Gravity wave drag effects on the future quasi-biennial oscillation in the tropical stratosphere under greenhouse gas increase up to year 2100: Simulations with a chemistry-climate model

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Outline

• MRI-CCM

• CCMVal-2 simulations

• Overall climate changes

• Changes in QBO

• Summary
Reference and sensitivity simulations in MRI for CCMVal-2

1960

REF-B2, 3 members
Observed+Simulated SST, GHGs, ODSs

SCN-B2b, 1 member
Modeled+Simulated SST, GHGs, Fixed ODSs

SCN-B2c, 1 member
Fixed SST, Fixed GHGs, ODSs

2100

ODSs Impacts
Climate & ODSs Impacts
Climate Impacts
Zonal wind in the tropics
Evolution of QBO amplitude at 30 hPa

30hPa B2(bk, gn, rd), Sb(bl), Sc(cy) 10S–10N
Evolution of GWD & EPD amp at 30 hPa
QBO-amp trend: U-wind
QBO-amp trend: GWD
QBO-amp trend: EPD

QBO-amp trend epd (m/s/d/dec)*100

QBO-amp trend epd_int (m/s/d/dec)*100

Pressure (hPa)
QBO-amp trend: vertical advection

![Graphs showing QBO-amp trend with pressure (hPa) vs. time (m/s/d/dec)*100 for different categories such as B21, B22, B23, Sb, and Sc.](image-url)
Summary

• Transient simulations were made from 1960 to 2100 using the CCMVal scenarios: REF-B2, SCN-B2b (fixed halogens), SCN-B2c (fixed climate).

• In the changing climate runs (REF-B2 & SCN-B2b) the QBO amplitude was decreased, while it was almost constant in the fixed climate run.

• QBO major forcings, parameterized gravity waves, resolved waves, and vertical advection were all related with the QBO amplitude decrease.

• Causality?