Geophysical Research Abstracts, Vol. 9, 10558, 2007
SRef-ID: 1607-7962/gra/EGU2007-A-10558

Precipitous climate change induced by sea-ice mechanics

J. Hutchings (1), W. Hibler (1 and S. Vavrus(2)
(1) University of Alaska Fairbanks, (2) University of Wisconsin Madison

An important mechanism that can lead to multiple equilibrium states of the Arctic climate system (and hence likely of the global climate system) is the modification of sea-ice flow out of the Arctic Basin by sea ice mechanics. In particular with non-linear plastic sea ice models having significant shear strength, ice flow out of the Arctic Basin may substantially reduced, and in the case of finite cohesive strength the flow may be stopped entirely. In recent work using an idealized seasonal thermodynamic sea ice model together with a plastic sea ice dynamics model employing a coulombic rheology, Hibler and Hutchings (2003) were able to demonstrate the existence of multiple equilibrium states for slightly cooler conditions then the current climate. Moreover since the suite of possible climate states includes unstable states, under climatic warming the transition from a 'low flow' thick ice state to a thinner 'high flow' state more resistant to climate warming can occur precipitously. To examine the degree to which such a transition may have occurred under recent CO2 warming, a combination of observed and simulated climatic forcing over the last 50 years is used to force a dynamic thermodynamic model to investigate the possibility of a precipitous climate change induced by this 'ice mechanics' mechanism. The investigation is carried out both by simulations with fixed seasonal forcing under historical cold conditions as well as current warm conditions, and with actual time varying forcing to elucidate the potential timing of such a transition.