



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

# Capacity-Building at the Brazilian National Institute for Space Research (INPE): an overview of the current activities and future challenges

[www.inpe.br](http://www.inpe.br)

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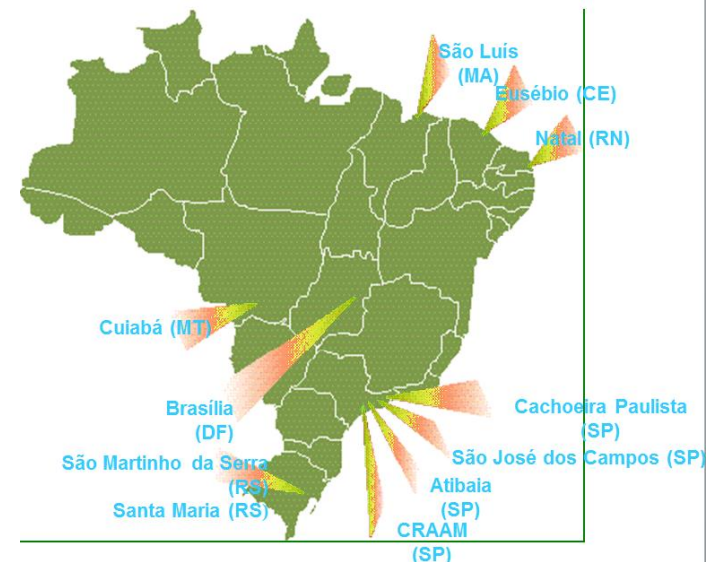
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# INPE: overview

- INPE is a research institute of the Ministry of Science, Technology, Innovations and Communications (MCTIC);
- Its mission is to contribute through scientific research, technological development and capacity building in the fields of **(1)** Space Science and Atmosphere, **(2)** Earth Observation, **(3)** Weather Forecasting and Climate Studies and **(4)** Space Engineering and Technology, in order that Brazilian society can enjoy the benefits from the access to space;
- Facilities spread all over the country;
- Almost 3000 workers (own staff, scholarship workers, graduate students, trainees, visiting researches and outsourcing personnel);





# Capacity-Building at INPE: brief history

- Arose from the need to train highly qualified professionals in space sciences to compose the teams of researchers;
- Graduate Program (1968);
- International Course on Remote Sensing (CISR) and short and medium term courses for graduates (1985);
- Inauguration of the Visitors Center – capacity building for children and youth (1992);
- Capacity-building dedicated to teachers and students on remote sensing and environment (1996) and astronomy (1998);





# Capacity-Building at INPE: brief history

- Space School - for students from 13 to 17 years old (1999);
- EDUCA SeRe Program, which objective was to generate teaching material (2001);
- Regional Center for Education in Space Science and Technology for Latin America and the Caribbean (CRECTEALC) (Brazil Campus operated at INPE's facilities from 2000 to 2013);
- Inauguration of the Mini Astronomical Observatory (2003);
- Distance learning short and medium term courses (2004).



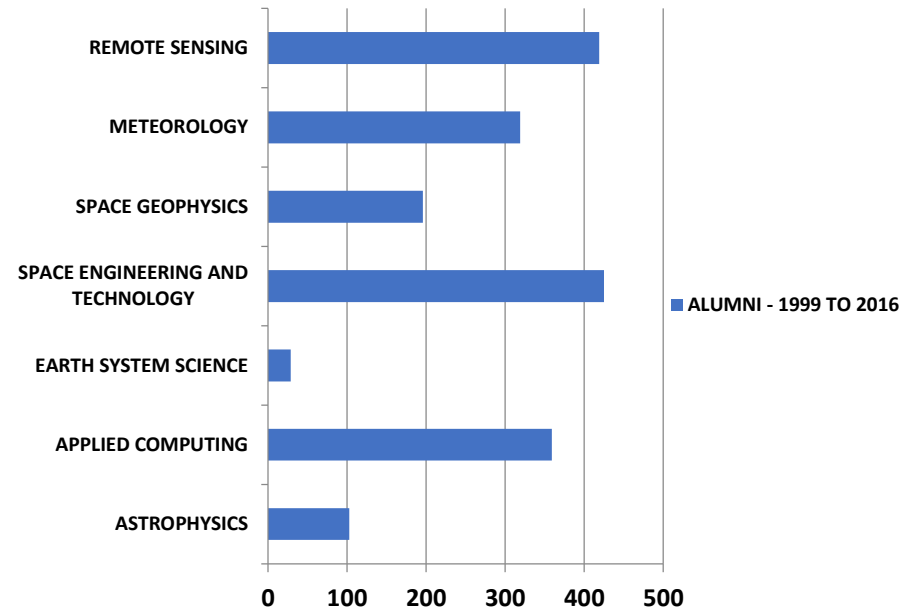
**Class of 1998 Astronomy Course**



**Space School Class of 1999**

# Capacity-Building at INPE: current activities

- Graduate Courses;
- Between 1968 and 2016, 2816 master's and doctoral degrees were awarded.



COURSE	MASTER	DOCTORATE
ASTROPHYSICS	X	X
SPACE ENGINEERING AND TECHNOLOGY	X	X
SPACE GEOPHYSICS	X	X
APPLIED COMPUTING	X	X
METEOROLOGY	X	X
REMOTE SENSING	X	X
EARTH SYSTEM SCIENCE		X



Area	Short and Medium Term Courses
<b>Earth Observation and Earth System Science</b>	<ul style="list-style-type: none"> <li>• Fundamentals of Geoprocessing</li> <li>• Introduction to SPRING System</li> <li>• Digital Image Processing</li> <li>• Geographical Database</li> <li>• Spatial Analysis of Geographic Data</li> <li>• Environmental Monitoring Platform TerraMa2 (Platform for the development of monitoring, analysis and alert systems)</li> <li>• Introduction to LUCME (Tool for modeling change of use and land cover)</li> <li>• Introduction to TerraView (Application built on the TerraLib geoprocessing library)</li> <li>• Fire Monitoring through Satellite</li> <li>• Introduction to INPE-EM (Tool for modeling emissions from deforestation)</li> <li>• Capacity Building on Advanced Geotechnologies</li> <li>• Educational Use of Remote Sensing for the Study of the Environment</li> <li>• Remote Sensing: Basic Concepts</li> <li>• Remote Sensing: Thematic Projects</li> <li>• Video Lessons: Remote Sensing</li> <li>• Youtube channel containing educational videos, talks and discussions about Topics in Earth Systems Science</li> </ul>
<b>Space and Atmospheric Sciences</b>	<ul style="list-style-type: none"> <li>• Introduction to Astronomy and Astrophysics</li> <li>• Advanced School in Astrophysics</li> <li>• Construction of a Didactic Telescope</li> <li>• Teacher Capacity Building in Astronomy</li> <li>• Cycle of Lectures - Astronomy for all</li> <li>• Workshops on Space Weather</li> <li>• Weekly Seminars</li> </ul>
<b>Space Engineering and Technology</b>	<ul style="list-style-type: none"> <li>• Winter Course: Basics of Space Engineering and Technology</li> <li>• Workshops on Space Engineering and Technology</li> <li>• Summer School of the Associated Laboratory of Computing and Applied Mathematics</li> <li>• Specific Certifications and courses in Electronics Manufacturing (Workmanship)</li> <li>• PCI Layout Analysis Course to Focus on Design, Rework, Defects and Customer IEC/UL/IPC Certification</li> <li>• Antennas - Basic Concepts, Projects and Antenna Measurements</li> <li>• Uncertainty Measurement Calculation</li> <li>• Radar Principles</li> <li>• Vector Modulation Principles and RF Measurements on Satellite Up-Link</li> <li>• Principles of Electromagnetic Compatibility</li> <li>• Project of Printed Circuit Board</li> <li>• General Requirements for the Competence of a Test and Calibration Laboratory According to Standard NBR ISO/IEC 17025: 2005</li> <li>• Radio-links, Spreading and Modulation</li> <li>• RF Project: basic concepts and projects of high frequency circuits</li> <li>• Test of Electromagnetic Compatibility in Automotive Systems (vehicles and components)</li> </ul>
<b>Weather Forecasting and Climate Studies</b>	<ul style="list-style-type: none"> <li>• Basic Course on Satellite Meteorology</li> <li>• Basic Meteorology for Teachers</li> <li>• Basic Meteorology for Journalists</li> <li>• Satellite Meteorology applied to Aviation</li> <li>• Satellite Meteorology applied to Hydrology</li> <li>• Satellite Meteorology applied to Agriculture</li> <li>• Weather and Climate Forecasting for Farmers</li> <li>• Practical Course on Calibration of Meteorological Sensors</li> <li>• Meteorology and Health</li> <li>• Synoptic Meteorology</li> <li>• Meteorological Instrumentation</li> <li>• Course on Radars</li> <li>• Remote Sensing and Modeling Course of precipitation formation processes - Project CHUVA</li> <li>• Use of Satellite Wind and Wave Products in South American Waters</li> <li>• Active weather systems during the rainy season in Brazil: severe weather forecasting operational tools</li> <li>• Course on the Atmospheric Model ETA</li> <li>• Course on surface modeling facing INLAND (Integrated Model of Land Surface Processes)</li> <li>• Introduction to Environmental Modeling System CCATT BRAMS (Coupled Chemistry Aerosol and Tracer Transport model to the Brazilian developments on the Regional Atmospheric Modeling System)</li> </ul>

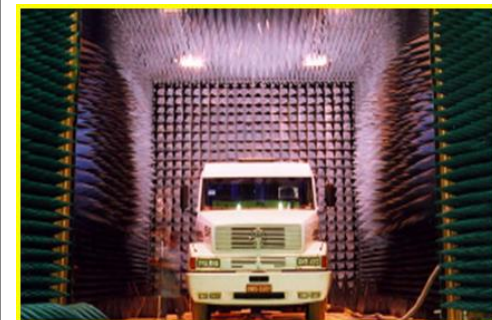
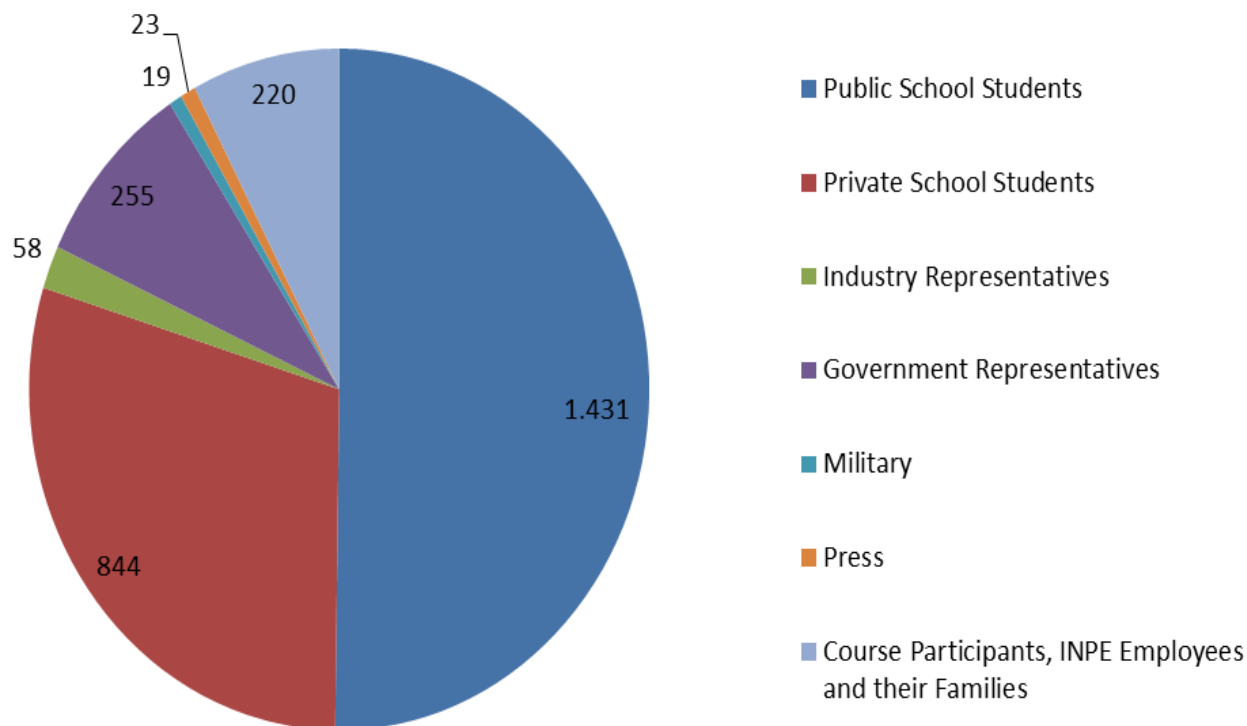


# Capacity-Building: International Cooperation

Organization	Project	Period	Courses	Languages	Countries	Technicians
<b>Food and Agriculture Organization of the United Nations through its representation in Brazil (FAO/Brazil)</b>	Use of remote sensing data for monitoring and forest cover	2014 to 2015	9 Forest Monitoring Courses	Portuguese + English + Spanish + French	24	136
<b>Organization of the Amazon Cooperation Treaty (OTCA)</b>	Forest Coverage Project in the Regional Amazon	2014 to 2016	8 Forest Monitoring Courses + 1 Forest Fire Course + 1 Radar Course	English + Spanish	OTCA (Bolivia, Brazil, Colombia, Ecuador, Guiana, Peru, Suriname, Venezuela)	195
<b>Japan International Cooperation Agency (JICA)</b>	Training Program for Third Countries (TCP)	2010 to 2013	9 Forest Monitoring Courses	Portuguese + English + Spanish + French	35	98



# Visits at the Laboratory of Integration and Testing (LIT) in 2016



## INPE's Capacity-Building Activities for Children and Youth

- Visits;
- Development and launch of nanosatellites jointly with universities and schools (NanoSatC-BR1 – 2014, Tancredo I – 2017);
- Booklets on various topics related to space and the environment (didactic material);
- Animations (meteorology, Earth system science, space weather, renewable energies, Earth observation and satellites) ;
- With an eye on the Earth:  
<https://youtu.be/O2R9nR8EfAg>



Booklet - INPE's tour



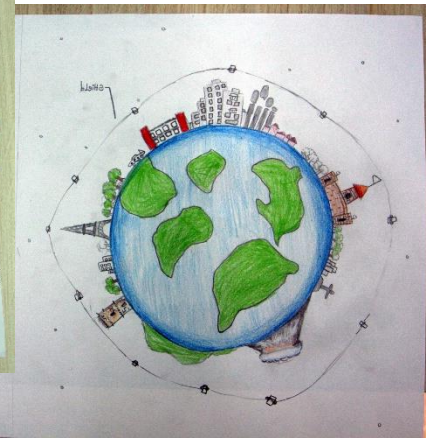
Booklet - The future we want: green economy, sustainable development and eradication of poverty

# INPE's Capacity-Building Activities for Children and Youth

- Peace and Cooperation School Award 2017 - Looking to the Stars - The Future of the World, 48 schools participated in the initiative and about 200 works were delivered, 48 were selected to participate.



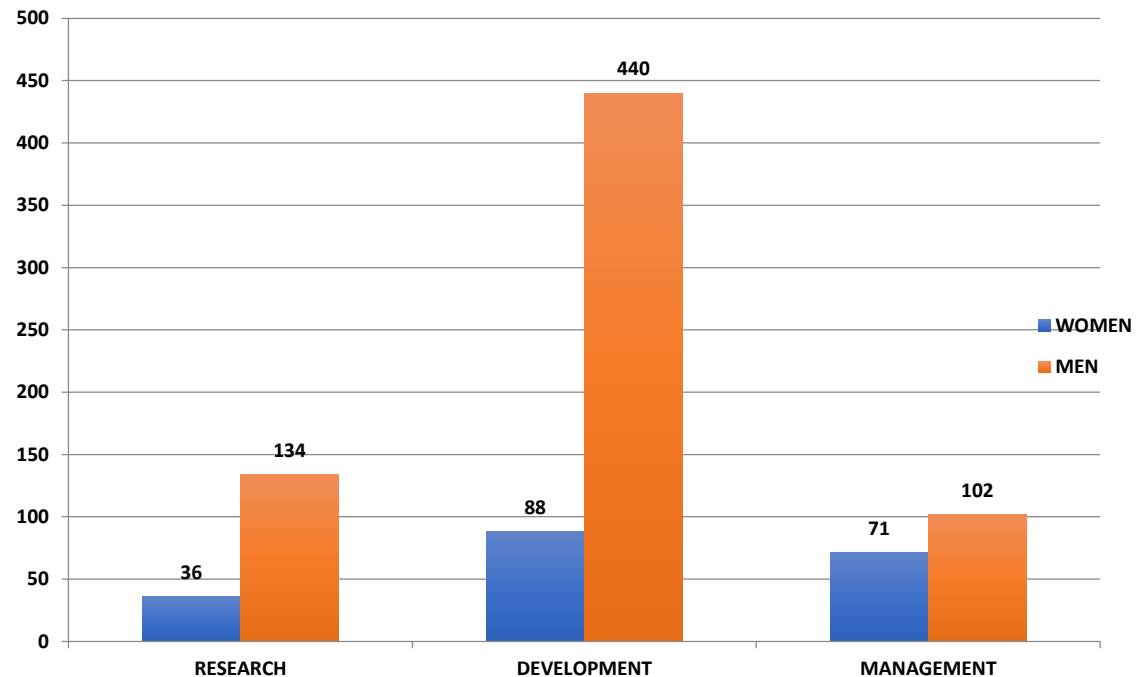
**Ceremony to receive the final art works  
– Looking to the Stars**





# INPE's Capacity-Building Initiatives for Women

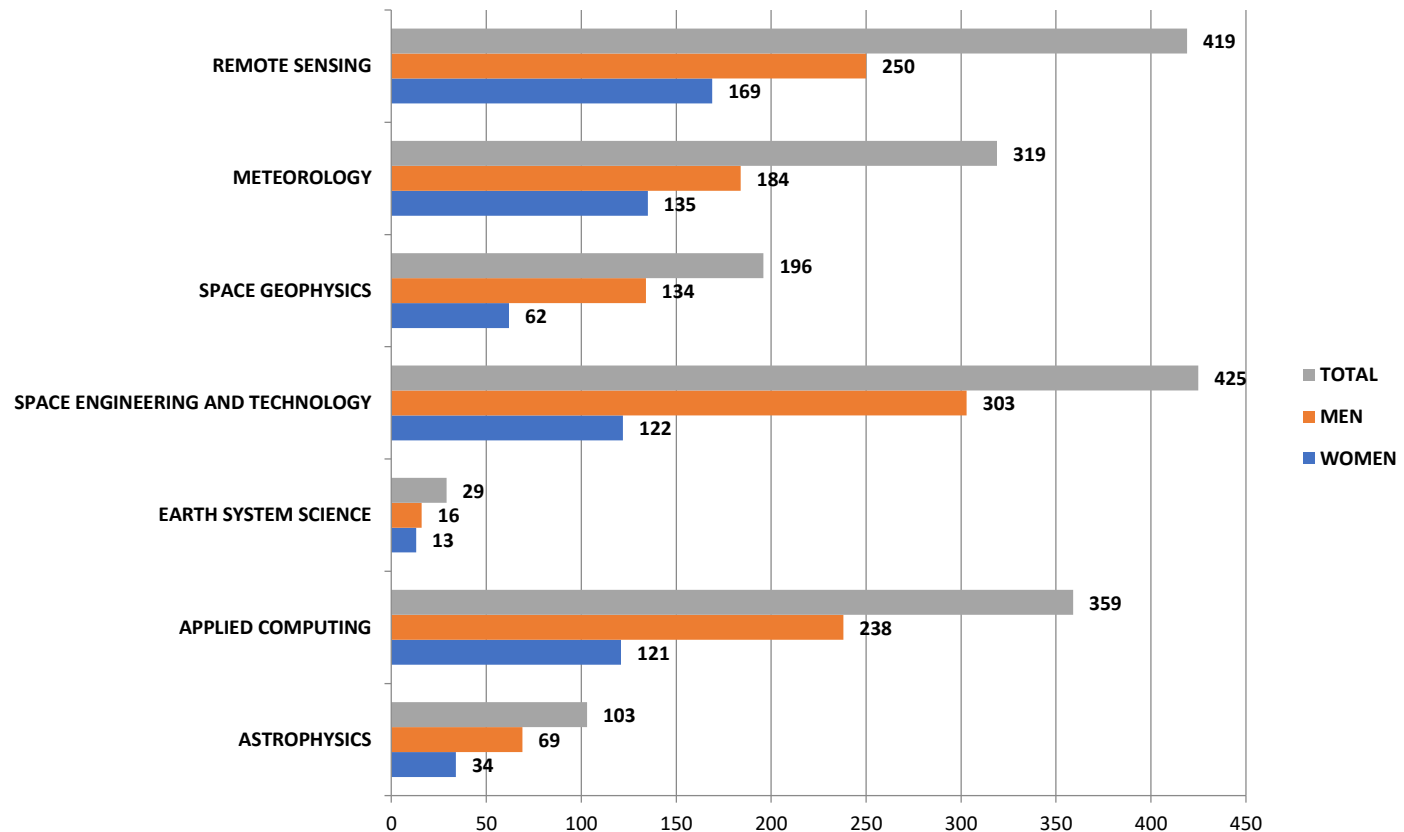
- There aren't specific capacity-building initiatives at INPE for women;
- INPE's staff is composed of 871 public servants (195 women and 676 men – Women 21% Res. and 17% Dev.).





# INPE's Capacity-Building Initiatives for Women

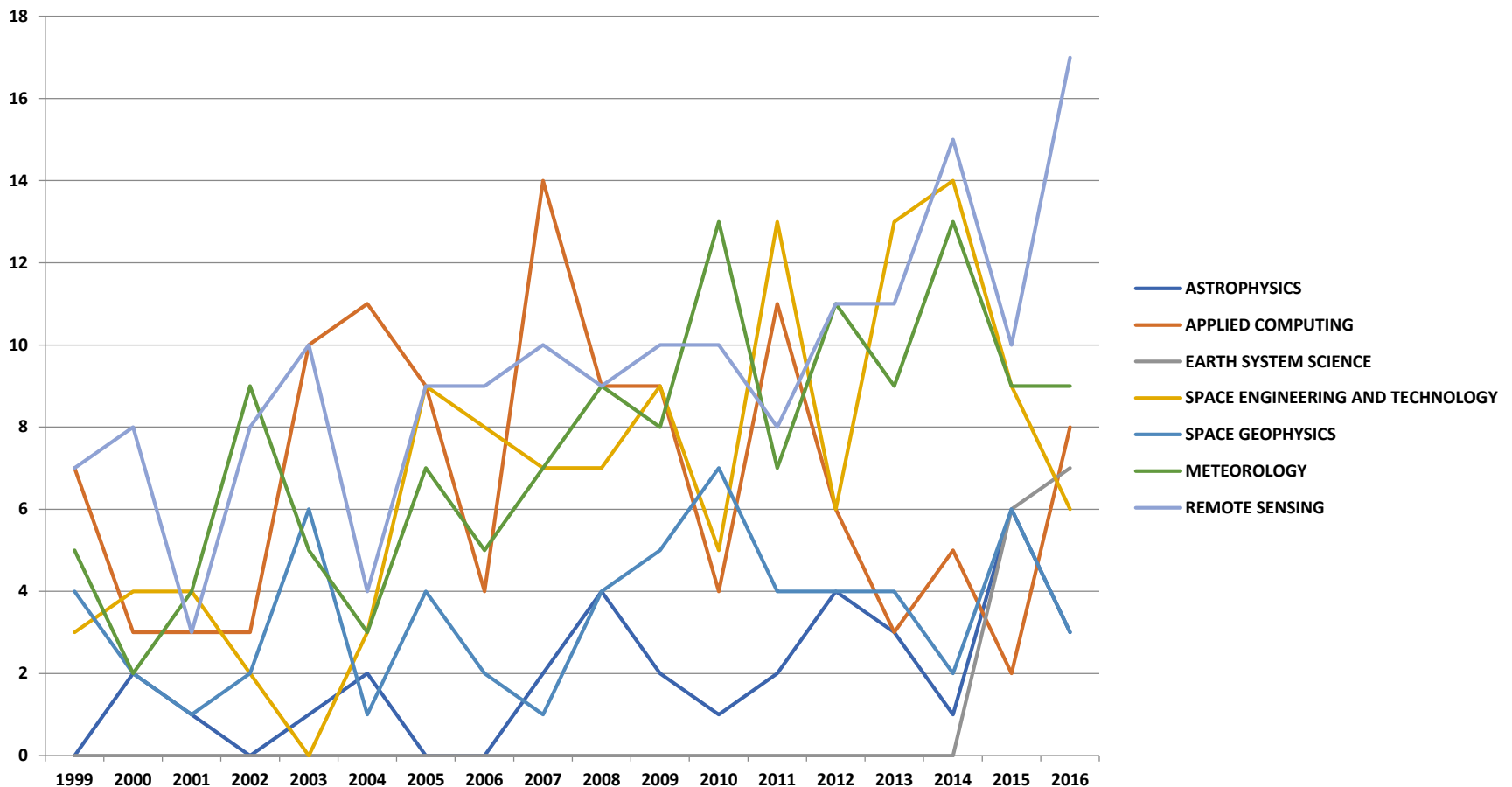
- 1850 master's and doctoral degrees awarded in the graduate programs between the years of 1999 to 2016 - 656 women and 1194 men (35% women, SET Course 29% women).





# INPE's Capacity-Building Initiatives for Women

- Trajectory of women's participation in each of INPE's graduate courses from 1999 to 2016;





# Future Challenges

- Progressive reduction of the annual budget and the lack of personnel;
- Constantly seeks new solutions so that the capacity-building can continue to be a benefit that the Institute provides to society;
- Increasingly offer more distance learning courses;
- Reactivation of the Visitors Center and the regular functioning of the Mini Astronomical Observatory;
- Graduate courses classes in English;
- Improvement of the data stored on students;
- Carry out an in-depth study of women's participation on the various fronts of the Institute;
- Better ways of measuring progress and development.



# References

- COORDINATION OF IMPROVEMENT OF HIGHER EDUCATION (CAPES). **Recommended and Recognized Courses**. Available in: <<https://sucupira.capes.gov.br/sucupira/public/consultas/coleta/programa/quantitativos/quantitativoPrograma.jsf?areaAvalliacao=0&cdRegiao=3&sgUf=SP&ies=338723>>. Access in: August 2017.
- FACULDADEaDISTÂNCIA. **Why distance learning courses are cheaper than face-to-face ones?** Available in: <https://www.faculdadeadistancia.blog.br/ead/porque-os-cursos-superiores-a-distancia-sao-mais-baratos/>.> Access in: August 2017.
- FERREIRA, H.; ET ALL. **Building capacity in remote sensing using distance learning**. Revista Brasileira de Cartografia (2012), Brasil, n. 64/6: 863-872. 2012.
- FERREIRA, H. S.; MUSTARO, P. N. **Remote sensing technology online education in Africa: a multicultural experience**. 8<sup>th</sup> International Technology, Education and Development Conference (INTED), Spain. 2014.
- FLORENZANO, T.; ET ALL. **Formação de professores em geotecnologia por meio de ensino a distância**. Educar em Revista, Curitiba, Brasil, n. 40, p. 69-84, abr./jun. 2011. UFPR Publishing Company. 2011.
- INTER-AMERICAN INSTITUTE FOR GLOBAL CHANGE RESEARCH (IAI). **Home page**. Available in: <<http://www.iai.int/>>. Access in: August 2017.
- INTERNATIONAL INSTITUTE FOR EDUCATIONAL PLANNING (IIEP). **Guidebook for Planning Education in Emergencies and Reconstruction**, UNESCO, Paris. 2006.
- MILÈN, A. **What do we know about capacity building?** Department of Health Service Provision, World Health Organization. Geneva, June 2001.
- MOREIRA, M. L; VELHO, L. **Trajetória de egressos da pós-graduação do Instituto Nacional de Pesquisas Espaciais: uma ferramenta para avaliação**. Avaliação, Campinas; Sorocaba, SP, v. 17, n. 1, p. 257-288, Brazil, March 2012.
- NATIONAL INSTITUTE FOR SPACE RESEARCH (INPE). **Strategic Plan 2016-2019**. São José dos Campos, Brazil. 2016.
- NATIONAL INSTITUTE FOR SPACE RESEARCH (INPE). **International Course**. Available in: <<http://www.inpe.br/unidades/cep/atividadescep/cursointernacional/introducao.html>>. Access in: August 2017a.
- NATIONAL INSTITUTE FOR SPACE RESEARCH (INPE). **INPE's 50<sup>th</sup> Anniversary**. Available in: <[http://www.inpe.br/50anos/linha\\_tempo/92.html](http://www.inpe.br/50anos/linha_tempo/92.html)>. Access in: August 2017b.



# References

- NATIONAL INSTITUTE FOR SPACE RESEARCH (INPE). **Astronomy Course**. Available in: <<http://www.das.inpe.br/ciaa/>>. Access in: August 2017c.
- NATIONAL INSTITUTE FOR SPACE RESEARCH (INPE). **First Space School**. Available in: <<http://www.inpe.br/unidades/cep/atividadescep/escoladoespaco/ementa1.htm>>. Access in: August 2017d.
- NATIONAL INSTITUTE FOR SPACE RESEARCH (INPE). **Mini-Observatory**. Available in: <<http://www.das.inpe.br/miniobservatorio/>>. Access in: August 2017e.
- NATIONAL INSTITUTE FOR SPACE RESEARCH (INPE). **Amazon Regional Center (CRA)**. Available in: <[http://www.inpe.br/cra/projetos\\_pesquisas/caf.php](http://www.inpe.br/cra/projetos_pesquisas/caf.php)>. Access in: August 2017f.
- NATIONAL INSTITUTE FOR SPACE RESEARCH (INPE). **Didatic Booklets**. Available in: <[http://www.inpe.br/ensino\\_documentacao/difusao\\_conhecimento/cartilhas\\_didaticas.php](http://www.inpe.br/ensino_documentacao/difusao_conhecimento/cartilhas_didaticas.php)>. Access in: August 2017g.
- REGIONAL CENTER FOR EDUCATION IN SPACE SCIENCE AND TECHNOLOGY FOR LATIN AMERICA AND THE CARIBBEAN (CRECTEALC). **Brazil Campus home page**. Available in: <<http://www.inpe.br/crs/crectalc/index.php>>. Access in: August 2017.
- SÃO JOSÉ DOS CAMPOS CITY HALL (SJC). **Projeto Decolar**. Available in: <[http://www.sjc.sp.gov.br/secretarias/educacao\\_cidadania/parceiros\\_do\\_decolar.aspx](http://www.sjc.sp.gov.br/secretarias/educacao_cidadania/parceiros_do_decolar.aspx)>. Access in: August 2017.
- RIBEIRO, V. **Conhecimento e Capacitação: uma aliança estratégica nos institutos de pesquisas**. Dissertação de Mestrado. Pontifícia Universidade Católica de São Paulo (PUC/SP), 2006..
- SAUSEN, T. M. **A Educação Espacial na América Latina e a Posição do Brasil no Contexto Regional**. Revista Parcerias Estratégicas, number 7. October 1999.
- SAUSEN, T.; ET ALL. **Projeto Educa SeRe III – A Carta Imagem de São José dos Campos**. Remote Sensing Symposium (SBSR). Foz do Iguaçu, 2001.
- VIDEO 1. **The air we breathe**. Available in: <<https://youtu.be/ttqsA85hPtA>>. Access in: August 2017.
- VIDEO 2. **Winter&Summer**. Available in: <<https://youtu.be/rjkii1cq8nE>>. Access in: August 2017.
- VIDEO 3. **The sun is magical**. Available in: <<https://youtu.be/SIULnO6AUfg>>. Access in: August 2017.
- VIDEO 4. **With an eye on the Earth**. Available in: <<https://youtu.be/O2R9nR8EfAg>>. Access in: August 2017.
- VIDEO 5. **Space Weather**. Available in: <<https://youtu.b/dPydb6iVgPs>>. Access in: August 2017.

# THANK YOU!

