13th AGILE Science Workshop
"AGILE: 8 and counting"
May 25 and 26, 2015
ASI Headquarters, Via del Politecnico, Rome

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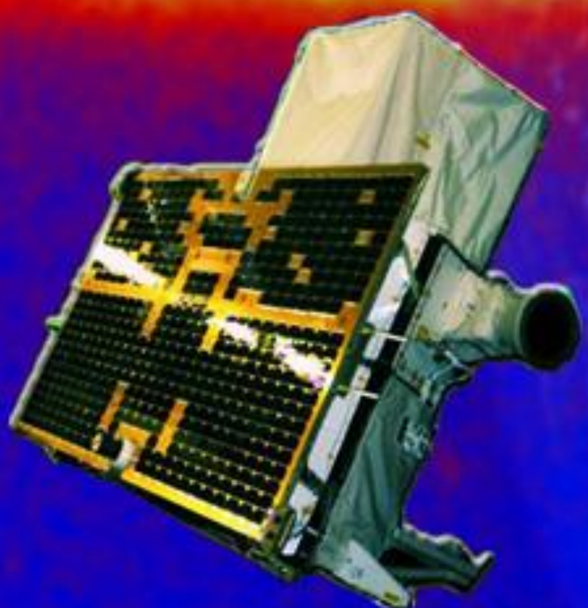
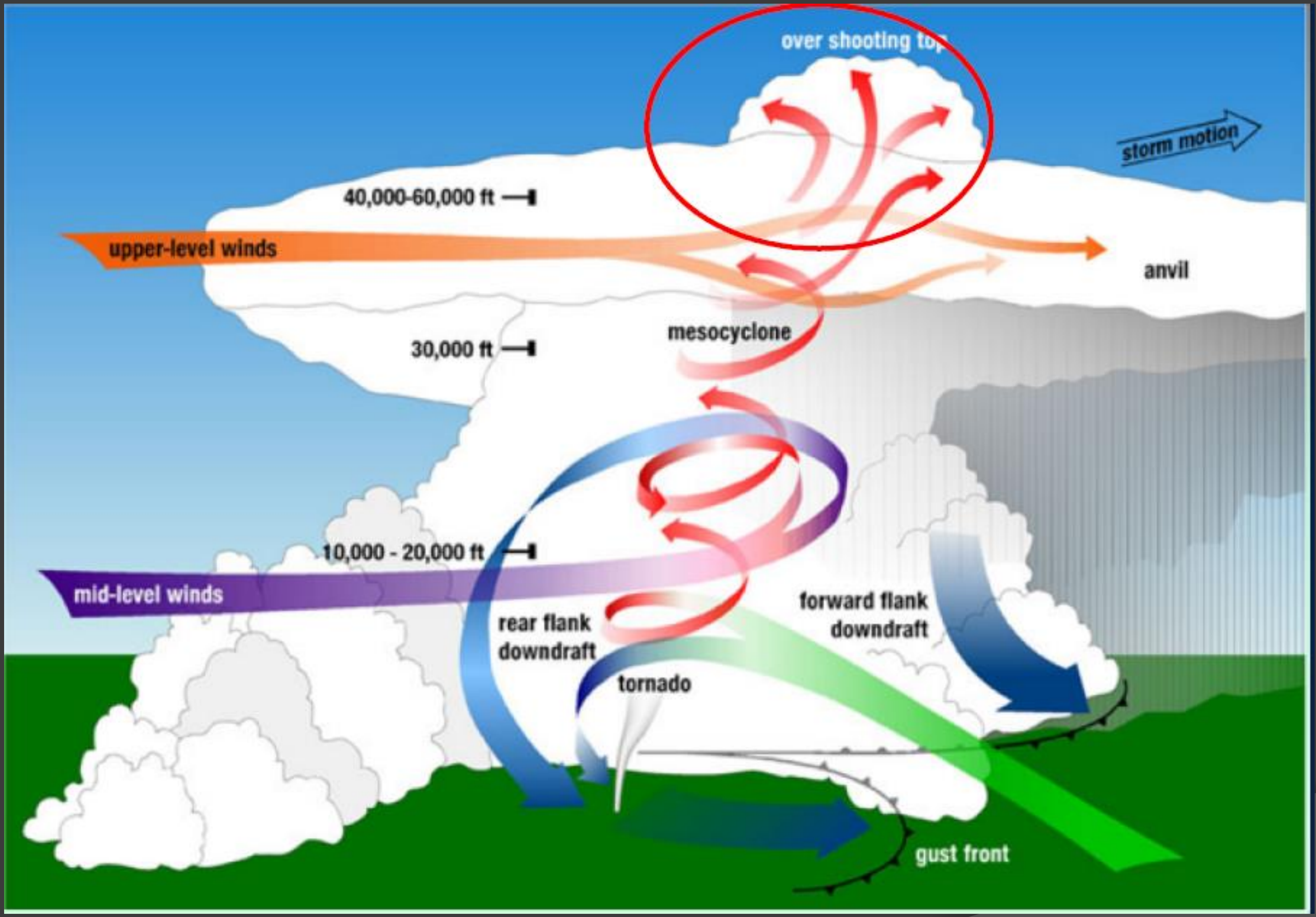
Meteorological Support for TGF Data Characterization

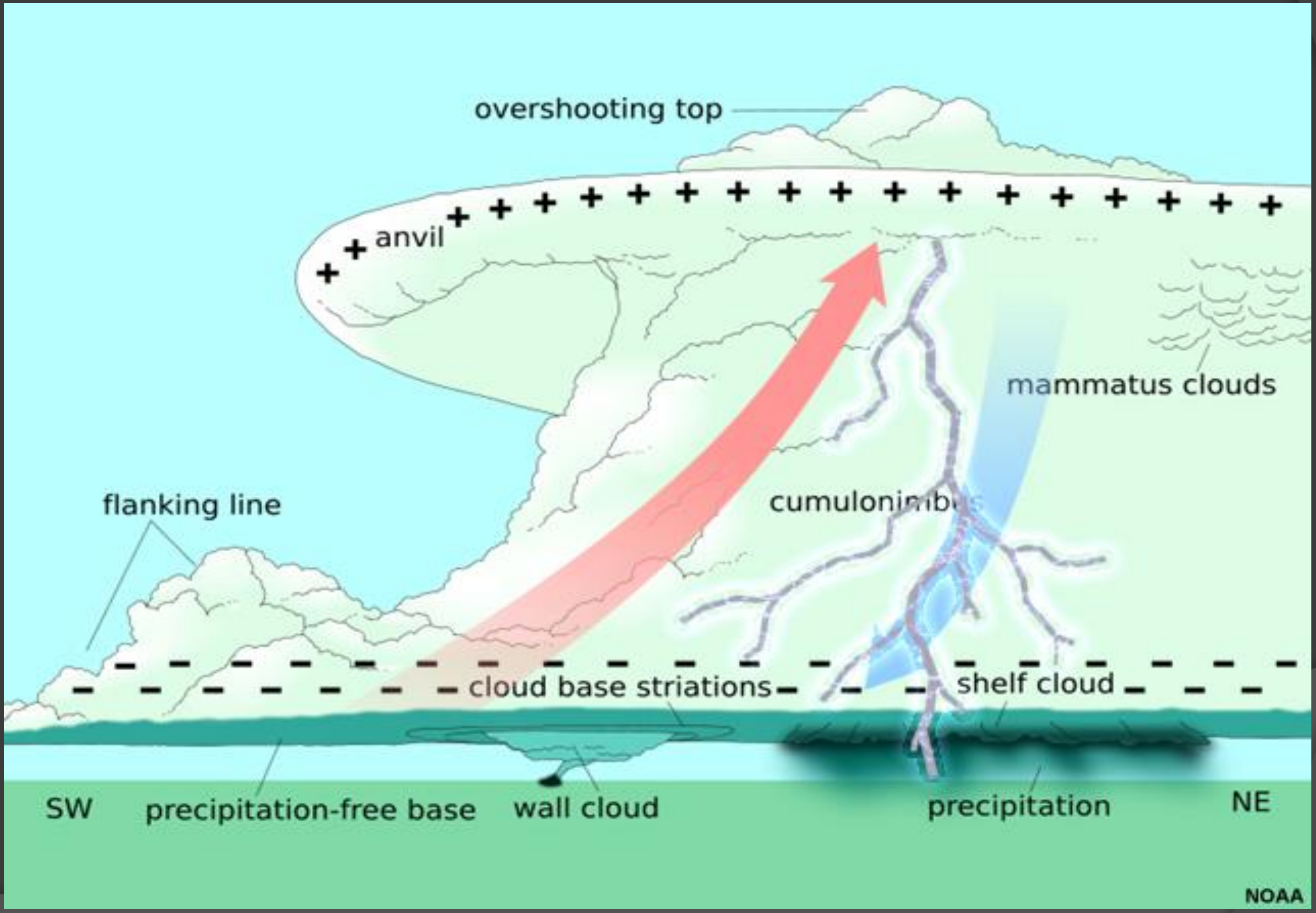


Meaning of “Convection”



Source: NOAA/NSSL (http://www.nssl.noaa.gov/primer/tornado/images/tor_formation_lg.jpg)

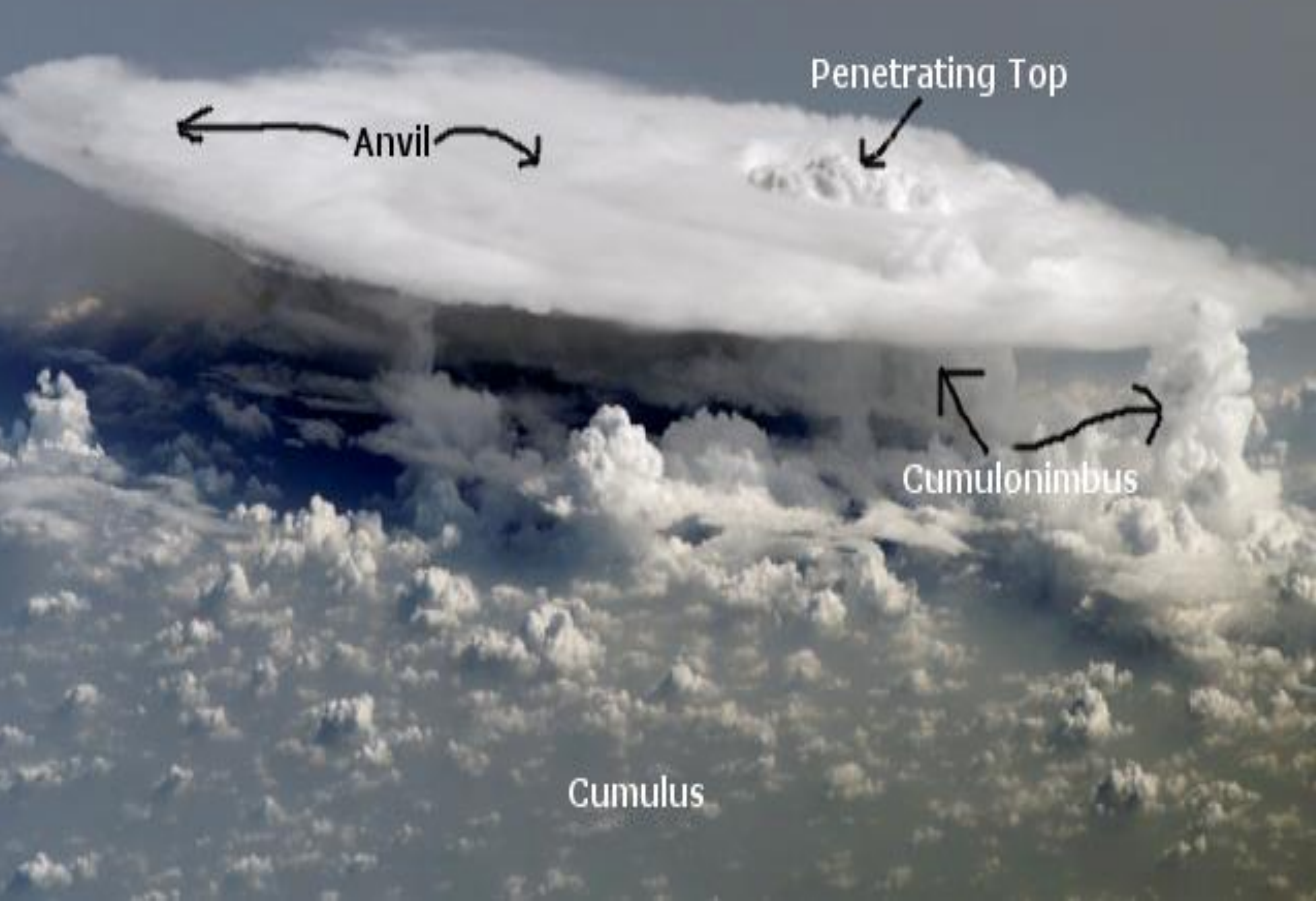
…and cloud electrification



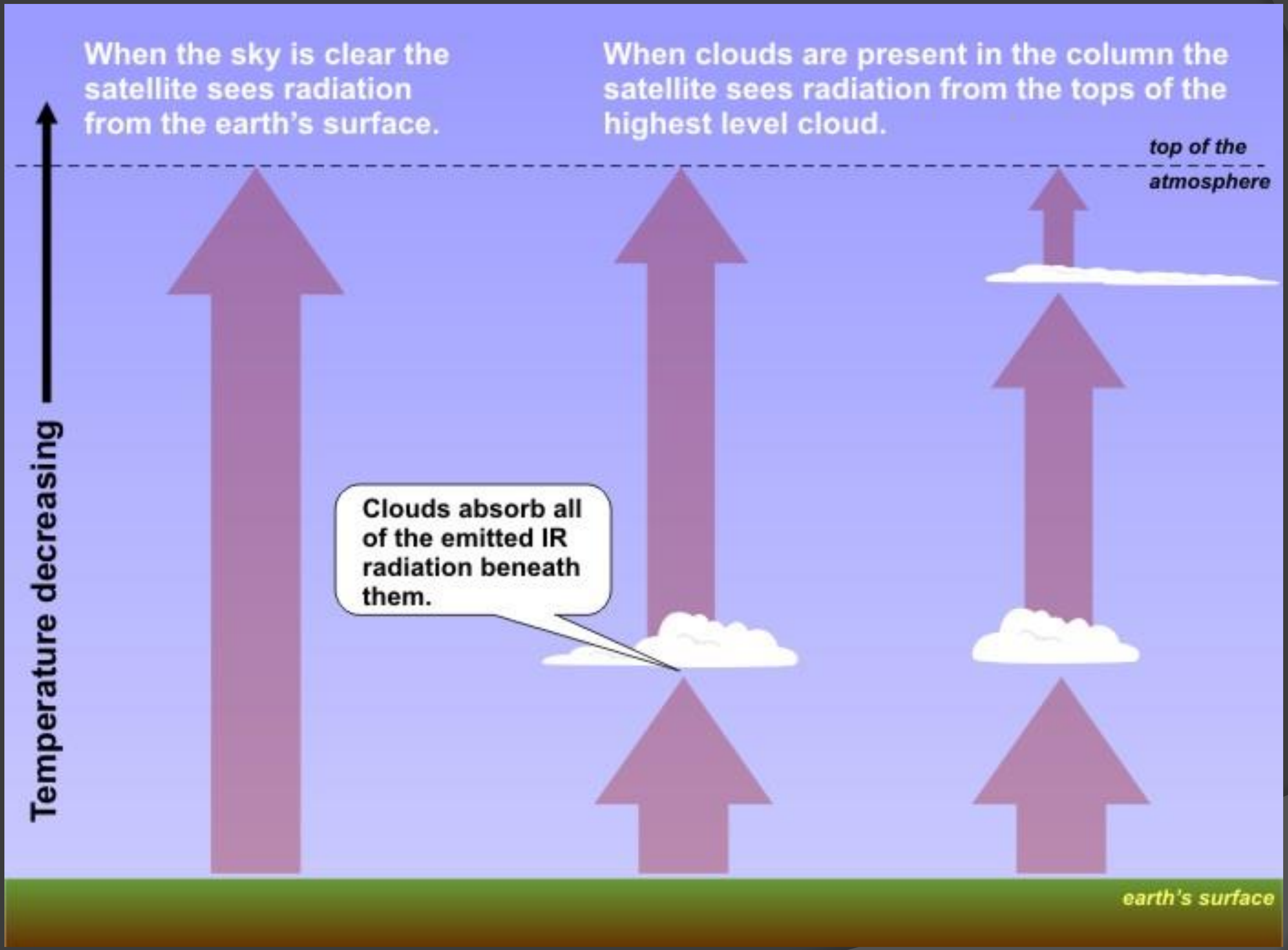
… a nice photo from airplane

Source: http://eoimages.gsfc.nasa.gov

International Space Station Photograph Of A Thunderstorm With An Overshooting Top Over The Ivory Coast, 5 February 2008

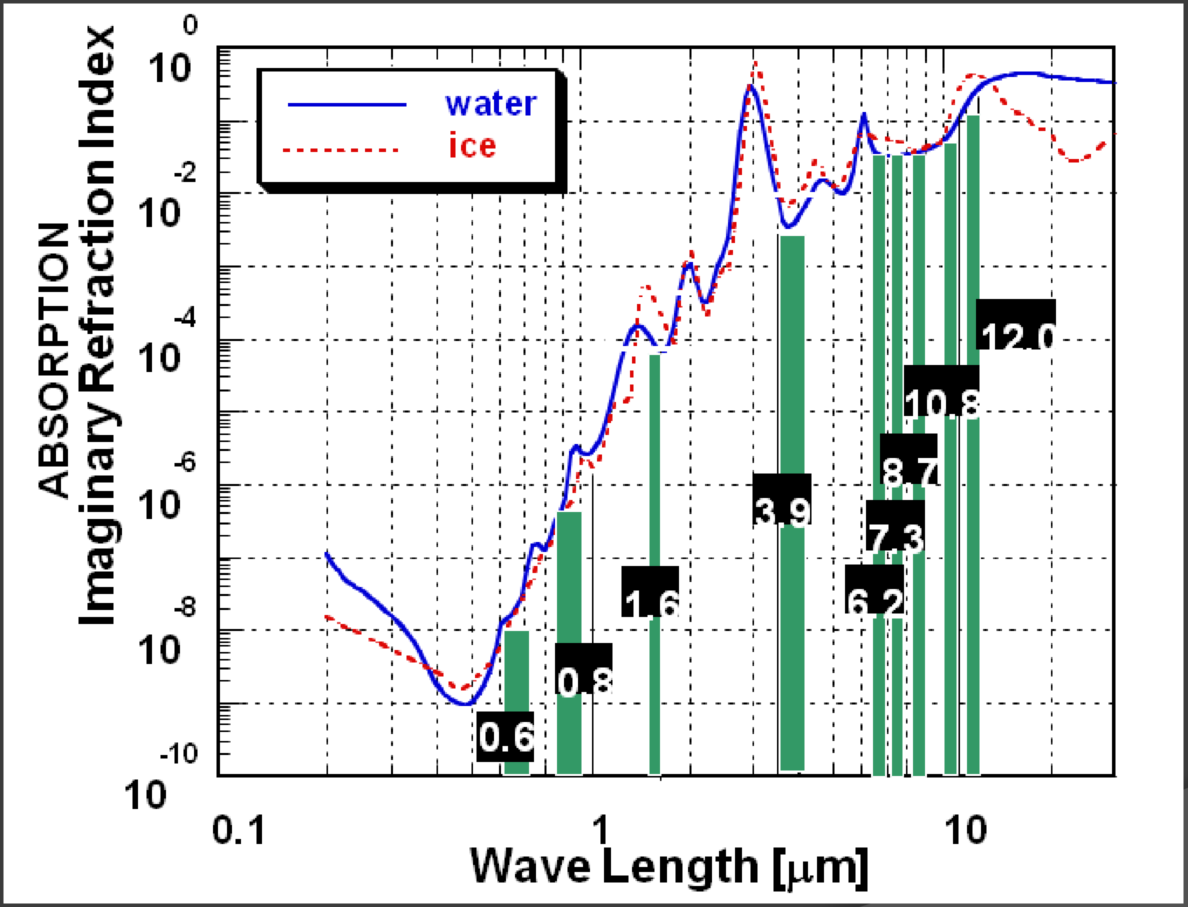


VIS-IR Observations

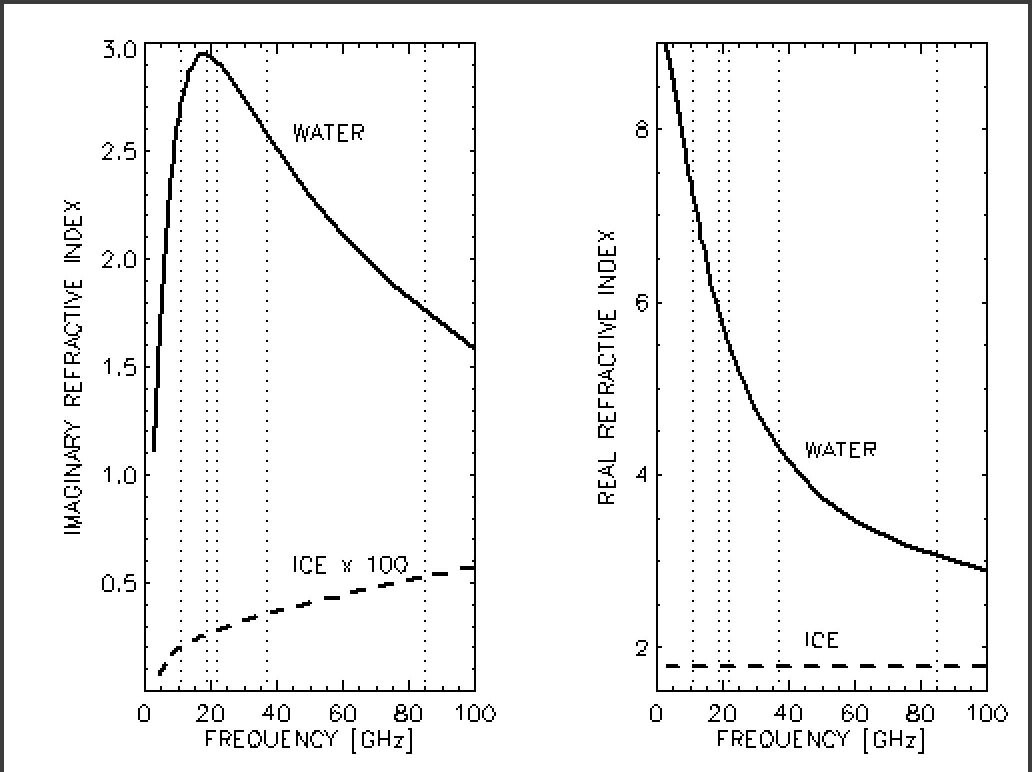


Source: http://learningweather.psu.edu/

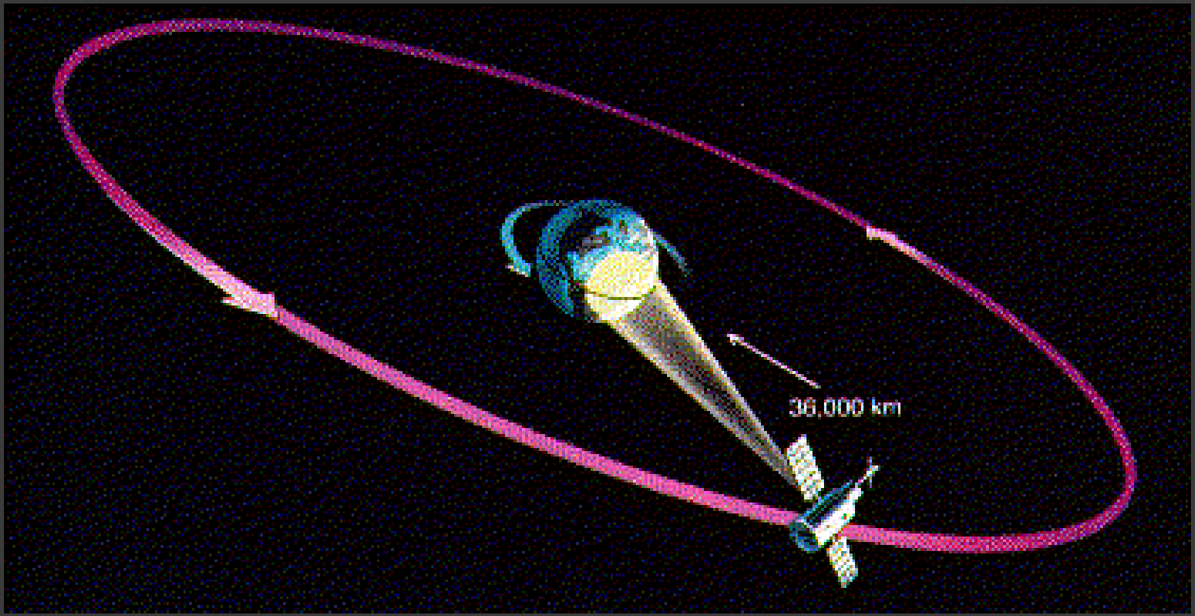
Vis-IR Refractive Index



MW Refractive Index

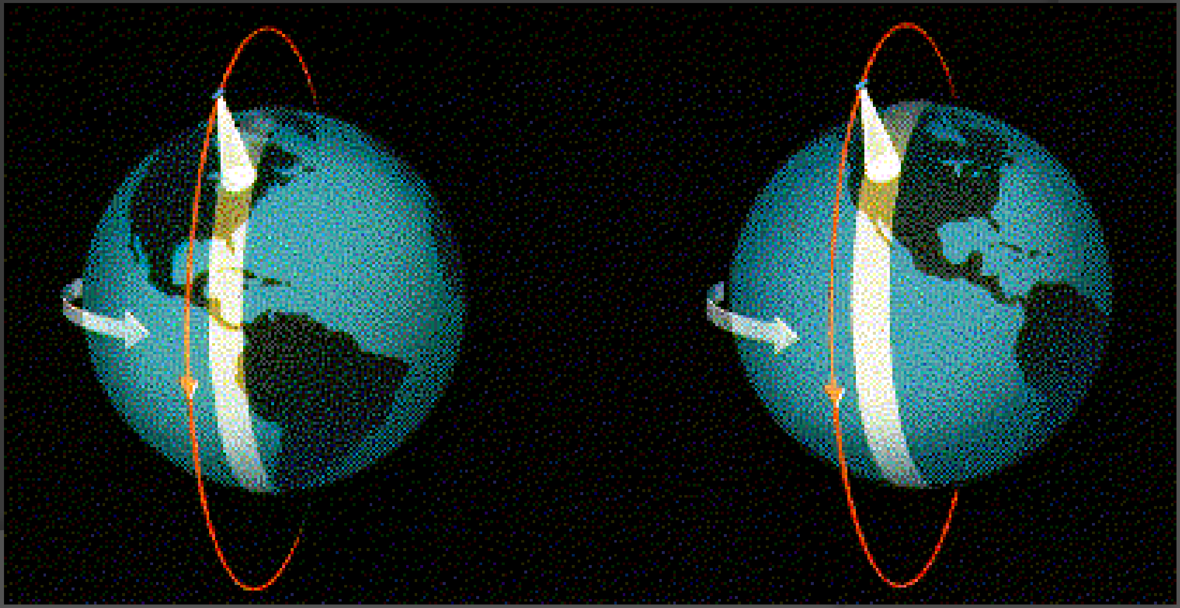


GEO- LEO

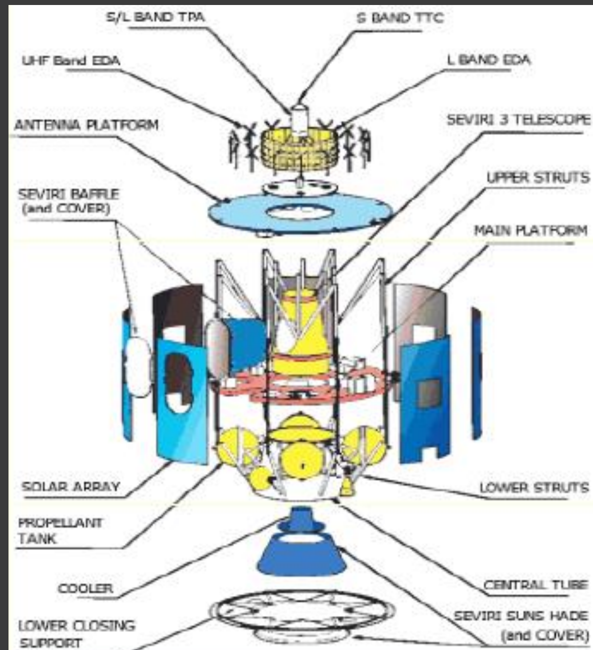


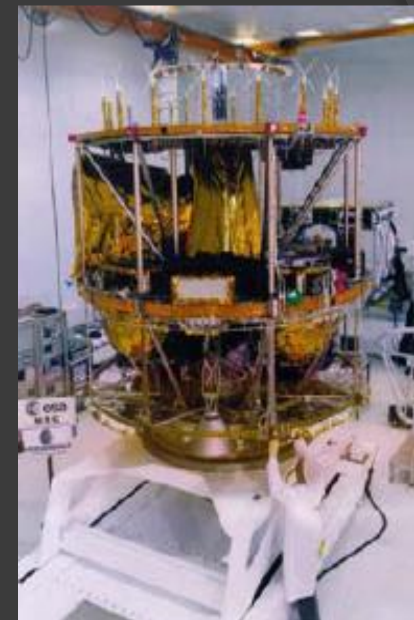
GEOSYNCHRONOUS EARTH ORBIT (GEO) SATELLITES

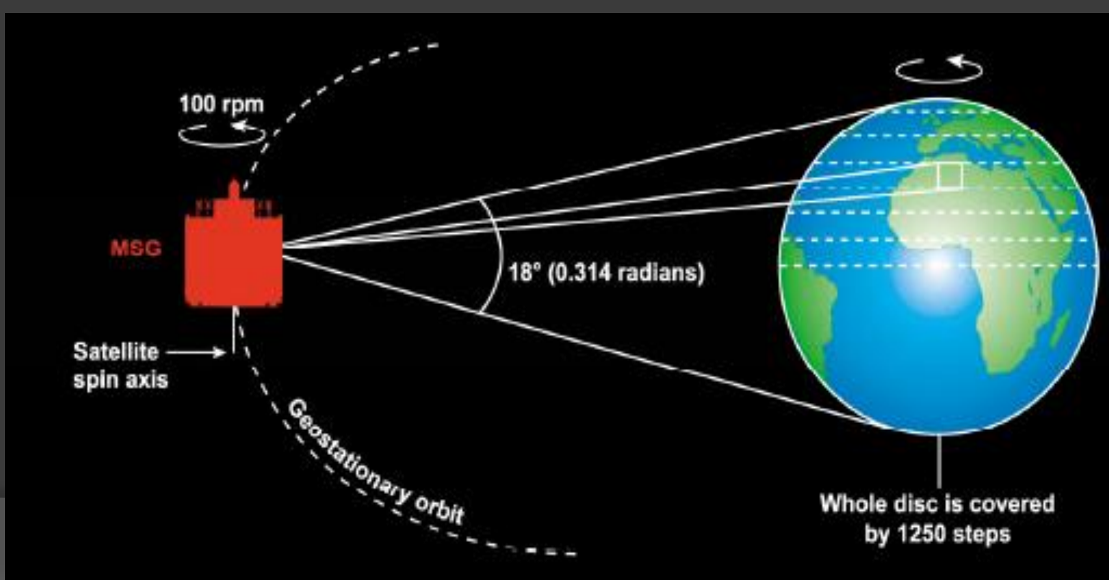
LOW EARTH ORBIT (LEO) SATELLITES



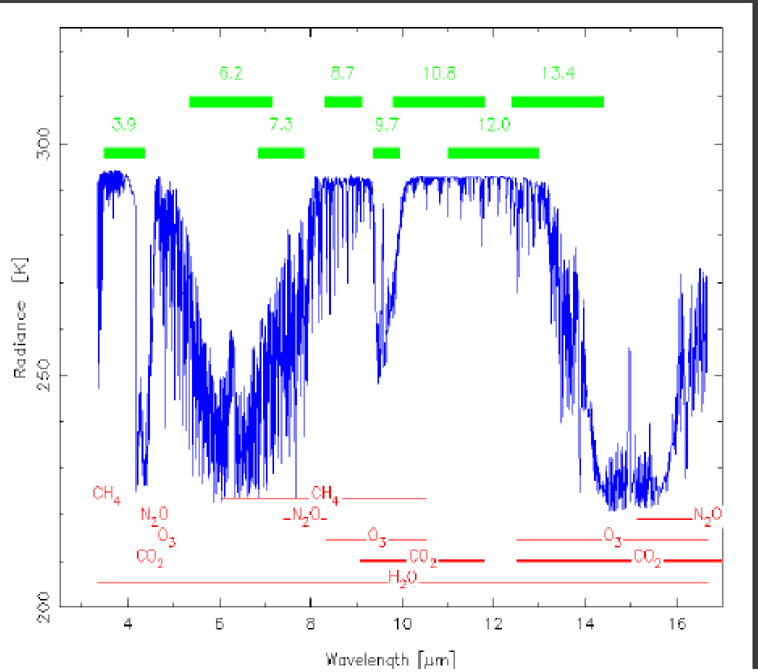
METEOSAT SECOND GENERATION (1)

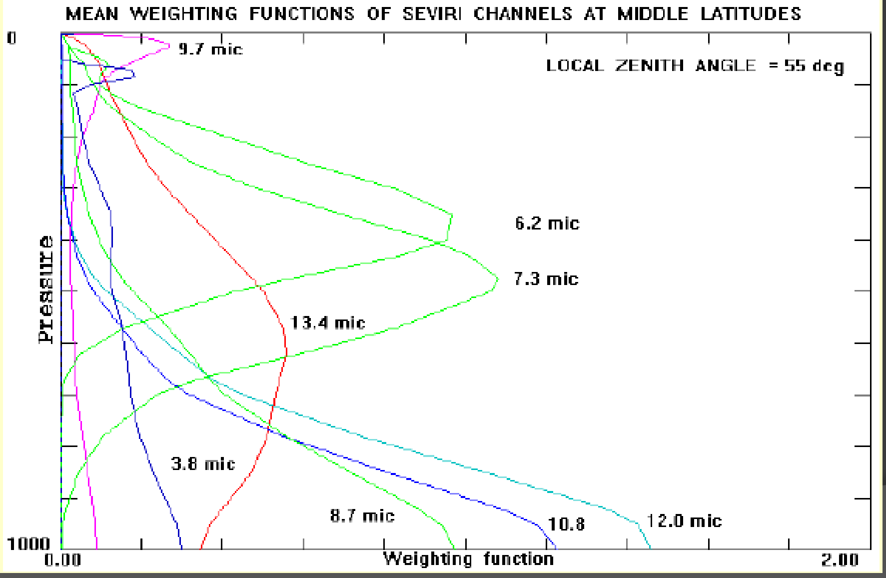






METEOSAT SECOND GENERATION (2)





Spinning Enhanced Visible and Infrared Imager (SEVIRI).

Channel	USE
0.6 and 0.8 μm	Cloud detection, scene identification, cloud tracking, aerosol observation, vegetation monitoring. Heritage from AVHRR
1.6 μm	Discriminates between snow and cloud, ice and water clouds. Aerosol information. Heritage from ATSR
3.9 μm	Low cloud and fog detection, Measurement of land and sea surface temperature at night. Spectral band broadened towards higher wavelength to improve signal-to-noise ratio. Heritage from AVHRR
6.2 and 7.3 μm	Upper- and mid-tropospheric water vapour, Cloud and water vapour tracking, Height allocation of semitransparent clouds
8.7 μm	Quantitative information of thin cirrus clouds, Discriminates between ice and water clouds. Heritage from HIRS
9.7 μm	Ozone radiances as input to NWP. Experimental channel used for tracking ozone patterns representative of wind motion in the lower stratosphere. Monitoring of evolution of total ozone field
10.8 and 12.0 μm	Measurement of earth surface and cloud top temperatures, Detection of cirrus and inference of total precipitable WV over sea.
13.4 μm	Split window channels from AVHRR Improvement of height determination of transmissive cirrus clouds, Temperature information from lower troposphere (cloud free areas) for instability assessment. Known from GOES VAS instrument.

broadband HRV (High Resolution Viible)

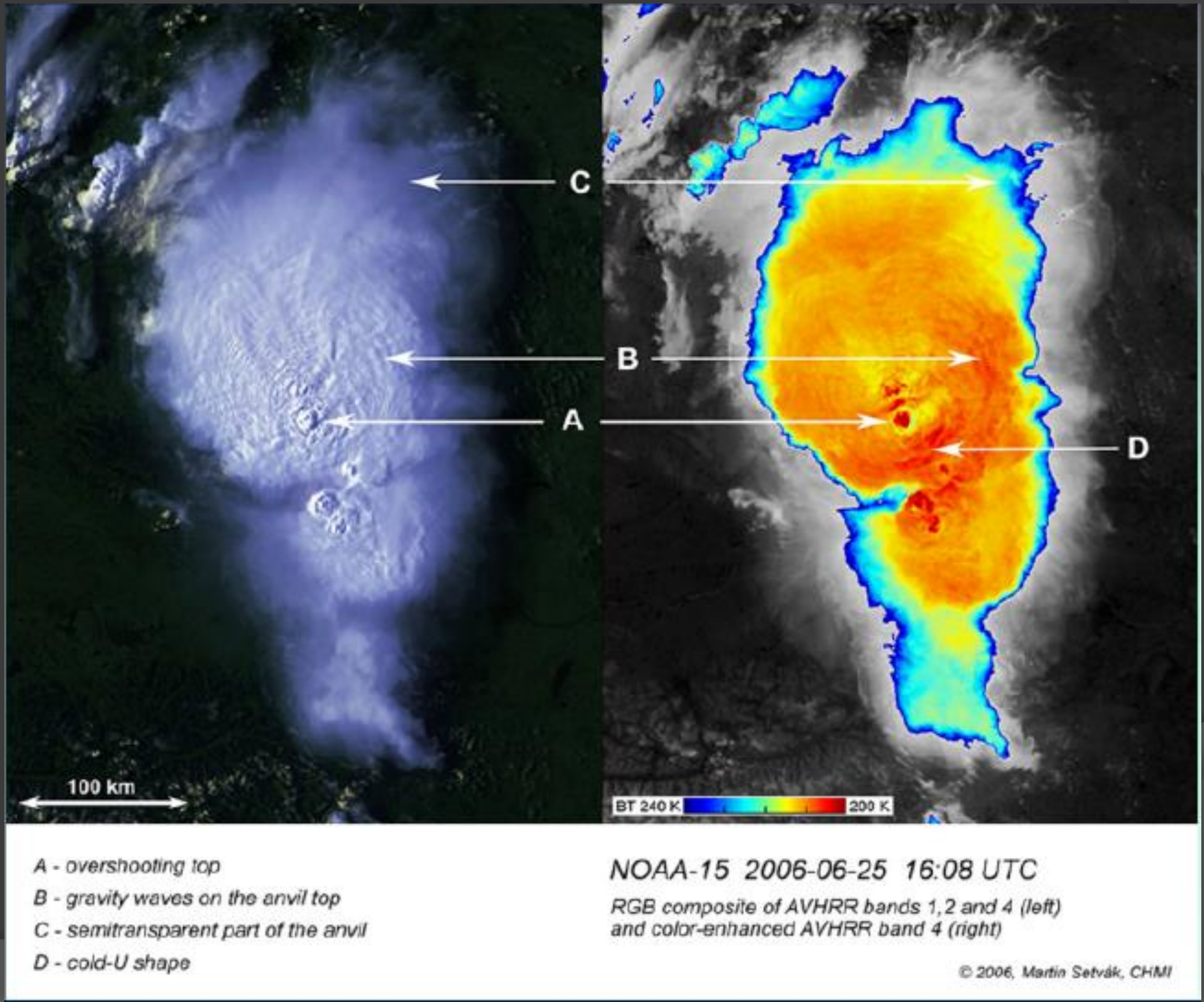
Overshooting Tops

Overshooting top: a domelike protusion above a cumuloninbus anvil, representing the intrusion of an updraft through its equilibrium level (level of neutral buoyancy)

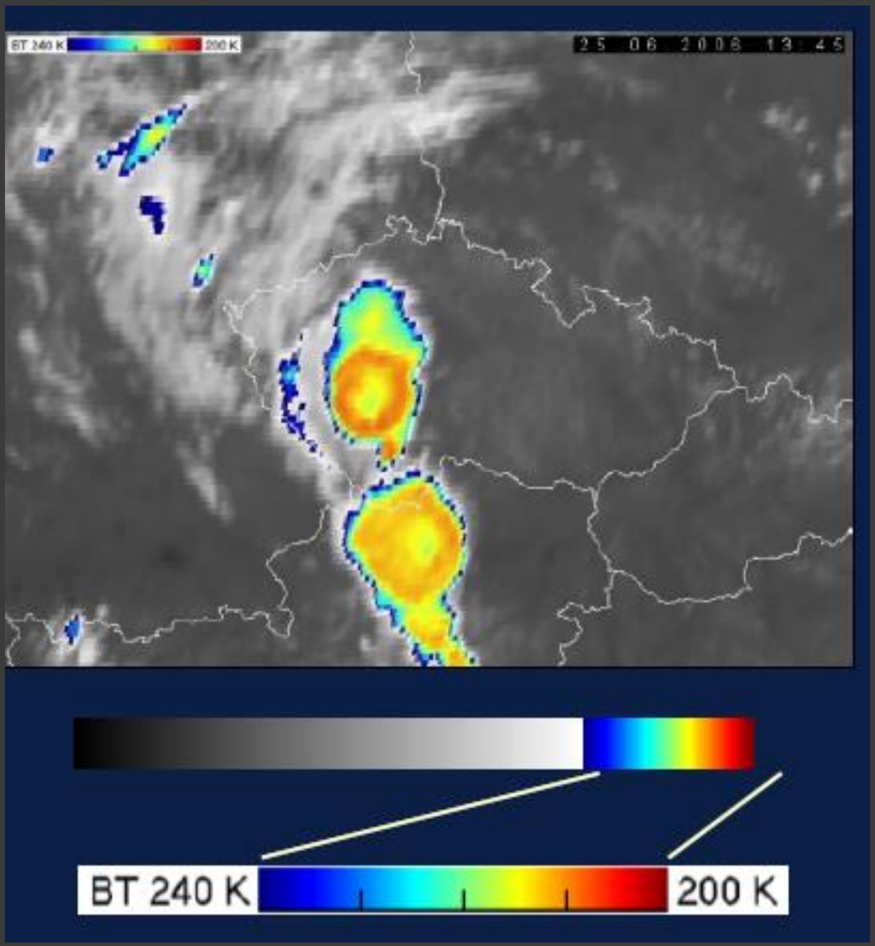
(AMS Glossary definition)

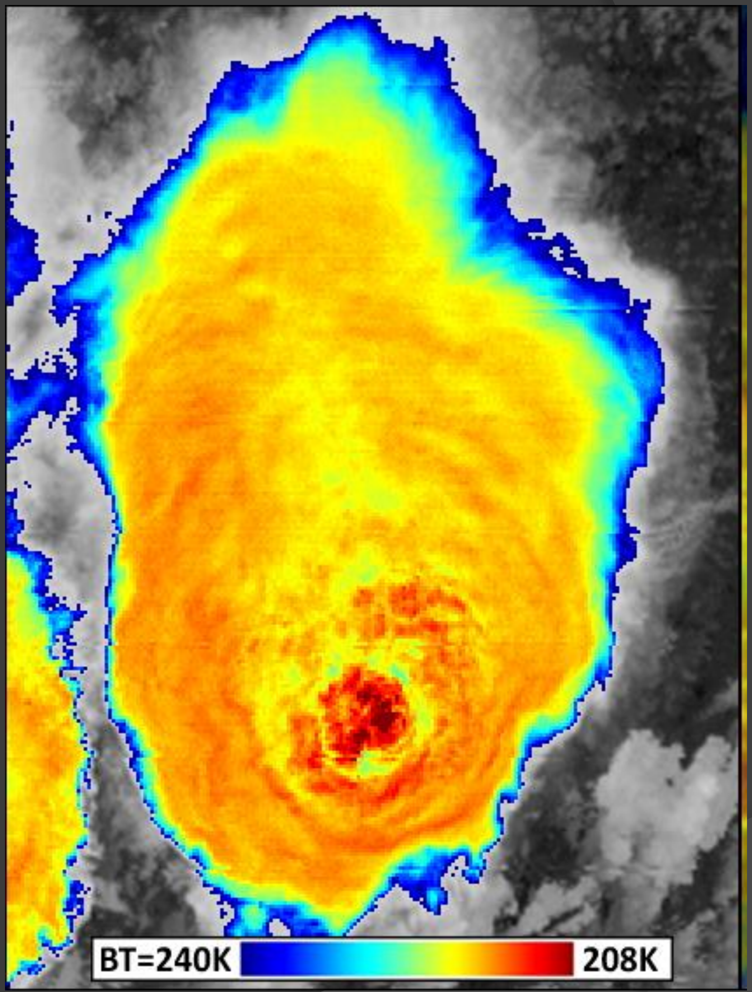
- Two concepts of the upper part of the updraft:
  - Series of individual “bubbles” –> short lived overshooting tops (5-15 minutes)
  - Quasi-steady continuous flow -> elevated dome-like structure (large and persistent overshooting top) above the updraft area, with a lifetime of tens of minutes up to 60-100 minutes.
- General characteristics of satellite observed overshooting tops:
  - Horizontal size: 5-15 km
  - Vertical extent: 2-3 km

General appearence of overshooting tops in satellite imagery



Observation of Convection Tecniques 1: Color enhancement





color-enhanced I5 (11.45 μm band) BT 208-240 K image

Day and Night
High rate of False Alarms

Setvák, Martin, et al. "BLENDED" SANDWICH" IMAGE PRODUCTS IN NOWCASTING." *Proc. 2012 EUMETSAT Meteorological Satellite Conference, Sopot, Poland*. 2012.

Observation of Convection tecniques 2: Blended Sandwich

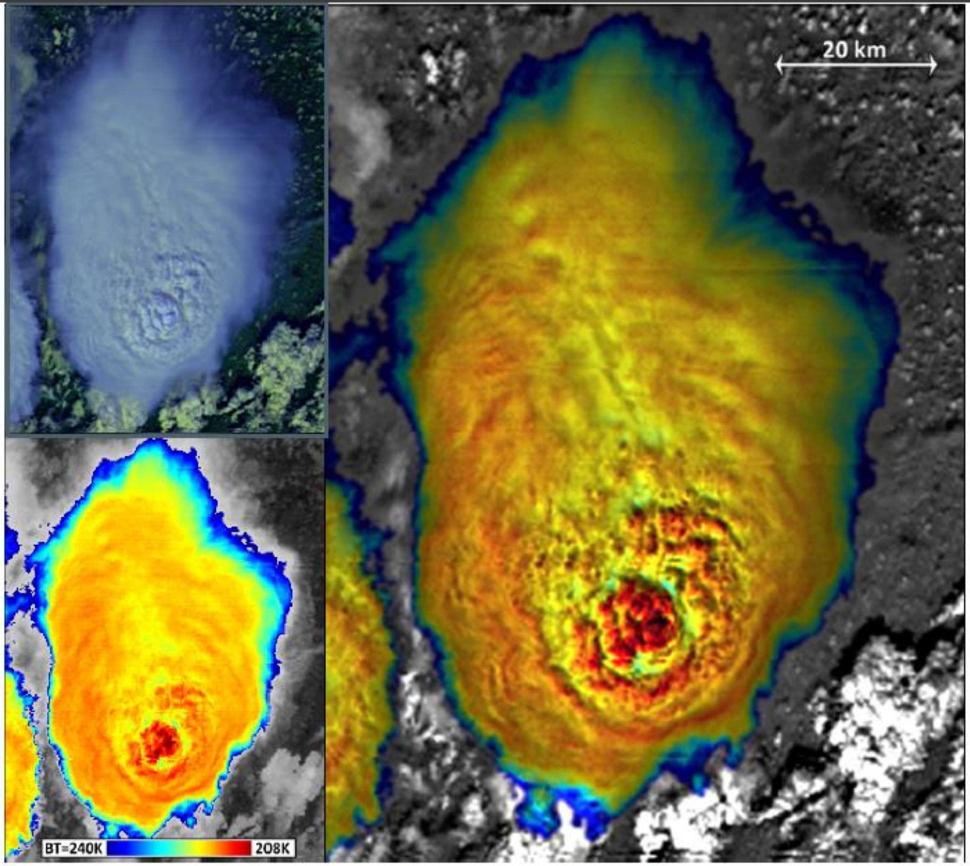
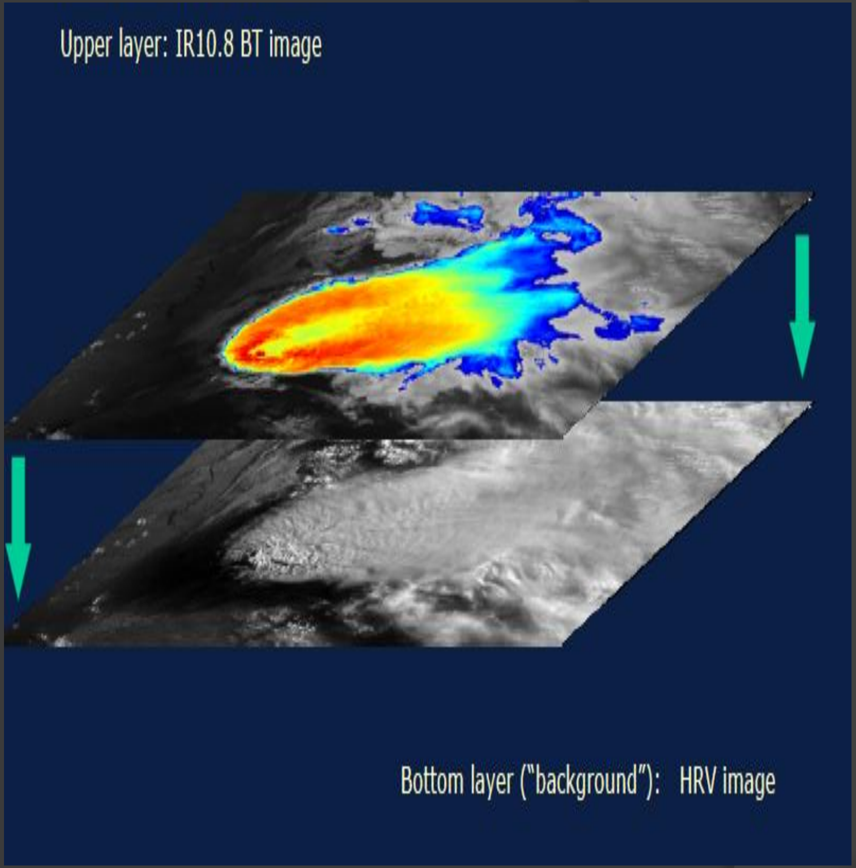


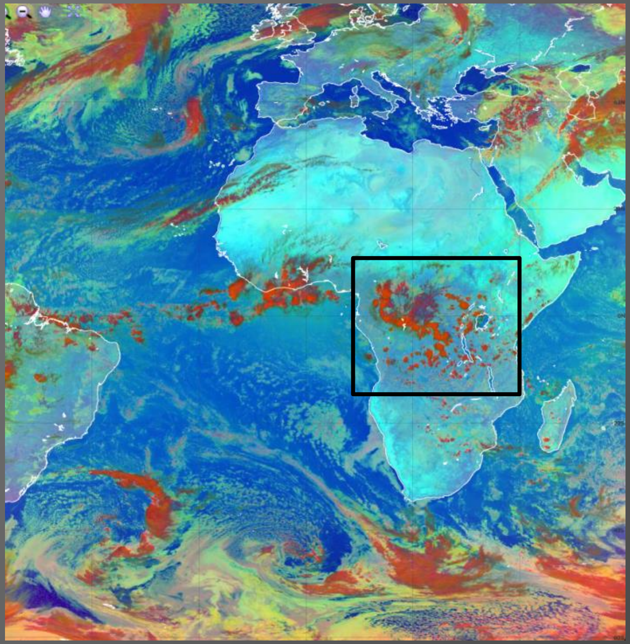
Figure 6: 2012-07-05, 12:07 UTC, Suomi NPP VIIRS, central-east Germany. Top left: RGB color composite of bands I1 (0.6 µm), I2 (0.9 µm) and I5 (11.5 µm). Bottom left: color-enhanced I5 (11.45 µm band) BT 208-240 K image. Right: sandwich product of I1 and color-enhanced I5 BT 208-240 K image.



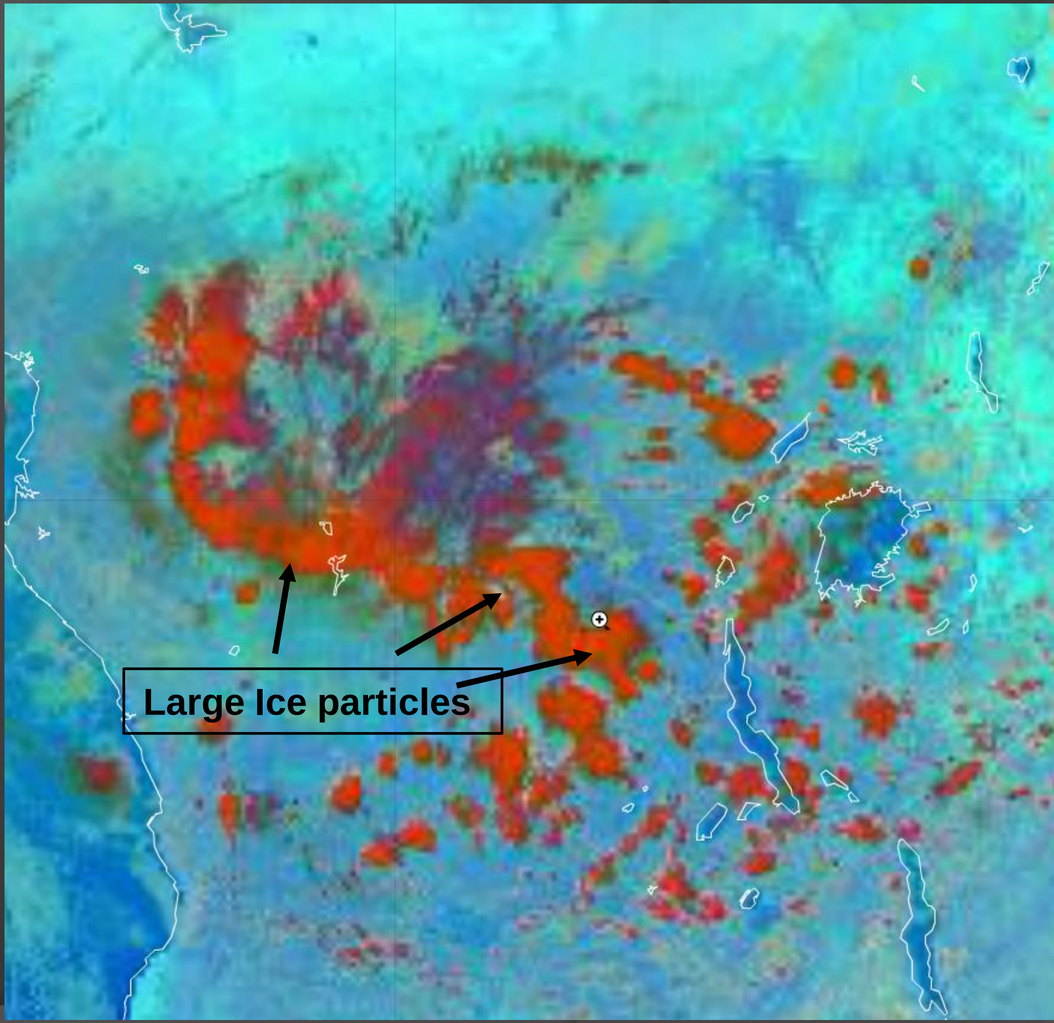
Day Only
High rate of False Alarms

Setvák, Martin, et al. "BLENDED" SANDWICH" IMAGE PRODUCTS IN NOWCASTING." *Proc. 2012 EUMETSAT Meteorological Satellite Conference, Sopot, Poland*. 2012.

Observation of Convection tecniques 3: Day Microphysics RGB



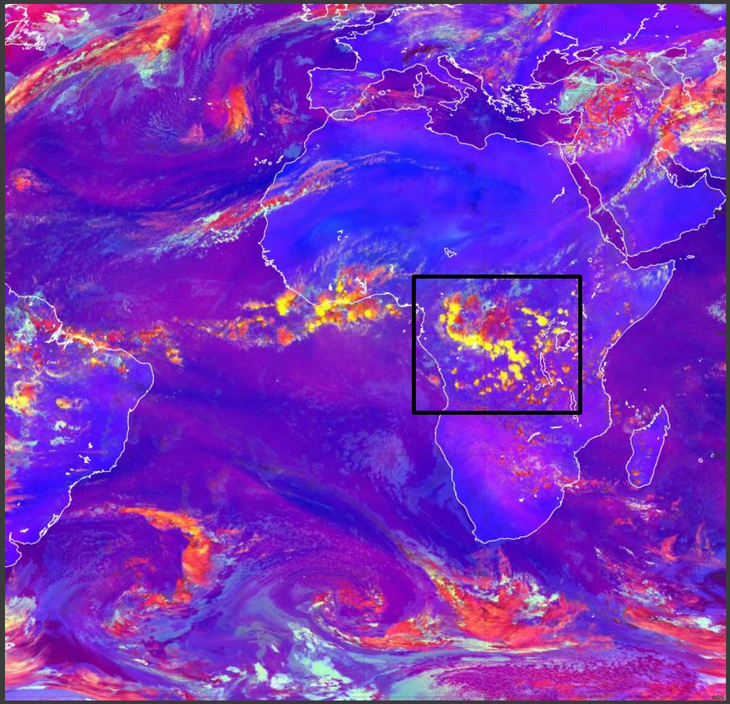
MSG –SEVIRI 2015/04/12 12:00



Red	=	VIS0.8	0 to 100%
Green	=	IR3.9r	0 to 60%
Blue	=	IR10.8	+203 to +323K

Day Only
Small Rate of False Alarms

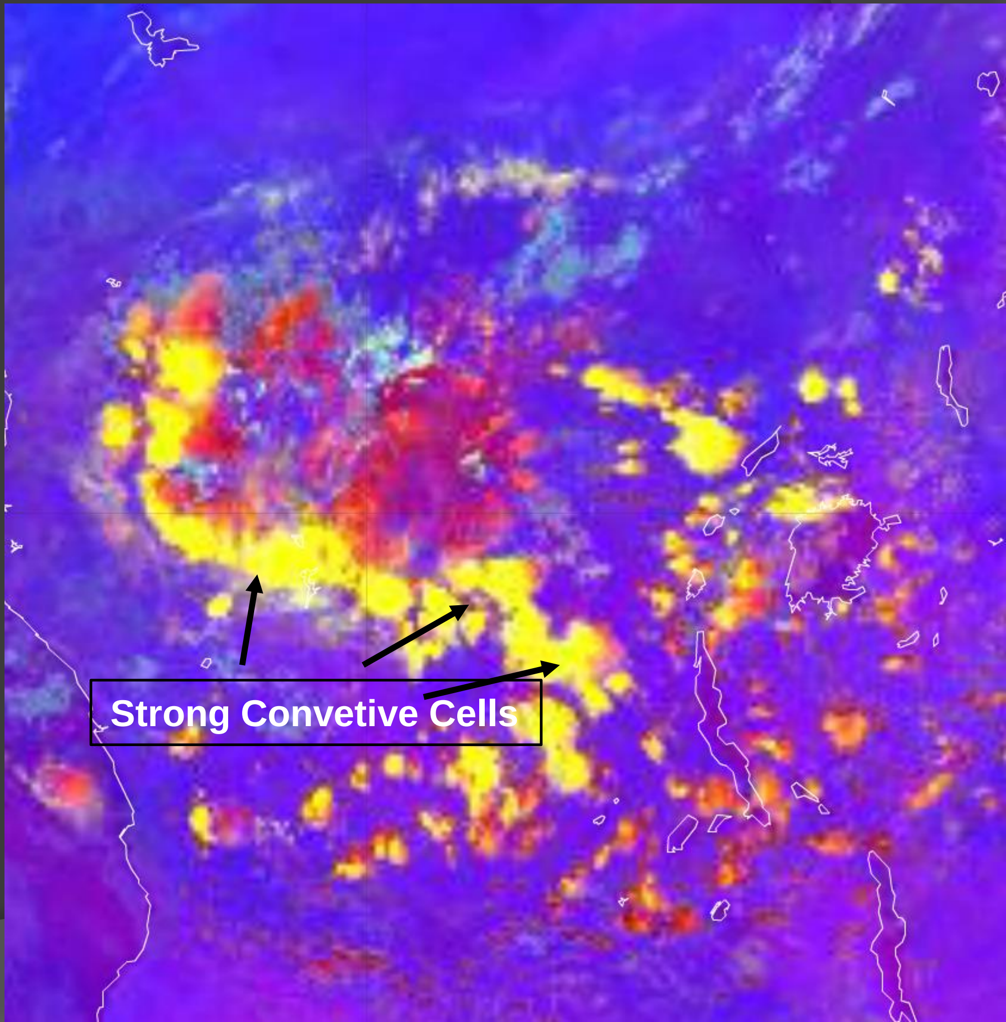
Observation of Convection tecniques 4: Severe Storm RGB



Red	=	WV6.2 – WV7.3	-35 to +5K
Green	=	IR3.9 – IR10.8	-5 to +60K
Blue	=	NIR1.6 - VIS0.6	-75 to +25%

Day Only
Small Rate of False Alarms

MSG –SEVIRI 2015/04/12 12:00



Observation of Convection tecniques 5: Global Convection Diagnostic (GCD)

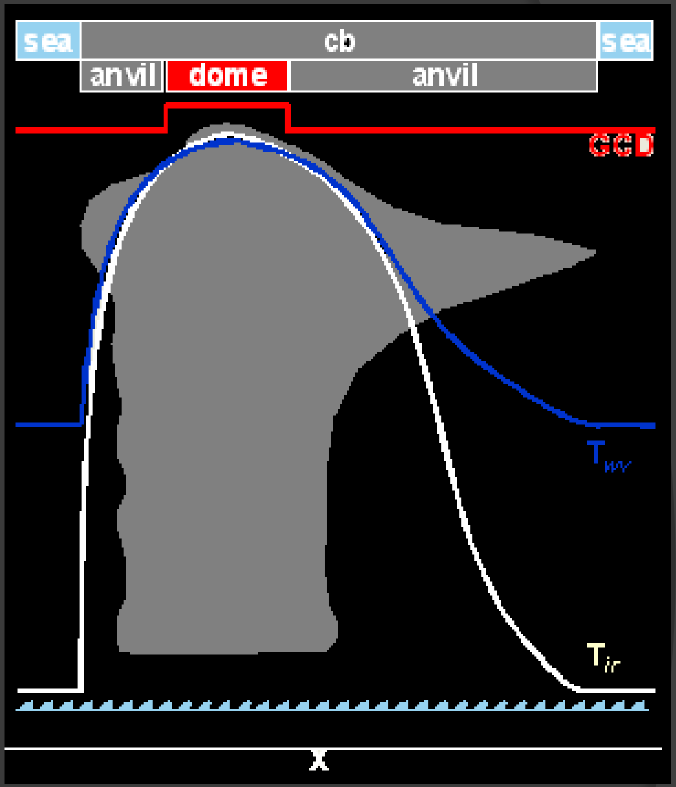
GCD is a binary index of deep, moist convection (Mosher 2002). It has been created to meet the needs of the aviation community for current information on thunderstorm over remote areas.

It operates on water vapor (6.25 μm) and thermal infrared (10.8 μm) image pairs from SEVIRI.

At a pixel:

IF: | Tir –Twv | < 1°C, THEN

GCD declares the pixel "deep convective" OTHERWISE, it remains "not deep convective."



Day and Night
Small Rate of False Alarms

•Mosher, Frederick R. "A satellite diagnostic of global convection." *Preprints, 11th Conf. on Satellite Meteorology and Oceanography, Madison, WI, Amer. Meteor. Soc., CD-ROM P*. Vol. 3. 2001.
•Mosher, F. "Detection of deep convection around the globe." *Preprints, 10th Conference on Aviation, Range, and Aerospace Meteorology*. 2002.

The EUMETCAST Service

EUMETCast is EUMETSAT's primary dissemination mechanism for the near real-time delivery of satellite data and products.

What is EUMETCast?

EUMETCast is a multi-service dissemination system based on standard Digital Video Broadcast (DVB) technology. It uses commercial telecommunication geostationary satellites to multi-cast files (data and products) to a wide user community. EUMETCast also delivers a range of third-party products.

EUMETCAST FEATURES

Secure delivery allows multicasts to be targeted to a specific user or group of users

Use of DVB turnarounds allows the easy extension of geographical coverage.

Use of off-the-shelf, commercially available, DVB reception equipment.

Highly scalable system architecture.

Three EUMETCast services are available covering **Europe**, **Africa** and **South America**.

http://www.eumetsat.int/website/home/Data/DataDelivery/EUMETCast/index.html

Data Processing Chain – step #1

Eumetsat

Eumetcast System (Near Real Time)

Dissemination of licenced products

ISAC-CNR
(Tor Vergata)

Geostationary Satellites

Satellite	Detail	Timeliness
MSG **Meteosat Second Generation**	**Meteosat 10 (MSG3) Longitude: 0°**	**15 min.**
MTSAT **Himawari (Multifunction Transport Satellite)**	**Himawari-7 Longitude: 145°E**	**30 Min.**
GOES **Geostationary Operational Environmental Satellites**	**GOES-East (GOES 13) Longitude: 75°W** **GOES-West (GOES 15) Longitude: 135°W**	**30 Min.**
FY **FengYun Meteorological Satellites**	**FY-2D Longitude: 86.5°E** **FY-2E Longitude: 105°E**	**30 Min.**

Data Processing Chain – Step #2

- ✓ Receiving the data stream on multiple channels
- ✓ Products identification (PID) procedure
- ✓ Detection of transmission errors
- ✓ Decryption of correctly transmitted data (licenced products)

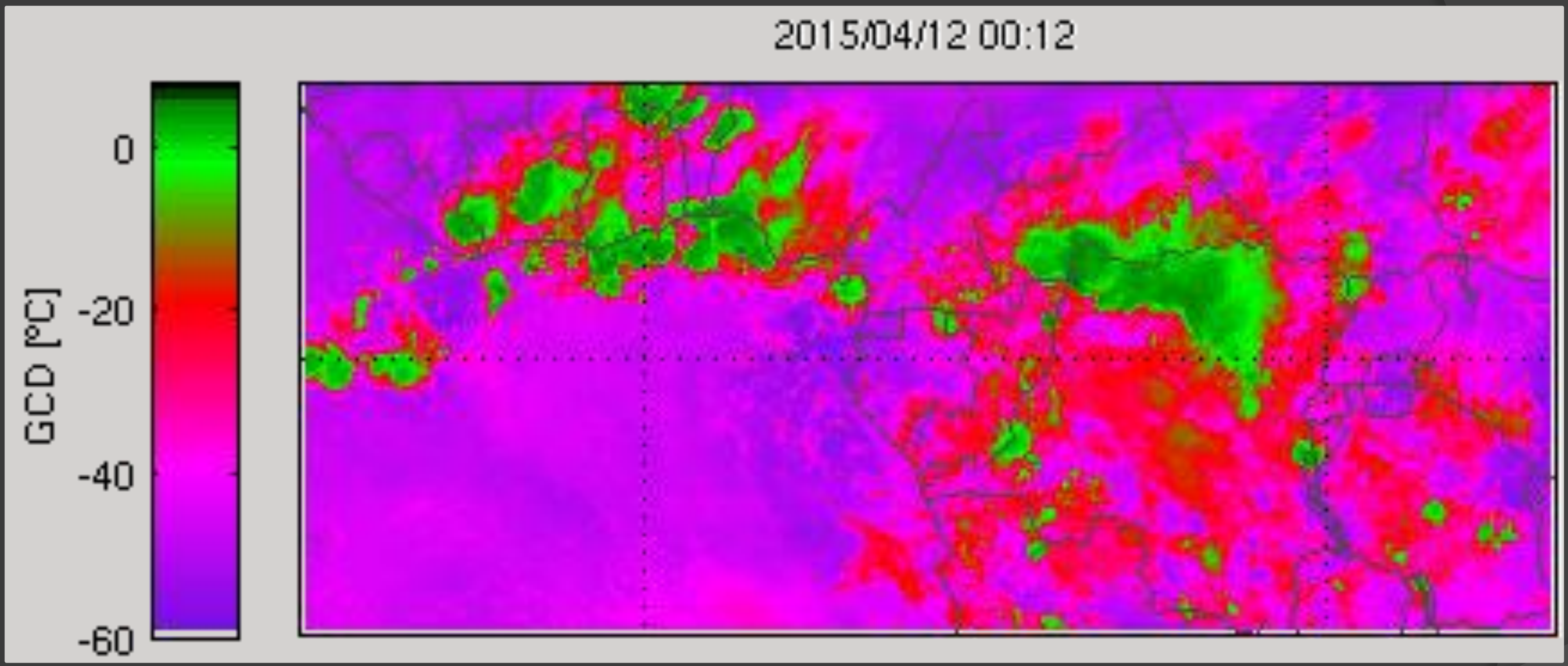
Processing Server

- ✓ Indexing of products for processing (based on data timeliness)
- ✓ Decompressing of selected data channels (for the GCD)
- ✓ Cropping data over the area of interest
- ✓ Data conversion (to semplify the storage procedure)
- ✓ Data upload on storage server

Storage Server

- ✓ Storage of Geostationary satellite data
- ✓ Storage of satellite data derived products
- ✓ Update of Web interface

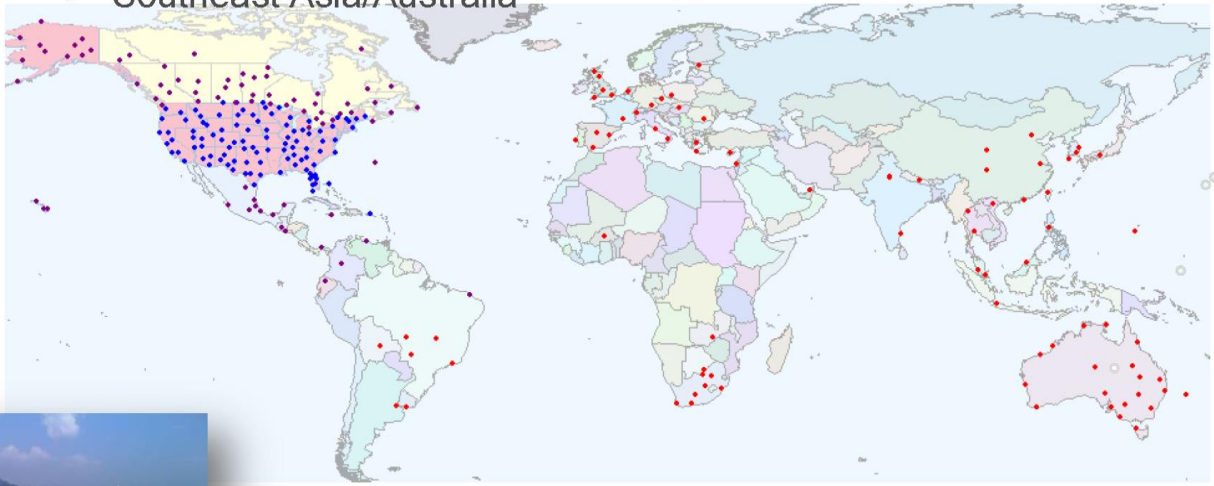
GCD Case Study 12/04/2015



Early results of real-time use of GCD in TGF analysis will be shown in next presentation

Global Lightning Network

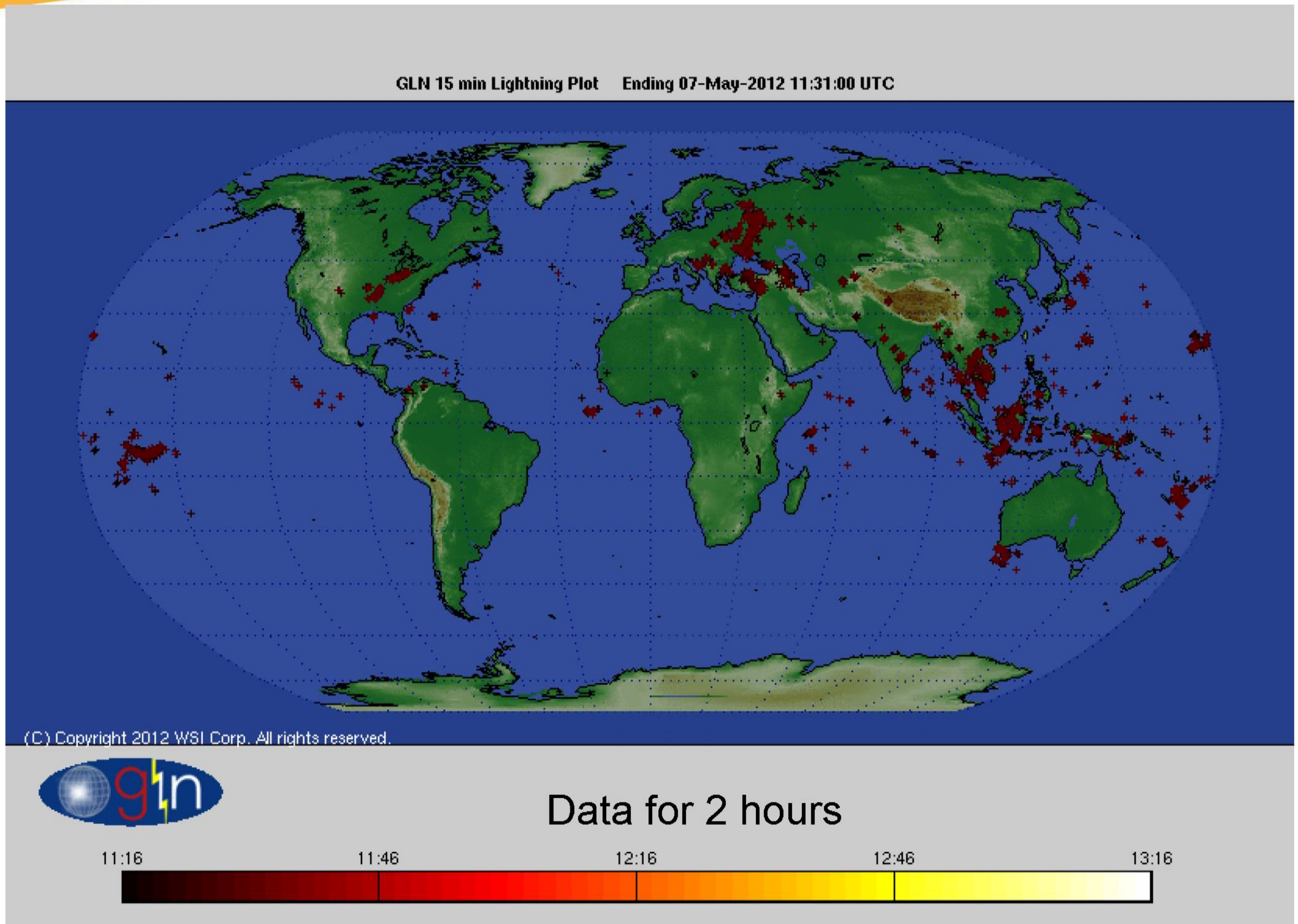
- GLN
  - Started in 2009, partnership of TOA Systems of Melbourne FL and WSI Corporation of Andover MA
  - Provide overall global coverage with areas of concentration
    - Americas
    - Europe
    - Southeast Asia/Australia



US-Americas Sensors

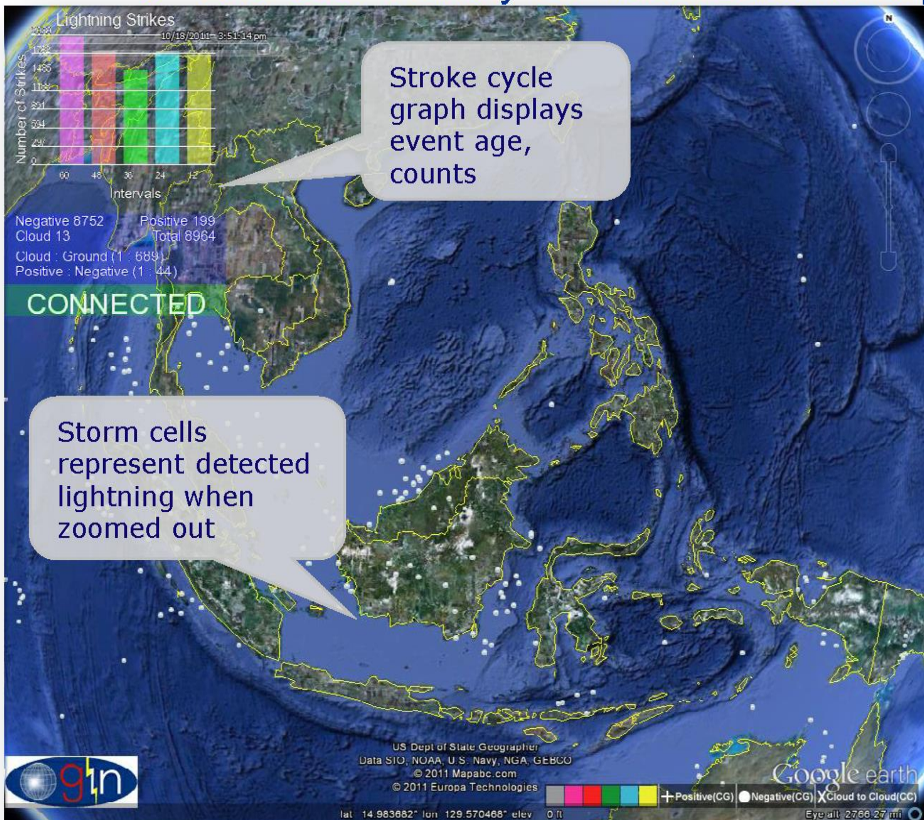
Global Sensors

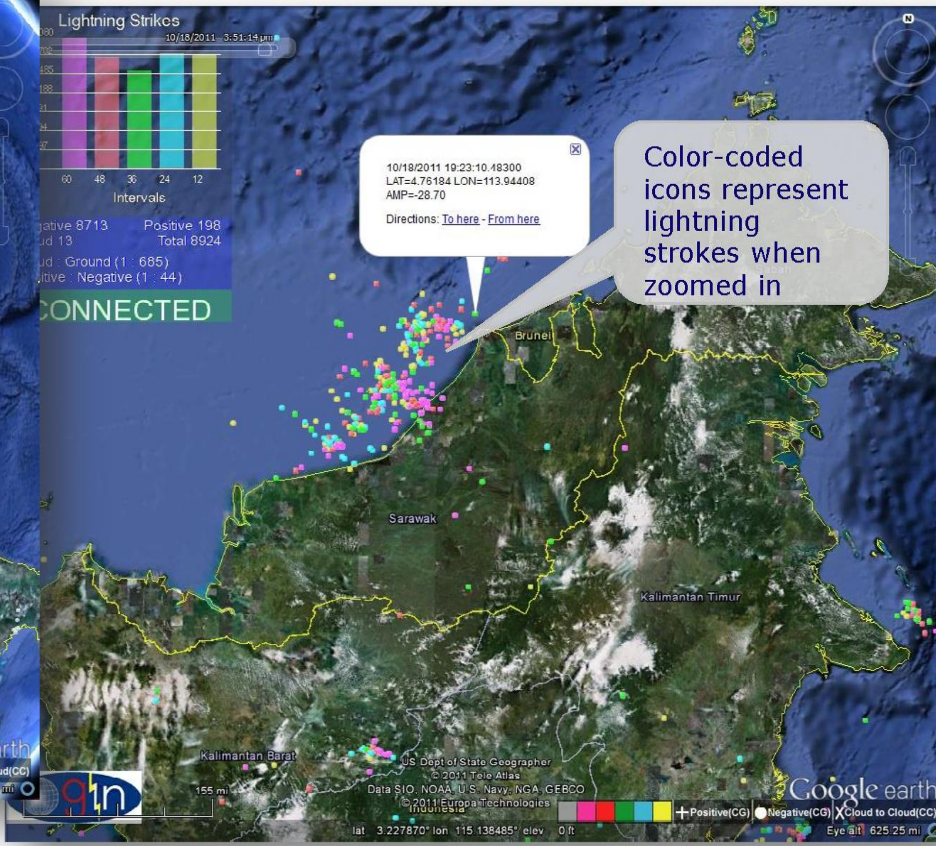
Global Lightning Network



Global Lightning Display

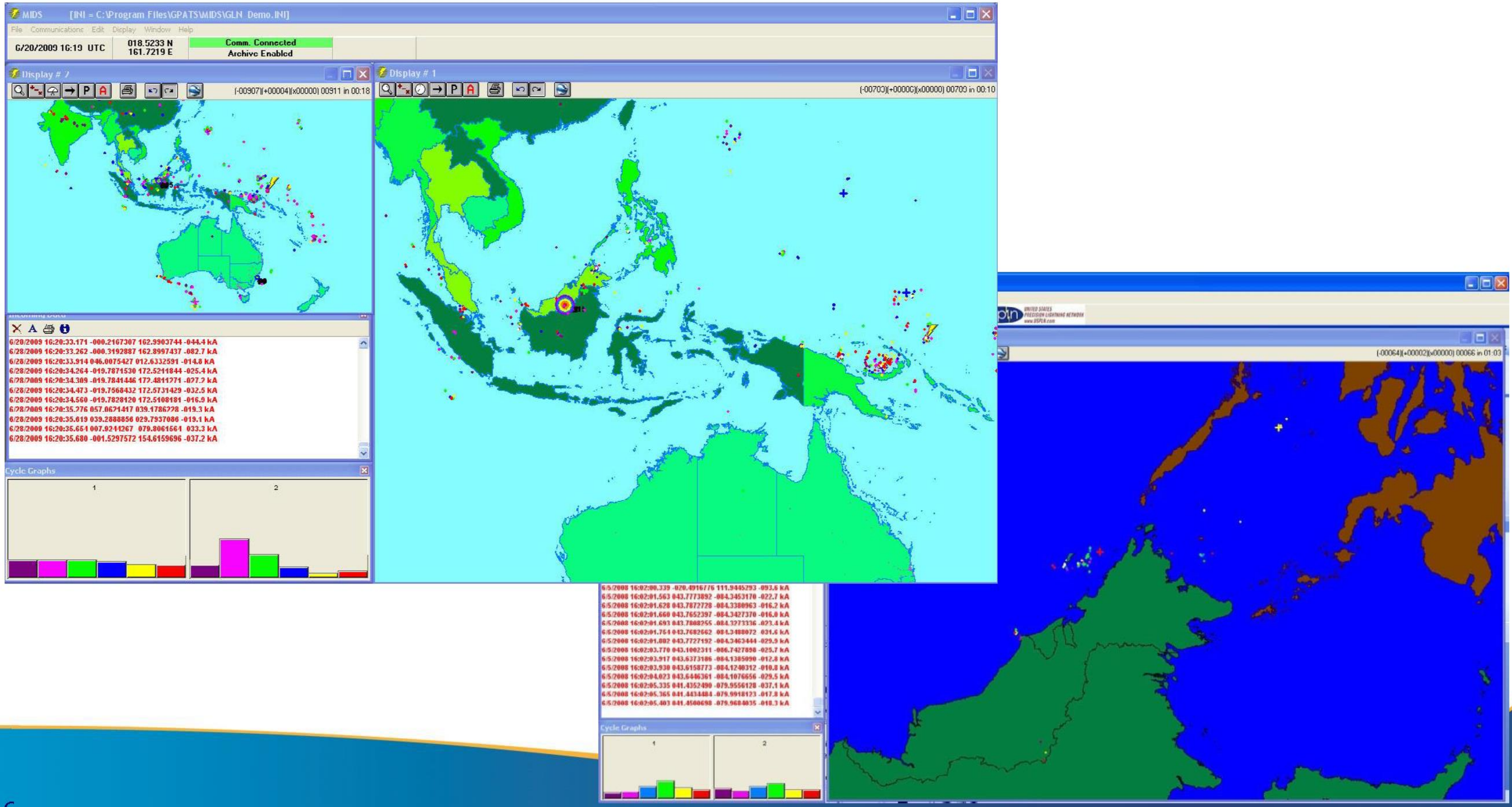
- **Google Earth Service**
  - End-user friendly for visualization and presentation



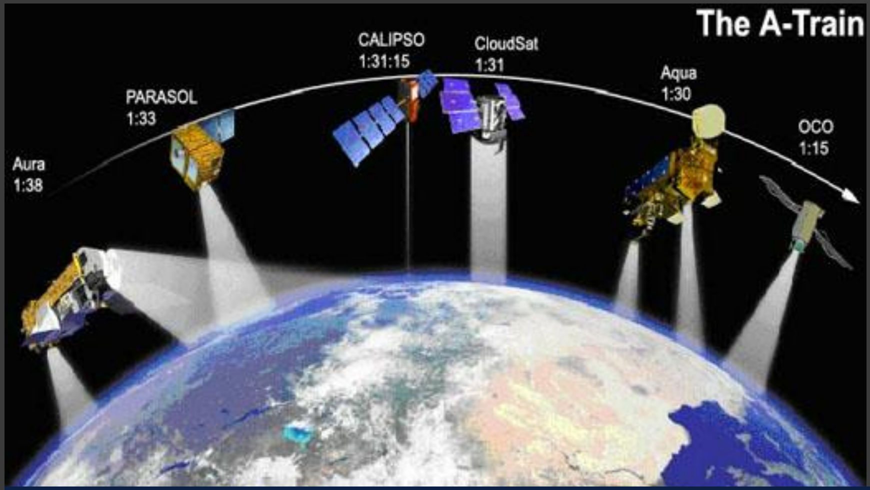


Global Lightning Display

- MIDS Software
  - Detailed visualization, alerting and archival

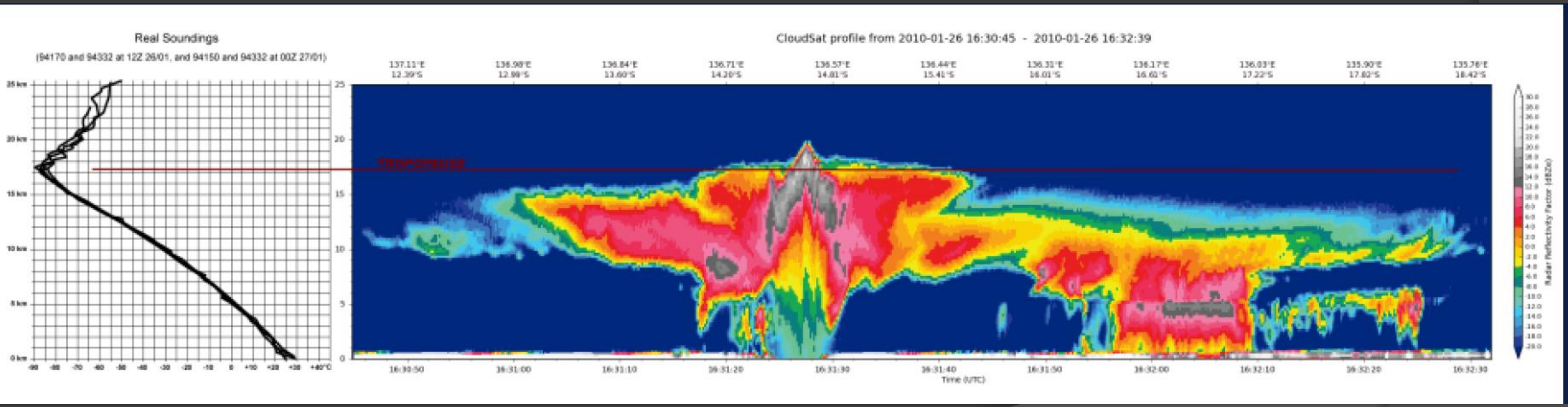


Cloudsat Cloud Profiling Radar



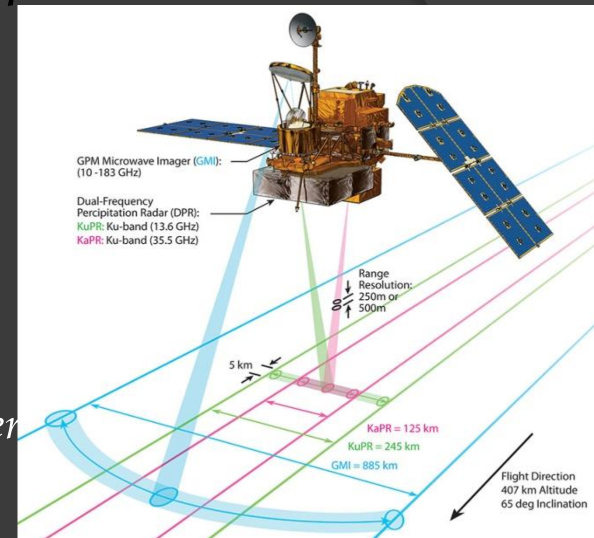
CloudSat home page: http://cloudsat.atmos.colostate.edu/

CloudSat quick-look images and data browser: http://www.cloudsat.cira.colostate.edu/dpcstatusQL.php



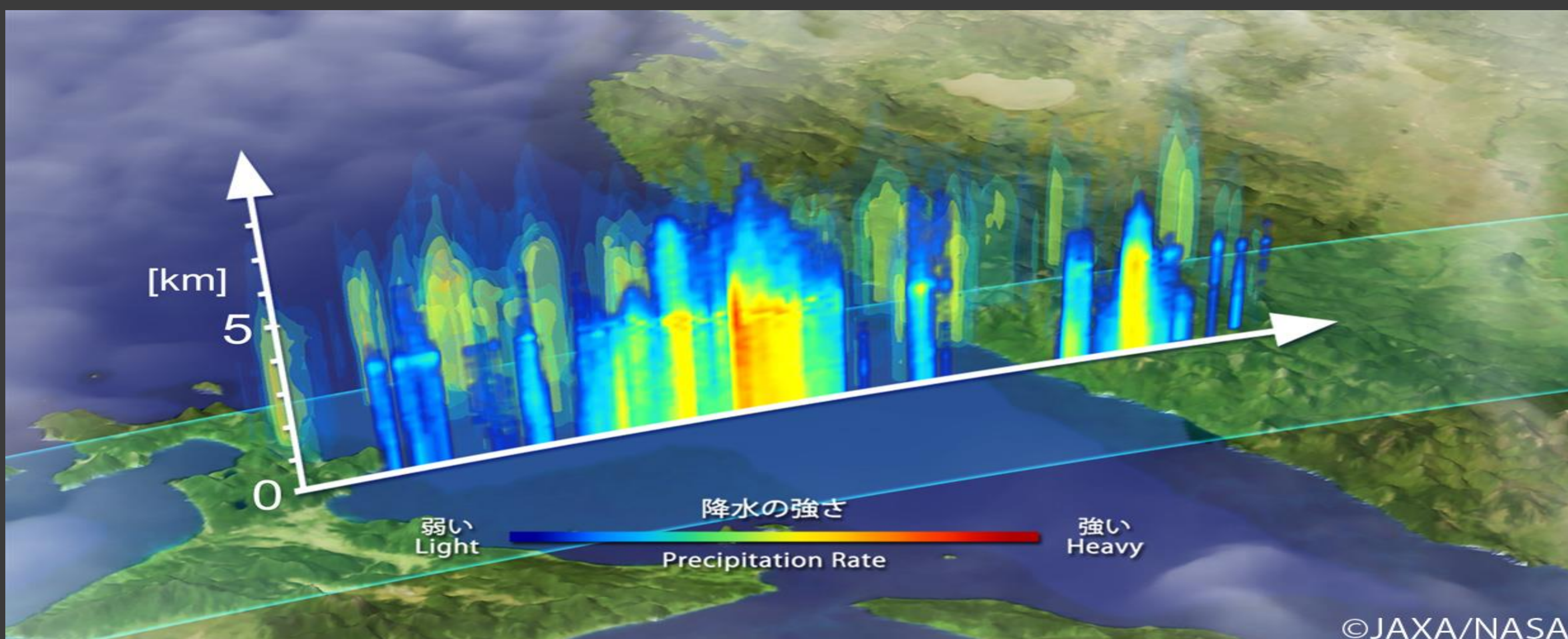
M. Stevak. Workshop on physics and dynamics of convective storms and their manifestation in satellite imagery, Praha, Czech Republic, 16-20 August 2010

GPM Core Instruments



Dual-Frequency (Ku-Ka band) Precipitation Radar (DPR):

- *Increased sensitivity (~12 dBZ) for light rain and snow detection relative to TRMM*
- *Better measurement accuracy with differential attenuation correction*
- *Detailed microphysical information (DSD mean mass diameter & particle no. density) & identification of liquid, ice, and mixed-phase regions*



Precipitation system around the Okinawa Island observed by the DPR at 2 (UTC) on June 14, 2014. Vertical cross section of three dimensional DPR rain rate along the white arrow