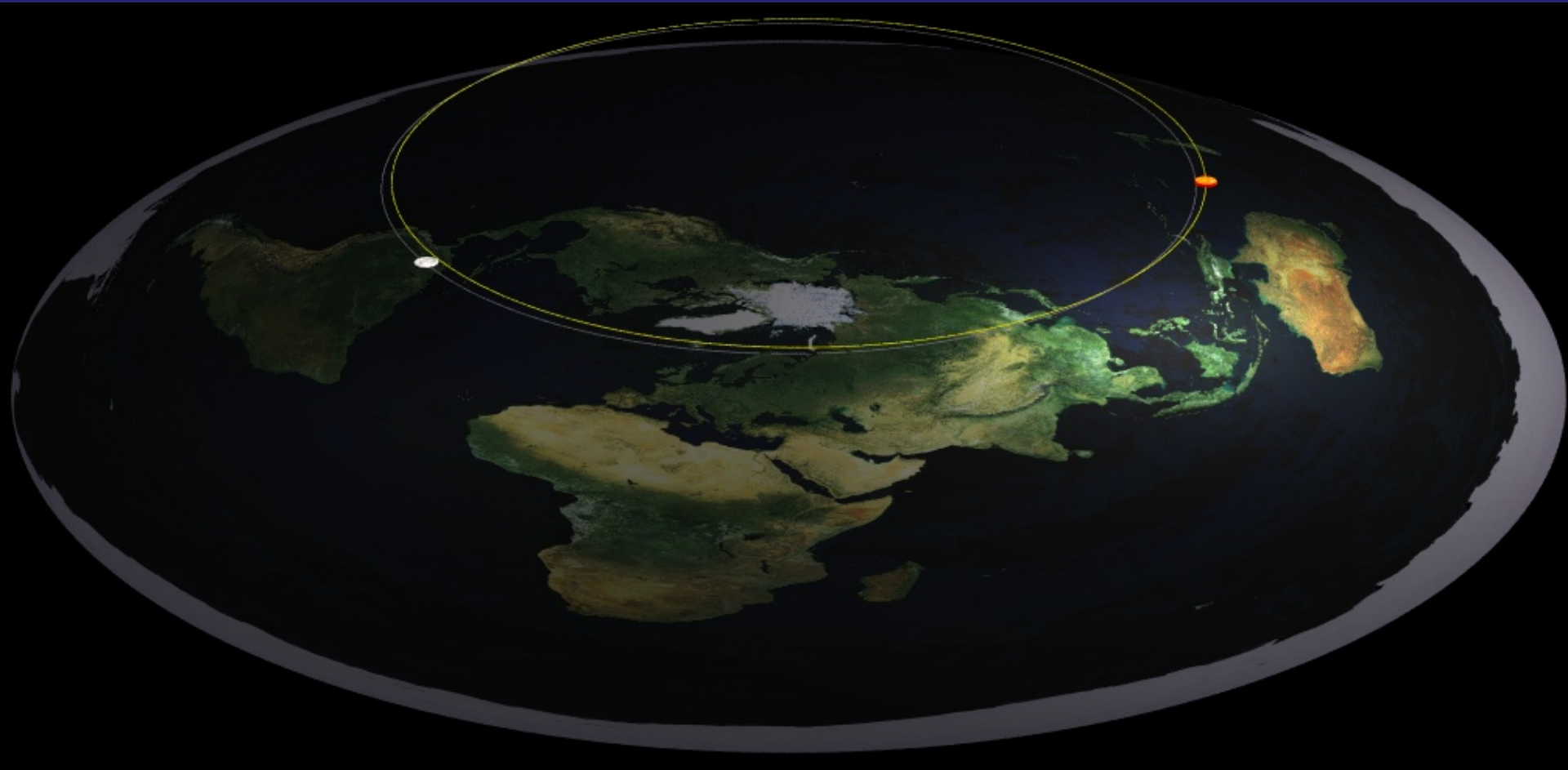


A Cloud Approach to Hydrologic Models: The Necessary Next Step for Today's Decisions



*Randy Hunt - USGS Wisconsin Water Science Center
(WWSC Modeling Group: Randy Hunt, Mike Fienen, John Walker)*

Image from: <http://theflatearthsociety.org>



Introduction

- *Imagination is the limit for modeling projects*
 - Memory and computational power are cheap
 - Graphical User Interfaces/GIS facilitate assimilation of

“The effectiveness of (today’s) decisions depends on the quality of information and on incorporating knowledge about the reliability (or conversely, the uncertainty) associated with predictive management tools.” and “...decisions are made while facing uncertainty about predictions. If that uncertainty is reduced and accurately described, then decisions will be made that tend to make for better use of the resource and increase public benefits and/or reduce risk.” *NSTC* (2007)

“The important uncertainties connected with your regulatory decisions need to be analyzed and presented as part of the overall regulatory analysis.” *OMB* (2003)

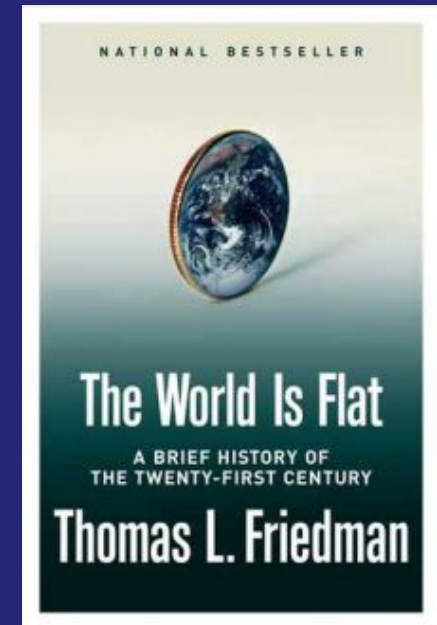
“A good analysis provides specific references to... the results of formal sensitivity and other uncertainty analyses.” *OMB* (2003)

parallel with computational advances

- ***Is it fair to demand all modelers to master all aspects, or are projects getting too complicated?***

The World is Flat—Outsourcing/Collaboration

- *“The World is Flat”*
 - *Discusses outsourcing in modern economy (importance of “value added”)*
 - *Enabled by rapid communication and an inexpensive workforce*
- *Motivation for Collaboration*
 - *Increased complexity/effort of project*
- *Enabling of Collaboration*
 - *Digital nature of all aspects of our data*
 - *Ability to wrap up and send a model*



Thomas Friedman

Taking advantage of the times: Cloud
Computing

*The PEST Conference
November 1-3, 2009
Potomac MD*

*Joe Luchette et al.
(McLane and assoc.)
Cloud Computing*

*Willem Schreuder
(Principia Mathematica)
BeoPEST*

Unlimited Virtual Computing Capacity using the Cloud for Automated Parameter Estimation

Joseph Luchette, Gregory K. Nelson, Charles F. McLane III,
Liliana I. Cekan

The PEST Conference 3:45pm Session, November 3, 2009 #20

ground
water

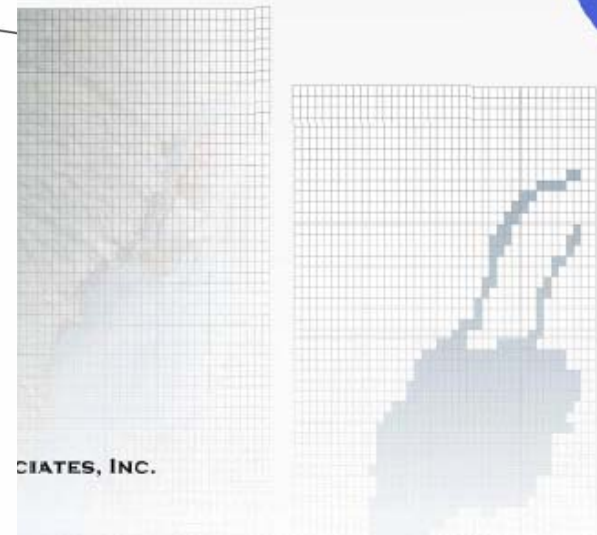
Issue Paper/

Are Models Too Simple? Arguments for Increased Parameterization

by Randall J. Hunt¹, John Doherty², and Matthew J. Tonkin^{3,4}

Abstract

The idea that models should be as simple as possible is often accepted without question. However, too much simplification and parsimony may degrade a model's utility. Models are often constructed to make predictions; yet, they are commonly parameterized with a focus on calibration, regardless of whether (1) the calibration data



CLOUD COMPUTING

Software-as-a-Service

Consumer applications.



Infrastructure-as-a-Service

On demand creation of server resources with root access.



Platform-as-a-Service

Primarily for developers.
Usually limited to one or two programming languages.



Jim Rumbaugh ESI - GoGrid Example

The screenshot shows the GoGrid website homepage. At the top, there is a navigation bar with the GoGrid logo, contact information for US & Canada (1.877.946.4743) and Worldwide (1.415.869.7444), and links for Blog, Live Chat, Customer Login, Cloud Hosting, Hybrid Hosting, Support, Community, and a Sign Up button. The main heading is "BUILD THE MOST COMPLETE INFRASTRUCTURE IN THE CLOUD". Below this, there are two main sections: "CLOUD HOSTING" and "HYBRID HOSTING". The "CLOUD HOSTING" section describes "On Demand Self-Service Hosting" and lists features like Standard Windows and Linux Cloud Servers, Create, Save, and Deploy Custom Server Images, and Scale Up or Down as Needed, in Real-Time. It includes buttons for "Take the Tour" and "Sign Up Now". The "HYBRID HOSTING" section describes "Scalable High-Performance Networks" and lists features like Create PCI Compliant Architectures, Maximize Your Database I/O Performance, and Fully Customizable to Meet Your Business Needs. It includes buttons for "Learn More" and "Contact Sales". At the bottom, there are tabs for "FEATURES", "PRICING", and "COMPARE". The "PRICING" tab is selected, showing "CLOUD HOSTING PRICING" with details on pay-as-you-go and pre-paid plans, and a list of features that GoGrid never charges extra for, such as f5 Hardware Load Balancing, OS Licensing, Up to 10 IP Addresses, Up to 10GB/mo of Cloud Storage, 24/7 Premium Support, and Inbound Data Transfer. Two pink ovals highlight the pricing and features sections.

US & CANADA: 1.877.946.4743 WORLDWIDE: 1.415.869.7444 | [BLOG](#) | [LIVE CHAT](#) | [CUSTOMER LOGIN](#)

GOGRID [CLOUD HOSTING](#) [HYBRID HOSTING](#) [SUPPORT](#) [COMMUNITY](#) [SIGN UP](#)

BUILD THE MOST COMPLETE INFRASTRUCTURE IN THE CLOUD

CLOUD HOSTING

On Demand Self-Service Hosting

Deploy cloud servers, cloud storage, and hardware load balancers on-demand to build and scale your cloud computing infrastructure in real-time

- Standard Windows and Linux Cloud Servers
- Create, Save, and Deploy Custom Server Images
- Scale Up or Down as Needed, in Real-Time

[Take the Tour](#) [Sign Up Now](#)

HYBRID HOSTING

Scalable High-Performance Networks

Connect your cloud computing infrastructure to dedicated physical hardware to build fully customized, scalable, high-performance hybrid networks

- Create PCI Compliant Architectures
- Maximize Your Database I/O Performance
- Fully Customizable to Meet Your Business Needs

[Learn More](#) [Contact Sales](#)

[FEATURES](#) [PRICING](#) [COMPARE](#)

CLOUD HOSTING PRICING

Pay-as-you-go Cloud Servers as low as 9.5¢/hour

Pre-paid Plans as low as \$199.99/month

[See Pricing Details](#) | [See Pre-Paid Plans](#)

GOGRID NEVER CHARGES EXTRA FOR:

- f5 Hardware Load Balancing
- OS Licensing
- Up to 10 IP Addresses
- Up to 10GB/mo of Cloud Storage
- 24/7 Premium Support
- Inbound Data Transfer

GoGrid Cloud Hosting : Pricing - Opera

File Edit View Bookmarks Widgets Tools Help

Open Save Print Find Home Tile Cascade Voice

http://www.gogrid.com/cloud-hosting/pricing.php

Google

Home Index Contents Search Glossary Help First Previous Next Last Up Copyright Author

Cloud Server Images

Custom Cloud Server Images

Cloud Storage

Pricing

Pre-Paid Plans

API

GoGrid vs. EC2 & Rackspace

Take a Tour

Sign Up Now

ESTIMATE YOUR COSTS

and compare pre-paid plans

STARTUPS

get FREE Microsoft software

DEVELOPERS

get FREE Microsoft Software

With GoGrid You Only Pay For:

- Your Server RAM Hours
- Your Outbound Data Transfer
- Your Cloud Storage Usage (in excess of 10GB)

Included Free With Every Account:

- f5 Hardware Load Balancing
- 10GB of Cloud Storage per month
- Unlimited Inbound Data Transfer
- 24/7 Premium Support

What is a Server RAM-Hour?

Simply put, server a RAM-Hour is the total amount of RAM you have deployed multiplied by the number of hours it's been deployed.

Example: one 2GB server deployed for 1 hour = 2 Server RAM-hours

ESTIMATE YOUR COSTS

and compare pre-paid plans

Cloud Server Pricing*

With our Pay-as-you-go Plan, Server RAM hours are billed at \$0.19 per GB of deployed RAM per Hour. Per server, that breaks down to:

CPU	RAM	Disk Size	Cost per Hour
1 x Xeon	0.5 GB	30 GB	\$0.095
1 x Xeon	1 GB	60 GB	\$0.19
1 x Xeon	2 GB	120 GB	\$0.38
3 x Xeon	4 GB	240 GB	\$0.76
6 x Xeon	8 GB	480 GB	\$1.52

SAVE MONEY

Pre-pay for your RAM Hour allotment with one of our pre-paid plans

LEARN MORE

Data Transfer Pricing

With our Pay-as-you-go Data Transfer Plan:

\$0.29

per GB of

OUTBOUND TRANSFER

FREE

Unlimited

INBOUND TRANSFER

SAVE MONEY

Pre-pay for your Data Transfer with one of our pre-paid plans

LEARN MORE

Cloud Storage Pricing

\$0.15

per GB per month

10GB per Month FREE

Cloud Storage is an optional service with an unlimited amount of space available to you. Your storage usage is determined by your peak storage space utilization during your billing cycle.

Add Web/App Server

Please enter the web server's name



Save



Cancel



Enter description here

Public IP: *

Enter public ip here

RAM: *

512MB



Image:

Windows 2003 Server R2 (32-bit) w/ None



win2k3r2_32_base

Remote Desktop Connection



Remote Desktop Connection

General

Display

Local Resources

Programs

Experience

Advanced

Logon settings



Enter the name of the remote computer.

Computer:

173.204.1.130



User name:

Administrator

You will be asked for credentials when you connect.

☐ Allow me to save credentials

Connection settings



Save the current connection settings to an RDP file or open a saved connection.

Save

Save As...

Open...

Connect

Cancel

Help

Options <<

Willem Schreuder - Principia Mathematica

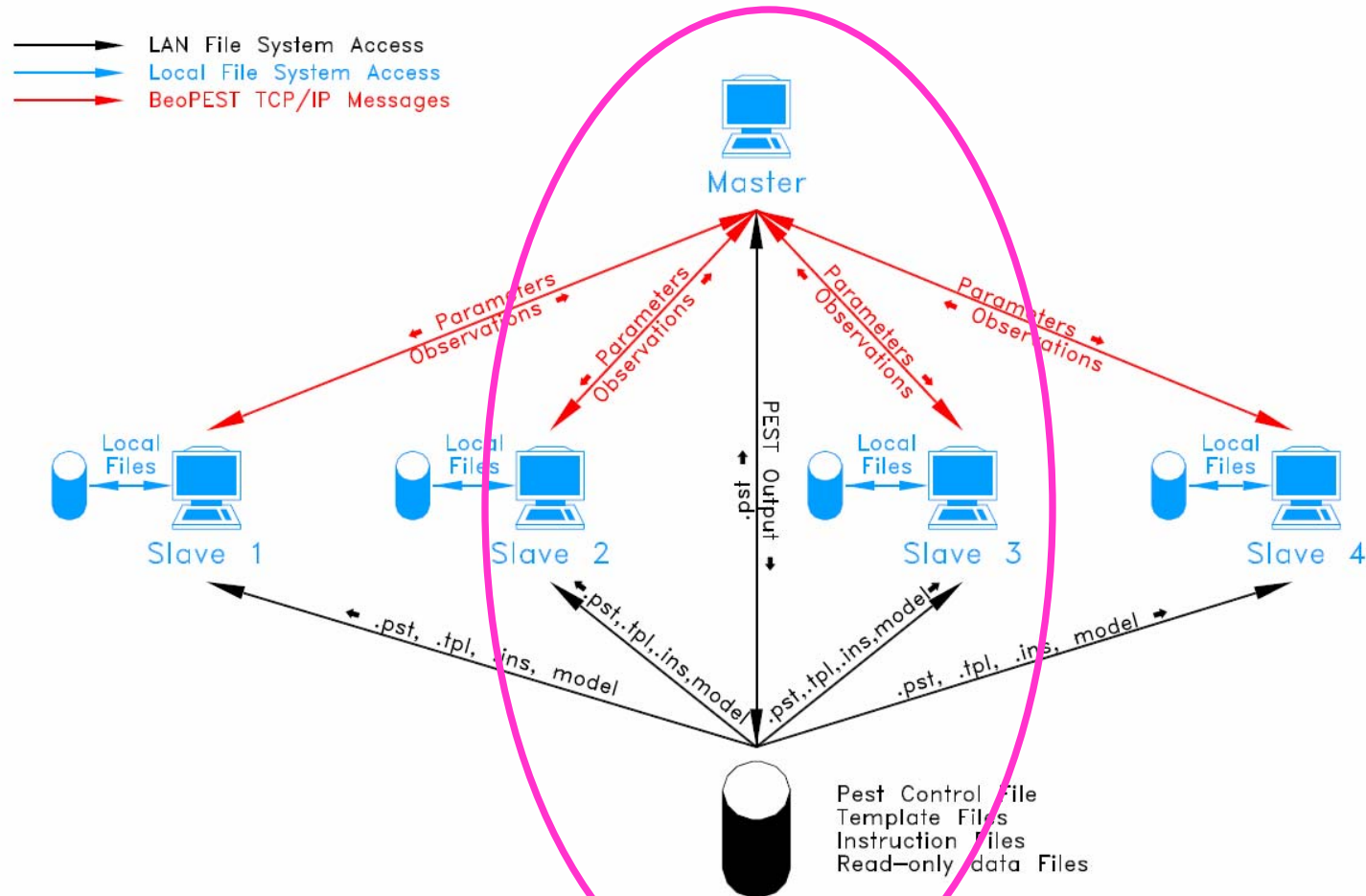
BeoPEST

www.prinmath.com

- Special version of *Parallel PEST* (Doherty 2009) inspired by *Beowulf Clusters*
- Primary difference is how it communicates with slaves, and higher level actions required of slaves
- Access any numbers of:
 - Local area networks (same as *Parallel PEST*)
 - Wide area networks (WAN, e.g., different USGS offices)
 - Cloud Servers
- More fault tolerant
- Slaves can be dynamically allocated or removed
- No additional files
- Security:
 - Binary string of parameters to run sent to slaves
 - Binary string of distilled model outputs returned from slaves
 - Maliciously corrupting the master-slave communications will cause the parameter optimization to go awry, but cannot cause slaves to execute arbitrary or malicious code.

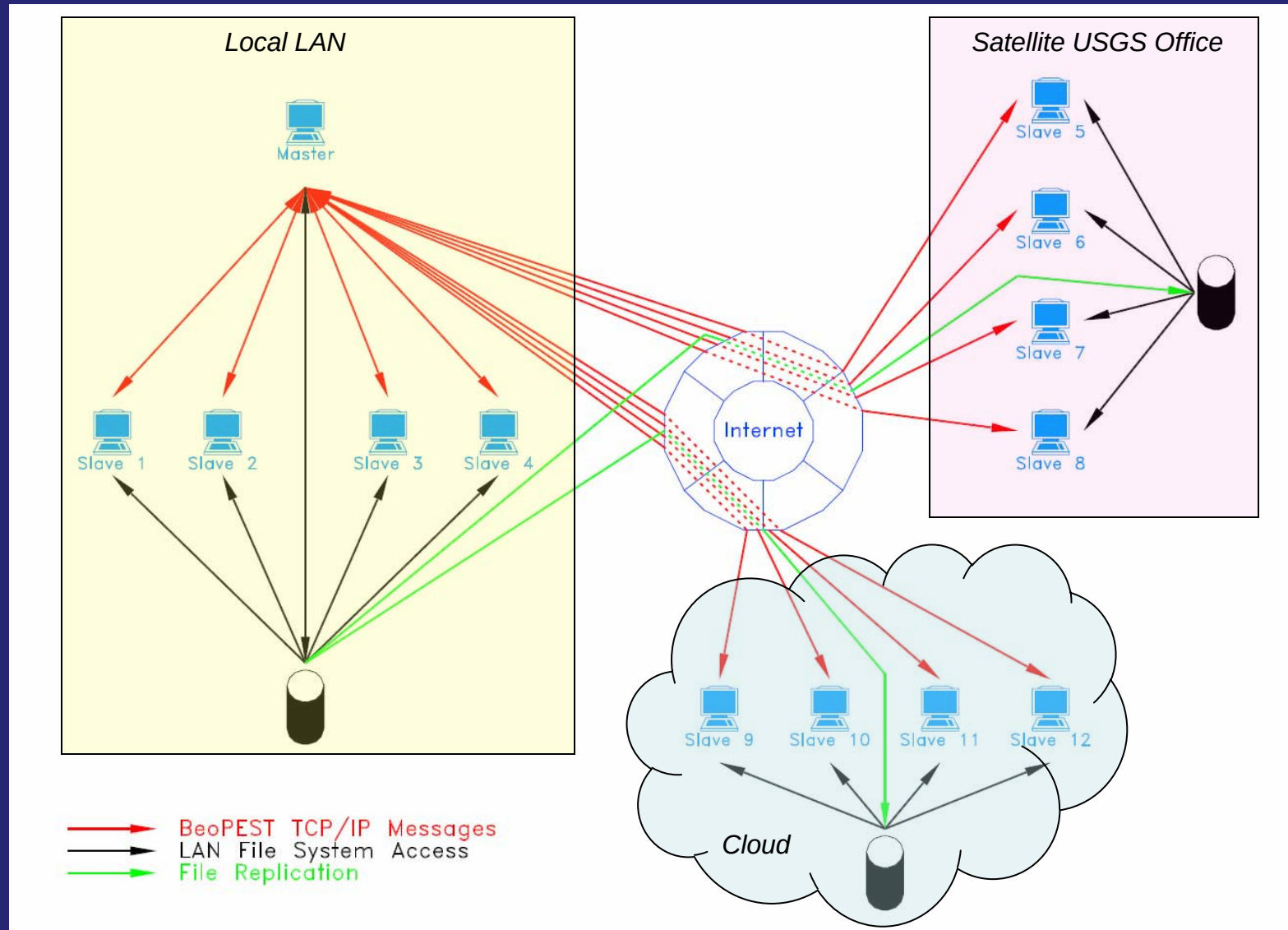
Willem Schreuder - Principia Mathematica

BeoPEST

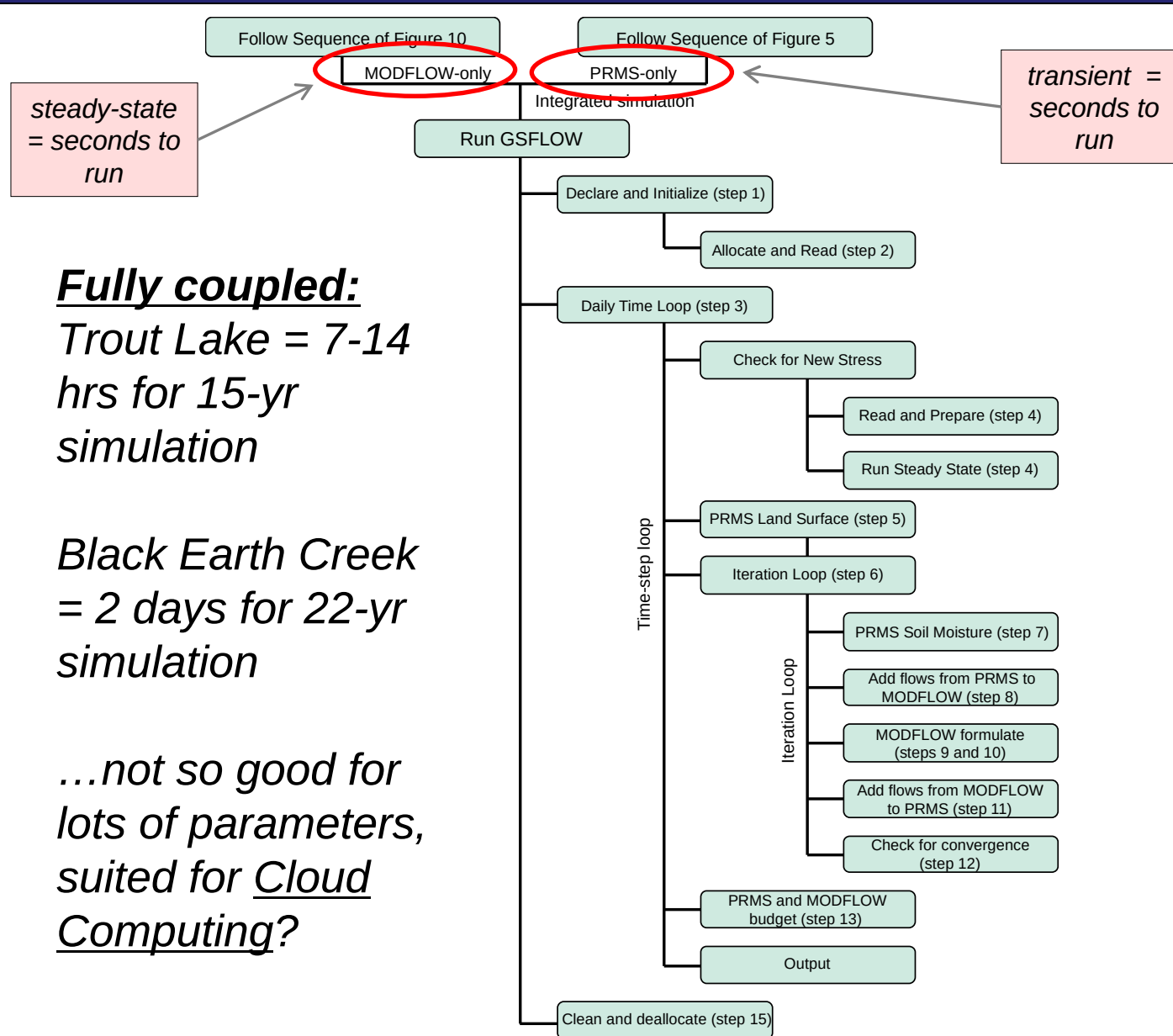


Willem Schreuder - Principia Mathematica

BeoPEST

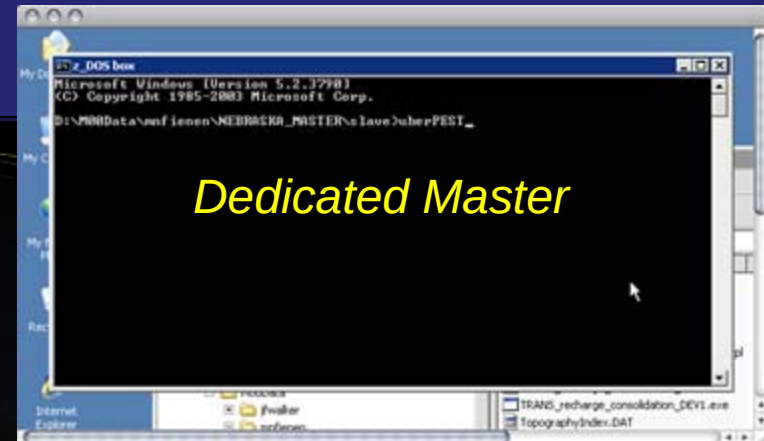


GSFLOW and the need for speed



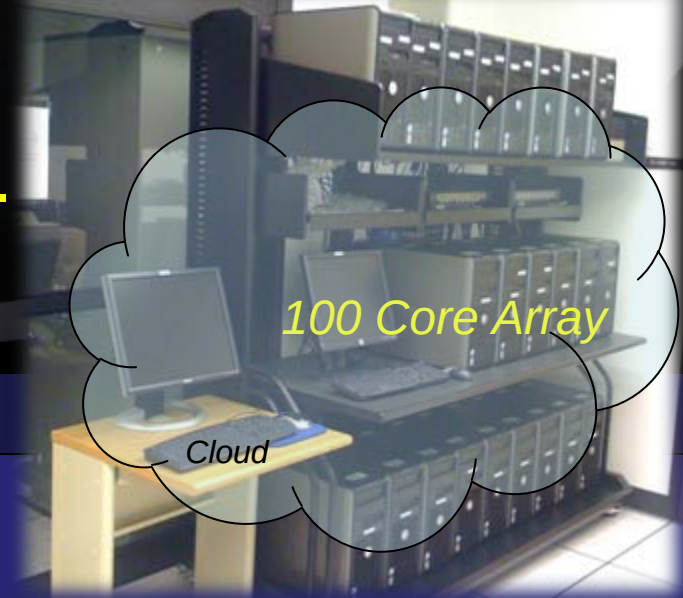
Wisconsin Water Science Center setup

Launch überPEST →

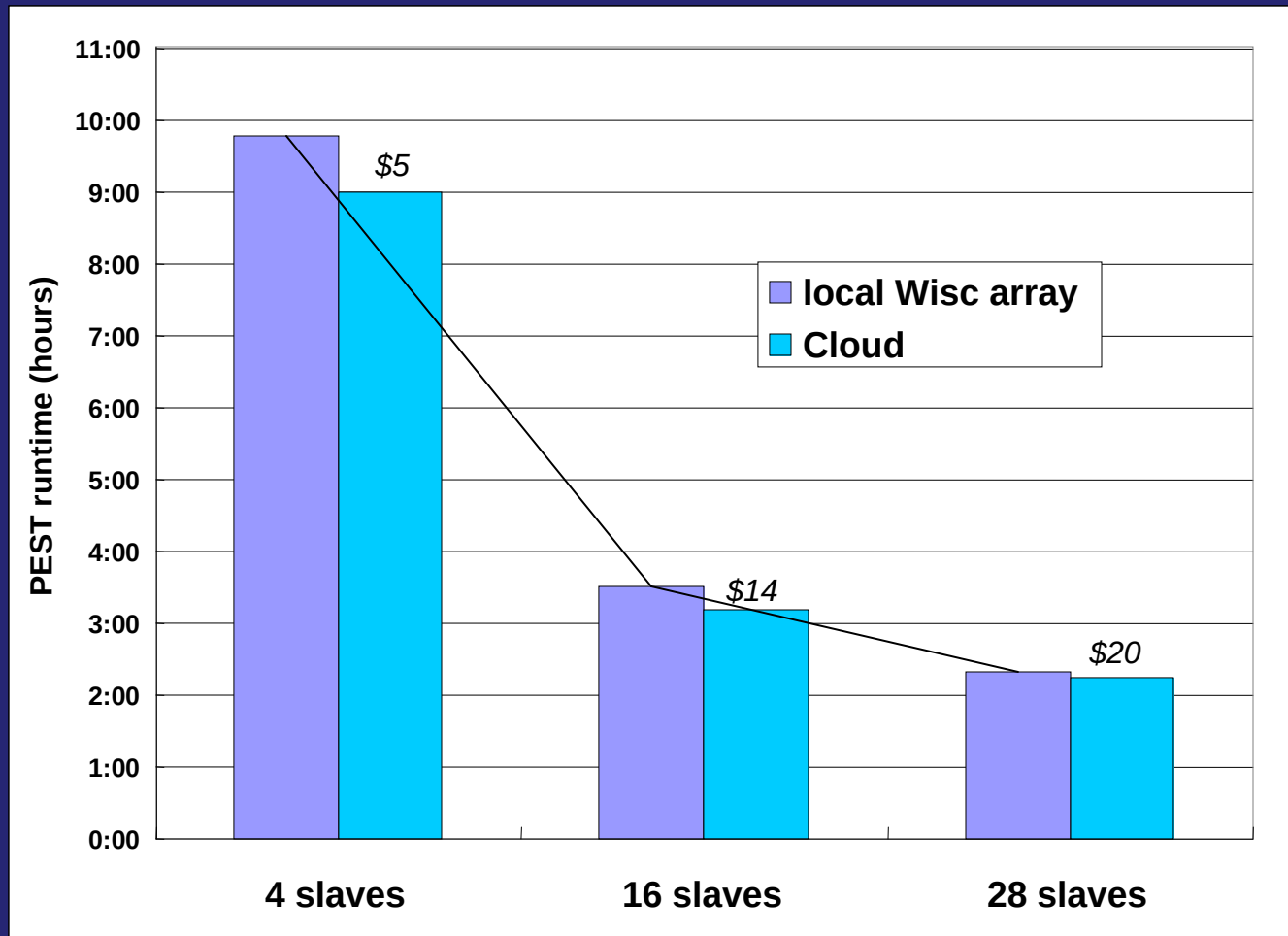


run ppest
or
BeoPEST

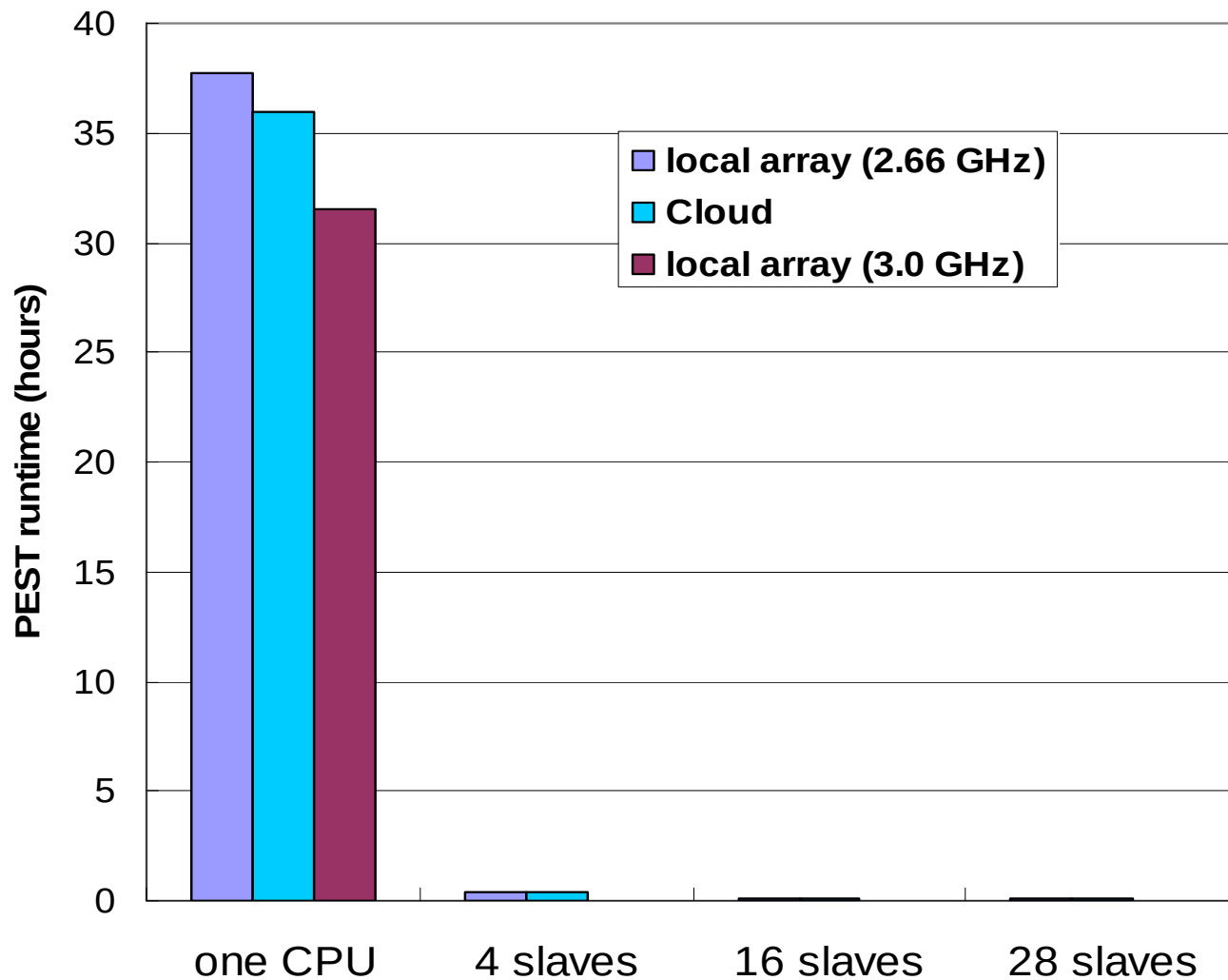
←
Post-process and
send email
on completion

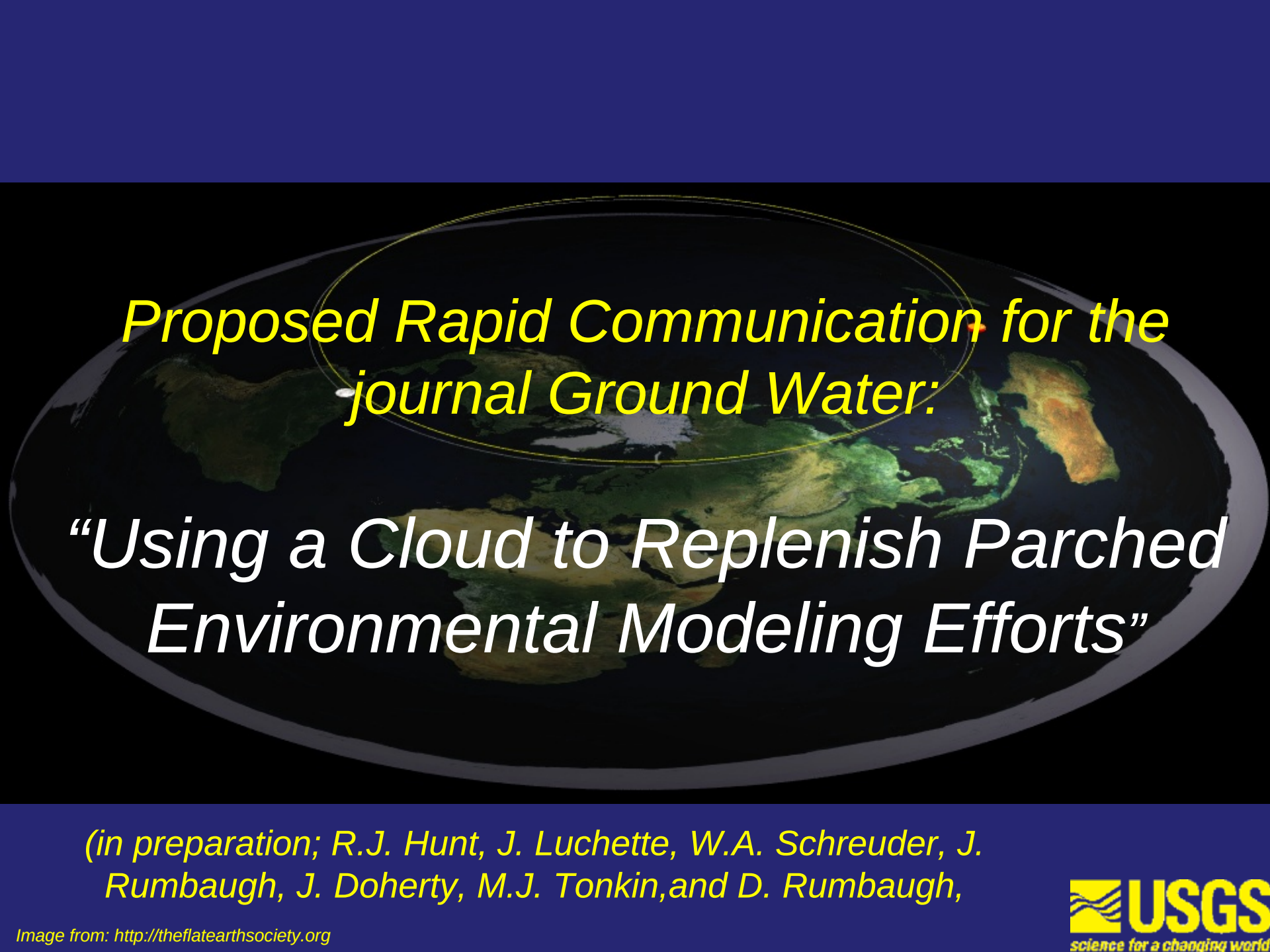


Cloud vs. Wisconsin Local Array



Non-parallel vs. parallel





*Proposed Rapid Communication for the
journal Ground Water:*

*“Using a Cloud to Replenish Parched
Environmental Modeling Efforts”*

*(in preparation; R.J. Hunt, J. Luchette, W.A. Schreuder, J.
Rumbaugh, J. Doherty, M.J. Tonkin, and D. Rumbaugh,*