Understanding the Role of Tropical Forcing on the High Latitude Circulation and Temperature Trends in Austral Spring

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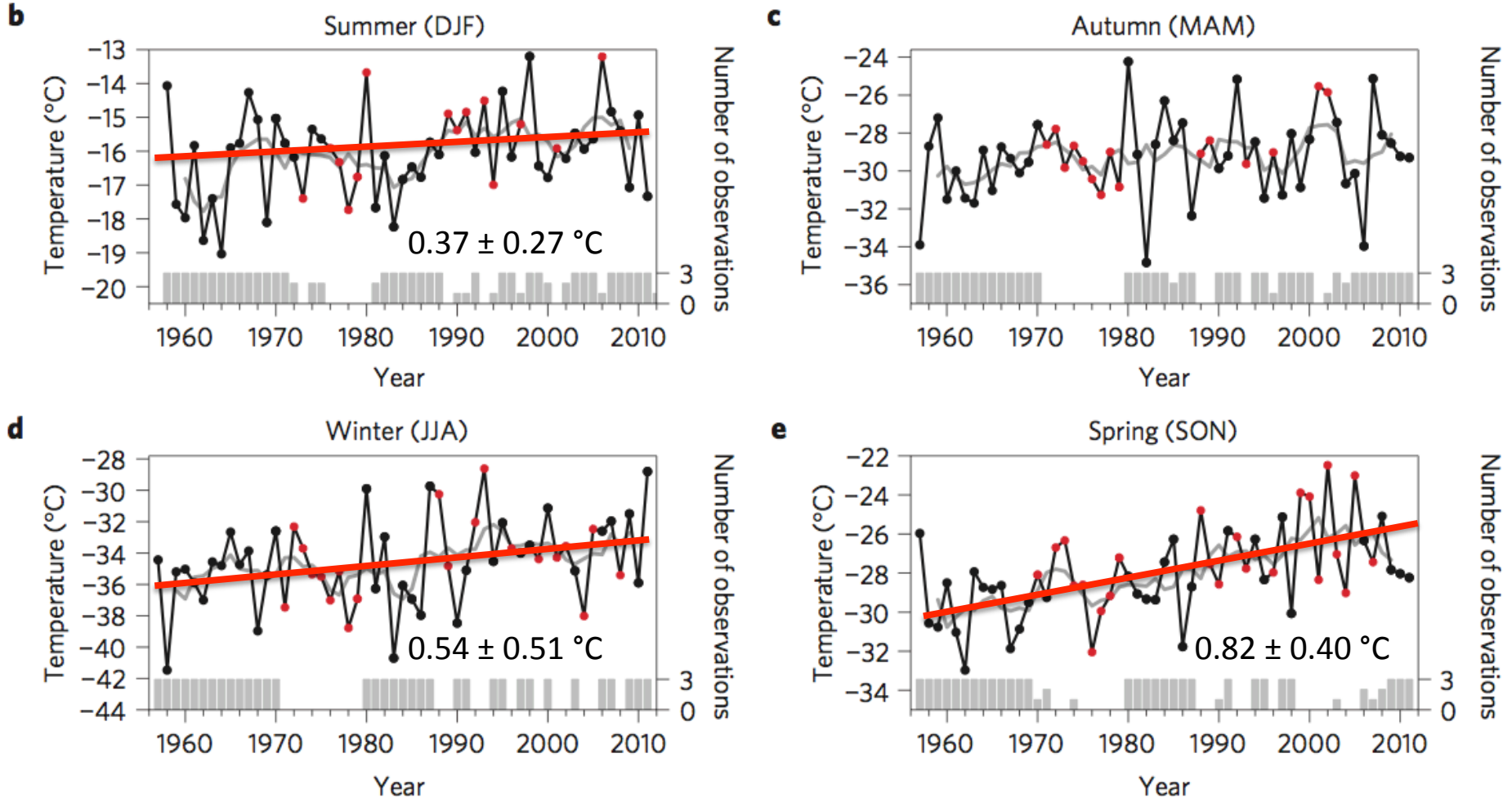
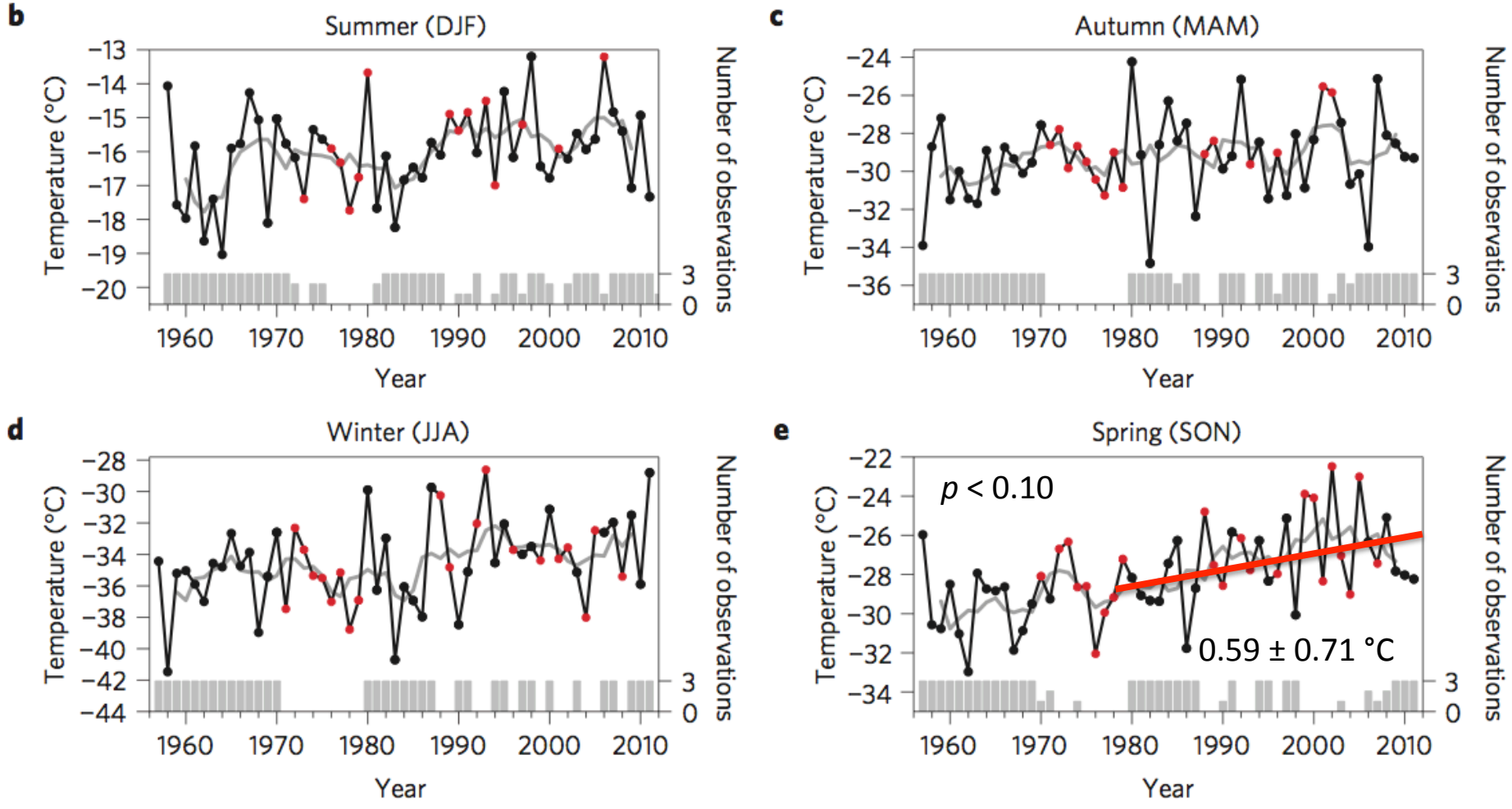
Byrd Temperatures (Seasonal)
1958-2010



Slopes and 95% CI in units of °C decade^{-1}

From Bromwich et al. (2013)

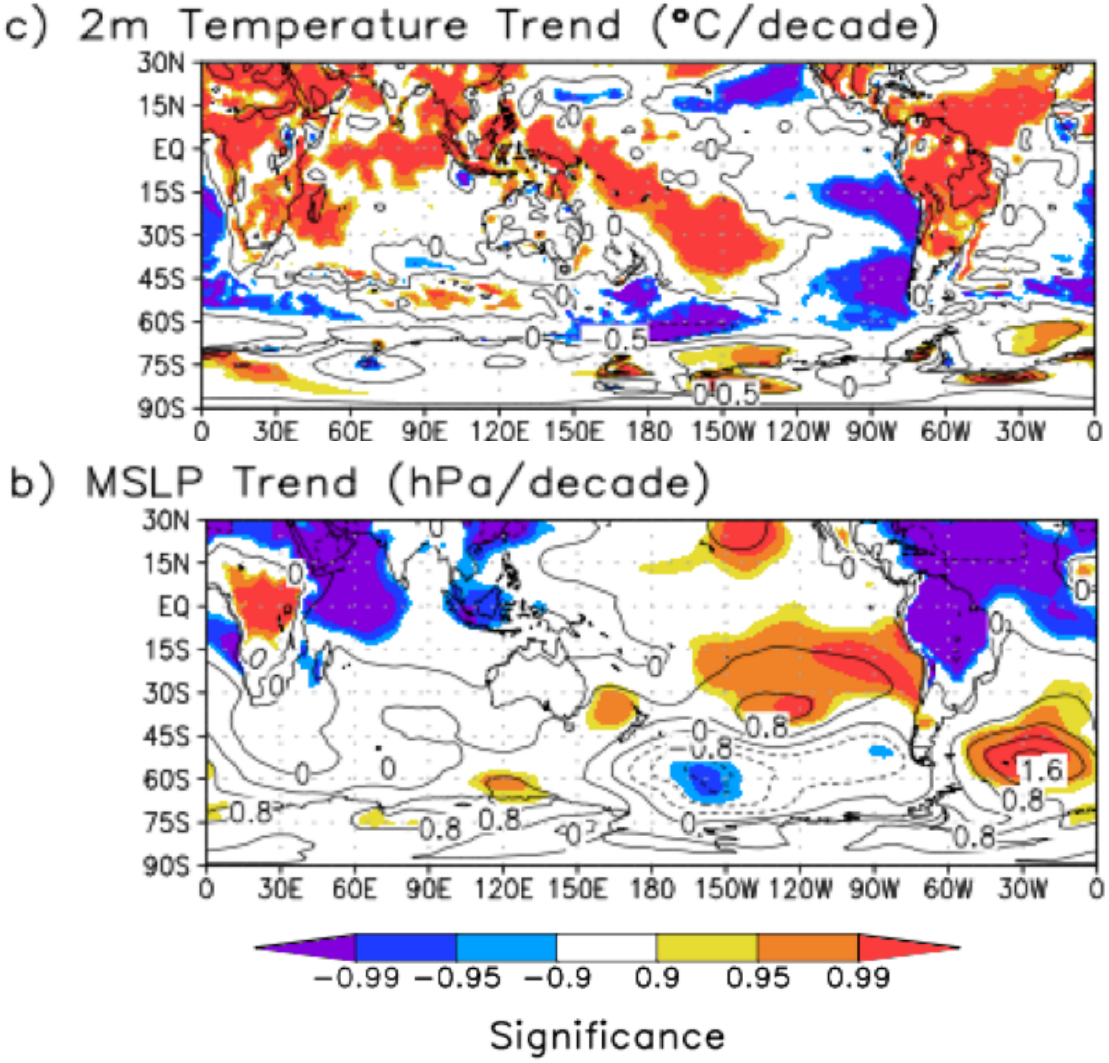
Byrd Temperatures (Seasonal)
1979-2012



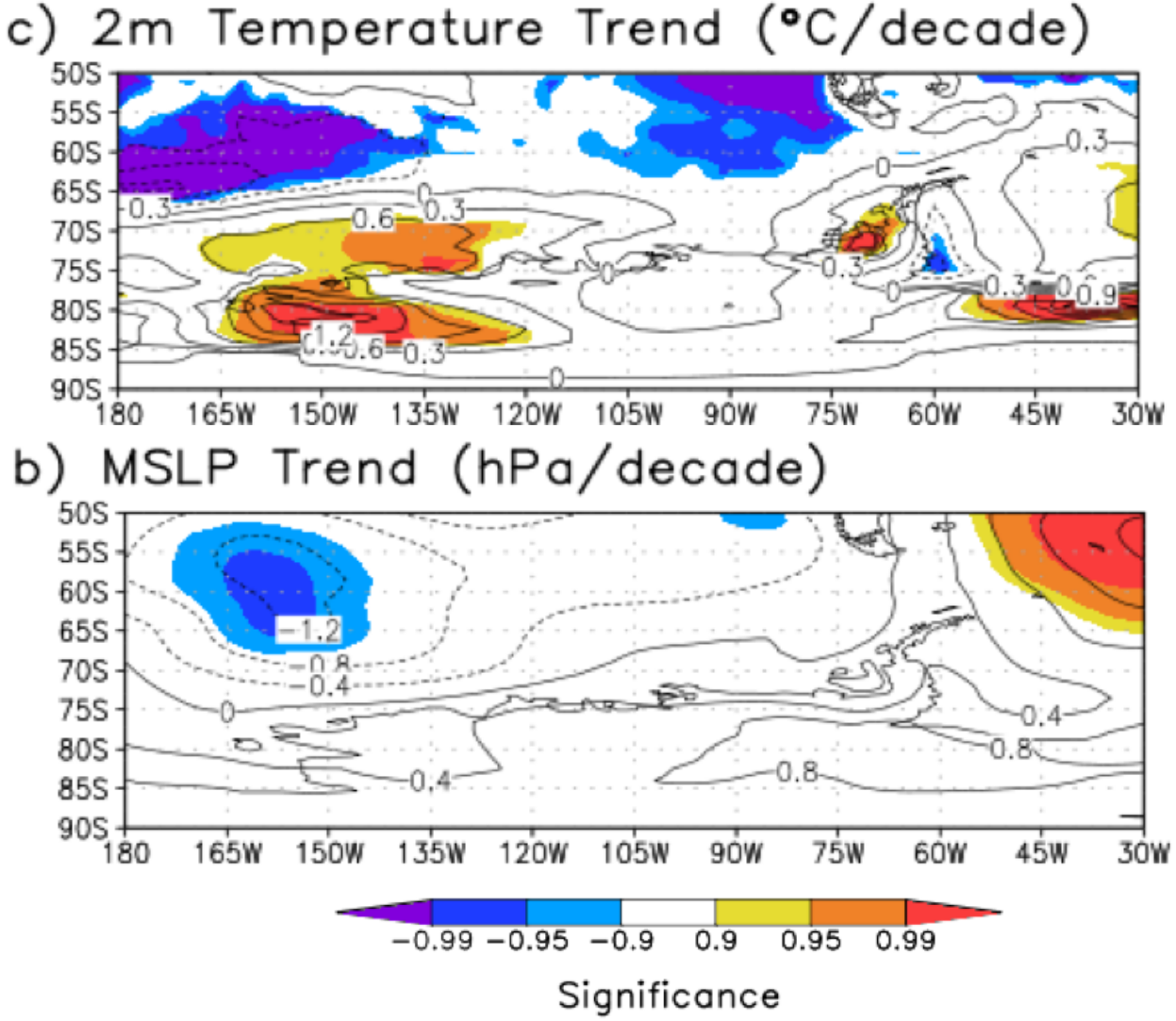
Slopes and 95% CI in units of °C decade^{-1}

From Bromwich et al. (2013)

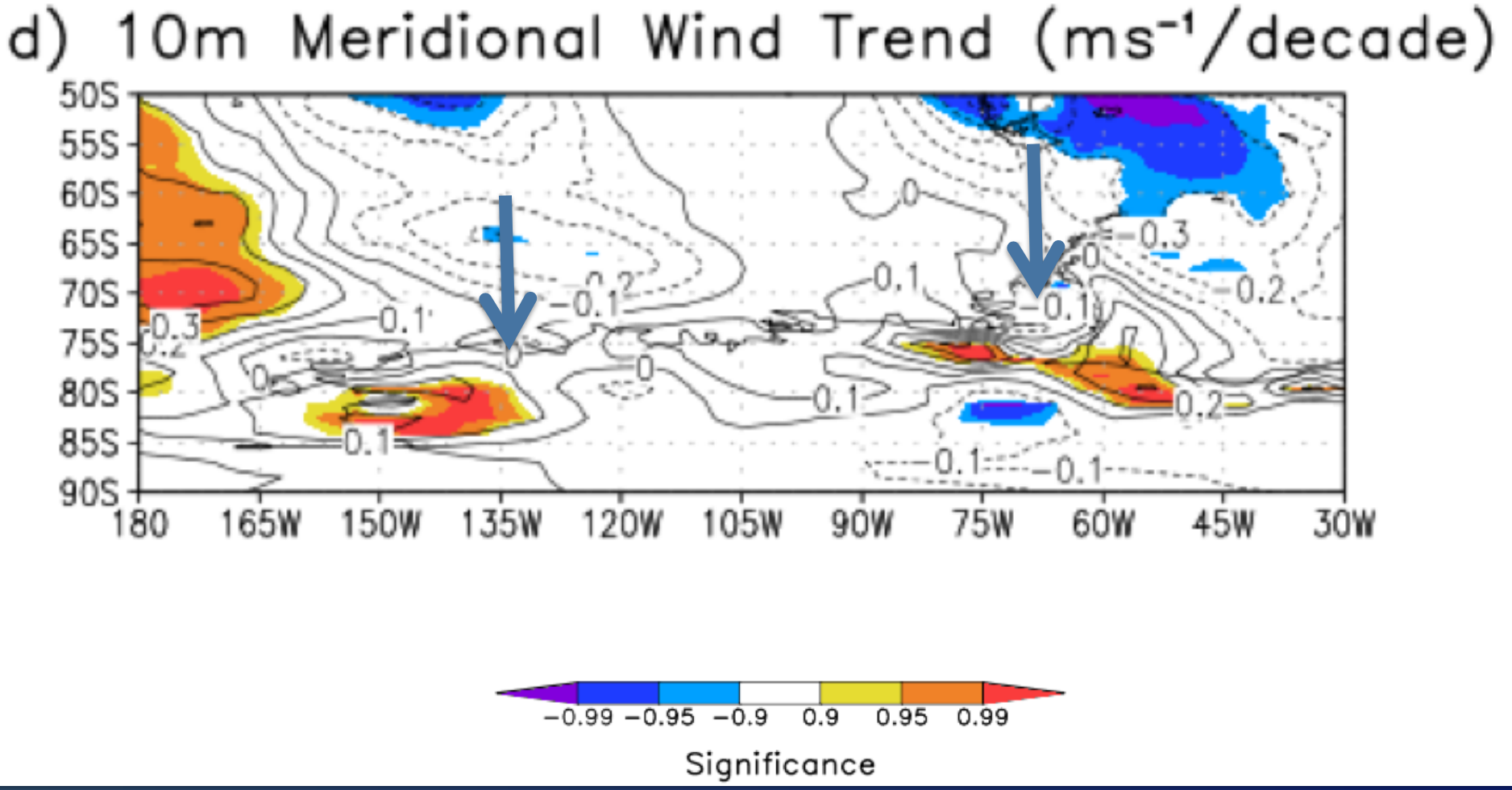
SON ERA-Interim Trends
1979-2012



SON ERA-Interim Trends
1979-2012

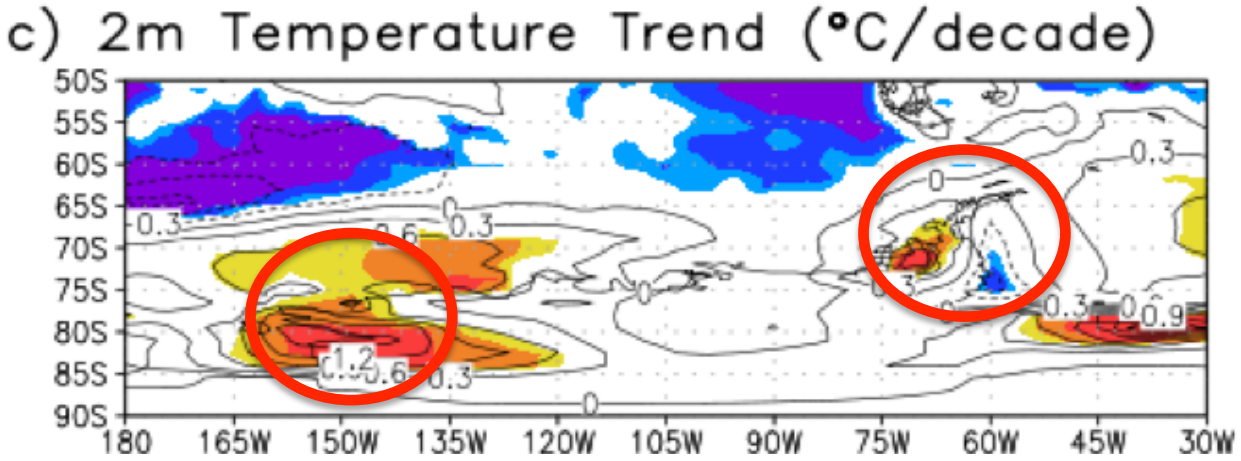


SON ERA-Interim Trends
1979-2012



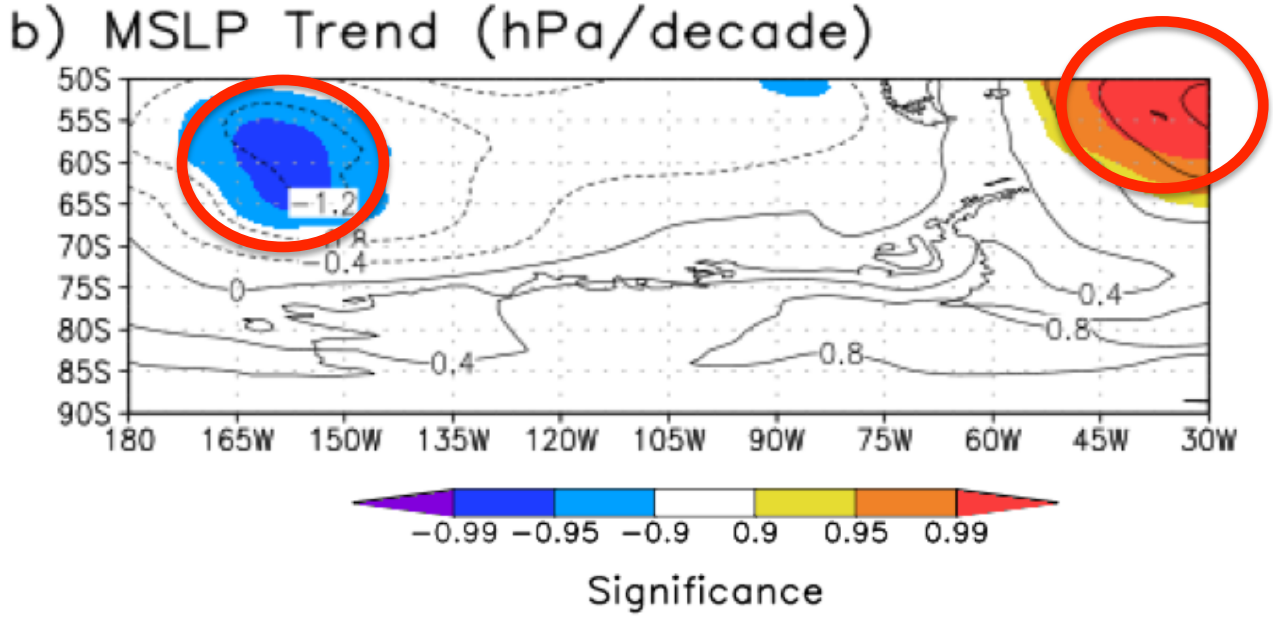
SON ERA-Interim Trends
1979-2012

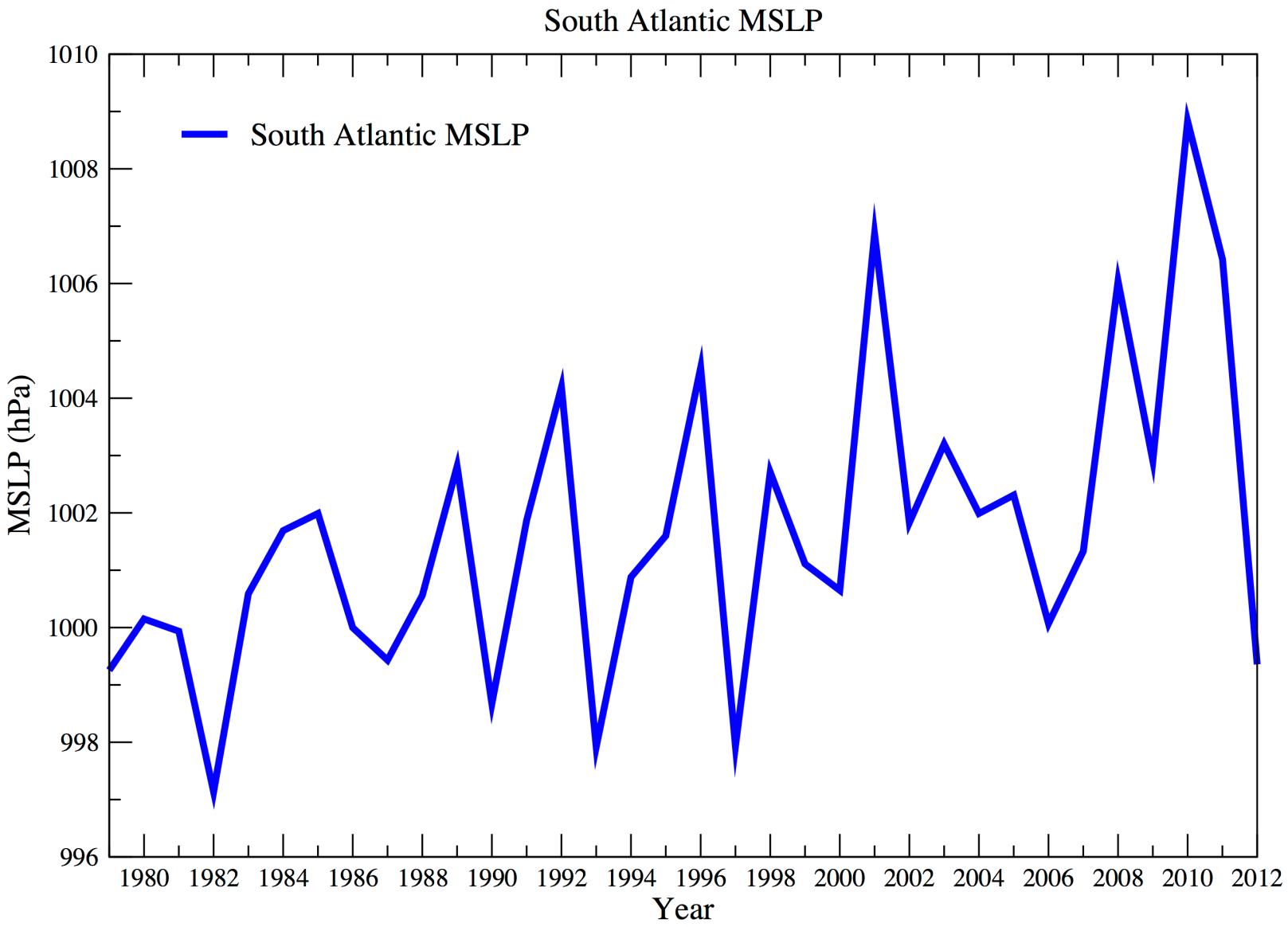
Western West Antarctica Temperatures
72°-82.5°S
156°-115.5°W

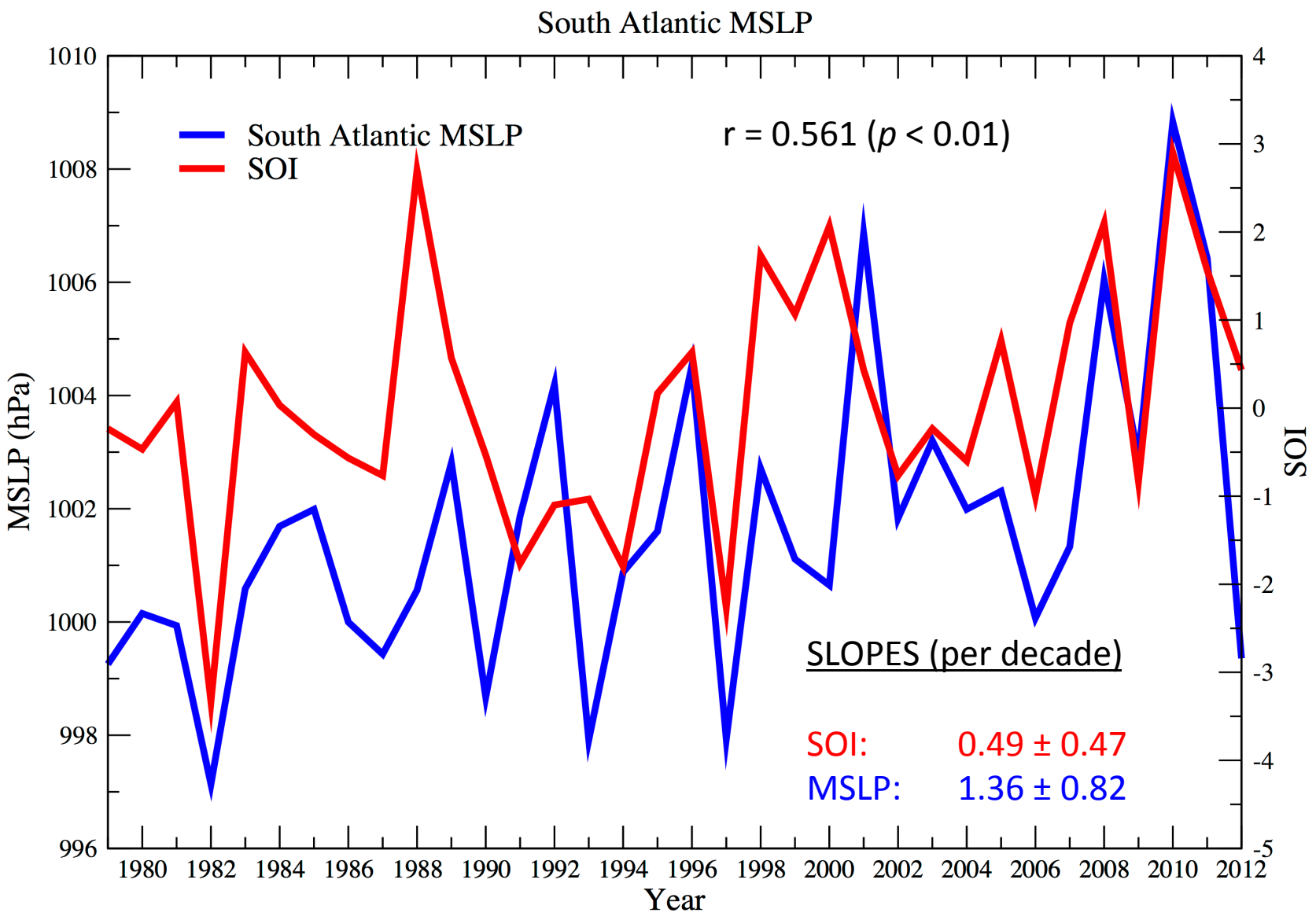


South Atlantic Pressures
45°-60°S
45°-15°W

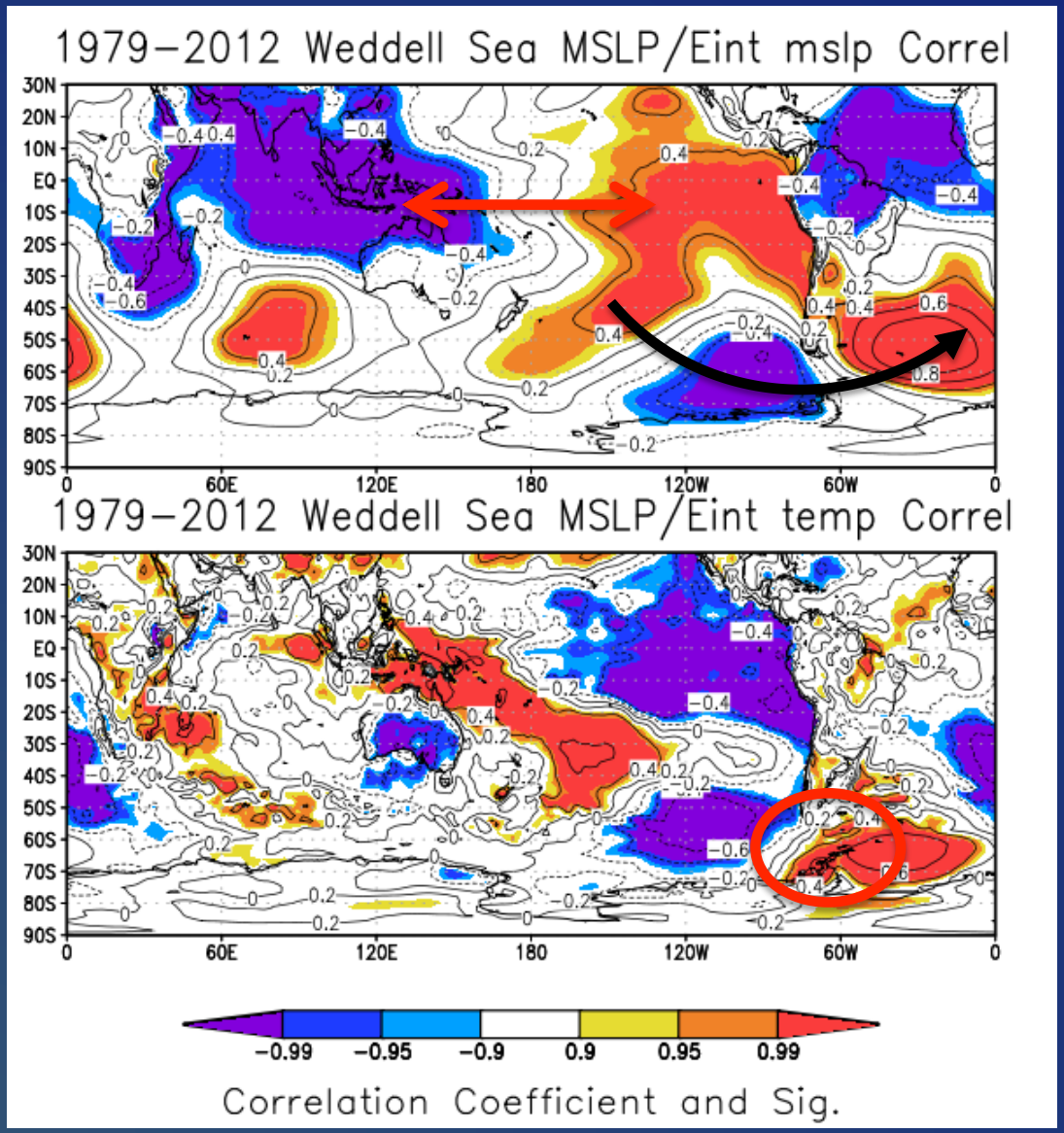
Ross Sea Pressures
55°-66°S
165°-150°W




South Atlantic MSLP
South Atlantic MSLP
MSLP (hPa)
1010
1008
1006
1004
1002
1000
998
996
1980
1982
1984
1986
1988
1990
1992
1994
1996
1998
2000
2002
2004
2006
2008
2010
2012
Year


South Atlantic MSLP
South Atlantic MSLP
SOI
r = 0.561 (p < 0.01)
SLOPES (per decade)
SOI: 0.49 ± 0.47
MSLP: 1.36 ± 0.82
MSLP (hPa)
SOI
Year
1010
1008
1006
1004
1002
1000
998
996
4
3
2
1
0
-1
-2
-3
-4
-5
1980 1982 1984 1986 1988 1990 1992 1994 1996 1998 2000 2002 2004 2006 2008 2010 2012

South Atlantic MSLP Correlations



Southern Oscillation

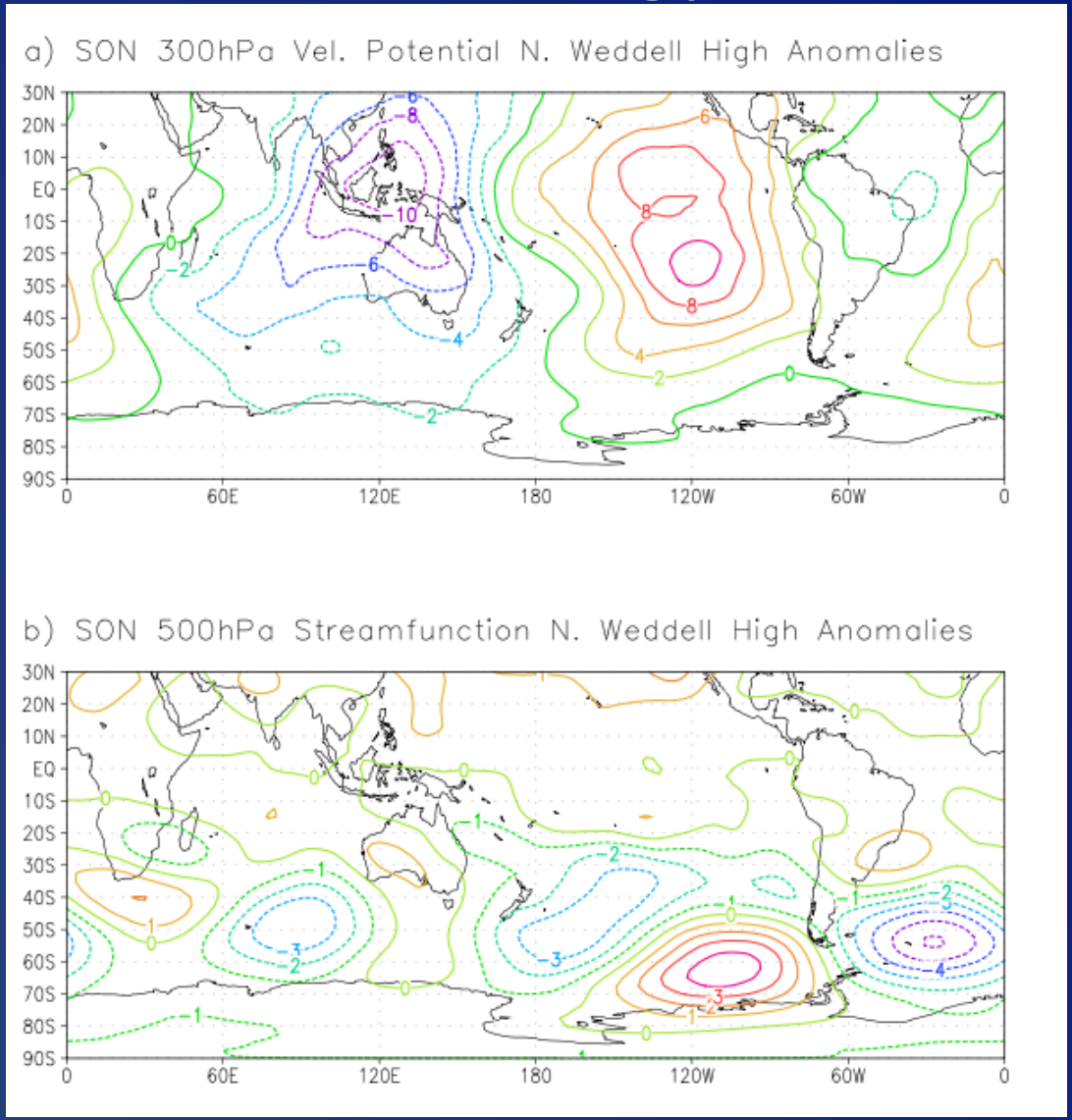
Pacific South American Pattern

Antarctic Peninsula Temperatures

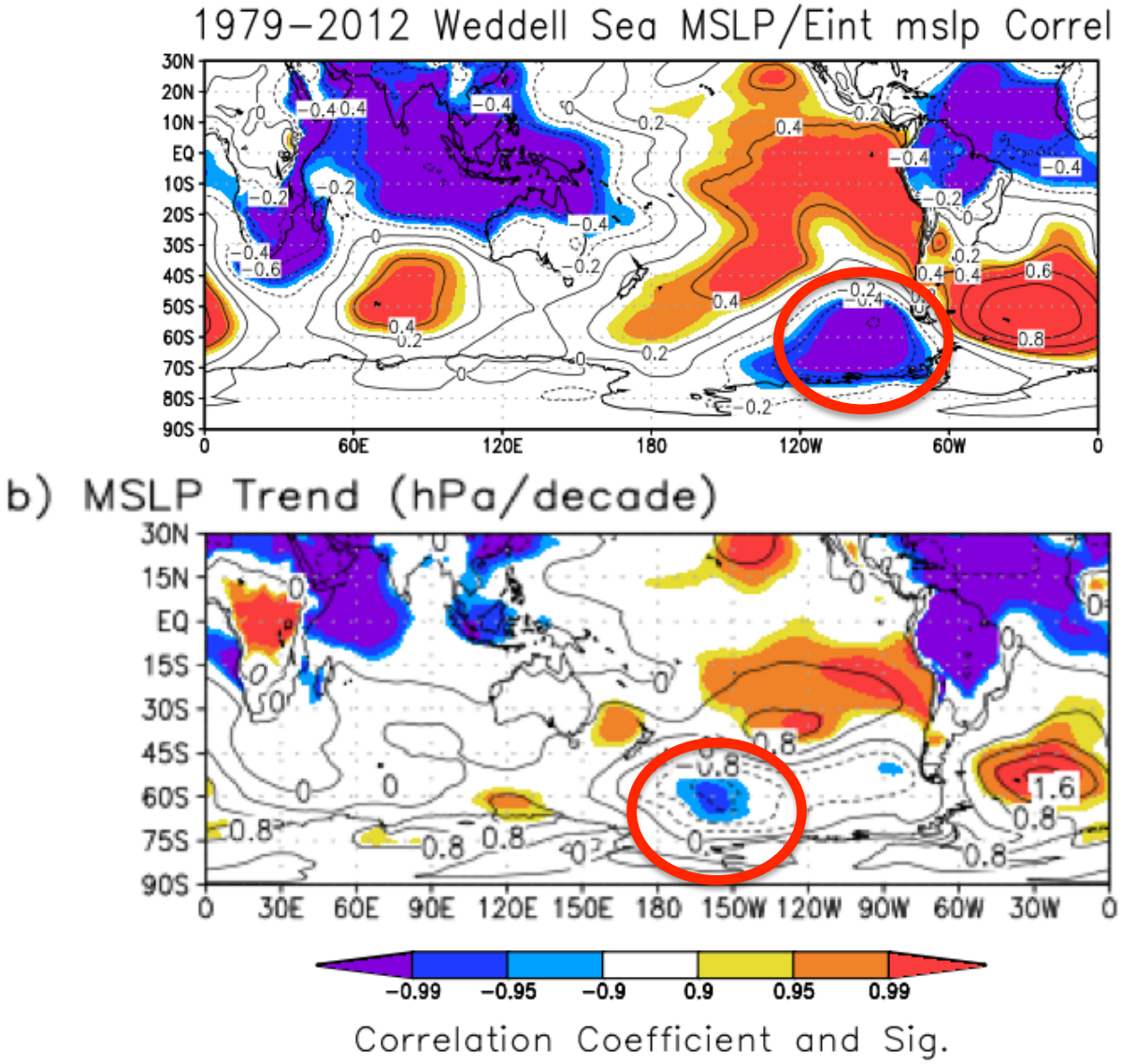
South Atlantic Composites (strong cases vs. climatology)

Tropical velocity potential couplet

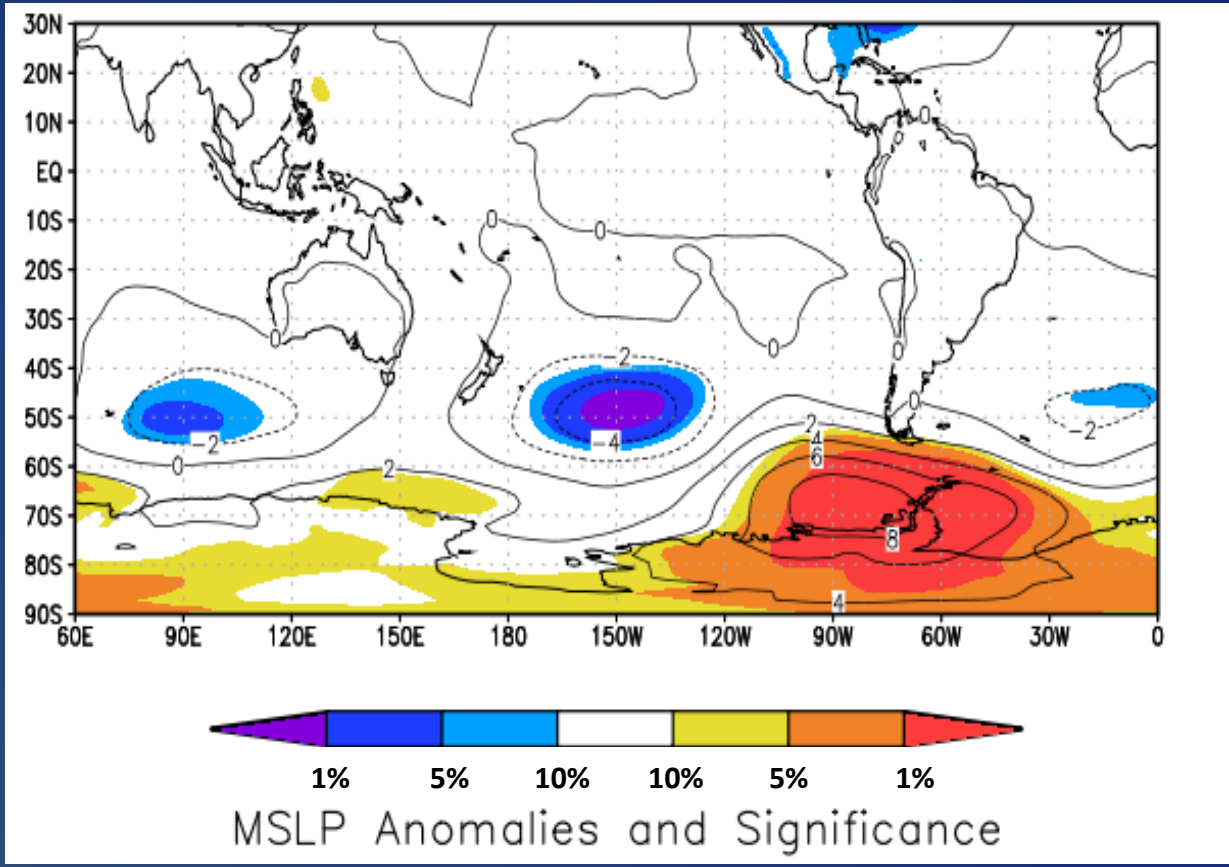
Well-defined Rossby wavetrain



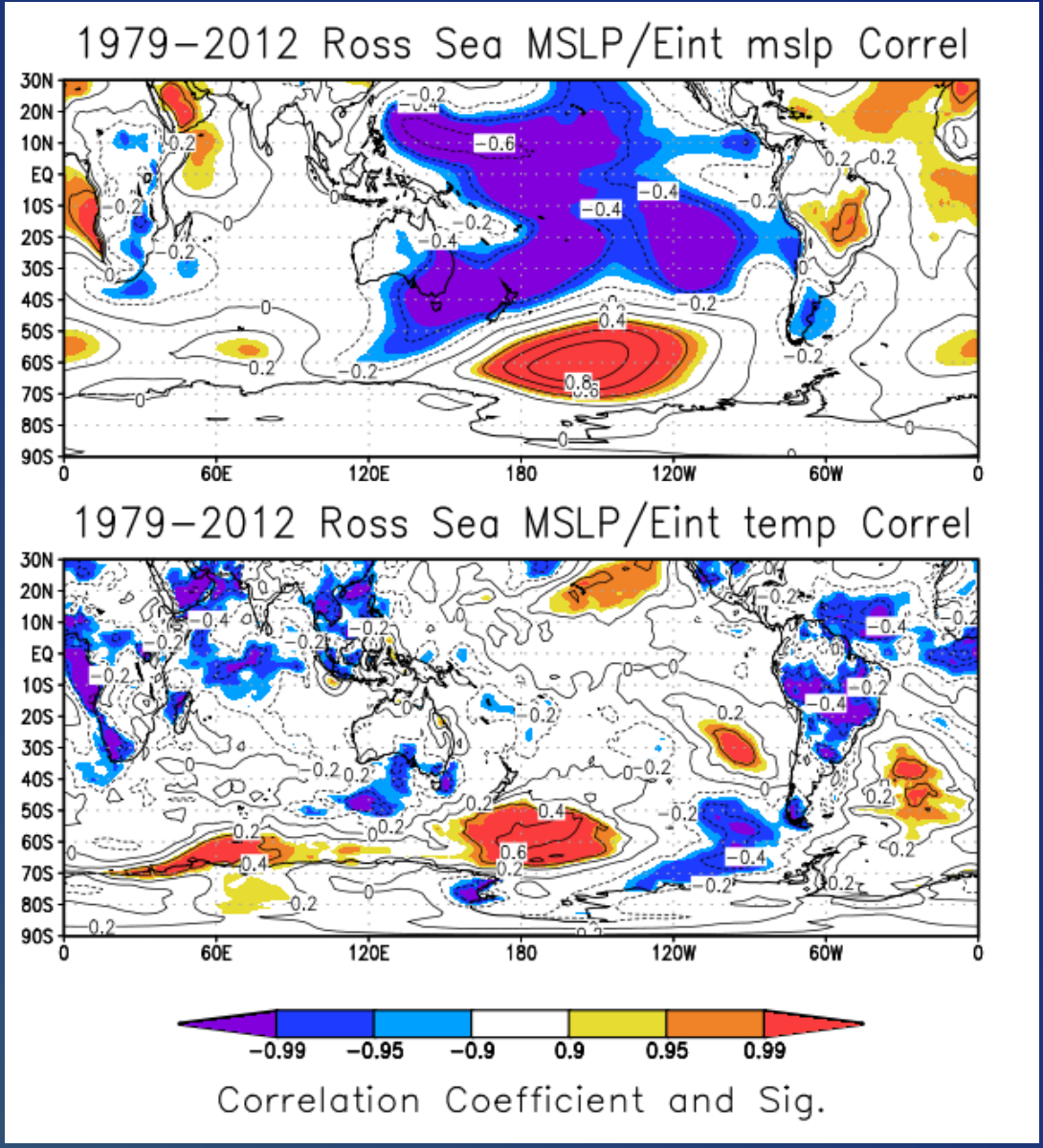
South Atlantic MSLP Correlations



Western West Antarctica Composites
Warm Events vs. Climatology



Ross Sea MSLP Correlations



Central tropical signal

Different from typical
La Niña
(no PSA / Southern Oscillation)

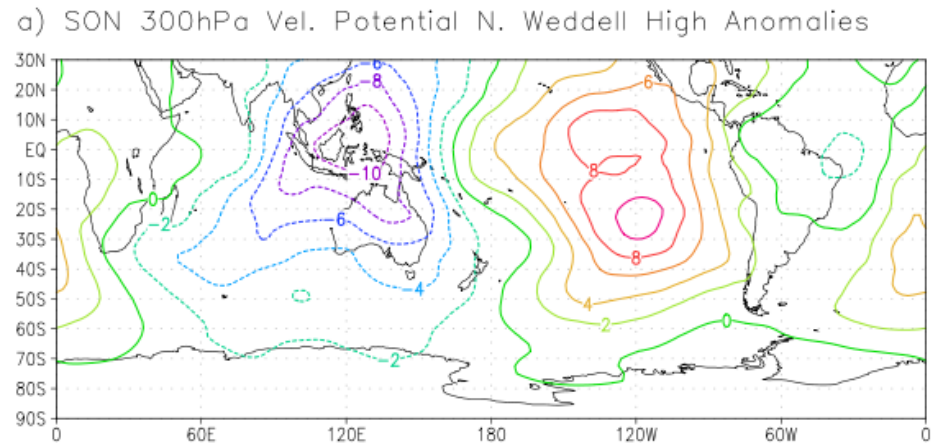
Warming across much of
Amundsen, Bellingshausen
and
some of West Antarctica

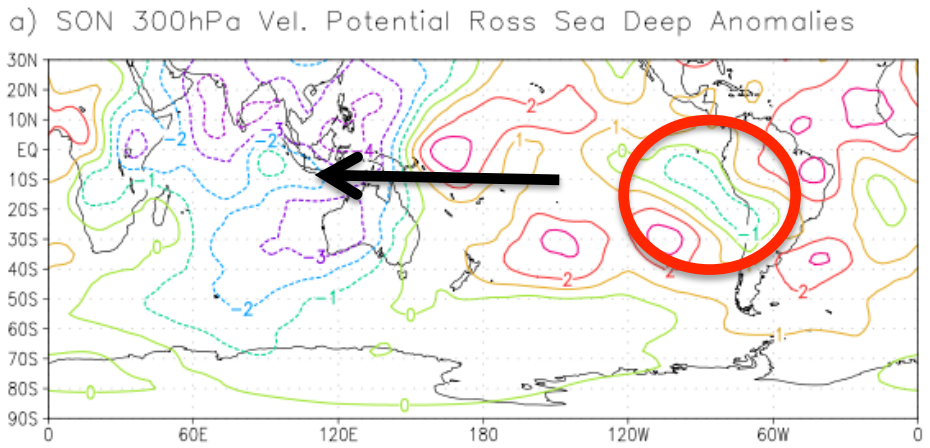
Ross Sea Composites (strong cases)

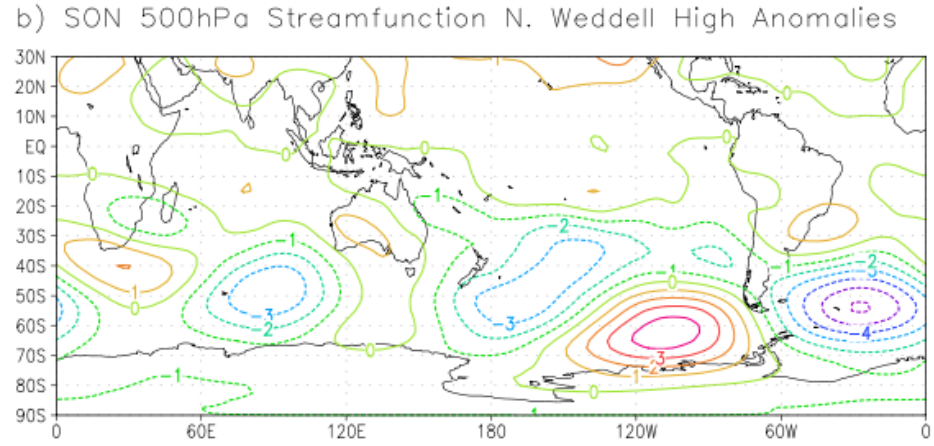
South Atlantic (classic La Niña)

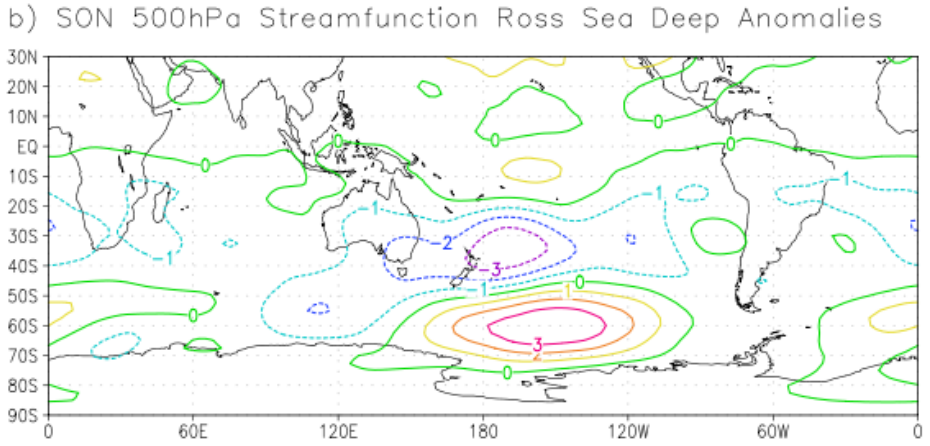
Ross Sea

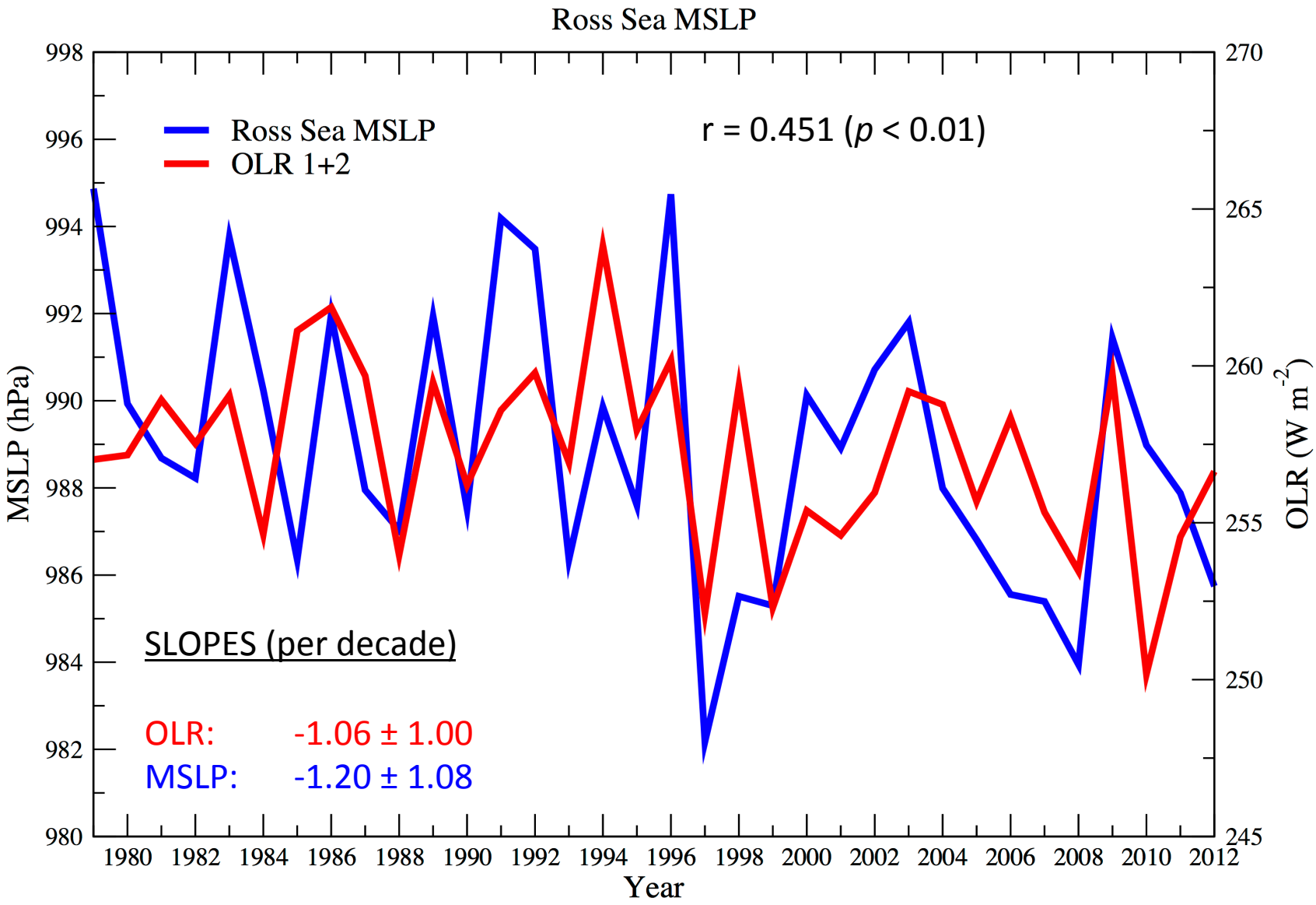
(La Niña-like?)










Ross Sea MSLP
Ross Sea MSLP
OLR 1+2
r = 0.451 (p < 0.01)
SLOPES (per decade)
OLR: -1.06 ± 1.00
MSLP: -1.20 ± 1.08
MSLP (hPa)
OLR (W m-2)
Year
998
996
994
992
990
988
986
984
982
980
270
265
260
255
250
245
1980
1982
1984
1986
1988
1990
1992
1994
1996
1998
2000
2002
2004
2006
2008
2010
2012

Linear Congruency 1979-2012

	SOI			OLR 1+2		
	trend	congruent	residual	trend	congruent	residual
Faraday	0.76	0.32	0.44	0.76	0.21	0.55
Rothera	0.61	0.35	0.27	0.61	0.18	0.44
Byrd	0.59	0.09	0.50	0.59	0.28	0.31
West W. Ant.	0.63	-0.02	0.64	0.63	0.24	0.39

40-50% of the Peninsula warming in SON Linearly congruent with the SOI

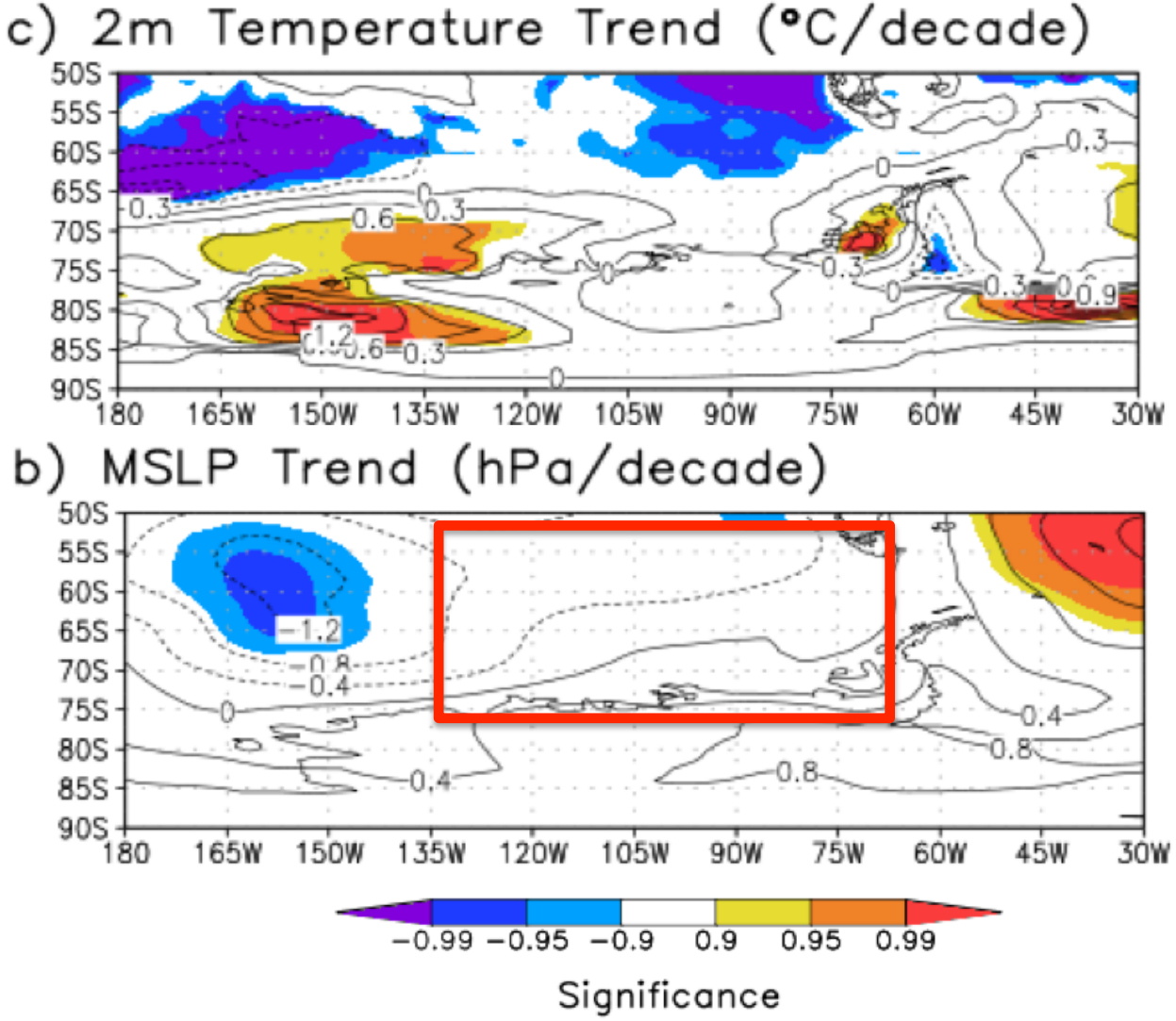
--more La Niña events, changes in South Atlantic high pressure

~40% of the warming in West Antarctic in SON is linearly congruent with the altered tropical state (measured here by OLR 1+2)

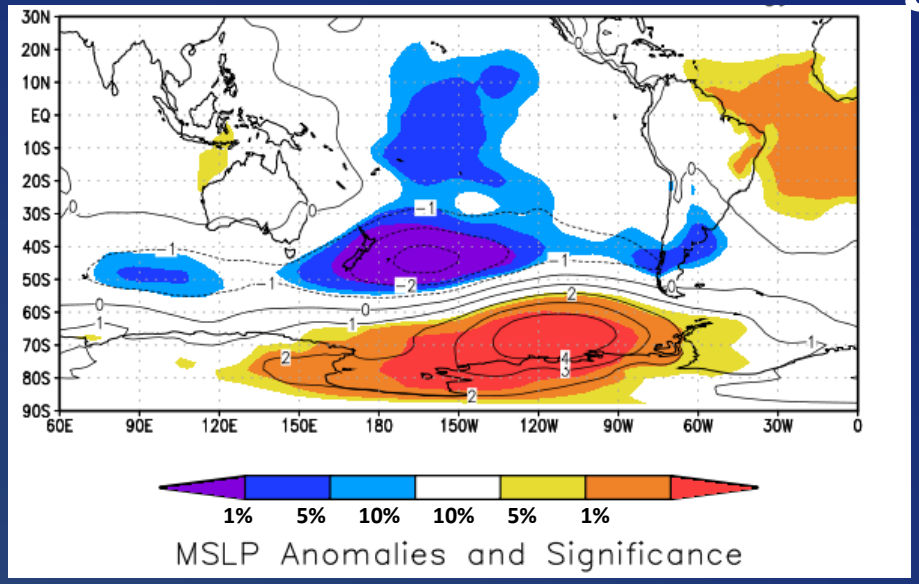
--Deepening of pressure in the Eastern Ross Sea

In reality, other forcings must play a role or some combination of the two

SON ERA-Interim Trends
1979-2012

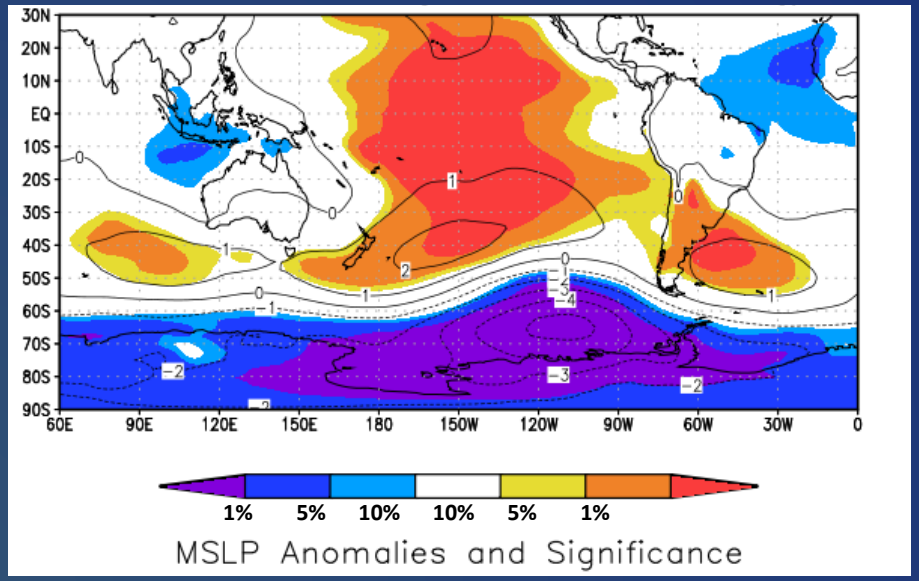


Amundsen Sea Low (ASL) Weak/Strong Events vs. Climatology (SON)



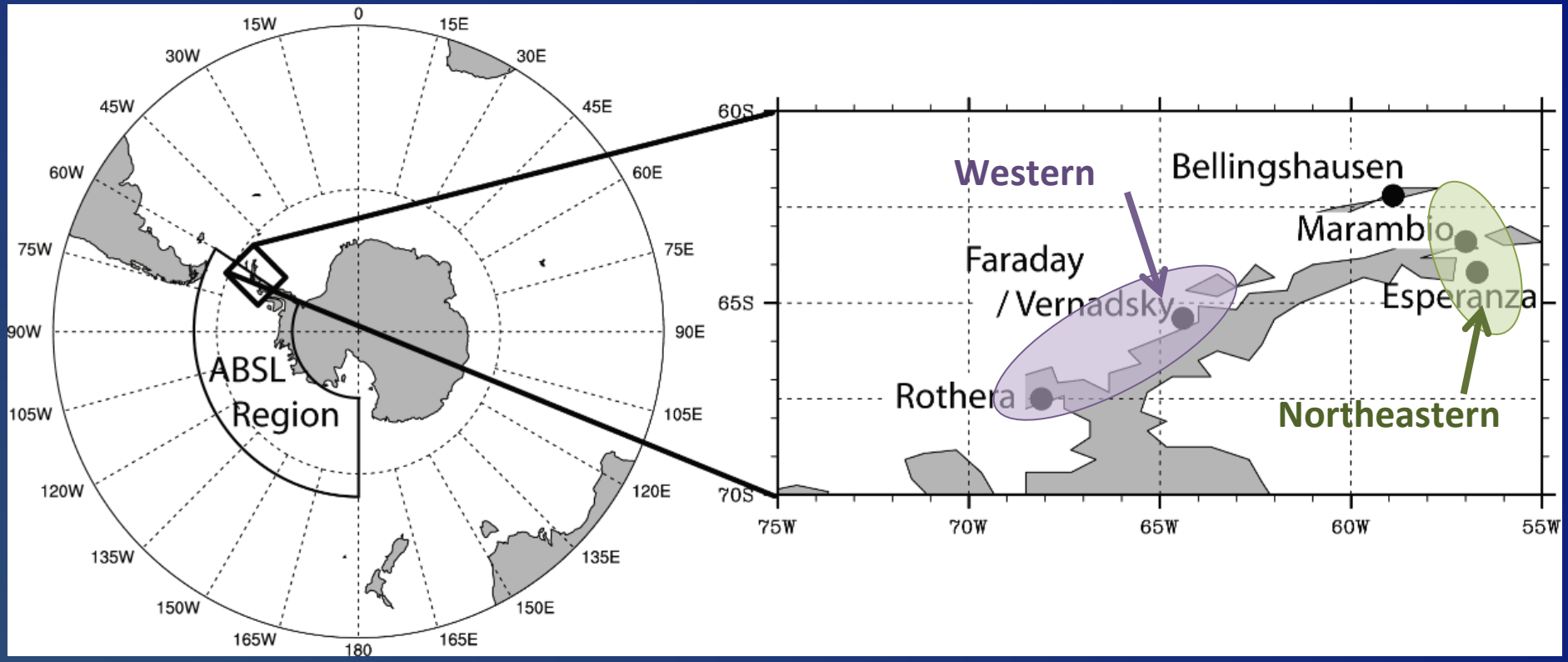
5 weakest ASL events

Tropical signal
West Antarctic warming



5 strongest ASL events

Tropical + SAM signal
Antarctic Peninsula Warming



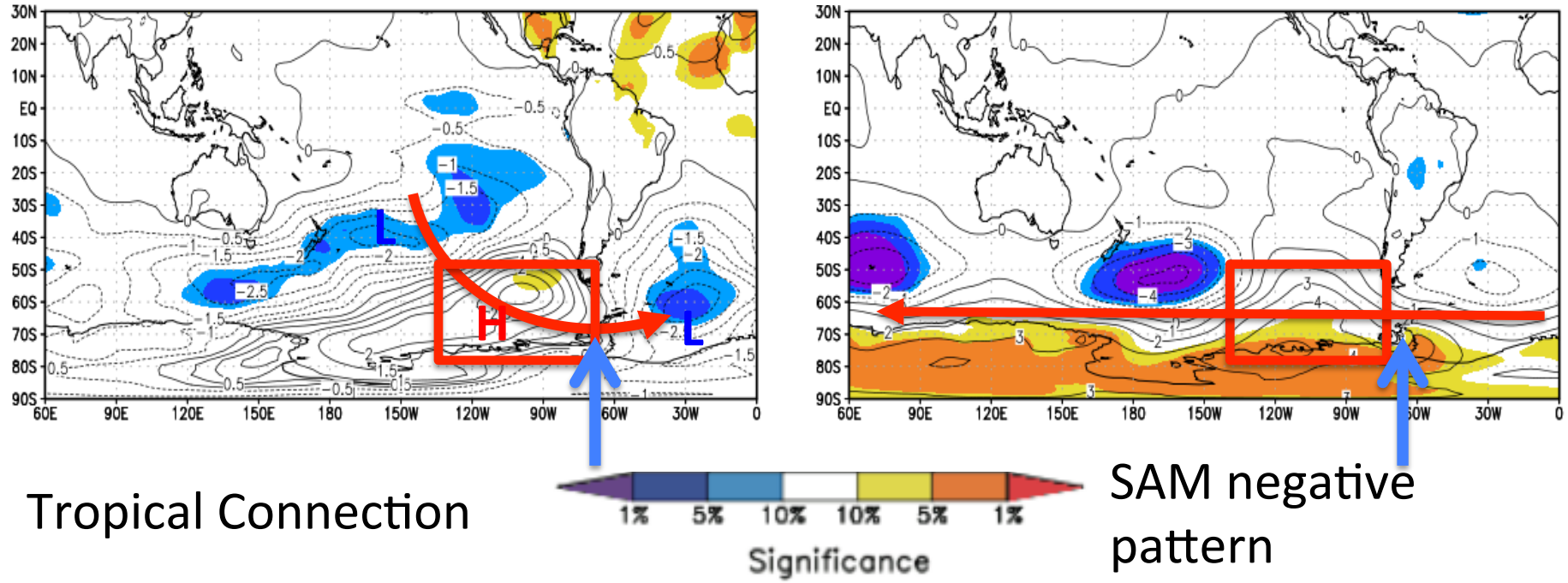
Modified from Clem and Fogt (2013)

Ant. Peninsula Cold Events vs. Climatology (SON)

MSLP Anomalies

West Peninsula

Northeast Peninsula



Tropical Connection

SAM negative pattern

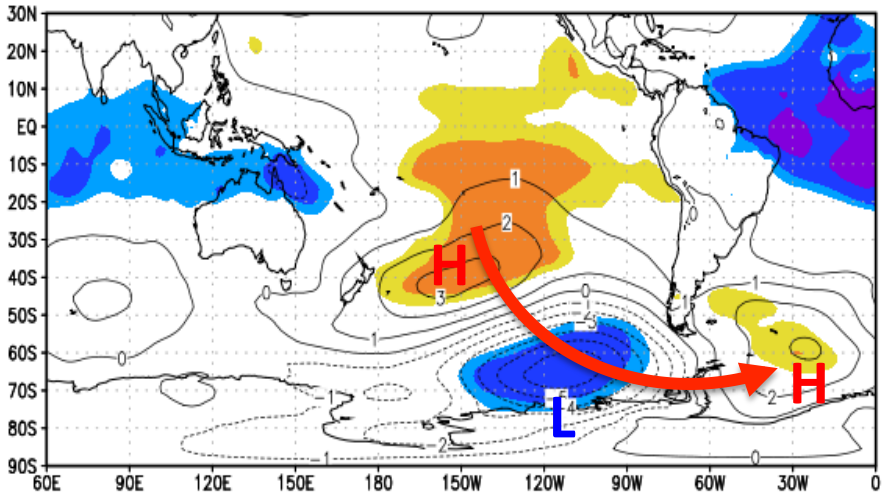
ASL Pressure Anomalies

From Clem and Fogt (2013)

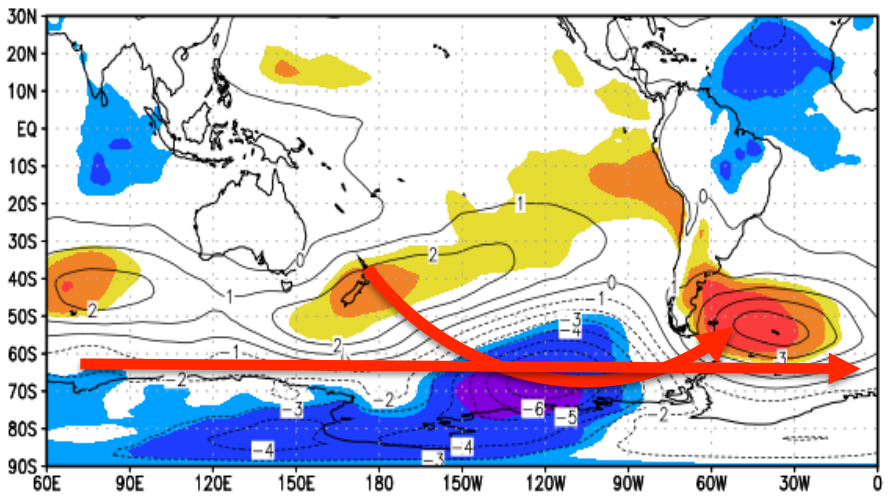
Ant. Peninsula Warm Events vs. Climatology (SON)

MSLP Anomalies

West Peninsula



Northeast Peninsula



Tropical Connection

Both Tropical and SAM+ Pattern

Changes in ASL size and location influence climate of the Antarctic Peninsula differently

From Clem and Fogt (2013)

Conclusions

- Antarctic Peninsula warming in SON related to increasing pressure in South Atlantic
  - Pressure & temp. trends consistent with SOI changes (towards more La Niña events)
- Western West Antarctica warming partially related to deepening in pressure in Ross Sea
  - Tied to a possible La Niña-like state, with OLR anomalies in the Niño 1+2 region a proxy
- Some combination of these cases and / or SAM events are needed
  - Justified by different forcing for temperature variability across the Antarctic Peninsula in SON