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A descent of the aurora over Lapland

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Abstract

A very large statistical study (~400000 measurements) into the peak emission height of the aurora has shown that the aurora over Laplanddescended significantly between 1996 and 2007. The study was performed using images from a network of ground-based all-sky cameras, which form part of the MIRACLE (Magnetometers-Ionospheric Radar-All-sky Cameras Large Experiment) network, and are located at various observation stations across northern Finland and Sweden.

1. Introduction

The height of the aurora was first measured about a century ago. Since then, it has generally been assumed that the peak emission height of any particular auroral emission is constant for similar geomagnetic and precipitation conditions. The present work was motivated by the need to improve estimates of the height of the aurora used to calculate other ionospheric and auroral properties, such as optical flow velocities and auroral arc widths. In recent years MIRACLE has produced approximately 100000 images of the aurora per station per year. In order to analyse such a large number of images, a novel fast and automatic method was developed for finding the peak emission height of an auroral structure from a pair of all-sky camera images with overlapping fields of view. This method has been applied to all auroral images recorded by the MIRACLE intensified CCD cameras in operation between 1996 and 2007. Such a large data set allows the study of variations in the height of the aurora with time (yearly, monthly, hourly) and with solar and geomagnetic parameters such as F10.7 and the solar wind speed. Results from the statistical study show that the peak emission height of green (557.7 nm, O1S-O1D transition) aurora over Lapland descended by about 10 km between 1996 and 2007. This descent occurred independently of the solar cycle. One possible cause for this descent is cooling and subsidence of the mesosphere and lower thermosphere.