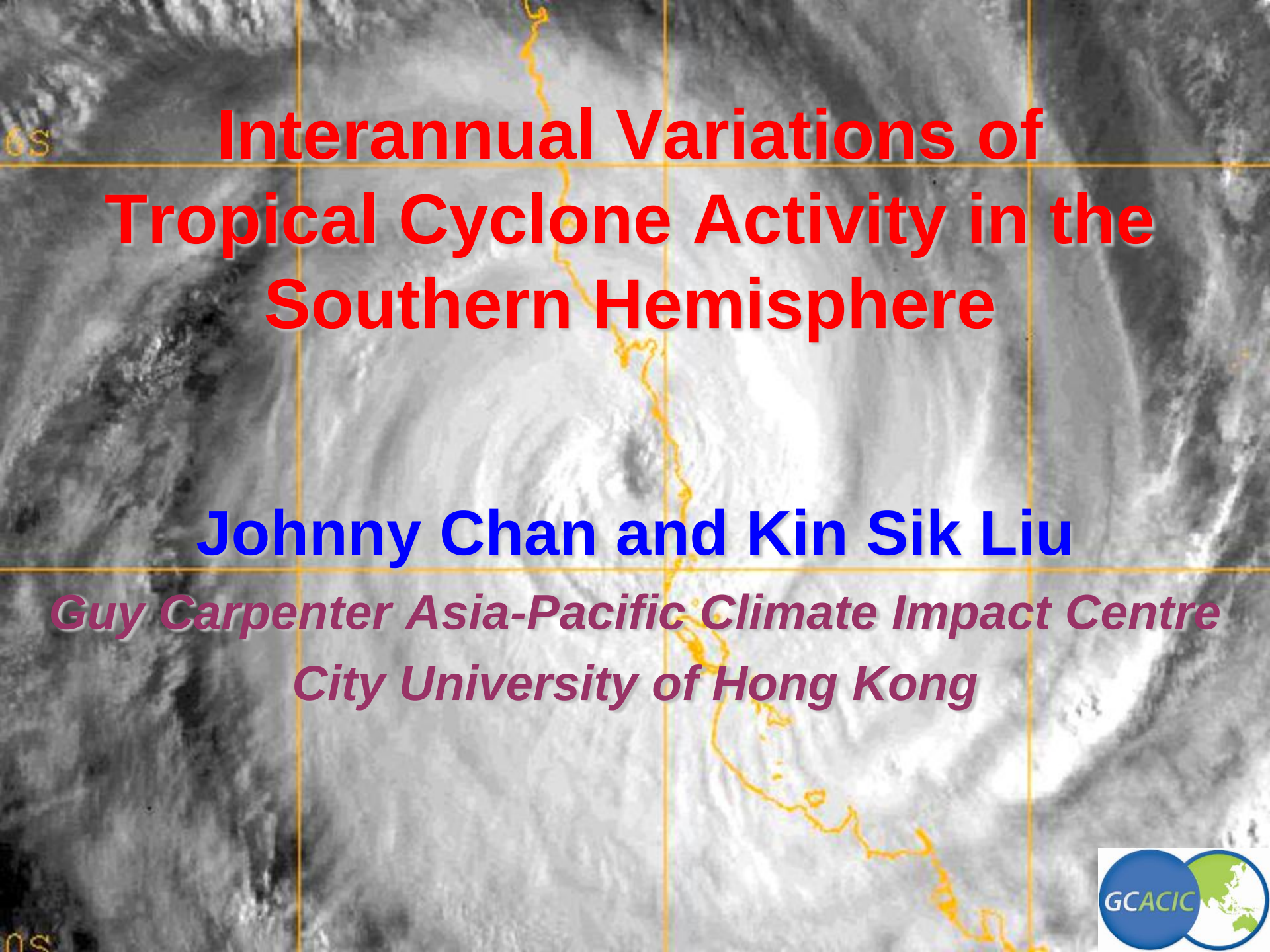
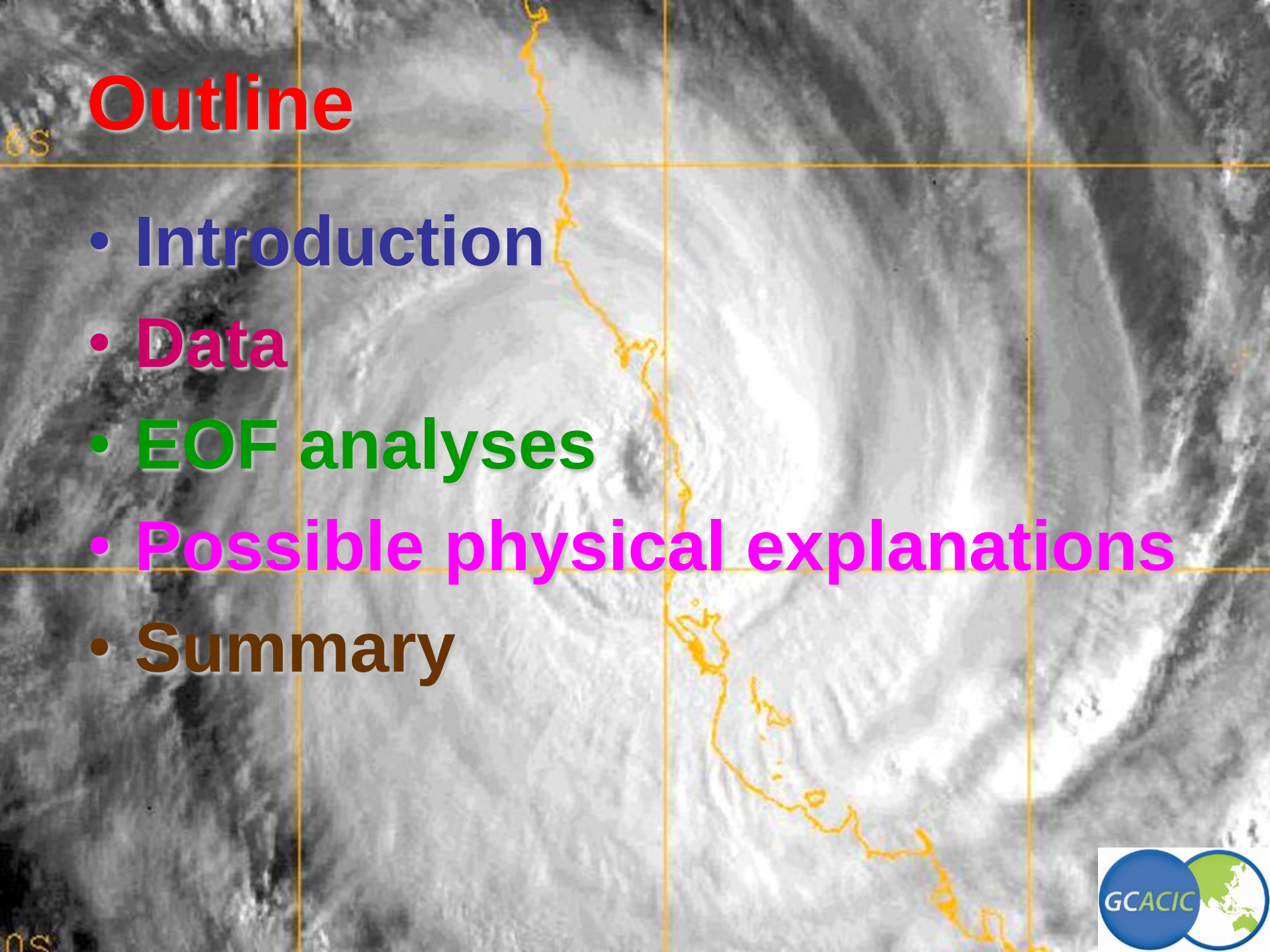


# Interannual Variations of Tropical Cyclone Activity in the Southern Hemisphere


**Johnny Chan and Kin Sik Liu**

*Guy Carpenter Asia-Pacific Climate Impact Centre*

*City University of Hong Kong*

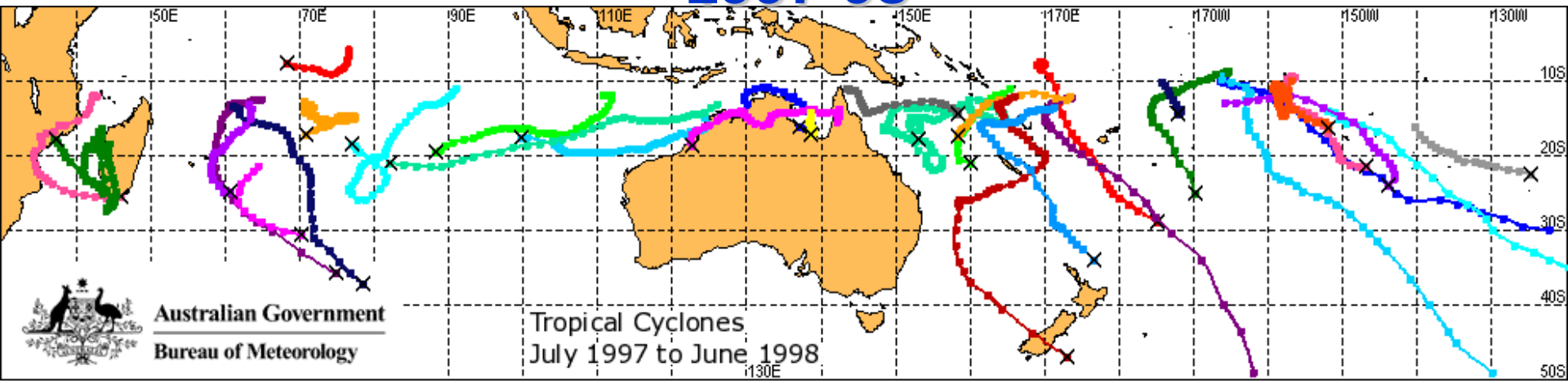



# Outline

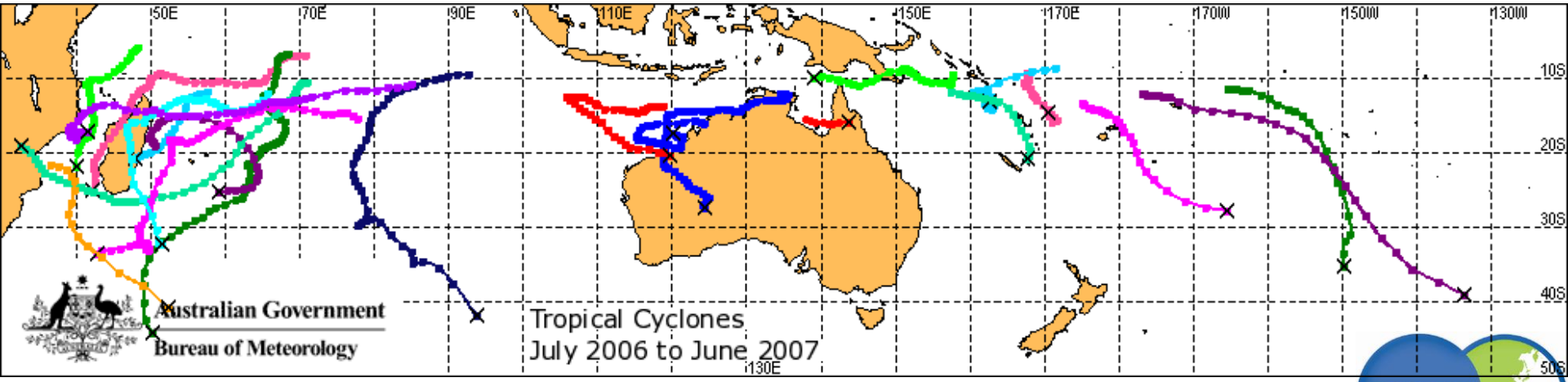
- Introduction
- Data
- EOF analyses
- Possible physical explanations
- Summary

# SH Tropical Cyclone Tracks

## 1997-98




## 2006-07




GCACIC

# Data

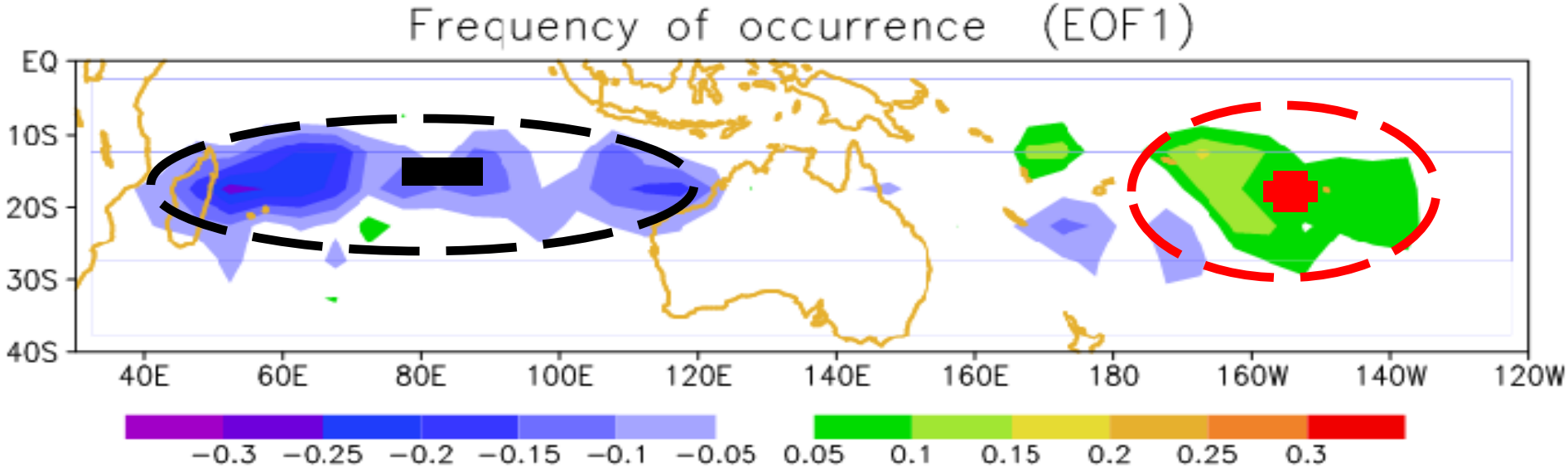
- JTWC best tracks 1983-2007
- Indian Dipole Mode Index (DMI):

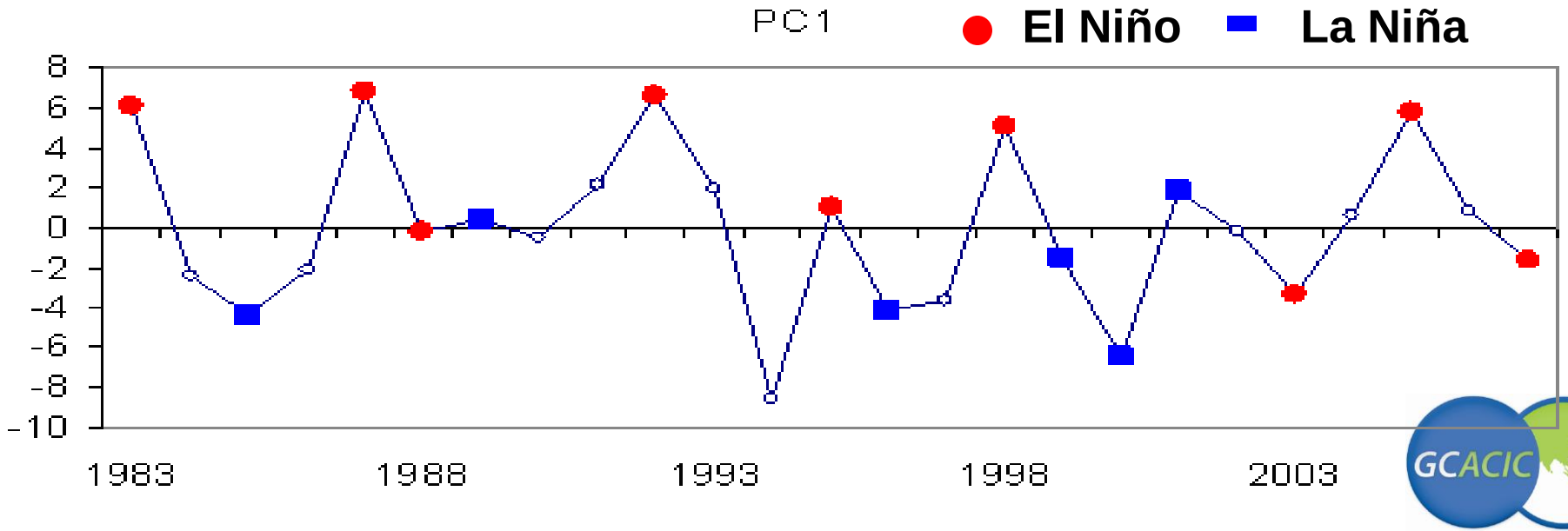
  SSTA difference:

  (60˚E-80˚E, 10˚S-10˚N) – (90˚E-110˚E, 10˚S-0˚)

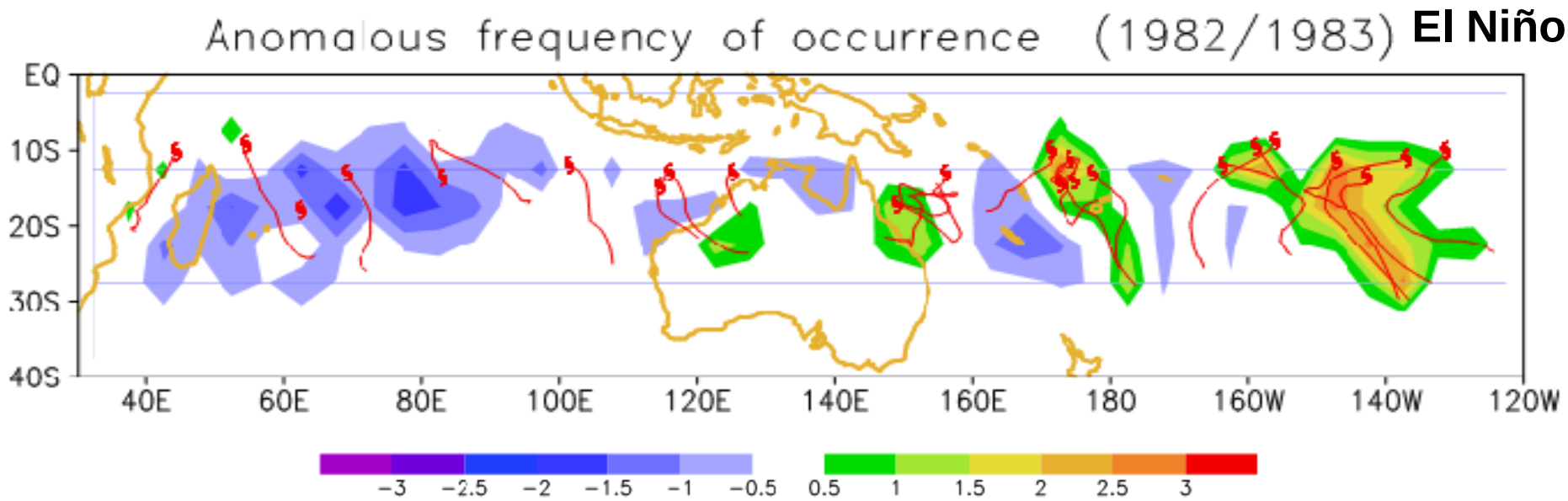
  SST dataset: Hadley Centre
- Nino indices
- NCEP reanalyses

# EOF1 (12.5%)

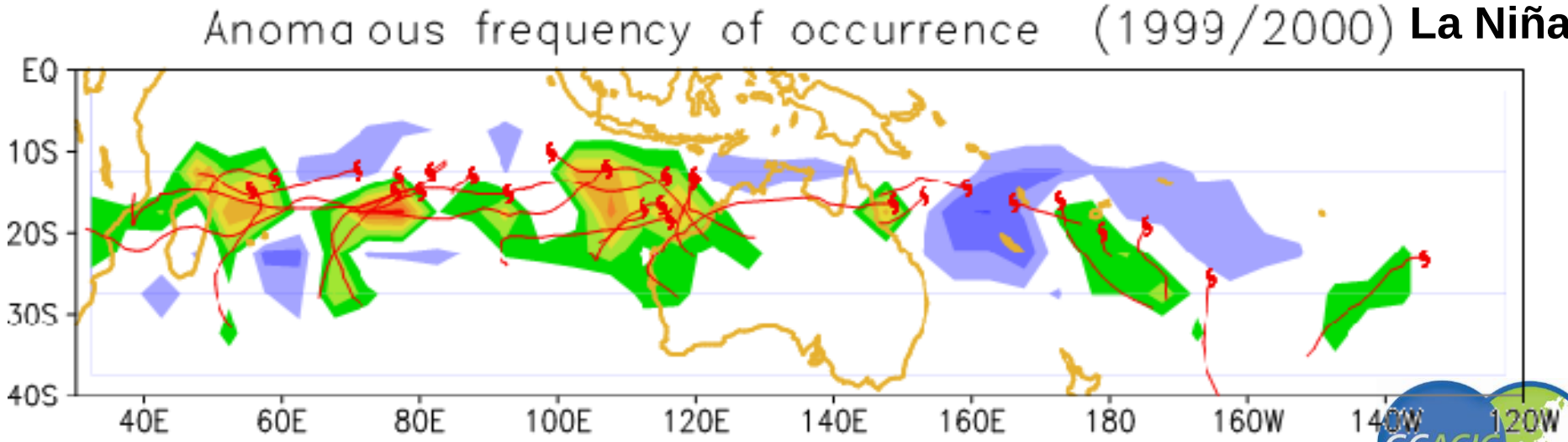

Frequency of occurrence (EOF1)
EQ
10S
20S
30S
40S
40E
60E
80E
100E
120E
140E
160E
180
160W
140W
120W
−0.3 −0.25 −0.2 −0.15 −0.1 −0.05 0.05 0.1 0.15 0.2 0.25 0.3


PC1
El Niño
La Niña
8
6
4
2
0
-2
-4
-6
-8
-10
1983
1988
1993
1998
2003

# Typical Examples for EOF1

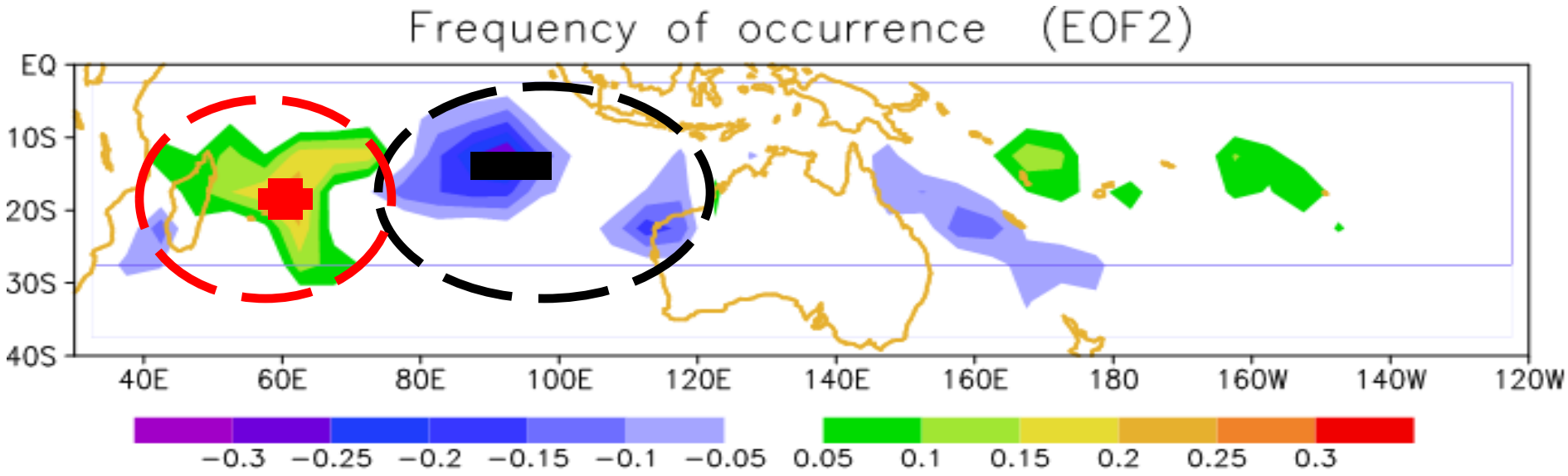


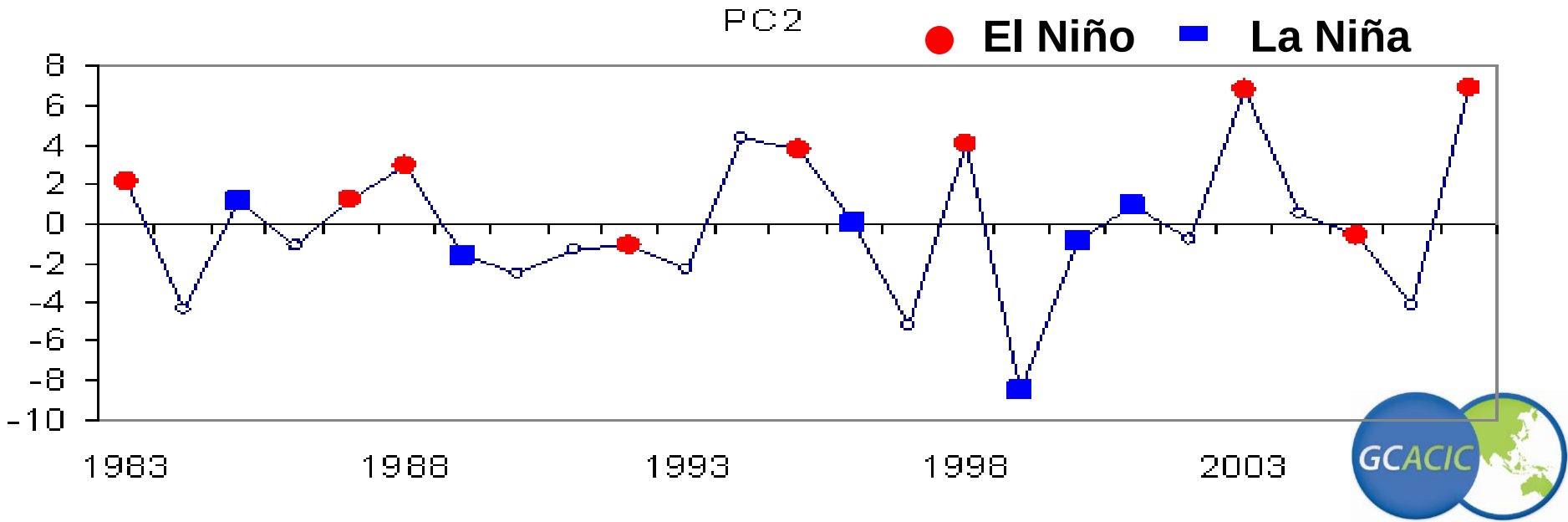

**El Niño**



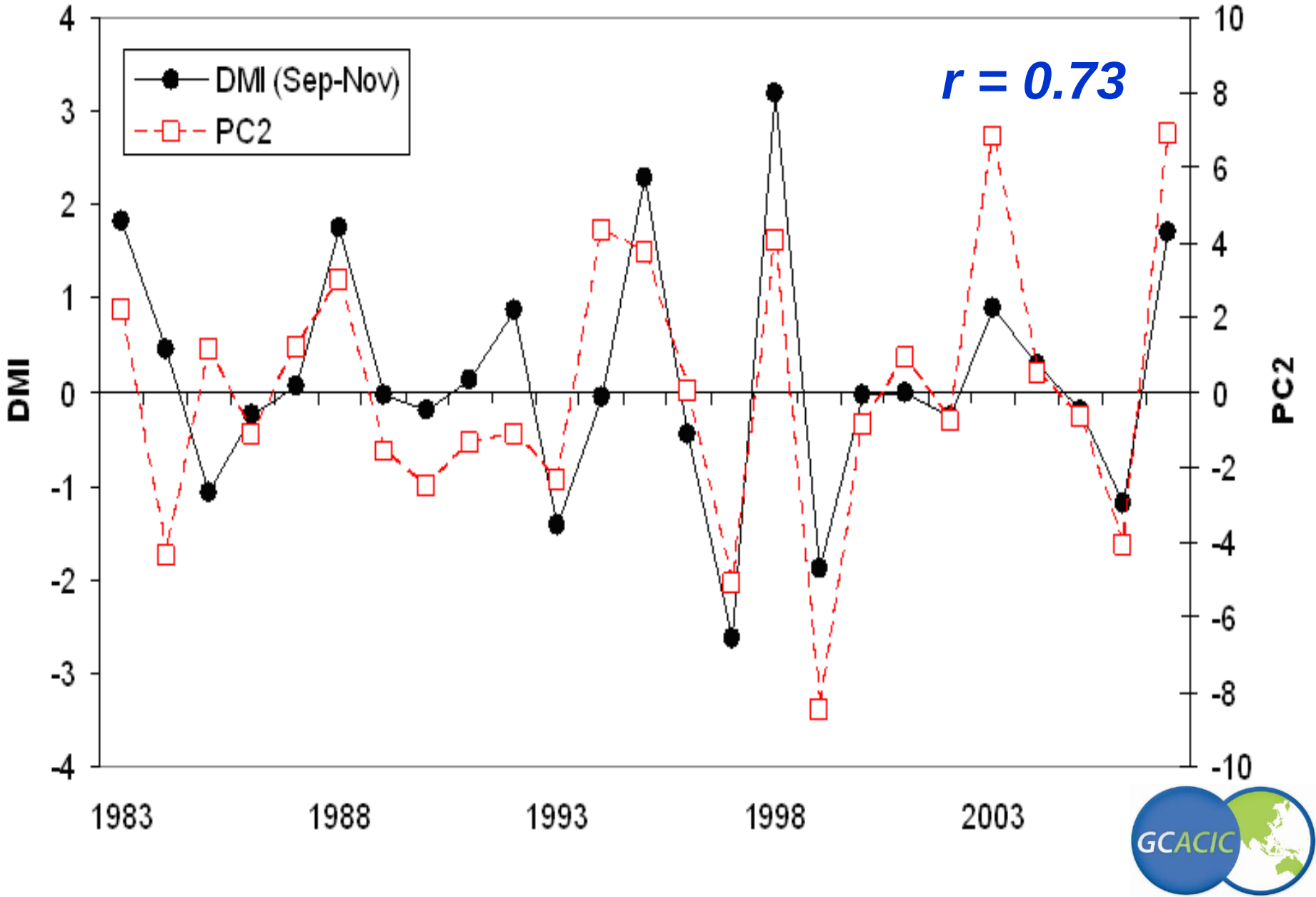

**La Niña**

# EOF2 (10 %)

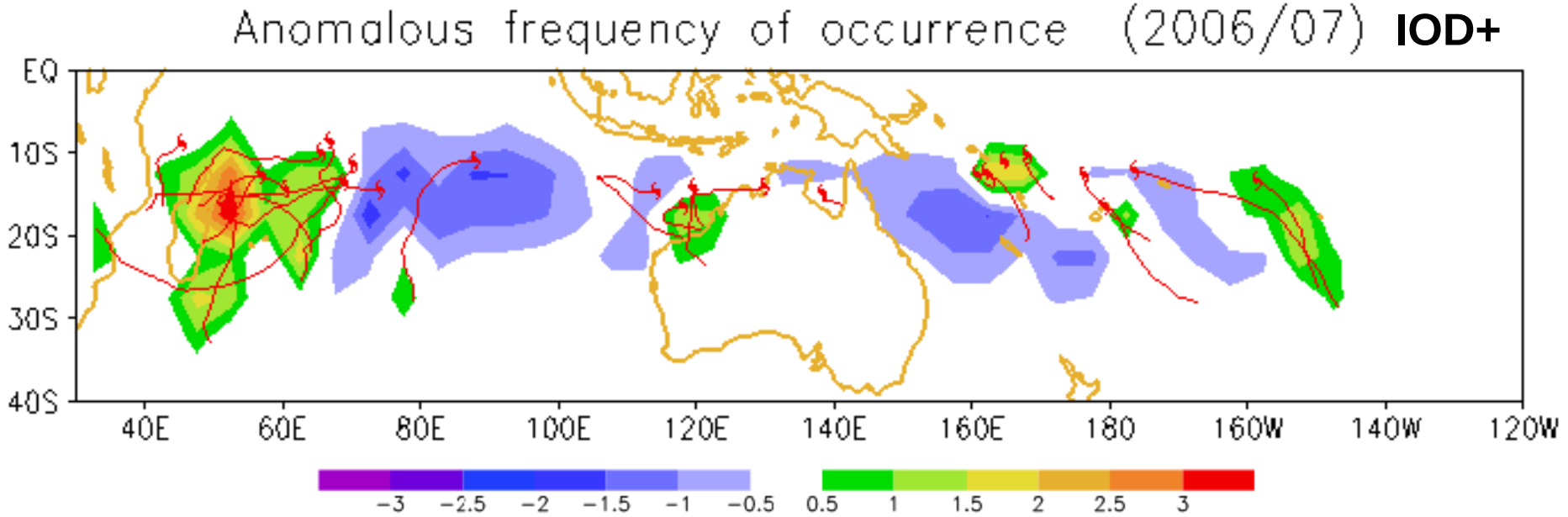

Frequency of occurrence (EOF2)
EQ
10S
20S
30S
40S
40E
60E
80E
100E
120E
140E
160E
180
160W
140W
120W
−0.3 −0.25 −0.2 −0.15 −0.1 −0.05 0.05 0.1 0.15 0.2 0.25 0.3

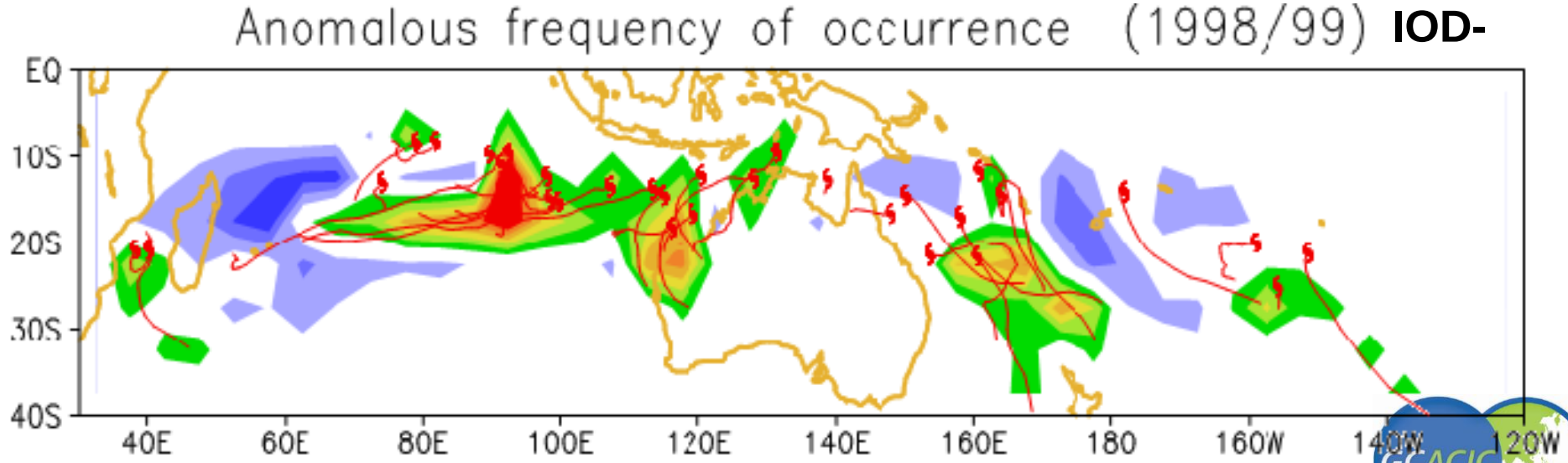

PC2
El Niño
La Niña
8
6
4
2
0
-2
-4
-6
-8
-10
1983
1988
1993
1998
2003

# Dipole Mode Index (Sep-Nov) vs PC2

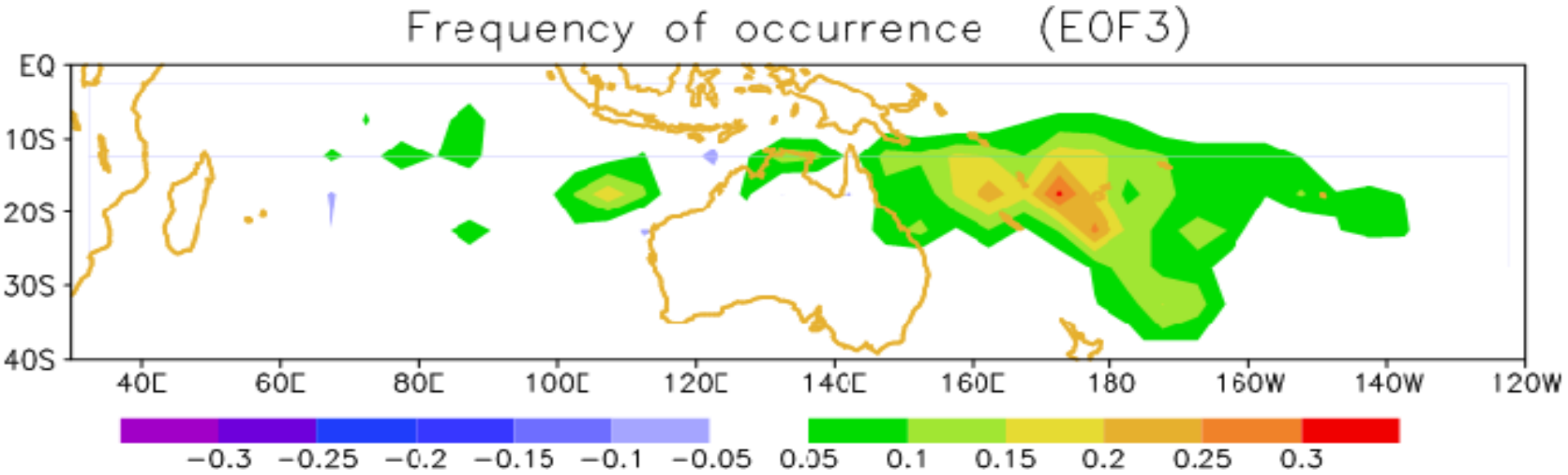


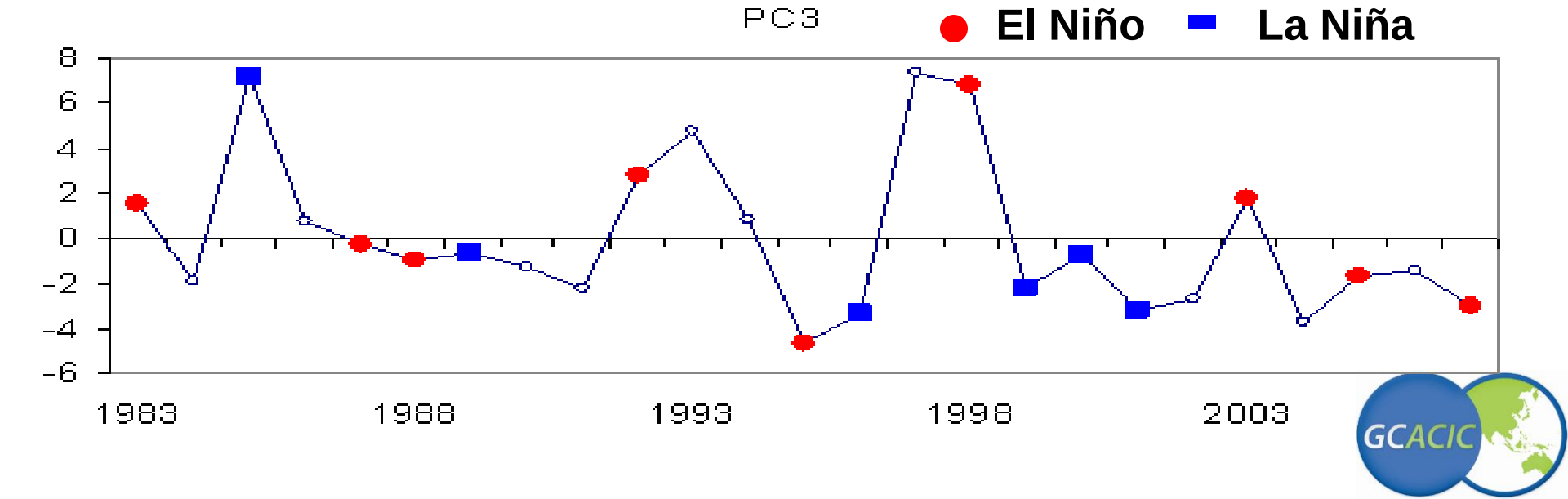
# Typical Tracks in IOD+ and IOD- years



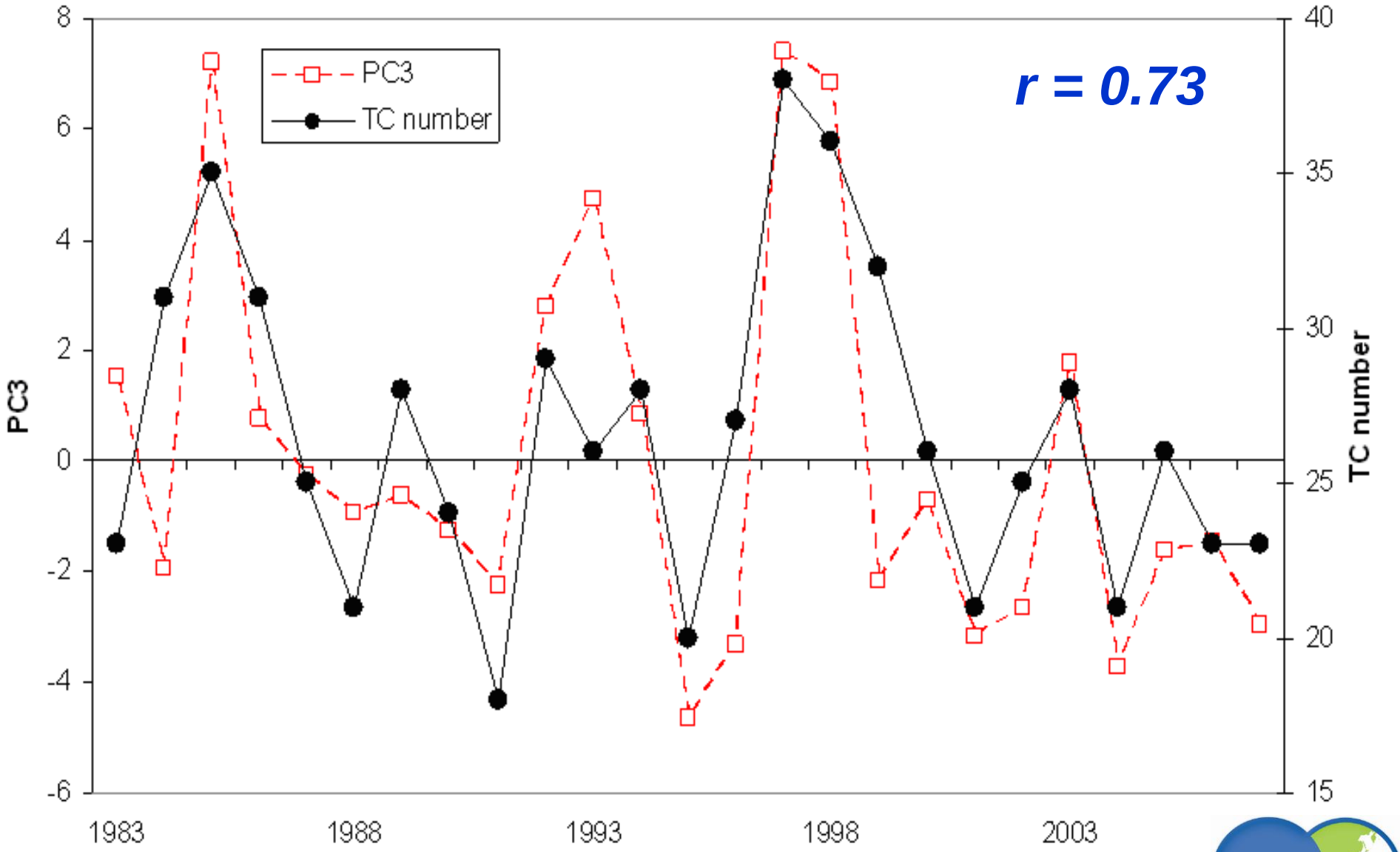



# EOF3 (9.1 %)

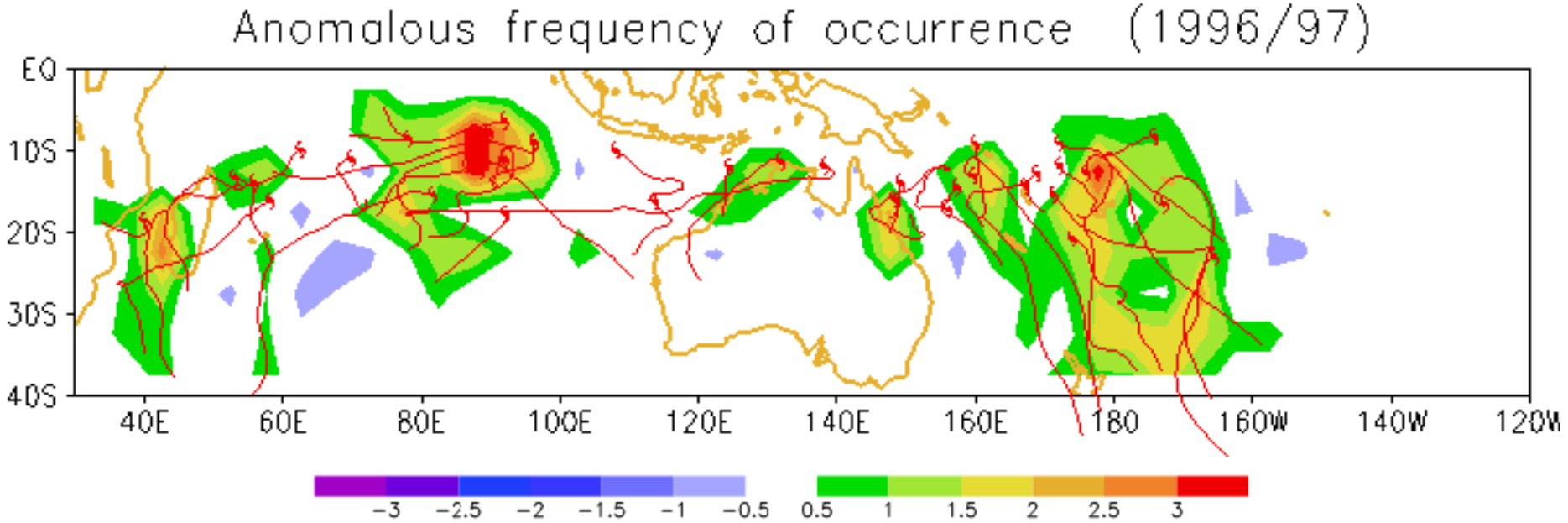

Frequency of occurrence (EOF3)
EQ
10S
20S
30S
40S
40E
60E
80E
100E
120E
140E
160E
180
160W
140W
120W
−0.3 −0.25 −0.2 −0.15 −0.1 −0.05 0.05 0.1 0.15 0.2 0.25 0.3

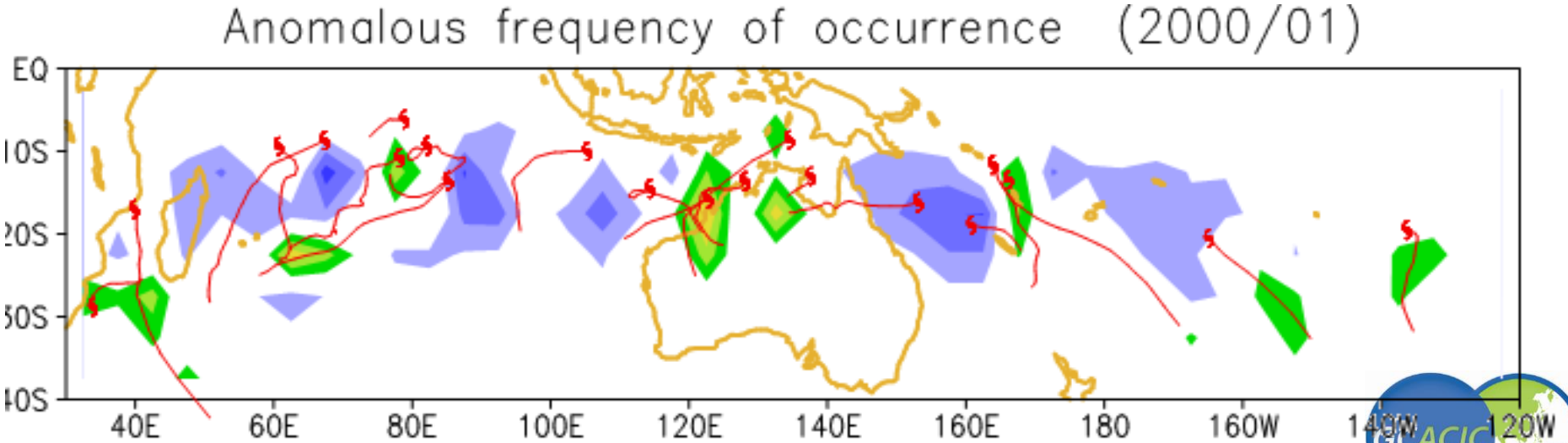

PC3
El Niño
La Niña
8
6
4
2
0
-2
-4
-6
1983
1988
1993
1998
2003

# No. of Southern Hemisphere TCs vs PC3



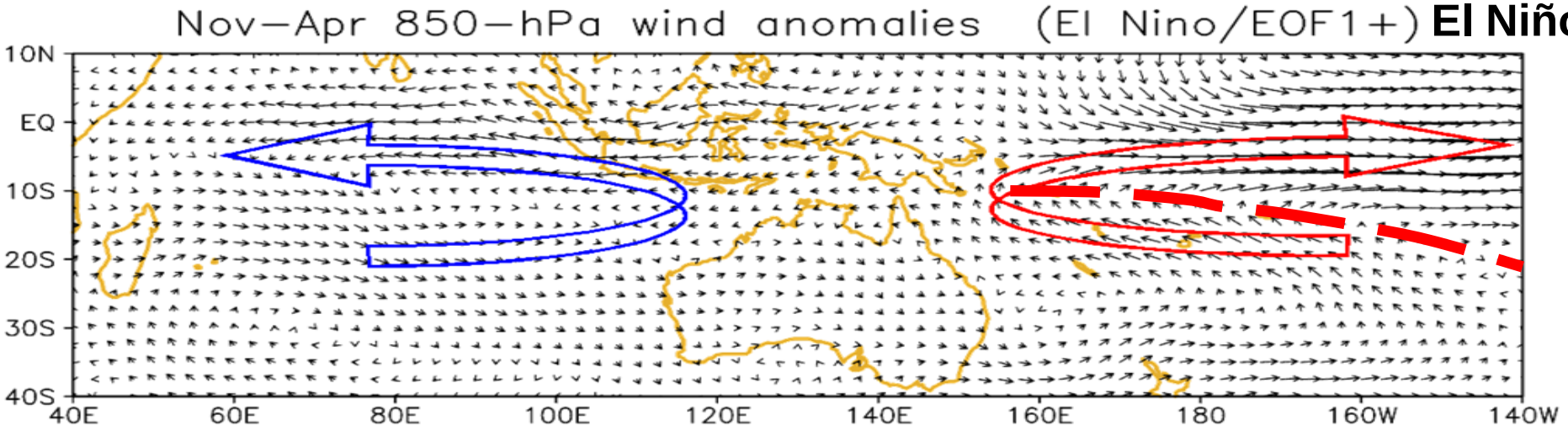
# Typical track patterns in high and low activity years



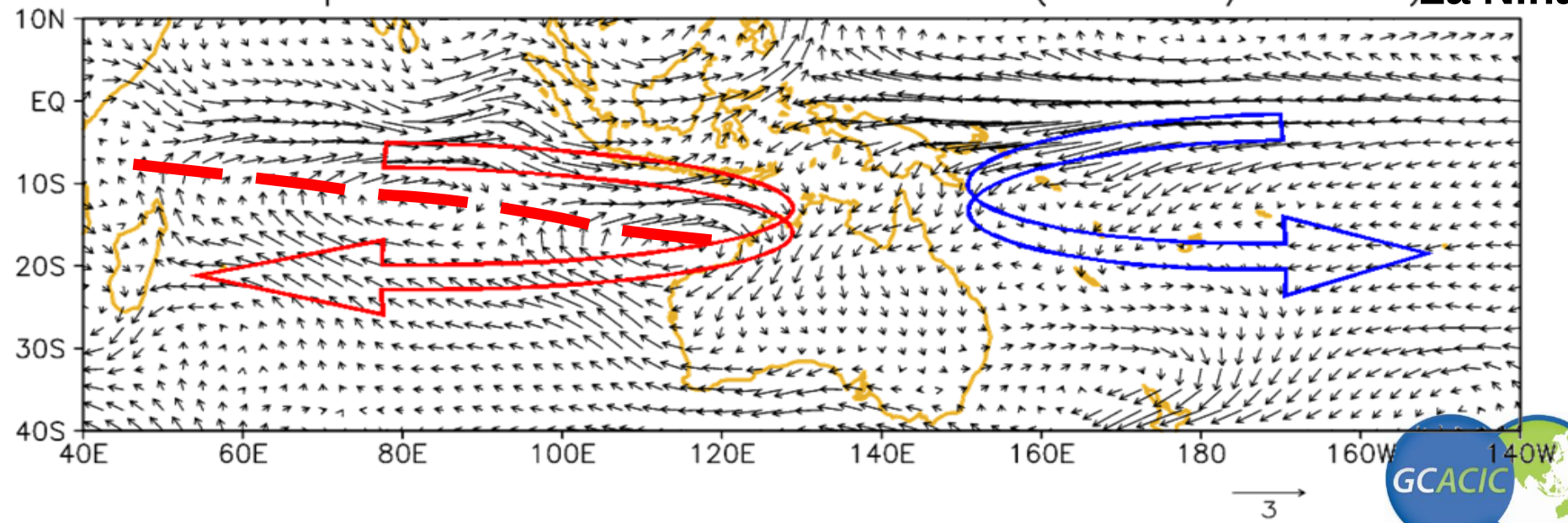
# Nov-Apr 850-hPa wind anomalies EOF1+ vs EOF1-

**1982/83, 1986/87, 1991/92, 1997/98, 2004/05**



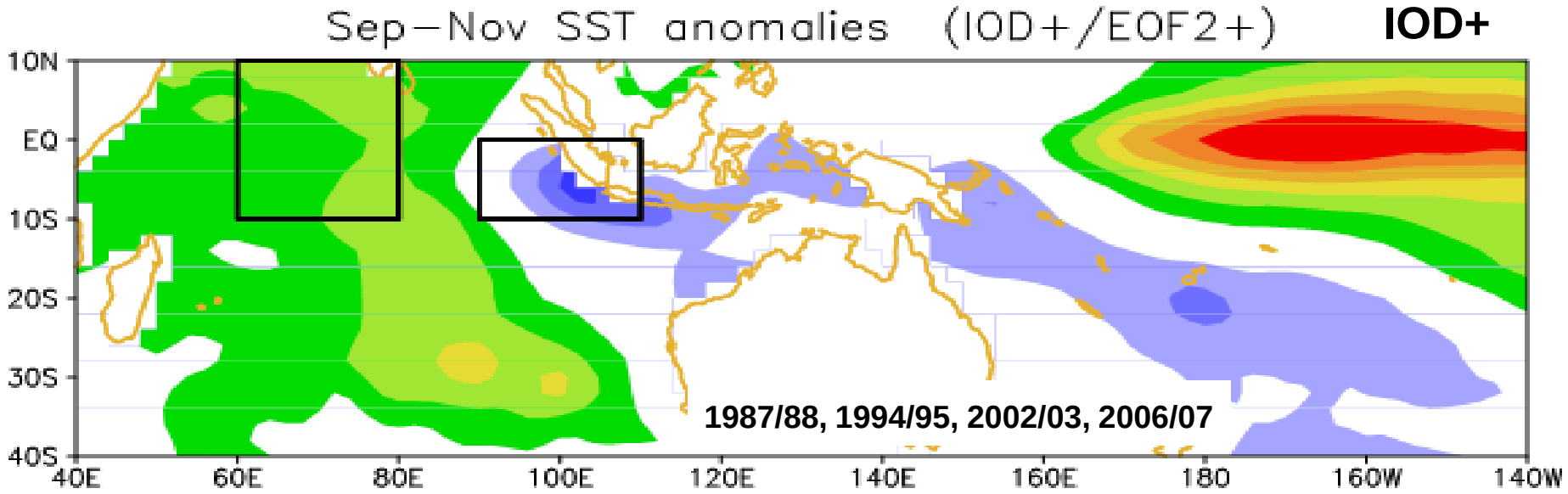

**El Niño**

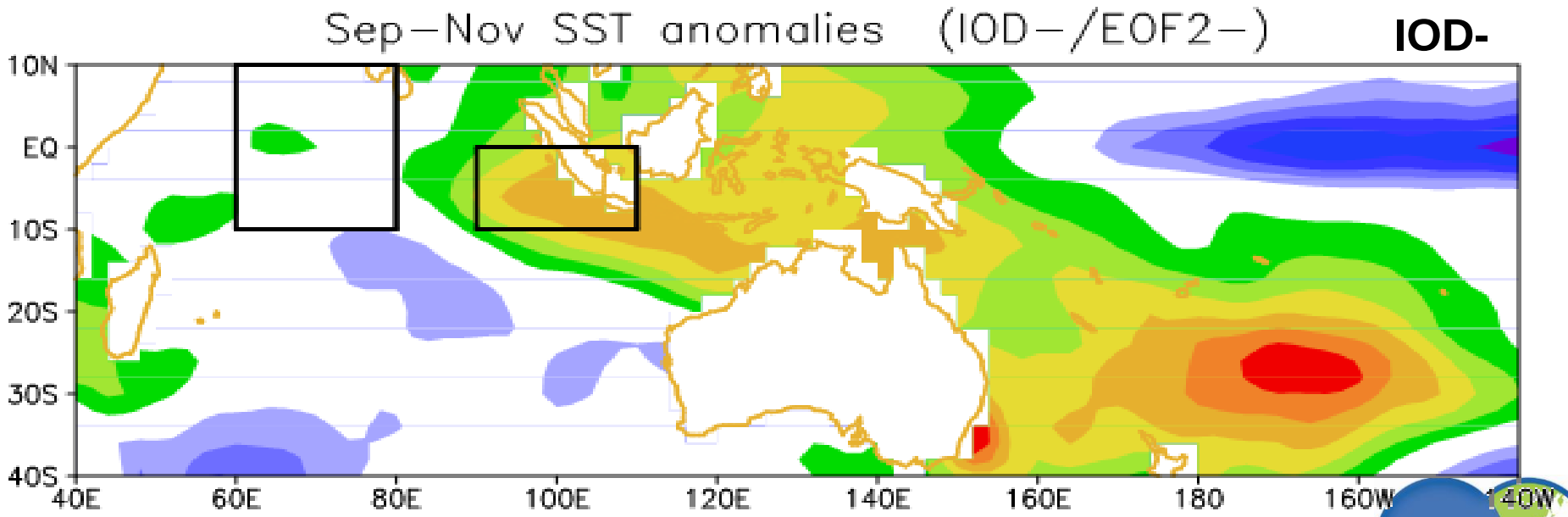
**1984/85, 1995/96, 1999/2000**




**La Niña**

# Sep-Nov SST anomalies EOF2+ vs EOF2-

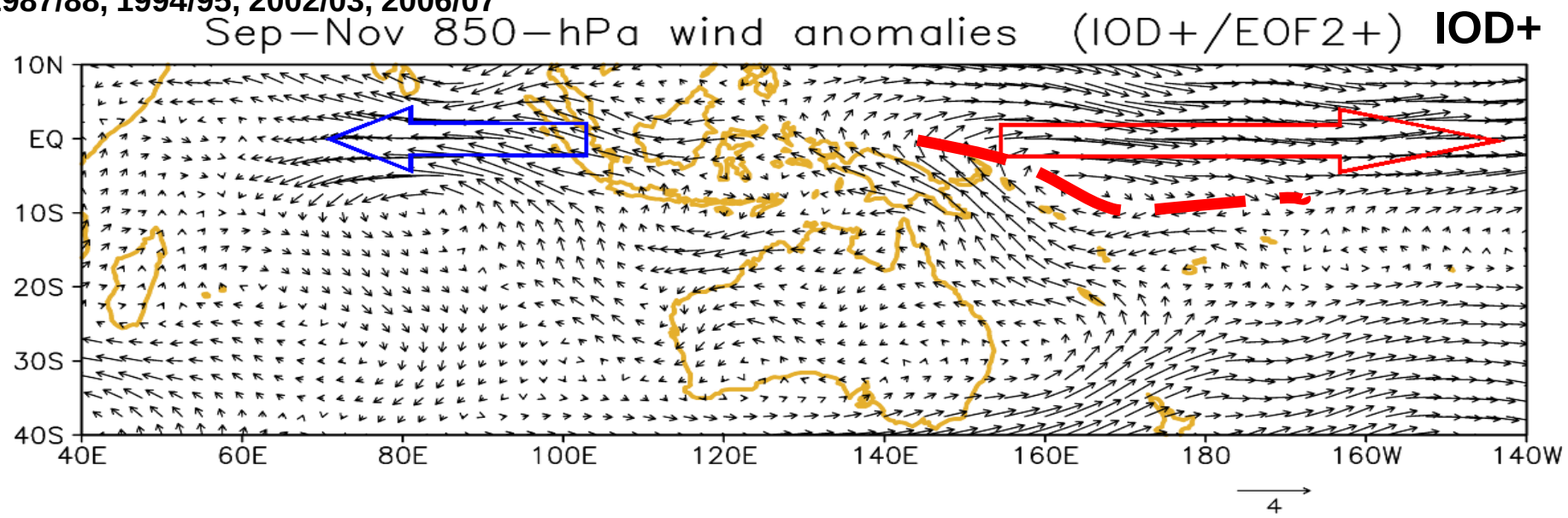


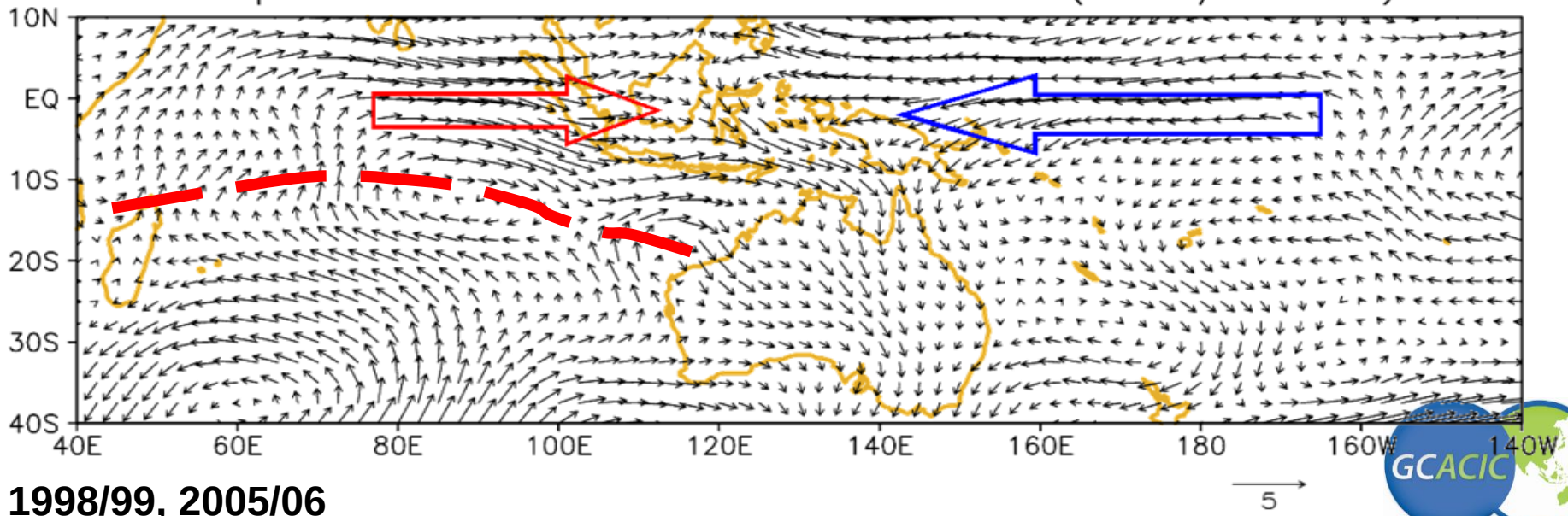

GCACIC

# Sep-Nov 850-hPa wind anomalies EOF2+ vs EOF2-

**1987/88, 1994/95, 2002/03, 2006/07**




**IOD+**



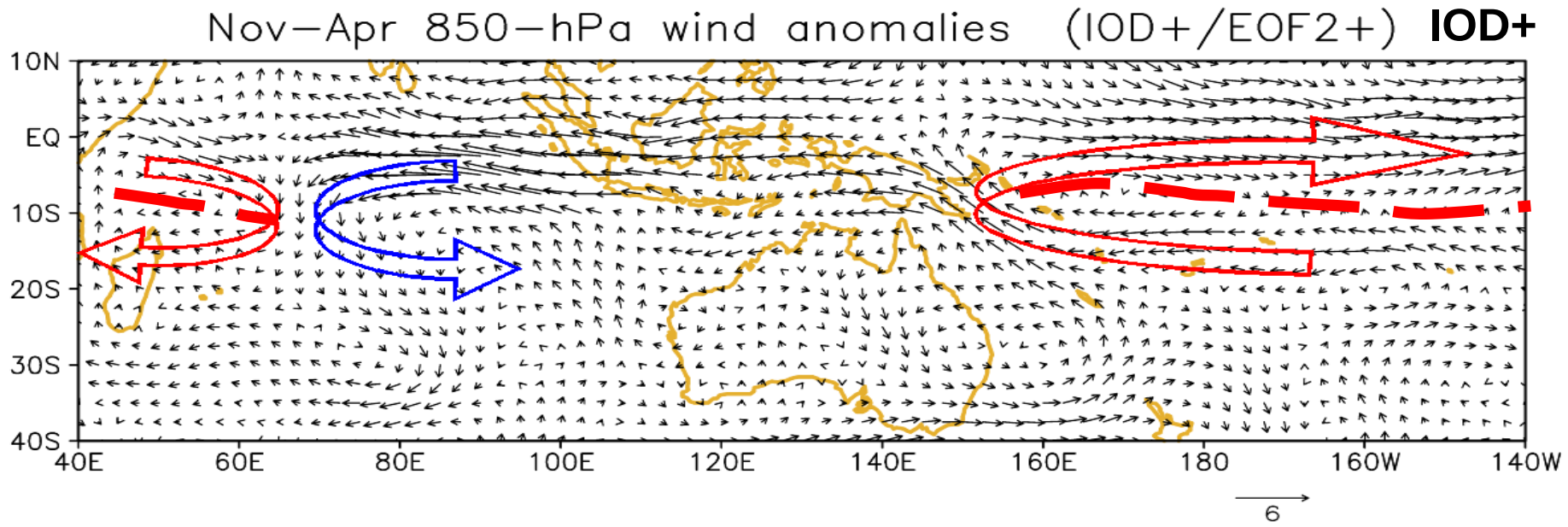

**IOD-**

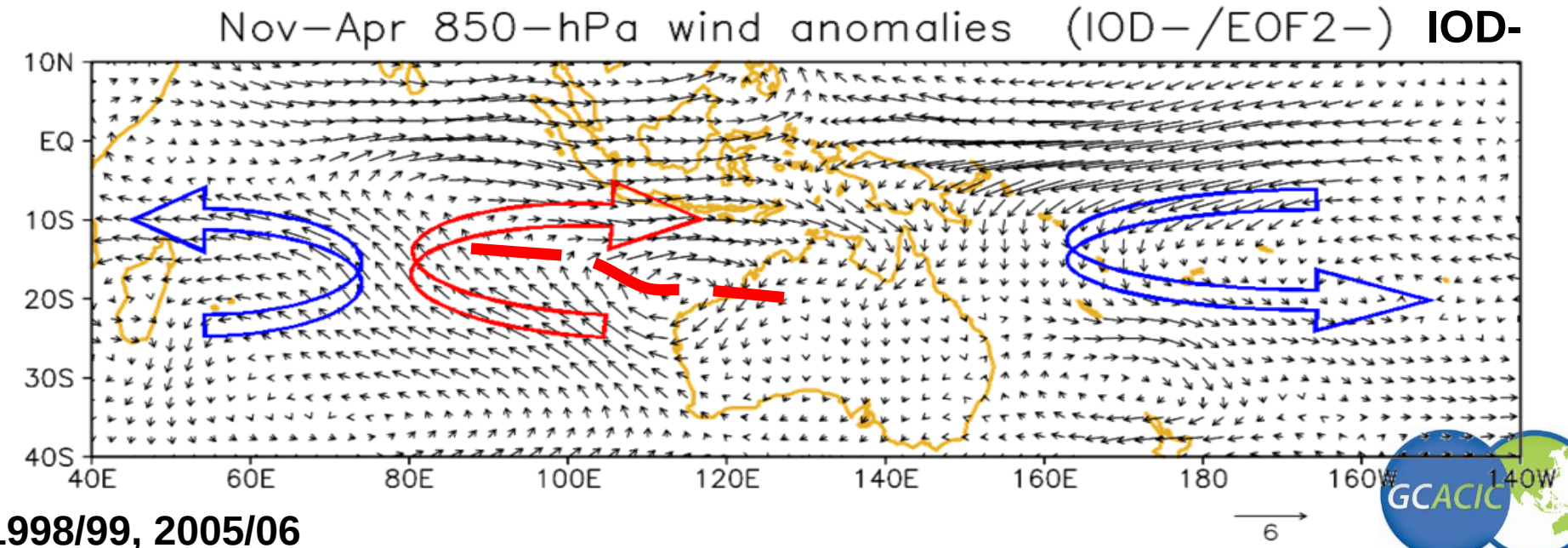
**1998/99, 2005/06**

GCACIC

# Nov-Apr 850-hPa wind anomalies EOF2+ vs EOF2-

**1987/88, 1994/95, 2002/03, 2006/07**




**1998/99, 2005/06**

GCACIC

# Summary

- Interannual variability of TC activity in the Southern Hemisphere exhibits 3 modes:
  - ENSO mode
  - IOD/ENSO mode
  - basin wide mode
- Such variations can be explained by variations in both the atmospheric and oceanographic patterns