Quarterly Report
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Part 1:

1. The project has made good progress during this quarter, despite having been delayed somewhat by the completion of my teaching responsibilities during the winter term, and by unforeseen difficulties with the repair of the Polar Camera. These delays are not critical.

2. The project is within budget.

3. The project is free of any areas of concern in which the assistance or guidance of Canada is required.

Part 2:

1. Description of progress:

    1.1 Patch signatures

    This project has made no further progress since my last report.

    1.2 Convection inference study

    This study has been delayed in starting, as time has instead been devoted to the mesopause wave spectrum study (see §1.6) and to the repair of the Polar Camera (see §1.7).

    1.3 Faint arc characteristics study

    NSERC have awarded me a 2-year research grant at $10,000 per year to investigate the 'polar diffuse auroras' observed at Eureka by the Polar Camera. This phenomenon was discussed in §2.3.1 of my annual report. I had planned for this topic to be investigated by a prospective graduate student from China, who was to come to the University of Saskatchewan for graduate studies in auroral physics. He was to work jointly with me and Prof. D. J. McEwen, with whom he had initially made contact. However, this student lately informed Prof. McEwen that he had accepted an offer from McGill University. I am therefore considering other means of conducting the study.

    On Feb. 19, 1996 a drifting polar arc was observed for about 20 minutes by all-sky imagers at both the U.S. National Science Foundation Early Polar Cap Observatory (EPCO) at Resolute Bay, NWT, and at the AStrO Laboratory at Eureka, NWT. Rick Doe at SRI International coordinated a tomographic study of the image data from both observatories, to which I contributed calibrated optical image data from the Polar Camera at Eureka.

An unusual effort was required to establish the look directions for the images, which were affected by a problem in the CCD readout electronics that developed just two days before the arc observations (see §1.7). At this writing we are assessing whether the Polar Camera data from this event are good enough for a publishable study. Whatever the outcome, it is clear that they illustrate the potential for coordination between the two observatories. Further coordinated observations are planned for the upcoming winter season.

1.4 Magnetospheric topology study

This study saw no progress during the quarter.

1.5 Northward IMF convection study

This study has also been delayed in starting, for the same reasons as those given above in §1.2.

1.6 Mesopause wave spectrum study

This study made significant progress during the quarter, especially during a working visit with Prof. Leroy Cogger at the University of Calgary during May 24-28, 1996.

Periods with good OH data and apparent wave activity during the first two winters of operation were identified, and the period December 22-25, 1994 was selected for study. Backgrounds due to scattered moonlight and airglow continuum were subtracted from the data set. During the visit to the University of Calgary, a modified full correlation analysis was applied to detect and characterize the scale, orientation, and velocity of moving structures in the airglow distribution. As well, a modified (Lomb-Scargle) periodogram analysis was applied to time series of data at points within the fields of view to identify significant periodicities in the data. Highly significant power at about 6 hrs period is evident during December 24-25, 1994, and peaks at other periods (8-10 hrs, 18-24 hrs) also appear in the periodogram. Further analysis will determine whether the 6-hr periodicity corresponds to moving airglow structures (implying a propagating tidal or gravity wave origin) or to a non-propagating tide. Comparisons are planned with other data from Eureka.

1.7 Polar Camera repair

During the 1995-96 winter season at Eureka the Polar Camera developed a number of anomalies. First in order of appearance was an *increase* in apparent sensitivity in mid-October 1995, of unknown cause, which persisted

throughout the winter. Possible explanations will be explored this summer, starting with secular increases in the filter passbands. As well, partially corrupted images were sometimes received from Camera 0, increasingly through the winter. In these images a number of rows, beginning at the first (top) row and extending downward over 10% to 50% of the image, showed lower count rates than expected. The structure and variability of the corruption suggests a problem in the readout electronics of the CCD camera. Finally, in mid-February 1996 the images from Camera 0 developed a further defect which rendered them largely unusable. This defect appears to stem from the serial binning portion of the readout electronics. These latter two problems must be addressed by the manufacturer, and so the camera detectors and readout electronics will be returned to Photometrics, Inc. in Tucson, AZ for repair and maintenance.

Simultaneously with the onset of the serial binning problem in Camera 0, a relay in the filter wheel positioning circuit in Camera 1 failed, leaving the camera viewing the background emission at 820 nm for the remainder of the winter. The relay has been replaced and further testing and repair is underway as of this writing.

1.8 Search for alternate funding / permanent position

During this quarter I applied for a faculty position at the University of Saskatchewan. The terms of the position required the successful candidate to be able to be registered as a Professional Engineer with the Association of Professional Engineers of Saskatchewan. I prepared and submitted the documentation required for an academic assessment of my credentials, as a step in seeking such registration, and am planning to prepare and submit further documentation on my work experience since graduation.

I also attended a joint meeting of researchers from the Institute of Space and Atmospheric Studies and the Saskatchewan Research Council on May 15, aimed at identifying areas of common interest and potential collaboration.

2. Explanation of Variation

I attach high priority to assessing the value of the OH image data sets obtained by the Polar Camera, as these were a primary purpose of the experiment. I pursued this assessment in favour of the other studies (§§1.2, 1.5) in order to determine the extent to which further effort should be expended on the OH image data sets. I anticipate completing this phase of the assessment by the end of August 1996, and will report my conclusions in the interim report due at that time.

A temporary delay in research progress was experienced during June 1996 when the hard drive on my PC failed. The external drive provided by the vendor while the

internal drive was being replaced also developed problems, ultimately failing completely just as a replacement for the internal drive arrived. A net delay of nearly two weeks resulted.

3. Trips and Conferences

I attended no conferences during the quarter. As mentioned above, I made a trip to the University of Calgary in order to collaborate with Prof. Leroy Cogger on the OH image data set, with very positive results.

4. Major Equipment

No major equipment has been purchased during the quarter. Major outlays were required for shipment of the Polar Camera from Eureka to Resolute Bay via a shared Polar Shelf charter, and from Resolute Bay to Saskatoon via Canadian Regional Airlines.