

**REPORT DOCUMENTATION PAGE**Form Approved  
OMB No. 0704-0188

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<b>1. REPORT DATE (DD-MM-YYYY)</b> 07/13/2012		<b>2. REPORT TYPE</b> Final		<b>3. DATES COVERED (From - To)</b> 12/01/2009 - 03/31/2012	
<b>4. TITLE AND SUBTITLE</b> Africa Partnership Station: Coastal Processes Large-Scale Coastal Evolution				<b>5a. CONTRACT NUMBER</b>	
				<b>5b. GRANT NUMBER</b> G N00014-10-1-0211	
				<b>5c. PROGRAM ELEMENT NUMBER</b>	
<b>6. AUTHOR(S)</b> Andrew D. Ashton				<b>5d. PROJECT NUMBER</b>	
				<b>5e. TASK NUMBER</b>	
				<b>5f. WORK UNIT NUMBER</b>	
<b>7. PERFORMING ORGANIZATION NAME(S) AND ADDRESS(ES)</b> Woods Hole Oceanographic Institution 360 Woods Hole Rd Woods Hole, MA 02543				<b>8. PERFORMING ORGANIZATION REPORT NUMBER</b>	
<b>9. SPONSORING / MONITORING AGENCY NAME(S) AND ADDRESS(ES)</b> Office of Naval Research 875 North Randolph Street Arlington, VA 22203-1995				<b>10. SPONSOR/MONITOR'S ACRONYM(S)</b> ONR	
				<b>11. SPONSOR/MONITOR'S REPORT NUMBER(S)</b>	
<b>12. DISTRIBUTION / AVAILABILITY STATEMENT</b> Approved for public release; distribution is unlimited.					
<b>13. SUPPLEMENTARY NOTES</b>					
<b>14. ABSTRACT</b>					
<b>15. SUBJECT TERMS</b>					
<b>16. SECURITY CLASSIFICATION OF:</b> Unclassified			<b>17. LIMITATION OF ABSTRACT</b>  UL	<b>18. NUMBER OF PAGES</b>	<b>19a. NAME OF RESPONSIBLE PERSON</b> Claire Reid
<b>a. REPORT</b>	<b>b. ABSTRACT</b>	<b>c. THIS PAGE</b>			<b>19b. TELEPHONE NUMBER (include area code)</b> 508 289-2462

## **Africa Partnership Station: Coastal Processes- Large-Scale Coastal Evolution**

### **Final Report**

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Award Number: N00014-10-0211  
7/19/2012

### **LONG-TERM GOALS**

The overarching goal of this research is to assist with the development of research capabilities of Gulf of Guinea nations and to increase the ability of these nations to predict and mitigate coastal hazards. This is being accomplished through sponsoring and developing the coastal processes research capabilities of these nations and their university systems. This projects focuses on interactions with the research group within the Department of Oceanography and Fisheries of the University of Ghana (UG) in Accra, with a goal of not only increasing the capabilities of Ghana to monitor and manage their coast, but to develop UG as a center of research excellence for the Gulf of Guinea region.

### **OBJECTIVES**

The objectives of these research activities are to provide guidance to the developing coastal processes research program at the Department of Oceanography and Fisheries, University of Ghana, Accra, Ghana. Development of this program is anticipated to aid long-term maritime governance capabilities and social stability within Ghana. Over the short term, this project provided technical assistance to researchers at UG to develop their capabilities to assess local coastal processes and hazards and to monitor coastal change. Development of technological capabilities (coastal processes expertise, terrestrial surveying, bathymetric surveying, wave computation, coastal change modeling, GIS skills) is intended to lead to a self-sustaining research group at the University of Ghana that can then independently pursue other research questions and seek other party funding, both locally and internationally. Technical assistance provided focused on coastal processes, with particular emphasis on shoreline change mapping, geomorphic characterization, field data collection, and development of large-scale numerical models of coastal evolution. An objective for future activities is the development of independently funded international-quality collaborative research between the PI and the coastal research team that has developed at UG.

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## **APPROACH**

This project consisted of technical advising and the development of collaborations between the PIs and UG scientists. The primary means of interaction was been periodic interaction via email and telephone conversations, visits by UG researchers to Woods Hole, and trips by the PI's to UG to engage directly with the researchers, students, and staff at UG. The initial visit, occurring in February 2009, was a week-long workshop at the University of Ghana in which included scientific presentations, field visits that included collection of preliminary topographic survey data, hands-on computer analysis exercises, and small-group discussions. Follow-up visits by the PIs to Ghana in June of 2010 and November of 2011 included more intense field efforts and detailed discussions regarding development the coastal hazards assessment program. Additional interactions between UG included a visit to WHOI by UG faculty member Selorm Ababio during July of 2009 and April 2010.

## **WORK COMPLETED**

Work consisted of participation in two workshops/field visits to Ghana and continued technical assistance and coordination with colleagues at UG. The two visits under this grant were a continuation of the first PI visit during a Coastal Processes Workshop held from February 23-27, 2009 at UG along with Cheryl Hapke of the U.S. Geological Survey (USGS), in conjunction with hosts George Wiafe and Selorm Ababio of UG.

Fieldwork, updates on historical data acquisition and processing, and scientific discussions were undertaken from June 20-July 1, 2010. Participants included ONR-funded researchers Andrew Ashton of the Woods Hole Oceanographic Institution (WHOI) and Cheryl Hapke of the U.S. Geological Survey (USGS) and researchers in the Department of Oceanography and Fisheries, University of Ghana (UG), Accra, Ghana, including George Wiafe, Selorm Ababio, Kwasi Appeaning Addo, and Kwame Adu Agyekum.

Fieldwork in June 2010 included numerous site visits along the 550-km-long Ghanaian coast with the objectives of:

- Conducting regional geomorphic characterization
- Assessing present state of erosion hazard/ hazard potential
- Collecting beach sediment samples for assessment of grain size
- Engaging in field discussions of coastal processes and the impacts of shoreline-erosion mitigation measures
- Collecting Ground-Penetrating Radar (GPR) data in beach ridge and delta locations

Interaction continued at UG the following week, including updates by UG faculty and students on regional shoreline change and theoretical aspects of coastal evolution that are likely applicable to understanding chronic erosion hazards along portions of the Volta Delta.

The second workshop was held from November 7-12, 2011, and included all ONR-sponsored PI's, Ashton (WHOI), Hapke, (USGS), Tom Lippmann (University of New Hampshire), and Dano Roelvink (UNESCO-IHE), along with Tom Drake of ONR. This workshop summarized participants' efforts and findings, and included the formation of a Ghanaian National Working Group on Coastal Processes Research that included government agencies and other researchers. Visits to the Volta Delta region revealed the extensive engineering projects being undertaken to combat erosion along the dynamic coast near the mouth of the Volta River. Fieldwork during this visit included the collection of sediment

samples on the Volta Delta that will be dated using Optically Stimulated Luminescence (OSL) to develop a preliminary age model of the formation and evolution of the delta.

## **RESULTS**

The workshops, discussions, and other interactions resulted in significant improvement of an understanding of the regional coastal geology and geomorphology of the Ghana coast and the development of state-of-the art research capabilities at UG. Data collected include GPR transects from sites along the Volta Delta and on the western beach ridge plains. Sediments collected for OSL dating have been submitted for analysis, these data represent the likely first geological dates of the formation and evolution of the modern delta complex. Preliminary analysis of wave climate trends (and consequent predicted trends in alongshore transport and shoreline stability) suggest knowable causes of some of the prominent erosion 'hotspots' along the Volta Delta coast. The project accomplishments and goals were also presented as an invited talk in the Nearshore Processes session at the American Geophysical Union meeting in San Francisco, CA, December 2010 (Hapke et al., 2010). The PI also hosted two extended visits to WHOI by Selorm Ababio of UG in the summer of 2009 and spring of 2010. Future collaboration plans involve comparing modeled predictions of shoreline change patterns with shoreline change measurements along the Volta Delta.

## **IMPACT/APPLICATIONS**

This project addressed the overarching goal of improving maritime security in the Gulf of Guinea, and specifically in Ghana. A short-term impact is the assessment of coastal hazards along the Ghana coast and development of a research plan to increase coastal safety through hazard identification and mitigation. Ongoing plans include sustained contact and continued development of scientific relationships between the PI's and African coastal researchers, hopefully through the development of grant proposals to other agencies, with a particular emphasis on the past and future evolution of the Volta Delta region. Over the long term, the objective is to continue to understand coastal change hazards along the Ghana coast and to develop the independent research capabilities of the University of Ghana to improve the national capabilities in coastal hazards management and eventually maritime and fisheries management.