

Boundary Layer and Dispersion Applications

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Outline

- **R&D Needs / Priorities**
 - MPAR
 - NRC Report : From the Ground Up
 - OFCM JAG/ Atmospheric Transport And Diffusion
- **PBL Science issues**
- **Key Challenges**

MPAR R&D Needs / Priorities

- **Weather Surveillance**
 - Real time Severe Weather
 - Nowcast Airport Wind Hazards
 - Enroute ice and turbulence
 - Heavy precipitation
 - Hydrometeorology
 - Initialize NWP wind models and near PBL
- **Aircraft Surveillance**
 - Cooperative
 - Non-cooperative
- **Other Surveillance**
 - Airborne release of toxins
 - Spaceflight ops
 - Ground truth satellites
 - Fire Weather / Wildland Fires
 - Mudslides
 - Air Quality and Health
 - Volcanic Ash
 - Birds as Hazards
 - Agriculture

NRC Observations Supporting Fundamental Infrastructure for Mesoscale Monitoring and Prediction

- Phenomenology for Observational Requirements
 - Temperature, moisture, and wind velocity universally required
 - Most requirements below 5 km (deepest PBL)
 - Smaller scale phenomena need high resolution
- Data Assimilation: Synergy of Data and Models
 - Measurement error
 - Representativeness error
 - **Model physics**
- Special Climate Requirements
 - Absolute accuracy
 - Long term
- Mesoscale Observations for Research
 - Research obs are often episodic, ephemeral, and of limited area tending to focus on details of processes. (They) may fail to contribute reliably or consistently to ongoing operations and therefore **could be viewed as untrustworthy, disruptive, or even parasitic.**

NRC Recommendations

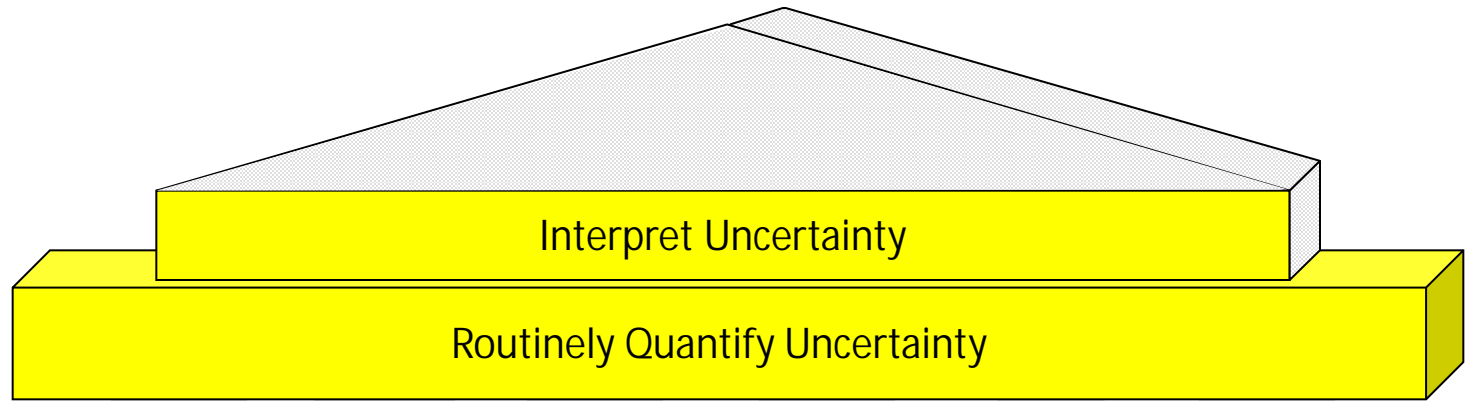
- Measurements and Infrastructure
 - Lidar and radar profilers for lower troposphere – 400
 - Air Quality Sensors – CO, SO₂, O₃, 2.5 μm aerosols - 200 in urban; 175 km rural separation
 - Soil moisture and temperature profiles - 3000
 - Distributive/ collaborative networks of radar and lidar
 - GOES based water vapor & temperature profiles in Continental boundary layer
 - Upgrade rail / ground transportation systems to WMO standards
 - Facilitate observational network of Vehicle Infrastructure Integration initiative

NRC Report

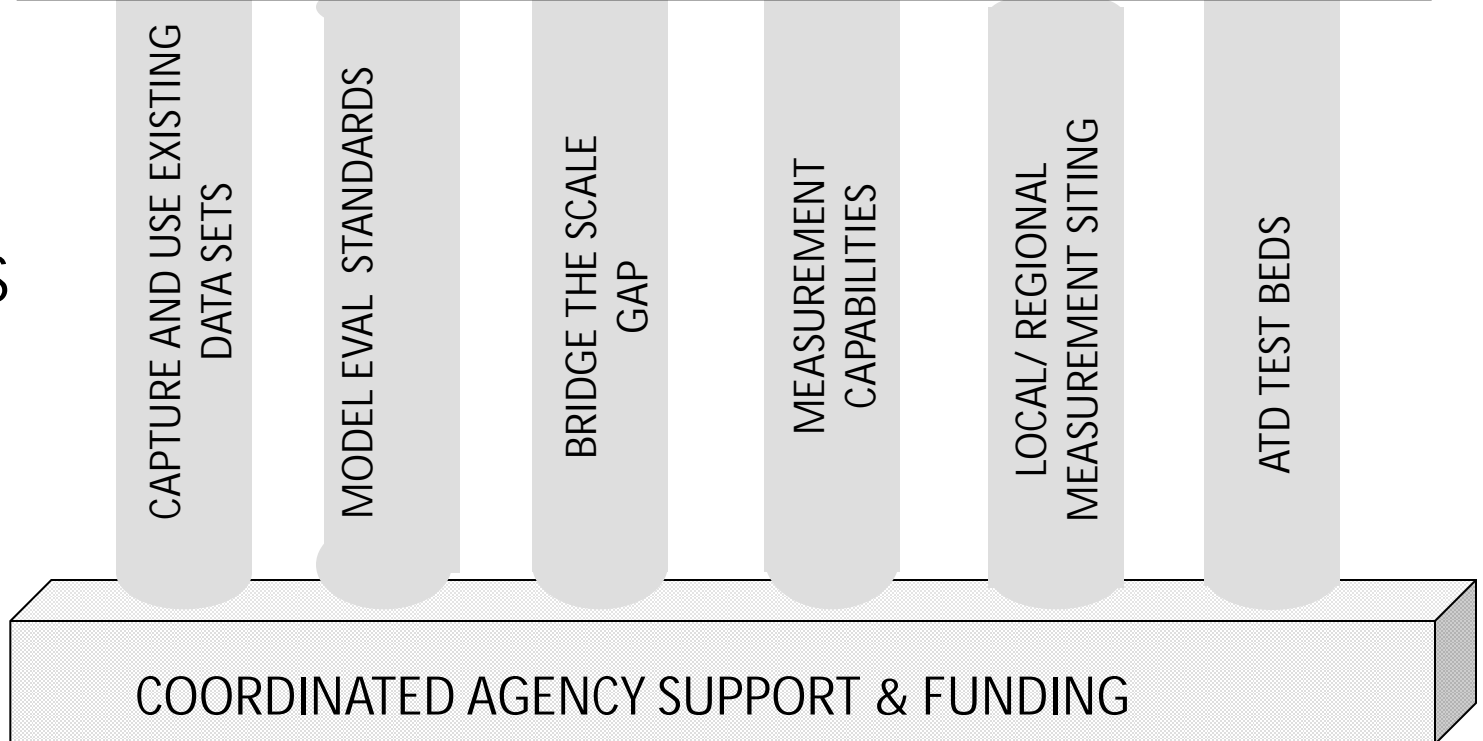
- Nearly all recommendations for improving the mesoscale observations address BL issues. Few address modeling issues.
- Network site recommendations (~ 125 km separation) adds finer structure to larger scale features through data assimilation, but are too coarse to address BL heterogeneity issues.
- Measurements, Modeling, and Use should be designed to work together – within a test bed network concept as recommended by the JAG/ATD and as JAG/JUTB is developing

JAG/Atmospheric Transport and Diffusion R&D Strategy to Meet User Needs

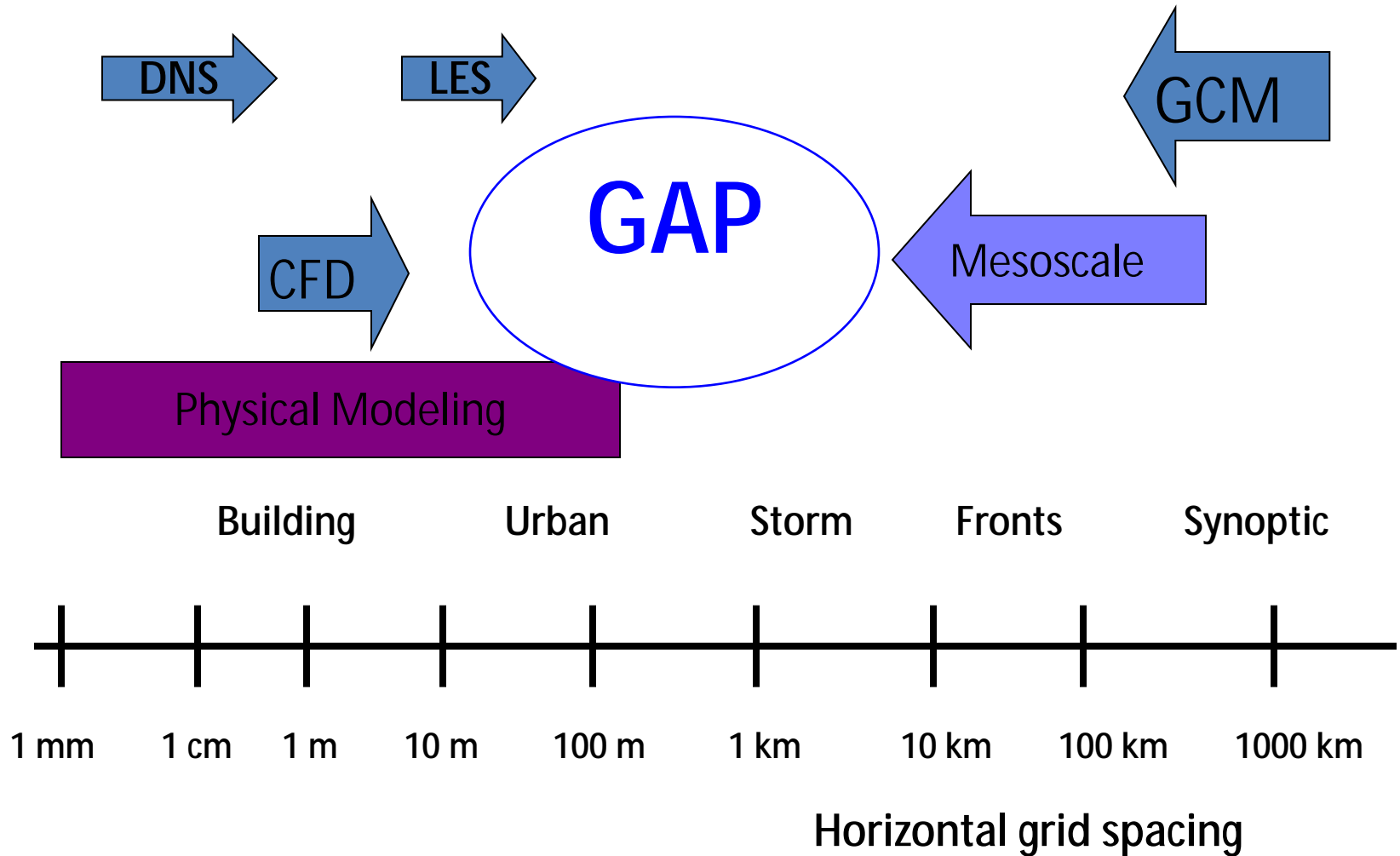
GOALS



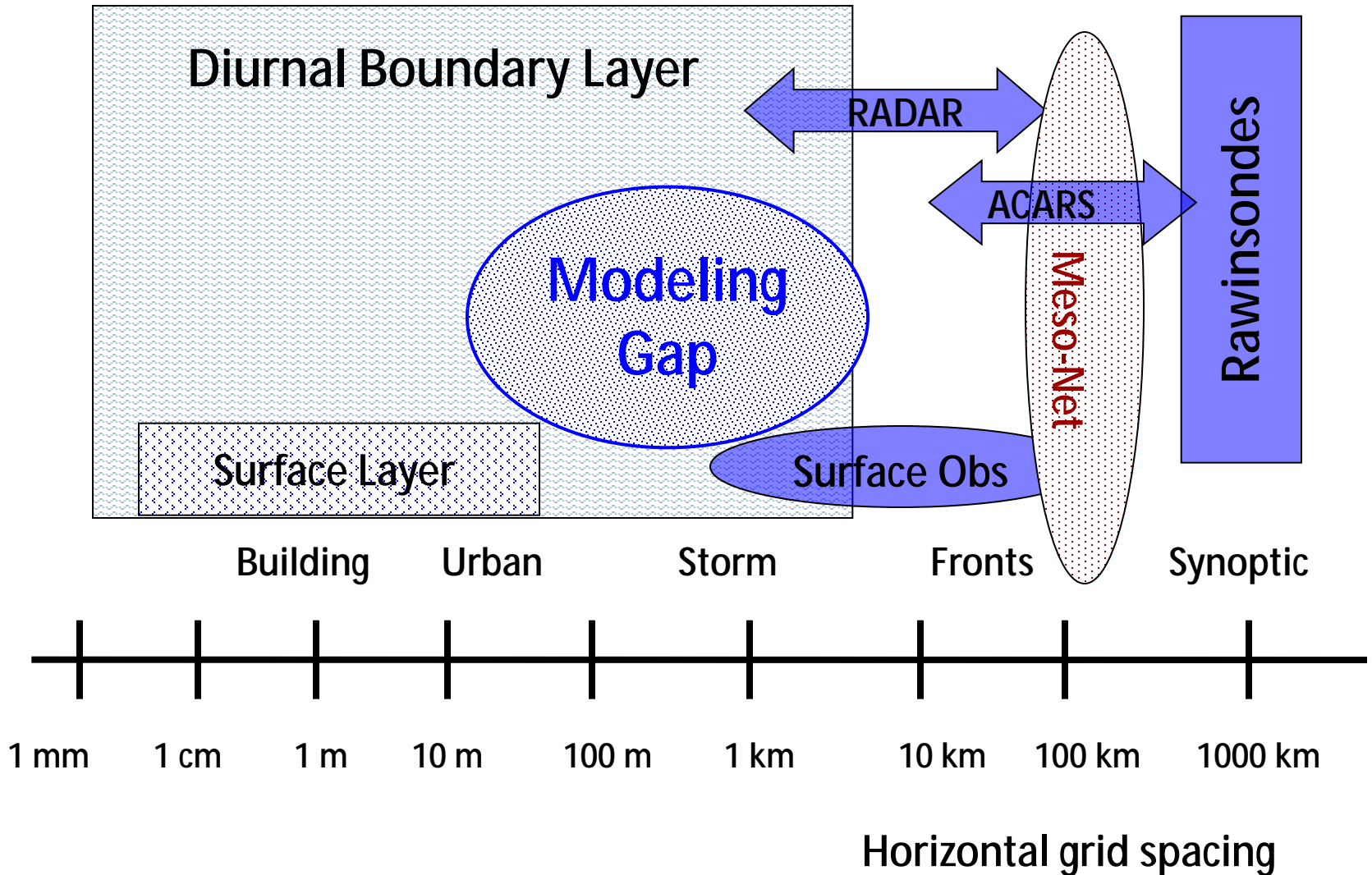
OBJECTIVES



Model Grid Sizes



Measurement Capabilities at Model Grid Spacing



PBL Science Issues

- Smallest scales of atmospheric motion affected by all larger scales
- Major energy exchange
- Most variable, least predictable part of atmosphere.
- Few measurements near ground; fewer aloft. Difficult to characterize existing measurements
- Forecast models are too coarse for local accuracy
 - PBL heights
 - Stability
 - Shear
 - Large rms wind direction error
- PBL models (turbulence closure, dispersion) have large uncertainty and large effects from small changes (chaotic).

Key Challenges

- Close the knowledge gap between the mesoscale and microscale modeling capabilities
 - Observations
 - Models
 - Theory
- Develop instrumentation for measuring PBL wind, temperature, and moisture at PBL time & space scales (smaller than models)
- Operate instruments in *high impact* networks covering 50 x 50 km footprint continuously.
- Quantify uncertainty in model inputs and predictions
- Represent transport and diffusion in complex flows, including urban and coastal environments

Questions

Comments

Positive

- Data assimilation of winds
- Increased space-time resolution

Negative

- Model Development
- Uncertainty