National Model and Program Data Requirements

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Purpose

- To highlight:
  - data requirements and issues from perspective of R&D and implementation experience
  - data processor changes required
  - system changes

Overview

Data issues related to

- Research and Development
- Operations
- Systems

Data Needs, Issues, and Requirements for R&D

Sources of error in hydrologic modeling:

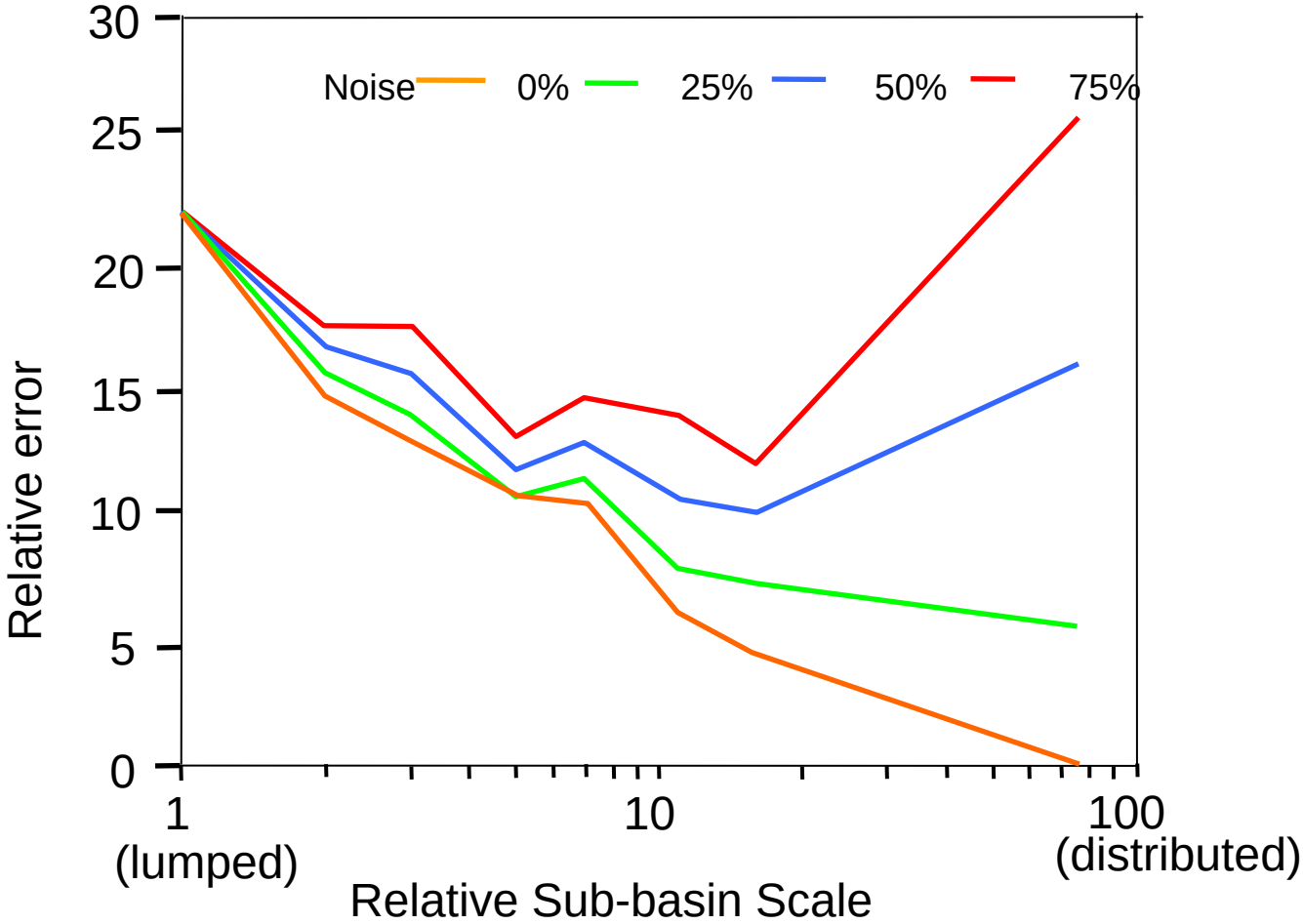
- Model error
- Input error
- Parameter error

Data Needs, Issues, and Requirements for R&D

1. Observed precipitation data at finer spatial and temporal scales
    - Needed scale: Gridded, hourly, 4km scale. Finer resolution for flash flood
    - Must be high quality, error characteristics understood.
    - Needed for:
        - Devl. of distributed models for river and flash flood modeling
        - Analyses of appropriate modeling scale and importance of spatial variability.
    - Issue: Lack of high resolution precipitation data is the dominant problem for DMIP 2 using a western basin
        - Lack of data affects the ‘purpose’ of DMIP 2 in a western basin: ‘MIP’ in contrast to ‘DMIP’ since data may not support distributed modeling
    - Solutions
        - MPE development
        - MPE re-analysis for consistent data sets

Why do we need high quality precip. data?

Data errors can mask gains from finer scale modeling.



Plot of numerical modeling error versus size of sub-basin for various levels of radar data error (Koren et al. 2003)

Understanding Precipitation Error Characteristics

12-Month Moving average of monthly MAPX/MAP ratio for period 1994-1998 (Wang et al., 2000)

Data Needs, Issues, and Requirements for R&D

2. Observed soil moisture:
   - Needed scale: point obs, and gridded fields at same scale as distributed model.
   - Needed for:
     - distributed model development
     - frozen ground modeling
     - validation, improvement of FFG
     - data assimilation
   - Issues:
     - Currently, very few point observations
     - Limited depth estimates from satellites; no real plan to increase this capability
   - Solutions
     - Push agencies to fund more point obs. at critical sites
     - Correlate satellite surface moisture with depth

Data Needs, Issues, and Requirements for R&D

3. Observed soil temperature:
   - Needed scale: point observations same as distributed model.
   - Needed for:
     - frozen ground modeling
     - advanced PE estimation
   - Issue: very few point observations
   - Solutions:
     - satellite estimates of skin temperature
     - Push for more point observations

Data Needs, Issues, and Requirements for R&D

4. Observed air temperature data at finer spatial and temporal scales
    - Needed scale: Gridded, hourly (?), 4km scale.
    - Must be high quality, error characteristics understood.
    - Needed for:
        - Development of snow component for distributed model for river and flash flood
    - Issue: derivation of suitable gridded temperature fields for distributed Snow-17 modeling in MARFC.
    - Solutions:
        - Eta, RUC model estimates

Data Needs, Issues, and Requirements for R&D

5. Observed streamflow data
   - Scale: Hourly, sub-hourly, at basin outlets and interior points
   - Must be high quality (check against USGS qme data)
   - Needed for development of:
     - Finer scale models
     - Assimilation techniques
   - Issues:
     - Loss of stations over time
     - Relatively few at interior points needed by HL
   - Solutions: emphasize need for these obs.

Data Needs, Issues, and Requirements for R&D

6. Meteorological data: solar radiation, wind speed, rel. humidity, dew point, etc.
    - Needed scale: daily, sub-daily, gridded.
    - Must be high quality due to model sensitivities (SnowMIP)
    - Needed for:
        - evaluate operational use of energy budget models for oper. forecasting
        - computation of daily estimates of PE (e.g. GOES estimates of solar radiation)
    - Issues:
        - Record length for calibration
        - Operational availability
        - Data quality
        - Biased compared to Syntran estimates?
    - Solution: evaluation of new data sources is ongoing
        - U. New Hampshire: GOES sat. data for PE estimates
        - Specific task in HL to evaluate new data sources, starts Aug 1

Data Needs, Issues, and Requirements for Operations

- Improved higher resolution precipitation observations everywhere, especially in inter-mountain west
- High elevation temperature obs. in Alaska
- Coherent, appropriately down-scaled, seamless suite of forecast model forcings over short to long time scales.
- Understand bias issues between calibration and real-time forcings
- Understand issues between calibration and real-time preprocessors.

Systems Needs and Issues

- Archival and retrieval system for OFS observations and processed (time series) data:
  - for verification and research, short term ESP, e.g., MARFC project.
- Advanced Calibration System for RFC use.
  - Any new modeling developments **must** be accompanied by a commensurate calibration system.
    - Current tools do not constitute an integrated system:
  - Need heightened by prototype testing of HL-RMS and DMS 1.0
  - Limited AHPS emphasis to meet this need.
  - Solutions:
    - Data display and analysis tools: Eric Anderson has functional requirements documents.
    - Links to other groups' data archives (e.g. U. Arizona).
    - New functional design of replacement for HDB, Legacy Programs
    - ICP functional requirements (no design, etc)
    - DMS-1.0 will guide DMS-2.0 development
- Consistency between Calibration and Operational Preprocessors

Implications of Gaps in Data and Systems

- Difficult to effectively realize gains from advanced models due to data issues (e.g inconsistency and noise of radar precipitation estimates makes model calibration difficult; lack of high resolution precip estimates in west) (MPE enhancements)
- Forced to use climatic means of potential evaporation when daily estimates would be better. (examine new data sources for solar radiation)
- Drawn-out process of hydraulic model calibration e.g., developing time series of qine (observed) data. (archival and retrieval capability)
- Unnecessarily cumbersome process of hydrologic model calibration. Existing programs and tools do not comprise a coherent and integrated system. Cannot effectively move forward with distributed and finer scale models without integrating entire system. (enhanced calb. system)
- Missing accurate diurnal variations in temperature which affects event-typing and snowmelt (updated MAT preprocessor)