

Inundation Science & Engineering Cooperative

An NSF Engineering Virtual Organization

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NSF's "Engineering Virtual Organizations"

- NSF providing seed funding to create 10 virtual organizations
 - Small amount over 2 years
 - Intended outcomes
 - Virtual organization with national participation
 - Prototype showing how cyberinfrastructure can enable collaborative research and education
 - Plan for full-blown cyberinfrastructure
 - Some will proceed to next step – acquiring funding for developing full cyberinfrastructure
- ARSC is part of one award
 - Inundation Science & Engineering Cooperative (ISEC)

Beyond Tsunamis

- Inundation accounts for \$billions in damage each year
 - Tsunamis
 - Hurricanes
 - Storm waves and surges
 - Dam failures
 - Levee breaches
- Mitigation and preparedness are limited by our incomplete understanding of
 - The phenomena
 - Impact on landforms
 - Impact on structures, lifelines, and other objects



Surge over-crests levee under Paris Road Bridge during Hurricane Katrina

Complex, Multiscale Models

- Inundation is complex
 - Multi-phase (water, air, solid) interactions
 - Occurs in 3-D real-world domain where some fundamentals (e.g., turbulence) remain unsolved
- Inundation is multiscale
 - Length scale of hurricanes, tsunamis, & floods is on the order of tens to hundreds of kilometers
 - Effects of levee breaches, scour holes, structural damage, etc., must be described at scales of a few meters or less



Animation of underwater mudslide generating a wave
[M. Aoki, E. Suleimani, U Alaska Fairbanks/ARSC]

Inundation Science & Engineering

➤ Goal

- Create the diverse – and distributed – community needed to develop comprehensive models of inundation

➤ Requires integration of research in

- Inundation effects on soil and landforms
- Inundation effects on structures and vegetation
- Generation of waves and rapid flows
- Complex wave behavior

➤ Interdisciplinary team

- Pancake and Williams
- Lynett (Texas A&M)
- Dalrymple (Johns Hopkins)
- Yeh (Oregon State)



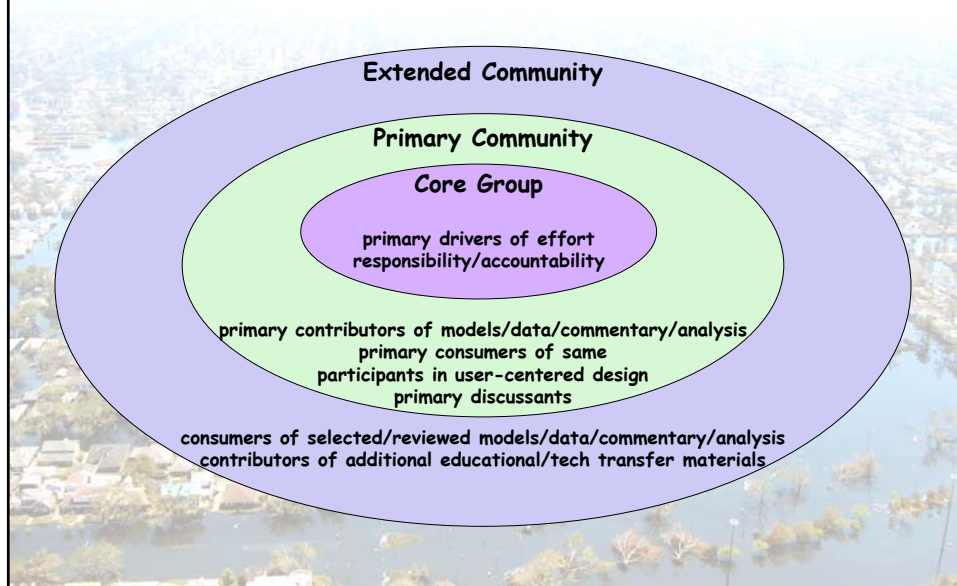
Failure of Teton Dam, 1976

What Cyberinfrastructure Can Do for ISEC

1. Create user-friendly virtual workspace for collaborative projects
2. Facilitate combining focused, single-scale models into multi-scale models
3. Motivate community-wide discussion, analysis, and directed improvement of the models
4. Expedite inclusion of new research findings into education
5. Broaden context within which researchers & students think about extreme events



How ISEC Is Organized



Changing the Way Research Is Done

- *Our concept:*
 - Evolve/expand results of individual research projects by coalescing them with outcomes from other groups
- *How we'll achieve it:*
 - Provide an environment that helps researchers
 - Identify mutual interests
 - Find appropriate collaborators
 - Deal with mechanics of collaborating with people from remote institutions
 - Get access to needed resources – data, models, tools, special expertise
 - Share and discuss results
 - Interface component models into larger, shared aggregates
 - Share and preserve research artifacts (data, models, tools, analyses, results)

Changing the Way Education is Done

➤ *Our concept:*

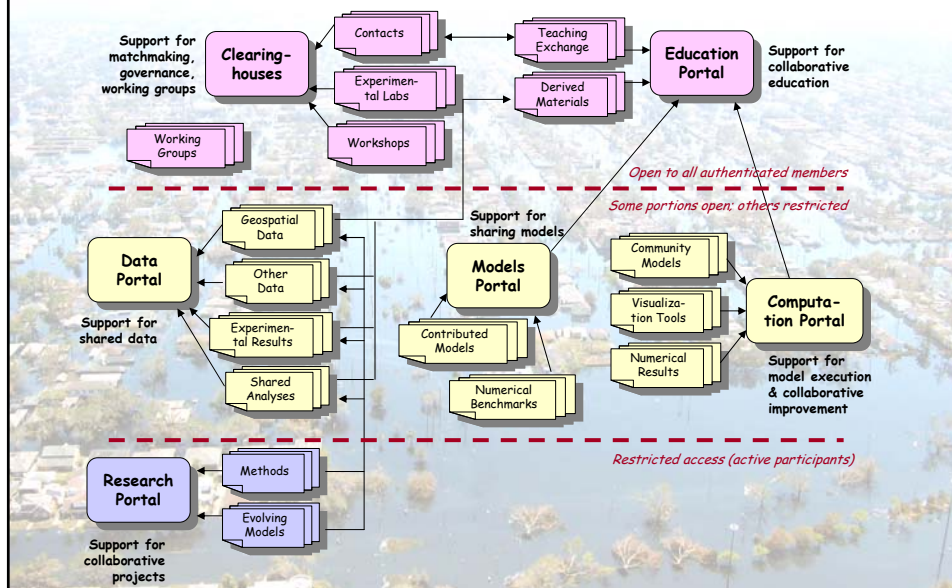
- Develop and share models/tools/data for use in the classroom

➤ *How we'll achieve it:*

- Provide an environment that helps educators
 - “Harvest” elements that can add realism to the classroom experience
 - Integrate and disseminate the components as learning modules
 - Deal with the mechanics of collaborating with people from remote institutions
 - Each working group will also identify components and themes for undergraduate & graduate education



Prototype – Interrelated Portals



Now Starting Month 5



The screenshot shows the ISEC (Inundation Science & Engineering Cooperative) website. On the left, there is a background image of a flooded urban area. Red circles and arrows point to specific sections of the website:

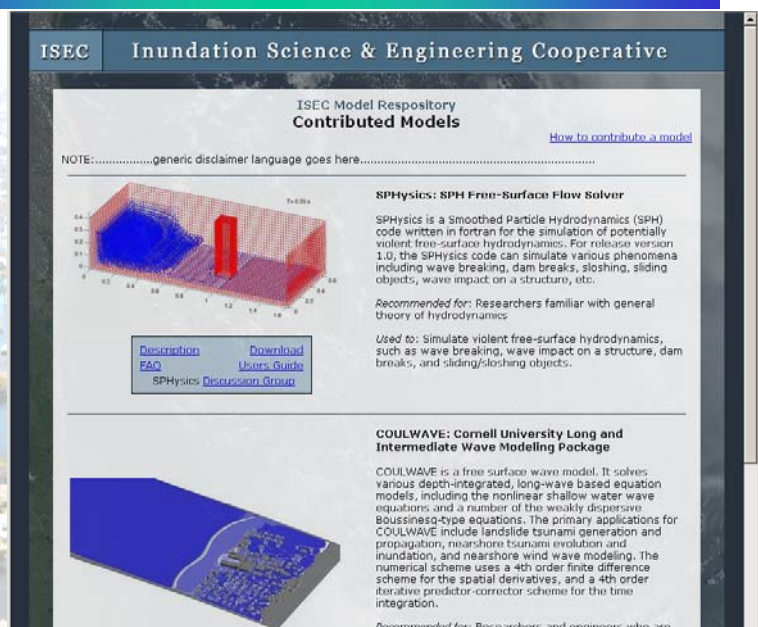
- Clearinghouses:** Points to the 'INFO CLEARINGHOUSE' section, which includes links for Workshop & Conferences, Experimental Facilities, Research Contacts, Teaching Contacts, and Discussion Forum.
- Models:** Points to the 'RESOURCES' section, which includes links for Education, Data, Models (highlighted with a red circle), Computation, and Working Groups.

The website header includes the ISEC logo and the title 'Inundation Science & Engineering Cooperative'. Below the header, there is a description of ISEC as a vital community. The footer mentions support from the National Science Foundation and logos for the Arctic Region Supercomputing Center and NACSE.

Models Portal: Homepage

All pages are generated automatically from metadata database

System uses open source components (Pylons framework, PostgreSQL, phpBB, mako, mapServer, etc.)



The screenshot shows the 'ISEC Model Repository Contributed Models' page. The page header includes the ISEC logo and the title 'Inundation Science & Engineering Cooperative'. Below the header, there is a section titled 'ISEC Model Repository Contributed Models' with a link to 'How to contribute a model'.

The page lists two models:

- SPHysics: SPH Free-Surface Flow Solver**
 - Description:** SPHysics is a Smoothed Particle Hydrodynamics (SPH) code written in Fortran for the simulation of potentially violent free-surface hydrodynamics. For release version 1.0, the SPHysics code can simulate various phenomena including wave breaking, dam breaks, sloshing, sliding objects, wave impact on a structure, etc.
 - Recommended for:** Researchers familiar with general theory of hydrodynamics.
 - Used to:** Simulate violent free-surface hydrodynamics, such as wave breaking, wave impact on a structure, dam breaks, and sliding/sloshing objects.
 - Links:** Description, Download, Users Guide, SPHysics Discussion Group.
- COULWAVE: Cornell University Long and Intermediate Wave Modeling Package**
 - Description:** COULWAVE is a free surface wave model. It solves various depth-integrated, long-wave based equation models, including the nonlinear shallow water wave equations and a number of the weakly dispersive Boussinesq-type equations. The primary applications for COULWAVE include landslide tsunami generation and propagation, nearshore tsunami evolution and inundation, and nearshore wind wave modeling. The numerical scheme uses a 4th order finite difference scheme for the spatial derivatives, and a 4th order iterative predictor-corrector scheme for the time integration.
 - Recommended for:** Researchers and engineers who are...

The page also features a 3D visualization of a wave impact on a structure.

Models Portal: Description

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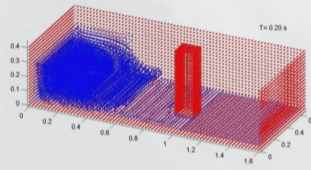
ISEC Model Respository

SPHysics: SPH Free-Surface Flow Solver

Type of Model: **Open-Source Smoothed Particle Hydrodynamics Code**

First Released: **August 01, 2007**

SPHysics is a Smoothed Particle Hydrodynamics (SPH) code written in fortran for the simulation of potentially violent free-surface hydrodynamics. For release version 1.0, the SPHysics code can simulate various phenomena including wave breaking, dam breaks, sloshing, sliding objects, wave impact on a structure, etc.



Description [Download](#)

[FAQ](#) [Users Guide](#)

SPHysics [Discussion Group](#)

SPHysics incorporates the following features:

- 2-D and 3-D versions
- Variable timestep
- Choice of two types of solid boundary condition:
 - dynamic and repulsive force
- Periodic open boundary conditions
- Choice of:
 - Artificial Viscosity
 - Laminar Viscosity
 - Sub-Particle Scale (SPS) Turbulence Model
- Different Types of Moving Objects (forced motion only)
 - Moving Gate
 - Wavemaker
 - Sliding Wedge

Models Portal: FAQs

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ISEC Model Respository

SPHysics FAQs

Description [Download](#)

[FAQs](#) [Users Guide](#)

SPHysics [Discussion Group](#)

1. [What is SPHysics](#) and what can it do?
2. [What platforms](#) does SPHysics run on?
3. What are it's main [features](#)?
4. What does SPHysics need as [input](#)?
5. What does SPHysics create as [output](#)?
6. How do I [try it out](#)?
7. Are there any [restrictions](#) on SPHysics use?
8. How do I [visualize the results](#)?
9. [Who wrote](#) SPHysics?
10. Has SPHysics been [validated](#)?
11. What if I find a [bug](#) in the code?
12. How can I [contribute](#) to the development of SPHysics?

What is SPHysics and what can it do?

SPHysics is a Smoothed Particle Hydrodynamics (SPH) code written in fortran for the simulation of potentially violent free-surface hydrodynamics. For release version 1.0, the SPHysics code can simulate various phenomena including wave breaking, dam breaks, sloshing, sliding objects, wave impact on a structure, etc.

What platforms does SPHysics run on?

The SPHysics source code can run on any operating system or platform where you have a Fortran compiler. During development every effort has been made to ensure that the SPHysics code is as portable as possible. The code has been tested on the following operating systems and compilers: Windows: Compaq Visual Fortran; Linux: GPL gfortran compiler, Intel fortran compiler; Mac: GPL gfortran;

Models Portal: Downloads

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Description
Download
FAQ
Users Guide
SPHysics
Discussion Group

Code [history](#)
Versions available:
[SPHysics_2D_v1.0](#) - August 2007
[SPHysics_3D_v1.0](#) - August 2007

SPHysics_2D_v1.0 (August 2007)
Disclaimers plus any special restrictions on usage would be described here... [Download now](#)
Relevant [Users Guide](#)
What changed since last version:
Corrected undefined tangents in updateNormals_2D.f;
Corrected bugs and updated plotting routines, e.g. SPHYICSgen2D/3D_Plot.m;
Corrected bugs in subroutines fill_part & wavemaker for iBC=2 in SPHYICSgen2D/3D.f;
Changed parameters in some CaseN.txt files to obtain improved results
What it includes:
README file describing contents and how to execute
SPHysics source code
Visualization codes for use on Matlab and ParaView
Four example cases
Copy of user guide
What you need to run it:
Fortran compiler;
For visualization, Matlab or ParaView

SPHysics_3D_v1.0 (August 2007) [Download now](#)

Clearinghouse for Experimental Labs

Home > Facilities
Experimental Facilities Clearinghouse

[How to contribute information](#)
Search:

Wind-Water Tunnels
▼ [DeFrees Hydraulics Laboratory](#), Cornell University
Name: **DeFrees Hydraulics Laboratory**
Location: **Cornell University**
[Website](#)
There are three facilities: 1) 32x0.6x1 m wave tank with a piston-type wavemaker, 2) 15x2x0.64 m recirculating type open-channel flume to study shallow coastal waters, and 3) 20x1x0.8 m tilting wind-water tunnel for air-water interface experiments. The facilities are mainly used for research within the institution. The DeFrees Hydraulics Laboratory houses three major facilities for generic studies of water waves, wave/current interaction, and wind waves. A 32x0.6x1 m wave tank with a piston-type wavemaker can create periodic and irregular waves for study of wave/structure interaction and waves over rippled beds. The Wide Meandering Wave-Current Flume is a recirculating channel that is 15x2x0.64 m. The Tilting Wind-Water Tunnel is also a recirculating basin, 20x1x0.8 m.
Contact: Todd Cowen, eac20@cornell.edu





Basins and Flumes
► [Coastal Engineering Laboratory](#), Johns Hopkins University
► [Coastal & Hydraulics Laboratory](#), USACE Engineer Research & Development

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