Joint IODE-JCOMM Steering Group for the Global Temperature-Salinity Profile Programme (SG-GTSSPP)

Fifth Session
University of Santiago de Compostela, Santiago de Compostela, Spain
26 – 28 June 2019
Joint IODE-JCOMM Steering Group for the Global Temperature-Salinity Profile Programme (SG-GTSPP)

Fifth Session
Santiago de Compostela, Spain
26 –28 June 2019
# ABSTRACT

At JCOMM-I (2001) it was decided that the former WMO-IOC GTSPP Programme would become part of JCOMM. As such the Steering Group is now called the IODE-JCOMM Steering Group for the GTSPP. The Fifth Session of the Joint IODE-JCOMM Steering Group for the Temperature-Salinity Profile Programme (GTSPP) was held at University of Santiago de Compostela, in Santiago de Compostela, 26 – 28 June 2019. The meeting was attended by 10 participants in Santiago de Compostela, while other 10 persons participated by Webex.

The objectives of the meeting were to:
1. Review of GTSPP inter-sessional activities
2. Review of the governance of GTSPP
3. Review connections with external programs
4. Explore future collaborations with the Global Ocean Observing System
5. Refine the GTSPP future directions

The document summarizes meeting discussion points, presentations given by both local participants in Santiago de Compostela and remote participants via Webex. The list of action items is shown in Annex III of the meeting report.

---

For bibliographic purposes this document should be cited as follows:

# TABLE OF CONTENTS

<table>
<thead>
<tr>
<th>Section</th>
<th>Title</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>OPENING OF THE MEETING</td>
<td>1</td>
</tr>
<tr>
<td>1.1</td>
<td>WELCOME</td>
<td>1</td>
</tr>
<tr>
<td>1.2</td>
<td>REVIEW OF GTSSP ACTIVITY</td>
<td>1</td>
</tr>
<tr>
<td>2</td>
<td>DATA FLOWS</td>
<td>2</td>
</tr>
<tr>
<td>2.1</td>
<td>RECENT SCIENCE HIGHLIGHTS FROM THE GLOBAL XBT NETWORK</td>
<td>2</td>
</tr>
<tr>
<td>2.2</td>
<td>WHAT HAVE WE LEARNED FROM DEEP ARGO DATA QC?</td>
<td>3</td>
</tr>
<tr>
<td>2.3</td>
<td>SEAS DATA FLOW</td>
<td>4</td>
</tr>
<tr>
<td>2.4</td>
<td>GLIDER QC</td>
<td>5</td>
</tr>
<tr>
<td>3</td>
<td>TEAM BUILDING EVENT</td>
<td>6</td>
</tr>
<tr>
<td>4</td>
<td>NATIONAL GTSSP PROGRAMME SUPPORT</td>
<td>7</td>
</tr>
<tr>
<td>4.1</td>
<td>AUSTRALIA</td>
<td>7</td>
</tr>
<tr>
<td>4.2</td>
<td>CANADA</td>
<td>9</td>
</tr>
<tr>
<td>4.3</td>
<td>FRANCE</td>
<td>9</td>
</tr>
<tr>
<td>4.3.1</td>
<td>MARINE IN SITU PROFILES FROM PUBLIC DATA SOURCES</td>
<td>9</td>
</tr>
<tr>
<td>4.4</td>
<td>JAPAN</td>
<td>11</td>
</tr>
<tr>
<td>4.5</td>
<td>USA-CMD</td>
<td>13</td>
</tr>
<tr>
<td>4.6</td>
<td>USA-SEAS</td>
<td>14</td>
</tr>
<tr>
<td>5</td>
<td>EXTERNAL CONNECTIONS</td>
<td>15</td>
</tr>
<tr>
<td>5.1</td>
<td>THE IMPORTANCE OF THE INTEGRATING XBT, ARGO, PROFILE DATA</td>
<td>15</td>
</tr>
<tr>
<td>5.2</td>
<td>OCEAN DATA VIEW SUMMARY</td>
<td>15</td>
</tr>
<tr>
<td>5.3</td>
<td>GTSSP-WOD INTEGRATION</td>
<td>17</td>
</tr>
<tr>
<td>6</td>
<td>GTSSP USER FEEDBACK</td>
<td>17</td>
</tr>
<tr>
<td>6.1</td>
<td>NOAA/GFDL</td>
<td>17</td>
</tr>
<tr>
<td>6.2</td>
<td>UK MET OFFICE</td>
<td>18</td>
</tr>
<tr>
<td>7</td>
<td>GENERAL DISCUSSION ON THE GTSSP FUTURE PLAN</td>
<td>20</td>
</tr>
<tr>
<td>8</td>
<td>CLOSING OF THE MEETING</td>
<td>20</td>
</tr>
</tbody>
</table>

## ANNEXES

<table>
<thead>
<tr>
<th>Annex</th>
<th>Title</th>
</tr>
</thead>
<tbody>
<tr>
<td>Annex I.</td>
<td>AGENDA</td>
</tr>
<tr>
<td>Annex II.</td>
<td>LIST OF PARTICIPANTS</td>
</tr>
<tr>
<td>Annex III.</td>
<td>ACTION LIST</td>
</tr>
<tr>
<td>Annex IV.</td>
<td>Dr Muñuzuri Welcome Speech</td>
</tr>
<tr>
<td>Annex V.</td>
<td>DRAFT TERMS OF REFERENCE (SECOND REVISION)</td>
</tr>
</tbody>
</table>
1 OPENING OF THE MEETING

1.1 WELCOME

Dr Joaquin Trinanes, meeting local host, opened the meeting at 09:00 on 26 June 2019. He welcomed participants and noted that budget reductions were forcing creative solutions to meeting attendance. So, in addition to the ten people present, there were nine persons who would join online through Webex. A complete list of the meeting participants is shown in Annex I of the meeting report.

The meeting agenda was adopted as published before the meeting (Annex II) but changes could be made as the necessity arises. Participants agreed to provide a brief text of their reports for inclusion in the meeting report. At the end of the meeting these would be reviewed to set the final list of actions, the parties involved in carrying them out and target dates for each. The final list, including a review and carry-over of tasks as necessary from the last meeting is shown in Annex III.

Dr Trinanes introduced Dr Vicente Pérez Muñuzuri, Vice-rector for research and innovation of the University of Santiago de Compostela (USC), to the GTSPPP-V participants and invited Dr Muñuzuri to give a welcome speech, after his opening remark. Dr Muñuzuri welcomed the meeting participants to USC and mentioned that USC was founded in 1495 and is one of the top ten Spanish universities in the different international university rankings. He emphasized that ocean and, in general, environment-related research have been always presented at the University and would like to acknowledge the role that the Global Temperature and Salinity Profile Programme is playing in managing temperature and salinity profile data to improve the quality control and facilitate the access and use of the GTSPPP datasets. He expressed that the university is very happy to host the SG-GTSPPP-V meeting and wished everyone does enjoy the city, the culture, art, lifestyle, gastronomy of Santiago de Compostela and Galicia. A complete note of his speech is shown in Annex IV.

Dr Peter Chu, the new GTSPPP chair, opened the first session of the meeting. Meeting participants, both in person and remote, introduced themselves. Dr Chu reported that he attended the 25th Session of the IODE Committee in Tokyo, Japan between Tuesday 19 and Friday 22 February 2019. The IOC project office for the IODE would like to give Dr Charles Sun the IODE Achievement award for his contribution to the GTSPPP project. Charles was an active Chair and worked hard to continue the development of GTSPPP as a service that provides essential, sub-surface climate variables of temperature and salinity profile data. Charles has now retired and could not attend the IODE-XXV session. Therefore, the IODE project office asked Dr Peter Chu accepted the Award on Charles’ behalf.

Dr Chu reminded the participants of the objectives of the meeting were to:

- Review of GTSPPP inter-sessional activities
- Review of the governance of GTSPPP
- Review connections with external programs
- Explore future collaborations with the Global Ocean Observing System
- Refine the GTSPPP future directions

1.2 REVIEW OF GTSPPP ACTIVITY

Dr Charles Sun, the former GTSPPP Chair, debriefed the history of GTSPPP. In the late 1980s, the international oceanographic community’s interest in creating a timely global ocean temperature and salinity dataset of known quality in support of the World Climate Research Programme (WCRP) led to preliminary discussions by Australia, Canada, and USA. In January 1989, an ad-hoc consultative meeting on the Global Temperature-Salinity Pilot Project
(GTSP) was held in Washington DC. The meeting agreed that Canada would assume responsibility for management of the real-time data stream and USA would assume responsibility for incorporating delayed-mode data into the so-called GTSP CMD (continuously managed database). Development of the GTSP (then called the Global Temperature-Salinity Pilot Project) began in 1989. GTSP began operation in November 1990. Since that time, there have been many developments and some changes in direction including a decision by IOC and WMO to end the pilot phase and implement GTSP as a permanent programme in 1996. Subsequent ad-hoc meetings were held in conjunctions with other major projects such as WOCE and Argo at various places till 2010, when IODE started to fund GTSP for conducting regular meetings.

Dr Sun highlighted the report of the IODE 25th session in reference to GTSP. The IODE-XXV committee reported that GTSP is one of the major data streams of the proposed JCOMM Marine Climate Data System. In addition, the IODE-XXV committee expressed its great appreciation to Dr Charles for his years of commitment to IODE and the GTSP projects. The committee expressed its appreciation for the work achieved and welcomed Dr Peter Chu as the new Chair of the SG-GTSP. The committee also recommended that GTSP should interact with GOOS.

Dr Sun reminded the participants that GTSP consists of four major components as follows: a) Data Assembly Centers from Canada, Australia, France, USA (NOAA/AOML) b) Long-Term Archive Center: USA (NOAA/NCEI), c) Data Product Center: Japan and d) Advisory Committee (created in 2018). He raised a few GTSP emerging challenges that need immediate actions. They are as follows:

- Missing Argo profiling data in the GTSP CMD since August 2018
- Serving the GTSP Best Copy files in the NetCDF format is interrupted (incomplete) since early May 2018 or so (The Best Copy files in the ASCII format are intact)
- Facing technical challenge of knowledge transfer at Long-Term Archive (NOAA/NCEI)

2 DATA FLOWS
2.1 RECENT SCIENCE HIGHLIGHTS FROM THE GLOBAL XBT NETWORK

Dr Janet Sprintall from Scripps Institution of Oceanography debriefed on the recent science highlights from the global XBT network. The global XBT network is logistically complex and so requires strong collaboration between many organizations and countries. XBT observations are currently used mainly to: 1) Monitor the variability of location and transport of key surface and subsurface ocean currents and boundary currents, 2) Monitor the variability of the meridional heat transport and the Meridional Overturning Circulation across ocean basins, 3) Provide a significant amount of upper ocean thermal observations, particularly in areas under sampled by other observational platforms, used for global ocean heat content estimates, and 4) Initialization and validation of numerical ocean forecast models. A strong synergy exists between XBT observations and observations from other platforms, such as altimetry, surface drifters, Argo, etc. enabling more robust scientific analysis.

The talk focused on recent scientific studies using XBT data by international members of the XBT Science Team. The goal of the XBT Science Team is to inform the oceanographic community on the benefits of using XBT transect data for monitoring mass and heat transports in boundary currents, and studies of eddy and frontal variability, and to work with other communities in the global observing network and modellers who use XBT data to improve their models and prediction. For more information on XBT Science Team see http://www.aoml.noaa.gov/phod/goos/xbtscience.
Many of the science studies were included at the 6th International XBT Science meeting that took place at the Intergovernmental Oceanographic Commission of UNESCO, in Oostende, Belgium (IOC, 2018). The international XBT science community contributed to a white paper on the XBT network as part of the Ocean Obs ‘19 effort (Goni et al., 2019).

Finally, the synergistic relationship of the XBT Science Team and the GTSSP objectives was discussed. Common Goals include the timely provision of ocean temperature profile data; implementation of a data flow monitoring system for real-time and delayed-mode data; uniform quality control and duplicates management systems; and facilitation of a wide variety of useful data analyses, data and information products, and data sets.

References
ii. https://unesdoc.unesco.org/ark:/48223/pf0000263920?posInSet=1&queryId=NC-EXPLORE-d2761a3c-4094-415e-be49-5eaf82a0646

2.2 WHAT HAVE WE LEARNED FROM DEEP ARGO DATA QC?
Dr Molly Baringer, with materials taken from Greg Johnson, John Gilson, and Taiyo Kobayasi, reported on what we have learned from deep Argo data QC. She said that a total of 80 Deep Argo floats have been deployed so far. A complete global array of Deep Argo floats includes 1200 floats globally. Argo floats sometimes return bad positions which need to be marked as such. Interpolation of position information improves salinity/temperature QC and adjustments (10-100 km). Many methods: a) Linear Interpolation b) On Potential Vorticity surfaces (e.g. Chamberlain et al. (accepted)) c) On Isobaths, and d) Model or measured statistics of float drift.

Argo floats can suffer from two major errors in time: a) Ghost messages. Probably Argos system transmission problems, under ice, etc. b) Clock reset/drift. Floats may reset their clock every cycle (e.g. SOLO) or not (e.g. APEX).

It is hard to perform pressure adjustments. Best <PARAM> data recovered in real-time when float autocorrects at surface (p=0, SOLO, PROVOR). APEX floats must be corrected in DMQC. Look for changes in p of more than a few dbar, noise. Look for <PARAM> changes not consistent with T/S, water mass changes.

Edit pointwise errors in PRES, TEMP, PSAL for pressure inversions, spikes, density inversions, salty hooks, biofouling, battery flu/passivation etc. The flags determined in DMQC replace the RTQC flags. At this point the two QC variables data should match.

Temperature and Conductivity are mismatched. Temperature is measured at the intake of the SBE ducted CTDs. Conductivity is measured further downstream of temperature. When sampling through temperature gradients, heat exchanges between the conductivity cell and water transiting the cell. Therefore, temperature at the thermistor and in the conductivity cell differ. This temperature difference can induce an error in salinity (typically fresh). Work has been done on this error for the SBE-9 at several flow rates. Analyses exploit thermohaline staircases and up-down profile differences. (Lueck, 1990; Lueck and Picklo, 1990; Morrison et al., 1994) For SBE-9 data with a 24-Hz time-series, this correction can be accurately determined and is routinely applied. For SBE-41 & SBE-41CP data from currently deployed
floats, the error is larger than that for the SBE-9, creates a significant fresh bias in strong thermoclines, and makes fresh spike at the base of mixed layers above strong thermoclines can be corrected, but with an error about as large as the correction.

A model of temperature error after transiting a 1°C step is: \( \alpha e^{(t-to)/\tau} \). The SBE-41 pumps fast & intermittently, so \( \alpha \) is small & \( \tau \) is large. The SBE-41CP pumps slowly & continuously, so \( \alpha \) is large & \( \tau \) is small. S error is roughly \( \nabla T/dt \) in constant gradients. SBE-41 error is about twice the SBE-9 error. SBE-41CP error is about quadruple the SBE-9 error. Order 0.1 \( \tau \) C s\(^{-1}\) gradients are occasionally observed by the floats giving. An error of about 0.04 in S for the SBE-41. An error of about 0.1 in S for the SBE-41CP. Thus, errors can sometimes exceed Argo specification of 0.01 in S. Real-time corrections require float type in meta file

<table>
<thead>
<tr>
<th>CTD</th>
<th>SBE-9</th>
<th>SBE-41</th>
<th>SBE-41CP</th>
</tr>
</thead>
<tbody>
<tr>
<td>( \alpha )</td>
<td>0.027</td>
<td>0.021 m s(^{-1})</td>
<td>0.164</td>
</tr>
<tr>
<td>( \tau ) (s)</td>
<td>9</td>
<td>21</td>
<td>5.87</td>
</tr>
<tr>
<td>( \alpha \times \tau ) (s)</td>
<td>0.24</td>
<td>0.44</td>
<td>0.96</td>
</tr>
</tbody>
</table>

The general guidance has been to correct PSAL once drift is over 0.01psu amplitude (e.g. minimum error is 0.01psu). Use least variable part(s) of the T/S curve for systematic departure of float salinity from background climatology on theta levels. Consider water mass migration vs. sensor drift.

The steps for general delayed real-time QC are:
1) Platform/Float ID checks
2) Quality control of the profile JULD
3) Quality control of the profile position
4) Is profile on land?
5) Speed check
6) Global <PARAM> checks (e.g. 0-41 psu)
7) Regional <PARAM> check (e.g. Red Sea, etc)
8) Confirm that the pressure sensor is returning valid data
9) <PARAM> spike check
10) Climatology Check
11) Adjust Delayed Mode <PARAM> offsets as necessary

The general delayed mode QC steps are
1) Quality control of the profile position (repeat)
2) Quality control of the profile JULD (repeat)
3) Confirm that the pressure sensor is returning valid data and adjust
4) Pointwise editing of <PARAM>_QC and <PARAM>_ADJUSTED_QC
5) Check for pressure drift
6) Apply thermal mass adjustment if appropriate
7) Assess conductivity sensor drift and error bars

She concluded that
1) CTD/float comparisons essential to improve corrections for Deep Argo.
2) Real-time meta files should contain more information
3) For improved accuracy,
   a. Sampling rate and pumping rate should be increased
   b. Descent rate should be decreased.
   c. Apply real-time adjustments of surface pressure offset and
d. Apply real-time thermal mass corrections

2.3 SEAS DATA FLOW
Dr Joaquin Trinanes presented the detailed architecture of the SEAS XBT data flow system. It consists of an operational pipeline with the following stages:

1) Temperature profiles are collected on-board
2) The data files are transmitted to shore in near-real-time (NRT) and arrive to the SEAS server at NOAA/AOML
3) Profiles pass through an RT Automatic Quality Control phase where they undergo a series of tests to detect the presence of artifacts (e.g. spikes, vertical gradients), impossible values (e.g. depth, temperature, location, date) and anomalies (when compared to climatologies and weekly analysis). Those measurements arriving in delayed time and/or in other formats might be incorporated to this stage if they were collected within the 30-day boundary separating NRT and delayed data.
4) Profiles flagged as good data are then encoded into BATHY and BUFR bulletins and put on the GTS for general distribution. The profiles that fail the AQC are submitted to Visual QC for additional checking.
5) The temperature profiles are also sent to NCEI to be incorporated into the GTSP CMDB.
6) Finally, ocean in-situ data from the GTS in alphanumeric and BUFR formats are decoded and stored locally. These records are used for multiple purposes, including XBT data tracking.

During the last years, the following milestones were reached:

- Communications: Migration to Iridium ( savings of ~$200K/year)
- Formats: Migration to TDCFs
- Profiles: 2-meter vs Full-resolution. They can be modified in RT.
- Rich-metadata environment. Integration into SOA and interoperable solutions
- QC: Integrated solution and Full-resolution.
- SW/HW development: SEAS, AOML-XBT Data Recorder, Autolaunchers, Iridium Antenna, …
- Reliability: ~100% RT transmissions, ~96% good profiles
- Science-driven operations: Boundary currents, MHT, HC, Sea Level changes, indicators, data assimilation, papers, …

2.4 GLIDER QC

Dr. Francis Bringas with contributions from Gustavo Goni and Caridad Gonzalez reported on the quality control of temperature and salinity profiles from underwater gliders.

NOAA/AOML, in partnership with CARICOOS, started underwater gliders operations in 2014 and has completed a total of 21 missions, producing more than 23,000 temperature, salinity, dissolved oxygen, 700nm backscattering, CDOM, and Chlorophyll profiles.

Glider data corrections and quality control in real-time are currently in place for all data acquired during NOAA/AOML and CARICOOS underwater glider operations. These procedures are necessary as loss in data quality can be observed when the glider is near the surface or moving at low speeds (for example during apogee or when the glider reaches the mixed layer depth during climb).

Data corrections and real-time QC is applied directly at the basestation. These corrections and QC are applied to the raw data and the result is recorded in NetCDF files that include quality control flags which follows the GTSPPP flagging convention.

The most important data corrections applied are:
Validating GPS locations and times (based on 3 GPS fixes, displacement precision < 35m)

Correcting depth and pressure: vehicle pressure and corrected depth, measured vehicle pitch, installation geometry of the CT instrument with respect to the pressure sensor are used to compute the depth and pressure at the CT instrument. This 'CT depth' is used in the temperature and salinity corrections.

Computing temperature, conductivity and salinity: uncorrected temperature, conductivity, and salinity values are checked against global bounds. Temperature and conductivity are checked for individual spikes.

Temperature and salinity adjustments: trapped water temperature anomalies during apogee, conductivity anomalies due to bubbles, and salinity corrections for thermal-inertia effects.

All glider data are submitted in real-time to the IOOS Glider DAC in NetCDF format including the QC flags from the RT procedures. Data are also submitted to the GTS in TESAC and starting in July 2019 in BUFR TM315003 template (Temperature and Salinity Profiles Observed by Sub-Surface Profiling Floats).

A delayed mode quality control is currently under development at NOAA/AOML for underwater glider data. This is an expert QC to produce a science quality data set. The procedures being implemented are based on the IOOS Glider DAC “Manual for Quality Control of Temperature and Salinity Data Observations from Gliders”. This QC is a visual, manual process conducted by an experienced operator and includes the following tests:

i. Date / Location
ii. Gross range
iii. Climatology
iv. Monotonically ordered pressure
v. Spike
vi. Constant Value
vii. Rate of Change
viii. Density Inversion
ix. Glider Speed

In summary:

- All NOAA/AOML glider data are transmitted in RT into the GTS (in TESAC and BUFR) and the IOOS glider DAC in NetCDF. All data from the IOOS Glider DAC is archived in NOAA/NCEI at the end of the mission.
- AOML expert glider QC procedures and program (in delayed-mode) are currently being tested. Delayed-Mode data will be distributed by AOML and submitted to the IOOS Glider DAC and NCEI, including quality flags. Clean profiles will be also distributed by AOML.

Only temperature, pressure and salinity are currently submitted to the GTS. Other parameters such as dissolved oxygen and Chlorophyll could be included when an specific BUFR template is approved (currently under development by OceanGiders Data Management Working Group).

3 TEAM BUILDING EVENT

In order to understand the ocean importance in local economy and society, the local host of the meeting arranged a team building event to visit Galicia located in the north-west of the Iberian Peninsula.
Galicia is a Spanish region where aquaculture and fisheries represent a core economic activity and define the socio-cultural landscape. As part of SG-GTSSP-V, the participants (shown in the following group photo) visited the mussel farms in the Ria de Arousa. Those farms (locally called “bateas”), are located in areas where the cold nutrient-rich waters bring the phytoplankton on which mussels feed. Galicia is, by far, the largest mussel producer in Europe. The regional ocean dynamics is characterized by an upwelling regime, which is stronger during summer months.

Participants could see first-hand the methods of production, learning about the parameters that contribute to the growth and quality of the mussels.

In the way back to Santiago, the meeting participants visited Martin Codax winery, one of the largest in the area. Local wine is albariño, defined by its high salinity and minerality, as a result of the proximity to the ocean. Participants received detailed information about the winemaking processes, and the relevance that this activity has in local economy.

### 4 NATIONAL GTSSP PROGRAMME SUPPORT

#### 4.1 AUSTRALIA

Dr Lisa Krummel CSIRO, the Bureau of Meteorology and Royal Australian Navy (RAN) all contributed to the Australian GTSSP program in 2018. Data were collected along several SOOP lines as shown below:

<table>
<thead>
<tr>
<th>Line</th>
<th>Operator</th>
<th>Target sampling regime</th>
<th>Sampling history</th>
<th>Number of profiles collected</th>
<th>Delayed mode or Real time</th>
</tr>
</thead>
<tbody>
<tr>
<td>IX12</td>
<td>Bureau</td>
<td>FR</td>
<td>1986-2015</td>
<td>0</td>
<td>-</td>
</tr>
</tbody>
</table>
All three agencies use the Turo Devil or Quoll XBT systems. However, Sippican Mk21 systems continue to be used on some RAN ships. Data undergo automated QC at the time of collection and JJVV bathymessages are then sent to the Bureau. This datastream includes all data from the Bureau’s and CSIRO’s SOOP ships and a select subset from RAN ships. In near-real time, the Bureau then creates BUFR bulletins, and submits both TAC (JJVV) and TDC (BUFR) bulletins to the GTS, through AMMC.

Delayed-mode data is QC’d by the relevant agency. Data from CSIRO and the Bureau is distributed to IMOS and NCEI routinely.

RAN’s delayed-mode data is not publicly available. Data from 2015 to the present is not included in delayed mode in Australian GTSPP data submissions. Support for the Australian XBT program continues from RAN, with provision of probes annually to the Bureau and CSIRO.

The major issue for our SOOP XBT program continues to be ship availability. IX12 remains unoccupied due to no suitable ships plying this line. Shipping changes in the Tasman Sea have required sampling along PX32, in lieu of PX34 and the use of multiple ships to occupy PX30.

Delayed-mode CTD data from the Investigator are submitted to NCEI annually. All data and information on publications and data products is available at IMOS: http://imos.org.au/
4.2 CANADA

Mr Mathieu Ouellet, Marine Environmental Data Section (MEDS) of Oceans Science Branch, Fisheries and Oceans Canada, reported GTSSP Real-Time DAC activities between April 2018 and May 2019. MEDS grep data from both Canada real-time and delayed real-time data (>30 days), and WMO Global Telecommunication System (GTS) from Germany, UDA, Japan and Canada, then send data to NEAR-GOOS, CMEMS in situ and NOAA NCEI via GTSSP. He reported that GTS provides two formats: a) Traditional Alphanumeric Code (TA) for temperature, salinity and currents (TESAC), bathythermograph (BATHY) and Buoy (BUOY) only for more than one depth) b) Binary Universal Form for the Representation of meteorological data (BUFR) (not integrated yet). The platform types are autonomous vertical profiling floats (Argo+equivalent, ITP..), ship (XBT, CTD), animals (seals, elephant seals), glider (subsurface gliders), moored stations (moored buoys with sensors at more than 1 depth), fixed stations and drifting (drifting buoys with sensors at more than 1 depth), and aircraft(AXBT, AXCTD)

4.3 FRANCE

4.3.1 MARINE IN SITU PROFILES FROM PUBLIC DATA SOURCES

Mr Thierry Carval reported the Coriolis data center’s GTSSP activities during the year of 2018 (see https://doi.org/10.13155/61486). The activities were about data aggregated in France (SHOM, Ifremer, IRD, CNRS, IPEV) and within Copernicus Marine services.

Marine in-situ profiles from public data sources are routinely aggregated: 2.4 million profiles from 5500 platforms with an observation year of 2018. The main contributors are:

a) GTS by way of Meteo-France and MEDS-Canada.
b) Argo (by way of Argo GDAC) remains the main provider of global ocean profiles.
c) Coriolis and EU service “Copernicus Marine In Situ” are the data aggregators of European data.
d) WOD (World Ocean Database) updates

e) ICES (“International Council for the Exploration of the Sea”) updates.
For year 2018, **37 706** new Coriolis profiles from 75 platforms are available to GTSPPP on:


### 4.3.2 HISTORICAL AND DELAYED MODE DATA

#### 4.3.2.1 Delayed mode data from MEOP sea-mammals program

In June 2018, the MEOP program published its 2018 release of sea-mammal delayed mode profiles ([https://doi.org/10.17882/45461](https://doi.org/10.17882/45461)). All sea-mammal profiles from GTS or previous MEOP release were removed and replaced with MEOP 2018. An action is underway with JCOMMOPS to assign WIGOS platform codes to historical sea-mammal platforms that never received a WMO platform code.

#### 4.3.2.2 Delayed mode data from French research vessels ADCPs

As part of Coriolis observing system, the hull ADCP from French research vessels are continuously measuring current velocity profiles. These data are public and reusable. In 2020, they will be distributed in Copernicus Marine current product, in the homogeneous Copernicus NetCDF format. If requested, they may contribute to GTSPPP project.

#### 4.3.2.3 CORA delayed mode data

CORA, the Coriolis delayed mode reanalysis on temperature and salinity is released once a year. CORA data set contains scientifically assessed temperature and salinity data from Coriolis data centre:

- In situ profiles, time series and trajectories
- Standardized vertical profiles (along pressure or depth)
- Gridded ISAS6 temperature and salinity fields


#### 4.3.2.4 ISAS objective analysis
All vertical profiles from 1950 to now are analyzed with ISAS V6 objective analysis. Alert on profiles generated by ISAS and by the MIN-MAX comparison are visually checked in Coriolis database. The visual inspection is performed by a scientist who may decide to flag suspicious data as bad. The version 7 of ISAS objective analysis is under implementation.


4.3.2.5 Deep Learning to Improve Quality Control

Deep learning quality control methods are developed and implemented to detect anomalies in large ocean in situ datasets, such as ISAS or CORA. These techniques significantly decrease the number of profiles to be visually checked by experts. Large datasets are classified with multiple criteria (P, T, S, position, QC flags history). These promising techniques are developed by Guillaume Maze and implemented by Sean Tokunaga and Robin Le Guen.


4.4 JAPAN

Dr Chu, on behalf of Mr. Kazuhiro Hayashi, reported the activities of the GTSPP data product center (GDPC) for the North Pacific Ocean operated by the Japan Meteorological Agency (JMA).

The GTSPP data product center (GDPC) for the North Pacific Ocean started the monitoring of BATHY/TESAC messages on GTS in March 2011. The GDPC website provides near-real-time (updated once a day) access to the messages on a call-sign basis or on a Pacific SOOP line basis. The messages can be found together with the temperature profiles, position maps, and the comparison results with JMA ocean data assimilation system. GDPC started issuing the Monthly Report in April 2012.

https://www.data.jma.go.jp/gmd/gtspp/data/index.html

Status of inter-sessional period

From February 2018 (after our report in the previous meeting) to March 2019, GDPC recognized 39 cruises by 14 ships going on GTS as “Frequently Repeated” or “High Density” or “JMA Research Vessel” SOOP line observations in the Pacific (see tables below). GDPC summarized the detailed status of all that SOOP cruises in Monthly Reports, every month.

• Number of observations by SOOP line (left) and SOOP lines in the Pacific (right).

<table>
<thead>
<tr>
<th>Line</th>
<th>Times</th>
<th>Line</th>
<th>Times</th>
</tr>
</thead>
<tbody>
<tr>
<td>PX05</td>
<td>4</td>
<td>PX34</td>
<td>4</td>
</tr>
<tr>
<td>PX06</td>
<td>4</td>
<td>PX37</td>
<td>4</td>
</tr>
<tr>
<td>PX09</td>
<td>1</td>
<td>PX40</td>
<td>2</td>
</tr>
<tr>
<td>PX11</td>
<td>8</td>
<td>PX45</td>
<td>2</td>
</tr>
<tr>
<td>PX13</td>
<td>2</td>
<td>PX46</td>
<td>6</td>
</tr>
<tr>
<td>PX30</td>
<td>2</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

• Number of observation cruises by ship

<table>
<thead>
<tr>
<th>Call-Sign</th>
<th>Name</th>
<th>Times</th>
<th>Call-Sign</th>
<th>Name</th>
<th>Times</th>
</tr>
</thead>
<tbody>
<tr>
<td>5BWD2</td>
<td>UNDARUM</td>
<td>2</td>
<td>JPBN</td>
<td>KEIFU MARU</td>
<td>4</td>
</tr>
<tr>
<td>9V3505</td>
<td>CAPITAINE QUIROS</td>
<td>1</td>
<td>KRBN</td>
<td>HORIZON ENTERPRISE</td>
<td>4</td>
</tr>
<tr>
<td>9V5317</td>
<td>CAPITAINE DAMPIER</td>
<td>2</td>
<td>OWKF2</td>
<td>JOSEPHINE MAERSK</td>
<td>2</td>
</tr>
<tr>
<td>9V9713</td>
<td>SHENGKING</td>
<td>1</td>
<td>V2DV4</td>
<td>CAP PASADO</td>
<td>4</td>
</tr>
<tr>
<td>A8RH7</td>
<td>CPO NEW YORK</td>
<td>1</td>
<td>V7GQ8</td>
<td>MAERSK LOME</td>
<td>4</td>
</tr>
<tr>
<td>D5BG5</td>
<td>ANL ELAROO</td>
<td>2</td>
<td>VNVZ</td>
<td>NORTHEWST SANDERLING</td>
<td>7</td>
</tr>
<tr>
<td>JGQH</td>
<td>RYOFU MARU III</td>
<td>4</td>
<td>VRGE3</td>
<td>OOCL LE HAVRE</td>
<td>1</td>
</tr>
</tbody>
</table>

Monthly Report

Monthly Report describes SOOP line observations. It summarizes JMA AQC results (etopo5 Grounded test and Position on land test, Regional range test, and Gradient test) together with some figures showing the comparison results with JMA assimilation system (Fig. 1). If the data passed AQC but are still likely to hit the sea bottom (almost “frozen” temperature with increasing depth), temperature profiles with the suspicious data and the adjacent map using etopo2 ocean topography are shown (Fig. 2).

Monthly Report reflects GTSPP best copy data, if available.

Figure 1
The GDPC website (http://ds.data.jma.go.jp/gmd/gtspp/data/index.html) provides near real time access to BATHY/TESAC messages, on a call-sign basis or on a Pacific SOOP line basis.

4.5 USA-CMD

Mr Chris Paver reported that the US NOAA National Centers for Environmental Information (NCEI; formerly NODC) continues to maintain membership on the GTSPP Steering Group, manage the GTSPP database (CMD) for real time and delayed mode temperature and salinity profile data, and provide these data to the public in the form of two products: Real Time and Best Copy. Several developments have arisen since the last GTSPP SG meeting: a. turnover in persons performing GTSPP activities, b. reduction in quantity of real time data being submitted for inclusion into the database, and c. NCEI IT paradigm shift.

The last two full time members of the NCEI GTSPP Program recently retired: Charles Sun on Dec 2019 and Norman Hall in July 2019. The NCEI team is now comprised of members that are contributing to the program as part of their daily tasks. The members include Ricardo Locarnini (real time data manager), Christopher Paver (product/program manager), and Alexandra Grodsky (platform code management). NCEI anticipates hiring a new physical oceanographer to help maintain the GTSPP components at NCEI. As a result of the change over in management, modifications to the software suite - loads the data into the database and generates the Best Copy and Real Time products - were made to facilitate a production status that removed dependencies from the former managers’ user environments.

NCEI has seen a continued reduction in real time data from the Tropical Ocean Global Atmosphere Program - Tropical Ocean-Atmosphere moored buoy array (TOGA-TAO) and a temporary reduction in real time data from the Argo program. To my understanding, both of
these issues are related to technical issues from our partner at DFO Canada. Argo changed the format of their GTS messages to BUFR around August of 2018. DFO was unable to include the management of BUFR formatted data into the GTSP database management paradigm and therefore, made the data available to NCEI without their normal processing. NCEI developed a method to process the real time Argo data and include it into the GTSP database. This process was implemented in May 2019 and subsequently, i.e. the backlog since August 2018, was included into the GTSP database and made publicly available. NCEI saw a significant decrease in TOGA-TAO data as of April 2019; anecdotally ~50%. DFO stated that they incurred a hardware malfunction which resulted in the data not being submitted. They started submitting the backlog of related data after the issue was resolved. Currently, NCEI is noticing an average of 80% submission rate compared to TOGA-TAO submissions before April 2019.

The Former National Oceanographic Data Center (NODC) migrated with two other NOAA Data Centers to form the National Centers for Environmental Information in 2015. Since then, the distributed organization has been working to centralize IT infrastructure to the Asheville, North Carolina, USA office. Therefore, the GTSP software is being migrated to the new IT environment and is to be in production mode by October 2019. NCEI has allocated resources beyond the GTSP Data Management team to facilitate the migration and not impact current production services.

4.6 USA-SEAS

Dr Joaquin Trinanes presented the detailed architecture of the SEAS XBT data flow system. It consists of an operational pipeline with the following stages:

a) Temperature profiles are collected on-board
b) The data files are transmitted to shore in near-real-time (NRT) and arrive to the SEAS server at NOAA/AOML
c) Profiles pass through an RT Automatic Quality Control phase where they undergo a series of tests to detect the presence of artifacts (e.g. spikes, vertical gradients), impossible values (e.g. depth, temperature, location, date) and anomalies (when compared to climatologies and weekly analysis). Those measurements arriving in delayed time and/or in other formats might be incorporated to this stage if they were collected within the 30-day boundary separating NRT and delayed data.
d) Profiles flagged as good data are then encoded into BATHY and BUFR bulletins and put on the GTS for general distribution. The profiles that fail the AQC are submitted to Visual QC for additional checking.
e) The temperature profiles are also sent to NCEI to be incorporated into the GTSP CMDB.
f) Finally, ocean in-situ data from the GTS in alphanumeric and BUFR formats are decoded and stored locally. These records are used for multiple purposes, including XBT data tracking.

During the last years, the following milestones were reached:

- Communications: Migration to Iridium (savings of ~$200K/year)
- Formats: Migration to TDCFs
- Profiles: 2-meter vs Full-resolution. They can be modified in RT.
- Rich-metadata environment. Integration into SOA and interoperable solutions
- QC: Integrated solution and Full-resolution.
- SW/HW development: SEAS, AOML-XBT Data Recorder, Autolaunchers, Iridium Antenna,
- Reliability: ~100% RT transmissions, ~96% good profiles
• Science-driven operations: Boundary currents, MHT, HC, Sea Level changes, indicators, data assimilation, papers.

5 EXTERNAL CONNECTIONS

5.1 THE IMPORTANCE OF THE INTEGRATING XBT, ARGO, PROFILE DATA

Dr Gustavo Goni with contribution from Shenfu Dong, Yeun-Ho Chong, Marlos Goes, and Francis Bringas addressed the importance of the integration of different observational platforms for profile data, such as XBT, Argo and underwater gliders. He said that a) XBTs have been deployed along fixed transects, 0-800 m depth, with observations every about 25km along fixed and repeated transects, targeted or sustained observations, b) Argo floats: deployed to observe oceans from 0-2000 m in 5x5 degree resolution, sustained or targeted (ALAMO floats) observations, c) Underwater gliders: short transects, regional in nature, 0-1000 m depth; targeted or sustained observations. Observations from these platforms are used for d) XBTs: boundary currents, surface and subsurface currents, trans basin meridional heat transport, e) Argo floats: global changes in heat content, mean deep (1000m) currents, f) Underwater gliders: boundary and surface currents, targeted mesoscale features.

The use of XBT, Argo, and underwater glider data has common objectives: from currents, transports to meridional heat transports. XBTs provide eddy resolving fields of temperature sections. Argo floats provide the basis to compute salinity and together with altimetry the background field information.

AOML has developed and produced several products: a) Meridional Heat Transport: GTSPP provides data that monitor across-basin meridional heat transports while also resolving mesoscale features. XBTs is the only observational platform that monitors across-basin meridional heat transports while also resolving mesoscale features, b) Ocean Current Monitoring: Monitoring and/or analysis performed together with altimetry (OSTST), drifters (GDP, DBCP), gliders, TAO (Pacific Ocean), SOOS (Southern Ocean), and Good Hope.

He recommended interaction with established XBT through XBTST and emerging groups (Glider DAC). GTSPP provides a unique data base for when better than real-time data is needed. There are many products that are routinely produced using GTSPP data. Not all of them may have a home for distribution and/or discussion, posting results.

5.2 OCEAN DATA VIEW SUMMARY

Dr Reiner Schlitzer with contribution from Sebastian Mieruch-Schnülle, Alfred Wegener Institute for Polar and Marine Research, Bremerhaven, Germany, gave a summary report on Ocean Data View (ODV).

ODV is a computer program for the interactive analysis and visualization of oceanographic and other geo-referenced profile, trajectory or time-series data. ODV is available for Windows, Mac OS X, Linux and UNIX systems and can be freely used for scientific and teaching purposes. Commercial and military users can purchase ODV software licenses at moderate costs.

Plot Types: ODV supports a large variety of data plot types; a few examples are shown below.
Data Collection and NetCDF Support: ODV has its own collection data format that is optimized for irregularly spaced multi-parameter data and provides dense storage and very fast access. Large data collections containing millions of stations can be handled on standard desktop and notebook computers. ODV data collections are platform-independent and can be exchanged between platforms. ODV can also read and display data in the widely used NetCDF format.

ODV web page: https://odv.awi.de
5.3 GTSPP-WOD INTEGRATION

Mr Tim Boyer reported internal synthesis of GTSPP and WOD workforce at NCEI. No more staff at NCEI solely focused on GTSPP in the ocean profile realm in the future. Forces economy of effort on both GTSPP and WOD. Needs clear delineation of tasks in ocean data flow. GTSPP: (1) Aggregation point for near-real time ocean profile data from the Global Telecommunications System (GTS) to make available in a timely manner (within 48 hours of measurement in the Continuously Managed Database, monthly best-copy on the first of the subsequent month) with quality flags. (2) Delayed-mode Global Data Assembly Center for Expendable Bathythermographs. WOD: (1) Aggregation point for all available near-real time and delayed-mode ocean profile data with quality flags (both originator and subsequent). International Quality Controlled Oceanographic Database (IQuOD): (1) Internationally agreed upon quality flagged aggregated ocean profile database with additional expert quality control.

Database structure Synthesis: Incorporate GTSPP and WOD into same database structure to cut down overhead of maintaining separate databases and facilitate cross-database data sharing. GTSPP is in a postgres database structure. WOD homegrown structure can’t share maintenance, can’t use SQL for fast customized selection and I/O. Must preserve unique aspects of each database while allowing integrated operations

Three possible solutions for structure in postgres:

a) Store entire cast (one or more concurrent profiles) as text strings referenced by unique identifier. Parsing information for use performed by postgres calls (GTSPP schema)
b) Store header information in a Postgres table, all same variable profiles in Binary Large Objects (BLOBs), parsing information by C routines (WOD schema)
c) Store WOD and GTSPP profiles in separate forms, incorporate metadata as “Nexus” to match casts across databases.

Progress to date

a) Work on a C/FORTRAN routine to load WOD metadata into the GTSPP postgres structure to utilize postgres functions
b) Completion of C routine to read GTSPP postgres data structures and write to standard output – a short step to a C routine to write out GTSPP data in postgres structures.
c) Next step is to decide how to store WOD profiles (strings, database BLOBs, or pointers to the external WOD data structure) with metadata in Postgres (Nexus) to optimize C input/output for processing/scientific calculations
d) Important to keep this work going, but resources are limited.

NCEI is one of the organizations which most utilizes GTSPP

a) Import into World Ocean Database (and subsequent products, such as World Ocean Atlas, ocean heat content, International Comprehensive Ocean Atmosphere Data Set - ICOADS)
b) Utilization (along with Argo, thermosalinograph database) in a number of satellite blended products with the National Centers for Environmental Prediction (NCEP)
   - Monthly sea surface salinity
   - Five-day running mean sea surface salinity
   - Monthly sea surface density

6 GTSPP USER FEEDBACK

6.1 NOAA/GFDL

Mr Matthew Harrison with contributions from Xiaosong Zhang, Seth Underwood, Tony Rosati, and Feiyu Lu reported GTSPP input for NOAA/GFDL Experimental NMME Seasonal
Forecasts. GFDL gets GTSPP delayed-mode and real-time data from NCEI and feed them into GFDL model for NMME forecasts. ARGO data constrains ensemble coupled model solutions prior to forecast. Prior to ARGO, XBT and MRB data are less effective due to relative poor sampling and lack of salinity data. Posterior QC issues detectable in spurious ensemble bias/inflation

Subject to real-time GTSPP QC procedure such as
a) Impossible location check (y=-90 to 90; x=-180 to 180)
b) Speed check
c) Global and regional temperature and salinity checks
d) Pressure increasing
e) Spikes
f) Gradient checks
g) “Bad data should be flagged (“4”) and removed from TESAC distribution”
h) Float “greylist” (“2-4”)

GFDL added additional RT quality control:
a) Subjective visual inspection of JULD, LONGITUDE, LATITUDE, PRESSURE
b) Surface pressure offset for APEX floats
c) “De-spiking” and vertical extrapolation for flagged data
d) Truncated negative pressure drift in APEX floats
e) Manual inspection for salinity drifts

QC gaps in GFDL NMME Workflow: Bad data slips through - not uncommon
Limited GFDL resources. Fixing problems as we encounter them. Bad position data (0,0) not flagged on “fossilized” GTSPP BUFR.

Additional GTSPP QC issues are:
a) Lost TAO/TRITON mooring data (July 2018) due to change in format impacting GTSPP BURF data. No resolution ATT.
b) Duplicative QC software. Lack of human resources
c) Advantages for research applications in having “one stop shop” for RT data
d) Investments needed to further automate QC for research applications.
e) Machine learning?

He concludes that
a) The global ARGO network is a tremendously valuable asset for climate change detection and forecast initialization.
b) Model-data consistency is important to avoid forecast initialization shocks
c) QC issues continue to impact seasonal forecast initialization
d) Data gaps (MRB) remain an issue
e) Strong desire for coordination/collaboration with observational community, DACs and NODC on enhancing quality of data sharing

6.2 UK MET OFFICE
Dr Rachel Killick, UK Met Office Hadley Centre, reported that the GTSPP data have been used in the production of the Met Office Hadley Centre EN series of data sets, the so-called “EN4”. EN4 is the Met Office Hadley Centre’s subsurface ocean temperature and salinity data set. This data set is freely available for private study and scientific research and can be accessed from (https://www.metoffice.gov.uk/hadobs/en4/). EN4 runs from 1900 to the present day and is formed of monthly downloadable files. The user can choose between profile files or complete analysis fields. EN4 data are available with two different expendable BathyThermograph (XBT) and Mechanical BathyThermograph (MBT) corrections: Gouretski and Reseghetti (2010, updated) and Levitus et al., (2009). Two more XBT corrections are soon
to be added: Cowley et al., (2013) and an updated version of Cheng et al., (2014). The latter of these two is the correction scheme currently recommended by the XBT community.

EN4 obtains its data from four input sources: Argo, ASBO (Arctic Synoptic Basinwide Oceanography), the World Ocean Database and GTSP. All four of these input sources are used when the data set is fully reprocessed, approximately once a year. Each month a monthly update is performed which produces a final file for two months prior, a preliminary file for the previous month and a ‘quick-look’ file for the current month. These monthly updates make use of GTSP best copy and real time data and the Argo real-time/ adjusted data. This means that GTSP is their only monthly updating source of non-Argo data, it therefore provides all their shelf-sea, under ice and varying platform input data – it is a vital source for EN4.

Having spoken about EN4 and the importance of GTSP as one of its main input sources Dr Killick went on to address each of the GTSP’s objectives in turn:

a) To provide a timely and complete data and information base of ocean temperature and salinity profile data. - GTSP is EN4’s only source of non-Argo data updated on a monthly basis and it is therefore noticed when it is not available. A lack of GTSP data available for download means either the EN4 update is delayed, which has knock on effects for those relying on it to run forecasts, or the update is run solely with Argo data. However, Dr Killick is incredibly grateful to the support team at NOAA who are prompt at responding to GTSP enquiries and seeking to provide the data even when difficulties are encountered.

b) To implement data flow monitoring system for improving the capture and timeliness of real-time and delayed-mode data. – Dr Killick reported that she has rarely had a problem with sources she expects to be in GTSP not being present, however, it would be good to provide notification of data source outages as/when they are discovered (as was done by GTSP when Argo switched to BUFR format). There are more tools for searching GTSP data (e.g. the platform searcher and web viewer) than she was previously aware of – perhaps these could be better advertised?

c) To improve and implement agreed and uniform quality control and duplicates management systems. – Because the UK Met Office ingests multiple input sources for EN4 they remove all input QC flags (apart from for delayed mode Argo data) and then run their own automated QC. They also do their own duplicate removal. This objective is therefore one Dr Killick felt less able to comment on, although she did find the online information about GTSP duplicate checking and QC helpful and it gave her some ideas of extra QC checks the UK Met Office could add in, such as the freezing point check and the depth-varying range check (something the UK Met office is currently working on with Ocean-Scope).

d) To facilitate the development of a wide variety of useful data analyses, data and information products and data sets. - EN4 is one data set that is formed from GTSP and it, in turn, is then used for multiple applications inside and outside the Met Office. Some of these applications include monitoring ocean heat content, initialisation of forecasts and models and validation of climate models. Work based on EN4 contributes to global reports such as the annual BAMS State of the Climate and the IPCC reports.

Dr Killick finished her presentation with some points for discussion, which were as follows:

- Timeliness is key – if there are problems it would be good to be able to communicate these to users – could there be an opt in mailing list?
- Input sources – want to make EN4 more traceable, good to acknowledge those who’ve put time and effort into providing the data – is there a searchable list of GTSP input sources? Does everything on the GTS go into GTSP? One of the
most common questions we receive for EN4 is “Is data source X contained in EN4?”.

- Validation – where do we go for the truth if the models and obs disagree in a data sparse area? Smaller local sources? Historical records? These can be hard to find (in general, not just in GTSSP).
- GTSSP advertising – lots of great stuff done that she didn't know about until she started writing this presentation! Could we advertise GTSSP more?
- CF compliance – how do we best deal with this when a lot of the variables we use (e.g. those containing quality control information) do not have CF compliant names?

References


7 GENERAL DISCUSSION ON THE GTSSP FUTURE PLAN

The members of the GTSSP advisory committee attended the meeting in person were Drs Molly Bariger, Reiner Schlitzer, and Janet Sprintall. Dr Reiner Schlitzer led the discussion on the feedback from the GTSSP advisory committee.

The committee members would like to learn the objectives and the terms of reference (ToRs) of the GTSSP before they can provide their comments and suggestions for the future of the GTSSP. Dr Charles Sun said that there was a first revision of the GTSSP ToRs revised in 2012 and provided it to Dr Peter Chu for him to present it on screen for discussion.

8 CLOSING OF THE MEETING

The meeting was closed at Noon on 28 June 2019.
ANNEX I

LIST OF PARTICIPANTS

**SG members in Santiago**

Dr Molly BARINGER  
Deputy Director  
NOAA, Atlantic Oceanographic and Meteorological Laboratories  
4301 Rickenbacker Causeway  
Miami Florida FL 33149  
United States  
Tel: +1 (305) 361-4345  

Mr Thierry CARVAL  
Head of Scientific Information Systems Engineering Team  
French Institute for the Exploitation of the Sea, IFREMER Centre de Brest  
France  
Tel: +33 2 98 22 45 97  

Dr Peter C. CHU  
Distinguished Professor and Chair Department of Oceanography  
Naval Postgraduate School  
833 Dyer Road (Sp-324)  
Monterey, CA 93943, USA  
Tel: +1 (831) 656-3688  

Dr Gustavo Jorge GONI  
Director  
Physical Oceanography Division  
Atlantic Oceanographic and Meteorological Laboratory  
National Oceanic and Atmospheric Administration  
4301 Rickenbacker Causeway  
Miami, FL 33149  
Tel: +1 (305) 361-4339  

Mr Christopher PAPER  
Oceanographer  
NOAA, National Centers for Environmental Information  
1315 Est-West Highway, Silver Spring  
MD 20910-3282 United States  
Tel: +1 (301) 713-4190  

Prof. Dr Reiner SCHLITZER  
Alfred-Wegener-Institut  
Helmholtz-Zentrum für Polar- und Meeresforschung  

Am Alten Hafen 26  
27568 Bremerhaven  
GERMANY  
Tel: +49 (0)471 - 4831 - 1559  

Dr Janet SPRINTALL  
Mail Code 0230  
Scripps Institution of Oceanography  
9500 Gilman Drive  
La Jolla CA 92093-0230  
United States  
Tel: +1 (858)-822-0589  

Dr Charles SUN  
Independent Scientist  
Tel: +1 (301)424-7031  

**SG members by Webex**

Dr Guilherme CASTELO  
Scripps Institution of Oceanography  
9500 Gilman Drive  
La Jolla CA 92093-0230  
United States  

Dr Mauro CIRANO  
Associate Professor  
Universidade Federal do Rio de Janeiro - UFRJ  
Avenida Athos da Silveira Ramos, 149  
Ilha do Fundão - Cidade Universitária da  
Universidade Federal do Rio de  
Janeiro  
Rio de Janeiro, Brazil, 21941-909  
Tel: +55 (21) 3938-9543  

Mr Matthew HARRISON  
NOAA, Geophysical Fluid Dynamic Laboratory  
201 Forrestal Road  
Princeton, NJ 08540  
United States  

Mr Mathieu OUELLET  
Senior Policy and Technical Advisor & Section Head
Invited experts in Santiago

Dr Francis BRINGAS
Oceanographer
NOAA, Atlantic Oceanographic and Meteorological Laboratories
4301 Rickenbacker Causeway
Miami Florida FL 33149
United States
Tel: +1 (305) 361-4316

Dr Joaquin TRINANES
NOAA, Atlantic Oceanographic and Meteorological Laboratories
4301 Rickenbacker Causeway
Miami Florida FL 33149
United States
Tel: +1 305 361 4435
Fax: +1 305 361 4392

Invited Experts by Webex

Mr Tim BOYER
NOAA, National Centers for Environmental Information
SSMC3, 4th Floor
1315 East West Highway
Silver Spring MD 20910-3282
Tel: +1 301 713 4846

Dr Shoichi KIZU
Tohoku University,
Physical Oceanography Laboratory
Sendai 980-8578
Japan
Tel: +81 22 795 6528
Fax: +81 22 795 6530

Dr Norman HALL
Physical Scientist
NOAA, National Centers for Environmental Information
8604 La Jolla Shores Drive
La Jolla California 92037
United States
Tel: +1 (858) 546-7110
ANNEX II

AGENDA

1. Opening of The Meeting
   1.1 Welcome and opening of the meeting
   1.2 Review of GTSPPP activity

2. Data Flows
   2.1 XBT network
   2.2 What have we learned from Deep Argo data QC?
   2.3 SEAS Data Flow
   2.4 Glider QC

3. Team Building Event: Understanding the ocean importance in local economy and society

4. National Programme Support
   4.1 Australia National Report
   4.2 Canada National Report
   4.3 France National Report
   4.4 Japan National Report
   4.5 USA National Report

5. EXTERNAL CONNECTIONS
   5.1 The importance of complementary XBT, floats and glider observations
   5.2 GTSPPP/ODV Connection
   5.3 GTSPPP-WOD Integration

6. User Feedback
   6.1 NOAA/GFDL
   6.2 UK Met Office

7. GTSPPP Future Plan
   7.1 Advisory Committee Feedback
   7.2 GTSPPP Future
   7.3 Review of Action Items from the meeting

8. Closing of The Meeting
## ANNEX III

### ACTION LIST

<table>
<thead>
<tr>
<th>No.</th>
<th>Action</th>
<th>Who</th>
<th>Target Date</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Coordinate with XBT Science team to conduct a back-to-back meeting, if possible</td>
<td>GTSSPP Chair, Janet Sprintall, Gustave Goni</td>
<td>Dec 2019</td>
</tr>
<tr>
<td>2</td>
<td>Invite AOML/GFDL/UK MetOffice to be GTSSPP Product Centers</td>
<td>GTSSPP Chair</td>
<td>GTSSPP-VI in 2020</td>
</tr>
<tr>
<td>3</td>
<td>Rename the so-called real time archived message (SEAS XBT data)</td>
<td>Gustavo, Goni NCEI</td>
<td>GTSSPP-VI in 2020 or sooner</td>
</tr>
<tr>
<td>4</td>
<td>Revise AOML QC manual and submit to IODE OBPS for publication</td>
<td>Joaquin Trinanes</td>
<td>GTSSPP-VI in 2020</td>
</tr>
<tr>
<td>5</td>
<td>Update the contents of GTSSPP web pages</td>
<td>NCEI</td>
<td>As needed</td>
</tr>
<tr>
<td>6</td>
<td>Update GTSSPP data FTP directory structure</td>
<td>NCEI</td>
<td>September 2019</td>
</tr>
<tr>
<td>7</td>
<td>flag the position on land found in WOD as bad positions and send a feedback to GTSSPP</td>
<td>Thierry Carval</td>
<td>GTSSPP-VI in 2020</td>
</tr>
<tr>
<td>8</td>
<td>Improve GTSSPP NetCDF in compliance with CF Conventions</td>
<td>NCEI</td>
<td>GTSSPP-VI in 2020 or sooner</td>
</tr>
<tr>
<td>9</td>
<td>CF compliance requirements</td>
<td>UK Met Office</td>
<td>GTSSPP-VI in 2020</td>
</tr>
<tr>
<td>10</td>
<td>Provide the SOOP ship operation line map to GTSSPP Chair</td>
<td>AOML</td>
<td>GTSSPP-VI in 2020</td>
</tr>
<tr>
<td>11</td>
<td>Ask if JMA would provide the XBT profile data from the many casts that are in the vicinity of Japan that are not part of the SOOP network as such.</td>
<td>GTSSPP Chair</td>
<td>GTSSPP-VI in 2020</td>
</tr>
<tr>
<td>12</td>
<td>Seek for addition GTSSPP product centers for Atlantic and Indian Oceans</td>
<td>GTSSPP Chair</td>
<td>GTSSPP-VI in 2020</td>
</tr>
<tr>
<td>13</td>
<td>Develop plans to interact with GOOS</td>
<td>GTSSPP Chair</td>
<td>GTSSPP-VI in 2020</td>
</tr>
<tr>
<td>14</td>
<td>Ask IODE Project office to conduct a survey for a GTSSPP data user workshop</td>
<td>GTSSPP Chair</td>
<td>September 2019</td>
</tr>
<tr>
<td>15</td>
<td>Find a home for distribution / discussion /posting results produced by AOML</td>
<td>GTSSPP Chair, AOML</td>
<td>GTSSPP-VI in 2020</td>
</tr>
<tr>
<td>16</td>
<td>1st Draft ToRs and submit to Steering Group for comments and suggestions</td>
<td>GTSSPP Chair</td>
<td>August 2019</td>
</tr>
</tbody>
</table>
Welcome to USC, This University, founded in 1495, just 3 years after Spain discovered America, is one of the university institutions with a great tradition in Europe. The USC is one of the top ten Spanish universities in the different international university rankings. The USC is organised into two core campuses, in Santiago de Compostela and Lugo (a city with impressive roman walls just 90 min from Santiago). In Santiago, there are three campuses. We are currently located in the Northern Campus, being Campus Vida and the Old Town Campus the other two. You can walk from one to the other in a few minutes. In terms of human resources, the university has more than 2,000 professional and research personnel involved in education and research, over 26,000 students each year, and more than 1,000 people working in administration and services.

Ocean and, in general, environment-related research has been always present at this University. As founder and former director of MeteoGalicia, Galician’s meteorological agency, I know how important are in-situ measurements to improve and validate our models. This applies not only to land-based stations but to ocean’s, too. From the operational perspective, I am aware of how a continuous stream of high-quality data can contribute to our models, and how the constellation of satellite sensors, stations, shops, buoys, gliders, ... make our products better, both for forecast and reanalysis. Operational oceanography is a reality nowadays. In Europe, the COPERNICUS MARINE ENVIRONMENT MONITORING SERVICE (CMEMS) managed by Mercator Ocean provides observations and forecasts of great value that allow countries and regions to provide added-value services to stakeholders and end users at a low cost. Harbours, fishermen, and maritime sports (sailing, surf, etc.) can benefit of the modelling and data acquisition efforts of the last decades. However, an important gap between meteorology and oceanography is known, as the number of observations in the ocean (not only at the surface) is quite low if compared to air. More data are needed, and lately biological and chemical observations are becoming important as well. Another issue where ocean observation become important is climate change. Without an adequate and long time series of observations in the ocean will be difficult to assess the rate of temperature increase and how much CO2 the oceans will be able to fix.

Today, I want to acknowledge the role that the Global Temperature and Salinity Profile Programme is playing in managing temperature and salinity profile data, to improve the quality control and facilitate the access and use of these datasets. We, the USV, are very happy to host this meeting. Please, enjoy the city, the culture, are, lifestyle, gastronomy of Santiago and Galicia, a region always embracing the ocean, which has shaped the character of our people and, of course, of this university too.
The Steering Group on the Global Temperature and Salinity Profile Programme (GTSPPP) shall conduct the program for the collection and management of temperature and salinity data sets to support IODE (International Oceanographic Data and Information Exchange) and JCOMM (Joint Technical Commission for Oceanography and Marine Meteorology) requirements with the following objectives.

Objectives

1. To provide a timely and complete data and information base of ocean temperature and salinity profile data
2. To implement data flow monitoring system for improving the capture and timeliness of real-time and delayed-mode data
3. To improve and implement agreed and uniform quality control and duplicates management systems
4. To facilitate the development and provision of a wide variety of useful data analyses, data and information products, and data sets

Implementation

1. Provide scientific and technical guidance for the program in the implementation and enhancement of the GTSPPP including:
   1.1. Near real time data (observations within 30 days) acquisition;
   1.2. Non real time data (observations older than 30 days or data never circulated on the Global Telecommunication System) acquisition;
   1.3. Communications infrastructures;
   1.4. Quality control and analysis procedures;
   1.5. Continuously managed database;
   1.6. Ocean data and meta data standards; and
   1.7. Data and information products.
2. In conjunction with user groups and data collectors, design and implement data flow monitoring systems to ensure that the data are collected, processed and distributed according to agreed schedules and responsibilities.
3. Collaborate with international projects and global scientific programs such as GCOS (Global Climate Observing System) and GOOS (Global Ocean Observing System) to assemble process and disseminate data managed by GTSPPP.
4. Actively promote the GTSPPP and provide information to the users of GTSPPP services, such as the planners of international science programs.
5. Provide GTSPPP status reports and other requested material to the IODE committee and JCOMM ETDMP, to international programs in which GTSPPP is a participant

Composition

The Steering Group of GTSPPP comprises five components. They are as follows:

1. Real-Time Data Assembly Center
2. Delayed-mode Data Assembly Centers
3. Long-Term Archive Center
4. Data Product Centers
5. Advisory Committee:

General Membership

One representative from each of the core participating countries (initially Australia, Canada, France, Japan, and USA) as identified by the countries. The core participating countries are the IOC Member States and WMO Members actively engaged in data and information exchanges with the long-term archive centre of GTSPP.

1. Experts from one or more Member / Member States of other programs/projects that are of relevance to GTSPP may accompany these representatives.
2. Representatives invited by the SG from Member States of the IODE and JCOMM and representatives of oceanographic projects those are important to GTSPP operations.
3. The Chair will be selected by the Steering Group and will serve a term of two sessions (four years).
4. Funding for participants and sessions of the SG will be provided by Members/Member States.
ANNEX VI

CERTIFICATE OF APPRECIATION TO PROFESSOR AND VICE-REETER VICENT PEREZ
FOR HIS GENEROUS SUPPORT ON THE GTSPP STEERING GROUP WORKSHOP V

Certificate of Appreciation

In grateful recognition of your generous support
on the GTSPP-SG-Workshop-V

Professor and Vice-Dean Vicente Perez

with this certificate of appreciation

by the GTSPP Steering Group

On this 28 day of June 2019

[Signature]
CERTIFICATE OF APPRECIATION TO PROFESSOR JOAQUIN TRINANES FOR HIS OUTSTANDING EFFORTS ON ORGANIZING AND HOSTING THE GTSPP STEERING GROUP WORKSHOP V