

## CLIVAR PACIFIC REGIONAL PANEL

Matthieu Lengaigne, [lengaign@locean-ipsl.upmc.fr](mailto:lengaign@locean-ipsl.upmc.fr)  
Xiaopei Lin, [linxiaop@ouc.edu.cn](mailto:linxiaop@ouc.edu.cn)

### Panel overview

The PRP general objectives cover a vast range of topics, including the ENSO dynamics and teleconnections (in conjunction with ENSO RF), decadal Pacific variability (in conjunction with Climate Dynamics RF), ocean mass transports and properties, the regional impact of climate variability and change, western boundary current variability and the development of a sustainable tropical observing system (in conjunction with TPOS2020). Due to time constraints of all panel members and the too wide topics to be tackled, the PRP decided to focus activity in the next couple of years on an emerging new challenge that has to be urgently addressed given its societal importance: the decadal variations in the tropical Pacific.

### Achievements for 2016-17

- **Workshops/Working groups**

A large number of sessions in international conferences and workshops have been chaired and/or organized by PRP members as individuals. In the following, we only focus on the achievements involving CLIVAR community:

- **ENSO complexity:** An ENSO workshop was held the week preceding the 12th PRP meeting in Busan, which most of the PRP members contributed by giving numerous oral sessions, some of them being also involved in its organization. This 5-days workshop focused on reviewing the spatio-temporal complexity of ENSO phenomenon. The last 3 days were dedicated in the writing of a review paper summarizing our knowledge and gaps regarding this ENSO complexity. The main scientific outcomes of this paper will be summarized in the next section.

- **PRP panel meeting:** The CLIVAR PRP further held its 12<sup>th</sup> session in Busan, South Korea on 21<sup>st</sup> October 2017, back to back with the ENSO complexity workshop. 10 out of 14 members attended the meeting. During this meeting, we mainly focused on discussing the main scientific issues and the way forward with a focus on two topics: the Pacific decadal variability and the connection with the paleo-community. We also discussed the TPOS2020 implementation plan. The outcomes of these discussions are summarized in the last section of this report (Plan for 2018 and beyond).

- **TPOS and Western Pacific:** Several PRP members are part of the TPOS2020 backbone team. Two panel members (X. Lin and J. Sprintall) and other regional experts formed a Western Pacific Task Team (WP-TT) to coordinate the PP and TPOS activities in the western Pacific. This led to the organization of two meetings during international conferences (Ocean Science Meeting - New Orleans, Feb 2016; WESTPAC annual meeting - Qingdao, Apr 2017) and several teleconferences. A Pilot Study Program ‘Observing WP boundary currents’ has further been proposed to TPOS2020. This WP-TT working group identified three priorities for this year: (1) updating cruises inventory and making data inventory, (2) designing an optimal sustained low latitude western boundary current observational array, and (3) testing new technologies.

- **Biophysical interactions:** A recent workshop gathering different scientists from the CLIVAR and PICES community led to the endorsement of a cross-cutting CLIVAR-PICES Working Group on “Climate and Ecosystem Predictability” for a period of three years. The co-chairs on the CLIVAR side are A. Capotondi, one of our PRP member, and R. Rycaczewski, a member of the Eastern Boundary Upwelling System panel.

- **Scientific results from activities**

All panel members contributed individually to a large number of papers relevant for the PRP activity. We will however only summarize in the following those which arise from a PRP community effort, including at least two PRP members. In this regard, two major themes have been tackled during the past year:

- **ENSO complexity:** The major achievement of the PRP as a community work this year relates to its contribution in writing a review paper on ENSO complexity to be considered for publication in *Nature* (Timmerman et al. 2017). PRP members were lead-authors of several sections of this very successful review, led by A. Timmerman, the director of the new IBS Center for Climate Physics (Busan, South Korea). This paper includes discussions on its seasonal dynamics, its space-time complexity, its evolution in the past and future climates and on a unified framework gathering these elements. Other papers dealing with extreme ENSO events (Santoso et al. 2017; Wang et al. 2017), recent ENSO intensification (Grothe et al. 2017), and the role of volcanic forcing on ENSO (Khodri et al. 2017) also involved several PRP members.

- **Pacific decadal/multi-decadal variations:** Several important papers involving PRP members have been discussing the strong trade wind strengthening and cooling of the tropical Pacific over the recent decades, which are known to have important consequences including higher sea levels in the western Pacific, an increased ocean heat uptake and a slow-down in the global-mean surface warming rate. These papers generally show that all CMIP5 historical simulations underestimate these recent trends (e.g. Kajtar et al. 2017). Several hypotheses have been formulated to explain this mismatch, including uncertainties in the observed estimates (e.g. McGregor et al. 2016) or model deficiencies such as an underestimated natural decadal variability, an inaccurate representation of the feedback of other tropical basins on the Pacific in these models (e.g. Kajtar et al. 2017) or an overestimated anthropogenically-induced tropical Pacific warming trend.

- **Scientific capacity building and career support**

Some PRP panel members have been involved with capacity building activities at institutions in developing countries. For example, A. Santoso gave lectures to undergraduate and master students at the oceanography department of the Bandung Institute of Technology in April 2017, established research collaborations, and further engaged Indonesian young scientists by taking part in the organization, discussion, and paper editorial of conferences in Indonesia. M. McPhaden participated in the GODAE Ocean View International School on Mallorca in October 2017 lecturing on the topic of ENSO and its impacts. Sixty nine students from 31 countries attended the school. A. Capotondi and J. Sprintall are serving as a mentors within the program “Mentoring Physical Oceanography Women to Increase Retention” (MPOWIR). This program, established in the United States about 10 years ago with support from the physical oceanography programs of the major US funding agencies (NSF, ONR, NASA, NOAA, DOE), has proven to be extremely valuable in providing support to young women physical oceanographers at critical stages of their careers.

## Plans for 2018 and beyond

During recent decades, an improved observing system allowed detection of strong decadal fluctuations in the tropical Pacific climate system. ENSO for instance underwent a decadal modulation in its spatio-temporal characteristics and predictability. As discussed in the previous section, the tropical Pacific also experienced strong decadal trends that the current generation of models seems unable to capture. The full range of these decadal modulations, their driving mechanisms and the ability of current models to capture them are currently unknown. Given the tremendous impacts of the tropical Pacific variability worldwide, the PRP acknowledges that there is an urgent need to address and overcome these issues through the combined analysis of instrumental and paleo ENSO records and model simulations. This led the panel to propose the following action items for the following year:

**1- CLIVAR recommendations on TPOS2020 design:** Despite the sizeable efforts of TPOS2020 committee towards the design of a tropical Pacific Ocean observing system that meet the scientific challenges of the next decades in many aspects, the proposed decommissioning of many mooring sites of the original TAO/TRITON array is of serious concern to the PRP. This strategy will irrevocably break the continuity of unprecedented time series of 25 years or more, which will likely compromise our ability to diagnose ENSO decadal variability as well as future ENSO behaviour in a changing climate, in all its dynamical, spatial, and temporal complexity. In conjunction with ENSO RF, we have written a letter that we will circulate to other relevant CLIVAR panels and SSG for endorsement, before sending this letter to TPOS2020 steering group. Along the same lines, paleo-ENSO records are the main measurements that could allow us to estimate the range of observed tropical Pacific decadal fluctuations in the past. However, these estimates would require repeated water isotope measurements in this region to better separate the SST and salinity contribution and better constrain the water budget. Unlocking the full potential of the paleo space require the climate community to include these isotopic measurements within the frame of the current TPOS2020 design. Towards that goal, the PRP panel is also planning to write a letter to TPOS2020 steering group to include these aspects in the redesign of the current tropical Pacific moored array.

**2- PRP involvement in TPOS2020 2018 workshop:** TPOS2020 is considering to organize a workshop gathering observationalists and modellers to identify the physical processes that will be most important to improve in models over the next decade in order to better understand the tropical Pacific variability, and what observational sampling strategies might be best to depict these processes through sustained monitoring. Given the above concerns, the PRP will try to get actively involved in this workshop to convey these important messages.

**3- ENSO conference in 2018 in Guayaquil:** the 4<sup>th</sup> international conference on ENSO in a warmer climate will be held in October 2018 in Guayaquil (Ecuador). Three PRP members are already part of the scientific committee of this conference which aims to review the progress on the science of ENSO with a focus on assessing the range of ENSO “flavors”, their potential distinct precursors and processes, their impact on their predictability in the context of a warming world. Given the focus of the PRP activities in the next couple of years, we plan to strongly contribute to this conference and to have our next PRP meeting right after it. We are also planning to have a small workshop to discuss the range of ENSO decadal variability simulated by long coupled runs (> 1000 years) that we will analyze in the coming year as part of our PRP activities.

**4- Review paper on trans-basins connection in the tropics:** A large body of literature recently discussed the potential decadal feedbacks between the Atlantic and Indian Ocean and the tropical Pacific that may have contributed to the recent Pacific cooling trend. In this context, PRP members are planning to contribute to a paper reviewing the connections existing between the three tropical basins across a wide range of timescales. A small workshop gathering the lead authors will be held in China or Australia at the beginning of 2018 to initiate the drafting of this review.

**5- ENSO summer school:** The PRP will get involved in the organisation of summer school on ENSO to be held in July 2019 in Urbino (Italy). This school should gather ~20 students and last for 10 days. It will also involve members from the ENSO RF. It will require funding sponsors such as CLIVAR.

## **Budget and other needs for 2018**

**1- TPOS2020 workshop:** TPOS2020 scientists are seeking funds to support a workshop to bring together observationalists and modellers to identify the physical processes that will be most important to improve in models over the next decade to understand tropical Pacific variability, and what observational sampling strategies might best depict these processes through sustained monitoring.

**2- ENSO summer school:** CLIVAR should consider endorsing the ENSO summer school in July 2019 and provide financial support

## **Articles published in 2016/17 as part of panel activities (PRP members in bold)**

1. Timmermann A., S.I. An, **J.-S. Kug**, F.-F. Jin, W. Cai, **A. Capotondi**, **K. Cobb**, **M. Lengaigne**, M. Stuecker, K. Stein, A. Wittenberg, T. Bayr, J. Boucharel, H.-C. Chen, Y. Chikamoto, B. Dewitte, D. Dommenget, E. Guilyardi, Y.-G. Ham, M. Hayashi, S. Ineson, D. Kang, W. Kim, J.-Y. Lee, T. Li, J.-J. Luo, **S. McGregor**, **M. McPhaden**, Y. Planton, S. Power, H. Rashid, H. Ren, **A. Santoso**, **K. Takahashi**, A. Todd, G. Wang, G. Wang, S.-W. Yeh, J. Yoon, K.-S. Yun, **X. Zhang**, 2017: ENSO complexity, to be submitted to *Nature*.
2. **Santoso, A., M. McPhaden**, W. Cai, 2017: The defining characteristics of ENSO extremes and the strong 2015/16 El Niño. *Rev. Geophysics*, revised.
3. Wang, G., W. Cai, B. Gan, L. Wu, **A. Santoso**, **X. Lin**, Z. Chen, and **M. McPhaden**, 2017: Continued increase of extreme El Niño frequency long after 1.5°C warming stabilization. *Nature Climate Change*, 7, 568-572.
4. Kajtar, J. B., **A. Santoso**, **S. McGregor**, and M. H. England, 2017: Model under-representation of decadal Pacific trade wind trends and its link to tropical Atlantic bias, *Climate Dynamics*, in press.
5. Abellán, E., **S. McGregor**, M. H. England and **A. Santoso**, 2017: Distinctive role of ocean advection anomalies in the development of the extreme 2015–16 El Niño, *Climate Dynamics*, (revised).
6. **McGregor, S.**, A. Sen Gupta, D. Dommenget, T. Lee, **M. J. McPhaden**, and W. S. Kessler, 2016: Factors influencing the skill of synthesised satellite wind products in the tropical Pacific, *Journal of Geophysical Research: Oceans*, 122, 1072–1089, doi:10.1002/2016JC012340.
7. Grothe, P.M., **K.M. Cobb**, G. Liguori, E. Di Lorenzo, **A. Capotondi**, Y. Lu, H. Cheng, R.L. Edwards, J.R. Southon, G.M. Santos, D.M. Deocampo, J. Lynch-Stieglitz, T. Chen, H.R. Sayani, K. Townsend, M. Hagos, G. O'Connor, D.M. Thompson, L.T. Toth, J.L. Conroy, A.L. Moore, 2017: Evidence for intensification of El Niño-Southern Oscillation over late 20th century, submitted to *Science*.
8. Khodri M., T. Izumo, J. Vialard, S. Janicot, C. Cassou, **M. Lengaigne**, J. Mignot, G. Gastineau, E. Guilyardi, N. Lebas, A. Robock, **M. McPhaden**, 2017: How tropical explosive volcanic eruptions trigger El Niño events, *Nature Communication*, 1–13. doi: 10.1038/s41467-017-00755-6

## Annex A

### Proforma for CLIVAR Panel requests for SSG approval for meetings

1. **Panel or Working Group:** Pacific Region Panel
2. **Title of meeting or workshop:** 13<sup>th</sup> session of the PRP meeting
3. **Proposed venue:** Guayaquil, Equator
4. **Proposed dates:** 19-20 October 2018
5. **Proposed attendees, including likely number:** PRP members + 5 invitees (~18 people)
6. **Rationale, motivation and justification, including: relevance to CLIVAR science & WCRP Grand Challenges, and any cross-panel/research foci links and interactions involved:** Opportunity to hold our meeting back to back with the ENSO international conference to allow cross-cutting discussion with ENSO-RF
7. **Specific objectives and key agenda items:** Decadal variability in the tropical Pacific, ENSO complexity, observational programs
8. **Anticipated outcomes (deliverables):**
9. **Format:**
10. **Science Organizing Committee (if relevant)**
11. **Local Organizing Committee (if relevant)**
12. **Proposed funding sources and anticipated funding requested from WCRP: USD 5k**