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General exchange of views and introduction to reports submitted on national activities

**INTERNATIONAL COOPERATION IN THE
PEACEFUL USES OF OUTER SPACE:
ACTIVITIES OF MEMBER STATES**

Note by the Secretariat*

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* This document has not been formally edited. It will be edited, translated into all official languages of the UN and distributed as document A/AC.105/816/Add.2 after the forty-first session of the Scientific and Technical Subcommittee.

Austria

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1. In 2003, Austria continued its space-related activities in the framework of the programmes of the European Space Agency (ESA), the Austrian Space Applications Programme (ASAP) and the Austrian Radio-navigation Technology and Integrated Satellite Navigation (Satnav) services and products Testbed (ARTIST). Several of the space application projects being implemented in these programmes respond to the recommendations of the Third United Nations Conference on the Exploration and Peaceful Uses of Outer Space (UNISPACE III).
2. Bilateral and international space cooperation activities with other national space agencies in the field of space sciences, space applications and the development of related technologies continued, and discussions with new potential space cooperation partners were held throughout 2003. It is expected that some of these discussion will lead to formal cooperation agreements in 2004.
3. With regard to space education, the Austrian Space Agency (ASA) organized the 27th Alpbach Summer School on the theme "Working and Living in Space: from the International Space Station (ISS) to Moon and Mars" from 15 to 24 July 2003. The annual Summer School is organised in cooperation with the Austrian Federal Ministry of Transport, Innovation and Technology (BMVIT), ESA and the national space authorities of the ESA Member States.
4. Following the decision taken in December 2002 by the ESA Member States to host the European Space Policy Institute (ESPI) in Austria, the ESPI foundation documents were signed by ESA officials and representatives of the Austrian host in Vienna on 26 November 2003. ESPI is expected to start operating in 2004.
5. Within the framework of its cooperation with the United Nations Programme on Space Applications (PSA), Austria supported the United Nations/Austria/ESA Symposium on "Space Applications for Sustainable Development: Supporting the Plan of Implementation of the World Summit on Sustainable Development", which was held in Graz, Austria, from 8 to 11 September 2003. Austria will continue to support PSA activities in 2004.
6. Detailed information on Austrian space activities is available from the website of the Austrian Space Agency at <http://www.asaspace.at>.

France

[Original Text: French]

1. Earth observation

Satellite pour l'observation de la terre—Earth Observation Satellite (SPOT-5)

1. Operational use of SPOT-5 is continuing successfully. The satellite has already covered more than 30 million km² in stereoscopic data. SPOT-5 has a high-resolution geometry instrument and a new stereoscopic imaging system (high-resolution stereoscopic instrument), which will permit three-dimensional modelling of the target terrain.
2. Thanks to an improvement in resolution to 5 m and 2.5 m, combined with the dimension of the images (60 km x 60 km or 60 km x 120 km), Spot Image, the company responsible for operation of the SPOT satellites, will be able to meet the new requirements in this area. The balance between high resolution (2.5 m) and wide-area coverage is a

major asset for applications such as medium-scale land mapping (1:25,000, and locally 1:10,000), urban and peri-urban planning and management of major hazards.

3. The second major advantage of SPOT-5 is the unparalleled capacity of its high-resolution stereoscopic instrument, which will enable a wide swathe of territory to be covered in a single pass. The stereoscopic images are indispensable for all applications requiring a precise knowledge of relief, such as flight simulator databases or the introduction of mobile telephony networks.

4. The Vegetation-2 instrument makes it possible to continue environment observation on a continental scale, as its predecessor on board SPOT-4 already does.

5. The international SPOT-5 validation programme, which is the subject of an agreement with Spot Image, has been signed and announced. It will enable eight selected foreign organizations to demonstrate to the international community the full benefit of the high resolution of SPOT-5 combined with its large coverage. The UNOSAT project being implemented by the United Nations Office for Project Services (UNOPS) on behalf of the United Nations Institute for Training and Research (UNITAR), and developed in partnership with the French Government and the European Space Agency (ESA), has been selected for a mapping project on the landslide risks in Nicaragua.

6. The programme of scientific evaluation of the high-resolution stereoscopic instrument is now under way, after the selection of 28 experiments on nine test zones around the world. The images from the instrument and also reference data provided by the main researchers have been distributed to all the researchers, who will then evaluate the quality and accuracy of the digital elevation models obtained from the high-resolution stereoscopic instrument. The results will be presented at the Congress of the International Society for Photogrammetry and Remote Sensing (ISPRS) in July 2004.

ORFEO, PLEIADES

7. The Franco-Italian Orfeo system will consist of Pléiades high-resolution optical minisatellites and four Cosmo-Skymed radar satellites. The Centre national d'études spatiales (CNES) recently signed a contract for the development of the French part of Pléiades with EADS Astrium, the prime contractor for the production of the platforms; Alcatel Space will produce the high-resolution instruments. These satellites will ensure the continuity of SPOT service in panchromatic and broad multispectral imaging. Their resolution will be 70 cm for a swathe of 20 km. Their tilting capacity allows them to take several images in succession along or outside the track. Their memory has been increased to 600 gigabits (Gb) and onward transmission to the ground has been increased to 450 megabits per second (Mbps).

Optimizing Access to SPOT Infrastructure for Science (OASIS)

8. The Optimizing Access to SPOT Infrastructure for Science (OASIS) programme will enable the European scientific community to access SPOT data for a nominal fee, thanks to an agreement concluded between CNES and Spot Image on funding from the European Union under the Sixth Framework Programme for Research and Technological Development. The German Aerospace Center (DLR) and the Italian Space Agency (ASI) are involved in this programme.

Infrared Atmospheric Sounding Interferometer (IASI)

9. The Infrared Atmospheric Sounding Interferometer (IASI) instrument will be used in the Metop meteorological satellites. Its advanced technology will permit measurements of temperature and humidity with a vertical resolution of 1 kilometre and an accuracy of 1 Kelvin (K) and 10 per cent humidity. The first flight model is scheduled for delivery in 2003. The IASI qualification review began in November 2003.

1.1 Scientific Earth observation missions

JASON-1 and JASON-2

10. The Jason-1 satellite, a product of cooperation between France and the United States, is functioning nominally and is delivering its products routinely.

11. The aim of the Jason-2 mission is to ensure continuation of the ocean altimetry measurements (climate forecasting and sea state) currently taken by Jason-1 (launched in December 2001) and the Ocean Topography Experiment/Positioning Ocean Solid Earth Ice Dynamics Orbital Navigator (TOPEX/POSEIDON, launched in 1992).

12. The mission is being carried out in cooperation with the United States National Aeronautics and Space Administration (NASA) and National Oceanic and Atmospheric Administration (NOAA), the European Organisation for the Exploitation of Meteorological Satellites (EUMETSAT) and CNES.

13. At the European level, delegations unanimously approved the memorandum of understanding between CNES and EUMETSAT at the EUMETSAT Council in November 2003.

14. The partners have continued their negotiations on an international agreement; the negotiation of the quadripartite memorandum of understanding will continue in 2004; and the Jason launch is planned for late 2007.

Cloud-Aerosol Lidar and Infrared Pathfinder Satellite Observations (CALIPSO)

15. Current uncertainties about the radiative impact of clouds and aerosols limit understanding of the climate system and the forecasting of global changes. The Cloud-Aerosol Lidar and Infrared Pathfinder Satellite Observations (CALIPSO) mission will provide a set of unique data about vertical profiles of the atmosphere measured by the first satellite-borne backscatter lidar.

16. CALIPSO is to fly in formation with two other American missions, Aqua and CloudSat, and with the French PARASOL (Polarization and Anisotropy of Reflectances for Atmospheric Sciences coupled with Observations from a Lidar) microsatellite, which together will make up an exceptional space observatory: the "Aqua train", which is placed in a sun-synchronous orbit at an altitude of 705 km and combines all active and passive measurement techniques.

17. The project continued in 2003 with assembly of the payload at Ball Industry (Boulder, Colorado) and the first atmospheric tests of the lidar were conducted successfully. The platform has also been assembled; the operations were carried out in Cannes.

18. On 18 June 2003, a bilateral meeting took place at CNES headquarters between CNES and NASA, in which a memorandum of understanding was signed between the two national space agencies relating to the CALIPSO mission.

19. The nominal launch date is set for February 2005; an American Delta II launcher will be used.

PARASOL

20. The PARASOL mission will complement the Franco-American CALIPSO mission. The payload, a Polarization and Directionality of the Earth's Reflectances (POLDER) instrument, will be carried on a microsatellite from the Myriade series.

21. Uncertainties about the radiative impact of clouds and aerosols are currently one of the main factors limiting understanding of the climate system and the forecasting of possible changes. The Aqua, CALIPSO, CloudSat and PARASOL missions in formation will make up an exceptional space observatory that combines all the active and passive measurement techniques currently available.

22. The design review for the mission was conducted in June 2003 and the launch should take place in late 2004.

Megha-Tropiques

23. The development costs of this Franco-Indian project are currently being revised. The two countries are looking together at several options that would allow them to carry through this project, which focuses on studying the water cycle and heat exchanges in the intertropical region. The project will help forecast cyclones.

Detection of Electromagnetic Emissions Transmitted from Earthquake Regions (DEMETER)

24. The DEMETER satellite is designed for the study of electromagnetic phenomena associated with natural geophysical phenomena such as earthquakes, volcanic eruptions and tsunamis, and for the analysis of disturbances of the planet's electromagnetic environment that are linked to human activity. The DEMETER mission is exploratory in nature and aims primarily to detect electromagnetic signals associated with seismic activity, but also to determine accurately the conditions for observing them, their characteristics—such as the frequency spectrum—and propagation conditions. DEMETER is the first mission in the Myriade microsatellite series developed by CNES. The satellite is currently in the phase of integration and testing. The launch is planned for mid-2004 on a Russian Dniepr launcher, which will place the satellite in a sun-synchronous polar orbit at an altitude of approximately 700 km. Its planned lifetime is two years. This mission is the result of close cooperation between CNES, the prime contractor for the satellite, the scientific community, which is responsible for the scientific payload, and the manufacturers involved in the development of the satellite.

SOIL MOISTURE AND OCEAN SALINITY (SMOS)

25. This minisatellite in the series known as PROTEUS (Plate-forme reconfigurable pour l'observation, les télécommunications et les usages scientifiques—reconfigurable platform for observation, telecommunications and scientific uses) will observe land-surface moisture and ocean salinity on a global scale. The mission will observe continental surfaces (surface moisture), the oceans (surface salinity) and high latitudes (cryosphere). It will make it possible to improve climatological and meteorological models and forecasting, to forecast extreme events (floods, drought), and plan water resource management.

26. The payload is a radiometer that uses an innovative interferometric technique and features a multiangular and bipolarization observational capability. It is being developed under the auspices of ESA by the prime contractor, EADS-CASA Espacio in Madrid. PROTEUS is a series of minisatellites (300 to 500 kg) developed under a partnership between CNES and Alcatel Space and produced by the latter.

1.2 Science, observation of the universe

Microscope

27. The main scientific objective of Microscope is to test the principle of equivalence to an accuracy 100 times greater than that obtained in experiments carried out on Earth. The secondary objectives are: construction of a continuous drag-free and attitude control system using electric propulsion units; and measurement of the accelerations on board the

satellite to an accuracy greater than 10^{-12} ms^{-2} . The two secondary objectives are a vital prerequisite for measuring the principle of equivalence. Microscope will be a microsatellite in the CNES Myriade series equipped with field emission electric propulsion units and two differential accelerometers.

Atomic Clock Ensemble in Space (ACES)/Project d'horloge atomique à refroidissement d'atomes en orbite—Project for an atomic clock based on laser cooling of atoms in orbit (PHARAO)

28. The ESA Atomic Clock Ensemble in Space (ACES) is designed to be installed on an external platform of the Columbus module of the International Space Station (ISS). The aim of the project is to demonstrate the great potential of a new generation of atomic clocks in space. The objectives are both technological (demonstration of a caesium atomic clock) and scientific.

Convection, rotation and planetary transits (COROT)

29. The convection, rotation and planetary transits (COROT) mission is a very-high-precision stellar photometry mission whose scientific objectives are to study stellar interiors through the analysis of stellar oscillation modes and measurement of their frequency, amplitude and lifetime, by observing variations in luminous flux. COROT is also used to search for exoplanets, in particular telluric planets, through occultation or transits. The instrument on board is a white-light photometer that uses a reflector telescope outside the pupil reduction axis, a dioptric imaging objective and large defocused charge-coupled device (CCD) detectors. PROTEUS ensures pointing accuracy in the focal plane—a few arc-seconds—using angle-error measurement information from the instrument. The accuracy for asteroseismology, a frequency of 0.1 microHz, requires a period of observation of 150 days on each star field selected. The orbit is inertial ($i=90^\circ$) and circular at an altitude of 850 km.

30. Scheduled for launch in mid-2006, COROT will be a mini-satellite in the PROTEUS series after Jason and CALIPSO.

Planck Surveyor

31. The Planck Surveyor mission is an astronomy mission involving the close study of the anisotropies of cosmic background radiation. It will provide key information on most fields of cosmology and astrophysics, making it possible to test models of the evolution of the early universe and the origin of cosmic structures. Two focal-plane instruments will be onboard: a millimetre-channel heterodyne detector (low-frequency instrument), made by an Italian prime contractor, and a submillimetre-channel instrument (high-frequency instrument) using bolometers cooled to 0.1 K, developed by a French prime contractor.

Herschel

32. Herschel will also provide different basic information about the formation of galaxies when the universe began to be formed, the physical chemistry of the interstellar medium and of the atmosphere of comets and planets, and the detection of planetary systems outside our solar system, objectives which are covered as a priority in the infrared and submillimetre domain.

33. Planck Surveyor and Herschel are ESA missions and will be launched together in 2007.

2. Space transport

Ariane

34. The last launch of the Ariane-4 rocket, version A44L, took place on 15 February 2003 and placed the International Telecommunications Satellite Organization INELSAT-

907 satellite in orbit. Three launches carried out by the generic version of Ariane-5 placed in orbit the Indian National Satellite System INSAT-3A satellite, Galaxy-XII, Optus and Defence C1, BSat-2C, INSAT-3E, e-Bird and the Small Mission for Advanced Research in Technology 1 (SMART-1) satellite.

35. A recovery and consolidation plan for the Ariane-5 series has been under way since Spring 2003 to deal with the difficulties encountered by the launcher in December 2002. In particular, modifications have been made to the nozzle of the first-stage Vulcain-2 engine. The Ariane-5 Evolution development plan is currently being completed; it will make it possible to improve the performance of the launcher and to adapt it to evolving market demands. These changes relate to the thrust of the Vulcain engine, the addition of welded cylindrical sections to the solid booster stages, and the development of the Sylda-5 structure, the upper stage and the equipment bay. A qualification programme for the Ariane-5 ECA version (based on a Vulcain-2 engine and a reignitable storable-propellant stage) will be carried out for the first launch of the automated transfer vehicle (ATV) to the ISS.

Franco-Russian cooperation on establishing the Russian Soyuz launcher in French Guiana

36. France and Europe play an active role in cooperation on launchers. The Montreal resolution (ESA Council of 12 June 2002) and, more recently, the resolution adopted at the Council of 27 May 2003 in Paris demonstrate European will and the potential scale of this cooperation. The most visible element of the French and European desire to enhance the partnership with the Russian Federation is the establishment of the Soyuz launcher in French Guiana, which will require a European investment of 314 million Euros, of which France will provide about 50 per cent.

37. The implementation of this decision made it necessary in particular for an agreement to be concluded between France and the Russian Federation to establish provisions on liability matters and, more particularly, on security, safeguards, registration, certification and supervisory authorities. The intergovernmental agreement between France and the Russian Federation was signed by the French and Russian Prime Ministers in Paris on 7 November 2003.

38. At the same time, an agreement is being negotiated at the Russian Aviation and Space Agency (Rosaviakosmos), Arianespace and Starsem, on conditions for the establishment and commercial exploitation of Soyuz in French Guiana.

39. On the technical front, the preliminary design review of the Soyuz launch system in French Guiana, organized by CNES, Arianespace and Starsem, took place at ESA in Paris from 15 to 17 July 2003. The general progress of the project is satisfactory and the major options for establishing the launcher in French Guiana have been validated.

3. Radiocommunications

European Satellite Navigation System (GALILEO)

40. The countries of the European Union and the member States of ESA have agreed on funding conditions, which have enabled the development/validation phase of this programme to begin. During this phase, an experimental satellite known as GALILEO System Test Bed version 2 (GSTB-V2) is due to be launched before June 2006. Thereafter, three GALILEO satellites will be launched and the satellite navigation service will be validated in orbit.

41. In addition, the GALILEO Joint Undertaking was founded this year following decisions taken by the European Union countries and the ESA member States that are taking part in the ESA GalileoSat programme. The purpose of the Undertaking is to supervise the development/validation phase of GALILEO, the optimum integration of the

European Geostationary Navigation Overlay Service (EGNOS)—the European programme that complements the Global Positioning System (GPS)—into the GALILEO programme, the preparation of the subsequent GSTB-V2 experimental phases, and the launches of the first three GALILEO satellites and their in-orbit validation. The Undertaking is focused on promoting value-added applications and services based on EGNOS and GALILEO, and on standardization and certification issues and downstream activities. It is also responsible for establishing the concessionaire that will operate the future GALILEO constellation. For its part, ESA launched several industrial activities in June 2003 relating, for example, to the delivery of the GSTB-V2a and GSTB-V2b experimental satellites, for phase C0 of the study on the detailed design of the different segments of the GALILEO system.

Positioning/Search and rescue

The low Earth orbit search and rescue (LEOSAR) system

42. Four Search and Rescue Satellite-Aided Tracking System (SARSAT) instruments, in orbit onboard NOAA satellites, are operational. Integration of three third-generation instruments (the SARSAT-3 project) is continuing in industry for the Metop and NOAA satellite. The last two SARSAT-3 instruments are planned to be installed on the first two American satellites in the National Polar-orbiting Operational Environmental Satellite System (NPOESS) under the International Satellite System for Search and Rescue (Cospas-Sarsat) agreements.

The geostationary search and rescue (GEOSAR) system

43. The European EUMETSAT Meteosat Second Generation 1 (MSG-1) satellite, equipped with a 406 MHz transponder, has been in operational use since late August 2003 thanks to round-the-clock reception at CNES. The results are highly satisfactory and a comprehensive review is scheduled for early 2004 with a view to declaring the system fully operational.

The medium Earth orbit search and rescue (MEOSAR) system

44. In conjunction with the GALILEO programme, the search and rescue/GALILEO (SAR/GALILEO) mission should enable improvements to be made to the existing LEOSAR and GEOSAR systems in close coordination with the American equivalent, SAR/GPS (Distress Alerting Satellite System—DASS) and the Russian equivalent, SAR/Global Navigation Satellite System (GLONASS).

Precise positioning

Doppler Orbitography and Radiopositioning Integrated by Satellite (DORIS)

45. The future DORIS instruments for Jason-2 and Pléiades should come into operation in early 2004 with a view to meeting the schedule requirements for these projects. The supply of DORIS beacons to upgrade the ground network (project for third-generation (3G) beacons) is continuing on schedule, with delivery of 10 beacons in late 2003 and the last 10 due in February 2004.

Alphabus

46. The Alphabus programme is a new-generation high-power large-platform programme launched by CNES with industrial cooperation from Alcatel Space and Astrium. It is aimed at developing innovative technologies in the field of satellite telecommunications for the benefit of industry and society. Work on designing the platform has progressed significantly this year. The two companies mentioned above have agreed on a sharing of the technical responsibilities for the development of the platform's main functional chains.

4. Applications with benefits for society

Global Monitoring for Environment and Security (GMES)

47. Global Monitoring for Environment and Security (GMES) is an initiative of the European Commission and the major space agencies, including CNES and ESA. It has three objectives:

- (a) To establish services for providing environmental information for public use on the basis of ground and space data along similar lines to meteorology services;
- (b) To set up information services to support action to protect people and property in the event of natural or man-made disasters; and,
- (c) In the context of the European Union Common Foreign and Security Policy (CFSP) and the Petersberg Tasks, to establish, in the long term, services to help European forces and organizations in their humanitarian or peacekeeping interventions.

48. Three phases are planned. The initial phase was completed in late 2003, and consisted of identifying possible themes for the development of specific services. It concluded with a report by the European Commission to the Council. The second phase, which lasts until 2007, consists in setting up pilot demonstrations for some of these services, at the Council's request, in accordance with the priorities set by the Commission. The third phase, which will begin in 2008, will focus on the actual establishment of GMES service centres according to themes, using funding not earmarked for research and development. The first services to be set up in 2008 will make use of existing ground and space infrastructure. The projects are funded by ESA or the European Union. The following areas have been identified as priorities: ocean and coastal zone management; land use and monitoring of plant resources; and natural disasters. ESA has selected about 10 projects to fund and the European Commission has selected about 20. Others will follow.

Réseau Terre et Espace (Earth/Space Network)

49. Réseau Terre et Espace (Earth/Space Network) is a French initiative that, through various projects, will provide some answers to the problems posed by GMES. The Network, under the aegis of the Ministry of Research, is designed to develop, through cooperation between industry and scientists, new services using, inter alia, data from space and space-based telecommunications and positioning facilities for natural and industrial risk management, precision agriculture and natural resource management (particularly water and forests), but also in emerging fields such as space-based epidemiology. All the projects that have been established and are in development are described briefly below:

- (a) *Cyclopes*: This project relates to the development of products from medium spatial resolution sensors and applications, and forms part of the Geoland initiative to create a thematic focus for land surfaces. It aims to develop biophysical products such as the leaf area index (LAI) and the fraction of absorbed photosynthetically active radiation (FAPAR) through the synergy between medium spatial resolution sensors such as the NOAA Advanced Very High Resolution Radiometer (NOAA-AVHRR), SPOT-Vegetation, the Medium-Resolution Imaging Spectrometer (MERIS)/Environmental Satellite (ENVISAT) and POLDER/Advanced Earth Observation Satellite (ADEOS). The products will be validated using a network of sites distributed around the globe. Two applications of the products are envisaged. They use the LAI fields produced to estimate carbon flux by model forcing and improvement of a surface scheme;
- (b) *AGIL (Aide à la gestion intégrée des littoraux—Integrated coastal zone management aid)*: This project is designed to establish a global, operational French capability in integrated coastal zone management, built around a

multidisciplinary team with expertise in innovative methodologies and environmental information systems applied to the coast. The service, aimed at decision makers and managers, will be based on a network of skills relating to coastal matters and a technical platform that uses Earth observation data, and information and communications science and technology;

- (c) *METIS-Forêts (Analyse multi-échelle et multi-temporelle en imagerie spatiale appliquée aux missions de gestion et de contrôle des forêts—Multi-scale and multi-temporal analysis in space imaging applied to forest management and control)*: The main purpose of this project is to help improve forest monitoring and management using space techniques. Two major types of need are addressed:
 - (i) Priority national needs; and,
 - (ii) International Protocols, in particular the Kyoto Protocol to the United Nations Framework Convention on Climate Change.
- (d) *RESSOURCE (Réseau souterrain d'observation unissant la ressource et les caractéristiques de l'eau—Underground observation network linking the potential and characteristics of water)*: This project should demonstrate how space telecommunications contribute to the collection of data on underground water resources. It is in line with the optimization of monitoring networks and with preparations to meet the quality- and quantity-monitoring requirements set out in the European Union Water Framework Directive in France;
- (e) *DELTA (Démonstrateur EGNOS de localisation du trafic aéroportuaire—EGNOS demonstrator for airport traffic positioning)*: This is designed to demonstrate the use of EGNOS for airport vehicle management (Advanced Surface Movement Guidance and Control System—A-SMGCS). The DELTA project has made it possible to prototype a complete chain comprising the navigators on board, the wireless communication network and the processing centre including the visualization of mobile objects moving around airport areas;
- (f) *CITRAM (Conseil à l'irriguant par télédétection, radar et modélisation—Advice for irrigators through remote sensing, radar and modelling)*: Using information from the MSG meteorological satellite and the HYDRIX hydrometeorological radar, the general objective of the project is to make a service available via the Internet allowing end users (agricultural technicians, farmers, etc.) to monitor the precise water content of their land at half-daily intervals and to integrate information from their own land (soil type, crop stage, etc.) and from weather forecasts in order to manage their crop irrigation more effectively;
- (g) *SADAISI (Service d'analyse directe par l'agriculteur d'images satellites par Internet—Service for direct analysis by farmers of satellite images via the Internet)*: The general objective of the project is to make a service available via the Internet allowing end users to access recent satellite images of their land and also tools for analysing these images using their own expertise in combination with other data;
- (h) *SUCRETTE (Système de suivi de la canne à sucre par télédétection—System for monitoring sugar cane through remote sensing)* ;

- (i) *TESS (Transport espace et société—Space Transport and Society)*: The aim of this project is to develop a demonstration platform for innovative services that use satellite communication and positioning systems. This covers improvements in the safety of people and materials, dissemination of multimedia information and optimum management of traffic news services. The system will be validated while in operation in two sectors that are being used for demonstration purposes: public transport and road transport. Several vehicles and a central office will operate in each of these sectors;
- (j) *TOPOPHYLLÉ*: This project is designed to update and validate a set of methods for relief reconstruction, giving digital elevation models of different levels of precision, and using (in combination) techniques already available from the partners in the project, such as radar and laser. Experiments in a pilot area in French Guiana will make it possible to develop products throughout the territory, consolidate French production for export and obtain a laser/radar combination algorithm that distinguishes French exports;
- (k) *UFOS (Ultraviolet Forecasting Operational Service)*: This is a service for ultraviolet index forecasts and information. The project brings together specialists in radiative transfer, instruments for taking measurements on the ground and in space, and modelling of atmospheric phenomena in order to make routine use of the measurements of stratospheric ozone distribution, cloud cover and the aerosol content of the atmosphere carried out by the ENVISAT instruments (MERIS and Global Ozone Monitoring by Occultation of Stars - GOMOS) to calculate the reduction in solar ultraviolet radiation reaching the ground;
- (l) *APOGE (Aide à la planification de l'occupation des terres à l'échelle régionale—Aid for land cover planning at the regional level)*: This project involves developing a decision-making tool for planning land cover in rural areas: diagnosis and scenarios for water and carbon;
- (m) *GEODESEA (Système de mesure précises de positionnement sous l'eau—System of precise measurements of underwater positioning)*: GEODESEA is designed to develop a system of precise measurements of underwater positioning. The project aims to achieve accuracy to within a few centimetres over an average range of about 5 km, possibly with several buoys to cover the distance, depending on the sea floor topography. These measurements are linked with surface accuracy, via GPS, to markers on land and/or platforms at sea. The project also opens up prospects for services for the future GALILEO system relating to the transfer of satellite positioning to the underwater domain;
- (n) *GEWED*: A website with educational resources on geographic information and geographic information systems (GIS) for teachers, trainers and students. Its purposes are:
 - (i) Provision of multimedia educational geographic information resources to meet teaching and (self-)training needs;
 - (ii) Easy identification of georeferenced data resources using the concept and architecture of the Geography Network of the United States Environmental Systems Research Institute (ESRI) (www.geographynetwork.com);
 - (iii) Downloading of georeferenced data (including satellite images) on preferential terms reserved for educational uses;

- (iv) Provision of information about training in geomatics in the French language; and,
 - (v) Organization of special forums and exchange of experiences between teachers, trainers and students in the fields of geographic information, GIS, remote sensing, automatic mapping, etc.
- (o) *S2E Argos (Satellite-based location and data collection system)*: Space surveillance of epidemics in West Africa. The aim is to set up an electronic network for epidemiological alerts by satellite, to specify and deploy an electronic system of epidemiological surveillance and early warning for priority diseases (meningitis, malaria, bloody diarrhoea) and environmental data, to study the links between environment and health in the sub-Saharan zone and, lastly, to validate the concept;
 - (p) *SMMAC (Service multimédia de maintenance et d'assistance chirurgicale—Multimedia surgical maintenance and assistance service)*: The objectives of this project are to design and set up a web services platform for collaboration between expert and non-expert or trainee surgeons to provide remote technical and/or surgical assistance. The ultimate objective is to market the service if it can be implemented and its value demonstrated on acceptable operational and economic terms;
 - (q) *SAFE-TIMES (Serveur d'applications et de formation évolutif et thématique d'images spatiales et aériennes—Evolving thematic server for applications and training with space and aerial images)*: The objectives of this project are to promote the use of space and aerial remote sensing for small and medium enterprises and industries and inter-municipal associations by improving knowledge of its potential; to assist each user in the selection, processing and integration of space and aerial images; and, to reduce the cost of carrying out remote sensing projects;
 - (r) *SHERPA (Suivi hydrologique et environnemental pour l'Amérique centrale—Hydrological and environmental monitoring for Central America)*: The proposed action is designed to develop, using the Coordination of Information on the Environment (CORINE) Land Cover database, applications that meet specific needs and to demonstrate their practical use. This demonstration will take place on a pilot site: the Río Lempa watershed;
 - (s) *SEAGERH (Service d'aide à la gestion des ressources halieutiques—Fish resource management aid service)*: This project aims (1) to combine the skills and experience of the Research Institute for Development (IRD) and Collecte Localisation Satellites (CLS) in order to develop a comprehensive and competitive range of French space oceanography products for the fish market; and (2) to offer a version of these products that meets the needs of fish resource management organizations, which constitute a new market; and,
 - (t) *RESUM (Réseau de suivi de subsidence urbaine et minière—Urban and mine subsidence monitoring network)*: The aim of the RESUM project is to develop innovative ways of measuring soil deformation phenomena (mine subsidence, impact of natural cavities, underground works) using a satellite observation technique: radar interferometry.

India

[Original Text: English]

1. The Indian Space Research Organisation (ISRO) falls under the auspices of the Department of Space (DOS), Government of India.
2. ISRO implements the Space Programme through:
 - (a) Research and development of space science and technologies;
 - (b) Design, manufacture, launch and operationalisation of remote sensing and communication satellites;
 - (c) Design, manufacture and launching of the satellite launch vehicles;
 - (d) Conceiving and implementing various applications using space-based data and information for national development.
3. India has been at the forefront of all the activities of the United Nations Committee on the Peaceful Uses of Outer Space, and actively contributed to the organization of the Third United Nations Conference on the Exploration and Peaceful Uses of Outer Space (UNISPACE-III). The representative of India served as President of the Conference.
4. The following paragraphs describe the institutional mechanisms in place in India to implement the recommendations of UNISPACE-III. It may be noted that in many areas, ISRO had a lot of activity related to most of the recommendations of UNISPACE-III, and hence the following paragraphs represent only the major initiatives.

1. Protecting the Earth's Environment and Managing its Resources

5. The National Natural Resources Management System (NNRMS) of India is administered by the Department of Space as the head agency. User agencies actively participate in this System, which monitors and assesses natural resources and the environment periodically. Ten standing committees, on various thematic areas are chaired by Secretaries of the respective Government Departments, and guide the activities of NNRMS.
6. Use of satellite remote sensing data for sustainable development is one of the important application areas for India. Land resources, water resources, ocean studies, biodiversity studies and the monitoring of agriculture are all covered under this application area. Recognising the country's experience in this field, India has been chosen as the Chairman of Action Team 2 on improving the management of Earth's natural resources, which was established by the Committee on the Peaceful Uses of Outer Space.
7. The meteorological observations of the Indian Ocean region is regularly carried out using GSO satellites by ISRO. This data and information is used at the national level for weather monitoring and prediction by the Indian Meteorological Department. India also shares this data with the World Meteorological Organization for the Indian Ocean region.

2. Using Space Applications for Human Security, Development and Welfare.

8. Space-based telemedicine projects are implemented by ISRO to connect rural hospitals with specialized hospitals in cities. A large number of telemedicine connections already exist. The telemedicine programme is centrally planned and executed from ISRO headquarters.
9. India utilizes space-based data / information for disaster management activities extensively. A Disaster Management Support (DMS) programme at ISRO Headquarters coordinates these activities. ISRO has become a signatory to the International Charter 'Space and Major Disasters', initiated by major space agencies in August 2001. Personnel were identified from various ISRO centres to support the Charter.

10. ISRO has in the past taken initiatives in the literacy and enhancement of rural education using satellite related infrastructure. The recent major initiatives include a 24-hour national satellite educational channel called Gyandarshan, which gives curriculum-based programmes. Some of the States in India have also initiated satellite based regional educational networks for programmes in the regional languages.

11. ISRO/DOS's Indian Institute of Remote Sensing (IIRS) provides expert training and capacity building in the specialized areas of remote sensing.

12. ISRO's Development and Educational Communication Unit concentrates on and implements all the developmental educational programmes using communication satellites.

3. Advancing Scientific Knowledge of Space and Protecting the Space Environment.

13. ISRO participates as a member of the Inter-Agency Space Debris Coordination Committee (IADC). It has contributed to the development of IADC's Space Debris Mitigation Guidelines and also implements them.

4. Enhancing Education and Training Opportunities and Ensuring Public Awareness of Space Activities.

14. ISRO's projects are always oriented towards national development. The Indian Space Programme is application-oriented, and its space applications are focused towards national development.

15. The decision makers are part of the top-level Policy Formulation and Review Committees for the Indian Space Programme.

16. ISRO headquarters has a strong unit – Publications and Public Relations – which undertakes a number of programmes for public outreach, including space exhibitions and programmes to increase the awareness about space activities among the general public.

5. Strengthening and Re-positioning of Space Activities in the UN System.

17. To assist in the improvement of capacity building processes in developing countries, ISRO undertakes a number of programmes under a scheme called, "Sharing of Experience in Space" (SHARES). ISRO has set up SHARES, through which training in different applications of space technology is provided to scientists from developing countries. According to the general arrangement under this scheme, selected candidates are provided with living expenditure and allowances by DOS, while the cost of international travel is borne by the sending country.

18. India hosts the Centre for Space Science and Technology Education in Asia and the Pacific, affiliated to the United Nations. The Centre was established in 1995 and is contributing significantly to capacity building activities among developing countries. Until now, more than 500 scholars from 29 countries have been trained. India spent approximately \$ 8 million building up the infrastructure for the Centre, and provides roughly half a million dollars as an annual grant to the Centre's activities.

6. Promoting International Cooperation.

19. India places great emphasis on working together with other countries and international bodies in promoting the development and use of space technology for different applications. ISRO implements this policy through bilateral agreements, participation in multilateral fora and participation in international professional organizations.

7. World Space Week.

20. ISRO organizes World Space Week celebrations every year in line with the recommendations of UNISPACE-III.

Poland

[Original Text: English]

1. This year, Polish activities in space have been conducted in the following fields: space physics; satellite geodesy; remote sensing; and space technology. Also, activities on space education and on future perspectives are reported.

Space Physics

Space weather effects in the Earth's ionosphere

2. In the area of space physics in 2003, the research activity in Poland continued on a wide range of issues starting from the phenomena at the frontier of the solar system to the practical problems related to space weather effects in the Earth's ionosphere.

3. Among the most important results are the following: theoretically predicted so called "mop" waves formed outside the heliopause in the process of interstellar dust grains penetration to the heliosphere; founding of the large-scale north-south asymmetry of the solar wind; study of the interstellar magnetic field effects on the termination shocks, heliopause, and the bow shock under the condition of an aligned magnetohydrodynamic (MHD) flow; analysis of the multifractal spectrum of the solar wind flow.

4. Solar physics studies were based on the results of the Polish experiment Resik, aboard the Coronas-F satellite. RESIK is the spectrometer of solar Roentgen radiation in the range of 3.2 to 6.1 Angstroms, developed in cooperation with the Naval Research Laboratory of the United States of America, Mullard Space Science Laboratory and Rutherford Appleton Laboratory of the United Kingdom of Great Britain and Northern Ireland (UK) and IZMIRAN of the Russian Federation. Nearly one million spectra in the active solar regions and flares were registered. Preliminary analysis identified several unexpected elements like potassium and chlorine. Broadband HF emissions were used to characterize the global changes of the ionosphere under varying solar activity and man-made effects, and the new methods were tested forecasting the total electron content in the ionosphere at discrete locations. The fine structure of the high-altitude polar cusp was studied from the Interball-Tail and Cluster using waves and plasma measurements. It was also discovered from the Polrad radio-polarimeter on Interball-Aurora, that the dayside polar cusp and the low latitude boundary layer could be the source of Auroral Kilometric Radiation (AKR), as well as the auroral oval. The polarization characteristics of AKR on the nightside compared to that on the dayside were also studied. Results of these experiments were published in 11 papers.

Planetological missions

5. In the area of planetology, the resonant dynamical evolution of small body orbits among the giant planets was evaluated. Tidal heating and convection in the medium sized icy satellites were also studied.

6. Polish scientists participated in the following planetary missions providing hardware and scientific interpretation of the obtained data:

- (a) European Space Agency (ESA)/National Aeronautics and Space Administration of the United States (NASA) mission of CASSINI (launched October 1997): the THP sensor (Thermal Properties meter), built in Poland, which is part of a British Surface Science Package experiment, has been installed on the Huygens lander to

Titan, one of Saturn's moons, to measure temperature and thermal conductivity of gases and liquids in the Titan's atmosphere and ocean;

- (b) MARS Express European Space Agency (ESA) mission - study of the Mars environment and the Martian dust properties using the Planetary Fourier Spectrometer (PFS). PFS was built in cooperation with France, Germany, Italy, and the Russian Federation. The instrument provides excellent spectra in the infrared range. The interpretation of these spectra is currently being undertaken;
- (c) ROSETTA ESA project - a mission to the comet P/Wirtanen: a contribution to the Multi-purpose Sensors for Surface and Subsurface Science (MUPUS) experiment in a penetrator PEN/MUPUS intended to measure the density, temperature, thermal conductivity and mechanical properties of the cometary nucleus. The laboratory model has been constructed.

Astrophysics

7. Polish astrophysicists are involved in ESA's International Gamma Ray Astrophysics Laboratory INTEGRAL project, devoted to measuring X-ray and gamma ray deep space sources.

8. Polish scientists involved in the field of space physics published and submitted together, more than 100 scientific papers in 2003.

Hardware for Future Experiments

9. Further development of instrumentation for several future international space projects continues in Poland, mostly in the Space Research Centre (SRC) of the Polish Academy of Sciences (PAS) Listed below are instruments to which Poland contributes:

- (a) Venus Express (ESA project): Planetary Fourier Spectrometer being developed from the Martian instrument to study the atmosphere and surface of Venus;
- (b) Herschel (ESA project): study of the formation of the stars and planetary system, particularly the Solar System in the microwave range;
- (c) Demeter (French project): aimed to study electric phenomena in the ionosphere stimulated by earthquakes. Poland has contributed to the plasma wave experiment;
- (d) Obstanovka (Russian project): study of the electromagnetic environment of the International Space Station;
- (e) Compass (Russian project): developing the radio spectrometer to study natural and artificial electromagnetic emissions in the ionosphere.

Satellite Geodesy

10. The main activities of the Satellite Geodesy Commission in 2003 can be specified as follows:

- (a) participation in the establishment of seven satellite permanent reference stations in the Silesia region for geodetic surveying in the frame of ASG-PL national network;
- (b) testing of accuracy and reliability of geodetic positioning on Polish territory with ASG-PL service;
- (c) development of Ranging and Integrity Monitoring Station (RIMS) Initial Operational Capability status of the European Geostationary Navigation Overlay System (EGNOS) station in Space Research Centre of Polish Academy of Sciences in Warsaw;

- (d) conducting permanent satellite global positioning system (GPS) observations in three Polish stations working for International Geodynamic Service (IGS) and five Polish stations working for EUREF service;
- (e) Studying the EGNOS System Test Bed (ESTB) European satellite navigation system during the development stage in the Central and East European Countries (CEEC) area;
- (f) Studying the accuracy, availability, reliability and continuity of GPS and EGNOS satellite dynamic positioning of cars, ships and aircrafts;
- (g) Participation in the Central Europe Regional Geodynamics Project (CERGOP) project and in the Unification of Gravity System in Central Europe (UNIGRACE) project;
- (h) Continuing and upgrading satellite laser observations (SLR) in Borowiec Observatory of SRC PAS;
- (i) Continuing to study the parameters of ionosphere in Lamkowo Observatory, University of Warmia and Mazury (UWM in Olsztyn);
- (j) Continuing Global Orbiting Navigation Satellite System (GLONASS) observations, time transfer and time comparison, data analysis and orbit determination, modelling of ionosphere and troposphere, satellite gradiometry, etc.

11. These activities were conducted mainly at the following research centres:

- (a) Department of Geodesy and Photogrammetry, Agricultural University in Wrocław;
- (b) Department of Mining Geodesy and Environmental Engineering, Academy of Mining and Metallurgy in Kraków;
- (c) Department of Planetary Geodesy, Space Research Centre, Polish Academy of Sciences in Warsaw;
- (d) Institute of Geodesy, University of Warmia and Mazury in Olsztyn;
- (e) Institute of Geodesy and Cartography in Warsaw;
- (f) Institute of Geodesy and Geodetic Astronomy, Warsaw University of Technology;
- (g) Naval Academy in Gdynia;
- (h) Maritime Academy in Gdynia;
- (i) Maritime University in Szczecin; and
- (j) Aircraft Academy in Deblin

Remote Sensing

12. Activities of the Remote Sensing Department, Institute of Geodesy and Cartography in Warsaw, were concentrated on land applications of satellite data. In particular, special emphasis was placed on further development and operational use of a remote sensing based system for crop condition assessment and yield forecasting. Extensive studies on the application of multi-sensor data for analysis of soil moisture/vegetation conditions within wetlands areas were also conducted. The major works carried out in 2003 are mentioned below.

- (a) *Development of a Crop Condition Assessment System for drought monitoring and yield forecast. Modelling of crop-soil parameters from Envisat Advanced Synthetic Aperture Radar (ASAR) (various polarisations) and Medium Resolution Imaging Spectrometer Instrument (MERIS) data – project with ESA CAT-1 ID 1427:* The aim of the project is to

obtain soil-vegetation parameters using water – cloud model, describing surface roughness and soil moisture. The project also involves modelling vegetation parameters such as LAI, biomass and vegetation –atmosphere heat fluxes –using meteorological and satellite data. Maps of crops have been created on the basis of microwave images;

- (b) *Developing methods for soil moisture assessment and classification of wetland areas on the basis of the synergic use of optical and microwave satellite data. The project has been undertaken in cooperation with ESA AO-ID122:* With this project, the method of soil moisture assessment for wetlands, using information derived from microwave satellite data, was created. In parallel, the methodology of studying ecological changes within wetlands through the application of multi-source optical/microwave satellite data, was prepared;
- (c) *Preparing the method for producing land use maps on the basis of high-resolution satellite images:* Research in this project resulted in the development of the hybrid method for producing satellite-derived land use/land cover maps;
- (d) *Methodology of studying the degradation of wetland ecosystems caused by peat fires based on information derived from satellite data:* In this project, analyses on applying different satellite data for detecting and monitoring wetland changes due to peat fires were conducted;
- (e) *Multimedia Geo-Information for e-Communities in Rural Areas with Eco-Tourism – ReGeo:* The aim of this IST Project, conducted within the Fifth Framework Programme, is to develop an improved tourist information system for promoting development of rural areas.

13. Activities of Remote Sensing of the Environment Laboratory (RSEL), Faculty of Geography and Regional Studies, Warsaw University, concentrated on applications of satellite and aerial data. The projects aim to assess the potential of hyperspectral data in the analysis and monitoring of mountain environments with a special focus on vegetation mapping and condition investigation. The study is based on airborne hyperspectral imagery analysis supported by a range of field remote sensing techniques and laboratory measurements within plant physiology. The activities are:

- (a) *Use of hyperspectral remote sensing for environment impact assessment and modelling in flood plains affected by mining wastes (in cooperation with Geological Institute of Hungary (MAFI), ITC, Netherlands, Debrecen University and JRC – Ispra of Italy):* The study aims to assess the potential of hyperspectral data in the analysis and monitoring of heavy metals contaminated vegetation, with a special focus on vegetation mapping and condition investigation. It also aims to study vegetation based on airborne hyperspectral imagery analysis supported by a range of field remote sensing techniques and laboratory measurements (plant physiology and chemical analysis);
- (b) *Assessment of the suitability of ERS-1/2 repeat-pass interferometry for landslide studies in West Carpathians:* The main goal of this study is to assess the possibility of charting and assessing the velocity of movement of the landslides in Polish Carpathians using differential repeat-pass interferometry. The study area comprises the central part of the Lower Beskid Mountains and neighbouring foothills (Pogórze Jasielskie, Obniżenie Gorlickie). The research work is performed using European Remote Sensing Satellites (ERS-1) and (ERS-2) data acquired during the summer in 1995 and 2003;
- (c) *Assessment of the potential of hyperspectral data and techniques in mountain vegetation analysis:* The proposed study aims to assess the potential of hyperspectral data in the

analysis and monitoring of mountain environments with a special focus on vegetation mapping and condition investigation. The study of vegetation is based on airborne hyperspectral imagery analysis supported by a range of field remote sensing techniques and laboratory measurements within plant physiology. The study also integrates hyperspectral aerial imagery and satellite multispectral imagery (using geostatistics).

14. Research in the Department of Photogrammetry and Remote Sensing Informatics in 2003 focused in three main areas:

Integration of hyperspectral data;

Remote sensing monitoring of an open-cast mine environment;

Satellite and close-range remote sensing monitoring for thermal anomalies detection over the salt dome areas.

15. Space activity at the Institute of Meteorology and Water Management (IMWM) in Krakow is mainly related to developing satellite data receiving and processing systems (focusing on meteorological satellites), its use in operational services for meteorology and hydrology and developing new methods of satellite product generation and data interpretation. The finalization of a project for the modernization of meteorological and hydrological services resulted in a completely new satellite infrastructure at IMWM. Certain research projects conducted during the last few years reached the phase of operational implementation. One of the very important activities of IMWM was close cooperation with the European Organisation for the Exploitation of Meteorological Satellites (EUMETSAT) according to a Cooperating State Agreement since 1999. There is a Satellite Research Department at IMWM, which is responsible for satellite data reception, processing and distribution to all IMWM users.

16. Research activity in the satellite field focused mainly on the practical applications of new satellite sensors. It was divided into four main projects contributing to the project group of IMWM, "Improvement of operational systems of meteorological and hydrological forecasts for reduction of natural disasters results and extraordinary hazards for people, economy and environment (including use of satellite and radar information)". These projects are:

- (a) Mapping precipitation using combined information from satellite, mesoscale forecast models and ground measurements (synoptic and climatologic) – a Geographic Information System (GIS) approach;
- (b) Improving the receiving, processing and distribution systems for meteorological satellite data;
- (c) Improving the methods of using satellite data for early detection and monitoring of storms;
- (d) Satellite monitoring of total ozone amount.

17. In 2003, EUMETSAT helped to organize a training course entitled "Practical applications of MSG satellite data in operational meteorological and hydrological forecasting", which took place at IMWM in Krakow from 12 to 15 November 2003. 35 participants from 15 countries took part in the course. The importance of this event has to be highlighted, particularly because Meteosat Second Generation (MSG) satellite data will become operational in 2004.

18. The initiative of Poland as a leading entity among three cooperating States concerning Satellite Application Facility (SAF) to support Operational Hydrology and Water Management became a crucial point of the IMWM's activity after approval of this theme by the EUMETSAT Council in December 2002. In 2003, the Working Group on Hydrological SAF was created by EUMETSAT.

19. In 2003, IMWM (Satellite Research Department) was involved in different international projects and activities concerning satellite data use. Among them, the most important were:

- (a) International Precipitation Working Group created by the World Meteorological Organization and the Coordination Group for Meteorological Satellites;
- (b) International TIROS Operational Vertical Sounder Working Group;
- (c) COST-718 Action ‘Meteorological Applications for Agriculture’;
- (d) COST-719 Action “Application of GIS in meteorology and climatology”– IMWM (Satellite Research Department) played an important role in this action by developing applications using satellite data and GIS;
- (e) COST –723 Action “Upper troposphere and lower stratosphere”– action started in 2003.

20. The Institute of Oceanology of PAS (IOPAS) is the leading government scientific institution on oceanography in Poland. Its research programme consists of a wide variety of oceanographic studies with special attention focused on the study and modelling of physical, chemical and ecological processes in the Baltic Sea, as well as on research on climate changes. Remote sensing is an essential tool for this research, therefore, developing a methodology and techniques for remote sensing of the water is one of the main goals achieved by the Institute. The Institute’s remote sensing activity is focused on the development and utility of ocean colour to estimate phytoplankton concentration, primary production and other ocean colour related products in the seawater. Access to ships and experience in marine optics allows the systematic validation of the remote sensing algorithms. The facilities of the Institute allow it to process satellite data from the Sea-Viewing Wide Field-of-view Sensor (SeaWiFS) project, Moderate Optoelectrical Scanner (MOS), Moderate Resolution Imaging Spectroradiometer (MODIS) and other ocean colour sensors. Most of the data is processed with the use of the institute’s own algorithms, which are more suitable to the local environmental conditions. Currently, the Institute is leading a national targeted project: developing a satellite method to monitor the Baltic ecosystem.

21. Main topics investigated at the Laboratory of Remote Sensing and Spatial Analysis, Faculty of Biology, Geography and Oceanology, University of Gdansk, using satellite (AVHRR, SeaWiFS, Meteosat) data in 2003 were:

- (a) Analysis of solar energy inflow and temperature distribution on the Baltic Sea surface based on satellite data:
 - (i) System of automatic registration and geometric correction of Advanced Very High Resolution Radiometer (AVHRR) data;
 - (ii) Procedure for calculation of physical fields parameters in the areas temporarily unseen from the satellite level;
 - (iii) Recognition of possibility/accuracy of spectral irradiance calculation at the sea level on the basis of satellite data using precise models of light transmission in the atmosphere (MODTRAN);
 - (iv) Investigations of optical properties of atmospheric aerosols in the Baltic Sea area on the basis of AERONET data; and
 - (v) Review and verification of AVHRR’s sea surface temperature (SST) algorithms for the Baltic Sea area.
- (b) The consequence of coastal upwellings phenomenon for biological productivity along the Polish coast of the Baltic Sea:

- (i) Surface water temperature during coastal upwelling along the Polish Baltic coast; and
- (ii) The influence of coastal upwelling on the concentration of chlorophyll-like pigments on the surface water along the Polish coast of the Baltic Sea.

22. The TeraScan High Resolution Picture Transmission (HRPT)/SeaWiFS/Weather Facsimile (WEFAX) reception and processing system was mounted and gained a signal at the end of 2000. This acquisition system is developed and manufactured to receive and process the full range of data imbedded within HRPT and SeaWiFS telemetry streams. The WEFAX telemetry involves the retransmission of data, and is received in an analog format.

23. The data obtained from HRPT and SeaWiFS sensors and Landsat Thematic Mapper (TM) data are used in the following ways:

- (a) South Baltic coastal circulation systems analysis;
- (b) Remote sensing analysis of surface current;
- (c) Upwelling structure study along the South Baltic coast;
- (d) Multispectral investigations of land cover changes;
- (e) Landsat TM multispectral data application for forest identifying and mapping;
- (f) Study of changes in coastal ecosystems.

24. Elaborated data is used from the WIN-HRPT system from the meteorological satellites of the National Oceanic and Atmospheric Administration of the United States (NOAA) for scientific and educational purposes. The Laboratory of Remote Sensing and Spatial Analysis detected some meteorological phenomena: thunderstorms, atmospheric fronts, radiation fogs, foehns and different cloud systems. Special attention was paid to Carpathians and Alps (1 PhD study). Some investigations were undertaken concerning urban heat islands (2 Master degree studies) and Normalized Difference Vegetation Index (NDVI).

Space Technology

25. Warsaw University of Technology (WUT) and Surrey Satellite Technology Limited (SSTL) of the United Kingdom are working on a project that might be co-financed by the European Community within the limits of the 6th Frame Programme. The aim of this project is to design and construct a small satellite for Earth observation and to establish the ground station in Poland. Satellite technology transfer is an integral part of the project. The satellite will be constructed in SSTL by a joint team of engineers and scientists from Poland (WUT and Space Research Centre) and SSTL, and the ground station will be constructed in Poland by Polish engineers. The project is similar to the ones already completed by Algeria, Nigeria and Turkey.

26. A designed satellite will be placed on low earth orbit (LEO) and will work as part of the Disaster Monitoring Constellation (DMC), which is an international system using small LEO satellites (7 – 8 satellites on one orbit) to observe the Earth, providing 32m multi-spectral imaging coverage anywhere in the world with a 24-hour revisit.

Activities in Space Education

27. In Poland, education directed into space research is carried out at WUT in three different Faculties. In the Faculty of Geodesy and Cartography, advanced studies cover: remote sensing and evaluation of space based pictures for geodesy, agriculture, urban planning, etc. Also at this Faculty, the theory of the motion of artificial satellites, the precise measurement of time and position, as well as the measurement of variation of gravity are included in the education

programme. At the Faculty of Electronics and Informative Technology, problems of satellites communication have been taught for a long time.

28. A special programme of education in astronautics began 10 years ago at the Faculty of Power and Aeronautical Engineering. In this programme, detailed lectures on space research include lectures on origin and evolution of the Universe and the Solar System, basic courses on space medicine, remote sensing, satellite telecommunication, GPS, space propulsion, design of spacecrafts, rockets and space-based instruments, etc. Education in this direction will be officially raised this year by the Polish Ministry of Higher Education and Sport to the level of “direction”, and could then be included in the education programme in all universities in Poland, which will have sufficient staff to run it.

29. Besides this specialized space education, in most Polish universities (specializing in education, science and technology), astronomy is included in physics, remote sensing and GPS technologies in geodesy. In many departments, satellite telecommunications is also taught. At Warsaw University, a course on Space Law is taught as well.

30. Students from the Faculty of Power and Aeronautical Engineering at WUT participated five times in microgravity flights, organized for students by ESA. They are also engaged in the student project YES2 and plan to be active in other students’ activities organized by ESA. Students are also actively involved in giving astronautics a profile by coordinating with the Polish Astronautical Society, as well as by participating in national and international conferences on this subject.

Future Perspectives

31. In 2003, the Committee for Space Research of the Polish Academy of Sciences and the National Space Office prepared a report outlining the prospects of the development of space activity in Poland after the accession of Poland to the European Union. The report summarises the research and technology potential of the country, underlines some more important achievements and proposes measures relevant to the new situation in Poland and the challenges of the twenty-first century.

32. The programme consists of three main elements: space science, application of the space systems and space technology development. In space science, the following research activities will continue or be developed: space physics, space astrophysics, Solar System exploration, satellite geodesy and remote sensing. Participation in the ESA missions, Rosetta, Herschel, Planck, XEUS and French mission Demeter, is supported. The recent success of the Mars Express Mission validates the specialisation of the Space Research Centre in optical spectrometry. Getting prepared and applying for the next Solar System missions is encouraged.

33. In space system application, the emphasis is placed on two European projects: Galileo and Global Monitoring for Environment and Security (GMES). Galileo is the important topic for modern transport solutions, however, the development of the time transfer methods with GPS will continue as well. The Earth observation programme will use ESA, French, American and other satellites. New method of data analysis will be developed for environment monitoring, agriculture applications and many other fields. Discussions are underway on a project to launch a mini-satellite into low orbit in co-operation with a foreign commercial consortium.

34. The programme for space technology development and the involvement of industry is being discussed in the context of possible membership with ESA. The necessity of a political decision in this domain is underscored.

35. Poland's principal partners in space for the coming years will be ESA and the European Commission. Nevertheless, continuing to co-operate with the Russian Federation and Ukraine to the extent possible is proposed.

36. Special attention is paid in the report to the legal and financial constraints of the programme of the European Union. The importance of the statement in the Constitutional Treaty of the European Union addressing space is underlined. According to the report, Poland must be prepared to fulfil the obligations resulting from the Treaty.