

PARTNERSHIPS IN SUPPORT OF HURRICANE RESEARCH

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Outline

- AGS organization and support for TC research
- AGS mission and position
- Possible future opportunities
 - NSF's Hazards SEES (CaMRA) and NOAA's Weather Ready Nation
 - NSF-NOAA Visiting Scientist Program
 - National Ensemble Project

The Challenges for the Geosciences

- 1) Understanding and forecasting the behavior of a complex and evolving Earth System
- 2) Reducing vulnerability and sustaining life
- 3) Growing the geosciences workforce of the future

NSF Geosciences Directorate

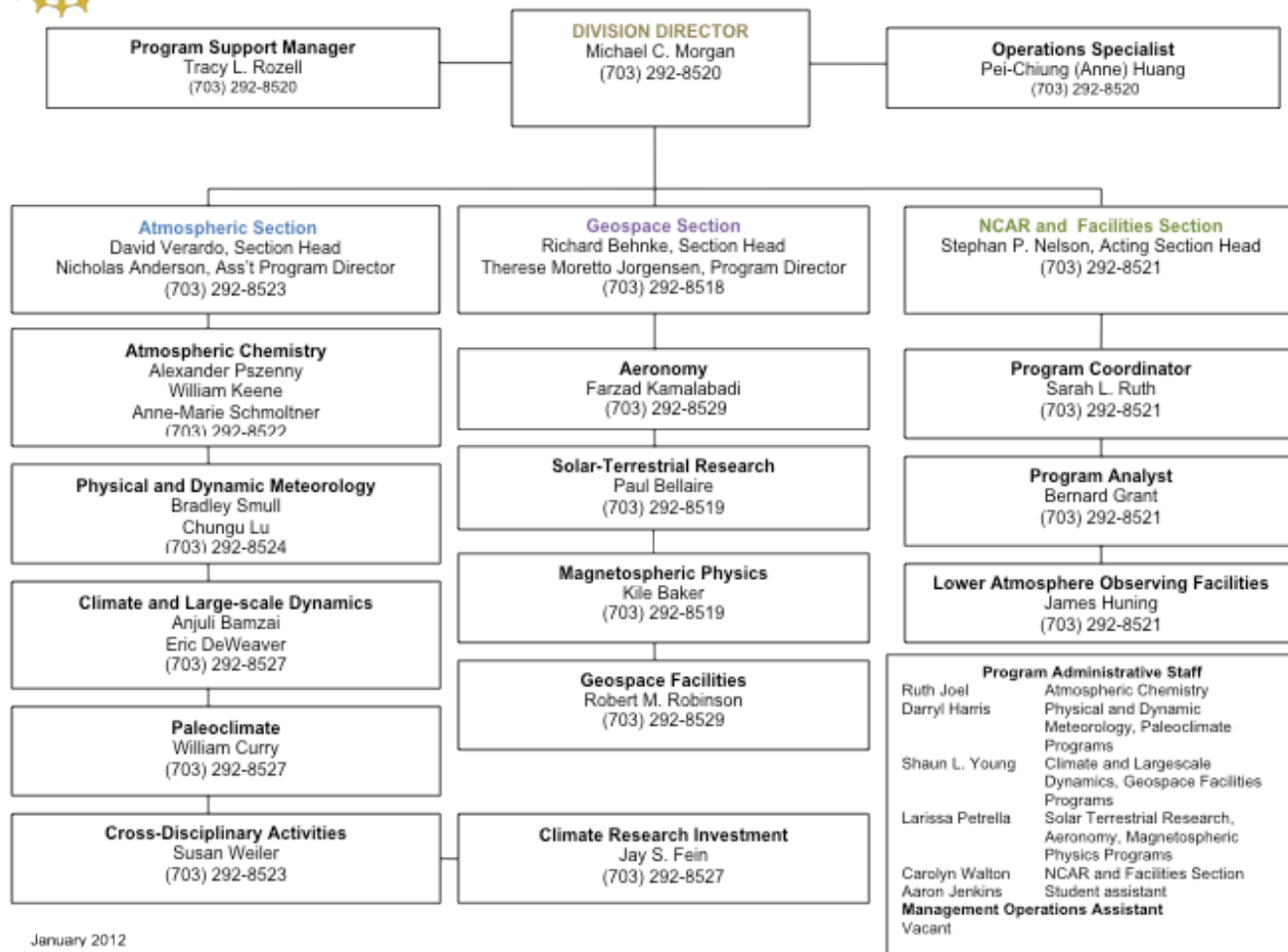
Earth Sciences

Atmospheric and Geospace Sciences

Ocean Sciences

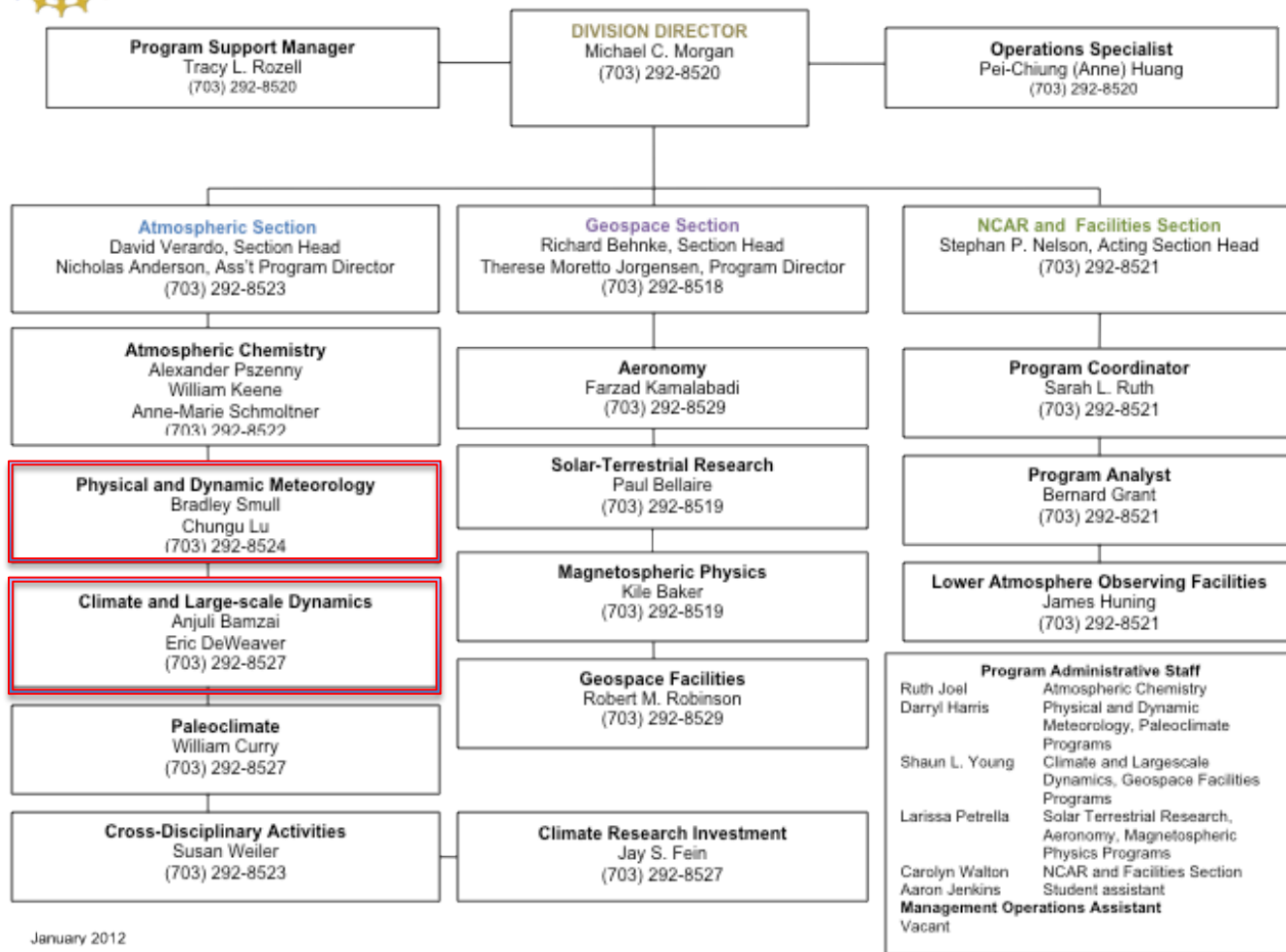


DIVISION OF ATMOSPHERIC AND GEOSPACE SCIENCES





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Physical and Dynamic Meteorology (PDM)

- PDM has traditionally supported a spectrum of research in:
 - Aerosols, nucleation & cloud physics (laboratory + field)
 - Atmospheric radiative processes
 - Boundary layer, energy transfer, land-surface/**air-sea exchange measurements & their parameterization**
 - Storm kinematics/dynamics & precipitation processes at scales from individual clouds (e.g., tornadic/supercell thunderstorms)
→ **“large mesoscale”** (e.g., TCs)
 - Atmospheric electricity/lightning; global circuit; TLEs/TGFs
 - Tropospheric gravity waves & turbulence
 - **Atmos. modeling/predictability studies for all the above**
 - **Development of select new observing techniques**



Largest PDM Investment Areas (FY08-11)

Tornadoes/Tornadic Storms & MCS Studies	20% ~Level*
Cloud Physics & Aerosols	16% Trend: Upward
PBL & Sfc-exchange/ Urban Processes	13% Trend: Upward
Tropical Cyclones & Tropical Meteorology	11% ~Level
Cloud Electrification & Lightning; Global Circuit	11% ~Level
Instrumentation & Observational Tech.	8% ~Level
Assorted Add'l Categories (e.g., Orographic Processes, Winter Storms, Radiation, etc.)	21%



Climate and Large-scale Dynamics (CLD)

- CLD has traditionally supported a spectrum of research in:
 - General circulation of the stratosphere and troposphere;
 - Synoptic to global scale weather phenomena;
 - Processes that govern mean climate, climate variability, and climate change;
 - Development and testing of physical parameterizations for use in large-scale weather and climate models;
 - Data assimilation;
 - Proof-of-concept studies for new, innovative climate observations.

Mission of AGS

To extend intellectual frontiers in atmospheric and geospace sciences by making responsible investments in fundamental research, technology development, and education that enable discoveries, nurture a vibrant, diverse scientific workforce, and help attain a prosperous and sustainable future.

AGS Infrastructure Investments

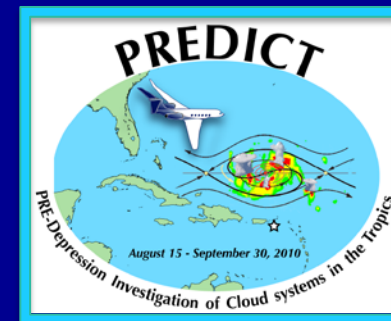


NSF's investments in building capacity

- Support for students, post-docs, and faculty through unsolicited and solicited proposals, and NCAR
- Support for undergraduates (REUs)
- Support for graduate students (GRFs)
- Support for post-doctoral researchers (PRFs)
- Support for early career faculty (CAREER)

NSF in the field

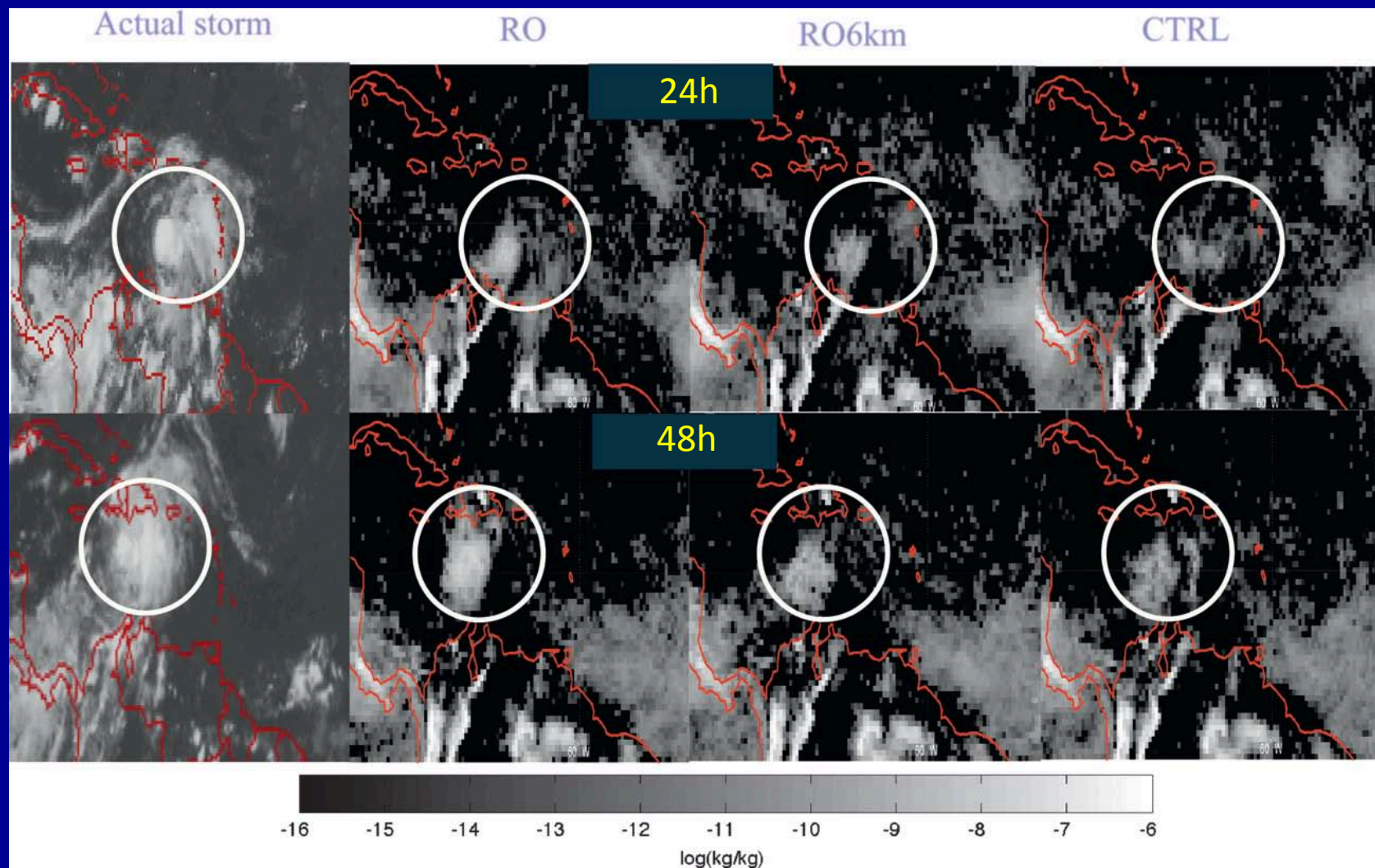
- Tropical Experiment in Mexico (TEXMEX), 1991 (genesis)
- Hurricane Rainband and Intensity Change Experiment (RAINEX), 2005 (intensity change)
- Pre-Depression Investigation of Cloud-Systems in the Tropics (PREDICT), 2010 (genesis)



Assimilation of COSMIC GPS/RO observations

Ernesto (2006)

Ensemble mean total column cloud liquid water concentration



. . . and a responsiveness to national priorities

AGS supports research activities that are consistent with or linked to *well-vetted, community-informed, national strategic science priorities.*



Guidance Relevant to National Priorities

- *Grand Challenges for Disaster Reduction* (National Science & Technology Council, 2005)
- *An Initial Inquiry into Meteorological Data Assimilation and Numerical Modeling Skills within the Federal Government* (FCM-R29-2010, 2010)
- *Strategic Guidance for the National Science Foundation's Support of the Atmospheric Sciences* (NRC/ National Academy Press, 2007)
- *Hurricane Warning: The Critical Need for a National Hurricane Research Initiative* (NSB, 2007)
- *Observing Weather and Climate From the Ground Up* (NRC/ National Academy Press, 2009)
- *When Weather Matters: Science and Service to Meet Critical Societal Needs* (NRC/ National Academy, 2010)

Possible future opportunities

- SEES-CaMRA and WRN
- NSF-NCEP sponsored Visitor Program
- University-based Nat'l Ensemble Program

SEES' Mission and Goals

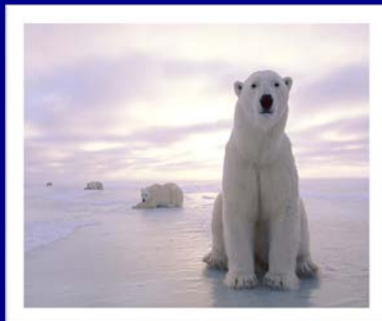
Mission Statement:

To advance science, engineering, and education to inform the societal actions needed for environmental and economic sustainability and sustainable human well-being

- **Goal 1:** Support interdisciplinary research and education that can facilitate the move towards global sustainability.
- **Goal 2:** Build linkages among existing projects and *partners* and add new participants **in the sustainability research enterprise.**
- **Goal 3:** Develop a workforce trained in the interdisciplinary scholarship **needed to understand and address the complex issues of sustainability.**

Proposed Future SEES Focus Areas

- Chemistry, Materials, Engineering
 - Renewable, non-toxic materials, process improvements
- Coastal and Arctic Regions
 - Vulnerability, resilience, cultural impacts
- Hazards and Disaster
 - Science, engineering, risk assessment, decision-making
- Information Science and Engineering
 - Energy consumption, clean computing issues



Hazards SEES (formerly SEES-CaMRA)

“Creating a More Disaster Resilient America”

- An interdisciplinary program involving several NSF Directorates - ENG, GEO, SBE, CISE, OCI, and MPS to catalyze basic research and education in hazard-related science, engineering, risk assessment, and decision making in order to improve prediction of natural hazards, mitigate their effects, and prepare communities to respond to, and recover from disasters.
- Consistent with some of the objectives of NOAA’s “Weather Ready Nation”

Possible future opportunities

- SEES- CaMRA and WRN
- NSF-NCEP sponsored Visitor Program
- University-based Nat'l Ensemble Program

NSF-NCEP sponsored Visitor Program

- **Goal:** To foster a closer cooperation between NCEP and the university community on problems relevant to NCEP's mission requiring access to NCEP models
- **Outcome:** Support for joint research projects that contribute to advancing fundamental research in NWP and data assimilation, while also contributing to the improvement of NCEP models and data assimilation systems

Possible future opportunities

- Hazards SEES (aka SEES: CaMRA)
- NSF-NCEP sponsored Visitor Program
- **University-based Nat'l Ensemble Program**

University-based ensemble

- Several hundred ensemble members possible
- Ensemble members consists of NSF, NOAA, and university supported NWP models run on the same domain using the same initial conditions
- Harnesses computing resources at colleges and universities at least once a day
- Model output is transferred via Unidata's LDM to a central data server
- Analyses of record are created each run
- Resulting data set made available to the entire community for research and education

University-based ensemble

- “Quasi-operational” model runs available to NWS, public, private sector
- Model improvement
- Ensemble modeling
- Conveying uncertainty
- NWP and data assimilation
- Community engagement
- Virtual field campaigns
 - Run high-resolution ensembles for “cases of interest” (IMP’s)
 - Work with local NWS and regional offices to support their use of output
 - Work with emergency managers and related interests to assess utility of this data for broader purposes
 - Use social networks to bring communities together to discuss scenarios and plan for significant events

Is there a compelling science interest in such an ensemble and the associated analyses and tools?