UNCERTAINTY AND PHYSICAL PROCESS MODELING

Define current state of:
(UNCERTAINTY AND PHYSICAL PROCESS MODELING)

- Key Points from Scientific Briefings

- Uncertainty^{n}
  - Physical
  - Meteorological
  - Transport and Dispersion

Physical Processes Uncertainty

- Van and others:
  - Wet and Dry deposition
    - Uncertainty of Wet > Dry
      - Wet: efficient process and difficult to predict
        - » Prediction of precipitation rates
        - » Precipitation scavenging
        - » For open space there are equations
        - » Complexity increases for urban and canopy
      - Dry: less efficient deposition process
        - » Complexity includes: particle size, roughness, surface type, moisture level, particle or gas, reactive?
      - Weathering effects: surface type, precipitation, moisture
  - Deposition Air ⇔ Ocean transfers
  - Resuspension

Meteorological (Regional) Uncertainty

- Dr. Liu and others:
  - Terrain
  - Land use
  - Soil
  - Multi-scale interactions (nesting models)
  - Spin up model time (dynamic and diabatic)
    - Short term zero-12 hr forecasts are difficult
  - Data assimilation
  - Sparse and irregular observations

Transport & Dispersion Uncertainty

- Surface Conditions
  - Wind field
    - Speed
    - Direction
  - Turbulence
    - Stability
      - Stable boundary layer
  - Moisture
- Boundary layer parameters
  - Depth (zi)
  - Surface heat flux
  - Roughness length
  - Surface type (canopy, urban, …)
  - Terrain

Expectations of Uncertainty Analysis

- Forward modeling: to provide probabilistic hazard zones (Lethal Concentration threshold's)
  - Uncertainty:
    - Source term
    - Weather
    - Transport and dispersion

- Becomes incorporated into the probabilistic STE methods (example: Priors for a Bayesians, sigmas for adjoint, population range for GA)

- Communicating risk and probability to decision makers and public

Path forward:

- Radar data for better precipitation information and deposition information
- Assimilation of precipitation data (radar and ground based measurements) into weather prediction
- Better methods (algorithms) for incorporating particles and gases on surfaces (canopies, open area, urban)
- Weather and resuspension that account for surface types, precipitation, moisture, soil type, etc… Use Fukushima data as reanalysis.

Path forward:

- Incorporate more types data and account for different Temporal and Spatial observations and of different averaging times
  - Types:
    - Surface
    - Wind profilers
    - Satellite
    - Aircraft
- Using ensemble forecasting in NWP models

- To overcome multi-scale: use nesting from synoptic to meso to micro

Near term operational improvements:

- Higher resolution meteorological and dispersion simulations in real time
- Real-time feed for observations including radar, satellite, and aircraft
- Incorporate spatial land-use databases in T&D and deposition models e.g. deposition resistance
- Deposition of particles and gases, e.g. effect of reactivity of the gases, roughness length, and urban/forest canopy
- Test current and new algorithms in a Fukushima reanalysis