REPLY TO BOYD ET AL.:

Large long-term sea level projections do not mean giving up on coastal cities

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Boyd et al. (1) are correct to note that our paper did not factor in potential adaptation measures such as levees, as, indeed, we explicitly indicated (2). Because our analysis extended up to 2,000 years into the future, we excluded consideration of adaptive responses because of the great degree of speculation that would be required. Although levees already play a major role for New Orleans, there are many other cities where they do not exist today but will likely be built and play critical roles in the future. Part of our goal in writing the paper was to indicate the strong adaptive measures that will likely be needed to protect many cities, even under the lowest carbon emissions scenarios.

Given this spirit and the time frame considered, we view a bathtub-type analysis as completely appropriate. Any detailed analysis would surely err in its details. In this vein, our paper clearly noted that the critical threshold on which we focused—50% of contemporary population on land below projected future sea levels—was arbitrary, and intended as indicative of threat, not determinative. Some cities will face geographic, physical, or human constraints that will prevent sufficient adaptation at lesser threat levels. Other

cities currently do or will one day be able to survive greater challenges through adaptive measures.

At the same time, it is fair to ask how much sea level rise any city might tolerate, even when using heroic adaptive measures. As levees rise around cities, within how deep a bowl will residents tolerate living? Barriers may protect against most storms, but when they fail, the results are likely to be catastrophic, as floodwaters swiftly rush in and then linger. It may be possible to build levees or renew wetlands that are robust enough for today's sea level and storms, but what happens after 2, 5, or 10 m of sea level rise?

None of these long-term considerations mean that we should give up on New Orleans or any other vulnerable city today. It would be just as foolish for an individual to give up living upon learning he is mortal, or to refuse medicine early in the course of a dangerous illness. If we protect the most vulnerable coastal cities, they will still have many gifts left to give to the world, not least of which could be modeling how to cope with rising waters in the most creative, safe, and just ways possible, maximizing opportunity and minimizing pain, even in places where abandonment may be the eventual endgame.

1 Boyd E, Pasquantonio V, Rabalais F, Eustis S (2016) Although critical, carbon choices alone do not determine the fate of coastal cities. *Proc Natl Acad Sci USA* 113:E1329.

2 Strauss BH, Kulp S, Levermann A (2015) Carbon choices determine US cities committed to futures below sea level. *Proc Natl Acad Sci USA* 112(44):13508–13513.

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