



WMO Space Programme Activities

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Space-based Observing System division
WMO Space Programme
World Meteorological Organization, Geneva

Overview

1. Introduction

- WMO programmes
- Monitoring the atmosphere

2. The space-based Global Observing System

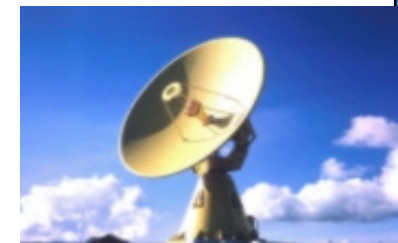
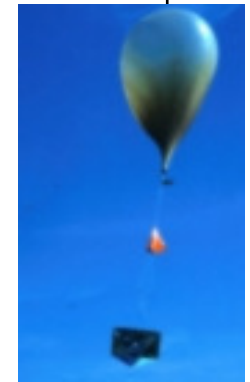
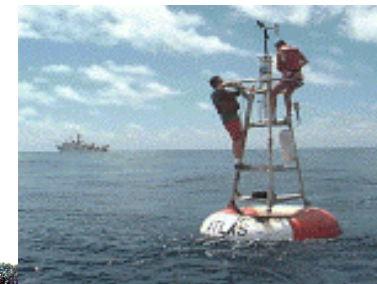
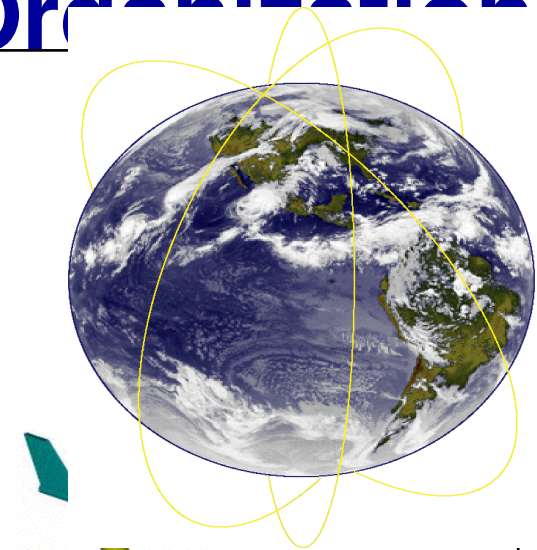
3. Spreading the benefits of space-based observations

- Data quality
- Data access
- User information and training

World Meteorological Organization

in

- Specialized organ in charge of weather related aspects of and disaster mitigation
- 188 Members (countries)
- Promotes cooperation
- Coordinates
 - Global observing system
 - Global Information system
 - Global Processing system (Requirements, procedures)
- Major components



WMO Programmes

World Weather Watch Programme

WMO Space Programme

Disaster Risk Reduction Programme

World
Climate
Programme

Atmospheric
Research
and
Environment
Programme

Applications
of
Meteorology
Programme

Hydrology
and
Water
Resources
Programme

Education and Training Programme

Technical Cooperation Programme

Regional Programme

*...and WMO-co-sponsored Programmes
(e.g. WCRP and GCOS)*

WMO Space Programme

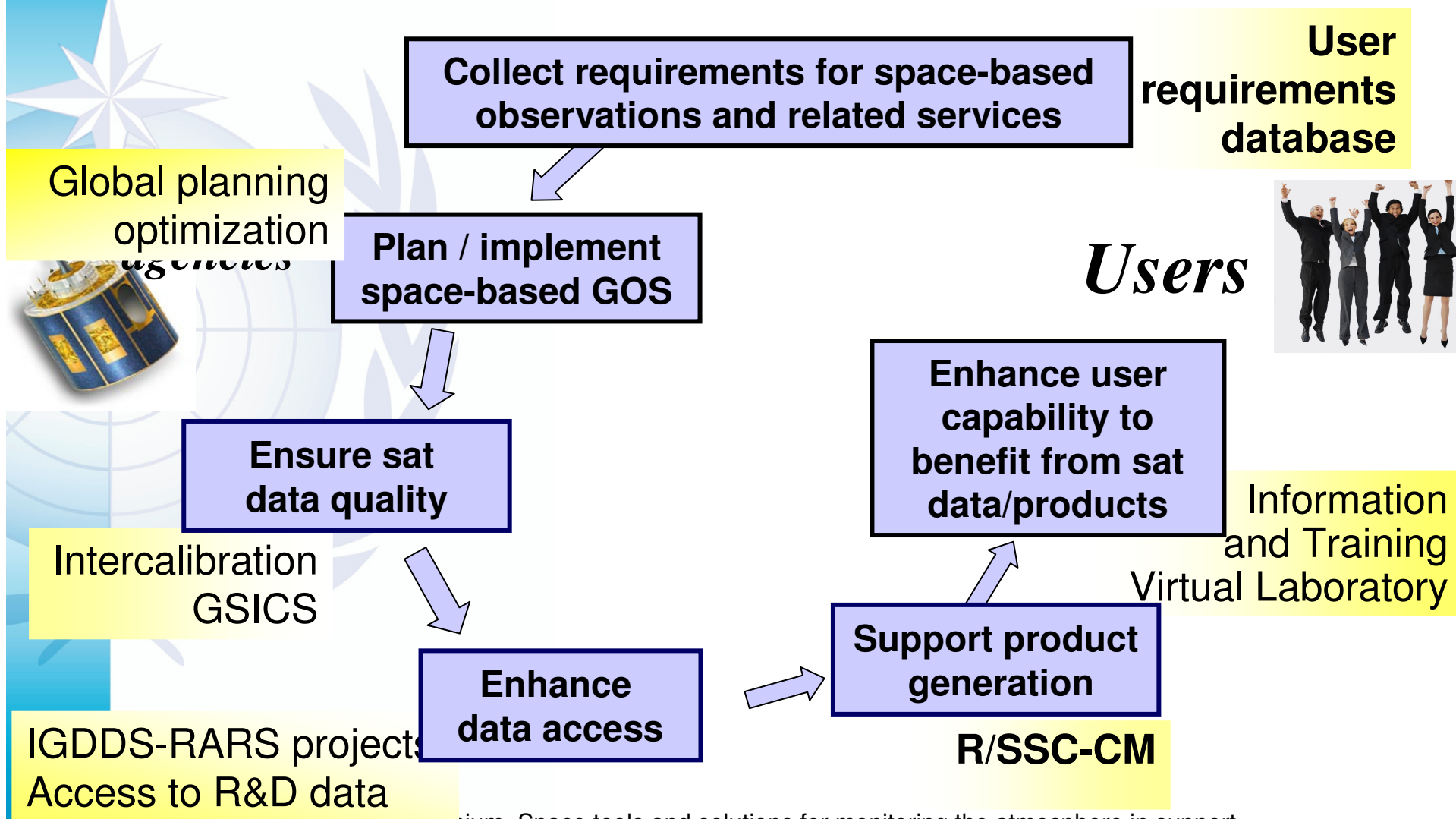
Coordinating environmental satellite matters within WMO

Two main goals :

- **Developing the space-based Global Observing System**
- **Promoting satellite data use worldwide for weather, water, climate and related applications**

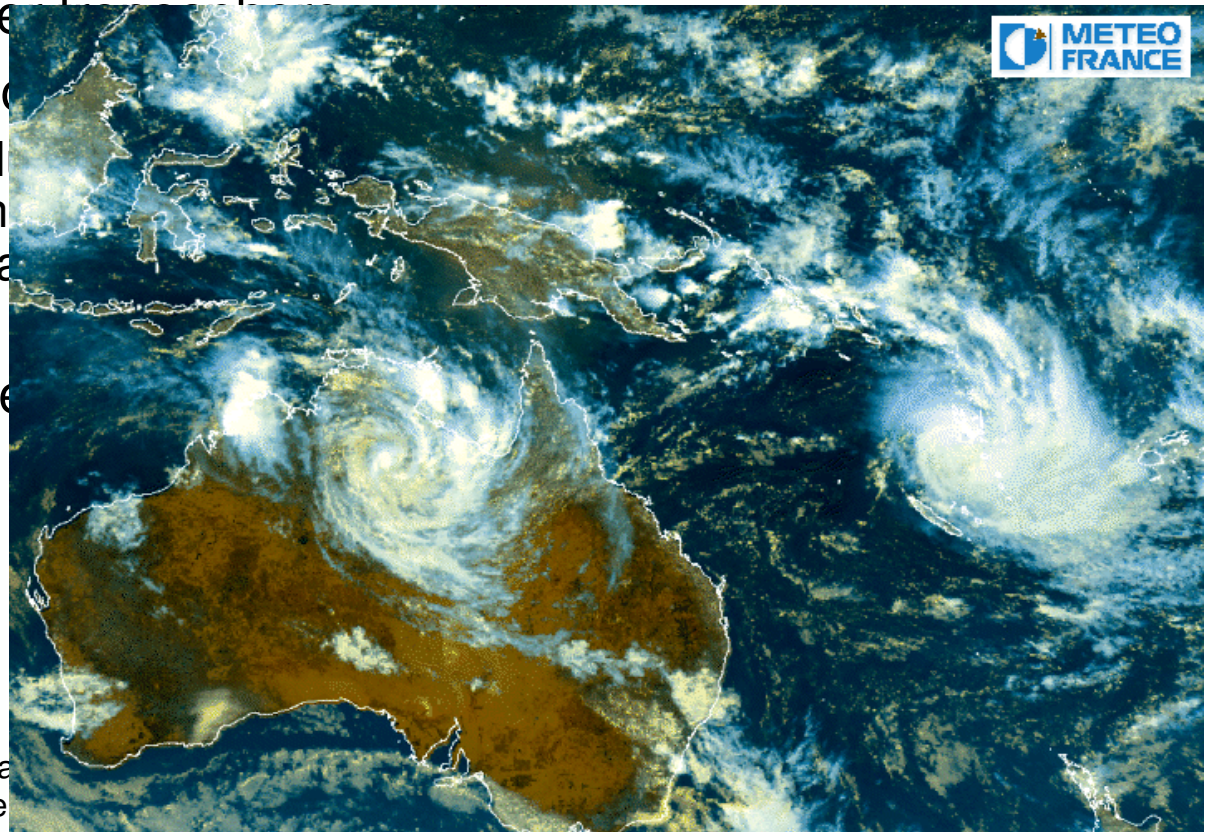
Main WMO Space Programme activities

involving WMO Members, their Space Agencies, and CGMS



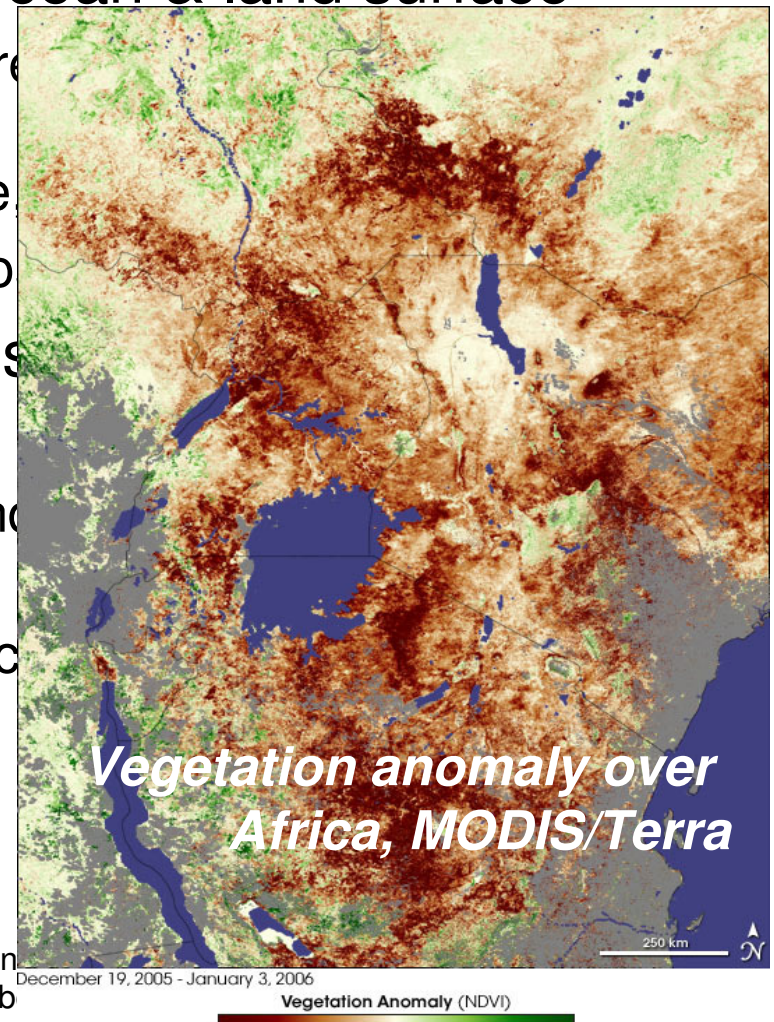
Monitoring the atmosphere: a priority for sustainable development

- Short-timescale: weather forecasting supports most human activities and management of natural resources
 - Weather-related disasters
 - Air quality in lower atmosphere
 - Long-timescale: climate change
 - Impact on evolution of natural resources and availability of natural resources
 - Sensitivity to natural resources
- ✓ All aspects above require satellite observations



Monitoring the atmosphere and land/ocean surface monitoring

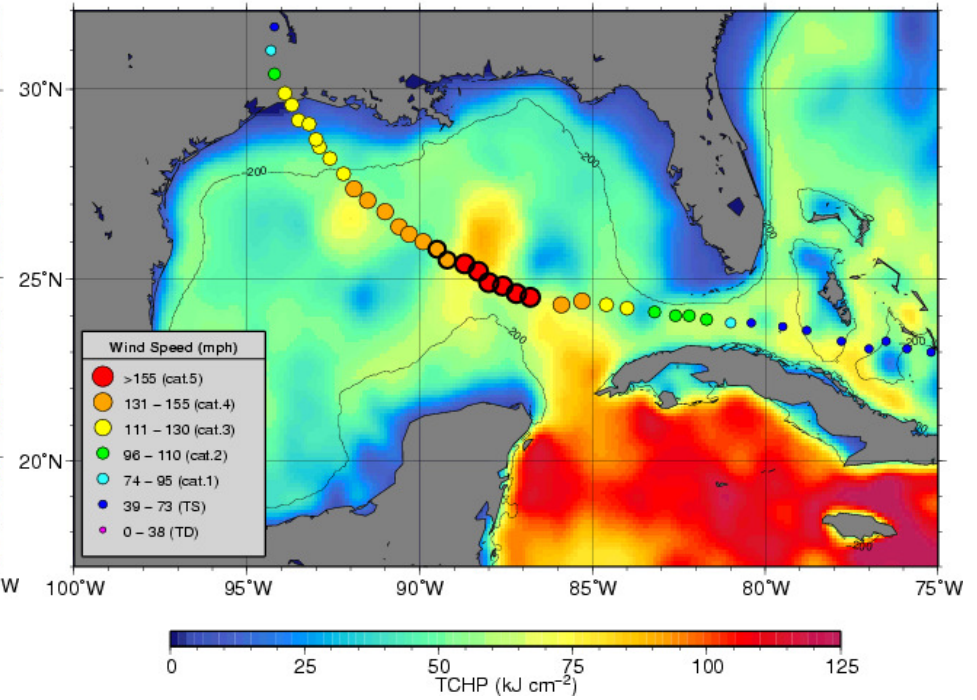
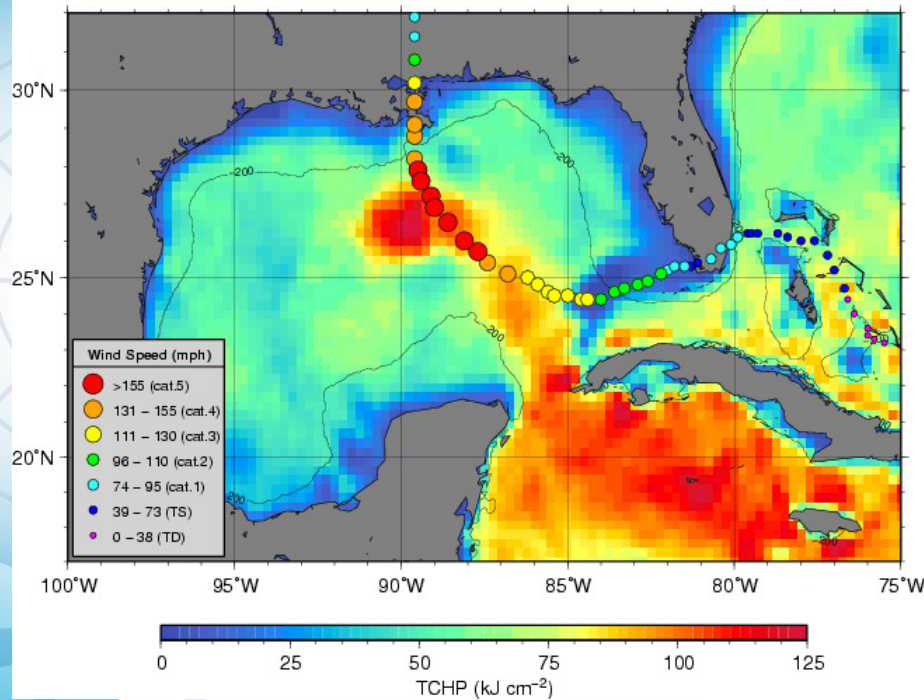
- Atmosphere is interacting with ocean & land surface
 - Boundary conditions for weather prediction: surface temperature, surface wind, vegetation status, snow/ice surface
 - Climate system involves ocean, bio
- Synergy in atmosphere/surface satellite observation
 - Common instruments for clouds and surface: VIS/IR/MW imagery
 - Atmospheric radiative transfer affects



Tropical Cyclone Heat Potential associated with Hurricanes Katrina and Rita

Gulf of Mexico – Tropical cyclone heat potential (TCHP) 08/28/2005

Gulf of Mexico – Tropical cyclone heat potential (TCHP) 09/22/2005



Figures courtesy of Gustavo Goni, NOAA/OAR/AOML

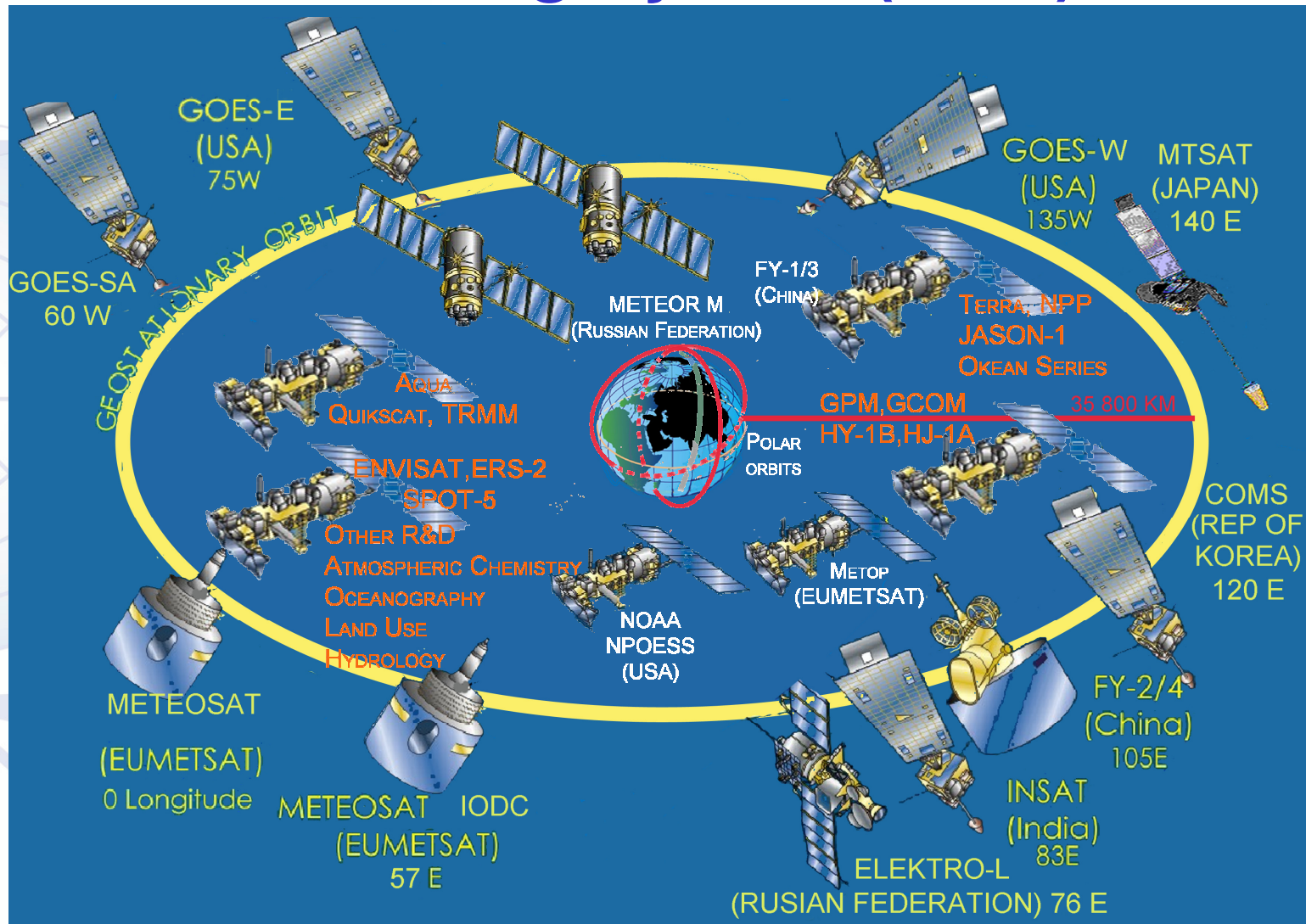
Based on NASA/CNES T/P & Jason-1, USN GFO, and ESA ENVISAT

UN/Austria/ESA Symposium, Space tools and solutions for monitoring the atmosphere in support of sustainable development, 11-14-September 2007, Graz

Overview

1. Introduction
2. The space-based Global Observing System
3. Spreading the benefits of space-based observations
 - Data quality
 - Data access
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Space-Based component of the Global Observing System (GOS)

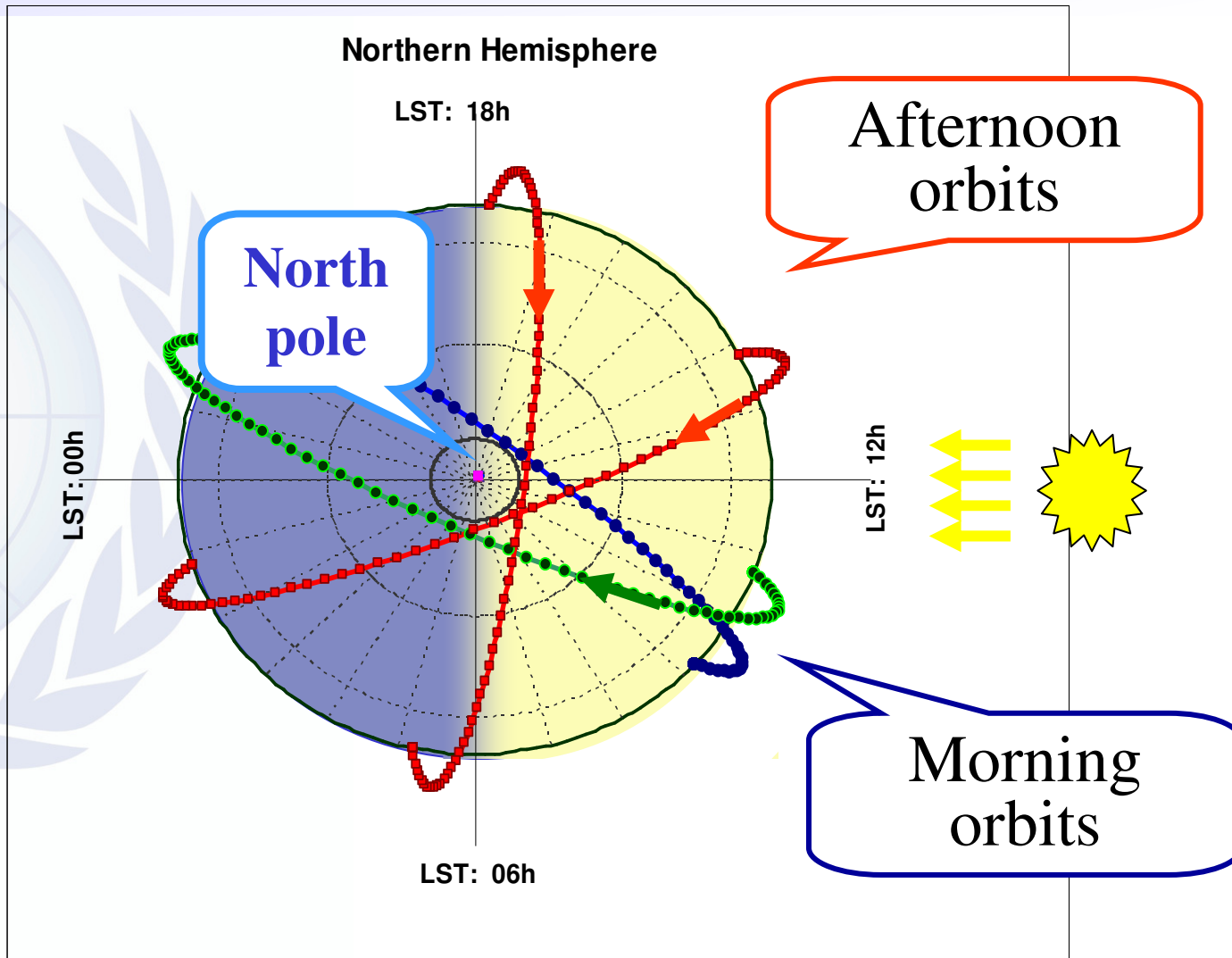


Evolution of the GOS to 2025: serving the needs of meteorology & climate

GOS re-design addressed by WMO with GCOS, the Coordination Group of Meteorological Satellites (CGMS) & Committee on Earth Observation Satellites (CEOS)

- Many R&D missions shall be continued on an operational basis (long-term commitment for continuity, wide data accessibility)
- Enhanced cooperation among space agencies to optimize global effort and ensure consistent data quality
- GOS will include various orbit types (inclination, altitude) adapted to specific missions

Optimized sun-synchronous IR/ MW sounding missions



An integrated GOS for operational meteorology & climate

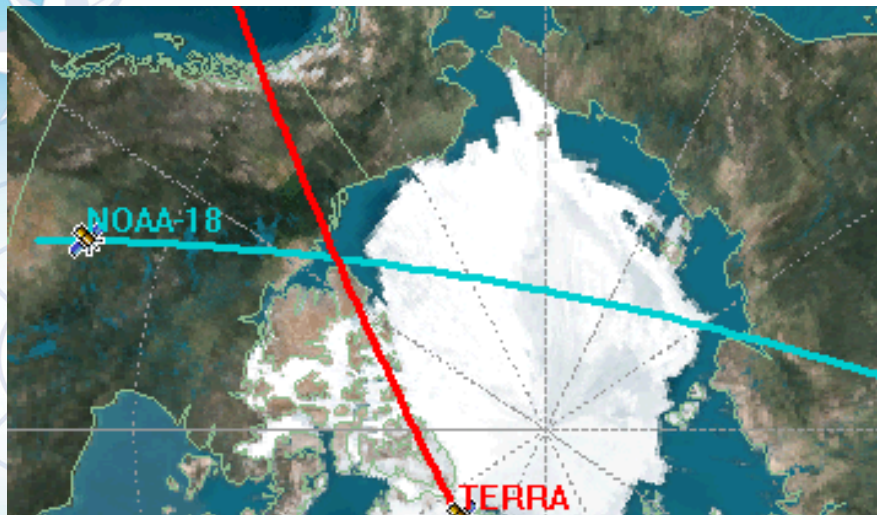
- Continue/enhance cloud and surface VIS/IR imaging
- Continue/enhance vertical IR/MW Temp/humid sounding
- Temp/Humid sounding by Radio-occultation constellation
- Ocean Surface Wind by scatterometer and MW imager
- Earth Radiation Budget (Top of Atmosphere)
- Ocean Surface Topography (radar altimeters)
- Atmospheric Composition (O₃, other GHG, aerosols)
- Global precipitation (radar and MW imagery)
- Ocean colour, vegetation

Overview

1. Introduction
2. The Global Observing System (space-based)
3. Spreading the benefits of space-based observations
 - Data quality
 - Data access
 - User information and training

Global Satellite Inter-Calibration System (GSICS)

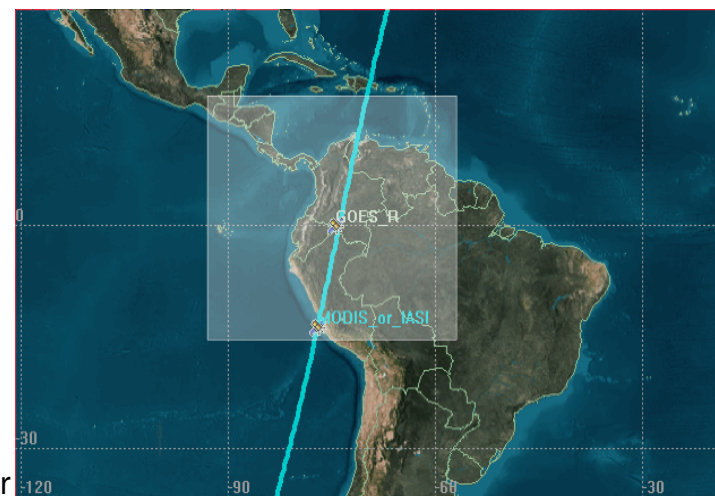
POLAR- POLAR intercalibration



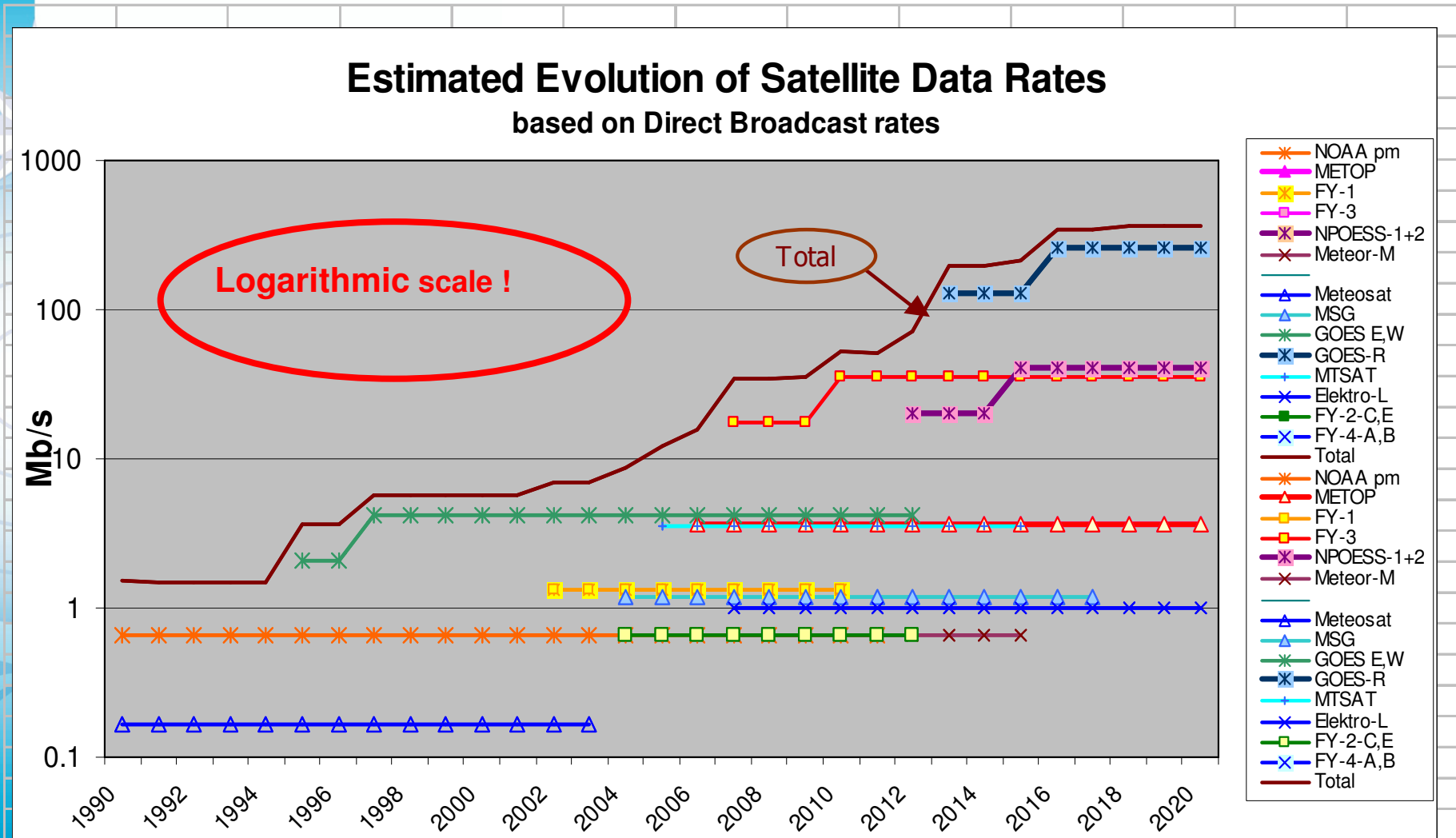
- To ensure consistency of datasets from different missions and operator

- Images: courtesy of Mitch Goldberg, NOAA/NESDIS

GEO versus Polar-orbiting

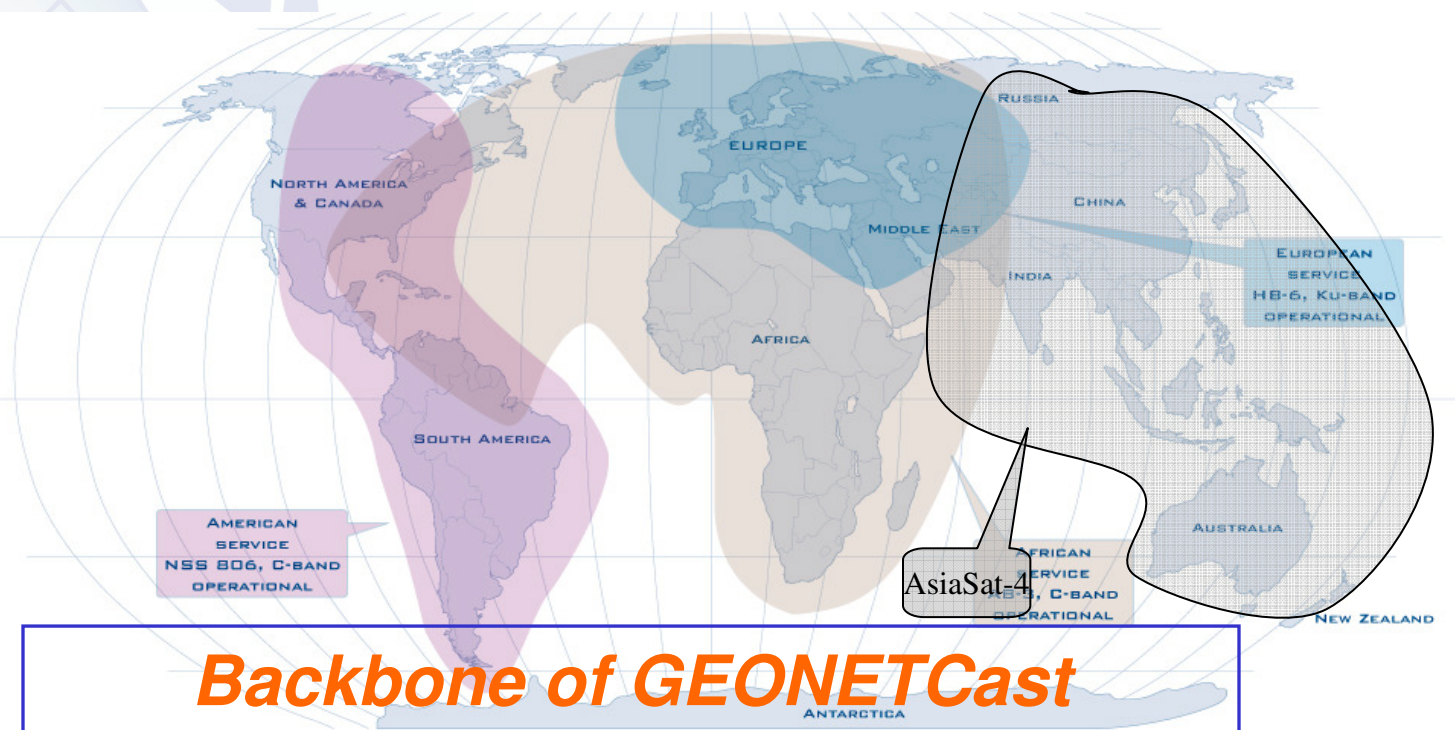


Data access



Near-real time dissemination by satellite broadcast (DVB/S)

- EUMETSAT's EUMETCAST covers Europe, Africa, the Americas
- ✓ NOAA might plan to continue over the Americas
- ✓ China's FengYunCast in Asia-Pacific expected to evolve into an operational component of IGDDS



User information

- [//www.wmo.int/pages/prog/sat/](http://www.wmo.int/pages/prog/sat/)
 - WMO Space Programme overview
 - Space-based Global Observing System
 - GEO, LEO, R&D satellites
 - Data formats, data access, products
 - Reference documents
 - Training centres
 - Schedule of events
 - Glossary
 - Links to agencies and other organizations

Training: Virtual Laboratory

- Nine “Centres of Excellence”
 - Kenya, Niger, Barbados, Costa-Rica, Melbourne, Nanjing, Oman, Argentina, Brazil
 - Sponsored by one or more space agencies
 - On-line Virtual Resources Library
 - Regional “Focus Group“ with regular on-line briefings
- High Profile Training Event in October 2006
 - Simultaneous inter-connected training events worldwide
 - Above 2000 participants involved
 - from 120 WMO Members
 - Demonstration of on-line briefing/distance learning

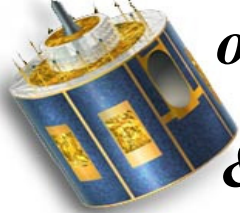
A comprehensive strategy to enhance the space-based Global Observing System and expand its benefits

Global planning
optimization
Inter-calibration

**Plan / implement
enhanced space-
based GOS**

User
requirements
database

*Satellite
operating
agencies
& CGMS*



*Users: all WMO
& co-sponsored
programmes*

**Enhance access
to sat data**

**Enhance users' capability
to benefit from satellite
data/products**

Integrated Global Data
Dissemination
Service

Product generation
Information: website and documents
Training events & Virtual Laboratory

Access to R&D data

and solutions for monitoring the atmosphere in support
ment, 11-14-September 2007, Graz



Thank you !



Additional slides

Planned GEO coverage in 2008

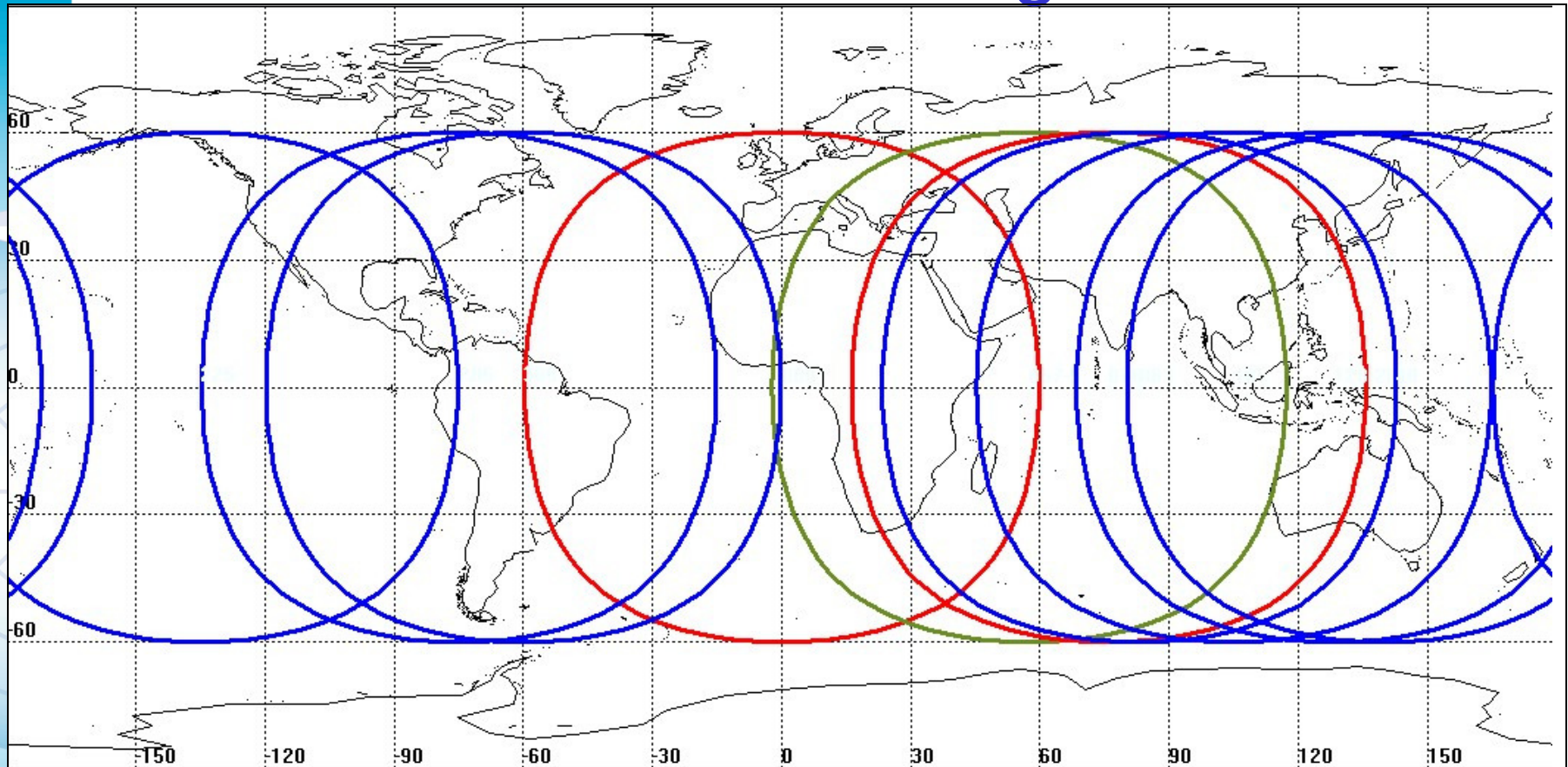
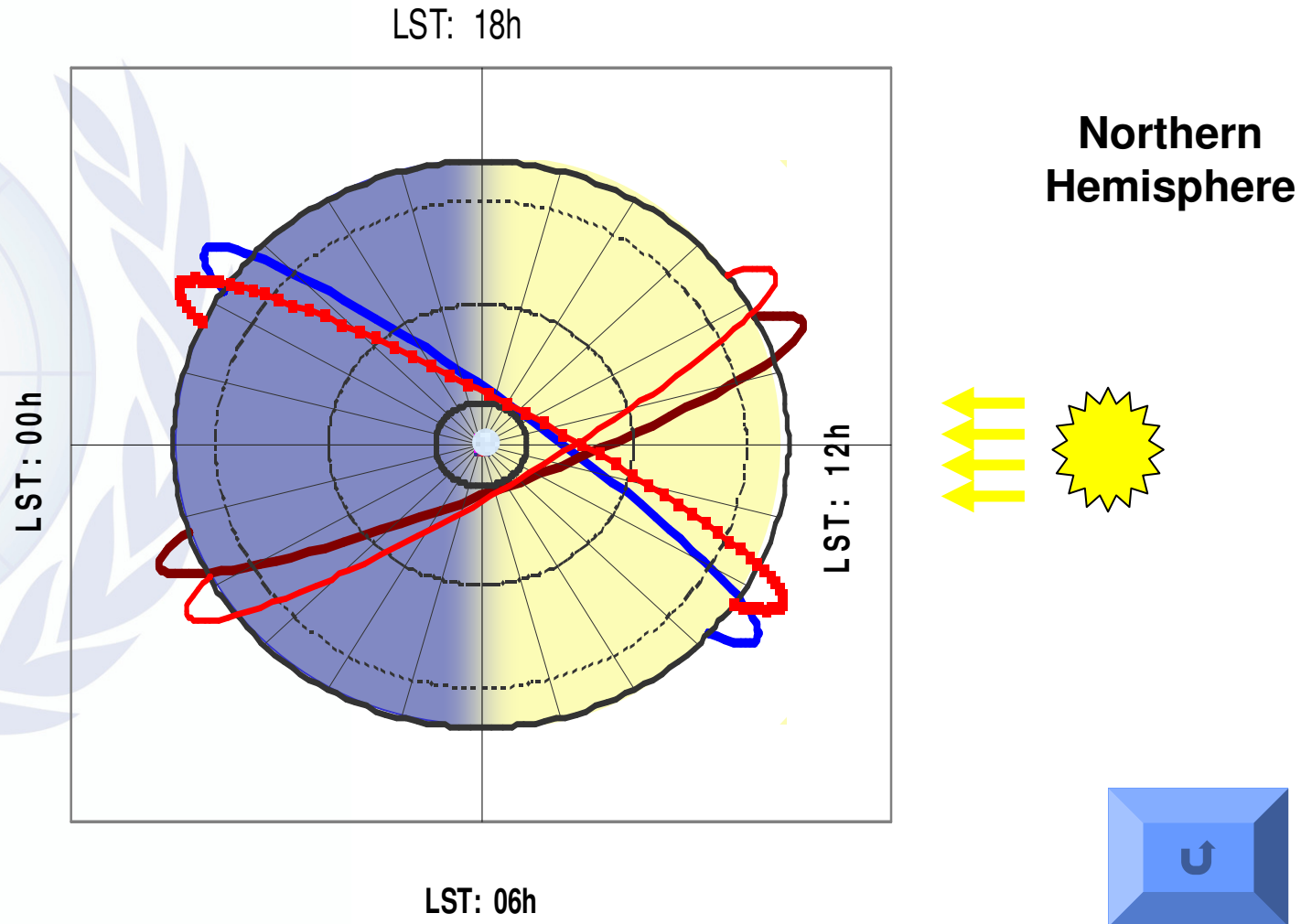
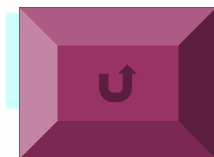
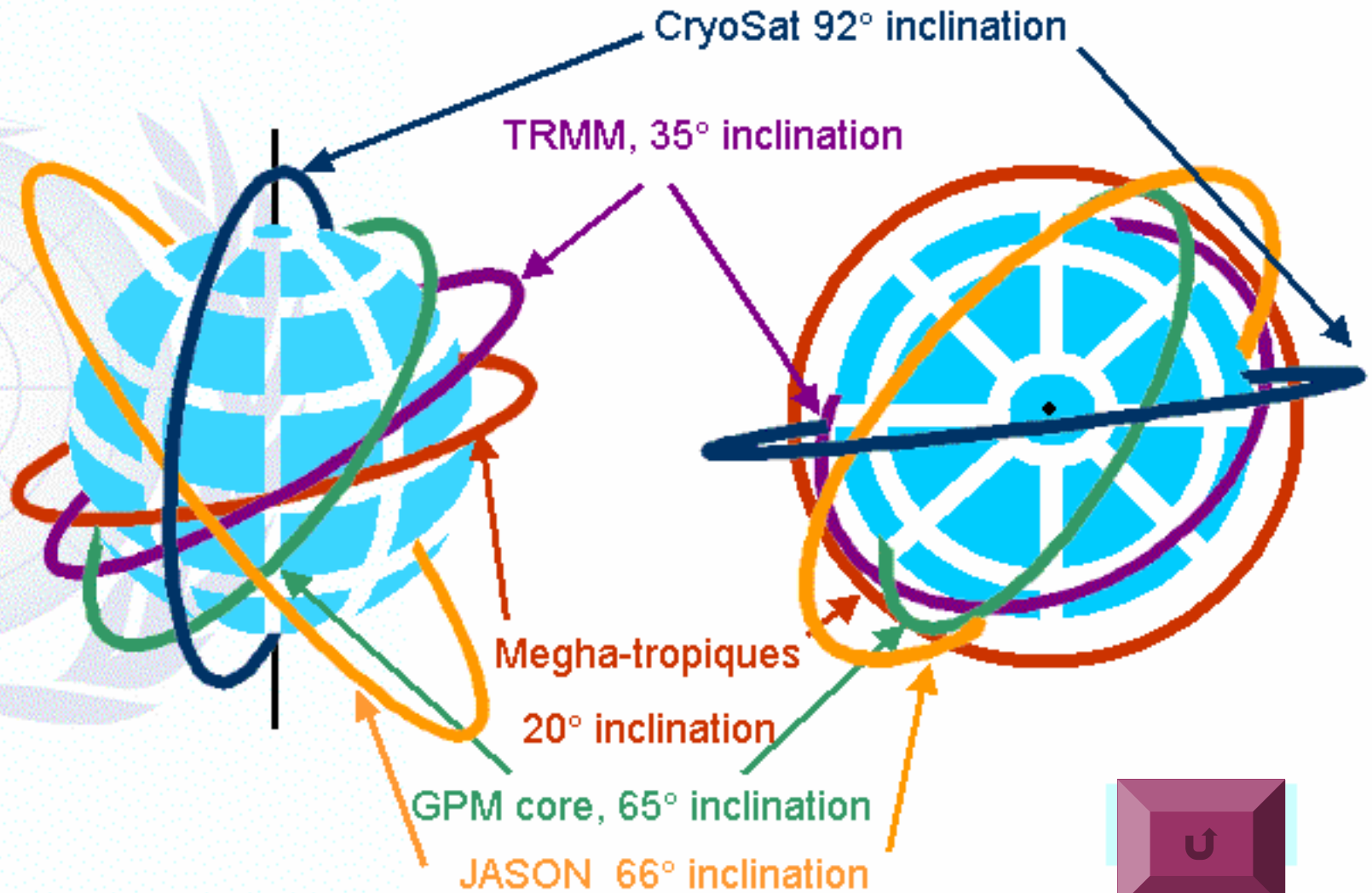


Fig. 2.9.2 – Coverage from operational geostationary satellites as expected in 2008. Satellites: GOES-13 (135°W), GOES-12 (75°W), GOES-10 (60°W), Meteosat-9 (0°), Meteosat-7 (57.5°E), Elektro-L-1 (76°E), INSAT-3D (83°E), FY-2C (105°E), COMS-1 (128.2°E) and MTSAT-1R (140°E). The figure also highlights the quality of the imager. Red: advanced imagers (Meteosat-9 SEVIRI, Elektro-L-1 MSU-GS); blue: 5-6 channel imagers (GOES 12/13 IMAGER, INSAT-3D IMAGER, FY-2C S-VISSR, COMS-1 MI and MTSAT-1 JAMI); green: 3 channel imagers (Meteosat-7 MVIRI). (from B. Bizzarri)

Planned sounding missions in sun-synchronous orbits in 2008-2020

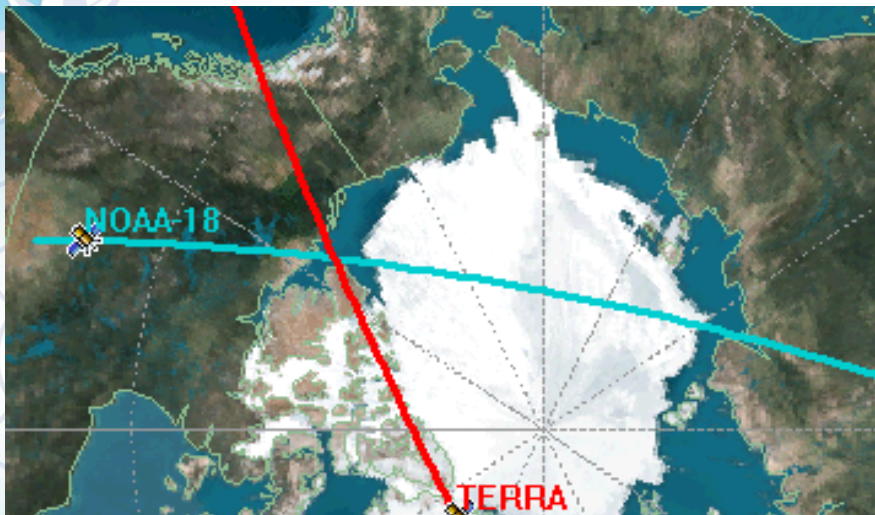


Non sun-synchronous LEO orbits



Simultaneous Nadir Overpass (SNO) Method a core function for GSICS

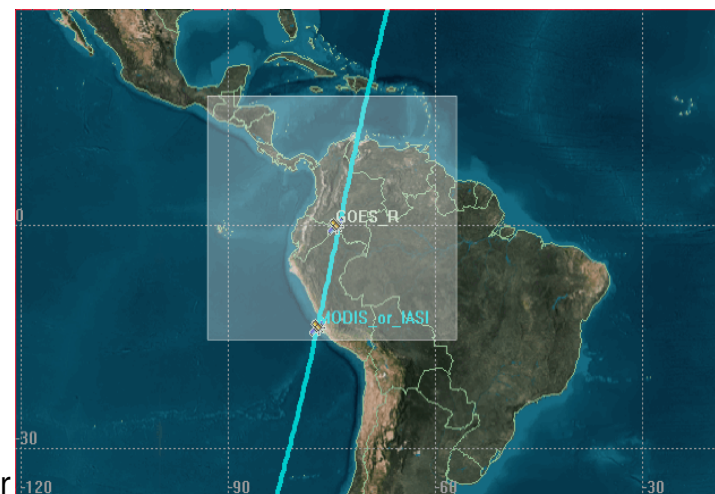
POLAR- POLAR intercalibration



- Unique capabilities developed at NESDIS
- Method has been adopted by other agencies, to be used operationally for GSICS

- Has been applied to microwave, VIS/NIR/IR radiometers for on-orbit performance trending and climate calibration support
- Capabilities of 0.1 K for sounders and 1% for vis/nir have been demonstrated in pilot studies

GEO versus Polar-orbiting





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WMO Space Programme



Programmes > Space

The WMO Space Programme is responsible for:

- **Coordinating environmental satellite matters within WMO**
- **Developing the space-based Global Observing System**
- **Promoting satellite data use for weather, water, climate and related applications**

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WMO Region	Centre of Excellence	Place, Country	Sponsoring Satellite Operator	Primary language
RA I	Institute for Meteorological Training and Research (IMTR)	Nairobi, Kenya	EUMETSAT	English
RA I	ASECNA, Ecole Africaine de la Meteorologie et de l'Aviation Civile (EAMAC)	Niamey, Niger	EUMETSAT	French
RA II & RA V	Nanjing Institute of Meteorology (CMA/NIM)	Nanjing, China	CMA	Chinese & English
RA II	Sultan Qaboos University, Remote Sensing and GIS Center (SQU/RSGIS)	Muscat, Oman	EUMETSAT, IMD	Arabic
RA III & RA IV	University of Costa Rica, School of Physics (UCR)	San Jose, Costa Rica	NOAA	Spanish
RA III	National Meteorological Service, & University of Buenos Aires	Buenos Aires, Argentina	NOAA	Spanish
RA III	National Institute for Space Survey (INPE)	Sao Jose dos Campos, Brazil	INPE	Portuguese
RA IV	Caribbean Institute for Meteorology and Hydrology (CIMH)	Bridgetown, Barbados	NOAA	English
RA V	Australian Bureau of Meteorology (BMTc)	Melbourne, Australia	JMA	English