PANEL

SESSION III

TECHNICAL BARRIERS TO DISPERSION MODELING

Moderator: Mr. Ronald Cionco, Army Research Laboratory
Rapporteur: Mr. Robert Lawson, Environmental Protection Agency

Synopsis

The panel, consisting of representatives from both developers and users of dispersion models, addressed five areas considered to be technical barriers (knowledge gaps) for dispersion modeling. These areas had been selected and agreed upon by the OFCM staff and the Joint Action Group for Atmospheric Transport and Diffusion prior to the workshop. The areas addressed by the panel were:

Turbulence and the Stable Boundary Layer: There is a need to better understand turbulence processes and turbulence exchange parameters under stable conditions as well as within and immediately above urbanized and forested areas.

Air-Surface Exchange: There is a need to better characterize air-surface exchange, pollutant deposition and other near-surface processes which relate not only to source and sink characterization, but also to human exposure assessment.

Probabilistic Modeling: There is need for better understanding of the use of deterministic models to simulate stochastic processes.

Mesoscale and Surface Layer Transport: There is a need for better understanding of the dynamics and interfacing between mesoscale and surface layer transport within these models.

Neighborhood Scale Processes: There is a need to characterize surface morphological features with adequate resolution in order to develop models which reflect the effects of local-scale features (important for urban areas and neighborhood-scale applications). Additionally, methods for assimilation of additional data sources need to be developed at all spatial scales of interest.

There was general agreement by the panel members that these areas represent key challenges or knowledge gaps faced by model developers and that further research work needs to be done particularly in the boundary layer under stable conditions, within the urban environment, and at smaller scales in order to better understand the processes taking place. A summary of the

key points and recommendations from the panel session follows on pages 2-3 through 2-5.

Panel Membership:

Dr. Ray Hosker, Director, Atmospheric Turbulence & Diffusion Division, Air Resources Laboratory
Mr. Paul Bryant, Federal Emergency Management Agency
Mr. Jim Bowers, Dugway Proving Ground, Department of the Army
Mr. Alan Cimorelli, Environmental Protection Agency
Dr. Jerome Fast, Pacific Northwest National Laboratory, Department of Energy

Summary of Technical Barriers Panel

•Questions:
- -What are the knowledge gaps which limit the performance of models?
- -What is impeding your research or restricting progress on model development?

•Anticipated Results:
- -Do you accept this as a barrier?
- -How do we satisfy this deficiency?
- -Identify which agencies are clearly addressing this barrier.

Turbulence and the Stable Boundary Layer (SBL): **Barrier**? Yes

•Need simultaneous meteorology measurements and dispersion data; need higher resolution measurements - scales of a few meters (being addressed by the Army and DOE laboratories).
•The SBL in coastal areas (in addition to urban and forested areas) needs more attention due to the location of power plants and cities near coasts.
•It's important to link chemistry and meteorology in the SBL.
•Need to be observers before we can be modelers.
•There are minimal observations available to verify and improve SBL parameterizations.
•Need information on the vertical structure of the SBL; not just surface-based measurements.
•Need to probe the SBL with multiple radars or sounders to establish the structure of the SBL. Need to combine technologies to get a better observation capability.
•How do we distinguish true dispersion from low frequency meandering?
•What is the limit to vertical mixing in the SBL?
•Should consider empirically correlated local phenomena with larger-scale phenomena.
•Should examine non-Gaussian models for the SBL.
•Pacific Northwest Laboratory is planning a field study in Salt Lake City to examine the SBL in an urban environment.

Agencies: DOE, NOAA, ARL, DOD

Air-Surface Exchange: **Barrier**? Yes

•This is the most important driving mechanism for models because it represents the lower boundary condition.
•There is a lack of data and observations on which to base parameterizations.
•There is a need for higher spatial resolution measurements of sensible and latent heat fluxes which appear to be the key to driving mesoscale models.
•Pollutant characterization is complicated by chemical and biological effects and their relation to micrometeorology.
•Need to consider the effects of precipitation - tends to move materials to lowest areas.

•Need for better understanding of acid deposition and nitrogen deposition to estuaries - multimedia processes.
•Need for deposition velocities and solubilities for toxic pollutants as well as better data for dry deposition in general.

Agencies: DOD, EPA, NOAA

Probabilistic Modeling: **Barrier**? Yes and No

•Probabilistic modeling requires educating the decision makers - "let the user know the consequences".
•To achieve probabilistic results requires that the models perform to a higher level than required for deterministic models.
•Probabilistic modeling techniques need to be applied to chemistry as well as meteorology. •These models are difficult to evaluate.
•Approaches:
-Conventional model with variance
-2-particle Lagrangian stochastic models
-SCIPUFF-type model
-Ensemble of runs with conventional models

Agencies: NRC, FEMA, DOD

Mesoscale and Surface Layer Transport: **Barrier**? Yes

•Important to recognize that the microscale process drives the mesoscale processes.
•Knowledge gaps exist because we don't have measurements at the scale needed to parameterize the process (being addressed by Army Research Laboratory).
•Current understanding of canopy models (urban and vegetative) has not been transferred to mesoscale models (being addressed by Army Research Laboratory).
•New instruments may show promise.
-Special-purpose aircraft
-Remote automated weather stations
•Coupling/decoupling of meso/micro scale models is not well understood. The mesoscale parameterization of the surface layer is problematic.
•Current model resolution is not adequate for surface layer phenomena.
•Need better understanding of energy budgets and spatial variability of sensible and latent heat fluxes.
•As the vertical resolution is improved, may require different closure schemes for models.

Agencies: DOE, DOD, NOAA

Neighborhood-Scale Processes: **Barrier**? Yes

•New instrumentation techniques and standards promise to provide very high resolution measurements of near-surface properties.
•Characterization of the morphological features of urban areas at high resolution is in progress by FEMA and Army Research Laboratory.
•CFD models for flow around buildings is improving, but still need wind tunnel modeling as well as field studies with greater data density.
•DOE's CBNP has upcoming field studies to address scales down to building scale - VTMX experiment in Salt Lake City; long term goal is to do full-scale urban experiment (2002).
•Need to include interstate highways as a large line source - may not be properly included in current models.
•Does the urban heat island effect need to be included?
•Models must resolve problems with local sources of particulates and with fenceline issues for toxics.

Agencies: DOE, EPA, FEMA, DOD

Recommendations:

-Follow up with scientific meeting.
-Invite more hands-on scientists.
-Probe deeper into these problems.
-Begin coordination in regard to future field studies.
-Explore sharing modeling products.