WMO OMM

World Meteorological Organization

Working together in weather, climate and water

# WMO Space Programme: Update

Stephan Bojinski

Virtual Lab Management Group, 6th Meeting

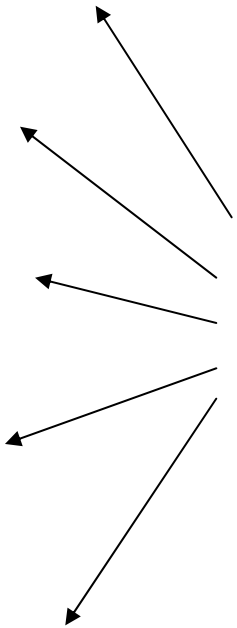
8-11 October 2012, São José dos Campos, Brazil

# World Meteorological Organization (WMO)


- Founded 1950, successor to IMO (1873)
- Specialized agency of the United Nations for meteorology (weather and climate), operational hydrology and related geophysical sciences (e.g., atmospheric chemistry, oceanography, agriculture);
- UN “authoritative voice”
- 189 Member states and territories; “Permanent Representatives”
- Promote, foster, facilitate world-wide cooperation, with a focus on National Meteorological and Hydrological Services

# World Meteorological Organization

1. Earth observation
2. Data exchange
3. Common standards
4. Integration, analysis, modelling
5. Weather, climate and related services



- Technical Cooperation
- Education and Training

# WMO Programmes

| | |
|---|---|
| World Weather Watch Programme | Marine Meteorology and Oceanography Programme |
| Global Atmosphere Watch Programme | WMO Quality Management Framework |
| World Weather Research Programme including THORPEX | Information and Public Affairs Programme |
| Hydrology and Water Resources Programme | Voluntary Cooperation Programme |
| World Climate Programme | Education and Training Programme |
| World Climate Research Programme | WMO Programme for the Least Developed Countries |
| WMO Space Programme | Regional Programme |
| Public Weather Services Programme | Disaster Risk Reduction Programme |
| Agricultural Meteorology Programme | Aeronautical Meteorology Programme |
| Tropical Cyclone Programme | |

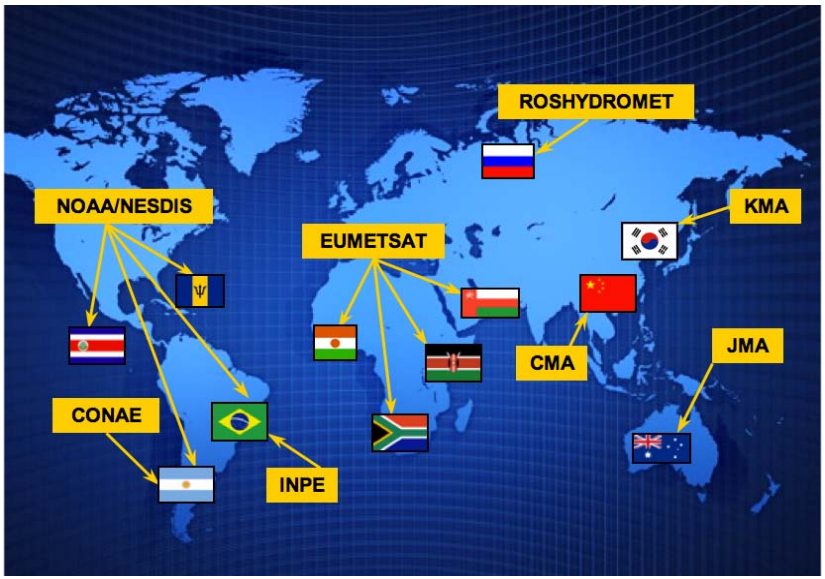
+ Co-sponsored Programmes: GCOS, GOOS, GTOS, IPCC, …

# WMO High-level Priorities 2012-2015

- Global Framework for Climate Services (GFCS)
- Integration of observation/information systems (WIGOS/WIS)
- Disaster risk reduction
- Support to Aviation
- Capacity building

(from WMO Strategic Plan 2012-2015)

# WMO-CGMS VLab: Education and Training, Capacity building




**A network of Centres of Excellence sponsored by satellite operators**

■ To provide training on meteorological and environmental satellite systems, data, products and applications;

■ To foster research and the development of applications for societal benefit at the local level by the NMHS.

# VLab CoE Establishment Procedure

- Procedure for establishing Virtual Laboratory Centres of Excellence for Training in Satellite Meteorology http://vlab.wmo.int (updated Jan 2012):
  - Expectations for Centres of Excellence
  - Expectations for supporting satellite operators
  - Expectations for WMO, CGMS
  - Procedural steps

# WMO 15th Congress (2011)

- Welcomed VLab expansion to 12 CoEs, allowing satellite training in all WMO languages and Regions
- Welcomed VLab widening its scope and audience, through partnerships
- Encouraged satellite operators to organize **Regional** Meteorological Conferences (including EUMETSAT, Asia/Oceania, GOES-related) to raise **regional** satellite user awareness and capacity

# VLab Management Group

- The Vlab Management Group reports to WMO and CGMS
- Meetings in Darmstadt (2001), Barbados (2003), Boulder (2007), Langen (2008), Beijing (2010), São José dos Campos (2012)
- Virtual meetings : 3 times a year

VLMG-5 meeting, Beijing, 2010

Two Co-chairs, currently:

- Kathy-Ann Caesar, CIMH, Barbados

- Volker Gärtner, EUMETSAT

Technical Support Officer:

- Luciane Veeck

# VLab 5-year strategy (2009)

- Initial focus on education and training for satellite meteorology
- To expand to:
  - Climate
  - Disaster support (e.g., Fires)
  - Marine applications
  - Land applications
  - Hydrology
  - Atmospheric chemistry, air quality, dust
  - Environment
- Taking advantage of:
  - Technical progress, use of satellite data in combination with radar, NWP, lightning, in-situ obs
  - Shared resources
  - New satellite systems (operational, R&D)
  - Partnerships with other institutes
- Implementation Plan
- <u>For discussion under item 17 on Thursday</u>

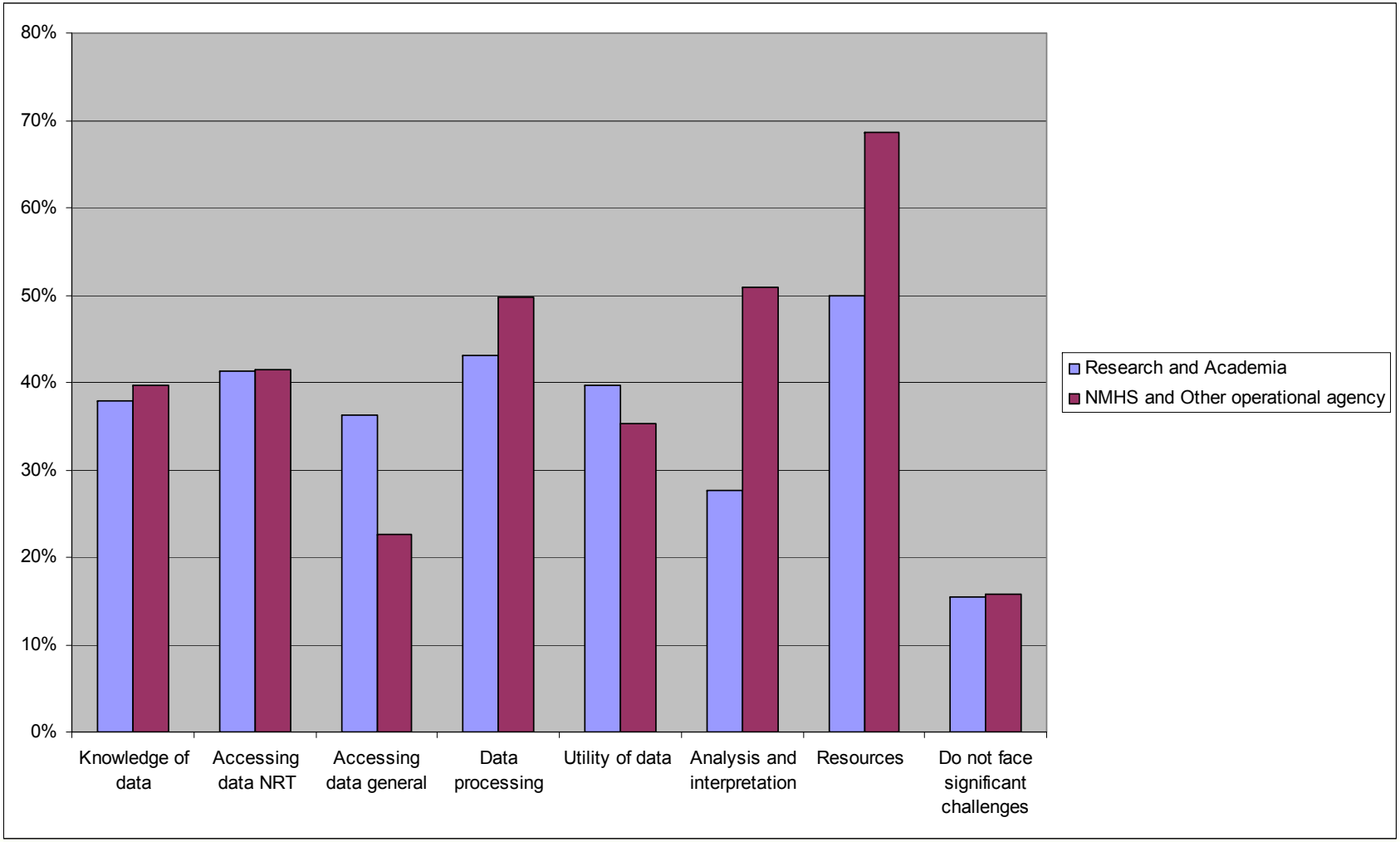
# WMO: Other VLab News

- Sustained funding mechanism for VLab TSO established, in partnership with CIRA / Colorado State University, USA
  - Dependent on annual contributions to WMO Trust Fund by satellite agencies in CGMS
  - KMA, NOAA/NESDIS and EUMETSAT contribute in 2012-13
- Translation (Fr, Ru) of COMET MetEd Environmental Satellite Resource Center website
- WMO-COSPAR partnership established
- Candidature of CoE Morocco (DMN, Casablanca) approved by WMO Commission for Basic Systems

# WMO Global Survey on Use of Satellite Data 2012

- 227 responses from 96 countries
- First indicate that:
  - Satellite image interpretation
    - 48% receive training, 18% have unmet training needs
  - Satellite product utilization and interpretation
    - 38% receive training, 30% have unmet training needs
  - Preparation for new generation of satellites
    - 22% receive training, 38% have unmet training needs, 10% do not see a training need

# WMO Survey 2012: Challenges in using satellite data

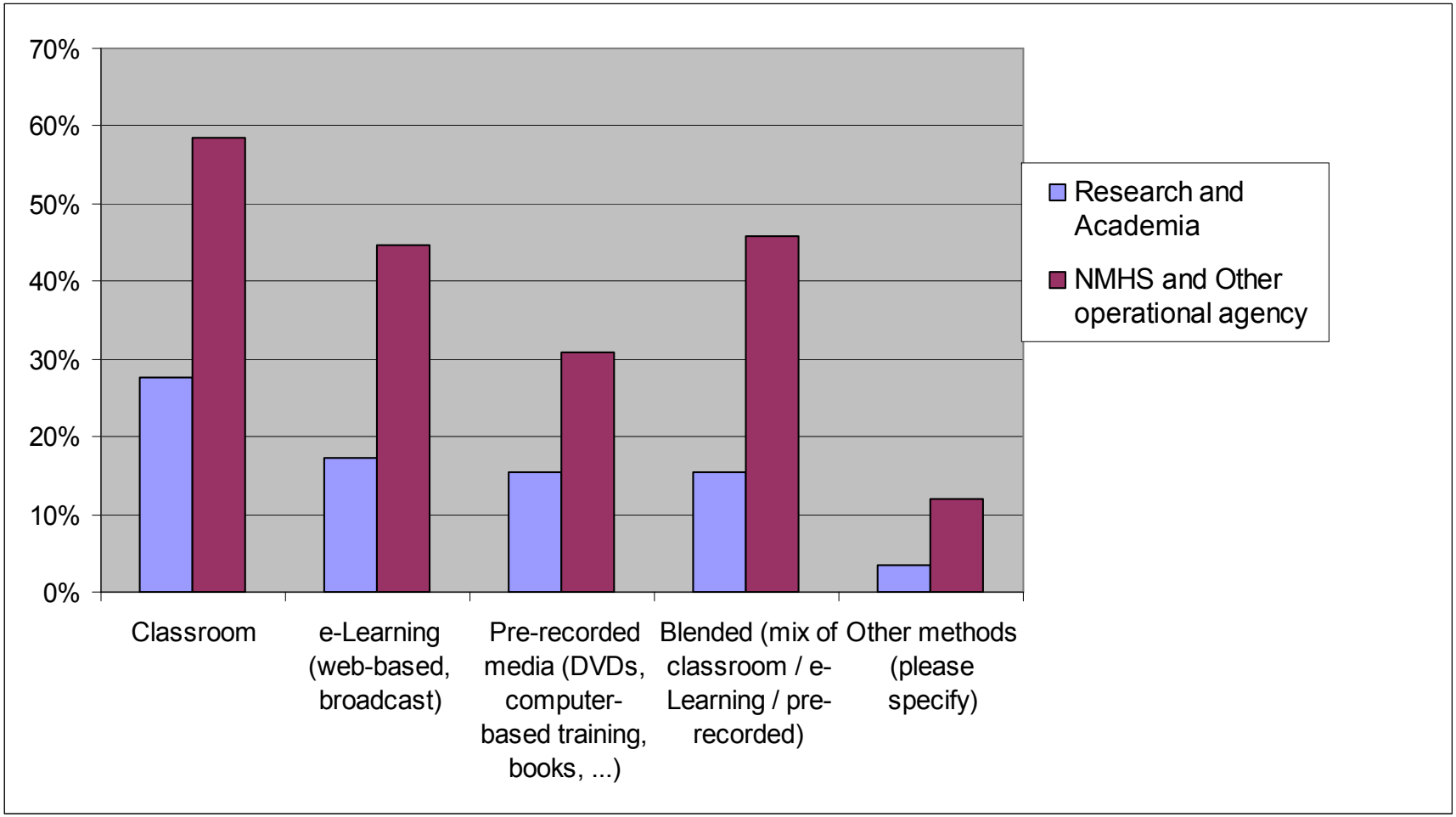


# WMO Survey 2012: Training needs

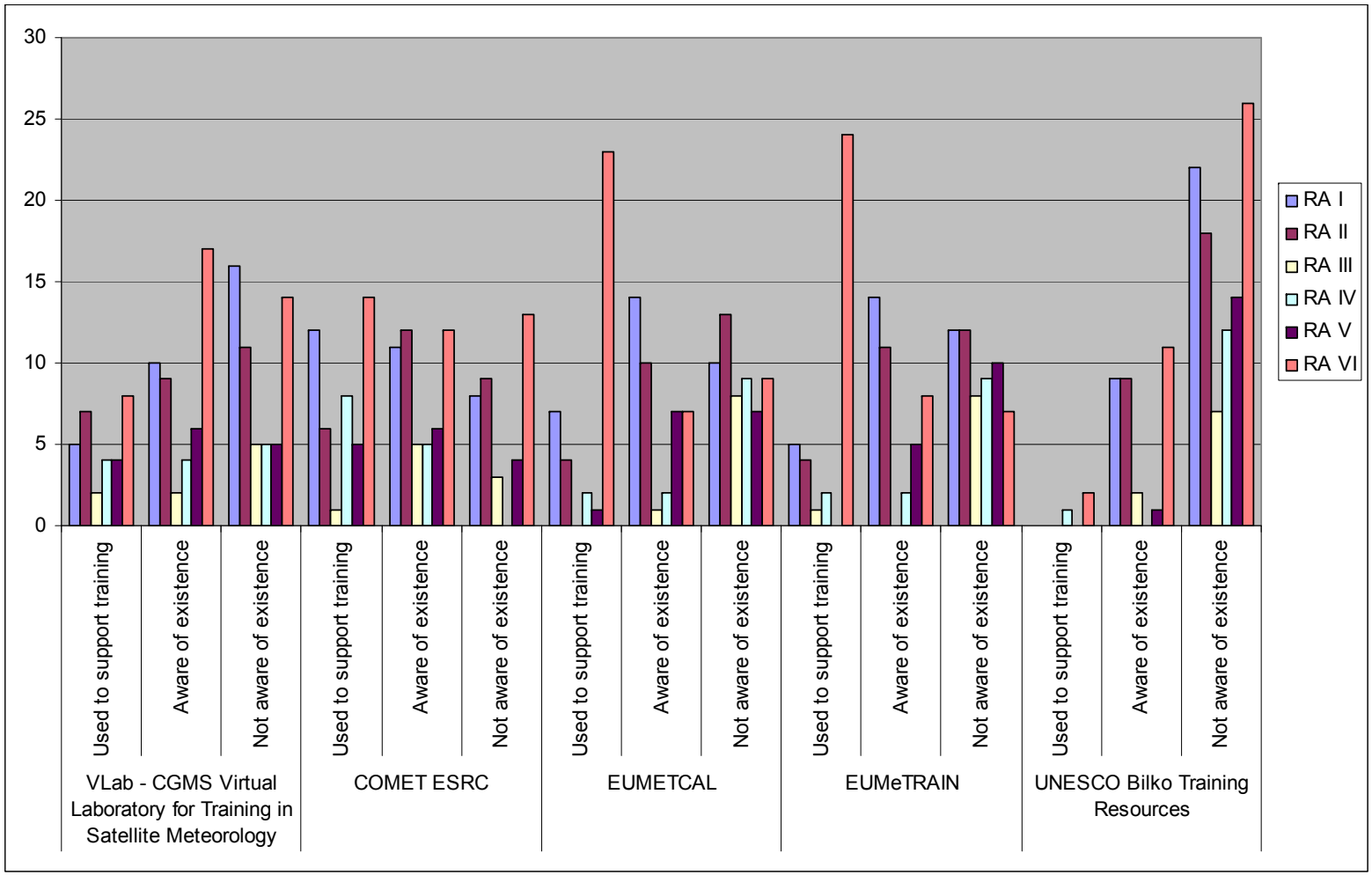
**Table 11: Area where training is needed but not delivered for NMHSs and other operational agencies (regional breakdown)**

| WMO Region | NMHSs and other operational agencies | | | | | | |
|---|---|---|---|---|---|---|---|
| | Total responses | Equipment operation & maintenance | Image interpretation | Use of software tools | Product utilization and interpretation | Physical basis for remote sensing | Preparation for new generation satellites |
| RA I | 32 | 11 | 7 | 15 | 14 | 14 | 17 |
| RA II | 27 | 5 | 3 | 8 | 6 | 7 | 13 |
| RA III | 10 | 4 | 5 | 6 | 7 | 4 | 6 |
| RA IV | 21 | 4 | 5 | 8 | 6 | 5 | 8 |
| RA V | 16 | 9 | 6 | 11 | 10 | 10 | 13 |
| RA VI | 53 | 13 | 9 | 16 | 15 | 14 | 19 |
| All | 159 | 46 | 35 | 64 | 58 | 54 | 76 |

# WMO Survey 2012 : Methods to deliver training



# WMO Survey 2012: Knowledge of distance learning (NMSs)



# WMO Survey 2012 : Other methods to deliver training

- On the job training (e.g., at forecasters' desk)
- "send emails to marvellous satellite data team who always answer them right away"

→ Full Survey report available in Jan 2013

# Thank you for your attention


http://www.wmo.int/sat

# Backup Slides

# Global Observing Systems

Space-based or surface-based remote sensing and in-situ measurements

WMO observing systems:

- Global Observing System (GOS)
- Global Atmospheric Watch (GAW)
- WMO Hydrological Cycle Observing System (WHyCOS)
- Future Global Cryosphere Watch (GCW)

Co-sponsored systems:

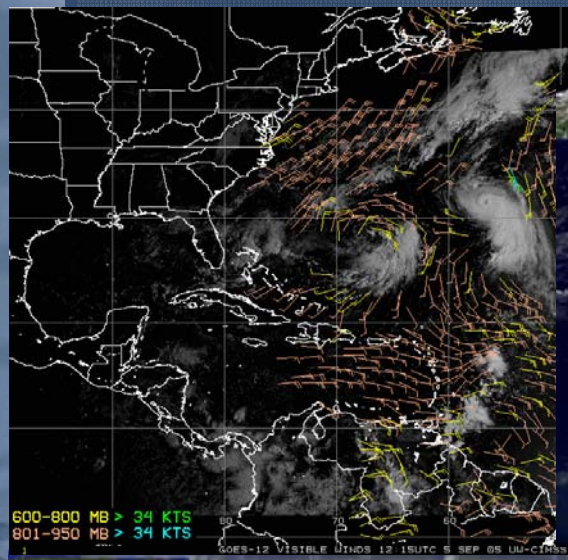
- GOOS (Ocean monitoring)
- GTOS (Terrestrial monitoring)

*(GCOS includes GAW, GOS, GOOS, GTOS)*

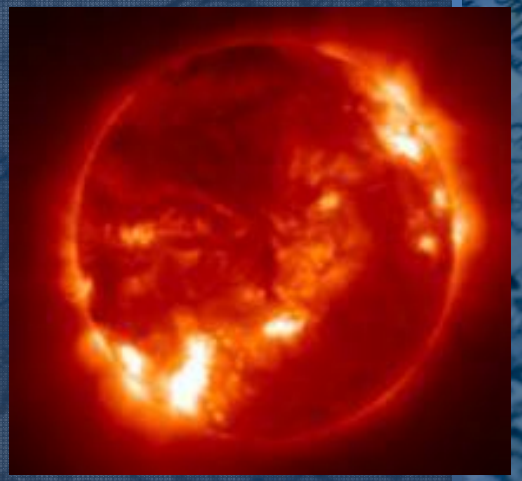
# Can't Imagine Life Without Satellite Data

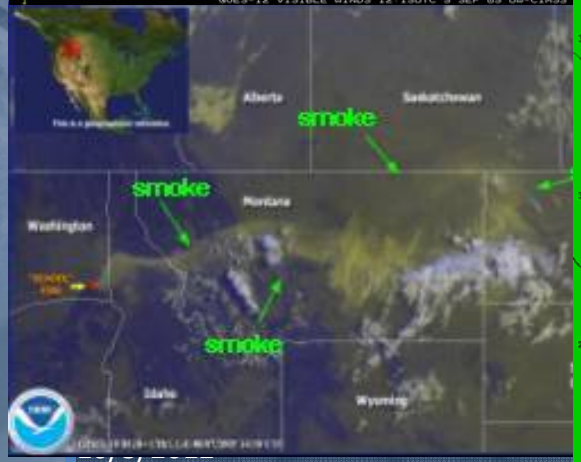
Sustained Real-time Observations of the Atmosphere, Oceans, Land and Sun vital to NOAA Operations and Research

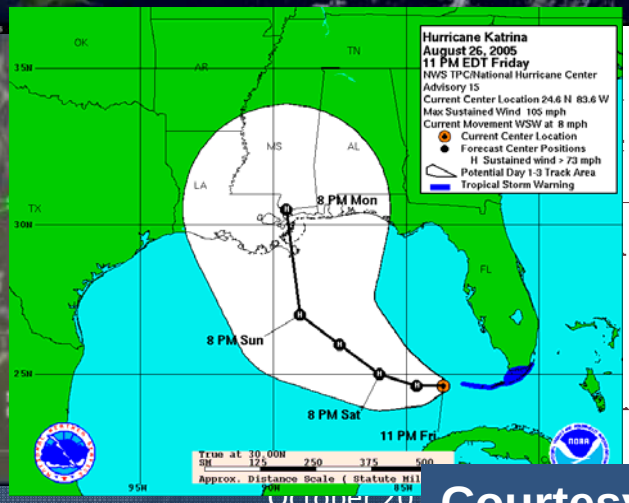
NWS SCIENCE AND TECHNOLOGY

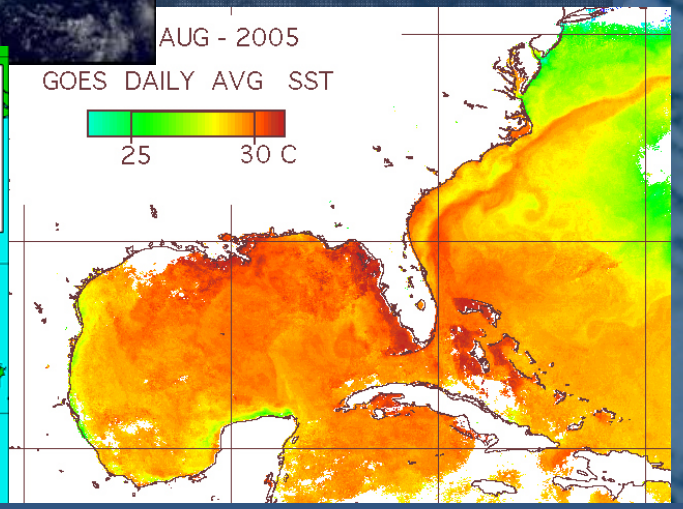








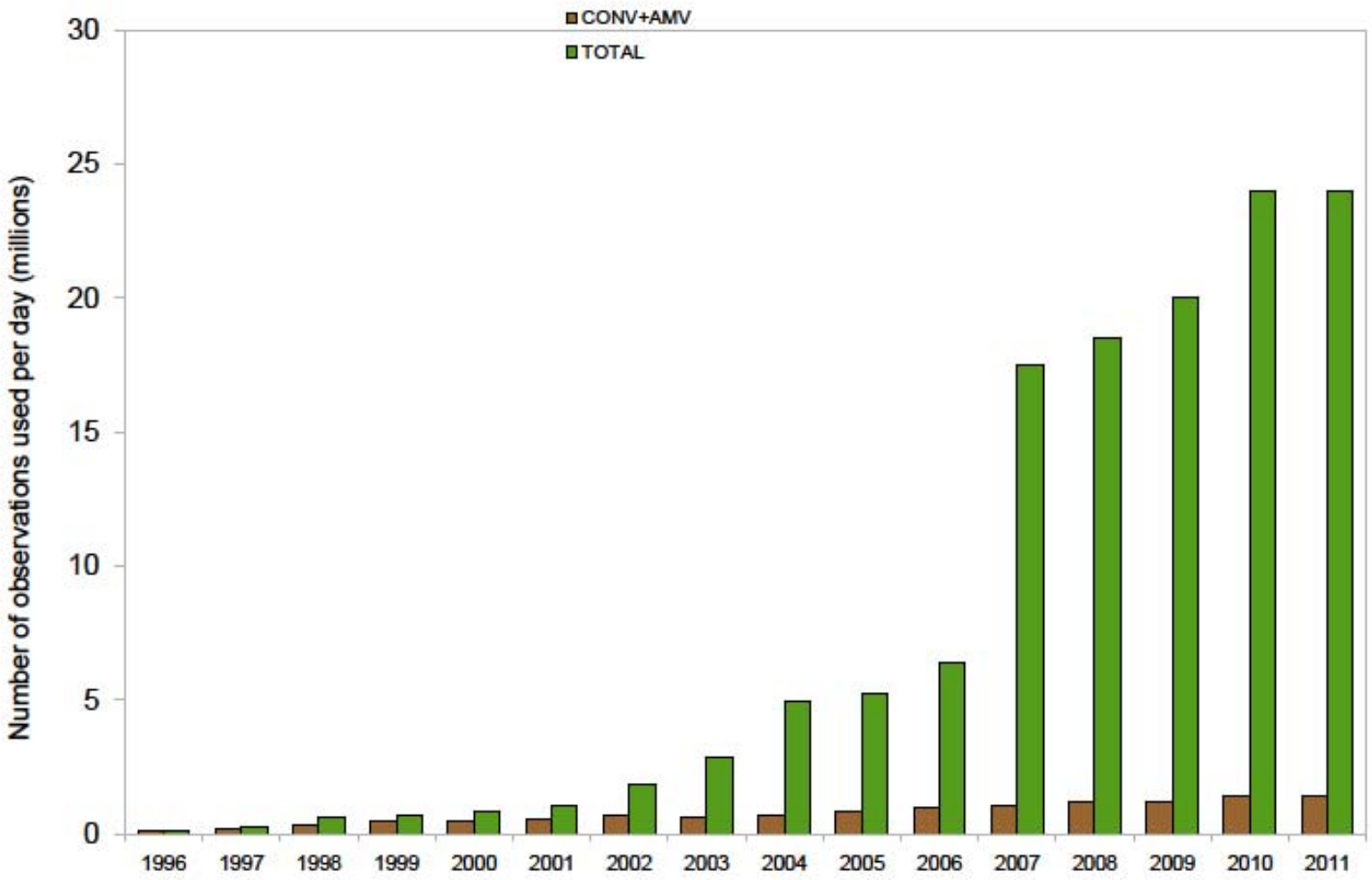




October 20

Courtesy of Don Berchoff, OST, USA

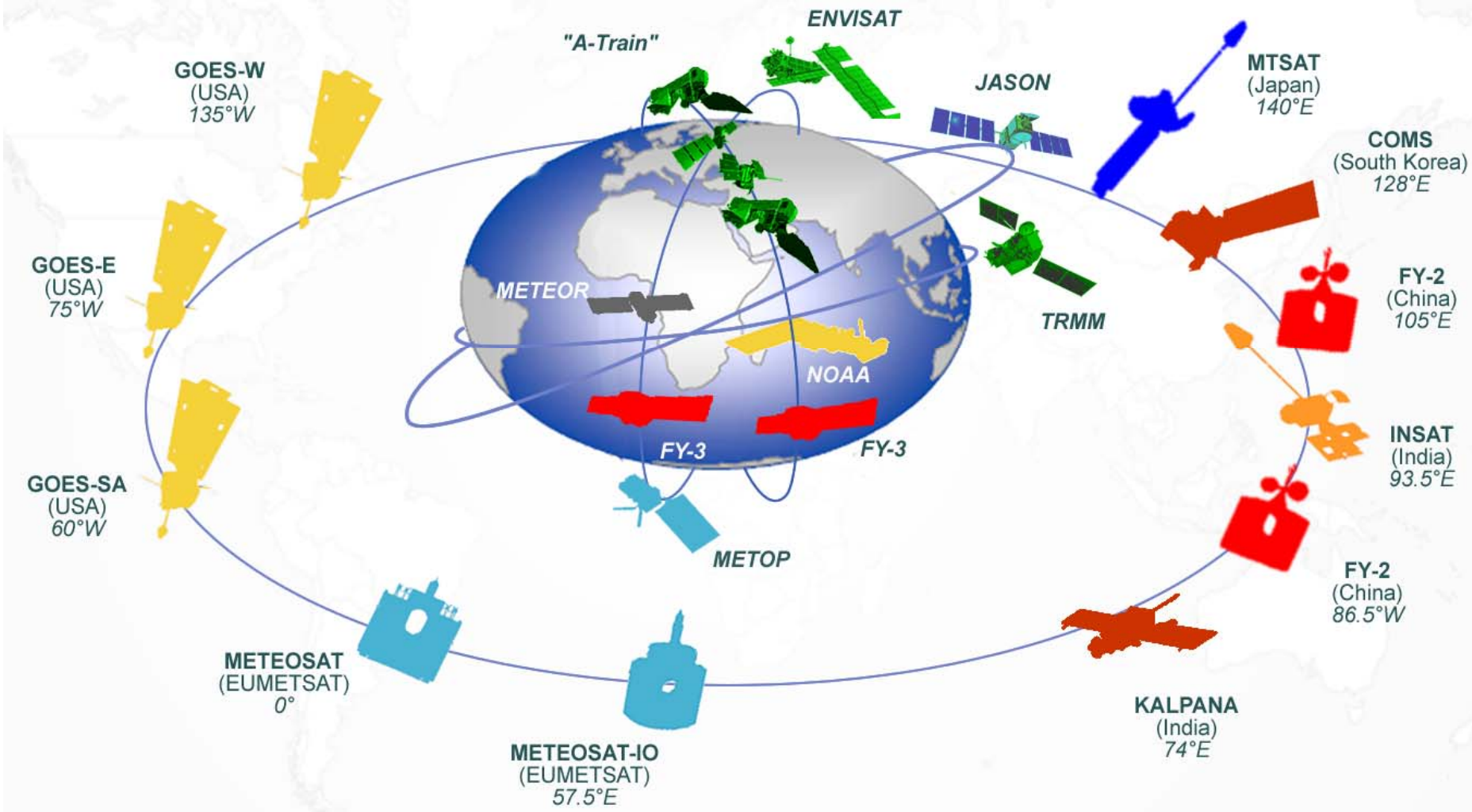
# Compared number of satellite/conventional observations used by ECMWF (millions per day)



# Space Programme goals

"To promote wide availability and utilization of satellite data and products for weather, climate, water and related applications of WMO Members"

# Space-based Global Observing System Schematic




São dos ...s, ...il, ...2

# Space-based Global Observing System

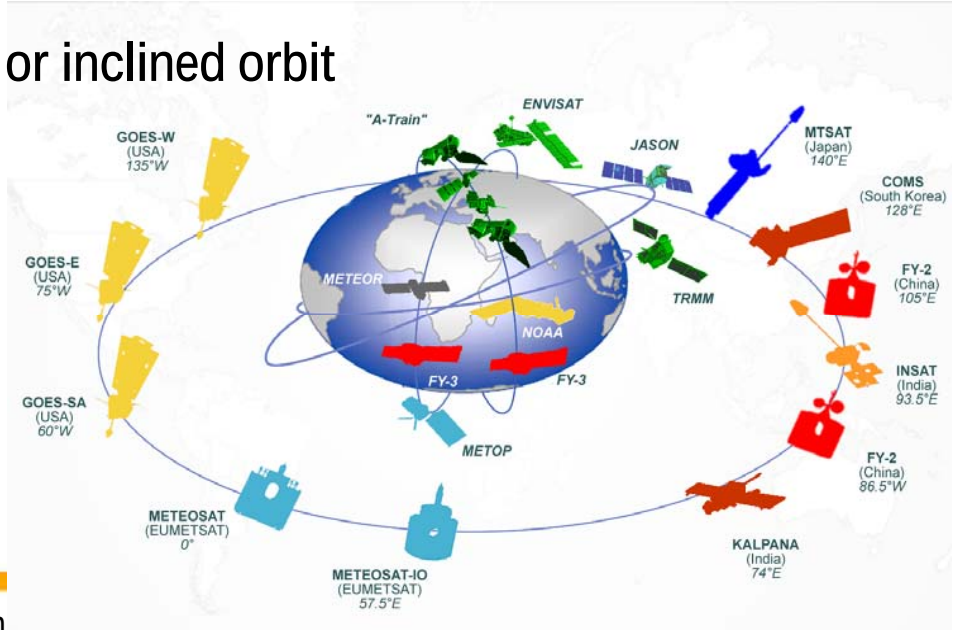
(June 2012)

- **12 operational geostationary satellites** (plus back-up)
  for permanent weather watch with quasi-global coverage
  *USA (3), EUMETSAT (3), China (2), India (2), Japan, Rep. Korea*

- **6 operational sun-synchronous** (plus back-up)
  global VIS/IR/MW imagery, IR/MW sounding, scatterometry, GNSS radio-occultation
  *USA (3), China (2), EUMETSAT*

- **~ 30 R&D satellites in sun-synchronous or inclined orbit**
  for land/ocean surface, O3, GHG, clouds, aerosols, radiative balance,altimetry, GNSS RO, precipitation radar

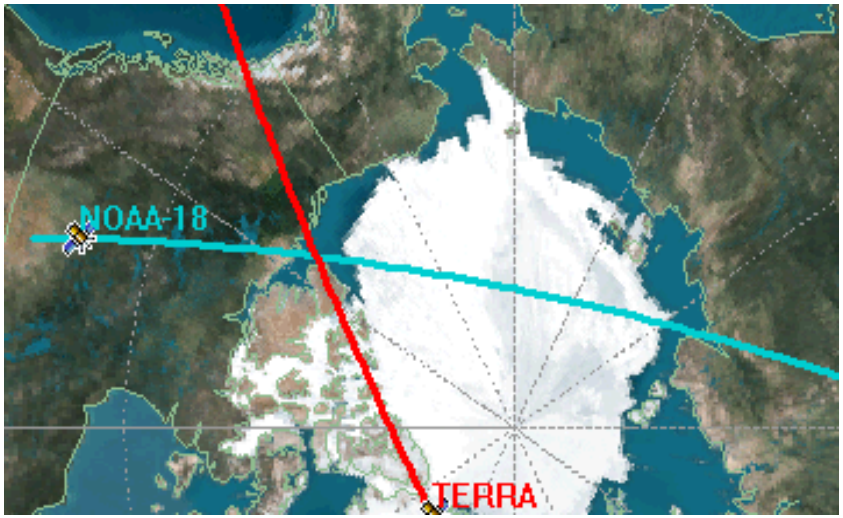
- **More than 50 satellites in operational service, carrying more than 120 instruments**



# Global Space-based Inter-calibration System (GSICS)

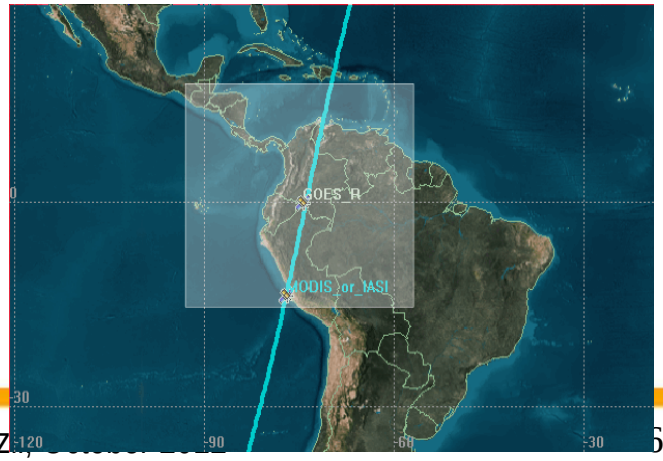
CMA-CNES-EUMETSAT-IMD-ISRO-JAXA-JMA-KMA-
-NOAA-NASA-NIST-Roshydromet-USGS-WMO

*LEO-LEO intercalibration*



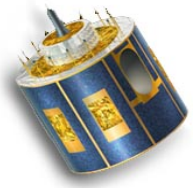

- Routine IR inter-calibration against IASI and AIRS on simultaneous overpass
- VIS and MW calibration under development

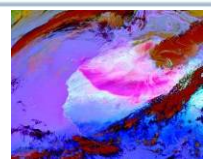
*GEO versus LEO*



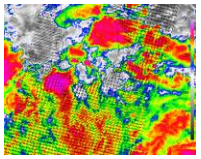

More on: http://gsics.wmo.int

# Strategy towards effective use of satellite data





- *Satellite observation capability*
- Sustained and quality-controlled products
  - Cooperative development and validation
  - Sharing products based on community requirements



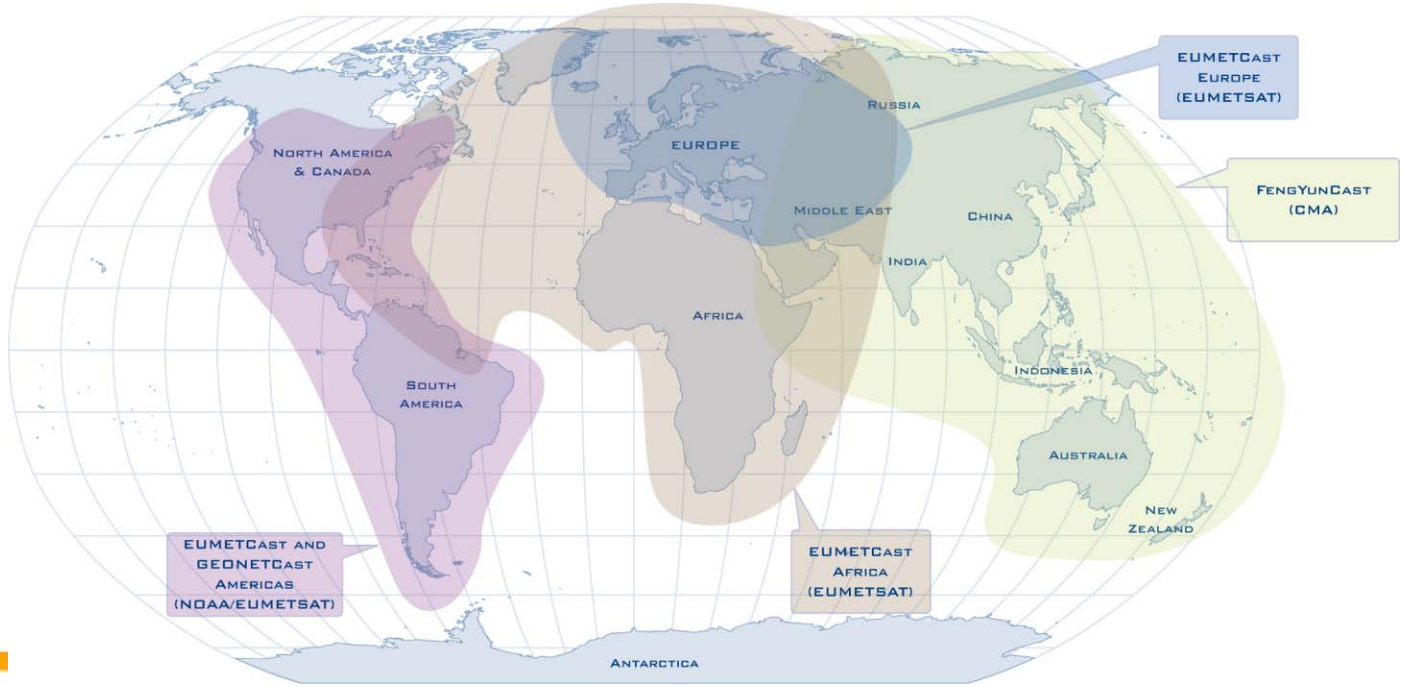
- Data access systems
  - Dissemination services (IGDDS initiative of DVB-S networks)
  - User receiving / processing equipment and software tools

- Adapting the services to the needs
  - Formulate user requirements
  - Dialogue between users and providers to include new data/products

- User awareness, education and training
  - Information on systems, products, access
  - Training on data/product access and applications

# Data accessibility

- Promote integrated dissemination services (e.g. EUMETCast)
- Support standardization of Direct Readout services
- Implement WIS standards and best practices
- Identify requirements for additional data to be disseminated



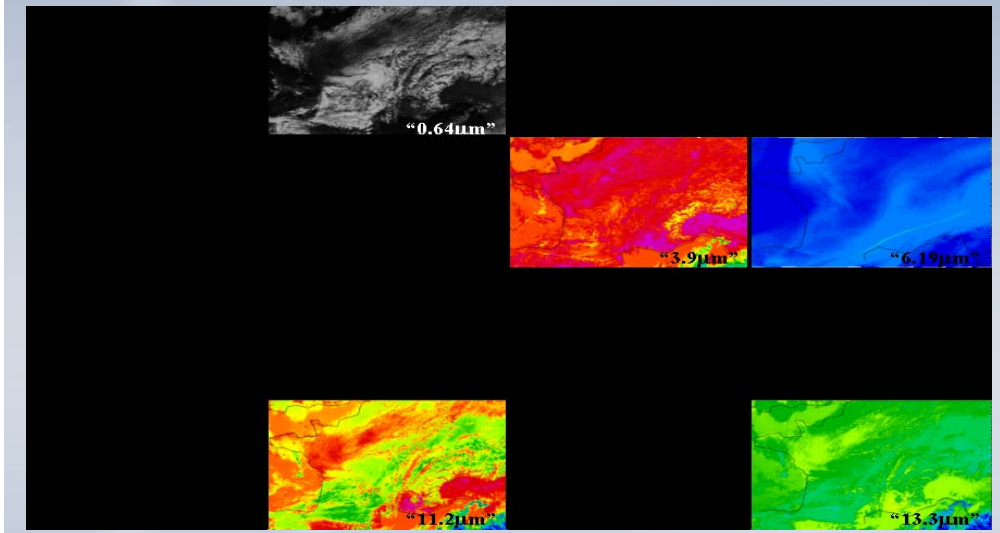
# Space Programme trends and challenges

- Trends
  - Satellites are the largely dominant data source for weather and climate modelling
  - Comprehensive, diversified constellations to meet weather / climate requirements
  - Integrating « R&D » and « Operational » components
  - « Data explosion » with onset of advanced sensors (e.g. hyperspectral)

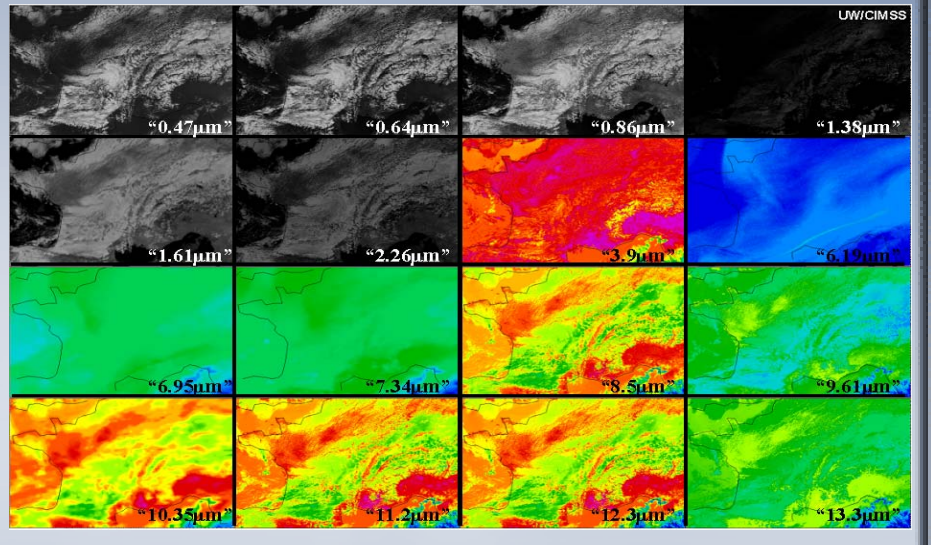
- Challenges
  - Continuity of essential climate measurements (e.g. $O_3$, GHG, radiative balance..)
  - End-to-end Architecture for Climate Monitoring from Space (with CGMS and CEOS)
  - Funding situation of key programmes : cooperation to optimize the global system
  - Data quality and traceability for consistent climate records
  - Stringent timeliness requirements for polar-orbiting sat data
  - Standardization enabling efficient data management (metadata)
  - User guidance and regional capacity building
  - User preparedness for new satellite/instrument generations

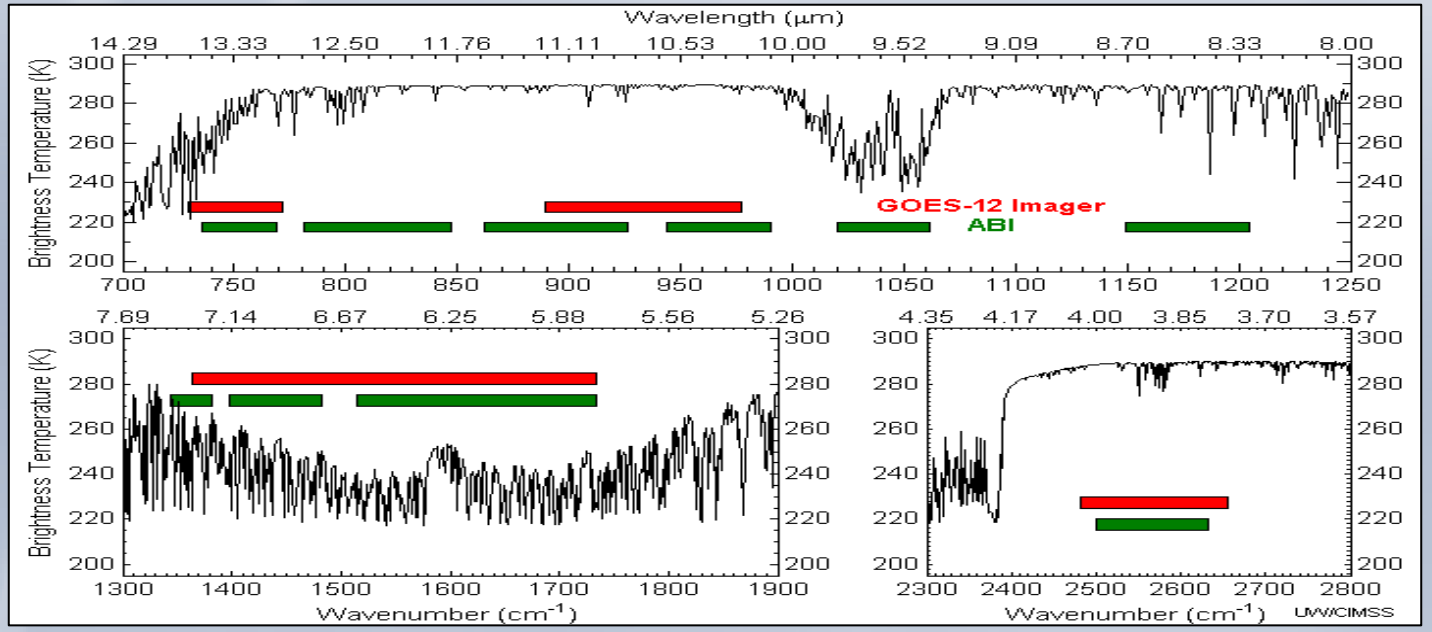
# ABI: Improved Resolution . . .

**Corresponding Simulated GOES Imager Spectral Bands:**




**Simulated "ABI" Spectral Bands:**



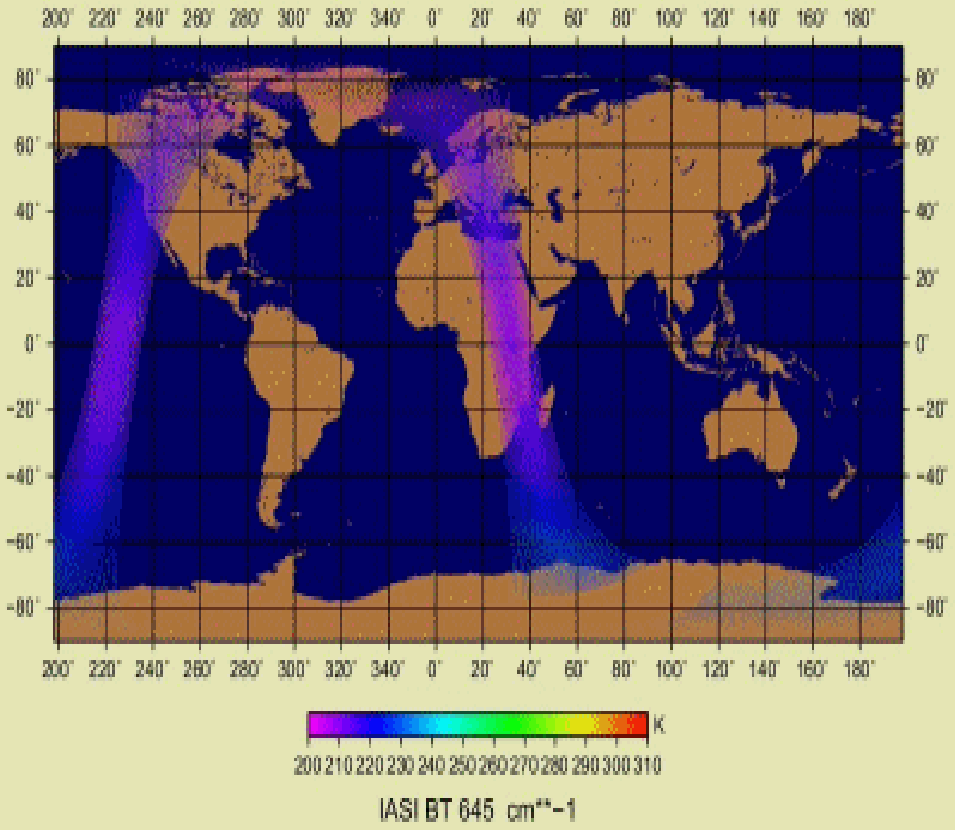



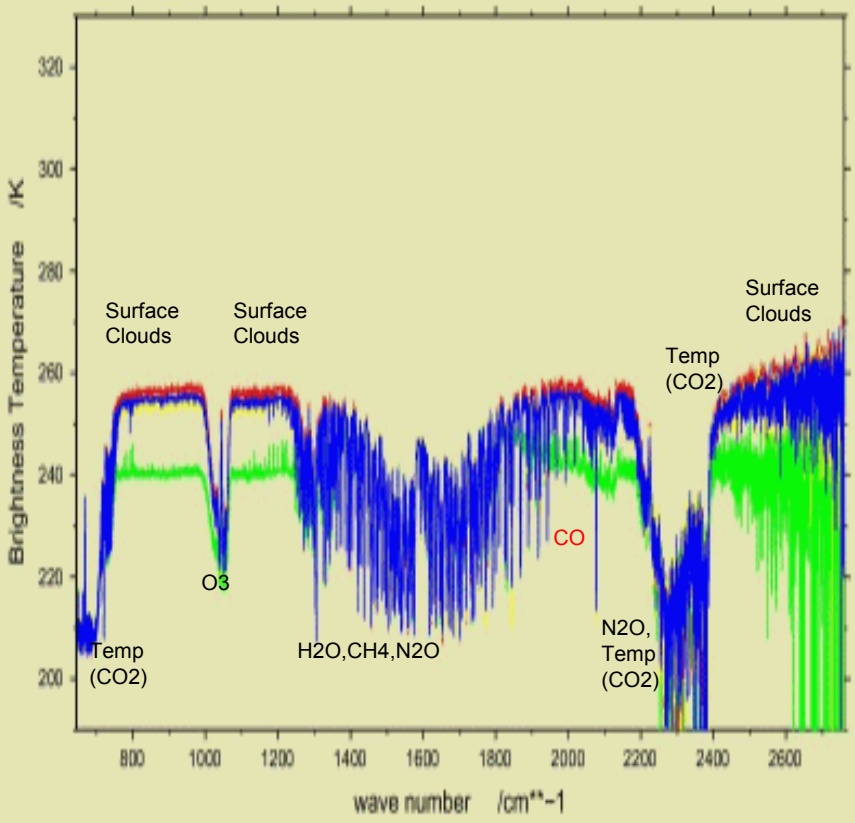

. . . over a wider spectrum

**Courtesy of Mark Mulholland, NOAA**

# IASI (8461 'channels')

From J. Ackermann, F. Montagner, D. Klaes, EUMETSAT




Vertical profiles of water vapour and temperature through inversion calculations;
Trace gases (ozone, methane, carbon monoxide, NOx); Cloud properties

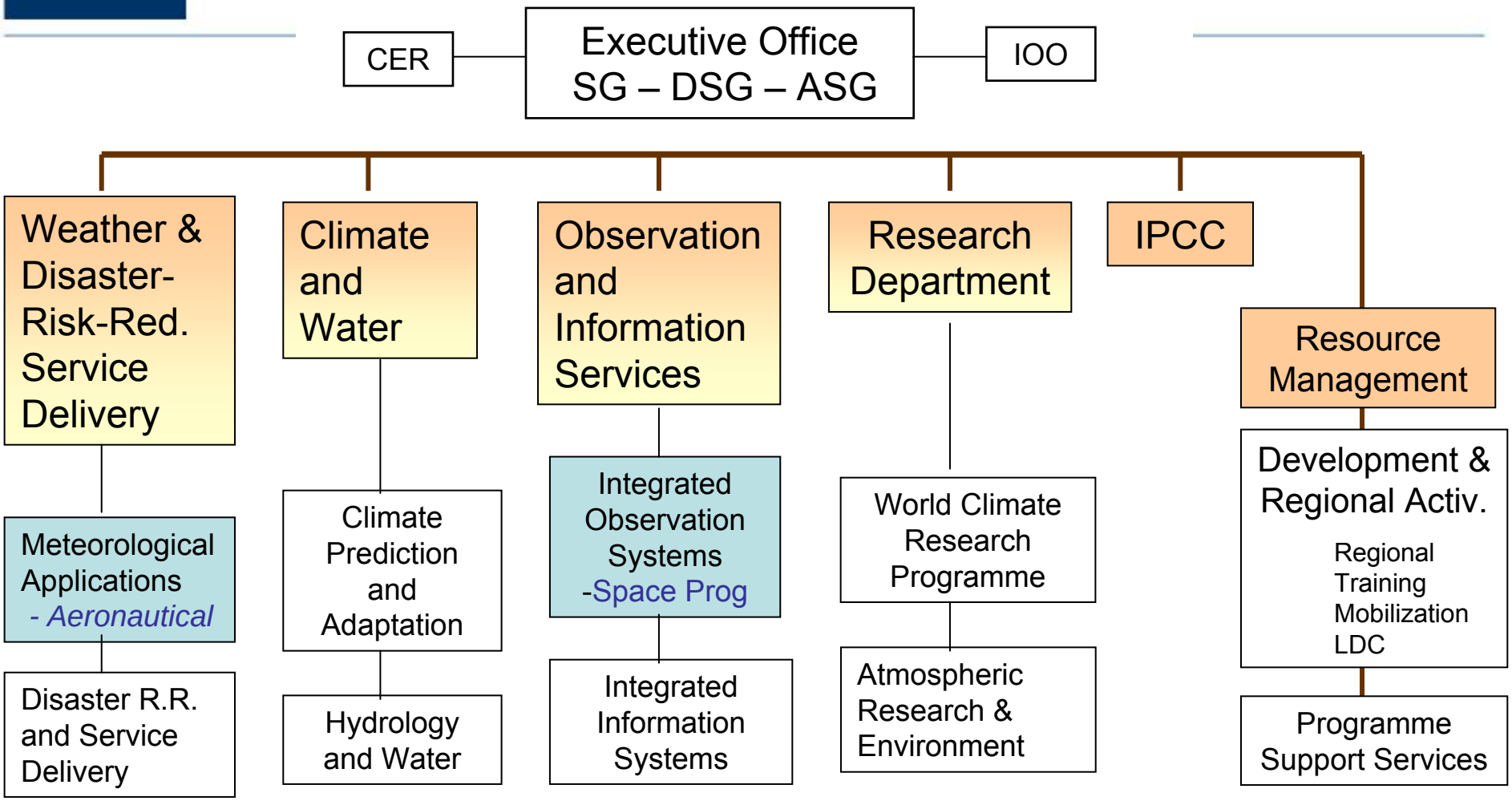
# Conclusions

- Space-based observation is fundamental to weather and climate monitoring and forecasting and all their applications for public safety and socio-economic benefits

- Global coordination must be achieved
  - To avoid gaps and redundancies: optimize observation efforts
  - To ensure interoperability of datasets,
  - To harmonize products when relevant
  - To align on best practices

- Upcoming technology and capabilities offer considerable opportunities … and challenges to the users

# Secrétariat



# WMO Space Programme Activities