Canadian Space Agency | Agence spatiale canadienne

Geospace Observatory – Instruments and Data

Announcement of Opportunity

Changes since the initial release of this document are indicated as follows:

- Text in red (example) has been updated or added.
- Text in red with strikethrough (~~example~~) has been removed.

Last updated: 25 April 2013

Canada

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1 INTRODUCTION

The Canadian Space Agency (CSA) is pleased to announce an opportunity for the Canadian solar-terrestrial science and space weather forecasting communities to participate in Geospace Observatory (GO) Canada. The GO Canada program aims to advance our knowledge of Canadian geospace and, in so doing, mitigate the impact of disturbances in geospace on the daily lives of Canadians. This Announcement of Opportunity (AO) is an initiative under the CSA Grants and Contributions (G&C) program aimed at funding a number of projects that will make high-value observations of geospace above Canada as part of the GO Canada program. These observations will aid in advancing knowledge in the geospace sciences and enhance Canadian space missions and projects, most notably the CASSIOPE/e-POP mission, the CEFI instruments on ESA's Swarm mission, and the ground-based observatories that comprise part of NASA's THEMIS mission.

For more than 20 years, the CSA has supported the collection of data on geospace, the region of near-Earth space comprised of the thermosphere, ionosphere, and magnetosphere, through arrays of ground-based instruments. These observations began with the Canadian Auroral Network for the OPEN Program Unified Study (CANOPUS), continued as the Canadian Geospace Monitoring (CGSM) program, and remain a central element of the Canadian Space Environment Community Roadmap (http://aurora.phys.ucalgary.ca/doc/Canadian_Space_Environment_Roadmap_2009.pdf).

With this AO, the CSA solicits proposals for projects that will gather observational data through ground-based instruments for use in scientific analysis and modelling as well as space weather forecasting. The resulting network of instruments and associated data management systems will constitute the infrastructure element of the new Geospace Observatory. Through a future opportunity, the CSA intends to solicit proposals for scientific investigation that will advance understanding of the geospace system through analyses and modelling of these and other Canadian geospace data.

Please read the AO thoroughly before submitting your application. The document outlines important elements including mandatory criteria for eligibility and the selection process. The AO will proceed in two phases, Notice of Intent and Application. Each phase has its own requirements, which are detailed in Sections 5 and 6 of this document.

In the event of any discrepancies between this AO and the individual funding agreements governing projects, the latter documents will take precedence.

2 OBJECTIVES

The overarching objective of the Geospace Observatory is to observe and understand geospace as a coupled system. The AO will support this objective by providing funding through contribution agreements to projects that observe Canadian geospace with networked arrays of ground-based instruments and return their data for processing, preservation, and access. These data will be made openly available as rapidly as possible in order to maximize both their scientific value and their value in mitigating the impact of space weather on the lives of Canadians.

More specifically, the objectives of this AO are:

A. To make continuous high-value observations of geospace;
B. To generate value-added data products based on these observations; and
C. To make these data rapidly and openly accessible while preserving them for future use.

Both objective A and B refer to the value of the associated activities: high-value observations of geospace and value-added data products. The value of proposed observations and data products will be evaluated by three criteria (see Section 12.3 for details): advancement of knowledge and technology in the geospace sciences, enhancement of scientific return from Canadian missions and projects, and enhancement of Canada's world-class expertise/leadership.

The first of these criteria, advancement of knowledge and technology in the geospace sciences, relates to the high-level objectives of the GO program:

- To understand how coupling across geospace influences system-level structure and dynamics; and
- To understand the response of the ionosphere and thermosphere to magnetospheric drivers.

A measure of the scientific value of the observations and data products is their ability to enable research aimed at addressing these objectives.

The second and third of these criteria, enhancement of scientific return from Canadian missions and projects and enhancement of Canada's world-class expertise/leadership, assess the scientific value of the observations and data products to Canadian and international space missions and projects. Such missions include the soon to be launched CASSIOPE mission with the e-POP scientific payload, ESA's Swarm mission with the Canadian CEFI instruments, and NASA's THEMIS mission and Van Allen Probes. A measure of the scientific value of the observations and data products is their ability to enable research aimed at addressing the objectives of the identified missions and projects.

3 ELIGIBILITY

3.1 CSA Priorities

The projects supported under this AO will contribute to the achievement of the CSA's Scientific Data Utilization program activity (SSA 1.1.3.3):

> *This Program Sub-Sub-Activity (SSA) develops the utilization and validates the quality of Canadian and foreign space-based scientific data and derived information that address science questions, such as those related to our understanding of the Earth's climate system and magnetic field (magnetosphere). This SSA involves the collaboration of Canadian scientists from Government of Canada (GoC) organizations and academia…*
>
> *This SSA engages the participation of the Canadian space industry* [not eligible under this AO], *academia and GoC organizations' scientists* [not eligible under this AO], *and is formalized under contracts, grants, contributions and partnership agreements with national, public/private and international organizations.*
>
> From *The CSA Report on Plans and Priorities (2012-2013 Estimates)*, p.14 (http://www.asc-csa.gc.ca/pdf/rpp-2012-detailed-eng.pdf).

3.2 Eligible Projects

In addition to being linked to the AO objectives (see Section 2) as evaluated by the evaluation criteria (see Section 12.3), a proposal must demonstrate that the project satisfies the following criteria for eligibility:

- The instruments must be ground-based.
- The measurements made by the instruments must be primarily associated with geospace phenomena.
- The instruments must be capable of autonomous and continuous operation whenever the phenomena being observed are present.
- Taken individually or as an array, the instruments must be able to confidently identify and monitor large features in geospace. For this criterion, a large feature is defined as one having a minimum dimension of 1000 km when geometrically projected to an altitude of 100 km.
- All data must be made fully, freely, and openly available on the shortest feasible timescale (e.g. one week after acquisition by the instrument). An exception may be made for those data that must be manually retrieved from the instrument (e.g. three months after acquisition by the instrument).

Although any type of instrument array satisfying the preceding criteria would be eligible, the selection process described in Section 7 ensures that the resulting arrays of instruments are capable of making a number of fundamental observations:

1. Magnetic field observations
   Measurements of the geomagnetic field using instruments such as magnetometers.
2. Electric field observations
   Measurements of the ionospheric electric field using instruments such as radars.
3. Plasma observations
   Measurements of ionospheric or magnetospheric plasma properties and their spatial distribution using active or passive instruments such as radars, radio receivers, photometers, and imagers.
4. Neutral gas observations
   Measurements of thermospheric neutral gas properties and their spatial distribution using active or passive instruments such as lidars or interferometers.

Proposals should identify the primary observation that would be made by the instruments. Note that the choice of primary observation may affect whether the proposal is selected and will be validated during evaluation.

The Government of Canada currently owns a number of instruments and support infrastructure that may be included as part of a proposal. The support infrastructure includes the Information Technology Infrastructure (ITI) system, telecommunications services, electrical power, and climate-controlled shelter. The support infrastructure will be shared among the winning proposals requiring this support. The instruments, their locations, and the supported infrastructure are described in Section 12.5.

3.3 Eligible Recipients

In order to be eligible, recipients must be Canadian universities or post-secondary institutions.

4 CONTACT INFORMATION

All enquiries must be directed to:

Project Officer, Geospace Observatory AO
Sun-Earth System Sciences
Canadian Space Agency
6767, route de l'Aéroport
Saint-Hubert, QC J3Y 8Y9
solar-terrestrial@asc-csa.gc.ca

Please see Section 11 for further information on enquiries.

5 NOTICE OF INTENT

The primary objective of the Notice of Intent (NOI) is to aid in establishing a review process that is free from conflicts of interest and that incorporates the necessary expertise. Although submission of a NOI is not a commitment to submit an application and the information it contains is not legally binding on the applicant, all submitted applications must have been preceded by an associated NOI.

5.1 Requirements

All applicants must submit a NOI; please use the form provided on the AO webpage at the CSA website. The NOI must include the following information:

- the Principal Investigator's name, institution, physical mailing address, telephone number, and email address;
- the name(s), institution(s), and email address(es) of any Co-Investigators known at the time of submission;
- a 250-word (maximum) text stating the objectives of the proposed project and summarizing the scientific and technical approach;
- the primary observation that would be made by the instruments (magnetic field, electric field, plasma, or neutral gas observations; see Section 3.2 for details) and the instrument locations;
- the names, institutions, and email address of up to five suggested reviewers (you may request that some individuals not be involved in the review of your application); and
- the language (English or French) that will be used for the application.

Incomplete documentation will lead to the rejection of the NOI. NOIs must be received by 6 May 2013, 17:00 (EDT) and must be emailed as an attachment to the CSA contact identified in Section 4.

5.2 Service Standards

The CSA has developed service standards related to the processing of the NOIs.

Acknowledgement and Decision: CSA goal is to respond to each NOI within one week of receiving the NOI with a decision on whether the NOI has been accepted or rejected. Applicants may modify and resubmit a rejected NOI up until the NOI deadline.

The achievement of these service standards is a shared responsibility. The applicant must submit all required documentation in a timely fashion.

6 APPLICATION

The objective of the application is to gather sufficient information to evaluate the proposal and decide which proposals will receive funding from the CSA under the GO Canada AO.

6.1 Requirements

All applicants must submit an application. The application must include the following:

- a completed typed original application form signed by the Duly Authorized Representative;
- one paper copy of the proposal;
- one paper copy of each supplementary document (Deployment & Operations Plan and Data Management Plan);
- a completed Natural Sciences and Engineering Research Council of Canada (NSERC) Personal Data Form (Form 100) for each investigator;
- letters from other funding contributors confirming their contributions (if applicable);
- a completed Declaration on Confidentiality, Access to Information and Privacy Act form signed by the Duly Authorized Representative;
- for organizations in Québec, a completed Chapter M-30 Supporting Documentation Form signed by the Duly Authorized Representative; and
- a single PDF-formatted file containing copies (identical to the paper copies) of all the above requested documents with all security features disabled on standard electronic media (USB memory key, CD, or DVD). The proposal and supplementary documents must be included in the file as searchable PDF-formatted documents (preferably PDF/A-1a format).

The application form and supporting documents must be sent by registered mail to the CSA contact identified in Section 4 postmarked by midnight on 27 May 2013. Any applications received without an associated NOI that has been accepted by the CSA will be declared non-responsive. Note: hand-delivered applications will be accepted between 8:00 and 16:30 EDT on 27 May 2013 but applications sent by email will not be accepted.

Any missing supporting document or any incoherence between the requested information and the information provided within the documents may lead to the rejection of the proposal on that sole basis.

It is the applicant's responsibility to ensure that the application complies with all relevant federal, provincial/territorial and municipal laws.

6.2 Service Standards

CSA has set service standards for the timely delivery of the acknowledgement of receipt, funding decision and payment processes.

Acknowledgement: CSA goal is to acknowledge receipt of proposals within 2 weeks of receiving a completed application package.

Decision: CSA goal is to respond to the proposal within 10 weeks of receiving a completed application package or closing date of the Announcement of Opportunity and, to send for signature a contribution agreement within 15 weeks after formal approval of the proposal.

Applicants will be notified in writing regarding the decisions related to their application. Successful applications will be announced and posted on the CSA website.

Payment: CSA goal is to issue payments within 6 weeks of the successful fulfillment of requirements outlined in the contribution agreement.

The achievement of these service standards is a shared responsibility. The applicant must submit all required documentation in a timely fashion.

7 SELECTION PROCESS

7.1 Evaluation Process

All potential applicants must submit a Notice of Intent (NOI) (Section 5) to indicate their intention to submit an application.

Only applications that pass the screening criteria described in Section 7.2 will be considered further. Several evaluators could assess each application based on evaluation criteria listed in Section 7.3. Evaluators will be experts in the field relevant to the applications and may include representatives of the Canadian government, other governments, and non-government agencies and organizations. A final evaluation committee will be formed to provide a uniform final score and ranking of proposals. The method of ranking applications for selection is described in Section 7.4.

Before a final decision is made, program managers may seek input and advice from others, including, but not limited to federal, provincial/territorial and municipal government agencies, etc.

7.2 Screening Criteria

Applications must satisfy the screening criteria. The screening process will determine if the application:

- represents a CSA priority (see section 3.1);
- represents an eligible project (see Section 3.2);
- represents an eligible recipient (see Section 3.3);
- meets program funding provisions (see Section 8);
- includes the required documentation and declarations (see Section 6); and
- has been completed and signed by the Duly Authorized Representative.

7.3 Evaluation Criteria

Only applications that have satisfied the screening criteria (see Section 7.2) will be retained. An evaluation committee will assess the applications according to the following criteria:

- Benefits to Canada;
- Feasibility;

- Resources;
- Results; and
- Risk and mitigation measures.

The associated scoring grid is provided in Section 12.3.

7.4 Selection Method

To be considered responsive, an application must:

a. be preceded by a NOI that has been accepted by the CSA;
b. satisfy the eligibility criteria specified in Section 3;
c. achieve the specified minimum score for each criterion in Section 12.3; and
d. achieve the specified minimum total score.

Responsive applications will be grouped according to their primary observation type. The applications in each group will be ranked in descending order of their total scores and the application(s) ranking highest in each group will be recommended for an award, according to the table below.

Primary Observation	Minimum Number of Awards
Magnetic Field	1
Electric Field	2
Plasma	3
Neutral gases	1

See Section 3.2 for further information on observation types.

The minimum number of awards associated with each observation type reflects the variety of instruments capable of making each type of observation and their relative cost to operate.

The remaining responsive applications will be ungrouped and ranked in descending order of their total scores. Recommendation for award will then be in descending order of score for the proposals, no matter what observation was proposed, until no more funds are available, subject to the restriction limiting each Principal Investigator (PI) to no more than three awards. Co-Investigators may be involved in any number of proposals. This method of selection is used to ensure a variety of observations, while promoting fair and open competition.

In the event that more than one PI requests the use of the same Government Furnished Equipement (GFE; see Section 12.5) instruments, the proposal with the highest overall score will be retained for funding. The remaining proposal(s) may be retained for partial funding as decided by the final evaluation committee.

7.5 Notification and Announcement

Applicants will be notified in writing regarding the decisions related to their application. Successful applications will be announced and posted on the CSA website.

8 FUNDING

8.1 Available Funding

The overall number of contributions to be awarded and their level will depend on the availability of funds. At the time of writing of this AO, CSA intends to fund approximately 15 applications. Each application submitted by a PI must be self-contained, cannot depend on instruments being proposed in a separate application, and must plan for the collection and processing of data until the end of the 5-year agreement. Each application will be evaluated seperately on its own merits. Each application must include a 5-year budget to support the proposed operation and be based on an anticipated start date of 1 July 2013. Each application must not exceed $400,000 CAD over five years. Each project will be provided the minimum level of funding required to secure the proposed activity in support of overall program objectives.

A PI may have up to 3 applications funded, in which case a single contribution agreement will be awarded. In the case of multiple applications being funded under a single contribution agreement, a revised budget will be requested from the PI. Due to efficiencies in having more than a single application funded, the maximum funding per contribution agreement will be as follows:

Number of applications funded per PI	**Maximum funding over 5 years**
1	$400,000
2	$730,000
3	$999,999

8.2 Complementary Funding

Complementary funds are funds provided outside of this contribution application that are required for the project to meet its mandate of providing high value data for the duration of the agreement. Recipients are required to identify all sources of funding in their application and to confirm this information in a funding agreement if the proposal is selected for funding. In addition, upon completion of a project, the recipient will be required to disclose all sources of funding.

Each applicant is required to identify in their application, complementary funds from any other sources of funding, either cash or in-kind, other than those from CSA. For projects requiring more than 25% of complementary funds in relation to the total project cost, the CSA must have received from the applicant proof that such funds have been confirmed before the contribution agreement is signed. If confirmation of funding from other sources is not received within three months of the submission deadline, the CSA may disqualify the project.

8.3 Eligible Costs

Eligible costs are direct expenses associated with the delivery of the approved project that are required to achieve the results to which it relates. Costs will include one or a combination of the following categories:

- access fees;
- accommodation and meal allowances;
- acquisition, development and printing of materials;

- acquisition or rental of equipment;
- aircraft and watercraft charter services;
- consultants services;
- cost for carrying out environmental screening and/or impact studies;
- costs related to obtaining security clearance;
- data acquisition;
- data management;
- licenses and permits fees;
- material and supplies including but not limited to
    - Telecommunication fees linked to the measurements
    - Electricity fees linked to the measurements
    - Equipment and spares costs linked to the measurements;
- overhead (administrative) costs (not to exceed 10% of eligible costs);
- participation fees at conferences, committees and events;
- PST, HST and GST net of any rebate to which the recipient is entitled to and the reimbursement of any taxes for goods and services acquired in a foreign country net of any rebate or reimbursement received in the foreign country;
- publication and communication services
- salaries and benefits;
- translation services; and
- travel

The applicant will be paid its authorized travel and living expenses, reasonably and properly incurred in the performance of the Work, at cost, without any allowance for overhead or profit, in accordance with the meal, private vehicle and incidental allowances specified in Appendices B, C and D of the Treasury Board Travel Directive (http://www.tbs-sct.gc.ca/hr-rh/gtla-vgcl/index_e.asp), and with the other provisions of the directive referring to “travellers”, rather than those referring to “employees”.

CSA intends to organize an annual science or programmatic meeting to ensure that the GO Canada observations and data are of the highest possible value. An amount of $4000 per contribution agreement must be budgeted yearly to allow the PI and/or team members to participate in the annual meeting. This amount is mandatory for each contribution agreement and will cover transportation, lodging, boarding and can only be allocated to that function.

A project may consist of several activities to attain its objectives or results. Any logical breakdown or combination of these activities can constitute a funded project. Furthermore, even if the maximum funding for one project is not reached, the completion of a funded activity does not automatically guarantee funding of the remaining activities of the project.

9 PRIVACY NOTICE STATEMENT

The CSA will comply with federal Access to Information Act and Privacy Act vis-à-vis applications received under this Component. By submitting your personal information, you are consenting to its

collection, use and disclosure in accordance with the following Privacy Notice Statement which explains how applicant's information will be managed.

Necessary measures have been taken to protect the confidentiality of the information provided by the applicant. This information is collected under the authority of the CSA Class Grant and Contribution Program to support Research, Awareness and Learning in Space Science and Technology – Research Component, and will be used for the evaluation and selection of proposals, possibly by evaluators outside the country. Personal information (such as contact information, biographical information, etc) included in the rejected proposals will be stored in a Personal Information CSA Bank for 5 years and then destroyed (Personal Information File no. ASC PPU045). Personal information included in the successful proposals will be retained along with the results of their proposals for historical purposes. These data are protected under the Privacy Act. According to the Privacy Act, the data linked to one individual and included in the proposal being evaluated can be accessed by the specific concerned individual who has rights with respect to this information. This individual may, upon request, (1) be given access to his/her data and (2) have incorrect information corrected or have a notation attached.

Applicants should note that for all agreements over $25,000, information related to the funding agreement (amount, grant or contribution, name of the recipient and project location) through this Component and the purpose of the funding will be made available to the public on the CSA website.

If you need additional information on privacy matters before sending your proposal, please contact the person identified in Section 4.

10 FUNDING AGREEMENT

10.1 Payments

The CSA and the successful applicants (hereinafter referred to as the Recipients) will sign a funding agreement. This represents a condition for any payment made by the CSA with respect to the approved project.

Payments for contribution agreements (including advance payments) will be made in accordance with the process and the reporting requirements described in the signed funding agreement. Upon notice of a successful application, the CSA will have no liability until a funding agreement is signed by both parties. Only eligible costs incurred after the funding agreement is signed and indicated in the agreement will be paid and/or reimbursed.

10.2 Performance Measurement

The CSA requires the beneficiary to report on certain elements relative to performance measurement of projects such as the following:

Knowledge

- Knowledge production (including publications)
- Presentations
- Intellectual property (including patents)

Capacity

- Research team (including highly qualified people supported)

Collaboration

- Partner contribution
- Partnership
- Multidisciplinarity

10.3 Conflict of Interest

In the funding agreement, the Recipient will certify that any former public office holder or public servant it employs complies with the provisions of the relevant Conflict of Interest and Post-Employment Code for Former Public Office Holders (http://www.pm.gc.ca/grfx/docs/code_e.pdf) and the Value and Ethics Code for Public Servants (http://www.tbs-sct.gc.ca/pol/doc-eng.aspx?id=25049&section=text) respectively.

10.4 Intellectual Property

All Intellectual Property that arises in the course of the project shall vest in the Recipient.

10.5 Organizations in Quebec

An organization in Quebec whose operations are partially or fully funded by the province of Quebec may be subject to An Act Respecting the Ministère du Conseil exécutif, L.R.Q., chapter M-30.

Under sections 3.11 and 3.12 of An Act respecting the Ministère du Conseil exécutif, L.R.Q., chapter M-30 (hereinafter referred to as Act) certain entities / organizations, as defined in the meaning of the Act, such municipal bodies, school bodies, or public agencies, must obtain an authorization by the Secrétariat aux affaires intergouvernementales canadiennes du Québec (SAIC), as indicated by the Act, before signing any funding agreement with the Government of Canada, its departments or agencies, or a federal public agency.

Consequently, any entity that is subject to the Act is responsible for obtaining such authorization before signing any funding agreement with the Government of Canada.

Applicants from Quebec must submit a signed M-30 Supporting Documentation Form before the contribution agreement can be approved.

11 ENQUIRIES

It is the responsibility of interested parties to obtain clarification of the requirements contained herein, if necessary, before submitting an application. To ensure the integrity of the competitive application process, enquiries and other communications regarding the AO, NOI, or application must be directed only to the contact identified in Section 4. All enquiries must be submitted in writing to the contact no later than seven (7) working days prior to the relevant closing dates given in Sections 5.1 and 6.1. Enquiries received after those dates will not be answered prior to the relevant closing date.

To ensure consistency and quality of information provided to applicants, significant enquiries received and the replies to such enquiries will be provided simultaneously to all applicants via updates to the Frequently Asked Questions section of the AO webpage at the CSA website (http://www.asc-csa.gc.ca/eng/ao/2013-ss-go-data.asp#FAQ).

12 APPENDICES

12.1 Appendix A – Deployment and Operations Plan

Proposals must include a supplementary document of no more than five pages labelled "Deployment and Operations Plan"; this document is not included in the page limit of the proposal. This plan describes the deployment and operation of the science instruments and how they will be managed. The Deployment and Operations Plan shall include the following information:

Technical description

- Description (functional, technical and interface specification) of the instrument, proposed or current.
- Description of the integration, testing, calibration, verification and characterization required of the instruments in preparation for the deployment, or during operation.

Deployment strategy

- Proposed or current location of all the instruments related to the applicant's proposal (please refer to Section 12.4).
- If the proposed or current instrument is not located at a GO core site, provide a description of the infrastructure required or currently in place for all sites related to the applicant's proposal (building, utilities, custodian, communication link, etc).

Risk assessment and mitigation

- Risk assessment (likelihood and impact) for instrument development, where applicable, and associated mitigation plan;
- Risk assessment (likelihood and impact) for instrument operation, and associated mitigation plan;
- Risk assessment (likelihood and impact) for schedule and cost associated with the project.

The Deployment and Operations Plan will be reviewed as an integral part of the proposal.

12.2 Appendix B – Data Management Plan

Proposals must include a supplementary document of no more than five pages labelled "Data Management Plan"; this document is not included in the page limit of the proposal. This document describes how the proposal will conform to the Geospace Observatory data policy (available on the AO webpage), and may include:

1. the types of data, software, and related materials to be produced in the course of the project;
2. the standards to be used for data and metadata format and content (where existing standards are absent or deemed inadequate, this should be documented along with any proposed solutions or remedies);

3. the methods to be used for accessing the data; and
4. plans for preserving data and other research products, and for long-term access to them.

The document must also include the following technical information:

a. the URL that will link to the project's data landing page;
b. the maximum anticipated rate (bytes/day) at which data will be collected or generated (one rate per dataset); and
c. the total amount (bytes) of data that will be collected or generated per year (one amount per dataset).

The Data Management Plan will be reviewed as an integral part of the proposal.

12.3 Appendix C – Evaluation Criteria Scale

Scoring and weights: Each evaluation criterion below will be rated on a letter scale from A to D, with A being the highest score. A numerical weight is associated with each letter as indicated hereafter.

The criteria assume that the proposed instruments will be deployed in isolation from any other instruments proposed in response to this AO. This condition ensures that the possible non-funding of other instruments will not compromise the proposed instrument array.

Criteria	Score	Min
1. Benefits to Canada		

1.1 Advancement of knowledge and technology in the geospace sciences
• Do the instruments proposed to collect the data represent an original contribution and innovation in technology for the geospace sciences?
• Will the data be of value to research aimed at addressing the GO program objectives?
  • To understand how coupling across geospace influences system-level structure and dynamics; and
  • To understand the response of the ionosphere and thermosphere to magnetospheric drivers.		

Poor. The proposed instrument technology lacks clarity and/or is of limited originality and innovation as compared to other instruments of this type deployed in Canada. The data are unlikely to contribute to advancements through research aimed at either of the GO program objectives.	D = 0	--
Average. The proposed instrument technology is presented, and has original and innovative aspects as compared to other instruments of this type deployed in Canada. The data may contribute to advancements through research aimed at addressing one of the GO program objectives.	C = 9	

Good. The proposed instrument technology is clearly presented, and is original and innovative as compared to the best instruments of this type deployed in Canada. The data are likely to contribute to advancements through research aimed at addressing one of the GO program objectives.	B = 14	
Excellent. The proposed instrument technology is clearly presented, and is highly original and innovative as compared to the best instruments of this type deployed worldwide. The data are very likely to contribute to ground-breaking advancements through research aimed at addressing either of the GO program objectives.	A = 20	
1.2 Enhancement of scientific return from Canadian space missions and projects • Will the data enhance the scientific return of Canadian space missions such as CASSIOPE/e-POP or missions with substantial Canadian involvement such as ESA's Swarm by enabling research aimed at addressing the science objectives of these missions?		
Poor. The data are unlikely to enhance the scientific originality and innovation of any space mission or project having substantial Canadian involvement.	D = 0	--
Average. The data are likely to enhance the scientific originality and innovation of at least one space mission or project having substantial Canadian involvement.	C = 4	
Good. The data will enhance the scientific originality and innovation of one space mission or project having substantial Canadian involvement.	B = 7	
Excellent. The data will significantly enhance the scientific originality and innovation of more than one space mission or project having substantial Canadian involvement.	A = 10	
1.3 Enhancement of Canada's world-class expertise/leadership • Will the data enhance Canada's expertise/leadership in the geospace sciences by enabling research aimed at addressing the science objectives of international missions that do not have substantial Canadian involvement such as NASA's Van Allen Probes?		
Poor. The data are unlikely to enhance Canada's expertise/leadership because they are unlikely to enable research aimed at addressing any of the science objectives of an identified international space mission.	D = 0	--
Average. The data have the potential to enhance Canada's expertise/leadership by enabling research aimed at addressing one science objective of an identified international space mission.	C = 4	

Good. The data will enhance Canada's expertise/leadership by enabling research aimed at addressing one science objective of an identified international space mission.	B = 7	
Excellent. The data will significantly enhance Canada's expertise/leadership by enabling research aimed at addressing more than one science objective of an identified international space mission.	A = 10	
Criterion Score	**Max = 40**	**Min = 9**

2. Feasibility		
2.1 Feasibility of the ground-based observation system • Does the proposal demonstrate an understanding of the requirements associated with collecting the data? • Is the proposed work feasible and is the approach capable of collecting the data within the budget requested? • Are the methods proposed for collecting the data of high quality?		
Poor. The Deployment and Operations Plan demonstrates poor understanding of the requirements associated with data collection. Objectives are not clearly described and/or not likely attainable. The budget does not clearly demonstrate how the proposed activities are distinct from and complement those funded by other sources. The methodology is not clearly described and/or appropriate.	D = 0	--
Average. The Deployment and Operations Plan demonstrates fair understanding of the requirements associated with data collection. Long-term and short-term objectives are described. The budget demonstrates how the proposed activities are distinct from and complement those funded by other sources. The methodology is partially described and/or appropriate.	C = 4	
Good. The Deployment and Operations Plan demonstrates good understanding of the requirements associated with data collection. Long-term goals are defined and short-term objectives are planned. The budget demonstrates how the proposed activities are distinct from and complement those funded by other sources. The methodology is clearly described and appropriate.	B = 7	
Excellent. The Deployment and Operations Plan clearly demonstrates complete understanding of the requirements associated with data collection. Long-term goals are clearly defined and short-term objectives are well planned. The budget clearly demonstrates how the proposed activities are distinct from and complement those funded by other sources. The methodology is clearly defined and appropriate.	A = 10	
2.2 Feasibility of the data processing and management system		

• Does the proposal demonstrate an understanding of the requirements associated with processing and managing the data? • Is the proposed work feasible and is the approach capable of processing and managing the data within the budget requested? • Are the methods proposed for processing and managing the data of high quality?		
Poor. The Data Management Plan demonstrates poor understanding of the requirements associated with data processing and management. Objectives are not clearly described and/or not likely attainable. The budget does not clearly demonstrate how the proposed activities are distinct from and complement those funded by other sources. The methodology is not clearly described and/or appropriate.	D = 0	--
Average. The Data Management Plan demonstrates fair understanding of the requirements associated with data processing and management. Long-term and short-term objectives are described. The budget demonstrates how the proposed activities are distinct from and complement those funded by other sources. The methodology is partially described and/or appropriate.	C = 4	
Good. The Data Management Plan demonstrates good understanding of the requirements associated with data processing and management. Long-term goals are defined and short-term objectives are planned. The budget demonstrates how the proposed activities are distinct from and complement those funded by other sources. The methodology is clearly described and appropriate.	B = 7	
Excellent. The Data Management Plan clearly demonstrates complete understanding of the requirements associated with data processing and management. Long-term goals are clearly defined and short-term objectives are well planned. The budget clearly demonstrates how the proposed activities are distinct from and complement those funded by other sources. The methodology is clearly defined and appropriate.	A = 10	
Criterion Score	**Max = 20**	**Min = 8**

3. Resources		
3.1 Quality and experience of the team • Is the mix of knowledge, expertise, and experience of the project team sufficient to attain the scientific and technical objectives? • Are the responsibilities and contributions of each of the team members clearly identified? • How will communication between the team members will be accomplished?		

Poor. The knowledge, expertise and experience of the proposed team is below an acceptable level. The quality and importance of contributions to, and used by, other researchers and end-users is below an acceptable level. The contribution, complementarity of expertise, and synergy of team members is poor. The approach to communication between team members to achieve the proposed objectives is not clearly described.	D = 0	--
Average. The knowledge, expertise, and experience of the proposed team are of reasonable quality, impact and/or importance. The quality and importance of contributions to, and used by, other researchers and end-users is modest. There is some contribution, complementarity of expertise, and synergy of team members. The approach to communication between team members to achieve the proposed objectives is clear.	C = 4	
Good. The knowledge, expertise, and experience of the proposed team are of superior quality, impact, and/or importance. The quality and importance of contributions to, and used by, other researchers and end-users is strong. The team members have demonstrated the ability to manage and complete similar projects. The approach to communication between team members to achieve the proposed objectives is clear and efficient.	B = 7	
Excellent. The knowledge, expertise, and experience of the proposed team are at the highest level of quality, impact, and/or importance to a broad community. The quality and importance of contributions to, and used by, other researchers and end-users is very strong and extensive. The team has demonstrated the required expertise in two or more similar projects. The approach to communication between team members to achieve the proposed objectives is clear, concise, efficient, and effective.	A = 10	
3.2 Access to other funding sources and resources • Are the resources sufficient to attain the scientific and technical objectives within the proposed schedule? • Is the budget appropriate and are the expenses justified? Is there a budget breakdown and does it support the proposed activities? • Are there other sources of funding and does the proposal establish their relationship with the proposed project? • Is there a clear methodology to how the work will be carried out to ensure that the planned activities will be accomplished on time and within the budget requested?		
Poor. The appropriateness and justification for the budget is inadequate. The requested budget does not seem to relate to the proposed methodology and expected results. The proposal does not show how the work can be performed given the funds available. There are no leveraged funds or in-kind contributions from the applicants or other organizations.	D = 0	--

Average. The appropriateness and justification for the budget is adequate but some questions remain. The requested budget relates to the proposed methodology and expected results. The proposal shows a rough breakdown of the expenses, including funds from partners if applicable. Funding from partners is required to deliver high-quality data but is not secured.	C = 4	
Good. The appropriateness and justification for the budget is solid. The requested budget is linked to the proposed methodology and expected results. The proposal shows a clear breakdown of the expenses, including funds from partners if applicable. The proposal does not require partners, or if it does, funding from the partners is promised in the form of support letters.	B = 7	
Excellent. The appropriateness and justification for the budget is very strong. The requested budget and categories are clearly linked to the proposed methodology and expected results. The proposal shows a clear breakdown of the expenses, including funds from partners. Leveraged funds from other organization(s) are significant, funding from the partners is guaranteed, and both are captured through signed agreement letters.	A = 10	
Criterion Score	**Max = 20**	**Min = 8**

4. Results		
4.1 Collection and generation of high-value data • Will the data be of high quality (i.e. high accuracy, high resolution, high cadence)? • Will the data be well-documented (i.e. complete instrument descriptions, full set of complete metadata)? • Will the data be recorded using open formats (i.e. non-proprietary formats such as ASCII, HDF, CDF, FITS)?		
Poor. The quality of the data will be lower than that of data collected or generated by instruments or systems of this type deployed in Canada. There is no indication that descriptions and metadata will be available. Most of the collected data will not be available in open formats.	D = 0	--
Average. The quality of the data will be comparable to that of data collected or generated by instruments or systems of this type deployed in Canada. The descriptions and metadata will contain most of the information necessary for the data to be understood by users. Most of the collected data will be available in open formats.	C = 8	

Good. The quality of the data will be higher than or equal to that of data collected and generated by the best instruments and systems of this type deployed in Canada. The descriptions and metadata will contain the essential information necessary for the data to be independently understood by users. The collected data will be available in well-known open formats.	B = 14	
Excellent. The quality of the data will be higher than or equal to that of data collected and generated by the best instruments and systems of this type deployed worldwide. The descriptions and metadata will contain all the information necessary for the data to be independently understood by users. The data will be available in community-standard open formats.	A = 20	
4.2 Preservation and accessibility of the data • Will the data be openly and rapidly accessible to all users? • Will the data be easy to use (i.e. intuitive repository structure and file names, metadata that provides all the information necessary for the data to be independently understood by users, web-based data landing page)? • Is there a plan for long-term preservation of the data and a stable access location on the internet?		
Poor. All of the data will be accessible to humans via the internet but logins, authentication, or communication with the project team will be required to access the data. Some of the data will not be available until more than three months after collection. The data will not be useable without information beyond what will be available through the data landing page. There is no evidence of planning for long-term preservation of the data.	D = 0	--
Average. All of the data will be accessible to humans via the internet; some of the data will be accessible to automated systems via the internet. No logins, authentication, or communication with the project team will be required to access the data. Little of the data will be available on the shortest feasible timescale. The data will be useable by geospace scientists and space weather forecasters but may require information beyond what will be available through the data landing page. There are plans for long-term preservation of the data.	C = 8	

Good. All of the data will be accessible to humans via the internet; most of the data will be accessible to automated systems via the internet. No logins, authentication, or communication with the project team will be required to access the data. Most of the data will be available on the shortest feasible timescale. The data will be useable by geospace scientists and space weather forecasters without requiring information beyond what will be available through the data landing page. There are plans for long-term preservation of the data and access at a stable location on the internet.	B = 14	
Excellent. All of the data will be accessible via the internet to both humans and automated systems. No logins, authentication, or communication with the project team will be required to access the data. The data will be made available on the shortest feasible timescale. The data will be useable by undergraduate physics students without requiring information beyond what will be available through the data landing page. There are concrete plans for long-term preservation of the data and access at a stable location on the internet.	A = 20	
Criterion Score	**Max = 40**	**Min = 16**

5. Risk and Mitigation		
5.1 Difficulties associated with operating remote observatories • Are the key risks identified along with the associated mitigation strategies (e.g. financial, managerial, and technical)? • Does the perceived risk level indicate the project is likely to complete?		
Poor. The proposal does not identify key any risks nor their mitigation strategies, or some risks are identified but their mitigation strategies are missing.	D = 0	--
Average. Some key risks and/or their mitigation strategies are missing. The risk evaluation occurrence probability is deemed unrealistic or incomplete.	C = 2	
Good. Key financial, managerial, and technical risks and their mitigation strategies are identified but some details are missing. The risk evaluation occurrence probability is deemed realistic but may be missing some details.	B = 3	
Excellent. All financial, managerial, and technical risks are identified and their mitigation strategies are relevant and clearly described. The risk evaluation occurrence probability is deemed realistic.	A = 5	
5.2 Difficulties associated with open access and reliable preservation of data		

• Are the key risks identified along with the associated mitigation strategies (e.g. financial, managerial, and technical)? • Does the perceived risk level indicate the project is likely to complete?		
Poor. The proposal does not identify key any risks nor their mitigation strategies, or some risks are identified but their mitigation strategies are missing.	D = 0	--
Average. Some key risks and/or their mitigation strategies are missing. The risk evaluation occurrence probability is deemed unrealistic or incomplete.	C = 2	
Good. Key financial, managerial, and technical risks and their mitigation strategies are identified but some details are missing. The risk evaluation occurrence probability is deemed realistic but may be missing some details.	B = 3	
Excellent. All financial, managerial, and technical risks are identified and their mitigation strategies are relevant and clearly described. The risk evaluation occurrence probability is deemed realistic.	A = 5	
Criterion Score	**Max = 10**	**Min = 4**

Total Score	**Max = 130**	**Min = 52**

12.4 Appendix D – Background Information

The CSA supports the collection of data on geospace through arrays of ground-based instruments. These observations began with the Canadian Auroral Network for the OPEN Program Unified Study (CANOPUS), continued as the Canadian Geospace Monitoring (CGSM) program (http://www.asc-csa.gc.ca/eng/sciences/cgsm.asp), and, with this AO, begin a new phase as Geospace Observatory (GO) Canada. This appendix provides background information on the program for the period leading up to the current AO.

Between 2008 and the present, the CGSM program was comprised of the following projects that observe geospace:

CANMOS	http://geomag.nrcan.gc.ca (in-kind contribution)
CARISMA	http://www.carisma.ca/
CHAIN	http://chain.physics.unb.ca/
NORSTAR	http://aurora.phys.ucalgary.ca/norstar/
SRMP (F10.7)	http://www.spaceweather.ca/sx-eng.php (in-kind contribution)
SuperDARN	http://ion.usask.ca/info.php

Between 2008 and 2012, the CSA also supported projects that developed numerical and space weather forecast models as part of the CGSM program:

FDAM	http://www.fdam.ca/
SDSW	http://www.math.uwaterloo.ca/groups/SSC/projects/CSA.shtml

SWULF http://www.spaceweatherforecast.ca/

The above list reflects the state of CSA support for geospace observation and modelling as of 2012, is provided for information only, and does not imply these projects will be funded under this AO.

Table 1: Instrument and infrastructure deployments (instrument acronyms are given in Table 2)

Site	Code	Lat (°)	Long (°)	ASI	MSP	FGM	ICM	GISTM	RIO	CADI	Radar	SRFM	ITI
Alert	ALE	82.5	62.3			●			●				
Ann Arbor	ANNA	42.4	-83.9			●							
Arviat*	ESKI	61.1	-94.1				~~○~~‡			~~○~~‡			○†
Athabasca	ATHA	54.7	-113.3	●	●†								
Back	BACK	57.7	-94.2			●							
Baker Lake	BLC	64.3	96.0			●			●				
Brandon	BRD	49.9	99.9			●			●				
Cambridge Bay	CBB	69.1	-105.0			●		●	●	●			
Churchill*	FCHU	58.8	-94.1			●†	●		●†				●†
Clyde River	CLY	70.5	-68.5								●		
Contwoyto Lake*	CONT	65.8	-111.3				~~○~~‡			~~○~~‡			○†
Dawson*	DAWS	64.0	-139.1			●†	●		●†				●†
Eureka	EUA	80.0	-85.9			●		●	●	●			
Fort Chipewyan	FCHP	58.8	-111.1			●							
Fort McMurray*	MCMU	56.7	-111.2			●†			●†				●†
Fort Simpson*	FSIM	61.8	-121.2	●		●			●†				●†
Fort Smith*	FSMI	60.0	-111.9	●	●†	●	●		●†				●†
Gillam*	GILL	56.4	-94.6	●†	●†	●	●		●†				●†
Gull Lake	GULL	50.1	-108.3			●							
Hall Beach		68.8	-81.3					●	●	●			
Inuvik	INUV	68.4	-133.8						●		●		
Iqaluit	IQA	63.7	-68.5			●		●	●	●			
Island Lake*	ISLL	53.9	-94.7			●†	●		●†				●†
Little Grand Rapids	LGRR	52.0	-95.5			●							
Meanook	MEA	54.6	113.3			●			●				
Ministik Lake	MSTK	53.4	-113.0			●	●	●					
Norman Wells	NORM	65.3	-126.7			●							
Osakis	OSAK	45.9	-95.1			●							
Ottawa	OTT	45.4	75.5			●			●				
Oxford House	OXFO	54.9	-95.3			●							
Penticton	PENT	49.3	-119.6						●			●	
Pinawa*	PINA	50.2	-96.0	●	●†	●	●		●†				●†

Site	Code	Lat (°)	Long (°)	ASI	MSP	FGM	ICM	GISTM	RIO	CADI	Radar	SRFM	ITI
Polson	POLS	47.7	-114.2			●							
Pond Inlet		72.7	-78.0					●	●	●			
Prince George	PGR	54.0	-122.6								●		
Qikiqtarjuaq		67.5	-64.0					●	●				
Rabbit Lake*	RABB	58.2	-103.7	●		●†			●†				●†
Rankin Inlet*	RANK	62.8	-92.1	●		●			●†		●		●†
Resolute	RESU	74.8	-95.0	●		●		●	●	●			
Sanikiluaq	SNKQ	56.5	-79.2			●		●	●				
Sachs Harbour*	SACHS	72.0	-125.2		~~○~~†		~~○~~†						○†
Saskatoon	SASK	52.2	-106.9	●					●		●		
St-John's	STJ	47.6	52.7			●			●				
Taloyoak*	TALO	69.5	-93.6	●		●†		●	●†				●†
Thief River Falls	THRF	48.0	-96.4			●	●						
Victoria	VIC	48.5	-123.4			●							
Vulcan	VULC	50.4	-113.0			●							
Well Gray	WGRY	51.9	-120.0			●							
Weyburn	WEYB	49.7	-103.8			●							
Yellowknife	YKN	62.5	114.5	●		●			●				

○ – Proposed
* – GO core site
† – Government Furnished Equipment (GFE)

The CSA has a contract in place to maintain a number of these sites, known as "core sites". Core sites are those sites where an Information Technology Infrastructure (ITI) system is installed; this system may be used free of charge by winning proposals. Also refer to Section 12.5 for a list of the instruments owned by the Government of Canada, as their operation may be included in the responses to this AO by anyone as per Section 8.1.

All data are currently accessible via the internet although the available bandwidth currently prohibits data retrieval in real-time from several of the high-bandwidth instruments. The data products are publicly available at the following locations:

Table 2: Instruments and data access

Instruments	Acronym	Data Access	Principal Investigator
All-Sky Imagers	ASI	http://aurora.phys.ucalgary.ca/data.cgsm-msi/	Eric Donovan University of Calgary
Meridian Scanning Photometers	MSP	ftp://aurora.phys.ucalgary.ca/data/MSP/	Brian Jackel University of Calgary

Instruments	Acronym	Data Access	Principal Investigator
Flux Gate Magnetometers	FGM	http://www.carisma.ca/ and http://cssdp.ca	Ian Mann University of Alberta
		http://geomag.nrcan.gc.ca/data-donnee/sd-eng.php	Benoît St-Louis/Lorne McKee Natural Resources Canada
Induction Coil Magnetometers	ICM	http://www.carisma.ca/ and http://cssdp.ca	Ian Mann University of Alberta
Riometers	RIO	ftp://aurora.phys.ucalgary.ca/data/riometer/	Eric Donovan University of Calgary
		http://www2.nrcan.gc.ca/dpspub/index.cfm?fuseaction=phonedir.empldet&userid=3221	Donald Danskin Natural Resources Canada
GPS Ionospheric Scintillation and Total electron content Monitor	GISTM	http://chain.physics.unb.ca and http://cssdp.ca	P. T. Jayachandran University of New Brunswick
Canadian Advanced Digital Ionosonde	CADI	http://chain.physics.unb.ca and http://cssdp.ca	P. T. Jayachandran University of New Brunswick
Super Dual Auroral Radar Network	Radar	http://cssdp.ca	George Sofko University of Saskatchewan
Solar Radio Flux Monitor (F10.7)	SRFM	http://www.spaceweather.gc.ca/sx-eng.php	Ken Tapping National Research Council

Note that several projects currently use a third-party data management system (http://cssdp.ca) to make their data available. This will also be allowed under the current AO, and may be charged under ”publication and communication services” (see Section 8.3 for details).

12.5 Appendix E – Government Furnished Equipement

Some instruments, communications infrastructure, and shelters owned by the government are available for loan as Government Furnished Equipment (GFE). The available GFE are identified in Table 1 of Section 12.4. This equipment can be included to be operated as part of a proposal by any applicant. Including GFE or not in a project will not confer any advantage for the selection, as the evaluation criteria do not differentiate on the ownership of the instruments.

12.5.1 Instruments

This section describes the instruments owned by the government and available for loan to the successful applicants that require their use for their projects. The applicants choosing to include GFE in their proposals must be prepared to accept the terms of the loan agreement from CSA, whose template is provided with the documents of this AO.

Magnetometers

The existing CANOPUS fluxgate magnetometers are NAROD Geophysics Ltd (Vancouver) model S100 (ring core type) and measure 3 component magnetic fields at 8Hz. These instruments have been operating

in the CANOPUS array since 1989, have an extensive, and proven field history of continuous operation with low noise, low baseline drift, and reliability.

Of the fluxgate magnetometers at the present core sites, the following five **will not be eligible** for operation and maintenance by applicants as their operation is supported by another means:

- Fort Smith;
- Fort Simpson;
- Rankin Inlet;
- Pinawa; and
- Gillam.

However, their data will be made publicly available immediately upon reception.

Specifically, the magnetometers meet the following criteria (or better):

- ± 80,000 nanotesla (nT) dynamic range on all axes
- resolution of 0.025 nT
- temperature coefficient < 0.1 nT/°C
- drift of < 0.01 nT/day
- noise figure of <0.007 nT at 1 Hz.

The data loggers are mainly composed of the following parts:

- IPC Rack-2000B/ACE-832A 2U chassis with AT power supply
- Juki-C3-1GR industrial single board computer (dual LAN, USB, PC/104, DIO)
- IP-P5SD passive backplane
- 512 MB SO-DIMM memory
- 3Ware 8006-2LP, 2-port serial ATA RAID PCI controller
- Dual 120 GB Maxtor SATA hard drives
- RS-232, parallel port and USB connectors and cables

Riometers

Each riometer is a 30 MHz zenith oriented 4-element antenna with a single 150 kHz broadband receiver. Essentially a radio receiver, the instruments at each remote field site record the voltage/power of the 30MHz cosmic background noise. Signal strength is converted non-linearly to voltage (0 to 7.5 V) which is digitized at 60 Hz to 12 bit values spanning a -10 to 10 V range. These are read by the ITI over an RS-232 serial interface and time stamped using the site GPS unit as a primary NTP reference.

For more information of the instrument, see the La Jolla Sciences website (http://www.lajollasciences.com/).

Meridian Scanning Photometers (MSPs)

The MSPs are composed of a meridian scanning eight-channel filter wheel photometer. Five of the eight channels measure auroral emissions (4709 Å, two at 4861 Å, 5577 Å, and 6300 Å). The three remaining

channels measure background intensities (4800, 4935 and 6250 Å) to correct for contamination caused by blended auroral emissions, and scattered light of solar and/or lunar origin.

The instruments operate during the period when the solar zenith angle is greater than 96 degrees. Operation is fully automatic, using a built-in solar ephemeris routine and a two-level dawn-dusk sensor for controlling the operating periods. The interference filters and the photomultiplier are temperature controlled. Backup heaters are provided to protect the interference filters in case of prolonged power outages. Every two minutes, each instrument transmits two scans in the four auroral emissions and two background channels and the housekeeping data. The housekeeping data include the instrument dark count, the auto-calibration data and other instrument status information, such as temperatures and voltages.

A separate campaign port (RS-232, 4800 baud) provides readout of all 510 samples for each channel as well as the housekeeping data.

Three of the MSPs are at GO core sites, as described at the beginning of this appendix, and the fourth is housed at Athabasca but can be moved as required by the successful applicant.

All Sky Imager (ASI)

The original requirements for the CANOPUS ASI imager were in part as follows:

- Resolution: 20×20 km at 110 km in zenith
- Dynamic range: 200 R to 300 kR in a 5-second exposure
- Monochromatic filters: 4 (557.7, 391.4, 427.8, and 630.0 nm)
- Imaging rate: 4 filter/sky ”maps” per minute

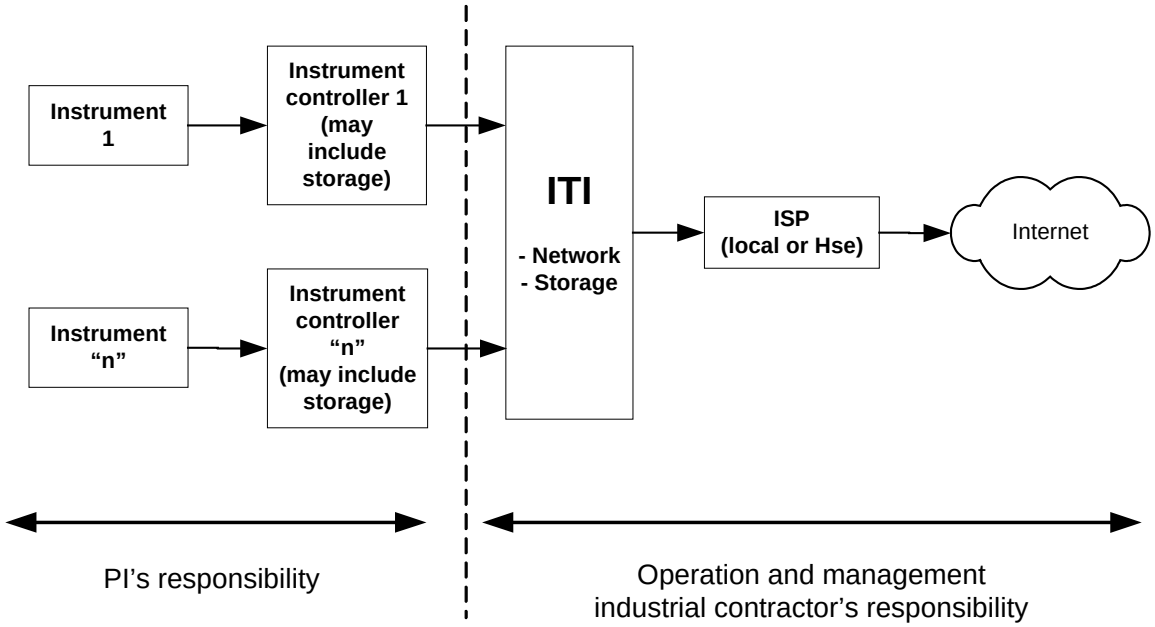
Through successive modifications, the imager currently takes images of the sky at the full 256×256 resolution, and then cropped radially, compressed, and transmitted data is collected at auroral wavelengths (471, 558, 630, and 486 nm). Background and star frames provide supporting information. Frame rates of at least 0.1 Hz are possible, though the typical cadence is 20-30 seconds/image for each filter.

12.5.2 Communication infrastructure

This section describes the communications infrastructure provided at the core sites, free of charge to all applicants.

At each core site, the PIs are responsible for the instruments (operation and maintenance), up to the point where each instrument connects to the Information Technology Infrastructure (ITI). The ITI and the internet connection are the responsibility of a distinct contract and furnished by the government.

New proposed instruments located at core sites should be compatible with the ITI to make efficient use of resources. A shelter is also provided to host the electronics and is described in Section 12.5.3.



The IT infrastructure provides basic network services, shared storage, and serial data acquisition capabilities at each GO core site. It is capable of autonomous operation under non-ideal conditions such as dusty environments, poor power quality, and potentially extreme temperatures.

The primary design goal for the ITI is to simplify the requirements for operating scientific instruments at remote field sites. This is done by providing a basic set of required services coordinated over standard internet connections. While the ITI is currently implemented by a particular hardware configuration, clients should only be concerned with the interface specifications.

Internal Network

Communication at each field site is via standard internet protocols (e.g. TCP/IP). The primary "bus" is a 24- port 10/100 Mbps Ethernet switch with an additional bank of surge protection modules. All connectors are standard RJ-45; all cables are Cat5. All networked devices can communicate with each other directly through the switch without any intervention by the ITI computer.

The main internal network is configured to allow up to 249 devices in addition to the ITI computer and four power related elements (see below). Several network addresses have been set aside for automatic (DHCP) allocation to temporary (e.g. short-term campaign) clients. Addition of each new permanent network devices requires some minor configuration file changes.

Internal Services

The ITI computer provides several services to clients on the internal network.

- DHCP – dynamic host configuration protocol;
- DNS – domain name services;
- NTP – a network time protocol reference is available to all internal clients. The primary standard is provided by a GPS (Trimble Accutime 2000), which should be accurate to less than 1 millisecond. Additional time sources can be obtained over the internet, but satellite travel time delays introduce significant and variable inaccuracies (e.g. 0.1 to 1 seconds).

Internet Connection

Each GO core site has a single connection to the internet provided by a satellite link (where no local ISP is available). Peak instantaneous uplink rates are approximately 100 kbps, but the average sustainable bandwidth is closer to 5 kbps. Note that the specific value for the new satellite link system is not precisely known, and may be significantly higher (e.g. 10 kbps). Current utilization for most sites (except those with all-sky imagers and scanning photometers) is typically 2.2 kbps.

External Services

The ITI computer acts as the primary gateway for the internal network. It provides multiplexing capabilities so that multiple internal clients can share a single external IP-address.

- SNAT – source network address translation allows internal clients to initiate network connections with external systems. This is accomplished automatically for all internal clients.
- DNAT – destination network address translation allows external devices to initiate network connections with internal clients. This requires minor configuration file changes for each additional client.

Power Management

Two devices are provided for clients. Both of these are network-enabled, allowing for remote monitoring and control. All plugs and outlets are standard NEMA 5-15.

- UPS – uninterruptible power supply filters line power and provides short duration (<30 minutes) battery backup.
- PDU – power distribution unit has 8 individually switchable outlets and a total current monitor.

Other

- Temperature sensors for monitoring.
- KVM – an 8-port keyboard/video/mouse switch allows clients to share the site LCD display and keyboard/mouse input devices.
- Rack – some legacy components (DCP, old GPS) have been removed from all sites and disposed of. This provides additional space for new client devices with a rackmount form factor.
- RS232 – as legacy serial devices are decommissioned, more ports will become available
- Storage – roughly 50 GB of disk space are available for client data. No interface is currently configured for this purpose, but it would be easy to provide multiple access methods (e.g. NFS, SMB, RSync, HTTP)

12.5.3 Shelter and site maintenance

The infrastructure for each core site (operation and maintenance of shelter, utilities, custodian, etc) is provided through a separate industrial contract at no cost to the observational elements of GO. A legacy temperature control system of heaters and ventilation should automatically maintain the building temperature within the 10-30 °C range. The shelter is approximately 8 feet long by 12 feet wide, and 8 feet in height.