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 a nutshell

- Specialized organization of the UN system in charge of weather issues and related aspects of climate, hydrology, environment and disaster mitigation
- 188 Members (countries or territories)
- Promotes cooperation and data exchange
- Coordinates
  - Global observing systems
  - Global Information Services
  - Global Processing (Requirements, procedures, formats)

Major components of GEOSS
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)

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

- Collect requirements for space-based observations and related services
- Enhance user capability to benefit from sat data/products
- Support product generation
- IGDDS-RARS projects
- Access to R&D data
- Intercalibration GSICS
- Plan / implement space-based GOS
- Ensure sat data quality

Global planning optimization
Agencies

Users

Information and Training
Virtual Laboratory

R/SSC-CM
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 troposphere
- Long-timescale:
  - Impact on evolution of the environment
  - Availability of natural resources (water, agriculture)
  - Sensitivity to natural plagues (farming and human health)
- All aspects above increasingly rely on space-based 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, biosphere, cryosphere
- Synergy in atmosphere/surface space-based observation
  - Common instruments for clouds and surface: VIS/IR/MW imagery
  - Atmospheric radiative transfer affects surface remote-sensing

Vegetation anomaly over Africa, MODIS/Terra
Tropical Cyclone Heat Potential associated with Hurricanes Katrina and Rita

Figures courtesy of Gustavo Goni, NOAA/OAR/AOML
Based on NASA/CNES T/P & Jason-1, USN GFO, and ESA ENVISAT

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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

Northern Hemisphere

LST: 06h
LST: 12h
LST: 18h

Afternoon orbits
Morning orbits

North pole
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)

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   - 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

Estimated Evolution of Satellite Data Rates
based on Direct Broadcast rates

Logarithmic scale!
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

Backbone of GEONETCast
User information

• //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

Satellite operating agencies & CGMS

Plan / implement enhanced space-based GOS

User requirements database

Users: all WMO & co-sponsored programmes

Enhance access to sat data

Integrated Global Data Dissemination Service
Access to R&D data

Enhance users’ capability to benefit from satellite data/products

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

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Non sun-synchronous LEO orbits

- CryoSat 92° inclination
- TRMM, 35° inclination
- Megha-tropiques 20° inclination
- GPM core, 65° inclination
- JASON 66° inclination
Simultaneous Nadir Overpass (SNO) Method
a core function for GSICS

POLAR- POLAR intercalibration

- Has been applied to microwave, VIS/NIR/IR radiometers for onorbit 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

- Unique capabilities developed at NESDIS
- Method has been adopted by other agencies, to be used operationally for GSICS
<table>
<thead>
<tr>
<th>WMO Region</th>
<th>Centre of Excellence</th>
<th>Place, Country</th>
<th>Sponsoring Satellite Operator</th>
<th>Primary language</th>
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<td>EUMETSAT</td>
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<td>EUMETSAT</td>
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