Automatic weather station research by Japanese Antarctic Research Expedition in East Droning Maud Land, East Antarctica.

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Outline

1. Automatic Weather Stations by Japanese Antarctic Research Expedition (JARE)
   • J-type AWS
   • Argos AWS (*Cooperative work with Prof. C. Stearns, Dr. G. Weidner and Dr. M. Lazzara, University of Wisconsin*)

2. Locations of AWS and the data condition by AWS

3. Data quality issues

4. Future plan

5. Conclusions
Self introduction

- Takao KAMEDA, Dr. Sc. (45)
- Major: Antarctic glaciology (surface mass balance, snow crystals, and ice core analyses), Solar eclipse Meteorology, AWS
- Associate professor in Kitami Institute of Technology (KIT). KIT is located in Kitami, Hokkaido. KIT is the most northern national university in Japan (44° N).
- Teaching in KIT: Earth science and classical physics.
- Family: wife and a kid
Two types of AWS have been used:

- Data logger type (J-type) prepared by our Kitami Institute of Technology (KIT) group, Japan (1993 – 2008)
  Elements: Temp, Ws, Wd
  Time interval: 1 hour

- Argos type prepared by UW, USA (1995 – 2008)
  Elements: Temp, P, Ws, Wd,
  Time interval: 10 minutes
J-type AWS

In snow

Aerovene by R.M. Young, USA

Radiation shield by Makino Applied Meteorology, Japan

Data logger made by NorthONE Co. Ltd., Japan ("KADEC series"). This logger works under -70 °C condition with extra batteries (Latium batteries)

I brought catalogue of this logger here, but.....
Catalogue of KADEC data logger

I brought 30 copies of this catalogue with me, but 29 copies are in my checked baggage that is now Madison airport or Chicago airport.
Radiation shield made by Makino Applied Meteorology, Japan

Bottom view (double wall with anti-reflected plate)
Fan-aspirated radiation shield (solar battery type) made by Davis Instruments (Hayward, CA, USA)

This shield was installed at week wind sites as Dome Fuji (inland) and S16 (coast).

Problems: Battery and frost

Frost at the bottom (Dome Fuji)
Locations of AWS installed by JARE (1993-2008)

- J-type AWS
- Argos AWS (UW-Madison)
At present, we have only continued J-type AWS at Dome Fuji and Middle Point, inland area; Ta, Ws and Wd.
At present, two Argos AWS in East Dronning Maud Land (Mizuho and JASE2007) have been transmitting the data; Ta, P, Ws and Wd, but the data from Mizuho seems has some problems.

<table>
<thead>
<tr>
<th>Site name</th>
<th>Latitude</th>
<th>Method</th>
<th>Elements</th>
<th>Data condition</th>
</tr>
</thead>
<tbody>
<tr>
<td>JASE 2007</td>
<td>75°53'17&quot;S</td>
<td></td>
<td></td>
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<tr>
<td></td>
<td>25°50'01&quot;E</td>
<td></td>
<td></td>
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<tr>
<td>Dome Fuji</td>
<td>77°19'01&quot;S</td>
<td></td>
<td></td>
<td></td>
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<tr>
<td></td>
<td>39°42'12&quot;E</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Relay Station (MD364)</td>
<td>74°00'29&quot;S</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>42°59'48&quot;E</td>
<td></td>
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</tbody>
</table>

In 2007/08 summer season, we success installation of Argos AWS at JASE2007. We tried to reboot Argos AWS at Dome Fuji by changing output frequency and Argos AWS at Relay Station by replacing electronics box, but we can not reboot these AWS. Next chance is 2009/10 season due to our icebreaker problem.
Syowa Station and icebreaker “Shirase“

Japanese main base,
Established in 1957 on East Ongle island
Summer: 60 persons
Winter: 30 persons

“Syowa” was named from Japanese emperor’s era, and “Shirase” was named after the first Japanese Antarctic explorer, Nobu Shirase (1861-1946, Antarctic expedition 1911 – 1912).
S16, departing site for inland traverse

J-type AWS
S16, departing site for inland traverse
Inland traverse party to Dome Fuji
Mizuho Station, 250km from S16

- Japanese first inland base
- Established in 1972, now closed
- Facility:
  - small buildings in snow
  - 30m tower
  - Met stations by J-type and Argos AWS

14 years results by J-type AWS. Data logger have been replaced at every year.

Data missing by stopping the logger, probably caused by discharge of batteries.
Comparison of air temperatures by J-type AWS and Argos AWS at Mizuho Station

Argos-AWS contains a lot of spike data ("noise like data"). We must delete these data. How? What is the definition of “noise like data”?
Ws by J-type AWS, 1 hour interval, each 10 minutes average

Ws by Argos-AWS, 10 minutes interval
J-type and Argos AWS at Mizuho Station

Jan. 2003 (photo taken by Dr. K. Fujita)

Jan. 2005 (photo taken by Dr. K. Goto-Azuma)
Argos AWS point
Established in 1993
Replacement of electronics box and batteries in 2007.
However, the data are not transmitted.
Comparison of air temperatures by J-type AWS and Argos AWS at Relay Point

Both data look similar, but some differences exist.
Operations at Relay Point in 2007 season

1. J-type, data collecting and finish observation

2. Argos, replacement of electronics box and batteries in order to reboot the Argos system

3. Results no transmission

Replacement of batteries
Dome Fuji Station, about 1000 km from S16

Japanese second inland base
Established in 1995, now closed

Facility:
- buildings in snow
- deep ice coring facility
  (2503m in 1996 and 3030 m in 2007)
- 10m tower

Met stations by
- J-type and Argos AWS
Deep ice core drilling (1)

Winch with 3400m cable

Drill pit (10m)
Air temperature at Dome Fuji by J-type AWS (1994-2007)

Data missing

Air temperature (°C)

1994 95 96 97 98 99 00 01 02 03 04 05 06 07
This graph was made by deleting “noise like data”. The criteria is temperature difference ($\Delta T$) within 10 minutes is larger than 5 K.

→ Are there any standard methods for deleting the “noise like data”?
Operations at Dome Fuji in 2007 season

1. J-type, data collecting and continue observation

2. Argos, move to 200 m site from the station buildings and adjustment of transmission frequency by rotating small hole without any instruments.

3. Results no transmission

J-type AWS at Dome Fuji
Argos 8904 at Dome Fuji Station

Feb. 1995 setup (No.1)

Dec. 2007 (No.3)

Frequency adjustment

Move to 200m site from buildings

After frequency adjustment, no transmission of the data (Dec. 2007)
Operations at JASE 2007

1. Installation of Argos 30305 in December 2007
   JASE: The Japanese-Swedish Antarctic Expedition in 2007-08

2. Success of transmission

Air temperature from Jan. to Mar. 2008 at JASE2007 by Argos #30305
Data acquisition rate by Argos-AWS (UW-Madison)

Acquisition rate of temperature (%) from Jan. 1995 to Mar. 2008 by Argos #8904 at Dome Fuji

Acquisition rate of temperature (%) from Oct. 2000 to Mar. 2008 by Argos #21359 at Mizuho Station

Acquisition rate of temperature (%) from Jan. 1995 to Mar. 2008 by Argos #8918 at Relay Station

Acquisition rate of temperature (%) from Jan. to Mar. 2008 by Argos #30305 at JASE2007
Problems in AWS data

1. Data quality
   Data lacking and “noise like data” containing (Argos).

   Warming of shelter caused by weak wind condition
   (J-type shield)
Warming of shield by weak wind and strong solar radiation condition in J-type AWS

- Artificial warming of shelter is seen in J-type AWS at Dome Fuji when wind speed becomes less than 1.9 m/s.
Deleting the data by temperature difference ($\Delta T$) within 10 min:

$|\Delta T| > 5K$

Are there any standard methods for deleting the “noise like data” in Argos temp. data?
Surface hoar on Argos AWS at Dome Fuji in winter season

We have tested anti-icing paint, on J-type AWS, but it does not work so good. Any there any good methods?
Future Plan

1. J-Type AWS
   - Continuing at Dome Fuji (Ta, Ws and Wd) and Middle Point (Ts, Ws and Wd)

2. Argos AWS
   - Continuing at Mizuho and JASE2007
   - We hope replacements of Dome Fuji (8904) and Relay Station (8918) in 2009/10 summer season. It is necessary to send two AWS units to Tokyo by the middle of September 2009.
Conclusions

1. We have obtained AWS data at six sites (S16, H21, Mizuho, MD180, Relay Point, MD550 and Dome Fuji; Ta, Ws and Wd) by J-type AWS since 1994. Some data were missing and some data contained artificial warming when wind is less than 1.9m/s.

2. We have obtained AWS data at four sites (Mizuho, Relay Station, Dome Fuji and JASE 2007; Ta, P, Ws and Wd) by Argos-AWS since 1995. Some data were missing and some “noise like data” contained.

3. Quality checking of the AWS data must be done before using the data. Are there any standard methods for checking and correcting the Argos-AWS data? What is the effective method for surface frost on the aerovene?

4. In 2009/10 summer season, we would like to install two AWS units at Dome Fuji and Relay Station.
Publications on AWS by JARE


### Name and position of Argos-AWS installed by JARE

<table>
<thead>
<tr>
<th>Name</th>
<th>Arogs ID number</th>
<th>Position (Latitude (S) Longitude (E))</th>
<th>Elevation (m)</th>
<th>Establishment</th>
</tr>
</thead>
<tbody>
<tr>
<td>Dome Fuji</td>
<td>8904</td>
<td>77°19'01&quot; 39°42'12&quot;</td>
<td>3810</td>
<td>January 1996</td>
</tr>
<tr>
<td>Relay Station</td>
<td>8918</td>
<td>74°01'29&quot; 42°59'48&quot;</td>
<td>3353</td>
<td>December 1995</td>
</tr>
<tr>
<td>Mizuho</td>
<td>21359</td>
<td>70°42'00&quot; 44°17'21&quot;</td>
<td>2250</td>
<td>October 2000</td>
</tr>
<tr>
<td>JASE2007</td>
<td>30305</td>
<td>75°53'17&quot; 25°50'01&quot;</td>
<td>3661</td>
<td>December 2007</td>
</tr>
</tbody>
</table>
J-type (logger type) AWS by JARE
Argos-AWS (UW-Madison) installed by JARE

Mizuho (21359) Jan. 2003
Relay Station (8918) Jan. 1995
Dome Fuji (8904) Feb. 1995
JASE 2007 (30305) Dec. 2007