



CONTENTS

- REPORT ON THE 11TH CEOS PLENARY 1 10
- News From the Working Group on Information Systems and Services 2 2
- The way ahead for WGISS 2 2
- CEOS Working Group on Calibration and Validation 3 3
- IGOS Strategic Implementation Team - Progress Report 4 5
- The Global Ocean Data Assimilation Experiment 5 5
- The Upper Air Measurements 6 6
- Long-Term Continuity of Ozone Measurements 7 7
- Ocean Biology 8 8
- Global Observation of Forest Cover 9 9
- Disaster Management Support 10 10
- The Global Terrestrial Observing System 11 11
- ISRO takes over CEOS Chair for 1998 12 12

REPORT ON THE 11TH CEOS PLENARY

Jean-Louis Fellous
CNES

In conclusion of its year of activity as CEOS Chair, CNES, the French Space Agency, hosted the 11th CEOS Plenary in Toulouse on 19 to 21 November 1997. 85 delegates were in attendance, representing 34 CEOS participating agencies, coming from 15 countries, and 15 International Programs or Organizations.



Participants of the 1997 CEOS Plenary in Toulouse

The WMO Secretary General, Dr. G.O.P. OBASI, accepted CEOS' invitation to participate in the 11th Plenary opening ceremony, together with Pr A. BENSOUSSAN and Gerard BRACHET, respectively President and Director General of CNES. At this occasion he delivered a very constructive speech supporting the IGOS initiative and confirming WMO involvement in its development.

During this fruitful meeting the Plenary adopted 9 resolutions and identified 18 action items for the forthcoming year.

11th Plenary Main Issues

Beyond its internal regular business the Plenary had to tackle some particularly important issues related to furthering the development of the IGOS initiative. The 10th Plenary had established two IGOS focused ad hoc groups, namely the Strategic Implementation Team (SIT) and the Analysis Group (AG), and the delegates had to consider the results achieved in the implementation of the six prototype projects identified to demonstrate the IGOS concept (see article p. 4).

The Chairman of the Analysis Group, Mr. Yukio HARUYAMA from NASDA reported to the Plenary on the results of his group and concluded that the AG had accomplished its mandate. The Plenary endorsed this recommendation to disband the AG and decided to maintain the SIT. A mandate was given to its Chairman, M. Brian EMBLETON from CSIRO, to reshape the Team and update its Terms of Reference in order to better respond to the development of the initiative.

The future of IGOS was the subject of a large and constructive debate involving many CEOS partners. Dr. Patermann recalled that IGFA is an informal international group of funding agencies interested in improving coordination in the allocation of resources identified for global change research. The IGFA Plenary extensively discussed the IGOS perspective and expressed its strong support for an IGOS, confirmed that IGFA will pursue strategic partnership with CEOS and other organizations in that field and will follow the development of the prototype projects.

The need to strengthen and widen the cooperation with other partners like the G3OS Sponsors group was also confirmed. Dr DAHL of UNEP, the current Chair of the G3OS Sponsors Group, noted that the CEOS initiative for an IGOS meets with UN consideration for providing integrated long-term, globally comprehensive data sets, both space-based and in-situ, suitable for the needs of broad user communities, including developing countries. Dr. DAHL reported that the Sponsors Group is working with CEOS to establish means of cooperation at technical and policy-making levels and informed that CEOS has been invited to participate on a regular basis in the Sponsors group meeting, continuing with the next meeting planned in June 1998 in Paris. Dr. STUYCK-TAILLANDIER commented that ICSU as the incoming Sponsors Group Chair will enforce the convergence arising on the political and scientific perspectives towards an IGOS. Dr. GRASSL of WCRP noted that ongoing projects like ISCCP, GPCP, GVAP, ISLCSP and GEWEX, met the IGOS prototype projects criteria and could be considered as the first generation of projects demonstrating the initiative.

The Plenary noted that interactions with the G3OS Sponsors Group will be crucial to CEOS efforts to conceptualize an IGOS and articulate a strategy for the space component of an IGOS.

Delegates had to consider various CEOS partnership issues at several occasions throughout the agenda. The

(to be continued on Page 10)



The opening ceremony

News From the Working Group on Information Systems and Services

Helen M. Wood, NOAA/NESDIS

Jean Schiro-Zavela, NOAA/NESDIS

The CEOS Working Group on Information Systems and Services (WGISS) held its fifth meeting in October 21-23, 1997 in Bangalore, hosted by the Indian Space Research Organization. It was preceded by the second meeting of the WGISS Strategy Task Team on October 20.

Dr. Kasturirangan, Chairman of ISRO and the 1998 CEOS Chair, welcomed the participants and presented an overview of India's current and planned Earth observation satellites. He noted several aspects of data and information that WGISS should work on, including guidelines for data archive management, compatibility of data formats, network improvements, use of high resolution data, and improving data availability and use in developing countries across a range of technological levels.

WGISS members reaffirmed their interest in the six Integrated Global Observing Strategy projects, and proposed a more active liaison between WGISS and the projects. Because of similarities between the goals of the WGISS Ocean Color and WGISS Hazards and Emergency Response Task Teams and their counterpart IGOS projects, these two Task Teams will be discontinued and WGISS will instead concentrate on supporting the IGOS Disaster Management Support and Long-Term Ocean Biology Measurements projects.

WGISS endorsed the Strategy Task Team's recommendations for outreach to users. These included user involvement in WGISS efforts, emphasis on demonstration projects involving users, preparation of a product portfolio identifying WGISS data products and tools suitable for distribution to (and adoption by) users, and an outreach campaign aimed at meetings of key external groups.

WGISS updated and approved the WGISS Five Year Plan, Version 2, for submission to the 1997 CEOS Plenary. WGISS also recommended to the Plenary that CEOS agencies extend the Global Land One Kilometer AVHRR Project to allow overlap with future sensors, provide data

for the High Resolution Satellite Data Project, support the Developing Countries CD-ROM as an annual project, and participate actively in WGISS. (These recommendations were all subsequently endorsed by the Plenary.)

The Access Subgroup reported on its activities, including the third EO/GEO World Wide Web workshop to be held February 17-19 in Salzburg. The operational version of the Catalog Interoperability Protocol will be available by April 1998. The efforts of the Yellow Pages, InfoSys, and InfoNext Tasks will be folded into a new CEOS Information Infrastructure Task, which will work to develop a new home page and links among key information systems and resources.

The Data Subgroup is working on a wide range of activities, including the upcoming planned release of version 1 of the Format Guidelines document, following its approval by WGISS. The Archive Management Task Team has decided to focus on defining archive maintenance recommendations, formulating CEOS guidelines for archiving baseline data, defining an interchange format for baseline data, and identifying and recommending metadata required for archive. In early 1998, the Global Land One-kilometer Base Elevation data set will be released via CD-ROM and FTP server.

The Network Subgroup has been active in improving network connectivity and performance. The virtual CEOSnet has added a recent link to UNEP and plans a future link to ISRO. Network performance between NASA and NASDA was improved by prioritizing the data traffic across the link. WGISS endorsed the CEOSnet Acceptable Use and Security Policies.

WGISS' new Chair, as of the end of the CEOS Plenary in November 1997, is Takashi Moriyama of NASDA. He will chair the next meeting of WGISS, to be held the week of May 11, hosted by ESA in Frascati.

The way ahead for WGISS

Takashi Moriyama, WGISS Chairman, NASDA

Since its establishment 2 years ago, the CEOS Working Group on Information Systems and Services (WGISS) has achieved a lot of practical progress - including the way in which activities are managed and monitored. We now have clearer visibility of everything which is ongoing under the WGISS umbrella and up-to-date knowledge of the schedule and status of each activity

A number of key activities have been completed and exciting new ones initiated under Ms. Helen Wood's capable leadership in those 2 years. As the next WGISS Chair, I should like to follow and build upon this excellent foundation and to continue to drive the efficiency and effectiveness of the WG activities within CEOS. In particular I will seek to emphasise the topics of 'user outreach, involvement, and

adoption' which have been discussed in the WGISS Strategy Task Team.

My objectives for WGISS for the next 2 years can be summarised as follows:

- 1 To enable the output of WGISS efforts to be more clearly identified, and the wider context of those results to be more clearly understood (eg. in relation to commercial efforts or relevant standards)
- 2 To achieve greater awareness of WGISS results, within member agencies, affiliates and observers and with external bodies, including more frequent and direct liaison with user, industry, and standards groups and most importantly..
- 3 To improve success in adoption of WGISS products and recommendations (by members as well as others groups), overcoming the

CEOS Working Group on Calibration and Validation

Alan Belward
WGCV Chair, EC
Mary James
WGCV Technical Secretary

Highlights of the 13th WGCV Meeting
The 13th meeting of the CEOS Working Group on Calibration and Validation (WGCV), hosted by Shanghai Institute of Technical Physics, was held 3-5 September in Shanghai, China. In addition to routine working group business, key activities included reports from the subgroups, discussions of the Integrated Global Observing Strategy (IGOS), progress reports on the WGCV three-year action plan, reports on accuracy and traceability from national standards laboratories and a special session on remote sensing activities in China. Complete minutes of the meeting are available on-line from the WGCV www site (<http://www.eos.co.uk/ceos-wgcv>).

Calibration and Validation in IGOS

Participants in WGCV13 spent considerable time discussing issues related to the need for calibration and validation in the IGOS pilot projects, and the response of WGCV to that need. It was noted that there is a need for calibration and/or validation within each of the IGOS projects, though this need varies considerably, depending on the maturity of the project. There exists within some of the projects calibration/validation expertise, however WGCV are able to act as a focal point for co-ordination and to provide technical support to pilot projects to help Identify cal/val needs. The WGCV has also offered to provide experts for technical review of requirements as identified by the IGOS Analysis Group (AG).

Following WGCV13, plans were formalised for an ad hoc meeting to specifically address cal/val issues associated with the IGOS Pilot Projects. This meeting will be hosted by the EC at JRC Ispra on March 23rd -24th . The meeting objective is to help identify and clarify IGOS Pilot Projects' detailed cal/val requirements, and identify the implications these have for organisations participating in an IGOS. Further information is available from the

WGCV Chairman, Dr Alan Belward (mail alan.belward@jrc.it, fax +39 332 789536).

Action Plan and Subgroup Activities
The work of the WGCV is carried out through the activities of the members and subgroups. Significant progress was reported on all key points of the WGCV three-year work plan including co-ordination and communication activities, education and outreach, and pilot projects. Highlights of recent work by the subgroups, as reported at WGCV13, can be summarised as follows.

Infrared Visible and Optical Subgroup (IVOS): Running two pilot projects: Radiance intercomparison focusing on the North African Desert site; SST validation and intercomparison focusing on Townsville.

Microwave Sensors Subgroup (MSSG): Continue drafting essential features in microwave radiometer calibration/characterisation identifying the fundamental elements of microwave radiometer calibration and details of the potential accuracy, permissible biases.

SAR Subgroup (SARSG): Organised several workshops addressing SAR calibration and validation issues; Meeting 4-6 Feb '97 in St Hubert, Canada, Wind and Wave Validation workshop, 3-5 June '97, ESTEC, SAR Workshop 3 to 6 February 1998, ESTEC.

Terrain Mapping Subgroup (TM): Executing tests of ERS Tandem data and IRS 1C data, continue to develop and test methods for DEM generation from all sources, consider special requirements of high resolution data, and proposing a central data base of reference data to be set up with on line access.

WGCV 14 will be hosted by NASDA in Japan July 21st-23rd 1998.

major barriers identified of 'synchronisation' and 'not invented here' issues within member agency programmes.

These objectives will be pursued within a *Strategy for User Involvement, Outreach and Adoption* which was developed at the last WGISS meeting in Bangalore in October 1997, and which includes: -a redefined outreach role for the WGISS Vice Chair for User Interests and not implementing the WGISS User Panel WGISS Vice-Chair for Users

-re-emphasising the key role of demonstration projects involving users as the 'building blocks' of WGISS activity, including new projects which promote adoption of key WGISS results - including links to the IGOS activity where practical;

-production and dissemination of a rationalised portfolio of WGISS 'products' as the basis for communicating our outputs to other groups and to decision-makers in our own agencies' programmes.

-a programme of focused and direct outreach activities to external

groups, including user groups, standards bodies, and relevant industry organisations involved in similar work.

-development of a new CEOS Information Infrastructure - linking various existing resources such as the Infosys, Database, IDN, WG/SG home pages etc.

WGISS work will emphasise support to the IGOS activity wherever possible. We are already developing plans for an Ocean Colour CIP demonstrator system as a pilot service to provide single search access of global ocean colour dataset holdings across CEOS agencies. Other projects are also at the definition stage. I believe that such practical IGOS services and datasets' based on CEOS developments can be realised by WGISS in the short and medium term

Practical action and realising benefits of our effort are the key themes for my Chairmanship of WGISS and I look forward to actively serving the interests of CEOS agencies over the coming 2 years.

IGOS Strategic Implementation Team - Progress Report

Brian J J Embleton

Chair, Strategic Implementation Team

As foreshadowed in CEOS Newsletter number 9, the British National Space Centre hosted the second meeting of the Strategic Implementation Team (SIT) at New College, Oxford, September 29-30, 1997.

The meeting: reviewed the work of the CEOS Analysis Group (AG);
 reviewed the status of, and assessed CEOS agency support for, the six IGOS prototypical projects;
 addressed issues common to the projects;
 considered an IGOS in the context of international conventions;
 discussed the way forward on an IGOS partnership approach with other entities;
 discussed CEOS' role in an IGOS.

The meeting proved exceptionally popular and attracted a broader representation, from the CEOS family of agencies, than was originally anticipated within the SIT framework.

CEOS Analysis Group Chair, Yukio Haruyama, NASDA, and Affiliate Focal Point, John Morgan, presented the AG Report which addressed cross-cutting issues such as the CEOS database on mission characteristics, integrated data products and in-situ sources of observations. The AG considered its initial task as having been achieved and recommended its own dissolution, with project-related activities to take place within the framework of the SIT. Plenary subsequently agreed to form a support group based on the SIT Organising Committee but expanded to include nominated scientists, project managers and technical experts.

Discussion of IGOS Projects

A status report and specific recommendations for SIT consideration were presented on each of the six projects. Meeting participants were invited to react with comments, recommendations for direction, and indications of support.

Philippe Courtier, CNES, addressed the status and recommendations of the Global Ocean Data Assimilation Experiment (GODAE), a project of the GCOS-GOOS-WCRP Ocean Observations Panel for Climate. GODAE was considered to be an excellent example of potential IGOS integration of satellite and in-situ measurements.

Paul Menzel, NOAA, addressed the Upper Air Measurements for Numerical Weather Prediction (NWP) Project, outlining initial findings that provision of satellite sounding and wind data over land could mitigate against the impending loss of radiosonde observations that will negatively impact global NWP forecasts. SIT participants noted that this project responded to an identified gap and is consistent with meeting an IGOS objective.

Chris Readings, ESA, noted the importance of cross calibration of space and in-situ data was highlighted in respect

of the Long-Term Continuity of Ozone Measurements Project.

Trevor Platt, Bedford Institute of Oceanography, noted that the Ocean Biology Project, which is now being pursued under the auspices of the International Ocean-Colour Coordination Group. The project presents an opportunity to address potential redundancies in the provision of observing systems for ocean colour, consistent with the pursuit of IGOS criteria.

Frank Ahern, CCRS, briefed participants on the Global Observations of Forest Cover Project, defining a suite of potential products that will be needed and identifying data access policies and costs as potential challenges. A number of agencies expressed strong interest in the project and a willingness to provide experts and other in-kind contributions.

Helen Wood, NOAA, outlined the Disaster Management Support Project which was recognised at the outset as different from the other projects in that specific user requirements for satellite data have not yet been developed. Most agencies expressed strong support for developing this area, which they deemed to be of high political and societal significance.

Yukio Haruyama, NASDA, briefly described a proposal from the Japan Meteorological Agency for a new IGOS project in the field of Global Land Surface Hydrology. It was suggested that this project might be considered within the context of GEWEX. The Oxford meeting recommended that proposals for new IGOS projects should be considered by CEOS and other partners in a more broadly based, future IGOS framework.

The Year Ahead

The 11th CEOS Plenary determined the SIT program for 1998, which will be guided by newly developed Terms of Reference to:

1. Produce a Strategic Plan for the space component of an IGOS.
2. Develop a set of Guiding Principles for an IGOS.
3. Guide, coordinate, redirect as necessary, and track progress of the IGOS Prototype Projects, and assist with the formulation of agency responses to project recommendations.
4. Plan the participation of CEOS with partner organisations (including IGFA and G3OS) and prepare for the June meeting with the G3OS Sponsors. (see below)
5. Liaise with the CEOS Working Groups to facilitate implementation of WG plans in support of IGOS projects.
6. Report to Plenary 12, Bangalore, India

The next SIT meeting is planned for 25 March 1998 and will be hosted by CNES in Paris. The main business will cover:

- a review of progress on the IGOS Strategic Plan;

(to be continued on Page 5)

The Global Ocean Data Assimilation Experiment

Neville Smith
Interim Chair of GODAE

The general objective and sub-objectives (see Table) of GODAE are:
To provide a practical demonstration of real-time global ocean data assimilation in order to provide regular, complete depictions of the ocean circulation, at high temporal and spatial resolution, and consistent with a suite of space and direct measurements and appropriate dynamical and physical constraints.

Objective	Driver/Needs	Output Characteristics
Extend predictability of coastal and regional sub-systems.	Coastal forecast systems; regional monitoring, prediction	scale ~ week, 100 km Fields: T, u, SL
Provide several -> 20 day high-resolution, upper open-ocean forecasts and nowcasts.	ship routing, transport, safety at sea, naval applications	rapid delivery, scales ~ 10km. Fields: u, SL, u(surface), T(zupper)
Integrated analyses for research and development. Reanalysis	CLIVAR, GLOBEC, etc. Hypothesis testing, process studies	~ 10 day, 150-100 km res., but high quality; delayed delivery OK; full depth, 10 v. modes; T, S, SL, u
Initial conditions for climate forecasts, e.g. Kuroshio, NAO, ENSO.	Western boundary current prediction; seasonal prediction; climate change.	~ 10 days, 100-200 km; SST, SL, heat content, high quality
Sustain and design for a permanent global ocean observing system, including remote and direct.	GOOS, GCOS, operational oceanography, multi-purpose applications	Managed data streams. QC systems Efficiency. Guided evolution.

GODAE is a practical test of our ability to deliver timely, useful products, derived from a global ocean data set, and assimilated into skilful models in order to extract greater benefit from the information. It will provide the proof-of-concept for the integrated global (ocean) observing strategy developed by CEOS.

GODAE is founded on the belief that such a demonstration is vital if we are to realise a permanent, global ocean observing network and prediction system, with all components functional and operating on a global domain, and delivering useful products in a timely manner. The transition of research systems into operational mode also demands

such demonstrations.

GODAE embodies a range of processes and applications, drawing power from the fact that they all require ocean data and models, and that there are important commonalities in all components that can be exploited for cost-effectiveness. It also poses a severe scientific challenge.

The scientific and technical strategy will be built around several projects, including real-time North Atlantic Ocean forecasting, North Pacific operational systems, and prototype global eddy-resolving assimilation systems. These projects will provide short-term products as well as the foundations for GODAE, the experiment. The schedule includes feasibility studies and scoping during 1998-1999, a pre-operational phase 2000-2002, and the intensive "experimental" phase during 2003-2005

A great deal has already been achieved in the definition of GODAE and in enlisting the encouragement and support of the community. However this enthusiasm must now be translated into real development of the observing network, and practical and tangible interim products, taking advantage of interest in the Year of the Oceans this year, and various Year 2000 initiatives.

Scientific and organisational planning meetings are scheduled for Melbourne, January 20-22. It is hoped that a draft plan might be available by the 2nd quarter of 1998.

The lead-time is very short for such an undertaking, but it is an opportunity that the oceanographic and remote sensing communities must take advantage of.

Further information can be found at
<http://www.bom.gov.au/bmrc/mrlr/nrs/ooop/godae/homepage.html>.

(continued from Page 4) IGOS Strategic Implementation Team- Progress Report

- the presentation of assessments of IGOS project activities by the expanded SIT Organising Committee. This will provide the basis for agency support and commitment to the prototypical projects;
- a review of the Guiding Principles for IGOS, which are contained in the Concept Paper currently being finalised by the Organising Committee.

The Paris meeting will provide a valuable opportunity for CEOS Principals to prepare for the important June meeting with the G3OS.

Partnership

The Oxford meeting reaffirmed that the IGOS concept does not belong to any one community and stated that an IGOS should be the joint product of all agencies involved in the collection and analysis of both space-based and in-situ data.

During 1998, SIT anticipates continuing progress in forging cooperative relations with partner organisations. The G3OS have invited CEOS to participate in a discussion on IGOS in early June. This meeting is indicative of the support for IGOS that has been demonstrated during 1997 among the global observing systems and their intergovernmental sponsors, as well as IGFA, WCRP and IGBP.

There is growing international interest in an IGOS which is shared by many entities, reflecting their increasing willingness to make commitments. To evolve, IGOS needs input and commitment from non-CEOS organisations contributing to its development as equal partners with CEOS. Dialogu with all such organisations has confirmed their commitment to discussing partnership arrangements with CEOS to make further progress in 1998.

The Upper Air Measurements

Paul Menzel

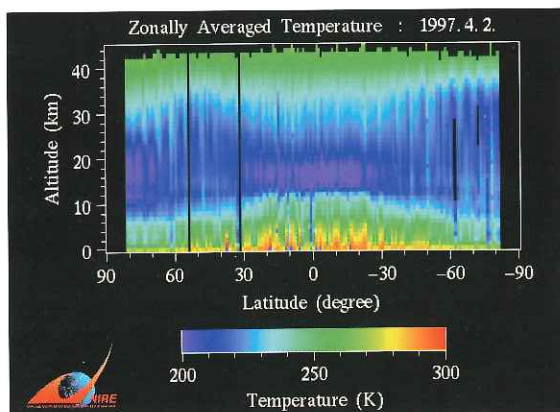
NOAA

Reduction of radiosonde and omega sonde observations of the upper atmosphere has raised concerns about possible degradation in weather forecasting. NOAA, in cooperation with the WMO and under the auspices of the Integrated Global Observing Strategy (IGOS), is leading an Upper Air (UA) Measurements Project to assess the impact of the sonde reduction on numerical weather prediction (NWP) models, to explore near term mitigation with satellite data, to evaluate satellite capabilities for satisfying NWP user requirements, and to plan for future space-based upper air measurements. In 1997 the IGOS UA Project has enlisted global modelers to conduct sonde denial studies and initiated enhanced use of satellite remote sensing data.

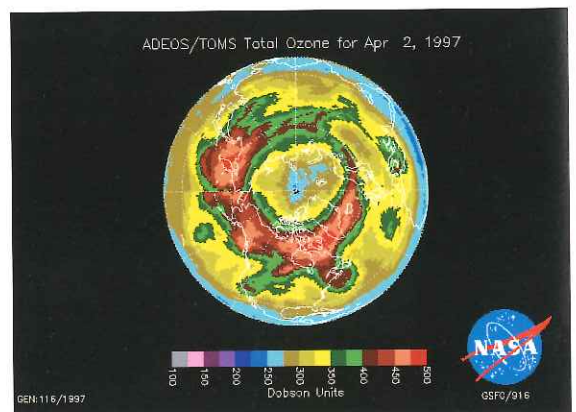
Initial studies have revealed that loss of radiosonde observations (raobs) will have a negative impact on global forecasts. Fortunately, raob reduction has not been as widespread as had been feared. However, satellite sounding data have not been utilized over land where the raobs are being removed. A preliminary study using sounder total precipitable water vapor and cloud heights over land reduced the negative impact of raob denial appreciably. The UA Project thus recommended that the global weather prediction centers collaborate with satellite data providers to further assess the impact of removing designated ground based upper air observations as well as including satellite observations over land. It was suggested that for a test period of ten days, wind estimates from all operational geostationary satellites would be assimilated at high density, four times daily, in both the control and the trial runs. Both runs would also include the direct assimilation of polar orbiter sounder radiances (or retrieved temperature and moisture profiles) over land as well as ocean. Scatterometer and aircraft winds would also be used in control and trial runs. The control would include all available ground based observations and the trial would remove the observations from the designated sites. The Strategic Implementation Team agreed to study action on this recommendation.

Evaluation of satellite observing capabilities versus NWP user requirements were guided by reports from the International Winds and TOVS working groups. Satellite

derived estimates of upper tropospheric motion (both cloud and water vapor motions) are generally produced every six hours at 100 km resolution (mostly in cloudy regions) with root mean square (RMS) vector differences with respect to radiosondes between 3 m/s for low and 7.5 m/s for high levels; the speed biases at all levels are less than 1.0 m/s. Wind vector production every three hours or better is envisaged in the near future. However, the stated NWP optimum requirements for hourly winds every 10 km with an accuracy of 1 m/s is far from being met by the existing remote sensing system. It is expected that the advent of satellite borne lidars (both backscatter and Doppler) will greatly improve the accuracy and coverage of global motion estimates. Satellite derived temperature profiles are produced twice daily every 100 kilometers in clear skies and compare within 2.0 to 2.5 K RMS of radiosonde temperature profiles; relative humidity profiles are within 20%. Significant progress has recently been realized from direct assimilation of the TOVS radiances over oceans in the global numerical weather prediction (NWP) models. In addition, more frequent soundings from geostationary orbit are expected to enhance NWP performance through 4-d variational assimilation of the hourly radiance measurements. However, the stated optimum NWP requirements are hourly soundings every 10 to 50 km with 1.0 K RMS temperature and 10% relative humidity with 1 km vertical resolution. Improvements in sounding are expected from high spectral resolution infrared sounders for better vertical resolution, advanced microwave humidity sounders for all weather soundings, and occultation sensors for tropopause and upper atmospheric definition. Preliminary findings of this evaluation (capabilities versus requirements) include: (a) the present suite of satellite observations do not meet median or optimum NWP requirements, with wind profiles needing the most help; (b) optimum global NWP requirements suggest the need for a global geostationary sounding capability; and (c) full capabilities of current satellite remote sensing have not been realized suggesting that more resources need to be focused on better usage.



Zonally Averaged Temperature obtained from IMG / ADEOS



Total Ozone image obtained from TOMS / ADEOS

Long-Term Continuity of Ozone Measurements

Jack. A. Kaye, NASA

Chris. Readings, ESA/STESTEC

As part of the CEOS Analysis group meeting, which was held in Tokyo in July 1997, the CEOS subgroup on "Long-Term Continuity of Stratospheric Ozone Measurements" met and discussed the construction of a long-term plan for ozone measurements.

It is hoped that this plan will be completed by the summer of 1998 and published in final form by the fall of 1998. Preliminary results of this meeting were presented during the CEOS Analysis Group meeting in Silver Spring, MD, USA, in early September, 1997, and again at the CEOS Strategic Implementation Team meeting in Oxford, UK in late September, 1997.

Participation at the Tokyo meeting included not only scientists associated with several of the major ozone measurement programs (both space- and ground-based) around the world, but in addition those with particular interest in the area of calibration. User groups were represented through the participation of the co-chair of the Stratospheric Processes and their Role in Climate (SPARC) subgroup of the World Climate Research Programme (WCRP). A close tie with the Global Atmospheric Watch of the World Meteorological Organization was ensured through the participation of key personnel from that network.

During this meeting the Group reached several important decisions:

- For ozone itself all relevant observational techniques, including space-based measurements of total column ozone and vertical profile of ozone, ozonesondes, and ground-based measurements (notably Dobson, Umkehr, microwave and lidar techniques) must be considered. Where measurement objectives extend beyond ozone itself (see below), again both ground- and space-based measurements must be included. Suggested space-based measurement programmes range from long-term monitoring to continuing series of sporadic measurements.
- The emphasis of the report should be on requirements associated with studies of ozone distribution as needed for long-term trend studies applied to predictions of climate change and levels of surface ultraviolet radiation. Uses of ozone data for other applications, such in meteorological forecasts or regional air quality models, may be also be considered but will not be viewed as primary requirements.
- Since ozone observations cannot be properly interpreted in isolation, monitoring requirements for other quantities, including meteorological parameters, solar forcing, aerosols and other atmospheric trace constituents must also be defined. It is likely that monitoring requirements for meteorological quantities in the region of the tropopause to come

from the ozone group will be more exacting than from the upper air group. Close coordination between the two groups will be essential to ensure that the rationale underlying the two sets of requirements is understood properly and that the origins of differences are adequately explained.

- There must be a strong focus on calibration and data quality in the report. The consideration of the validation of space-based measurements through use of ground- and balloon-based measurements, as well as the use of space-based measurements to help in the intercomparison of ground-based measurements, must all be addressed in some depth. The importance of a broad and long-term approach to the validation of space-based measurements is clear; the report will detail what this means for future programs.

- In its later stages, the group will concentrate on the formulation of concrete recommendations to space agencies and other bodies concerning their plans for space-based ozone and atmospheric chemistry measurements. Such recommendations can only be made following completion of the draft report and extensive consultation with the atmospheric chemistry community.

It is envisaged that the report will be of the following form:

- Executive Summary
- Introduction
- User Requirements
- Available and Planned Measurements
- Harmonization of Provisions and Requirements
- Validation
- Recommendations and Conclusions

The participants in the group's activities come from three interrelated groups. Firstly, representatives from CEOS agencies and other established international bodies; secondly, scientists associated with specific measurement programs (space-, balloon- and ground-based systems); finally, scientists with expertise in specific areas of scientific study which require access to stable long-term measurements of atmospheric ozone data. This wide span of expertise is intended to ensure that the report fully represents current requirements and expertise.

It is hoped to have a full draft of the report available early in the winter of 1998. A workshop, involving a broad cross section of the atmospheric chemistry community, may be organised in the spring of 1998 to consolidate the drafting of initial sections and the content of the rest of the report, including the recommendations.

Ocean Biology

Tasuku Tanaka, NASDA/EORC

Trevor Platt, Bedford Institute of Oceanography (Canada)

Project Definition

To implement a strategy for understanding ocean biogeochemical and ecosystem processes by combining long-term ocean-colour and other remote-sensing satellite data with in situ measurements.

Significance

The principal deliverable from ocean-colour missions is the concentration of chlorophyll pigments in the surface layer of the ocean. Chlorophyll concentration, an index of phytoplankton biomass, is the single most important property of the marine ecosystem whose magnitude we would like to know on synoptic scales. It has a dynamic range in the ocean of at least four orders of magnitude over regions and seasons. Phytoplankton use carbon dioxide as a substrate for their nutrition (photosynthesis). On a global scale, this activity (called the primary production) accounts for a carbon flux of about 50 Gtonnes per annum. Hence they play a significant role in the planetary carbon cycle.

In addition, phytoplankton are important as the basis for the food web in the ocean that supports the integrity of the marine ecosystem and drives the continuity of renewable resources such as fish stocks. Because long time series of ocean-colour data can be established on synoptic scales, they afford the means to assess the extent to which the variance in the abundance of exploited stocks can be accounted for by fluctuations in ecosystem and environmental properties. Beyond their importance for fisheries management, ocean-colour data are significant as a tool for coastal zone management in general.

Finally, chlorophyll concentration is easily the major determinant of the transmissibility of visible light through the ocean. This property is an important element in phys-

ical models that calculate the depth and temperature of the mixed layer, and therefore, ultimately, in numerical weather prediction. Thus, ocean-colour data are central to the issue of the interplay between physics and biology in the surface layer of the ocean. At larger scales, ocean-colour data provide the ideal vehicle for study of the effect of major events such as El Nino on the global marine ecosystem and on the fisheries embedded therein.

Feasibility

In March 1996, India launched the German sensor MOS, which provides local coverage. In August 1996, Japan launched the Japanese sensor OCTS (Figure 1) and the French sensor POLDER on the ADEOS mission, which operated until June 1997. In August 1997, the USA launched the SeaWiFS sensor which is now producing global coverage (Figure 2). Over and above these sensors already launched, a number of others are planned for the very near future. A certain plurality of sensors in orbit is essential if complete continuity (spatial and temporal) is to be achieved on a routine basis as we progress from the research to the operational mode of ocean-colour applications.

Existing sensors for ocean colour are adequate with respect to spectral, spatial and temporal resolution to meet the basic needs of an IGOS Ocean-Biology Project. The availability of in situ data, so essential for the proper calibration and validation of the remotely-sensed product is assured through liaison with the core projects of the IGBP.

Organisation & Activities

Because the objectives of the Ocean Biology Project are entirely met by the activities of the International Ocean-Colour Coordinating Group (IOCCG), responsibility for its implementation has been entrusted by CEOS to the IOCCG. This group, whose foundation was endorsed by a resolution of CEOS in 1995, came into being in March 1996. A Project Office has been established at the Bedford Institute of Oceanography (Nova Scotia, Canada).

The IOCCG is an Affiliate Program of the Scientific Committee on Oceanic Research (SCOR). The activities of the group are supported by subscriptions from a number of space agencies: in this respect, the IOCCG is entire-

(to be continued on Page 9)

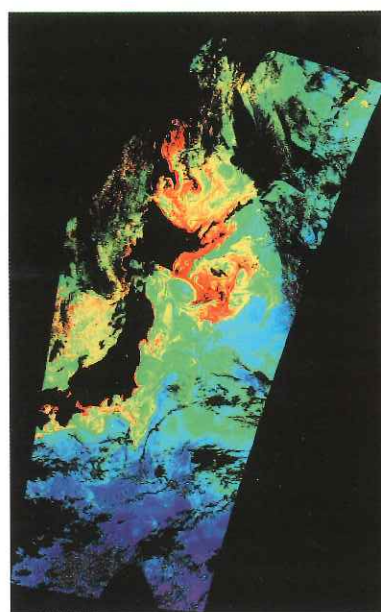
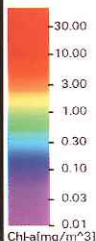


Figure 1. OCTS image showing chlorophyll-a concentrations in the waters off the coast of Japan, 26 April, 1997. Red and orange colours indicate high chlorophyll concentrations while blue and purple colours show low concentrations. Image provided by NASDA, Japan.



ADEOS/OCTS Chlorophyll-a concentration image (Apr. 26, 1997 01:37 UT / Japan)

NASDA

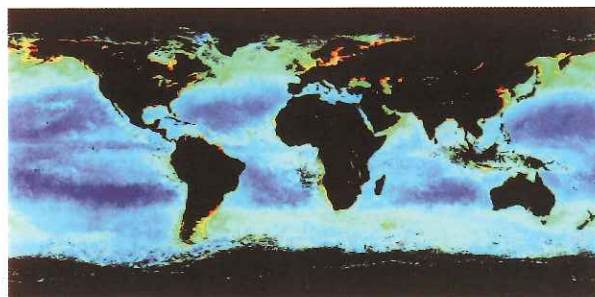


Figure 2. SeaWiFS image showing global binned chlorophyll-a concentrations for the period 4 September - 20 November, 1997. Image provided by the SeaWiFS Project, NASA/Goddard Space Flight Center.

Global Observation of Forest Cover

Frank J. Ahern (Canada)

Introduction

In 1997, a number of technology developments have converged with world-wide concern about the future of the earth's forests and climate to stimulate international cooperation in a new project called Global Observations of Forest Cover.

Environmental concerns

Deforestation and global warming have become important environmental concerns. These are immense problems, global in scope. The nations of the earth, led by the United Nations, have laid the groundwork to deal with them. Several initiatives have resulted in numerous institutional developments and scientific studies attempting to better understand and deal with global processes, particularly those driven by increasing population and development pressures.

Technology developments

Since 1972, the earth has been under observation from space with satellites designed to provide more detailed information about earth resources, such as forests. The data from these satellites has been widely used to map and monitor forest resources. However, these mapping and monitoring projects have generally been made within individual jurisdictions, such as states, provinces, or forest management units. Until recently, there has been little effort to use earth observation data, particularly from the higher resolution natural resource satellites, to create a consistent global picture of the earth's forests, or to monitor changes in the forests worldwide. In response to concerns about the global impact of human activities on the earth's forests, researchers have begun to assemble national, continental, and global data sets from earth-observation satellites in an attempt to provide badly-needed information about the state of the earth's forests, and how they are changing.

These efforts have demonstrated that it is technically possible to bring together data from the earth-observation satellites from several countries, and to analyze the data to provide better information than previously available about the extent of the earth's forests, how forest ecosystems are functioning, and how they are changing as a result of human activities and climate change. A number

of scientific collaborations have been created to combine such massive amounts of data with other information about forests and the human and natural processes which affect them, to provide a better understanding of forest changes in the context of the current economic and social situation. As part of its mandate to provide reliable information about the state of Earth's forests, the United Nations Food and Agriculture Organization has also used data from earth observation satellites to help provide a more complete picture.

CEOS Response

Recognizing the accomplishments to date, but also the shortcomings (earth observation data could be much more widely used than they are at present to assist in sustainable management of earth's forests), the space agencies of the world, through the Committee on Earth Observation Satellites, have indicated their interest in a program of Global Observations of Forest Cover. The objectives are to increase international cooperation in the integration and use of data from several earth observation satellites for mapping and monitoring the earth's forests, and to provide feedback to the space agencies to enable them to better coordinate future space missions. A team of experts met in Ottawa, Canada, in July, 1997 to draft a plan for a co-ordinated program of Global Observations of Forest Cover. This plan resulted in an ambitious list of nine types of products (such as land cover, landcover change, fire scars, and several indicators of the biophysical functioning of forests) which could be produced for all of Earth's forests through suitable use of data from existing optical and microwave satellites. They also proposed a plan to achieve ongoing operational production of these products within a five-year timeframe. Subsequently, this plan has been endorsed by CEOS members. As a result, there will be a one-year design phase in 1998 to produce a detailed design of for a network of agencies to work together to develop the systems and know-how to produce the proposed products. Following this will come a two-year prototype phase where the products are produced regionally to test the system and iron out problems, and then a two-year execution phase to demonstrate the process on a world-wide basis.

(continued from Page 8) Ocean Biology

ly self-supporting. The IOCCG uses the magazine backscatter as a publication outlet. A server is maintained on the World-Wide Web (www.ioccg.org) to provide a one-stop information dispensary on ocean colour.

Effective liaison has been established between users and providers of ocean-colour data (the committee consists of elements from both camps). A technical workshop convened by the IOCCG in October 1997

will provide the space agencies with important advice on how to ensure the compatibility of future ocean-colour missions. A two-week training course on remote sensing, held in Chile in November 1997, co-sponsored by the IOCCG, helped to broaden the base of expertise worldwide in the applications of ocean-colour data, and in particular was instrumental in stimulating applications of ocean colour in the Latin American Region.

Disaster Management Support

Helen M. Wood
NOAA/NESDIS

The world community could better mitigate the human and economic losses caused by disasters if data from current and planned Earth Observation (EO) satellites were used more effectively in disaster management support. Today, meteorological satellites are widely used to detect and track severe storms and to support other weather-driven events.

However, operational application of data from these and other EO satellites to support management of other types of disasters (e.g., oil spills, harmful algae blooms, earthquakes, forest fires) is significantly less common. And although there have been a great many research and operational demonstrations which illustrate the potential usefulness of EO satellite data for other hazards, a thorough understanding of the requirements of the diverse range of users is needed as a first step toward planning for operational support services derived from EO satellite data.

The Disaster Management Support project is working with emergency management authorities and other users

and data providers to develop and refine a set of requirements profiles for this important application area. In addition, prototype tools are being developed to support access to data and information for these applications. During 1997, four project meetings were held. These provided opportunities to survey the extensive work conducted over a number of years that demonstrates the use of EO satellite data for a wide variety of disaster types and phases. A similar meeting was held earlier in the U.S. (Washington, D.C. January 1997) by the CEOS WGISS Hazards Response Task Team.

This team has since been folded into the IGOS disaster project and WGISS has created a liaison function to ensure close ties to the project.

Strong support for this project has been expressed by CEOS agencies, user agencies and other organizations that work closely with emergency management authorities.

Participating organizations include the UN IDNDR which involves authorities from more than 140 countries, the EC DG XI Civil Protection Unit which works with civil protection departments of EU member states, Japan's National Research Institute for Earth Science and Disaster Prevention, the Council of Europe, and the U.S. Subcommittee on Natural Disaster Reduction. NOAA is hosting a prototype information server to provide "one stop shopping" for locating and acquiring EO satellite data. Several agencies are participating in the development of this service. Hazard teams have been formed to address the satellite data requirements for specific hazard areas, including drought, earthquake, flooding, fires, oil spills, tropical cyclones, and volcanic ash clouds.

Agencies are invited to participate in the project, its hazard teams, and development of the prototype information server. A project workshop is planned for the week of March 30 near Washington, DC.

For more information contact:

Helen M. Wood (chair), NOAA, Tel: 1.301.457.5120, Fax: 1.301.457.5184, E-mail: Helen.Wood@noaa.gov; Kenneth Inglis (vice chair), European Commission/KEMSAT, Tel: 32.2.345.7190, E-mail: ken.inglis@club.innet.be or visit the Internet server at www.ceos.noaa.gov.



Welcome to the DISASTER MANAGEMENT SUPPORT Project

DISASTER INFORMATION SERVER PROTOTYPE

The Disaster Management Support Project supports natural and technological disaster management on a worldwide basis, by fostering improved utilization of existing and planned Earth Observation satellite data. Clicking on any one of the images below will take you to pages for specific disaster types.



Let us know what **you think** about this service and please **inform us** as soon as you can about any disaster events in your country or area.

(continued from Page 1) REPORT ON THE 11TH CEOS PLENARY

Plenary confirmed the need to revisit the definitions of the membership categories described in the CEOS terms of reference in order to better fit with the role now played by some participating agencies and by potential newcomers. The Plenary charged the Secretariat to commission a small group of CEOS members to further develop recommendations addressing CEOS partnership and to report to the 12th Plenary.

Other Outstanding Events

The Plenary agreed on the principle of welcoming ISPRS as a new CEOS observer.

The 11th Plenary thanked Ms. Helen WOOD for her most dedicated work as Chair of the Working Group on information Systems and

Services since its creation, and for her outstanding involvement in CEOS over a long period and welcomed Dr. Takashi MORIYAMA as new Chair for WGISS. Also the 11th Plenary thanked M. Yukio HARUYAMA for his excellent work in chairing the Analysis Group.

A revised version of the CD-ROM "Resources in Earth Observation" published by CNES on behalf of CEOS was distributed. This version was in free consultation in the demonstrations room, located next to the Conference room, together with 10 other technical demonstrations set up by some of the CEOS participating agencies:

- Space PC AVHRR Processing for Windows NT 4.0 by the European Commission
- Radarsat, Radiometric Calibration by the Canada Center for Remote Sensing
- Global Observations of Forest Cover: a glimpse of the Future by the

The Global Terrestrial Observing System

Jeff Tschirley
GTOS

The Global Terrestrial Observing System was established in 1996 by five international organizations Food and Agricultural Organization of the United Nations (FAO), International Commission Scientific Unions (ICSU), United Nations Educational, Scientific and Cultural Organization (UNESCO), United Nations Environment Programme (UNEP) and World Meteorological Organization (WMO).

A steering committee consisting of about 15 recognized scientists helps to guide programme development and in developing new initiatives. The GTOS secretariat, located at FAO in Rome, Italy, provides for the day-to-day operations of the programme, including liaison with the sponsors, steering committee members, and other global change initiatives such as GCOS and GOOS.

Unlike the global observing systems that exist for climate and for oceans, there is no single organization that can provide comprehensive information (or the means for gaining access to it) on land and water resources, biodiversity and pollution impacts. The central mission of GTOS is to address this problem by linking existing networks and terrestrial observing systems to provide policy makers, resource managers and researchers with access to the data needed to detect, quantify, locate, understand and warn of changes (especially reductions) in the capacity of terrestrial ecosystems to support sustainable development. This is achieved by focusing on five issues of global concern: changes in land quality; availability of freshwater resources; loss of biodiversity; pollution and toxicity; climate change.

The programme aims to provide guidance in data collection and analysis, and to promote (a) integrated analysis of bio-physical and socio-economic data (geo-referenced where possible); (b) interaction between monitoring networks, research programmes and policy makers; (c) data exchange and application; and (d) quality assurance and harmonization of measurements methods.

The work for the past 12 months has concentrated on the following main areas:

- Formation of the GTOS Steering Committee (GTSC)
- Preparation of a GTOS Plan
- Initiation of a global network of terrestrial observing systems

- Preparation of project proposals
- Attendance at meeting of joint panels dealing with space observations (GOSSP) and data and information management (DIMP)
- Information development and dissemination

Where there are common interests between the Global Observing Systems (G3OS), joint panels have been established with the Global Climate Observing System (GCOS) and the Global Ocean Observing System (GOOS). For example, the Terrestrial Observation Panel for Climate is co-sponsored with the GCOS; and both the Joint Data and Information Management Panel and the Global Observing Systems Space-based Observation Panel are jointly sponsored with the GCOS and the GOOS.

GTOS has already established the terrestrial ecosystems monitoring sites (TEMS) meta-database which has registered information about more than 700 terrestrial sites around the world and is accessible on the Internet (<http://www.fao.org/gtos/tems>) It has now been working to expand the number of sites, update the content and quality of existing data, introduce and distribute a pc-based version of the meta-database, incorporate new user features and promote wider use of TEMS among scientists and policy analysts.

During 1997 GTOS, in collaboration with GCOS and IGBP launched an initiative to establish a Global Terrestrial Observing Network (GT-Net) in order to begin to link and initial group of 12 existing network that carry out regular terrestrial monitoring and assessment. In addition, GT-Net defined a demonstration project on terrestrial ecosystem productivity that will be supported by the members of GT-Net.

During 1998 work will begin on the preparation of a list of variables for "in situ" and space measurements for land, freshwater and biodiversity which is of interest to CEOS and members of GT-Net. It would be especially helpful if this network could develop common approaches to data collection to assure the comparability of data and to collaborate on modelling techniques to "upscale" the data. Joint collaboration with CEOS in the development of the joint proposal on forest cover monitoring and to develop an integrated global observing strategy will continue.

- Canada Center for Remote Sensing
- CEOS/IGOS Disaster Management Support Project: Prototype Disaster Information Server by NOAA
- The CEO's prototype EO information exchange server by the European Commission
- A quick tour of Polder by CNES
- Forecasting the ocean by CNES/CLS
- View-it, the leading way in terrain avoidance training by Computed Air Services/Spot-Image
- Application case studies using Earth Observation data and a gallery of IRS data samples by ISRO
- The CEOS Database by ESA
- To conclude the 11th Plenary, ISRO as the new Chair of CEOS pre-

sented their plans. ISRO will host the 12th Plenary on 10-12 November 1998 in Bangalore. EUMETSAT will follow in 1999, and INPE accepted the role of CEOS Chair in the year 2000.



The 11th CEOS Plenary 1997 in Toulouse

ISRO takes over CEOS Chair for 1998

Krishnaswamy Kasturirangan

CEOS Chair, Indian Space Research Organisation

Indian Space Research Organisation (ISRO), the premier space agency of India, took over the Chairmanship of CEOS on November 21, 1997 from CNES at Toulouse, France.

ISRO has been one of the founding members of CEOS and has been involved fully with its evolution and activities over the past years. ISRO considers it an honour to steer the activities of CEOS for 1998. In this context, the role that the CEOS community has entrusted ISRO will enable it to share its vast and rich experience of relating the EO applications with space segment definition and development - specifically for local and regional level development.

The coming year will herald considerable developments - considering some of the very important activities that CEOS has embarked upon. The integration of efforts of the space agencies and the user agencies, under the Integrated Global Observing Strategy (IGOS), is into its second year of evolution and is taking good shape. The past year has seen the excellent work of user requirement analysis undertaken by the Analysis Group (AG) and also the development of the concept of IGOS by SIT. The 11th Plenary at Toulouse has endorsed the IGOS activities and called for a renewed thrust for IGOS activities - specially on finalising the IGOS framework, linkages with user agencies and furthering the IGOS projects. Developing guidelines for IGOS and dialogue with user agencies for involving them in the IGOS framework will have to be the major thrust of activities. A quick demonstration of the IGOS concept thru the IGOS projects would also help in focussing on short-term achievements.

IGOS is also of technology - newer ones at that. The need for calibration techniques - not only of EO data but also of the analysis modelling and parameter retrieval, have to be well integrated with the IGOS needs. IGOS calls for efficient information services on missions, data availability, models and analysis, accuracies of parameters etc. The Working Groups of CEOS have a very challenging role to play in support of IGOS and the projects.

IGOS is also of "partnerships" - a recognition of the fact that CEOS

can just not get the strategy in place on its own. Developing linkages with other groups, amongst them the major ones being the user agencies and other international and commercial agencies - all together having a stake in furthering EO technology and applications, will be another major activity that CEOS has outlined. Discussions with these groups and agencies will have to be the prime activity towards getting the space agencies, the users and the service providers to participate in the global endeavor of IGOS.

ISRO attaches special concern for the development of EO technology and applications amongst the developing countries. The problems faced by developing countries - mainly on population dynamics, land and water management, disasters, environment and ecology etc, can very well be addressed by EO data. Many of the developing countries have excellent examples of how EO has been utilised to address very local and specific problems of their countries. There is a need for a two-way transfer of experience and knowledge on their capabilities and what CEOS and IGOS propose to achieve - which could very much be of benefit to the developing countries. Some of the activities of the Working Groups in support of developing countries are helping in reaching out to the developing world.

ISRO has also proposed an initiative for chronicling the benefits and values of EO technology over the past 25 years. Many a time, space agencies feel the need for a collection of good examples of the benefits that EO has given to society. ISRO has proposed to make a collection of world examples with focus on benefits and values (rather than techniques and models) as a treatise of how our society has benefited from this technology. Under WGISS, ISRO hopes to be able to pursue this endeavor in the coming days.

ISRO has geared up for the CEOS activities and looks forward to the support and guidance from all its members, affiliates and observers. Particularly, ISRO also recognises the rich experience of the Secretariat and will depend on them for carrying out the CEOS activities.

Contributions for future issues of the CEOS Newsletter from the CEOS Members, Observers and Affiliates, and subscriptions to the CEOS Newsletter, please contact CEOS Japan Secretariat : ceosj@ipx.tksc.nasda.go.jp

http://www.eoc.nasda.go.jp/guide/guide/eoc/committee/ceos/ceosnews_menu_e.html

As of Feb. 1998

Meeting Calendar

Activities	1997		1998										
	November	December	January	February	March	April	May	June	July	August	September	October	November
CEOS Plenary	▲ 19-21 11th Plenary CNES / Toulouse												▲ 10-12 12th Plenary ISRO / Bangalore
CEOS WGISS (Working Group on Information Systems & Services) Subgroups Task Team						20-24 ▲ SGs Meeting DLR / Germany	▲ 11-15 WGISS-6 ESA / Frascati					21-25 ▲ SGs Meeting NOAA / Boulder	19-23 ▲ WGISS-7 NASDA / Kyoto
CEOS WGCV (Working Group on Calibration and Validation) Subgroups				▲ 3-6 SAR SG ESA / ESTEC	23-24 ▲ WGCV / IGOS EC / Ispra	▲ 2-4 MS SG Alabama			21-23 ▲ WGCV 14 Tokyo			29 ▲ TM SG Hannover	
IGOS / SIT (Strategic Implemen- tation Team)					25 ▲ SIT CNES / Paris								
Others					26 ▲ G30S / CEOS ESA	30-3 IGOS Disaster NOAA, Silver Spring		6 ▲ G30S / CEOS Paris	▲ 9 IRSSSE TROMSO				▲ 28-2 IAF #49 Melbourne

▲ : determined △ : to be determined
(Date, Host organization/Location)

CEOS-related meetings are open only to designated participants.

For further information contact in each area allocated:

Published by
Office of Earth Observation Systems
**National Space Development Agency
of Japan (NASDA)**
World Trade Center Bldg.,
2-4-1, Hamamatsu-cho, Minato-ku,
Tokyo 105-60, JAPAN

[Asia, Pacific]
Mr. H. Fujita, STA
TEL:+81-3 3581 1678
FAX:+81-3 3501 3683
e-mail:ceosj@ipx.tksc.nasda.go.jp

[North & South America]
Ms. L. Charles, NASA
Dr. B. Smith, NOAA
TEL:+1-202 358 0793
FAX:+1-202 358 2798
e-mail:leslie.charles@hq.nasa.gov,
brent.smith@noaa.gov

[Europe, Africa]
Dr. H. Arend, ESA
TEL:+33-1 5369 7550
FAX:+33-1 5369 7735
e-mail:harend@hq.esa.fr