

## NTHMP Grant Semi-Annual Progress Report

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Period of performance (start date to end date of entire grant): September 1, 2015 – August 31, 2017

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Primary award recipient (name, address, telephone, email): James T. Kirby  
 Center for Applied Coastal Research  
 University of Delaware  
 Newark, DE 19716 USA  
 1-302-831-2438, kirby@udel.edu

Subaward recipient(s): (name, address, telephone, email): Stephan Grilli  
 Department of Ocean Engineering  
 University of Rhode Island  
 Narragansett, RI 02882 USA  
 1-401-874-6636, grilli@oce.uri.edu

Person submitting report: James T. Kirby

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Instructions: add rows to the table below as needed to complete reporting on all tasks awarded. Fill in all cells within the table. Make sure that task titles match the current Project Narrative for this grant.

Task #	Task title	Progress made during this reporting period	Challenges and successes	% of total task completed
1	Tsunamigenic Landslide Modeling Benchmark Development, Validation Workshop and Workshop Documentation	The workshop was held in Galveston in January. An overview of activities may be seen at <a href="http://www.udel.edu/kirby/landslide/">www.udel.edu/kirby/landslide/</a> The site will be maintained as a public repository for data and model results after the workshop completion.	Workshop was completed successfully, with over 30 attendees and with results for over 10 models submitted.	80%
2	Refinement and extension of potential SMF sources and source modeling techniques for tsunami activity in the North Atlantic	Work on West Bahama Banks potential landslides was published.  SMF Currituck slide proxies modeled as rigid slumps north of the Carolinas were revisited and modeled as deforming slides. The Hudson River	Four journal papers published on Bahama Bank, Deforming slides in Kitimat and upper east coast, and tide-tsunami interactions.  Methodology for	80%

		<p>Canyon SMF (Area 1; Grilli et al., 2015b) and the Currituck slide were first remodeled assuming they behave as a dense fluid layer (Fig. 1). The model used was validated with lab. Experiments. As expected, tsunami generation is reduced</p> <p>Model parameters/rheology for the deforming slides were selected based on simulating laboratory experiments and field case studies.</p> <p>A comparison solid vs deforming slide with respect to coastal hazard off of NJ, NY/Long Island was performed. Both maximum elevation and minimum drawdown are reduced when assuming a deforming slide rather than a rigid slump. For detail see, Grilli et al. (2015b, 2017).</p> <p>Following the same methodology, deforming SMFs of various rheologies were simulated in Areas 2,3 and 4, further south using NHWAVE and results compared to rigid slump simulations. Simulations with FUNWAVE in higher resolution nested grids are being performed to serve as a basis for updating inundation maps in the future.</p> <p>Additional SMFs will be simulated in the southern New England arc, East of Long Island), and in the Cape Fear area, once we receive information and parameters from USGS.</p>	<p>computing deformable landslides has been developed and used to refine East Coast source descriptions as well as tsunami coastal impact. Two types of deforming slide models (dense fluid and granular flow) were validated against lab experiments and applied to case studies.</p> <p>NGDC tsunami DEM's are now available for the southern portion of Florida, and delayed inundation mapping will be completed during the remainder of this project.</p> <p>Work on deformable slide modeling is strongly synergistic with Grilli and Kirby NSF supported work, covering ongoing model development and improvement, with technology immediately transferred to NTHMP project. This is also synergistic with the organization of the landslide model benchmarking workshop.</p>	
3	Tsunami Hazard Assessment for Un-modeled East Coast Sites	<p>Storm surge maps for US East Coast stated being collected from constituents.</p> <p>Analysis of correspondence between storm surge inundation lines and tsunami inundation lines for mapped areas underway.</p> <p>Work on effect of shelf geometry in controlling location</p>	<p>Contacts are being made with individual state agencies to gather information on category 1-5 storm surge inundation maps and evacuation procedures to assist in interpreting tsunami height estimates based</p>	60%

		of high tsunami hazard is being completed.	on the ray tracing estimates.	
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During this reporting period, was any budget reprogramming required for this award? If so...

- a. Date reprogramming approved by NWS Tsunami Program Office:
- b. Date approved by NOAA Grants Office:
- c. Describe where funds were moved and why:

General comments from recipient about progress during this reporting period:

**PROBLEMS ENCOUNTERED:** DEM's for southern Florida were recently obtained. Inundation mapping for the Florida east coast is underway. Work is slowed somewhat by a change-over in student assigned to the project, with Babak Tehranirad graduating in December 2016.

**ANTICIPATED OUTCOMES:** Results for the additional mapping efforts described here will be presented in the form of technical reports for each NGDC DEM or similarly sized coastal region, and in the form of draft inundation maps for coastal communities within the DEM regions. Project results are displayed at the project website <http://www.udel.edu/kirby/nthmp.html> and will be displayed at the NTHMP website <http://ws.weather.gov/nthmp/index.html> as they are finalized. Draft maps and reports are presently available at an unlinked site [http://www.udel.edu/kirby/nthmp\\_protect.html](http://www.udel.edu/kirby/nthmp_protect.html) prior to their review by local state agencies.

Refinement of modeling techniques for simulating landslide (SMF) tsunami generation has led to published papers, and more will be prepared, and enhancements to the public domain model NHWAVE. These have played a central role in the organization and preparation of the landslide tsunami benchmark workshop in January 2017.

## **PUBLICATIONS AND PRESENTATIONS REFERENCING FY14-15 WORK**

Grilli, S.T., Grilli, A.R., Tehranirad, B. and J.T. Kirby 2015a, "Modeling tsunami sources and their propagation in the Atlantic Ocean for coastal tsunami hazard assessment and inundation mapping along the US East Coast". In *Proc. 2015 COPRI Solutions to Coastal Disasters Conf.* (Boston, USA. September 9-11, 2015), ASCE, 12 pps., [http://personal.egr.uri.edu/grilli/COPRI15\\_sgrilli.pdf](http://personal.egr.uri.edu/grilli/COPRI15_sgrilli.pdf).

Grilli S.T., O'Reilly C., Harris J.C., Tajalli-Bakhsh T., Tehranirad B., Banihashemi S., Kirby J.T., Baxter C.D.P., Eggeling T., Ma G. and F. Shi, 2015b, "Modeling of SMF tsunami hazard along the upper US East Coast: Detailed impact around Ocean City, MD". *Natural Hazards*, **76**(2), 705-746, doi: 10.1007/s11069-014-1522-8.

Grilli, S.T., Shelby, M., Kimmoun, O., Dupont, G., Nicolsky, D., Ma, G., Kirby, J. T. and Shi, F., 2017, Modeling coastal tsunami hazard from submarine mass failures: effect of slide rheology, experimental

validation, and case studies off the US East coast. *Natural Hazards*, **86**, 353-391, doi: 10.1007/s11069-016-2692-3

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- Shelby, M., Grilli, S. T. and Grilli, A. R., 2015, "Dynamic tide-tsunami interaction in the Hudson River estuary", [Research Report No. CACR-15-10](#), Center for Applied Coastal Research, Dept. of Civil and Environmental Engineering, University of Delaware.
- Shelby, M., Grilli, S. T. and Grilli, A. R., 2016a, "Tsunami hazard assessment in the Hudson River Estuary based on dynamic tsunami-tide simulations." *Pure and Applied Geophysics*, 39 pps., doi:10.1007/s00024-016-1315-y (published online 5/24/16)
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- Tehranirad, B., Kirby, J. T., Callahan, J. A. and Shi, F., 2015g, "Tsunami Inundation Mapping for Cape Hatteras, NC NGDC DEM", [Research Report No. CACR-15-12](#), Center for Applied Coastal Research, Department of Civil and Environmental Engineering, University of Delaware. (DRAFT)
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