RFI MEASUREMENT DATABASE ASSEMBLED DURING THE SQUARE KILOMETRE ARRAY SITE QUALIFICATION CAMPAIGNS.

M.R. Inggs∗, S.B. Dunn†
University of Cape Town
Department of Electrical Engineering
Rondebosch 7701, South Africa

J. Jonas
Rhodes University
Department of Physics and Electronics
Grahamstown 6140, South Africa

ABSTRACT

The Radio Astronomy and Remote Sensing communities are linked both formally and informally. The objective of this paper is to bring to the attention of the wider RF sensor remote sensing community some of the recent work undertaken while qualifying potential sites around the world for siting of the Square Kilometre Array (SKA). The construction of this SKA telescope is planned for some time after 2015, in a number of phases. At present, demonstrator systems are being assembled and tested at a number of locations around the world. Although remote sensing RF sensors are mostly directed from space to the earth, and the SKA candidate sites have been selected for radio quietness, it will be seen that SKA qualification measurements do provide a good assessment of the broad spectrum of radio frequency signals measured close to the surface of the earth, almost with global coverage. The SKA project adopted an approach of measuring average RF occupancy over a wide band (70MHz to 26GHz) and true RFI only in the L Band. The latter uses time domain sampling and FFT spectral analysis of the whole L Band.

Index Terms—RF occupancy, remote sensing, radiometer, interference.

1. INTRODUCTION

The Square Kilometre Array [http://www.skatelescope.org] is an international project that aims to construct a telescope covering the frequency range from 150MHz to about 20GHz, having a collecting area of one square kilometre, construction starting in about 2015. The exact form of the telescope, its frequency range and performance are being informed by numerous studies and prototype systems. The Karoo Array Telescope, KAT, is an example of such a prototype system [http://www.ska.ac.za].

Site RFI levels is clearly an important issue for such a sensitive instrument (especially the core site, containing more than 40% of the collecting area). The international SKA Engineering Work Group (SKA EWG) recognised this, and has established a document that defines a measurement protocol for the assessment of candidate sites [1]. This protocol resulted in test equipment being assembled in a number of countries, and intensive, long time duration studies (at least one year in most cases) made of sites being offered to the project.

The measurement equipment and procedures were overseen by an engineering team from ASTRON in the Netherlands [http://www.astron.nl], to ensure common standards of equipment and methods. All the competing sites then submitted a summary of the RFI data, and an international selection committee (Site Evaluation Working Group (SEWG)) recommended that sites offered in Australia and South Africa potentially met the needs of the SKA project. The SEWG uses the RFI Assessment Task Force to provide RFI advice. It must be pointed out that the site selection took in many other criteria, such as ionospheric and other space weather issues.

Further measurements of the two candidate sites will be made during 2008 and onwards. The final decision as to which site will be selected for the SKA is planned for 2011. Clearly, RFI is only one of the criteria for site selection, but would be a very important.

This paper aims to publicise to the Remote Sensing community that utilises the Microwave EM spectrum, this enormous resource in terms of SKA RFI measurements made over most frequencies from a 70MHz to 20GHz, over many parts of the world i.e. Australia, South Africa, Argentina/Brasil, China[2]. We will show how the measurements were made, using the South African measurement campaign as an example.

This paper would also like to suggest an active collaboration between the Microwave Remote Sensing Community. Clearly some links do exist, but a strong collaboration could result in a firmer voice becoming apparent to the ITU in matters relating to spectrum protection. A recent memo by the SKA Project discusses the needs for quiet zones in some detail [http://www.skatelescope.org/pages/memos/].

The paper starts with a discussion about the measurement of RF occupancy, and the difficulty of determining RFI. The
protocol utilised by the SKA EWG [1] is introduced, and is shown to measure spectral occupancy rather, and true RF interference only in the problematic parts of L Band utilised by radar and other navigation aids i.e. sources with high peak power, low average power.

The next section presents some typical results from the South African measurement campaign. In particular, the data processing and statistical formulation are presented. Before this, the equipment utilised for measurements is presented, together with a discussion of the difficulties due to self interference.

The last section summarises the paper, and makes some recommendations on possible uses of the data sets by the Remote Sensing Community.

2. CONCLUSIONS AND RECOMMENDATIONS

In this paper, we have reviewed the experimental campaigns utilised by the SKA Project to investigate the suitability of potential sites offered to host the building of the telescope itself. These Mode 1 measurements were taken with a scanning receiver, thus meaning that the probability of intercept of high peak value emissions is low, due to the wide bandwidths measured. In addition, the data is averaged for presentation.

We believe that the Mode 1 data are thus a good measure of spectral occupancy, especially when observing broadcast band emissions from terrestrial and satellite systems. These remarks are true even for satellite emitters overhead the site, since either the satellites orbit, or, the rotation of the earth would bring them into the beam of the receiver system.

The Mode 2 measurements taken in the L Band only allow for a better characterisation of pulsed emissions, since direct sampling and computation of the spectrum is carried out.

The paper suggests that the Remote Sensing Community takes note of this large database of practical measurements when planning equipment operating frequency, as a predictor of potential degradation of performance. The data has been gathered in South America, Africa, Australia and Asia (China) and is quite representative of the situation in 2005.

The SKA project will be refining the measurements of the Australian and South African sites in 2008 and onwards, which will provide further sources of data.

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3. REFERENCES
