Japan Geoscience Union Meeting 2013
(May 19-24 2013 at Makuhari, Chiba, Japan)

ACC03-01 Room:101B Time:May 22 09:00-09:20

Polar amplification: major drivers and implications for global climate

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Surface albedo feedback is widely believed to be the principle contributor to polar amplification. However, a number of studies have shown that coupled ocean-atmosphere models without ice albedo feedbacks still produce significant polar amplification in 2xCO2 runs due to atmospheric heat transports and their interaction with surface conditions. The relative importance of atmospheric heat transport and surface albedo is assessed in a hierarchy of models. While both processes are shown to contribute to the polar amplified response of the model, feedback analysis points to a tendency for surface albedo to mask the effect of atmospheric heat transport in the full model.

Global climate models predict polar amplified pattern of warming in the Northern Hemisphere (NH) high- to middle latitudes during boreal winter. However, recent trends in observed NH winter surface land temperatures diverge from these projections. For the last two decades, large-scale cooling trends have existed instead across large stretches of eastern North America and northern Eurasia. We argue that this unforeseen trend is probably not due to internal variability alone. Delayed freeze-up in the Arctic and the consequent heat input in the atmosphere lead to significant changes in the circulation caused by a number of factors. Those factors include a direct response to the heat anomaly over the open ocean and a dynamic response to changes in the snow cover in northern Eurasia. Understanding this counterintuitive response to radiative warming of the climate system has the potential for improving climate predictions at seasonal and longer timescales.

Keywords: global warming, polar amplification