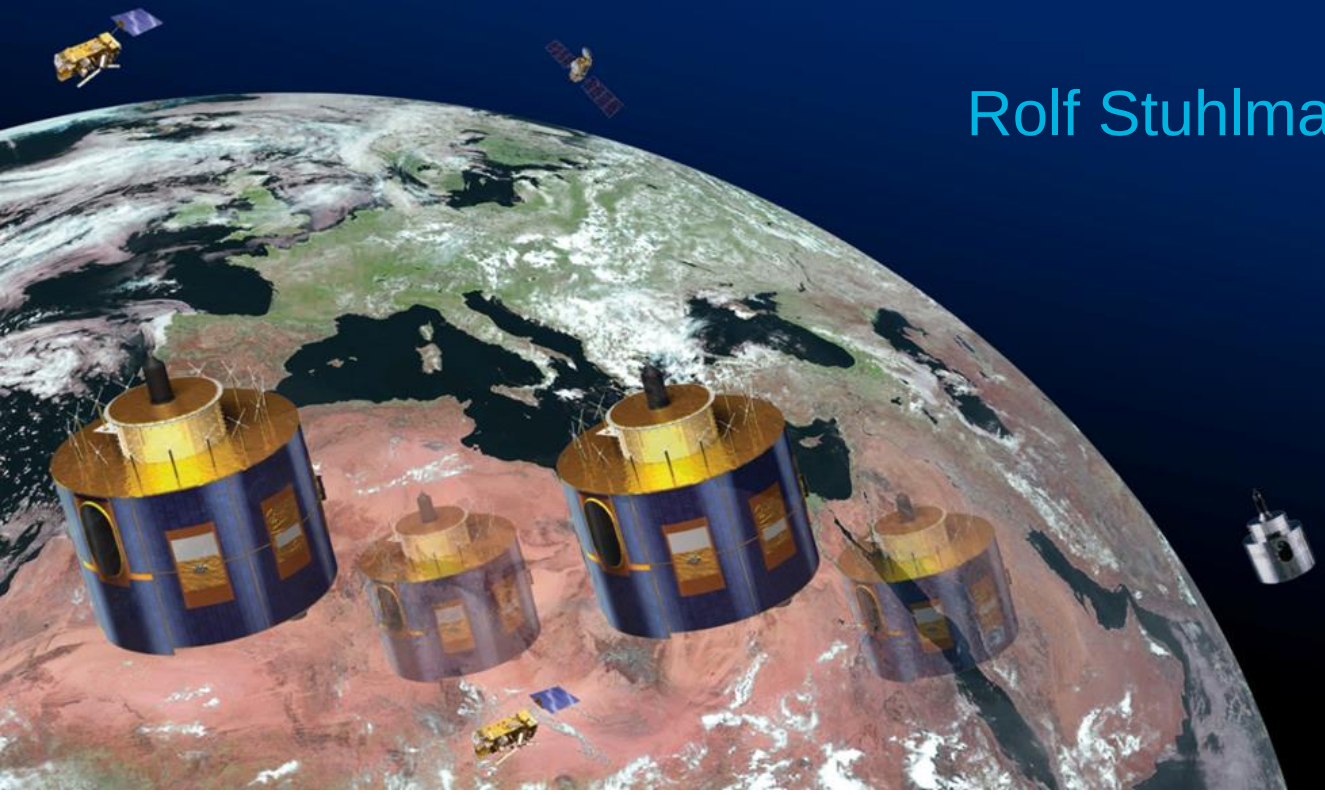
# MTG Introduction

Rolf Stuhlmann and Jochen Grandell

7 November 2016



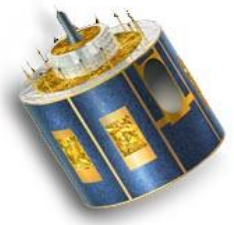
# The Meteosat Programme – A rough overview

**1977** ***Meteosat First Generation (MFG)***

Observation mission: - MVIRI (3 channels)

Spinning satellite, ~ 800 kg

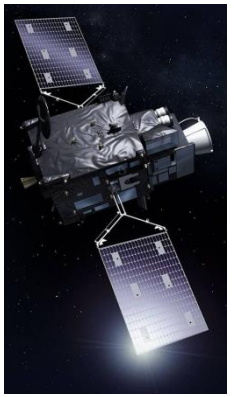
**2002** ***Meteosat Second Generation (MSG)***



Observation mission: - SEVIRI (12 channel imager)

- GERB (radiometer)

Spinning satellite, ~ 2.000 kg



**2021/ 2022** ***Meteosat Third Generation (MTG)***

# MTG Programme – Space Segment

**Twin satellite concept – based on 3-axis platforms:**

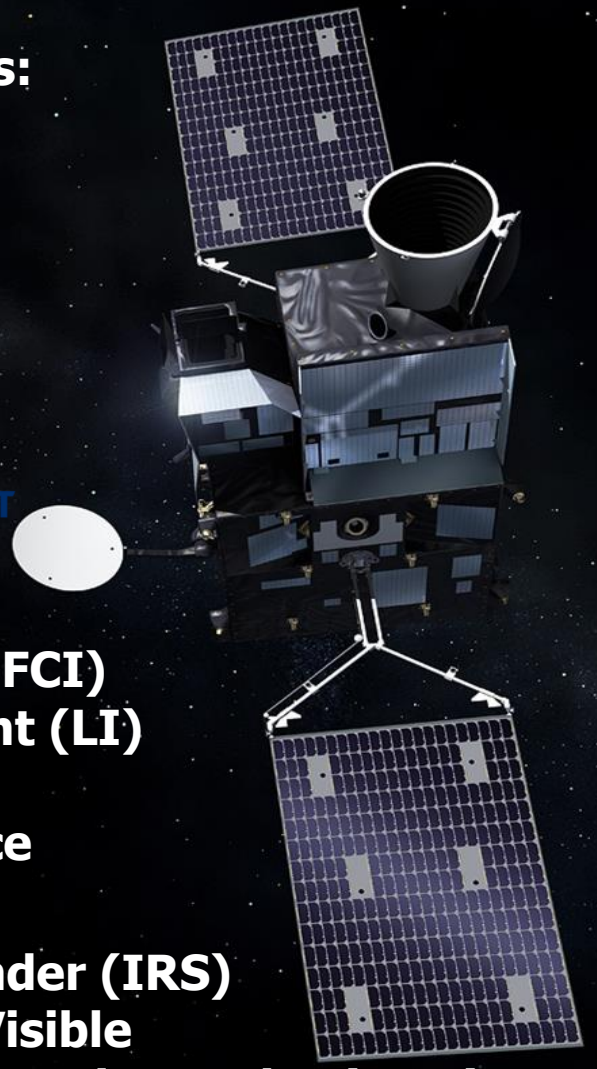
4 geostationary imaging satellites **(MTG-I)**

2 geostationary sounding satellites **(MTG-S)**

**Established through a cooperation between:**

esa

EUMETSAT



**MTG-I: - Flexible Combined Imager (FCI)**
**- Lightning Imager Instrument (LI)**

**20 years of operational service**

**MTG-S: - Infrared Sounder (IRS)**
**- Ultra-violet, Visible and Near-infrared Sounder (UVN)**

**15.5 years of operational service**

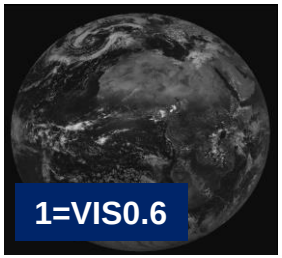
# MTG – I : Flexible Combined Imager (FCI)

- FCI will continue the **Full Disc Scanning Service** (FDSS) and **Rapid Scanning Service** (RSS) currently provided by the MSG SEVIRI instruments.
- **Full Disc High Spectral resolution Imagery** (FDHSI) **and High Resolution Fast Imagery** (HRFI) mission requirements are established for FDSS and RSS respectively.

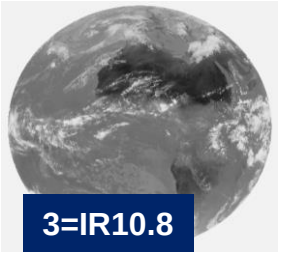
- Full Disk Scan Service (FCI-FDSS):
  - global scales: Full Disk; @ 10 min Repeat Cycle
  - 16 channels at spatial resolution:
    - 1.0 km for the 8 solar channels;
    - 2.0 km for the 8 thermal channels.

- Rapid Scan Service (FCI-RSS):
  - local scales: 1/4$^{th}$ of Full Disk; @ 2.5 min Repeat Cycle
  - 4 channels at high spatial resolution:
    - 0.5 km for the 2 solar channels;
    - 1.0 km for the 2 thermal channels.

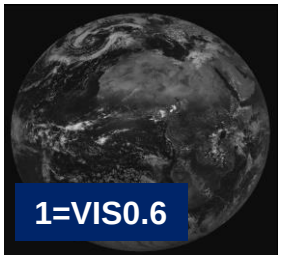
# From MVIRI through SEVIRI to FCI on MTG

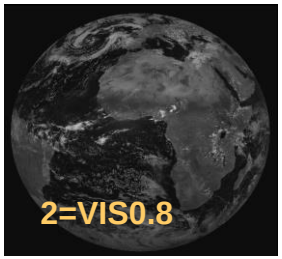




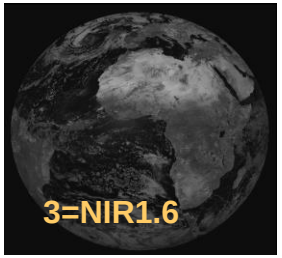


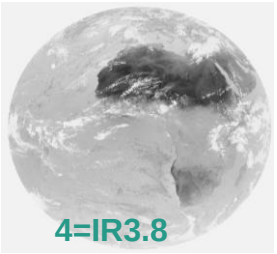
# From MVIRI through SEVIRI to FCI on MTG



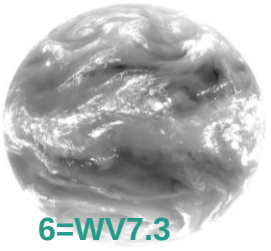



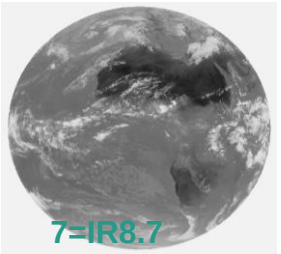


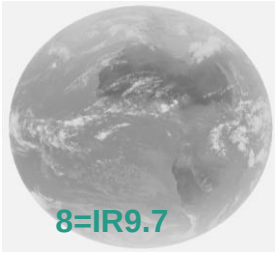


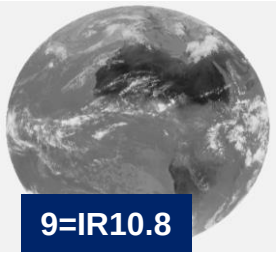



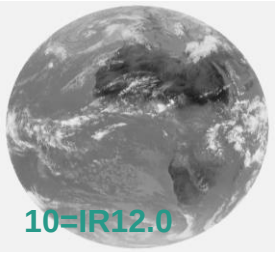


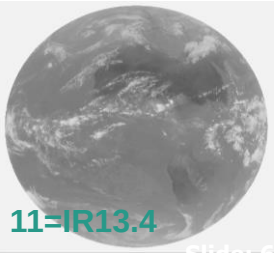


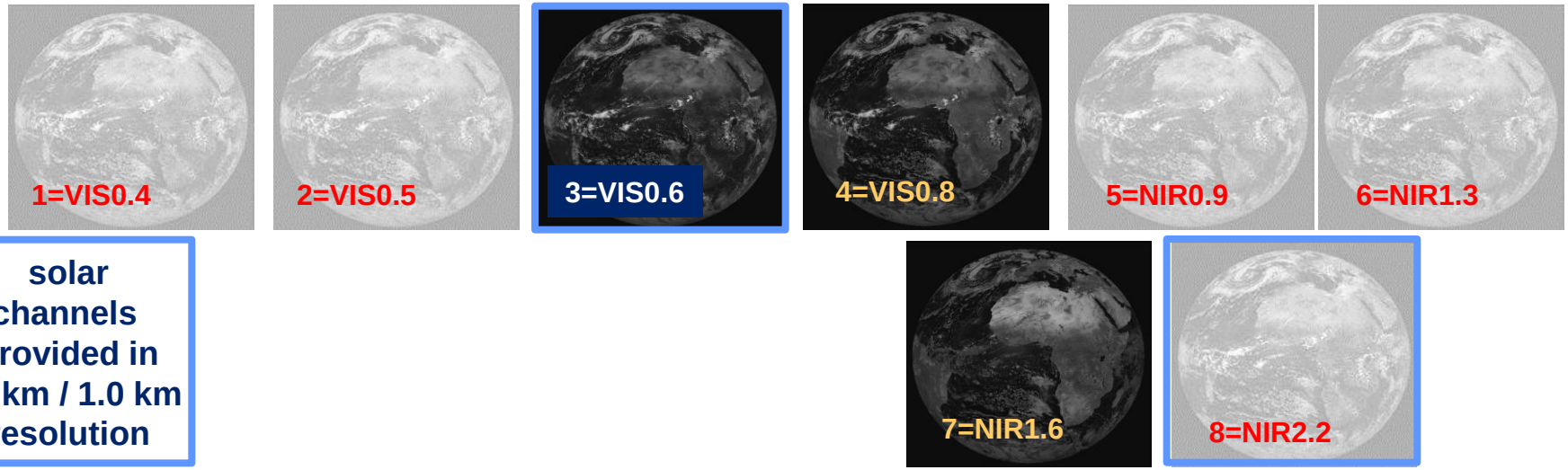



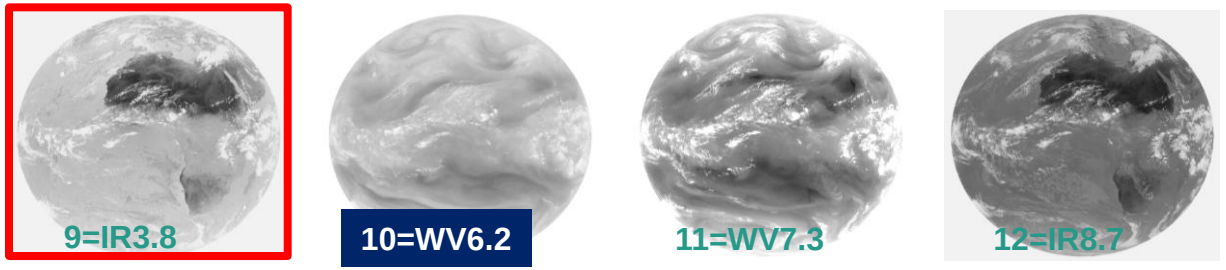



# From MVIRI through SEVIRI to FCI on MTG

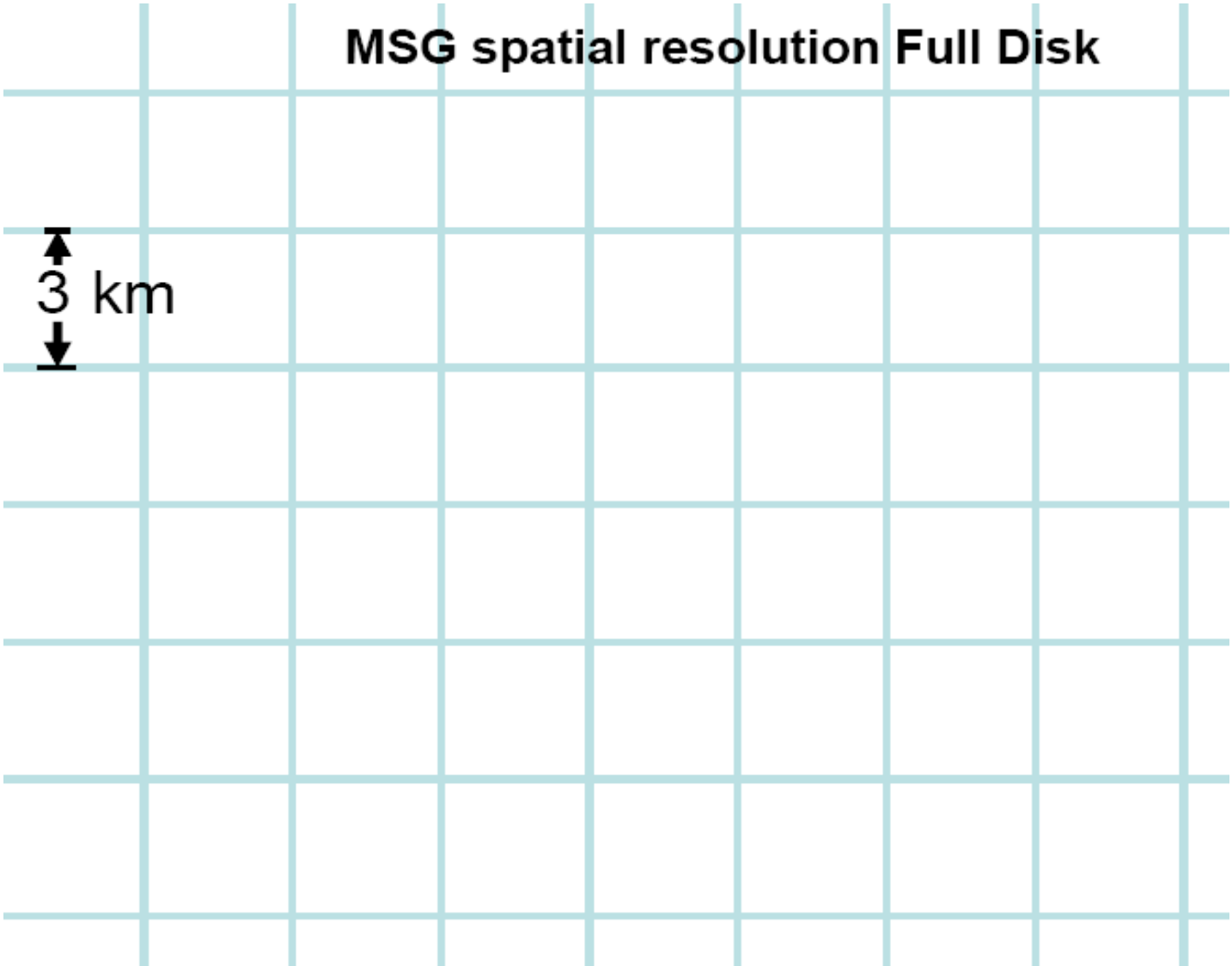



**solar channels provided in 0.5 km / 1.0 km resolution**

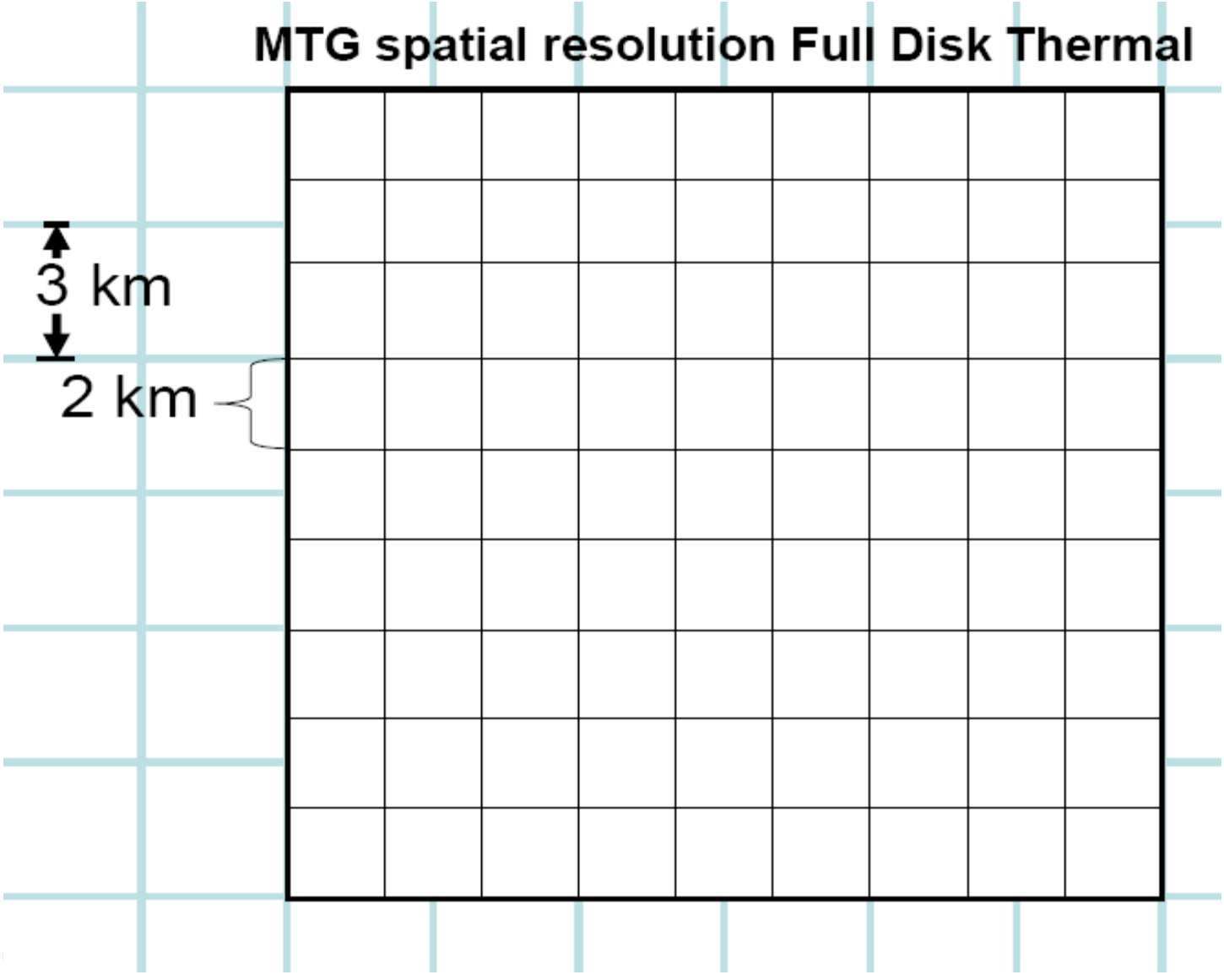



**thermal channels provided in 1 km / 2 km resolution**

# Sampling Distance Issues



# Sampling Distance Issues



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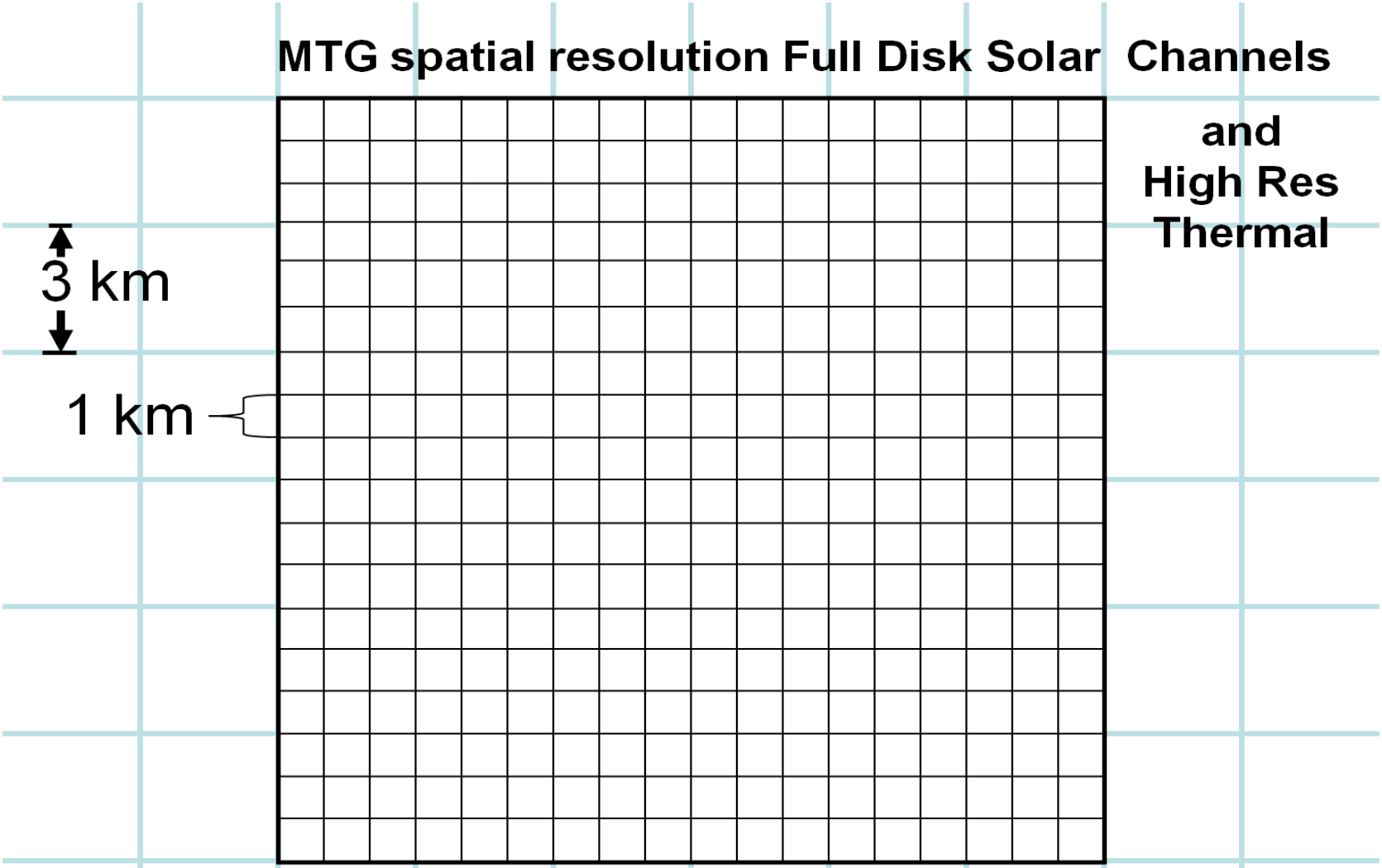
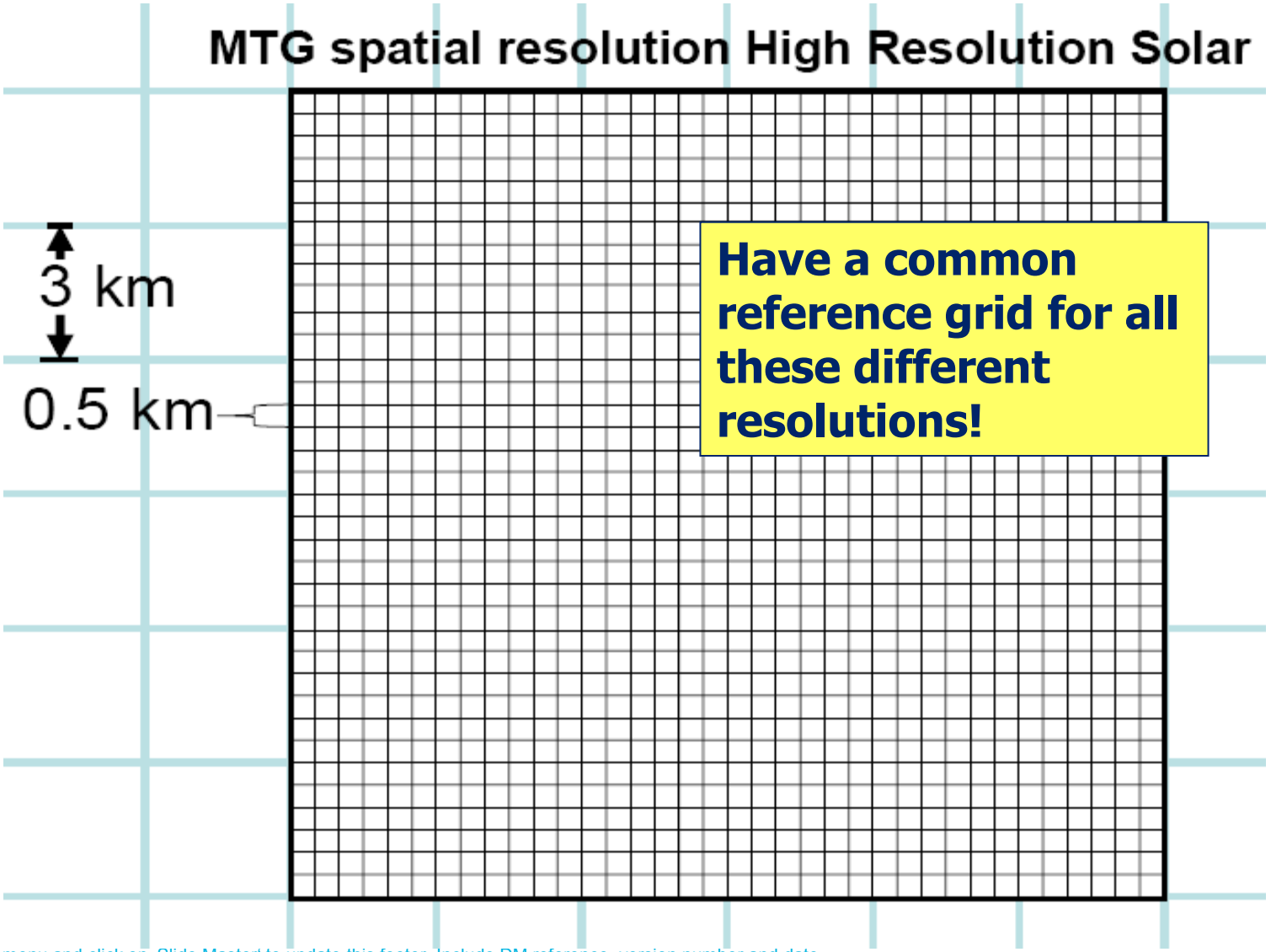
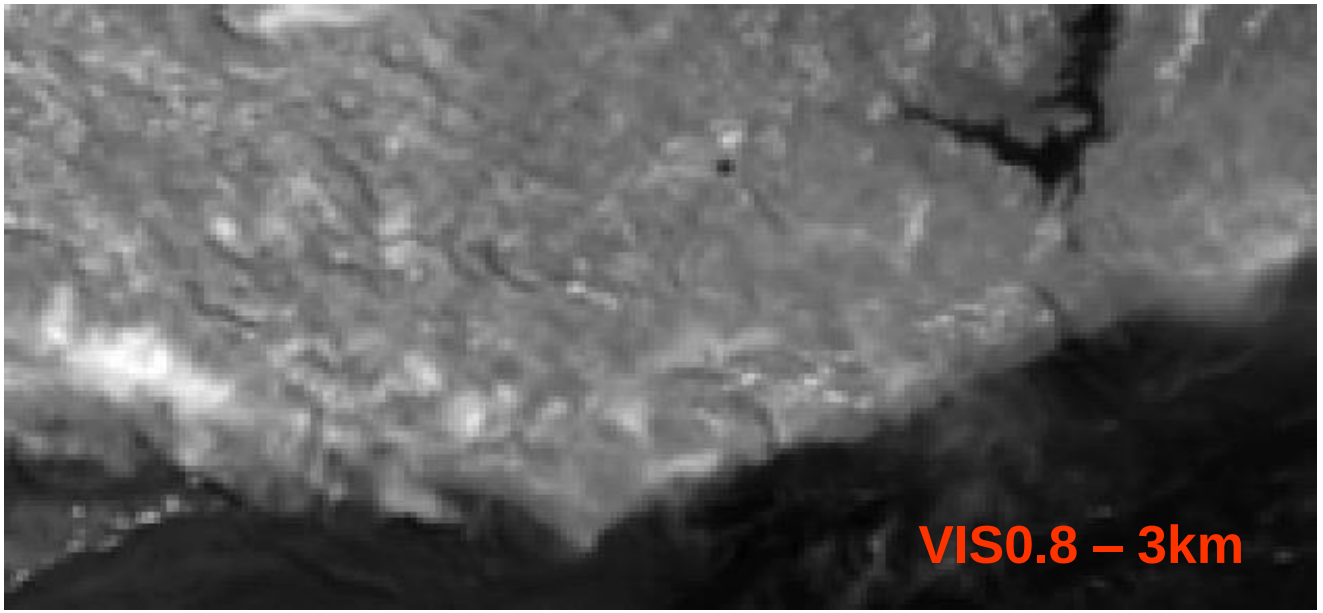
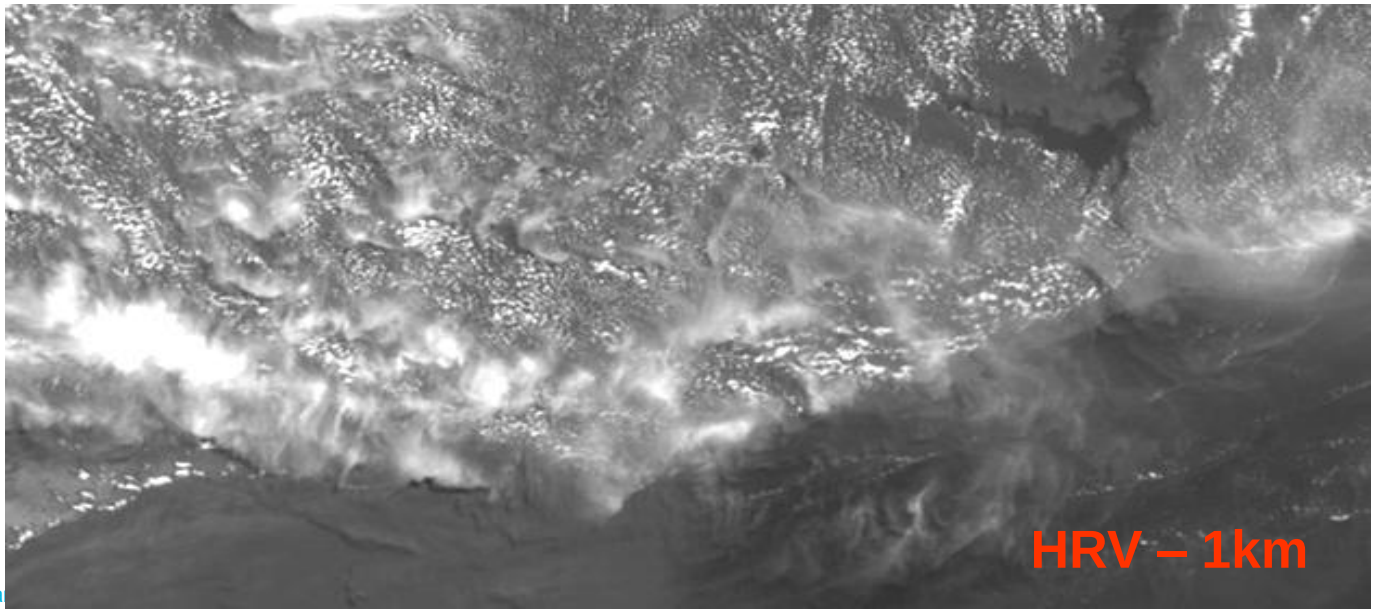


# Sampling Distance Issues



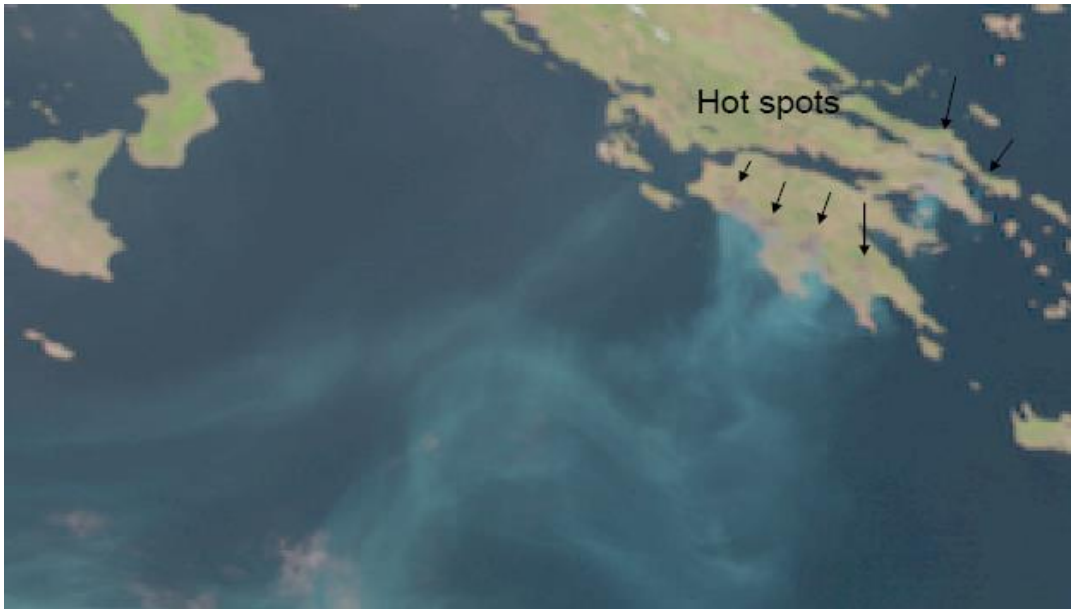
# Spatial Resolution: Small Scale Cumulus



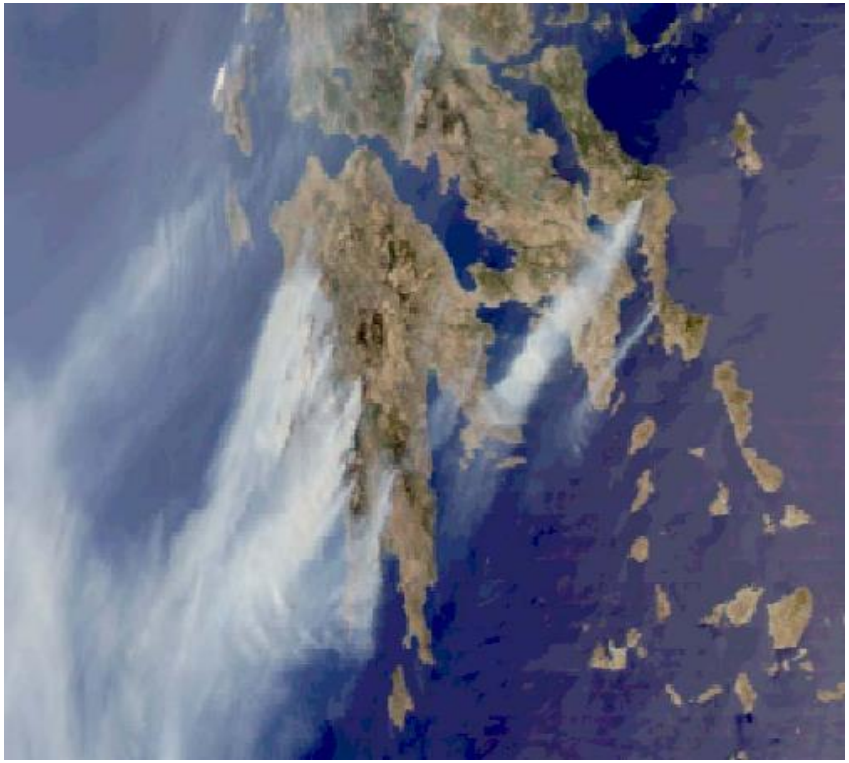
# Spatial Resolution: No Fire Without Smoke …

- MTG will also detect finer structures of smoke and fires:




**NIR1.6 VIS0.8 VIS0.6**

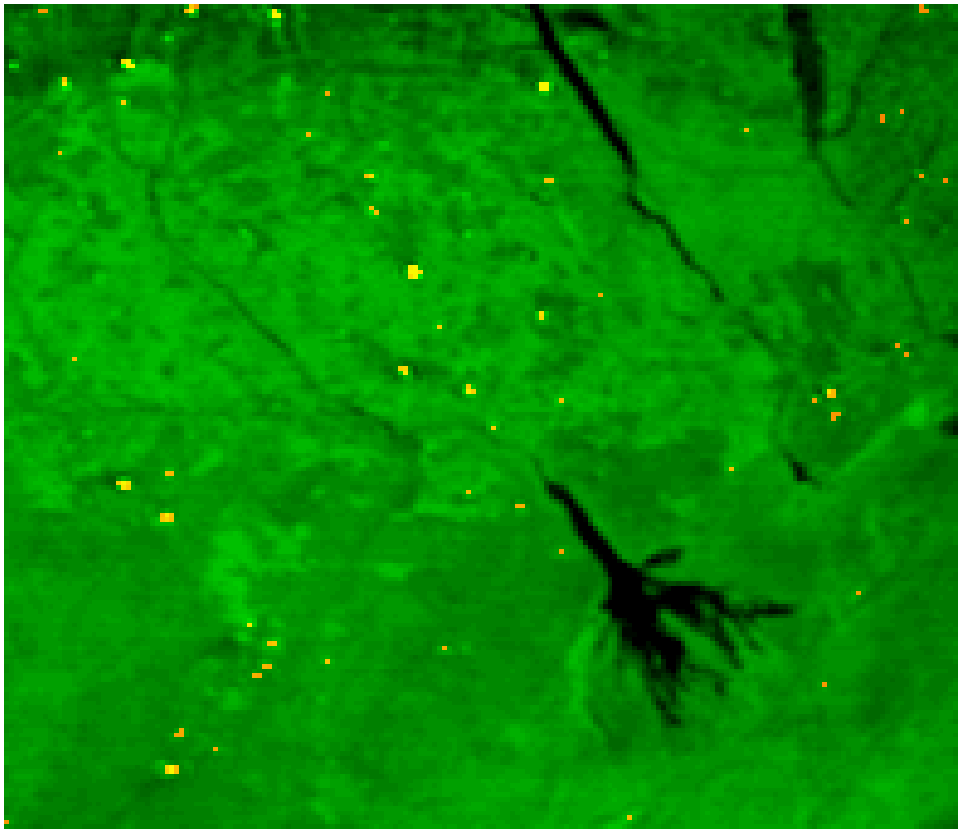
**(courtesy D. Rosenfeld)**



**VIS0.6 VIS0.5 VIS0.4**

# MTG FCI improvements: Fire detection

## SEVIRI (12:57 UTC)



## MODIS (12:20 UTC)

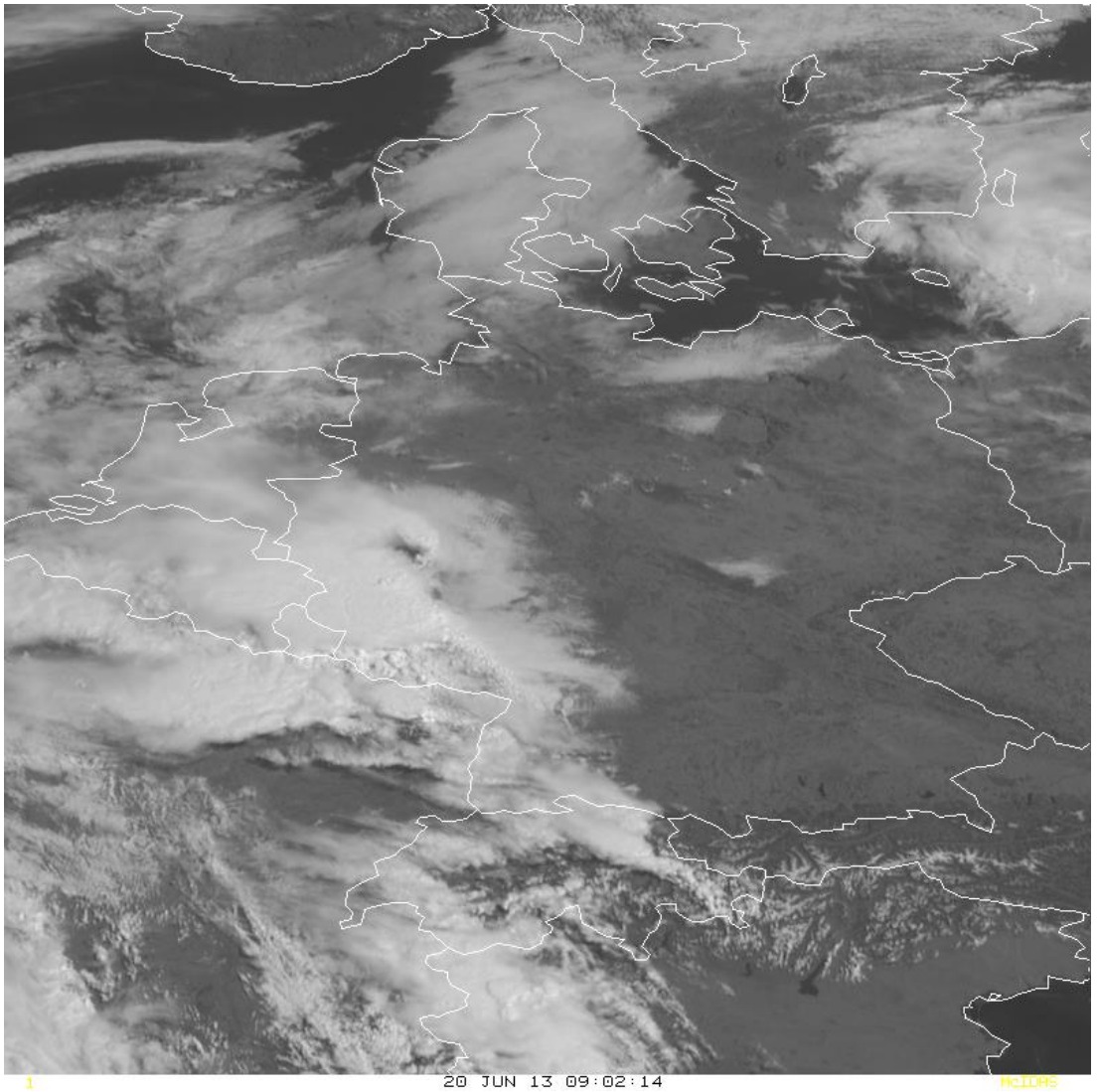
**Green : IR3.9 channel radiance background**

**Yellow : Detected fire pixels using alg. based on Giglio *et al* (2004)**

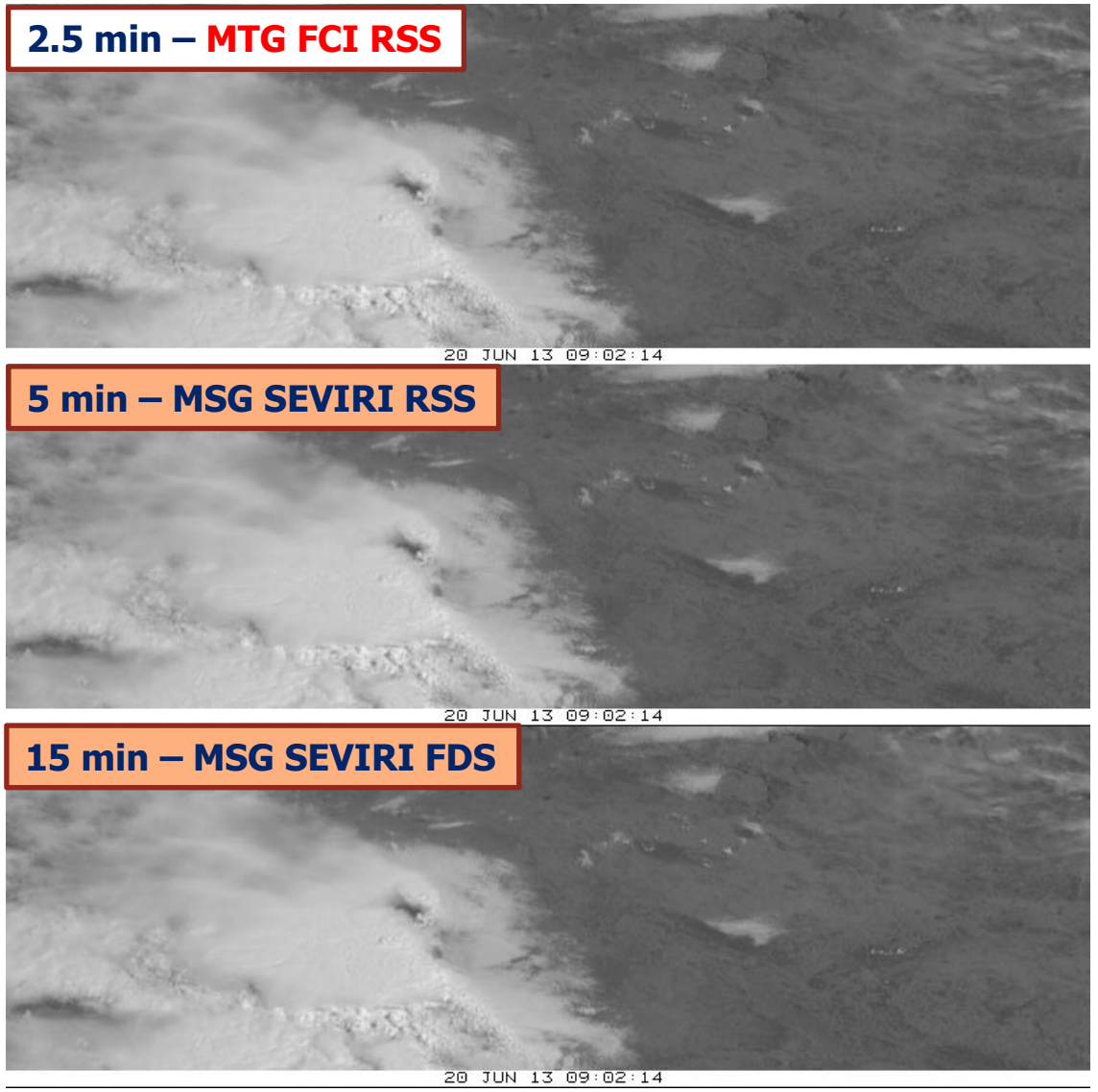
**Courtesy: L. Giglio (NOAA)**

# New insights: Higher temporal resolution

- Rapid image updates are important when we have “interesting” weather situations, i.e. rapid changes
- On 20th June 2013 SEVIRI did a high (temporal) resolution campaign
- A day with high convective activities and severe thunderstorms all over central Europe
- “Standard” SEVIRI imagery at HRV channel @ 15 min temporal resolution, 1 km spatial resolution (“FCI like”)
  [HRV: Broadband channel from 0.4µm – 1.1 µm]



# New insights: Higher temporal resolution



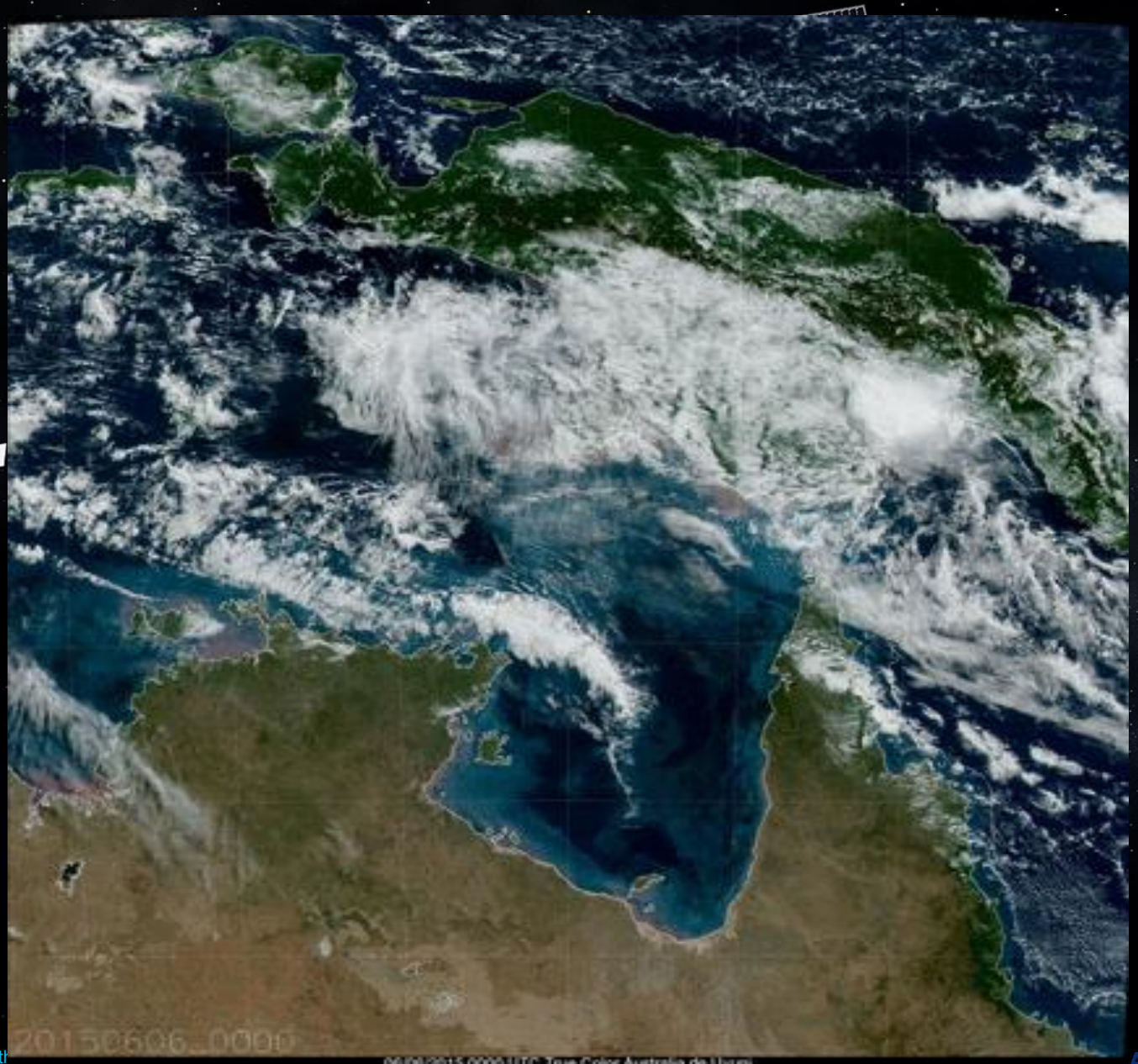

**2.5 min resolution**

**5 min resolution**

**15 min resolution**

# AHI True Colour

# © Steve Miller

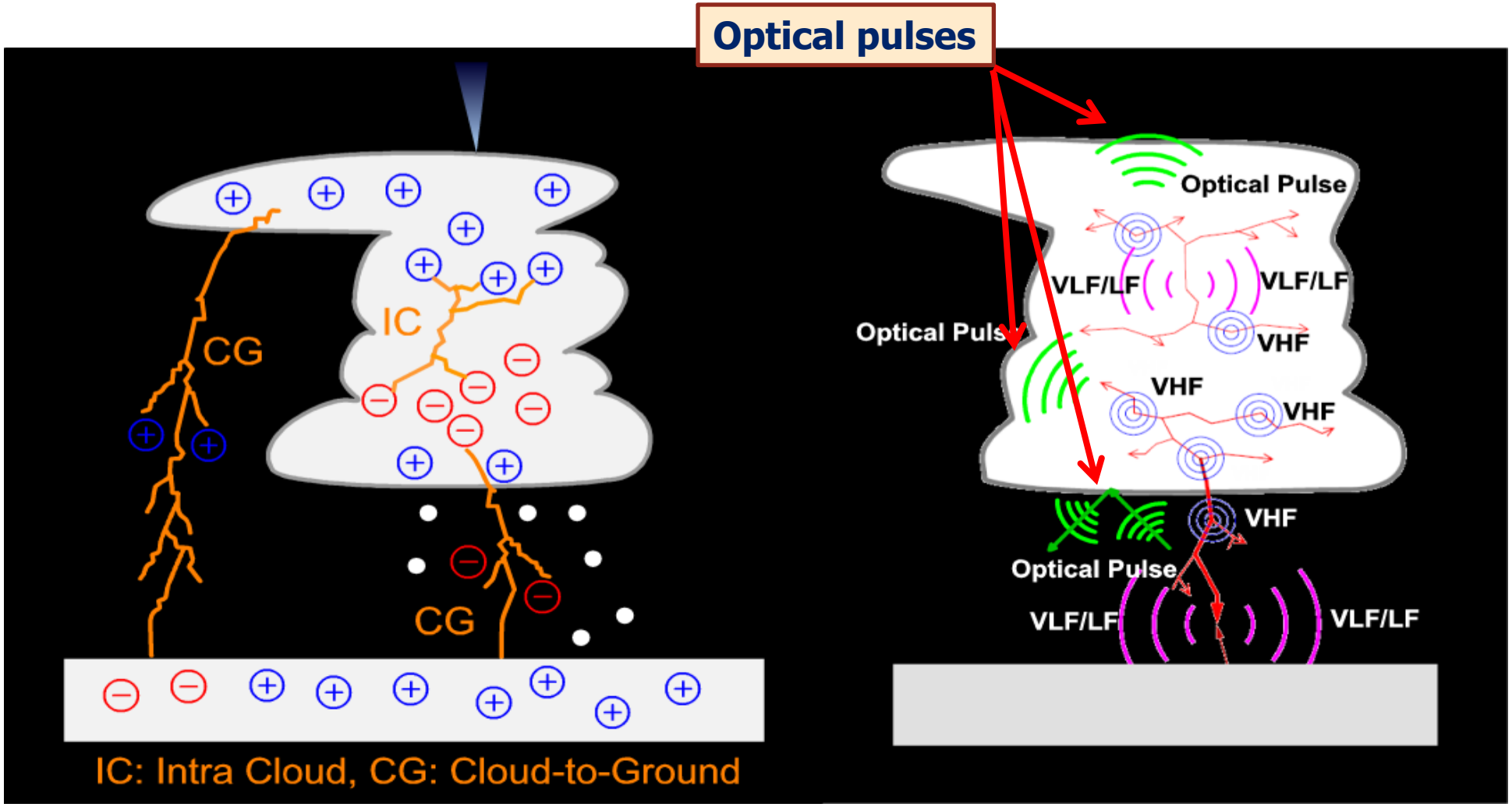


# Benefits just from the FCI...

- New channels (0.444 µm and 0.51 µm) will support **true colour images** and permit surpassing current **aerosol retrievals** especially over land – also an important contribution to air quality monitoring.
- The 0.91 µm channel will provide during **daytime total column precipitable water** especially over land surfaces.
- The 1.375 µm channel will improve detection of **very thin cirrus clouds** not seen by the current system. If not detected, errors are introduced in all clear sky products.
- The 2.26 µm channel will provide the capability for an **improved retrieval of cloud microphysics.**
- The higher spatial resolution (1 km and 2 km) of the 3.8 µm channel will **improve fire detection** and, via its extended dynamical range (from 350 K to 450 K), the quality of products.
- To **improve the convection detection** through the shorter repeat cycle and better spatial resolution.


© David Piano

# Thunderstorm Electrification - Lightning and its Emissions

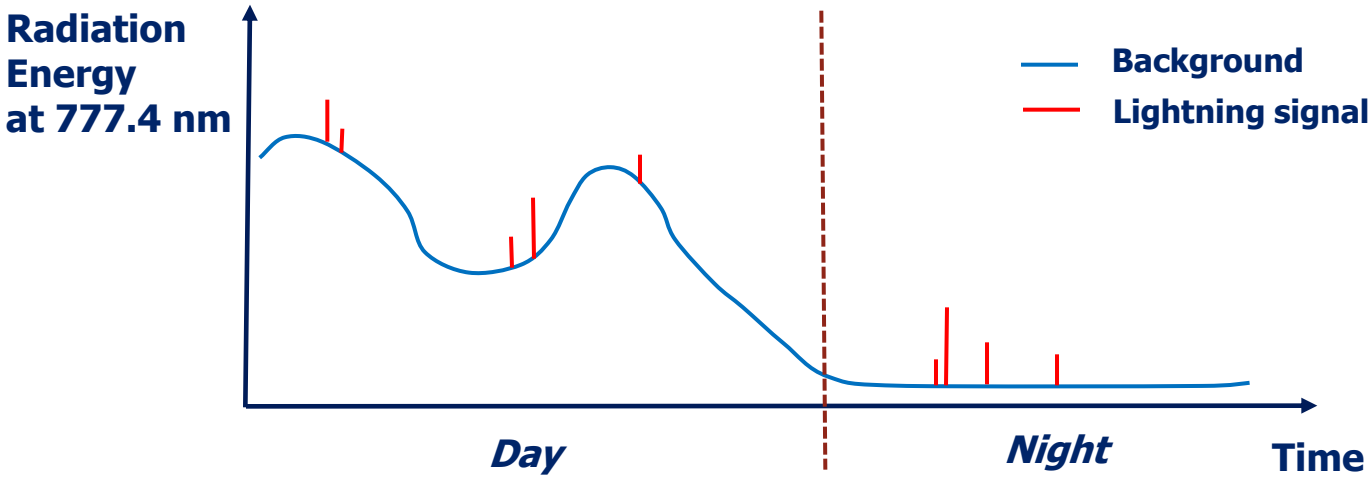



- VHF – Very High Frequency, (V)LF – (Very) Low Frequency

# Optical Signal of a Flash – High speed

# What the LI measures

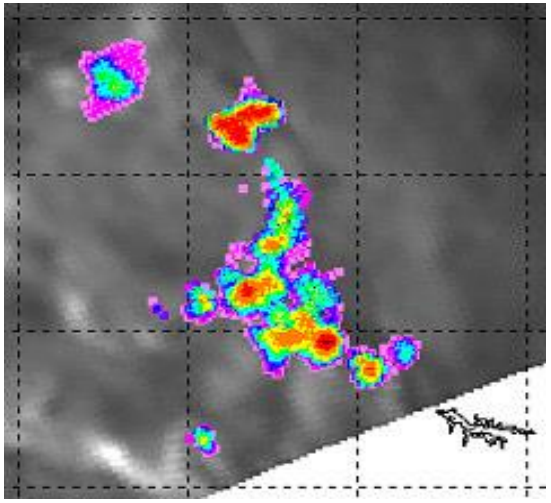
- Lightning with a background signal (bright clouds) changing with time:

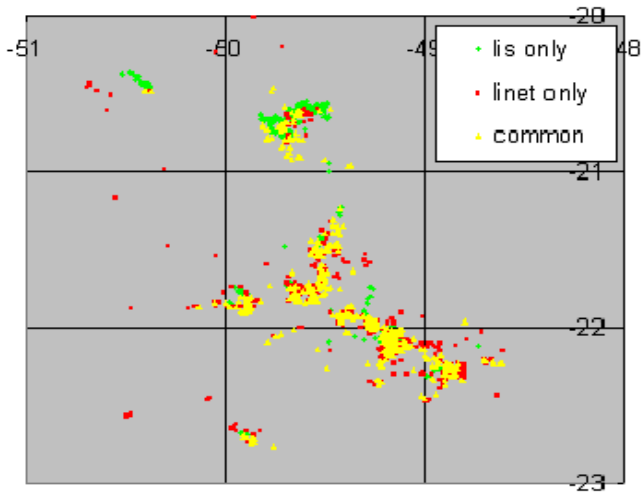



- Lightning is not recognized by its bright radiance, but by its transient short pulse character (bright background)
- For detection of lightning, a variable adapting threshold has to be used for each pixel which takes into account the change in the background radiance

# Lightning as seen from space

Lightning seen from Space Shuttle






LIS on TRMM vs. LINET

898 LIS groups 1293 LINET strokes

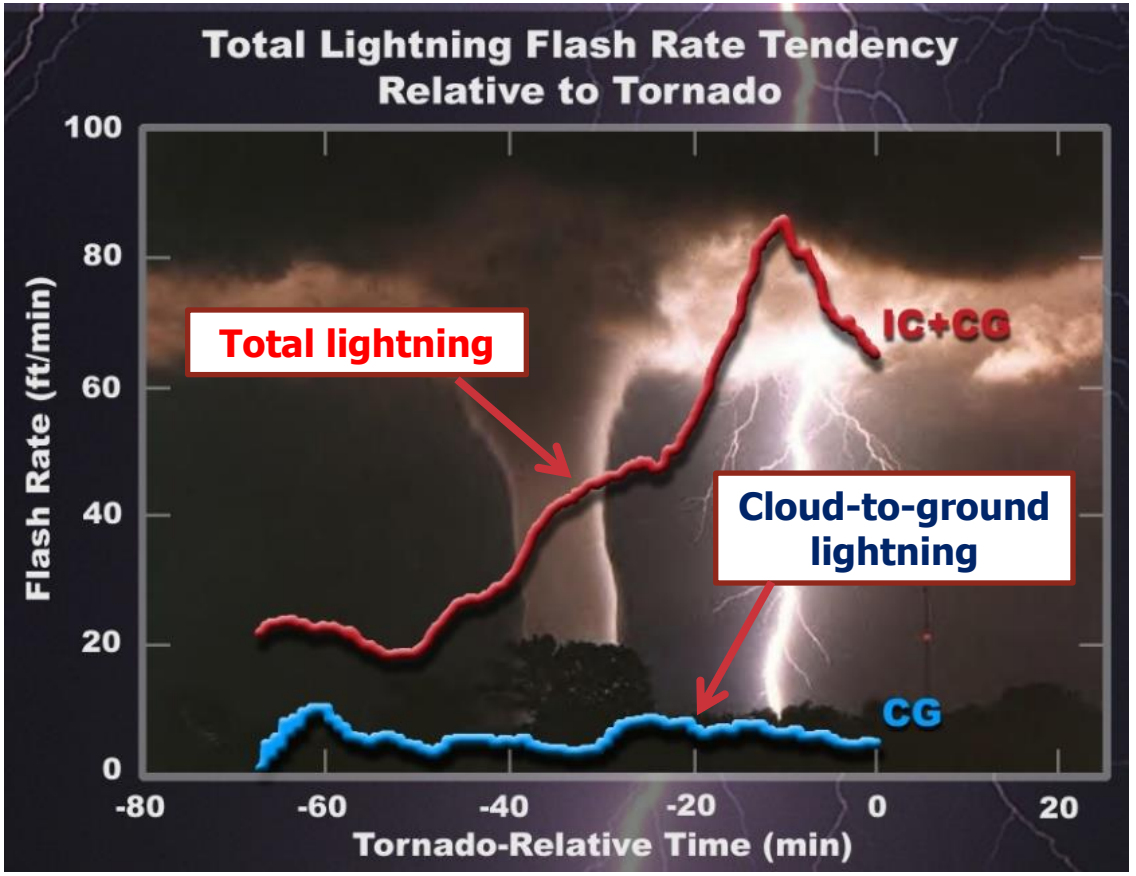
Storm in Bauru (Brazil):

**MTG LI will deliver continuously and simultaneously information on total lightning over the full disk (high timeliness and homogeneous data quality), that will allow to apply NWC algorithms on severe weather warning over the full Earth Disk.**

# The LI – Role of Lightning – Why do we care?

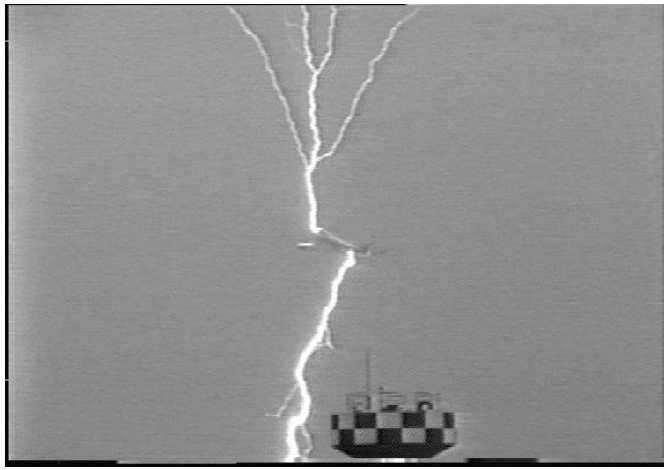
- Lightning is a precursor of severe weather, with a lead time of tens of minutes
- Most ground-based lightning location systems are mainly sensitive to CG lightning
- No increase in CG due to "weather intensification" observable → Total lightning is the parameter of interest

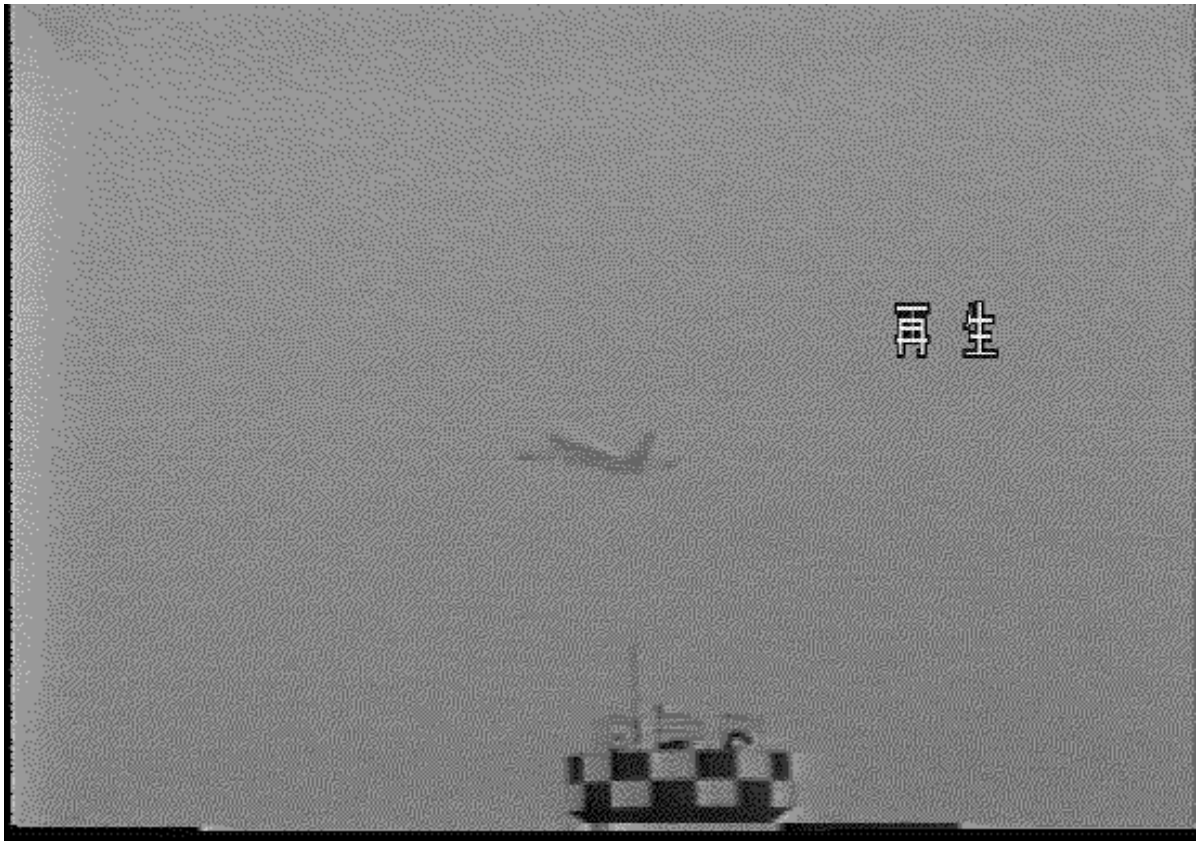
**Total lightning =**
**cloud-to-ground**
**+ cloud-to-cloud lightning**



# The LI – Role of Lightning – Why do we care?

- Improved knowledge of the state of electrification of thunderstorms (weak electrification within the extended anvils) will improve aviation guidance in the vicinity of airports and en route.






**Source: Kawasaki, Univ. Osaka**

# Benefits just from the LI...

- **Main benefit from GEO lightning observations**:
- homogeneous and continuous observations delivering information on location and strength of lightning flashes to the users with a timeliness of 30 seconds

- **Main objectives are to detect, monitor, track and extrapolate in time:**
- Development of active convective areas and storm lifecycle
- Lightning climatology
- Chemistry (NOx production)

- **Furthermore:**
- Good coverage in developed countries and around major airports
- Most areas of the earth are without any good-quality lightning data from ground, but with significant severe weather and lightning causing risks for aviation (e.g. Africa)
- This situation on the availability of ground-based data is not expected to change in the near future (technical/physical limitations)

# Conclusion on MTG Missions

## MTG Missions will

- Ensure continuation and improvement of existing services
- Enable new services expected from 2021 onwards