Study in Mathematical Climate Modeling

Amanda Gartside, Class of 2012

My independent study focused on finding questions in climate science that can be analyzed through simple mathematical models, building upon the work of my professor, Mary Lou Zeeman, and the Math Climate Research Network (MCRN) (http://www.mathclimate.org/).

Specifically, I focused on an update of Mihal Budyko’s ice-albedo feedback model that calculates temperature of the Earth at a given latitude. In her 2010 thesis, Esther Widiasih introduced the movement of the iceline into the model, and I explored the McGehee and Widiasih model (2010).

As shown in Figure (1) below, I wrote a MatLab program using nulcline analysis on the system of two equations “wdot,” which represents the changing partial average temperature, and “ndot,” which represents the changing iceline. I confirmed the finding that the first rest point is a saddle and the second is a sink. Furthermore, I graphed in Figure (2) the intersection of the wdot and ndot equations, as w and n varied. As is evident from the graph, the changing partial average temperature has a slow but steady relationship with the movement of the iceline. Moving forward, I hope to analyze the effects of solar forcing in addition to building other components of climate into the model.

Figures (1) and (2)

Faculty Mentor: Professor Mary Lou Zeeman

Funded by the National Science Foundation, “Mathematics and Climate Research Network” Grant

References