EXPLOITATION OF CHRIS DATA FROM THE PROBA MISSION

Announcement of Opportunity

18 October 1999
1. Introduction to the Opportunity

The European Space Agency (ESA) announces an opportunity to the Earth observation community to participate in a science and applications programme using CHRIS imaging spectrometer data from the PROBA mission.

The Project for On-Board Autonomy (PROBA) small satellite mission to be launched in early 2001 is a technology proving experiment to demonstrate the on-board autonomy of a generic platform suitable for small scientific or application missions. A number of different Earth observation instruments have been included in the payload to test platform pointing and data management capabilities, and these present opportunities for using the data for Earth observation purposes. The instrument payload includes a Compact High Resolution Imaging Spectrometer (CHRIS), a radiation measurement sensor (SREM), a debris measurement sensor (DEBIE), high resolution and wide angle Earth pointing cameras, a star tracker and gyroscopes.

The CHRIS imaging spectrometer system has been designed principally to provide remote sensing data for land applications, and is intended to demonstrate that compact imaging spectrometers can be low-cost but viable instruments when combined with agile small satellite platforms. CHRIS will provide a spectral coverage from 400 to 1050nm with a minimum spectral sampling interval ranging between 1.25 and 11nm, and a ground sampling interval of 25m. at nadir. The PROBA satellite platform will provide along- and across-track pointing.

A first version of the PROBA/CHRIS Experimenters Handbook provides more details of the CHRIS instrument and data characteristics, and a baseline programme of scientific investigations concerning aerosol retrieval and land surface studies. This Announcement of Opportunity (AO) offers the possibility of widening the science and applications interest, and there is particular interest in encouraging the use of CHRIS data for coastal applications. There are a very broad range of possible application areas, including vegetation mapping, agricultural crop forecasting, forestry, water quality, air quality and pollution monitoring.

2. Scientific Objectives

The CHRIS instrument will use the PROBA pointing capabilities to obtain visible/near infrared reflectance measurements with a wide range of different viewing configurations, and provide Bidirectional Reflectance Distribution Function (BRDF) data for selected test sites on the Earth’s surface.

Atmospheric science objectives focus on aerosols, which as well as being important for weather and climate, are also a consideration for accurate atmospheric correction of satellite data. Previous research using the 2 different viewing angles of the ATSR-2 instrument on ERS-2 has shown that accurate aerosol retrieval is possible using a pointable multi-spectral instrument. Compared to the ATRS-2 instrument, CHRIS offers additional look angles and more bands, which will permit a better estimate of aerosols. Dr. Jeff Settle, University of Reading, UK, is providing the science lead for aerosol studies.

Land studies will concentrate on the estimation of land surface biochemical (chlorophyll content) and biophysical (LAI/biomass, albedo, fAPAR) properties using multi-angle reflectance data. To date most land surface studies have used information from the spectral and temporal domains, but there is increasing interest in using directional reflectance properties. Theory suggests that directional reflectance is controlled by the spatial and geometric structure of the reflecting surface, as well as by the optical properties of its component elements. CHRIS will be used to acquire sets of hyperspectral images covering the same area of ground with different sensor viewing angles. Surface biophysical parameters will be estimated from the CHRIS data using a number of different techniques, ranging from traditional (the so-called vegetation
indices), through more recent developments (such as red-edge position), to more advanced
techniques (notably BRDF model inversion). The science leader for land studies is Professor Mike Barnsley, University of Swansea, UK.

3. Test Sites and Data Acquisition
Preliminary plans are for a total of 30 test sites: 15 for aerosol/atmosphere studies, 10 for land surface studies and 5 for coastal studies. Aerosol studies will include a number of different continental, marine, urban and desert test sites. Land surface sites will include temperate agricultural areas, boreal forests and semi-arid areas. The baseline programme already includes some key test sites, many of which are being used within on-going international remote sensing programmes. Selection of the remaining test sites will be based on responses to the AO. The ability of PIs to provide in-situ data will be a prime consideration in the selection of test sites.

There is a strong requirement for sets of CHRIS hyperspectral images obtained with different viewing geometries during a single satellite overpass. The nominal operating mode is a set of 5 along track images with incidence angles of 0°, +/-25° and +/-44° (n.b. viewing angles from the vertical at the ground surface). Across-track viewing (up to 30°) will be used to obtain additional angular samples and to increase the range of solar zenith angles. In nominal operation, images will be acquired with the full swath coverage (i.e. 18.6km x 18.6km image size). The nominal mode for land studies will be 19 spectral bands at 25m x 25m resolution, and for aerosol studies it will be 62 bands at 50m x 50m resolution.

For aerosol studies there is a strong requirement for monthly acquisitions throughout a complete year. For land surface studies the minimum revisit is once per season, but again once per month may be preferable. Coastal studies will need at least a similar frequency of temporal coverage. Careful daily programming of satellite acquisitions will be organised to maximise the number of cloud free images, but inevitably some images will be unusable because of cloud cover.

Based on the scope of the programme discussed above, there are expected to be a total of 30 sites for which monthly sets of images are acquired. Since the on-board storage capacity of PROBA/CHRIS is limited to a single set of images, this data requirement equates to 1 download to a ground receiving station per day.

4. Data Provision
Following acceptance of a proposed project into the ESA science programme, the data sets necessary to execute the research work will be provided to the Principal Investigators free of charge within the limits of an assigned quota.

Level 1A products will be provided. The scientific investigators will carry out geometric corrections, co-registration, atmospheric correction and all science processing.

5. Reporting
All selected Principal Investigators will be expected to attend planning and results meetings (provisionally 3 meetings at ESTEC), and prepare a paper for the Final Results Meeting likely to take place in mid 2002. ESA funding of scientific investigators will be limited to the provision of CHRIS data.

6. Proposal Content
Interested institutes and researchers are invited to submit concise proposals, providing information under the following headings:
1. Name of the Proposal
2. Investigators (i.e. Principal and Co-investigators)
3. Objectives
4. Study approach
5. Anticipated results
6. Proposed test sites (indicating if a new test site is proposed)
7. In-situ data collection
8. Instrument data requirements (no. of images and temporal coverage)

This information will be used by ESA to define the campaign programme in advance of an Experimenters Planning Meeting in February 2000. All those responding to this AO will be informed of this meeting. Both measurement objectives and instrument capabilities will be considered fully at this meeting, before finalising the programme.

7. Submission of Proposals
Proposals are to be submitted using the on-line AO submission form, by 17 December 1999, at the following URL address:

http://www.estec.esa.nl/CONFANNOUN/proba/

Requests for more information on the AO should be addressed to Evert Attema, ESTEC.

Evert Attema (eattema@estec.esa.nl)
Earth Sciences Division, ESA/ESTEC, Postbus 299, 2200 Noordwijk, The Netherlands
Tel: +31 71 565 4461  Fax:+31 71 565 5675