

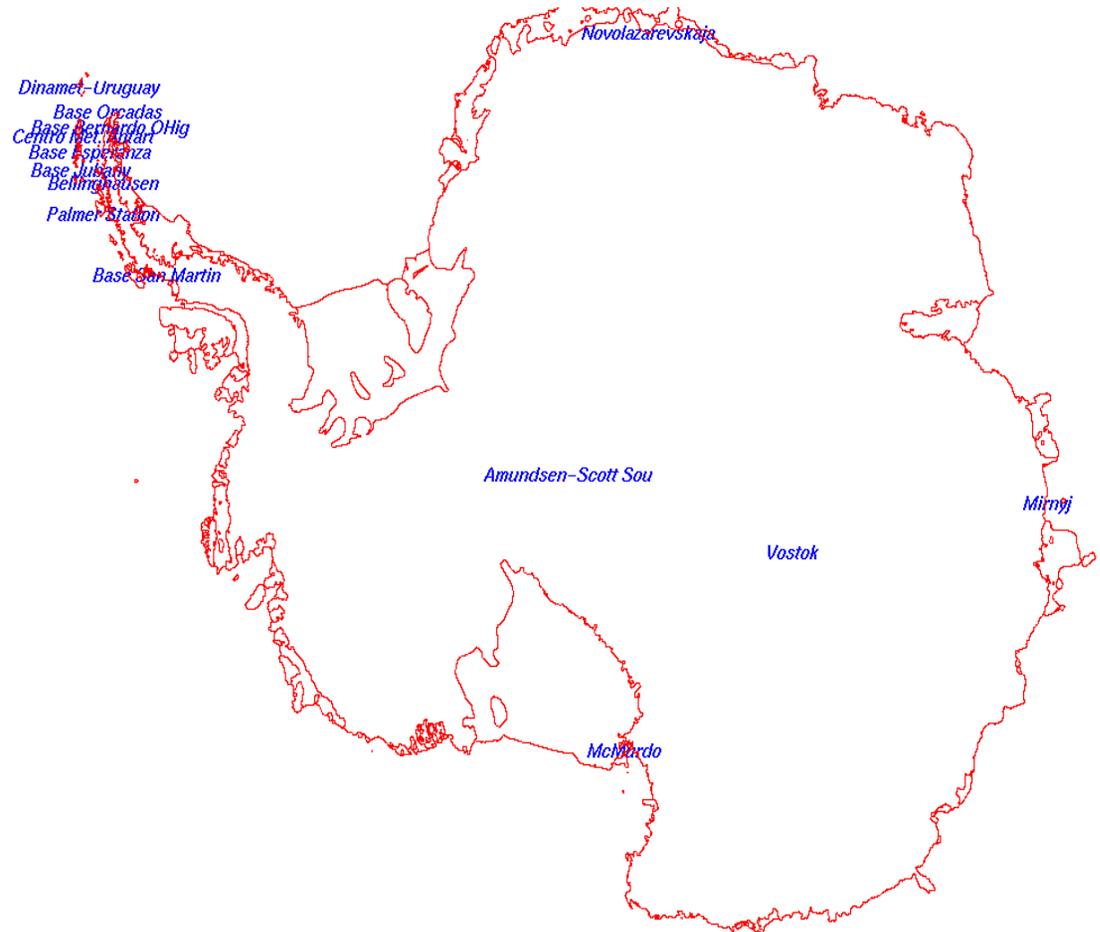
Estimation of Snow Accumulation in Antarctica Using Automated Acoustic Depth Gauge Measurements

Shelley L. Knuth, G.J. Tripoli, J.E. Thom, G.A.
Weidner, and C.R. Stearns

Automatic Weather Stations Project
University of Wisconsin

Motivation

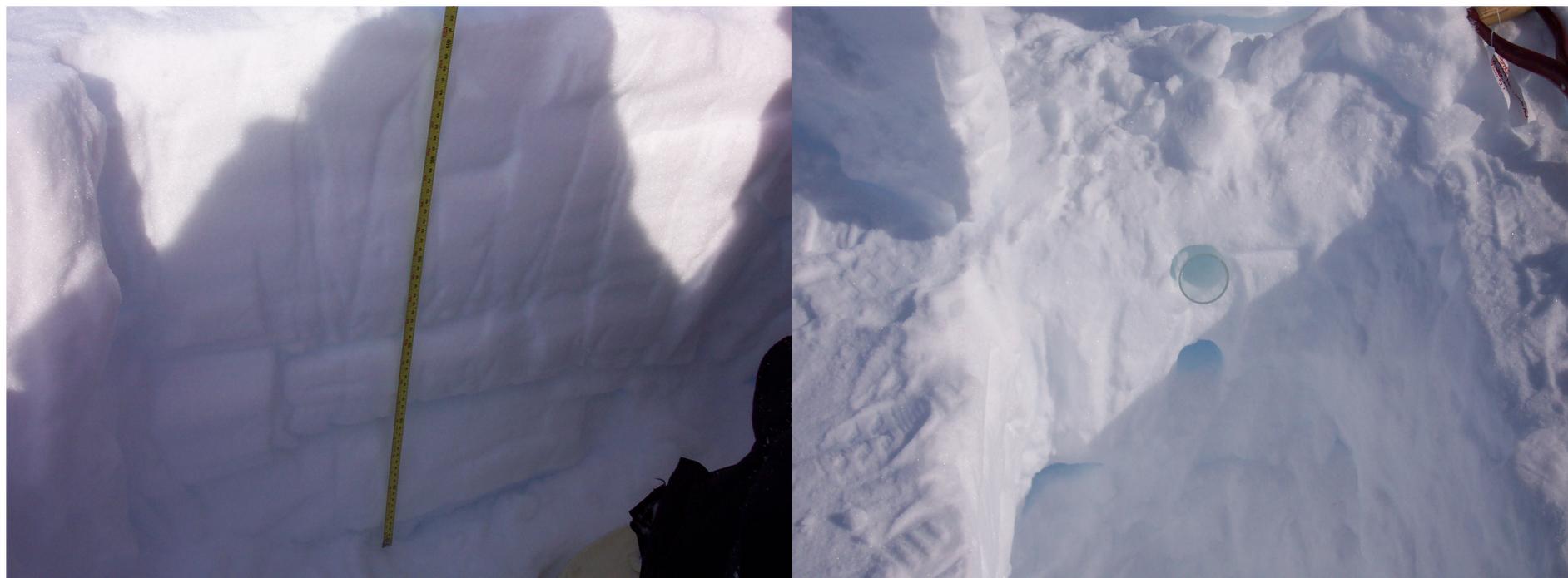
- Extreme weather – AWS monitoring
- No precipitation
- Very few observations
- Need monitoring network
- First – snow depth change and causes



Purpose

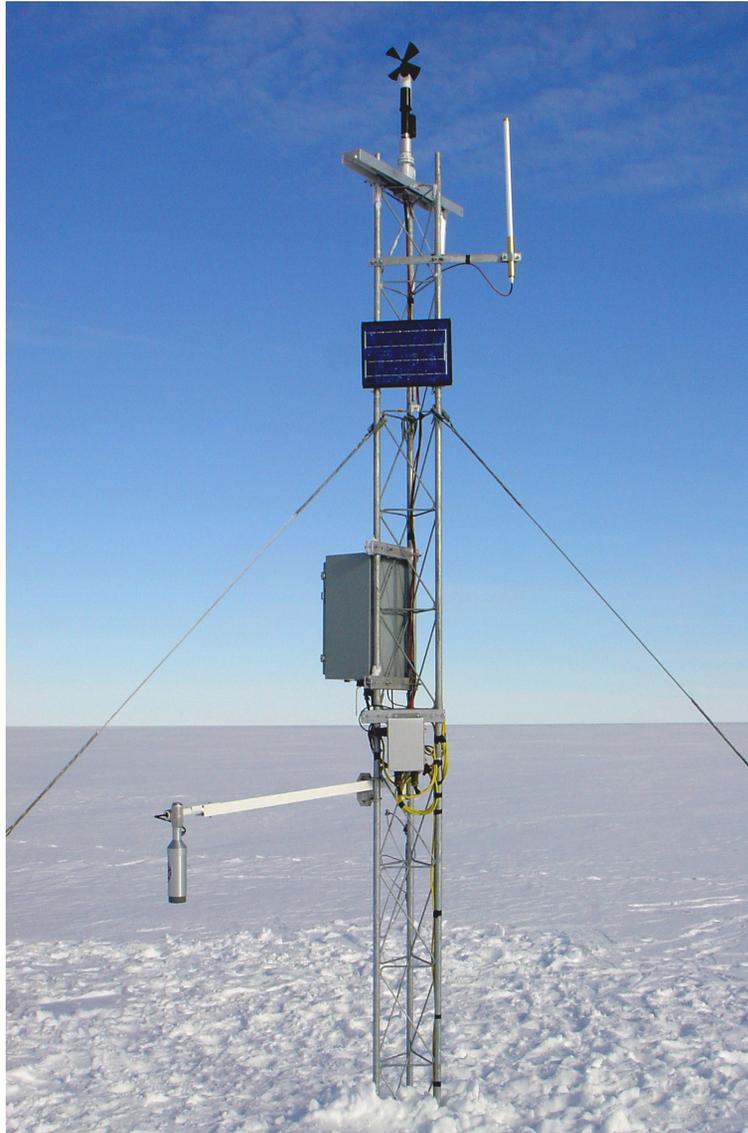
- End goal is to quantify precipitation in Antarctica
 - Data assimilation of all Antarctic observations into the University of Wisconsin-Nonhydrostatic Modeling System (UW-NMS)
- Currently focus is snow depth change
 - Meteorological Causes
 - Blowing snow and precipitation
 - Topographical influences
 - Comparison to model results

Project Details



- Strategic placement of ADGs
- 8 ADG sites
- Snow density measurements
- Visual stratigraphy
- Comparison to AWS data

Instrumentation



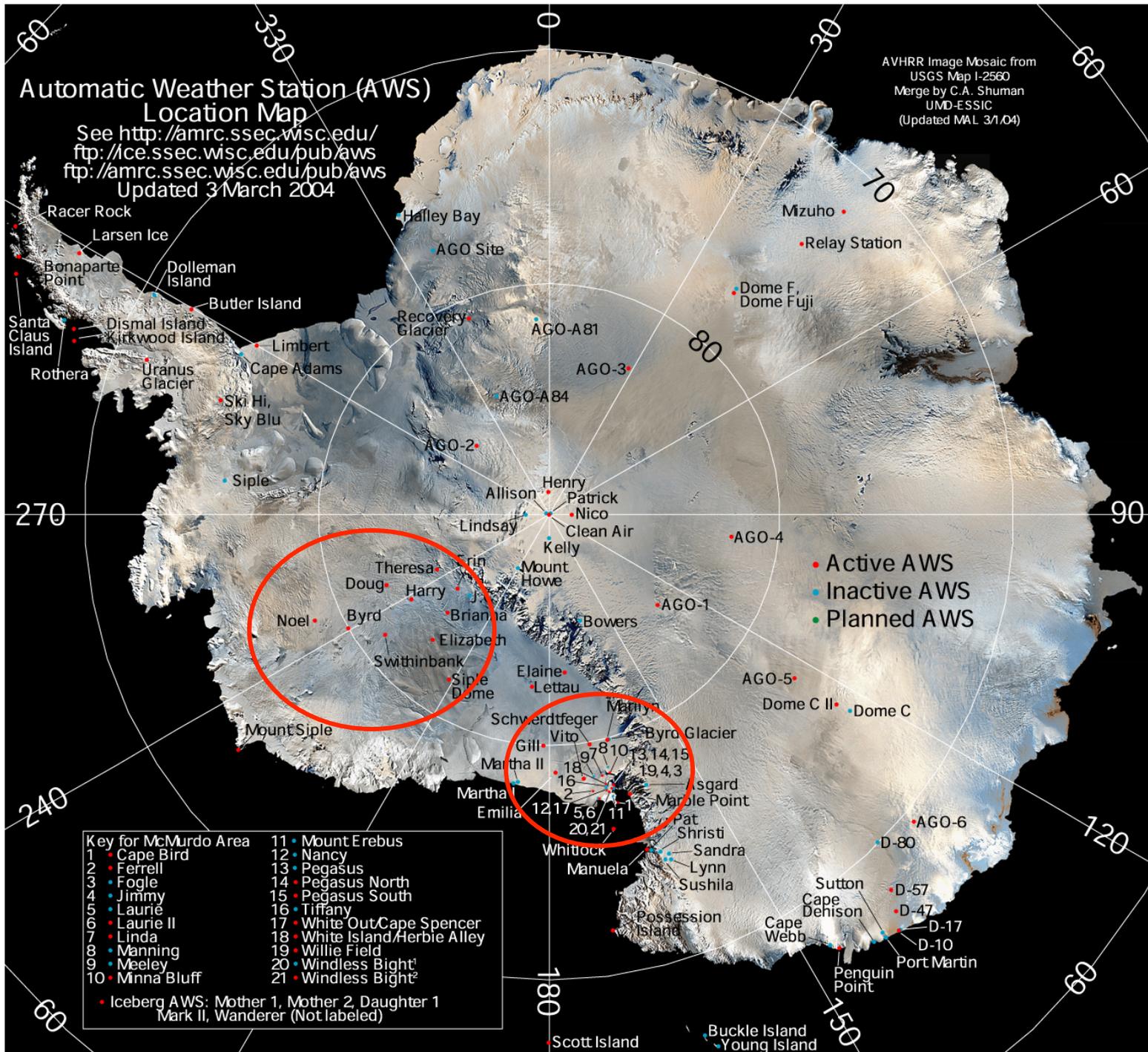
- AWS
 - Low power consumption
 - Basic meteorological measurements
 - Project in operation since 1980
- ADG
 - SR50
 - ARGOS
 - 8 sites



Automatic Weather Station (AWS) Location Map

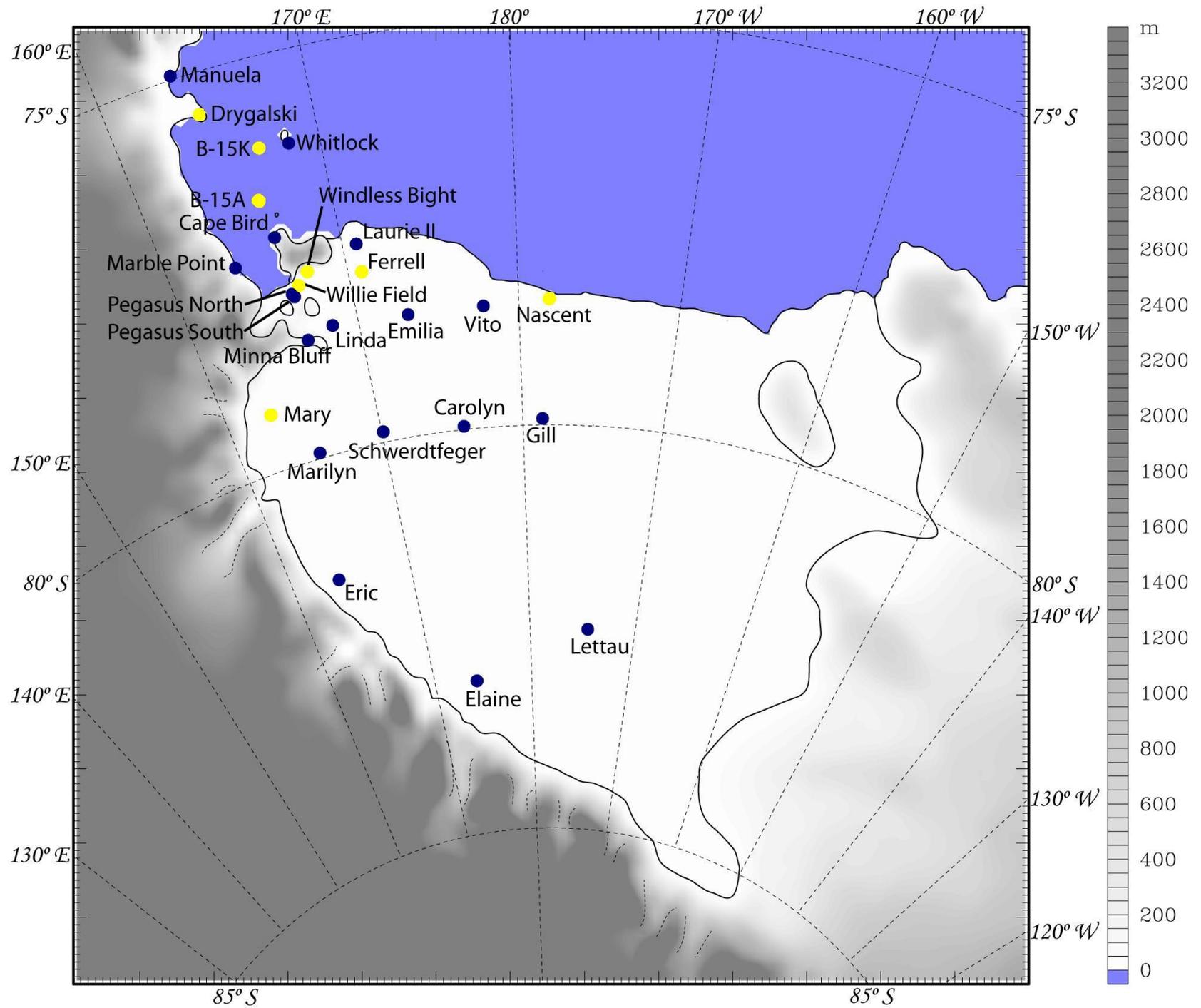
See <http://amrc.ssec.wisc.edu/>
<ftp://ice.ssec.wisc.edu/pub/aws>
<ftp://amrc.ssec.wisc.edu/pub/aws>
 Updated 3 March 2004

AVHRR Image Mosaic from
 USGS Map I-2560
 Merge by C. A. Shuman
 UMD-ESSIC
 (Updated MAL 3/1/04)



- | Key for McMurdo Area | |
|----------------------|-----------------------------|
| 1 | Cape Bird |
| 2 | Ferrell |
| 3 | Fogle |
| 4 | Jimmy |
| 5 | Laurie |
| 6 | Laurie II |
| 7 | Linda |
| 8 | Manning |
| 9 | Meeley |
| 10 | Minna Bluff |
| 11 | Mount Erebus |
| 12 | Nancy |
| 13 | Pegasus |
| 14 | Pegasus North |
| 15 | Pegasus South |
| 16 | Tiffany |
| 17 | White Out/Cape Spencer |
| 18 | White Island/Herbie Alley |
| 19 | Willie Field |
| 20 | Windless Bight ¹ |
| 21 | Windless Bight ² |
- Iceberg AWS: Mother 1, Mother 2, Daughter 1, Mark II, Wanderer (Not labeled)

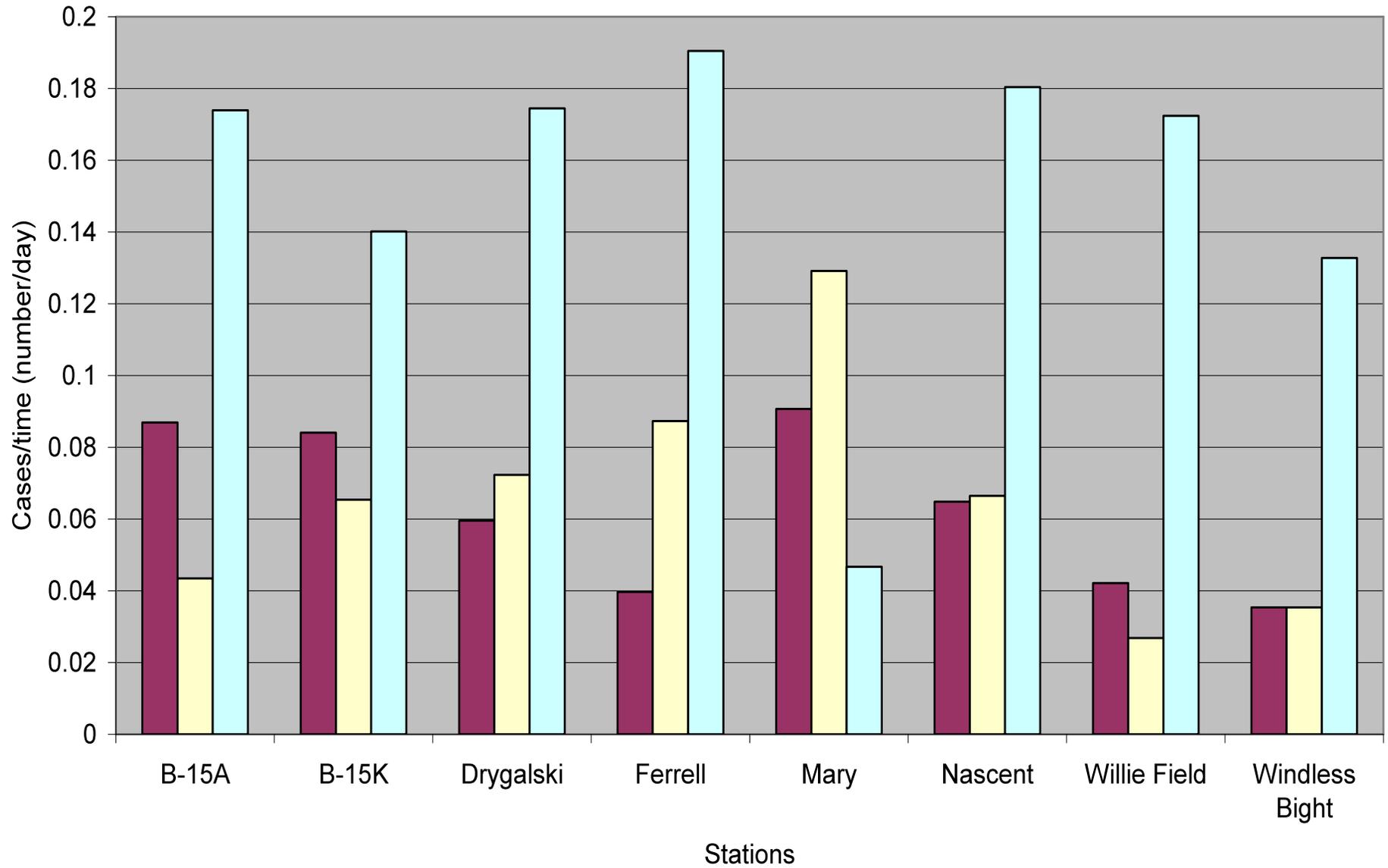
- Active AWS
- Inactive AWS
- Planned AWS



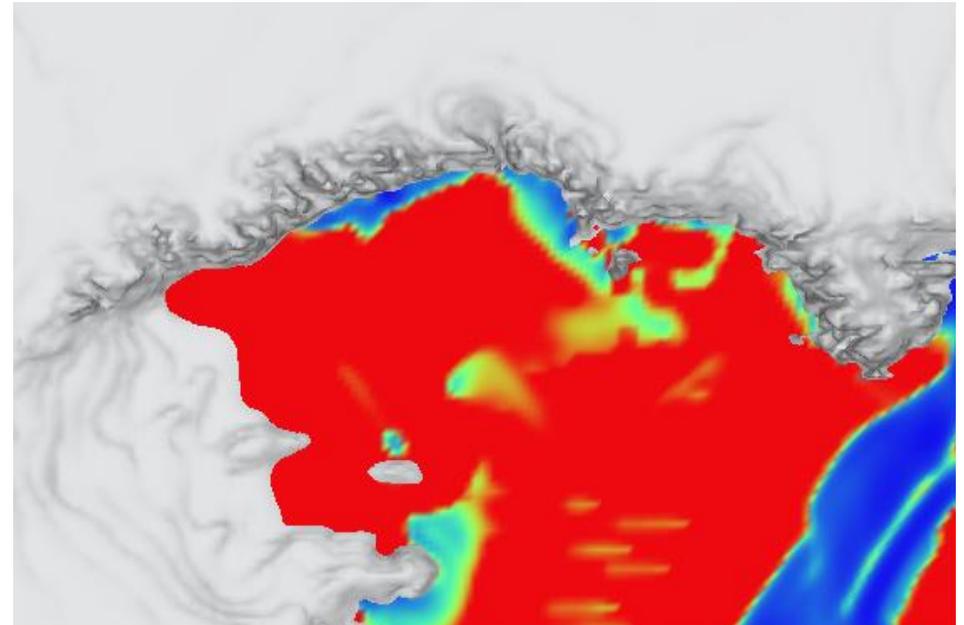
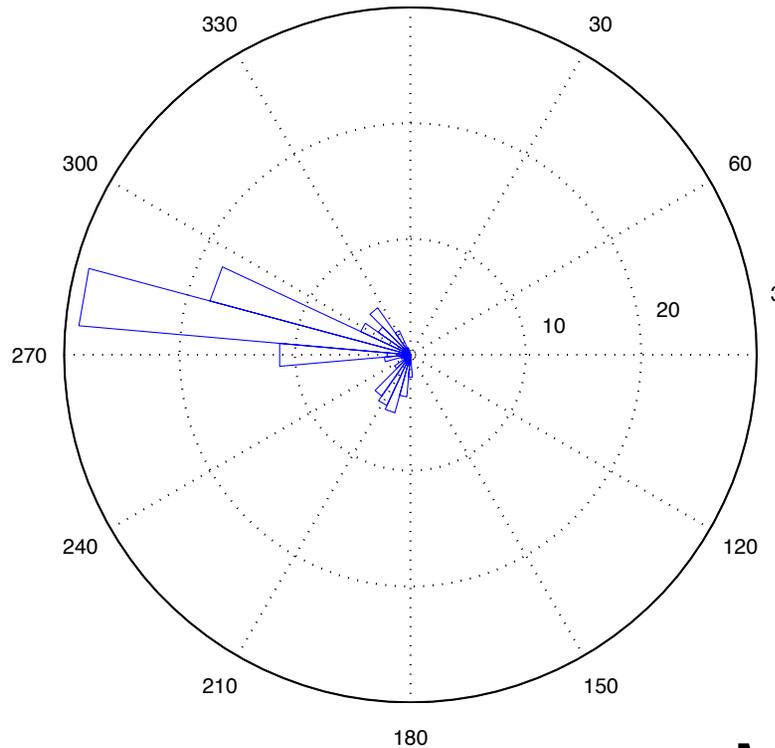
ADG Data Analysis

- Data from 2004-2006
- Depth change events identified (750 in all)
- Five categories
 - Undetermined
 - Unexpected
 - Blowing snow
 - Precipitation
 - Combined (Blowing snow and precipitation)
- Blowing snow threshold
- Constant relative humidity
- Further analysis for each station for each case

Known Cases Per Time by Type

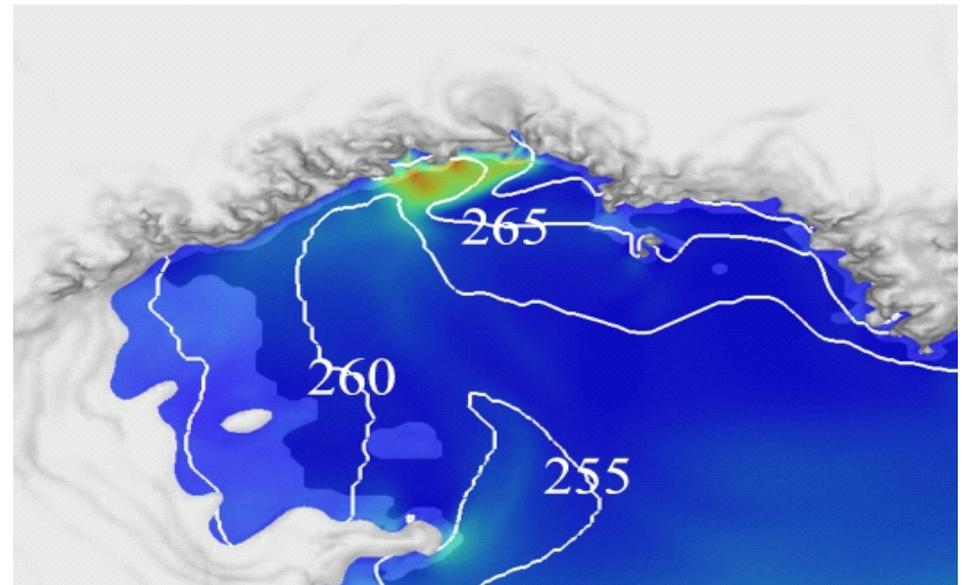


Blowing Snow Blowing Snow and Precipitation Precipitation

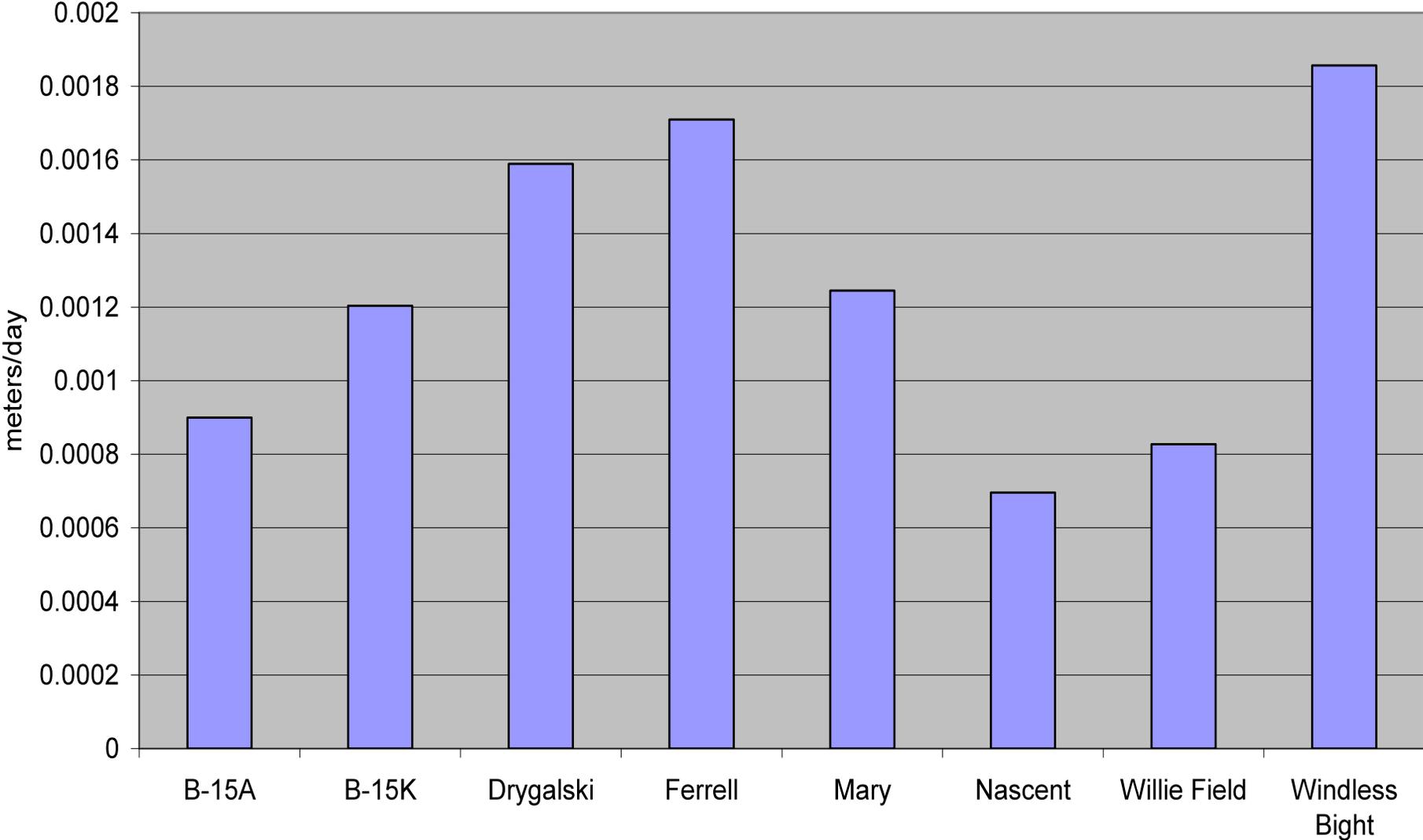


Mary Site

- Base of Transantarctics
- Net accumulation lower (B offsetting P)
- Orographic precipitation
- Katabatic wind flow
- Wave of energy (Adams, 2004)

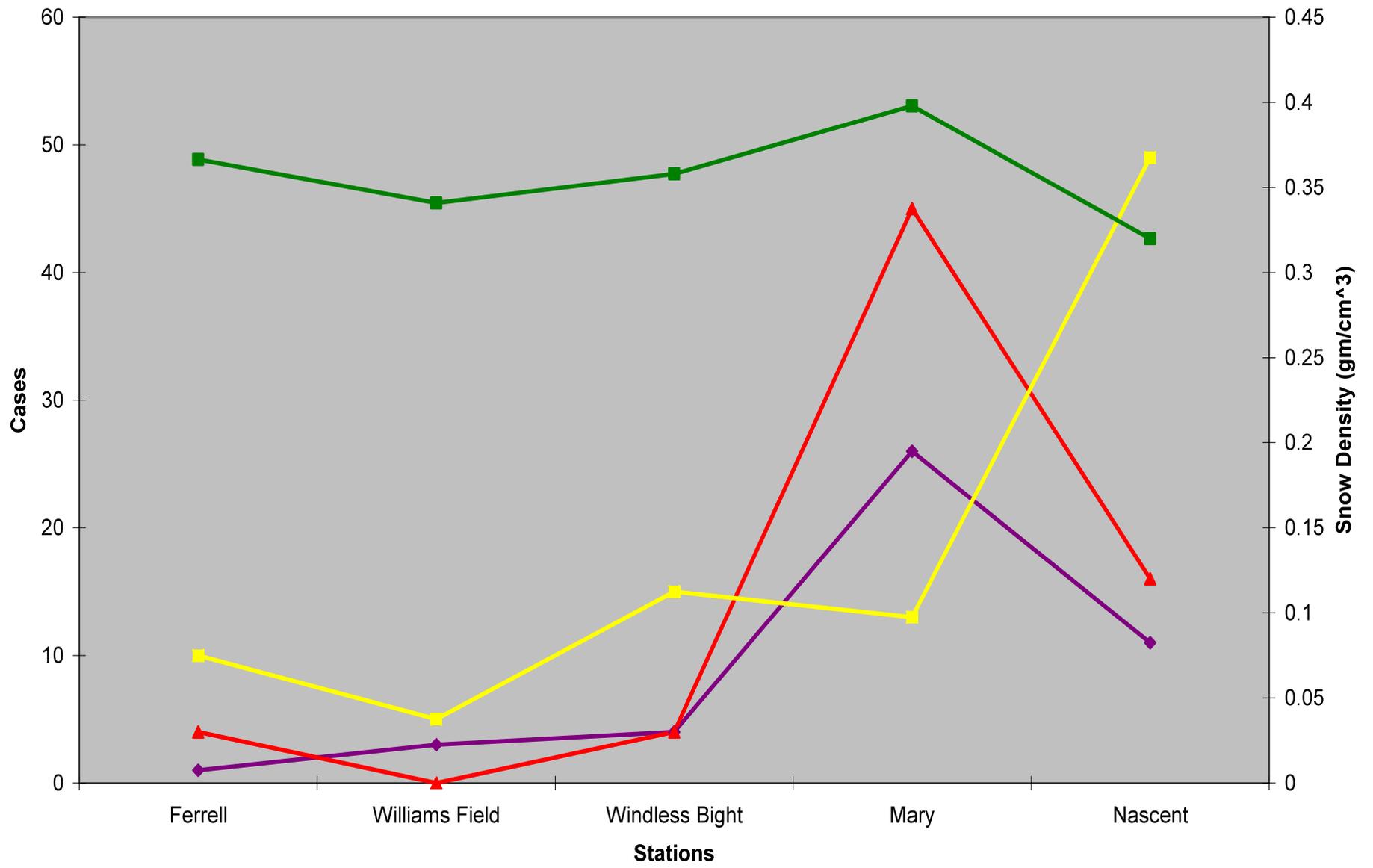


Net Accumulation over Time



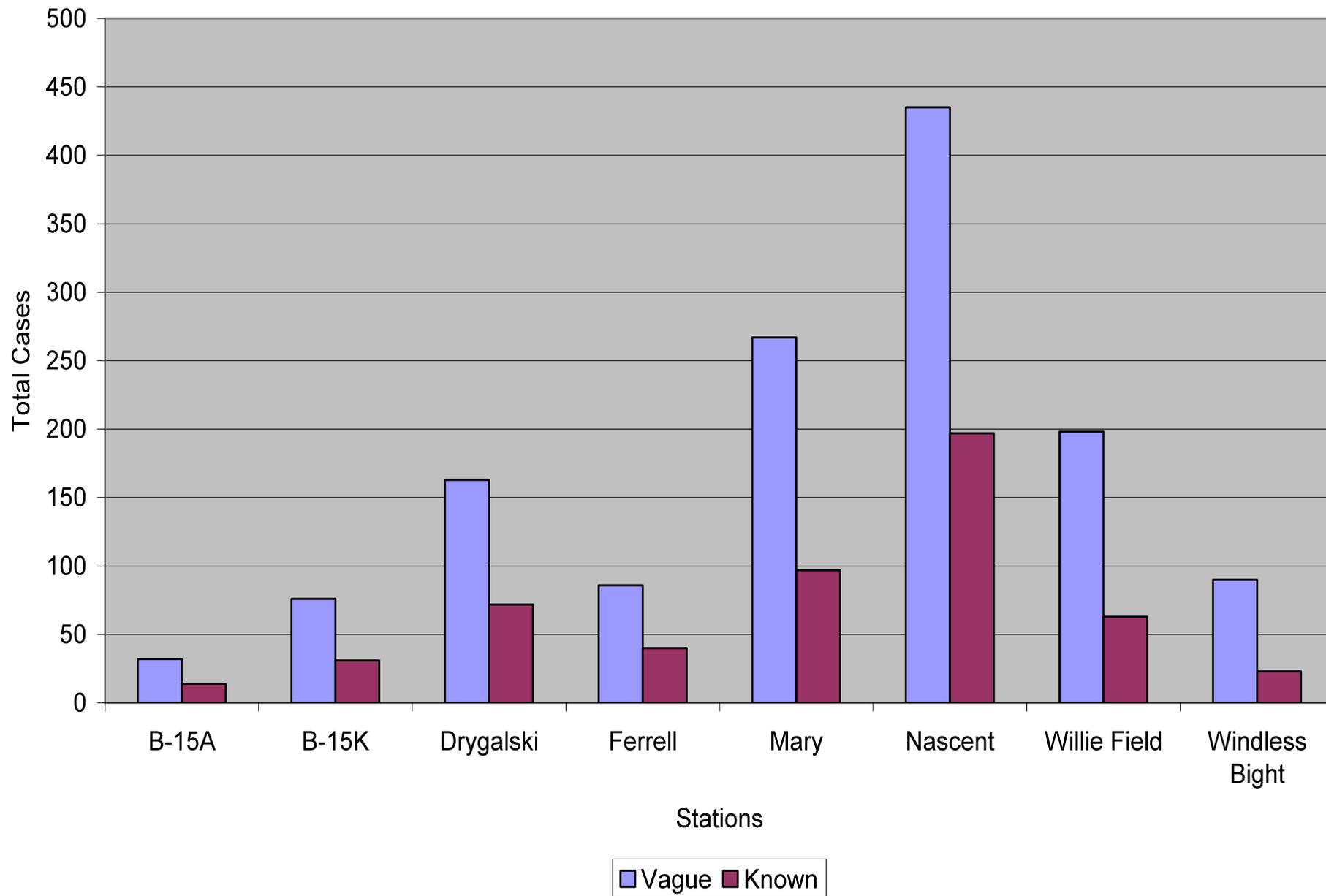
Net Accumulation over Time

Snow Densities vs. Case Type for Each Station with an ADG during 2005



Blowing Snow Blowing Snow and Precipitation Precipitation Snow Densities

Vague Results vs. Known for All Stations in 2004-2006



Comparisons to Modeling Studies

- Horizontal flux of B negative near slopes, positive on ice shelves
 - Mary
 - Ferrell
- Precipitation max along windward slopes of Transantarctics
 - Also southern slope of Ross Island
- Katabatics at Drygalski felt as far out as Franklin island
- Willie shows B as much as P
 - Follows well with known flow down lee slopes of Ross Island
- Accumulation higher in topographical regions

Conclusions

- Net accumulation over time at all sites
- All sites show more precipitation cases than blowing snow (except Mary)
- Topography plays an important role
- Snow densities correlate with accumulation values
- Can't use ADGs alone to determine all events
- Need a better monitoring network combined with data assimilation to determine precipitation

Acknowledgments

- Dr. Gordon Hamilton from the University of Maine for the acoustic depth gauges used during the 2004-2006 field seasons



shelleyk@ssec.wisc.edu