NOAA Updates

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NOAA Climate Program Office

GEWEX SSG Meeting
Pasadena, CA
Jan.27, 2020

Outline

- *NOAA, CPO, and CPO Overviews*

- *Ongoing activities relevant to GEWEX*

- *Future interests/activities relevant to GEWEX*
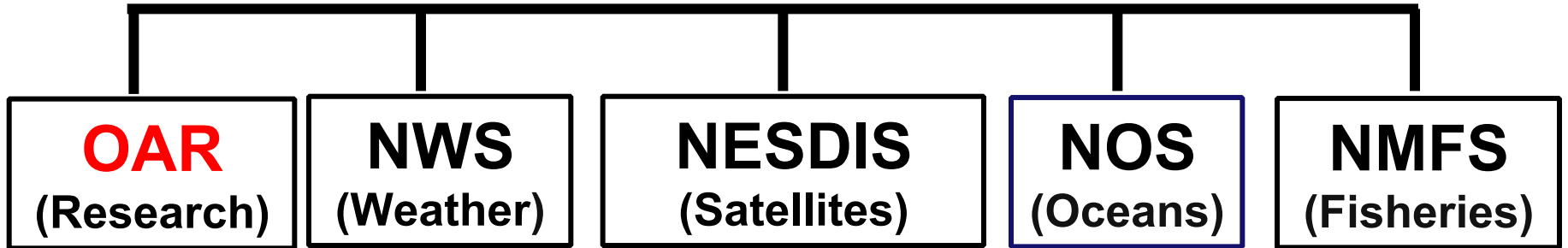
- *Questions*

MISSION:
- To understand and predict changes in climate, weather, oceans and coasts;
- To share that knowledge and information with others; and
- To conserve and manage coastal and marine ecosystems and resources.

Current NOAA Priorities:

- Reduce the impact of extreme weather and water events (**Weather Act**)

- Increase the sustainable economic contributions of our fishery and ocean resources (**Blue Economy**)
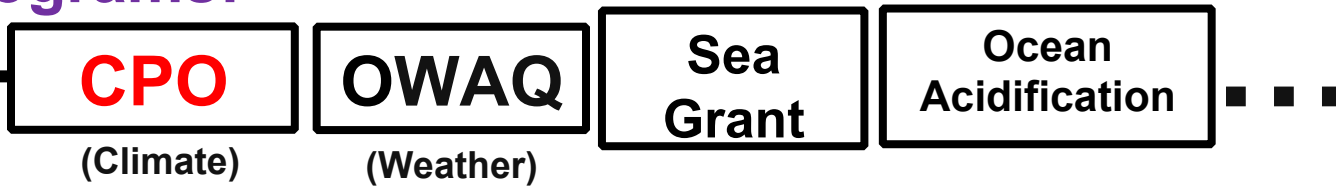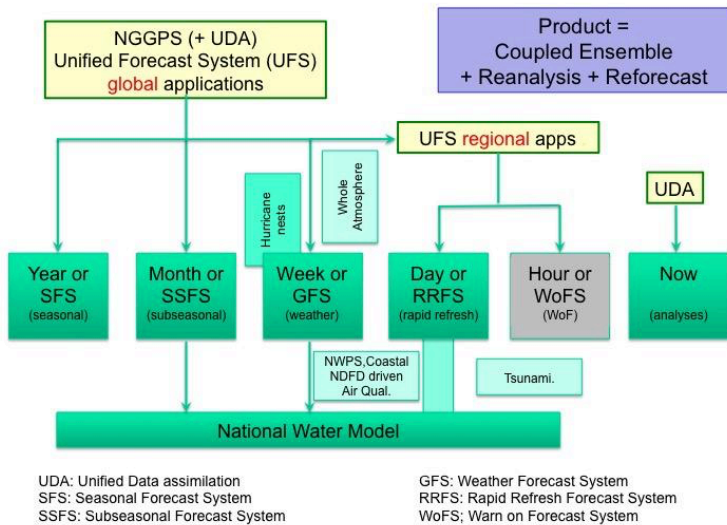
NOAA Org Chart

Line Offices:

OAR (Research)	**NWS** (Weather)	**NESDIS** (Satellites)	**NOS** (Oceans)	**NMFS** (Fisheries)

Labs

GFDL	ESRL	PMEL	ARL	AOML	GLERL

Programs:

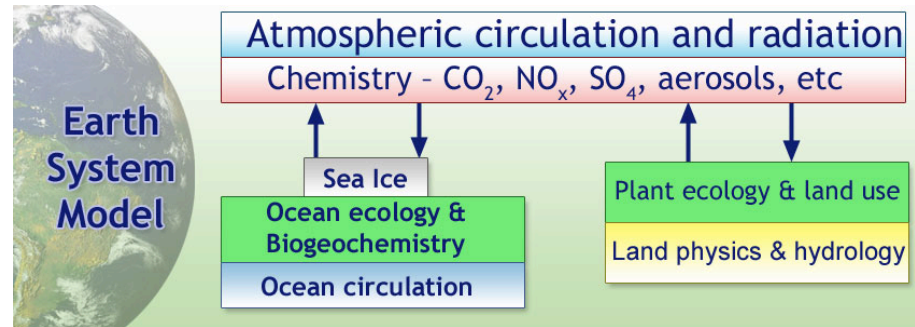| **CPO** (Climate)	**OWAQ** (Weather)	Sea Grant	Ocean Acidification	▪ ▪ ▪

NOAA Major Global Model Systems

NWS/NCEP

OAR/GFDL

GFDL Next Generation Model System: **"SPEAR"** (**S**eamless System for **P**rediction and **Ea**rth System **R**esearch)

EPIC
(Environmental Prediction Innovation Center)

Oceanic and Atmospheric Research (OAR) Strategic Plan: Goals

GOAL 1

Explore the Marine Environment

Increase knowledge of the oceans, coastal areas, and Great Lakes to support resource management and public literacy.

GOAL 2

Detect Changes in the Ocean and Atmosphere

Produce, analyze, and interpret observation records to understand the Earth system and inform the public.

GOAL 3

Make Forecasts Better

Improve accuracy, precision, and efficiency of climate, weather, and ecosystem forecasts and predictions to save lives and property and support a vibrant economy.

GOAL 4

Drive Innovative Science

Cultivate and deliver mission-relevant research to lead the environmental science community.

NOAA Climate Program Office (CPO)

Director: Wayne Higgins; Deputy Director: Ben DeAngelo

History:

- **1985: NOAA Climate & Global (C&G) Program** was originated in the Tropical Ocean Global Atmosphere (**TOGA**) Program.

- **1990**: The **Office of Global Programs (OGP)** was established

- **2006:** OGP was re-named to **Climate Program Office (CPO)**

- **NOAA directly contributed to GEWEX via GCIP, GAPP, CPPA programs since 1990s**

CPO Mission: Advance scientific understanding, monitoring, and prediction of climate and its impacts to enable effective decisions

Three Major Components:
1) Earth system science and modeling
2) Informing decisions
3) Communication, education and engagement

Unique Values:
- Competitive research proposals
- Climate and Global Change (C&GC) Postdoc Program (230 postdocs since1991)
- **Engage USGCRP and WCRP**
- Coordinate with NOAA labs and centers

CPO Earth System Science and Modeling Division
Jin Huang, Chief of CPO/ESSM Division

ESSM Competitive Research Programs	Program Staff
AC4: Atmospheric Chemistry, Carbon Cycle, and Climate	Monika Kopacz Ken Mooney
COM: Climate Observation and Monitoring	Virginia Selz
CVP: Climate Variability and Predictability	Sandy Lucas
MAPP: Modeling, Analysis, Predictions and Projections	Annarita Mariotti Dan Barrie Courtney Byrd

CPO/ESSM also manages
- NOAA **C&GC Postdoc Program**
* **Assessments Program**

Climate Program Office
ESSM
Earth System Science and Modeling Division

Process Studies and Field Campaigns
in partnership with OAR labs and other agencies

To Understand MJO

- **DYNAMO** Field Campaign (2011-2012) (**FY11**) and Research (**FY13**)
- NOAA Climate Process Teams – Understanding MJO Initiation and Propagation (**FY15**)
- Years of Maritime Continent (**YMC**) Field Campaign (**FY17**)

CVP-TPOS pre-field modeling studies (FY18)

To understand upper-ocean processes and shallow convection in Tropical Atlantic Ocean
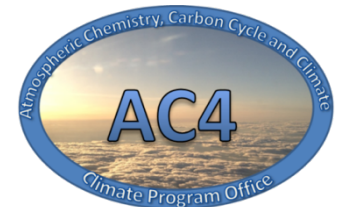- **Supports field experiment (ATOMIC, FY19)**

To understand wildfire smoke - emissions and chemistry
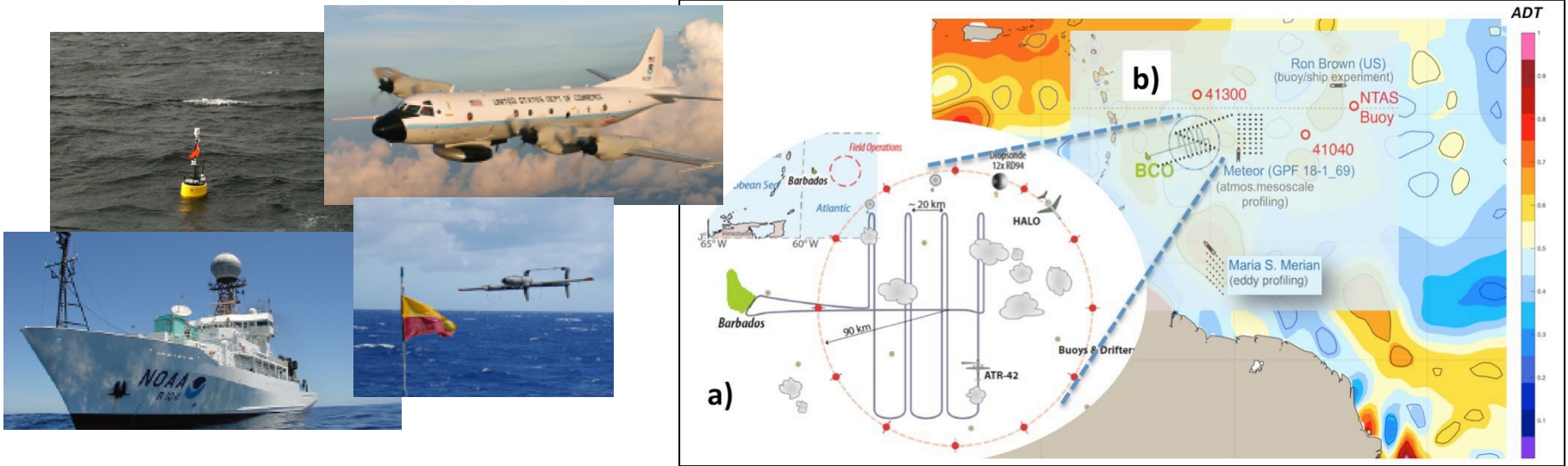- **FIREX/FIREX-AQ field campaign 2016-2020**

To Understand methane leakages from oil & gas production
- **TOP-DOWN** field campaign (**FY14**)
- **SONGNEX** field campaign (**FY15**)
- National Academies of Science report (**FY18**)

Air-Sea Interaction and Shallow Convection

- ATOMIC Field Campaign (Jan-Feb 2020) -- Atlantic Tradewind Ocean-Atmosphere Mesoscale Interaction Campaign (ATOMIC, US-led research) and the EUREC^{4}A (European-led research)

- **CPO/CVP funded 10 Projects in FY19-21** on "Observing and Understanding Upper-Ocean Processes and Shallow Convection in the Tropical Atlantic Ocean"
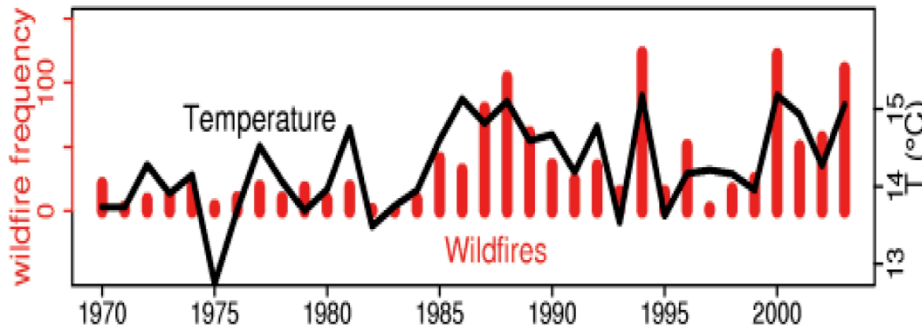
NOAA/NASA FIREX-AQ Experiment

A combination of a warmer, drier climate with fire-control practices over the last century has produced a situation in which we can expect more frequent fires and fires of larger magnitude in the Western U.S. and Canada.

A Western US Forest Wildfires and Spring–Summer Temperature
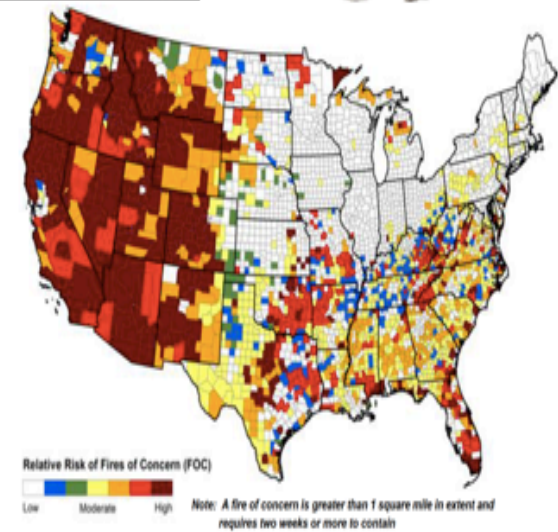
Temperature

Wildfires

NOAA Project Scientists: Carsten Warneke, James Roberts, Joshua Schwarz
NASA Project Scientists: Jim Crawford, Jack Dibb
NOAA Program Managers: Monika Kopacz & Kenneth Mooney
NASA Program Manager: Barry Lefer

Fire Influence on Regional to Global Environments and Air Quality (FIREX-AQ)

The Impact of Biomass Burning on Climate and Air Quality: An Intensive Study of North American Fires

Relative Risk of Fires of Concern (FOC)

Low   Moderate   High   Note: A fire of concern is greater than 1 square mile in extent and requires two weeks or more to contain

NOAA/NASA Field Study in 2019

Climate Process Teams (CPTs)

To speed the improvement of coupled models, data assimilation systems, and model components

5 new CPTs starting in FY19 co-funded with NSF, DOE and NASA

✓ **2 Atmospheric-focused**

<u>Teixeira,</u> et al. "From Boundary Layer to Deep Convection: The Multi-Plume Eddy-Diffusivity/ Mass-Flux (EDMF) Fully Unified Parameterization
<u>Zarzycki</u>, et al. "Improving modeled momentum flux in the atmospheric boundary layer"

✓ **1 Ocean-focused**

<u>Zanna</u>, et al. "Ocean Transport and Eddy Energy"

✓ **2 Land-focused**

<u>N. Chane</u>y, et al, **"**Parameterizing the effects of sub-grid land heterogeneity on the atmospheric boundary layer and convection
<u>K.-N. Liou ,</u> et al, "3D-Land Energy and Moisture Exchanges: Harnessing High Resolution Terrestrial Information"

NOAA/CPO has been supporting CPTs since 2010:

- Internal-wave driven mixing in global ocean models (2010-16, co-funded by NSF)

- Cloud parametrization and aerosol indirect effect (2010-16, co-funded by NSF)

- Cloud and boundary layer (2014-15)

Process-Level Diagnostics to Accelerate Model Development

- NOAA MAPP Model Diagnostic Task Force projects have developed process-oriented metrics (PODs) that enable targeted model testing and accelerated improvement

- In FY18, exploiting CMIP6 to extend set of diagnostics; continued GFDL interest and involvement given CMIP6 investments

- Accelerate GFDL model development

- Need process-level datasets
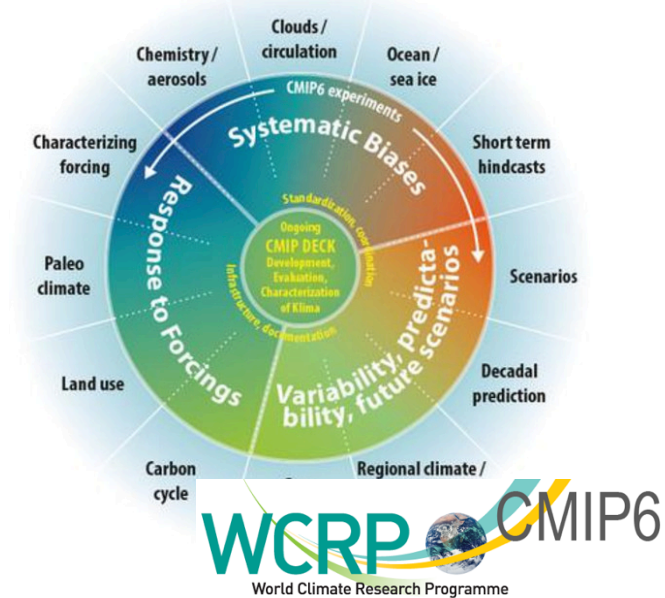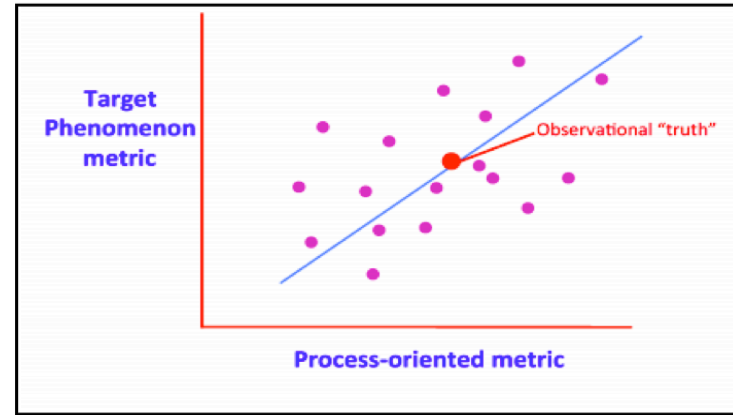
CPO Previous S2S Research

- S2S prediction research (e.g. MAPP S2S Task Force)

- Climate Test Bed (e.g. CFS improvements; Climate Forecast Products)

- Climate reanalysis and reforecasts

- Ensemble Predictions
  - NMME seasonal forecast system
  - SubX real-time S2S ensemble predictions
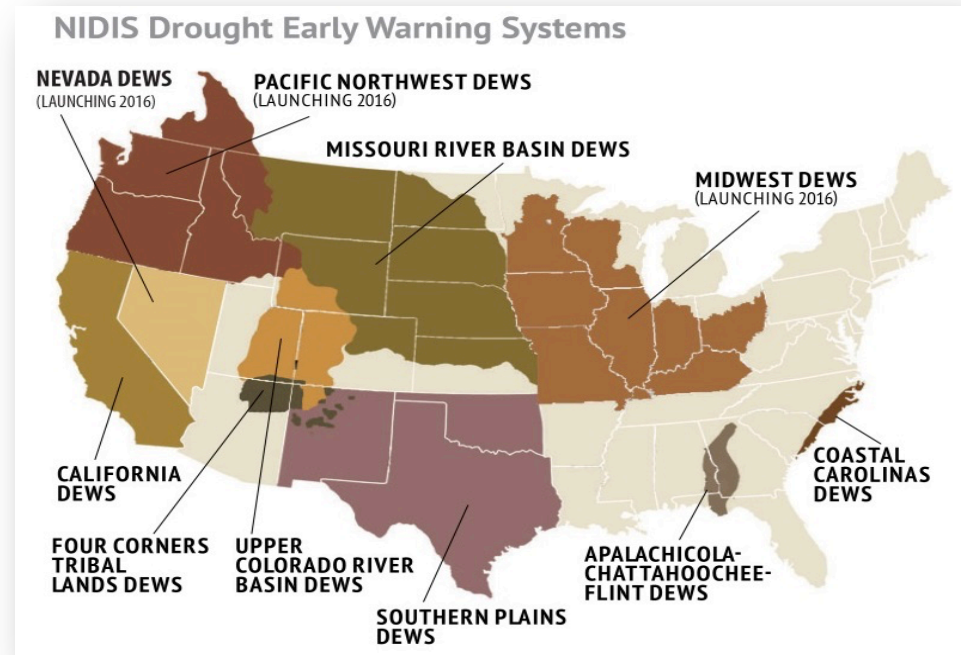
- Week 3-4 prediction tools
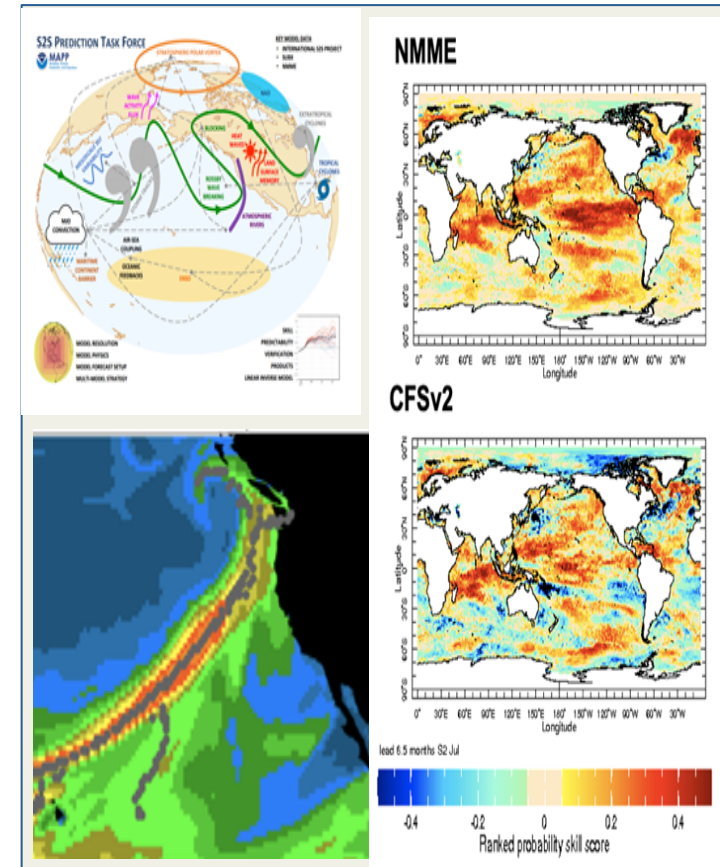
CPO's S2S activities transferred to OWAQ in FY18 to bolster OAR support of the Weather Act

Drought and NIDIS

National Integrated Drought Information System (NIDIS) is a NOAA led multi-agency program

National Coordinated Soil Moisture Monitoring Network (NSMN) Strategy Document
- developed by NIDIS, called for In the 2018 NIDIS Reauthorization
- available in drought.gov website
- open for public reviews until Feb. 13
- one of the recommendations is "engaging with the citizen science community".
- a collaboration with CocoRaHS will be a logical path forward.

NIDIS Drought Early Warning Systems

NEVADA DEWS (LAUNCHING 2016)
PACIFIC NORTHWEST DEWS (LAUNCHING 2016)
MISSOURI RIVER BASIN DEWS
MIDWEST DEWS (LAUNCHING 2016)
CALIFORNIA DEWS
FOUR CORNERS TRIBAL LANDS DEWS
UPPER COLORADO RIVER BASIN DEWS
SOUTHERN PLAINS DEWS
APALACHICOLA-CHATTAHOOCHEE-FLINT DEWS
COASTAL CAROLINAS DEWS

CPO/MAPP Drought Task Force has been supporting research to improve drought understanding, monitoring and prediction in NWS and NIDIS

CPO/ESSM FY20 New Foci

- **Urban Atmosphere**: Chemistry, Carbon and Composition (AC4)

- **Climate-Fish**: Process-level understanding of changing ocean conditions that directly affect marine species and fisheries and Modeling Climate Impacts on the Predictability of Fisheries & Other Living Marine Resources (CVP and MAPP)

- **Drought Complex Interactions**: Advance our capability to more integrally characterize and anticipate US droughts in the context of hydroclimatic variability and change, linking this research to practical NIDIS applications (MAPP)

- **Climate Sensitivity**: Constraining climate model sensitivity focusing on clouds, convection and aerosol processes and their role within the coupled Earth system, with the goal of reducing overall uncertainties in future climate projections (MAPP)

- Developing **boundary layer datasets** to improve BL processes in models (COM)

- **Explaining Climate Extreme Events**: Developing a Rapid Assessment Capability and Understanding the Causes and Mechanisms of Extreme Events

CPO Risk Area Initiative

To better align CPO, NOAA and community capabilities to address climate risks.

Four targeted climate risks and CPO risk area teams:

- *Extreme Heat*

- *Marine Ecosystems*

- *Coastal Inundation*

- *Water Resources*
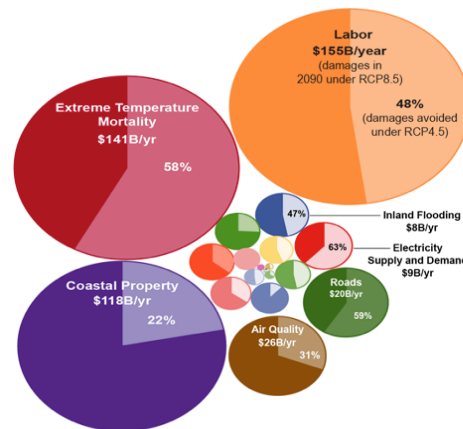
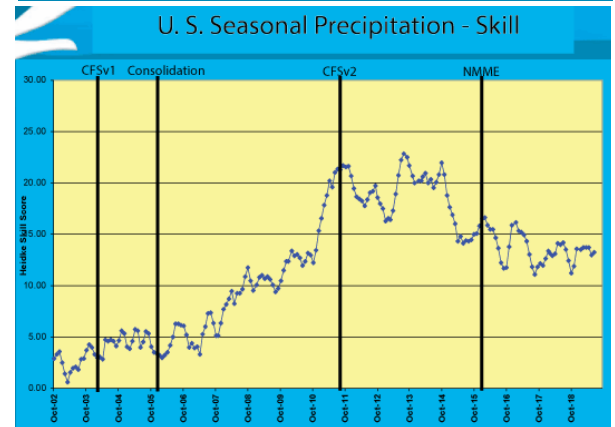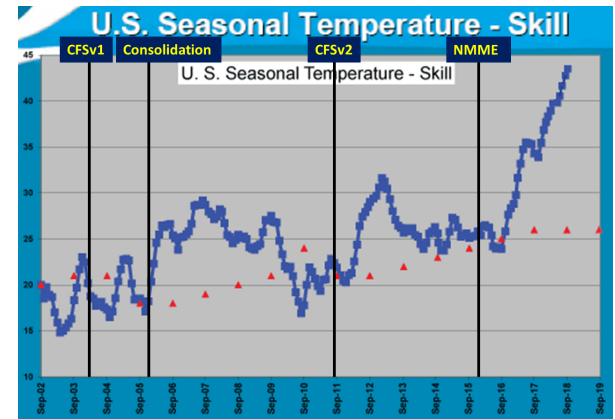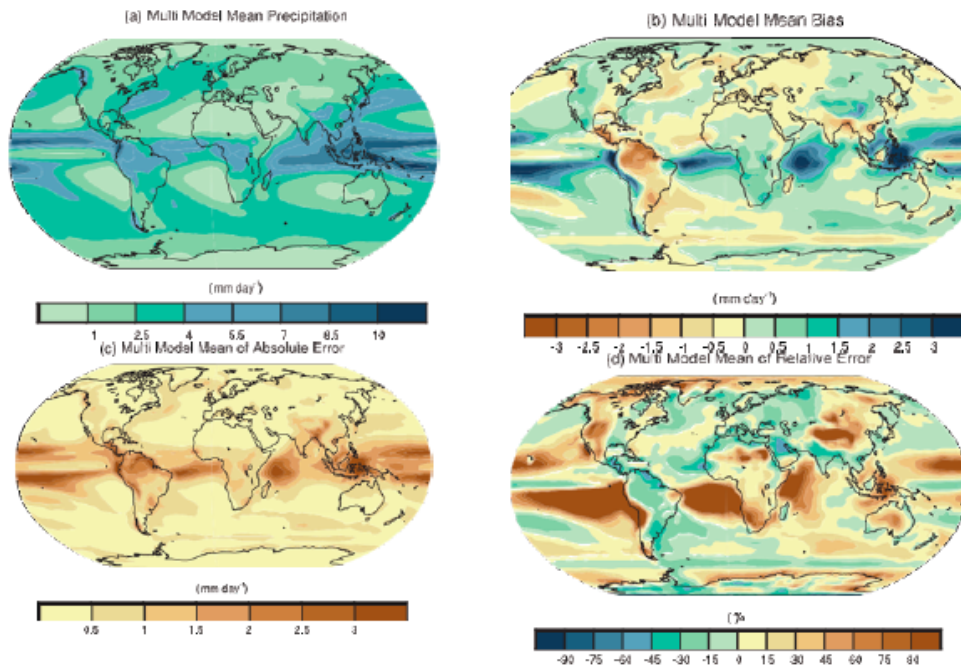| Annual Economic Damages in 2090		
Sector	Annual damages under RCP8.5	Damages avoided under RCP4.5
Labor	$155B	48%
Extreme Temperature Mortality◊	$141B	58%
Coastal Property◊	$118B	22%
Air Quality	$26B	31%
Roads◊	$20B	59%
Electricity Supply and Demand	$9B	63%
Inland Flooding	$8B	47%
Urban Drainage	$6B	26%
Rail◊	$6B	36%
Water Quality	$5B	35%
Coral Reefs	$4B	12%
West Nile Virus	$3B	47%
Freshwater Fish	$3B	44%
Winter Recreation	$2B	107%
Bridges	$1B	48%
Munic. and Industrial Water Supply	$316M	33%
Harmful Algal Blooms	$199M	45%
Alaska Infrastructure◊	$174M	53%
Shellfish*	$23M	57%
Agriculture*	$12M	11%
Aeroallergens*	$1M	57%
Wildfire	−$106M	−134%

Multi-sector Analyses of Annual Economic Damages in 2090 (NCA4, 2018)

NOAA Precipitation Prediction Grand Challenge

Global research (including targeted observations, and process studies) required to address the *Challenge*

Systematic errors in coupled ocean atmosphere models have been present since their inception in early 90s
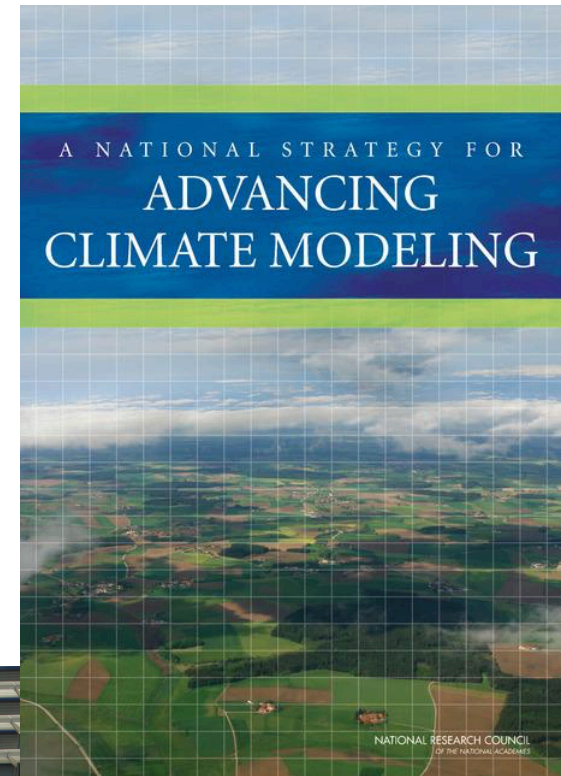
CMIP5 models and coupled models for S2S prediction have similar errors in distribution of mean precipitation including double ITCZ

(a) Multi Model Mean Precipitation
(b) Multi Model Mean Bias
(c) Multi Model Mean of Absolute Error
(d) Multi Model Mean of Relative Error

U.S. Seasonal Temperature - Skill

U. S. Seasonal Precipitation - Skill

Precipitation forecast skill has been decreasing

US Climate Modeling Summit

- A follow-up to 2012 NAS report on climate modeling

- USCMS convenes annually the leads from the major "CMIP-class" model development groups.

- The USCMS is to enhance coordination toward a common national climate modeling strategy and communication with the broader modeling community

- **The theme of 2020 US Climate Modeling Summit is aerosol-cloud interaction**

A NATIONAL STRATEGY FOR
ADVANCING CLIMATE MODELING

NATIONAL RESEARCH COUNCIL
OF THE NATIONAL ACADEMIES

WEATHER AND CLIMATE

Questions
to help better align NOAA and GEWEX priorities:

- There are good alignments between GEWEX and NOAA climate mission.

- **How can NOAA better contribute to GEWEX activities**, given NOAA's priorities and our program scopes?
  - science questions in WCRP and GEWEX ?
  - capabilities in NOAA labs and centers
  - CPO/ESSM research programs

- **How can NOAA benefit from GEWEX activities?** e.g.
  - precipitation initiative;
  - extremes;
  - model improvement and evaluation