WAND auroral imager for SANAE

G Hough & M W J Scourfield

Space Physics Research Institute
University of Natal
4001 DURBAN
South Africa

Aurorae are optical emissions excited by the collisions of charged particles with the upper atmosphere at about 100 km, the altitude of the ionospheric E-region. In fact, the ionosphere has often been likened to a giant TV screen. For the latter, the electrons are fired from an electron gun, whereas the sources of high energy electrons that cause aurorae are located in the magnetosphere. One of the central problems in space physics is locating the sources and mechanisms causing the acceleration of auroral particles.

Traditionally, auroral optical emissions have been imaged by All-sky cameras which, as the name implies, have fields of view extending from horizon to horizon. This spans about 2 000 km of the curved ionosphere. These images suffer severely from "fish-eye distortion", particularly towards the outer parts of the field of view.

Computer image processing can be used to remove this distortion but the computational costs and time are very large. Typically 250 000 pixels per image must be processed at a rate of 25 images per second!

Figure 1 shows an example of an all-sky "fish-eye" image of an auroral form (inset) and the image with distortion removed by digital image processing projected onto the globe.

To circumvent the computational problems an imaging system, WAND (Wide Angle No Distortion), was designed which removes distortion in real time as the image is being recorded.

A photograph of the WAND system, together with a schematic diagram is shown in Figure 2. The auroral light is collected by the primary curved mirror A and, after reflection from mirror B, images are recorded by the low light level TV camera at C. The rounded "cone-like" surface is machined using a computer program designed to eliminate the fish-eye distortion.

Final tests have now been completed and the WAND system is scheduled to be deployed in the Antarctic at SANAE in 1993.

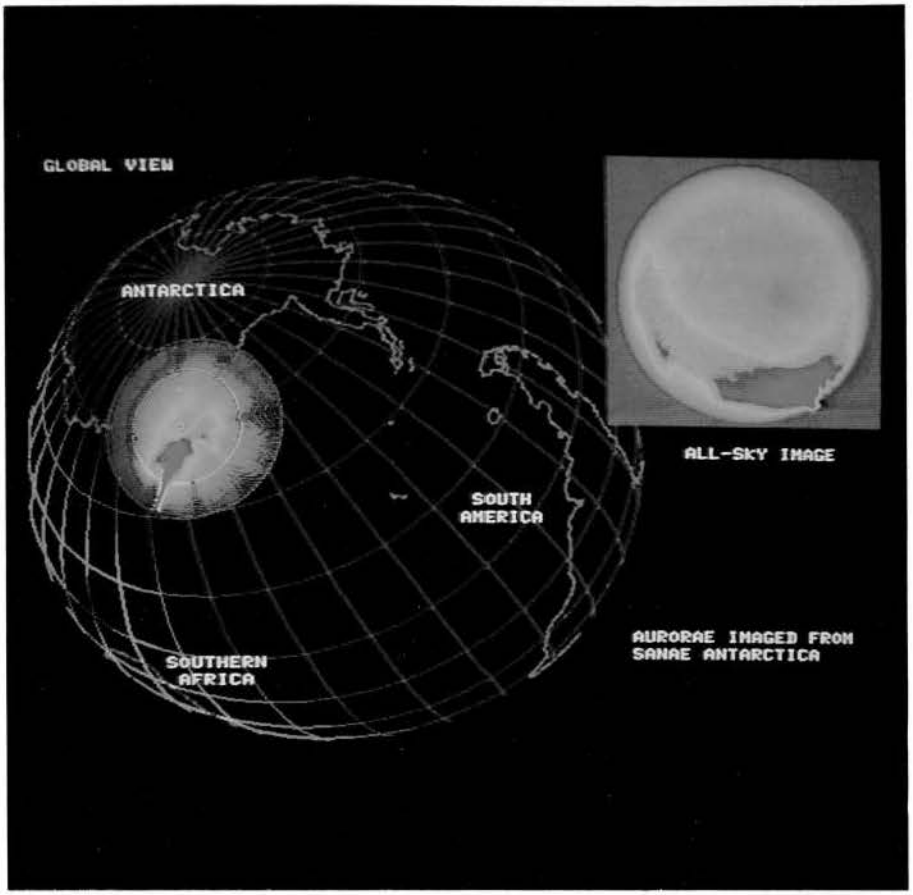

Fig 1 The inset is a sample low light level all-sky auroral image. The digital image transform, viewed in a global perspective depicts the transform to be preformed by the new auroral imaging system

Fig 2 The all-sky imaging system to be deployed in the Antarctic with from left to right, Dr Nozumu Nishitani visiting from Japan, and the inventors Mr Gavin Hough and Prof Malcolm W J Scourfield. The schematic on the right illustrates how light incident from auroral forms in the ionosphere are reflected off the primary mirror so as to cancel all-sky distortion