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Asian Monsoon Years (2007-2012): Back-trajectory analyses of water vapor in Northern Mongolia

Yuriko Koike[†]; Jun Asanuma
[†] University of Tsukuba, Japan
Leading author: koike@suiri.tsukuba.ac.jp

In this study, the origin and transport pathways of water vapor were estimated that contribute to the precipitation in northern Mongolia using back-trajectory analyses. A back-trajectory model of atmospheric water vapor in an isentropic coordinates was developed, that can be used to examine the origin of rainwater. In this study, Japanese 25-year Reanalysis / JMA Climate Data Assimilation System (JRA-25/JCDAS) of the Japan Meteorological Agency [Onogi et al., 2007] was used for 3D field of meteorological variables for the calculation. In an effort to find out factors causing droughts the model was applied to rainfall at a surface station in northern Mongolia called Kherlenbayan-Ulaan(KBU). First, the model was compared with two other models, namely , Meteorological Data Explorer of the Centre for Global Environmental Research(METEX/CGER) [Zeng et al., 2003], and the trajectory model of the National Institute of Polar Research(NIPR model) [Tomikawa and Sato, 2005], to find that model results are fairly robust within 5days from the computational start, i.e., the end of the trajectory, regardless of different datasets and schemes employed. Then, the model was applied to the observed precipitation during the warm season of 2003 and 2005 with relatively larger and smaller rainfall respectively. Trajectory lines of water vapor ended at KBU were computed over prior 5days. In order to track at the altitude with the largest amount of water vapor content, we calculated at the isentropic level of 300K, 310K, and 320K. The results show that, in general, surface sources of rainwater at KBU are located to the north and the west, which include central Asia, Siberia, the Atlantic Ocean and the Arctic Ocean. This result is consistent with the result of previous study [Sato et al. 2007] which used a regional climate model (RCM). The trajectories in the wetter year of 2003 and the drier year of 2005 showed a significant difference from each other as follows: 1) There are more trajectory lines traveling from the north in 2003 than in 2005, and 2) the value of specific humidity above KBU when the trajectory line traveling from the north was tends to be higher with the northern trajectory lines than with the western trajectory lines. And the amount of precipitation associated with the northern trajectory lines in 2003 was larger than that in 2005. From these results, it can be hypothesized that with the more trajectory lines from the north the more precipitation during the warm season at the northern Mongolia. In addition, back-trajectory analyses of water vapor ware proved to be of use when analyzing the source of rainwater.