Hourly Variation of Gaseous Attenuation at a Tropical Location in 2013

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Abstract

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Abstract:

Electromagnetic signals are attenuated by atmospheric gases is a phenomenon that has attracted the attention of many researchers for years now. The effect of gaseous attenuation is especially significant at frequencies from 10 GHz and above. This work investigates hourly gaseous attenuation from 10 to 50 GHz frequency range. The hourly and diurnal impact of gaseous attenuation at Ku, Ka and V bands frequency in 2013 at Covenant University ota southwest Nigeria a tropical station has been investigated. One minute integrated time atmospheric data such as pressure, temperature and relative humidity were obtained for the location from January to December 2013 as input data to the International Telecommunications Union (ITU-676-) gaseous attenuation model was used to calculate the attenuation due to oxygen and water vapor is hereby presented.

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I. Introduction

The two most effective gases involved in attenuating electromagnetic signals are oxygen and water vapour [1], [2]. The magnetic dipole moment of a gas determines the ability of that gas to attenuate electromagnetic waves. The molecules of water vapour have a magnetic dipole moment that is twice in magnitude compared to that of oxygen. By implication, water vapour in theory has a higher attenuating power compared to oxygen but in reality, the reverse is the case because the amount of oxygen in the atmosphere is far greater than that of water vapour [3], [4]. Gaseous attenuation occurs when the electric or magnetic dipole moment of gases causes them to interfere with the incoming

electromagnetic waves of frequency in the order of the magnetic or electric dipole moment of the attenuating gas, converting the electromagnetic energy first into mechanical energy, and then to heat energy. At thermodynamic equilibrium the gas return back to its default energy state [1], [3]. The 20 to 300 GHz range is the region where the effect of water vapour and oxygen is most significant. Below 40 GHz the effect of oxygen is insignificant, however, it is of undeniable effect at around 50 GHz. Around 60 GHz, it becomes most significant. Attenuation due to oxygen is inversely proportional to temperature. In addition, the concentration of the absorption lines of oxygen is dependent on temperature as well as air pressure [5].

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