

**Report on attendance of
3rd Matjiesfontein Space Geodesy Station Technical Workshop
16-20 March 2009, Matjiesfontein
by
Pierre Cilliers and Ben Opperman**

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1. Objectives

The HMO was invited to participate in the Matjiesfontein Space Geodesy Station Technical Workshop for the purpose of exploring the feasibility of locating HMO Space Weather related facilities on the proposed Matjiesfontein observatory site and exploring opportunities for synergy between HartRAO and HMO.

2. Attendance

The workshop was attended by 12 persons from HartRAO(6), Council for Geosciences(2), HMO(2) and DLR(2). The attendees were the following:

Dr Sandile Malinga (HMO, MD)
Dr Pierre Cilliers (HMO, Space Physics)
Dr Ben Opperman (HMO, Space Physics)
Dr Ludwig Combrinck (Space Geodesy, HartRAO)
Lesley Nicola (Enrolled for UNISA)
Marissa Nicola Hartbeesthoek Radio Astronomy (MSc student, UP)
Chistina Botai Hartbeesthoek Radio Astronomy (PhD candidate, UP)
Leon Croucamp (Council for Geosciences)
Stoffel Fourie (CSIR Mining Tech)
Johan Bernard (HartRAO, SLR Manager)
Dr Oliver Montenbruck (DLR Germany)
Andre Hauschild (DLR Germany)
Roelf Botha (HartRAO, PhD candidate -Stellenbosch, CSIR Laser Centre)

Dr Sandile Malinga attended on 16 March only, and Dr Ben Opperman attended on 18-20 March. A group photo of the attendees is given in appendix A.

3. Programme

The programme included presentations and planning discussions on the various proposed activities at the Matjiesfontein observatory and on the formulation of the lease agreement with the owners of the land. Drs Pierre Cilliers and Ben Opperman gave a joint presentation on the topic “HMO Space Weather Infrastructure and Ionospheric Applications of GPS in South Africa”. The programme is attached as appendix B. All the presentations given at the workshop are to be made available on the HartRAO website <http://geodesy.hartrao.ac.za> onder Past Events.

4. Highlights

During the Matjiesfontein meeting the HMO delegates visited the site of the proposed observatory. Some photos of the surroundings and of existing instrumentation at the site are given in Appendix C. A map of the proposed area of the Matjiesfontein Observatory is given in Appendix D.

The HMO delegation had fruitful discussions with Dr Oliver Montenbruck of DLR on the problems with implementing a GPS receiver and other ionospheric experiments on a cubesat, particularly the limitations of the available power and communication infrastructure and satellite stabilization. Dr Montenbruck and Mr Hauschild shared valuable information on latest trends in real-time GNSS data distribution via NTRIP protocol: a valuable tool for significantly improving real-time ionospheric calculations from GPS signals. After the workshop at Matjiesfontein, some of the participants including Drs Cilliers and Opperman visited the Sutherland Observatory for a guided tour of the SALT facility, the Sutherland GPS facilities, the gravimeter facility, and the HMO pulsation magnetometer facility.

5. Outcomes

The outcome of the workshop was among others the following:

1. An identification of required resources to establish Matjiesfontein as an atmospheric, ionospheric and geodesic observatory.
2. A proposed lease agreement between the NRF and the Matjiesfontein Educational trust regarding the use and development of the land to be made available for the Matjiesfontein Observatory.
3. A demarcation of the area proposed for the Matjiesfontein Observatory.
4. Identification of potential locations for Atmospheric and Space Weather related instrumentation on the site of the Matjiesfontein Observatory.
5. Identification of suitable locations for a Science Centre in the Matjiesfontein Village.
6. A planning outline for the installation of instrumentation at the Matjiesfontein Observatory as well as for required upgrading of resources (See Appendix C)

6. Expenses

The organisers of the workshop paid for the accommodation and meals of the HMO delegation. The HMO provided payment for the transport of the HMO delegates to and from Matjiesfontein.

7. Conclusion

The proposed site of the Matjiesfontein Observatory has several benefits including existing ESKOM power to the site, boreholes, roads, proximity to the HMO (3.5 hour drive), support from the local community and owners of the land, and proximity to the Sutherland Observatory of the SAAO. The participation in the workshop made a significant contribution to the establishment of an observatory at Matjiesfontein and provided the HMO delegation an opportunity to benefit from interaction with the international participants in the workshop. The HMO delegation had the opportunity to visit the proposed site of the Matjiesfontein Observatory and participate in the formulation of the proposed lease agreement with the owners of Matjiesfontein. The discussions with attendees paved the way for future collaboration.

8. Photos.

Appendix D shows various maps and photos of the site and of the current infrastructure. Additional photos of the site taken from various locations along the border of the proposed site can be obtained from the authors.

Appendix A: Group Photo



From left to right: Roelf Botha(HartRAO), Marisa Nicola(HartRAO), Lesley Nicola(UNISA), Cristina Botai(HartRAO), Andre Hauschild(DLR), Ben Opperman(HMO), Ludwig Combrinck(HartRAO), Pierre Cilliers(HMO), Oliver Montenbruck(DLR), Johan Bernard(HartRAO), Leon Croucamp(CGS), Stoffel Fourie(CSIR)

Appendix B: Workshop Programme

Appendix C: Planning outline

Equipment to install during 2009:

1. Gravimeter
2. DORIS
3. Seeing Monitor (maybe 2010)
4. Comms tower
5. Seismograph (maybe 2010)
6. Cloud Mapper

Other equipment at later stage:

1. MOBLAS6 (?)
2. Maser / 10 exp (-15) accuracy, in controlled environment
3. SLR / LLR system (under development)
4. VLBI (after RFI tests on-site, hopefully tests to commence during 2009)
5. Meteor radar
6. HF Radar (high rate)
7. Ionosonde
8. GPS / VHF scintillation receiver (300 mb / day)
9. Fixed LIDAR (aerosols, temperature)
10. Met network (~ 8 stations)
11. VLF Receiver

Infrastructure planning (priority 1 highest 3 lowest)

1. Road, bridges (in collaboration with Laingsburg City Council / Public Works) (2)
2. Transport (4x4 via Leon) (1)
3. Communications (1)
4. Electricity and backup power (60Hz via DC conversion) (2)
5. Water (3)
6. Overnight accommodation (room, toilet, kitchen) (3)
7. Vault for Gravimeter (1)
8. Mounts platforms for Seeing monitor (2)
9. Train coaches- upgrade / refurbish for Office, Science Awareness, computer facility (1)
10. MOA- land use, land for housing (expand scientific area to top of mountain, 40m north of ridge), train (like accommodation etc) (0)
11. Piers for SLR (3)
12. Footprint network 30 units (1)
13. Workshop and labs, toilets, kitchen, store, library (3)

On-Site support staff

1. Science educator / outreach (2010)
2. Security (2009)
3. Road construction team (2009)

Appendix D: Selected Photos and images of the proposed site

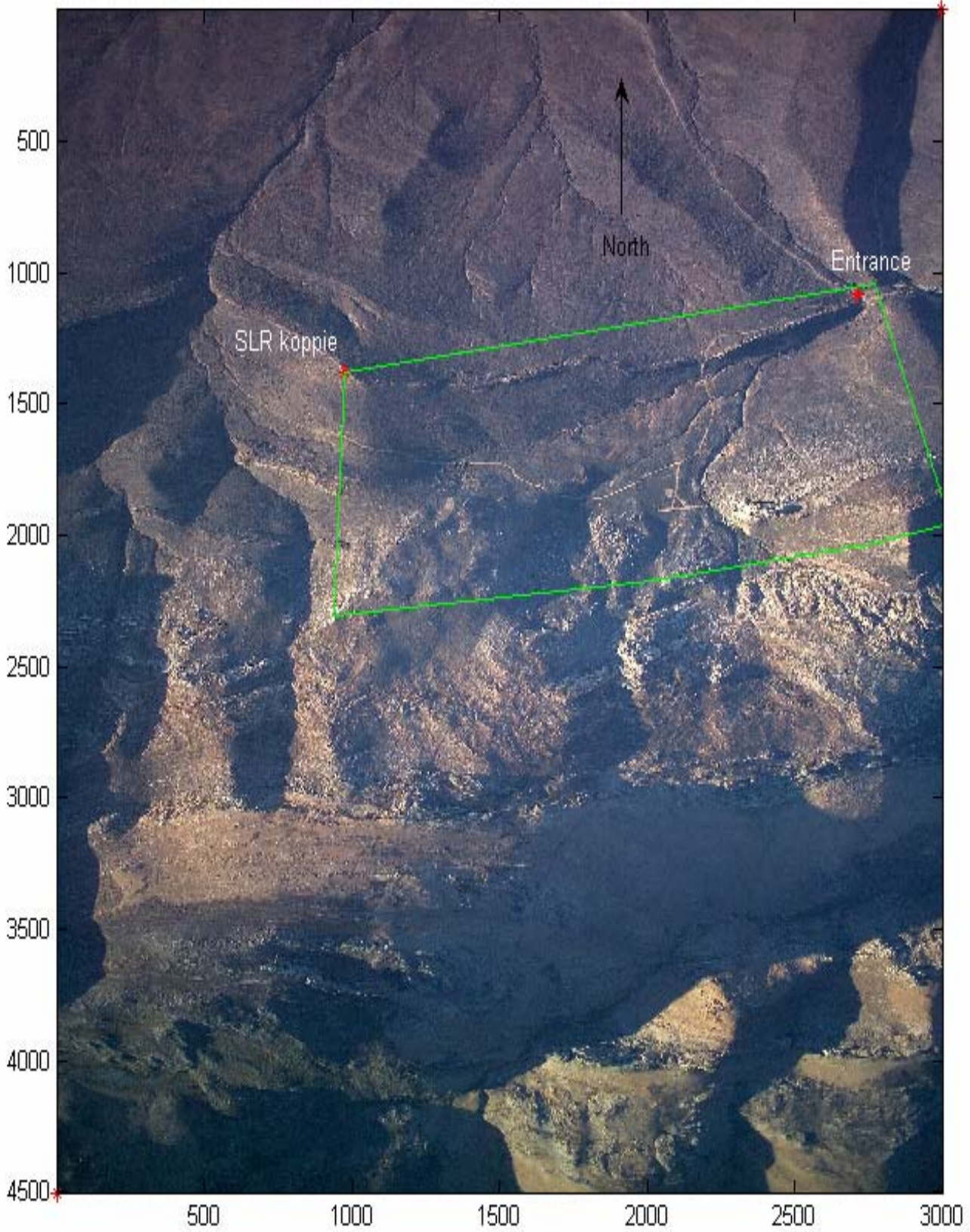


Photo 1: Aerial Photo of the proposed site with the borders of the site marked in green.

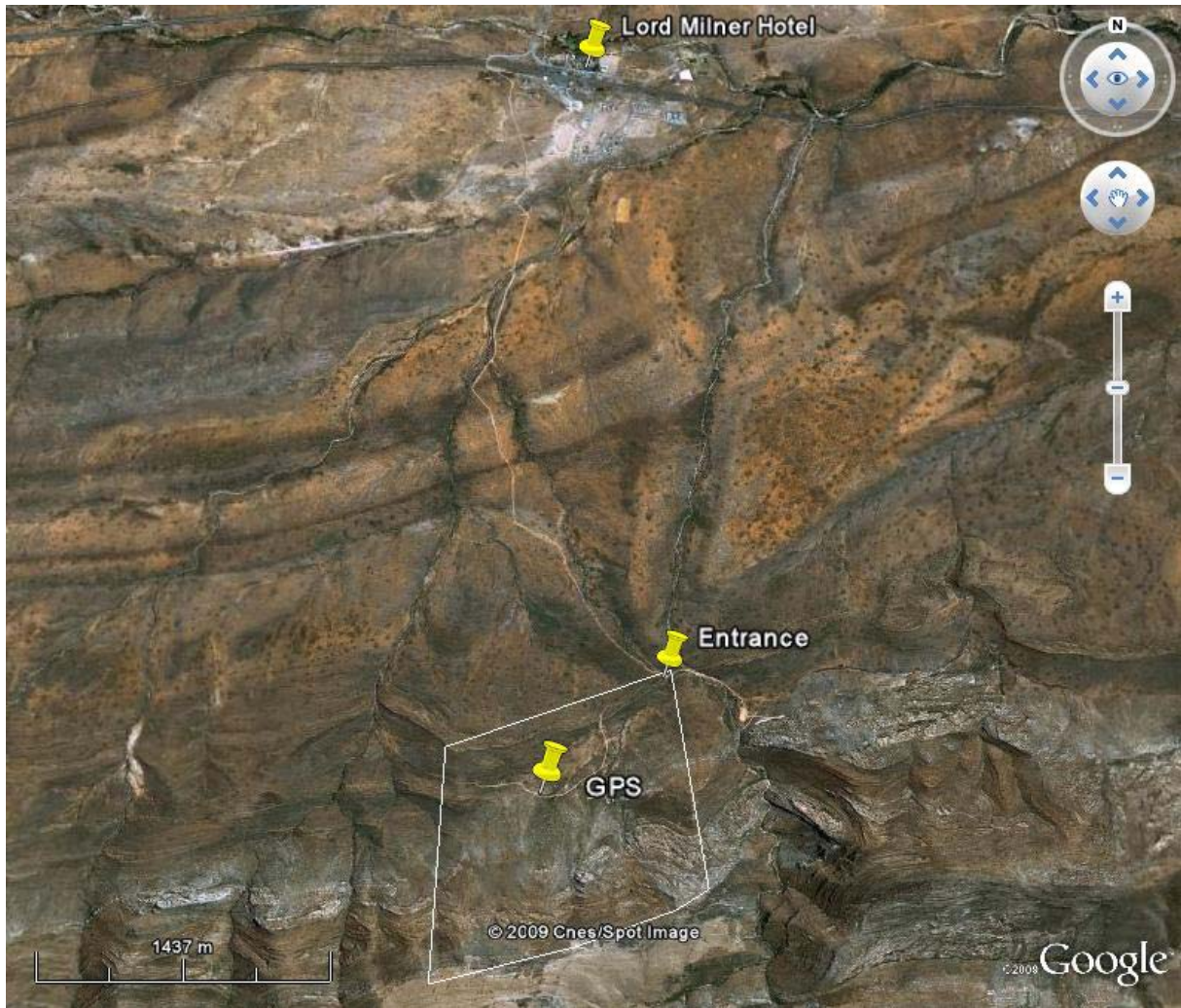


Photo 2: Google Earth image of the proposed site and its location relative to the Matjiesfontein Village. The Lord Milner Hotel is about 4 km directly North of the Matjiesfontein GPS antenna.



Photo 3: Zoomed Google Earth image of the proposed site.



Photo 4: View towards the south of the access road to the proposed site. The horizon forms the southern border of the proposed site.



Photo 5: Existing Automatic Weather Station and GPS Antenna at the proposed site of the Matjiesfontein Observatory. The GPS Antenna position is $33^{\circ} 16' 00.9309''\text{S}$, $20^{\circ} 34' 47.0883''\text{E}$