Preliminary Selection Criteria and Considerations for Receiver Site Installation at McMurdo, Station Antarctica

Adam C. Hicks[(1)], Robert J. Achatz [(1)]
(1) National Telecommunications and Information Administration, Institute for Telecommunication Sciences, 325 Broadway, Boulder CO,(ahicks@ntia.gov), https://its.ntia.gov

Abstract—**Spectrum and noise measurements were conducted in 2024 at McMurdo Station, Antarctica. The measurement system and select results are presented for two sites. A site selection criterion is introduced and used to evaluate site suitability for a High Frequency receiver station. Location, noise floor and received signal strength of desirable and undesirable signals are considered.**

Keywords—noise measurements, receiver design, spectrum management

I. Introduction

In November of 2024, engineers at the Institute for Telecommunication Sciences (ITS) from Boulder, CO, conducted a High Frequency (HF) noise characterization study at McMurdo Station, Antarctica, to inform HF modernization efforts at the station. The results of the measurement campaign have been published in [1].

Radio frequency noise characterization measurements are traditionally conducted as described in [2], where characterized systems are selectively tuned to quiet frequencies within the band of interest to determine what effects atmospheric (including lightning, solar or galactic sources) and man-made noise may have on the environment. If man-made noise is present, or other localized sources of electromagnetic interference (EMI) are, they can be mitigated through filtering or antenna design, but the most effective mitigation is site selection. Proper site selection can reduce the impact of local EMI and enhance reception of desired signals, simplifying the receiver design.

This paper presents criteria for HF Receiver site selection at McMurdo Station, using known signals captured during the HF noise campaign. The measurement system used is briefly introduced. Two sites are considered for discussion.

II. Selection Criteria

HF antenna systems for long range communication are inherently large to support the required wavelengths for optimal performance. A typical HF antenna used in these systems, such as a ¼ wavelength conical monopole, can be 43 m tall and almost 100 m wide, depending on the model and system requirements. Space availability becomes the primary concern when selecting an appropriate site for operations.

The environmental noise floor of a site establishes the baseline for system performance. Once a candidate site of sufficient size to support HF operations is identified, the next step before finalizing a system design should be to characterize the noise floor.

The final requirement for site selection is based on how well wanted or unwanted signals are received or affected by the surrounding terrain. Using the terrain to the advantage of HF system performance should be considered.

The HF receiver site selection criteria are summarized as follows:

- Is there room at the site?
- What is the noise floor of the environment?
- How well are wanted signals received?
- How well are unwanted signals rejected?

III. Measurement Description

The measurement system comprised a 1 m active rod antenna set directly upon a 15.24 m radius ground plane with 20 radials, connected to an RFeye 50-8 spectrum analyzer by a 30.48 m coaxial RF cable. Between the cable and spectrum analyzer is a biasing unit that drives the active rod's impedance matching circuitry, a 3.8 to 32 MHz bandpass filter (BPF), and a common noise rejection filter (CMNF). The system is shown as a block diagram in Fig. 1. The spectrum analyzer was set to sweep from 2 MHz to 32 MHz every minute for up to 24 hours.

The measurement system was deployed at sites MGS (north of McMurdo Station) and MTRS-2 (east of McMurdo Station). The radial ground plane ensures that the antenna pattern remains consistent between sites and is suitable for frequencies down to 4.9 MHz. The system was also deployed at other locations and configurations, but that information is beyond the scope of this paper.

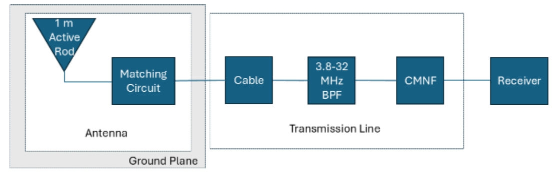

Figure 1: Block diagram of measurement system used for comparison study.

IV. SITE COMPARISON

The preliminary comparison is based on a few reasonable assumptions:

- The atmospheric conditions and system configuration at both sites was effectively identical
- The signals observed between captures are from the same systems and adhere to a daily routine

A selection of signals used for comparison are summarized in Table 1, with center frequencies and system names provided by [3], [4], and discussions with the McMurdo Station radio community. The measured sites and relevant landmarks are shown in Fig. 2.

Table 1: Signals used for HF receiver site evaluation.

Frequency (MHz)	System	Desired
4.718	HF Field Coms	Yes
7.995	MacOps Central Coms	Yes
9.032	Air Traffic Control (Primary)	Yes
14.00–14.350	Amateur Radio Band	No
10.18–10.33	Super DARN	No
26.875	NGD Transmitter	No

The resulting criteria for both sites are presented in Table 2. The selection criteria consider space availability, the mean noise power as determined in [1], and the Mean, Median, Maximum and Minimum (M4) statistics of received powers of both desirable and undesirable signals. A green highlight represents where one site performs better. Of the 1443 captures from MGS, 1071 resulted in the spectrum analyzer being in compression and therefore they are not included in this analysis.

Table 2: Selection criteria data and results. Green highlights indicate where the site outperforms the other.

	MGS				MTRS-2			
Space Available	Yes				Yes			
Noise Categ.	Rural/Residential				Rural			
Received Signal (dBm)	*Mean*	*Median*	*Max*	*Min*	*Mean*	*Median*	*Max*	*Min*
HF Field Coms	-112.0	-112.57	-98.98	-114.92	-106.4	-106.03	-103.5	-111.4
MacOps Central Coms	-112.25	-113.26	-74.54	-116.37	-110.21	-109.8	-103.76	-119.54
ATC (Primary)	-110.23	-112.24	-77.35	-116.67	-110.19	-110.01	-100.75	-115.34
Amateur Radio	-110.74	-112.14	-88.57	-115.54	-107.16	-107.4	-97.48	-116.71
Super DARN	-102.86	-107.8	-51.86	-112.29	-90.57	-89.0	-81.81	-104.06
NGD Tx	-115.92	-118.63	-86.71	-121.44	-118.3	-118.3	-81.59	-120.75

V. SUMMARY

Using an identical system for both site measurements shows that MRS-1 is a slightly better receiver location than MGS, although the difference is within the margins that could be accounted for with appropriate antenna design and filtering. Proximity to the SuperDARN (a powerful super dual auroral radar network) should be avoided to remove the potential for overload. These results establish a starting point for site consideration and project planning. Further modeling of antenna patterns and signal propagation should be conducted to supplement measured results and planning.

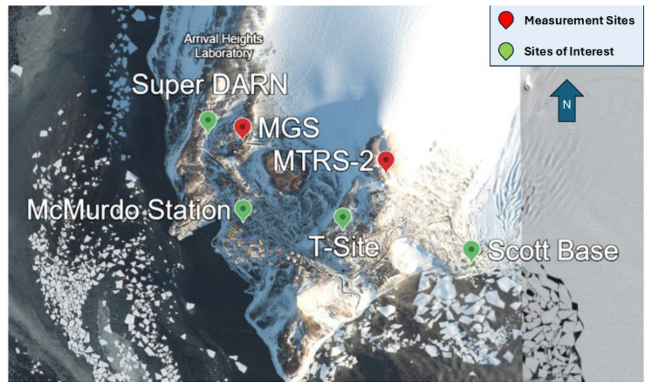

Figure 2: McMurdo Station measurement (red) and landmark (green) locations. (McMurdo Area, Ross Island, Antarctica, Google Maps, 2025).

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