

## IMPACTS OF CLIMATE CHANGE ON SEAPORTS: A SURVEY OF KNOWLEDGE, PERCEPTIONS, AND PLANNING EFFORTS AMONG PORT ADMINISTRATORS

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### Abstract

Port authorities from around the world were surveyed to ascertain how administrators feel climate change might impact their operations, what level of change would be problematic, and how they plan to adapt to new conditions. The survey was distributed to 350 major ports through two leading international port organizations, the International Association of Ports and Harbors and the American Association of Port Authorities.

### Introduction

Climate change will disproportionately affect ports and port-based economies, depending on their geographic location and the institutional capacities of the ports themselves and the communities in which they are located. Ports in a hurricane belt will face different challenges than those on emergent coastlines far removed from storm-impacts. Ports in developing nations will have a different suite of options available to them than those in developed nations. Ports located in estuaries that provide nursery environments for marine life have an even greater responsibility to protect coastal waters. A recent United States Environmental Protection Agency (EPA) report on climate impacts on U.S. seaports states, “most ports do not appear to be thinking about, let alone actively preparing to address, the effects of climate change” (EPA, 2008). To meet these challenges, decision makers must understand the nature of the problem and what options may be considered. We surveyed port authorities from around the world to ascertain how administrators feel that climate change might impact their operations, what level of sea level change would create operational problems, and how they plan to adapt to new environmental conditions. Little research has been done in this area and results of this survey serve as an important step to understanding where this audience stands and what information they require to increase resiliency.

### Background

By the very nature of their business, seaports are located in one of the most vulnerable areas to climate change impacts: on the coast susceptible to sea level rise and increased storm intensity and/or at mouths of rivers susceptible to flooding. 90% of world freight moves by ship (IMO, 2008). Thus, seaports play a crucial role in the global economy as transportation hubs for the vast majority of goods transported around the world. Given shipping’s efficiencies and its smaller relative carbon footprint size compared to other modes of transport, as well as forecasted increases in world freight volumes, demands on ports are likely to only grow in the coming century (Transportation Institute, 2004). To remain efficient and resilient, seaports must anticipate the impacts of climate change and proactively prepare for sea level rise, increased flooding, and more frequent extreme storm events (Hallegate, 2008; PIANC, 2008; UNCTAD, 2008; EPA, 2008).

We believe this is the first survey to address this issue and this sector of the global economy. However, at least two similar surveys have been conducted on a smaller scale. A group from Texas A&M conducted a survey in 2005 and 2006 entitled, ‘Port Planning and Views on Climate Change’. The survey focused on the central question, ‘Is planning for climate change on the radar screen of the USA seaport industry?’ This survey found that about half of the 27 respondents felt climate change would affect their ports. Of those, a small majority were taking at least initial steps to plan for it (Bierling & Lorented, 2008) The State of California, arguably one of the most progressive states in the US when it comes to climate change issues, conducted a survey of its major coastal facilities. Survey results found that marine facilities in California are generally not considering climate change or sea level rise, which is projected to reach 1.4 meters in the State by 2100 (California Lands Commission, 2009). Our survey targeted a global audience and was designed to generate baseline data about how ports think about adaptation to climate change.

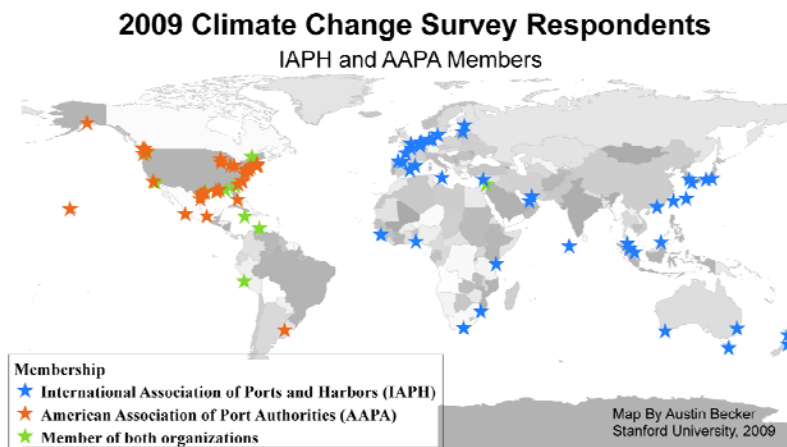
### Methods

The survey targeted a wide variety of port authorities in an attempt to sample ports in developing and developed nations, and ports in geographic areas with varying amounts of risk to coastal and ocean storms. We distributed the survey to member ports of the International Association of Ports and Harbors (IAPH) and the American Association of Port Authorities (AAPA). Together, the IAPH and AAPA represent 345 ports from around the world which are considered to be the largest and most important ports in global marine commerce. Most ports, if not all, that play a critical role in international trade and are interested in global issues are likely to be members regardless of size, ownership and traffic character.

We designed an online survey consisting of 30 questions, using Survey Monkey, with input from the two port associations. Representatives from the AAPA, the IAPH, and others reviewed and pre-tested the survey tool. Review and pretesting helped insure that the questions and response options were easily understood and the questions were appropriate for the audience. The survey should have taken about 10-15 minutes to complete. We distributed the survey to AAPA and IAPH member ports in August 2009.

## Results

98 ports responded to the survey and provided 93 usable responses. Port directors and members of the port environmental departments constituted nearly half of the respondents, with planners, engineers, and making up the remainder. Most respondents had significant experience, with over half having spent at least 16 years working in maritime industries.



Key results show 48% of respondents believed that climate change negatively impacts their port operations in the coming decades. 86% felt that the international port community needs to address these issues. However, 66% did not feel well-informed about how climate change might directly impact their own port. Our respondent ports were rapidly expanding but on the whole administrators were not accounting for potential climate impacts in years to come. 68% of respondents indicated that their ports plan only ten or fewer years ahead. 58% will implement new infrastructure within the next five years. Most, however, had no policies in place that specifically address climate change adaptation. Only 44% reported that they had taken any specific steps to prepare for potential climate change effects. When asked an open-ended question about their main concerns, most listed storm impacts and sea level rise. 38% expected a 0.5-1m rise by 2100 and 15% expected 1m or more. Interestingly, when asked about the degree to which this might be an issue, 64% felt their port could handle the expected rise without building any additional protections.

Mitigation through reducing port emissions, and adaptation by preparing for the impacts of climate change on ports, require very different initiatives. Survey results show that ports working to address one initiative also tend to be the same ports working to address the other. Overall, however, respondents placed more importance on mitigation issues over adaptation. This may be a result of anticipated regulations or global attention to CO<sub>2</sub> issues. There are still uncertainties in the scientific models of climate change, so it is not surprising that ports were not yet focused on the potential impacts on their operations.

## Discussion

Current scientific projections on sea-level rise range from nearly a meter to two meters by 2100 (IPCC, 2007; Rhamstorf, 2007; Wu et al., 2009). Possible consequences of climate change include a doubling of Category 4 and 5 storms by 2100 (Bender, et al., 2010). These events create interruptions in the flow of cargo through ports and, as demonstrated by Hurricane Katrina, can devastate a regional economy and environment for months or even years after an event.

More than half of the responding ports – 58% – planned for the historic 100-year storm period. But this preparation will not be effective if the 100-year return period becomes a new 30-year return period due to climate change. With typical port infrastructure designed to last for 50 years or more, new infrastructure put in place today should be built with the new climate regime in mind. Infrastructure often outlasts its design life and costs of repair easily outweigh the expense of anticipating climate change through good design at an earlier stage. Moreover, even though the design lifetime of many capital projects is 50 years (well within the horizon for many predicted climate change scenarios) the capital planning cycles are typically 5 to 10 years. This mismatch between planning cycles and infrastructure lifetimes may be at the root of many structural organizational difficulties in addressing this complex issue.

Good business practice dictates that ports protect their infrastructure and operations. The insurance industry will play a large role in covering some of this additional risk. But with 93% of respondents being either public or public/private owned or operated, public policy will also play a part in addressing overt risk to the ports as well as more covert risks to the environment and port-dependent economy. Although the costs of proactively adapting to climate change are thought to be far lower than the costs of a reactive response, adapting will require significant investment.

## Conclusion

Results show that the world port community is very concerned with impacts of climate change, but generally feels the need for more specific information from the scientific community in order to make good decisions. It appears that the quality of scientific information available is at a level of granularity that simply does not match the shorter-range planning horizons typical in the ports community. This situation must be resolved if decisions are to be made that will protect both the port infrastructure itself and the environmental and economic systems that depend on a resilient and efficient maritime industry. Results of this survey serve as a clear call for the world ports community and the scientific community to engage more deeply to ensure that seaport decision makers have the best climate-change information available.

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