Impact of Tropospheric Scintillation Models on Earth-Space Path in Southwest, Nigeria

Publisher: IEEE

6
Author(s)

Akinwumi Sayo Akinloye ; Omotosho Temidayo Victor ; Ogunrinola Iyanuoluwa Enoch ; Emetere Moses Eterigho ; Ometan Oluwafunmilayo Oluwayemisi ; Adewusi Oladimeji Mustapha

Abstract:
Much investigative studies have been performed over the years on electromagnetic wave signals being attenuated by rain, cloud, gas and tropospheric scintillation. This paper present the impact of tropospheric scintillation on earth-space path in southwest, Nigeria at 12.245 GHz. Twenty-four months of scintillation data from ASTRA 2E/2F/2G on latitude 6.7° N and longitude 3.23° E for two years (2015-2016) were statistically analysed and compare with four existing models. The result reveals that under non-rainy atmosphere, ITU-R model gave the lowest percentage error of about 1.07%, followed closely by Karasawa model with 1.67%. The work also shows that ITU-R is the best fit model of tropospheric scintillation fade for the study area at 1% of time. A modified ITU- R scintillation fade model was also proposed for the tropical region of Ota and its environs.

Published in: 2019 6th International Conference on Space Science and Communication (IconSpace)
Date of Conference: 28-30 July 2019
Date Added to IEEE *Xplore*: 30 December 2019
ISBN Information:
ISSN Information:
INSPEC Accession Number: 19277403
DOI: 10.1109/IconSpace.2019.8905936
Publisher: IEEE

Conference Location: Johor Bahru, Malaysia, Malaysia

I. Introduction

One of most important clear sky effect involved in attenuating electromagnetic wave signals transmission is tropospheric scintillation [1], [2]. Scintillation is known as rapid fluctuation of signal on refractive index at small elevation angle in tropical region. The importance of tropospheric scintillation cannot be overemphasized most especially in the tropical regions with a significant effect on satellite links at frequencies above 10 GHz. However, at small elevation angles, tropospheric scintillation causes random scintillation fade and enhancements for small receiving antenna [3], [4]. Increase in temperature and relative humidity can result in high scintillation intensity for an earth-space path. Fades and enhancement types of tropospheric scintillation can cause signal loss in electromagnetic wave propagation of signals. It can be observed that temperate region have less scintillation intensity than the tropical region because of the increase in temperature and increase in relative humidity in the climates of the tropical region [5]–[7]. Though, on a bright day light

the sky may appear to be clear, however, scintillation phenomenon occurs due to the presence of high relative humidity and high temperature regularly. Hence, to realize communication systems that required little fade margin at low elevation angles and at the same time at higher frequency, then the study of scintillation must be taken into account to have a good link budget [8]. The objective of this work is to analyse well-known four tropospheric scintillation models and compare with the observed data from Ota at 1 % of time. Among several models that exist for tropospheric scintillation models, the carefully chosen four existing models for this work are; ITU-R P618-13 [9], Karasawa [10], Van de Kamp [11] and Otung model [12].