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Simulating Glacial Inception at 115ka: Relative Effects of Orbital Forcing and CO2

F. Otieno(1), M. Essig (2), **R. Oglesby** (2) and D. Bromwich (1)

1. Polar Meteorology Group, Byrd Polar Research Center, Ohio State University
2. Department of Geosciences, University of Nebraska, Lincoln (roglesby2@unl.edu/ +1 402-4724917 / +1 4024721507)

The onset of Northern Hemisphere glaciation at around 115 Ka is thought to have been caused by a number of factors, especially a reduction in atmospheric CO2 and changes due to Milankovitch orbital cycles. To investigate this glacial inception, we used the NCAR CCSM3 GCM in fully coupled mode to simulate the climate at 115.5 ka B.P. Sea level and the distribution of the continents were held at present-day values, since they changed little between 0 Ka and 115.5 Ka. Thus, our model simulation can also be thought of as examining the relative roles of lowered CO2 and orbital configuration in driving glacial inception. In particular, we hypothesize that these climatic forcings will lead to a succession of cool summers and warm wet winters in key regions of the high latitude Northern Hemisphere. In turn, we expect this will be conducive to building the perennial snow pack that is an essential precursor to the Laurentide and Fenno-Scandinavian ice sheets. The exact value of atmospheric CO2 at 115.5 ka is uncertain as ice core data show it decreasing strongly around that time so for our preliminary work we used a low-end value of 180 ppm (e.g., such as occurred at the last glacial maximum). This simulation did lead to the buildup of perennial snow in high northern hemisphere land areas, especially where nucleation of the Laurentide ice sheet is thought to have occurred. Additional inception regions appear over Alaska and Siberia where the presence or absence of ice is more controversial. The orbital forcing appears to work together with the lower CO2 in the northern hemisphere, but to strongly oppose it in the southern hemisphere. Indeed, in the southern hemisphere the simulation had somewhat warmer conditions and slightly less sea ice than a prein-

dustrial control with 290 ppm CO_2 and present-day orbital configurations. Model results are also compared to the limited amount of geologic data available for that time period. Future work will examine more realistic CO_2 values of 230-250 ppm, as well as separate the effects of CO_2 and orbital forcing.