CONSIDERATIONS IN DESIGNING AND IMPLEMENTING A MODELING AND POSTPROCESSING SYSTEM

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EMPHASIS ON "SYSTEM"

- Modeling and postprocessing forecast system must include
  - Data assimilation
  - Numerical model(s)
  - Postprocessing
  - Delivery to users (push or pull)
- Each component must mesh with the ones upstream and downstream
- Applies to mesoscale and synoptic scale, single member and ensemble

CURRENT SITUATION

- Numerical model and data assimilation are usually well coupled
  - Developed together so that the assimilation is near optimum for the particular model
- Postprocessing and delivery systems are generally well coupled
- Models and postprocessing have **not** been well coupled in the NWS
  - Many times, even usually, operational model data are not saved in consideration of postprocessing needs
  - Model archive may consist of
    - Too few time projections (e.g., 6- or 12-hourly, vice needed hourly or 3-hourly
    - Different ensemble members saved at different spatial resolutions
    - On a grid that is not the target user grid, incurring interpolation errors
    - In a format different from other models, and perhaps difficult to deal with
    - Inadequately documented as to file name, structure, and content
    - Contain errors

CURRENT SITUATION (cont.)

- Operational delivery system in the NWS is complicated
  - Must have agreement to implement with metrics
  - Much coordination required:
    - for implementation on supercomputer
    - to interface with other systems (e.g., gateway, AWIPS)
    - to inform public and other users
      - OSIP and Public Information Notices, with comment periods
      - Applies to changes as well as new or obsolete data and products (e.g. the NGM model products)
  - Advanced coordination not adequate for timely implementation

FOR A MESOSCALE ENSEMBLE SYSTEM TO BE SUCCESSFUL

- Strong governance
  - For a model or postprocessing system to be implemented:
    - The interfaces must be well defined and adhered to
    - Total system must be considered and mesh well with other subsystems
    - Quality of product be judged by an independent entity (e.g., DTC)
    - A base set of model variables output for postprocessing with consistent definitions (e.g., ceiling height be measured from an agreed-upon base level in agreed upon units)

QUALITY OF MODEL OUTPUT

- Accuracy/skill
  - One or more appropriate measures must be defined and used
  - Variables verified must include those likely to be used for postprocessing (e.g., 2-m temperature vice 500-mb height)

QUALITY OF POSTPROCESSED PRODUCTS

- Accuracy/skill
  - One or more appropriate measures must be defined and used
  - Consider high impact weather variables (e.g., ceiling height and precip type) as well as the more mundane (e.g., surface temperature)
  - Include most weather variables in the evaluation

QUALITY OF POSTPROCESSED PRODUCTS (cont.)

- Reliability
  - Probability forecasts must be reliable (e.g., when a 20 percent forecast is made many times, the event should occur about 20 percent of the time)
  - Critical for use in decision models
  - Measures of reliability must be used together with other measures, such as Brier Score that take sharpness into account

QUALITY OF POSTPROCESSED PRODUCTS (cont.)

- Temporal consistency
  - Projection to projection
    - Primarily an issue for hourly or 3-hourly forecasts
      - Changes from hour to hour should occur for meteorological reasons, not noise in the system
  - Run time to run time
    - Forecast valid at one specific place, day, and time made from two successive model runs should not bounce around just due to the run time

QUALITY OF POSTPROCESSED PRODUCTS (cont.)

- Spatial Consistency
  - A graphic produced from the gridpoint values should present a meteorologically reasonable pattern
  - “Reasonable” is somewhat in the eye of the beholder
    - Some criteria be developed for how much detail (spottiness) is reasonable and desired
      - Needed detail may depend on user, but if the detail is not meteorologically justified, it is just noise and should not be included.

QUALITY OF POSTPROCESSED PRODUCTS (cont.)

- Consistency among weather elements, for example:
  - Dew point must not exceed temperature
  - Definite or heavy rain should not be forecast with clear skies
- Rules for observations can be a guide

CONSIDERATIONS FOR EASE OF IMPLEMENTATION

- Generality of technique
  - Operational forecasts are required for:
    - Many different weather elements
    - For many points (observation locations and/or gridpoints)
    - For many different projections
    - For multiple run times (from 2 to 24)
    - From different operational models
  - Much easier to implement and maintain one “system” or “technique” than several

UNDERSTANDABILITY OF POSTPROCESSING TECHNIQUE

- Operational 24/7 system requires considerable resources
  - Computers are constantly undergoing changes
    - Adequate offsite backup capability must be maintained
    - Disks and their use undergo change
    - Compilers on new machines sometimes require mods to the code and regression testing
  - A full suite of "products" (data availability formats) requires considerable care
    - User questions must be answered (e.g., why did Baltimore have a 10 degree temperature error on a specific date)
      - Technique and software must be understood by operational unit personnel in order to answer and trouble shoot
  - Forecaster training must be provided

BUSINESS CASE

- Cost of implementing a new or multiple techniques must be balanced against the measured improvement

SUMMARY

- Design, development, testing, and implementation of a mesoscale ensemble modeling and postprocessing system must be treated as a SYSTEM
- Governance is critical to system success
- Business case must be made for implementation and changes, based on quality of product and effort and resources to implement