Japan Geoscience Union Meeting 2015
(May 24th - 28th at Makuhari, Chiba, Japan)

ACG31-02 Room:201B Time:May 25 15:30-15:45

The effect of atmospheric heat and moisture transport on Arctic warming under the elevated CO_2 experiment

YOSHIMORI, Masakazu[1*] ; ABE-OUCHI, Ayako[2]

[1]Hokkaido University, Faculty of Environmental Earth Science, [2]University of Tokyo, Atmosphere and Ocean Research Institute

It is well known that, under the elevated atmospheric CO_2 concentration, the Arctic experiences larger warming than the rest of the world. In this so-called Arctic amplification, ice albedo feedback plays a central role (Yoshimori et al., 2014a). While the ice albedo feedback is a process unique to the polar region, the magnitude of the Arctic warming is well correlated to the global mean warming among climate models, indicating a strong coupling of the Arctic to the rest of the world. In order to elucidate how the extra-Arctic warming remotely influences the Arctic warming, we conducted sensitivity experiments which isolate the remote and local effect by using an atmospheric general circulation model with thermally interactive and non-interactive ocean mixed layer depending on the region. We note, however, that the effect of ocean circulation change is not considered here. The resulting Arctic warming is generally larger when the model is forced by the remote warming, rather than responding to the local CO_2 increase. This indicates that much of the Arctic warming under the elevated CO_2 condition is initially induced by the lower latitude warming via the increased atmospheric heat transport. An additional experiment separates the following two effects: the initial Arctic atmospheric response to the remote warming and the subsequent effect of ice-ocean changes on the Arctic warming. In addition to the surface energy balance analysis, the climate feedback and response analysis method (CFRAM) following Yoshimori et al. (2014b) reveals that the remote warming initially warms the Arctic surface via the increased downward longwave radiation due to an enhanced greenhouse effect of water vapor and cloud as well as via the increased large-scale condensation and decreased evaporative cooling. Once the ocean temperature and sea ice cover is allowed to respond, the greenhouse effect of cloud increases substantially (positive feedback) while the evaporative cooling increases (negative feedback).

Yoshimori et al. (2014a) Clim. Dyn., 42, 1613-1630.
Yoshimori et al. (2014b) J. Climate, 27, 6358-6375.

Keywords: climate modelling, Arctic amplification