

# Update on “A Peer Review of IWFM and MODFLOW-Farm Process, *CWEMF-2010, Kadir and Hanson*”

IWFM-IDC Users Group Meeting

Sacramento, California

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Tariq Kadir (California Department of Water Resources)



# IWFM and MODFLOW-FMP

- Both Integrated Hydrologic Models
- Chronology:
  - IWFM
    - IGSM 1990
    - IWFM (DWR) 2002
    - Current version 3.1 (*as of Feb 2010*)
  - MODFLOW-FMP
    - MODFLOW 1988
    - Farm Process 2006
    - Current version MODFLOW2005 and Farm Process v.2
- Main focus is computation of land-use based demands and associated physical processes (runoff, deep percolation, etc)
- Limitations placed on full capabilities of both models to compare using hypothetical simulation examples



# Background on DWR-USGS Collaborative Effort

- Preliminary contacts dating back to late 2005
- Initial thoughts of migrating to MODFLOW for modeling ground water in CalSim-3
- Contract DWR-USGS to compare:
  - Phase-1: IWFM and MODFLOW-FarmProcess (academic)
  - Phase-2: Application to Central Valley (CVHM and C2VSIM)
- DWR assistance to USGS in the development of CVHM
- Phase-1 resulted in two sets of draft documents (each composed of a Technical Information Report and a journal paper):
  - Outlining the theoretical bases of each model
  - Comparing the two models using hypothetical examples
- USGS Peer Review process



# Peer Review Process & Selection of Reviewers

- Need for the peer review process
- What constitutes peer review per USGS guidelines
- Four reviewers selected by DWR and USGS:
  - Theoretical comparison between IWFM and MF-FMP
    - Dr. Graham Fogg (UC Davis)
    - Dr. Richard Snyder (UC Davis)
  - Comparison using “hypothetical” problem
    - Dr. Thomas Harter (UC Davis)
    - Dr. Devin Galloway (USGS)
- Review period: Sept 1-30, 2009
- All reviewers comments received by Jan 29, 2010



# Two Reports Comparing IWFM and MODFLOW-FMP

## INTEGRATED WATER FLOW MODEL AND MODFLOW-FARM PROCESS: A COMPARISON OF THEORY, APPROACHES, AND FEATURES OF TWO INTEGRATED HYDROLOGIC MODELS

### **Emin C. Dogrul**

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### **Wolfgang Schmid**

Department of Hydrology and Water Resources, University of Arizona, Room 316D, 1133 E James E. Rogers Way, Tucson, AZ 85721, Tucson, AZ 85721-0158

### **Randall T. Hanson**

US Geological Survey, California Water Science Center, San Diego Projects Office, 4165 Spruance Road, Suite 200, San Diego, CA 92101

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## Comparison of Simulations of Land-use Specific Water Demand and Irrigation Water Supply by MF-FMP and IWFM

By Wolfgang Schmid<sup>1</sup>, Emin C. Dogrul<sup>2</sup>, R.T. Hanson<sup>3</sup>, Tariq Kadir<sup>2</sup>, and Francis Chung<sup>2</sup>

Prepared by the U.S. Geological Survey, California Water Science Center in collaboration with the University of Arizona and the California Department of Water Resources, Hydrology Development Unit, Modeling Support Branch, Bay-Delta Office

California Department of Water Resources Technical Information Report No. xx

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# Final Thoughts about Peer Review Process (Kadir and Hanson, CWEMF 2010)

- Vigorous (but healthy) scientific debates between modelers
- Great learning experience by both agencies
- Features of models limited to make them comparable
- Reviewers comments pointed to areas of further investigations to improve both models
- In hindsight: provide all documents to all reviewers
- Next phase comparing C2VSIM (DWR) and CVHM (USGS)

**USGS approval for public release of documents received October 24, 2011  
Documents will be posted on DWR website during November 2011**



# Additional Information on Reviewers Comments and DWR-USGS Responses at [www.CWEMF.org](http://www.CWEMF.org)



California Water and Environmental Modeling Forum

## 2010 Annual Meeting Abstracts

"Modeling in the Eye of the Storm"



February 22-24, 2010

Asilomar Conference Grounds  
800 Asilomar Boulevard  
Pacific Grove, California

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### Session Nineteen: IWFM & IDC 2008-2009 Enhancements and Applications

Moderator: Tariq Kadir (CA DWR)

Location: Kiln

[A Peer Review of IWFM and MODFLOW-Farm Process](#) Tariq Kadir (CA DWR) and Randall Hanson (USGS)

 1.4 MB

As part of the on-going collaborative effort between the USGS and CA DWR, a peer review process was initiated by the agencies to compare the MODFLOW-FarmProcess and IWFM. Four reviewers were selected by the agencies to review two documents prepared by the agencies: a DWR Technical Memorandum and draft journal paper comparing the two models in both theory and sample problem applications. This presentation will summarize the peer review process, key comments from the reviewers, and the responses by the agencies.

[Enhancing Solver Performance in the Integrated Water Flow Model](#) Matthew Dixon (UC Davis)

 0.3 MB

This presentation describes the accuracy control and performance enhancement of linear solvers for IWFM. First explained are how multi-layer aquifer flow and stream-groundwater interaction affects the scaling, conditioning and sparsity structure of the linear systems in IWFM. These properties guide the choice of scaling which, together with preconditioning, not only offset the ill-conditioning effects of multi-scale flow, but improve the control of the linear solver forward error (necessary for data consistency). Next is the implementation of a preconditioned Krylov subspace linear solver based on the Generalized Minimum RESidual (GMRES) algorithm and demonstrating that (i) the scaling improves forward error control in IWFM and (ii) there is a 7.7x overall speedup compared to using the SOR method. Further performance profiling shows that the new linear solver removes a major performance bottleneck in IWFM.



**Thank you**

