

**USWRP SSC Meeting  
Washington DC**

**January 26, 2004**

**Bob Gall**

**Lead Scientist  
US Weather Research Program**





***Public expectations for weather forecasting are rising faster than the current rate of improvement in weather forecasting technology.***

**Purpose: Accelerate the rate which weather forecasts are improved**

- **Interagency Initiative (NOAA, NSF, NASA, DoD)**
- **Focus narrowed to two initial programs:**
  - Improving Precipitation Forecasts**
  - Forecasting Hurricanes at Landfall**
- **Full implementation plans for each program have been prepared**
- **Expected result: Within five years a noticeable increase in the accuracy of forecasts of rain/snow, severe weather, and hurricane landfall.**

***The program has been designed to address specific goals***



## Specific USWRP Goals for Quantitative Precipitation Forecasting

- **Provide west coast forecasts as accurate as forecasts for the rest of the country**
- **Increase the skill by two full days of current Day-5, Day-6 and Day-7 forecasts**
- **Increase the skill of Day 2 and Day 3 operational numerical weather prediction model QPF's by one day**
- **Provide weather and water forecasts in probabilistic terms out to three days**
- **Increase the skill of the Day 1 operational NWP model QPF's by 25%**

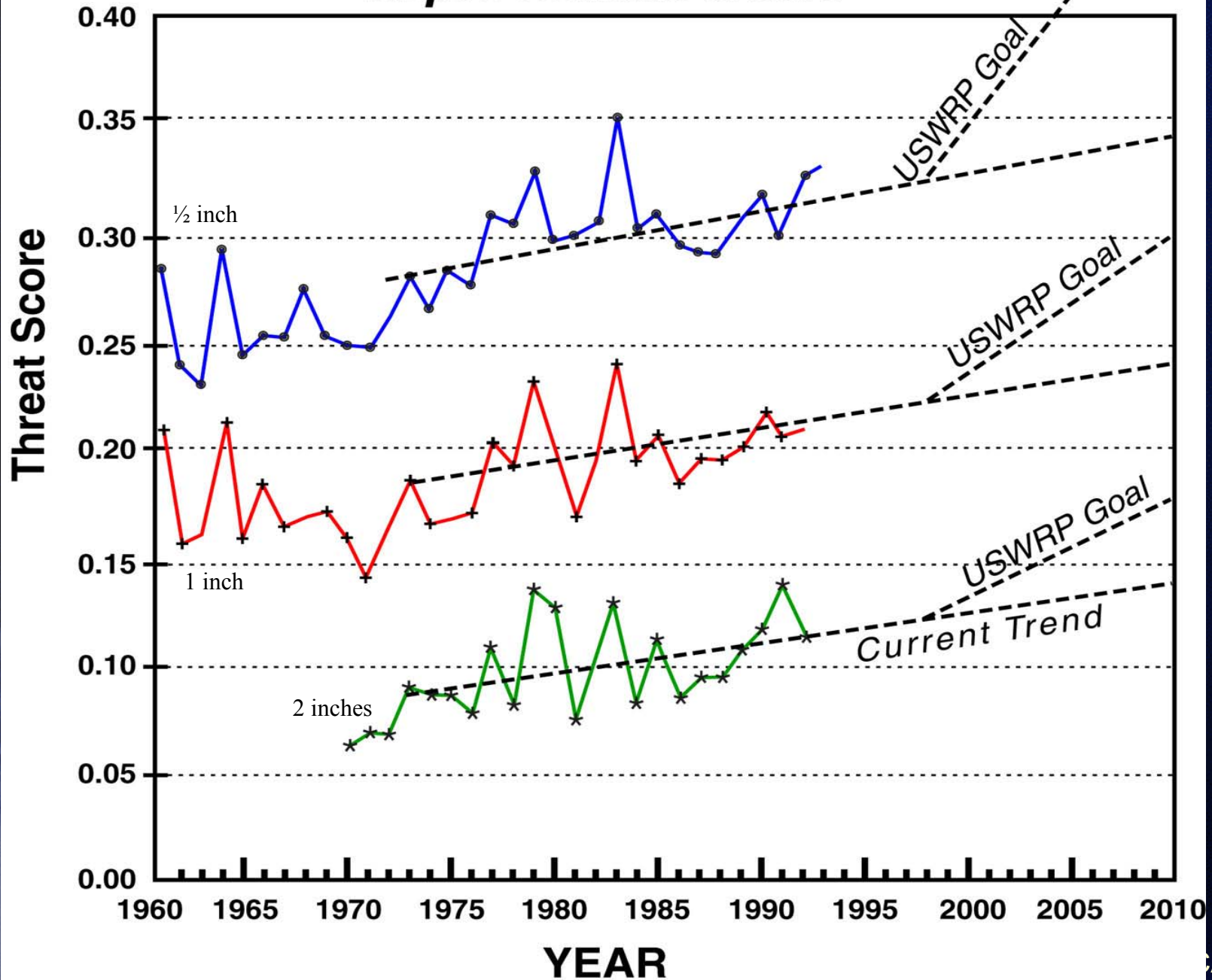


## Specific USWRP Goals for Quantitative Precipitation Forecasting (cont.)

- Increase flash-flood warning lead time from 52 minutes (1998) to 65 minutes (2005).
- Develop and implement a weather research and forecast community model.
- Achieve the optimal mix of observing and data processing systems to support the NWS mission.
- Decrease by 50% the time necessary to incorporate new satellite data sets into an operational assimilation system.
- Incorporate Doppler radar data into operational mesoscale models.



# Acceleration of Forecast Improvement Goals



## USWRP Goals for Hurricane Landfall

- **Reduce landfall/track/intensity forecast errors by 20%**
- **Increase warning lead-time to and beyond 24 h with 95% confidence without increasing the present 3 to 1 over-warning**
- **Make skillful (vs. persistence) forecasts of gale-and hurricane-force radii out to 48 h with 95% confidence**
- **Extend QPF to 3 days and improve skill of day-3 forecasts to improve inland flooding forecasts**



## **US Weather Research Program The Broad Program**

- **Technology Transfer**
  - **Provide a smooth path of new technology and forecasting techniques into operations**
  - **Emphasis on achieving USWRP goals**
- **Basic and Applied Research**
  - **A research program to provide the new science and technology for tech transfer**
  - **Both short and long-term research strategies for addressing the goals**



# USWRP—Technology Transfer

- Transfer is primarily accomplished through:
  - **Community Models**
    - WRF
  - **Operational Transition Test Beds**
    - Joint Hurricane Testbed (JHT)
    - Developmental Testbed Center
    - Joint Center for Satellite Data Assimilation
  - **Expert Systems**
    - Several examples including Auto-Nowcasting
  - **Education and Training**
    - COMET



# USWRP

## Basic and Applied Research Program

- **Quantitative Precipitation Program**

- Three Components:

- Extended range: QPF                      2-14 Days, global (THORpex)
    - Short-term Warm Season QPF            0-48 hours, mesoscale
    - Short-term Cool Season QPF            0-48 hours, mesoscale

- **Hurricane Landfall**

- **Air Quality Forecasting**



# Programs Within USWRP

- WRF
- THORpex
- Pacjet
- IHOP
- IMPROVE
- CRAFT
- CONDUIT
- Hurricane Landfall (HL)
  - Includes several field programs (CAMEX, CBLAST...)



# Programs Within USWRP

- (WSR)?
- National Test Facilities
  - JHT
  - DTC
  - JCSDA
  - HMT
- Education and Training (COMET?)
- Societal Impact Research





**Interagency Working Group  
Uccellini, Killeen Co-Chairs**

**Interagency Program Office  
Gaynor, Director**

**Office of the Lead Scientist  
Gall, Lead Scientist  
Kerschner, Admin. Asst.  
Fredrick, Webmaster**

**Science Steering Committee  
(Gall)**

**Workshops  
(as needed)**

**Prospectus Development Teams  
(as needed)**

**Field Programs  
(as needed)**





# US Weather Research Program SWRP

## Prospectus Development Teams (Co-Chairs)

<b>Team 1</b>	<b>Overarching Issues &amp; Opportunities in Weather Prediction</b> <i>K. Emanuel, MIT.; D. Raymond, New Mexico Mines</i>	Oct '94	<b>Team 2</b>	<b>Observations In the Forecast System</b> <i>W. Dabberdt, NCAR; T. Schlatter, NOAA</i>	May '95
<b>Team 3</b>	<b>Coastal Issues &amp; Opportunities</b> <i>L. Pietrafesa, NCSU; R. Rotunno, NCAR</i>	Sept. '95	<b>Team 4</b>	<b>Mountain Issues &amp; Opportunities</b> <i>J. Paegle, U of Utah; R. Smith, Yale</i>	March '96
<b>Team 5</b>	<b>Landfalling Hurricanes</b> <i>F. Marks, NOAA; L. Shay, U of Miami</i>	April '96	<b>Team 6</b>	<b>Societal Aspects</b> <i>J. Kimpel, NOAA; R. Pielke, Jr., NCAR</i>	May '96
<b>Team 7</b>	<b>Observing &amp; Assimilation Strategies for Data-Sparse Regions</b> <i>K. Emanuel, MIT; E. Kalnay, U of Oklahoma</i>	July '96	<b>Team 8</b>	<b>Quantitative Precipitation Forecasts</b> <i>J.M. Fritsch, PSU; R. Houze, U of Washington</i>	Sept. '96
<b>Team 9</b>	<b>Hydrological Aspects &amp; Flood Prediction</b> <i>K. Droegemeier, U of Oklahoma; J.D. Smith, USGS</i>	Jan. '98	<b>Team 10</b>	<b>Urban Forecast Issues &amp; Opportunities</b> <i>S. Changnon, Illinois State Water Survey; W. Dabberdt, NCAR</i>	July '98



# PDT 9 Recommendations

- **QPE**
  - Improve Algorithms for radar based QPE and establish measures to quantify uncertainty
  - Develop techniques for blending data from multiple sensors
  - Establish a community database for remote and in-situ data
  - Enhance current in-situ US hydrological observing network



# PDT 9 recommendations

## • Numerical Modeling

- Conduct sensitivity and parameter estimation studies of the individual and coupled models
- Develop coupled atmospheric/hydrologic models
- Conduct verification studies with emphasis on using the hydrologic models to verify the atmospheric models
- Improve data assimilation techniques in hydrologic models
- Assess the suitability of current microphysical parameterizations for use in hydrological models
- Combine deterministic and statistical modeling approaches
- Improve characterization of surface and subsurface properties and physical processes in atmospheric and hydrologic models



# PDT 9 recommendations

## •Natural laboratories

–Utilize “natural laboratories” for studying a variety of natural phenomena in meteorology-hydrology coupled systems

- Floods caused by intense rainfall from topographically induced summer convection

- Floods caused by intense rainfall that lands on preconditioned ground

- Floods produced by rainfall on snow-covered ground

- Floods associated with tropical and extratropical cyclones

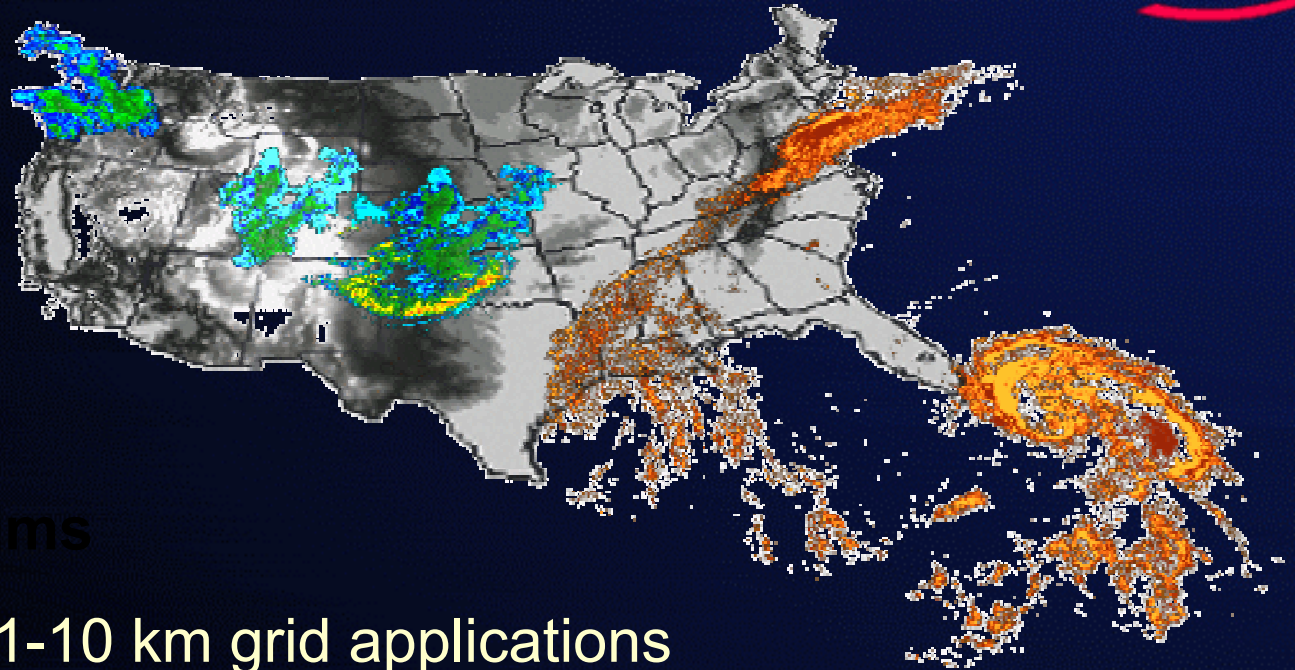
–Hold a workshop to establish the logistics and scientific framework for the “natural laboratories”



# Next-Generation Mesoscale Modeling: The **W**eather **R**esearch and **F**orecasting Model

**WRF Project Goals:** *To develop an advanced mesoscale forecast and assimilation system and to accelerate research advances into operations*





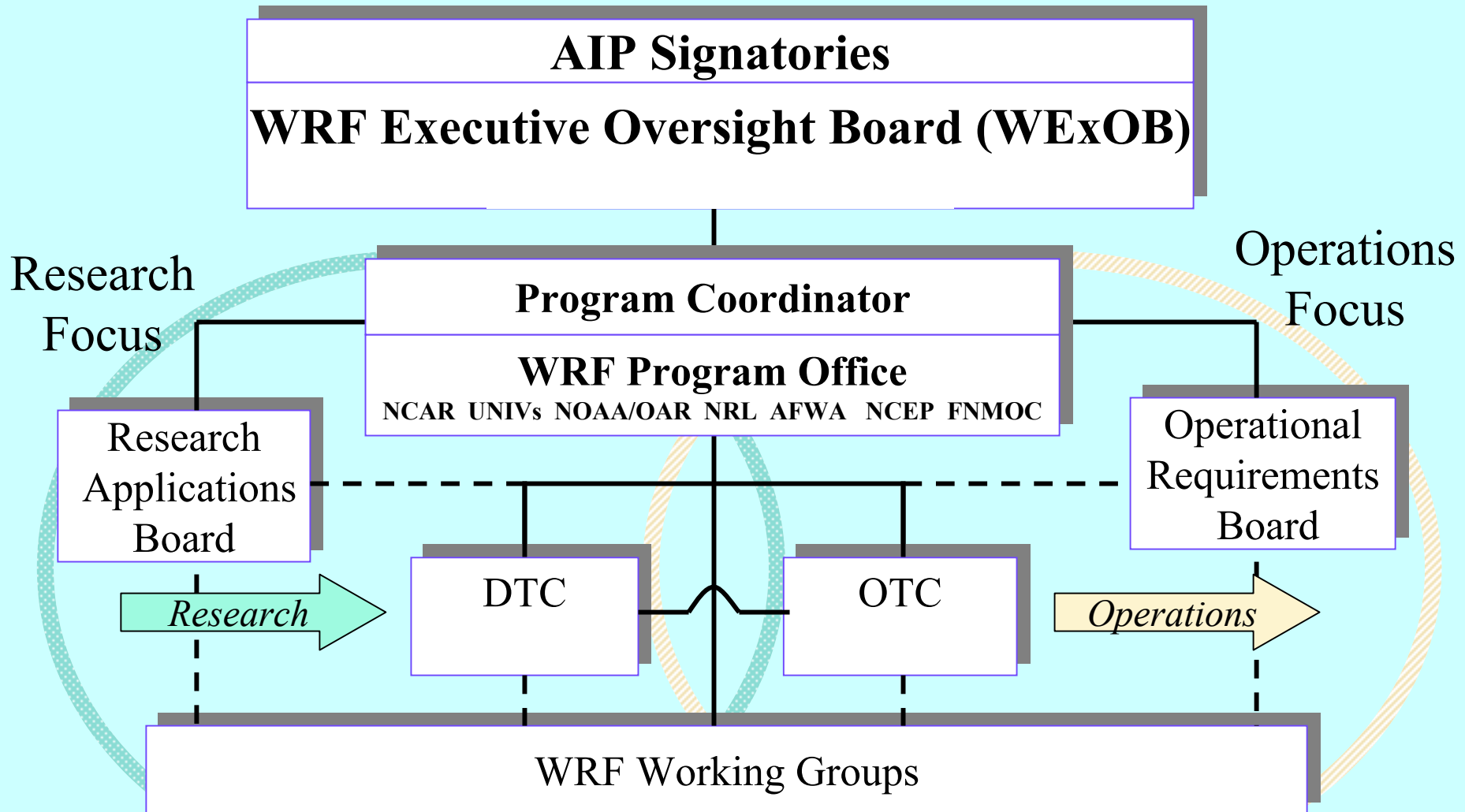
## WRF R&D aims

- ✓ Priority for 1-10 km grid applications
- ✓ Advanced data assimilation and model physics
- ✓ Portable and efficient on parallel computers
- ✓ Well-suited for a broad range of applications
- ✓ Community model with direct path to operations



# WRF Organization: [Working Draft 1 ]

## (Research & Operations Foci)

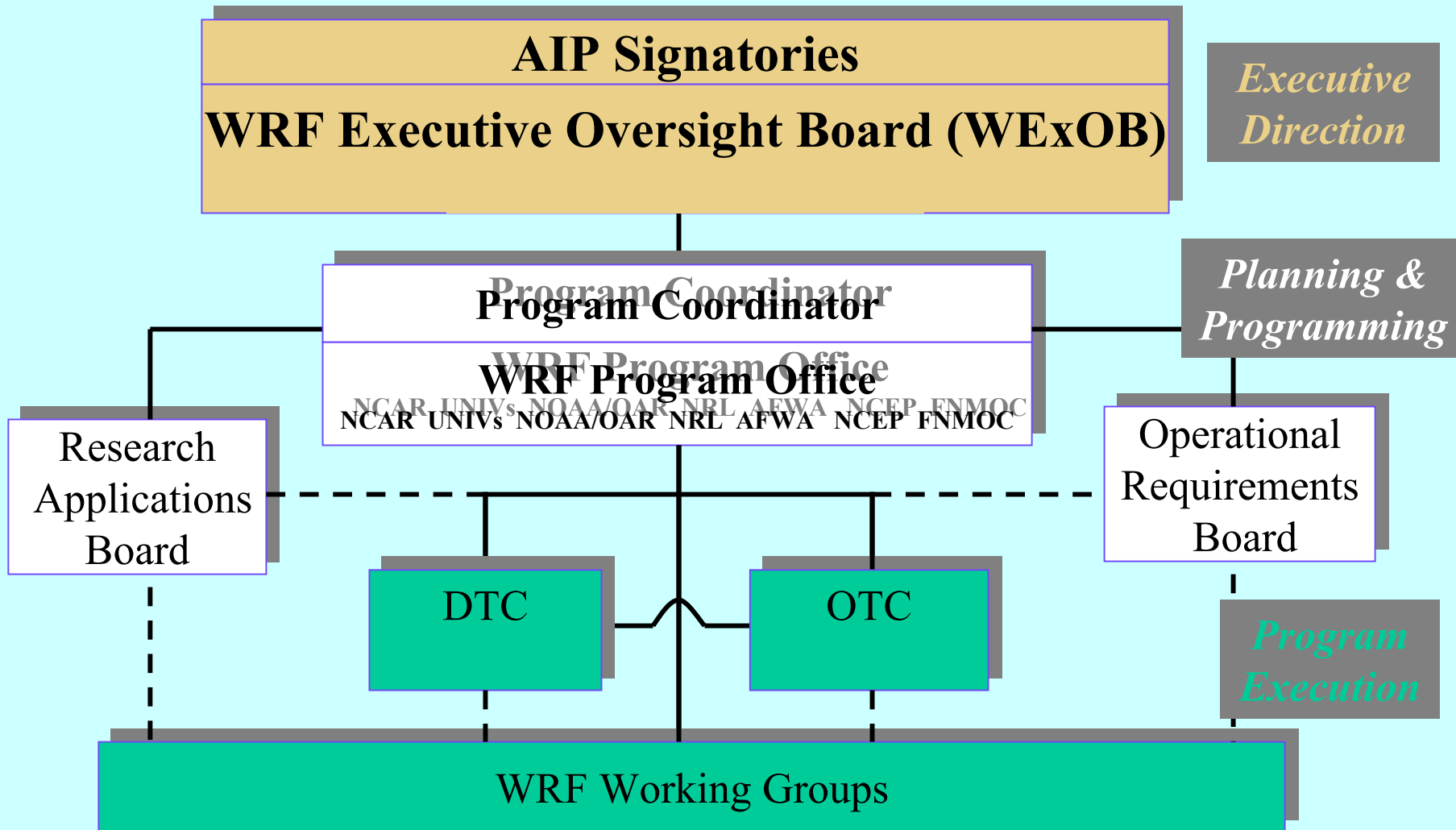


\* Note – separate OTC functions exist for each OPC



# WRF Organization: [Working Draft 1 ]

## (Functional Responsibilities)

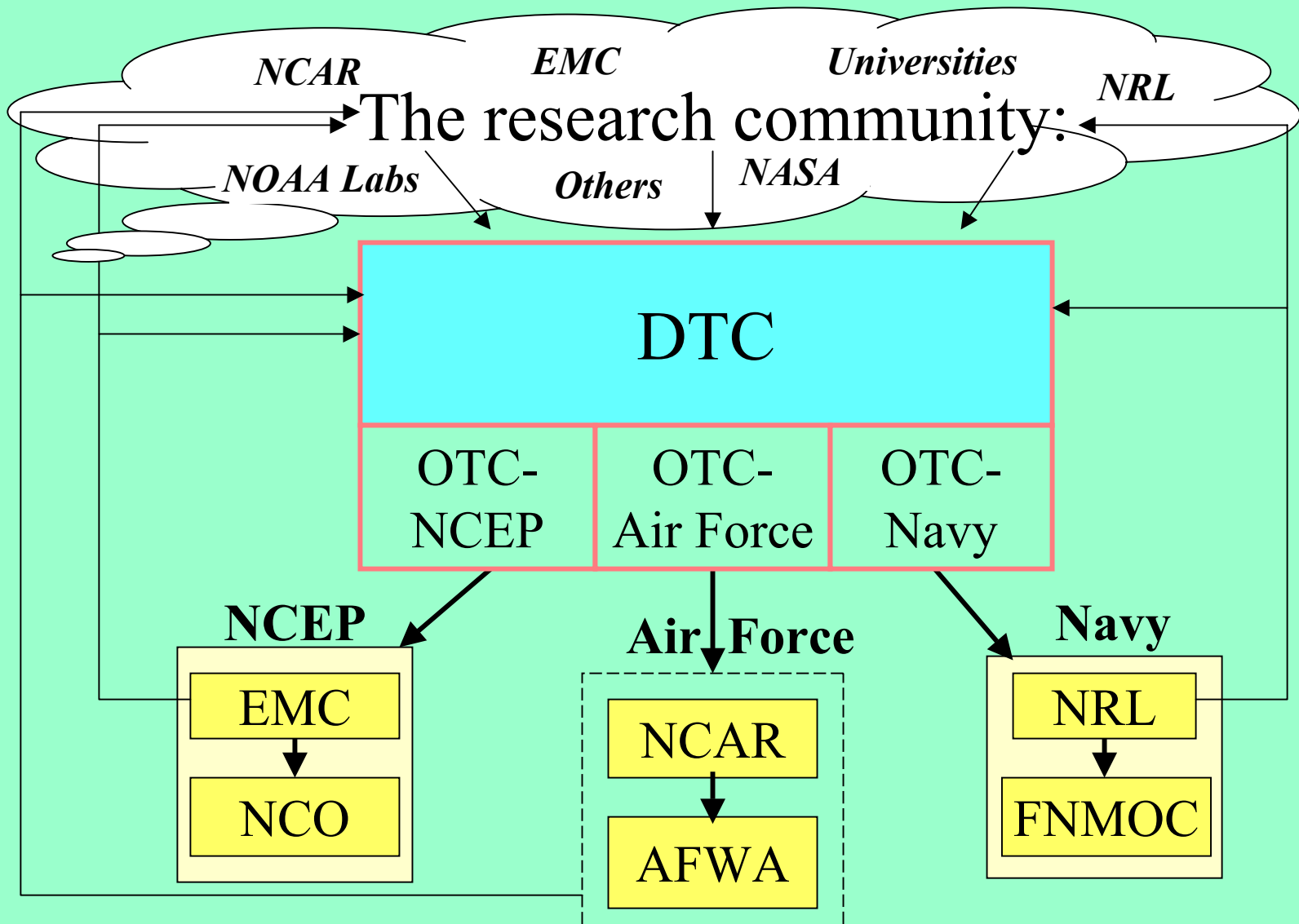


\* Note – separate OTC functions exist for each OPC



# The Flow of Science from Research to Operations in the WRF Era:

**Bridging the "Valley of Death"**







USWRP



Initial Operational WRF will be implemented at NCEP and AFWA as an Ensemble System



## ***WRF Mesoscale Ensemble:***

- Replace a deterministic WRF with an *ensemble* running in the current High-Resolution Window domains
  - 6-member initial ensemble:
    - > 2 control members
      - NCEP NMM core,  $Dx = 8$  km**
      - NCAR Mass core,  $Dx = 10$  km**
    - > 4 Additional members  
(alternative physics or I.C. anomalies)

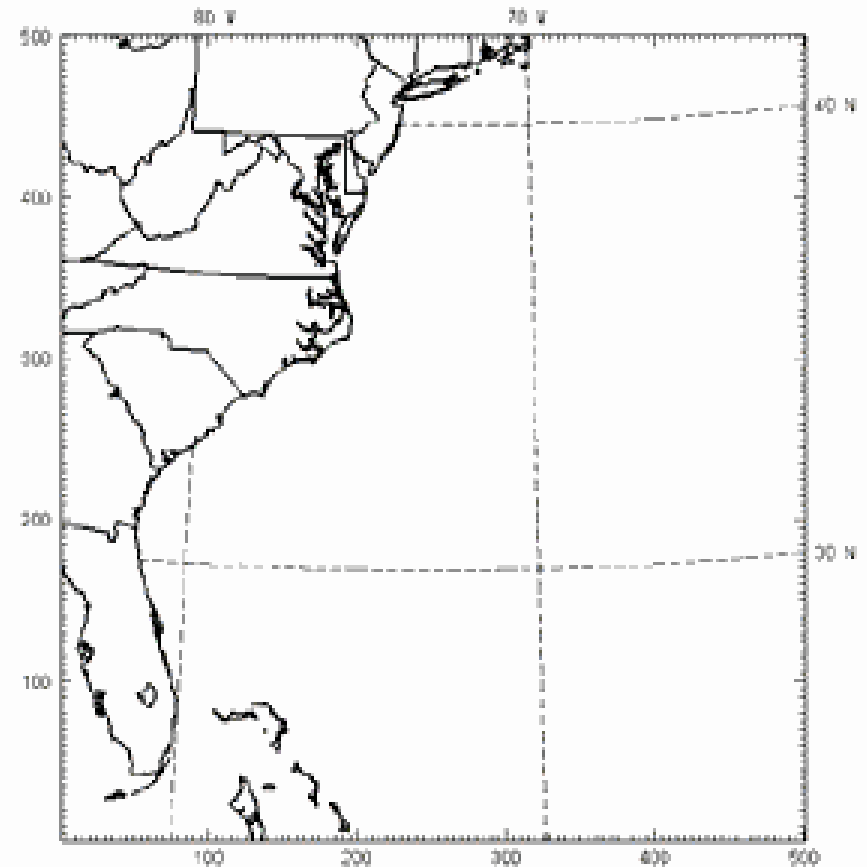
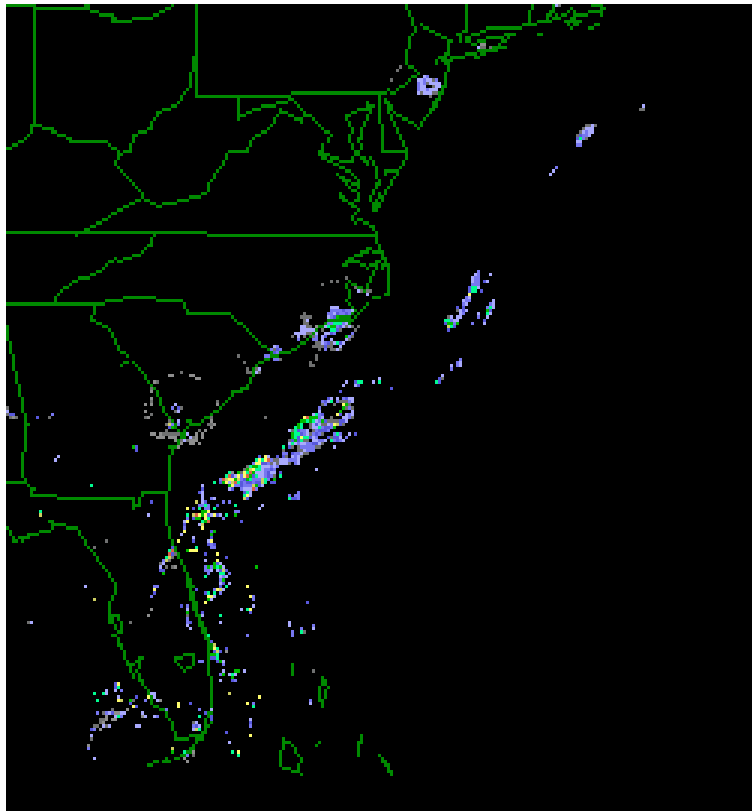
**WRF operational at NCEP: 1 Oct. '04**



# 48 h Hurricane Isabel Reflectivity Forecast

Initialized 00 UTC 17 Sep 03

00 UTC, 17 Sep 03





**The End**