



NUOPC

NATIONAL UNIFIED OPERATIONAL PREDICTION CAPABILITY

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NUMERICAL WEATHER PREDICTION AND EARTH SYSTEM PREDICTION TO BETTER UNDERSTAND SEA LEVEL RISE/COASTAL ISSUES AS THEY AFFECT READINESS

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Vision

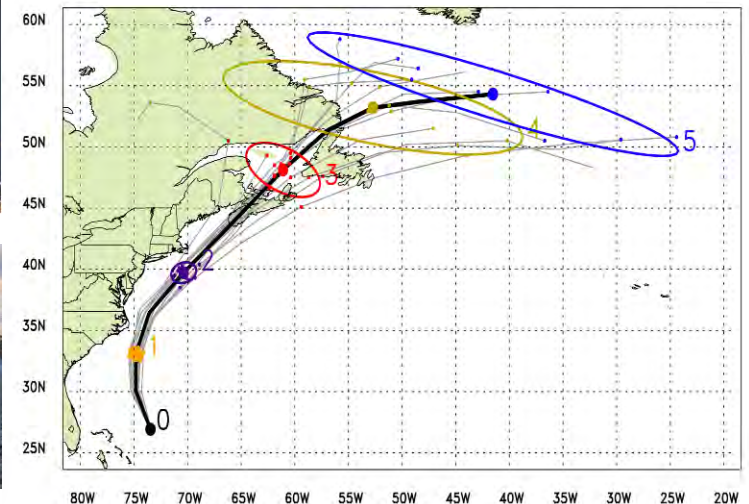
The Future US National Global Prediction System

Managed in the national interest meeting the national need for better forecast guidance and built on:

- partnering of responsible Federal agencies
- common modeling framework linking operations, research and the Federal partners
- common R&D agenda guiding future development.



Example of probabilistic hurricane track forecast based on ensembles and depicting forecast uncertainty



Growing National Need



- National Security and Defense
- Natural Disaster Preparedness
- Energy and Transportation
- Food Security
- Quantify climate change risks

U.S. must lead the way forward



Approach



- AF, Navy, and NOAA partnership to address common operational global NWP needs/requirements
- Managed multi-model ensemble system
- Accelerate transition of new technology to operations
- Common modeling architecture for interoperability
- National Research and Development Agenda



Challenges



- Creating a common modeling infrastructure
- Fostering a collaborative research environment
- Improving R2O and O2R
- Resources: computing, investment



Benefits



Improved capabilities to support agency missions measured by:

- Effective disaster prediction, preparation, response and mitigation
- More effective global military operations
- Less weather delay and disruption for air transportation
- Energy saved
- Improved efficiencies throughout the Nation's economy
- National response to changing climate
- Lives saved
- Dollars saved



Where We Are

- Well Established Tri-Agency Partnership
- Initial Operational Capability of National Unified Ensemble in January 2011
- Software architecture and interoperability standards part of latest release of the Earth System Modeling Framework.
- National R&D agenda for advancing global NWP presented to the American Meteorological Society Annual Meeting and to the Federal research funding agencies.



National Unified Ensemble

- IOC-1 January 2011
 - 3 models @ 1 degree output grid
 - 63 member ensemble
 - Common output format
 - Same forecast times
 - 73 common variables
- New products to support mission needs
- Tri-agency management committee to coordinate operations and plans

Common Model Architecture

- NUOPC Layer part of the Earth System Modeling Framework (ESMF)
- Agreed to interoperability standards implemented
- New areas being explored and standards developed
- Standards being implemented in many different modeling systems.

Operational Modeling Systems Implementing ESMF

- Global Forecast System (GFS)
- Global Ensemble Forecast System (GEFS)
- North American Mesoscale Model (NMM)
- Finite Element Icosahedral Model (FIM)
- NOAA Environmental Modeling System (NEMS)
- Global Assimilation of Ionospheric Measurements (HAF-GAIM)
- Weather Research and Forecasting Model (WRF)
- Land Information System (LIS)
- Naval Operational Global Atmospheric Prediction System (NOGAPS)
- Coupled Ocean Atmosphere Mesoscale Prediction System (COAMPS)
- Navy Coastal Ocean Model (NCOM)
- Hybrid Coordinate Ocean Model (HYCOM)
- Wave Watch 3 (WW3)
- Community Ice Code (CICE)
- Ensemble Forecast System (EFS)
- Simulating Waves Near Shore (SWAN)
- Advanced Circulation Model (ADCIRC)

National R&D Agenda

- Developed at Workshop fall 2010
- Published to community
- Workshop held for 1st focus area
 - User Products
- New initiatives underway supporting needs at Navy, NSF and NOAA

Future



Next Generation Prediction Capability

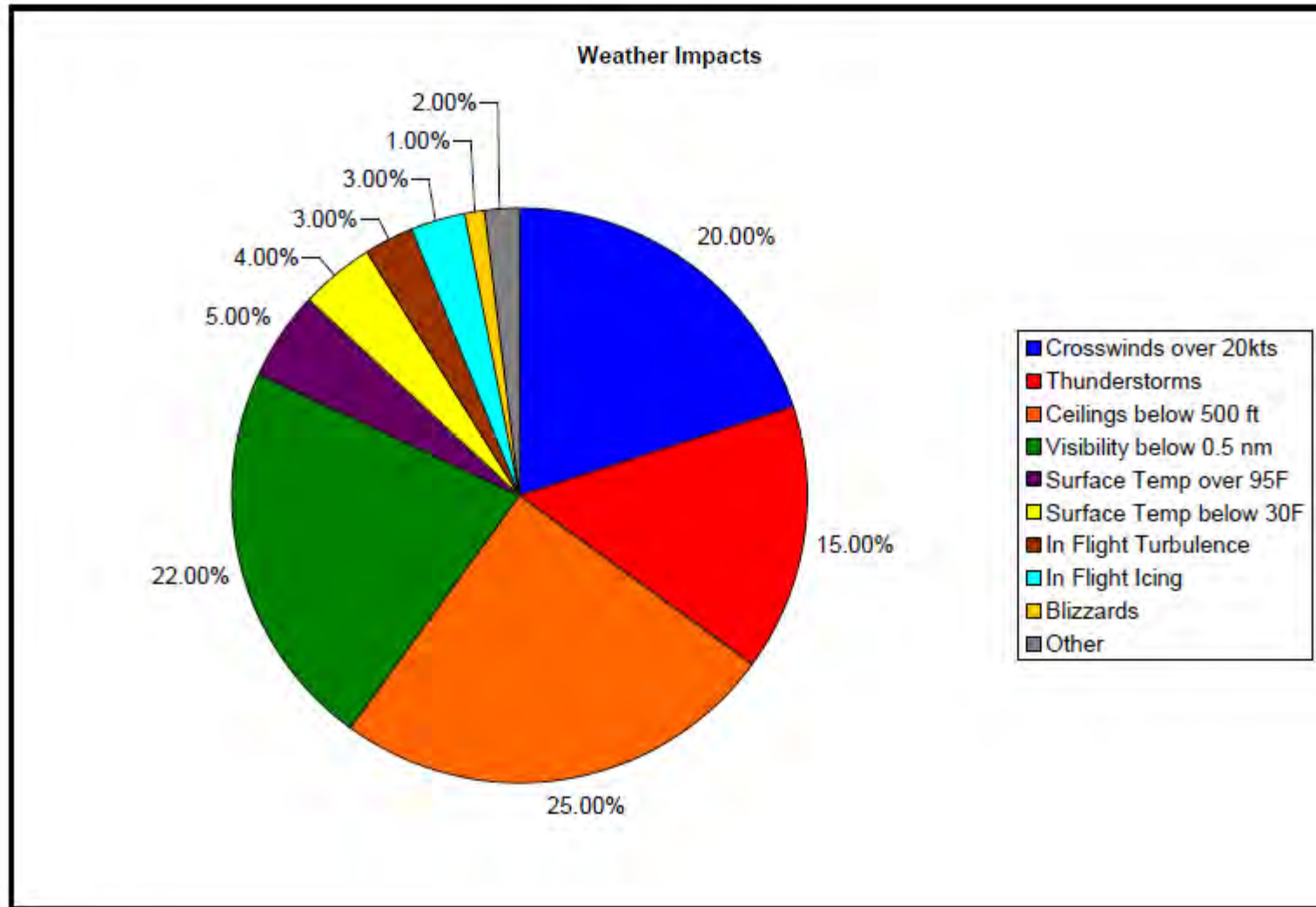
- New modeling techniques to improve predictive skill
- Exploit interoperability architecture for a fully coupled system: land, ocean, ice, wave, atmosphere, space, ecosystem.
- Exploit emerging computing capabilities
- Improved inter-annual to decadal predictions

Earth System Prediction Capability (ESPC)

Climate Change Impacts on DoD

- Risks to regional stability
 - Drought
 - Storms
 - Arctic
 - Sea Level
 - Perma frost
- Military preparedness
 - Equipment
 - Facilities
 - Training

Immediate Recognition for Where to Focus Resources



Weather Impact Distribution (example of a typical Air Force Base)

(Based on Capt Jeffrey C. Jarry, Analysis of Air Mobility Command Weather Missions Execution Forecasts: Metrics of Forecast Performance and Impacts on War Fighting Operations, thesis prepared for the Naval Postgraduate School, Monterey, CA, Apr 2005.)

Benefits: Air Space Management

- The total cost of domestic air traffic delays to the U.S. economy was as much as **\$41 billion** for 2007."
- Weather accounts for **70% of all air traffic delays** within the U.S. National Airspace System (NAS)
- **The Federal Aviation Administration (FAA) has determined two thirds of this is preventable with better weather information**
- "A key finding, based on an analysis of several 2005-2006 convective events, is that as much as **two-thirds** of the **weather related delay** is potentially **avoidable**¹."

- **\$19 Billion in Avoidable Costs**



Benefits: Improved Water Management

- Hydropower – **\$100M** with improved forecasts
- Improved River Commerce – **\$200M** efficiency gain
- Agriculture – **\$300M** with better balance between irrigation, regional water supply and fisheries
- Flooding Damage Reduction – **\$400M**

Annual Benefits exceeds \$1B

National Hurricane Forecast System

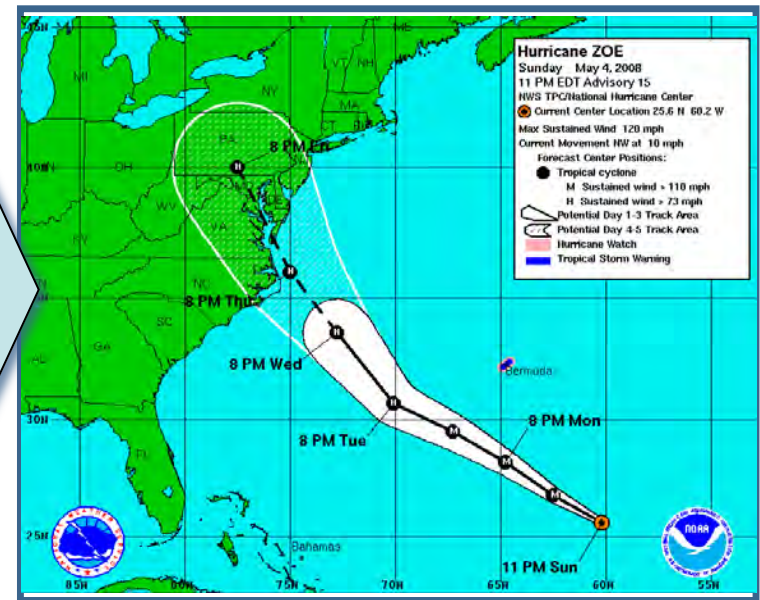
Goals

Track forecasting today



50%
reduced
forecast
errors

Track forecasting after HFIP
Improvements



- 50% improvements to hurricane track and intensity forecasts out to 7 days

- Reduce cone of uncertainty

Cost to the Nation for False Warnings

Inaccurate Track Forecast Costs

- Hurricane Charlie – 2004
 - Hurricane Floyd – 1999
- Forced major evacuations of areas not affected by the storm

Charlie Unnecessary Cost: \$380M

+

*Plus—loss of work and inconvenience...
will they leave next time?*

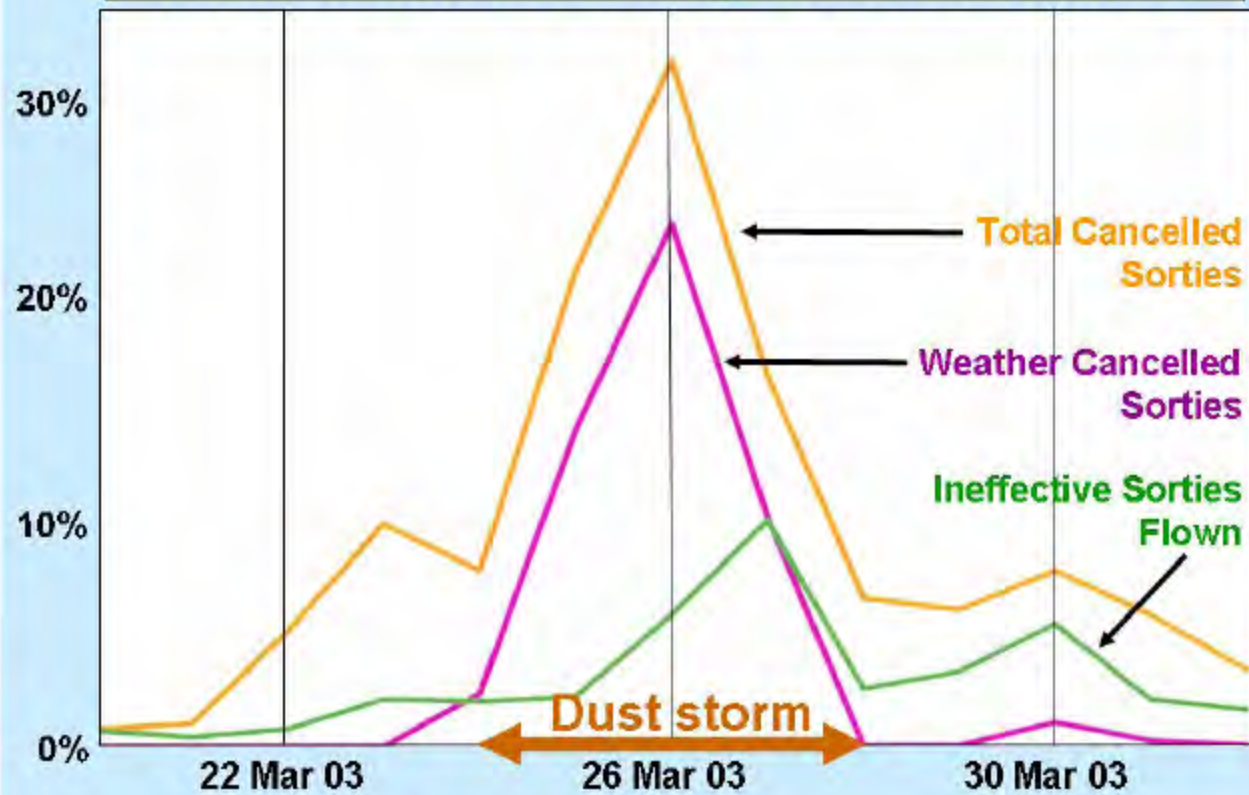
Inaccurate Intensity Forecasts Costs

- Wilma – 2005
- Lili – 2002

Neither Wilma's explosive intensification, nor Lili's rapid weakening just before landfall was forecast. Sub-optimal skill with rapid intensification changes lead to improper warnings, with significant economic consequences

Lili's Unnecessary Cost: \$225M

Preliminary Results: METOC Impacts on OIF Aviation Sortie Planning and Effectiveness



Cancelled Sorties during OIF Dust Storm

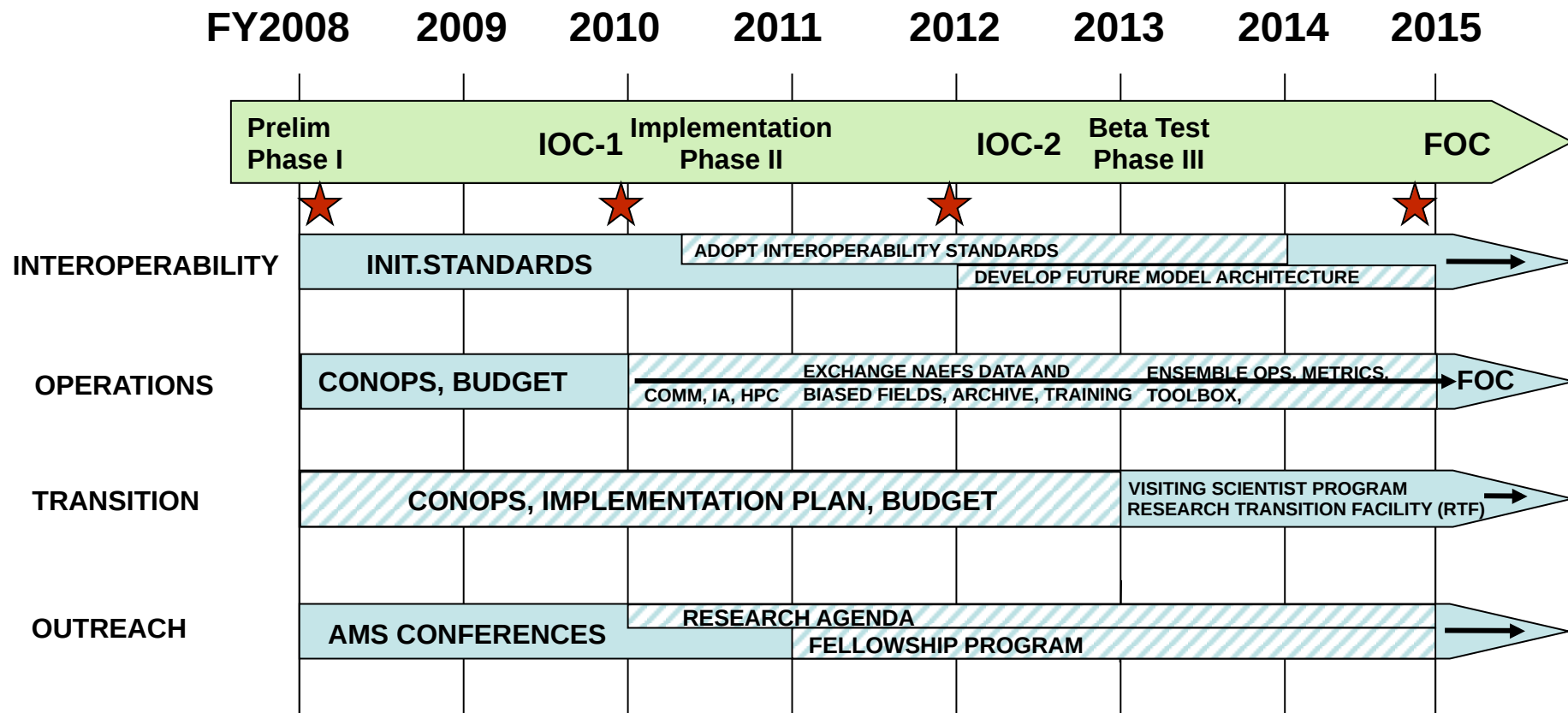
(Based on LCDR Jake Hinz, Tom Murphree, LCDR Brett Martin, LCDR Alex Cantu, and Carlyle Wash, Systems for analyzing METOC impacts on military operations, Briefing, Dept. of Meteorology, Naval Postgraduate School, 2004, slides 1-15; and, Prof Carlyle Wash, Meteorological requirements and contribution to 'sea strike', *Naval Postgraduate School Research*, Vol 14, No. 1, Feb 2004, pp 2-4.



QUESTIONS??

Backup Material

NUOPC Implementation Schedule



DECISION BRIEF TO PRINCIPALS

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