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Climate Change Thresholds

Climates change! Whatever the cause, be it anthropogenic CO_2 emissions, sun spots, termite-generated methane, or something we do not understand, there is no reason to view climate as static. The geologic record tells us as much. Sometimes the effects of change reach a tripping point, or "threshold", at which gradual changes are replaced by a more immediate consequence that has to be dealt with. (A senior researcher at the US EPA introduced me to climate change thresholds. Terrifically important concept!)

A good example appeared on a television show about a town in Alaska: sea ice retreat led to flooding. The narrative goes like this: The town fronts on the shore and normally – or at least for many, many years – the ice lay close to the shore. But in recent years the ice retreated, thus increasing the fetch which, in turn, led to higher waves. Higher waves resulted in more frequent overtopping of the town's seawall. Thus, flooding.

"Fetch" is the distance over which wind-driven waves gather energy and height. The greater the fetch, the higher the waves, all other things being equal. Sea ice covers the water, thereby shielding it from the effects of wind. With less ice cover, more water is exposed to the wind. So …

Ice retreat did not happen suddenly. Although there may have been occasional years when it was farther offshore, it was not a regular thing. Neither was the flooding. But at some point, it retreated far enough and often enough to make the fetch great enough to make flooding more frequent. Now the town had to raise the height of its seawall because a threshold had been reached.

When a threshold has been reached, some human activity is affected enough to require action – or at least make the consequences more painful. In this case, it was an expensive seawall project. Other cases may be more subtle. On the North Carolina coast, sea level rise is a frequent theme. If it rises past a certain point, how much potential tax base will be removed? How much agricultural land will become unusable – or unreachable – thus reducing employment? At what point will saltwater intrusion make wells unsuitable for irrigation or potable water? Where is that threshold? Because you can't turn back the sea (ignoring the Dutch for the moment), how can you plan for the day when the threshold is reached?

The lesson is that thresholds exist and once their effects are recognized, we can plan for them rather than reacting to them. Watching ice retreat over a period of years, the Alaskan town had time to understand, plan and take action. We may not know how to quantify a threshold but perhaps we can incorporate thresholds into our planning. Something like

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the sea ice example is easy. You know the height of the existing wall so you know how much to raise the wall for a given wave. You know (or can model) the fetch-wave relationship so you know how much ice retreat will be an issue. Now you watch the ice and figure out what to do and when. Other effects might not be as straight forward.

But how do we plan? What should you plan for? Who should do the planning? Who are the stakeholders?