

Evaluation of Spectral Overview and Radio Frequency Interference (RFI) Sources at Four Different Sites in CALLISTO Network at the Narrow Band Solar Monitoring Region

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ABSTRACT

Continuous observation of solar radio burst in CALLISTO network was started since 2002 with Blein Switzerland is the first site that launched the system. Since then, there are more than 35 sites around the world that monitor the Sun activity within 24 hours until 2014. However, there is an issue of Radio Frequency Interference (RFI) that need to be considered. This noise is a major obstacle when performing observation with CALLISTO system. We selected 4 sites as preliminary analysis to analyze in detailed at a specific frequency which is very important in solar burst monitoring. The selected sites are (i) Blein, Switzerland (ii) Mauritius (iii) KASI Korea and (iv) ANGKASA, Malaysia. The regime narrow band that we focused are from (i) 72 – 75 MHz (ii) band 145 – 153 MHz (iii) 240 – 250 MHz (iv) 320 – 330 MHz (v) 406 – 410 MHz. The results of the sources of the RFI also will be highlighted. This work is was part of a larger study which focuses on a specific region that can be used for detailed investigation of solar burst. This issue of Radio Frequency Interference (RFI) needs a dialogue and interactions between different actors and networks. It is hoped that the analysis will help the solar physicist to choose a better data.

Keywords: CALLISTO; Radio Frequency Interference (RFI); RFI sources; solar radio burst

1. INTRODUCTION

The Radio Frequency Interference (RFI) is one of the main issues in solar monitoring in radio region. This noise is due to the technology application for human purpose. Continuous

observation of solar radio burst in CALLISTO network was started since 2002 with Blein Switzerland is the first site that launched the system [1]. Since then, there are more than 35 sites around the world that monitor the Sun activity within 24 hours until 2014. We have started by proposing this research in early 2011, through the MARA University of Technology, University of Malaya, and the National University of Malaysia and as universities collaborator [2]. In previous work, some evaluation in terms of Radio Frequency Interference (RFI) indication has been done [3,4].

The main objective of this work is to investigate in detail what kind of sources that might affect the signal of the Sun. We also want to investigate either due to population density, which is specifically for the solar monitoring purpose [5]. There are many physical processes and propagation effects for the producing the time variable radio emission in radio region. It is very important because although the signal is intermittent, the solar burst signal can be exploded at any time. Therefore, we should concern about this issue.

2. CALLISTO SYSTEM AND OBSERVATION

E-Callisto network is one of the most outstanding project under the International Space Weather Initiative (ISWI) for solar monitoring study [6,7]. Malaysia becomes the 19th countries that involve this research. We have installed a solar radio spectrometer CALLISTO on February 2012 at the National Space Centre; Selangor, Malaysia. This noise is a major obstacle when performing observation with CALLISTO system. We selected 4 sites as preliminary analysis to analyze in detailed at a specific frequency which is very important in solar burst monitoring. It could not be denied that that the Earth environment has a close connection with Sun activities [8]. So far, we have productively obtained a good solar radio burst data associated with solar flares and Coronal Mass Ejections (CMEs) [9-11]. The impact of solar activities indirectly affected the conditions of earth's climate and space weather [12].

The strong progress in the development of the antenna, methods and instrumentation allowed to start the corresponding investigations at new quality and quantity levels. We construct the antenna with the length is about 5.45 meters and covers the range from 45 – 870 MHz with a gain of about 7 dBi. As a part of the system, we use a low noise preamplifier between the antenna and receiver [3]. During the installation, a the spectral overview analysis to know the quality of each site [13].

3. RESULTS AND ANALYSIS

This work is was part of a larger study which focuses on a specific region that can be used for detailed investigation of solar burst. The selected sites are (i) Blein, Switzerland (ii) Mauritius (iii) KASI Korea and (iv) ANGKASA, Malaysia. The regime narrow band that we focused are from (i) 72 – 75 MHz (ii) band 145 – 153 MHz (iii) 240 – 250 MHz (iv) 320 – 330 MHz (v) 406 – 410 MHz.

The results of the sources of the RFI also will be highlighted. Details spectral overview at specific region is illustrated in the Figure 1 - Figure 6. The calibration of RFI in solar burst data is very important to calculate the actual value of solar burst that associated with the solar flares and Coronal Mass Ejections (CMEs) associated with different types of solar bursts [14,15]. So far, we only focused on the short term variability of solar flare and CMEs events

[16]. The data is then can be compared with an X-ray region data [17]. There are also other types such as type U, V and IV that have been analyzed in detailed [18,19].

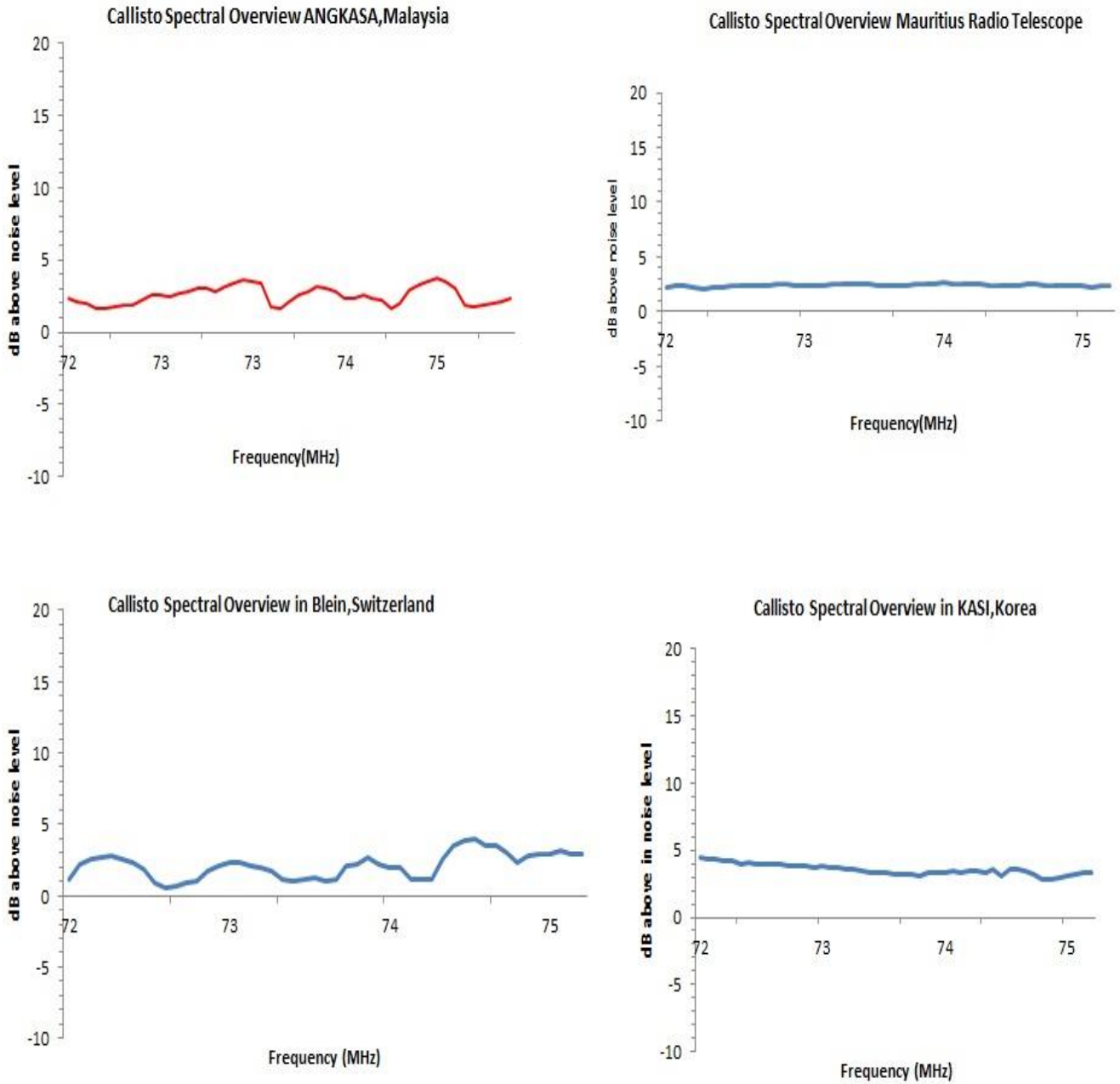


Figure 1. Spectral overview measured at four sites. Shared use of the radio astronomy band 72-75 MHz.

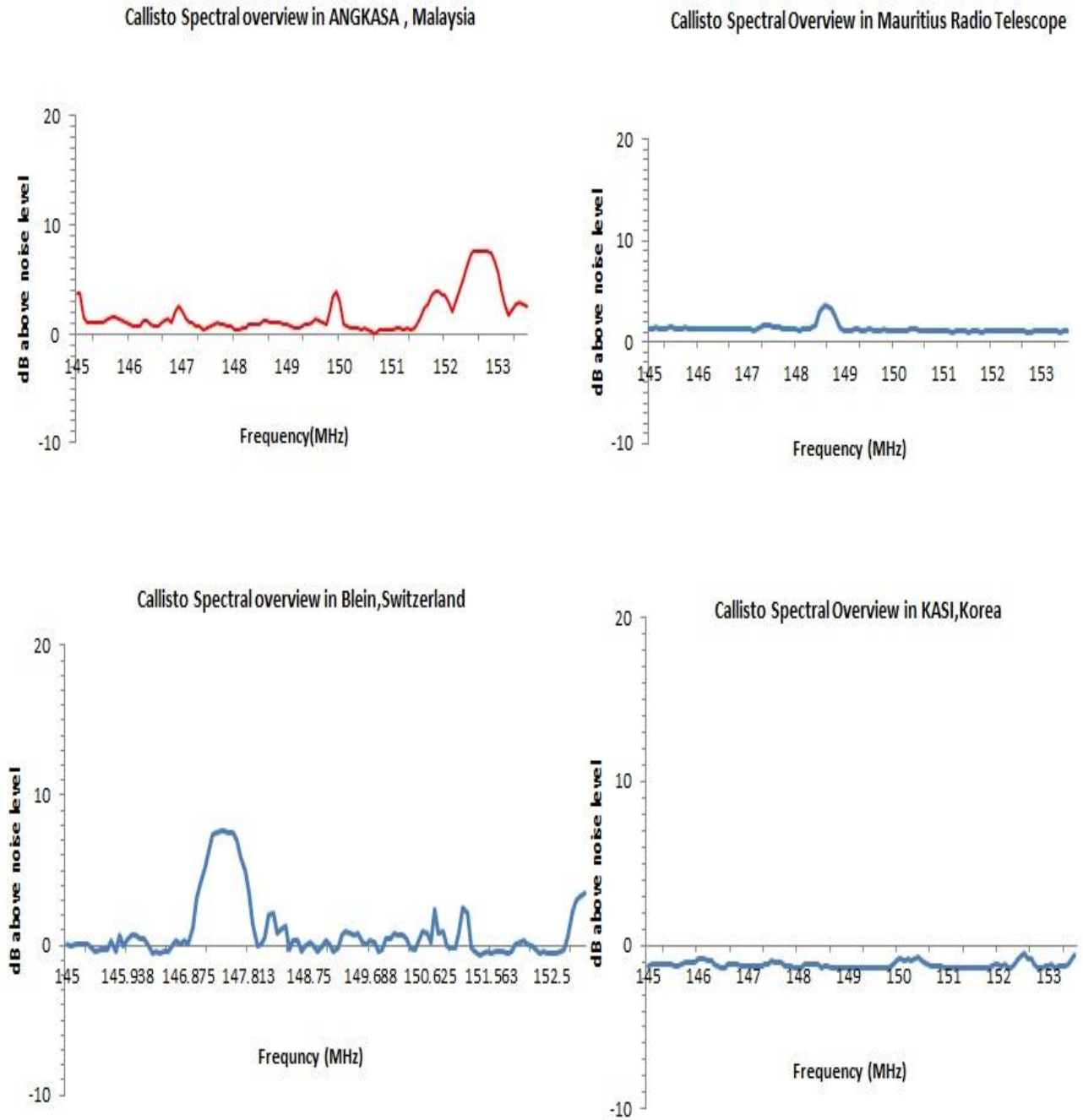


Figure 2. Spectral overview measured at four sites. Shared use of the radio astronomy band 145-153 MHz.

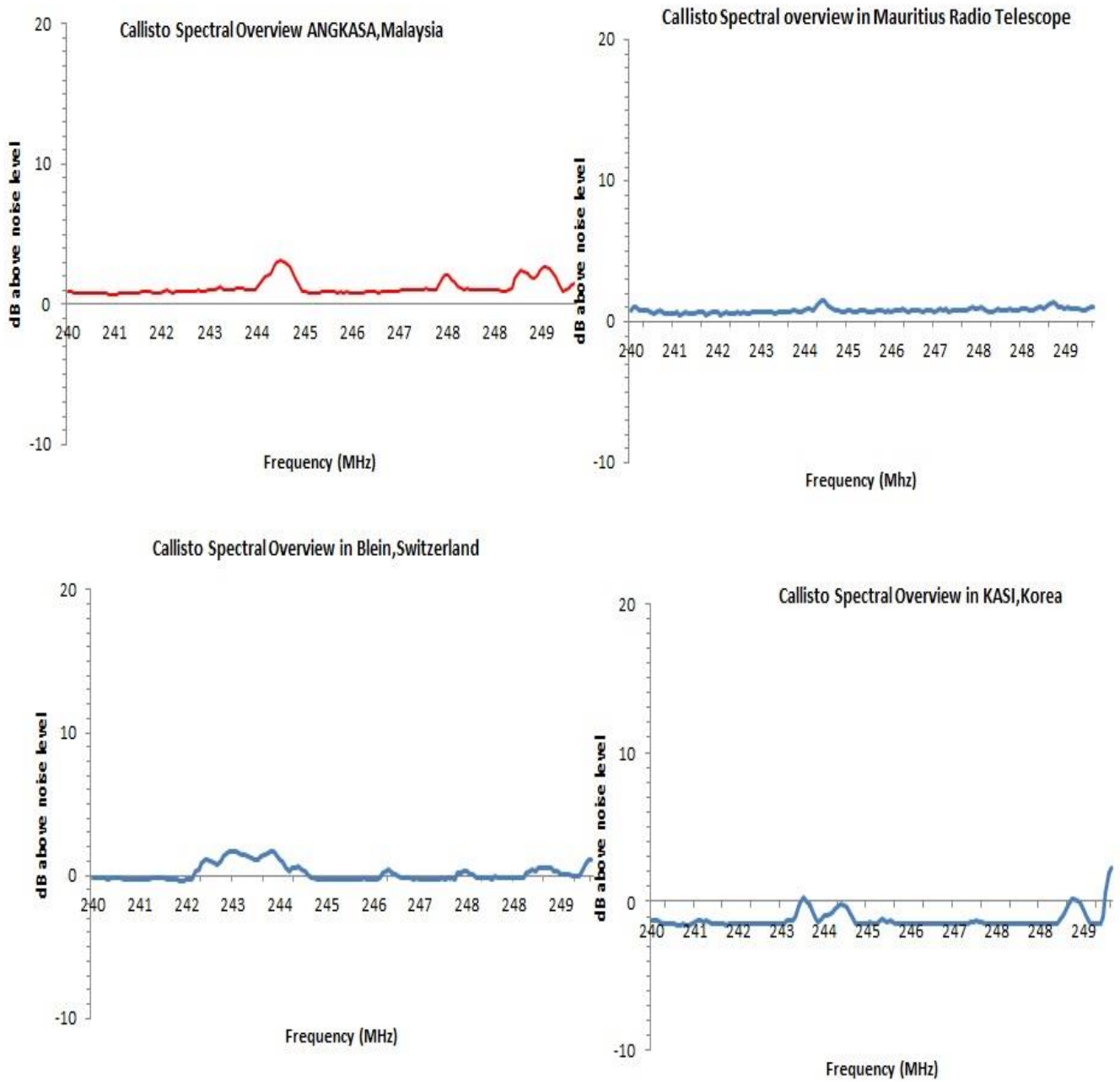


Figure 3. Spectral overview measured at four sites. Shared use of the radio astronomy band 240-250 MHz.

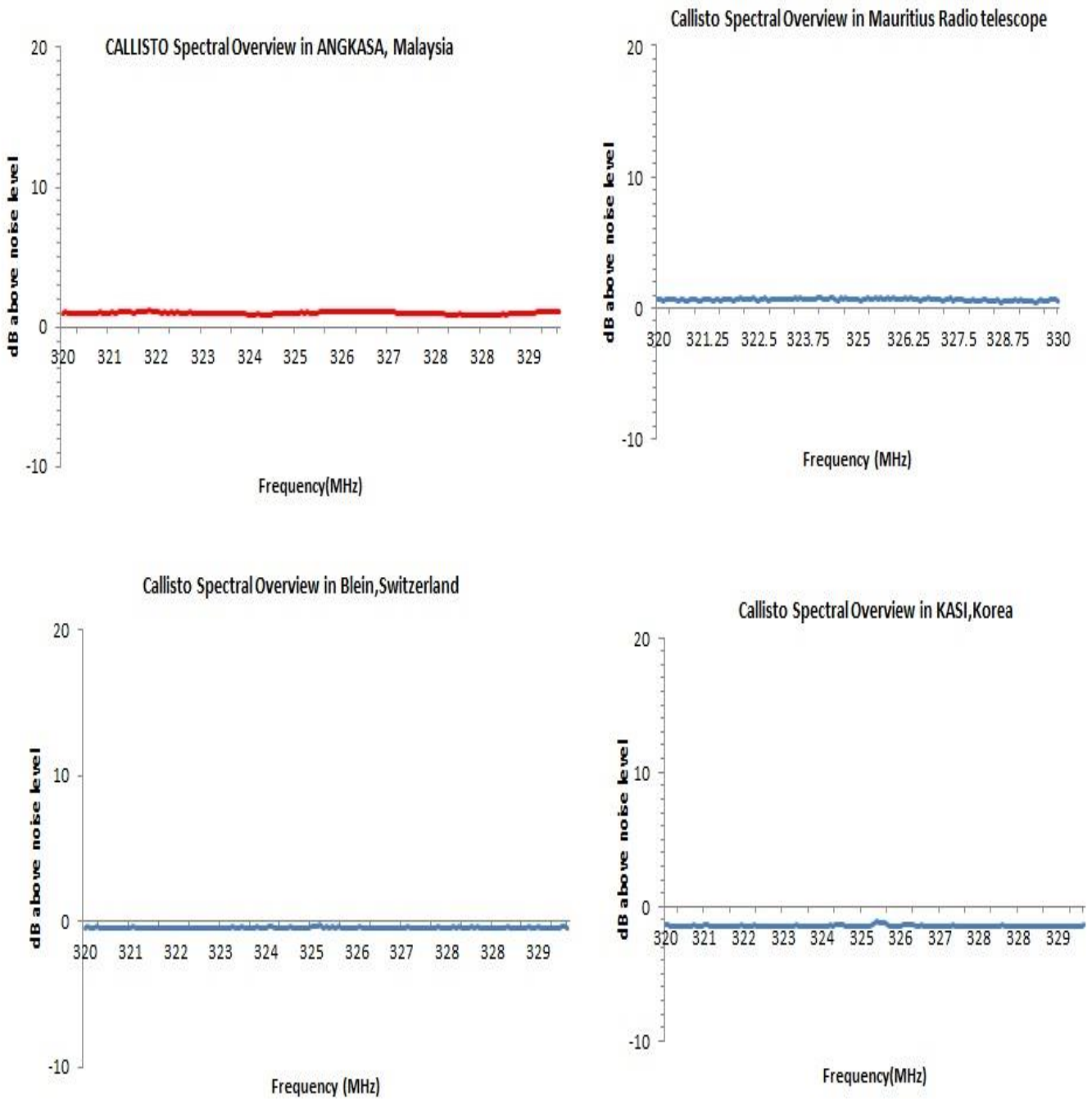


Figure 4. Spectral overview measured at four sites. Shared use of the radio astronomy band 320-330 MHz.

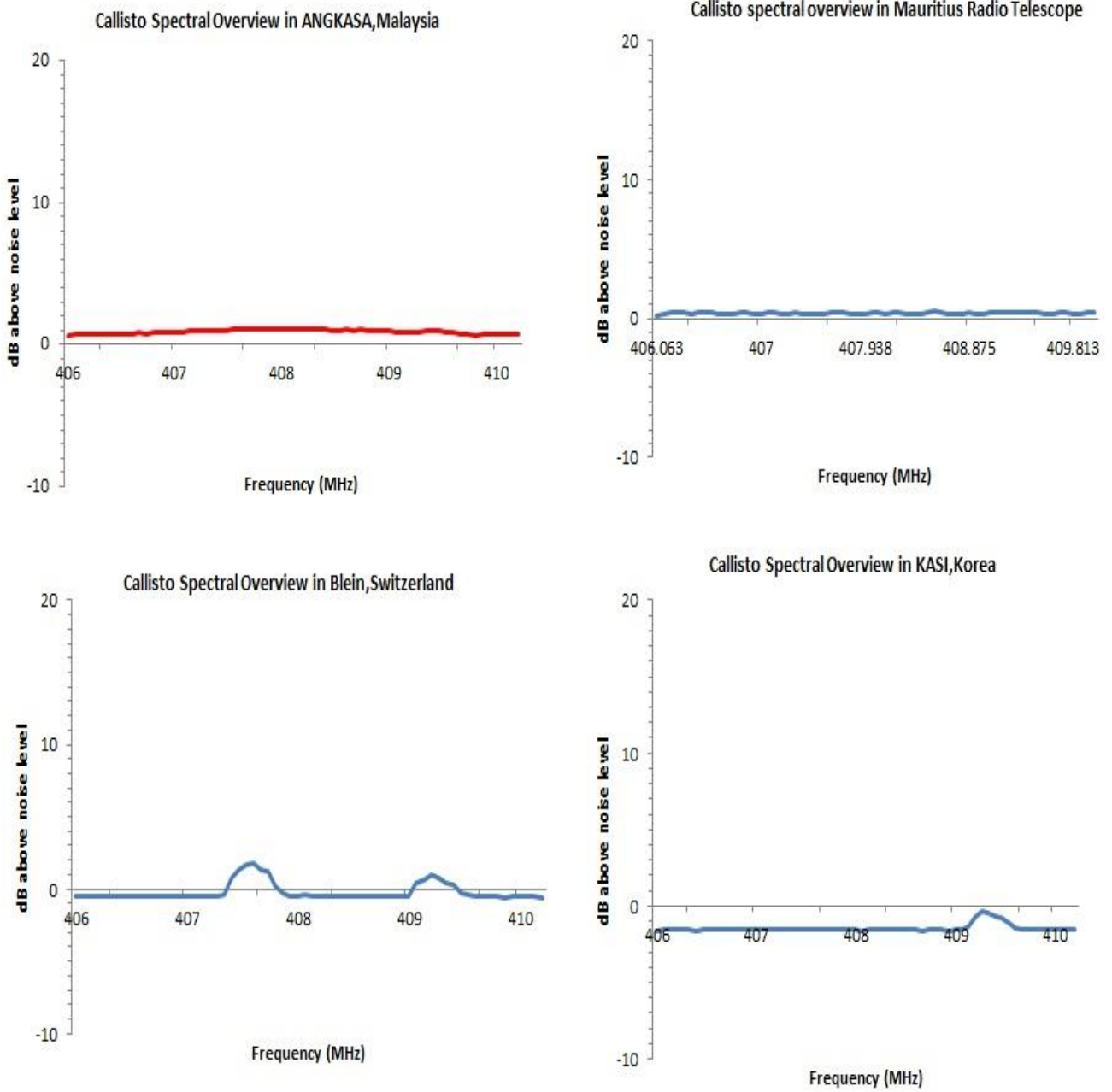


Figure 5. Spectral overview measured at four sites. Shared use of the radio astronomy band 406-410 MHz.

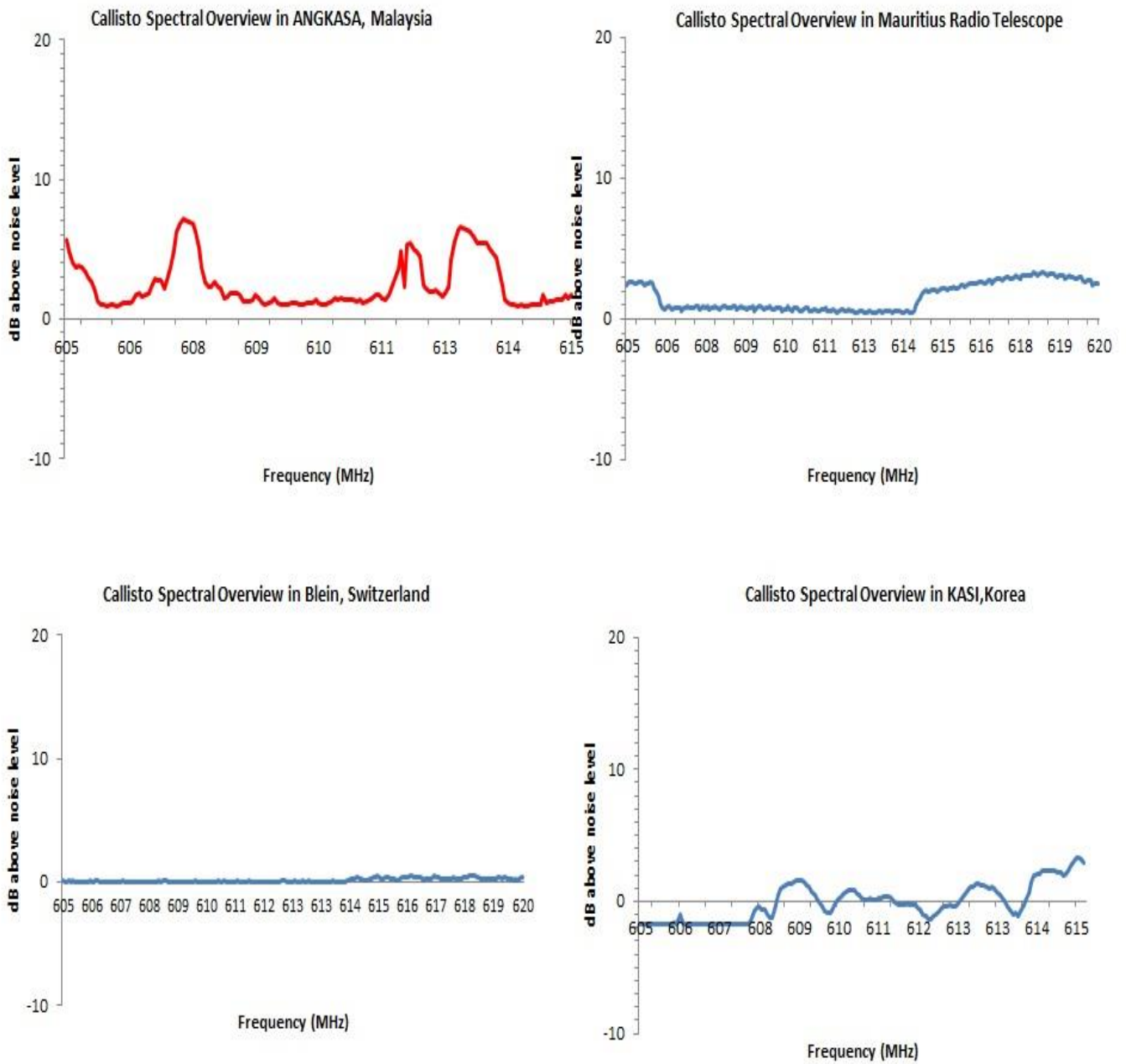


Figure 6. Spectral overview measured at four sites. Shared use of the radio astronomy band 605-615 MHz.

Table 1. Lists the RFI sources at specific region for the four sites of e-CALLISTO network.

Frequency (MHz)	RFI Sources	ANGKASA, Malaysia	Mauritius	Blein, Switzerland	KASI, Korea
72-75	Local electronic	Radio navigation	Extremely quiet	Fixed/mobile radio-communication users (73.0-74.6)	TV Band III (73 MHz until 74.6 MHz)
145-153	Communication traffic	Broadcasting	150.05 MHz until 153 MHz Primary use in the West foreseen for radio astronomy. This may be a case for local OFCOM or CRAF.	Weak signal at 149 MHz shared with other service	150.05 MHz (communication traffic) until 153MHz are reserved for radio astronomy and they are not free from interference.
240-250	Other services	Aeronautical navigation 245.5 MHz, 248.7 MHz and 249 MHz	245 MHz : other services in the West	Free from Interference	245 MHz is a fixed frequency for the measurement of quiet sun flux but shared with other services in the West.
320-330	Free from Interference	Free from Interference	Free from Interference	Free from Interference	(322 MHz until 328.6 MHz) bad due to a strong nearby pager transmitter
406-410	A weak signal outside of the RA band	Free from Interference	402 MHz: there is a weak signal outside of the RA band	Free from Interference	Low interference level 409 MHz There is a weak signal in the middle of the RA band.
605-615	A weak signal outside of the RA band	Fixed mobile	602.5 MHz : is some weak interference	Free from Interference	High level of interference in Daejeon due to analog Tvon the left and DVB-T on the right.

In conducting the case studies and for better data analyses, we identify each sources of RFI in details. Table 1 lists the RFI sources at specific region for the four sites of e-CALLISTO network. Each site shows a weak and strong of noise. It is not easy to conclude which site is the best and low of interference. However, we still possible to choose by looking the average of the signal. Most of the RFI sources can be found in the region less than 250 MHz. Nevertheless, there is still a region that is free from interference.

One interesting fact to point out is that in the region 320-330 MHz, three out of the four sites have a very minimum of noise. This region is very good to detect type II and type III solar burst. In the region below of 100 MHz, most applications are used for the radio communication purpose. It is still possible to detect a good data of solar burst at the region more than 300 MHz and above. This range is possible to detect solar burst type (I-V).

4. CONCLUSION

This issue of Radio Frequency Interference (RFI) needs a dialogue and interactions between different actors and networks. Although the application of technology becomes more demanding, radio astronomy should be the first priority in exploration of the Universe because this range is the potential range that can tell us more comprehensive of celestial object with the wide coverage of electromagnetic spectrum compare the others. The specific range for radio astronomy purpose should be sustain and cannot be used for other application. This is very important for us to realize it. It is hoped that the analysis will help the solar physicist to choose a better data.

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BIOGRAPHY

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