Session: C11 Poster: M121A

Impact of daily Arctic sea ice variability on an atmospheric GCM

Dyre Dammann[†]; Uma Bhatt; Jeremy Krieger; Peter Langen; Xiangdong Zhang
[†] University of Alaska Fairbanks, USA
Leading author: dodamman@alaska.edu

The arctic sea ice plays an important role in the climate system in the way that changes in the extent has the ability to drastically alter fluxes, temperature and albedo at the sea surface. The sea ice is in a state of constant change due to annual fluctuations in incoming solar radiation, but the sea ice show a much higher frequency of inter-annual variability. We have studied sea ice concentration (SIC) data created from passive-microwave satellite images (Comiso et al. 2003) and found significant day-to-day change. Today's global climate models (GCMs) are not including daily data when forcing the model with SIC, but instead use interpolated/splined values based on temporal means, which reduce the variability of the forcing. Comparing SIC output from a coupled NCAR CCSM3.0 (Collins et al. 2006) model simulation with observations verifies an underestimated frequency of variability in the model. We hypothesize that when forcing GCMs with daily observed SIC data we will get a significantly different atmospheric response than if forcing with a lower variability dataset. In this study we made changes to the NCAR CAM3 to enable daily SIC forcing. The daily SIC forcing data set was created from passive-microwave satellite sensors using the boot-strap algorithm (Comiso et al. 2003). The SST forcing is part of NOAA extended reconstruction of historical SST using improved statistical methods. All simulations in this project used climatological (1982 -2007 averages) SST and Antarctic sea ice. We ran a control simulation (100 years) using monthly mean ice conditions smoothed to daily values using averaged climatological SIC values in the arctic. Our three other experiments consist of seventeen months simulations forcing the arctic with a version of 2006-2007 SIC conditions. First experiment (DAILY) uses daily values (100 ensembles), second (SMTH) uses monthly smoothed daily values (100 ensembles) and third (SPLN) uses splined values from monthly averages (50 ensembles). The SMTH forcing for the second experiment was created by slightly adjusting the peaks of the thirty day running average of the daily values (in each grid point) ensuring equal monthly average in DAILY and SMTH. This is not the case for the forcing in DAILY and SPLN. Analyzing the differences between ensemble averages of model outputs of DAILY and SMTH don't show a large response in circulation over all. However significant features in SLP can be observed in certain months. With a 99% confidence we observe a difference (DAILY - SMTH) in SLP of 2.5hPa in the months forced with Sep.06 conditions over Murmansk, Russia, -3.5hPa in Dec.06 over northern Siberia and 2hPa in the Bearing Sea of the same month. Running each ensemble of all four experiments through a storm track algorithm (Zhang et al. 2004) show interesting features. Both in the Arctic (55N-90N) and in mid-latitudes (30N-55N) the ensemble average show of DAILY shows a higher storm count than SMTH for almost all months. We have observed differences in storm density of up to 43% when analyzing 10x10 degree boxes in the ensemble average for individual months. Surface flux difference (DAILY-SMTH) tends to be significantly negative in the Arctic Ocean, Chukchi Sea and Sea of Okhotsk during winter months. References 1. Collins, W. D., et al. (2006), The Community Climate System Model version 3 (CCSM3), J Climate, 19(11), 2122-2143. 2. Collins, W. D., et al. (2006), The formulation and atmospheric simulation of the Community Atmosphere Model version 3 (CAM3), J Climate, 19(11), 2144-2161. 3. Comiso, J. C., et al. (2003), Sea ice concentration, ice temperature, and snow depth using AMSR-E data, Ieee T Geosci Remote, 41(2), 243-252. 4. Zhang, X. D., et al. (2004), Climatology and interannual variability of arctic cyclone activity: 1948-2002, J Climate, 17(12), 2300-2317.