

The tripping points of sea level rise

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PERSPECTIVE

The tripping points of sea level rise*

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When President Nixon created the US Environmental Protection Agency (EPA) in 1970 he said the environment must be perceived as a single, interrelated system. We are nowhere close to achieving this vision. Jim Titus and his colleagues [1] highlight one example of where one set of regulations or permits may be in conflict with another and where regulations were crafted in the absence of understanding the cumulative impact of global warming. The issue here is how to deal with the impacts of climate change on sea level and the latter's impact on wetland polices, clean water regulations, and ecosystem services.

The Titus paper could also be called 'The tripping points of sea level rise'. Titus and his colleagues have looked at the impact of such sea level rise on the east coast of the United States. Adaptive responses include costly large-scale investment in shore protection (e.g. dikes, sand replenishment) and/or ecosystem migration (retreat), where coastal ecosystems move inland. Shore protection is limited by available funds, while ecosystem migrations are limited by available land use. The driving factor is the high probability of sea level rise due to climate change. Estimating sea level rise is difficult because of local land and coastal dynamics including rising or falling land areas. It is estimated that sea level could rise between 8 inches and 2 feet by the end of this century [2].

The extensive data analysis done by Titus *et al* of current land use is important because, as they observe, 'property owners and land use agencies have generally not decided how they will respond to sea level rise, nor have they prepared maps delineating where shore protection and retreat are likely'.

This is the first of two 'tripping points', namely the need for adaptive planning for a pending environmental challenge that will create economic and environment conflict among land owners, federal and state agencies, and businesses. One way to address this gap in adaptive management, according to Titus *et al*, is for communities to develop a common vision about which lands will be protected and which lands will yield to the rising sea, similar to the way land use plans identify commercial, residential, agricultural, and conservation lands. The supplementary material in their paper (as well as a related web site suggested by the peer review process of this journal) provides maps that depict the likelihood of shore protection based on existing land use data and the assessment of the local governments. Such maps, they suggest, might be used as a starting point to promote dialogue within communities about which lands should be protected and which lands are allowed to become submerged.

A second tripping point relates to conflict between existing environmental laws and their collective ability to respond to the impacts of global warming. For example, property owners are automatically issued permits for construction of hard shore-protection structures (e.g. bulkheads and revetments) without an assessment of their environmental impact. Normally, under the Clean Water Act, the impact of each permit is assessed separately, but there is a special expedited process for activities with no cumulative impact. The Corps of Engineers concluded that shore protection does not have a cumulative impact, and that might be true if shore erosion was rare and stable shores the general rule. But once we recognize that the sea level is rising, then shore erosion becomes the general rule and a cumulative impact is likely. Under the National Environmental Protection Act (NEPA), cumulative impacts have been defined as 'the impacts of an activity

* The views expressed in this article are those of the author and do not necessarily represent official positions of EPA.

“added to other past present and reasonably future actions” regardless of who takes the other actions’. If the NEPA were actually evoked, it would considerably delay permit approvals and substantially impact the Corps of Engineers’ process for issuing permits.

The potential impact of sea level rise clearly requires a holistic approach to coastal management in which options for shore protection or retreats are clearly identified and where economic, ecosystem and social impacts can be clearly evaluated. At stake are both the future of wetlands that provide important ecosystem services and the safety and sustainability of our coastal communities.

This is a huge challenge requiring adequate data, long-term planning, federal-state cooperation, and integration of environmental laws. The time is at hand to assess a business-as-usual response to sea level rise or to explore a more holistic and integrated approach. President Obama has said: ‘The threat from climate change is serious, it is urgent, and it is growing. Our generation’s response to this challenge will be judged by history, for if we fail to meet it—boldly, swiftly, and together—we risk consigning future generations to an irreversible catastrophe’ [3]. Though the President was talking about action to reduce emissions of greenhouse gases, cooperation to address the consequences of rising sea level and changing climate is just as urgent.

References

- [1] Titus J G *et al* 2009 State and local governments plan for development of most land vulnerable to rising sea level along the US Atlantic coast *Environ. Res. Lett.* **4** 044008
- [2] US Global Change Research Program 2009 *Global Climate Change Impacts in the United States* (June 2009)
- [3] www.whitehouse.gov/the_press_office/Remarks-by-the-President-at-UN-Secretary-General-Ban-Ki-moons-Climate-Change-Summit/