TPOS 2020

Tropical Pacific Observing System

A Prospectus

Additional Information

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The TPOS 2020 Project will evaluate, and where necessary change, all elements that contribute to the Tropical Pacific Observing System (TPOS[1]) based on a modern understanding of tropical Pacific science. The project aims for enhanced effectiveness for all stakeholders, informed by the development and requirements of the operational prediction models that are primary users of TPOS data. **TPOS 2020** embraces the integration of diverse sampling technologies, with a deliberate focus on robustness and sustainability, and will deliver a legacy of improved governance, coordination and supporting arrangements.

TPOS 2020 is a focused, finite term project, beginning in 2014 and completing in 2020, with its primary outcome being an internationally-coordinated and supported sustainable observing system for the Tropical Pacific Ocean.

The Project will work within the Framework for Ocean Observing developed by the Global Ocean Observing System (GOOS) and use this as a reporting mechanism to other relevant coordination mechanisms. A sustained TPOS will be its principle outcome and legacy for GOOS.

Since the TPOS does not and will not exist in isolation, the TPOS 2020 project welcomes partnerships with other global ocean observing communities, the meteorological community, and the operational centers that use TPOS data for ocean state estimates and forecast initialization; along with coastal and regional ocean communities.

The Project must facilitate and embrace observing element contributions from multiple agencies and countries, through a coordinated portfolio of resources and high-level oversight of the scientific and technical design, sub-projects and interfaces to the user community.

This Project has the following scientific objectives:

- To redesign and refine the TPOS to observe ENSO and advance scientific understanding of its causes,
- To determine the most efficient and effective observational solutions to support prediction systems for ocean, weather and climate services, and
- To advance understanding of tropical Pacific physical and biogeochemical variability and predictability.

The social and economic impact of the ability to predict El Niño and associated climate variations, and extreme events is well documented. These predictions have proven to be useful, but have not yet reached the level of skill and detail required to fully realize the potential benefits of sustained observation. Major advances will require enhanced collaboration, including shared planning and implementation, and targeted studies to address current gaps and systematic shortcoming in forecast systems.

TPOS 2020 will deliver the following benefits:

- A refreshed and more effective design for the TPOS, promoting sustainability, and making full use of new and emerging technologies,
- Greater cooperation and coordination among the international sponsors and contributors to the TPOS, delivering efficiency, reduced risk and greater robustness,
- Facilitation of experiments and studies in process parameterisation and modelling to guide improvements in climate prediction and associated applications,
- Integration of biogeochemical and biological sampling into the TPOS design and implementation; and
- Fuller assessment of climate change signatures and the impacts in the tropical Pacific.

[1] TPOS is used when referring to the observing system, and TPOS 2020 is used when referring to the project.

Background and Need

During 1985 through 1994 a major international project, the Tropical Oceans-Global Atmosphere (TOGA) Experiment, established a tropical Pacific Ocean observing system. The primary rationale behind TOGA was to enable the prediction of large-scale interannual climate fluctuations, in particular El Niño and its global effects. The tropical Pacific observing system became the template for corresponding networks in the tropical Atlantic and Indian Oceans.

Over the next 20 years, new in situ and satellite observational technologies have emerged. There has also been a profound evolution in the sophistication of analysis, modelling and predictions systems. Moreover, the understanding of Tropical Pacific variability and predictability has advanced to the point where a fresh articulation of observational requirements and system design is now needed.

The deterioration of the TOGA network in recent years highlights the risks to this system which underlies the capability for seasonal forecasting around the globe requiring a renewed international effort to redesign the system. This effort is challenged to first consider the underpinning scientific understanding and rationale for the TPOS, and its implications for a more modern consideration of requirements, observing techniques, and data products. Second, the ensuing project must forge international agreement not only on the form of a rebuilt system, but also in the development of the governance structures required to ensure an efficient, effective and sustainable observing network for the next decade and beyond.

Project Approach

In January 2014, NOAA and JAMSTEC, in collaboration with the Ocean Observations Panel for Climate (OOPC), convened a Review of the TPOS, through a Workshop and associated White Papers. These deliberations considered the immediate actions to address the deterioration in the observing system, as well as activities and recommendations that will lead to a more robust and sustainable system. These considerations formed the basis for initiating the TPOS 2020 project.

Toward this end a TPOS 2020 Steering Committee (SC) was formed following the January 2014 Workshop, consisting of 15 members from seven nations throughout the Pacific, and spanning a wide range of scientific and engineering expertise. The SC first met in October 2014; it reaffirmed the goals set forth for TPOS 2020 and began the planning required for the successful implementation of the Project. Task Teams were appointed by the SC with the challenge of organizing activities agreed to at the Workshop. These include:

- Evaluation of the backbone of the observing network, including broad-scale aspects of the TPOS.
- Elaboration of the scientific need and feasibility of observing the planetary boundary layers, including air-sea fluxes, near surface processes and diurnal variability,
- Evaluation of approaches to observation of the eastern and western boundary regions,
- Development of rationales, requirements and strategy for biogeochemical observations, and
- Consideration of approaches to advancing modelling, data assimilation and synthesis so that observations can achieve their fullest impact.

The TPOS 2020 project refers to the sustained sampling network (formerly called “broadscale”) as the “backbone” of the system. This terminology emphasizes that the backbone anchors and underlies all other pieces of the observing system; some of which may be implemented for a limited time. The backbone will be designed to maintain consistent and well-understood sampling rates and scales that allow for the detection of decadal variability and climate trends.

Since much of the use and benefit of TPOS data products will be achieved through model assimilation and syntheses, the operational modeling centers must be considered key partners; TPOS 2020 efforts, including embedded process studies, will be designed to address phenomena that cause systematic errors in models, or where detailed observations are needed to guide model design. The initial meeting of the SC highlighted approaches needed for greater involvement of modeling centers in developing process studies to better answer these questions. Among potential studies will be those geared toward a greater understanding of the relationship of ocean near-surface conditions and convective rainfall in the tropics, and the mechanisms that communicate surface fluxes into the subsurface ocean.

The initial TPOS Review, and the subsequent in-depth discussions at the TPOS 2020 SC-1 meeting, resulted in a number of recommendations that will define the approach to the six year project. Beyond the matters already highlighted above, these include:

- Consideration of the observing system as an integrated whole, including satellites, modeling, data management and the range of modern in situ technologies. Thus the project will articulate the strengths of a multi-platform approach appropriate to the multi-scale variability of the tropical Pacific.
- Explicitly assessing risks to the observing system as part of TPOS 2020, taking into account system requirements such as necessary redundancy, sensor diversity, etc.
- Identifying and sustaining critical long-term climate records.
- Urgently exploring strategies to minimize the impact of the reduction in the TRITON Array.
- Initiating discussions with interested organizations to broaden engagement in supporting the TPOS, with respect to ship support, participation in joint process studies, and development of models and data assimilation systems.
- Taking advantage of opportunities to make observations from vessels involved in servicing moorings, and to use the backbone network as infrastructure to enable limited-duration process studies and to test and improve observing technology.
- Ensuring appropriate levels of investment in data processing and product distribution.

Dependencies and Governance

As highlighted earlier, TPOS 2020 must be managed and implemented within the context of existing and planned activities of the GOOS; and in particular the activities of the Joint Technical Commission for Oceanography and Marine Meteorology (JCOMM) which coordinates the implementation of many of the community's existing in situ networks.

Other critical partners include the Climate Variability and Predictability Project (CLIVAR) and GODAE/OceanView. CLIVAR supports a number of research activities and projects relevant to TPOS 2020, particularly with respect to modelling and process studies. The work of GODAE/OceanView is relevant to the planned ocean prediction and observing system studies of TPOS 2020.

TPOS 2020 will operate as an independent Project and work through its sponsors to ensure all dependencies and links are appropriately managed. As such, four primary elements are included in the governance of the Project:

- A TPOS 2020 Steering Committee responsible for oversight and coordination.
- A Resources Forum drawn from sponsors and responsible for coordinating resources.
- An Executive populated from the leadership of the above and responsible for reporting.
- A Project Office focused on coordination activities supported and resourced by the sponsors.

It is through these partnerships and governance structure that TPOS 2020 will design a modern, sustained tropical Pacific observing system that meets both science and societal needs.