A study on the paleoclimatic change in the Asia during the Cretaceous (145~65Ma) with MIROC AOGCM

Taro, Higuchi*[1], Ayako Abe-Ouchi[1], and Wing-Le Chan[1]
1 Atmosphere and Ocean Research Institute, The University of Tokyo, Kashiwa, Japan
*Correspondence to: taro-h@aori.u-tokyo.ac.jp

The Cretaceous (145~65 Ma) is known as one of the warm periods, comparable to global warming prediction of near future due to rising CO_2 concentration in the atmosphere. Paleoclimatic study in the Cretaceous is important for the understanding of Earth system operating during greenhouse conditions. The “mid-Cretaceous” (125~90 Ma) was a time of extraordinarily high atmospheric CO_2 concentration (>1000 ppm) during the Cretaceous, and many studies have reported the aridification in the Asia associated with water cycle change during the mid-Cretaceous. Hasegawa et al. (2012) suggested the paleoclimatic change may be attributed in the equatorward shift of the subtropical high-pressure belt caused by Hadley cell shrinkage due to increasing CO_2 levels. However, this hypothesis is inconsistent with the global warming prediction with GCM. In this study, we set up the Cretaceous configuration experiments using AOGCM MIROC 4m which differ only in the atmospheric CO_2 concentration, and aim to investigate the water cycle response on the Cretaceous geography and continental distribution due to increasing CO_2 concentration. We found the precipitation in the Asia decreases with increasing atmospheric CO_2 concentrations on the Cretaceous geography, while increases on the Present Day. This precipitation change obtained by the Cretaceous experiments is consistent with the paleoclimatic change in the Asia during the mid-Cretaceous, despite no remarkable change of the meridional atmospheric circulation change Hasegawa et al. (2012) proposed. This implies that the paleoclimatic change in the Asia during the Cretaceous can be explained by local water cycle change with increasing CO_2. Additionally, to evaluate the difference of the water cycle response between Present Day and Cretaceous experiments due to increasing CO_2, we focus on the Tibet plateau and similarly set up the sensitivity experiments to the CO2 levels using the Present Day configuration “without Tibet Plateau”. The experiments show the precipitation in the Asia decreases with increasing atmospheric CO_2 concentrations, which is comparable with Late Cretaceous experiments. These results indicate that local water cycle change due to increasing CO_2 is strongly dependent on the mountains or continental distribution and Tibet plateau is important to determine the basic field and climate change in the Asia to increasing CO_2.

Key words: Paleoclimate, Cretaceous, MIROC AOCGM, Tibet plateau

References

Hasegawa, H., R., Tada, X., Jiang, Y., Suganuma1, S., Imsamut, P., Charusiri, N., Ichinnorov, and Khand, Y. (2012) Drastic shrinking of the Hadley circulation during the mid-Cretaceous Supergreenhouse. Clim. Past, **8**, 1323-1337, doi:10.5194/cp-8-1323-2012