ANTENNAS AND PROPAGATION

Modeling, Simulation & Measurements

Edited by

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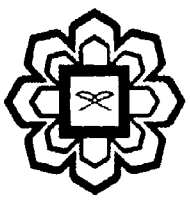

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Table of Content

Chapter 40

Investigation of Solar Environment Effects on Space Assets & Satellite Signals

Othman O. Khalifa[1], Md Rafiqul Islam[1], Jalel Chebil[1],Saad Bashir[1] and Sivamohan A/L V.Shunmugam[1]

40.1 Introduction

The sun-earth environment is the region of space extending from the surface of the sun out to, and including, the earth's ionosphere and magnetic field. It is a harsh environment dominated by electromagnetic radiation and electrically charged particles from the sun. It is subject to dramatic and violent change as events on the sun, such as solar flares, blast streams of radiation and energetic particles towards the earth. The goal of this study is to highlight the effects caused by the solar radiation. Despite being far away from everyday experience, the sun-earth environment has a surprisingly wide range of effects on many aspects of everyday life. Changes to conditions in the sun-earth environment are often called "space weather" and this can cause significant damage to technological systems, particularly to communications. Space weather results from changes in the speed or density of the solar wind, the continuous flow of charged particles from the sun past the earth and into interplanetary space. This flow distorts the earth's magnetic field, compressing it in the direction of the sun and stretching it out in the anti-sun direction. Fluctuations in the flow of solar wind cause variations in the strength and direction of the magnetic field measured near the surface of the earth. Abrupt changes in this dynamic medium are called geomagnetic disturbances [1].

At the same time the earth's ionosphere can be severely disturbed by flows of charged particles in the region. This is important because the ionosphere acts as a "mirror", reflecting High Frequency (HF) signals and allowing cheap and convenient communication over long distances. HF is significant for many people including defense, emergency services, broadcasters, and marine and aviation operators. Many other phenomena are associated with space weather. Some of the more notable include heating of the outer layers of the earth's atmosphere altering the orbits of satellites and contributing to their early return to earth. Surge currents induced in power lines sometimes lead to the failure of power grids and currents in long pipelines cause increased corrosion and solar interference to satellites [1].

Most of people are familiar with the effect of weather on their lives. Often this is relatively minor - determining what to wear and where to go; but on occasions, it is dramatic and costly as major events inflict severe damage and even loss of life.Space weather is another important kind of weather that normally people do not know. Space weather serves great importance to many modern technologies. Like ordinary weather,

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