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EDITORIAL

Global climate change: building links between the climate and ecosystem impact research communities

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The earth's climate system is extremely complex and nonlinear, so uncertainties exist in understanding the causes and the processes of climate variability and change. Nevertheless, significant advances in the scientific understanding of climate change make it clear that the change over the last few decades is beyond the range of natural variability.

The globe is warming at a dramatic rate. Global surface temperatures today are >0.7°C warmer than at the beginning of the 20th century, and rates of temperature rise are greatest in recent decades; 9 of the last 10 years are among the 10 warmest in the instrumental surface temperature record. Based on reconstructions of temperature from proxy data, such as tree rings and ice cores, several studies have concluded that Northern Hemisphere surface temperatures are warmer now than at any time in the last 1000 years.

This surface warming is consistent with a large body of other observations. For example, there has been a widespread reduction in the number of frost days in middle latitude regions and an increase in the number of warm extremes. Ocean temperatures have warmed and, as a result, global sea levels have risen 15 to 20 cm over the course of the 20th century. Snow cover has decreased in many regions, and the extent of sea ice has decreased in the Arctic. There has been a nearly worldwide reduction in mountain glacier mass and extent.

Greenhouse gas (GHG) concentrations in the atmosphere are now higher than at any time in the last 750 000 years. In the absence of controls, future projections are that the rate of increase in carbon dioxide may accelerate, and concentrations could double from pre-industrial values within the next 50 to 100 years. Because today's best climate models are able to simulate the climate of the past century, they are very useful tools for understanding and determining the changes in forcing that have driven global warming. These models show reliably that the global surface warming of recent decades is a response to increased concentrations of GHG in the atmosphere.

This pronounced global climate change is altering the structure and functioning of ecosystems: the feedback structures among components of various ecological systems are changing in response to climate change. These ecological changes may affect the abundance of various species and their population dynamics, both of which in turn may affect economic systems. Ecologically mediated changes may also affect the magnitude of some feedbacks between ecosystems and the climate system. A grand challenge is to understand and project the effects of global climate variability and change on ecosystems, the goods and services that ecosystems provide, the drivers and consequences of human responses to ecosystem variability and change, and ecosystem links to the climate system.

There is growing agreement that changes in the frequency and amplitude of modes of natural climate variability, such as the El Niño/Southern Oscillation (ENSO) and the North Atlantic Oscillation (NAO), profoundly influence a variety of ecological processes and, consequently, temporal and spatial patterns of population and species abundance. Moreover, it has been argued that the responses to anthropogenic forcing may alter the modes of natural climate variability. Since mode variations produce coherent changes in climate over large regions, they impact ecosystems at great spatial scales and have major effects on society in many ways, affecting Atlantic and Pacific fisheries,

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wildfire outbreaks and other disturbances. Modal variability thereby represents a natural subject area in which investigators of climate, ecosystem and climate impact science can — and must — collaborate. Such interdisciplinary collaboration is also required to determine those effects of global change on ecosystems that are most relevant to human society.

Unfortunately, work in these disciplines remains too disparate. Interdisciplinary work is difficult, partly due to great differences in traditions and terminologies, and also because there are too few opportunities for scientists from different disciplines to meet. *Climate Research* is a meeting place for climatologists, ecologists and social scientists: in *Climate Research* papers focus on climate and the effects of climate variation from different perspectives, thereby providing the basis for a better understanding of climate change and its ecological and societal effects.

As Editors-in-Chief of *Climate Research* we aim to further develop the journal so as to include key papers of interest to the broad spectrum of scientists that the journal serves. We welcome submissions of excellent interdisciplinary manuscripts on climate variation and the effects of such variation — manuscripts that aim at understanding the underlying processes, but also at bringing this information to the policy makers.