



NOAA RESEARCH • ESRL • PHYSICAL SCIENCES DIVISION

Five Year Review of ESRL Physical Sciences Division (2010-2014): Overview

Robert S. Webb

Science Review
12-14 May 2015
Boulder, Colorado



Outline

- Vision, Mission & Goals
- What is PSD
- Staffing Demographics
- Funding Portfolio
- Information Products and Services
- Research Themes
- Structure of this Review

NOAA Strategic Objectives

- Improved scientific understanding of the changing climate system and its impacts
- Assessments of current and future states of the climate system that identify potential impacts and inform science, service and stewardship decisions
- Reduced loss of life, property, and disruption from high impact events
- Improved freshwater resource management
- Integrated services meeting the evolving demands of regional stakeholders

Top Eight OAR Science Questions



- What is the **state of the climate system** and **how is it evolving**?
- What **causes climate variability and change** on global to regional scales?
- What **improvements in global and regional climate predictions are possible**?
- How can **modeling be best integrated and improved** with respect to skill, efficiency, and adaptability?
- How can we **improve forecasts, warnings, and decision support for high-impact weather events**?
- How does **climate affect seasonal weather and extreme weather events**?
- How can we **improve forecasts for freshwater resource management**?
- How can we **improve the way scientific information and its uncertainty are communicated**?
- How do environmental changes affect marine and coastal ecosystems?
- How can we best use current and emerging environmental data?
- How can we support informed public response to changing environmental conditions?
- How can NOAA best inform and support the Nation's efforts to adapt to the impacts of climate variability and change?

PSD 2010 Strategic Goals

- Improve observations and understanding of Earth system processes.
- Integrate climate, weather and water research.
- Understand, attribute and predict extremes in a variable and changing climate.
- Advance understanding of regional processes and develop applications related to climate variability and change.
- Conduct research and develop prototypes to improve NOAA environmental information and services.

PSD 2010 Vision and Mission

- *Vision:* advances in physical process research provide the nation with the scientific information necessary for decision making
- *Mission:* to conduct weather and climate research to observe and understand Earth's physical environment, and to improve weather and climate predictions on global-to-local scales

The Origins of the Physical Sciences Division



National Oceanic and Atmospheric Administration

Summary of the President's Budget

Fiscal Year 2002

Scott B. Gudes
Acting Under Secretary/Administrator
and Deputy Under Secretary



Weather-Climate Connection: \$0.9 million

NOAA requests a total of \$0.9 million for Weather-Climate Connection. This investment will assist in understanding predictions variability beyond the El Niño Southern Oscillation (ENSO) and predicting the weather-climate connection. As during El Niño, other sub-seasonal tropical fluctuations can also lead to shifts in the Pacific storm track, affecting the paths of storms approaching the U.S. west coast, and influencing weather across the entire country. Sub-seasonal tropical-mid-latitude interactions thereby provide a potentially important additional source of predictability beyond ENSO. NOAA will expand its diagnostic and modeling efforts to understand the relationship between sub-seasonal tropical variability and changes in the frequency, location and intensity of extreme weather events over the U.S., and document the structure of variations in tropical rainfall on weekly to monthly time-scales, as well as air-sea interactions in both tropical systems and in mid-latitude oceanic and land-falling storms.

First 10 years of the Physical Sciences Division



National Oceanic and Atmospheric Administration

Summary of the President's Budget

Fiscal Year 2002

Scott B. Gudes
Acting Under Secretary/Administrator
and Deputy Under Secretary



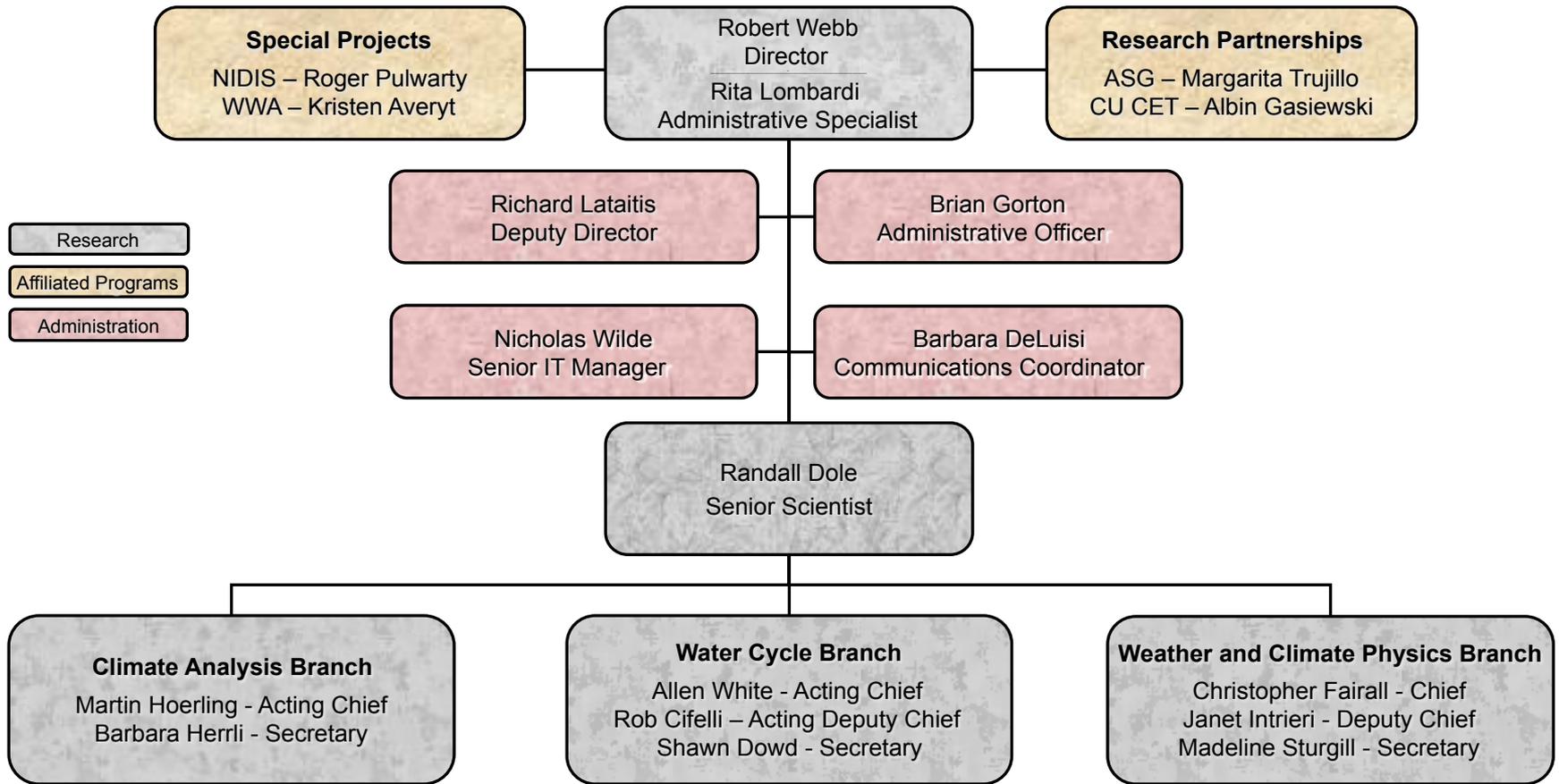
Weather-Climate Connection: \$0.9 million

NOAA requests a total of \$0.9 million to support research that will assist in understanding predicted changes in weather-climate connections. This funding will also lead to a better understanding of shifts in the Pacific Ocean and how they influence weather patterns, and thereby provide a potentially valuable diagnostic and modeling tool to help predict changes in the frequency and structure of variations in both tropical systems and in mid-latitude oceanic and land-falling storms.



will assist in predicting the connections between the ocean and the atmosphere, and thereby expand its understanding of oceanic variability and document the interactions between the ocean and the atmosphere.

How PSD was Organized through 2014



NIDIS – National Integrated Drought Information System
 WWA – Western Water Assessment

ASG – Advanced Systems Group
 CU CET – University of Colorado Center for Environmental Technology

PSD 2015 Reorg: Stole a page from GFDL

- Removed Branches as an unnecessary organizational layer and impediment to integration of research across PSD
- Created a **Research Council** (*tactical*) and **Science Board** (*strategic*)

Research Council Charge

- **Energize collaboration** across PSD
- **Optimize the investment** of PSD's science and technology resources
- Better **utilize PSD research science expertise**
- **Foster the integration of research** across the division through enhanced communication and improved understanding of the full spectrum of PSD research
- Work to **ensure a coordinated research approach** in the scientific progress needed to meet PSD's annual research goals
- **Identify new opportunities** for integrative research spanning PSD

New PSD Organizational Structure (2015)

Director
Robert Webb
-
Administrative Specialist
Rita Lombardi

Research Council Chair
Richard Lataitis

Deputy Director
Brian Gorton

Senior Scientist
Randall Dole

PSD
Research Council
(Integration/Coordination)

IT
Nicholas Wilde
Senior IT Manager

Admin. & Budget
Tina Schiffbauer

Communications
Barbara DeLuisi
Coordinator

PSD
Science Board
(Strategic Planning)

Research
Partnership
Programs*

Attribution and
Predictability
Assessments

Atmosphere-
Ocean
Process

Boundary Layer
Observations
and Process

Dynamics and
Multiscale
Interactions

Forecast and
Modeling
Development

Hydrometeorology
Modeling
and Applications

Hydrometeorology
Observations
and Processes

Polar
Observations
and Processes

*NIDIS – National Integrated Drought Information System
*ASG – Advanced Systems Group

Fostering Integration of Research Across PSD

- **Research Council**

- Started meeting at the beginning of 2015

- **Flash Seminars**

- Stretch 10 - 15 minute AGU/AMS talks to 20 minutes with 10 minutes for questions and discussion (2 per hour)
- Introduce ongoing research to spur collaborations across the division

- **Field Campaign Observer Program**

- Send weather/climate modelers and data diagnosticians out to experience and better appreciate how data is collected in field experiments



Why we do the research we do

*Research in the Physical Sciences Division provides a **physical basis for understanding and predicting extremes and other weather and climate phenomena** to advance NOAA's mission responsibilities to provide early warning and inform preparedness.*

OAR Vision - trusted leader, authoritative, deliberative

How we do the research we do

- **Deploy** existing observing technologies, and **develop** new technologies, to **advance observation-based process understanding**
- Analyze data and information to provide **diagnostic explanations** and to advance **predictive understanding**
- Develop and apply models to **transform predictive understanding into predictive capabilities to forecast and predict** past and future conditions
- Transform our science-based knowledge into **actionable science** that is readily available to **support operations, applications and decision making**

OAR Mission - understand and predict, develop technology, transition results

PSD Research - Across Timescales Integration

Attribution and
Predictability
Assessments

Atmosphere-
Ocean
Process

Boundary Layer
Observations
and Process

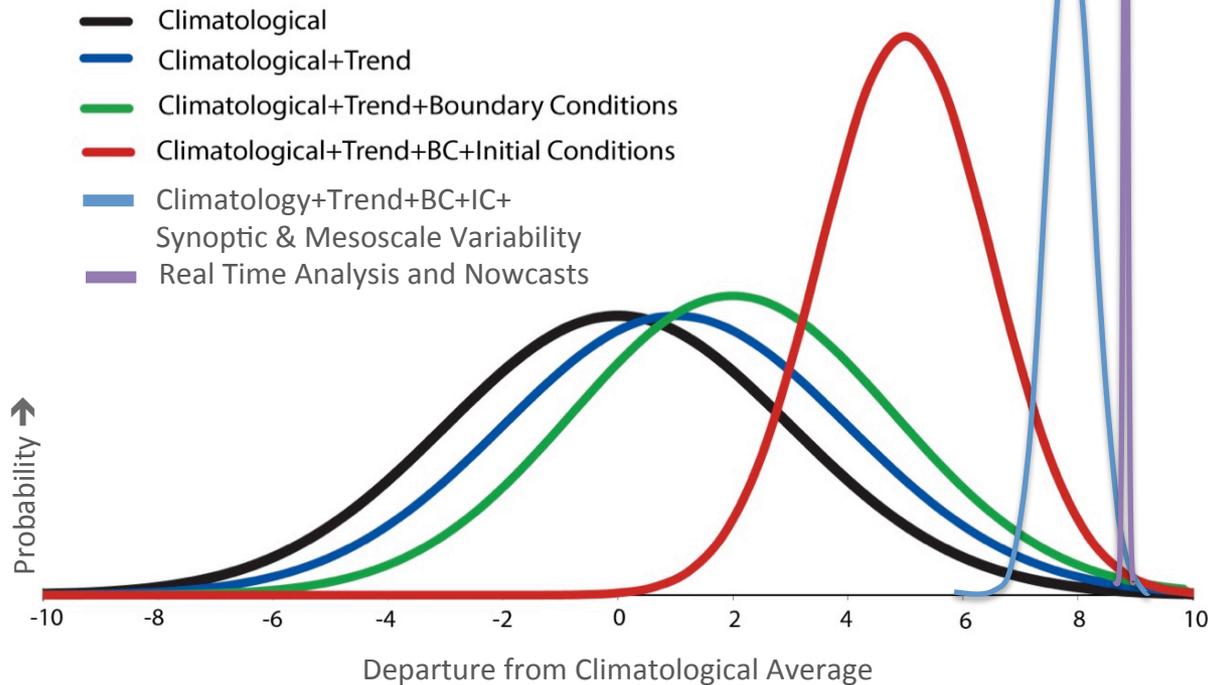
Dynamics and
Multiscale
Interactions

Forecast and
Modeling
Development

Polar
Observations
and Processes

Hydrometeorology
Observations
and Processes

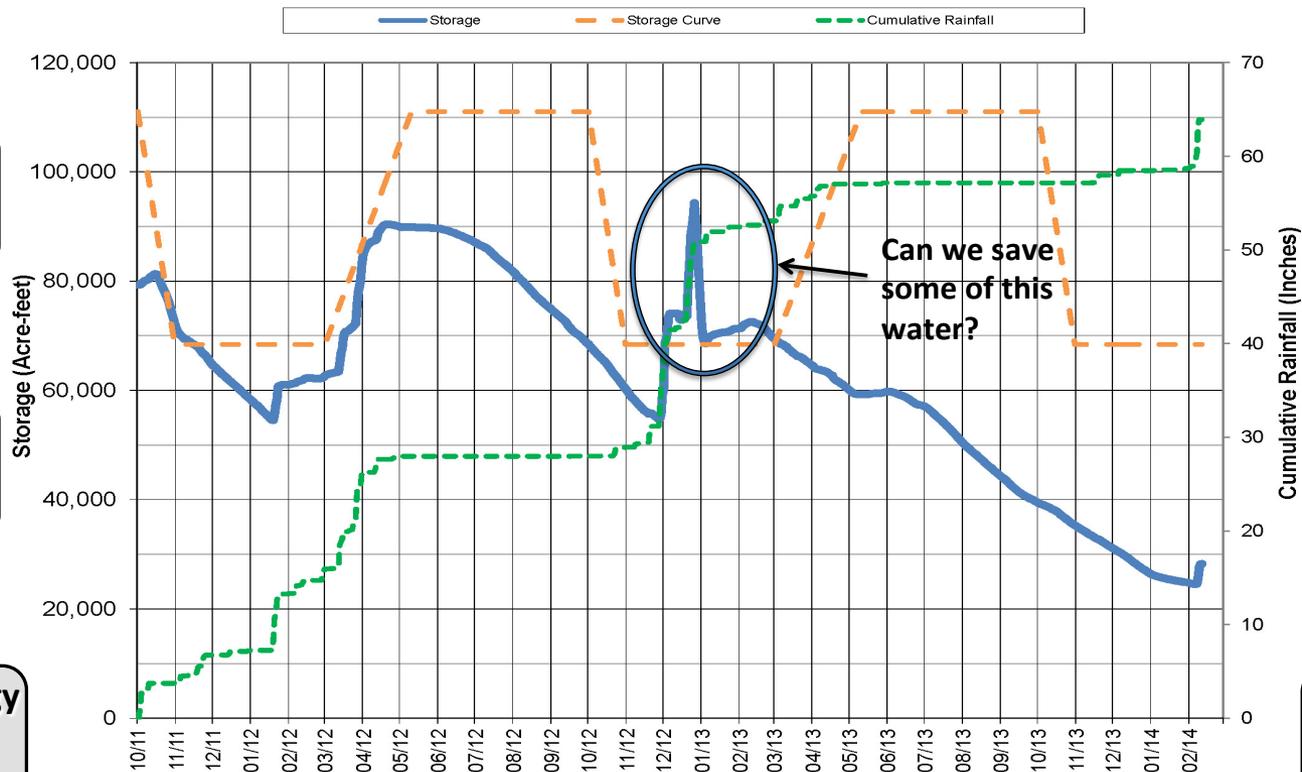
Hydrometeorology
Modeling
and Applications



PSD Research - Problem Focus Integration

Reservoir Operations to Improve Resiliency

Lake Mendocino Water Years 2012 - 2014



Attribution and Predictability Assessments

Atmosphere-Ocean Process

Boundary Layer Observations and Process

Dynamics and Multiscale Interactions

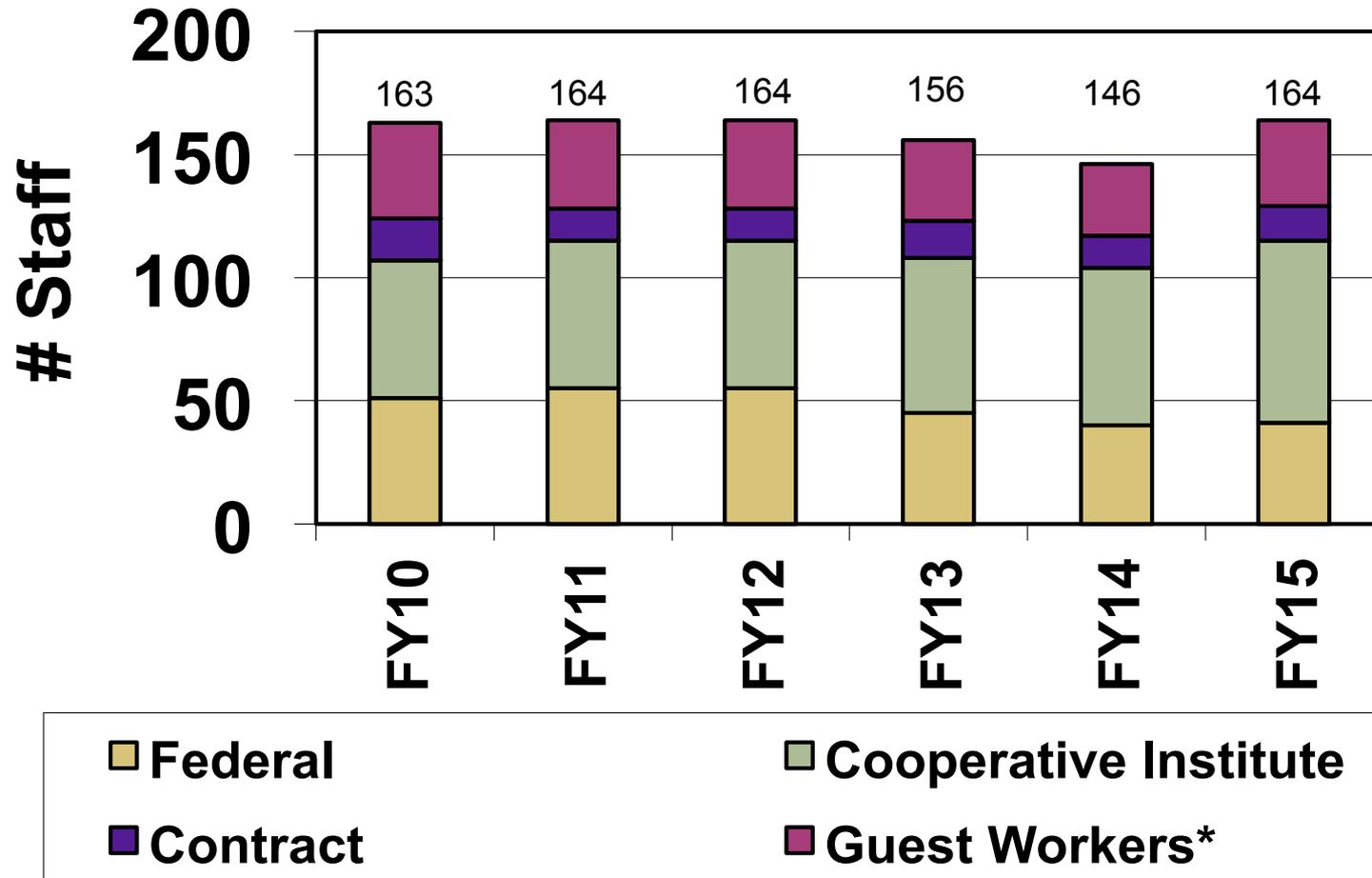
Forecast and Modeling Development

Polar Observations and Processes

Hydrometeorology Observations and Processes

Hydrometeorology Modeling and Applications

PSD Staffing by Fiscal Year



*Guest Workers: Scientists Emeriti (3), Guest Scientists (25), Post-docs (6), Externally Supported Staff (2)

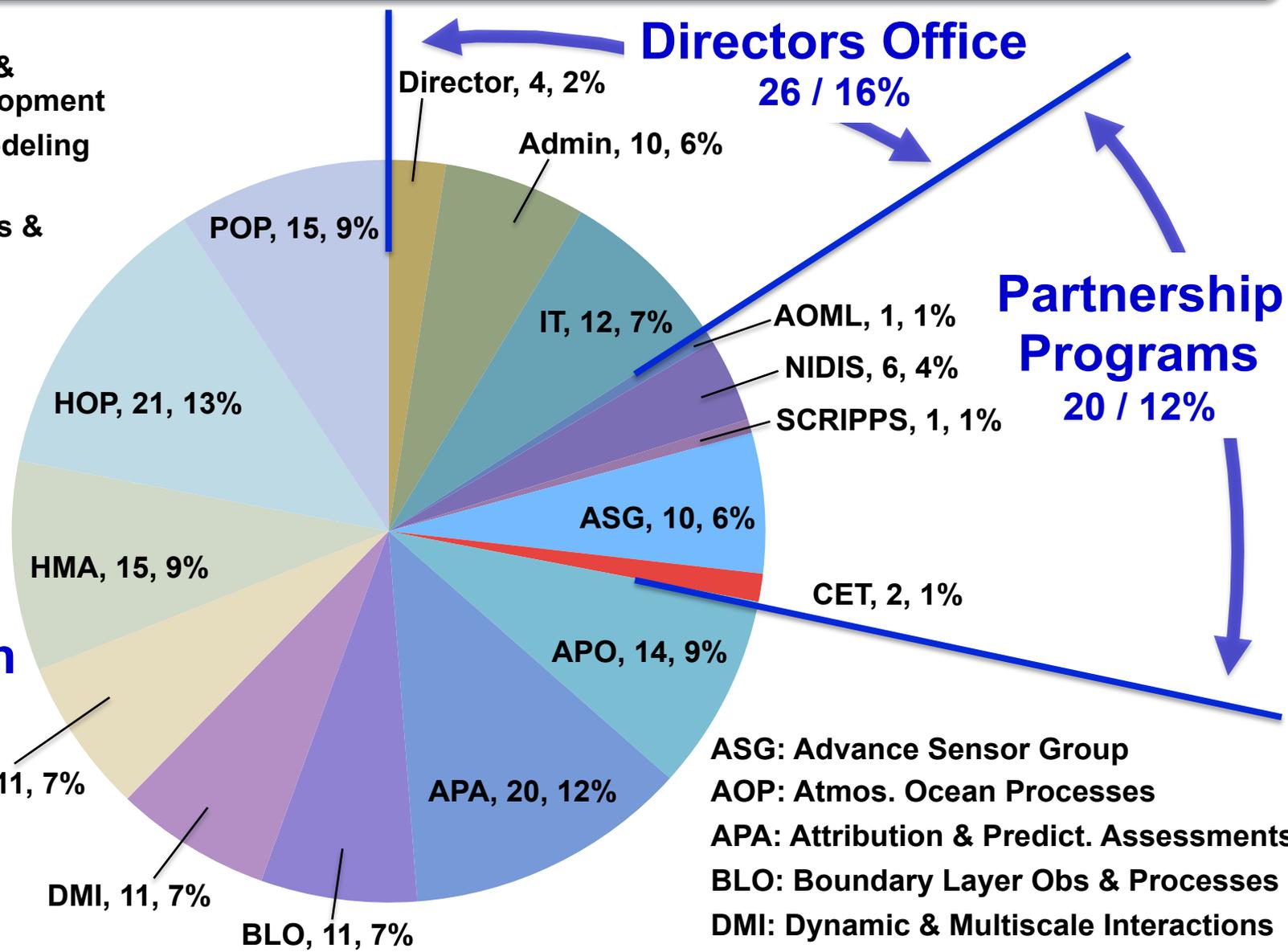
FY15 PSD Staff Distribution (Total=164)

FMD: Forecast & Modeling Development
 HMA: Hydro Modeling & Applications
 HOP: Hydro Obs & Processes
 POP: Polar Obs & Processes

Core Research
 118 / 72%

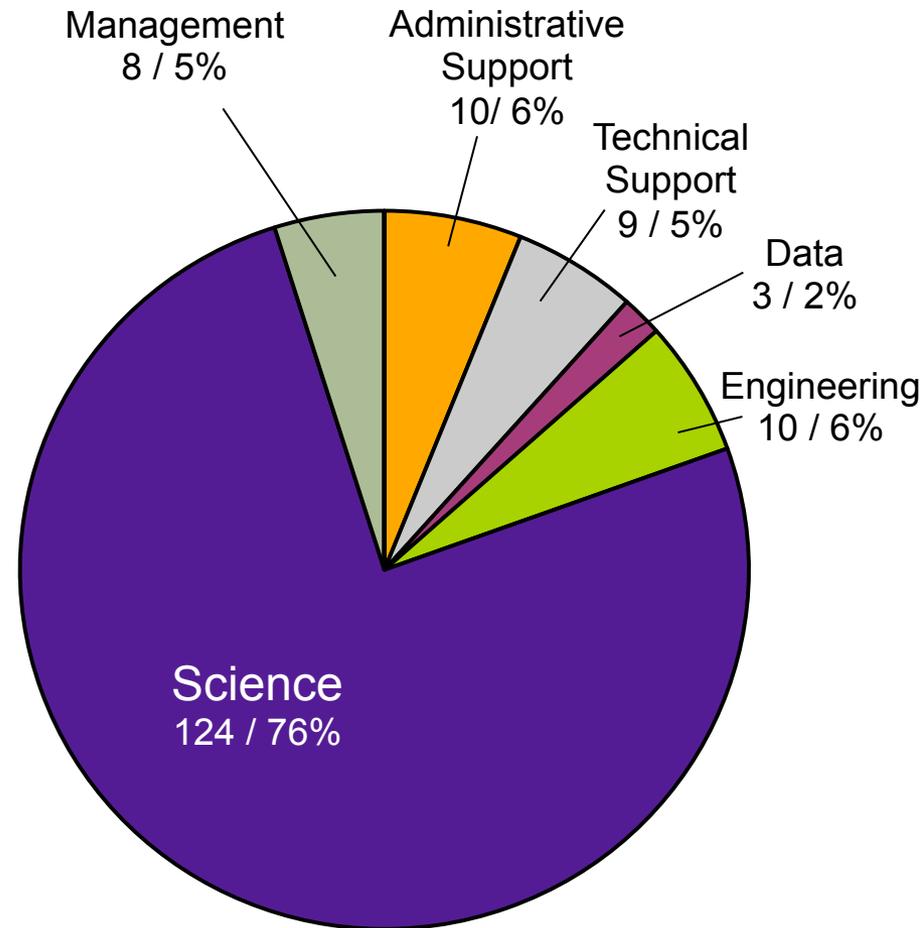
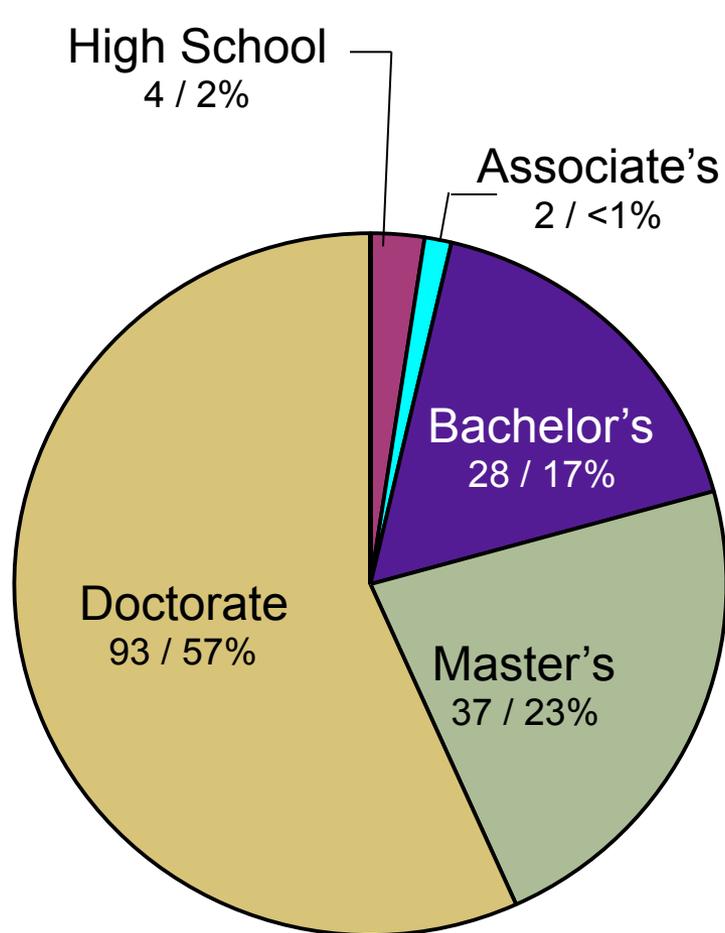
Directors Office
 26 / 16%

Partnership Programs
 20 / 12%

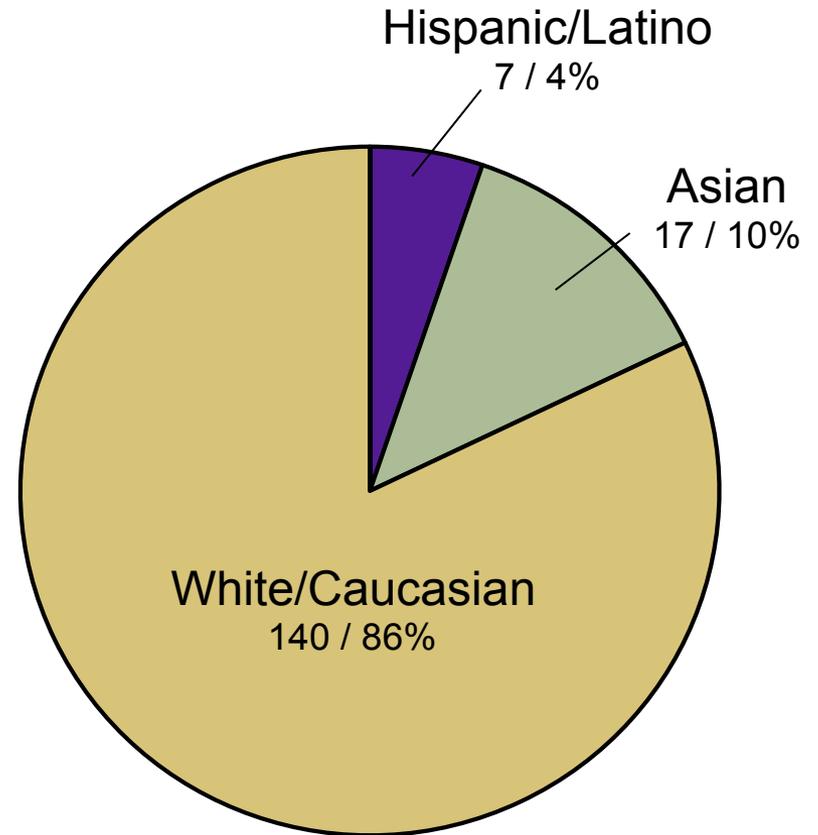
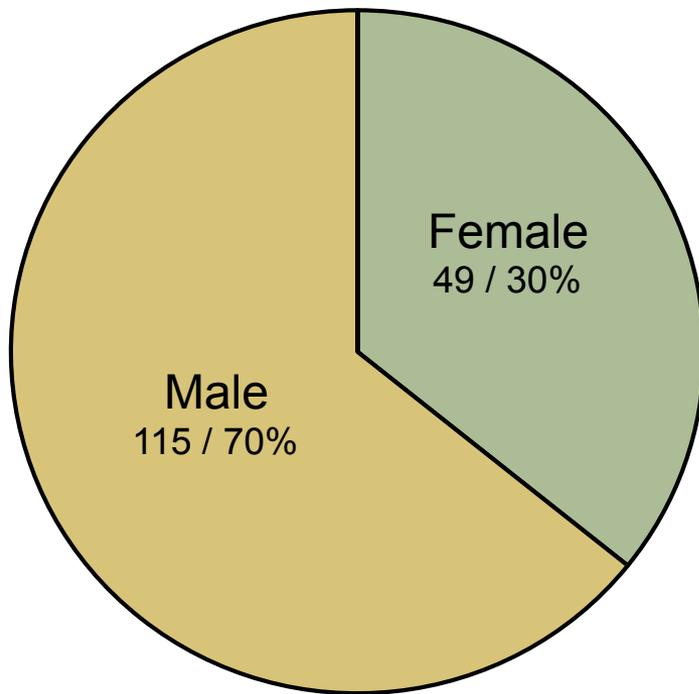


ASG: Advance Sensor Group
 AOP: Atmos. Ocean Processes
 APA: Attribution & Predict. Assessments
 BLO: Boundary Layer Obs & Processes
 DMI: Dynamic & Multiscale Interactions

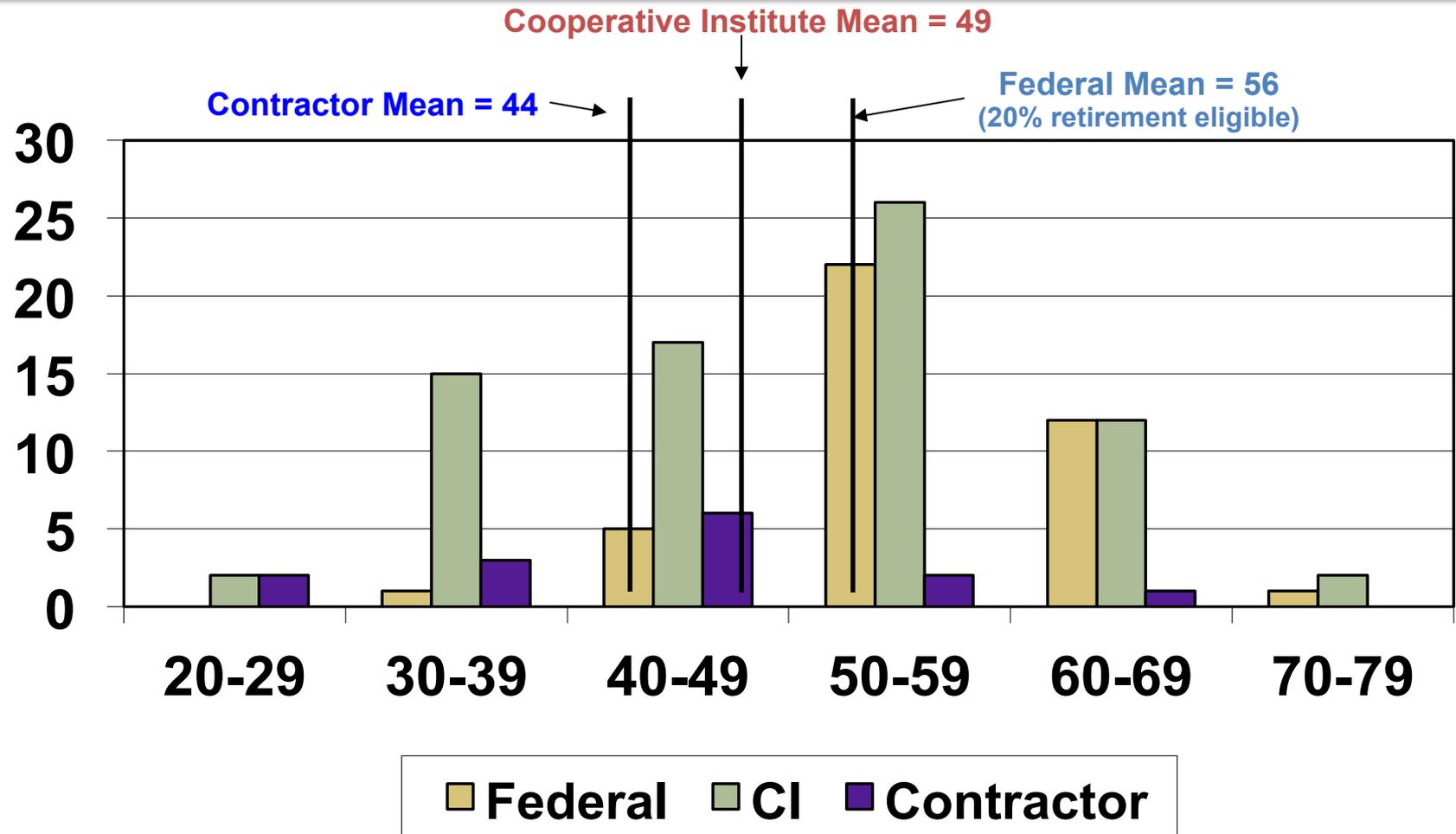
FY15 PSD Staff Degree Distribution and Functions (Total=164)



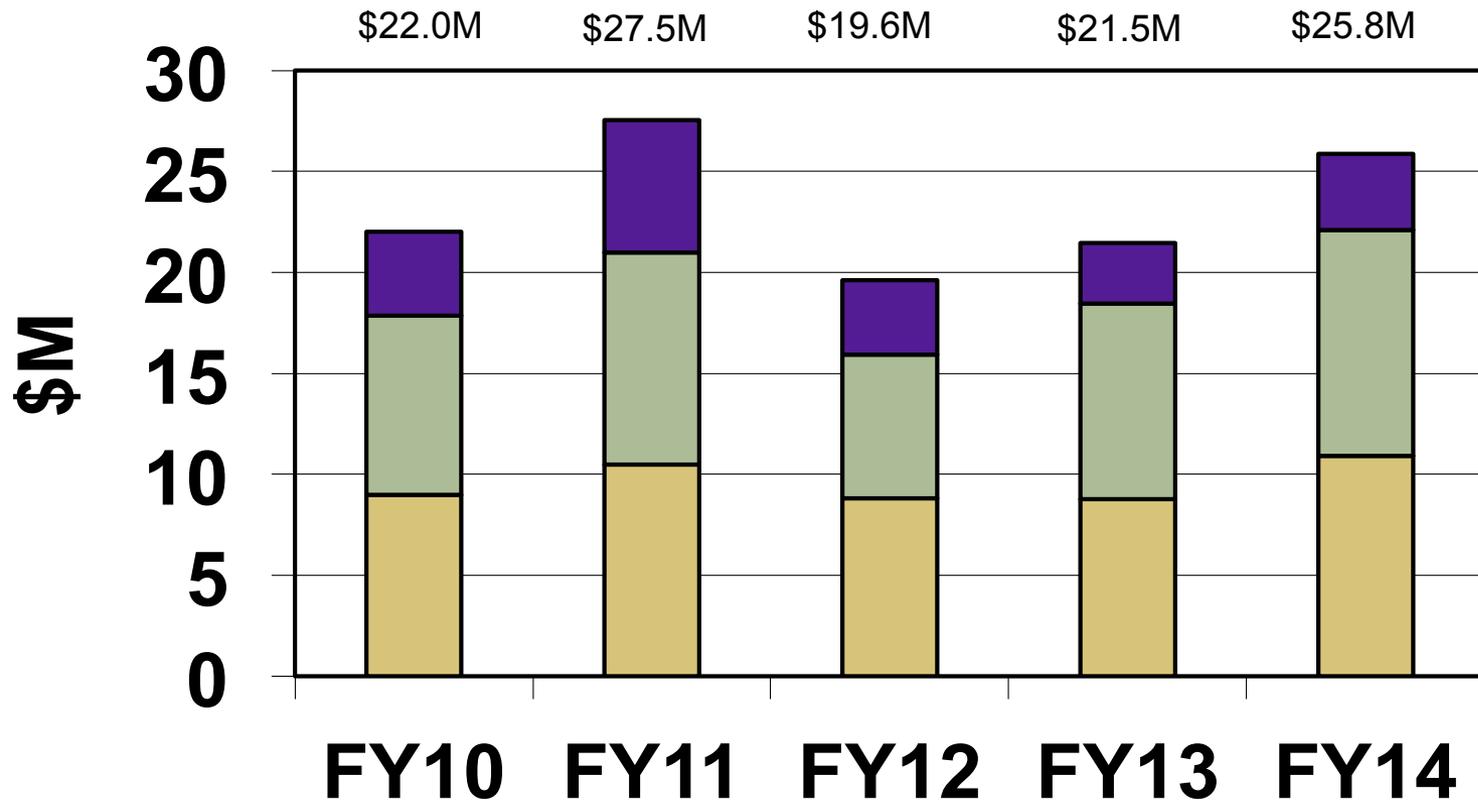
FY15 PSD Staff Diversity (Total=164)



FY15 PSD Staff Age Distribution (Total=164)



PSD Income by Fiscal Year



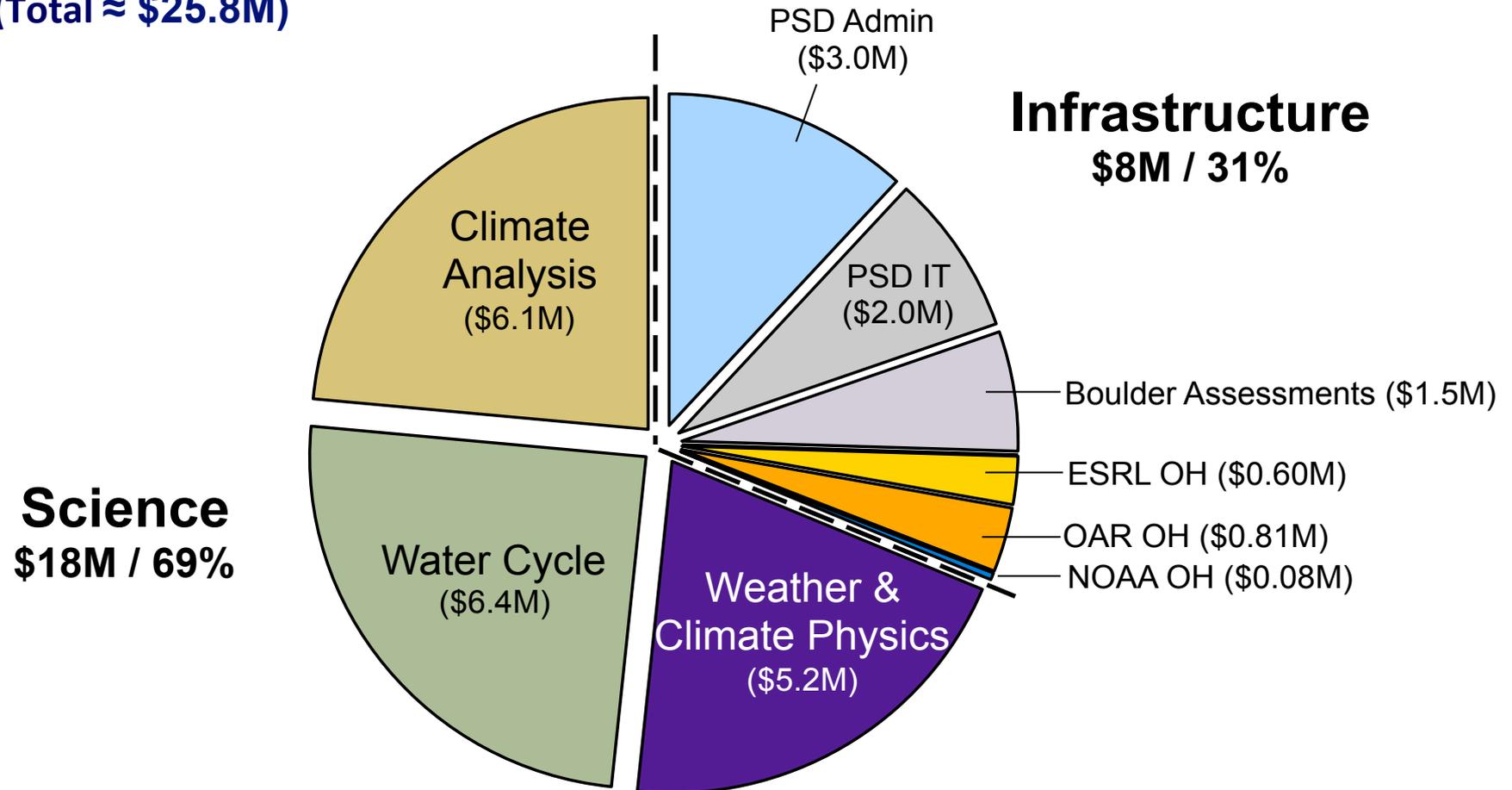
■ Base

■ Other-NOAA

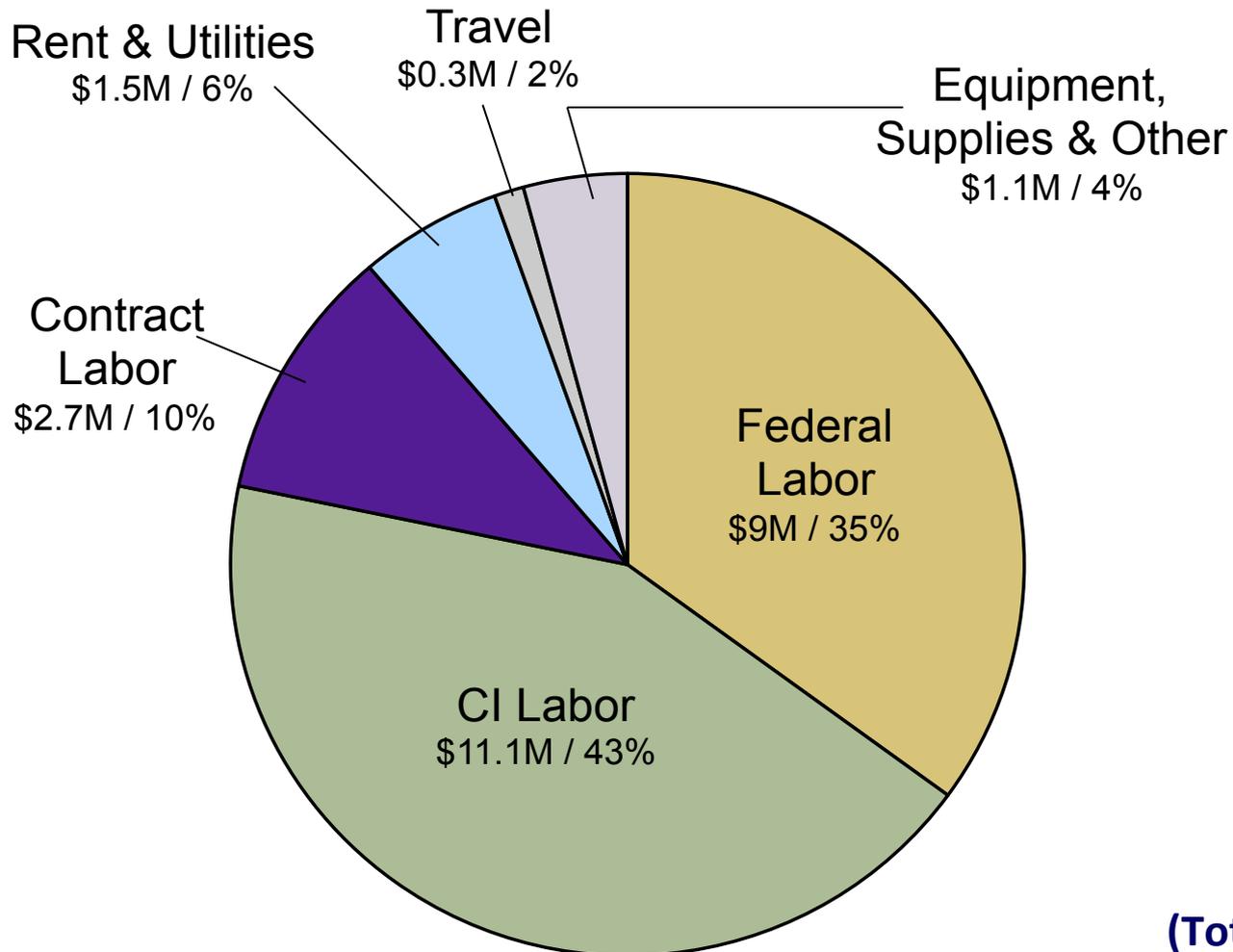
■ Other-Agency

PSD FY14 Expenditures by Function

(Total ≈ \$25.8M)



PSD FY14 Expenditures by Category



(Total ≈ \$25.8M)

Measures of Excellence – Quality & Performance

Awards and Recognition International

DOC/NOAA/OAR
CIRES
Federal and State Agencies
Professional Society
Reviewer/Editor
Journal and Publications
Presentations and Posters
Outreach, Education, EEO and
Diversity Efforts

Professional Organization Fellowships

American Meteorological Society
Acoustical Society of America
Institute for Electrical and
Electronics Engineers
Cooperative Institute for Research
in Environmental Sciences

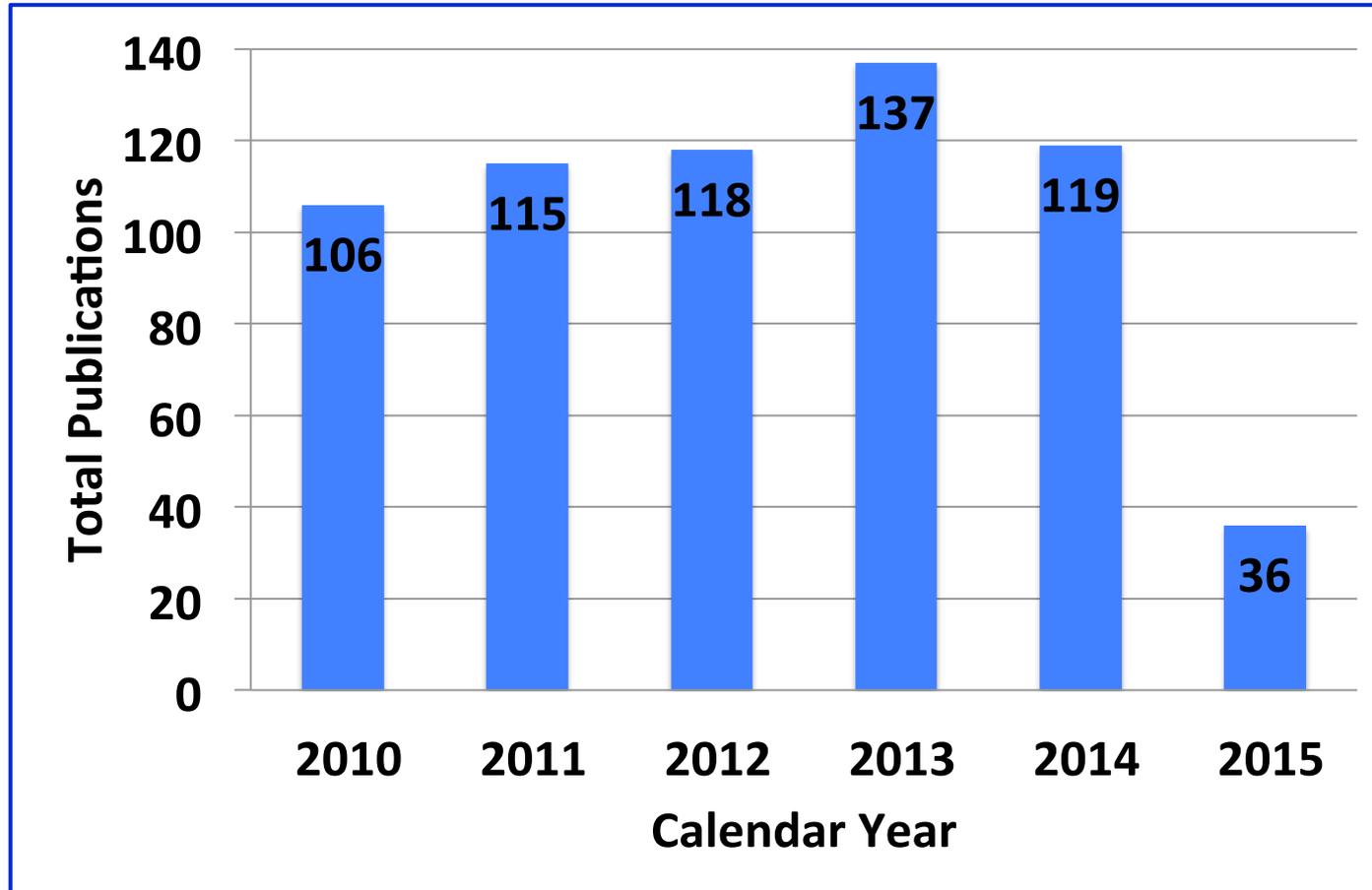
Scientific Leadership

International
NOAA
Other Federal Agencies
State Agencies
Research Programs
Field Campaigns
National and international
workshops and Conferences

Postdoctoral Research Fellowships

National Academy of Sciences,
National Research Council
University Corporation for
Atmospheric Research, Postdocs
Applying Climate Expertise
Cooperative Institute for Research
in Environmental Sciences

PSD Peer-Review Publications

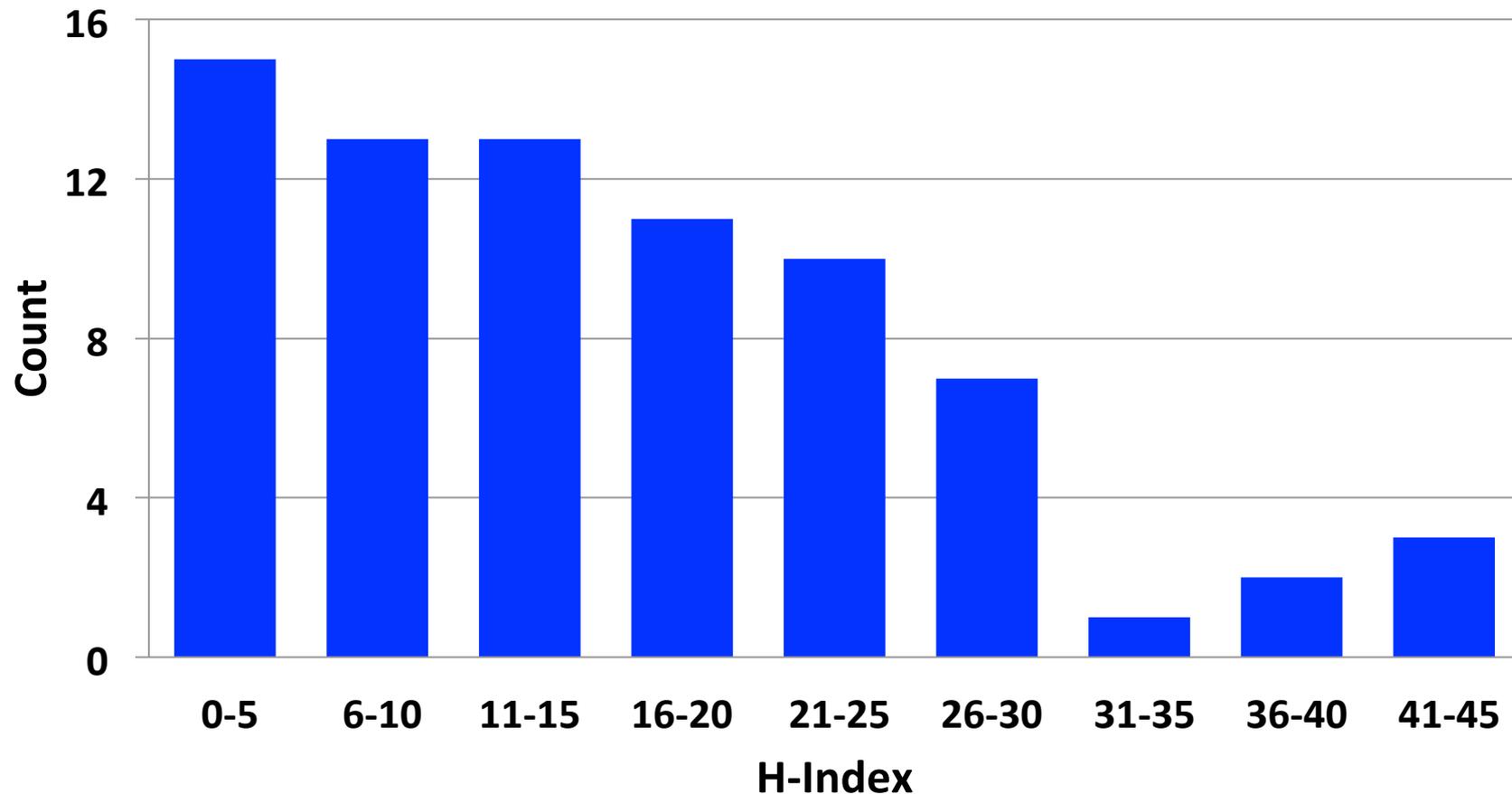


5-year
average = 119

1.5 papers
per scientist

Peer-reviewed journal publications establish scientific credibility

PSD Research Impact



595 peer reviewed PSD papers published from 2010 to 2014

PSD Median H-Index = 15

Strengthening NOAA's Future Science Directions

- Numerous PSD scientists contribute to NOAA, OAR, and ESRL strategic planning reports and science implementation plans
- PSD scientists **chaired or co-chaired four of the six NOAA Science Challenge Workshops**
- PSD **hosted three of the NOAA Science Challenge Workshops**

Strengthening NOAA Science

*Findings from the NOAA Science Workshop
April 20-22, 2010*



Co-Chairs: Dr. Paul Sandifer and Dr. Randall Dole
Prepared by the NOAA Science Workshop Program Committee

Toward Understanding and Predicting Regional Climate Variations and Change

*Findings from the NOAA Science Challenge Workshop
September 20-22, 2011*



Understanding the Water Cycle

Findings from NOAA's Water Cycle Science Challenge Workshop

28 August – 1 September 2011, NOAA Earth System Research Laboratory, Boulder, Colorado



28 September 2012

Predicting Arctic Weather and Climate and Related Impacts

Status and Requirements for Progress



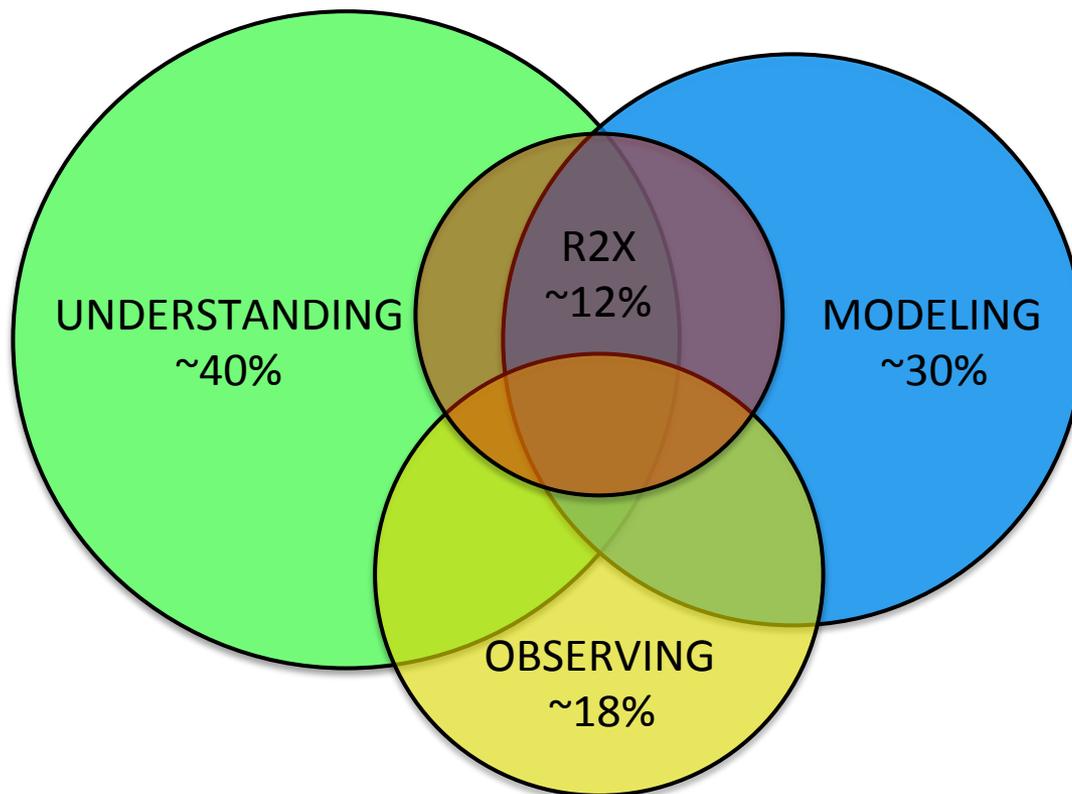
Findings from the NOAA Science Challenge Workshop

May 13-15, 2014
NOAA Earth System Research Laboratory
Boulder, Colorado



PSD Review Research Themes

Allocation of PSD resources as a function of research theme



R2X = Research to Applications/Operations/Services

Research Theme: Observing the Physical System

Observations are critical for monitoring, analyzing, interpreting, and predicting atmospheric, oceanic, cryospheric, and land surface processes

- PSD has expertise in the design, testing, deployment, and maintenance of *in situ* and remote sensing observing systems.
- PSD collects high-quality observations of boundary and surface layer fluxes between and among the ocean, atmosphere, sea-ice, and land.
- PSD makes strategic use of observations to advance understanding of physical processes controlling high-impact extreme weather and climate.
- PSD applies advances in observation-based scientific understanding to guide development of physical process-based parameterizations to improve global and regional forecast models.

Research Theme: Understanding the Physical System

An integrated understanding of weather and climate processes is essential to improve the environmental intelligence NOAA delivers to the nation.

- PSD describes, interprets, and assesses the predictability of weather, climate, and water variations and trends across time scales.
- PSD applies innovative diagnostic methods to detect, understand, explain, and predict extreme events, and trends.
- Understanding how weather and climate conditions are currently being impacted and may be affected in the future is critical to identify prospects for improved forecasts and projections.
- PSD's diagnostic explanations are vital to inform policy, planning, and decision making in the management of current and future risks.

Research Theme: Modeling the Physical System

Numerical modeling transforms observations and process understanding into diagnostic and predictive capabilities.

- PSD develops and applies data assimilation systems to advance analysis, forecast, and prediction capabilities.
- PSD advances the scientific basis to improve global and regional forecast and prediction modeling systems.
- PSD explores pre- and post- processing and parameterization development to advance forecast and prediction capabilities.
- PSD's modeling research is critical to better diagnose and predict variations in climate, weather, oceans, and coasts.

Research Theme: Research to Applications/Operations/Services

The transition of research to applications, operations and services is fundamental to ensure the best available science is being applied to support NOAA mission responsibilities.

- PSD works closely with the NOAA service line offices (NWS, NMFS, NOS, NESDIS) and external partners to accelerate the transfer of research advances into operational settings, and as information in policy, planning, and decision making.
- PSD conducts research on how stakeholders use weather, climate, and water information to assess what is needed for the information to be useable and actionable.

PSD Research: Future Plans

- Continue the science PSD is uniquely recognized for.
- PSD Strategic Planning Process.

Pursue compelling science questions:

- Should trends in days 3-10 skill be expected to continue or are there limits to predictability?
- Should similar skill behavior be expected across NOAA's vision of a seamless suite of weather and climate forecasts, outlooks and projections?

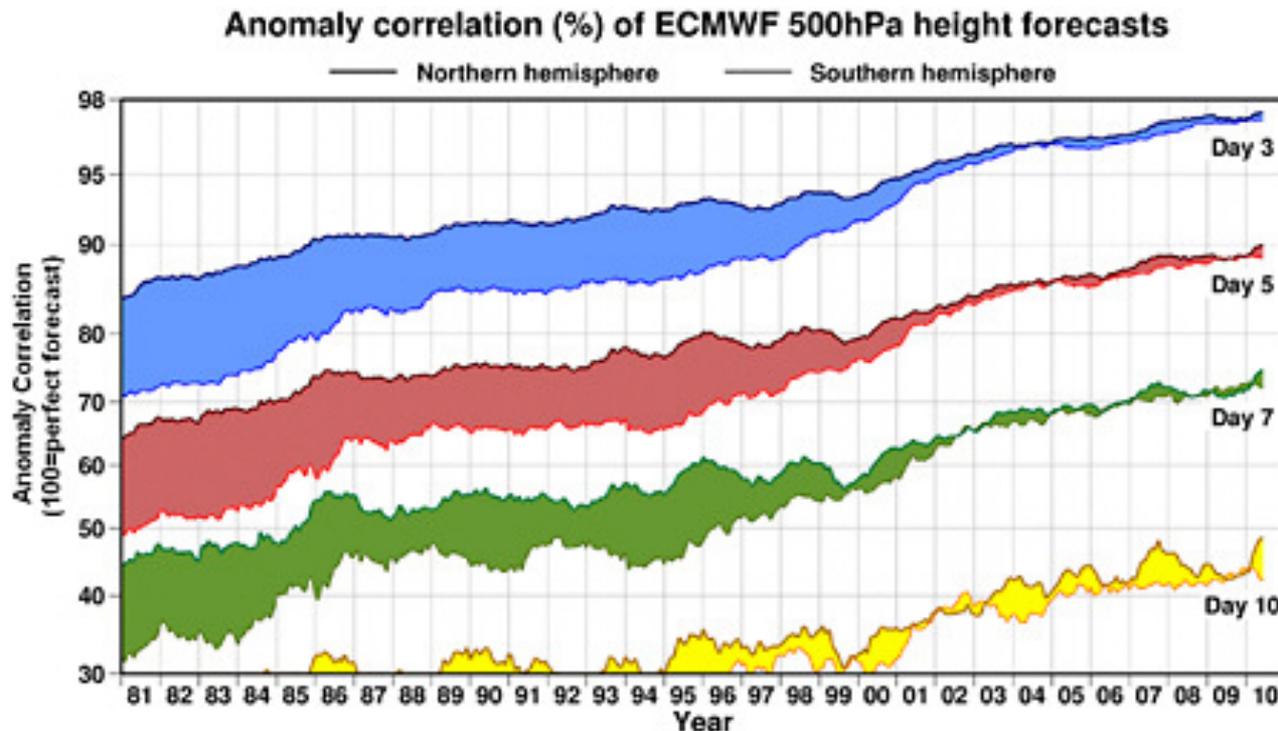


Figure from National Research Council Report (2010). Assessment of Intraseasonal to Interannual Climate Prediction and Predictability

Structure for the Public Part of Review

- Overview of Strategic Planning
- Eight oral sessions (2 for each research theme) – an overview, ~4 ten minute talks each with 5 minutes for clarifying questions, a summary wrap up, and a question and answer discussion.
- Three presentations of web-based research capabilities during breaks
- Two poster sessions

Thanks and Recognition

- ✧ Barb Deluisi, Rich Lataitis, Brian Gorton, Randy Dole
- ✧ Lisa Darby, Janet Intrieri, Cathy Smith
- ✧ Rita Lombardi, Babs Herrli, Shawn Dowd
- ✧ Alex McColl, Nick Wilde, Chesley McColl
- ✧ Mike Uhart, Mary Ann Whitcomb, Bridget Seegers
- ✧ The entire Physical Sciences Division Staff
- ✧ The PSD 2015 Review Panel