Infrastructure Interdependencies and Sea Level Rise in Coastal Areas

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Abstract

The threat of Sea Level Rise (SLR) to infrastructures and their services especially in coastal areas is severe and continuing. Anticipated increases in sea level in coastal areas at urban and regional scales continue to be documented (USACE, NOAA, EPA, DOT, IPCC, city entities such as the NY Panel on Climate Change, and numerous academic studies). Substantial variations in estimates are recognized (IPCC 2012). Moreover, U.S. Census data has revealed that population continues to move to and build on coasts, and these activities depend on infrastructure services. Infrastructure service capacity does not always stay abreast of population and development changes. Impacts on infrastructure from SLR occur on top of existing vulnerabilities created by condition and performance problems that infrastructure services experience. Moreover, these problems are compounded by infrastructure interdependencies. Understanding infrastructure interconnections is a critical input for plans to reduce service vulnerabilities and consequences associated with SLR. Though estimates of coastal infrastructures at risk exist, they mostly focus on single infrastructures rather than interconnectedness.

Scenarios illustrating the interplay of alternative infrastructure interconnections and different SLR estimates are presented, drawing from a risk-based framework and network theory concepts. They are constructed from and applied to selected databases for different infrastructure combinations, configurations, and degrees of interconnectedness. Scenarios range from broad generic types of infrastructures to component-specific characteristics to plan for coastal area actions for SLR, with strategies ranging from protection to radical changes in the way services are provided.

First, critical infrastructure interdependencies and dependencies will be identified using data from major cities in the U.S. where connections exist under normal situations or arising from damages in extreme situations and that are spatially or functionally related to SLR areas. The focus is interconnected electric power, transportation, and water infrastructures with telecommunications treated as an intermediary. Second, the degree of concentration spatially, functionally or by virtue of heavy usage or facility co-location will be applied to the subset of connected infrastructures at generic and component specific levels. Third, the portrayal and quantification of interdependencies will draw from approaches used in modeling of interdependencies such as network theory. Fourth, the feasibility and effectiveness of applying alternative corrective actions for coastal planning will be applied to the data set in light of alternative SLR scenarios to determine the change in the level and type of risk of damage from those actions. The decision space is well known encompassing protection through elevation and barriers, removal, changes in how a service is provided, and modifying service procedures.

Outcomes will be how to identify interdependencies and their ramifications under alternative SLR conditions, ways of intervening and mitigating the risk, and the feasibility of applying such measures.

Key Words: infrastructure interdependencies and dependencies, electric power, transportation, water, adaptation