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A Diagnosis of Contributing Processes in Maintaining Arctic Amplification in MIROC GCM

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Both observational and model studies show enhanced warming in the Arctic compared to lower latitudes in response to increasing level of greenhouse gases. There have been many proposed mechanisms that contribute to this "Arctic amplification". In order to understand the mechanisms of Arctic amplification and verify each process represented in models, it is essential to first identify and quantify the relative importance of individual processes. While the traditional feedback analysis evaluates radiative effect of processes relevant to radiation at the top of the atmosphere, it does not provide other important information such as the effect of meridional heat transport change. CFRAM, recently proposed diagnostic by Lu and Cai (2009, Clim. Dyn., 32, 873-885), does provide a more complete picture of contributing processes for temperature change. Here we apply this relatively new method to a general circulation model MIROC with partially utilizing the information from the traditional radiative feedback analysis (PRP), and examine the important processes that determine the temperature response in the Arctic to different levels of atmospheric carbon dioxide concentration. We emphasize how processes other than albedo feedback is important in creating the temperature response contrast between Arctic and lower latitudes.