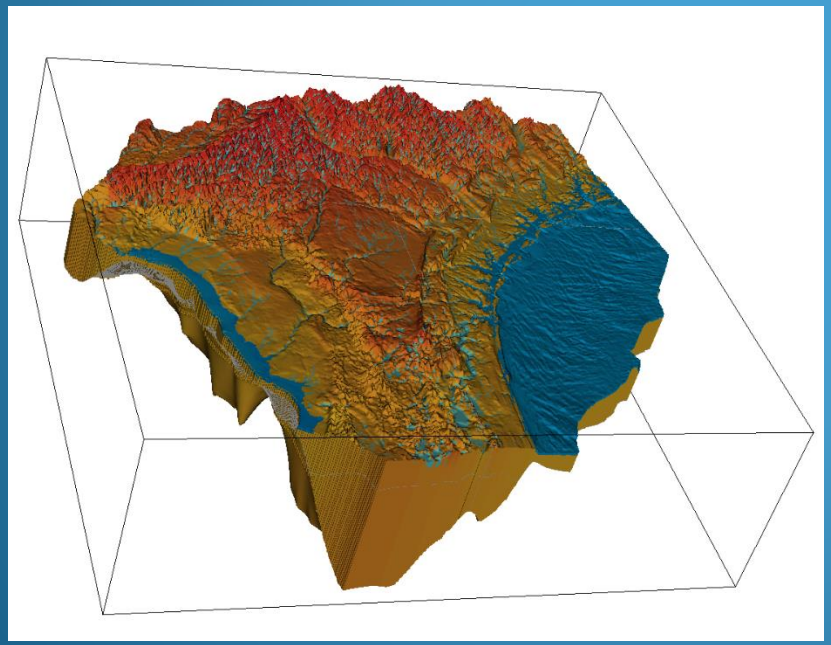
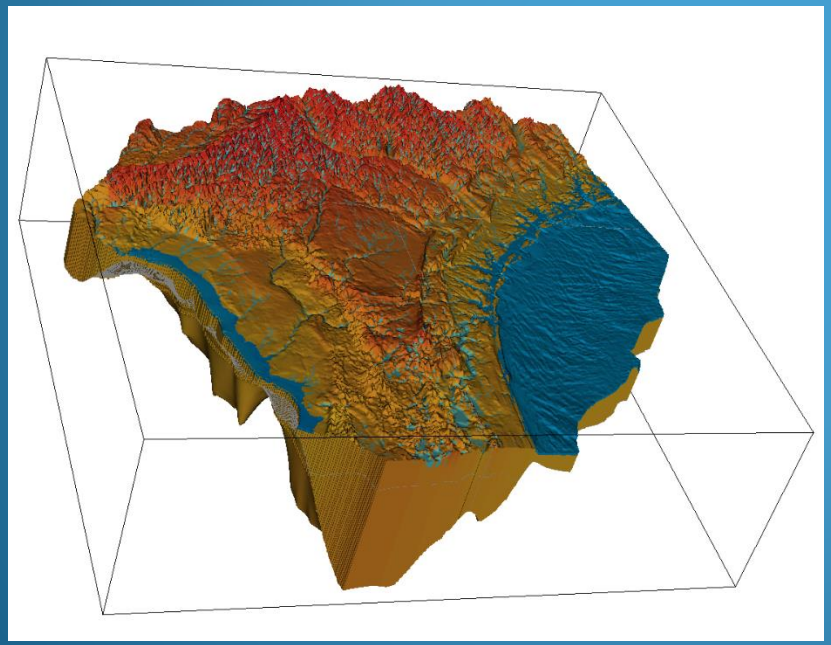
# NFSEG Peer Review
# Task A.3 Draft Initial Comments



Peer Review Panel:
Louis Motz
Brian Bicknell
Hal Davis
Jim Rumbaugh
Dann Yobbi

**April 13, 2017**

# Draft Initial Comments for HSPF Model



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# Summary of 1.0 Model (Bicknell)

**The HSPF model is generally well conceptualized, and in accord with current practice for generating recharge for a GW model.**

- Delineation of watersheds appears appropriately scaled
- Closed basins appear to be modeled with a creative "virtual sink" method to avoid calibration parameter values that are outside normal ranges
- Springs are modeled using two methods
  - measured inflows are imposed on model reaches
  - simulated springshed recharge is routed to a subsurface reach and then routed to the surface reach
- Land use categories modeled to allow differentiation of hydrologic response and water use inputs

# Summary of 1.0 Model (continued)

- Primary inputs appear to be conceptualized correctly
  - Precipitation – NLDAS with verification by comparison with gage data
  - Potential Evapotranspiration – NLDAS with adjustment to approximate “shallow water body”; should be lake evaporation
  - Spring flow
  - Water usage and application of irrigation
- Interface with MODFLOW appears correct
  - Recharge and MSET
  - Different for water and wetland land categories to avoid double counting surface ET
  - Closed basin recharge added to sinks and wells in basin

# Summary of 1.0 Model (continued)

- Calibration
  - Uses PEST with complex objective function
    - Comparisons of streamflow at various time increments plus frequency distribution
    - Computed ET similar to literature values
    - Baseflow comparisons
  - Calibrated to USGS streamflow over longest POR available for each gage
  - Some HUC8's with multiple gages are calibrated only at outlet
  - Parameters constrained to be in reasonable bounds
  - Parameters **not** constrained to be similar for the same land use category in adjacent watersheds

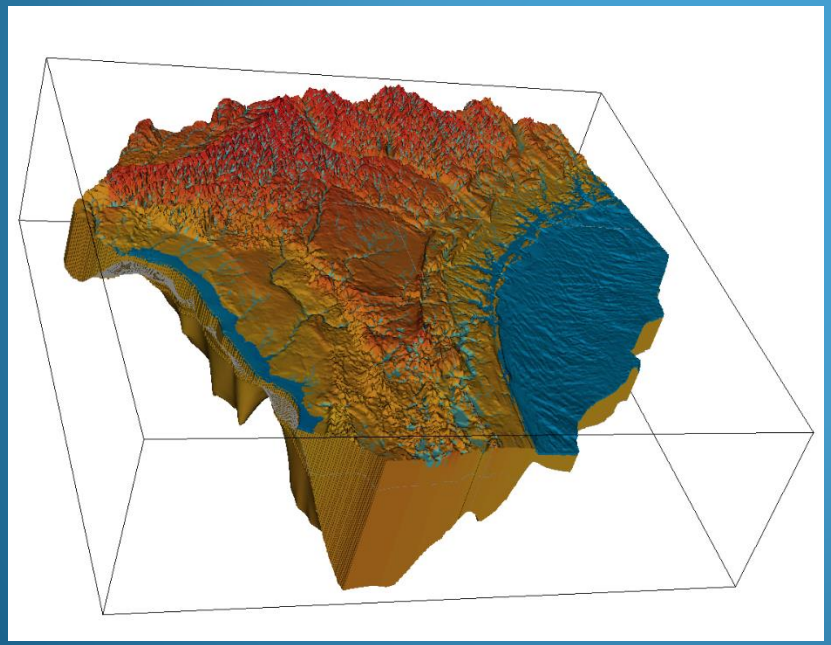
# Suggested Changes

- Calibration should be improved
  - All gages should be calibrated if sufficient data are available (1.1)
  - The objective function should place more emphasis on matching the total overall flow plus the flow frequency (1.1)
  - Parameters should be constrained to be similar in adjacent watersheds for the same land use category (final version)
  - Water balance should be reviewed to ensure it is reasonable for all land uses; includes inputs (rainfall, irrigation), components of runoff, recharge, and components of ET (final version)
  - Are the simulated springs calibrated to measured spring discharges? (final version)

# Suggested Changes (continued)

- Interface with MODFLOW
  - Areal recharge should be less discontinuous at watershed boundaries; provide recharge areal displays (maps) for each land use category and the overall recharge to verify that it is relatively continuous (1.1)
  - Provide details of the overall recharge computation from the land use category recharge (1.1)
- Documentation
  - Include more detail of the PEST calibration and objective function, including components and their initial and revised weights (1.1)
  - Include tables of the hydrologic parameter values for all watersheds and land use categories in an appendix (final version)
  - Compute and include tables of additional statistics, such as percent bias and % differences at high and low flows (final version)

# Draft Initial Comments for MODFLOW Model



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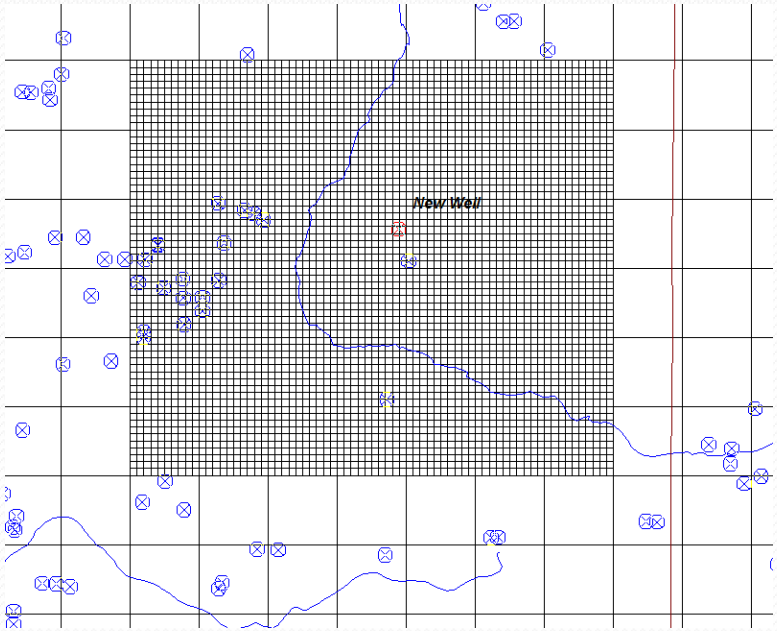
# PEST Calibration (Rumbaugh)

- Review Observation Weights
  - Revise and Rerun PEST if Adjustments are Needed
  - Report the Rationale for Weighting Scheme
  - Report Observations Statistics with and without Weights
- Change ET to Adjustable Parameter (time permitting)
  - ET and Kz Help with Flooded Cells
  - Right now, only Kz is Estimated

# Investigate MODFLOW-USG

- Same Capabilities as NWT
- Adds Conduit Flow (CLN)
- Can Pinch Out Layers
- Local Gridding for Predictions
  - Single Model; No Bdy Affects
  - Local Sublayering



# GENERAL COMMENTS (Yobbi)

***The level of supporting model documentation is incomplete.***

***For example:***

- No description of the conceptual model is provided--Need N/S E/W hydrogeologic sections.
- No water budget analysis is provided--Independent and model simulated balances are needed.
- Hydraulic properties--Need comparison of simulated and observed hydraulic properties.
- Parameter Uncertainty--Need to quantify relative reliability of parameter values.

# MORE EXAMPLES

- No discussion or justification of modelers assignment of weights.
- Inadequate discussion of sensitivity of input parameters/boundary--Composite scaled sensitivity or other analysis is not included.
- Statistical assessment of MODFLOW model results is insufficient. (see requested statistics and plots by LSG)
- Model Limitations discussion is incomplete—For example, report does not provide a discussion of (1) the model's limitation regarding simulation of a conduit network nor (2) the appropriateness of using a uniform orthogonal grid.

# STATISTICS AND MODEL FIT

***Additional figures, graphs and tables are needed***

- ***Water Budget***--Simulated yearly water budgets for individual river basins and model-wide (tables and figures).
- ***River Baseflows***--Table, graphs, figures showing simulated and estimated baseflows (including % differences) for all stream gages used for calibration of the river baseflows in MODFLOW.
- ***Spring Flows***--Tables, graphs, figures showing simulated and estimated flow (including % differences) for all springs.
- ***Head Residual Grouped by Layer***--Maps of simulated WT/POT surfaces and residuals by layer.
- ***Leakage***--Maps showing simulated leakage through confining layers, lakes, streams, drains, etc.
- ***Summary statistics of spring flow***-- (POR, mean, accuracy, etc.).

# Alternates to "Pumps Off" Model Scenario

- ***Linear method***--Vary pumping rates, but pumping is not reduced to zero but by a percentage +/- 50%. Plot predicted flows against total pumpage and determine intercept.

- ***Ratio method***-- Ratio method uses actual pumping rates rather than percentages.

# General Comments (Davis)

- **Purpose of the model should be stated in the Introduction.**
- **A conceptual model section should be added describing the major groundwater flow system features, such as:**
  - a) Potentiometric surface maps for the Upper Floridan aquifer for 2001 and 2009 using the heads collected for calibration.
  - b) A discussion of the importance of the chosen years of 2001 and 2009 (to put the model years in context).
  - c) Plots of river flows at a few critical gages spanning the years from 1995 to present (or whatever range seems appropriate).
  - d) Plot of rainfall over the same period from at least one station.
  - e) Cross sections showing the basic lithology and the model layering.
  - f) A map showing the distribution & results of aquifer testing where known.
  - g) A map of conduit features and discussion of karst development.

# General Comments (Davis)

- **Discussion of the recharge rates needs to be expanded** (the use of the HSPF model code and method was very good but the explanation of how the results were used in the model needs to be expanded).
  - One suggestion is to choose 2 basins (suggest) -Little River (03110204) and -Lower Suwannee (03110205) and describe the HSPF process and show the numbers determined, especially the AGWT and IGWT. And describe how these were incorporated into MODFLOW.
  - A map showing all the streamflow calibration points and estimated baseflows would provide a greater understanding groundwater discharge from the aquifers.
  - A map showing the recharge rates to the UFA would indicate where the most important and less important recharge areas are located (from MODFLOW).

# General Comments (Davis)

- **The methodology used in setting up the PEST calibration should be discussed in greater detail.**

- **An example was taken from the book Applied Groundwater Modeling:**

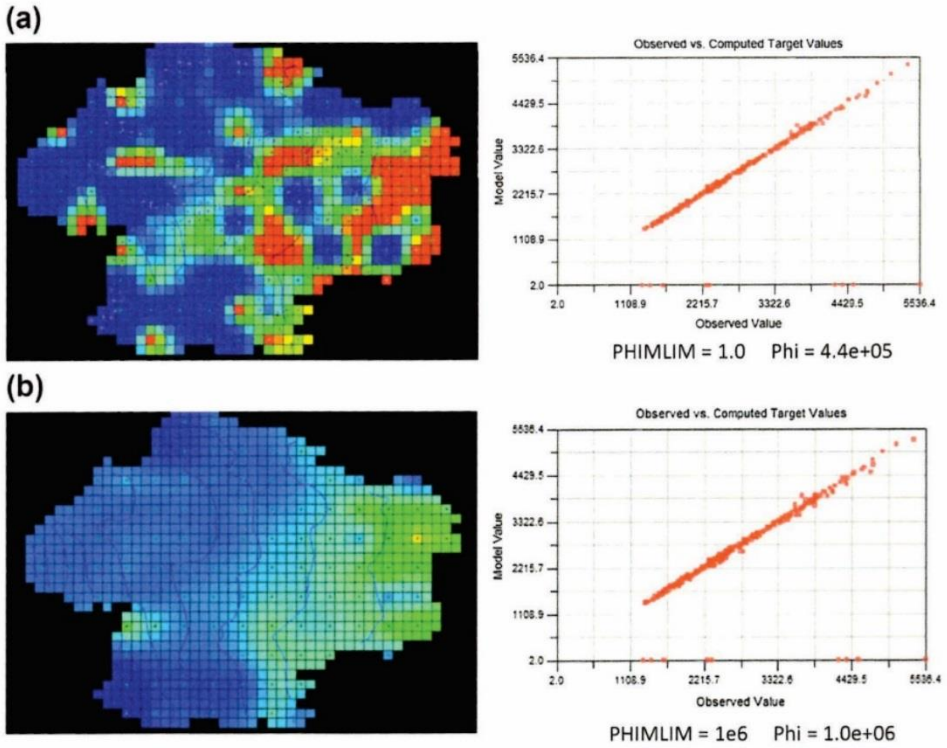



**Figure 9.16** Visualization of parameter estimation using alternative Tikhonov regularization, where the same parameter estimation problem is solved using two different values of the target objective function (PHIMLIM variable in PEST). (a) When the target objective function is set unrealistically low (PHIMLIM = 1), user soft knowledge is disregarded and optimality of the inverse solution is defined solely by the model's fit to calibration targets (i.e., minimization of the measurement objective function, Phi). The resulting field has extreme contrasts and parameter "bulls eyes" that reflect the code's unchecked pursuit of the best fit. (b) When the target objective function is set to a value around 10% higher than the best Phi obtained (PHIMLIM = 1e6), the resulting fit is slightly worse (as shown by a slightly larger spread around the 1:1 line in the scatter plot of heads), but heterogeneity in the optimal parameter field is reduced. Whether the heterogeneity expressed is reasonable is the decision of the modeler; thus both models might be considered part of the Pareto front shown in Fig. 9.17 *(modified from USGS unpublished data).*

# General Comments (Davis)

- **A water budget for the model needs to be added and discussed.**
- **Estimated baseflows and model simulated baseflows need to be shown on a map at all calibration points.**
- **The sensitivity analysis needs more discussion.**
  - The sensitivity analysis described in the report is difficult to translate into how heads and flows will be affected in the model, an expanded discussion would give more clarity.
  - Since recharge is so important to the predictive capability of the model it may need to be singled out for discussion.
  - Appendix J, while through, was difficult to understand. An overview in the report would help clarify the meaning of the Appendix.

# General Comments (Motz)

- P. 2: Is any Pumping From Layer 2 Included in the Model (e.g., Keystone Heights)?
- Better Documentation, Referencing Is Needed; Examples:.
  - P. 4 : Define/Reference “Fall Line” and “Gulf Trough”
  - P. 7: Define /Reference “Florida-Hatteras Slope”
- P. 28: How are equivalent freshwater heads calculated?
- P. 54: Does saltwater upconing into UFA still occur at Brunswick (Maslia and Prowell 1990)?

# General Comments, con'd.

- Pp. 75-76: Label major springs on Figures 3-1 and 3-2?
- P. 83: Would *gradient* be a better metric than *horizontal head difference*?
- P. 93: Graphical representation for calibration statistics would improve readers' understanding of results (this applies to estimated water use and groundwater model water budgets (inches/year) for 2001 and 2009 as well).

# General Comments, con'd.

- Model Capabilities and Limitations pp. 96-97:
  - "Accuracy that is comparable or better than models currently used for planning or regulatory purposes…." Document this?
  - 2001 and 2009 "…represent significantly different hydrologic conditions…." What are these hydrologic conditions? Where is this explained?
  - "Expanded availability of water-level data…through implementation of sophisticated statistical estimation techniques…." What are the techniques?

# General Comments, con'd.

- Model Capabilities and Limitations pp. 96-97:
  - "Inclusion of additional calibration constraints not used in the development of many of the models currently in use in Florida…." Document this?
  - Will the regional model provide sufficient detail to assess MFL's for lakes, streams, and springs?

- 4.0 Reference List pp. 132-135:
  - Make sure that references are alphabetized correctly.

# Simulation of Lakes

- Will the use of the River Package provide sufficient accuracy for simulating lakes in the regional model area?
- Will the River Package be used to assess MFL's for any lakes in the model area? If so, discuss the accuracy of this.

# Simulation of Lakes, con'd.

- Provide details of the Keystone Heights sub-regional transient groundwater flow model that is currently under development by SJRWMD:
  - Indicate that the Lake Package is being used to simulate lakes Geneva, Brooklyn, Magnolia, and Lowry.
  - Indicate that MFL's for lakes Geneva and Brooklyn will be assessed using the Lake Package.

# Simulation of Springs

- Figures 3-40 to 3-43 demonstrate that the simulated spring discharges closely match the observed discharges:
  - Several very large negative discharges on the order of -200 to -400 cfs are plotted in Figures 3-40 and 3-41 but apparently are not included in the bar graphs in Figures 3-42 and 3.43; please provide an explanation for this.
  - The set of GHB conductance values for the springs should be provided in the report or an appendix.

# Simulation of Springs, con'd.

- Please describe any future plans for investigating whether the simulations for selected, larger springs could be improved.
- This could include:
  - Development of a more finely discretization sub-regional groundwater flow model;
  - Evaluating the availability and accuracy of cave maps; and/or
  - Considering the use of a model package such as Conduit Flow Process (CFP) for MODFLOW-2005.