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PARADIGM USING JOINT DETERMINISTIC GRID MODELING AND SUB-GRID VARIABILITY STOCHASTIC DESCRIPTION AS A TEMPLATE FOR MODEL EVALUATION.

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The goal of achieving verisimilitude of numerical meteorological and air quality grid model simulations to observed data is problematic. When grid sizes are such that the existence of significant and inherent spatial, within-grid variabilities are not resolved, the comparison against one or more point measurements cannot in general, be expected to be equal, except under very special limited circumstances. Yet, since models are judged by these comparative analyses, there is an implicit assumption (or hope) that the point measurement is representative of the grid model prediction, and vice versa.

In this paper, we accept the fact that there will always be some degree of inherent within-grid variability to grid models, despite using finer scale grid resolution. This is true whether it be in meteorological or air quality model simulations. Contributions to subgrid variability in meteorological simulations arise from within grid areal variability in land use, land cover, building distribution, complexities in terrain, shorelines. Sub-grid air quality concentration simulations arise from source distributions, from incomplete dispersion in the grid from within-grid sources (both anthropogenic and biogenic) and at times, significant variability arising from coupled chemical and turbulent interactions. On the other hand, general siting guidance for locating monitors may not necessarily mean that such measurements will be representative of the outcome of the grid model simulations. This desired goal is achievable only for idealized horizontally homogeneous fully dispersed, uniform source distributions situations. In fact, especially in urban areas, the circumstance in which the monitors and grid model output are really expected to be completely comparable is conceptually fortuitous.

In the presence of inherent within-grid variability, we suggest a more reasonable formulation for the comparative between models and monitoring information is to start by recognizing and accepting the (1) a priori presence of within-grid variability in the model results and (2) reality that a measurement cannot completely represent these subgrid variabilities (SGV) adequately leading to biased results. A rigorous expectation is that the observation should fall within the grid simulation and some indicator of each grid's SGV; it follows that the paradigm for model evaluation (or comparative) of grid predictions against observations must include allowance for this SGV. A conservative measure is that the difference be at least as large as or some value contained within the range of SGV. The problem becomes one of characterizing and estimating the SGVs.

We provide illustrative examples of SGVs for typical model application (say at 12 or even 4 km gid resolutions) from (a) simulations at finer (~1 km) grid scale air quality simulations (Neighborhood scales) (b) analyses of within grid source variability and (c) from chemical variability due to reactions that take place in turbulent flows.