



MINISTÉRIO DA CIÊNCIA, TECNOLOGIA E INOVAÇÃO
INSTITUTO NACIONAL DE PESQUISAS ESPACIAIS

Print

Programa Institucional
de Internacionalização
da CAPES

NATIONAL INSTITUTE FOR SPACE RESEARCH **INPE**

INTERNATIONALIZATION OF GRADUATION PROGRAMS PROJECT **PII-INPE**

PRÓ-RECTOR

ANTONIO FERNANDO BERTACHINI DE ALMEIDA PRADO

October / 2018



CALL AND INSTITUTION INFORMATION

Program – Capes/Print

Call 41/2017 – Capes/Print

Institution - National Institute for Space Research

Institution acronym - INPE

REGISTRATION DATA

Registration number

IP

CAPES-PRINT774712P

150.163.58.149

Start date

Submission date

Receipt data

09/03/2018 09:41:29

10/05/2018 13:24:49

10/05/2018 13:24:50

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Tax ID

034.846.788-52

ID number

Issuing agency

Expedition date

139073474

SSP-SP

10/05/2018

ORCID number

ResearchID

0000-0002-7966-3231

C-7808-2012

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INSTITUTIONAL COMMITTEE

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Celso von Randow	celso.vonrandow@inpe.br	551232087921
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Earth System Science	Environmental Sciences	01/12/2010 12:00:00

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Postgraduate Program	Field of research	Admission Date
Meteorology	Geosciences	01/09/2007 12:00:00

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Astrophysics	Astronomy	01/02/1994 12:00:00

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Postgraduate Program	Field of research	Admission Date
Space Geophysics	Geosciences	01/09/2004 12:00:00

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Postgraduate Program	Field of research	Admission Date
Earth System Science	Environmental Sciences	01/01/2013 12:00:00

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Postgraduate Program	Field of research	Admission Date
Applied Computing	Engineering / Technology Management	01/04/2005 12:00:00



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Postgraduate Program	Field of research	Admission Date
Remote Sensing	Remote Sensing	01/04/2013 12:00:00

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DIAGNOSTICS

Strengths

Title

International recognition



Justification

From 2012 to 2017, post-graduate students and professors from the 7 programs at INPE received 37 international awards, many of which as a result from publications in international meetings. Many researchers from all programs were involved in the organizations of international meetings and many are members of international committees. Among the programs, the percentage of researcher granted with CNPq productivity fellowship varies from 15% to 45%. Several professors from INPE are enrolled in international projects of very high relevance. For instance, some researchers are members of the LIGO collaboration, whose research findings lead to the Nobel Prize in Physics (2017). Some INPE researcher participated in the first detection of short duration gamma ray bursts using data from the HETE (High Energy Transient Explorer) satellite. Some researchers are members of the COSPAR (Committee on Space Research) Bureau, the executive committee of IAGA (International Association of Geomagnetism and Aeronomy) and members of the expert group of the UN/COPUOS Space Weather. In addition, some researchers participate in the CEOS (Committee on Earth Observation Satellites) and in the IPCC (Intergovernmental Panel on Climate Change). INPE's EMBRACE program is the Brazilian representative at the World Meteorological Organization (WMO) for Space Weather.

Title

Continuous Efforts for Internationalization

Justification

INPE's postgraduate programs have already made efforts related to internationalization. Several programs have encouraged students to publish their thesis and dissertations in English: in these programs the average number of thesis and dissertations published in English varies between 12 and 22 percent, considering the period between 2012 and 2017. It is important to note that all thesis and dissertations are made available on the Internet through the INPE Library, in an open and free way. The programs have also been prepared to welcome foreign students. All programs intend to offer at least 40 percent of their courses in English, up to 100 percent for some programs over the next four years. Several courses in the programs already have specific material available in English.

Title

Large fraction of publications in journals included in JCR (Journal of Citation Reports) and large fraction of participation of foreign coauthors in projects and publications.

Justification

From 2012 to 2017 all 7 postgraduate programs at INPE had a large fraction of publications in journals included in JCR. The average percentage in each program ranged from 58% to 93%. This is an evidence of the high quality of the research produced at INPE's programs. In this same period, foreign coauthors were present in 20% to 67% of the published papers, depending on the program. Regarding the approved projects, 8% to 42% of them had foreign participants. These figures were obtained from averages per year and per program. Foreign participants and coauthors were from a number of nationalities, covering from 23 to 69% of all the countries with which CAPES already has formal agreements, depending on the program. Other activities also have collaboration / participation of foreign researchers: organization or member of organizing committees of more than 80 meetings, symposiums, schools, and similars. In the analyzed period, INPE received more than 180 visitors from abroad, all of which had very productive interactions with professors/researcher and students through activities such as seminars, lectures, courses, project activities, etc.

Title

International experience of the researchers / professors and level of enrolment of the students in internationalization efforts.

Justification



A substantial fraction of the researchers / professors from INPE postgraduate programs were trained in foreign institutions (doctorate, post-doctoral or visiting fellowships). From 2012 to 2017 the percentage of researchers / professors in this situation has been on average 50%, ranging from a lower limit of 30% and upper limit of 80%, depending on the program. Some postgraduate programs at INPE have foreign professors which were trained in Brazil or abroad in the early years of the institute. Currently, the 7 postgraduate programs at INPE have 577 students altogether, both in Masters and Doctorate levels. All students are advised to apply and participate in international meetings, with support from INPE or other funding sources. Doctorate students are stimulated to apply for doctoral internship abroad (PDSE) to spend up to 1 year at an institution abroad to complement his/her thesis work. From 2012 to 2017 more than 100 doctorate students spent at least 3 months in institutions abroad. Some of them formally include the foreign host researcher as a co-supervisor of the thesis. All students have mandatory foreign languages exams which may include well known exams such as TOEFL, TOEIC, TCL, DELE, etc. We estimate that 15 to 50% of all students are fluent in a foreign language. INPE's programs has traditionally attracted foreign students for Masters and Doctorate training. In the above mentioned period, 53 postgraduate foreign students concluded their Masters of Doctorate studies at INPE. Currently some programs have percentages of foreign students ranging from 7 to 17%.

Title

Institutional Facilities

Justification

INPE maintains many laboratories for basic and applied research, all related to the mission of the institute. These facilities are widely used by the researcher who are also professors/advisors at the postgraduate programs. Among them, we highlight a few laboratories: Solar Polarimetry; solar wind and magnetospheres; gravitational waves; geomagnetism; high energy astrophysics; integrated environmental modeling; image processing; geoinformatics; oceanography; remote sensing applied to agriculture and forests; environmental biochemistry; meteorological instrumentation, among others. Supporting laboratories are also very important: propulsion lab; electro-optical systems lab; energy supply lab; hardware and software labs; space electronic manufacturing lab (clean room 100,000 class); imaging, optical and attitude systems characterization lab (clean room 10,000 class); etc. INPE also has a wide infrastructure of earth and space observation which are used in conjunction with the postgraduate programs. Some examples are: LIDAR systems; airglow imagers; LEONA network; ionospheric radars; ionospheric receivers; digisondes / ionosondes; onboard instrumentations (balloons, sounding rockets and satellites); the Brazilian Decimetric Array; the Multidirectional Cosmic Rays Detector (MUONS); magnetometer network. INPE also maintains the Remote Sensing Data Centre, with satellite earth and meteorological data from the Brazilian territory; the Lab. for Atmospheric Electricity, which operates three lightning detection networks; lab of energy and renewable resources (SONDA); Space Weather Program (EMBRACE), among others. In terms of computational facilities, INPE has several clusters from research projects, a supercomputer with 31,296 processors for high performance processing, storage capability of 2 Petabytes and a 10 GB broadband internet connection, etc.

Weaknesses

Title

Limited experience in double degree doctorates

Justification

It is of INPE's main interest to be able to offer its postgraduate students the possibility of double titulation. Efforts underway show that bilateral agreements are required between INPE and each foreign institution with which there is the desire to jointly award double degrees. INPE is not an autonomous institution and all agreements have to go through appropriate legal government evaluation organisms.

Title

Reduced technical staff



Justification

INPE is largely composed by researchers and technicians (with M.S. or Ph.D. degrees) who normally engage in teaching activities at one of the postgraduate programs. There has been an increasing number of staff personnel retirements without new hirings. Some support activities are conducted by researchers and students, or sometimes outsourced.

Does it have a well-defined institutional vocation?

Yes

Describe the vocation of your institution

INPE's mission is to conduct scientific research and technology development in space and earth environment, aiming at the production of knowledge and offering unique services and products for the benefit of Brazil.

Describe other relevant information about the level of internationalization of your institution

The institute has an international scope since its foundation in the early 60s. Its whole history is found at http://www.inpe.br/institucional/sobre_inpe/historia.php. In the beginning, many foreign researchers were hired to work at INPE. Nowadays, many researcher and technicians have training in foreign institutions. INPE organizes and hosts several international meetings every year. INPE maintains cooperations with other countries to improve the production and dissemination of knowledge, sharing scientific and environmental data, access to technology, capacity building workshops, fostering space industry, improving political, economical and commercial relations with partner countries, in resonance with the guidelines from the Ministry of Science, Technology, Innovation and Communication, Brazilian Space Agency and Ministry of Foreign Relations. We highlight some international cooperations: agreement with the National Research Council of Argentina; MOU with the National Space Administration of China; Program with the National Geological Service of the US; agreement with the University of Maryland (USA); MOUs with NOAA (USA), LIGO lab. (USA); INPE/AEB and NASA (USA); CNRS (France); ISRO (India); letter of intent with JAXA (Japan); agreement with University of Leeds (UK); European Union and ESA; UN/FAO. More detailed information about all INPE's formal international cooperation can be found at:

http://www.inpe.br/institucional/sobre_inpe/relacoes_internacionais/cooperacoes_vigentes.php.

INSTITUTIONAL PROJECT REGISTRY - PII

Institution of the Project Coordinator

National Institute for Space Research

General Goals

In more than 50 years, INPE has acquired competences, recognized nationally and internationally, in scientific and technological development activities, generating knowledge, products, processes and services that are disseminated to the society. These competencies are a result of the Institute's Postgraduate Programs (PGPs), which has been forming specialists and scientists contributing with the creation of new graduate and postgraduate centers throughout the country, since the 1960s or are employed by high-technology companies in Brazil. Through cooperation agreements and/or partnerships in several research fields, whether with national or international institutions, public or private, all INPE's activities had traditionally some degree of internationalization. Special attention has been given to terms of exchange of researchers (professors) and students, and to collaborations and partnerships in most different forms: cooperation projects, joint publications, courses and training, technology transfer, among others. In this way, the overall objective of this Project is to consolidate INPE as a leading institution with internationally recognized academic activities as well as technological developments. Moreover, further expanding international partnerships, collaborations and personnel training at an international level will help achieving its mission to produce science and technology in Earth and Space areas in order to offer singular products and services for the benefit of Brazil and enabling INPE to accomplish its vision of being a national and international reference in Earth and Space



areas, with emphasis on the generation of knowledge and services, as well as the anticipation of development demands and quality of life of Brazilian society. Specifically, the objectives of the proposed internationalization project are to: I - Promote the development, implementation and consolidation of a strategic plan for the internationalization of the Institute's PGPs based on the seven priority thematic areas; II - Maintain and expand the existing international research networks at INPE as well as foment the creation of new networks to improve the quality of academic production of its PGPs; III - Expand the internationalization actions in the INPE's PGPs, encouraging the consolidation of research projects in cooperation with Institutions abroad; iv - Maintain and expand the academic training of human resources through the mobility of professors and students, with emphasis on doctoral students, postdoctoral students and professors, from Brazil to abroad and from abroad to Brazil, linked to the stricto sensu PGPs; V - Expand and consolidate INPE as an institute with an international environment; VI - Integrate several actions of each PGP for supporting INPE's internationalization effort.

PROJECT THEMES AND SPECIFIC GOALS

Theme	Countries
INSTRUMENTAL ASTROPHYSICS	United Kingdom; South Korea; Portugal; Chile; Uruguay; Ecuador; Peru; Bolivia; Paraguay; Italy; Japan; Mexico; Poland; Russia; Switzerland; France; Taiwan; Canada; China; Australia; Belgium; Germany; Hong Kong; Hungary; India; Spain; Netherlands; Argentina; Colombia; Venezuela; United States

Justification

INPE's Astrophysics has as its characteristic to be the most focused in the country for the development of astronomical instrumentation. Instrumental development encompasses the entire electromagnetic spectrum, from the radio range, through the infrared and optical bands to the high energy range. INPE also leads the only Brazilian project for a gravitational wave detector. The constitution, formation, evolution and phenomenology of diverse astrophysical objects are investigated through the collection / analysis of observational data, the development of astronomical instrumentation and the construction of theoretical models. The research lines of the AST-INPE thematic area are: High Energy Astrophysics, Cosmology, Optical and Infrared Astrophysics, Radiophysics, Interplanetary Medium Physics, Gravitational Waves and, more recently, Space Weather. Due to the vocation for the development of instrumentation and development for technology generation, there is interaction with national companies and specific technology transfer activities for local industries. DIDAS / INPE is the main institution of the country in the effective instrumental development in astronomy. As a direct consequence, the AST-INPE program produced purely instrumental theses on pioneering instruments such as "*Development of high sensitivity parametric transducers for the Mario Schenberg gravitational wave detector*", "*Polarization of galactic radiation at 5 GHz: instrumentation, measurements and maps*", "*High-energy astrophysics: development of the MASCO telescope and observations of GRO J1744-28 with the SIGMA telescope*", "*Radio interferometric investigations of solar phenomena and calibration method using GPS satellites*", among others. In addition, there are several dissertations and theses in which astronomical instrumentation is at least partly considered and/or studied. An internationalization program will give a new dimension to a training in astrophysical instrumentation, as it will allow: (i) visiting of foreign professors to teach advanced instrumentation techniques; (ii) visiting of Brazilian students and postdocs fellows to the best international centers of astronomical instrumentation; (iii) visiting of foreign students and postdocs fellows from the United States and Europe, who had better laboratory training and, therefore, would have greater skills in the development of instrumentation theses; greater international visibility of the course.

Goals

Goal

Developing State-of-the-Art Astronomical Instrumentation



Description

The development of state-of-the-art astronomical instrumentation is one of the main objectives. And it is intended to achieve it through international partnerships with the countries mentioned and participation of the national industry. A good example is the development of laser interferometers for gravitational wave astronomy. INPE is the only national institution that participates in the development of the instrumentation of the LIGO interferometer, which recently detected gravitational waves for the first time, and which resulted in the Nobel prize of 2017 and several other awards.

Goal

Training Human Resources in the Astronomical Instrumentation Area

Description

This objective will be fulfilled naturally, as we train students and guide postdocs in the work related to this topic, mainly being able to rely on foreign participation in this training. These human resources will certainly be able to continue in the future or be used by the national industry in other high technology projects, as happens in the first world countries.

Goal

Producing scientific knowledge in the frontiers astrophysics and physics and communicate them to the scientific community and the society in general.

Description

Also as a consequence of the participation in the collaborations of projects that develop state-of-the-art astronomical instrumentation, the scientific knowledge that will be obtained should be at the frontier of knowledge. Publishing it in scientific journals and releasing it to the general public is a duty of this public institution.

Goal

Fostering the Participation of the National Industry in the Development of High Technology Instrumentation

Description

As we are able to engage the national industry in the development of state-of-the-art instrumentation for astronomy, we will be furthering its capability to develop high-tech, value-added instrumentation. Parts of telescopes, radio telescopes, X-ray and gamma satellites, or laser interferometers may eventually be built in the country.

Theme	Countries
SATELLITE APPLICATIONS FOR SUSTAINABLE DEVELOPMENT	Peru; Portugal; South Africa; Austria; Germany; Australia; Netherlands; Italy; Japan; Colombia; Denmark; Chile; Belgium; Finland; Norway; New Zealand; Poland; Russia; France; Switzerland; India; Spain; United States; Ireland; Mexico; United Kingdom; Sweden; Canada; Argentina; China

Justification

In the global context of the discussions on environmental change, sustainable development, health and food security, Brazil has a leading position in the development of satellite monitoring and geoprocessing techniques for natural resources, development of technologies for image processing, analysis of satellite data and provision of services. The main objective of this thematic area, within the context of the INPE Postgraduate



Program, is to train scientists and professionals, guaranteeing that they acquire recognized competence and leadership to act on national issues aligned with global initiatives. Thus, the theme aims to form scientific leaderships to subsidize actions and create solutions within international forums such as the United Nations Framework Convention on Climate Change (UNFCCC), the Intergovernmental Panel on Climate Change (IPCC) the Convention on Biological Diversity (CBD), the Convention on Floodplains of International Importance (RAMSAR), the Convention to Combat Desertification (UNCCD) and the Sendai Framework for Disaster Risk Reduction (UNISDR). The competent acting of the leaderships formed within this thematic line, through the development of state-of-the-art knowledge, will strategically assists Brazil to fulfill its international targets established within the National Policy on Climate Change (PNMC - Law 12,187). This includes identifying and implementing actions on mitigation; impacts, vulnerabilities and adaptation; research and development; as well as education, training and communication. These actions will also have a direct impact on the National Strategy for REDD + in Brazil (ENREDD+), which formalizes, to the Brazilian society and signatory countries to the United Nations Framework Convention on Climate Change, actions to prevent and control deforestation and forest degradation and to promote sustainable development. This multidisciplinary subject requires not only the understanding of complex environmental systems, but also the knowhow on satellite image processing, the knowledge and capacity of developing sensors for the monitoring specific targets and the ability to model these systems.

Goals

Goal

Promote advanced research and technological development in Earth Observation focusing on remote sensors and their applications

Description

This objective aims to establish solid collaborations between INPE's postgraduate program in this subject with international partners to transfer technical knowledge and increase the quality of scientific production at the international level. The theme focuses mainly on the development of techniques for satellite monitoring and geoprocessing for natural resources, development of technologies for image processing and use of satellite data for environmental monitoring and provision of services to society.

Goal

Provide excellence in higher education and technical training in the area of satellite applications for sustainable development

Description

To train researchers and professionals with recognized competence and leadership to act on national issues, related to international sustainable development goals, aligned with global initiatives. The objective is to train scientific leaderships to subsidize actions and create solutions within the national scenario with insertion in international technical forums . The objective includes both the participation of postdoctoral students (Brazilian and foreign) in the postgraduate course, as well as the opportunity for scientific exchange for students enrolled in this topic, and the participation of foreign professors in the postgraduate activities with this thematic for students' training.

Goal

Communicate scientific results to society

Description

This objective includes the dissemination of scientific knowledge both in dissertations, theses and scientific articles that must be available to society in open access policy. In addition, it values the communication of the results to the general public through the use of vehicles of wide reach like webpages, specialized blogs,



newspapers and journals. To achieve the widespread dissemination, the mastery of foreign languages, especially English, becomes critical.

Goal

Promote the state of the art of scientific knowledge in areas of research in line with the demands of Brazilian and international society

Description

This objective aims to prioritize the teaching of scientific issues aligned with the current demands regarding the elaboration of technical solutions that require the understanding of complex environmental systems, the domain of satellite image processing, knowledge and development of sensors for the monitoring of targets and the ability to model such systems. The objective is to achieve a competent performance of the leaderships formed within this thematic line, strategically assisting Brazil to fulfill its international goals. Aiming at the direct impact of research in Brazilian society and countries signatory to the United Nations Framework Convention on Climate Change, actions to prevent and control deforestation and forest degradation, promote forest recovery and promote sustainable development. Thus, the transfer of scientific knowledge will focus on the development and application of Remote Sensing and Geoprocessing in the following areas: 1. Tropical agriculture; 2. Tropical ecosystems and environmental sciences; 3. Climate change and land use; 4. Tropical Forest Resources; 5. Oceanography; 6. Inland Waters; 7. Geology and Geomorphology; 8. Urban Studies; 9. Geoprocessing; 10. Hyperspectral Remote Sensing and Spectroradiometry; 11. Remote Sensing Image Processing: High and moderate resolution optics, LIDAR and RADAR.

Theme	Countries
MODELLING AND ANALYSIS OF EARTH AND SPACE DATA	Chile; China; Portugal; Argentina; India; Germany; Brazil; Canada; Cuba; Spain; United States; France; Netherlands; Ireland; Italy; Japan; Mexico; United Kingdom; Russia; Sweden; South Africa;

Justification

Space and Earth data are those that allow the understanding of Earth and Space as dynamic systems composed of subsystems (such as the atmosphere, forests and urban areas, geosphere, oceans, interplanetary environment, etc.) that interact at different spatial and temporal scales. These data are used in applications for the systematic monitoring of environmental resources with impact on health, urban development, food security and to monitor impacts and changes in climate and the environment. These data are collected by sensors of various types, purposes and characteristics, created and deployed so that the measured systems can be understood through the application of scientific knowledge. Since its inception, the National Institute for Space Research has been an international reference in the collection, analysis and distribution of environmental and space sensor data and in applied research involving these data. For example, using data from remote Earth observation sensors along with other spatial data, INPE produces, through institutional projects or joint projects with other federal institutions, environmental monitoring data. Examples of these data products are the deforestation maps of the Brazilian biomes produced by the PRODES, DETER and FIP-Cerrado projects; information on burnings and fire risk produced by the Queimadas Program; and annual estimates of greenhouse gas emissions by changes in land cover in Brazil. Space and Earth data are voluminous and diverse, since they are collected systematically over time by different measurements obtained by different sensors. To model and analyze this data, several issues need to be addressed; from the organization and management of this data in an integrated way (information from diverse sources, different spatial and temporal scales and access to historical data) to the creation of analysis methods and tools that allow its use to solve important scientific questions. In addition to the analysis of data from Earth and Space sensors there is also the need to create, apply and evaluate numerical and computational models to better understand the various phenomena related to the subsystems of Earth and Space. Given the complexity of these systems and the knowledge about their operation, it is always necessary to look for new numerical techniques and to execute the models in an acceptable time.



Goals

Goal

Storage and Processing of Large Volumes of Spatiotemporal Data

Description

Carrying out research, development and applications of new techniques for data storage and processing, in particular for spatiotemporal data and data representing environmental variables collected through networks of sensors, satellites, or models (climate, meteorological, astrophysical, complex networks, etc.), which often has a large volume or complex structure. It also includes research and development of high-volume data processing techniques, such as high-performance processing, distributed processing and data processing on mixed platforms such as clusters, FPGAs, GPGPUs, etc. It also involves application of robust software development techniques for processing such data and modeling for large volume and / or complex structure storage and retrieval.

Goal

Space and Earth Data Analysis, Modeling and Mining

Description

Carrying out research and development of new methods and algorithms for the extraction of knowledge from spatiotemporal data such as climate and meteorological time series; remote sensing images of diverse types, scales and applications; astronomical objects' images and catalogues; spatiotemporal data such as those obtained from sensor networks, trajectories and events' mapping; complex networks of interaction between different types of agents; environmental and cosmological simulations, etc. It also involves research on environmental and spatial phenomena and their relationship with computation and modeling, and the creation and validation of models for all these types of phenomena and the implementation of the corresponding algorithms (of analysis and modeling) in an efficient and reliable way.

Goal

Development of Scientific Software for Environmental and Space Applications

Description

Carrying out development of specific scientific software for diverse space and Earth applications, ranging from software for spatiotemporal data processing based on geographic information systems, publication of space and environmental data on the Web, interoperability between environmental and space data collection systems, software patterns for data modeling and distribution, modeling of databases and data distribution systems and software for analysis prototyping and simulation algorithms applied to INPE's areas of research and development. It also involves research and development of new methodologies in software engineering and software testing for embedded systems, for the Web and for scientific applications.

Theme	Countries
SPACE MISSIONS	Netherlands; United Kingdom; Argentina; Spain; Russia; U.S; Portugal; Germany; Italy; Colombia; Israel; China;

Justification

This topic includes R&D from all segments of a space mission within the scope of its theses and dissertations:(1) subsystems/payloads and even complete satellites, (2) launchers and (3) ground systems (command and tracing, mission center and operation center). In the PG in Engineering and Space Technologies of INPE, there are a series of technical partnerships with other foreign institutions, as well as co-



orientations of thesis / dissertations. An example is the development of RaioSat, a 3U cubesat that will keep the payload of interest for lightning monitoring. There is the opportunity for a German HEI to develop some subsystems (Optics and Control Attitude) and share the control infrastructure with Germany and Colombia. Another project to be investigated is sprites in the Space and Atmospheric Sciences, that could benefit from a payload in cubesats. Another project deals with research and development of materials with tolerance and/or attenuation properties of ionizing radiation, mitigation of impacts of space debris and of thermal oscillations in satellites and orbital platforms, in collaboration with Portugal and Italy. In the area of surface coatings of materials with Diamond Like Carbon (DLC), there is a strong collaboration with the University of Bogotá, Colombia. Other institutions that have shown interest were from countries: Israel, Holland, Italy, China, USA, UK, Argentina, Colombia, Spain, Japan and Russia. In addition, there are many more academic partnerships, with doctoral students and postdoctoral researchers developing part of their research in various countries topics.

Goals

Goal

Management of Space Systems

Description

Design, Specification, Architecture and Management of Space Systems, Onboard Systems for Space Missions, Soil Systems for Space Missions, Space Mission and Product Guarantees, and Space Systems Modeling and Simulation.

Goal

Attitude and Orbit Control

Description

This objective consists in the study of different techniques for the control of orbit and attitude of a spacecraft.

Goal

Research in Astrodynamics

Description

Conduct research at the world-wide border in astrodynamics. Several topics are considered, such as maneuvers using gravity, trajectories around small bodies, etc.

Goal

Development of satellite components

Description

Search for international partnerships for the development of satellite components in order to give larger autonomy to INPE's space missions.

Goal

Nanosatellite platform

Description

Provide a nanosatellite-based platform for space ray monitoring (RaioSat) to complement the terrestrial network present in the Earth System Science Center.

Goal



Material research for use in space

Description

The purpose of this theme is to study several topics related to functional materials for space applications, in particular in artificial satellites and orbital platforms. The main objective is to increase the useful life of satellites in space and/or decrease the costs of these satellites. In this sense, there is a collaboration between two areas of Post-graduation in Engineering and Space Technologies and European research and teaching institutions for the research and development of: i) materials and devices with high tolerance to ionizing radiation; ii) multifunctional materials that act with attenuators of ionizing radiations, impacts of space debris and thermal oscillations in space.

Goal

Research and development of surface modifications with micro and nanostructured materials

Description

The objective of the present study is the research and development of surface modifications with films of micro and nanostructured materials, including thin and thick films of Diamond Like Carbon (DLC) in the institution's laboratories. These materials, due to their high hardness and performance as solid lubricants, should be used for the coating of mobile components for use in satellites and orbital platforms.

Goal

Thermal analysis of space vehicles

Description

The objective is to study the thermal conditions of a spacecraft, taking into account the large differences in temperature in space.

Theme	Countries
GLOBAL ENVIRONMENTAL CHANGES	Sweden; United States; United Kingdom; The Netherlands; Argentina; Germany; France; Belgium

Justification

The recently launched Sustainable Development Goals ("Sustainable Development Goals"- SDG) aim to guide the agendas and policies of the member states of the United Nations (UN) by the year 2030 and research in this priority topic can significantly contribute to the production of relevant indicators for some SDGs and the development process sustainable development of the tropical region. In this context, in the priority area of Global Environmental Changes, it is proposed to develop interdisciplinary research in search for scientifically based solutions and technologies that promote the path towards a sustainable, safe and socially fair development, particularly in the tropics, minimizing negative impacts of environmental changes in socio-economic and natural systems vital to environmental sustainability and human well-being, as regards access to food, water, energy and health. INPE's PGP's have many collaborative efforts in the areas of observation of the terrestrial system in surface networks or by remote sensing, as well as the development of computational modeling frameworks that represent the different components of the Terrestrial System, as well as parameterization of existing models, such as modeling the dynamics of the terrestrial biosphere, land cover and land use change models and greenhouse gas emissions, ecohydrological and agricultural models, and climate modeling.

Goals

Goal



Diagnostics and scenarios of socio-environmental interactions

Description

International collaboration projects that contribute to the formulation of diagnostics and scenarios of the functioning of the terrestrial system, considering natural and / or anthropic aspects, aiming at a sustainable national development, integrating results of observation and modeling activities. It is proposed to promote the transition from the traditional research logic, focused on socio-environmental impact studies, to the analysis of the trajectories, limits and spatio-temporal patterns under which the stability of natural systems can be sustained. This transition represents one of the greatest challenges to modern science and also a fundamental aspect to subsidize the formulation of more consistent public policies. The specific objectives are: (i) Formulation of scenarios of the functioning of the Terrestrial System, considering natural and / or anthropic aspects. (ii) Integrated analysis of the pathways and key decisions for reconciling the three pillars of sustainability. (iii) Awareness of the population, considering that sociological studies and the interface between science and public policy processes indicate that it is an important element for a transition to sustainability.

Goal

Earth System Modeling

Description

To increase the capacity to represent the Earth system in computational models, encompassing not only physical and biological dimensions, but also human dimensions. The general objective of the theme is to integrate existing modeling efforts with new international projects to improve the representation of the atmospheric, biophysical and socioeconomic processes in the Brazilian territory that contribute to the better understanding of the Earth System. Specific objectives are: i. Parametrization and development of models of different components of the Earth System appropriate to the processes observed in South America, especially in the tropical region, contributing to the integrated understanding and simulation of the Terrestrial System in the recent and future past, which may contribute to the construction of scenarios. ii. Parametrization and development of models that allow the regionalization of the projections coming from global climate models, aiming to subsidize integrated research and projects that need more detailed future spatial scenarios

Goal

Water-food-energy nexus

Description

To promote scientific research in the area of Sustainability Science, having as central theme the nexus between water, energy and food security. The objective is to seek partnerships and attract researchers from foreign institutions with interests in interactions between the various disciplines (multi and transdisciplinary) and sectors, with a view to solving problems arising from global environmental change (including climate change). Its management requires innovative approaches that can enable public and private decision-making in favor of sustainability with equity and human well-being

Goal

Network of observations of the Earth System

Description

To foster international research and partnerships to synthesize reliable observational databases with a history and future perspective that capture the effects of global environmental changes in different domains of the Earth's surface, such as global networks of greenhouse gas measurements and biogeochemical cycles, characterization of the potential for the production of renewable energies and detection of atmospheric electrical discharges.

Theme	Countries
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HELIOPHYSICS

Nepal; United Kingdom; Sweden; Argentina; U.S; South Africa; Japan; Australia; Chile; Canada; Mexico; China; Austria; Nigeria; Germany; Cuba; Belgium; Italy; India; France; Spain

Justification

Heliophysics can be understood as an extension of Geophysics. It focuses on the interconnections between the Sun, interplanetary space and the planets. Historically, this research field has its roots on the First International Polar Year (IPY-1) in 1883 and the Second International Polar Year (IPY-2), in 1933 which paved the way to the International Geophysical Year (IGY), held in 1957., IGY was an unprecedented international cooperation during which the World Data Centers (WDCs) were established. Open access to a variety of instruments around the world fostered the advance of scientific knowledge. During the years 2007 to 2009 the International Heliophysical Year (IHY) took place, celebrating 50 years since IGY. Many experimental campaigns and activities occurred under the sponsorship of the United Nations (UN) and several Space Agencies around the world. The theme Heliophysics aims at qualifying, in an international standard, personnel coming from engineering and exact sciences to work on research, development and teaching at Universities and research institutes, as well as R&D in private companies. Of special interest are the disciplines related to solar physics, planetary physics, interplanetary medium, magnetospheres, ionospheres, atmospheres and planetary magnetic fields and other bodies. The main connection of this thematic area is with the Postgraduate Program in Space Geophysics (GES). Member of the "Excellence Program" (PROEX), from Brazilian funding agency CAPES, GES began its activities in 1968. It has since graduated over two hundred of MsC and PhD. Other postgraduate programs at INPE are also involved in research within the heliophysics theme.

Goals

Goal

Developing or improving state-of-the-art instrumentation for heliophysics observations.

Description

INPE has since long time expertise in developing instrumentation for space and atmospheric observations, both ground based and onboard balloons and rockets. Traditionally, the focus has been on ionospheric, airglow, cosmic particles, atmospheric parameters and geomagnetic field observations. In recent years, new instrumentation is under development, in particular for solar, earth's radiation belts and transient luminous events (TLE) observations. International collaboration is key to this activity. We highlight the development of the "Earth Equatorial Research Satellite" - EQUARS, lead by INPE, the cubesat programs, which have strong participation of Universities, the INPE's Solar Telescope in collaboration with partners from the USA, Germany and Spain, the broad band radiometer in collaboration with american institution, the LEONA network, whose goal is to cover the whole South America, the EMBRACE magnetometer network (MagNet), which expands from north of Brazil to the Argentinian Patagonia, in collaboration with institutions from Argentina, Brazil and Chile, the digissondes and LIDARs in operation at INPE in collaboration with chinese institutions.

Goal

Conducting research in heliophysics by means of data analysis, modeling and theory and publish the results for the scientific community and for the general public.

Description

Over the last decades INPE has achieved excellence level in theoretical and empirical research on space and atmospheric sciences. We highlight international collaborations on magnetotelluric studies, on the interplanetary medium (USA), ionospheric studies which lead to the discovery of equatorial phenomena, such as the ionospheric plasma bubbles (in collaboration with USA, India and Peru), airglow studies in collaboration with japanese institutions, solar physics studies in collaboration with german institutions, just to name a few.



There is a long lasting tradition in the development of ionospheric numerical modeling which benefited from international collaborations (e.g. joint development of SUPIM-INPE model with Sheffield University). In recent years, new areas of research were fostered at INPE, such as Earth's radiation belt studies using observations from the Van Allen probes under an agreement between Brazilian Space Agency, INPE and NASA, planetary magnetospheres and the influence of volcanic activity in the magnetospheric dynamics of celestial bodies (USA), solar photospheric magnetic field dynamics (Germany), Solar-Terrestrial disturbances using novel space missions from NASA and ESA, magnetic variations over South America using MagNet data. High Performance Computing (HPC) systems were acquired and made available to the space and atmospheric community, which allowed the implementation of sophisticated numerical codes, such as the "Block-Adaptive-Tree-Solarwind-Roe-Upwind-Scheme" (BATS-R-US) developed by the University of Michigan (USA). INPE conducts the Space Weather (EMBRACE) program whose goals are to develop space weather products and distribute them to the community. EMBRACE hosts the China-Brazil Joint Laboratory for Space Weather.

Goal

Training personnel to work on heliophysics research at international level.

Description

This goal will be achieved organically as postgraduate students and postdoctoral researcher conclude their works in subjects related to heliophysics. The goal is to capacitate them to fellows in universities, research institutes and private companies, both as private or civil servants. Special emphasis will be given to the attraction of foreign postgraduate students, postdoctoral fellows and senior researchers, to conduct joint teaching and research activities at INPE.

Theme	Countries
TROPICAL METEOROLOGY	Argentina; Colombia; Israel; Cape Verde; Australia; Chile; Switzerland; U.S; United Kingdom; Japan; Mexico; France; Canada; Cuba; Netherlands; Bolivia; Paraguay; Peru; Sweden; India; Germany; Spain; Italy

Justification

The region of South America has much of its extension in the tropical region, where there is a domain of meteorological systems that interact with the Amazon rainforest, the largest tropical forest in the world. The interaction between tropical and mid-latitude systems makes the theme unique and with great internationalization potential. Brazil has one of the largest collections of observational data from the tropical region, mainly from field experiments, with emphasis on the Amazon. Research developed and in development using this data together with parameterization of numerical models by the best specialists, members of the MET PGP, allows INPE to be a pole of research in the area of tropical modeling.

Goals

Goal

Ocean-Atmosphere Interaction

Description

Observational, theoretical and numerical simulation studies of the interactive phenomena between atmosphere and the oceans, on the temporal and seasonal scales of weather and climate (seasonal, annual and decadal) and their variability; oceanic modeling to couple with the atmosphere.

Goal



Climate Studies and Modeling

Description

Development of studies: Observational and/or with climate models and the processes controlling global climate and climate change in Brazil and worldwide.

Goal

Biosphere-Atmosphere Interaction

Description

Development of micro-meteorological studies of the processes of exchange of energy, momentum and water vapor and of carbon dioxide, which occur at the water-soil-vegetation-atmosphere interface, possible future climate scenarios due to deforestation.

Goal

Weather Studies and Modeling

Description

Development of studies of (1) meteorological systems and phenomena responsible for weather and its changes in the scale of hours, days and weeks; (2) the physical and dynamic processes by which systems and meteorological phenomena develop and move.

POSTGRADUATE PROGRAMS LINKED TO THIS PROPOSAL

Theme

INSTRUMENTAL ASTROPHYSICS

Postgraduate Program

Capes evaluation (2017 evaluation's grade)

Astrophysics

4

Justification

INPE's Astrophysics has as its characteristic to be the most focused in the country for the development of astronomical instrumentation. Instrumental development encompasses the entire electromagnetic spectrum, from the radio range, through the infrared and optical bands to the high energy range. INPE also leads the only Brazilian project for a gravitational wave detector.

Postgraduate Program

Capes evaluation (2017 evaluation's grade)

Space Engineering and Technology

4

Justification

This theme (Instrumental Astrophysics) has a strong observational and instrumentation component, including artificial satellites, which justifies the involvement of space engineering.

Postgraduate Program

Capes evaluation (2017 evaluation's grade)

Space Geophysics

6

Justification



The Post-Graduation Program in Space Geophysics has strong intersection with Astrophysics research topics. In particular, special interest exist on the development of instrumentation for solar-terrestrial physics, as well as for planetary physics.

Postgraduate Program **Capes evaluation (2017 evaluation's grade)**

Remote Sensing 7

Justification

The PGP in Remote Sensing brings to this topic the deep knowledge of the characteristics of the electromagnetic spectrum and its ability to detect specific features. Thus, the training of PGSER professors adds knowledge for the development of orbital sensors, remote sensing data processing techniques and methods for quantitative analysis of large databases.

Postgraduate Program **Capes evaluation (2017 evaluation's grade)**

Applied Computing 5

Justification

There is a need in Astrophysics for the treatment of large amounts of astronomical data and computational modeling. PGP CAP can help to meet this need, both in application of existing computational methods and in research and development of new methods.

Theme

SATELLITE APPLICATIONS FOR SUSTAINABLE DEVELOPMENT

Postgraduate Program **Capes evaluation (2017 evaluation's grade)**

Space Engineering and Technology 4

Justification

The complexity of the theme requires a transdisciplinary approach that can be achieved with the participation of other INPE PGPs. With its focus on space technologies, PGP ETE brings a critical element to the improvement and development of new sensors and satellites that can provide information to the areas of application of satellite data for the generation of products.

Postgraduate Program **Capes evaluation (2017 evaluation's grade)**

Meteorology 6

Justification

The complexity of the theme requires a transdisciplinary approach that can be achieved with the participation of other INPE PGPs. With its focus on small-scale and large-scale atmospheric processes, PGP MET provides a critical element for the complementarity and integration of satellite data from surface, air and field meteorological data for environmental diagnostics, processes and impacts of environmental and climate in terrestrial environments, as well as the parameterization of terrestrial system models to evaluate these impacts.

Postgraduate Program **Capes evaluation (2017 evaluation's grade)**

Remote Sensing 7

Justification

The PGP in Remote Sensing is the national leader in the dissemination of knowledge in applications based on orbital sensors for solving problems related to tropical agriculture, tropical ecosystems and environmental sciences, climate change and land use, tropical forest resources, oceanography, inland waters, geology and



geomorphology, Urban studies. In addition, it has a tradition in the scientific production and lecturing of geoprocessing, remote sensing and spectroradiometry, image processing, and the use of high and moderate resolution optical sensors, LIDAR and RADAR. The PGP in Remote Sensing is specialized in the main areas critical for achieving the objectives established in this theme.

Postgraduate Program **Capes evaluation (2017 evaluation's grade)**

Applied Computing 5

Justification

The complexity of the theme requires a transdisciplinary approach that can be achieved with the participation of other INPE PGPs. With its focus on systems development, the Applied Computing PGP can provide a critical element for the development of computational tools applied to the integration of satellite data with Earth system models.

Postgraduate Program **Capes evaluation (2017 evaluation's grade)**

Earth Systems Science 6

Justification

The complexity of the theme requires a transdisciplinary approach that can be achieved with the participation of other programs from INPE. With its focus on Earth System Modeling, the Earth Systems Science PGP brings a critical element for the integration of satellite data with environmental models.

Theme

MODELING AND ANALYSIS OF EARTH AND SPACE DATA

Postgraduate Program **Capes evaluation (2017 evaluation's grade)**

Remote Sensing 7

Justification

The PGP in Remote Sensing brings to this topic the deep knowledge in the generation, processing and analysis of geospatial data. Thus, the expertise of PGSER professors brings knowledge to identify problems that can be solved through the analysis of geospatial data, interpretation of orbital data, development of remote sensing data processing techniques and methods for quantitative analysis of large databases.

Postgraduate Program **Capes evaluation (2017 evaluation's grade)**

Earth Systems Science 6

Justification

The complexity of the theme requires a transdisciplinary approach that can be achieved with the participation of other INPE PGPs. With its focus on modeling the interactions of the natural system with human dimensions, in the context of Earth System Science, the Earth Systems Science program has strong connections with the theme in all of its lines of research.

Postgraduate Program **Capes evaluation (2017 evaluation's grade)**

Applied Computing 5

Justification

The program is central to the subject of data modeling and analysis, and will collaborate developing numerical models and applications (computational infrastructure, software) using data from sensors, missions, instruments and networks created and / or operated by INPE's various research projects, in addition to do



research on the scientific and technological advances that allow the creation of new mechanisms of spatial and Earth data collection.

Postgraduate Program **Capes evaluation (2017 evaluation's grade)**

Space Engineering and Technology 4

Justification

The complexity of the theme requires a transdisciplinary approach that can be achieved with the participation of other INPE PGPs. With its focus on space technologies, PGP ETE brings a critical element to the improvement and development of new sensors and satellites that can provide information to the areas of application of satellite data for the generation of products.

Postgraduate Program **Capes evaluation (2017 evaluation's grade)**

Space Geophysics 6

Justification

The Post-Graduate Program in Space Geophysics develops research studies on heliophysics using space plasma modeling. There already exist joint supervisions of students between Space Geophysics and Applied Computation. Also, studies using data analysis of ground and space missions have been conducted in this same joint collaboration effort.

Postgraduate Program **Capes evaluation (2017 evaluation's grade)**

Meteorology 6

Justification

The PGP in Meteorology has a great interaction with the subject of modeling and data analysis, since it develops great systems of modeling of the terrestrial system, at local, regional and global level, in which it involves a great number of meteorological variables, of control and of observational data. The analysis of these results presents a very strong relation with the theme, and of interaction among the researchers of the different areas.

Theme
 SPACE MISSIONS

Postgraduate Program **Capes evaluation (2017 evaluation's grade)**

Earth Systems Science 6

Justification

INPE's Earth Systems Science PGP fosters research and international partnerships to synthesize observational databases that capture the effects of global environmental change on different land surface domains, such as the detection of atmospheric electrical discharges, and can contribute substantially to the development goals of a platform based on nanosatellite for monitoring of lightnings from space (RaioSat).

Postgraduate Program **Capes evaluation (2017 evaluation's grade)**

Space Engineering and Technology 4

Justification

PGP in space engineering and technology works heavily with space missions and astrodynamics research.

Postgraduate Program **Capes evaluation (2017 evaluation's grade)**



Remote Sensing 7

Justification

The PGP in Remote Sensing brings to this theme the deep knowledge of the characteristics of the electromagnetic spectrum and its ability to detect specific fundamental features in the planning of missions. Thus, the expertise of PGSER professors adds knowledge for the development of orbital sensors, remote sensing data processing techniques and methods for quantitative analysis of large databases. In addition, PGSER professors have extensive experience in the calibration and validation of data coming from sensor systems, mainly orbital, thus guaranteeing the design specifications and the final quality of the product that will reach the user.

Postgraduate Program Capes evaluation (2017 evaluation's grade)

Applied Computing 5

Justification

The program will be able to collaborate in the modeling for simulations of space missions and in the analysis of data (telemetry or collected) by such missions.

Postgraduate Program Capes evaluation (2017 evaluation's grade)

Space Geophysics 6

Justification

The Post-Graduation Program in Space Geophysics conducts research using space missions most of the time. The program is intimately connected to the Coordination for Atmospheric and Space Sciences, which develops scientific satellite and cubesat programs. Recently, a viability study for a solar mission was ordered by the Atmospheric and Space Sciences area to INPE's Engineer Coordination.

Theme

GLOBAL ENVIRONMENTAL CHANGES

Postgraduate Program Capes evaluation (2017 evaluation's grade)

Earth Systems Science 6

Justification

The PGP in Earth System Science seeks to develop understanding of the interactions of natural system components (oceans, atmosphere, cryosphere, soil-vegetation) with each other, as well as modeling the interaction of this system (biogeophysics, biogeochemistry and biodiversity) with the human dimensions (institutions, politics, culture, economy, demography, etc.), that is, it seeks to understand the dynamics of the complex interaction of natural and social systems. The notion of Environmental Change refers to changes in the biophysical environment due to natural causes and / or human activities, which in turn may interfere with the functioning of society itself.

Postgraduate Program Capes evaluation (2017 evaluation's grade)

Applied Computing 5

Justification

The program will collaborate by developing numerical models to simulate aspects related to global environmental changes and analysis applications for data collected from sensor networks.

Postgraduate Program Capes evaluation (2017 evaluation's grade)



Space Engineering and Technology 4

Justification

The complexity of the theme requires a transdisciplinary approach that can be achieved with the participation of other INPE PGPs. With its focus on space technologies, PGP ETE brings a critical element to the improvement and development of new sensors and satellites that can provide information to the areas of application of satellite data for the generation of products.

Postgraduate Program Capes evaluation (2017 evaluation's grade)

Remote Sensing 7

Justification

The PGP in Remote Sensing brings to this topic the deep knowledge in the generation, processing and analysis of geospatial data. Thus, the expertise of PGSER professors adds knowledge to identify problems that can be solved from the modeling perspective with geospatial data. The interpretation of orbital data, the development of remote sensing data processing techniques and methods for quantitative analysis of large databases are fundamental requirements for the generation of input data for terrestrial system models.

Postgraduate Program Capes evaluation (2017 evaluation's grade)

Space Geophysics 6

Justification

The Post-Graduate Program in Space Geophysics has a area of concentration in atmospheric sciences which includes research on global environmental change, atmospheric electricity, atmospheric chemistry and the impacts of global change in the middle and upper atmosphere.

Postgraduate Program Capes evaluation (2017 evaluation's grade)

Meteorology 6

Justification

The PGP in Meteorology works fundamentally with the development of models of numerical weather forecasting and climate at all temporal and spatial scales, which justifies its link with the present theme. Another strong point for the linkage is associated with the experience of the teachers of the PGP, with several researches, involving students, in the area of global climate change.

Theme
 HELIOPHYSICS

Postgraduate Program Capes evaluation (2017 evaluation's grade)

Remote Sensing 7

Justification

The PGP in Remote Sensing brings to this theme the deep knowledge of the characteristics of the electromagnetic spectrum and its ability to detect specific features. Thus, the training of PGSER teachers adds knowledge for the development of orbital sensors, remote sensing data processing techniques and methods for quantitative analysis of large databases.

Postgraduate Program Capes evaluation (2017 evaluation's grade)

Applied Computing 5

Justification



The PGP in Applied Computing will collaborate by developing techniques and applications of data analysis of sensors such as Sun imaging satellites, magnetometer networks and ionospheric sensors, and in the modeling of heliophysical phenomena and Sun-Ionosphere-Earth interaction through numerical models.

Postgraduate Program **Capes evaluation (2017 evaluation's grade)**

Space Engineering and Technology 4

Justification

The complexity of the theme requires a transdisciplinary approach that can be achieved with the participation of other INPE PGPs. With its focus on space technologies, PGP ETE brings a critical element to the improvement and development of new sensors and satellites that can provide information to the areas of application of satellite data for the generation of products.

Postgraduate Program **Capes evaluation (2017 evaluation's grade)**

Space Geophysics 6

Justification

Heliophysics is closely linked to the research activities developed at the Post-Graduation Program in Space Geophysics. Heliophysics is a natural evolution from Geophysics, in particular since the International Geophysical Year (IGY - 1957) and since the International Heliophysical Year (IHY - 2007). Research topics in heliophysics involve solar physics, interplanetary medium, planets, their magnetic fields and their atmospheres. Of particular interest is the physics of particles and plasmas, in different regimes. Universal processes such as magnetic reconnection interconnect a variety of phenomena in different scales.

Theme

TROPICAL METEOROLOGY

Postgraduate Program **Capes evaluation (2017 evaluation's grade)**

Earth Systems Science 6

Justification

The Earth Systems Science program has in its lines of research many aspects related to the theme of Tropical Meteorology, mainly in the development of studies of the role of physical processes in the tropical atmosphere in the global climate system and bringing the scientific paradigm of conducting interdisciplinary research on environmental changes in Brazil and in the world.

Postgraduate Program **Capes evaluation (2017 evaluation's grade)**

Applied Computing 5

Justification

The program will collaborate developing numerical models for simulating weather and climate systems and data analysis applications collected from various atmospheric sensor networks.

Postgraduate Program **Capes evaluation (2017 evaluation's grade)**

Remote Sensing 7

Justification

The PGP in Remote Sensing brings to this topic the deep knowledge in the generation, processing and analysis of geospatial data of the biosphere-atmosphere system. Thus, the expertise of PGSER professors aggregates knowledge to identify solvable problems based on the large-scale modeling of the biosphere-hydrosphere-



atmosphere interaction, its impacts and feedback mechanisms. The generation and interpretation of orbital data, the development of remote sensing data processing techniques and methods for quantitative analysis of large databases, is the focus of the research developed in the PGSER, and is a fundamental requirement for the generation of input data for the models of the terrestrial system and synoptic analysis of events.

Postgraduate Program

Capes evaluation (2017 evaluation's grade)

Meteorology

6

Justification

PGP is a leader in the field of tropical meteorology, with research in the experimental area, numerical weather prediction and global climate change, with several researchers involved in these areas.

Postgraduate Program

Capes evaluation (2017 evaluation's grade)

Space Engineering and Technology

4

Justification

The complexity of the theme requires a transdisciplinary approach that can be achieved with the participation of other INPE PGPs. With its focus on space technologies, PGP ETE brings a critical element to the improvement and development of new sensors and satellites that can provide information to the areas of application of satellite data for the generation of products.

ACTIONS

Theme

INSTRUMENTAL ASTROPHYSICS

Goal

Develop state-of-the-art Astronomical Instrumentation

Action	Start Date	End Date
Coming of foreign researchers specializing in astronomical Instrumentation	11/2018	07/2022

Description

This action aims to bring foreign researchers specializing in astronomical instrumentation to exchange experiences in these subjects with the existing groups at INPE.

Action Indicators

Type	Index	Current Situation	Goal of 2 nd Year	Final Goal
Quantitative	Number of foreign researchers who came to Brazil	0	3	8

Action	Start Date	End Date
Visits to foreign groups that carry out astronomical instrumentation development	01/2019	07/2022

Description



Through internship stages, postdoctoral studies abroad and visits of researchers to foreign groups that develop astronomical instrumentation, it would be possible to transfer technology from these foreign centers to INPE.

Action Indicators

Type	Index	Current Situation	Goal of 2 nd Year	Final Goal
Quantitative	Number of visits to foreign groups	2	9	15

Action	Start Date	End Date
Develop, calibrate and test, at the prototype level, astronomical Instrumentation	11/2018	07/2022

Description

The research lines of Instrumental Astrophysics cover the following bands of the electromagnetic spectrum: radio, infrared, optical, X-rays and gamma rays, beyond the detectable spectrum in gravitational waves. The aim is to develop new instruments for observation and monitoring of new phenomena in these bands, or the improvement of existing instruments and techniques for observation or monitoring.

Action Indicators

Type	Index	Current Situation	Goal of 2 nd Year	Final Goal
Quantitative	Number of prototypes developed per year	1	2	5

Goal

Train Human Resources in the Astronomical Instrumentation Area

Action	Start Date	End Date
Increase the number of foreign coorientators in the conclusion thesis of INPE's post-graduation linked to topics related to Instrumental Astrophysics.	11/2018	07/2022

Description

For training professionals at the international level, it is important to have co-mentorship of researchers from foreign institutions to at least part of the students. It is intended to raise the proportion of foreign co-advisers to at least 20%.

Action Indicators

Type	Index	Current Situation	Goal of 2 nd Year	Final Goal
Quantitative	Percentage of foreign co-advisers	0	4	20

Action	Start Date	End Date
Increase the number of students with doctorate internship abroad working on topics related to Instrumental Astrophysics	01/2019	07/2022

Description

For training professionals at the international level, it is important to have part of the students with experience in foreign institutions of high scientific relevance. Historically, the percentage of students who undertake doctoral internships per year in subjects related to Instrumental Astrophysics ranged from 0% to 4% in the last 6 years. The aim is to increase the percentage, taking advantage of historical experience, to at least 20%.

Action Indicators



Type	Index	Current Situation	Goal of 2 nd Year	Final Goal
Quantitative	Percentage of students performing doctoral internships per year	2	10	20

Action	Start Date	End Date
Increase the number of theses written in English in themes related to Instrumental Astrophysics	11/2018	07/2022

Description

For training professionals at the international level, it is important to have part of the theses written in a language accessible to the greater part of the International community.

Action Indicators

Type	Index	Current Situation	Goal of 2 nd Year	Final Goal
Quantitative	Percentage of theses in English per year	0	10	50

Action	Start Date	End Date
Exchange of visiting researchers to strengthen collaborations in astronomical instrumentation research	11/2018	07/2022

Description

The aim is the coming of foreign researchers and the visit to foreign labs of researchers / teachers to strengthen scientific collaboration on issues related to astronomical instruments.

Action Indicators

Type	Index	Current Situation	Goal of 2 nd Year	Final Goal
Quantitative	Number of researchers exchanged	3	8	23

Action	Start Date	End Date
Raise the percentage of foreign students of the first world countries developing work on topics related to Instrumental Astrophysics	11/2018	07/2022

Description

For training human resources in astronomical instrumentation, it is advantageous to attract students from the countries of the first world, who have a more solid laboratory training and would therefore contribute better to the development of astronomical instrumentation in Brazil. They would set good examples for the training of Brazilian students in this area. The percentage of foreign students attracted to the postgraduate course in astrophysics, in the last six years ranged from 14% to 21% of the total, but all students came from South America and Africa. A policy to attract students from the the first world (USA, Europe, Australia, Canada) needs to be implemented in a internationalization like this.

Action Indicators

Type	Index	Current Situation	Goal of 2 nd Year	Final Goal
Quantitative	Percentage of foreign students from the first world countries	0	1	4



Action	Start Date	End Date
Visit of foreign researchers to teach courses related to Instrumental Astrophysics	11/2018	07/2022

Description

In order to training professionals at the international level, it is important to have part of the courses taught in full or in part by researchers from foreign institutions of high relevance for the training of researchers. It is intended that foreign researchers teach courses for INPE graduate students, which can be partially face-to-face and partly by internet or fully face-to-face in the form of intensive course.

Action Indicators

Type	Index	Current Situation	Goal of 2 nd Year	Final Goal
Quantitative	Number of teachers who came	0	3	8

Action	Start Date	End Date
Increase the percentage of classes taught in English in the INPE graduate programs linked to Instrumental Astrophysics	11/2018	07/2022

Description

For professional training at the international level, it is important to have discussions of topics of international interest in language accessible to the international community, which in this case is the English language. It is intended to offer the core courses of Post-Graduation in Astrophysics in English as final goal, in order to allow any student and any teacher to be a member or participant of INPE's postgraduate program in subjects related to Instrumental Astrophysics.

Action Indicators

Type	Index	Current Situation	Goal of 2 nd Year	Final Goal
Quantitative	Percentage of classes taught in English	0	33	67

Goal

Produce scientific knowledge in frontier astrophysics and physics and communicate them to the scientific community and society in general.

Action	Start Date	End Date
Conduct excellent research in physics and astrophysics through instrumentation built in whole or in part by the group, and communicate it to the scientific community and society in general	11/2018	07/2022

Description

One way to measure the achievement of excellent research in astrophysics subjects is to evaluate the percentage of article publications in journals included in JCR. Historically, the work published by INPE on astrophysical subjects in journals included in JCR ranged from 83% to 100% in the last 6 years, which is quite significant. It is intended to maintain this level of quality in the coming years, in addition to increasing scientific dissemination to the general public, through colloquiums, articles in scientific journals and magazines.

Action Indicators



Type	Index	Current Situation	Goal of 2 nd Year	Final Goal
Quantitative	Number of colloquies given to the public in general per year	2	4	10
Quantitative	Percentage of total articles published in journals included in JCR	96	96	100

Goal

Fostering the Participation of the National Industry in the Development of High Technology Instrumentation

Action	Start Date	End Date
Involving, whenever possible, the national industry in the development of astronomical instrumentation	11/2018	07/2022

Description

Order part of the astronomical instrumentation in the national industry will allow this industry to acquire new technologies, which can lead to expansion of business and new jobs. This involvement must be attempted at the research level. If this is not possible, at least it should be done at the construction level.

Action Indicators

Type	Index	Current Situation	Goal of 2 nd Year	Final Goal
Quantitative	Number of orders in national industry	0	1	6

Theme

SATELLITE APPLICATIONS FOR SUSTAINABLE DEVELOPMENT

Goal

Promoting advanced research and technological development in Earth observation focusing on remote sensors and their applications

Action	Start Date	End Date
Establishing solid collaborations with international partners	11/2018	07/2022

Description

Establishing solid collaborations between INPE's graduate program in this subject with international partners to transfer technical knowledge and increase the quality of scientific production at the international level. To implement this action is planned bilateral exchange between students and teachers. This aims to promote the transfer of knowledge and the consolidation of partnerships that will lead to the development of collaborative projects and the improvement of the quality of scientific production.

Action Indicators

Type	Index	Current Situation	Goal of 2 nd Year	Final Goal
Quantitative	Number of scholarships for internship PhDs	1	5	6
Quantitative	Number of scholarships for post-doctorate abroad	0	1	2
Quantitative	Number of scholarships for Young Talent from abroad	0	1	1
Quantitative	Number of scholarships for Visiting Senior	0	1	1



Quantitative	Professor abroad Number of scholarships for Visiting Junior	0	1	1
Quantitative	Professor abroad Number of scholarships for Visiting Professor from abroad	0	1	1

Goal

Providing excellence in higher education and technical training in the area of satellite applications for sustainable development

Action	Start Date	End Date
Forming scientific leaderships with national and international insertion	11/2018	07/2022

Description

Training researchers and professionals, with recognized competence and leadership to act on national issues, related to sustainable development, aligned with global initiatives. It is planned to consolidate this action from the involvement of teachers with recent experience abroad. The implementation of this action will take place through the implantation of scholarships for visiting junior and senior professor abroad, visiting professor in Brazil, post-doctorate with experience abroad and involvement of these professionals in teaching postgraduate courses.

Action Indicators

Type	Index	Current Situation	Goal of 2 nd Year	Final Goal
Quantitative	Number of faculty who completed the scholarship of visiting junior professor abroad involved in the PGP	0	1	3
Quantitative	Number of faculty who completed the scholarship of visiting senior professor abroad involved in the PGP	0	1	4
Quantitative	Participation of teachers with recent experience abroad in the PGP	5	7	10
Quantitative	Number of postdoctoral fellows with overseas experience involved in the PGP	0	1	2
Quantitative	Number of professors with a visiting scholarship in Brazil involved in the PGP	0	1	1
Quantitative	Number of teachers with Young Talent scholarship involved in the PGP	0	1	1

Goal

Communicate scientific results to society

Action	Start Date	End Date
Dissemination of scientific knowledge to society in open access politics	08/2018	07/2022

Description

Disseminate scientific knowledge both in dissertations, theses and scientific articles for society in open access politics. Act in communicating the results to the general public through the use of wide-ranging vehicles such



as web page, specialized blogs, newspapers and magazines. In the stage of widespread dissemination, the mastery of foreign languages, especially English, becomes critical.

Action Indicators

Type	Index	Current Situation	Goal of 2 nd Year	Final Goal
Quantitative	Number of publications in English	20	25	35
Quantitative	Number of technical staff involved in scientific outreach activities	1	2	3
Qualitative	Websites in English and Portuguese	0	1	1
Quantitative	Number of dissertations & theses in English	2	3	5
Quantitative	Number of web pages, international journals and magazines disseminating research	2	5	10
Quantitative	Number of citations of articles in the international literature	100	150	300

Goal

Promoting the state-of-the-art of scientific knowledge in the areas of knowledge in line with the demands of Brazilian and international society.

Action	Start Date	End Date
Prioritizing the teaching of scientific issues aligned with emerging themes and demands of society	08/2018	07/2022

Description

This action aims to prioritize the teaching of emerging scientific issues in line with the current demands of national and international society. It is intended to focus on technical solutions to complex environmental problems, the domain of satellite image processing, the knowledge and development of sensors for the monitoring of specific targets and the ability to model these systems. The competent performance of the leaderships formed within this thematic line, strategically assisting Brazil to fulfill its international goals is superlative. This aims to obtain a direct impact of research in Brazilian society and in the countries that are signatories of the United Nations Framework Convention on Climate Change, actions to prevent and control deforestation and forest degradation, promote forest recovery and promote sustainable development. Thus, the transfer of scientific knowledge will focus on the development and application of Remote Sensing and Geoprocessing in the following areas: 1. Tropical agriculture, 2. Tropical ecosystems and environmental sciences. 3. Climate change and land use. 4. Tropical Forest Resources, 5. Oceanography, 6. Inland Waters, 7. Geology and Geomorphology, 8. Urban Studies, 9. Geoprocessing, 10. Hyperspectral Remote Sensing and Spectoradiometry. 11. Remote Sensing Image Processing. : High and moderate resolution optics, LIDAR and RADAR.

Action Indicators

Type	Index	Current Situation	Goal of 2 nd Year	Final Goal
Quantitative	Number of publications in English aligned with emerging themes and national and international demands	2	5	10
Quantitative	Number of students and teachers participating in national and international discussion forums aligned to global demands	2	3	4
Quantitative	Number of results published in international literature that was also published in	2	5	6



Quantitative	government media Number of theses and dissertations aligned with emerging themes and national and international demands.	8	12	15
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Theme

DATA MODELING AND ANALYSIS OF EARTH AND SPACE DATA

Goal

Storage and Processing of Large Volumes of Spatiotemporal Data.

Action	Start Date	End Date
Research in High Performance Computing	08/2018	07/2022

Description

Research and Development in High Performance Computing Technologies, Hybrid Computing and Distributed Computing, using technologies such as clusters, FPGAs, GPGPUs and hybrid architectures to execute modeling and simulation or large volume data analysis.

Action Indicators

Type	Index	Current Situation	Goal of 2 nd Year	Final Goal
Quantitative	Post-doctoral fellow abroad	0	1	1
Qualitative	Training of short courses abroad	0	1	1
Quantitative	Projects in partnerships with Brazilian and Foreign Institutions	1	2	4
Quantitative	Sending students (internship PhD.) abroad	0	1	1
Quantitative	Visiting of Professors and Young Talents from abroad	0	1	1

Action	Start Date	End Date
Research in Storage and Retrieval of Spatiotemporal Information	08/2018	07/2022

Description

Research and Development on techniques for storing, indexing, retrieving and analysing large volumes of data, especially data with spatio-temporal characteristics such as time series, geographic data, satellite images, etc. It also includes research and development on new high volume data access techniques to facilitate reproducible research.

Action Indicators

Type	Index	Current Situation	Goal of 2 nd Year	Final Goal
Quantitative	Visiting of Professors and Young Talents from abroad	0	1	1
Quantitative	Projects in partnerships with Brazilian and Foreign Institutions	2	3	4
Quantitative	Sending students (internship PhD.) abroad	0	2	2
Quantitative	Post-doctoral fellow abroad	0	1	2
Quantitative	Training of short courses abroad	0	1	2



Goal

Analysis, Modeling and Mining of Space and Earth Data.

Action	Start Date	End Date
Research in Modeling of Earth and Space Systems	08/2018	06/2022

Description

Research, development and testing of models related to spatial, environmental, meteorological and similar phenomena and implementation of algorithms related to these models.

Action Indicators

Type	Index	Current Situation	Goal of 2 nd Year	Final Goal
Quantitative	Projects in partnerships with Brazilian and Foreign Institutions	1	2	3
Quantitative	Sending students (internship PhD.) abroad	1	2	3
Quantitative	Visiting researchers from abroad	2	3	4

Action	Start Date	End Date
Research in Mining and Analysis of Earth and Space Data	08/2018	07/2022

Description

Research and development of new methods and algorithms for the extraction of knowledge from spatiotemporal data such as climate and meteorological time series; images of remote sensing of diverse natures, scales and applications; images of astronomical objects and catalogues; spatial-temporal data such as those obtained from sensor networks, trajectories and events mapping; complex networks of interaction between different types of agents; environmental and cosmological simulations, etc.

Action Indicators

Type	Index	Current Situation	Goal of 2 nd Year	Final Goal
Quantitative	Projects in partnerships with Brazilian and Foreign Institutions	1	2	3
Quantitative	Visiting researchers from abroad	0	1	2
Quantitative	Sending students (internship PhD.) abroad	0	1	2

Goal

Development of Scientific Software for Environmental and Space Applications.

Action	Start Date	End Date
Research and Development of Scientific Software	08/2018	07/2022

Description

Software Research and Development for Scientific Applications, involving software engineering methodologies for the creation of robust, reliable and easy maintenance applications, creation of libraries, APIs and frameworks for spatiotemporal data manipulation and software testing for scientific applications, for the Web, and for mobile devices.

Action Indicators



Type	Index	Current Situation	Goal of 2 nd Year	Final Goal
Quantitative	Visiting researchers from abroad	0	1	2
Quantitative	Projects in partnerships with Brazilian and Foreign Institutions	0	1	2
Quantitative	Sending students (internship PhD.) abroad	0	1	2

Theme

SPACE MISSIONS

Goal

Space Systems Management

Action	Start Date	End Date
Conceptualization of Space Missions	08/2018	07/2022

Description

This action consists of the initial conception of all the stages of a space mission.

Action Indicators

Type	Index	Current Situation	Goal of 2 nd Year	Final Goal
Qualitative	Sending doctoral students abroad to the internship program	0	1	2
Qualitative	Publications in journals and events of this area	0	1	2
Qualitative	Bring visiting lecturers from abroad to the post-graduate program	0	1	1
Qualitative	Sending lecturers for sabbaticals abroad	0	1	1

Action	Start Date	End Date
Modeling and simulation of space systems	08/2018	07/2022

Description

This action aims at modeling and simulating space systems, including satellites, tracking stations, launchers, etc.

Action Indicators

Type	Index	Current Situation	Goal of 2 nd Year	Final Goal
Qualitative	Bring postdoctoral fellows with experience abroad	0	1	2
Qualitative	Bring postdoctoral fellows with experience abroad	0	1	2
Qualitative	Publications in journals and events of this area	0	1	2

Goal

Attitude and Orbit Control

Action	Start Date	End Date
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Satellite Attitude Control

08/2018

07/2022

Description

This action aims at developing the attitude control systems of a satellite in orbit, addressing theoretical to practical aspects of the process.

Action Indicators

Type	Index	Current Situation	Goal of 2 nd Year	Final Goal
Qualitative	Bring postdoctoral fellows with experience abroad	0	1	2
Qualitative	Publications in journals and events of this area	1	2	4
Qualitative	Attract students from abroad	0	1	2
Qualitative	Bring visiting lecturers from abroad to the post-graduate program	0	1	2

Action	Start Date	End Date
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Development of the orbit control

08/2018

07/2022

Description

This action aims at the development of the satellite orbit control systems, addressing theoretical and practical aspects of the process.

Action Indicators

Type	Index	Current Situation	Goal of 2 nd Year	Final Goal
Qualitative	Sending lecturers for sabbaticals abroad	0	1	2
Qualitative	Publications in journals and events of this area	0	1	2
Qualitative	Sending doctoral students abroad in an internship program	0	1	2

Goal

Research in Astrodynamics

Action	Start Date	End Date
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Orbits studies around small bodies

08/2018

07/2022

Description

Detailed study considering several models for orbits around asteroids and other small bodies of the solar system

Action Indicators

Type	Index	Current Situation	Goal of 2 nd Year	Final Goal
Quantitative	Publications in journals and events of this area	4	6	10
Qualitative	Bring postdoctoral fellows with experience abroad	1	2	4
Qualitative	Sending lecturers for sabbaticals abroad	0	1	2
Qualitative	Bring visiting lecturers from abroad to the post-graduate program	0	1	2
Qualitative	Attract students from abroad	2	4	6



Qualitative	Sending doctoral students abroad in an internship program	1	4	8
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Action	Start Date	End Date
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Studies related to orbital maneuvers	08/2018	07/2022
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Description

Conduct research related to space vehicle maneuvers in different systems, such as the Earth or other bodies that may be of interest to this type of study

Action Indicators

Type	Index	Current Situation	Goal of 2 nd Year	Final Goal
Quantitative	Publications in journals and events of this area	2	4	8

Goal

Development of satellite subsystems equipment

Action	Start Date	End Date
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Development of components for determination of satellite orbit	08/2018	07/2022
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Description

Development of satellite orbit determination components to be on-board future space missions.

Action Indicators

Type	Index	Current Situation	Goal of 2 nd Year	Final Goal
Qualitative	Attract students from abroad	0	1	1
Qualitative	Bring postdoctoral fellows with experience abroad	0	1	1
Qualitative	Bring visiting lecturers from abroad to the post-graduate program	0	1	2

Action	Start Date	End Date
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Development of components for communication inter-satellite links	08/2018	07/2022
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Description

Development of components for communication between satellites and the control center, to be sent on board in future space missions.

Action Indicators

Type	Index	Current Situation	Goal of 2 nd Year	Final Goal
Qualitative	Bring postdoctoral fellows with experience abroad	0	1	2
Qualitative	Sending doctoral students abroad in an internship program	0	1	2
Qualitative	Sending lecturers for sabbaticals abroad	0	1	2

Goal



Nanosatellite Platform

Action	Start Date	End Date
Conduct the conceptual design of the RaioSat nanosatellite.	08/2018	08/2019

Description

Using the DSE / ETE / INPE Simultaneous Engineering infrastructure, named CPRIME, define the a suitable and feasible mission architecture as well as evaluate the main envelope of space systems budgets.

Action Indicators

Type	Index	Current Situation	Goal of 2 nd Year	Final Goal
Qualitative	Conceptual Design Review	0	1	1
Quantitative	Publications in journals and events of this area	2	4	8

Action	Start Date	End Date
Development of the RaioSat nanosatellite power subsystem	12/2018	08/2020

Description

Definition of the solar panel, its regulation topology and main elements for power generation in the nanosatellite.

Action Indicators

Type	Index	Current Situation	Goal of 2 nd Year	Final Goal
Qualitative	Critical Design Review (CDR)	0	0	1
Qualitative	Preliminary Design Review (PDR)	0	1	1
Quantitative	Publications in journals and events of this area	0	2	4

Action	Start Date	End Date
Development of the on-board computing subsystem with radiation shielding to the RaioSat nanosatellite	11/2018	07/2020

Description

Definition of the topology of on-board computing, telemetry, remotes, FDIR (Failure Detection, Isolation and Recovery) policies.

Action Indicators

Type	Index	Current Situation	Goal of 2 nd Year	Final Goal
Quantitative	Publications in journals and events of this area	2	4	8
Qualitative	Preliminary Design Review (PDR)	0	1	1
Qualitative	Critical Design Review (CDR)	0	0	1
Qualitative	Sending doctoral students abroad in an internship program	0	1	2

Action	Start Date	End Date
Definition of the RaioSat nanosatellite launch segment	11/2018	08/2020

Description



Launchers availability, feasibility and Cost-Benefit study as well as contact for launch scheduling (prospective partnership using either a national launchers from IAE / DCTA or USA, India, Russia, Japan or China).

Action Indicators

Type	Index	Current Situation	Goal of 2 nd Year	Final Goal
Qualitative	Publications in journals and events of this area	0	2	4

Action	Start Date	End Date
Development of the RaioSat nanosatellite attitude control subsystem	11/2018	08/2020

Description

Definition and implementation of the 3-axis attitude controller for the mission (Prospective partnership with Germany, EAH Jena).

Action Indicators

Type	Index	Current Situation	Goal of 2 nd Year	Final Goal
Quantitative	Publications in journals and events of this area	0	2	4
Qualitative	Preliminary Design Review (PDR)	0	1	1
Qualitative	Critical Design Review (CDR)	0	0	1
Quantitative	Sending lecturers for sabbaticals abroad	0	1	2

Action	Start Date	End Date
Development of the RaioSat nanosatellite payload subsystem	11/2018	07/2020

Description

Definition and manufacture of a lightning detection camera optics (prospective partnership with Germany, Jena EAH and with Argentina, CONAE) and subsequent image processing on board the nanosatellite.

Action Indicators

Type	Index	Current Situation	Goal of 2 nd Year	Final Goal
Quantitative	Publications in journals and events of this area	0	2	4
Qualitative	Preliminary Design Review (PDR)	0	1	1
Qualitative	Critical Design Review (CDR)	0	0	1

Goal

Material Science research for space use

Action	Start Date	End Date
Research and development of ionizing radiation tolerant materials	08/2018	07/2022

Description

Investigate materials and devices with high tolerance to ionizing radiation in the space environment and to establish their specific characterization techniques

Action Indicators

Type	Index	Current Situation	Goal of 2 nd Year	Final Goal
Qualitative	Publications in journals and events of this area	4	6	8



Qualitative	Sending doctoral students abroad in an internship program	1	2	3
Qualitative	Bring postdoctoral fellows with experience abroad	0	1	2
Qualitative	Attract students from abroad	0	1	2
Qualitative	Bring visiting lecturers from abroad to the post-graduate program	0	1	2
Qualitative	Sending lecturers for sabbaticals abroad	0	1	2

Action	Start Date	End Date
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Research and development of ceramic materials and functional composites attenuating ionizing radiation, debris impacts and thermal oscillations in space environment	08/2018	07/2022
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Description

To study multifunctional materials that act as attenuators of ionizing radiations, impacts of space debris and thermal oscillations for use in the space environment and establish specific techniques of characterization.

Action Indicators

Type	Index	Current Situation	Goal of 2 nd Year	Final Goal
Quantitative	Publications in journals and events of this area	4	8	14
Qualitative	Sending doctoral students abroad in an internship program	0	2	4
Qualitative	Attract students from abroad	0	2	3
Qualitative	Sending lecturers for sabbaticals abroad	0	2	3
Qualitative	Bring visiting lecturers from abroad to the post-graduate program	0	1	2
Qualitative	Bring postdoctoral fellows with experience abroad	0	1	3

Goal

Research and development of surface modifications with micro and nanostructured materials

Action	Start Date	End Date
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Growth and characterization of thin and thick films of Diamond Like Carbon (DLC)	08/2018	07/2022
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Description

Investigate the growth and specific techniques for characterization of thin and thick DLC films for space applications and in the industry

Action Indicators

Type	Index	Current Situation	Goal of 2 nd Year	Final Goal
Quantitative	Publications in journals and events of this area	4	6	10
Qualitative	Sending doctoral students abroad in an internship program	0	1	2



Qualitative	Bring postdoctoral fellows with experience abroad	0	1	2
Qualitative	Bring visiting lecturers from abroad to the post-graduate program	0	1	2
Qualitative	Attract students from abroad	2	2	6
Qualitative	Sending lecturers for sabbaticals abroad	0	1	2

Action	Start Date	End Date
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Development of nanostructured materials for space applications	08/2018	07/2022
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Description

Research and development of nanostructured materials for functional structural applications for use in space environment and respective characterization techniques in a simulated space environment

Action Indicators

Type	Index	Current Situation	Goal of 2 nd Year	Final Goal
Qualitative	Sending lecturers for sabbaticals abroad	0	2	3
Qualitative	Bring visiting lecturers from abroad to the post-graduate program	0	1	2
Quantitative	Publications in journals and events of this area	0	6	10
Qualitative	Attract students from abroad	0	1	2
Qualitative	Sending doctoral students abroad in an internship program	0	1	3
Qualitative	Bring postdoctoral fellows with experience abroad	0	1	2

Goal

Thermal analysis of space vehicles

Action	Start Date	End Date
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Planning for thermal protection of space vehicles	08/2018	07/2022
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Description

Study of thermal protection planning of space vehicles. Includes sizing and choice of material to maintain temperatures within specified standards.

Action Indicators

Type	Index	Current Situation	Goal of 2 nd Year	Final Goal
Qualitative	Publications in journals and events of this area	1	2	4
Qualitative	Bring postdoctoral fellows with experience abroad	0	1	2
Qualitative	Attract students from abroad	0	1	2
Qualitative	Sending lecturers for sabbaticals abroad	0	1	2

Action	Start Date	End Date
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Study of temperature gradients

08/2018

07/2022

Description

Study of temperature gradients in space vehicles in space conditions.

Action Indicators

Type	Index	Current Situation	Goal of 2 nd Year	Final Goal
Qualitative	Publications in journals and events of this area	1	2	4
Qualitative	Bring postdoctoral fellows with experience abroad	0	1	2
Qualitative	Sending doctoral students abroad in an internship program	0	1	2
Qualitative	Bring visiting lecturers from abroad to the post-graduate program	0	1	1

Theme

GLOBAL ENVIRONMENTAL CHANGES

Goal

Diagnostics and scenarios of socio-environmental interactions

Action

Support for the construction of scenarios and indicators of sustainability (qualitative and quantitative)

Start Date

08/2018

End Date

07/2022

Description

Actions to support the construction of integrated scenarios (qualitative and quantitative - based on either projections of climate change or global environmental changes) and sustainability indicators (present and future, according to the scenarios), as well as impact, adaptation and vulnerability to environmental change, such as support for the realization of doctoral internships, attraction of young talents, consolidation of existing international partnerships, as well as the construction of new partnerships and cooperation projects, with studies focused on the theme.

Action Indicators

Type	Index	Current Situation	Goal of 2 nd Year	Final Goal
Quantitative	Visiting scholars and postdocs with experience abroad	2	2	4
Quantitative	Number of international visits by students in the research line	0	1	1
Quantitative	Projects with international cooperation	2	4	4
Quantitative	Theses in the line of research co-oriented by foreigners	0	1	2

Goal

Earth System Modeling

Action

Start Date

End Date



Actions for the development of new functionalities in Earth System Models

08/2018

07/2022

Description

Actions to promote the development of new parameters or functionalities of models of different components of the Terrestrial System appropriate to the processes observed in South America, especially in the tropical region, that contribute to the integrated understanding and simulation of the Earth System in the recent and future past, including knowledge appropriation of students who hold a internship PhD. abroad on related topics, attraction of students or foreign visiting researchers and participation in international projects with models of the terrestrial system.

Action Indicators

Type	Index	Current Situation	Goal of 2 nd Year	Final Goal
Quantitative	Visits of foreign researchers or students	4	4	6
Quantitative	Projects of international cooperation in modeling the Earth system	2	3	4
Quantitative	Inclusions of new features or processes in models	2	5	10
Quantitative	International seminars on the theme	1	2	2

Goal

Water-food-energy nexus

Action	Start Date	End Date
Promote international partnerships	08/2018	07/2022

Description

Actions to promote research, in cooperation with international partners, for sustainability in the context of the water-energy-food nexus, in view of climate change, taking into account economic, social and environmental aspects. In addition, actions should be taken to promote knowledge appropriation from students that take their doctoral internship studies abroad on related subjects, to attract students or visiting foreign researchers, and to participate in international projects.

Action Indicators

Type	Index	Current Situation	Goal of 2 nd Year	Final Goal
Quantitative	Theses in the line of research co-oriented by foreigners	0	1	2
Quantitative	Realization of doctoral internship abroad	0	1	2
Quantitative	Projects of international cooperation	2	3	4

Goal

Observational sensor networks of the Earth System

Action	Start Date	End Date
Compile data from observing networks of the Earth system in digital platform	08/2018	07/2022



Description

Adding information on the observing networks of the Earth System of which INPE and other relevant institutions participate, including for example observations of the impacts of climate change in Brazil (SISMOI) on a digital platform that will compile such data, seeking a language accessible to those who are outside the academy, especially the decision makers.

Action Indicators

Type	Index	Current Situation	Goal of 2 nd Year	Final Goal
Qualitative	Creation & maintenance of digital database platform system	In planning	System implemented & in evaluation	System deployed, available to the society

Theme

HELIOPHYSICS

Goal

Develop or improve state-of-the-art instrumentation for heliophysics observations

Action	Start Date	End Date
Design, build, calibrate and test, at prototype level, at least 2 scientific instruments in the field of heliophysics	09/2018	07/2022

Description

Observation and monitoring of heliospheric phenomena requires observations of the sun, interplanetary space, magnetospheres of the earth, other planets and bodies, ionosphere and atmosphere of the earth and other planets/bodies. It is the goal of this activity to capacitate INPE to conduct autonomous observations and modeling in areas related to heliophysics, building up on the existing expertise in the Space Geophysics and Aeronomy divisions. Actions will promote the design of new instrumentation or improvement of existing ones, as well as development of observation techniques.

Action Indicators

Type	Index	Current Situation	Goal of 2 nd Year	Final Goal
Quantitative	Number of tested, calibrated or validated instruments or prototypes	0	1	2

Action	Start Date	End Date
Visits of foreign researchers with expertise on scientific instrumentation or numerical simulations in heliophysics	08/2018	07/2022

Description

The intention is to gather autonomy in observations and computational modeling in some areas of research in Heliophysics, complementing INPE's tradition. It is the goal of this activity to bring foreign visiting researchers with expertise on scientific instrumentation in heliophysics or numerical simulations in heliophysics, in order to foster exchange of know-how in these areas between the visitors and the existing groups at INPE.

Action Indicators



Type	Index	Current Situation	Goal of 2 nd Year	Final Goal
Quantitative	Number of visitors (1 month duration each)	0	2	3

Goal

Conduct research in heliophysics by means of data analysis, modeling and theory and publish the results for the scientific community and for the general public

Action	Start Date	End Date
Exchange of researchers to foster scientific collaboration in heliophysics	08/2018	07/2022

Description

It is the goal of this activity to bring visiting researchers to INPE and to send INPE's researcher abroad in order to improve collaboration in topics related to heliophysics.

Action Indicators

Type	Index	Current Situation	Goal of 2 nd Year	Final Goal
Quantitative	Number of visitors (1 month duration each)	0	1	2
Quantitative	Number of INPE researchers visiting abroad (1 year duration each)	0	1	2

Action	Start Date	End Date
Conduct high level scientific research on heliophysics through theoretical studies, data analysis or numerical modeling and make it available to the scientific community and for the general public.	08/2018	07/2022

Description

One way to evaluate the excellence in scientific research is to measure the percentage of publications in journals included in JCR. Historically, INPE's publications in topics related to heliophysics in journals included in JCR range from 72% to 95% in the last 6 years. It is the goal of this activity to maintain this percentage.

Action Indicators

Type	Index	Current Situation	Goal of 2 nd Year	Final Goal
Quantitative	Percentage of publications in journals included in JCR	80	80	80

Goal

Training personnel to work on heliophysics research at international level

Action	Start Date	End Date
Visiting professors to give postgraduate level courses at INPE in topics related to heliophysics.	08/2018	07/2022

Description

For professional training at the international level, it is important to have a number of courses taught totally or partially by foreign teachers coming from institutions with a high relevance for the training of researchers. It is



the goal of this activity to bring foreign professors to give postgraduate level courses in topics related to heliophysics, either intensive or partially online.

Action Indicators

Type	Index	Current Situation	Goal of 2 nd Year	Final Goal
Quantitative	Number of visitors (1 month duration each)	0	2	3

Action	Start Date	End Date
Increase the number of postgraduate student exchanges as internship programs	08/2018	07/2022

Description

In order to train high level personnel at international level, it is necessary to have a fraction of the students with international experience. In the last 6 years, 5% to 8% of all students in this field have been sent abroad through exchange internship programs (1 year duration each). It is the goal of this activity to increase the number of postgraduate student exchanges for internship programs to 20% of all students developing research work on heliophysics.

Action Indicators

Type	Index	Current Situation	Goal of 2 nd Year	Final Goal
Quantitative	Number of postgraduate fellow exchanges for internship programs (1 year duration each)	1	4	8

Action	Start Date	End Date
Increase the number of PhD thesis in English	08/2018	07/2022

Description

In order to have international level of personnel, it is important to have at least a fraction of the conclusion works (thesis) written in english language. In the last 6 years, this percentage oscillated from 0 to 44%. Currently, this number is 20%. It is the goal of this activity to increase to at least 30%.

Action Indicators

Type	Index	Current Situation	Goal of 2 nd Year	Final Goal
Quantitative	Percentage of PhD thesis in English	20	25	30

Action	Start Date	End Date
Increase the number of foreign postgraduate co-supervisors	08/2018	07/2022

Description

To achieve international level, it is desirable to have a fraction of advisors from foreign institutions. In the last 6 years, the number of foreign supervisors of thesis in topics related to heliophysics oscillated from 0 to 8%. It is the goal of this activity to increase this number to at least 20%.

Action Indicators

Type	Index	Current Situation	Goal of 2 nd Year	Final Goal
Quantitative	Percentage of foreign postgraduate	8	12	20



co-supervisors

Action	Start Date	End Date
Increase the number of foreign postgraduate students developing research on heliophysics.	08/2018	07/2022

Description

It is very desirable to have a fraction of the postgraduate students coming from abroad in order to establish an international environment. In the last 6 years, 12% to 21% of the postgraduate students in topics related to heliophysics were foreigners. It is the goal of this activity to increase this number to 25%.

Action Indicators

Type	Index	Current Situation	Goal of 2 nd Year	Final Goal
Quantitative	Percentage of foreign postgraduate students in heliophysics	14	20	25

Action	Start Date	End Date
Increase the percentage of heliophysics-related postgraduate courses in english language.	08/2018	07/2022

Description

Having level courses in English language is a necessary condition to allow training personnel at international level. It is the goal of this activity to offer all mandatory courses in topics related to heliophysics in english language.

Action Indicators

Type	Index	Current Situation	Goal of 2 nd Year	Final Goal
Quantitative	Percentage of mandatory courses in topics related to heliophysics taught in English	1	50	100

Theme

TROPICAL METEOROLOGY

Goal

Ocean-Atmosphere Interaction

Action	Start Date	End Date
Identify the processes of Ocean-Atmosphere interaction and their consequences for tropical weather and climate.	12/2018	07/2022

Description

The identification of the processes that involve the interaction between the oceans and the atmosphere is crucial for the development of parameterizations and conceptual models that govern weather and climate. The understanding of these processes is carried out through modeling studies and the use of observational data.



Action Indicators

Type	Index	Current Situation	Goal of 2 nd Year	Final Goal
Qualitative	Improve weather and climate forecast	Under development	Pre-operational version	Operational version
Qualitative	Publications in journals and events	1	2	4
Qualitative	Sending students to doctoral internship abroad	0	1	2
Qualitative	Bring postdoctoral researchers from abroad	1	1	2

Goal

Climate Studies and Modeling

Action	Start Date	End Date
Development of Climate Forecasting Systems	11/2018	07/2022

Description

The use of numerical models of global climate prediction is fundamental for the understanding of phenomena associated with global and regional climate studies, as well as the use of the observational database and simulations. In the development of the models will include the various components that affect the climate, with emphasis on the inclusion of aerosols and atmospheric chemistry.

Action Indicators

Type	Index	Current Situation	Goal of 2 nd Year	Final Goal
Qualitative	Improve weather and climate forecast	Under development	Quality control tests	Operational version + Quality control
Qualitative	Sending professors to internship abroad	0	1	2
Qualitative	Publications in journals and events	2	3	5
Qualitative	Sending students to PhD internship abroad	1	2	3

Goal

Biosphere-Atmosphere Interaction

Action	Start Date	End Date
Better understanding of Biosphere-Atmosphere interaction	11/2018	07/2022

Description

Making use of observational data, already available and in the collection phase, will be studied the main processes of biosphere-atmosphere interaction. These studies will be used to include these processes in the improvement of the quality of the models used for the understanding of the biosphere-atmosphere interaction.

Action Indicators



Type	Index	Current Situation	Goal of 2 nd Year	Final Goal
Qualitative	Improvement in the quality of process understanding, with publications in the area	Under development	Publications of scientific articles	Publication of several articles in the area
Qualitative	Bring postdoctoral from abroad	0	0	1
Qualitative	Bring teacher from abroad	0	1	2
Qualitative	Sending student to doctoral internship	0	1	2
Qualitative	Publication in magazines and events	2	4	6

Goal

Weather Studies and Modeling

Action	Start Date	End Date
Improve the understanding of the meteorological process that act in the diverse temporal and spatial scales	11/2018	07/2022

Description

The weather forecast in the tropics is a slower development process, as most of the global research and operation centers are outside the tropics. However, in order to advance knowledge in the modeling area of the terrestrial system, it is necessary to understand the role of the tropics and this fact facilitates the interaction between the various research and operation centers. Making use of several meteorological experiments, consolidated in a data collection phase, it is possible to expand this knowledge, which must be integrated in the modeling processes. This development is done in all scales of time, hours, days, weeks and in diverse spatial resolutions.

Action Indicators

Type	Index	Current Situation	Goal of 2 nd Year	Final Goal
Qualitative	Increased quality and temporal resolution understanding, with publications in the area	Medium range forecast	Nowcasting forecast	Forecast on all time scales, from hours to weeks
Qualitative	Increase in quality and spatial resolution	Forecast of the order of 15 km	Forecast of the order of 5 km	Forecast of the order of 2 km
Qualitative	International cooperation projects	2	3	5
Qualitative	Sending student to doctoral internship	1	2	3
Qualitative	Publication in magazines and events	4	6	8

STRATEGIES

Strategies for the consolidation of existing international partnerships, as well as the construction of new partnerships and cooperation projects to increase the relationship between the Brazilian institution and research groups abroad.



(i) Expanding the exchange of students and professors of the Institute with foreign institutions through the dissemination of announcements by the Technological Innovation Center (NUIIT), which has competence, together with the Technical-Scientific Council (CTC) and the International Relations Service (SCRIN) to identify potential opportunities for international cooperation; (ii) Encouraging participation of students and professors in ongoing international projects through the provision of grants and/or resources for training and participation in scientific events; (iii) Encouraging new partnerships through international workshops to discuss research topics of common interest, with emphasis on institutions based in countries which CAPES maintains cooperation agreements; (iv) Planning and developing an integrated on-line system for publishing opportunities of partnerships and calls for submitting projects of interest to INPE to attract international partners;

Strategies to attract foreign students to Brazil.

i. Creating specific courses and/or offering courses in priority thematic areas in foreign languages (preferably English), enabling the student's interdisciplinary training and encouraging them to carry out academic activities at INPE; (ii) Publishing the activities and/or academic opportunities at international events through advertisements in trade journals, web pages and/or social media and implementation an on-line system for registration of potential candidates to INPE's PGPs; (iii) Promoting summer and winter schools with relevant topics in the priority areas; (iv) Publishing MSc dissertations and PhD theses in English, broadening access to the scientific production of INPE's PGPs; (v) Helping foreign students to apply for INPE's PGPs through the acceptance of the credits and/or prerequisites of subjects held outside country; (vi) Promoting equivalence of Brazilian courses to foreign courses with the disciplines of the Postgraduate Programs of INPE through unified criteria in order to encourage that foreign students have facility in accomplishing academic activities in the Institute; (vii) Creating or adapting specific disciplines / strategies of the Postgraduate Programs to be taught by foreign lecturers / researchers through distance or face-to-face classes, when the researcher is visiting the Institute;

Strategies to attract professors and researchers with international experience.

(i) Organizing of international workshops, conferences or symposiums to discuss research topics relevant to INPE and of interest to foreign institutions, partners or not; (ii) Promoting of international courses, schools, and trainings at INPE, where professors and researchers with international experience will be invited to integrate these activities by transferring their knowledge and experiences to the students and professors of the Institute's PGPs; (iii) Planning and organizing of international courses at INPE by relevant researchers in topics of institutional interest, particularly those that already collaborate with research activities of the Institute in the projects of cooperation in execution; (iv) Encouraging professors and researchers to advise foreign students and eventually include them in the research projects they coordinate or participate in, thus allowing foreign co-supervisors to carry out activities in Brazil within the scope of the project and related to the PGPs; (v) Carrying out, whenever possible, the objectives of the international cooperation projects and scientific campaigns in Brazil encouraging the participation of foreign researchers with longer stays in the country in order to integrate to the different scientific activities of the project and academic of the related PGPs.

Strategies to prepare the scholars for the period abroad as well as for their return, especially in order to increase the knowledge appropriation by the institution.

(i) Promoting, whenever possible, according to the available budget, language courses, focusing on the English language, for students of INPE; (ii) Encouraging professors and students to have proficiency in foreign languages, especially the English language, by performing the tests of foreign language available in the country, such as TOEFL, IELTS, among others; (iii) Creating opportunities and define specific criteria for professors and/or newly graduated foreign students to do postdoctoral studies in Brazil, continuing their research activities; (iv) Promoting, within the framework of each international cooperation project and each PGP of the Institute, the exchange of scientific information through the encouragement of the joint production of specialized documentation, co-orientations of MSc Dissertations and/or PhD Theses and scientific and/or technical-scientific publications in peer-reviewed journals; (v) Stimulating permanent professors at INPE to do



internships of short (3 to 6 months) and/or medium duration (1 to 2 years) so that, in return, they can establish the knowledge acquired by teaching new disciplines courses and/or lectures and orientation of new students;

Describe innovative strategies that will be used by the institution that were not mentioned above.

(i) Promoting and expanding the interaction of different INPE PGPs in the construction of international cooperation projects and attraction of foreign professors and students; (ii) Integrating disciplines from the different subject areas, offering them in a foreign language; (iii) Listing and ranking research topics with strong potential international cooperation based on INPE's history and experience in the area of Sciences, Technologies and Space Applications; (iv) Providing language courses in INPE's Annual Training Plan for employees, students, and technicians; (v) Creating international environments where discussions, dialogues and interactions in foreign language and in Portuguese are encouraged for foreign students, support for foreign students; (vi) Enabling and encouraging bilateral programs in INPE's PGPs; (vii) After the publication of Law No. 13,243 of January 11, 2016 and its subsequent regulation through Decree No. 9283 of February 7, 2018, a new Legal Framework for Science, Technology and Innovation was established in Brazil. In addition to encouraging innovation and scientific and technological research, this legislation has established new mechanisms for the internationalization of Brazilian Scientific, Technological and Innovation Institutions, like INPE. INPE will use those mechanisms to promote the internationalization of its institutional projects and programs as well as its PGPs through the development of international cooperation and interaction with organizations and groups of excellence, allocation of human resources outside Brazil, which may be postgraduate professors, INPE's participation in international or foreign institutions involved in research and scientific and technological innovation by sharing of equipment, laboratories and/or infrastructure with foreign Institution.

POLICIES

Policy for selection of foreign partners, considering that 70% (at least) of the resources should be earmarked for partnerships with institutions based on countries that Capes maintains effective cooperation (listed in Annex I of the call).

(i) The selection of foreign partners should be made in order to consolidate the wide range of international cooperation already existing in INPE, whose activities produce relevant results in the production of advanced scientific knowledge, training of researchers and/or specialists, exchange of foreign professors and students and technological development, generating new products and services for society. Currently, most of the existing international partnerships at INPE already occur with foreign institutions in countries with which CAPES has effective cooperation; (ii) The selection of foreign partners for new projects should raise INPE's international cooperation, i.e. academic activities involving inter-country exchanges, transfer of technology between research groups and training of internationally-oriented personnel, giving priority to institutions in countries with which CAPES maintains effective cooperation, assuming they have similar activities.

Policy for internal selection of specific actions and beneficiaries, within the funding lines of the Capes-Print program. In case of cooperation projects with foreign institutions, the proposer should send an application of funds, the plan of activities, reciprocal funding, academic mobility, technical - scientific production, counterparts of the partner institutions, among others.

The internal selection of specific actions and beneficiaries will take into account, fundamentally: (i) transparency in the dissemination of funding opportunities, with broad dissemination of the calls to the target audiences in the main INPE web site, mainly through Internet pages with Portuguese and English versions; (ii) the definition and detailing of merit criteria for selection, which include curriculum analysis, academic production quality from a technical point of view and impact factor, academic performance of the candidate, with an emphasis on international activities; (iii) the eventual use of notes and/or grades of international exams to apply for the programs and/or cooperation projects through the creation of a weights table that emphasizes the academic performance of the candidate with good grades and/or concepts in international exams; (iv) the inclusion, in the case of scholarships, of the criteria for uneligibility of candidates in accordance with the normative instruments of CAPES and INPE; (v) the requirements for language proficiency according to minimum requirements per Type by CAPES; (vi) the right to administrative appeal and respond to appeals by



unapproved candidates; (vii) compliance with the provisions of Decree 7.203 / 2010 and Binding Summary No. 13/STF, legal provisions dealing with the practice of nepotism in the public sector. Regarding the selection of international cooperation projects, the proponents will have to: (i) present of resource application plan; (ii) provide plan of activities, detailing the objectives and actions that emphasize the innovative proposal as well as its international activities; (iii) proof the counterpart of infrastructure, personnel and financial of the Institution or foreign research team involved in the project; (iv) show that activities that will benefit from exchanges of researchers and students between the Institutions (academic mobility), with emphasis on lectures, courses, trainings, internships and/or joint fieldwork; (v) make joint technical-scientific production that guarantees the maintenance of the scientific knowledge acquired in the project activities at INPE; (vi) draw strategies for transferring knowledge to INPE through masters and doctorates with co-orientation or co-supervision, execution of postdoctoral projects and/or training at INPE.

Policy for hiring professors with recognized scientific performance in international level.

Since INPE is a public government institution, hiring is allowed only by public tenders. Thus, whenever budget is available and authorization of the competent agencies, in the eventual tender for filling positions in the Institution, the criteria for analysis of merit that take into account the candidate's international experience will be included as conditions for recruitment of researchers, emphasizing academic activities carried out outside Brazil through participation and/or coordination of international cooperation projects, joint technical-scientific production with foreign groups, orientation or co-orientation of foreign students and participation in courses, workshops, training abroad. In the case of temporary activities foreseen in the ongoing cooperation projects, the granting of fellowships for researchers will take into account, in their criteria of merit, the level of internationalization of the candidate. The selection of visiting researchers to carry out specific activities at INPE will be based on scientific production and international experience which are directly related to the interests of the projects being carried out, in order to broaden the Institute's international research environments through maximum interaction with the researchers (professors) and students of the PGPs;

Policy to increase proficiency in foreign languages for students, postgraduate faculties and technical staff that has direct relationship with the proposed Internationalization Project.

Increase proficiency in foreign languages in INPE's PGPs by the following directions: (i) including language courses in INPE's Institutional Training Program, with the objective of periodically and within budget possibilities, to provide training for students, professors and technical staff in foreign languages, mainly English; (ii) requiring proficiency in English as a criterion in the selection processes for the admission of Brazilian and foreign students in the Graduate Programs of the Institute and for candidates to INPE's national development programs with a view to internationalization; (iii) encouraging students, professors and staff members of the Institute to take language courses at more advanced levels in specialized schools with reduced costs due to the formalization of agreements and/or partnerships; (iv) prioritizing the selection of students, Brazilian and foreign, who have performed international language exams in Brazil or abroad through the use of the concepts obtained in these exams as a differential in the indicators of merit; (v) prioritizing the selection of international cooperation projects whose team of proponents has proficiency in languages, including this as a differential in merit indicators.

Policy of recognition of academic and scientific activities performed by faculties and students abroad.

The INPE's PGP General Regulation, established by Ordinance No. 35/2018 / SEI-INPE of 02/15/2018, allows the equivalence of the contents and number of hours of classes and / or academic activities carried out by the student in other PGPs in Brazil, as long as it is approved by the respective PGP's Course Council. Thus, in order to recognize the academic and scientific activities carried out by professors and students outside Brazil based on the following directions: (i) allowing the equivalence of the menus and hours of class of the disciplines and/or academic activities carried out by the student in other Graduate Programs abroad, if approved by the respective Course Council; (ii) establishing specific equivalence criteria of the subjects studied by the student in the foreign institution in order to meet the requirements of the PGPs; (iii) recognizing the activities carried out by students in foreign internships as credits for oriented-studies; (iv) taking as valid credits in the student's academic record, their participation in courses, lectures, seminars or isolated disciplines in foreign institutions,



provided that they are officially recognized by the Institution as academic and/or scientific activities; (v) encouraging the participation of professors in events and/or training abroad for later incorporation of the new knowledge acquired in the menus of the subjects of INPE's PGPs. The PGP's General Regulation also foresees co-tutelage PhD, which should be regulated through specific agreements between the institutions involved, taking into account the regulations of each PGP of the two Institutions and observing the current legislation. This regulation should have at least: (i) the minimum time of student stay in each of the two institutions involved; (ii) the financial obligations to be assumed by the parties involved; (iii) the responsibility for the research work by an advisor of INPE and by the other of the foreign institution; (iv) reciprocity between institutions, ensuring the validity of the thesis in the scope of the joint orientation and exempting students from school fees; (v) the guarantee that the subject of the thesis, the publication, the exploitation and the results of the research will be common to the partner institutions, considering the norms in force in the two participating countries; (vi) recognition that the thesis may have a single defense, but with double titulation.

Policy to host and support of foreign faculties, researchers and students.

In order to better host foreign people, creating the Foreign Visitor Support Program, which will have as basic guidelines: (i) establishing a Foreign Visitor Support Committee, which will be composed of students and at least one faculty member of the PGPs, with a 2-year term of office with the possibility of renewal, whose main function is to coordinate all activities foreseen in the Program; (ii) appointing a professor, researcher or student as tutor of the respective professor, researcher or foreign student during the initial period of up to 60 days; (iii) implementing, during the first week of the arrival of the visitor, specific adaptation activities, including the Coordination of the PGPs, in order to enrich the foreign visitor to culture, social customs and language, giving them support in their arrival and installation in Brazil; (iv) creating a standard orientation material for foreign visitors that will be delivered in the adaptation week containing various information from the country, including basic legislation, customs, culture, cuisine, language, means of transportation, lodging, food options; (v) promoting activities such as lectures, short seminars, meetings, etc. aimed at integrating foreign visitors to the academic activities of the PGPs, including instructions about the regulations and guidelines of the PGPs and the Institution.

Policy for the appropriation of the knowledge and experience acquired abroad by the beneficiaries of the actions of the Institutional Project of Internationalization.

Acquire all knowledge and experience acquired abroad by the beneficiaries of the internationalization actions based on the following guidelines: (i) compliance with the CAPES Ordinance No. 186 of 09/29/2017; (ii) publish articles in peer-reviewed journals, preferably with a high QUALIS classification, or technical reports of activities together with professors, researchers and/or students of the INPE's PGPs, or in the period of the foreign internship or when returning to the country; (iii) integrating the beneficiary into existing cooperation projects or propose new cooperation projects in the area of research related to its activities abroad; (iv) encouraging the participation of the newly-doctoral students, who was a beneficiary of the Internship Program Abroad (PDSE), in the National Post-Doctoral Programs (PNPD) so that his international experience is internalized in the academic activities of the PGPs; (v) encouraging the orientation of new students or co-orientation of students already enrolled in the area of research that was the subject of their activities abroad, proposing innovative research themes; (vi) promoting mini-courses, special classes in courses of the Course, seminars, workshops and round tables to encourage new studies and increase the knowledge in the area of research related to the theme developed by the beneficiary abroad.

Policy for management and operationalization of the Institutional Project of Internationalization.

Perform specific actions to ensure smooth running of the activities planned in the Institutional Internationalization Project, maximizing the achievement of the planned objectives and correctly executing the entire budget: (i) Engaging the Project Management Group with the entire scientific community of the Institute through semiannual periodic meetings involving the Area and Academic Coordinators, in which the objectives of the Project, benefits, opportunities, rules and partial results obtained from its implementation will be presented, updating the information whenever there is progress in the progress of activities, changes in current legislation, budget replanning, prioritization and re-evaluation of activities whose results are not satisfactory,



opening up new opportunities for cooperation projects; (ii) Establishing detailed guidelines (through specific information and specific forms) for access to the benefits provided for in the Project in accordance with beneficiary selection policies and international cooperation projects, which provide for the transparency of the dissemination of opportunities, establish clear criteria and selection objectives, based on the academic / scientific merit of the project and/or the proponents, establish the alignment of the opportunities with the Thematic Areas prioritized in the Institutional Project and promote the wide dissemination of the results of the selective processes, with broad access to the administrative resource; (iii) Developing web pages for dissemination of all activities of the Institutional Project, including calls for funding opportunities, dissemination of academic / scientific events promoted within the scope of the Internationalization Project, publication of the Minutes of the meetings of the Management Group and its deliberations, conventions for administrative events, dissemination of related news through periodical information, dissemination of the evaluations of the goals and execution of the Project, among others; (iv) Producing of technical dissemination material containing the main objectives of the Project, its funding opportunities, goals, regulations, among others; (v) Evaluating the accuracy of the Institute's PGPs' rules in order to encourage the participation of the PGPs in the activities of the Internationalization Project, creating new regulatory mechanisms to increase access to internationalization for students and professors.

Policy for monitoring and internal evaluation of the goals of the Institutional Project of Internationalization.

In order to ensure transparency in monitoring and internal evaluation of the goals of the Internationalization Project, it is planned to create an independent Evaluation Committee of Internationalization, of advisory nature, to evaluate the results of the Institutional Project, which will be composed of internal and external members of INPE, in the approximate proportion of up to 50%, if there is sufficient availability of specialists interested in joining the Committee. Its main attributions will be: (i) Ensuring the transparency of the process of management and internal evaluation of the goals and execution of the Internationalization Project; (ii) Applying the evaluation metrics of the Internationalization Project defined by the Management Group based on the information provided in the institutional diagnosis, the actions foreseen in the project, the targets established for each year and the allocated budget; (iii) Performing annual meetings to evaluate all the activities carried out and results achieved in the last year from the technical reports produced by the Project Management Group; (iv) Producing an evaluation report on the goals and execution of the Project, summarizing all the activities that effectively led to relevant results from the point of view of institutional internationalization, correlating them with the financial execution of the Project in order to verify the cost / benefit ratio of each share; (v) Recommending to the Management Group any revisions to the Project's goals and/or actions, in addition to possible re-allocation of resources, focusing on the activities with the greatest impact and/or producing relevant results and/or encouraging activities that are not yet producing satisfactory results. the fundamental objective of obtaining the maximum efficiency in the execution of the Project;

Policy for the conciliation of national development programs supported by Capes to the internationalization effort.

Integrate the national programs of financial support to the internationalization effort through the following actions: (i) Encouraging the students and/or professors of the INPE Graduate Programs, who are beneficiaries of resources of the national programs, such as PROAP, DS, PROEX, PNP, DINTER, PVNS, PAEP, to the internationalization activities according to the policies of management and operationalization of the Institutional Project described above, aiming at the engagement of beneficiaries of national programs with international resources; (ii) Prioritizing access to national programs for students, professors and researchers who already have international experience or who are involved in international activities, either through the Institutional Project or through partner Institutions; (iii) Promoting the training of the beneficiaries of the national programs for internationalization, publicizing the available opportunities and encouraging the realization of new projects of international cooperation and/or organization of international academic / scientific activities; (iv) Attracting foreign researchers to Brazil through PNP (post-doctoral fellowship) opportunities;

Describe here other innovative policies that will be adopted by the institution that were not addressed before in the above items.



1) Promote annual summer/winter schools as part of the academic activities of the INPE's PGPs in order to:

- (i) Consolidate international environments within the Institute, where there is greater social and academic interaction between Brazilians and foreigners;
- (ii) Attract foreign students, professors and researchers to integrate into the activities of each PGP and eventually identify potential opportunities for future cooperation;
- (iii) Encourage the participation of students, professors and Brazilian researchers to the internationalization activities, expanding access to the opportunities and benefits offered by the Internationalization Project;
- (iv) Provide the academic content of schools as credits in specific subjects of the organizing PGP, either as supervised studies, or as seminars;
- (v) Allow international experience to students, professors and researchers participating in that subsequently serve as differential indicators in the merit of the beneficiary selection process and/or cooperation projects under the internationalization project;
- (vi) Promote the co-orientation and/or co-guidance of Brazilian students by foreign professors and/or foreign students by Brazilian professors in research projects related to the subject(s) of the schools.

2) Encourage the participation, mainly of students, in events outside country with the objective:

- (i) Increase the visibility of your research projects;
- (ii) Consolidate your proficiency in a foreign language;
- (iii) Encourage interactions with other foreign research groups working in related areas to allow potential future partnerships, such as joint technical-scientific publications, co-orientations, co-advising and the design of cooperation projects;

FURTHER INFORMATION

Number of postgraduate courses taught in English between 2013 and 2016	18
Number of cotutelle postgraduate programs between 2013 and 2016	7
Number of double degree postgraduate programs between 2013 and 2016	1
Number of bilateral postgraduate programs between 2013 and 2016	0
Number of contributions for derived products and databases of international research projects	32
Number of Capes development programs of which the institution has benefited from between 2013 and 2016	5
Number of CAPES international research projects of which the institution has benefited from between 2013 and 2016	42

Insertion of materials, themes and subjects in foreign language in the postgraduate program curricular structure.

The curricular structure and the academic activities program of the INPE's PGP will be updated in order to meet the objectives of the Internationalization Project proposed as follows: (i) offering mandatory and elective courses in a foreign language, mainly English, in all PGPs; (ii) promoting interdisciplinarity of topics by allowing student's curricular timetable to have disciplines of any PGPs, depending on the thematic area in which the student's research project is inserted, as defined by the ad-hoc interviews; (iii) allowing activities carried out by students in internships abroad to be incorporated as credits for studies oriented in their school history; (iv) allowing the student's participation in courses, lectures, seminars, summer / winter schools or isolated disciplines in foreign institutions, only if those activities are officially recognized by the Institution as valid academic and / or scientific activities; either the credits can be accepted in student's history or the academic



activities can be used as a method of evaluation; (v) encouraging the participation of teachers in events and / or training abroad for later incorporation of the new subjects in the disciplines of the PGP's of the related thematic area; (vi) organizing and making available online teaching materials to support the courses (in the form of textbooks or video-lessons), technical-scientific documents, dissertations, theses and scientific articles in foreign languages for the students of the subject areas; (vii) including foreign language courses as academic activities in the student's academic curriculum; (viii) encouraging the writing, defense and publication of dissertations and theses in a foreign language; (ix) regulating publishing standards for dissertations and theses in a foreign language, in particular formats based on scientific articles published in peer-reviewed journals; (x) defining a minimum among of curricular activities in a foreign language in all thematic areas provided for in the Internationalization Project, which includes not only disciplines, but other academic activities such as participation in events, lectures, seminars, summer / winter schools, level courses performed in Brazil or abroad.

EXPECTED BENEFITS

Theme

INSTRUMENTAL ASTROPHYSICS

International Cooperation Projects

Project Name	Start Date	End Date
Research and Development in Instrumental Astrophysics	01/11/2018	31/07/2022

Description

The constitution, formation, evolution and phenomenology of diverse astrophysical objects will be investigated through the collection / analysis of observational data, development of state-of-the-art astronomical instrumentation and construction of theoretical models. Emphasis is given to the production of quality/frontier science in physics and astrophysics with instrumental resources developed by the group itself, in collaboration with international institutions. This is the definition of Instrumental Astrophysics, that astrophysics performed by instrumentation developed, in whole or in part, by the group itself. The internationalization of these activities only benefits the realization of this research and development, since it can count on laboratories and foreign personnel, mainly in the first world countries, with experience in the development of astronomical instrumentation. However, the participation of Brazilian students and the national industry is fundamental, so that we can train human resources in the area of astronomical instrumentation and encourage the participation of the national industry in the development of high technology instrumentation. This research and development project on Instrumental Astrophysics will cover the electromagnetic spectrums of radio, infrared, optical, X-rays and gamma rays, in addition to the detectable spectrum in gravitational waves.

Work Missions Related to Cooperation Projects

Year	Quantity	Amount
2018	0	R\$ 0,00
2019	0	R\$ 0,00
2020	0	R\$ 0,00
2020	0	R\$ 0,00
2021	0	R\$ 0,00

Resources for Maintenance of Projects

Year	Amount
2018	R\$ 0,00
2029	R\$ 0,00
2020	R\$ 0,00
2021	R\$ 0,00
2022	R\$ 0,00



Fellowships Related to Cooperation Projects

Year	Type	Quantity	Amount
2018	Visiting Professor in Brazil (1 month)	0	R\$ 0,00
2019	Postdoc with Int'l Experience (12 months)	0	R\$ 0,00
2019	Capacitation (15 days)	0	R\$ 0,00
2019	Doctoral internship (6 months)	2	R\$ 80.956,80
2019	Visiting Professor in Brazil (1 month)	1	R\$ 23.155,29
2019	Visiting Senior Professor Abroad (4 months)	0	R\$ 0,00
2020	Capacitation (15 days)	0	R\$ 0,00
2020	Visiting Senior Professor Abroad (4 months)	0	R\$ 0,00
2020	Doctoral internship (6 months)	2	R\$ 80.956,80
2020	Postdoc with Int'l Experience (12 months)	0	R\$ 0,00
2020	Visiting Professor in Brazil (1 month)	1	R\$ 23.155,29
2021	Doctoral internship (6 months)	2	R\$ 80.956,80
2021	Capacitation (15 days)	0	R\$ 0,00
2021	Visiting Senior Professor Abroad (4 months)	0	R\$ 0,00
2021	Visiting Professor in Brazil (1 month)	1	R\$ 23.155,29
2021	Postdoc with Int'l Experience (12 months)	0	R\$ 0,00
2022	Doctoral internship (6 months)	2	R\$ 80.956,80
2022	Capacitation (15 days)	0	R\$ 0,00
2022	Visiting Professor in Brazil (1 month)	1	R\$ 23.155,29

Work Missions Not Related to Cooperation Projects

Year	Quantity / Year	Amount
2019	2	R\$ 30.844,00
2020	0	R\$ 0,00
2021	0	R\$ 0,00
2022	0	R\$ 0,00

Fellowships Not Related to Cooperation Projects

Year	Type	Quantity	Amount
2019	Visiting Professor in Brazil (1 month)	0	R\$ 0,00
2019	Capacitation (15 days)	0	R\$ 0,00
2020	Capacitation (15 days)	0	R\$ 0,00
2020	Visiting Professor in Brazil (1 month)	0	R\$ 0,00
2021	Capacitation (15 days)	0	R\$ 0,00
2021	Visiting Professor in Brazil (1 month)	0	R\$ 0,00
2022	Visiting Professor in Brazil (1 month)	0	R\$ 0,00

Other Actions Not Related to Cooperation Projects

Year	Action	Description	Amount
2018	Dissemination of scientific knowledge in frontier physics and astrophysics to society in open access politics	Resources for payment of publication fees, aiming to achieve wide dissemination of scientific results published in international journals with a body of judges and high impact factor	R\$ 0,00



2019	Dissemination of scientific knowledge in frontier physics and astrophysics to society in open access politics	Resources for payment of publication fees, aiming to achieve wide dissemination of scientific results published in international journals with a body of judges and high impact factor	R\$ 10.000,00
2020	Dissemination of scientific knowledge in frontier physics and astrophysics to society in open access politics	Resources for payment of publication fees, aiming to achieve wide dissemination of scientific results published in international journals with a body of judges and high impact factor	R\$ 10.000,00
2021	Dissemination of scientific knowledge in frontier physics and astrophysics to society in open access politics	Resources for payment of publication fees, aiming to achieve wide dissemination of scientific results published in international journals with a body of judges and high impact factor	R\$ 10.000,00
2022	Dissemination of scientific knowledge in frontier physics and astrophysics to society in open access politics	Resources for payment of publication fees, aiming to achieve wide dissemination of scientific results published in international journals with a body of judges and high impact factor	R\$ 0,00

Theme

SATELLITE APPLICATIONS FOR SUSTAINABLE DEVELOPMENT

International Cooperation Projects

Project Name	Start Date	End Date
Use of satellites for environmental solutions informing nations globally (SENSING - Satellites for ENvironmental Solutions Informing Nations Globally)	01/08/2018	31/07/2022

Description

The SENSING project aims to focus efforts on scientific developments capable of solving emerging global problems in the field of environmental change, sustainable development, health and food security. Teachers and students will focus on techniques of environmental monitoring and geoprocessing, development of technologies in image processing and satellite data and services. In this project, we aim to train researchers and professionals, with recognized competence and leadership to act on national issues aligned with global initiatives. Thus, the project will subsidize the formation of scientific leaders with competence to deal with actions and create solutions on international issues such as the United Nations Framework Convention on Climate Change (UNFCCC), the Intergovernmental Panel on Climate Change (IPCC, the Convention on Biological Diversity (CBD), the Convention on Wetlands of International Importance (RAMSAR Convention), the Convention to Combat Desertification (UNCCD) and the Sendai Framework for Disaster Risk Reduction (UNISDR). The competent action of the leaderships formed with subsidies of this project, through the development of leading research, will strategically assist Brazil to fulfill its international goals established within the National Policy on Climate Change (PNMC - Law 12,187). The research will have a direct impact on the National Strategy for REDD + in Brazil (ENREDD +), which formalises, before Brazilian society and countries signatories to the United Nations Framework Convention on Climate Change, actions to prevent and control



deforestation and degradation forest promotion, and promotion of sustainable development. The success of this project requires not only the understanding of complex environmental systems, but also the domain of satellite image processing, the knowledge and development of sensors for the monitoring of specific targets and the ability to model such systems. The goals include: 1) Promote advanced research and technological development in Earth observation; 2) Provide excellence in higher education and technical training in the area of satellite applications; 3) Communicate scientific results to society; 4) Promote the state-of-the-art of scientific knowledge in the areas of knowledge in line with the demands of Brazilian and international society.

Work missions related to the cooperation project

Year	Quantity	Amount
2018	0	R\$ 0,00
2019	3	R\$ 46.266,00
2020	2	R\$ 30.844,00
2021	2	R\$ 30.844,00
2022	2	R\$ 30.844,00

Resources to maintenance of the projects

Year	Amount
2018	R\$ 0,00
2019	R\$ 10.000,00
2020	R\$ 10.000,00
2021	R\$ 10.000,00
2022	R\$ 10.000,00

Fellowships Related to Cooperation Projects

Year	Type	Quantity	Amount
2018	Visiting Professor in Brazil (12 months)	0	R\$ 0,00
2018	Young Talent with Int'l Experience (36 months)	0	R\$ 0,00
2018	Capacitation (15 days)	0	R\$ 0,00
2018	Post-doc with Int'l Experience (36 months)	0	R\$ 0,00
2019	Visiting Junior Professor Abroad (12 months)	0	R\$ 0,00
2019	Doctoral internship (12 months)	3	R\$ 228.830,40
2019	Post-doc with Int'l Experience (36 months)	2	R\$ 354.621,16
2019	Visiting Professor in Brazil (12 month)	0	R\$ 0,00
2019	Capacitation (15 days)	0	R\$ 0,00
2019	Young Talent with Int'l Experience (36 months)	0	R\$ 0,00
2019	Visiting Senior Professor Abroad (12 months)	0	R\$ 0,00
2020	Visiting Senior Professor Abroad (12 months)	0	R\$ 0,00
2020	Doctoral internship (12 months)	3	R\$ 228.830,40
2020	Visiting Junior Professor Abroad (12 months)	0	R\$ 0,00
2020	Capacitation (15 days)	0	R\$ 0,00
2020	Visiting Professor in Brazil (12 months)	0	R\$ 0,00
2020	Young Talent with Int'l Experience (30 months)	0	R\$ 0,00
2020	Post-doc with Int'l Experience (24 months)	0	R\$ 0,00
2021	Visiting Professor in Brazil (12 months)	0	R\$ 0,00
2021	Young Talent with Int'l Experience (18 months)	0	R\$ 0,00
2021	Visiting Junior Professor Abroad (12 months)	0	R\$ 0,00
2021	Doctoral internship (12 months)	3	R\$ 228.830,40
2021	Visiting Senior Professor Abroad (12 months)	0	R\$ 0,00
2021	Post-doc with Int'l Experience (18 months)	0	R\$ 0,00



2021	Capacitation (15 days)	0	R\$ 0,00
2022	Visiting Senior Professor Abroad (6 months)	0	R\$ 0,00
2022	Visiting Junior Professor Abroad (6 months)	0	R\$ 0,00
2022	Capacitation (15 days)	0	R\$ 0,00
2022	Visiting Professor in Brazil (6 months)	0	R\$ 0,00
2022	Doctoral internship (12 months)	3	R\$ 228.830,40

Work Missions Not Related to Cooperation Projects

Year	Quantity / Year	Amount
2019	2	R\$ 30.844,00
2020	0	R\$ 0,00
2021	0	R\$ 0,00

Fellowships Not Related to Cooperation Projects

Year	Type	Quantity	Amount
2018	Capacitation (15 days)	0	R\$ 0,00
2018	Post-doc (36 months)	0	R\$ 0,00
2019	Post-doc (36 months)	0	R\$ 0,00
2019	Doctoral internship (12 months)	0	R\$ 0,00
2019	Young Talents - A (36 months)	0	R\$ 0,00
2019	Capacitation (15 days)	0	R\$ 0,00
2020	Visiting Senior Professor Abroad (12 months)	0	R\$ 0,00
2020	Capacitation (15 days)	0	R\$ 0,00
2020	Doctoral internship (12 months)	0	R\$ 0,00
2020	Post-doc (30 months)	0	R\$ 0,00
2022	Capacitation (15 days)	0	R\$ 0,00
2021	Doctoral internship (12 months)	0	R\$ 0,00
2021	Capacitation (15 days)	0	R\$ 0,00

Other Actions Not Related to Cooperation Projects

Year	Action	Description	Amount
2019	Dissemination of scientific knowledge in frontier physics and astrophysics to society in open access politics	Resources for payment of publication fees, aiming to achieve wide dissemination of scientific results published in international journals with a body of judges and high impact factor	R\$ 10.000,00
2020	Dissemination of scientific knowledge in frontier physics and astrophysics to society in open access politics	Resources for payment of publication fees, aiming to achieve wide dissemination of scientific results published in international journals with a body of judges and high impact factor	R\$ 10.000,00
2021	Dissemination of scientific knowledge in frontier physics and astrophysics to society in open access politics	Resources for payment of publication fees, aiming to achieve wide dissemination of scientific results published in international journals with a body of judges and high impact factor	R\$ 10.000,00



2022	Dissemination of scientific knowledge in frontier physics and astrophysics to society in open access politics	Resources for payment of publication fees, aiming to achieve wide dissemination of scientific results published in international journals with a body of judges and high impact factor	R\$ 0,00
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Theme

MODELING AND ANALYSIS OF EARTH AND SPACE DATA

International Cooperation Projects

Project Name	Start Date	End Date
Research and Development in Modeling and Analysis of Earth and Space Data	01/08/2018	31/07/2022

Description

Since its creation, the National Institute for Space Research has been an international reference in the collection, analysis and distribution of environmental and space sensor data, and in applied research involving this data. It is also a specialist in the creation and implementation of numerical models and simulations of phenomena related to climate, time and space. The postgraduate program in Applied Computing (CAP) brings together researchers and students involved in the research, creation, implementation and testing of software, computational solutions and models to support INPE research. Although many research applications are focused on specific problems in Brazil (or related to the demand of INPE researchers in the applied areas of the Institute), CAP maintains several international collaborations, through individual projects of its professors, exchange of researchers, etc. One objective of this project is to strengthen the international collaborations of the program by increasing the opportunities for exchange of teachers and students and the creation of thematic research networks that can lead to proposals for joint projects and publications with foreign researchers; considering the experience of the international partners in the topics of interest of the program. Another objective is to disseminate knowledge about the different areas, in particular seeking experiences that can be incorporated into the program and challenges that can be solved together. As the Graduate Program in Applied Computing works together with all other graduate programs of INPE, a third objective of this project is to seek, through partner programs, acquisition of knowledge in new methodologies and technologies for modeling and processing of data from various sensors (astronomical, geophysical, environmental, meteorological, etc.). The themes of this research proposal are: Research in High Performance Processing; Research in Storage and Retrieval of Spatiotemporal Information; Research in Modeling of Earth and Space Systems; Research in Mining and Analysis of Earth and Space Data; and Research and Development on Scientific Software Creation

Work missions related to the cooperation project

Year	Quantity	Amount
2018	0	R\$ 0,00
2019	2	R\$ 30.844,00
2020	2	R\$ 30.844,00
2021	2	R\$ 30.844,00
2022	2	R\$ 30.844,00

Resources to maintenance the projects

Year	Amount
2018	R\$ 0,00



2019	R\$ 10.000,00
2020	R\$ 10.000,00
2021	R\$ 10.000,00
2022	R\$ 10.000,00

Fellowships Related to Cooperation Projects

Year	Type	Quantity	Amount
2018	Doctoral internship (12 months)	0	R\$ 0,00
2018	Capacitation (01 months)	0	R\$ 0,00
2018	Doctoral internship (12 months)	0	R\$ 0,00
2018	Visiting Professor in Brazil (15 days)	0	R\$ 0,00
2019	Visiting Junior Professor Abroad (03 months)	0	R\$ 0,00
2019	Doctoral internship (12 months)	3	R\$ 121.435,20
2019	Young Talent with Int'l Experience (06 months)	0	R\$ 0,00
2019	Visiting Professor in Brazil (15 days)	1	R\$ 16.155,29
2019	Capacitation (02 months)	0	R\$ 0,00
2019	Capacitation (01 months)	3	R\$ 46.375,20
2019	Visiting Senior Professor Abroad (03 months)	0	R\$ 0,00
2019	Doctoral internship (12 months)	0	R\$ 0,00
2020	Visiting Professor in Brazil (15 days)	1	R\$ 16.155,29
2020	Doctoral internship (12 months)	0	R\$ 0,00
2020	Capacitation (02 months)	0	R\$ 0,00
2020	Young Talent with Int'l Experience (06 months)	0	R\$ 0,00
2020	Visiting Junior Professor Abroad (03 months)	0	R\$ 0,00
2020	Visiting Senior Professor Abroad (06 months)	0	R\$ 0,00
2020	Capacitation (01 months)	4	R\$ 61.833,60
2020	Visiting Senior Professor Abroad (06 months)	0	R\$ 0,00
2020	Doctoral internship (06 months)	3	R\$ 121.435,20
2020	Visiting Professor in Brazil (15 days)	0	R\$ 0,00
2020	Visiting Junior Professor Abroad (06 months)	0	R\$ 0,00
2020	Doctoral internship (12 months)	0	R\$ 0,00
2021	Capacitation (02 months)	0	R\$ 0,00
2021	Visiting Professor in Brazil (15 days)	1	R\$ 16.155,29
2021	Doctoral internship (06 months)	3	R\$ 121.435,20
2021	Visiting Junior Professor Abroad (06 months)	0	R\$ 0,00
2021	Visiting Junior Professor Abroad (03 months)	0	R\$ 0,00
2021	Visiting Senior Professor Abroad (03 months)	0	R\$ 0,00
2021	Doctoral internship (12 months)	0	R\$ 0,00
2021	Doctoral internship (12 months)	0	R\$ 0,00
2021	Visiting Professor in Brazil (1 months)	0	R\$ 0,00
2021	Visiting Senior Professor Abroad (6 months)	0	R\$ 0,00
2021	Capacitation (1 months)	4	R\$ 61.833,60
2021	Young Talent with Int'l Experience (6 months)	0	R\$ 0,00
2022	Visiting Professor in Brazil (15 days)	1	R\$ 16.155,29
2022	Doctoral internship (06 months)	3	R\$ 121.435,20
2022	Doctoral internship (12 months)	0	R\$ 0,00
2022	Visiting Senior Professor Abroad (6 months)	0	R\$ 0,00
2022	Capacitation (1 months)	3	R\$ 46.375,20
2022	Visiting Junior Professor Abroad (3 months)	0	R\$ 0,00
2022	Doctoral internship (12 months)	0	R\$ 0,00
2022	Doctoral internship (12 months)	0	R\$ 0,00
2022	Young Talent with Int'l Experience (6 months)	0	R\$ 0,00



Work Missions Not Related to Cooperation Projects

Year	Quantity / Year	Amount
2018	0	R\$ 0,00
2019	0	R\$ 0,00
2020	0	R\$ 0,00
2021	0	R\$ 0,00
2022	2	R\$ 30.844,00

Fellowships Not Related to Cooperation Projects

Year	Type	Quantity	Amount
2018	Capacitation (15 days)	0	R\$ 0,00
2018	Capacitation (2 months)	0	R\$ 0,00
2019	Capacitation (2 months)	0	R\$ 0,00
2019	Capacitation (15 days)	0	R\$ 0,00
2020	Capacitation (2 months)	0	R\$ 0,00
2020	Capacitation (15 days)	0	R\$ 0,00
2021	Capacitation (2 months)	0	R\$ 0,00
2021	Capacitation (15 days)	0	R\$ 0,00
2022	Capacitation (2 months)	0	R\$ 0,00
2022	Capacitation (15 days)	0	R\$ 0,00

Theme

SPACE MISSIONS

International Cooperation Projects

Project Name	Start Date	End Date
Research and Development in Space Missions	01/08/2018	31/07/2022

Description

Besides building satellite equipment and algorithms, the main objective also is to improve personnel at Masters and Doctoral levels in the areas of Orbital Dynamics, Guidance and Control, Thermal Control and Structure, Combustion and Space Vehicle Propulsion, Engineering and Management of Space Systems and Technology of Materials and Sensors for space applications, aerospace and terrestrial applications, serving as a source of specialized human resources to be employed by INPE itself, others research institutions or in academia and Industry. The topics of Masters Dissertations and Doctoral Theses are, in general, closely related to projects and R&D activities in development at INPE. In the INPE's ETE coordination there are a number of technical partnerships with other foreign institutions as well as co-supervisions of thesis / dissertations. An example is the development of RaioSat, a 3U cubesat that will carry a CCST-suggested payload for monitoring lightning from space. There is the opportunity for a German university to develop some subsystems (Optics and Attitude Control) and share operations control infrastructure with Germany and Colombia. Another project investigates sprites seen from space with INPE's CEA can benefit from a cubesat payload. Other institutions that have shown interest were from countries: Israel, Netherlands, Italy, China, USA, UK, Argentina, Colombia, Spain, Japan and Russia.

Missions related to this cooperation research project:

Year	Quantity	Amount
2018	0	R\$ 0,00
2019	2	R\$ 30.844,00



2020	2	R\$ 30.844,00
2021	2	R\$ 30.844,00
2022	2	R\$ 30.844,00

Provision Resources for this project:

Year	Amount
2018	R\$ 0,00
2019	R\$ 20,000,00
2020	R\$ 20,000,00
2021	R\$ 20,000,00
2022	R\$ 20,000,00

Scholarships related to this cooperation research project:

Year	Type	Quantity	Amount
2018	Doctoral internship (12 months)	0	R\$ 0,00
2018	Post-doc (24 months)	0	R\$ 0,00
2019	Visiting Professor in Brazil (03 months)	1	R\$ 51.955,29
2019	Doctoral internship (12 months)	3	R\$ 228.830,40
2019	Post-doc (24 months)	1	R\$ 123.310,58
2019	Capacitation (1 months)	0	R\$ 0,00
2020	Post-doc (24 months)	2	R\$ 246.621,16
2020	Capacitation (1 months)	2	R\$ 30.916,80
2020	Doctoral internship (12 months)	3	R\$ 228.830,40
2020	Visiting Senior Professor Abroad (03 months)	0	R\$ 0,00
2021	Visiting Professor in Brazil (03 months)	1	R\$ 51.955,29
2021	Visiting Senior Professor Abroad (12 months)	0	R\$ 0,00
2021	Capacitation (1 months)	2	R\$ 30.916,80
2021	Post-doc (12 months)	2	R\$ 138.621,16
2021	Doctoral internship (12 months)	3	R\$ 228.830,40
2022	Capacitation (1 months)	2	R\$ 30.916,80
2022	Post-doc (36 months)	0	R\$ 0,00
2022	Doctoral internship (06 months)	3	R\$ 121.435,20

Scholarships not related to cooperation research project:

Year	Type	Quantity	Amount
2019	Doctoral internship (12 months)	0	R\$ 0,00
2020	Post-doc (36 months)	0	R\$ 0,00

Theme

GLOBAL ENVIRONMENTAL CHANGES

International Cooperation Projects

Project Name	Start Date	End Date
Modeling scenarios of socio-environmental interactions in the tropics	01/08/2018	31/07/2022

Description

Representing the Earth system in computational models, encompassing not only the physical and biological dimensions, but also the human dimensions is a challenge of interest to the entire international scientific



community of Environmental Sciences. In this project it is proposed to expand the existing international cooperation in INPE's PGPs to improve the representation in atmospheric, biophysical and socioeconomic processes in the tropical region that contribute to the better understanding of the Global Climate System, especially in the Brazilian territory. The activities involve three main axes of research that are integrated in a transdisciplinary way: 1) Collection and synthesis of observational data of the Earth system and effects of global environmental change, such as global networks of measurements of greenhouse gases and biogeochemical cycles, characterization of the potential for the production of renewable energies and detection of atmospheric electric discharges. 2) Parameterization and development of different components of the Earth System in models appropriate to the processes observed in South America, especially in the tropical region, contributing to the integrated understanding and simulation of the Earth System in the recent past and future, which may contribute to the construction of scenarios. 3) Formulation of scenarios and diagnoses of the functioning of the Earth System, considering natural and / or anthropic aspects.

Work missions related to the cooperation project

Year	Quantity	Amount
2018	0	R\$ 0,00
2019	1	R\$ 15.422,00
2020	1	R\$ 15.422,00
2021	1	R\$ 15.422,00
2022	1	R\$ 15.422,00

Resources for the maintenance of the projects

Year	Amount
2018	R\$ 0,00
2019	R\$ 2.000,00
2020	R\$ 2.000,00
2021	R\$ 2.000,00
2022	R\$ 2.000,00

Fellowships related to the cooperation project

Year	Type	Quantity	Amount
2018	Visiting Professor in Brazil (01 month)	0	R\$ 0,00
2018	Postdoc with Int'l Experience (06 months)	0	R\$ 0,00
2018	Internship PhD (06 months)	0	R\$ 0,00
2019	Internship PhD (12 months)	2	R\$ 152.553,60
2019	Visiting Young Professor Abroad (10 months)	0	R\$ 0,00
2019	Capacitation (15 days)	1	R\$ 13.118,40
2019	Visiting Professor in Brazil (02 months)	1	R\$ 37.555,29
2019	Postdoc with Int'l Experience (06 months)	0	R\$ 0,00
2019	Young Talent with Int'l Experience (12 months)	0	R\$ 0,00
2020	Visiting Professor in Brazil (2 months)	1	R\$ 37.555,29
2020	Young Talent with Int'l Experience (12 months)	0	R\$ 0,00
2020	Postdoc with Int'l Experience (12 months)	0	R\$ 0,00
2020	Internship PhD (06 months)	1	R\$ 40.478,40
2020	Visiting Senior Professor Abroad (10 months)	0	R\$ 0,00
2020	Capacitation (15 days)	0	R\$ 0,00
2021	Young Talent with Int'l Experience (12 months)	0	R\$ 0,00
2021	Postdoc with Int'l Experience (06 months)	0	R\$ 0,00
2021	Capacitation (15 days)	1	R\$13.118,40
2021	Visiting Professor in Brazil (02 months)	1	R\$ 37.555,29



2021	Internship PhD (12 months)	2	R\$ 152.553,60
2022	Young Talent with Int'l Experience (06 months)	0	R\$ 0,00
2022	Internship PhD (06 months)	1	R\$ 40.478,40
2022	Capacitation (15 days)	0	R\$ 0,00
2022	Postdoc with Int'l Experience (06 months)	0	R\$ 0,00

Missions not related to the cooperation project

Year	Quantity	Amount
2019	0	R\$ 0,00
2020	0	R\$ 0,00
2021	2	R\$ 30.844,00

Fellowships not related to the cooperation project

Year	Type	Quantity	Amount
2019	Postdoc with Int'l Experience (12 months)	0	R\$ 0,00
2019	Young Talent with Int'l Experience (12 months)	0	R\$ 0,00
2020	Young Talent with Int'l Experience (12 months)	0	R\$ 0,00
2020	Postdoc with Int'l Experience (12 months)	0	R\$ 0,00
2021	Postdoc with Int'l Experience (12 months)	0	R\$ 0,00
2021	Postdoc with Int'l Experience (12 months)	0	R\$ 0,00
2021	Young Talent with Int'l Experience (12 months)	0	R\$ 0,00

Other Actions Not Related to Cooperation Projects

Year	Action	Description	Amount
2019	Dissemination of scientific knowledge in frontier physics and astrophysics to society in open access politics	Resources for payment of publication fees, aiming to achieve wide dissemination of scientific results published in international journals with a body of judges and high impact factor	R\$ 10.000,00
2020	Dissemination of scientific knowledge in frontier physics and astrophysics to society in open access politics	Resources for payment of publication fees, aiming to achieve wide dissemination of scientific results published in international journals with a body of judges and high impact factor	R\$ 10.000,00
2021	Dissemination of scientific knowledge in frontier physics and astrophysics to society in open access politics	Resources for payment of publication fees, aiming to achieve wide dissemination of scientific results published in international journals with a body of judges and high impact factor	R\$ 10.000,00
2022	Dissemination of scientific knowledge in frontier physics and astrophysics to society in open access politics	Resources for payment of publication fees, aiming to achieve wide dissemination of scientific results published in international journals with a body of judges and high impact factor	R\$ 0,00



Theme

HELIOPHYSICS

International Cooperation Projects

Project Name	Start Date	End Date
Research in Heliophysics	01/08/2018	31/07/2022

Description

The goals of this project are to conduct research in heliophysics, develop instrumentation and observation techniques, and training personnel at postgraduate level in heliophysics. Topics cover solar physics, planetary physics, interplanetary medium, magnetospheres, ionospheres, atmospheres, magnetic fields of the earth and other planetes/bodies. This project has 3 main goals: 1) Develop or improve state-of-the-art instrumentation for heliophysics observations; 2) Conduct research in heliophysics by means of data analysis, modeling and theory and publish the results for the scientific community and for the general public; 3) Training personnel to work on heliophysics research at international level. Taking advantage of the existing tradition at INPE, this project aims at fostering collaborations with the following countries: United States of America; South Africa; Japan; Australia; Chile; Canada; Mexico; China; Austria; Germany; India; France; Spain; United Kingdom; Belgium, Italy; Cuba; Sweden; Argentina; Nigeria and Nepal.

Work missions related to the cooperation project

Year	Quantity	Amount
2018	0	R\$ 0,00
2019	2	R\$ 5.774,00
2020	0	R\$ 0,00
2021	0	R\$ 0,00
2022	0	R\$ 0,00

Resources to maintenance of the projects

Year	Amount
2018	R\$ 0,00
2019	R\$ 1.000,00
2020	R\$ 950,00
2021	R\$ 1.000,00
2022	R\$ 0,00

Scholarships related to the cooperation project

Year	Type	Quantity	Amount
2018	Visiting Professor in Brazil (01 months)	0	R\$ 0,00
2018	internship PhD (12 months)	0	R\$ 0,00
2018	Capacitation (15 days)	0	R\$ 0,00
2019	Capacitation (15 days)	0	R\$ 0,00
2019	internship PhD (08 months)	2	R\$ 112.521,60
2019	Visiting Professor in Brazil (15 days)	0	R\$ 0,00
2019	Young Talent with Int'l Experience (36 months)	0	R\$ 0,00
2019	Post-doc with Int'l Experience (32 months)	1	R\$ 159.310,58



2020	Visiting Senior Professor Abroad (12 months)	0	R\$ 0,00
2020	Visiting Young Professor Abroad (12 months)	0	R\$ 0,00
2020	Capacitation (15 days)	0	R\$ 0,00
2020	internship PhD (08 months)	2	R\$ 112.521,60
2020	Visiting Professor in Brazil (15 days)	0	R\$ 0,00
2021	Capacitation (15 days)	0	R\$ 0,00
2021	Visiting Senior Professor Abroad (12 months)	0	R\$ 0,00
2021	Visiting Young Professor Abroad (12 months)	0	R\$ 0,00
2021	Visiting Professor in Brazil (15 days)	0	R\$ 0,00
2021	internship PhD (08 months)	2	R\$ 112.521,60
2022	internship PhD (07 months)	0	R\$ 102.513,60
2022	Visiting Professor in Brazil (15 days)	0	R\$ 0,00
2022	Capacitation (15 days)	0	R\$ 0,00

Theme

TROPICAL METEOROLOGY

International Cooperation Projects

Project Name	Start Date	End Date
Research and Development in Tropical Meteorology	01/08/2018	31/07/2022

Description

Identify the Ocean-Atmosphere interaction processes and their consequences for tropical weather and climate. Improve the understanding of the meteorological processes that act in the diverse temporal and spatial scales of weather and climate. Identify and improve the understanding of the processes of biosphere-atmosphere interaction and the inclusion of these processes in the models.

Work missions related to the cooperation project

Year	Quantity	Amount
2018	0	R\$ 0,00
2019	2	R\$ 28.627,00
2020	2	R\$ 28.627,00
2021	2	R\$ 28.627,00
2022	0	R\$ 0,00

Resources to maintenance of the projects

Year	Amount
2018	R\$ 0,00
2019	R\$ 5.000,00
2020	R\$ 5.000,00
2021	R\$ 5.000,00
2022	R\$ 5.000,00

Scholarships related to the cooperation project

Year	Type	Quantity	Amount
2018	Young Talent with Int'l Experience (24 months)	0	R\$ 0,00
2018	Capacitation (15 days)	0	R\$ 0,00



2018	internship PhD (06 months)	0	R\$ 0,00
2018	Post-doc with Int'l Experience (24 months)	0	R\$ 0,00
2018	Visiting Senior Professor Abroad (6 months)	0	R\$ 0,00
2018	Visiting Professor in Brazil (15 days)	0	R\$ 0,00
2019	Capacitation (15 days)	2	R\$ 26.236,80
2019	Capacitation (1 months)	0	R\$ 0,00
2019	Visiting Young Professor Abroad (12 months)	0	R\$ 0,00
2019	Young Talent with Int'l Experience (24 months)	0	R\$ 0,00
2019	Visiting Senior Professor Abroad (12 months)	1	R\$ 123.076,80
2019	internship PhD (06 months)	2	R\$ 80.956,80
2019	internship PhD (12 months)	1	R\$ 76.276,80
2019	Post-doc with Int'l Experience (12 months)	1	R\$ 69.310,58
2019	Visiting Professor in Brazil (15 days)	2	R\$ 32.310,58
2020	Capacitation (15 days)	2	R\$ 26.236,80
2020	Capacitation (01 months)	0	R\$ 0,00
2020	internship PhD (12 months)	1	R\$ 76.276,80
2020	Post-doc with Int'l Experience (12 months)	0	R\$ 0,00
2020	Visiting Professor in Brazil (15 days)	0	R\$ 0,00
2020	Visiting Senior Professor Abroad (06 months)	0	R\$ 0,00
2020	Visiting Young Professor Abroad (12 months)	0	R\$ 0,00
2020	Visiting Young Professor Abroad (12 months)	0	R\$ 0,00
2020	internship PhD (06 months)	2	R\$ 80.956,80
2020	Young Talent with Int'l Experience (24 months)	0	R\$ 0,00
2021	Post-doc with Int'l Experience (12 months)	1	R\$ 69.310,58
2021	Visiting Professor in Brazil (15 days)	0	R\$ 0,00
2021	internship PhD (6 months)	2	R\$ 80.956,80
2021	Capacitation (15 days)	2	R\$ 26.236,80
2021	Visiting Young Professor Abroad (12 months)	0	R\$ 0,00
2021	internship PhD (12 months)	1	R\$ 76.276,80
2021	Visiting Professor in Brazil (15 days)	2	R\$ 32.310,58
2021	Young Talent with Int'l Experience (12 months)	0	R\$ 0,00
2021	Visiting Senior Professor Abroad (12 months)	1	R\$ 123.076,80
2021	Capacitation (01 months)	0	R\$ 0,00
2022	Visiting Senior Professor Abroad (06 months)	0	R\$ 0,00
2022	Capacitation (15 days)	1	R\$ 13.118,40
2022	internship PhD (06 months)	2	R\$ 80.956,80
2022	Visiting Young Professor Abroad (12 months)	0	R\$ 0,00
2022	Young Talent with Int'l Experience (12 months)	0	R\$ 0,00
2022	Visiting Professor in Brazil (15 days)	0	R\$ 0,00
2022	Post-doc with Int'l Experience (12 months)	0	R\$ 0,00

Missions not linked to the Project

Year	Quantity	Amount
2019	0	R\$ 0,00
2020	2	R\$ 30.844,00
2021	0	R\$ 0,00

Scholarships not linked to Research Projects

Year	Type	Quantity	Amount
2019	internship PhD (6 months)	0	R\$ 0,00



2019	Visiting Senior Professor Abroad (6 months)	0	R\$ 0,00
2019	Post-doc (12 months)	0	R\$ 0,00
2020	internship PhD (6 months)	0	R\$ 0,00
2020	Post-doc (12 months)	0	R\$ 0,00

Other Actions Not Related to Cooperation Projects

Year	Action	Description	Amount
2019	Dissemination of scientific knowledge in frontier physics and astrophysics to society in open access politics	Resources for payment of publication fees, aiming to achieve wide dissemination of scientific results published in international journals with a body of judges and high impact factor	R\$ 10.000,00
2020	Dissemination of scientific knowledge in frontier physics and astrophysics to society in open access politics	Resources for payment of publication fees, aiming to achieve wide dissemination of scientific results published in international journals with a body of judges and high impact factor	R\$ 10.000,00
2021	Dissemination of scientific knowledge in frontier physics and astrophysics to society in open access politics	Resources for payment of publication fees, aiming to achieve wide dissemination of scientific results published in international journals with a body of judges and high impact factor	R\$ 10.000,00
2022	Dissemination of scientific knowledge in frontier physics and astrophysics to society in open access politics	Resources for payment of publication fees, aiming to achieve wide dissemination of scientific results published in international journals with a body of judges and high impact factor	R\$ 0,00

COUNTERPART

Internationalization of the curriculum - Incorporation of international themes in the undergraduate and graduate classes.

INPE, as a traditionally international institution, naturally already addresses international issues in its Graduate Programs. Thus, in order to consolidate the internationalization of teaching in its PGPs (Graduate School Programs), the following actions will be taken: (i) increasing the participation of foreign researchers in the courses offered so that the description of the courses are frequently updated in order to incorporate and update international themes; (ii) seeking in existing cooperation projects topics that may eventually be incorporated into the courses of the PGPs involved; (iii) promoting discussion forums between Brazilian and foreign teachers and researchers in the search for international themes that align with the academic activities of the PGPs so that they can be incorporated into teaching; (iv) using the international experience of students, teachers and researchers who are currently participating in the Internationalization Project to identify relevant topics to be included in the course papers.

International publicity materials production in other languages, including websites of the graduate schools.



(i) Translation of the Internet pages of INPE's Graduate School Programs for foreign language, preferably English; (ii) Production of technical material for dissemination in other languages containing the descriptions of the thematic areas of the Institutional Internationalization Project, its main objectives, funding opportunities, goals, regulations with the purpose of publicizing INPE's international activities in scientific and/or technological activities abroad, exhibitions, science fairs and Science and Technology events in Brazil; (iii) Publication of announcements of opportunities (scholarships, vacancies for students and teachers, specific activities of cooperation projects) in international scientific journals and the monthly, bimonthly or quarterly scientific periodicals.

Training and qualification of staff for the institution internationalization.

i) Adding language courses in INPE's Institutional Capacity Building Program, which is returning to the training and qualification of the Institution's servers through the Competence Management Service (SESGC); (ii) Encouraging Institute staff to take language courses at more advanced levels in specialized schools with reduced costs through the formalization of agreements and / or partnerships; (iii) Conducting INPE's staff training by presenting the Institute's Internationalization Plan and Project, its opportunities, main activities, tools, methodologies, legislation in order to raise awareness of the importance of internationalization, encouraging engagement.

Counterparties offered by foreign partnership institutions, when applicable.

i) Access to all institution's facilities such as laboratories, measuring equipments, and computers to carry out activities that complement or are part of internationalization activities; (ii) Eventually, depending on the partnerships and / or cooperation projects, exemption of school taxes to Brazilian students that will participate in their post-graduate programs; (iii) Availability of professors, researchers and technical staff for execution of activities related to internationalization; (iv) Access to extension academic or technical classes (remotely or in person); (v) Dissemination of the results of the cooperation projects and / or joint partnership agreements on institutional internet pages, academic journals, social media and / or in technical-scientific journals.

Other counterparties, when available.

Access to all physical and administrative infrastructure of INPE, which has: (i) several laboratories for fundamental and applied research among the main ones: solar polarimetry; solar wind and magnetospheres; gravitational waves; geomagnetism; high energy astrophysics; integrated environmental modeling; image processing; geoinformatics; oceanography; remote sensing applied to agriculture and forestry; environmental biogeochemistry; meteorological instrumentation, including support laboratories and instrumentation such as propulsion laboratories; electro-optical systems; energy supply; onboard supervision; hardware and software; space electronic manufacturing (clean 100,000 class); characterization and testing of imaging, optical and attitude systems (these with 10,000 class clean areas); (ii) extensive instrumentation of Earth and Space observation, such as: laser radar systems; atmospheric aeroluminescence imaging instruments; LEONA Network imaging instruments; radars for probing the equatorial ionosphere; network of receivers for ionospheric measurements; digisonde / ionosondes for measurements of ionospheric parameters for spatial climatology; embedded scientific instrumentation (balloons, sounding rockets and satellites); "Brazilian Decimetric Array" radio-telescope facility, multidirectional muon detector, magnetometer network, among many others; (iii) Remote Sensing Data Center, which hosts the Earth observation and meteorological satellites database of Brazil, Atmospheric Electricity Laboratory, which operates three lightning detection networks, Laboratory for Studies and Modeling of Energy Renewable Resources, responsible for the SONDA network for data collection; EMBRACE Program (Space Weather); (iv) a wide range of computational resources to support research and graduate activities, including several clusters of common and project-specific use, supercomputer with a system of 31,296 processors, high performance computing servers with dedicated virtualization, enterprise data storage of 2 Petabytes, 10 GB broadband network telecommunication system; (v) several administrative sectors supporting scientific and technological development activities, mainly the Technological Innovation Center (NUNIT), the Competence Management Service (SESGC), the International Relations Service (SCRIN), the Information Technology Service (SESTI), among others.



DOCUMENTS

Description	Type	Date
Executive Summary Int'l INPE 2018.pdf	Executive Summary, in English, of the Institutional Plan aligned with Project presented in Print	05/10/2018 01:11:26 pm
Sumario Executivo Int'l INPE 2018.pdf	Executive Summary of the Institutional Plan aligned with Project presented in Print	05/10/2018 01:11:19 pm
Port35 Regimento Geral PPG-INPE.pdf	Institutional Plan of Internationalization of HEI or similar document	05/10/2018 01:40:48 pm
Oficio Pro-Reitor Plano INPE Int'l.pdf	Institutional Plan of Internationalization of HEI or similar document	05/10/2018 03:39:30 am
Steven_Goodman_CV_2018.pdf	Curriculum Vitae - of the foreigner's members	05/10/2018 03:37:37 am
Rosaly_Lopes_CV_2018.pdf	Curriculum Vitae - of the foreigner's members	05/10/2018 03:37:31 am
Barry Barish CV 2018.pdf	Curriculum Vitae - of the foreigner's members	05/10/2018 03:37:24 am
Alexander_Szalay_CV_2018.pdf	Curriculum Vitae - of the foreigner's members	05/10/2018 03:37:17 am
Oficio Diretor PrInt-CAPES.pdf	Submission form issued by the highest authority (8.2.4 of Notice)	05/09/2018 02:57:23 am