

Supporting information

**For Impact of the QBO on prediction and predictability
of the MJO convection**

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In this supplement, we summarize a few analysis of the MJO and QBO in the WMO/S2S models, as outlined in Table 1. Figure S1 and S2 show the vertical structure of tropical zonal winds and zonal mean temperature in the two contrasting QBO phases. Specifically, Figure S1 shows the difference in the zonal mean zonal winds, averaged between 10 °S and 10 °N, from the S2S reforecasts in QBO easterly and westerly phases, as a function of forecast leads and pressure. Figure S2 shows the difference in the zonal mean temperature. Figure S3 extends Figure S2, showing the bivariate correlation skill of the MJO ROMI index in boreal winter (solid) and summer (dashed) for the individual S2S models under the QBO easterly and westerly phases. Figure S4 shows difference in correlation skill between EQBO and WQBO versus temperature stratification, T200-T100, and temperature at 100hPa. The correlation coefficients are 0.42 and 0.51, but the p values are higher than 0.1, hence deemed not statistically significant. Therefore, Figure S4 lends support to the key point that the model forecasted stratosphere has little influence on MJO prediction. Figure S5 shows lag correlation between the predicted ROMI-1 and ROMI-2 in the 10 S2S forecast models in EQBO and WQBO in northern winter.

The data used in the supporting information is the same as described in the acknowledge section of the main text:

- The S2S reforecast dataset is available at: <http://apps.ecmwf.int/datasets/data/s2s-reforecasts-instantaneous-accum-ecmf/levtype=sfc/type=cf/>, and <https://iridl.ldeo.columbia.edu/SOURCES/.ECMWF/.S2S>
- The QBO index is available through <http://www.cpc.ncep.noaa.gov/data/indices/qbo.u50.index>

- The ROMI index from 1979 to 2018 and the S2S ROMI data are available at http://dynamo.appmath.columbia.edu/s2s_romi_version2/ or upon request from the first author.

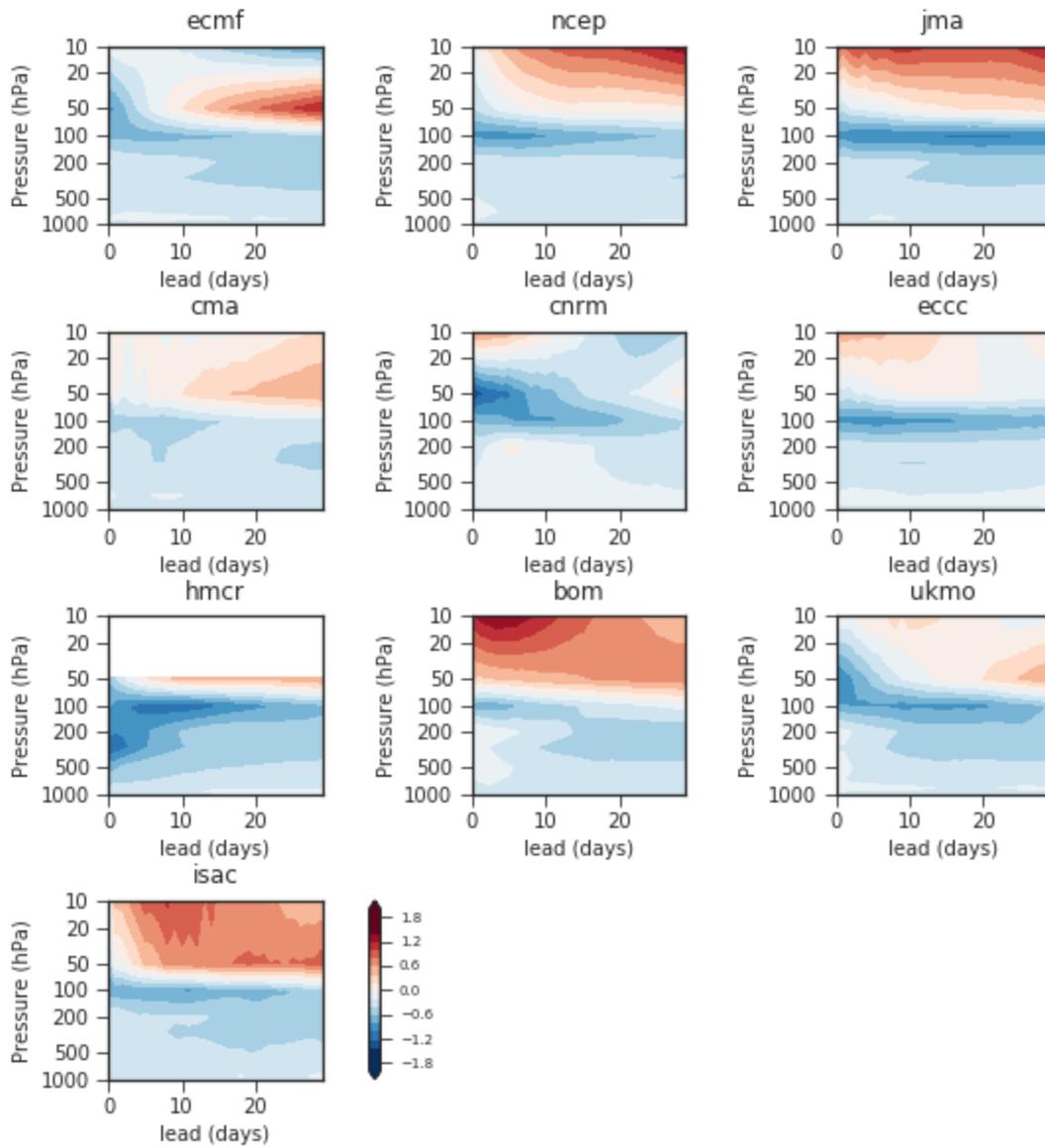


Figure S1 Difference in zonal mean zonal winds, averaged between 10 °S and 10 °N, from forecast in QBO easterly and westerly phases, as a function of forecast leads and pressure.

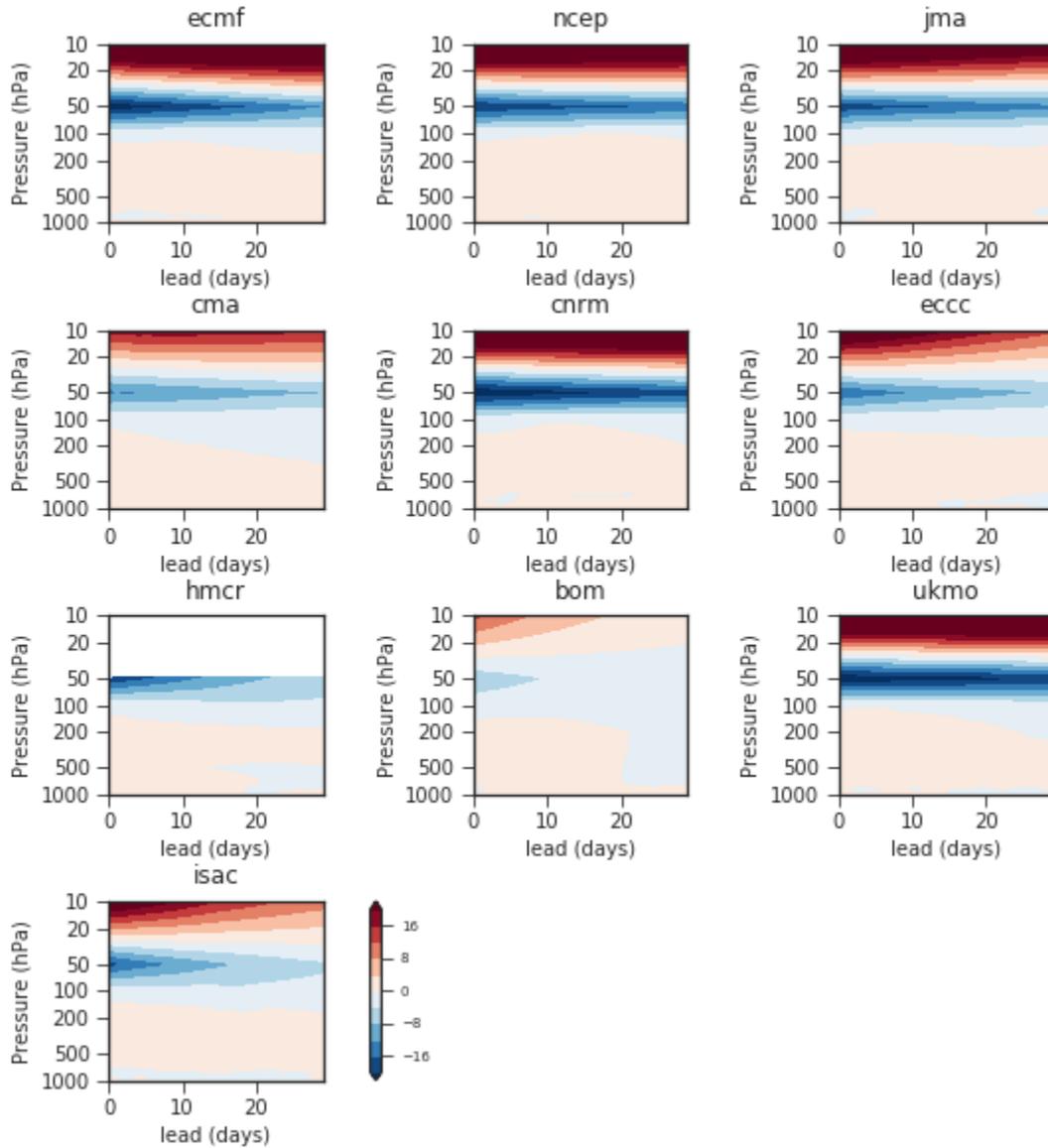


Figure S2 As in Figure S1 but for difference in zonal mean temperature.

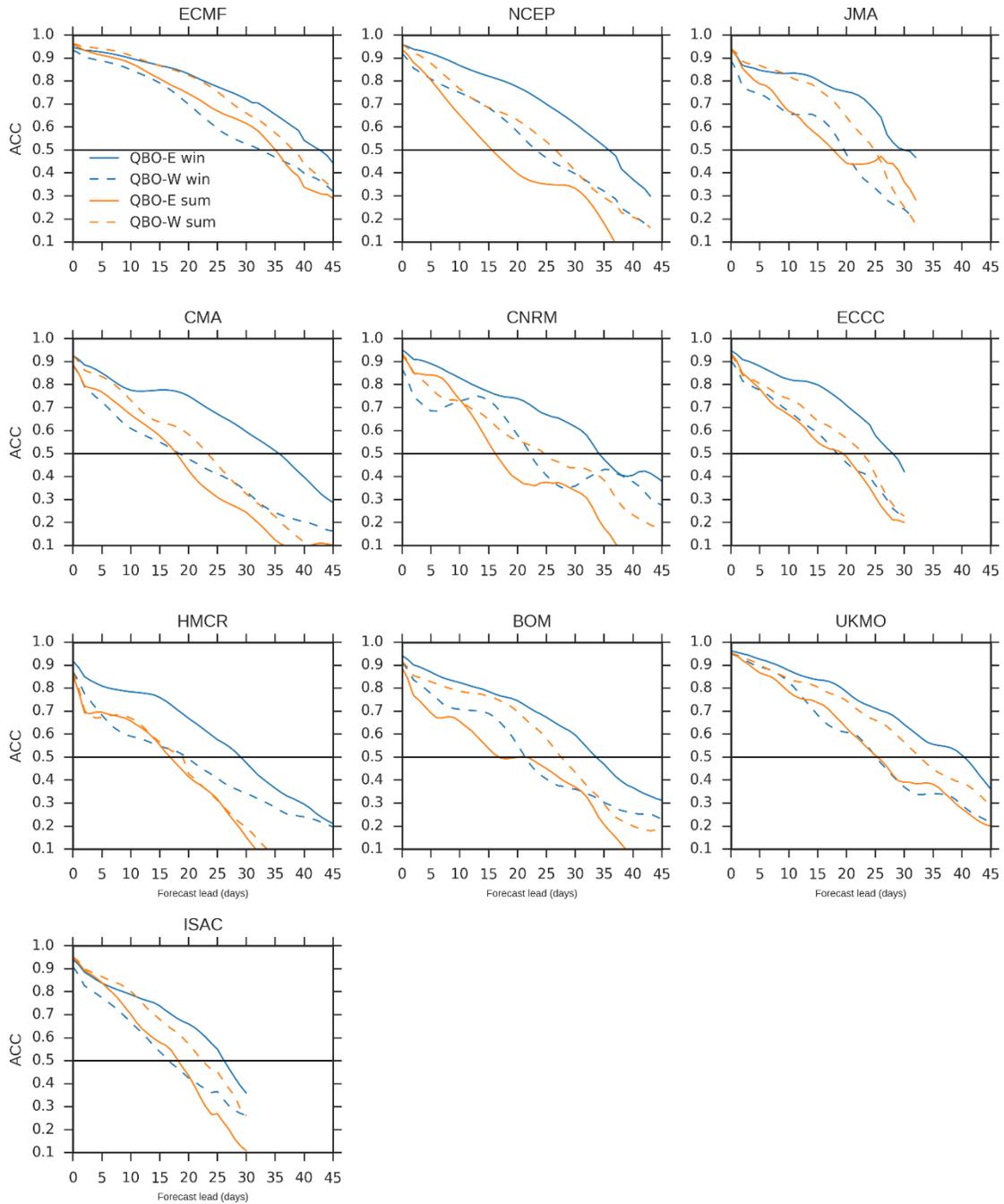


Figure S3. Bivariate correlation skill of the MJO ROMI index in boreal winter (solid) and summer (dashed) for each S2S model under the EQBO (blue) and WQBO (orange) phases.

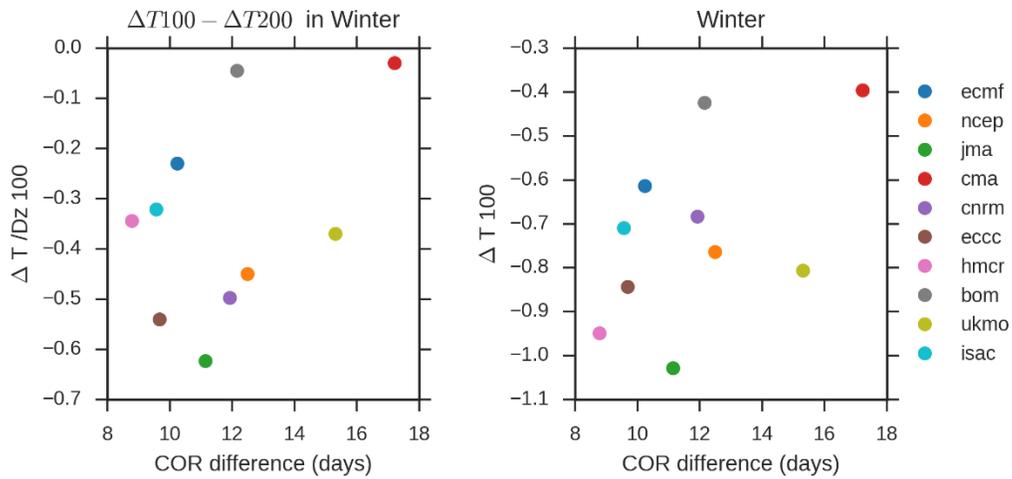


Figure S4. Difference in correlation skill between EQBO and WQBO versus temperature stratification, T200-T100 (a), and temperature at 100hPa (b). The correlation coefficients are 0.42 and 0.51, but the p values are higher than 0.1, hence deemed not statistically significant.

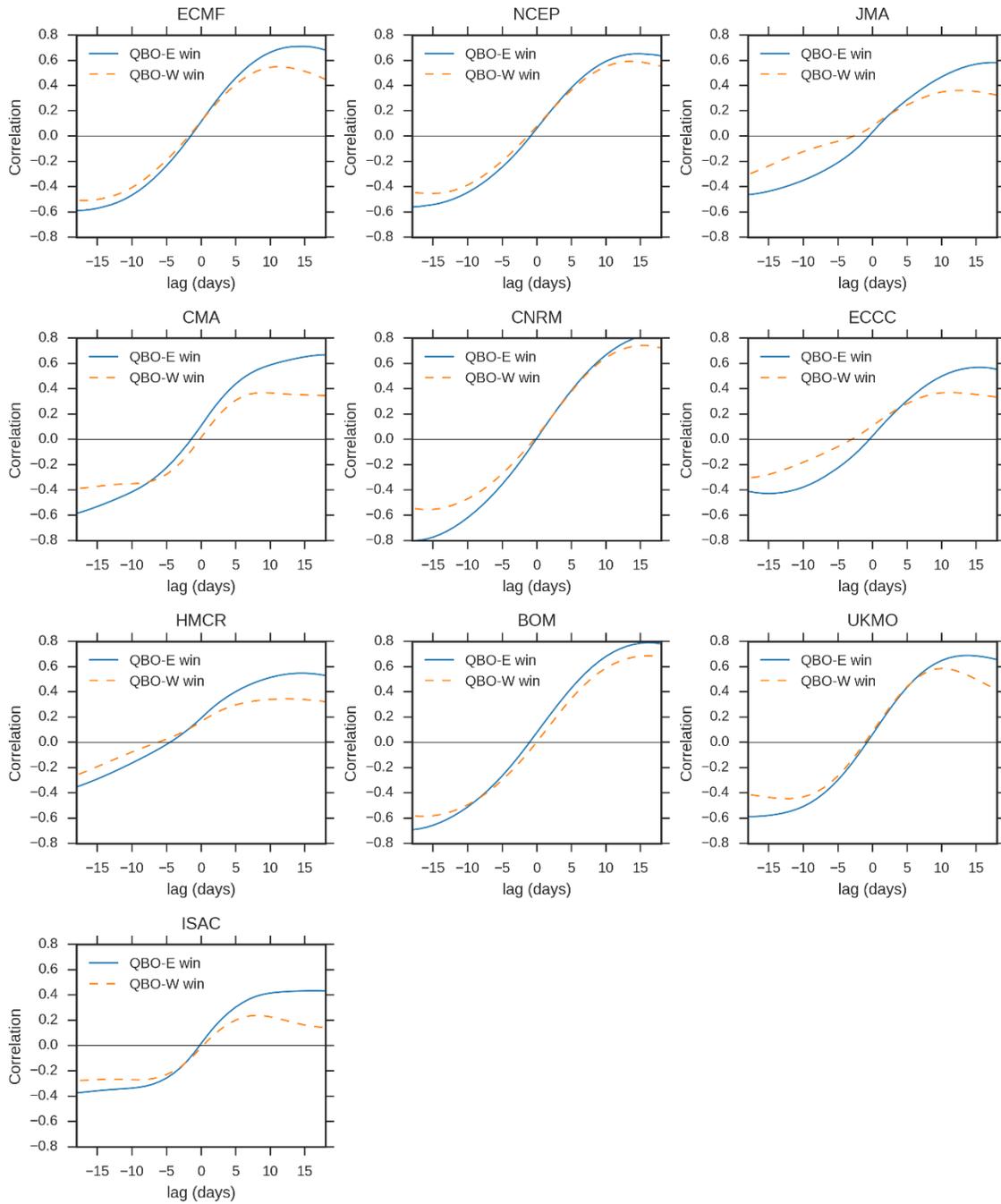


Figure S5. Correlation between ROMI-1 and ROMI-2 in the 10 S2S forecast models in EQBO (blue) and WQBO (red) in northern winter.