Pan-Arctic Sea Ice Prediction System with the MIROC Climate Model

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Under the GRENE project, we have developed the prediction system for the Pan-Arctic sea ice with the climate model MIROC5 (Watanabe et al., 2010) that has an improved sea ice module (Komuro et al., 2012). So far we have conducted a series of assimilation experiments and prediction experiments. Here we present the newest experiments and discuss their results. We performed assimilation experiments from 1975 to 2011 using the MIROC5 whose the atmosphere component has a resolution of T42 and L40 and the ocean component has a resolution of 1.4° x 0.5° - 1.4° and 50 levels. The method used for the assimilation is a simplified version of an incremental analysis update (Bloom et al., 1996). The data for used the assimilation are ocean temperature, salinity, and sea-ice (Ishii and Kimoto, 2009), and air-temperature and wind from the ERA and ERA-Interim. Further, we carried out ensemble prediction experiments with 8 members, which were initialized by the assimilation experiments. Theses experiments were started from initial state of January, April, July, and October. We compared the reproducibility of sea ice in September and investigated the predictability. The assimilation followed the observed trend and inter-annual variations in sea ice well. In contrast, the prediction started from July captures well the observed features except for 2007, but not for January, April, and October cases. The prediction skill is also better in April and July than January and October. In addition to above experiments, we have participated in the Arctic Predictability and Prediction On Seasonal to Inter-annual Timescales (APPOSITE) project and performed control simulation and ensemble predictions with MIROC 5.2, following the APPOSITE protocol, to investigate the Arctic sea-ice predictability. It was found, from lagged correlation analysis using our APPOSITE control-run data, that the potential predictability were 1-2 and 2-3 years for sea-ice extent and volume (not shown), as in the previous studies (Blanchard-Wrigglesworth et al., 2011a). Furthermore, two re-emergence features can be seen in the sea-ice extent, which is attributed to the memory of ocean temperatures and sea-ice thickness. We have currently been developing the sea ice assimilation system with the Ensemble Kalman Filter and also examined the further key processes for improving the Pan-Arctic sea ice prediction system, which will be discussed during the presentation.

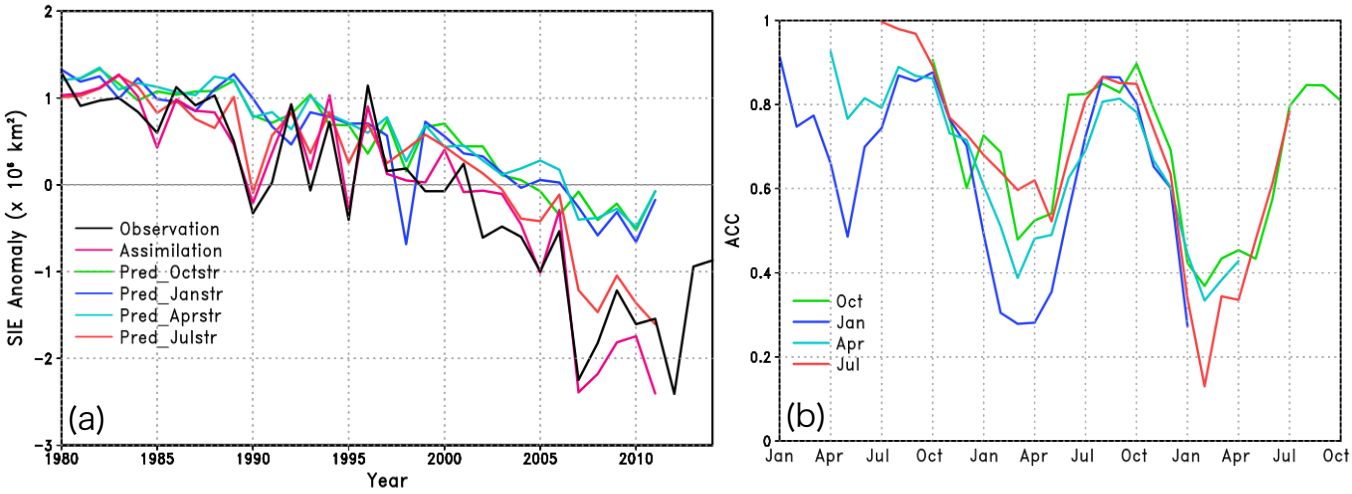

Figure 1. (a) Monthly September Arctic sea ice extent anomaly in 1980 to 2011. The result started from January is shown in blue, April in cyan, July in red, and October in green. Assimilation and observation are also shown in magenta and black (up to 2014). (b) Lead-time dependence of Arctic sea ice extent anomaly correlation.

References

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