2021 (selected) Science Team highlights

Example: sea level rise scenarios in Washington DC
Source: NASA (sealevel.nasa.gov)
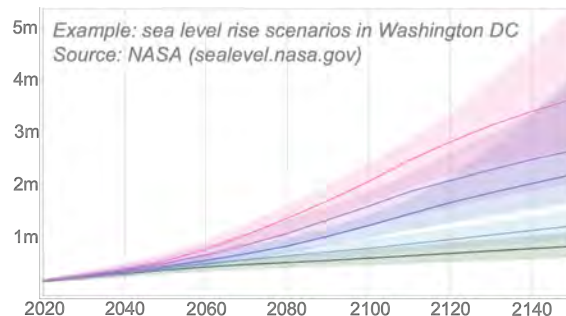
Ocean Surface Topography

S6MF - NASA's first cloud-native mission

GMSL - 3.46 mm/yr, 0.82 mm/yr/decade

ECCO
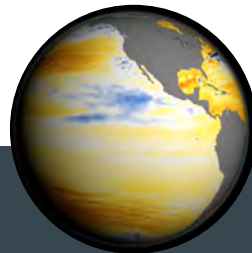
NASA's first cloud, multi-platform data integration & modeling framework for climate research

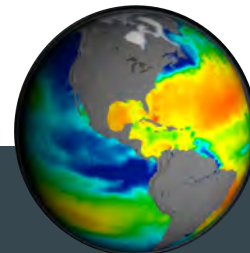*featured 2021 Nobel Prize for Physics NASA agency award*

Sea Level Change

Actionable sea level science

IPCC, COP26, WH, SOST

Agency-first projections of relative sea level change

Ocean Salinity

Welcome new team!

New Arctic mission - SASSIE

2021
Airborne Science
& Process studies
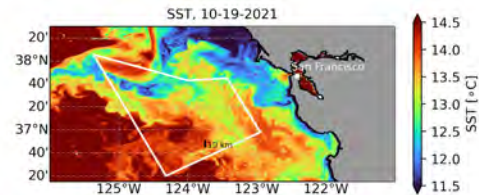
OMG
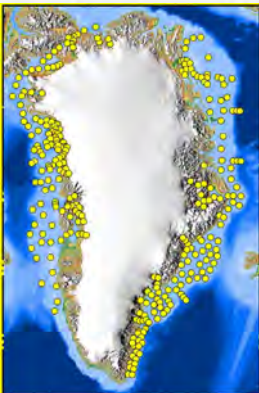
S-MODE

SASSIE
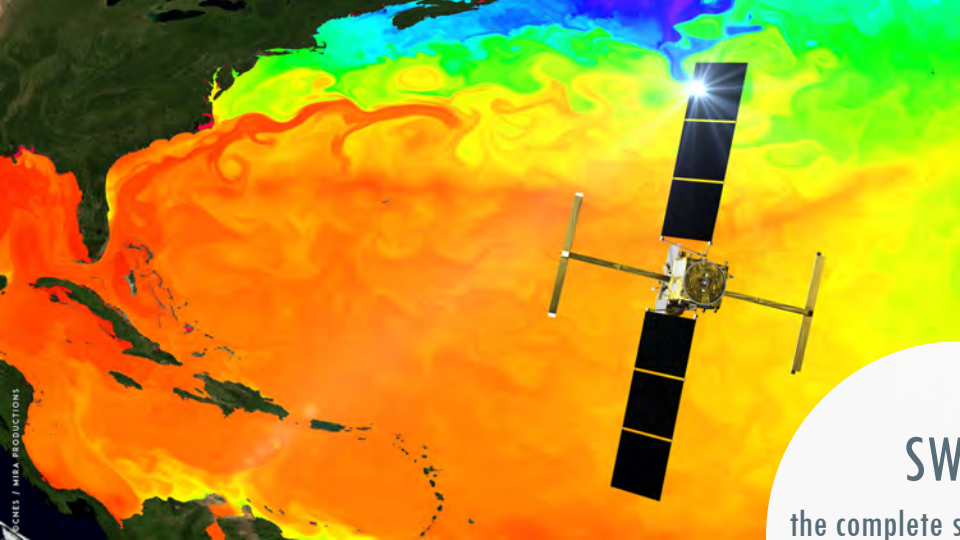
SWOT

the complete story of Earth's surface water

(from ocean to land and back)

Research Opportunities 2022 –

Ocean Physics (A.8)

Ocean Vector Winds Science Team (A.13)

Coastal Resilience (A.52)

Earth-Moon system in a changing climate (A.28)
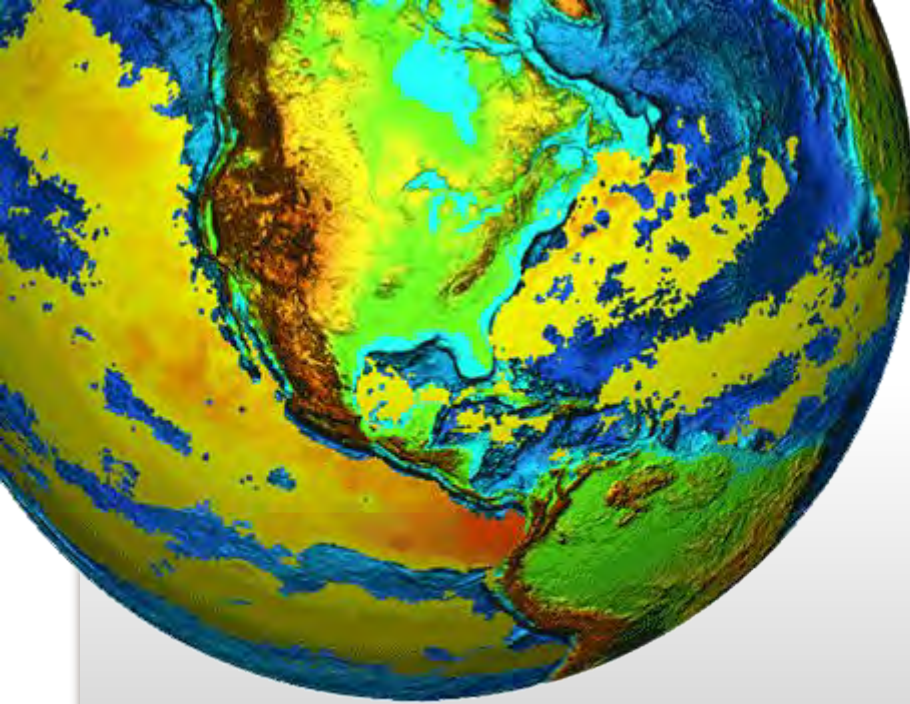
NOAA's Engagement with U.S. CLIVAR

U.S. CLIVAR Summit
Washington, DC
14 - 16 March 2022

NOAA/OAR Climate Program Office

Sandy Lucas
Program Manager
NOAA Climate Variability and Predictability

Jin Huang
NOAA Earth System Science and Modeling, Division Chief

Annarita Mariotti and Dan Barrie
NOAA Modeling, Analysis, Prediction, and Projections

Jessie Carman
NOAA Weather Program Office

Virginia Selz
NOAA Climate Observations and Monitoring

David Legler and Jim Todd
NOAA Global Ocean Monitoring and Observing

NOAA Line Offices

National Ocean Service

National Weather Service

National Fisheries Service

NOAA Research (OAR)

National Environmental Satellite, Data, and Information Service

NOAA's Overarching Priorities

1. Enhancing climate information and services
2. Integrating equity into everything
3. Advancing the Blue Economy
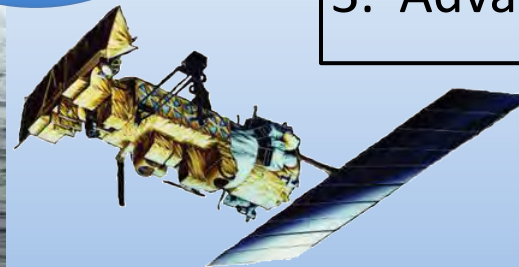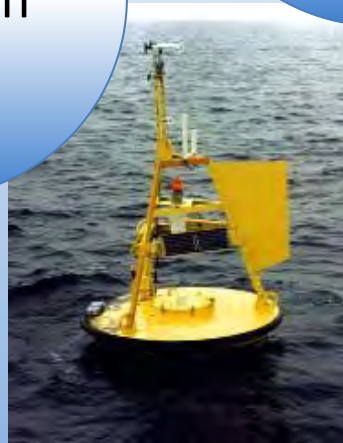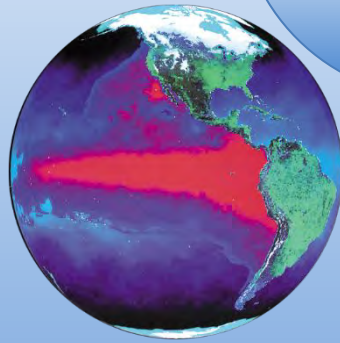
Recent U.S. CLIVAR-Relevant Activities Supported by NOAA

Process Studies & Field Campaigns

- Past: EPIC, NAME, VOCALS, DYNAMO;
- Current: AMOC, ATOMIC, CVP-TPOS, YMC

Sustained Ocean Observations

- Argo, Tropical moored buoy array (e.g. RAMA, PIRATA, TPOS 2020), GO-SHIP, global surface drifters, air-sea flux moorings, gliders, new technologies, ocean carbon and biogeochemistry, Arctic ocean variability (including biological)

Synthesis Dataset and Product Development

- Focus on BGC, air-sea interactions, past field campaigns

Modeling and Applications

- Climate Process Teams
- CMIP5 & 6
- Reanalyses: 20CR, CFSR
- MAPP Process-level model diagnosis package
- Drought understanding, monitoring, prediction
- MAPP S2S Task Force, Climate Test Bed prediction projects (e.g., NMME and SubX) [managed by WPO]
- Experimental seasonal prediction of sea-level and marine resources
- MAPP Marine Ecosystem Task Force

New Program at CPO

- NOAA Earth's Radiation Budget (ERB) Program

Long-range Climate Research Areas Related to U.S. CLIVAR

- Sustaining , evolving, and enhancing the **ocean observing system** (including the Arctic), over for the next decade, e.g. - Tropical Pacific Observing System-TPOS 2020 project, global biogeochemistry, etc.

- **Observing system impact and design studies**, improved observation-based datasets and products; **Field campaigns and process studies**

- Predictability, prediction and projections: improving **understanding of climate processes**, their **predictability** and their **representation in models** and prediction systems;

- Focus on **process-oriented metrics** for model development (leverage CMIP6)

- **Drought** understanding, predictability and prediction.

- Climate reanalyses

- **Information to support decision-making** on a regional scale for coastal inundation, precipitation, marine ecosystems

Recent NOAA Strategies

- [Precipitation Prediction Grand Challenge](#)
- [Climate-Fisheries Initiative](#)
- Coastal Flooding and Inundation at Climate Timescales (public version coming soon)
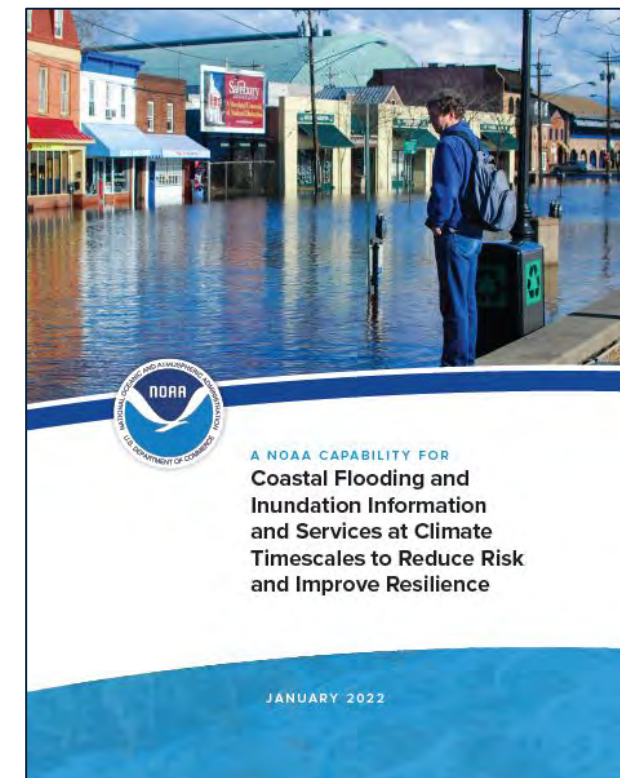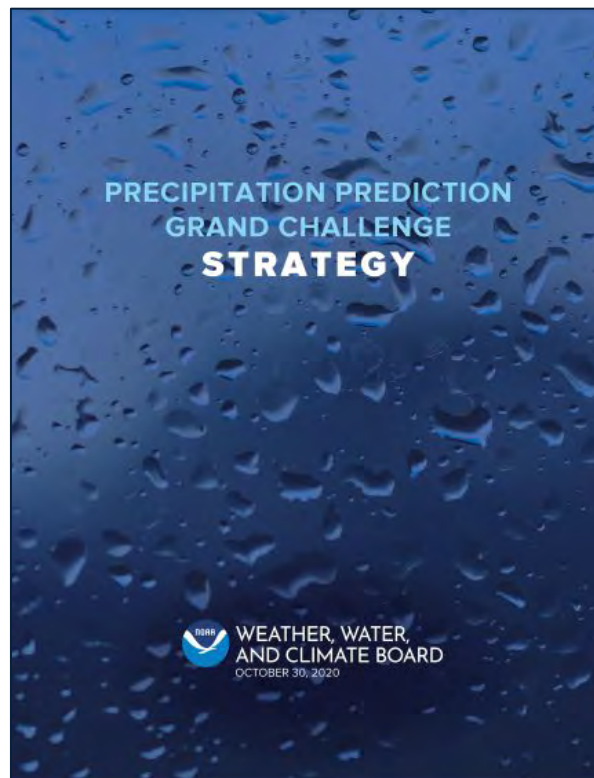
CPO and GOMO Budget (in $K)

- FY22 combined budget is $160M

- The Black Line shows the FY11 high value before major budget reductions.

- FY11 budget for CPO/GOMO was $165.5M ($208.8M with inflation).

Note: Infrastructure Investment and Jobs Act, and a one-time Disaster Supplemental spend plans are under review at Congress. These include additional funding for climate-related topics across NOAA.
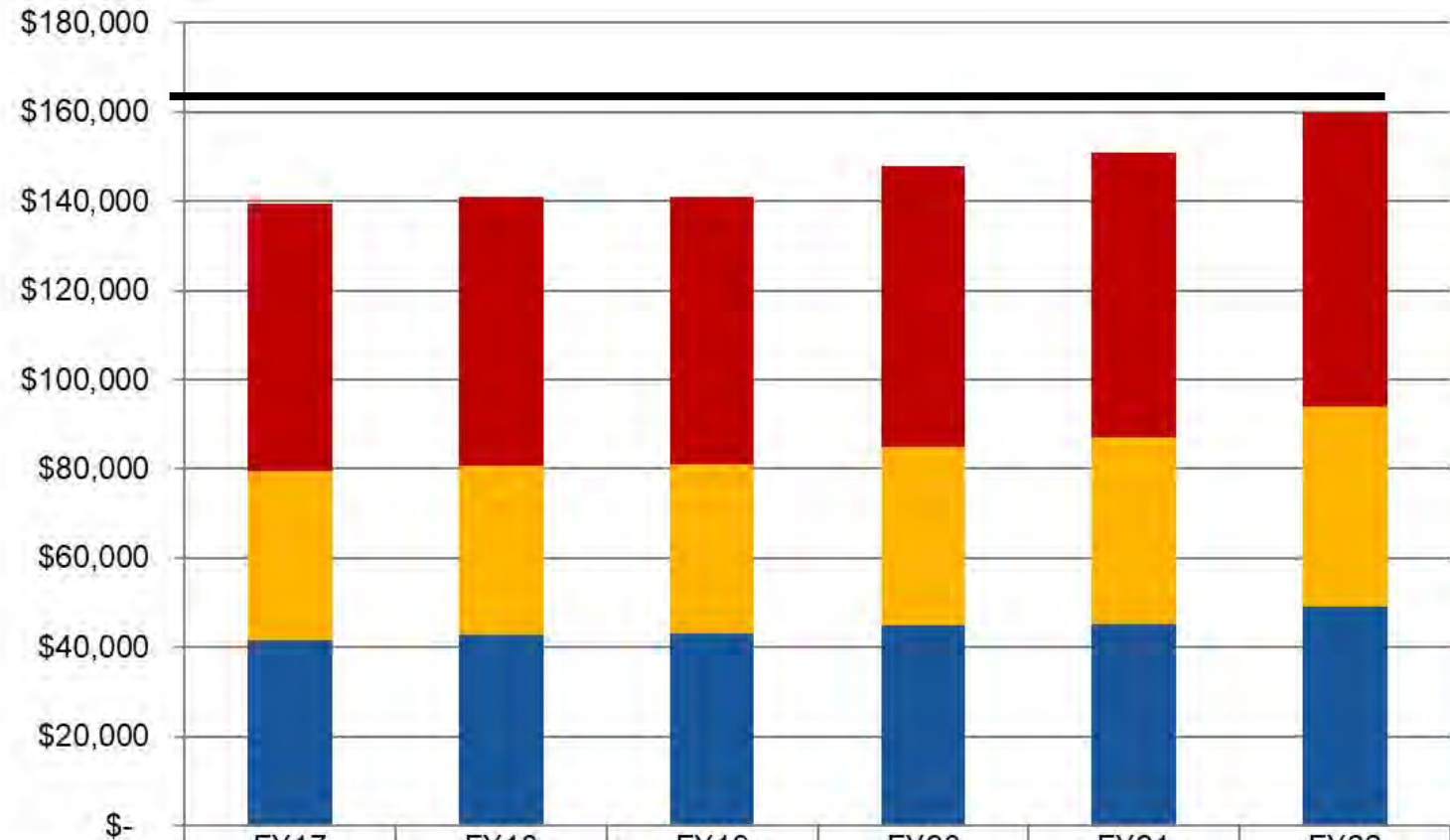
	FY17	FY18	FY19	FY20	FY21	FY22
Climate Competetive Research (CCR)	$60,000	$60,000	$60,000	$63,000	$63,795	$66,000
Regional Climate Data and Information (RCDI)	$38,000	$38,000	$38,000	$40,000	$42,107	$45,000
Sustained Ocean Observations and Monitoring (SOOM)	$41,596	$42,823	$43,000	$45,000	$45,063	$49,000

Background Slides

**Sandy.Lucas@NOAA.gov
NOAA Climate Program Office**

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NOAA has many parts - OAR has NOAA Labs, Cooperative Institutes, and Research Programs
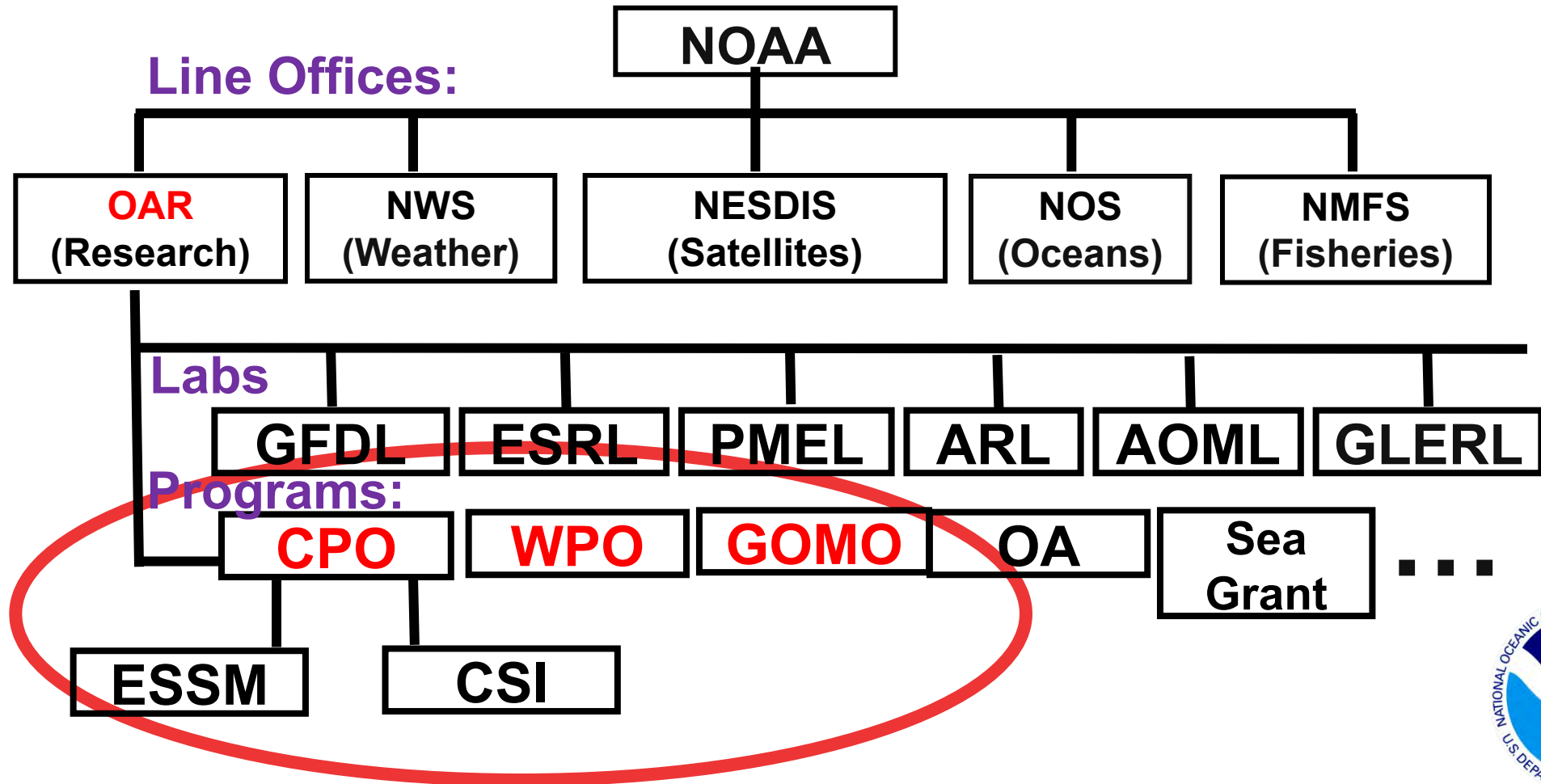
CPO Grant Programs

Earth System Science and Modeling Division

AC4 - Atm. Composition, Chemistry, and Carbon Cycle

COM - Climate Observations and Monitoring

CVP - Climate Variability and Predictability Program

MAPP - Modeling, Analysis, Predictions and Predictions

ERB - Earth's Radiation Budget

Climate and Societal Interactions Division

RISA - Regional Integrated Sciences and Assessments

Ad Sci - Adaptation Sciences Program

CAFA - Climate and Fisheries Adaptation (formerly COCA)

Each program develops a targeted call for proposals in the Notice of Funding Opportunity (NOFO), which is published annually at Grants.gov and posted on the CPO website.

NSF Update to CLIVAR SSC
14 March 2021

- Budget Update
- Relevant agency-wide activities
- Program-level activities and issues

Eric DeWeaver, Program Director

Climate and Large-Scale Dynamics Program

Division of Atmospheric and Geospace Sciences

edeweave@nsf.gov

FY22 Budget

- FY20: $8.3B
- FY21: $8.5B
- FY22: $8.8B, up $351M

FY22 increase is 4.1%, not 20%, no money for TIP

NEW Science & Tech Centers (STCs)

LEAP: Center for Learning the Earth through Atmosphere through AI and Physics

Harness new ML + data to transform the open NSF-funded Community Earth System Model (CESM)

New Algorithms

High-Fidelity Models

Observations

New Parameterizations

Next-Generation CESM

More Accurate Projections

NCAR Model Development Liaison
David Lawrence

Data Science Director
Carl Vondrick

Geoscience Director
Laure Zanna
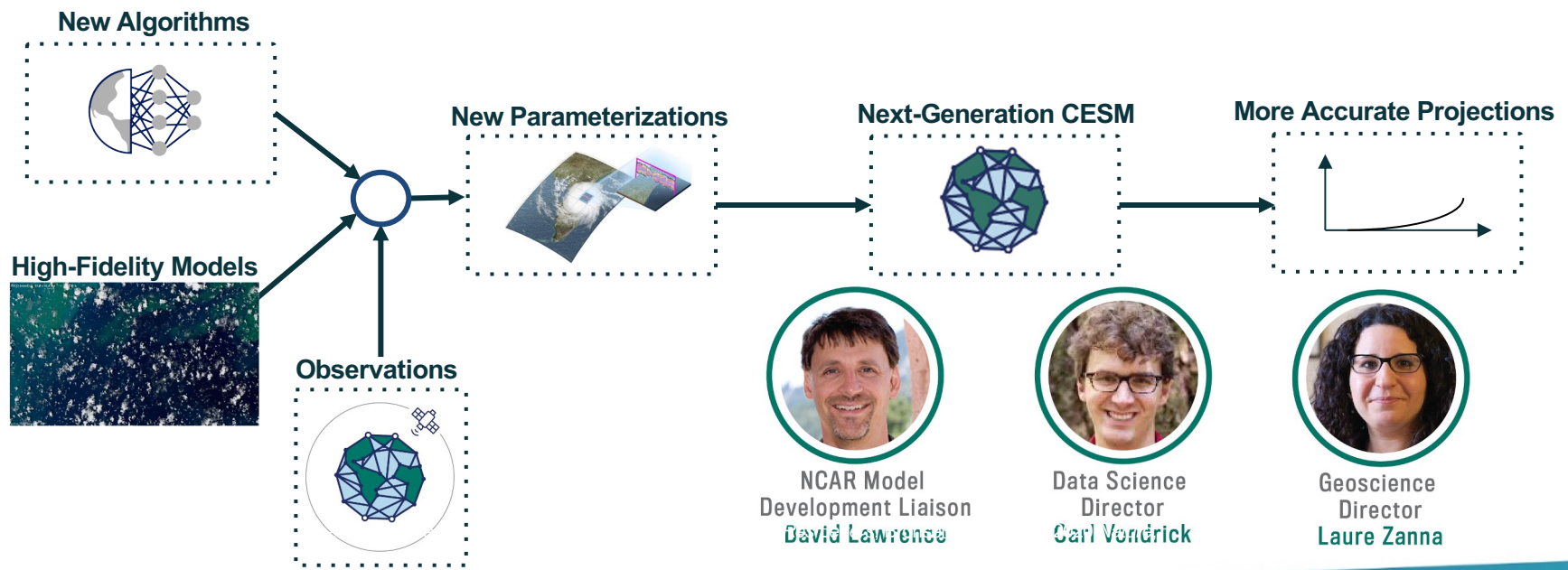
LE∆P

OCE Updates

COVID Impacts on OCE Field Programs

- UNOLS vessels continued to operate with some port restrictions. Limited impact on US-based cruises in the last year.

- GO-SHIP completed two NSF-led sections in the Atlantic, will occupy Pacific section next. Reordered sections to promote those staged entirely from US ports. Little maneuvering room left for for future sections.

- OSNAP cruises were completed with some adjustments.

- RAPID array continued. Funding for the US component of the array extended for 5 years, contingent on UK funding on an annual basis.

- MINTIE field work has fallen behind schedule by 2 years. Cruise scheduled for early 2023.

- Backlog of cruises will take some time clear. Ship scheduling will remain difficult for the foreseeable future, especially for the larger ships and remote locations.

OCE Updates

Recent Solicitations and New Starts

- New NOPP solicitation on internal waves, mixing and their representation in global models
    - Envisioned as a long-term multi-agency research initiative
    - Multiple cycles of fieldwork, confronting models with data, reconciling differences, making modeling improvements, developing new ideas for further field work (to restart the cycle)
    - Multiple proposal opportunities for ideas and teams to evolve
    - First round of proposals currently under review

- Physical Oceanography continuing to diversify research portfolio by taking advantage of PI initiated opportunities
    - Starting three new SAMOC-related projects to balance our portfolio that has been heavily invested in the N Atlantic.
    - Invested in a couple reanalysis approaches to extend data sets back in time
    - New project to explore Seismic Ocean Thermometry
    - Funded new moored turbulence measurements in the Atlantic and Pacific cold tongues to understand mixing, cold biases and oceanic heat uptake.

CLD Updates

- Strateole-2 second deployment, see Martina's talk.

- Plans for a third deployment are not finalized.

- Data distribution is not finalized, possible workshop.
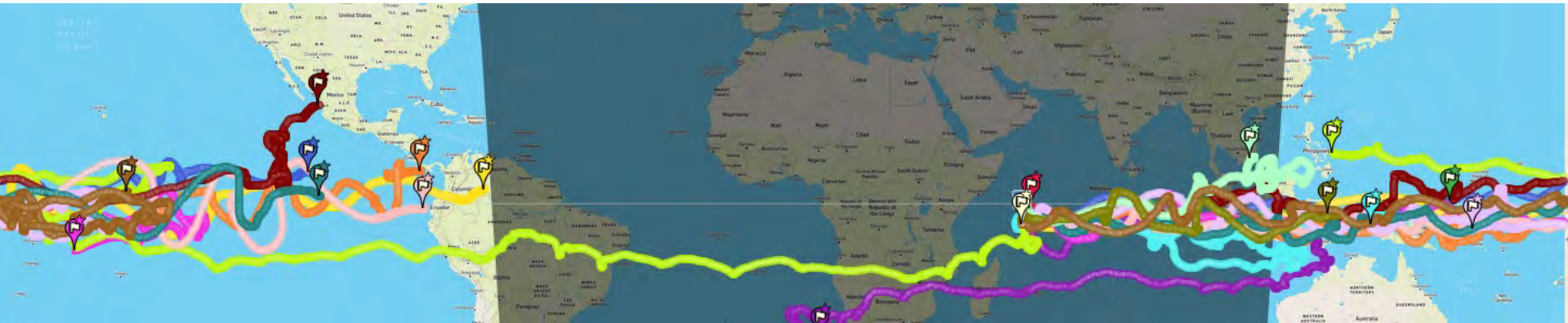
- Climate Process Teams are doing well.

Update on Data Buys

- NOAA's latest RO data buys can't be shared with ECMWF, UKMO despite intent to share with WMO partners.

- Science allowed but usefulness for science and climate is unclear.

- Not just RO, NOAA is now looking at microwave purchases.

Omnibus bill cuts funding for future weather satellites

by Jeff Foust — March 10, 2022

Space News: "Appropriators cut funding for a new generation of weather satellites while increasing funding for the Office of Space Commerce"

Update on Data Buys

NASA Data Buy

Commercial SmallSat Data Acquisition Program has purchased data from Spire, Planet, Maxar, more coming.

Original license: "Data will be made available only to the NASA scientific community"

License "Uplift": Access for "all U. S. Government and government-funded research communities for scientific purposes."

Is this a good solution?

Update on Data Buys

What would US-only data mean for climate research?

20-year Trends from RO in AR6:

- Missions from US/Taiwan (COSMIC) and Germany (CHAMP)

- Data processing in the US and Austria (ROM-SAF and Wegener Center)

Can we observe global climate with nationalized data?
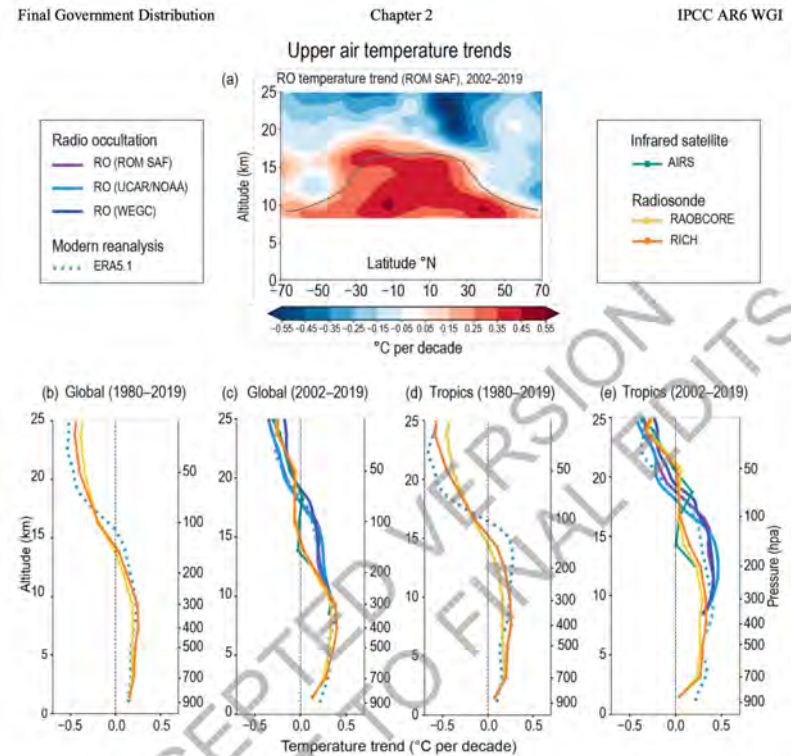
Figure 2.12: **Temperature trends in the upper air.** (a) Zonal cross-section of temperature anomaly trends (2007–

Should we push for a US climate observing strategy?

Thank You!

Extra Slides

Data Sharing and Scientific Credibility

"It's important to recognize that there are four other groups that make similar measurement estimates, so it's possible to compare the temperatures of one group against another."

This comparison, made possible by data sharing, debunked the claim that the troposphere is not warming.

More errors identified in contrarian climate scientists' temperature estimates

A new study suggests there are remaining biases in the oft-corrected University of Alabama at Huntsville atmospheric temperature estimates

Guardian, 11 May 2017

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Staffing Updates

Candace Major
AGS DD (acting)

Alex Isern
GEO AD

Anjuli Bamzai
Sr Science Advisor
Global Climate Change

GEO's Racial Equity Budget theme

Removal of barriers to participation in the geosciences.

- Geoscience Opportunities for Leadership in Diversity (GOLD)

- Improving Undergraduate STEM Education: Pathways into the Earth, Ocean, Polar and Atmospheric & Geospace Sciences (GEOPAths)

Cultural Transformation in the Geoscience Community (NSF 22-562), to build diverse and inclusive research ecosystems to tackle Earth system research challenges.

New Funding Opportunities

12 Nov 2021	**Ocean Sciences Postdoctoral Research Fellowships**
15 Nov 2021	**Dynamics of Integrated Socio-Environmental Systems**
06 Dec 2021	**Coastlines and People Hubs for Research and Broadening Participation**
08 Dec 2021	**Industry-University Cooperative Research Centers Program**
02 Feb 2022	**Frontier Research in Earth Sciences**
07 Feb 2022	**Mid-Career Advancement**
07 Feb 2022	**Office of Polar Programs Postdoctoral Research Fellowships**
15 Mar 2022	**Centers for Innovation and Community Engagement in Solid Earth Geohazards**

NEW Science & Tech Centers (STCs)

NSF's Class of 2021 Science and Technology Centers (STCs)

This Antarctic ice core contained air bubbles tracing 800,000 years of climate history. REUTERS/L. AUGUSTIN/LABORATOIRE DE GLACIOLOGIE ET GEOPHYSIQUE DE L'ENVIRONNEMENT.

- Center for OLDest Ice EXploration (COLDEX)

- Center for Chemical Currencies of a Microbial Planet (C-COMP)

- Center for Learning the Earth with Artificial Intelligence and Physics (LEAP)

- Science and Technologies for Phosphorous Sustainability Center (STEPS)

- Center for Research On Programmable Plant Systems (CROPPS)

Climate Vision for GEO

GEO Directorate-wide Climate Challenge

Outcome-, community-, and solutions-oriented

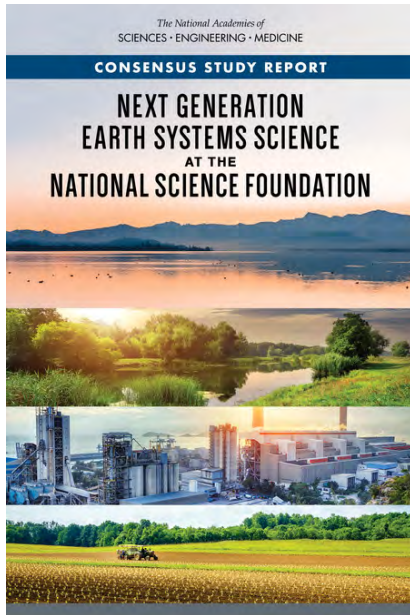Justice, equity, diversity, and inclusion central to investments

Convergent approach

Various spatial-temporal scales

Next generation climate workforce

NASEM Study

Next Generation Earth Systems Science at the National Science Foundation

Vision

A next generation Earth Systems Science that explores interactions among natural and social processes that affect Earth's capacity for sustaining life, now and in the future.

NSF Role

To innovate, advance, and nurture systems approaches to discover how our planet functions and to inform how society can function as part of Earth's systems for the well-being of communities, regions, the nation, and world.
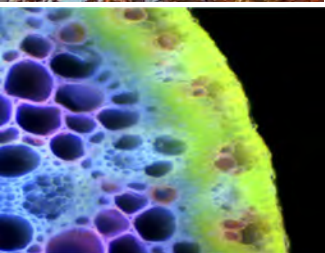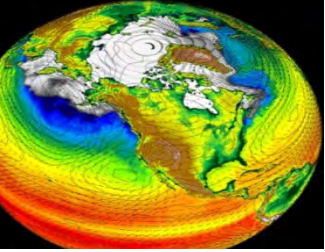
Updates from DOE's Earth and Environmental Systems Sciences Division

Renu Joseph & Xujing Davis

U.S. DEPARTMENT OF ENERGY

Office of Science

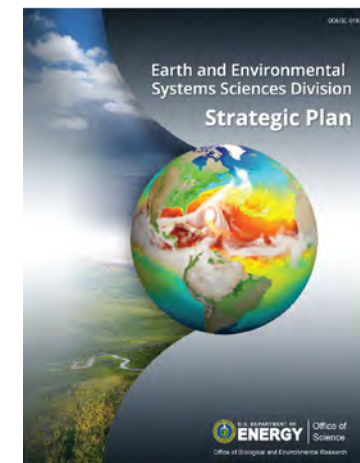**Office of Biological and Environmental Research**

U.S. DEPARTMENT OF ENERGY
Office of Science

Biological and Environmental Research (BER)

Earth & Environmental Systems Sciences Division (EESSD)
Gary Geernaert

Atmospheric Sciences

Atmospheric System Research

Atmospheric Radiation Measurements User Facility

Earth and Environmental Systems Modeling (EESM)

Earth System Model Development

Regional and Global Model Analysis

Multisector Dynamics

Environmental System Science

Subsurface Biogeochemical Research

Terrestrial Ecosystem Science

**Environmental Molecular Sciences Laboratory**

Data Management

Budget: ~$350M Roughly Divided Equally Among the Three Groups

Earth and Environmental Systems Modeling Program

EESM Vision: EESM provides transformative insights on natural Earth systems, their interactions and co-evolution with human systems, at time scales ranging from sub-seasonal to centennial, delivering knowledge foundations and science-based tools for the Nation's planning of next-generation, resilient energy, environmental, and economic systems and infrastructures.

Goal: To develop and demonstrate advanced modeling and simulation capabilities, in order to enhance the predictability of the Earth system over multiple temporal and spatial scales.

https://climatemodeling.science.energy.gov/

ESMD

RGMA
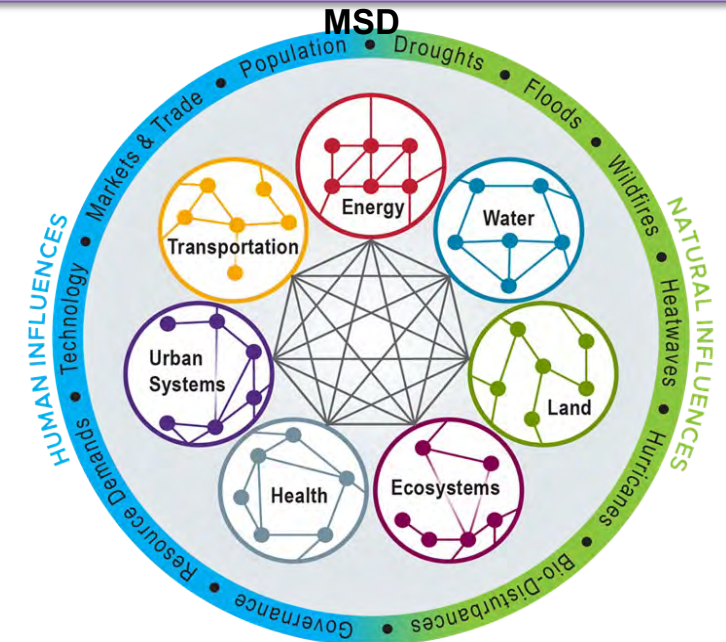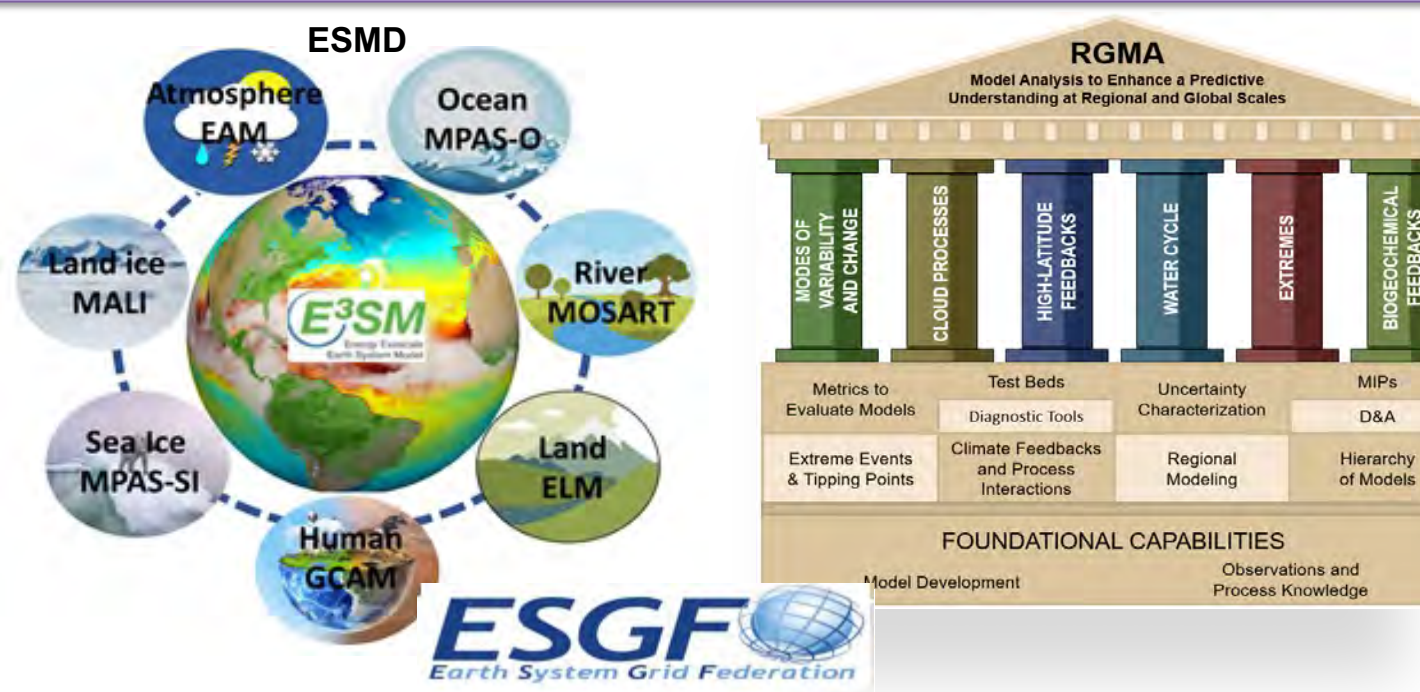
MSD

Energy Exascale Earth System Model (E3SM)

SciDAC Projects
ProSPECT
CANGA
Non-Hydrostatic DyCores
Numerical Solution of Atm. Phy.
Adaptive Ver. Grid Enhancements
Terrestrial Dynamical Cores
Time-stepping Algorithms
Discrete Element Sea-ice Mode

Enabling Aerosol-cloud interactions at Global convection-permitting scalES (EAGLES)

Water Cycle and Climate Extremes Modeling (WACCEM)

Calibrated and Systematic Characterization, Attribution and Detection of Extremes (CASCADE)

Reducing Uncertainty in Biogeochemical Interactions Through Synthesis and Computation (RUBISCO)

High-Latitude Application and Testing (HiLAT)

Program for Climate Model Diagnosis & Intercomparison (PCMDI)

Cooperative Agreement to Analyze variability, change and predictability in the earth SysTem (CATALYST)

A Framework for Improving Analysis and Modeling of Earth System and Intersectoral Dynamics at Regional Scales (HyperFACETS)

Integrated Multi-sector Multi-scale Modeling SFA (IM3)

Global Change Intersectoral Modeling System SFA (GCIMS)

Program on Coupled Human Earth Systems (PCHES) Cooperative Agreement

Integrated Global Systems Modeling (GSM) Cooperative Agreement

Integrated Coastal Modeling (ICoM)

Interdisciplinary Research for Arctic Coastal Environments (InteRFACE)
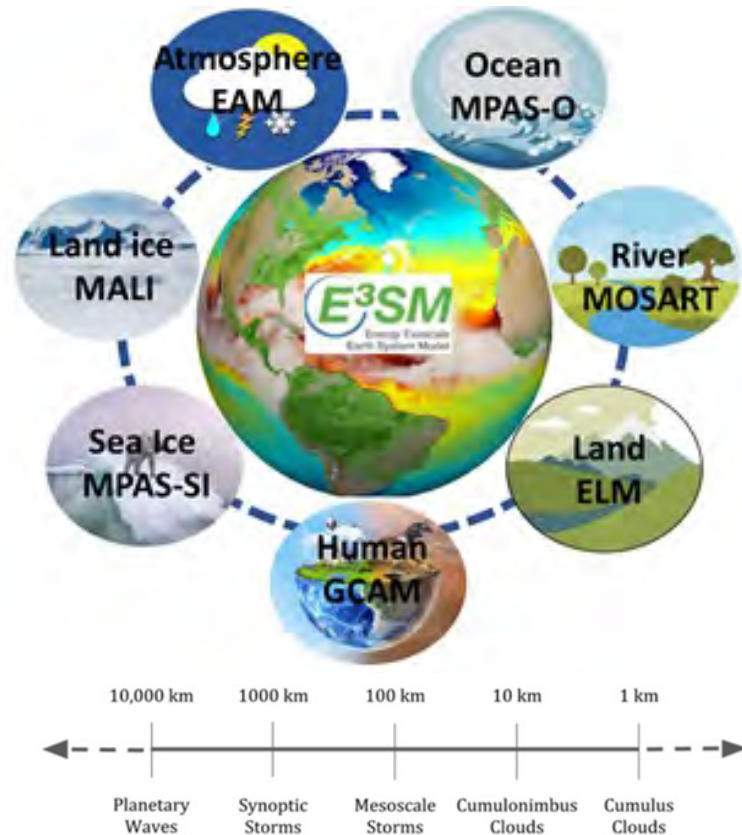
COMPASS-Great Lake Modeling (GLM)

Puget Sound Scoping Study

University Projects (through joint or individual FOAs) + co-funding CPTs with other agencies

ESMD: The Energy Exascale Earth System Model (E3SM)

DOE model, on DOE Machine for DOE Mission

EAM: E3SM Atmosphere Model; **ELM:** E3SM Land Model ; **GCAM:** Global Change Assessment Model; **MOSART:** Model for Scale Adaptive River Transport; **MPAS-SI:** Model for Prediction Across Scales (MPAS) – Sea Ice; **MPAS-O:** MPAS – Ocean; **MALI:** MPAS- Land Ice

Goal: Assert and maintain an international scientific leadership position in the development of Earth system models that address the grand challenge of actionable predictions of Earth system variability and change, with an emphasis on the most critical scientific questions facing the nation and DOE.
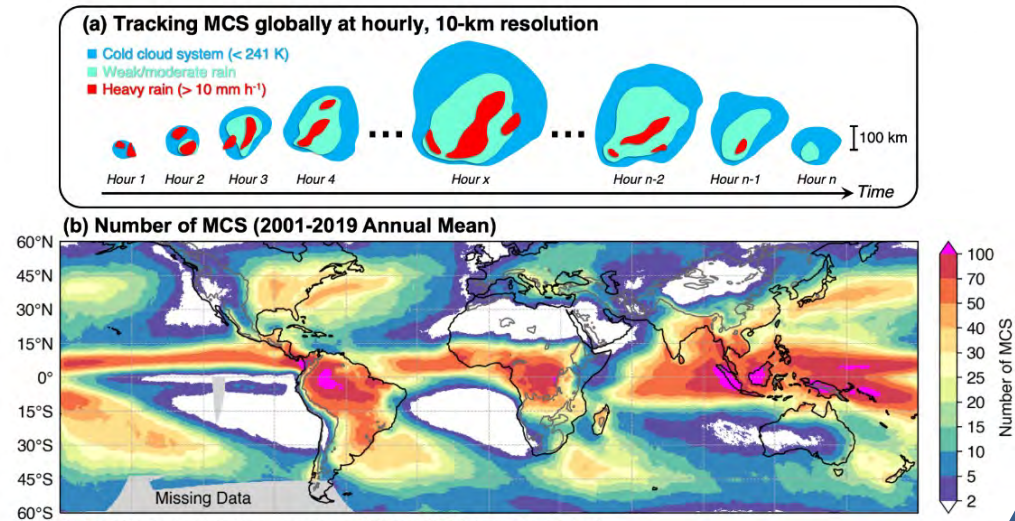
E3SM Current Status:
- ➢ **E3SMv1** released in Apr 2018; E3SM became an open development project
- ➢ **E3SMv2** released in Sep 2021, better and faster than v1
- • *Improved precipitation, reduced cloud feedback and equilibrium climate sensitivity*
- • *Regional refinement capabilities in all components for coupled simulations*
- • *Doubling of computational performance compared to v1*
- ➢ **Model configurations:**
  - *- LR: 100 km atmosphere and land; 50 km river; 60 to 30 km ocean and sea-ice (v1 and v2);*
  - *- HR: 25 km atmosphere and land; 12 km river; 18 to 6 km ocean and sea-ice (v1);*
  - *- NARRM: 25 km atmosphere and land; 12 km river; 14 km ocean and sea-ice over North America (v2)*
- ➢ **Ultra high-resolution modeling:**
  - **-** Storming-resolving atmosphere (SCREAM): ~3km using global, RRM, or idealized regional domains
  - **-** Land: 1 km simulation over North America

E3SM over FY22 and FY23:
- ➢ Further improve model fidelity and enhance capability (e.g., address major bias and uncertainties using AI/ML and large-ensemble simulations)
- ➢ Continue targeted algorithm development, software and performance improvement for DOE HPCs including optimizing the use of GPU
- ➢ Further coupling of human component to address energy questions (e.g., decarbonization strategies)

From WACCEM SFA: MCS feature tracking, data sets, metrics, modeling hierarchy, model evaluation

US and global MCS tracking data sets developed using the FLEXTRKR MCS tracking algorithm

(a) Tracking MCS globally at hourly, 10-km resolution
- Cold cloud system (< 241 K)
- Weak/moderate rain
- Heavy rain (> 10 mm h⁻¹)

Hour 1 Hour 2 Hour 3 Hour 4 ... Hour x ... Hour n-2 Hour n-1 Hour n → Time

(b) Number of MCS (2001-2019 Annual Mean)

Missing Data

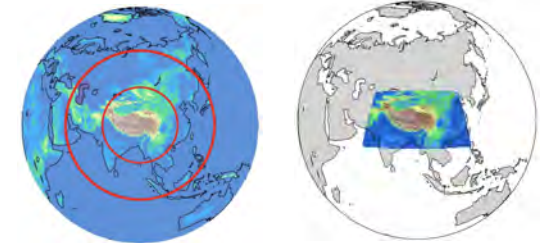(Feng et al., 2021 JGR-A)

A model hierarchy to advance understanding and modeling of MCSs

A multi-column parcel model of convective aggregation
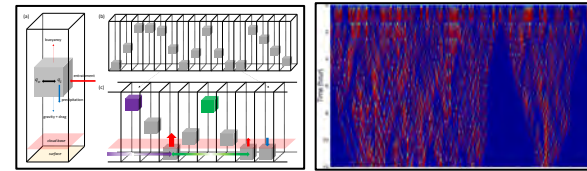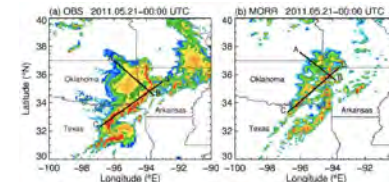

(Yang et al., 2021 JAS)

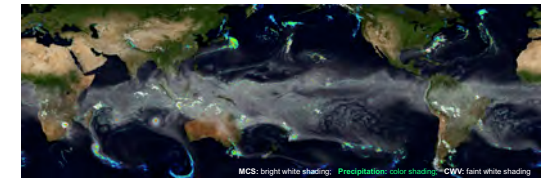Global variable resolution and limited area models

(Source: Koichi Sakaguchi)

Regional (WRF) and global cloud-resolving (SCREAM) simulations

(a) OBS 2011.05.21~00:00 UTC   (b) MORR 2011.05.21~00:00 UTC

MCS: bright white shading; Precipitation: color shading; CWV: faint white shading
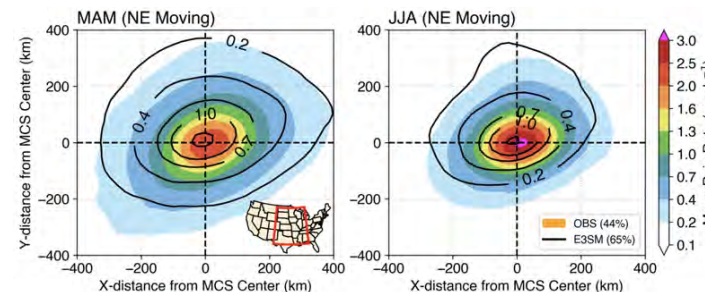
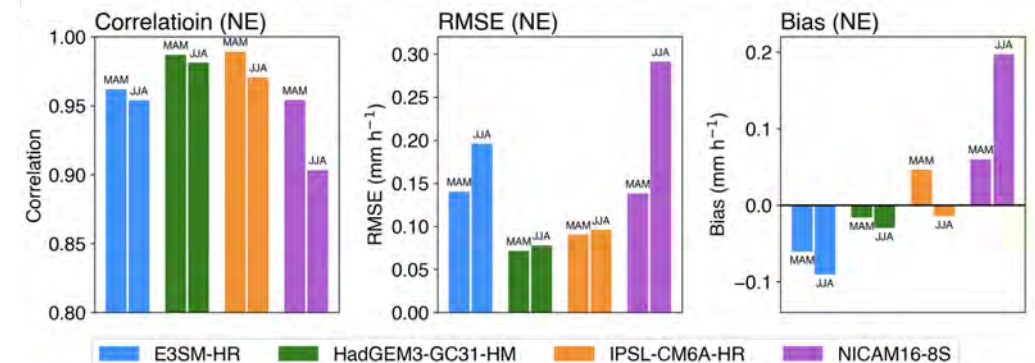(Feng et al., 2018 JAMES)   (Feng et al., in prep)

Exploratory precipitation metrics: spatiotemporal characteristics, process-oriented, and phenomena-based

- A grass root effort developed during the 2019 DOE Precipitation Metrics Workshop
- Develop and apply various precipitation metrics to CMIP5 and CMIP6 simulations
- Models exhibit diverse skill as measured by a suite of metrics, motivating the need to understand model biases and possible relationships among metrics and biases

MCS in HighResMIP simulations

MAM (NE Moving)   JJA (NE Moving)

OBS (44%)   E3SM (65%)

Correlation (NE)   RMSE (NE)   Bias (NE)

E3SM-HR   HadGEM3-GC31-HM   IPSL-CM6A-HR   NICAM16-8S

(Leung et al. 2022 JCLIM)

PCMDI & RUBISCO projects contribute to Advancing Community Activities for Model Intercomparisons, Model Diagnostics and Scientific Assessments

- Leading components of CMIP6: CMIP6+, input4MIPs, obs4MIPs

- Developing PMP diagnostics through community engagement (e.g., CLIVAR ENSO Metrics Package, precipitation benchmarks from a 2019 DOE Workshop)

- Advancing the Coordinated Model Evaluation Capabilities – A platform facilitating the inter-operability of repeat-use model diagnostics
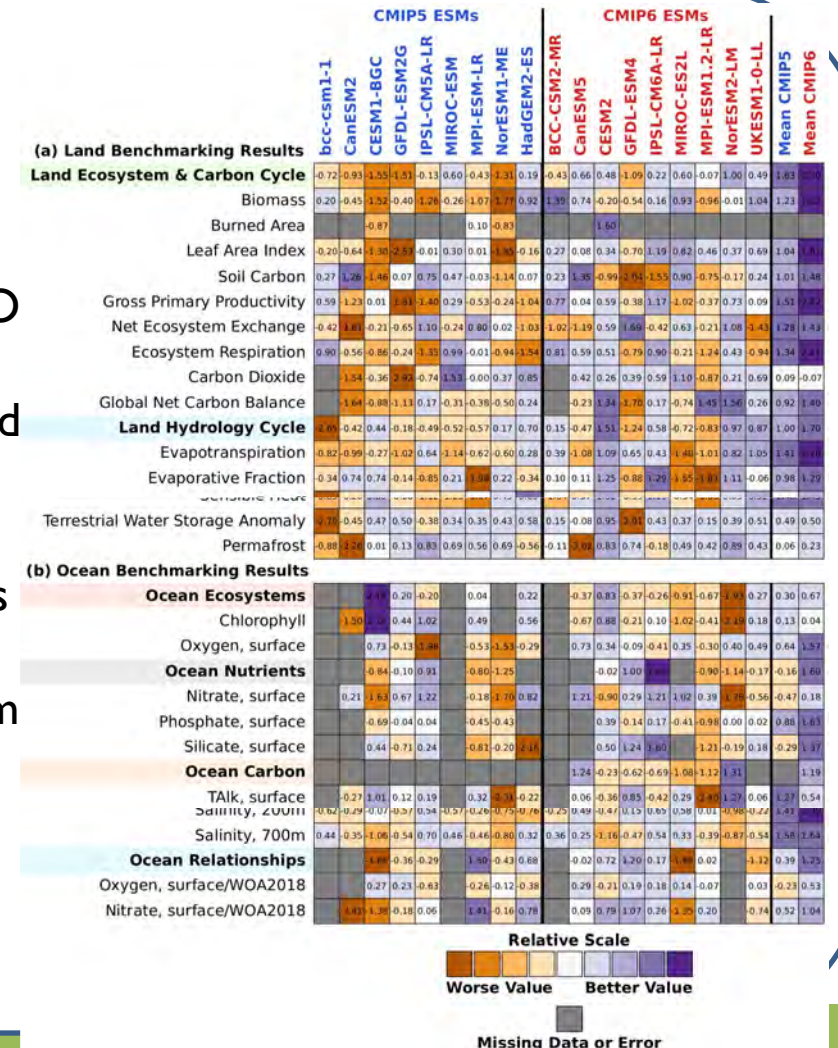
  - CMEC will unify evaluation efforts throughout the analysis communities

    - Links with NOAA's Model Diagnostics Task Force and others

- Participating in community scientific assessments (IPCC AR6, WCRP Climate Sensitivity Assessment)

ILAMB and IOMB from the RUBISCO SFA have been used to evaluate CMIP5 vs CMIP6 improvements

AI4ESP Workshop in 2021

https://www.ai4esp.org

Goal: How can we combine AI and machine learning with the traditional physics-based approach to prediction research, in order to reduce uncertainties for climate predictions of complex extreme phenomena in high gradient environments

A workshop that included over 740 participants from 178 institutions
- Was held Oct-Dec '21
  - 17 sessions
  - 10 days
  - 5 weeks

Earth System Predictability Topics
- Ecohydrology
- Land Modeling
- Human Systems & Dynamics
- Atmospheric Modeling
- Aerosols & Clouds
- Climate Variability & Extremes
- Ecohydrology
- Land Modeling
- Human Systems & Dynamics
- Hydrology
- Watershed Science
- Coastal Dynamics / Oceans / Ice

Cross-Cutting Topics
- KDSL
- AI Architecture Co-Design
- Neural Networks
- Data Acquisition
- Knowledge-Informed Machine Learning
- Explainable AI
- Hybrid Modeling
- Surrogate Models
- Emulators

Soon

AI4ESP Workshop Report
- **Grand Challenges**
- **State-of-the-Science**
- **Experimental, Data & Modeling Opportunities**
- **Research Priorities**
- **Short-term (<5 years), 5-year & 10-year Goals**

Other Workshops

- **NOAA-DOE Precipitation Processes and Predictability Workshop – Dec 2020**

- **Understanding and Predictability of Integrated Mountain Hydroclimate - Nov 2021& Jan 2022**
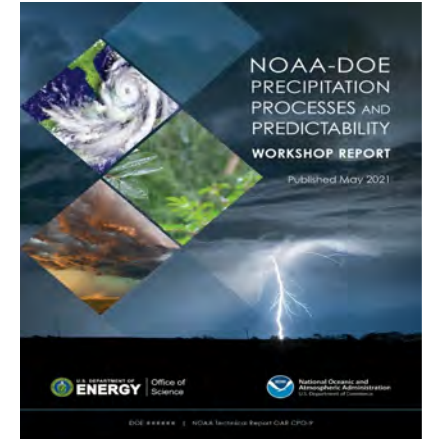
Current and Future Opportunities

FY22 Funding Opportunity - proposals currently under review

For FOA 2593 which has a focus on **Model Development and Model Analysis**

- The two foci of the model development track are: 1) Improved representations of low-level clouds; 2) Improved treatment/parameterization of other key physical and biogeochemical processes including their coupling with various components of E3SM.
- The two foci on the model analysis track : 1) Water cycle and associated extremes; 2) Modes of Climate Variability and extreme events.

SCIDAC FOA (joint ESMD-ASCR FOA)

- Model development focus is on Atlantic Meridional Ocean Circulation (AMOC), the Antarctic icesheet, marine biogeochemistry, and quasi-biennial oscillation (QBO); and improved physics and numerics to enhance coupling of the various components with high and variable resolutions of the model. ASCR investments will employ applied mathematics and computer science (with AI/ML in both) that leads to improved prediction capabilities

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Open Solicitations:

- **FOA 2688: Research Development and Partnership (RDPP)**
Catalyzing partnerships between underrepresented colleges and universities and DOE climate, Earth, and environmental sciences research – Due April 20, 2022

- **Applications for Science Graduate Student Research (SCGSR) Awards** – Due May 4, 2022

- **Early Career FOA in FY2023**

- **Potential EESM FOA in FY2023**
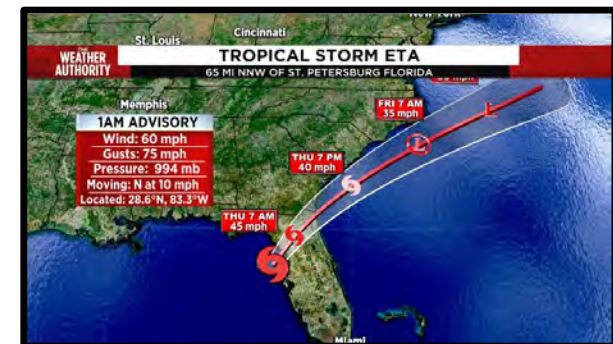
ARM and ASR activities

- ASR FY22 Funding Opportunity
  - proposals currently under review
  - aerosol-cloud interactions, aerosol processes, convective cloud processes, high-lat atmospheric processes
- ASR Future of LES workshop – April 2022
- ARM Mobile Facility campaigns:
  - SAIL – surface-atmosphere interactions in mountainous terrain – Crested Butte, CO; Sep 2021 – June 2023
  - TRACER - aerosol-deep convection campaign in Houston
    - Delayed due to COVID; Oct 2021-Sep 2022
  - EPCAPE – marine stratocumulus and aerosol-cloud interactions; AMF on Scripps Pier; Feb 2023 – Feb 2024
  - Southeast US - 3rd Mobile Facility (AMF3) ~2023-2028
    - Submitting special use permit to USFS for site in Bankhead National Forest, in northern Alabama
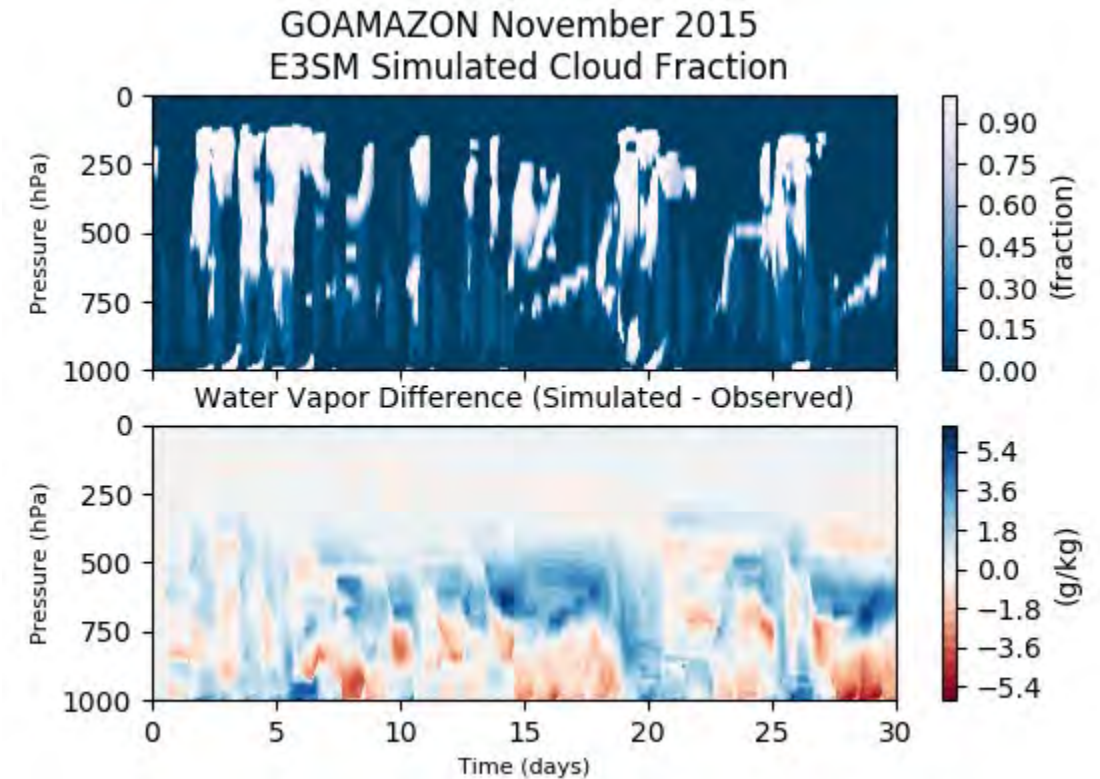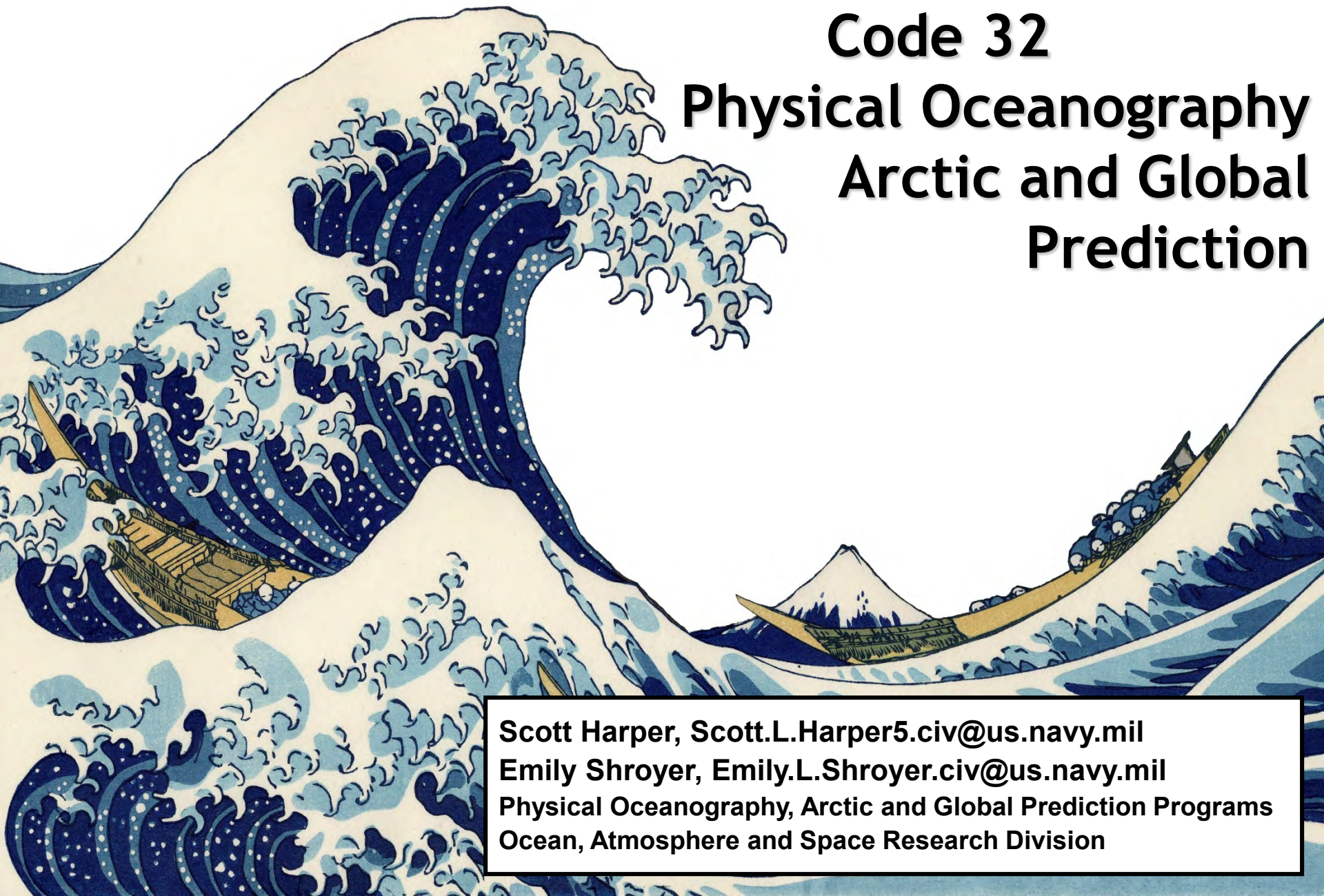 - **Pre-proposals for AMF campaigns due April 5**

Thank you!

Atmospheric Radiation Measurement (ARM) & Atmospheric System Research (ASR)

- Modeling efforts:
  - ARM diagnostics package for GCMs
    - https://github.com/ARM-DOE/arm-gcm-diagnostics
  - New open-source ground-based instrument simulator framework for climate models
    - https://github.com/columncolab/EMC2
  - Enhanced number of single column cases
    - https://github.com/E3SM-Project/scmlib/wiki/E3SM-Single-Column-Model-Case-Library
  - LASSO (large eddy simulation modeling)
    - Simulations of over 70 shallow convection cases at ARM Oklahoma site
    - Extending to deep convection; initial focus on CACTI (Argentina) campaign

GOAMAZON November 2015
E3SM Simulated Cloud Fraction

Water Vapor Difference (Simulated - Observed)
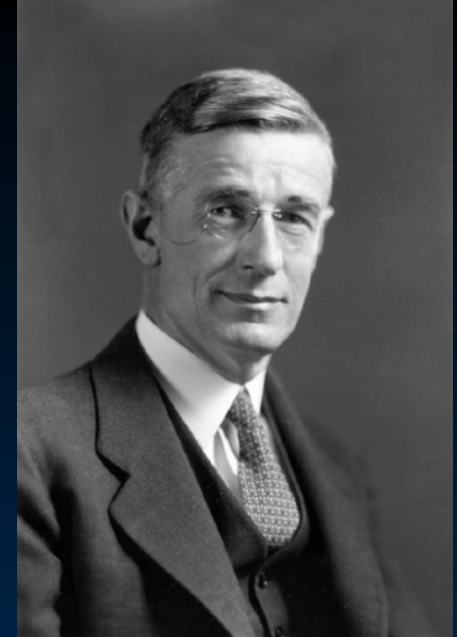
Office of Naval Research
Code 32
Physical Oceanography
Arctic and Global
Prediction

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Physical Oceanography, Arctic and Global Prediction Programs
Ocean, Atmosphere and Space Research Division

The Office of Naval Research

Vannevar Bush
"Science: The Endless Frontier"

- Founded in **1946**, ONR was the first permanent US federal agency devoted to the support of scientific research.

- ONR was the model for the National Science Foundation (established in 1950).

ONR is a **"mission agency"** as is NOAA and NASA (and really, NSF as well).
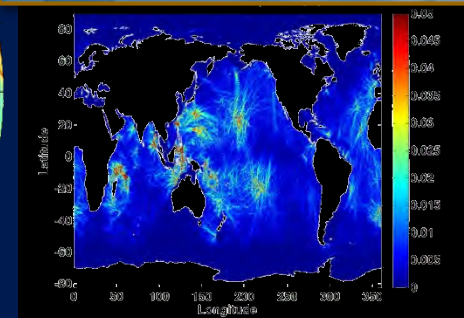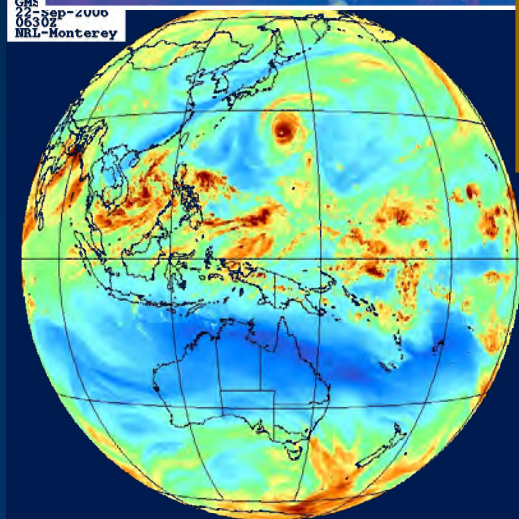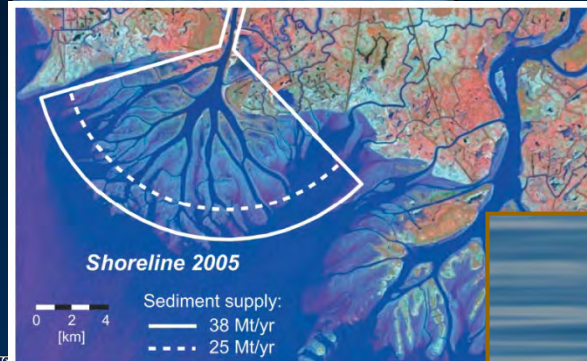
The mission of the **Office of Naval Research**:

"…to **foster, plan, facilitate and transition scientific research** in recognition of its paramount importance to enable future naval power and the preservation of national security."

Code 32
Ocean Battlespace and Expeditionary Access

OCEAN, ATMOSPHERE, AND SPACE RESEARCH DIVISION

- **PHYSICAL OCEANOGRAPHY**

- **COASTAL GEOSCIENCES**

- **MARINE METEOROLOGY**

- **MARINE MAMMALS**

- **OCEAN ACOUSTICS**

- **ARCTIC AND GLOBAL PREDICTION**

Shoreline 2005

Sediment supply:
- 38 Mt/yr
- 25 Mt/yr

0   2   4
[km]

GMS
22-Sep-2006
0630Z
NRL-Monterey

General Theme of ONR Oceanographic Research

Achieve a better understanding of the processes that impact and govern the logistics of operating above, on, or in the ocean environment:

waves, temperature, density structure, sea surface height, tides, fog, sea ice, strong currents, internal waves, visibility, coastal river plumes, …

To develop knowledge that may eventually improve predictive models of the environment that provide forecasts on time scales on the order of hours to weeks.

The program strongly encourages hypothesis-based research aimed at improving model formulation and parameterizations. We are also interested in advancing autonomous methods of ocean sampling, numerical modeling capabilities, and data assimilation techniques.

Physical Oceanography "DRI" Efforts

DRIs are typically five-year efforts focused on making progress on a critical scientific issue. They involve a team of scientists collaborating to advance our knowledge on chosen topics often working with international partners.
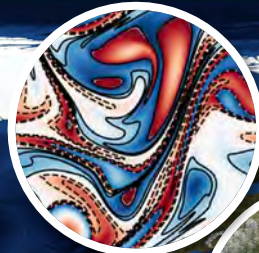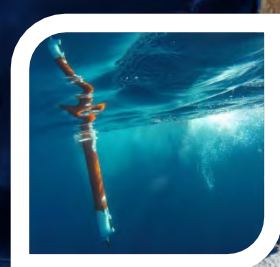
An international footprint enables…

Advancing Science

Promoting Innovation

Fostering Collaboration

Circles show regions of recent or ongoing research initiatives with partner nations.

FY23 New Start- The Arabian Sea Transition Layer: Exchange across the air-sea interface

The <u>A</u>rabian <u>S</u>ea <u>Tr</u>ansition <u>L</u>ayer (ASTraL)
Exchange across the Air-Sea Interface

"EKAMSAT" FY23-27

Land-locked to the north, the Arabian Sea is a natural laboratory for the study of localized air-sea interaction with a clear north-south variation in upper ocean stratification and lower atmospheric boundary layer properties. Additionally, the collapse of the warm layer evolves rapidly in time during the monsoon onset—a timescale appropriate for ship-based work.
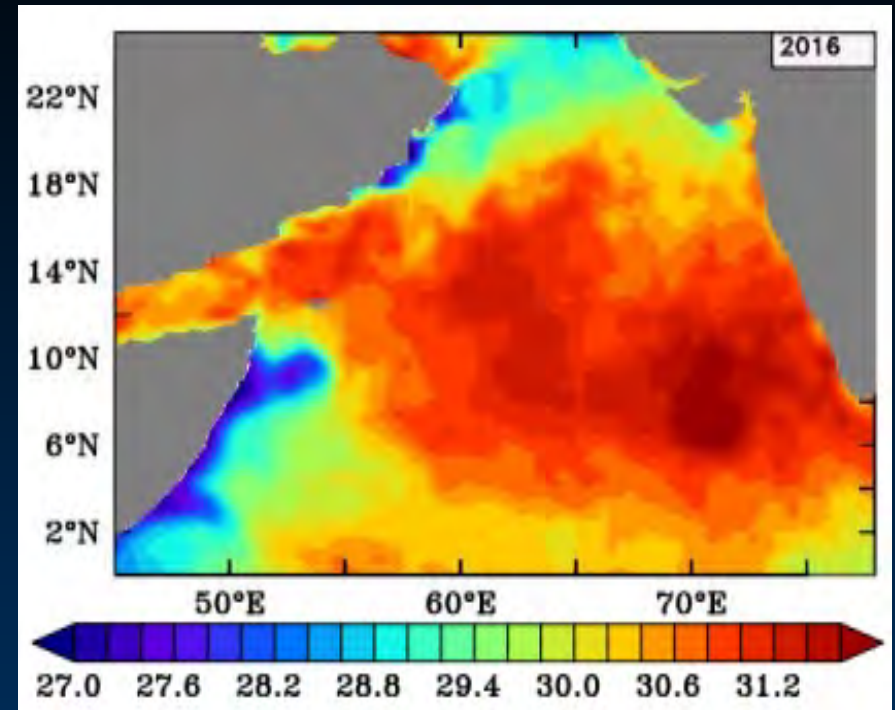
1. What ocean processes control the maintenance and dissipation the Arabian Sea warm pool?
2. How does variation in warm pool strength and stability in the ABL modulate local air-sea fluxes?
3. How does the collapse of the warm pool change boundary layer structure and surface fluxes?
4. What exchange processes are misrepresented in coupled models leading to moisture & precipitation dry biases in forecasts?
5. Do improved physical parameterizations of local air-sea exchange lead to improved ocean and atmosphere forecasts?