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Input parameters of the HV model above canarian observatories

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ABSTRACT

The possibility of using high-data-rate optical transmitters for satellite communication has generated interest in laser communication systems for ground-to-space and space-to-ground data links. Among the parameters useful to model propagation along a vertical path are the refractive index structure constant $C_n^2(z)$ profile and boundary layer turbulent strength. One of the most widely used turbulent models is the Hufnagel-Valley (HV) which depend on vertical wind profile and integrated turbulence along the propagation path. We have developed a statistical studied of the input parameters above Canary Island Observatories using a metereological database to collect the wind profiles and DIMM database to evaluate zero order moment. We are estimated the isoplanatic angle and the down-link scintillation. To check the consistency of the model, we are compared the isoplanatic results with isoplanatic angle measured by SCIDAR campaigns (17 nights along the year). To establish the average turbulence wind speed, we are used an observational correlation finds by Sarazin[12] at other high mountain observatories.

Keywords: Hufnagel Valley turbulence model, canarian observatories, isoplanatic angle, 200 mbar wind speed, optical communication

1. INTRODUCTION

The presence of atmospheric turbulence in ground-space links induces severe effects on beam propagation and limited the performance of the transmission bit-rate. The effects of turbulence are different for down-links and up-links. In down links, the turbulence is close to the receiver, while in up-links, the turbulence is concentrated in the path section close to the transmitter, producing also scintillation (like in the down-link) and the beam wander effects. Andrews[2] has developed an analysis model for up-link and down-link propagation channels. An alternative model has been developed by Comeron[8] for the up-link. Both theoretical studies require as fundamental input the characteristics of the atmospheric turbulence and the average wind speed through the beams are propagating. Optical turbulence intensity is described by the refractive index structure constant profile (C_n^2). The transversal wind speed through propagation path is important to compare observation with theoretical developments. Models of wave propagation in turbulence have described optical effects in terms of spatial statistics. However, the measurements are refereed to temporal statistics. For this reason, the Taylor hypothesis permit converting this two statistics.

To reduce turbulence effects to the maximum, launching laser telescope can be built in astronomical sites. The usual selected model in this field to describe optical turbulent is the Hufnagel-Valley model, this model has two parameters which describe the surface and the high altitude turbulence strength. However, the HV model does not take in account the specific characteristics of the high mountain observatories. In this paper, we present the adequate HV parameters for canarian observatories (Teide Observatory (OT) and Roque de los Muchachos Observatory (ORM)). Both sites are supported by the Instituto de Astrofisca de Canarias (IAC). Currently, in the Teide Observatory it is operated the SILEX experiment of ESA for validation of bidirectional propagation models. Therefore, we have an ideal and unique test-bed to study and characterise laser beam propagation through atmospheric turbulence. Hence, theoretical models of laser beam propagation through atmospheric turbulence require accurate input parameter for Teide Observatory. The

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