QBOi

Scott Osprey, Neal Butchart and
Kevin Hamilton

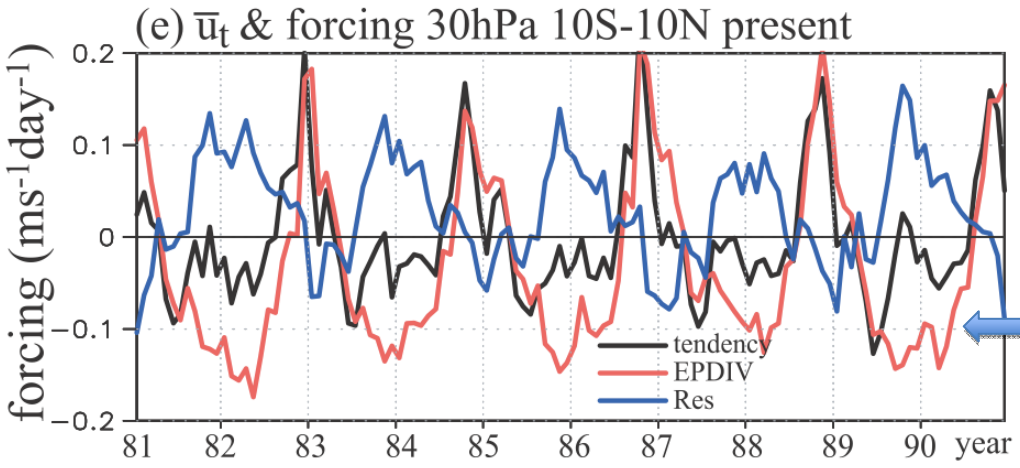
“Although several GCMs have produced simulations of the QBO, there is no simple set of criteria that guarantees a successful simulation.”

The Quasi-biennial Oscillation: Baldwin et al., 2001

Background

- The QBO is a litmus test of GCM performance, and is directly linked with circulation and chemistry in other regions of the atmosphere.
- QBO variability is a function of: **modeldiscretisation**, **diffusion**, **parameterisation** (e.g. gravity waves, convection) and **resolved waves**.

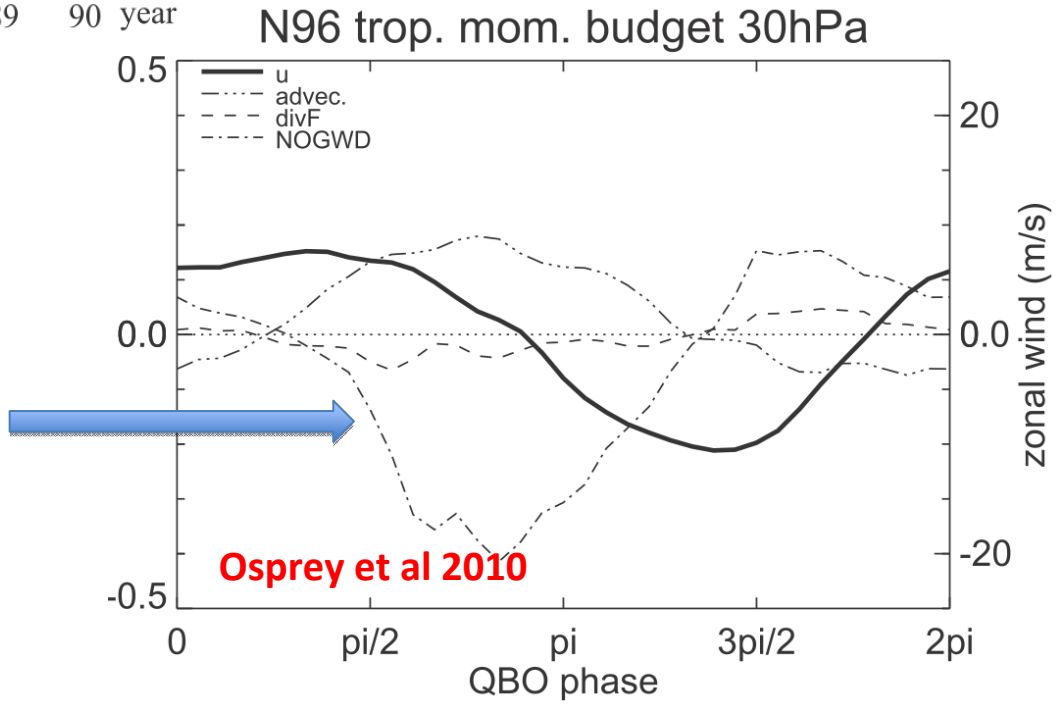
Partitioning of QBO Forcing in GCMs



Kawatani et al 2011

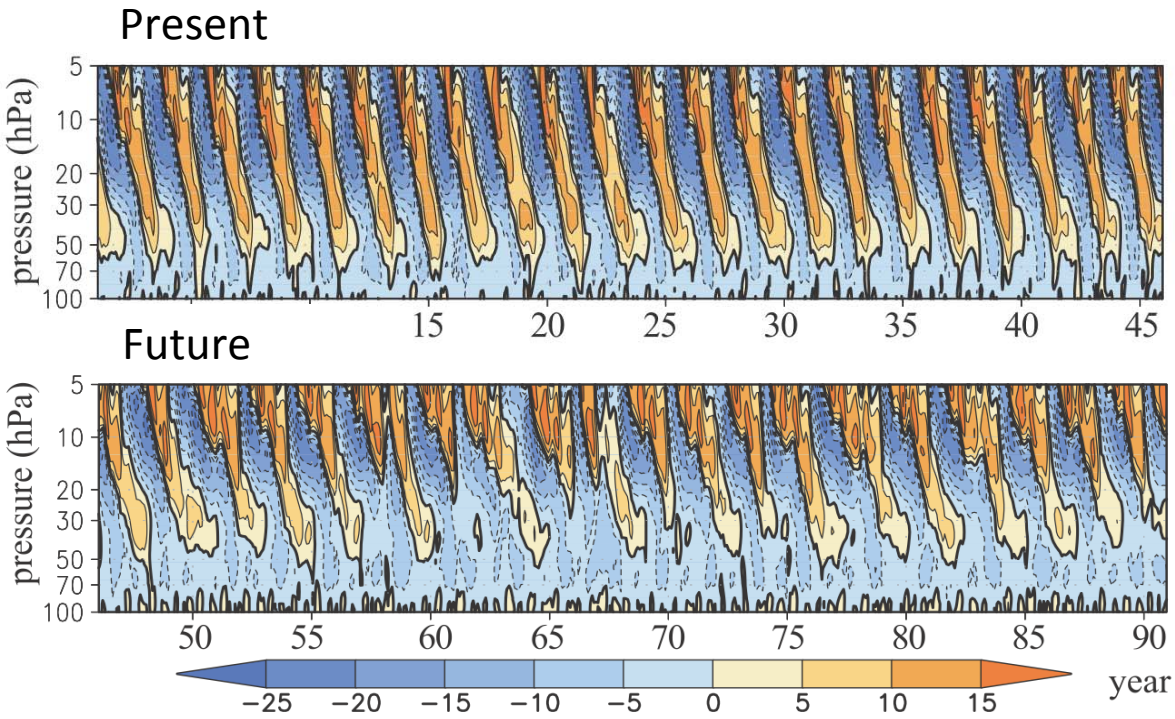
MIROC QBO explicitly driven by model resolved waves. No spectral GW parameterisation is used

The QBO in HadGEM2 L60 is predominantly driven by parameterised GW waves

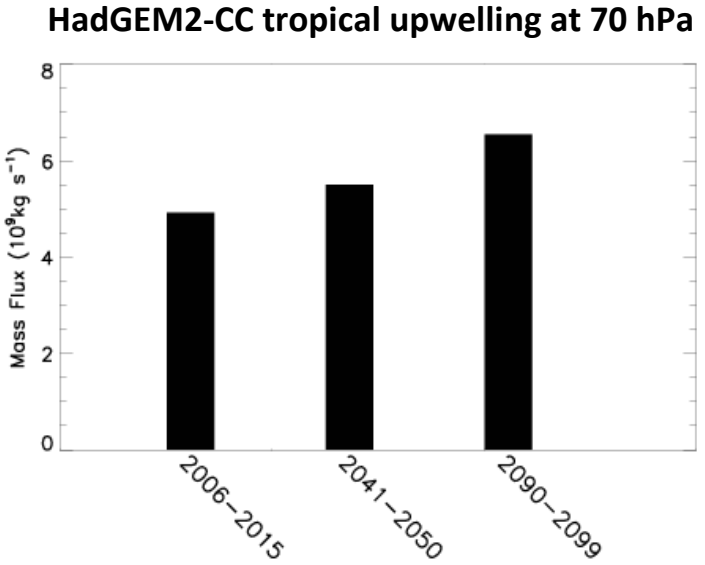


Osprey et al 2010

No Consensus in Future QBO Trends



Kawatani et al 2011

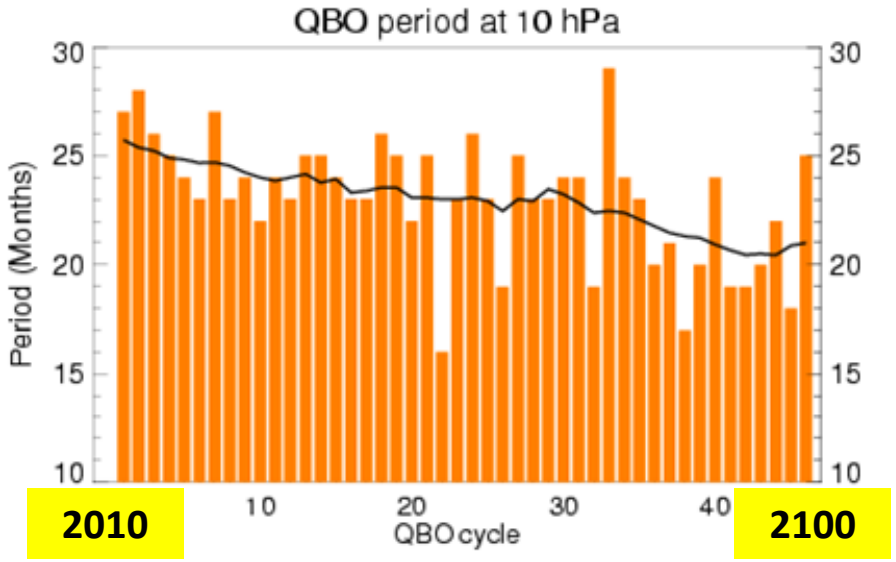


Neal Butchart

Tropical upwelling predicted to increase throughout 21st C in MIROC & HadGEM2-CC

➔Longer QBO?

HadGEM2-CC predicts shorter period, while MIROC predicts longer period.



Motivation

A number of climate models have simulated the QBO, however there has been little recent progress.

- **SPARC Report on the Evaluation of Chemistry-Climate models:** only MRI and UK Met Office models submitted simulations with an internally generated QBO. Seven models used nudging to the observed QBO, while the remainder had no QBO
- **Coupled Model IntercomparisonProject Phase 5:** Of **26** models listed in DYNVAR, only **3** (HadGEM2-CCS, MPI-ESM-MR and MIROC-ESM-CHEM) exhibit a QBO.

CMIP5 High-top and Low-top Models listed under the DYNVAR Project

Low-top
High-top
High-top (QBO)

- bcc-csm1-1
- CanESM2
- CCSM4
- CNRM-CM5
- CSIRO-Mk3-6-0
- EC-EARTH
- EC-EARTH-low
- GISS-E2-H
- GISS-E2-R
- GFDL-CM3
- GFDL-ESM2M
- GFDL-ESM2G
- **HadGEM2-CC**
- HadGEM2-ES
- HadCM3
- INMCM4
- IPSL-CM5A-LR
- IPSL-CM5A-MR
- MIROC4h
- MIROC5
- **MIROC-ESM-CHEM**
- MRI-CGCM3
- MPI-ESM-LR
- **MPI-ESM-MR**
- NorESM1-M
- WACCM4

http://www.sparcdynvar.org/storage/pubs/727165_0_merged_1340095695.pdf

Provisional Plan

We propose to design a coordinated set of numerical experiments to systematically explore the effects of:

- vertical resolution,
- resolved waves,
- parameterisedsmall-scale (gravity) waves and
- diffusion

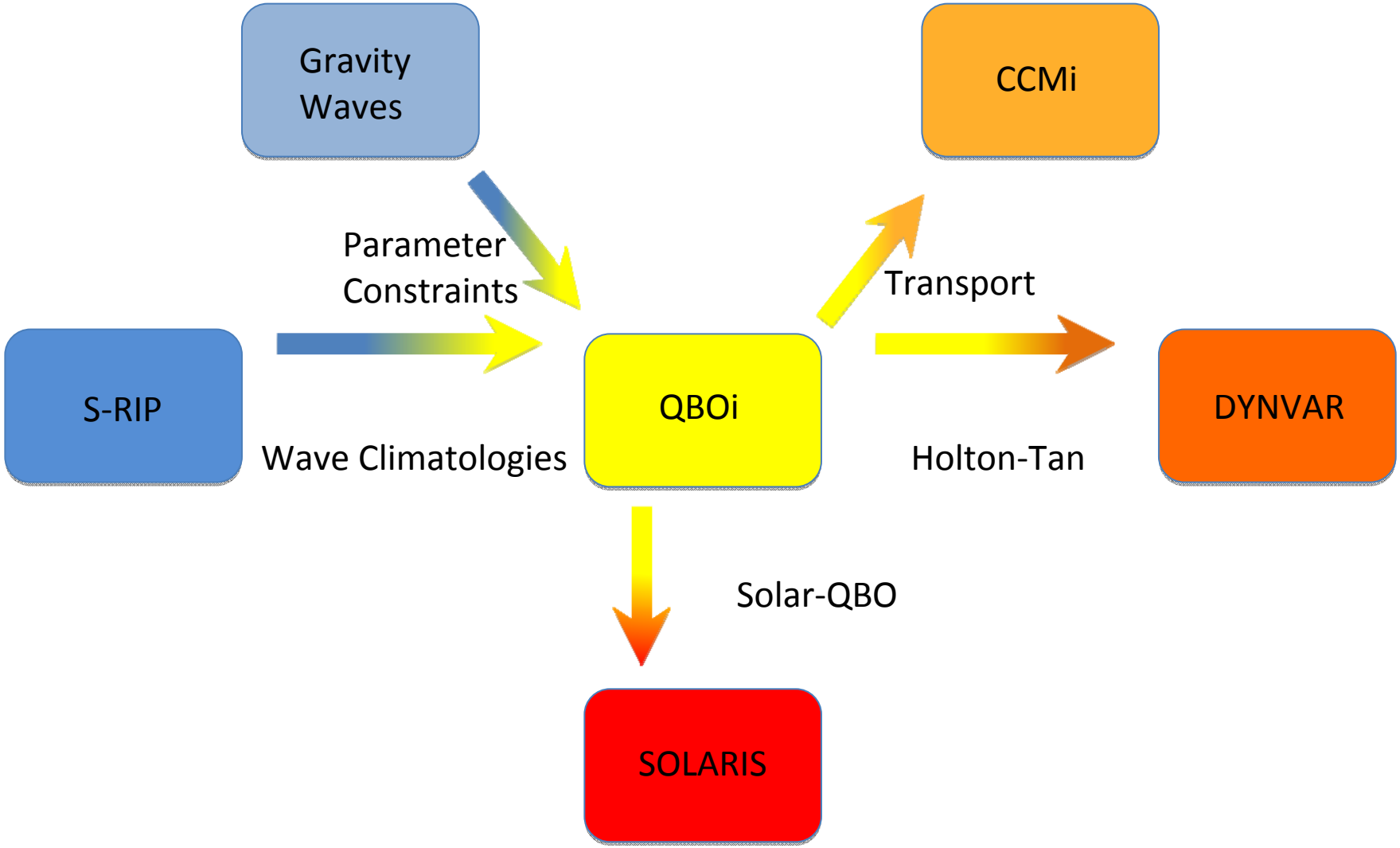
on the morphology of the tropical QBO and projected changes thereof. Similar experiments with intermediate-complexity models, which can explore parameter space more efficiently than GCMs, are also welcomed.

Outside of a pre-scheduled SPARC meeting, there is no firm decision of a location for a start-up event for QBOi. Possible venues are Oxford or Hawaii before mid-2013. This is subject to change.

Stakeholders invited so far (Nov 2012)

Country/Organization	Name	Affiliation	Interested ☑☒☐
Canada	JohnScinocca	CCCma	☑
	Charles McLandress	Toronto	☑
Denmark	Bo Christiansen, Shuting Yang	DMI	☑
France	Francois Lott, RiwalPlougonven, Albert Hertzog	LMD	☑
ECMWF	Tim Palmer, Tim Stockdale	Oxford/ECMWF	☐
Germany	Marco Giorgetta	Max Planck	☐
Italy	Chiara Cagnazzo	CMCC	☐
Japan	Shingo Watanabe, Yoshio Kawatani	JAMSTEC	☑
	Kiyotaka Shibata	MRI	☐
UK	Scott Osprey, James Anstey	NCAS/Oxford	☑
	Neal Butchart, Adam Scaife, Andrew Bushell	Met Office	☑
US	Kevin Hamilton	IPRC	☑
	Stephen Eckermann	NRL	☐
	Rolando Garcia, Dan Marsh	UCAR	☐
	StevenPawson, Lawrence Coy	NASA-GSFC	☑
	Drew Shindell	NASA-GISS	☐
	Larry Horowitz	GFDL	☐
	Ed Gerber	NYU	☐

Links to other SPARC Activities



Outcomes

Goal is to provide a better understanding of what is needed to produce a reliable QBO in climate models, in terms of model details such as vertical resolution, wave parameterizations, etc.

i.e. a “recipe book” for simulating a reliable QBO (with computational cost), to guide CMIP5 and NWP modelling groups

Tangible deliverables for the project should include:
- a **SPARC report(?)** and
- **peer reviewed papers** from individual groups.

Details of specific deliverables will be further discussed at the start-up meeting.