Role of Earth observation in climate action

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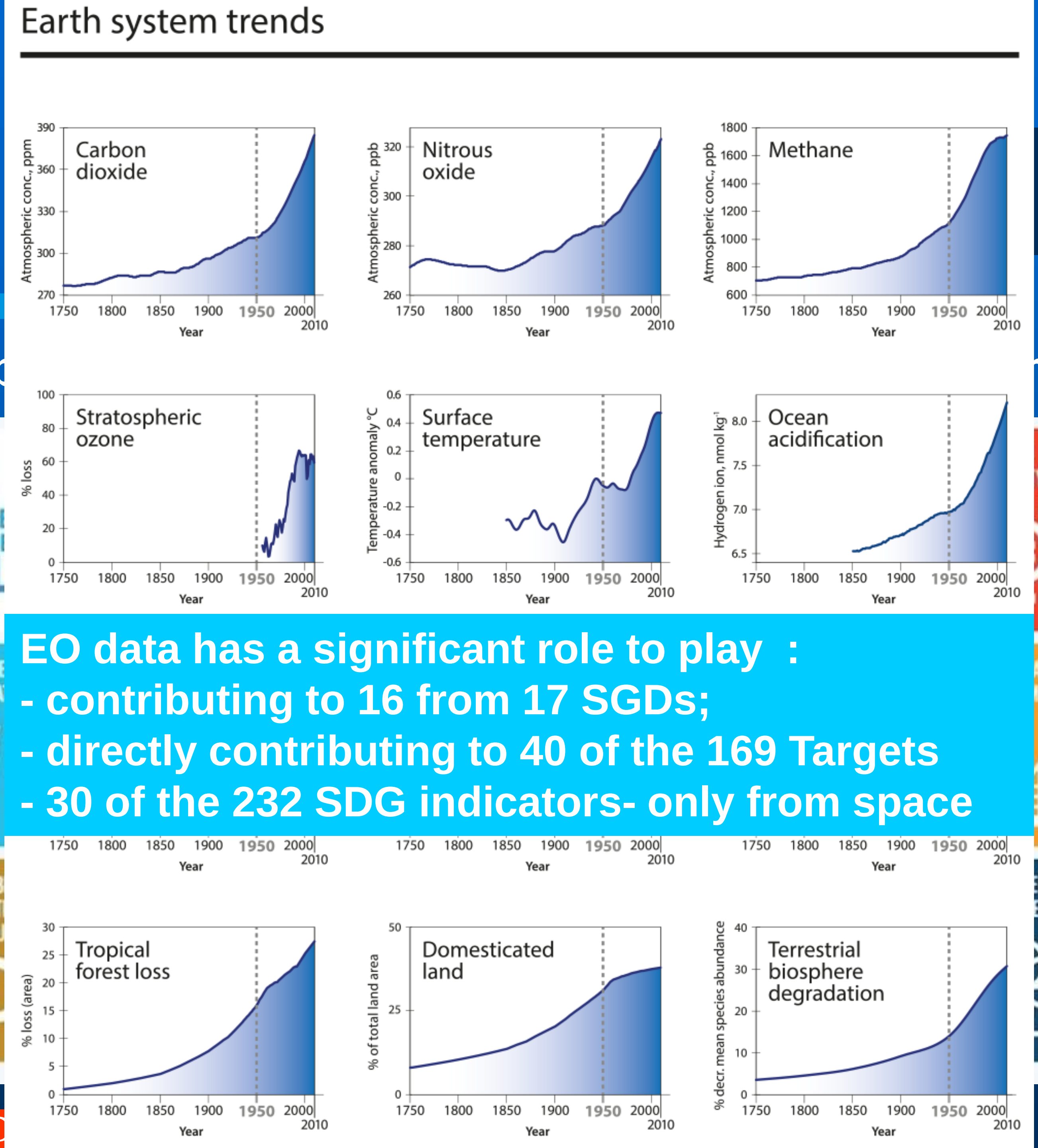
International Telecommunication Union

Committed to connecting the world

Sustainab… …nit 2016)



EO data has a significant role to play :

- **contributing to 16 from 17 SGDs;**
- **directly contributing to 40 of the 169 Targets**
- **30 of the 232 SDG indicators- only from space**

Rio-20 D

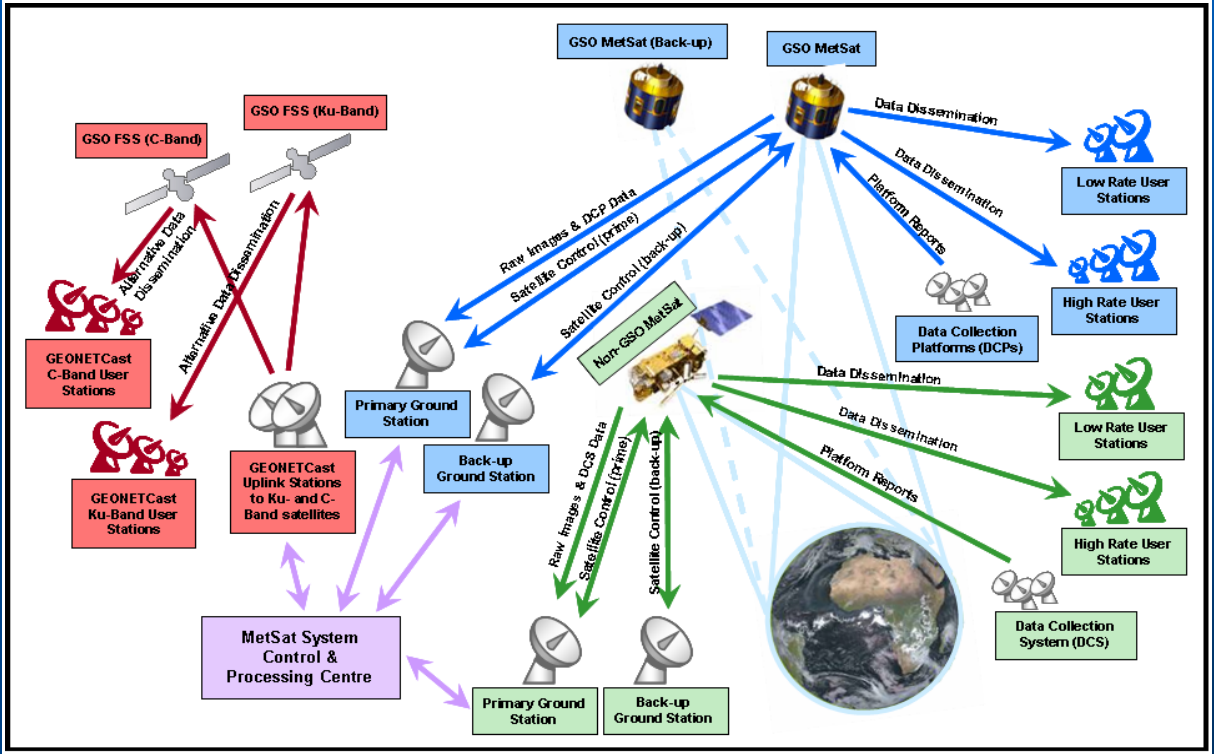
EO applications

Environmental data	Disaster management:	Economy development
Atmospheric chemistry (atmospheric pollution levels) Water temperature/salinity Coastal erosion Forest size and biomass evolution Soil moisture Polar ice extension and depth Land usage Security Mining investigation	Coastal hazards/tsunamis Drought Earthquakes Extreme weather/tornados Flooding Landslides Pollution (e.g. oil spills) Sea and lake ice Volcanoes eruptions Wild land fires	Urban planning support High resolution mapping Fishing stocks localization Agricultural productivity Water preserving

EO basics

FIGURE 2-1

General architecture of a MetSat system



Meteo-02-1

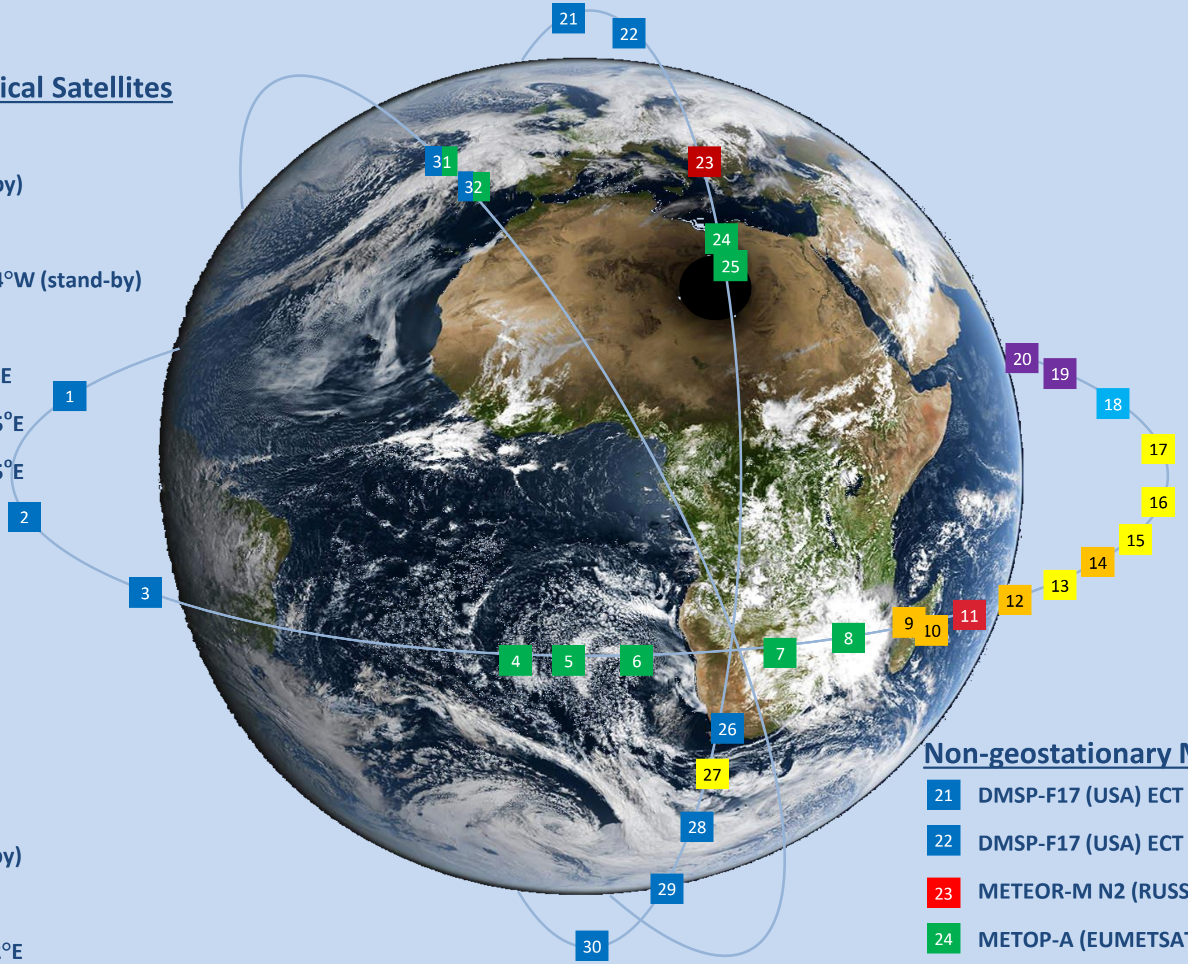
- *NGSO and GSO*
- *Main functions*:
- Data collection: DSP, optical, infrared, RF sensors
- Data delivery (direct or by pass DRS)
- Data distributions

EESS Handbook, MetSat Handbook, RS Recommendations

Currently operational Meteorological Satellites (Status: June 2016, Information Source: CGMS)

Geostationary Meteorological Satellites

1 GOES-15 (USA) 135°W
2 GOES-14 (USA) 105°W (stand-by)
3 GOES-13 (USA) 75°W
4 METEOSAT-11 (EUMETSAT) 3.4°W (stand-by)
5 METEOSAT-10 (EUMETSAT) 0°
6 METEOSAT-9 (EUMETSAT) 9.5°E
7 METEOSAT-8 (EUMETSAT) 41.5°E
8 METEOSAT-7 (EUMETSAT) 57.5°E
9 INSAT-3C (INDIA) 74°E
10 KALPANA-1 (INDIA) 74°E
11 ELECTRO-L N2 (RUSSIA) 77.8°E
12 INSAT-3C (INDIA) 82°E
13 FY-2E (CHINA) 86.5°E
14 INSAT-3A (INDIA) 93.5°E
15 FY-2G (CHINA) 105°E
16 FY-2F (CHINA) 112.5°E (stand-by)
17 FY-2D (CHINA) 123.5°E
18 COMS-1 (SOUTH KOREA) 128.2°E
19 HIMAWARI-8 (JAPAN) 140.7°E
20 HIMAWARI-7 (JAPAN) 145°E (stand-by)



170 operating missions

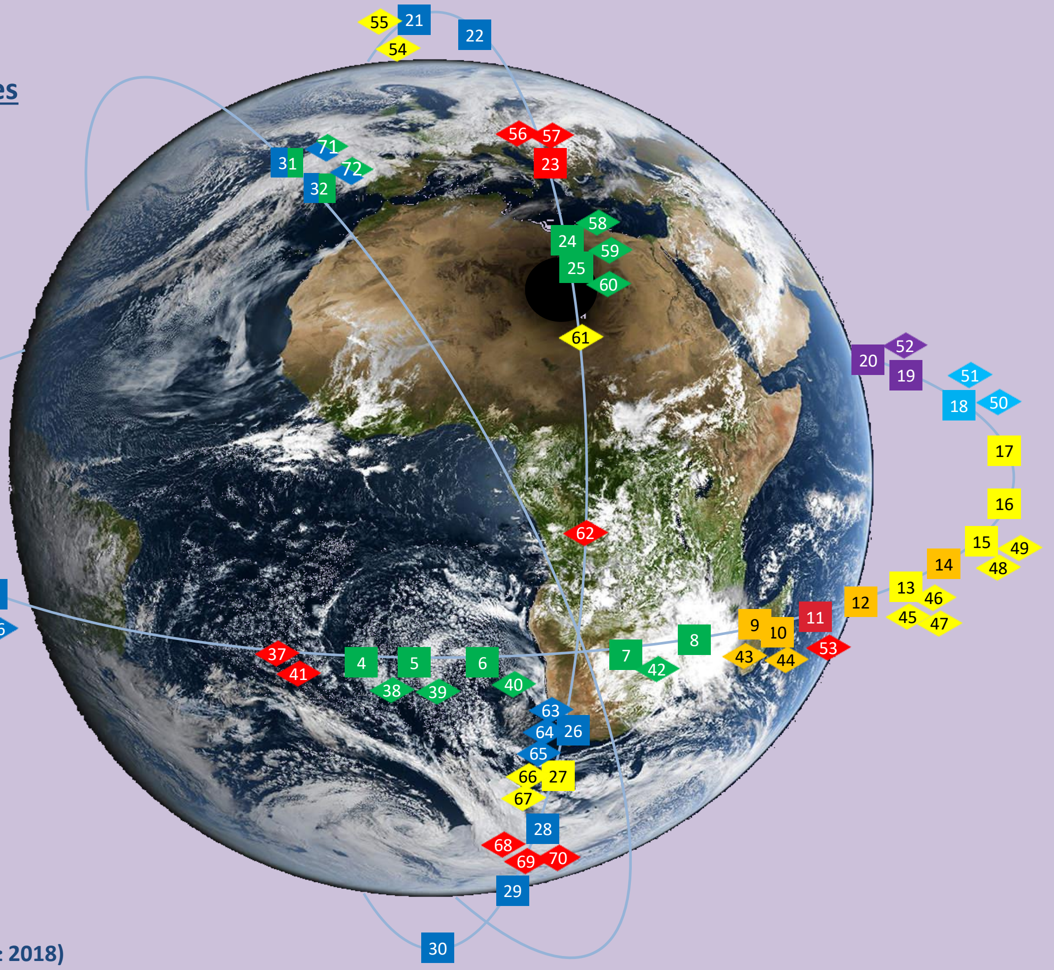
Non-geostationary Meteorological Satellites

21 DMSP-F17 (USA) ECT 06:20 descending
22 DMSP-F17 (USA) ECT 07:08 descending
23 METEOR-M N2 (RUSSIA) ECT 09:10 descending
24 METOP-A (EUMETSAT) ECT 09:30 descending
25 METOP-B (EUMETSAT) ECT 09:30 descending
26 SNPP (USA) ECT 13:29 ascending
27 FY-3B (CHINA) ECT 13:38 ascending
28 NOAA-19 (USA) ECT 14:36 ascending
29 DMSP-F16 (USA) ECT 16:12 ascending
30 NOAA-18 (USA) ECT 17:53 ascending
31 JASON-2 (USA, EUROPE) 66° inclination
32 JASON-3 (USA, EUROPE) 66° inclination

Planned Meteorological Satellites in the Timeframe 2016 - 2026 (Status: June 2016, Information Source: CGMS)

Geostationary Meteorological Satellites

- 33 GOES-T (USA) 137°W (≥ 2019)
- 34 GOES-R (USA) 89.5W (≥ 2016-11)
- 35 GOES-S (USA) 75°W (≥ 2018)
- 36 GOES-U (USA) 75°W (≥ 2025)
- 37 ELECTRO-L N3 (RUSSIA) 14.5°W (≥ 2017)
- 38 MTG-I1 (EUMETSAT) 0°E/9.5°E (≥ 2020)
- 39 MTG-S1 (EUMETSAT) 0°E (≥ 2022)
- 40 MTG-I2 (EUMETSAT) 0°E (≥ 2023)
- 41 ELECTRO-L N5 (RUSSIA) TBD (≥ 2025)
- 42 METEOSAT-8 (EUMETSAT) 41.5°E (≥ 2016-09)
- 43 INSAT-3DR (INDIA) 74°E (≥ 2016-08)
- 44 INSAT-3DS (INDIA) 74°E (≥ 2022)
- 45 FY-4A (CHINA) 86.5°E (≥ 2016)
- 46 FY-2H (CHINA) 86.5°E (≥ 2017)
- 47 FY-4C (CHINA) 86.5°E (≥ 2020)
- 48 FY-4B (CHINA) 105°E (≥ 2018)
- 49 FY-4D (CHINA) 105°E (≥ 2020)
- 50 GEO-KOMPSAT-2A (SOUTH KOREA) 128.2°E (≥ 2018)
- 51 GEO-KOMPSAT-2B (SOUTH KOREA) 128.2°E (≥ 2019)
- 52 HIMAWARI-9 (JAPAN) 140°E (≥ 2016)
- 53 ELECTRO-L N5 (RUSSIA) TBD (≥ 2019)

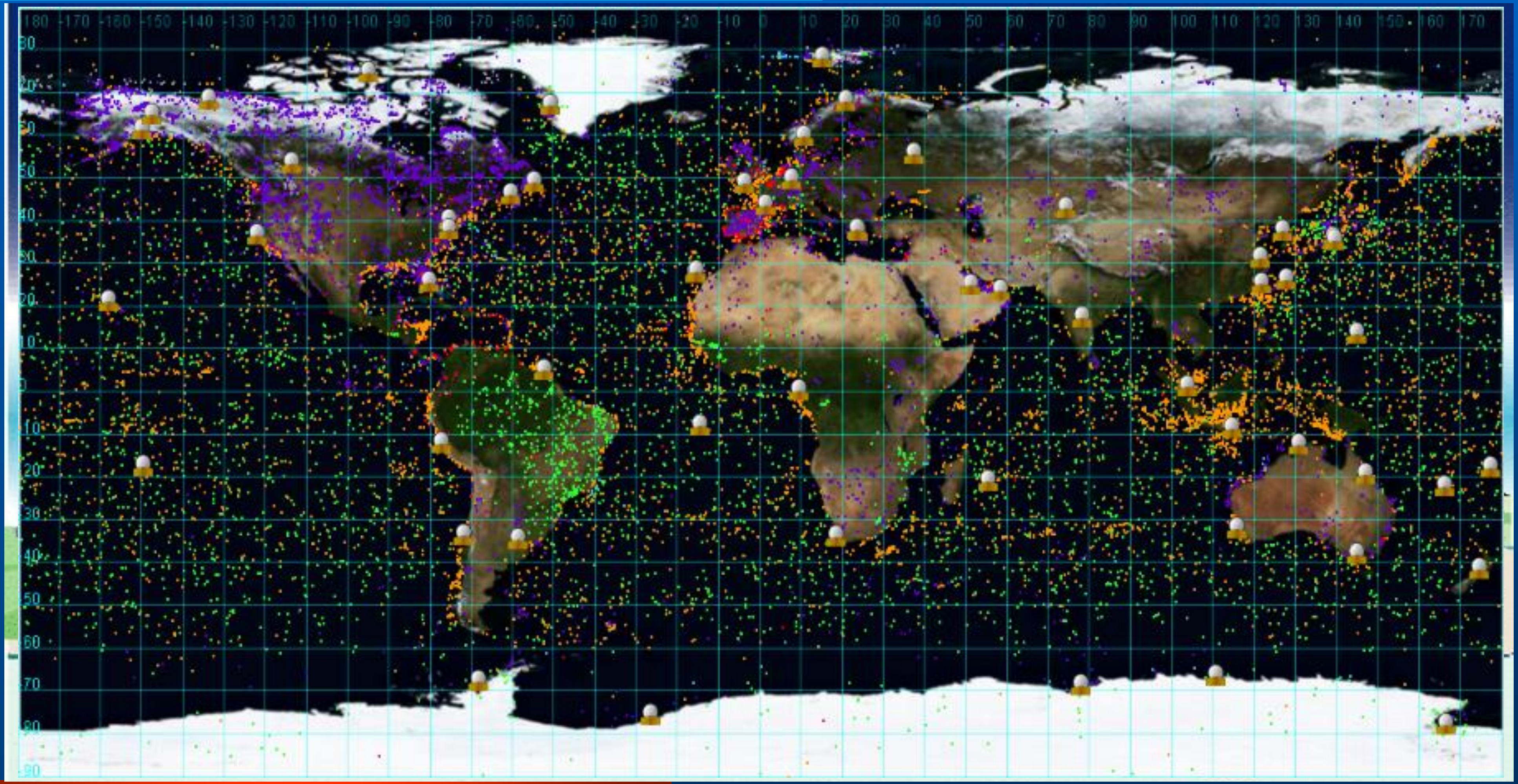


170 planned missions

Non-geostationary Meteorological Satellites

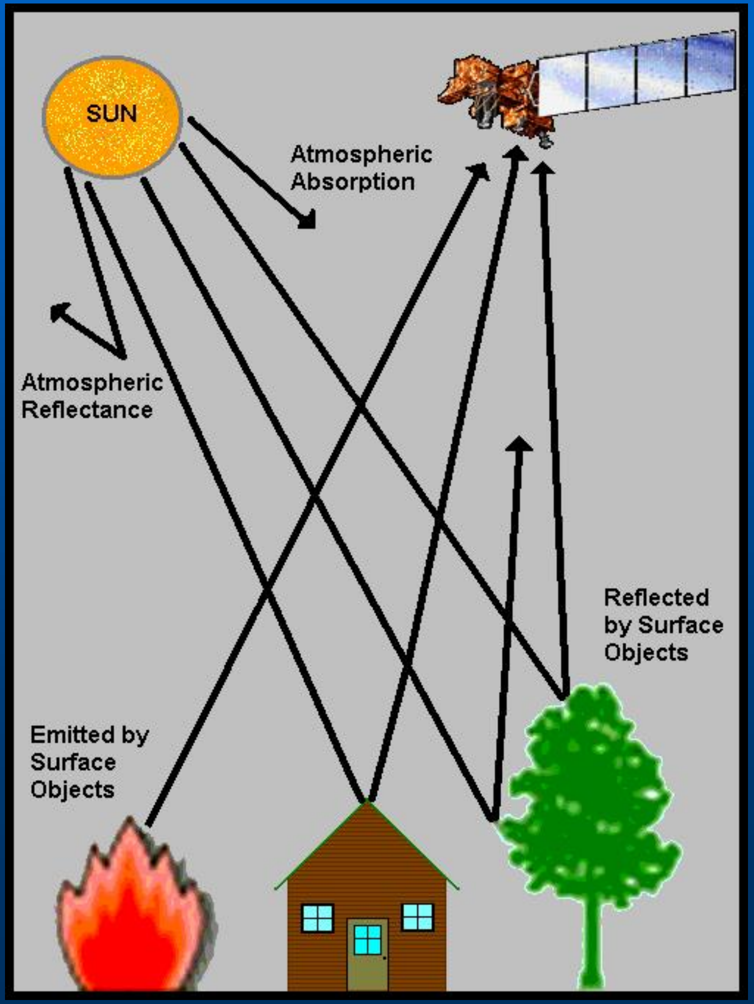
- 54 FY-3E (CHINA) ECT 06:00 desc. (≥ 2018)
- 55 FY-3H (CHINA) ECT 06:00 desc. (≥ 2021)
- 56 METEOR-M N2-2 (RUSSIA) ECT 09:00 desc. (≥ 2017)
- 57 METEOR-M N2-4 (RUSSIA) ECT 09:00 desc. (≥ 2021)
- 58 METOP-C (EUMETSAT) ECT 09:30 desc. (≥ 2018-10)
- 59 METOP-SG A (EUMETSAT) ECT 09:30 desc. (≥ 2021)
- 60 METOP-SG B (EUMETSAT) ECT 09:30 desc. (≥ 2023)
- 61 FY-3F (CHINA) ECT 10:00 desc. (≥ 2019)
- 62 METEOR-M N3 (RUSSIA) ECT 12:00 asc. (≥ 2021)
- 63 JPSS-1 (USA) ECT 13:30 asc. (≥ 2017-01)
- 64 JPSS-2 (USA) ECT 13:30 asc. (≥ 2021)
- 65 JPSS-3 (USA) ECT 13:30 asc. (≥ 2026)
- 66 FY-3D (CHINA) ECT 14:00 asc. (≥ 2016-12)
- 67 FY-3G (CHINA) ECT 14:00 asc. (≥ 2021)
- 68 METEOR-M N2-1 (RUSSIA) ECT 15:00 asc. (≥ 2017)
- 69 METEOR-M N2-3 (RUSSIA) ECT 15:00 asc. (≥ 2020)
- 70 METEOR-M N2-5 (RUSSIA) ECT 15:00 asc. (≥ 2022)
- 71 72 SENTINEL-6 A/B(USA, EUROPE) 66° incl. (≥ 2020/2025)

EO and MetSat basics



EO and MetSat basics

- all matter emits low levels of EM radiation
- every body has unique emissivity characteristics depending on temperature and electromagnetic properties of the emitting medium to absorb, emit, and scatter electromagnetic waves (Kirchhoff)
- the thermal noise power radiated at a given frequency is commonly expressed as a *brightness temperature* (radiometer)
- absence of radiation- presence in the atmosphere of specific gases



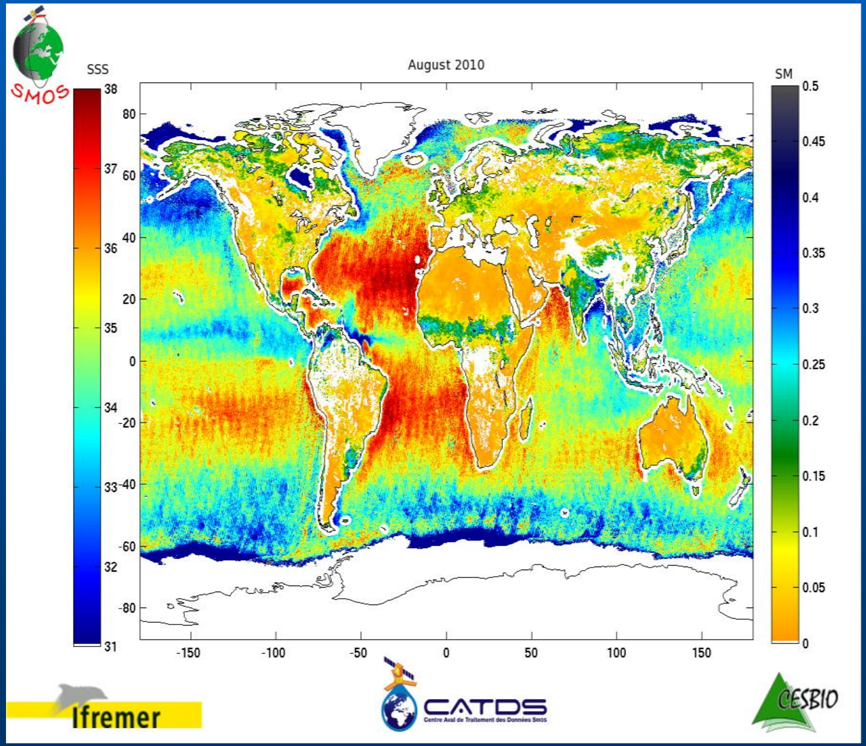
EO and MetSat basics

- *Soil Moisture and Ocean Salinity (SMOS)*

-The satellite orbit, instrument design and data processing are designed to provide data every three days with a 35–50 km resolution.

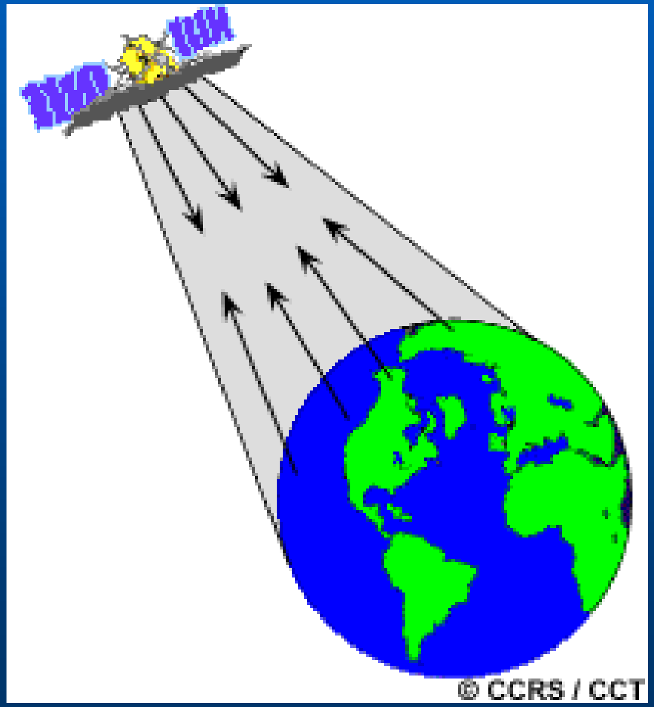
-The accuracy requirement of the ocean salinity observations has been set to **0.1 psu** every 10 days at 200 km spatial resolution.

-1 psu= 1 g of in 1 kg of seawater



EO and MetSat basics

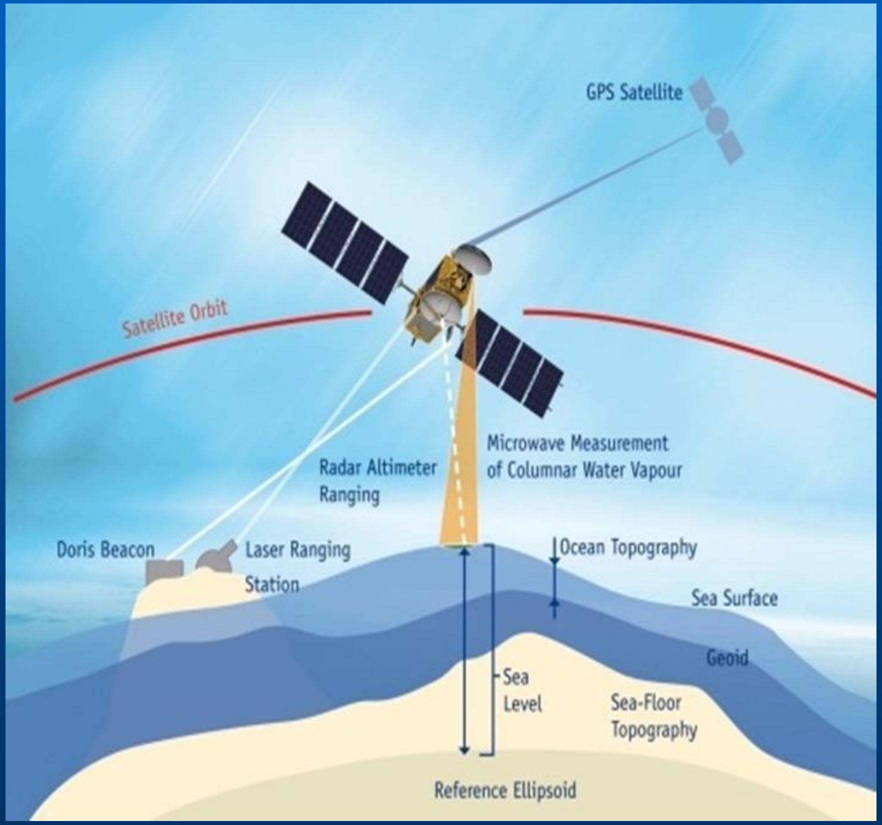
- the satellite illuminating the object or surface to be studied and capturing the reflected signal as a source of information for analysing various characteristics or phenomena
- unique sensitivity to a number of fluctuating land/sea/atmosphere parameters (e.g. vegetation humidity and cloud height)
- All weather, high spatial resolution and measurement quality



Altimeter

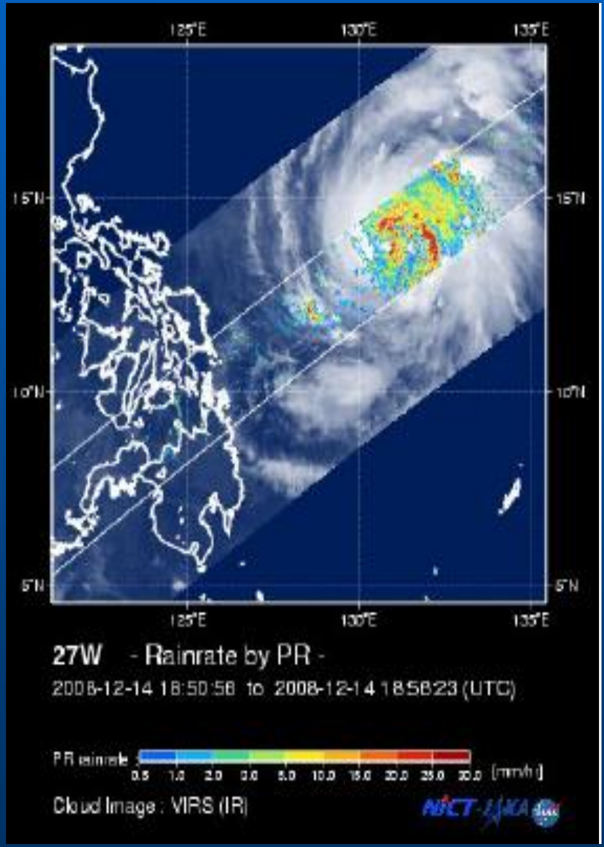
- global ocean surface data on a continuous basis for several decades. satellites measure the global sea surface height to an accuracy of a few centimetres every 10 days which enables the determination of ocean circulations and mean sea level trends in support of weather forecasting, climate monitoring and operational oceanography.

Jason-1, -2 and -3



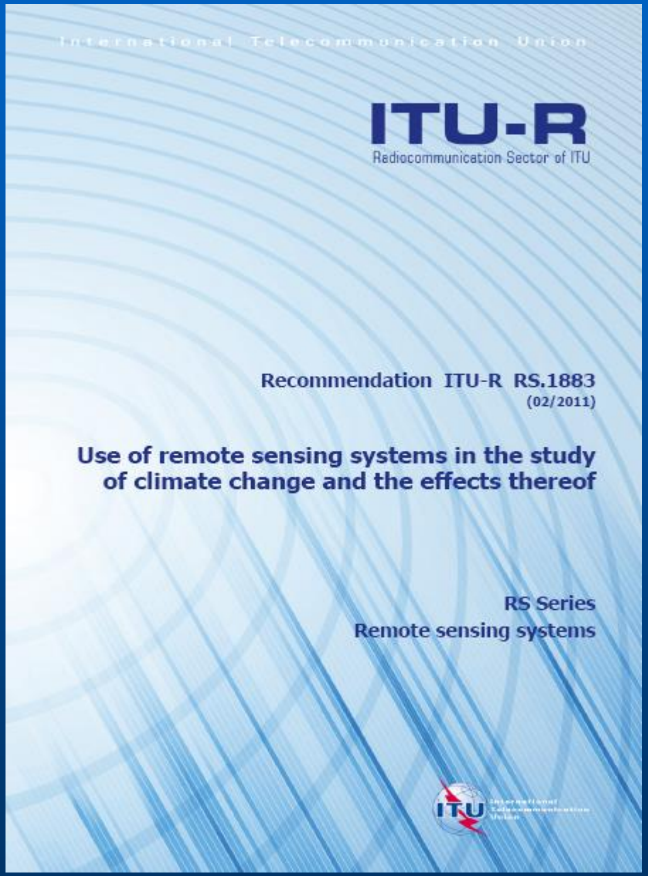
Precipitation radar

- **TRMM- 13-GHz spaceborne rain radar   vertical distribution of precipitation over the tropics**
- **understanding the interactions between water vapor, clouds and precipitation that is central to regulating the climate system**
- ***Image*: rain rate distribution of a Typhoon near Philippines on 14 Dec. 2008**



ITU-R study highlights

- **Guidelines on the provision of satellite-provided remote sensing data for the purpose of studying climate change**
- **Summary of status of major climate variables and forcing factors**
- **Protection of science service spectrum**
- **WMO/ITU Handbook "Use of Radio Spectrum for Meteorology: Weather, Water and Climate Monitoring and Prediction"**
  https://www.itu.int/pub/R-HDB-45-2017



Conclusions

- ICT is absolutely essential Tools to ~~compliment global environmental decisions~~ to achieve SGD
- ITU is essential for worldwide ICT development (Standardisation, spectrum allocation, technical regulations, satellite and terrestrial radiosystems recording, international radiomonitoring, interference reporting) – Follow ITU-R SG activity and WRC process

  Register spectrum for development of satellite observation networks
- Country case studies on application of Earth observation for climate change What are the opportunities and challenges for the use of Earth Observation for climate change, especially in developing countries? Study ITU-R Reports and Recommendation RS-series and Handbooks of ITU-R
- What guidelines could be given to faciliate the use of Earth Observation for climate change, especially in developing countries? Introduction low cost technology- drons, small sat;

  use available data – Eumetsat, https://www.sfcgonline.org/Remote%20Sensing/default.aspx, www.opendatacub.org,