二つの MIROC GCM における北極域温暖化増幅プロセスの季節性について

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Seasonality of processes contributing to Arctic warming amplification in two MIROC GCMs

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The Arctic is experiencing a rapid warming in recent years with magnitude larger than the rest of the world. This so-called Arctic amplification was predicted decades ago by numerical simulations and verified by observations more recently. While albedo feedback is the most cited, many other processes operate simultaneously and were also suggested as important in previous studies. It is challenging to quantify systematically the relative importance of such processes in the Arctic warming, yet necessary in order to understand the mechanism. Yoshimori et al. (2013) took a step forward by applying a feedback analysis method, called Climate Feedback-Response Analysis Method (CFRAM) originally proposed by Lu and Cai (2009), to two and four times CO_2 equilibrium experiments in the MIROC3 GCM. The diagnosis quantified the relative importance of individual feedbacks, and provided insight into what processes contribute to the enhanced Arctic warming than the global average and what processes contribute to the enhanced Arctic surface warming than aloft. The analysis was, however, only applied to the annual mean field. The lack of seasonal analysis is a concern as different physical processes may be dominant in different seasons, and may impede our understanding. In the current study, we apply the CFRAM analysis to monthly model output by including additional terms omitted in Yoshimori et al. (2013), in order to investigate the seasonality of processes contributing to the Arctic warming. In addition, the identical experiment performed by two different versions of MIROC GCM, MIROC4 and MIROC5 is analyzed, allowing underscoring a robust result. It is a transient experiment in which CO_2 concentration is increased by 1% per year and the 20-year average centered at the year 70, which corresponds to the year of doubled CO_2 concentration, is analyzed. The smallest warming occurs in June-July, the largest reduction of sea ice concentration occurs in September, and the largest warming occurs in October-November-December (OND). We will present the contribution of individual feedbacks to the seasonal Arctic warming, and the contrast between summer and late autumn (OND).

References

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