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)

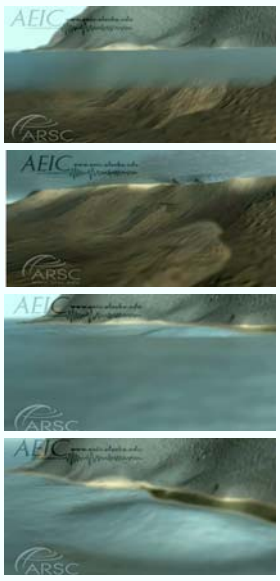
Beyond Tsunamis

- 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

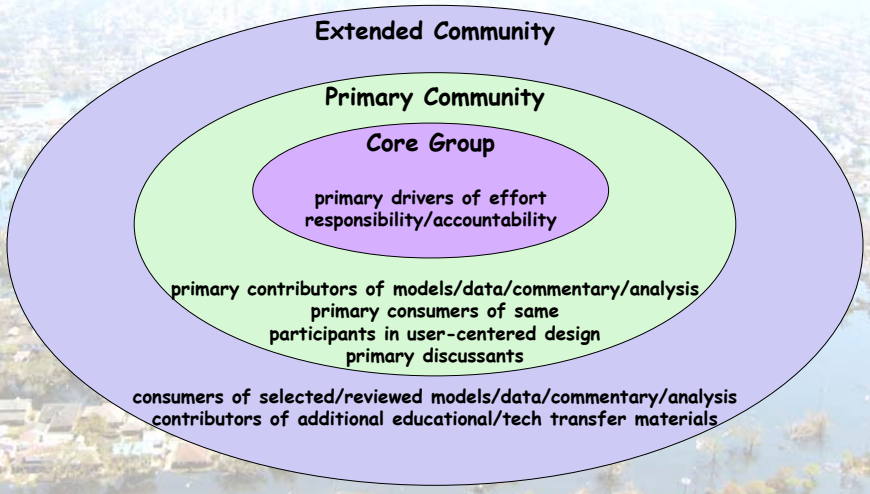
- Goal
  - Create the diverse – and distributed – community needed to develop comprehensive models of inundation
- Requires integration of research in
  - Inundation effects on soil and landforms
  - Inundation effects on structures and vegetation
  - Generation of waves and rapid flows
  - Complex wave 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

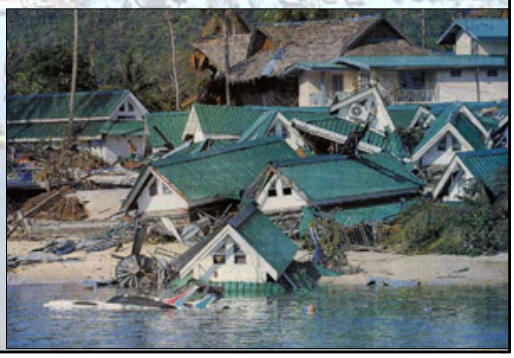


Changing the Way Research Is Done

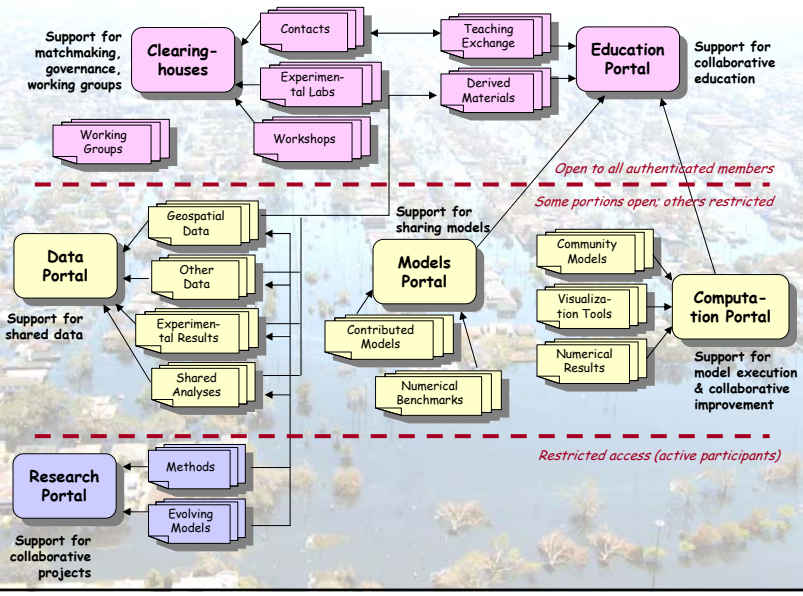
- *Our concept:*
  - Evolve/expand results of individual research projects by coalescing them with outcomes from other groups
- *How we'll achieve it:*
  - Provide an environment that helps researchers
    - Identify mutual interests
    - Find appropriate collaborators
    - Deal with mechanics of collaborating 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

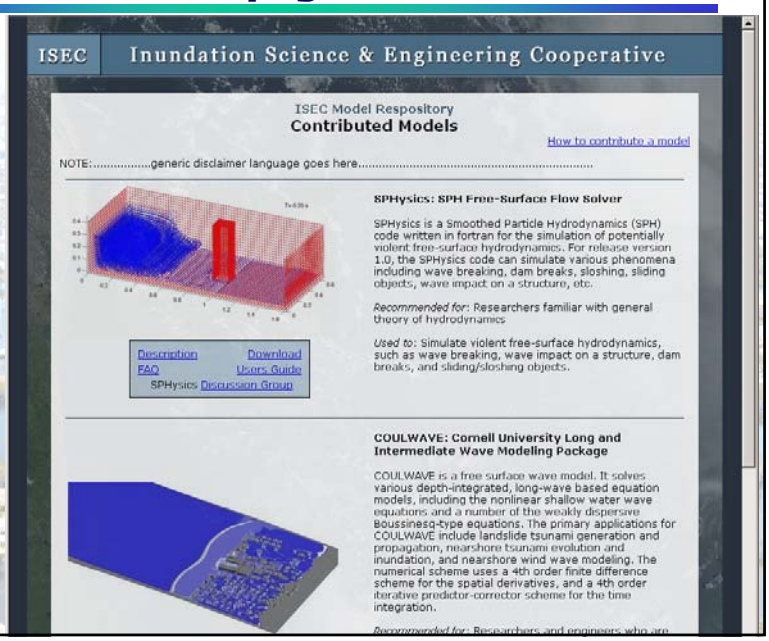
Clearinghouses

Models

Models Portal: Homepage

All pages are generated automatically from metadatabase

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



Models Portal: Description

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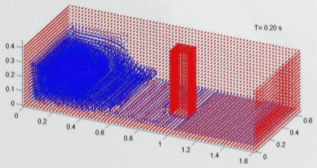
ISEC Model Respository

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?

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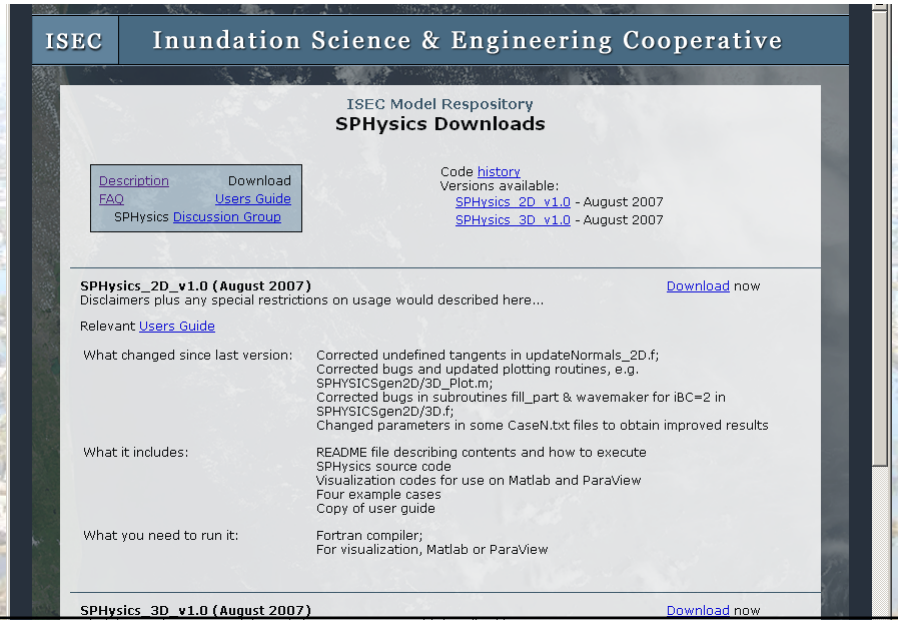
What platforms does SPHysics run on?

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



Clearinghouse for Experimental Labs