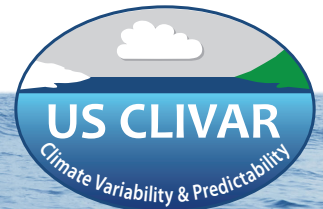


US CLIVAR Perspective

Kris Karnauskas

**Bridging Sustained Observations &
Data Assimilation for TPOS 2020**

BOULDER, CO | MAY 1-3, 2018



Special thanks to...

US CLIVAR Project Office: Mike Patterson, Kristan Uhlenbrock and Jill Reisdorf

Workshop co-chair: Billy Kessler (NOAA PMEL)

Scientific Organizing Committee:

Craig Bishop (NRL)

Meghan Cronin (NOAA PMEL)

Maria Flatau (NRL)

Samson Hagos (PNNL)

Steve Penny (NOAA NCEP, UMD)

Janet Sprintall (Scripps)

Sam Stevenson (UCSB)

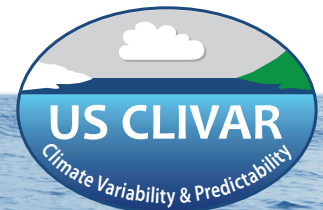
Aneesh Subramanian (Scripps)

Agencies generously providing funding for this workshop:

NOAA Ocean Observations and Monitoring Division (OOMD)

NASA Physical Oceanography Program

NOAA Modeling, Analysis, and Prediction Program (MAPP)





US CLIVAR Mission: To foster understanding and prediction of climate variability and change on intraseasonal-to-centennial timescales, through observations and modeling with emphasis on the role of the ocean and its interaction with other elements of the Earth system, and to serve the climate community and society through the coordination and facilitation of research on outstanding climate questions.

→ *Long-standing tradition and strength in the tropical Pacific*

US CLIVAR Science Goals:

- Understand the role of the oceans in observed climate variability on different timescales
- Understand the processes that contribute to climate variability and change in the past, present, and future
- Better quantify uncertainty in the observations, simulations, predictions, and projections of climate variability and change
- Improve the development and evaluation of climate simulations and predictions
- Collaborate with research and operational communities that develop and use climate information

The work of US CLIVAR is carried out by panels and working groups populated by enthusiastic scientists from all career stages. Serving is typically seen by one's peers/ institutions as a significant service activity.



US CLIVAR

Interagency Group

Scientific Steering
Committee

Project Office

Panels

Phenomena,
Observations &
Synthesis

Process Study
Model
Improvement

Predictability,
Prediction &
Applications Interface

Science Teams

Atlantic Meridional Overturning
Circulation (AMOC; 2020)

Funded Projects

Observing Systems (ongoing)
Process Studies (ongoing)
Climate Process Teams (ongoing)
Climate Model Evaluation (2013)

Working Groups

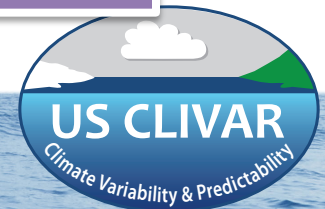
Large Ensembles (2021)
Water Isotopes (2021)

Widening of Tropical Belt (2019)
Arctic-Midlatitude Interactions (2018)

ENSO Diversity (2015)
Extremes (2015)
Tropical Ocean Synthesis (2015)
Ocean Carbon Uptake (2015)
Southern Ocean (2015)
Hurricanes (2014)
Greenland Ice Sheet/Ocean (2014)

Decadal Predictability (2012)
High Latitude Sfc Fluxes (2012)
Madden Julian Oscillation (2008)
Drought (2008)
Western Bndy Current (2007)
Salinity (2007)

Workshops, Conferences, & Trainings



US CLIVAR Panel Missions

Phenomena, Observations, and Synthesis (POS) Panel

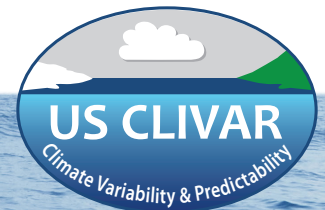
Advocates and leverages long-term climate monitoring and synthesis strategies to better document, understand, model, and predict climate variability

Predictability, Predictions, and Applications Interface (PPAI) Panel

Coordinates plans to understand predictability of the oceans and climate across time scales, advance climate predictions and projections, and quantify/communicate skill and uncertainty

Process Studies & Model Improvement (PSMI) Panel

Aims to reduce uncertainties in general circulation models used for climate variability prediction and climate change projections through an improved understanding and representation of the physical processes governing climate and its variation



Timeline of US CLIVAR Interactions on TPOS 2020

2013

- November – Initial briefing of US CLIVAR Interagency Group (David Legler)

2014

- April – Invited briefing of Scientific Steering Committee (David Legler)

2015

- February – Update for Interagency Group (Billy Kessler)
- August – US CLIVAR Summit joint session of POS and PSMI Panels on TPOS 2020
- October – Coordinated POS Panel input on strawman design for TPOS 2020 Steering Committee Mtg

2016

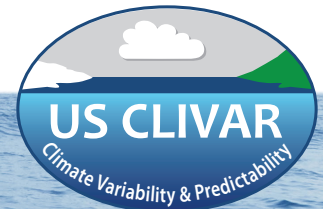
- July – Interagency Group briefing (David Legler)
- September – PSMI and POS Panel inputs to open review of draft 1st TPOS 2020 Report

2017

- February – Interagency Group briefing (David Legler)
- August – Summit briefing of PSMI Panel on TPOS and process studies (Billy Kessler)
 - There is limited communication with modeling centers and lack of observing system simulation experiments.
 - There is insufficient support for communication and interacting between observationalists designing TPOS2020 and modelers/assimilation experts who will make systematic and operational use of the observing system.
- September – PSMI Panel (with POS) request for Workshop on Bridging Sustained Observations and Data Assimilation for TPOS 2020

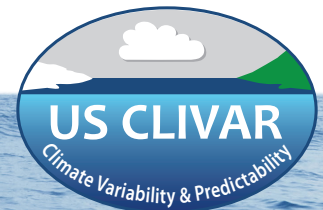
2018

- April – Interagency Group Briefing (Shelby Brunner)
- May – US CLIVAR / TPOS 2020 Workshop
- Summer – Workshop report findings and recommendations as input to 2nd TPOS 2020 Report



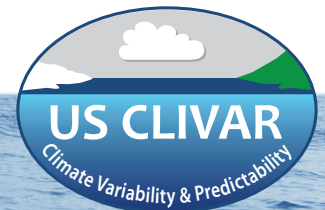
Relevance of TPOS 2020 and this workshop to US CLIVAR

- ❑ From the beginning of TPOS 2020, US CLIVAR has been involved through regular **dialogue and feedback**, and cross-pollination of personnel in TPOS 2020 Task Teams and US CLIVAR Panels.
- ❑ At the 2017 US CLIVAR Summit, PSMIP held a breakout session “TPOS 2020 and Process Studies” including a discussion providing feedback to TPOS 2020 leadership regarding identified and **potential future process and pilot studies**.
- ❑ A **critical need for communication** was identified between TPOS 2020 and the communities involved in modeling and data assimilation that will use (and in some cases, rely heavily on) the suite of measurements collected by the observing system that may ultimately emerge.
- ❑ The observing system will **reach its full potential** only when the models are able to correctly infer the processes detected in the data, while the models need observational guidance to improve their representations of those processes.
- ❑ This pointed to a critical need for regular, **iterative** interaction between observationalists involved in the design of TPOS 2020; modelers who are improving the physical and biogeochemical process representation in ocean and coupled ocean-atmosphere modeling systems, and data assimilation scientists who will make use of the observing system to generate monitoring products, initialize forecasts, diagnose model errors, and provide feedback regarding weaknesses in the observing system itself.



Relevance of TPOS 2020 and this workshop to US CLIVAR

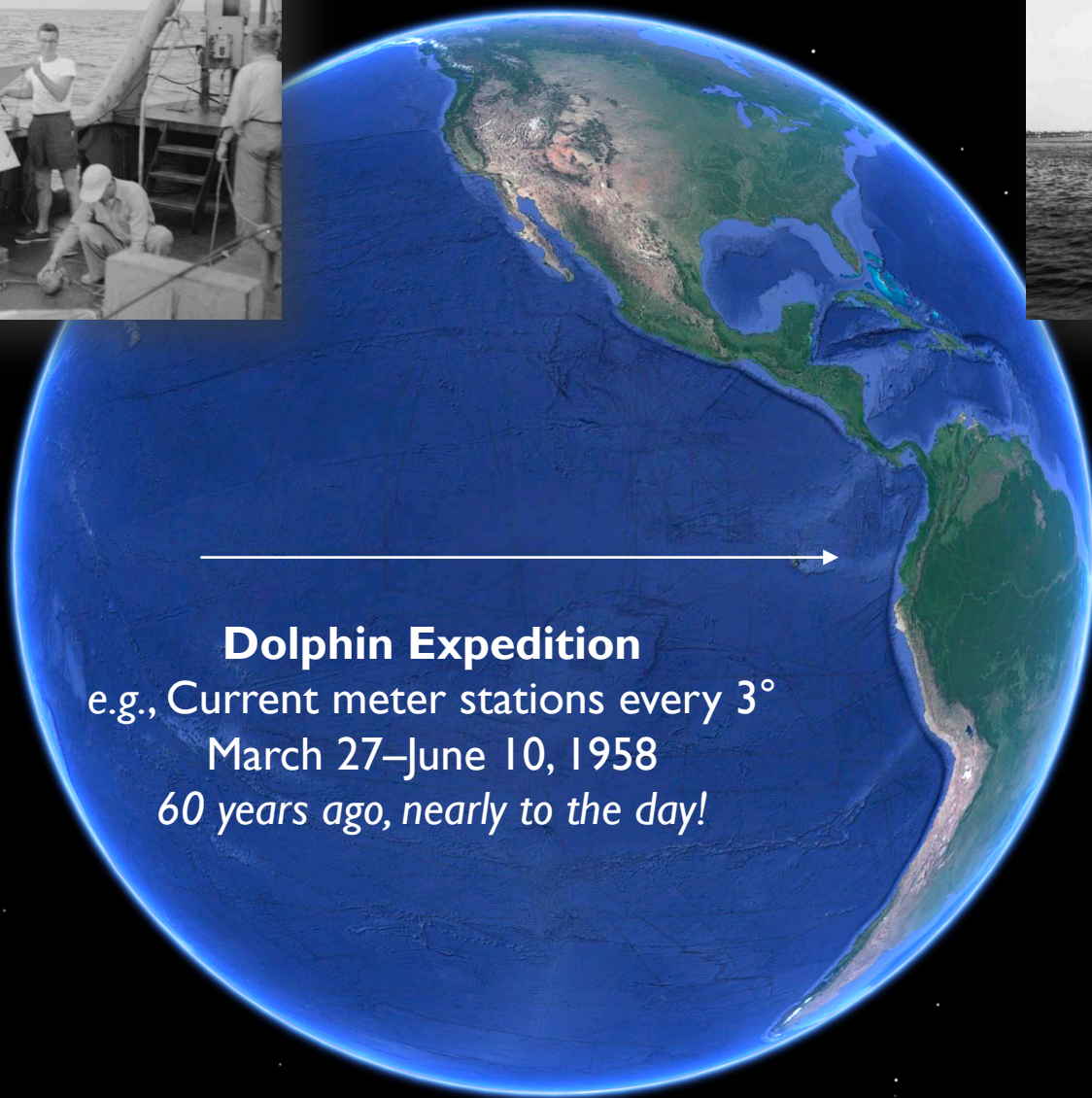
- ❑ The TPOS 2020 project seeks to **integrate diverse data platforms** that have very different sampling characteristics. This integration will inevitably be done through the use of data assimilation and state-of-the-art Earth system models.
- ❑ Potential **consequences of not setting up this communication channel would be severe**, including being left with an observing system that is neither optimized for the forecasting needs of the major operational prediction centers, nor the development requirements of the modeling centers.
- ❑ The relevance (and benefit) to US CLIVAR is clear. Ensuring that the next generation observing system in the tropical Pacific is applicable to model development and data assimilation activities is **consistent with all five of the US CLIVAR science goals**, especially: fostering collaboration with research and operational communities that develop and use climate information.
- ❑ Moreover, this workshop advances one of the POS Panel priorities and Summit action items: Facilitating connections to the DA/CDA community; begin determining what data exists which could aid in developing OSSE-like information relevant for the design of observing networks.





John Knauss and crewmen with oceanographic instrument aboard R/V Horizon (1952) Scripps Institution of Oceanography Photographs

A view of the Scripps Institution of Oceanography research vessel, R/V Horizon, at anchor (1960) Scripps Institution of Oceanography Photographs



Dolphin Expedition

e.g., Current meter stations every 3°

March 27–June 10, 1958

60 years ago, nearly to the day!

US CLIVAR

Climate Variability & Predictability

Dolphin Expedition: March 27–June 10, 1958

Ship-based current meter observations (Knauss 1960)

Measurements of the Cromwell Current

JOHN A. KNAUSS

(Received 15 August 1959)

THE Cromwell Current is a major feature of the oceanic circulation whose presence was unsuspected nine years ago, and whose existence was not predicted by any of the theories of oceanic circulation. Apparently the first indication that there was anything unusual about the currents at the equator in the Pacific was in September, 1951, aboard the *Hugh M. Smith*,* when fishing for tuna at the equator south of Hawaii. The long line gear drifted to the east while the surface drift of the ship was to the west.

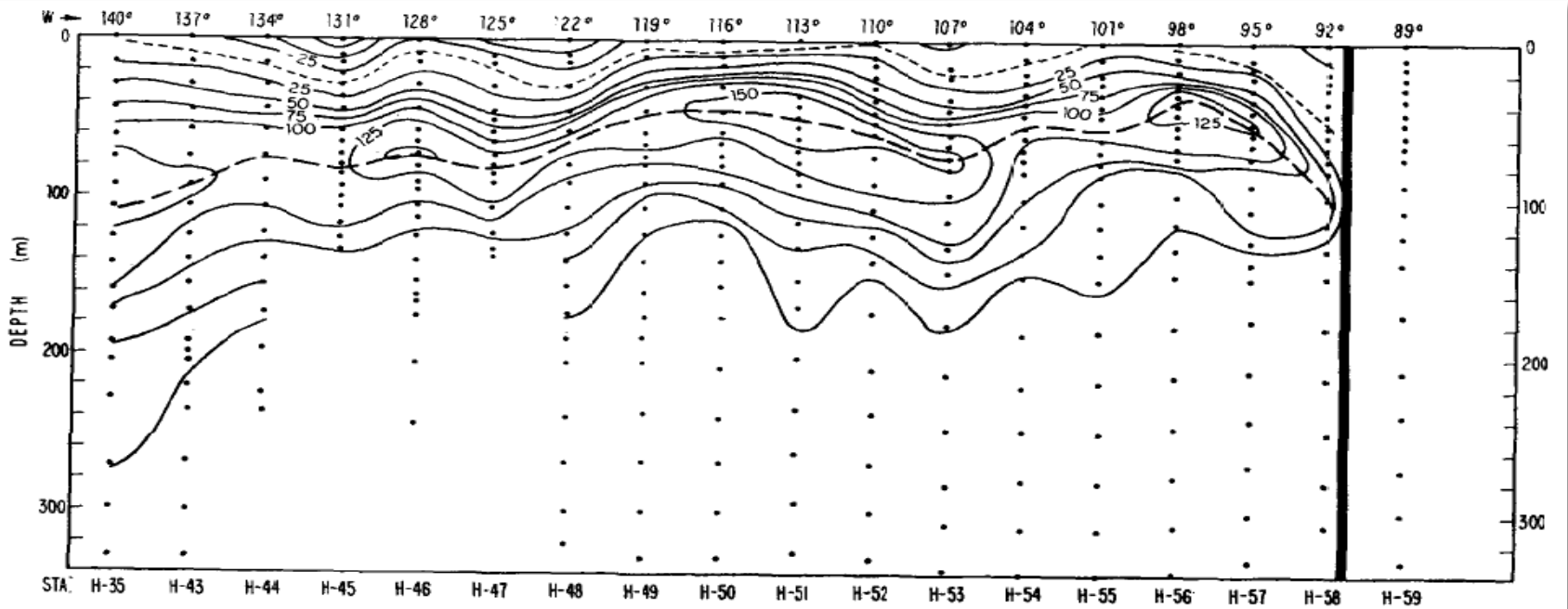




Photo: Kris Karnauskas

← Mike McPhaden viewing subsurface obs. from the TAO Array (in the poster hall of the 2015 AGU Fall Meeting!)

What's in store for the next generation, in terms of...

Observing needs?
Model development needs?
Data assimilation needs/inputs?

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