EMERGING NEEDS
HYDROMETEOROLOGICAL FORCINGS

An Operational Perspective to Support Integrated & Adaptive Water Resources Management

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Operational Imperatives for IWRSS

Hydrometeorological Forcing Requirements

Scope
- U.S., North America, Global
  - Summit to Sea
  - Anywhere, anytime

Scale
- Gridded Information
  - “High resolution”
  - NWC Initial Goal: 0.5 km; 0.5 hour

Qualities
- Continuous Record: Past – Present – Future
  - Internally consistent
  - Best possible (we want it all: observations; models)
  - Interoperable: e.g. NOAA AOR & USGS Water Census

Fields
- Hydrologic Forcings
  - Precipitation (Amount, Type, & Density); 2m Air Temperature, Pressure, Humidity; 10 m Vector Winds; Radiation
  - Support State Parameters: e.g. Soil Moisture; ET; etc.
Provide summit to sea, high-resolution (goal: half hour; half km) gridded water resource information for the United States & North America and globally (at lower resolution); derived from observations and model output.
Provide summit to sea, high-resolution (goal: half hour; half km) gridded water resource information for the United States & North America and **globally** (at lower resolution); derived from observations and model output.
Continuous Record/Best Possible
A bit of a Conundrum

Cone of uncertainty…

Analysis of Record

“Gage Era”  “Satellite Era”  “Radar Era”

~ -50 yrs+  ~ -30 yrs  ~ -20 yrs  0 yrs
Emerging Needs
Water Now, Next & Future

**Modeling**
- Reanalyses & Forecasts
- High resolution
- Coupled/integrated

**Assimilation**
- Intelligent integration of observations and models
- Direct (nudging); variational; sequential (EnKF)
- Conservative (close the water cycle budget)
- Atmospheric, LSMs; hydrology models

**Observations**
- High quality, long-term
- Validation
- Process studies/physics
- Optimal network design (OSSEs/OSEs)

**Downscaling**
- Low density of observations
- High spatial & temporal variability of phenomena
- Statistical, physical, climatological
NOHRSC: 10,000 points (once daily). Sounds like a lot, but…

Courtesy of Greg Fall
24 hour totals from gages: New England is relatively “data rich”
HUC 10 “Watershed” Boundaries in white

Courtesy of Greg Fall
Sampling Issues

24 hour totals from gages (dots) & gage adjusted radar (Q2)
HUC 10 “Watershed” Boundaries in white

Courtesy of Greg Fall
A metaphor for downscaling...

There is water everywhere...

“Why is the rum gone?”

But, nothing to drink...
A metaphor for downscaling...

There is data everywhere...

But, nothing at the required resolution...
A Role for Testbeds: HMT

- Observational framework
- QPE
- QPF
- Snow Information
- Hydro-Apps & Surface Processes
- Decision Support
Hydromet Forcings:
- The lesson of GIGO…

Challenge Remains:
- Water Forecasting

High Resolution, Gridded Info:
- “Model-driven” process
- Downscaling
- Smoothed fields (process filters extremes)
- Hyper-resolution modeling

Best-possible, continuous record
- Reanalysis (AOR) – Analysis – Forecast (Weather & Climate)
- How to blend observations & model information
- Assimilation

High resolution coupled/integrated modeling

Physics/process-based

Research to Operations
Thank You!
Radiation Challenges

Surface radiative fluxes evaluation over the pan-Arctic

GEBA (Global Energy Balance Archive) station locations

Note: DSW (downward shortwave radiation); DLW (downward longwave radiation).

Courtesy of X. Shi & D. Lettenmaier
Figure 2 Plot of Catch Ratios versus Wind based on best fit regression equations shown in Table 3 for snow; the Tretyakov curve was plotted for $T_{max} = -2.0^\circ C$. 

Goodison, 1998
Radar Gaps: the CASA Model

- Radar “Gap”
- Spatial Resolution
- Temporal Resolution
- Radars function autonomously

NEXRAD coverage at 3 km (10,000 ft) AGL.

NEXRAD coverage at 1 km (~3200 ft) AGL.

Courtesy of V. Chandrasekar
Gauge comparison was investigated to evaluate the QPE system

USDA ARS Micronet – A rain gauge network located at the center of the IP1 test bed

Source: [http://ars.mesonet.org](http://ars.mesonet.org)

Courtesy of V. Chandrasekar
Comparison of 5-minute rainfall from CASA IP1, NEXRAD and rain gauges.

*Courtesy of V. Chandrasekar*
Hydrologic Cataloging Unit Streamgage Score

Score

1-2
2-3
3-5
5-7
7-9
9-12
12-18
18-83

Scoring:
1 point for every active streamgage
1 point for each long-term streamgage
1 point for each non-regulated streamgage
1 point for each HUC outlet streamgage

Courtesy of E. Evensen