Long-term optical studies of the aurora using the MIRACLE cameras

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The Finnish Meteorological Institute has been operating a network of all-sky auroral cameras and ground magnetometers for the past 40 years, now known as the Magnetometers–Ionospheric Radar–All-Sky Cameras Large Experiment (MIRACLE) network. The auroral cameras have been located at 15 different stations across northern Finland and Scandinavia and on Svalbard. This network provides an extremely valuable long-term data set of auroral images from a dense network of observing stations. Originally film cameras were used, but these were upgraded to digital intensified CCD (ICCD) cameras in the mid-1990s, and more recently to a mix of electron-multiplying CCD (EMCCD) cameras and colour CCD cameras. All ICCD and EMCCD cameras use interference filters to image specific auroral emissions. In recent years MIRACLE has produced approximately 10^5 images of the aurora per station per year.

Recently a very large statistical study of the peak emission height of the aurora has been performed using MIRACLE camera data. This 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. Results from this study show that the aurora over Lapland descended significantly between 1996 and 2007. This is thought to be due to a cooling and contraction of the mesosphere and lower thermosphere. Other recent work has examined the auroral occurrence frequency as a function of latitude and year, and variation in the complexity ("arcyness") of auroral structures across the solar cycle. The large amount of data together with modern data analysis tools also allow the estimation of the electron precipitation energy and flux for input to ionospheric models.

We will discuss the instrumentation utilised in MIRACLE, and present recent results from the all-sky camera data.

References

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