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Mesoscale modeling of convective feedbacks over an ice-free Arctic Ocean

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Extreme high latitude polar warmth during the Eocene remains a puzzle. Coupled climate models generally fail to maintain wintertime arctic conditions above freezing, despite very high imposed carbon dioxide concentrations. Proposed solutions to this problem have involved either mechanisms that would enhance meridional heat fluxes (e.g. Emanuel and Korty (2007), who proposed a feedback via an expanded region of hurricane activity) or by mechanisms that would preferentially increases the greenhouse forcing over the polar regions (e.g. Sloan and Pollard (1998) who imposed polar stratospheric clouds). The former category of mechanisms have yet to be shown to have sufficient ability to warm the Arctic (which was largely cut off from the world ocean during the Eocene) while the latter face the difficulty of maintaining sufficient cloud depth despite sedimentation of cloud ice (Kirk-Davidoff and Lamarque (2007)). Here we investigate the possibility that deep convective feedbacks over a winter time Arctic ocean could resist wintertime cooling of the arctic ocean by enhancing high cirrus outflow. GCMs might be expected to represent such feedbacks poorly, since their convective parameterizations are tuned to represent present day conditions, which never include the combination of warm surface temperatures (10° C), low cold tropopause, and effectively permanent night. We will present analysis of experiments using a mesoscale model (the Weather Research and Forecast (WRF) model) that explicitly represents convective storms. We run the model for a 500 km square region of the Arctic Ocean, under conditions of high surface temperature (10 to 15° C), with boundary conditions specified using output from the NCAR Community Atmospheric Model, run with fixed sea surface temperatures.