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Distinct Upward Propagation of the Westerly QBO in Winter 2015/16 Compared to 2019/20 and its Relationship with Brewer-Dobson Circulation

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The quasi-biennial oscillation (QBO), describing alternate easterly and westerly winds in the tropical stratosphere, originally shows downward phase propagation with time. However, in February 2016 and January 2020, downward-propagating westerly winds were split into two with one propagating upward and the other propagating downward, so-called a QBO disruption. Previous studies have mainly focused on the cause of the localized negative momentum forcing initiating the QBO disruption. However, the upward displacement of the westerly QBO followed by the negative momentum forcing, clearly seen in 2015/16 but not in 2019/20, has not been investigated in detail. Here, we show that the distinct upward propagation of the westerly winds in 2015/16 can be explained by the stronger Brewer-Dobson circulation (BDC) using MERRA-2 global reanalysis data. We found that strong Rossby waves with wavenumbers 1 and 2 propagating from the troposphere mainly induce the strong BDC in 2015/16. Potential contributions of El Niño and Barents–Kara sea ice reduction to wavenumber 1–2 Rossby waves are also discussed.