



# National Weather Service Science and Technology Roadmap, v 2.0

Progress Update to Corporate Board  
Don Berchoff, Director

Office of Science & Technology  
National Weather Service

10 March 2010



# Overview

- Purpose
- Why a S&T Roadmap
- OST Mission
- Building the S&T Roadmap
- Roadmap Themes
- Improving Research to Operations
- Next Steps



# Purpose

- **Update Corporate Board**
- **Stimulate discussion**
- **Acquire comments and feedback**



# Why a S&T Roadmap?

- **Rapid advances in S&T—need strategy for streamlined infusion**
  - *Enormous S&T capability available/emerging, but disjointed, unfocused*
- **The operational environment is changing**
  - *Speed at which decisions are made*
  - *Increasing demand for decision support services*
- **Huge data explosion on horizon...**
- **US industry reliance on accurate, accessible, timely and reliable “foundational” weather data...**
  - *Will increase expectations and place great demand on NWS systems*
  - *Become an integral part of business decisions, productivity, US GNP growth...*
  - *Can increase US global competitive advantage*
- **Federal deficits and resource constraints**
  - *Enterprise IT solutions*
  - *Integrated/optimized observation systems*
  - *More efficient R2O/O2R*
  - *Every dollar counts!*



# NWS/OS&T Mission

## Drive S&T Advances into NWS Operations

- **Respond to Field Requirements and Emerging Opportunities (user pull and S&T push balance)**
- **Plan, Develop and Implement Enterprise Solutions**
  - *Optimize performance, payback to Nation while improving quality, reliability*
  - *High-performance computing, cloud computing, next-generation collaboration/dissemination technologies, etc*
- **Enable Continuous Improvement...with**
  - *Better, faster, and more cost effective solutions*
  - *Architectures for agile, rapid S&T insertion*
  - *Partnerships—for identifying, developing transformational and emerging S&T beyond horizon*

***Listen to what customers want to accomplish,  
then find and integrate best capabilities***



# Building the Roadmap

## *Guiding Principles*

- Enable DOC, NOAA, NWS strategic goals and priorities
- Develop stretch goals to rally and influence Nation's research strategies, plans and investments
- Harness the Nation's best expertise to solve scientific challenges
- Think next generation observing/modeling/forecast systems
- Ensure rapid, on-demand access to information for all users of information

***Result: Improved service performance for government decision makers, private sector, public***



# Building the Roadmap

## Schedule, Milestones, and Status

### PHASE I

- ✓ Establish Framework Team 17 Nov 2008
- ☑ Framework Brief to Corporate Board 10 Dec 2008

### PHASE II

- ✓ Roadmap plenary workshop 21 Dec 2008
- ✓ Capstone Group completes initial draft 3 Feb 2009
- ✓ Update for NOAA/NWS leadership 27 Mar 2009
- Apr 2009

**(Progressive updates)**

- ☐ 22 Focus Area Teams complete robust outlines (briefing) 30 Jun 2009
  - 21/22 Completed; overview and summaries posted on 28 Sept 2009
  - <http://www.weather.gov/ost/S&TRoadmap/>

### PHASE III

- ☑ Stakeholder input: NOAA Res Council, BASC, Partners, NWA Jun - Oct 2009
- ☑ OAR Lab visits Jul-Sep 2009
- ☑ NWS-OAR Retreat Oct 2009
- ☐ Full Documentation of Focus Area Plans 21/22 Completed Nov 2009
  - SSD Chief Review Feb 2010

- Capstone summary publish-ready April 2010
- ☐ All S&T Roadmap documents published mid 2010

### Status 12/09

- ✓ Completed
- In progress
- ☐ Milestone



# Building the Roadmap Construct

NWS SCIENCE AND TECHNOLOGY ROADMAP  
Prep

- Fire Weather
- **Hydrology**
- **Aviation**
- Severe Weather
- Winter Weather
- Marine
- **Tropical Weather**
- **Climate**
- Air Quality
- Space Weather
- Tsunami
- Sensible Weather & Emerging areas (e.g. energy, ecosystems, health)



- Observations
- Data Assimilation
- Forecasting:
  - Models
  - Post Processing
  - Human Aided
- Dissemination
- Decision Support
- Verification & Metrics
- Customer Outreach, Feedback Technologies
- Social Sciences

- Universities
- Government Labs
- Private Industry

**S&T Research to Operations**

**Protection of Life and Property  
Enhance Economy**





# Building the Roadmap Participants

- **Focus Area Teams:**
  - *NWS: Regions, OST, OCWWS, NCEP, OHD, CIO, OPS*
  - *OAR, NESDIS, NOS, PPI Partners*
- **NWS Field input and review:**
  - *SSD Chiefs*
  - *NWS field forecasters: Regions, NCEP centers*
  - *WFO Milwaukee SOO, Jeff Craven*
- **Stakeholder engagement:**
  - *Research Council: 2/09, 6/09*
  - *NWS "Partners": 6/09, 10/09, 1/10*
  - *NAS/NRC Board on Atm Sciences and Climate: 7/09*
  - *National Meetings: NWA, GOES User Conf, AMS*
  - *OAR Labs (7/09-9/09); OAR-NWS Retreat: 10/09*



# Building the Roadmap

## *OAR Laboratory Visits*

National Severe Storms Laboratory	Norman, OK	7/14/09
Earth System Research Laboratory	Boulder, CO	7/15/09
Air Resources Laboratory	Silver Spring, MD	8/07/09
Atlantic Oceanographic and Meteorological Laboratory	Miami, FL	8/18/09
Great Lakes Environmental Research Laboratory	Telecon	9/1/09



# Building the Roadmap

## Aligned with NOAA, NWS Strategic Themes

NOAA Strategic Themes (Draft)	NWS Strategic Goals (Draft)	S&T Roadmap Themes
Climate Adaptation and Mitigation	Enable Integrated Environmental Prediction Capabilities (ecosystems)	<ul style="list-style-type: none"> <li>✓ Integrated observing and analysis system</li> </ul>
Weather Ready Nation	Enhance Climate Prediction and Services	<ul style="list-style-type: none"> <li>✓ Integrated environmental modeling: data assimilation, prediction, post-processing (e.g. ensembles)</li> </ul>
	Improve Water Services	
Sustainable and Resilient Fisheries, Habitats, Species	Expand Sector-Relevant Services ( e.g. energy, transportation, telecoms, agriculture)	<ul style="list-style-type: none"> <li>✓ Next generation Forecast and Decision Support System</li> <li>✓ 4D Digital Weather Information Database (WIDB)</li> <li>✓ Transforming dissemination/communication/outreach capabilities</li> <li>✓ Incorporating social sciences strategies in research and operations</li> </ul>
Sustainable Coastal Communities and Economies	Deliver Comprehensive Decision Support Services for high-impact events	
Accelerate transition of applications from research to operations		

**Science-service Focus Areas**



# Building the Roadmap

➤ **Comments, Questions, Concerns??**



# S&T Roadmap Themes

## 2025 Stretch Goals for Science and Technology

NWS SCIENCE AND TECHNOLOGY ROADMAP

Preparing for Tomorrow... Today

Science Service Area	Key Products/ Services	Key Products:	2025 Stretch Goal:	Research Needs/Oppty Examples:
Fire Weather	Red Flag Warni	<b>Hydrology</b>		
<b>Hydrology</b>	Inundation Fo	<b>Aviation</b>		
<b>Aviation</b>	Convection Ini evolution and	<b>Key Products:</b>		
<b>Severe Weather</b>	Tornado Warn	<b>• Convection Initiation</b>		
<b>Winter Weather</b>	Winter Storm	<b>2025 Stretch Goal:</b>		
<b>Marine</b>	Storm Warnin	<b>• 30 minute lead time</b>		
<b>Tropical Weather</b>	Hurricane Track, Inten	<b>Research Needs/Oppty Examples:</b>		
<b>Climate</b>	Sea	<b>• Initiation, evolution of convection</b>		
<b>Air Quality</b>	Air Q	<b>Climate</b>		
<b>Space Weather</b>	Geo War	<b>Tropical Weather</b>		
<b>Tsunami</b>	Tsu	<b>Key Products:</b>		
<b>Emerging Areas/ Surface Wx</b>	Win	<b>• Hurricane Track, Intensity Forecasts</b>		
		<b>2025 Stretch Goal:</b>		
		<b>• Errors reduced by 50%</b>		
		<b>Research Needs/Oppty Examples:</b>		
		<b>• Causes of rapid intensity changes</b>		



# S&T Roadmap Themes

## Aviation Example (transportation)

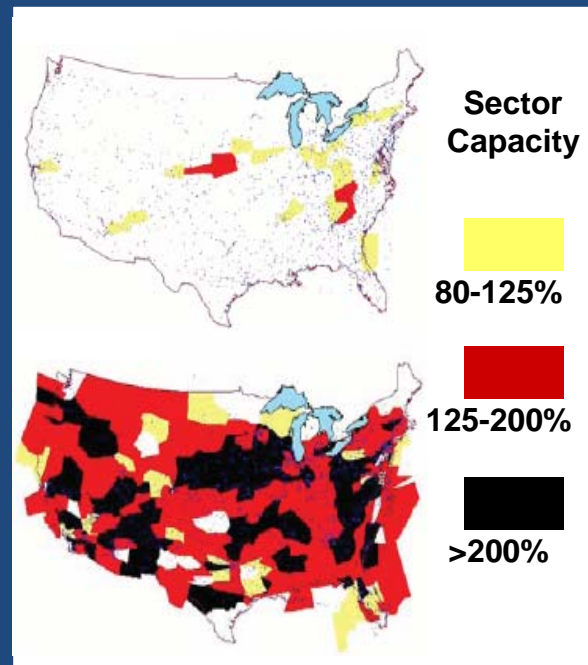
- Air traffic likely doubling by 2025
- Delays cost \$41 billion/year (2007)
- 70% were weather related

NextGen 2025 goal:

- *2/3 reduction with better weather information*
- *Improvements to forecast lead-time for initiation of storm-scale convection, ceiling/visibility*

requires:

- Better, more integrated Observations
- More accurate, higher-resolution models/data assimilation/post-processing
- Enhanced Forecaster Assistance Tools
- Enhanced Decision Support Tools
- Effective Social Sciences integration





# S&T Roadmap Themes

## *Tropical Example*

Stretch goal:  
50% Reduction in  
Forecast Track and  
Intensity Errors



requires

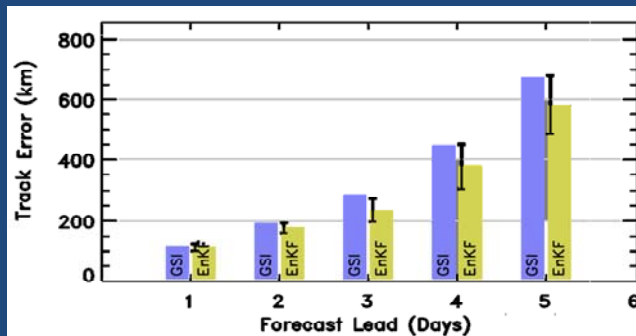
- Better sea surface observations and data assimilation
- Better ocean-atmosphere coupled models
- Social Sciences integration ...



# S&T Roadmap Themes

## Tropical Focus Area Summary

### Hurricane Forecast Improvement Program: Recent Progress



NCEP Reworking Data Assimilation plans based on finding

- Accomplishments:**
- ✓ Improved Data Assimilation system gave 14% improvement in 5-day track forecast
  - ✓ High resolution ensemble systems show both track and intensity forecast improvements

**Vision**

Finer scale and highly accurate track, intensity and inundation forecasts that trigger appropriate responses resulting in reduced loss of life and economic impacts

- Halved track & intensity forecast
- Improvements in forecasts prior to cyclogenesis
- Communication of accurate high-resolution information

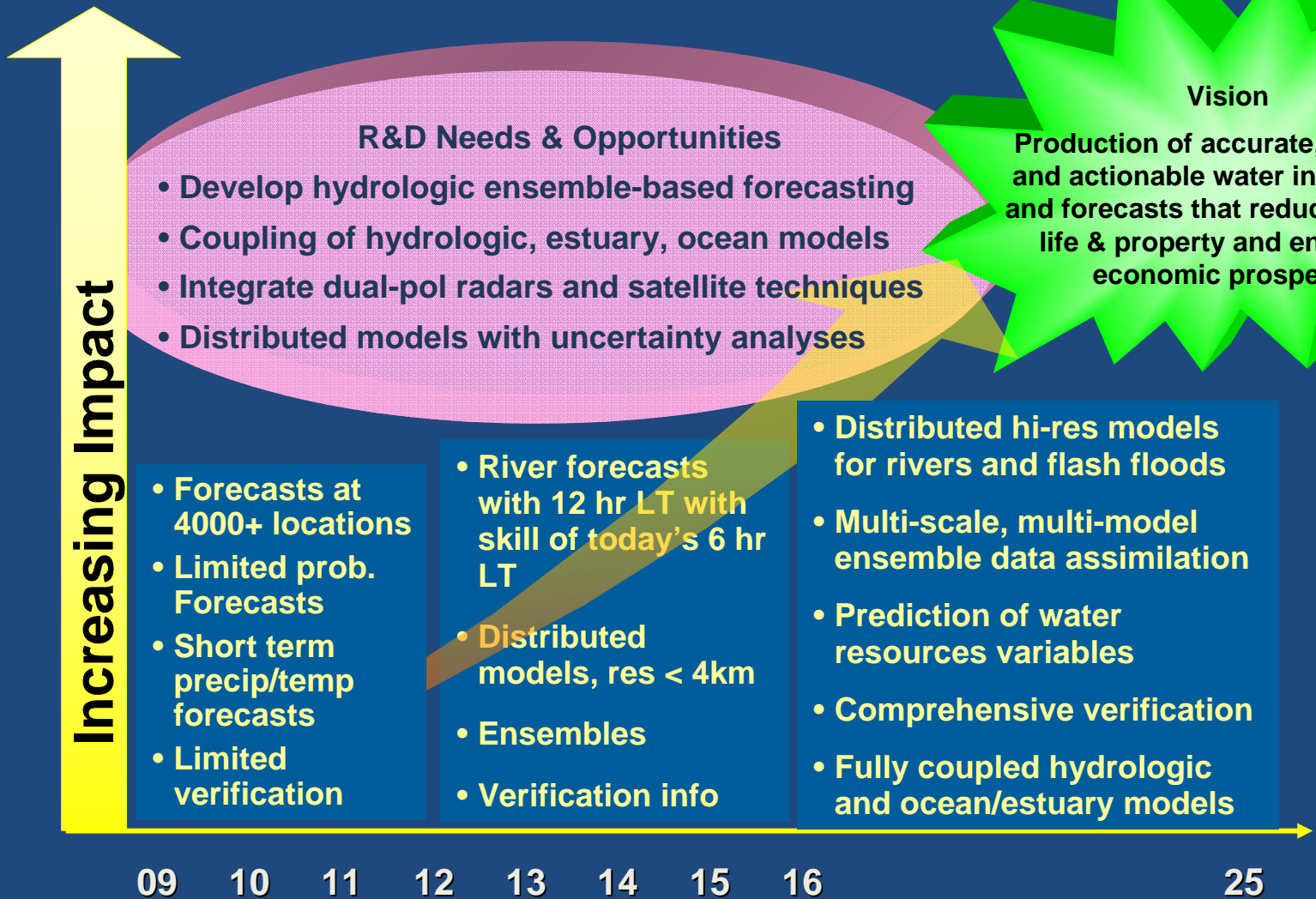
09 10 11 12 13 14 15 16 25





# S&T Roadmap Themes

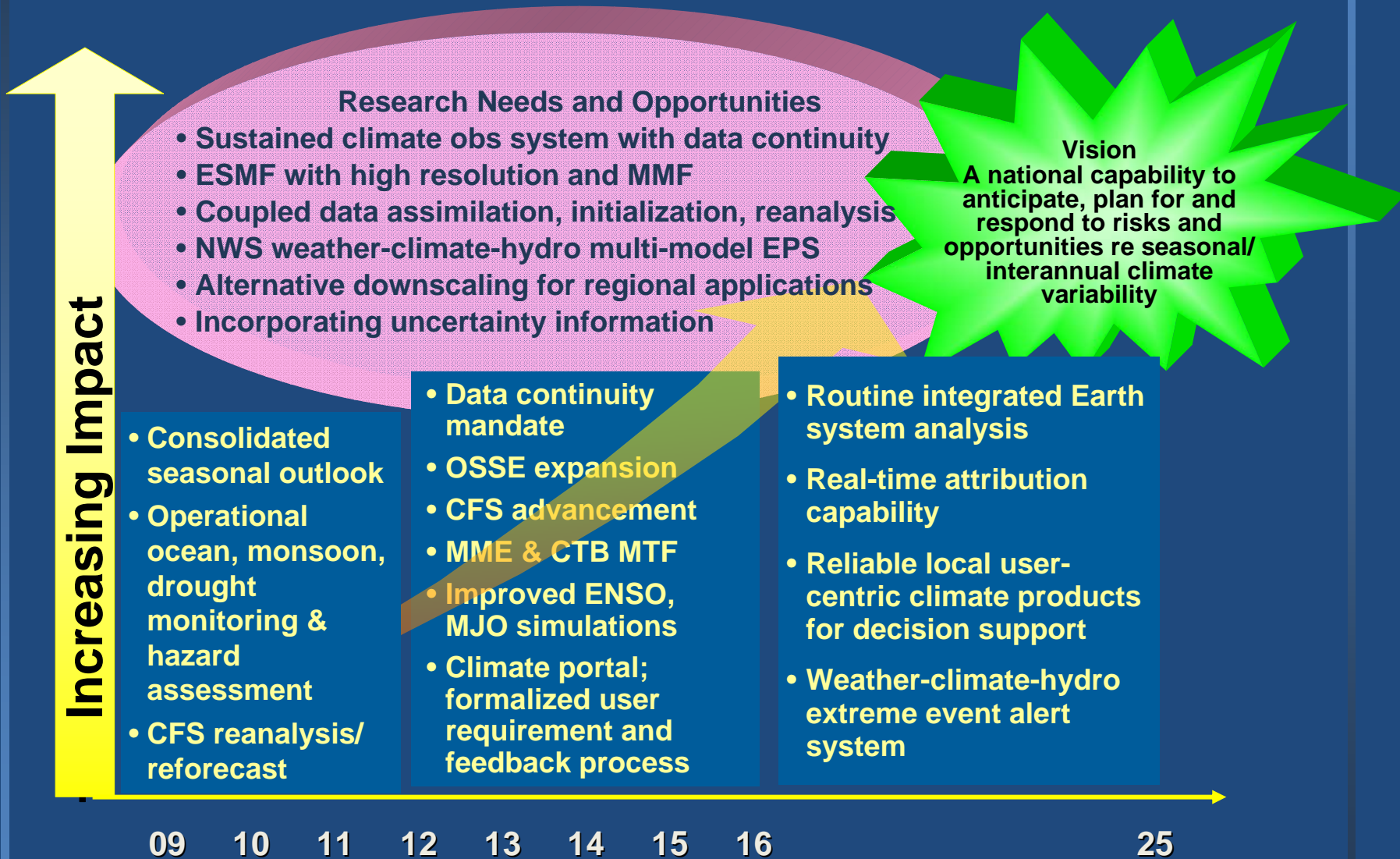
## Hydrology Focus Area Summary





# S&T Roadmap Themes

## Climate Focus Area Summary



-----NWS Next --- / NWS After Next --

# S&T Roadmap Themes

## *Integrated Observation/Analysis System*

### Current

#### Individual Systems

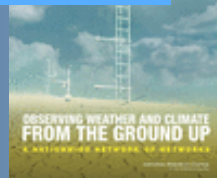
Public, Private.  
Universities

Radar, Satellite  
Surface; in-Situ,  
Upper Air....

### Analysis

Inventory &  
Assess  
systems,  
metadata

Assess  
interdepend-  
encies,  
oversampling,  
gaps, levels of  
criticality



### Strategies

**Integration:**  
National Mesonet,  
Network of Networks,  
Integrated Radar (Lidar,  
gap-fillers, MPAR),  
Global Systems,  
multisensor platforms

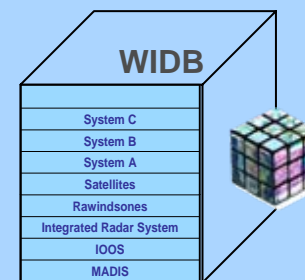
**Optimization:**  
OSEs, OSSEs

**Standards  
Architectures,  
Protocols**

**Maximize investment  
value**

### Future

**Weather Information  
Database**



**Open Architecture**

### Accomplishments

- ✓ MADIS, WVSS transition and expansion
- ✓ Established Mesonet Project Office
- ✓ Contracts for Mesonet Pilot
- ✓ Integrated Weather Radar Plan
- ✓ Government - Private Sector - Academia Partnerships

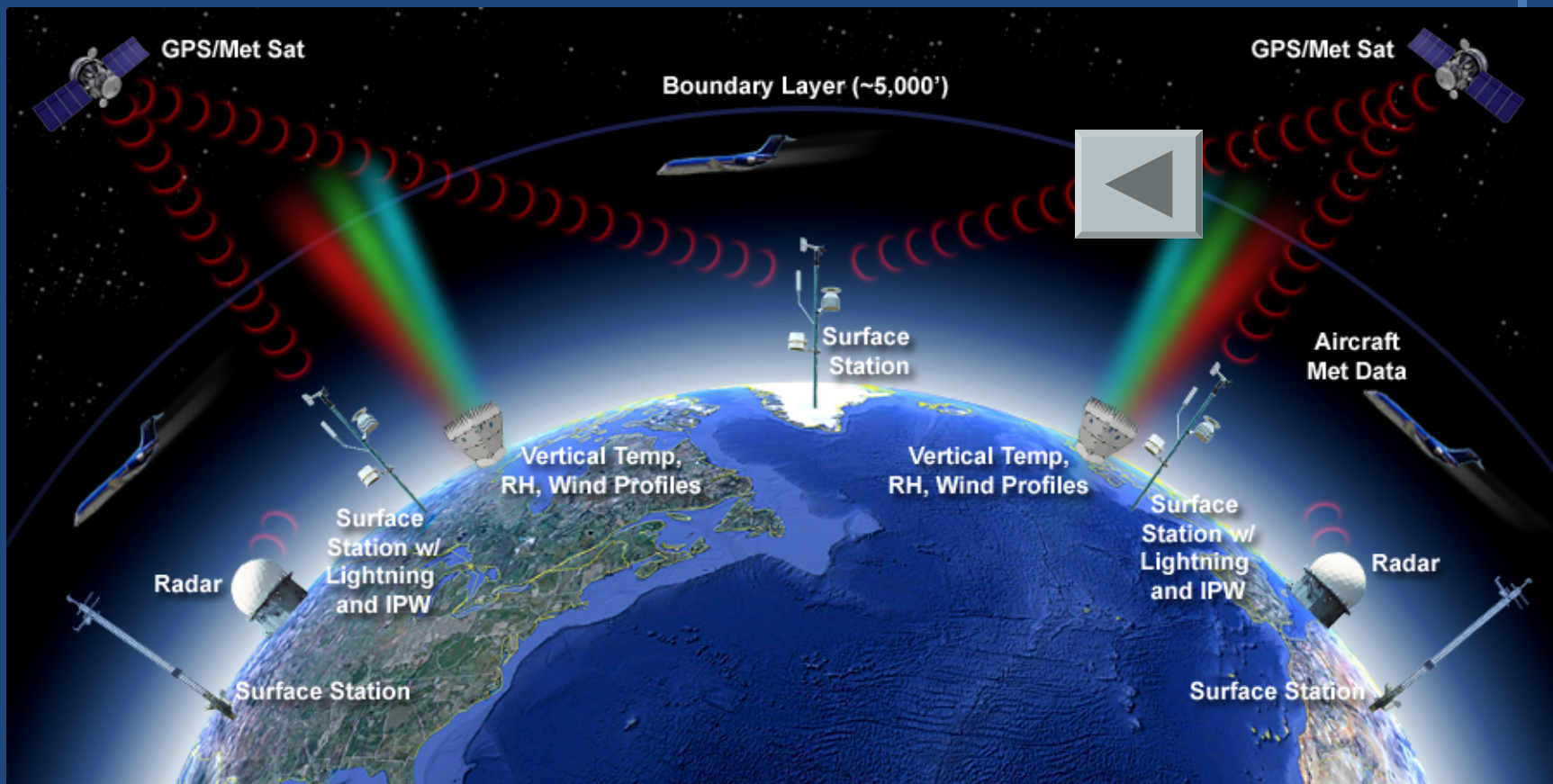


# S&T Roadmap Themes

## *Integrated Observation/Analysis System*

NWS SCIENCE AND TECHNOLOGY ROADMAP

Preparing for Tomorrow... Today



***Extending through boundary layer  
critical for forecast improvements***



# S&T Roadmap Themes

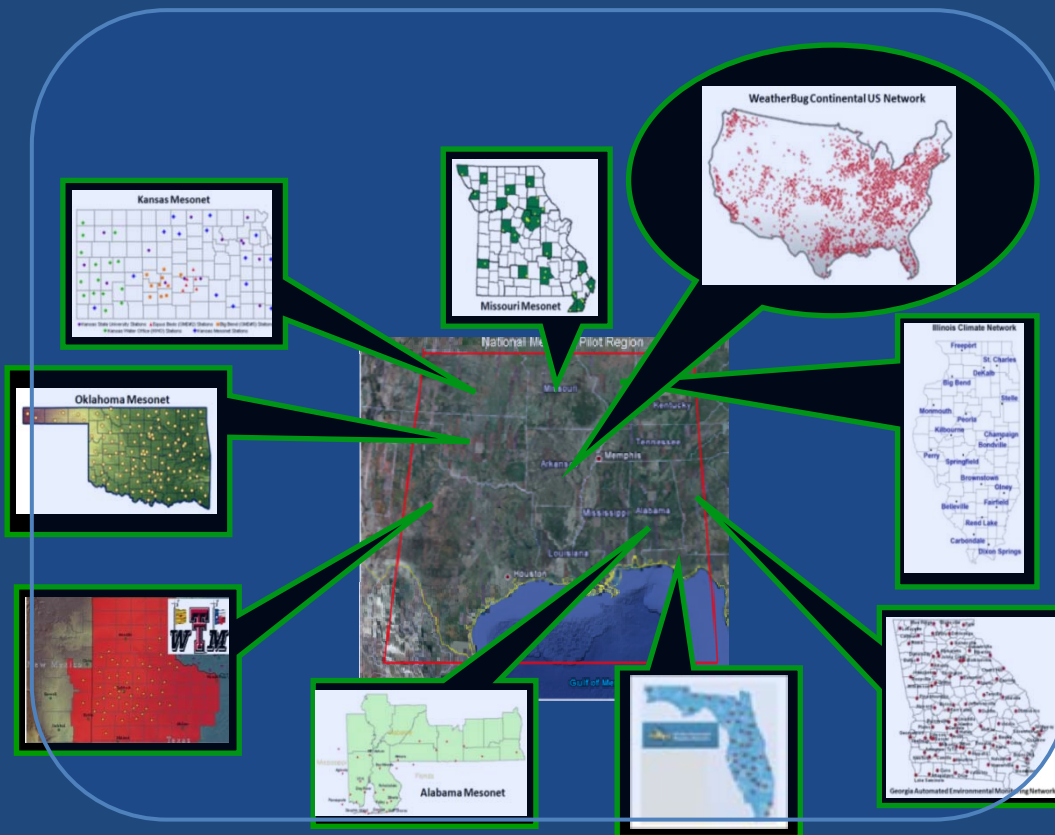
## *Integrated Observation/Analysis System*

### National Mesonet Pilot Project

NWS SCIENCE AND TECHNOLOGY ROADMAP

Preparing for Tomorrow... Today

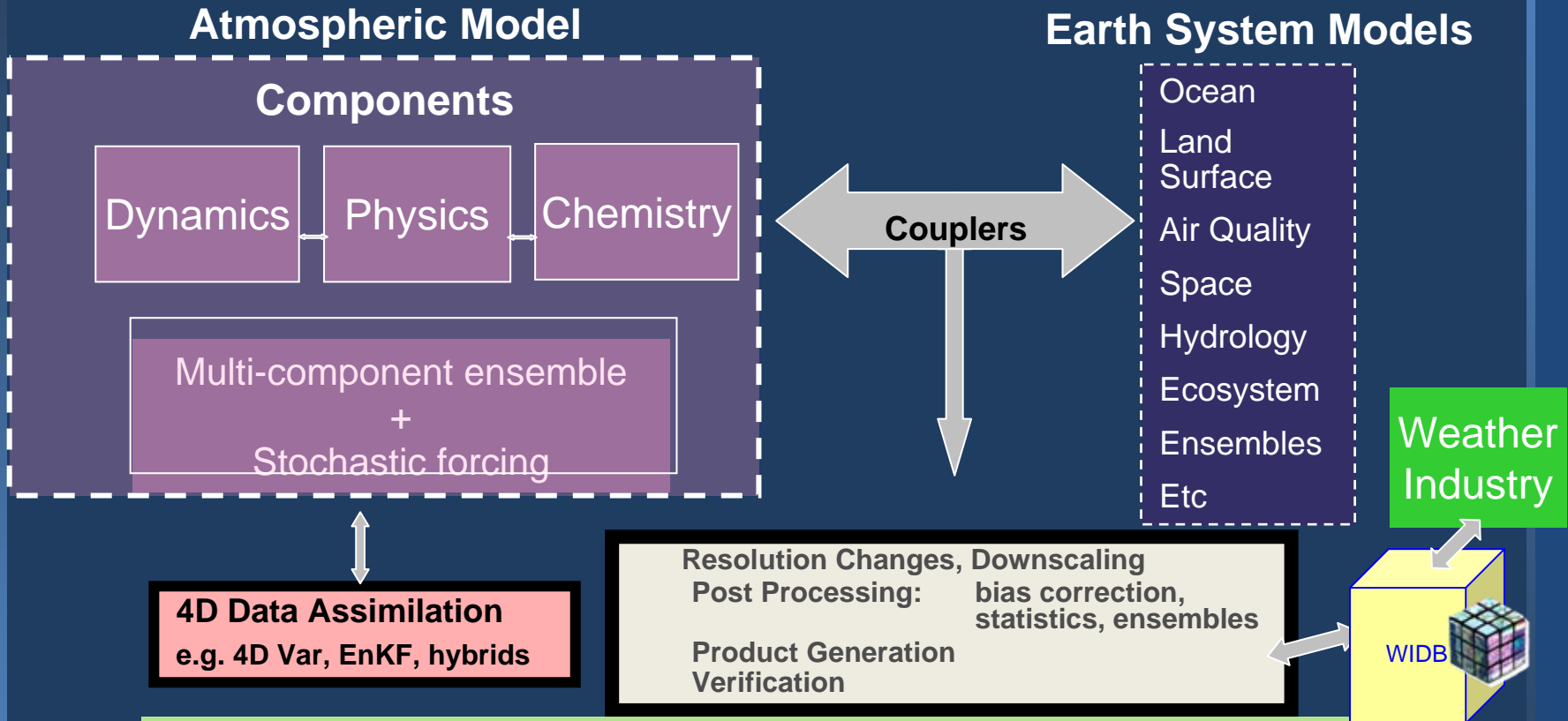
- ✓ *Aggregate atmospheric and soil observations from disparate networks*
- ✓ *Develop comprehensive metadata exchange interface*
- ✓ *Real-time quality assurance / quality control*



#### Mesonet Next Steps:

- Complete Pilot Mesonet
- Assess boundary layer gaps
- Build business case for investments

# S&T Roadmap Strategies: Integrated Environmental Modeling System

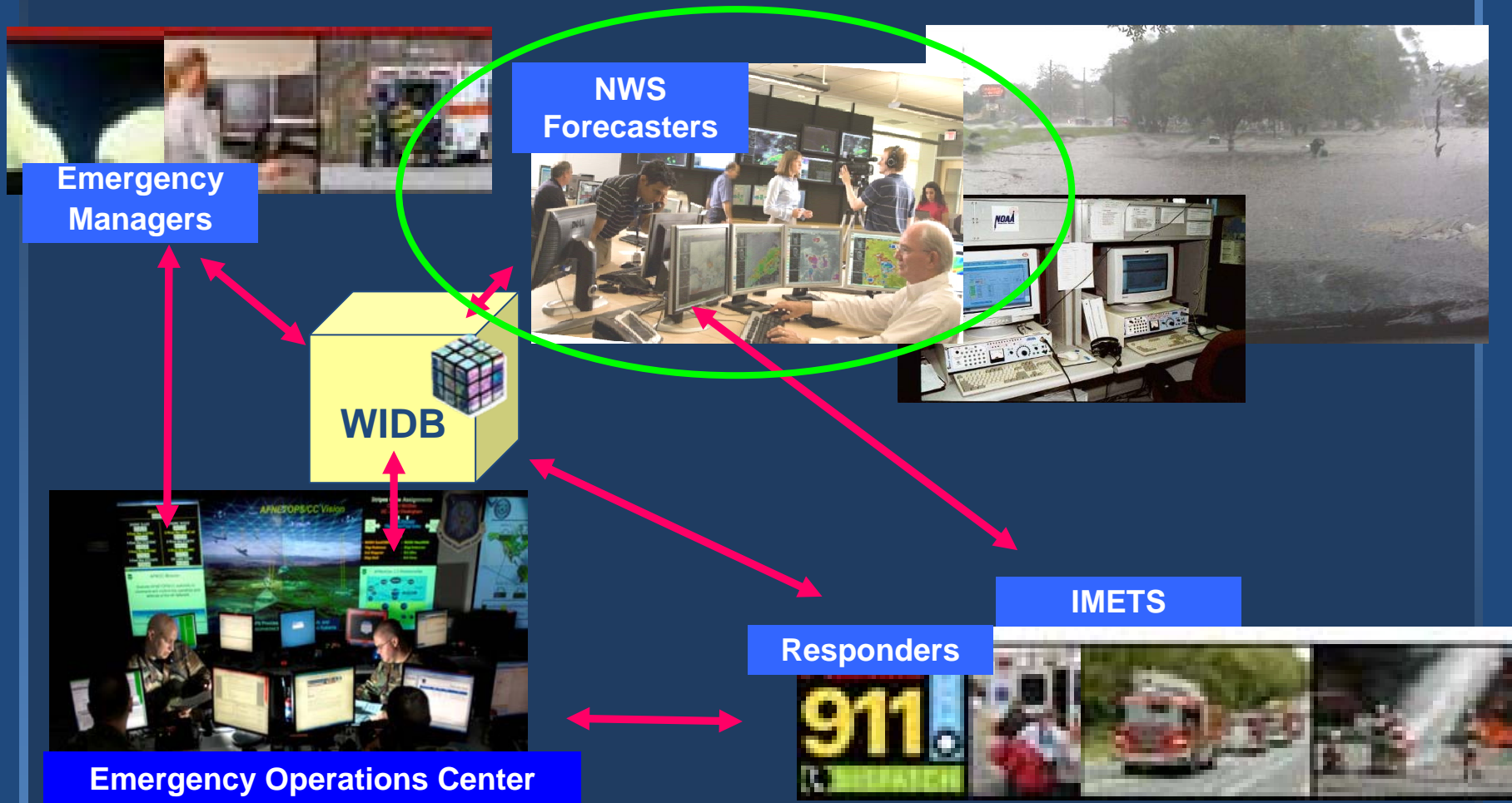


## Accomplishments

- ✓ NCEP-ESRL partnership solidified
- ✓ Investment in Developmental Test Center –
  - ✓ WRF today; Ensembles tomorrow, Global models in future
- ✓ Mesoscale Prediction Workshop; Refined Ensembles Roadmap
- ✓ NUOPC NOAA/Navy/AF partnership
- ✓ NCEP Data Assimilation Plan Completed

# S&T Roadmap Themes

## Next Generation Forecast & Decision Support System



### Accomplishments

- ✓ Innovation center outreach
- ✓ Groundwork to advance iNWS enterprise-wide
- ✓ Develop and implement high-res guidance (snow, precip) for Alaska



# S&T Roadmap Themes

## Next Generation Forecast & Dec Support System

NWS SCIENCE AND TECHNOLOGY ROADMAP  
Preparing for Tomorrow... Today



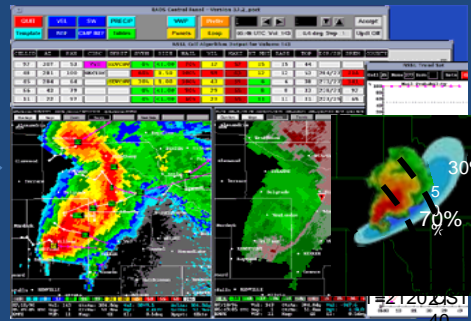
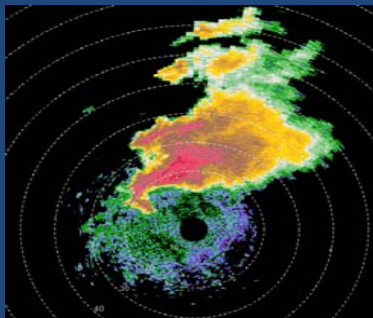
Next Gen Forecasts and Decision Support



Observations

Models

Next Gen Forecasts and Decision Support System



Most Likely Tornado Path

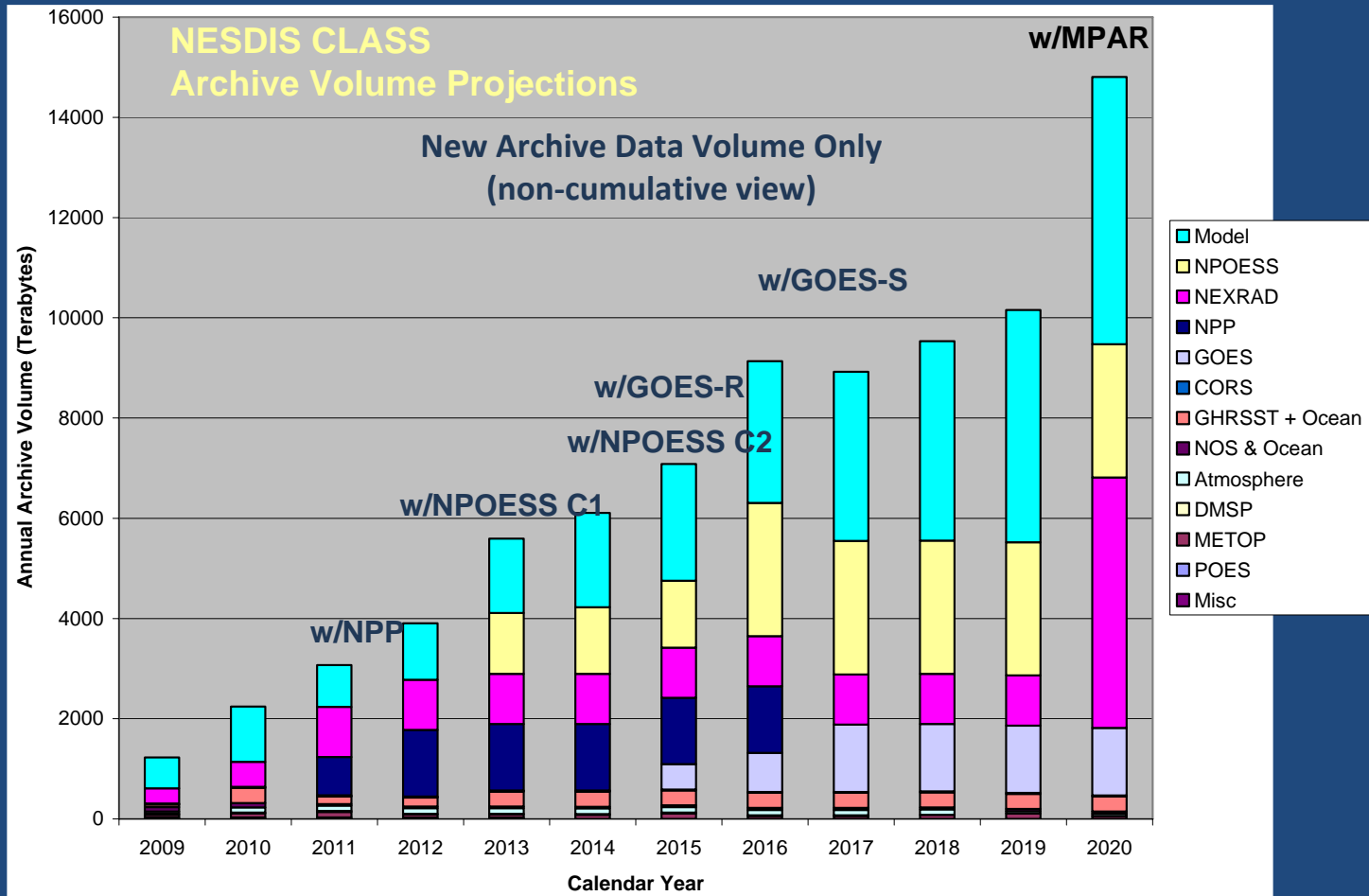




# S&T Roadmap Themes

## Next-Gen Forecast & Dec Support System Data Explosion

NWS SCIENCE AND TECHNOLOGY ROADMAP  
Preparing for Tomorrow... Today

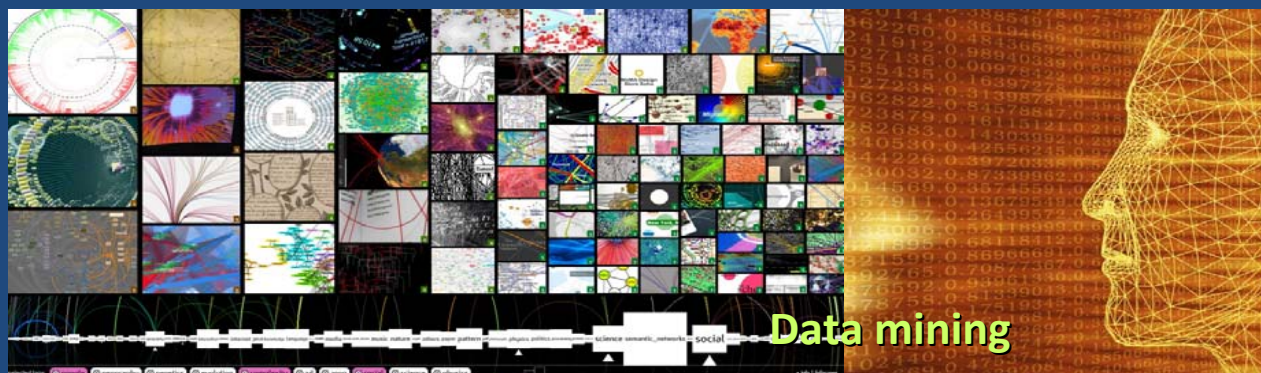




# S&T Roadmap Themes

## Next-Gen Forecast & Dec Support System

### Data Mining for Forecaster Assistance



- Accelerating insight, delineating patterns, probabilities and impact
- Helping forecasters focus on what matters, where uncertainty is
- Integrated tools to deliver coherent picture of distributed data from remote sources

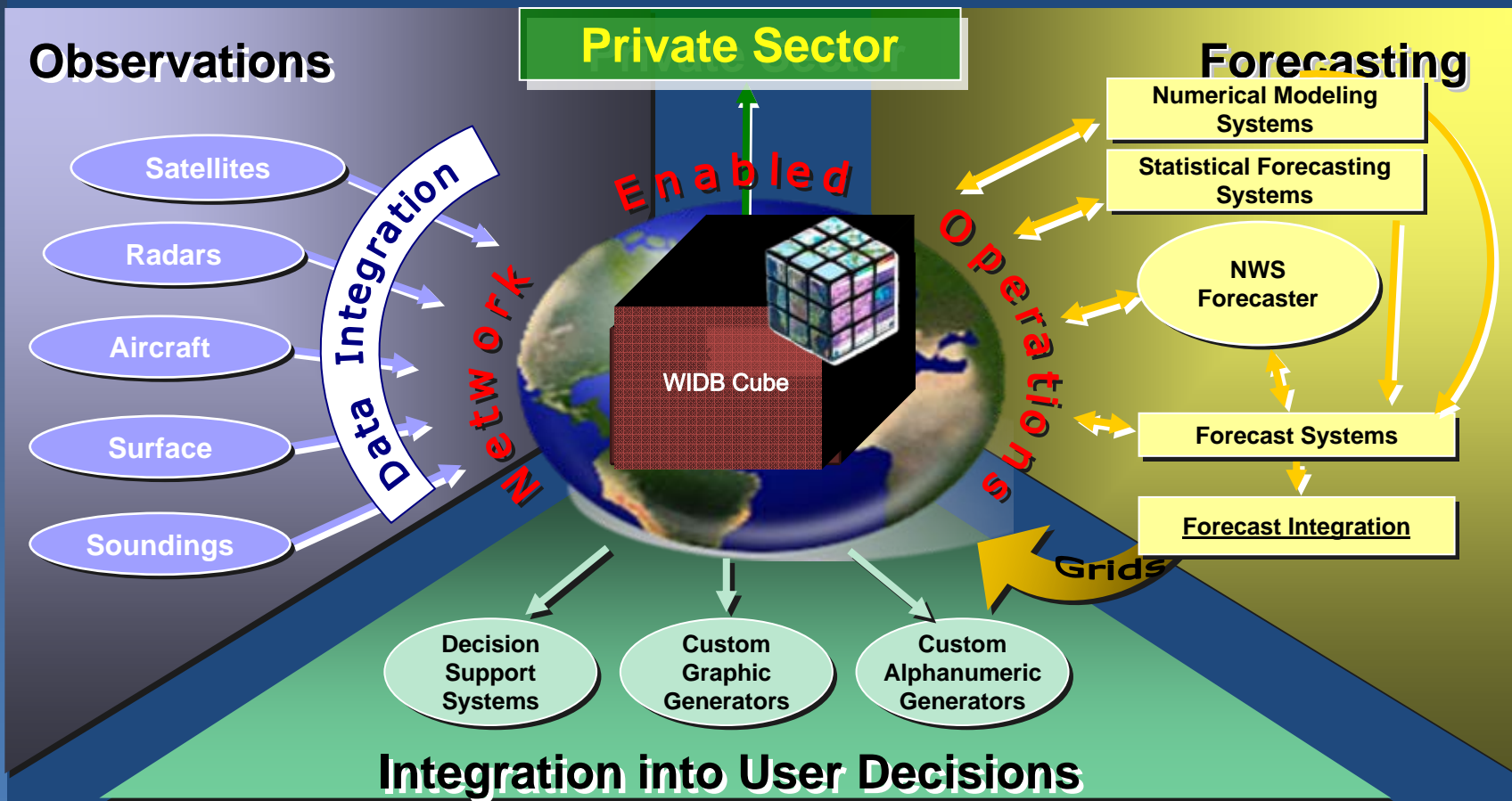
***Transforming Data into Knowledge***



# S&T Roadmap Themes

## Weather Information Database (WIDB)

NWS SCIENCE AND TECHNOLOGY ROADMAP  
Preparing for Tomorrow... Today



### Accomplishments

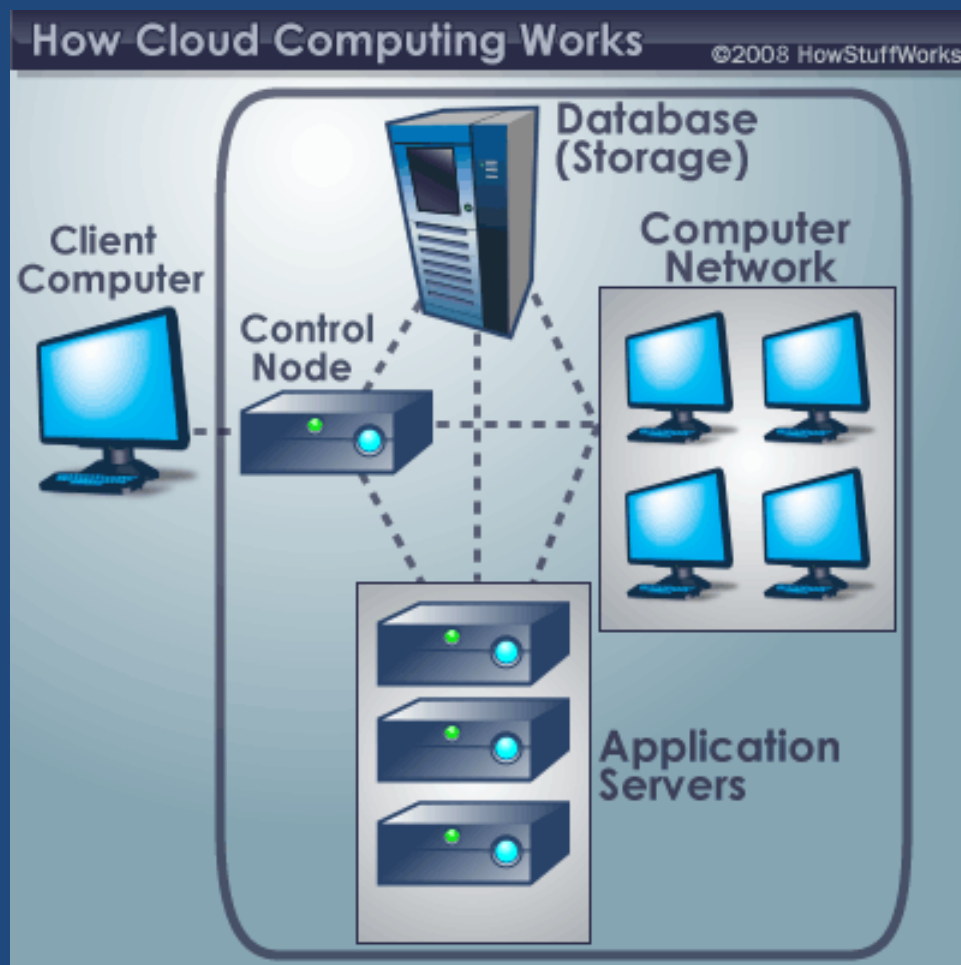
- ✓ NOMADS, MADIS, NDFD data/information ready
- ✓ Progress on weather IT architecture integration
- ✓ Progress on required IT infrastructure investment

# S&T Roadmap Themes

## *Weather Information Database (WIDB)*

### Cloud Computing

- Expectation is that ...software will be virtualized ... and taken care of by systems and/or professionals that are somewhere else - out there in The Cloud."  
- Irving Wladawsky-Berger, IBM
- Investigating ways to leverage (SR)



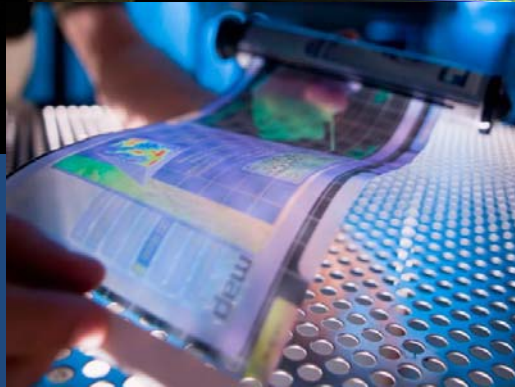
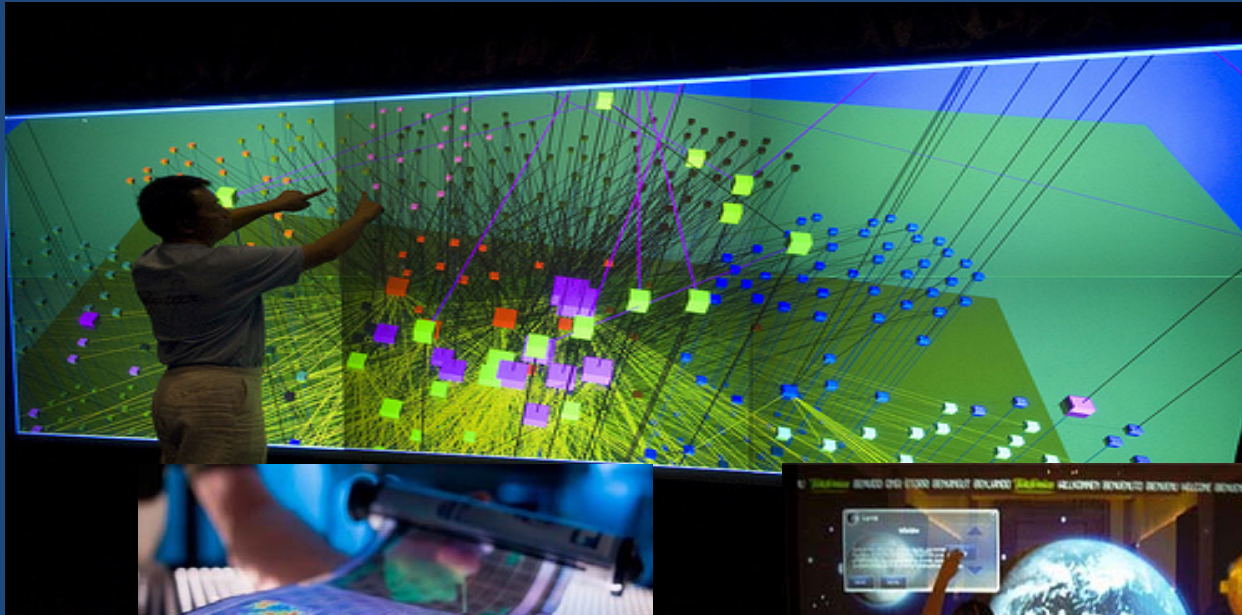


# S&T Roadmap Themes

## *Transform Dissemination/ Communication / Outreach Architectures for NWS Users*

NWS SCIENCE AND TECHNOLOGY ROADMAP

Preparing for Tomorrow... Today



### Accomplishments

- ✓ Emerging Technologies IWT, Customer Outreach/Feedback Focus Area Team
- ✓ Social Media Expanded: NWS Facebook Page

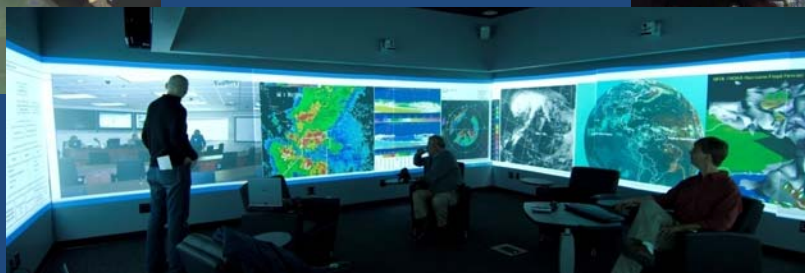
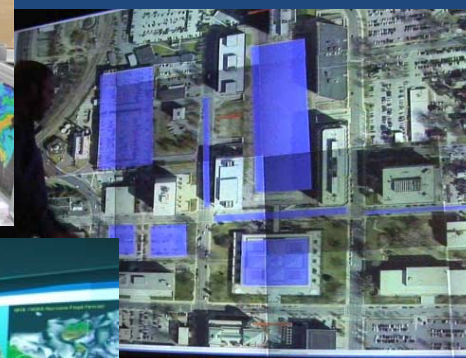
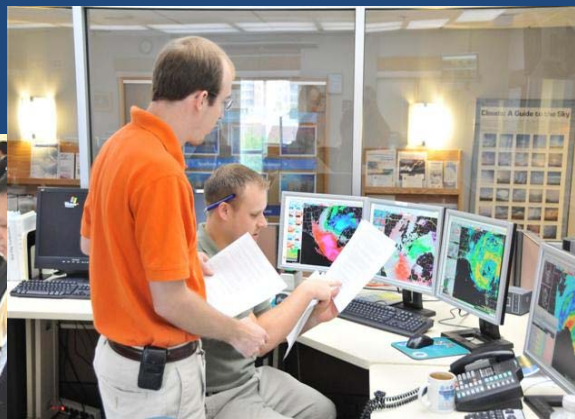


# S&T Roadmap Themes

## *Transform ... Architectures:*

### Forecaster Collaboration Technologies

- Improving collaborating with emergency managers via virtual environment (prototyping w ER partners)
- Innovation center approach: testing comms technologies, rapid prototyping of DSS applications, incorporating social sciences in comms

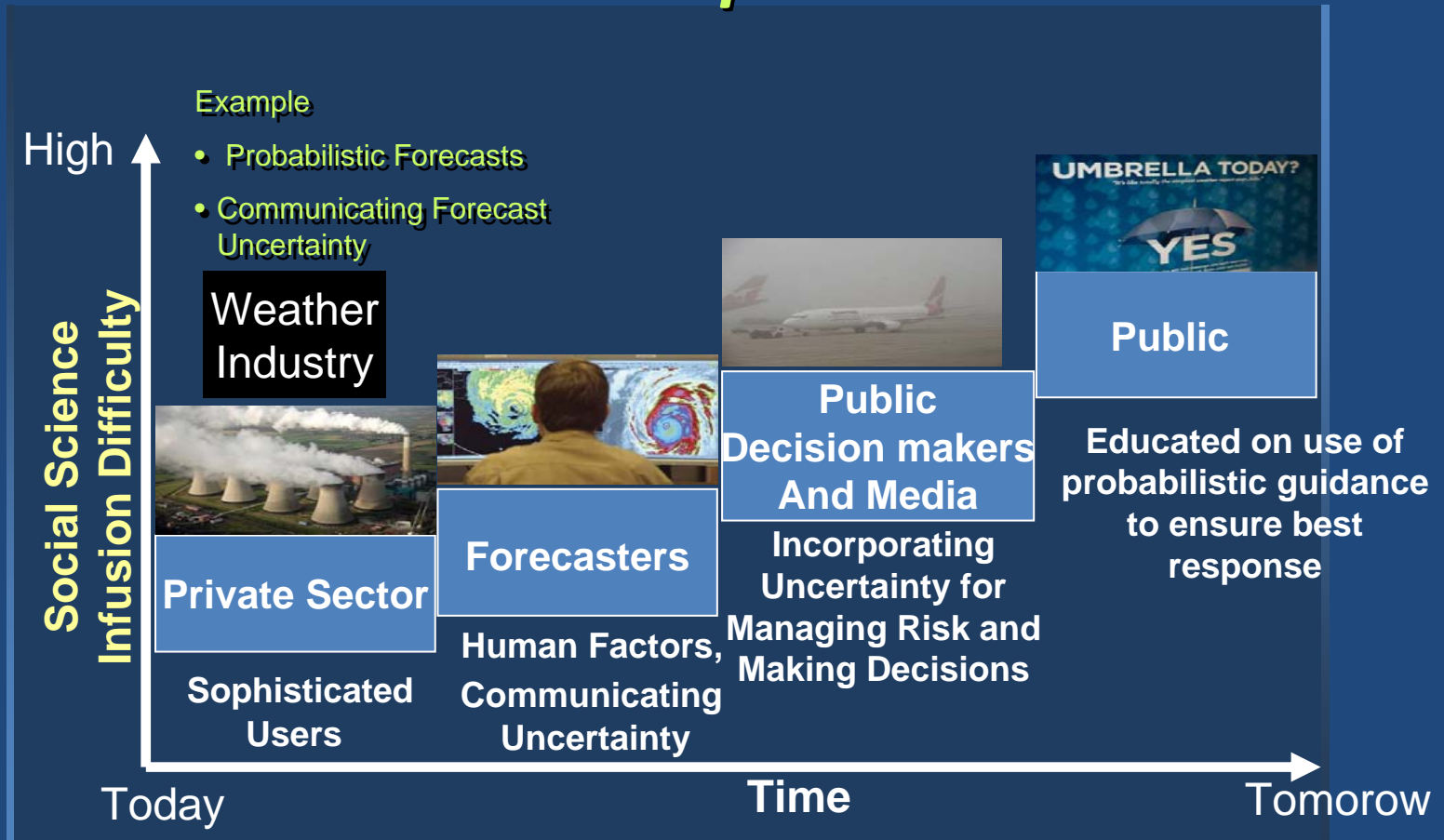




# S&T Roadmap Themes

## Incorporate Social Sciences Strategies in Research & Operations

NWS SCIENCE AND TECHNOLOGY ROADMAP  
Preparing for Tomorrow... Today



### Accomplishments

- ✓ Initiated study on improving icons, text of point forecasts
- ✓ Social science participation in NWS service assessments
- ✓ WAS\*IS summer workshop, whitepaper



# S&T Roadmap Themes

➤ **Comments, Questions, Concerns?**





# Improving Transition of Research to Operations (R2O/O2R) Framework

- More agile, rapid software development and infusion
- Skipping a generation of technology
- Innovation center partnerships
- Partnerships with academia, private industry, government
- Strengthen O-to-R processes: partner participation in testbeds, proving grounds
  - *Rapid prototyping*
  - *Developmental testbeds and operational proving ground*



# Improving R2O/O2R

## Testbed System & Ops Proving Ground

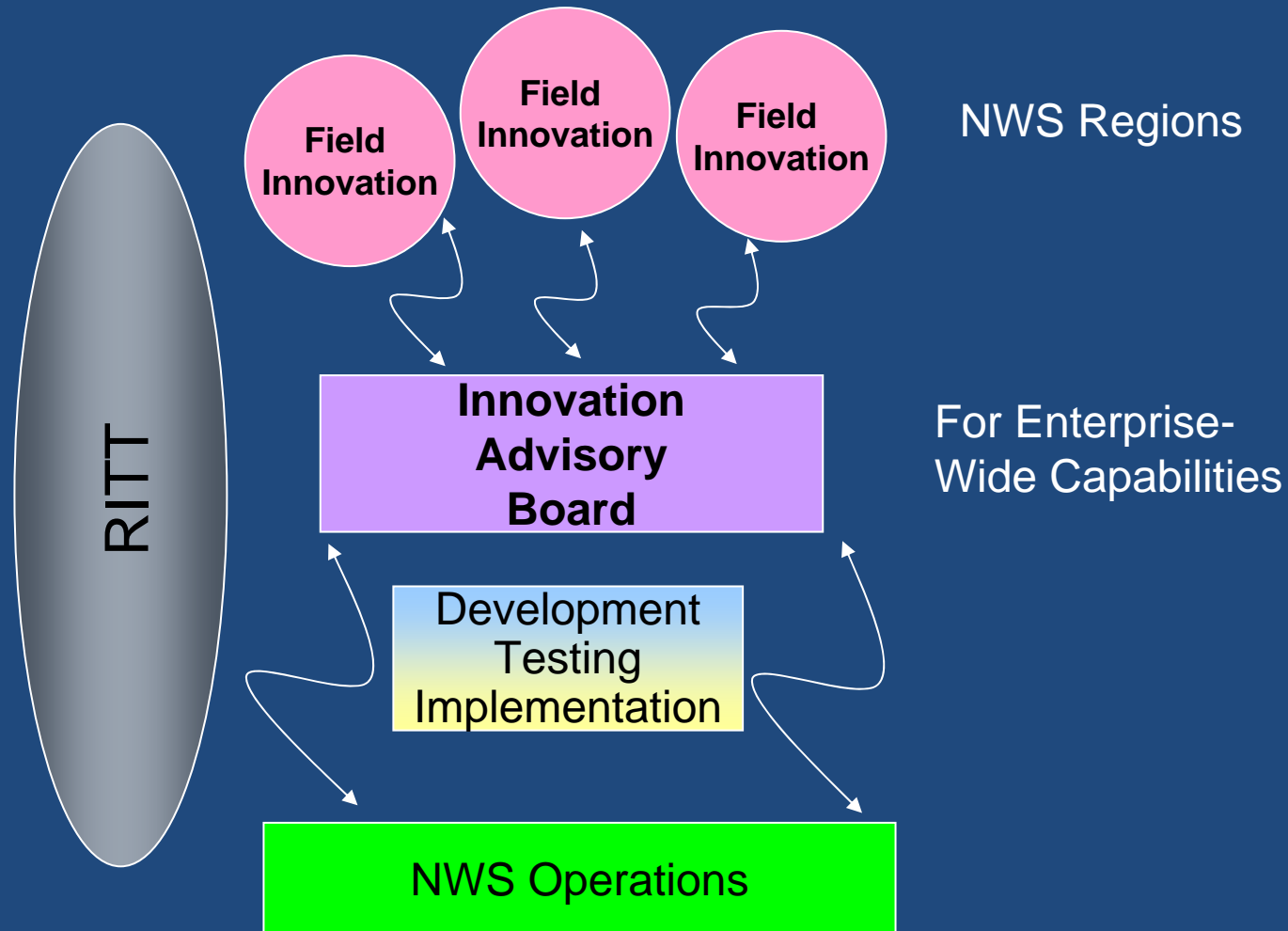




# Improving R2O/O2R

## Research and Innovation Transition Team (RITT)

### Managed Innovation





# Improving R2O/O2R *RITT Accomplishments*

- National Public Observing Program (NPOP)- completed Jan. 2010
- Mobile Decision Support Services (iNWS)
  - \$100K in FY10 to nationalize iNWS capability- IAB
  - Stage 3 of OSIP (#09-010)
- Iris
  - \$35K in FY10 for week-long workshop in SLC to determine web requirements, developer agreements on framework technologies, future tasking
  - Stage 2 of OSIP (#09-021)
- GIS Storm Reports
  - \$20K to run storm survey application on Blackberry



# Improving R2O/O2R *Demonstration Projects*

- **OCWWS, OST, OAR collaborating on major demonstration projects**
  - *Develop, implement S&T advances needed for improved*
    - **Prediction of initiation, evolution of convection**  
*winds forecasting for renewable energy*
    - **Ecosystem prediction with hydrology focus**



# Improving R2O/O2R

➤ **Comments, Questions, Concerns?**



# Next Steps

- **Publish S&T Roadmap summary document**
- **Track progress and update S&T Roadmap**
- **Continue planning, programming, budgeting, execution processes**



# S&T Roadmap

## Discussion