as well. The determination of the optimum model and form of inversion, taking expected payload drift and star rising and setting into account, will be made during Phase A.

2.4 Data Acquisition and Processing

Data will be telemetered from the payload on two frequencies. Losslessly compressed data from the imaging spectrograph (ISG) will be merged with data from the GPS receiver, the temperature sensor, and possibly the chemiluminescent ozonesonde, and transmitted to the ground using bi-phase PCM-FM telemetry at an S-band frequency. In addition, the 2-MHz bandwidth analog video signal from the AVC, carried on a different S-band frequency, may be RF-multiplexed onto the same antenna or transmitted to the ground from another antenna. The raw telemetry data will be recorded on tape as well as being decommutated in real time.

The time-stamped AVC data will determine the look direction of the ISG at each moment. This technique was used successfully in the GEMINI project. The combination of the GPS-determined position-velocity data and the AVC attitudes defines precisely the atmospheric column along which the total ozone concentration is measured, as well as the rate of change of the column.

The ISG images must be decompressed and spectrally inverted to determine the optically absorbing species and their corresponding column densities. The first step is to remove the blurring caused by payload spin during the 1-s exposure time. This blurring will be primarily horizontal, and therefore perpendicular to the vertical wavelength dispersion caused by the horizontal orientation of the grating rulings. Therefore, adjacent spectra can be shifted and summed to compensate for the motion of the ISG. This is accomplished by referring to the angular deflections obtained over time from the AVC results. This summation will simultaneously intensify the measured spectra and tend to cancel the readout noise present on each measured spectrum.

3 NiteOwl in the Canadian and International Context

Ozone monitoring in Canada is currently carried out using a network of ground-based Brewer ozone spectrophotometers, part of the Global Ozone Observation Network, together with balloon-borne ozonesondes, and lidars at Toronto and Eureka, NWT. While Brewers routinely use both the sun and moon as sources, development of a stellar Brewer is nearing completion. Canada is developing the OSIRIS and MOPITT space experiments to address the need for global measurements of ozone and other key trace gases in the UTLS region.

Much of our current knowledge of global ozone trends has come from the Total Ozone Mapping Spectrometer (TOMS) on Nimbus 7, which provided nearly fifteen years of accurate global ozone maps using solar backscattered ultraviolet (SBUV) observations. Successor instruments on the Japanese Advanced Earth Observing Satellite (ADEOS) and NASA Earth Probe continue to monitor total column ozone. The Global Ozone Monitoring Experiment (GOME) on the European Space Agency (ESA) Remote Sensing 2 (ERS-2) platform also provides global ozone column and profile data in the nadir using differential optical absorption spectroscopy (DOAS) at wavelengths from the UV to the near infrared (IR).

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Several current satellites use solar occultations to derive profiles of ozone and other species. The Halogen Occultation Experiment (HALOE) on the Upper Atmosphere Research Satellite (UARS) and the Stratospheric Aerosol and Gas Experiment (SAGE) II on the Earth Radiation Budget Satellite (ERBS) are currently operational in orbits which allow only seasonal coverage of the polar regions. The Polar Ozone and Aerosol Monitor (POAM) II instrument, which provided excellent coverage of high-latitude ozone, is no longer operational as the French Satellite pour l'Observation de la Terre (SPOT)-3 platform which hosts POAM II began recently to tumble. An Improved Limb Atmospheric Spectrometer (ILAS) in a polar orbit on ADEOS has begun to acquire ozone profiles.

The Microwave Limb Sounder on UARS is currently providing ozone profiles with 6 km vertical resolution, and experiments operating on similar principles at microwave (AMAS) and IR (MIPAS) wavelengths are planned.

The ESA Global Ozone Monitoring by Occultation of Stars (GOMOS) instrument on the ENVISAT platform has been in preparation for over five years, and is scheduled for launch in late 1998. GOMOS will measure ozone and numerous other minor constituents using a stellar occultation technique, as does NiteOwl. The large number of target species necessitates much higher spectral resolution and coverage than are proposed for NiteOwl, enormously increasing the cost and complexity of the instrument. As well, observations are restricted to the relatively few first-magnitude stars, thus hindering both spatial resolution and the possibility of tomographic analysis. A smaller instrument (Calibration for Ozone by Atmospheric Limb Acquisitions - COALA) operating on similar principles has been proposed as a payload complement to an ozone sensor operating on other principles.

It is our intention to provide a Canadian polar night ozone measurement by tomographic technique. A key element for quality tomographic results is redundant measurements. These would be of the same atmospheric cell taken from different vantage points during descent and improved by multiple lines-of-sight provided by the various stars in our field of view. Presently, this is accomplished by making observations over multiple passes of the same area. The NiteOwl payload will rotate as it descends, thereby getting multiple looks through the same cells, each from a different angle. In addition, the broad ozone absorption feature of the Chappuis band (450 - 750 nm) can be measured satisfactorily with only moderate spectral resolution. This may affect the number of recoverable species but will reduce the cost of the mission.

4 Required Theoretical and Modelling Support

During the Phase A study, simulations of the spectral inversion technique and the tomographic inversion technique will provide important support to the mission and have the potential to substantially improve the quality of the measurements. Funding for these studies will come from existing sources such as NSERC.

4.1 Spectral Inversion Modelling

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