Application Name	
Application Area	Climate modeling
Keywords	Snow cover, atmospheric, NCAR mesoscale model, sea ice, CAM3,
Project/Dept. Affiliation	University of Delaware / Department of Geography; Office of Information Technologies
Value of grids to this application	CAM3 is currently running on a department Linux box which is a single processor 1.5 GHz box. One year of model output from the CAM using the DOM takes approximately 5-6 days real time. For the proposed study, the use of a multi-processor machine would greatly broaden the scope of the study allowing for the use of the SOM. An interactive ocean and sea ice surface would illustrate a more dynamic and realistic response to the hemispheric snowcover perturbations.
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Participating sites	Delaware

General description	**Background:** The presence of snowcover in the Northern Hemisphere represents an important component of the global climatic system. High reflectivity associated with fresh snow affects the energy balance of a region by increasing surface albedo and thermal emissivity and consequently the amount of infrared radiation lost to the atmosphere (Wagner 1973; Robinson and Kukla, 1985; Walland and Simmonds, 1997). Snow also acts as a thermal insulator due to its low thermal conductivity resulting in decreased sensible heat flux from the ground into the lower atmosphere. Energy allocation involved in the warming and melting of the snow pack serves as a sink for latent heat (Cohen and Rind, 1991), thus making snowcover a useful tool for detecting changes in climate (Scialdone and Robock, 1987). It is therefore assumed that snowcover anomalies on both continental and hemispheric scales affect interannual and interseasonal Northern Hemisphere climate variability. Snowcover-atmosphere interaction has been the subject of much climate modeling research in recent years. Most studies have focused on Siberian or Eurasian snowcover anomalies' potential interaction with the atmospheric teleconnection modes such as the Arctic Oscillation (Gong et al., 2003; Gong et al., 2004). Although the tendency has been to concentrate on Eurasia due to the magnitude of snowmass, those which consider North American snowcover have generally found a weak and inconsistent relationship with downstream climate. **The proposed study:** Previous modeling studies using general circulation models (GCMs) have investigated the potential impacts of anomalous snowcover on the atmosphere and atmospheric teleconnection modes. However these studies have exclusively been carried out using a Data Ocean Model (DOM), in which sea surface temperatures (SSTs) are forced to a historical monthly average and cannot be modified by atmospheric processes. The use of a static ocean surface greatly inhibits interpretation of model output as cause and effect relationships between different climate variables can only be inferred. Furthermore, studies investigating the influence of SSTs on atmospheric circulation have shown statistically significant lagged relationships between large-scale SST anomalies and subsequent mid-tropospheric anomalies in the North Atlantic (Czaja and Frankignoul, 1999). The study being proposed would investigate the impact of realistic snowcover perturbations, both extreme positive and negative anomalies, in North America and Eurasia and any subsequent impacts on atmospheric circulation patterns. Realistic anomalies would be based upon historical observations, satellite and gridded data. Influence on Arctic and/or North Atlantic Oscillation type patterns will be explored in particular. This experiment would be carried out using the National Center for Atmospheric Research (NCAR) Community Atmospheric Model (CAM) together with the Slab Ocean Model (SOM), allowing an interactive ocean surface. The SOM uses specific mixed layer depths and seasonally and geographically varying ocean heat fluxes to calculate SST while sea ice is calculated by a multilayer thermodynamic model (Kiel et al., 1998). The resulting SST is the mixed layer temperature output and the sea ice fraction and depth are predicted rather than forced from a boundary dataset.

Anticipated system requirements for SURAgrid nodes running this application	As noted above, CAM3/DOM requires 5-6 days of processor time on a basic Linux/Intel box running at 1.5 GHz in single-processor mode. (Our experience is that single processor runs scale fairly proportionally to the rated processor speed.) CAM3/SOM does not require a massively greater amount of processor time per simulated year, but it requires a significantly greater amount of years to be simulated. A simple CAM3/DOM project looking at the season effects of some specified surface condition would require essentially no spinup, on the order of 10 years of ensemble (i.e., 10 repetitions of the "experiment" to obtain some statistical reliability), and these 10 years would need to be repeated at least twice to provide control and perturbation. Hence, a minimum, basic research project would involve 20 years of simulation. A CAM3/SOM project may take up to 40 years to stabilize the ocean (commonly called "spinup"), and would have to be spun up separately for control and perturbation. Because of the greater persistence, it is also likely that 10 year runs would not be sufficient for statistically reliable ensembles, as "independence" might require several years for each case. We are thus looking at roughly a factor of 10 increase in length of time required. In the scale of a graduate student's education cycle, this is a particularly important factor of 10. With CAM3/DOM, a basic experiment can be done in a couple of months, then followups and variations can be done in response to the first set, all within a matter of a fraction of a year. With CAM3/SOM, run times in excess of a year, with no chance for followup, would make this a highly unpalatable prospect for most students. Most of the improvement in calculation time would come from the ability to implement multi-processor capabilities. We note that these models are already intensively optimized to work in a parallel environment on IBM SP-family computers, reflecting the NCAR computing environment from which they originate.
Anticipated non-system requirements for SURAgrid nodes running this application	We would anticipate doing graphics and data analysis at UD, so printing and long-term model output storage will not but needed from SURA. I am not quite sure what they mean by this.
Grid focus (data sharing, computation, access to unique resources, collaboration)	Computation
Network dependencies (bandwidth, latency, multicast, other)	None
Expected frequency of application run (one-time, occasional, monthly, weekly, daily…)	"Frequency" is 2 to 10 runs per research projects, depending on how many variations on the experimental perturbation will be needed. At most, 2 to 4 of these can be running at once, typically, without making serious guesses as to how things are going to work. As noted above, each run could be taking a considerable amount of time.
Estimated start date for application run	June 15, 2007
Describe expected application invocation mechanism (by user submitting job, programmatically by some event or timing…)	User submitting job via sshGrid

Is this application open to others to use with their own data or revisions?	CAM3 with its various subcomponents and related models including DOM and SOM, are products of the National Center for Atmospheric Research (NCAR). NCAR is mandated to produce these models in such as way that they are distributable widely, both legally (open licensing with essentially no restrictions) and practically (written and documented with porting by others to non-NCAR sites in mind).
Additional comments	