
# ITU Radiocommunication Conferences and monitoring, mitigating and adapting to climate change

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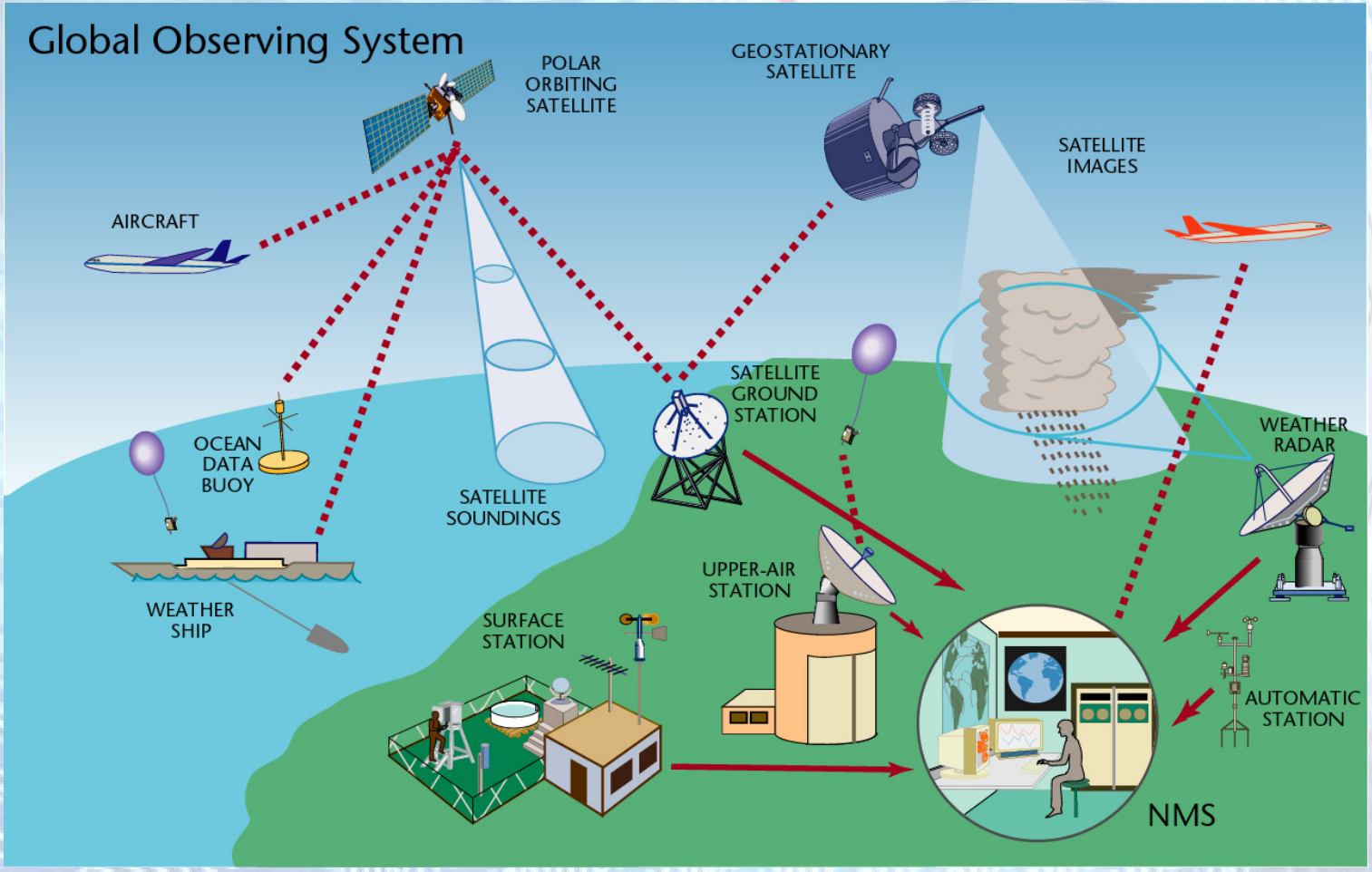
# World Global Observation System (GOS)
# (World Meteorological Organization (WMO))

**The backbone is radio based remote sensors - measuring instruments by means of which information is obtained by transmission and reception of *radio waves* *(active sensors)***
**or reception of *radio waves* of natural origin (passive sensors)**




***Source:*** WMO and ITU Handbook "Use of Radio Spectrum for Meteorology

Note: NMS = National Meteorological Service.

# ITU Radiocommunication Sector (ITU-R) and International Spectrum Management

| | |
|---|---|
| **78**<br>**PP-98** | **1 1) The functions of the Radiocommunication Sector shall be, bearing in mind the particular concerns of developing countries, to fulfil the purposes of the Union, as stated in Article 1 of this Constitution, relating to radiocommunication:**<br>**– by ensuring the rational, equitable, efficient and economical use of the radio-frequency spectrum by all radiocommunication services, including those using the geostationary-satellite or other satellite orbits, subject to the provisions of Article 44 of this Constitution, and**<br>**– by carrying out studies without limit of frequency range and adopting recommendations on radiocommunication matters.**<br>**….** ***ITU Constitution (Article 12)*** |

# Radio and Environment Information

**Most of people think that the radio frequencies are used for radiocommunications. However, radio emissions are also used for obtaining information about the environment with which they have been in contact.**
**In the radio frequency spectrum number of frequencies are better suited, due to the physical phenomena, for extracting the environmental information.**

**Environmental information, including climate monitoring data, is currently being obtained by special measuring instruments called remote sensors.**
**Remote sensors (passive and active) are radio devices, that derive environmental information by analyzing received radio waves.**

# Radiocommunication Sector (ITU-R) Main Tasks

*"To ensure rational, equitable, efficient and economical use of the radio-frequency spectrum by all radiocommunication services, including those using satellite orbits, and to carry out studies and adopt recommendations on radiocommunication matters."*

**In implementing this mission, the actions in ITU-R aim at creating the conditions for harmonized development and efficient operation of existing and new radiocommunication systems, taking due account of all parties concerned.**

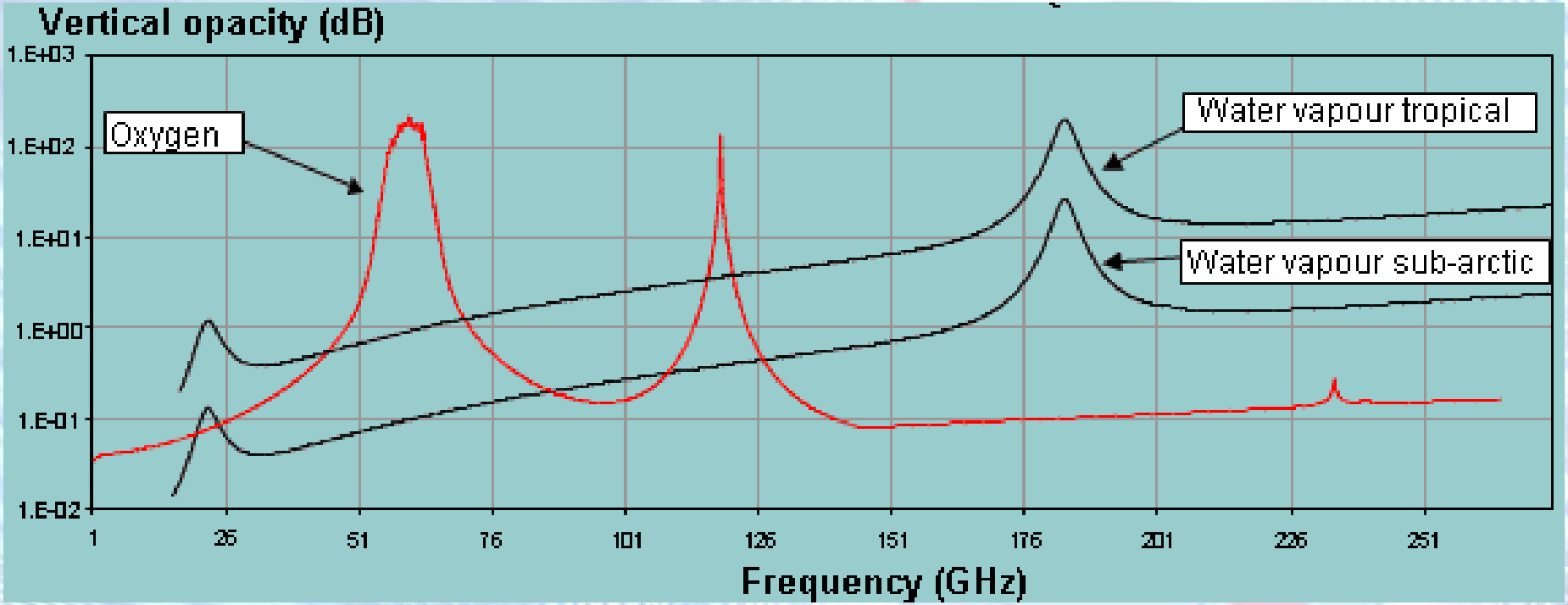
# XV World Meteorological Congress, 2007

**In Resolution 3:**

- **Re-affirmed the crucial importance of RF bands for meteorological and related environmental operations and research, and for disaster risk reduction**
- **Stressed that some RF bands are a unique natural resource for passive sensing that deserve absolute protection**
- **Urged all Members to do their utmost at national, regional and international levels to ensure the availability and protection of suitable RF bands**
- **Appealed to ITU and its Administrations to ensure the absolute protection of the passive sensing RF bands, and to give due consideration to the WMO requirements for RF allocations and regulatory provisions**

# Choice of Frequency Bands – Rather Limited!

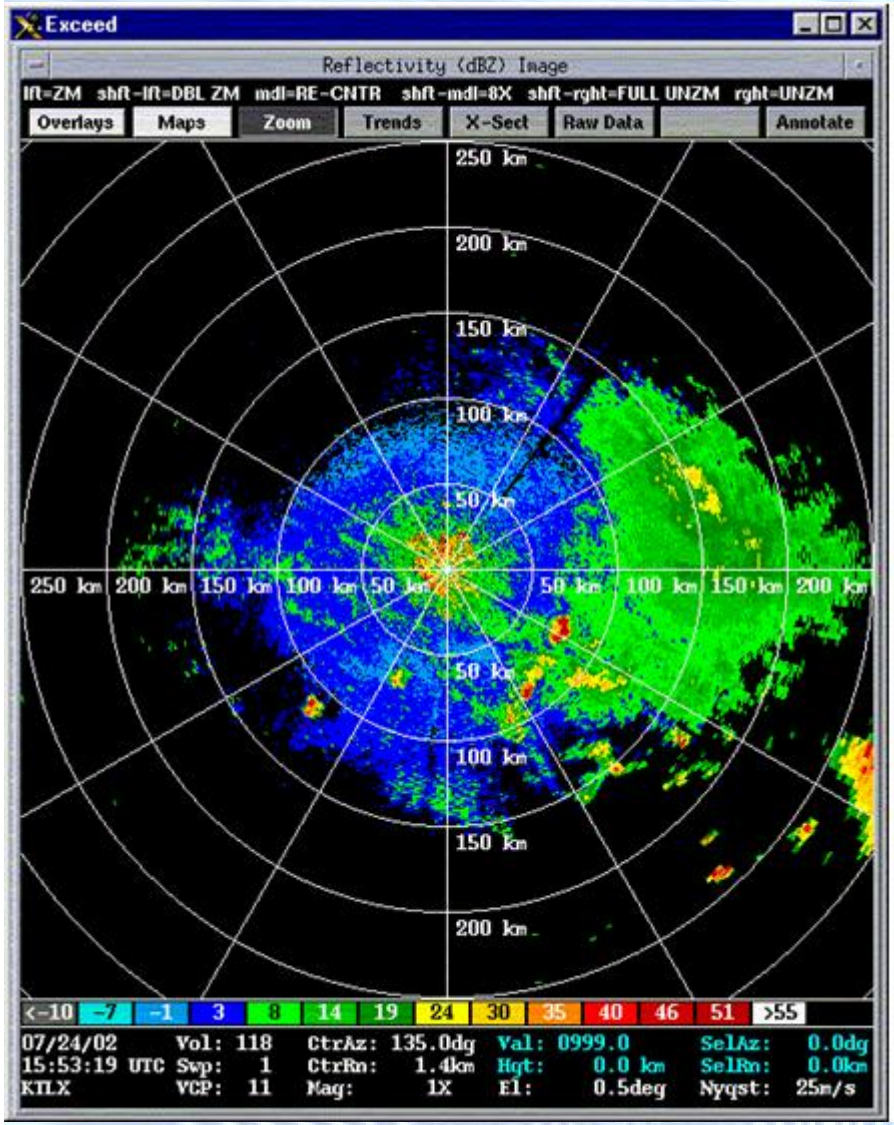
**There is no free choice of frequency bands used for environmental measurements; the choice of the frequency band is dictated by the physical phenomena to be observed.**

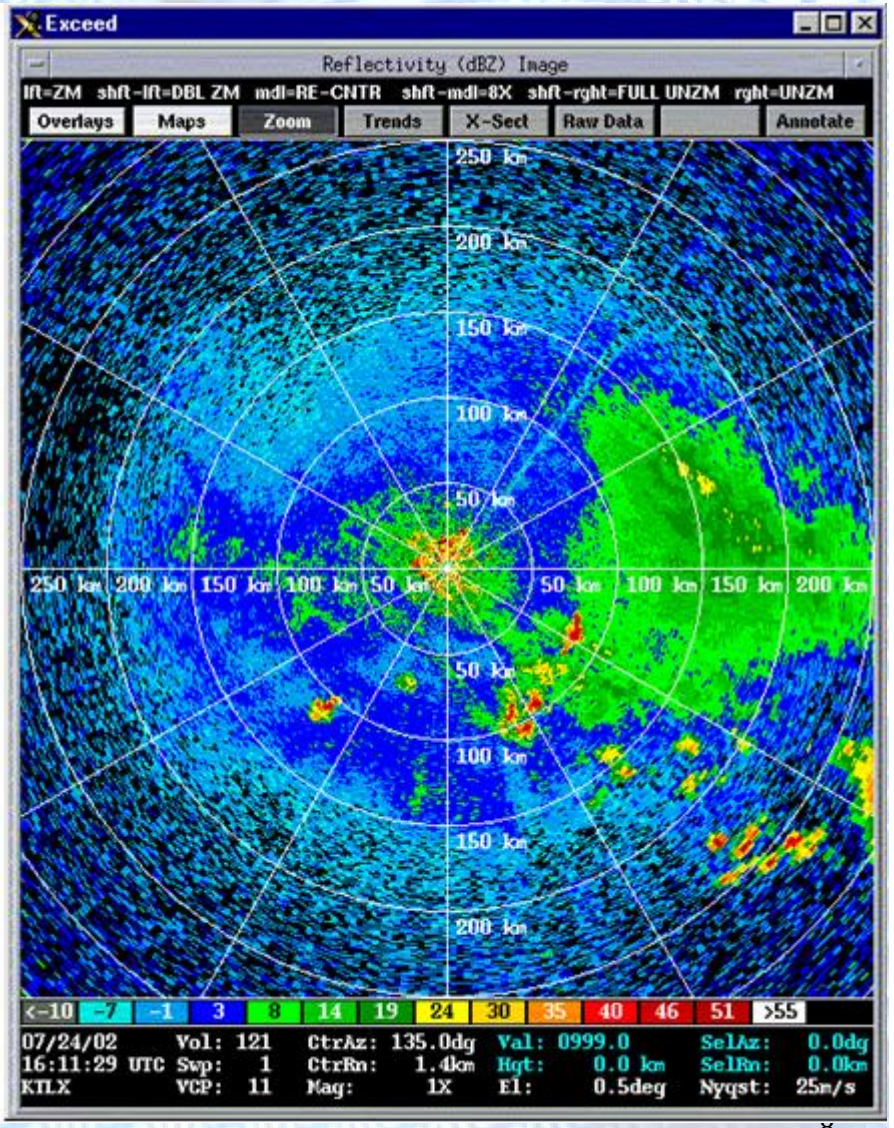



**As shown in Figure it is not possible to use frequency bands from 75 to 100 GHz for measuring the oxygen level in atmosphere.**

***Source*: Radiocommunication Study Group 7 (Science Services)**

# Interference Free (left) Versus Interference Corrupted Meteorological Radar Imagery



# The Role of Radiocommunication Services in Climate Monitoring

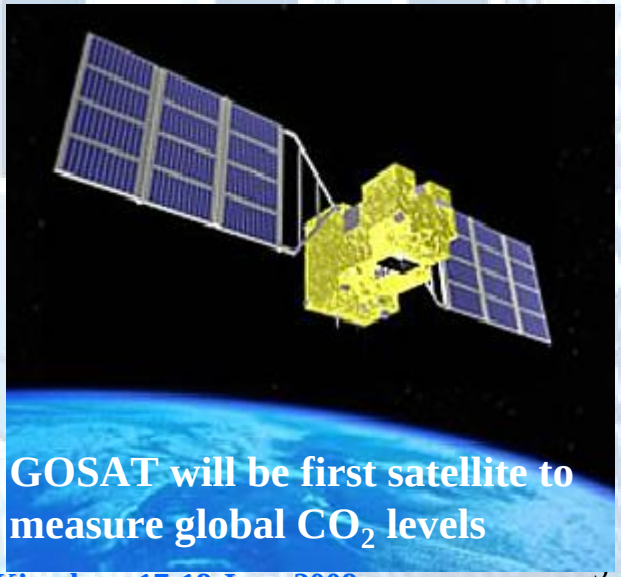
- **Radiocommunication systems and applications employing remote sensors are the main source of information for climate monitoring, disaster prediction, detection and disaster relief operations**
- **Space-based remote sensors are the only tools that provide environmental data on a long term, repetitive and global scale.**

***A sample:***

**According to many researchers the increasing release of greenhouse gases (GHG) is the main reason for the global warming.**

**Remote sensors provide global systematic observation of the terrestrial carbon budget.**

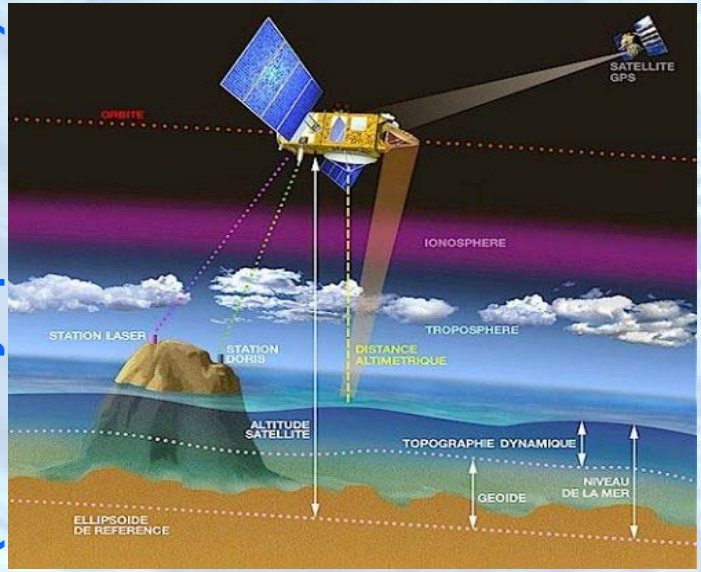
**JAXA Greenhouse gases Observing SATellite "GOSAT"**

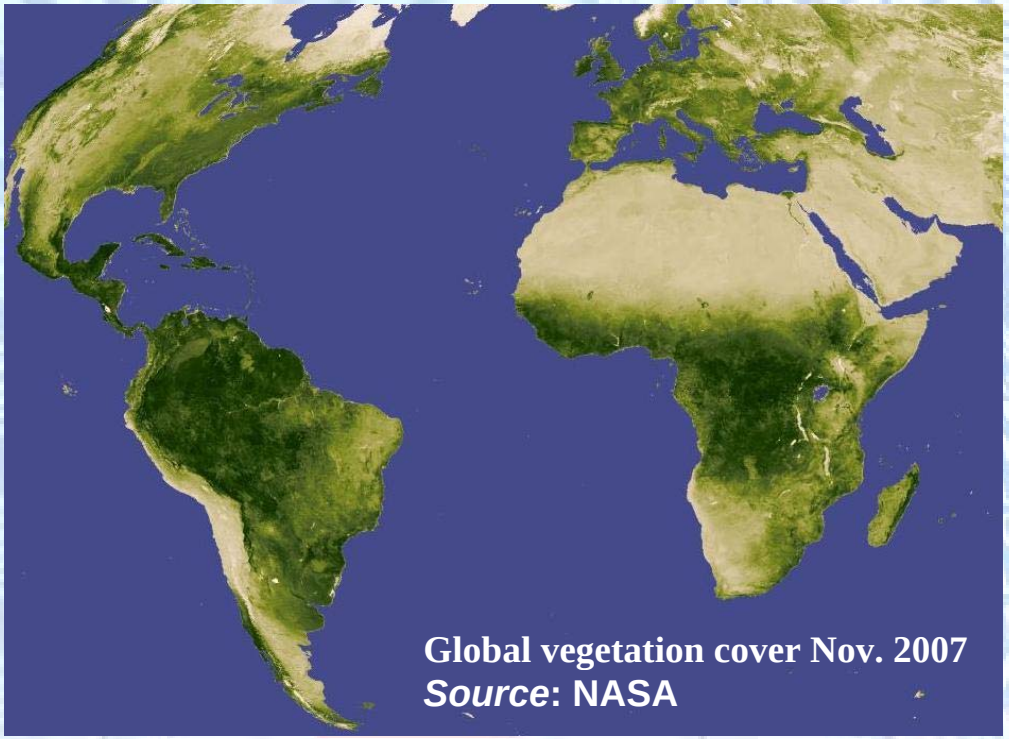


**GOSAT will be first satellite to measure global $CO_2$ levels**

# Few Samples

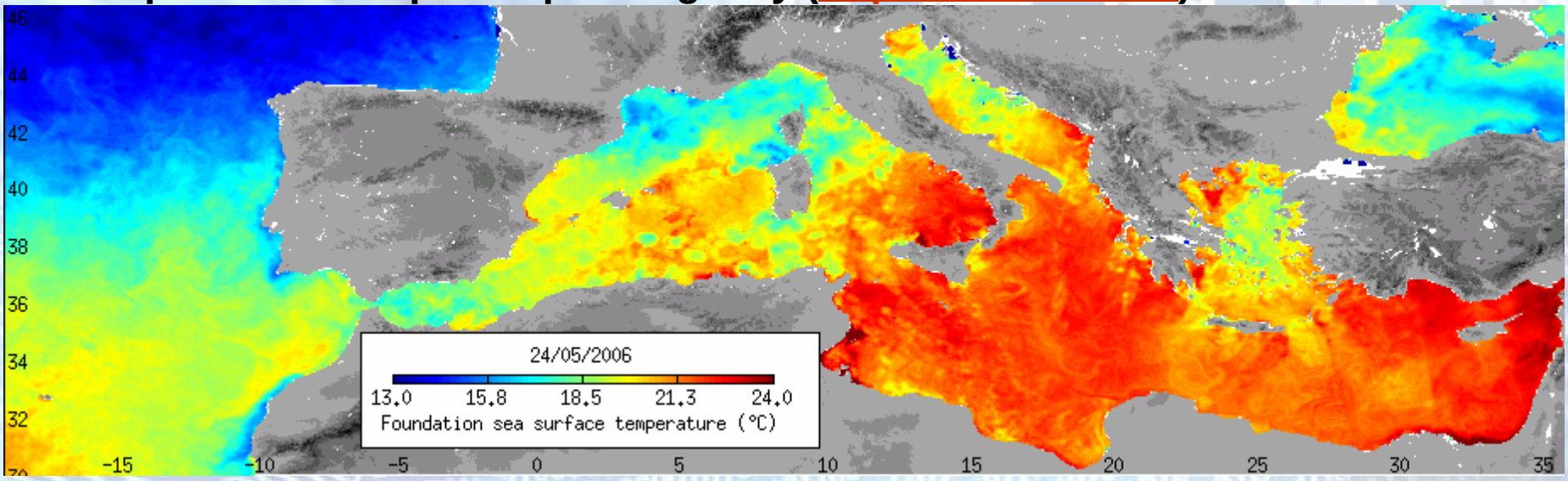
Sea level measurement (accuracy up to 2-3 cm)



Global vegetation cover Nov. 2007
*Source*: NASA

**Sea surface temperature measurement (accuracy of up to 0.2° C).**
**A sample from European Space Agency (http://www.esa.int/)**



# Spectrum, Frequency Band and Precision

**In many cases remote sensing precision depends on the radio spectrum available for a remote sensing application.**

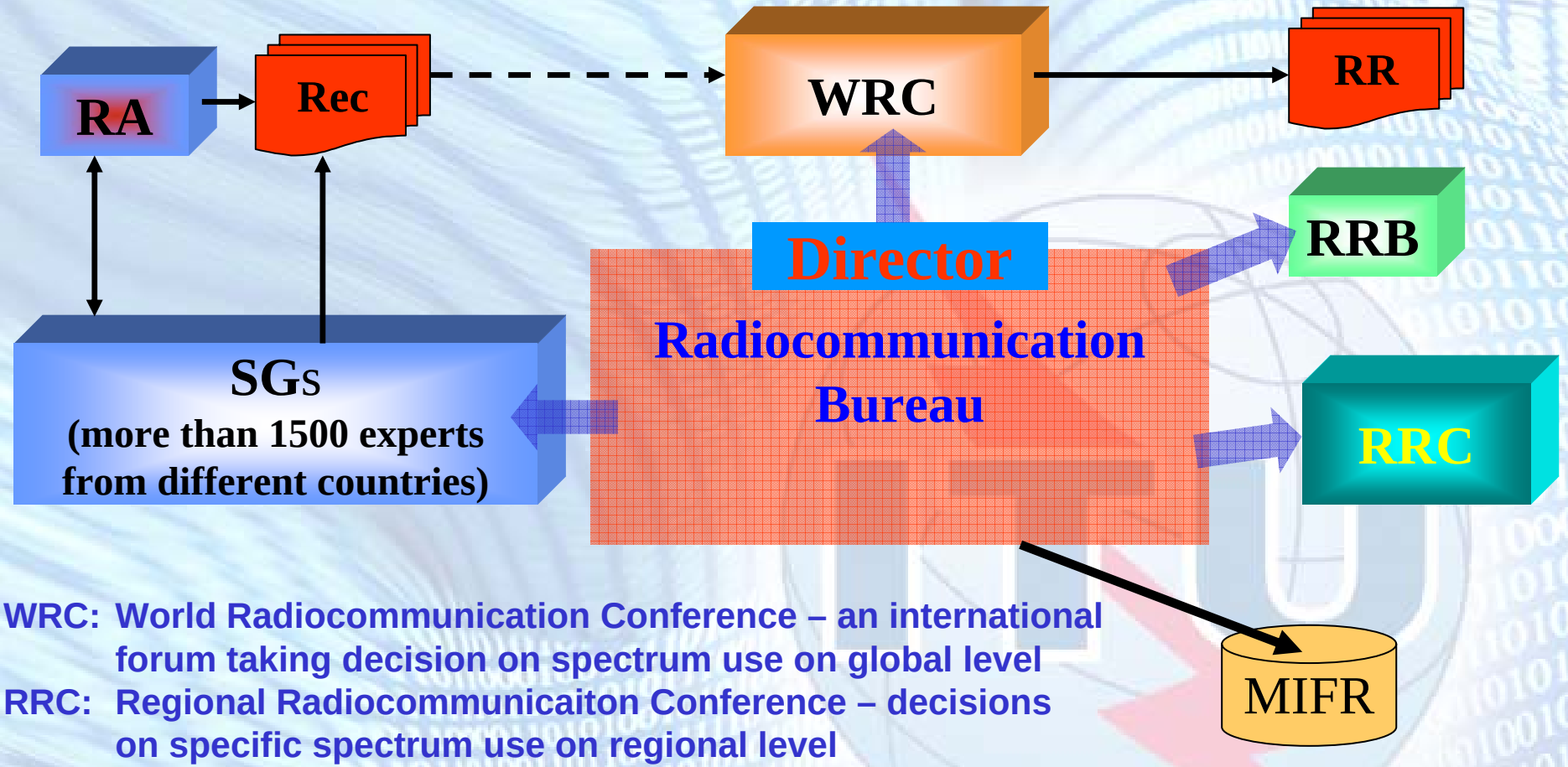
**For example, to achieve 1 meter resolution at 30° incidence angle an Advanced Synthetic Aperture Radar (ASAR) needs 300 MHz.**

***(ASARs provide Earth's images (through clouds too) for monitoring ice, flooding, estimate the effect of different disasters, etc.)***

**Microwave observations at frequencies below 100 GHz** enable studies of the Earth's surface and its atmosphere from spaceborne instruments **even in the presence of clouds!**

**At the same time the radio frequency spectrum is a very limited natural resource and the ITU has to find a proper balance between spectrum provided for environment monitoring and for other radiocommunication needs.**

# ITU-R Structure and Decision Taking Process




WRC: World Radiocommunication Conference – an international forum taking decision on spectrum use on global level

RRC: Regional Radiocommunicaiton Conference – decisions on specific spectrum use on regional level

RR: Radio Regulations (treaty status)

RA: Radiocommunication Assembly

MIFR: Master International Frequency Register

Rec: ITU-R Recommendations (international voluntary standards, some part of RR)

RRB: Radio Regulations Board

SGs: Study Groups

# WRC and Climate Monitoring

**WRCs allocate necessary spectrum and provide the required protection for radio-based systems used for climate monitoring such as:**

- **satellites based system that collect environment information (sea temperature, atmosphere characteristics (including CO2), vegetation, soil moisture, ice level, etc.), track the progress of hurricanes, typhoons, etc.;**
- **weather radars for tracking tornadoes, thunderstorms, and the effluent from volcanoes and major forest fires;**
- **radio-based meteorological aid systems that collect and process weather data;**
- **broadcasting systems and mobile systems for public warning (dangerous weather events, and aircraft pilots of storms and turbulence);**
- **satellite systems for dissemination of environment monitoring data; etc.**

# WRC-07 Decisions and Climate Monitoring

**WRC-07*:**

- **extended by 100 MHz spectrum allocation to meteorological-satellite service in frequency band near 18 GHz (now 300 MHz – see previous slide on precision):**
- **upgraded status of meteorological radars to primary:**
- **extended by 200 MHz spectrum allocation to Earth exploration-satellite service in frequency band near 9 GHz;**
- **adopted protection criteria for active and passive services involved in environment monitoring in climate monitoring;**
- **etc.**

**** WRC-07 was the biggest forum in ITU history with participation of more than 2'800 participants from 161 ITU Member States and 94 observer organizations.***

# WRC-07: WRC-11 Agenda Items Relevant to Climate Monitoring

**WRC-07 included several Agenda items (AI) in the draft of WRC-11 Agenda concerning the use and further development of radicommunication systems involved environment monitoring such as:**

- **AI 1.6: related to the spectrum use by the passive services between 275 GHz and 3000 GHz, and to consider possible procedures for free-space optical-links;**
- **AI 1.15: related to oceanic radars in HF bands;**
- **AI 1.16: related to lightening detection below 20 kHz;**
- **AI 1.24: related to extention of allocation to meteorological-satellite service in frequency band near 8 GHz;**
- **etc.**

# WRC-07: New Studies Relevant to Climate Monitoring

**WRC-07 adopted several Resolutions on studies and actions by Radiocommunication Sector (ITU-R) related to the services involved in climate monitoring, disaster prediction, detection and relief such as:**

- **Resolution 612 "Use of the radiolocation service between 3 and 50 MHz to support high-frequency oceanographic radar operations";**
- **Resolution 671 "Recognition of systems in the meteorological aids service in the frequency range below 20 kHz";**
- **Resolution 672 (WRC-07) "Extension of allocation to the meteorological-satellite service in the band 7 750 – 8 850 MHz";**
- **Resolution 673 (WRC-07) "Radiocommunications use for Earth observation applications"; etc.**

# Resolution 612 (WRC-07) "Use of the radiolocation service between 3 and 50 MHz to support high-frequency oceanographic radar operations"

**Requesting to carry out studies on the use of high-frequency oceanographic radars for measurement of coastal sea surface conditions to support environmental, oceanographic, meteorological, climatological, maritime and disaster mitigation operations with aim to consider possible allocations in the range 3-50 MHz to the radiolocation service for oceanographic radar applications at WRC-11 (Agenda item 1.15).**

***These radars could be also used for tsunami detection (they could see beyond the horizon).***

## Resolution 672 (WRC-07) "Extension of allocation to the meteorological-satellite service in the band 7 750 – 8 850 MHz"

**In order to further improve accuracy of Earth observation data this Resolution requests to carry out studies on possible allocation of additional 50 MHz for transmission of data from high-resolution sensors used for global weather forecast, climate change and hazard predictions and present the results to WRC-11 (Agenda item 1.24).**

## Resolution 673 (WRC-07) "Radiocommunications use for Earth observation applications"

**This Resolution calls for studies on possible means to improve recognition of the essential role and global importance of Earth observation radiocommunications applications and knowledge regarding the benefit of these applications. The results of studies to be reported to WRC-11.**

# Radiocommunication Assembly 2007

**Radiocommunication Assembly has the same status in radio matters as the World Telecommunication Standardization Assembly (WTSA) in telecommunication standardization matters.**

**RA-07 approved 2 resolutions related to studies to be carried out by the Radiocommunication Study Groups concerning development and operation of remote sensing:**

- **Resolution ITU-R 53 "The use of radiocommunications in disaster response and relief"**
- **Resolution ITU-R 55 "ITU studies of disaster prediction, detection, mitigation and relief"**

# Cooperation with Other Organizations

- World Meteorological Organization (WMO);
- United Nations Office for Humanitarian Affairs (OCHA) and other UN offices;
- Group on Earth Observation (GEO);
- International Amateur Radio Union (IARU)
- Space Frequency Coordination Group (SFCG) – international and national space agency group;
- International and national space and meteorological agencies/organizations
- Partnerships with international and national satellite organizations/operators/companies (INMARSAT, ICO, Thuraya, etc.)…..
- etc.

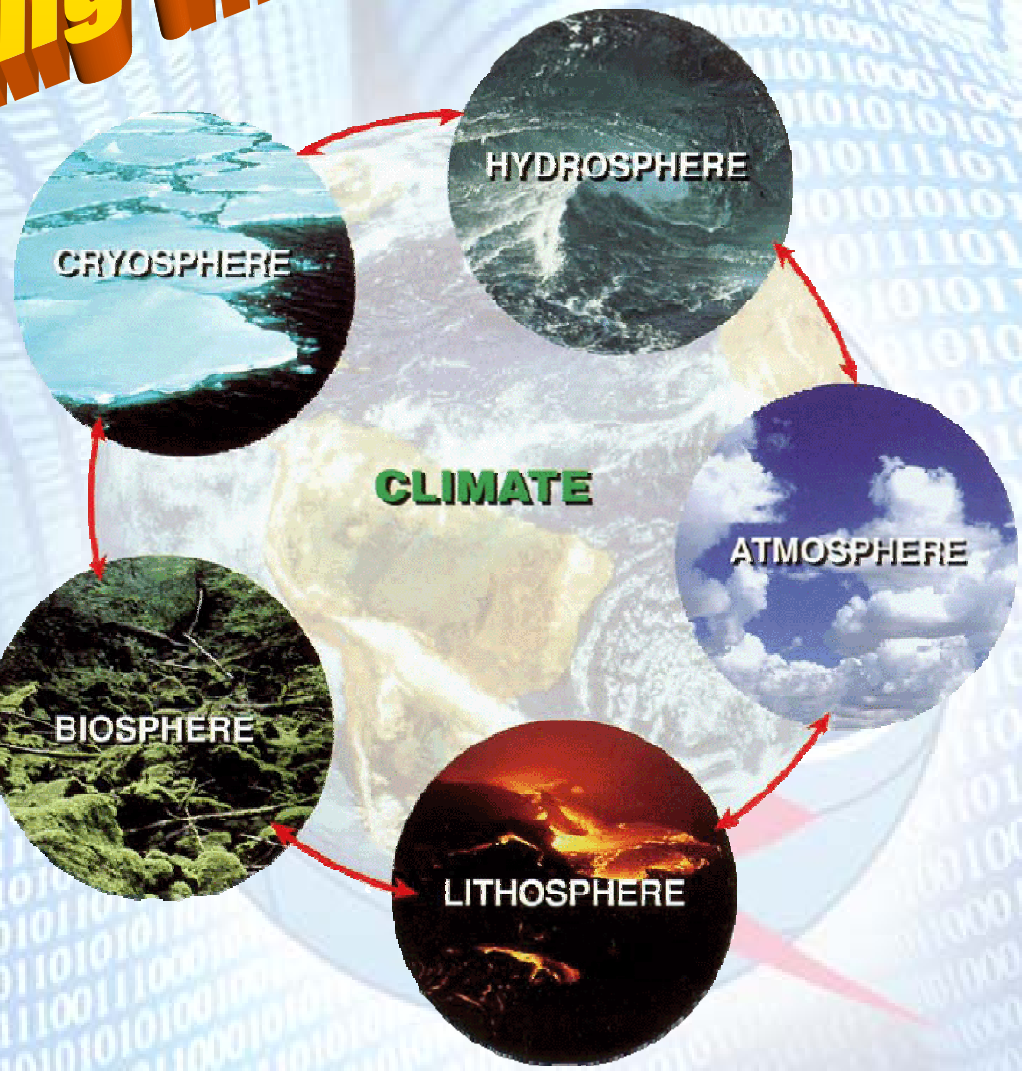
# Conclusion

- **Radio based technologies such as remote sensing are the essential tools for climate monitoring, prediction, detection and relief from natural and man-made disasters;**
- **Remote sensing systems are key global assets that serve the world as a whole;**
- **It is very important to protect non-interference operation of remote sensors, and provide radio and telecommunication infrastructure, for obtaining and disseminating remote sensing data;**
- ***As the steward of the global framework for spectrum,* ITU in general and WRCs in particular provide for the necessary radio-frequency spectrum and orbit resources for satellites systems and other radiocommunication systems used for climate monitoring, as well as promoting their use for the interests of all countries, …**

# EXTRA SLIDES

**These slides provide some additional information and details related to the use of radio based applications for climate monitoring, disaster prediction and relief operation planning**

# Radio based systems are used for monitoring all elements of Earth systems

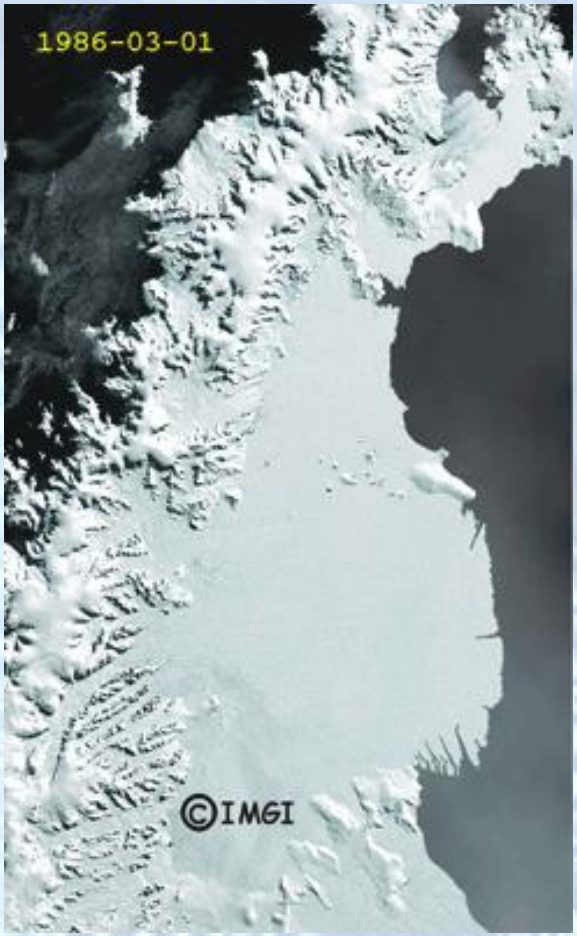


# Radiocommunication Services Involved in Climate Monitoring

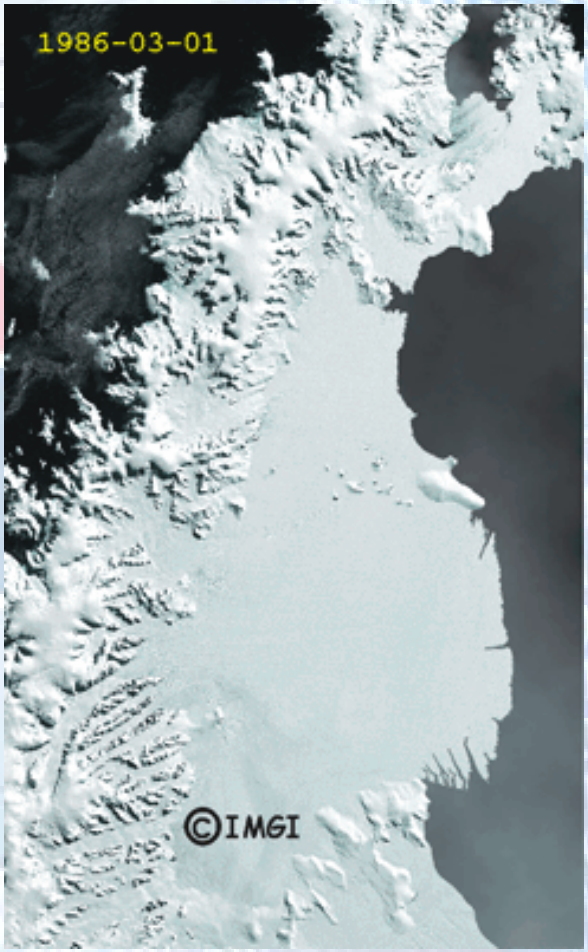
- **Meteorological-satellite, Earth exploration-satellite and meteorological aids services are the main users of remote sensors employed for climate monitoring;**
- **Fixed-satellite service, broadcasting-satellite service, broadcasting, fixed, mobile services are used for dissemination of remote sensing data;**
- **All above-mentioned services are also employed for planning relief operations and mitigating of local effects of climate change and related natural disasters.**

# Advanced Synthetic Aperture Radar (ASAR) allows Envisat to produce high-quality images of ice sheets in Greenland and Antarctica through clouds and darkness

*Animated picture*

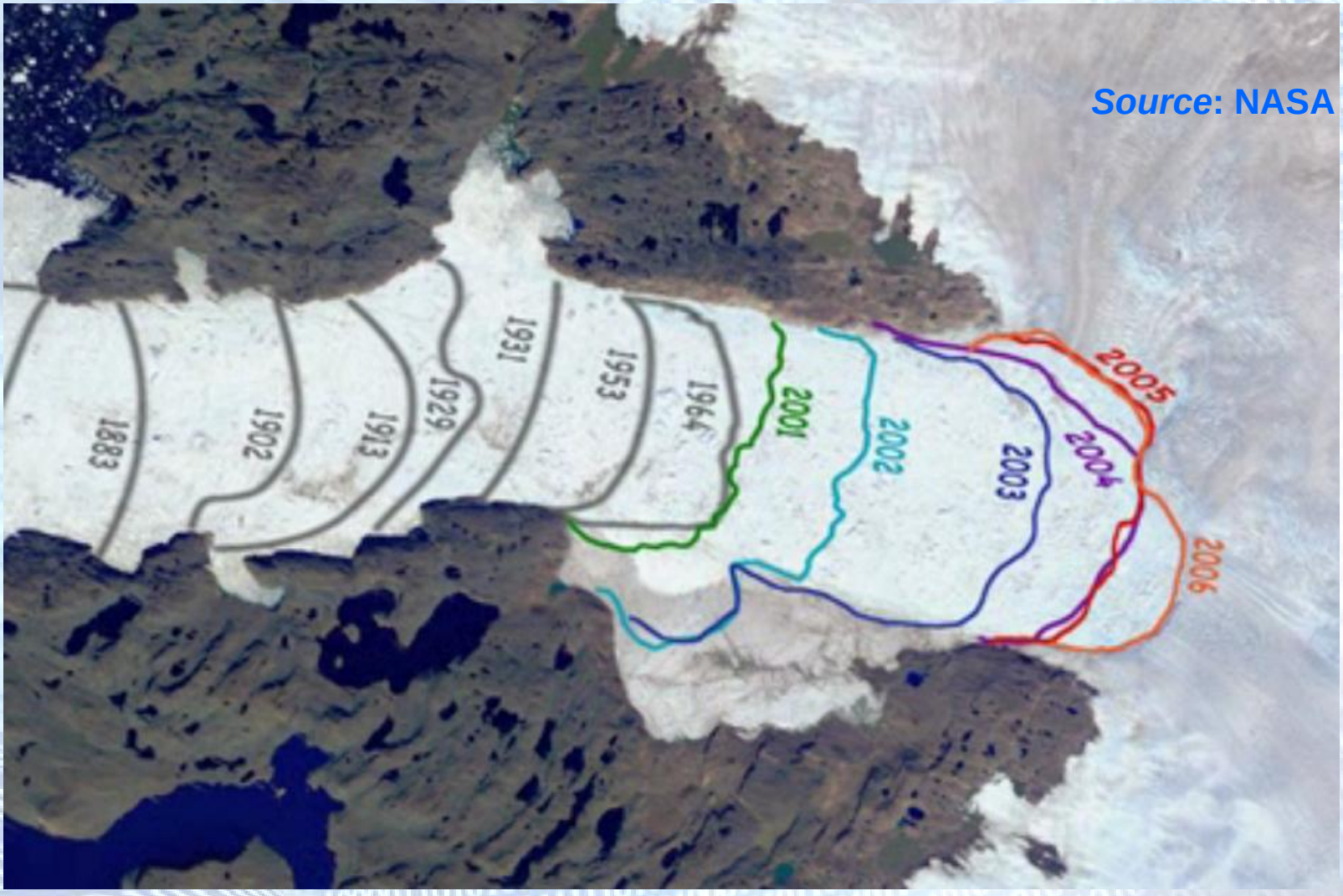






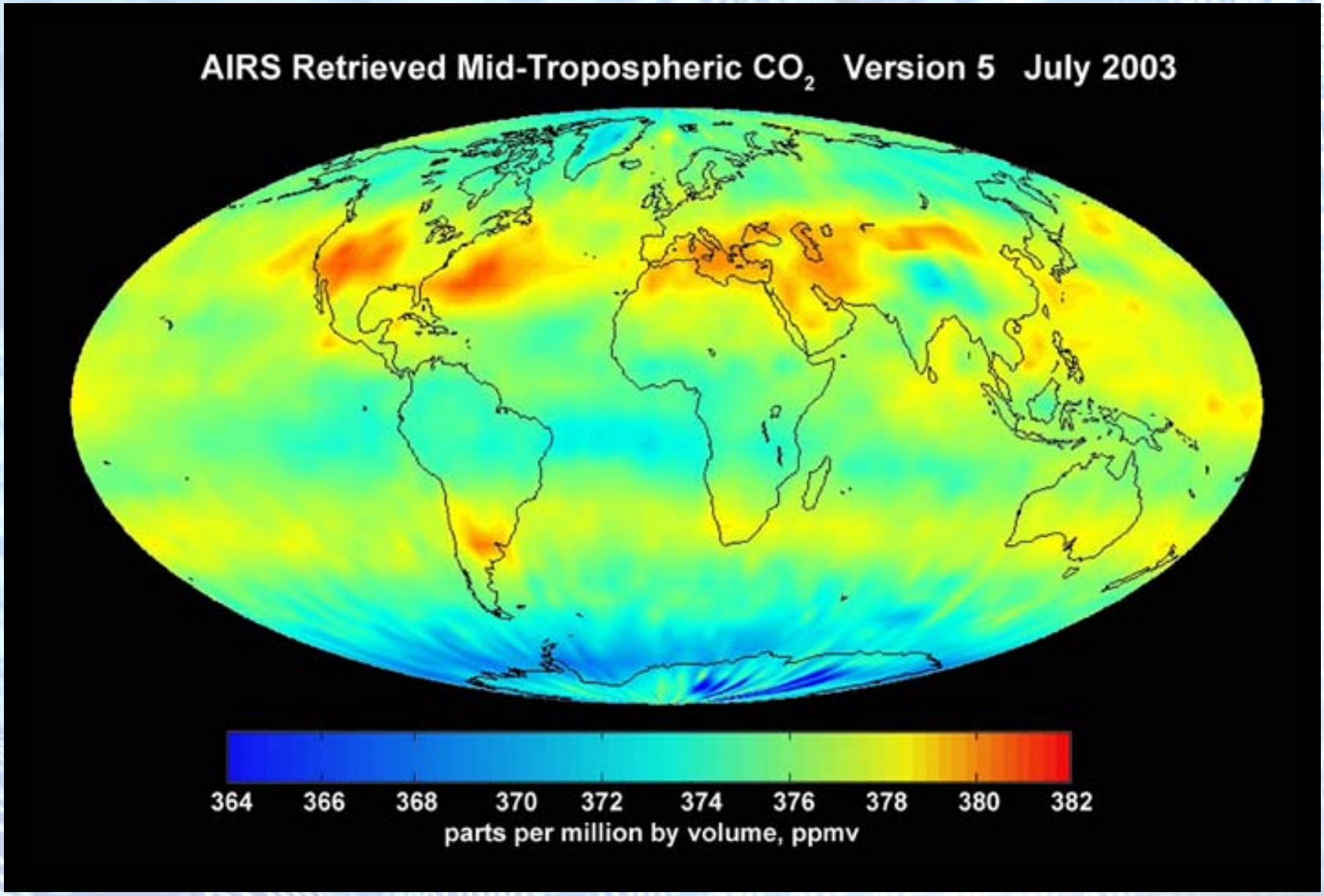

*Source*: ESA

# Greenland Jakobshavn Glacier Calving front retreat from 2001 through 2006 with Blue/White Elevation Change



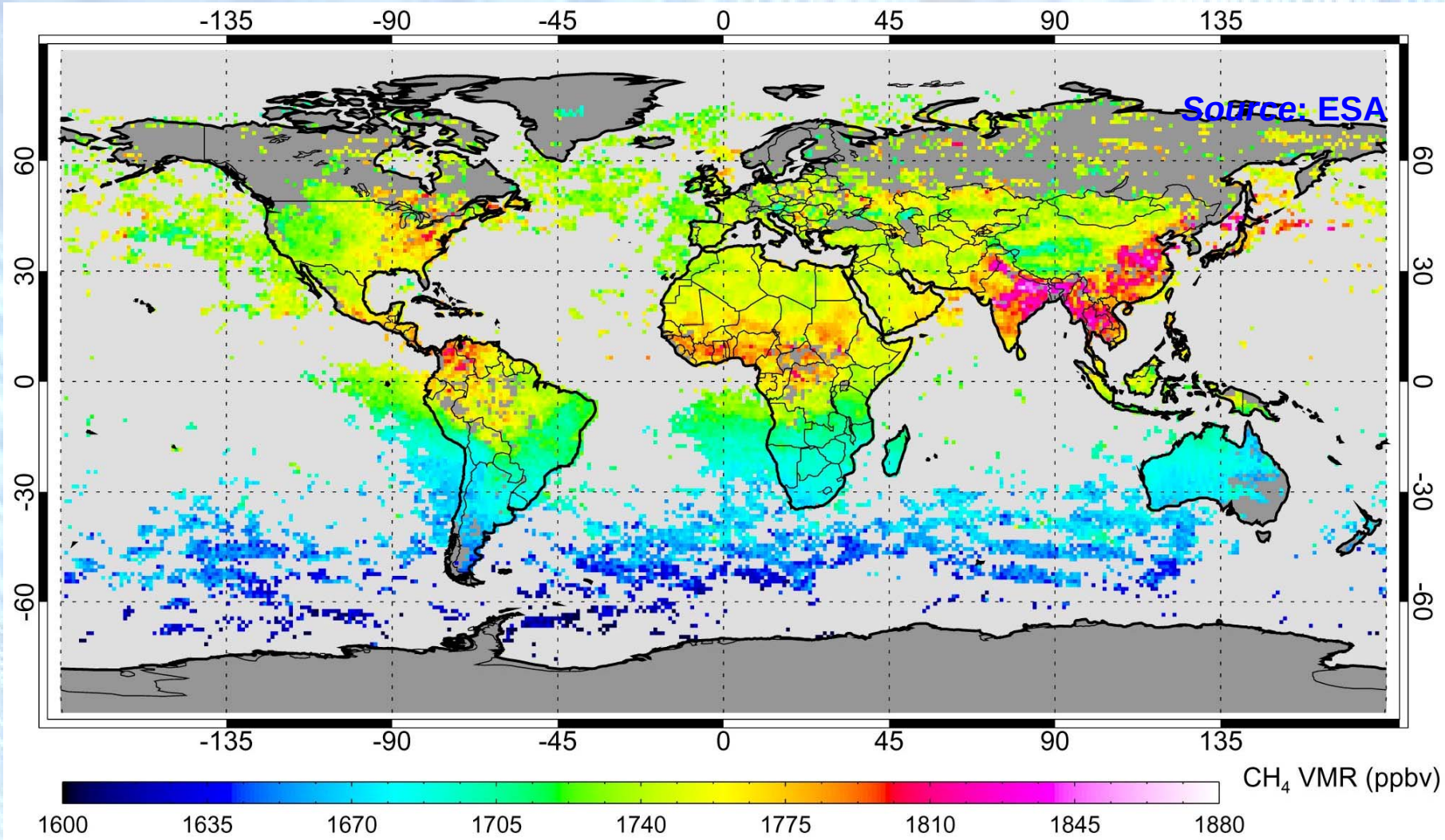

*Source*: NASA

# Greenhouse gases monitoring

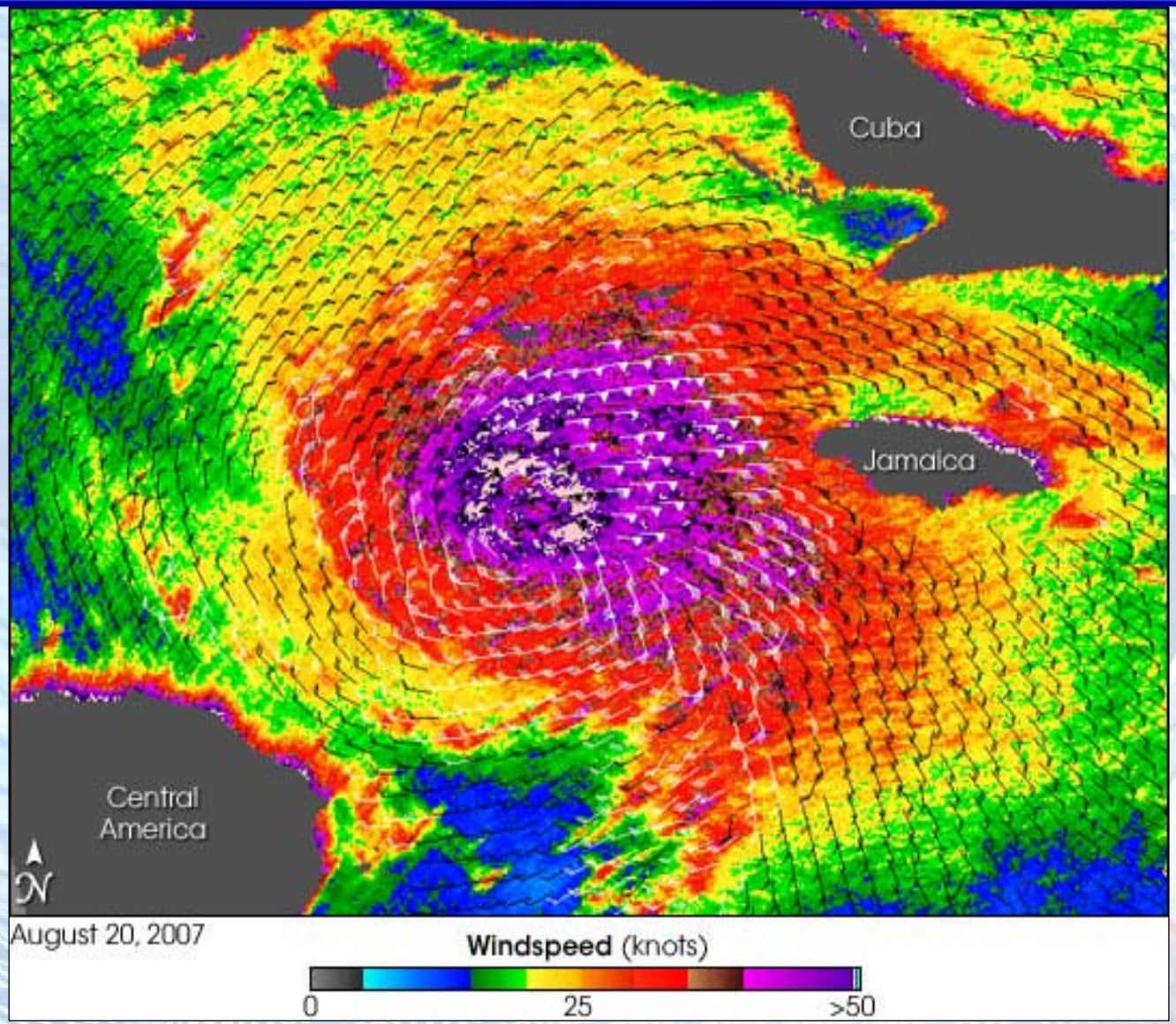



Source: NASA

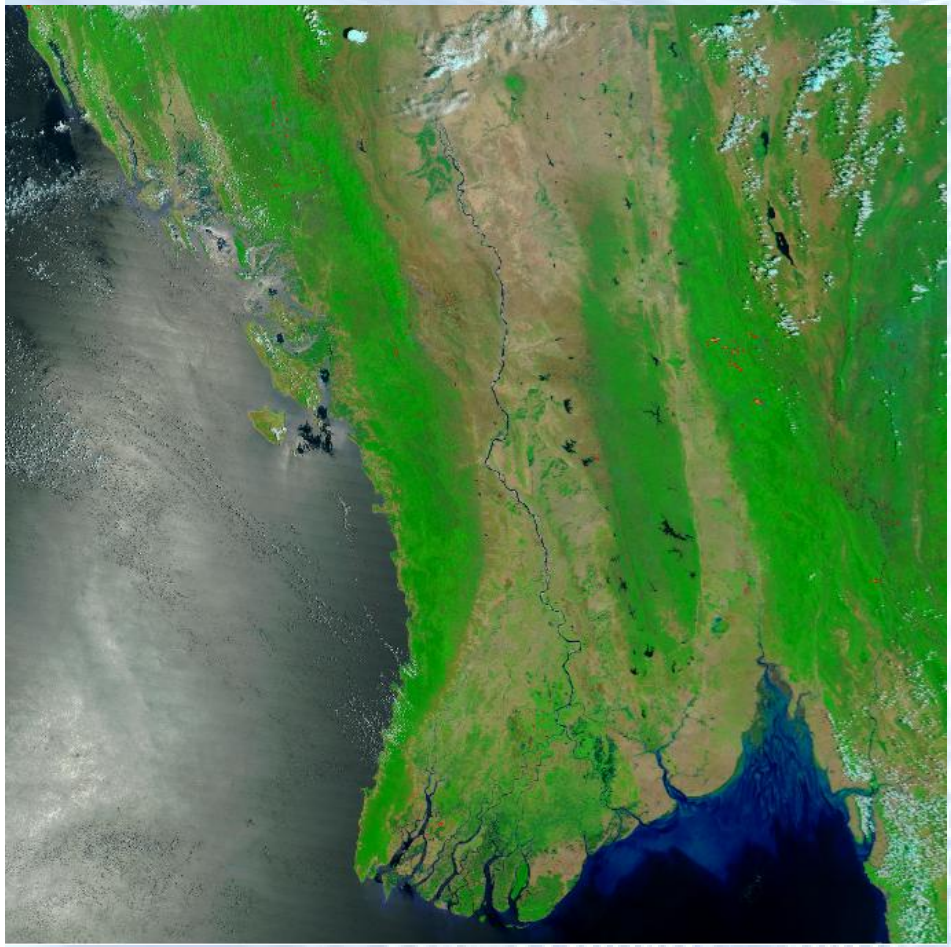
# Measurements of methane (CH4) – the second most important "negative" greenhouse gas after carbon dioxide (only few over ocean)



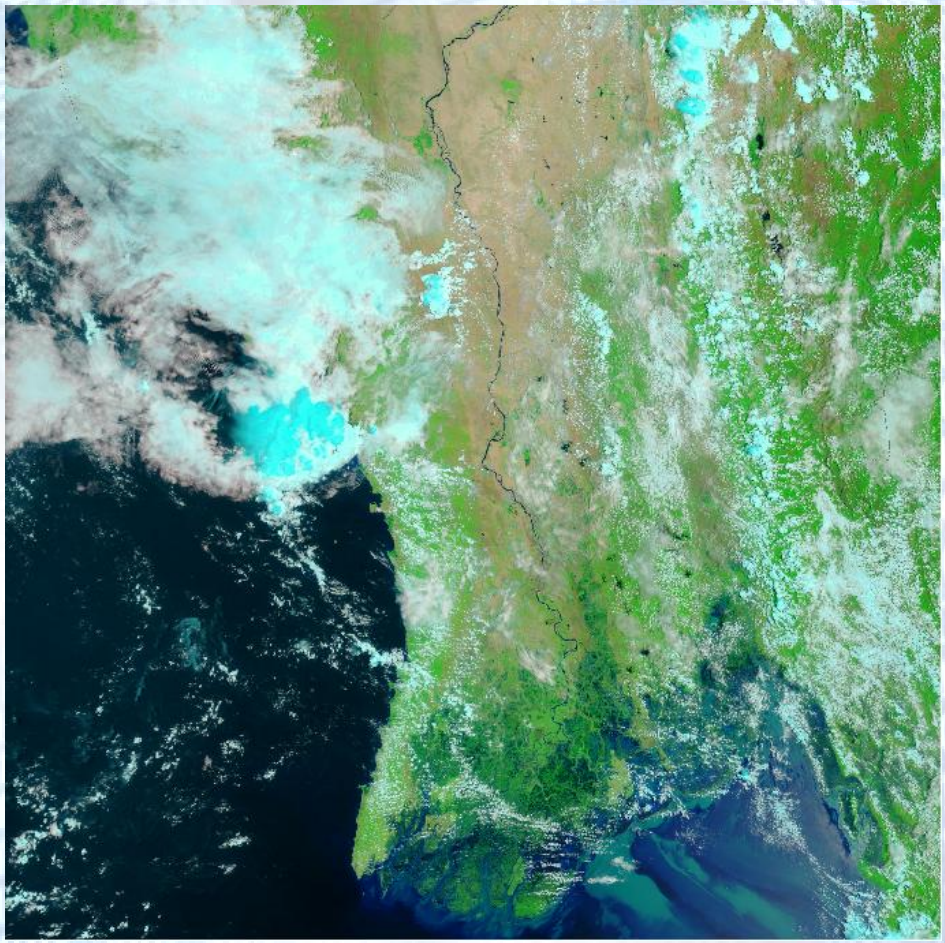
# QuikSCAT image of hurricane Dean in Gulf of Mexico 20 August 2007



# NASA's Terra Satellite Captured Images of Myanmar Showing the Devastation of Flooding from Cyclone Nargis



Before cyclone



After cyclone

# Web resources

**ITU and Climate Change page**
http://www.itu.int/themes/climate/

**ITU Radiocommunication Sector (ITU-R) page**
http://www.itu.int/ITU-R/index.asp?category=information&rlink=rhome&lang=en

**ITU Radiocommunication Sector (ITU-R) emergency telecommunications page**
http://www.itu.int/ITU-R/index.asp?category=information&rlink=emergency&lang=en

**ITU-R Publications page**
http://www.itu.int/publications/sector.aspx?sector=1&lang=en

**Remote Sensing Workshop** (during ITU Global Forum on Effective Use of Telecommunications/ICT for Disaster Management) http://web.itu.int/ITU-D/emergencytelecoms/events/global_forum/rs_present.html

**List of some Remote Sensors** (provided at ITU Global Forum on Effective Use of Telecommunications/ICT for Disaster Management – produced by ITU-D) **see at:** http://www.itu.int/ITU-D/emergencytelecoms/doc/Remote%20Sensing%20Sensors%20for%20Disaster%20Type%20and%20Phaseweb.pdf