



**The Abdus Salam  
International Centre for Theoretical Physics**



**1968-16**

**Conference on Teleconnections in the Atmosphere and Oceans**

*17 - 20 November 2008*

**Teleconnections between ENSO and the SAM, and the role of Rossby wave breaking**

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# *ENSO - SAM Teleconnections*

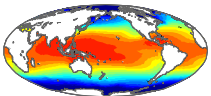
Joe Kidston and James Renwick

NIWA, New Zealand

*j.renwick@niwa.co.nz*

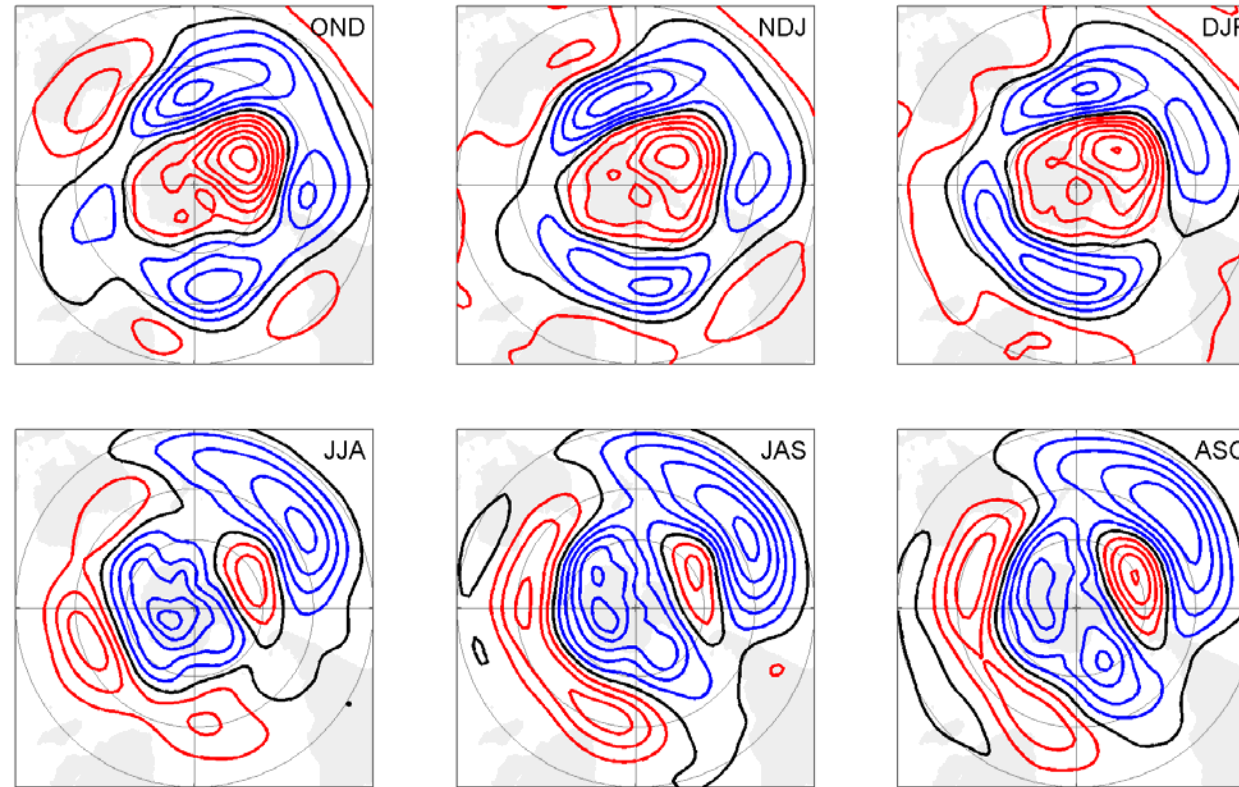
# Outline

- ENSO-SAM linkage - motivation
- Zonal symmetry
- Wave propagation and the storm track
  - Barotropic and baroclinic forcing
- Summary

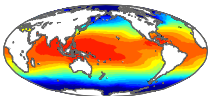


# Covariance, CTI & 500hPa height

1979 - 2007



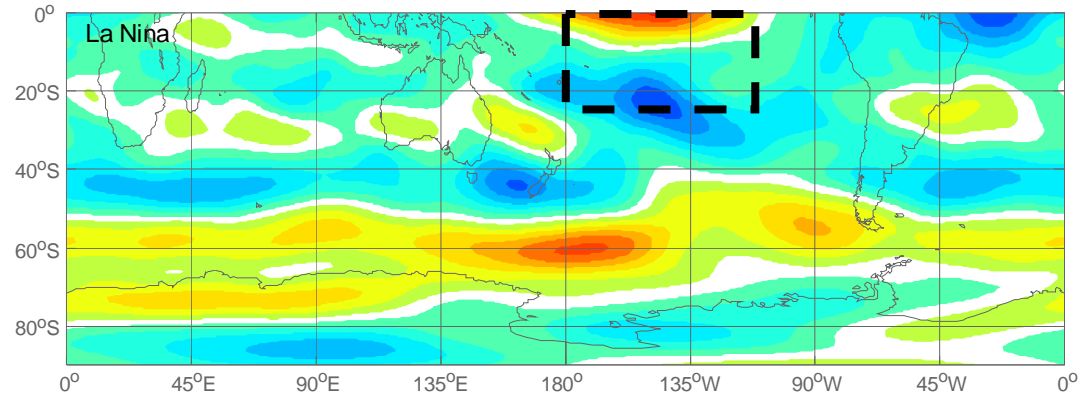
- Seasonally varying correlation at high latitudes



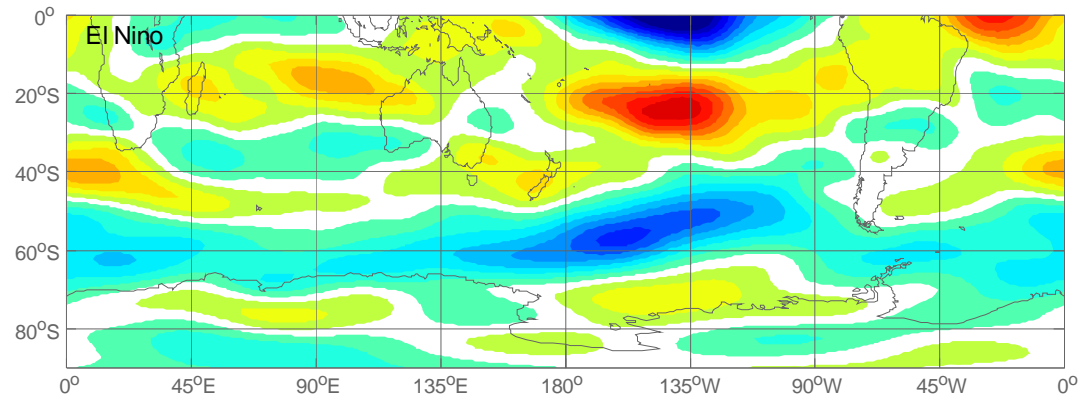
# ENSO and SH zonal winds

u300 DJF, 1979 to 2007

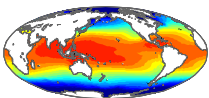
La Niña



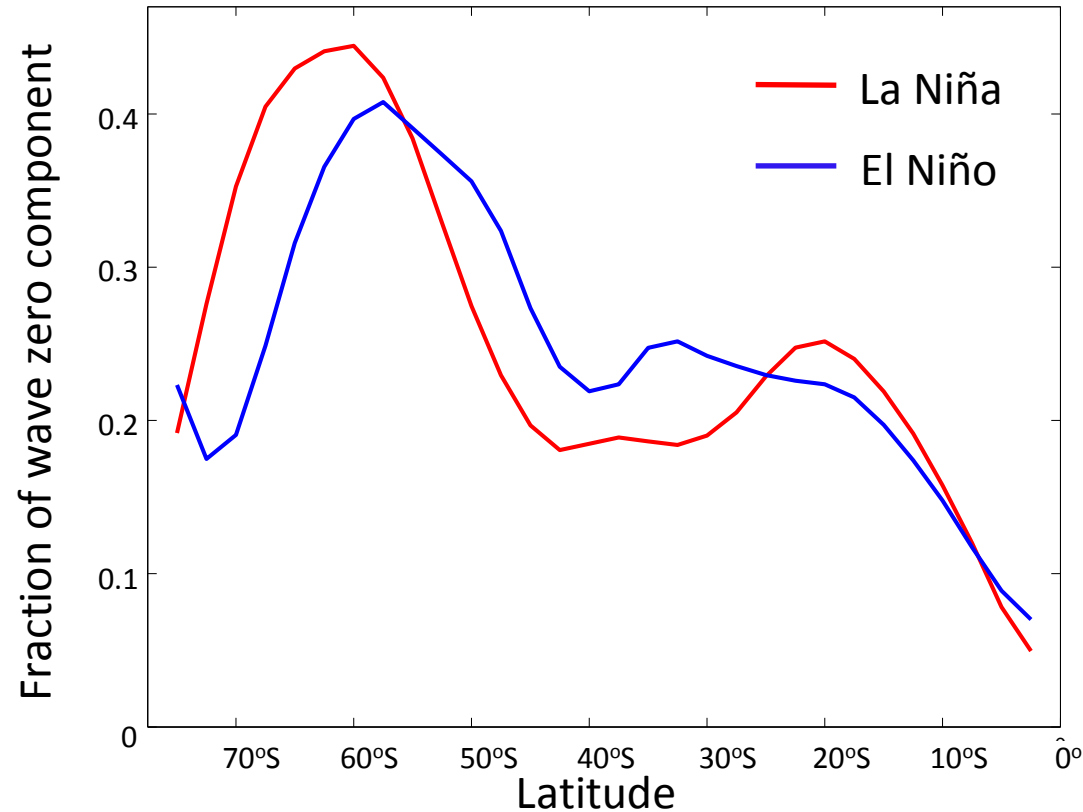
El Niño



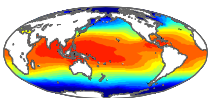
- Meridional wave train in either El Niño or La Niña
  - Tropical “forcing” across central Pacific
  - Zonally symmetric “response” near 60°S



# Zonal symmetry



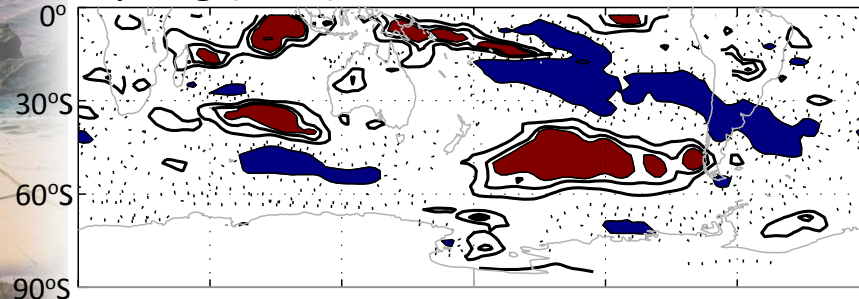
- Fourier decomposition of DJF  $u$  anomalies (smoothed)
- Response becomes more annular at higher latitudes
- Zonally asymmetric forcing initiates a symmetric response



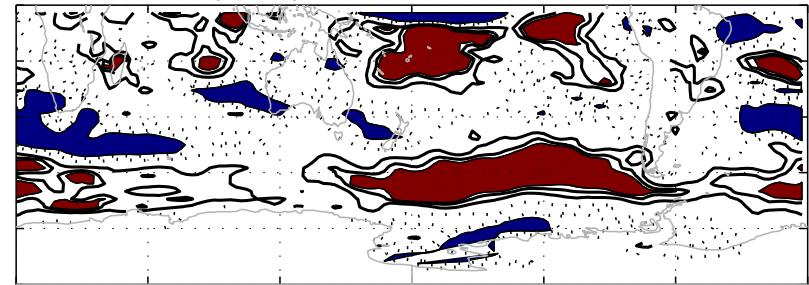


# Baroclinicity

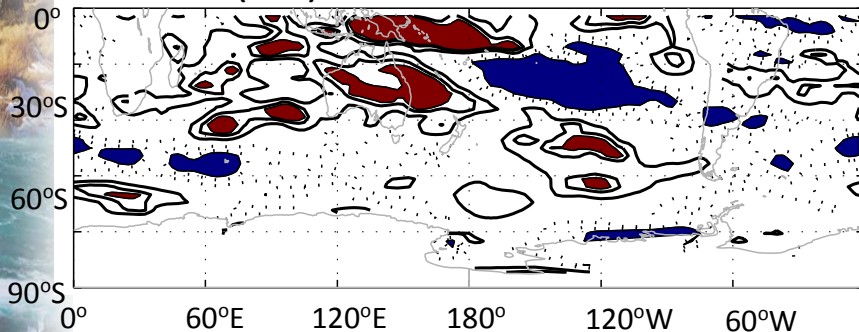
Spring (SON)



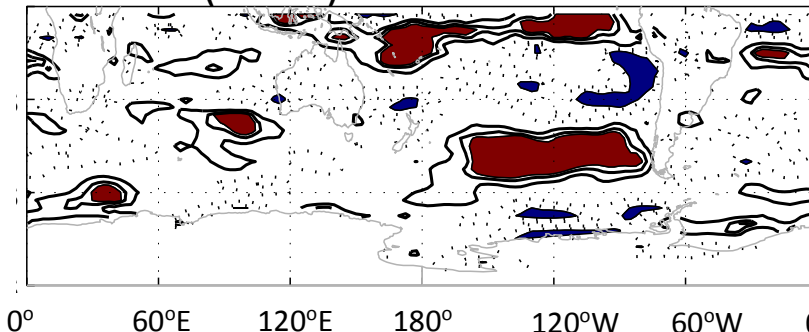
Summer (DJF)



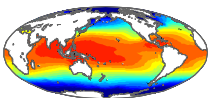
Winter (JJA)



Autumn (MAM)



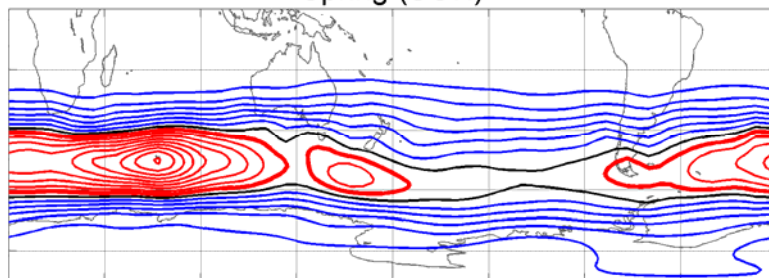
- Correlation between 700-850 hPa baroclinicity and SOI
  - ENSO-induced wave a baroclinic forcing
  - Baroclinicity increases during La Niña over S. Pacific in all seasons
    - Equivalent barotropic – changes vertical wind-shear, Eady growth rate
  - Separate from wave-related meridional momentum flux



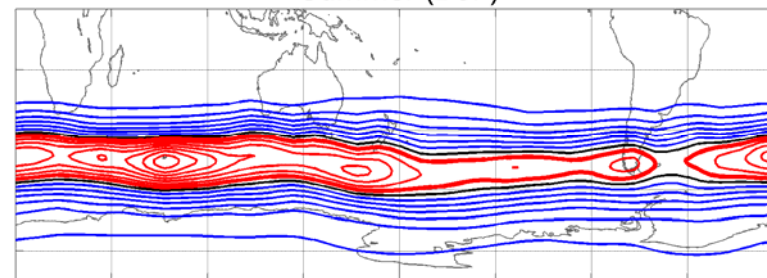
# Storm track variability

300 hPa high-pass filtered geopotential height variance

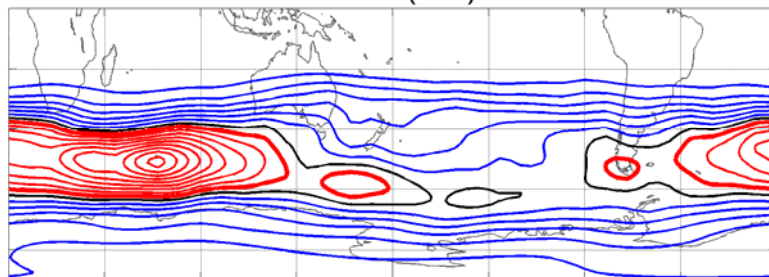
Spring (SON)



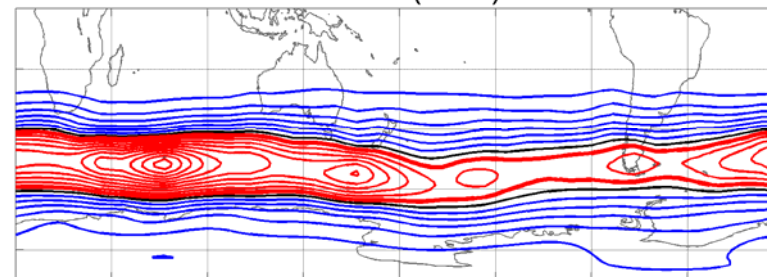
Summer (DJF)



Winter (JJA)



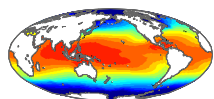
Autumn (MAM)



Weak storm track over the Pacific

More zonally symmetric

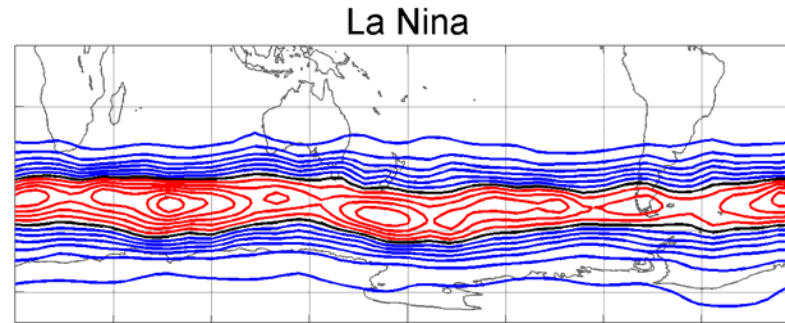
During summer/autumn, is enhanced baroclinicity better able to be communicated downstream?



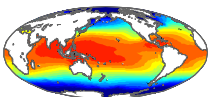
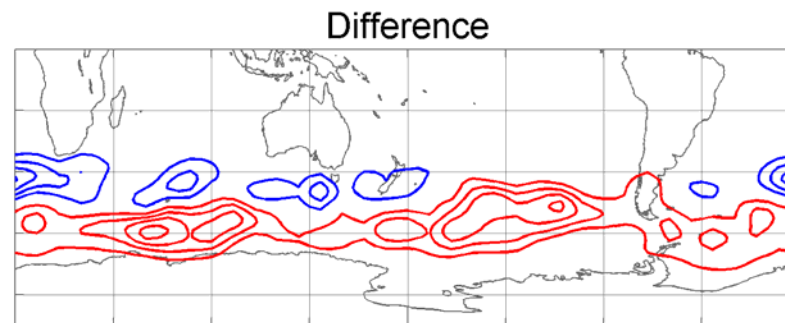
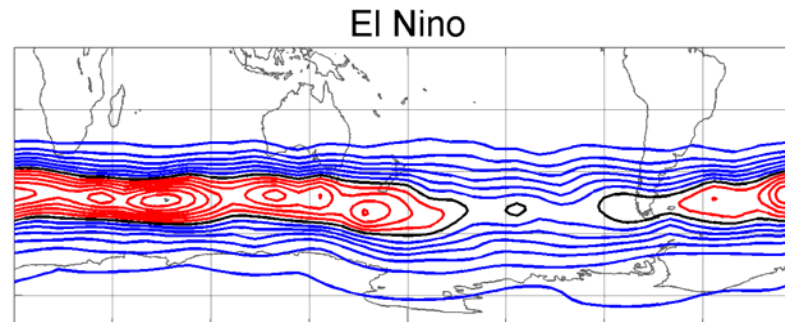


# Storm track variability: ENSO (DJF)

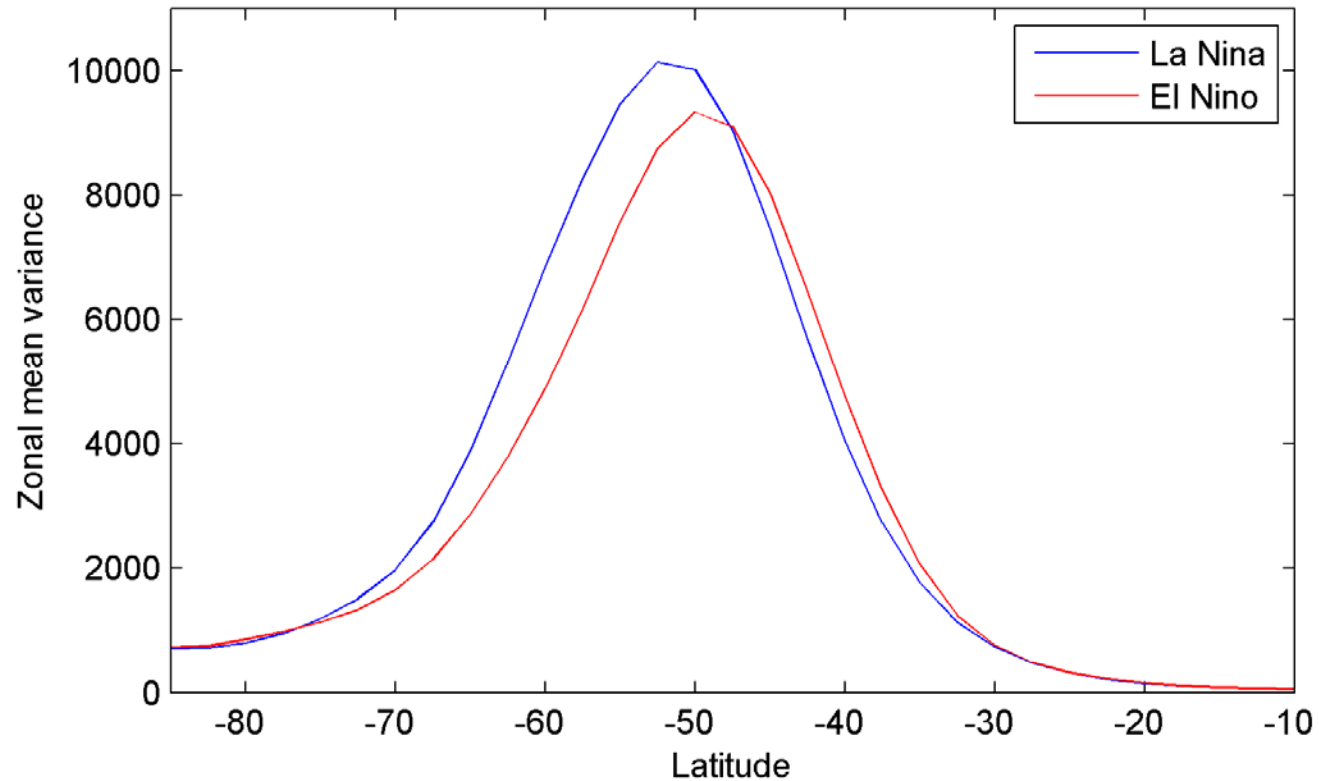
Zonally symmetric



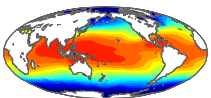
Less eddy activity over South Pacific



# ENSO and eddy activity



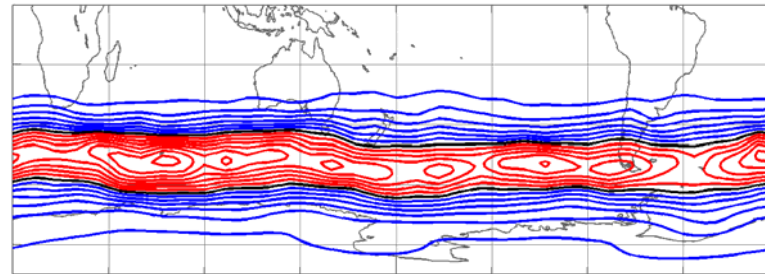
- La Niña:
  - Eddy peak slightly poleward
  - 20% more eddy variance south of 50°S



# Storm track variability: SAM (DJF)

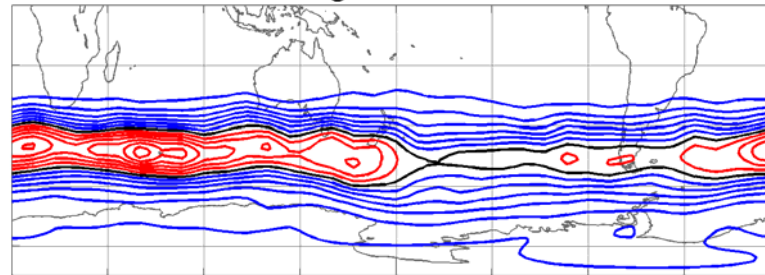
Zonally symmetric

Positive SAM

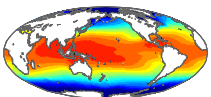
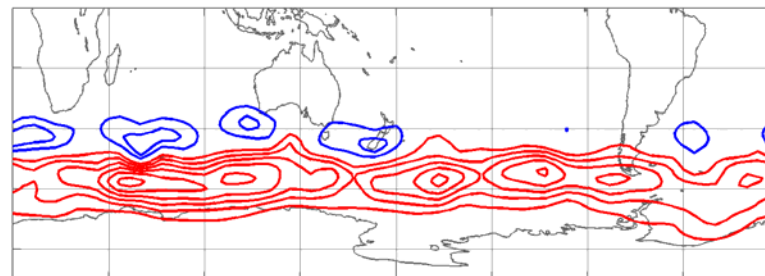


Less eddy activity over South Pacific

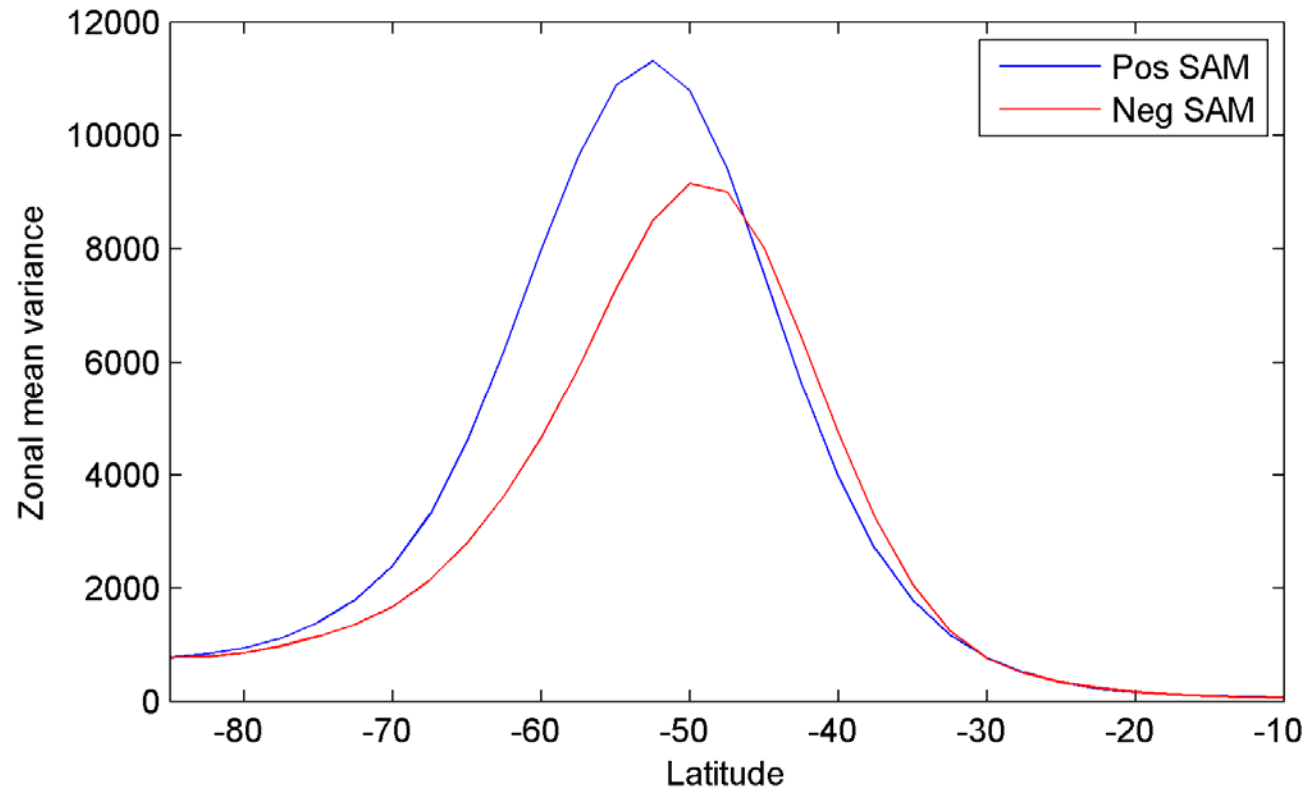
Negative SAM



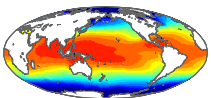
Difference



# SAM and eddy activity

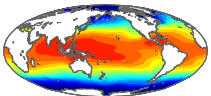


- Positive SAM:
  - Eddy peak slightly poleward
  - 40% more eddy variance south of 50°S



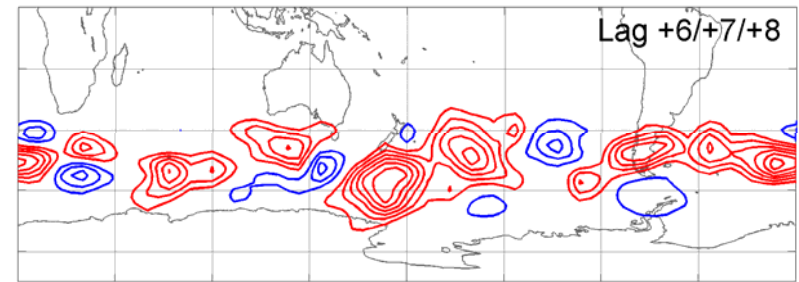
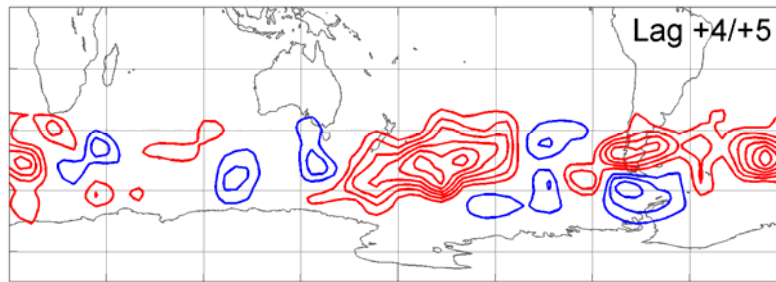
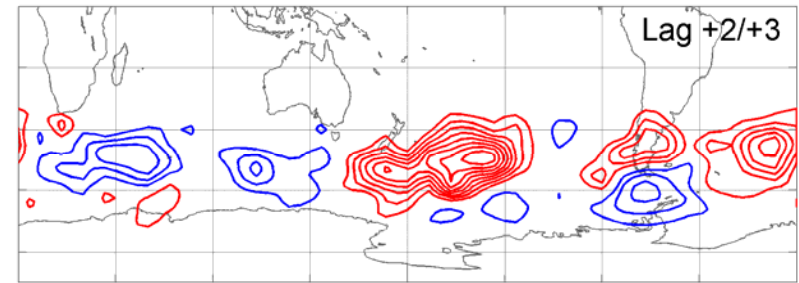
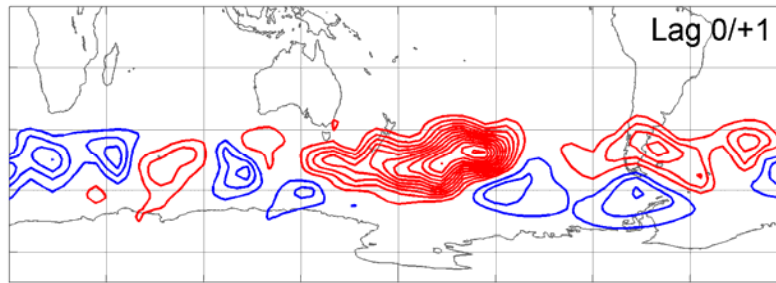
# SAM and eddy activity

- Do eddies generated in the South Pacific push the jet poleward downstream?
- Downstream propagation/development?
  - Can we see this?
- Why the lack of winter response?
  - Weaker waveguide and propagation?

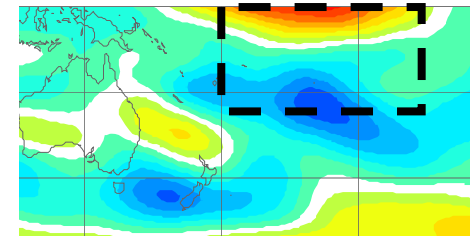




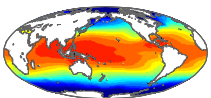
# Wavetrain composites



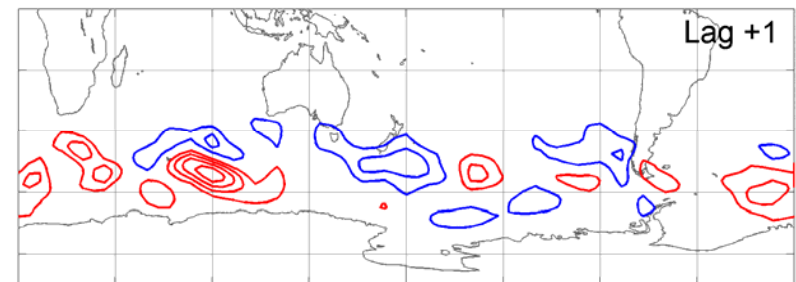
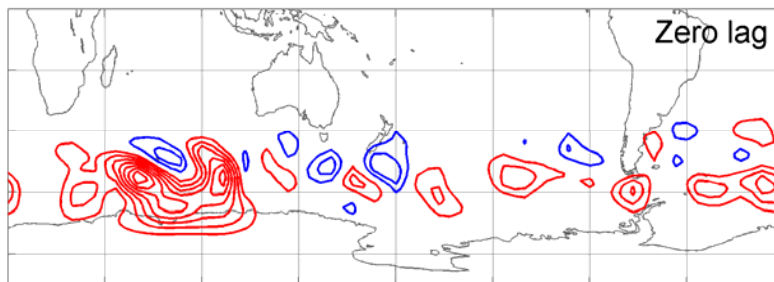
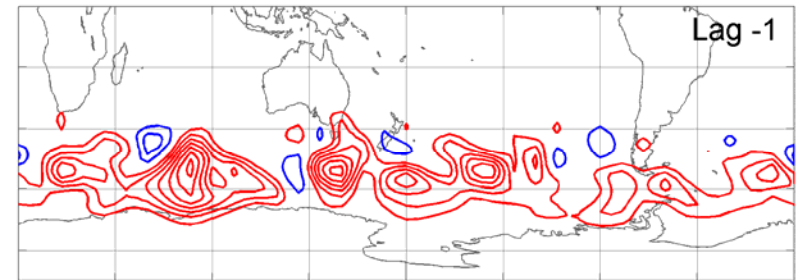
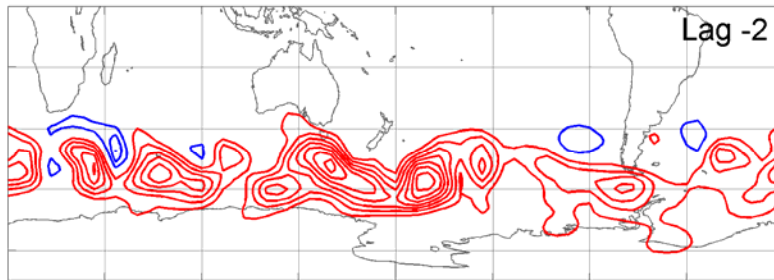
Based on tropical Pacific 300hPa wind dipole



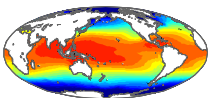
- Suggestion of spreading out from the South Pacific
  - Lull in eddy activity at days 2-3, then increase



# Positive SAM composites

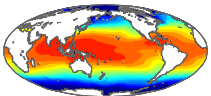


- Enhanced eddy activity before positive SAM development
- No sign of Pacific locus/downstream development
  - Regional (Pacific) SAM index looks similar



# Summary

- Impact of ENSO on the SAM
  - Not due to zonally symmetric forcing
  - ENSO-related meridional wave train
    - Is associated with momentum fluxes that maintain the SAM
    - Forces baroclinicity anomalies across South Pacific that initiate SAM changes?
  - Increased eddy activity (during La Niña) pushes the jet poleward?
- More data analysis and modelling to come



# Regional SAM?

- Ideas of Mike's...
- ...etc

