# SLEIGH Documentation

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# Introduction

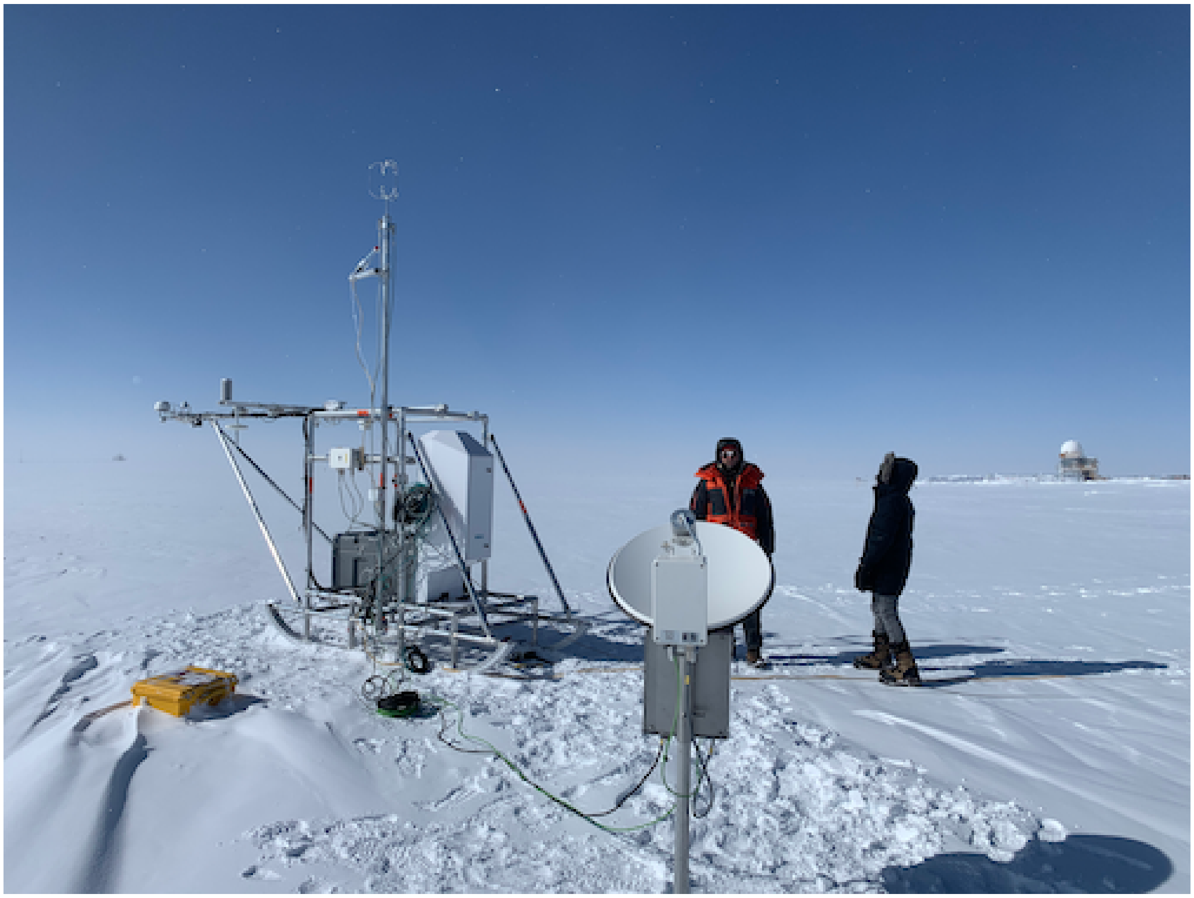

Figure 1: The SLEIGH's first deployment at Summit Station in May 2023.

This documentation provides information on the instrument platform for NSF's Arctic Observing Network (AON) ICECAPS-MELT project. The Integrated Characterization of Energy, Clouds, Atmospheric state, and Precipitation at Summit (ICECAPS) is a long-term experiment that has been conducted at Summit Station, Greenland since April 2010. The MEasurements along Langrangian Transects (MELT) is the most recent sub-project of ICECAPS, which was funded for 2022-2024.

The instrument platform is called the **SLEIGH** - Surface-Layer Environmental Instruments for Greenland Hydrology.

The SLEIGH includes the following instruments:

| Instrument | Acronym |
|---|---|
| Cincoze computer | Cincoze |
| Automated Surface Flux Station | ASFS |
| Ground Penetrating Radar | GPR |
| Micro Rain Radar (MRR) | MRR |
| Microwave Radiometer | MWR |
| SIMB3 thermistor string | SIMB3 |
| Vaisala (CL61) Depolarization Lidar | CL61 |

Note that the Cincoze is the main computer system that controls the platform. All of the other instruments interface to it. In addition to controlling the platform, the Cincoze handles all of the raw data archival.

The ASFS itself is composed of a series of additional instruments:

| ASFS Instruments | Acronym |
|---|---|
| Broadband Radiometers | BRad |
| Meteorological instrument (T,P,U) | Met |
| Metek Sonic Anemometer | Metek |
| Licor gas analyzer | Licor |
| Global Positioning System | GPS |
| Flux plates | FPlt |

# Getting Started

This chapter describes some basic tasks related to operating the platform and how to copy data.

## Startup and Shutdown of the Platform

### Startup

To power on (start up) the instrument platform, ensure that it is plugged into AC 110-V power. Then remove the cover of the gray platform control box, and press the power button on the Cincoze computer. The image below shows the front of the Cincoze computer with the small silver power button in the upper right. Once the power button is pressed, the icon on the button should turn green.


Figure 2: The front of the Cincoze computer with power off; power icon is not green

## Shutdown

To power off (shutdown) the instrument platform, log onto the Cincoze computer using the instructions in **?@sec-loggingIn** below and type

```
poweroff
```

Type the iceman password, if prompted. (Contact either Von or Michael for SLEIGH passwords.)

## Ethernet Access

Before connecting to the platform through the Cincoze computer, one will have to have a direct ethernet connection to the Cincoze. This may be accomplished usijg one of several different setups:

### Remote connection during Summer 2023

There are several steps to connect remotely (in summer 2023) to the platform at Summit Summit. Therefore, these steps are shown here.

### Skylink satellie link

TBD

### MissionLink satellite link

TBD

### Summit Station network

To connect to the Cincoze via the network at Summit Station, one must first log into local network at Summit. There are a couple of different possibilities for how to do this:

- First remotely log into another computer that is already connected to the Summit Station network (e.g., dataman).
- Connect to the local wifi network while at Summit Station.

### Verizon HotSpot

The ICECAPS-MELT project has a Verizon HotSpot that will be connected to the instrument platform when it is deployed in Boulder, Colorado. Researchers will be able to connect to this hotspot using a cellular connection and then log in to have a direct internet connection to the platform. The login credentials are:

- SSID: icecaps
- p: RavenBound

Warning

Typically one must NOT be connected to a virtual private network (VPN) when trying to acces

## Logging into the Cincoze computer

Once you are connected to a device that has a direct connection to the Cincoze, type the following command to SSH to the Cincoze:

```
ssh iceman@xxx.xxx.xxx.xxx
```

where xxx.xxx.xxx.xxx can be found in the following table:

| Connection | IP address |
|---|---|
| Skylink | ???.???.???.??? |
| MissionLink | ???.???.???.??? |
| Summit | 192.168.98.50 |
| Verizon | ???.???.???.??? |

Enter the password for the iceman account, if prompted. This should log you into the Cincoze. The Cincoze uses a Linux-based operation system, so one can issue normal Linux commands from the Cincoze prompt.

Warning

Be careful when executing Linux commands on the Cincoze computer.

## Checking the System Status

The platform is operated using System Services in Linux.

- To view all of the system services running on the Cincoze, type:

  ```
  systemctl status | less
  ```

Note

The addition of "| less" allows one to scroll up and down.

- To view the status of only those processes run by the iceman user (assuming that you're logged in as iceman), type:

  ```
  systemctl --user status | less
  ```

- To view the status of a particular process, type:

  ```
  systemctl --user status mrr
  ```

  - To see a full list of the various processes running on the Cincoze to support the platform, see

## Internal Network

Once you're logged onto the Cincoze computer, you can connect to other instruments using the IP addresses listed below:

| Device | Local IP |
|---|---|
| Cincoze Computer | 192.168.1.10 |
| Skylink Certus Modem | 192.168.111.1 |
| Windows VM | 192.168.1.166 |
| CR1000X Logger | 192.168.1.120 |
| Licor 7500DS Gas Analyzer | 192.168.1.15 |
| Smart Flux | 192.168.1.221 |
| Phoenix EEM-MA370 Energy Meter | 192.168.1.32 |
| MODBUS relay for logger reboot | 192.168.1.97 |
| APC power supply | 192.168.1.11 |
| Ground Penetrating Radar | 192.168.1.161 |
| Metek MRR-Pro | 192.168.1.20 |
| Vaisala CL61 data | 192.168.1.111 |
| Vaisala CL61 maintenance | 172.17.0.2 |

Currently, one must use the `sshpass` command to connect. Below is an example command to connect to the MRR from the Cincoze computer

```
sshpass -p "password-for-mrr" ssh mrruser@192.168.1.20
```

## Retrieving data

Below is a description of the data directory on the Cincoze computer and the associated data filenames. The base directory is /home/iceman/data/. The data in the sub-directories contain near data from the various platform instruments that is copied to the Cincoze in near-real time.

```
home
   iceman
      data
 |   |    asfs
 |   |   |     raw
 |   |   |    |    crd
 |   |   |    |   |     icecaps_asfs_fast_YYYYMMDDHHMM.dat
 |   |   |    |   |     icecaps_asfs_sci_YYYYMMDDHHMM.dat

 |   |    batts
 |   |   |     level0
 |   |   |    |    lynk_bms_candump_YYYYMMDD.log
 |   |   |     level1
 |   |   |    |    BatteryAlarms_YYYYMMDD.csv
 |   |   |    |    BatteryLimits_YYYYMMDD.csv
 |   |   |    |    BatteryMeasurements_YYYYMMDD.csv
 |   |   |    |    BatteryStatus_YYYYMMDD.csv

 |   |    blesensors
 |   |   |     ble_temperatures_YYYYMMDD.log

 |   |    cl61
 |   |   |     live_YYYYMMDD_HHMMSS.nc

 |   |    energymeter
 |   |   |     energymeter.sled.level0.1sec.YYYYMMDD.HHMMSS.nc

 |   |    mrr
 |   |   |     YYYYMM
 |   |   |    |    YYYYMMDD
 |   |   |    |   |     YYYYMMDD.log
 |   |   |    |   |     YYYYMMDD_HH0000.nc

 |   |    mwr
 |   |   |     level0
```

```
|   |   |    |   |      YYMMDDHH.BRT
|   |   |    |   |      YYMMDDHH.HKD
|   |   |    |   |      YYMMDDHH.MET
|   |   |    |   |      YYMMDDHH.BRT.NC
|   |   |    |   |      YYMMDDHH.HKD.NC
|   |   |    |   |      YYMMDDHH.MET.NC
|   |   |       vmdata

|   |      pics
|   |   |       Allsky
|   |   |    |      SKY_YYYYMMDD_HHMMSS.jpg
|   |   |    |   |      small
|   |   |    |   |   |      SKY_YYYYMMDD_HHMMSS_lowres.jpg
|   |   |       Overview
|   |   |    |      FAR_YYYYMMDD_HHMMSS.jpg
|   |   |    |   |      small
|   |   |    |   |   |      FAR_YYYYMMDD_HHMMSS_lowres.jpg
|   |   |       Radiation
|   |   |    |      RAD_YYYYMMDD_HHMMSS.jpg
|   |   |    |   |      small
|   |   |    |   |   |      RAD_YYYYMMDD_HHMMSS_lowres.jpg
|   |   |       SLEIGHMonitor
|   |   |    |      SLEIGH_YYYYMMDD_HHMMSS.jpg
|   |   |    |   |      small
|   |   |    |   |   |      SLEIGH_YYYYMMDD_HHMMSS_lowres.jpg

|   |      power
|   |   |       level1
|   |   |    |      victron_cerbo_data_YYYYMMDD.csv
```

---

To sychronize data from the Cincoze computer to your local computer, one can use the Linux `rsync` command.

```
# Example for syncing the entire CL61 data
rsync -av --rsh=ssh iceman@192.168.98.50:/home/iceman/data/cl61/ /Users/vonw/data/icecaps/pla
```

---

To copy a subset of data from the Cincoze to your local computer, one can use `sftp`.

```
# Example for copying energy data for a given day; single file.
rsync -av --rsh=ssh iceman@192.168.98.50:/home/iceman/data/energymeter/energymeter.sled.level
```

> **Note**
>
> Note that the IP address used in the above rsync commands will vary depending on what mode

To synchonize data from instruments to the Cincoze, one can also use the `rsync` command, but one must include the `sshpass` command:

```
# Example for copying data from the MRR to the Cincoze for data archival
rsync -avz --progress --partial -e 'sshpass -p "metek" ssh' mrruser@192.168.1.20:
/media/mmcblk0p1/data/ /home/iceman/data/mrr
```

# Services

The instrument platform uses Linux services to manage all the instruments. For instance, services can be used to turn certain instruments off or on. Services can also be scheduled to perform certain tasks, like data transfers or backups.

The operation of Linux services are logged into the system journal, so the system journal is a complete record of how the instrument platform services were used during a particular time period, such as a field experiment. The system journal can be used to determine the history of activity of a particular service.

The services for the instrument platform are stored in

```
/home/iceman/.config/systemd/user
```

Here is a complete list of services for the instrument platform as of 21 May 2023:

```
Permissions Size User   Date Modified Name
.rw-r--r--   172 iceman  1 Mar 04:36  asfssync.service
.rw-r--r--   157 iceman  1 Mar 04:36  asfssync.timer
.rw-r--r--   221 iceman 20 May 11:28  datamansync.service
.rw-r--r--   157 iceman 20 May 11:23  datamansync.timer
drwxr-xr-x     - iceman 21 May 13:27  default.target.wants
.rw-r--r--   467 iceman 22 Jul  2022  emacs.service
.rw-r--r--   326 iceman 17 May 15:26  energymeter.service
.rw-r--r--   415 iceman 20 May 15:17  gpr-data-transfer.service
.rw-r--r--   194 iceman 18 May 19:49  gpr-data-transfer.timer
.rw-r--r--   427 iceman 20 May 11:20  gps-data-collect.service
.rw-r--r--   330 iceman 20 May 01:05  midnight.service
.rw-r--r--   181 iceman 21 May 13:26  midnight.timer
.rw-r--r--   266 iceman 18 May 19:29  mrr-data-transfer.service
.rw-r--r--   186 iceman 18 May 19:32  mrr-data-transfer.timer
.rw-r--r--   314 iceman 19 May 12:58  mrr.service
drwxr-xr-x     - iceman 22 Mar 02:43  multi-user.target.wants
.rw-r--r--   226 iceman 15 Dec  2022  mvp_emulator.service
.rw-r--r--   499 iceman 16 Dec  2022  mwr.service
.rw-r--r--   370 iceman 22 Mar 02:45  phonehome.service
```

```
.rw-r--r--  1.8k iceman  1 Mar 01:05  qemu@.service
.rw-r--r--   572 iceman 21 May 13:19  simba-data-collect.service
.rw-r--r--   365 iceman 19 May 12:58  cl61.service
.rw-r--r--   586 iceman 16 May 22:29  vnc.service
```

To view any of these services while logged into the Cincoze computer, type

```
# For instance, asfssync.service
less /home/iceman/.config/systemd/user/asfssync.service
```

Typically, services run scripts on the Cincoze to accomplish certain tasks. Scripts written for the instrument platform are stored in

```
/home/iceman/scripts
```

The directory structure for scripts is

```
  home
      iceman
          scripts
    |   |     apc
    |   |     asfs
    |   |     blesensors
    |   |     cams
    |   |     cruft
    |   |     datatx
    |   |     gps
    |   |     jupyter
    |   |     misc
    |   |     mrr
    |   |     mvp
    |   |     mwr
    |   |     platform
    |   |     simba
    |   |     cl61
```

> **Note**
>
> Navigate to this link to learn more about Linux services.

## Using the System Journal

> **Note**
>
> The system journal is described here.

Some useful commands for accessing information from the system journal are:

```
journalctl --user -b -u mrr
```

which is an example that lists all the activity of the `mrr` service since the last boot, and

```
journalctl --since="2023-05-10 12:00:00" | grep mrr
```

which lists all the activity of the `mrr` service since 10 May 2023 at 12 UTC.

# Configuration

## Windows Virtual Machine (Windows VM)

To configure certain instruments, it is necessary to login into a Windows virtual machine that is setup on the Cincoze computer. To do this from your local computer, you will use a VNC viewer. Before connecting via VNC, you will need to execute the following command to forward the port from the VM to your local computer:

```
ssh -L 5901:localhost:5901 iceman@192.168.98.50
```

This will create an SSH tunnel from your local computer to the Cincoze computer, and then log you in to the Cincoze. Enter the password for the iceman account, if prompted. Once you're logged in, use a VNC client on your local computer to make a VNC connection to:

```
localhost:5901
```

Enter the password for the iceman account again, if prompted. Your VNC client should then show the desktop of the VM on the Cincoze.

Once you have access to the Windows VM desktop, you will be able to configure the ASFS, MRR and MWR as described below.

### Automated Surface Flux Station (ASFS)

### Micro Rain Radar (MRR)

- How to set "comment" and "site_name" using MRR GUI on VM

### Microwave Radiometer (MWR)

## Command Line Interface (CLI)

### Ground Penetrating Radar (GPR)

### SIMB3 thermistor string (SIMB3)

### Vaisala (CL61) Depolarization Lidar (CL61)

- How to set latitude and longitude using maintenance port via the CLI

## APC Internet-Enabled Power Strip

The instrument platform uses an APC internet-enabled power strip to turn certain instruments on and off. The table below lists the instruments and which port of the power strip it uses. The Cincoze computer has a Linux script that can be used to turn any of the port on or off.

| Port | Instrument |
|---|---|
| 1 | |
| 2 | |
| 3 | |
| 4 | |
| 5 | |
| 6 | Vaisala CL61 |
| 7 | |
| 8 | Micro Rain Radar |

# Remote Connection

## SSH connection

### Obtain SSH keys

For easy remote login to the platform (Cincoze) computer, one needs two sets of SSH keys; one for dataman and another for iceman (Cincoze). Please contact Michael Gallagher; he will be able to supply the keys.

### Set up config file for SSH

Add the following to your config file in your ~/.ssh directory on your local computer.

```
Host dataman
    User dataman
    # ....Contact Michael Gallagher for IP address and port number
    Hostname xxx.xxx.xxx.xxx
    Port xxxx
    PubkeyAuthentication yes
    IdentitiesOnly yes
    IdentityFile ~/.ssh/id_rsa_buoy
    ProxyJump gaia

Host iceman
    User iceman
    Hostname 192.168.98.50
    ForwardX11 yes
    ForwardAgent yes
    IdentitiesOnly yes
    IdentityFile ~/.ssh/id_ed_iceman
    ProxyJump dataman
```

```
Host dataman
    User dataman
    # ....Contact Michael Gallagher for IP address and port number
    Hostname xxx.xxx.xxx.xxx
    Port xxxx
    PubkeyAuthentication yes
    IdentitiesOnly yes
    IdentityFile ~/.ssh/id_rsa_buoy
    ProxyJump gaia

Host iceman
  User iceman
  Hostname localhost
  Port 5901
  ProxyJump oracle
  IdentitiesOnly yes
  IdentityFile ~/.ssh/id_ed_iceman

Host oracle
  User flux
  Hostname 158.101.13.249
  Port 22
  ForwardAgent yes
  IdentitiesOnly yes
  IdentityFile ~/.ssh/id_ed_iceman
```

> **Note**
>
> Note that the necessary SSH keys are: - ~/.ssh/id_rsa_buoy - ~/.ssh/id_ed_iceman

> **Caution**
>
> Note that you will have to set the line `ProxyJump gaia` to use the name of your local computer. gaia is Von Walden's linux workstation at WSU.

### Connect to dataman

Using the settings above, one can now connect to dataman by typing:

```
ssh dataman
```

### Connect to iceman (Cincoze)

Using the settings above, note that the connection to iceman uses a ProxyJump to dataman (at Summit). One can connect directly to iceman by typing:

```
ssh iceman
```

## Connecting to the Cincoze VM using vnc

1. Open a terminal window on your local computer and type:

   ```
   ssh -L 5901:localhost:5901 iceman
   ```

   This will set up forwarding from port 5901 to port 5901 on your local computer.

2. Open your VNC client on your local computer and connect to

   ```
   localhost:5901
   ```

3. If the VNC connection works properly, you should be prompted to enter the password for iceman.

List of web servers to connect to using Microsoft Edge Browser

| IP address | Web Server |
|---|---|
| 192.168.1.20:8001 | METEK MRR Pro Webcontrol |
| 192.168.1.20/#Home | MRRPro92: System Configuration |

## Connecting to Web Servers

## Connection to the Jupyter Server

There is a Jupyter Notebook server running on the Cincoze computer. It runs on port 8888, which is the default port used by Jupyter.

1. To avoid, conflicting with a possible Jupyter server on your local computer, type the following command on your local computer to forward the Jupyter server to another port on your local computer:

   ```
   ssh -L 7777:localhost:8888 iceman
   ```

2. To keep this SSH connection active, type `top` in the terminal running SSH once you're logged in to iceman. This provides a more responsive web browser experience.
3. Now connect to the Jupyter Server on the Cincoze by navigating your local browser to

   `localhost:7777`

Please note that this connection can take a long time (minutes). But once you're logged into the Jupyter Server, your browser will be much more responsive.

## Setting up the Windows VM on the Cincoze

```
From Michael G. on 11/29/2023:

There are two ways to use qemu. Without assistance and using libvirt. For the VM I'm using ba

~/.config/systemd/user/qemu@.service
~/.config/qemu/windows.conf
/data/vm/windows_vm.qcow

You start the VM, or shut it down, with "systemctl --user start qemu@windows.service"... the

Finally FYI, something about my tap-bridge config broke with the updated OS and I need to fig

"Connecting" to the VM remotely can be done with vncviewer or with remote desktop. This is pr
```

# Manuals

## SLEIGH

### Automated Surface Flux Station (ASFS)

- User Guide - TBD

### Ground Penetrating Radar (GPR)

- User Guide

### Micro Rain Radar (MRR)

- User Guide
- Theory
- Tutorial
- Improved Mrr Processing Tool - IMProToo

### Microwave Radiometer (MWR)

- User Guide

### Vaisala CL61 Depolarization Lidar (CL61)

- User Guide
- Installation Guide

# MVP

## Orange Pi

## Batteries

## Solar Panels

## Wind Turbines

## Victron Cerbo GX

## Victron Maximum Power Point Tracking 150/70 (MPPT)

- 150 stands for 150 V maximum voltage
- 70 stands for 70 amps maximum current

## Lynx II Battery Management System (BMS)

## Plus Dimension Load Leveler

# Data Summaries

This chapter will describe the summarization process applied to the data, prior to its transfer via Iridium satellite network to SANTA (**S**LEIGH **A**ccess **N**ode for data **T**ransfer and **A**nalysis).

**Note:** the data summarisation is a work in process. If a particular instrument isn't described, or the variables for a given instrument won't be sufficient to assess its performance, get in touch with [who's details, if anyone's, shall we give out on a public website…].

## Notation

The variables reorded by the instruments will be described in tables below, and the descriptions for the reducing of the data will take the form:

- The variable name will be described in the `var` collumn, as it is given in the .nc, .dat or .csv files onboard iceman.
- The dimensions for each variable will be described in the `dims` collumn. For each instrument, the resolution and length of the original dimensions will be described.
- The data reductions will aggregate data along these dimensions to produce new dimensions, described for each variable in `new_dims`. The resolution and size of these dimensions will also be described.
- The function(s) used to aggregate the data from `dims` to `new_dims` will be described in the collumn `fn`.
- A brief description of the use of these reduced variables will be given in the `details` collumn, as well as any other supporting information.

## cl61

### Dimensions

| dimension | resolution | length |
|---|---|---|
| time | *FILL* | (unlimitted) |
| layer | 1 | 5 |
| time' | 15 minutes | 96 per day |

### Variables

| var | dims | new_dims | fn | units | details |
|---|---|---|---|---|---|
| cloud_base_heights | time, layer | time', layer | mean, std | m | The 15-minute mean and standard deviation of the cloud base height for each detected cloud layer |
| cloud_thickness | time, layer | time', layer | mean, std | m | The 15-minute mean and standard deviation of the cloud geometric thickness for each detected cloud layer |
| beta_att_sum | time | time' | median, std | $10^{-4}$ $sr^{-1}$ | The 15-miunte median and standard deviation of the vertically-integrated backscatter coefficient |
| tilt_angle | time | time' | mean, std | ° | 15-minute mean and standard deviation of the instrument zenith angle (from vertical) |
| precipitation_detection | time | time' | sum | 1 | The number of recorded profiles in which precipitation was detected |
| fog_detection | time | time' | sum | 1 | The number of recorded profiles within which fog was detected |
| time | time | time' | count | 1 | The number of recorded profiles per 15-minute window. A proxy for instrument uptime |

## MWR

### Dimensions

| dimension | resolution | length |
|---|---|---|
| time | *FILL* | (unlimitted) |
| number_frequencies | 1 | 8 |
| time' | 15 minutes | 96 per day |

## Variables

### BRT

| var | dims | new_dims | fn | units | details |
|---|---|---|---|---|---|
| time | time | time’ | count | 1 | The number of data records every 15 minutes. Proxy for instrument uptime |
| RF | time | time’ | sum | 1 | The number of data points where the rain flag is present |
| TBs | time, number_frequencies | time’, number_frequencies | mean, std | K | 15-minute mean and standard deviation of the brightness temperatures at each recorded frequency |

### HKD

| var | dims | new_dims | fn | units | details |
|---|---|---|---|---|---|
| time | time | time’ | count | 1 | The number of data records every 15 minutes, proxy for instrument uptime |
| ALFL | time | time’ | sum | 1 | Sum of **AL**arm **FL**ags, indicating critical system status |
| AT1_T | time | time’ | mean, std | K | Ambient target 1 temperature |
| AT2_T | time | time’ | mean, std | K | Ambient target 2 termperature |
| Rec1_T | time | time’ | mean, std | K | Receiver 1 temperature |
| Rec2_T | time | time’ | mean, std | K | Receiver 2 temperature |
| Rec1_Stab | time | time’ | mean, std | K | Receiver 1 temperature stability |
| Rec2_Stab | time | time’ | mean, std | K | Receiver 2 temperature stability |

### MET

| var | dims | new_dims | fn | units | details |
|---|---|---|---|---|---|
| time | time | time’ | count | 1 | The number of data records every 15 minutes, proxy for instrument uptime |

| var | dims | new_dims | fn | units | details |
|---|---|---|---|---|---|
| Surf_P | time | time' | mean, std | hPa | 15-minute mean and standard deviation of surface pressure |
| Surf_T | time | time' | mean, std | K | 15-minute mean and standard deviation of surface temperature |
| Surf_RH | time | time' | mean, std | % | 15-minute mean and standard deviation of surface relative humidity |
| RF | time | time' | sum | 1 | The number of data points where the rain flag is present, should match RF from the BRT data stream |

## Energymeter

### Dimensions

| dimension | resolution | length |
|---|---|---|
| time | *FILL* | (unlimitted) |
| time' | 15 minutes | 96 per day |

### Variables

| var | dims | new_dims | fn | units | details |
|---|---|---|---|---|---|
| time | time | time' | count | 1 | The number of data records per 15 minute period, proxy for instrument uptime |
| ac_voltage | time | time' | mean, std, min, max, median | V | Statistics for the 15-minute distribution of instantaneous supplied voltage |
| ac_current | time | time' | mean, std, min, max, median | A | Statistics for the 15-minute distribution of instantaneous supplied current |

| var | dims | new_dims | fn | units | details |
|---|---|---|---|---|---|
| ac_active_power | time | time' | mean, std, min, max, median | W | Statistics for the 15-minute distribution of instantaneous supplied current |

# MRR

## Dimensions

| dimension | resolution | length |
|---|---|---|
| time | *FILL, 10 s?* | (unlimitted) |
| range | 35 m | 128 |
| time' | 15 minutes | 96 per day |
| range' | 280 m | 16 |

## Variables

| var | dims | new_dims | fn | units | details |
|---|---|---|---|---|---|
| time | time | time' | count | 1 | Number of data records per 15 minute period, proxy for instrument uptime |
| Z | time, range | time', range' | median, std | dBZ | Log-reflectivity |
| VEL | time, range | time', range' | median, std | m $s^{-1}$ | Doppler velocity |
| WIDTH | time, range | time', range' | median, std | m $s^{-1}$ | Doppler spectrum width |
| RR | time, range | time' | mean | mm $hr^{-1}$ | Mean rainfall rate throughout the collumn |
| LWC | time, range | time' | mean( sum[range] ) | g $m^{-2}$ | Mean liquid water path |

# SANTA

The **S**leigh **A**ccess **N**ode for data **T**ransfer and **A**nalysis (SANTA) is a VM set up as part of the ICECAPS external tenancy on the NERC's JASMIN computer.

## Access

## Data Storage

## Data Transfer

## Website Hosting

We have a website! http://www.icecapsmelt.org

### Dashboard Update Pipeline

1. Perform `git pull` on dashboard repo to obtain the latest data visualisation code.
2. Ensure that a `data_dir.txt` file in the root of the repo exists, and is contained in the repo's `.gitignore`. This will allow different users of the repository to securely link to locally stored data.

**Listing 0.1** `e.g. example data_dir.txt on SANTA`

```
/data
```

3. `quarto render` will render the dashboard, which will use `data_dir.txt` to point to the most recently generated data. The render location can be set to the hosted website's location on SANTA. This will automatically update a static quarto render to display the latest available data.

There are a few considerations to implement this procedure: - We need to decide on a timeframe after which the `quarto render` is reran to keep the website up to date. 15 minutes would ensure that as a minimum time delay between a data downlink and it being publicly viewable. - We need a way to ensure that data isn't read as its being written from the SLEIGH. This would be disasterous, as the data partition that SANTA uses is no-parallel-write and this could corrupt data if read and write calls are made at the same time.

#### Solution #1

Push the data to a seperate directory (e.g. `/data/current_downlink`), from which a simple `mv` command is applied, only once the data has been safely downloaded and checked.

**Listing 0.2** `e.g. data transfer pipeline`

```
data on SLEIGH -> /data/current_downlink on SANTA -> /data/hourly_summaries on SANTA
                ^                                  ^

              Iridium                            mv
```