Contributing Processes to Arctic Temperature Amplification for a Range of Forcing in MIROC GCM

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The finding that surface warming over the Arctic exceeds that over the rest of the world under global warming is a robust feature among general circulation models (GCMs). While various mechanisms have been proposed, their contributions have not been systematically quantified. Such diagnosis is an important task in order to understand model behavior and operating mechanisms. Here we apply a recently proposed feedback analysis technique to a GCM under different external forcings. The contribution of individual feedbacks to enhanced Arctic temperature change relative to low latitudes, an essential feature of Arctic amplification, is quantified. Surface temperature response in the Arctic is amplified by radiative feedbacks of albedo, water vapor and clouds, and large-scale condensation heating. This diagnosis is consistent with increased moisture transport from lower latitudes, and reduced sea ice cover and consequent increased evaporation under warming. Albedo feedback is not always a predominant factor and the change in evaporative cooling equally contributes or exceeds it in some cases in maintaining the anomalous meridional temperature contrast. As a consequence, the sign of the total radiative feedback contribution to the contrast depends on the forcing, but the total non-radiative feedback contribution is consistently positive. An important contribution to the contrast is also made not via the ‘dry’ heat transport process but through the hydrological cycle.