

THE COMMITTEE ON EARTH OBSERVATION SATELLITES AND ITS WORKING GROUP ON INFORMATION SYSTEMS AND SERVICES

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Commission II, WG II/3

KEY WORDS: CEOS, WGISS, Earth Observation, Information Systems

ABSTRACT:

The Committee on Earth Observation Satellites (CEOS) was established in 1984, in response to a recommendation from a panel of experts on remote sensing from space, under the auspices of the Economic Summit of the Industrialised Nations Working Group on Growth, Technology, and Employment. CEOS was created with three main objectives:

- To maximise satellite Earth observation (EO) benefits through mission planning and through the development and use of compatible and standardised data products, formats, services, applications, and policies.
- To serve as the primary forum for international cooperation and coordination for satellite Earth observation.
- To use that forum to exchange technical knowledge and policy as a means to promote compatible satellite Earth observations systems.

CEOS operates on three main levels:

- (i) CEOS Plenary provides overall direction and reviews progress undertaken by all CEOS elements.
- (ii) Working Groups, of which there are currently four, manage the technical activities and report to Plenary. These are:
 - The Working Group on Calibration and Validation (WGCV).
 - The Working Group on Information Systems and Services (WGISS).
 - The ad-hoc Working Group on Disaster Management Support (DMSG).
 - The ad-hoc Working Group on Education and Training (WG-Edu).
- (iii) Subgroups, reporting to their respective Working Group, carry out most of the detailed technical work, making use of specific Task Teams as required.

This paper concentrates on describing the activities of WGISS and its Subgroups. The overall objective of WGISS is to facilitate the implementation of information systems and services by its members and other data providers and users of EO data. Its scope covers the capture, archiving, description, discovery, access, processing and exchange of EO data and supporting ancillary and auxiliary data and information, with the aim of improving efficiency and enabling improved interoperability and interconnectivity of information systems and services.

1. BACKGROUND

The Committee on Earth Observation Satellites (CEOS) is an international organisation charged with co-ordinating international civil space-borne missions designed to observe and study planet Earth. Comprising 41 space agencies and other national and international organisations, CEOS is recognised as the major international forum for the co-ordination of Earth observation satellite programs and for interaction of these programs with users of satellite data worldwide.

CEOS was created as a result of recommendations from a panel of experts on remote sensing from space, which was sponsored by the 1984 Economic Summit of Industrialised Nations (G7) Working Group on Growth, Technology and Employment.

The main goal of CEOS is to ensure that critical scientific issues relating to Earth observation and global change are covered and that satellite missions do not unnecessarily overlap each other. Dozens of EO missions have been launched since the establishment of CEOS and many more are planned for launch within the next five to ten years. Co-ordination in planning and policy for these missions is undertaken at the highest level within CEOS by the Plenary.

CEOS, as an organisation, does not have its own budget. The participating agencies support the activities, as they see fit, on an individual basis. Participating agencies make their best efforts to implement CEOS recommendations.

2. STRUCTURE

CEOS has three primary levels.

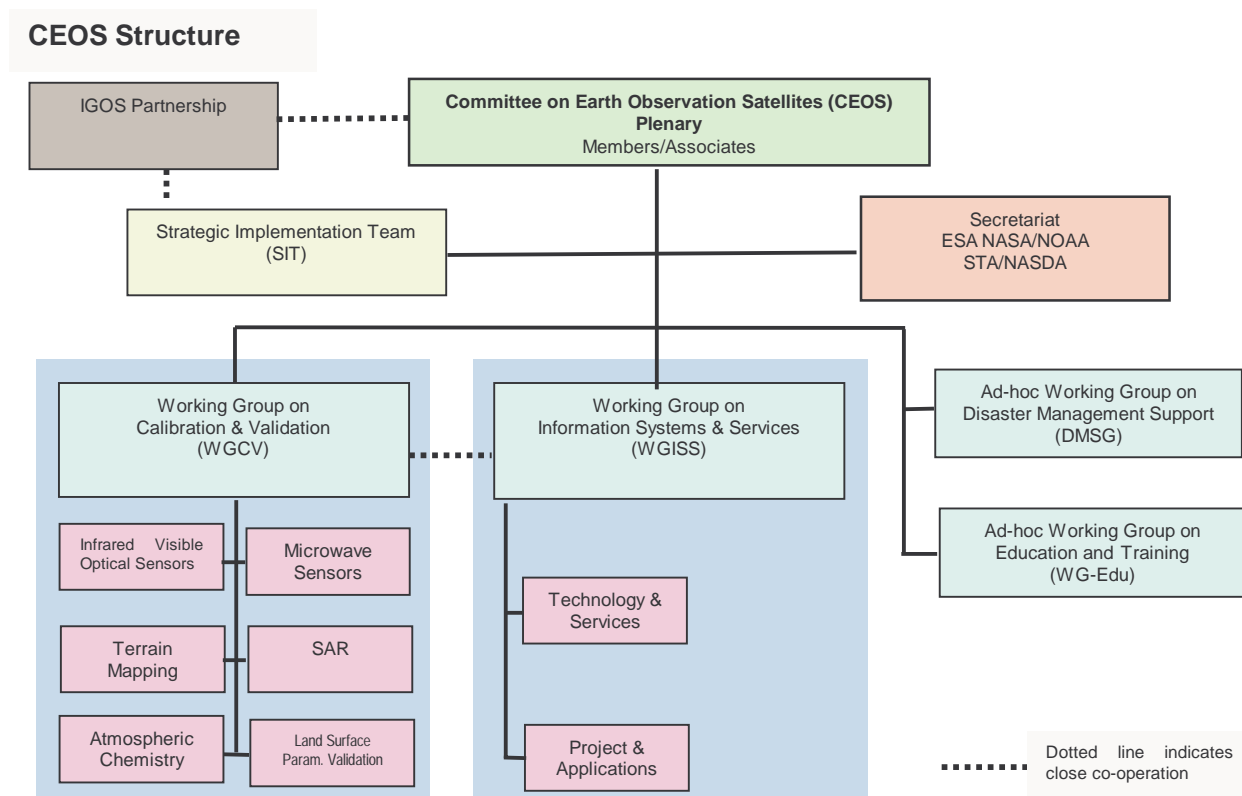


Figure 1. Current CEOS Structure

2.1 CEOS Plenary

At the top level is CEOS Plenary, which provides overall direction and reviews project and activity progress undertaken by all CEOS elements.

The Plenary Chair rotates annually and is supported by a permanent Secretariat provided by Europe (through the European Space Agency), the United States (through the National Aeronautics and Space Administration and the National Oceanic and Atmospheric Administration), or Japan (through the Science and Technology Agency and the National Space Development Agency of Japan).

The Plenary established a Strategic Implementation Team (SIT) in 1996 to address the function and role of the space component of the Integrated Global Observing Strategy (IGOS). The IGOS objective is to develop a comprehensive strategy to enhance levels of scientific, operational, and research community support. The development and implementation of the Integrated Global Observing Strategy is supported by a partnership among space agencies grouped in CEOS, the sponsors of the Global Observing Systems, the programme offices of the Global Observing Systems, major national funding agencies grouped in IGFA, and two major international research programmes, IGBP and WCRP (see IGOS Partnership website for more details).

In practical terms, IGOS Partnership plans to bring together the satellite and ground-based systems for global environmental monitoring of the Earth's atmosphere, land, oceans, and life

forms. IGOS strives to link research, long-term monitoring, and operational programs in a structure that identifies information gaps and attempts to fill those observation needs.

2.2 CEOS Working Groups

The second primary level of organisation within CEOS consists of two permanent groups and, currently, two ad-hoc working groups. The first of the permanent groups is the Working Group on Calibration and Validation (WGCV), which seeks to enhance co-ordination, to promote international co-operation, and to focus upon the calibration and validation of Earth observations benefiting both CEOS agencies and the larger international science community. Sensor-specific calibration, validation, and geophysical parameter validation are the main areas addressed by this group.

The other permanent group is the Working Group on Information Systems and Services (WGISS), which facilitates information and data management for users who interact with Earth-observation resources related to global, regional, and local issues. The overall objective of WGISS is to facilitate the implementation of information systems and services by its members and other data providers and users of EO data. Its scope covers the capture, archiving, description, discovery, access, processing and exchange of EO data and supporting ancillary and auxiliary data and information, with the aim of improving efficiency and enabling improved interoperability and interconnectivity of information systems and services.

Ad-hoc groups are created as required to focus on specific areas of interest. Currently, the first is the Ad-Hoc Working Group on Disaster Management Support (DMSWG), which supports natural and technological disaster management by analysing requirements and providing recommendations for the better use of Earth-observation satellite data. Recommendations for applications of satellite data are grouped according to the particular hazard themes covering drought, earthquake, fire, flood, ice, landslide, oil spill and volcanic hazards.

The second ad-hoc group is the Ad-Hoc Working Group on Earth Observation Education and Training (WG-Edu). This group strives to accomplish the following objectives:

- Assess the Earth-observation educational requirements of developing countries.
- Assess Earth-observation technology trends and relay that information through training programs.
- Recommend a plan of action for CEOS to follow in Earth-observation education areas.
- Focus CEOS agencies on capacity-building activities that contribute to Earth-observation education activities.

2.3 CEOS Subgroups

The third primary level within CEOS consists of subgroups that support the two permanent working groups. The subgroups are chartered by the working groups to address specific areas of interest.

The following subgroups report to the WGCV:

- Infrared/visible optical sensors
- Microwave sensors
- Synthetic aperture radar
- Terrain mapping
- Land surface parameter validation
- Atmospheric chemistry

The WGISS subgroups have recently been reorganised and, following formal WGISS approval in September 2002, are expected to be:

- Technology and Services Subgroup
- Project and Applications Subgroup

2.4 Participants

The agencies and organizations that compose CEOS are made up of members and associates. Members are governmental organizations that are national or international in scope and are involved in civil space-borne Earth observation programs. Associates are governmental organizations or other satellite coordination, scientific, or governmental bodies that are national or international in scope and have significant programmatic involvement that supports CEOS objectives. The current list of CEOS members and associates is given in the appendix.

3. WGISS

3.1 WGISS Overview

Based on the aims, rationale and scope for WGISS, the following five main themes provide a framework for the activities.

3.1.1 Agency Consultation and Strategy

A major role for WGISS is the definition of a long-term strategy for the development of EO service provision and the co-ordination of the work of its members in accord with this strategy. WGISS also has to address the "high-level" requirements coming from CEOS Plenary and reconcile these with the "low-level" requirements emerging from its Subgroups and Task Teams. WGISS monitors the work and outputs of its Subgroups and Task Teams, evaluating the extent to which they meet CEOS and Agency requirements.

WGISS obtains feedback on its endeavours from CEOS Plenary, and through consultation with the individual CEOS Agencies and the other organisations it works with. It uses the information obtained to develop the WGISS strategy.

3.1.2 Data and Information Management

WGISS provides guidelines containing procedures and standards to be followed in the management of data to establish and maintain its quality, availability, accessibility and reliability.

3.1.3 User Services

The CEOS agencies and associates provide a range of services to their users. WGISS aims to co-ordinate the provision of these services in order to ensure interconnectivity and interoperability of these services. More specifically, WGISS aims to encourage the wider utilisation of EO data through:

- wider and easier access for users - as enabled by networks (assisting users to locate and utilise data and to collaborate with other users);
- co-ordination in the provision of distributed capabilities to users (e.g. for computing, data search, algorithm development, data caching and temporary storage, and co-operative tools);
- interoperability of user services such as guide, directory, catalogue/inventory, order, browse;
- supporting as appropriate IGOS prototype demonstration projects and other science projects through the WGISS Test Facility approach (see below).

To assist with locating the services offered by the CEOS Agencies, WGISS has created the WGISS Menu portal website. This portal has two parts. Part 1 contains links to the particular Services offered by the CEOS Agencies (e.g. data catalogues, order and delivery services). This is likely to be of benefit to value-adders or end-users who make use of the Agency products and services in their projects. Part 2 contains links to the more specific tools and support services offered by WGISS and its members (e.g., guideline documents, lessons learnt from Test Facility Projects etc.). This is likely to be of benefit to data providers or value adders who wish to create their own information systems.

3.1.4 CEOS Information Services

WGISS has established a CEOS Information Service activity to support the work of WGISS members and to aid communication of information about CEOS to external organisations, users and potential users. The focus of the activity is the set of information websites headed by: <http://www.ceos.org/>.

Since 1996, WGISS has also produced CD-ROMs containing useful reference material concerning the exploitation of Earth Observation data. The CDs are updated and re-issued, typically, every two years or so. More information is available at <http://ceos.cnes.fr/>.

3.1.5 Promotion

WGISS works to promote its activities to a wide audience through:

- 1) the production and distribution of publicity material, (e.g. a WGISS brochure, which can be viewed and ordered through the WGISS website (wgiss.ceos.org).
- 2) production and presentation of papers at conferences, seminars and workshops,
- 3) the creation of highly visible demonstrations projects in support of, for example, WGISS Test Facility Projects and presentations to CEOS Plenary.

WGISS also places emphasis on promoting the output of its work to its own member Agencies in order to demonstrate the benefits of WGISS activities and to ensure the adoption of results and recommendations within Agency developments of information systems and services.

3.2 WGISS Subgroups

WGISS works towards achieving its technical objectives through a broad range of activities organised under two Subgroups.

3.2.1 Technology and Services Subgroup

The emphasis here is on internal management of data, the creation of information systems and the delivery of interoperable services. The interests of the Subgroup span the full range of the information processing chain from the initial ingestion of satellite data into archives through to the incorporation of derived information into end-user applications. The creation and standardisation of metadata to support the discovery of and access to data is an important aspect to this work. The co-ordination of member Agency computer networks, making use of the Internet where appropriate, is also a major feature of the activities.

The main issues being addressed are:

Data Management. This covers issues relating to the management of archives, data formats, auxiliary data requirements, data product standards and data packaging. The CEOS Superstructure Format was an early attempt to standardise the format of EO Data Products. The more recent emphasis is towards exploiting the Internet related developments in markup languages (such as XML) to describe data in a machine-readable way, rather than attempt to squeeze data into a pre-defined format. Defining the semantic content of data products is also a focus of consideration.

Close contact is maintained with the activities of the Consultative Committee on Space Data Systems (CCSDS) Panel 2 (concerned with information interchange over space and time). CCSDS Panel 2 is a part of the International Standards Organisation (ISO) and WGISS is able to both influence their recommendations and exploit the resulting international standards.

Interoperable Information Services. This aspect of WGISS activity is becoming increasingly World Wide Web related. Specific issues include data discovery, inventory search, data retrieval, processing and visualisation. The scope includes information exchange protocols and metadata standards and formatting.

Close contact is maintained with ISO TC211 (Geographic Information) and the Open GIS Consortium (OGC) who work on the test-bed prototype activities to help formulate the requirements for standards. Again WGISS is able to participate in the prototyping activities and influence the standards making process.

Networks. Work in this area uses a projects-oriented approach to help agencies coordinate the provision of networking resources and services in support of CEOS prototyping, pilot, and ongoing project activities. This work area provides WGISS with the necessary understanding of ongoing developments in the global network infrastructure and its capabilities, to ensure networking issues are taken into account in the planning of on-line services. It also keeps WGISS up to date with the networking tools which might be used by data providers and data users to exploit the network infrastructure for the management and supply of EO data or services.

The technical work is carried out by a number of Task Teams that are created and disbanded as required.

3.2.2 Projects and Applications Subgroup

The emphasis here is on the development of specific projects and applications, working with outside organisations to understand their requirements and help them exploit the tools and services available through WGISS and its member Agencies. To this end, WGISS has developed the concept of the WGISS Test Environment.

The Test Environment offers a framework under which WGISS will work in partnership with selected international science and EO projects to test and develop information systems and services to meet their requirements (Figure 2). Specific Test Facilities can be set up to address the needs of individual projects. By making available Test Facilities for this purpose, WGISS information systems, services and products can be demonstrated and improved to take account of user requirements. Such demonstrations and prototyping activities advertise WGISS's technical capability, lead to an improved take-up of its products and facilitate improved co-ordination of information systems and services across the spectrum of EO space operations.

The WGISS Test Environment encompass the agglomeration of WGISS tools and services held and operated by CEOS WGISS members and associates. These are made available via the on-line WGISS Menu mentioned previously.

The various Test Facilities created under the WGISS Test Environment report to and are monitored under the Projects and Applications Subgroup. Other Projects with a strong external interaction are also included in this Subgroup. The scope of the activities includes convening workshops, authoring books and developing global dataset products. External organisations with specific overlapping interests include the International Society for Photogrammetry and Remote Sensing (ISPRS) and the Global Map project.

3.3 WGISS Achievements

The following illustrates some of the achievements of WGISS:

Resource discovery and access

- Archive - e.g. Purge alert in place; archive interchange format developed;
- Catalogue - e.g. Developed Catalogue Interoperability Protocol (CIP). Over 1200 catalogues linked to Interoperable Catalogue System (ICS).

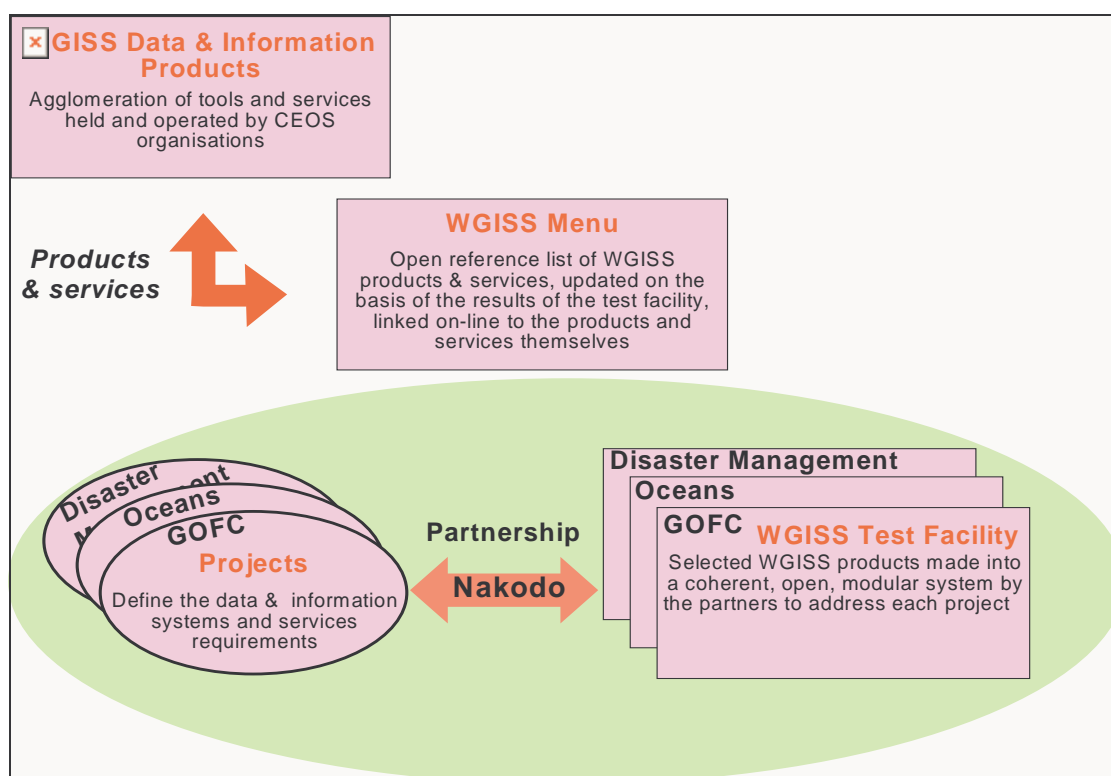


Figure 2. The Components of the WGISS Test Environment

- Search - e.g. One-stop-shop directory search in place (over 9200 datasets described in International Directory Network).
- Browse - e.g. Browse guidelines available.
- Order - e.g. Data order integrated into CIP.
- Access - e.g. Established virtual CEOS Net to optimise CEOS Agency use of Internet networks.

Data generation, evaluation and utilisation

- Data sets - e.g. AVHRR 1km and digital elevation model 1km (GLOBE) global datasets supported.
- Data formats - e.g. Data Format Guidelines issued.
- Data rescue - e.g. African data sets rescued at WGISS instigation.

Outreach

- Workshops - e.g. Sixth annual EO-GEO workshop held at JRC in May 2002.
- Promotional material - e.g. 2000 copies of WGISS brochure distributed; 40,000 copies of the WGISS Resources in Earth Observation CD-ROM distributed.

- **Test Facilities**

- WGISS Global Observation of Forest Cover (GOFC) Test Facility instigated; activity includes a demonstration of the use of EO for the monitoring of forest fires in Thailand.
- Additional Test Facilities under consideration, covering Oceans (providing seamless access to satellite, in-situ and model data), the Water Cycle (CEOP) (combined data access for designated sites) and Calibration and Validation (comprehensive data for test sites).

4. CONCLUSION

CEOS fills a critical role in fostering co-operation and co-ordination for civil-agency Earth-observation missions. This role benefits the agencies involved and environmental researchers worldwide by co-ordinating planning, reducing over-lapping activities, increasing efficiency and improving ease of use of EO data. As well as working towards improved co-ordination between its members, WGISS has created the

concept of "Test Facilities" to improve working with outside organisations. As the number of EO satellites continues to grow, CEOS is poised to play an even bigger role in the greatly expanding Earth-observation component of understanding the planet.

WGISS website: <http://wgiss.ceos.org/> (accessed 30/5/02).

CEOS website: <http://www.ceos.org/> (accessed 30/5/02).

IGOS Partnership website:
<http://www.igospartners.org/> (accessed 30/5/02).

REFERENCES

WGISS Five Year Plan V6.0. (2002), WGISS website.

APPENDIX A: CEOS AGENCIES

The following lists the CEOS Members and Associates participating in CEOS activities:

A.1 CEOS MEMBERS

| | |
|---|-----------|
| Agenzia Spaziale Italiano (ASI) | Italy |
| British National Space Centre (BNSC) | U.K. |
| Chinese Academy of Space Technology (CAST) | China |
| Centre National d'Etudes Spatiales (CNES) | France |
| Comision Nacional de Actividades Espaciales (CONAE) | Argentina |
| Canadian Space Agency (CSA) | Canada |
| Commonwealth Scientific and Industrial Research Organization (CSIRO) | Australia |
| Deutsche Zentrum für Luft-und Raumfahrt (DLR) | Germany |
| European Commission (EC) | Europe |
| European Space Agency (ESA) | France |
| European Organization for the Exploitation of Meteorological Satellites (EUMETSAT) | Germany |
| Instituto Nacional de Pesquisas Espaciais (INPE) | Brazil |
| Indian Space Research Organization (ISRO) | India |
| Ministry of Education, Culture, Sports, Science and Technology Agency (STA) | |
| /National Space Development Agency of Japan (NASDA) | Japan |
| National Aeronautics and Space Administration (NASA) | U.S. |
| National Oceanic and Atmospheric Administration (NOAA) | U.S. |
| National Remote Sensing Center of China (NRSCC) | China |
| National Space Agency of Ukraine (NSAU) | Ukraine |
| Russian Federal Service for Hydrometeorology and Environmental Monitoring (ROSHYDROMET) | Russia |
| Russian Aviation and Space Agency (RSA) | Russia |
| Swedish National Space Board (SNSB) | Sweden |
| United States Geological Survey (USGS) | U.S. |

A.2 CEOS ASSOCIATES

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|--|-------------|
| Canada Centre for Remote Sensing (CCRS) | Canada |
| Crown Research Institute (CRI) | New Zealand |
| Federal Office for Scientific, Technical and Cultural Affairs (OSTC) | Belgium |
| Global Climate Observing System (GCOS) | Switzerland |
| Global Ocean Observing System (GOOS) | France |
| Global Terrestrial Observing System (GTOS) | Italy |
| International Council for Science (ICSU) | France |
| International Geosphere-Biosphere Programme (IGBP) | Sweden |