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Targeted Observations on Arctic Sea Ice Concentration for Improving Extended-range Prediction of Ural Blocking

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The predictability of certain extreme weather events can exceed the traditional two weeks by considering the boundary conditions. Targeted observations in sensitive areas on Arctic sea ice concentration (SIC) can improve the extended-range (4 pentads) forecast skills of long-lasting and strong Ural blocking (UB). The sensitive areas are determined based on the SIC optimally growing boundary errors, obtained by the conditional nonlinear optimal perturbation method. The sensitive areas are mainly located in the Barents Sea, Greenland Sea, and Okhotsk Sea. The results of observing system simulation experiments for 8 UB cases indicate that the targeted observations can remarkably improve the prediction skills of UB in the 4th pentad. Targeted observations have a positive effect on 75% of 160 experiment members, reduce 35% forecast errors of the 4th pentad mean blocking index, and perform even better when the original forecast errors are greater. Further diagnosis shows that targeted observations contribute to more accurate SIC boundary conditions in the Barents Sea, Greenland Sea, and Okhotsk Sea and reduce temperature errors in the lower and middle troposphere. It further results in well-described westerly winds in the Ural region and its adjacent regions, corresponding to the more skillful predictions of blocking circulations. The above results supply a theoretical base for the design of Arctic SIC observations and more skillful extended-range predictions for mid-latitude extreme weather.