

CRASTE-LF



Education and Training in GNSS

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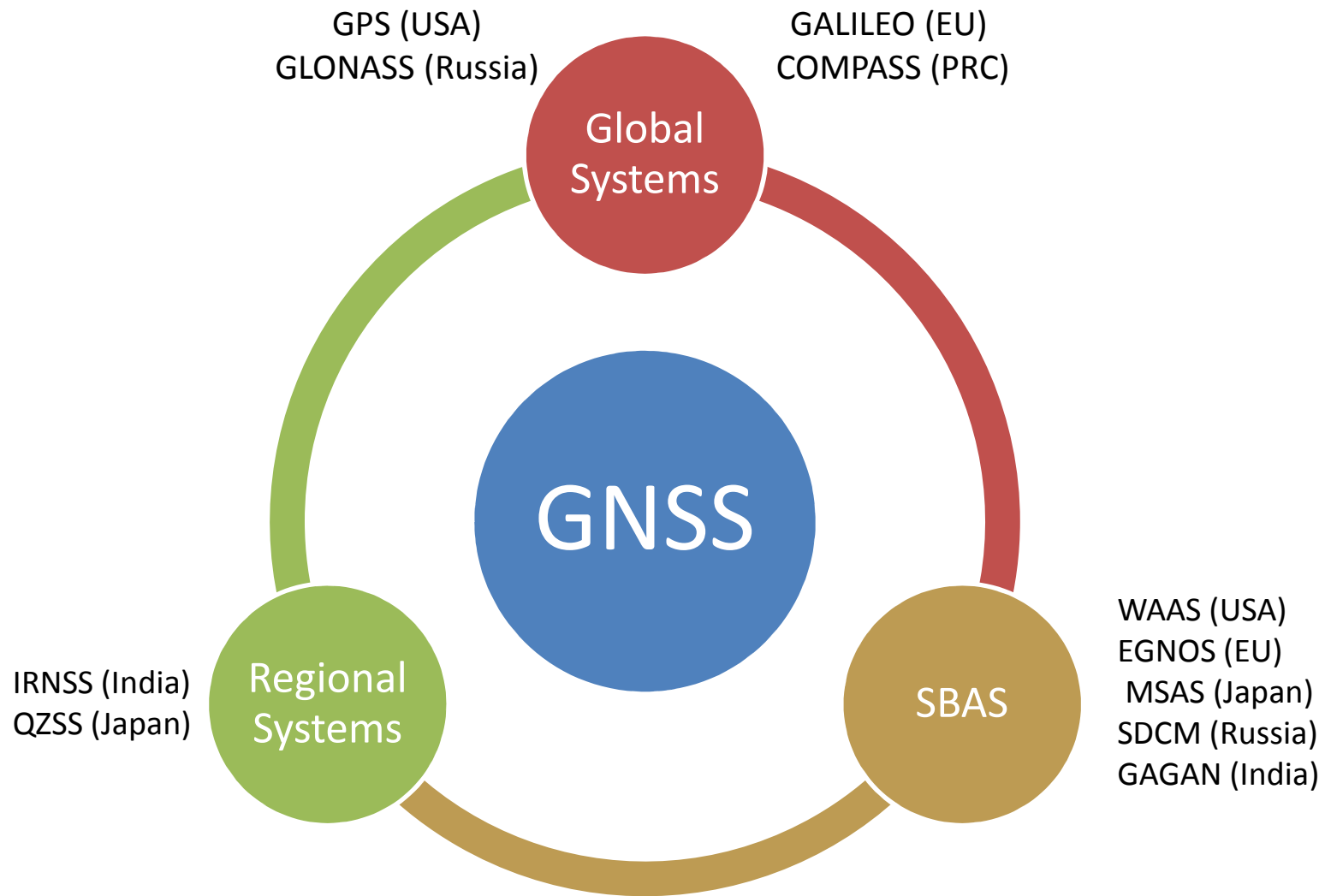
Cordinator of GNSS Master Curriculum
CRASTE-LF, Affiliated to the United Nations

OUTLINE

- Trends and opportunities of the GNSS market
- Capacity building in GNSS
- Master in GNSS (CRASTE-LF)



GNSS : Current and planned systems



GNSS: Global constellations

GNSS : constellations of Earth-orbiting satellites that broadcast signals containing their locations in space and time. Suitable receivers use this information to calculate positions anywhere and at all time.

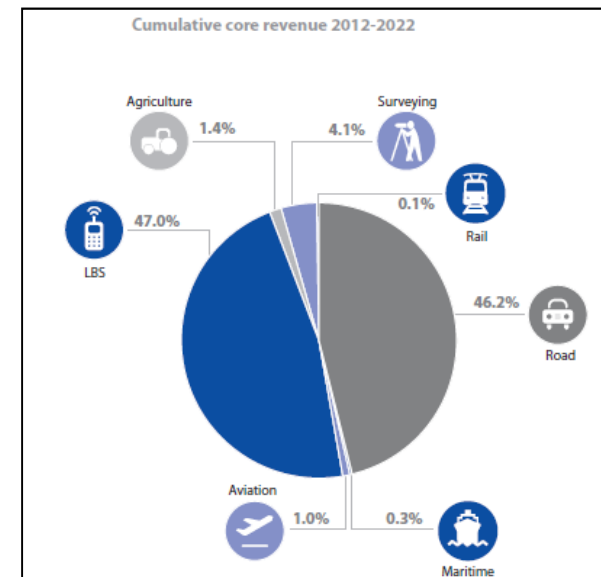
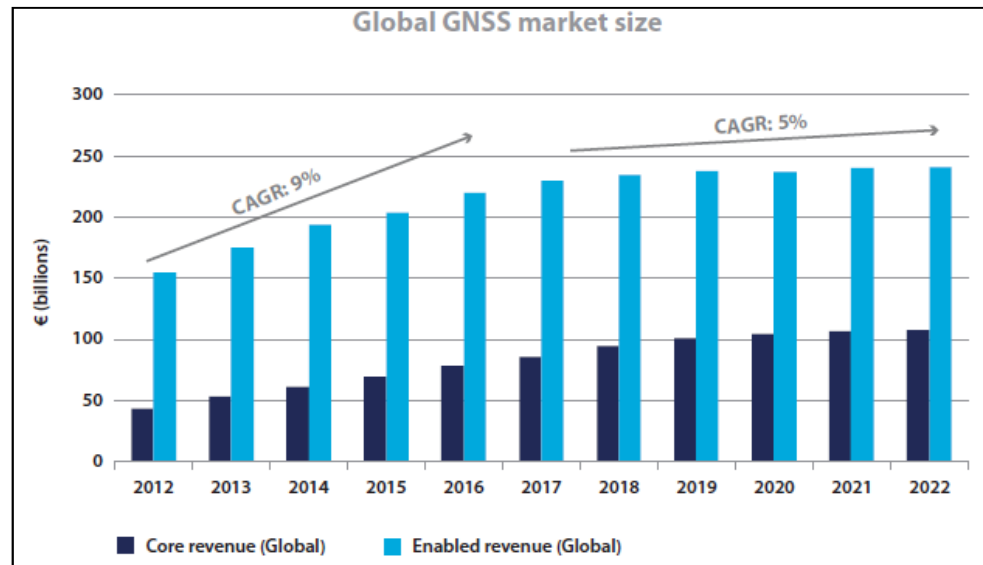


Modernization
New frequencies
Reliable service
Accuracy improvement

When all global constellations will be fully operational and interoperable, more than 100 satellites may be available for navigation, positioning, and timing.

GNSS Market

- The development of GNSS have a major influence in the creation and development of GNSS-related applications and foster the growing global GNSS market.
- New GNSS-related job opportunities are created : application developers, analysts, risk assessors and space weather forecasters.
- It is essential to build capacity to use the GNSS signals and ensure there is a prepared workforce for the growing opportunities in the GNSS sector.



Source : EGA (2013)

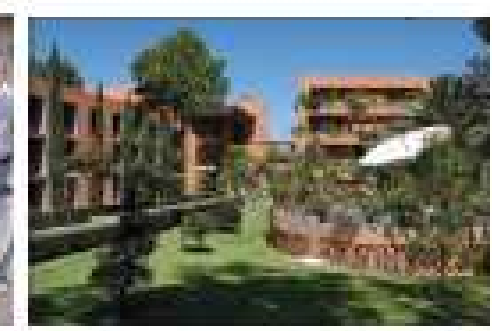
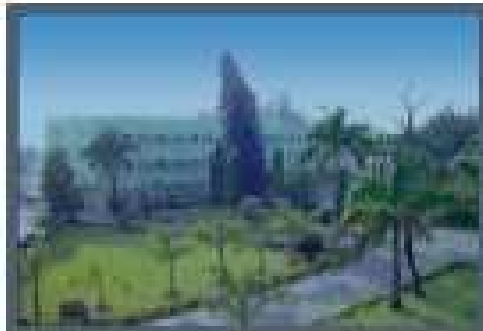
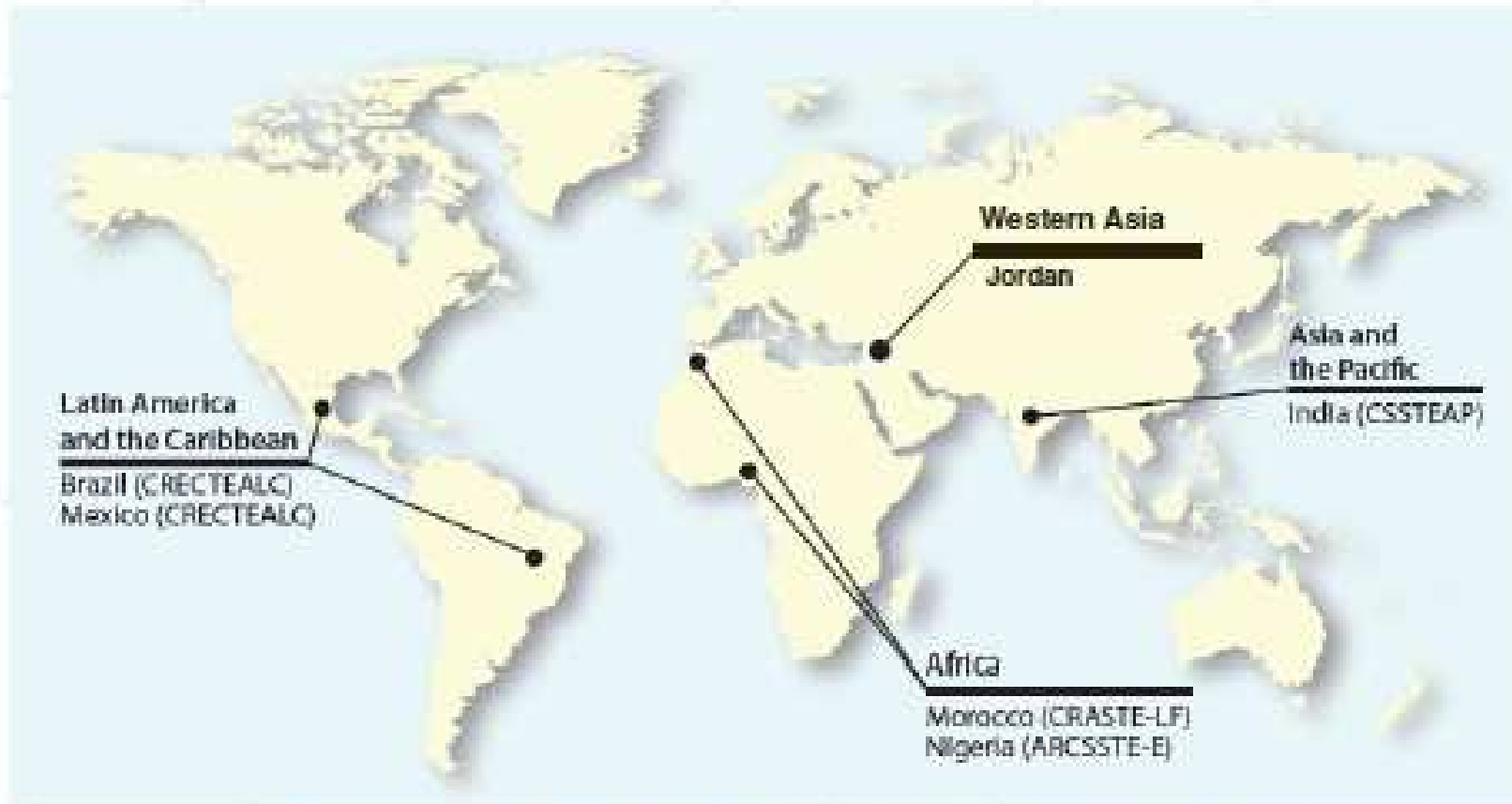
Outlook

- The modernization of GPS and GLONASS and the development of Galileo and Compass/Beidou as well as Augmentation systems will improve the precision, the reliability and the productivity.
- The manufacturers provide smaller, lighter and more capable receivers.
- Sensor integration is seen as a solution to overcome signal obstruction in challenging sites.
- New markets are developing very fast : location based services.

Impacts

- Significant increase of the number of fields using and relying on positioning and navigation.
- GNSS and GNSS-dependent industry is highly dynamic and evolving.
- Opportunities to contribute to the economic and social development.
 - It is important to :
 - Stay abreast of the latest developments in GNSS-related areas
 - Build the capacity to use the GNSS signal.
 - Increase the number of experts and application developers in GNSS

Regional centres, affiliated to the UN



Regional centres, affiliated to the UN ***Conducting short and long-term Training on GNSS***

- Regional centers on space science and technology education run Postgraduate Diploma programs in different areas of space science and technology applications.
- Regional centers on space science and technology education have been conducting short and long-term training on various aspects of GNSS.
- The centers also serve as information centers for the International committee for GNSS.

Regional centres, affiliated to the UN

Conducting short and long-term Training on GNSS

- Within the framework of the workplan of ICG, UNOOSA organized international training courses on satellite navigation and location-based services at the United Nations affiliated regional centres .
 - **India (2008), Mexico (2009), Morocco (2009) and Nigeria (2010).**
- These courses were part of the work of UNOOSA to develop a GNSS education curriculum for teaching GNSS.
- New Education curriculum (2012) :
 - **Global Navigation Satellite System (GNSS)**



CRASTE-LF



The **CRASTE-LF** has been established
in Rabat on October 23, 1998.
Initiative of the UN-OOSA.

**Education and training on
Space Science and Technology
for sustainable development**

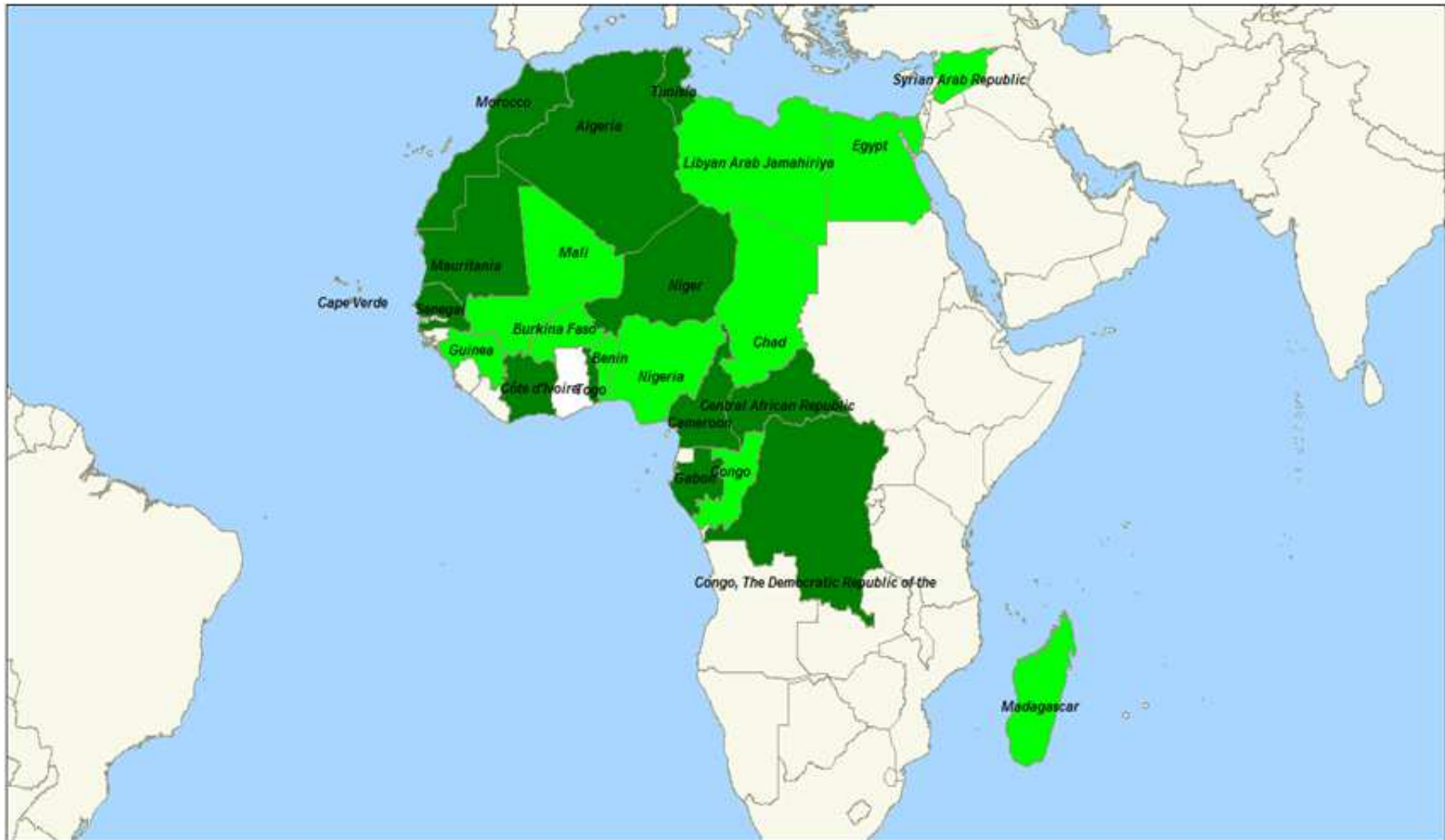
Thirteen Member States : Algeria,
Cameroon, Cape Verde, Central
African R., Ivory Coast, D. R. of
Congo, Gabon, Morocco, Mauritania,
Niger, Senegal, Togo and Tunisia.



Building of CRASTE-LF

Origine of candidates (1998-2013)

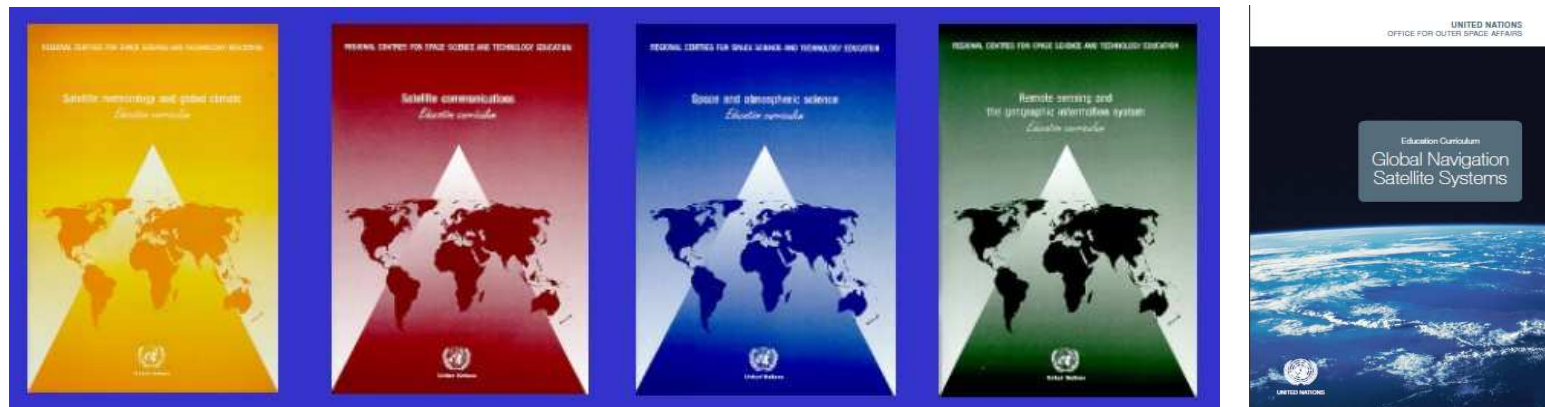
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Education Programmes

- Remote Sensing and Geographic Information Systems,
- Satellite Communications,
- Satellite Meteorology and Global Climate,
- Space and Atmospheric Sciences
- **Global Navigation Satellite Systems**



Education Curricula established and Published by UN-OOSA

International Course



"Navigation and Services Based on Satellite Positioning".

28 September au 24 October 2009

Regional Training Workshop



« **Global Navigation and Based Service on Satellite Positioning**

»

Lomé, Republic of Togo, 3 - 7 October 2011

Trainings in GNSS (CRASTE-LF, IAV H2)



Education Curriculum in GNSS

- The incorporation of elements of GNSS science and technology into university-level education curricula serves a dual purpose:
 - *Enable countries to take advantage* of the benefits inherent in the new technologies;
 - *Introduce the concepts of high technology to help* create national capacities in science and technology in general.
- Currently efforts are being made worldwide to introduce GNSS, in terms of science, technology and applications, as a stand-alone discipline in university-level curricula.

Example of postgraduate programs in GNSS

- Program in GNSS and Related Applications studies hosted by the Politecnico di Torino (School of Information Technologies), Turin, Italy.
- Master of Science in Global Navigation Satellite System (ISAE-ENAC)
- Master Program on Space Technology Applications (MASTA) focused on Global Navigation Satellite Systems (GNSS), Beihang University, China.
- GPS, Geodesy and Application Program, Maine University, United States
- Master's degree in Geomatics and Navigation (GEONA), UPC and EETAC, Barcelona, Spain

Education Curriculum in GNSS (CRASTE-LF)

- The programme is based on the *“Global Navigation Satellite Systems, Education Curriculum”* (December 2012) prepared by the International Committee on Global Navigation Satellite Systems (UNOOSA).
- This Master in GNSS is recommended to candidates graduated in electronic engineering, telecommunication Engineering, civil engineering, forestry, geomatics and geographic sciences, mathematical sciences and physical sciences.

Education Curriculum in GNSS (CRASTE-LF)

The Master programme in GNSS is divided into four parts:

- **Lessons organized in 9 modules** consisting of 690 hours.
 - Lectures, tutorials, practical works and thematic seminars.
- **Laboratory experiments, practical activities and projects** related to the applications of GNSS consisting of 200 hours.
- **A GNSS project** realized in 12 weeks corresponding to 360 hours.
- **One year project** conducted by each candidate in his country on an issue related to the GNSS applications. The research project will lead to the development of a thesis document that will be presented in the CRASTE-LF centre.

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Modules of the programme

- The Master program starts first with upgrading modules in the fundamental areas:
 - mathematics, physics and computer sciences.
- It addresses then topics related to areas of GNSS:
 - basics of geodetic positioning, study of current and future GNSS systems, satellite positioning techniques, GNSS receivers and complementary navigations systems, GNSS applications, Space weather.
- Data management and data representation :
 - Geographic information systems, cartography, web-mapping.
- Thematic seminars:
 - Agriculture, Navigation, Civil engineering, Natural Resources management, Geodesy and surveying, Mapping, legal aspects, space weather.

Module 1 : Mathematics

Statistics

Mathematics

Signal Processing

Module 2 : Physics

Electronics

Orbital Mecanics

Physics of the Globe

Module 3 : Computer Science

Databases

Programming

Embedded systems

Protocols and Network
Architecture

Module 4 : Signals and Receivers

Signal structure and
transmission

Receivers

Module 5 : Geodesy and Surveying

Geom/Geodesy

Surveying

Physical Geodesy

Least squared adjustment

Module 6 : Fundamentals of Satellite Positioning

Introduction to GNSS

Data Processing

Module 7 : Satellite Positioning Techniques

Positioning and Navigation Techniques

Differential Positioning and Augmented systems

Module 8 : Thematic Applications

Navigation, Agriculture, Space Weather,
Surveying and Mapping, Environment,

Module 9 : GIS and Mapping

GIS

Mapping

Web-mapping

Practical works

- The Master program will provide in-depth knowledge and practical works for candidates in order to apply and implement the acquired theoretical concepts :
 - handling of GNSS receivers,
 - use of GNSS software,
 - design and development of applications related to the use of GNSS.
- The project is an opportunity for the candidate to carry out a comprehensive project in GNSS, from planning to implementation.
- The research project carried out by each candidate is an opportunity to conduct a thesis in GNSS on a theme corresponding to the needs of his country.

Education in GNSS: *2013-2014*



Candidates

Countries

- Algeria : 01
- Cameroun : 03
- Cote d'Ivoire : 01
- Morocco : 02
- Tunisia : 02
- Senegal : 02

Needs

- Agriculture
- Military
- High Education
- Mapping and Surveying
- Research and Innovation
- Transportation and Logistics

Recommendations

- Long term trainings, In-depth high-level training.
- Sensor integration.
- Applications for sustainable development.
- Encourage Partnership between universities and public/private organizations and industry.
- Information dissemination about training and education possibilities.

Thank you

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