900 **DIRECTOR OF EARTH SCIENCES**

Plans, organizes, and evaluates a broad program of scientific research, both theoretical and experimental, in the study of Earth sciences. The program ranges from basic research, to flight experiment development, to mission operations and data analysis.

900.3 GLOBAL MODELING AND ASSIMILATION OFFICE

Focuses on comprehensive global climate modeling and on satellite data synthesis through assimilation. Promotes the use of satellite data by operational agencies through the transition of targeted assimilation technology, to enable their use by the research community through the provision of research products associated with NASA's Instrument Teams, and to provide a comprehensive global climate model resource to address the research priorities of the Enterprise.

Provides a core resource for the Enterprise in terms of model development to meet the strategic needs for global climate modeling within the Enterprise. The mission will cut across several themes, but all will focus on enhancing or demonstrating the utility of remotely sensed observations.

Satellite data synthesis: Develops the capability to assimilate remotely sensed observations into state-of-the-art ocean, atmosphere and land surface models with the purpose of generating value-added products for NASA's instrument teams. The development of assimilation systems in advance of future missions will be undertaken as a contribution to mission planning. Where appropriate, undertakes applications, e.g., in the context of the Joint Center for Satellite Data Assimilation (JCSDA) and/or seasonal prediction, to demonstrate the utility of satellite observations in an operational framework. The synthesis of multiple satellite data streams with comprehensive models will be an important contribution to the current climate record as well as to helping diagnose model deficiencies.

Seasonal-to-Interannual Prediction: Demonstrates the utility of remotely sensed observations of the ocean and land surface for enhancing prediction of El Nino/Southern Oscillation **(**ENSO) and other significant seasonal-to-interannual signals and their global teleconnections using comprehensive coupled models of the atmosphere, land surface, ocean, and sea-ice. Partnerships with the National Oceanic and Atmospheric Administration (NOAA) and the International Research Institute for Climate Prediction (IRI) will allow us to bring the utility of satellite observations to operational seasonal forecasts and applications. Our interest in the ability to forecast extreme events provides the link between our modeling of climate and weather.

Observing System Simulation Experiments (OSSE's): Makes an important

contribution to mission planning through observing system experiments, helping define the observing system requirements (sampling and accuracy) of new measurements for particular applications.

Global climate modeling: The foundations of successful assimilation systems are comprehensive, skillful models. Provides the focus for model development in the Enterprise and for its coupled model activities relevant to climate variability. Will be a resource for the agency, providing an experimental modeling facility in a model development framework and a comprehensive model to support, for example, the Global Water Cycle and Carbon Initiatives. Provides a focus for other national modeling efforts to interface with NASA in terms of model development and validation, with satellite observations used to help guide model development and testing.

JCSDA: Will participate in the JCSDA as the primary mechanism to interface with NOAA/National Center for Environmental Prediction (NCEP) so as to jointly develop state-of-the-art assimilation systems focused on remotely sensed observations, and to transition such technology to operations in NCEP and other JCSDA partners for both weather and climate forecasts.

Other formal collaborations: Will continue or establish formal collaborations with laboratories/groups in other U.S. agencies both to enhance NASA's modeling and assimilation capabilities and to facilitate NASA's contributions to the national climate model efforts.

902 GLOBAL CHANGE DATA CENTER

The Global Change Data Center provides Earth science data operations and archive management to key Earth science flight missions and data collection projects. Publishes data produced by NASA flight missions in forms that are conducive to scientific research and education. Develops and operates key advanced data systems in support of NASA flight missions. Develops, implements, and operates the GSFC DAAC and provides special services for the Earth science communities. Performs outreach to the science and education user communities to promote awareness and utilization of NASA data and to solicit input from users regarding data and information needs. Works closely with flight project and Earth scientists in data system planning and utilization; develops and implements capability to support Earth sciences mission needs. Responsible for supporting instrument algorithm development and operational project data set production systems.

903 EARTH SCIENCES ADMINISTRATION AND RESOURCES MANAGEMENT OFFICE

Serves as the focal point for the Earth Sciences Directorate in all resources and business management activities carried out at the Center. Areas of resources and business management include: budget, financial analysis, pricing, scheduling, configuration management, personnel, general business, and administrative automation. Serves as the primary business management interface between the Directorate and all external organizations. Has responsibility for identifying, planning and evaluating all activities for business management for the Directorate, coordinates with appropriate divisions/offices to ensure compliance with policies, regulations, and applications of business management techniques. Trains and provides collocated resources support to all divisions/offices within the Directorate to ensure effective utilization of resources.

910 LABORATORY FOR ATMOSPHERES

Serves as the focal point at the Center for the leadership, planning, management, and execution of a comprehensive theoretical and experimental research program dedicated to advancing our knowledge and understanding of the atmospheres of the Earth and other planets. The research program is aimed at advancing our ability to predict the weather and climate of the Earth's atmosphere; advancing our understanding of the structure, dynamics, and radiative and chemical properties of the troposphere, stratosphere, and mesosphere, from global to mesoscales; determining the role of natural and anthropogenic trace species on the ozone balance in the stratosphere; and advancing our understanding of physical properties of the atmospheres and ionospheres of the Earth and other planets. Identifies problems and requirements for observations of atmospheric processes by satellite or other techniques. Conceives, designs, develops, and implements electromagnetic, mechanical, ultraviolet, infrared, optical, electronic, radio, solar diameter, and chemical experiments and techniques for remote and in situ exploration and examination of terrestrial and planetary atmospheres. Provides for analysis and interpretation of data to further our knowledge of atmospheric phenomena. The importance of interdisciplinary research is recognized, and consequently, as examples, research in related aspects of oceanography is coordinated with the Laboratory for Oceans, of hydrology with the Laboratory for Terrestrial Physics, of climate research in the areas of modeling studies and predictive techniques with the Goddard Institute for Space Studies, and of solar terrestrial relations with the Laboratory for Extraterrestrial Physics.

912 MESOSCALE ATMOSPHERIC PROCESSES BRANCH

The mission of this branch is to conduct research to understand the physics and dynamics of atmospheric processes through the use of satellite, aircraft and surface-based remote sensing observations and computer-based simulations. Development of advanced remote sensing instrumentation (primarily lidar) and techniques to measure meteorological parameters in the troposphere is an important focus. Key areas of investigation are cloud and precipitation systems and their environments from the scale of individual clouds and thunderstorms through mesoscale convective systems and cyclonic storms, and up to the scale of the impact of these systems on regional and global climate. The processes of the interaction of the atmosphere with the land and ocean surface beneath it are also of high priority.

913 CLIMATE AND RADIATION BRANCH

Conducts research on the climate system, radiative processes involving the atmosphere and surface, and remote sensing techniques. Special emphasis is

placed on the analysis and interpretation of satellite data, including the development and improvement of methods for retrieval of climate-related parameters from satellite measurements. Numerical models of varying levels of complexity and detail are developed to test our understanding of climate and to determine its sensitivity to various types of forcing. Both data and models are used in fundamental studies of climate predictability and the detection of climate change.

Field experiments, including observations from airborne and ground-based sensors, are conducted to test new sensor concepts and to collect data in support of climate research.

915 ATMOSPHERIC EXPERIMENT BRANCH

Conducts experimental research pertaining to the atmospheres of the Earth, the planets, and the comae of comets. Conceives and develops new instrumental techniques for the determination of parameters of the atmospheres relating to structure, dynamics, chemical composition, and temperature. Designs and develops new instruments and systems for Earth and planetary balloons, satellites, and probes. Conducts laboratory studies to determine the characteristics of newly developed instruments in atmospheric environments. Develops calibration techniques, designs calibration systems, and performs instrument calibration of flight experiments. Tests new instruments in rocket and balloon flights. Applies methods and practices of experimental physics and electrical (electronic), optical, and mechanical engineering to the solution of these problems.

916 ATMOSPHERIC CHEMISTRY AND DYNAMICS BRANCH

Performs frontier scientific research in all facets of the radiation-chemistry-dynamics interaction in the troposphere-stratosphere-mesophere system. This is accomplished through global-scale modeling; satellite measurement, especially of ozone; and the collection, analysis, and interpretation of global-scale data. These culminate in a leadership role in the scientific results from the Upper Atmosphere Research Satellite.

920 LABORATORY FOR TERRESTRIAL PHYSICS

The Laboratory carries out research to advance knowledge in Earth science, and to aid in the improved management of the resources of the Earth, through the application of remote sensing and other space technology. Efforts include specific research in areas such as: the Earth's geoid; gravity and magnetic fields, and their application to ocean and crustal dynamics, Earth structure, and earthquake mechanisms; motions and mechanics associated with plate tectonics and their relationship to geologic resource provinces; spatial and temporal dynamics of land surface features such as vegetation, dry and green biomass, landforms, and other geological features, soils and soil moisture; and massed works of Man. Data systems are developed; new one-of-a-kind ocean, atmosphere, and Earth resources remote sensing active and passive instruments covering primarily the visible and infrared are designed, fabricated, calibrated, and tested. Observational studies using data acquired by ground-based, airborne, and spaceborne sensors are included along with the modeling and analysis of the sensor concepts that may be involved.

921 GEODYNAMICS BRANCH

Conducts research into the nature, dynamics, and evolution of the solid Earth and planets, including: the analysis and interpretation of magnetic and gravity fields, collection and analysis of topographic data, measurement and modeling of regional crustal deformation, morphological and morphometric studies of planetary landforms, and investigation of volcano-climate and orbital-rotational-climate interactions. Focus is on construction of models of planetary geophysical and geological processes, especially: core fluid flow and mantle convection; lithospheric response to loading and unloading; tectonic motion; earthquake, volcanic eruption, and other natural hazards; and surface change and landscape evolution. Provides scientific impetus and leadership in developing geopotential and topographic airborne and spaceflight experiments and missions for the study of the solid Earth and planets.

922 TERRESTRIAL INFORMATION SYSTEMS BRANCH

Advances the research programs and institutional administrative activities in the Laboratory for Terrestrial Physics through research in and application of information technologies. Activities include: developing data systems to process and distribute information from Earth observing satellites, aircraft sensors, ground-based networks and field experiments; developing software for the visualization, analysis and presentation of scientific data; operating and enhancing the Laboratory’s scientific research to students at all educational levels; leading efforts to facilitate interoperability among computing systems and applications and conducting research in information systems and remote sensing.

923 BIOSPHERIC SCIENCES BRANCH

Conducts fundamental and applied research in global and regional ecology, emphasizing the use of remote sensing techniques. Studies are conducted on the dynamics of ecological systems ranging from small-scale forest pest infestations and anthropogenic alterations to the urban environment to regional agricultural crop productivity, and desertification processes. Study techniques include biophysical on-site measurements; aircraft overflights; satellite data from Landsat, SPOT, and the operational NOAA satellites; and theoretical modeling. In addition, research is conducted in support of the ecological sciences. This includes the determination and modeling of the optical properties of vegetative materials, the development of advanced information extraction techniques, and the development of low-cost versatile remote sensing instruments for field use.

924 LASER REMOTE SENSING BRANCH

Defines, develops, and demonstrates advanced laser and electro-optic sensors for NASA's Earth and planetary science missions. Enhances the evolution of laser sensor technology from ground-based and airborne to space-based use. Specializes in the development of laser altimeters; water vapor, aerosol, and ozone-measuring lidars; and other laser atmospheric sounding experiments. Concentrates substantial effort to developing passive optical instruments, which sense ocean and atmospheric phenomena.

Works closely with science users to define, design, and build state-of-the-art scientific instruments; and maintains the necessary skills within the branch to accomplish this purpose. Collaborates with other Earth science and technological instrument groups in developing instruments which answer a broad range of Earth science research thrusts and scientific endeavors.

926 SPACE GEODESY BRANCH

Conducts solid Earth and oceans research using space methods and capabilities. Uses precise geodetic methods, including laser ranging and very long baseline interferometry; altimetry; data from highly accurate tracking systems such as GPS and Doppler; gradiometry; and satellite-to-satellite tracking to measure and study the motion of the Earth on its axis, the kinematics of plate motion, the deformation of the crust, the Earth and ocean tides, ocean circulation, and models of the gravity fields of the Earth and planets. Determines the positions of fundamental points on the Earth's surface, and the precise positions of geophysical, oceanographic, and planetary spacecraft. Develops spaceflight concepts for furthering research into space geodetic methods for studying the Earth and planets.

930 EARTH AND SPACE DATA COMPUTING DIVISION

Manages and operates a world class supercomputing and data center, pioneers in the application of advanced communications and networking support to making NASA science data more accessible to all elements of our society, both the expert and the interested novice. The Division utilizes state-of-the art computational equipment; networks and data systems and end-to-end support to Laboratory research within both Goddard science directorates. This support includes meeting the scientific data needs through the simulation and modeling activities of the Earth science community; provides specialized computational processing and archival services for the NASA science community and outreach programs to minority and other communities. In addition the Division provides support in the areas of sensor algorithms for direct ground communication read-out, information processing, discipline data base management systems, high performance scientific computing and parallel processing, high speed local and wide area network support and advanced scientific data visualization systems. The Division serves the general purpose supercomputing and data needs of both Goddard scientists and, on a national basis, the external NASA and university community.

The specific objective is to integrate scientific supercomputing and data delivery; science network access; and high performance computing into a scientific resource that supports a spectrum of OSSA science disciplines by maintaining, operating, and managing an efficient and accessible facility that is responsible to NASA's programmatic needs. The ESDCD is responsible for facilitating interdisciplinary and multi-disciplinary research by providing state-of-technology user friendly computer architectures, state-of-the-art computational sciences and scientific visualization tools, and user support for the scientific communities supported by the Office of Mission to Planet Earth, Office of Space Science, and Office of Aeronautics.

Serves as central scientific focus for local computer facilitates and external users. Manages projects in High Performance Computing, Networking, Visualization and Computational Sciences. Serves as Directorate and Center interface for coordinating plans and programs with Headquarters Information Systems, Office of Aeronautics, and Office of Space Access and Technology.

931 SCIENTIFIC COMPUTING BRANCH

The Science Computing Branch (SCB) is responsible for managing, provisioning, operating, and making accessible all production and R&D high performance computing and mass storage system facilities; support for Earth and space sciences applications; related allocation and accounting systems for efficient utilization of these resources to approved researchers. Support for research and development in high performance computing systems and scalable parallel

computational techniques that hold the promise of maturing into mainstream components of NASA Earth and space sciences computing systems scalable to sustained TeraFLOPS performance.

The SCB is responsible for providing the system and operations support for the NASA Center for Computational Sciences (NCCS) mass storage and computing complex, the High Performance Computing Project (HPC) testbeds, and other serve systems and equipment supporting the Earth and Space Data and Computing Division. This includes testing performance, benchmarking, installing, upgrading, and modifying all operating system and mass storage data management software; allocating all system and mass storage resources along with tracking and reporting utilization; acquiring all hardware, software, and maintenance necessary to support a large scale government computing center with its component of mass storage hardware and software; and overall configuration management and change planning for both the NCCS facility and the HPC Testbed resources. The SCB is responsible for working with the Earth and space sciences user community to ensure that all its supported platforms meet current and anticipated future user requirements. This includes ensuring that the operating systems, application software libraries, and hardware interfaces among all supported platforms appear as seamless as possible to the user.

The SCB is responsible for providing science applications and optimization support, including code optimization and conversion, user assistance and guidance, documentation, user outreach, and training. The SCB plans and implements a broad-based user outreach program that includes local and remote user support, algorithm development, software conversion, and testbed system development projects. Testbed system development projects include, but are not limited to, benchmarking applications software and tailoring discipline-specific applications for use by the Earth and space sciences communities. Staff members work closely with the Earth and space sciences user community to define requirements for general purpose, multi-user software support systems, including graphics, data management, and mathematical and statistical libraries. The branch plans and develops improved system capabilities and provides expertise in numerical analysis with specific emphasis on vectorization, parallelization, and optimization methods.

The SCB is responsible for development of scalable computational techniques which enable HPCC Grand Challenge applications and NASA flight missions, adapting the techniques to perform well on highly parallel systems, and capturing the successes in reusable forms.

933 SCIENCE COMMUNICATIONS TECHNOLOGY BRANCH

Leads the Division effort in the design, development, and implementation of advanced networking systems for high speed remote system access by universities, NASA, and in-house scientists. Provides central focus for external and internal accessibility of scientific computation platforms/support and data archives. Serves as the Directorate interface for networking of scientific and data analysis systems. Responsible for assessing advances in computer network technologies and information processing capabilities and planning, as appropriate, necessary developments for incorporation into the Division. Provides for the network security of the Division's systems in conjunction with the other operating elements of the Division. Responsible for installing, maintaining, and upgrading the Division next generation gigabit/s science network. Develop, evaluate, testbed, and implement Internet technologies that will maximize researchers use of the network as a multi-media entity to enhance collaboration and sharing of science information. Evaluate, testbed, develop, and install systems for direct read-out and processing of innovative satellite based remote sensing data to universities, government agencies, international partners of NASA, pathfinder studies, and public regional data centers for utilizing existing satellites and ground based receiving stations. Leads the Divisions outreach efforts both by managing projects such as Mu-Spin, an effort to upgrade minority university networks and by providing advanced networking expertise to other NASA initiative. Conduct a program of digital library technology and Earth science information value added products. Conducts workshops, symposia, and training sessions with NASA and University-related centers, organizations, and professional groups.

935 APPLIED INFORMATION SCIENCE BRANCH

The Applied Information Science Branch (AISB) performs original research in computer science, such as artificial intelligence, data structures, data compression, computer graphics, system planning and scheduling, distribution, data management, automatic data labeling and characterization, image processing, knowledge bases and expert systems, etc., that can provide short-term as well as long-term benefits to NASA and GSFC data systems and operations. The ISTB works with other organizations within the Division to provide guidance to NASA missions in the area of data and information management systems and techniques for the acquisition, storage, retrieval, manipulation, display, and analysis of scientific data and information; develops and integrates appropriate capabilities to facilitate interdisciplinary research needs expressed by space and Earth scientists by supporting multi-source, multi-parameter, and multi-project data sets and databases, and by developing advanced database facility and analysis capabilities; leads NASA activity in development of high performance satellite low-cost direct

readout capabilities, image browse, advanced data storage, data compression and analysis techniques, and distributed system architecture technologies.

The AISB will be organized into two functional groups. The first group will concentrate on applied computer and information science research. The second group will concentrate primarily on applied technologies. The two groups will work together and share requirements and developments as appropriate to meet the Branch's overall character and goals.

940 **GODDARD INSTITUTE FOR SPACE STUDIES**

Conducts a comprehensive theoretical and experimental research program focused on the causes of long-term climate change. The program includes remote sensing of the atmospheres of the Earth and the planets, modeling activities to understand the factors influencing long-term climate change, the development of far infrared detectors for atmospheric measurements, and the application of the measurement techniques developed to astrophysics.

970 **LABORATORY FOR HYDROSPHERIC PROCESSES**

Responsible for a broad program of theoretical and experimental research in ocean and cryospheric sciences, ocean dynamics, and the role of oceans and ice in global- scale processes such as climatology and global habitability, and for the development of environmental remote and in situ sensing systems and processing facilities. Plans and directs studies and investigations to determine needed observations and measurements to improve fundamental knowledge and understanding of oceanic and cryospheric processes, instrument physics, and electromagnetic interaction with the surface/medium. Develops theoretical models, laboratory and field experiments and instrument and data systems, and produces geophysical information from the remote sensor data. Collaborates with other elements of the Directorate in areas of unique expertise dealing with multidisciplinary measurements, microwave sensors, and high quality laboratory and field facilities for calibration. Maintains a capability throughout the visible, infrared, and microwave portions of the electromagnetic spectrum. Maintains a capability for oceanographic research to enable the Laboratory to cooperate with the oceanographic research community and reflect its needs and interests in remote sensing development.

970.2 SeaWIFS PROJECT OFFICE

Manages the definition, implementation, development, and operation of the NASA Sea Wide Field Sensor (SeaWIFS) program under the program guidance of the NASA Headquarters Oceanic Processes Branch and the administrative direction of Goddard Space Flight Center through the Laboratory for Hydrospheric Processes, Code 970. The functions are detailed in the SeaWIFS Project Implementation Plan approved by NASA Headquarters and Goddard.

971 OCEANS AND ICE BRANCH

Carries out research on the roles of oceans and ice in global weather and climate. Develops remote sensing methods of remote sensing algorithms and interpretation, assists in sensor development, and demonstrates, through research applications and flight programs, the use of remote sensing in research on the Earth environment and global habitability. Works with the scientific community on problems in oceanography, air-sea interaction, and glaciology. Carries out research in climatology in cooperation with scientists in meteorology and other neighboring fields. Works jointly with engineers and physicists on sensor development and the planning and execution of experiments. Serves as liaison between NASA and the oceanographic and glaciological research community by collegial interactions and participation in joint research.

972 OBSERVATIONAL SCIENCE BRANCH

Responsible for theoretical and experimental research of observational systems and techniques associated with oceanic remote sensing. Performs instrument systems performance assessments. Plans and conducts laboratory and field measurements to improve the fundamental knowledge of remote sensing, and to evaluate sensor systems, and to quantify their performance. Assists other branches with field experiment planning, flight platform interfacing, and data acquisition. Develops, maintains, and operates research facilities (i.e., wave tank, laboratory field standards, aircraft remote sensors, ground-based ozone and wind sensors) to obtain high quality measurements that support the development of new sensors and to obtain key scientific data. Establishes agreements for field data exchanges in support of scientific studies and satellite sensor calibration (i.e., vertical sounding of or one temperature's, humidity, ocean waves and chlorophyll, etc.,). develops and furnishes algorithms to flight project personnel that convert the instrument observations into geophysical parameters.

974 HYDROLOGICAL SCIENCES BRANCH

Conceives and executes research activities that have the objective of contributing to an improved understanding of hydrological processes occurring within the Earth and its atmosphere and of increasing Man's ability to monitor cycle that affect the balance of natural resources and human activities. These research activities principally emphasize the application of the principle of physics involved in remote sensing experiments to observe the physical properties of the storage components of the hydrological cycle, such as lakes, streams, rivers, groundwater, snow and ice cover, and soil moisture, and the fluxes, such as precipitation, evapotranspiration, and energy. Techniques are developed from the effective use of water resources on all scales from agricultural fields to global studies by employing remote sensing as a major observational tool. Relationships between hydrology and Man's well-being and activities (agriculture, transportation, and recreation) are investigated. Measurements are developed with space-related techniques so as to improve the management of water resources and the monitoring of the hydrological environment.

975 MICROWAVE SENSORS AND DATA COMMUNICATION BRANCH

Performs research and development on advanced microwave sensing systems and data collection systems directed at providing remote and in situ data for research in the areas of the oceans, weather, climate, and hydrology. Plans research and technology development, conducts system studies, develops concepts, conducts experimentation, develops systems, and provides consultation to other entries such as flight projects, other NASA centers, and government agencies. In collaboration with discipline scientists, conducts studies which develop and document the scientific and applications rationale for future environmental

sensors, sensor systems, and missions. Performs basic laboratory and field studies which elucidate the interaction of electromagnetic radiation with the environment as it relates to improving our understanding of remote sensing systems. Develops models which describe and predict the performance of remote sensing systems as applied from the ground, aircraft, and space. Develops data analysis algorithms which are designed to provide useful geophysical information from remote sensor data. Maintains an end-to-end sensor and system development and technique capability.