On the simulation of the QBO in WACCM

by

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Motivation
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II. The Quasi-Biennial Oscillation (QBO) is one of the most prominent modes of stratospheric variability.
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II. The Quasi-Biennial Oscillation (QBO) is one of the most prominent modes of stratospheric variability.

III. WACCM (and other GCMs) struggle with obtaining an internally generated QBO.
WACCM 4: Prescribed QBO
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• Better than no QBO

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QBO: Connection to Mid-latitudes

QBOE - QBOW U

OBS

[Graph showing data with color-coded regions and labeled axes]
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WACCM 4
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WACCM 4

CAM 5.3 46 L
What is needed to get the QBO?
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   -> generated by Convection Scheme
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   in troposphere & stratosphere (Giorgetta et al 2002, Richter 2014)
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4. Implicit diffusion in a dynamical core affects the QBO!
   (Yao and Jablonowski 2013)
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QBO in CAM5

30L CAM5 GW

60L CAM5 GW

Richter et al. 2014
QBO in CAM5

30L CAM5 GW

Forcing:

Resolved

Parameterized GW

Richter et al. 2014
More Kelvin Waves

More MRG Waves

QBO in CAM5

60L CAM5

30L CAM5

60 - 30L CAM5
Effects of Dynamical Core:

60L CAM5 GW

SE Dycore

FV Dycore

FV Dycore is more diffusive: period of QBO longer
Other Modeling Centers:

**ECHAM-6 Beres**
95 levels up to 0.01 hPa (80 km) dx ~1.9 deg;  

Schirber et al 2014

**NASA GISS Model E**
102 levels up to 0.002 hPa (95 km); dx = 2 deg  

Rind et al 2014
Standard WACCM Grid for CMIP6: 70L
QBO

OBS

70L WACCM 5.3  
ne30 ~ 1°

110L WACCM 5.3  
ne30 ~ 1°
QBO Forcing

70L WACCM 5.3
ne30 ~ 1°

Resolved

Parameterized GW

110L WACCM 5.3
ne30 ~ 1°

Resolved

Parameterized GW
WACCM 2 deg with 110L?
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110 L
ne 30 (1deg)

110 L
FV 2 x 2.5 deg

Could be tuned to get right period
70L WACCM 5.4 FV
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70L WACCM 5.4 FV CLUBB
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70L WACCM 5.4 FV

70L WACCM 5.4 FV CLUBB

70L WACCM 5.4 FV CLUBB 1800
WACCM 5.4 CLUBB

CLUBB Default

Resolved

Parameterized GW

CLUBB 1800

Resolved

Parameterized GW
SPARC QBOi: Overview

**Coordinators:** Scott Osprey (U. of Oxford), Neal Butchart (Met Office), Kevin Hamilton (IPRC)

**Participating GCMs:** LMDz, HadGEM2-CCS, EC-EARTH, GISS Model-E, GEOS-5, CMCC-CMS, AGCM3-CMAM, MIROC-ESM, CAM5, WACCM?
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Timeline:

March 2015: 1st Workshop

May 2015: Finalize details of common experiments

May 2016: Complete first set experiments

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2. Seasonal hindcasts (predictability)
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More info:  http://tinyurl.com/QBOi-html
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HVR WACCM:

- Doubled vertical resolution: Boundary Layer, Troposphere, Stratosphere, Mesosphere
- 1 deg horizontal resolution
- Preferably SE Dycore
- Convection scheme tuned for PW generation
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If this is important to you, come talk to us!