Climate Change Impact on Coastal Resources

ABSTRACT – Jeff Donnelly, Associate Scientist, Woods Hole Oceanographic Institution

An increase in the rate of sea-level rise and potential changes in storminess represent important components of global climate change that will likely affect the extensive coasts of the Northeastern USA. Raising sea level not only increases the likelihood of coastal flooding, but changes the template for waves and tides to sculpt the coast, which can lead to land loss orders of magnitude greater than that from direct inundation alone. There is little question that sea-level rise, and in particular an increased rate of rise, will result in permanent losses of coastal land. However, quantitative predictions of these future coastal change remains difficult due in part to the complexity of coastal systems and the influence of infrequent storm events, and is further confounded by coastal science's insufficient understanding of the behavior of coastal systems over decadal timescales. Although quantitative predictions remain constrained, there remains little doubt that the predicted climates changes will have profound effects upon the Northeastern coast.

The approximately threefold increase in the rate of sea-level rise starting in the late 19th century may have already caused profound changes to salt marsh form and function. As a result of this relatively recent increase in the rate of sea-level rise, marshes need to accrete vertically at a faster rate in order to prevent drowning. Continuing land subsidence in the region and the relatively low quantities of sediment available to salt marshes in the Northeast may make these systems highly susceptible to changes in morphology, community structure, and drowning-related increased rates of sea-level rise. The documentation of cordgrass invasion of the New England high marsh and marsh drowning in other areas may already indicate that marshes are failing to keep up with the increased rate of inundation. Extensive marsh loss since 1938 at the Blackwater Wildlife Refuge in Maryland has been attributed to local rates of sea-level rise outpacing marsh accretion. About 2,300 ha of salt marsh were lost there, between 1938 and 1979 primarily through the growth and coalescing of pannes. Similar losses have been documented in Jamaica Bay, NY.

If current rates of sea-level rise persist or increase only slightly over the next century in southern New England, marshes will likely continue to be transformed into cordgrass-dominated wetlands. Moreover, if sea-level rise rates accelerate to 6 mm/year or more over the second half of the century, cordgrass communities may drown as well, leading to significant loss of coastal wetlands throughout the Northeast. In the face of these changes and the potential for significant wetland loss, many questions need to be addressed. How will the productivity of coastal wetlands change? Coastal wetlands are intimately linked to the productivity and health of other estuarine ecosystems. More frequent flooding of the cordgrass-dominated high marsh surface may result in greater export of organic matter to the surrounding estuarine environment and may result in more fine-grained inorganic material being sequestered within marsh sediments. How might these potential changes impact the estuarine productivity? What are the potential impacts to migratory bird populations as the diversity of marsh flora decreases? What mitigation strategies should be implemented in order to prevent future marsh loss? How will the loss of salt marshes impact coastal ecosystems?

There is significant uncertainty with respect to how storminess will change in the future. Reconstructions of past hurricane activity throughout the western North Atlantic indicate a likely link between ENSO variability and the West African monsoon and hurricane frequency. But

theoretical studies indicate that recent climate warming is increasing hurricane intensity. Regardless of the cause we currently appear to be in an active hurricane regime. The combination of more rapidly increasing sea level and more frequent hurricanes poses a significant threat to the heavily developed coastal communities of the region. For example, if a storm similar to the 1938 hurricane were to make landfall in the northeast US today it would likely result in about 40 billion dollars in damage, given increases in population and wealth over the last several decades. If the active hurricane regime of the middle part of the century were to reoccur the resulting damage in the northeast would likely be close to 100 billion dollars. Many lives may also be lost due to future hurricane strikes because of difficulties evacuating this densely populated region in advance of a fast-moving intense hurricane.