Representation of the Tropical Stratosphere in Global Climate Models - QBOi

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QBOi - Phase 1

Butchart et al. 2018, GMD:

1) Intercompare QBOs under present day conditions

2) Identify robustness to commonly changed climate forcings

3) Examine model dependence of QBO predictability

Exp 1 ("AMIP"): Specified SSTs, sea-ice, external forcings

Exp 2 ("Present-day timeslice"): Repeating SSTs, sea-ice, forcings

Exp 3 ("2xCO2"): same as Exp 2, but 2xCO2, SST+2K

Exp 4 ("4xCO2"): same as Exp 2, but 4xCO2, SST+4K

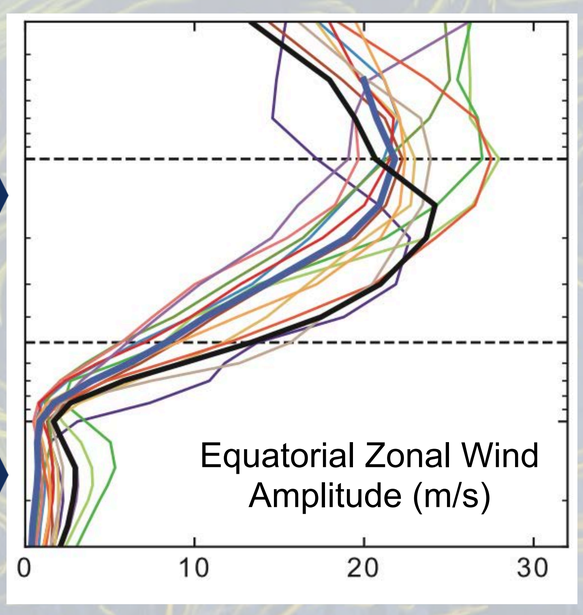
Exp 5 ("Hindcasts"): 9-12 months, prescribed SSTs, forcings

QBOi Core Paper #1

Bushell et al. 2020, QJRMS:

Most models show peak QBO winds above ERA-Interim

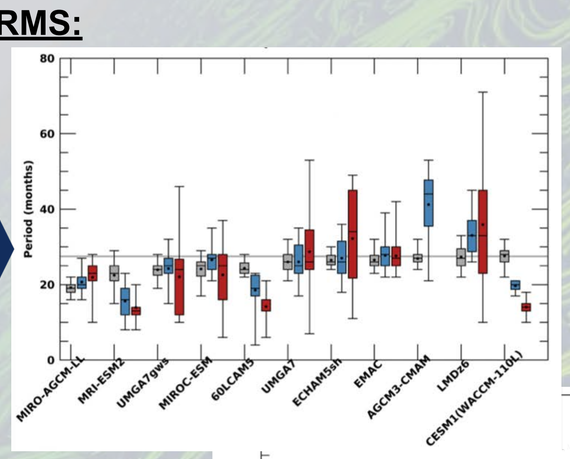
10 hPa amplitude realistic but largely underestimated at 50 - 70 hPa



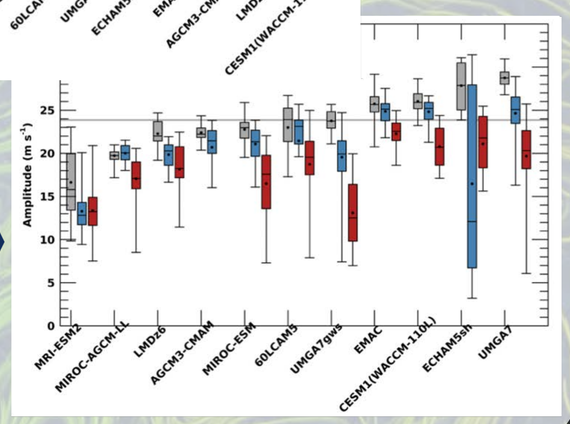
QBOi Core Paper #2

Richter et al. 2020, QJRMS:

There is no consensus how the QBO period would change in a warming climate



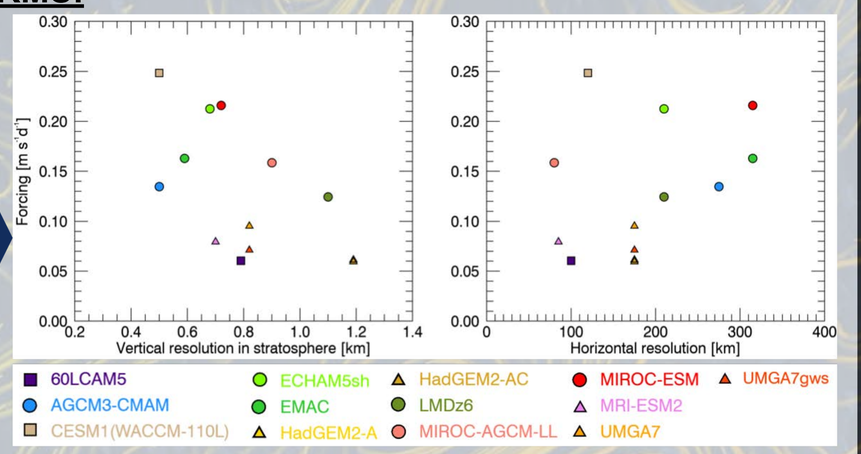
Robust weakening of QBO amplitude in a warming climate



QBOi Core Paper #3

Holt et al. 2020, QJRMS:

QBO resolved wave forcing strongly depends on model vertical resolution



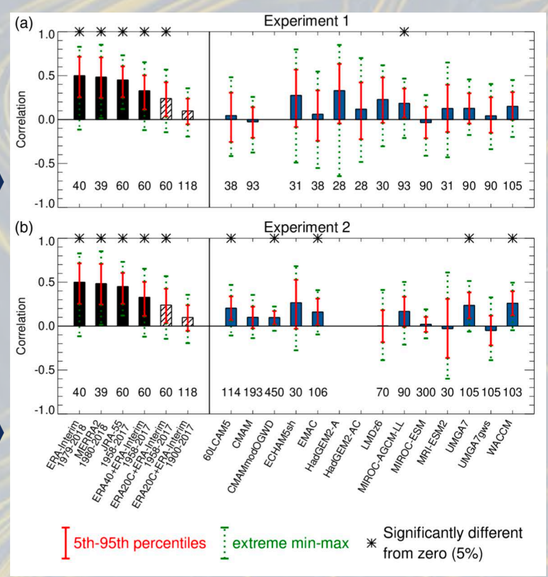
QBOi Core Paper #4

Anstey et al. 2021, QJRMS:

QBO teleconnection to the polar vortex:

generally weaker than observed

NAO shows no consistent response (not shown)

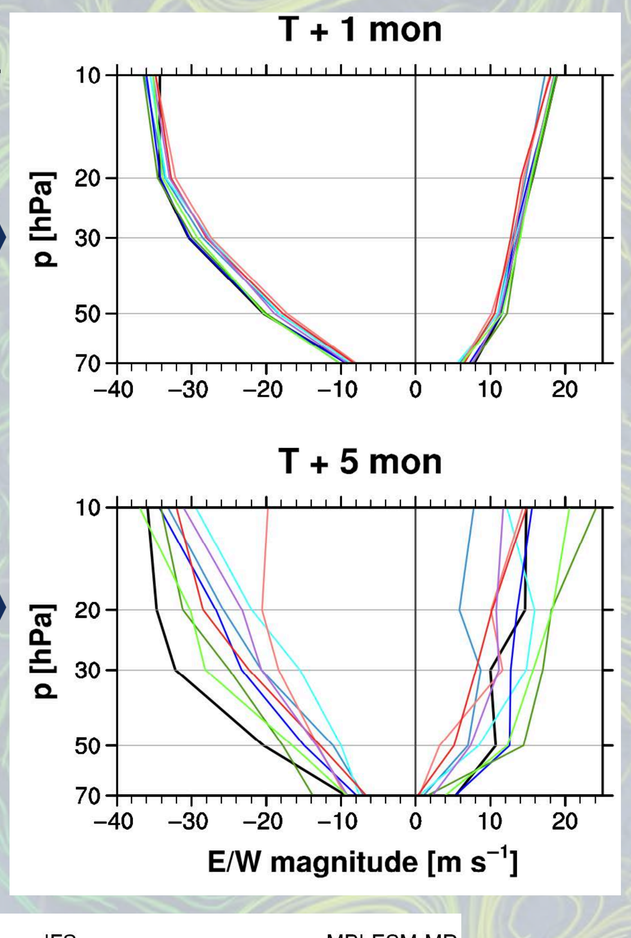


QBOi Core Paper #5

Stockdale et al. 2020, QJRMS:

High skill in predicting the phase evolution of the QBO at 20-30 hPa

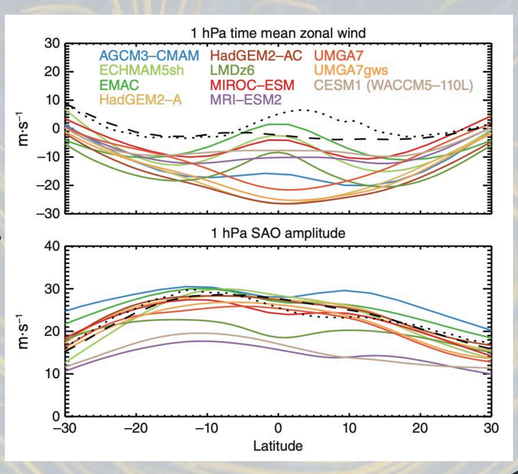
Easterly phase too weak at 20 to 50 hPa



QBOi Core Paper #6

Smith et al. 2019, QJRMS:

Westward zonal wind bias common in models around the stratopause



QBOi - Phase 1.5

How does ENSO impact the QBO?

100 years perpetual El Nino

100 years perpetual La Nina

Control, neutral ENSO, **Exp 2**

QBOi - Phase 2

1) What are the consequences of QBO biases found in CMIP models?

2) How do we fix these biases?

Exp 1 ("AMIP"): Specified SSTs, sea-ice, external forcings

Exp1-ObsQBO: Nudging tropical stratosphere to realistic state

Exp1-NoQBO: Nudging tropical stratosphere to climatological state