Geophysical Research Abstracts
Vol. 13, EGU2011-14221, 2011
EGU General Assembly 2011
© Author(s) 2011

The Future Is Warm but Uncertain

Michael Ghil
Ecole Normale Supérieure, Paris, France, and University of California, Los Angeles, USA

There is considerable confidence as to global warming over the last 100 years and as to the continuation of this trend for the next 100 years[1]. There is also little reasonable doubt about the role of anthropogenic factors — with greenhouse gases overwhelming aerosol cooling — for the last few decades. Substantial uncertainties persist, however, as to the degree and timing of the future warming. These uncertainties are of two kinds: (i) given a certain anthropogenic emission scenario of greenhouse gases and aerosols, what is the range of climate change, not only in global temperatures and large-scale precipitation, but also in the probability distributions of events that are more localized, in space and time; and (ii) assuming the best-possible estimates for (i), what will the actual trajectory of human behavior be, i.e., how will that scenario be selected or modified? This talk will mostly address the first question, but will touch upon the second one, too.

After reviewing the present evidence on the uncertainties[1], we shall try to get at some fundamental causes for them. These causes include, of course, imperfect knowledge on the many physical, chemical and ecological mechanisms that contribute to the climate system's behavior, but also a still imperfect understanding of the dynamics of a complex system like the Earth system[2,3]. Issues of stable or unstable dynamics and statistics with respect to changes in poorly known parameters will be discussed, emphasizing the role of nonlinearities and of random processes in this behavior[4]. Some recent ideas on the systematic optimization of general circulation models will be outlined[5]. The second question will be posed as one of the coupled modelling of the natural and social environment, including one or two surprises as to the results of such coupling[6]. Finally, a road map for this coupled modelling will be outlined, with tongue solidly pressed in cheek.

[1] S. Solomon, et al., *Climate Change 2007: The Physical Science Basis. Contribution of Working Group I to the Fourth Assessment Report of the IPCC* (Cambridge University Press, 2007)

[2]I. M. Held, The gap between simulation and understanding in climate modeling, *Bull. Amer. Meteorol. Soc*., **86** (2005) 1609–1614.

[3]J. C. McWilliams, Irreducible imprecision in atmospheric and oceanic simulations, *Proc. Natl. Acad. Sci. USA*, **104**(2007) 8709–8713.

[4]M. Ghil, D. Chekroun, and E. Simonnet, Climate dynamics and fluid mechanics: Natural variability and related uncertainties, *Physica D*, **237**(2008) 2111–2126, doi:10.1016/j.physd.2008.03.036 .

[5]J. D. Neelin, A. Bracco, H. Luo, J. C. McWilliams, and J. E. Meyerson, Considerations for parameter optimization and sensitivity in climate models, *Proc. Natl. Acad. Sci. USA*, **50**(2010) 21349–21354.

[6] S. Hallegatte and M. Ghil, Natural disasters impacting a macroeconomic model with endogenous dynamics, *Ecological Economics*, **68**(2008) 582–592, doi:10.1016/j.ecolecon.2008.05.022 .