EISCAT_3D Deliverable 13.1

Additional input materials related to the preparation of D1.5/D11.1

Lars-Göran Vanhainen, Tarmo Laakso, Markku Postila and Inge Marttala
EISCAT Scientific Association
Box 812
SE-98128 Kiruna
Sweden

Version 1.1 2009-04-15

Contents

1. Introduction 1
2. Summary of the Site survey 2005 2
2.1 Tromsö area (Ramfjordmoen) 3
2.2 Inari area (Säytsjärvi) 5
2.3 Masi area (Suolojavrras) 7
2.4 Abisko area (Miellejokk) 9
2.5 Porjus area (Parivierra) 11

1. Introduction

Work Package 13 addresses issues related to the preparations for the next phase of the EISCAT_3D project in so far as they are relevant to the Design Study. Deliverable 13.1 contains additional input materials related to the preparation of the Final Design Document for the Next Generation EISCAT Incoherent Scatter Radar.

The exact locations of the EISCAT_3D sites will not be decided within this Design Study. A team of engineers from the Kiruna and Sodankylä EISCAT sites, performed a site survey during the autumn 2005. The work was done as part of WP2: Evaluation of design performance goals.
The site survey resulted in a tentative model of the EISCAT_3D geometry (figure 1). The central core (transmitter site) is assumed to be located near the present EISCAT site at Ramfjordmoen, Norway, and the receiving sites near Porjus and Abisko (Sweden), Säytsjärvi (Finland) and Masi (Norway). However, recent information indicates that the city of Tromsö have plans to allow industrial facilities to locate in the Ramfjordmoen valley. The establishment of an EISCAT_3D site is dependent on an interference-free surrounding over a long period of time (min. 20 years). An alternative location for the central core is near Överbygd, 80 km south of Tromsö.

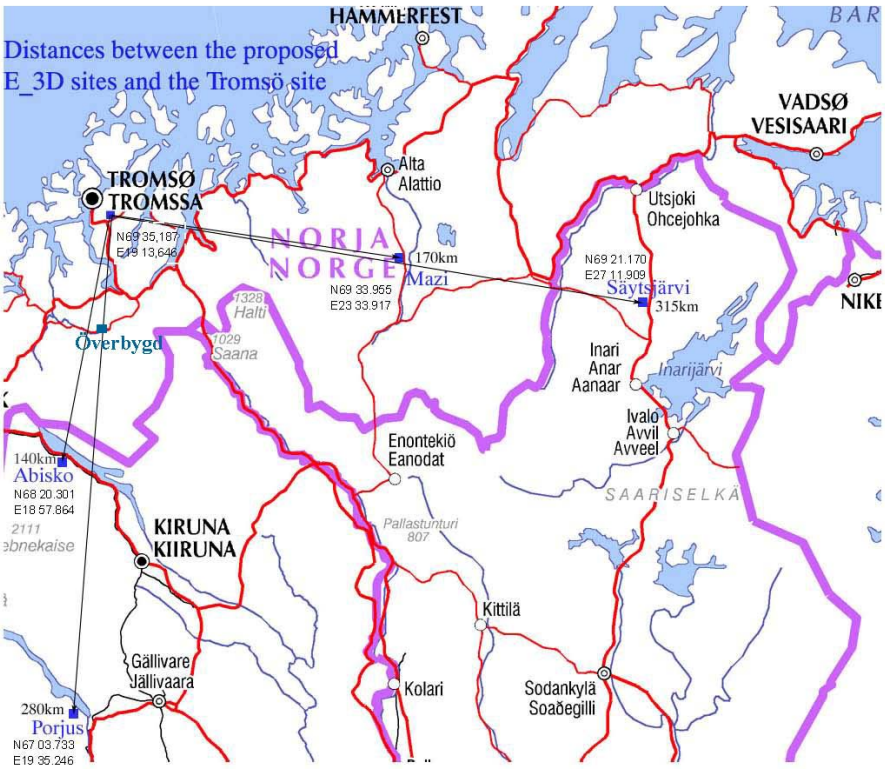

Figure 1. One possible layout of the EISCAT_3D system.

2. Summary of the Site survey 2005

The objective of the Site survey was to find potential construction sites for the EISCAT_3D radar system, on the basis of the EISCAT_3D Design Specification Document:

- A central transmitting/receiving core, located close to the EISCAT Tromsö radar site at Ramfjordmoen, Norway.
- Two receiving facilities, located at ground distances of 90-120 km roughly south and east of the transmitting facility, respectively.
- Two receiving facilities, located at ground distances of 220-280 km roughly south and east of the transmitting facility, respectively.

The areas near Abisko (Sweden), Masi (Norway), Inari (Finland), Porjus (Sweden) and Tromsö (Norway) were selected as interesting for the survey.
A hand-held GPS unit and digital maps were bought in order to map the potential sites.

At each location, the search criterias for a potential antenna site were:

- For the central core - a 300 by 300 meter area, relatively flat and dry. With possibilities to place smaller interferometry antenna arrays at roughly 120 degrees angular separation and extending out to a distance of about 1 km from the system midpoint.
- For the receiving sites - a 300 by 300 meter area, relatively flat and dry, and with an incline of 2-20 meters, in the direction towards Tromsö.
- The absence of TV/radio transmitters and cell phone base stations in the neighbourhood.
- Infrastructure – data communications, power supply

In parallel to this, the field team made RFI (Radio Frequency Interference) measurements at the potential EISCAT_3D sites, and collected basic data for the E3D receiver design engineers. This included measurements of the field strength and in-band interference. The in-band interference measurements aim at locating weaker signals, inside the frequency band of interest (230-240 MHz). The field strenght measurements aim at locating the strong signals that could potentially cause saturation and distortion in the receivers.

The measurements were done using EISCAT-owned equipment:

- Spectrum analyzer: Rohde& Schwarz FSP7
- Omnidirectional antenna: Discone Diamond D-130J, 25-1300 MHz
- Log-Periodic antenna: Create 5130-1N, 50-1300 MHz

The results of the measurements are presented in the EISCAT_3D web site.
On page 3-12 follows a presentation of the five potential EISCAT_3D sites that were investigated by the site survey team.

2.1 **Tromsö area** (Ramfjordmoen)

Location:
- Coordinates**:** N 69 35.344 E 19 13.897
- Tromsö EISCAT site, Ramfjordmoen valley

Ground:
- Mountain birch wood. The ground is covered with moss on gravel bed.
- The area NE of the EISCAT site is almost entirely flat.

Infrastructure:
- Power connection at the EISCAT site (200 m)
- Fiber optic link at the EISCAT site

RF surrounding:
- RF survey plots, see figure 3 and 4.

Neighbours:
- Houses along the main road 91, the nearest at 1,2 kilometer distance.

Others:
- Private land owner

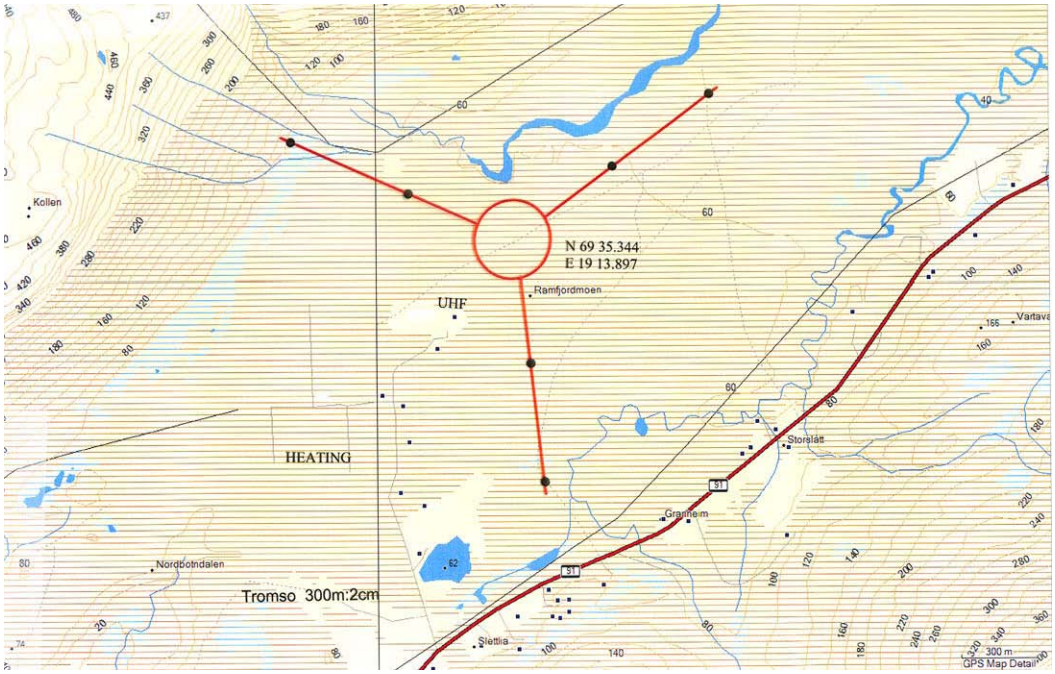

Figure 2. GPS map of the Tromsö area.

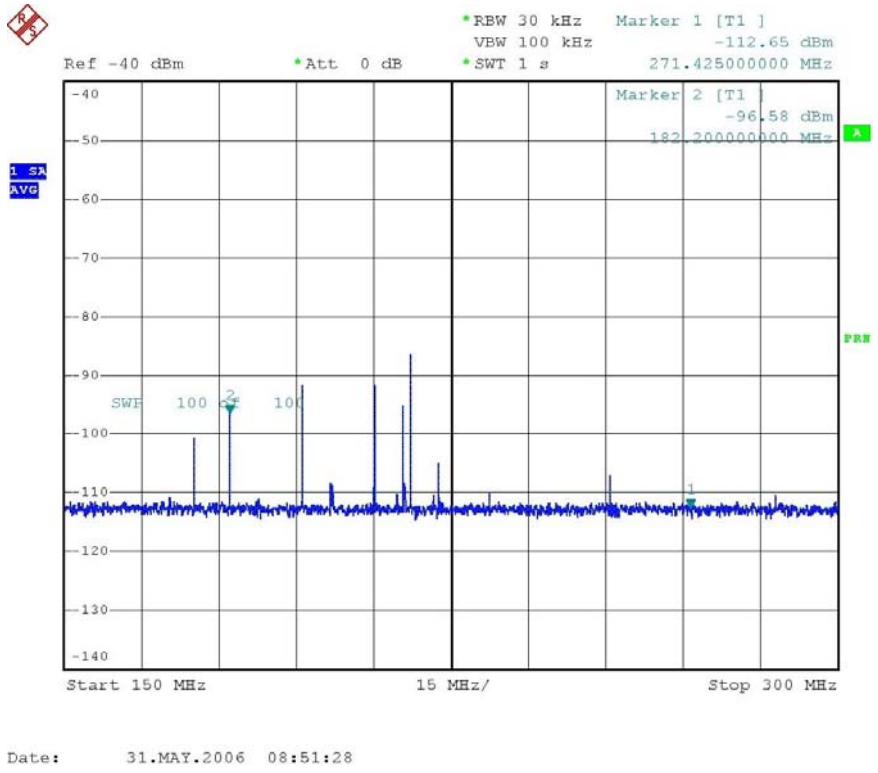

Figure 3. Frequency plot from the Tromsö area, range 150–300 MHz. Measured with an omnidirectional antenna.

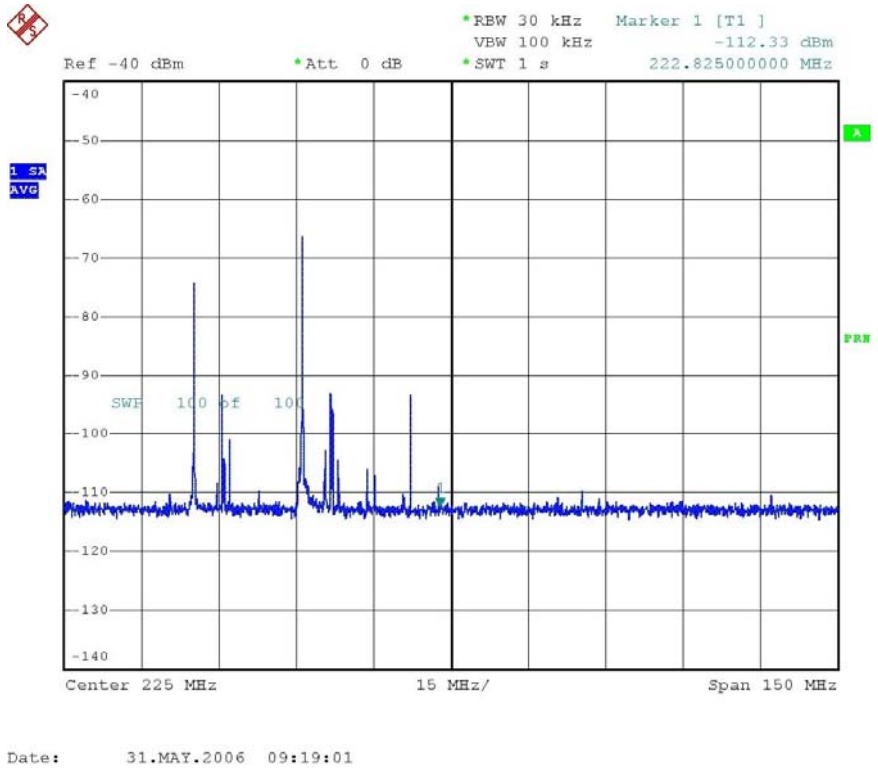

Figure 4. Frequency plot, range 150–300 MHz. Measured with a log-periodic antenna. Azimuth = 240 degrees

2.2 Inari area (Säytsjärvi)

Location:
- Coordinates**:** N 69 21.170 E 27 11.909
- 30 km to the north of Kaamanen and 58 km from Inari.

Ground:
- A 300 x 300 m area was recorded with a GPS unit.
- Mountain birch wood. The ground is covered with moss on gravel bed.
- Incline, roughly 2 meters, in the direction towards Tromsö.

Infrastructure:
- 600 m to a power line.
- 600 m to main road E75.
- Nearest fibre optic link is in Kaamanen (30 km), 1-2 Gbit/s is available.
- There are plans for a fibre optic link between Kaamanen and Utsijoki (Telia-Sonera).

RF surrounding:
- RF survey plots, see figure 6 and 7.
- Big power line (maybe 110 KV or more) in front of the area, 1 km.

Neighbours:
- Some cottages on the shore of Lake Säytsjärvi (2 kilometres).

Others:
- Land owner: Metsähallitus (National Board of Forestry)

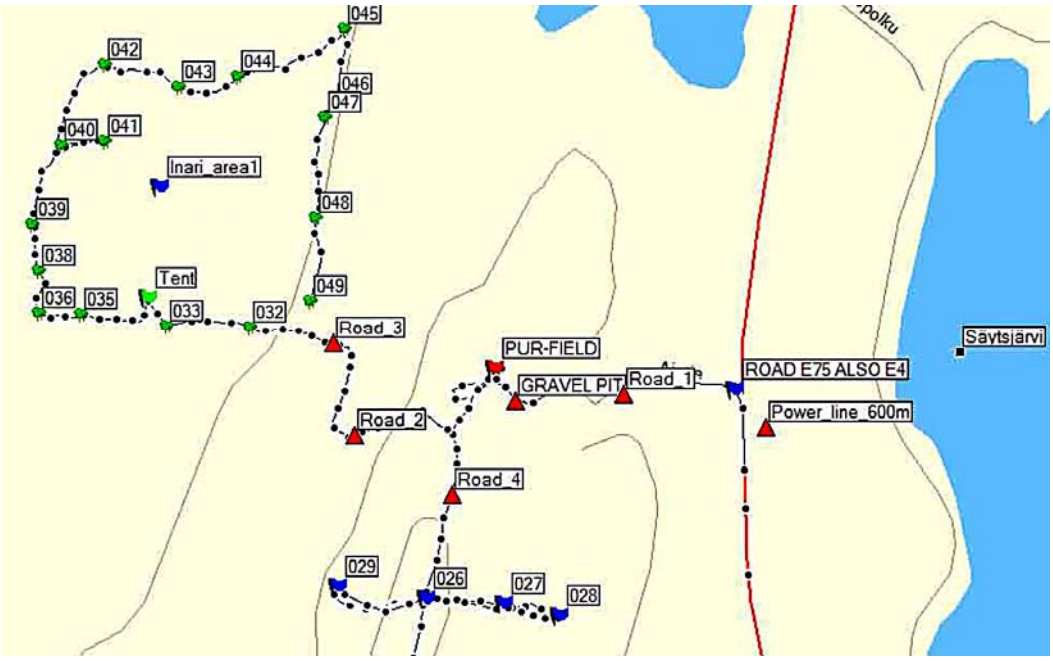

Figure 5. GPS map of the Inari area.

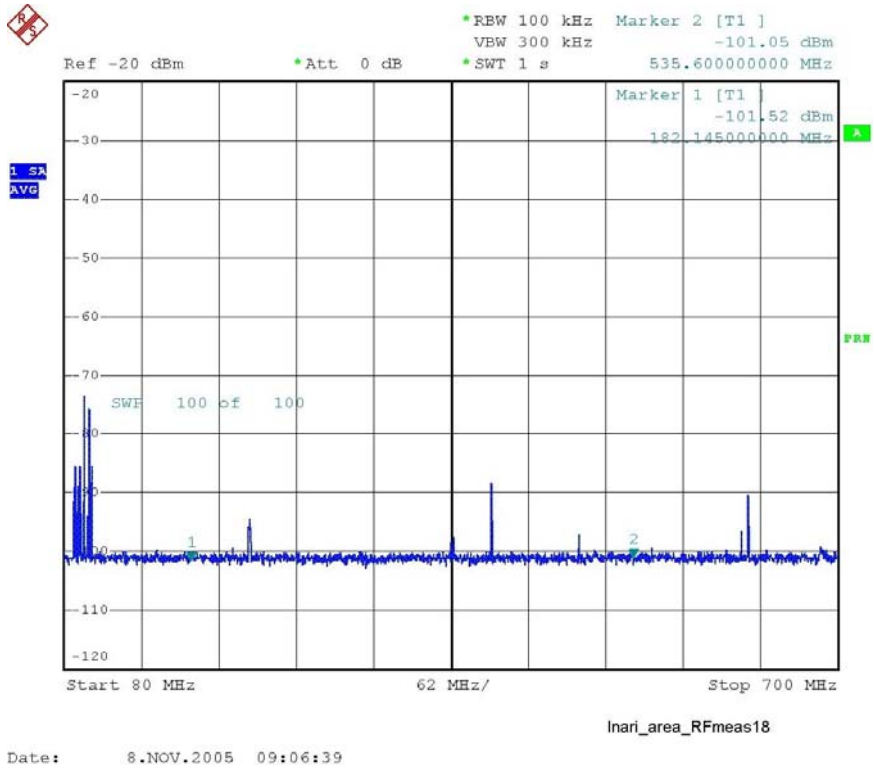

Figure 6. Frequency plot from the Inari area, range 80–700 MHz. Measured with an omnidirectional antenna.

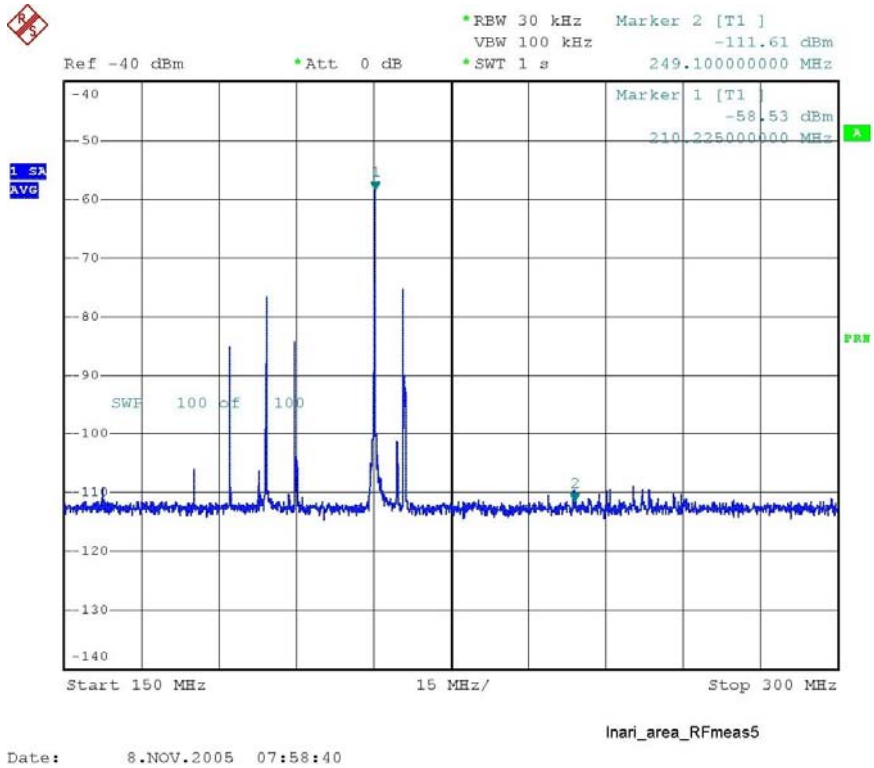

Figure 7. Frequency plot, range 150–300 MHz. Measured with a log-periodic antenna. Azimuth = 120 degrees

2.3 Masi area (Suolojavrras)

Location:
- Coordinates: N 69 33.955 E 23 33.917
- 14 km north from Masi, 70 km from Kautokeino.

Ground:
- A 300 x 300 m area was recorded with a GPS unit..
- Mountain birch wood, the ground covered with moss.
- Incline, roughly 10 meters, in the direction towards Tromsö.
- Almost entirely flat

Infrastructure:
- About 1000 m to the power line on opposite side of the road.
- 600 m to main road (93).

RF surrounding:
- RF survey plots, see figure 9 and 10.

Neighbours:
- Masi 14 km to the south.

Figure 8. GPS map of the Masi area.

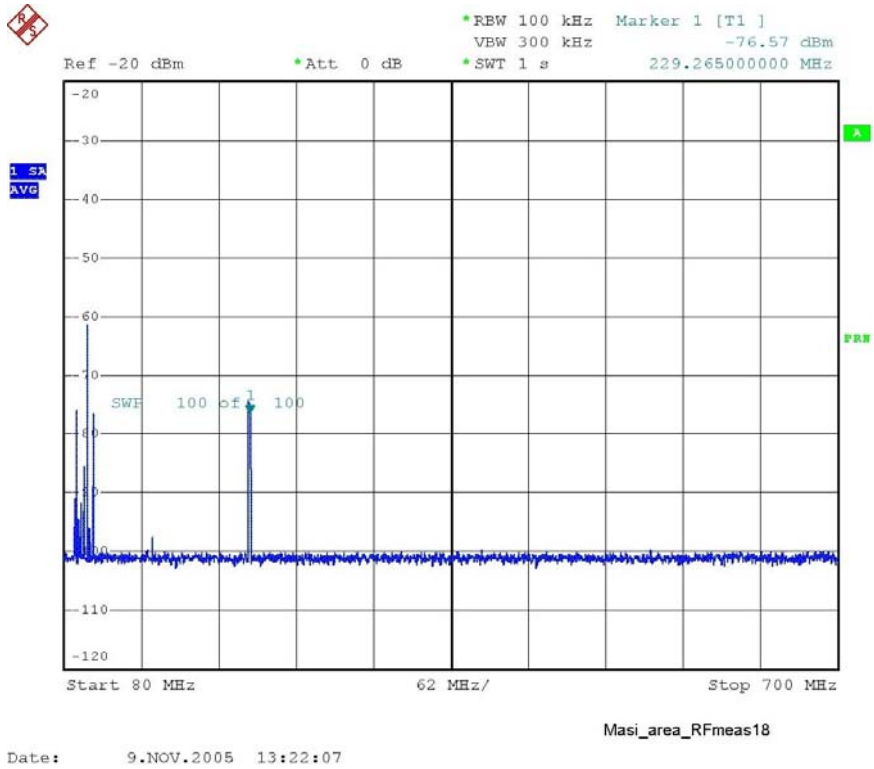

Figure 9. Frequency plot from the Masi area, range 80–700 MHz. Measured with an omnidirectional antenna.

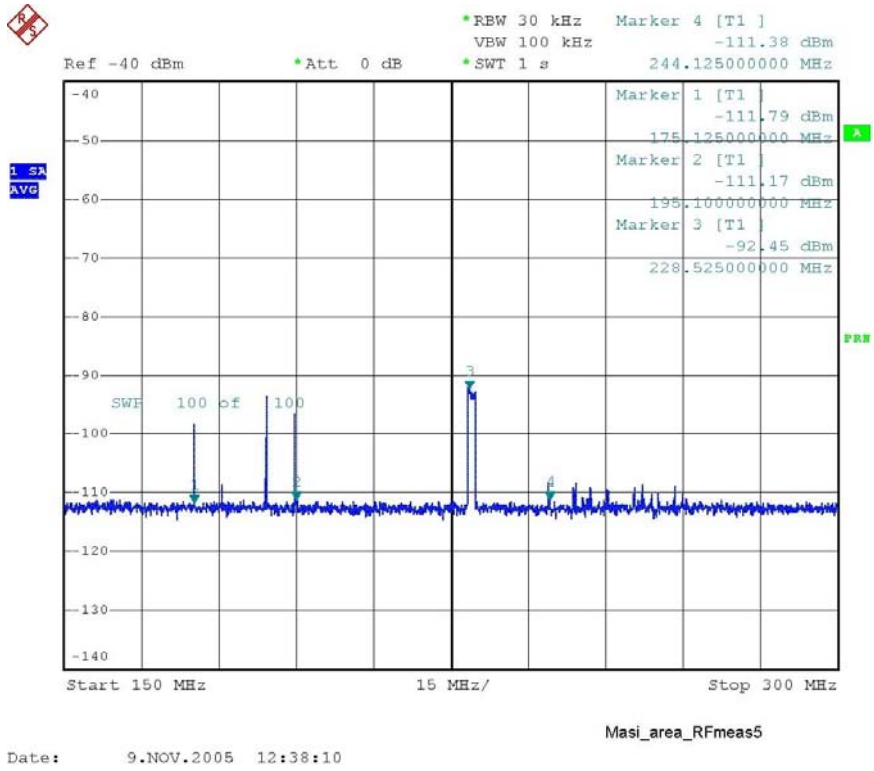

Figure 10. Frequency plot, range 150–300 MHz. Measured with a log-periodic antenna. Azimuth = 120 degrees

2.4 **Abisko area** (Miellejokk)

Location:
- Coordinates**:** N 68 20.301 E 18 57.864
- 5 km east of Abisko.

Ground:
- A 300 x 250 meter area was recorded with a GPS unit.
- High birch wood, the ground covered with grass and moss.
- Incline, roughly 10 meters, in the direction towards Tromsö.
- Almost entirely flat.
- Preparation of the ground is needed along the east side to get a 300 x 300 m area.

Infrastructure:
- 800 m from main road (E10)
- 300 m to a power line.
- 450 m to fibre optic link (railway), 10 Gbit/s

RF surrounding:
- RF survey plots, see figure 12 and 13.

Neighbours:
- Private cottage (old Miellejokk railway station).

Others:
- Land owner: National Property Board.

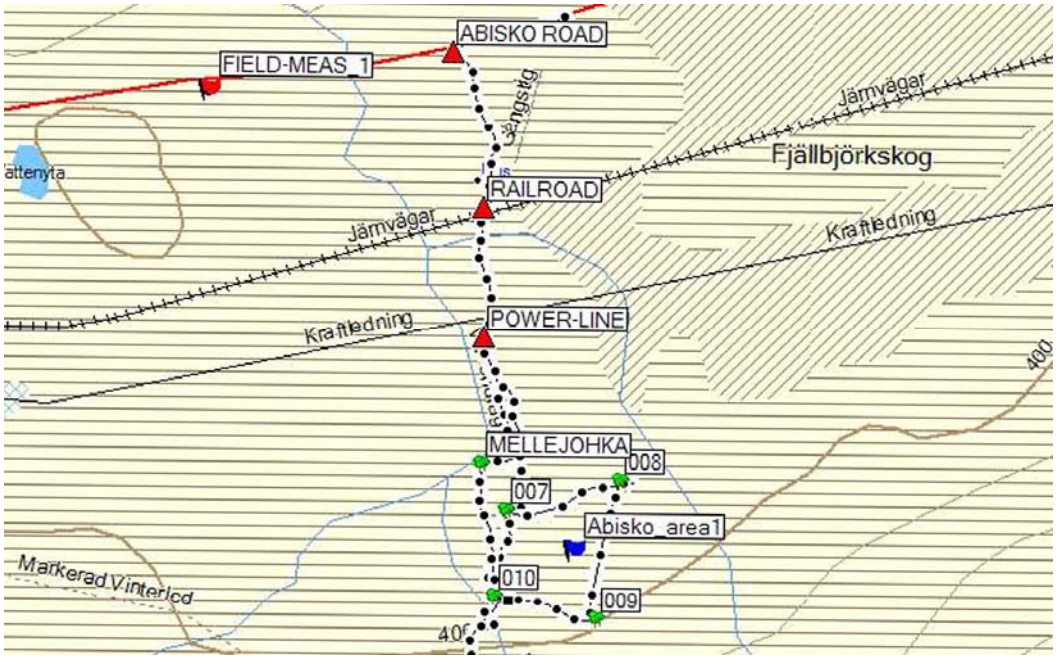

Figure 11. GPS map of the Abisko area.

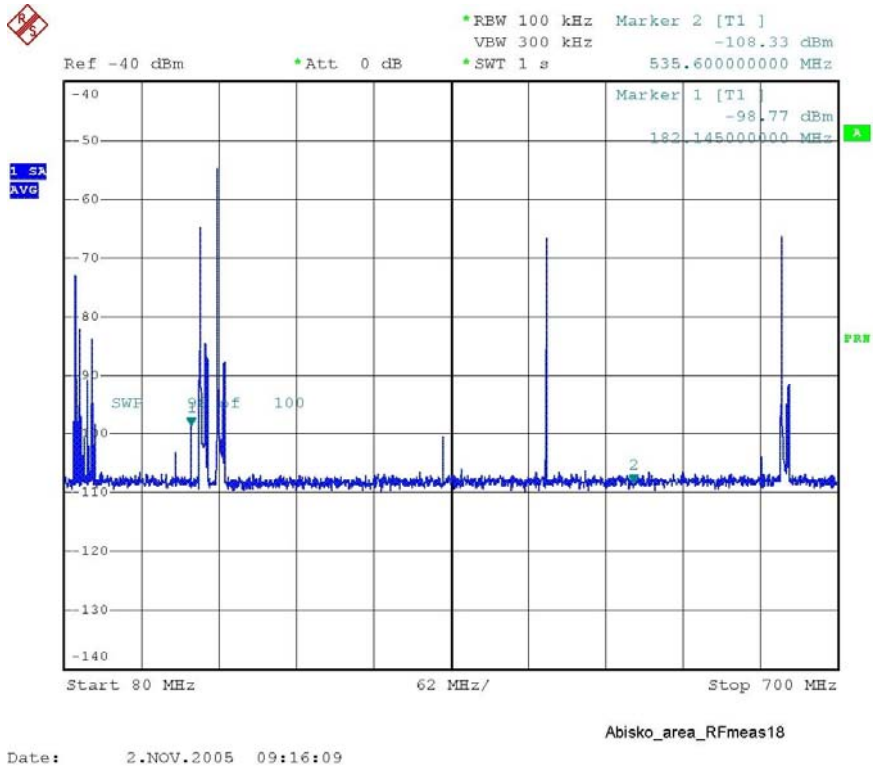

Figure 12. Frequency plot from the Abisko area, range 80–700 MHz. Measured with an omnidirectional antenna.

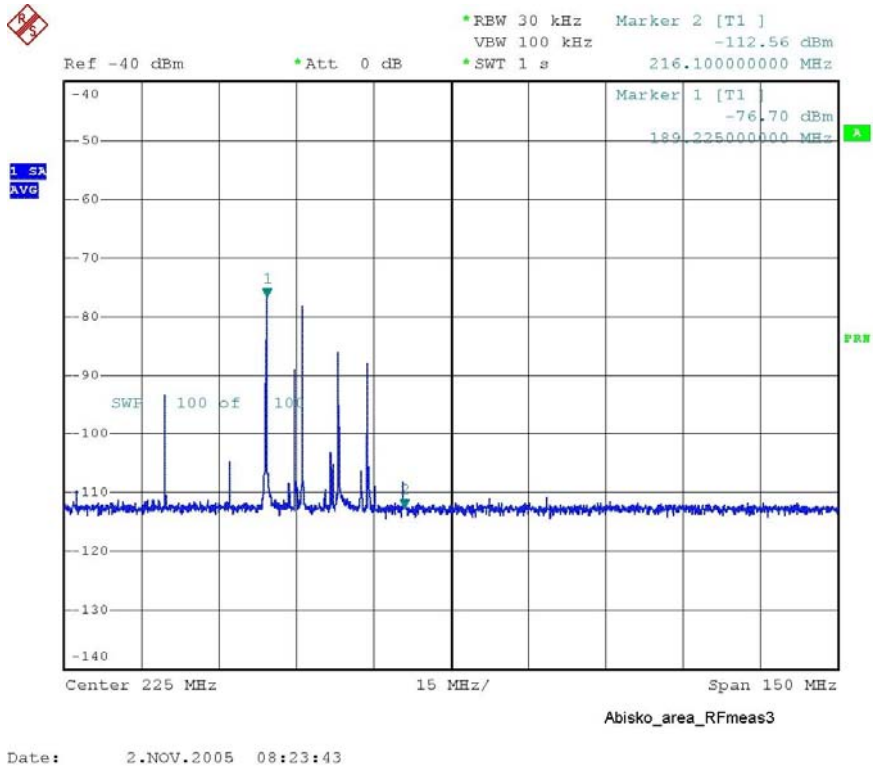

Figure 13. Frequency plot, range 150–300 MHz. Measured with a log-periodic antenna. Azimuth = 0 degrees

2.5 **Porjus area** (Parivierra)

Location:
- Coordinates: N 67 03.733 E 19 35.246
- 15 km north east from Porjus, near Parivierra.
- South side of Stora Lulevatten

Ground:
- A 300 x 300 meter area was recorded with a GPS unit.
- Virgin forest (spruce, birch and pine), the ground covered with thick moss and fallen threes.
- Incline, roughly 20 meters, in the direction towards Tromsö.
- Not entirely flat, moderate height variations within the area.

Infrastructure:
- 600 m to a power line.
- 700 m south from the road.
- 15 km to fibre optic link (Porjus). 10 Gbit/s

RF surrounding:
- RF survey plots, see figure 15 and 16.

Neighbours:
- One house in Parivierra.

Others:
- Land owner: National Property Board.

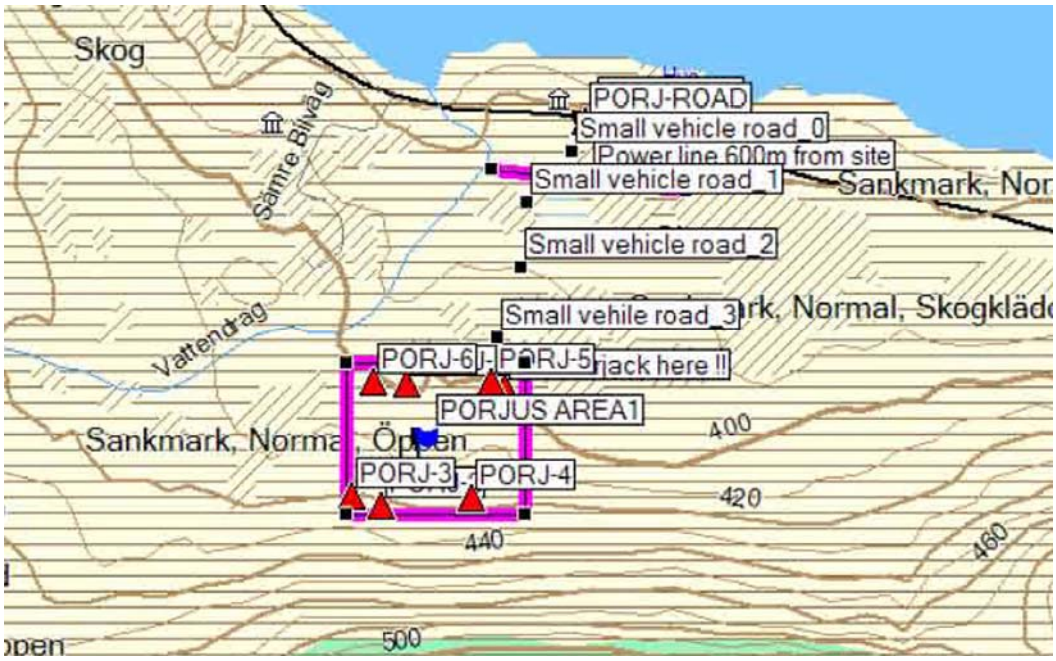

Figure 14. GPS map of the Porjus area.

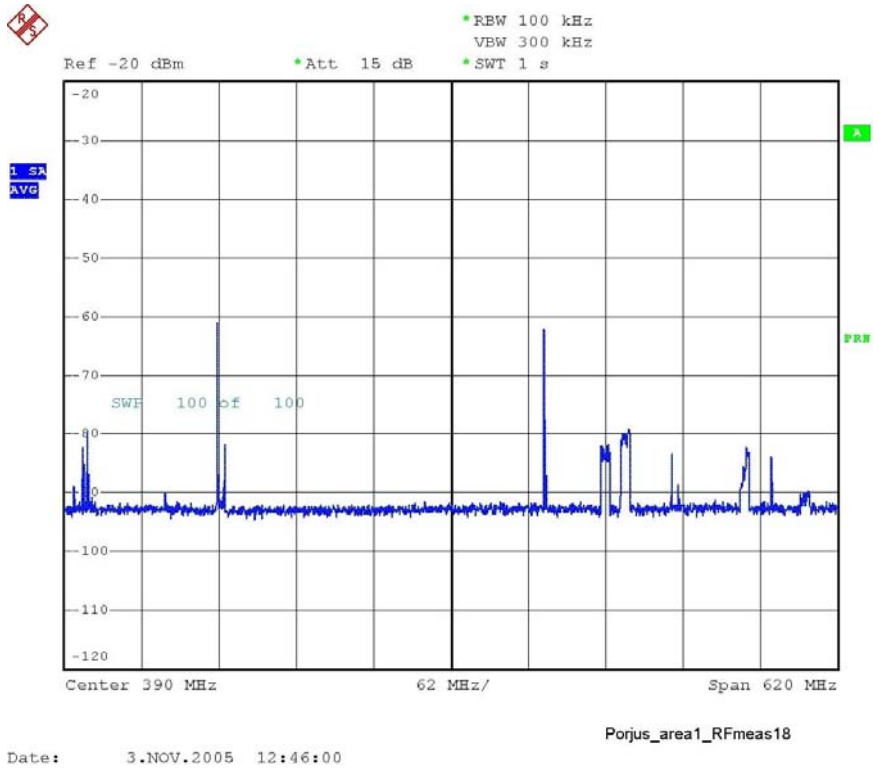

Figure 15. Frequency plot from the Porjus area, range 80–700 MHz. Measured with an omnidirectional antenna.

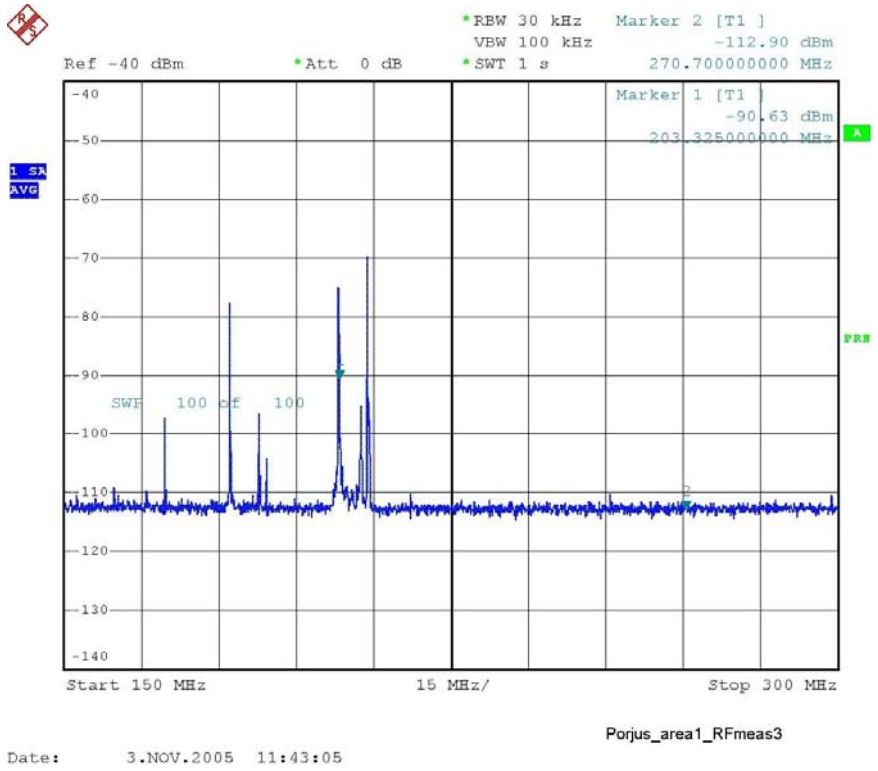

Figure 16. Frequency plot, range 150–300 MHz. Measured with a log-periodic antenna. Azimuth = 0 degrees