Workshop motivation

Large variations in the climate system progress only subtly within the time frame of a human lifetime, making it difficult for society to grasp. Climatic changes are thus rarely observed as they happen and can be grasped only in retrospect. Our understanding of the present climate system and our ability to predict changes in the future are therefore strongly influenced by past examples of global climate change. The discovery in 1980 that the demise of the dinosaurs at the end of the Cretaceous was caused by a meteorite impact led to the social realization that a full exchange of nuclear weapons might lead to our own extinction. Society took longer, however, to accept the possibility of abrupt and catastrophic climate change. For example, the sharp change in climatic conditions of the Younger Dryas was first detected in a pollen record excavated in the 1930's. This was a brief event (~1000 years) of abrupt return to glacial conditions during the gradual warming at the end of the last ice age, with worsening climate that was thought to have triggered large social changes. But the realization that fast and potentially socially devastating climatic changes are possible had disseminated only recently in the general society (even if through a distorted Hollywood filter). This was the result of many years of paleoclimate research that analyzed in details the temperatures of the past.

One of the crucial elements is that past climate analysis relies on is a variety of temperature proxies. These are chemical and biological materials that were produced in the past and reflect the climatic conditions under which they were formed. Can we rely on these paleotemperature data? In order to judge that, one has to be mindful of what these proxies represent. Namely, what are these materials, how do they record past temperatures, and what is the context under which each proxy is valid.

The science of climate proxies started with the use of the biological records, using microorganisms in the deep oceans and fossil plants on land to make indirect inferences about local climate. Geochemistry joined the game in the 1950's and 1960's with the discovery that the skeletons of foraminifera, that are a widespread marine microorganism, retained a record of oxygen isotopes that could be used to study the temperatures of the oceans and the volume of glacial ice back to events over a 100 million years ago. In the last two decades this field grew exponentially both in terms of proxy application to create climate records and in terms of development of new proxies. Interpretation of these proxy data, though, relies on calibration and its extrapolation to the past. Correct interpretation requires understanding of the chemical or biological processes that create each proxy and control its temperature relationship.
The Yale Climate & Energy Institute workshop "From Process to Proxy" is a two-day interdisciplinary workshop exploring the fundamental science behind the climate proxies used to estimate past temperatures.

The workshop will provide an opportunity for a broad audience to learn about how records of temperature variations at the Earth's surface are obtained and how reliable these temperature estimates are. It will help economists and anthropologists to understand how seemingly small temperature changes, such as 0.5°C change in 100 years, can be measured and what are the implications of these small changes for ocean and terrestrial environments. It will also enable climate physicists to assess the credibility of the paleoclimate information they apply in models.