JOINT ACTION GROUP FOR ATMOSPHERIC TRANSPORT AND DIFFUSION MODELING (RESEARCH AND DEVELOPMENT PLAN)

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Overview

- **Purpose**
- **Approach**
- **Findings**
  - Users Needs
  - Observations and Challenges
- **Recommendations**
  - Keystone
  - Supporting
- **Next Steps**

Purpose

Present a research and development (R&D) plan for providing the ATD modeling capabilities needed to meet established needs of the user communities, with special emphasis on enabling the National strategy for responding to domestic CBRN incidents.

The Plan is directed to the Federal Committee for Meteorological Services and Supporting Research (FCMSSR)

Approach

- User's perspective – needs and wants
  - Planning
  - Response
  - Recovery
- Research & Development Perspective – Capabilities and Improvements
  - Synoptic to intra-urban scales
  - Simple to complex environments
  - Analysis and prediction capabilities for atmospheric fields
- Provide recommendations to Federal agencies

JAG/ATD(R&DP) Members

Co-Chairs:

- Dr. Walter D. Bach, Jr., DOD/Army/ARO
- Ms. Nancy Suski, DHS/S&T

Members:

- Mr. Bruce Hicks, NOAA/ARL
- Dr. Paula M. Davidson, NOAA/NWS
- Ms. Debbie Payton, NOAA/NOS
- Mr. Jim Bowers, DOD/Army/DPG
- CDR Stephanie Hamilton, USN, DOD/DTRA
- Mr. Rickey C. Petty, DOE
- Mr. John Perry, DHS/EP&R
- Mr. Stephen D. Ambrose, NASA
- Ms. Jocelyn Mitchell, NRC
- Mr. John S. Irwin, EPA/NOAA

JAG/ATD(R&DP) Members

Alternates:

- Mr. Walter Schalk, NOAA/ARL/SORD
- Dr. Rayford P. Hosker, Jr., NOAA/ARL/ATDD
- Mr. Mark W. Miller, NOAA/NOS
- Maj Brian Beitler, USAF
- Mr. Peter Lunn, DOE HQ
- Dr. Gayle Sugiyama, DOE/DHS/ NARAC
- Ms. Teresa Lustig, DHS/S&T
- Mr. Chris Doyle, DHS/S&T
- Dr. Bruce A. Davis, NASA/SSC
- Dr. Steve McGuire, NRC

Technical Advisors:

- Dr. John Hannan, DTRA/NG-IT
- Mr. John Pace, DTRA/CBDP

FINDINGS

What Users Want

- Users want accurate and timely predictions of hazards to human health and safety and the environment
- Users want actionable information in their terms
- Key question: How bad is it (or could it have been) and where?
- Users need to know implications of uncertainty for their actions
- Users need a technical reachback capability

User's Needs

- Focus on emergency response applications, including planning, response, and recovery
  - Urban capability
  - Sensor fusion
  - User Interface enhancements to communicate uncertainty
  - Protocols for distribution of products
  - Reachback to technical experts

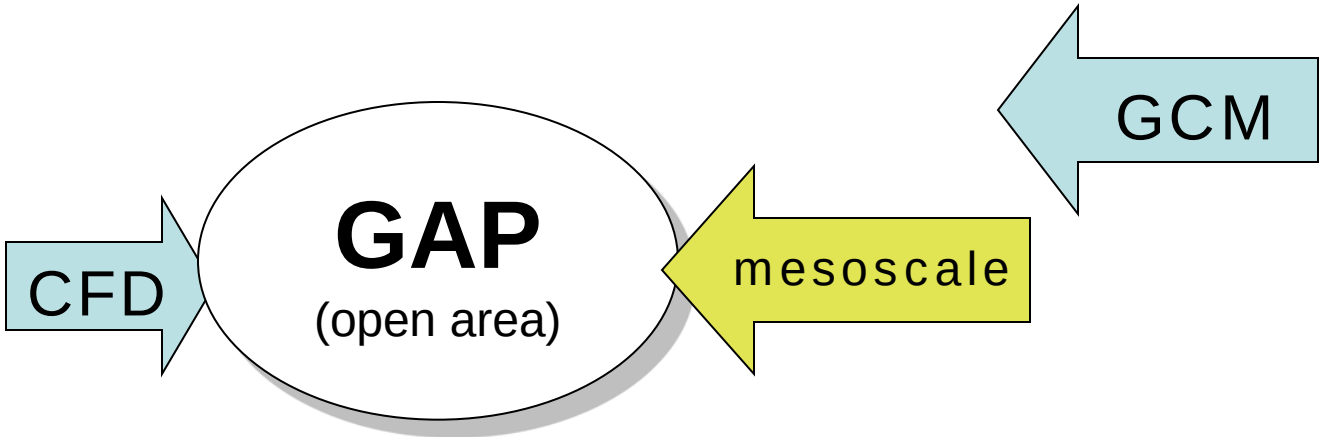
- Relevant to other applications:
  - Military applications
    - Urban capability
    - Sensor fusion

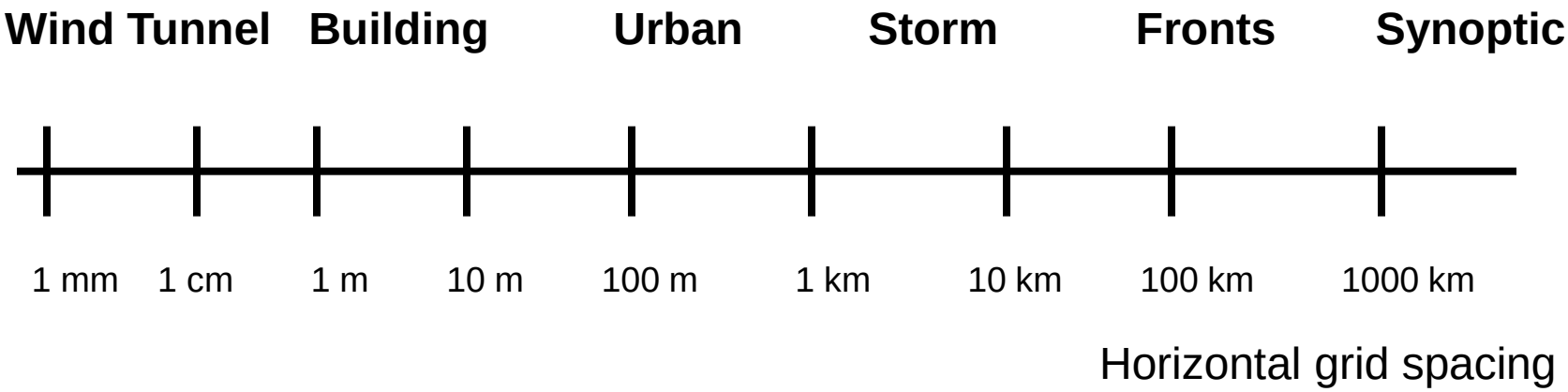
  - Air Quality Monitoring Applications
    - Need for improved physical understanding
    - Need for improved capabilities for estimating uncertainty and predictability and for evaluating models

Key Challenges

- Quantify uncertainty in model inputs and predictions
- Close the knowledge gap between the mesoscale and microscale modeling capabilities
- Represent transport and diffusion in complex flows, including urban and coastal environments

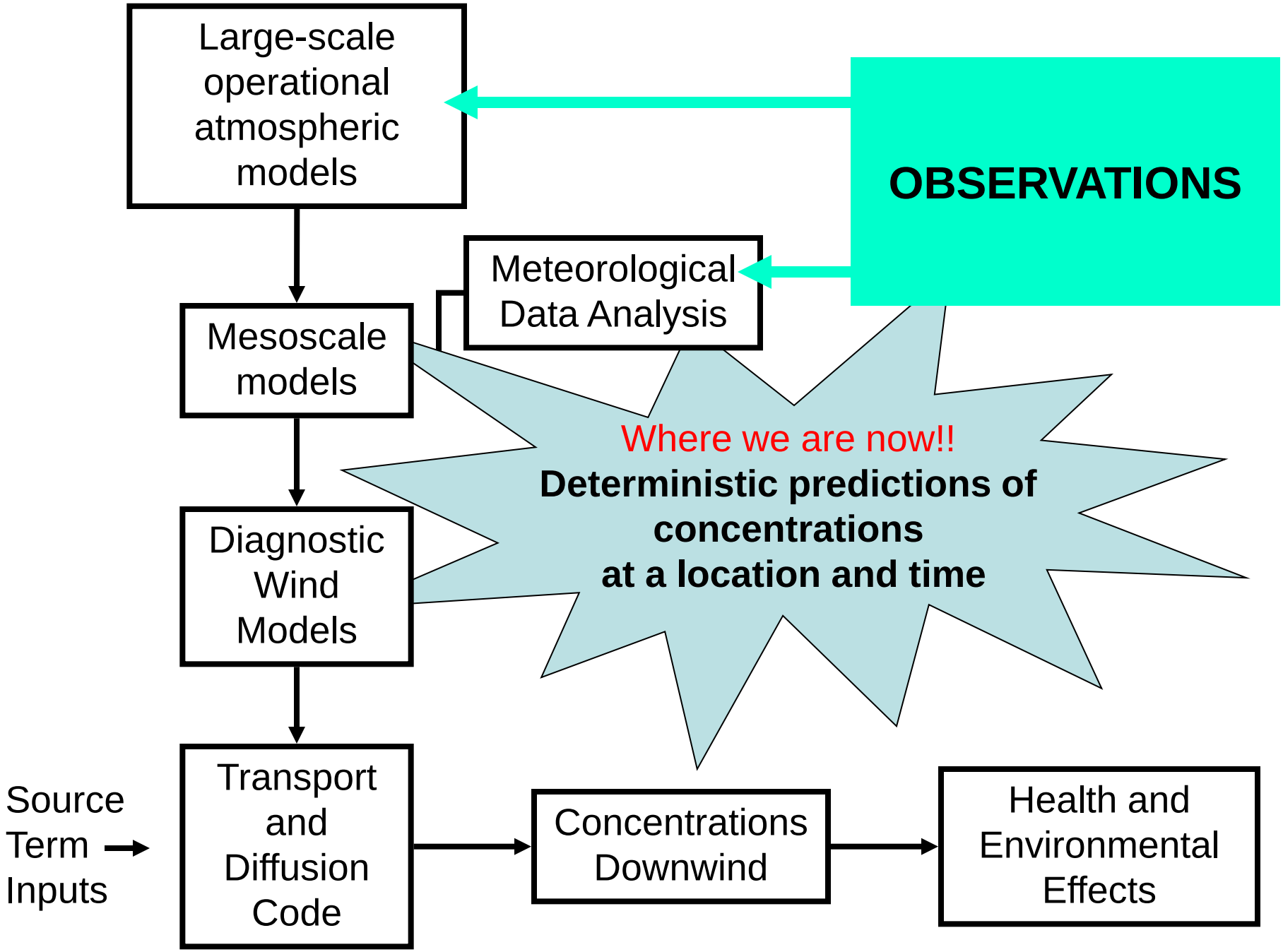
Transport And Diffusion Scales And Model Grid Sizes





Observations and Challenges

- Timely and accurate hazard predictions in urban areas are required to assess vulnerabilities and threats to public safety
- Acceptance of local-scale meteorological and concentration data into consequence assessment systems
- Examine the role of regional meteorological monitoring networks
- Diverse requirements and capabilities argue for diverse models
- Conduct field experiments and sustained analysis of data to understand ATD, especially in urban environments
- Develop meteorological and tracer measurement capabilities
- Provide a robust “reach-back” capability to support responder community during “incidents of national significance”


Large-scale operational atmospheric models
OBSERVATIONS
Meteorological Data Analysis
Mesoscale models
Where we are now!!
Deterministic predictions of concentrations at a location and time
Diagnostic Wind Models
Source Term Inputs
Transport and Diffusion Code
Concentrations Downwind
Health and Environmental Effects

Large-scale operational atmospheric models

Satellite-derived

Upper Air Soundings

Surface Obs

Volumetric measurements (Lidar, sounders, & radar)

Meteorological Data Analysis

Mesoscale models

Account for variance in winds and turbulence

Transport and Diffusion Code

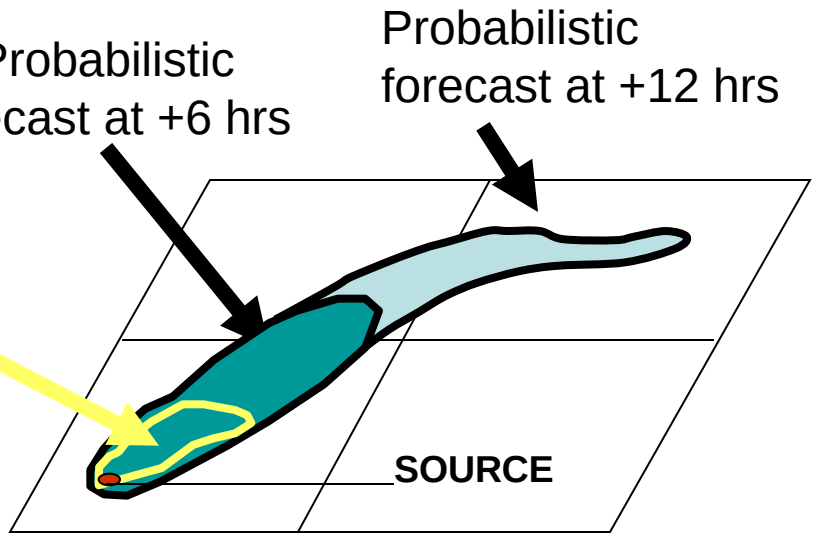
Concentrations Downwind

Probabilistic Forecast

Probabilistic forecast at +6 hrs

Probabilistic forecast at +12 hrs

Analysis (e.g., sensor fusion)



RECOMMENDATIONS

Keystone Recommendations

- **Quantify Uncertainty:** ATD modeling systems should routinely quantify the uncertainties in their results.
- **Interpret Uncertainty:** ATD modeling R&D community work with representative users to determine effective means to quantify and communicate uncertainties.

Quantify Uncertainty Implementation Actions

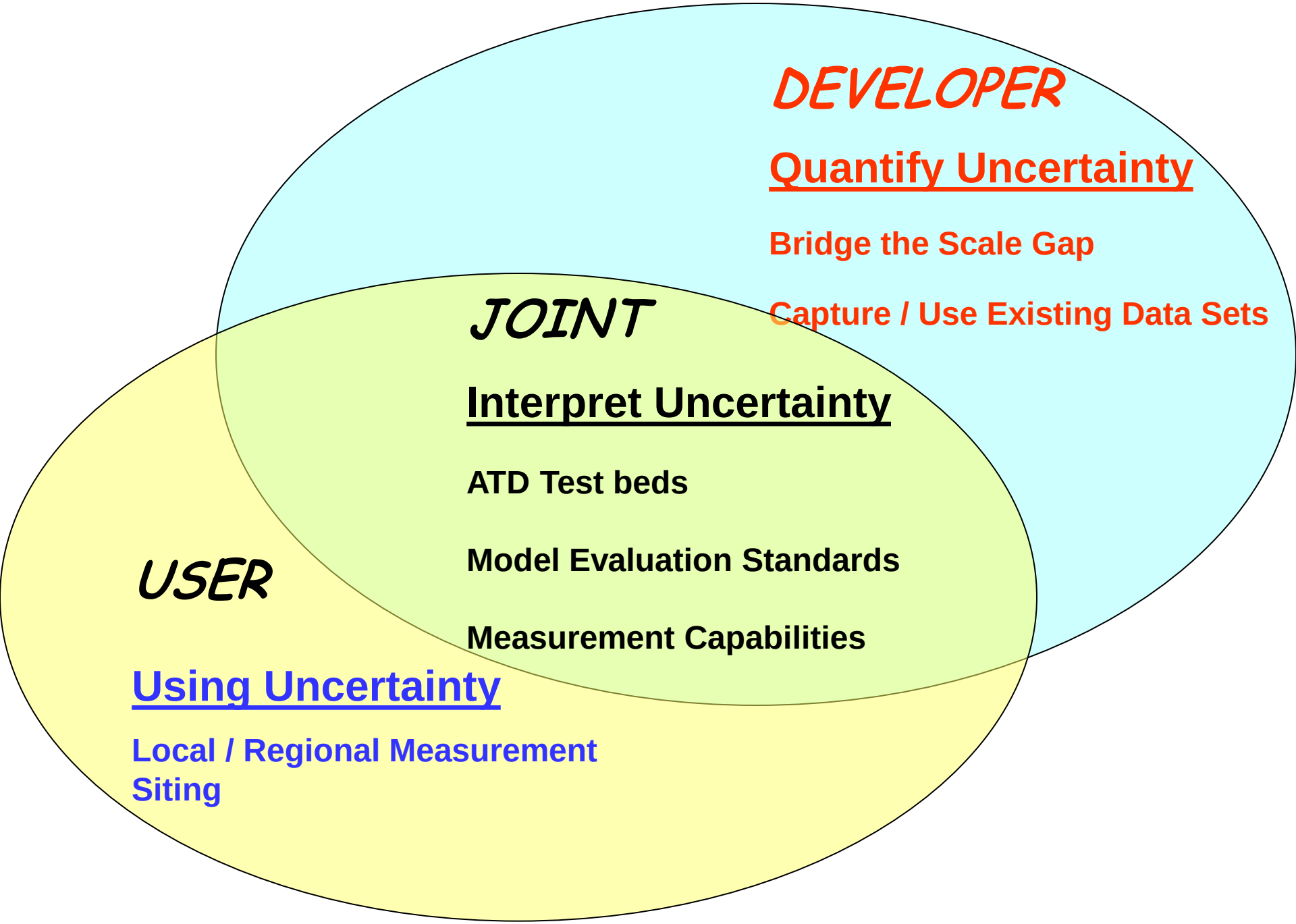
- Develop robust techniques to assess probabilities of occurrence
- Adapt (or develop) and verify measurement capabilities at or below the scales of interest for model predictions
- Test, verify, and validate model improvements, including probabilistic methods of process representation, parameterization, and data acceptance/assimilation
- Establish a shared data system with substantial sets of data to test and evaluate the new measurement capabilities and the uncertainty quantification techniques

Quantify Uncertainty Implementation Actions (2)

- Develop techniques for utilization of sources of opportunity
- Develop regression techniques that are applicable in nonlinear regimes to display important sources of uncertainty (near-term activity)
- Use outcome from new techniques for estimation of uncertainty to guide improvements in ATD models (intermediate-term activity following previous action)
- Develop and implement processes for uncertainty displays in data-sparse environments (intermediate-term activity).

Interpret Uncertainty Implementation Actions

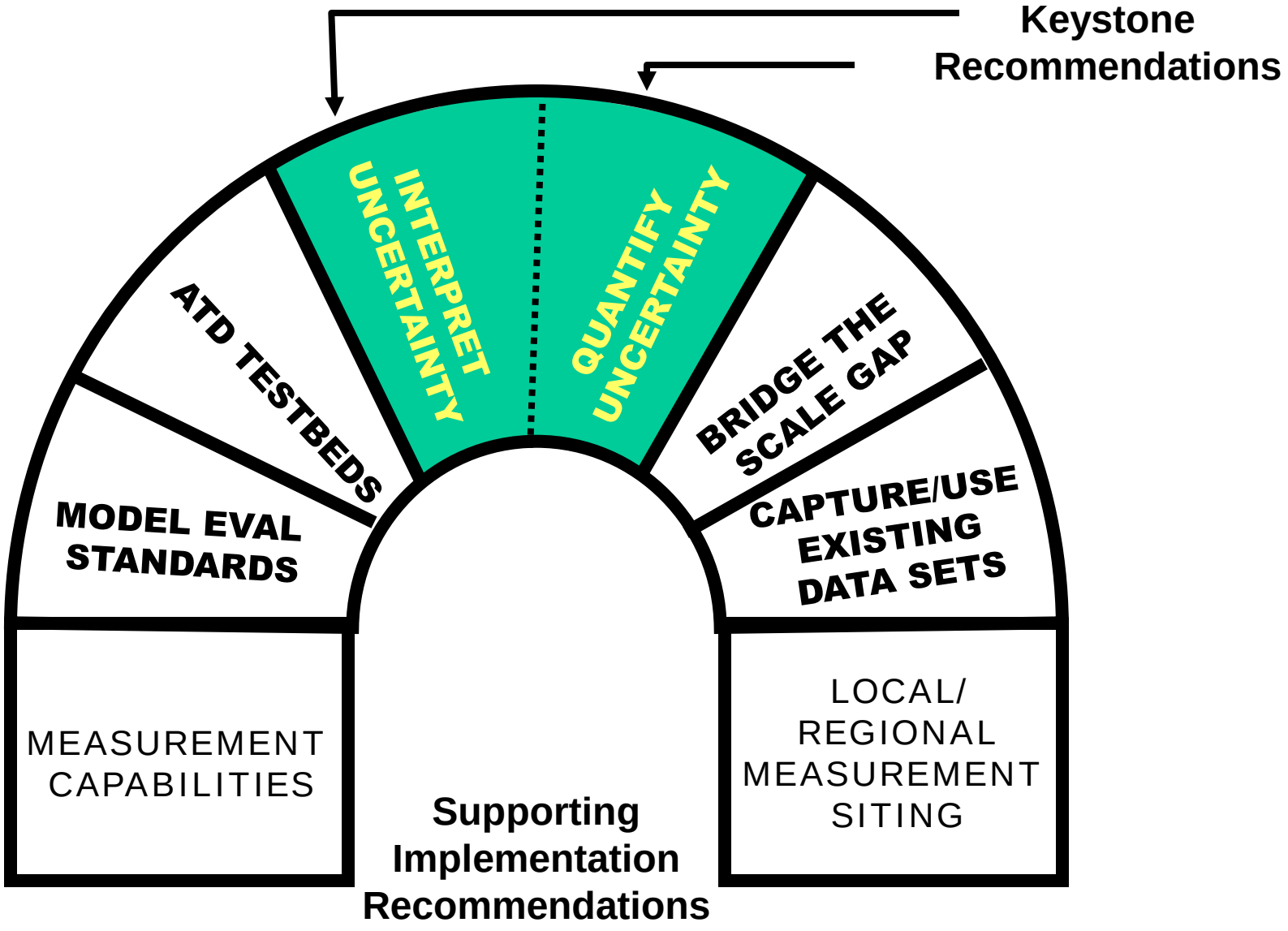
- Use training sessions with users on probabilistic tools for decision processes
- Incorporate feedback from users into the ATD model R&D process


DEVELOPER
Quantify Uncertainty
Bridge the Scale Gap
Capture / Use Existing Data Sets
JOINT
Interpret Uncertainty
ATD Test beds
Model Evaluation Standards
Measurement Capabilities
USER
Using Uncertainty
Local / Regional Measurement
Siting

Examples of Expected Impacts:

- Improved hazard predictions in urban areas
- Better understanding of ABL physics in complex environments
- Increased fidelity in meteorological inputs to ATD models
- More effective incorporation of user feedback
- Increased collaboration among Federal agencies

Recommendations



Supporting Implementation Recommendations

- **Capture / Use Existing Data Sets**

  OFCM convene an interagency effort to develop guidelines for acquisition, archiving, and access of data from previous field and laboratory ATD experiments

- **Establish ATD Test beds**

  Participating Federal agencies establish a multi-agency testbed authority to oversee the development and operation of multiple test beds for urban and complex-environments, in locations selected for national and/or R&D priorities

- **Develop Model Evaluation Standards**

  The Federal agencies involved establish and maintain a working group within an existing standards development organization to develop model evaluation guidelines and standards

Supporting Implementation Recommendations

- **Develop / Improve Measurement Capabilities**

A coordinated Federal ATD R&D program should provide financial resources to existing Federal laboratory scientists to develop or improve evolutionary and revolutionary atmospheric sensors supporting ATD R&D transition the technology into tools for ATD model researcher, developers, and users

- **Develop Local / Regional Measurement Siting Criteria**

OFCM establish a working group to establish performance guidelines for ATD and mesoscale meteorological instrumentation systems in complex environments

- **Bridge the Scale Gap**

Address difficulties in interfacing models at different scales

Next Steps

- Incorporate feedback from this session
- Publish Plan
- Presentation of final recommendations - ICMSSR Meeting 2004-2 (August 2004)
- Urban Meteorology Forum (September 21 – 23, 2004)