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**Title:** *The impact of radiosonde data over the ice-free Arctic Ocean on the atmospheric circulation in the Northern Hemisphere*

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We investigated the impact of radiosonde data from the ice-free Arctic Ocean, obtained by the Japanese R/V Mirai during a cruise in the fall of 2010, on the AFES-LETKF experimental ensemble reanalysis version 2 (ALERA2) dataset. The analysis used radiosonde data over the ice-free region. Compared with observations, it captured Arctic cyclogenesis along the marginal ice zone, including a tropopause fold, very well. Without the observations, a 5 K cold bias in air temperature was found, suggesting that radiosondes over the Arctic Ocean are vital for reproducing the change in tropopause variability. As a consequence, a tropopause height difference was formed and persisted after cyclogenesis, increasing the sub-polar jet in ALERA2 by 3 % at 65-70N. The air temperature in the whole troposphere north of 70N showed a cooling in the 2 weeks after cyclogenesis, whereas a warming was observed in the lower stratosphere, reflecting the regional impact of the intensive radiosonde observations. A remote response of the radiosondes over the Arctic Ocean to the mid-latitudes was discussed by focusing on the density of observing network and seasonal march of atmospheric circulations. Our results demonstrated that the high-temporal radiosonde observations over the Arctic Ocean help to reduce the uncertainty in reanalyses and numerical weather predictions throughout the northern half of Northern Hemisphere for weeks afterwards.