Office for Outer Space Affairs
United Nations Office at Vienna

UN/ESA/NASA/JAXA Workshops
Basic Space Science
International Heliophysical Year 2007
International Space Weather Initiative

THE WHOLE SHEBANG 1989-1999-2009

Information Dissemination: 178 UNDP, 185 PM

BSS Workshops 1991-2004
Telescopes, Planetariums
Literature: ADS
Images: VO
IHY Workshops 2005-2009
Instrument arrays
ISWI Workshops 2010-2012
Array of arrays

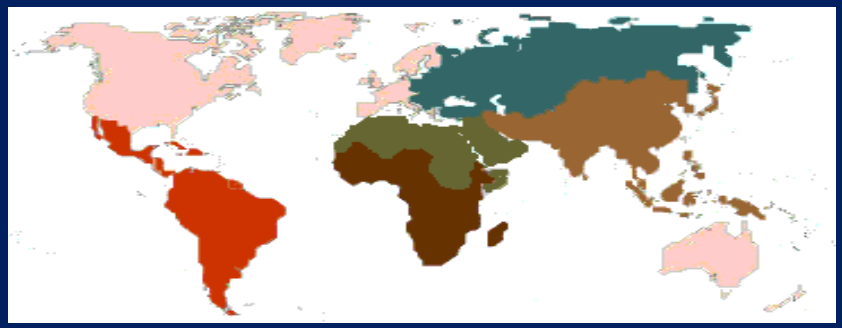
Regional Education Centres
Education Curricula: RS, SM, SC, SS, GNSS, SL

UN Information Dissemination Network

- **United Nations International Space Information System (UNISIS)**

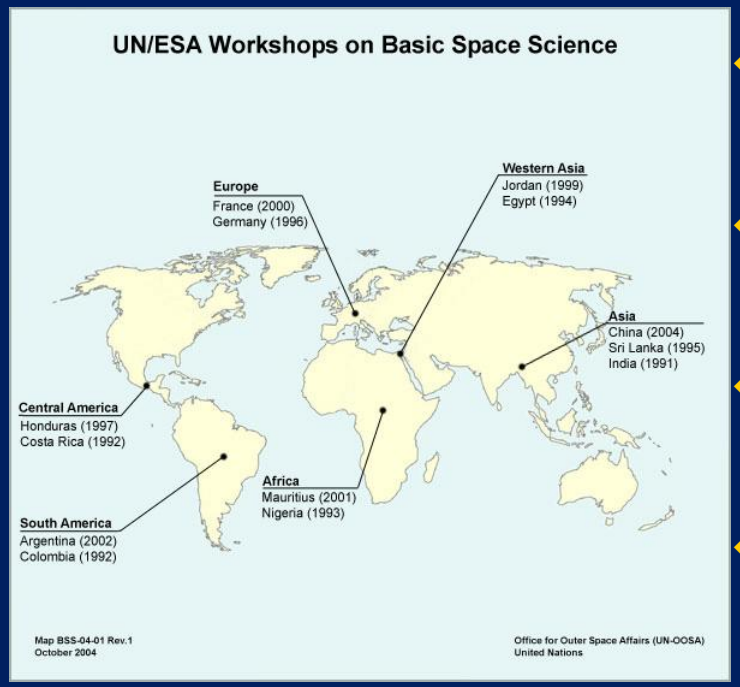
  http://www.unoosa.org/

- **United Nations Development Programme (UNDP) Offices**
  - **178 offices worldwide**
  - **185 Permanent Missions of 192 UN Member States**



UNDP Regional groupings

Basic Space Science Workshops



- **Regional:**
  India, Costa Rica, Colombia, Nigeria, Egypt
- **Inauguration of optical telescopes:**
  Sri Lanka, Honduras, Jordan
- **International:**
  Germany, France, Mauritius, Argentina
- **Review of all workshops:**
  P.R. China


Mauritius 2001


Argentina 2002

BSS TRIPOD: Telescope, Observing, Teaching

- **Government of Japan:**
  - **Japanese Cultural Grant Aid**
    45cm reflecting telescope
  - CCD & computer equipment
  - Building/ dome/ maintenance provided by local institution
  - Singapore 1987, Indonesia 1988, Thailand 1989, Sri Lanka 1995, Paraguay 1999, The Philippines 2000, Chile 2001, Mongolia?, India?

Sri Lanka 1996

- **American Association of Variable Star Observers (AAVSO):**
  - **Hands-on Astrophysics**
  - **Setting Up a Variable Star Observing Programme**
  - **Astronomy, mathematics, computer science**

BSS TRIPOD: Telescope, Observing, Teaching

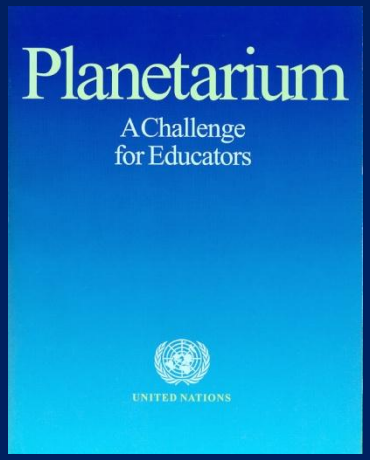
- **International Astronomical Union (IAU):**
  - **Astrophysics for University Physics Courses**
    - Study/ comparison of university education curricula in developing countries
    - Elementary calculus
    - Classical mechanics
    - Statistical mechanics
    - Thermodynamics applied to astronomy
    - Advanced teaching material recommended: K.R. LANG / J. BENNET et al.

Planetariums

Myanmar 1986

Peru 2003

Viet Nam 1998



- **Government of Japan**
- **Host country**
- **UNOOSA**

- **Myanmar, Jordan, Malaysia, The Philippines, India, Argentina, Uruguay, Vietnam, Thailand, Sri Lanka, Uzbekistan, Paraguay, Equador, Honduras, Costa Rica, Peru, Bolivia, Cuba, El Salvador**

International Virtual Observatory Alliance and ADS

IVOA

VO

TRIPOD

ADS

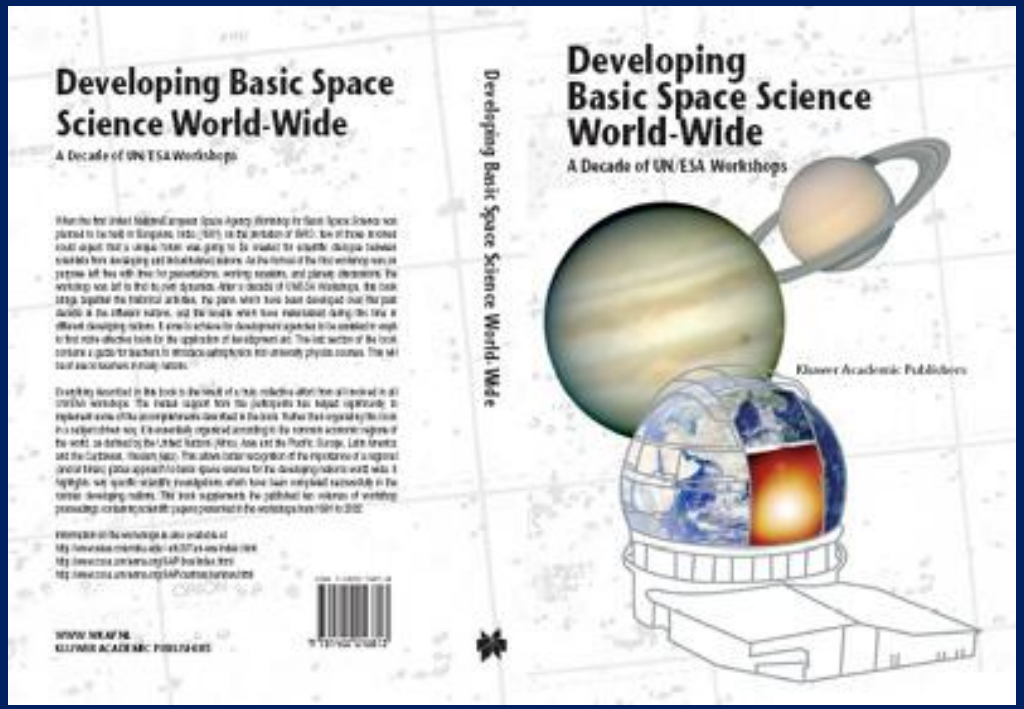
space technology

space science

ads

Astrophysical Data System

Final Report BSS



International Heliophysical Year 2007

UN/ESA/NASA/JAXA Workshops

1st 2005, Al-Ain, UAE

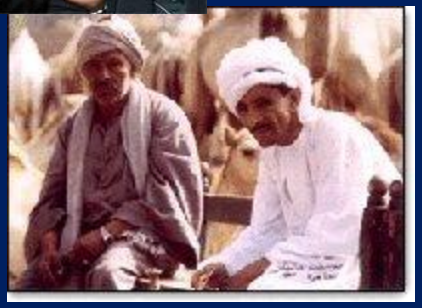
- Instrument providers and hosts
- Coordinated investigation programmes
- Education and outreach

2nd 2006, Bangalore, India

3rd 2007, Tokyo, Japan

4th 2008, Sozopol, Bulgaria

5th 2009, Seoul, South Korea



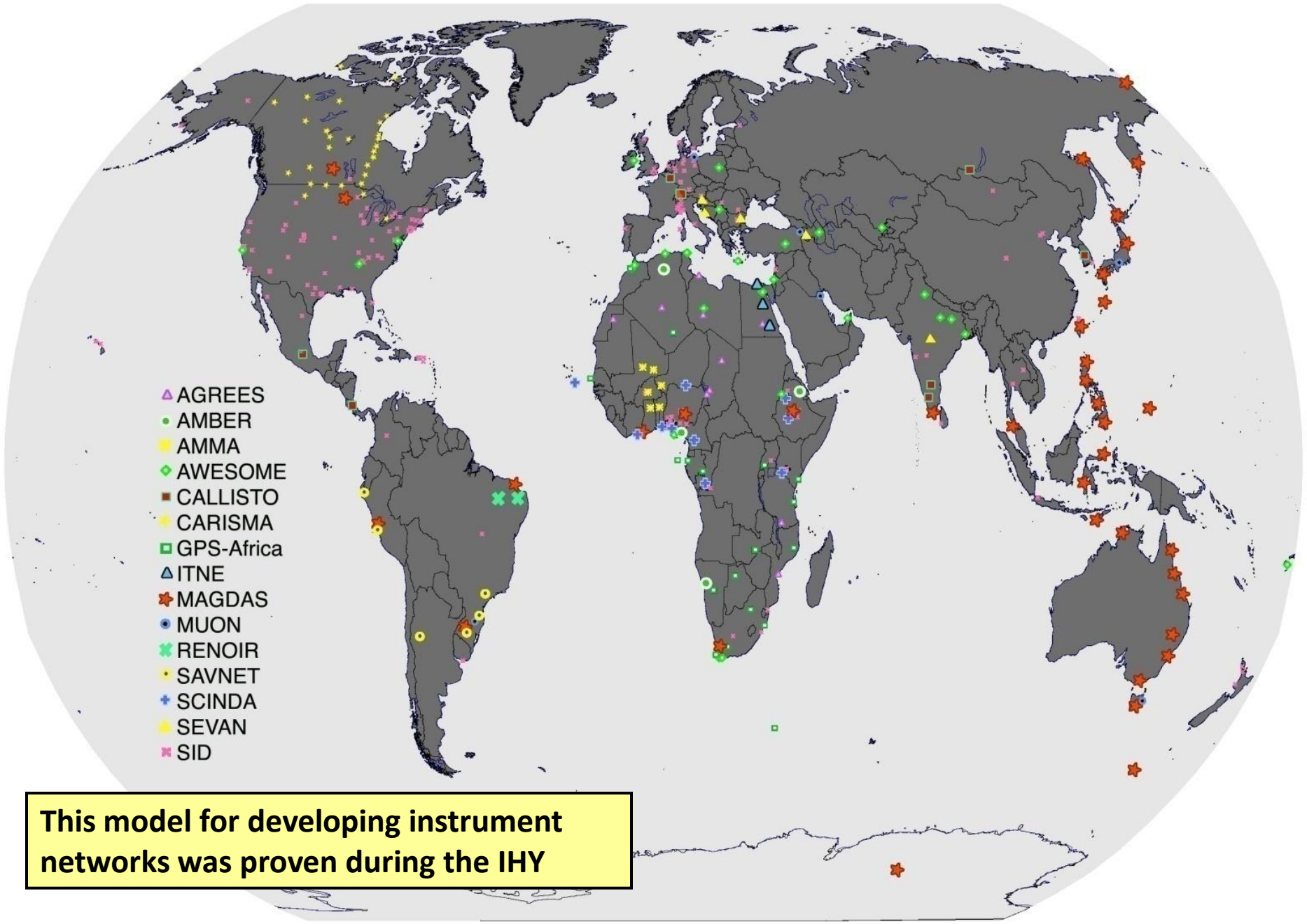
IHY TRIPOD: Instrument Array, Data, Teaching

- Since 2005, deploying small inexpensive instruments such as magnetometers, radio antennas, GPS receivers, particle detectors around the world to make global measurements of ionospheric, magnetospheric, and heliospheric phenomena

- Partnership between instrument providers and instrument host nations.
  - Provision of instrumentation by PI
  - Host institution makes available manpower, facilities, and operational support

- Data taking, sharing, analysis, publication

- Teaching space science at university level utilizing data



This model for developing instrument networks was proven during the IHY

THE 5TH UN/ESA/NASA/JAXA WORKSHOP

ON BASIC SPACE SCIENCE AND THE INTERNATIONAL HELIOPHYSICAL YEAR 2007

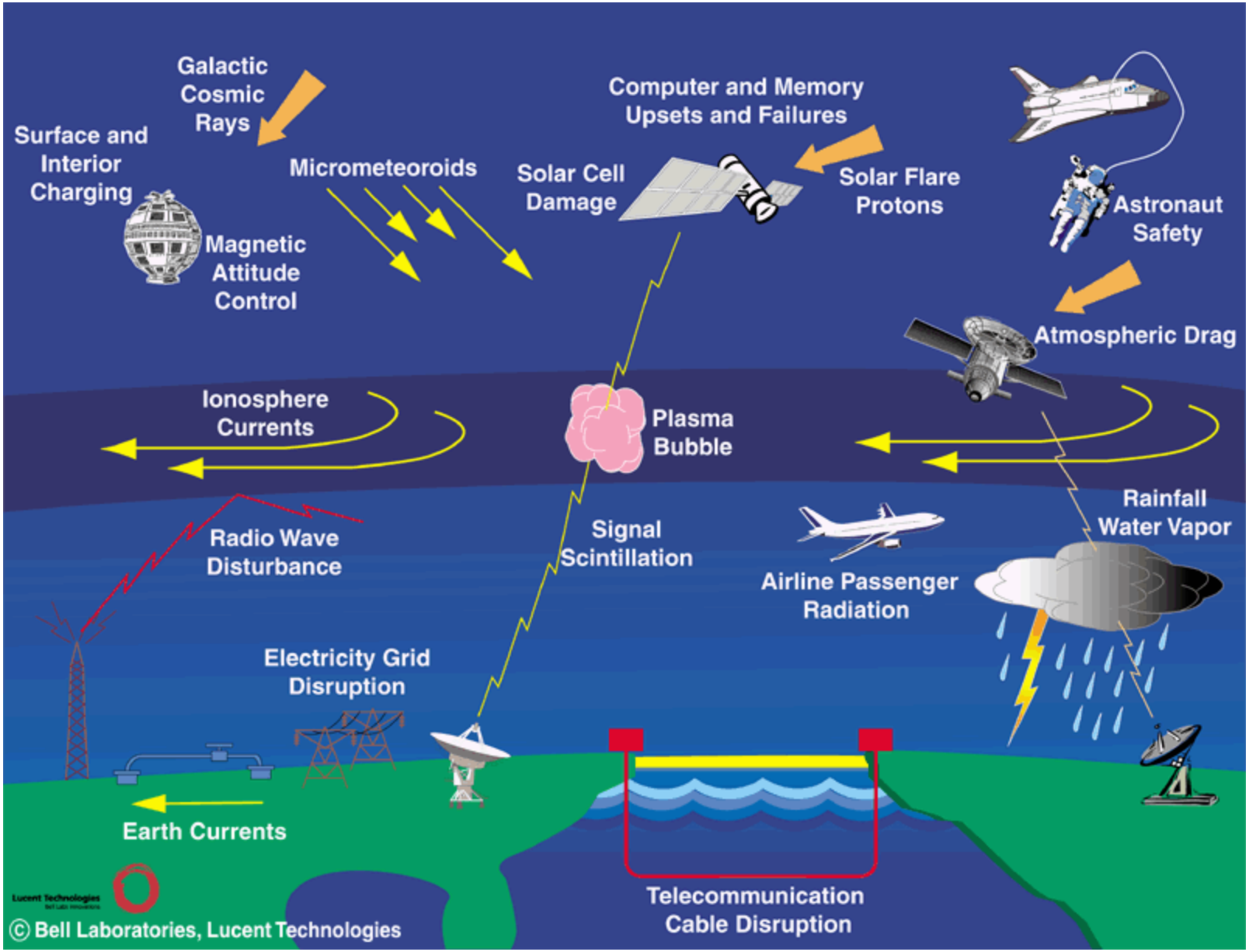
22~25 September 2009
HYATT REGENCY JEJU IN KOREA

Topics

- Fundamental Physics
- Astronomy and Astrophysics
- Solar-terrestrial Interaction and Its Influence on Terrestrial Climate
- Planetary and Atmospheric Studies
- Origin of Life and Exo-biology

Hosted by Korea Astronomy and Space Science Institute (KASI)
on behalf of Korean Ministry of Education, Science and Technology (MEST)

IHY 2007


Galactic Cosmic Rays
Surface and Interior Charging
Micrometeoroids
Solar Cell Damage
Computer and Memory Upsets and Failures
Solar Flare Protons
Astronaut Safety
Magnetic Attitude Control
Atmospheric Drag
Ionosphere Currents
Plasma Bubble
Rainfall Water Vapor
Radio Wave Disturbance
Signal Scintillation
Airline Passenger Radiation
Electricity Grid Disruption
Earth Currents
Telecommunication Cable Disruption
Lucent Technologies
© Bell Laboratories, Lucent Technologies

Current Instrument Arrays (July 2009)

ID	INSTRUMENT	Lead Scientist	Country	Objective
1	Scintillation Network Decision Aid (SCINDA) www.fas.org/spp/military/program/nssrm/initiatives/scinda.htm	K. Groves keith.groves@hanscom.af.mil (Hanscom AFRL)	USA	Study equatorial ionospheric disturbances to aid in the specification and prediction of communications degradation due to ionospheric scintillation in the Earth's equatorial region
2	Coherent Ionospheric Doppler Radar (CIDR) No webpage?	T. Garner garner@arlut.utexas.edu (U Texas)	USA	To tomographically reconstruct the ionosphere and to provide input to data assimilation models
3	Atmospheric Weather Education System for Observation and Modeling of Effects (AWESOME) and Sudden Ionospheric Disturbance monitor (SID) http://solar-center.stanford.edu/SID/AWESOME/	U. Inan inan@stanford.edu D. Scherrer deborah@solar2.stanford.edu" M. Cohen mcohen@stanford.edu (U Stanford)	USA	Lightning, sprites, elves, relation to terrestrial gamma ray flashes, whistler induced electron precipitation, conjugate studies

Current Instrument Arrays (July 2009)

ID	INSTRUMENT	Lead Scientist	Country	Objective
4	Remote Equatorial Nighttime Observatory for Ionospheric Regions (RENOIR) http://airglow.csl.uiuc.edu/Facilities/RENOIR/	J. Makela jmakela@illinois.edu (U Illinois)	USA	Study the equatorial/low-latitude ionosphere/thermosphere system, its response to storms, and the irregularities that can be present on a daily basis
5	African GPS Receivers for Equatorial Electrodynamics Studies (AGREES) www.igpp.ucla.edu/public/ekassie/AGREES.html	E. Yizengaw ekassie@igpp.ucla.edu M. Moldwin (UCLA)	USA	Understand unique structures in equatorial ionosphere, low/mid latitude plasma production, effect of ionospheric and plasmaspheric irregularities on communications
6	African Meridian B-field Education and Research (AMBER) www.igpp.ucla.edu/public/ekassie/AMBER.html	M. Moldwin mmoldwin@igpp.ucla.edu E. Yizengaw (UCLA)	USA	Understand low latitude electrodynamics, ULF pulsations, effect of Pc5 ULF on MeV electron population in inner radiation belts

Current Instrument Arrays (July 2009)

ID	INSTRUMENT	Lead Scientist	Country	Objective
7	Compound Astronomical Low-cost Low-frequency Instrument for Spectroscopy and Transportable Observatory (CALLISTO) http://helene.ethz.ch/instrument/callisto/_callisto.html	A.Benz benz@astro.phys.ethz.ch C. Monstein monstein@astro.phys.ethz.ch (ETH-Zentrum)	Switzerland	Study the magnetic activity of a wide range of astrophysical objects with emphasis on the Sun and cool stars
8	South Atlantic Very Low frequency Network (SAVNET) No webpage?	J.-P. Raulin raulin@craam.mackenzie.br (U Presbiteriana)	Brazil	Study of the SAMA region at low ionospheric altitudes and its structure and dynamics during geomagnetic perturbations
9	Magnetic Data Acquisition System (MAGDAS) www.serc.kyushu-u.ac.jp/magdas/	K. Yumoto yumoto@serc.kyushu-u.ac.jp (Kyushu U)	Japan	Study of dynamics of geospace plasma changes during magnetic storms and auroral substorms, the electromagnetic response of iono-magnetosphere to various solar wind changes, and the penetration and propagation mechanisms of DP2-ULF range disturbances
10	African Dual Frequency GPS Network No webpage?	C. Amory-Mazaudier christine.amory@lpp.polytechnique.fr (CETP/CNRS)	France	To increase the number of real-time dual-frequency GPS stations worldwide for the study of ionospheric variability, response of the ionospheric total electron content (TEC) during geomagnetic storms over the African sector

Current Instrument Arrays (July 2009)

11	Space Environmental Viewing and Analysis Network (SEVAN) http://sevan.aragats.am/	A.Chillingarian chili@aragats.am (Aragats)	Armenia Croatia Bulgaria India Slovakia	A network of particle detectors that aims to improve fundamental research of the particle acceleration in the vicinity of the Sun and the space environment, as well as to provide forewarnings of dangerous consequences of space storms and research on atmospheric electricity
12	Global Muon Detector Network (GMDN) No webpage?	K. Munakata kmuna00@gipac.shinshu-u.ac.jp (Shinsu U)	Japan	To identify the precursory decrease of cosmic ray intensity that takes place more than one day prior to the Earth-arrival of shock driven by an interplanetary coronal mass ejection
13	Continuous H-alpha Imaging Network (CHAIN) www.kwasan.kyoto-u.ac.jp/CHAIN/index.html	S. UeNo ueno@kwasan.kyoto-u.ac.jp K. Shibata (Kyoto U)	Japan	Solar activity, flares, filaments, filament eruptions
14	Optical Mesosphere Thermosphere Imager (OMTI) http://stdb2.stelab.nagoya-u.ac.jp/omti/	K. Shikawa (Nagoya U)	Japan	Dynamics of the upper atmosphere through nocturnal airglow emissions

Space Weather Monitor Sites

IHY Distribution 2007-2009

USA

Mexico

Germany

Nigeria

Ethiopia

China

AWESOME research monitors (26)

SID student monitors (300) *Larger dots indicate multiple sites*

USA

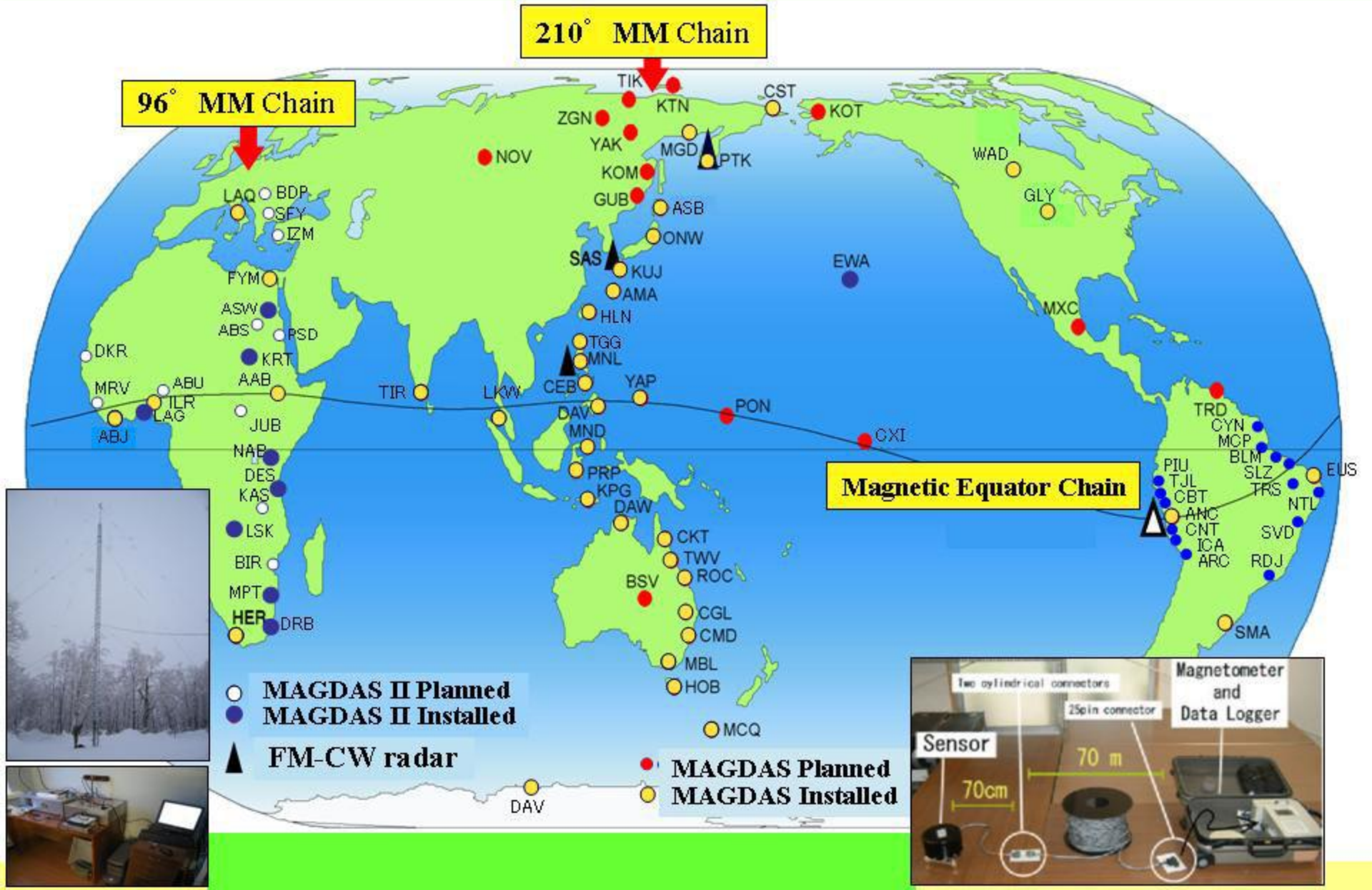
Romania

Lebanon

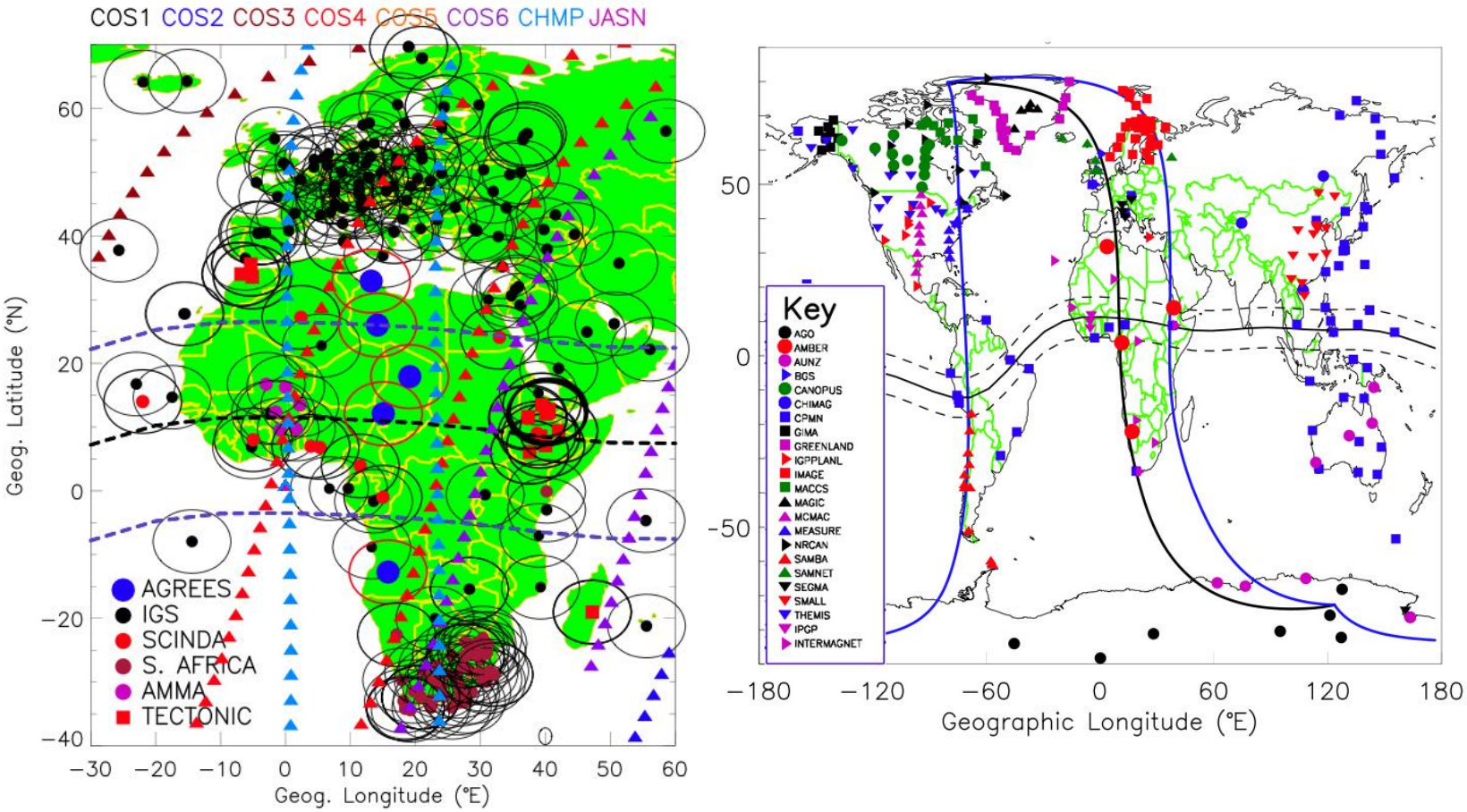
Thailand

MAGDAS I & II Projects at SERC, Kyushu U.

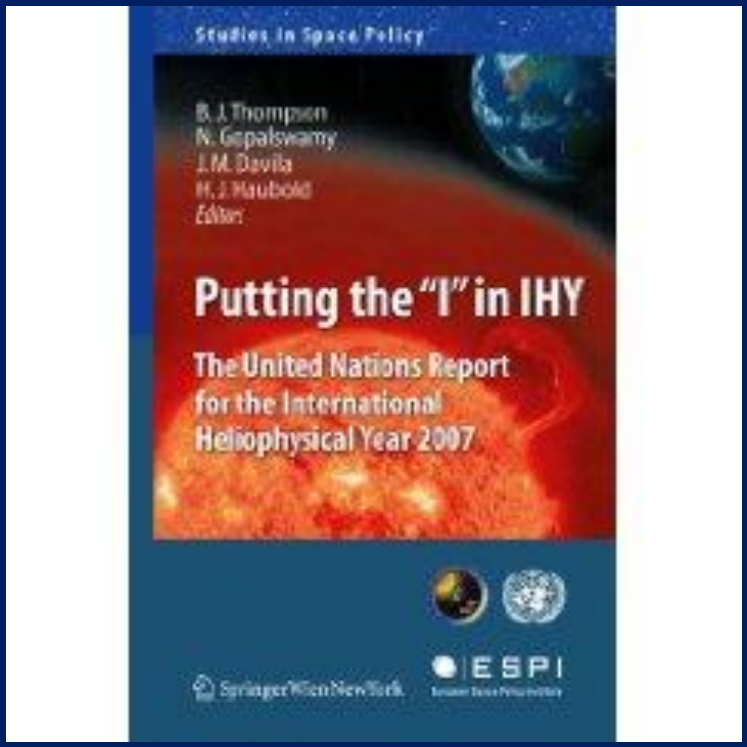
(MAGnetic Data Acquisition System/Circum-panPacific Magnetometer Network)



GPS Network and AMBER Mags



Final Report IHY



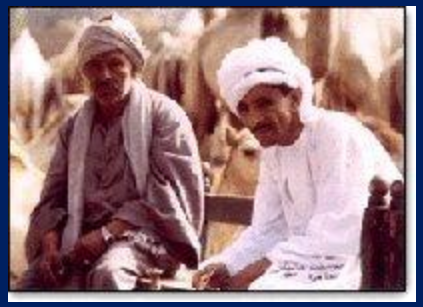
International Space Weather Initiative (ISWI)

UN/ESA/NASA/JAXA Workshops

1st 2010, Luxor, Egypt ESCWA

- Instrument providers and hosts
- Coordinated investigation programmes
- Education and outreach

2nd 2011 ECA

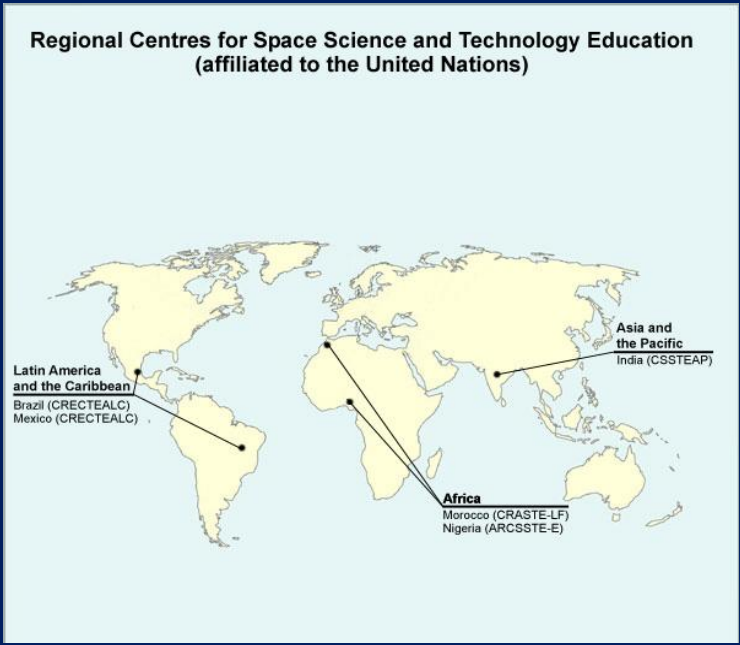


3rd 2012 ECE

4th 2013 ECLAC

5th 2014 ESCAP

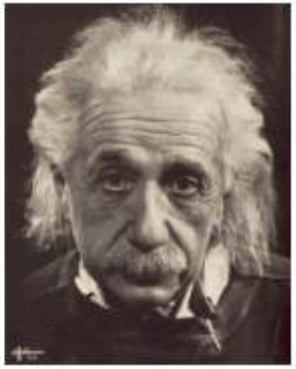
Regional Centres for Space Science and Technology Education (affiliated to the UN)

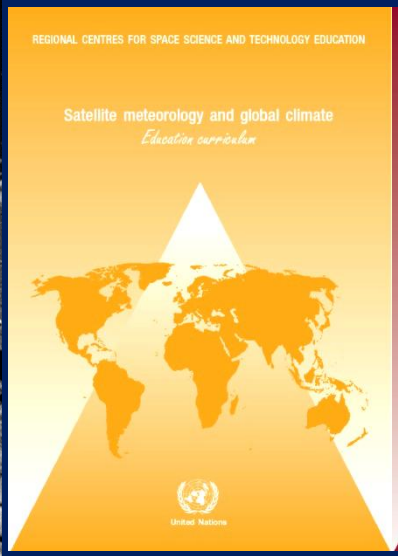


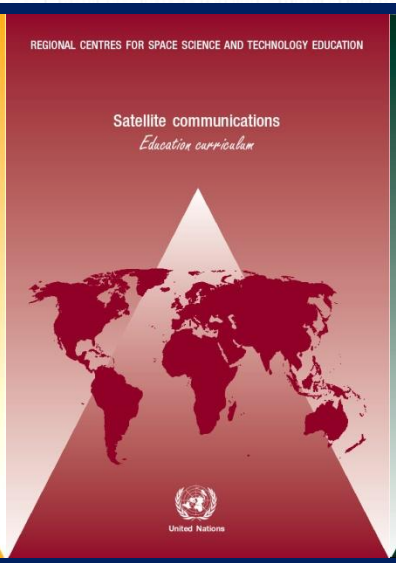
- The Regional Centres for Space Science and Technology Education were created under the auspices of the United Nations
- Goal: to develop, through in-depth education, an indigenous capability for research and applications in the core disciplines of:
  - Remote Sensing & GIS
  - Satellite Communications
  - Satellite Meteorology and Global Climate
  - Space and Atmospheric Sciences
- Regional Centres located in:
  - African region: CRASTE-LF (Morocco), CSSTE-E (Nigeria)
  - Asia and the Pacific region: CSSTEAP (India)
  - Latin America and the Caribbean: CRECTEALC (Brazil/Mexico)

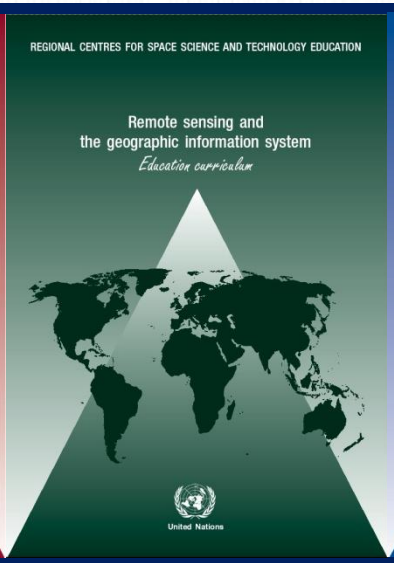
Regional Centres for Space Science and Technology Education (affiliated to the UN)

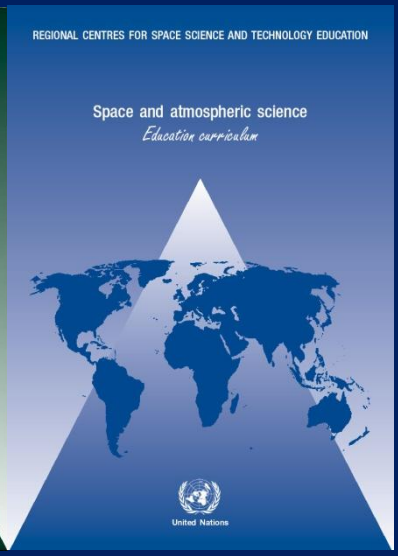
$$ds^2 = -\left(1+\frac{2\Phi}{c^2}\right)(c\ dt')^2 + \left(1-\frac{2\Phi}{c^2}\right)(dx^2+dy^2+dz^2)$$











Meteorology | Communications | Remote Sensing | Space Science

Future: GNSS, Space Law

Centre for Mathematical Sciences (CMS)
Pala, Kerala, India

1995, 2000, 2005, 2006, 2007, 2008 six-week SERC Schools on Special Functions and Functions of Matrix Argument: Recent advances and applications in stochastic processes, statistics, wavelet analysis and astrophysics

Lecture Notes available on request from
cmspala@gmail.com or downloadabe at www.cmsintl.org

2008 SERC School on Matrix Variable Calculus and Statistical Distribution Theory and Applications in Data Analysis, Model Building and Astrophysics Problems
15 April – 17 May 2009

Non-extensive Statistical Mechanics

Generalizing Boltzmann-Gibbs statistical mechanics

B.G. Statistics - A reminder.

- Entropy: $S = -k\sum_i \rho_i \ln \rho_i$
- Constraints: $\begin{cases} 1 = \sum_i \rho_i \\ U = \sum_i \rho_i \epsilon_i \end{cases}$

- Maximize the objective: $J = -k\sum_i \rho_i \ln \rho_i + \sum_i \rho_i + \beta \sum_i \rho_i \epsilon_i$ $\qquad \frac{\partial J}{\partial \rho_j} = 0$
- Yields distribution: $\rho_i = e^{-\beta \epsilon_i} / Z$ where $Z = \sum_i e^{-\beta \epsilon_i}$

Postulate: [C. Tsallis J. Stat. Phys. 52 p479 (1988)]

Generalized entropy:

$$S_q = k\frac{1-\sum_i \rho_i^q}{q-1} \qquad q \in \Re$$

where q characterizes the extensivity of the statistics.

Note: For q=1 regular B.G. Statistics is recovered:

$$S_{q\to 1} \to -k\sum_i \rho_i \ln \rho_i$$