—報告—
Report

Automatic Weather Station (AWS) Program operated by the University of Wisconsin−Madison during the 2011−2012 field season

Matthew A. Lazzara[1], Lee J. Welhouse[1*], Jonathan E. Thom[1], John J. Cassano[2], Alice K. DuVivier[2], George A. Weidner[3], Linda M. Keller[3] and Lars Kalnajs[4]

ウィスコンシン大学マディソン校が実施している南極無人気象観測（AWS）計画の 2011–2012 年夏期の活動

(Received July 2, 2012; Accepted January 22, 2013)

要旨: ウィスコンシン大学マディソン校で推進している南極無人気象観測計画（Antarctic Automatic Weather Station（AWS）program）の 32 年目の観測が，2011/2012 年の南半球夏期に完了した．無人気象観測網を利用して南極の気象と気候の研究が行われている．今シーズンはロス島周辺域，ロス棚氷，西南極，東南極にわたる領域で活動した．基本的に観測点のデータはアルゴス衛星を中継して配信されるが，今年はロス島周辺域の多くの観測点で，マクマード基地を中継して“Freewave modem”を通して配信された．各無人気象観測点報告には，現在設置されている測器と動作状況が含まれる．また，無人気象観測計画の全体像を，野外活動の実施状況に沿って示す．

Abstract: During the 2011–2012 austral summer, the Antarctic Automatic Weather Station (AWS) program at the University of Wisconsin−Madison completed its 32nd year of observations. Ongoing studies utilizing the network include topics in Antarctic meteorology and climate studies. This field season consisted of work throughout the Ross Island area, the Ross Ice Shelf, West Antarctica, and East Antarctica. Argos satellite transmissions are the primary method for relaying station data, but throughout this year, a number of stations in the Ross Island area have been converted to Freewave modems, with their data being relayed through McMurdo station. Each AWS station report contains information regarding the instrumentation currently installed and the work performed at each site. An overview of the AWS applications is included along with field work accomplished.

[1] Antarctic Meteorological Research Center, Space Science and Engineering Center, University of Wisconsin–Madison, 1225 West Dayton, Madison, WI 53706.
[2] Cooperative Institute for Research in Environmental Sciences and Department of Atmospheric and Oceanic Sciences, University of Colorado–Boulder, 216 UCB, University of Colorado, Boulder, CO 80309.
[3] Department of Atmospheric and Oceanic Sciences, University of Wisconsin–Madison, 1225 West Dayton, Madison, WI 53706.
[4] Laboratory for Atmospheric and Space Physics, University of Colorado–Boulder, 1234 Innovation Drive, Boulder, CO 80303.
* Corresponding author. E-mail: lee.welhouse@ssec.wisc.edu

南極資料，Vol. 57，No. 1，125−135，2013
Nankyoku Shiryô (Antarctic Record), Vol. 57, No. 1, 125−135, 2013

1. Background

The National Science Foundation's Office of Polar Programs funds the University of Wisconsin's Automatic Weather Station Program to design, fabricate, deploy, and maintain an array of automatic weather stations (AWS) in remote areas in Antarctica in support of meteorological research, applications and operations (Lazzara *et al*., 2012). The basic AWS units measure air temperature, wind speed, and direction at a nominal height of 3 meters above the surface. Air pressure is measured at the height of the AWS electronics enclosure, which varies between 0.5 and 2.5 meters. Some units measure relative humidity at 3 meters above the surface and the air temperature difference between 0.5 and 3 meters above the surface at the time of installation. A small but increasing number of AWS sites measure snow accumulation (using an acoustic depth gauge) and/or solar radiation. The data are primarily collected by the ARGOS Data Collection System (DCS) on board the National Oceanic and Atmospheric Administration (NOAA) and MetOp (operated by European Organization for the Exploitation of Meteorological Satellite (EUMETSAT)) series of polar-orbiting satellites. This year also saw an increase in the stations in the Ross Island region using Freewave modems to transmit observations to a receiving station in nearby McMurdo Station.

The AWS units are located in arrays for specific research activities and are also used for operational purposes. Any one AWS may support several experiments and all support operational meteorological services-especially support for weather forecasts for aircraft flights around the Antarctic continent. This was the 32nd field season for the project under the direction of Principal Investigators (PI) from the University of Wisconsin–Madison and University of Colorado–Boulder. There are a number of configurations of AWSs currently in use in the University of Wisconsin Automatic Station network; specific instrumentation is indicated in each station visit report provided within this document. Figures 1 and 2 show the more common types of station.

The AWS network supports a wide array of science activities. Current efforts are focused on Antarctic surface climatology (e.g. Bromwich *et al*., 2012), and wind phenomena over the Ross Ice Shelf (e.g. Nigro *et al*., 2012), in addition to uses by others for additional science and logistic activities. The current Wisconsin AWS network began in 1980 after several years of research and development within the United States Antarctic Program (USAP). A more complete history of the AWS development in Antarctica, and specifically the Wisconsin AWS program, can be found in Lazzara *et al*., 2012.

2. Field Season Overview

One of the unique aspects of maintaining the AWS observational network is the necessary fieldwork. Keeping a network of roughly 60 AWS systems (Fig. 3) operating, even with international partners, requires a devoted effort of AWS fabrication and repair team members doubling as field personnel. Flying to remote places around the Antarctic and dealing with polar weather conditions makes maintenance a challenge. Over the 2011–2012 field season, 24 AWS sites were visited by the AWS team or collaborators (Fig. 4, Table 1). This represents a typical field season, where roughly one third of the network is visited for

Fig. 1. Lorne AWS, consisting of two R.M. Young RTD and one Vaisala HMP 155- all three in Gill Radiation shields, LI200X pyranometer, SR50A ADG, and R.M. Young Wind Monitor system. Within the electronics enclosure is a Paroscientific pressure sensor.

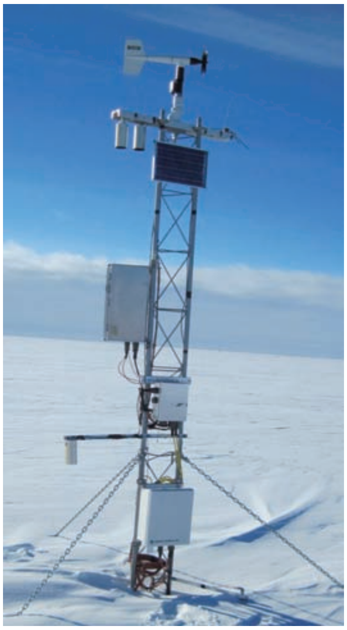

Fig. 2. Kominko-Slade station prior to servicing. Instrumentation consists of a Weed platinum resistance thermometer (PRT), a two-junction thermocouple temperature-difference sensor set (measuring temperature difference between the sensor boom at top of the tower and at the half meter mark above the snow), an R.M. Young Wind Monitor, a Vaisala HMP 45 for humidity, and a Paroscientific pressure sensor within the enclosure.

repairs and servicing along with any AWS station removals or new installation of AWS systems.

For the 2011–2012 field season, the field team consisted of Jonathan Thom and Lee Welhouse from the University of Wisconsin–Madison Space Science Engineering Center, and John Cassano and Alice DuVivier from the University of Colorado–Boulder. Team members Jonathan Thom and Lee Welhouse deployed to McMurdo on 4 November 2011 or the early portion of the field season, which consisted of updating a number of AWS units on the Ross Island region to Freewave transmitters, some AWS service work in the Ross Ice Shelf, and the consolidation of the stations at Cape Hallett. Jonathan Thom departed McMurdo on 7 December 2011 for the return to Madison. Lee Welhouse completed the middle portion of the season, which consisted of work out of Siple Dome field camp, WAIS-Divide field camp, Byrd field camp, and South Pole Station, though weather issues would require a return to Byrd field camp later in the season. Team members John Cassano and Alice DuVivier arrived in McMurdo on 2 January 2012 to complete the final portion of the season. The final portion of the season consisted of work out of Byrd field camp done by

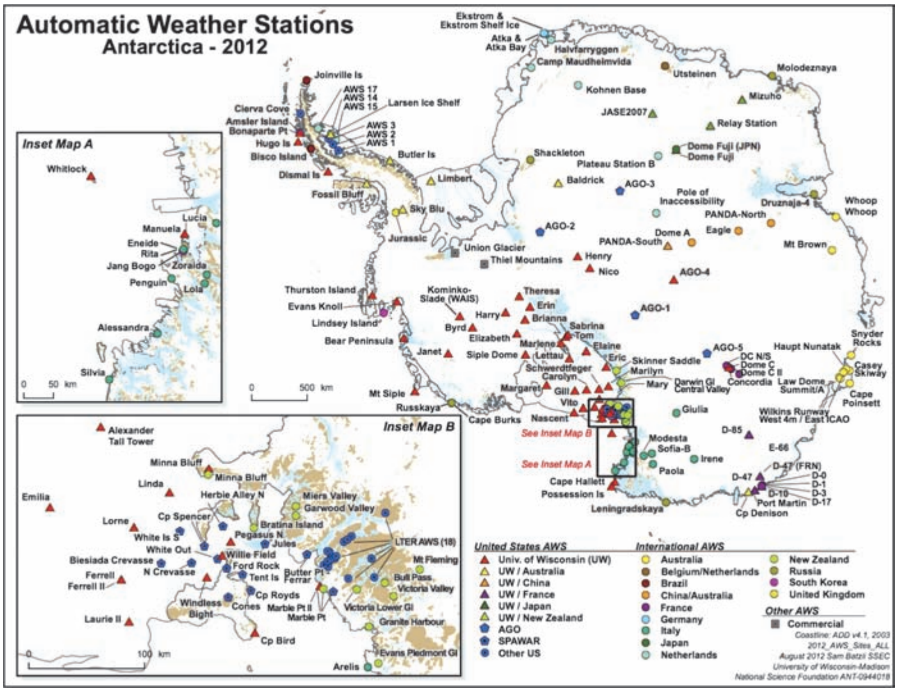

Fig. 3. Map of all known Automatic Weather Stations operating during the 2011–2012 field season. All AWS marked with a triangle are University of Wisconsin AWS or AWS systems collaborating with the University of Wisconsin–Madison.

Lee Welhouse and Alice DuVivier, and work on the Ross Ice Shelf and the Ross Island region completed by John Cassano and Alice DuVivier. John Cassano and Alice DuVivier also conducted small unmanned meteorological observer (SUMO) unmanned aerial vehicle (UAV) (Reuder *et al.*, 2009) flights at the Long Duration Balloon (LDB) launch site at Willie Field on 15, 22, 28, and 29 January. These flights were intended to demonstrate the utility of SUMO UAVs for local boundary layer measurements and observed a wide range of boundary layer behavior.

3. Field Work

3.1. McMurdo Area

Research in the McMurdo area was expanded to include a new project studying tropospheric ozone. With several sites in the area having new ozone sensors installed this season and with increased demand for real-time data reception and reduced expenditures for satellite communications, new power and communications systems have been installed at AWS sites in the region. Recent developments in power systems (Stehle and Dahl, 2007) were employed to meet these new requirements. The additional data is also being transmitted via a Freewave communications system directly to McMurdo Station, where the data can be made available both on station as well as relayed to Wisconsin for broader

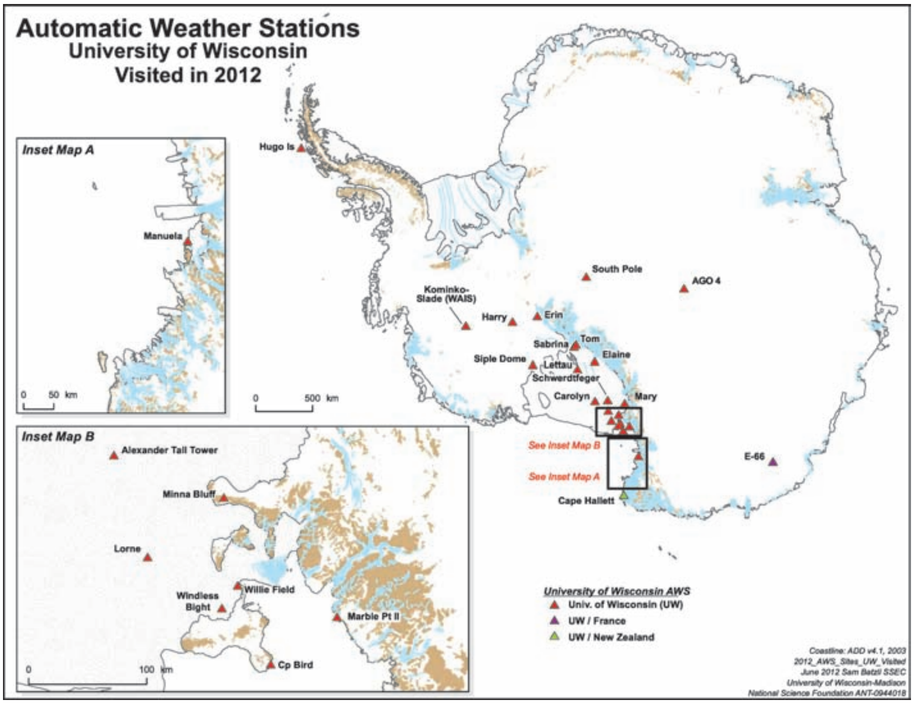

Fig. 4. Map of Automatic Weather Stations visited during the 2011–2012 field season.

Table 1. List of stations serviced by both the McMurdo field team and collaborating institutions.

Summary of 2011/2012 field season for O-283		
Station	**Date**	**Work Performed**
Sabrina	11/15/2011	Faulty pressure sensor replaced
Tom	11/15/2011	Power system replaced
Elaine	11/15/2011	Tower raised
Windless Bight	11/17/2011	Tower raised
Cape Hallett	11/20/2011	LTER and New Zealand station consolidated
E-66	11/27/2011	Station removed
Minna Bluff	11/30/2011	Installation of new enclosure and Freewave antenna
Marble Point II	12/1/2011	Installation of Freewave Station
Cape Bird	12/2/2011	Installation of Freewave Station
Lorne	12/3/2011 and 01/14/2012	Installation of new Freewave station which was unable to reach McMurdo, transition to Argos station
Willie Field	12/4/2011	Converted station to Freewave
Siple Dome	12/8/2011	Updated and raised station
Kominko-Slade	12/17/2011	Removed old station and installed new station
South Pole	12/30/2011	Removed South Pole test station
AGO 4	12/30/2011	Installed new station at AGO facility
Harry	1/19/2012	Raised station
Mary	1/20/2012	Removed station
Erin	1/21/2012	Raised station
Alexander	1/26/2012	Tall tower inspected and data retrieved
Schwerdtfeger	1/31/2012	Installed new power system
Carolyn	2/04/2012	Replaced enclosure and raised instruments
Lettau	2/04/2012	Removed electronics for repair and redeployment
Manuela	2/07/2012	Removed old station and installed new station
Hugo Island	3/29/2012	Removed old station and installed new station

dissemination.

Six weather stations in the McMurdo Station area were visited this season. On 17 November 2011, Windless Bight AWS (77.726°S, 167.684°E) was the first sited visited. This station consists of an R.M. Young platinum resistance temperature device (RTD), a Vaisala HMP 155 humidity probe, an R.M. Young Wind Monitor, a CSI Canada SR50A Acoustic Depth Gauge (ADG), and a Vaisala pressure sensor housed in the enclosure. Upon arrival, the ADG and enclosure were below the snow surface, with the instrumentation boom containing the RTD, HMP and Wind Monitor at 1.2 m. The station was raised one 2.1 m (7 foot) tower section. Argos transmission was received after the station was powered back up. The final heights after the raise place the ADG at 2.2 m, the sensor boom at 3.7 m, and pressure sensor at 1.9 m.

Minna Bluff AWS (78.555°S, 166.691°E) required two site visits over two days, 28 and 29 November 2011. The first trip involved removing the old antenna and AWS enclosure. On arrival at the site, the existing Freewave Yagi antenna was hanging loosely on the tower. Although the antenna was loose, connections were made periodically to the station. On the second trip, the new Minna Bluff enclosure and a new Freewave Yagi Antenna were installed. The new enclosure will allow data and power connections with the ozone instrumentation. The new Yagi has a much more robust antenna mount and should not loosen as a prior one did. The polarization of the antenna is still horizontal. This station consists of a Weed platinum resistance thermometer (PRT), Vaisala HMP45 humidity sensor, and Taylor High Wind Speed (HWS) System in a singular boom at 2.2 m. Minna Bluff is the site of the strongest wind ever recorded (61 m/s) by the Wisconsin AWS network.

Marble Point, just across from McMurdo Station, is the site of both a new AWS system and an existing system (77.439°S, 163.759°E). The new station was installed on 30 November 2011, and a new tower for the new site was erected. The new AWS relays data via Freewave and is a repeater site for Cape Bird AWS. The new installation went well, and everything was operating nominally. This station consists of two R.M. Young RTD probes at 2.2 m and 5.4 m, a Vaisala HMP 155 at 5.4 m, an R.M. Young Wind Monitor at 5.9 m, a CSI Canada SR50A ADG at 2.9 m, a Paroscientific pressure gauge housed in the enclosure at 0.9 m, and a LI200X pyranometer at 3.1 m. The new AWS will be compared against the original AWS installed at this location over the next year.

The Cape Bird AWS (77.217°S, 166.439°E) was fully replaced on 3 December 2011. Upon arrival, the station consisted of an instrument boom at 2.8 m containing a Weed PRT, R.M. Young Wind Monitor system, Vaisala HMP 45, and a Paroscientific pressure sensor at 1.1 m. This was replaced with a new Freewave based AWS. The tower section was replaced with a stainless steel tripod. The power system will be replaced in a future field season. There was a lot of corrosion on the connectors, and the solar panel had lost most of its back coating. The new station has an R.M. Young RTD probe at 3.4 m, Vaisala HMP 155 at 1.8 m, R.M. Young Wind Monitor at 3.2 m, CSI Canada SR50A ADG at 2.9 m, and a Paroscientific pressure sensor at 1 m.

Lorne AWS (78.222°S, 170.0145°E) was replaced with a Freewave based AWS on 2 December 2011. The old station had an instrument boom at 3.1 m with R.M. Young RTD and Wind Monitor and Vaisala HMP 45, and a Paroscientific pressure sensor at 1.2 m. While at the station, it was not possible to make a Freewave connection to McMurdo Station. This may be due to the distance and low angle of the Yagi antenna at the site. The Freewave antenna was later replaced with an Argos transmitting system. The new station has two R.M. Young RTD probes at 2.1 m and 5.2 m, Vaisala HMP 155 at 5.2 m, CSI Canada SR50A ADG and LI200X pyranometer at 3.30 m, R.M. Young Wind Monitor at 5.8 m, and Paroscientific pressure sensor at 1.3 m.

The Willie Field AWS is now connected into the Freewave network as of 4 December 2011. The CR1000 at Willie Field displayed some hardware issues. The serial number is not visible through the device configuration set up window, and there are issues with the compact flash card writer. The CR1000 module should be replaced in the future and the existing CR1000 returned to Campbell Scientific for evaluation. There were gaps in the data written to the CF card. The station has two R.M. Young RTD probes at 0.7 m and 3.3 m, Vaisala HMP 45 at 3.3 m, R.M. Young Wind Monitor at 3.8 m, and Vaisala pressure gauge at 1.3 m.

3.2. Ross Ice Shelf Region

The Ross Ice Shelf Region contains some of the longest observational records in the AWS network. Historically, observations from these stations have been utilized to improve our understanding of the climate throughout this region. In recent years, emphasis has been placed on near surface wind observations, which have been used in tandem with numerical models, to improve our understanding of the dynamics behind the Ross Ice Shelf Air Stream (RAS) and tip jets (Nigro *et al*., 2012; Parish *et al*., 2006; Seefeldt and Cassano, 2012).

Eight stations were visited throughout this region. Sabrina, Tom, and Elaine stations were all visited on 15 November 2011. Sabrina station (84.25°S, 170.07°W) consists of two R.M. Young RTD probes at 0.8 m and 4.3 m, a Vaisala HMP 155 at 2.6 m, an R.M. Young Wind Monitor at 4.5 m, a CSI Canada SR50A ADG at 2.3 m, a Vaisala pressure sensor housed in the enclosure at 2.6 m, and an LI200X pyranometer at 2.3 m. Sabrina pressure readings had failed soon after installation last season. The Paroscientific pressure sensor was replaced with a Vaisala PTB110 pressure sensor. The compact flash card was replaced, and a new program was uploaded to the station for the new pressure sensor. Some loose cables were tied down. All data were nominal, and Argos transmissions were received.

Tom station (84.43°S, 171.48°W) contains two R.M. Young RTD Probes at 1.1 m and 4.9 m, a Vaisala HMP155 at 2.8 m, a CSI Canada SR50A ADG and LI200X pyranometer at 3.5 m, a Paroscientific pressure sensor at 2.3 m, and an R.M. Young Wind Monitor at 5.3 m. Tom experienced a total power system failure during the winter. The station resumed transmitting as the sun came up, but only when the solar panel was in full sun. The power system was replaced with new batteries, charge controller and solar panel. The compact flash card was replaced and the station restarted. All data were nominal, and Argos transmissions were received.

Elaine (83.094°S, 174.285°E) was functioning, but snow accumulation required the station to be raised. The ADG boom was raised, and the pyranometer was moved to the ADG boom. The CR1000 firmware was updated to the current version, and a new program was uploaded. The compact flash card was recovered. However, the compact flash card was not readable, and the data could not be recovered. The station consists of an R.M Young RTD probe at 2.4 m, a Vaisala HMP155 at 0.9 m, a Vaisala pressure sensor at 0.9 m, a Weed PRT buried in the snow, and an R.M. Young Wind Monitor at 3 m. The station also has a

CSI Canada SR50A ADG which was at 0.6 m and was raised to 2.3 m. A LI200X pyranometer was also added at 2.7 m. Accumulation will require another raise in approximately two years.

Mary (79.310°S, 163.037°E) was visited 12 January 2012. Mary AWS was entirely removed, including the solar panel, AWS enclosure, junction box, lower boom / ADG, and one 2.1 m tower section. All other tower sections, anchors, and battery boxes were left at the site. The site consisted of an instrument boom containing a Weed PRT, R.M. Young Wind Monitor, and Vaisala HMP 45 at 1.7 m, and a Paroscientific pressure sensor which was under snow level.

Alexander Tall Tower (79.0387°S, 170.661°E) was visited on 26 January 2012. A 1GB memory card was removed, and a new memory card was installed. Riggers with the USAP inspected the tower, and it appeared to be in good condition. The guy wires were retensioned, and the tower was vertical. The heights of the first two levels of anemometer measurements were 1 m and 1.9 m, and the first two levels of temperature measurements were 0.6 m and 1.6 m.

Schwerdtfeger (79.837°S, 170.271°E) was visited 31 January 2012. The station was found to be in good condition, though data indicated the batteries needed to be replaced. Two new battery boxes were installed, but the station did not require raising as the instrument bar was at a height of 3.9 m. The instrument bar contained a Weed PRT, Belfort/ Bendix Aerovane, and Vaisala HMP 45. The Paroscientific pressure sensor is located at 1.2 m.

Carolyn (79.920°S, 175.917°E) had been offline for several months and was visited 4 February 2012. The AWS was checked to ensure power was being supplied, and the batteries were checked and reported 12.6 Volts (V) from each battery box, with 12.6 V recorded at the AWS enclosure. The power was disconnected and reconnected and checked for data transmission with no successful transmission recorded. The AWS was replaced with AWS 8983 (removed from Mary on 20 January 2012). A 2.1 m tower section was added. The junction box, AWS, solar panel, and boom were all raised to new heights. The lower delta T boom, ADG, and ADG Campbell logger were removed. All instruments appeared to be in good condition. The original station was an instrument bar consisting of a Weed PRT, R.M. Young Wind Monitor, and Vaisala HMP 45 which was placed at 3.7 m. The Paroscientific pressure sensor was placed at 1.8 m.

Lettau (82.472°S, 174.596°W) was visited 4 February 2012. The power system was reporting 6.4V from each battery box, with the solar panel reporting 14 V and 14 V at the plug going to the CR1000. The CR1000 electronics gave no signal when a connection was attempted, so the enclosure was removed for return to Madison. All instruments appeared to be in good condition, and the station did not need to be raised. It appears that there is a problem with the batteries (and possibly junction box), and these should be replaced during the next site visit. The instruments on the station are two R.M. Young RTD probes at 0.9 m and 4.9 m, a Vaisala HMP 45 at 2.7 m, an R.M. Young Wind Monitor at 5.2 m, CSI Canada SR50A ADG and LI200X pyranometer at 3.4 m, and a Vaisala pressure sensor at 2.2 m.

3.3. North Victoria Land

Two stations were visited in this region, and both are of interest for varying reasons. The first station visited was Cape Hallett station on 20 November 2011. This station has a long standing history, as it is near the location of the prior USAP base that was used until 1973. This location can provide a long climate record, and for the purposes of the USAP AWS network, it can act as a replacement for a station on Possession Island. The second station, Manuela, was visited on 7 February 2012. This station will provide ground observations for future unmanned aerial vehicle (UAV) flights into this area (Cassano *et al*., 2010; Knuth and Cassano, 2011).

Initially two stations were located at Cape Hallett, a New Zealand station (72.319°S, 170.227°E) and the Long Term Ecological Research (LTER) station (72.319°S, 170.226°E). A Wisconsin AWS has replaced these two units. The instrumentation on the current station consists of an R.M. Young RTD probe at 1.9 m, Vaisala HMP45 at 2.7 m, R.M. Young Wind Monitor at 3 m, CSI SR50A ADG at 1.7 m, Paroscientific pressure sensor at 1.2 m, CNR2 radiation sensor at 1.80 m, soil moisture probes at the surface, and photosynthetically active radiation sensor (PAR) at 2.8 m. The visit involved a two-night trip to Cape Hallett with Raytheon Polar Services personnel Cindy Dean and John Rand. The LTER station was moved to the location of the New Zealand AWS to incorporate the soil moisture and temperature sensors.

Manuela (74.945°S, 163.692°E) was visited on 7 February 2012. This station consists of an instrument boom containing a Vaisala pressure sensor, Weed PRT, Vaisala HMP45 and Taylor High Wind Speed system installed at 2.1 m. The old AWS, batteries, and tower sections were removed and replaced with all new systems.

3.4. West Antarctica

The stations in this region are being utilized for a number of research opportunities. The primary use for these stations in recent years has been monitoring West Antarctic climate with a focus on the potential for warming in the region (Steig *et al*., 2009; Ding *et al*., 2011). A recent publication has more clearly defined the warming in central West Antarctica to be on the order of 2.4 ± 1.2℃ between 1958 and 2010 (Bromwich *et al*, 2012). These locations have also been used to support the ongoing research activities in the Pine Island Glacier area. This season four stations were visited, with repairs and upgrades being performed in the region.

Siple Dome (81.656°S148.772°W) was visited on 8 December 2011 and on 21 January 2012. The station was mostly buried. The only visible portion of the station was the instrument boom consisting of a Weed PRT, Vaisala HMP 45, and R.M. Young Wind Monitor at 0.5 m. The old enclosure and boom were removed, a new tower section was added to increase the height, and a new station was installed. The later visit was to adjust the direction of the aerovane as it was improperly oriented. The station contains two R.M. Young RTD probes at 2 m and 3.1 m, Vaisala HMP 155 at 3.1 m, R.M. Young Wind Monitor at 3.5 m, CSI Canada SR50A ADG at 1.8 m, Paroscientific pressure sensor at 1.6 m, and LI200X pyranometer at 1.8 m.

Kominko-Slade (79.466°S, 112.1062°W) was visited on 17 December 2011. The old station was removed, except for the snow temperature string which is connected through a secondary enclosure to the new station. The old station had a lower Weed PRT, which was at snow surface, a mid-level Weed PRT at 1.02 m, a Paroscientific pressure sensor at 1.52 m, and an instrument boom containing a Weed PRT, Vaisala HMP 155, and R.M. Young Wind Monitor at 3.175 m. The new station contains two R.M. Young RTD probes at 3.07 m and

5.89 m, a Weed PRT at 1.63 m, snow profiles, Vaisala HMP 155 at 5.89 m, R.M. Young Wind Monitor at 6.29 m, CSI Canada SR50A ADG and CNR2 radiation sensor at 2.84 m, and Paroscientific pressure sensor at 1.02 m.

Harry (83.005°S, 121.4033°W) was visited on 19 January 2012. The station was raised by a single tower section. The station has an instrument boom consisting of a Weed PRT, Belfort/Bendix aerovane, and Vaisala HMP 45. This boom was at 1.49 m prior to the raise and was at 3.63 m after the raise. The station also contains a Paroscientific pressure sensor, which was at 0.25 m prior to the raise and at 1.68 m after the raise.

Erin (84.90269°S, 128.8528°W) was visited on 21 January 2012. The station was partially buried. The junction box, solar panel, and main instrument boom were found above the snow surface. The instrument boom consists of a Weed PRT, R.M. Young PRT, and Vaisala HMP 45 at 0.94 m, and a second temperature boom consisting of a Weed PRT was buried under the snow surface. The instruments were raised up with two 2.1 m tower sections, and the station transmitted successfully. The instrument boom was placed at 5.38 m, the Paroscientific pressure sensor was placed at 2.84 m, and the lower Weed PRT was placed at 2.51 m. Issues with temperature, wind speed, and delta-T were discovered later.

An attempt was made to visit Brianna AWS. The region around Brianna was heavily crevassed, so no visit was viable. The crevassing in this region is recent. Hence, future visits will depend on the surface conditions.

3.5. Polar Plateau

Two visits were performed in the Polar Plateau region. The first was the removal of a test station at South Pole. This test station was deployed to provide data for studying the effect different radiation shields have on temperature measurements during low wind conditions on the plateau (Genthon *et al*., 2011). The second was at Automatic Geophysical Observatory (AGO) number 4, and was a test to determine how our station performed when connected with their power system.

South Pole station was visited on 30 December 2011. The test station was successfully removed and returned to McMurdo. All batteries, tower sections, and instrumentation were recovered. The test station consisted of an instrument bar of Weed PRT and R.M. Young RTD temperature sensors being tested in various radiation shields. Upon removal, the height of the instrument bar was 0.5 m above the surface.

AGO-4 (82.01°S, 96.76°E) was also visited on 30 December 2011. The station contained an R.M. Young RTD probe at 2.3 m, a Vaisala HMP155 at 2.1 m, an R.M. Young Wind Monitor at 2.9 m, a Paroscientific pressure sensor at 1.1 m, and an LI200X pyranometer at 1.8 m. The station was successfully integrated into the AGO power system.

4. Summary

During this field season, the field team visited a total of 22 stations. Two other stations were serviced by collaborators in the East Antarctic Plateau and Antarctic Peninsula (Table 1). This season was very successful with repairs made and new equipment installed, and most of the goals for station visits were met. Continued observations from stations throughout the various regions of Antarctica are invaluable in answering a number of questions regarding Antarctic meteorology and climate.

Acknowledgements

The success of the AWS network would not be possible without the support of all those who help, directly or indirectly. Thanks go to Ken Borek Air, the 109th New York Air National Guard, PHI Helicopters, Raytheon Polar Services, our international partners in France, Australia, United Kingdom, Japan, New Zealand and China. Thanks to field help from Jay Cairns, Alec Chin, Andy Stiller, Michelle Brown, Cindy Dean, and John Rand. The authors wish to acknowledge the Office of Polar Programs at the National Science Foundation in the USA for their support of this project. This material is based upon work supported by the National Science Foundation Grant Nos. ANT-0944018, ANT-0943952, ANT-1043266 and ANT-1043478.

References

Bromwich, D.H., Nicolas, J.P., Monoghan, A.J., Lazzara, M.A., Keller, L.M., Weidner, G.A. and Wilson, A.B. (2012): Central West Antarctica among most rapidly warming regions on Earth. Nature Geosci., **6**, 139–145, doi: 10.1038/ngeo1671.

Cassano, J.J., Maslanik, J.A., Zappa, C.J., Gordon, A.L., Cullather, R.I. and Knuth, S.L. (2010): Observations of Antarctic polynya with unmanned aerial systems. Eos, **91**, 245–246, doi: 10.1029/2010EO280001.

Ding, Q., Steig, E.J., Battisti, D.S. and Kuttel, M. (2011): Winter warming in West Antarctica caused by central tropical Pacific warming. Nature Geosci., **4**, 398–403, doi: 10.1038/ngeo1129.

Genthon, C., Six, D., Favier, V., Lazzara, M. and Keller, L. (2011): Atmospheric temperature measurement biases on the Antarctic Plateau. J. Atmos Ocean Tech., **28**, 1958–1605, doi: 10.1175/JTECH-D-11–00095.1.

Knuth, S.L. and J.J. Cassano (2011): An analysis of near-surface winds, air temperature, and cyclone activity in Terra Nova Bay Antarctica from 1993 to 2009. J. Appl. Meteor. Climatol. **50**, 662–680, doi: 10.1175/2010JAMC2507.1.

Lazzara, M.A., Weidner, G.A., Keller, L.M., Thom, J.E. and Cassano, J.J. (2012): Antarctic Automatic Weather Station Program: 30 Years of Polar Observation. Bull. Amer. Meteor. Soc., **93**, 1519–1537, doi: 10.1175/BAMS-D-11-00015.1.

Nigro, M.A., Cassano, J.J., Lazzara, M.A. and Keller, L.M. (2012): Case study of a barrier wind corner jet off the coast of the Prince Olav Mountains, Antarctica. Mon. Wea. Rev., **140**, 2044–2063, doi: 10.1175/MWR-D-11-00261.1.

Parish, T.R., Cassano, J.J. and Seefeldt, M.W. (2006): Characteristics of the Ross Ice Shelf air stream as depicted in Antarctic Mesoscale Prediction System simulations. J. Geophys. Res., **111,** D12109, doi: 10.1029/2005JD006185.

Reuder, J., Brisset, P., Jonassen, M., Müller, M. and Mayer, S. (2009): The Small Unmanned Meteorological Observer SUMO: A new tool for atmospheric boundary layer research. Meteorol. Z., **18**, 141–174, doi: 10.1127/0941-2948/2009/0363.

Seefeldt, M.W. and Cassano, J.J. (2012): A description of the Ross Ice Shelf air stream (RAS) through the use of self-organizing maps (SOMs). J. Geophys. Res., **117**, D09112, doi: 10.1029/ 2011JD016857.

Stehle, R.H., and Dahl, T. (2007): Polar Power. Org—Sharing knowledge about power systems for polar regions. Arctic Energy Summit Technology Conference, Anchorage, Alaska. 17 October 2007. http://www.polarpower.org/events/aetc2007/RUR-17_Stehle_paper.pdf

Steig, E.J., Schneider, D.P., Rutherford, S.D., Mann, M.E., Comiso, J.C. and Shindell, D.T.(2009): Warming of the Antarctic ice-sheet surface since the 1957 International Geophysical Year. Nature, **457**, 459–462, doi: 10.1038/nature07669.