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Modifying the current sea ice thickness initialization in CFSv2 to improve prediction of Arctic surface sea ice

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Sea ice thickness has been known to influence patterns of surface sea ice concentration for several months into the future. Here, two sea ice thickness datasets were investigated, namely from the National Centers for Environmental Prediction (NCEP) Climate Forecast System Reanalysis (CFSR) and the Pan-Arctic Ice Ocean Modeling and Assimilation System (PIOMAS) developed at the Polar Science Center. Monthly data from 1982-2013 were used. The focus was on the predictability of the September sea ice minimum. Both CFSR and PIOMAS assimilate observed sea ice concentration which is then used to produce sea ice thickness values. It was found that PIOMAS had a greater downward trend in total sea ice volume in the last ten years. Comparisons to Ice, Cloud, and Land Elevation Satellite (ICESat) data revealed better agreement from the PIOMAS sea ice thickness data than from the CFSR data.

To assess the impact of interannual anomalies of sea ice thickness, correlations between detrended anomalies of sea ice thickness from CFSR and PIOMAS and September sea ice concentration from NASA Team were calculated. For detrending, the best fit second order polynomial was removed from the raw data for both thickness and concentration. Findings showed that the area of significant increase in correlation when using the PIOMAS ice thickness dataset was greater than the area where there was a significant correlation decrease relative to using CFSR ice thickness. While the pattern was most prevalent out to a 3 month lead, it was still seen to some degree out to a 6 month lead.

Using this information hindcasts were carried out using Version 2 of the Climate Forecast System (CFSv2) model forced with PIOMAS ice thickness rather than CFSR and initialized in the month of March for the years 2009-2014. Results show an improvement in the prediction of September sea ice coverage using the PIOMAS data. However, the new hindcasts were not perfect, particularly in the prediction of sea ice concentration which was overestimated when PIOMAS data were used. Despite these imperfections, the fact that the hindcasts have some improvement in skill out to a six month lead show promise for creating a better prediction of Arctic sea ice cover using the PIOMAS dataset.