

Recent temperature change on the Antarctic Peninsula

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Annual mean surface temperature trend (1957-2006)





Steig et al. 2009

O'Donnell et al 2010

Ice sheet thickness change 1994-2008

Sea ice duration change 1979-2010



Shepherd et al 2010

Trend of the Southern Annular Mode (SAM):

stratospheric ozone depletion and increased greenhouse gas concentrations



Thompson and Solomon 2002

Southern Annular Mode (SAM)

leading mode of low-frequency circulation variability in the SH



Positive phase

Basic state does not favor an annular-like SAM



New physical understanding of the SAM



Ding et al. 2012

Focus of this study: 1979-2009 period

- Reanalysis : ERA-interim (1979-2009) , ERA40 (1958-1978), NCEPII (1979-2009) ,NCEP (1948-2009), MERRA(1979-2009), NOAA 20th reanalysis
- SST & sea ice: ERSST3, HADISST, Kaplan, COBE
- Surface temperature: AVHRR, ERA-interim, MERRA, READER
- ECHAM4.6 AGCM (T42L19)+ slab ocean
- Trend: epochal difference or linear trend
- Trend significance (signal to noise ratio, Mannkendall test)

Surface temperature trend in Antarctica (1979-2009)

AVHRR surface temperature



ERA-interim 2m temperature 2.4 DJF MAM JJA SON 1.8 1.2 റ് –0.6 0.6 -1.2 -1.8 -2.4 MERRA skin temperature DJF MAM JJA SON

JJA, SON West Antarctica warming can be explained by the tropical forcing MAM Peninsula warming is still unlcear





Ding et al. 2011

Sea ice concentration trend in Antarctica (1979-2009)





8 stations data used in this study

APT index = Antarctic Peninsula Temperature (mean of 8 stations)





	1	2		3		4		5		6		7		8	
1	Rothera	0.79	0.92	0.27	0.76	0.16	0.74	0.32	0.78	0.21	0.62	-0.01	0.56	0.08	0.81
		0.88	0.91	0.59	0.75	0.59	0.7	0.54	0.35	0.54	0.66	0.42	0.56	0.51	0.34
2	0.2 0.69			0.69	0.11	0.67	0.15	0.71	0.02	0.51	-0.17	0.47	0.09	0.69	
	r ar aday/ ver nadsky			0.6	0.72	0.6	0.65	0.53	0.39	0.55	0.60	0.4	0.51	0.48	0.41
3	Rallingshausan					0.73	1.0	0.8	0.9	0.53	0.9	0.5	0.86	0.48	0.77
5	Dennigsnausen					0.98	0.97	0.88	0.42	0.92	0.84	0.86	0.86	0.64	0.44
	Marsh							0.53	0.9	0.17	0.92	0.16	0.87	0.24	0.77
4									0.33	0.92	0.82	0.83	0.85	0.64	0.42
5	-0.08 0.46								0.46	-0.11	0.47	0.08	0.07		
								-0.06	0.3	-0.03	0.35	-0.02	0.21		
6	Fsneranza										0.31	0.98	0.16	0.64	
0	Сърстанzа								0.95	0.91	0.64	0.44			
7	Marambio													0.58	0.6
/													0.55	0.43	
8	Orcadas														

Cross correlation between temperature in any two stations

Correlation of APT with temperature in each station



APT is a good index to represent a Peninsula-wide temperature change

Correlation of APT with ERA-interim 2m Temp



APT is a good index to represent a Peninsula-wide temperature change

Correlation of APT with sea ice















APT related Z200 and tropical SST anomalies



APT time series (1979-2009)







Surface temperature trend in each station in 1979-2009

Surface Temperature trend in 1979-2009

AVHRR surface temperature





Sea ice concentration trend in 1979-2009





MAM Z200 and tropical SST trend in 1979-2009



MCA analysis: MAM tropical SST-Peninsula temperature





MCA analysis: MAM tropical SST-Peninsula sea ice





Model response to observed tropical SST trend (1979-2009)



Persistence of decreasing sea ice from MAM to JJA and SON



SH Z200 circulation change: natural forcing vs. anthropogenic forcing (CO2+Ozone)





Summary

Austral autumn is the only season during which spatially extensive warming has occurred on the Antarctic Peninsula, accompanied by significant reduction in sea ice off the west coast.

Warming in other seasons is restricted to smaller areas, with winter and spring warming observed mainly on the western side of the peninsula, reflecting the persistence of sea-ice anomalies from the autumn.

The large-scale forcing behind the autumn warming is linked to lowfrequecny tropical Pacific sea surface temperature anomalies affecting atmospheric circulation.

To predict the future change of SH circulation and related change in Antarctica, we have to better understand and predict the low-frequency SST variability in the tropics





a)Obs

0.8

0.7

30N

20N

10N



Tropical SST trend during 1950 to 2000





