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USWRP SSC Meeting
Washington DC

January 26, 2004

Bob Gall

Lead Scientist
US Weather Research Program

U.S. Weather Research Program (USWRP)

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

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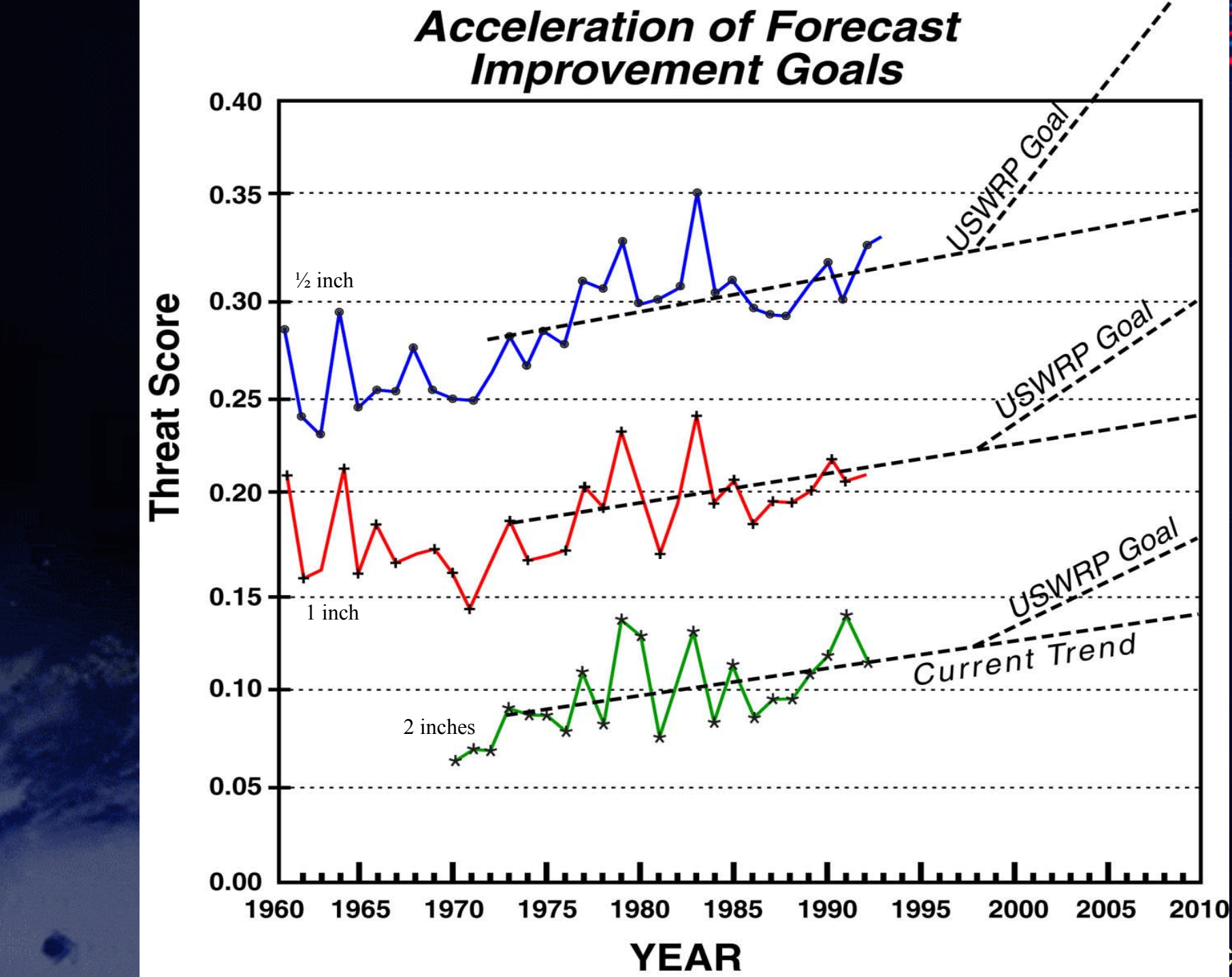
Specific USWRP Goals for Quantitative Precipitation Forecasting

- **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 form 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
Threat Score
0.40
0.35
0.30
0.25
0.20
0.15
0.10
0.05
0.00
1960
1965
1970
1975
1980
1985
1990
1995
2000
2005
2010
YEAR
½ inch
1 inch
2 inches
USWRP Goal
USWRP Goal
USWRP Goal
Current Trend

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**

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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

USWRP Organization

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 Prospectus Development Teams (Co-Chairs)

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

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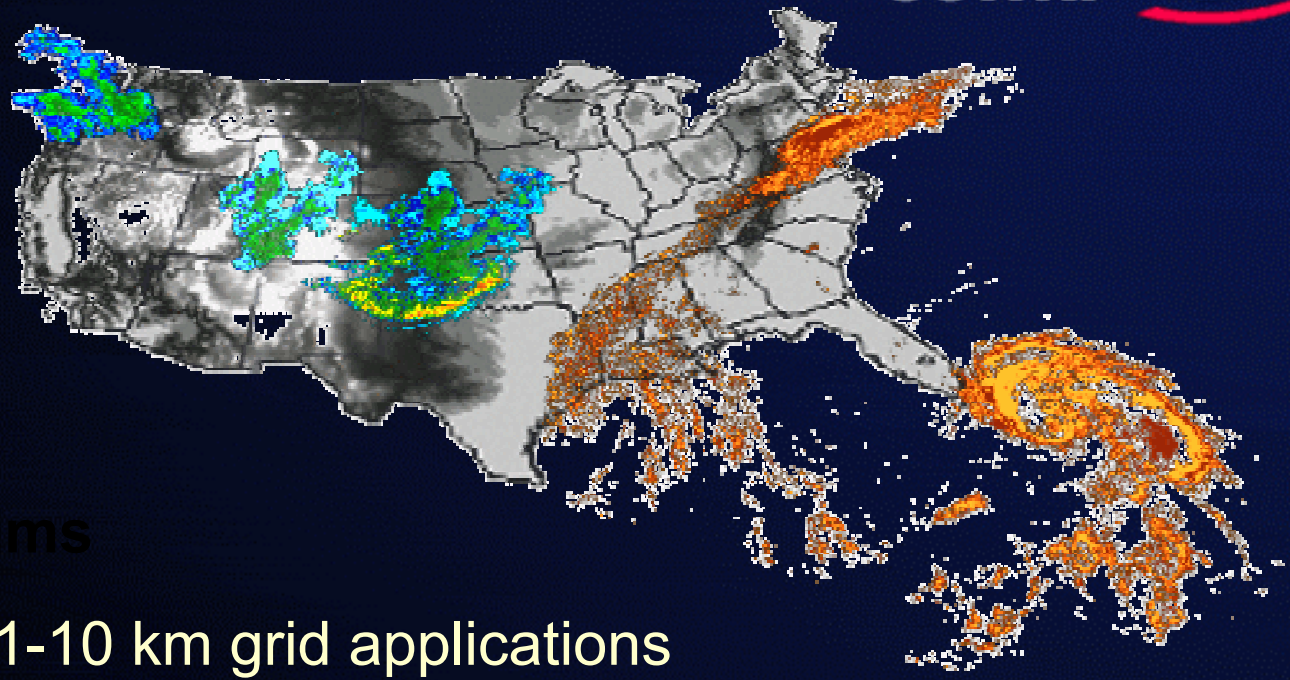
Next-Generation Mesoscale Modeling:
The Weather Research and Forecasting Model

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

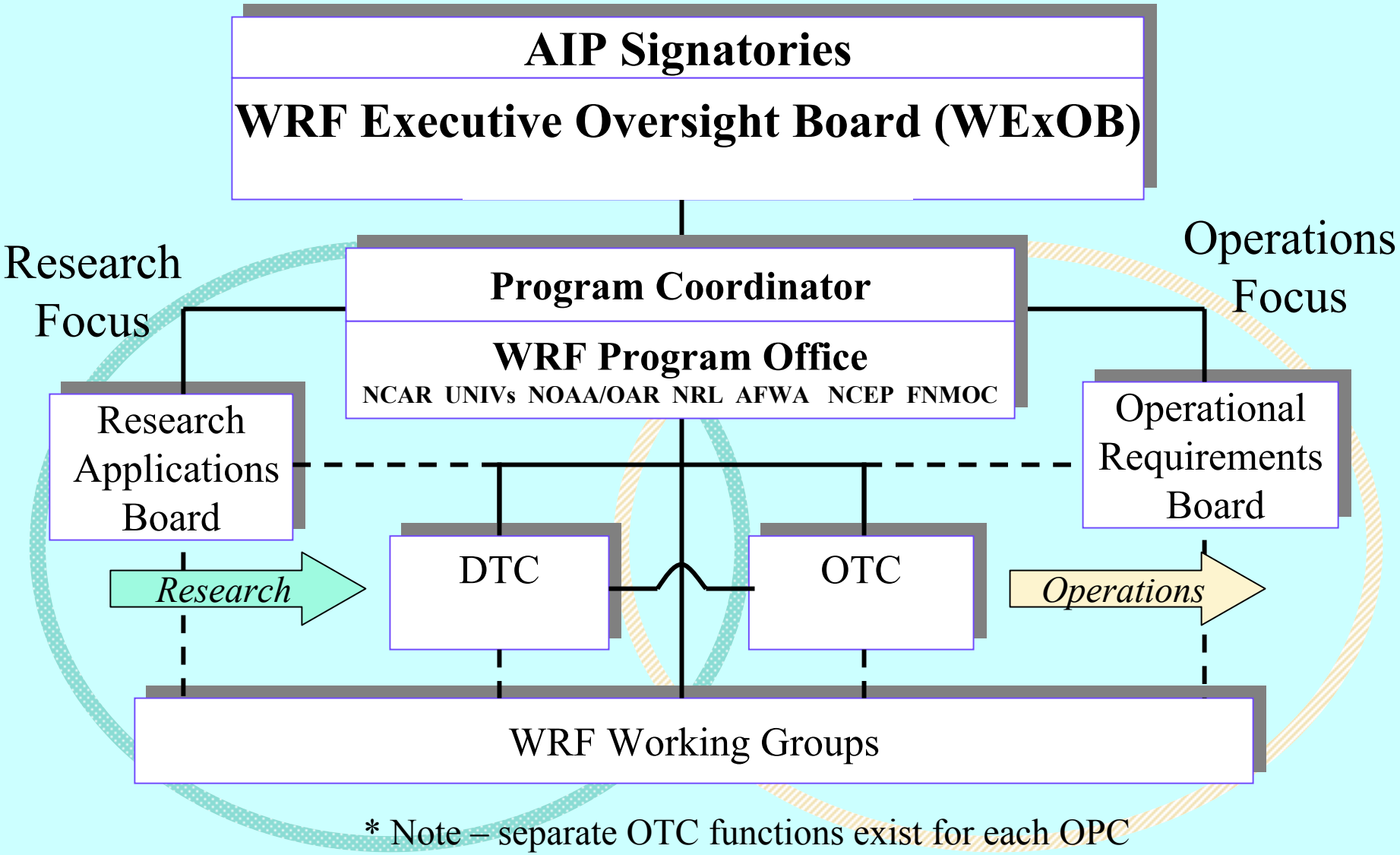
Robert Gall - NCAR



WRF R&D aims

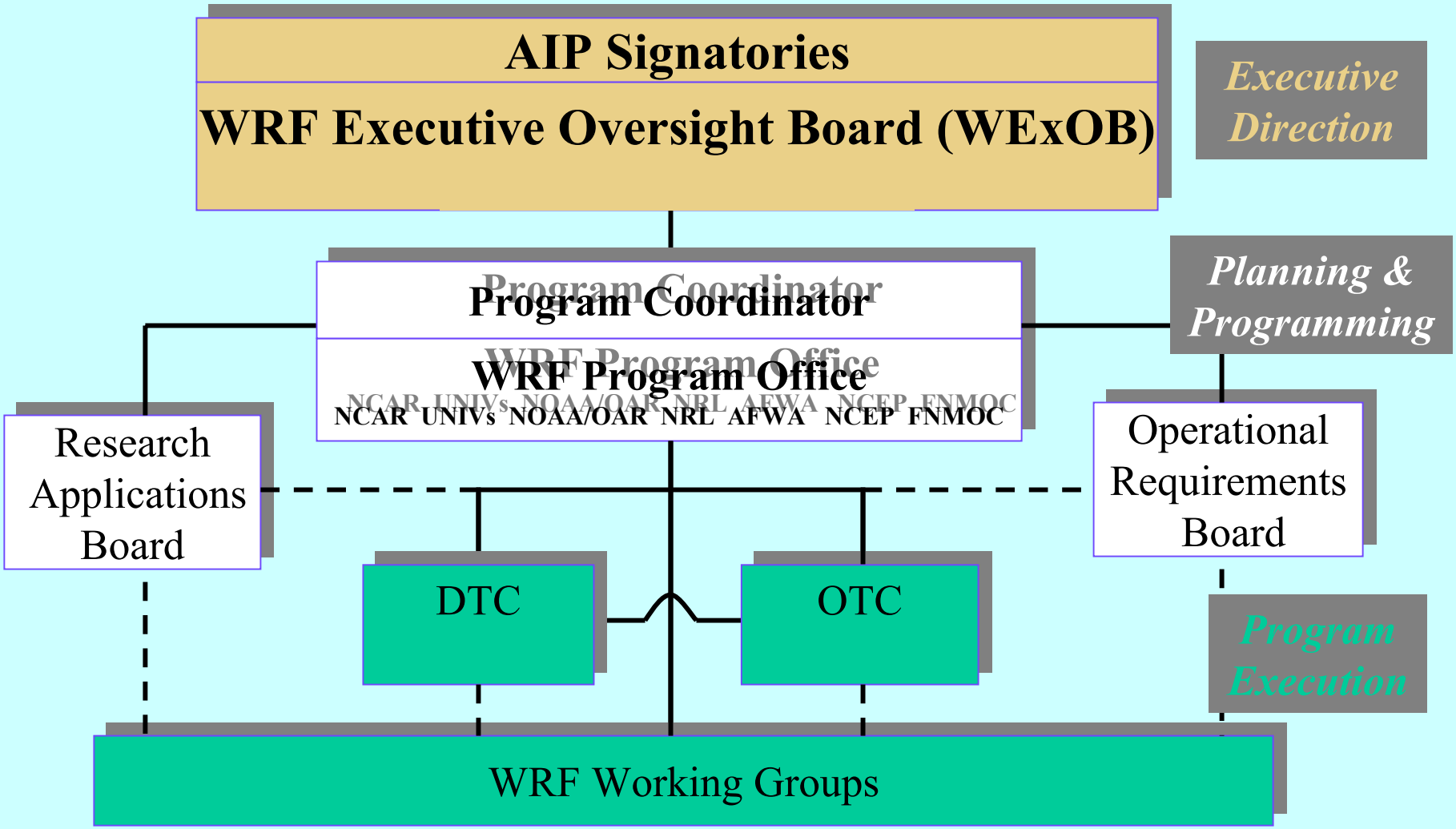
- ✓ Priority for 1-10 km grid applications
- ✓Advanced data assimilation and model physics
- ✓Portable and efficient on parallel computers
- ✓ Well-suited for a broad range of applications
- ✓ Community model with direct path to operations

WRF Organization: [Working Draft 1] (Research & Operations Foci)



* Note – separate OTC functions exist for each OPC

WRF Organization: [Working Draft 1] (Functional Responsibilities)



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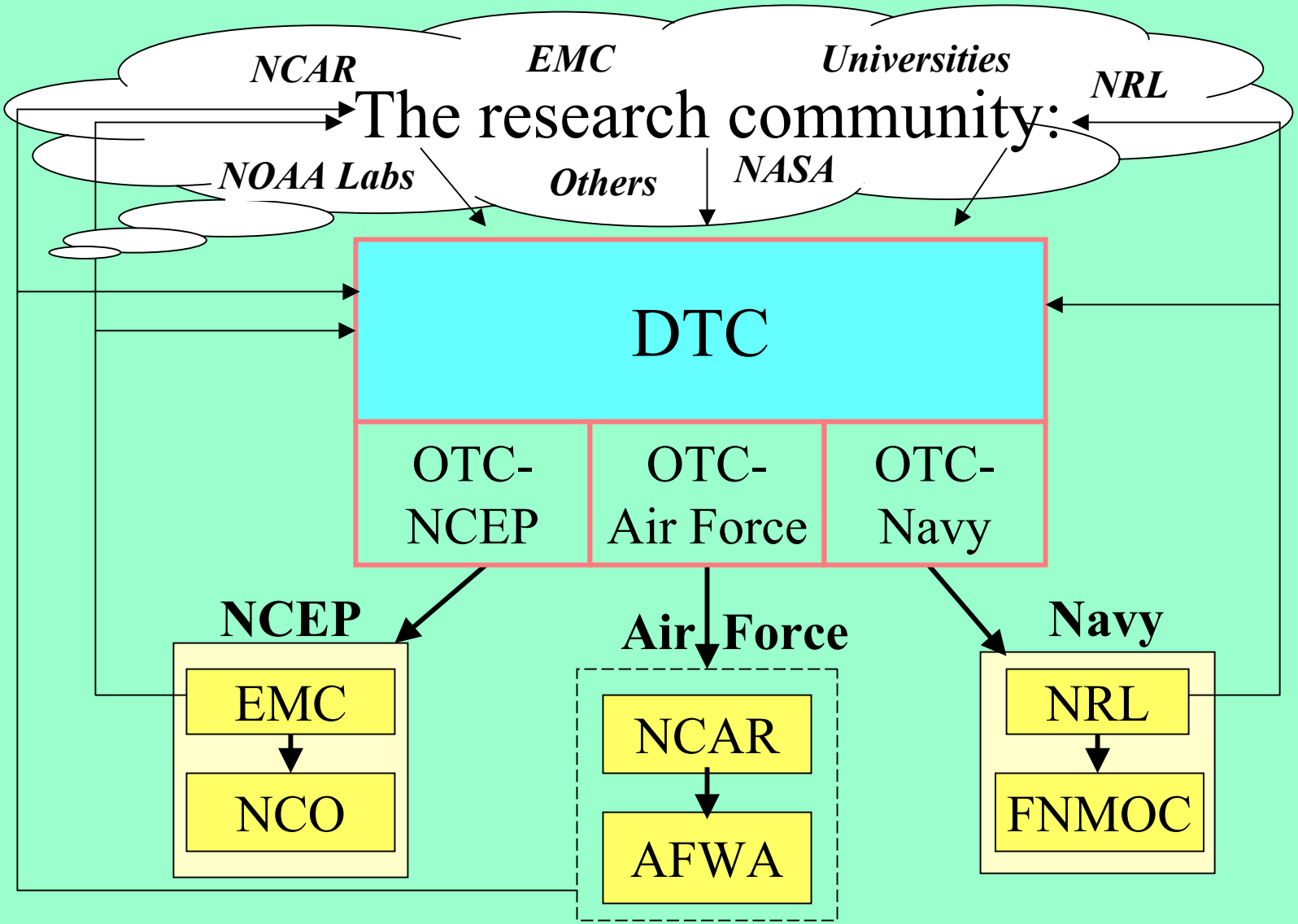
The Flow of Science from Research to Operations in the WRF Era:

Bridging the "Valley of Death"



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

Robert Gall - NCAR

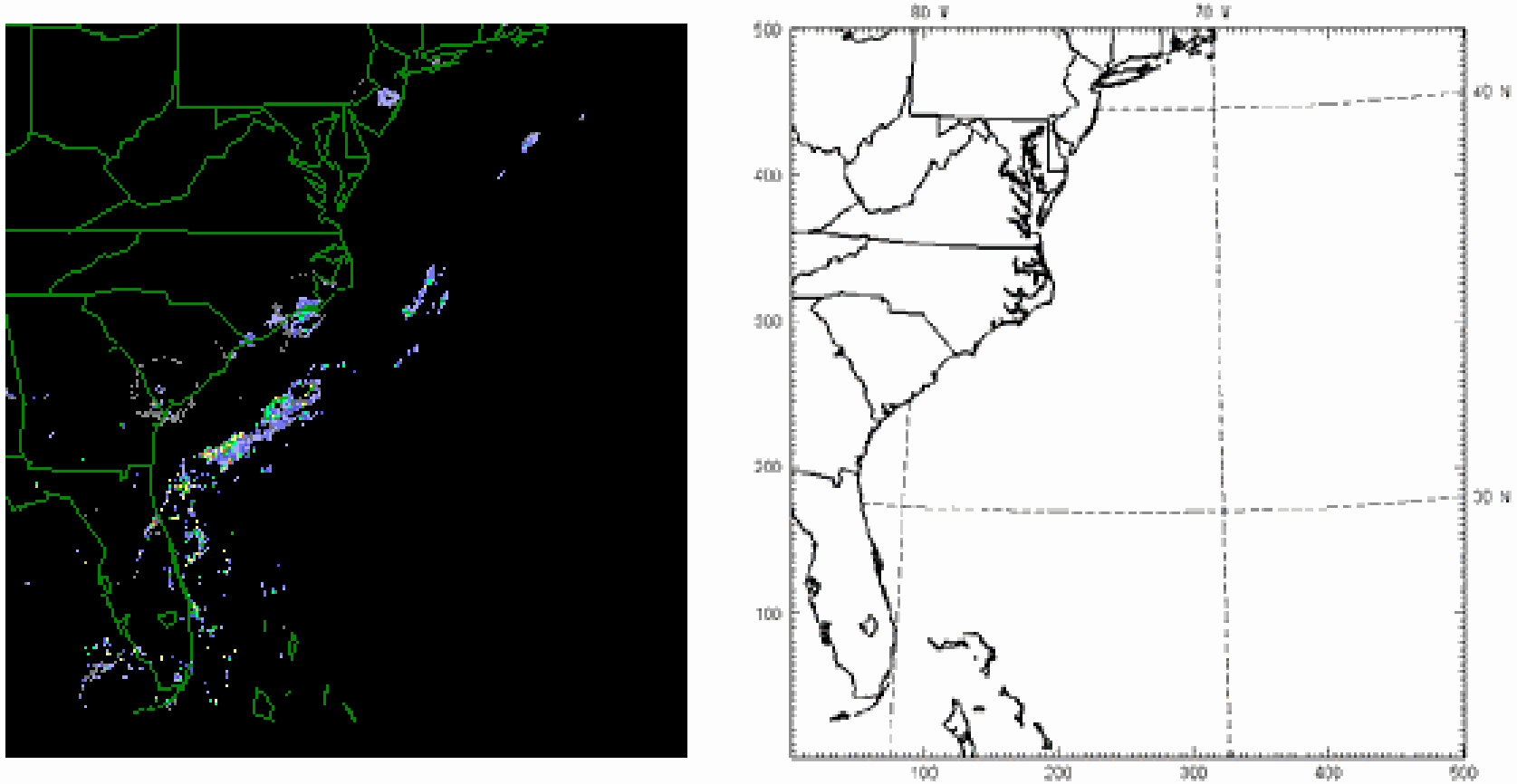
WRF Mesoscale Ensemble:

- 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



The End