Distributed Hydrologic Modeling

-WGRFC experience and perspective

2008 DOH Conference

Silver Spring, MD

July 17th, 2008

Bob Corby[1], Paul McKee[1] Mike Schultz[1]

[1]West Gulf River Forecast Center

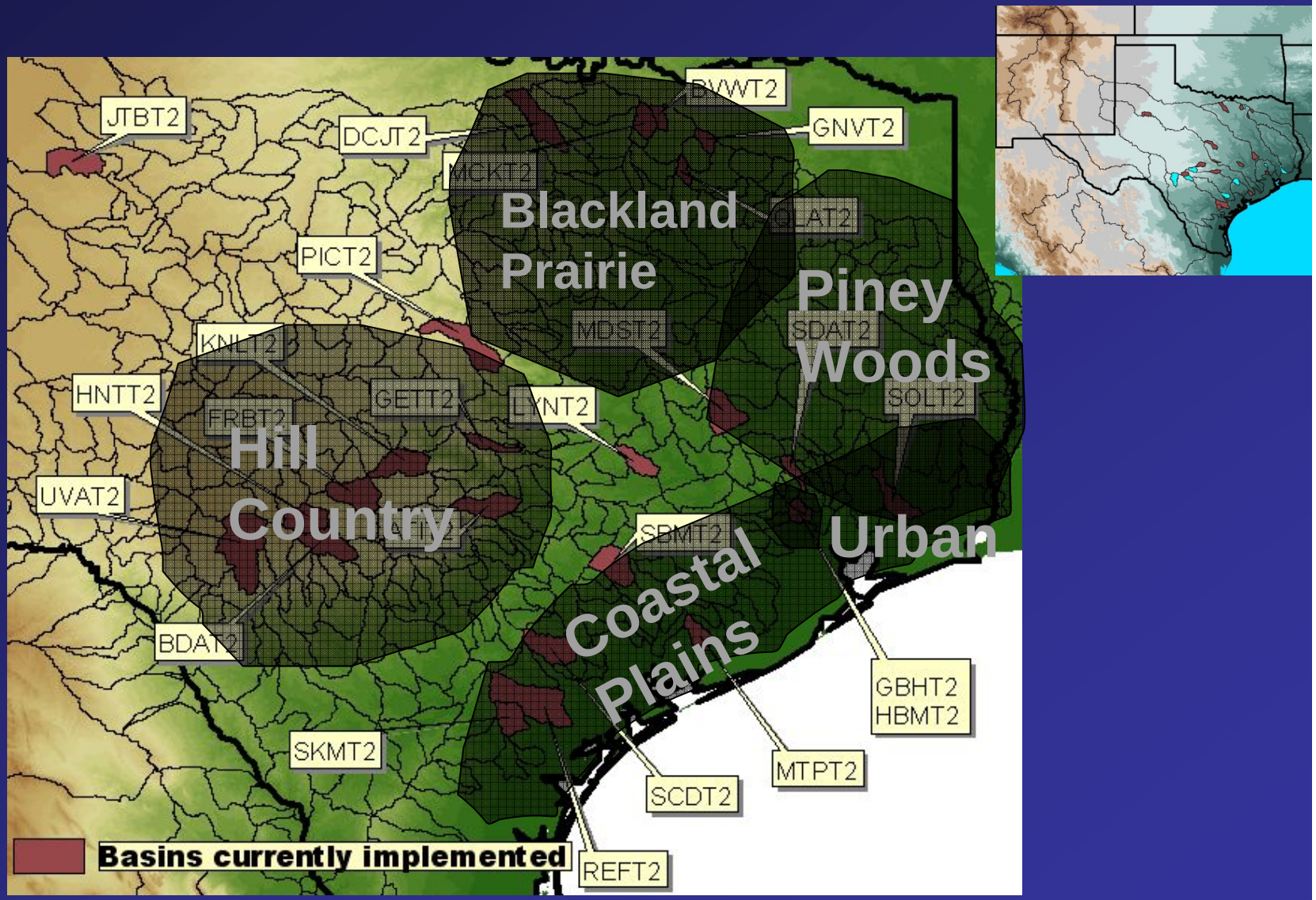
History of WGRFC involvement

- Fall 2003/Spring 2004 – DHM 1.0 released to ABRFC and WGRFC. Began testing basin setup and calibration
- Feb 2004 – Setup hourly DHM runs for operational forecast comparisons (8 basins).
- 2004 – 2006 - early testing and calibration (25 basins)
- 2004 - 2007 –Providing feedback to OH and detailing requirements for an operational DHM (OSIP process); latest version…Operational DHM OB8.3;
- 2006 - 2007 – not much progress with calibrations; hl-rdhm continuing to develop (ie. new apriori SAC parameter grids, optimization, forecast mode, sac-HT, etc)
- Presently… Recently began testing with HL-RDHM and use of optimization and new SAC parameter grids; waiting to implement DHM OB8.3

Initial Interest in DHM

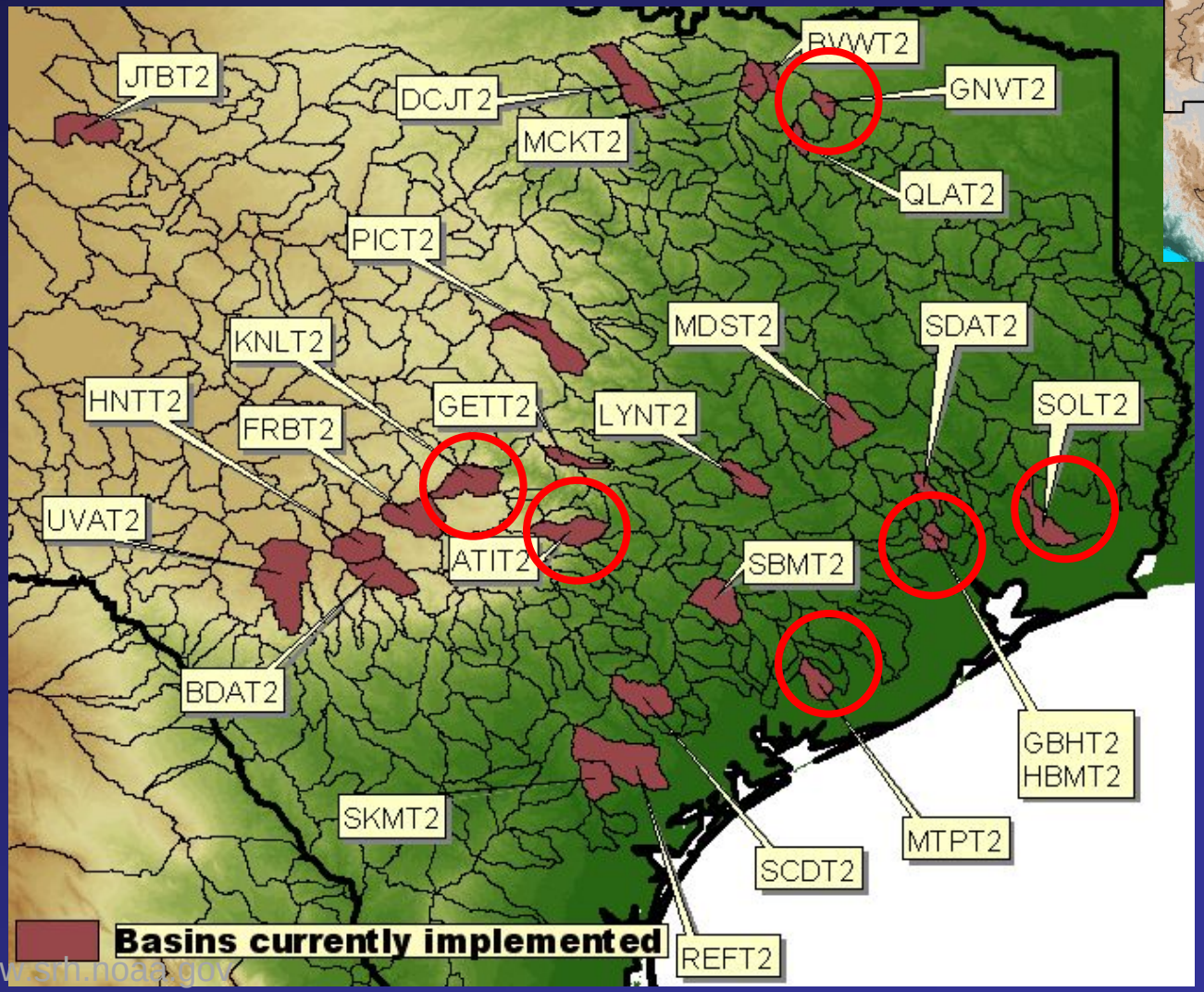
- Limitations of Lumped modeling potentially averted with ability to distribute parameters (ie. precip, land-use, soils)
- Rapid hydrologic response times of WGRFC forecast pts (approx 50% crest in 12hrs or less)
- Ability to compare with VAR study basins

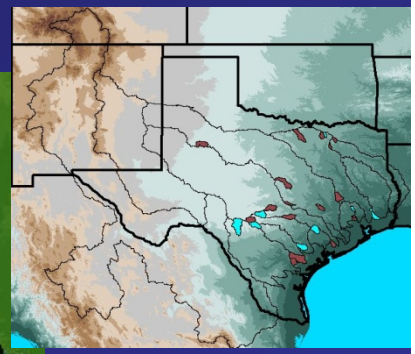
Test Basins Locations



DHM Test Basins

Varied basin size, terrain, land-use/cover, soils





DA:

75 – 400 mi2

Peak times:

6 – 60 hr

http://www.srh.noaa.gov/wgrfc

Operational Forecasting

- Continue to use DMS 1.0 forecast mode
- Runs on cron once per hour
- No operational mods possible (ie. precip, sac)
- TS displayed in IFP with Tulsa-plot
- Forecasts issued on DHM as desired using QINE mod

Early Research Conclusions

- Manual “expert” calibrations improvement over apriori parameters
- Limited success with manual calibration improvement over 1hr lumped model
- Event timing generally good; a few basins with unexplainable timing issues
- Biggest challenge in matching peaks
- More experience needed with calibration

Early Research Conclusions

Questions/Concerns of DHM at WGRFC

- Difficult to calibrate peak flows
- Model errors and uncertainties tend to increase at smaller scales
- Does SAC model error compound for each grid cell (diffused with lumped)?
- Gridded data for all parameters may be too much complexity (ie. zones?)
- QPE most sensitive parameter… spatial and magnitude errors explain false peaks and compound peak flow errors

Transitioning from early research to present

- Early OB8.x versions of Operational DHM a good start, but decided to wait for OB8.3 improvements before implementing (ie. runtimes, scalar precip and sac mods)
- Currently focused on HL-RDHM to explore optimization and use of different apriori sac parameter grids

Apriori SAC-SMA Parameters Grids

- 3 available apriori SAC parameter grid sets (statsgo, statsgolu, and surgofil)
- All at 4km resolution
- 11 of 17 sac parameters have grids
- All computed from Koren's methodology, with hopeful improvements by using higher resolution data

1. statsgo- Based on STATSGO + constant LU
   - Assumed "pasture or range land use" under "fair" hydrologic conditions
   - National coverage
2. statsgolu- Based on STATSGO + variable LU
   - National coverage
3. surgofil- Based on SSURGO + variable LU
   - Parameters for 25 states so far
   - Soils and LU data sets much higher resolution

***all available now via CAP*

Current Research Objectives

comparisons and questions to answer…

- dms vs. rdhm… for the same data sets, are both models simulating the same results?
- apriori SAC parameter grids… are there any clear advantages/benefits between statsgo, statsgolu, and surgofil apriori parameter grids?
- apriori vs manual calibrations…
- lumped vs distributed SAC model… is there clearly benefit to using distributed SAC parameters?
- optimization strategies… does the opt utility benefit the calibration process?... Are there certain strategies to make the use of optimization more effective?

Current Research Objectives

Data Preparation

- Created quality controlled one hour qin timeseries from USGS unit value data for 8 year period: 1/1/2000 – 1/31/2007.
- Checked for consistency with USGS daily values.
- Ran MAPX for 8 year period.

Current Research Objectives

Model Preparation

- Made calibration runs for lumped 1hr and 6hr models.
- Updated dms calibration runs through 12/31/2007.
- Converted dms decks to hl-rdhm format.

Current Research Objectives
Model Preparation

- Created hl-rdhm decks for
  - Apriori Parameters (dms grids)
  - Apriori Parameters*
  - Manual Calibrations*
  - 1 Hour Lumped parameters *
  - 1 Hour Lumped equivalent parameters*

* Using statsgo, statsgo w/ variable land use, and surgo parameter grids

Current Research Objectives

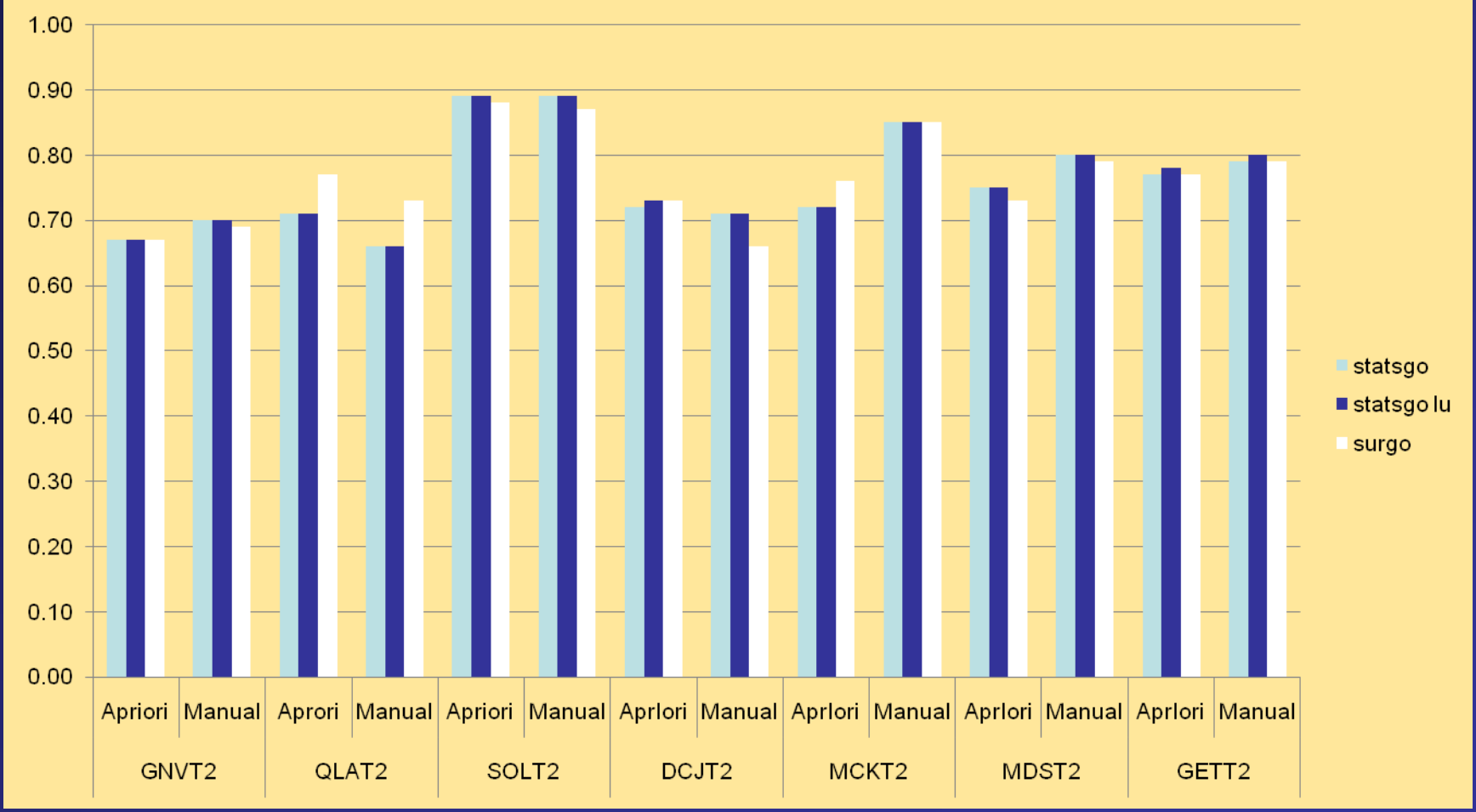
Data Analysis

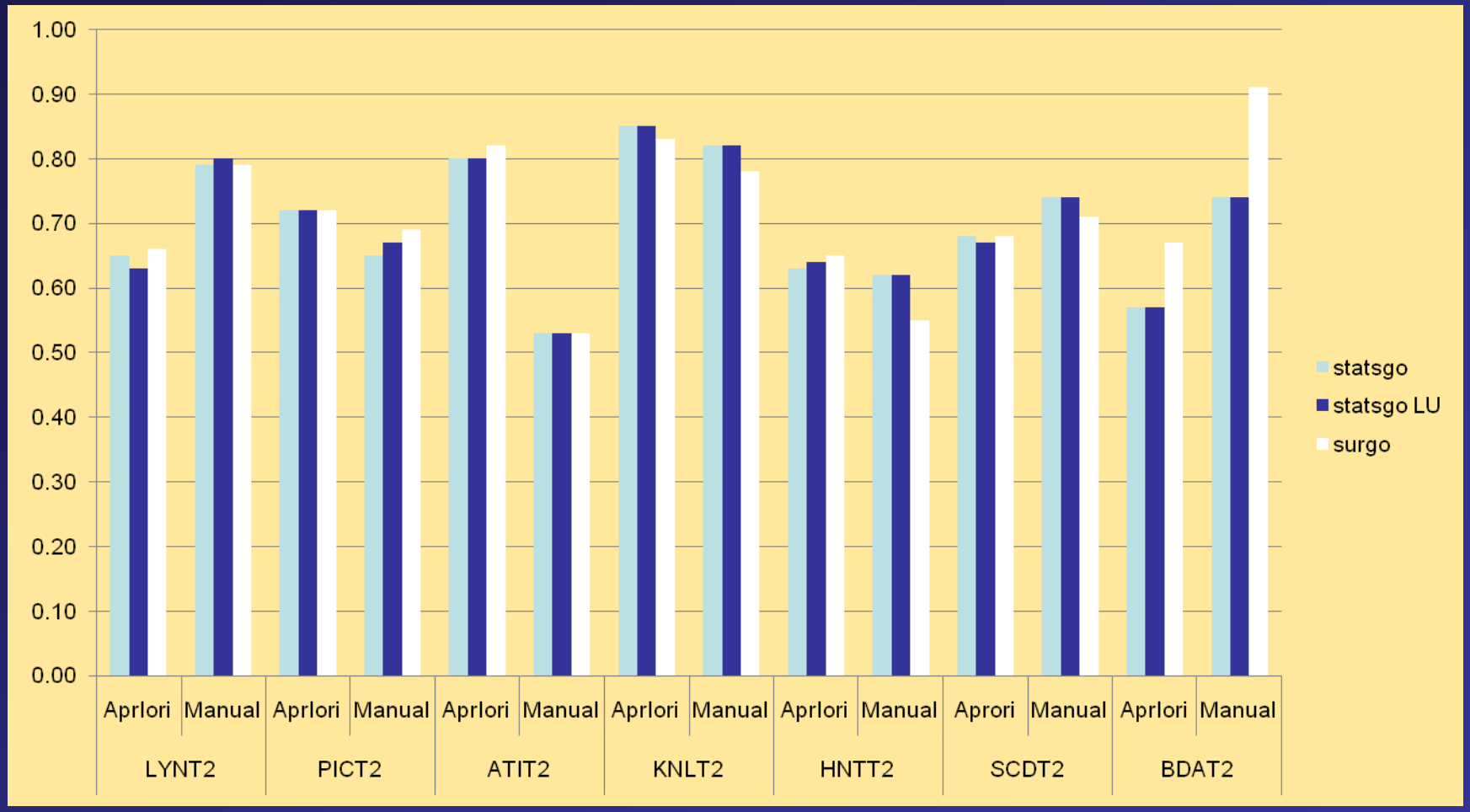
- Set up stat-q decks to compute statistics on each simulation.
- Set up ICP decks to view simulations.
- Set up optimization decks to become familiar with the process.
- Made preliminary rdhm runs & a few optimization runs.

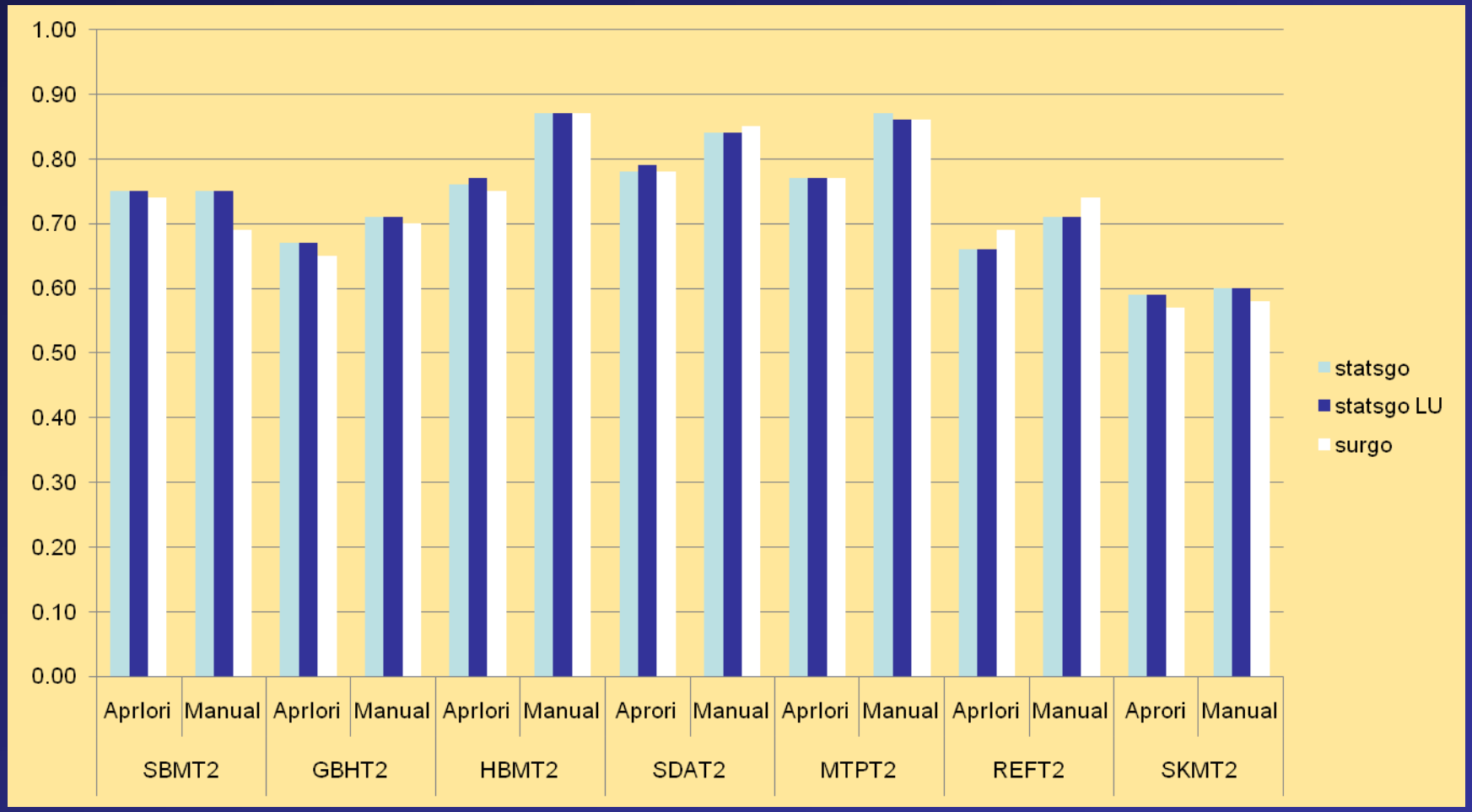
A Cursory Look at Model Correlations

- Hl-rdhm simulations using dms parameter grids, yield the same simulaitons.
- Similar “r” for statsgo, statsgo w/ LU, and surgo parameter grids for most sites.
- Similar “r” for lumped and lumped equivalent parameters for many sites.
- Well calibrated lumped 1 hour model shows similar “r”.
- Can increase “r” thru optimization.

Simulation Correlations




1.00
0.90
0.80
0.70
0.60
0.50
0.40
0.30
0.20
0.10
0.00
Aprlori
Manual
Aprlori
Manual
Aprlori
Manual
Aprlori
Manual
Aprlori
Manual
Aprori
Manual
Aprlori
Manual
LYNT2
PICT2
ATIT2
KNLT2
HNTT2
SCDT2
BDAT2
statsgo
statsgo LU
surgo


1.00
0.90
0.80
0.70
0.60
0.50
0.40
0.30
0.20
0.10
0.00
Aprlori
Manual
Aprlori
Manual
Aprlori
Manual
Aprori
Manual
Aprlori
Manual
Aprlori
Manual
Aprori
Manual
SBMT2
GBHT2
HBMT2
SDAT2
MTPT2
REFT2
SKMT2
statsgo
statsgo LU
surgo

Current Research Objectives

From Here

- Much more needs to be examined beyond overall correlation.
- Continue to attempt to improve simulations thru optimization.

Thanks