**NTHMP Grant Semi-Annual Progress Report**

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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.

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| Task # | Task title | Progress made during this reporting period | Challenges and successes | % of total task completed |
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| 1 | Task 1: Development of maritime hazard assessment for U. S. East Coast: | | The major challenge is that the "safe depth" developed based on travel times and usual bathymetric conditions on the west coast will not be viable for the east coast, given wide shelf conditions. We are examining alternative recommendations based on east coast modeling results, which are all archived for the areas that have been mapped. | 5% |
| 2 | Task 2: Presentation of MMS mapping results to East Coast state agencies and coordination with state EMA | Discussions with Ed Fratto and Rocky Lopes are continuing to identify additional appropriate local | A first presentation was given by J. Kirby and S. Grilli to the Massachu-setts Emergency | 66% (100% as of end of |

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| | managers on development of evacuation and warning efforts. | representatives to aid in choosing locales for presentations. | Management Agency, on July 12, 2017, at their HQ in Framingham, MA.<br>Ed Fratto was present. Feedback from MEMA was excellent. A second presentation will be given on March 28, in Norfolk, VA, with the third to follow in mid April in North Carolina. | April) |
| 3 | Task 3: Reanalysis of selected mapping products based on improved treatment of modeled physics for source description and tsunami propagation:<br><br>Subtask 1: Landslide events using a range of recently developed models for landslide/tsunami employing deformable slides with a range of modeled rheologies.<br><br>Subtask 2: Reanalysis of frictional dissipation effects and impact on shoreline tsunami amplitudes in areas with wide continental shelves. | SMF Currituck slide proxy in Hudson River Canyon was modeled as deforming slides of various rheology and tsunami inundation at the coast was computed and compared to earlier rigid slump simulations.<br>Model parameters and rheology were selected based on simulating laboratory experiments and field case studies.<br><br>Following the same methodology, SMF Currituck slide proxies were modeled in areas 1-4 as deforming slides, in higher resolution grids, and the coastal inundation was compared to that caused by the same SMFs modeled as rigid slumps (which was the basis of current NTHMP maps). The conclusion is the slumps cause worst-case scenarios tsunamis in all cases, but are probably too conservative in view of geological field evidence. Modeling SMFs as slides with a moderate deformation rate (at the upper range of debris flow viscosity) is recommended for future work.<br><br>As part of this work, the sensitivity of coastal inundation to bottom friction for wide shelves was reassessed. First of all, | One journal paper was published on deforming slide simulations and validation with laboratory experiment.<br>Presentations/posters were made at AGU and results discussed with the community.<br>Methodology for computing deformable landslides was 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.<br>Work performed on deformable slide modeling, both laboratory validation and field work, was an integral part of the NTHMP tsunami model validation workshop organized by the PIs in Galveston (Jan., 2017).<br>This work is synergistic with Grilli and Kirby's NSF supported work, covering ongoing slide model development and improvement, with technology immediately transferred to NTHMP project.<br>The newer work on deformable SMFs and | 3.1: 100%<br>3.2: 100% |

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| | | unlike earlier work that used a constant bottom friction coefficient, the latter is now computed in the propagation model using Manning's formula (i.e., Cd is an increasing function of depth). Simulations were performed using two values of the Manning *n* coefficient, one 50% larger than the other. In the latter case, coastal inundation was decreased by up to 15%, showing the importance of properly selecting bottom friction as a function of geological data and land use. | effects of bottom friction on inundation caused by those is detailed in a report of the UD Center for Applied Coastal Research. A corresponding journal paper is under review for Pure and Applied Geophysics.. | |
| | Task 4: Simulation and evaluation of meteo-tsunami hazard and estimation of return periods of tsunami events from various sources.<br><br>Subtask 1: Simulation of propagation and coastal impact of meteo-tsunamis generated on the wide EC shelf, for events of 100-200 year return period.<br><br>Subtask 2: Estimate of return periods of extreme tsunamis from various sources used in inundation mapping with emphasis on landslide tsunamis | A methodology for modeling meteo-tsunamis generated by a moving surface pressure has been developed and has been validated through numerical modeling of the June 13, 2013 event off the coast of New Jersey. This event is being documented in a technical report that describes model extensions, model configuration, and testing of sensitivity of results to variations in input conditions.<br>The Monte Carlo (MC) methodology that was developed by Grilli et al. prior to this NTHMP EC work and applied in 2004-2006 to the EC and later to the Gulf (2015-2016) is being revisited in light of new field data and using a more accurate propagation and coastal impact model, in order to develop better estimates of return periods of landslide tsunamis.<br>A model developed by Belotti et al. (who participated in the landslide workshop) for the fast simulation of SMF tsunami | We have established a collaboration with Greg Dusek and colleagues at the NWS, who have analyzed the past 20 years of tide gauge data for the US East Coast and Caribbean islands, and have established a climatology of meteo-tsunami events based on this record, with extensions to longer time periods based on extreme value estimation.<br>Properly estimating the return period of landslide tsunami events on the EC, besides assessing the relevance of the proposed MC methodology, requires extensive field data and dating of past events, which is being done by USGS. Results from the latest field surveys, however, particularly in the "New England Slide Complex" are not yet available.<br><br>Work on simulating the June 13, 2013 event has been presented at the 2018 | 4.1: 85%<br>4.2: 35% |

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| | | generation (based on the linear Mild Slope Equation; MSE) has been evaluated in collaboration with Dr. Belotti, by simulating some of the benchmarks of the NTHMP landslide model workshop. This MSE model will be used as a component of the MC simulations in order to provide a more accurate computation of SMF propagation and coastal runup. | Ocean Sciences Meeting. | |

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**PROBLEMS ENCOUNTERED:** The organization of the NTHMP tsunami model validation workshop by the PIs in Galveston (Jan., 2017), which is a FY15 task that was delayed, has taken a lot of time and efforts from the PIs in the first half of this fiscal year; the completion of the workshop report has similarly taken a lot of the PI time during the second half of the fiscal year. This has delayed the start of some of the FY16 tasks, particularly the maritime hazard assessment. Work on this task will start at the beginning of 2018, after the landslide workshop documentation is complete. Additionally, we have had turnover in our graduate students, with two graduating and two new students starting on the project, who have had to be brought up to speed.

**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 completed and finalized. Draft maps and reports are presently available at an unlinked site http://www.udel.edu/kirby/nthmp_protect.html prior to their review by local state agencies.

Input will be provided for the Maritime Guidance document for east coast settings. Maritime hazard results will be documented for each mapped region, possibly as additions to draft inundation reports on a region by region basis.

Refinement of modeling techniques for simulating landslide (SMF) tsunami generation has led to published papers 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 that was held in January 2017 in Galveston, TX. Results of the new simulations of deforming slides off of the upper East Coast have been performed down to120 m resolution grids and archived for future use, should a second generation of NTHMP inundation maps be developed in the future, using a different set of tsunami sources.