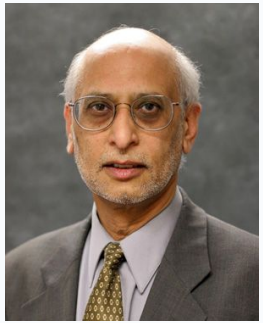
CWG's Recommendations to NOAA on: "S2S2D – A Pathway to Improved Predictions"

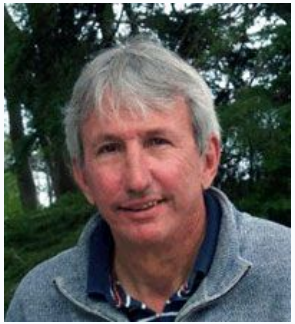
Presented by: Joellen Russell, Ph.D.
Chair
Climate Working Group
December 17, 2019

CWG Members

Joellen Russell
CWG Co-Chair



A.R. Ravishankara
CWG Member

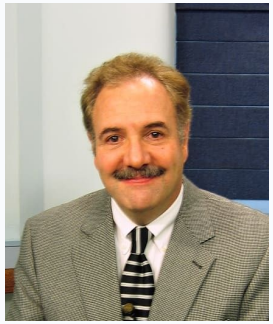


Dean Roemmich
CWG Member

Rong Fu
CWG Member

Paul Fleming
CWG Member

Cecilia Bitz
CWG Member



Paul Knight
Former CWG Co-Chair

Kirstin Dow
CWG Member

Lesley-Ann Dupigny-Giroux
CWG Member

Susan Wijffels
CWG Member

Le Jiang
CWG Member

Why?

- **The idea**. Climate change and earth system prediction on subseasonal-to-seasonal-to-decadal timescales (S2S2D) is essential to saving lives & property and supporting industry.
- **The timing.** The convergence of climate and weather modeling, occasioned by the implementation of Finite Volume Cubed-Sphere dynamical core-Global Forecasting System (FV3-GFS) model, provides the opportune time for NOAA to leverage earth system observational capabilities to better save lives and property and support the Blue Economy.
- **The focus areas.** The CWG asserts that an orderly prioritization and resourcing of pertinent projects focused on modeling, processes, observations, and communication will define the path to a successful and seamless S2S2D prediction system.

Five Focus Areas

- Hybrid statistical-dynamical models
- Boundary layer processes
- Global ocean observations
- Biogeochemical processes: oceanic and terrestrial
- Improved engagement and communications on S2S2D timescales

Hybrid-Statistical Models

Opportunities and Gaps

Hybrid statistical-dynamic models have shown **increased prediction skill** over many regions where dynamic models have shown no prediction skill, especially at the S2S, regional, and local scales.

Hybrid statistical-dynamic predictions can also challenge our understanding of the predictability and **lead to the discovery of sources of predictability.**

The development of hybrid statistical-dynamic models is **relatively inexpensive and effective** for incorporating the insight gained from climate process studies and for providing predictions tailored to the needs of the stakeholders.

Recommendation #1

Fund hybrid statistical-dynamic models (including contributions from machine learning, artificial intelligence, deep learning, etc.) to bridge the gap between the needs of stakeholders and limitations of the dynamic models at regional scales, especially for S2S2D predictions.

Boundary Layer Processes

Opportunities and Gaps

Advances in earth system prediction are predicated upon increased skill in boundary layer simulations.

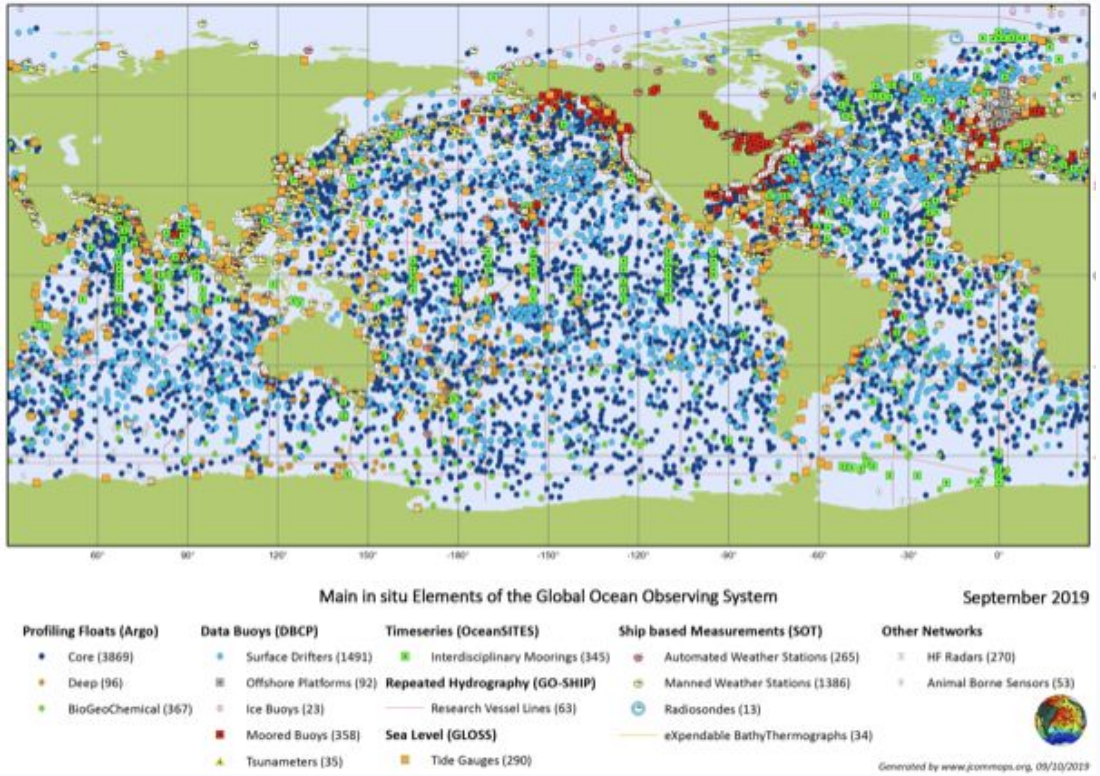
Much of the research into measurements and processes within the boundary layer has been spread across various NOAA labs and partner agencies **with limited coordination**.

Using chemicals with multiple lifetimes has not been utilized as a diagnostic of boundary layer processes. **Chemical measurements need to be integrated** with other parameters such as energy balance, soil moisture, turbulence, vertical profiles, etc. and carried out **in a coherent manner** to understand and quantify the boundary processes.

Recommendation #2

Fund boundary layer chemical dynamics research to help weather forecasting and calculations, as well as quantification of emissions for air quality and climate needs.

Global Ocean Observations

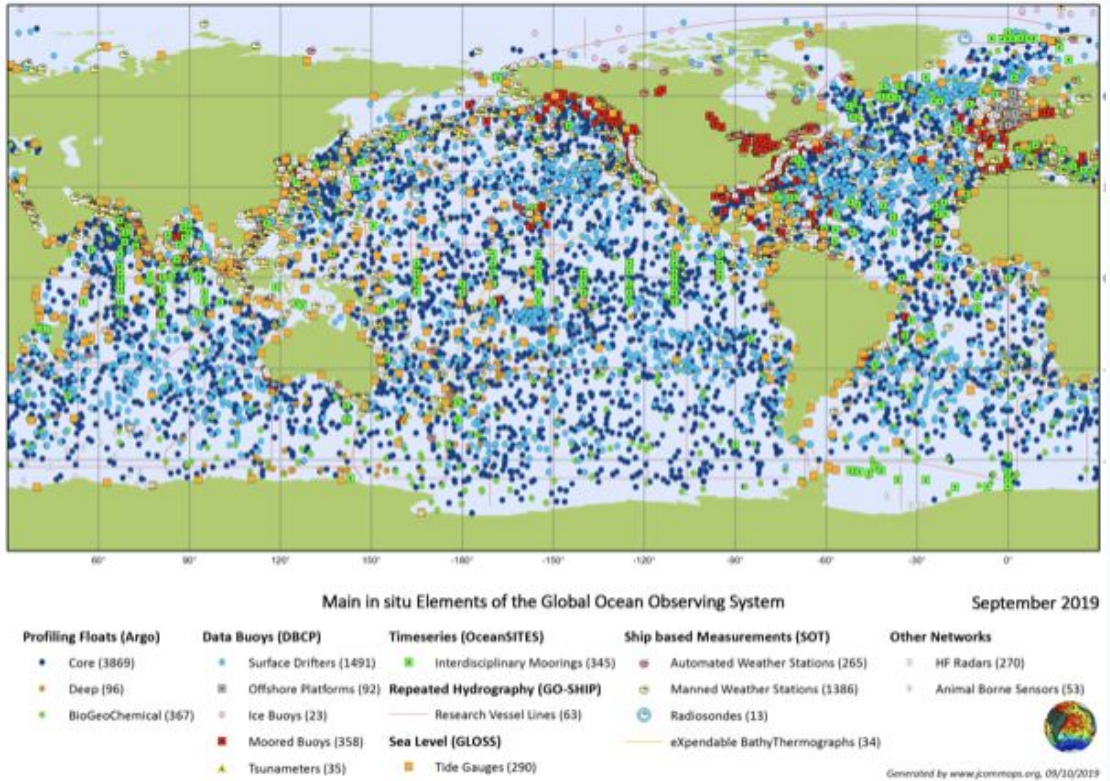


Opportunities and Gaps

NOAA's **research fleet of regional-to-global-capable vessels** that are critical for *in situ* elements of the observing system has **declining support.**

The **expansion of NOAA's ocean portfolio** (e.g., Deep Argo, BGC Argo, and Polar-deployed Argo) **has little secured, committed funding.**

Global Ocean Observations

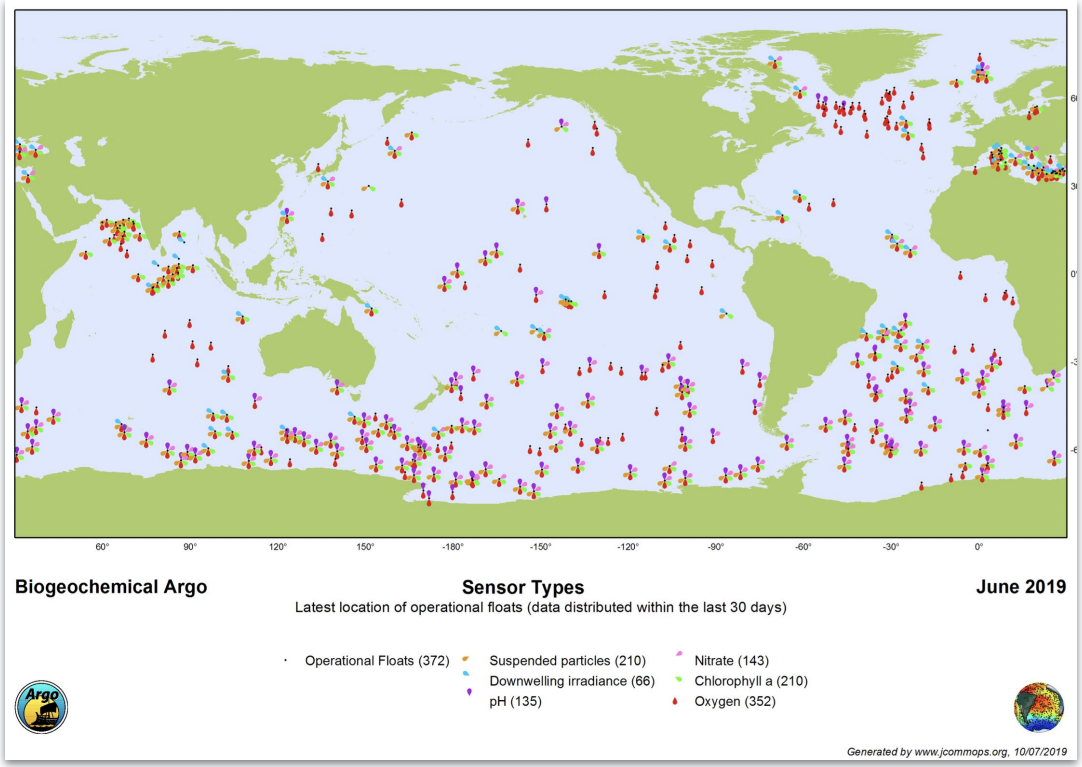


Recommendations #3 and #4

Work towards realizing an expansion of observations networks into the tropics, deep, and polar oceans; obtain global oceanic BGC observations through the implementation of deep Argo, BGC Argo and enhancements in Argo beyond the 2020 design.

Restore funding for ship time in support of sustained observations and deployments.

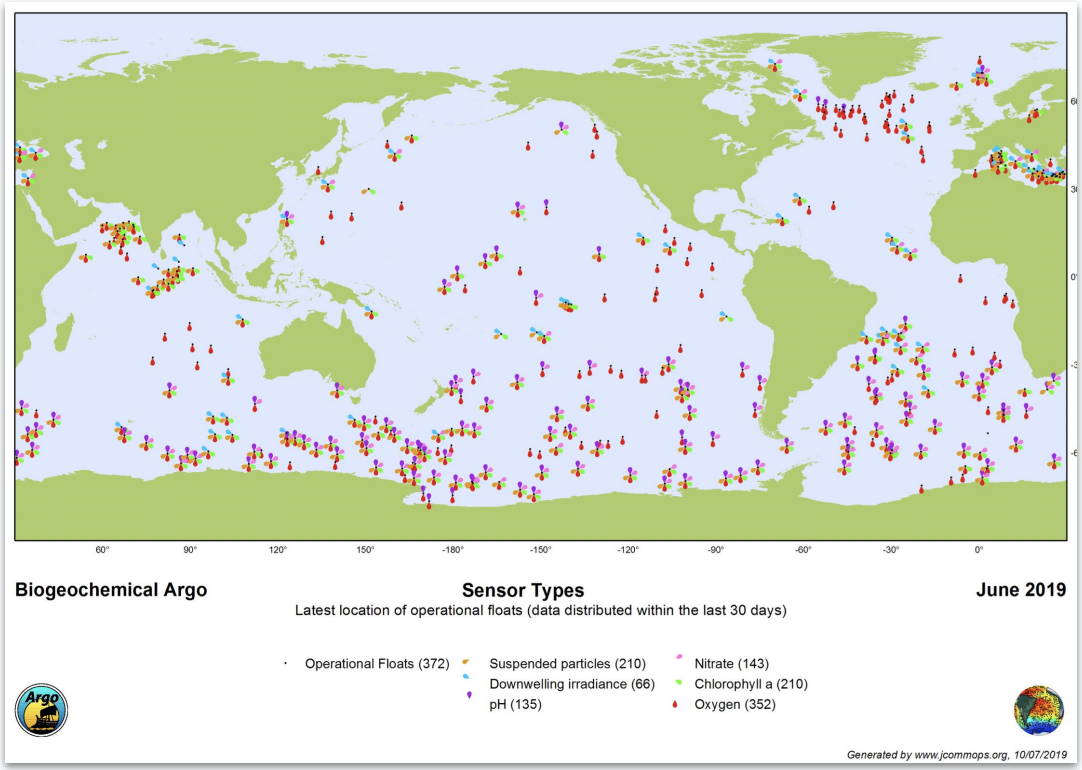
Biogeochemical Observations: Oceanic



Opportunities and Gaps

Large areas of the ocean are **only sampled once per decade, if at all**, with sampling occurring mainly in summer. Assimilation of global atmospheric and oceanic data **will open avenues of research** in forecasts and predictions from the latest earth system models and the global carbon state estimate.

Biogeochemical Observations: Oceanic



Recommendation #5

Fund a global biogeochemically-sensored autonomous profiling float array and train the personnel to deploy and calibrate them.

Biogeochemical Observations: Terrestrial

Opportunities and Gaps

The **improved understanding of vegetation responses to climate variability, extremes, and biogeochemical models** have laid a foundation for improving our predictive understanding and modeling capability for climate variability and extremes, as well as for marine ecosystems.

While the **importance of vegetation in determining S2S predictability** has been increasingly appreciated in recent years, it is still understudied.

Recommendation #6

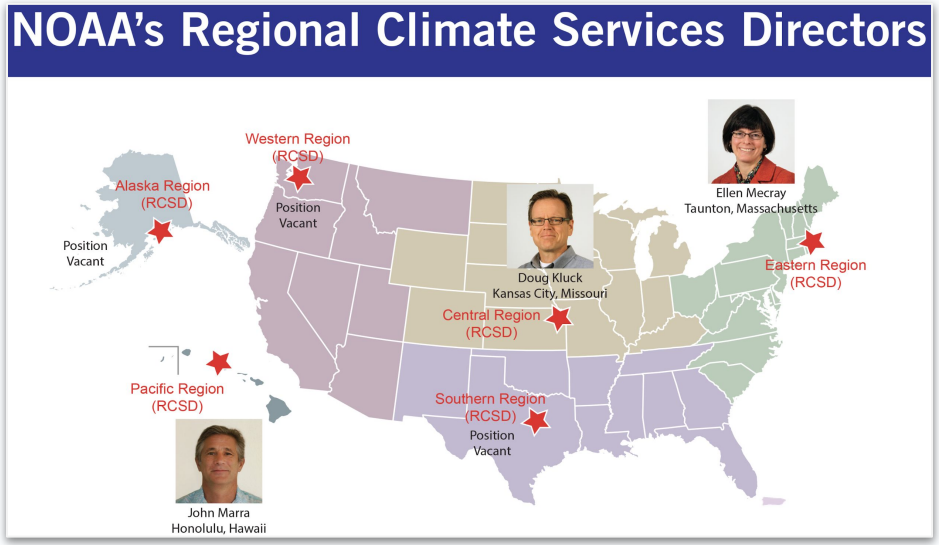
Invest in terrestrial biogeochemical research and modeling, especially collaborations with USDA. Collaboration between GFDL and CPC would accelerate improvement of terrestrial biogeochemical processes in S2S2D predictions.

Improving NOAA's Engagement and Communications with Stakeholders

Opportunities and Gaps

- **Fill in the gaps in geographic coverage** for the existing organizational structure supporting climate services.
- **Enhance capacity to produce tailored forecast communication products** through software development.
- **Further the development of forecasts and decision-making tools** to address S2S2D information needs.
- **Expand capacity to assess the return** on science investment.

Improving NOAA's Engagement and Communications with Stakeholders



Recommendations #7, #8, #9

Train NOAA's workforce, academics, and commercial enterprises in the use of FV3 and invest in educational outreach and resources.

Invest in the social sciences and human infrastructure for engaging sectors and communities in supporting decision-making and communicating earth system predictions.

Expand capacity to assess the return on science investment using multiple metrics such as economic impacts, diversity and number of people and locations served.

THANK YOU

BACKUP SLIDES

Climate Working Group
SAB December 2020 Meeting

Working Group Overview

Chair/Co-Chairs: Russell
NOAA SAB liaison(s): Kalnay and Joseph

Membership (vacancies, expertise, timing of approval):
- Submitted requests for second term: Russell, Dow, Ravishankara (September 2022).
- Recommended new members for: Roemmich, Zhang, Mote, Murtugudde. Approved new members are: Cecilia Bitz, Michael Anderson, Susan Wijffels, and Le Jiang.

Activities since July 2019 SAB meeting

- Planned and held an in-person Fall Meeting.
- Finalized the content of a white paper.
- Discussed a potential collaboration with EISWG to review S2S Reports from NOAA to Congress.
- Finalized dates for the Spring 2020 virtual meeting.
- Submitted a membership package to the SAB with: 3 second term requests; 4 candidates for replacement positions; 4 alternate candidates; and an co-chair recommendation.
- Developed a draft 2020-2022 work plan

Scope and Focus of Current Efforts

- Develop a white paper that will review current capabilities and future opportunities for Subseasonal-to-Seasonal-to-Decadal (S2S2D) forecasting.
- Pending collaboration with EISWG to review S2S Reports from NOAA to Congress.
- Provide comments on NOAA's 2020 Ocean Acidification Strategic Plan.
- Provide comments on NOAA's climate-related programs as requested by the NOAA Climate Team.

Future

- Update the SAB at the next meeting.
- Develop the content for the Spring 2020 in-person meeting and coordinate with NOAA partners on presentations.
- Continue to collaborate with the EISWG.
- Continue to comment on NOAA's climate-related programs as requested by the NOAA Climate Team.
- Continue to deliver informed recommendations per the work plan.