The 1997/98 El Niño: A test of the Hadley Centre Atmospheric Model (HadAM3)

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HadAM3 Simulations

- Normal year: Prescribed climatological SSTs averaged from 1961 to 1990. After spin up, integration was performed for one year beginning on December 1.

- El Niño year: Observed SSTs. After spin up, integration was performed from January 1, 1997 to August 31, 1998.

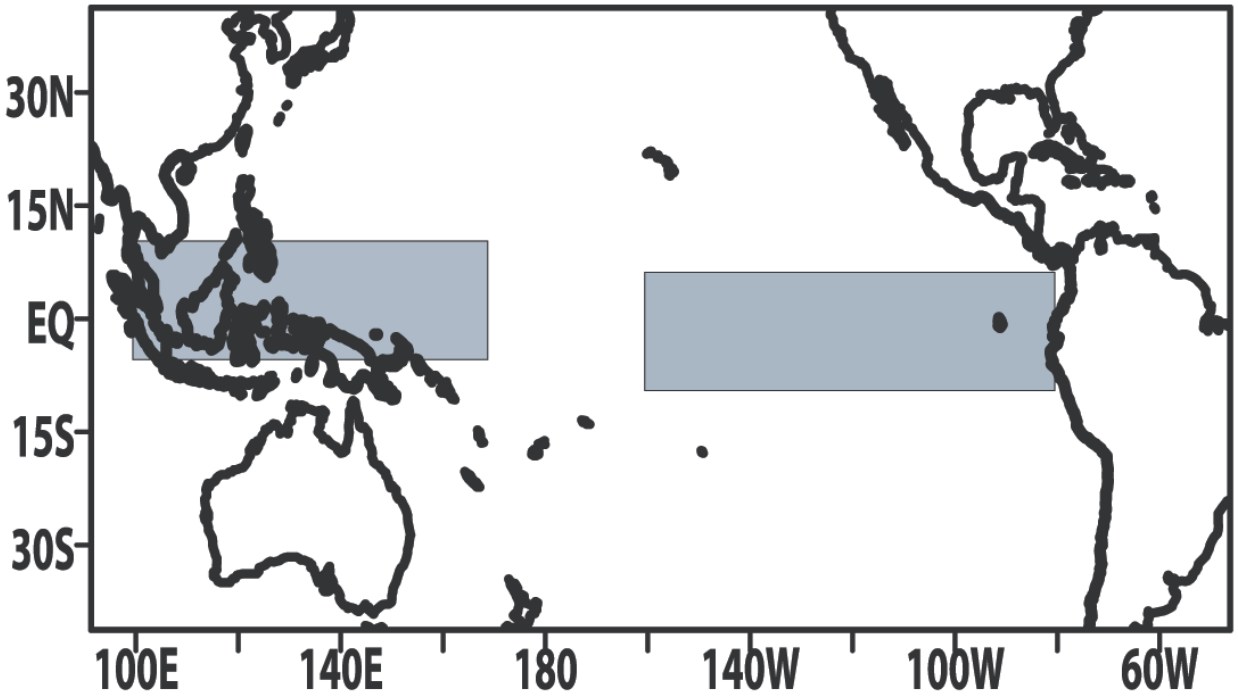
Each experiment consists of the average of an ensemble of 10 runs.

NCEP/NCAR Reanalysis

First four months of the average of 1985, 86, 88 & 89 (normal year), and first four months of 1998 (El Niño year).

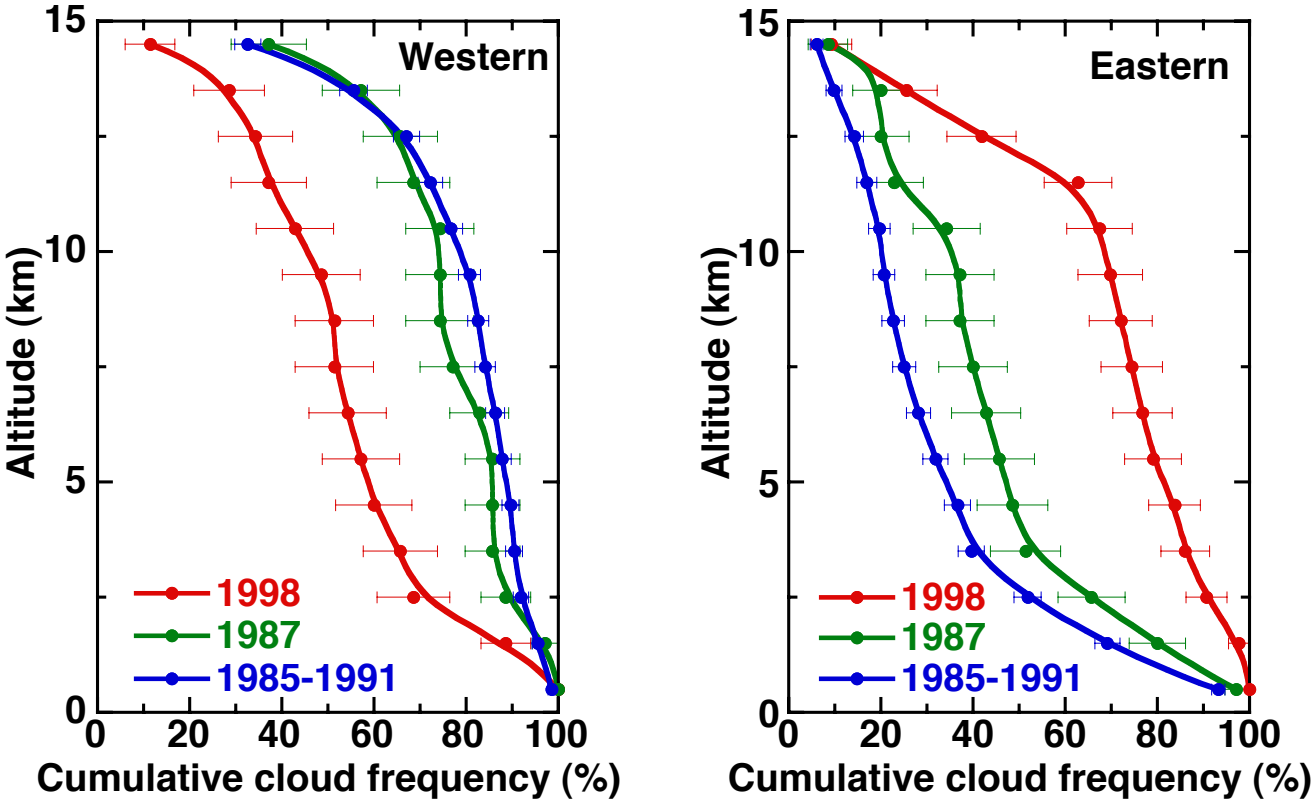
ERBE/CERES Data

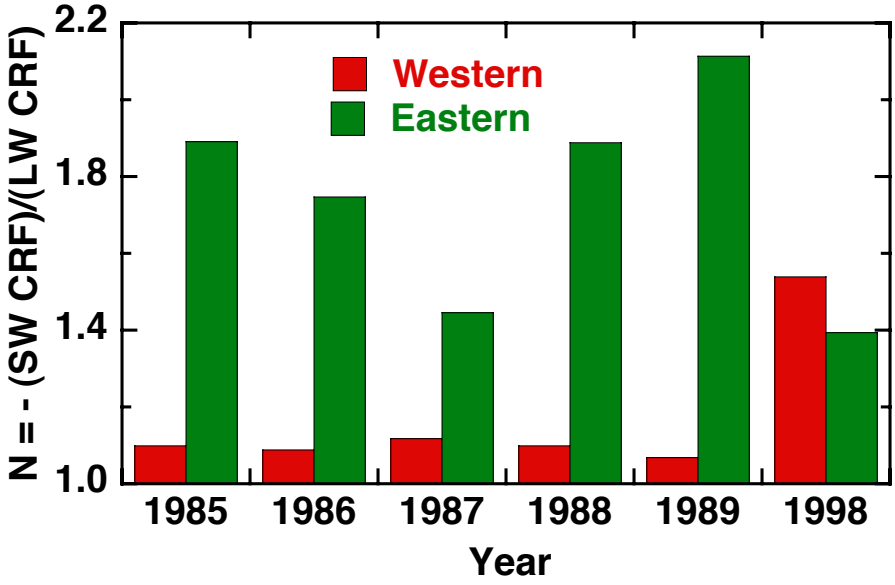
Same time periods as for the NCEP/NCAR reanalysis.


30N
15N
EQ
15S
30S
100E
140E
180
140W
100W
60W

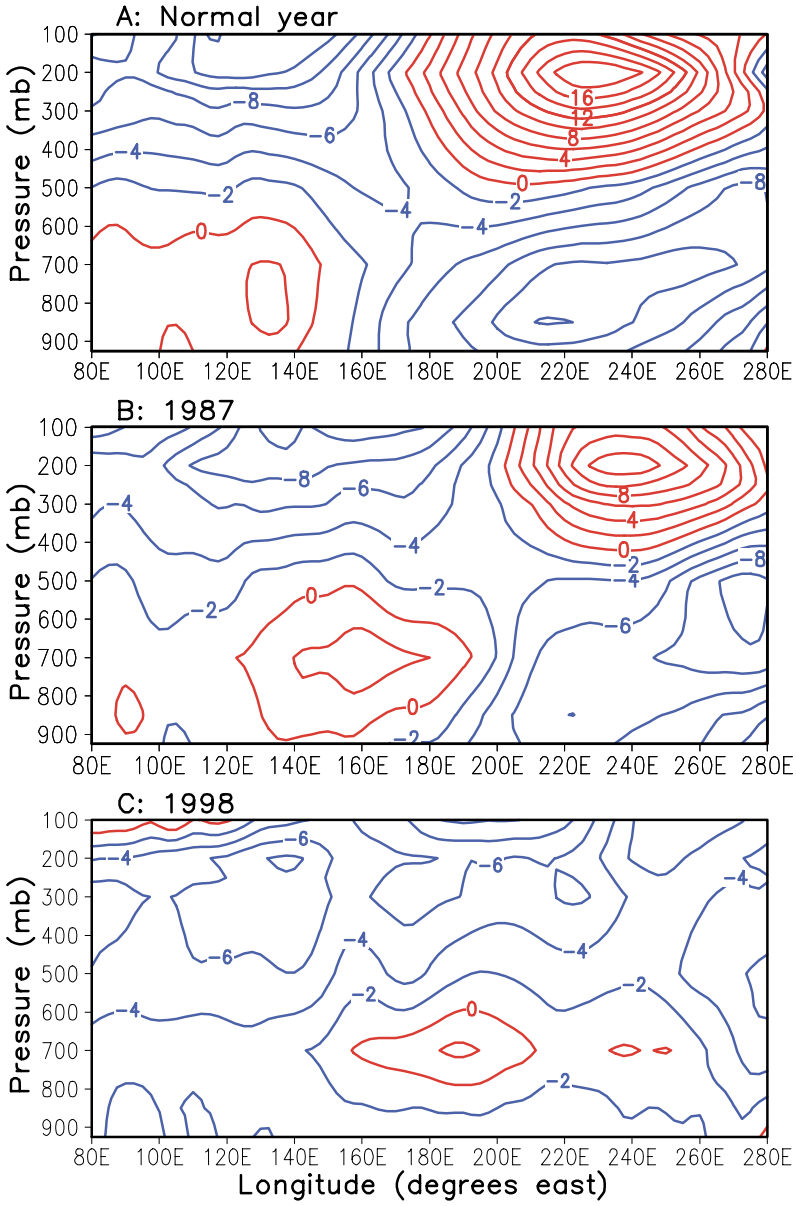
R. D. Cess, M. H. Zhang, P.-H. Wang & B. A. Wielicki, GRL, 2001.

SAGE II cloud profiling (DJFMA averages) & ERBE/CERES TOA fluxes (JFMA averages).

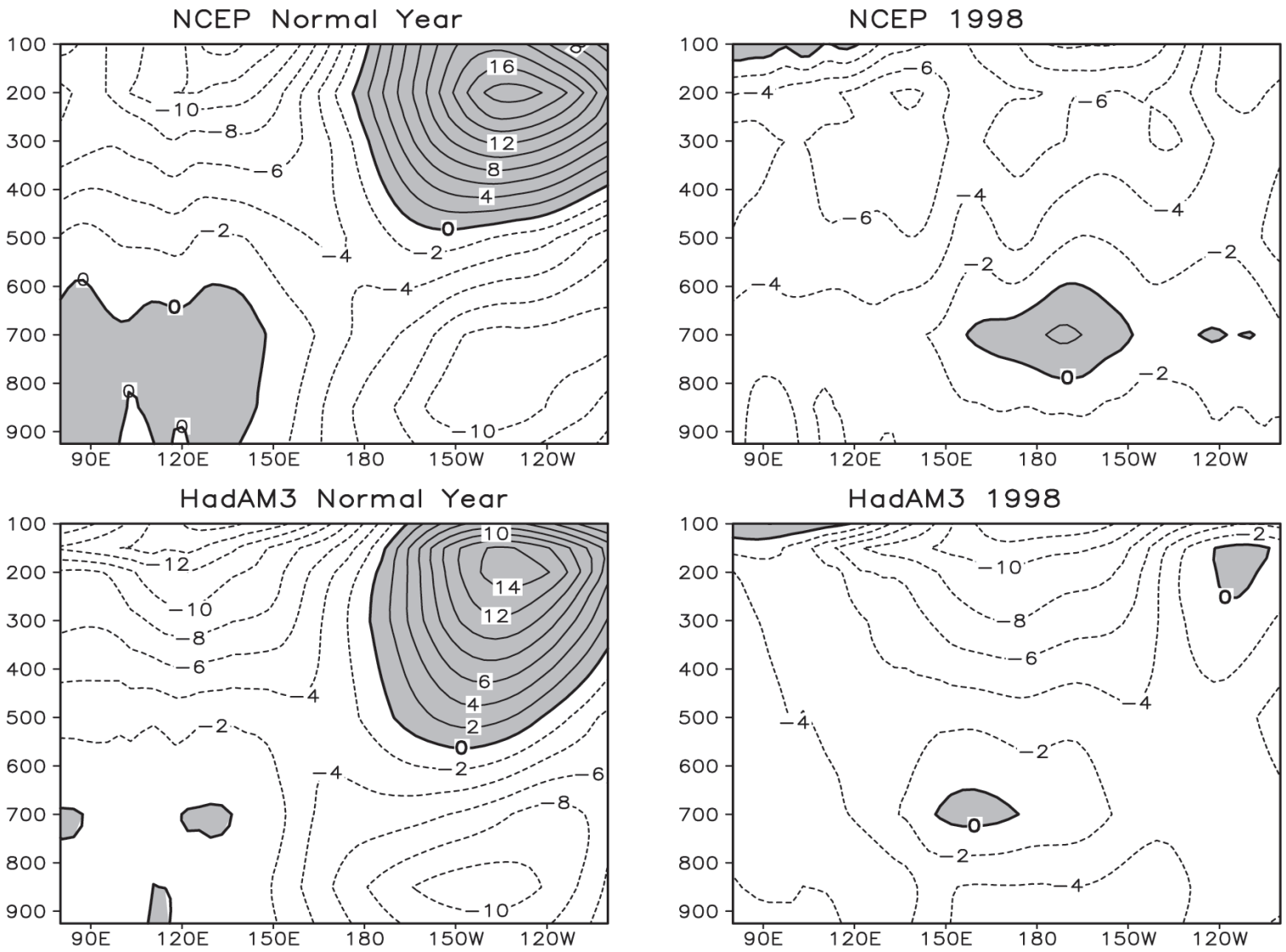


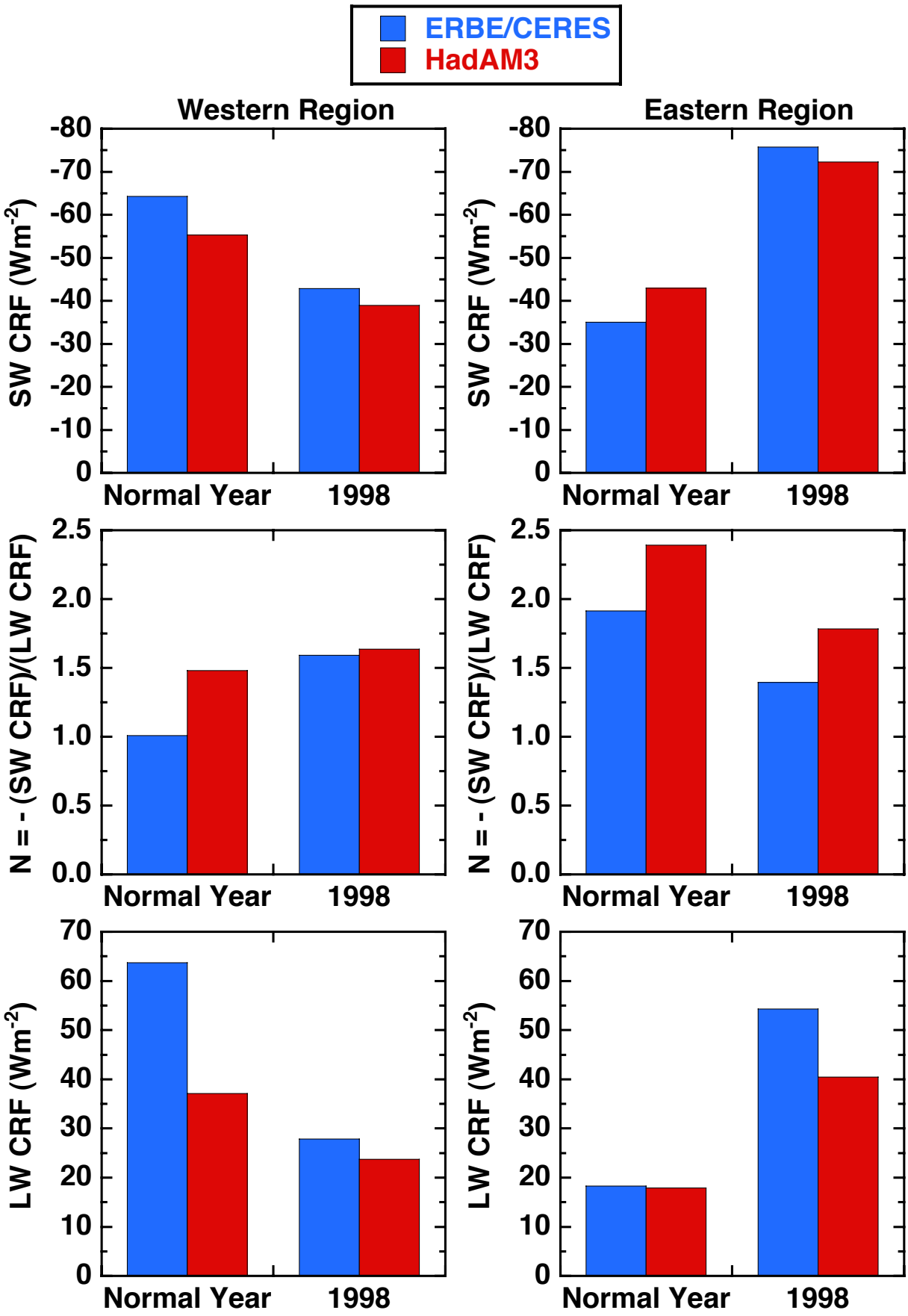


Pressure-longitude cross sections of zonal wind for 5S-5N
Cause: A change in the dynamics of the Walker circulation



Pressure-longitude cross sections of zonal wind for 5S-5N




ERBE/CERES
HadAM3
Western Region
Eastern Region
SW CRF (Wm-2)
N = - (SW CRF)/(LW CRF)
LW CRF (Wm-2)
Normal Year
1998
-80
-70
-60
-50
-40
-30
-20
-10
0
2.5
2.0
1.5
1.0
0.5
0.0
70
60
50
40
30
20
10
0

R. P. Allan, A. Slingo & M. A. Ringer, J. Clim. 2002:

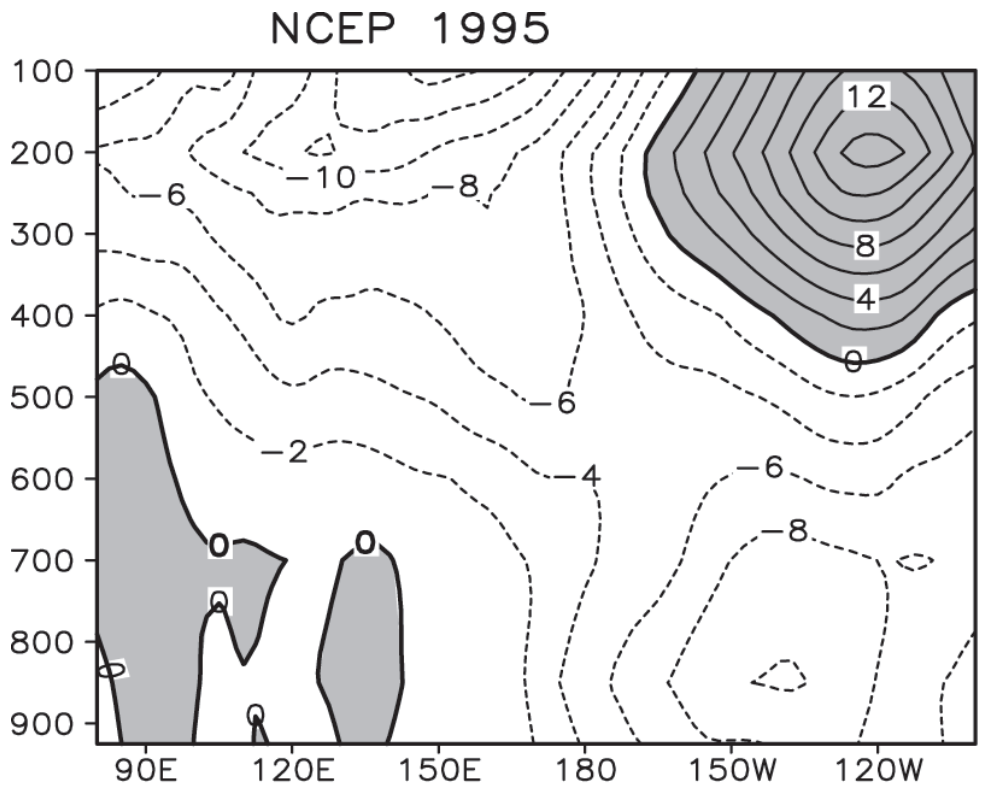
- **Showed that HadAM3 produced realistic changes in 500 mb vertical velocities during the 1997/98 El Niño.**
- **Found similar TOA radiative anomalies for 1994/95 (ScaRab measurements) as for 1997/98 (CERES measurements), suggesting the radiative anomalies might be the result of decadal variability (Wielicki et al., 2002) and not the 1997/98 El Niño.**

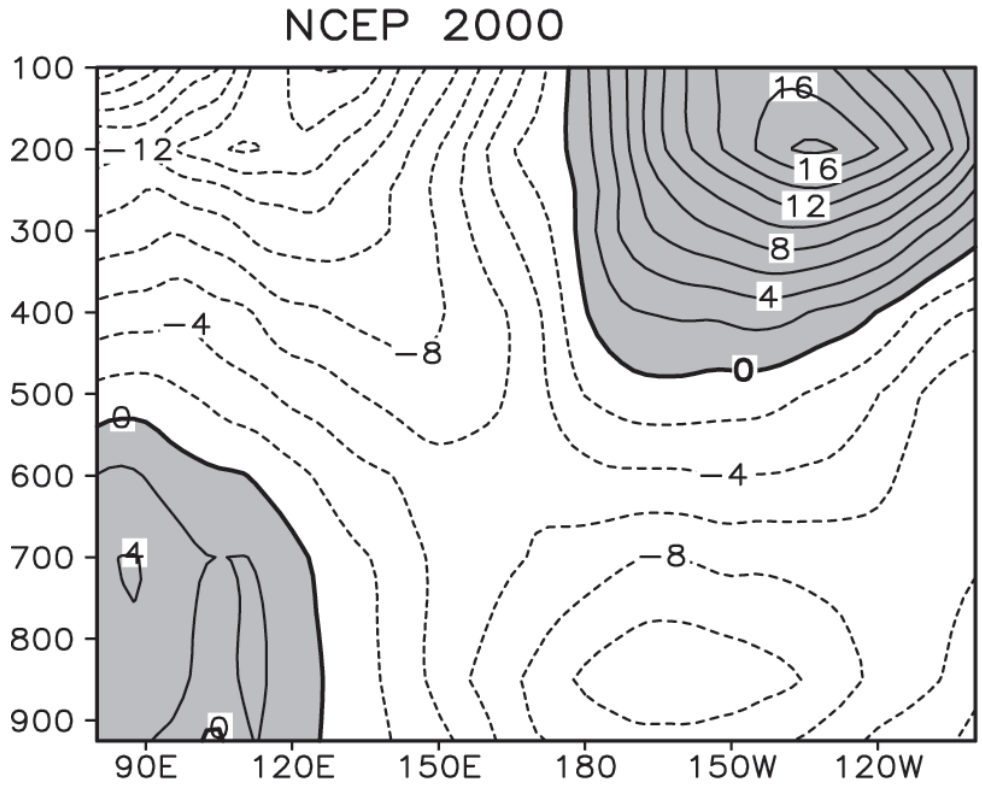
P.-H. Wang, SAGEII:

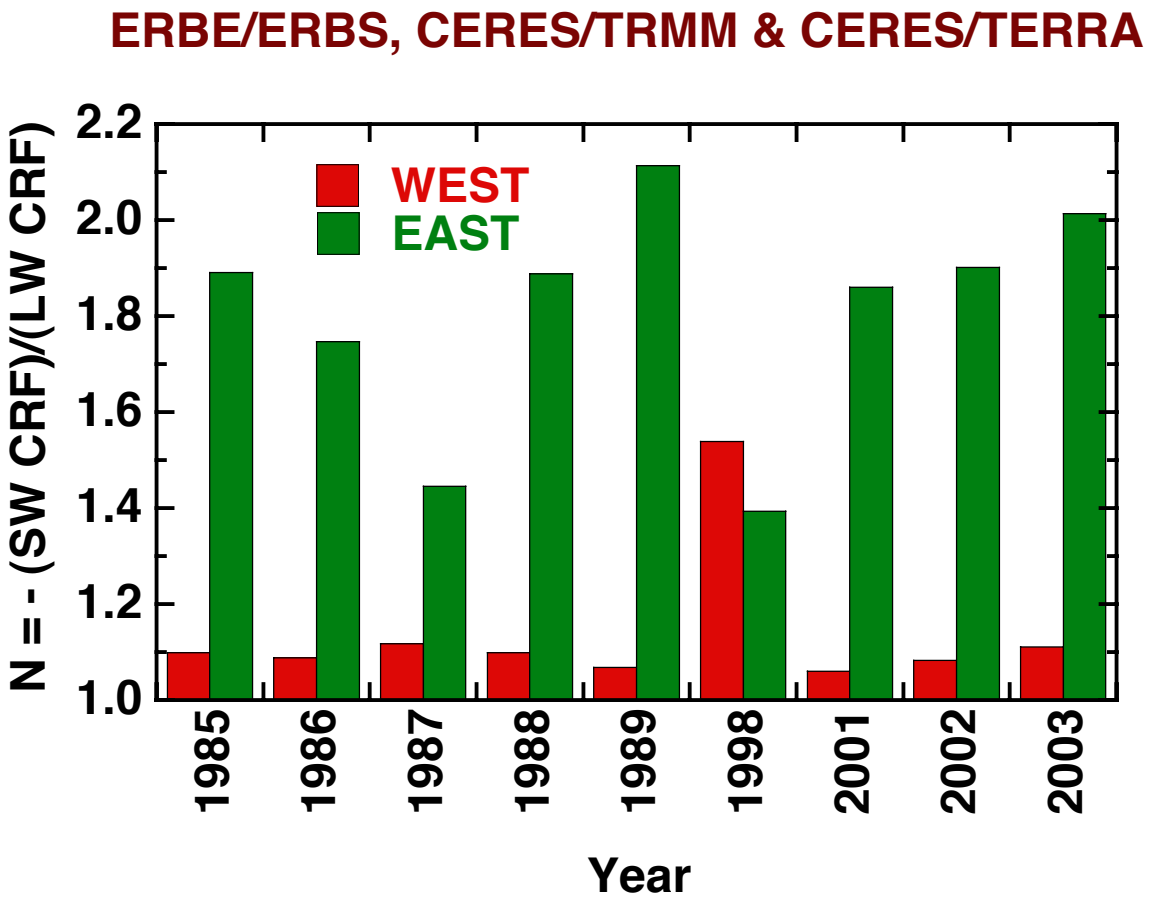
In 1994/95 there was a change in cloud vertical structure in the western tropical Pacific but not in the eastern region, followed by a return to normal until 1997/98.

What event occurred in 1994/95? The 1994/95 El Niño.

First four months of each year






ERBE/ERBS, CERES/TRMM & CERES/TERRA
WEST
EAST
N = - (SW CRF)/(LW CRF)
2.2
2.0
1.8
1.6
1.4
1.2
1.0
1985
1986
1987
1988
1989
1998
2001
2002
2003
Year

Summary

The cloud structure changes observed both by SAGE II and ERBE/CERES are primarily related to the 1997/98 El Niño.

Steps in using the 1997/98 El Niño to test a GCM:

1. See if the model produces a collapse of the Walker circulation. If not, stop. If so, proceed to step #2.

2. Compare the GCM to the ERBE/CERES data.

HadAM3 does an excellent job with respect to step #1 and a reasonable job with respect to step #2.