Shoreline Adaptation Land Trusts: Concept for Rising Sea Level
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Summary
Rising sea level is now unstoppable despite the important work to reduce greenhouse gas (GHG) emissions and the international goals to limit warming. Regardless of those good efforts, we must begin adapting to a new era with substantially higher sea level and shorelines that will move far inland in many locations. Financial and tax policies that recognize the need to plan for multiple meters of sea level rise (SLR) would be an efficient tool for cooperative efforts between the private and public sectors to begin as orderly a transition as possible. A special purpose public land trust, herein termed a Shoreline Adaptation Land Trust (SALT) could be a vehicle to facilitate and encourage the vast adjustments that large ocean incursions will necessitate.

Current realities
For context, three concepts need to be clarified or corrected: 1) Confusion of storms, extreme tides, and SLR with erosion and other types of flooding. 2) The idea that it is possible to stop SLR by slowing the warming or other “sustainable behaviors”, and 3) a belief that the worst possible case for SLR this century is 3 feet, or even 6 feet. Coastal flooding occurs for a variety of reasons that are often confused, but have totally different magnitudes and timescales. Flooding might be divided into seven causes from storm surge to extreme high tides, heavy rainfall, downstream flooding, land subsidence, coastal erosion, and SLR. (Tsunamis, caused by seismic activity, would be yet another type and cause.) The forces for each flood type, the predictability, relative vertical change, and permanence are all quite different and need to be understood if we are to have effective policy to be more resilient and to adapt, two terms that are often interchanged but here are used with important distinction.

Storms, extreme high tides (“king tides”), heavy rainfall and downstream flooding are familiar events that quickly recede, making it possible to recover and rebuild. They are appropriate to think of in terms of resiliency, i.e. the ability to recover to normal. Beach erosion is different than flooding, being caused either by storm action, by routine ocean currents, or the effect of interrupting sand movement along the shore as happens with construction of groins or waterway inlets. Such erosion is not actually flooding, though rising sea level will make erosion far worse.

Sea level rises for entirely different reasons. Mostly it is the melting of glaciers and ice sheets on land, plus the thermal expansion of seawater, as the ocean warms. As the Earth’s average temperature changes over many decades and centuries, these forces move sea level up or down by astonishing heights. Contrary to popular belief, sea level does not change due to the melting of floating ice, whether in the form of icebergs or the solid polar ice cap around the North Pole, or the fringing sea ice around the island-continent of Antarctica.

All forms of flooding are additive. For example a severe storm will reach greater height and further inland, if it hits at an unusually high tide. Over time, all of those temporary events will be lifted to higher levels as the base sea level rises. SLR, and land subsidence, are special because the effects will not be reversed for centuries or millennia and therefore should be considered permanent. As the planet warms, melting the great ice sheets and glaciers, we need to recognize this as lasting change to ocean height, which will actually work to move the shoreline. That requires adaptation, rather than resiliency—typically used in a context of recovering to the pre-event condition and some state of previous normalcy.

Global average warming is now estimated to be 0.85 degrees C (approximately 1.5 degrees F) over preindustrial levels. Current international efforts are striving to set a goal to keep the warming to no more than 2 degrees C over preindustrial levels, or about one additional degree,
by reducing carbon emissions. Yet, from geologic history, we know that when ice sheets and glaciers have fully adjusted to temperature changes over centuries, that sea level changes by roughly 20 meters per degree C of average global temperature, or about 35 feet per degree F. (Archer & Brovkin, 2008) Thus, rising sea level is now unstoppable, even with 100 % conversion to sustainable, non-carbon based energy. That point was made in this summer’s high-profile paper by Dr. James Hansen et al., “ice melt, sea level rise and superstorms.”

Our ignorance about SLR stems from the fact that it has hardly changed in the last five thousand years, roughly the span of our civilization and written record. Yet geologically it is clear that sea level varies in a rather regular pattern, following the “ice ages”, roughly on a hundred thousand year natural cycle as shown on the attached graph of 400,000-years. That pattern has been repeating for several million years. Sea level moves up and down 300-400 feet with each ice age cycle as global temperature changes by five degrees C (9 degrees F). One hundred twenty thousand years ago, sea level was twenty-five feet higher than present. Now we are in a “super warming” phase triggered by extraordinary levels of CO₂, a potent GHG.

Considering the unstoppable aspect of rising sea level and the scale of what lies ahead, many public policies are not sustainable financially, such as subsidies to the National Flood Insurance Program, using FEMA funds for buildings that are in flood zones, approval of new projects in vulnerable zones, or the concept of buying homeowners out of coastal property at pre-storm values, as was done after “Sandy” in New York. With more frequent flooding events and the increasing awareness of unavoidable submergence, property values will likely start to go “underwater” long before the land actually does. Long before the water rises we need to chart a course for better public policy recognizing the new reality. Delay only makes things worse.

Scientific opportunities and challenges
SLR will be more severe than most realize. Due to scientific protocol, nearly all projections omit the largest potential cause of higher sea level – the melting of the West Antarctic glaciers. For example, the authoritative 2013 UN-IPCC points to as much as three feet of SLR by the year 2100, but omits the ten feet of potential SLR from just the most unstable glaciers (Bamber, et al., 2009) on the basis that it cannot be precisely quantified with probabilities. That inability does not mean the risk is not real. We simply cannot predict collapse points. (Englander, 2014) The wishful idea of a technology “fix” to stop sea level ignores some basic physics.

One scientific opportunity is to better refine the measurements of melting ice on Greenland and Antarctica, research that now has the highest priority by the National Science Foundation (NSF), which should improve the models. Still, there are severe limits to the modeling of any tipping point where there is not a large measured sample, or the ability to put the system in a laboratory setting for test and measurement— quite impossible for Greenland or Antarctica. We must recognize that SLR will almost certainly exceed the projections, due to the tipping points that cannot be programmed into models. Given that uncertainty, our challenge is to find ways to facilitate the adaptation that is now inevitable, even if the precise rate of SLR is unknowable.

Shifting the focus from glaciology to economics could be one pragmatic path towards adaptation. Instead of the present focus on trying to forecast exactly how fast the ice will melt, we would do better to begin to plan for the adaptation that is now inevitable. Adapting to higher sea level will be one of the most challenging things mankind has ever faced. Costs from real estate write-offs, relocations, and business interruption will be in the trillions. Besides the huge losses and dislocations, there will also be opportunities. The sooner we start, the better.

Policy issues
As sea level rises, the options to avoid going underwater are to elevate, isolate, or relocate. Isolate often means levees as used in New Orleans and the Netherlands, though that approach
will not work in areas with porous structure like most of South Florida and coral-based islands. In limited areas it will be possible to elevate vulnerable land and to further defend from temporary storm surge. Where that is not feasible, the need is for strategic relocation. Shoreline Adaptation Land Trusts (SALT) are one concept that warrant consideration. In brief:

- A SALT is a nonprofit public land trust established pro bono for any defined area, e.g. state, county, community, or in the case of island nations, perhaps the entire country.
- The purpose is to get property into the public sector in anticipation of its submergence.
- Private and commercial property owners will be encouraged to donate coastal real estate, vulnerable to erosion and sea level rise, per criteria that will adjust over time.
- The owner would be allowed to continue full use for his / her lifetime, subject only to the progress of SLR and other intermittent flooding.
- The immediate benefit to the donor would be to terminate property taxes.
- A second benefit would be a tax-deductible gift donation for the value of the property, including the land, buildings and infrastructure. To encourage early participation, the percentage of deductibility would decline two percent every year from the inception of the SALT. E.g. Thirty years from inception the rate would be 60% less – i.e., donations would be calculated at 40% of the current value.
- As a further benefit of donating the land to the SALT, there could be a variance to allow certain extraordinary measures to shore up the property from erosion for a limited number of years, suggested to be no more than thirty years from the inception of the SALT (not from the donation of that parcel).
- At such time as the relevant jurisdiction declares the property to be uninhabitable, the SALT will endeavor to remove any built structures and remediate environmental damage, recognizing that the property will eventually be part of the marine environment.
- As a means of developing further value and working capital, the SALT could rent out properties it acquires, after the donating owner dies or abandons.
- In addition to such rental income, the SALT could get working capital from the government in support of its role to facilitate an orderly transition inland in the face of ever-rising sea level. Also there could be deductible charitable donations from the public, philanthropic and civic organizations.
- The concept and establishment of SALTs could be accomplished at any level of government, though the tax benefits would likely require Federal and state legislation.
- Having an actual SALT would be extremely helpful as a model. Accordingly some vulnerable and progressive jurisdiction should be solicited as a prototype. The United Nations might be a forum to recommend the concept for adaptation internationally.

SALTs could be a useful tool and catalyst for this unprecedented transition upwards and inland. We can rise with the tide — if we anticipate it in time.

References

A policy position paper prepared for presentation at the conference Sea Level Rise: What's The Next Step? convened by the Institute on Science for Global Policy (ISGP) on October 2-3, 2015 at St. Petersburg College, St. Petersburg, Florida, U.S.