Scientific Requirement of Radio Astronomy Observation in the Philippines

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Abstract. Planning to perform radio astronomy related observation necessarily requires a specific device known as radio telescope. These specially designed instruments observe the longest wavelengths of light, ranging from 1 millimeter to over 10 meters long. It offers various avenue of observation such as continuum observation, solar wind observation, up to spectral line observation. In archipelagic countries like Philippines, opportunities for radio astronomy observations can offer wide variety of location. That features the regions of high frequency and low frequency were identified. The researcher was able specify the characteristics of each regions as suitable site for radio observations including the types of observation to be made.

Keywords: Philippines, Radio astronomy, and Radio telescope

1. Introduction

When we started to identify the selection of the most suitable site in which where we can conduct radio astronomy observation in the Philippines. One of its primary goals is to select the best location where a radio telescope can be constructed including the bandwidth that can be observed in the locality chosen. The construction of the radio telescope can be used to improve the radio frequency coverage of different networks within the Southeast Asia. Radio frequencies within the bandwidth of 73 – 74.6 MHz, 80.5 – 82.5 MHz, and 150.05 – 153 MHz were identified that is specified for both solar and continuum observation [1]. Considerations must be clear before performing land based astronomy observations. Bandwidth identification plays a significant role; this will specify the target radio observation and will make the determined frequency set the standard and desired outcome. Also note that archipelagic, and topographic characteristics of Philippines in which can provide a wide variety of observational outcome for both high and low frequency. For high frequency observation, the site should have low water vapor contents and lower dust density; for a low frequency observation should be distant from man-made radio noise signal [2]. This study offers a brief, precise, and cost time effective way for setting the scientific requirement needed for a mentioned bandwidth for radio astronomy observation. It also gives the practically of observations for each region. For validation, measuring the RFI dimensions needed to do in order to see the classify background of interference this will verify the analysis that is provided in this study. As assumption, the region will be described depending on the criterion specified.
2. Methodology

2.1 Criterion

One of the key goals is to have a better field of view in the radio frequency spectrum within the various parts of the Philippine archipelago. Two general factors ponder in order to provide added information about the electromagnetic condition in the radio frequency spectrum. These are the geographical and anthropogenic factors [3].

2.2 Population density

The radio astronomy spectrum is increasingly polluted by intentional and unintentional human generated Radio Frequency Interference (RFI). This RFI is primarily produced by urban activity in dense residential and commercial areas. Contrarily, on rural areas one need to take into account the absorption, reflection, and scattering of radio energy around objects such as trees and other plants, and their impact in the various directions near the receiving antenna of telecommunication link. It is important to quantify the effects of these RFIs on the radio astronomy spectrum [4].

2.3 Climate Type

Climate type is one of important variable to radio propagation and must be considered. It will affect penetration of radio wave propagation where the water occupied in atmosphere will reflect or refract attenuate as well as the signal penetration in the atmosphere. We must consider a dry place in Philippines [5].

2.4 Altitude

Radio astronomy uses specified radio spectrum to recognize different emissions from sources outside the earth and the others signal known as Radio Frequency Interference (RFI). It is an essential issue to address in order to characterize a type radio astronomy observation. Different altitude of observation for example will have an effect on RFI level or noise environment to radio observation.

2.5 Atmospheric Conditions

The atmosphere is transparent or partially transparent within the radio wave range from about 15 m – 1 mm, or 200 m – 1 mm in terms of its wavelength. The density of molecules in the atmosphere could absorb, scatter, reflect, and penetrate radio signals that will lead to the reduction of signal’s amplitude. This is through the analysis of amount of rainfall.

2.6 Topography

In locating an observatory and avoid spectrum pollution most of radio observatories are often placed in valleys to further shield them from ground interference. So that altitude is a one factor in the site selection of radio astronomy observatory. Isolated land form can also be used for radio astronomy observatory.

2.7 Site Selection

Luzon Island has an area of 109,964.9 km². Regions in Luzon were primarily selected in order to determine what suitable radio observation can be performed within the northern part of the Philippine archipelago over each region with features different feasible characteristics [6].

3. Result and Discussion

Each parameters specified on Table 1 are important factors in conducting a radio astronomy observation on or before determining the frequency bandwidth. These are the altitude, population density, climate type, atmospheric conditions, and topography. Stated parameters are vital in order to associate the radio
signal that can be detected in a particular area of interest. This will unlock the radio windows to be observed.

Table 1. Regions in Luzon and its Characteristics

| Region        | Altitude (Highest point) | Population Density (persons per km²) | Climate Type | Atmospheric Conditions (amount of rainfall per year in mm) | Topography                                                                 |
|---------------|--------------------------|-------------------------------------|--------------|------------------------------------------------------------|----------------------------------------------------------------------------|
| Ilocos Region | 1,154 m                  | 388                                 | I            | 2000 - 2750                                               | At east composed of mountain ranges, at west composed of seas               |
| Cagayan Valley| 1,850 m                  | 116                                 | IV           | 1700 - 3000                                               | At east seas and oceans, and at west composed of mountain ranges           |
| Central Luzon | 1,252 m                  | 512                                 | I, III       | 1800 - 3800                                               | Marked by an extensive central plain surrounded by three mountain ranges  |
| CALABARZON    | 2,328 m                  | 870                                 | I, II        | 1550 - 3500                                               | Marked by scattered mountains, hills, plains, and mixtures of valleys      |
| MIMAROPA      | 2,133.6 m                | 100                                 | II, IV       | 1550 - 3500                                               | Mostly composed of islands and islets                                     |
| Bicol         | 2,462 m                  | 320                                 | II, III, IV  | 1450 - 3750                                               | Marked by a peninsula and surrounded by seas                              |
| CAR           | 2,922 m                  | 87                                  | I            | 2500 - 3600                                               | Composed of mountain ranges                                               |
| NCR           | 127 m                    | 20,875                              | III          | 1800 - 3800                                               | Marked with coastal margin, plateau, and valley                           |
Table 2. Essential RFI Characteristics for each region

| Region          | Essential Characteristics                                      | Advantage                           | Disadvantage                        |
|-----------------|----------------------------------------------------------------|-------------------------------------|-------------------------------------|
| Ilocos Region   | Advisable for low and high frequency observation               | Observations can only be made from  |
|                 |                                                                 | November to April                   |                                     |
| Cagayan Valley  | Advisable for low and high frequency observation               | Inaccessibility of possible locations for observations |                                     |
| Central Luzon   | Not advisable for radio observation                             |                                     |                                     |
| CALABARZON      | Advisable for low frequency observation                         | The region has the most number of total rainfall |                                     |
| MIMAROPA        | Advisable for low frequency observation                         | Inaccessibility of possible locations for observations |                                     |
| Bicol           | Not advisable to conduct radio observation                      |                                     |                                     |
| CAR             | Advisable for low frequency observation                         |                                     |                                     |
| NCR             | Not advisable to conduct radio observation                      |                                     |                                     |

Advantages and disadvantages as specified in Table 2 describe the essential RFI characteristics for each regions. The primary classifications of the characteristics for advantages are specified as (1) low population density; (2) Climate type which is IV; (3) Altitude, and topography, which naturally isolates manmade radio noise; (4) atmospheric conditions that requires low amount of rainfall per year with the disadvantages. The classification of low frequency and high frequency observation. Regions suitable for low frequency observations are Ilocos, Cagayan, CALABARZON MIMAROPA, and CAR. On the other hand, for high frequency observation, Cagayan is suitable by having a low water vapor contents.

4. Conclusion
The parameters has been chosed and comparing it with other region. Majority of regions in Luzon were identified as a suitable location to conduct radio astronomy observation. The advantages and disadvantages showed the essential RFI characteristics of each region for suitable radio astronomy observation. This determines that Luzon is appropriate for low frequency and high frequency observation. This is also vital in determining the best place to construct radio telescope.

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