Annual Report
Grant NA13OAR4310116

Project Activities through May 31, 2015

Our project continues to examine how local emergency managers (EMs) can use seasonal (*i.e.*, spanning multiple months) climate forecasts in planning, preparation, and mitigation of weather-related natural hazards. Our work focuses on the unique characteristics of seasonal forecast information itself—their use and actions taken in response to them differs substantially from the more-common 24-hour to 72-hour forecast context—as well as challenges that uncertainty presents to EMs' decisionmaking more generally. We are particularly interested in expanding EMs' use of seasonal climate forecasts to prepare for floods by improving understanding of seasonal climate forecasts among EMs and EM higher education instructors, as well as by improving the presentation of information to EMs and others responsible for flood management.

The project consists of three elements that we also work on through our parallel NSF-supported project (case studies of seasonal climate forecast use, decision experiments with local emergency management stakeholders, and a national-level survey of emergency managers) and development of a best practices guide. The NSF project supported some data collection and theoretical development, whereas the NOAA project supports connections between scientists and materials produced in NOAA and other national level organizations and the users in states and localities.

We discuss each of these elements in turn:

Case Study Progress: We completed research for our case studies in the previous project year and our case study paper reporting on this work—"Using Climate Forecasts Across a State's Emergency Management Network"—is currently under review at the *Natural Hazards Review* journal (manuscript NHENG-457). This paper examines the factors that influence the willingness of county EMs to use seasonal climate information to improve flood and drought planning and management, and the types of actors most centrally involved in forecast use. We have also presented versions of this paper at conferences.

Decision Experiments Progress: We constructed in the previous project year an approach to assess how emergency managers deal with probability and uncertainty and tested this in two forums, the first the annual statewide meeting of the Oregon Emergency Management Association in Eugene, Oregon in October 2013, and the second in the current reporting period at the June 2014 Emergency Management Institute Higher Education Conference in Emmitsburg, Maryland.

As noted in our July 2014 progress report, our participation rate in the Oregon meeting was too low to draw generalizable conclusions, but the limited evidence suggests that EMs are more concerned about not doing the "right" thing (ignoring a forecast of a destructive event and then having the event occur) that doing the "wrong" thing (taking

action in response to a forecast of a destructive event and then not having the event occur). This help across different styles of forecast presentation (tabular vs. map) and forecast complexity (simple vs. cumulative frequency). We call these, respectively, acts of "omission" and acts of "commission."

Our decision experiments with another small group of local emergency participants (n = 14) at the 2014 Higher Education Conference in Maryland yielded similar results. In that exercise, we posed flood forecast scenarios to participants and asked them to indicate on a scale that ranged from -5 to +5, the relative acceptability to them of the same kind of omission and commission acts. The value "-5" represents an act of commission would be significantly easier to accept than an act of omission, and "+5" represents an act of omission would be significantly easier to accept than an act of commission. Each participant saw three forecast scenarios that differed only in the way uncertainty was presented. One scenario provided historical flows as a single number (average peak flow), the forecasted peak flow as a single number, and the expected damages as a single number. Another scenario continued to express damages as a single number, but represented both historical and forecasted flows as a range. Still another scenario presented historical and forecasted flows as ranges, and damage as a range.

Participants again expressed lower concern with acts of commission than acts of omission, consistent with the greater willingness to continue to take actions after an act of omission from the earlier decision experiment. However, in the Maryland case, the relative acceptability varied across the three treatments of uncertainty, with the relative acceptability of acts of commission compared to acts of omission decreasing as more of the uncertainty was included through the inclusion of ranges.

Survey Progress. Since our July 2014 progress report, we completed the questionnaire design for our national-level survey of stakeholders engaged in flood and drought planning and emergency management, pre-tested the instrument, finalized our sampling frame, and implemented the survey to a sample of EMs. This has yielded 231 responses. In addition, we administered a modified version of the survey to members of the general public (n = 205), to allow comparisons between expert and lay-person responses.

Our questionnaire contains of 44 questions (abridged for the layperson version), which EM respondents took roughly 22 minutes (median) to answer (median for lay-person equals 9 minutes). Most answers required the respondent to select from a list of options or to provide a rating on a 7-point scale. The first eight questions elicit background information, including the respondent's age, professional experience, education level, organization type, organizational rank, the share of work time devoted to emergency management work, and the most recent serious flood in the respondent's county. Following this background section, we present eight emergency management scenarios that elicit information about the decision process in light of risk. The online survey platform Qualtrics allows us to use a randomized survey flow so that one of four versions of each scenario is presented. Our final set of nineteen questions focuses on general preferences and concerns. For our lay-person survey, we purchased contact information for a sample of general population adults from EMI Research Solutions. This version

eliminated questions directly referring to experience in the Emergency Management profession, one of the eight scenarios, and several of the general preference questions.

Our recruitment protocol entailed sending individual recruitment emails to participate in the online survey. The recruitment message contained a short description of the project and a unique code to enter when accessing the survey. The survey was hosted on the Virginia Tech website. Our recruitment messages were sent out in multiple waves between in April 2015. Each wave was followed by a reminder message to non-respondents 7-10 days after the initial recruitment message.

Our relatively low response rate among the EM sampling frame (17.1%) likely reflects competing demands on time that make completing a voluntary survey a low priority during working hours. This could influence the survey results, in that those most likely to respond to the survey are those most interested in emergency management decision-making. The relatively complex decision scenarios may have discouraged those least interested or least experienced in the survey topic (roughly 10% of the sample frame started but did not finish the survey).

We are currently analyzing survey results.

Structured Forecast Presentations Progress: We tentatively scheduled structured presentations of forecast information in the Oregon and Washington winter forecast meetings, but have had to pull back on these due to an illness with our project subcontractor, which precluded participation in the meetings. We tried to reschedule these presentations for the 2014-2015 season but were not able to get on any of the state's winter forecast meeting schedules.

Web Forum and Best Practices Guide Progress: Our Best Practices Guide (BPG) provides information to emergency managers in the U.S. on the availability, interpretation, dissemination, and use of seasonal climate forecasts. As noted in our original proposal, it seeks to serve as a bridge between the producers of information in scientific agencies such as NOAA and the end users in local governments.

We completed a 60-page working version of the BPG that contains five sections, as well as a list of references. Section 1 provides an introduction and overview of the BPG, describing the purpose and intended audience of the guide and its organization. Section 2 discusses the science of seasonal climate events, with a particular emphasis on El Niño Southern Oscillation (ENSO) conditions. Section 3 provides pointers to and descriptions of relevant climate information available from NOAA and other entities, while Section 4 puts this information in the context of the planning for natural hazards done by emergency managers. It includes case study information of ENSO forecast use. Section 5 summarizes the BPG. Throughout the document, we have embedded vignettes of climate information use to motivate the discussion with practical examples.

The BPG received extensive internal review by all members of our project team. We also circulated the most recent version to a half-dozen external reviewers (academics and

EMs) and hosted a small workshop with this group to vet the BPG in August 2014. We made minor revisions in response to comments made at the workshop.

We are still looking for the appropriate venue(s) to distribute the guide.

Project Outputs through May 31, 2015

Written Products:
"Seasonal Climate Forecast Serves as a Call to Action," as a vignette for the U.S. Climate Resilience Toolkit: https://toolkit.climate.gov/taking-action/seasonal-climate-forecast-serves-call-action

Presentations Aimed at Professionals and Managers and their Instructors
Presentation of preliminary findings to emergency managers at the Oregon Emergency Management Association Annual Conference, October 2013 (Eugene, Oregon)

Presentation of preliminary project findings at the American Meteorological Society Annual Meeting, February 2014 (Atlanta)

Poster presentation summarizing the project's research approach and preliminary findings at the Disaster Research Center in Delaware, May 2014 (Newark, Delaware)

Presentation of preliminary project findings at the FEMA Higher Education Conference, June 2014 (Emmitsburg, Maryland)

Advanced Topics in Pubic Management: Managing for Extreme Events (Virginia Tech's PAPA 6354). Project investigator Roberts offered a Spring 2014 class associated with this project on public management of natural disasters. Students—early and mid-career public managers in an public administration program in Richmond, Virginia—learned tools for dealing with the kinds of scientific information associated with climate forecasts, and were exposed to structured decision making techniques, risk management, and cognitive biases and decision heuristics

Presentations to Scholars:
Presentation at the Opportunities in Crises: Technogoverning Sustainable Landscapes workshop, University of Virginia, Charlottesville, VA, March 18, 2015

Presentation at the Disaster-STS Workshop, Drexel University and University of Pennsylvania, April 2014 (Philadelphia)

Presentation of preliminary project findings at the International Urban and Environmental Planning Association Conference (Simposio de la Asociación Internacional de Planificación Urbana y Ambient), September 2014 (La Plata, Argentina)

Presentation of preliminary project findings at the Association of Collegiate Schools of Planning Conference, October 2014 (Philadelphia, Pennsylvania)