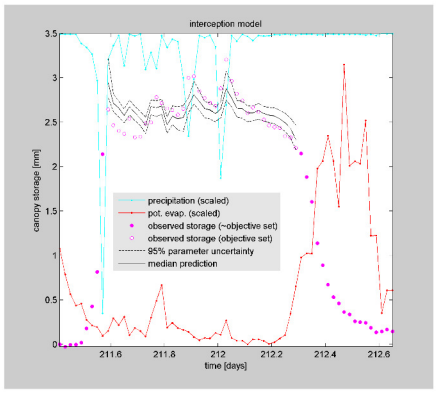
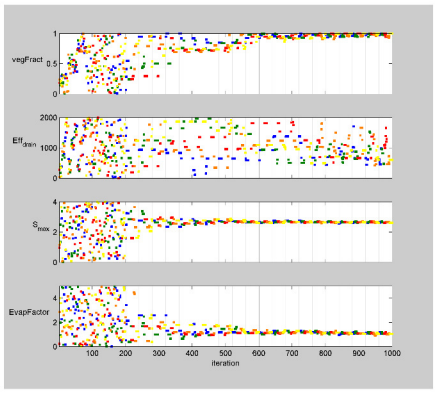
SCGE-2011
Summer courses Computational Geo-Ecology

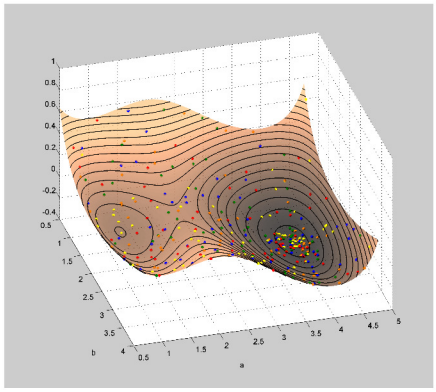
Summer Course Inverse Modeling

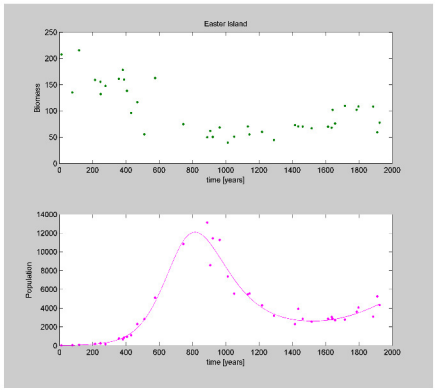
for improving Hydrological, Environmental and Ecological Models

June 26 - July 1, 2011
University of Amsterdam









Willem Bouten
Jasper A. Vrugt
Sander Huisman
Jurriaan H. Spaaks

Contents

Chapter 1

Introduction

Dear participant, welcome to the SCGE summer course on Inverse Modeling. The document you have before you contains all of the exercises you will be making as part of the course. There are two types of exercise, labeled differently:

▶ 1. The exercises indicated by a black solid triangle are the core exercises; most of these will be discussed in class. Any files needed for completing the exercises can be found in the appropriate subdirectory of './exercises/'. Solutions are also available for most exercises; these are stored under './solutions/'. As you can see, the exercises are numbered for convenient referencing.

▷ 2. The exercises indicated by an open triangle are optional exercises; these, you can make if the topic has your specific interest or if you feel you could use some more training, or just for fun!

Feel free to ask any of us if something isn't clear. You are also encouraged to discuss your results with the other participants. We hope you'll enjoy the course!

Chapter 2

Program

Sunday 26/06

- Get-together and dinner at Ponteneur (from 17:30 onward)

Monday 27/06: Getting started

- Welcome & Program of the week
- Introduction to inverse modeling (lecture Willem)
- Local search methodologies (lecture Sander and exercises)
- 12.00–13.00: for those who are interested, there's a lecture by Simon Levin "Evolution of ecosystem properties" in room C.0.110
- Local *vs.* global search (lecture Jasper)
- Implementing a simple global optimization algorithm (exercises)

Tuesday 28/06: Working with DREAM

- Uncertainty of model output and parameter estimates (lecture Jasper)
- DREAM toolbox (exercises)
- Implementing a new model (exercises)

Wednesday 29/06: Objectives & Information in Data

- Introduction to exercises (lecture Willem)
- Distribution of information within the data (exercises)
- Data transformation (exercises)
- Multi-objective optimization (lecture Jasper)
- Model complexity *vs.* information content of data (exercises)
- Final discussion with questions

Thursday 30/06: Analysis of model-observation discrepancies

- Opportunity to answer questions that have come up during the week
- Combining data assimilation and parameter identification (lectures Willem, Jasper, Jurriaan)
- Inverse modeling on parallel machines (lectures Pieter, Jasper)
- Planning of activities on Friday

Friday 01/07: Working towards your own case

- Hands-on implementation or design/discussion of your case
- Final discussion: What is the impact of SCGE-2011 on your own research?

Every morning we start at 9:00 with an inventory of questions.

Bibliography

Bouten, W., M. G. Schaap, J. Aerts, and A. W. M. Vermetten (1996). Monitoring and modelling canopy water storage amounts in support of atmospheric deposition studies. *Journal of Hydrology 181*, 305–321.

Boyle, D. P., H. V. Gupta, and S. Sorooshian (2000). Toward improved calibration of hydrologic models: Combining the strengths of manual and automatic methods. *Water Resources Research 36*(12), 3663–3674.

Brander, J. A. and M. S. Taylor (1998). The Simple Economics of Easter Island: A Ricardo-Malthus Model of Renewable Resource Use. *The American Economic Review 88*(1), 119–138.

Duan, Q., V. K. Gupta, and S. Sorooshian (1992). Effective and efficient global optimization for conceptual rainfall-runoff models. *Water Resources Research 28*(4), 1015–1031.

Gupta, H. V., S. Sorooshian, and P. O. Yapo (1998). Toward improved calibration of hydrologic models: Multiple and noncommensurable measures of information. *Water Resources Research 34*(4), 751–763.

Nelder, J. A. and R. Mead (1965). A simplex method for function minimization. *The Computer Journal 7*(4), 308–313.

Storn, R. and K. Price (1997). Differential Evolution – A Simple and Efficient Heuristic for Global Optimization over Continuous Spaces. *Journal of Global Optimization 11*, 341–359.

Vrugt, J. A., C. ter Braak, C. Diks, B. A. Robinson, J. M. Hyman, and D. Higdon (2009). Accelerating Markov Chain Monte Carlo Simulation by Differential Evolution with Self-Adaptive Randomized Subspace Sampling. *International Journal of Nonlinear Sciences & Numerical Simulation 10*(3), 271–288.