Characteristics of Surface Meteorology at Lindsey Island, Amundsen Sea, West Antarctica from 2008 to 2014

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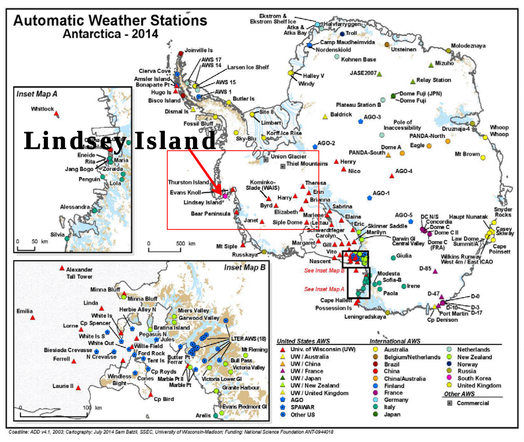
1. INTRODUCTION

Research on warming in West Antarctica is important to understand and predict mass balance change of the ice sheet over the region, which is directly connected to global sea level. Air temperature over West Antarctica is known to have increased moderately over past decades [e.g., *Steig et al.*, 2009; *Schneider et al.*, 2011; *Ding et al.*, 2011; *Bromwich et al.*, 2013]. However, it seems rather complicated to identify the dominant and direct cause for the warming. In addition, a lack of ground based measurements of meteorology across West Antarctica have limited better understanding of how the large area has been influenced by the warming through atmospheric processes and how fast the warming has progressed on the region. Some AWSs on West Antarctica have been operated long time and used to identify vast warming but their location is biased inland [e.g., *Reusch and Alley*, 2004; *Bromwich et al.*, 2013]. Meteorology at coastal area should be different from that inland. Therefore, to better understand the processes of West Antarctica warming, climate at coastal area is required. In addition, meteorology at coastal area is also important in polyna, sea ice melting/formation and air-sea interaction near West Antarctica.

An automatic weather station was setup at the Lindsey Island, Amundsen Sea close to the coastal area of West Antarctica in 2008 and has been operated for about seven years. Here, we present meteorological characteristics at the coastal area in Amundsen Sea through analyzing measured data at the site together with those from three AWSs at coastal area and two inland. To extend its characteristic over limited period, we compare them with reanalysis data to investigate long term change . Amundsen sea low indies are used to explain atmospheric variability at that region.

2. Material and Methods

1. AWS Site: Lindsey Island, Amundsen Sea



2. Summary of sensors for the AWS at Lindsey Island

Data	Model (Period)	Model (Period)	Heights (from the surface)
Wind	05103MA (Feb. 2008~)	05103 (Feb. 2012~)	5.2/2.2 m
T/RH	HMT335 (Feb. 2008~ Feb. 2012)	HMP155 (Feb. 2012~)	4.9/2.0 m
RSDN	LI-210 Type SL (Feb. 2008~)		5.1/4.9 m
SH	SR50M-45 (Feb. 2008~)		4.7 m
P	PTB100B (Feb. 2008~ Feb. 2012)	PTB110 (2012.2~)	0.1 m
Logger	CR1000 (Feb. 2008~)		0.1 m

2. Complementary data

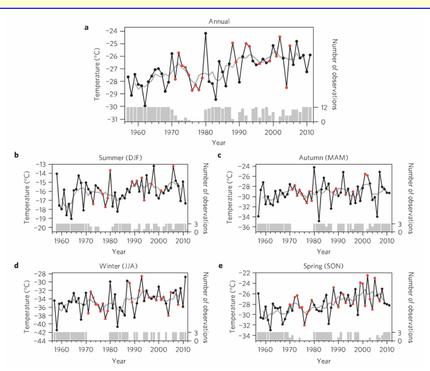
2.1 AWS data

AWS sites	Lat./Lon.	Elevation	Periods	Distance from Lindsey	Installed dates
Lindsey Island	73.601S, 103.021W	37 m	Feb. 2008 ~ Dec. 2014		Feb. 2008
Thurston Island	72.932S, 97.545W	145 m	Jan. 2011 ~ Dec. 2014	~190 km	Jan. 2011
Evans Knoll	74.850S, 100.404W	178 m	Jan. 2011 ~ Dec. 2014	~160 km	Jan. 2011
Bear Peninsula	74.546S, 111.885W	312 m	Jan. 2011 ~ Dec. 2014	~290 km	Jan. 2011
Theresa	84.602S, 115.841W	1,455 m	Feb. 2008 ~ Dec. 2014	~1,260 km	Nov. 1994
Byrd (Byrd Station)	80.007S, 119.404W	1,530 m	Feb. 2008 ~ Dec. 2014	~820 km	Feb. 1980

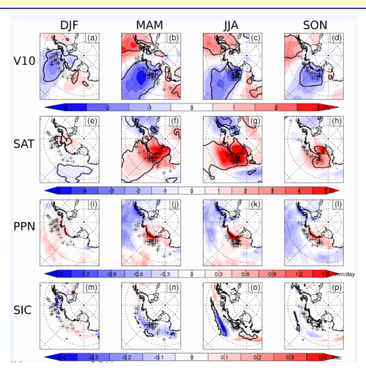
2.2 Reanalysis data of monthly pressure, temperature and wind
- ERA-Interrim: 1980-2014 (T: 2m, P: surface, WS: 10m,)
- MERRA2: 1980-2014 (T: 2m, P: surface)

2.3. Amundsen Sea Low Indices Ver2.: 1980-2014 https://legacy.bas.ac.uk/data/absl/)

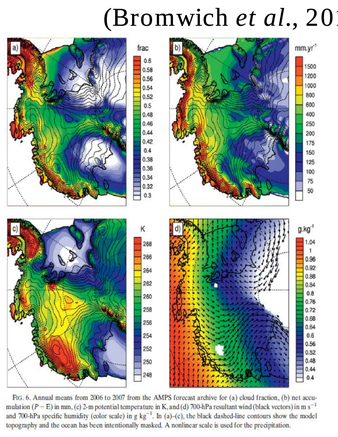
3. Previous Studies



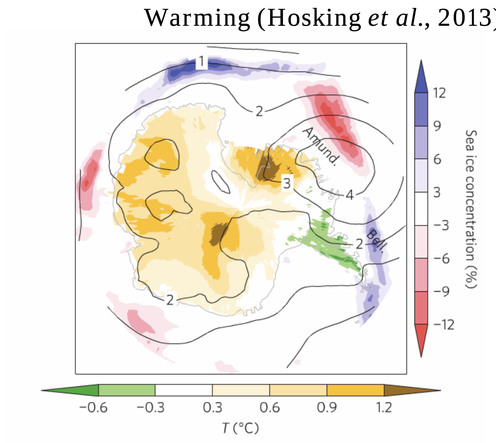
Significant Central West Antarctic Warming (Bromwich *et al.*, 2013)



The role of ASL location on West Antarctic Warming (Hosking *et al.*, 2013)



Spatial variation of surface meteorology by the intrusion of marine air mass (Nicolas and Bromwich, 2010)



Teleconnection: Winter warming in continental West Antarctica due to central Pacific tropical warming (Ding *et al.*, 2011)

5. Discussion and Conclusions

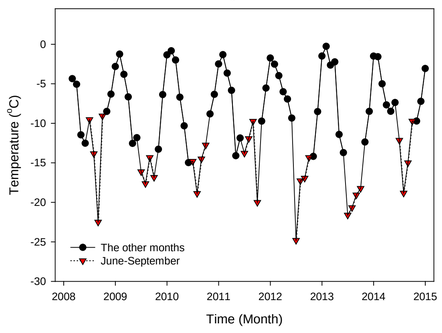
1. Changes in T, P, WS from ERM-Interim agree well with those from AWS at Lindsey Island over 2008-2014.
2. Measured pressure over 2008-2014 at Lindsey island has decreased significantly in autumn as well as the decreasing trend since 1980, consistent with decrease in pressure at the sector of ASL.
3. Decrease in background pressure since 1980 resulted in increase in wind speed in the same season, but not in temperature.
4. Seasonal averaged temperature shows large inter-annual variability and did not show trend at all season significantly over 1980-2014 as well as 2008-2014.
5. Large variability in temperature, particularly in winter is related with the longitude of ASL center.
6. T and P at Lindsey Island shows good correlations with those at neighboring coastal sites, particularly at Bear Peninsular including wind speed, but not those inland sites.

▶Temperature trend at coastal area is insignificant at a coastal area over 1980-2014, likely reflecting different atmospheric processes from those inland.

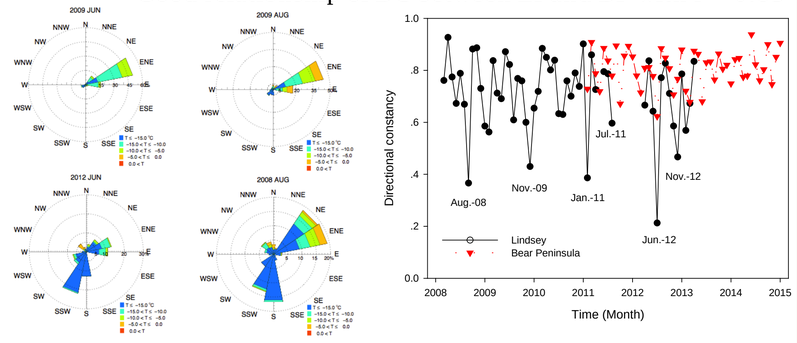
▶ The location of ASL is important in controlling temperature at the site in winter.

4. RESULTS

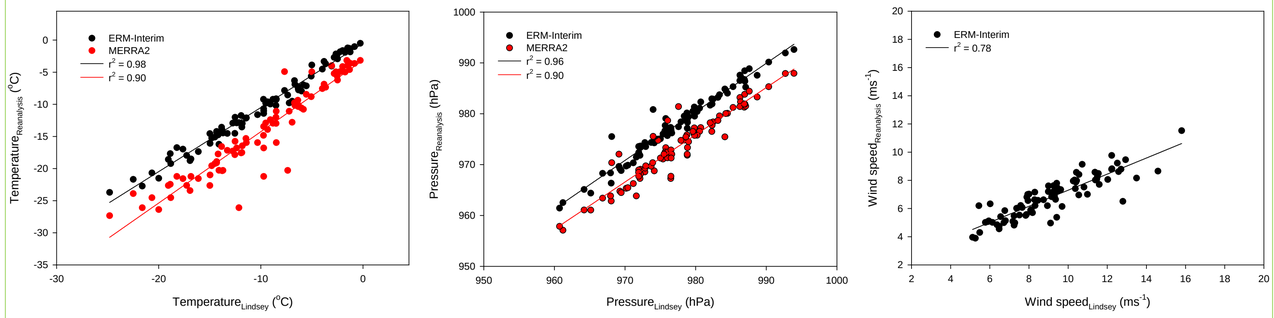
1. Large inter-annual variability of temperature, particularly June to September



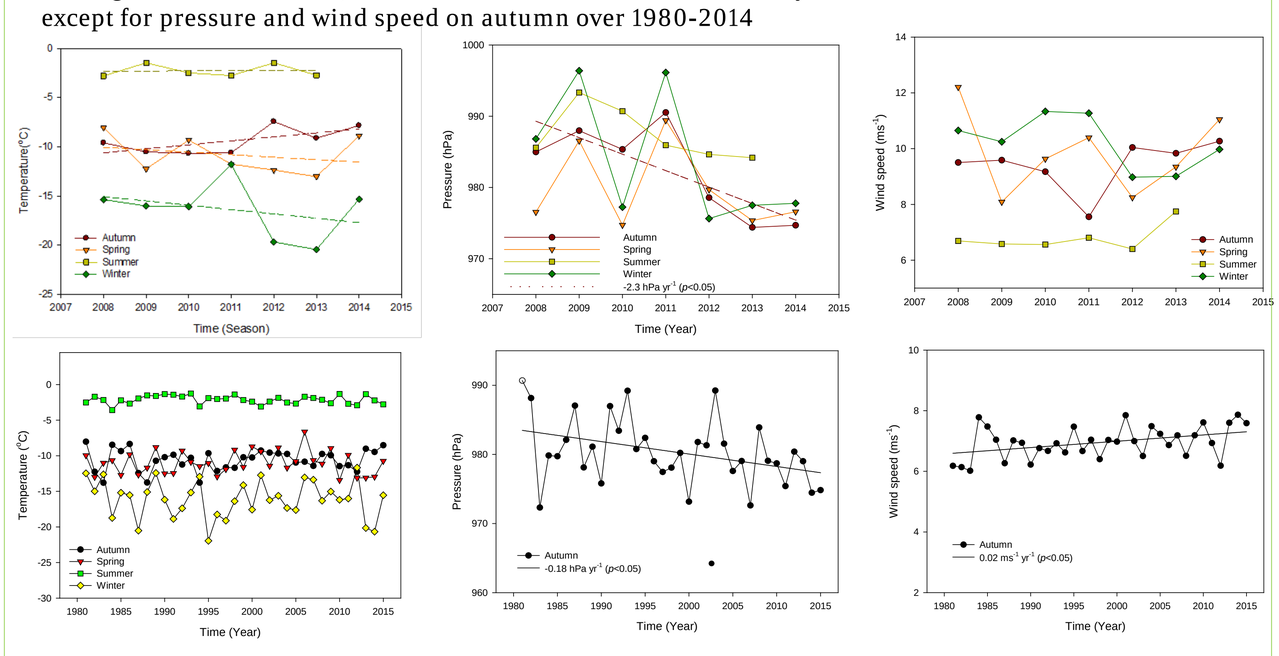
Intermittent small directional constancy at LI
Good relationship of DC between LI and BP with r = 0.83



2. Good correlation between temperature , pressure and wind speed at Linsey Is. and those from ERA-Interim



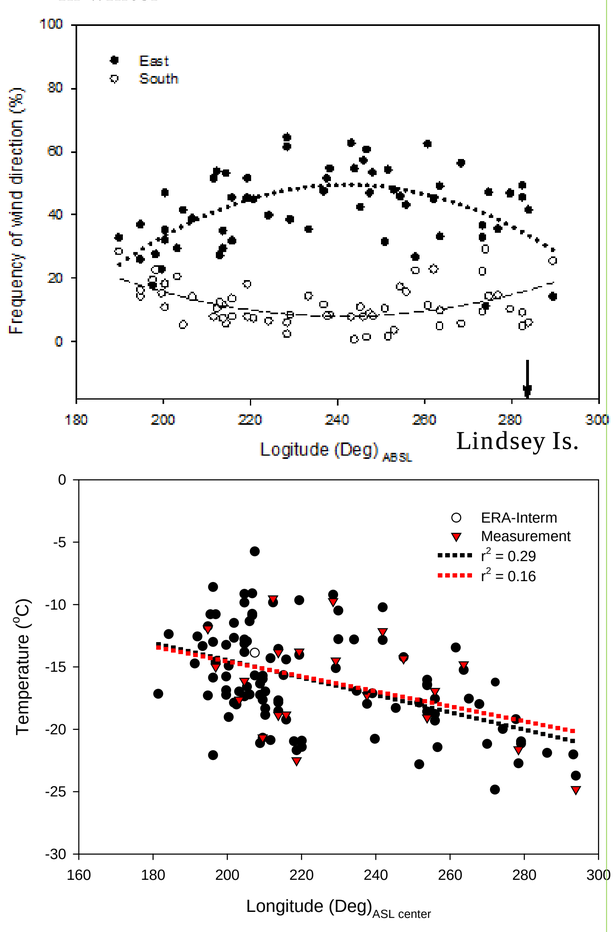
3. Not significant trends of T, P and WS over 2008-2014 from Lindsey Is. and 1980-2014 from ERM-Interim except for pressure and wind speed on autumn over 1980-2014



4. Correlation coefficients of temperature, pressure and wind speed among AWS's sites

Sites	Season	R_T	R_P	R_{WS}
Thurston Island	Autumn	**0.92**	**0.97**	0.49
	Winter	**0.89**	**0.97**	0.49
	Spring	**0.92**	**0.98**	0.47
	Summer	**0.89**	**0.99**	0.34
Evans Knoll	Autumn	**0.85**	**0.98**	0.44
	Winter	**0.89**	**0.98**	0.27
	Spring	**0.91**	**0.92**	0.23
	Summer	**0.83**	**0.99**	0.35
Bear Peninsula	Autumn	**0.82**	**0.94**	**0.83**
	Winter	**0.82**	**0.95**	**0.78**
	Spring	**0.88**	**0.94**	**0.68**
	Summer	**0.80**	**0.94**	**0.79**
Theresa	Autumn	0.61	0.48	0.24
	Winter	0.46	0.59	0.30
	Spring	0.69	0.58	0.27
	Summer	0.58	0.68	0.33
Byrd (Byrd station)	Autumn	0.57	0.66	0.36
	Winter	0.58	0.76	0.31
	Spring	0.72	0.70	0.50
	Summer	0.56	0.72	0.33

5. Wind direction change at Lindsey Is. with the ALS's location and its effect on temperature in winter



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