EL NINO EVENTS IN DIFFERENT PDO PHASES

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LIFE CYCLE ANALYSIS OF THE SALLJEX CONVECTIVE SYSTEMS

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Buenos Aires, Argentina, 27-29 July 2010

EL NIÑO EVENTS IN DIFFERENT PHASES OF THE PACIFIC DECADAL OSCILLATION: OBSERVATIONAL AND NUMERICAL ANALYSES OVER SOUTH AMERICA

Silva GAM, PhD Thesis, IAG/USP, Brazil

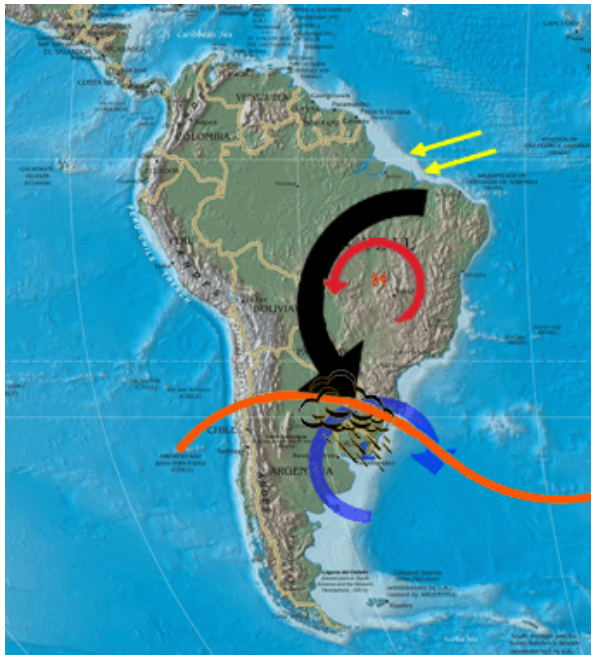
Silva, Drumond and Ambrizzi (2010), submitted to *TAC*

Silva, Ambrizzi and Marengo (2009 – *Annales Geophysicae*)

Low Level Jet, ENSO and PDO

Silva et al. (2009): 1977-2004, LLJ in canonical EN and LN events are associated to increase precipitation over the SESA, however it seems to be more intense and displaced northward during the LN years

EN



LN

Silva et al. (2009)

Marengo et al. (2004) – suggestion of some relation between LLJ and PDO – No detailed dynamical analysis was performed.

SOME IMPORTANT BASIC QUESTIONS THAT NEED TO BE ANSWERED:

1. Are there any differences on the atmospheric circulation over the SA during ENSO neutral years for different PDO phases?

2. What are the possible differences in moisture supply over the SA during the austral summer of EN years for the PDO(+) and PDO(-)?

3. Could an AGCM forced with canonical EN SST on the Equatorial Pacific and distinct PDO regimes simulate the patterns observed in Question 2?

4. Are there any differences on the temporal and spatial variability of the SALLJ cases detected on the events described in Question 2?

5. How are the extratropical cyclones properties influenced by the modifications In the austral circulations associated to the patterns described in Question 2?

DATA AND METHODOLOGY

- **Austral summer, 1950 - 1999 period -> neutral and EN extremes selected according Zhou et al. (2001) and separated according the PDO phases (Mantua et al., 1997).**
- **2.5º X 2.5º: Prec,** Chen et al. (2002); **Daily and monthly reanalisys from NCEP** (Kalnay et al., 1996)
- **2º X 2º: monthly SST from Met Office Hadley Centre's,** Rayner et al. (2003).

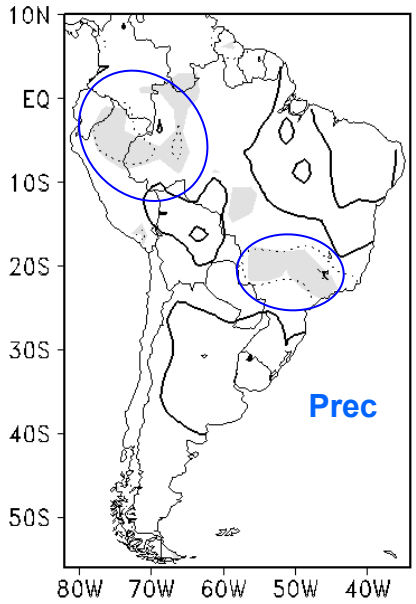
	El Niños	Neutral events
PDO(-)	1952/53, 1957/58, 1958/59, 1963/64, 1969/70, 1972/73	1951/52, 1953/54, 1956/57, 1959/60, 1960/61,1961/62, 1962/63,1966/67, 1967/68, 1971/72
PDO(+)	1976/77, 1977/78, 1979/80, 1982/83, 1987/88, 1990/91, 1991/92, 1992/93, 1994/95, 1997/98	1978/79, 1980/81, 1981/82, 1985/86, 1989/90, 1993/94, 1996/97

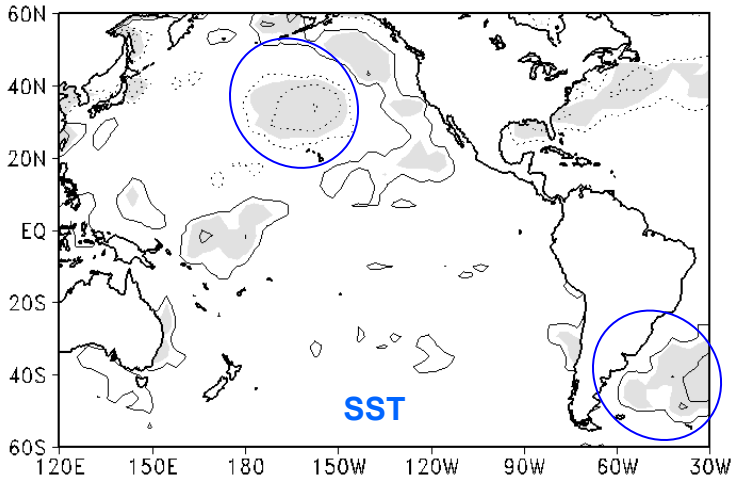
- **Two numerical experiments were performed with the AGCM *Community Atmosphere Model v.* 3.0 (CAM3) (Collins et al., 2006), T85L26;**
- **Two ensembles with 10 members for each experiment; analysis for DJF**

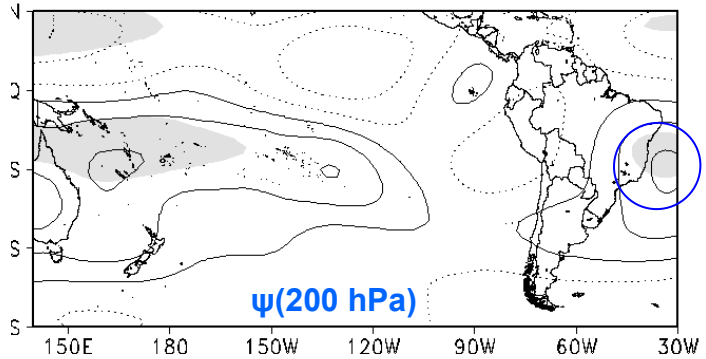
Experiment	Forcing in domain between 20ºS-20ºN;120ºW-175ºW	Forcing in others regions
ENPDO(+)	$aSST_{(El\ Niños)}$ + $mean\_SST_{(neu\_PDO(+))}$	$mean\_SST_{(neu\_PDO(+))}$ $mean\_ice\ marine_{(neu\_PDO(+))}$
ENPDO(-)	$aSST_{(El\ Niños)}$ + $mean\_SST_{(neu\_PDO(-))}$	$mean\_SST_{(neu\_PDO(-))}$ $mean\_ice\ marine_{(neu\_PDO(-))}$

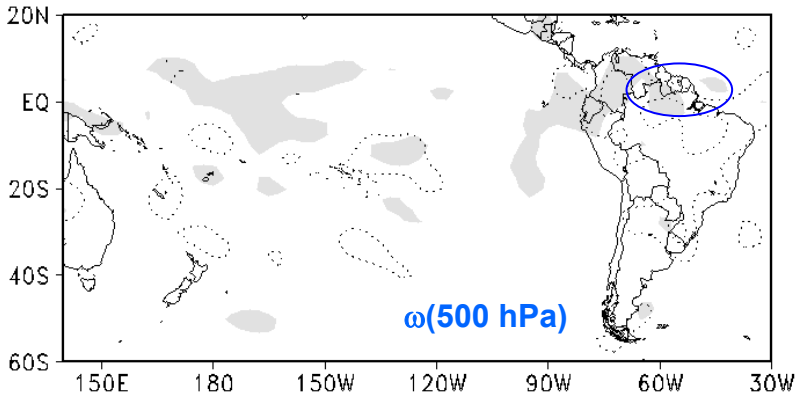
Austral summer circulations over SA during neutral years for opposite PDO phases

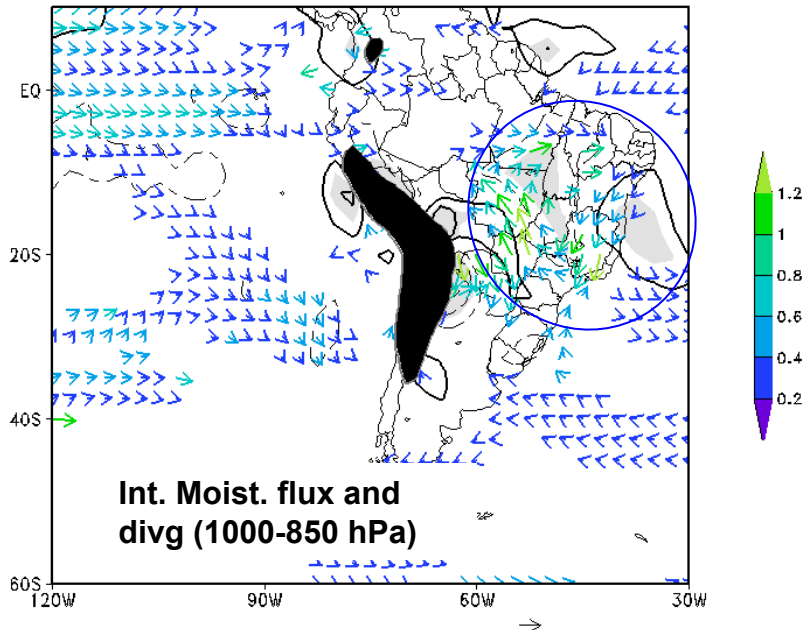
Difference: mean NEU PDO(+) – mean NEU PDO(-)









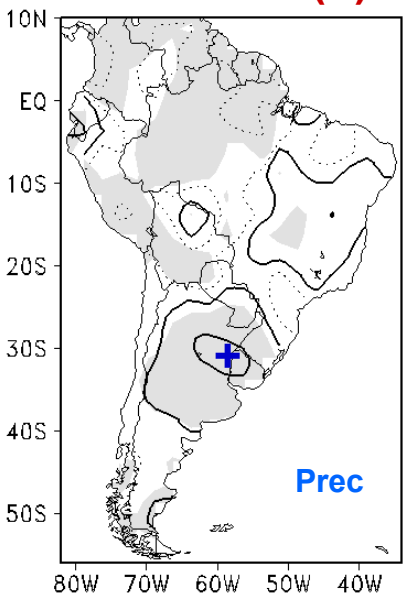


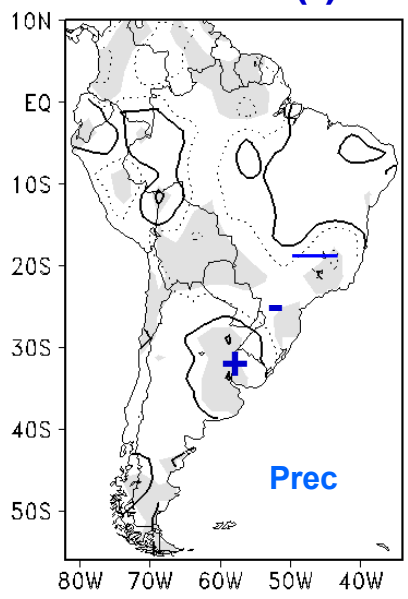
Impacts of the EN's events during opposite PDO phases

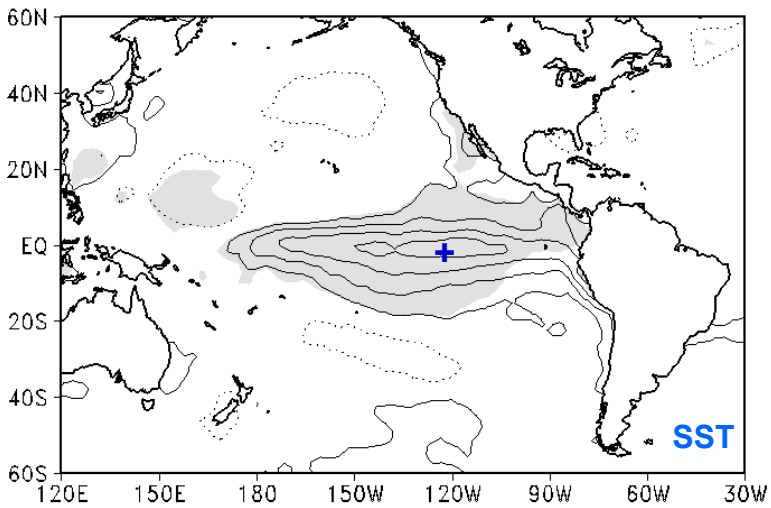
EN PDO(+)

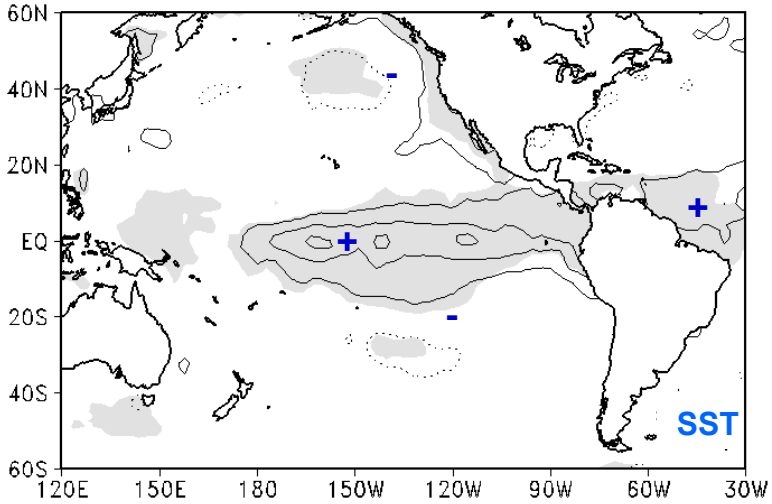
Anomalies

EN PDO(-)



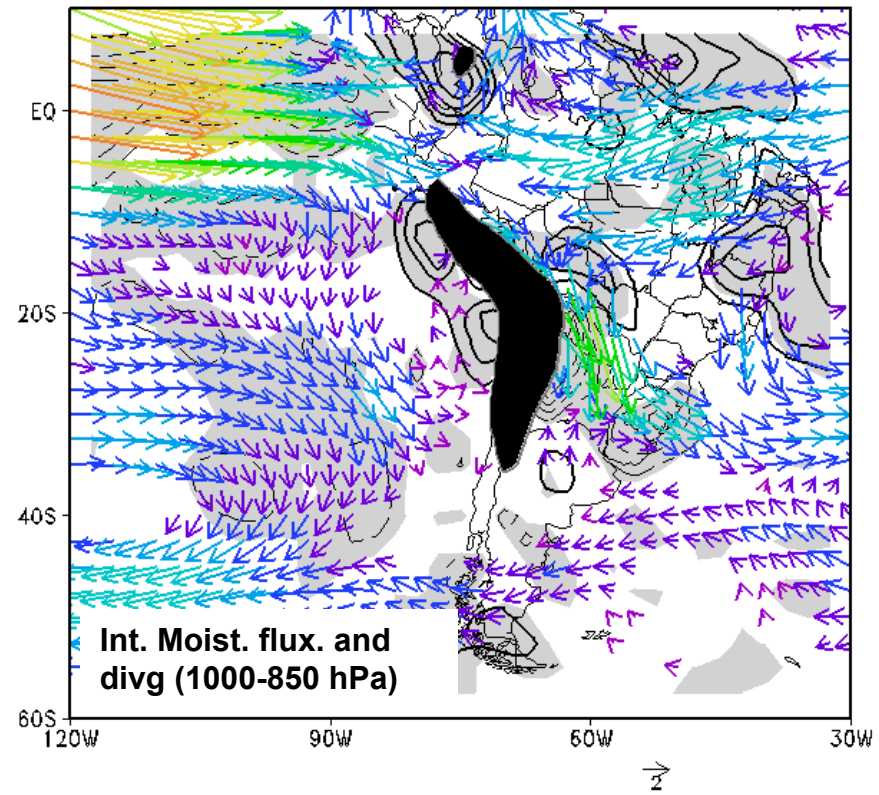


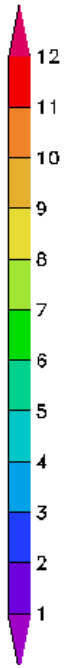




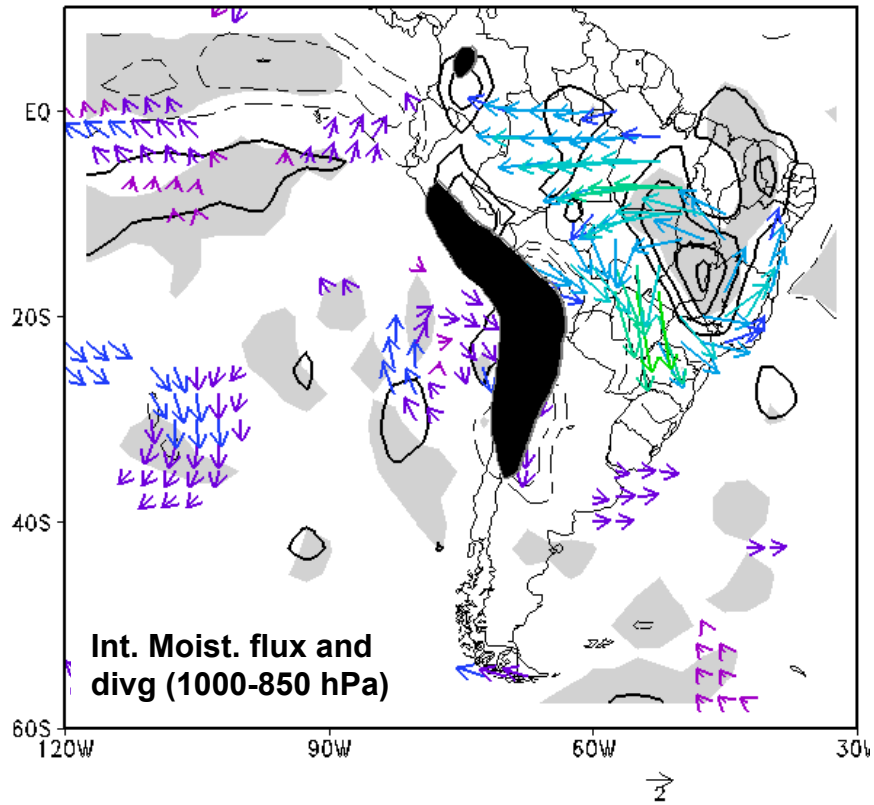
Integrated moisture flux and divergence anomalies during opposite PDO phases

EN PDO(+)

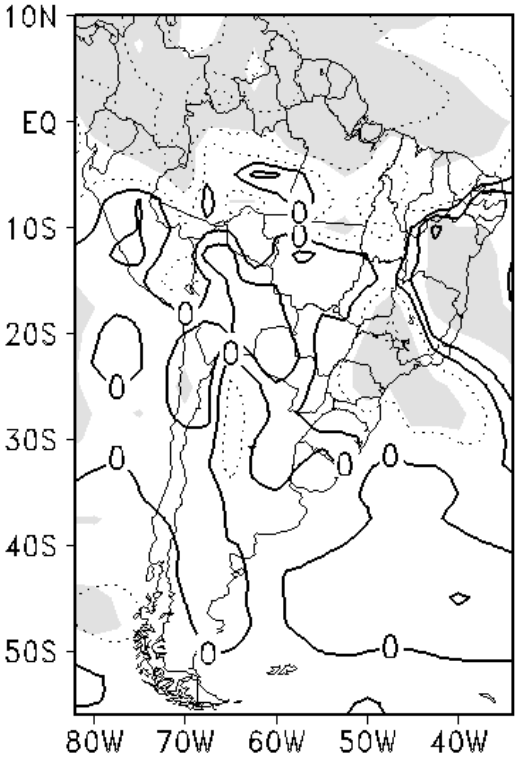




EN PDO(-)

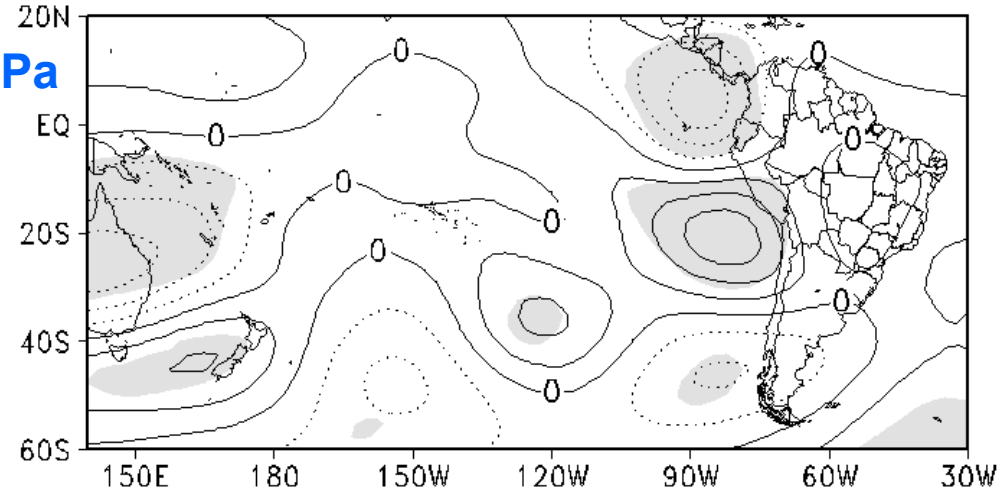


Difference between the ENPDO(+) and ENPDO(-) numerical experiments

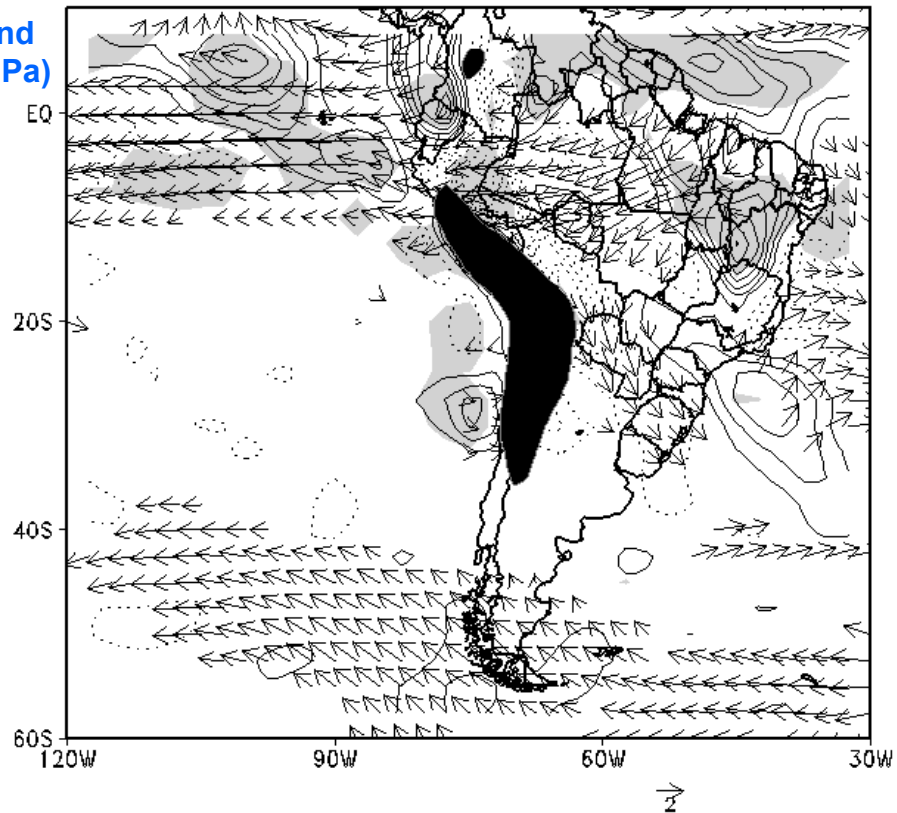


PCP

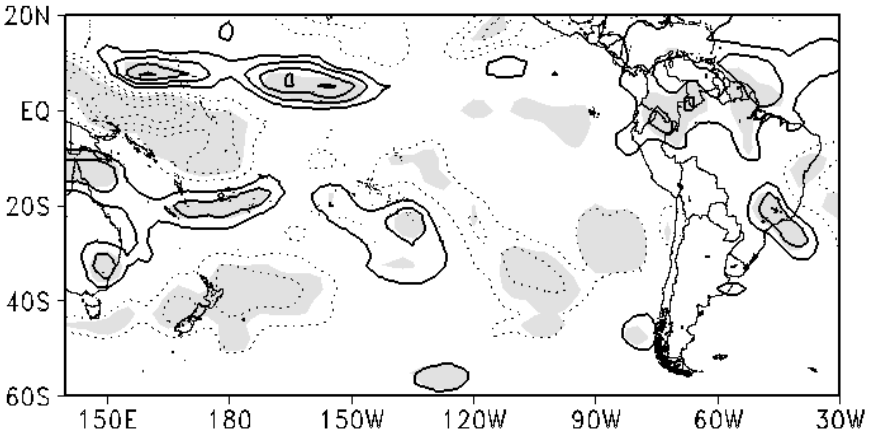
Ψ – 200hPa



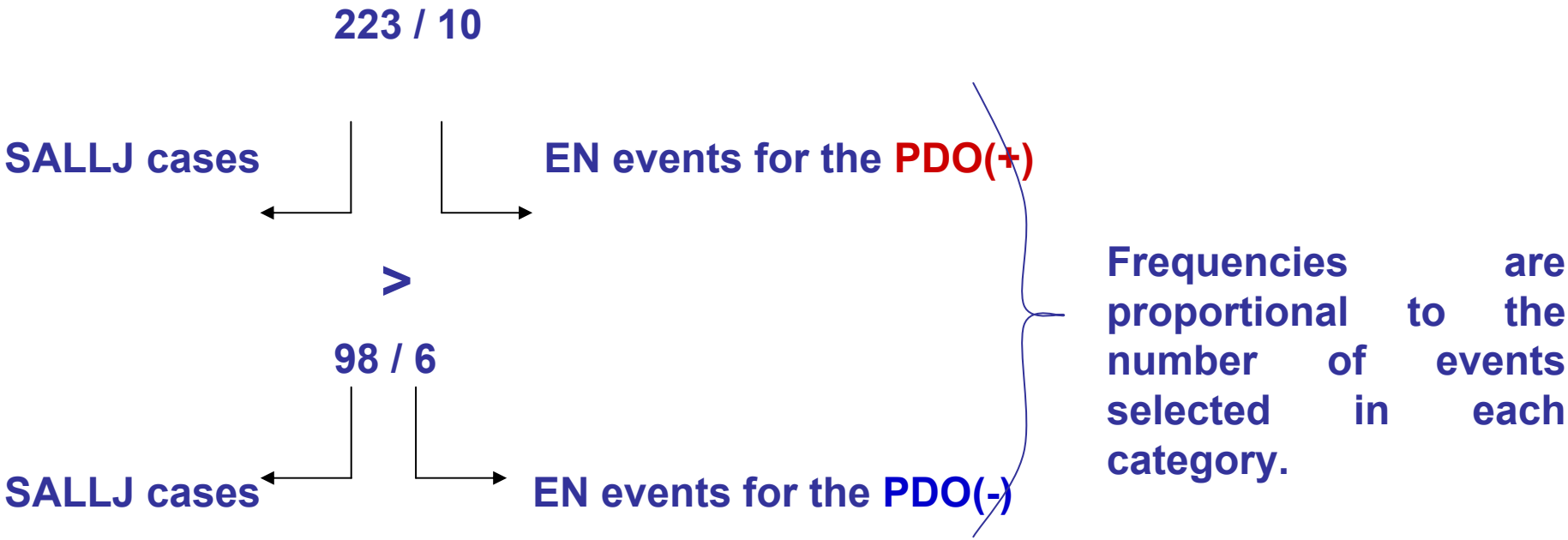
Int. Moist. flux and divg (1000-850 hPa)



ω – 500 hPa

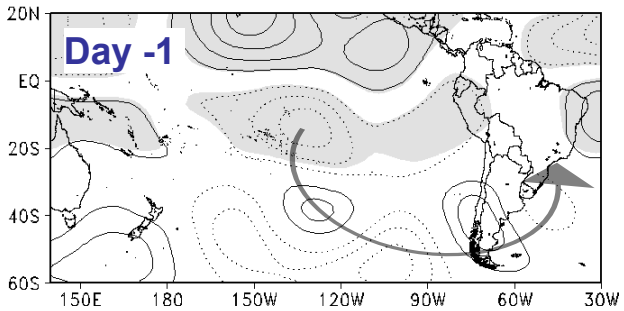


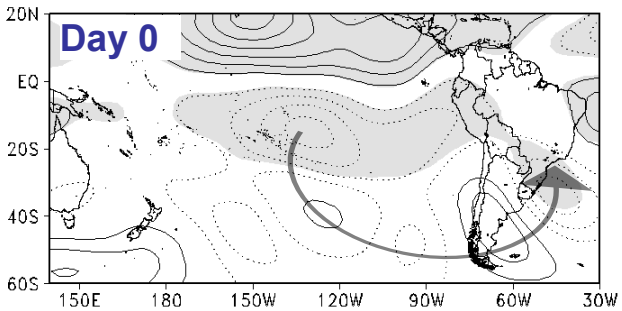
EN's events during opposite PDO phases: impacts on the SALLJ

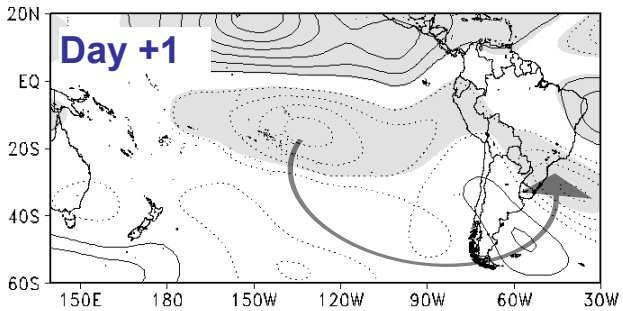


Streamfunction Anomaly Composites at 200 hPa for the periods with SALLJ during Different PDO phases

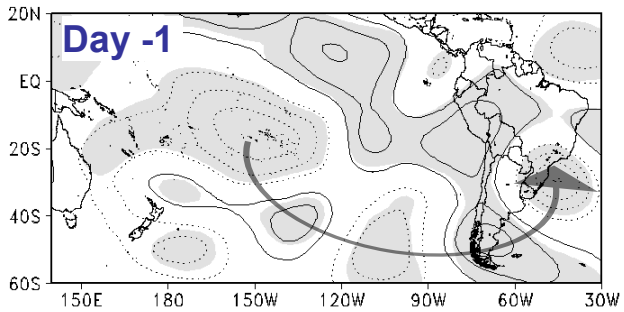
EN PDO(+)

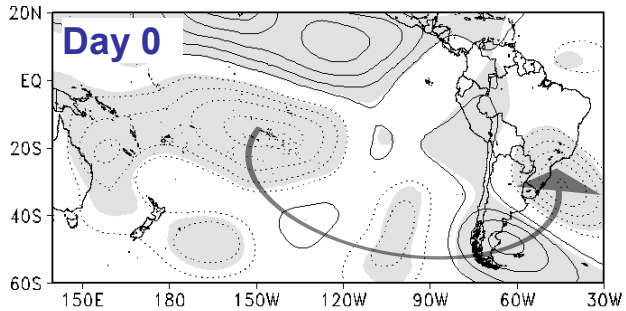


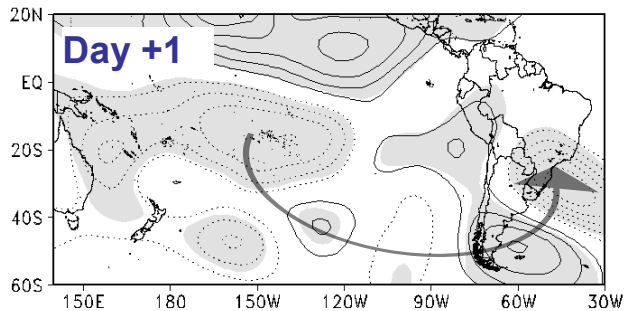




EN PDO(-)

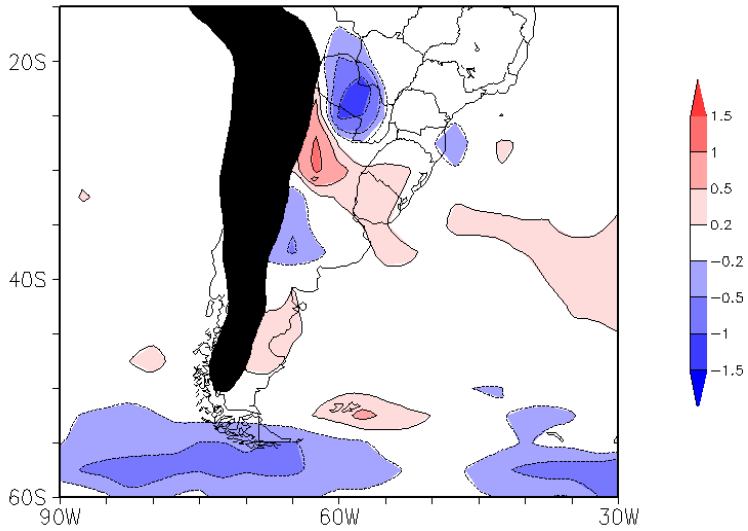




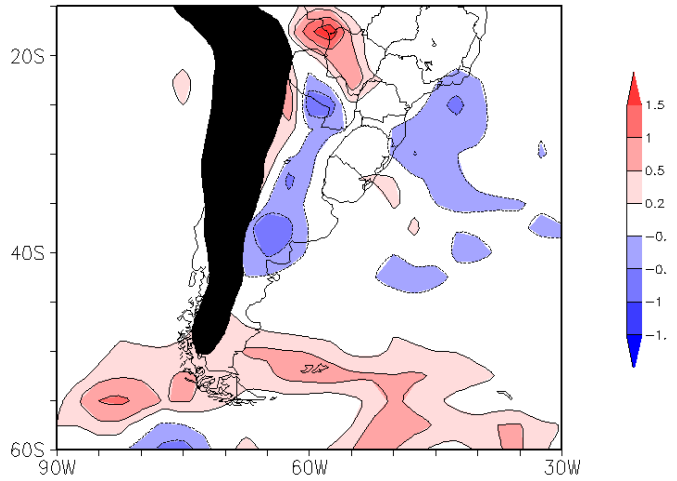


Cyclone Density Anomaly and Surface Pressure during EN events with different PDO phases

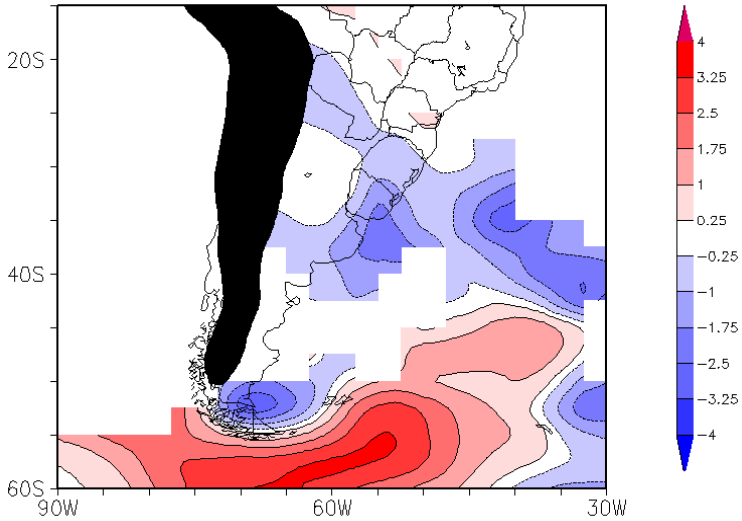
CD EN PDO(+)



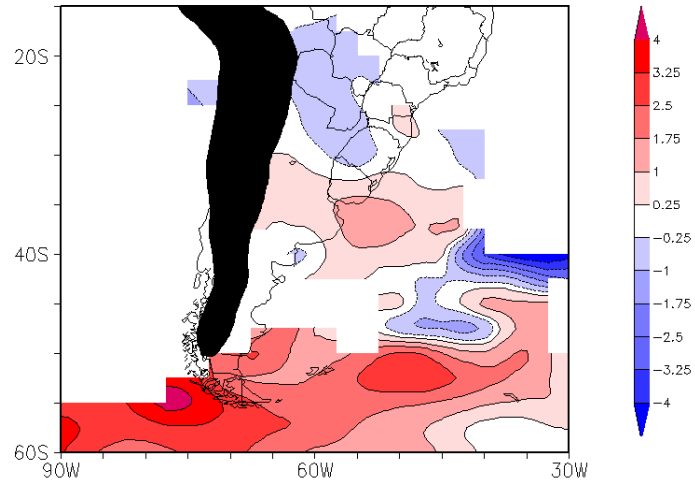
CD EN PDO(-)

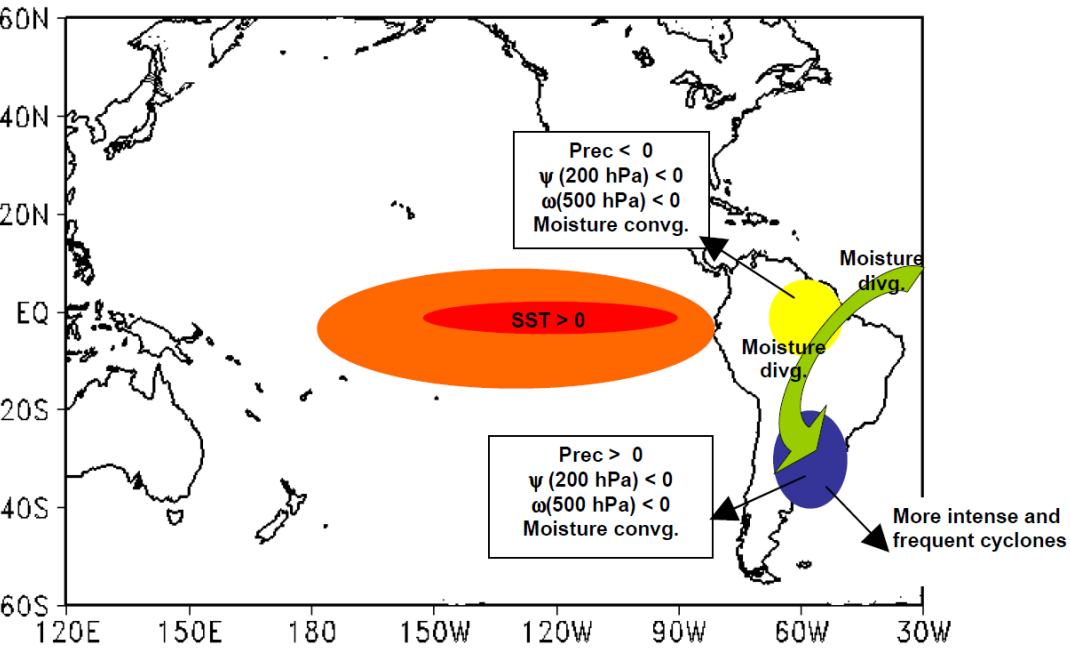


CP EN PDO(+)



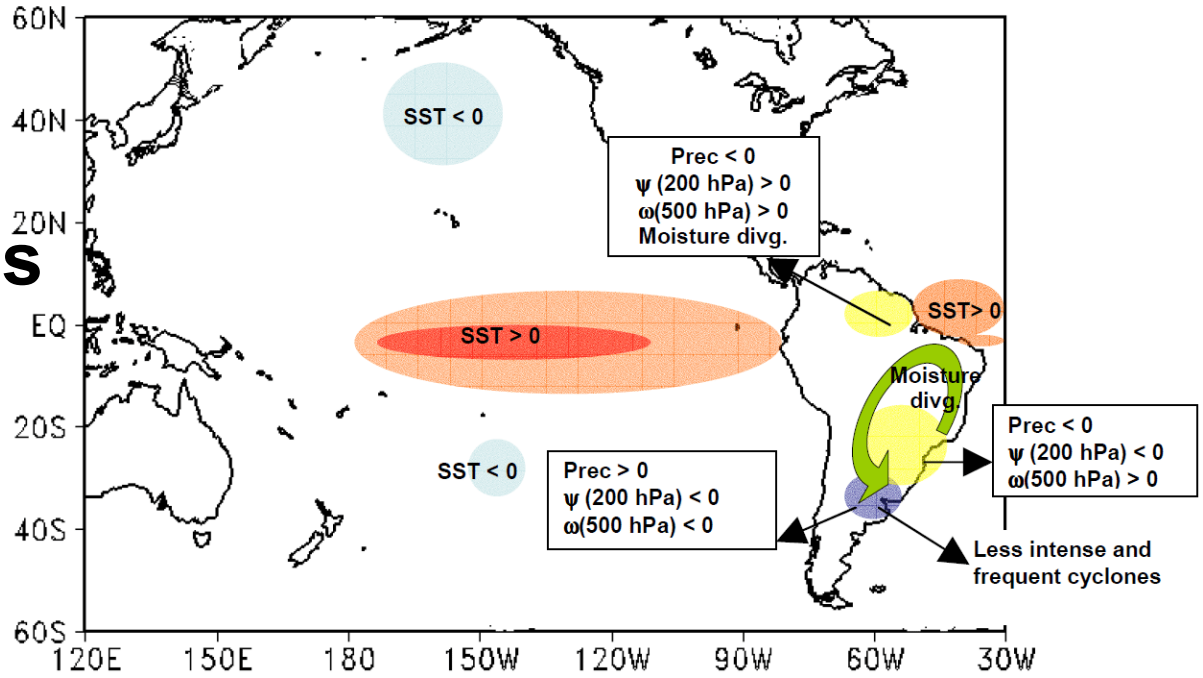
CP EN PDO(-)





EN PDO(+) Anomalies

EN PDO(-) Anomalies



LIFE CYCLE ANALYSIS OF THE SALLJEX CONVECTIVE SYSTEMS

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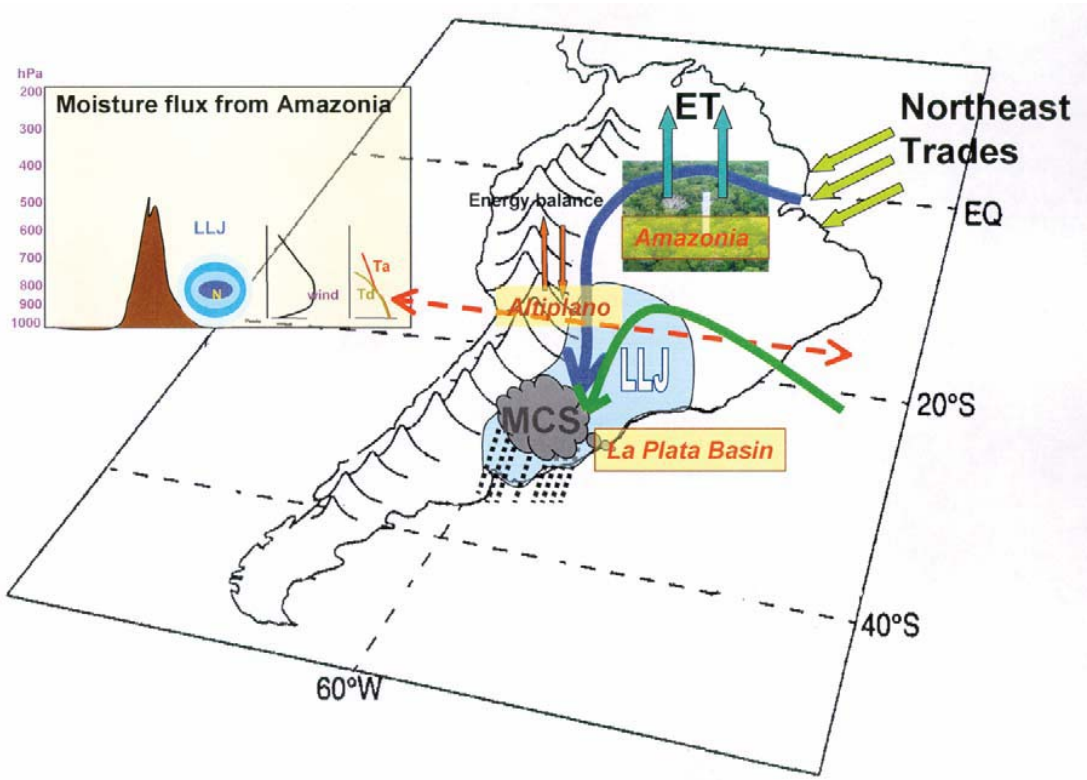
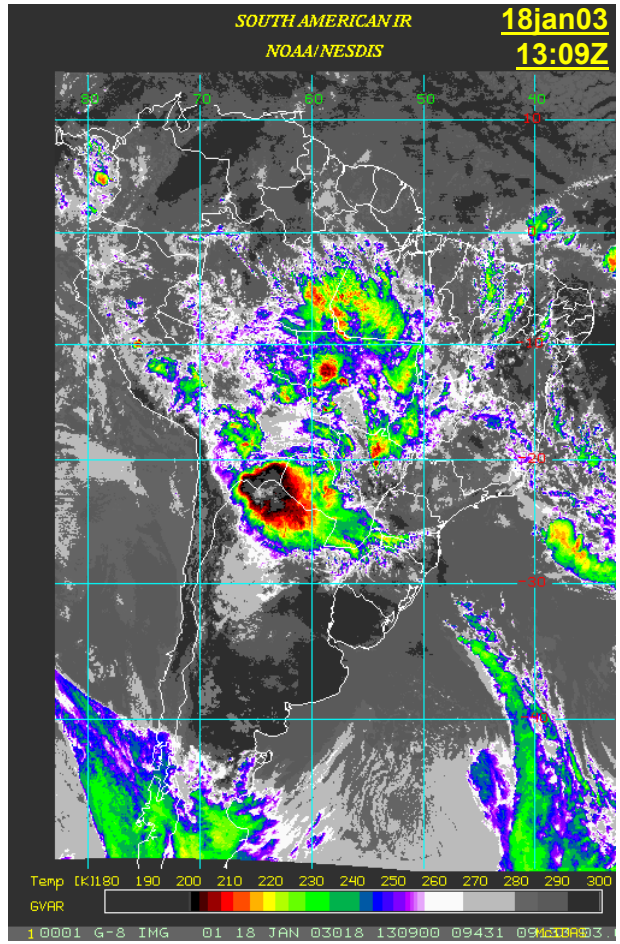
[3]University of Vigo, Ourense, Spain

SALLJEX – South American Low Level Jet Experiment

15Nov2002-15Feb2003





Marengo et al., 2004

Convective System (CS) identification:

Infrared satellite images from CPC/NCEP/NWS
(4 km horizontal resolution at sub satellite point and 30 minutes intervals)

ForTraCC (Forecast and Tracking of active Convective Cells), Vila et al (2008)
Temperature threshold of 235K
Minimum cluster of 150 pixels (2,400 km²)
Life cycle ≥ 6 hours

SALLJEX network data set

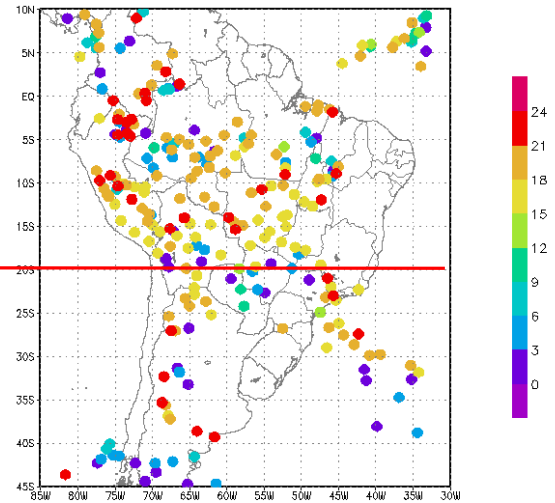
Special CPTEC reanalysis (1°x1°) for 15/Dec/2002 to 15/Feb/2003
Herdies et al (2007)

Lagrangean Model (Flexpart) applied to ECMWF operational analysis (1°x1°)
Stohl and James (2004,2005)

20ºS latitude to delimit Tropical and Subtropical CS

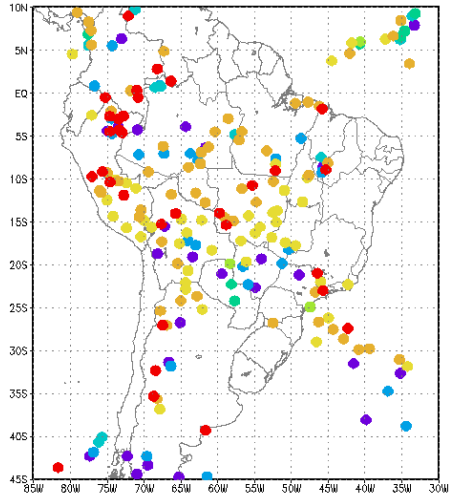
CS observed in 02/Dec/2002

All CS

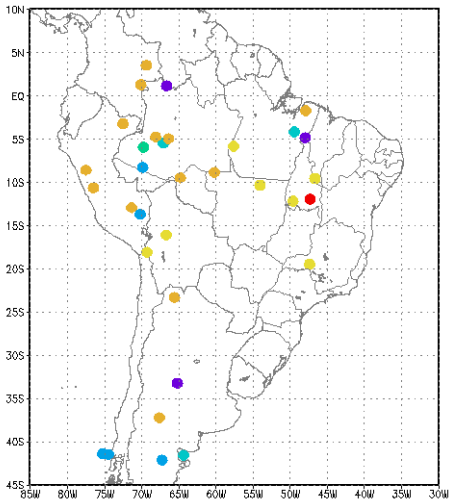


20°S

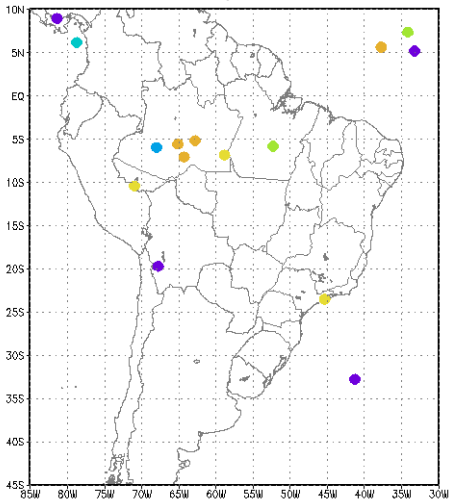
Life cycle ≤ 3h



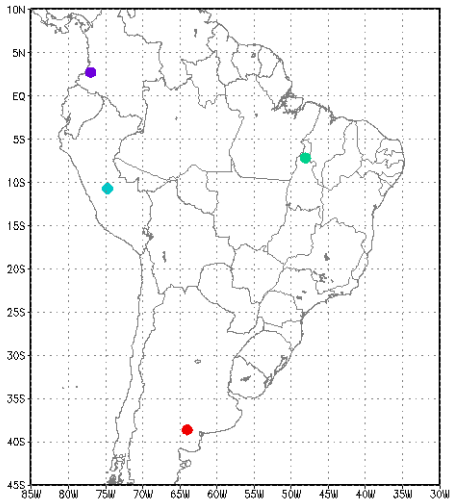
3h < Life cycle ≤ 6h



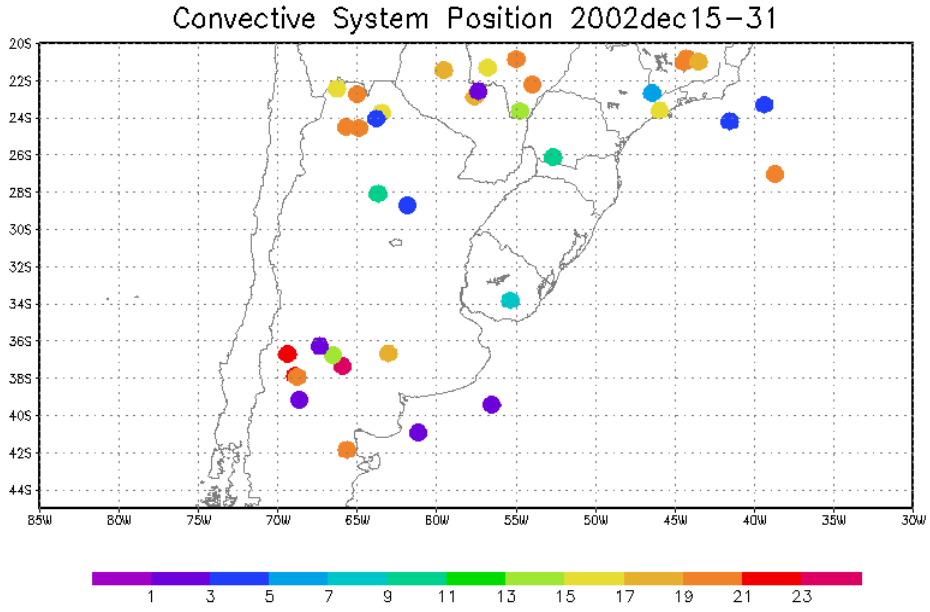
6h < life cycle ≤ 12h

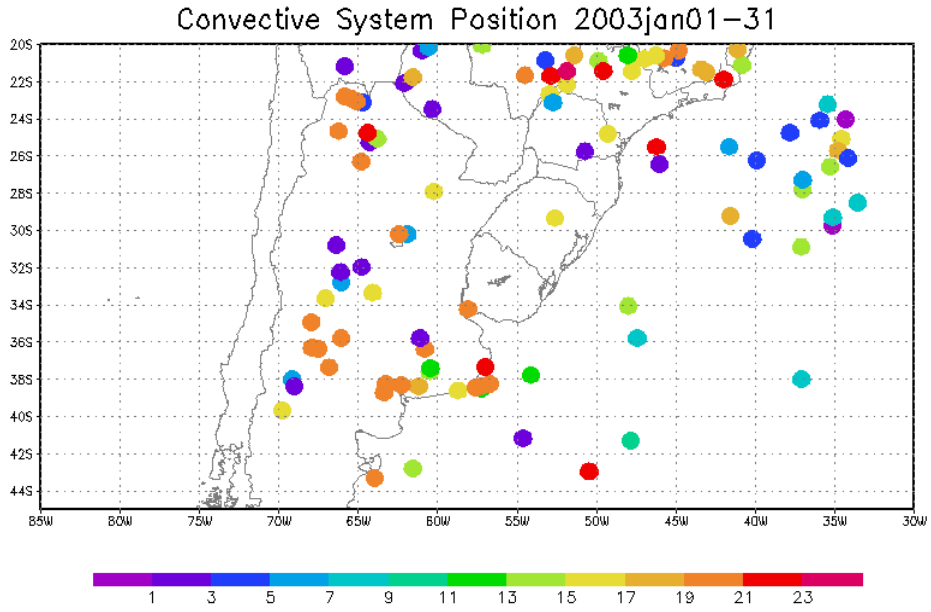


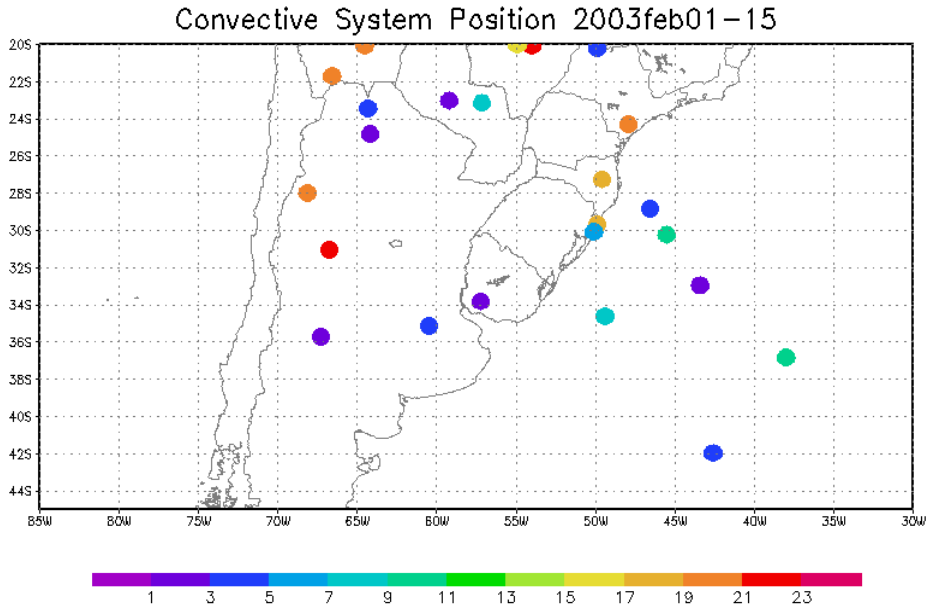
Life cycle > 12h



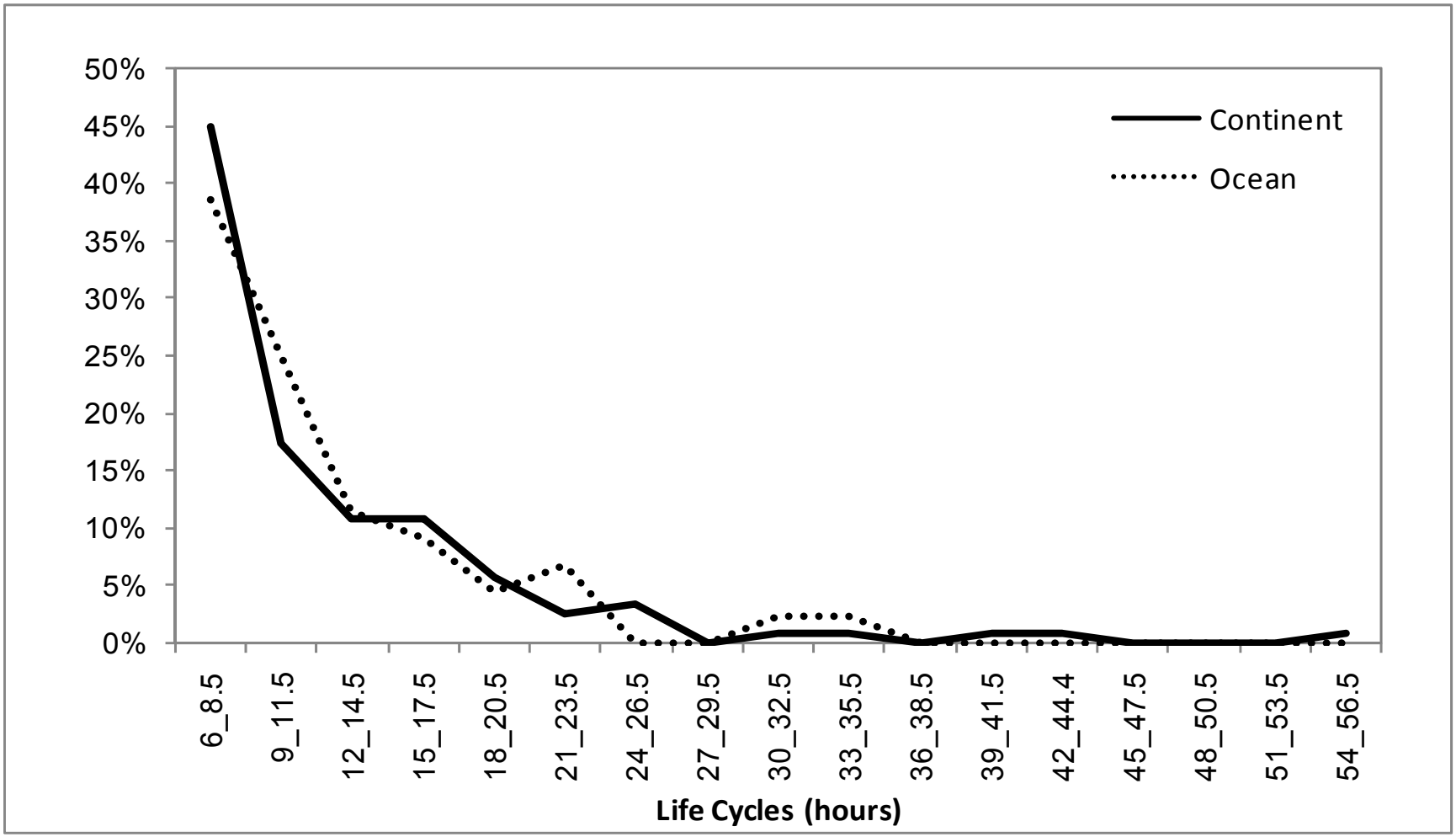
Convective system position from 15/Dec/2002 to 15/Feb/2003



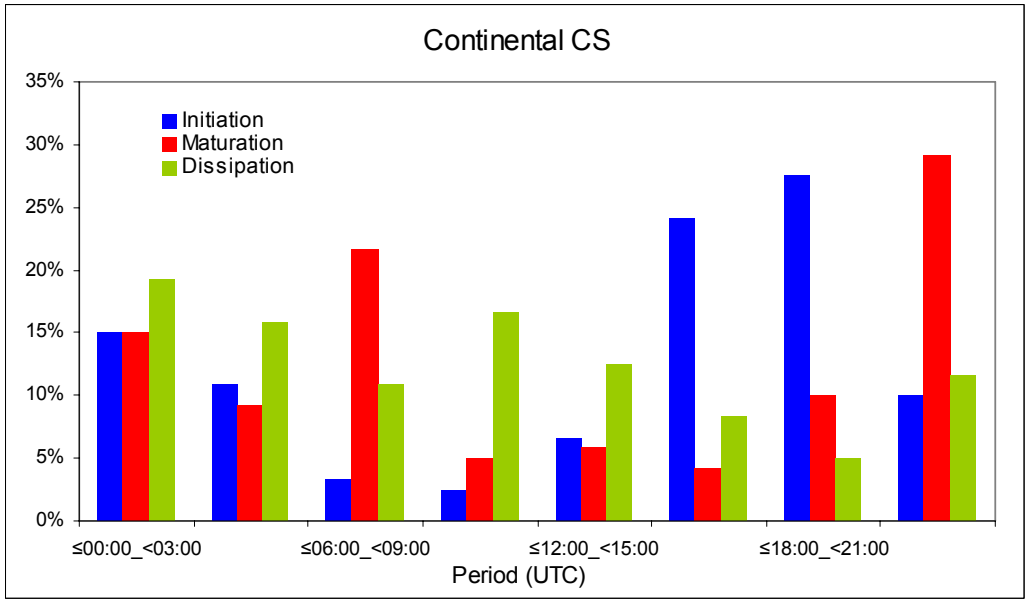


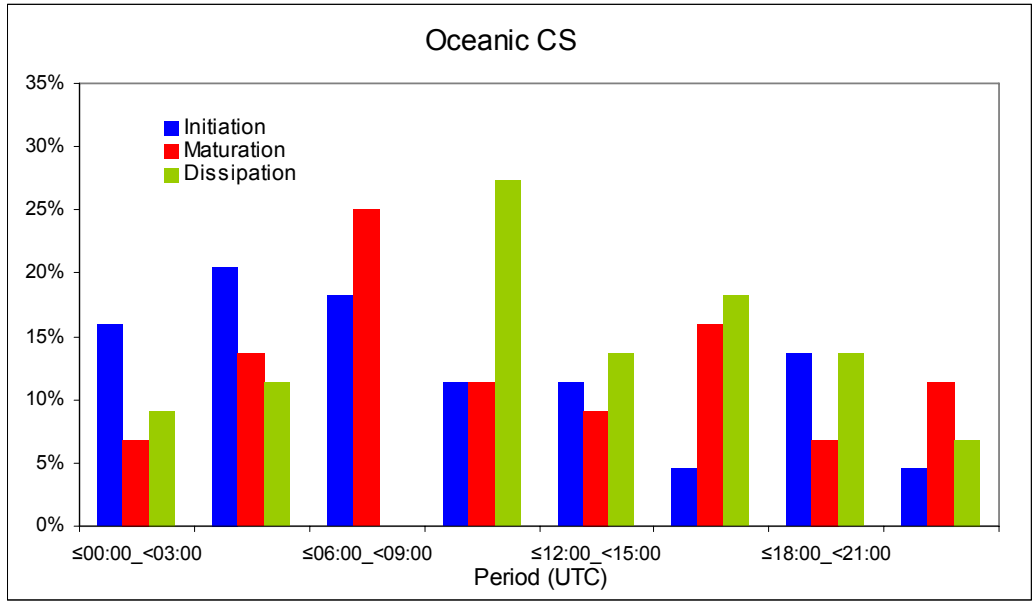


Distribution of continental and oceanic convective systems according to their life cycles

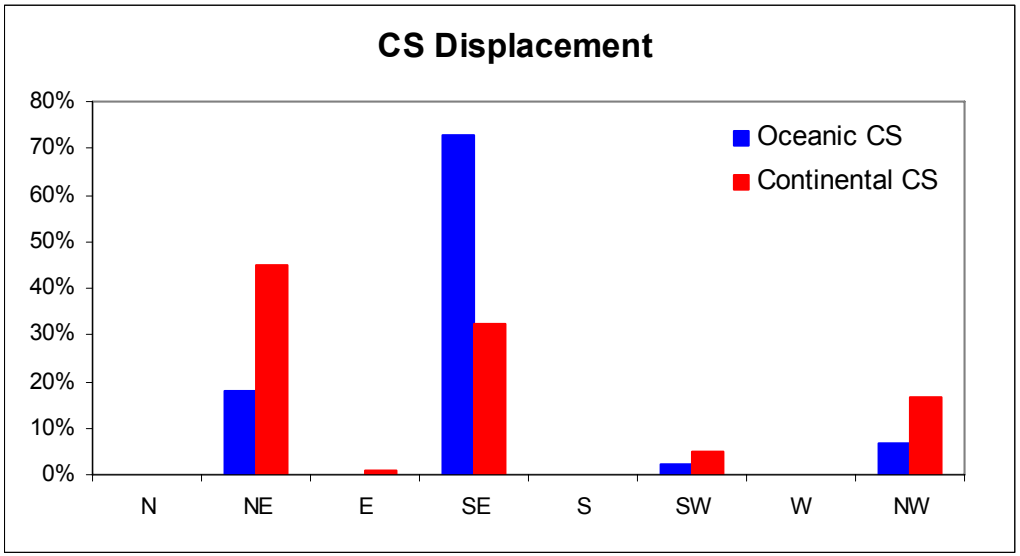


Distribution of convective systems according to their initiation, mature and dissipation periods (UTC)

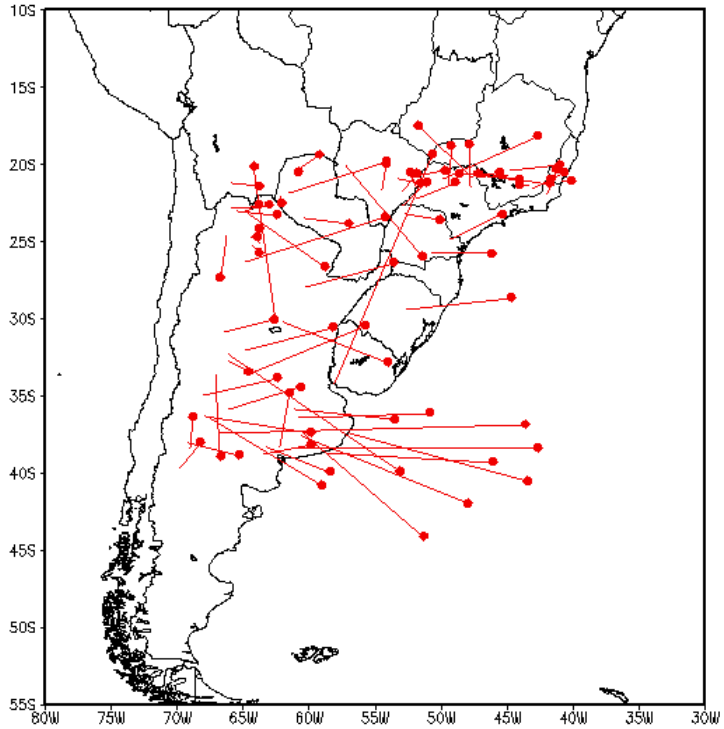




CS Displacement



CS displacement (Jan/2003)



Continental CS				
Eastward 78%			Westward 22%	
Northeastward 57%	Southeastward 41%	Eastward 1%	Northwestward 74%	Southeastward 23%

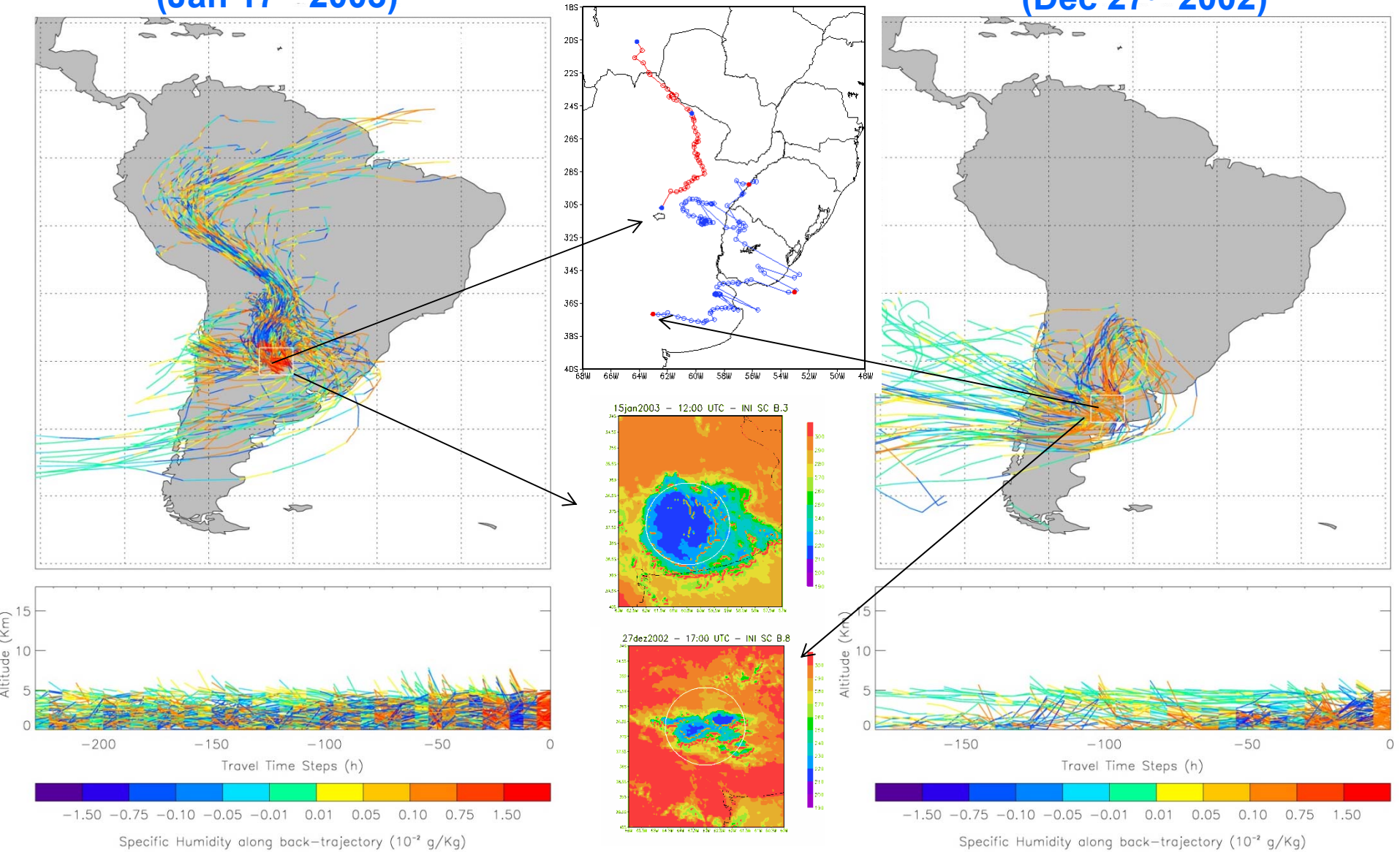
Oceanic CS			
Eastward 91%		Westward 9%	
Northeastward 20%	Southeastward 80%	Northwestward 75%	Southeastward 25%

Moisture Source Trajectories from the Lagrangean Model

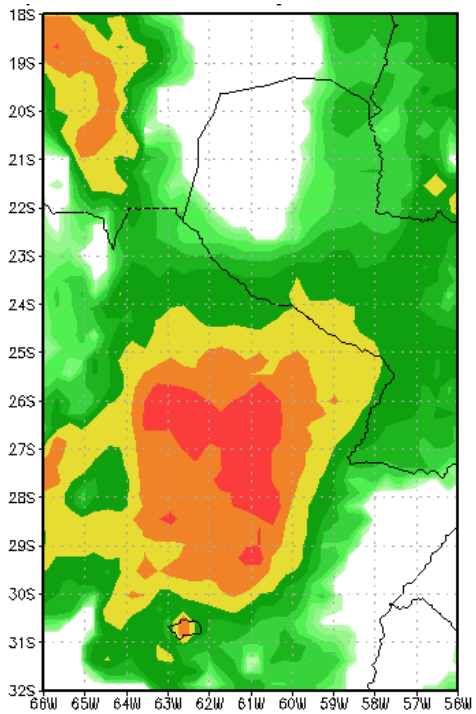
dq/dt > 0.1 (10^{-2} g/kg)

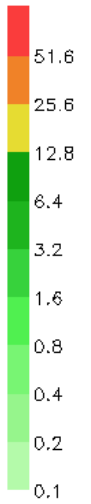
(Jan 17th 2003)

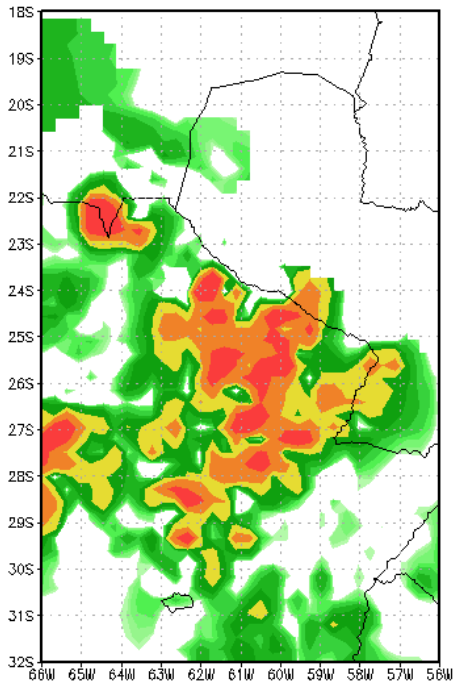
(Dec 27th 2002)



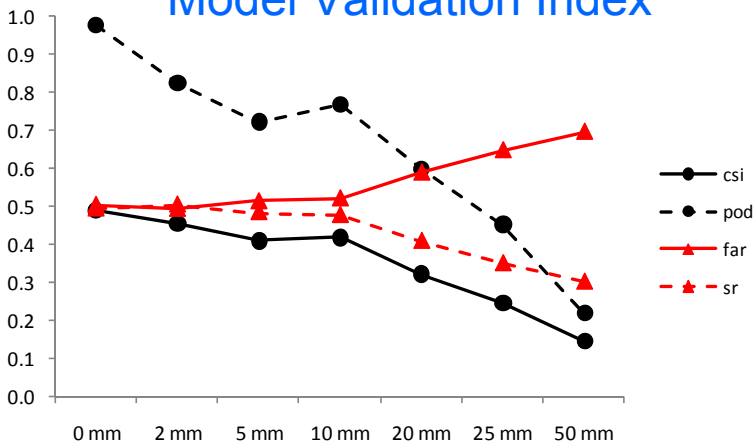
Numerical (WRF) and Observational (SALLJEX) Precipitation for the event initiated in 17/Jan/2003







Model Validation Index



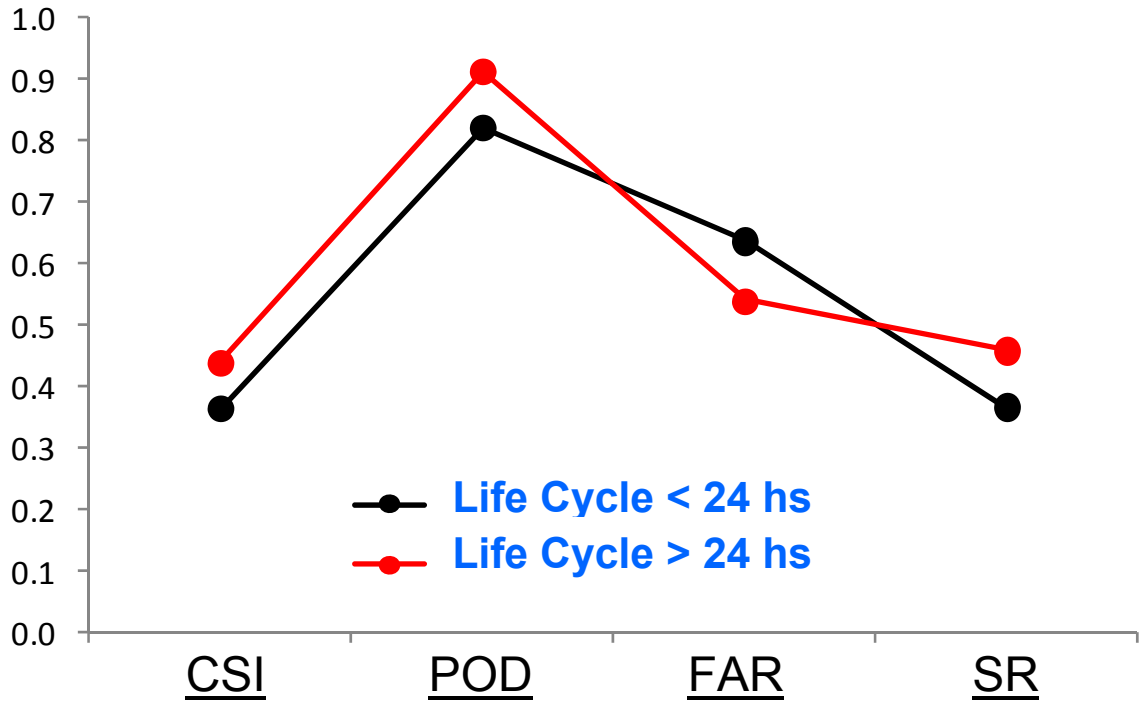
(Critical Success Index – CSI=1)

(Probability of Detection – POD=1)

(False Alarm Ratio – FAR=0)

(Success Ratio – SR=1)

Model Validation Index for all events

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Monsoon Experiment South America
MESA
Experimento del Monzón de SudAmérica

THANKS