

*From Global to Coastal: Cultivating New Solutions and Partnerships for an Enhanced Ocean Observing System in a Decade of Accelerating Change*



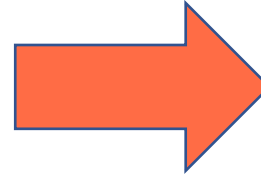
# **TROPICAL PACIFIC** *OBSERVING SYSTEM*

# From TPOS2020 project to TPOS



Time-limited project  
2014-2021

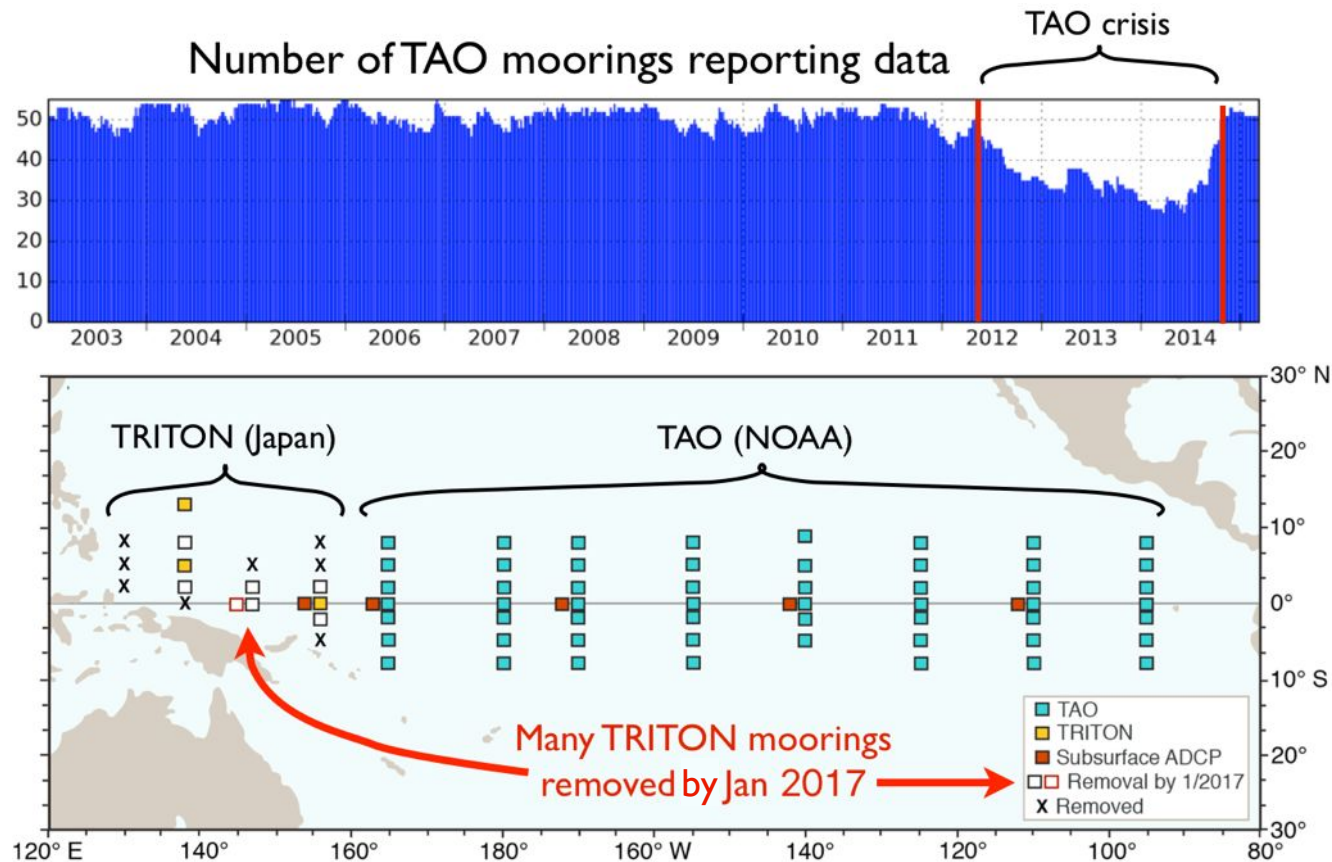
- Evaluate the observing system to identify gaps and needs for the coming decades
- Make recommendations to rejuvenate the system



Project starting  
2022-

- Turn focus toward **implementing** these recommendations
- TPOS seeks to:
- accelerate advances in technology
  - inform policymakers.

# TPOS2020 began in a crisis (2014)



The crisis showed the risk to ENSO prediction.

TPOS2020 started:

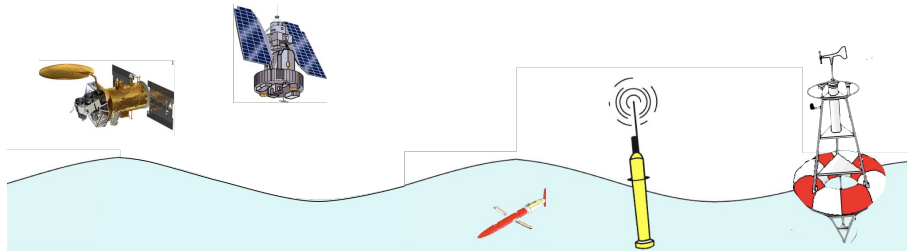
to build a more modern, robust and resilient system, meeting the needs of research and forecasting systems, considering:

- New technical possibilities
- New scientific issues
- New model and DA developments

## We published 3 reports of recommendations (with extensive consultation and review from the broader community)

- Recommendations for the **Backbone** observing system (including biogeochemical observations)
- Recommendations for the **western** and **eastern Pacific regions**
- Recommendations for **pilots\*** and **process\*** studies

## Our vision: an integrated system



Integrated via gridded products  
(syntheses / model products)

- A “Pilot Study” aims to evaluate feasibility, cost, risks, and observational options ahead of sustained implementation
- A « Process Study » is a research experiment, usually with a phenomenological focus, for improved knowledge

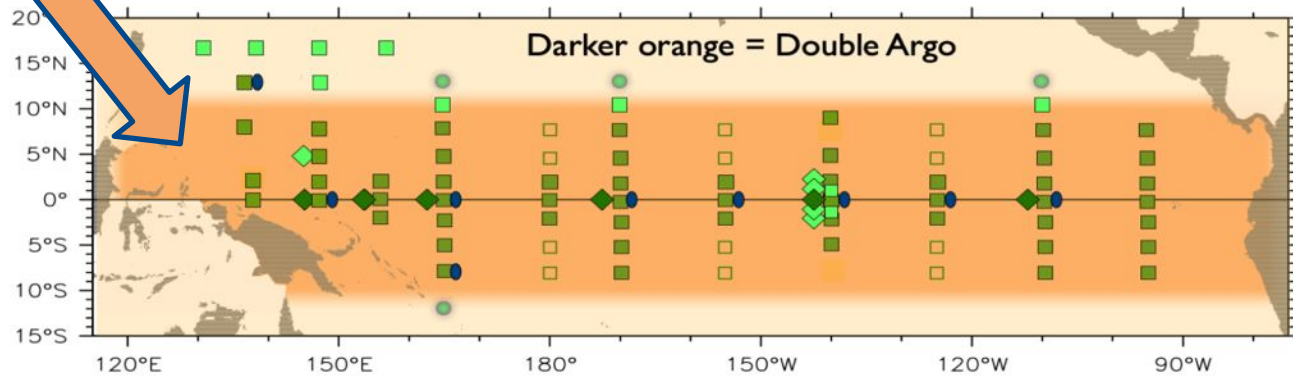


We provided plans for an integrated system responding to multiple needs



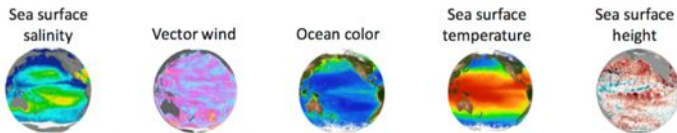
DOUBLING ARGO  
Including  
124 BGC floats

## TPOS 2020 proposed reconfiguration



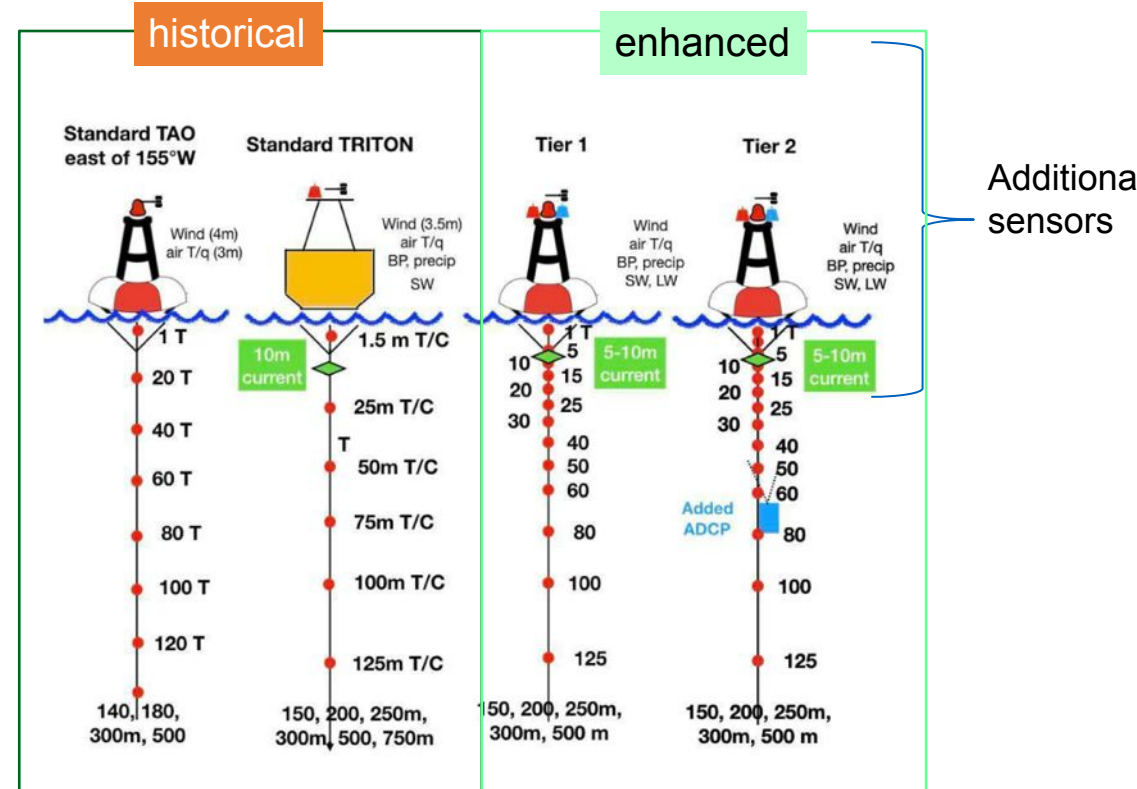
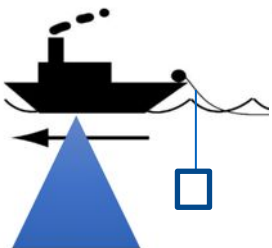
### Moorings:

Type: ■ Tier 1 (upgrade)  Lower priority ◆ ADCP (velocity) ● pCO<sub>2</sub>  
 Present/historical sites: ■ New sites: ■ Locations TBD: ●



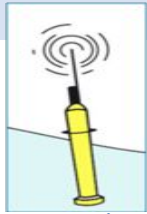
### Ships are essential:

- BGC suite along moorings servicing lines
- Underway pCO<sub>2</sub>



Additional sensors

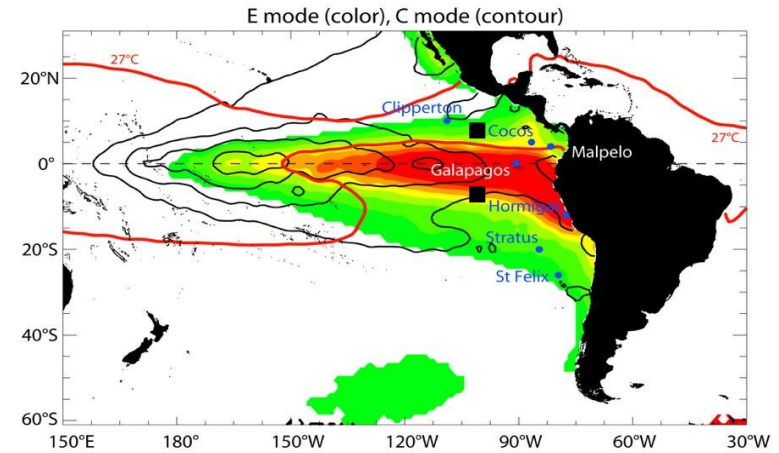
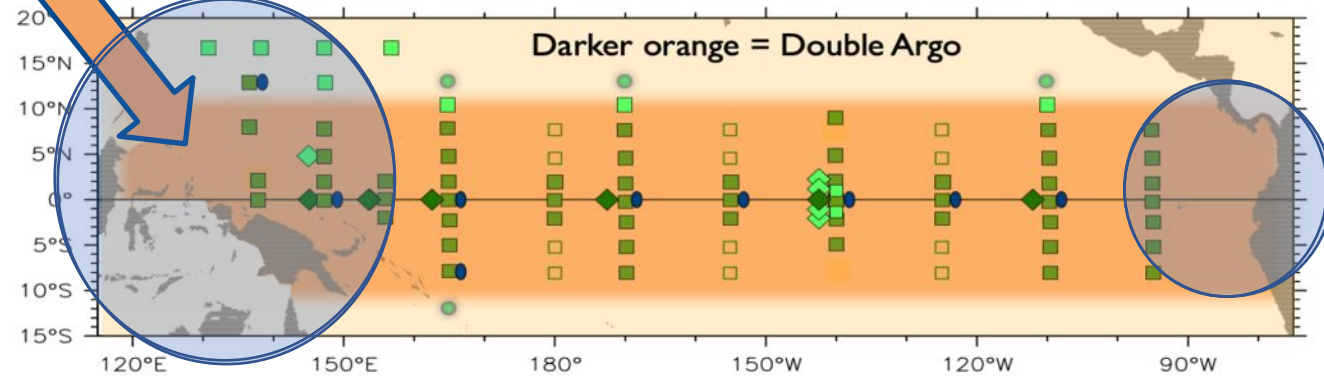
# TPOS2020 recommendations for the western and eastern regions



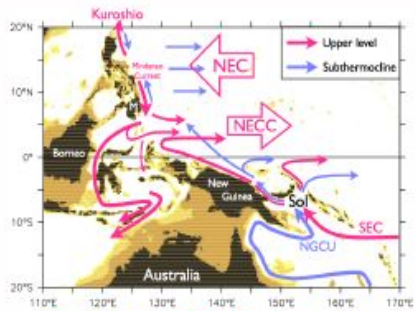
**DOUBLING ARGO**  
Including  
124 BGC floats

- Enhance/improve regional coordination
- Pilots and process studies

## TPOS 2020 proposed reconfiguration

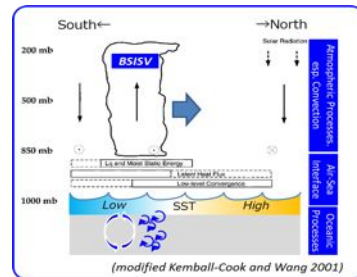
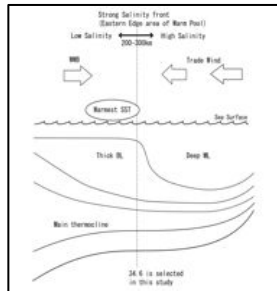


### Low-Latitude WBCs



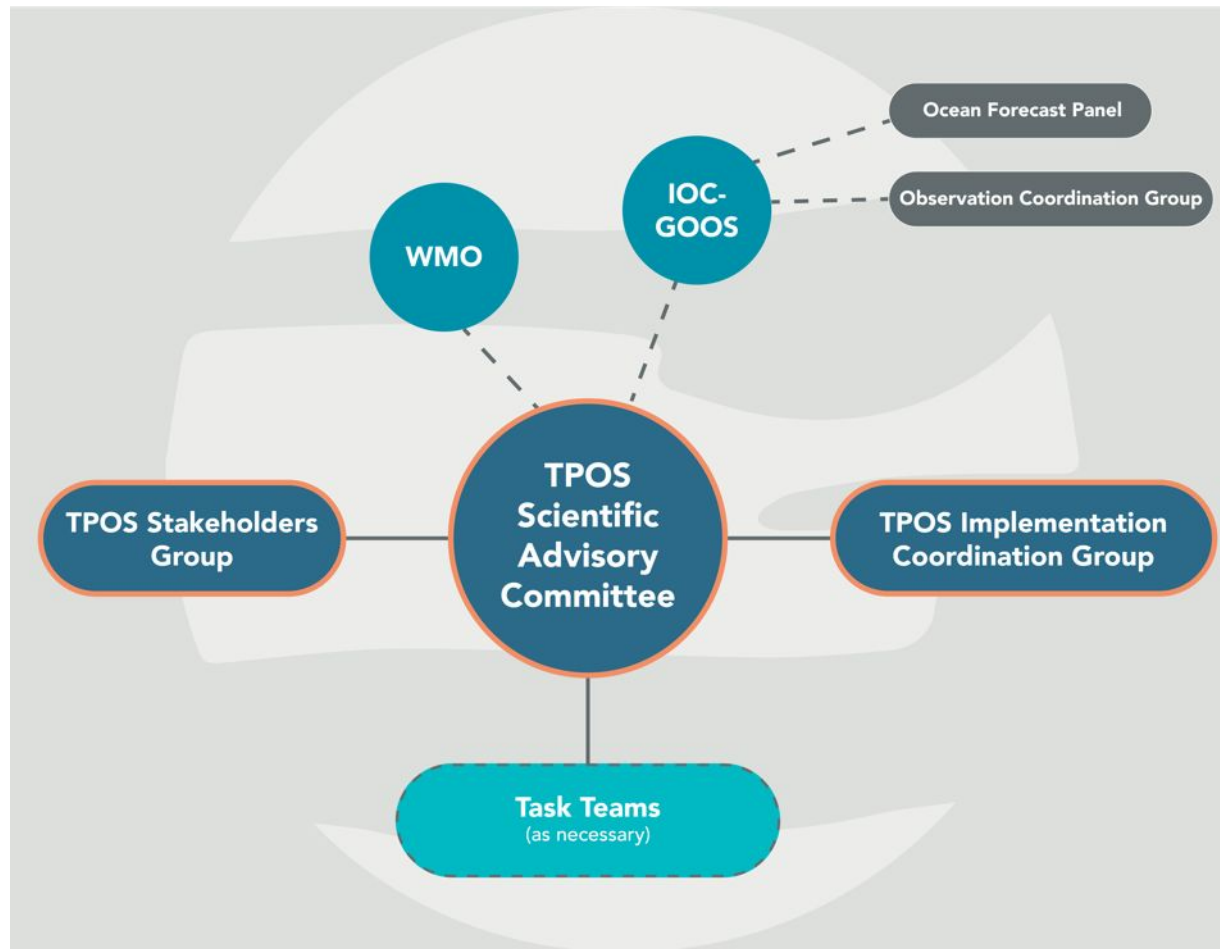
Low-latitude western boundary currents and the Indonesian Throughflow are principal conduits of tropical-subtropical interaction.

### Air –Sea Interaction at the Eastern Edge and northern edges of the Warm Pool



- Ocean/atmosphere interactions (cold tongue/ITCZ/stratus regions)
- Develop "atmosphere/ocean sites" in strategic islands
- Pilots for the Oxygen Minimum Zone

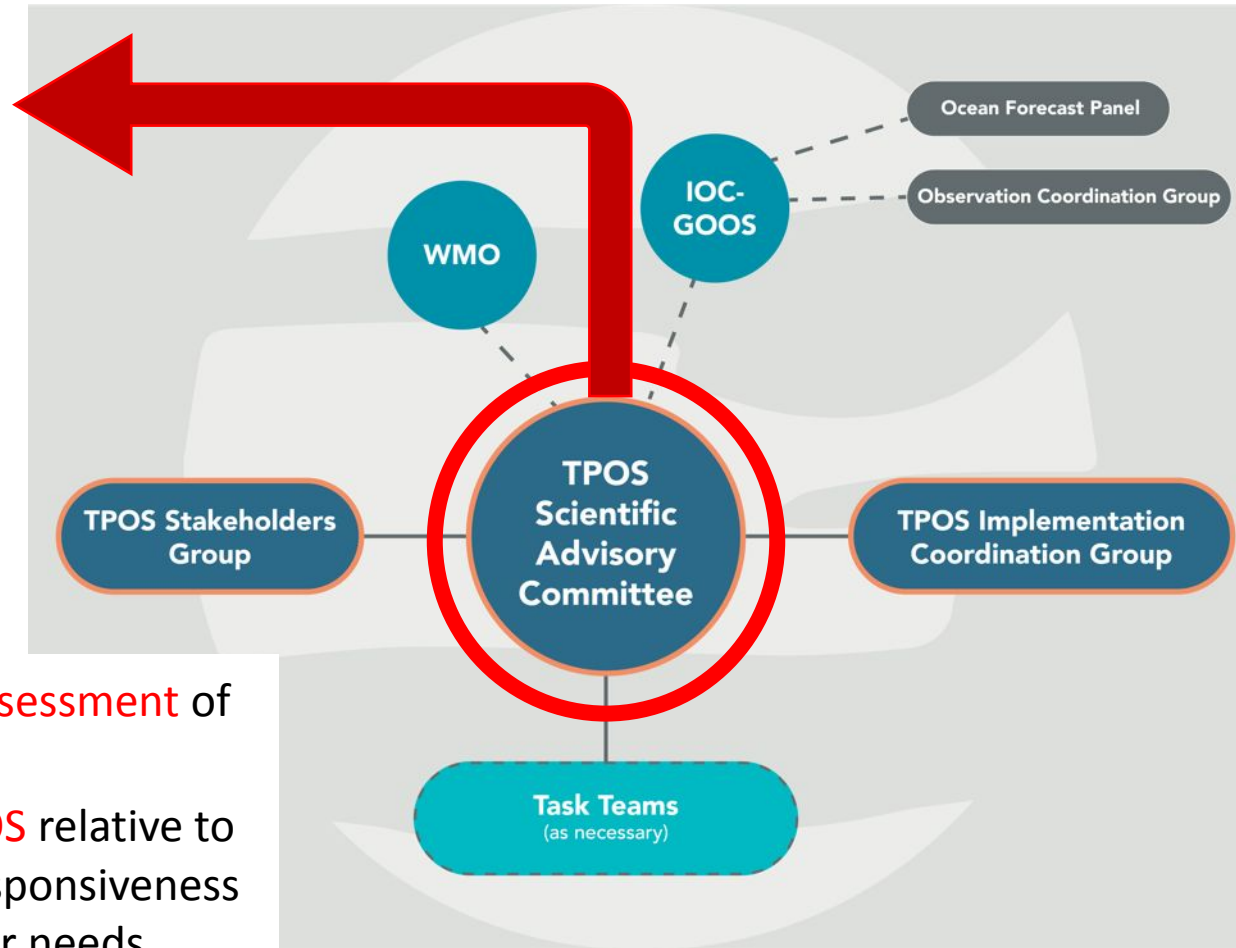
# TPOS new governance and ToRs



# TPOS new governance and ToRs

**Dr. Billy Kessler**  
NOAA PMEL

**Dr. Fei Chai**  
SIO-MNR



- **Oversee the design and assessment** of the TPOS backbone
- **Report on the state of TPOS** relative to its aims by maintaining responsiveness to sponsor and stakeholder needs
- **Develop and foster ties to regional partners** who could leverage TPOS efforts to better meet regional needs



# TPOS new governance and ToRs

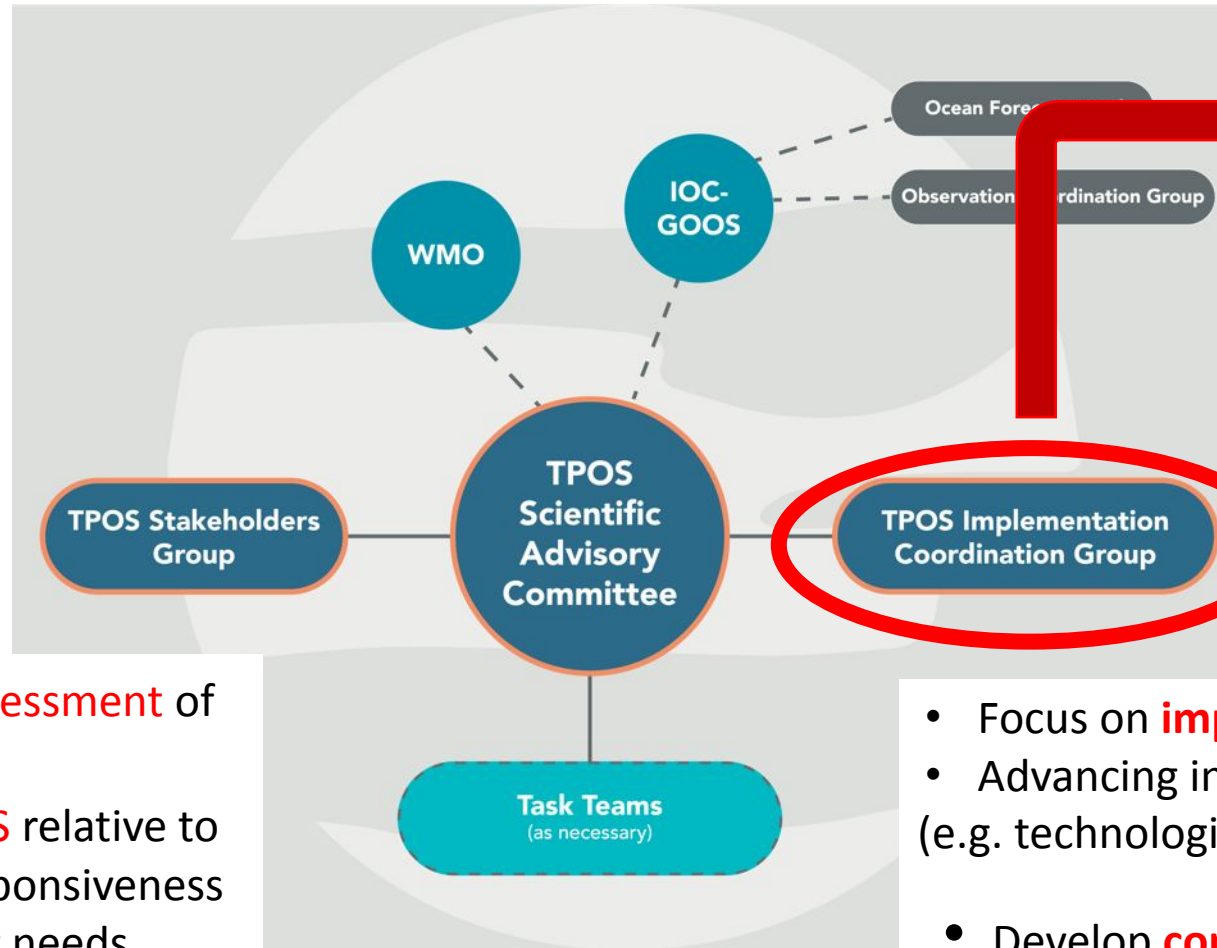
**Dr. Billy Kessler**  
NOAA PMEL

**Dr. Fei Chai**  
SIO-MNR



**Dr. Karen Grissom**  
NOAA NDBC

**Dr. Iwao Ueki**  
JAMSTEC



- **Oversee the design and assessment** of the TPOS backbone
- **Report on the state of TPOS** relative to its aims by maintaining responsiveness to sponsor and stakeholder needs
- **Develop and foster ties to regional partners** who could leverage TPOS efforts **to better meet regional needs**

- Focus on **implementation** of the TPOS
- Advancing integration of new capabilities (e.g. technologies, regional efforts, pilot studies)
- Develop **common procedures** (mooring configuration, implementation procedures and data management principles and dissemination).

# Challenges for the future

BGC

**Greater entrainment of ecological observations**

**Further consultation with international panels** (GOOS Biology and Ecosystem Panel, Pacific Fisheries Commission)

Eastern  
region

**Several actions on-going => efforts to continue**

**Foster dialogue among international partners and key players**

Western  
Pacific  
region

**Encourage collaboration with scientists in the regions, encourage educational outreach with regional institutions**

TPOS - Tropical Pacific Observing System

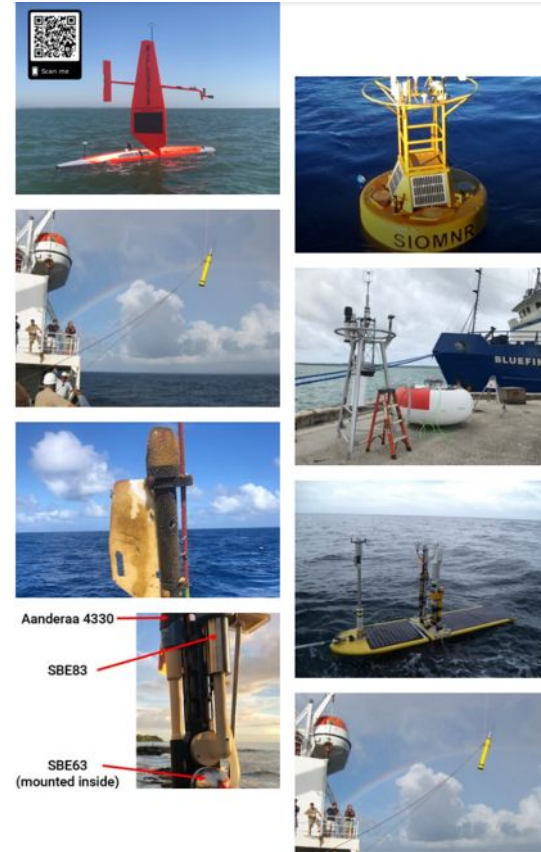
A resilient and integrated observing system that meets observational, experimental, and operational needs of today and the future.

**What is TPOS?**

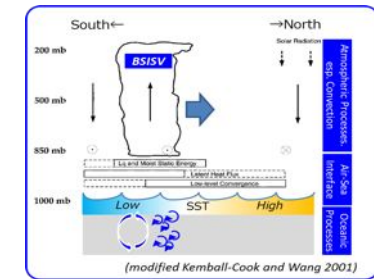
TPOS is a multinational observing system designed to measure the subsurface and surface ocean and the atmosphere spanning the tropical Pacific from approximately 10°S to 10°N. Many agencies and institutions contribute to and operate elements of this observing system. TPOS seeks to accelerate advances in technology, understand and predict tropical Pacific variability, and inform policymakers and benefit society.

**TPOS 2020 proposed reconfiguration**

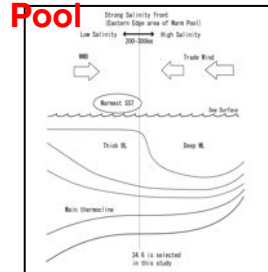
Moorings: Type: ■ T1 (Temp, Met) × Omitted TAO ◆ ADCP (velocity) ● pCO<sub>2</sub>  
 Present/historical sites: ■ New sites: ■



## Air-sea interaction at the northern edge of the Western Pacific Warm Pool



## Air-Sea Interaction at the Eastern Edge of the Warm Pool

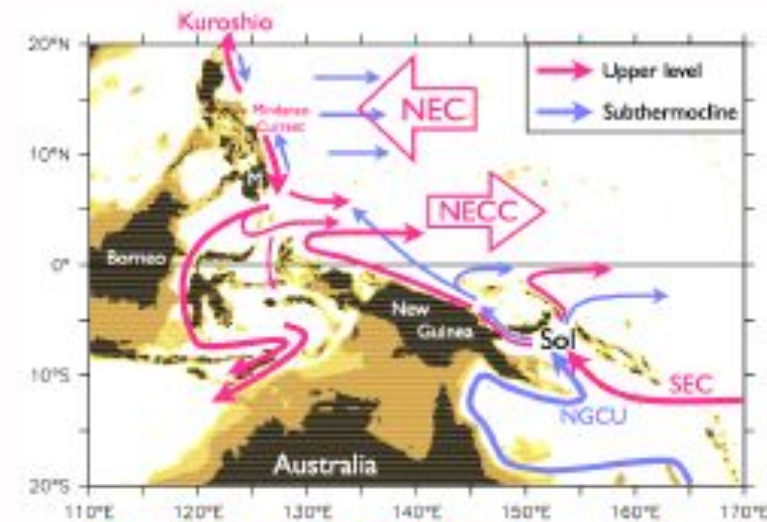


Email Cheyenne ([cheyenne.stienbarger@noaa.gov](mailto:cheyenne.stienbarger@noaa.gov)) and Lucia ([lucia.upchurch@noaa.gov](mailto:lucia.upchurch@noaa.gov)) to stay in touch, ask questions, etc.

# WP-TT: SCOPE and MEMBERSHIP

The goal of the WP-TT was to identify the significant features of the western Pacific circulation and air-sea exchange and to oversee and develop an integrated strategy towards an observing system that resolves these features (e.g. typhoon forecasting, boundary current systems, warm pool migration, climate forecasting and research etc.)

Masaki Katsumata (co-chair, JAMSTEC, Japan)  
Janet Sprintall (co-chair, SIO, USA)  
Tim Moltmann (IMOS, Australia)  
Dongliang Yuan (IOCAS, China)  
Xiaopei Lin (OUC, China)  
Dake Chen (SIO, China)  
Alexandre Ganachaud (former co-chair, LEGOS, France)  
Donald Sukma Permana (BMKG, Indonesia)  
Jae Hak Lee (KIOST, Korea)  
Dongchull Jeon (KIOST, Korea)  
Bo Qiu (UH, USA)  
Olive Cabrera (UP, Philippines)  
Ken Ando (former co-Chair, JAMSTEC, Japan)

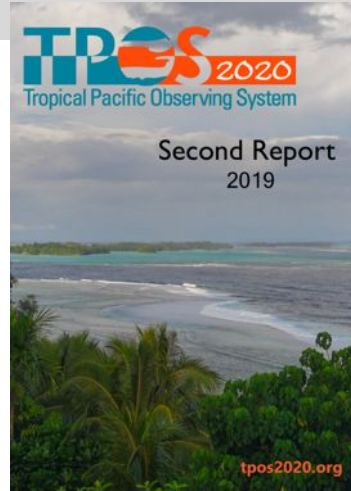
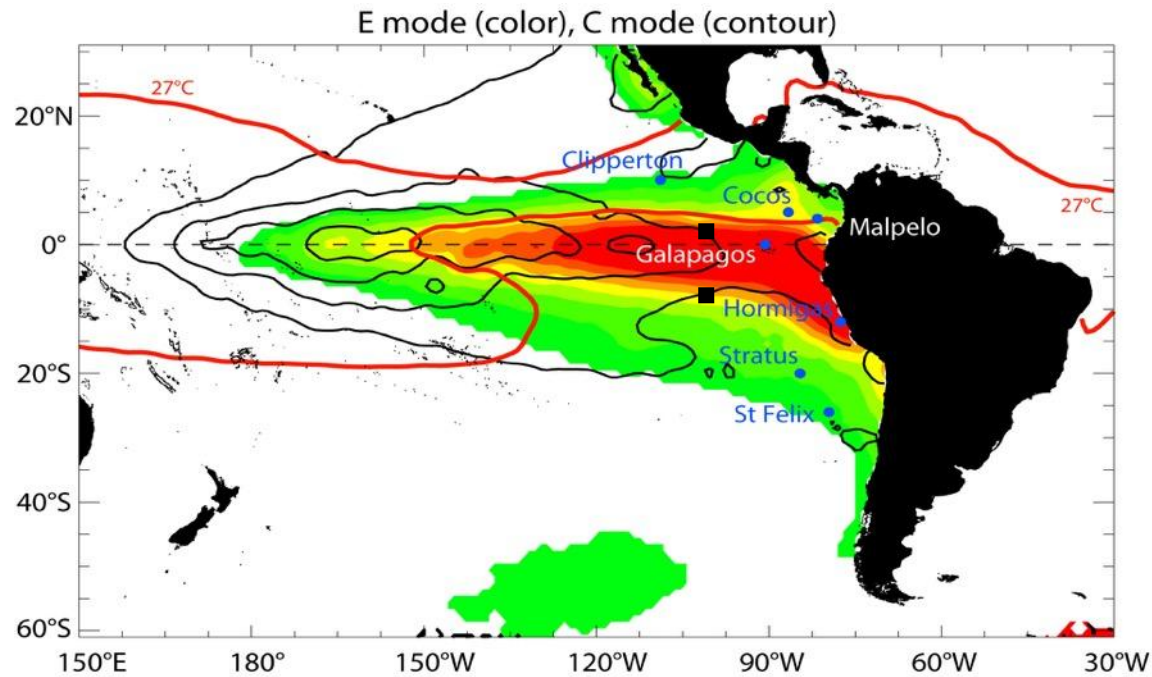


Low-latitude western boundary currents and the Indonesian Throughflow are principal conduits of tropical-subtropical interaction.

Source: B. Kessler



# Recommendations for the eastern Pacific O.S



- Opportunities to enhance/improve regional coordination (Peru, Chile, Ecuador, Costa Rica, Mexico) for developing the regional observing system (real-time data sharing, Argo doubling, pilot studies)
- Develop "atmosphere/ocean sites" in strategic islands, observations of atmospheric vertical structure
- Observations for the Oxygen Minimum Zone

# Greater entrainment of ecological observations

- from moorings and ships
- acoustic observations of zooplankton and fish
- passive acoustic sensors on moorings to listen for tagged fish (Ocean Tracking Network receivers)
- environmental DNA sampling
- Applications: map the spatial and temporal variability of animals driven by ENSO, changes in the type of El Niño events, and climate change

## Further consultation with international panels

- Western and Central Pacific Fisheries Commission
- Inter-American Tropical Tuna Commission
- GOOS Biology and Ecosystem Panel



# TPOS2020 project goals

We rethought the system in light of its many functions.

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

The vision: an integrated system

- We viewed the system as a whole (with complementarities among platforms)
- We probed how users accessed the TPOS data streams (mostly via gridded products) and which data streams mattered to these.

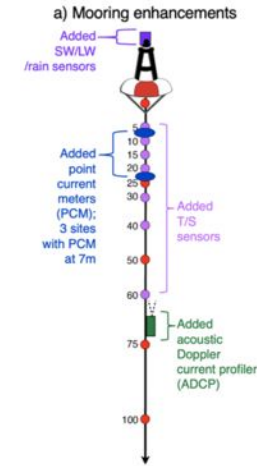
# New Technology pilots

## Test new technology, assessing their potential for TPOS

### Autonomous platforms



Fig 4c) Wave Glider  
© Dr Ueki



### Moored instrumentation

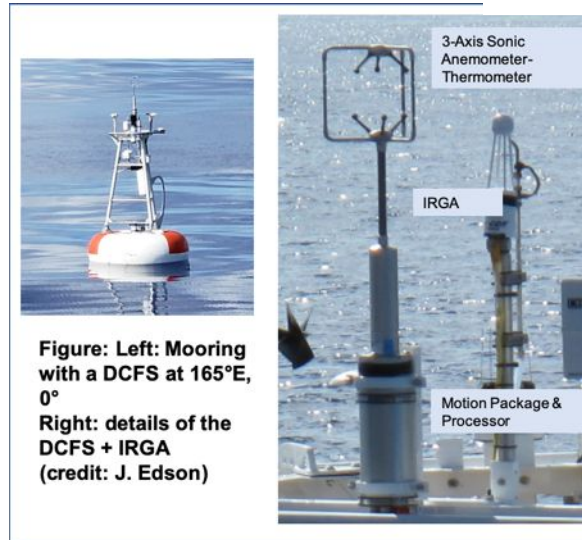
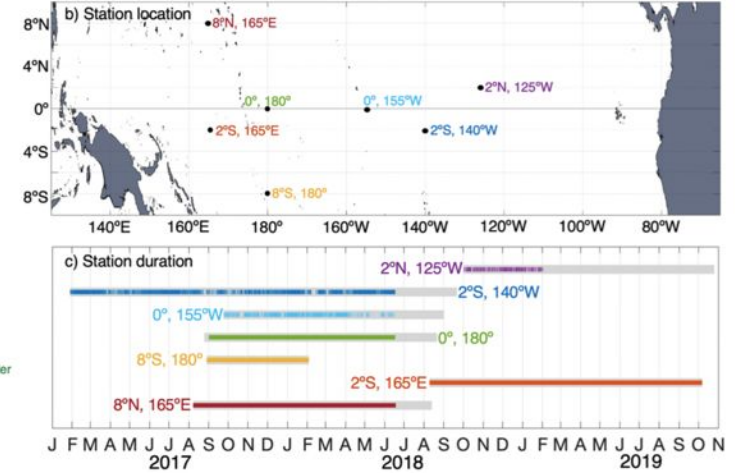


Figure: Left: Mooring with a DCFS at 165°E, 0°  
Right: details of the DCFS + IRGA (credit: J. Edson)

