Quarterly Report
October 1, 1995 - December 31, 1995

Contract No. 9F007-5-8005/01-SR
SSC File No. 019SR.9F007-5-8005

Prepared by: David P. Steele
Institute of Space and Atmospheric Studies
Department of Physics and Engineering Physics
University of Saskatchewan
116 Science Place
Saskatoon, SK, CANADA
S7N 5E2

Prepared for: Mr. Glen Rumbold
Scientific Authority
Canadian Space Agency
Space Science Program
100 Sussex Drive, Room 1039
Ottawa, ON, CANADA
K1A 0R6

Part 1:

1. Good progress was made during this quarter. The project remains behind schedule in a number of areas, as detailed below in §1 of Part 2. Further delay is anticipated in the final quarter of the contract year, as outlined in §1.9 of Part 2.

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 study

    In October I submitted a revised version of an optical study of patch signatures to a special issue of Radio Science, devoted to the results of the 2nd joint CEDAR HLPS / STEP GAPS workshop on high-latitude plasma structures. This study used Polar Camera images to measure patch drift velocities and thereby infer ionospheric convection velocities. It included a synthetic image of the large-scale structure of the high-latitude patch distribution. The convection velocity component of the study was augmented by Canadian Advanced Digital Ionosonde measurements from Eureka, which were in agreement with the optically-derived velocities.

    During this quarter I contributed to a ground-breaking study of patch formation and evolution, led by Dr. P. Prikryl of the Communications Research Centre, entitled "Observations of polar patches generated by solar-wind-driven Pc5 magnetic field line resonances and pulsed magnetic reconnection at the dayside magnetopause." The study identifies previously unknown connections between solar wind and IMF fluctuations, dayside ionospheric phenomena at cusp and lower latitudes, and the creation and evolution of polar patches.

    Further work on patch signatures during this quarter was pre-empted by the preparation of an NSERC Research Grant application, as detailed below in §1.2.

    1.2 Faint arc characteristics study

    By virtue of my appointment as Adjunct Professor of Physics at the University of Saskatchewan, I submitted a grant application for the current competition, entitled "Polar Diffuse Aurora and its Magnetospheric

Implications". I requested a total of $119,100 over four years, mostly in support of one or two graduate students to expand the study of faint diffuse emissions described in my last report. I have begun a manuscript on this study, for submission to Geophysical Research Letters as soon as possible.

At the Fall Meeting of the American Geophysical Union, held in San Francisco, CA, in early December, Dr. Israel Oznovich and I presented some preliminary results of a joint study on auroral height-finding from a single station, using simultaneous multi-wavelength observations of auroral arc emissions. We examined a sequence of arcs observed at Eureka, NWT on October 23, 1993, and determined unusually high (≥180 km) emission centroid heights for the [OI] green line emissions, based on their zenith angles and angular distances from the corresponding [OI] red line emissions. By coincidence, the DMSP F10 satellite overflew the arcs while they were in view from Eureka, and the instantaneous coordinates of the electron precipitation exciting the arcs strongly confirmed the heights inferred solely from the optical data. The measured precipitating electron spectra were also consistent with high-altitude emission. The study is continuing, and will be submitted for publication as soon as possible. The technique we are investigating will be useful as an aid to mapping polar arcs to geographic/geomagnetic coordinates for purposes of comparison with observations from other space- and ground-based instruments.

1.3 Magnetospheric topology study

This study has yet to begin, as opportunities for progress in the two areas described above were pursued in preference to this area. The study of Polar Diffuse Aurora described above in §1.1 will require an examination of the magnetic field topology in the neightbourhood of the diffuse emission regions.

1.4 Convection inference study

This study was to have begun October 1, 1995, but was delayed in favour of the faint arc study efforts.

1.5 Storm precursors study

This study was also to have begun October 1, 1995, but was delayed. An opportunity exists to contribute to an extensive study of a major storm period in November 1993, and the study will begin along these lines during the last quarter of the contract year.

1.6 Mesopause wave spectrum study

Arrangements have been made for a collaborative effort with Professor Leroy Cogger of the University of Calgary to assess the value of the OH and [OI] green line airglow data from Eureka. This work will begin early in the final quarter of this contract year, putting this study behind the schedule originally set. It is now judged that this schedule was overly optimistic, and that more time and care than originally thought will be required to make proper use of the OH image data. However, this work will proceed in the remaining quarter.

1.7 Stratospheric warming effects study

As stated in the previous quarterly report, this study depends upon the progress made in the mesopause wave spectrum study. Owing to the slower-than-expected progress of that study, no progress has been made in this one.

1.8 Stratospheric disturbance propagation study

This study was to have begun October 1, 1995. As with the stratospheric warming effects study, the conduct of this study depends on a clear detection of the signature of mesopause waves in the OH images. This study will commence as soon as possible after such a detection has been made.

1.9 Search for alternate funding / permanent position

No opportunities for permanent positions consistent with my qualifications and experience arose during the quarter.

In late November I accepted an opportunity to teach a third-year Engineering Physics course in fluid and rigid-body mechanics during the winter term at the University of Saskatchewan. The course is now under way. I had a relatively short time in which to prepare the course, so more than 50% of my time each week is required for the various duties associated with the course. For this reason my anticipated research progress during the final quarter of the contract year is expected to be significantly reduced, and the delays experienced thus far will not be made up over the remainder of the contract year. However, I judge that teaching the course is a necessary step toward eligibility for a permanent position at the University of Saskatchewan should one arise, and is thus an appropriate activity under the terms of the contract.

2. Explanation of variation

Apart from the delays described and explained above, no variations from the plan of work set out in the contract have taken place.

3. Trips and conferences

During the weekend of September 8-11, 1995, I travelled to the University of Calgary to collaborate with Professor Leroy Cogger, my co-author on the patch characteristics manuscript described in §1.1 above.

4. Major Equipment

During this quarter I purchased a Canadian-made Comtex Mach 5 PC, equipped with a Pentium 120 MHz processor, 32 MB of RAM, a 4 GB SCSI-2 hard disk drive, a 4x CD-ROM, and various other accessories, as well as a 15" SVGA monitor. The PC system and the monitor are now on CSA inventory. After some unforeseen difficulties configuring the PC to run the combination of IDL, the NovaStor tape backup software used on the Polar Camera project, and TCP/IP for network communications, the PC is now proving very effective for Polar Camera data reduction and analysis.