

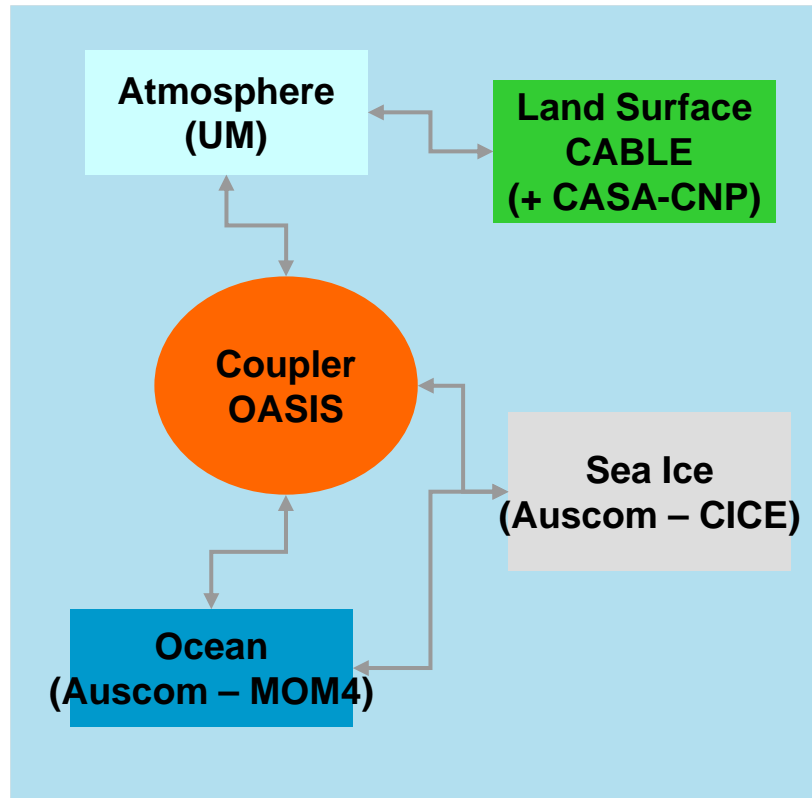


Interactions of ENSO, the IOD, and the SAM in CMIP3 models + ACCESS

Arnold Sullivan, Wenju Cai, Tim Cowan, Tony Hirst, Dave Bi, Simon Marsland

Greenhouse 2011 @ 04 to 08 April 2011 – Cairns

ACCESS - Australian Community Climate and Earth System Simulator



Friday 11:20, Harun Rashid,
*Modelling climate variability
using the Australian Community
Climate And Earth System
Simulator (ACCESS), CAWCR*

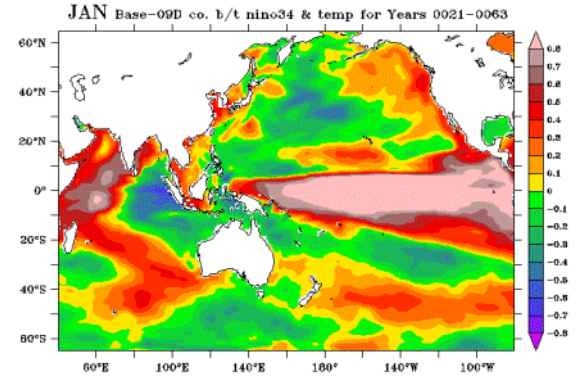
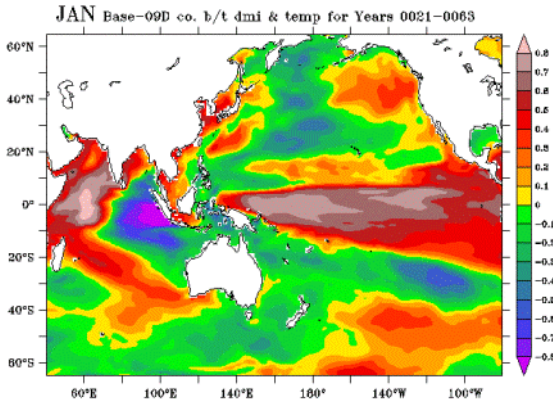
Friday 12:40, Daohua (Dave) Bi,
*ACCESS coupled model for IPCC
AR5 and CMIP5, CAWCR*

The **ACCESS** Model is being developed by the Centre for Australian Weather and Climate Research, a partnership between **CSIRO** and the **Bureau of Meteorology**

Outlines

Cai et al. 2005

Mutual impacts - IOD and ENSO.



IOD

ENSO

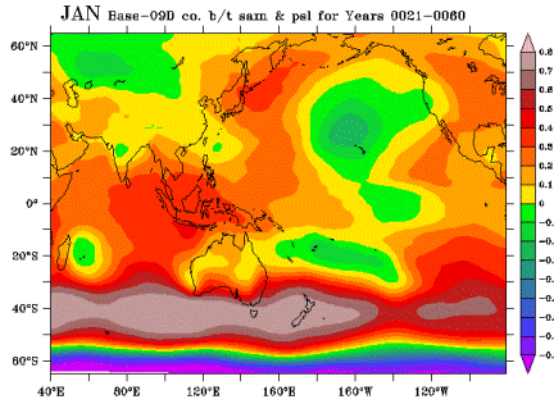
NO control by the SAM on the IOD.

ENSO signals project strongly onto the SAM, but ENSO-forced signals tend to peak before ENSO.

Lau and Nath 2004

Method

SAM



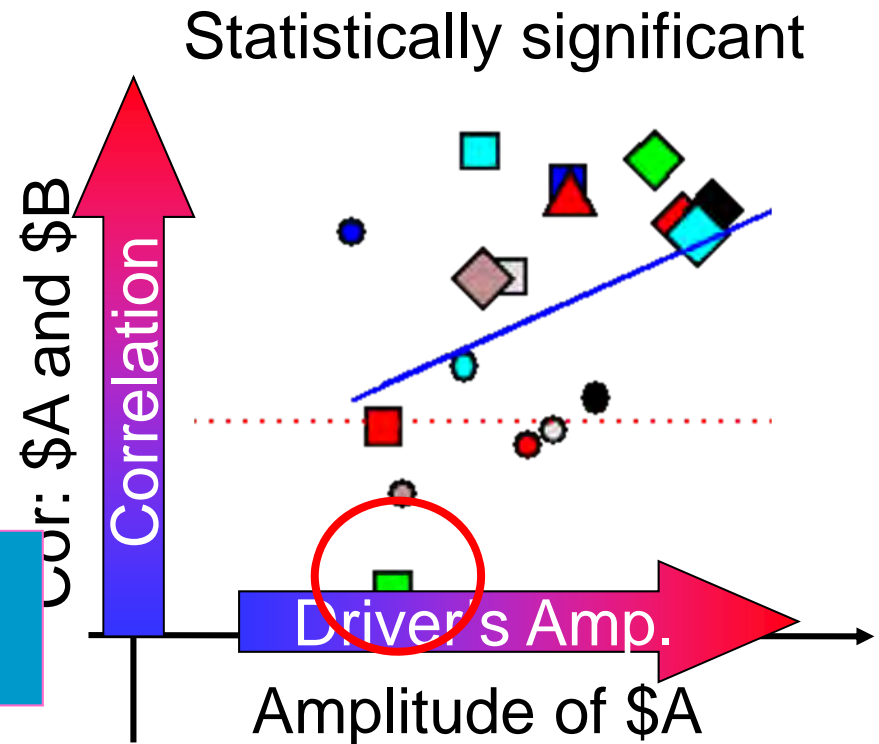
Pause/Stop

Our approach – a necessary condition

- Use detrended data
- If
 - climate mode $\$A$ has a control on mode $\$B$
- Criteria
 - in models with greater amplitude of $\$A$, the correlation between $\$A$ and $\$B$ should be stronger

Inter-model rather than inter-annual variability

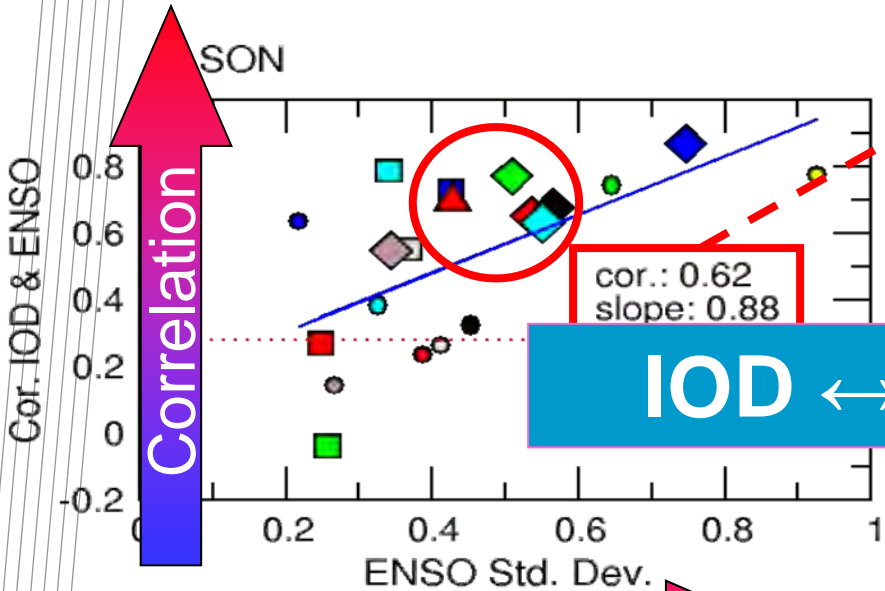
- The linear fit must be statistically significant.



Climate mode control scatter plot



Mutual impact between the IOD events and ENSO events



95% Significant Value is 0.45. ENSO is the driver

IOD ↔ ENSO

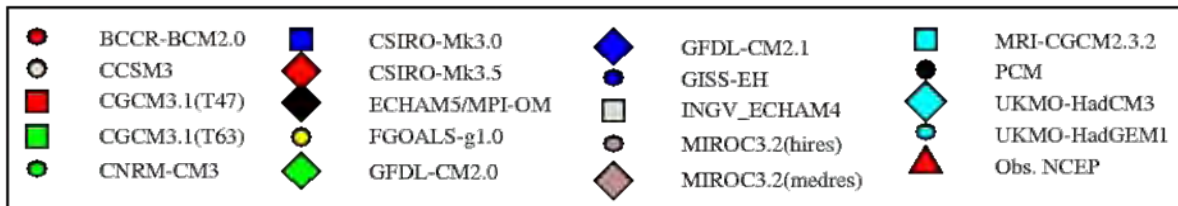
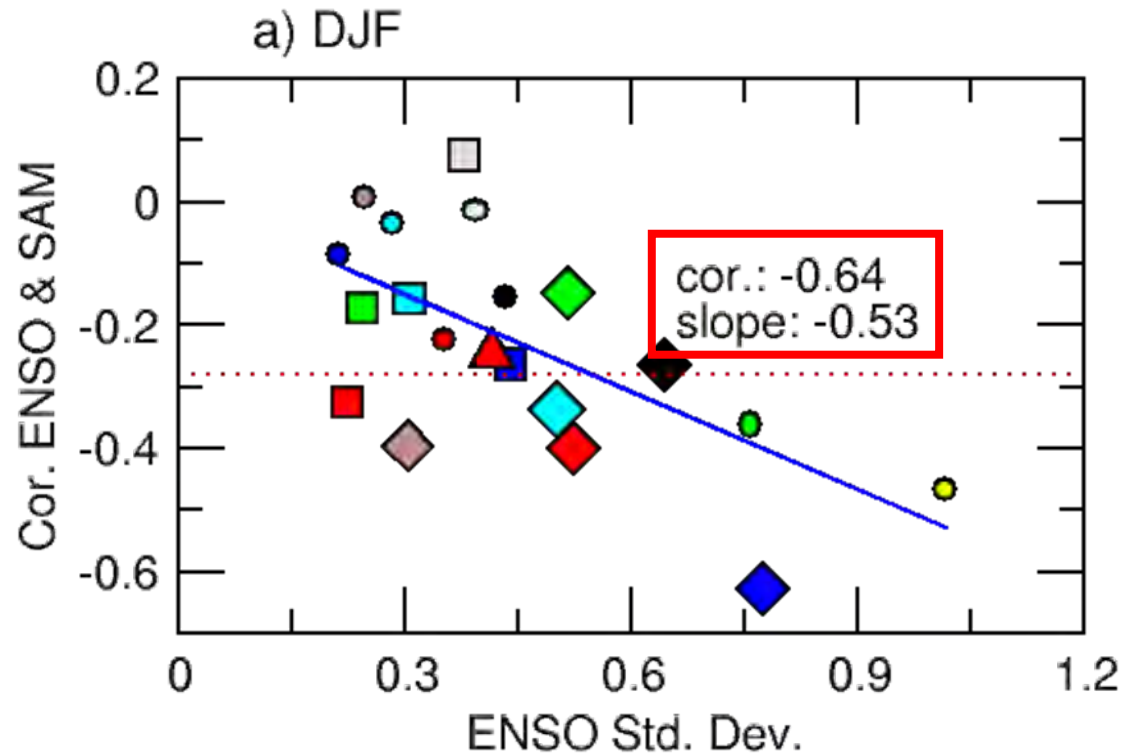
Driver's Amplitude

We use detrended data to test this assumption.

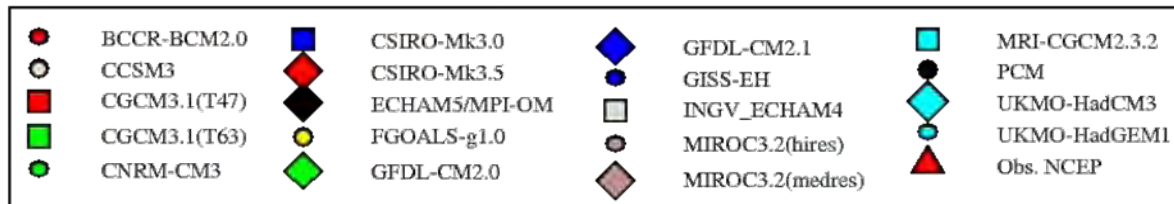
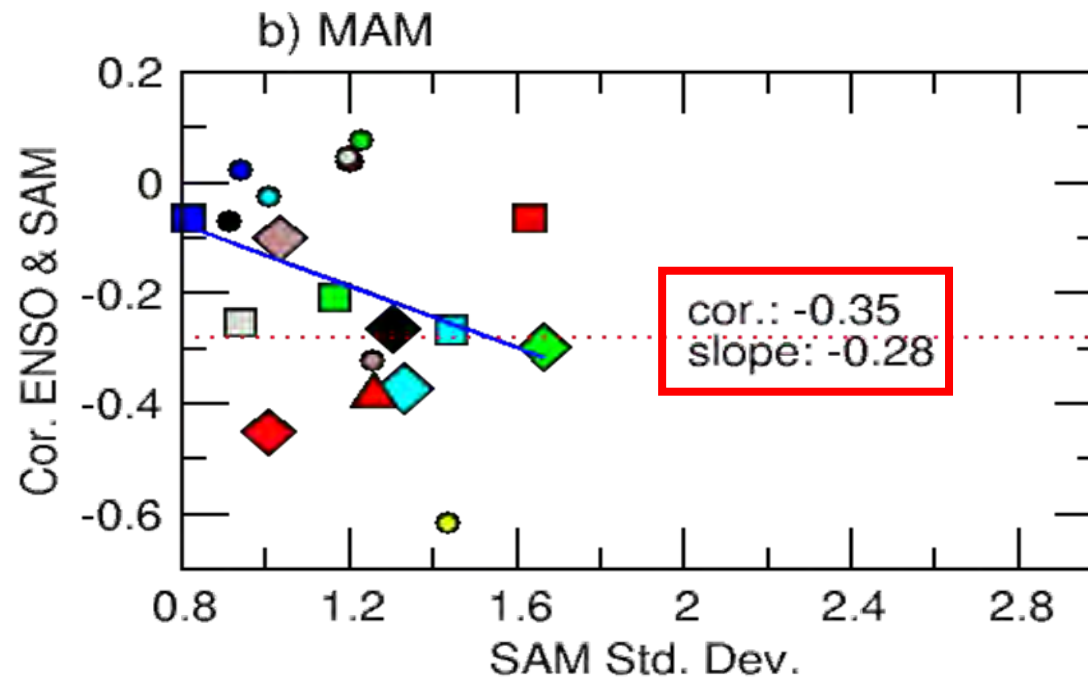
BCCR-BCM2.0	CSIRO-Mk3.0	GFDL-CM2.1	MRI-CGCM2.3.2
CCSM3	CSIRO-Mk3.5	GISS-EH	PCM
CGCM3.1(T47)	ECHAM5/MPI-OM	INGV_ECHAM4	UKMO-HadCM3
CGCM3.1(T63)	FGOALS-g1.0	MIROC3.2(hires)	UKMO-HadGEM1
CNRM-CM3	GFDL-CM2.0	MIROC3.2(medres)	Obs. NCEP



Do ENSO events control the SAM?



Does the SAM control ENSO events?

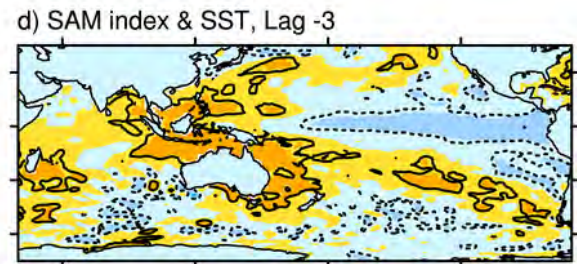
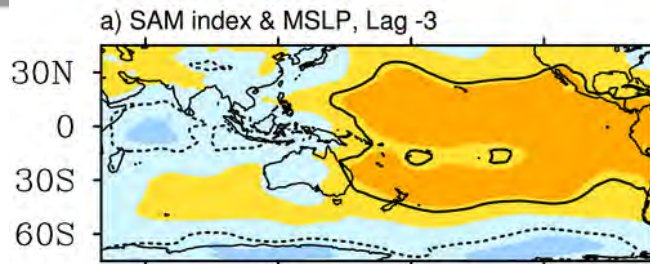


Most models produce the feature that the SAM peaks earlier than ENSO

- An example.....

ECHAM5: Lag correlation - SAM index & MSLP / SST

3m ahead



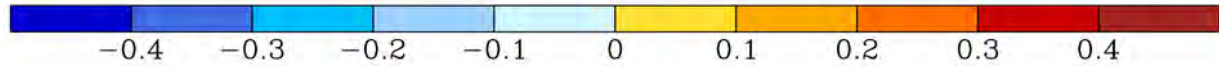
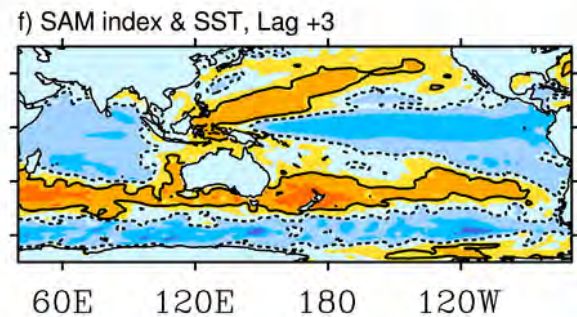
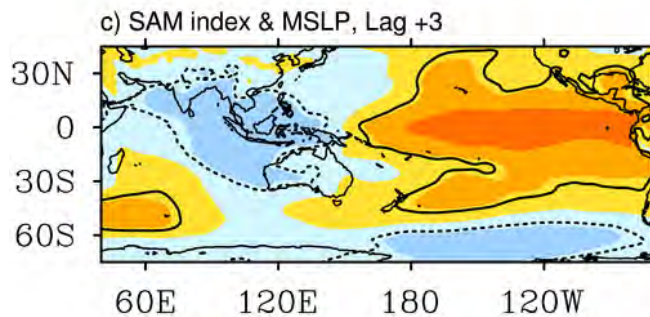
b) SAM index & MSLP, Lag 0

e) SAM index & SST, Lag 0

SAM matures

ENSO signals project strongly onto the SAM, although ENSO-forced signals tend to peak before ENSO.

3m later



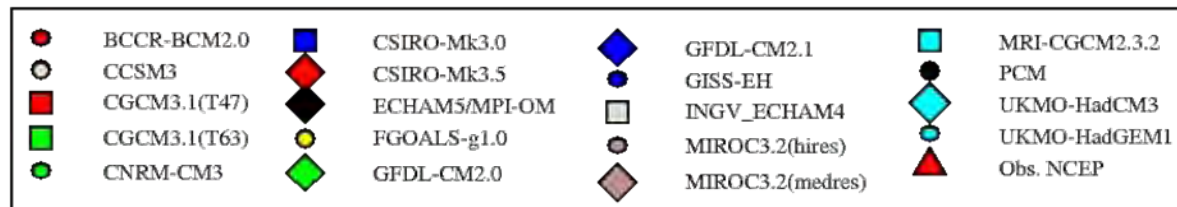
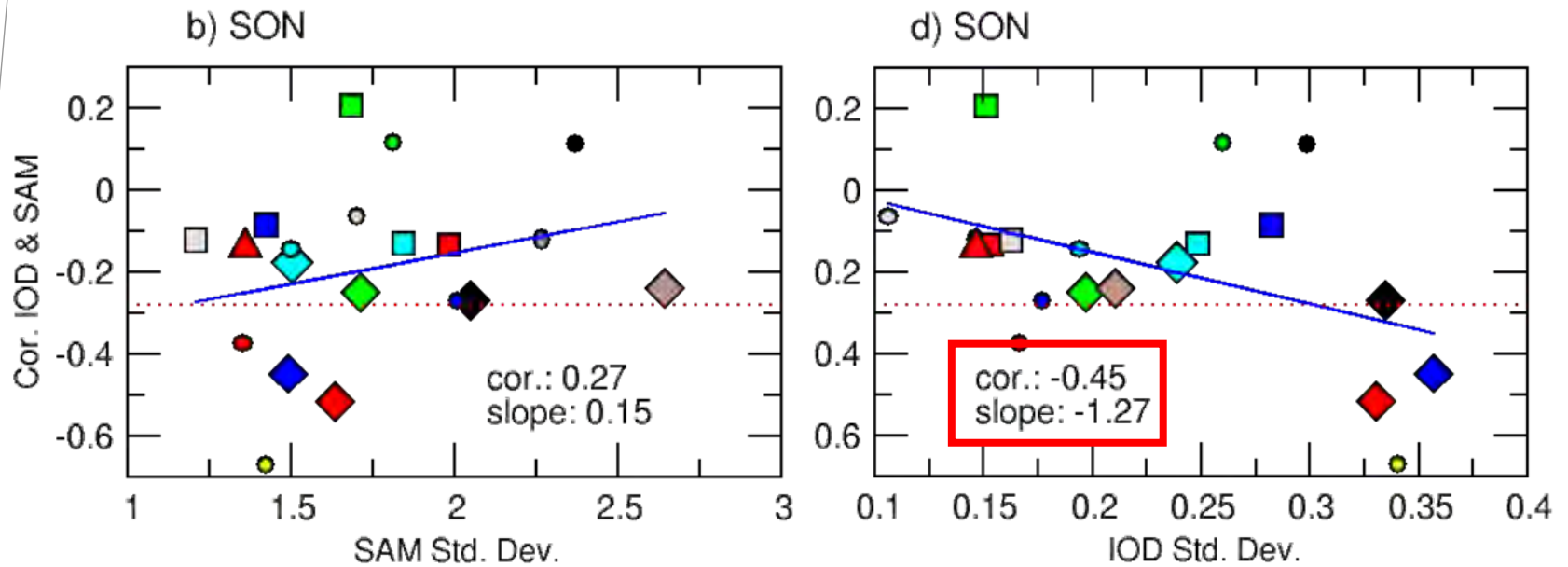
It turns out ...

- This is due to the seasonality of the Southern Hemisphere, which has maximum variance in winter and spring, however ENSO peaks in summer (Dec-Feb).
- In the Southern Hemisphere, a lead-lag correlation is not a good indicator of the relationship between cause and effect.
- In CSIRO Mk3.5, ENSO peaks in May or June, and the SAM peaks concurrently.
- In ACCESS Base-09D run, ENSO peaks in Mar, the SAM peaks in DJF and SON, and the IOD could start from Jun and last till Jan.

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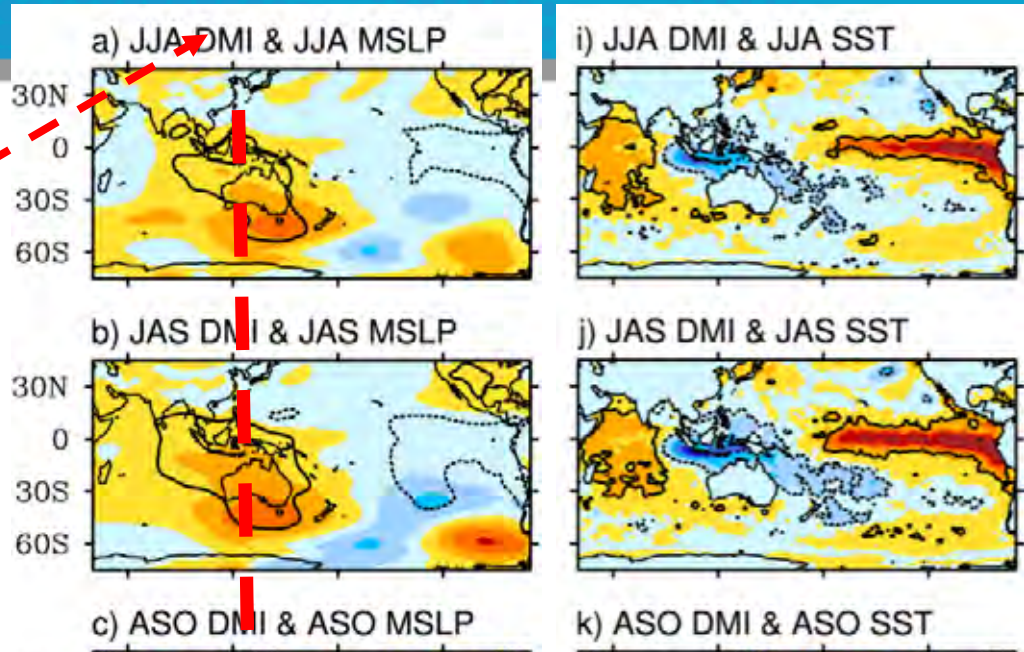


Can the SAM control IOD events??

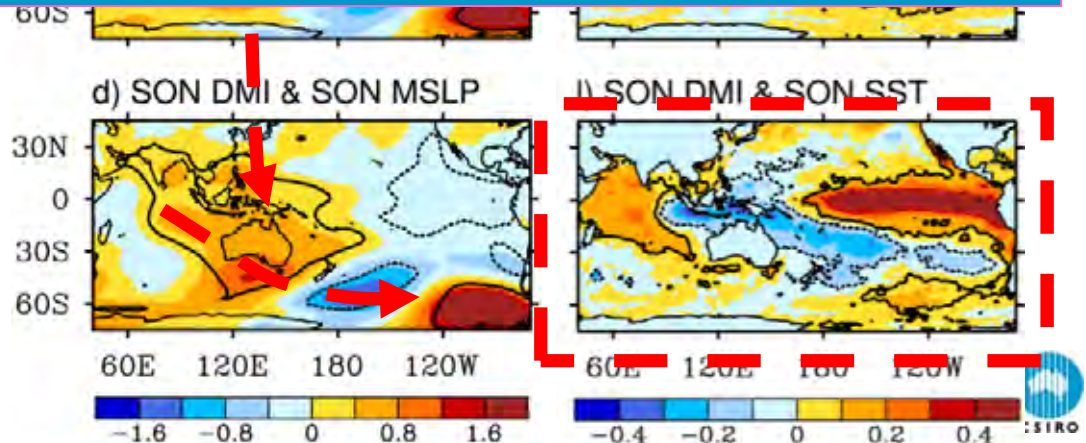


Positive IOD events forcing a high pressure south of Australia

Dipole Mode Index

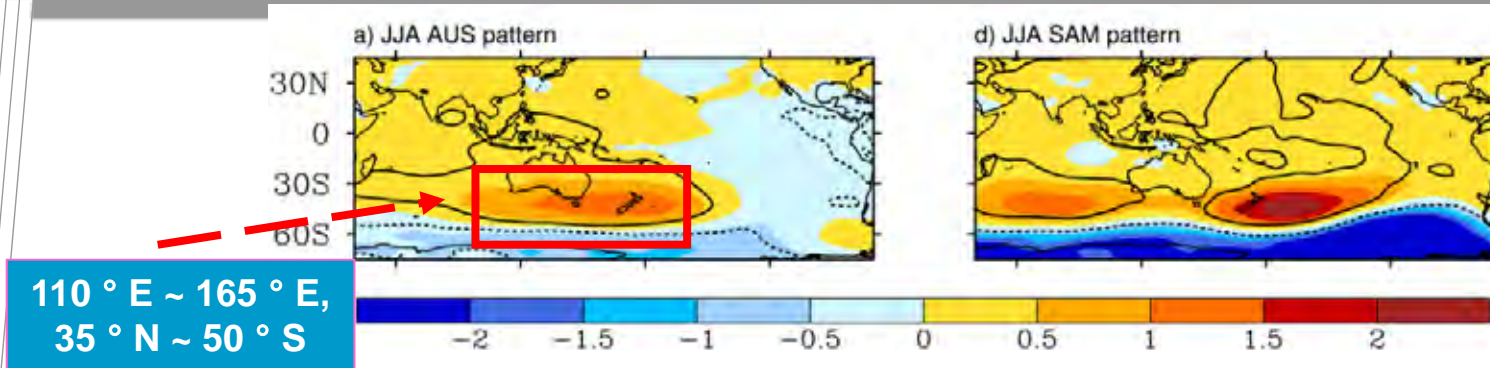


MSLP anomalies reflect a wavetrain centre which peaks before the IOD itself.



Cai, W., P. van Rensch, T. Cowan, and H. Hendon, 2011. *J. Climate*, in press.

Argument of IOD events forced by the SAM



The SAM has a negative cor. with the IOD.



Lau and Nath, 2004: Coupled GCM simulation of atmosphere-ocean variability associated with the zonally asymmetric SST changes in the tropical Indian Ocean. *J. Climate*, 17, 245-265.

Wenju Cai, Arnold Sullivan, and Tim Cowan (2010). **Interactions of ENSO, the IOD, and the SAM in CMIP3 models.** Journal of Climate.
doi: 10.1175/2010JCLI3744.1

www.csiro.au

Thank you and question!

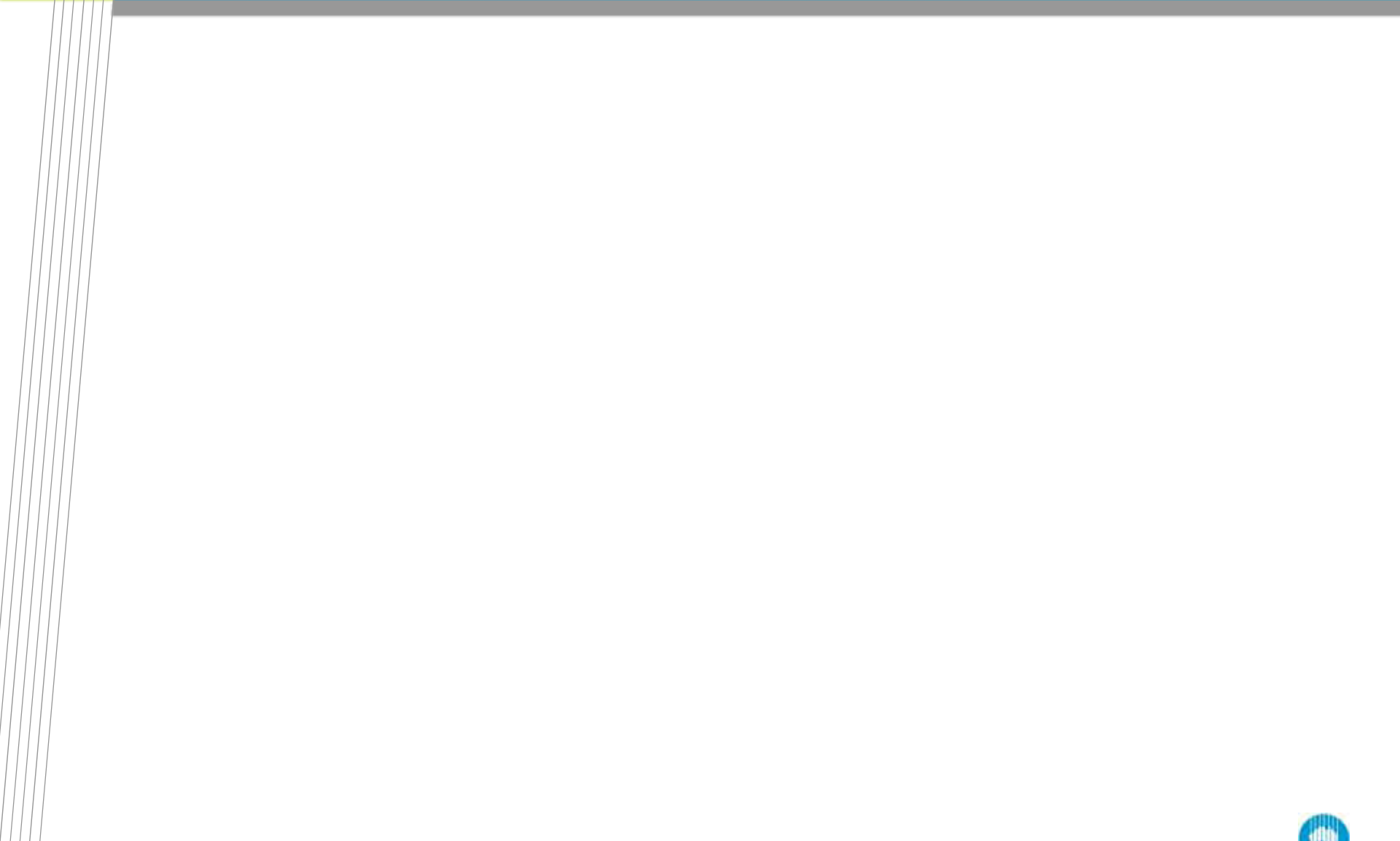
Contact: [Arnold Sullivan](mailto:arnold.sullivan@csiro.au)

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Email: arnold.sullivan@csiro.au

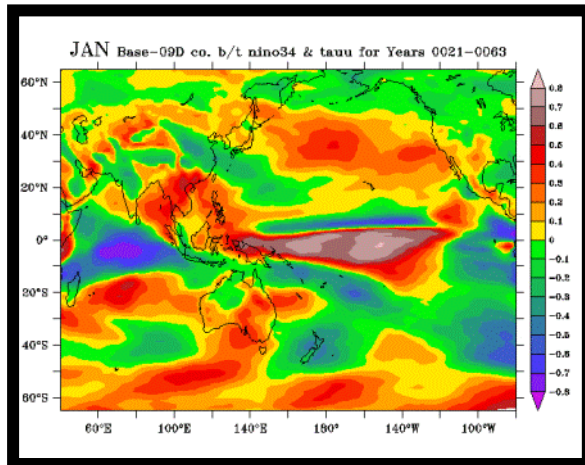
CSIRO.



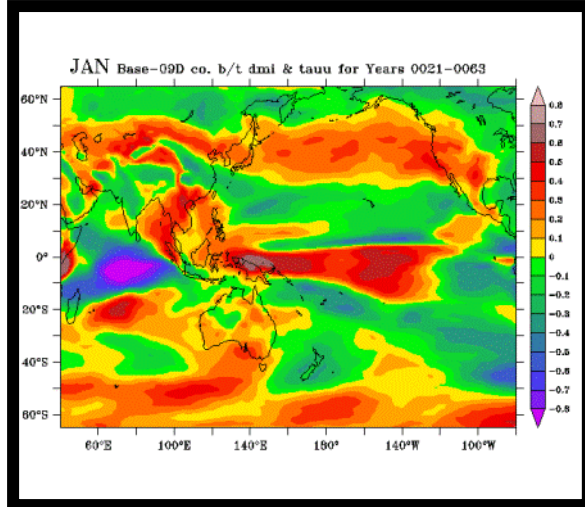


Monthly simultaneous cor. b/t indices & tauu

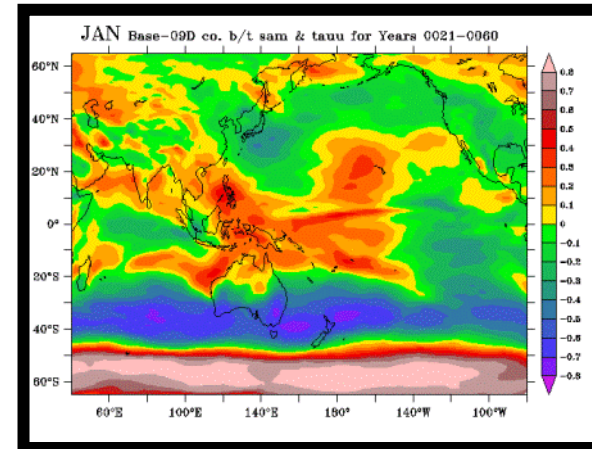
ENSO



IDO

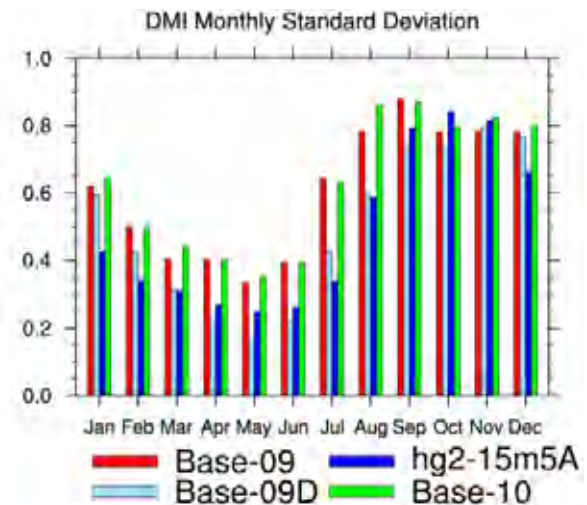
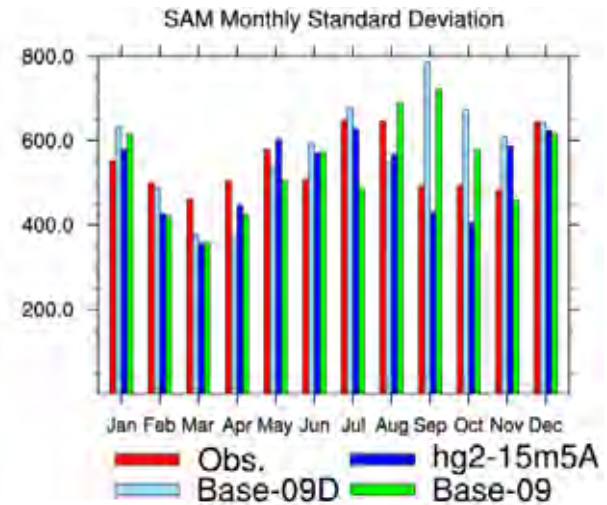
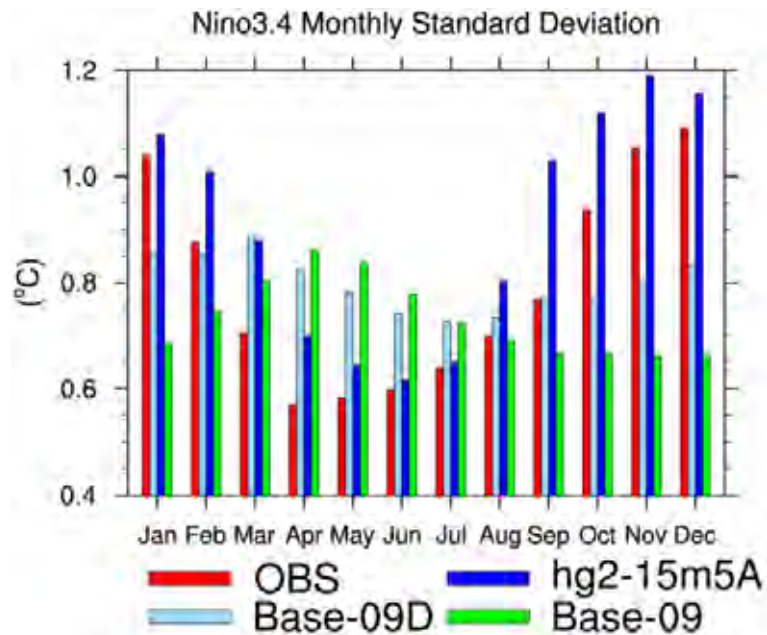


SAM



- In ACCESS Base-09D run, ENSO peaks in Mar, the SAM peaks in DJF and SON, and the IOD could start from Jun and last till Jan.

Seasonal phase-locking of ENSO/SAM/IOD variability



Three motivations

- We know ENSO can force the IOD (Cai et al. 2005), but can the IOD influence ENSO?
- There is a suggestion that the SAM can control the IOD (Lau and Nath 2004). However the mechanism is not clear.
- It is also shown that ENSO can control the SAM (L'Heureux and Thompson 2006), but the SAM leads (Jin and Kirtman 2009). How come?
- Interactions between climate drivers will vary significantly from one model to another, because each model may represent one of the many possible regimes. Therefore, we will use multi-model outputs to address these issues.

Cai, W., A. Sullivan, and T. Cowan, 2010: Interactions of ENSO, the IOD, and the SAM in CMIP3 models. *J. Climate*, under review