CCSM portal projects:

CCSM3.0(Community Climate System Modeling) is a fully coupled state of the art climate model that is developed at the National Center for Atmospheric Research(NCAR). NSF funds have allowed Purdue to develop a user interface where students and researchers can set up and run CCSM3.0 on the Steele computing cluster at Purdue. A course taught by Dr. Matthew Huber, and Dr. Leigh Raymond during the Fall of 2009, allowed students to use the CCSM portal to explore geoengineering solutions to mitigate the affects of climate change. All modeling simulations were run for 100 years. In addition, all results are compared against a control carbon dioxide case where pCO2 is in increased 1% per year to explore how effective our engineering approaches are when faced with enhanced carbon dioxide. This creates a realistic experiment which explores how future pCO2 changes will affect our mitigation strategies.

Student Project 1: Changing albedo of the earth to reflect incoming solar radiation and reduce global temperatures.

Currently, global climate models predict that global temperatures will increase due to anthropogenic carbon dioxide increases. Project 1 focused around changing vegetation and forest albedos within the land model component of CCSM3.0 to look how this would affect global temperature. Albedo can be defined as the reflectivity of the object. The hope is that higher plant albedos will reflect more incoming sunlight thus reducing global temperatures. Plant albedos were doubled in the tropical and mid-latitude regions and figure 1a shows the anomalous changes in global albedo. Results show that plant albedo is increased over the areas where we manually increased albedo. Interestingly, results showed an increase in global temperature. Our albedo changes in Africa and South America caused equatorial temperature gradients to shift due to large decreases in tropical temperatures, resulting in increased poleward heat transport, thus diminishing any reductions in incoming solar radiation and temperature seen in tropics. This project was not able to show that increases in plant albedos decreases global temperature.

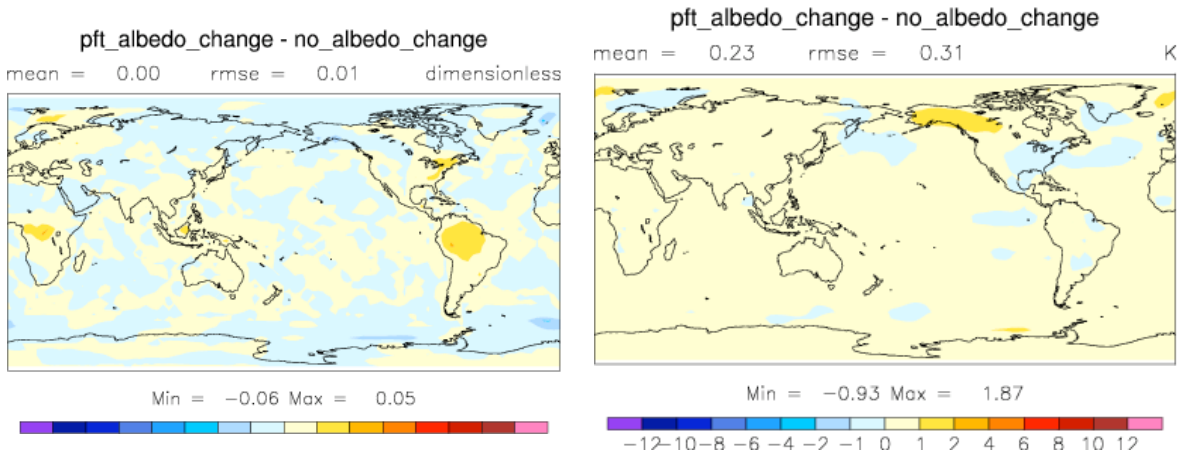

Figure 1: 1a shows the increases in albedo due to the increase in plant reflectivity. 1b shows the temperature anomaly that is driven by the albedo changes compared with the ramped carbon dioxide cases in Kelvin.

Student Project 2: Reforestation of tropical regions to increase precipitation and decrease temperature.

Group 2 chose to reforest the tropical regions around 20 North to 20 South in hopes of increasing rainfall due to increased evapotranspiration and cloud cover. Results show a slight decrease in global temperature around .02˚C, and large increases in tropical precipitation around 1.37 cm/year. Temperature anomalies are seen in figure 1a and precipitation anomalies in cm/year are seen in figure 1b. Both results can be seen as fairly positive. Especially the increases in precipitation over many tropical regions, which are always in need of precipitation. In addition the small decrease in global temperature forced by reforestation shows that this approach may be a piece of the puzzle in mitigating climate change issues.

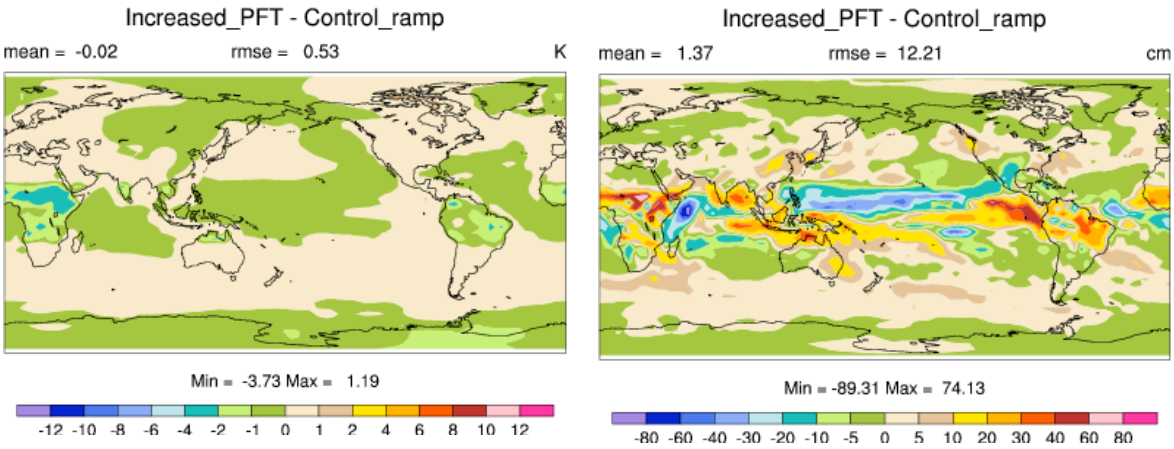

Figure 2: Anomaly for global temperature(Kelvin) compared against the ramped carbon dioxide control run seen in figure 2a. Cumulative precipitation(cm/year) anomaly seen in figure 2b.

Students at work:

Insert pictures of students working on CCSM portal