SOUTH AFRICAN NATIONAL ANTARCTIC EXPEDITION

South African National Space Agency

SANAE Training Guide

September 2017

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1 Introduction

Welcome to the South African National Space Agency (SANSA). We hope that you enjoy your training period and your stay in Hermanus.

You are now part of the small band of people who have had the opportunity to spend a year in the most fascinating of continents, Antarctica. You can be justifiably proud to contribute to this international research effort.

SANSA expects you to fulfill your part in this effort to the best of your abilities. Your studies harnessed you with the necessary skills required for maintenance of equipment and smooth running of the data acquisition systems. The necessary physics behind the engineering will be covered in a separate document. The purpose of this orientation guide, training and work program is to explain the tasks which you have to perform; the training that you have to undergo. It will serve as a comprehensive training manual as well as empower you with the necessary background information needed to successfully fit in at SANAE IV (the Base).

Detailed schematics as well as all wiring diagrams and technical procedures are included, as will be used for on-site system training at the base.

During your SANAE team training and during your time at the Base, you will be accountable to the Team Leader on matters concerning the Base household activities and logistical requirements. You are expected to give your scientific work the highest priority.

Part I

The Base

2 SANAE IV Base

2.1 SANAE IV Base

SANAE IV, the fourth South African National Antarctic Base (the Base), has been in use since 1997 where it serves the scientific community of South Africa as a summer and winter research station. Researchers and support personnel visit the station on an annual basis for the installation of necessary instruments for the various scientific projects as well as for maintenance on the basis itself. The over-wintering team is responsible for the various scientific projects as well as for maintaining the base throughout the year.
The Base is built at Vesleskarvet, a nunatak, which is a rocky outcrop peeping out of a snowy surface.

Base Design

The Base consists of three interlinked double story units which can accommodate up to 80 people. Each unit is joined at lower level by inter-leading passageways. All three units are raised above rock surface of the nunatak on stilts.

Temperature Control

The interior temperature of the Base is fully controlled by means of heat exchanges that utilize generator exhaust and coolant heat to warm the Base.

Water Supply

Fresh water is obtained from a manually operated snow smelter (Smelly). Overwintering SANSA team members are responsible for keeping the Smelly filled with fresh snow on a daily basis or as ordered by the Base Team Leader.

Waste Management

All sewage is pumped into a sealed effluent treatment plant, treated and discharged at a certified location.

All other waste is sorted, containerized and transported back to the RSA. It

Figure 2.1: SANAE IV

is the responsibility of Overwintering team members to sort and containerize waste as per Base operations.

Electricity Generation

Electricity is generated by means of water cooled diesel generating sets. An Uninterrupted Power Supply (UPS) system is installed to cater for scientific and medical equipment in case of system failure. It is the responsibility of Overwintering team members to abide by the Base power usage regulations to ensure minimal power wastage.

Communication

The Base is equipped with a satellite link to Cape Town for telephony, fax and internet. All costs for private calls are payable by Overwintering team members, as per the DEA communication policy.

Internet usage is constantly monitored and a fair use policy applies. Overwintering team members must ensure the bandwidth is used more effectively.

Medical

Medical assistance is available at the Base, however, persons suffering known ailments are responsible for ensuring that they take adequate supplies of their own medication for their specific condition.

Toiletries

It is the responsibility of the Overwintering team members to purchase sufficient toiletries.

Recreation

The Base is equipped with several recreational facilities such as, cinema, pool table, table tennis table, dart board, gym, sauna, ect. It is advised that Overwintering team members bring their own materials along to keep busy during the year.

2.2 Engineer Responsibilities

The SANSA Space Weather and Radar Engineers have a number of important roles at the Base. The role of the engineer can be summarised as follows:

1. Maintenance of all SANSA systems, keeping downtime to a minimum.
2. Monthly reporting of all maintenance conducted and general status of all systems.
3. Notifying relevant Principle Investigations of any problems incurred by their system/s.
4. Making a backup of the data collected during the expedition, to be sent back to SSS.
5. Maintain a professional relationship with everyone during the expedition. Represent SANSA proudly.

These points are a simple guideline to the job, and a more formal duty sheet will follow.

Essentially it is important to maintain all the systems so that the best quality of data is captured, with as few interruptions as possible. It is important to record all events that effect the systems, as well as work conducted. Annually a new engineer starts working at the base, so to ensure that all projects develop smoothly, it is important to document all work and adjustments for future engineers to work from.

While the systems are operating smoothly, it is your responsibility to develop the systems further and assist SANSA as far as possible in other project goals. If a system is damaged, it is your sole responsibility to repair it. Normal working hours do not apply in these situations therefore it is your responsibility to ensure that all downtimes are as short as possible.

What follows is a more formal account of duties and responsibilities.

Responsibilities on the S.A. Agulhas

1. Present a talk on the space weather research and related engineering work conducted at the Base and SSS.
2. Supervision of the GPS and data logger during the voyage.
3. Maintain a professional relationship with the Captain, staff and passengers of Agulhas II.

Responsibilities during Take-Over

1. Familiarisation with the daily checking required for maintenance and operation of all the systems at the Base.
2. Coordination of tasks that require assistance of other persons with Scientific coordinator of the handover team.
3. Assisting the handover team leader from SANSA Space Science (SSS) with the compilation of a report on the Space Weather related activities during the handover.
4. Complete duties outlined in the relevant SANAP 3 with assistance of the other Space Weather Scientists.

Year's Duties

1. Ensure that the SANSA Space Science Project runs optimally and as far as possible without interruptions. All failures and interruptions must be reported to the SANSA Antarctic Programme Engineer, and where possible rectified immediately.
2. Daily checking that all equipment and systems are functioning.
3. Daily checking that the system data is recording correctly, and uploaded as per prescribed schedules.
4. Regular inspection of antennas, sensors, cables, loggers and other exposed equipment, especially after terrestrial storms.
5. Field maintenance to address any problems with the equipment such as fault finding, rebooting a PC, running diagnostic software, changes to software, exchanging components where available and investigating sources of noise or anomalous data.
6. Compiling a monthly report in the required format proposed by the previous overwintering member with due record of:
   a) A summary of results of each project.
   b) Changes and adjustments made to any system.
   c) Problems experienced.
   d) Recommendations for improvements.
7. Timely submission of the report i.e. before the 8th (on the 7th) of the following month to the relevant Stakeholders.

8. Notify the relevant Principle Investigators of any known disturbances of data through man-made interference due to maintenance or otherwise.

9. Completion of an event log regarding maintenance and disturbances.

10. Advising the Antarctic Program Engineer of any special conditions which prohibits monitoring duties such as field excursions or base maintenance duties.

11. Cooperation with relevant Principle Investigators in the compilation of data sets for special investigations.

12. Any other duties that may from time to time be requested by SANSA Engineers or PIs.

13. Prior to leaving on a field trip, a complete training guide for the running of the projects must be given to a person who will take over your duties in your absence. Please inform the SANSA Antarctica Programme Engineer about the times and dates of the intended trip.

14. Maintain all documentation, books, equipment, spares, parts and tools of the Space Weather Program. Keep note of items required for ordering.

15. Conduct asset verification whenever requested by the Antarctica Program Engineer. A copy of this document should be left at the Base.

16. At the end of the expedition period all data which has been recorded must be backed up on the available media and removed from the data logging PCs.

17. Verify with relevant P.I. AND SANSA Data Acquisition Practitioner before purging any data.

18. An annual report must be submitted before the end of the Takeover Period. This report along with the monthly reports must remain on the Base.

19. A minimum of 40 hours per week should be dedicated to the Projects and base maintenance. At least 5 hours a week should be dedicated to the Projects during Base emergencies that require attention to be focused elsewhere. All idle time should be dedicated to the analysis of data.

20. Please ensure that all equipment is in good working order when your successor takes over the program during the following year. Train your successor well so that he/she can cope and run the Projects with confidence when you leave.

21. Hand over the program to your successor at least two weeks before the ship departs to allow him/her to become comfortable with the systems, and has time to ask questions when problems arise.

22. Assist the SANAE Team Leader with base duties as required, however this needs to be managed to ensure that scientific work is not jeopardised.

23. Maintain a good documentation base for following engineers. Add to this document where necessary.

Deliverables

The following deliverables were defined in the above duty lists:

1. Monthly Reports as specified, before the 8th of every month.

2. Year-End Report before the end of Take over period.

2.3 Useful Links

Space Weather Links:

In here you will find K-Indices and Solar data.
`http://legacy-www.swpc.noaa.gov/ftpdir/indices/`
`http://www.swpc.noaa.gov/NOAAscales/`
`http://www.tesis.lebedev.ru/en/sun_flares.html`
`http://www.solen.info/solar/`
`http://spaceweather.com/`
`http://www.swpc.noaa.gov/ftpmenu/lists/`

UltraMSK Links:
`http://www.vlf.it/itulist/itulist.htm`
`http://www-user.uni-bremen.de/~ews2/RDF_project.html`
`http://www.smeter.net/stations/vlf-stations.php`
`http://sidstation.loudet.org/stations-list-en.xhtml`
`http://www.aavso.org/vlf-station-list`
`http://alexander.n.se/in-english/`

VLF Group Links:
`http://www.sidmonitor.net/topic/index.html`
`http://www.scribd.com/doc/124373588/An-Experimenters-Approach-to-Detecting-the`
`http://pa3ang.nl/wp/site-overview/wl1030-loop-antenne`
`http://air-radiorama.blogspot.it/2014/03/elf-electromagnetic-pollution-compari`

html
http://www.vlf.it/smith1/opticalink.html
http://www.unixnut.net/efield-nj.html
http://www.unixnut.net/splitrx.html#ReceiverModule
http://ileriseviye.wordpress.com/2012/03/20/baudline-how-to-solve-the-all-inpu
http://abelian.org/vlfrx-tools/
http://solar-center.stanford.edu/SID/sidmonitor/
https://sites.google.com/site/swljo30tb/home
http://www.heliotown.com/Radio_Sprites_Ashcraft.html
http://www.mwlist.org/vlf.php
http://www.vlf.it/
http://www.qsl.net/dl4yhf/spectra1.html
http://theinspireproject.org/
http://www.tubebooks.org/technical_books_online.htm
http://www.sidmonitor.net/topic/index.html
http://www.vlf.it/obs1/monitoringstation.html
http://www.vlf.it/ewer3/spectrum1.html
http://vlf.stanford.edu/

Graphite:
http://graphite.wikidot.com/installation

Weather:
http://www.yr.no/place/South_Africa/Other/Marion_Island/hour_by_hour_detailed.html

MOOC's:
https://courses.edx.org
http://www.coursera.org

Useful Links:
http://www.crontab-generator.org/

Telephone Numbers

SANAE 021 405 9450 (or 9450 internally).

SANSA 028 312 1196 (extension 273 for Space Science).

Conference Call 0, *69 (pin), 0862 000 000, (prompt 1), 13570#.

Marion Island 021 405 9460/1 (from outside).

Part II

Space Weather Systems

3 Space Physics Research Institute Systems

3.1 Overview

The Space Physics Research Institute (SPRI) from the University of Kwa-Zulu Natal (UKZN) historically conducted various Very Low Frequency (VLF) projects at the Base. However, management of the projects was handed over to SANSA. Since then, several other international research institutions, such as the University of Washington, Stanford University, etc., have collaborated with SANSA to expand the scope of VLF projects and produce world class research.

The Space Weather engineer is responsible for the following instruments:

1. World Wide Lightening Location Network (WWLLN).
2. UltraMSK
3. Digital Very Low Frequency Recording and Analysis System (DVRAS)
4. AWD - PLASMON.
5. Pulsation Magnetometer (PMR)

The Space Weather and RADAR engineer has a combined responsibility for both the Scientist Data Server and the Grafana Live Monitoring systems.

System Architecture

All VLF based projects in the SPRI system have a similar five-stage design. The stages can be seen in the figure 3.1 below.

Figure 3.1: Five-stage design of VLF projects in the SPRI system.

1. Sensing – This stage consists of two orthogonal antennae loops orientated in the North/South and East/West directions. These antennae are located roughly 300m from the Base.

2. Amplification – This stage typically consists of a set of pre-amplifier and amplifier that adjust the gain on the signal received from the antenna.

3. Filtering – This stage makes use of low pass, high pass and/or band pass filters depending on the particular projects.

4. Logging – This stage will usually employ a sound card (eg. Delta 44) to convert the signal to a sound file, that is recorded in a data logging computer.

5. Analysis – The raw data is analysed by the project specific software and graphs generated on a daily basis.

3.2 World Wide Lightening Location Network (WWLLN)

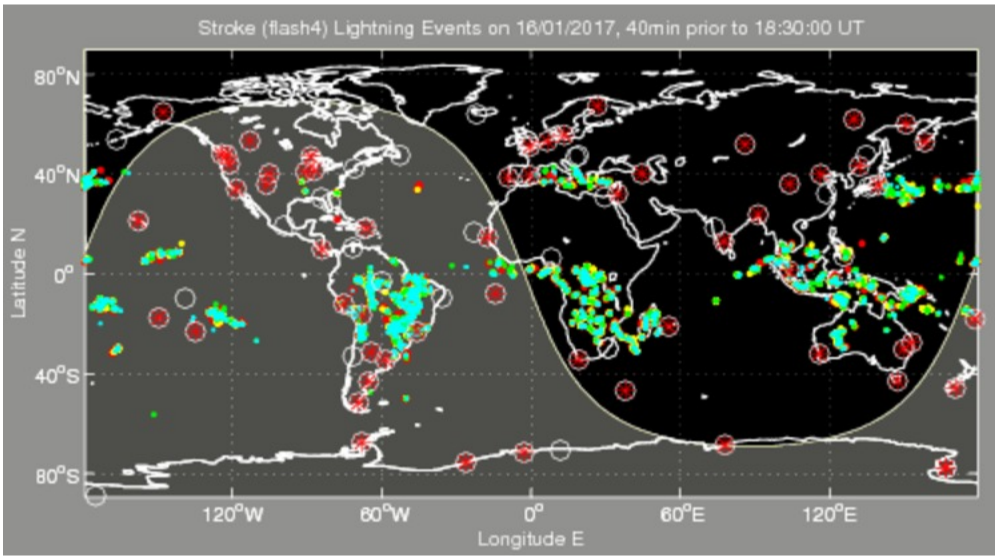


Figure 3.2: WWLLN world map for 16/01/2017. [wwlln.net]

The University of Washington operates a network of lightning location sensors at VLF (3-30kHz) that accurately monitors location and time for lightning strokes over the entire world. This is achieved by the monitoring of sferics on the VLFL system. Sferics are impulsive signals produced by lightning discharges. By calculating the Time of Group Arrival (ToGA) of the sferics, the location of lightning strikes is calculated. The WWLLN node at SANAE forms fart of this network and actively contributes to the global database.

Hardware

The sferics are picked up by the VLF antennae. The signal is amplified by the pre-amp. The amplified signal is then routed via a long (≈ 350m) coaxial cable into the Base, to the Service Unit, which serves to isolate the

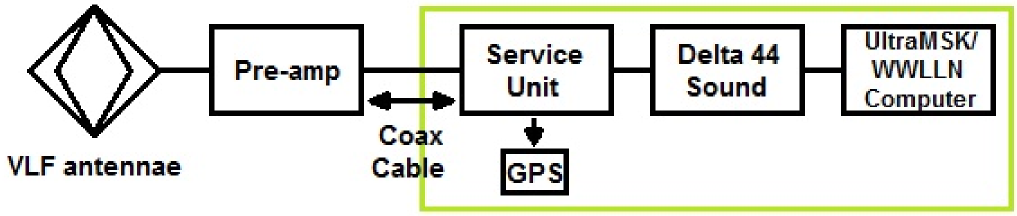


Figure 3.3: VLF antennae hardware.

signal via an audio transform. The service unit feeds the signal to the UltraMSK/WWLLN PC via a Delta 44 sound card that digitises the signal. The GPS provides one pulse per second input to the computer sound and too adjust the time-stamp on each Vlf waveform. The GPS also provides a NMEA( ) signal giving the exact location of SANAE.

Software

The WWLLN software is hosted on the WWLLN/UltraMSK computer. It runs on linux based Slackware 13.1.0 operating system.
There are two user accounts for the computer, "sferix" and "root".
The root user only has root privilages to the UltraMSK system.
The sferix user has root privileges to the WWLLN system, however, that is only accessible by the PI. Generally the PI controls this account remotely via SSH.
To test the system, the "root" user can view the "sferix" user files. To check if data is being uploaded, the file sferics.log can be read using the following command:
sudo tail -f /home/sferix/sferics/sferics.log
Daily checks:

1. To check the WWLLN system, look at the sferics.log file which, on the SANAE WWLLN PC, is located in the /root/sferics/:

   root@SANVLF:~/sferics# ls –l
   total 1520
   -rw-r–r– 1 root root 1546275 Feb 23 10:04 sferics.log
   -rw-r–r– 1 root root 5 Feb 23 09:34 sferics.pid

2. To check whether new data is being added to the file:

   root@SANVLF:~/sferics# tail -f sferics.log
   PPS: t = 1298448273.023, Fs = 96007.241950 Hz, dt = -6.69077e-08 s, 1, r = -1.000000
   Detector: Sferic # 6462 detected

TOGA: offset = 0.000372322 s
Dispersion: (0.000161642 -19.7816 910543), RMS = 20.7714 deg
Sferic: TOGA = 0.00995932 s, RMS amplitude = 2560
UDP: 20 bytes to 128.208.22.18
Detector: threshold = 0.269559, atc = 92, avg rate = 2.96268, total = 6467, reject = 1069
PPS: t = 1298448274.023, Fs = 96007.241965 Hz, dt = -1.3213e-07 s, 1, r = -0.999999

This will keep on writing to the terminal if the system is running. Use Control-C to exit. The main items to check are that there are lines stating "UDP: 20 bytes to 128.208.22.18". If these are present then this means that data is being sent out to the WWLLN data processors. If the 1PPS is missing or NTP is not synced then there will be messages stating NTP bad or 1PPS bad.

3. To check the VLF signal, look at the VLF spectrum image. This is located at /root/public_html/vlf.png and is also available online: http://flash4.ess.washington.edu/sanae/vlf.png

4. Also check that the red lights are flashing at about 1Hz to ensure that it is generating a 1 pps from the GPS unit.

5. All the worldwide stations (including SANAE IV, Marion and Hermanus) can be checked for active operation at: http://flash4.ess.washington.edu/manage/light.log.htm

Troubleshooting

<u>**Contact details**</u>	<u>**Software details**</u>
Contact person: Prof. Robert Holzworth **Email:** bobholz@ess.washington.edu **Website:** http://wwlln.net **Other site:** http://flash4.ess.washington.edu/manage/light.log.htm (SANAE Station ID 48)	**jackd:** Audio server splitting audio input between WWLLN and UltraMSK **toga.jack:** Transfer data to Washington slackware_msk: UltraMSK logging software that also runs on the computer

Computer details **OS:** Slackware 13.1.0 **IP:** 192.168.1.71 **User name:** root **Password:** sanvlf	**Auxiliary programs** **NTP:** Network time protocol server using the GPS time (GPS_NMEA) as favourite **baudline_jack:** Display program for jack inputs (Channel 1 GPS, Channel 2 signal) **alsamixer:** Sets computer gain in software for both systems
Data details **Data directory:** As root: ∼/sferics.log file – Logs sferics that gets send per hour/day etc. Note that none of the sferics data are saved for more than 24 hours. **Data type:** sferics.log **Size:** sferics dependant Daily .png: On server pc **Transfer:** Transmitted to Seattle and Dunedin. The E/W signal does not go through the SU box.	**Useful links** http://wwlln.net/L_plot_global_map.jpg http://flash4.ess.washington.edu/manage/light.log.htm http://wwlln.net/WWLLN_Stn_Hbook_2011.pdf http://flash4.ess.washington.edu/manage/light.log.htm
Useful Linux Commands **/sbin/reboot:** Reboot computer **Startx:** Starts graphical users interface **Sudo baudline_jack:** Start frequency viewing program **alsamixer:** Use arrow keys to move between channels and up and down **ntpq – p:** Checks NTP server for accuracy	

Table 3.1: General Information about the WWLLN system.

3.3 UltraMSK

The UltraMSK is used to remotely sense the bottom side of the ionosphere for magnetospheric disturbances. The instrument records the phase and amplitude of minimum shift keying (MSK) modulated narrow band signals. There are a number of transmitters world wide, of which signal is received from 7 at SANAE. These transmitters have been chosen basec on the propagation path from T_x to R_x. Paths are for different science purposes.
In general, the signals received from these transmitters will change in a

semi-predictable manner throughout the day (during the diurnal cycle), however, certain space weather events such as solar flares will have an immediate effect on the MSK signals.

Hardware

The VLF antennae picks up signals from the transmitters. The loop facing N-S monitors signals from European origin, whereas E-W loop monitors signals propagating zonally [dahlgren_2011].

Software

As explained in section 2.1.2, the UltraMSK software is hosted on the same machine as the WWLLN. The VLF signal input from the Delta 44 creates a "vtcard" audio, so that multiple clients (UltraMSK and WWLLN) can connect to the source. Figure **??** shows an illustration of the system connections.

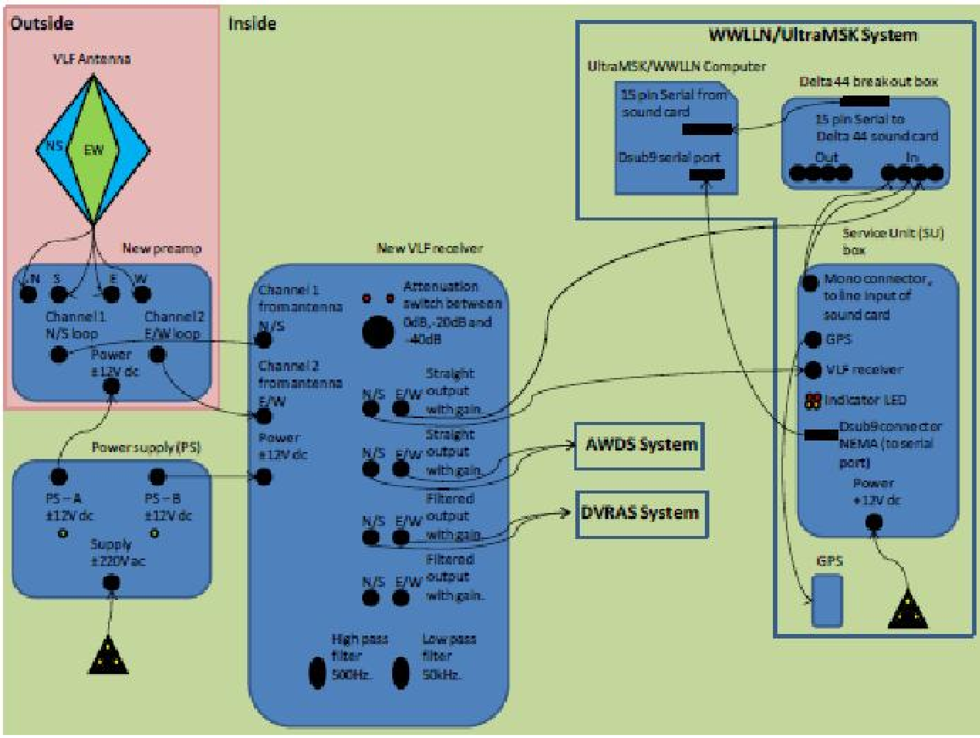


Figure 3.4: Diagram of the WLLN/UltraMSK systems.

Monthly Checks

Startup script:
>cd /home/sferix/ultramsk

>./run-ultramsk.sh

Mailing script. To add or remove email address look at the last lines of the script:
> vim /home/sferix/ultramsk/report-ultramsk-bin_mutt.sh

The jackd start-up script and log:
>/home/jackd_restart.py
>cat /home/jackd_start.log

To use baudline to display real-time data of the N/S signal and the pps signal:
>cd /usr/local/bin/baudline/baudline_1.08_linux_x86/
>./ baudline_jack – jack
Right click record, click inputs, channel mapping (I used red and blue). Keep the terminal open, baudline closes with the terminal.

Troubleshooting

Contact details **Contact person:** James Brundell **Email:** jbrundell@gmail.com	**Software details** **jackd:** Audio server splitting audio input between WWLLN and UltraMSK **msk-slackware-1:** UltraMSK logging software – one instance per frequency should always be running
Computer details **OS:** Slackware 13.1.0 **IP:** 192.168.1.71 **User name:** root **Password:** sanvlf	**Auxiliary programs** **NTP:** Network time protocol server using the GPS time (*GPS_NMEA) as favourite **baudline_jack:** Display program for jack inputs (Channel 1 GPS, Channel 2 signal) **alsamixer:** Sets computer gain in software for both systems

Data details	**Useful Linux Commands**
Data directory: /home/sferix/ultramsk/data/	**/sbin/reboot:** Reboot computer
Data type: .bin (binary files)	**Startx:** Starts graphical users interface
Logging frequency: 1 data file per day for each frequency monitored	**Sudo baudline_jack:** Start frequency viewing program
Size: 1.8MB / file per frequency per day	**alsamixer:** Use arrow keys to move between channels and up and down
Naming format: frequency_YearMonthDay_SAN.bin e.g. 23.4_EW_20111202_SAN.bin for 2011/12/02	**ntpq – p:** Checks NTP server for accuracy
Notification: Spectrogram report via email. Daily .png: On server pc	**cat /etc/slackware-version:** check version of OS on the computer.
Transfer: return to South Africa after each summer voyage.	**ps aux | grep msk:** Instances of different frequencies running
Backups: Data is backed up data to NAS.	**ps aux | grep toga**

Table 3.2: General information on UltraMSK

Email Configuration

The email configuration is done in /etc/msmtprc. The following settings is used:

host smtp.gmail.com
port 587
protocol smtp
auth on
from sanae.physics@gmail.com
user sanae.physics@gmail.com
password whistlers789

3.4 Digital Very Low Frequency Recording and Analysis System (DVRAS)

General information about the DVRAS system.

The analysis of VLF wave data at high latitudes is a powerful tool for remote sensing of processes in the magnetosphere, providing data complementary to other techniques which, for example, monitor particle precipitation and magnetic field variations see manual: https://projectswiki.hmo.ac.za/index.php/File:Dvrasmar [Dvrasmanual.pdf, A. B. Collier, Space Physics Research Institute, University of KwaZulu-Natal, August 1, 2010, A.B. Collier].

The Digital Very Low Frequency (VLF) Recording and Analysis System (DVRAS) is used to collect this VLF wave data.
See Figure **??** for connections to the DVRAS system.

See that process is running:

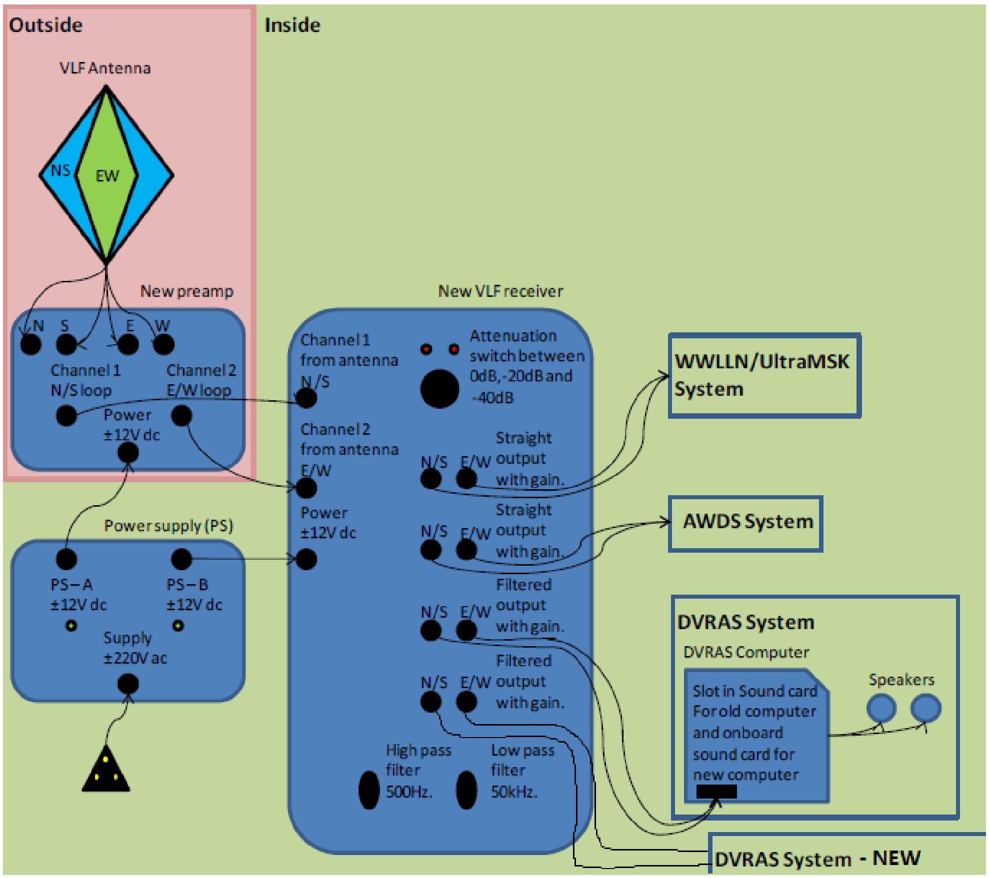


Figure 3.5: Diagram of the connections to the DVRAS system.

>ps aux |grep dvrecord

Find files for the last ten minutes:
>cd usr/local/share/dvras/data (or cd /mnt/datahdd/dvras/data – locations are linked)
>find. –mmin –10

Check that last quicklook email was sent:
>tail ~/dvreport-log.txt

Scripts of importance:
>cd /usr/local/bin
dvreport, dvrecord, dvcalibrate
>cd /usr/local/lib/python2.7/dist-packages/dvras
notify.py – contains SMTP details etc.

Combined quicklook files are stored in the /tmp folder, but this folder is intermittently cleared. Thus the files are moved to /home/dvras/work/combined_quicklooks_60days and only cleared after 60 days with crontab instructions. Individual quicklooks are stored on /mnt/datahdd/dvras/data/pdf

The sound files are recorded to /mnt/datahdd/dvras/data and zipped to ./archive after one day with a crontab instruction.

Edit tables in mysql:
>sudo mysql –u dvras –p dvras
User password >dvras001

Password for mysql database >fofedfi
Tables in mysql:
mysql> SHOW TABLES;
mysql> SELECT * FROM email WHERE email LIKE 'bvaneden@sansa.org.za';
mysql> DELETE FROM email WHERE email LIKE 'bvaneden@sansa.org.za;
mysql> INSERT INTO email (email) VALUES ("bvaneden@sansa.org.za ");
mysql>exit;

Configuration file location:
/home/dvras/.dvrasrc

Monthly Checks

Useful Linux Commands

Quick commands
whereis dvrecord: Find dvrecord
sudo Crontab -l : See crontab schedule)
sudo Crontab -e: Edit crontab i: Insert, :wq: write quit.
/usr/local/bin/dvrecord: Startup script for recording

Troubleshooting

Contact details **Contact person:** Dr. Stefan Lotz **Email:** slotz@sansa.org.za **Website:** http://chinstrap.ukzn.ac.za/mdvdep/	**Software details** **dvrecord.sh:** Recording script for new DVRAS **dvreport:** Quicklook generator from database
Computer details **OS:** Ubuntu 10.04 LTS **IP:** 192.168.1.180 **User name:** dvras **Password:** dvras001 **Username:** sanvlf1 **Password:** sanvlf1	**Auxiliary programs** **NTP:** Network time protocol server using the GPS time (GPS_NMEA) as favourite **mysql:** Data base program for data and email server
Data details **Data directory:** //mnt/datahdd/dvras/data **Data type:** audio .wav files **Logging frequency:** data file per 2 minutes Size: 721 files/day, 9.6MB/file (6.2MB zipped) Daily .png: Not yet **Naming format:** yyyym-mdd_hhmmss_stationname e.g. 20141229_145200_SAN.wav for 2014/12/29 at 14:52 **Transfer:** return to South Africa after each summer voyage. **Backups:** Backup data to NAS **Soundcard gain:** Set in /home/dvras/.dvrasrc (file)	

3.5 AWD - PLASMON

Contact details **Contact person:** Dr. Janos Lichtenberger **Email:** lityi@sas.elte.hu	**Software details** **AWD:** Data collection and software module (driver starts data logging).
Computer details **Old New** **OS:** Fedora ? **IP:**192.168.1.170 **Username:** root **Password:** Tihany	**Auxiliary programs** **NTP:** Network time protocol server 192.168.1.8

Data details **Data directory:** /u2/sanae/vr2/wh_vr2_rt/* **Data type:** *.vr2 Wh_vr2_rt: minute files and Kesz: hourly files **Logging frequency:** Hour data files, closed when round hour is reached. Hour files is processed by PLASMON to create files that may contain whistlers (4 second files) **Size:** 2.3MB **Daily .png:** sever computer **Naming format:** yyyy-mm-ddUThh:mm:ssssssss.sanae.vr2 (records fraction of a second up to 8th digit) **Transfer:** return to South Africa after each summer voyage. **Backups:** Backed up to NAS	

Table 3.4: General information about the PLASMON system.

Description

The PLASMON system extracts portions of the VLF broadband waveform which contains whistlers.
The processing system composes of four computers which are labelled AWD1, AWD2, AWD3 and AWD4 which are connected via a gigabit Ethernet switch.
For details please see the document 'Setting up the new (2012) automatic whistle detector' written by Gavin Mutch. The file can be found here:
https://projectswiki.hmo.ac.za/index.php/SPRI#Automatic_Whistler_Detector_.28AWD.29

Monthly Checks

Useful Linux Commands

ntpq – p: Checks NTP server for accuracy

Troubleshooting

3.6 Aurora Camera

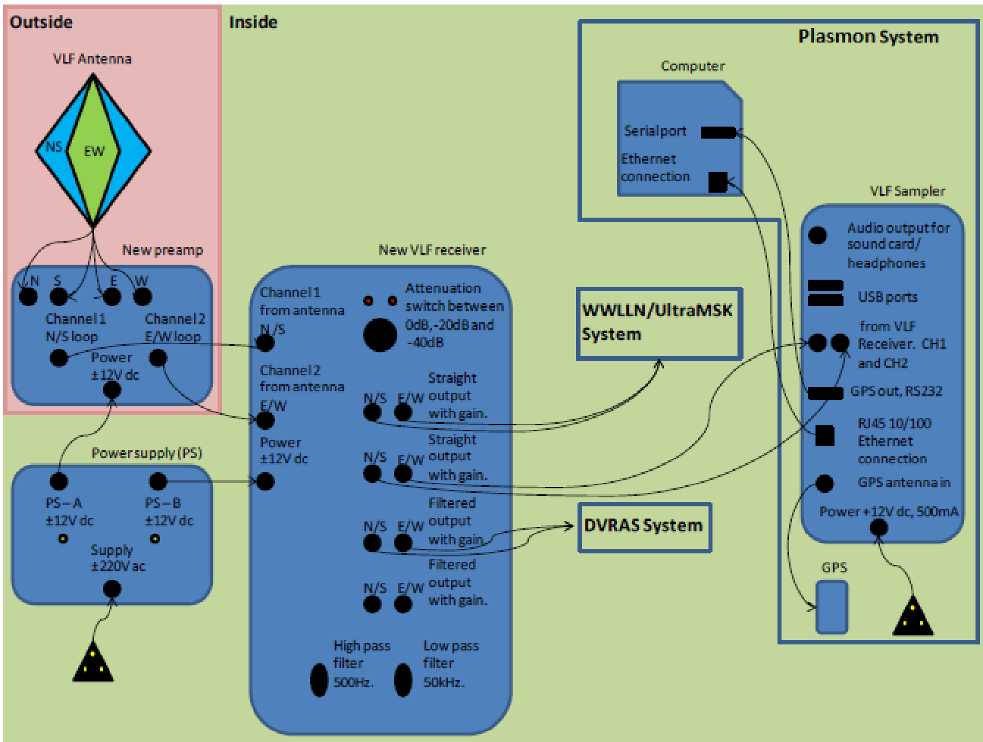


Figure 3.6: Diagram of connections to PLASMON System.

Contact details **Contact person:** **Email:**	**Software details**
Computer details **OS:** Ubuntu desktop 11.04 **IP:** 192.168.1.155 **User name:** sanaur1 **Password:** sanaur1	**Auxiliary programs** VLC media player – for the recording of video

Table 3.5: Aurora Camera

Description

There used to be two cameras, a wide angle and narrow angle camera. The cameras were handed over to SANSA from NWU at the beginning of 2011. The system was neglected and mostly in disrepair. The only camera that was still operational at the beginning of 2012 was the narrow angle camera. This camera takes black and white light intensity videos and was operational but quality of the video produced by this unit was in doubt as to whether it was usable. Also the dome demister of this unit was not working and the dome would mist up.

The video amplifier box broke in Aug of 2012 and it is under review whether the whole system is to be replaced with a more up to date system.

Aurora Alarm:

automatically on computer startup. The alarm tone and other alarm scripts (e.g. static alarm...) can be found at /home/magneto/Alarm/ directory although they are not used.

Monthly Checks

Troubleshooting

3.7 Pulsation Magnetometer (PMR)

Contact details **Contact person:** Dr. Andrew Collier **Email:** collierab@gmail.com **Website:** http://chinstrap.ukzn.ac.za/moodle/	**Software details** The adam4017logger–0.1 software was modified to accommodate this system.
Computer details **OS:** Ubuntu Server 10.04 **IP:** 192.168.1.207 **Username:** sanpmr **Password:** sanpmr **Data location:** /home/sanpmr/pmr/New_Software/adam4017logger-0.1/src	**Auxiliary programs** Backup and plotting scripts on Server computer in /home/mag/scripts directory

Table 3.6: Information about PMR system.

Description

The Pulsation Magnetometer works by means of two coils aligned North-South and East-West which enables the system to measure changes in the earth's magnetic field.

Unfortunately no documentation on the system design could be found and what little information was available was used to at least log the values obtained from the A-to-D modules connected to the two coils.

Software:

As mentioned above, the software was initially written by Herman Theron and modified for this system. To enable the system to capture the data to an HDF5 file the software was modified. The executable and data files can be found in the following directory on the PMR computer:
>cd ~/home/pmr/New_Software/adam4017logger–0.1/src/
>sudo ./adam4017–logger

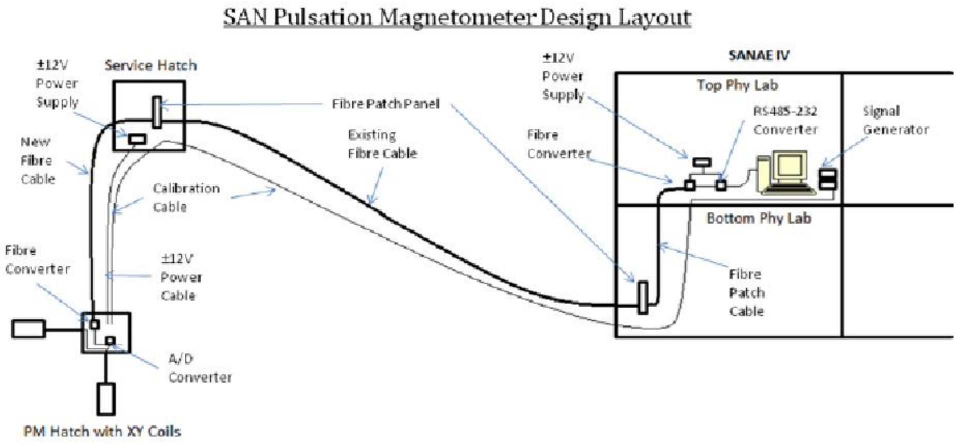


Figure 3.7: Diagram of the Pulsation Magnetometer.

Currently the software logs the values obtained from the 4017 module every second.

Monthly Checks

Troubleshooting

4 Polar Space Weather Studies Systems

4.1 Overview

Put intro here

The Space Weather engineer is responsible for the following instruments:

1. Rock Magnetometer (SANRKM1)
2. Overhauser Magnetometer (SANOVH1)
3. Fluxgate Magnetometer (SANFGM1)
4. DTU Magnetometer (SANDTU1)
5. Imaging Riometer
6. Wide Angle Riometer

The Space Weather and RADAR engineer has a combined responsibility for both the Scientist Data Server and the Grafana Live Monitoring systems..

4.2 Rock Magnetometer (SANRKM1)

Contact details **Contact person:** **Email:**	**Software details** The magneto software performs the data logging on the system.
Computer details **OS:** Slackware **IP:** 192.168.1.154 **User name:** magneto, root **Password:** dorian, anoksamigo	**Auxiliary programs** Backup and plotting scripts on Server computer in /home/mag/scripts directory /home/CheckforData/checkfordata script – which restart magneto program if it fails before midnight

Data details **Data directory:** /home/magneto/data **Data type:** .DAT **Data file size**: 7.17MB **Logging frequency:** 1 file per day **Daily .png:** on server pc **Naming format:** YearJulianDay.MAGRIO.DAT e.g. 2012290.MAGRIO.DAT for 2012/10/16 **Transfer:** return to South Africa after each summer voyage. **Backups:** Backed up to NAS **Aurora alarm log:** /home/nuwe_alarm/alarm.log	

Table 4.1: Information about the SANRKM1 system.

Description

Aurora alarm:

The aurora alarm is executed on this system and monitors fluctuations of the magnetic field. When the fluctuations exceed the sensitivity value an audio (.mp3) file is played on the speakers located in the top physics laboratory.

The Rock Magnetometer receiver:

Figure **??** shows a picture of the modified receiver.

The circuit that usually suffers from static damage is the PC36 circuit shown in 4.2. In particular the op–amp is usually the component that requires replacement.
When static damage does occur, switch off the receiver and replace the op–amp. Switch the receiver back on and either restart the computer or restart the magneto program to resume data logging. Please note that during storms with high winds it is sometimes better to only resume logging once the wind speed has dropped.

Weekly and Monthly Checks

Weekly procedure for data processing:

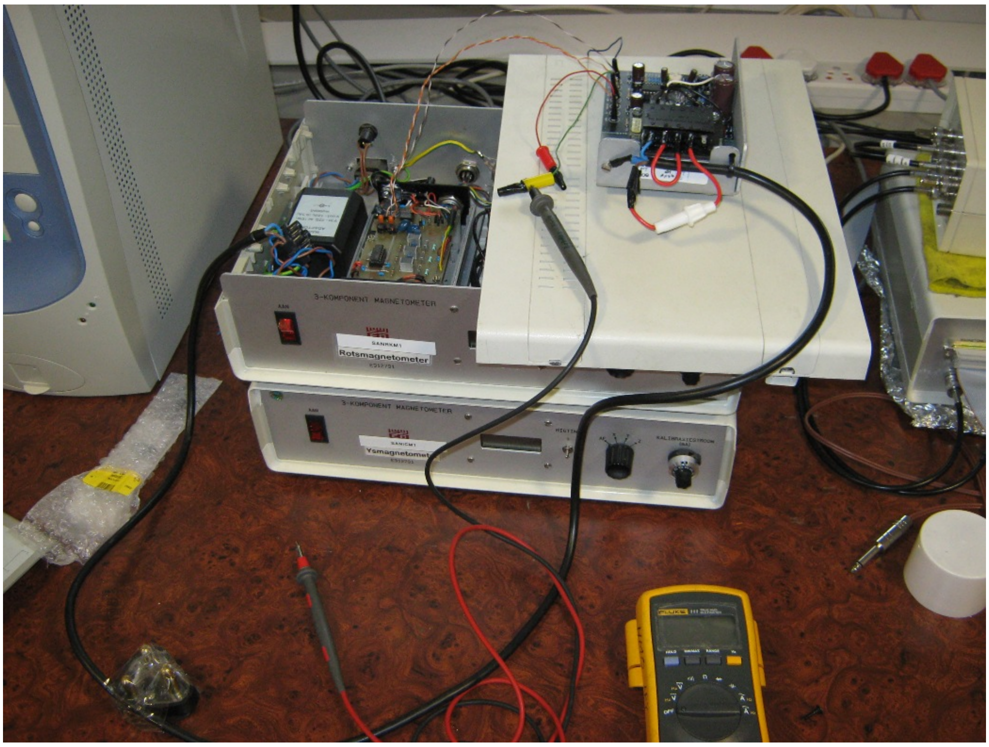


Figure 4.1: The Rock Magnetometer receiver.

Magnetometer and wide-angle riometers - Weekly uploads

In these instructions the following substitutions should be made:
[YEAR] is the four digit year number. (eg. 2011)
[MONTH] is the two digit year number. (eg. 01)
[START_DAY] is the three digit first day of the week. (eg. 001)
[END_DAY] is the three digit last day of the week. (eg. 008)

1. Open a new shell window.
2. Change to the data directory.
   'cd data'
3. Check that all the files for the week are there.
   'ls'
4. For the first upload of the month, create the directories for the processed data in the form [YEAR]/[MONTH]/arch, [YEAR]/[MONTH]/dat and [YEAR]/[MONTH]/min.
   eg. 'mkdir –p 2011/01/arch 2011/01/dat 2011/01/min'
5. Change to the 'arch' directory for the month.
   eg. 'cd 2011/01/arch'

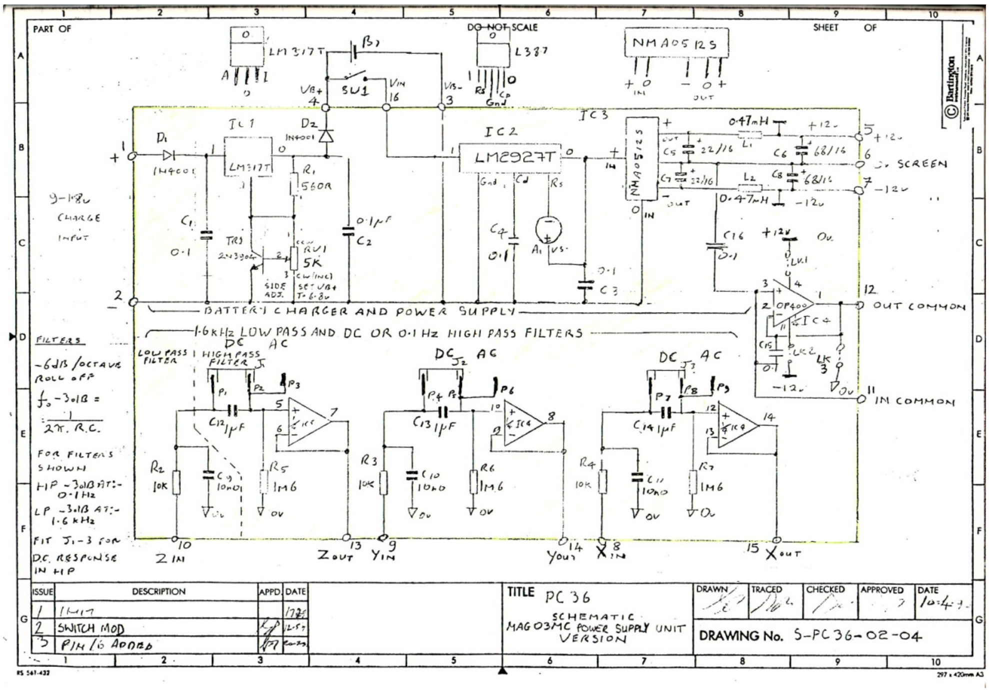


Figure 4.2: The PC36 circuit diagram.

6. Copy the files to be uploaded to the arch directory just created.
   eg. ’for DAY in ’seq –w [START_DAY] [END_DAY]’; do cp –v ∼/data/[YEAR]$DAY.MAGRIO.DAT ./; done’

7. Run the IDL environment to edit the data files.
   ’idlde’

8. Open the editor IDL program.
   File > Open : /home/magneto/MNRioEdit.pro

9. Compile and run the program.
   Run > Compile All, Run > Run MNRioEdit

10. Edit all the files for the week and save them as required.

11. Exit IDL.

12. Calculate the minute average files for every day.
    ’~/bin/minute_averages.py ./.MAGRIO.DAT’

13. Create a BZIP2 archive to upload with the name [START_DAY][END_DAY][YEAR].MAGRI
    eg. ’tar cjvvf 0010082011.MAGRIO.minute_average.tar.bz2 .minute_average× .DAT’

14. Upload the data file to Potchefstroom IP 143.160.38.203 as user ’sanae’ with password ’3blindmice0’.
    eg. ’scp 0010082011.MAGRIO.minute_average.tar.bz2 sanae@143.160.38.203: ’

15. Move all the files to their appropriate directories.
    'mv .minute_average.DAT ../min/' and
    'mv .MAGRIO.DAT ../dat/'

16. Close the shell window.

Monthly Calibration of Magnetometer:

A calibration of the system is performed once a month. The calibration of the systems requires that a multimeter set to measure current is connected to right hand side of the receiver. A potentiometer is then tuned to the following values:

0mA, 50mA, -50mA, -100mA, 100mA, 150mA, -150mA, 0mA

for a 10 second time period through all three of the magnetometer axes. After the calibration has been completed a copy of the data file can be made and viewed in the MAGRIOEdit program. Whilst in the program, go to B magnetometer, highlight the appropriate part of the data with the mouse and press + on the keyboard to zoom in. Read the nano Tesla values off of the graph and record these values for the table in the PSWS monthly report.

Figure 4.3: RKM Calibration

Monthly Plot of Magnetometer Data:

On the work PC, copy the data files for the month to the RKM_monthly directory. Correct the date in the RKM_monthly.py script and run the script. This script will create a monthly plot of the data for inclusion in the PSWS monthly report.

Useful Linux commands

Su root: Switch user to root
df –lh: See hard drive information
cd /usr/local/magneto/bin
./magneto :restart process
./nuwe_alarm/aurora_alarm_
nuut & disown: Execute aurora alarm from home directory
ps aux | grep nuut: check if aurora alarm process is running

Troubleshooting

4.3 Overhauser Magnetometer (SANOVH1)

Contact details **Contact person:** Herman Theron or Errol Julies **Email:** htheron@sansa.org.za or ejulies@sansa.org.za	**Software details**
Computer details **OS:** Ubuntu **IP:** 192.168.1.202 **User name:** data_reader **Password:** !dsfs!reader_sna **Type:** iBox	**Auxiliary programs** OVH_monthly.py and SANOVH1_monthly_days.py scripts

Data details **Data directory:** /data **Data type:** (text file with no extension) **Data file size:** 303.75KB **Logging frequency:** 1 file per day **Daily .png:** on server pc **Naming format:** SNAOVH1-YYYYMMDD e.g. SNAOVH1–20121016 for 2012/10/16 **Transfer:** return to South Africa after each summer voyage. **Backups:** Backed up to NAS	

Table 4.2: Information about the SANOVH system.

Description

This section is an introduction written by Dr. Ivan Hrvoic for the overhauser magnetometers.

Proton magnetometers are an excellent example of nuclear physics phenomena brought into and exploited in our normal, macroscopic world. Relatively easy and efficient manipulation of nuclear precession phenomena is possible and very often done even without proper understanding of the underlying physics.

Overhauser effect is based on the same nuclear physics phenomena, although marginally more complex and again macroscopically engineered to improve on "simple" proton precession effects in order to achieve much better precession signals from smaller sensors and using less power. Since the polarization of protons (generation of proton precession signal) does not require strong static magnetic fields but uses strong radio frequency magnetic fields transparent to protons, measurements can be done concurrently with it. Furthermore, in the ultimate triumph of the method one can produce a stationary, non- decaying proton precession signal, in vague similarity to alkali vapour magnetometers using simple feedback techniques.

Overhauser magnetometers are unique in:

– Keeping highest absolute accuracy of proton precession (this is primary standard for measurement of magnetic field in general).
– Improving greatly on sensitivities of proton magnetometers and enabling

the highest accuracy to be practically achieved in weak magnetic fields such as the Earth's.
– Allowing for continuous, uninterrupted measurement of the magnetic field of the Earth with sufficient speeds for any airborne work of study of fast phenomena occurring in the Earth's magnetic field.

There is a GSM-19 magnetometer that was the first magnetometer installed at SANAE IV for the Hermanus Magnetic Observatory (HMO) in 2007, and so is a portable, high sensitivity total field magnetometer, used in a base station application at SANAE IV. The speciications offered by the equipment are:

- Resolution: 0.01nT
- Absolute accuracy: 0.2nT
- Data input and format: Serial FS-232 & ASCII

The set-up consists of the following system components:

1. Dual-coil magnetometer sensor
2. Electronics console with graphical man-machine interface
3. 6 pin console with graphical man-machine interface
4. GPS position reference
5. Power supply
6. Data acquisition interface (RS-232 to optical converter)

To view the data, do not log in with WinSCP, rather use Putty.

Monthly Checks

Monthly Plot of Magnetometer Data:
On the work PC, copy the data files for the month to the OVH_monthly directory. Correct the date in the OVH_monthly.py and SANOVH1_monthly_days.py script and run the scripts. These scripts will create a monthly plot of the data and daily plots for the month for inclusion in the PSWS monthly report.

Useful Linux Commands

ls –l

Troubleshooting

4.4 Fluxgate Magnetometer (SANFGM1)

Contact details **Contact person:** Herman Theron or Errol Julies **Email:** htheron@sansa.org.za or ejulies@sansa.org.za	**Software detail**
Computer details **OS:** Ubuntu **IP:** 192.168.1.202 **User name:** data_reader **Password:** !dsfs!reader_sna **Type:** iBox	**Auxiliary programs** FGM_monthly.py script
Data details **Data directory:** /data **Data type:** (text file with no extension) **Data file size:** 59 376B **Logging frequency:** 1 file per day **Daily .png:** on server pc **Naming format:** SNADSFS1–YYYYMMDD e.g. SNADSFS1–20121016 for 2012/10/16 **Transfer:** return to South Africa after each summer voyage. **Backups:** Backed up to NAS	

Table 4.3: Information about the SANFGM system.

To view the data, do not log in with WinSCP, rather use Putty.

Description

Monthly Checks

Monthly Plot of Magnetometer Data:

On the work PC, copy the data files for the month to the FGM_monthly directory. Correct the date in the FGM_monthly.py script and run the scripts.

These scripts will create a monthly plot of the data and daily plots for the month for inclusion in the PSWS monthly report.

Useful Linux Commands

ls –l

Troubleshooting

Yearly calibration

Orientation around the SANFGM1 hatch: This system has to be calibrated once a year during takeover. This consists of using a multimeter and a non-magnetic screwdriver to set the voltage levels of the 3 axes by turning a pot. Adjust the output to all the channels to a value between 0 and +/- 0.3125V Analogue outputs:

- Yellow: X-0ut (H)
- Black: Ground
- Green: Y-Out (D)
- Grey: T2
- White: T1
- Blue: Z-Out (Z)

4.5 Imaging Riometer

Contact details **Contact person:** Herman Theron or Errol Julies **Email:** htheron@sansa.org.za or ejulies@sansa.org.za	**Software details**
Computer details **IP:** 192.168.1.157 **User name:** ira **Password:** dorian	**Auxiliary programs** Beeldrio_monthly.py script

Data details **Data directory:** /mnt/data/ira **Data type:** (text file with .dat extension) **Data file size:** 33 955 200B **Logging frequency:** 1 file per day **Naming format:** YYYY-DDD.beeldrio.dat e.g. 2012032.beeldrio.dat for 2012/02/01 **Backups:** Backed up to NAS	

Table 4.4: Imaging Riometer

Description

Monthly Checks

Monthly Plot of Imaging Riometer Data:

On the server, copy the data files for the month to the IRio directory. Correct the date in the Beeldrio_monthly.py script and run the scripts. These scripts will create a monthly plot of the data for inclusion in the PSWS monthly report.

Useful Linux Commands

ls -l

Troubleshooting

4.6 Wide Angle Riometer

Computer details **OS:** Slackware **IP:** 192.168.1.154 **User name:** magneto **Password:** dorian	**Auxiliary programs** WyehHoek_monthly_2015_v0.py script

Data details **Data directory:** /home/magneto/data **Data type:** *.DAT **Data file size:** 7.17MB **Logging frequency:** 1 file per day **Daily .png:** on server pc **Naming format:** YearJulianDay.MAGRIO.DAT e.g. 2012290.MAGRIO.DAT for 2012\10\16 **Transfer:** return to South Africa after each summer voyage. **Backups:** Backed up to NAS	

Table 4.5: Wide Angle Riometer system specifications.

Description

Monthly Checks

Monthly Plot of Wide Riometer Data:

On the server, copy the data files for the month to the IRio directory. Correct the date in the WyeHoek_monthly_2015_v0.py script and run the scripts. These scripts will create a monthly plot of the data for inclusion in the PSWS monthly report.

Useful Linux Commands

ls -l

Troubleshooting

4.7 System maintenance

VLF Antenna

The VLF antenna requires that inspection be carried out in terms of the loops and the mast

The loops should be located as high as possible on the mast and NOT be pulled tight as this will cause vibrations on the loops and damage to the loops.

The stay ropes of the antenna mast should remain tight and to aid in tightening these stay ropes the best technique was found to insert an alpine butterfly above the alpine butterfly made for the trucker's hitch and use a winch to tighten the stay rope. Once the winch has pulled the stay rope as tight as desired the trucker's hitch can be tightened and secured where after the winch is released. Do this procedure on both sides of the mast preferably at the same time as to not cause the mast to lean to one side or the other.

How to build a VLF loop

The following section is a guide on how to build a VLF-loop. We follow Cornelia Oberholzer's VLF Construction guide (2014) which was written with information from the "'VLF goniometer system for SANAE, Antarctica"' instruction manual by A.J. Smith.

Material requirements

To build one loop the following materials are needed:

Item	**Amount**	**Notes**
RG 231/U Coax Cable	50 meters	This approximate length, slightly longer or shorter should not affect performance, as long as both loops are the same length
0.1 microF non-electrolytic capacitor	One	Installed at the top of the loop, making a gap in the sheath (refer to sketch)
N-type connectors	Two	To connect both side of loop to instrument. The reusable screw type is suggested

Resin joint kit	One	To protect and reinforce capacitor at top of loop
Rope thimbles (non magnetic)	Three	Used to secure the top and sides of the loop. It is important the fibre rope and steel wire rope thimbles are used, to prevent the thimble from damaging the rope
Plastic/Aluminium disks	Two	Used to secure bottom of loop to mast. Refer to rest of the guide for details
U bolt clamps (non magnetic)	Five	Secure the rope to the thimble and disk
Rope	Quantity unknown	The rope is used to connect the thimble and disks to the loop
Heat shrink and/or self amalgamating tape	Quantity unknown	Used to where the ropes are connected to the loops, thimbles and disks.

Table 4.6: List of the materials required, by Cornelia Oberholzer (2014).

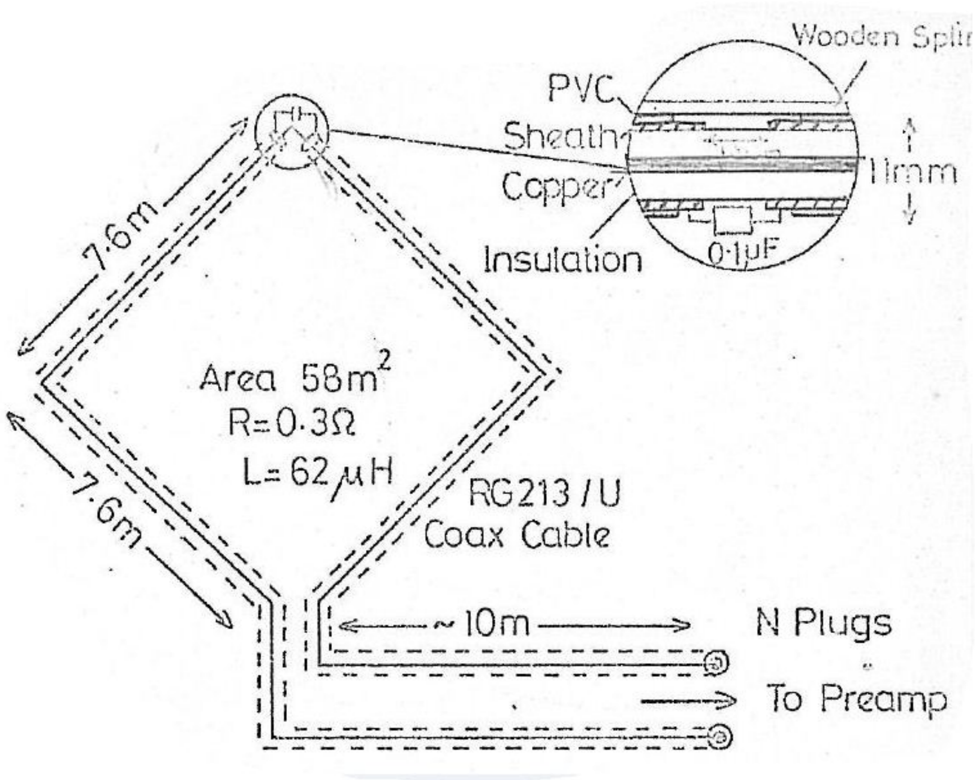


Figure 4.4: Schematic for VLF loop construction.

Figure **??** describes the construction of the loop. Follow the order of the numbers and red circles.

Point 1
Gap capacitor – At the top of the loop (middle of the cable), take off a short portion of the insulation (around 20 mm) and make a cut through the outer copper sheath in the middle of the exposed section. Make the copper sheath on both sides of the cut into bundles and solder the capacitor between these two points. Cover the area with insulation tape if so desired and then use a resin joint cut to seal and strengthen the capacitor area.
Top loop suspenders - With the use of the rope, thimble, U bolt clamp and tape construct a suspender for the top of the loop, as seen in the picture below. We used a icicle hitch rope tie.

Point 2
Top loop suspenders – At the points 7.6 meters from the centre of the loop, construct the side suspenders of the loop, as per the method followed at point 1.

Point 3
Bottom loop connectors – At the points 7.6 meters from the centre of the side suspenders, the bottom loop connectors are attached to the mast, with the use of round disks. These disks may be constructed from plastic or aluminium disks (only non-magnetic materials), with a groove around the outer edge to guide and hold the rope. The outer diameter of the disk shown below is 40 mm, but this is not an important measure. The diameter of the hole through the disk is 10.7 mm. This hole must be between 10.5 mm and 11 mm.

Point 4 N-type connectors – Connectors at the ends of the loop connect it to the instrument. The reusable screw type connectors are suggested.

VLF

VLF Receiver PC OS: Ubuntu desktop 11.04

The Splitter unit basically provides some minor gain adjustments, as well as some filtering to reject the mains hum in the lower spectrum, and higher frequencies that are not part of the VLF spectrum. Each of the Splitter outputs is fed by its own unity gain buffer so that one output does not affect any of the others. Information on the original VLF system setup can be found here

home/nerd/Engineers_Documentation/2013_2014_Work/Projects/

Project_Pre-Amp/Research_Documentation/vlf-goniometer.pdf

Additional Information on the Splitter can be found here

home/nerd/Engineers_Documentation/2013_2014_Work/Projects/Project_Splitter/

The VLF systems are: DVRAS, UltraMSK and WWLLN.

The VLF receiver is used as a front-end for the respective VLF logging PC's.

DVRAS

DVRAS stands for: Digital VLF Recording and Analysis System.

Configuration and Installation

A full installation guide can be found on the SANSA server: */Engineers_Documentation/2013_2014_Work/Projects/Project_DVRAS2/Install_Documentation/DVRAS2_Install_Guide.pdf.* This guide is very specific, and will discuss everything about setting up the system.

The only other configuration that may be necessary would be the setting the alsa capture levels. If the VLF input level changes (due to changes in the Pre-Amp or Splitter), then the capture level of the system will have to be checked. Basically monitor the spectrograms being produced by the system. If they are too dark then the capture levels are too high (lots of noise). If the spectrograms are too light then the capture levels are loo low. Adjust the capture level using "alsamixer", and then save the configuration using "alsactl". This is also discussed in the installation guide.

Troubleshooting

Occasionally the dvrecord process tends to crash, and you will need to go through system logs and dvrecord logs to diagnose the problem.

In the case that the systems hangs you will need to restart the system, but that rarely happens as the system runs itself.

Sometimes you cannot ssh to DVRAS2, due to some errors with Public/Private key authentication. run this command *ssh-add* it adds private key identities to the authentication agent.

Training Duration

Refer to table 4.7 for the training duration.

Training Focus	**Estimated Time**
SPRI Systems UltraMSK WWLLN DVRAS PLASMON AWESOME Aurora Camera Pulsation Magnetometer (PM)	**3 days** Introduction to the systems and some hands on evaluation of data.
PSWS Systems Rock Magnetometer Overhauser Magnetometer Fluxgate Magnetometer	**1 day** Introduction to the systems and maintenance information.
Outside Training VLF Antenna AWESOME Antenna Rock Magnetometer Overhauser Magnetometer Fluxgate Magnetometer Pulsation Magnetometer	**1 day**
Monthly Report Training	**1 day**

Table 4.7: Training Duration

SANRKM1 and SANICM1

Go out and observe where the hatches of these systems are located.

SANOVH1

OS: Slackware 9.0.0

The receiver and magnetometer of this system is outside in the SANOVH1 hatch. The receiver memory fills every 96 days and has to be manually cleared outside in the hatch. This is done to prevent the memory of the receiver to fill up which causes the system to stop capturing data.

How to Reset the Overhauser to clear Memory and record data "REMOTE":
Do the following:

- Press 0 and F simultaneous. This will put the instrument OFF
- Press B. The instrument will start now
- Press 4 and 5 simultaneous. This is to clear the memory
- Press 3 and 7 simultaneous. You will note on the screen when deleting is finished, else Press F.
- Press C – info
- Press A – remote
- Press F – ok This is for "tune initialize no"
- Press F – ok This is for "auto-tune yes"
- Press F – ok This is for "tuning .... microT"
- Press C and 1 simultaneous. Return to Main menu.
- Press A – survey
- When asked which MODE, select BASE.
- Press A – start
- It will most probably take a little while for the internal clock to synchronize with the GPS. Then the data would be visible.

If there is a problem contact Errol Julies at Space Science (ejulies@sansa.org.za).

The systems hatch is temperature regulated. Show new engineer the regulator and IR Lamps.

SANFGM1

Orientation around the SANFGM1 hatch: This system has to be calibrated once a year during takeover. This consists of using a multimeter and a non-magnetic screwdriver to set the voltage levels of the 3 axes by turning a pot. Adjust the output to all the channels to a value between 0 and $\pm$ 0.3125V.
Analogue outputs:

- Yellow: X-0ut (H)
- Black: Ground
- Green: Y-Out (D)
- Grey: T2
- White: T1
- Blue: Z-Out (Z)

SANPMR1 (UKZN)

Go and look at the SANPMR1 hatches of the systems and get familiarise with the new system. The ±12V dc power in the service hatch feeds the SANPMR1 coils and Adam modules with power over a 110m cable.

Disk Usage

See table 4.8 for the disk usage.

System	Description	Disk usage/year
SANRKM1	Rock Mag. 1 file per day	2.6GB
SANOVH1	Overhauser Mag. 1 file per day	114MB
SANFGM1	Fluxgate Mag. 1 file per day	21.6MB
SANVLF1–desktop	New DVRAS	1.2TB (1 in 2min recording)
SANMSK1	UltraMSK 5 files per day	7.9GB
SANWLN1	WWLLN	N/A
SANAWE1	AWESOME system – Narrowband data 58 files per day, Synoptic data 576 files per day, Continuous data 92 files per day	$\sim$ 2.6 TB
SANAWD1	AWDS PLASMON	$\sim$ 400GB
SANAUR1	Aurora camera PC	In disrepair
SANPMR1	Pulsation Magnetometer, 1 file per day	621MB

Table 4.8: List Usage

4.8 Useful Links

For information about the various systems these two websites can be consulted:
http://chinstrap.ukzn.ac.za/moodle – Located at UKZN
https://projectswiki.hmo.ac.za – Located at SANSA

Procurement lists can be found and updated here:
https://projectswiki.hmo.ac.za/index.php/SAN_Order–list
For more information about the data of the systems visit this page:
https://projectswiki.hmo.ac.za/index.php/List_of_Data_Pages

Month end reports can be found here:
https://projectswiki.hmo.ac.za/index.php/SPRI#Reports
Month end reports will contain some more information about what problems that arose and developments that took place on systems which could prove helpful.

Part III

RADAR

5 Radar Engineer Training

5.1 Background

The radar engineer is responsible for the following instruments:

- Scintillation GPS (Scinda/Novatel) - SANGST
- Dual Frequency GPS (Ashteq) - SANDFG
- HartRAO GPS - SANIGS
- Septentrio PolaRxS GNSS Receiver (DemoGRAPE Project: SANDEM1)
- 4tuNe Software Defined GNSS Receiver (DemoGRAPE Project: SANDEM2)
- Ozone Radiometer/Monitor
- HF Radar (SANAE SuperDARN Radar)

The Space Weather and RADAR engineer has a combined responsibility for both the Scientist Data Server and the Grafana Live Monitoring systems.

The main responsibility is the HF radar and it will take up most of your time. All other systems rarely give problems but are actively monitored and their statuses checked daily, should any issues arise that they can be addressed and resolved as soon as possible.

Additionally there are three month-end reports that you will be responsible for and/or contribute to. The HF radar (SDR) report and the DemoGRAPE is created and compiled only by the radar engineer. Whereas the PSWS (Polar Space Weather Science) report is compiled by the radar engineer and the space weather engineer. The radar engineer contributes the sections dealing with the GPS systems information and data (GST, DFG and HartRAO), as well as the ozone radiometer/monitor in the PSWS report. These reports describe current issues encountered, how they were addressed, new additions/improvements to the systems as well as data of note captured throughout the month during space weather events.

5.2 Scientist Server and Data Collection

The Scientist server runs daily scripts which collects the data remotely from the instruments and archives it on a hard drive in Scientist. The previous day's data is collected and plotting scripts are executed to process and display the data. These scripts are all listed in the crontab of the Scientist server and execute between the hours of 00h00 and 06h00 (To view the crontab execute the command: "crontab -l"; to edit the crontab using nano editor, execute the command: "VISUAL=nano crontab -e"). By viewing the crontab you can determine what scripts are responsible for which system, where the script and the logfile it logs to is located on the scientist server and at what time it executes.

These daily plots are used to determine whether the instrument ran successfully and correctly the previous day and to keep an active archive of all the systems data, with the added benefit of being able to quickly/easily access daily plots of the archived data for investigation purposes of space weather events and data quality control of each system. Though it is the responsibility of the radar engineer to check that these daily plotting and archiving scripts are running and that the data is being backed-up as well as checked on a daily basis to determine whether all instruments are successfully capturing data; a LIVE monitoring system (called Grafana) has been implemented and rolled out at SANAE IV base in 2017 to actively monitor all of SANSA's science equipment and servers.

This live monitoring system and its setup/functionality is described in chapter 6.2 of this training manual. In terms of the systems that fall under the responsibilities of the radar engineer, all systems are being monitored actively on Grafana for live data capturing as well as daily plots and data backups. The script automatically checking the the daily plots and data backups is located on the scientist server (/home/scientist/datacrawler/RADARDailyCheck _GrafanaDataCrawler.sh) and is called from the Grafana server in its crontab from 6h00 to 22h00 every 4 hours in the form of a data collector and database posting script.

Each one of the systems daily plots and data backups are monitored by Grafana in terms of the number of files created/backed-up and whether these files are of the correct size. For more detail concerning the monitoring of each system (in terms of live data capturing, as well as daily plots and back ups), find the applicable information in the following instrument specific sections.

All faults and down-time for all instruments and their logging PCs need to be logged to the relevant locations in as much detail as possible and included in your month-end reports. Major faults and causes for down-time of a system should be reported to the RSU at SANSA and the PI (Principle Investigator of the project) should be informed as well. At the time of writing this document the contact person at SANSA is Jon Ward. When attempting to resolve an issue with a system, the first step for any issues on instruments will be to inspect the log files (incl. storage and memory) and to restart processes that could solve the issue as well as test it's network connectivity. Last resort, restart system.

All IP addresses and login details for all science equipment on base are listed in the document *Machine List*. A global copy of this document is kept on the SANSA_NAS (172.17.20.7/SANSA Documents) or on the Desktop of the radar PC. Make sure that you always keep this document up to date and that you and the Space Weather Engineer keep measures in place and good communication in order to ensure that you both keep your systems data up-to-date and the data in the document relevant and inform one another of changes as to not overwrite anyoneś additions.

5.3 GPS Systems

SANGST1

Login and Equipment details

IP address: *172.17.30.201*
Username: *gps*
Password: *hmo*

Machine: *SuperMICRO*
Operating System: *Ubuntu 14.04*
Instrument: *GPS Ionospheric Scintillation and TEC Monitor*
NTP Server: *172.17.30.8*
Location: *Bottom Physics Laboratory*

Principle Investigator: *Dr. Pierre Cilliers*
Contact Details: *pjcilliers@sansa.org.za*

System Setup

The SANGST and SANDFG run on the same logging PC (SuperMICRO situated in the server rack in the bottom physics lab), each with a separate user. Each of them receive their data from their individual receivers but have the same antenna input. This GNSS antenna is located right outside the South-Western corner of A-Block of base, on the Southern buttress.

The Novatel GPS Ionospheric Scintillation and TEC Monitor is located in the same server rack in the bottom physics lab and connected directly to the

SuperMICRO, using a version of Scinda to capture data. This super micro is then connected to a KVM switch and linked to the workstion (screen, mouse and keyboard) furthest away from the server rack.

System Running

In order to a check whether the system is running correctly at the physical work station, the following steps can be followed:

1. Flick through the KVM switch untill you see "SCINDA GPS Data Collection System" written at the top of the screen
2. In order to cycle through the various screen sessions attached to the PC, hold in "Ctrl + Alt" and press F1-F12.
3. There are always 2 screen sessions already linked to the PC on F1 (tty1) and F2 (tty2). SANGST live data collection can be observed on F1 (tty1).
4. In order to open an empty command prompt to login to either of the systems, "Ctrl + Alt + F3 to F12". This will open new screen session as required by the user.
5. When on the SANGST screen session ("Ctrl + Alt + F1" - tty1) there are a couple of things that can be verified. Firstly it can be verified that the date, time and location is correct.
6. Next it can be verified that 9 satellites (PRNs) are currently being tracked in the TRACKING table.
7. Then beneath the STATISTICS table; the directory where the data is saved can be noted and observed.
8. Lastly it can be checked that the "Status" is "Normal" and "Lost Bytes" should ideally be "0" for most of the time.

The same checks can be executed remotely from any other PC with access to the science network, by logging into the system with a putty session and using *"sudo screen -x <whatever_the_correct_name_for_the_tty1_screen_ session_is_at_that_point_in_time>"*. This screen session name tends to change with every system restart as a PID number gets attached to it with start up ("*PID.Zorg.tty1*").

The SuperMICRO is set up in such a way that the system will start itself back up automatically as soon as power is supplied. This means that if a power failure has occurred and the systems had to be shut down because the UPS battery got drained, the SupeMICRO will boot itself back up once the power is restored and start up all the processes internally to resume the logging of data.

Data, Daily scripts and Archiving

The data for SANGST for the last 24h is located in the directory: */home/gps/data*

On a daily basis the data of the previous day gets sorted, compressed and moved to different directories for various purposes and archiving:

- */home/gps/archive:* All hourly data files older than 24hrs is compressed and archived in this location; in this file structure /"YEAR"/"MONTH"/.
- */home/gps/dailyism:* On a daily basis, all hourly *.ism data files are combined into one singular *.ism file for the previous day.
- */home/gps/minData:* On a daily basis, the singular *.ism file for the previous day is parsed into a text file, compressed and then saved in this location.
- */home/gps/processed_data:* On a daily basis, the produced data files for the previous day are processed using *wintec* to create daily *.bias and *.log.gz files.
- */home/gps/sync:* All hourly data files of the previous day are combined into daily files, compressed and archived in this location; in this file structure /"YEAR"/"MONTH"/.
- */home/gps/xfer:* Every 15 mins a "sangps.dat.gz" and "sanpos.dat.gz" is created and updated for transfer purposes in this location.

The data folders (dailyism, minData, sync and archive) are also rsynćd to the scientist PC on a daily basis to the file directory:
/mnt/raidhd1/SANSA_INSTRUMENTS/GST/SANGST1

Make sure that you are familiar with these directory structures and file name conventions. Also know which data needs to the backed up and to which folder on the Scientist PC. Also know which data is used to create the daily plots.

*Familiarise yourself with all the scripts. Learn how to parse the scintillation data (ISM files) and plot and filter the ISM files (bin plots and scatter plots). You need these for the month end reports and this is also the technique used to process the data to be imported into the database for display purposes in Grafana.

Grafana monitoring

SANGST is actively monitored by the Grafana LIVE monitoring system in totality. This includes the PC statistics of the logging PC, the real-time data and file update time, as well as the daily archiving of the data on the scientist server.

The datacrawler scripts that gather and process the various types of data into one transfer file to be posted to the database, along with their logfiles are located in the directory */home/gps/datacrawler*.

The following parameters are being displayed and monitored on Grafana (NOTE: All data is imported, though decisions were made as to what data is useful and interesting to display for monitoring purposes.):

1. Logging PC Statistics: (Updated every 30mins)
    - CPU Load
    - Free RAM
    - NTP Offset
    - Harddrive space
    - Ping time to Scientist server
2. System Statistics: (Updated every 5mins; and 24hrs respectively)
    - Status of the system; whether it is running or not
    - Uptime of the system. This is calculated daily, based on the quality and amount of datapoints imported into the database for a day and can be displayed for any period of time with the smallest interval being 24hrs.
3. Scintillation Data: (Updated every 5mins)
    - Raw S4 and SigmaPhi (Scintillation Intensity Index) Values
    - Processed and filtered S4 and SigmaPhi (Scintillation Intensity Index) Values
    - Time binned S4 and SigmaPhi (Scintillation Intensity Index) Values; where the data points that exceed a set threshold of interest over a certain time period are counted.
4. Daily Checks (Daily plots and archives)
    - In the /mnt/raidhd1/SANSA_INSTRUMENTS/GST/SANGST1/sync /"*yesterdayYEAR*"/"*yesterdayMONTH*"/ directory on the Scientist server the following files should be found with yesterdays timestamp:

- 1 *.scn.gz file with a file size greater than 270K
- 1 *.psn.gz file with a file size greater than 450K
- 1 *.rng.gz file with a file size greater than 3M
- 1 *.ism.gz file with a file size greater than 1M

- In the /mnt/raidhd1/SANSA_INSTRUMENTS/GST/SANGST1 /archive/"*yesterdayYE* directory on the Scientist server the following files should be found with yesterdays timestamp: (144 files in total)
  - 24 *.scn.gz files with an accumalative file size greater than 300K
  - 24 *.psn.gz files with an accumalative file size greater than 450k
  - 24 *.rng.gz files with an accumalative file size greater than 3M
  - 24 *.ism.gz files with an accumalative file size greater than 1M
  - 24 *.nvd.gz files with an accumalative file size greater than 300M
  - 24 *.msg.gz files with an accumalative file size greater than 700K

Notes, tips and regular issues

SANGST is a very stable and self-sustaining system that has very little to no issues.

SANDFG1

Login and Equipment details

***IP address**: 172.17.30.201*
***Username**: dgps*
***Password**: hmo*

***Machine**: SuperMICRO*
***Operating System**: Ubuntu 14.04*
***Instrument**: Dual frequency GPS receiver*
***NTP Server**: 172.17.30.8*
***Location**: Bottom Physics Laboratory*

***Principle Investigator**: Dr. Ben Opperman*
***Contact Details**: ben.opperman@sansa.org.za*

System Setup

The SANGST and SANDFG run on the same logging PC (SuperMICRO situated in the server rack in the bottom physics lab), each with a separate user. Each of them receive their data from their individual receivers but have the same antenna input. This GNSS antenna is located right outside the South-Western corner of A-Block of base, on the Southern buttress.

The Ashteq Dual frequency GPS receiver is located in the same server rack in the bottom physics lab and connected directly to the SuperMICRO, using a modified version of Scinda to capture data (the captured data for this system is in a RINEX format). This super micro is then connected to a KVM switch and linked to the workstion (screen, mouse and keyboard) furthest away from the server rack.

System Running

In order to a check whether the system is running correctly at the physical work station, the following steps can be followed:

1. Flick through the KVM switch untill you see "SCINDA GPS Data Collection System" written at the top of the screen
2. In order to cycle through the various screen sessions attached to the PC, hold in "Ctrl + Alt" and press F1-F12.
3. There are always 2 screen sessions already linked to the PC on F1 (tty1) and F2 (tty2). SANDFG live data collection can be observed on F2 (tty2).
4. In order to open an empty command prompt to login to either of the systems, "Ctrl + Alt + F3 to F12". This will open new screen session as required by the user.
5. When on the SANDFG screen session ("Ctrl + Alt + F2" - tty2) there are a couple of things that can be verified. Firstly it can be verified that the date, time and location is correct.
6. Next it can be verified that 9 satellites (PRNs) are currently being tracked in the TRACKING table.
7. Then beneath the STATISTICS table; the directory where the data is saved can be noted and observed.
8. Lastly it can be checked that the "Status" is "Normal" and "Lost Bytes" should ideally be "0" for most of the time.

The same checks can be executed remotely from any other PC with access to the science network, by logging into the system with a putty session and using *"sudo screen -x <whatever_the_correct_name_for_the_tty2_screen_ session_is_at_that_point_in_time>"*. This screen session name tends to change with every system restart as a PID number gets attached to it with start up ("*PID.Zorg.tty2*").

The SuperMICRO is set up in such a way that the system will start itself back up automatically as soon as power is supplied. This means that if a power failure has occurred and the systems had to be shut down because the UPS battery got drained, the SupeMICRO will boot itself back up once the power is restored and start up all the processes internally to resume the logging of data.

Data, Daily scripts and Archiving

The all data for SANDFG is located in the directory: */home/dgps/data-uz*

New files with the following file extensions are created hourly and updated every 30secs untill the next hour is reached:

- **.psn*
- **.scn*
- **.msg*
- **."YEAR"o: The observational RINEX Data File*

The all hourly data files (*.psn, *.scn, *.msg and *."YEAR"o) are also rsynćd to the scientist PC on a daily basis to the file directory:
/mnt/raidhd1/SANSA_INSTRUMENTS/DFG/SANDFG1/"YEAR"/"MONTH"/"DAY"/

Make sure that you are familiar with these directory structures and file name conventions. Also know which data needs to the backed up and to which folder on the Scientist PC. Also know which data is used to create the daily plots.

Grafana monitoring

SANDFG is actively monitored by the Grafana LIVE monitoring system in totality. This includes the PC statistics of the logging PC, the real-time data and file update time, as well as the daily archiving of the data on the scientist server.

The datacrawler scripts that gather and process the various types of data into one transfer file to be posted to the database, along with their logfiles are located in the directory */home/dgps/datacrawler*.

The following parameters are being displayed and monitored on Grafana (NOTE: All data is imported, though decisions were made as to what data is useful and interesting to display for monitoring purposes.):

1. Logging PC Statistics: (Updated every 30mins)
    - CPU Load
    - Free RAM
    - NTP Offset
    - Harddrive space
    - Ping time to Scientist server
2. System Statistics: (Updated every 5mins; and 24hrs respectively)
    - Status of the system; whether it is running or not
    - Uptime of the system. This is calculated daily, based on the quality and amount of datapoints imported into the database for a day and can be displayed for any period of time with the smallest interval being 24hrs.
3. RINEX Data: (Updated every 5mins)
    - RINEX Observations(L1, L2, C1, P1 and P2)
4. Daily Checks (Daily plots and archives)
    - In the /mnt/raidhd1/SANSA_INSTRUMENTS/DFG/SANDFG1 /"*yesterdayYEAR*"/"*yesterdayMONTH*"/"*yesterdayDAY*"/ directory on the Scientist server the following files should be found with yesterdays timestamp: (96 files in total)
        - 24 *.scn files with an accumalative file size greater than 96K
        - 24 *.psn files with an accumalative file size greater than 6M
        - 24 *.msg files with an accumalative file size greater than 96K
        - 24 *."YEAR"o files with an accumalative file size greater than 2M

Notes, tips and regular issues

SANDFG is a very stable and self-sustaining system that has very little to no issues.

HartRAO (SANIGS1)

Login and Equipment details

IP address*: 192.168.1.200*
External IP address*: 155.232.186.30*
Username*: hartrao*
Password*: d@taFMv1*

Machine*: No Logging PC; stand-alone device linked to the network directly*
Operating System*: Proprietary FTP Interface*
Instrument*: IGS GPS Geodesy Monitor*
NTP Server*: N/A*
Location*: Bottom Physics Laboratory*

Principle Investigator*: Monitorred externally by the Hartebeesthoek Radio Astronomy Observatory*
Contact Details*: N/A*

System Setup

The SANIGS runs on a stand-alone device with a proprietary FTP interface. This GNSS receivers' antenna is located right outside the South-Western corner of A-Block of base, on the Southern buttress.

The IGS GPS Geodesy Monitor is located in the South-Western corner of the bottom physics lab and connected directly to the network. Besides its power cable and antenna input, it has no further connections to any other devices.

System Running

The SANIGS is monitored and managed remotely by one of our research partners (HartRAO - Hartebeesthoek Radio Astronomy Observatory). Just make sure that it has power all the time and that a new RINEX file is created for every day and has the correct file size.

Data, Daily scripts and Archiving

Each day, as a courtesy, we backup the data onto the Admin PC. Make sure that the size of the data look correct compared to previous days. An FTP cronjob script runs that performs daily backups. It is your duty to check that all files are transferred and you can check this in WinScp. The FTP(File

Transfer Protocol) is a very basic protocol which lacks the flexibility of commands such as rsync. If there seems to be a fault which needs serious attention, contact the HARTRAO people.

Make sure to understand the RINEX file naming conventions. How to splice RINEX files and how to run the plotting script. At the moment there is not much that needs to be done on this instrument but you should understand the basics of it in case that changes in the future.

The data is also backed up on the scientist PC:
/mnt/raidhd1/SANSA_INSTRUMENTS/IGS/SANIGS1

Grafana monitoring

Notes, tips and regular issues

HartRAO (SANIGS) is a very stable and self-sustaining system that has very little to no issues.

NB: The system can only sustain ONE active connection at a time. This is done via FTP. Make sure that if you log into the system that you log back out properly (disconnect in WinSCP, don't close program) or you will not be able to get back in (or at least not until it times out). If you cannot connect then sometimes it means that the HARTRAO people are logged in, which means that you will have to try again later.

5.4 Radar

The radar is expected to run 24hours a day for 365 days of the year. It should only be switched off if there is a good reason for it. These reasons include serious damage to the array, hardware problems or antenna maintenance.

During 2015, the radar experienced unusual amounts of down time, this was due to the rate at which the stay ropes failed. The stay ropes which were used were not very UV resistant as a result became very brittle. The fact that the stay ropes were not friction resistant compounded the rate of failure. This take over, a major operation will be undertaken with the complete upgrade of all stay ropes to dyneema (ultra high molecular weight polyethylene), these will solve many of the issues which I had with the radar.

During the month the time will be divided into three types of operating modes. These are Common Time (CT), Discretionary Time (DT) and Special Time (ST).

CT – at least 50% of the the time and made up of three modes. Normalscan, Normalscan -fast and themisscan. During normalscan the integration time is about 7secs and the length of the entire scan (all 16 beams) is less than two minutes. Each scan starts exactly 2 mins after each other. The -fast scan has integration time of 3secs and the scans are 1 min apart.

DT – at most 30% of the time. Unless you receive specific instructions from the PI, you will run *normalscan –fast*. This is also the time where you will do maintenance on the array and tx boxes. Keep careful and accurate logs when you do maintenance.

ST – at most 20% of the time. Used for special experiments. Each station will be told what scan to run.

It is generally understood that during the Antarctic summer, radar maintenance needs to be performed. This will take precedence over everything else, as this is the only time to do it.

Main server - Joshua

Joshua is the control server which runs the scanning programme (start.radar).
OS: Ubuntu 12.04 LTS
IP: 172.17.30.50
Login: radar/sanaeradar (root and administrative password)

There is a cold standby server (Caleb) in the rack 172.17.31.51. This server is also used to troubleshoot individual transceiver boxes (spares) while Joshua is running the radar program. Make regular backups on Caleb of the newest image that runs on Joshua (you can decide what 'regular' means). Also keep an image (.iso) of Joshua somewhere in the base (example admin PC OS HDD).

Network setup

The network that is set up in the radar runs on the 172.17.31.0/24 subnet. The base science network runs on the 172.17.30.0/24 subnet. The two subnets are connected in the radar hut via the Mikrotik router in the middle cabinet. There are three network cables connected to each transceiver module, these are CONTROL (black cables), DATA (grey), TIMING (green cables).

Timing Box

There are two Timing Boxes, an active unit and a spare. The Timing Box provides the timing signals in real time. They both run QNX 4.25 and are networked together.

Transceiver Boxes

There are 16 transceiver boxes in the main array and 4 boxes in the secondary array. The transceiver boxes in the secondary array are not used at the moment , but will always be implemented in receive only mode.

All the different modules of the transceivers are explained in the *Setup and Troubleshooting* guide.

Main array

The main array will experience more than its share of wear and tear during the year from the wind and cold (so will you). The elements and masts are held by stay ropes which will need to be monitored and replaced when they become damaged.

NB: Because of expansion and contraction you need to be careful not to make the ropes too tight. They might snap in winter.

Secondary array

The secondary array has not yet been integrated with the new digital radar. From my knowledge it hasn't been used on the old radar for many years. Antenna maintenance is done in takeover using a cherry picker for in case your PI suddenly gets a reason for integrating it. At the moment it is not a priority.

Radar Hut

Always take a radio down with you. Take some emergency supplies including food, medical and sleeping gear in case you get stuck down there during a storm. There is a kettle for making coffee.

All your climbing and safety gear is also stored in the radar hut. I suggest that you keep it down there and don't get it mixed up with the base gear. There is plenty of decent gear in the base climbing store so you should not need to have to bring up radar specific gear to do base work.

After takeover you will do most work for the radar in the radar hut. There is enough space to have a decent set-up to quickly do all required transceiver troubleshooting on the work bench.

Just keep track of all your tools and make lists of what is running low or needs replacing so that it can be purchased by the RSU for the next year.

Small Sat-Dome

IP: 192.168.1.13; U:ozone; P:N0n13FT

The ozone monitor is installed in the Small Sat-Dome. The data is backed up daily using a cronjob on the Scientist PC and can be viewed at: /mnt/raidhd1/SANSA_INSTRUMENTS/OZO/OZONE. Check occasionally that the trip switch for the mains (heaters) is ON. You will see from daily checks if there are any issues with the UPS power.

5.5 Training Schedule 2016

TRAINING SCHEDULE 2016/2017
RADAR

[redacted]	Description	No. Of Days	Completed
TTFD Antenna			
	Design		
	Maintenance		
Main Array			
	Design		
	Theroy		
	Maintenance		
Secondary Array			
	Design		
	Theory		
	Maintenance		

RF Cable					
	Distance to fault				
	Cable maintenance				
	RF connector attachment				
	Cable strapping				
	Cable trunking				
Radar Hut					
	Tools				
	Network				
	UPS				
	Mains Power				
	Spares				
	Food + survival gear				
	Climbing equipment				
	First-Aid kit				
	Human waste				
	General waste and clean -up				
Radar Transmitters					
	Tx RF Path				
	Power Distribution				
	HV supply				
	Power amp - calibration				
	HP switch				
	Cap farm				
	Transceiver board				
	FBGA board				
	Calibration				
	Test + measurement equipment				
	Fault finding and repairs				

Timing Box				
	Rx path			
	(Calibration)			
Scripts and Data				
	Radar scripts			
	radar schedule			
	data transfer			
Outside Work				
	Rope work - knots			
	Cherry-picker operation			
	PSWS			
[redacted]				
Scinda				
	Maintanence			
	Trouble shooting			
	Data			
Dual Frequency				
	Maintanence			
	Troubleshooting			
	Data			
Scripts + Data				
	Data archiving			
	Data types			
	Plotting scripts			
	Data backup and storage			
Ozone Radiometer				
	Sat-dome			

	Scripts			

DemoGRAPE

Septentrio				
	Maintanence			
	Troubleshooting			
	Data			
SDR				
	Maintanence			
	Troubleshooting			
	Data			
Scripts + Data				
	Data archiving			
	Data types			
	Data backup and storage			

DATA STORAGE

Scientist Server				
	Configuration			
	scripts			
	crons			

Table 5.1: Training Schedule 2016

Part IV

Data Server and Live Monitoring

6 Data Server & Live monitoring

6.1 Overview

Up until 2016, systems status and data quality were monitored manually and with python scripting. With over 30 data acquisition and PC systems running at SANAE IV it become a necessity to use a modern data monitoring system to ensure that all the instruments are running and producing valid data.

Solution

Initially development was started with Graphite, similar to the system that has been implemented for SANSA at Marion Island. This development has been abandoned and Grafana was chosen due to its compatibility with numerous data sources, ease of configuring dashboards and alerting capabilities. As data source InfluxDB time series database was used.

Design principles

The primary goal is to monitor instrumentation data live to enable quick response time to resolve problems as they occur. Data is therefore captured live at the source which is in most cases the instrumentation data logger. It is transmitted over Ethernet to the Grafana PC where the data is then saved in a SQL database. The InfluxDB allows quick access to the data which can then be displayed according to the data type of the instrument at hand. The Grafana PC is accessible through any of the PCs on the local network and at Harmanus through the external IP assigned by the DEA allowing the engineer on base to easily keep an eye on all the systems.

6.2 Data server and monitoring systems

Grafana

Installation

Hardware

The load on the hardware is determined according to the requirements of InfluxDB. The developer specifies that they define the load that will be placed

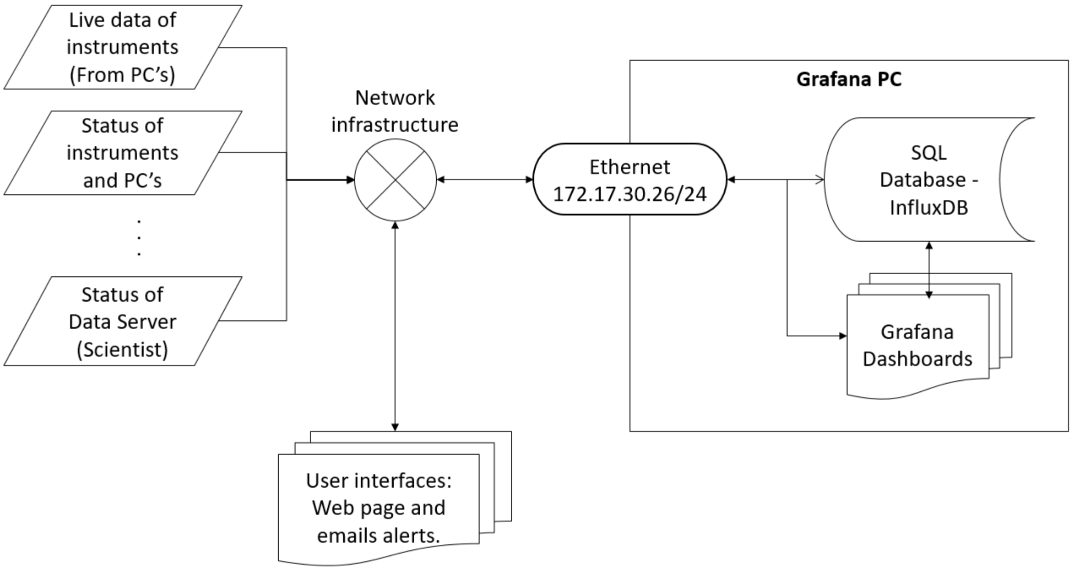


Figure 6.1: Grafana System Connections

on InfluxDB by the number of fields written per second, the number of queries per second, and the number of unique series. Based on the load, they make general CPU, RAM, and IOPS recommendations.
The system at SANAE is currently configured for a low load environment (Field writes per second less than 5000; Moderate queries per second less than 5; Unique series less than 100,000).
Low load recommendations
CPU: 2-4 cores (Currently 2 core)
RAM: 2-4 GB (Currently 4 GB. It was found that the PC struggles with 2 GB)
IOPS: 500

See the developer website for more details: `https://docs.influxdata.com/influxdb/v1.3/guides/hardware_sizing/`

The Grafana PC has been configured with 2 HDD of 2TB each in a Raid1 configuration. Please see the RAID configuration documentation on the SANSA NAS for more information.

Usefull links:

- `http://docs.grafana.org/`
- `http://docs.grafana.org/guides/getting_started/`

- `http://docs.grafana.org/installation/debian/`
- `http://docs.grafana.org/features/datasources/influxdb/`
- `http://docs.grafana.org/installation/configuration/`
- `https://docs.influxdata.com/influxdb/v1.3/guides/hardware_sizing/`

Usefull commands

- sudo service influxdb stop - sudo service influxdb start - sudo service grafana-server stop - sudo service grafana-server start

- influxdb - USE DatabaseName - To select the database to use
- precision rfc3339 - To select the time format displayed
- drop MEASUREMENT TableName - To delete an entire table
- SELECT FROM *TableName* WHERE *time* > 1483315020000000000 and *time* < 1483317000000000000
- SHOW FIELD KEYS ON "TableName"
- SHOW DATABASES
- SHOW RETENTION POLICIES
- CREATE DATABASE "RIOdb" WITH DURATION 1825d REPLICATION 1 SHARD DURATION 1d NAME "5Years"
- SHOW CONTINUOUS QUERIES
- CREATE CONTINUOUS QUERY "DFqueryDTUFcal" ON "MAGdb" RESAMPLE FOR 30m BEGIN SELECT mean("Fcal") AS "DTUFcal"INTO "DF_Table" FROM "DTU_Table" GROUP BY time(1m) END
- CREATE CONTINUOUS QUERY "DFqueryOVHF" ON "MAGdb" RESAMPLE FOR 30m BEGIN SELECT mean("TotalField") AS "OVHFmeas"INTO "DF_Table" FROM "OVH_Table" GROUP BY time(1m) END
- CREATE CONTINUOUS QUERY "DFqueryFGMFcal" ON "MAGdb" RESAMPLE FOR 30m BEGIN SELECT mean("Fcal") AS "FGMFcal"INTO "DF_Table" FROM "FGM_Table" GROUP BY time(1m) END
- DROP CONTINUOUS QUERY "DFqueryDTUFcal" ON "collectd"
- SELECT COUNT() FROM TableName
- SHOW FIELD KEYS ON "TableName"

Scientist

Useful commands for RAID:

- sudo blkid
- ls -l /dev/disk/by-uuid/
- mdadm –examine /dev/sda1
- sudo fdisk -l
- sudo vi /etc/fstab
- cat /proc/mdstat
- mdadm –manage –add /dev/md0 /dev/sda1
- mdadm –detail /dev/md1
- nano /etc/mdadm/mdadm.conf
- watch cat /proc/mdstat

Time Server

NTP Server

-To be populated-

NTP Clients

Usefull Linux Commands:
ntpdc -c sysinfo (gives information about system)
sudo ntpq -p (Gives status information about NTP)

date –set "25 Sep 2013 15:00:00" (Manually set time)

netstat -rn (Network status)

DTU:
sudo /etc/init.d/ntp restart
sudo /etc/init.d/ntp stop
sudo /etc/init.d/ntp start
sudo /etc/init.d/ntp status
File: /etc/ntp.conf
ntpdate 172.17.30.8 (only if ntp is stopped)
ntpdc -c sysinfo
dpkg-query –list ntp (to see the version of ntp installed)
sudo ntpq -p

Grafana (Ubuntu)
service ntp start
service ntp stop

ntpdc -c sysinfo #gives information about system
sudo ntpq -p #Gives status information about NTP

Manually set time: date –set "25 Sep 2013 15:00:00"

runs: ntpq - standard NTP query program - Ver. 4.2.4p4

Network status:
netstat -rn

Part V

Daily checks

7 Daily System Checks

7.1 Radar Engineer

Scientist Server

- /home/scientist/dayly_data/plots

  Check that data is being plotted in "SANGST" and "SANDEM".

- /mnt/raidhd1/SANSA_INSTRUMENTS/

  OZO: Make sure the file "dock" is being updated.

  GST: In SANGST1/sync/"year"/"month number", check that 4 files where created for the date of the previous day.

  In SANGST1/archive/"year"/"month number"/"date of the day", check that 144 files where logged.

  In SANDFG1/"year"/"month number"/"date of the day", check that 96 files where created.

- /mnt/raidhd1/Demogrape (In LIVE/"most recent file")

  Check that files where created in the last 15 min. There should be .O,._,.N and .ismr files.

  Open up most recent folder and check that the files that are being created are larger than 0kB!

- /mnt/raidhd1/Demogrape (In SANDEM2/sdr–quicklooks/"month"/"date of the day")

  Make sure that the date are up to date.

- /mnt/raidhd1/HARTRAO/IGS/SANIGS1/"year"

  Check that the changed date is the date of yesterday or today, and that the name is the day before that.

For the Radar:

- Open PUTTY and go to "Joshua"[1]

  username: radar

  password: sanaeradar

[1] The data is stored in /data/ros/fitacf and the scripts are stored in /home/radar/transfer_data/script/sanrad_new. (Use crontab -e to see what is used for the transfer of the data.)

- Run screen -x

  Make sure that it is updating.

For the Demogrape:

SANDEM1

1. Open RxLogger of flit to the Rxlogger Page.
   → Check the HDD space.
   → Check that the radar data is being logged.
   - Current file changes and there is a changing data rate.
   - "Start logging" button is greyed out.
   - There is an active floppy disk symbol at the bottom right.
   - The circle next to SBF in the bottom left corner is green (it shows the status of the system; hover over it for more details.)
2. The data is logged to HOME/DATA.
3. The settings to how and when the data is set are in the SBF tab of RxLogger.
4. When a issue is encountered and/or resolved, it is written up in the issuelog.ods on the desktop.
5. Open RxControl and select VSB connection to see interesting plot and details on the data.

SANDEM2

1. Check harddrive space (change at $\sim$ 90%)
2. Check that the new data is logged every 50 mins on the hard drive[2].

7.2 Space Weather Engineer

Daily checks on Grafana

Insert Grafana Daily Checks Here

[2]The program runs from MATLAB from a folder on the desktop FORTUNE with program name scintmon.

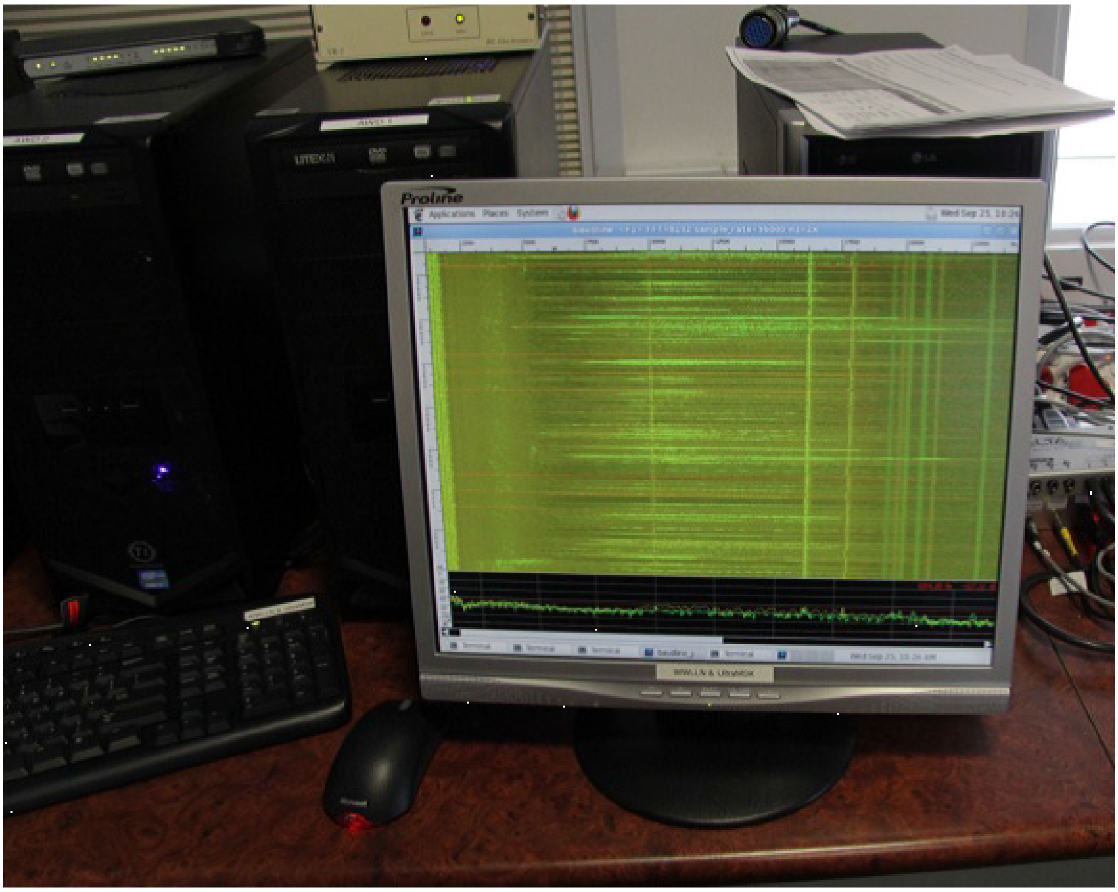
Basic alternative daily checks if Grafana is out of order

World Wide Lightening Location Network (WWLLN)

1. Verify operation on http://flash4.ess.washington.edu/manage/light.log.htm

UltraMSK

1. Verify that the daily email has been sent and review images for any solar flare activity.
2. Press "select" on KVM switch to select the UltraMSK computer screen.
3. Check that Baudline is running.



Digital Very Low Frequency Recording and Analysis System (DVRAS)

1. Use Putty and Login with username: dvras and password: dvras001

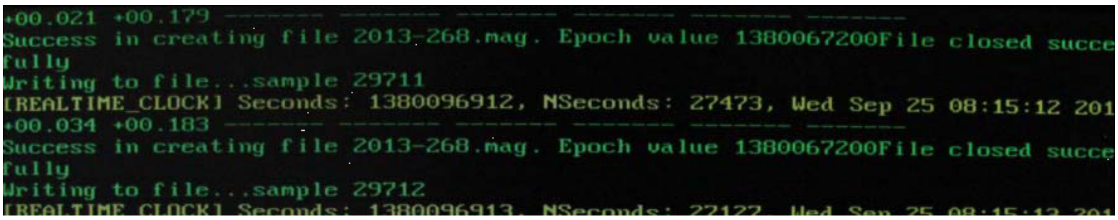
2. Check that the process dvrecord is running with $ ps aux | grep dvrecord.
3. In another terminal type tail /home/dvras/dvreport-log.txt and check that the file for the previous day was appended.
4. Verify that the quick look email was sent and review the data in the file.

AWD - PLASMON

1. Use Putty and Login with username: root and password: Tihany
2. Verify in putty with ls | tail that files are created in /u/sanae/vr2/wh_vr2_rt/

Pulsation Magnetometer (PMR)

1. Press "select" on D-Link KVM switch to select the PMR computer screen.
2. Select the screen where the script should be running with CTRL+ALT+F1
3. If the script is running correctly, there should be a green message every second stating that the file was created successfully.



Rock Magnetometer (SANRKM1)

1. Verify that the script on the RKM machine is running, it should display a time, four sets of zeros then three values of +- 13000, +- 13000 and +- 35000. Next is a set of zeros and then two wide angle riometer values +-31200 and +-10300.

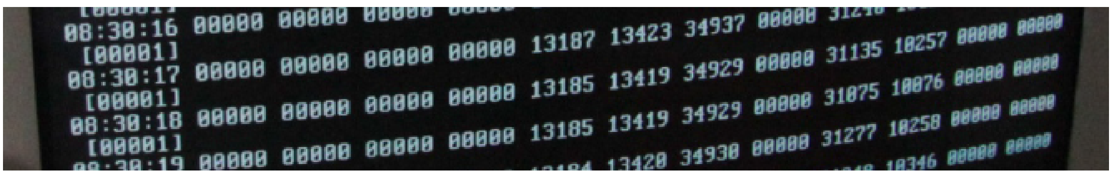


Figure 7.1: RKM Screen Clip

Overhauser Magnetometer (SANOVH1) and Fluxgate Magnetometer (SANFGM1)

1. Use Putty and Login with user name: data_reader and password: !dsfs!reader_sna (This PCs responce is slow)
2. Verify that the OVH data file is being appended with the latest data in /data/SNAOVH1-20170211 |tail -10
3. Verify that the FGM data file is being appended with the latest data in /data/SNADSFS1-20170211 |tail -10
4. Check that light on the back Adam's module blinks orange (it should glow green with orange blinks every second or so).

Figure 7.2: FGMOVH Box

DTU Magnetometer (SANDTU1)

1. Verify that the machine is plotting data on the screen.

Imaging Riometer

1. Use Putty and Login with username: ira and password: dorian.

2. Open putty and verify that the data file is being appended with the latest data in /mnt/data/ira/cat 2017042.beeldrio.dat | tail

Wide Angle Riometer

1. Use Putty and Login with username: magneto and password: dorian
2. Open putty and verify that the data file is being appended with the latest data in /home/magneto/data/cat 2017042.MAGRIO.DAT | tail

Scientist

1. Create a session with WinSCP to Scientist.
2. Check for 15 files in /home/scientist/daily_data/plots
3. Open the DVRAS .PDF and verify if the data is plotted form 12h until 00h.
4. Open the NAS_Check .txt and verify that the NAS transfers were successful for the previous day.
5. Open the ALL_Space file and verify that there is HDD space available on all machines.
6. Go through all the .PNG files and verify that the data is plotted on all the systems for 24hrs. The files should look similar to the ones below:

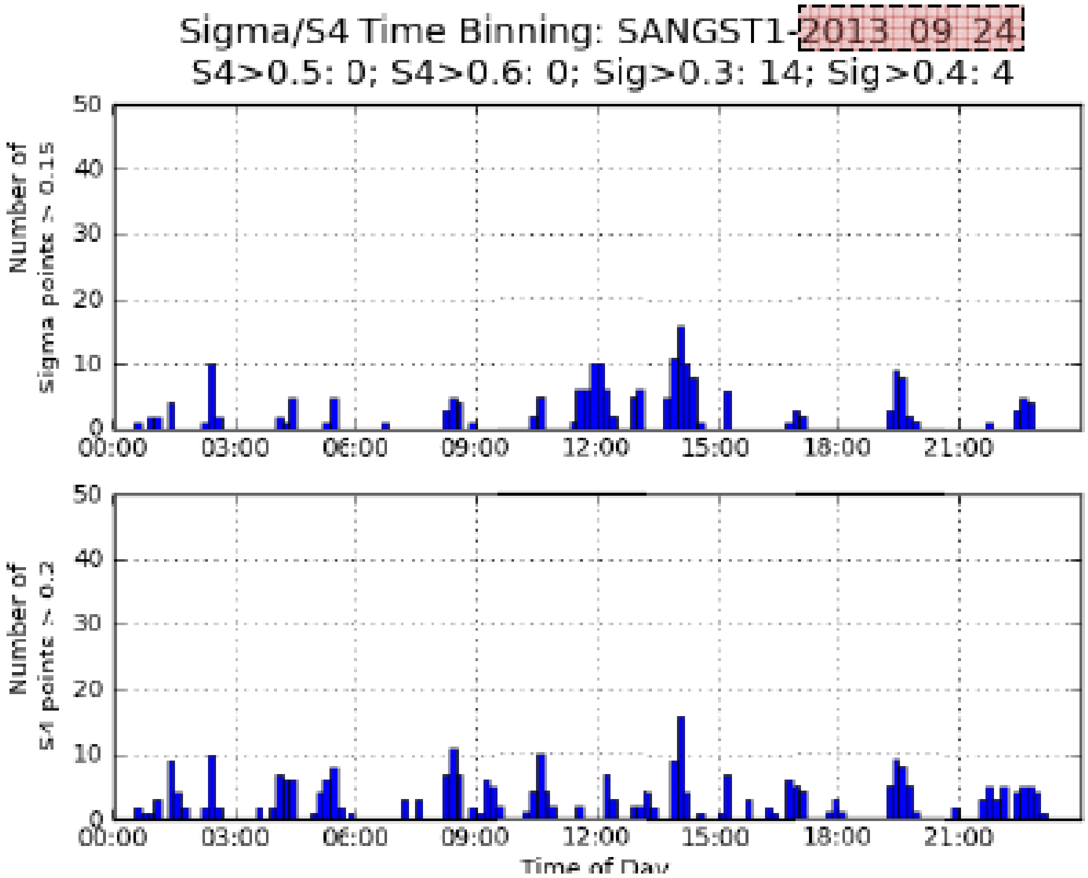


Figure 7.3: SANSGT Plot

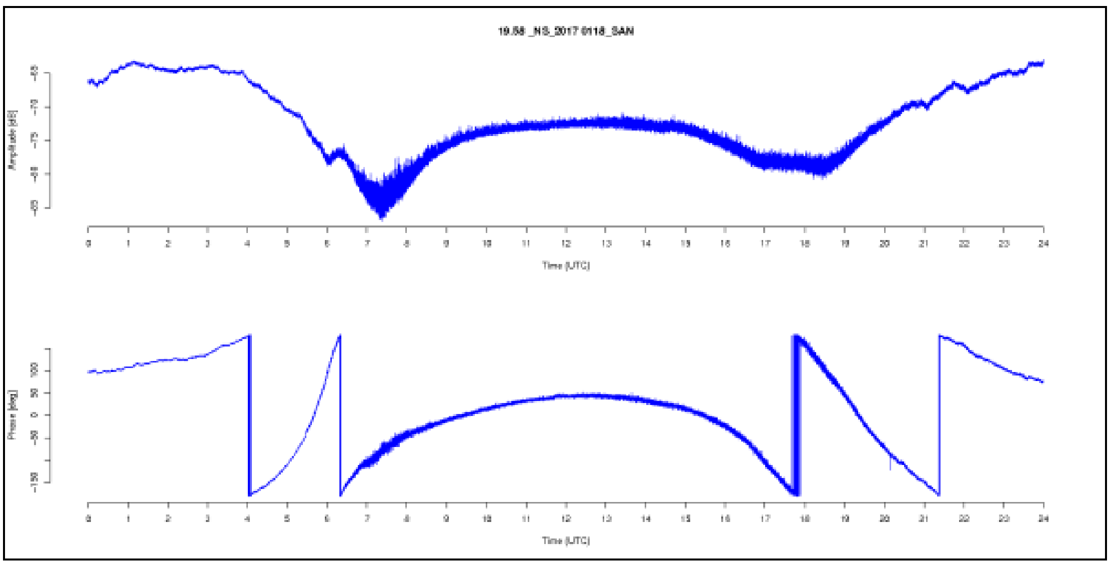


Figure 7.4: UltraMSK Plot

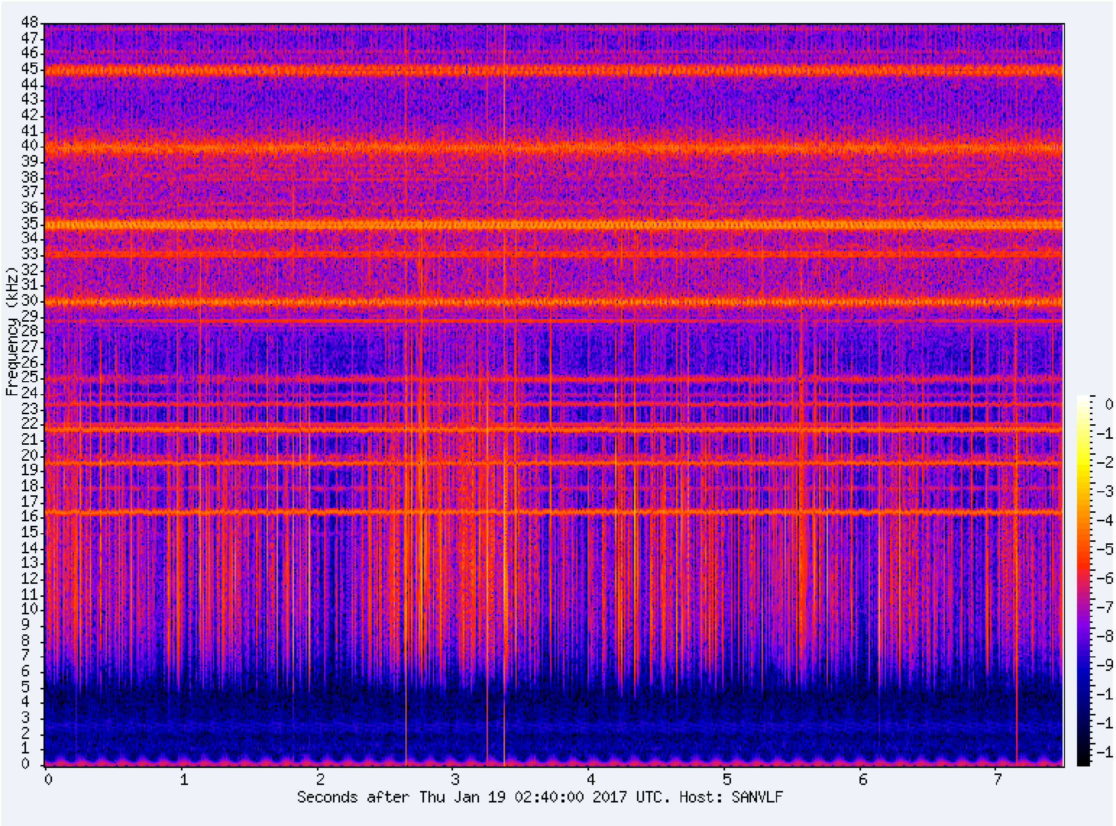


Figure 7.5: WWLLN Plot

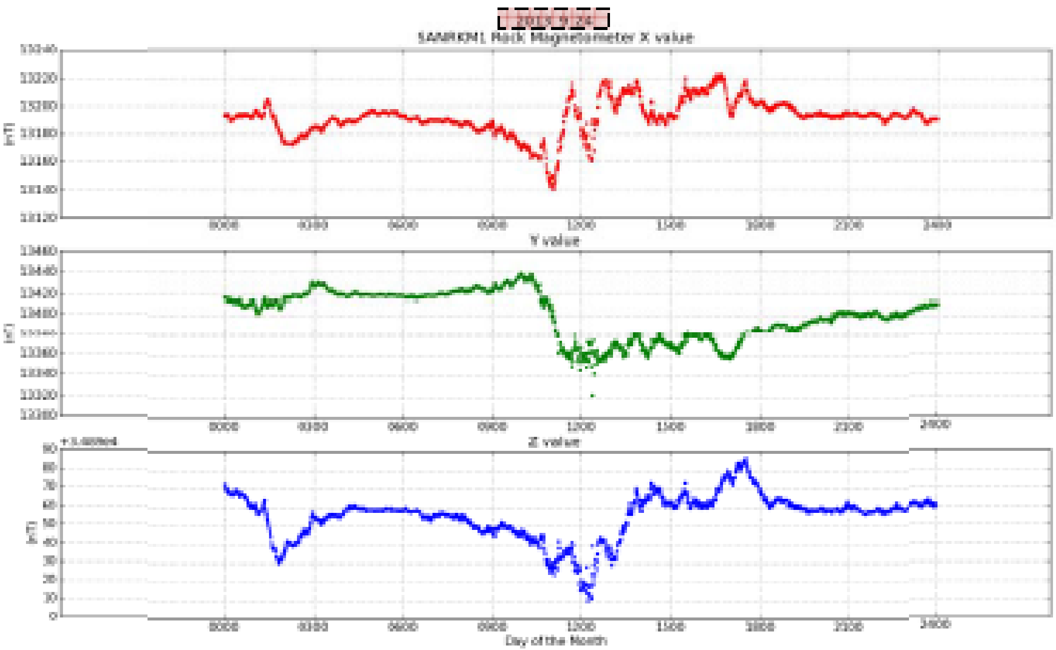


Figure 7.6: RKM Plot

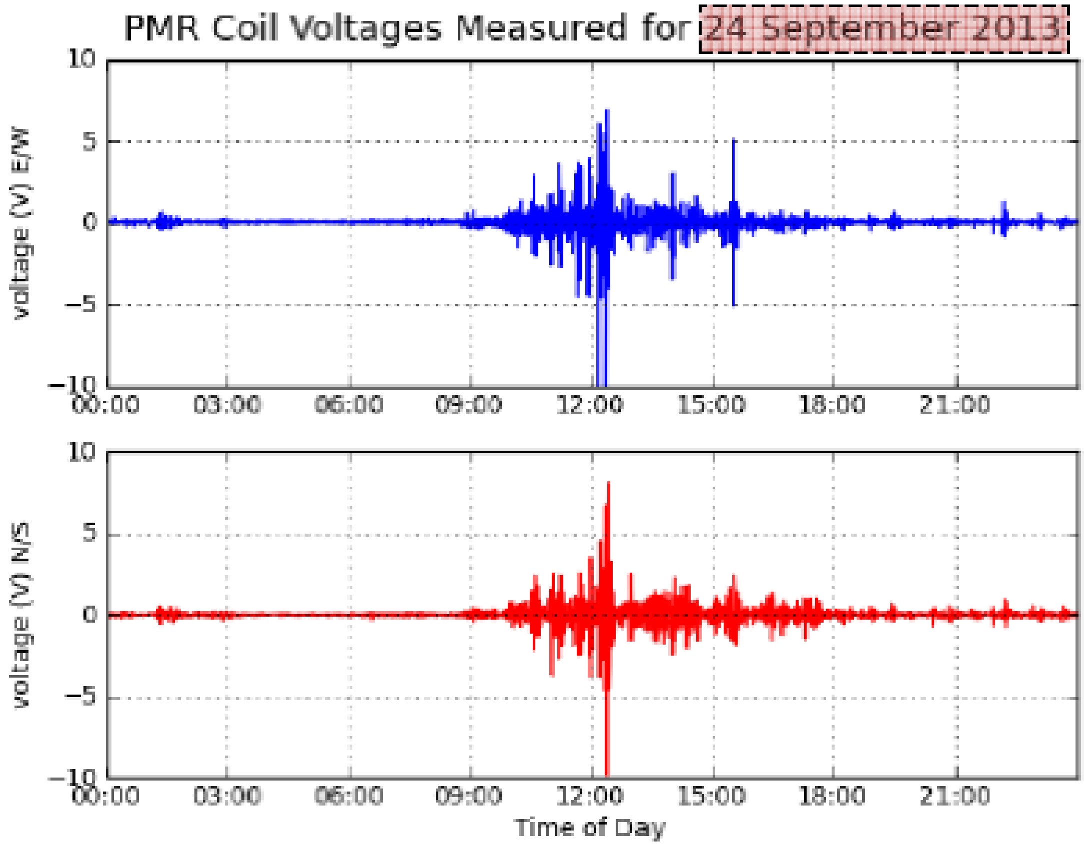


Figure 7.7: PMR Plot

Figure 7.8: OVH Plot

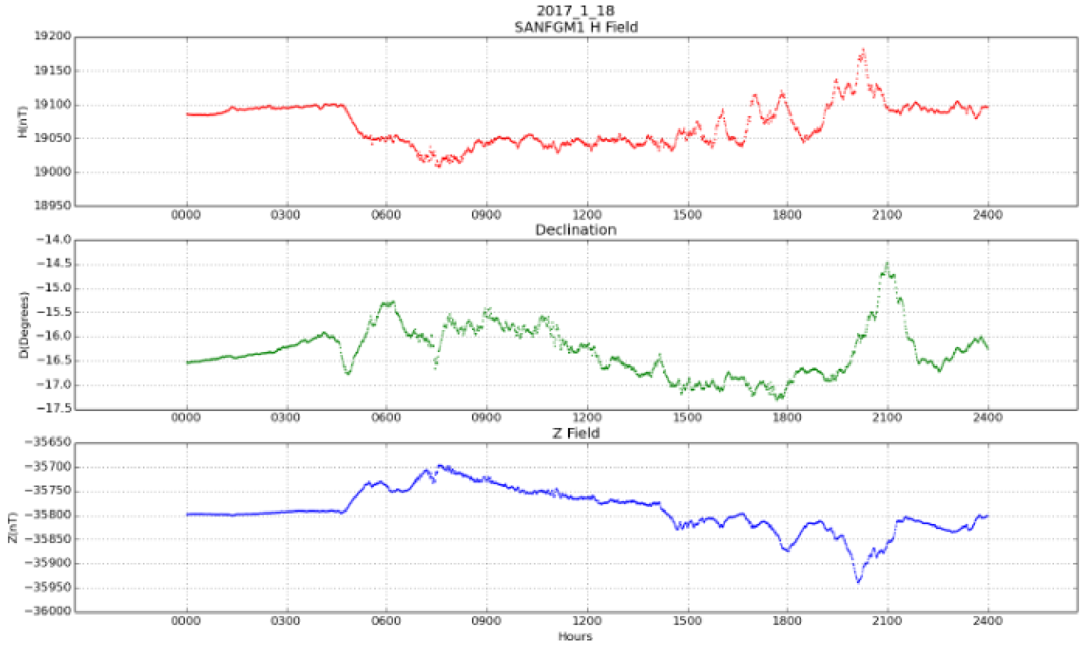


Figure 7.9: FGM Plot

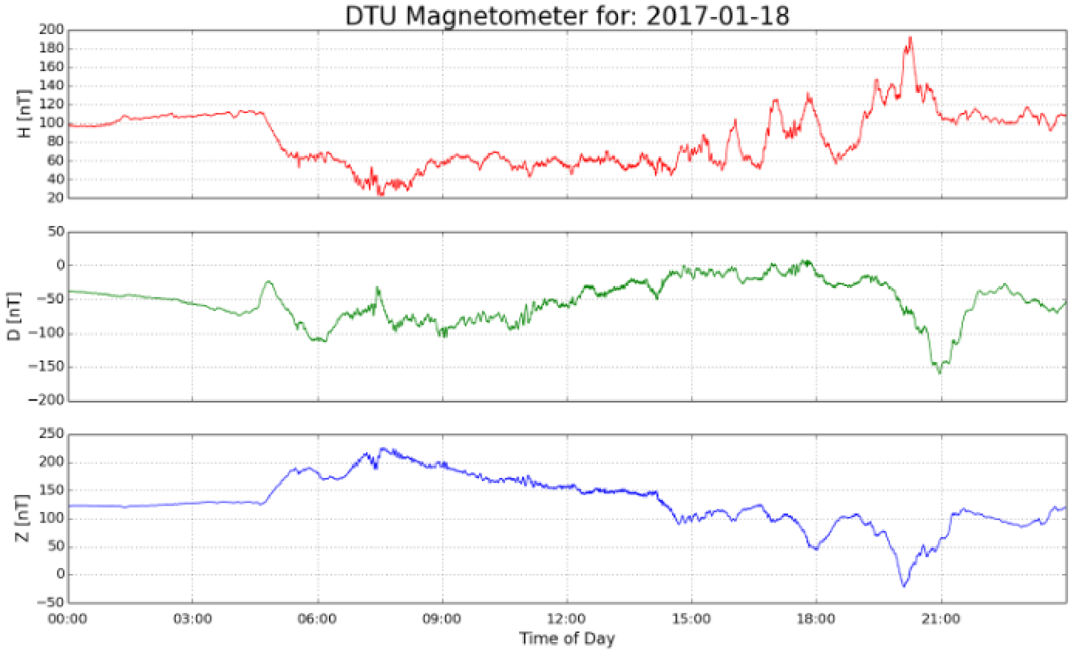


Figure 7.10: DTU Plot

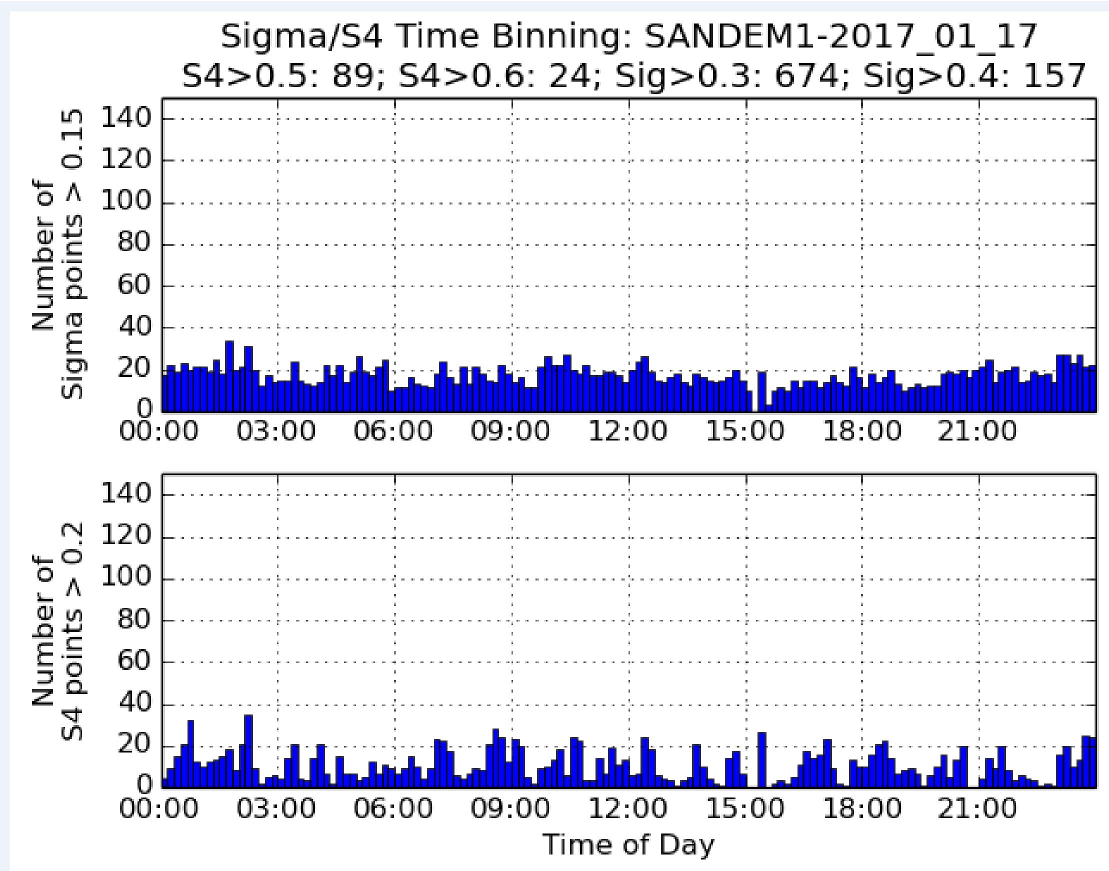


Figure 7.11: SANDEM Plot

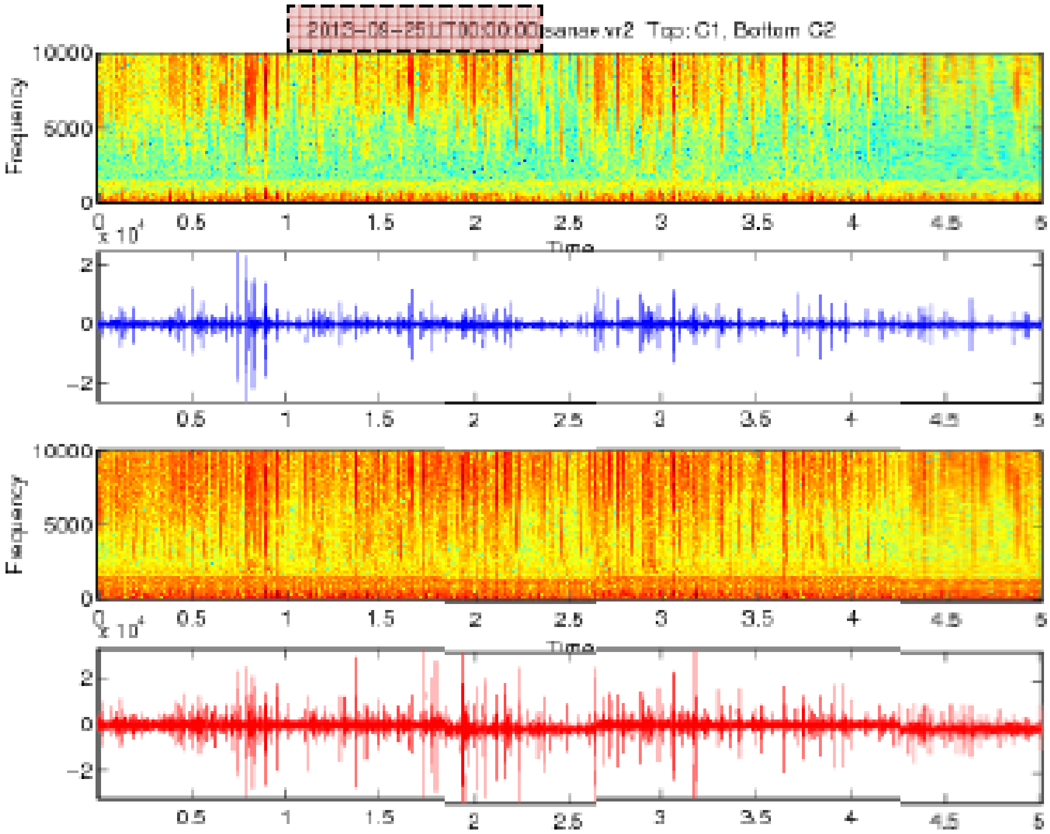


Figure 7.12: AWD Plot

Appendix C: Science Field Map

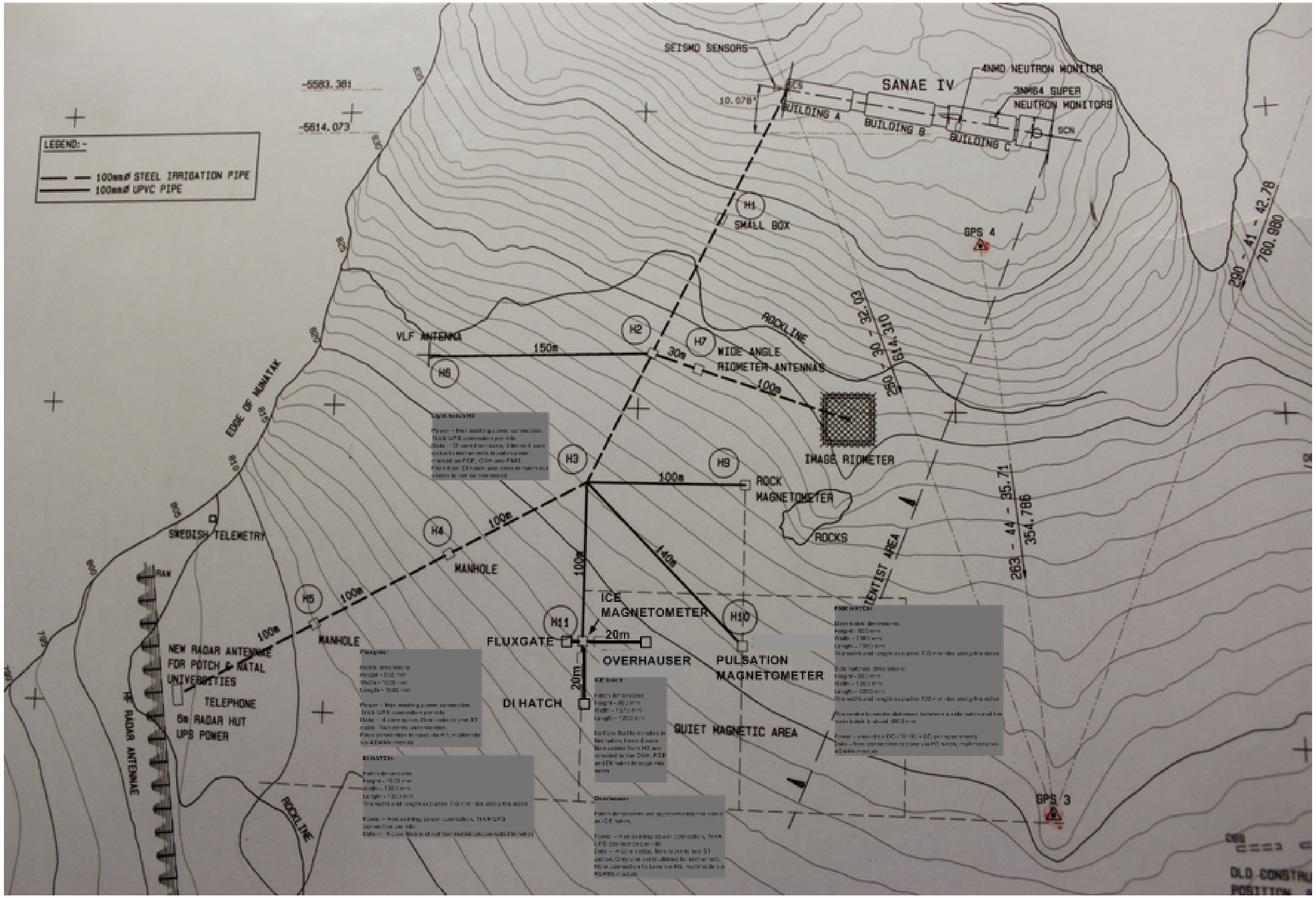


Figure 7.13: Map of the science area of SANAE IV.

7.3 Appendix D: WWLLN and UltraMSK PC installation

WWLLN and UltraMSK PC OS: Slackware 13.1.0
WWLLN and UltraMSK PC (new) OS: CentOS 6.7

The following subsection was written by Pierre Joubert, M72 Marion Island Engineer and S55/56 SANAE IV Take-over Team Leader.

Introduction

The purpose of this document is to guide the user through the installation steps of UltraMSK and World Wide Lightning Location network systems on a new computer. These are two separate systems running on the same computer and using the same input source.

This guide focuses on the installation of the system for Marion Island, using a supermi- cro 1U with a M-Audio delta 44 sound card. The input source a magnetic field loop antenae with a preamlifier and splitter unit in-line.

This guide follows on the guide available online for the ultraMSK system at ultramsk.com.

Equipment

The following equipment is required:

- A computer that will server as the host. In our case a Supermicro 1U
- CentOS installation media. CentOS 6.6 minimal installation will be used on a boot able USB drive.
- GPS receiver with 1 PPS output.
- VLF antenae
- Sound card with at least 3 inputs that is capable of sampling at 48 or 96kHz and uses sigma-delta analog to digital convertors. (NS, EW and GPS)

CentOS installation

Before installing CentOS, you would need to setup the raid structure if required. This is a fairly straightforward and simple process but will be machine dependant.

CentOS installtion media can be downloaded from: http://isoredirect.centos.org/centos/6/isos/x86_64/
The following command is used to place the iso image on a flash drive:
"sudo dd if=input of=output"
Where input is the downloaded iso file and output the USB drive location ex. "/dev/sdb". Do NOT use a partition on the drive such as "/dev/sdb1". The usb drive location can be found by using the dmesg command after plugging it in to the computer.
After the operation has finished CentOS can now be installed from the USB drive. Insert it into the target machine and follow the required steps. Be sure to select the time zone as UTC.

On Marion, the hostname is set to "Thor", and the root password set to "ultramsk001".

Once CentOS is installed it should reboot and allow you to login as root. The next two things that needs to be done is the network needs to be set up and users need to be created.

1. Network setup

Use the command "ip a" to show available network interfaces.

The file containing network setup is located at "/etc/sysconfig/network–scripts" and is named according to the interface. (eg. ifcfg-eth0)
You will need to use vi to edit this file and configure the network parameters as required.

Example configuration show below.

DEVICE=eth0
HWADDR=0C:C4:7A:12:E9:B8
TYPE=Ethernet
UUID=570c1022–b80d–4632–8fe2–3dc0badeece2
ONBOOT=yes
NM CONTROLLED=yes

BOOTPROTO=static
IPADDR=172.18.30.121
NETMASK=255.255.255.0
GATEWAY=172.18.30.10
DNS1=172.18.30.10
DNS2=172.18.30.10

2. Required programs

yum update can now be run to install system updates.

The following software packages need to be installed using yum:

nano – optional
rsync – optional
wget – optional
libpng–devel – required
fftw–devel – required
ntp – required
ntpdate – required

3. NTP setup

To setup the ntp client, edit /etc/ntp.conf to point to the local ntp server.
You can ensure the service will run at boot time by running:
sudo /sbin/chkconfig ntpd on
To make sure the NTP service starts after installing it, run:
sudo /etc/init.d/ntpd start
Use "ntpdc –p" to check whether ntp is able contact the server.

4. Creating users

To create a new account use: useradd –m username
To set a password to the account use: passwd username

Following users are created:

Username: nerd
Password: !nerd001

Use: Default administrative account

Username: ultramsk
Password: ultramsk001
Use: ultramsk account

Username: sferix
Password: sferix
Use: WWLLN account

User needs to be added to the sudoers group in order to perform functions that need to be run as root.
The command "visudo", run as root, allows user to be added to the sudoers group.
Edit the file by adding your user as seen below. User nerd was added.

```
## Next comes the main part: which users can run what software on
## which machines (the sudoers file can be shared between multiple
## systems).
## Syntax:
##
## user MACHINE=COMMANDS
##
## The COMMANDS section may have other options added to it.
##
## Allow root to run any commands anywhere
root ALL=(ALL) ALL
nerd ALL=(ALL) ALL
```

5. UltraMSK Installation

The ultraMSK installation files used on Marion is located at:
/2015_2016_Work/Projects/Project_UltraMSK/UltraMSK_WWLLN_Setup/

There are four main files:

vtcard: The vtcard process that allows the sound card input to be streamed to multiple processes. This file should be placed in:
/usr/local/bin/
msk.vtlib.el6: The latest msk executable that works with vtcard, should be placed in:
/usr/local/bin/

license.dat: The ultraMSK license file, should be placed in:
/home/ultramsk/data/
run-ultramsk.sh: The script that runs the vtcard process and each ultramsk process. Should be placed in:
/home/ultramsk/

Edit the run-ultramsk.sh script to include the relevant sound card. Frequencies to log can also be added and removed by editing the script.

Sound card details to be used in the script can be found using:
cat /proc/asound/cards

Example output of the command:

0 [M44]: ICE1712 – M Audio Delta 44
M Audio Delta 44 at 0xd040, irq 21

To ensure run–ultramsk.sh is run at startup, add the command:
(cd /home/ultramsk; ./run–ultramsk.sh) &
to the file
/etc/rc.d/rc.

6. Alsamixer

Alsamixer allows the user to configure sounds settings and adjust the volume of the incoming signals. To run alsamixer, simply type the command "alsamixer" and a gui will pop up as shown in figure 7.14.
The levels shown are for those used at marion. The level for the GPS signal on input 1 are set so the signal PPS signal level is around 50%. (UltraMSK triggers at around 25%) To check the input level, arecord can be used to record the PPS for some time period and can then be viewed using a program like audacity. It is important that this signal does not clip.

The signal levels for the other two channels from the VLF loop antenna were set arbitrarily to roughly match the previous system.

7. Conclusion

The run ultramsk.sh script can now be run as root and data should be generated in the data folder. If data is not being generated, and no

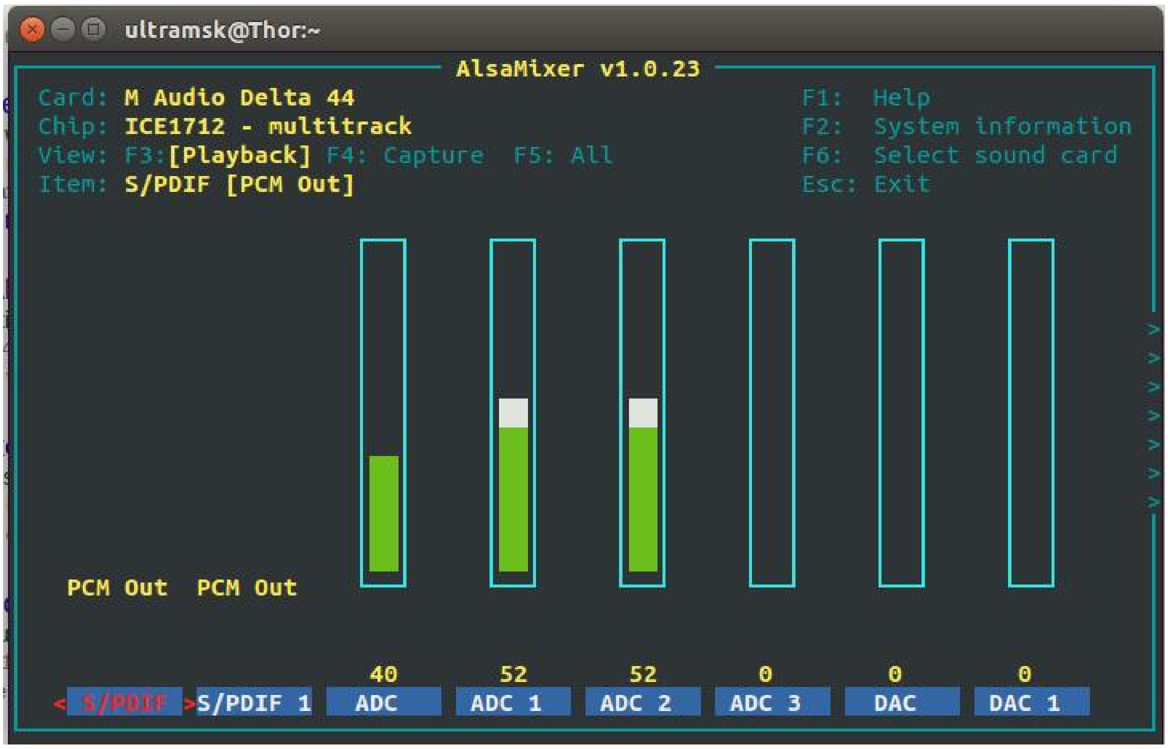


Figure 7.14: Alsamixer setup

debug output is shown to follow, the first thing to check is the GPS PPS signal level.

In order for WWLLN to be installed, external access is required by the WWLLN PI's. (Dr James Brundell and and Dr Robert Holzworth) They do the WWLLN installation from their side on the sferix account.

Note that as of 30 December 2015, Dr Brundell has not completed the WWLLN installation and these installation steps have not been confirmed to be working.