



Report of the
5th Meeting of the
TPOS 2020
Steering Committee

6-8 November 2018
YES/JAMSTEC, Yokohama, Japan

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Project Website: www.tpos2020.org

1. Opening and Welcome

The fifth meeting of the TPOS 2020 Steering Committee (TPOS 2020 SC) opened at 0900 Tuesday 6 November.

The session was opened by Dr Takeshi Kawano, Director of Center for Global Change, who welcomed members and guests to the Yokohama Institute for Earth Sciences. He noted that JAMSTEC is in the process of planning for their next mid-term plan, covering 2021-2028, which includes priority marine and environmental issues and contributions to GOOS and GCOS main activities, including continuing support of TPOS 2020. Of particular importance is that TAO/TRITON responsibilities should be shared by multiple countries and new technology and observations are critical.

The Co-Chairs added their welcome and noted apologies from Steering Committee members Harry Hendon, Dean Roemmich, Pete Strutton and Ken Takahashi.

2. Agenda and Review of Actions

TPOS 2020 SC co-Chair Neville Smith introduced the Agenda (Appendix 1) for the meeting and asked the TPOS 2020 SC to consider the desired outcomes for each section. Some changes were noted, primarily that intersessional activity for task teams (Section 8) would likely be covered under Item 6. Additionally, due to unforeseen conflicts, co-chair Smith informed the Session that he would leave after the close of Day 2 and would therefore try to cover his relevant sections prior to departure.

Project Office member Shelby Brunner reviewed outstanding actions from previous TPOS SC meetings. She noted:

- TPOS 2020 performance metrics development (SC-2);
- Tracking of regional planning activities in China and Peru/South America is ongoing (SC-3);
- The Backbone TT should develop a phased plan for implementation and transition of backbone components (SC-4);
- Add links to relevant TPOS 2020 data sources to TPOS2020 website (SC-4); and
- Development of a pilot study to test and evaluate the feasibility of deploying autonomous surface vehicles to partially or wholly replace fixed point moorings (SC-4).

It was also pointed out that there would be 3 scientific presentations given by JAMSTEC scientists and that the agenda would be flexible to accommodate the speakers, depending on the progress being made. The scientific presentations are listed below, with additional information available upon request:

1. Shuhei Masuda: A new approach to El Nino Prediction beyond the spring season
2. Kunio Yoneyama: Recent progress and scientific results from YMC
3. Yosuke Fujii: Recent progress in ocean observing system evaluation in JMA and GODAE

Appendix 2 contains a list of all participants.

Co-chair Neville Smith stated his intention to step down as co-chair following the completion of the 2nd Report.

Action SC-5.1. Select the next TPOS 2020 SC Co-Chair (Steering Committee)

3. Stakeholder Information Sharing

3 (i) Overview and future challenges

Co-Chair Kessler provided an overview of intersessional activities and highlighted several of the challenges facing TPOS 2020 in the coming years. US CLIVAR hosted a “Bridging Modelling and Observational Gaps in Support of TPOS 2020” workshop in Boulder, Colorado during May 2018, which identified various needs within the modelling and data assimilation communities. If the workshop report is published soon, it was noted that it will provide useful information for the Second Report.

Kessler noted the Ocean Obs '19 TPOS Community White Paper (CWP) tried to be specific in the TPOS 2020 design rationale, given the criticisms of the 1st Report, as well as clear about observing needs and requirements for the envisioned system. Combining tools and efforts increases robustness of the system. Some mentioned examples of complementarities and needs include:

- Argo complements SSH measurements and should be leveraged;
- Fast sampling in the near surface on moorings is essential;
- Models and data assimilation products need to be considered as part of the design.

Kessler also re-emphasized that the rigor of the First Report has given TPOS 2020 credibility with the sponsors and has led to a reinvigorated array. Most recently, there were 8 pre-field modelling studies funded for 2 process studies within the First Report – Eastern Edge of Warm Pool and PUMP. This rigor is important to sustain throughout upcoming report recommendations and actions, despite pushback from some groups.

CLIVAR Pacific Regional Panel (PRP) has been one group that has vocalized concerns over the First Report Recommendations and Actions, primarily the deprioritization of some off-equatorial moorings because it will compromise the climate record from their viewpoint. TPOS 2020, specifically the Backbone-TT, has a dialogue with the PRP to address concerns. Co-chair Kessler pointed out that in general TPOS 2020 should more clearly present the evidence in favour of the recommendations ultimately made, as well as potential losses. As CLIVAR historically has had an implementation role in observing systems, continuing to work productively with them is important as TPOS navigated the transition process.

3 (ii) TPOS Resource Forum (TRF) expectations and aspirations

Resource Forum Chair David Legler opened by commending the remarkable process being made by TPOS 2020 led by the Steering Committee and stating he wants to ensure the TRF meets its potential. He outlined various roles and challenges for the TRF, including:

- Continued support of the TPOS 2020 project planning
- Increased support of implementation activities
- Increased stakeholder engagement (current and potential; multiple sectors)
- Increased external communications, socialization of the process and progress

- Assuring progress towards the TPOS continues past the formal end of TPOS 2020
- International cooperation for western and eastern boundaries

Co-Chair Smith noted plans for a communique to address:

- Who owns the Tropical Pacific Observing System? Is it the TRF? Research Agencies? Etc.
- Who frames the question: TPOS 2020, OOPC, WCRP would frame it differently.
 - *Nothing in the ocean obs community gives us a steer on this.*
- Every time series should have multiple applications for broad impact.

3 (iii) Agency/national information sharing

JAMSTEC

Takeshi Kawano-san reaffirmed JAMSTEC's dedication to the 3 TRITON sites that are now supersites. Mooring work in the Indian and Arctic Oceans, as well as collaboration on KEO and K2 was highlighted. Other JAMSTEC contributions of interest to TPOS 2020 include operation of flux surface/wave gliders, shallow float (3-500 m depth) development and testing, and testing of Sairdrones. There was also mention of a late 2019/early 2020 cruise to western edge of warm pool, pending funding, that could serve as a collaborative international activity.

NOAA/NASA

Kathy Tedesco of NOAA presented on behalf of NOAA and NASA. Both agencies are contributing funds for BGC Argo deployments in the tropical Pacific. NOAA's Climate Variability Program funded 8 projects in 2018 focused on pre-field modeling studies in support of PUMP and Eastern Edge of Warm Pool pilot projects that were described in the first report.

NOAA continues to provide strong support for observations, including:

- 80% TAO reporting rate maintained,
- Continued support for sustained Argo, drifters, and CO₂,
- Pilot testing of new technologies,

Tedesco also noted NOAA is continuing research-to-operation discussions and planning and that they are ready to begin implementing new mooring design.

NOAA also provides support for the Project Office and other TPOS activities. There is also an active effort around TPOS 2020 planning and implementation.

NASA activities of note include:

- Continuation of JASON series altimetry and development of SWOT for submesoscale SSH measurements,
- Technology development of DopplerScatt for simultaneous measurements of ocean surface wind and current,
- SPURS 2 field campaign support,
- Projects for understanding tropical Pacific upper-ocean processes and improving S2S predictions.

SOA

Xiangzhou Song of the Ministry of Natural Resources (MNR)/SOA provided insights into drivers of China's scientific interest in the Western Pacific as well as the efforts China is taking to fill knowledge gaps. Chinese contributions towards TPOS 2020 include:

- Research cruise capabilities both for pilot project support and operational buoy maintenance,
- 12 surface buoys with 6 co-existing subsurface moorings in Western Pacific (called the Bailong/Ding array),
- Satellite launches – 3 in 2018 and 2 additional before 2020,
- 400 new Argo floats over next 3-5 years as part of operational plan.

SOA underwent a profound reform in 2018. Now that it is finalized, the roles of various groups is becoming clear. Song noted a variety of proposals from various Chinese institutions. Furthermore, MNR is ready to establish a national coordination mechanism called National Advisory Committee for TPOS 2020 Implementation (NACTI). NACTI will incorporate momentum from these various groups including MNR, Ministry of Education, and QNLM.

IMOS/CSIRO/BoM

Tim Moltmann provided the Australian agency outlook, with a strong focus on IMOS. The Bureau of Meteorology (BoM) supports operational networks, including drifters, wave buoys and XBT lines. IMOS and CSIRO support sustained networks, including Argo, SOOP and the Southern Ocean Time Series.

IMOS recently secured funding out to 2023 and likely beyond. The goal for IMOS's contribution to Argo is 10% of the global array, with small expansions to BGC and ice capable floats. IMOS has stopped their deep mooring activities, but are planning to collaborate with WHOI going forward. Finally, IMOS satellite activities are focused on calibration and validation with plans to contribute cal/val to SWOT.

CSIRO has two projects of interest to TPOS 2020 including "Indo-Pacific Interbasin Exchange" and "Coupled Dynamics of the Indo-Pacific warm pool." The second phase of the latter's field campaign is due to begin in November 2018.

BMKG

Nelly Florida gave an overview of BMKG's interest in the western Pacific, specifically in the role of the ocean-atmosphere in generation of ENSO. The 2015 El Nino had strong impacts in Indonesia and BMKG wants to improve their marine observation capacity for future events. Other phenomena of interest to BMKG include Indonesian throughflow dynamics, cyclone development, and the ITCZ.

BMKG observing plants include sea gliders, wave gliders, HF Radar (in throughflow straights), drifter buoys, coastal buoys and Argo. The specific locations are yet to be determined, but will likely include Makassar Strat, Lombok Strait, Banda Sea, and North Papua waters. The Year of the Maritime Continent was also a productive time for BMKG to collect observations.

Discussion followed the mention of these observing assets and Nelly noted that a National Consortium for Ocean Research was established to consult with the community regarding placement of the platforms.

KIOST

Jae Hak Lee provided updates on KIOST's recent field campaigns utilizing their new R/V Isabu. The Low Latitude Western Boundary Current study involving 7 mooring sites in the western Pacific is underway, with plans to recover and redeploy moorings in 2019, after 2 years of sampling. This study will conclude in 2021. Second, an air-sea interaction study is spinning up, utilizing both radiosondes and a surface mooring. The surface mooring will be placed near the northern edge of the Warm Pool.

JMA

Konishi-san presented JMA observation networks and drivers of their interest in TPOS. Their primary networks are grouped into 3 areas: 1) coastal tide gauges, wave radars, and surface drifters for coastal and marine disaster mitigation; 2) satellite SST and profiling floats for oceanography; and 3) R/V hydrography for marine environment monitoring. The interest in TPOS stems from concerns that deterioration of the mooring array will result in negative impacts to seasonal predictions, including ENSO prediction. Their resourcing doesn't allow for them to fill in mooring gaps, but are interested in more cost-effective platforms as a substitute.

To consider these as a future possibility, JMA needs advice, for example: how much would alternative observation platforms, such as profiling floats or drifting buoys, have a quantitative impact on seasonal prediction if all TMA stopped observation? It was also noted that JMA's support in TPOS 2020 could result in additional support by other met agencies.

IRD/French agencies

Sophie Cravatte began by noting that France's research efforts are organized and therefore her comments are given as a viewpoint for all French institutes, not just IRD. IRD promotes equitable development and has a strong footprint in Tropical Pacific (Islands, coastal areas). Sustained obs to help quantify local impacts of climate variability on these areas will be useful for TPOS societal benefits.

Support or investments will rely on bottom up process, primarily proposal writing. Coordination between Coriolis and Ifremer has led to contributions of 10 Argo floats/year towards R1 Actions 3 and 4, but Cravatte emphasized the need to find solution for deployments.

France continues to support SSS observing system.

Potential TPOS 2020 collaborations with French institutions includes satellite cal/val and blended product development and, specifically, Mercator-Ocean is open to conduct experiments to help inform TPOS design (if someone takes a lead).

Discussion focused around question of float deployments, both in terms of priority areas and how to leverage partnerships for deployments. JCOMMOPS have coverage map, so can target deployment areas. However, a map against doubling requirements would be valuable in planning. Dynamic

planning process also should consider age of existing floats and projected drift. Of note is that it takes 6 months to 1 year lead time for clearance issues to be resolved.

Action SC-5.2. Provide clarity to partners of whether float provider or ship operator asks for clearance. Further work could include a more specific guidance document, and coordination team.

4. Roundtable discussion with Stakeholders and Steering Committee

This session is envisioned to let partners share their perspectives, hear from sponsors regarding near and long term visions, expectations for the final report, and discuss future governance arrangements.

Future governance of TPOS 2020 and the transition to that is still be developed. The current working plan is to develop a Scientific Advisory Committee and a Forum, created out of resource forum members to be shared between sponsors and JCOMM. Ideal membership includes major agencies, ECMWF, big users and intergovernmental sponsors. It is still unclear what TPOS 2020's connection will be into the new JCOMM, following the pending WMO reform. GOOS may play a larger role, but understanding where GOOS is strategically looking is important. One major, unresolved question was who will chair the next phase of the project? i.e. who is in charge?

KIOST noted that structure doesn't matter, but there must be a connection to the Korean government. SOA stated that their leadership prefers intergovernmental procedures and connections, as it helps for long-term security. It was agreed by the group that governance structure has to deliver value.

China has many agencies competing in various spaces- specifically 4 programmes independently pushing for observations in the Pacific. Also, there will be 20 new satellites in the next 10 years; Dake Chen will chair the national committee for coordination of efforts.

There was also mention to refine TPOS 2020 connections with regional alliances through GOOS and WMO. Furthermore, navigating the Project's relationship with CLIVAR, which has been challenging, will be an ongoing issue.

Sponsors and SC member agreed that the Project cannot wait to establish an implementation team; a lot of activity is already starting in the next year. At SC-6 we need key implementing people in the room to be part of the planning process.

Action SC-5.3. DPO to invite key individuals to SC-6 to be part of planning conversation. These individuals needs to be identified by SC members and agency representatives.

5. Second Report

5 (i) Report from Face-to-Face Meeting

Backbone TT co-chairs Susan Wijffels and Sophie Cravatte gave a review on the face-to-face (F2F) writing workshop held at Woods Hole to propel progress on the Second Report. The 2.5 day

workshop, held September 26-28, 2018, focused on working through the major sections that were outlined for the Backbone Chapter, as well as address identify additional needs and work through outstanding questions.

Major outcomes from the meeting include:

- Inclusion of a “Winds Annex” to have an in depth evaluation of the needs surrounding wind measurements,
- Agreement to 4 mooring extensions, instead of the previous 3,
- Outlining the different “tiers” of moorings,
- Development of a response to CLIVAR PRP’s most recent letter.

More information is provided below in the Backbone Observing System section.

5 (ii) Overview out Outline and Schedule

The original Project goal of Report publication by the end of 2018 has been relaxed due to Ocean Obs ’19 Community Whitepaper writing. Neville presented the updated proposed timeline for completion of the Second Report, noting that the date of release is driven by deadlines for WMO Congress resolutions:

- December 1: Completion of First Order Draft of all chapters.
- December 25: Completion of Second Order Draft for Community Expert Review
- December 30: DPO to share SOD for Community Review. Note: This is the only external review period.
- January 31: Comments received from community
- February 28: Revised Report finalized by authors.
- March 15: Release of Second Report.

The outstanding issue is whether a planetary boundary layer chapter will need to be included. Wind, air temp and humidity are only potential observing issues; everything else is proposed to be improved.

5 (iii) Chapter-by-chapter review/status

1. Introduction and Background

Co-chairs Smith and Kessler are responsible for this section and will draw primarily from the Ocean Obs ’19 Community Whitepaper.

2. Coupled weather and S2S

It was decided to include a short chapter on coupled weather, subseasonal to seasonal understanding and modeling.

Action SC-5.4. Yuhei Takaya, Bill Large, Arun Kumar, Yosuke Fujii and Neville Smith will outline this chapter by the end of the meeting.

3. Biogeochemistry and ecosystems

Adrienne Sutton presented progress on this section, which was one of the best developed at the time of this meeting. The priorities that the biogeochemistry-task team laid out include:

- Ecosystems response to climate change,
- Oxygen minimum zone impacts to ecosystems,
- Seasonal to decadal variability in the biological pump and for CO₂ flux,
- Carbon export quantification,
- Volume and nutrient fluxes into the EUC.

Recommendations from this Chapter should focus on EOV requirements, as well as requirements related to the backbone (e.g. surface pCO₂ climate record). For example, an ample number of BGC Argo floats should be recommended to ensure coverage, especially as lifetime of floats is still be determined. Finally, having modellers involved with biogeochemistry section is important for coordinating efforts.

Action SC-5.5. SC to review BGC Chapter, provide comments and ensure cross-discipline connections.

4. Coupled models for sub-seasonal to interannual predictions

The primary content for this chapter in its current state is from the US CLIVAR Workshop on “Bridging Observations to Modelling” from May 2018 and responses from an operational center survey conducted by A. Kumar. Recommendations from the workshop include: process studies are fundamentally important to improve parameterization of models; efforts like CMIP should be promoted for operational S2IP community; and reiterate need for OSSEs and infrastructure to exchange information.

One of the major theme is biases. A focus for this chapter should be how observations can make more substantial model improvements, instead of serving as buffers to biases. Developing a process or protocol to systematically ensure research observations result in operational improvements would be of value to the community.

Action SC-5.6. Modellers on SC should review this Chapter and provide comment (Dake, Yosuke, Yuhei)

5. Eastern Pacific

Yolande Serra presented updates to the Eastern Pacific chapter content. A variety of pilot and process studies are recommended, but identifying activities that can happen in near-term to get some momentum started will be important. Many of the proposed ideas are within EEZs, so TPOS 2020 can only provide suggestions but not act upon them without country partnership. Additional specific recommendations to address important EP needs include:

- Maintain 20S, 80W mooring in Stratus region for monitoring, specifically surface radiative fluxes,
- TMA line along 95W should be maintained, with expansions into northeast Pacific ITCZ and seasonal southeast Pacific ITCZ, and

- BGC Argo floats combined with satellite data to measure variability of upper ocean structure and oxygen minimum zones.

One need from the modelling community is the observation of East Pacific source waters that advect onto equator. These observations should result from backbone observing investments.

Observing approaches for increasing flux observations could include a radiosonde network through GOOS and a surface reference network on E. Pacific islands through GCOS. The supersites proposed at the F2F#2 could tie into the surface reference network. There was uncertainty about TPOS 2020's role in advocating for the Stratus mooring.

Action SC-5.7. BGC-TT Co-Chairs to liaise with EP-TT regarding oxygen sensors on moorings.

6. Backbone Observing System

Backbone-TT co-chairs Susan Wijffels and Sophie Cravatte outlined primary goals of the backbone chapter, which include:

- Finalization of backbone TMA/Argo recommendation;
- Defining TMA core moorings and enhanced moorings;
- Status and expected schedule of implementation;
- Update on wind/wind stress issue;
- Review of R1 recommendations and actions (by exception).

There has been a lot of activity and progress within the BB-TT to make progress towards these goals through a number of telecons, including one with CLIVAR's Pacific Regional Panel, the face to face meeting, and formation of a Winds team. The Winds team, led by Larry O'Neil of Oregon State University (USA), will write an annex chapter for the Second Report to highlight their work and needs. Major outcomes from the F2F#2 include having 4 mooring extensions, as well as 3 types of moorings. Tier 1 moorings, or bulk flux moorings, will have enhanced mixed layer depth measurements of temperature and salinity. Tier 2 moorings, or bulk flux plus moorings, have enhanced upper ocean shear measurements. Tier 3 moorings, or supersites, will be highly instrumented, potentially moveable, platforms to improve a wide suite of cross-discipline phenomena. The Supersite definition and location priorities are still being developed and should be addressed in the 3rd report.

Costs should continue to be considered as part of design, not just scientific need. Observational needs should be prioritized as much as possible. The report should also be clear on what is backbone versus experimental. Also, one component of the backbone should serve more than one purpose.

CLIVAR PRP has expressed concern surrounding our ability to capture climate change signals with a reduced mooring grid. It was noted that these signals are small, and are difficult to capture from current moored measurements anyway. Moving forward, TPOS 2020 will create a summary highlighting the gains for the Second Report, include a section on decadal/long-term trends, and ensure tracking of review responses for future reference. Justification of our decisions needs to be clear.

Action SC-5.8. Identify purpose of each sensor on Tier 1 moorings with lens of "backbone multifunctionality" (N. Smith, Y. Fujii)

Action SC-5.9. Update “gains” figure to show what we would get from the updated mooring array and moorings.

Action SC-5.10. Backbone to liaise with PBL, BGC, and TP-TT re. coordinating plants and communicating about the Supersites.

The planetary boundary layer TT presented their view of needs and issues that a future backbone can/should address. The main example, related to winds, is that there is the most disagreement between buoys and scatterometers on synoptic timescales in rainy regions. A PBL chapter outline was developed, including:

- Introduction
 - Importance of measuring fluxes and quantifying Qnet, E-P, TAU
- Recommendations and Actions
 - Full heat flux sites increasing from 4 to 64
 - Wind/air temp/humidity sites increasing from 56 to 64
- Raise/address outstanding questions
 - Fewer sites in Eastern Pacific, can scatterometers mitigate coverage?
 - Scatterometer-buoy disagreement, particularly in Western Pacific?

Action SC-5.11. Frequency spectrum diagram for humidity, winds, etc should be made by PBL.

Extensive discussion followed these presentations. It was noted that based on our knowledge, near equatorial variability can only be monitoring by moorings. However, we need to balance equatorial enhancements with meridional extensions. Could 140W, for example, only have 3 sites, while 110 W is shallow and could be a candidate for Saildrone replacement. A dry zone extension was also discussed as a potential process study, but no consensus was reached. It was decided that the range of views needs to be reflected in the Report.

The value of barometric pressure measurements on buoys and drifters was emphasized. The numerical weather prediction (NWP) community believes that pressure measurements are critical for NWP applications. However, the PBL TT needs to evaluate the sampling value due to the cost of instrumentation.

The status of satellites was reviewed. SLH, SST, and scatterometers are healthy, but SSS has no follow on planned.

The implementation timetable should include dependencies, suggestions for assessments as part of the transition, and partners. For example, doubled Argo should be in place before moorings removed. Review points should have routine assessments; this should be part of post-2020 SC meetings. It should also be noted in the Report that TPOS 2020 is taking a systems approach to design and implementation; there must be cross-network coordination.

Action SC-5.12. Carryout census of old Argos transmitting floats we still have in the region (Susan).

Action SC-5.13. Add BGC Argo to last row of Phasing Chart

Action SC-5.14. Resource managers and implementers need to provide input to Phasing Chart for realistic timeline

The Backbone chapter outline for the Second report is:

- Highlight content from the First Report
- Prioritization framework

- Summarize community concerns expressed and our response to these
- Synthesis of enhancements: dynamical regimes targeted, types of moorings, Argo enhancements
- Satellite coverage
- Summary of the gains

It was noted that this chapter may have to break apart as it is getting quite long in terms of material.

7. Data management

Despite difficulties in engaging people to write such a chapter, the SC decided it was valuable to include a short chapter rather than nothing. The data management chapter leads are Neville Smith and Kevin O'Brien. Potential topics could include OpenGTS, system level monitoring and quality of fluxes from moorings.

It was suggested that a pilot data team be formed in parallel with pilot implementation team, with a particular need to identify SOA DM representatives.

Action SC-5.15. Include brief data management chapter in 2nd Report.

Action SC-5.16. Form pilot data team in parallel with pilot implementation team.

8. Emerging technologies

Saildrone abilities were presented by Meghan Cronin. Current Saildrone missions have goals of 1) performing intercomparisons for CO₂ and ADCP measurements, 2) performance tests against winds and currents, 3) observe El Nino onset, and 4) monitor eastern edge of warm pool. The SC recommended that Saildrones be continually tested and validated from now until 2020 for possible consideration in TPOS 2020 final design. There are also questions around the cost for long-term use of Saildrone, since Saildrone Inc owns the platform and sells the data.

M. Cronin also presented prawler technology abilities. Prawlers provide finer scale resolution of temperature data, but the rate of profiles is variable since they are wave powered. However, if you lose the one sensor you lose the entire profile and you have to place your ADCP strategically. Also, it was noted that there will be some non-zero aliasing, but you can still capture diurnal variability.

Wave gliders abilities to observe air-sea fluxes was presented by Iwao Ueki. The sensors are 1.5 m above platform, resulting in problems during severe weather. JAMSTEC is planning a long-term monitoring experiment for their Wave Glider with 3 observation lines associated with TRITON moorings. It was noted that a wave glider cost is equivalent to ~100 days of Saildrone data.

IMOS has a technology transition plan, which was presented by Tim Moltmann. IMOS uses the Framework for Ocean Observing to guide their investments, focusing on pilot and mature technology instead of "proof of concepts." IMOS will invest \$2M over next 4 years in testing pilot technologies though. Two challenges that were identified are 1) incorporating efficiency, enhancement and effectiveness and 2) design for impact.

An "emerging technologies" chapter was outlined, with Ken Ando as lead author. Secondary authors include T. Moltmann, Y. Serra, A. Sutton, and potentially others. The current working outline is:

- Introduction

- Emerging in situ technologies: wavegliders, Saildrone, crawlers
- Remote sensing, and remote sensing needs (inc. carbon and surface currents)
- Evaluation of readiness for backbone
- Gaps: Possible solutions in near-future that aren't available yet
- Summary

General Discussion

Co-chair Smith outlined an ambitious timeline driven by WMO Congress in June 2019. A zero order draft due is 4 weeks from close of the meeting (early December) and a first order draft due 2 weeks past that. There will be a single expert and stakeholder review over a 4 week period from late December to late January. The publication date is early March 2019, with the executive summary released before the full report.

It was also noted that the Backbone Chapter may have to be broken down, as the proposed content is becoming quite large.

Recommendations and Actions from the First Report should only be revised if there are substantial changes to be made. For example, being more explicit about the importance of mooring servicing ships for underway and ancillary measurements qualifies to be re-written.

Action SC-5.17. The Implementation Pilot Project description needs to be restructured (N. Smith)

6. Updates from Task Teams (as required)

6 (i) Backbone

Co-chairs Susan Wijffels and Sophie Cravatte did not have additional information or updates about the Backbone Task Team to share beyond the preparations for the Second Report.

6 (ii) Planetary Boundary Layer

Co-chairs Tom Farrar and Meghan Cronin also did not have any updates about the Planetary Boundary Layer Task Team to share with the SC beyond their preparations for the Second Report. Co-chair Farrar did use his time to emphasize that it is important to begin socializing the new "dots on the mooring map" with the task teams.

Action SC-5.18. Task Team chairs need to socialize the dots on the mooring map with their respective task teams immediately.

Action SC-5.19. The coordinates of the dots (above) need to be shared with the Steering Committee and Task Team Co-chairs for figure making (S. Wijffels).

6 (iii) Biogeochemistry

Adrienne Sutton provided a brief update on the BGC Task Team. She noted that the membership may change after the Second report is completed and that the BGC-TT would like feedback on post-Second Report goals for them. The Task Team co-chairs are keeping track of BGC Argo pilot deployments.

Adrienne also noted that the Final Report might include more analysis on emerging sensors and new technology platforms for future consideration.

6 (iv) Western Pacific

Co-chairs Janet Sprintall and Masaki Katsumata provided an overview of the several interim activities and projects that the Western Pacific Task Team was involved with. They have been involved in organizing special sessions at various meetings (e.g. WESTPAC) and trying to connect activities. The community, as a whole, has been thinking about OO'19 recommendations, primarily a future integrated observing system for LLWBCs and ITF.

KIOST continues to maintain their moored array in the Mindanao Current and have committed to 4 additional years. This is related to typhoon studies. There are many moored ADCPs deployed in this area, which provides potential to create a velocity atlas. It should be easy for models to take up, but how to engage the modelling community? It would be of most value to assemble all of the data together for sharing, instead of having the multiple sources. For this to happen, the observers have to agree to process data in the same way to make it more attractive for assimilation. It was also discussed that before planning new field experiments in this area, the community should evaluate all existing observations. Weidong offered to help connect the WP-TT Co-chairs with NPOCE.

The interim observing efforts include the PISTON cruise, from August to October 2018, and YMC finalizing. The WP-TT believes it would be great to build on the legacy of YMC and conduct another field campaign. The SC asked the WP-TT to consider how existing, and developing, efforts would tie back into the backbone design.

6 (v) Eastern Pacific

Yolande Serra provided the Steering Committee with a picture of the progress and needs within the Eastern Pacific task team. There are ongoing data sharing exercises, such as ocean reanalysis product creation. Yolande suggested that increased efforts to engage Peru in data sharing, such as through development of a Mercator system transformation, would be of value. There was also discussion on the need to enhance regional partnerships with regards to Argo deployments, specifically by seeking formal concurrence to international Argo programme to deploy floats in Eastern Pacific EEZs. This is difficult to achieve, but greatly improves the ease of deployment.

The Eastern Pacific Task Team is also in need of a few membership changes, including a new co-chair, as Ken Takahashi wishes to step down as co-chair and as a Steering Committee member. Boris DeWitte of Chile was nominated as the new co-chair and the Steering Committee agreed. It was also suggested to extend an invitation to Yvonne (IMARPE) to join the EP-TT. In general, it was also agreed that Eastern Pacific representation on the Steering Committee and in the Resources Forum needs to be enhanced.

Action SC-5.20. Add Boris DeWitte as new Steering Committee member

Action SC-5.21. EP-TT co-chairs to evaluate membership and make new recommendations for both TT and Resources Forum. Tim Moltmann also offered to connect with EP-TT re. membership and connections to GOOS RA's.

- a. Yolande/Katy/Tim to seek advice on best way to connect into Eastern Pacific in SC and TF (via GOOS).

6 (vi) Modeling and Data Assimilation

Arun Kumar, M&DA TT Co-Chair, noted his major intersessional activity has been the operational center survey he presented earlier in this meeting. There have also been a few meetings that have required his involvement through the TPOS 2020 lens.

Arun requested that this task team be formally disbanded, noting the lack of a co-chair and lack of need. He recommended that task teams could be formed if pilot projects take off that require Modeling and Data Assimilation expertise. The Steering Committee identified strong needs for modeling and DA within the project, but eventually approved the disbandment of this group. One of the recommendations of note is to build a process similar to the CMIP for operational forecast models (S2S2I) that shows how systems are benefiting from additional observations.

Action SC-5.22. Identify outstanding modelling and data assimilation issues that TPOS 2020 will need to address in future (Arun, for SC as whole)

- a. Provide list of data that gets into modeling systems
- b. Mechanism for how to deal with future issues

7. Intersessional Activity overview

7 (i) US CLIVAR “Bridging” Workshop outcomes

Co-chair Kessler noted this meeting brought together a wide array of observationalists and modelers with interest in the Tropical Pacific, including many “new faces” to TPOS 2020. The workshop report is being prepared and will be released in early 2019.

7 (ii) Response to CLIVAR SSG

CLIVAR has expressed their concerns regarding First Report recommendations to decommission moorings in the Tropical Pacific. The Pacific Regional Panel (PRP) of CLIVAR sent a presentation to the Backbone Task Team at the Face-to-face meeting stating their concerns and next steps they were prepared to take. For example, they recommended that TPOS 2020 has an additional oversight committee to ensure scientific merit of the TPOS 2020 plans. Additionally, the Steering Committee received a letter from the CLIVAR Scientific Steering Group (SSG) expressing their concerns more broadly. The TPOS 2020 Steering Committee discussed an appropriate response to this letter and how to engage them moving forward.

A response letter was initially drafted by Co-chair Billy Kessler and the Steering Committee reviewed the content. The SC was thoughtful to ensure they understand we respect them, but that they do not accept that the TPOS 2020 work is at the detriment of the system.

Dake Chen sits on both groups and volunteered to carry a message to the CLIVAR SSG meeting, in late November 2018 in Washington, D.C. The Steering Committee agreed to prepare a list of talking points and time points for productive engagement for Dake to communicate to the SSG and PRP representatives.

Action SC-5.23. Invite CLIVAR PRP to a telecom during the writing of Second Report to talk through gains/changes of proposed Backbone Observing System (Distributed Project Office).

7 (iii) Stakeholder meeting read-out

Resources Forum chair, David Legler, had a lunch meeting with the Stakeholders present in the room. He provided a read-out of this meeting on the last day of the Steering Committee meeting. He emphasized that the Stakeholders reaffirmed the Steering Committee and Task Teams' progress within the project thus far, having done well with the initial mandate. They requested that a range of communication materials be developed to raise visibility of TPOS 2020. It was encouraged that news releases and blog posts be shared with the TPOS 2020 community through the quarterly updates and on the website. David noted that the stakeholders would develop a set of talking points around project successes in an effort to improve communication with colleagues about the Project.

Intergovernmental group connections, such as IOC, GOOS, WMO, JCOMM, and PICES, are valuable and critical to have to the Project. GOOS Regional Alliances can be leveraged for access to EEZ issues, coordination of ocean observing, and sharing data issues. The Steering Committee co-chairs should ask more of GOOS to better leverage its activities and ongoing work. Kay Hill can help make connections at IOC and WMO meetings, especially between delegations. It is important to plug into both of these bodies since not all agencies involved with TPOS 2020 attend one or the other.

David Legler noted that he would continue dialogue with the manager-level people, as opposed to higher level originally envisioned for the TRF. His vision is that closer to the completion of the Final Report he will re-engage these higher level people for a 3rd Resources Forum meeting.

8. Progress with Implementation

8 (i) Short Report from implementation workshop (5 November)

Co-chair Smith presented a brief report on Monday's Technical Implementation Workshop that preceded SC-5. The full report can be found in Annex B. The importance of a "core TMA" definition and documentation was reaffirmed, especially for partners who are developing their technology.

8 (ii) NW Pacific Drivers

Weidong Yu provided this report and he began by highlighting the drivers (societally relevant factors) for China:

- Typhoon/Wave/Surge
- Asian Monsoon
- El Niño
- Indian Ocean Dipole
- Eutrophication/HAB/Red/Green Tide
- Ocean Anoxia
- Degradation of the marine ecosystem

Weidong Yu presented on the Chinese priorities in the northwest priorities, specifically how they relate to the backbone observations. He noted that China is particularly impacted by varying climate modes. Improved observations that help understand/predict the trend of typhoons following more northern tracks is also of interest to the Chinese government.

Observations of particular interest include air-sea fluxes, surface and mixed layer temperature, and subsurface ADCP to capture thermocline currents. There is also a desire to support seamless prediction.

9. Recap and Actions

9 (i) Meeting Actions

DPO member Shelby Brunner provided an overview of the Actions from the meeting. Many of them are focused on Second Report drafting

10. Other Business

10 (i) Changes to TPOS 2020 Steering Committee

Co-Chair Smith announced his intention to stepdown as Co-Chair of the Steering Committee at the completion of the Second Report. Weidong Yu, of MNR/SOA, was nominated as the next co-chair by Billy Kessler. The nomination was supported and approved enthusiastically by the Steering Committee.

As noted above, Ken Takahashi also expressed he would like to step off of the Steering Committee due to his limited ability to engage in the project from his new position. Boris DeWitte was identified as a potential replacement and was confirmed by the SC.

10 (ii) Next meeting

Dake Chen offered to host the 6th TPOS Steering Committee meeting in Hangzhou, China.

11. Close

Co-Chair Kessler closed the meeting at 1200 on Thursday 8 November.

Appendix 1 SC-5 Agenda



TPOS 2020 SC-5 FINAL Agenda 17 October 2018

TPOS 2020 SC-5 Desired Outcomes:

- A. Workshop: TPOS 2020 actions/implementation (Mon 5 Nov 1400-1630)
- B. Engagement with regional TPOS stakeholders
- C. Review progress of Second Report
- D. Review Task Team progress
- E. Discuss possible future governance arrangements (TPOS 2020 and beyond)
- F. Agree to schedule of work 2018-19 including Oceanobs '19

Location: Yokohama Institute for Earth Sciences, JAMSTEC

November 6-8, 2018

09:00

1. Opening and Welcome (BK, NS)
 - Introduction and local welcome by JAMSTEC
 - Logistics overview
2. Agenda (NS)
 - Agenda approval
3. Stakeholder session ~2 hr 30 min (plus a 20 min break)
 - Overview and future challenges (BK) - 15+15 min
 - TRF expectations and aspirations (DL) - 10+10 min
 - Agency/national information sharing - 1.5 hr
(2-3 slides/agency outlining interests and directions related to TPOS 2020)
 - i. SOA -- confirmed, presenter TBD
 - ii. NOAA/NASA -- K. Tedesco
 - iii. IMOS/CSIRO/BoM -- T. Moltmann
 - iv. JAMSTEC -- T. Kawano
 - v. BMKG -- N. Florida
 - vi. KIOST -- J. Lee
 - vii. JMA -- T. Yoshida/M. Konishi
 - viii. IRD -- S. Cravatte
4. Roundtable discussion with Stakeholders and Steering Committee (DL, NS) -- 45 min

- a. Partner (scientist perspectives)
- b. Sponsor near-term and long-term vision, strategy
- c. Expectations for final report
- d. Future governance arrangements

[break for lunch ~ 1230]

13:30

5. Review of Actions (Shelby, NS) - 30 min
 - o Review of SC-4, intersessional actions

NB We have scheduled **three scientific presentations** from our hosts. Depending upon our rate of progress they may need to be rescheduled to suit the speakers.

- **Shuheii Masuda -- A new approach to El Nino Prediction beyond the spring season 15+10**

6. Second Report [Afternoon break near here]
 - o Report from WHOI F2F meeting (SCr, SW)
 - o Overview of outline, schedule (NS)
 - Inclusion of a PBL chapter?
 - o Section-by-section review/status
 - [Check commitment; agree schedule, responsibilities]
 - 1. Introduction and Background (NS, BK)
 - 2. Coupled weather and S2S (YT, HH)

- **Kunio Yoneyama-- Recent progress and scientific results from YMC 15+10**

3. Biogeochemistry and ecosystems (AS, PS)
4. Coupled models for sub-seasonal to interannual predictions (AK, NS)

- **Yosuke Fujii-- Recent progress in ocean observing system evaluation in JMA and GODAE 15+10**

[break day 1 around here]

0900 Wed 7 Nov

5. Eastern Pacific (YS, KT)
6. Backbone Observing System (SCr, SW)
 - Finalisation of Backbone TMA/Argo recommendation
 - TMA core and enhancements
 - Status and expected schedule of implementation
 - Update on the wind/wind stress issue
 - Review of R1 recommendations and actions (by exception)

[break around here]

7. Data management (NS)
 - Include action from SC-4
8. Emerging technologies (??)
 - Iwao Ueki-- wave gliders
 - Tim Moltmann -- IMOS technology transition
9. Recommendations and conclusions (BK, NS)

- Options for review, publication
 - General discussion of second Report
 - Overnight drafting tasks
 - Drafting: Leads, contributors, reviewers
 - Schedule for release
 - Schedule for finalising

[close day 2 around here]

0900 Thu 8 November

7. Updates from Task Teams (as required)

- Backbone
- Planetary Boundary Layer
- Biogeochemistry
- Western Pacific
- Eastern Pacific
- Modeling and Data Assimilation

[break]

8. Intersessional Activity overview

PS Please notify the Co-Chairs if any of these items need to be before the discussion of the second Report

- US CLIVAR "Bridging" Workshop outcomes
- Ocean Obs '19 papers (as relevant; any recommendations to be aware of)
 - (i) TPOS paper (NS)
 - (ii) Surface fluxes (MC)
 - (iii) Governance/FOO (NS)
 - (iv) OSE paper (Yosuke F)
 - TAOS (KH, NS)
 -

9. Progress with Implementation

- Short report from implementation workshop (5 Nov 1400) (NS)
- General schedule (from 4.3 OO paper; SW)
- Low-latitude western boundary current (SCr; see TPOS OO paper)
- Western Pacific projects (MK, JS)
- T&I TT
 - Future governance arrangements

[lunch]

10. Recap and actions

- Revisit metrics/performance (NS)
- Second Report (all)
- Implementation

11. Other business

- Changes to TPOS 2020 Steering Committee
- Next meeting

Appendix 2 SC-5 Participants

TPOS 2020 Steering Committee Members

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Appendix 3 Updated Outline of 2nd Report

1. Introduction and background
2. Coupled weather and subseasonal applications
 - 2.1. Introduction
 - 2.2. Background
 - 2.3. Requirements (on EOVs)
 - 2.4. Recommendations (for observing system, for R&D)
 - 2.5. Actions, next steps
 - 2.6. Summary
3. Biogeochemical and ecosystem backbone observations
 - 3.1. Biogeochemical and ecosystem processes of the tropical Pacific
 - 3.2. EOv requirements for the tropical Pacific
 - 3.3. Biogeochemical and ecosystem requirements of the backbone observing system
 - 3.4. Required actions
 - 3.5. Summary
4. The current state of coupled models for sub-seasonal to interannual predictions
 - 4.1. Background
 - 4.2. Models for S2IP and their characteristics
 - 4.3. Model development and tuning
 - 4.4. Techniques for assessing model performance
 - 4.5. Observations in support of model development and evaluation
 - 4.6. Model performance for prediction and applications
 - 4.7. Outstanding questions and issues
 - 4.8. Recommendations
 - 4.9. Summary
5. Developing an Eastern Pacific backbone OS
 - 5.1. Background
 - 5.2. Building knowledge, engagement and experience
 - 5.3. Enabling regional activities
 - 5.4. Toward an enhanced and sustainable EP Backbone
 - 5.5. Recommendations and actions
 - 5.6. Summary
6. The TPOS 2020 Backbone Observing System
 - 6.1. Introduction
 - 6.2. Update on the 1st Report Backbone recommendations and actions
 - 6.3. Synthesis of possible enhancements and changes, including from earlier chapters
 - 6.4. Recommendations and changes
 - 6.5. Progress with implementation, including pilots and process studies
 - 6.6. Summary
7. TPOS data flow and access
 - 7.1. Background
 - 7.2. Essential elements and requirements
 - 7.3. Quick turn-around data requirements

- 7.4. Delayed and re-processed data streams
- 7.5. Recommendations, actions
- 7.6. Summary

- 8. An evaluation of emerging technologies
 - 8.1. Introduction and Background
 - 8.2. Emerging in situ technologies
 - 8.3. Remote sensing
 - 8.4. Evaluation of readiness for Backbone
 - 8.5. Gaps
 - 8.6. Summary

- 9. Summary and conclusions

Appendix 4 SC-5 Consolidated Decisions and Actions

Actions Carried Over

Action SC-2.18: TPOS 2020 performance metrics (A. McCurdy, N. Smith)

Action SC-3.1: Consider the development of a science capability matrix (or similar device) to summarise the links from high-level objectives through to recommendations and actions (TPOS 2020 SC Co-Chairs, DPO and KT; April 2018).

Action SC-3.6: Further develop Pilot/Process studies into “implementation strategy” style documents, with guidance on who may contribute, when, and in what form (Study authors, Task Teams, SC, by July 2018)

Action SC-3.13: DPO to keep track of regional planning activities e.g. in China and Peru/South America and any input needed from TPOS 2020 SC (as part of engagement plans) (DPO, ongoing).

Action SC-3.20: Develop a slide deck highlighting the scientific background, rationale, Recommendations, Actions, and key technological/scientific challenges of the First Report (DPO with TPOS 2020 SC, Jan 2018)

Action SC-3.43: SC Co-Chairs to liaise offline with respect to SC membership and membership/terms of reference for TTs (Ongoing, SC Co-Chairs).

Action SC-4.2. Maintain a watching brief on the deep-ocean observing system – implications for the deep-ocean observing system from TPOS 2020 recommendations and actions, and vice versa – and liaise with DOOS, as appropriate (Backbone Task Team, Andrea McCurdy).

Action SC-4.4. Contact Fabrice Ardhuin, Fangli Qiao and others for guidance on if/where TPOS can add value in wave observations (Sophie, Neville).

Action SC-4.6. Undertake a high-level audit around data flow and accessibility of Western Pacific observations (i.e., is available or not through JCOMM/IODE, ERDDAP, WOA or other “standard” mechanisms) and identify priorities among those not available (WP TT, May 2018).

Action SC-4.9. The Backbone TT to maintain a watching brief on a possible DOOS Clarion-Clipperton project (see also Action SC-4.2; Andrea McCurdy for DOOS; BB TT).

N.B. This action replaces Actions SC-2.12, SC-2.13 and SC-3.24.

Action SC-4.14. Examine the feasibility of compiling inventories of (a) observational networks, (b) research and other cruises, and (c) mooring deployments in the eastern Pacific (EP TT, for inclusion in 2nd Report).

Action SC-4.16. Scope a TPOS 2020 reanalysis for the Western Pacific and/or TPOS region whereby extant data are made accessible and re-processed suitable as input for data assimilation, and the requirements on the potential reanalysis systems and the evaluation of products are specified (M&DA TT, BB TT, WP TT).

Action SC-4.18. Develop a pilot study to test and evaluate the feasibility of deploying autonomous surface vessels to partly or wholly replace fixed point moorings where the return rate from moorings is unacceptable or marginal (EP and PBL TTs; Pilot proposal ready by Feb/March 2018).

Action SC-4.22. The Backbone Task Team to participate ex-officio as a member of the T&I TT, as required (Co-Chairs, BB TT Co-Chairs).

Actions from SC-5

- Action SC-5.1.** Select the next TPOS 2020 SC Co-Chair (Steering Committee)
- Action SC-5.2.** Provide clarity to partners of whether float provider or ship operator asks for clearance. Further work could include a more specific guidance document, and coordination team.
- Action SC-5.3.** DPO to invite key individuals to SC-6 to be part of planning conversation. These individuals needs to be identified by SC members and agency representatives.
- Action SC-5.4.** Yuhei Takaya, Bill Large, Arun Kumar, Yosuke Fujii and Neville Smith will outline this chapter by the end of the meeting.
- Action SC-5.5.** SC to review BGC Chapter, provide comments and ensure cross-discipline connections.
- Action SC-5.6.** Modellers on SC should review this Chapter and provide comment (Dake, Yosuke, Yuhei)
- Action SC-5.7.** BGC-TT Co-Chairs to liaise with EP-TT regarding oxygen sensors on moorings.
- Action SC-5.8.** Identify purpose of each sensor on Tier 1 moorings with lens of “backbone multifunctionality” (N. Smith, Y. Fujii)
- Action SC-5.9.** Update “gains” figure to show what we would get from the updated mooring array and moorings.
- Action SC-5.10.** Backbone to liaise with PBL, BGC, and TP-TT re. coordinating plants and communicating about the Supersites.
- Action SC-5.11.** Frequency spectrum diagram for humidity, winds, etc should be made by PBL.
- Action SC-5.12.** Carryout census of old Argos transmitting floats we still have in the region (Susan).
- Action SC-5.13.** Add BGC Argo to last row of Phasing Chart
- Action SC-5.14.** Resource managers and implementers need to provide input to Phasing Chart for realistic timeline
- Action SC-5.15.** Include brief data management chapter in 2nd Report.
- Action SC-5.16.** Form pilot data team in parallel with pilot implementation team.
- Action SC-5.17.** The Implementation Pilot Project description needs to be restructured (N. Smith)
- Action SC-5.18.** Task Team chairs need to socialize the dots on the mooring map with their respective task teams immediately.
- Action SC-5.19.** The coordinates of the dots (above) need to be shared with the Steering Committee and Task Team Co-chairs for figure making (S. Wijffels).
- Action SC-5.20.** Add Boris DeWitte as new Steering Committee member

Action SC-5.21. EP-TT co-chairs to evaluate membership and make new recommendations for both TT and Resources Forum. Tim Moltmann also offered to connect with EP-TT re. membership and connections to GOOS RA's.

- b. Yolande/Katy/Tim to seek advice on best way to connect into Eastern Pacific in SC and TF (via GOOS).

Action SC-5.22. Identify outstanding modelling and data assimilation issues that TPOS 2020 will need to address in future (Arun, for SC as whole)

- c. Provide list of data that gets into modeling systems
- d. Mechanism for how to deal with future issues

Action SC-5.23. Invite CLIVAR PRP to a telecom during the writing of Second Report to talk through gains/changes of proposed Backbone Observing System (Distributed Project Office).

Appendix 5 Report of Implementation Workshop

5 November 2018, TPOS 2020 SC-5, JAMSTEC YES, Yokohama, Japan

Summary Report

1. Introductions

The Chair welcomed attendees to the second meeting on TPOS implementation. The participants are listed in Annex 1. The Chair note the purpose of the meeting was to:

- To foster technical discussions among TPOS partners
- Help coordinate implementation activities
- Discuss standards

2. Recap from Workshop in Seattle Oct 2017

The Chair provided a brief summary of the discussion from the first workshop, held at PMEL in October 2017. The Agenda was to:

1. Develop a description of a standard/core TPOS mooring; and
2. Discuss technical specifications/guidance for TPOS TMA

The main outcomes:

- Agreed to develop Core Tropical Mooring Array document;
- Highlighted importance of overlaps in instrumentation;
- Idea: establish a data management team;
- Ken Connell to report to DBCP; and
- Agreed to keep talking.

Progress has been slow.

DBCPC 33 (14– 17 Nov 2017) passed the following recommendations:

- Noted TPOS plans. Importance of QC, data service
- **Rec 8.8/1:** *Establish a core TPOS 2020 Tropical Mooring Array (TMA). This should define and document the "Core TMA" similar to the "Core Argo" document. A baseline configuration should begin with ATLAS configuration, quality control (QC), and accuracy; Incorporate developments for TAO, PIRATA and RAMA; further refinements should be made with current understanding of future requirements. Overlapping deployments should be implemented when prototyping emerging methodologies or technologies*
- **Rec 8.8/2:** *Develop Technical Specifications/Guidance for TPOS TMA.*

3. Update on TPOS 2020 SC/BB TT progress

Billy Kessler provided an overview of work undertaken through the Backbone Task Team and/or the SC. He explained how the TPOS 2020 recommendations added value to the existing Backbone and how the recommended moorings would deliver more value on subsurface temperature and current structure. He also discussed the current status against EOVs and an outline of the implementation schedule.

The discussion noted that mooring configurations could vary among regions. There was also discussion about enhanced salinity measurements. It was agreed this should be revisited as part of the standard/core mooring discussion.

4. Implementation updates

Billy Kessler (for NOAA) noted that the National Weather Service (NDBC) stands ready to implement changes.

Xiangzhou Song introduced the SOA plans (called C-GOOS), which spans observations from space to the interior.

The Project received initial approval in 2017 and a feasibility study for 2017-18 was approved by the National Development and Reform Commission (NDRC). The restructure of the Ministry of Natural Resources has delayed final appropriations; resources will likely flow from the start of 2019. The design stage is being undertaken 2018-19 and the construction plan should be completed in 2019. Implementation may start in 2020.

He noted implementation may be spread over 2020-2024. Any parallel deployments for intercomparison may occur in 2019 (for testing data flow, etc.).

Dong-Chull Jeon provided a brief summary of a KIOST project with IMARPE (KOPE-LAR). The aim was to set up a sustainable coastal Peruvian observing system. Two lines at 5S (Paíta line) and 8S (Chicama line) were planned and data sharing was included in the plans. The potential for vandalism has hindered progress.

Ken Ando noted that JAMSTEC still intends to maintain two TRITON moorings.

The discussion noted the importance of a common set of measurements, QC procedures, capabilities and reaffirmed the importance of side by side comparisons in the pilot.

5. Defining a Core Tropical Mooring Array

The Chair reminded the group of the discussion 12 months ago and the conclusion then that such a document was important. Given the lack of progress since, this decision needs to be reconfirmed. He also pointed to some existing documentation that might provide a basis. The group confirmed this decision and Weidong Yu emphasized that such documentation would be useful if it could be developed in a timely way.

The document would consider:

- Typical mooring configuration (e.g. as in Fig. 3 of the CWP)
- Sampling rates, averaging, ...

- Capture the mixed layer enhancements (focusing moored sampling on upper 50-100m; so-called tier 1)
- Include the surface current meter but not barometric pressure (latter tier 2)
- Regional variations, e.g. TAO v TRITON
- List options and variations (Tier 1; Tier 2 + options, incl. some BGC; Tier 3 – supersites, BGC)
- Data management requirements and principles
 - One to have a seamless array and be able to download data from website
- ADCP is enhancement, not core.
- Would like to see point current meters as close to the surface.

We would aim for an annex to the 2nd Report, perhaps attached to the implementation update. A first draft will be completed by the end of the year and be circulated for the 2nd Report review. The BB TT agreed to lead and, as last time, it was agreed that at least one scientist and one technician from each agency should be involved. Meghan Cronin from PMEL volunteered to be a NOAA participant (it is important that there is both PMEL and NDBC engagement):

- JAMSTEC
- SOA
- NOAA/PMEL
- NOAA/NDBC

6. Technical matters

As discussed above, coordination of data and information management is a critical issue for the TMA.

The "core" paper will aim to harmonize some of the technical issues

7. Western Pacific Implementation Pilot Project

The participants agreed it is helpful to have coordination. A Pilot implies a planned and agreed set of activities rather than simply an exchange of ideas/plans. The Pilot should include floats and plans for float deployments. Could be extended to TPOS, even if the western Pacific is the initial priority.

NS agreed to redraft the description of the Project.

The project team needs a lead/co-leads. Participants in Project: start with attendees of the first two workshops.

8. Participants

Neville Smith (Chair)

Billy Kessler (PMEL)

Weidong Yu (FIO/SOA/MNR)

Susan Wijffels (WHOI)

Xiangzhou Song (Marine Division, MNR)

Iwao Ueki (JAMSTEC)

Zhi Chen (Marine Division, MNR)

Sophie Cravatte (LEGOS/IRD)

Ken-Taro Ando (JAMSTEC)

Masaki Katsumata (JAMSTEC)

Janet Sprintall (SIO)

Tom Farrar (WHOI)

Ishihara Yasuhisa (JAMSTEC)

Tatuya Fukuda (JAMSTEC)

Takeshi Maki (JAMSTEC)

Lucia Upchurch (PMEL/NOAA)

Shelby Brunner (OOMD/NOAA)

Katy Hill GOOS/GCOS WMO)

Meghan Cronin (PMEL/NOAA)

Yuhie Takaya (MRI/JMA)

Jae Hak Lee (KIOST)

Dong Chull Jeon (KIOST)

Dake Chen (SIO/SOA)

Nelly Florida (BMKG)