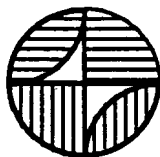


**ASSOCIATION INTERNATIONALE DE GEODESIE
UNION GEODESIQUE ET GEOPHYSIQUE INTERNATIONALE**



**INTERNATIONAL ASSOCIATION OF GEODESY
INTERNATIONAL UNION OF GEODESY AND GEOPHYSICS**

CALL FOR PARTICIPATION

International Global Positioning System Geodynamics Service (IGS)

Letter of Intent Due	March 29, 1991
Proposal Due	May 31, 1991

**PRECISION GPS PRODUCTS IN SUPPORT OF THE
INTERNATIONAL EARTH SCIENCE COMMUNITY**

February 1, 1991

INTERNATIONAL GPS GEODYNAMICS SERVICE

INTERNATIONAL ASSOCIATION OF GEODESY
INTERNATIONAL UNION OF GEODESY AND GEOPHYSICS

CALL FOR PARTICIPATION

Soliciting proposals in support of the establishment of an international service for the determination of precision GPS satellite ephemerides, terrestrial reference frame, earth rotation parameters, global and regional crustal motion, and associated products

PARTICIPATION IS REQUESTED IN THE FOLLOWING CATEGORIES

• Observatories	Core stations for continuous tracking Fiducial stations for intermittent tracking
• Data Centers	
• Analysis Centers	Coordinator Processing centers Evaluation center
• Central Bureau	

February 1, 1991

Dear Colleague:

This IAG Call for Participation solicits support in the establishment of a permanent international service under IAG auspices for the purpose of providing precision ephemerides and associated products derived from observations of the Global Positioning System (GPS). These products are considered fundamental for the proper use of GPS in global and regional geodesy and in geodynamics during the next decade and may contribute to other areas of geophysical research.

Participation in this International GPS Geodynamics Service—IGS—is open to government agencies, educational institutions and other organizations whose financial resources allow a firm commitment to be made in support of the service. Proposals may be submitted at any time during the period ending May 31, 1991.

Based on the proposals received, a plan will be submitted to the IUGG General Assembly in Vienna in August, 1991, for endorsement and approval. This plan will be for a test campaign to be conducted during the International Space Year in 1992, followed by the establishment of the Service in 1993, provided all goes well.

The enclosed document provides program information on the IGS, outlining its roles, responsibilities, and functional areas for which proposals are sought. Proposals may address any aspect of IGS activity for which the proposing organization has the capability and capacity to support.

Those organizations interested in participating in the IGS should submit a letter of intent by March 29, 1991, expressing their interest in the Service. Those organizations which respond will receive a second document providing additional details on the Service such as the standards to be followed and proposal submission information. For this reason an early letter of intent may be advisable.

The IAG is aware of already existing successful global international GPS scientific efforts such as CIGNET for orbit determination or GIG '91 for Earth rotation monitoring. IGS will offer full cooperation to these groups and thus enhance their effectiveness. For this reason, participants in these current activities are strongly encouraged to respond to this solicitation.

Your interest and cooperation in participating in this international effort are welcomed and appreciated. Please feel free to contact any member of the Steering Committee with questions or comments regarding the IGS.

Sincerely yours,



Ivan I. Mueller, President
International Association of Geodesy

INTERNATIONAL GPS GEODYNAMICS SERVICE

Introduction

The International GPS Geodynamics Service (IGS) represents a permanent international service to be established under the auspices of the International Association of Geodesy (IAG) whose purpose is to provide earth science related products using the satellites of the Global Positioning System (GPS) as well as highly accurate ephemerides. In the future these products are considered fundamental for the proper use of GPS in global and regional geodesy and in geodynamics and will significantly contribute to other areas of geophysical research. The IGS represents an international support activity which services the needs of the scientific community and other users involved in research and operational endeavors which will require the highest levels of GPS accuracy. The products of the IGS would greatly facilitate the planning, execution and completion of experiments which depend on GPS for their success.

Background

It is natural for space geodesy to adopt a global perspective. This holds for many existing or planned techniques and networks, e.g., SLR, VLBI and QUASAT, DORIS, PRARE, CIGNET and DSN. Global GPS campaigns have also been conducted successfully (e.g., GOTEX, IERS). Although the IAG's focus is on geodesy, other disciplines dealing with solid earth science are actively deploying global networks of their own, including seismic networks (e.g., GEOSCOPE, IRIS/GSN, GSE) and magnetic observatories (INTERMAGNET). Partly in recognition of this situation, the concept of Fiducial Laboratories for an International Natural science Network—FLINN, a set of globally distributed sites with a multidisciplinary vocation was proposed at the NASA 1989 Coolfont workshop. To support the establishment of such a network is one of the major goals of IGS.

The GPS is becoming, and promises to remain for some time, one of the most important and readily accessible geodetic measurement systems. The recent contributions of GPS to geodesy and geophysics are truly revolutionary, encompassing such applications as measurement of crustal movements, precise positioning of remote sensing platforms, monitoring ionospheric conditions, and supporting precise undersea positioning to name a few. What began as an improved satellite navigation system in the early 1970's has become one of the most important systems supporting geodetic and geophysical operations and research. Given this demonstrated capability of GPS, its economic advantages and accessibility, it is certain that GPS will continue to proliferate as the dominant positioning technology throughout the world. Consequently a permanent, reliable source of accurate GPS data products developed under strict standards is of high importance to the international scientific community.

1.2 Goals and Objectives

The primary objective of the IGS is to provide a GPS service which would support through its products geodetic and geophysical research activities. The service would provide IGS users information and data products developed at its analysis centers. The goal would be to provide these products to sufficient accuracy and detail so that the objectives of a wide range of experimentation depending on GPS would be satisfied. The service would therefore develop necessary standards and encourage international adherence to its conventions. The goal for ephemeris accuracy is a few parts in 10^9 with timely development and distribution of associated data products. These products such as earth rotation parameters, baseline length variations, etc., will have comparable accuracies. For these products the Service will depend on a global network of GPS tracking stations.

Geodetic objectives to be achieved by the global network include the following:

- Realization of a precise Global Terrestrial Reference Frame
- Precise determination of Earth rotation parameters
- Support of local and regional geodynamic studies
- Support of scientific orbital missions
- Determination of precise GPS orbits

Some of these objectives pertain to *providers* of IGS data products; others to *users* of the IGS. Since there exists a large community of potential users of IGS products (primarily ephemerides), the concept of a *Service* is important, and impacts critical issues of data processing, management and distribution.

Separate objectives may be listed for other *users*, namely the IGS scientific customers; geological and geophysical objectives take primarily the form of applications of the global network and include

- Global sea-level change
- Post-glacial rebound
- Tectonic motions and deformation

These applications may require densification of the network in order to achieve the spatial and temporal resolutions needed to make substantial contributions.

1.3 Scope of Activity

The sections of this document which follow present the functional areas of activity within the IGS, the data products which would be available from the Service, and its currently envisioned organizational structure. The evolution of the IGS will commence with the selection of the core organizations whose data acquisition and analysis will be the basis for the Service. During 1991 a campaign to test the feasibility of the service will be planned and presented at the IUGG General Assembly in Vienna. The campaign will be performed in 1992 in conjunction with the International Space Year. Based on the results of this campaign a recommendation will be made to the IAG for the inception of an operational service in 1993.

1.4 IGS Structure

The functional elements of the IGS are illustrated in Figure 1. The Governing Board has oversight responsibility for the Service. Its membership is drawn from each of the key IGS organizational components and from the IAG, other IUGG associations, and FAGS. The role of each element and its functional responsibilities are defined below. Organizations responding to this Call for Participation are encouraged to address their capability to support functional responsibilities across the IGS organization and not necessarily limit their response to any specific element provided in the figure. For instance, it is anticipated that a data center as illustrated in Figure 1 might be physically located within an observatory or an organization acting as an analysis center. Similarly the evaluation function shown here as a Central Bureau responsibility may be handled by an analysis center.

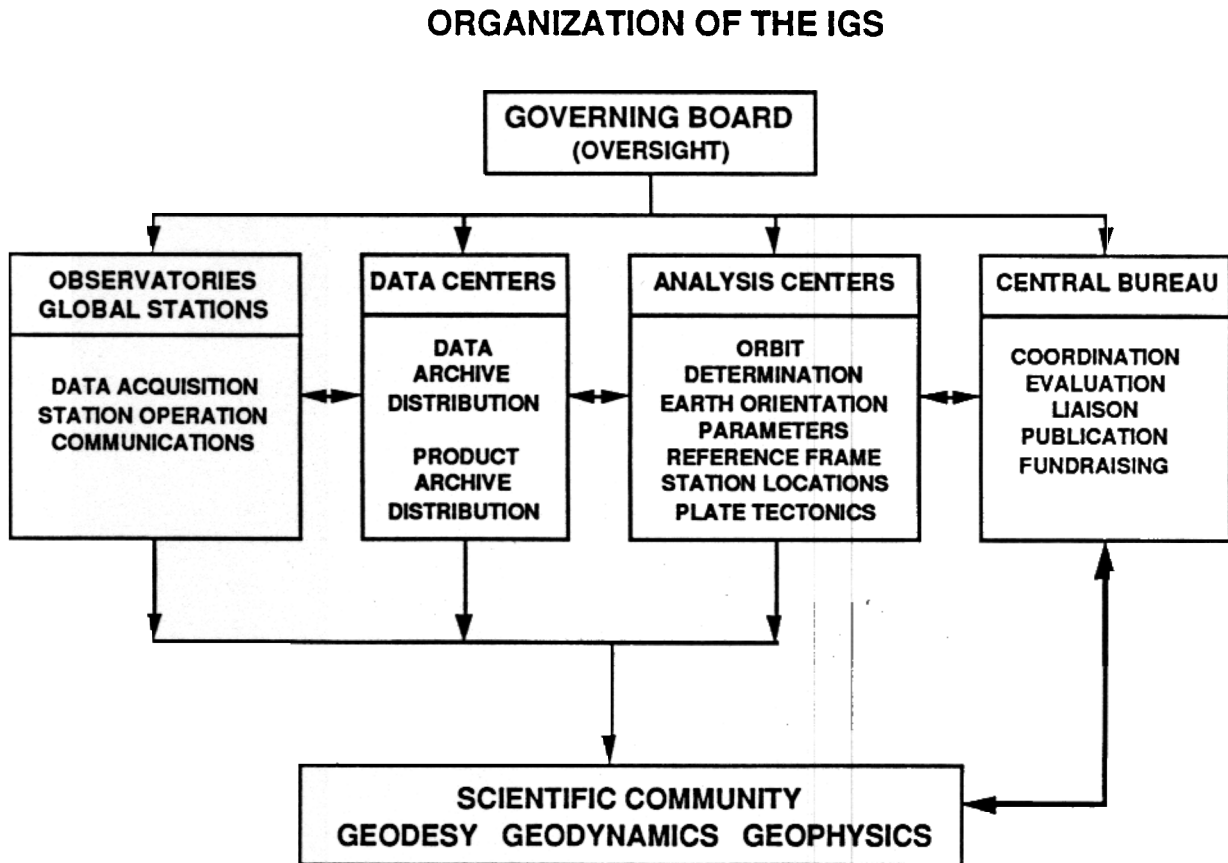


Figure 1

2.0 Call For Participation

The International Association of Geodesy through this Call for Participation solicits support for the establishment of a permanent service which will support the international scientific community where GPS data and products are required. Participation in the Service is open to a broad range of organizations. It is expected that certain organizations, such as CIGNET, IERS, with purposes and goals common with some of those of the IGS will be interested in participating in this Service. The scope of a proposal to participate in the IGS may reflect almost any degree of support consistent with your organization's capabilities and interests. The areas for which support is solicited follow.

2.1 Data Acquisition Network (Observatories)

Proposals are sought for participation in the IGS data acquisition network of tracking stations whose observations are utilized by the analysis centers to develop the products of the IGS. A global network of contributing stations will be required to meet the needs of the scientific community. This network of stations must provide sufficient coverage with inter-site spacing and locations which will optimize its practical use in supporting scientific goals. The network should be eventually integrated into the VLBI/SLR network for the realization of a common frame of reference. It will become the fundamental network for the Service to which densification would be linked. The responsibility of organizations participating in the network will be the acquisition of data and its communication to data/processing centers consistent with specifications and standards promulgated by the IGS.

Based on the objectives in Section 1.2, a global network comprising two main categories of sites is envisaged:

1. A *core* network, comprising 20 to 30 globally distributed, very high quality sites, with continuous, reliable operation, near-real-time data acquisition and transmission to data/processing centers. This network would contribute the data from which key products would be derived such as
 - precise orbits, including force model parameters
 - GPS clock estimates
 - earth orientation information
 - ties to the terrestrial reference frame through co-location with other techniques
2. A much larger set of *fiducial* stations, numbering between 100 and 200, providing denser coverage of tectonic deformation zones, regions of post-glacial rebound, and coastal areas near tide gauge networks. Such sites might be occupied at regular intervals (in particular during global campaigns) to determine secular geodetic signals, but many would be upgraded to continuous operation over time, thereby contributing data similar to those derived from the *core* network. These stations would contribute to the solution of global geological and geophysical problems, as stated above.

Existing permanent global GPS stations, primarily from the CIGNET and IERS (GIG '91) networks, can be taken as a major step toward the *core* network, with which the major data flow issues can already be examined. Continued growth should take advantage

of advances in receiver technology, as well as data collection, processing, and distribution techniques. Deployment of the more numerous FLINN-type stations requires a broadly based international participation and will proceed at different rates in different regions, depending on local logistical conditions, and on the availability of reconnaissance surveys.

Given that data flow and the logistics of network operation will necessarily be critical considerations in the actual deployment, use of existing facilities, and co-location with existing or planned geodetic and geophysical installations will be important, particularly in instances where data transmission is thereby facilitated.

A sample network is shown in Figure 2.

2.2 Data Centers

Proposals are sought for participation as a designated data center. The data centers will most likely be in direct contact with the tracking sites. This will require detailed local knowledge of the receiver types to be encountered and the possible data transmission options. In some cases, tracking receivers will be deployed by an organization that restricts direct access by others to those receivers. The data centers will then need to work through these agencies to obtain access to that data.

The data centers must perform certain tasks that are common to all the GPS data. These include:

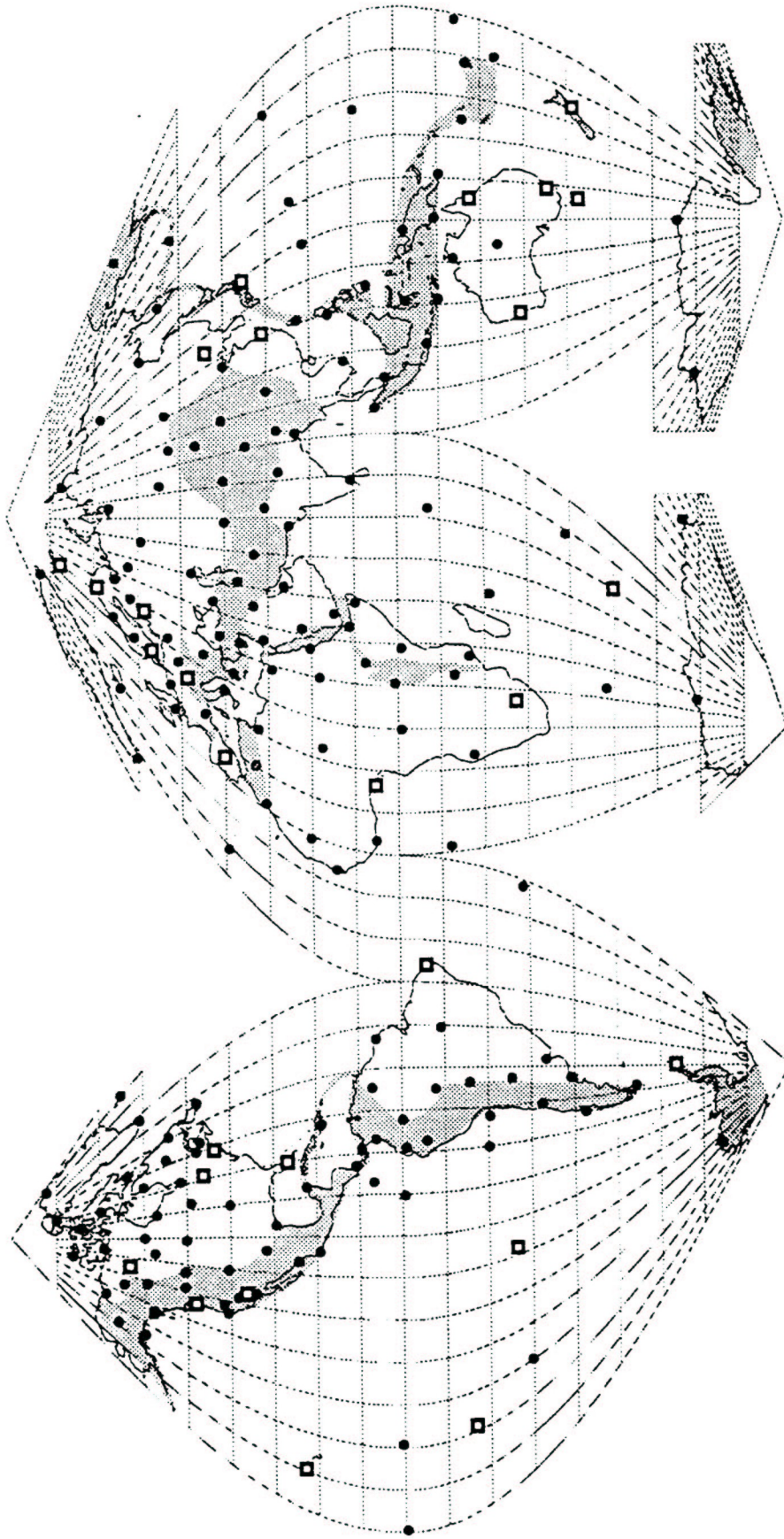
- Reformat all the data to RINEX
- Maintain an archive of the data in its original receiver format and in RINEX format
- Provide timely electronic access to the data by all potential users

The centers which manage data from the core observatories must download that data every 24 hours so that it is available to all users on a daily basis. Although the quality of this data will be monitored at the tracking stations, since it is of such critical importance, additional independent quality checking at the data centers will be valuable. Data centers collecting data from the fiducial sites that are occupied intermittently may not be able to obtain immediate electronic access to the tracking data due to the remote location or poor communications links available. In these cases alternate methods must be found to transfer the data as quickly as possible to the data center for quality checking and archival.

The data from all the core stations form a single suite of global data. The entire suite must be available to any users. If a data center collects core tracking data from a portion of these receivers, it must contribute its data to another data center distributing the complete set of global core data. Alternatively, any of the data centers collecting core data may exchange this data so that the complete set is available at more than one location. Data centers collecting data from only a particular region are not responsible for data collected from other regions. They need only follow the guidelines given above. However, they should be aware that a central data center may query them regularly should a single repository for all the data eventually be deemed desirable.

Data centers may be located at and be part of certain core observatories.

- Tracking "core" network (28 sites)
- Global Fiducial Sites (about 150 sites)



Example of Possible Global Network

2.3 Analysis Centers

Proposals are sought for participation in the service as a designated analysis center. The expected products of the IGS analysis centers would include some or all of the following:

- GPS ephemerides determined with both regional and global networks
- GPS clock information for both satellites and selected ground stations
- Atmospheric and ancillary data
- Satellite and station status
- Assessment reports on data and product quality
- Edited tracking data
- Earth orientation and reference frame information
- Point positions and baseline lengths
- GPS modeling standards

This Call for Participation includes the following analysis center categories:

Coordinator. The responsibility of the coordinator is to organize the analysis centers' activities to ensure that the IGS objectives are carried out. Specific expectations include the development of appropriate standards, quality control and interaction with other IGS coordinators. The coordinator's institution is expected to provide the coordinator with the appropriate infrastructure to carry out the responsibilities of the IGS.

Processing Centers. The responsibility of these centers is to receive and process tracking data from the data centers (or from cooperating IGS sites) for the purpose of producing high accuracy GPS ephemerides and other products listed above. Providing information regarding data quality and interaction with the tracking network to assure high quality data are part of the center's responsibilities. It is not expected that each processing center will provide all possible products, i.e., a center may focus on particular objectives of the IGS.

Evaluation Centers. The responsibilities of these centers will be to gauge the timeliness, accuracy, and usefulness of the products from the processing centers and to work with them to assure generation of the highest quality products. It is expected that one of the primary means of evaluating the ephemerides of the Service will be through studies of baseline repeatability and comparison with baselines determined by other techniques. The activities of an evaluation center may be included as part of a processing center or as part of the Central Bureau.

2.4 Central Bureau

Proposals are sought for participation as a Central Bureau responsible for the general management of the service and providing internal coordination of IGS activities across a number of supporting organizations responsible for data acquisition and management, and product development and distribution.

The Central Bureau staff is envisioned to consist of the Director in charge of office operations and several other persons to meet organizational requirements. The Director will

be a member of the Governing Board and will be the principal IGS interface with the IAG, government agencies, and other affiliated organizations.

The Central Bureau will be responsible for several major functions which are critical to the overall successful operation of the service. These responsibilities are the following:

Coordination of IGS Activities. As noted above the Governing Board of the IGS provides oversight of the Service and thus establishes general policy and direction. The Central Bureau is then responsible for providing general management of the Service consistent with that policy and direction. Since the IGS is based on support provided by a body of organizations each having unique capabilities and functions, overall coordination of the activity is essential to the successful operation of the Service.

Evaluation of IGS Products. As mentioned in Section 2.3, the Central Bureau may also serve as an evaluation center.

Liaison. The Central Bureau will be responsible for interfacing with organizations external to the IGS in order to promote informational exchange necessary to ensure a proper focus for the Service and to ensure that critical information on planned GPS activity, policy and system status are properly understood and factored into IGS operations as necessary.

Liaison with the United States Government agencies associated with GPS policy formulation or information exchange is required by the IGS in order to effectively operate the Service, maximize resource utilization and keep the IGS user community properly informed on issues, policy and events impacting their activities.

Publication, Product Distribution and Information Dissemination. The Central Bureau will have the responsibility to publish and distribute a series of reports which summarize the results of its activity, disseminate information on the operational status of GPS and the service, interface with the user community and provide for product distribution.

Information on GPS program activities, policy, and status as well as specific IGS program information could be provided to the user community through an electronic bulletin board service, similar to several already in place to support GPS navigation users.

Finally, the Central Bureau may need to implement the means to partially or fully fund its operation. The nature of this funding could be in the form of nominal user fees for the service, grants, contributions, etc. The requirement for funds may depend on the type of organization selected as the Central Bureau from the submitted proposals.

Administrative Details

Letter of Intent

Those organizations interested in submitting a proposal in response to this Call for Participation should send a one-page Letter of Intent to:

Ivan I. Mueller
President, International Association of Geodesy
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The Ohio State University
Columbus, Ohio 43210-1247 USA
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Internet MUELLER@MPS.OHIO-STATE.EDU

This letter should include the following information:

- Organization name and address
- Name, address, and telephone and fax numbers of the principal point of contact
- Specific areas of support which will be addressed in the proposal.

Letters of intent must be received on or before March 29, 1991. Material in these letters is for information purposes only and is not binding on the signatories. Those organizations responding will receive additional documentation on the IGS, such as standards to be followed, details on data management, data analysis, site selection criteria, etc.

General Proposal Information

Proposals submitted in response to the Call for Participation must include specific details on the technical support which will be offered by the organization and a management plan. These two main proposal sections will be used for proposal evaluation and to facilitate comparative analysis. Proposal must be signed by an official authorized to certify institutional support, sponsorship, and management of the proposed activities. Further details will be mailed to organizations providing a letter of intent.

Proposals are due on or before May 31, 1991, at the address provided above. The IGS Steering Committee reserves the right to consider proposals received after this deadline if such action is judged to be in the interest of the IGS; however, there is no guarantee that such late proposals can be considered.

Proposal Evaluation, Selection, and Implementation

The principal elements considered in evaluating any proposal are its relevance to the IGS objectives, intrinsic merit, and its overall contribution to the service when considered against potential contributions available through other proposals. In addition to these criteria management factors will be considered separately in the selection.

If the IGS Steering Committee decides to accept only a portion of the proposal, the submitting organization will be given the opportunity to accept or decline such partial acceptance.

Accepted proposals and the results and recommendations of the reviews will form the basis for planning the Campaign Proposal which will be presented to the XX General Assembly of the IUGG in Vienna, Austria, during 11-24 August 1991.

Organizations responding to this announcement will be notified by the IGS Steering Committee of the outcome of the proposal selection process by June 28, 1991. Selected organizations will be subsequently contacted to participate in finalizing the Campaign Proposal for presentation to the General Assembly.

3.4 Schedule of IGS Activity

March 29,1991	Letters of intent due
May 31,1991	Proposals due
June 28,1991	Selection notification
July 26,1991	Campaign planning completion
August 11-24,1991	Campaign proposal at IAG/IUGG General Assembly
__?__,1992	Campaign period
__?__,1992	Presentation of IGS proposal based on campaign results to IAG Executive Committee
.?__,1993	Initiation of IGS

Acknowledgment. The IAG is grateful for the wide distribution of this document by the following organizations: DGFI—German Geodetic Research Institute, Institut Géographique National France, Jet Propulsion Laboratory, NASA Goddard Space Flight Center, National Oceanic and Atmospheric Administration, U.S. Naval Observatory.

Planning Committee for the IAG International GPS Geodynamics Service

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Number following name refers to group designation.