Next Generation Urban Dispersion Field Programs

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Outline

- History of Urban dispersion Field Programs
  - US
  - Europe
- Usefulness of Urban Dispersion Field Programs
- Motivation for Workshop
  - Usefulness of Urban Dispersion Field programs
  - November Workshop
- Urban Workshop Findings

Recent Dispersion Experiments

Experiment	Year	Location	measurements
Urban 2000	2000	Salt Lake City	SF_6
BUBBLE	2001	Nantes	Meteorological
Joint Urban 2003	2003	Oklahoma City	SF_6
Madison Square Garden	2005	New York City	SF_6 and PFTs
Mid-town Manhattan	2005	New York City	SF_6 and PFTs
Dapple	2007	London	PFTs
S-SAFE	2013	New York City	PFTs

Usefulness of Urban Dispersion Field Programs

- A Google search on Salt Lake City “Urban 2000” Publications: 677 results
- A Google search on “Joint Urban 2003” Publications: 435 results
- A Google search on “Jack Rabbit Test Program” Publications: 250 results

Urban Dispersion Workshop: Designing the Next Generation Urban Dispersion Field Programs

- Urban dispersion experiments have been extremely useful for development and testing of transport and dispersion models.
- There is an urgent need for improvement of the science of urban transport and validation of the current generation of dispersion models..
- New, high-resolution data in the multi-scale environment with significant gradients (e.g., land/urban/water) that characterizes major urban areas is necessary.
- New data are also necessary to design effective real-time meteorological and Chemical, Biological, Radiological, Nuclear (CBRN) monitoring networks.
- **It is timely to design and execute the next generation of Urban Dispersion field programs to address these**

Motivation for the Next Generation Urban Dispersion Experiments

- There have been significant technological improvements since the last urban dispersion experiments were conducted in 2005.
- Models are now more sophisticated, and capable of data assimilation.
- New tracer techniques and equipment are available that can provide data with unprecedented temporal and spatial resolution.
- High resolution meteorological instruments such as mobile Radar and LIDAR systems and Hyper-spectral imaging producing data with improved spatial and temporal resolution are now available.

“Urban Dispersion Virtual Workshop: Designing the Next Generation Urban Dispersion Field Programs”

https://www.bnl.gov/urbandispersionworkshop/

Urban Dispersion Virtual Workshop: Questions:

- What are the needs of the emergency response community and how do we design models and experiments to address them?
- What model improvements do the user communities need?
- How do we design tracer release and sampling to address questions temporal (e.g., diurnal and seasonal variation) and spatial (e.g., land/urban/water gradients) for the broadest applicability?
- What are the next-generation measurements needed to improve the data sets?
- How do we implement the next generation urban dispersion experiments?

Findings of the Virtual Urban Dispersion Workshop

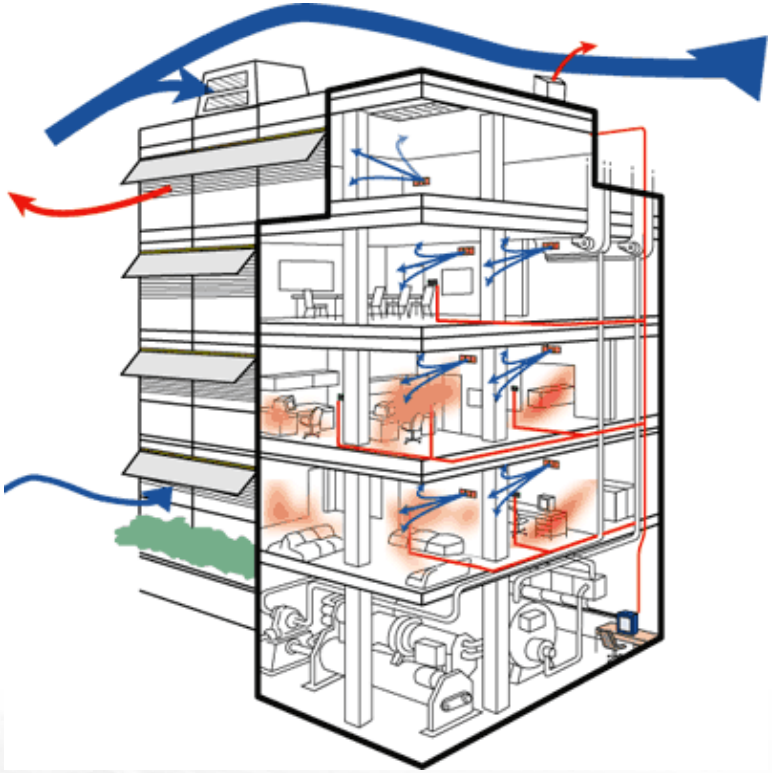
Input from the users of dispersion model products, the emergency response community, is essential.

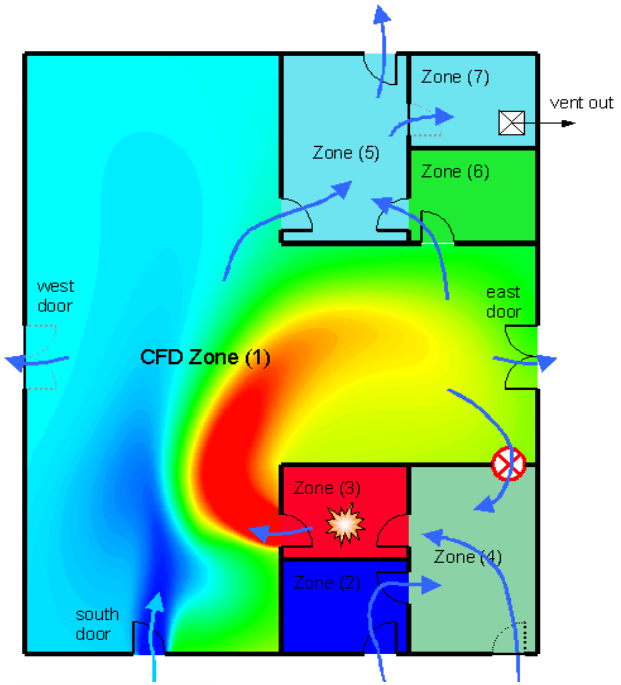
- The science questions that drive the next generation urban dispersions experiments must start with the needs of the emergency response community.
- In addition to the work on making models faster and more accurate, an effort must be made to communicate results and uncertainty in ways that emergency managers can understand and use.
- More dialogue between the people who are creating the models and those who are using them is necessary.
- What do we need to do to start that dialogue?

Questions emergency managers need to address:

- Leonard Willitts, Jr., FEMA IMAAC Program Manager
  - Do they issue a directive to shelter-in-place (SIP)?
  - What are the personal exposures in shelters and evacuation routes?
  - Do they issue a directive to evacuate?
    - How? What routes?
  - What areas to restrict entry and egress?
  - Where do I stage my response assets and resources?
  - What PPE is required for this event? For how long?
  - Do I need decontamination assets? What kind? Where? How much? For public and responders?
  - What do I tell the public?

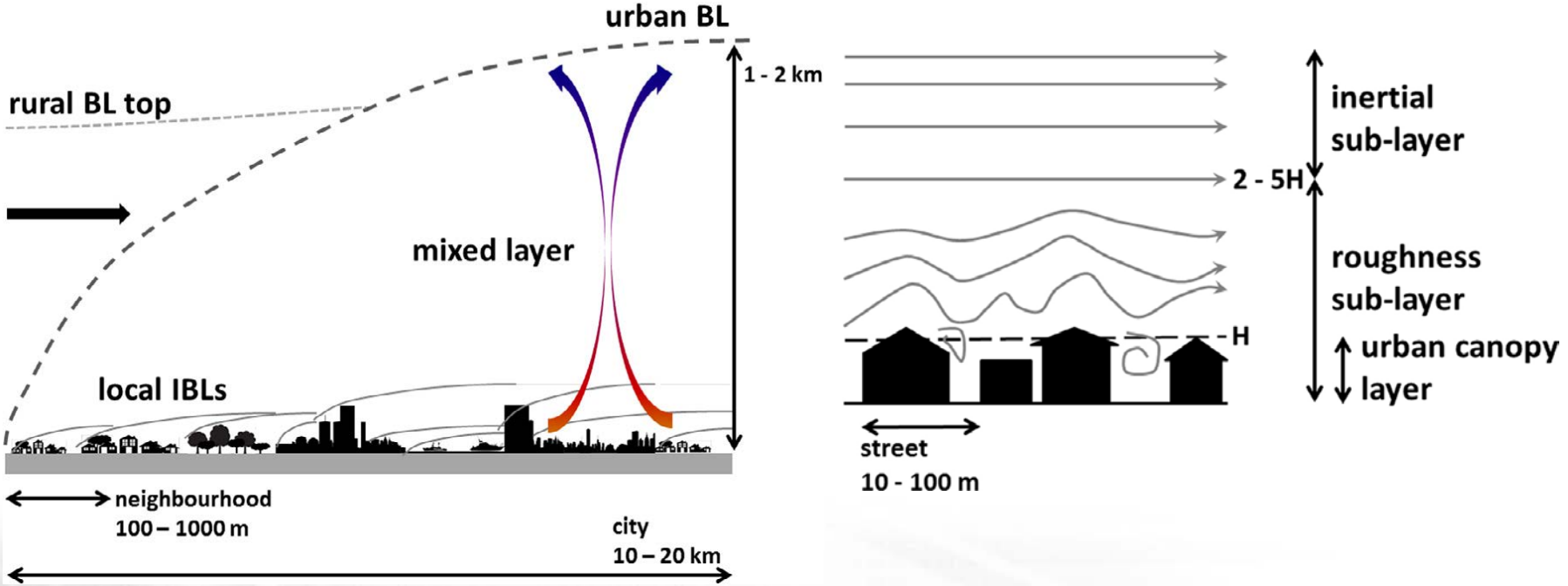
More extensive data on particle deposition and the indoor/outdoor interface is necessary.





- Mr. Rick Fry, Defense Threat Reduction Agency
  - One of the biggest gaps is a lack of data to validate the simulations of coupled outdoor to indoor and indoor to outdoor releases.
  - We do not have the data sets that will support indoor model validation.
  - We don’t have any data or even have any models that treat vertical deposition on buildings.
  - These data and the ability to simulate these effects are very important for supporting decontamination efforts and also for responding to radiological releases.

Meteorological measurements at all scales are necessary to establish the connection between street level effects and meso-scale systems.



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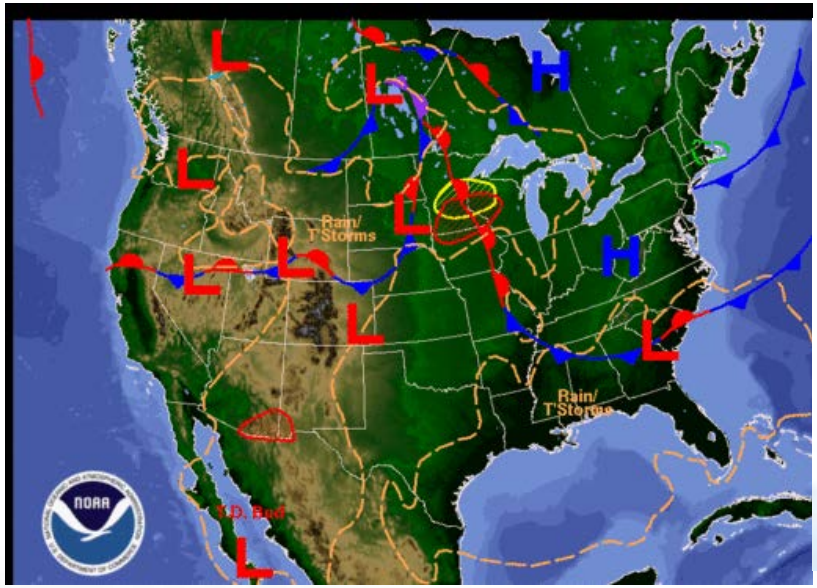
- Pavlos Kollias
  - How simple can we afford to make our urban dispersion models?
  - What is the appropriate reference level where data should be collected to provide the necessary understanding of street-level flow, and its coupling to the flow aloft?
  - There is a need to characterize boundary conditions at the surface and at the mesoscale and all scales in between.
  - The DAPPLE studies in London concluded that the height where measurements can be made that relate to the conditions at street level are about 10 times higher than the average rooftop height.
  - Is this applicable in other locations?

BNL/Stony Brook Lidar and MRR installed in New York City

Determination of the scale of meteorological input necessary to drive the models is a critical need.



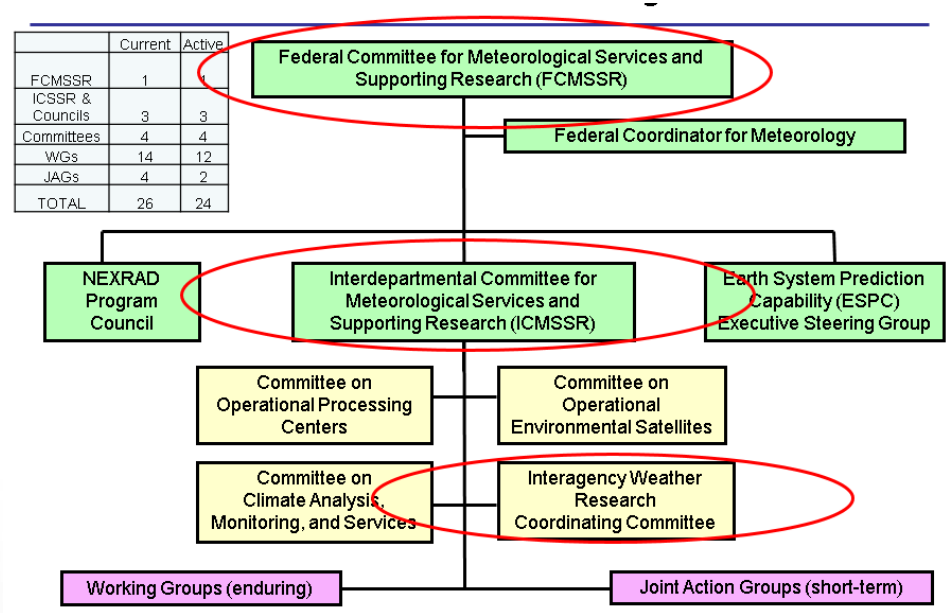
- Joe Chang
  - I don’t think we have determined best weather data to use.
  - We have not found any conclusive answer to the question: What is the preferred met input to an urban dispersion model so we will consistently get better performance?
  - The next generation experiments need to be designed to address this question.
- Rick Fry:
  - How much value do we get from using microscale weather versus using mesoscale forecast data?
  - Where do we get the best bang for the buck?
  - A lot of money could be spent on setting up a very highly resolved weather network and it is not clear is that effort will be worth the increased fidelity.

Data in the multi-scale environment with significant gradients (e.g., land/urban/water) that characterizes major urban areas is necessary.

- There is a lack of measurements over water and across the land water interface.
- There are multiple internal boundary layers that develop in regions of the transition from land, to marine, to urban environments.
- Detailed meteorological data from both horizontal and vertical profiles are necessary to capture the evolution of the boundary layer.
- We have not had a sustained measurement campaign across the land to sea interface.

A working group committee to engage the Federal Weather enterprise and develop a collaborative strategy across Federal agencies is the next step.

	Current	Active
FCMSSR	1	
ICSSR & Councils	3	3
Committees	4	4
WGs	14	12
JAGs	4	2
TOTAL	26	24



- It is necessary to build awareness at higher levels.
- Establish a working group
  - organize workshops, exploratory meetings, and conference sessions
  - identify funding sources and collaborative areas and to develop proposals that leverage multiple agency funding sources
- Working group next steps
  - Communicate with a wider audience
    - Reach out to others outside of the Dispersion modeling community that may have important contributions to urban studies.
      - EPA :Can learn from various regional air quality programs such as SCCCAMP, LMOS, and GMAQS
      - Engineering community: building departments, the planning departments require pedestrian level wind studies
  - Designate a Chair
  - Establish meeting schedule
  - Develop a plan of action.
  - Brief ICMSSR (meets in November, February, May, and August) and gain authorization to establish a working group; have an ICMSSR agency representative introduce the plan to the FCMSSR.

Summary: Next Generation Urban Dispersion Experiment Needs

- Obtain input from the users of dispersion model products – the emergency response community.
- Design and execute experiments that provide particle dispersion and deposition data, both indoors and outdoors
- Design and execute experiments that include meteorological measurements at all scales to establish the connection between street level effects and meso-scale systems.
- The determination of the scale of meteorological input necessary to drive the models should be a goal of the next generation of urban dispersion experiments.
- Data in the multi-scale environment with significant gradients (e.g., land/urban/water) that characterizes major urban areas is necessary.
- A working group/steering committee should be formed to engage the Federal Weather Enterprise and develop a collaborative strategy across Federal agencies.

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