



CRASTE-LF

African Regional Centre for Space Science and Technology Education, in French Language (CRASTE-LF)



Affiliated to UN

Capacity Building on GNSS in CRASTE-LF for African French Speaking Countries

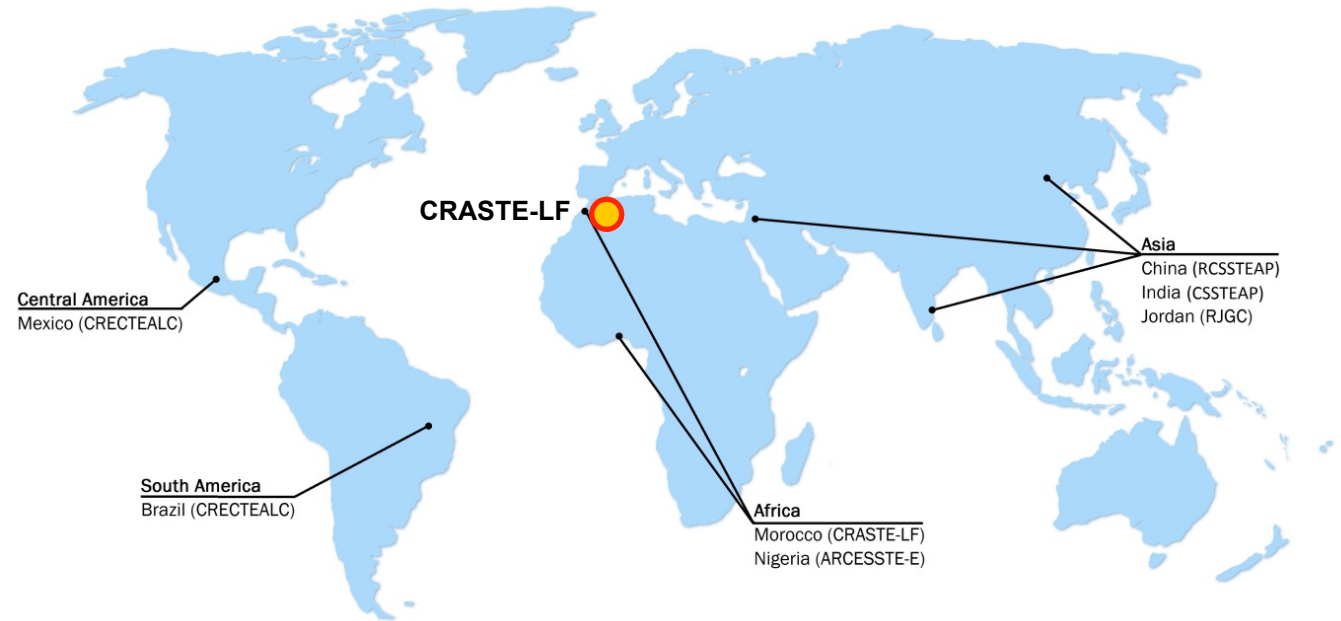
CRASTE-LF

Boulder, 1-6 November 2015



Network of Regional Centres for Space Science and Technology Education

Regional Centres for Space Science and Technology Education
(affiliated to the United Nations)



United Nation General Assembly Resolutions: 45/72 of 11th NOV. 1990 and 50/27 of 6th Dec 1996.

6 Centres affiliated to UN in activities through a World regions :
India (**CSSTEAP**, Asia & the Pacific), Morocco (**CRASTE-LF**, Africa in French Language), Nigeria (**ARCSSTE-E**, Africa in English Language), Brazil Campus & Mexico Campus (**CRECTEALC**, Latino America & Caribbean), Jordan (**RCSSTEWA**, Western Asia) and China (**RCSSTEAP**, Asia & the Pacific).





Contribution of Post Graduate training on Space Science and Technology

The **CRASTE-LF** has been established, on the initiative of the UN-OOSA program on applied of the UN/G.A. Resolutions, in Rabat on October 23, 1998, by 11 African States.

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

Other countries non-member can benefit from the services offer by CRASTE-LF



Building of CRASTE-LF

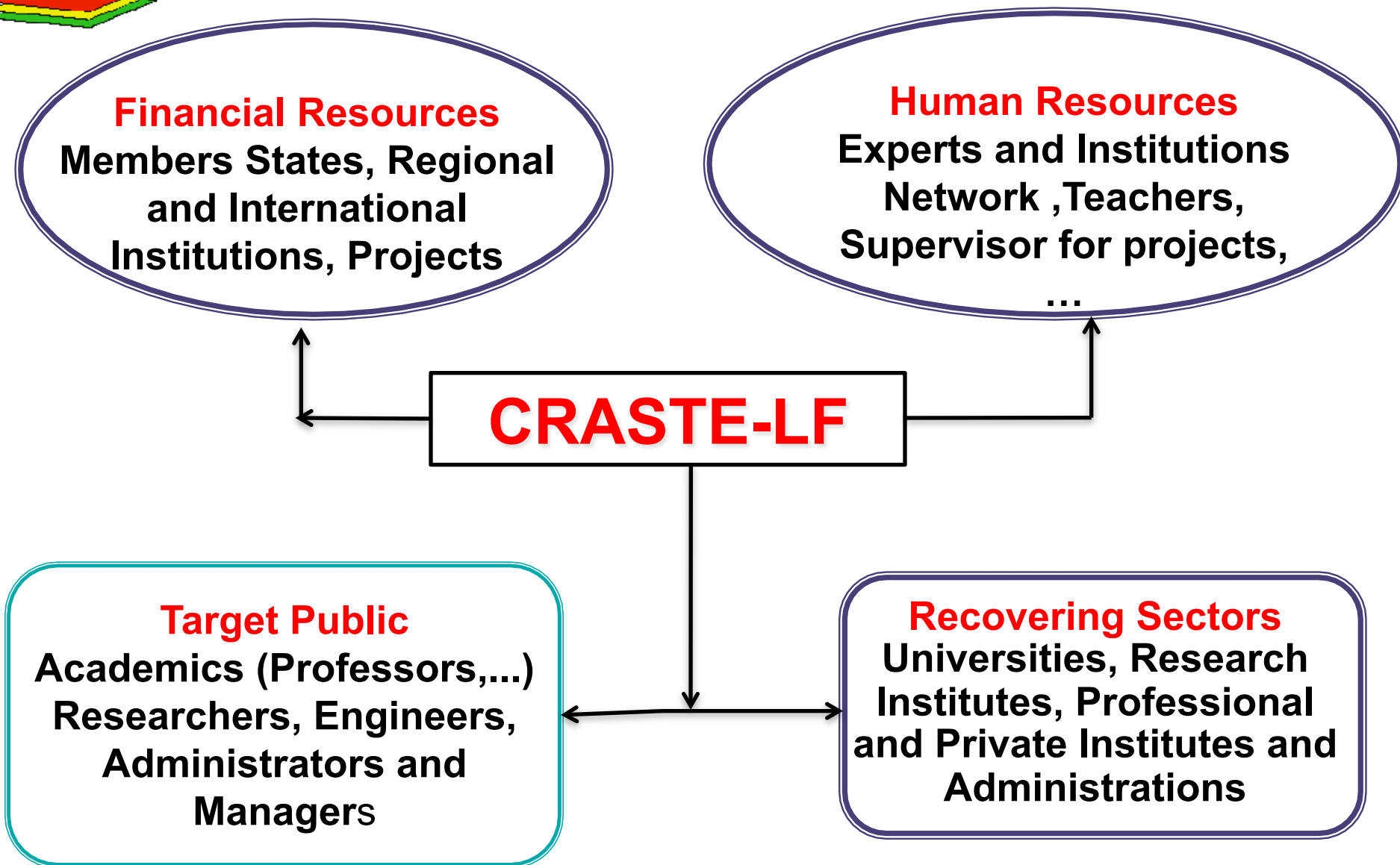


Objectives of the Centre

- To **increase knowledge** in Space Sciences and Technologies by organizing Postgraduate and/or Short courses, Seminars, workshops, conferences at the Regional level,
- To improve the technical **competences** of the **experts, teachers, decision-makers** and to hold them informed about technical progress .
- To **assist** the countries of the region on the development of endogenous capacities in space tools.
- To **Strengthen** the Local and Regional Capacities.
- To promote **Cooperation** between the **Developed Countries** and **States Members** as well as among **these States**.
- To develop **expertise** in Space Sciences and Technology.



Functioning of the Centre

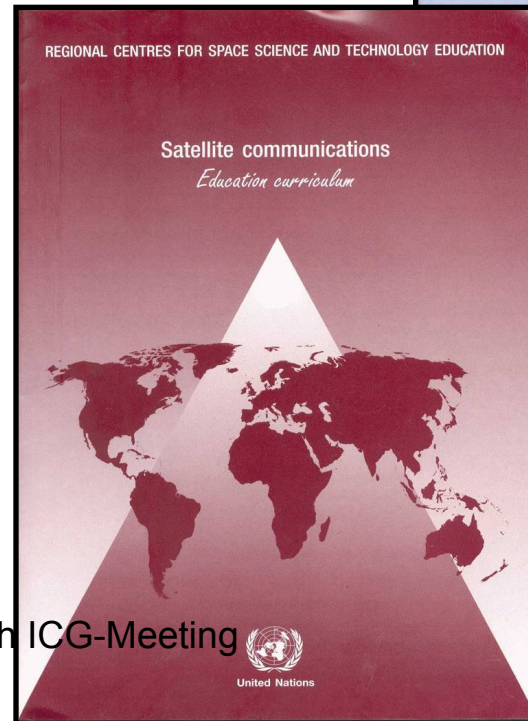
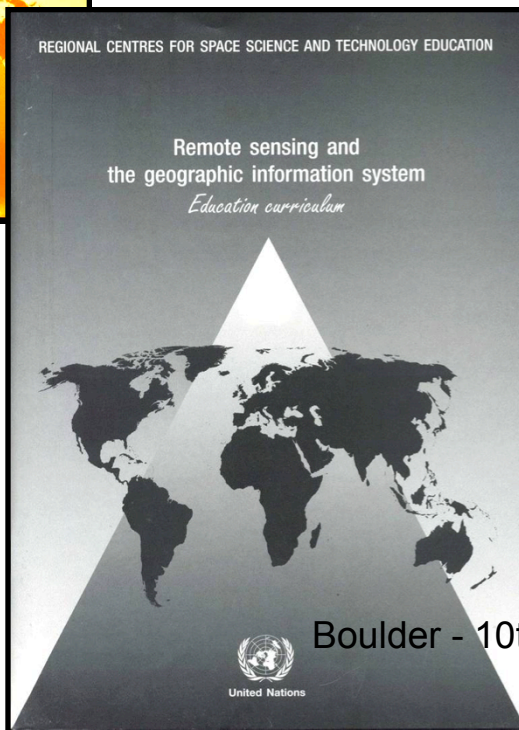
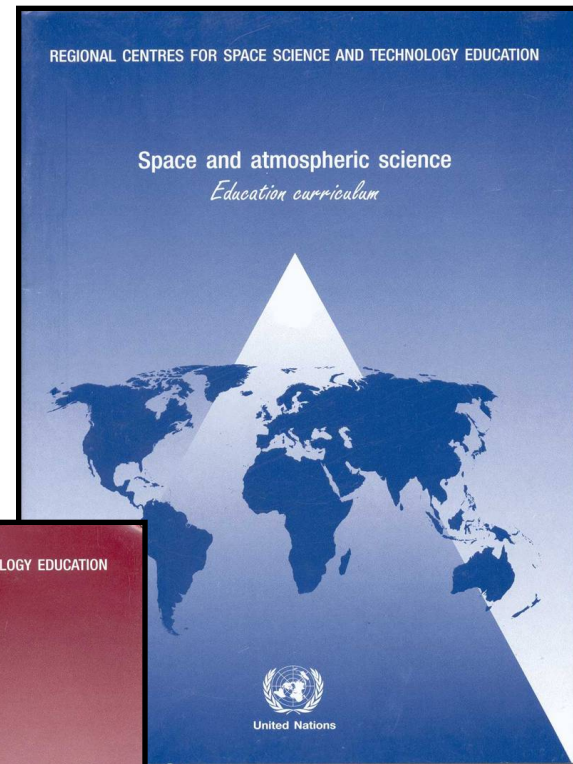
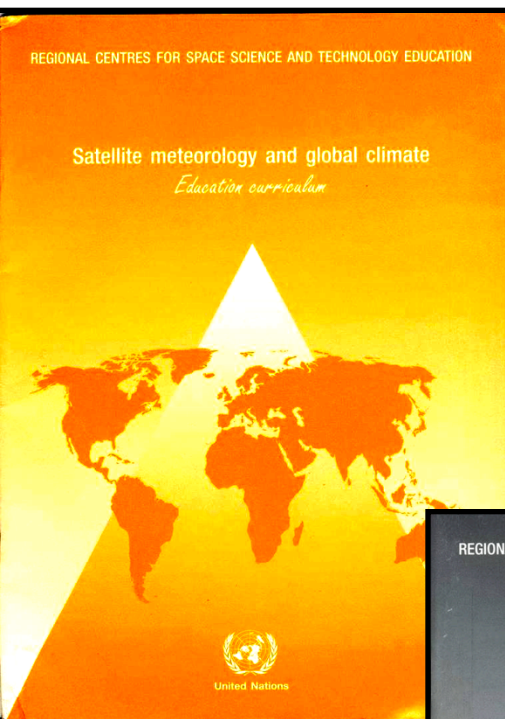




Main Courses Programs (1)

Education Curricula established and Published by UN-OOSA for Regional Centres for Space Science and Technology Education in:

- Remote Sensing & GIS,
- Satellite Communications,
- Satellite Meteorology & GC,
- Space and Atmospheric Science.





Main Courses Programs (2)

UNITED NATIONS
OFFICE FOR OUTER SPACE AFFAIRS

Education Curriculum
Global Navigation
Satellite Systems



UNITED NATIONS

Education Curriculum established and published by UN-OOSA for Regional Centres for Space Science and Technology Education in:

- GNSS (Since 2012),
- Space Law

UNITED NATIONS OFFICE FOR OUTER SPACE AFFAIRS

Education
Curriculum on
Space Law



UNITED NATIONS



Contents



Training Stages

Each Training Session takes place in 2 phases

Phase I : 9 to 10 Months or 3 semesters , in Centre, theoretical and practical courses, land study and pilot project ~ 1000 h.

Phase II : 12 to 15 Months, achieve the Research Project in their institution.

End of phase II : Defense of Memoire in Centre (Jury Members are Professors and Experts) .

Détail of courses in Web Site:

www.crastelf.org.ma

- www.oosa.unvienna.org/SAP/centres/centres.htm
- www.unoosa.org/oosa/SAP/gnss/icg.htm



Accreditation

In 2012 the CRASTE-LF launched of Accredited Post- Graduate training in Space Sciences & Technology with two options Remote Sensing & GIS and Satellite Meteorology & Global Climate in collaboration of Mohamed V University of Rabat.

This year there are the fourth postgraduate training courses accredited.



Affiliated to UN

1) Post-graduate Training on Space Science and Technology

Option : «Global Navigation by Satellite System- GNSS»



Introduction

Affiliated to UN

- ❖ The training courses is based on the document entitled "**Global navigation satellite systems, education curriculum**" prepared by UNOOSA in cooperation with the ICG (International Committee on Global Navigation Satellite Systems).
- ❖ It also follows the work and recommendations of the document "Report on training courses on Global Navigation Satellites Systems held at the United Nations affiliated regional centers for space science and technology education in 2008 through 2010" (A/AC.105/C.1/2011/CRP.11)
- ❖ The training takes into account the characteristics of the region and priorities of the member States of CRAFT-LE in terms of GNSS applications and qualified human resources needs.



Conduct of Training Courses

Theoretical Teaching

- 690 hours
- 9 Modules
- Courses, supervised work and thematic seminar.

Practical Works

- 200 hours
- Practical Works and projects related to GNSS applications

Pilot Project

- During 12 weeks
- Pilot Project on GNSS

Research Project/ Memoire

- 12 – 15 months
- A research project carried out by the candidate in his home country (Institution, ..) on an issue related to GNSS applications.



Curriculum on GNSS

1. Upgrade courses in the Basic Module :

- Mathematics,
- Physics,
- Computer Sciences.

2. Courses topics related to GNSS :

- Fundamentals of geodesy and surveying,
- Basic concepts in geodesy and topography,
- Basics positioning satellite,
- Study of current and future GNSS systems,
- Satellite Positioning and Navigation techniques,
- Receivers and complementary systems.

3. GIS & Mapping:

- GIS,
- Mapping,
- Cartography and Web-Mapping

4. GNSS thematic Applications.



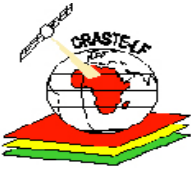
Laboratory experiments, practical Exercises

- Practical work enables the candidates to practice the theoretical concepts learned.
- The practical works will focus on three aspects :
 - handling of GNSS receivers,
 - use of GNSS software,
 - design and development of applications related to the use of GNSS.



Project Pilot (~10 weeks)

- The pilot project is an opportunity for the candidate to carry out a comprehensive project in GNSS, from planning to implementation:
- The theme of the pilot project has to be chosen by the candidate with his administration.
- The following themes are given for information only :
 - GNSS and GIS to improve the management of Lands.
 - Integration of GNSS signals and mobile telephony.
 - Improvement of the positioning by integration of inertial systems.
 - GNSS and web-mapping (online tracking of vehicles movement).
 - Embedded Application for public services.
 - Integration of GNSS and GIS to improve the management of the land heritage.
 - GNSS Application for the management of natural resources.
 - GNSS Application for disaster relief purposes.
- A project report must be submitted by each candidate.



Thesis

- The final step of the Master is to carry out a research project.
- Each candidate will have to conduct a thesis in GNSS on a theme corresponding to the needs of his institution in his country.
- The research project has duration of 12 to 15 months and will lead to the development of a thesis document that will be presented in the CRASTE-LF.



Realized Short Training Courses on GNSS (1)

1 training Short courses on “Satellite Navigation and Location Based Services” ,
28 September – 24 October 2009, with participation of
35 trainees from **19 Countries** & from **32** different
institutes supervised by **10** experts.





Cours International

Navigation et Services basés sur le Positionnement par Satellites

Rabat, du 28 septembre au 24 Octobre 2009

organisé par

Le Centre Régional Africain des Sciences et Technologies de l'Espace

En Partenariat avec

Le Bureau des Affaires Spatiales de l'ONU à Vienne (UN-OOSA)

Le GIE GALILEO Morocco Group (Maroc)

L'Ecole Mohammeda d'Ingénieurs (EMI) - Maroc

L'Office National Des Aéroports (ONDA-Maroc)

Avec le Soutien de l'Agence Spatiale Européenne et des Etats Unis d'Amérique à travers le Comité International de Navigation Globale par Satellite (ICG)





Participation of trainees to the demonstration on live under the METIS project team at Mohamed V Airport.



Realized Short Training Courses on GNSS (1bis)

The contribution by the demonstration of the use of the EGNOS, organized under the METIS (European project) team in partnership with National Office of Airports of Morocco (ONDA) at the Mohamed V Airport in Casablanca (Morocco) and which trainees had attended, is a real example of support for capacity building GNSS applications, indeed:

- this training has seen the participation of stakeholders,
- The awareness of the use of GNSS and augmented systems for development,
- the development of Human Resources in the use of GNSS services,
- the benefit of African countries through the transfer of these technologies,
- support for training course by the assistance of expertise and equipments,



Realized Short Training Courses GNSS (3) - Togo

Regional Training Workshop on Navigation and Positioning Services Based on Satellite, Organized in Lome , Togo in October 2011 with 24 participants from 6 African countries.

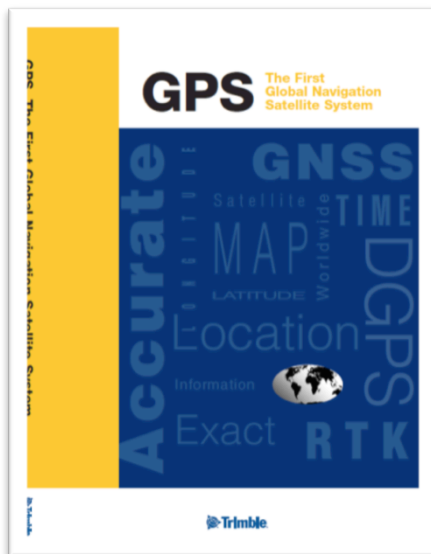




Realized Postgraduate Training Courses GNSS (3)

1 Post Graduate training courses on GNSS, **Nov. 2013 – Aug 2015**
12 trainees from **6** member Countries & **8** different institutes

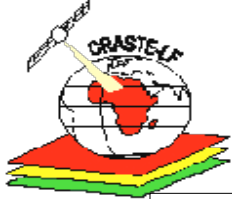
GPS Materials



The trainees supervised by four Experts from International Institute for GNSS Education of Beijing China,

GNSS BEIDOU Equipment





Realized Training Courses (4)

Training Workshop on “Space Weather & GNSS Applications” , Feb 2015
with participation of **29** trainees from **13** African Countries supervised by
8 teachers.





Realized Training Courses (5)

The first project realized in ANCFCC (National Agency of Land Conservation, Cadastre and Cartography) by one trainee on **“Design of a mobile application relating to plot recognition of land registration overall”** has been presented in September 2015 in the Centre.



The CRASTE-LF participate now in European Project H2020 to benefit of trainees and member States on using E-EGNOS for Intelligent Transportation Systems. (us it participated before in three FP7 European project for analyzing state of use of Earth Observation and to promote to stakeholders the benefit for their countries to use this techniques, GEONETCAB, EOPOWER & IASON)



2) Post-graduate Training on Space Science and Technology

Option :
Remote Sensing & GIS,
Satellite Communications,
Satellite Meteorology & Global Climate.



Realized Training Courses

11 training courses in Remote Sensing and GIS, Apr. 2000 and Nov. 2001, 2003, 2005. 2006. 2008, 2010, 2011& Sept 2012, Sept.2013, Sept.2014 and Sept. 2015

250 trainees from **21** member and non member countries & **27** different institutes .

6 training courses in Satellite Meteorology and Global Climate Jan. 2002, Nov. 2004, Dec. 2009, Sept. 2012 , Sept. 2013, Sept.2014 and Sept. 2015

65 trainees from **10** member countries & **16** different institutes.

3 training courses in Satellite Communications Dec. 2000, Nov. 2002 and 2007

33 trainees from **10** member Countries & **10** different institutes.

1 training courses on GNSS, Nov. 2013

12 trainees from **6** member Countries & **8** different institutes



1^{ère} Promotion accréditée de Master STE/T-SIG & MSCM



Etudiants de la 8^{ème} promotion Master Télédétection -SIG



Photo de la promotion en présence des conférenciers



Boulder - 10th ICG-Meeting Photo of 1st Session GNSS 2013 – 2014



Trainees Profiles

R.S. and G.I.S

- Engineer in Geodesic Sciences
- Engineer in topography
- Engineer in Agro meteorology
- Engineer in Cartography
- Master in Applied mathematics
- Master in Geography
- Doctorate in Geography
- Doctorate in Physics

S.M.G.C.

- *Engineer in Meteorology,*
- *Mechanical Engineer,*
- *Forest Engineer,*
- *Master in Signal Processing*
- *Computer Engineer,*
- *Master on Environment,*
- *Master en Communication*
- *Doctorate d'état on Sciences Physiques*

S.C. & GNSS

- Engineer on Communications,
- Engineer on Mechanical engineering,
- Master on Signal Processing,
- Engineer on Electromechanically,
- Master on Electronics and
- Master on Communications
- Bachelor on theoretical Physics
- Engineer Multimedia Designer
- Doctorate on Communications
- Doctorate on Physics (electro-optics),
- Teachers & researchers,
- Professionals

Countries: *Morocco, Algeria, Tunisia, Mauritania, Senegal, Niger, Chad, Ivory Coast, Togo, Cameroon, Cape Verde, R.D. Congo, Central Africa, Gabon, Syria, Madagascar, Mali, Benin, Burkina Faso, R. of Congo*



Research Projects Topics

Research Projects for prepare the memoire of Master Degree in Space Sciences et Technologies cover almost all the applications : 1) Mapping, Urban, Agriculture, Geology, Water and Natural Resource Management, Ecology, forest, desert progress, Coast Management, migration of populations, etc...

2) Communications, Image reception, Ground Station reception , Telemedicine, Television reception via Satellite, Tele Education, Micro Satellite, Study of the European satellite navigation system Galileo and compared to the GPS system etc..



3) Climate Change Model, Desert Progress, Forest Fire, Epidemiology Vectors, Health, etc...





October 2007

International Conference « Climate Change & Adaptation in Africa – role of space technology »

November 2008

international Workshop "The Spatial tool for disaster management and emergency situations in Africa"



June 2010 international workshop on Space Law



Conference in Alger 2007, Clim Chgt & Adapt in Africa



Conference in Rabat 2009, Disaster Management



Boulder - 10th ICG-Meeting

17-Nov-15

Workshop of Launching of ROACC Network ”

**Launch of the
African Network of
Experts on the
Earth Observation
and Climate
Change.**

**Ouagadougou,
Burkina Faso
November 2010**



**Regional Workshop" Creation of the
Network and its application for
scientific purposes in Africa”**

**establishment of the African
Network on Earth Observation
and Climate Change**

**Lome - Republic of Togo, June
2010**

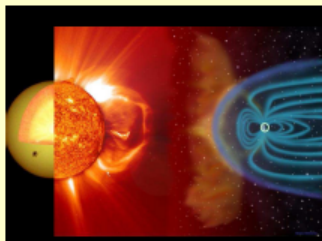
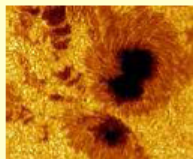


SCHOOL ON SPACE WEATHER
RABAT / MAROC [December 5-16, 2011]
 Organized by the French ISWI national committee
CRASTE – EMI – MENESFCRS

ISWI
 EMI
 ICC
 MENESFCRS
 CRASTE
 UNOOSA
 Cnes

Ministry of National Education at High Level Teaching
 For Scientific Research Teachers
 University for Technology

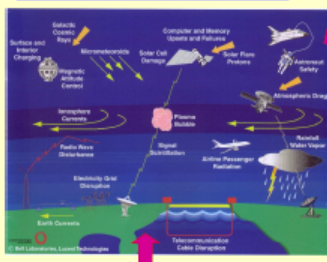
On l'espace pour le Terre



Northern Lights

The Sun is the source of many physical processes (radiations, winds, mass ejections, energetic particles) that may affect the terrestrial environment

Sunspot and magnetic loops at the surface of the Sun



The community of users of space weather products (from Bell Laboratories Lucent Technologies)

Context of the school

International Space Weather Initiative (ISWI) 2010-2012

Registration before April 30, 2011 at the 2two addresses
craste@emi.ac.ma
christine.amorv@jpp.polytechnique.fr

Objectives

- To learn about the solar processes influencing the terrestrial environment
- To learn how to use data obtained with the network of instruments in Africa

Program

Lectures and practical work

First week

Solar Physics:
 Solar radiation and its variability
 Solar cycle and activity
 Solar flares, Coronal mass ejection and solar energetic particles
 Solar wind and its perturbations
 Magnetosphere and Ionosphere of the Earth
 Solar-terrestrial Physics and Space Weather



Instruments deployed in Africa in the context of the International Heliophysical Year (IHY) (2007-2009)

Program

Lectures and practical work

Second week

Upper Atmosphere
 Ionospheric electric currents
 Earth's magnetic field
 Atmospheric electricity
 Precipitation Systems
 Chemistry and Transport in the atmosphere
 Sounding of the earth's atmosphere by microwave radio instruments

International Conference on Geospatial Information, effects and impacts of the CC in Africa

Rabat from 30/11 to 02/12 2011



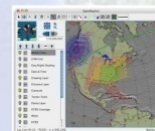
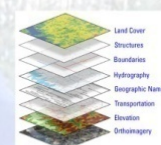
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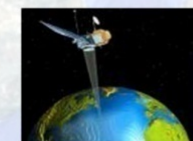
CONFERENCE INTERNATIONALE



INFORMATIONS GEOSPATIALES : EFFETS & IMPACTS DES CHANGEMENTS CLIMATIQUES EN AFRIQUE



Les 30 Novembre, 01 et 02 Décembre 2011
 A l'Ecole Mohammadia d'Ingénieurs, Rabat - Maroc



Boulder - 10th ICG-Meeting

17-Nov-15



CRASTE-LF : Sis EMI, Avenue Ibn Sina, BP 765, Agdal - Rabat (Maroc)
 Tél. : 212 537 68 18 26 – Fax : 212 537 68 18 24 Email : craste@emi.ac.ma



Training workshop and plenary Conference in Cameroon



Photo of participants in Workshop organized in Cameroon



Summary Education in CRASTE-LF

*Until now, more than **350 trainees** followed or follow postgraduate courses in the CRASTE-LF from **21 countries** and, near 110 Master Diploma in Space Sciences and Technology have been delivered by the Centre in various fields.*



Scientific Animation

Until now, more than 1700 experts from over 50 countries from Africa, Europe, Middle East and North America attended different Conferences and Workshops organized by the Centre in each fields in Space Technologies and in 10 African Counties.



Next training and activities

- 20th session on Satellite Communications (SC) and GNSS, **September 2016**.
- Will be organize **3 workshops** (**April 2016**) and 2 in Morocco (**June and Sept. 2016**) on use Earth Observation Techniques (Remote Sensing & GIS, Meteorology by Satellite and GNSS).



Success stories

- 350 trainees
- Professionals become a part in the higher management in their institutions
- Up 90% go back to their home countries (original institution or others)
- Themes of research projects in connection with local problematic
- In many cases, the trainees generated new activities related to space technology in their country (courses in local universities : trainers, projects, ...) : *snow ball effect*
- Creation of an Expert Network through the all Africa
- Substantial contribution in rising the awareness of the utility of space technologies for development.

THANK YOU FOR YOUR ATTENTION



www.crastelf.org.ma