GFD Newsletter 2005
Faculty of Walsh College

The 2005 GFD Photograph.

A Sketch of the Summer

The 2005 GFD program was entitled "Fast Times and Fine Scales" with a focus on asymptotic and stochastic modeling methods that exploit a physical scale separation. The first week consisted of principal lectures from Joe Keller on waves in fluids, ray methods, and a variety of applications. The second week was divided between Eric Vanden-Eijnden's lectures on Brownian motion and stochastic differential equations, and George Papanicolaou's lectures on variational principles and asymptotic methods in homogenization theory. Research lectures by staff and visitors were delivered daily throughout the program addressing topics ranging from applications of multiscale methods in ocean and atmosphere dynamics, to applications of stochastic methods in populations dynamics and chemical kinetics, to applications of homogenization theory in materials science and engineering.

Oliver Bühler and Charlie Doering acted as co-Directors for the summer. Janet Fields, Jeanne Fleming and Penny Foster provided the administrative backbone for the program. Keith Bradley supplied technical support, and Matt Finn ran the computer network and graciously helped with the production of the summer's proceedings volume. As always we are grateful to Woods Hole Oceanographic Institution for the use of Walsh Cottage, the perfect setting for the GFD program.

Schedule of Principal Lectures

Week 1, Joseph B. Keller (Stanford):

Monday, June 20: Review of ideal fluid dynamics; derivation of surface and gravity wave equations

Tuesday, June 21: Linear perturbation theory, short wave asymptotics and ray methods

Thursday, June 22: Applications: shoaling, scattering and waves in channels of variable depth

Thursday, June 23: Heat conduction in inhomogeneous media, effective conductivities and multiscale analysis

Friday, June 24: Long-wave dynamics; a harbour with a small opening and energy exchange with the outside

Week 2, Eric Vanden-Eijnden (Courant Institute) and George Papanicolaou (Stanford):

Monday, June 27: Brownian motion, stochastic integrals, stochastic differential equations
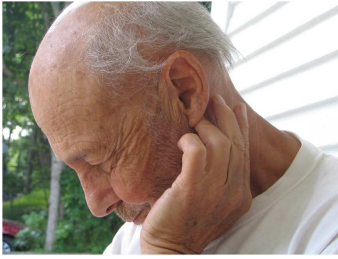
Tuesday, June 28: Kolmogorov backward and forward equations, Feynman-Kac formula, Girsanov theorem

Wednesday, June 29: Averaging theorems for Markov chains and stochastic differential equations
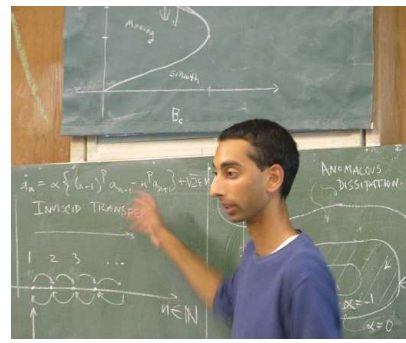
Thursday, June 30: Introduction to the use of variational methods for high-contrast diffusivity problems

Friday morning, July 1: Variational principles for convection-diffusion and their use for the analysis of high Peclet number behavior.

Friday afternoon, July 1: The notion of eddy viscosity for 2D cellular flows and its behavior at large Rayleigh numbers.

Our Principal Lecturer caught in thought on the porch. And be careful what you Google.

Presentation of fellows.

From top to bottom: Srinivasan, Tanabe, Roper Zarnescu, Hasha Pauls, Koszalka, Akers, Sargsyan, Rudge, Shaw

Fellows' Reports

Benjamin Akers, University of Wisconsin-Madison
 Shallow water flows through a contraction

Alexander Hasha, New York University
 A search for baroclinic structures

Inga Koszalka, Politecnico di Torino
 The vibrating pendulum and stratified fluids

Walter Pauls, University of Nice
 Diffusion processes in cellular flow

Marcus Roper, DEAS, Harvard University
 Internal wave breaking and mixing in the deep ocean

John Rudge, University of Cambridge
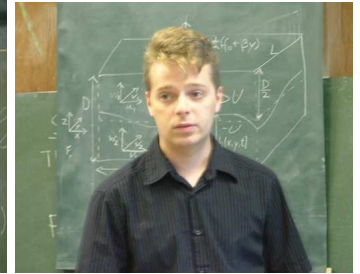 *Scattering past a cylinder with weak circulation*

Khachik Sargsyan, University of Michigan
 Fluctuations in chemical systems in the large volume regime

Tiffany Shaw, University of Toronto
 Bounds on multiscale mixing efficiency

Ravi Srinivasan, Brown University
 Simple models with cascade of energy and anomalous dissipation

Aya Tanabe, Imperial College of London
 Laboratory experiments on mesoscale vortices colliding with multiple islands

Arghir Dani Zarnescu, University of Chicago
 Intermittency in simple models for turbulent transport

Softball Report

GFD softball this year was put to the test immediately since our first game (against PO) was scheduled for the third day of the program. We were lucky to have Andy Thompson and Joel Miller from GFD 2003 in the outfield for the first week and that, together with an astonishingly eager class of fellows, led to softball practice at the end of each of the first two days. The result was a gratifying 10 to 6 victory. The fellows continued to practice, with and without the staff, every week throughout the summer and often would wander down to Bell Tower field to play for other teams when players were needed. Ben was an inspiring leader of the team and he had a great deal of help from Tiffany, Ravi, Alex and our computer expert, Matt, all of whom had played before. And as has happened so often in the past, some of the fellows who started out with no idea of which end of the bat to hold ended up competent ballplayers. That group included Inga, Walter, John, Khachik, Dani and Manuel. By the end of the season the fellows themselves could field an entire team of respectable softball players. We had a couple of frustrating losses and two definite defeats, but we won four and lost four. Our last two games (both wins) were against the carpenters and facilities, two teams which normally beat us handily. For the first time ever we had a shut-out and that was against the carpenters, whom we had never beaten before. In the final game the staff spoiled it for the fellows by importing a bunch of ringers. After the game we reassembled at Crooked Pond to finish the day with boating, swimming, food and fun.

Ed explains to a captive audience how to operate a computer.

The GFD Website

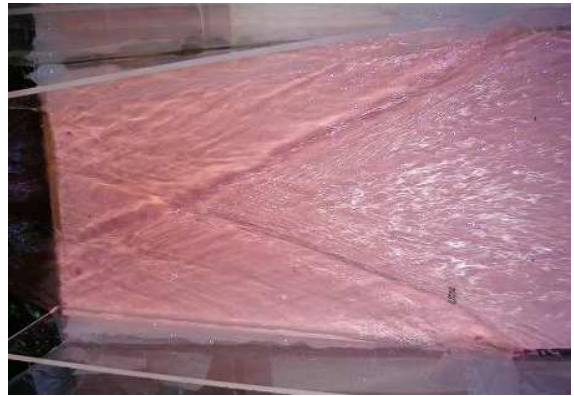The lectures notes and reports are available online at `gfd.whoi.edu`. The GFD website also contains:
- lecture and seminar schedules
- electronic versions of proceedings and newsletters
- lists of alumni and visitors
- application materials
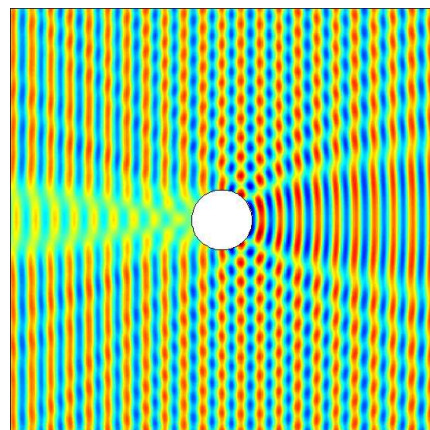- picture galleries of life at GFD
- useful information and links.

The Sears Public Lecture

In 2005, the Sears Public Lecture was entitled
*The Great Sumatra Earthquake
& Tsunamis in the Indian Ocean*
and delivered by Professor Philip L.-F. Liu, of the Department of Civil and Environmental Engineering, Cornell University. An audience of over eighty people congregated for the lecture, which gave an overview of how and why the recent Tsunami in the Indian Ocean occured. Coupled with descriptions from survivors, and elements of how tsunamis are theoretically modelled, Professor Liu elegantly educated us all.

Experiments from the Coastal Research Lab: Ben's hydraulic jumps inside a contraction in shallow water.

Diffraction pattern around a circular island (further details in J. Rudge's report)

The GFD Faculty

The GFD Faculty handles the scientific and administrative duties of the school. This group is made up of members of the scientific community, across several disciplines, united by their interest in GFD. These are the faces to be seen at GFD over future summers, and their research interests help to define the scientific direction and flavor of the Program.

Neil Balmforth *University of British Columbia*
Oliver Buhler *New York University*
Claudia Cenedese *W. H. O. I.*
Eric Chassignet *University of Miami*
Charles Doering *University of Michigan*
Glenn Flierl *M. I. T.*
Karl Helfrich *W. H. O. I.*
Lou Howard *M. I. T. and Florida State University*
Joseph Keller *Stanford University*
Richard Kerswell *University of Bristol*
Norman Lebovitz *University of Chicago*
Willem Malkus *M. I. T.*
Philip Morrison *University of Texas at Austin*
Michael Proctor *University of Cambridge*
Antonello Provenzale *ISAC-CNR, Torino*
Richard Salmon *Scripps Institution of Oceanography*
Edward Spiegel *Columbia University*
Melvin Stern *Florida State University*
Jean-Luc Thiffeault *Imperial College, London*
George Veronis *Yale University*
John Wettlaufer *Yale University*
Jack Whitehead *W. H. O. I.*
William Young *Scripps Institution of Oceanography*

Dambusting on the porch.

Contributions

The GFD program has established an endowment fund to help support the program in the future and for a specially funded position intended to help finance the extended visit of a key participant, such as the summer's Principal Lecturer. The fund is administered by WHOI, under the guidance of George Veronis. If you would like to contribute, please send your check (made payable to WHOI) to

Woods Hole Oceanographic Institution
GFD Fund, MS 40
Woods Hole, MA 02543

Donations can also be made by credit card by calling the Development office at 508-289-4895.

Scenes from the Sears lecture reception

Please send comments to njb@math.ubc.ca if you have any suggestions regarding this newsletter or the GFD Program.