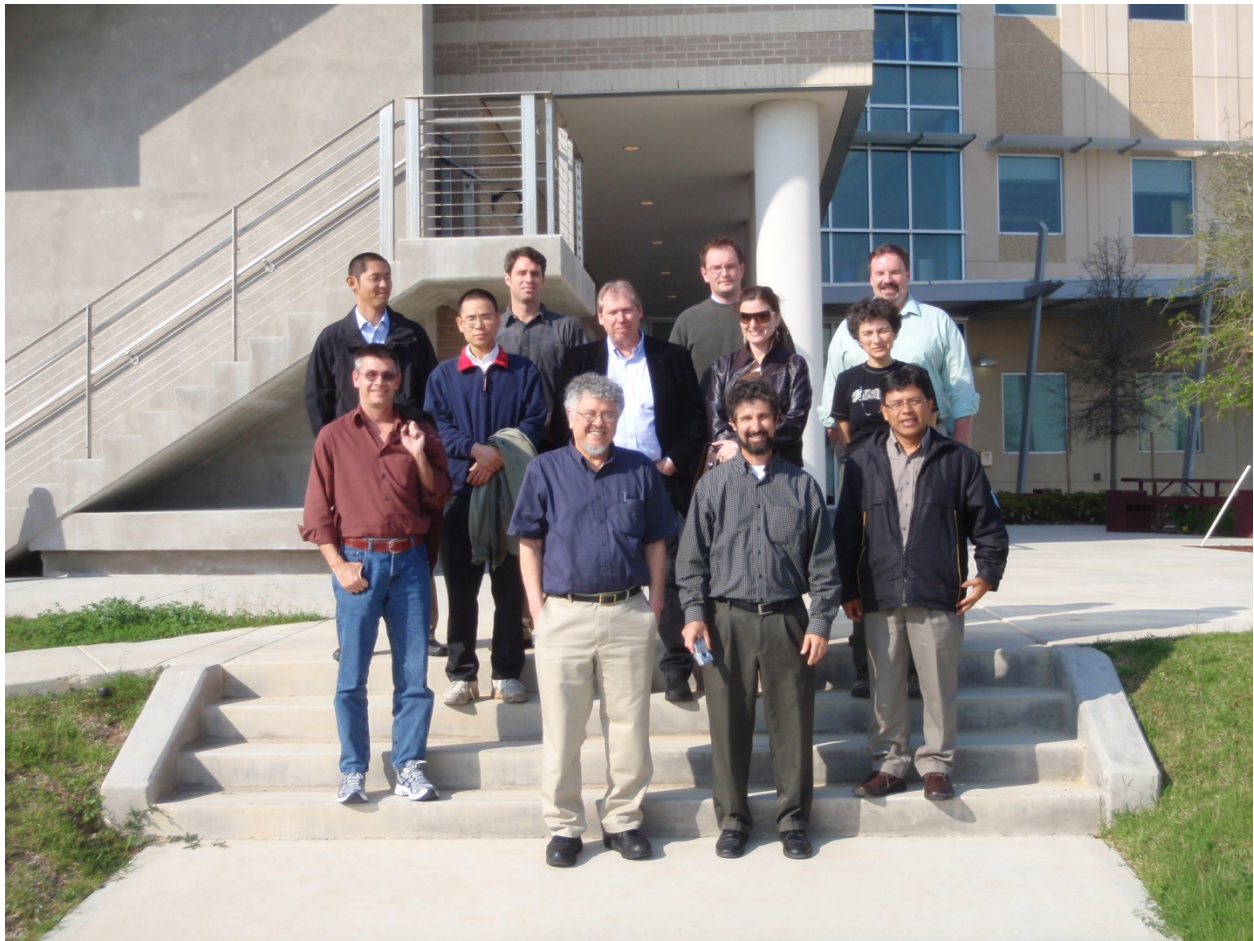


## Summary Report

### NTHMP MMS Tsunami Inundation Model Validation Workshop

3-28-2011 to 4-1-2011 Texas A&M Galveston campus



## MMS Tsunami Inundation Model Validation Workshop

**3-28-2011 to 4-1-2011 Texas A&M -Galveston campus**

This workshop, under guidance from the NTHMP Mapping and Modeling Subcommittee (MMS), was tasked with developing and implementing the strategy for validation of tsunami inundation models. The work done in this session starts the process of clearly defining the validation procedure all such models will need to follow to obtain NTHMP funding, as stated in the NTHMP Strategic Plan as the following Performance Measure: "All NTHMP-funded models will meet established standards by 2012." Specifically, a model will be deemed validated when it is able to successfully simulate a series of tsunami benchmark problems, covering all the relevant tsunami processes the model is targeting. The initial list of NTHMP benchmark problems was established based on the OAR-PMEL-135 report list. Besides reviewing current model validation efforts, one of the goals of this workshop is to revise and/or add to the list of benchmark problems.

### Attendees

Name	Affiliation (model for state)		Models Presented
			(models used but not presented in parentheses)
Juan Horrillo (host)	Texas A&M Galveston (Gulf Coast)	Conference Sponsor & host	Tsunami 3D+NeoWave
Victor Huerfano	PRSN (PR)		(MOST)
Yoshiki Yamazaki	UH (HI)		NEOWAVE
Stephan Grilli	URI (East Coast)		Funwave
Barry Eakins	NGDC		
Roger Hansen	UAF-GI (AK)		
Dmitry Nicolski	UAF-GI (AK)		Alaska Model
Elena Tokova	PMEL		MOST
Joseph Zhang	OHSU (OR)		SELFE
Jeff Harris	URI		
Fengyan Shi	UD (East Coast)		Funwave
Frank Gonzalez	UW		GeoClaw
Rick Wilson	CA Geol. Survey	MMS co-chair	

Aggeliki Barberopoulou	USC (CA)		(MOST)
Stephane Abadie	URI (East Coast)		Thetis
Bill Knight	NOAA-TWC	MMS co-chair	ATFM
Volker Roeber	UH (HI)		BOSZ

## Session Summary

The workshop was divided roughly into two parts. Days one and two were devoted to presentations by the modelers on their benchmark results, with each presentation followed by discussions. Part two (1/2 day) was focused entirely on crafting recommendations to the NTHMP Coordinating Committee, critiquing model results, and setting goals to put the validation process on firm ground. A second workshop addressing landslide-generated tsunami issues was held following the model benchmark workshop; some of the discussion and findings from this landslide workshop will result in long term recommendations for developing new landslide tsunami benchmarks for NTHMP funded modeling activities.

Significant work by the benchmark workshop coordination team (Stephan, Juan, Dmitry, and Bill) as well as other workshop participants helped make the pertinent data available for modelers to run the validation tests. Most of the workshop attendees presented their model results for the existing benchmark problems as defined in the report OAR-PMEL-135. In view of presented results, it became clear that some of these benchmark problems were not well defined and that others were missing supporting data, or at least some data was difficult to locate. The relevance of current benchmarks was also discussed, and that in turn led to a proposal for several long term recommendations to the NTHMP:

- The group recommended the continuing use of existing benchmarks for the immediate future, although in some cases with a reduced set of initial conditions.
- Two exceptions were the recommendations to immediately replace benchmarks 3 and 8 (sub-aerial landslide on a simple beach and 3D slide) with similar, but more carefully documented and/or comprehensive problems.
- As agreed to in earlier MMS meetings' discussions, models may be validated for either co-seismic or slide sources (or both). Slide source validation specifically requires passing the slide benchmarks (NOTE: In the landslide workshop, there were some discussions about using justifiable initial conditions for a landslide source with validated, generic wave propagation models as an alternative to completion of the slide benchmarks).
- Workshop discussions also focused on how to conduct the required peer review of models and benchmark results, how to craft "pass/fail" criteria for the benchmarks, and how to submit model results.

The final day included a model-by-model self-assessment, followed by the group consensus assessment on how to determine whether or not models that were presented passed the

attempted benchmarks and whether or not there is need to resubmit some of these results for consideration.

Workshop results include a set of short term goals, recommendations to the CC, and a timeline for completion. These are listed in more detail below; NTHMP MMS Co-Chairs will send out email reminders regarding these goals and the timeline.

### Short term Goals and Timeline

Goal one – completed: Set up a collection point for the workshop presentations. Modelers should send their workshop presentations, in their present form, to Juan Horrillo for an initial compilation. Juan has already set up an ftp site for this purpose, with the following instructions:

Removed for security purposes from a publicly-available document

- 1- Once you log in .... click on TAB <Shared Storage>
- 2- Click on Tsunami\_Validation\_Workshop.
- 3- then Click again on Tsunami\_Validation\_Workshop
- 4- then you will see directories with your names... then click on your name
- 5- upload your presentation and files.

Goal two - completed: Create a single collection point for all benchmark problems. The University of Washington created a site (put up by Randy LeVeque and Frank Gonzalez) which will be the short term repository for all benchmarks. Each benchmark problem has its own slot on the wiki. Here is the site for this information: <https://github.com/rjleveque/nthmp-benchmark-problems>

Goal three – by the end of 05/2011: “Clean up” and clearly present each benchmark on the wiki with the necessary supporting documentation. This should include instructions, references, datasets, diagrams, description of initial conditions, and Matlab scripts or other formatting instructions for the model outputs. A “champion” for each benchmark, drawn from the group of attendees, was identified. These champions will be responsible for putting their assigned improved benchmark problems out on the “Wiki” site. All conference attendees can contribute material to any of the benchmarks on the wiki, but the champions will have the final say on what stays for their part. The champions are:

**BP1** – Analytical – Single wave on simple beach –

**BP7** – Lab – Runup on Monai Valley Beach –

Dmitry Nicolski	Dmitry Nicolski
<b>BP2</b> – Analytical – Solitary wave in composite Beach – Dmitry Nicolski	<b>BP-8</b> - Lab – 3D landslide – Hermann Fritz
<b>BP3</b> – Lab – Saucer landslide - Stephan Grilli	<b>BP-9</b> - Field – Okushiri Island – Frank Gonzalez
<b>BP4</b> – Lab – Single wave on simple beach – Joseph Zhang	<b>BP-10</b> - Field – PNG landslide – Stephan Grilli
<b>BP5</b> – Lab – Solitary wave on composite Beach- Elena Tolkova	<b>BP-11</b> – Lab – landslide – Hongqiang Zhou
<b>BP6</b> – Lab – Solitary Wave on Conical Island – Frank Gonzalez	<b>BP -12</b> - Field – Rat Island - ?

Goal four – by the end of 05/11: Create a “results” website where modelers can place their results from later attempts at the benchmarks. Frank Gonzalez will arrange this - following completion of work by the “champions” on the wiki benchmarks. The UW wiki will serve as the results website. Both the results and the benchmarks will be moved at a later date to a long term repository. Juan will provide Matlab scripts as needed.

Goal five – by the end of 05/11: Individual modelers to send their first pass benchmark results and a brief model description to Juan, who will compile them into a single document. The model description should include grid / meshing scheme, numerical schemes, time step, convergence, adaptive / fixed mesh, CPU time / hardware.

Goal six – by the end of 05/11: Present recommendations and draft model validation procedure to the MMS and CC. Rick and Bill (or his successor) will do this.

Goal seven – by 06/13/11: Individual draft reports from modelers put into “template” format

Goal eight - by 07/01/11: Review committee will review model output on the “results” website and respond to individual authors. Volunteers for the review committee are: Stephan (lead), Juan, Dmitry, and Joseph (Co-chairs will also provide support with this review).

Goal nine – by 07/15/11: Individual authors to respond to input from review committee and finalize their reports.

Goal ten – by 07/15/11: Co-chairs to convene one or more telecons or e-mail exchanges with MMS members on finalizing consensus approval procedure and pass / fail criteria for the various models.

Goal eleven – by 07/25/11: Individual author papers readied for collection into draft proceedings along with summary paper.

Goal twelve – by early 08/11 (planned prior to MMS meeting): draft proceedings delivered to MMS members for their review. Decision to be made at the 08/11 MMS meeting on need for any additional validation sessions.

Goal thirteen – by early 2012 (prior to next NTHMP CC meeting): Following the 8/11 MMS session, final reviewed papers to be compiled into a special journal issue release or book for peer review.

Note to authors / reviewers: Aggeliki Barberopoulou has kindly offered to assist in reviewing documents. Basically, a second pair of eyes to help catch any errors.

### **Short term Recommendations**

- 1) Benchmarks shall include analytical, lab, and field benchmark problems.
- 2) Existing benchmarks in OAR-PMEL-125 will be retained with the exception of BP-3, to be replaced with a saucer source lab case (Grilli) and BP-8 (3D slide) which will be replaced with a more carefully documented challenge problem. Case “A” in BP-6 will be optional, case “B” in BP 4 will be optional, and cases “B” and “C” in BP-5 will be optional.
- 3) The UW wiki will be the temporary repository for benchmark problems and model results
- 4) Pass / Fail criteria will be developed by consensus of MMS members, in consultation with state modelers, during review of the model results on the “results” wiki.

### **Long term recommendations**

- 1) Establish a benchmark problem repository – perhaps under NTHMP, NGDC or PMEL. This will require a partially funded position. Materials accumulated on the UW wiki will be transferred to the repository.
- 2) Identify a SME or “curator” for each of the benchmarks in the repository
- 3) Periodic reviews of current benchmarks with consideration of new proposed benchmarks.
- 4) Proposed for future use are new field BPs for Samoa 2009, Chile 2010, Japan 2011. One sub-aerial slide lab BP, two submarine slide lab BPs, and a submarine slide field BP (PNG) were proposed. One seiche lab BP was proposed (Barberopoulou) and an analytical seiche problem was suggested after the conference ended (Knight). A folder on the UW repository has been set up to collect this information.
- 5) Develop and incorporate new, standardized digital elevation models for the field benchmark problems.

**Best Practices**

- 1) Identify grid alignment sensitivity or variations in results on exchange of x and y, or so that the solution can be tested for arbitrary grid orientation in the computational domain.
- 2) Validate against three benchmark categories: analytical, lab, and field

**Unresolved Questions (some questions for MMS input)**

- 1) What form will the final presentation take? Could be a NOAA report, proceedings, special journal issue, and/or a book.
  - a. How will peer review be achieved?
- 2) Why are better results obtained with “linear only” on some of the benchmarks?
- 3) Why do the models predict early ETAs?
- 4) Should tide / tsunami interactions be considered or incorporated into the benchmarks?
- 5) Should funding be provided to the repository (NTHMP, NGDC, PMEL) for the hosting the benchmark data?
- 6) Should funding be made available to modelers who develop new benchmarks recommended by the MMS to be included in future validation testing?
- 7) Clarification needed: If the initial conditions (positive/negative waves) of a landslide source can be sufficiently justified, can a generic wave propagation model be used (funded) to model a landslide-generated tsunami?



**Review of Models Presented at Conference**  
**Conducted on day 3 following all model presentations**

<b>Model</b>	<b>Intended Use</b>	<b>Self assessment</b>	<b>Group Consensus</b>
<b>ATFM</b>	Forecasting / tectonic sources only	Partial completion. Need to submit more BPs results	Approval
<b>MOST</b>	Forecasting, NTHMP - WA, CA, PR; Tectonic sources only	Inundation algorithm needs some improvements	Approval
<b>UAF</b>	NTHMP – AK tectonic and slide sources (2 models)	Awaiting slide benchmarking	Approval
<b>GeoClaw</b>	NTHMP – WA, FEMA map modernization. Tectonic and slide sources	Partial completion (few BPs completed to date)	Approval pending benchmark completion
<b>BOSZ</b>	For near field use. Tectonic sources only	Not currently used for NTHMP – possible use for near field tsunamis or coupled with other models	Approval

<b>NEOWAVE</b>	NTHMP – HI and PR. Tectonic sources only	Coupled with Tsunami 3-D for slide sources	Approval
<b>FunWave / Thetis</b>	NTHMP – East Coast. For tectonic and slide sources	Want to see additional slide BPs	Approval
<b>SELFE</b>	NTHMP – OR, PR and storm surge. Tectonic sources only	Carefully validated prior to MMS. Unstructured meshing. Need to revisit the composite beach BP	Approval
<b>Tsunami_3D</b>	NTHMP-Gulf of Mexico States. slide sources	Need to include more physics, reduce run time	Approval for slide sources