

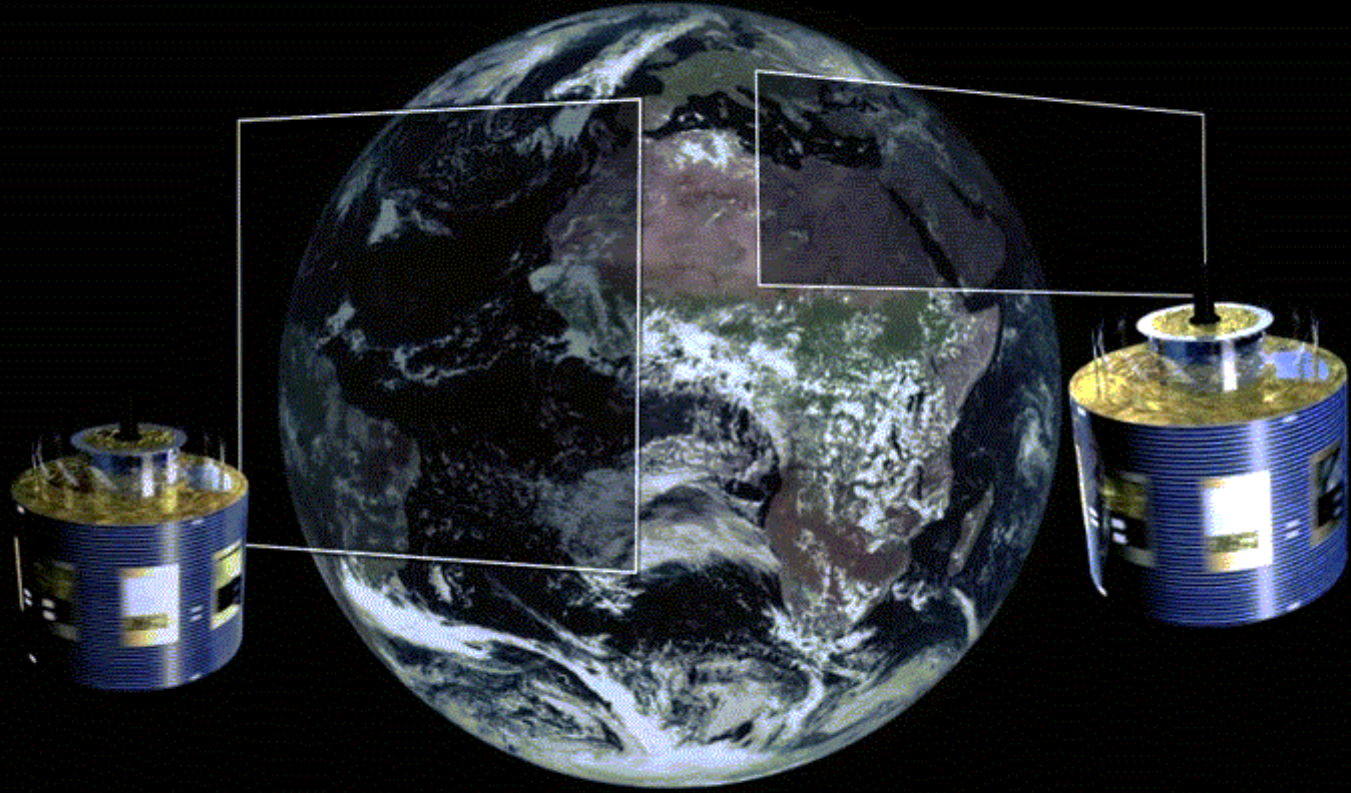


# Meteosat Third Generation mission overview

Ivan Smiljanic, (EUMETSAT)



# Meteosat Second Generation: a two-satellite operational system for meteorology

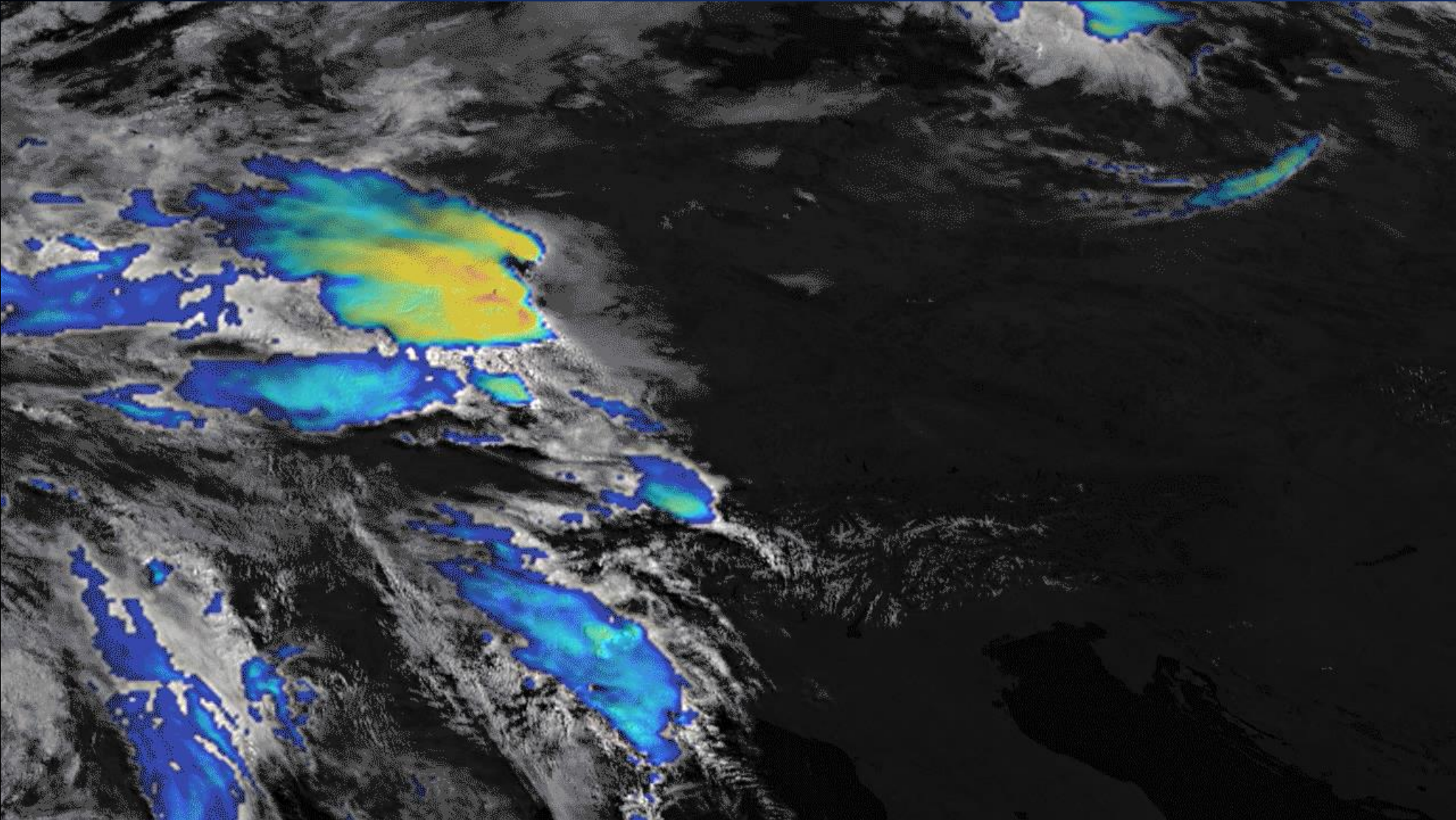


Time-lapse  
00:00

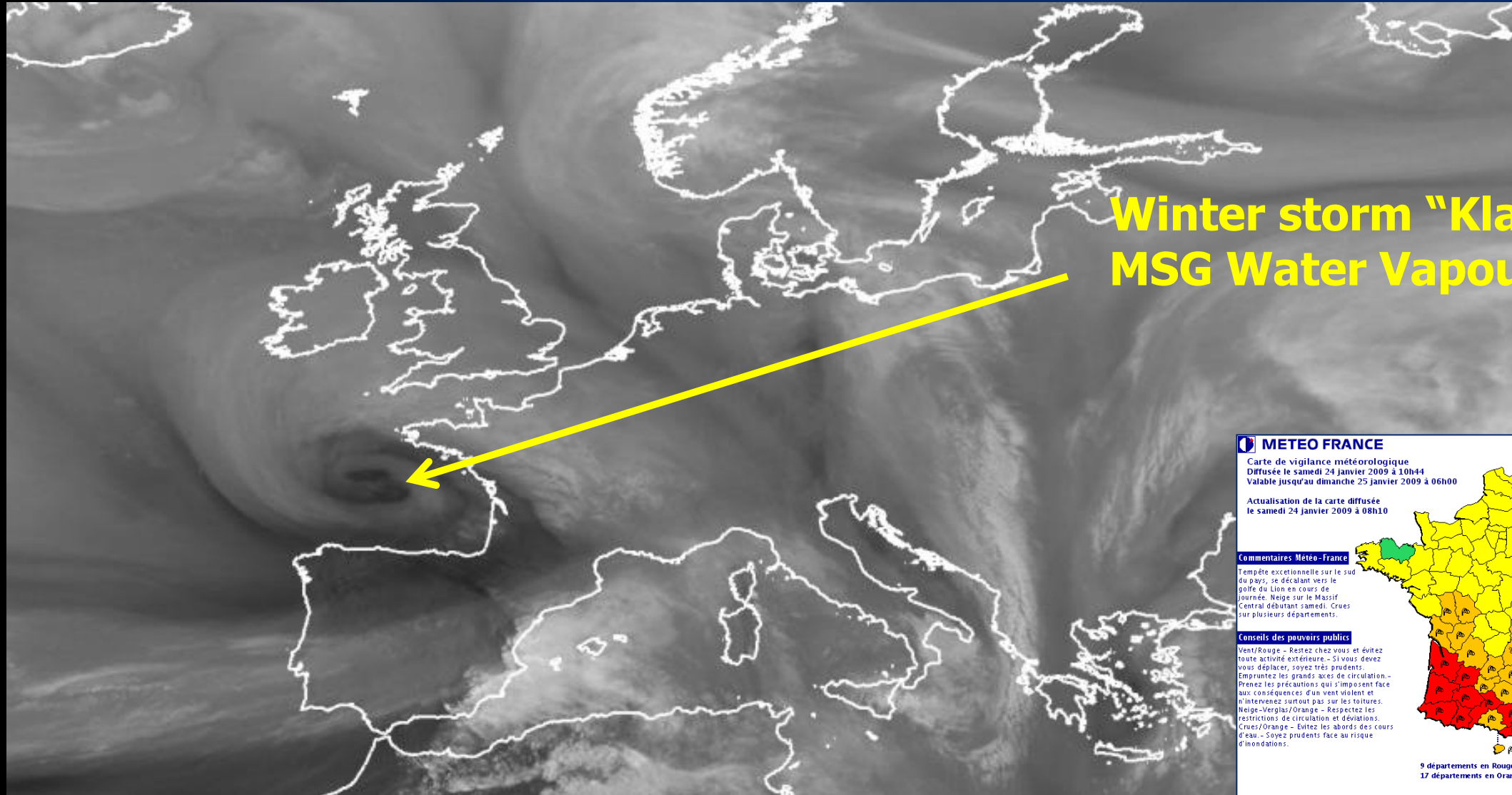
Animated representation



# Meteosat Second Generation for nowcasting of severe weather: thunderstorms



# Meteosat Second Generation for confirmation of forecasts



Winter storm "Klaus" 2009  
MSG Water Vapour Imagery

**METEO FRANCE**  
Carte de vigilance météorologique  
Diffusée le samedi 24 janvier 2009 à 10h44  
Valable jusqu'au dimanche 25 janvier 2009 à 06h00  
Actualisation de la carte diffusée le samedi 24 janvier 2009 à 08h10

**Commentaires Météo-France**  
Tempête exceptionnelle sur le sud du pays, se décalant vers le golfe du Lion en cours de journée. Neige sur le Massif Central débutant samedi. Crues sur plusieurs départements.

**Conseils des pouvoirs publics**  
Vent/Rouge – Restez chez vous et évitez toute activité extérieure. Si vous devez vous déplacer, soyez très prudents. Empruntez les grands axes de circulation. Prenez les précautions qui s'imposent face aux conséquences d'un vent violent et n'intervenez surtout pas sur les toitures. Neige-Verglas/Orange – Respectez les restrictions de circulation et déviations. Crues/Orange – Évitez les abords des cours d'eau. Soyez prudents face au risque d'inondations.

**9 départements en Rouge.**  
**17 départements en Orange.**

**Legend:**  
Vent violent  
Pluie - Inondation  
Orages  
Neige - Verglas  
Grand Froid  
Avalanches

**Alert Levels:**  
Rouge : Une vigilance absolue s'impose: des phénomènes d'exceptionnels sont prévus; tenez-vous régulièrement au courant de l'évolution de la situation et respectez impérativement les consignes de sécurité émises par les pouvoirs publics.  
Orange : Soyez très vigilant: des phénomènes dangereux sont prévus; tenez-vous au courant de l'évolution de la situation et suivez les conseils de sécurité émis par les pouvoirs publics.  
Jaune : Soyez attentif si vous pratiquez des activités sensibles au risque météorologique ou de crues de phénomènes habituels dans la région mais occasionnellement dangereux (local, orage d'été, montée des eaux) sont en effet prévus; tenez-vous au courant de l'évolution de la situation.  
Vert : Pas de vigilance particulière.  
Les cartes de vigilance météo paraissent 2 fois par jour à 06h et 16h.  
En cas de vigilance orange ou rouge, des bulletins de suivi sont disponibles.



# Meteosat Third Generation: Imaging mission (MTG-I)



- Imagery mission implemented by two MTG-I satellites
- Full disc imagery every 10 minutes in 16 bands
- Fast imagery of Europe every 2.5 minutes
- New Lightning Imager (LI)

# Meteosat Third Generation: Sounding mission (MTG-S)



- Hyperspectral infrared sounding mission
- 3D weather cube: temperature, water vapour, O<sub>3</sub>, every 30 minutes over Europe
- Air quality monitoring and atmospheric chemistry in synergy with Copernicus Sentinel-4 instrument

# Meteosat Third Generation (MTG): Full operational configuration

✓ **Continuity**

✓ **Innovation**

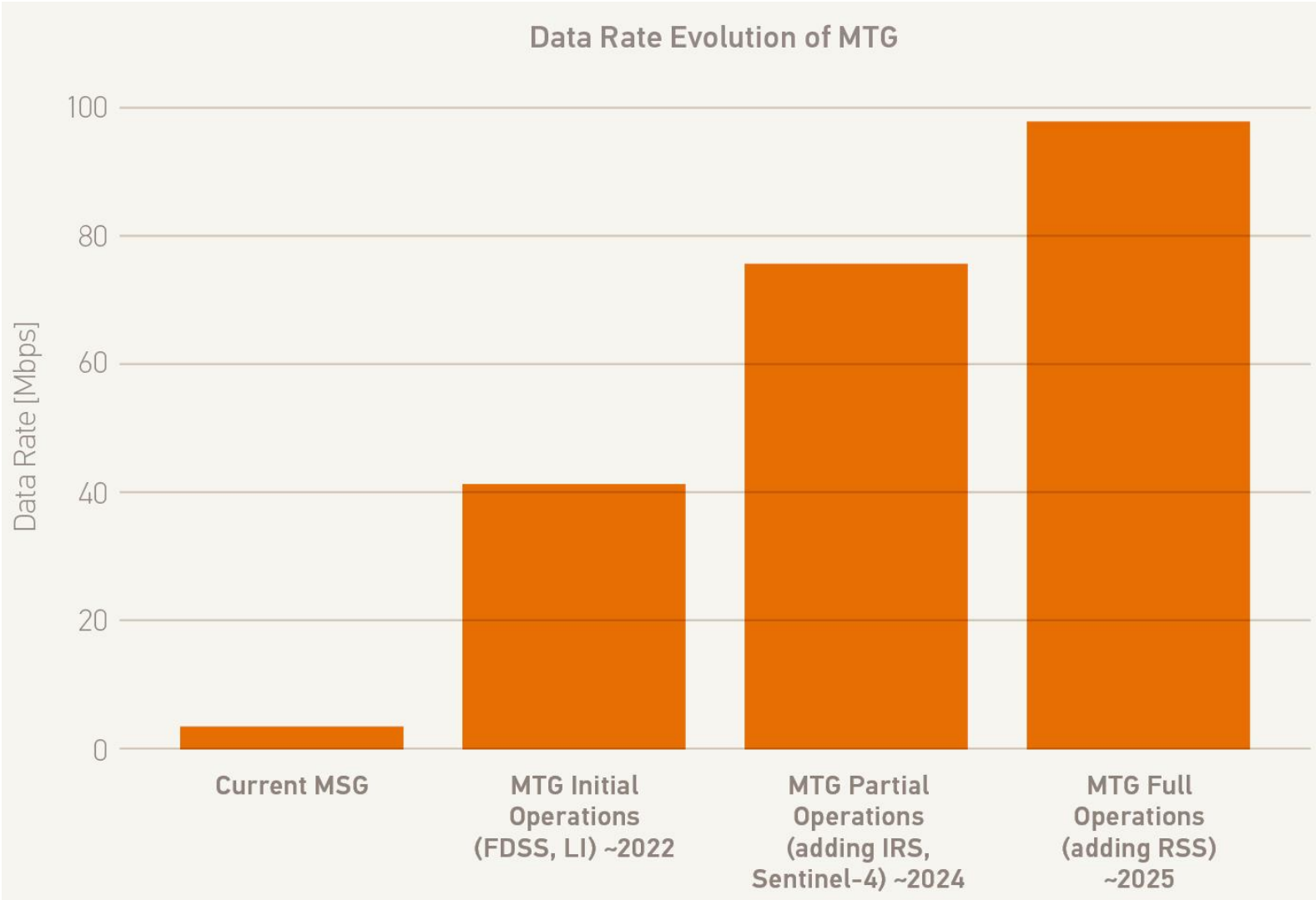


**MTG-I**  
Rapid Scan  
Service

**MTG-S**  
Sounding  
Service

**MTG-I**  
Full Scan  
Service

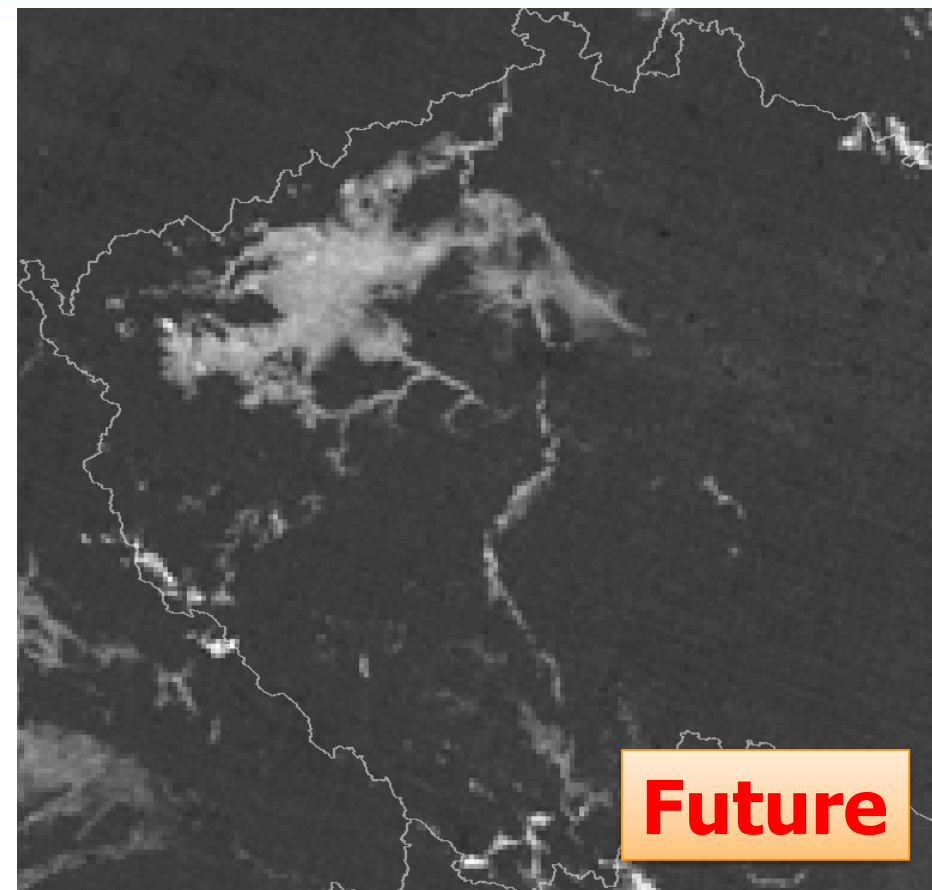
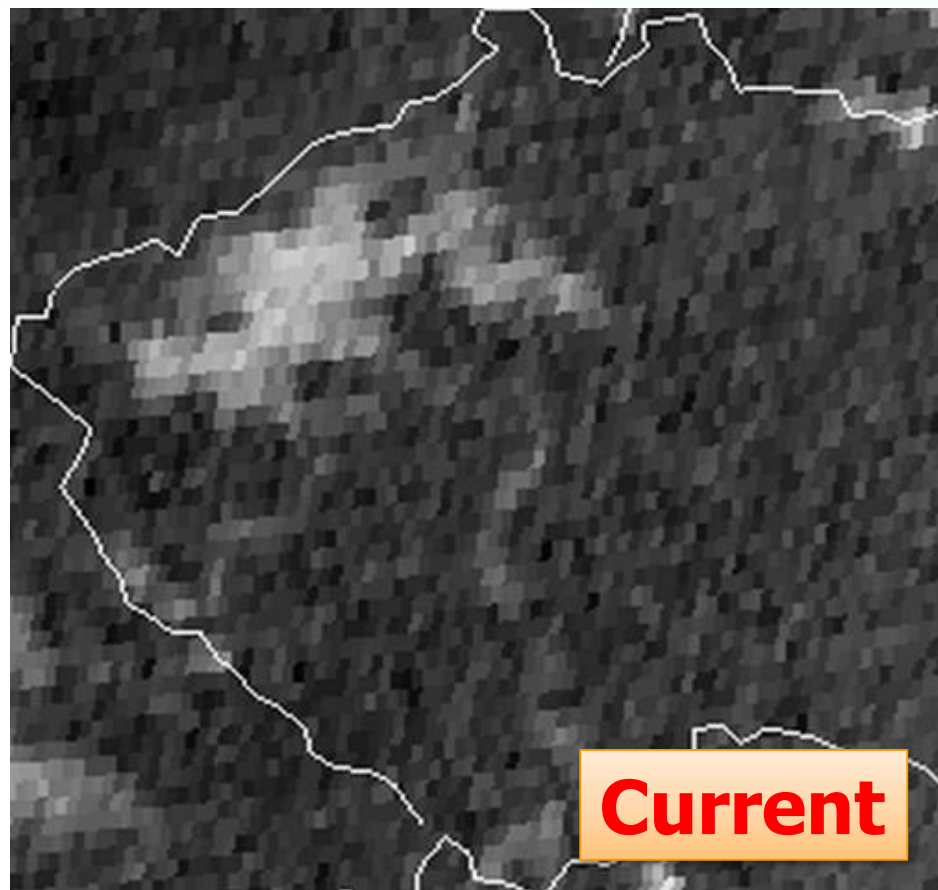
# Illustration of MTG data rates





# Expected improvements

# MTG Imager (FCI): higher spatial resolution imagery



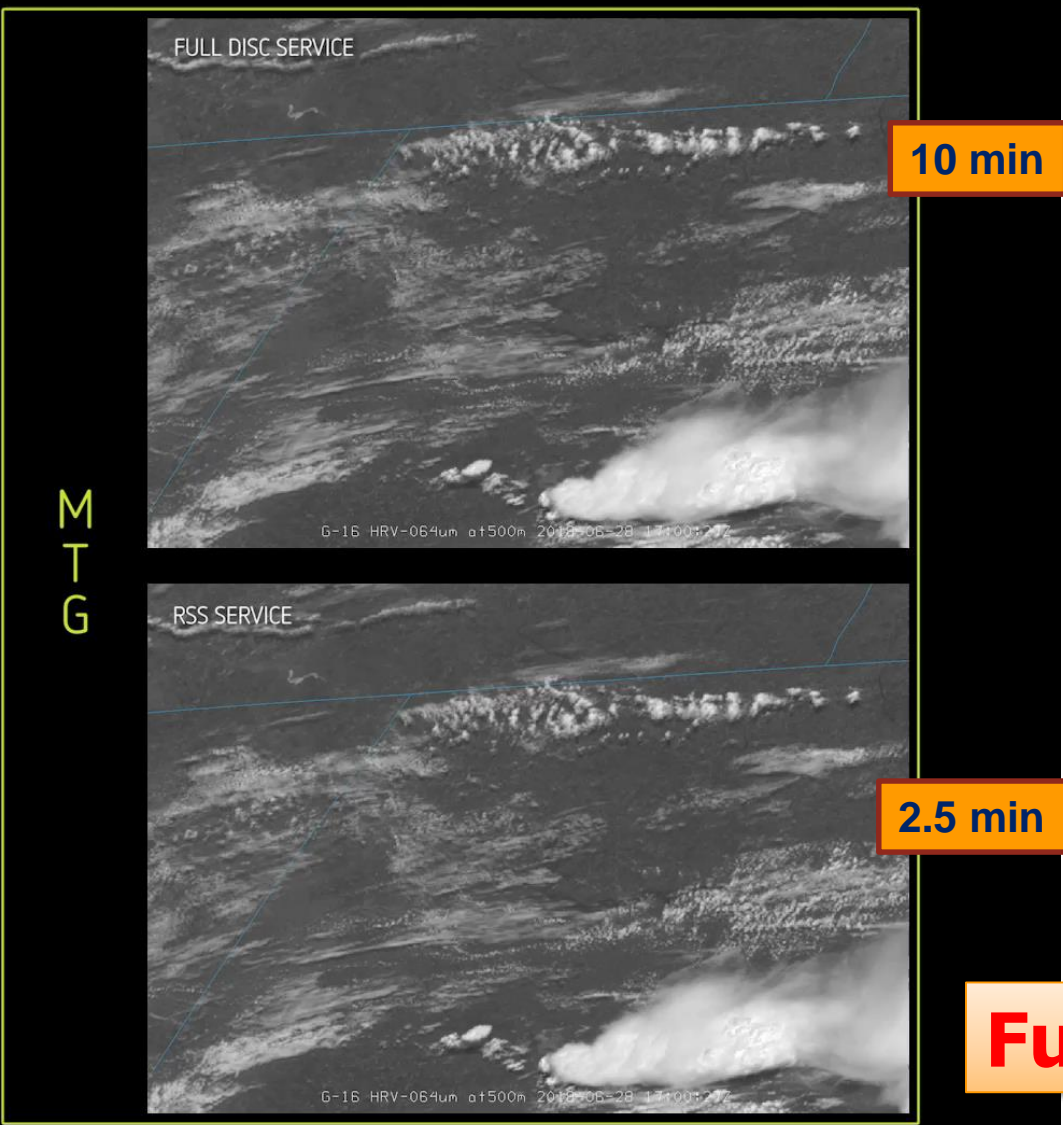
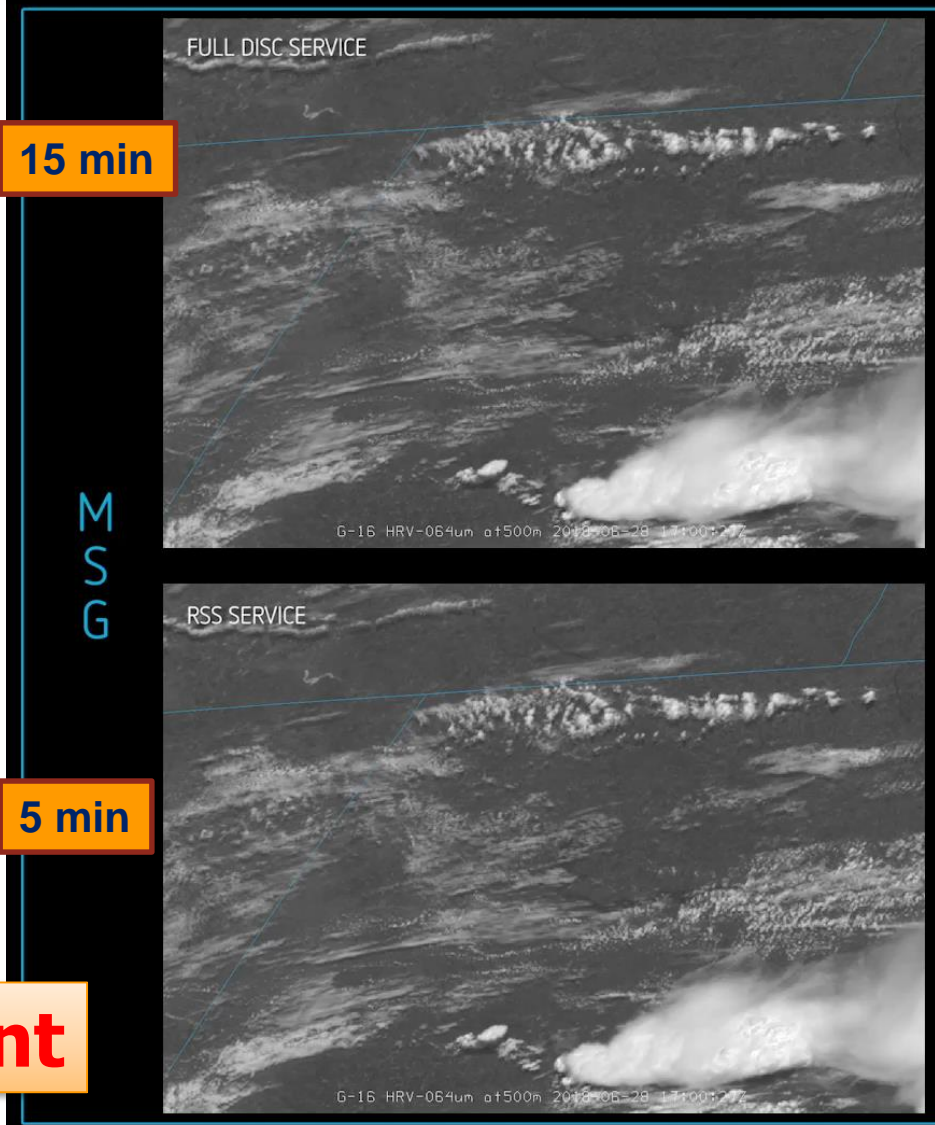
## Example of fog detection over Czech Republic

Source: M. Setvak, J. Kerkmann; 16 Nov 2018, 01.37 UTC

Right panel: simulated FCI imagery at ~2 km effective resolution  
(1 km nominal), based on NOAA Suomi-NPP VIIRS data

Left panel: MSG SEVIRI imagery at 5 km effective resolution (3 km nominal)

# MTG Imager (FCI): New insights through higher temporal resolution

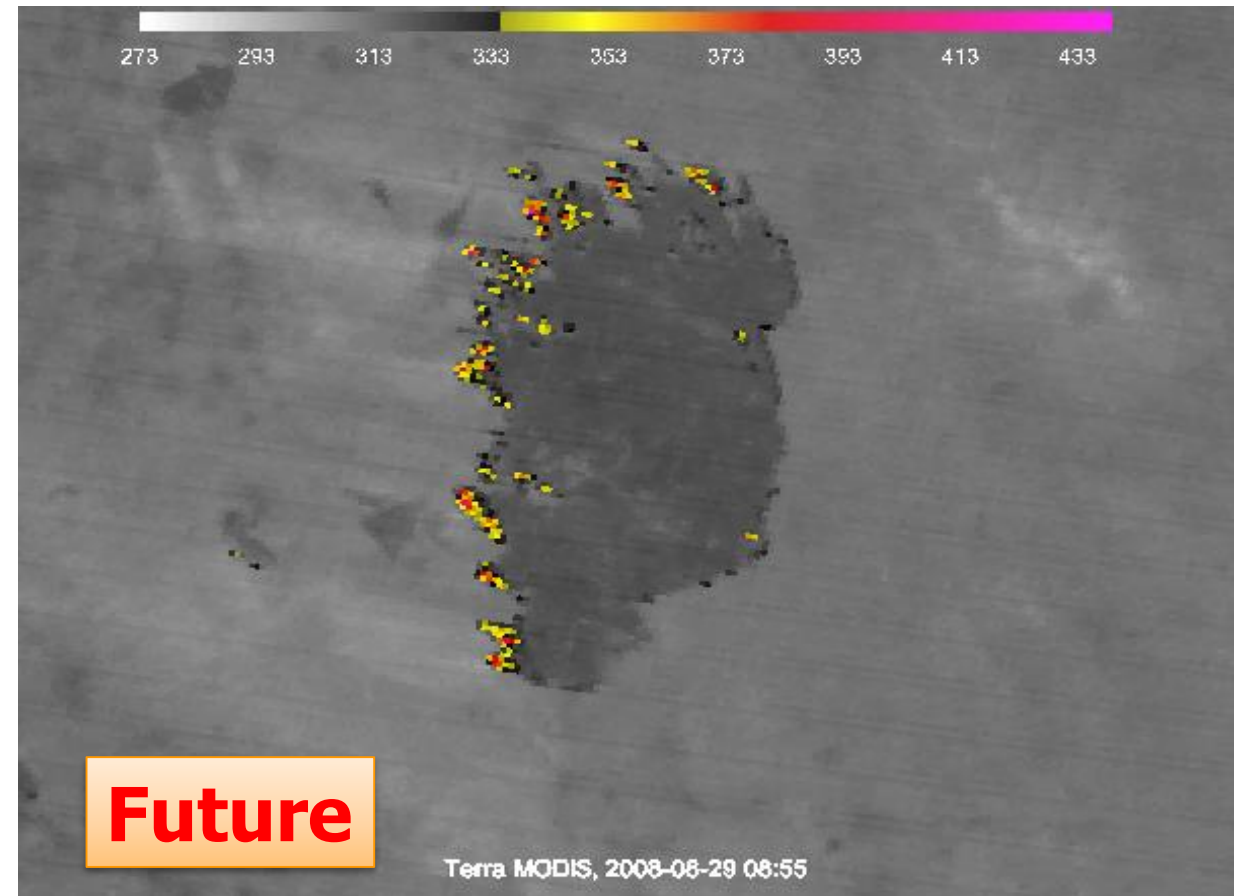
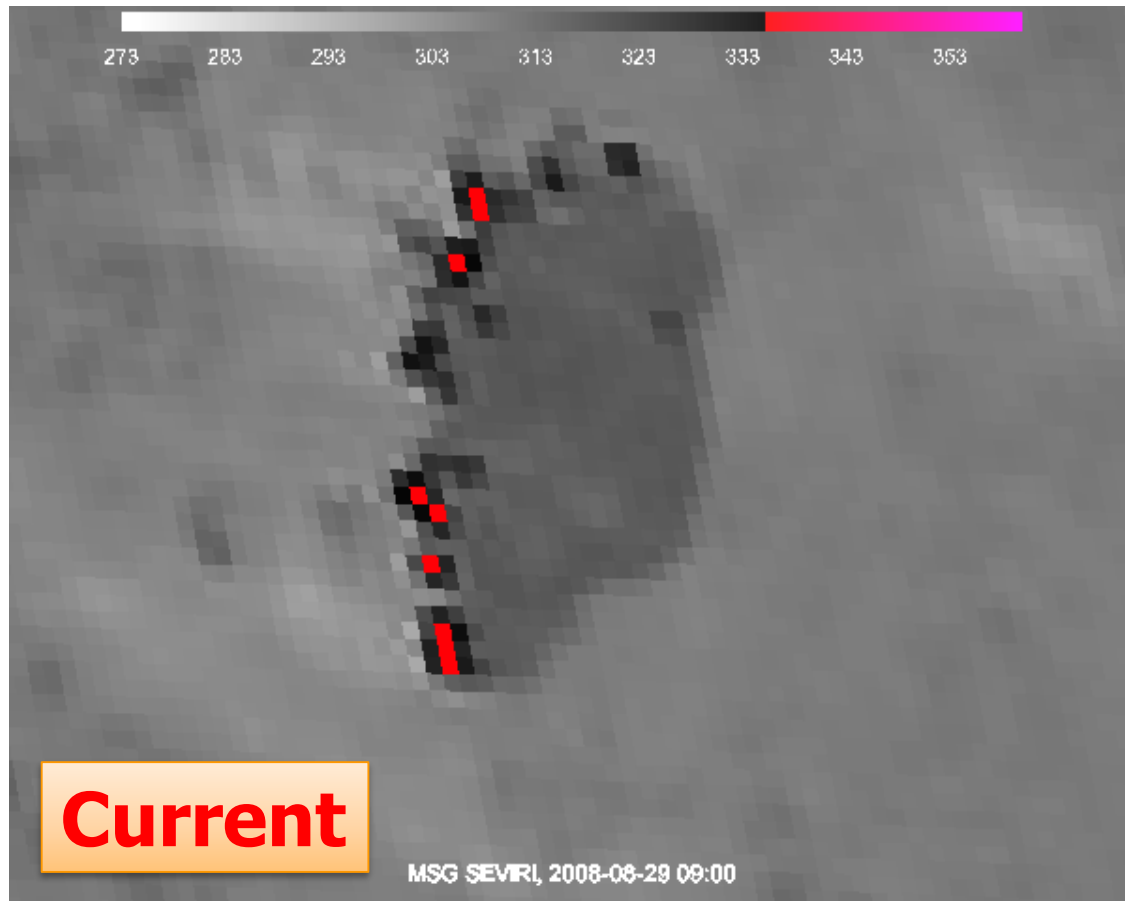


**Current**

**Future**



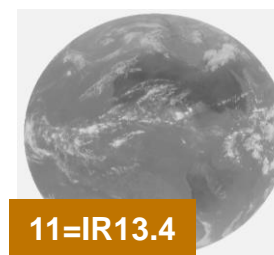
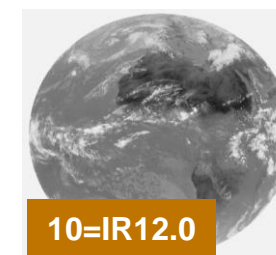
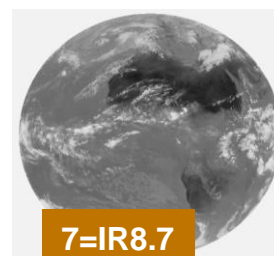
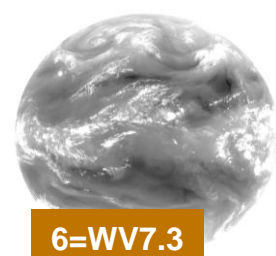
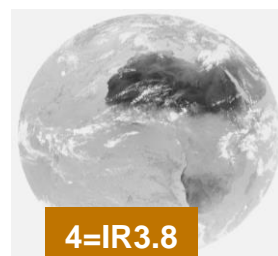
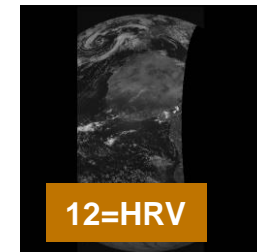
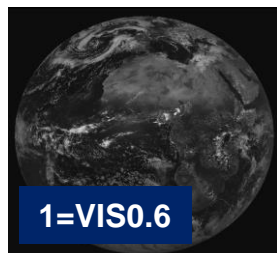
# MTG Imager (FCI): New prospects for fire detection and monitoring



Botswana, August 2008

**Higher spatial and temporal resolution; new channel for improved fire detection at 2.2  $\mu\text{m}$**

# Current and future imagers channels: MSG SEVIRI and MTG FCI



**Current SEVIRI**

# Current and future imagers channels: MSG SEVIRI and MTG FCI



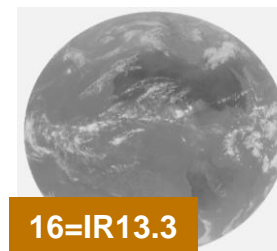
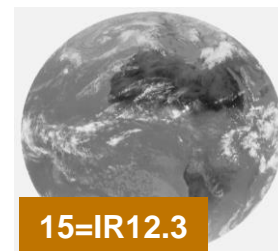
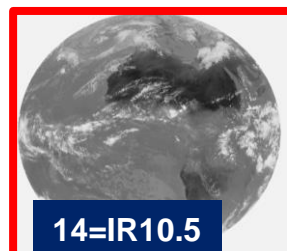
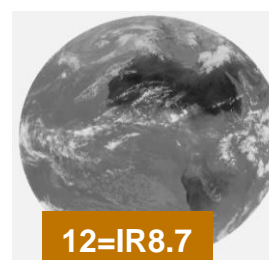
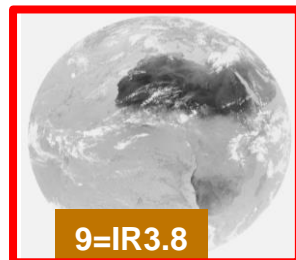
solar  
channels  
provided in  
0.5 km / 1.0 km  
resolution



✓ **Continuity**

✓ **Innovation**

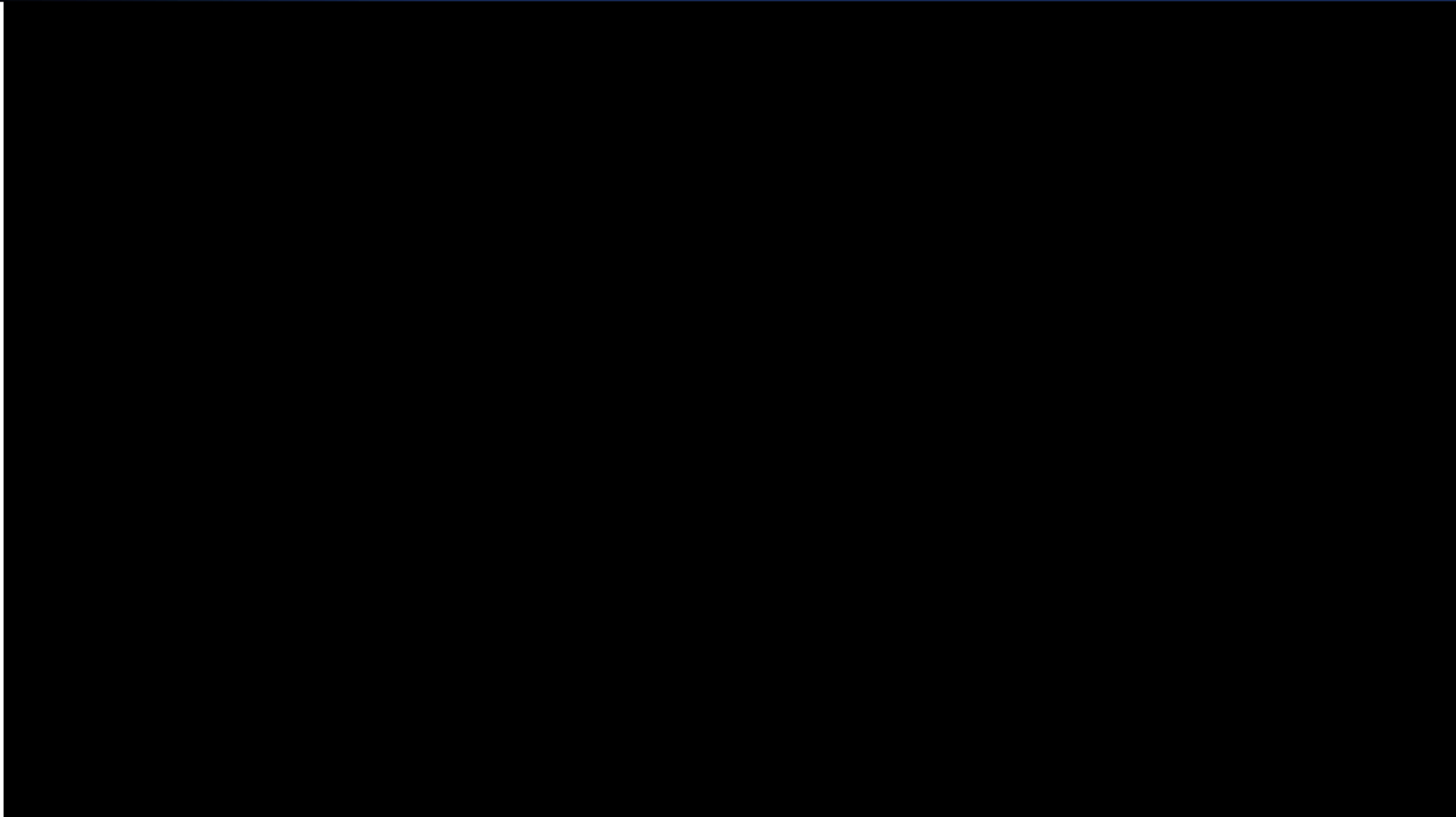
thermal  
channels  
provided in  
1 km / 2 km  
resolution



**Future FCI**



# FCI instrument



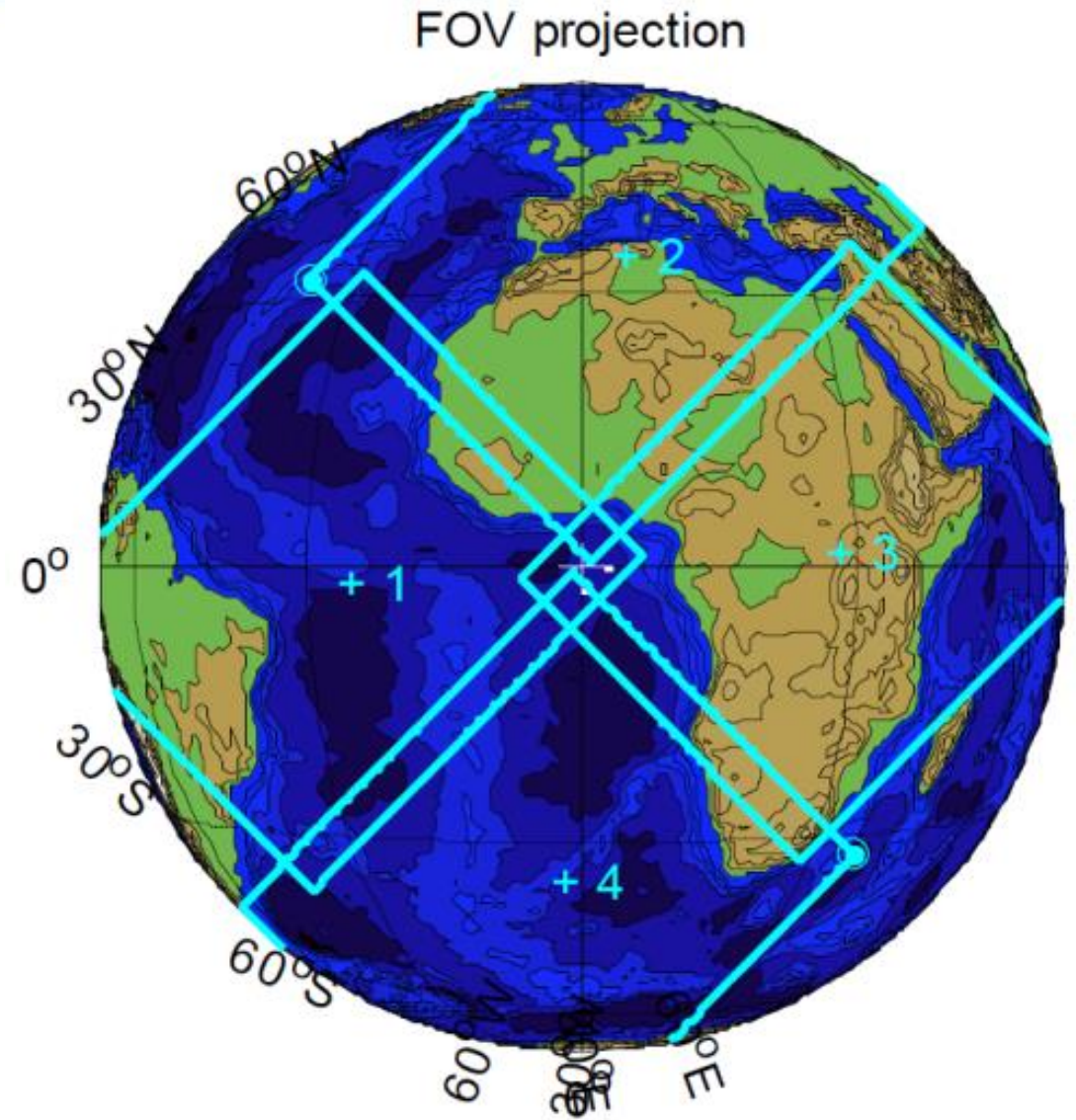
# Benefits from the MTG Imager (FCI)

- New channels (0.444  $\mu\text{m}$  and 0.51  $\mu\text{m}$ ) 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  $\mu\text{m}$  channel will provide during **daytime total column precipitable water** especially over land surfaces.
- The 1.375  $\mu\text{m}$  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  $\mu\text{m}$  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  $\mu\text{m}$  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.

# MTG lightning imager mission: *Why do we care?*

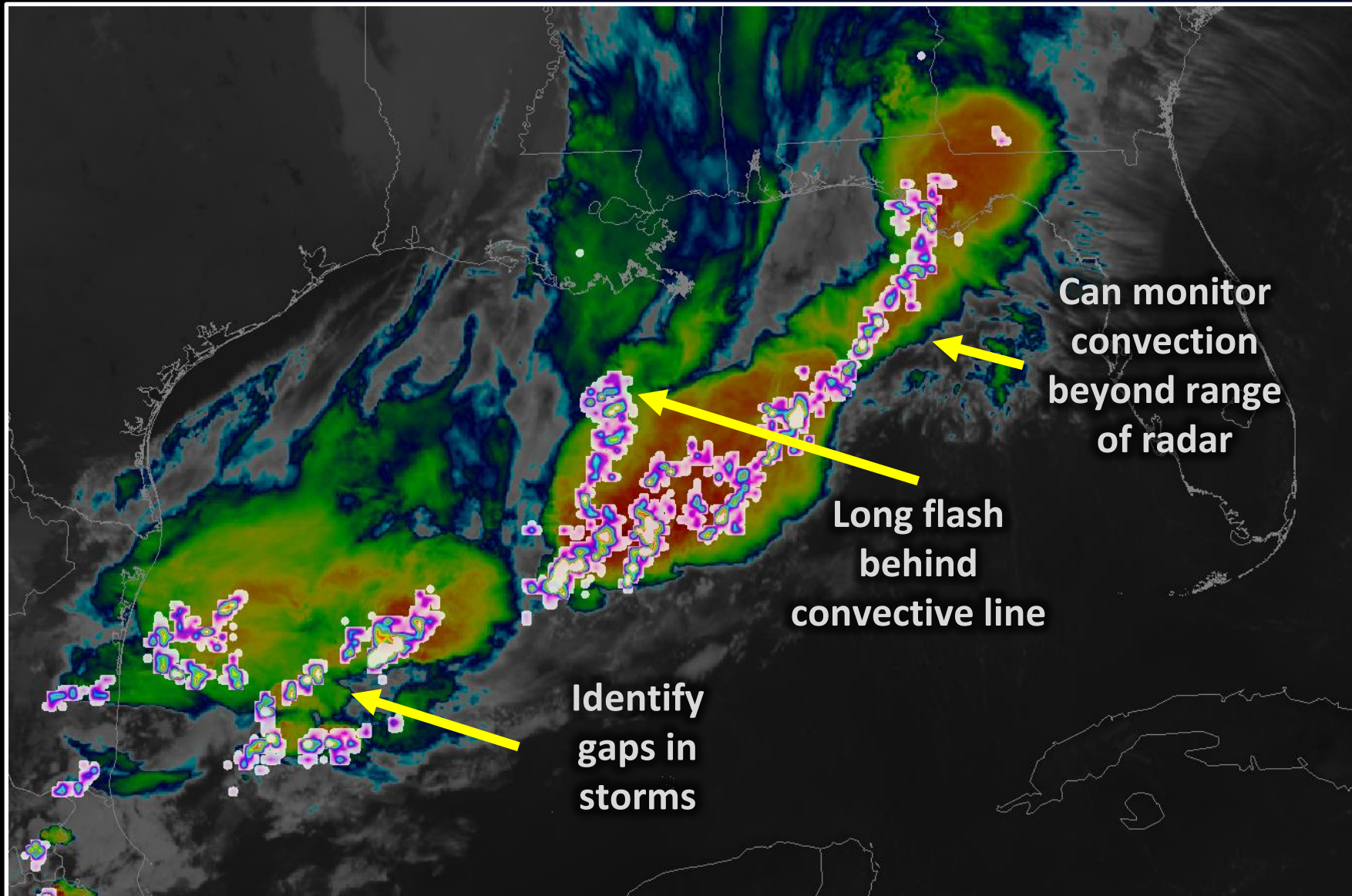
- Lightning is a precursor of severe weather, with a lead time of tens of minutes
- Most ground-based lightning location systems are mainly sensitive to cloud-to-ground lightning (CG)
- Often, no increase in CG due to “weather intensification” observable  
→ Total lightning is the parameter of interest

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



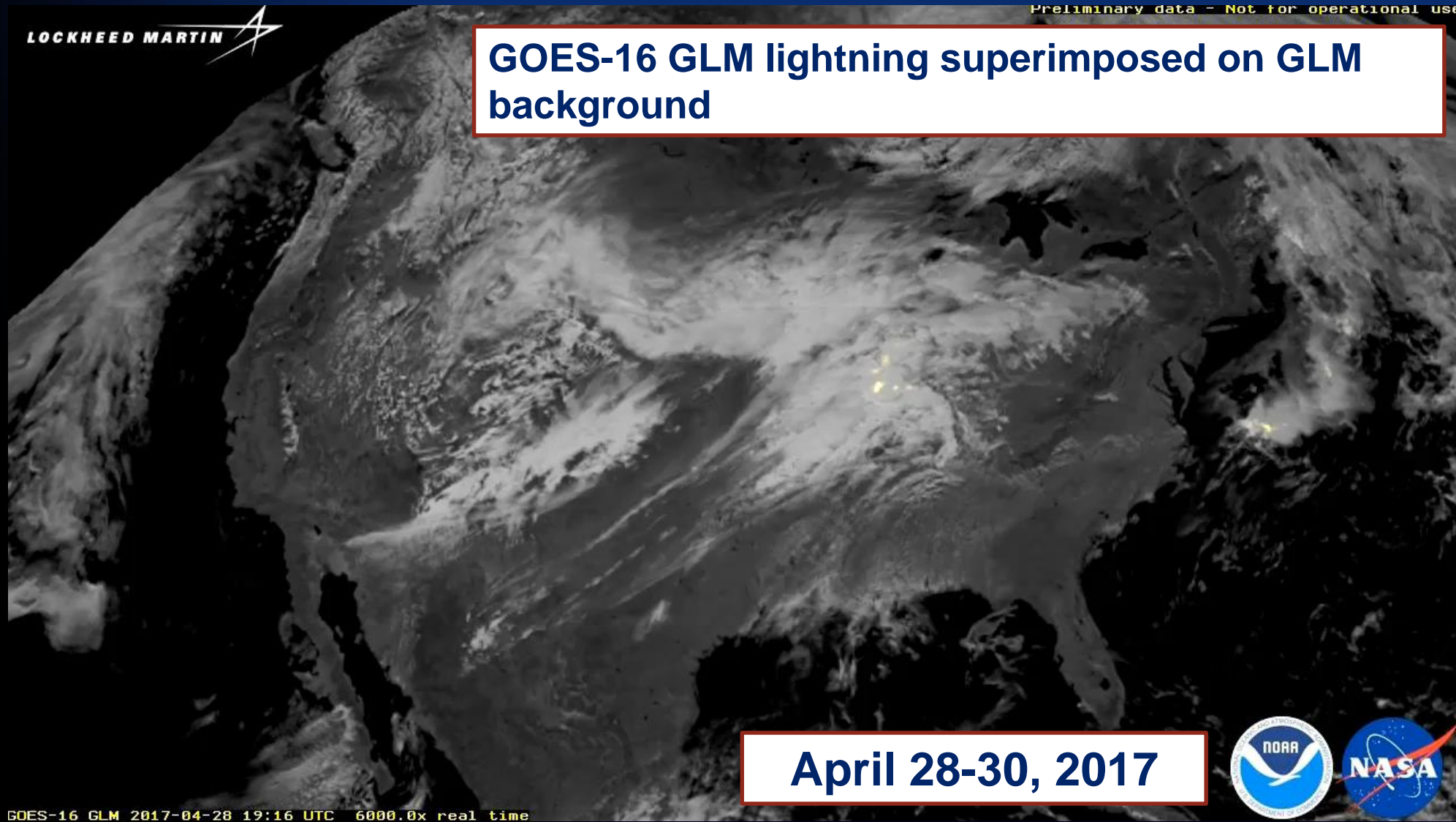


# MTG Lightning Imager (LI): US Proxy Data

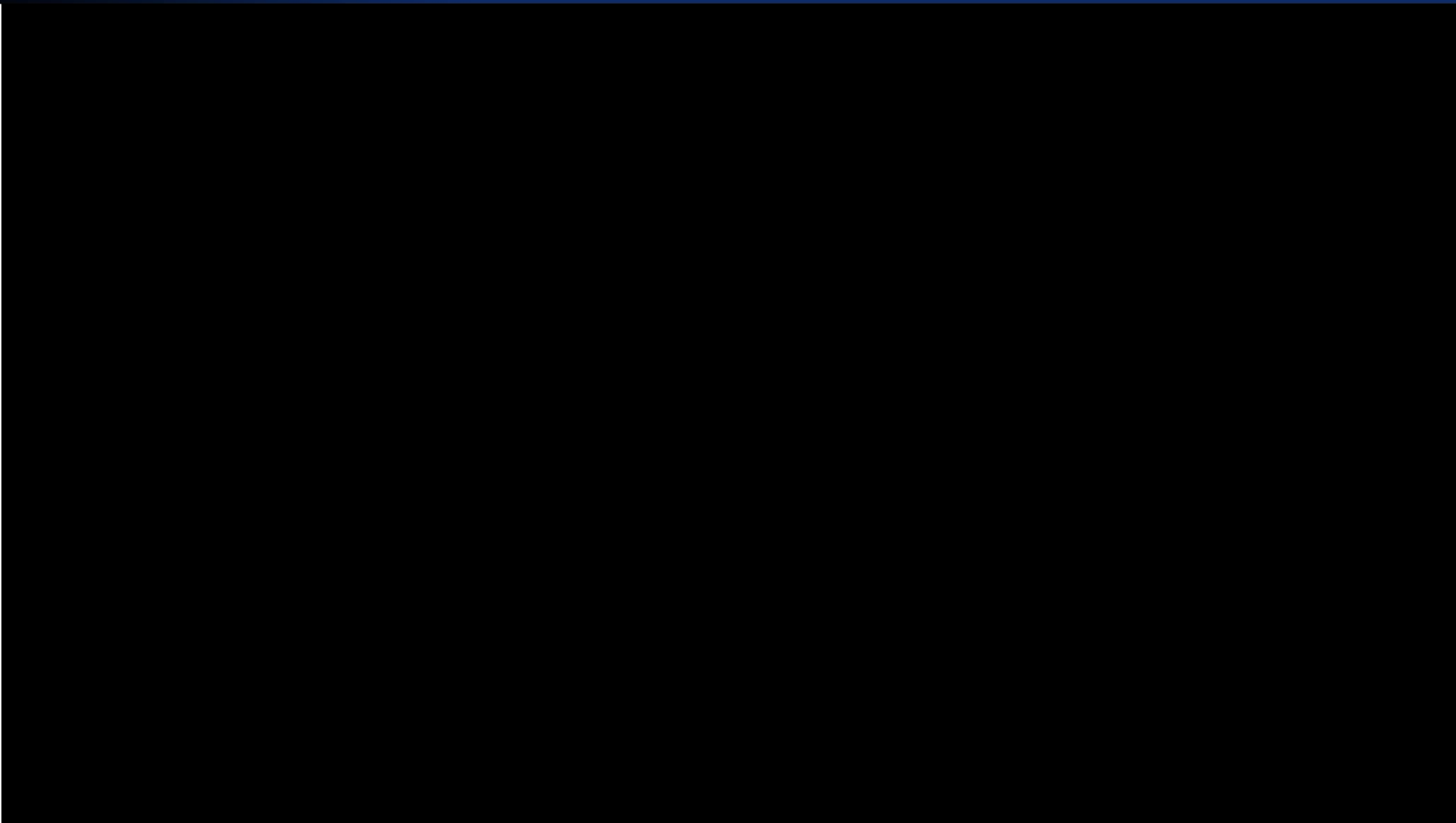


- GOES Lightning Mapper (GLM) Group Density
- Repeat cycle: 1 min
- Horizontal resolution: 8 km
- GOES ABI 11.2 IR
- 4 May 2017
- Source: G. Stano, NASA SPoRT
- **MTG LI features:**  
Spatial resolution: ~ 4.5 km at SSP  
Update cycle: 30s

# MTG Lightning Imager (LI): US Proxy Data



# LI instrument

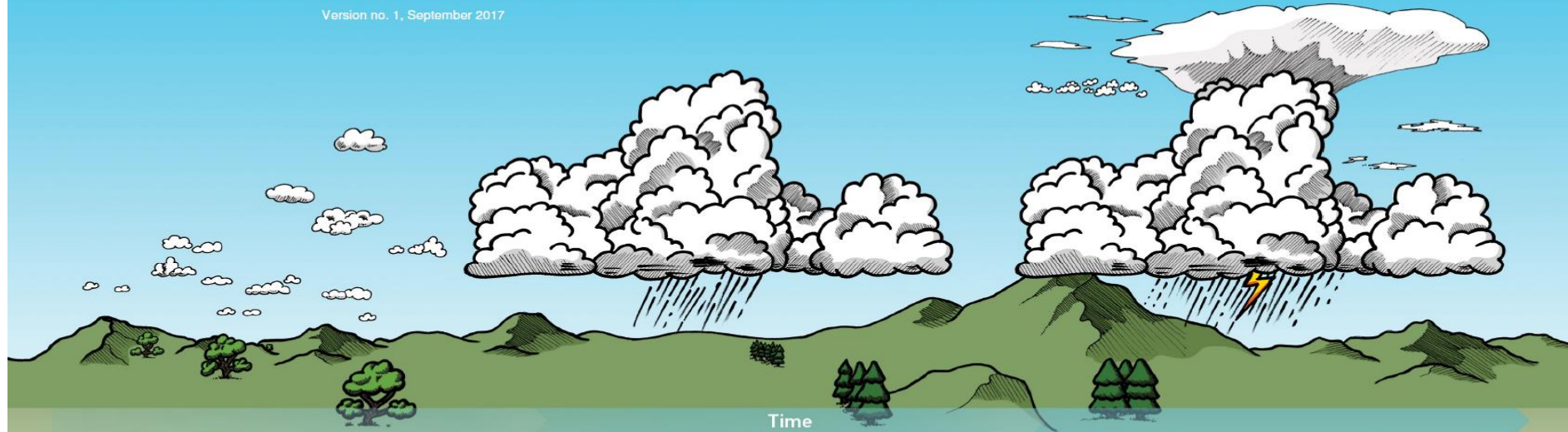




# MTG Imager and Sounder: Tools for Nowcasting

## STEP BY STEP DEEP CONVECTION NOWCASTING

Version no. 1, September 2017



### 1. Pre-Convective Environment

Refers to the 4-D thermodynamic and wind field present before convective initiation occurs.

#### Useful tools:

NWP data, Radiosonde and aircraft measurements  
 MSG GI/RII Product – instability & moisture  
 iSHAI Products – instability & moisture  
 HRW Product – wind fields  
 METOP/IASI level2 – temp & moisture vert. profiles



### 2. Convective Initiation

Refers to the process where an existing cumulus cloud begins rapid vertical growth.

#### Useful tools:

Radar, lightning data  
 Cloud Type  
 Cloud Top Temperature  
 Cloud Microphysics  
 Convection Initiation – demonstrational  
 Optimal Cloud Analysis



### 3. Mature Convective Storm

Refers to the presence of convective clouds with tops at or above their local equilibrium level.

#### Useful tools:

Radar, lightning data  
 RDT Product – storm tracking  
 Precipitating Clouds  
 CRR Product – precipitation  
 NEFODINA  
 Convection RGB  
 Overshooting Top Detection  
 MSG Sandwich Product (HRV+IR10.8 enhanced)

Existing  
 satellite  
 products

To be enhanced  
 with MTG data

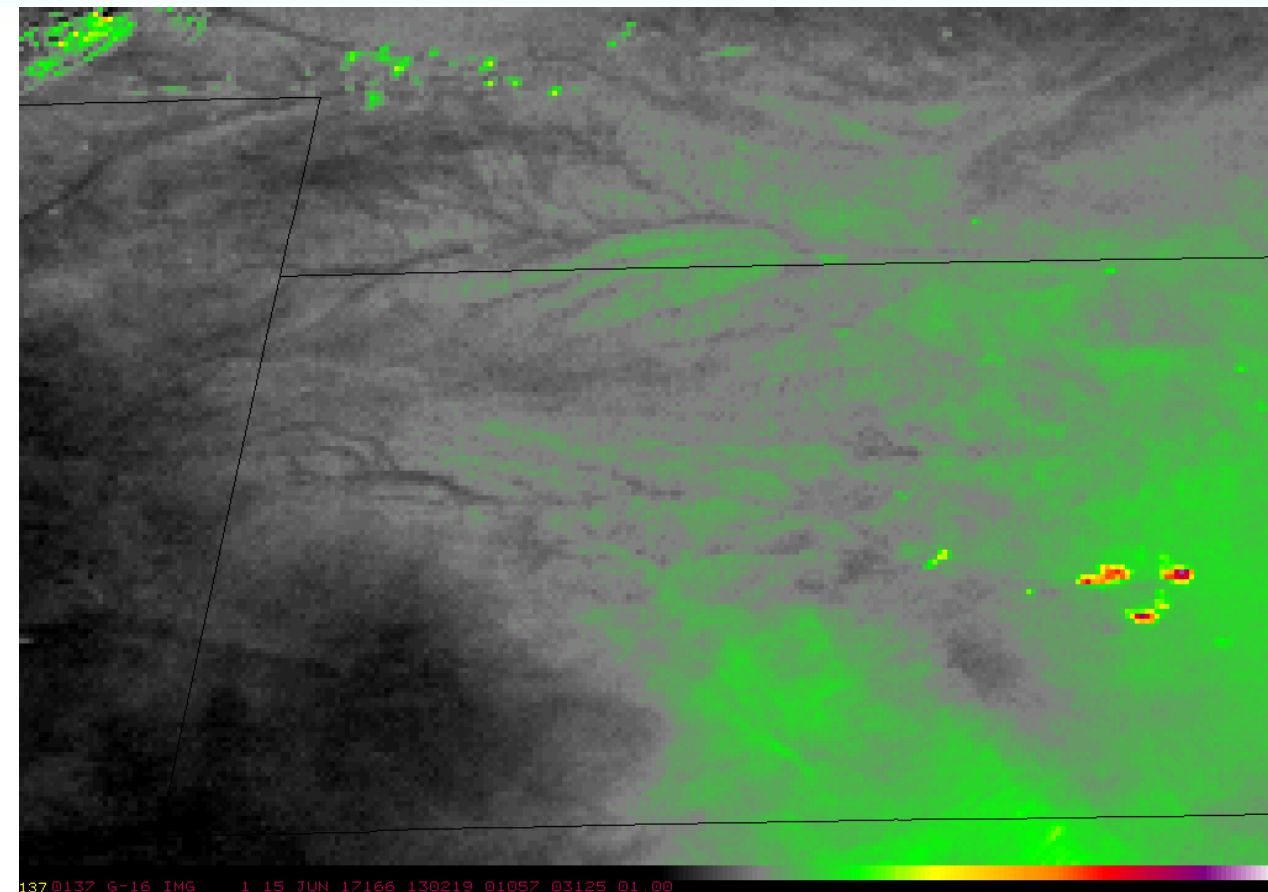
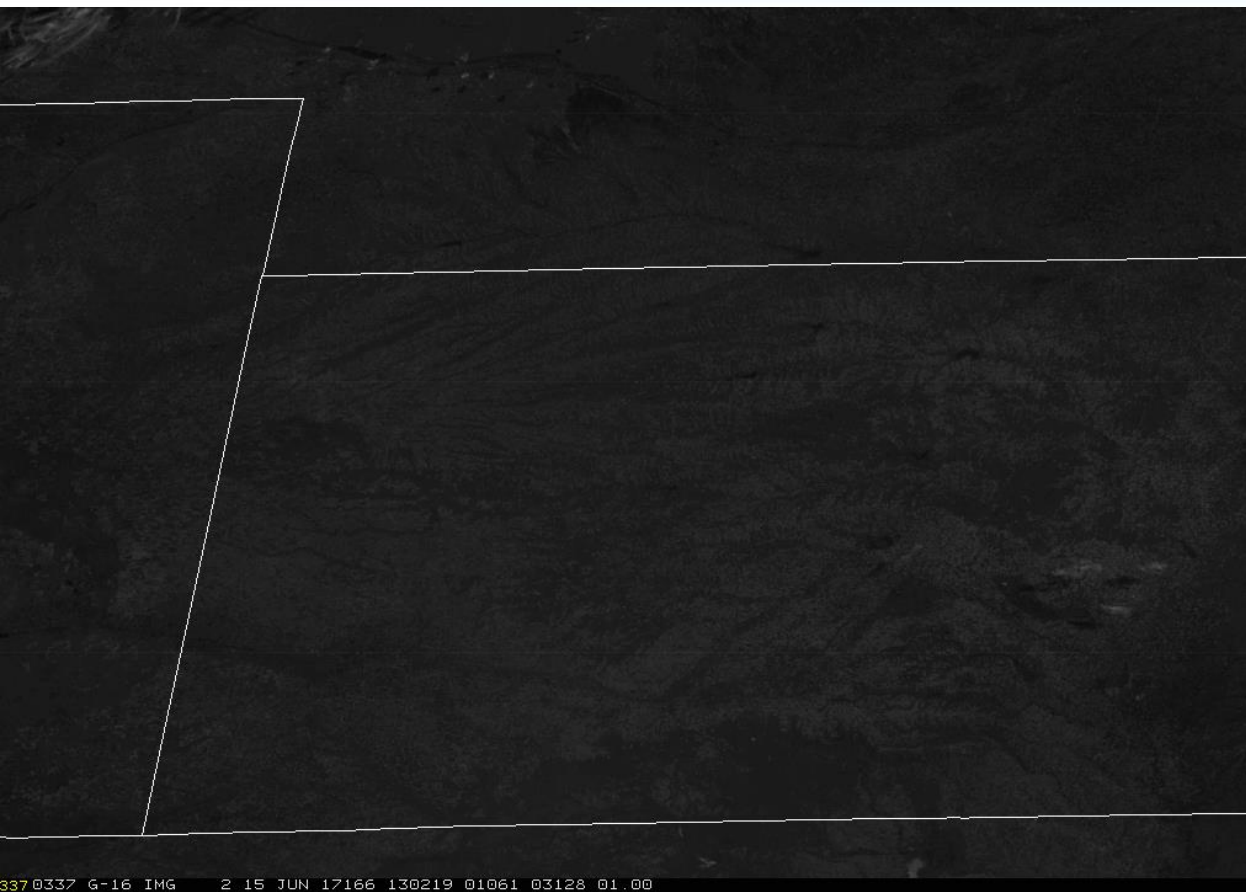


**ARSO METEO**  
 Slovenian Environment Agency



Cloud photos source: WMO International Cloud Atlas, Copyright Stephen Burt and Matthew Clark

# MTG Imager and Sounder: Tools for Nowcasting



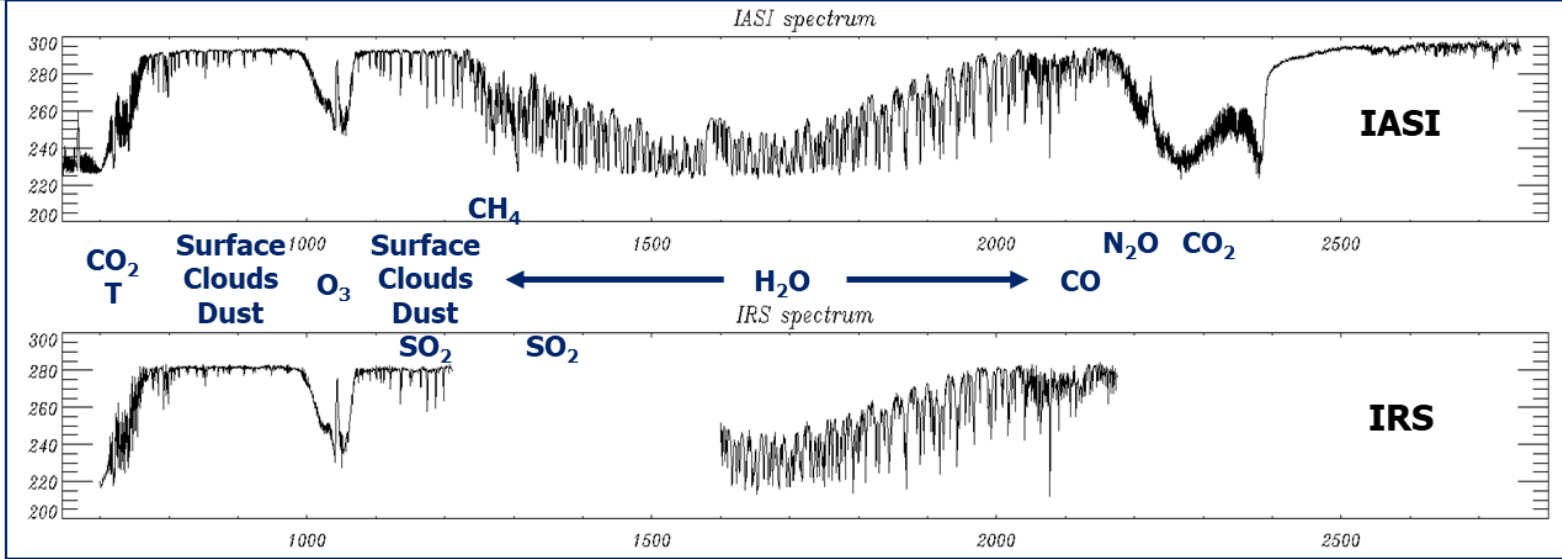
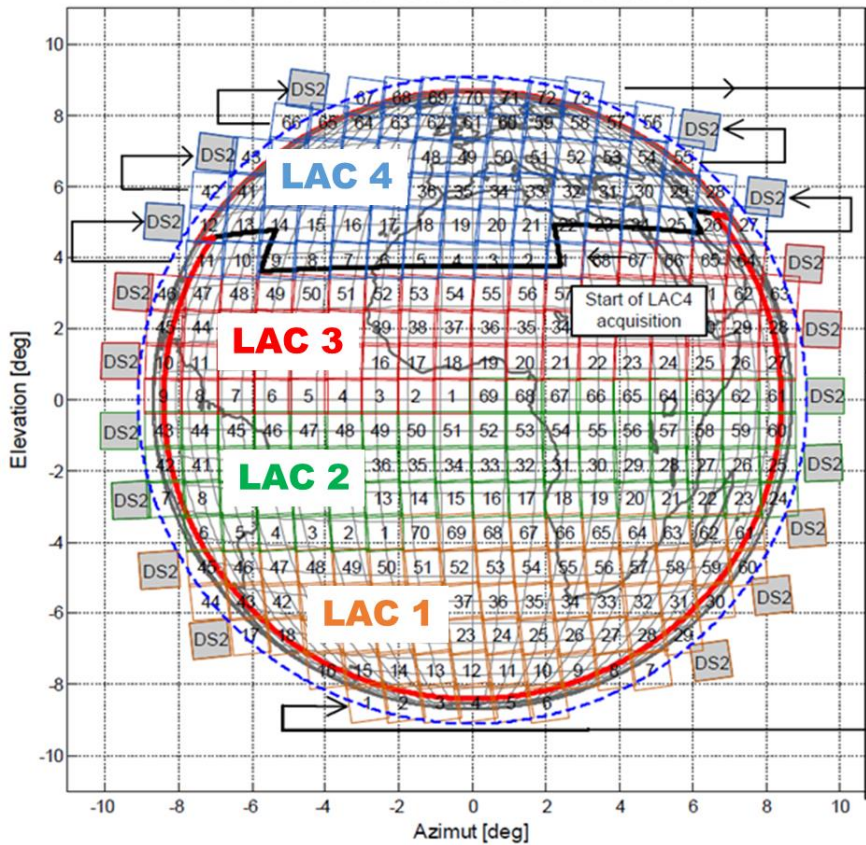
Detection of low-level moisture over Kansas, USA, using the Split Window Difference ( $10.35 \mu\text{m}$  minus  $12.3 \mu\text{m}$ ) of NOAA GOES-16 ABI data (right panel, in orange-red colours), a precursor for potentially severe storms, while conventional imagery detect no signal (left panel)

**The low-level moisture boundary is evident about 2.5 h before clouds form.**

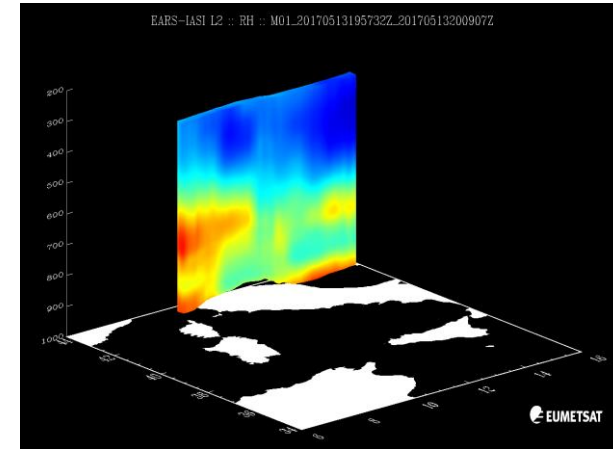
Courtesy: Dan Lindsey (NOAA), 15 June 2017



# MTG Infra-Red Sounder (IRS)



**Major innovation:  
Operational spectro-  
imagery at high spectral,  
spatial & temporal  
resolution**

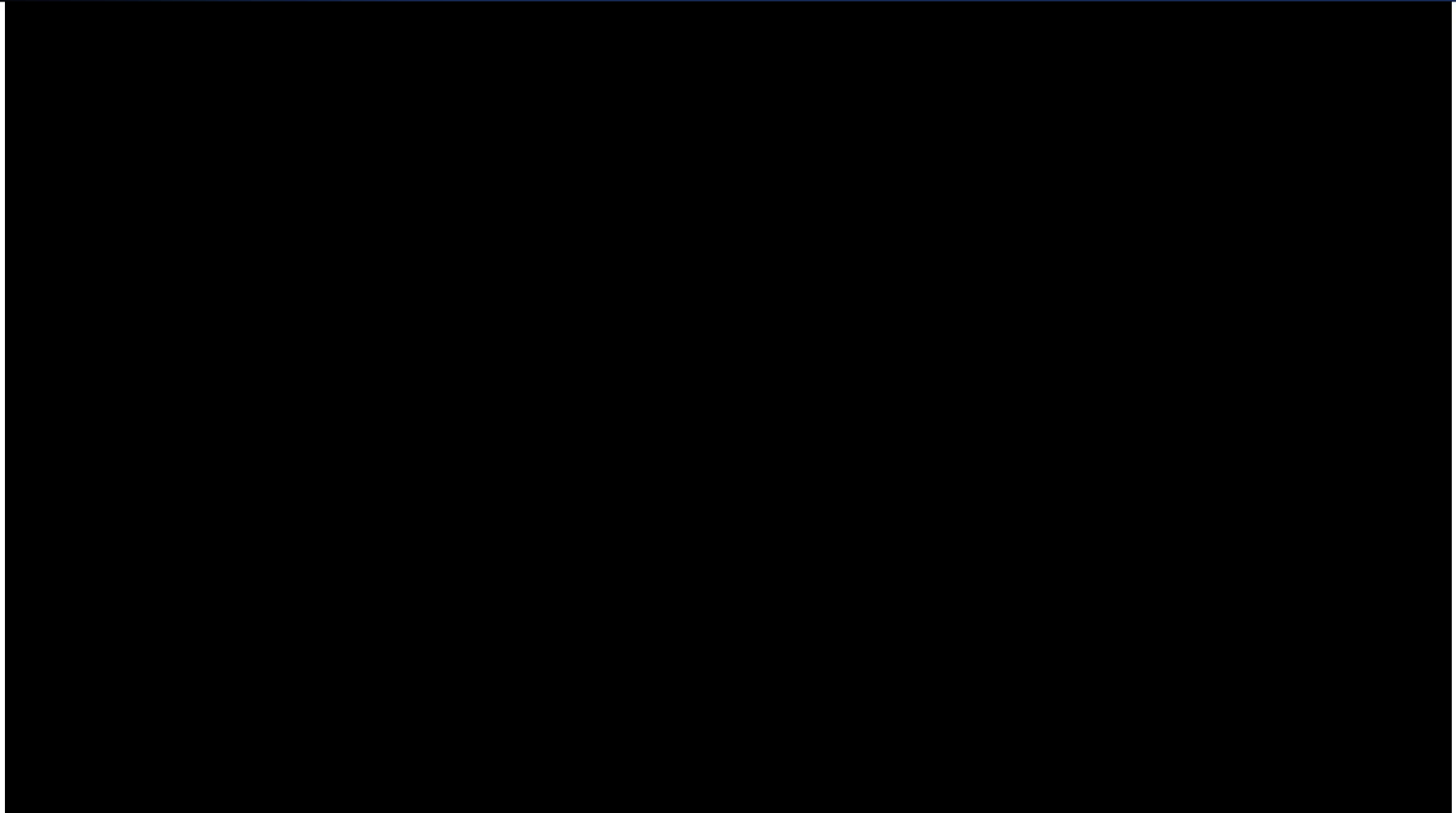


## 4 Local Area Coverage (LAC):

- One LAC acquired within 15'
- Overlapping step & stare dwells
- 160x160 pixels, ~4km at Nadir
- Europe (LAC 4) observed every 30'

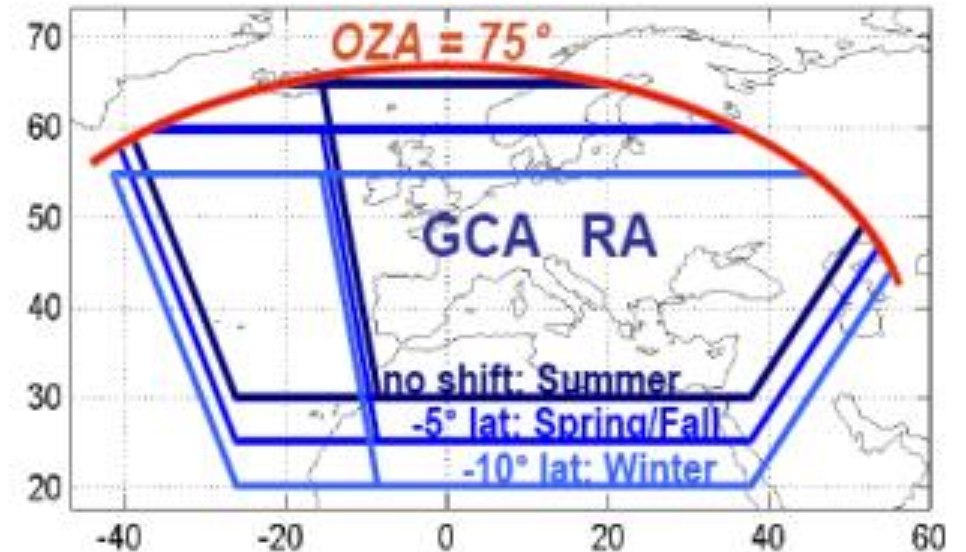
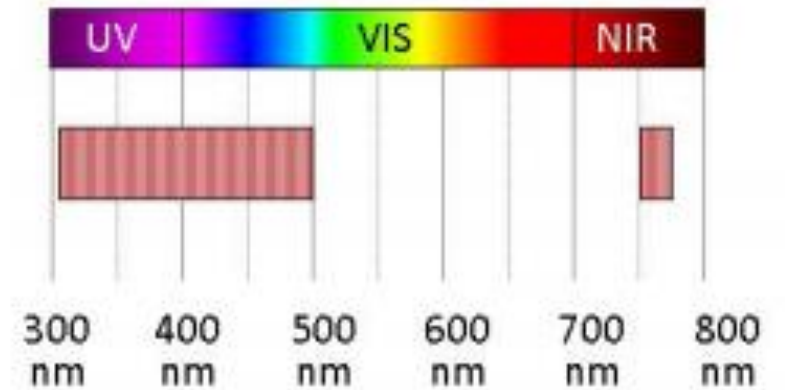


# IRS instrument

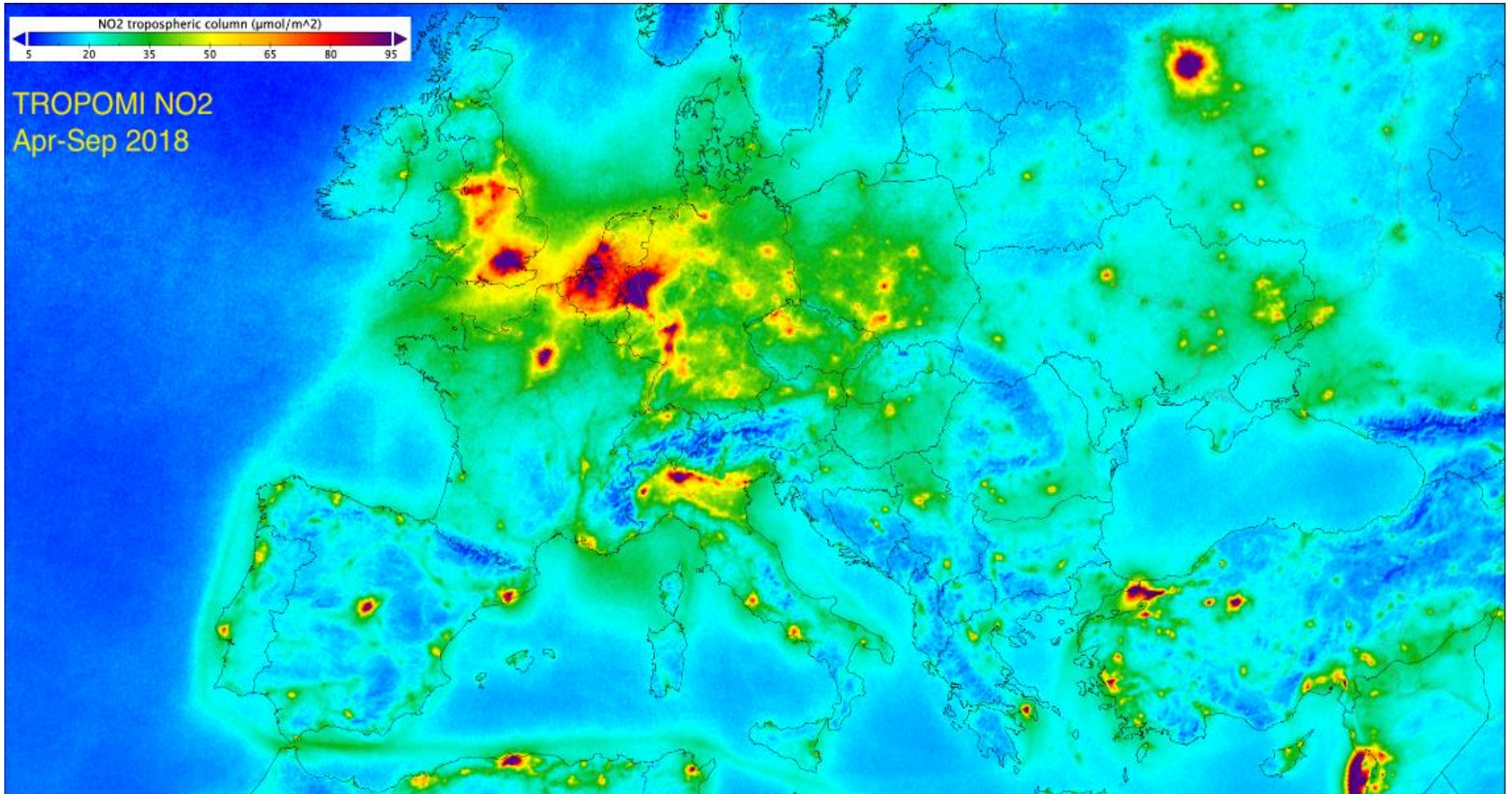


# MTG-S: Monitoring atmospheric composition

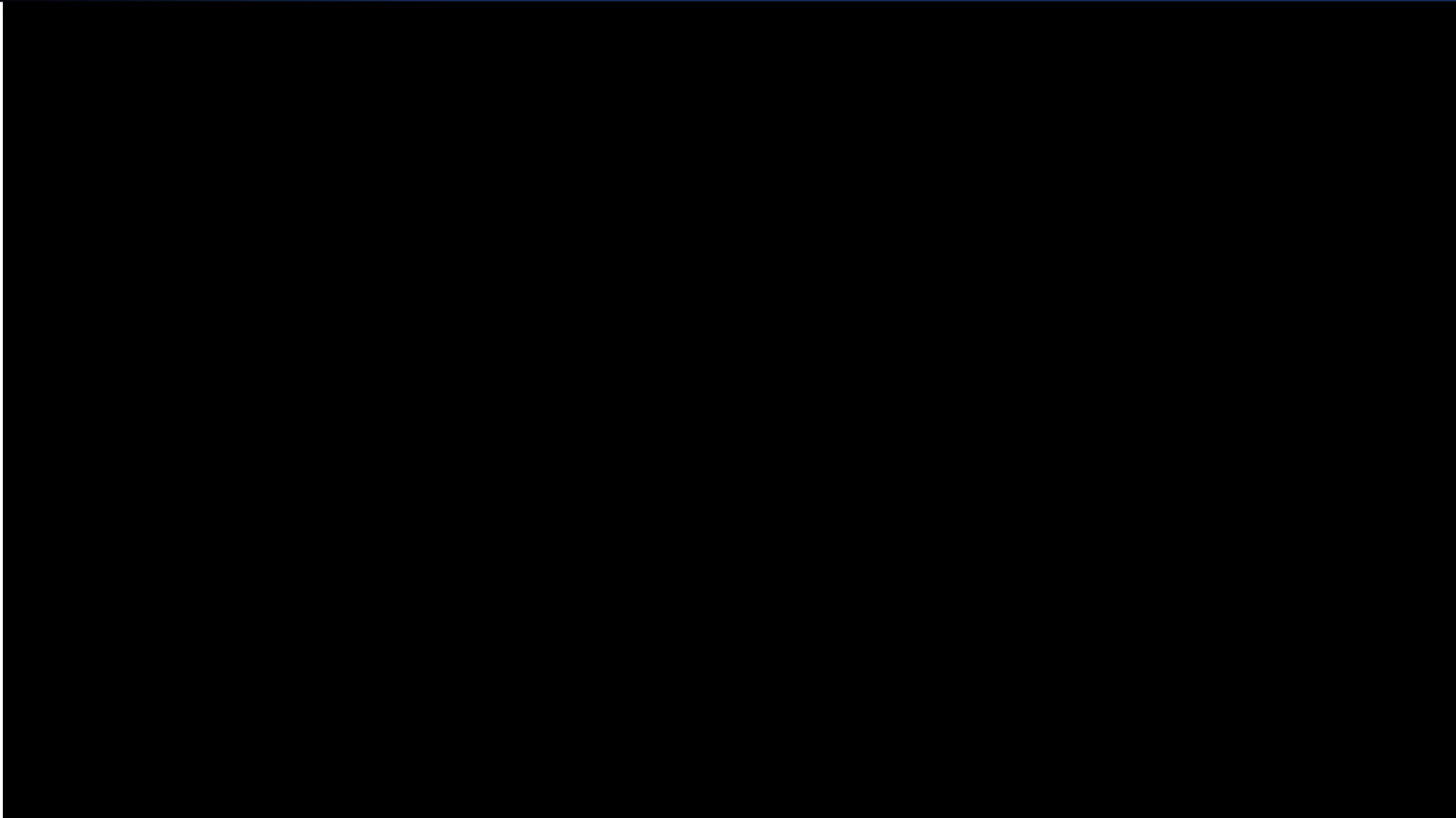
- The second instrument aboard MTG-S: the Ultraviolet Visible Near-infrared (UVN) spectrometer – *Copernicus Sentinel-4*
- This mission covers the need for continuous monitoring of atmospheric composition / chemistry.
- **Focus on air quality with the main data products being O<sub>3</sub>, NO<sub>2</sub>, SO<sub>2</sub>, HCHO, and aerosol optical depth.**
- Spatial sampling at 45° North: 8 x 8 km<sup>2</sup>
- Temporal resolution: 60 min.



# MTG-S: Monitoring air pollution



# UVN (Copernicus) instrument

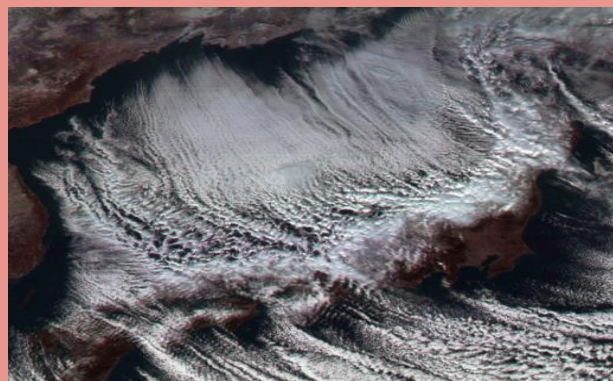




# Meteosat Third Generation: FCI + LI + IRS = 4D

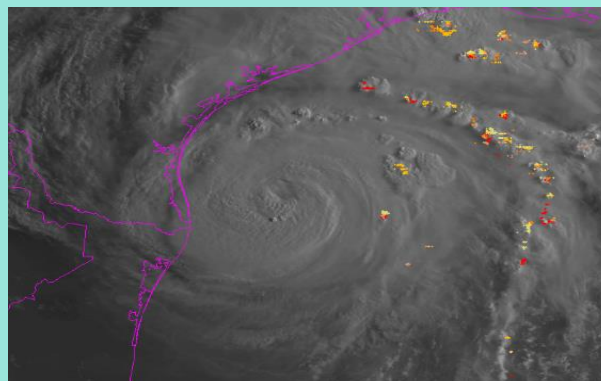
## IMAGERY

18 December 2014  
(Japan snowstorm)



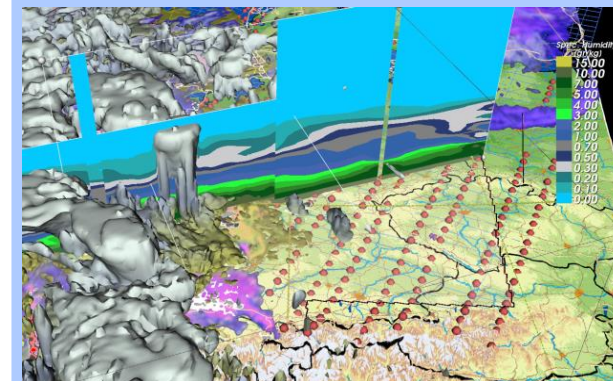
## LIGHTNING

12 August 2017  
(Hurricane Harvey)

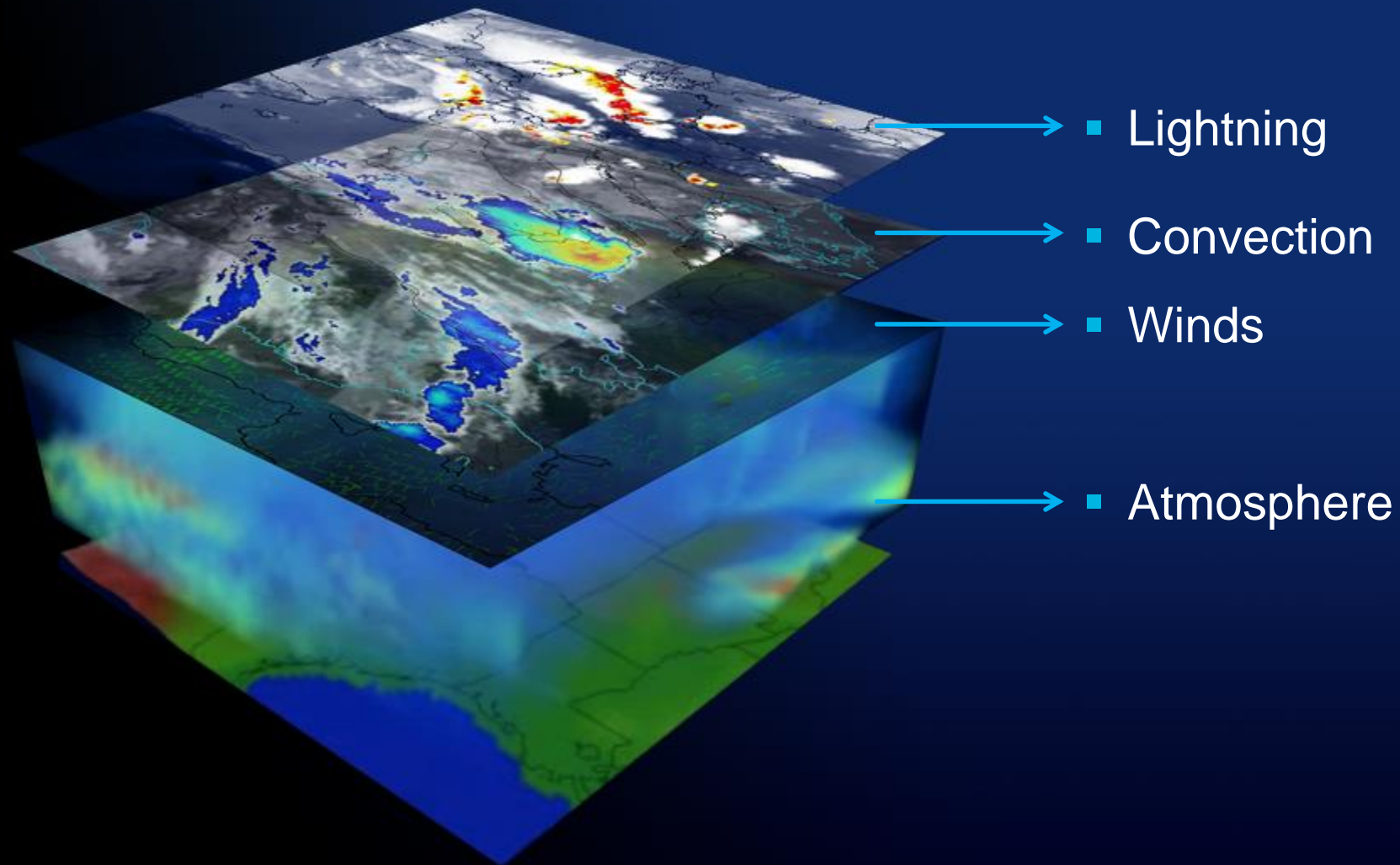


## SOUNDINGS

20 June 2013  
(IASI vs Harmonie)



# MTG in a nutshell: 4D weather cube (MTG-I and MTG-S)



Thank you for your attention.