A bottom-up strategy for uncertainty quantification in complex geo-computational models

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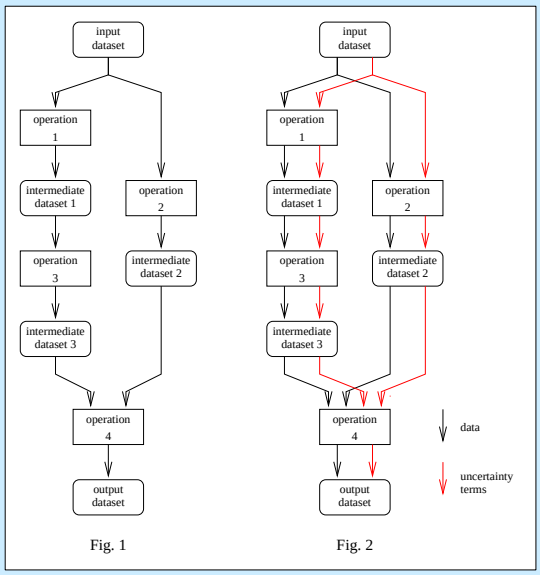
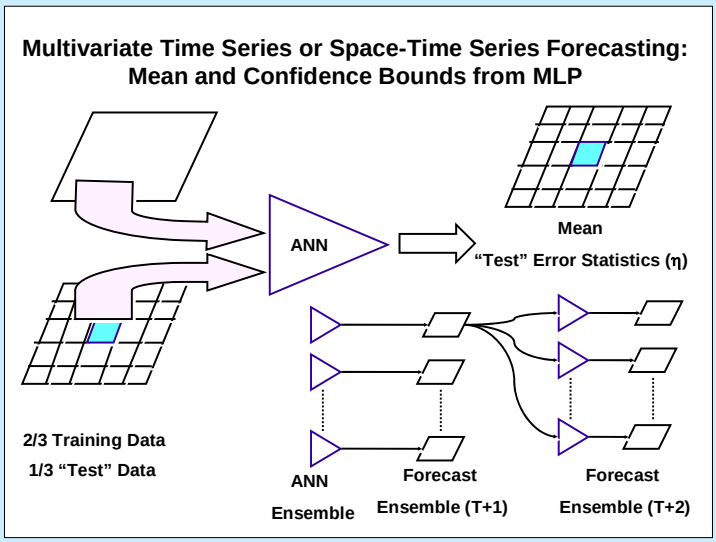
A. Process-driven Uncertainty Quantification

Process decomposition



1. Decompose problem into known geospatial operations or processes
2. Compute input and process dependent uncertainty for each operation
3. Compute overall uncertainty, noting that the whole can be greater than the sum of the parts

"Ensemble Neural Network"

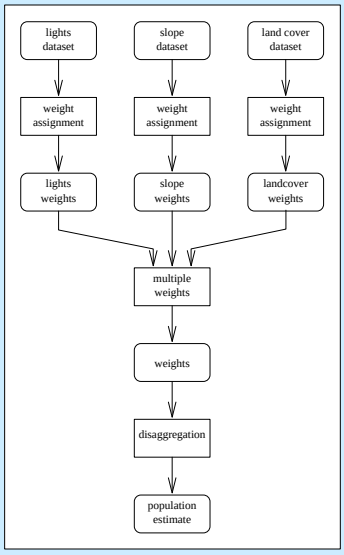


Ganguly, 2002; Ganguly and Bras, 2003

The "ensemble neural network" is an example of an approach that computes input and operation dependent uncertainty resulting from certain kinds of geospatial-temporal operations.

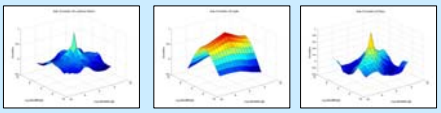
B. High-resolution population estimation

LandScan Model



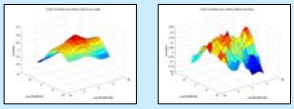
The schematic of the LandScan model hides much of the complexities.

Spatial Auto-correlations



Population Lights Slope

Spatial Cross-correlations



Population vs. Lights Population vs. Slope

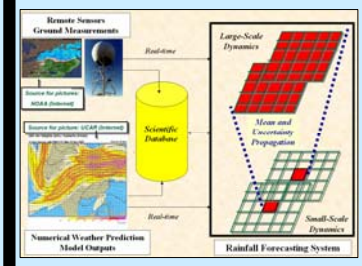
Spatial correlations are important for geospatial uncertainty quantification.

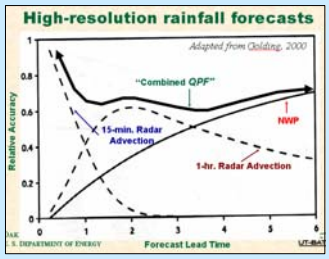
Process Uncertainty

1. Input data assimilation
2. Automated population assignment
3. Judgmental updates

C. High-resolution rainfall forecasts

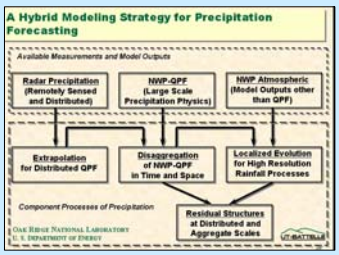
Numerical Weather Prediction & Radar

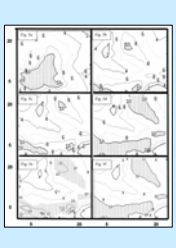


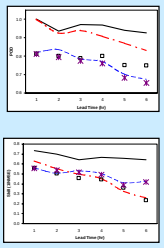


Golding,2000; Ganguly,2002; Ganguly & Bras,2003

Process-driven solution







Ganguly,2002; Ganguly & Bras,2003