SISMER, and NODC*	*May 2010*	*US$10,000.00 for supporting two-three people to attend the workshop (or to be hosted by IOC Project Office).*	*ISDM, SISMER, and NODC*
Implement a BUFR read-write capability for ocean profile data	*ISDM*	*November 2010*	*None*	*ISDM*
Document the procedure of processing the CTD data derived from marine mammals	*ISDM, SISMER, and NODC*	*November 2010*	*None*	*ISDM, SISMER, and NODC*
Continue the feasibility study of serving the GTSPP data via the WIGOS	*SISMER, CORIOLIS, and NODC*	*November 2010*	*None*	*SISMER, CORIOLIS, and NODC*

Action item description	*To be implemented by [name]*	*Deadline date*	*Requested from UNESCO RP*	*Requested from other sources*
2011				
Complete bi-annual report for 2009 - 2010	*NODC and ISDM*	*April 2011*	*None*	*NODC and ISDM*
Design and Publish GTSPP data on DVD for using in the IODE training/outreach programs	*GTSPP Steering Group*	*September 2011*	*US$30,000.00*	*NODC*
Populate the GTSPP data via the WIGOS	*SISMER, CORIOLIS, and NODC*	*November 2011*	*None*	*NODC and ISDM*
complete the feasibility study of adding OA-like methods to the existing QC tests	*NODC and ISDM*	*November 2011*	*None*	*NODC and ISDM*
Conduct a training course on ocean data management in Oostende	*NODC*	*2011 (To be determined)*	*US$7,000.00 for travelling to Oostende and return*	*NODC*

APPENDIX

Ad Hoc Session of the Joint IOC-WMO Steering Group on Global Temperature-Salinity Profile Program Honolulu, Hawaii, USA, 27 October 2008

Meeting Report

By Charles Sun

1. Opening of the session

The session opened at 0900 on 27 October 2008 at the John A. Burns Hall of the East-West Center. Charles Sun of the US National Oceanographic Data Center (NODC) chaired the meeting and welcomed participants. The local host, Dr. Steven Piotrowicz, US Argo Program Manager, explained the local arrangements. On behalf of the NODC director, Charles presented a certificate of appreciation to Steve for providing meeting arrangements and logistics for the GTSPP meeting.

2. Session arrangements

Charles said that the meeting would have two sessions with a lunch break around 12:00 pm and adjourn before 5:00 pm. Charles also said that he along with a few meeting participants would attend the Argo Executive Board meeting in the afternoon and would be absent from the meeting. Ann Gronell Thresher would chair afternoon session. He then introduced the provisional agenda to the group, noting no changes. The meeting participants adopted the final agenda (Annex 3). Ann was designated rapporteur.

3. Status of GTSPP – Chair's report

Charles Sun gave the Chair's report. He reported that Bob Keeley has retired from his role in the GTSPP and the SOOPIP (Ship-of-Opportunity Programme Implementation Panel) of the Joint WMO-IOC Technical Commission for Oceanography and Marine Meteorology (JCOMM) endorsed Charles as Chairperson of the GTSPP at the 7th session of the SOOPIP at Geneva, Switzerland on 21 April 2007. Charles emphasized that GTSPP is an on-going program, not project and the primary objective of GTSPP is to provide improved access to the highest resolution, highest quality data as quickly as possible. He then continued to review the history of the GTSPP, including the four contributing countries (USA, Australia, France and Canada), and the collaborating programs.

Charles reported that NODC is the biggest player in the GTSPP, but funding is limited. He encouraged everyone to become involved in the evolution of the GTSPP, including resource sharing. Charles reported that he recruited two new partners – the National Marine Data and Information Service (NMDIS) of China and the Federal Maritime and Hydrographic Agency (BSH) of Germany as GTPP delayed-mode (DM) data assembly centers in 2007 and really wants all SOOP operators to be DM operators. He plans to add Korea/KODC, Italy, JMA, JODC, BODC, NIO of India and wants more coordination in data deliveries, management, etc. and plans also to implement data product centres (DPCs). The core functions of the DPCs will be: 1) Provide data product service on the Internet, 2) Report GTSPP-related activities at the GTSPP annual meeting, if any, and 3) Provide feedback to the GTSPP steering group on data quality issues. Other functions, including but not limited to, are to perform GTSPP data quality control and return the QCed GTSPP

data to the NODC. He also would like Mr. Yoshiaki Kanno to act as liaison with JODC to become the delayed mode data centre for Japan. He reported that it is still difficult to monitor who is using data and for what. Currently NODC only knows if someone asks for help with the data or reports independently to NODC. We need feedback from data users and we need a product server. This will replace science centres, which no longer exist.

Discussions/Questions – We need a formal citation for GTSPP data – currently users can only cite the web page. Charles reported that it is hard for NODC to determine who and how many are using data. Dr. Yu of the International Pacific Research Center (IPRC) suggested that GTSPP needs words on the web page to specify citation form if users use the GTSPP data.

Dr. Moon-Sik Suk of Korea Ocean Research and Development Institute (KORDI) clarified that depth and temperature are as important as temperature, salinity, and pressure, and asked where data should be sent in real-time or delayed-mode. There is some confusion about the US NODC and the Word Data Center system. Charles replied that there is a division between NODC, GTSPP and WOD, so we currently need to coordinate all three to access the complete data set.

4. GTSPP Data Centers Overview

4.1. Real-Time Data Center Overview (Anh Tran, ISDM)

Anh Tran of the Integrated Scientific Data Management of Canada (ISDM) previously known as MEDS reported that ISDM has been involved in GTSPP since 1989. Mr. Bob Keeley was the chair for GTSPP until 2007. Some of the ISDM's activities also support Ship Observation Opportunity Program (SOOP).

ISDM collected data reported on the GTS from JMA, BSH, NMC data centers and from the ship and buoys to ensure that we got the most complete data sets possible. ISDM performs manual decoding for messages that are incorrectly encoded in an attempt to rescue the data. They then perform automatic and visual QC of track, speed and profile as well as removing duplicate data. Once data have been properly quality control, ISDM updates the archive and sends a copy of the data to NODC, IFREMER, and other users. ISDM processes GTSPP data 3 times per week. And each time, it takes at least 6 hours to complete.

Each month, ISDM processes and archives in near real-time approximately 100,000 profiles in TESAC format compared to only 2000 profiles in 1999. The total number of profiles reported in BATHY format decreased from more than 60,000 profiles in 1999 to about 20,000 profiles in 2008. On average 50% of the profiles reported in BATHY format are on the GTS within 30 days of the observation date.

One of the common errors we discovered at ISDM are format errors such as unexpected characters, confusion between variable identification codes in BATHY format, depth not increasing, and strange call signs (such as JJVV?).

On the product side, ISDM provides a website for GTSPP which updates on a monthly basis. We produce monthly real-time maps, catalogs, statistics of GTS data from various sources, monitoring reports for each ocean basin, and we also generate maps of data density for SOOP. We also publish monthly ship reports that list any errors found and this is sent to the operators for corrections.

Since most of the ISDM's system to process GTSPP was developed in the 1990s with old technologies (VMS, FORTRAN and ISAM), ISDM is planning to upgrade its system to the newer technology. ISDM plans to migrate data base management software to Oracle, improve QC tests, duplicate checks and automate more checks because of increasing in volume of data, setup the system to handle BUFR messages (operational by 2012), as well as provide online data access, additional products and remove products that are no longer useful.

4.2. Long-Term Archive Overview (Charles Sun, NODC)

Charles reported the activities of the GTSPP Long-Term Archive (LTA) Center since the last GTSPP meeting in Hobart 2007. The LTA center completed the scheme to assign profiles to TWI Lines, which improved the delivery of the GTSPP data via the Internet, collaborated with WOD and CCHDO in support of the Argo reference data set, and developed a strategy to fix the confusion of some Argo profiling floats reporting pressure as depth on GTS. Currently, NODC is collaborating with the Naval Postgraduate School to adapt the Optimal Spectral Decomposition method which is a possible test that can be added to the existing QC procedures.

Charles suggested a new test for detecting bad or suspect data. Climatology doesn't work well for anomalous conditions. Objective Analysis (OA) is an obvious candidate but has limitations. It can be enhanced by the Optimal Spectrum Decomposition (OSD) developed by Dr. Peter Chu of the Naval Postgraduate School. OSD will assess and see if it's useable, particularly near shore or across fronts.

The LTA Web service interface was improved. We now have monthly archives and data sorted by ocean basin. Web service use is increasing (as is ftp server – total usage has increased massively since 2005)

China offered to produce GTSPP data on DVD but they are not here so the status of this is uncertain. The current size of the GTSPP data is about 17GB total. So we need new and better compression methods (tar/gzip) to reduce this volume of data to one DVD.

Charles reported that there has been cohesive cooperation between the GTSPP and WOD (World Ocean Database). WOD uses the GTSPP data to update its database every three months. With input provided by Tim Boyer, Charles reported the main support to Argo from the NODC World Ocean Database (WOD) is in relation to the Argo CTD Reference Database used for delayed-mode quality control of Argo salinity data. The quality control of Argo salinity data requires high quality CTD measurements delivered in a timely manner. The WOD provides fully quality controlled data sets approximately every 4 years. To increase the timely dissemination of more recent data to the Argo community, the WOD[1] is now updated on a quarterly schedule. The quality control is not as complete as for the full updates every 4 years and is considered preliminary. The WOD has now been updated 3 times in 2008, most recently in late September. To date, 284,244 CTD or bottle casts containing salinity data have been added in the 3 updates since WOD05. Of these, 26,767 came from the Global Temperature-Salinity Profile Program[2] (GTSPP). 33,204 of these additional casts are from cruises completed between January, 2006 and August, 2008, with 19,806 coming from GTSPP.

There has been CCHDO and GTSPP cooperation as well. NODC are developing a 'webcrawler' to pull CCHDO data from the Internet quarterly, while CCDHO's non-public CTD profiles will be pushed to CORIOLIS. This data will be used for DMQC of Argo data.

[1] http://www.nodc.noaa.gov/OC5/WOD05/updates05.html
[2] http://www.nodc.noaa.gov/GTSPP/

GTSPP monitors floats reporting on the GTS. There have been issues with floats reporting pressure as depth and Charles went through the procedure used to identify these floats. The Argo data centre responsible is then notified that they need to fix their reporting methods.

Cyclical Redundancy Check (CRC) was discussed – XBT data arrives at NODC in a split path from bathy to full resolution data. So NODC gets CRCs direct from AOML and from the GTS and can directly compare the two to see if there are any transmission errors, etc. Tests show this seems to be working, catching up to 90% of duplicates, simplifying matching. Australia already supplies delayed mode data with the CRC attached, so does France.

We will suggest JCOMM/IODE implement this test so we need to publish paper on the method as a GTSPP group publication. We will need to compare results and get statistics together for the paper. All of us should be involved but Charles will take the lead.

Charles raised a few issues for the group to consider. The issues are: Should we have an outside review of GTSPP? Do we need feedback? He also mentioned that Scientific QC has ceased – we need other partners or other methods to push this forward.

Future plans:

- Complete report to JCOMM/IODE by mid-March 2009.
- Continue collaborations with Argo, WOD and CCHDO,
- Work on CRC tag,
- Work on or assess spectral decomposition method, and
- Implement Google earth layers to make data more visible and useable.

5. GTSPP Data Issue – I

5.1. BUFR format (Anh Tran, ISDM)

Anh reported that ISDM reminded the members of GTSPP that BUFR message will be operational by 2012. At the moment, a SOOP template has been populated but needs approval. GTSPP will plan to send and receive data in BUFR format. GTSPP will have a task team to assess all templates to see if there are commonalities and will put Anh, Ann, and Birgit on a template working group. Is it unclear if Devil transmits BUFR now? Ann replied that Devil does not currently produce BUFR format files. CSIRO will work on this with Alex Papij.

5.2. NetCDF format (Charles Sun, NODC)

Charles reviewed the GTSPP format history and informed the meeting that the GTSPP NetCDF format is due to change because: 1.) Some characters/variables are not readable in Matlab, 2) We need to extend the conventions for climate and forecast metadata and 3) we need to extend the format to meet Argo requirements. He proposed: 1) all variables need dimensions even if scalar, 2) global attributes need to be standardized, 3) “no_hist” (number of histories) should be changed to the unlimited dimension, and 4) we need a creation date and time for each file.

6. New data sets – CTDs from animals/seals

Lesley Rickards, Deputy Director of the British Oceanographic Data Centre (BODC), was invited by the GTSPP chair to give a presentation on developing procedures to attach CTDs to diving marine animals. She began with the "SEaOS (Southern Elephant Seals as Oceanographic Samplers)" project which is aimed at increasing our understanding of how southern elephant seals interact with their physical environment. BODC works closely with the research scientists at the Sea Mammal Research Unit (SMRU) of the University of St. Andrews, UK to acquire, archive and deliver real-time temperature and salinity profile data from seal tags to the Global Telecommunication System (GTS) for incorporation into Met Office models.

Scientists at SMRU have designed and built special tags that can be harmlessly attached to the seals, which take continuous measurements of the water temperature, conductivity and depth while the seals are swimming. The seal tags are moulded resin blocks containing small computers with memory, a transmitter, a clock, batteries and a sensor. These small computers last for several months (10 or more) and can be retrieved and recalibrated if still attached. The tag collects temperature and salinity data to reasonable resolution so the data are useful for oceanographers. Data are stored until can transmit via ARGOS.

The computer manages internal specs as well – battery power, etc and also needs to manage what is transmitted on the limited band width. New instruments will include fluorometers. SMRU deployed 70 transmitters in between 2003 and 2004 – fascinating data. The data are useful because they get high data return from data sparse areas. Areas far to south are now being sampled between 60° S and 70°S where there is very little other data. Depths are normally to 800m+ and can reach 2000m. The profiles are effectively transects. Kerguelen tagged seals: allow you to look at monthly variability in the data, movement of the polar front. Now we need a similar island in the south Pacific.

Lesley continued to brief us on another project, known as "Marine Mammals Exploring the Oceans – Pole to Pole (MEOP)". MEOP is a proposed project for International Polar Year (2007-2008) which builds upon existing Polar research, including strands from SEaOS. MEOP uses beluga whales and 4 species of seals. It involves tagging deep-diving seal species to provide data on their location and behaviour, and information relating to the waters they inhabit. MEOP is similar to the SEaOS project in aims and results and can get data within sea ice. MEOP is now extended to the poles, getting data from 100 seals, 3 species, and more, providing 24,000 profiles since February. These are nice transects. But there is still a gap in the Pacific.

Data will shortly be freely available on GTS in real-time, submitted by BODC. BODC has taken on this role in part because it already sends data to GTS and other data users. SMRU and MEOP data fits well with their mandate. BODC will probably be involved in data QC as the program evolves. Currently BODC does not do any QC since it's up to the scientists to work the data. WMO have allocated 300 WMO numbers (Q9900000-Q9900299) for biological tags so they are identifiable in databases. Delayed-mode data is still a problem but real-time data will be available freely

Anh commented that she has problems with this data e.g., some partial profiles, different data points which look like two profiles but are not identified properly, multiple profiles from same animal. She is in contact with BODC to resolve these issues.

7. GTSPP Data Issue – II

7.1. XBT fall rate issue (Ann Thresher, CSIRO)

Ann updated the GTSPP group on the XBT bias issue. She reported that XBTs remain important and useful elements of the Global Ocean Observation Systems. XBT profiles comprise 60-70% of past ocean in-situ temperature data and is crucial for determining past ocean structure, variability and change. The XBT network complements Argo in many ways: it resolves Ocean geostrophic transport and associated heat transports of major current systems and eddies along repeat transects. XBTs have a long and valuable history. Many lines have been occupied for 10-20+ years. Currently no mature technology exists to replace XBT sampling along these lines. XBTs also sample in marginal seas which Argo currently does not cover such as the Banda Sea. The science community is not the major user of XBTs but navies are.

She continued to report that technology changes and bias issues are now being recognised, for examples: Gouretski and Koltermann (2007) reported a warm bias in XBT's and Lyman et al, 2007 reported 'spurious recent ocean cooling'. Currently, the oceanographic community does not have consensus on what causes the error and how to correct it. Several scientists, such as Ishii and Kimoto, Wijffels et al , Levitus et al, and Gouretski, have different approaches to correct the XBT data bias . Gouretski , for instance, thinks that XBT bias is a temperature offset plus a depth bias, where Wijffels and Ishii et al believe it is a fall rate error. Ann recommended that 1) until we have a definitive understanding of the problem, the recommended fall-rate for reporting data should NOT CHANGE – all data should be reported with the Hanawa et al, (1995) coefficients, 2) Meta data should label fall-rates correctly, and 3) we must avoid any further confusion or ambiguity regarding fall-rates used in data reported to the NODCs. She also proposed draft recommendations:

<u>Quantifying Past Biases</u>

The time history of past XBT biases requires further investigation – there is no consensus recommendation – the work is very new. We have 4 statistical approaches (Gouretski, Ishii & Kimoto, Levitus et al and Wijffels et al) with differing results, and 2 altimetric approaches (Willis, de Nezio). Currently there is no agreement on the true bias and its associated error bars. Thus we recommend:

A – that comparisons of the indirect statistical approaches be made - NODC has volunteered to host the corrections for users to compare and apply.

http://www.nodc.noaa.gov/OC5/XBT_BIAS/xbt_bias.html

B – that the community work to assemble all known side-by-side XBT and CTD data sets, and that these be re-analysed in a consistent way to determine, if possible, the time-history of the fall-rates. They should then be used to test the results of the indirect methods. This is happening now (Boyer, Tchen, Wijffels, etc)

http://www.nodc.noaa.gov/OC5/XBT_BIAS/xbt_bibliography.html

C – that past test data from the manufacturers (Sippican/LMCO and TSK) should also be sought and examined, and possibly compared with other (BATS) data. Who will do this?

D – that we work to reduce metadata problems (which fall rate?). Where possible originating institutions should check their XBT data held at NODC and its associated

meta-data to ensure the data and meta-data match. Tim Boyer will assist – many institutions might just want to replace all XBT data at NODC.

Tracking Future Biases

Until the source of the time-variable bias is understood and removed, we recommend that future biases be tracked through ongoing and regular XBT/CTD intercomparisons.

A - Co-ordinate and collaborate with the manufacturers for regular and ongoing comparison data to be collected and analysed in a timely and consistent way. Any fall-rate detectable changes should be discussed by an XBT WG. Several ongoing activities present opportunities for this – the CLIVAR/Carbon repeat hydrographic sections, ocean-time series sites (BATS, HOTS, PAPA), Argo, altimetry.

B – A system needs to be created to associate biases with XBT data arriving at the NODCs – this will require much better tracking of meta data such as SN, batch date etc.

C – Further field comparisons are required to tease out possible sources of biases (besides manufacture changes) such as drop height, wind speed, ship speed, acquisition system, water temperature or viscosity.

D –the form of the fall-rate equation itself be revisited – we need to understand near-surface acceleration, startup transients and other non-uniformity of the fall-rate. This may well require field or laboratory experiments.

Future – more questions than answers

- Challenging!
- The source of the error needs to be confirmed – rework past CTD/XBT data sets
- We will revisit the form of the fall rate equation – early acceleration, acquisition delay,
- We need to continue to exploit altimetry - is the basin divergence in deep XBTs after 2000 real or a meta-data problem?
- Can we do better using ocean reanalyses – remove possible biasing of decadal signals into bias estimates (especially for regionally dominated data sets such as TSK probes
- What to do about future fall-rate changes? Can we piggy back on the CLIVAR lines to 'batch' calibrate? But what is a batch?

7.2. Logic of identifying the XBT probe information in the GTSPP long-term archive (Charles Sun, NODC)

Charles reported that an XBT fall rate workshop was held 10-12 March 2008 at the Atlantic Oceanographic and Meteorological Laboratory (AOML), Miami, Florida, USA. Charles gave a presentation about how NODC manages XBT data in the GTSPP database. He reported that NODC has preserved XBT data in the GTSPP Continuously Managed Database (CMD). The probe type and fall rate equation information is stored in the GTSPP CMD if it was provided. The NODC also worked with Canada's Integrated Science Data Management and Australia's Commonwealth Scientific and Industrial Research Organisation (CSIRO) to develop logic for the depth correction process of archived XBT data. It was agreed that corrections to the depth will be applied only to the data that will be placed on the WOCE (World Ocean Circulation Experiment) DVDs. The NODC will not make depth corrections on the archived XBT data. Two new codes will be created to retain depth correction information in the surface codes structure. The "DPC$" indicates

the status of depth correction and the "FRA$" will retain the conversion factor of 1.0336. The "DPC$" code will have the following states:

01 = Known Probe Type, Needs Correction,
02 = Known Probe Type, No need to Correct
03 = Unknown Probe Type, Not enough information to know what to do, leave alone,
04 = Known XBT Probe Type, Correction was done, and
05 = Unknown Probe Type, but a correction was done.

Having determined which profiles are from XBTs by querying the data type, then determining the XBT probe type and the fall rate equation as they are stored in the XBT archives, the strategy for the fall rate correction (if required) is to simply multiply the existing depths by a factor of 1.0336. This was the technique employed with the multiplication factor stored in the file structure, when GTSPP played a key role in the WOCE (World Ocean Circulation Experiment) and contributed to the final WOCE Data Resource DVD.

It is suggested that the correction to global archives be carried out in cooperation with other data centers around the world to ensure international standards.

8. QuOTA Project (Ann Thresher, CSIRO)

Ann Thresher briefed the GTSPP group on an on-going project, known as "Quality-controlled Ocean Temperature Archive" or "QuOTA" for short. The aim of QuOTA is to build a high quality upper ocean temperature dataset for the Indian Ocean and the South-West Pacific. QuOTA uses a process of automated screening, followed by 'hand-QC' of data that fails the automated tests. A critical step is to ensure that all depths are calculated using consistent coefficients – this relies on accurate metadata. All XBT data have been (where possible) checked to make sure depths conform to Hanawa (95). Older data are still a challenge as well as some modern profiles which lack adequate metadata to identify the fall rate coefficients used. The procedures[3] was published in 2008.

Both Indian Ocean and SW Pacific data sets are now fully QC'd and available for use. Web page links to documents and data can be found at http://www.marine.csiro.au/~cow074/quota/quota.htm. CSIRO plans to provide a data selection tool for full resolution profile data. The link will appear on the Quota web page when available. Future plans include continuing updates of the Indian Ocean and SW Pacific datasets. Depending on pending funding (or partners), the dataset will be extended to the east to complete the S Pacific dataset and eventually to extend it globally (well down the track and dependent on major funding or partners).

[3] Gronell, A., and S.E. Wijffels. 2008. A Semiautomated Approach for Quality Controlling Large Historical Ocean Temperature Archives. Journal Atmospheric and Oceanic Technology. v25, pp990-1003. Available at: http://www.marine.csiro.au/~cow074/quota/Quota_Paper.pdf

9. Scientific Presentations

9.1. GTSPP-related activities in JMA (Yoshiaki Kanno, JMA)

Charles Sun invited Mr. Yoshiaki Kanno of the Japan Meteorological Agency (JMA) to brief the GTSPP group on the GTSPP-related activities in JMA. Mr. Kanno showed a very nice coverage of temperature and salinity data around Japan and through north Indian and central N Pacific. Approximately 20% of the total are TESACs with salinity from CTDs on research vessels. JMA collects data from multiple sources including Japan Agency for Marine-Earth Science and Technology (JAMSTEC), Japan Coast Guard, Fisheries Research Institutes, universities, and local governments and puts on GTS daily.

JMA participates in the NEAR-GOOS (North-East Asia Regional Global Ocean Observing System) pilot project. Other participating countries are China, Korea, and Russia. JMA operates the NEAR-GOOS Regional Real-Time Data Base (RRTDB), makes GTS ocean data available on RRTDB and sends real time data to ISDM on a daily basis. ISDM provides JMA with the real-time GTSPP data for inserting into RRTDB.

JMA uses the GTSPP data along with sea surface height and temperature data for incorporation into the JMA operational model – Meteorological Research Institute Multivariate Ocean Variational Estimation system (MOVE/MRI.COM). The MOVE/MRI.COM system produces maps of sea surface height, currents, water temperature, and salinity with the resolution of 0.1 degree around Japan and 0.5 degree for N. Pacific.

9.2. Optimal spectral decomposition (OSD) for ocean data analysis (Peter Chu, NPS)

Dr. Peter Chu of the Naval Postgraduate School was invited by Charles to give a presentation about his recently published work on the new data analysis scheme to help with QC. Peter raised an issue - how can we ingest the many different data sources into a model?

Data density has changed massively in last 10 years. How can we analyze these data best? Currently use the method of optimal interpolation (OI) for interpolating observations from irregular grids to model grids for predictions. The traditional OI has three requirements: it needs 1) need the first guess field, 2) autocorrelation coefficients (scales) and 3) high signal-to-noise ratio. However, if any of these are missing, we can't do OI but can possibly use spectral representation.

The benefits of OSD are that you don't need first guess fields, don't need autocorrelation functions, don't need high signal to noise ratio and basis functions are predetermined before analysis. Advantages of optimal spectral decomposition (OSD) in ocean data analysis are demonstrated in this talk. This method is based on a classical mathematical theory that any ocean variable (velocity, temperature, or salinity,) can be represented by a generalized Fourier series with pre-determined basis functions, which are the eigenfunctions of the Laplacian operator with given boundary conditions. A cost function used for poor data statistics is introduced to determine the optimal mode truncation. An optimization scheme with iteration and regularization is proposed to obtain unique and stable solutions. The capability of the method is demonstrated through reconstructing a 2D circulation on the Texas-Louisiana continental shelf from drifter data, deep circulation in the North Atlantic from the Argo data, and global surface circulations from the satellite altimetry data.

10. Other business including additional partners should be pursued.

BODC has accepted Charles' invitation to resume its level of participation in the GTSPP as a delayed-mode data assembly center and will coordinate with the UK Hydrographic office for data submission to the GTSPP long term archive.

11. Next meeting date/place

The next meeting was discussed. Charles proposed to have a one-day GTSPP workshop in conjunction with the annual Argo data management team meeting 2009. Birgit said that BSH would host the 10th Argo data management team meeting in Hamburg and would like to host the next GTSPP meeting at the same time. Charles accepted her offer.

12. Closing

The Meeting closed at 5:00 pm on 27 October 2008 with the chair thanking Steven Piotrowicz for providing meeting arrangements and logistics.