The EMC/MMM/DTC Joint Hurricane Workshop and WRF Tutorial for Hurricanes

Office of the Federal Coordinator for Meteorological Services and Supporting Research (OFCM)

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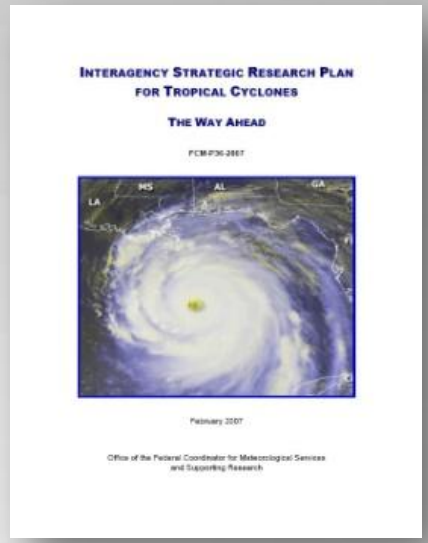
Hurricane-Related Coordination Activities

- **Interdepartmental Hurricane Conference (IHC)**
  - **Annually hosts IHC to educate attendees on the status and future plans of the Nation's hurricane forecasting and warning program**
  - **Provides a forum for the responsible Federal agencies to review Nation's hurricane forecasting and warning program and to make recommendations on how to improve the program in the future**
  - **During the IHC, the OFCM-sponsored Working Group for Hurricane and Winter Storms Operations and Research (WG/HWSOR) meets**
    - **Reviews submitted action items regarding the hurricane program, including recommended changes to the National Hurricane Operations Plan (NHOP)**
    - **Applicable new approved procedures and agreements are then documented for implementation in the NHOP**
    - **NHOP published annually prior to the upcoming hurricane season**

Hurricane-Related Coordination Activities

- ***Interagency Strategic Research Plan for Tropical Cyclones: The Way Ahead (Feb 2007)***
  - **Culmination of working action item from 2004 IHC**
  - **Underpinning of NOAA's Hurricane Forecast Improvement Project (HFIP)**
  - **Table 6-2, Recommendation #2:**
    - **Monitor and update the operational priorities of tropical cyclone forecast and warning centers**
    - **Monitor and update research needs**
    - **Develop multiagency research implementation strategy to address all research needs**



Hurricane-Related Coordination Activities

- **Formed new Working Group for Tropical Cyclone Research (WG/TCR) to address recommendation #2, with objectives / tasks of:**
  - **Monitor and update the operational priorities of the tropical cyclone forecast and warning centers (Table 1) and the TC research needs (Table 2)**
  - **Map agency meteorological TC research efforts against TC research needs and operational priorities**
  - **Analyze results**
  - **Update information at IHC**
  - **Publish results & analysis of agency research**

Table 1: Ops Priorities

NHC & CPHC Priority[1]	JTWC Priority[1]	Operational Need[1]	Linkage to Research Needs
1	1	Guidance for tropical cyclone intensity change, with highest priority on the onset, duration, and magnitude of rapid intensification events. Similar guidance is also needed on when rapid over-water weakening (such as had been observed in recent Gulf of Mexico hurricanes) will occur.	A1a-f, B1, B2, B3a-e, B6, B7
2	2	Improved capability to observe the tropical cyclone and its environment to support forecaster analysis and model initialization.	B1, C1-C3
3	5	Statistically-based real-time guidance on guidance for track, intensity and precipitation (e.g., multi-model consensus approaches), provided to forecasters in probabilistic and other formats.	B5,B6
4	6	Enhancements to the operational environment to increase forecaster efficiency, by expediting analysis, forecast, coordination, and/or communication activities.	C1c
5	7	Additional operational guidance on coastal inundation (e.g., storm surge and waves).	A4, A5, B2, B3, B6
6	8	Improved and extended track guidance. Identification, and then reduction of, the occurrence of guidance and official track outliers, focusing on both large speed errors (e.g., accelerating recurvers and stalling storms) and large direction errors (e.g., loops), and on specific forecast problems, including interactions between upper-level troughs and tropical cyclones, track forecasts near mountainous areas, and extratropical transition.	A2, B1-B3, B5-B6
7	3	Guidance for tropical cyclone genesis that exhibits a high probability of detection and a low false alarm rate, and/or provides probability of genesis.	A3, B1-B3, B5-B7
8	9	Operational analysis of the surface wind field (including maximum sustained winds) in tropical cyclones. This also includes methods for forecasting the wind field over elevated terrain and high-rise buildings.	B1, B2, C1-C3
9	4	Guidance for changes in tropical cyclone size/wind structure and related parameters, including combined sea heights.	A1a-g, B1-B7
10	10	Guidance on the operational utility and relative merits of high-resolution model output compared to lower resolution ensemble model output.	B6, B7
11	11	Guidance for tropical cyclone precipitation amount and distribution.	A4, B1-B7
12	12	Improved utility of microwave satellite and radar data in tropical cyclone analysis.	B1, C1c
13	13	Improved techniques for estimating the intensity of tropical cyclones passing over and north of sea-surface temperature gradients (e.g., in the eastern North Pacific Ocean and the Atlantic Gulf Stream).	C1
14	14	Quantitative guidance tools for seasonal tropical cyclone forecasts for the Atlantic and North Pacific basins, using statistical and/or dynamical methodologies.	A6,B2, B6

Table 1 Ops Priorities of NHC / CPHC and JTWC

Ops Priorities Linked to Research Needs (right column) (Research Needs are in Table 2)

Table 2: Tropical Cyclone Research Needs

Table 2: Research Needs

(A. General Research B. Model Develpment C. Obs / Obs Strategies)

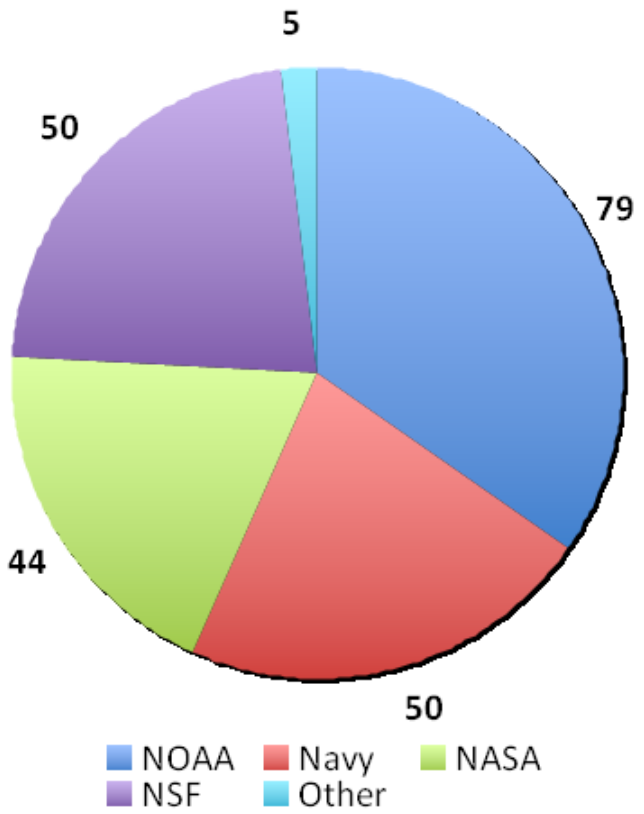
Research Topics	Type of Research B = Basic; A =Applied
A. General Research	
1. Intensity and Structure Changes. a. Environmental scale processes (e.g., dry air, midlevel easterly jet, and suspended mineral dust from Saharan Air Layer; vertical shear of horizontal wind; easterly wave disturbance; TUTT and monsoon trough influences). b Vortex scale processes (e.g., eyewall replacement and rainband development, vortex mixing and resilience). c. Convective scale processes (e.g., convective bursts, vortical hot towers). d. Turbulent and microphysical scales (e.g., momentum and enthalpy fluxes; cloud microphysics; radiation; e. Upper ocean processes and structure (e.g., oceanic heat content; currents; waves; SST; mesoscale features). f. Landfall effects (e.g., surface flux changes; topographic and land surface effects). g. Extratropical transition. h. Predictability limits.	B,A
2. Track. a. Convective and vortex structure (e.g., asymmetries) b. Land interaction. c. Multi-vortex interactions. d. Predictability limits.	B,A
3. Tropical cyclone formation. a. Convective processes. b. Mesoscale processes (e.g., stratiform precipitation, vorticity structure). c. Environmental processes. d. Tropical transition.	B,A
4. Precipitation. a. Environmental interaction. b. Microphysical processes (hydrometeor production and conversion, fallout, aerosol impacts). c. Topographic effects.	B,A
5. Coastal and inland inundation (i.e., surge, waves, flooding). a. Surge wave and ocean bottom interaction. b. Wave breaking and set up.	B,A
6. Predictability of seasonal tropical cyclone activity.	B,A

Research Topics	Type of Research B = Basic; A =Applied
B. Model Development Topics	
1. Data assimilation (e.g., technical approach, high resolution data, new data sources/instrument, vortex initialization, atmosphere and ocean initialization; techniques to evaluate the uncertainty and representativeness of observations and use of observations for initializing NWP models).	A
2. Global and regional model development/improvements (e.g., resolution, nesting, coupling to ocean; coupling with hydrology/inundation models).	A
3. Relative importance of physical processes in global and regional models on track, intensity and structure, and precipitation. a. Atmosphere-ocean boundary layer for coupled air-sea-wave problem; momentum (wave-induced drag) and enthalpy fluxes (sea spray complexity). b. Upper ocean processes and structure (e.g., oceanic heat content; currents; waves; SST; mesoscale features). c. Land surface coupling: sensitivity of Land Surface Model, radiation. d. Microphysical processes (e.g., hydrometeor production and conversion, fallout, aerosol impacts, radiation). e. Convective processes (e.g., latent heating, momentum transfer, mixing).	B, A
4. Verification for three dimensional, high-resolution regional models for all phases of the tropical cyclone life cycle; varying atmosphere/ocean environment.	A
5. Diagnostic techniques to further increase the utility of global and regional models in forecasting tropical cyclone track, intensity structure, precipitation, and genesis.	A
6. Development of advanced, probabilistic guidance (e.g., ensembles); optimal ensemble construction and configuration; value of high-resolution deterministic forecasts vs. ensembles.	A
7. Studies to optimize resolution and scale dependent parameterization.	B, A
C. Observations and Observing Strategies	
1. Observing strategies/capabilities to improve analyses and forecasts of tropical cyclones (e.g., formation, track, intensity, structure, inundation). a. Where to take observations for initialization of tropical cyclone vortex and environment. b. Alternatives and tradeoffs for observing tropical cyclone and their environment (OSE, OSSE, cost/benefit). c. Information systems (e.g., data fusion, visualization).	A
2. Required observations to support model diagnostics and verification (e.g., IFEX, TCS-08, CAMEX III/IV. TCSP, RAINEX, NAMMA).	A
3. New and/or improved observational technologies.	B,A

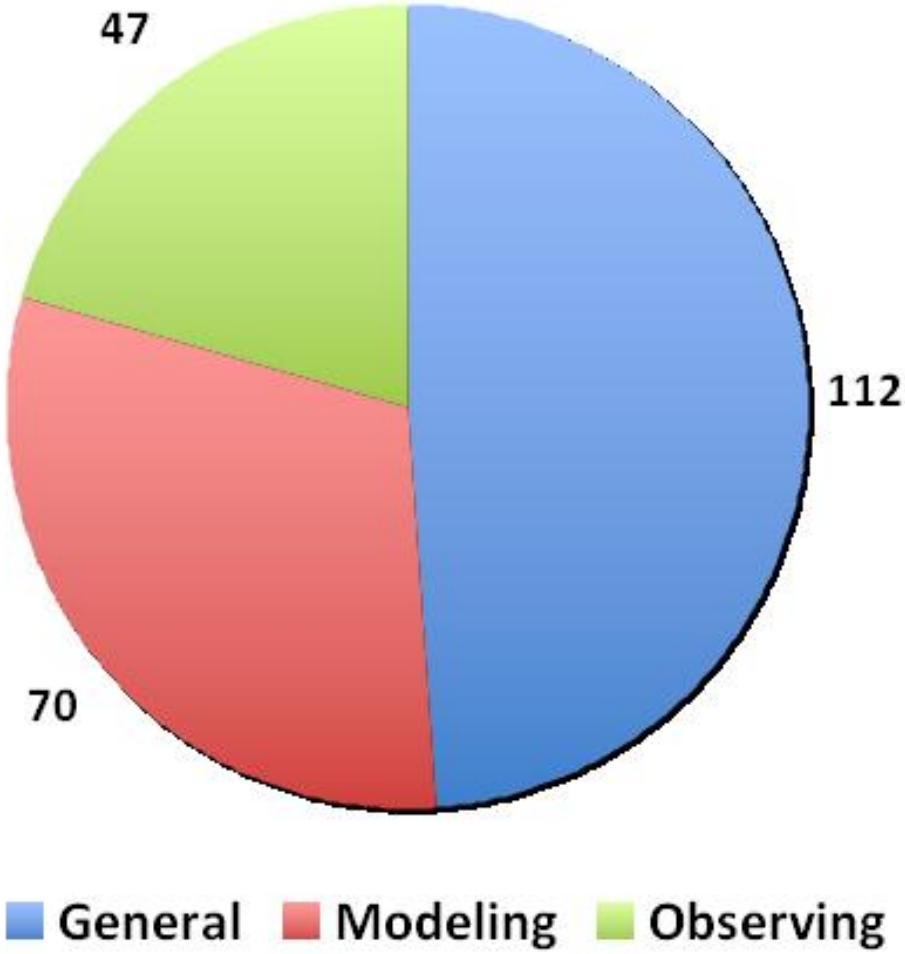
Tropical Cyclone R & D

2008 / 2009 Snapshot

Total Man-Years: 228

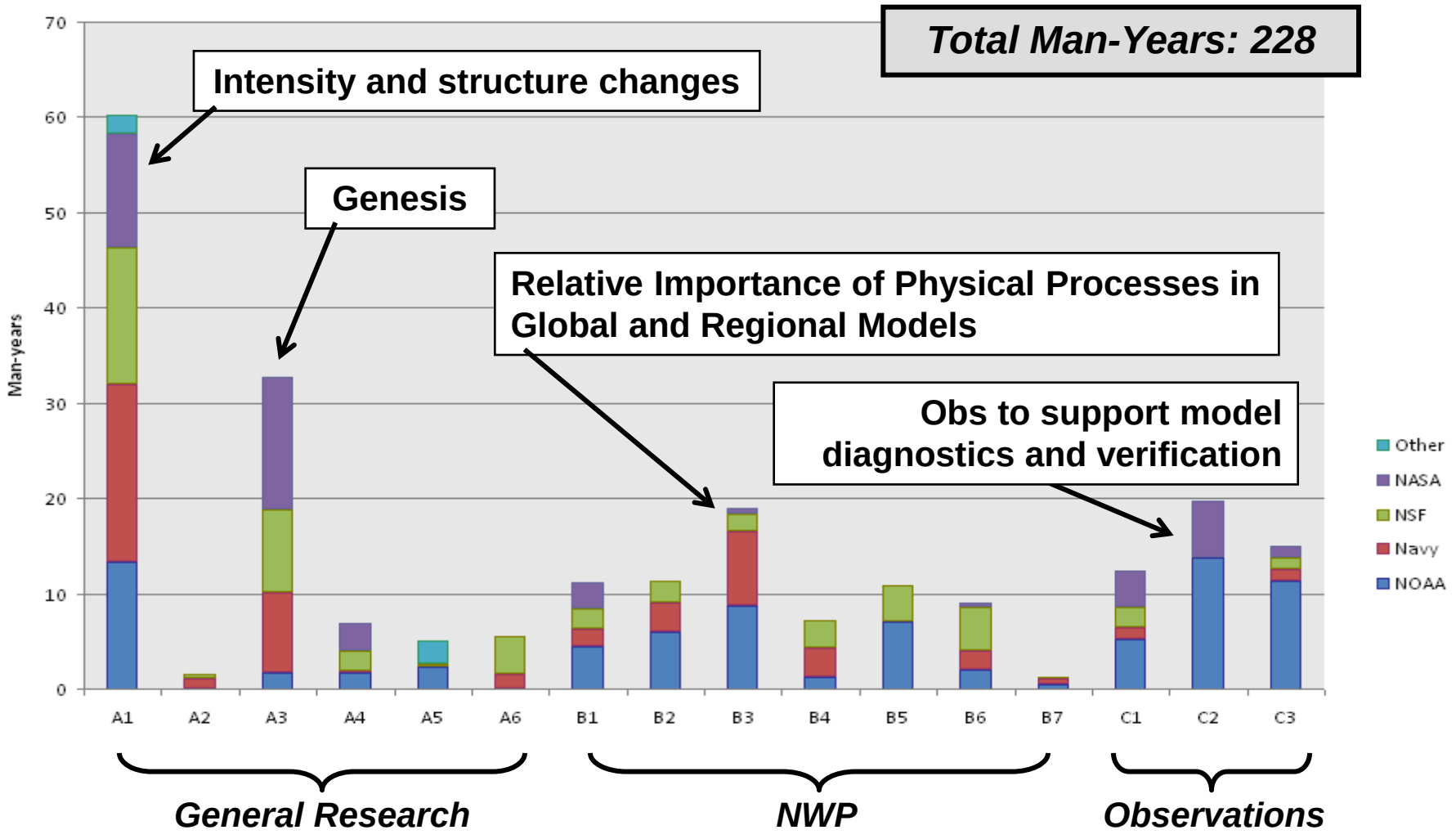


Combined Man-Years vs. Research Category



Tropical Cyclone R & D

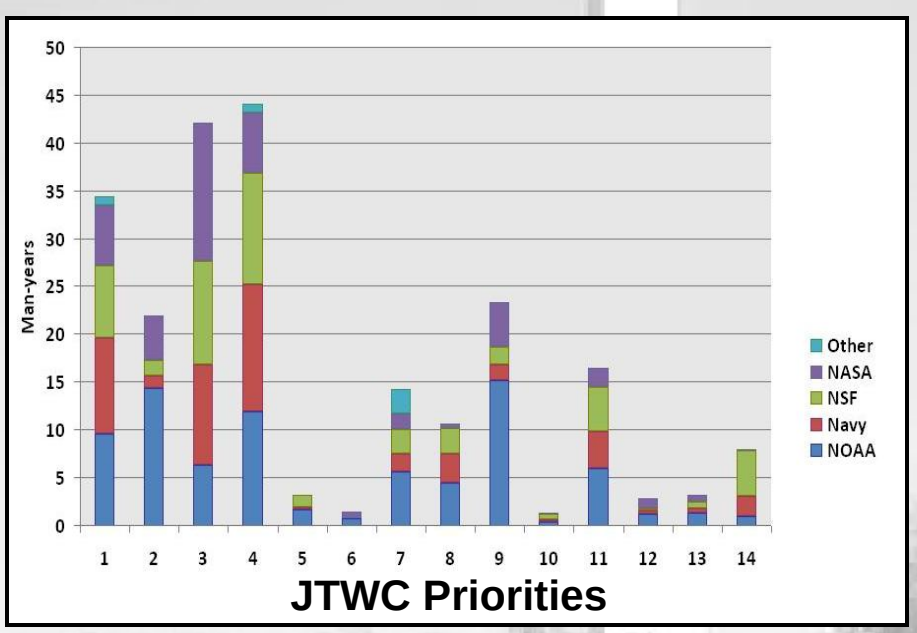
TC R&D (by Man-Years) Conducted in Each Research Category (from Table 2)

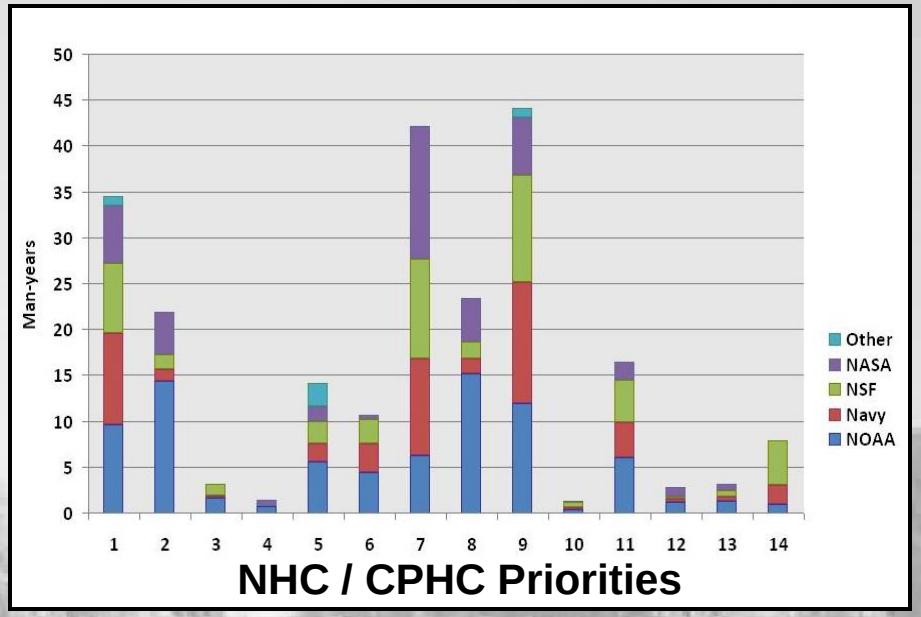


Note: "Other" is USACE, DOI/MMS, DHS S&T

Tropical Cyclone R & D

TC R&D Mapped to Operational Priorities (from Table 1)





Tropical Cyclone R & D

- **Current research mostly aligned with ops priorities**
  - **# 1 operational priority for NHC / CPHC / JTWC: <u>intensity change</u>**
    - **National effort focused on #1 priority: 35% of research toward intensity and structure changes**
  - **Little emphasis on forecaster aids and "guidance on guidance"**
- **Further results of the interagency TC R&D analysis will be presented at 64th IHC**
  - **64th IHC: Savannah, GA, March 1-4, 2010**

Summary

- Provided examples of recent Federal coordination activities relating to hurricanes
- OFCM is
  - A central touchstone for assessing needs, identifying requirements, developing strategies and implementation plans, and coordinating execution across the federal government's meteorological services and supporting research enterprise
  - Experienced at developing needs from the bottom up
  - Experienced at building and sustaining consensus and collaboration to improve efficiency and effectiveness
  - Committed to interagency cooperation
  - Reliant on a degree of independence to act as an honest broker among the agencies and offices of the coordinating infrastructure
  - A recognized successful interagency facilitator

Engages Agencies to Help Resolve Differences, Work Issues, Find Common Thread

Backups

Mission

To ensure the effective use of federal meteorological resources by leading the systematic coordination of *operational weather requirements, services, and supporting research,* among the 15 stakeholding federal agencies and offices.

High-Level Focus:

- **Needs, issues, and problems**
- **Leveraging partnerships and collaboration**
- **Studies, reports, plans, and handbooks**
- **Crosscut reviews, assessments, and analyses**

Background

- **1964: OFCM formed in response to Public Law 87-843**
  - **OMB Circular A-62 established framework and responsibilities**
  - **Department of Commerce Implementation Plan established OFCM and coordinating infrastructure**
  - **Today: Department Organizational Order 25-5**
- **1980: GAO study revitalizes OFCM**
  - **Independent function with full-time staff**
- **1985: DOC IG reviewed OFCM and made two specific recommendations, directing OFCM to:**
  - **Perform crosscut studies to review agency weather programs and requirements**
  - **Document OFCM studies; make information available to interested parties in the decision-making and budgeting processes**

Partners

Departments of:

- Energy
- Agriculture
- Commerce
- Defense
- Homeland Security
  - Science & Technology
  - FEMA
  - Coast Guard
- Interior
- State
- Transportation

Independent agencies:

- Environmental Protection Agency
- National Aeronautics and Space Administration
- National Science Foundation
- National Transportation Safety Board
- Nuclear Regulatory Commission

Executive Office of the President:

- Office of Management and Budget
- Office of Science and Technology Policy

Affiliations

National Research Council (NRC)
- Board on Atmospheric Sciences and Climate (BASC)
- Climate Research Committee (CRC)

University Corp. for Atmospheric Research (UCAR)

National Science Foundation's National Science Board

American Geophysical Union (AGU)

National Center for Atmospheric Research (NCAR)

American Meteorological Society (AMS)

US Global Change Research Program (USGCRP)

National Science and Technology Council (NSTC)
- Committee on the Environment and Natural Resources (CENR)
  - Subcommittee on Disaster Reduction (SDR)
  - Subcommittee on Air Quality Research
  - Subcommittee on Earth Observations (USGEO)
  - Subcommittee on Global Change Research