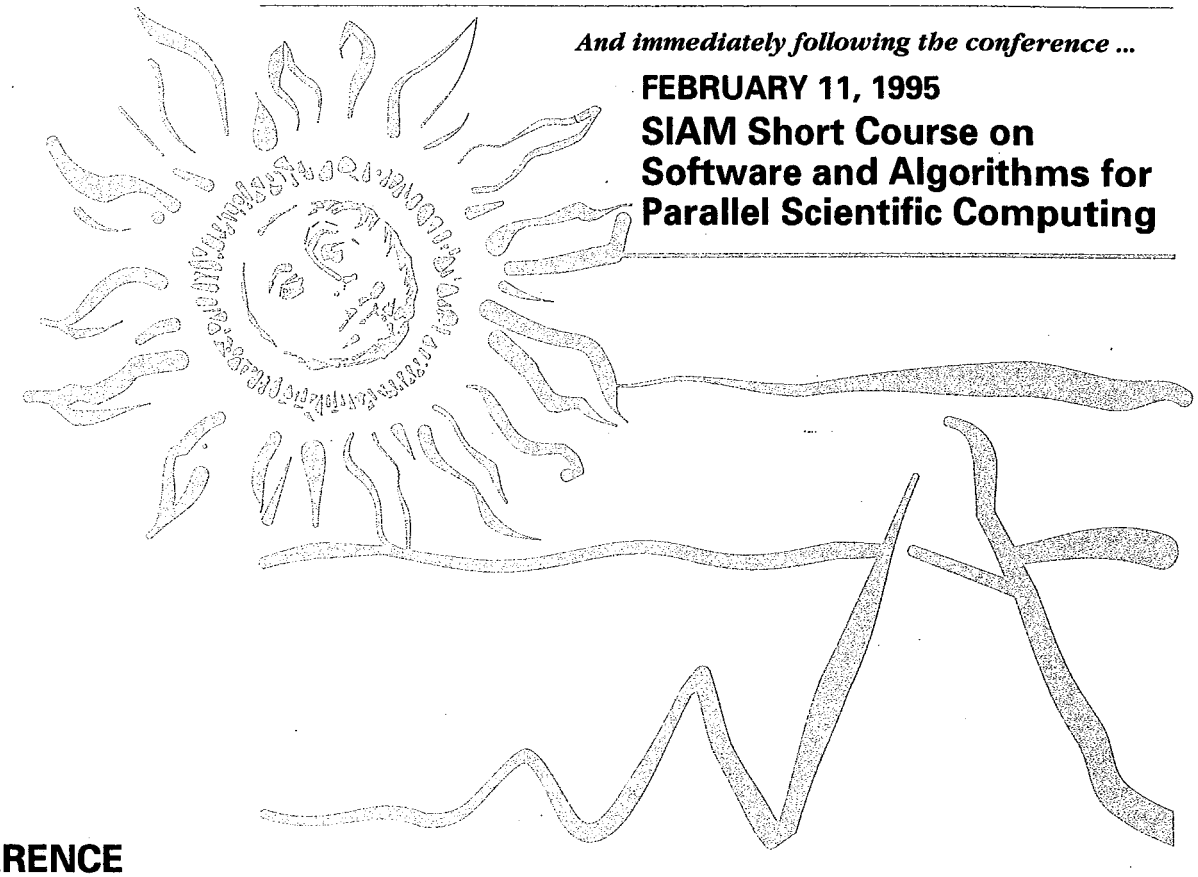
Preliminary Program

Society for Industrial and Applied Mathematics

Third SIAM Conference on Mathematical and Computational Issues in the Geosciences

FEBRUARY 8-10, 1995

Sponsored by SIAM Activity Group on Geosciences



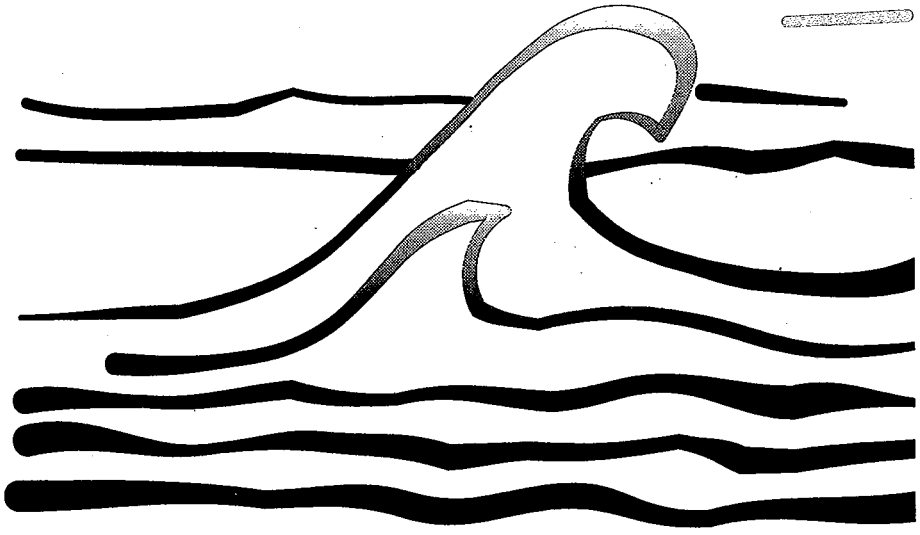
And immediately following the conference ...

FEBRUARY 11, 1995

SIAM Short Course on Software and Algorithms for Parallel Scientific Computing

CONFERENCE THEMES

- Seismic Imaging
- Reservoir Engineering
- Hydrology
- Geostatistics and Reservoir Characterization
- Environment/Ecology
- Atmospheric Science
- Oceanography
- Estuaries
- High Performance Parallel Computing
- Porous Media



ST. ANTHONY HOTEL ◎ SAN ANTONIO, TEXAS

CONTENTS

DEADLINE DATES

Hotel Reservation
Monday, January 9, 1995

Conference Preregistration
Wednesday, January 25, 1995

ORGANIZING COMMITTEE

James G. Glimm (Chair)
State University of New York, Stony Brook

Rick H. Dean
ARCO Oil & Gas Company

William E. Fitzgibbon
University of Houston

Thomas W. Fogwell
International Technology Corporation

William G. Gray
University of Notre Dame

William W. Symes
Rice University

Mary F. Wheeler
Rice University

FUNDING AGENCY

SIAM would like to thank the National Science Foundation and the Department of Energy for their support in conducting this conference.

Message from the Conference Chair

This conference captures the leading trends shaping research in the geosciences. These trends include computational modeling, stochastic and statistical modeling, environmentally motivated applications, high performance computing, and the detailed modeling of physical, chemical and biological processes in a geosciences context.

The need for reliable predictions of the future, and reliable estimates of errors or confidence in predictions are the questions driving these trends. The research trends are of necessity interrelated, in order to address such basic questions. The ability to integrate capabilities across disciplines is a traditional strength of applied mathematics. Such integration has become increasingly important. The conference offers the opportunity to learn the state-of-the-art of methodology in these major themes, as well as the chance to exchange the latest research results with fellow experts. The juxtaposition of this conference with the immediately following SIAM Short Course on Software and Algorithms for Parallel Scientific Computing, February 11, 1995 and the Thirteenth SPE Symposium on Reservoir Simulation, February 12-15, 1995 further emphasizes the importance of cross-disciplinary science.

In accordance with the requests following the previous conference, we have managed to decrease slightly the number of parallel sessions. Unfortunately, on this basis, some worthwhile papers were not accepted.

On behalf of the organizing committee, I invite you to attend the conference. We are certain that you will find the conference truly stimulating and rewarding.

See you all in San Antonio!

James G. Glimm
Conference Chair

GET-TOGETHERS

SIAM Poster Session and Welcoming Reception
Wednesday, February 8, 1995
5:15 PM - 7:00 PM
Anacacho Ballroom

Complimentary beer, wine, sodas and chips/dip will be available.

Business Meeting
SIAM Activity Group on Geosciences
Wednesday, February 8, 1995
5:15 PM - 7:00 PM
Anacacho Ballroom

Complimentary beer, wine, sodas and chips/dip will be available. This meeting will take place during the welcoming reception/poster session. All are welcome.

Banquet Dinner
Thursday, February 9, 1995
6:15 PM - 9:00 PM
Trinity University (Skyline Room)

The evening will begin with the opportunity to enjoy complimentary cocktails (beer, wine, sodas) and the spectacular view of the San Antonio skyline. Dinner will be served at 7:00 PM and will feature chicken breast stuffed with spinach and pine nuts as the main entree. Seating is limited and ticket purchases will be on a first come, first served basis. Cost per person $29.00.

Software and Algorithms for Parallel Scientific Computing

Saturday, February 11, 1995 • St. Anthony Hotel • San Antonio, Texas

Ken W. Kennedy
Department of Computer Science and Center for Research on Parallel Computation, Rice University

Jack Dongarra holds a joint appointment as Distinguished Professor of Computer Science in the Computer Science Department at the University of Tennessee, Knoxville (UT) and as Distinguished Scientist in the Mathematical Sciences Section at Oak Ridge National Laboratory (ORNL). He specializes in numerical algorithms in linear algebra, parallel computing, use of advanced-computer architectures, programming methodology, and tools for parallel computers. Other current research also involves the development, testing and documentation of high quality mathematical software. He was involved in the design and implementation of the software packages EISPACK, LINPACK, the BLAS, LAPACK, ScaLAPACK, the BLACS, MPI, and PVM/HeNCE; and is currently involved in the design of algorithms and techniques for high performance computer architectures.

Ken Kennedy holds the Noah Harding Professorship in the Department of Computer Science at Rice University and serves as Director of the Center for Research on Parallel Computation, an NSF Science and Technology Center with six participating institutions — Rice University, California Institute of Technology, Los Alamos National Laboratory, Argonne National Laboratory, the University of Tennessee and Syracuse University. His research concentrates on compiler technology for high performance parallel computer systems and he has supervised the construction of several major software systems including an automatic vectorizer for Fortran 77 and an integrated scientific programming environment. Recently he has been concerned with the compilation of Fortran D, a research language designed to support machine-independent parallel programming. Since 1992, he has chaired the High Performance Fortran Forum, which is seeking to define an informal standard for machine-independent parallel programming extensions to Fortran 90. These extensions are based in part on those found in Fortran D.

Who Should Attend

This course will benefit people involved with loosely coupled concurrent computing, and people interested in mathematical software, computational science, or numerical analysis and their applications. It should be of particular benefit to researchers and graduate students involved in solution of linear algebra problems. Application and systems developers in the areas of large-scale scientific computing, heterogeneous systems, and general-purpose concurrent processing will also benefit from the material covered in this course.

Recommended Background

The lectures assume a general knowledge of numerical linear algebra and some familiarity with high-performance computers and parallel processing.

PROGRAM

8:30 AM	Registration
9:00 AM-10:00 AM	**Message Passing MPI Standard/Parallel Virtual Machine (PVM)** Jack Dongarra
10:00 AM-10:30 AM	Coffee
10:30 AM-12:30 PM	**High Performance Fortran** Ken Kennedy
12:30 PM-2:00 PM	Lunch
2:00 PM-3:30 PM	**Algorithms and Libraries for Linear Algebra** Jack Dongarra
3:30 PM-4:00 PM	Coffee
4:00 PM-5:00 PM	**National Software Exchange** Ken Kennedy/Jack Dongarra
5:00 PM	Short Course adjourns

Registration fees*	**SIAG/GS	SIAM Member	Non-SIAM Member	Student
Preregistration (before 1/25/95)	$120	$120	$135	$55
Registration (after 1/25/95)	$135	$135	$155	$75

* Include short course notes.
** Member of SIAM Activity Group on Geosciences.

To register, please complete the Preregistration Form found on inside back cover of program.

The short course will be held in Anacacho Ballroom. The coffee breaks will be in Peacock Alley Room, and lunch will be in Georgian Room.

A hard copy of the following books will be available to short course attendees at discounted prices.

Solving Linear Systems on Vector and Shared Memory Computers, Jack Dongarra, Iain S. Duff, Danny C. Sorensen, and Henk A. Van der Vorst, SIAM, 1990.

Templates for the Solution of Linear Systems: Building Blocks for Iterative Methods Barrett et al., SIAM, Philadelphia, 1994.

High Performance Fortran Handbook, Koelbel et. al. MIT Press, 1994

PVM: Parallel Virtual Machine - A Users Guide and Tutorial for Network Parallel Computing, Geist, et al. MIT Press, 1994.

The Templates and PVM books are available in postscript form on the Internet.
ftp to `netlib2.cs.utk.edu`, then `cd pvm3/book`, then `get pvm-book.ps`
ftp to `netlib2.cs.utk.edu`, then `cd linalg`, then `get templates.ps`

The HPF and MPI standards are available in postscript form on the Internet.
ftp to `netlib2.cs.utk.edu`, then `cd hpf`, then get `hpf-v10-final.ps`
ftp to `netlib2.cs.utk.edu`, then `cd mpi`, then get `mpi-report.ps`

Following are subject classifications for the sessions. The codes in parentheses denote session type and number. The session types are: contributed presentations (CP), invited plenary presentations (IP), and minisymposia (MS). For the poster presentations, see pages 9 and 10.

Bioremediation
A Finite Element Model of Bioventing Using a System of Coupled Nonlinear Conservation Laws with Reaction (IP5, page 10)
Difficulties of Groundwater Modeling at Contaminated Field Sites (MS1, page 6)

Diffusion and Dispersion
High Performance Computing and Solid Earth Dynamics and Structure (MS14, page 11)
Multiscale Processes in Porous Media: Parts 1 and 2 (MS19, and MS23, pages 12, and 14)
Reaction-Diffusion Systens: Parts 1, 2 and 3 (MS2, MS8, and MS13, pages 6, 8 and 10)

Field Studies
Difficulties of Groundwater Modeling at Contaminated Field Sites (MS1, page 6)
Mathematical Modeling and Simulation for Applications of Fluid Flow in Porous Media (IP6, page 12)
Reactive Transport Processes in the Geosciences: Parts 1 and 2 (MS17 and MS21 pages 12, 14)
Poster Session (page 9)

Fracture
Advanced Mathematical Modeling in the Waste Management Program (MS11, page 9)
Multiscale Processes in Porous Media: Parts 1 and 3 (MS19 and MS26, pages 12, 15)

Geology, Geostatistics, and Earth Dynamics
Geostatistical Methods Provide More Effective Integration Methods for Reservoir Models (IP4, page 10)
Geostatistics (CP11, page 16)
High Performance Computing: Medium Characterization and Fluid Flow (IP1, page 6)
High Performance Computing and Solid Earth Dynamics and Structure (MS14, page 11)
Reactive Transport Processes in the Geosciences Part 1 (MS17, page 12)
Poster Session (page 9)

Groundwater
Advanced Mathematical Modeling in the Waste Management Program (MS11, page 9)
Difficulties of Groundwater Modeling at Contaminated Field Sites (MS1, page 6)
Groundwater (CP7, page 15)
Innovative Approaches for Modeling Multiphase Systems (MS24, page 14)
Numerical Methods (CP1, CP2, CP4, and CP7, pages 9, 11, 13 and 15)
Reactive Transport Processes in the Geosciences Part 1 (MS17, page 12)
Poster Session (page 9)

Heterogeneities, Multiscale and Scaleup
High Performance Computing: Medium Characterization and Fluid Flow (IP1, page 6)
Incorporating Uncertainty in Reservoir Simulation (IP7, page 14)
Multiscale Processes in Porous Media: Parts 1, 2 and 3 (MS19, MS23 and MS26, pages 12, 14, and 15)
Porous Media Flow Computation in Germany (MS5, page 7)
Poster Session (page 9)

Multiphase Flow
Innovative Approaches for Modeling Multiphase Systems (MS24, page 14)
Porous Media Flow Computation in Germany (MS5, page 7)
Problems and Issues with Constitutive Relationships Needed for Accurate Modeling of Multiphase, Multicomponent Flow in Permeable Media (IP8 page 14)
Monte Carlo Methods in Porous Media Flow Simulations (MS10, page 8)
Poster Session (page 9)

Numerical Methods
Computational Issues in Modeling Porous Media Flow and Transport for Geologic Repositories (MS7, page 8)
Domain Decomposition Methods: A Computational and Modeling Tool for Reservoir and Groundwater Flow Models (MS25, page 15)
Flexible Grids in Numerical Reservoir Simulation (MS6, page 7)
Innovative Approaches for Modeling Multiphase Systems (MS24, page 14)
Issues in Hyperbolic Equations for the Simulation of Fluid Flow in Porous Media: Parts 1 and 2 (MS18 and MS22, pages 12 and 14)
Mathematical Modeling and Simulation for Applications of Fluid Flow in Porous Media (IP6, page 12)
Monte Carlo Methods in Porous Media Flow Simulations (MS10, page 8)
Porous Media Flow Computation in Germany (MS5, page 7)
The Application of Neural Networks to Problems in Meteorology and Oceanography: Parts 1 and 2 (MS3, page 6)
Poster Session (page 9)

Parallel Computing
Domain Decomposition Methods: A Computational and Modeling Tool for Reservoir and Groundwater Flow Models (MS25, page 15)
High Performance Computing: Medium Characterization and Fluid Flow (IP1, page 6)
High Performance Computing and Solid Earth Dynamics and Structure (MS14, page 11)
Innovative Approaches for Modeling Multiphase Systems (MS24, page 14)
Visualization and Computation Using Scalable Parallel Approaches (MS15, page 11)
Mathematical Modeling and Simulation for Applications of Fluid Flow in Porous Media (IP6, page 12)
Reactive Transport Processes in the Geosciences: Part 1 (MS17, page 12)
Poster Session (page 10)

Risk Estimation
Advanced Mathematical Modeling in the Waste Management Program (MS11, page 9)
Incorporating Uncertainty in Reservoir Simulation (IP7, page 14)
Issues in Hyperbolic Equations for the Simulation of Fluid Flow in Porous Media: Part 1 (MS18, page 12)

Reactive Transport
A Finite Element Model of Bioventing Using a System of Coupled Nonlinear Conservation Laws with Reaction (IP5, page 10)
Reactive Transport Processes in the Geosciences: Part 1 (MS17, page 12)
Reaction-Diffusion Systems: Parts 1, 2 and 3 (MS2, MS8 and MS13, pages 6, 8 and 10)

Seismic Studies
High Performance Computing and Solid Earth Dynamics and Structure (MS14, page 11)
Macroscopic Description of Multiphase Interactions in Porous Media (MS4, page 7)
Seismic Inversion for Reservoir Characterization (MS20, page 13)
Poster Session (page 10)

Software Tools, Standards and Visualization
Standards and Software Tools for Computational Geosciences (MS16, page 11)
Visualization and Computation Using Scalable Parallel Approaches (MS15, page 11)

Theory
Issues in Hyperbolic Equations for the Simulation of Fluid Flow in Porous Media: Parts 1 and 2 (MS18 and MS22, pages 12 and 14)
Reaction-Diffusion Systems: Parts 1, 2 and 3 (MS2, MS8 and MS13, pages 6, 8, and 10)

Thermodynamics and Constitutive Laws
Macroscopic Description of Multiphase Interactions in Porous Media (MS4, page 7)
Multiscale Processes in Porous Media: Parts 2 (MS23, page 14)
Problems and Issues with Constitutive Relationships Needed for Accurate Modeling of Multiphase, Multicomponent Flow in Permeable Media (IP8, page 14)
Reactive Transport Processes in the Geosciences: Parts 1 and 2 (MS17 and MS21, pages 12 and 14)

Transport
Issues in Hyperbolic Equations for the Simulation of Fluid Flow in Porous Media: Parts 1 and 2 (MS18 and MS22, pages 12 and 14)
Mathematical Modeling and Simulation for Applications of Fluid Flow in Porous Media (IP6, page 12)
Multiscale Processes in Porous Media: Part 2 (MS23, page 14)
Reactive Transport Processes in the Geosciences: Part 1 (MS17, page 12)

Waste Management
Advanced Mathematical Modeling in the Waste Management Program (MS11, page 9)

Weather and Oceanography
Application of Neural Networks to Problems in Meteorology and Oceanography: Parts 1 and 2 (MS3 and MS9, pages 6 and 8)
Convergence Studies of Tides and Hurricane Response in Continental Margin (IP2, page 6)
Reactive Transport Processes in the Geosciences: Part 1 (MS17, page 12)
Some Computational Problems in the Next Generation Comprehensive Air Quality Models (IP3, page 8)
Poster Session (page 10)

PROGRAM-AT-A-GLANCE

Tuesday Afternoon, February 7

5:00 PM-7:00 PM
Registration for Conference opens
Anacacho Ballroom Foyer

Wednesday Morning, February 8

7:30 **Registration opens**
Anacacho Ballroom Foyer

8:20 **Opening Remarks and Announcements**
James G. Glimm
Anacacho Ballroom

8:30 IP1 High Performance Computing: Medium Characterization and Fluid Flow
W. Brent Lindquist
Anacacho Ballroom

9:15 IP2 Convergence Studies of Tides and Hurricane Response in Continental Margin Waters
Joannes J. Westerink
Anacacho Ballroom

10:00 **Coffee**
Peacock Alley

10:30 AM-12:30 PM
Concurrent Sessions

MS1 **Difficulties of Groundwater Modeling at Contaminated Field Sites**
Organizer: Philip B. Bedient
Anacacho Ballroom

MS2 **Reaction-Diffusion Systems: Part 1 of 3**
Organizer: William E. Fitzgibbon
Peraux Room

MS3 **Application of Neural Networks to Problems in Meteorology and Oceanography: Part 1 of 2**
Organizer: Laurence C. Breaker
Travis Room

MS4 **Macroscopic Description of Multiphase Interactions in Porous Media**
Organizer: Pratap N. Sahay
St. Anthony Room

MS5 **Porous Media Flow Computation in Germany**
Organizer: Peter Knabner
Jefferson Room

MS6 **Flexible Grids in Numerical Reservoir Simulation**
Organizers: Alvaro L.G.A. Coutinho, Abimael F.D. Loula and Paul R. Ballin
Bowie Room

Wednesday Afternoon, February 8

12:30-2:00 **Lunch**

2:00 IP3 Some Computational Problems in the Next Generation Comprehensive Air Quality Models
Julius Chang
Anacacho Ballroom

2:45 **Coffee**
Peacock Alley

3:15-5:15
Concurrent Sessions

MS7 **Computational Issues in Modeling Porous Media Flow and Transport for Geologic Repositories**
Organizers: Patrick Knupp and Thomas H. Robey
Peraux Room

MS8 **Reaction-Diffusion Systems: Part 2 of 3**
Organizer: William E. Fitzgibbon
Travis Room

MS9 **Application of Neural Networks to Problems in Meteorology and Oceanography: Part 2 of 2**
Organizer: Laurence C. Breaker
St. Anthony Room

MS10 **Monte Carlo Methods in Porous Media Flow Simulations**
Organizer: Thomas W. Fogwell
Jefferson Room

MS11 **Advanced Mathematical Modeling in the Waste Management Program**
Organizers: Amvrossios C. Bagtzoglou and Stuart A. Stothoff
Bowie Room

CP1 **Numerical Methods 1: Parallel Computational Methods**
Lafitte Room

5:15-7:00 PM
Poster Session and Welcoming Reception
Anacacho Ballroom

5:15-7:00 PM
Business Meeting SIAM Activity Group on Geosciences
Anacacho Ballroom

Thursday Morning, February 9

8:30 **Registration opens**
Anacacho Ballroom Foyer

8:30 IP4 Geostatistical Methods Provide More Effective Integration Methods for Reservoir Models
John R. Sherwood
Anacacho Ballroom

9:15 IP5 A Finite Element Model of Bioventing Using a System of Coupled Nonlinear Conservation Laws with Reaction
Linda M. Abriola
Anacacho Ballroom

10:00 **Coffee**
Peacock Alley

10:30 AM-12:30 PM
Concurrent Sessions

MS12 **Finite Element Methods for Surface Water Flow and Transport**
Organizers: William G. Gray and Joannes J. Westerink
Anacacho Ballroom

MS13 **Reaction-Diffusion Systems: Part 3 of 3**
Organizer: William E. Fitzgibbon
Peraux Room

MS14 **High Performance Computing and Solid Earth Dynamics and Structure**
Organizers: Scott D. King
Travis Room

MS15 **Visualization and Computation Using Scalable Parallel Approaches**
Organizer: Ernest A. Franke
Jefferson Room

MS16 **Standards and Software Tools for Computational Geoscience**
Organizer: David A. Archer
Bowie Room

CP2 **Numerical Methods 2: Transport**
St. Anthony Room

Thursday Afternoon, February 9

12:30-2:00 **Lunch**

2:00 IP6 Mathematical Modeling and Simulation for Applications of Fluid Flow in Porous Media
Richard E. Ewing
Anacacho Ballroom

2:45 **Coffee**
Peacock Alley

3:15-5:15
Concurrent Sessions

MS17 **Reactive Transport Processes in the Geosciences: Part 1 of 2**
Organizer: Clint N. Dawson
Anacacho Ballroom

MS18 **Issues in Hyperbolic Equations for the Simulation of Fluid Flow in Porous Media: Part 1 of 2**
Organizers: Helge Holden, Barbara L. Keyfitz, and Dan Marchesin
Peraux Room
(Session will run until 5:45)

MS19 **Multiscale Processes in Porous Media: Part 1 of 3**
Organizers: John H. Cushman and Anthony C. Hess
St. Anthony Room

MS20 **Seismic Inversion for Reservoir Characterization**
Organizer: William W. Symes
Jefferson Room

CP3 **Atmospheric and Oceanographic 1**
Travis Room

CP4 **Numerical Methods 3: Finite Elements**
Bowie Room

6:00 PM
Buses board for Banquet Dinner
Hotel Lobby

6:15-9:00 PM
Banquet Dinner
Trinity University (Skyline Room)

Friday Morning, February 10

8:30 **Registration opens**
Anacacho Ballroom Foyer

8:30 IP7 Incorporating Uncertainty in Reservoir Simulation
Michael E. Christie
Anacacho Room

9:15 IP8 Problems and Issues with Constitutive Relationsips Needed for Accurate Modeling of Multiphase, Multicomponent Flow in Permeable Media
Gary Pope
Anacacho Room

10:00 **Coffee**
Peacock Alley

10:30-12:30
Concurrent Sessions

MS21 **Reactive Transport Processes in the Geosciences: Part 2 of 2**
Organizers: Clint N. Dawson
Anacacho Ballroom

MS22 **Issues in Hyperbolic Equations for the Simulation of Fluid Flow in Porous Media: Part 2 of 2**
Organizers: Helge Holden, Barbara L. Keyfitz, and Dan Marchesin
Peraux Room

MS23 **Multiscale Processes in Porous Media: Part 2 of 3**
Organizers: John H. Cushman and Anthony C. Hess
St. Anthony Room

MS24 **Innovative Approaches for Modeling Multiphase Systems**
Organizer: Alex S. Mayer
Jefferson Room

CP5 **Atmospheric and Oceanographic 2**
Travis Room

CP6 **Estimation, Characterization and Scaleup**
Lafitte Room

Friday Afternoon, February 10

12:30-2:00 **Lunch**

2:00-5:00
Concurrent Sessions

MS25 **Domain Decomposition Methods: A Computational and Modeling Tool for Reservoir and Groundwater Flow Models**
Organizer: Magne S. Espedal
Anacacho Ballroom

MS26 **Multiscale Processes in Porous Media: Part 3 of 3**
Organizer: John H. Cushman
St. Anthony Room

CP7 **Groundwater**
Peraux Room

CP8 **Numerical Methods 4**
Travis Room

CP9 **Multiphase**
Jefferson Room

CP10 **Seismic**
Bowie Room

CP11 **Geostatistics and Heterogeneities**
Lafitte Room

5:00
Conference Adjourns

Saturday, February 11

8:30 AM
Registration for Short Course opens
Anacacho Ballroom Foyer

9:00 AM-5:00 PM
Short Course

5:00 PM
Short Course adjourns

Times allowed for each presentation, including questions and answers:
20 minutes for a contributed presentation (CP)
30 minutes for a minisymposium presentation (MS)
45 minutes for a plenary presentation (IP)

The Conference Organizing Committee expects every speaker of accepted paper to attend the conference and give the presentation. If it becomes inevitable for a speaker to cancel a presentation, the speaker is expected to find an alternate speaker or one of the speaker's co-authors should give the presentation.

WEDNESDAY MORNING, FEBRUARY 8

7:30/Anacacho Ballroom Foyer
Registration opens

8:20/Anacacho Ballroom
Opening Remarks and Announcements
James G. Glimm, State University of New York, Stony Brook

8:30/Anacacho Ballroom
IP1
High Performance Computing: Medium Characterization and Fluid Flow

The speaker will discuss the impact of high performance computing on porous media characterization and fluid flow. Computational geometry tools, such as the "medial axis transform", and network flow models from graph theory allow for geometrical characterization of void pathways in high resolution, three-dimensional tomographic images of rock core samples. Massively parallel architectures allow for practical generation of artificial permeability data with specified statistical scaling behavior over several decades of length scales. A new generation of high performance, parallelized, numerical codes are pushing towards a thousand-fold increase in grid cells, enhancing both the ability to study specific physical processes and large-scale sites requiring remediation evaluation.

W. Brent Lindquist
Department of Applied Mathematics and Statistics
State University of New York, Stony Brook

9:15/Anacacho Ballroom
IP2
Convergence Studies of Tides and Hurricane Response in Continental Margin Waters

The influence of grid structure and domain size on tidal and hurricane storm surge response is examined in the deep ocean and in continental margin waters. The grid convergence studies indicate the importance of providing a very high level of resolution on the shelf, particularly in the vicinity of the continental shelf break with steep gradients in response occur as well as in near shore waters with shallow bathymetry and complex coastlines. Furthermore it is shown that the size of the computational domain significantly influences tidal response as well as primary storm surge in addition to hurricane forerunner effects. For tidal predictions, deep ocean boundaries simplify the specification of boundary conditions due to the slower spatial variation of tidal response in deep water. To minimize the influence of the required boundary conditions on storm surge response, the boundary of the domain should also be located in the deep ocean well away from the shelf, where storm surge varies rapidly, as well as from basins for which resonant modes are excited due to the storm passage.

Joannes J. Westerink
Department of Civil Engineering and Geological Sciences
University of Notre Dame

10:00/Peacock Alley
Coffee

10:30 AM-12:30 PM
Concurrent Sessions

MS1/Anacacho Ballroom
Difficulties of Ground Water Modeling at Contaminated Field Sites

Excellent models exist for groundwater contaminant transport, and for reaction processes in the subsurface, but their specific application to predict migration and remediation at field sites can be very complex. The speakers in this minisymposium will point out the advantages and disadvantages involved in model application. They will address both soluble and NAPL transport issues and will include biodegradation and soil vapor processes, which represent some of the most important and perplexing issues at hazardous waste sites.

Organizer: Philip B. Bedient
Rice University

10:30 Modeling of Groundwater Remediation Systems
Hanadi Rifai, Rice University

11:00 *In-Situ* Bioremediation Simulation
Chen Chiang, Shell Research Development Company

11:30 Practical Applications for LNAPL Contamination
Randy Charbeneau, University of Texas, Austin

12:00 Modeling Mass Transfer Across the Capillary Fringe
Rick Johnson, Oregon Graduate Center

MS2/Peraux Room
Reaction-Diffusion Systems (Part 1 of 3)

Reaction diffusion systems arise in a variety of contexts in geoscience. The speakers are actively engaged in application and theory. They will present analytical and computational results.

Organizer: William E. Fitzgibbon
University of Houston

10:30 Some Results for Reaction-Diffusion Systems with Diffractive Diffusion and Local Kinetics
Jeff J. Morgan, Texas A&M University, College Station

11:00 A Stefan Problem for Multidimensional Diffusion Systems
Avner Friedman, University of Minnesota, Minneapolis

11:30 On An Unsteady Porous Flow Problem with a Free Surface
Gieri Simonett, University of California, Los Angeles, and Joachim Escher, University of Basel, Switzerland

12:00 Modeling of Multi-Particle and Multi-Phase Flow and Rock-Fluid-Particle Interactions in Geological Porous Formations
Faruk Civan, The University of Oklahoma

MS3/Travis Room
The Application of Neural Networks to Problems in Meteorology and Oceanography (Part 1 of 2)

Neural networks are mathematical devices or algorithms that can be trained to recognize various patterns. Neural networks have been used in such fields as psychology, physiology, computer sciences, and engineering. Methodologies that employ neural networks have been somewhat slower to emerge in the geosciences, a fact that may simply reflect a general lack of awareness with respect to the flexibility and versatility of these devices. Within the last five years however, neural networks have appeared in a variety of applications in the geosciences including time series forecasting, pattern prediction, recognition of cloud types and patterns, and transfer function modeling where satellite sensor outputs are related to various atmospheric and oceanographic parameters of interest.

The speakers, a group of neural network users, will share their experiences, both positive and negative, in applying neural networks to various meteorological and oceanographic problems. In addition to articulating the advantages and disadvantages of neural networks, they will emphasize the continually increasing variety of applications where neural networks are being employed in the geosciences.

Organizer: Laurence C. Breaker
NOAA/National Weather Service, Camp Springs, Maryland

10:30 Neural Networks as a Tool for Solving Inverse Problems in Satellite Retrievals of Geophysical Information
Vladimir Krasnopolsky, General Sciences Corporation, Laurel, Maryland

11:00 Neural Networks for the Retrieval of Atmospheric Properties from Microwave and Infrared Spectra
Howard Motteler, University of Maryland, Baltimore County

11:30 Neural Networks: An Alternative Methodology for Time Series Prediction in Oceanography and Meteorology
Laurence C. Breaker, Organizer

12:00 Appropriate Uses of Neural Networks with an Example from Atmospheric Remote Sensing
Charles Butler, Reston, Virginia

Note:
For papers with multiple authors, the speaker is shown in italics if known at press time.

10:30 AM-12:30 PM

Concurrent Sessions

MS4/St. Anthony Room

Macroscopic Description of Multiphase Interactions in Porous Media

By volume averaging well-established porescale continuum prescription and argumenting it by physical constraints, de la Cruz and Spanos (AICHE J., 29(7), 854-858, 1983) have incorporated porescale phasic interactions in the macroscopic equations governing two-phase flow in porous media. For homogeneous porous media, this approach has been generalized to include steam water phase transition, and low frequency seismic wave propagation. The solutions for static deformations, porosity diffusion and seismic motions obtained in this framework are in agreement with experimental results. Recently the effects of inhomogeneity due to porosity gradient and frictional contacts at poresurfaces have been incorporated in this formalism. The speakers will present a guided tour through this approach of the prescription of multiphase continuum processes.

Organizer: Pratap N. Sahay
Centro de Investigacion Cientifica y Educacion Superior é Ensenada (CICESE), Mexico

10:30 The Thermomechanics and Thermodynamics of Porous Media
T.J.T. Spanos, University of Alberta, Canada

11:00 Macroscopic Elastic Parameters of Porous Materials
Craig J. Hickey, University of Mississippi

11:30 Kinetic Phase Transition in Porous Media
Mikhail B. Geilikman, University of Waterloo, Canada

12:00 Seismic Response of Porous Media
Pratap N. Sahay, Organizer

MS5/Jefferson Room

Porous Media Flow Computation in Germany

In the last decade various groups in Germany emerged, both in applied mathematics and in engineering, that deal with flow problems in porous media. A wide range of problems have been addressed, including multiphase fluid flow coupled with reactive solute transport. The research groups aim at the development of efficient numerical schemes such as multigrid methods and of appropriate software for concrete case studies. The speakers will present work at research groups from Stuttgart, from Bochum (both engineering) and from Erlangen/Berlin and Stuttgart (both applied mathematics).

Organizer: Peter Knabner
Universitat Erlangen-Nuernberg, Germany

10:30 Robust Multigrid Solution of Diffusion Equations with Large Jumps in the Coefficients
Peter Bastian, University of Heidelberg, Germany

11:00 A Fast Solution Technique for 3d Transport in Ground Water
Christoph Koenig, University of Bochum, Germany

11:30 Two Phase Flow Computation Using Algebraic Multilevel Preconditioners
Juergen Fuhrmann, Institut für Angewandte Analysis und Stochastik, Germany

12:00 Mathematical Modeling and Simulation of Multiphase Processes in Heterogeneous Media with Finite Element Methods
Rainer Helmig, Universität Stuttgart, Germany

MS6/Bowie Room

Flexible Grids in Numerical Reservoir Simulation

The increased need for complex fluid flow simulations in oil reservoir studies demands the use of flexible grids, capable to handle arbitrary 2-D and 3-D geometries, heterogeneities and faults, precise representation of moving fronts and flow around vertical and deviated wells. The speakers will discuss some recent developments in finite difference, finite volume and finite element methods in this areas, including boundary fitted and Voronoi grids to model general anisotropic reservoirs, local grid refinements in space and time, stabilized finite element methods with dynamic grid refinements and moving meshes.

Organizers: Alvaro L.G.A. Coutinho, COPPE/UFRJ, Brazil; Abimael F.D. Loula, LNCC/CNPq and Paulo R. Ballin, CENPES/PETROBRAS, Brazil

10:30 Three Dimensional Voronoi Grids in Reservoir Simulation
Santosh Verma, Khalid Aziz and John Fayers, Stanford University

11:00 Three Dimensional Petroleum Reservoir Simulation Using Boundary Fitted Grids
Clovis Maliska, Federal University of Santa Catarina, Brazil

11:30 Space and Time Grid Refinement for Oil Reservoir Simulation
Jose Roberto Rodrigues, PETROBRAS Research Center, Brazil; and Flavio Dickstein, Federal University of Rio de Janeiro, Brazil

12:00 Finite Element Methods for Fluid Flow Simulation in Oil Reservoirs
Alvaro L.G.A. Coutinho, Co-organizer; J.L.D. Alves, L. Landau and F.L.B. Ribeiro, COPPE/UFRJ, Brazil; Abimael F.D. Loula, Co-organizer; E.L.M. Garcia, J.N.C. Guerreiro and S.M.C. Malto, LNCC/CNPq, Brazil

12:30
Lunch

2:00/Anacacho Ballroom
IP3
Some Computational Problems in the Next Generation Comprehensive Air Quality Models

Computational models of atmospheric chemical and transport processes have become essential tools not only for understanding the complex coupling among these processes but also for applications such as explorations of control strategies in atmospheric acid deposition, stratospheric ozone destruction and troposheric oxidant formation. Further it is also suggested through modeling that changes in atmospheric chemical balance may lead to climatic changes that is as important as the climatic impact of atmospheric CO_2 increase. In the past, it is customary to consider the so called urban-, regional-, and global-scale models with the obvious separation in spatial scale. Recent developments in air quality studies have demonstrated the importance of multi-scale interactions, hence more complex models with heavy increase in computational demands. A modern comprehensive model needs to consider such computational concepts such as multi-scale coupling, nesting, adaptive grid, parallel processing and in particular advanced techniques for solving stiff chemical kinetics equations.

In this presentation, the speaker will first introduce a regional-scale air quality model which is representative of a modern comprehensive system. He will then demonstrate the performance of such a model in selected current applications. This is followed with some exploratory works involving the computational concepts mentioned above. In particular he will provide some explanations for the physical constraints that have limited our choices of solution techniques. In conclusion, the speaker will suggest some specific computational advances, if realized, that will lead to significant improvements in air quality modeling.

Julius S. Chang
Atmospheric Sciences Research Center
State University of New York, Albany

2:45/Peacock Alley
Coffee

3:15-5:15
Concurrent Sessions

MS7/Peraux Room
Computational Issues in Modeling Porous Media Flow and Transport for Geologic Repositories

Modeling porous media flow and transport in geologic repositories poses a wide variety of computational challenges. The porous media surrounding a repository are often highly heterogenous, producing a great deal of variation and discontinuities in the hydraulic conductivity, which results in numerical problems such as poorly conditioned matrices. The model may also contain regions of widely varying Darcy fluxes, saturated zones with moving surfaces, partially saturated zones with a high degree of nonlinearity, and, for salt repositories, brine pockets. The speakers will present some algorithms that address the numerical challenges associated with these phenomena.

Organizers: Patrick Knupp, Ecodynamics Research Associates and Thomas H. Robey, Spectra Research Institute

3:15 **Calculation of the Jacobian Matrix and Newton Step for a Mixed Finite Element Method for Unsaturated Flow**
Thomas H. Robey, Co-organizer

3:45 **A Moving Mesh Algorithm for 3D Groundwater Flow With a Water Table and Seepage Face**
Patrick Knupp, Co-organizer

4:15 **Moving-mesh Refinement Applied to Brine-Transport Models in Porous Media**
Paul Zegeling, Rijksuniversiteit Utrecht, The Netherlands

4:45 **Comparison of Solution Methods for Coupled Flow and Transport in a Porous Medium**
Toon Leijnse, National Institute for Public Health and Environmental Protection (RIVM), The Netherlands

MS8/Travis Room
Reaction-Diffusion Systems (Part 2 of 3)

(For description, see MS2, Page 6)

Organizer: William E. Fitzgibbon
University of Houston

3:15 **Reactive Flows in Porous Media**
John Chadam, The Fields Institute, Canada

3:45 **A Reaction-Diffusion Equation with Time-Delay from Climate Modeling**
Georg Hetzer, Auburn University

4:15 **An Efficient Numerical Method for Advection-Diffusion-Reaction Systems in Groundwater Contaminant Transport**
Hong Wang, University of South Carolina

MS9/St. Anthony Room
The Application of Neural Networks to Problems in Meteorology and Oceanography (Part 2 of 2)

(For description, see MS3, Page 6)

Organizer: Laurence C. Breaker
NOAA/National Weather Service, Camp Springs, Maryland

3:15 **Predicting Surface Temperature and Precipitation from 700 mb Heights Using Neural Networks**
Russell Martin, NOAA/National Weather Service, Camp Springs, Maryland

3:45 **Rainfall Forecasting Using a Neural Network Model**
Mark French, University of Louisville

4:15 **The Application of Neural Networks to the Prediction of ENSO Events in the Tropical Pacific**
Vernon Derr, NOAA/Environmental Research Laboratory, Boulder

4:45 **On the Use of Electric Field Data and Neural Networks in Extended Period Forecasting**
Mark E. Ewens, NOAA/National Weather Service, Fargo, North Dakota

MS10/Jefferson Room
Monte Carlo Methods in Porous Media Flow Simulations

The limiting factor for flow simulations in porous media is data. The accuracy and amount of the data are what determine the quality of the simulations, the predictive value of the modeling, and the effectiveness of designs based on these models. Currently, the numerical methods and the computational power which can be brought to bear on these problems are able to produce far greater numerical accuracy than exists in the data on which simulations are based.

In the past, the models were kept simple, and various parameters, such as dispersion, adsorption, etc. were used to account for fine scale phenomena (not necessarily due exactly to these properties) which manifested themselves on the scales of the discretizations in the models. The models were then "tuned" or "history matched" to fit the observations. It was assumed that the resulting model was then ready to predict what would happen in the future. It has become clear that the failures of many of these predictions are due to the fact that these simple models with their "tuned" parameters do not correspond to what is actually happening in the porous media.

A method to give increased accuracy to porous media flow simulations, while remaining faithful to the uncertainty and scarcity of the data, is to approach the entire modeling problem from a statistical point of view. With this approach the data are used in statistically appropriate ways, producing simulations which accurately reflect uncertainties. The physics and chemistry of the problem, however, are computed on the finest possible scales in order to accurately represent the actual phenomena which are responsible for the flow. Together, then, the fine scale discretizations (resulting in large problems) and the statistical approach provide more realistic predictions for design and monitoring purposes. Then results then can also be used directly in probabilistic risk assessments.

Organizer: Thomas W. Fogwell
International Technology Corporation

3:15-5:15
Concurrent Sessions

3:15 **Time Parallel Black Box Multigrid**
Joel Dendy, Los Alamos National Laboratory

3:45 **Stochastic Flow Simulation via Parallel Computing**
Andrew Tompson, Lawrence Livermore National Laboratory

4:15 **Reactive Transport in Complex Groundwater Systems**
Steve Yabusaki, Battelle Pacific Northwest Laboratory

4:45 **Conditioning Monte Carlo Simulations by Projections onto Convex Sets**
Paul LaPointe, Golder & Associates, Seattle

MS11/Bowie Room

Advanced Mathematical Modeling in the Waste Management Program

Assessing the ability of the proposed high-level nuclear waste repository and any other waste disposal system, to satisfy radiological or toxic safety regulations for a wide range of potential disruptive scenarios requires the extensive use of complex mathematical models. Typically, these models simulate the flow of water, transport of heat, and movement of contaminants from the repository to the accessible environment. The models describing unsaturated flow and contaminant transport in an unsaturated, heterogeneous, fractured medium, such as the welded tuffs at Yucca Mountain, are extremely difficult to solve numerically. The excessive computational burden imposed by these models is, in fact, posing a technological obstacle to the development and application of reliable predictive tools that will be used to assess regulatory compliance.

Organizers: Amvrossios C. Bagtzoglou and Stuart A. Stothoff Center for Nuclear Waste Regulatory Analyses

3:15 **Advanced Mathematical Modeling in the Waste Management Program: Defining Technical Challenges in a Regulatory Context**
Wesley C. Park, President, Center for Nuclear Waste Regulatory Analyses

3:45 **Computational Issues in High-Level Nuclear Waste Disposal**
K. Pruess, Lawrence Berkeley Laboratory

4:15 **Estimation of Groundwater Travel Times from a High Level Waste Repository in Fractured Granite Under Non-Isothermal Conditions**
Gordon W. Wittmeyer, Budhi Sagar, and Akshai Runchal, Center for Nuclear Waste Regulatory Analyses

4:45 **Comparison of Unsaturated Flow Codes and Conceptual Models for Fractured Heterogeneous Porous Media**
Clifford K. Ho, Sandia National Laboratories, and *Thomas H. Robey*, Spectra Research Institute

5:15 **Application of CFD Methods to the Solution of Richards' Equation**
R.G. Baca, Center for Nuclear Waste Regulatory Analyses, and Stuart A. Stothoff, Co-organizer

CP1/Lafitte Room

Numerical Methods 1: Parallel Computational Methods

Chair: Steven F. Ashby, Lawrence Livermore National Laboratory

3:15 **Reservoir Simulation Using Parallel Adaptive HP Finite Element Techniques**
Olivier Hardy, Computational Mechanics Company, Inc., Austin, Texas

3:35 **Modeling Groundwater Flow and Contaminant Transport on Massively Parallel Computers**
Steven F. Ashby, R.D. Falgout, S.G. Smith, and A.F.B. Tompson, Lawrence Livermore National Laboratory; and T.W. Fogwell, International Technology Corporation, Martinez, CA

3:55 **Nonoverlapping Domain Decomposition Methods for the Equations of Miscible Displacement in Porous Media**
Seongjai Kim, Purdue University, West Lafayette

4:15 **A Parallel Domain Decomposition Solver for Reservoir Simulation on MIMD Computers**
Emmanuel Piault, Institut Francais du Petrole, France, CISI and Comissariat a l'Energie Atomique, France; F-X. Roux, Office Nationnal d'Etudes et Recherches, France; and F. Willien, Institut Francais du Petrole, France

4:35 **A Distributed Implementation of A Finite Element Approach for the Computer Simulation of Two-Phase Flow Problems**
Donald J. Morton, Jr., University of Alaska; John M. Tyler, A. Ted Bourgoyne and Philip A. Schenewerk, Louisiana State University

4:55 **Parallel Alternating Direction Implicit Method for Contaminant Transport Problems**
T. Basaruddin, University of Indonesia, Indonesia

5:15-7:00 PM/Anacacho Ballroom

Poster Session and Welcoming Reception

Field Studies

Application of Numerical Simulation on Improved Oil Recovery for Bai 828 Block
Chen Yueming, Jiang Hanqiao, and Gu Jianwei, University of Petroleum Engineering, People's Republic of China

The Role of Pattern Recognition and High Resolution Inversion in Basin and Mini-Basin Reservoir Characterization
Albert Boulanger and Wei He, Lamont-Doherty Earth Observatory

Geostatistical

The Use of Layered Permeability Probability Model to Determine Geostatistical Parameters of High Permeability Channel in Injection Well
Jiang Hanqiao, Liu Fen, and Chen Yueming, University of Petroleum Engineering, People's Republic of China

Evaluation of Missing Data Gridding Schemes Using the 2D Wavelet Transform
James F. Scholl, Rockwell Science Center, Thousand Oaks, CA

On Searching Optimal Velocities for Oil Prospection
Susana Gomez, IIMAS-National University of Mexico, Mexico

Heterogeneities

Towards Higher Resolution Modeling of Hydraulic Conductivity Fields
James R. Brannan, Clemson University and William J. Bosl, Lawrence Livermore National Laboratory

Effective Hydraulic Conductivity of Two-Dimensional Fracture Networks
Robert W. Zimmerman and Gudmundur S. Bodvarsson, University of California, Berkeley

Multiphase Flow

Dynamic Simulation Model for Reservoirs a State Variable Approach
Mabruk M. Methnani, ABB Atom, Sweden

Effects of Viscous Heating in Temperature-Dependent Viscosity Convection
David A. Yuen, S. Balachandar, David M. Reuteler and Gregory Lauer, University of Minnesota, Minneapolis and University of Illinois, Urbana

Analysis of Three-Phase Gravity Segregated Flow and Its Application To Gas-Water Injection
George A. Virnovsky, Hans M. Helset and Svein M. Skjaeveland, Rogaland University Center, Norway

Statistical Modeling of the Breakthrough Time Function in Reservoir Simulation
Hans Petter Langtangen, University of Oslo, Norway

Modeling of Well Singularity in Flow Simulation
Y. Ding and G. Renard, Institut Francais du Petrole, France

Numerical Method for Critical Rate Estimation
Habib Menouar, King Fahd University of Petroleum and Minerals, Saudi Arabia

Importance of Coreflood Simulation in Assessing Appropriate Relative Permeability Tests on Omani Reservoir Cores
M.Z. Kalam and H. Al-Hashmi, Sultan Qaboos University, Sultanate of Oman

A Computer Software for Generation of Permeability/Porosity Averaged Capillary Pressure Curves
T.C. Patra and D. Banerjee, Oil & Natural Gas Corporation, Ltd., India

Numerical Methods

Nonlinear Multilevel Preconditioning of Full Domain Decomposition for Multiphase Reservoir Simulation
David A. Collins, Computer Modelling Group, Canada

Adaptive Implementation of Multigrid Solution for Petroleum Reservoir Simulation on Distributed Memory Parallel Processors
Kefei Wang, *David O. Ogbe* and Akanni S. Lawal, University of Alaska, Fairbanks

Element-by-Element Multigrid Strategies for Two Phase Immiscible Flow
I.D. Parsons, University of Illinois, Urbana; and A.L.G.A. Coutinho, COPPE/Federal University of Rio de Janeiro, Brazil

Multilevel Substructuring Preconditioners for Mixed Methods for Second Order Elliptic Problems
Serguei Maliassov, Texas A&M University

3:15-5:15
Concurrent Sessions

On the Asymptotic Solution of Richards' Equation for Unsaturated Flow
Christopher L. Cox, Clemson University; and Walter F. Jones, Savannah River Site, Aiken, SC

Parallel Computing

Parallel Preconditioners for Flow and Transport Models
Leesa Brieger, Center for Advanced Studies - Research and Development, Italy

Seismic

Generation of a Realistic 3D Seismic Dataset
Eugene Gravrilov, Ken Lee, John Pearson and Robert Webster, Los Alamos National Laboratory; *Laurent Anne*, Alain Bamberger, Jean Brac, Pierre Duclos and Philippe Klein, Institut Francais du Petrole, France

Ray Perturbations and Traveltime Tomography
Jay Pulliam and Roel Snieder, Utrecht University, The Netherlands

Seismic-Rock Properties Integration: A Case Study
Reinaldo Gonzalez, Adrian Peranau and Debora S. Vega, Intevep S.A., Venezuela; and Maritza Jimenez, Corpoven S.A., Venezuela

The Effect of an Inversion-Estimated Energy Source on Separate Determination of the Earth Parameters
Susan E. Minkoff, Rice University

Cooperative Inversion of Geophysical Data
Alexander V. Avdeev, Novosibirsk Computing Center, Russia

Seismic Velocity Inversion and the Relationship of Differential Semblance Optimization to Other Formulations of the Inverse Problems
Mark S. Gockenbach and William W. Symes, Rice University

The Use of Convex Duality in Seismic Velocity Inversion
Mark S. Gockenbach and William W. Symes, Rice University and Guy Chavent, University of Paris IX-Dauphine, France

Weather and Oceanographic

On Nonlinear Channel Theory of Tides
Nabil Moussa, The American University in Cairo, Egypt

A Numerical Realization of Wave Energy Propagation in the Wind Wave Models
I. Lavrenov, Artic and Antarctic Research Institute, Russia; J.R.A. Onvlee, Royal Meteorological Institute, The Netherlands

Using Symbolic Computer Packages for Simulation of Atmospheric Vortexes
Yuri Bratukhin and *Serguei Makarov*, Perm State University, Russia

Multifractal Characterization of Environmental Pollution from Small to Large Scales
Gianfausto Salvadori, S. Ratti and G. Belli, Universita di Pavia, Italy

Absorbing Boundaries with Chebyshev Pseudo-Spectral Methods for Wave Propagation
Rosemary A. Renaut, Arizona State University

5:15-7:00 PM/Anacacho Ballroom
Business Meeting
SIAM Activity Group on Geosciences

8:30/Anacacho Ballroom Foyer
Registration opens

8:30/Anacacho Ballroom
IP4
Geostatistical Methods Provide More Effective Integration Methods for Reservoir Models

Over the past few years the exploration and production sector of the petroleum industry has invested large sums of money in acquiring 3D seismic data. Much of this 3D seismic data has been recorded over producing oil and gas properties. A requirement does exists to maximize the use of the 3D seismic data to provide improved reservoir models that can be used for reservoir volumetrics and numerical simulation.

Geostatistical methods such as kriging, cokriging and sequential simulation provide an effect method to provide the integration between the regular dense sampling of a 3D seismic survey with the sparse, spatially biased sampling of well petrophysical data and depositional geological trends.

In this presentation, the speaker will illustrate with field examples the improvement in integration and accuracy of reservoir models that can be obtained using interactive workstations and geostatistical applications.

John R. Sherwood
Western Geophysical

9:15/Anacacho Ballroom
IP5
A Finite Element Model of Bioventing using a System of Coupled Nonlinear Conservation Laws with Reaction

Bioventing is a subsurface remediation technology developed to stimulate the biodegradation of contaminants in the vadose zone. In this process, advective gas fluxes are generated in order to deliver oxygen to aerobic microorganisms.

The speaker will present a comprehensive model of bioventing which couples equations describing multiphase flow, multicomponent advective diffusive transport, and bioreaction. Nonlinearities are present in the bioreaction terms, constitutive relationships, and material properties. Rate limited mass exchange between phases is modeled with linear driving force expressions. A two dimensional finite element method using a set iterative approach is used to solve the model system of nonlinear time dependent partial differential equations. The speaker will present numerical results.

Linda M. Abriola
Department of Civil and Environmental Engineering
University of Michigan, Ann Arbor

10:00/Peacock Alley
Coffee

10:30 AM-12:30 PM
Concurrent Sessions

MS12/Anacacho Ballroom
Finite Element Methods for Surface Water Flow and Transport

Finite element (FE) based methods are ideally suited for flow computations in the coastal ocean due to relatively well defined scales of motion. Robust FE based algorithms have emerged and continue to emerge allowing for truly optimal flow predictions that apply grids with highly varying nodal densities. Due to the rapid growth in computational power, coastal modelers are considering ever increasingly larger regions, bathymetric variability, number of degrees of freedom and ranges of scales of motion. This places new demands on the robustness and structure of the numerical methods used in coastal flow models. Furthermore the issue of how to parallelize algorithms specifically designed for the highly unstructured grids associated with FE based codes is of significant interest.

The speakers in this minisymposium will examine recent developments in FE based algorithms for use in coastal oceanography. Novel algorithms and parallelization issues will be the basis of the session.

Organizers: Joannes J. Westerink and William G. Gray
University of Notre Dame

10:30 Research Progress on Least-Squares, Taylor Galerkin and SUPG Schemes for Shallow Water Equations
Graham F. Carey, S. Bova and Y. Shen, University of Texas, Austin

11:00 Title to be announced
Daniel R. Lynch, Dartmouth College

11:30 Parallel Computing for Finite Element Models of Surface Water Flow
Srinivas Chippada, *Clint N. Dawson*, Bala Ramaswamy and Mary F. Wheeler, Rice University; and Randy Kolar, University of New Haven

12:00 An Exploration of Parallelization Issues and the Applicability of *p* Type Finite Element Methods for the Shallow Water Equations
Roy Walters and *Ted Barragy*, Intel Corporation, Albuquerque

MS13/Peraux Room
Reaction-Diffusion Systems (Part 3 of 3)

(For description, see MS2, Page 6)

Organizer: William E. Fitzgibbon
University of Houston

10:30 Numerical Approximation of Advection-Diffusion-Reaction Equations and Studies of Asymptotic Behavior of Solutions
Clint N. Dawson, Rice University

11:00 Gas-solid Reactions
Ivar Stakgold, University of Delaware

11:30 Models for the Migration of Grain Boundaries
Paul C. Fife, University of Utah

10:30 AM-12:30 PM
Concurrent Sessions

MS14/Travis Room
High Performance Computing and Solid Earth Dynamics and Structure

Many computational issues arising in the study of the dynamics and structure of Earth's interior are similar to those being faced in other areas of Earth Science. In some cases, the physics is fairly well understood, but the problems are computationally challenging and new algorithms are being developed to take advantage of parallel computers. In other cases, there are uncertainties regarding the basic physics that must be explored through computational experiments. The speakers will illustrate some of the connections between research on deep earth dynamics and structure and other areas of Earth Science. They will discuss: numerical methods for flow in fluids with complex rheologies, porous flow and transport of magma, and seismic imaging of complex structures.

Organizers: Scott D. King, Purdue University, West Lafayette, and E. Marc Parmentier, Brown University

10:30 High Performance Computing and Mantle Dynamics
Scott D. King, Co-organizer

11:00 Mantle Dynamics and Melt Migration
E. Marc Parmentier, Co-organizer

11:30 Lattice Gases and Multiphase Flow Through Porous Media
Daniel H. Rothman, Massachusetts Institute of Technology

12:00 Physical Wavelet Characterization and High Resolution Inversion
Y.F. Sun, Lamont-Doherty Earth Observatory

MS15/Jefferson Room
Visualization and Computation using Scalable Parallel Approaches

Rapid advances in parallel and distributed computing now allow modeling and simulation of physical systems with high levels of complexity and accuracy. The massive data sets generated by computer models or physical experiments require efficient and flexible approaches to scientific visualization.

Researchers are investigating the use of software systems such as PVM and Linda to provide scalable computing from distributed workstations to massively parallel processors. High speed data connections, including fiber optic with ATM switches, can provide the needed bandwidth.

The speakers will discuss four systems developed to use current and impending advances in scalable computing and high performance data networks and provide the potential for interactive use of computer resources at remote locations. They will show how existing computing resources (both in-house and at remote locations) can be used to meet the requirements for advanced computation and visualization.

Organizer: Ernest A. Franke
Southwest Research Institute

10:30 The ACES Project, An Approach to Achieving True Scalable Parallel Computing
Christopher J. Freitas, Southwest Research Institute

11:00 AVTP - An Architecture for Visualization using Remote Parallel/ Distributed Computing
Ernest A. Franke, Organizer

11:30 Parallelization of ALEGRA
James S. Peery, Sandia National Laboratories, Albuquerque

12:00 A Parallel System for Structural and Fluid Dynamics Modeling and Visualization: ALE3D/MESHTV
Richard G. Couch, Lawrence Livermore National Laboratory

MS16/Bowie Room
Standards and Software Tools for Computational Geoscience

Geoscience is becoming increasingly computational. Inexpensive workstations along with connectivity to powerful computational and visualization engines, puts an unprecedented computing resource in the geoscientist's hands. The recent avilability of open computing standards and reusable software libraries has come to the assistance of geoscientists who need ready access to high-levels of computational expertise but who have neither the time nor the inclination to master the fine details of parallel computation, user interface construction or state-of-the-art visualization. In this minisymposium, the speakers will show how standards based software libraries and development environments can assist geoscientists with the computational tasks that they must address today.

Organizer: David A. Archer
Interactive Network Technologies, Inc., Houston

10:30 An Overview of Standards and Software Development Tools
David A. Archer, Organizer

11:00 Buy Don't Build — What Does that Mean for a Software Developer?
Todd E. Little, Western Atlas Software, Houston

11:30 Parallel and Distributed Development Tools for the Geosciences
Andrew H. Sherman, Scientific Computing Associates, New Haven

12:00 The Handling of E&P Bulk Data in the POSC Specifications
Alan Doniger, Petrotechnical Open Software Corporation, Houston

CP2/St. Anthony Room
Numerical Methods 2: Transport

Chair: Anna Grossi, State University of New York, Stony Brook

10:30 A Conservative Finite-Volume Eulerian-Lagrangian Localized Adjoint Method for the Two-Dimensional Advection-Dispersion Equation
Richard W. Healy, U.S. Geological Survey, and Thomas F. Russell, University of Colorado, Denver

10:50 A Tracer Particle Algorithm for Simulating Solute Transport with Lattice Gas Automata
Chunhong Li and John L. Wilson, New Mexico Institute of Mining and Technology

11:10 Toward a General Multiphase Flow and Transport Simulator
J.F. Kanney and C.T. Miller, University of North Carolina, Chapel Hill

11:30 Methods for Discretization on Triangular Grids for General Media
Ivar Aavatsmark, Tor Barkve, Oistein Boe, and Trond Mannseth, Norsk Hydro, Norway

11:50 Front Tracking for Tracer Flow
Ana C. Grossi and James Glimm, State University of New York, Stony Brook; and Dan Marchesin, Instituto de Matematica Pura é Aplicada, Brazil

12:10 A Flux-Based Eulerian-Lagrangian Localized Adjoint Method for the Two-Dimensional Transient Advection Equation
Rick V. Trujillo, University of Colorado, Denver

12:30
Lunch

2:00/Anacacho Ballroom
IP6
Mathematical Modeling and Simulation for Applications of Fluid Flow in Porous Media

Understanding the fate and transport of contaminants to determine water quality and to develop remediation strategies or optimizing the recovery of hydrocarbons in petroleum applications each require the ability to model multiphase flow in heterogeneous three-dimensional reservoirs. Model equations and corresponding parameters must be determined at the appropriate length scales to describe the scaled physics of flow. Effective simulators require accurate numerical methods on general geometries. The speaker will discuss the use of mixed finite element methods and local grid refinement, present example calculations for field simulations in aquifers or reservoirs with complex boundaries, and also address the parallelization of the codes.

Richard E. Ewing
Institute for Scientific Computation
Texas A&M University, College Station

2:45/Peacock Alley
Coffee

3:15-5:15
Concurrent Sessions

MS17/Anacacho Ballroom
Reactive Transport Processes in the Geosciences (Part 1 of 2)

Transport in subsurface and atmospheric environments involves advective and diffusive processes and can include complex chemical reactions. In subsurface contaminant transport, for example, precipitation/dissolution, ion exchange, adsorption, and biodegradation are important phenomena and should be included in the mathematical model. These phenomena can greatly increase the complexity of the problem, due to their inherent nonlinearity and the highly disparate temporal scales involved.

The speakers will address current mathematical and numerical techniques for understanding and simulating these processes. They will discuss the effects of these nonlinear processes on the behavior of solutions, and numerical techniques for modeling advection and diffusion with equilibrium and kinetic reactions.

Organizer: Clint N. Dawson
Rice University

3:15 **Analysis of Crystal Dissolution Fronts in Porous Media**
C.J. van Duijn, Delft University of Technology, The Netherlands

3:45 **Parallel Computation on Advection-Dispersion-Reaction Geochemical Model**
Chong H. Wang, Fredrik Saaf, Todd Arbogast, Mary Wheeler and Clint N. Dawson, Rice University

4:15 **Transport of Contaminant Mixtures Controlled by Both Equilibrium and Kinetic Reactions**
George T. Yeh, Pennsylvania State University

4:45 **Parallel Computing for Weather Prediction and Related Models**
Ute Gaertel, German National Research Center for Computer Science (GMD), Germany; Wolfgang Joppich, Institute for Algorithms and Scientific Computing; and Anton Schueller, Schloss Birlinghoven, Germany

MS18/Peraux Room
Issues in Hyperbolic Equations for the Simulation of Fluid Flow in Porous Media (Part 1 of 2)

(This session will run until 5:45 PM).

Challenging mathematical problems arise in the simulation of petroleum reservoir flow. The reason is fourfold. First, the equations are nonlinear; some models include PDE's which change type. These may be ill posed, and may not represent the flow correctly. Second, some important physical effects, such as mass transfer, are not yet well modelled. Third, the petrophysical data are poorly known. Fourth, numerical simulations cannot resolve reservoir heterogeneities which have effects at the engineering level. In view of these limitations, how can one perform simulations of practical value? The speakers will focus on modeling of reservoir physics, mathematical theories of equations which change type, and computational techniques.

Organizers: Helge Holden, University of Trondheim, Norway;
Barbara L. Keyfitz, University of Houston; and
Dan Marchesin, Instituto de Matematica Pura é Applicada, Brazil

3:15 **On the Role of Viscosity in the Stability of Shock Waves**
Suncica Canic, Iowa State University

3:45 **Structural Stability of Riemann Solutions for a Multiphase Kinematic Conservation Law Model that Changes Type**
Vaidyanath Vinod, University of New Orleans

4:15 **Oscillation Waves in Riemann Problems Inside Elliptic Regions for System of Mixed Type**
Hermano Frid and I-Shih Liu, Federal University of Rio de Janeiro, Brazil

4:45 **Stability of Asymptotic Solutions of Systems of Conservation Laws**
Arthur Azevedo, University of Brasilia, Brazil; Dan Marchesin, Co-organizer; Bradley Plohr, State University of New York, Stony Brook; and Kevin Zumbrun, Indiana University, Bloomington

5:15 **Sensitivities of Solutions to Conservation Laws and Application to Production Optimization**
Ole Vignes, Norsk Hydro, Norway

MS19/St. Anthony Room
Multiscale Processes in Porous Media (Part 1 of 3)

Processes of relevance to the transport of chemicals and the flow of fluids in porous media occur on scales from the atomic (Å) to that of the reservoir (miles). To properly account for the physics of flow and transport, one must understand how small scale information cascades to higher scales.

The methods currently being used to attack multiscale problems include quantum chemical, nonequilibrium statistical mechanical (generalized hydrodynamics), renormalized and unrenormalized perturbation, high resolution numerical experiments, various stochastic techniques, homogenization and related averaging techniques.

The speakers will focus attention on complex problems over a hierarchy of scales.

Organizer: John H. Cushman
Purdue University, West Lafayette

3:15 **Multiscale Swelling Porous Media and Consolidation**
Marcio A. Murad and Lynn S. Bennethum, Purdue University, West Lafayette

3:45 **Multiscale Swelling Systems with Interfaces**
Lynn Schreyer Bennethum, Purdue University, West Lafayette and John H. Cushman, Co-organizer

4:15 **Diagrammatic Perturbation Analysis of Stochastic Groundwater Flow**
George Christakos, University of North Carolina, Chapel Hill

4:45 **Classical-, Quasi-, Convolution-Fickian and More General Dispersive Fluxes: Regions of Validity**
John H. Cushman, Organizer

3:15-5:15
Concurrent Sessions

MS20/Jefferson Room

Seismic Inversion for Reservoir Characterization

Simulation of petroleum reservoirs contributes greatly to modern reservoir management. However the accuracy of a flow simulation depends on the accuracy of the reservoir description. Well logging gives very detailed rock property information, but very sparsely distributed in space. Seismology, together with well data and geostatistical and geological modeling, can constrain reservoir structure and sometimes lithology and even gas/fluid content over entire fields, to yield pre-drill evaluation of the reservoir and increase the predictive power of flow simulators. Repeated seismic surveys can in some circumstances map the progress of fluid fronts, thus informing flood and infill drilling decisions. The speakers in this minisymposium will explore the basis, capabilities and limitations of seismic reservoir characterization, including the fundamental rock physics linking seismic and flow parameters, the joint exploitation of imaging and geologic modeling, quantitative estimation of lithologic parameters (inversion), and time-lapse imaging of fronts.

Organizer: William W. Symes
Rice University

3:15 **Improving Geophysical Data Interpretation by Quantitative Geologic Process Modeling**
Daniel M. Tetzlaff, Texaco Inc.

3:45 **Role of Rock Physics in Reservoir Characterization**
James G. Berryman, Lawrence Livermore National Laboratory

4:15 **4-D Seismic Monitoring of Reservoir Fluid Flow**
David E. Lumley, Stanford University

CP3/Travis Room

Atmospheric and Oceanographic I

Chair: Martin Berzins, University of Leeds, United Kingdom

3:15 **Diffusion in Stably Stratified Turbulence with and without Rotation**
Yoshifumi Kimura, University of Colorado, Boulder, and National Center for Atmospheric Research; and Jackson R. Herring, National Center for Atmospheric Research

3:35 **Application of the Glimm Method to Meteorological Modeling**
Aron Jazcilevich, Vicente Fuentes, and Ivan Rivera, Universidad Nacional Autonoma de Mexico, Mexico

3:55 **Efficient High Resolution Methods for Air Pollution Models**
Martin Berzins, Justin Ware, Alison Tomlin, Mike Pilling and Anne Heard, University of Leeds, United Kingdom

4:15 **Finite Element Methods for Weakly Non-linear and Dispersive Water Waves**
Hans Petter Langtangen and Geir Pedersen, University of Oslo, Norway

4:35 **On the Dynamics of the Moon and the Inner Planets**
A.A. Khentov, University of Nizhni Novgorod, Russia

CP4/Bowie Room

Numerical Methods 3: Finite Elements

Chair: Lawrence C. Cowsar, AT&T Bell Laboratories

3:15 **Multigrid Preconditioners for Hybrid Mixed Finite Elements**
Lawrence C. Cowsar, AT&T Bell Laboratories

3:35 **Accurate and Efficient Flow Velocity Computations on Unstructured Meshes**
Philip T. Keenan, Rice University

3:55 **Finite Element Simulation of Well Tests**
Mary Beth Yard and John B. Thuren, Texaco-EPTD, Houston

4:15 **Conservative Flux Calculations for the Finite Element Method**
Joseph H. Schmidt and John F. Peters, Waterways Experiment Station, Vicksburg, MS

4:35 **Sensitivity Studies with D4Z Ordering for ILU Preconditioning of Iterative Methods for 3-D Anisotropic Systems**
Kenneth L. Kipp, U.S. Geological Survey; Thomas F. Russell and James S. Otto, University of Colorado, Denver

4:55 **A Lagrange-mixed Finite Element Approximation for Advection Dominated Nonlinear Contaminant Transport in Porous Media**
K. Velten and P. Knabner, University of Erlangen-Nuernberg, Germany

6:15-9:00 PM

Banquet Dinner

Trinity University (Skyline Room)

FRIDAY MORNING, FEBRUARY 10

8:30/Anacacho Ballroom Foyer
Registration opens

8:30/Anacacho Ballroom
IP7
Incorporating Uncertainty in Reservoir Simulation

Risk management is becoming increasingly important in the oil production business. Uncertainty arises directly from our lack of knowledge of the detailed reservoir desciption and its impact on fluid flow. A prerequisite for good risk management is good uncertainty estimation.

Classical reservoir simulation cannot address the whole range of uncertainties in any practical time. A simple Monte Carlo approach based on exploring the sensitivity to twelve key input items each of which was allowed three values (high, medium, low) would generate over half a million input cases each requiring several hours computer time to run.

The speaker will describe one aproach to uncertainty estimation in reservoir simulation focussing on two key elements: speed of simulation and selection of cases.

Michael A. Christie
BP Exploration, Inc.

9:15/Anacacho Ballroom
IP8
Problems and Issues with Constitutive Relationships Needed for Accurate Modeling of Multiphase, Multicomponent Flow in Permeable Media

This presentation will be an overview of the state of modeling of physical and chemical properties relevant to the large scale modeling of reactive transport in permeable media, with special emphasis on those properties applicable to enhanced oil recovery and the remediation of soils. These properties include phase behavior, capillary pressure, relative permeability, adsorption, chemical reactions with the permeable medium, rate limited mass transfer between fluid phases and dispersion. Both of these applications typically involve two to four fluid phases plus solids and anywhere from several reactive chemical species to hundreds of reactive species. Example species are contaminants such as trichloroethylene, hydrocarbons, surfactants, polymers, radionuclides, microbes and oxygen just to name a few. Most of these properties depend on the local characteristics of the medium such as permeability, porosity, mineral composition, surface area, wettability and the like as well as on the temperature, pressure and composition of the fluids. This makes the accurate modeling of these properties very difficult and expensive and we are typically faced less than adequate experimental data to test these models and to determine appropriate coefficients. This presentation will point out a number of the most critical problems and limitations, what data are most needed, how we can apply consistency criteria to help guide us in the development and application of such models embedded in the framework of multiphase, multicomponent, multidimensional flow and transport simulators and how we should decide how much detail and accuracy is needed or feasible for a given field scale application.

Gary Pope
Center for Petroleum and Geosystems Engineering
University of Texas, Austin

10:00/Peacock Alley
Coffee

10:30 AM-12:30 PM
Concurrent Sessions

MS21/Anacacho Room
Reactive Transport Processes in the Geosciences (Part 2 of 2)

(For description, see MS17, page 12)

Organizer: Clint N. Dawson
Rice University

10:30 Stochastic-convective Approach for Transport with Kinetic and Equilibrium Reactions
Brian D. Wood and T.R. Ginn, Pacific Northwest Laboratory, and W.E. Hathhorn, Washington State University

11:00 Reduction of Trapped Oil in Cross-bedded Sandstone Reservoirs
Hans Bruining, J. Molenaar and G.A. Bartelds, Delft University of Technology, The Netherlands

11:30 Importance of Hysteresis in Modeling Contaminant Transport in Permeable Media
Mojdeh Delshad, University of Texas, Austin

12:00 A Linear Equation Solver for Moderately and Massively Parallel Computers
K. Gary Li, A.E. McDonald, A.B. Bash-Ayan, N.A. Sobh, A.R. Merchant, H.A. Al-Sunaidi, A.H. Dogru and A.A. Al-Mulhem, Saudi Aramco Oil Company, Saudi Arabia

MS22/Peraux Room
Issues in Hyperbolic Equations for the Simulation of Fluid Flow in Porous Media (Part 2 of 2)

(For description, see MS18, page 12)

Organizers: Helge Holden, University of Trondheim, Norway; Barbara L. Keyfitz, University of Houston; and Dan Marchesin, Instituto de Matematica Pura é Applicada, Brazil

10:30 Adaptive Methods for Shear Band Formation and Chemical Flooding
John Trangenstein, Duke University

11:00 Scaling Issues in the Numerical Simulation of Advection-Dominated Transport in Porous Media
Myron B. Allen III, University of Wyoming, and Frederico Furtado, University of Campinas, Brazil

11:30 Tracer Simulations Using Front Tracking
Tore Gimse and Frode Bratvedt, Technical Software Consultants AS, Norway; and Tor Bu, Norsky Hydro, Norway

12:00 Improved Methods for High Resolution Simulations: A Comparison Study
Kent Holing, Statoil, Norway and Tore Gimse, Technical Software Consultants AS, Norway

MS23/St. Anthony Room
Multiscale Processes in Porous Media (Part 2 of 3)

(For description, see MS19, Page 12)

Organizers: John H. Cushman, Purdue University, West Lafayette and Anthony C. Hess, Battelle Pacific Northwest Laboratory

10:30 Solute Transport in Porous Media
Randall A. LaViolette, Idaho National Engineering Laboratory

11:00 Molecular Diffusion in Zealites
John B. Nicholas, Battelle Pacific Northwest Laboratory

11:30 Discrete Atomic Phenomena in Porous Media
Anthony C. Hess, Co-organizer

12:00 Chemical Kinetics and Transport in Porous Media
Carl Steefel, Battelle Pacific Northwest Laboratory

MS24/Jefferson Room
Innovative Approaches for Modeling Multiphase Systems

Simulation of flow and transport in multiphase, porous media systems presents a significant challenge. Proper equation formulations are important for physical accuracy, numerical stability, and mass conservation properties.

The selection of numerical approximation methods is critical for enhancing model efficiency. Front tracking, adaptive grid refinement, and domain decomposition techniques have been investigated. Intensive research efforts are found in the fields of petroleum reservoir and hydrologic system simulation; however, interaction between these fields is infrequent. The speakers will present and discuss the latest advancements and encourage cross-disciplinary interaction in multiphase simulations.

Organizer: Alex S. Mayer
Michigan Technological University

10:30 A Nonlinear Mixed Finite Element Method for a Degenerate Parabolic Equation Arising in Flow in Porous Media
Todd Arbogast, Rice University

11:00 Multiphase Fluids in Porous Media in Environmental Applications: Process Identification and Modeling Implications
Tissa Illangasekare, University of Colorado, Boulder

11:30 Review of Recent Developments in Modeling of Multiphase Multicomponent Transport in Groundwater
Thomas F. Russell, University of Colorado, Denver

12:00 Domain Decomposition for Multiphase Flow Problems
Alex S. Mayer, Organizer

10:30 AM-12:30 PM
Concurrent Sessions

CP5/Travis Room
Atmospheric and Oceanographic II

Chair: Donna Calhoun, Computer Sciences Corporation

10:30 Arctic Ice Modeling on Parallel Computers
Steve Piacsek, Naval Research Laboratory; and D. Norton, Kaman Sciences Corporation, Colorado Springs

10:50 Variational Data Assimilation Experiments with NASA/GLA Semi-Lagrangian Semi-Implicit GCMs
I.M. Navon and W. Yang, Florida State University; and Y. Li, General Sciences Corporation, NASA/GLA, Greenbelt, MD

11:10 Relaxation Spectra of Surface Waves
Daniel L. Marcus and David Chambers, Lawrence Livermore National Laboratory

11:30 Sensitivity Analysis of Distribution of Pollutants in the Atmosphere
Donna Calhoun, Computer Sciences Corporation, Seattle, and Andrzej Lewandowski, National Oceanic and Atmospheric Administration, Seattle

CP6/Lafitte Room
Estimation, Characterization and Scale-Up

Chair: Laurence Bentley, University of Calgary, Canada

(This session will run until 12:50 PM)

10:30 Invesgtigation of Mathematical Modeling of Groundwater Flow and Contaminant Transport: Scale Up, Mathematical Theory and Experimental Validation
David W. Dean, University of Colorado, Denver

10:50 Modeling Multiphase, Multicomponent Displacements in Heterogeneous Porous Media Using Streamtubes
Marco R. Thiele, Martin J. Blunt, and Franklin M. Orr, Jr., Stanford University

11:10 Parameter Identification Using Simulated Annealing
Laurence R. Bentley, University of Calgary, Canada

11:30 Sensitivity Analysis and Predictability in Presence of Data
Francois-Xavier Le Dimet and Hans-Emmanuel Ngodock, CNRS-INRIA, and Universite Joseph Fourier, France

11:50 On the Stability of Pressure and Velocity Computations for Heterogeneous Reservoirs
Are Magnus Bruaset and B.F. Nielsen, SINTEF, Norway

12:10 Homogenization for Upscaling Reservoir Simulation: A Review of the Results
Alain P. Bourgeat, Universite de St Etienne, France

12:30 Mathematical Modeling and Computation for Determination of Optimum Geographical Locations of Emergency Medical Facilities
Richard S. Segall and Richard A. Albanese, Armstrong Laboratory

12:30
Lunch

2:00-4:30
Concurrent Sessions

MS25/Anacacho Ballroom
Domain Decomposition Methods: A Computational and Modeling Tool for Reservoir and Groundwater Flow Models

The speakers in this minisymposium will discuss the application of domain decomposition methods within porous media models like groundwater- and petroleum-reservoir flow. These models represent very large computational problems well suited for such methods.

Modeling of flow at horizontal wells, faults, fluid interfaces represent problems where local refinement is needed and where domain decomposition may be an excellent tool requiring only a fairly simple extra datastructure. In other regions of the model, only a global coarse grid solution may be needed. This means that proper methods for upscaling has to be developed.

Organizer: Magne S. Espedal
University of Bergen, Norway

2:00 Domain Decomposition Methods for Mixed Finite Element Approximation to Flow Problems
Raytcho Lazarov, Texas A&M University, College Station

2:30 Parallel Domain Decomposition Algorithms for Reservoir Models
Petter E. Bjørstad, University of Bergen, Norway

3:00 Domain Decomposition and Mixed Finite Volume Methods in Reservoir Simulation
Olivier Gosselin, Elf Aquitaine Production, France

3:30 Blending Finite Volumes and Finite Elements in Domain Decomposed Oil Reservoirs
Alfio Quarteroni, Politecnico di Milano, Italy

4:00 Domain Decomposition Methods and Parameter Upscaling for Porous Media Flow Models
Magne S. Espedal, Organizer

MS26/St. Anthony Room
Multiscale Processes in Porous Media (Part 3 of 3)

(For description, see MS19, Page 12)

Organizer: John H. Cushman
Purdue University, West Lafayette

2:00 Reservoir Flow Problems in MIMD Systems
Jim Douglas, Jr., Felipe Pereira and John Spyropoulos, Purdue University, West Lafayette, and Li-Ming Yeh, National Chiao Tung University, Taiwan

2:30 A Quantitative Multiscale Theory for Heterogeneous Porous Media
Qiang Zhang, State University of New York, Stony Brook

3:00 A Model for Contaminant Transport in Naturally Fractured Porous Media
Mauricio Kischinhevsky, Universidade Federal Fluminense, Brazil; and *Paulo George Paes Leme*, Universidade do Estado do Rio de Janeiro, Brazil

3:30 Simulation of Flow in Partially Fissured Media
Jim Douglas, Jr.and Felipe Pereira, Purdue University, West Lafayette; Malgorzata Peszenska, Polish Academy of Sciences, and Purdue University, West Lafayette; and *Ralph E. Showalter*, University of Texas, Austin

4:00 Renormalization Calculations of Flow in Porous Media
Peter King, BP Exploration Operating Company, United Kingdom

CP7/Peraux Room
Groundwater

Chair: Linda M. Abriola, University of Michigan, Ann Arbor

2:00 The Effects of First- and Second-Order Rate-Limited Sorption Models on Contaminant Transport and Pulsed Pumping Remediation
J.L. Caspers and *D.L. Coulliette*, Air Force Institute of Technology

2:20 A Comparison of Methods for Resolving Sharp-Front Infiltration Problems
C.T. Kelley and M.J. Tocci, North Carolina State University; and C.T. Miller, University of North Carolina, Chapel Hill

2:40 A Network Model for the Dispersion of Reactants in Porous Media
Gilbert Yevi and *Pasquale Cinnella*, Mississippi State University

3:00 Uncertainty Analysis of Steady-State Infiltration Through a Heterogeneous Layered Formation
Yanyong Xiang and Srikanta Mishra, INTERA Inc., Las Vegas

3:20 Discrete Interpretation of Non-Local Transport Laws
John F. Peters and Stacy E. Howington, Waterways Experiment Station, Vicksburg, MS

3:40 Richards Equation vs. Fractional Flow
Cathrine Tegnander, University of Oslo, Norway; and Tore Gimse, Technical Software Consultants AS, Norway

4:00 Simulation of Soil Venting
Ulrich Hornung, University of the Federal Armed Forces Munich, Germany

4:20 Spatial Weighting Techniques for Advective Terms During the Simulation of Air Sparging
Andre J.A. Unger, Peter A. Forsyth and Edward A. Sudicky, University of Waterloo, Canada

CP8/Travis Room
Numerical Methods 4

Chair: Myron B. Allen, University of Wyoming

2:00 Mathematical Theory and Numerical Approximation of a Revised Model for Miscible Displacement in Porous Media
Xiaobing Feng, University of Tennessee, Knoxville

2:20 Combining Streamline Diffusion with Characteristic Timestepping in Underground Transport Models
Biyue Liu and Myron B. Allen, University of Wyoming

FRIDAY AFTERNOON, FEBRUARY 10

2:00-4:30
Concurrent Sessions

2:40 Coupled Model for Fluid-Rock Interactions in Reservoir
Y. Le Gallo, Institut Francais du Petrole, France; A. Clement, Centre National de la Recherche Scientifique, France; and E. Sonnenthal, Institut Francais du Petrole, France

3:00 Time Stepping via Exact Time Integration of Mass Velocity
A.E. McDonald, G.K. Li, A.B. Bash-Ayan, N.A. Sobh, A.R. Merchant, H.A. Al-Sunaidi, A.H. Dogru, and A.A. Al-Mulhem, Saudi Aramco Oil Company, Saudi Arabia

3:20 The Numerical Simulation of Flow and Tracer Transport within an Experimental Heterogeneous Flow Bed
Peter Grindrod, Michael D. Impey, and Jason P. Humm, Intera Information Technologies, United Kingdom; and Hiroyasu Takase, JGC Corporation, Japan

3:40 A Novel Optimization Approach to Multiphase Flow
Lawrence Cowsar, AT&T Bell Laboratories; Roland Glowinski, University of Houston; Tony Kearsley, Richard A. Tapia, Mary F. Wheeler, and *Ivan Yotov*, Rice University

CP9/Jefferson Room
Multiphase
Chair: Andre Nachbin, IMPA, Brazil

2:00 Numerical Simulation of Non-Newtonian Fluid Flow and Displacement in Porous Media
Yu-Shu Wu, HydroGeoLogic, Inc., Herndon, VA

2:20 Evaluation of Rock/Fracture Interactions During Steam Injection Through Vertical Hydrofractures
Anthony R. Kovscek, University of California, Berkeley; R.M. Johnston, Shell Western E&P, Bakersfield, CA; and T.W. Patzek, University of California, Berkeley

2:40 Capillary Limit Effective Two-Phase Properties for 3D Porous Media
Steinar Ekrann and *Kaare Langaas*, RF-Rogaland Research, Norway; and Magnar Dale, Rogaland University Center, Norway

3:00 Non-Equilibrium Waterflood in Heterogeneous Porous Media
Maria Cristina Castro Cunha, UNICAMP, Brazil; Deise Ferreira, PETROBRAS, Brazil; and Antonio C. Correa, PETROBRAS, and UNICAMP, Brazil

3:20 Numerical Simulation for Hysteretic Flow in Porous Media
Jim Douglas, Jr., Purdue University, West Lafayette; T.S. Ramakrishnan, Schlumberger-Doll Research, Ridgefield, CT; and *Yuting Wei*, Purdue University, West Lafayette

3:40 Regularization Mechanisms for Unstable Interfacial Flows
Andre Nachbin, Instituto de Matematica Pura e Aplicada, Brazil

4:00 The Effect of Gravity and Capillary Pressure on Three-Phase Fluid Flow in a Porous Medium
Rafael E. Guzman, F. John Fayers, and Khalid Aziz, Stanford University

CP10/Bowie Room
Seismic
Chair: Guy Chavent, CEREMADE, Universite Paris-Dauphine, and INRIA, France

2:00 Seismic Waveform Inversion via Duality and Progressive Illumination
Guy Chavent, CEREMADE, Universite Paris-Dauphine, France and INRIA, France; Francois Clement and Jean David Benamou, INRIA, France

2:20 Nonlinear Theory of Poroelasticity and Applications
Andrew N. Norris and *Michael A. Grinfeld*, Rutgers University

2:40 High Resolution Adaptive Finite Difference Methods for Wave Equations
Robert H. Hoar and Curtis R. Vogel, Montana State University

3:00 Multi-resolution Filter Banks: Application to Stratigraphy
Daran L. Rehmeyer, Quaternary Resource Investigations, Inc., Baton Rouge, LA; and Jorge L. Aravena, Louisiana State University, Baton Rouge

3:20 Solving Geophysical Inverse Problems by the Mean Field Annealing (MFA) Method
Carlos Calderon and Mrinal K. Sen, University of Texas, Austin

3:40 An Inverse Problem Solution Method with Fractal and Discontinuity Constraints
Bryan J. Travis, Los Alamos National Laboratory

4:00 Convergent Algorithms for 3-D Diffraction and Diffusion Tomography
Semion Gutman, University of Oklahoma and *Michael V. Klibanov*, University of North Carolina, Charlotte

4:20 Error Analysis for the Wave Equation in Heterogeneous Media
Alain Sei, Rice University

4:40 Interaction of Elastic Waves with a Discontinuity
Valery V. Mansurov and Yu. A. Buyevich, Urals State University, Russia

CP11/Lafitte Room
Geostatistics and Heterogeneities
Chair: Alex H. Treadway, Sandia National Laboratories, Albuquerque

2:00 Six Factors Which Affect the Condition Number of Matrices Associated with Kriging
George J. Davis, Georgia State University; and Max D. Morris, Oak Ridge National Laboratory

2:20 Inversion of Soil Conductivity Profiles from Geomagnetic Induction Measurements
Brian Borchers, Jan M.H. Hendricks and Thomas Uram, New Mexico Institute of Mining and Technology

2:40 A Spectral Multipole Algorithm for Modeling Extensive Fracture Formation and Interaction in Brittle Rocks
Anthony P. Peirce, McMaster University, Canada; and John A.L. Napier, CSIR Division of Mining Technology, South Africa

3:00 Texture Analysis: Mathematical Methods of Determination and Interpretation of Crystallographic Preferred Orientation
Helmut Schaeben, Aachen University of Technology, Germany

3:20 On the Sensitivity and Spatial Resolution of Transient Pressure and Tracer Data for Heterogeneity Characterization
Akhil Datta-Gupta, D.W. Vasco and J.C.S. Long, Lawrence Berkeley Laboratory

3:40 Sensitivity of Spatial Permeability Connectivity Patterns to Variogram Parameters
Sitakanta Mohanty, Southwest Research Institute, San Antonio and K.V.K. Prasad, Amoco Production Company, Tulsa

4:00 Sandia National Laboratories Site Wide Hydrogeologic Characterization Project: Stochastic Modeling - Composite Media Formulation
Alex H. Treadway, Sandia National Laboratories, Albuquerque

4:20 Estimation and Simulation with Source Point Method
Saleem G. Ghori, King Fahd University of Petroleum and Minerals, Saudi Arabia; John P. Heller and Allan Gutjahr, New Mexico Institute of Mining and Technology

5:00 PM
Conference Adjourns

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❑ American Express ❑ MasterCard ❑ VISA

Credit Card # _____ Expiration date_____

For further information, please contact SIAM Customer Services:
Telephone: 215-382-9800 / Toll-free (U.S. only): 800-447-SIAM / Fax: 215-386-7999
E-mail: service@siam.org / Address: 3600 University City Science Center, Philadelphia, PA 19104-2688

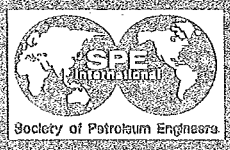
Society of Petroleum Engineers

13th Symposium on

RESERVOIR SIMULATION

12-15 February 1995

San Antonio, Texas, USA



The Society of Petroleum Engineers will hold its 13th Symposium on Reservoir Simulation immediately after the SIAM conference. The SPE symposium will be held on 12-15 February 1995 at the Hyatt Regency Hotel, San Antonio.

For more information about the SPE symposium, please contact:
Society of Petroleum Engineers,
P.O. Box 833836, Richardson, TX 75083-3836, U.S.A.;
Street Address: 222 Palisades Creek Drive, Richardson, TX 75080,U.S.A.;
Telephone: 214-952-9393; Fax: 214-952-9435;
or
Society of Petroleum Engineers, 4 Mandeville Place, London W1M 5LA, U.K.;
Telephone: (44) 71-487-4250, Fax: (44) 71-487-4229.

SPEAKER INDEX

CP = Contributed Presentation
IP = Invited Presentation
MS = Minisymposia
PS = Poster Session

HOTEL INFORMATION

ST. ANTHONY HOTEL
300 East Travis Street, P.O. Box 2411
San Antonio, TX 78205-1821
Telephone (210)-227-4392
Fax (210)-227-0915

SIAM is holding a block of rooms at the St. Anthony Hotel. These rooms are being held on a first come, first served basis at $90.00 single or $100.00 double room. These rooms will be held for our exclusive use only until Monday, January 9, 1995, after which date, reservations will depend on availability.

We urge you to make your reservations as soon as possible. You may do so by calling the St. Anthony Hotel, faxing your reservation or mailing in the Hotel Reservation Form located on the back of this program. When making your reservation by phone, please be certain to identify yourself as an attendee at the SIAM Conference on Geosciences to receive the discounted rate.

Location: The St. Anthony Hotel is located in the heart of downtown San Antonio, just two blocks from the famed Riverwalk, which is famous for shopping and its many restaurants. The hotel is just a few blocks from Texas' number one tourist attraction - - The Alamo.

Deposit: To confirm your reservation, a deposit equivalent to one night's room rate is required at the time you make the reservation. Payment can be made by either AMEX, MC, Visa, Diner's Club or check.

Arrivals and Departures: Check-in time is 3:00 PM and check-out time is 12:00 Noon.

Cancellations: If you need to change or cancel your reservation, you must contact the hotel by 1:00 PM Western Standard Time on your stated date of arrival to avoid any unnecessary charges.

Dining: The St. Anthony Hotel has two restaurants. The Cafe, which serves informal dining with a Southwestern flair; and Pete's Pub, which has a lively atmosphere of a Victorian Pub. There are many restaurants, with a variety of gourmet cuisines at reasonable prices, within walking distance of the hotel.

Recreational Facilities: Located on the sixth floor is an outdoor heated swimming pool with a sundeck. Exercise/workout equipment is available.

Parking: Valet parking is available at a rate of $9.00 per day. There is a Self-Park parking lot across the street from the hotel. The daily rate is $6.00 per person. (these are the rates quoted at time of printing).

Public Transportation (Trolley System): San Antonio has a great public transportation system. You can get to most of the downtown area and local attractions on the trolley. The cost of riding the trolley is twenty-five cents. The major downtown area trolley can be caught at the Alamo, two blocks from the hotel. Those wishing to go to the Market Place area can catch the trolley at the corners of Houston and Navarro Streets.

TRANSPORTATION INFORMATION

AIRLINES

Official Carrier for Continental USA and Canada

SIAM has selected USAir as the official carrier for this conference. Discounts are available to conference attendees from February 6-13, 1995.

By flying USAir you become eligible for the following discounts:

- 5% off of the Supersaver Fares (21 day advance purchase with a Saturday night stayover)
- 10% off of Standard Coach Fares (7 day advance purchase with no Saturday night stayover)
- 45% off of Full Coach Fare (less than 7 day advance purchase and no Saturday night stayover)

SIAM has selected Get-A-Way Travel agency to assist attendees in making travel arrangements. Get-A-Way Travel will make your reservations on USAir or any airline of your choice. To take advantage of the USAir discounts, you must book your reservation through Get-A-Way Travel by calling 1-800-223-3863 or 215-379-6800, and ask for Carol Brecht. Be sure to mention that you are attending the 1995 SIAM Conference on Geosciences. Get-A-Way Travel will issue your tickets and mail these to you.

CAR RENTAL

Dollar Rent A Car has been selected as the official car rental agency for this meeting. The following rates are available to attendees between February 1 - 18, 1995. Dollar is located in-terminal at San Antonio's International Airport. Attendees will also earn frequent flyer miles from United, TWA or Continental Airlines when renting from Dollar Rent A Car. All rentals include unlimited mileage.

Type of Car	Daily Rate (1-4 days)	Weekly Rate (5-7 days)
Compact	$27.88	$139.88
Intermediate	$29.88	$149.88
Standard	$33.88	$169.88
Luxury	$45.88	$229.88
MiniVan	$45.88	$229.88

Additional charges:
$11.95/day Loss Damage Waiver
$4.50/day Personal Accident Insurance & Personal Effects Protection.
$8.95/day SLI

RESERVATIONS

We encourage you to make advance reservation, as on-site availability cannot be guaranteed. Make reservations by calling Dollar Rent A Car at (800) 800-0044. Be sure to mention that you are attending the 1995 SIAM Conference on Geosciences, February 8-11, 1995 in San Antonio, Texas, in order to receive the discounted rates. **The conference reservation code number is CCSIAM2.**

- Cars must be picked up and returned to the same location.
- You must be at least 25 years of age and have a valid U.S. or International Drivers License.
- You must have one of the following credit cards to rent a car: American Express, MasterCard, or VISA.
- Refueling charges, collision insurance, and taxes are not included in the above rates.

On occasion, the car rental agency may offer special rates that are lower than rates quoted above. As an attendee, you are eligible for the lower of the two rates. In most instances, the conference discount rates are lower than those quoted to the general public.

AIRPORT TRANSPORTATION

Star Shuttle is the van service that runs from the airport to the hotel and back. The shuttle runs every 15-20 minutes and is available from 8:00 AM to midnight, 7 days a week. Outside the baggage claim area are blue and yellow ticket booths where you can purchase tickets for the shuttle. A local taxi will cost approximately $13.00 each way.

HOTEL ROOMMATE-SHARING LIST

SIAM is keeping an e-mail list of attendees who may wish to share a room with another attendee at the conference to cut down on expenses. To be placed on this list, you should forward the following information via e-mail to: degiulio@siam.org or by fax: 215-386-7999. Be sure to specify that you want to be on the GEOSCIENCES Roommate-Sharing List.

Name
Address
Phone/Fax/E-mail
Gender
Smoker/Non-Smoker
Arrival/Departure Dates

SIAM will forward a list to any attendee who requests one. It is the responsibility of the attendee to make the contacts and arrangements with attendees on the list.

DRIVING DIRECTIONS TO THE ST. ANTHONY HOTEL

From the Airport: Continue straight out from the airport onto US 281/IH-37 South (which is an extension of Airport Blvd). Stay on US 281/IH-37 to Houston Street (Exit 141 B), turn right. Follow the main flow of traffic to Broadway (4th light) and turn left, going two blocks to East Travis Street, then turn right on East Travis for 2 blocks. The St. Anthony Hotel will be on your left at the corner of East Travis and Jefferson Streets. The parking garage entrance is on East Travis immediately after crossing Jefferson.

From Houston: Continue on IH-10 West to IH-37/US 281 North, getting onto IH-37, go approximately 3/4 mile to the Durango Street exit (140B). Turn left on Durango to South Alamo (3rd light), turn right, going past the Alamo. After crossing Houston Street, get into the left turn lane and turn left onto East Travis proceeding toward the second light. The St. Anthony Hotel will be on your left at the corner of East Travis and Jefferson streets. The parking garage entrance is on East Travis immediately after crossing Jefferson.

From El Paso: From IH-10 East take IH-35 North toward Austin (Exit 570) to IH-37/US 281 South (Exit 158) towards Corpus Christi for approximately 1 mile until you come to the Houston Street Exit (#141B),, turn right. Follow the main flow of traffic to Broadway (4th light) and turn left, going two blocks to East Travis Street, then turn right on East Travis for 2 blocks. The St, Anthony Hotel will be on your left at the corner of East Travis immediately after crossing Jefferson.

From Dallas/Austin: Take IH-35 South to IH-37/281 South (Exit 158B), and as quickly as safely possible, get into the right lane. Get off on Houston Street (Exit 141 B), turn right. Follow the main flow of traffic to Broadway (4th light) and turn left, going two blocks to East Travis Street, then turn right on East Travis for 2 blocks. The St. Anthony Hotel will be on your left at the corner of East Travis and Jefferson streets. The parking garage entrance is on East Travis immediately after crossing Jefferson.

From Highway 90 East: Take exit 574 to IH-35 North towards Austin (this will take you around the downtown area). After the McCullough Street exit, take IH-35/US 281 South (NOTE: you will see another exit for McCullough) to Houston Street (Exit 141B), turn right. Follow the main flow of traffic to Broadway (4th light) an turn left, going two blocks to East Travis Street, then turn right on East Travis for 2 blocks. The St. Anthony Hotel will be on your left at the corner of East Travis and Jefferson streets. The parking garage entrance is on East Travis immediately after crossing Jefferson.

REGISTRATION INFORMATION

The registration desk will be located at the entrance of the Anacacho Ballroom on the Lobby Level. The registration desk will be open as listed to the right:

Tuesday, February 7	5:00 PM - 7:00 PM
Wednesday, February 8	7:30 AM - 3:30 PM
Thursday, February 9	8:30 AM - 3:30 PM
Friday, February 10	8:30 AM - 3:30 PM
Saturday, February 11	8:30 AM - 2:00 PM

REGISTRATION FEES

Preregistration deadline: Wednesday, January 25, 1995.

		SIAG/GS*	SIAM Member	Non-Member	Student
Conference	Before 1/25	$135	$140	$170	$30
	After 1/25	$165	$170	$200	$30
" Short Course	Before 1/25	$120	$120	$135	$55
	After 1/25	$135	$135	$155	$75

* Member of SIAM Activity Group on Geosciences.
" Fees include short course notes and lunch.

To register, complete the Preregistration Form found on page 23 of this program and return it with your payment to SIAM. You can also register in the following ways:

- Telephone: 215-382-9800; Toll free-800-447-7426 (USA only).
- E-mail: meetings@siam.org
- Fax: 215-386-7999

We urge attendees to preregister and save!. To qualify for the preregistration fee, the Preregistration Form and payment must be received at the SIAM Office by Wednesday, January 25, 1995.

Preregistration received at the SIAM office after Wednesday, January 25, will be subject to the difference between the preregistration and the on-site registration fees. The difference will be charged to your credit card or collected from you on-site.

There will be no prorated fees. No refunds will be issued after Tuesday, February 7, 1995.

On-site registration begins on Tuesday, February 7, 1995. If your preregistration payment arrives at SIAM after the conference has started, that payment will returned to you. Your on-site registration will be processed.

CANCELLATION POLICY

Cancellation prior to:	
January 25, 1995	Full refund
January 26-February 7, 1995	$25.00 Cancellation Fee
After February 7, 1995	No Refund

NON-SIAM MEMBERS

Non-SIAM members are encouraged to join SIAM to obtain the member rate for meeting registration and enjoy all the other benefits of SIAM membership. Join SIAM by returning your completed membership application form (see page 17) and your Preregistration Form to SIAM. Be sure to include both membership dues and preregistration fees with your forms and return these to SIAM by Wednesday, January 25, 1995.

CREDIT CARDS

SIAM accepts VISA, MasterCard and American Express. Please indicate credit card type, account number and the expiration date on the Preregistration Form.

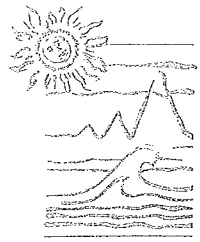
SIAM CORPORATE MEMBERS

Non-member attendees who are employed by the following institutions are entitled to the SIAM member registration fees.

Amoco Production Company
AT&T Bell Laboratories
Bellcore
The Boeing Company
Cray Research, Inc.
E.I. du Pont de Nemours & Company
Eastman Kodak Company
Exxon Research and Engineering Company
General Motors Corporation
GTE Laboratories Inc.
IBM Corporation
ICASE
IDA Center for Communications Research
MacNeal-Schwendler Corporation
Martin Marietta Energy Systems
Mathematical Sciences Research Institute
NEC Research Institute
Supercomputing Research Center, a Division of Institute for Defense Analyses
United Technologies Corporation
Visual Numerics, Inc.

TELEPHONE MESSAGES

The telephone number of the St. Anthony Hotel is 210-227-4392. The St. Anthony will either connect you with the SIAM registration desk or forward a message to the attendees room.



HOTEL RESERVATION FORM

SIAM Conference on Geosciences

February 8-10, 1995
St. Anthony Hotel
San Antonio, Texas

Specially discounted rooms are being held for our exclusive use until Monday, January 9, 1995. After that date, reservations will depend on availability. Your reservation is not confirmed until acknowledged in writing by the hotel or verified by phone. A deposit in the amount of one night's room rate is required in order to confirm your reservation. When making reservations by phone, be certain to identify yourself as an attendee at the SIAM Conference on Geosciences. The St. Anthony's telephone is: 210-227-4392; fax: 210-227-0915.

Please send me a confirmation

PLEASE PRINT

Name _____

Address _____

City _____ State _____ Zip _____

Phone _____

Please reserve a [ ] $90/Single [ ] $100/Double

Arrival Date _____ Arrival Time _____ Departure Date _____

❑ I am a disabled participant and require appropriate accommodations

❑ I am enclosing my deposit for the first night's room rate. I choose to pay by:

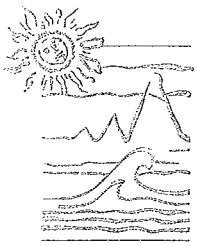
❑ American Express ❑ MasterCard ❑ Visa ❑ Personal Check

Credit Card Number _____

Exp. Date _____ Deposit $ _____

Signature _____

Detach this card and enclose it in an envelope with postage and mail to: Reservations, St. Anthony Hotel, 300 East Travis Street, P.O. Box 2411, St. Antonio, TX 78205-1821.



PREREGISTRATION FORM

SIAM Conference on Geosciences

February 8-10, 1995
St. Anthony Hotel
San Antonio, Texas

Preregistration deadline: Wednesday, January 25, 1995.

REGISTRATION FEES		SIAG/GS*	SIAM Member	Non-Member	Student
Conference	Before 1/25	$135	$140	$170	$30
	After 1/25	$165	$170	$200	$30
** **Short Course**	Before 1/25	$120	$120	$135	$55
	After 1/25	$135	$135	$155	$75
*** **Banquet Dinner**		$ 29	$ 29	$ 29	$29
Total amount paid		$ _____	$ _____	$ _____	$ _____

* Member of SIAM Activity Group on Geosciences.

** Fees include short course notes and lunch.

*** Banquet Dinner, Thursday, February 9, 1995, 6:15 PM - 9:00 PM, Trinity University (Skyline Room). The evening will begin with the opportunity to enjoy complimentary cocktails (beer, wine, sodas) and the spectacular view of the San Antonio skyline. Dinner will be served at 7:00 PM and will feature chicken breast stuffed with spinach and pine nuts as the main entree. Seating is limited and ticket purchases will be on a first come, first served basis. Cost per person $29.00.
No refunds will be issued after Tuesday, February 7, 1995.

For your convenience, you can register in any of the following ways:

- **By Phone:** 215-382-9800; Toll free: 800-447-7426 (USA Only)
- **By E-mail:** meetings@siam.org
- **By Fax:** 215-386-7999
- **By Mail.** Complete and return this form and payment to: SIAM Conference Department, 3600 University City Science Center, Philadelphia, PA 19104-2688 U.S.A.

PLEASE PRINT:

Name _____
FIRST MIDDLE INITIAL LAST

Organization _____ Department _____

Business Address _____

City _____ State _____ Zip _____

Telephone _____ Fax _____ E-Mail _____

Home Address _____

City _____ State _____ Zip _____

Please send all SIAM correspondence to the following address: ❑ Home ❑ Business

Please update my SIAM records to reflect the above: ❑ Yes ❑ No

[ ] I am a disabled participant and require appropriate accommodations.

I wish to pay by: ❑ AMEX ❑ VISA ❑ Master Card ❑ Check (payable to SIAM)

Credit Card # _____ Expiration Date _____

Signature _____

NAME BADGE-I prefer my name and affiliation to read as follows:

Name: (20 characters) ☐☐☐☐☐☐☐☐☐☐☐☐☐☐☐☐☐☐☐☐

Affiliation: (20 characters) ☐☐☐☐☐☐☐☐☐☐☐☐☐☐☐☐☐☐☐☐

Preregistration Form and payment must be received at the SIAM office by Wednesday, January 25, 1995.

Society for Industrial and Applied Mathematics
3600 University City Science Center
Philadelphia, PA 19104-2688

POSTMASTER PLEASE DELIVER TO:

Science and Industry Advance with Mathematics
If you receive multiple copies of this program, please pass the extras along to your colleagues.