Chapter 12

Space Weather Effects on Communications

An overview of historical and contemporary impacts of solar and geospace disturbances on communications systems

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Abstract
In the last century and one-half, the variety of communications technologies that are embedded in environments that can be affected by processes occurring in space have vastly increased. This paper presents some of the history of the subject of “space weather” as it affects communications, beginning with the earliest electric telegraph systems and continuing to today’s wireless communications using satellites and land links. An overview is presented of the present-day communications technologies that can be affected by solar-terrestrial phenomena such as galactic cosmic rays, solar-produced plasmas, and geomagnetic disturbances in the Earth’s magnetosphere.

Keywords Solar disturbance, geomagnetic disturbance, communications technologies, cable communications, wireless communications, communication satellites, ionosphere currents, aurora, magnetosphere.

1. INTRODUCTION AND SOME HISTORY

In 1847, during the 8th solar cycle, telegraph systems that were just beginning to be deployed in common use in Europe were found to often exhibit “anomalous currents” in their wires. W. H. Barlow [1849], a telegraph engineer with the Midland railroad in England appears to be the first to have recognized and systematically sought to understand these currents that were disturbing the operations of the railways’ communications system. Making
use of a spare wire that connected Derby and Birmingham, Barlow recorded during a two-week interval (with the exception of the weekend) in May 1847 the deflections in the galvanometer at the Derby station that he installed specifically for his experiment. These data (taken from a Table in his paper) are plotted in Figure 1. The galvanometer deflections obviously varied from hour to hour and from day to day by a cause (or causes) that was (were) unknown.

Plotting the hourly means of the Barlow data for the Derby to Birmingham link, as well as for the measurements on the dedicated wire from Derby to Rugby, a very distinct diurnal variation in the galvanometer readings are apparent. As shown in Figure 2, the galvanometers had large right-handed swings during the local day interval, while a left-handed swing appeared during local night. Such a diurnal variation has now been recognized for many decades to be produced by solar-induced effects on the Earth’s dayside ionosphere [e.g., Chapman and Bartels, 1940; Matsushita, 1967]. The systematic daily change evident in Figure 2, while not explicitly recognized by Barlow in his paper, is likely the first measurement of the diurnal component of geomagnetically induced Earth currents (often referred