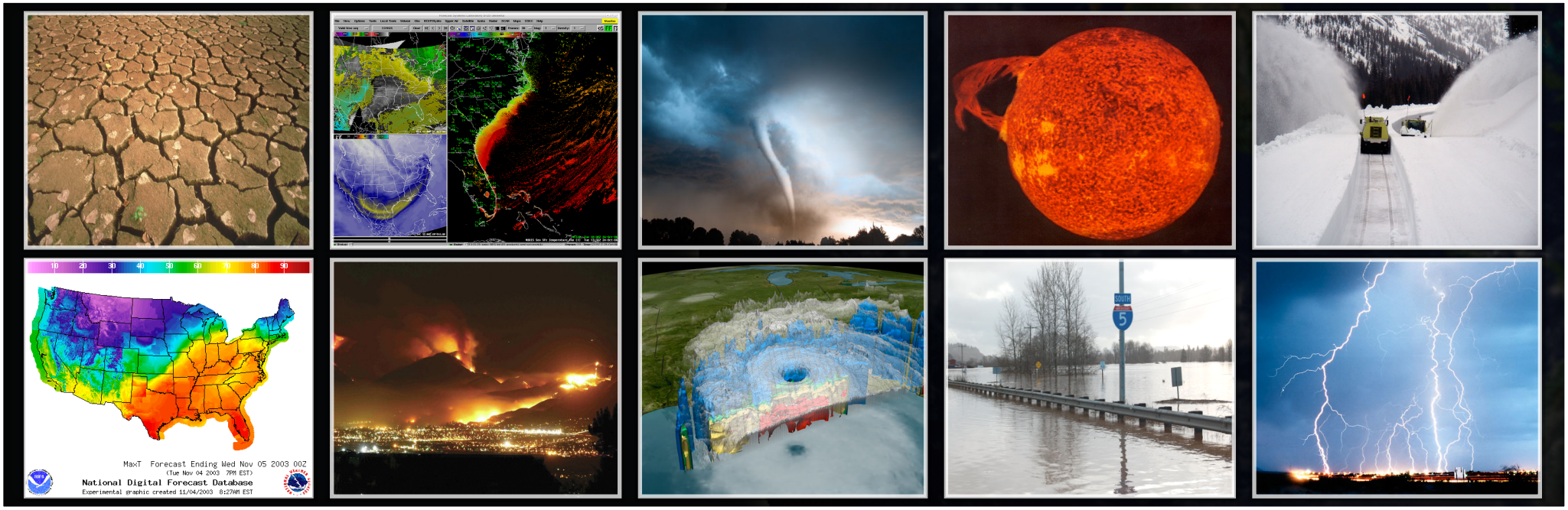
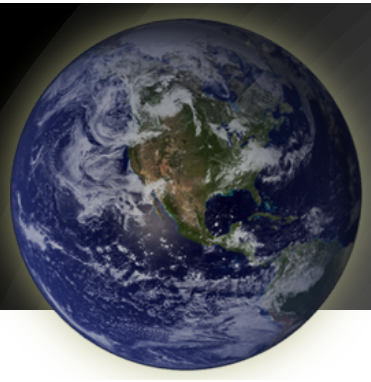
The NCEP Production Suite:

Big Data on Steroids…..



Dr. William M. Lapenta
Director, National Centers for Environmental Prediction
NOAA/National Weather Service
ADAPT/PSU Symposium
24 May 2016



Presentation Outline

- NWS and the Weather Ready Nation
- NCEP Production Suite
- Big Data: NWS and NOAA

NWS Strategic Outcome: A Weather-Ready Nation

- Becoming a Weather-Ready Nation is about building community resiliency in the face of increasing vulnerability to extreme weather, water & climate events

"Ready, Responsive, Resilient"

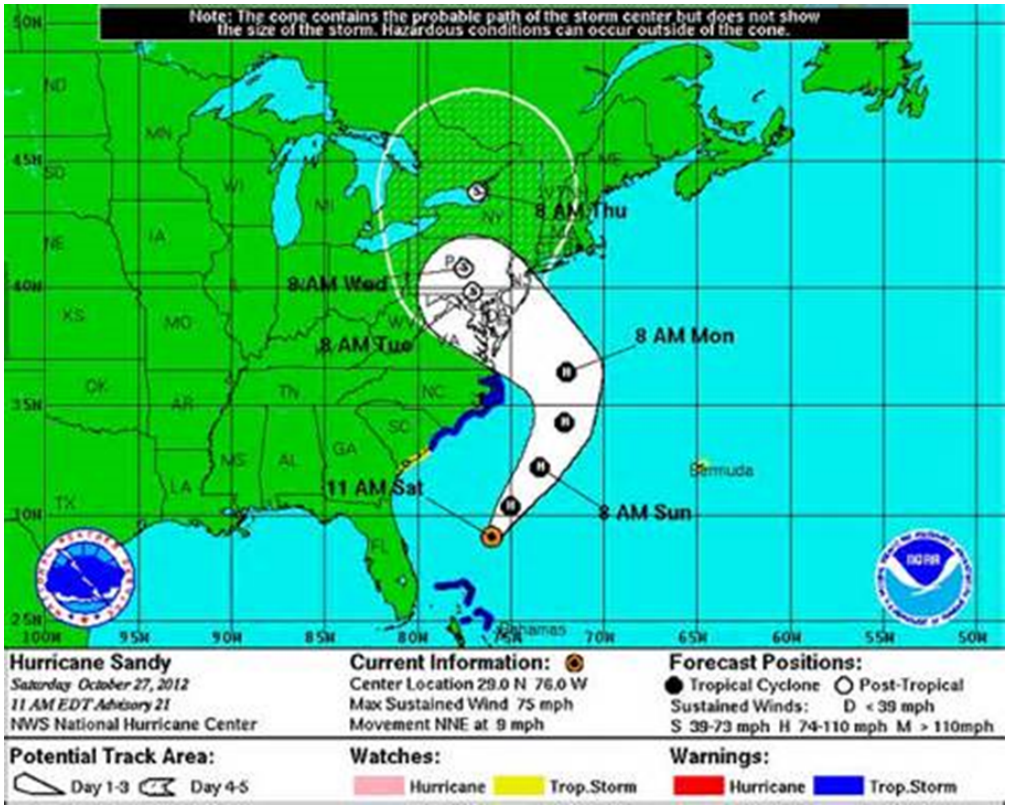
- Requires NWS to:
  - Fully integrate our field structure to produce:
    - *Better forecasts and warnings*
    - *Consistent products and services*
    - *Actionable environmental intelligence*

- Address the "last mile" that connects forecast to critical national, state and location decisions
  - *Provide Impact-based Decision Support Services (IDSS)*
  - *Deliver through multiple and reliable dissemination pathways*
  - *Work with partners, including embedding NWS in Emergency Operations Centers and incorporating Social Sciences, to gain the public's needed response*

Involves entire US Weather, Water and Climate Enterprise WORKING TOGETHER to achieve far-reaching national preparedness for weather events

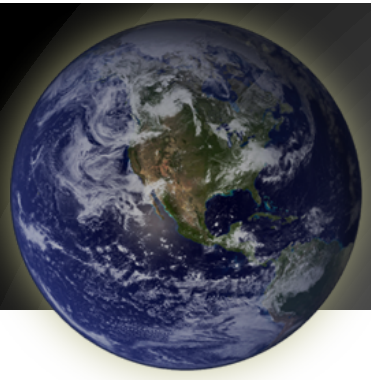
Tom Geyer (White House Military Office): "The $$ Chart"

- What's happening?
- What's the impact?
- What are the proposed courses of action?
- What are the risks?



COMMUNICATION with decision makers: "we don't want a map discussion"

Impact-based Decision Support Services (IDSS): going the last mile!



The Job Doesn't End with Forecasts and Warnings

"What is a Good Forecast? An Essay on the Nature of Goodness in Weather Forecasting"

by Allan H. Murphy; Weather and Forecasting (June 1993)

"First, it should be understood that forecasts possess no intrinsic value. They acquire value through their ability to influence the decisions made by users of the forecasts."

Connecting All the Pieces
January 2016 Blizzard Timeline

Jan 17 & 18

Medium Range products highlight snowstorm threat

Jan 19

Medium Range products highlight snowstorm threat

2 pm:
NWS Collaboration call focused on messaging and strategy

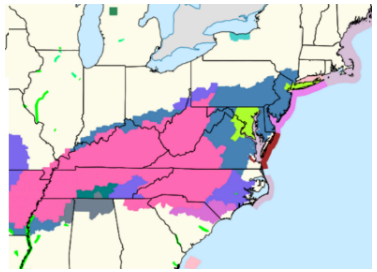
Several national media interviews

Jan 20

8:30 am: NWS briefs FEMA HQ

Numerous national media interviews

Blizzard Watches Issued



Jan 21

8:30 am: NWS briefs FEMA HQ

Coordination with state and local governments

1 pm: National Press Briefing

State of Emergency Declared:
- North Carolina
- Virginia
- West Virginia
- District of Columbia
- Maryland
- Pennsylvania
- New Jersey
- New York

Jan 22

Collaboration to raise snowfall in NYC area

Schools and Government Close

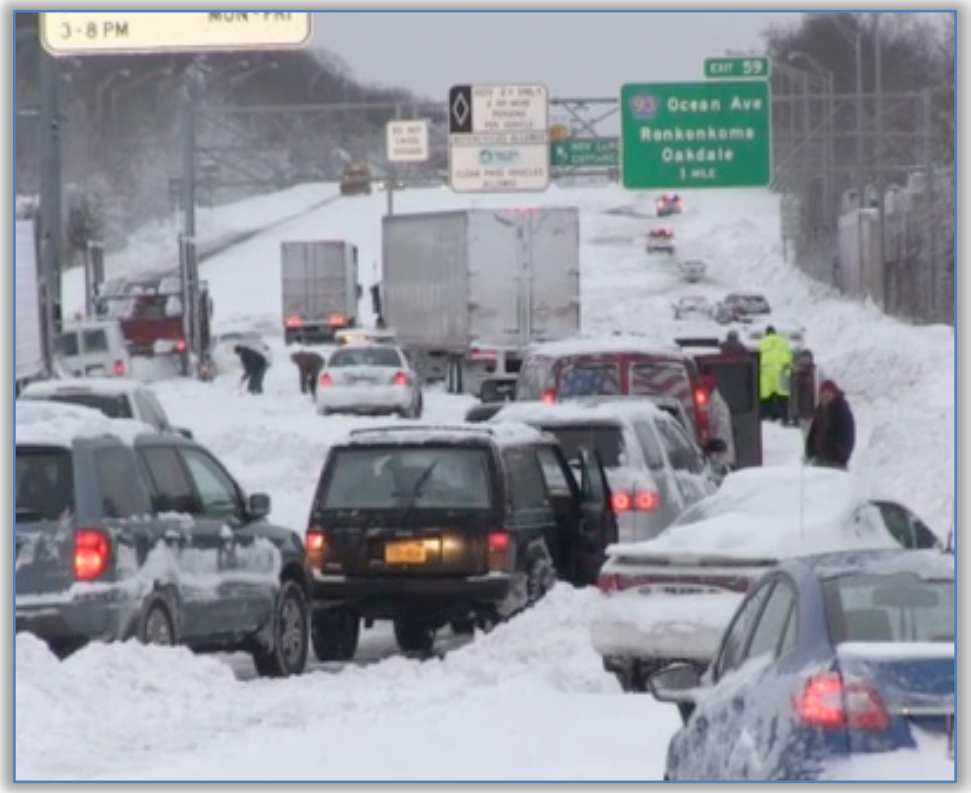
Flights Canceled

Roads Closed

Connecting All the Pieces

Long Island Expressway

2013 Snowstorm



The Past

2016 Snowstorm

With Decision Support

NWS Strategic Outcome: Weather-Ready Nation

NWS Strategic Goals

- Improve Weather Impact-Based Decision Support Services
- Improve Water Forecasting Services
- Enhance Climate Services and adapt to climate-related risks
- Improve sector-relevant information in support of economic productivity
- Enable environmental forecast services supporting healthy communities and ecosystems
- Sustain a highly skilled, professional workforce equipped with training, tools, and infrastructure to meet mission

Operational numerical guidance:

Foundational tools to used to improve public safety, quality of life and make business decisions that drive U.S. economic growth

Prediction is what makes NOAA/NWS unique and indispensable!

1955 - US Weather Bureau
First Operational Production Suite

Baroclinic:

- 300 km / 3-layer CONUS to 36 hr
- 1500z run
- Started 2100z
- Finished 2230z

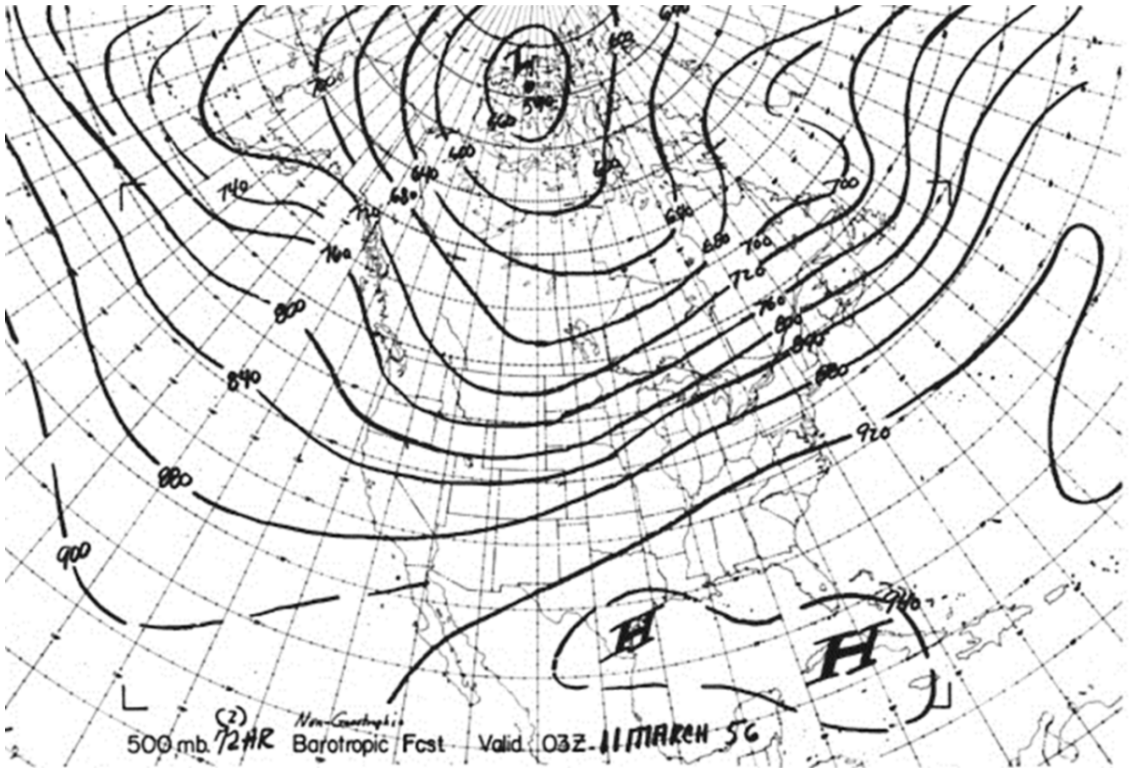
Thermotropic:

- 375 km / 2 layer No. Am to 36 hr
- 0300z run
- Started 1000z
- Finished 1230z

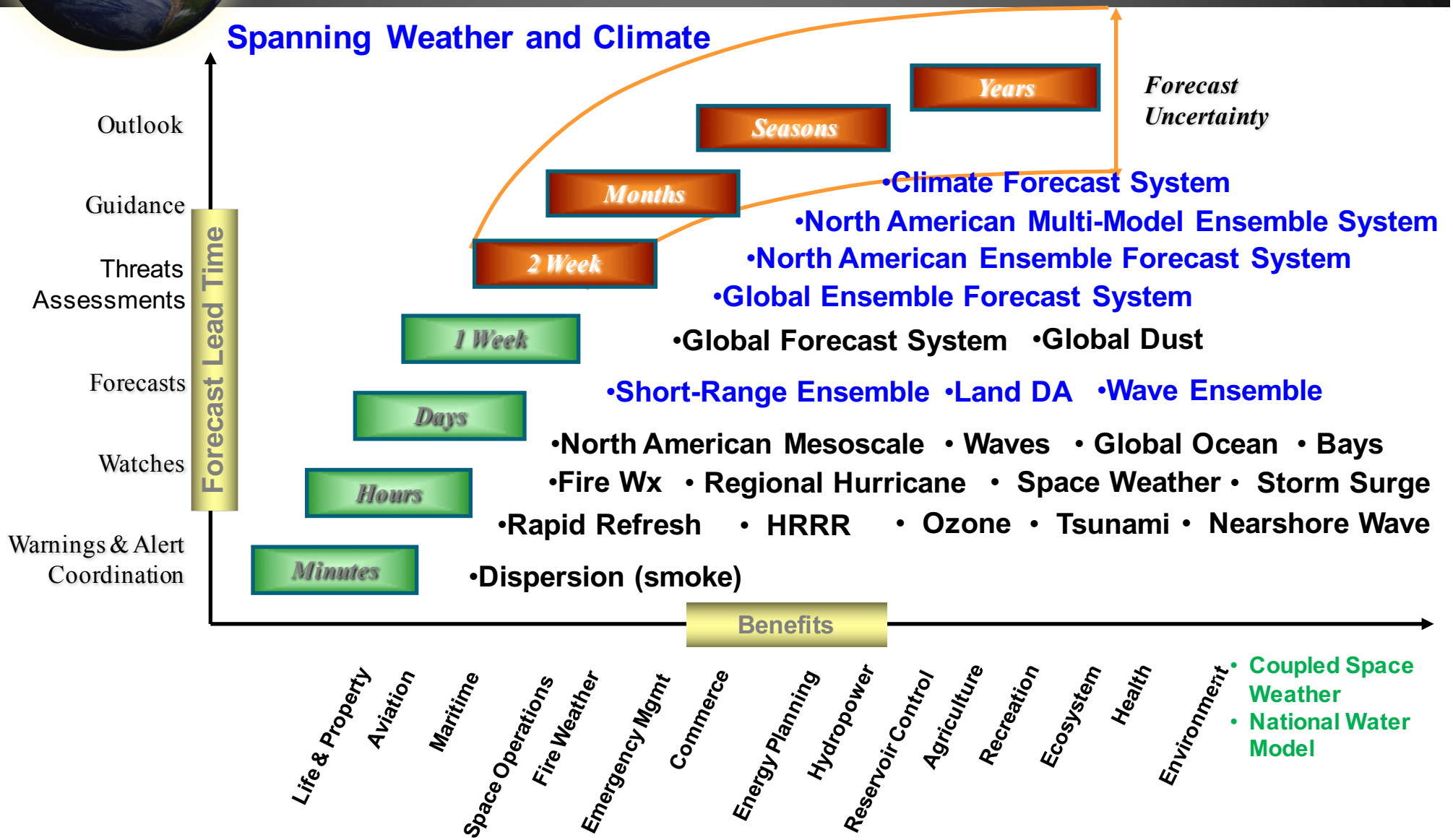
Barotropic:

- 600 km / 1 layer ~NHemis to 72 hr
- 0300z run
- Started 1230z
- Finished 1300z

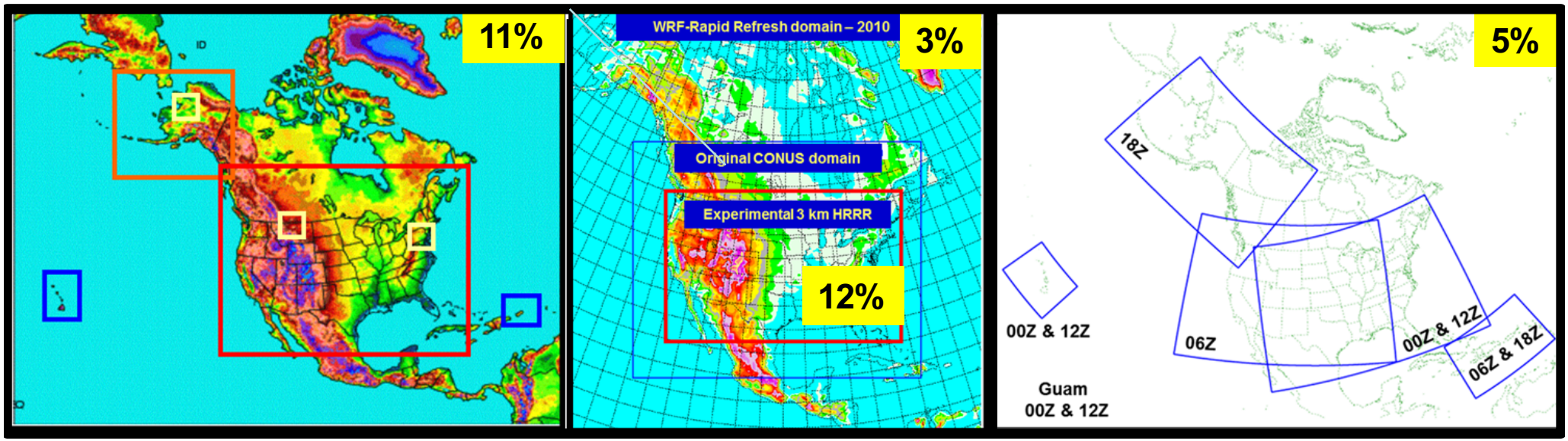
500mb Height
72h Forecast Valid 03Z 11 March 1956



Seamless Suite of Operational Numerical Guidance Systems



Modeling CONUS & O-CONUS: Expensive and Requires Nesting…



North American Model (NAM)

- Runs 4x/day
- Outer grid at 12 km to 84hr
- Multiple Nests Run to ~48hr
  - 4 km CONUS nest
  - 6 km Alaska nest
  - 3 km HI & PR nests
  - 1.3km DHS/FireWeather/IMET

Rapid Refresh (RAP)

- Runs 24x/day to 18h
- 13 km Domain includes Alaska
- 3 km HRRR runs 24x/day out to 15h

High Res Windows (HiRESW)

- Typically run 2x/day
- 4 km WRF-NMM
- 5.15 km WRF-ARW
- 48 hr fcsts from both

Short Range Ensemble Forecast System

- Runs 4x/day
- 21 members out to 72h
- 16km CONUS grids

10%

Feedback: Model Requirements and Pre-Implementation Assessments

- **Requirements definition**
  - Identified as a weakness by NCEP stakeholders
  - incomplete requirements may create false expectations
  - NWS needs an improved process—is portfolio management the answer?

- **Stakeholders--- need earlier access to information**
  - What changes are being made?
  - What's the rational?
  - What characteristics of the tool will change?
  - Stakeholder calibration methods need time and access to pre-implementation data in order to adapt (i.e., GEFS FY15 Upgrade)
  - 30-day NCO parallel insufficient for customer assessment

IMPROVE COMMUNICATION BETWEEN MODEL DEVELOPERS AND STAKEHOLDERS

Proposed Implementation Process

Requires Access to Big Data…..

Start of Development Cycle

- Conduct a workshop (modelers, field, academia, customers)
- Prioritize features to be improved
- How do you propose to improve them?
- How much will it cost (time=$, HPC)
- How will data be disseminated?
- Develop detailed test plan
- Create end-to-end charter
- Get appropriate approval to proceed

↓

Phase 1 of test plan (2-4 months)

↓

Assessment of Phase 1 results (2 weeks) Invite SOO's to participate

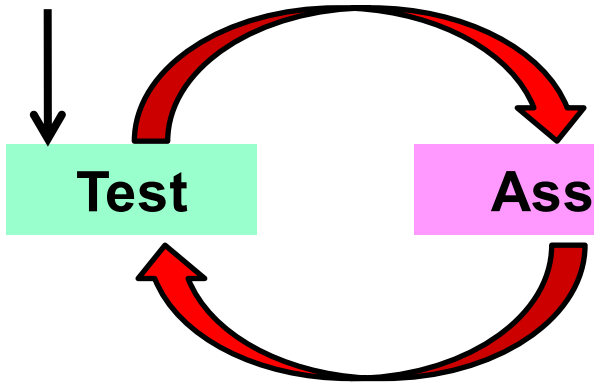
→

Phase 2 of test plan (2-4 months)

↓

Assessment of Phase 2 results (2 weeks) Invite SOO's to participate

↓



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Final Approval

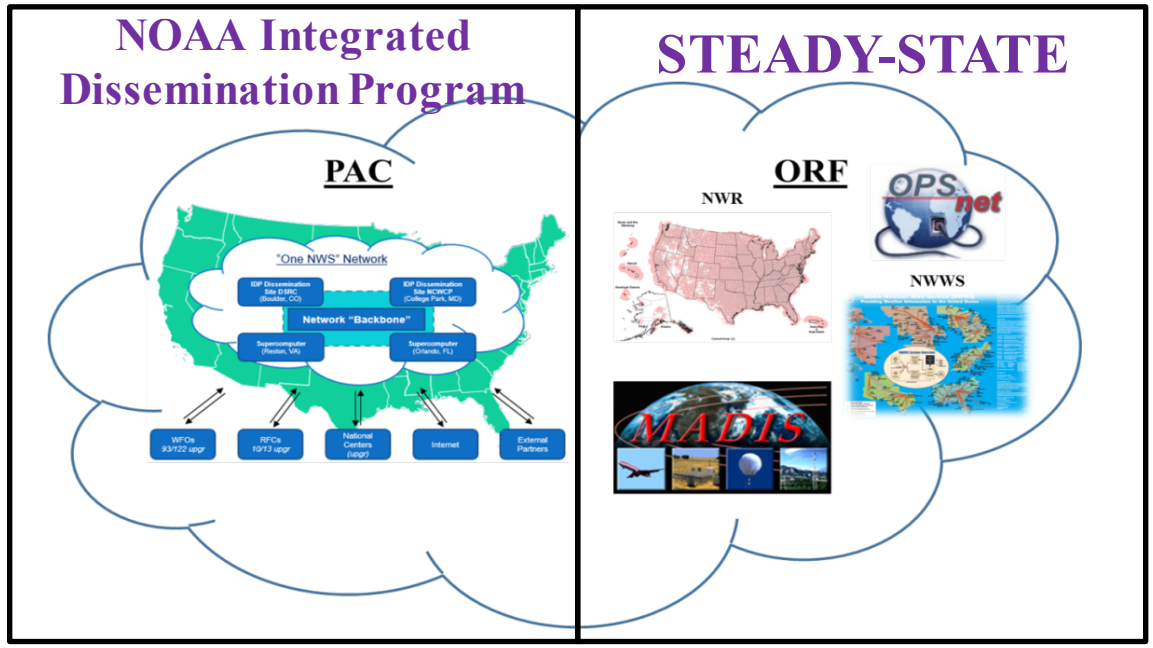
↓

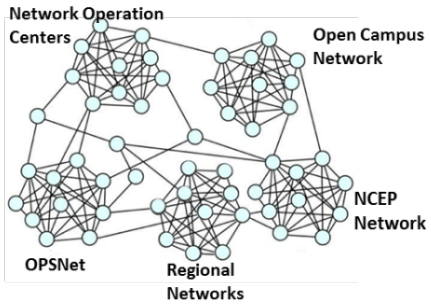
NCO Testing & Implementation

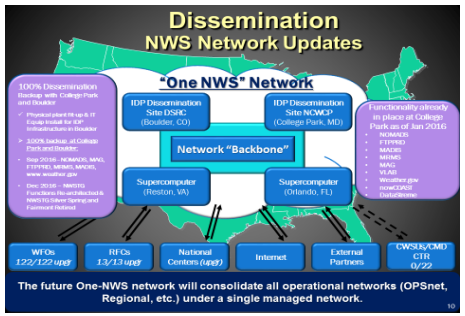
NWS Responding to Big Data Requirements: Office of Dissemination

Office of Dissemination Thrust Areas

- Service 1: Dissemination IT Infrastructure and Virtualized Application Services
- Service 2: Terrestrial and Satellite Networking Services
- Service 3: Weather Information Distribution Services







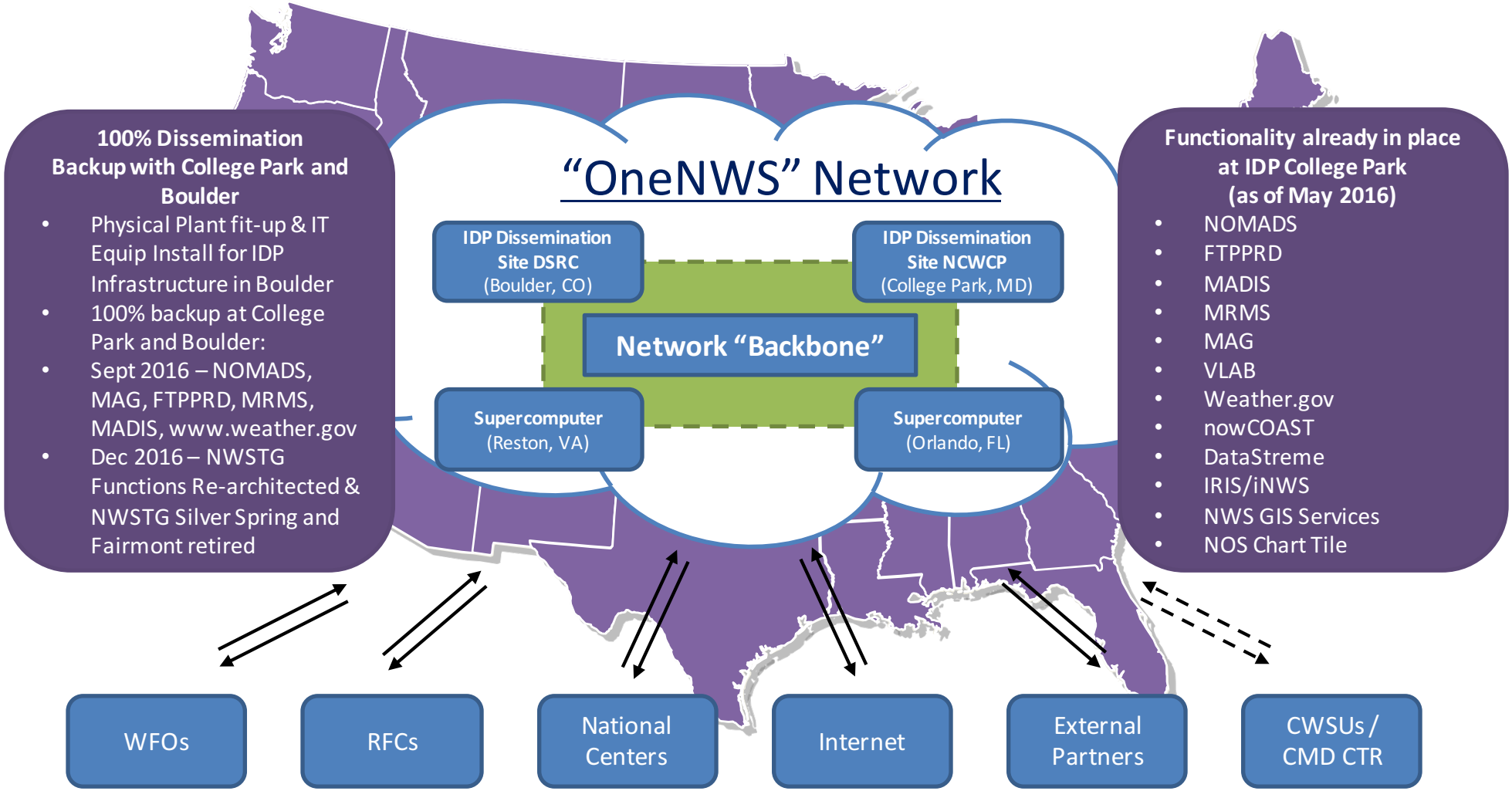
IMPACT: *Seven (7) multi-day outages which occurred Nov-Dec 2013 during severe weather events vs. three (3) multi-hour outages occurred Nov-Dec 2015 with legacy systems during severe weather.*

Integrated Dissemination Program (IDP)

Transforming NOAA's Enterprise dissemination services

- **Includes NWS' dissemination infrastructure**
- **Provide timely and reliable dissemination of weather, water, and climate data, forecasts and warnings supporting NWS' mission**

Integrated Dissemination Program (IDP) OneNWS Network
Long-Term Sustainable Solution



100% Dissemination Backup with College Park and Boulder

- Physical Plant fit-up & IT Equip Install for IDP Infrastructure in Boulder
- 100% backup at College Park and Boulder:
- Sept 2016 – NOMADS, MAG, FTPPRD, MRMS, MADIS, www.weather.gov
- Dec 2016 – NWSTG Functions Re-architected & NWSTG Silver Spring and Fairmont retired

Functionality already in place at IDP College Park (as of May 2016)

- NOMADS
- FTPPRD
- MADIS
- MRMS
- MAG
- VLAB
- Weather.gov
- nowCOAST
- DataStreme
- IRIS/iNWS
- NWS GIS Services
- NOS Chart Tile

The future OneNWS Network will consolidate all operational networks (OPSnet, Regional, etc.) as single managed network under NCEP Central Operations (NCO).

Central Processing Portfolio
NOAA Big Data Project

Research through Data Alliances

Collaborators established in April 2015 as nucleus around which data marketplaces (Data Alliances) can form

https://data-alliance.noaa.gov/

Research Objective

- **Explore value proposition and self-sustainability of business model by mimicking full market ecosystem via Data Alliances**

What does success look like?

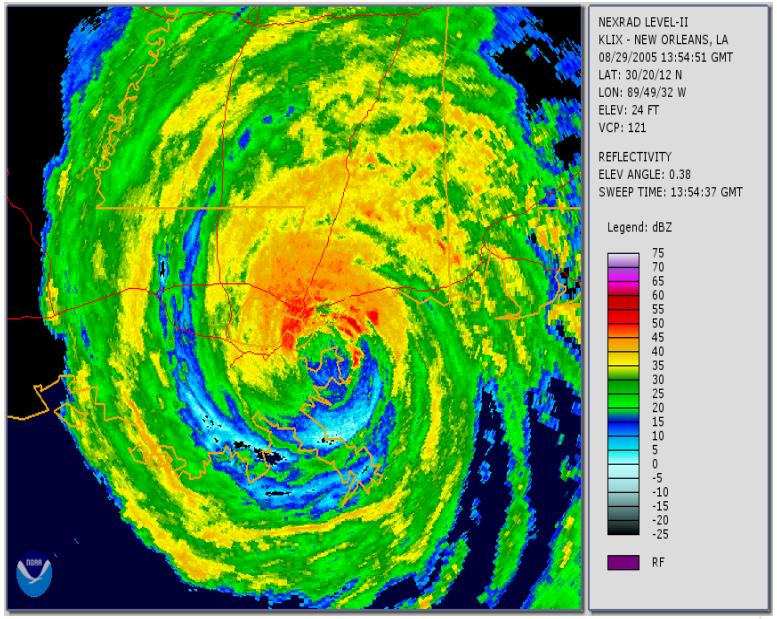
- **Demonstrated sustainable use cases of a market ecosystem in one or more Data Alliance**

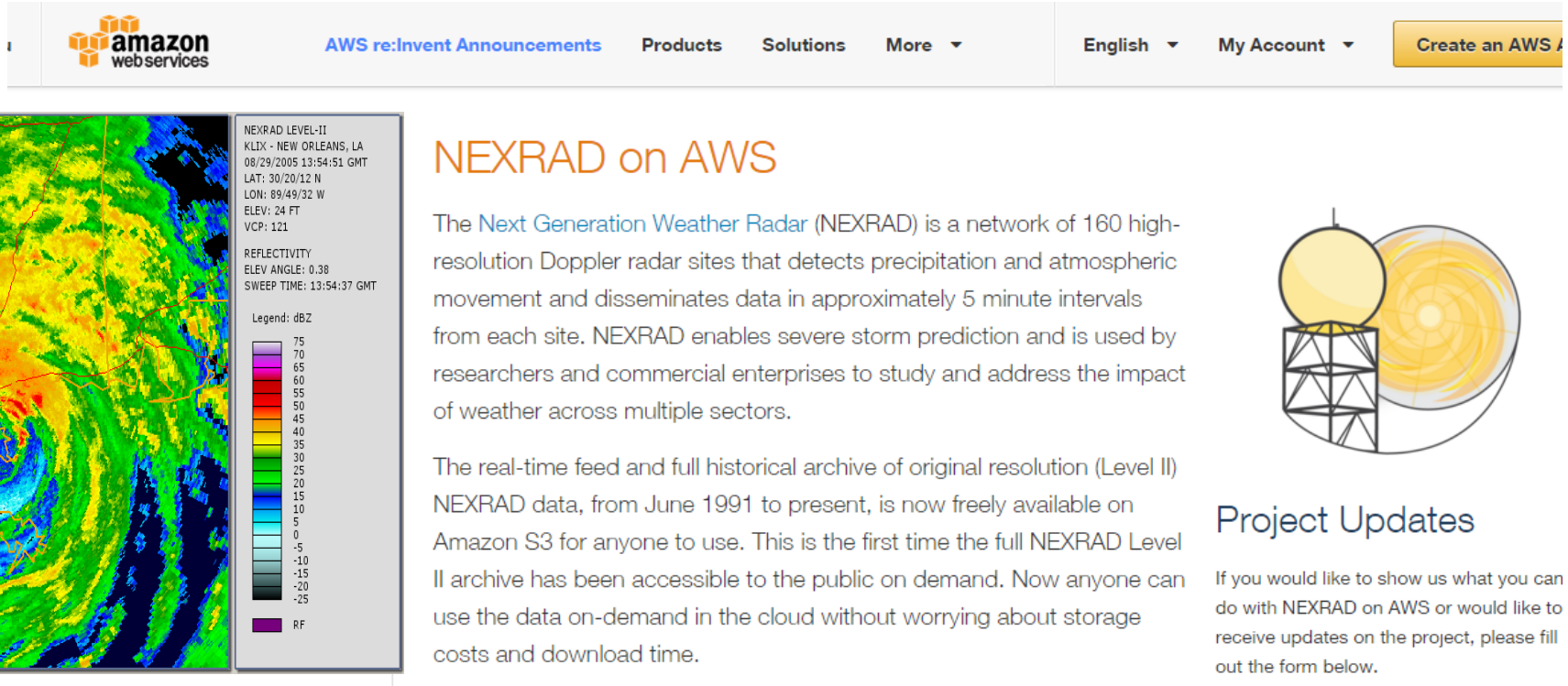
Researching self-sustainable business model mimicking market ecosystem

Central Processing Portfolio

NOAA Big Data Project – Current Activities

- NEXRAD Level II Data
  - Archive and real-time data freely available to public on Amazon Web Services
  - June 1991 - Present (270 TB compressed / 1 PB uncompressed)
  - 180 million files





Researching self-sustainable business model mimicking market ecosystem

Thanks for your Attention