Science policy and research on climate: Ecosystem sensitivity analysis

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Abstract

Predicted climate change has been cited in scientific and popular literature as a large, or even the primary, stressor on some ecosystems. The scientific focus on climate might come at the expense of research on other drivers of change, for example land use and invasive species, regardless of their importance as determinants of future ecosystem conditions. Although it might be a significant stressor on ecosystems, our ability to control climate is limited compared with our ability to influence other stressors. Our project consists of analyzing the sensitivity of two ecosystems to various potential drivers of change by synthesizing available research findings and convening consensus workshops with active researchers. The object of our ecosystem sensitivity analysis is to identify gaps in the current ecology research portfolio. We have selected the Phoenix urban ecosystem as our first study area and are in the process of developing a methodology to rank the potential drivers of change to this ecosystem. Our second study area has not yet been selected, but will be larger in scale and more 'pristine', i.e., less dominated by human action. This poster presents our efforts thus far to develop a methodology for our ecosystem sensitivity analysis.

Background & Justification

Scientists have made great progress in elucidating the causes of climate change and potential feedbacks with other processes. As scientific understanding of climate change drivers has matured, however, our society's approach to mitigating the anticipated effects of climate change has remained myopically focused on reducing greenhouse gas emissions. As Pielke et al. (2000) argue, the conventional approach to addressing global warming—reducing emissions—ignores many strategies that would lead to greater reduction of climate change related losses. Their study addresses the assumption that climate change will be responsible for drastic increases in hurricane related losses in the future. They take advantage of IPCC scenarios to tease out the expected contributions of climate change and population/demographic changes to those predicted increased losses. Their findings, displayed in Figure 1, were that the expected rise in hurricane losses due to population increases in vulnerable places will far outweigh losses due to predicted increases in cyclone frequency and severity associated with climate change. Rarely, however, are factors such as development patterns considered in discussions about how best to deal with impending climate change. Our ecosystem sensitivity project will include a similar analysis of the importance of drivers causing unwelcome ecosystem change.

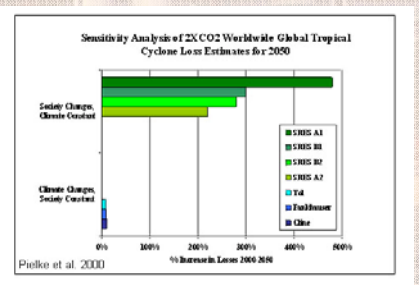


Figure 1
This graph from Pielke et al. (2000) shows the relative impact on hurricane related losses expected to occur by 2050 due to social change and those expected from climate change using IPCC scenarios.

Methodology

We propose a five step methodology to perform an ecosystem sensitivity analysis to rank the relative importance of various drivers of change in the two selected ecosystems:

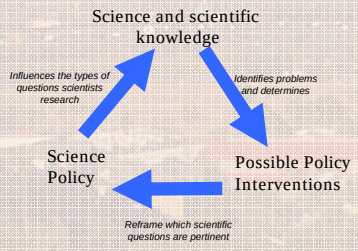
1. Identify ecosystem stressors from literature
2. Identify cause/effect relationships and how they are modeled by relevant scientists
3. Extrapolate trends into the future
4. Compare trends and expected effects from various stressors and seek to understand future relationships between the stressors
5. Consult with relevant experts throughout process to validate assumptions and findings

Science, Policy, and Science Policy

Science is a human enterprise and is influenced by social and political pressures throughout the scientific process. If we choose to focus our research on the climate's effects on ecosystems, that knowledge will come at the expense of understanding of other drivers of change because of limited research funding. In an ideal world, research funding would be commensurate with the scale of the effects for each driver of change. Over the past thirty years climate research has expanded to become a significant portion of our national research portfolio.

Science policy including resource allocation determine in part the types of knowledge that we have about our world and thereby define the options we consider in ecosystem and environmental management decision making processes (see Figure 2). In the Pielke et al. example, by focusing research on atmospheric physics we limit our approaches for dealing with climate change to those that deal with the causes. Though an admirable goal, even if we were able to reduce the greenhouse effect, the lag time would likely be significant; scientists speculate that greenhouse gasses already in the atmosphere will likely continue to cause additional warming for the next 50 years (Gitay et al., 2001). By focusing on climate change as a driver of ecosystem change we might be failing to adequately study other potential drivers of change. Neglecting to study other drivers of change limits which policy interventions are considered in environmental management decision making processes.

Figure 2
This conceptual model shows the relationship between the science we pursue as a society, the policy options we have for environmental management, and the feedback between policy intervention options and science policy. Our aim is to help educate scientists and science policy makers to allow for knowledge creation that allows for the most effective policy interventions.



Summary

Pielke et al. (2000) demonstrate that our approach to mitigating the effects of climate change, largely limited to reducing greenhouse gas emissions, fails to address human development patterns, a factor likely to be many times more important in determining future climate related losses. We plan to perform a similar sensitivity analysis on two ecosystems to determine which drivers of change are likely to be the most significant in the future. By helping researchers to identify which drivers are likely to be most influential in driving ecosystem change we hope to help steer the scientific enterprise toward more effective policy interventions for managing a changing planet.

The research outlined here does not suggest that we should not research greenhouse gas emissions and their relationship to climate change, but we do seek to determine if other interventions that could be effective in managing the effects of climate change are being neglected in our current national research portfolio.

Literature Cited:

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