

The difference of hemispheric climates under the influence of astronomical forcing

Zhipeng Wu^{1,2,3}, Qiuzhen Yin¹, Andre Berger¹, Zhengtang Guo^{2,3,4}

¹Georges Lemaître Center for Earth and Climate Research, Earth and Life Institute, Université catholique de Louvain, Louvain-la-Neuve, Belgium

²Key Laboratory of Cenozoic Geology and Environment, Institute of Geology and Geophysics, Chinese Academy of Sciences, Beijing, China

³University of Chinese Academy of Sciences, Beijing, China

⁴CAS Center for Excellence in Life and Paleoenvironment, Beijing, China

e-mail: zhipeng.wu@uclouvain.be

The response of climate system to astronomical parameters is a very important scientific issue, but the internal processes and feedbacks are still not very clear. In order to discuss the difference of hemispheric climates under the influence of astronomical forcing solely, a more than 90,000-year long transient simulation starting from 511 ka BP is performed with only varying insolation forcing. The results of surface air temperature (SAT), sea surface temperature (SST) and sea ice are analyzed. Our results show that the most interesting difference between the Northern (NH) and Southern (SH) Hemispheres is in the sea ice variability. Precession plays a dominant role on sea ice in the NH mainly due to its response to the local summer insolation. The Arctic sea ice is also influenced, but to a less degree, by the northward oceanic heat transport (mainly via the Atlantic meridional overturning circulation). However, obliquity plays a dominant role on sea ice in the SH. First, a smaller obliquity leads to lower insolation in high latitudes and finally to a cooling and more sea ice formation. Second, a smaller obliquity leads to larger latitudinal temperature and pressure gradients, and then to stronger westerly winds, which cool the sea surface and leads to more sea ice formation in the Southern Ocean. For the SAT and SST, precession plays a dominant role at low latitude in the NH and SH, because both of them involves vegetation feedbacks and meridional oceanic heat transport. Compared to low latitudes, middle and high latitudes are more influenced by obliquity. This is partly due to the increased role of obliquity on the daily insolation towards the high latitudes, and is also due to the increased role of the atmospheric heat transport on the SAT at high latitudes. Precession is more important in the NH middle and high latitudes than SH due to the vegetation and sea ice feedbacks. More details on the atmospheric and oceanic processes and feedbacks will be presented.