



Report of the 2nd
Meeting of the
TPOS 2020
Steering
Committee

14-17 October, 2015,
CSIRO, Hobart, Australia

18 November 2015
Version 3-1 - Released
Project Website: www.tpos2020.org

Document Control Sheet

Version	Date	Author(s)	Changes Overview
0	24 Oct	N. Smith	First full Draft
1	31 Oct	N. Smith	Includes initial feedback from TT Co-Chairs
2	18 Nov	N. Smith	Includes extended SC comments
2	18 Nov	N. Smith	Post Co-Chair discussion - final
3	18 Nov	A. McCurdy	Formatting changes for Release
3-1	05 Dec	McCurdy/Smith/ Kessler	Minor revision to Actions 6, 21, 23 (deliverable dates)

Table of Contents

1.	Opening and welcome	1
2.	Agenda and Review of Actions	1
3.	Status	2
4.	Established Major Activities	2
4 (i)	Planetary Boundary Layer	2
4 (ii)	Biogeochemistry TT	5
4 (iii)	Eastern Pacific Task Team.....	6
4 (iv)	Backbone TT	8
4 (v)	Modelling TT	11
4 (vi)	Western Pacific Small Group Report	12
4 (vii)	Cross-cutting issues, general discussion.....	13
5.	TPOS Contributions and Related Activities.....	14
5 (i)	Deep ocean observations.....	14
5 (ii)	Years of the Maritime Continent	15
5 (iii)	GOOS/GCOS General, Expert Panels, AtlantOS	15
5 (iv)	CLIVAR	16
	Additional item: Discussion of 2015 ENSO	17
5 (v)	SPURS-2.....	17
5 (vi)	Update on satellite observations.....	18
5 (vii)	Update on Chinese Activities	19
5 (viii)	Republic of Korea initiatives and the new Vessel “Isabu”.....	19
5 (ix)	IMOS.....	19
5 (x)	USA: NOAA Solicitation.....	20
6.	PROJECT OPERATION AND ENGAGEMENT.....	20
7.	INITIAL ASSESSMENT OF PROGRESS AND ACHIEVEMENTS	21
8.	TPOS 2020 TARGETS.....	22
9.	GENERAL DISCUSSION	22
	SEQUENCE OF MAJOR OUTPUTS FROM TPOS 2020	22

THE PROCESS OF TRANSITION	23
THE BACKBONE REVIEW PROCESS	24
ADDITIONAL BACKBONE MATTERS	25
PLANETARY BOUNDARY LAYER STUDIES	26
(1) Years of the Maritime Continent Joint Working Group	27
(2) Diurnal cycle	27
(3) Equatorial Pacific Upwelling and Mixing Physics (PUMP)	27
(4) Double ITCZ process study	28
WESTERN PACIFIC TASK TEAM.....	28
FOLLOW-UP ON MODELLING DISCUSSION	29
VISIT TO R/V INVESTIGATOR.....	30
10. SC-2 ACTIONS	31
KEY POINTS FOR GODAE OceanView STEERING COMMITTEE (NOV 2015).....	31
OCEAN SCIENCES TOWN HALL.....	31
KEY MESSAGES (GENERAL).....	31
11. OTHER BUSINESS.....	32
12. CLOSE.....	32
Appendix 1 SC-2 Agenda.....	33
Appendix 2 SC-2 Attendance.....	35
Appendix 3 Synthesis of Planetary Boundary Layer Survey Responses	41
Appendix 4 Update on satellite observation	43
Appendix 5 Western Pacific Task Team.....	44
Appendix 6 Consolidated Decisions and Actions.....	45

1. OPENING AND WELCOME

The TPOS 2020 Steering Committee (SC) Co-Chairs opened the second meeting of the SC at 0900 Wed 14 October and thanked Commonwealth Scientific and Industrial Research Organization (CSIRO), the Integrated Marine Observing System (IMOS) and the Institute for Marine and Antarctic Studies (IMAS) for their sponsorship of the SC-2 meeting. The SC Co-Chairs noted that all SC members and Task-Team Co-Chairs (bar Dake Chen) will participate; Harry Hendon and Weidong Yu joined remotely. They also welcomed the non-SC Task Team (TT) Co-Chairs, all of whom are able to participate (Eric Guilyardi joined remotely for Item 4(v) only).

They also welcomed a number of our key stakeholders, from NOAA, NASA, IMOS and CSIRO, and a number of observers who joined for parts of the meeting (see Appendix 2 for a full list of attendees).

The Co-Chairs then invited opening remarks by David Smith (CSIRO), Tim Moltmann (IMOS) and Pete Strutton (for the Executive Director IMAS, Richard Coleman). They added their welcome and noted the many attractions of Hobart and of the IMOS, IMAS and CSIRO facilities close by. There are strong links to the tropical Pacific and they welcomed the opportunity to participate in the TPOS 2020 Project. David made reference to the new R/V *Investigator* and hoped the SC would take advantage of the opportunity to visit on Friday.

2. AGENDA AND REVIEW OF ACTIONS

AGENDA

Neville Smith introduced the Agenda for the meeting.

He introduced the draft Agenda (Appendix 1) and noted that the Co-Chairs expected the meeting to go through to noon on Saturday as planned. He drew attention to the outcomes they were seeking from the meeting and that the items under Item 4 would be critical for achieving for those outcomes. In this respect, the Co-Chairs noted that they do expect most of the items 4(i)-(vi) will require additional time to fully consider SC views and to frame the Actions, and so there would likely be regular adjustments to the schedule to meet this priority.

Neville Smith noted that some items will need to be scheduled to suit attendees joining remotely, or to accommodate the schedules of guests/observers. He further noted a number of small changes:

- A presentation by Dr Masumoto on EIOURI under Item 5(ii);
- Dr Eric Lindstrom will speak to Item 5(vi);
- Item 9 will be used to draw all the discussions and actions together;
- The tour of the *investigator* will be at 1600 on Friday 16 October; and
- The Ocean Sciences Town Hall meeting should be considered under Item 10.

The modified agenda was agreed.

INTERSESSIONAL ACTIVITIES

The Co-Chairs then introduced the Actions from SC-1, noting the following points:

- There was intersessional engagement with Indonesia (BMKG) but ultimately they did not nominate a person to attend this meeting;
- The nexus with Indian Ocean Global Ocean Observing System (GOOS) remains important and further opportunities will be sought to share information (see also Item 5(ii));
- Progress with modelling was not as strong as expected and the Modelling and Data Assimilation Task Team (M&DA TT) has been reset (see 4(v));
 - The deeper discussion on data assimilation envisaged for this meeting has not been included on the agenda, but different aspects will be discussed under Item 4(v);
 - Links to the Sub-seasonal-to-Seasonal (S2S) have not progressed as envisaged. The Steering Committee responded that this should still remain a priority (see Action 14);
 - The systematic errors Workshop has not yet gained traction;
- The establishment of Task Teams has progressed well, but with some moving more quickly than others. This meeting provides an opportunity to synchronise;
- The action on time series/the climate record was completed but the lead has now been assumed by the Backbone TT; and
- There has been no significant progress in studies/exemplars of the societal relevance of TPOS 2020's work.

The Co-Chairs noted that the intersessional period had been busy and that the Co-Chairs and Distributed Project Office (DPO) met every two weeks. The first TPOS Resources Forum (TRF) was held immediately after SC-1 and there had been some follow-up from the Forum interim Chair. The Co-Chairs (and other members of the SC and the DPO) have delivered numerous presentations and six articles had been produced on TPOS 2020, including the Prospectus. We welcomed IMOS as a contributor to the DPO and it is hoped the First Oceanography Institute (FIO) Qingdao node will be operating shortly.

3. STATUS

Item cancelled.

4. Established Major Activities

4 (i) Planetary Boundary Layer

The Co-Chairs of the Planetary Boundary Layer Task Team (PBL TT), Meghan Cronin and Tom Farrar introduced the Team activities.

Three teleconferences have been held (May, June, and July) and they have used the “strawman” approach to stimulate discussion of both the sustained observing system and of short-term enhancements/pilot studies. They noted that the discussion of short-term enhancements to the existing TPOS has been easier since, at this stage, they are not

concerned with priorities and trade-offs. There are a number of challenges in understanding the requirements for PBL observations (whether in sustained or campaign mode), and then to determine the best design for sampling and technologies to meet those requirements. Some preliminary discussion has been held on the relative merits of regime-vs-grid sampling but further discussion is required.

The PBL TT also developed a survey to gather community input on PBL measurements and this is discussed in more detail below.

Tom Farrar introduced the strawmen that have been developed thus far by the Team

1. Years of the Maritime Continent (YMC)

YMC is discussed in more detail under Item 5(ii) and the PBL TT has benefited from the participation of Chidong Zhong, one of the leaders of the YMC, as one of its members. A number of ideas have been discussed including enhancements to the existing observing system (e.g., a 13N, 137E mooring), and shipboard observations devoted to resolving the diurnal cycle of fluxes and atmospheric convection.

Subject to the discussion under 5(ii), the Steering Committee believed this should be further developed as a joint activity and postponed further discussion until Item 9 (see Action 27).

2. Diurnal cycle

This proposal is not yet fully formulated, but emphasizes how day-night asymmetry in the variability of SST and in the upper oceans through the diurnal cycle can rectify into low-frequency signals. In light of its role in transmitting surface momentum fluxes into the thermocline, there is significant interest from modeling centers in having more detailed observations of the upper-ocean diurnal cycle to help determine model parameters and to test underlying assumptions of the parameterizations.

The SC recalled the enthusiasm for this topic that was generated at the Review and SC-1 and reaffirmed its desire to see a study/pilot experiment developed around this theme. They also noted such an action would inform the evolution of the design for the Backbone within TPOS 2020, and that such a project would hold strong interest for at least the Biogeochemistry Task Team, if not all Task Teams.

Given the priority of this topic for SC, it was agreed to postpone further discussion until all other Task Teams had made their presentations. It was further noted that TPOS 2020 needed to refine PBL advice for the Backbone, including on the relative level of priority for elements of the proposed system (refer to Item 9: Action 24, Action 25, Action 29).

3. Equatorial Upwelling, Mixing Physics

This strawman focused on the relative roles of upwelling and mixing in the eastern equatorial Pacific. Their spatial and temporal variability, and underlying scales and dynamical mechanisms remain poorly understood, and poorly represented in climate models.

The SC noted multiple cross-TPOS interests and saw significant potential for a multiyear sub-project, with PBL as the lead and the Biogeochemistry and Eastern Pacific TTs as contributors (refer to Item 9, Action 30).

4. Double ITCZ Process Study

A double Inter-Tropical Convergence Zone (ITCZ) is a persistent systematic error in climate models, especially in the SE Pacific. A weaker SE Pacific ITCZ is observed in March-April and we need better observations of the 3D latent heating/vertical velocity and relation to surface/ocean properties. Shipboard observations on research cruises and continued maintenance of 95W TAO line have been suggested to develop climatology supported by radiosondes/remote sensing and scanning precipitation radar. Galapagos has been suggested as a potential profiling station.

This strawman was originally developed within the PBL TT but has also received considerable attention in the Eastern Pacific TT, with an aircraft-based process study to complement sustained observations.

As with the other studies, the SC believed this idea should be developed further (see further discussion under Item 4(iii) and Item 9, Action 31).

Other strawmen may emerge from the outcome of the NOAA proposal call (see Item 5(x)) and from the SPURS-2 process study taking place at 10N, 125W Aug 2016 - August 2017. The latter offers a near-term opportunity for testing new technologies against proven climate-quality systems. The ITCZ region was identified as a region in need of monitoring. SPURS can offer guidance on developing these plans.

The Steering Committee subsequently agreed on two further actions for the PBL arising from the Backbone work (see Action 25, Action 26).

Meghan Cronin then introduced the Survey which consisted of eight questions broadly around the design of the PBL observing system component. The questionnaire sent to about 90 tropical Pacific PBL experts worldwide on August 26 with a deadline for responses of September 10, 2015. By October 13, 34 responses had been received but some are still coming in. By most measures, this is an excellent level of response.

It is clear from the responses that many enjoyed the opportunity to provide input to the TPOS 2020 process, so just in terms of engagement it is clearly a resounding success. Most of the responses also provide valuable perspectives on the options that are under consideration, as well as on the scientific and operational drivers for which PBL observations are relevant. Many of the comments followed similar lines to that pursued by the SC and PBL TT, but others provided fresh insights.

The SC commended the PBL TT on this initiative and agreed that the results would be an important contribution to the evidence base, and not just for the PBL TT. The SC Co-Chairs suggested a synopsis of the survey response should be included with the Report of this meeting and asked participants to provide comments directly to the PBL Co-Chairs.

Action 1 PBL TT Co-Chairs to produce a synopsis of the PBL survey responses for inclusion in the SC-2 meeting Report [PBL TT Co-Chairs, Oct 2015].

The Steering Committee also agreed that a small group should investigate the potential value of a follow-up survey.

Action 2 Form a small group (a representative from each TT plus 1 from the SC to Chair) to consider the potential value of a follow-up survey [SC Co-Chairs; report by SC-3]

4 (ii) Biogeochemistry TT

The Biogeochemistry Task Team (BGC TT) Co-Chairs, Adrienne Sutton and Pete Strutton introduced this item. The BGC TT has been established for around six months with the membership now largely settled (see [BGC TT Terms of Reference](#)).

The Co-Chairs noted that three WebEx meetings have been convened. In addition to the initial task of familiarising the team members with TPOS 2020 and the tasks that they face, the TT has developed a strawman outline of core science questions, variables of interest, and potential pilot projects emerging from initial ideas from the task team. The BGC TT had identified 4 core motivating science questions and created writing teams to flesh these out. The Co-Chairs provided some further elaboration of these themes.

Given that this area is less mature than others in TPOS 2020 (from a sustained observing perspective), the BGC TT scientific and societal drivers are mostly couched in terms of scientific issues. The BGC TT identified four broad scientific questions/ requirements:

1. Long-term change
 - a. How do changing winds, currents and iron delivery affect the variability of nutrients, O₂ and C fluxes (air-sea, export)?
 - b. How do La Niña, central vs eastern Pacific El Niños impact the decadal changes in nutrients, O₂ and C fluxes (air-sea, export)?
 - c. How do the longer-term oscillations, such as PDO, affect the air-sea flux and carbon transport in the tropical Pacific?
 - d. What are the impacts of ocean acidification (specifically W. Pac corals)?
2. Natural variability
 - a. Diurnal cycle: Mixes nutrients and changes air-sea CO₂ gradient. So far strawmen are advocating increased vertical resolution, so 'ok'.
 - b. Kelvin waves: Cause downwelling (sometimes upwelling), impacting nutrient availability. All of TPOS agrees we need to resolve them, so 'ok'.
 - c. TIWs: Mesoscale and submesoscale velocity variability. Strong gradients in physics, nutrients and biology. Probably more amenable to process studies.
 - d. ENSO: Need to capture El Niño (no kidding!) and be able to tell the difference between central and eastern Pacific events.
3. Source waters: Source waters carry an anthropogenic (preformed) CO₂ signal which we need to distinguish from natural variability.
 - a. What are the pathways of carbon and nutrients to the cold tongue?
 - b. What is the role of the equatorial undercurrent in oxygenating the ecosystem?
 - c. Are these processes changing? How is BGC impacted?
4. Ecosystem impact
 - a. What are the consequences of variability and long-term change in primary productivity for higher trophic levels, including economically and ecologically significant fisheries?
 - b. Does tropical Pacific variability and ocean acidification expose Pacific coral ecosystems to corrosive carbonate conditions?

Science questions 1 and 2 capture the core biogeochemical uncertainties in the tropical Pacific. Science Questions 3 and 4 build on 1 and 2 and are likely more amenable to process studies and subject to continued technology development.

The Steering Committee welcomed this progress, noting numerous points of potential synergy with other TTs, and therefore opportunities to truly address the challenge posed in TPOS 2020 goals of integrating biogeochemistry into the design. A number of questions went to knowledge of the scales of variability and where these varied from those that would be implied from the physical mechanisms.

The SC also encouraged the BGC TT to give some consideration of the climate record in this context: is the ability to detect change still the overarching principle? The BGC TT Co-Chairs noted a concern that some of the existing climate records are at risk, principally because of the large drop in ship time available for sampling. In many cases, autonomous sensors do not yet exist and so the reliance on R/V sampling is relatively high.

The Co-Chairs also presented some early thoughts on required sampling. Following the BB TT meeting in Noumea, the BGC TT considered the emerging Backbone strawman and discussed aspects that are compatible, or not, with BGC observations.

The BGC TT also presented a number of Pilot Project ideas, including technology development and process studies that may be necessary to implement biogeochemical contributions to TPOS. These included:

- Pilot 1: New autonomous surface vessel
- Pilot 2: Modelling to determine key time and space scales of observations
- Pilot 3: Biogeochemical sensors on enhanced floats
- Pilot 4: Long range AUVs

The SC encouraged the BGC TT to develop these ideas, but also to take advantage of Pilots that are emerging in other TTs.

The Co-Chairs ended with an outline of their immediate work plan, which included:

- Continue discussion of how best to accommodate BGC in TPOS2020, prioritize a list of BGC variables, and identify needed new technologies.
- Analysis of model output to determine the important time and space scales to resolve.
- Analysis of model data to determine the best longitudes to focus process studies on source waters to the equatorial undercurrent (165°E, 110°W).
- Continued communication on how the draft Backbone observing system is evolving and how it is suiting the needs of the BGC TT.

The SC supported this work plan.

4 (iii) Eastern Pacific Task Team

The Eastern Pacific Task Team (EP TT) Co-Chairs, Yolande Serra and Ken Takahashi introduced this item, making reference to the [Terms of Reference](#) (which were finalised out of Session, in July) and the members of the newly formed Team. The EP TT has had one videoconference meeting and another face-to-face meeting (in Santiago, Chile, Oct 8, 2015); in both cases only a part of the Membership could attend. The videoconference served to begin the process of framing the main issues and clarifying what was needed from the strawman plans.

The TT then focused on developing two initial strawmen for the region: (1) Eastern Pacific equatorial-coastal waveguide & upwelling system, and (2) Eastern Pacific ITCZ/warm pool/cold tongue/stratus system. Ken Takahashi is also a member of the PBL TT and contributed to their strawman outline for the “Double ITCZ Process Study”. The Co-Chairs then provided further elaboration of these ideas, but noting that there has not yet been an opportunity to fully discuss these (or other ideas) in the EP TT.

Strawman #1: Eastern Pacific equatorial-coastal waveguide & upwelling system

This strawman focused on the need to document, monitor and predict the variability of the physical and biogeochemical coastal environment and its impact on the productivity on intraseasonal to interannual scales associated with the forcing from the equatorial region, particularly Kelvin waves, and the local processes. As noted at the La Jolla Workshop (see the whitepaper [Takahashi et al, 2014](#)) and in SC-1, these issues have strong regional societal relevance. On intraseasonal to interannual time-scales, the equatorial Kelvin wave dynamics affect the coastal region primarily by vertical advection, as well as onshore advection

The EP TT developed the strawman around a number of scientific questions including:

1. How do equatorial/coastal Kelvin waves interact with the zonal/alongshore gradients in the mean thermal structure in the eastern Pacific? How does this affect ENSO dynamics?
2. How does the coastal physical and biogeochemical environment and current system respond to equatorial and local forcing on different timescales?
3. What processes control the interaction between the thermocline and the surface?
4. How does the coastal upwelling connect to the large-scale circulation and climate?
5. What are the characteristics of decadal variability in the SE Pacific, in contrast to the North Pacific (e.g. Pacific Decadal Oscillation), and how does it affect ENSO dynamics and climate change in this region?

The presentation made a number of additional points:

- Climatological far eastern Pacific equatorial temperatures reveal a shallow thermocline, which climate models do not consistently represent;
- The direction of vertical velocity anomalies in the eastern equatorial Pacific is not well constrained in reanalysis products as evidenced by the different reanalysis estimates during the 1997-98 El Niño;
- The effect of the thermocline tilt in the eastern Pacific on the propagation and dispersion characteristics of intraseasonal Kelvin waves appears to be substantial but is not well documented observationally; and
- The coastal upwelling is connected with the large-scale tropical circulation, namely the equatorial undercurrent and the Tsuchiya jets, but this has not been systematically studied observationally.

The SC saw good potential in this idea, particularly as it focused on an aspect of the TPOS that was relevant to the region. The initial ideas for observations drew a number of comments, including a discussion on how well they might capture the zonal jets.

The SC encouraged the EP TT to take these ideas to the next stage in the form of a Pilot Project that might be used to test technology options and to provide further insights on the eastern Pacific elements of the Backbone and other contributions to TPOS. There also seemed potential to engage the BGC TT in this study. In developing the Pilot Project outline,

consideration should be given to the schedule of milestones, particularly in relation to information for the Backbone, and to the composition and leadership of the associated project team.

Action 3 *The Eastern Pacific equatorial-coastal waveguide and upwelling system strawman to be further developed into a possible Pilot Project [EP TT, Oct 2016].*

Strawman #2: Eastern Pacific ITCZ/warm pool/cold tongue/stratus system

The main thrust here is observing the atmosphere and ocean from the stratocumulus region off South America, northward into the tropical northeast Pacific ITCZ region. This transect is highlighted as a primary focus area for an eastern Pacific observing system to address the double ITCZ problem, a major bias in nearly all climate models that has persisted through several iterations of Coupled Model Intercomparison Project (CMIP) with little improvement. Further detail can be found in the outline attached to the paper for Item 4(iii).

The presentation touched on a number of aspects including:

- The far eastern Pacific ITCZ as seen in atmospheric and oceanographic observations, OLR and precipitation'
- The contrast in precipitation in CMIP5 models as assessed in AR5, with a double ITCZ and large biases south of the equator;
- The fact that a double ITCZ does occur in nature, but only in boreal spring (March and April; Zhang, 2001), which raised questions about the presence of surface wind convergence near 5S in the far Eastern Pacific. Increased meridional resolution of in situ surface meteorological observations at 5S may provide important information for this bias and phenomena;
- The moisture profiles in reanalysis products reveal a bottom heavy latent heating profile (qualitatively consistent with the shallow meridional cell observed in EPIC2001) whereas satellite retrievals indicate a top-heavy profile, with the maximum in the upper-troposphere;
- The importance of 95°W for capturing initiation and early intensification of tropical cyclone formation, and the complex interactions of the gap winds and low-level jets with the ITCZ; and
- The fact that the 110°W and 95°W mooring lines sample different regimes, and that island stations may provide useful platforms for atmospheric profile observations.

The presentation generated significant interest. The Co-Chairs noted that a study such as this would engage atmospheric scientists, modellers and specialists in convection, among others. The initial list of potential observations was much more extensive than those being considered for the Backbone, in part because this study was regional and largely research (searching for understanding). From a TPOS 2020 perspective, the Steering Committee saw great potential (see the follow up discussion under Item 9 and Action 31).

4 (iv) Backbone TT

The Backbone Task Team (BB TT) Co-Chairs, Sophie Cravatte and Susan Wijffels introduced this item and the associated paper. They provided a broad overview of the establishment of the Task Team and progress intersessionally.

The BB TT has held two videoconferences, the first in late April and the second in June 2015. Following discussion at the SC Interim videoconference in early April, the TT began developing strawman designs loosely arranged around the objectives for the Backbone (see BB TT [Terms of Reference](#)), which were then refined and consolidated at a face-to-face meeting in Nouméa, New Caledonia 16-18 September 2015. At this meeting the TT prepared the first set of recommendations on the process for achieving a new configuration of the Backbone of the TPOS, together with a list of pilot elements that could contribute to the evolution and refinement of the TPOS design.

The BB TT Co-Chairs noted that the Objectives of the Backbone contained in the [Terms of Reference](#)¹ mandated a very broad scope, overlapping with the domains of each of the other Task Teams, and they sought advice from the SC on how this should be managed. In terms of the process by which the Backbone would be defined, they required input and feedback from the other TTs with recommendations for the sustained part of the observing system (Item 9 picks up these cross-cutting TT issues in more detail; also see Action 24, Action 25, Action 26, Action 22, Action 23).

The BB TT sought some discussion around the “Terms of Reference” which they argued required further clarity. Noting that the comments pertained to the Backbone objectives and that this was just one part of the [Terms of Reference](#), the Steering Committee felt that further fine tuning at this stage would not be of significant benefit and that the existing [Terms of Reference](#) were adequate. The SC Co-Chairs further noted that the [Terms of Reference](#) indicated that “The Task Team should liaise with the other Task Teams as appropriate ...” and that it was therefore sensible to seek advice and ideas, even in cases where the BB TT had expertise of its own. The BB TT’s responsibility is to consolidate and prioritise this advice into a set of recommendation for the “cornerstone/fundamental contributions to the overall system”. The invitations issued to other TT Co-Chairs to join BB TT meetings was a very good first step.

The proposed directions for future activities are discussed in more detail under Item 9.

The BB TT Co-Chairs then stepped through an initial set of Backbone Strawmen, emphasising that the presentation was a draft only, to stimulate community input and focus consultation. They noted that the range of capabilities available has changed significantly since the original tropical Pacific/ENSO network was designed. Remote sensing, which the presentation showed would provide a substantial proportion of the “cornerstone/fundamental contribution”, is more capable in terms of spatial and temporal resolution, in terms of the Essential Ocean Variable (EOV) space covered, and in terms of quality and timeliness. Similarly, in situ sensing is now more comprehensive, covering more variables, and is being delivered more efficiently by autonomous platforms in many cases.

The major new thrusts (measurement characteristics) included:

- Improved integration of satellite data streams into the observing system design, including for calibration;
- Tracking ocean variability at *weekly* as well as longer timescales;

¹ These objectives align with layer 2 in the Framework for Ocean Observation construction that is discussed more fully under Item 5(iii). They are one aspect of the “purpose and requirements for the backbone observations” as requested in the Terms of Reference.

- Higher temporal and vertical resolution in the oceanic boundary layer;
- Priority on quality and continuity (space and time) to maintain and strengthen the climate record;
- Better resolution of near equatorial and near surface ocean physics across ENSO cycles and regimes;
- A stretch goal of monitoring the volume, heat and freshwater inflows and outflows of the Pacific tropical region including the Low-Latitude Western Boundary Currents (LLWBCs) and the Indonesian Throughflow (ITF); and
- Improved ability to diagnose air-sea exchanges of heat and freshwater in all regimes, including the South Pacific Convergence Zone (SPCZ) and the ITCZ.

Three different solutions were presented for the Backbone, at one extreme building enhancements on top of the existing networks (assuming all were maintained fully functional) and taking a very broad interpretation of “cornerstone/fundamental”, and at the other imposing some stratification based on requirements and perceived levels of scientific and societal utility and impact, and employing a much tighter “cornerstone/fundamental” filter. At this end of the spectrum, “fundamental” implies there are multiple uses for a contribution, and that there is at least one significant non–research use.

Not surprisingly, these initial ideas drew significant debate from within the extended SC. Key points were:

- There was considerable uncertainty surrounding the PBL aspects, particularly measurements for the key essential climate variables wind and wind stress;
- Further work is needed on the integration of satellite measurements, particularly on time scales important for boundary layer processes and in convective (rainy) region;
- More advice is needed around the surface flux elements;
- The evidence base for the design would benefit from model OSE/OSSE experiments; and
- The designs in the West Pacific and eastern Pacific needed further refinement.

Given the dependencies on other TT presentation it was decided to delay further debate until later in the meeting (under Item 9).

The presentation also generated discussion on the way the (initial) BB TT Report would be reviewed, and how this process would be coordinated and scheduled with other TPOS 2020 work and this too was added as a topic under Item 9, to take advantage of presentations under Items 5-8.

The presentation concluded with a discussion of one of the proposed pilot studies, the so-called “Wyrki Challenge Revisited”: an attempt to close the mass, heat, and freshwater budgets in regions of long zonal extent between 8°N and 8°S. This proposition, along with the pilot studies to close the LLWBC transports introduced with the strawmen, resonated with a number of Steering Committee members, though such a goal such a goal brings many challenges. This strawman, however, possessed that “stretch goal” idea that TPOS 2020 was seeking, with sufficient scientific challenges to make it daunting, but not so much so as to render it unlikely to deliver major successes on the way. It was noted that the “Wyrki Challenge” would deliver great value in terms of testing and validating CMIP5/6-class models, irrespective of whether the ultimate goal of closing the budget was achieved. The Steering Committee encouraged further refinement of both plans (note that a following action brings this opportunity to the attention of the GODAE OceanView (GOV) SC).

- Action 4** *The BB TT to further develop the “Wyrcki Challenge” strawman, initially through undertaking a small simulated sampling study using a high-resolution ocean model output [BB TT, Oct 2016].*
- Action 5** *Western boundary transports: BB TT to further consider this as a pilot activity, in parallel with the initial Backbone recommendations, to refine approach, bring in modelling, etc. with a view to bringing back recommendations later in TPOS 2020 [BB TT, Oct 2016].*
- Action 6** *Scope out the ARMOR-3D quantitative assessment study of an integrated Argo, altimeter, mooring observing system, and perhaps use the AtlantOs OSE/OSSE workshop (17-18 December) to develop joint work [BB TT, Dec 2015].*
- Action 7** *Through the M&DA TT, and in collaboration with the PBL TT, seek links for atmospheric and wave expertise (e.g., within JCOMM, WGNE, AOPC) around specific points of concern [BB TT, Jan 2016].*
- Action 8** *Contact Tommy Moore (PIGOOS) re. existing activities, capabilities used locally to monitor impacts (e.g., inundation) [Katy Hill, March 2016].*
- Action 9** *Consider mechanisms to improve delivery of data, products and information, specifically around data integration plans within the JCOMM Observations Coordination Group [David Legler, Katy Hill, March 2016].*

4 (v) Modelling and Data Assimilation TT

The Co-Chairs of Modelling and Data Assimilation Task Team (M&DA TT), Eric Guilyardi and Arun Kumar introduced this item. The accompanying paper provided a discussion of the intersessional issues that were encountered when attempting to establish the TT. After discussion among the SC Co-Chairs and Arun Kumar, the Terms of Referenced were revised and subsequently endorsed out of session, in September 2015 ([see M&DA Terms of Reference](#)). Subsequently, Dr. Eric Guilyardi accepted the invitation to share the responsibility to Co-Chair the M&DA TT. Currently the Co-Chairs are in the process of populating the M&DA TT membership and expect to have their first meeting by the end of November 2015.

The presentation covered some of the scientific rationale for establishing the TT, including systematic errors in coupled models and data assimilation systems, and the recognition that the current generation of ocean data assimilation systems do not make full use of observational data, e.g., ocean currents.

The Co-Chairs noted that the M&DA TT could:

- Provide a bridge between TPOS observational community and ongoing efforts to improve models and analysis systems; Model improvement should eventually reduce the need for some observations that are now needed to correct biases;
- Contribute to attribution of model biases and how observations can be used more efficiently for this purpose, and provide guidance on what additional observations may be required;
- Use models and assimilation systems to inform requirements and design of the observing system;

- Determine the accuracy requirements on observational data for ocean analysis and prediction;
- Promote use of analysis increments (*aka* innovations) in diagnostics and attribution of model biases;
- Use initialized forecasts and other information for attribution of model biases (e.g., the Vanni re et al. approach);
- Lead evaluation of ENSO metrics in the context of model biases (CLIVAR Research Focus 'ENSO in a changing climate'); and
- Because the equatorial Pacific is a strongly coupled system, provide guidance on the complementary aspects of observational data in resolving ocean state.

Given the seemingly endless range of possible activities, the SC agreed there would need to be some level of prioritisation. Further, it noted that each of the other TT papers pointed to specific areas where they felt assistance was required. In a number of cases, it was simply providing a conduit to expertise and advice (e.g., with respect to the impact Mean Sea Level Pressure (MSLP) measurements from the Backbone, or to GOV expertise for OSEs).

It was agreed to postpone more detailed discussion to allow the Co-Chairs to gather specific advice from the other TTs, and to consider an initial set of priorities (see Item 9, [Follow-Up on Modelling Discussion](#)).

Action 10 *Finalisation of the M&DA TT members and sign off by SC Co-Chairs [M&DA Co-Chairs, Nov 2015]*

Action 11 *Convene first M&DA TT meeting [M&DA TT Co-Chairs, Dec 2015]*

4 (vi) Western Pacific Small Group Report

The Chair of the small group, Ken Ando introduced this item. He noted that the main purpose was to report on the conclusions of the work undertaken by the Western Pacific Small Group (WPSG), (Action 13 from SC-1), and to provide a proposal for future activities. In doing so, the presentation also covered issues around the future of the TRITON array. The Western Pacific Small Group comprised a subset of SC members, but the intersessional work drew in contributions and expertise from elsewhere.

The Small Group's initial task was to document the existing activities in the Western Pacific. There would be benefits to all by joining these activities together as an integrated whole, including connecting up the science rationales. Such integration may raise opportunities for greater collaboration, and could also lead to discussions about what a sustained regional observing system for the Western Pacific could look like post 2020. Ken Ando's presentation touched on several of these activities including:

- The Southwest Pacific Ocean Circulation and Climate Experiment (SPICE);
- NPOCE (the Northwestern Pacific Ocean Circulation and Climate Experiment) program under CLIVAR;
- JMA activities, including the 137E and 165E North Pacific transects (as part of GO-SHIP);
- Various XBT and mooring lines maintained in the Indonesian Throughflow (ITF) (by the USA, Australia, China and France/Indonesia);
- Observations in the Indonesian Seas (see also Item 5(ii));

- Planned RCO/LIPI-IOCAS joint cruises (Dongliang Yuan's group);
- France (IRD) and Indonesian (IPB) joint observations;
- Argo deployments in the western Pacific; and
- The TRITON array.

The US, Japan, China, Australia, Indonesia and the Republic of Korea all have plans at various stages of development relevant to the TPOS 2020 period, and beyond. Engagement with SE Asian agencies in these research activities was a strong theme (e.g. Indonesia, Philippines).

In terms of future directions, the WPSG noted the following:

- The WPSG canvassed options for next steps at its August videoconference, noting that these seemed to range from a lower-key coordination task group to a more ambitious project proposal task;
- The issue of coordination of ship time (short- and long-term) is a priority. The WPSG Report highlighted the opportunities for better coordination and cooperation and that NPOCE, SPICE, YMC and the WESTPAC-led Cooperative Studies of the Kuroshio (CSK) feasibility study might provide a foundation upon which a more substantial collective effort might be built;
- The WPSG noted that (a) a potential high-level State Oceanic Administration (SOA) and NOAA meeting and (b) a delayed China-Japan-RoK high-level officials' workshop (possibly Q1 2016 in Qingdao, China) do provide opportunities to engage, and supported investigating both these opportunities;
- The Solomon Islands research and SPICE could be important contribution to a process study;
- The general there was agreement in the WPSG that a more connected, coordinated effort in the Western Pacific would be a good thing.

The SC broadly supported these conclusions, noting the links to the ITF work and Indian Ocean GOOS/Indian Ocean Panel, and to the Years of the Maritime Continent (YMC) study (see Item 5(ii)). The interest and drivers (scientific and societal) are diverse, which is likely a positive for a Project like TPOS 2020. There is potential to test new technologies (e.g., micro-floats, JAMSTEC TRITON) and strong relevance to intraseasonal timescales (e.g., monitoring and forecasting the Madden-Julian Oscillation).

The Steering Committee tasked a small sessional group to review and, as appropriate, revise the proposed terms of reference contained in the paper and return under Item 9 with a proposal (see Decision 1. Actions for TRITON were also postponed until Item 9 (Action 32, Action 33).

4 (vii) Cross-cutting issues, general discussion

The discussions were brought together under Item 9.

5. TPOS CONTRIBUTIONS AND RELATED ACTIVITIES

5 (i) Deep ocean observations

Dean Roemmich introduced the associated paper. He provided some background on existing elements such as GO-SHIP and on the Deep Ocean Observing Strategy (DOOS) which is under consideration as a Global Ocean Observing System (GOOS) project. The draft DOOS report has been available for 18 months, and has drawn comments from community experts, but is not yet finalized (SC-1 Action 17 requested SC members to consider TPOS needs in the context of DOOS Strategy).

A key component of DOOS is Deep Argo, the global extension of the Argo Program to the ocean bottom. A Deep Argo Implementation Planning meeting was held in May 2015, and a draft report is available at <http://www.argo.ucsd.edu/DAIW1report.pdf>. Dean discussed available technologies and noted that the current plan is for around 1228 Deep Argo floats at a resolution of 5° x 5° globally in waters deeper than 2000 m, in order to observe ocean climate signals (temperature, salinity, density) in the deep sea, with adequate signal-to-noise ratio, on interannual and longer timescales.

As noted in the paper, there is certainly common ground with DOOS, for example in understanding tropical Pacific variability and predictability, and as noted, the deep ocean should not be excluded *a priori* as irrelevant to ENSO's decadal modulation. In the context of ENSO variability, Dean showed an example of coherence between the upper ocean (less than 500m) and the deep ocean. The opportunity exists for TPOS 2020 to help define the requirements and technologies of a top-to-bottom tropical Pacific Ocean observing system. Members noted that this consideration should include the deep ocean circulation.

With respect to potential actions, the SC noted that GO-SHIP is already embedded in the Backbone initial design and that we expect its role to be endorsed within that context. DOOS planning is the responsibility of the GOOS Steering Committee and any coordination issues with TPOS 2020 can be picked up through this common sponsor.

The SC agreed that TPOS should be seamless with respect to upper and deep ocean requirements, with most of the responsibility falling to the BB TT. The adequacy of the proposed Deep Argo array for meeting TPOS objectives should be picked up by the BB TT, noting that the "Wyrki Challenge" might provide a useful unifying framework. Both the BB TT and Western Pacific Task Teams (WP TT) should consider requirements for deep ocean sampling that might utilize tropical Pacific moorings (for example, sea level budget, calibration).

Action 12 Consider requirements relevant to, and the adequacy of, the proposed Deep Argo Array for meeting TPOS objectives [Backbone Task Team, Oct 2016].

Action 13 Develop guidance on requirements for deep ocean sampling, utilizing tropical Pacific moorings as appropriate [Backbone Task Team, Oct 2016].

5 (ii) Years of the Maritime Continent

Harry Hendon introduced the paper, co-authored by Chidong Zhang (PBL TT) and Matthew Wheeler (BB TT). The Years of the Maritime Continent (YMC) experiment (2017-18) focuses on the Indonesian Archipelago, a unique mixture of land and ocean processes occurring roughly between 100-160E, and time scales of several days to several months (see http://www.bmkg.go.id/ymc/Scientific_Background.bmkg for further background).

The science will be organised around five themes: (i) Atmospheric Convection, (ii) Upper-Ocean Processes and Air-Sea Interaction, (iii) Stratosphere-Troposphere Interaction, (iv) Aerosols, and (v) Prediction improvement. The activities will centre around (1) Data Sharing; (2) a Field Campaign; (3) Modelling; (4) Prediction and Applications; and (5) Outreach and Capacity Building. The connections to TPOS arise through goals (ii) and (v), and activities under (1)-(3).

Through Chidong Zhang, the PBL TT has already explored a strawman that would span issues of common interest, such as around locations that need long-term observations of the ocean and air-sea interface and around feasibility studies.

Much of the discussion focused on the potential overlaps, and the concern that the Western Pacific may not be of interest to the YMC. The SC noted the significant atmospheric elements and suggested that joint process studies would provide a mechanism to engage with the atmospheric community.

Dr Yukio Masumoto provided some background on EIOURI, an international research initiative, under CLIVAR/Indian Ocean Panel-IMBER/SIBER, focusing on physical and biogeochemical/ecological aspects of the upwelling systems in the eastern Indian Ocean, and addressing the research avenue towards the sustainable development in the region. The Eastern Ocean Upwelling Research Initiative (EIOURI) is one of the core projects of International Indian Ocean Expedition-2 (IIOE-2), with an overlapping target period of 2015-2020. A pilot observation cruise has been conducted, and more research cruises are being planned. There are clear links to both YMC and TPOS 2020.

The SC reaffirmed its interest in collaborating with the YMC and concluded that this should be explored through a joint study. A small group was asked to look at the scope and possible composition of this study team (see (1) Years of the Maritime Continent Joint Working Group under Item 9). Both Weidong Yu and Chidong Zhang would be at the November YMC meeting in Jakarta and could present our ideas for joint work.

5 (iii) GOOS/GCOS General, Expert Panels, AtlantOS

Katy Hill introduced this Item, on behalf of Eric Lindstrom (GOOS SC Co-Chair) John Gunn (SC Co-Chair) and Albert Fischer (GOOS Director). The presentation included the GOOS (structure of their work; the Framework for Ocean Observations; strategic mapping; and Essential Ocean Variables/EOVs), GCOS (delivery to Services; the next Implementation Plan) and regional activities (AtlantOs, the Southern Ocean Observing System (SOOS)).

GOOS is working to implement the Framework globally, through setting requirements for EOVs, and clearer development of network missions and targets. In the Framework, the scientific and societal drivers (including operational needs) are represented by three layers

(in order): (1) the information needs of these ultimate users, (2) the implications of the needs in terms of what to measure, and (3) translating this in terms of requirements of the EOVs. Layer (1) is the ultimate determinant of priorities; in research this is often represented by a set of goals/objectives. Outside research it is user uptake and impact. Successive layers then refine these priorities in terms of measurements and observations. The solutions are then provided by a combination of different observing networks, though this is sometimes also referred to as requirements of ocean or network sampling; for example, “TPOS requirements for deep ocean sampling”. In practice many other factors need to be taken into account, including models and data assimilation.

The AtlantOS and SOOS projects have placed emphasis initially on the Framework and setting requirements for EOVs, whereas TPOS (through the strawmen) has started work at the solutions (networks) and is working back through the other levels (1 through 3 above).

The GOOS Co-Chair noted that it is possible to start at a variety of places in the Framework, so long as there is consistency and an evidence base for the final design, which should include all requirement layers.

The presentation noted that GOOS and Global Observing System for Climate (GCOS) provide support to TPOS 2020 through international coordination and connections to other programmes. The intergovernmental links through GCOS and GOOS can also be used to support the development of the Resources Forum at the IOC and WMO assemblies.

5 (iv) CLIVAR

The Co-Chairs noted that this was an unscripted item and that while there were no supporting documents provided to SC-2, there had been a number of email exchanges between members of the SC. The Item provided an opportunity to think more deeply about the links to/from TPOS 2020 from/to the research community, WCRP, and CLIVAR in particular; noting that these links were the subject of extensive discussion at SC-1. Moreover, given the presence of Dr Wenju Cai (CSIRO focal point for TPOS 2020, and deeply involved with the CLIVAR research program), the Item provided an opportunity to explore requirements from the perspective of decadal and longer time scales.

Dr Cai opened the dialogue by discussing some of the properties that reveal whether a model is good or not, and noted that there is a strong relationship to our understanding of processes. Climate change projections and predictions, with the levels of complexity forever increasing, are providing severe challenges in terms of our ability to test and validate models and the mechanisms and processes that are captured by those models. As an example, he noted that many CMIP5-class models had major errors in the Indian Ocean, often with the east-west slope in the opposite direction to that observed. He also noted the uncertainty around the role of salinity and the degree to which its variability needs to be represented realistically, particularly around the barrier layer

A number of SC members emphasised that TPOS 2020 has a challenge to provide an observing system that will support model improvement effort. The research communities focus on convection will assist improved understanding of the barrier layer.

Additional item: Discussion of 2015 ENSO

The Steering Committee added this item largely for information. Dr Andrew Marshall (CSIRO) joined the meeting and provided an update on the state of the Pacific and Indian Oceans, and on the success of models in predicting the current El Niño.

The sub-surface ocean began warming in March as a consequence of three Madden-Julian Oscillation (MJO) events which triggered down-welling Kelvin Waves which propagated eastward. Sea Surface Temperatures (SSTs) in the central to eastern tropical Pacific continue to warm, further entrenching El Niño, while waters south of Indonesia have cooled, strengthening the positive Indian Ocean Dipole. So far, the 2015 El Niño is the strongest seen since 1997 and bears a number of similarities to that event. The strong El Niño is expected to last until at least the end of the year before declining in the first quarter of 2016.

Coupled prediction models have largely provided a reliable forecast of the growth of this El Niño once the westerly wind burst events were captured in the initial conditions (March/April). By contrast, these same systems faltered in 2014, continuing to predict and event until May-June. It appears that intraseasonal variability is a factor in this different skill. It is not clear whether the present observing system (including atmospheric observations like Outward-going Longwave radiation/OLR) is adequate for intraseasonal timescales.

The SC noted that, while the SC-1 highlighted intraseasonal variability as a key factor in determining requirements, this session had not included an item dedicated to this topic. The 2015 ENSO makes it clear that this should be a priority.

Action 14 Schedule a discussion on the observational requirements arising from tropical Pacific intraseasonal variability and predictability [TPOS 2020 SC Co-Chairs, Mar 2016].

Dean Roemmich provide some additional slides on salinity variability through the build up to, and evolution of the 2015 El Niño. It seems clear that further analysis is required on this aspect also.

5 (v) SPURS-2

Tom Farrar introduced the Salinity Process in the Upper Ocean Regional Study (SPURS). The second mission, SPURS-2 is located in the NE Pacific, around 12N, 125W in a salinity minimum and divergent (upwelling) ocean zone. The freshwater balance is precipitation dominated (buoyancy gain) leading to a shallow mixed layer and thermocline. There is strong mean advection and a large annual cycle.

There are a number of observational challenges:

- Strong seasonal variability of SSS and rainfall
- Swift currents and rapidly shifting fronts make combined Eulerian/Lagrangian observations challenging
- Strong advection, with strong depth dependence
- Precipitation is patchy

The experiment relies on the existing tropical Pacific observing system and temporarily extends the system to the ITCZ; Tom noted that, in his view, the site is worth considering for sustained occupation and provides one model for the 'supersite' concept that has arisen in

both the Planetary Boundary Layer and Eastern Pacific Task Team strawmen. SPURS also provides a near-term opportunity to test new technologies that might be deployed for TPOS 2020 against proven climate-quality systems (for example, direct covariance fluxes, gliders, wavegliders, prawler moorings, hydrophone rain gauges, saildrones). The ITCZ region was identified as a region in need of monitoring. SPURS can offer guidance on developing these plans (see also “(4) Double ITCZ process study” under Item 9).

5 (vi) Update on satellite observations

Dr Eric Lindstrom (NASA, USA) provided an update on NASA satellite plans relevant to TPOS (see Appendix 5). He reinforced the need to integrate satellite requirements into the design, a message that has been heeded by TPOS Task Teams.

Eric noted his responsibility for continuity of satellite missions and that for satellite winds/wind stress, Frank Wentz has been tasked with providing guidance. Mark Bourassa (Co-Chair of the Ocean Observations for Climate Predictions (OOPC) is also engaged with this work. He invited TPOS 2020 to provide input to this work, particularly around the role of *in situ* observations for continuity and systematic wind stress errors that are appearing in various products. Eric noted that future satellite vector wind missions were less certain than required by the climate community and TPOS-2020; in view of the centrality of satellite winds to TPOS-2020 planning, we need to be vocal in expressing our concerns. The SC referred to issues surrounding rain contamination of data and were informed that future dual-polar instruments might provide a work around. Again, Eric encouraged TPOS 2020 to carefully articulate future requirements.

Action 15 *Based on the available Wentz Report outline, and direct engagement with the study authors, develop a TPOS 2020 submission for the Report [Tom Farrar, with assistance from Yolande Serra and Tony Lee, as required; Nov 2015].*

The SC drew attention to the insecure provision of microwave SST data and were encouraged to provide advice on the importance of such products in the tropical Pacific.

In response to a question around precipitation products, Eric noted that much of the focus of water cycle research is over land and that the needs of oceanography have received far less attention. Again, there is an opportunity to advocate for Tropical Pacific needs.

Finally, Eric noted that the US National Research Council is looking to provide recommendations to NASA for its portfolio of missions for the 2020-2030 period. An opportunity to provide submissions to NRC is open until the end of 2015. White papers of 1500 words will be used to inform the new US National Academy of Sciences Decadal Survey on Earth Sciences. Eric encouraged advocacy of satellite wind measurements that are robust in convective regions (not susceptible to rain contamination). TPOS should provide some report on its needs for satellites as it may help drive decisions for the long term.

Action 16 *Develop a white paper submission on TPOS requirements for the new US National Academy of Sciences Decadal Survey on Earth Sciences [Tom Farrar, Dec 2015].*

National Initiatives

5 (vii) CHINA: Update on activities

Dr Weidong Yu provided a brief update. The State Oceanographic Administration is undergoing a major restructure and this places a number of the ideas discussed last year on hold. The situation should be clearer in 2016. Dr Yu noted the appointment of a new Administrator, but there had not yet been an opportunity for a briefing on TPOS 2020. He also drew the attention of the Steering Committee to opportunities that might arise from a likely NOAA-SOA bilateral meeting later this year (or early next), and from a Japan-China-Republic of Korea high-level workshop scheduled early next year (see also the paper for Item 5(vi)). The Steering Committee that it was willing to assist in the preparation of briefing material if requested.

Dr Yu also drew attention to the efficiency and effectiveness of the Resources Forum that does not seem to be meeting its expectations. In this context, he noted that SOA was willing to look at options for assisting in the maintenance of the remaining TRITON moorings.

The Co-Chair concluded by recognizing the commitment of the First Institute for Oceanography to support of the DPO; such a contribution should strengthen engagement with Northwest Pacific partners.

5 (viii) REPUBLIC OF KOREA: Initiatives and the new vessel “Isabu”

Dr Dongchull Jeon spoke to this Item. He provided a brief background on the new R/V “Isabu”, noting that it would be undergoing tests and trials during the first of 2016 and should commence operations around June 2016. At this time, a budget has been identified for the academic community’s use of the vessel, but not for KIOST. It is likely to spend around 50% of its time in the Pacific and potentially could contribute to a number of TPOS 2020 activities. Dr Jeon further noted the “Onnuri” would remain funded for operations (for example, for its Chile cooperative study), and that the Antarctic supply vessel “Araon” might also provide some opportunities.

Dr Jeon noted the capabilities of the GOCI-2 satellite mission (2018-19) which will provide full ocean color for the western Pacific. He also provided some details of the GIAI project with the University of Hawaii (Kelvin Richards).

5 (ix) AUSTRALIA: Integrated Marine Observing System

Tim Moltmann provided a presentation on the Integrated Marine Observing System (IMOS), for which he is the Director. IMOS is one of the Australian national research infrastructure capabilities and has been routinely operating since 2006 maintaining a wide range of observing equipment throughout Australia’s coastal and open oceans, making all of its data accessible to the marine and climate science community. Given the importance of the Tropical Pacific for seasonal forecasting and climate research in Australia, it is natural for

IMOS to take a keen interest in TPOS 2020. (IMOS provides TPOS 2020 DPO node support.)

IMOS is now one of the Global Regional Alliances (GRA) within GOOS (Tim is now Chair of the GRA Forum) and has drawn broadly on the GOOS approach. He noted the importance of identifying priorities and that the IMOS Nodes which guide science planning undertaken collaboratively across the Australian marine and climate science community, have ensured a user-driven approach to priority setting. He also noted the importance of “readiness” and the need to balance this against the need for robustness and surety.

5 (x) USA: NOAA solicitation

Kathy Tedesco briefly described the NOAA solicitation for funding proposals for “In Situ Technologies to Contribute to the Tropical Pacific Observing System (TPOS 2020) Project”. The solicitation aims to advance the readiness of in situ observing platforms (e.g. floats, gliders, moorings) for sustained deployment. The focus is on the measurement of Essential Ocean Variables (EOVs) as defined in “A Framework for Ocean Observing (FOO)” to provide information needed to detect, track and attribute, either directly or using models, changes in the physical and biogeochemical systems of the tropical Pacific.

Full proposals were due 23 September 2015 and selected projects will start around July 2016. The funding level is around \$500,000 per year (up to 3 years) and 2-4 projects are expected to be supported.

Session 3: *Project Execution and Engagement*

6. PROJECT OPERATION AND ENGAGEMENT

Andrea McCurdy provided an abbreviated presentation on the implementation of the Project, the activities of the Distributed Project Office, and on the draft engagement plan. She pointed to the availability of information on the www.tpos2020.org website and requested participants complete a short survey to provide feedback on its effectiveness. A number noted verbally that it was not always easy to identify the major activities, or to follow progress. For products like the PBL survey, it is important that there is a clear way to access the information.

Action 17 The DPO to lead a small group looking at ways to improve web access to key materials and communications [A McCurdy, Mar 2016].

Andrea also referred to the important communication role of the Monthly Status Reports and noted the development of an Integrated Master Schedule to support the Project. In particular, Gantt Charts (or equivalent) would be developed and monitored in order to coordinate activities and follow progress (also see discussion on schedules under Item 9).

As part of this presentation an overview of project sponsorship was delivered. While almost all of the non-NOAA SC Members time and travel were generously supported by their home institutions, it was noted that this year the NOAA Climate Office Division provided travel support for the non-SC Member, Task Team Co-Chairs to attend the SC-2. This was in addition to providing travel support for the Backbone TT face-to-face meeting in Noumea a month earlier (hosted at the Institut de Recherche pour le Développement (IRD)), which was

also generously supported by PACE-Net.) Additional travel was provided throughout the year by NASA. The Intergovernmental Oceanographic Commission (IOC) also provided critical support for SC member Ken Takahashi.

Andrea noted the importance of the distributed inputs to the DPO and thanked NOAA, PMEL, IMOS and (soon) the First Institute of Oceanography for their input. The Steering Committee, and in particular the Task Team Co-Chairs, expressed their appreciation for the strong support.

The Engagement Plan sets out the goal of TPOS 2020 engagement and the general approach that is being taken. The approach is not overly formal to avoid burdening the participants with unnecessary complexity and bureaucracy. To achieve alignment with the shared goals, TPOS 2020 will adopt activities as described by stages in the internal project document titled the “TPOS 2020 Engagement Action Plan.” It is proposed that these activities are conducted under the guidance of a group of stakeholders focused on the successful outcomes of TPOS 2020, the Engagement Advisory Panel. The SC Committee endorsed this approach.

7. INITIAL ASSESSMENT OF PROGRESS AND ACHIEVEMENTS

The Co-Chairs opened this item by referring to the questions posed within the annotated agenda, and remarked that, through the course of the discussions thus far, many of the concerns around the effectiveness of the Committee and its Task Teams had abated.

The Co-Chairs invited two of the external stakeholders, David Legler (NOAA and Chair of the JCOMM Observations Program Area) and Tim Moltmann (IMOS and Chair of the GOOS Regional Alliances) to provide their impressions. Neither attempted to provide a comprehensive response to the questions but rather used them to frame their input.

David noted that the level of engagement at the scientific level was a positive and that the Task Teams were generally making good progress (the Western Pacific and Modelling and Data Assimilation TTs were not yet fully developed). The approaches of the Task Teams were diverse creating some challenges for the SC to harmonise the various inputs. The concepts of readiness and fitness-for-purpose, as well as the methodology for setting priorities would be very important. As a program manager, he is looking to the SC for ideas and guidance on priorities: he can help if there is an orderly and transparent process. The SC needs to manage expectations and provide greater visibility of the expected milestones.

Tim Moltmann reinforced a number of these points. TPOS 2020 is different and unique and the different approaches have been on full display. More focus is needed on the research and operational requirements. Prioritisation is required if TPOS 2020 is to have influence and he suggested members of the TPOS Resources Forum may be able to assist. He noted that while we have a number of observational networks operating in the tropical Pacific, the Observing System does not yet exist. He noted the absence of discussion of data management and synthesis and suggested this may need to become a focus as plans are produced. Finally, he noted that societal benefits should be articulated.

The SC was comfortable that the Project was largely on track and was garnering interest and engagement appropriate to its status as a major international project. The organisational

structure (SC, Task Teams, studies, all supported by the DPO) seems appropriate. The SC recognized that the level of engagement across the major stakeholder varied, and that more needed to be done to grow the participation.

8. TPOS 2020 TARGETS

The Co-Chairs introduced the paper for this item. The subsequent discussions did identify a number of points, some of which are picked up under Item 9.

These included:

- Uncertainty around the deliverables of TPOS 2020;
- Facilitation of cooperation among the Task Teams;
- The schedule of work and major milestones;
- The distribution of responsibilities for major products such as the initial Backbone report;
- The approach to ensuring quality of outputs; and
- Efficient and effective coordination among the Co-Chairs

The Steering Committee agreed the initial draft of nine metrics provided a good starting point, but that further detail on targets and time would be needed.

Action 18 The draft TPOS 2020 performance metrics to be further elaborated to include specific milestones and targets [N Smith, A McCurdy, March 2016].

9. GENERAL DISCUSSION

SEQUENCE OF MAJOR OUTPUTS FROM TPOS 2020

The discussion under items 7 and 8 exposed significant uncertainty around the timeline for delivery of TPOS 2020 outputs and outcomes. While it is self-evident that the closure of the Project would be accompanied by a final report, including on the benefits realised, it was less clear to SC members how that point would be reached.

The Co-Chairs outlined a staged process, with an initial “Interim Report” published in 2016; a Mid-term Report publish in 2018, and a Final Report with the closure of the Project in 2020 (see Figure 1). The Interim Report would contain initial recommendations for the design of the Backbone (an outline was given at this meeting), but also a synopsis of initial results and plans for the various initiatives sponsored by TPOS 2020.

The Co-Chairs noted that nothing is “final” until 2020 but that interim reports or updates should progressively guide stakeholders on recommended changes, with indications on the degree of confidence (certainty). Within this context of phased reports, the Backbone Task Team can be regarded as the focus of consolidation and prioritisation, with the other Teams leading innovation and change.

It is important to note that the Project is more than the Backbone design. Various initiatives sponsored by all the Task Teams (or the SC) will test new ideas (approaches, technology, etc.) and provide the foundations for change. More importantly they will provide points of engagement with the scientific community and users as TPOS 2020 evolves.

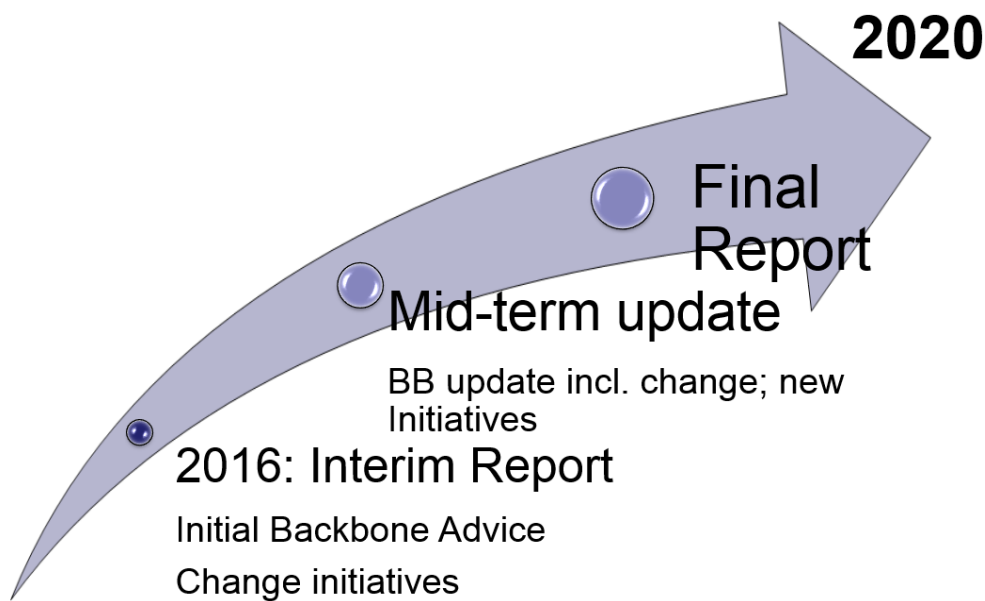


Figure 1. Schematic of likely reporting timeline.

Action 19 *The extended Steering Committee should provide an elaboration of the reporting schedule (Figure 1) that includes major milestones down to the level of Task Teams [SC Co-Chairs, TT Co-Chairs, DPO; March 2016]*

THE PROCESS OF TRANSITION

The above discussion led naturally to a discussion of the process for transition which had not been discussed at the La Jolla Workshop or at any TPOS 2020 meeting since.

The Co-Chairs provided an initial sketch of how transition might work (see Figure 2) but noted that any process would require consultation and discussion with TPOS stakeholders including GCOS, GOOS, the Joint Technical Commission for Marine Meteorology (JCOMM), Climate Variability and Predictability Program (CLIVAR), among others.

Initial thoughts suggest the transition process should be initiated at around the time of the publication of the Interim Report (late 2016). Change management/transition should be in place in parallel with the staged delivery of advice. From that point onward, a variety of stakeholders will be contemplating, perhaps even reacting to the recommendations, despite their nature as “interim” advice. Implementation is likely to lag the recommendations on design by around two years, with the handover of responsibility occurring progressively from 2016 through to 2020.

The SC emphasised the need to identify and manage risks associated with the transition process, such as insufficient overlap of old and new networks and inadequate resources for transition. Since the degradation of TRITON is already of considerable concern, steps should be taken quickly to identify and where possible mitigate current risks.

Governance responsibilities will need to be clarified but we might anticipate TPOS 2020 sharing responsibility with the community responsible for implementation (e.g. JCOMM).

Governance will also undergo change, transitioning from Project to business-as-usual governance.

The final report will include the completed design but probably also research/technical initiatives and collaboration arrangements that will transition to other governance arrangements. The form of the governance arrangements beyond 2020 is unknown but the Steering Committee feels strongly that it must be of a form that will maintain strong cooperation for the Tropical Pacific region.

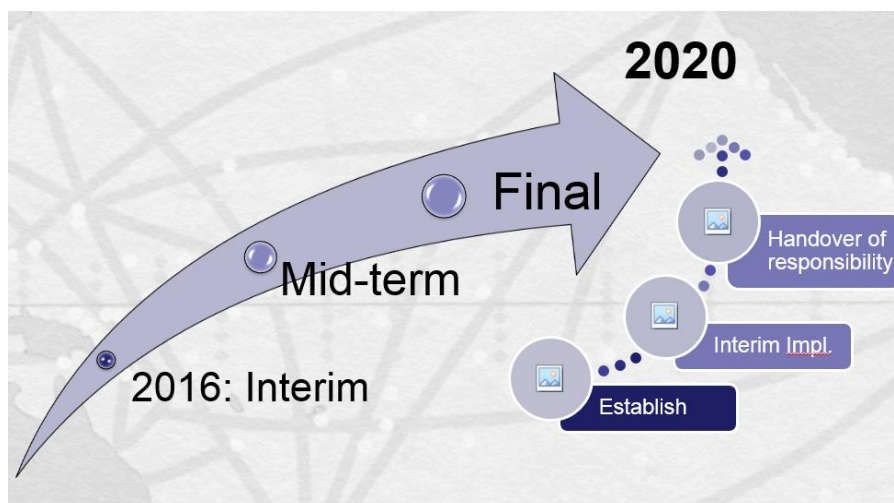


Figure 2. Schematic of the transition process.

Action 20 *A paper on a possible TPOS 2020 transition process should be developed, initially in consultation with GOOS and JCOMM [Smith, Legler, Lindstrom; March 2016]*

THE BACKBONE REVIEW PROCESS

The discussion arose from the BB TT presentation and questions of process for review, but it is conceivable other aspects of TPOS 2020 work might be subject to similar review.

The Co-Chairs outlined a possible process, drawing on the IPCC procedures, but much lighter. Like the Intergovernmental Panel on Climate Change (IPCC) Review Reports, there might be 3 or 4 stages in the drafting process, from a zero-order draft and outline, through 1st and 2nd drafts with different levels of review, and a final draft approved by the SC. The zero and 1st order drafts would largely be managed at the task Team level, while the 2nd order and final draft would be coordinated at the level of the Steering Committee.

After some discussion it was agreed that an author team should be identified for major reports. In the case of the initial Backbone Report, the BB Task Team Co-Chairs would act as Coordinating Lead Authors, with 6-8 supporting Lead Authors drawn from the BB and other Task Teams. A diversity of views and expertise should be present. Other Task Team members, members of the Steering Committee, and other experts can be called on to contribute. While the IPCC nomenclature is convenient, this process should not be confused with the formal intergovernmental procedures of the IPCC which are not appropriate to the TPOS 2020 process. However, as with the IPCC procedures, providing some formality around the authorship and responsibilities delivers clarity and transparency for stakeholders.

Review of 1st draft would be restricted to scientists and stakeholders with a strong connection to the subject matter (that is, experts in the field). Most if not all Task Teams will be involved with the drafting, but a number may also choose to be part of the review process. The experts will be selectively drawn from the community, including key research groups; the review of the 1st order draft will not engage the broad stakeholder community, but it will also not bar any interested party who wishes to provide input. The 1st draft is expected to be ready by around the end of February 2016. A window of around 6 weeks will be provided for reviews.

The 2nd draft is scheduled to be available in July 2016, and the Steering Committee will progressively take the lead for the process (but not as Authors). The Review will be more extensive and reach out all external and internal stakeholders, as well as to focal points identified through the TPOS 2020 Resources Forum. As in IPCC, it is desirable to have a level of traceability and transparency to provide assurance that comments have been treated seriously. This does of course increase the burden for Authors, so an appropriate balance will need to be struck; an effective review process with traceability will create a more powerful and influential product. The review process should run no later than the last week of September to allow sufficient time for initial consideration of the comments prior to the Steering Committee meeting in October. That meeting can be used to reach consensus on any contentious issues.

While the initial guidance on the Backbone will be the major focus, the Interim Report should cover all activities of TPOS 2020, including key initiatives, outstanding science questions, and an indicative timeline for the remaining work of the TPOS 2020 Project. It should also provide an update on engagement and other activities of the resources Forum.

It is likely a small ‘executive team’ will be needed to guide the final stages of publication, which is likely to be toward the end of 2016. It will be important that the process is orderly and transparent and that expectations are managed appropriately. It is also important to note that many activities will be developed in parallel with this review process.

Action 21 The TPOS 2020 report review process should be described in a stand-alone document and circulated for comment by the extended Steering Committee and key stakeholders. [N Smith, Dec 2015]

Action 22 In consultation with the Backbone TT and other Task Teams as appropriate, a list of around 30 possible reviewers should be drawn up [DPO, Jan 2016]

Action 23 A list of 6-8 “lead authors” for the Initial Backbone Report to be drawn up based on nominations from the Task Team Co-Chairs. [SC Co-Chairs in consultation with TT Co-Chairs; Nov 2015].

ADDITIONAL BACKBONE MATTERS

The discussions under the PBL, BB and M&DA Task Team items (4(i), (iv) and (v)) reiterated the SC’s concerns around errors in wind and surface wind. The BB Task Team concluded that a rigorous assessment of the impact of a potentially refocused and reshaped tropical moored buoy on wind and surface flux estimates was required, as a matter of urgency. A small group from the PBL, EP TT and BGC TTs offered an alternative mooring array design option to the ones given by the BB TT, and the SC welcomed this input. All options in the Interim Report will be subject to a demanding requirements test. To reach the Backbone we

must focus on those elements which support broad objectives, from the shorter time and space scale of ocean prediction and intraseasonal variability, to the longer time and broader space scales of seasonal-to-interannual and decadal variability, and reflecting that we are referring to cornerstone/fundamental contributions to the overall system (see the Terms of Reference for the BB TT). The structure of the author team for the Interim report ensures all perspectives can be taken into account.

Action 24 *The Backbone Task Team to draft a note for the Planetary Boundary Layer Task Team articulating their concerns around errors in wind and surface wind stress estimates [BB TT Co-Chairs, Oct 2015].*

Action 25 *The Planetary Boundary Layer Task Team to lead an additional study of the wind/wind stress and surface flux requirements, and of possible solutions, and to provide recommendations for consideration in the Backbone Interim Report [PBL TT Co-Chairs, Jan 2016].*

The SC agreed that TPOS 2020 should seek opportunities to have various backbone options assessed by the ocean and climate modelling and data assimilation communities. The upcoming GOV meeting (2-6 Nov Sydney) provided an early opportunity to expose our initial thinking (see Action 35). Further opportunities in the GOV and AtlantOs work programs were also discussed.

The SC expressed strong interest in the strawman “Wyrki’s Challenge revisited” and agreed that an appropriate initial step would be to test the approach in a suitable high-resolution ocean model. This idea, along with the proposed ARMOR-3D work would be included in the paper presented at the GOV meeting.

The BB TT raised concern about surface waves and inundation forecasting. Quite clearly both are important for the Pacific Island Countries and for others vulnerable to change. The SC noted that JCOMM has responsibility for such services and that an upcoming symposium and workshop (8-13 Nov, Florida, USA) on storm surges and wave hindcasting and forecasting will address a number of related issues. The JCOMM Expert Team on Waves and Coastal Hazards’ Forecasting Systems brings together relevant expertise from the operational and research communities.

At this time the SC believes observations related to impacts or vulnerabilities are out scope, but did note that GCOS has been considering such requirements.

Action 26 *Seek a point of contact for advice on waves [Katy Hill, David Legler, by Oct 2015].*

The PBL TT will take the lead for developing advice.

PLANETARY BOUNDARY LAYER STUDIES

The strawman exercise generated a number of ideas on potential studies and experiments. Given the significant overlap across the Task Teams, the Steering Committee postponed decisions on future actions (Item 9 Discussion) until all Task Team presentations had been completed and the TPOS contributions under Agenda Item 5 had been presented.

(1) Years of the Maritime Continent Joint Working Group

The Years of the Maritime Continent (YMC) Working Group (TMC WG) would develop the overlap with the YMC (see Agenda Item 5(ii)) as a pilot study for TPOS, guiding TPOS 2020 development based upon the lessons learned from the YMC. These lessons will include determination of robust new technologies for platforms and sensors that might be incorporated into the TPOS of 2020, and better understanding of what TPOS observations are needed for improved MJO forecasts. The YMS WG would also help guide the TPOS redesign for better weather and extended range forecasts on 3-100 day timescales, which are likely to depend upon air-sea interaction in the Western Pacific associated with MJO and Tropical Cyclones. The early draft of a PBL strawman was led by Chidong Zhang, so there is already good alignment and an outline of possible joint activities.

Potential Members: Chidong Zhang, Chris Fairall, Harry Hendon, Ken Ando, Yukio Masumoto, Iwao Ueki, Jae Hak Lee, Meghan Cronin, Tom Farrar (chair(s) to be confirmed).

Action 27 The Steering Committee agrees to create a joint Working Group with YMC, with the scope and membership as above and subject to agreement with the YMC, and reporting through the PBL [PBL TT Co-Chairs proposal to YMC through Weidong Yu, Nov 2015].

Action 28 An elaborated outline of possible joint work on the YMC to be developed [PBL TT Co-Chairs, Mar 2016].

(2) Diurnal cycle

As discussed at La Jolla and at TPOS 2020 SC-1, the diurnal cycle has emerged as a high priority within the initial considerations of the future observing system. The PBL TT have developed a strawman around this theme, focusing on the role of the diurnal cycle in transmitting surface momentum fluxes into the thermocline and how day-night asymmetry of the SST diurnal cycle leads to low-frequency signals in SST. PBL TT meetings and the survey revealed modeling center interest in having more detailed observations of the upper-ocean diurnal cycle to constrain model parameters and test underlying assumptions of parameterizations.

The SC confirmed this priority and requested the PBL TT to further develop the strawman into a pilot research project with the aim of refining advice for the TPOS strategy for observations and any associated initiatives and coordination, including for technology development. The SC noted that other TTs will have an interest and that their expertise should be drawn in as appropriate. In developing the pilot project, consideration should be given to the schedule of milestones, particularly in relation to the Backbone, and to the composition and leadership of the associated project team.

Action 29 Develop a project outline around diurnal-multiscale variability, including scope, rationale within the context of TPOS, goals and possible participation [PBL TT Co-Chairs, March 2016]

(3) Equatorial Pacific Upwelling and Mixing Physics (PUMP)

The relative roles of upwelling and mixing in the eastern equatorial Pacific, their spatial temporal variability, and dynamical mechanisms remain poorly understood and poorly constrained in climate models. Both the EP TT and PBL TTs have discussed strawman

around this general idea and the latter have written down some early ideas on scientific issues.

The SC has been attracted to this idea from the outset and has noted that the integration challenge, particularly with respect to biogeochemistry, would be informed by progress in this area. The SC confirmed their strong interest in such a potentially multiyear sub-project and noted the cross-TPOS interest. It asked the PBL TT to lead further development of the ideas into a pilot research project, in collaboration with the BGC TT and EP TTS, with the aim of refining advice for the TPOS strategy for observations and any associated initiatives and coordination, including for technology development. In developing the pilot project, consideration should be given to the schedule of milestones, particularly in relation to the Backbone, and to the composition and leadership of the associated project team.

Action 30 Develop a project outline around the interplay of equatorial Pacific upwelling and mixing, including scope; rationale within the context of TPOS; goals; and possible participation [PBL, EP, BGC TT Co-Chairs, March 2016]

(4) Double ITCZ process study

A double ITCZ (Inter Tropical Convergence Zone) is a persistent bias in climate models, especially in the SE Pacific. Both the PBL TT and EP TTs have developed strawmen around these ideas, with the latter providing additional detail on connections with the cold tongue and warm pool, and the relationship with stratus clouds. A weaker SE Pacific ITCZ is observed in March-April and better observations are needed of the 3D latent heating and vertical velocity and of the relation to surface/ocean properties. Considerable emphasis is given to the atmospheric aspects of the issue, including the need for an aircraft-based process study to complement sustained observations. Some of the ideas put forward include shipboard observations on research cruises; continued maintenance of the 95W TAO line; development of a climatology with radiosondes/remote sensing; deployment of a scanning precipitation radar; and development of a Galapagos profiling station.

The Steering Committee saw great potential in such a project, particularly for its ability to engage regional scientists (eastern Pacific) and atmospheric experts. It asked the Eastern Pacific Task Team to lead further development of the ideas into a pilot research project, in collaboration with the BGC TT and PBL TTs, with the aim of refining advice for the TPOS strategy for observations and any associated initiatives and coordination, including for technology development. In this last respect, SPURS-2 will be an important study. In developing the pilot project, consideration should be given to the schedule of milestones, particularly in relation to the Backbone, and to the composition and leadership of the associated project team.

Action 31 Develop a project outline around the concept of a double ITCZ process study, including scope; rationale within the context of TPOS; goals; and possible participation [EP TT Co-Chairs, March 2016]

WESTERN PACIFIC TASK TEAM

A small intra-session group reviewed the draft terms of reference as provided in the paper for Item 4(vi), noting some concerns around the order. The SC agreed to the revised proposal. The Steering Committee welcomed Dr Ken Ando's offer to be the Co-Chair from

the TPOS TC and supported his suggestion to contact Alex Ganachaud as a possible Co-Chair.

Decision 1. The Steering Committee agrees to create a Western Pacific Task Team with the Terms of Reference as given in Appendix 4.

The Committee also returned to the important question of how risks to the remaining Western Pacific moorings might be alleviated. The TPOS 2020 SC agreed to:

- (a) more broadly raise the issue of the decay in TRITON and the disruption this will cause to ENSO and longer-time climate data;
- (b) more clearly articulate the short-term requirement (mooring build options/needs, ship requirements), focusing initially on the 2017 period; and
- (c) develop a brief communique on the issue for distribution among TPOS participants and stakeholders.

Action 32 Develop a communique on the risks arising from fewer TRITON moorings, including the disruption to the climate data record, for distribution among TPOS participants and stakeholders. [TPOS 2020 SC Co-Chairs, Ken Ando, Nov 2015]

Action 33 Develop a document on the short-term requirement for maintaining the TRITON contribution (mooring build options/needs, ship requirements), focusing initially on the 2017 period, for circulation among TPOS 2020 participants and stakeholders [Ken Ando, Nov 2015]

FOLLOW-UP ON MODELLING DISCUSSION

Following the presentation under item 4(v), Steering Committee members and Task Team Co-Chairs were asked to consider potential initial foci for the M&DA TT. The Co-Chairs suggested that this consideration should include (a) the items presented by the M&DA TT Co-Chairs (see 4(v) presentation); (b) priorities articulated by SC-1 and captured in the Terms of Reference (see <http://tpos2020.org/meetings/task-team-3/#a>) and (c) matters raised in other Task Team papers. With respect to (c), the SC Co-Chairs recalled (among other references):

- The contribution of models to determining the specificity and integration of satellite observations into the Backbone;
- Understanding where and how models and data assimilation might alleviate the pressure on direct observations (e.g. see the survey responses);
- The use of ARMOR-3D for refining the Backbone design, and the role of models in synthesis;
- The need for data for developing coupled model data assimilation techniques;
- The need for guidance from observing sensitivity experiments (also see below);
- Analysis of model data and products to determine biogeochemistry observing strategies;
- The numerous references to modelling (positive and negative) in the Survey conducted by the PBL TT; and
- The role of models in the PBL TT and EP TT strawmen.

With respect to the latter, the SC agreed that Large Eddy Simulations and other modelling studies for PBL-led sub-projects such as the diurnal cycle would be best led out of these groups rather than the M&DA TT.

Dr Peter Oke (CSIRO, and Co-Chair of the GOV Observing System Experimentation Valuation Task Team; (OSEVal) joined the meeting to discuss these issues. He noted that GOV now has a Task Team for Data Assimilation in addition to the Intercomparison and Validation and Coupled Modelling Task Teams which, together with OSEVal, provide opportunities for collaboration. He invited TPOS 2020 to articulate questions and potential OSE/OSSEs for consideration by OSEVal, with a view to results being evaluated at the OSEVal Workshop in late 2016. He also noted the rich information contained in the real-time data assimilation innovation records and associated metrics which are now maintained by most of the GOV systems.

The Steering Committee offered the following advice to the M&DA TT in terms of initial areas for focus:

- Give immediate attention to potential OSE/OSSE experiments that might be conducted in conjunction with GOV OSEVal, including the ARMOR-3D study (Backbone);
- Consider options for a more systematic approach to understanding biases (e.g., Vanni re et al (2014)), with satellite winds and SST as potential candidates (contributing to improved specificity for the Backbone);
- Through the PUMP pilot project or otherwise, seek avenues to improve understanding and modelling of coupling between the surface and the thermocline;
- Promote intercomparison studies on the assimilation of salinity in ocean and climate models;
- Examine options for improved understanding of errors and uncertainty in analyses and forecasts (ocean, coupled), including through GOV real-time data assimilation innovation records and associated metrics; and
- Examine options for a tropical ocean systematic errors workshop, involving observational, modelling and assimilation experts, perhaps in conjunction with WGCM and WGNE.

The SC also noted the requirement to provide advice, and facilitate discussions, between other Task Teams and the external modelling and data assimilation (e.g., on NWP systems for the Backbone; atmospheric modelling for the Eastern Pacific).

Action 34 Develop an initial work plan for the M&DA Task Team, drawing on the Terms of Reference, advice from the Steering Committee and ideas from the task Team members [M&DA Task Team Co-Chairs, March 2016].

VISIT TO R/V INVESTIGATOR

The meeting attendees were invited on a tour of the R/V *Investigator*, hosted by Ron Plaschke, Director of the Marine National Facility, and Toni Moate, CSIRO National Facilities and Collections Director, CSIRO.

10. SC-2 ACTIONS

KEY POINTS FOR GODAE OceanView STEERING COMMITTEE (NOV 2015)

- A number of possible joint actions were identified within the modelling discussion.
- Peter Oke noted there is potential to bring a number of activities forward but this would need some prioritisation from the TPOS side.
- The ARMOR-3D and “Wyrcki Challenge” studies should also be of interest to GOV.

Action 35 *Develop a brief paper for the GOV meeting 2-6 Nov in Sydney [N Smith, A Kumar, BB TT; by 30 Oct 2015]*

OCEAN SCIENCES TOWN HALL

Katy Hill provided a broad outline of the abstract under item 5(iii). The SC agreed that sufficient guidance was now available from this meeting to guide those discussions. Given that the session also includes AtlantOs and SOOS, focus should be given to matters that could benefit from the broader audience.

KEY MESSAGES (GENERAL)

The SC agreed it was timely to enhance communication around the progress of TPOS 2020.

Key points include:

- The Second meeting of the now extended Steering Committee (with TT Co-Chairs participating ex-officio) held at CSIRO in Hobart was able to make significant progress across most aspects of the Project. The level of scientific engagement is strong, though not uniformly high around the sponsors.
- The community survey, led by the PBL TT, revealed a strong interest in TPOS 2020 work and provided guidance across the broad scope of TPOS 2020 work and suggested there was good potential for building on this initial work. TPOS 2020 is aiming to strengthen engagement and participation through its various Task Teams and early indications from the BPL TT and EP TT has been very positive.
- The “strawman” approach to developing initial ideas has worked well and led to options for reshaping the backbone as well as a number of proposals for supporting studies. The Steering Committee will continue to use this approach to encourage engagements in its work and to generate new ideas of the design and operation of the observing system.
- The SC has decided to further elaborate four of the strawman TPOS research activities : (a) Joint study with Years of the Maritime Continent, (b) The Diurnal Cycle (multiple time scales), (c) Equatorial Pacific upwelling and mixing physics, and (d) Double ITCZ process study. Each potentially spans the interest of two or more Task Teams and will extend and deepen engagement. The studies will also inform further evolution and change in the design and priorities of the Backbone.
- Options for a redesign of the Tropical Pacific Backbone Observing System were presented and the methodology for determining priorities discussed. Further advice is being sought around a number of aspects including surface stress, humidity, and possible extensions for surface variables. This interim design will undergo refinement and scientific and external stakeholder review over the coming 12 months prior to publication.

- Further consideration was given to priorities for modelling and data assimilation, integration of satellite contributions into the design, biogeochemical science questions and strategy for the Western Pacific. In each case strong actions have been agreed for the next year.
- An indicative schedule was discussed, including interim (2016), mid-term (2018) and final (2020) updates and reports. The outputs will include new and refined designs, but will also pay attention to the governance and participation required to sustain a TPOS. Some early consideration was given to transition arrangements.

Action 36 *A draft of the key messages to be circulated to the extended SC after the meeting and finalised for the Report [N Smith, by 23 Oct]*

11. OTHER BUSINESS

VENUE, DATE FOR SC-3:

It was agreed that future face-to-face meetings of the SC should be held toward the end of October.

Ken Takahashi (Instituto Geofísico del Perú) offered to host the third meeting of the SC in Peru, in the week beginning 24 October, at a location to be determined. Current expectations are that the meeting will require 3-4 days. The Steering Committee welcomed this proposal.

The Co-Chairs noted that an extended SC video-conference would be organised for late March/early April. A number of actions are scheduled for completion prior to this meeting, including the completion of the 1st Draft of the Backbone Report.

Further discussion will be held on the desirability of the SC Co-Chairs and TT Co-Chairs meeting intersessionally, perhaps quarterly.

12. CLOSE

The Co-Chairs thanked CSIRO, IMAS and IMOS for hosting the second meeting of the TPOS SC and for providing such excellent meeting and video-conferencing arrangements. In particular, they recognized the support Susan Wijffels gave to all aspects of the meeting along with her contributions as Co-Chair of the BB TT.

The Co-Chairs expressed special thanks to IMOS and CSIRO for supporting the lunches and breaks, and IMAS for hosting the Wednesday evening dinner. The Co-Chairs expressed their appreciation to Toni Moate and Ron Plaschke for guiding them on the tour of the R/V Investigator, and to the IMOS Director for hosting participants immediately following the tour.

The meeting closed at 1230 Saturday 17 October.

Appendix 1 SC-2 Agenda

Session 1: *Opening and Overview*

1. OPENING AND WELCOME (Co-Chairs)
 - Introduction
 - Local welcome, arrangements

2. AGENDA AND REVIEW OF ACTIONS (NS)
 - Agree agenda
 - Review of Actions from SC 1 (paper)
 - Review of intersessional actions

3. STATUS
 - Overview of TPOS and the scientific context (WK)

Session 2: *Review and Evaluation of Activities*

4. ESTABLISHED MAJOR ACTIVITIES
 - 4(i) Planetary Boundary Layer TT [Cronin and Farrar] (paper)
 - 4(ii) Biogeochemistry TT [Strutton and Sutton] (paper)
 - 4(iii) Eastern Pacific TT [Takahashi and Serra] (paper)
 - 4(iv) Backbone TT [Wijffels and Cravatte] (paper)
 - 4(v) Modelling and Data Assimilation TT [Kumar and Guilyardi] (paper)
 - 4(vi) Western Pacific [Ken Ando and Smith] (paper)
 - 4(vii) Cross-cutting issues, general discussion

0900 Thu 15

Session 2 (continued)

5. TPOS CONTRIBUTIONS AND RELATED ACTIVITIES

Other Projects and Contributions to TPOS

- 5(i) Deep ocean observations and TPOS [Dean Roemmich] (paper)
- 5(ii) Years of the Maritime Continent [Hendon, Wheeler and Chidong Zhang] (paper)

- 5(iii) GOOS/GCOS General, Expert Panels, AtlantOS (Katy Hill)
- 5(iv) CLIVAR (discussion with Wenju Cai)
- 5(iv) **Added item:** Discussion of 2015 ENSO (led by Andrew Marshall, CSIRO)
- 5(v) SPURS (Tom Farrar)
- 5(vi) Update on satellite observations (Eric Lindstrom)

National Initiatives

- 5(vii) Update on Chinese Activities [Weidong Yu]
- 5(viii) Republic of Korea initiatives and new Vessel "Isabu" [Dongchull Jeon]
- 5(ix) IMOS (Tim Moltmann)
- 5(x) USA: NOAA Solicitation (Kathy Tedesco)
- 5(xi) Others

0900 Fri 16 Oct

Session 3: *Project Execution and Engagement*

- 6. PROJECT OPERATION AND ENGAGEMENT [Andrea McCurdy]

Session 4: *Future of the TPOS 2020 Project*

- 7. INITIAL ASSESSMENT OF PROGRESS AND ACHIEVEMENTS [All]
- 8. TPOS 2020 TARGETS [Co-Chairs] (paper)
- 9. GENERAL DISCUSSION [Co-Chairs]

1600 Tour of *Investigator*

0900 Sat 17 Oct

Final Session: *Actions, Schedule*

- 10. SC-2 ACTIONS (NS)
- 11. OTHER BUSINESS
 - Venue, date for SC-3
- 12. CLOSE (at approximately 1200) [Co-Chairs]

Appendix 2 SC-2 Attendance

TPOS 2020 Steering Committee Members

Kentaro ANDO
Research Scientist
Japan Agency for Marine-Earth Science and Technology, Yokosuka
Research Institute for Global Change Japan Marine Science and Technology Centre 2-15
Natsushima-cho
Yokosuka
237-0061
Japan
Tel: +81-46-867-9462
Fax: +81-46-867-9835
Email: andouk@jamstec.go.jp

Prof. Dake CHEN (unable to attend)
Professor
Second Institute of Oceanography, SOA
No.36 baochubei Road
310012 Hangzhou
Zhejiang
China
Email: dchen@sio.org.cn

Sophie CRAVATTE
Researcher
Institut de Recherche pour le Développement, Centre de Nouméa
101 Promenade Roger Laroque
Anse
BP A5
98848 Noumea Cedex
New Caledonia
Email: sophie.cravatte@ird.fr

Tom FARRAR
Woods Hole Oceanographic Institution
Woods Hole MA 02543
United States
Email: jfarrar@whoi.edu

Harry HENDON (by videoconference)
Bureau of Meteorology, Melbourne
700 Collins Street
Docklands
GPO Box 1289
Melbourne VIC 3001
Australia
Email: h.hendon@bom.gov.au

Dr Dongchull JEON
P.I. of POSEIDON Project/KORDI
Korea Institute of Ocean Science and Technology
787 Haeanlo
Ansan 426-744
Korea Rep
Tel: +82 010 3305 6124
Email: dcjeon@kiost.ac

William KESSLER (Co-Chair)
NOAA Pacific Marine Environmental Laboratory
7600 Sand Point Way NE, Bldg. 3
Seattle WA 98115
United States
Email: William.S.Kessler@noaa.gov

Dr. Arun KUMAR
Chief, Development Division
National Centers for Env
NOAA Center for Weather and Climate Prediction
5830 University Research Court
College Park Maryland 20740
United States
Tel: (1) 3016833385
Fax: (1) 3016831557
Email: arun.kumar@noaa.gov

William LARGE
University Cooperation for Atmospheric Research
3090 Center Green Drive
P.O.Box 3000
Boulder Colorado 80301
United States
Email: wily@ucar.edu

Dr Yukio MASUMOTO
Co-Chair, Indian Ocean Panel of CLIVAR/GOS
Observational Research System for Global Change
2-15 Natsushima-cho
Yokosuka-city
237-0061
Kanagawa
Japan
Email: masumoto@eps.s.u-tokio.ac.jp

Dr. Neville SMITH (Co-Chair)
Australia
Tel: +61 407 824 129
Email: nsmi3118@bigpond.net.au

Peter STRUTTON
University of Tasmania, Institute for Marine and Antarctic Studies
Private Bag 129
Hobart TAS 7001
Australia
Email: peter.strutton@utas.edu.au

Dr. Ken TAKAHASHI
Instituto Geofísico del Perú
Peru
Email: ken.takahashi@igp.gob.pe

Dr Weidong YU (by video conference)
Director
First Institute of Oceanography, SOA
6 Xian-xia-lin Road
High Technology Park
266061 Qingdao
China
Tel: + 86 532 88967403
Fax: +86 532 88967403
Email: wdu@fio.org.cn

Task Team Co-Chairs

Dr Meghan Cronin (PBL Task Team)
NOAA PMEL Bldg #3
7600 Sand Point Way NE
Seattle, WA 98115 USA
Tel: +1 206-526-6449
Email: Meghan.F.Cronin@noaa.gov

Dr Eric Guilyardi (Model and Data Assimilation TT; by videoconference day 1)
IPSL/LOCEAN - Dir. Rech
CNRS
Tour 45, 4eme, piece 406
UPMC, case 100
4 place Jussieu, F-75252 Paris
Tel: +33 (0)1 44 27 70 76
Email: Eric.Guilyardi@locean-ipsl.upmc.fr

Dr Yolande Serra (EP Task Team)
JISAO
University of Washington
Box 357941, Seattle, WA 98195
Email: yserra@uw.edu

Dr Adrienne Sutton (BGC Task Team)
Research Scientist
Carbon Program
Pacific Marine Environmental Laboratory
NOAA-UW Joint Institute for the
Study of the Atmosphere and Ocean
Tel: 206.526.6879
Email: adrienne.sutton@noaa.gov

Dr Susan Wijffels (BB Task Team)
Research Oceanographer
Oceans & Atmosphere Flagship CSIRO
Tel: +61 3 6232 5450
Email: Susan.Wijffels@csiro.au

Organisation Representatives

Dr Wenju CAI
Research Director
Oceans & Atmosphere Flagship
CSIRO
Tel: +61 3 9239 4419
Email: Wenju.Cai@csiro.au

Dr David LEGLER
Chief, Climate Observations
National Oceanic and Atmospheric Administration Office of Oceanic and Atmospheric
Research
1100 Wayne Ave
Suite 1202
Washington DC 20910
United States
Tel: +1 301 427-2460
Email: david.legler@noaa.gov

Dr. Eric LINDSTROM (via videoconference)
NASA Physical Oceanography Program
Co-Chair, Global Ocean Observing System Steering Committee
NASA
300 E Street SW
Washington, DC 20546
Tel: +1 202-358-4540
Email: eric.j.lindstrom@nasa.gov

Mr Tim MOLTMANN
IMOS Director
University of Tasmania
Hobart TAS 7001 Australia
Tel: +61 (3) 6226 2767
Email: Tim.Moltmann@imos.org.au

Kathy TEDESCO
Program Manager
Climate Observation Division
NOAA Climate Program Office
1315 East West Highway (SSMC3)
Silver Spring, MD 20910
Tel: +1 301 427 2462
Email: kathy.tedesco@noaa.gov

Observers

Dr Louise Newman
Executive Officer
Southern Ocean Observing System
SOOS International Project Office
Institute for Marine and Antarctic Studies
University of Tasmania
20 Castray Esplanade, Battery Point
Hobart, TAS Australia, 7004
Tel: +61 (0)3 6226 6011
Email: Louise.Newman@utas.edu.au

Secretariat/Distributed Project Office

Dr Katherine (Katy) HILL
GOOS/GCOS Programme Specialist
World Meteorological Organization
7bis, avenue de la Paix
Case Postale 2300
1211 Geneva
Switzerland
Tel: +41 (0)22 730 80 83
Fax: +41 (0)22 730 8052
Email: khill@wmo.int

Andrea MCCURDY
Sr. Program Manager
Consortium for Ocean Leadership
1201 New York Ave. NW, 4th Floor
Washington DC 20005
United States
Tel: 01 202 288 1989
Email: amccurdy@oceanleadership.org

Dr Ana Lara-Lopez
Scientific Officer
Integrated Marine Observing System
University of Tasmania,
Private Bag 110, Hobart, Tas, 7001
Tel: +61 (0) 3 6226 8538
Email: Ana.Lara@utas.edu.au

Appendix 3 Synthesis of Planetary Boundary Layer Survey Responses

In late July 2015, the TPOS-2020 PBL Task Team designed a questionnaire specifically about the PBL observational needs within the TPOS backbone design. These questions were vetted during the PBL TT telecon and then sent to only members of the task team for responses. At that point, it was determined that there were too many questions and some of the questions would not draw out the respondent. The questionnaire was revised, reviewed, and then sent to approximately 90 PBL experts worldwide. A deadline of September 10, 2015 was set.

As of October 13, 2015, 34 responses were received. Several of these were consensus responses from groups, sometimes in the form of letters from which we cut and pasted answers into the form. One such was a 4-page letter from the WGNE MJO Task Force. It was clear that respondents cared strongly about TPOS and PBL observations and appreciated being involved in the process. Not surprisingly, some responses were targeted on improving observations of certain phenomena (e.g. MJO, hurricanes,...), while other respondents were more holistic. Nearly all called for more heavily instrumented sites (e.g. solar and longwave radiation to get net flux, better resolution of the mixed layer depth, more current observations, barometric pressure, rain, biogeochemical obs, direct flux, waves, LIDAR, cloudbase height,...) in important “regimes”. Of the 34 responses, 11 recommended maintenance or expansion of the grid of in situ PBL time series measurements. 6 called on employing new platform technologies (e.g., wave gliders, gliders, “controllable mobile assets”, Prowler moorings).

The PBL TT co-chairs are considering making the questionnaire accessible through the TPOS2020 website. As part of a more in-depth synthesis of the results, the task team will likely make public a compilation of the responses, with names and affiliations removed. For other groups considering querying the community using a questionnaire, the PBL TT recommends careful vetting of the form, including having the TT fill out the form before sending it out to the public. This we believe was critical for the success of the questions.

The introduction and questions included in the questionnaire are shown here:

Questions to the Planetary Boundary Layer Task Team and Community about Tropical Pacific Observing System Backbone Design

The TPOS 2020 Project (<http://tpos2020.org/>) is evaluating, and where necessary, will implement changes to the Tropical Pacific Observing System. The project's aim is to ensure and improve the utility and sustainability of the Tropical Pacific Observing System. These deliberations obviously need to be based on the current understanding of tropical Pacific science and on anticipation of the needs of observing system stakeholders in the coming decades. To this end, the TPOS-2020 Planetary Boundary Layer Task Team has put together the following set of questions specifically about the Planetary Boundary Layer observational needs within the TPOS backbone design. The assessment of tradeoffs in the TPOS design will depend in part upon answers to the following questions. We very much appreciate your help answering these questions and getting other experts to answer them. Please distribute widely. Supporting material (citations, a figure, ...) would be extremely helpful. Please send all supporting material to the co-chairs of the TPOS 2020 Planetary Boundary Layer Task Team, Meghan Cronin (Meghan.f.cronin@noaa.gov) and Tom Farrar

(ifarrar@whoi.edu), with cc to Lucia Upchurch (lucia.upchurch@noaa.gov). Input before September 12 would be most helpful.

Please consider the following questions in terms of the observing system that will be needed in 2020-2040.

Thank you for helping with the design of the future Tropical Pacific Observing System!

1. “Strawman” designs of the future Tropical Pacific Observing System (TPOS) are being used to stimulate discussion in the TPOS 2020 Project. One such strawman design is for the future TPOS to be a combination of Argo float, drifter, and satellite measurements for ocean and planetary boundary layer observations, with heavily instrumented surface moorings along equator (maintaining long climate record) and at a few scattered off-equatorial sites. Considering the uses of the TPOS (assimilation, weather prediction, ocean and atmosphere research, climate records, cal/val for remote sensing,...), how would you rank the pros and cons of such an approach?

2. In convective regions wind direction can be highly variable causing significant differences between scalar and vector averaged wind speed. How important is it to monitor wind variability at diurnal time scales? How would you recommend TPOS monitor spatial (and seasonal) distribution of wind variability?

3. How do you envision moored oceanic and atmospheric Planetary Boundary Layer (PBL) observations being used for data assimilation purposes in the next decades? What would be the impact of relying exclusively upon satellite, drifter, and Argo float observations for data assimilation in the future? What is the value of co-located surface and subsurface observations for coupled data assimilation?

4. Are there particular regions where PBL observations make important contributions to prediction skill?
For example: Convective regions? Warm Pool? ITCZ? Along the equator? Frontal regions?

5. Are there particular regions that should be high priorities for sustained in situ upper-ocean or atmospheric PBL observations? Why?

6. What spatial and temporal scales of variability should be monitored within TPOS for moisture? Air temperature? SST? Fluxes? Other PBL variables? How should zonal fronts associated with the edge of the warm pool and meridional fronts associated with the edges of the cold tongue be resolved? How would you prioritize these requirements?
Supporting material (e.g. citations, figures) would be very much appreciated.

7. How do you recommend the TPOS be configured to observe the Planetary Boundary Layer?

8. If you would like to identify yourself, please enter your name, affiliation, and email address.

Could you please provide supporting documentation for these questions?

Supporting material (citations, a figure, ...) would be extremely helpful- please send all supporting material to Meghan (Meghan.F.Cronin@noaa.gov), Tom (ifarrar@whoi.edu), and Lucia (lucia.upchurch@noaa.gov).

Appendix 4 Update on satellite observation

Satellite talking points to TPOS 2020 SC

From: Eric Lindstrom, NASA HQ

17 October 2015

I am going to talk not about measuring the TP with satellites, but how TPOS can communicate views in a constructive and impactful way to NASA. I am assuming you all have some serious opinions about the utility and need for satellites as part of TPOS. It's not just about the TAO array or Argo floats. However, it may take a decade for the ideas of today to become the satellite observing system of the future, so your patience will certainly be tested. Note that without your opinion the space agencies may miss ways to optimize observing for the most impactful patch of ocean on the planet. That would be seriously bad!

Let's start with the toughest news. Knowing wind forcing is critical in TP. That gave rise to the TAO array! Honestly, in some ways are struggling a bit with the climate record and continuity of high quality ocean vector winds. We have some foundation in ASCAT on METOP and European operationalization. NASA is working on plans for how we can continue winds as a climate variable despite the imminent end of Quikscat and a Rapidscat that is acting a bit flaky. Frank Wentz is leading a task team of our Ocean Vector Winds Science Team and I would be happy to introduce TPOS material to his outline report on maintaining the wind climate record (draft report to NASA due by end January).

Altimetry is quite secure with Jason-3 to be launched when rocket problems are solved. NASA will work with European partners to assure the Jason-CS/Sentinel-6 series for altimetry in the 2020-2030 era.

Salinity took a hit with the loss of Aquarius in June but L-Band salinity is still proceeding with SMOS (since 2009) and SMAP (since January 2015). I have been charged with developing a sort of "salinity continuity" plan for NASA with a robust research component going forward (plan due at NASA HQ by end December).

There is certainly an opportunity for TPOS to provide input to the NASA planning for the aforementioned variables – needs for altimetry, winds, and salinity. Of course there are interest developments in other areas such as SST and Ocean Color, Ocean currents and mixed layer depth. In the SST world I will be supporting a new project to attempt to provide at 10 km resolution microwave product. NASA has the PACE and SWOT missions focused on high resolution altimetry and color products in the 2020-2023 period. JPL has been working on a proposals for an ocean current and winds mission also with high spatial resolution, but timing is presently uncertain.

I am certainly open to direct input from TPOS groups on all the satellite variables. The next three months seems to have become especially opportune time for input – directly to NASA and through the US National Research Council.

The NRC opportunity that is open before the end of 2015 is for 1500 white papers to the new US National Academy of Sciences Decadal Survey on Earth Sciences. It is looking to recommend to NASA its portfolio of missions for the 2020-2030 period. TPOS should provide some report on its needs for satellites as it may help drive decisions for the long term. Details available at http://sites.nationalacademies.org/SSB/SSB_167627.

Appendix 5 Western Pacific Task Team

Terms of Reference

Considering the regional features in the Western Pacific region and the applications of the ocean observing system (e.g. typhoon forecasting, climate forecasting and research), develop and oversee a Project to:

- 1) Foster interaction and collaboration between the TPOS and other international programs that have an observational focus in the tropical western Pacific region, in particular WESTPAC and CLIVAR.
- 2) Determine the observational requirements for over the next few decades, including time and space scales that should be resolved, through Backbone contributions, or specialised/pilot contributions to TPOS, such as SPICE, NPOCE and other relevant projects.
- 3) Develop observational strategies and design plans for the region, taking into account, as appropriate, the readiness of technology and feasibility of measurements, the evolving Backbone Observing System, existing activities, and guidance being developed by other TPOS 2020 Task Teams.
- 4) Provide guidance as required to the Backbone Task Team and, as required, other Task Teams on strategies and plans for the region.
- 5) Seek mechanisms for improved cooperation and coordination of logistics and ship time for the region, with the initial focus being on the evolution of the Western Pacific mooring contributions (e.g. TRITON, NPOCE, etc).
- 6) Provide guidance on implementation and explore potential opportunities to engage with and collaborate with regional institutions for the implementation and maintenance of TPOS and its national components, and to evolve process-oriented boundary region measurements towards a sustained system.

Process

The Task Team should report to the Steering Committee at its annual meetings and otherwise as required.

Membership

To be determined.

Appendix 6 Consolidated Decisions and Actions

Decision 1. The Steering Committee agrees to create a Western Pacific Task Team with the Terms of Reference as given in Appendix 4.

Action 1 PBL TT Co-Chairs to produce a synopsis of the PBL survey responses for inclusion in the SC-2 meeting Report [PBL TT Co-Chairs, Oct 2015].

Action 2 Form a small group (a representative from each TT plus 1 from the SC to Chair) to consider the potential value of a follow-up survey [SC Co-Chairs; report by SC-3]

Action 3 The Eastern Pacific equatorial-coastal waveguide and upwelling system strawman to be further developed into a possible Pilot Project [EP TT, Oct 2016].

Action 4 The BB TT to further develop the “Wyrski Challenge” strawman, initially through undertaking a small simulated sampling study using a high-resolution ocean model output [BB TT, Oct 2016].

Action 5 Western boundary transports: BB TT to further consider this as a pilot activity, in parallel with the initial Backbone recommendations, to refine approach, bring in modelling, etc. with a view to bringing back recommendations later in TPOS 2020 [BB TT, Oct 2016].

Action 6 Scope out the ARMOR-3D quantitative assessment study of an integrated Argo, altimeter, mooring observing system, and perhaps use the Atlantos OSE/OSSE workshop (17-18 December) to develop joint work [BB TT, Dec 2015].

Action 7 Through the Modelling and Data Assimilation Task Team, and in collaboration with the PBL TT, seek links for atmospheric and wave expertise (e.g., with in JCOMM, WGNE, AOPC) around specific points of concern [BB TT, Jan 2016].

Action 8 Contact Tommy Moore (PIGOOS) re. existing activities, capabilities used locally to monitor impacts (e.g., inundation) [Katy Hill, March 2016].

Action 9 Consider mechanisms to improve delivery of data, products and information, specifically around data integration plans within the JCOMM Observations Coordination Group [David Legler, Katy Hill, March 2016].

Action 10 Finalisation of the M&DA TT members and sign off by SC Co-Chairs [M&DA Co-Chairs, Nov 2015]

Action 11 Convene first M&DA TT meeting [M&DA TT Co-Chairs, Dec 2015]

Action 12 Consider requirements relevant to, and the adequacy of, the proposed Deep Argo Array for meeting TPOS objectives [Backbone Task Team, Oct 2016].

Action 13 Develop guidance on requirements for deep ocean sampling, utilizing tropical Pacific moorings as appropriate [Backbone Task Team, Oct 2016].

Action 14 Schedule a discussion on the observational requirements arising from tropical Pacific intraseasonal variability and predictability [TPOS 2020 SC Co-Chairs, Mar 2016].

- Action 15 Based on the available Wentz Report outline, and direct engagement with the study authors, develop a TPOS 2020 submission for the Report [Tom Farrar, with assistance from Yolande Serra and Tony Lee, as required; Nov 2015].
- Action 16 Develop a white paper submission on TPOS requirements for the new US National Academy of Sciences Decadal Survey on Earth Sciences [Tom Farrar, Dec 2015].
- Action 17 The DPO to lead a small group looking at ways to improve web access to key materials and communications [A McCurdy, Mar 2016].
- Action 18 The draft TPOS 2020 performance metrics to be further elaborated to include specific milestones and targets [N Smith, A McCurdy, March 2016].
- Action 19 The extended Steering Committee should provide an elaboration of the reporting schedule (Figure 1) that includes major milestones down to the level of Task Teams [SC Co-Chairs, TT Co-Chairs, DPO; March 2016]
- Action 20 A paper on a possible TPOS 2020 transition process should be developed, initially in consultation with GOOS and JCOMM [Smith, Legler, Lindstrom; March 2016]
- Action 21 The TPOS 2020 report review process should be described in a stand-alone document and circulated for comment by the extended Steering Committee and key stakeholders. [N Smith, Dec 2015].
- Action 22 In consultation with the Backbone TT and other Task Teams as appropriate, a list of around 30 possible reviewers should be drawn up [DPO, Jan 2016]
- Action 23 A list of 6-8 “lead authors” for the Initial Backbone Report to be drawn up based on nominations from the Task Team Co-Chairs. [SC Co-Chairs in consultation with TT Co-Chairs; Nov 2015].
- Action 24 The Backbone Task Team to draft a note for the Planetary Boundary Layer Task Team articulating their concerns around errors in wind and surface wind stress estimates [BB TT Co-Chairs, Oct 2015].
- Action 25 The Planetary Boundary Layer Task Team to lead an additional study of the wind/wind stress and surface flux requirements, and of possible solutions, and to provide recommendations for consideration in the Backbone Interim Report [PBL TT Co-Chairs, Jan 2016].
- Action 26 Seek a point of contact for advice on waves [Katy Hill, David Legler, by Oct 2015].
- Action 27 The Steering Committee agrees to create a joint Working Group with YMC, with the scope and membership as above and subject to agreement with the YMC, and reporting through the PBL [PBL TT Co-Chairs proposal to YMC through Weidong Yu, Nov 2015].
- Action 28 An elaborated outline of possible joint work on the YMC to be developed [PBL TT Co-Chairs, Mar 2016].
- Action 29 Develop a project outline around diurnal-multiscale variability, including scope, rationale within the context of TPOS, goals and possible participation [PBL TT Co-Chairs, March 2016]

Action 30 Develop a project outline around the interplay of equatorial Pacific upwelling and mixing, including scope; rationale within the context of TPOS; goals; and possible participation [PBL, EP, BGC TT Co-Chairs, March 2016]

Action 31 Develop a project outline around the concept of a double ITCZ process study, including scope; rationale within the context of TPOS; goals; and possible participation [EP TT Co-Chairs, March 2016]

Action 32 Develop a communique on the risks arising from fewer TRITON moorings, including the disruption to the climate data record, for distribution among TPOS participants and stakeholders. [TPOS 2020 SC Co-Chairs, Ken Ando, Nov 2015]

Action 33 Develop a document on the short-term requirement for maintaining the TRITON contribution (mooring build options/needs, ship requirements), focusing initially on the 2017 period, for circulation among TPOS 2020 participants and stakeholders [Ken Ando, Nov 2015]

Action 34 Develop an initial work plan for the M&DA Task Team, drawing on the Terms of Reference, advice from the Steering Committee and ideas from the task Team members [M&DA Task Team Co-Chairs, March 2016].

Action 35 Develop a brief paper for the GOV meeting 2-6 Nov in Sydney [N Smith, A Kumar, BB TT; by 30 Oct 2015]

Action 36 A draft of the key messages to be circulated to the extended SC after the meeting and finalised for the Report [N Smith, by 23 Oct]