THE CLIMATOLOGY OF THE ROSS ICE SHELF, ANTARCTICA

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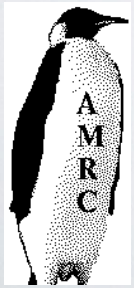
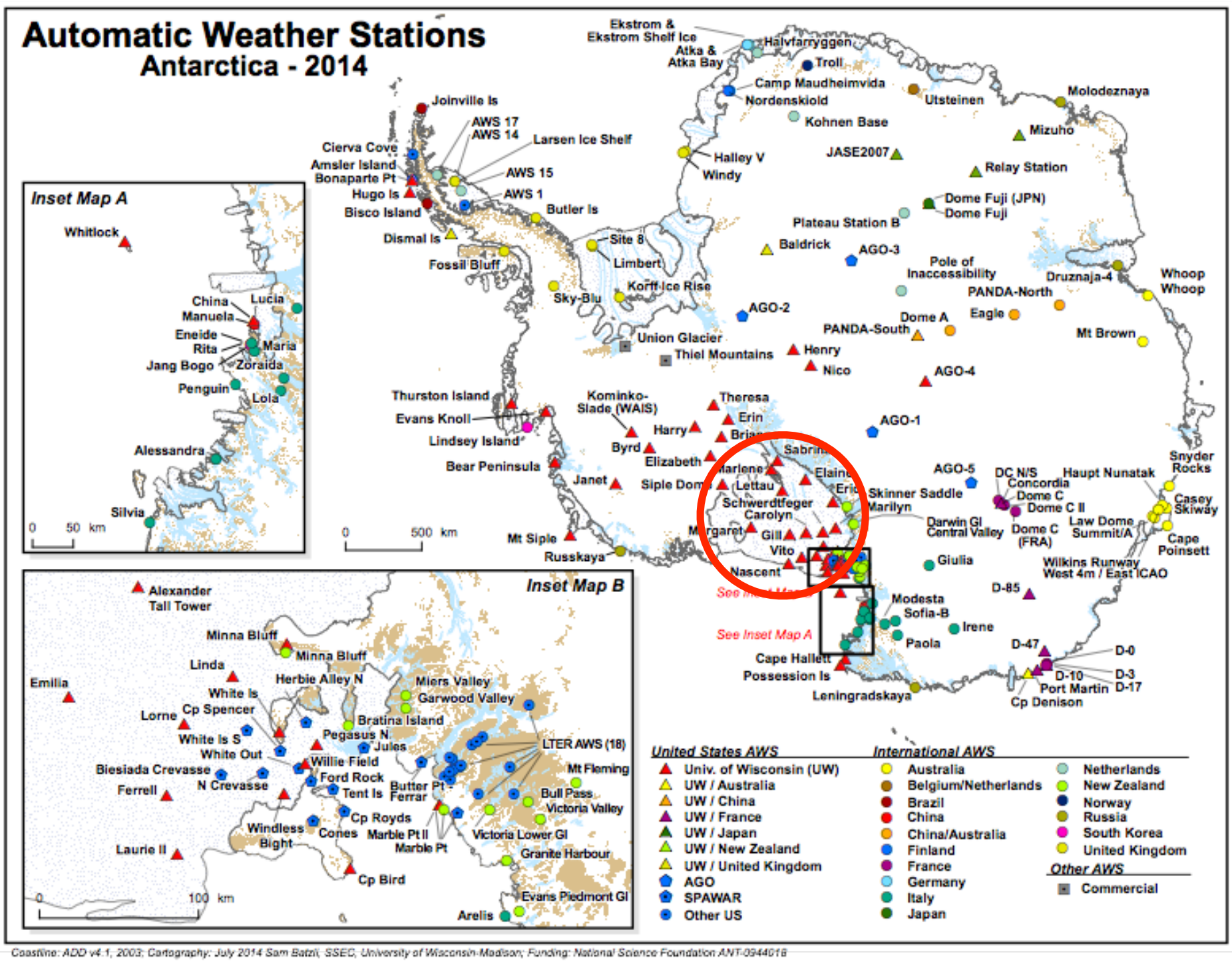


OUTLINE

- Motivation
- Data and Methods
- Discussion and General Conclusion of Climatology

Photo Courtesy of Carol Costanza



Coastline: ADD v4.1, 2003; Cartography: July 2014 Sam Batzli, SSEC, University of Wisconsin-Madison; Funding: National Science Foundation ANT-0944018

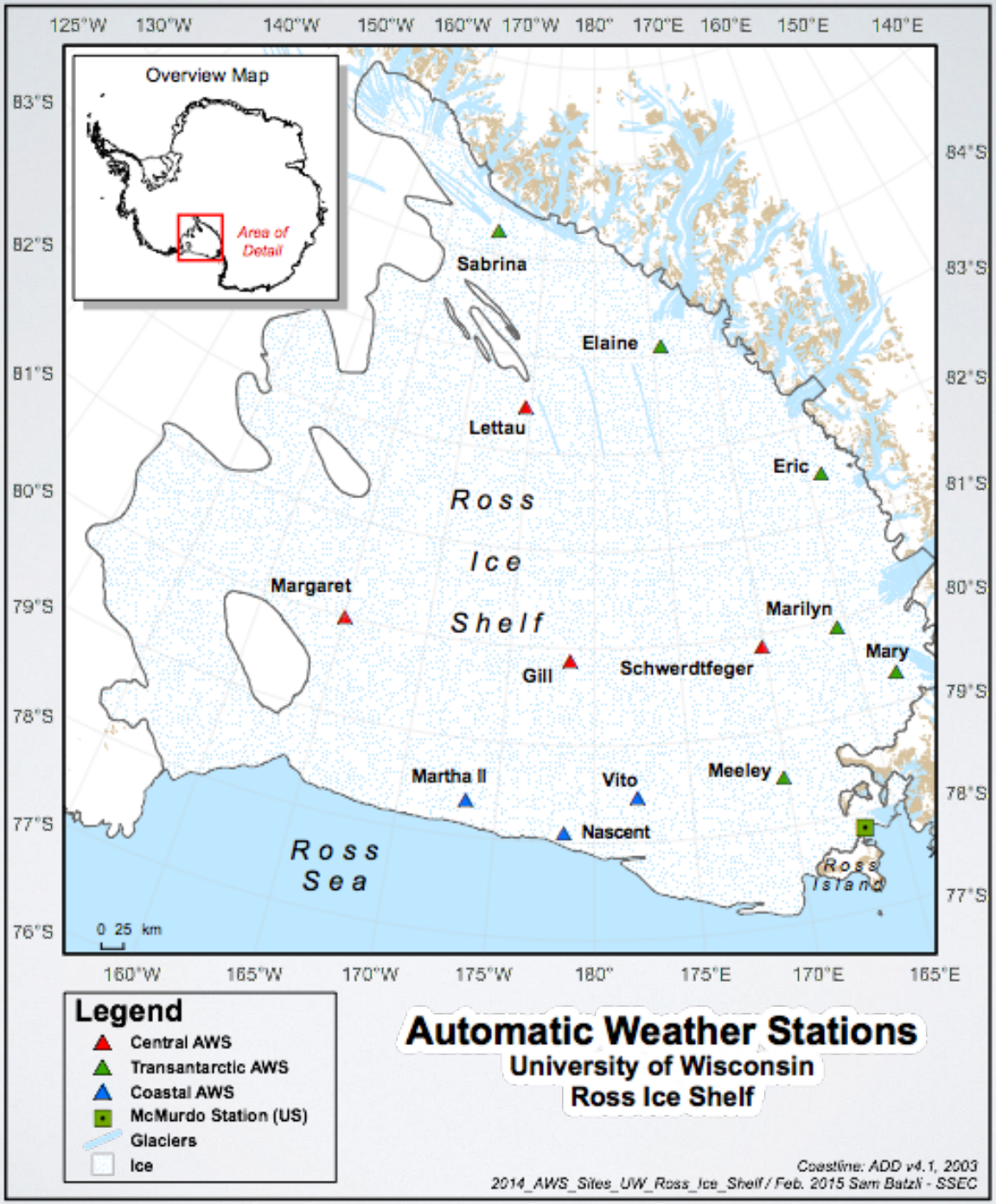
ROSS ICE SHELF CLIMATOLOGY STUDY: MOTIVATION

- AWS program installation started in 1980, therefore roughly 30 years of data available for climatology
- The *only* available dataset for surface climatology of the ice shelf is AWS data!
- Climatology of the entirety of the ice shelf using AWS data has yet to be completed…in progress
- Using temperature, pressure, and wind data from AWS to further our understanding of RIS atmospheric phenomena

Schwerdtfeger AWS 1985

DATA AND METHODS

- Mean parameters are calculated using 3-hourly observations and maximum and minimums are calculated using 10-minute observations
- Operational periods range from 5 to 30 years and periods of instrumentation error are evaluated
- Daily missing mean values are replaced with the long-term corresponding daily mean values if the number of days missing in a year is less than 60, otherwise the annual mean is eliminated from the the dataset.
- Seasonal means have threshold values of 40 (all winter periods) and 25 (all other seasons) missing values when the seasonal means are eliminated from the dataset
- The RIS is divided into 3 regions: (Transantarctic Mountains, Central, and Coastal)
- Seasons are divided: Spring(ON), Summer(DJ), Autumn(FM), Winter1 (AMJ), Winter2 (JAS)


Overview Map
Area of Detail
125°W 130°W 140°W 150°W 160°W 170°W 180° 170°E 160°E 150°E 140°E
83°S
82°S
81°S
80°S
79°S
78°S
77°S
76°S
84°S
83°S
82°S
81°S
80°S
79°S
78°S
77°S
Sabrina
Elaine
Lettau
Eric
Ross
Ice
Shelf
Margaret
Marilyn
Mary
Gill
Schwerdtfeger
Martha II
Vito
Meeley
Nascent
Ross
Sea
Ross
Island
0 25 km
160°W 165°W 170°W 175°W 180° 175°E 170°E 165°E
Legend
Central AWS
Transantarctic AWS
Coastal AWS
McMurdo Station (US)
Glaciers
Ice
Automatic Weather Stations
University of Wisconsin
Ross Ice Shelf
Coastline: ADD v4.1, 2003
2014_AWS_Sites_UW_Ross_Ice_Shelf / Feb. 2015 Sam Batzli - SSEC

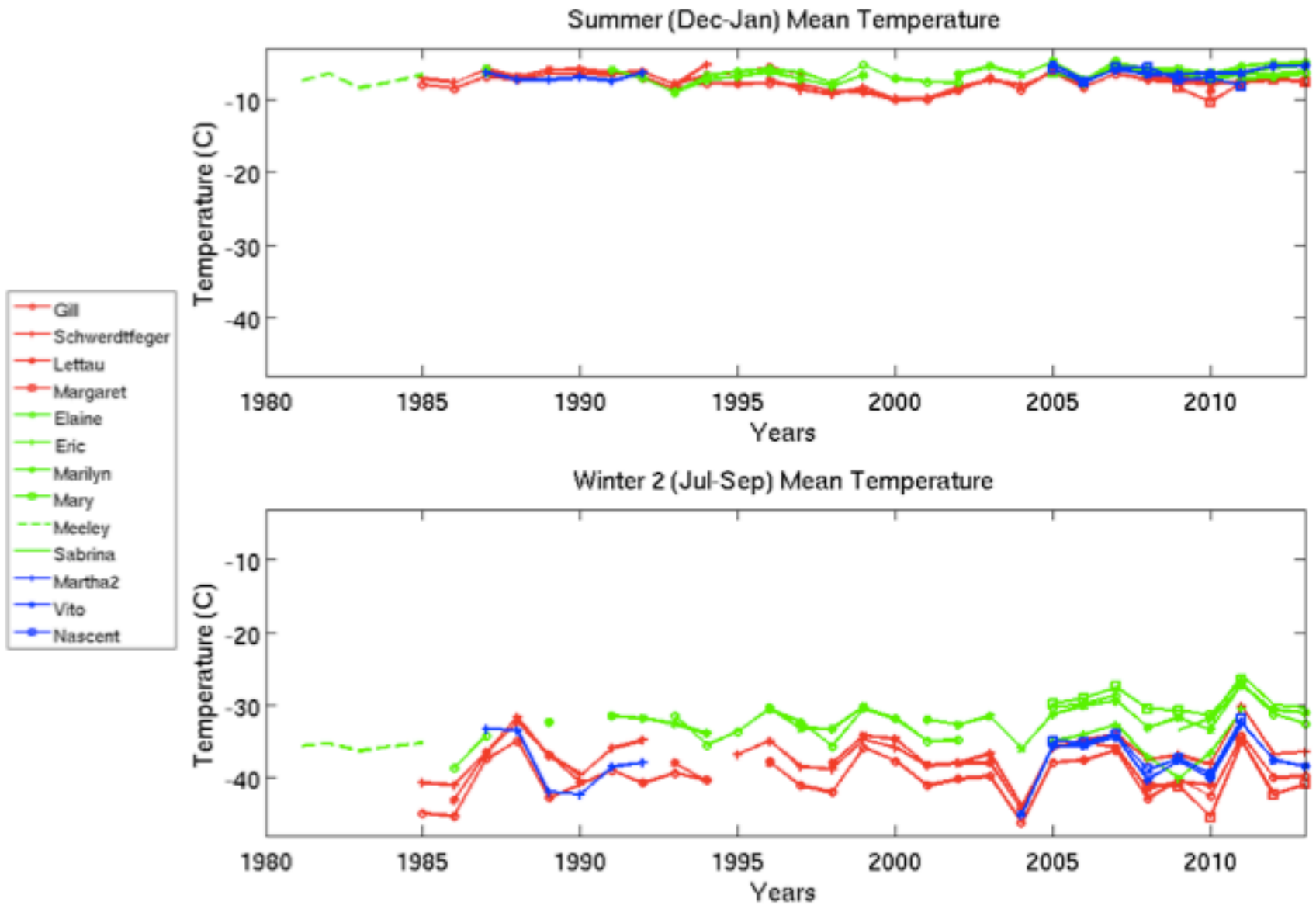
Station	Years	Total # Years
Gill	1985-2013	29
Lettau	1986-2011	26
Margaret	2009-2013	5
Schwerdtfeger	1985-2013	29
Elaine	1986-2013	28
Eric	2005-2013	9
Marilyn	1984-2013	30
Mary	2005-2011	7
Meeley	1980-1985	6
Sabrina	2009-2013	5
Martha II	1987-1992	6
Vito	2004-2013	10
Nascent	2004-2011	8

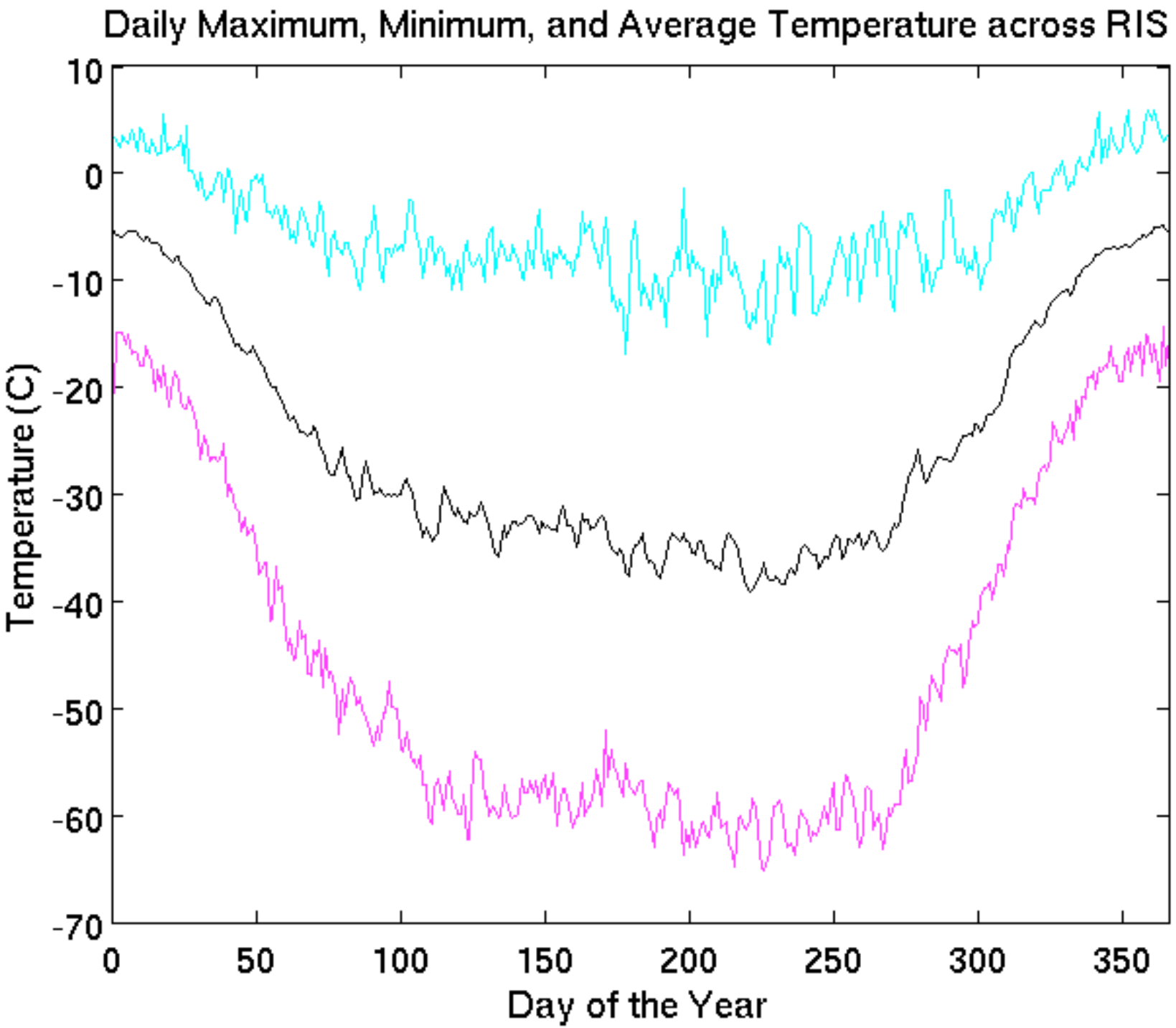
TEMPERATURE

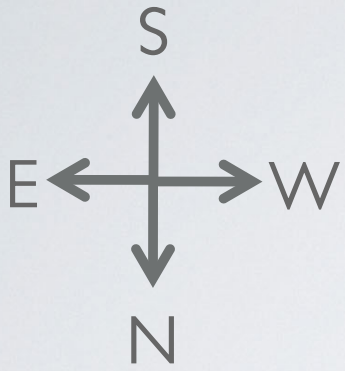
- Marilyn AWS **+0.9°C ± 0.6** per year
- Maximum 6.2**°C for 26 December 2011 at Schwerdtfeger AWS**
- Minimum **-65.4 °C** at Gill AWS 14 Aug. 2001

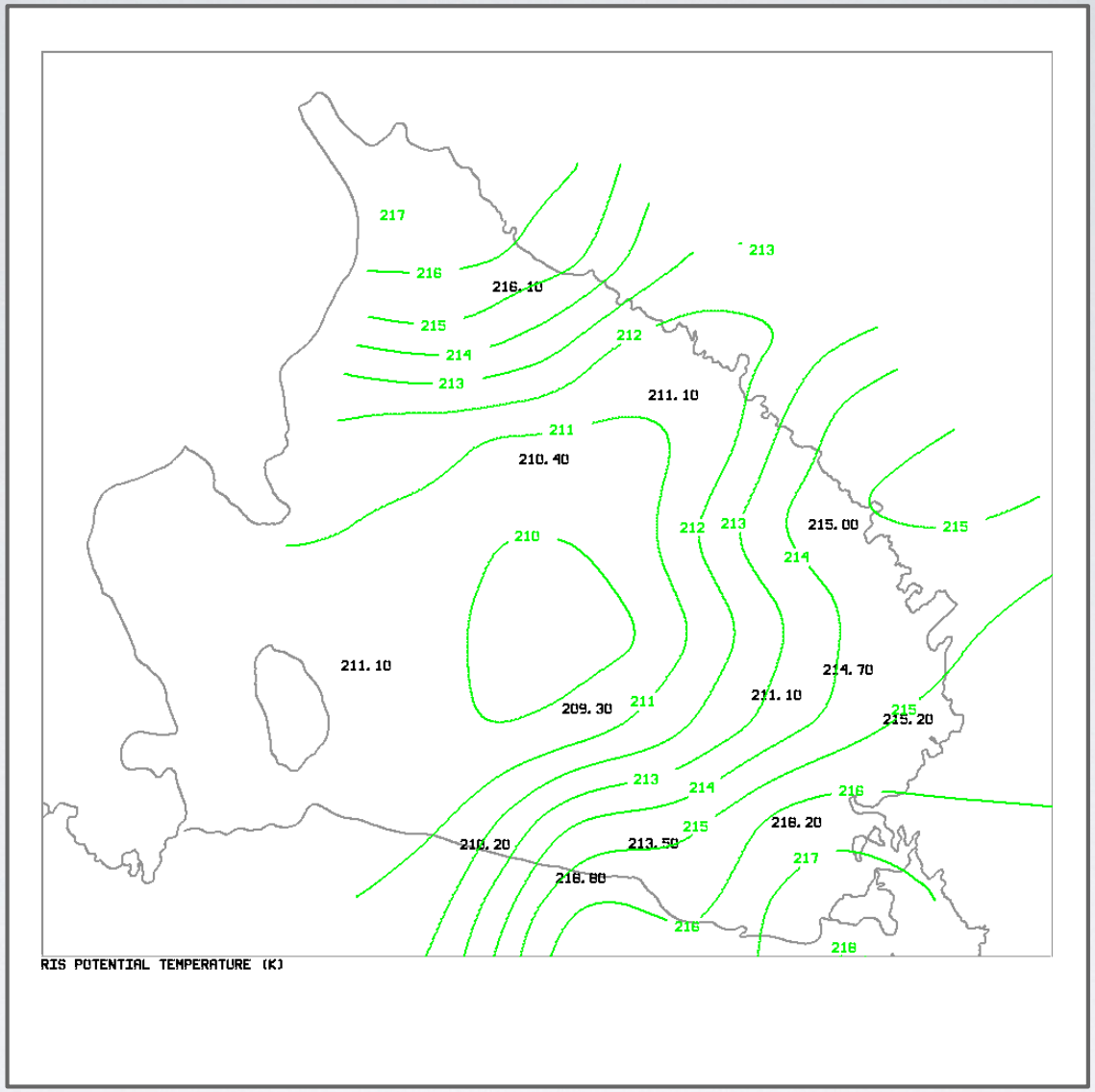
- Transantarctic: -23.1 °C
- Coastal: -26.1 °C
- Central: -27.1 °C

- Significantly correlated to **SAM** and **SAO**


Summer (Dec-Jan) Mean Temperature
Temperature (C)
-10
-20
-30
-40
1980
1985
1990
1995
2000
2005
2010
Years
Winter 2 (Jul-Sep) Mean Temperature
Temperature (C)
-10
-20
-30
-40
1980
1985
1990
1995
2000
2005
2010
Years
Gill
Schwerdtfeger
Lettau
Margaret
Elaine
Eric
Marilyn
Mary
Meeley
Sabrina
Martha2
Vito
Nascent


Daily Maximum, Minimum, and Average Temperature across RIS
Temperature (C)
10
0
-10
-20
-30
-40
-50
-60
-70
0
50
100
150
200
250
300
350
Day of the Year





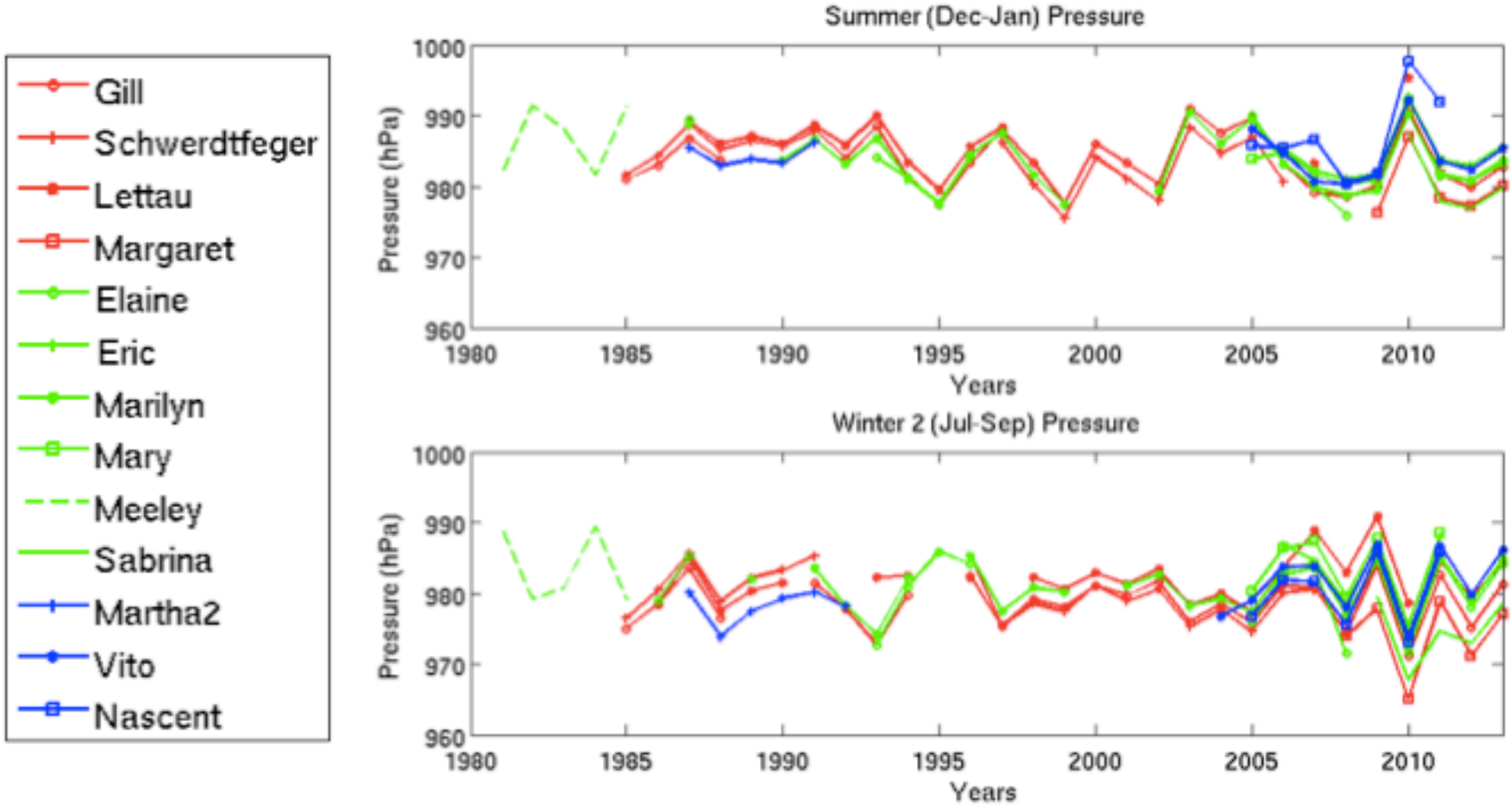
Potential Temperature ***possibly*** lowest in the world with a minimum of 209.3 K at Gill AWS on 19 May 2000 (Theta=-65.1 °C and P=979.3 mb)

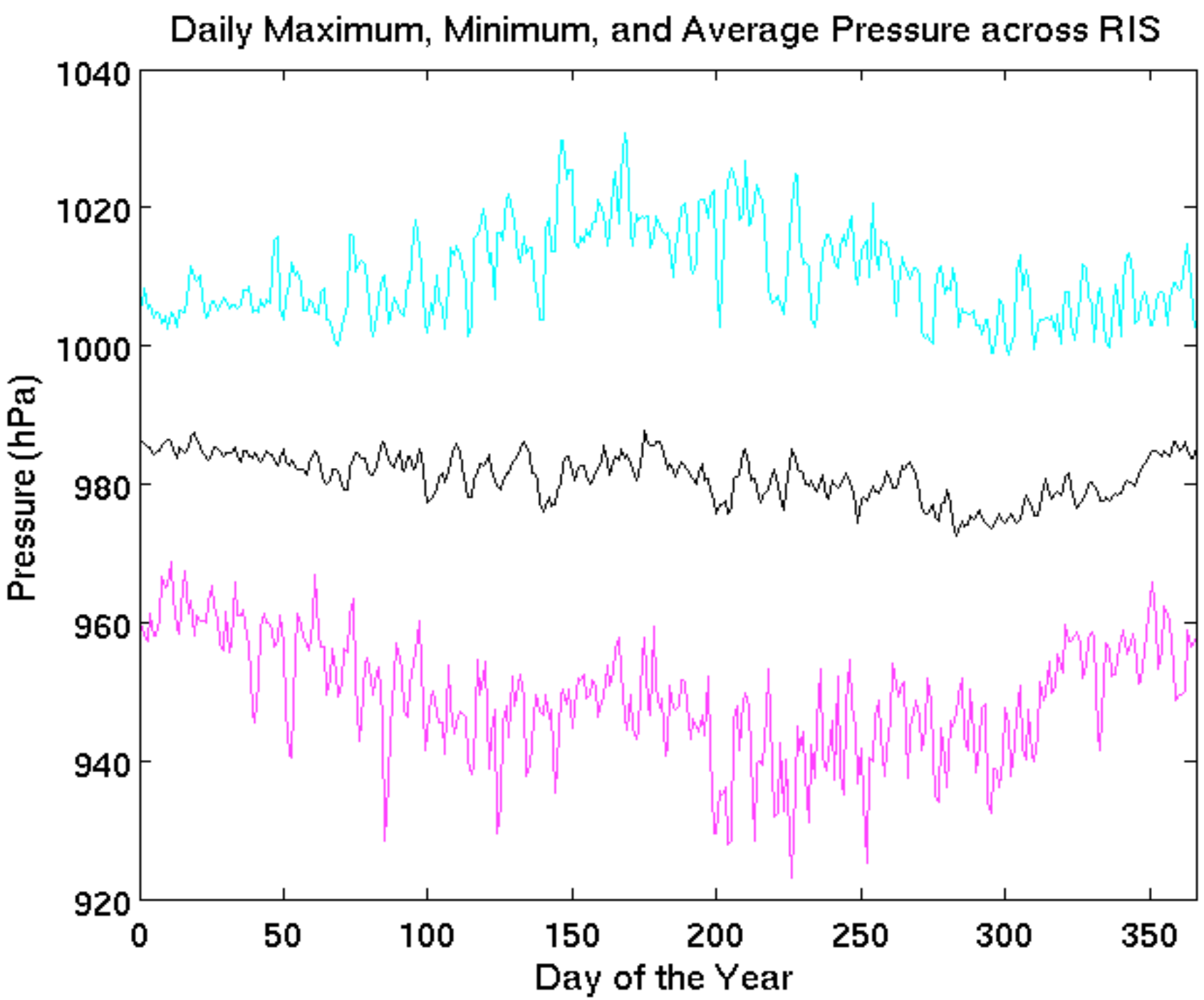
PRESSURE

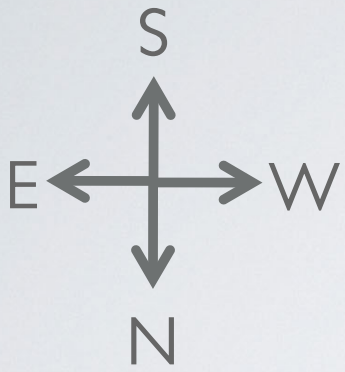
- Gill AWS and Schwerdtfeger AWS significant pressure decresases???
- Maximum 1030.8 hPa at Elaine AWS 17 June 1999
- Minimum 922.0 hPa at Gill AWS 13 August 2007

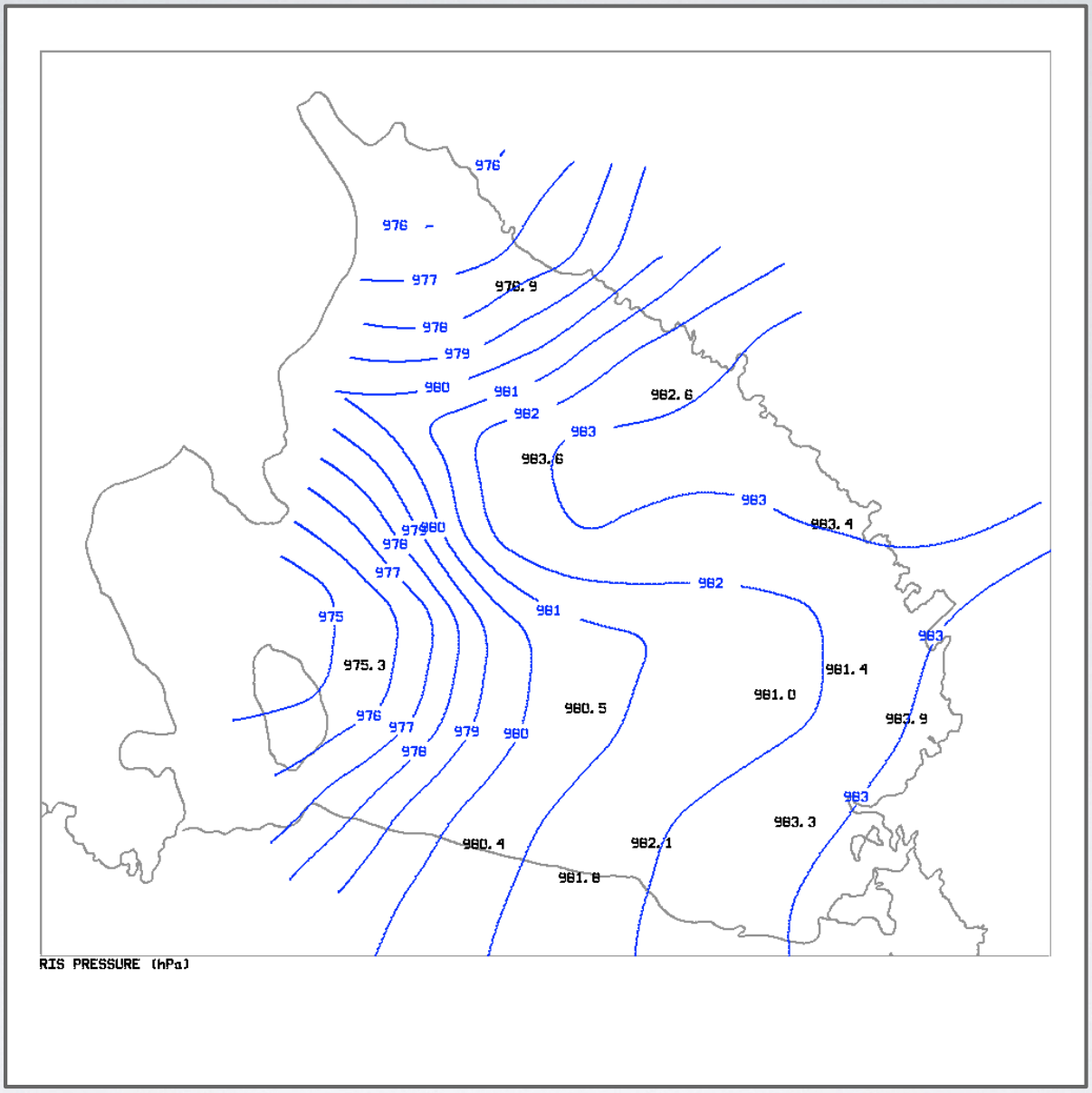
- Transantarctic: 982.1 mb
- Coastal: 981.5 mb
- Central: 981.1 mb

- Significantly correlated to SAM, SAO, and MEI


Gill
Schwerdtfeger
Lettau
Margaret
Elaine
Eric
Marilyn
Mary
Meeley
Sabrina
Martha2
Vito
Nascent
Summer (Dec-Jan) Pressure
Pressure (hPa)
1000
990
980
970
960
1980
1985
1990
1995
2000
2005
2010
Years
Winter 2 (Jul-Sep) Pressure
Pressure (hPa)
1000
990
980
970
960
1980
1985
1990
1995
2000
2005
2010
Years


Daily Maximum, Minimum, and Average Pressure across RIS
Pressure (hPa)
1040
1020
1000
980
960
940
920
0
50
100
150
200
250
300
350
Day of the Year



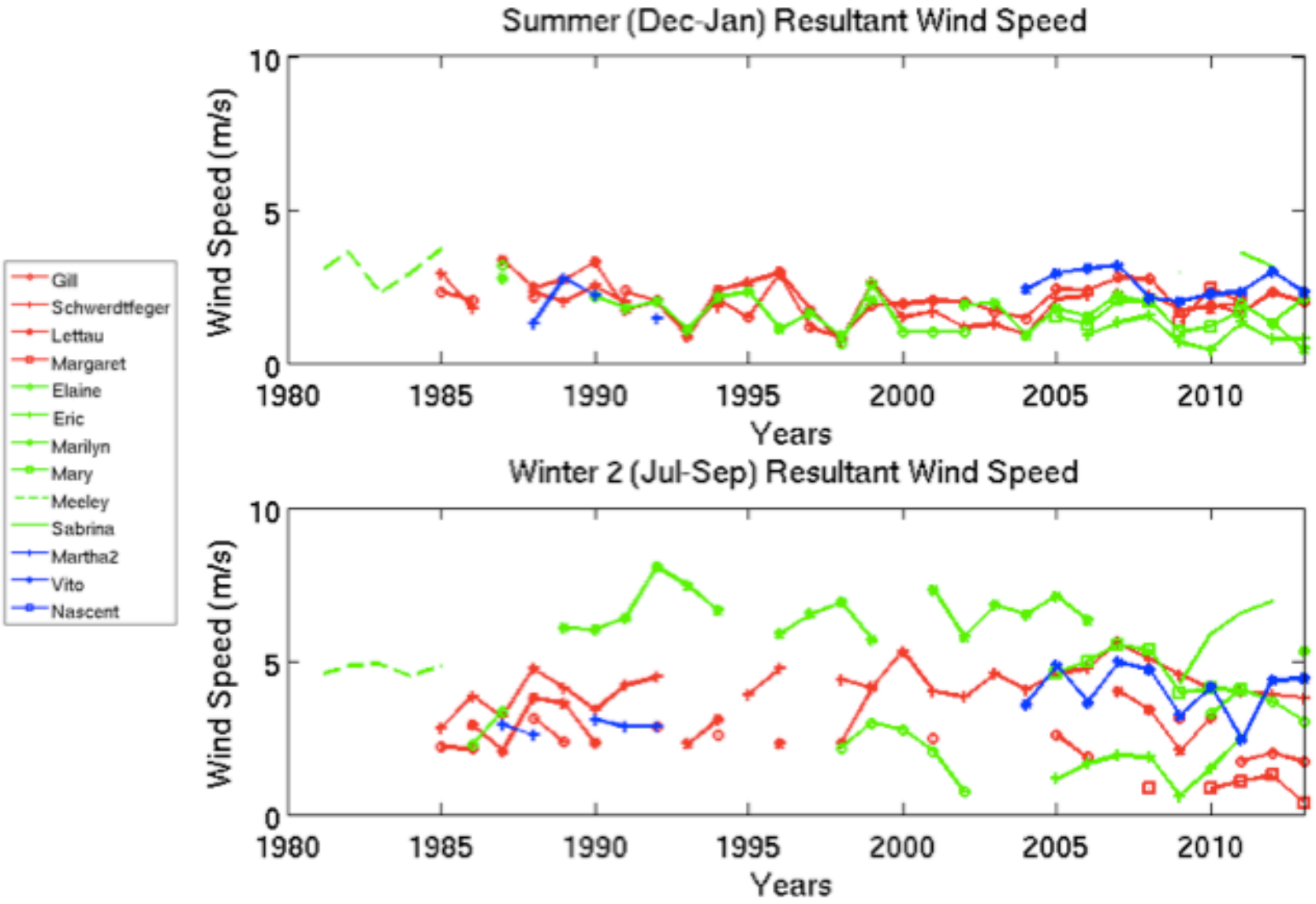


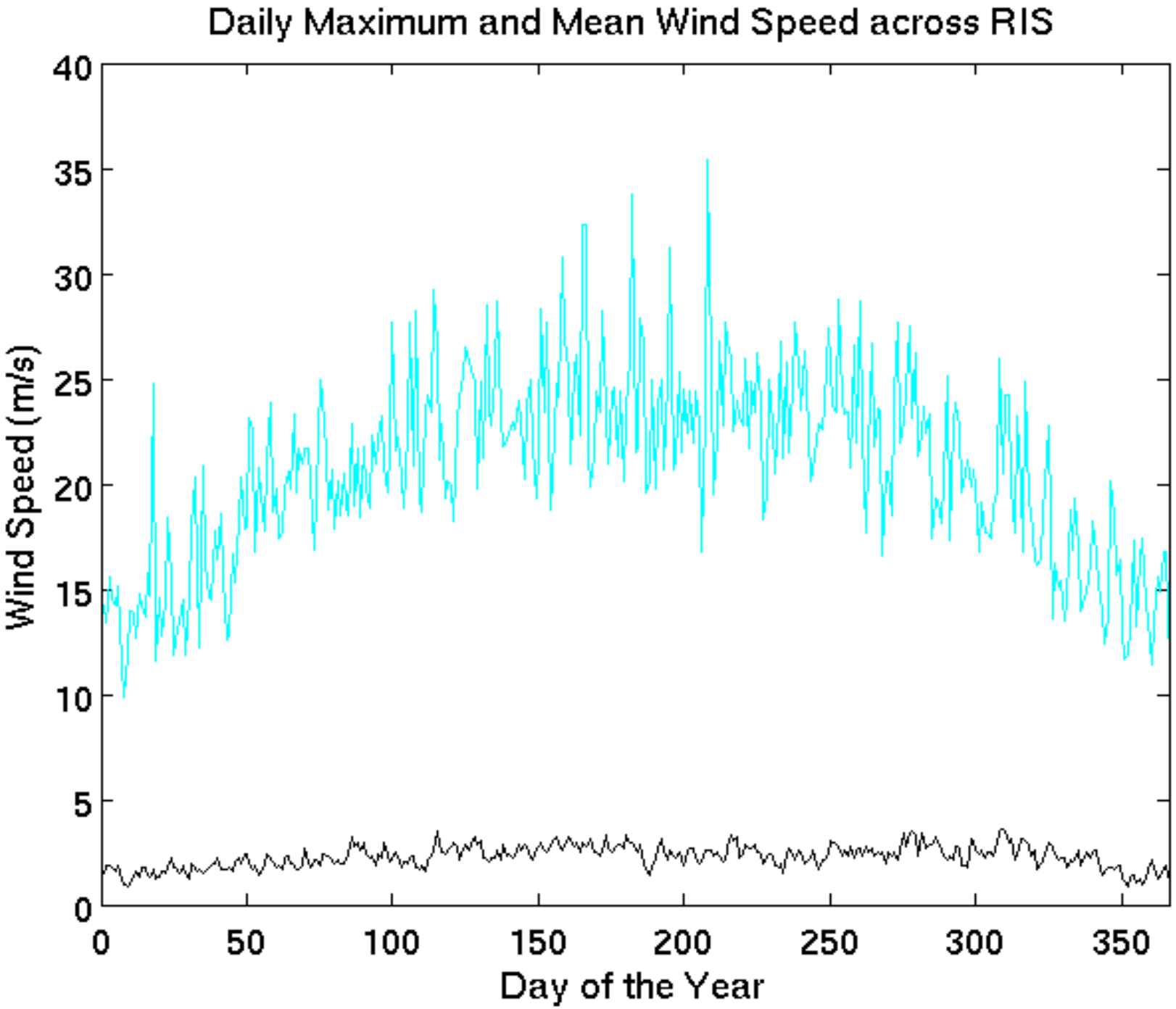
North - South orientation of eastern RIS with a west to east decrease in pressure due to flow over the mountains

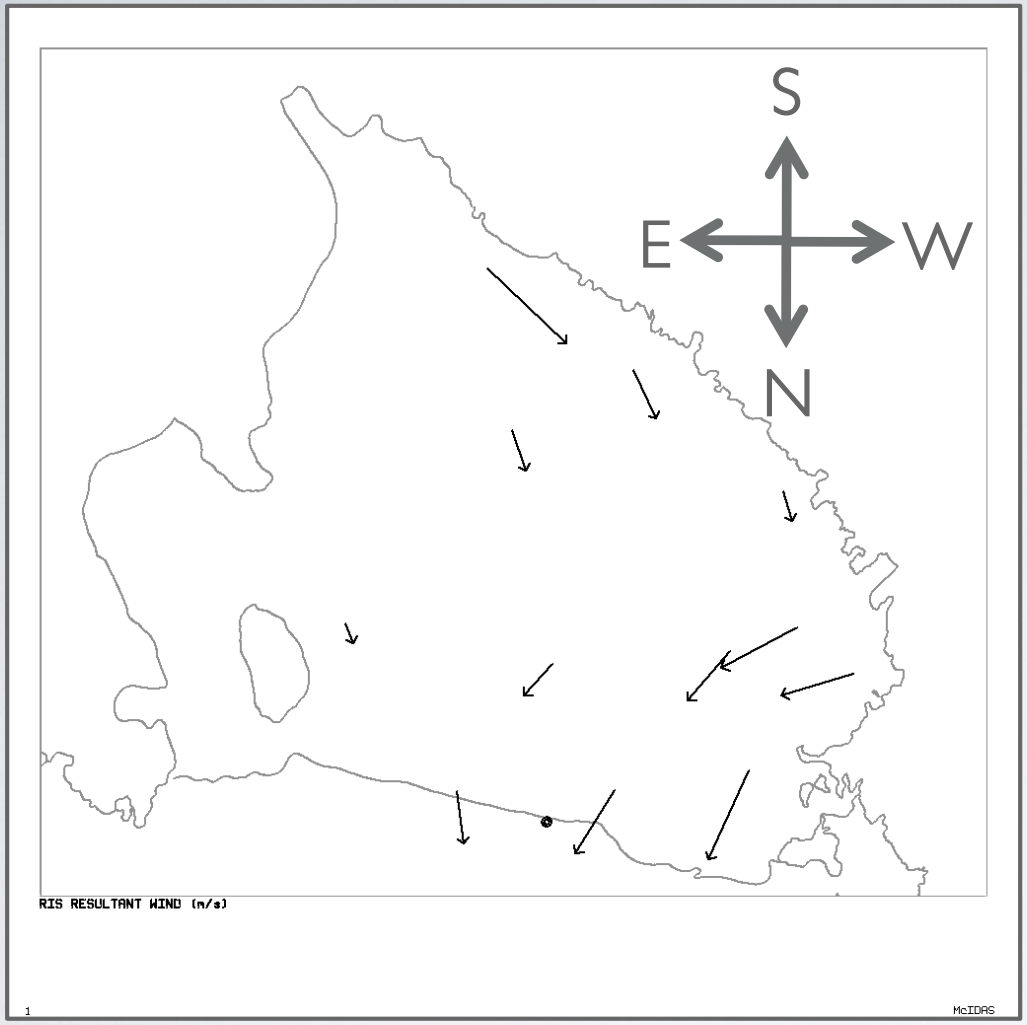
WIND SPEED

- Schwerdtfeger resultant wind speed increase???
- Maximum 35.4 m/s at Sabrina AWS on 27 July 2011
- Most difficult parameter!

- Transantarctic: Resultant: 3.4 m/s; Scalar: 5.1 m/s
- Coastal: Resultant: 2.7 m/s; Scalar: 4.4 m/s
- Central: Resultant: 2.2 m/s; Scalar: 4.1 m/s

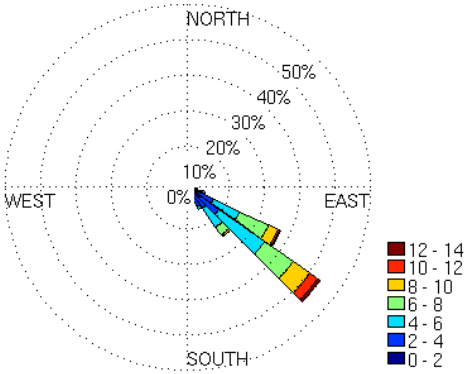

Summer (Dec-Jan) Resultant Wind Speed
Wind Speed (m/s)
10
5
0
1980
1985
1990
1995
2000
2005
2010
Years
Winter 2 (Jul-Sep) Resultant Wind Speed
Wind Speed (m/s)
10
5
0
1980
1985
1990
1995
2000
2005
2010
Years
Gill
Schwerdtfeger
Lettau
Margaret
Elaine
Eric
Marilyn
Mary
Meeley
Sabrina
Martha2
Vito
Nascent


Daily Maximum and Mean Wind Speed across RIS
Wind Speed (m/s)
Day of the Year
0
5
10
15
20
25
30
35
40
0
50
100
150
200
250
300
350

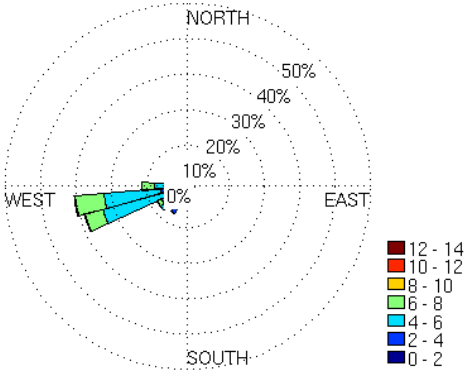


Winds are generally directed from the south with higher winds speeds in the northwest region of the RIS

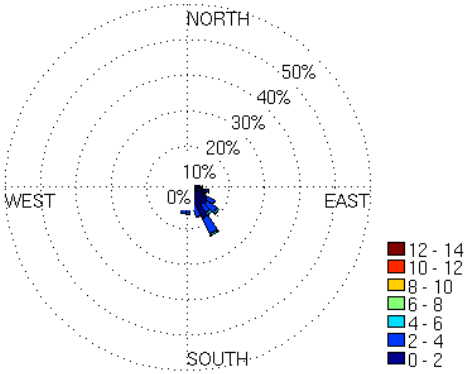
Resultant Wind Speed and Direction Sabrina AWS



Resultant Wind Speed and Direction Marilyn AWS



Resultant Wind Speed and Direction Margaret AWS



ADDITIONAL NOTES

- AWS Horizontal Movement (~0.5 km per year) and Net Accumulation (~0.3 m per year)
- Station malfunction during winter months and changes in hardware create data voids in seasonal and annual means
- Maintenance every few years always creates difficulties in perfectly consistent datasets

CONCLUSIONS

- Marilyn AWS warming 0.9°C ± 0.6 will prompt further studies at Marilyn AWS when there are 30-50 years available
- Central RIS AWS (red) experience the coldest mean temperature, the lowest mean pressure, and lowest resultant wind speed
- Transantarctic Mountain RIS AWS (green) experience the warmest mean temperature, the highest mean pressure, and the highest wind speed
- Climatology will provide valuable information for weather forecasters, Antarctic researchers, and future logistics planning

THANK YOU!
QUESTIONS?

Matthew Lazzara at Windless Bight AWS

2014-2015 AWS Field Team:
David Mikolajczyk, Lee Welhouse, Carol Costanza, Elin McIlhattan, and Drew Slater (inset)

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