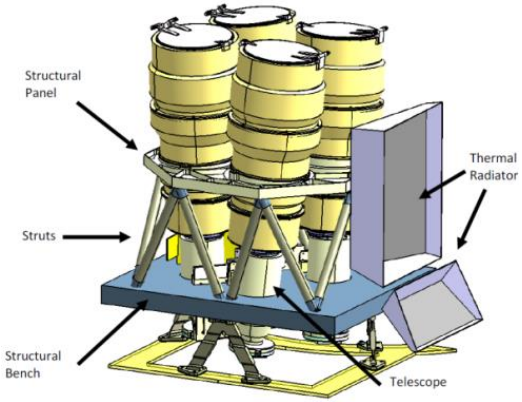
13th AGILE Science Workshop
May 25-26, 2015, aula "Cassini“
ASI Headquarters, Rome

Meteosat Third Generation Lightning Imager



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Contents:

- **Introduction**
- **Operational use of lightning detection**
- **MTG Lightning Imager**
- **Possible common interest**
- **Conclusions**

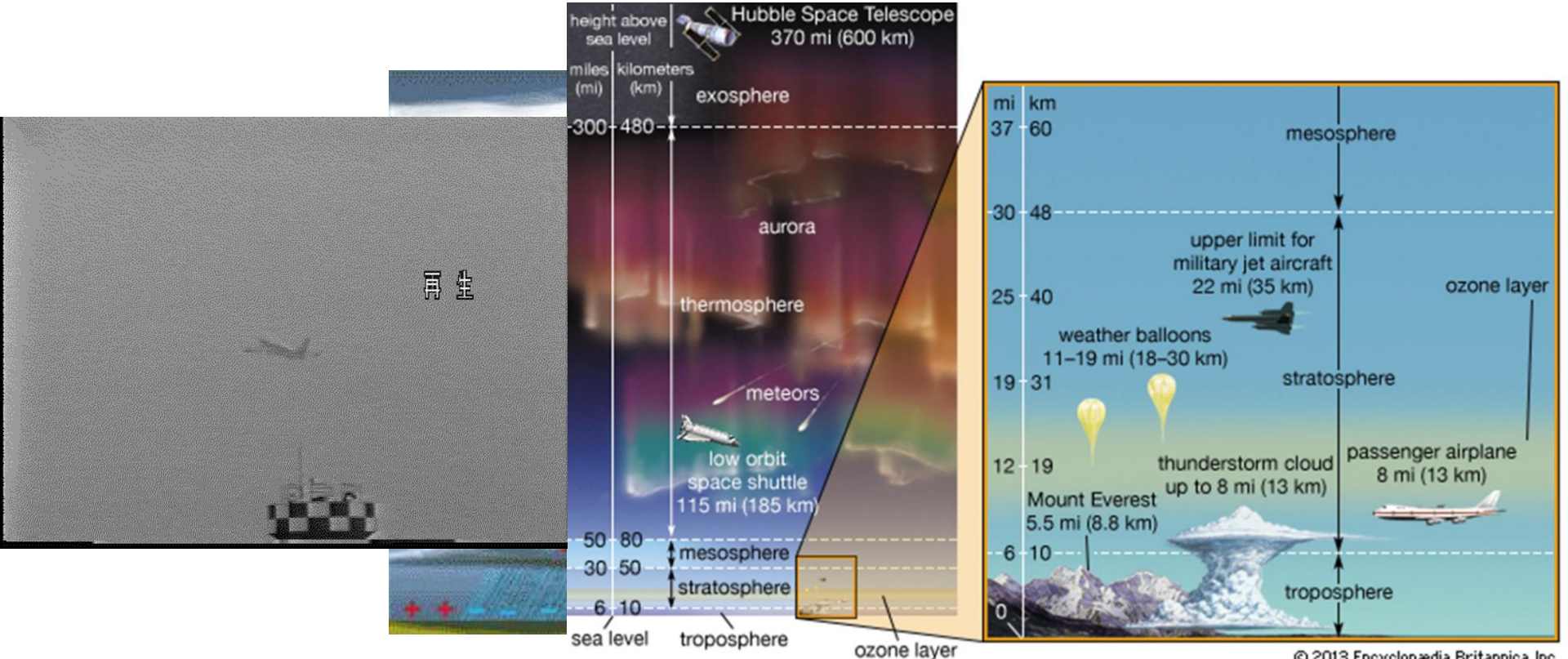
- **Introduction**

Introduction 1/3

Lightnings are brilliant electric spark discharges in the atmosphere, occurring within a thundercloud, between clouds, or between a cloud and the ground.

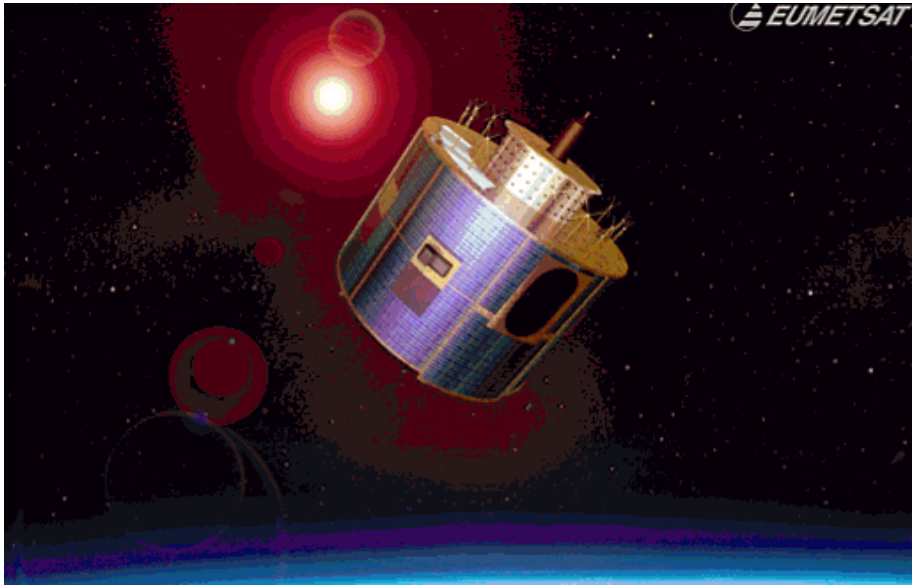
Lightnings are threats for operations (e.g. aeronautical).

Not all atmospheric electrical phenomena have an impact on operations, depending on user requirements and assets.



Introduction 2/3

For the next series of geostationary meteorological satellites EUMETSAT (European Organization for the Exploitation of Operational Meteorological and Environmental Satellites) has planned a:
Meteosat Third Generation (MTG) a Lightning Imager (LI).

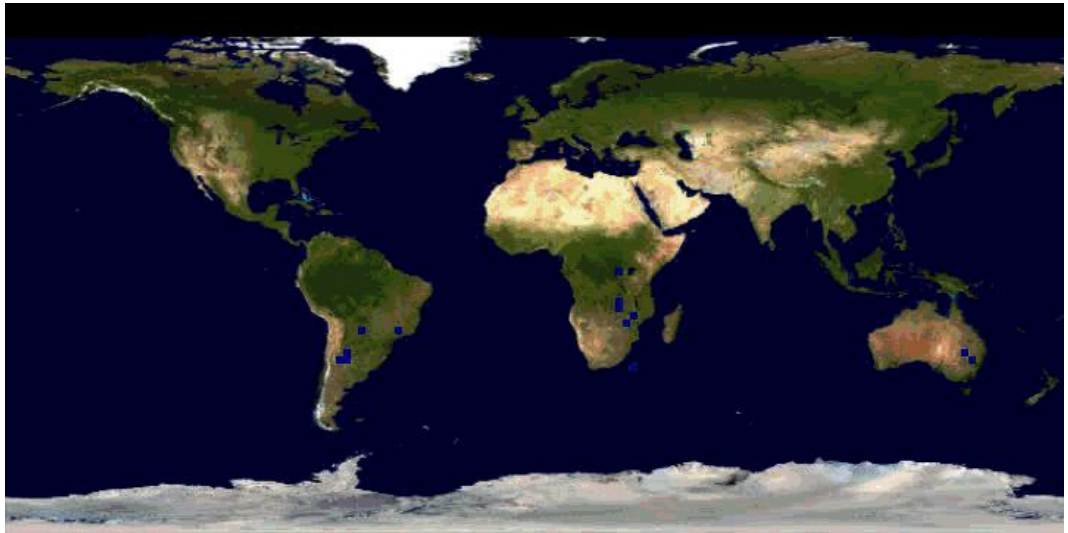


Public information available in ESA, NASA, EUMETSAT, NOAA sites.

Introduction 3/3

With Geostationary Lightning Mapper (GLM) on the next generation of NOAA (National Oceanographic and Atmospheric Administration) Geostationary Operational Environmental Satellite (GOES), and state of the art ground-based networks, LI will provide a global lightning detection capability.

This continuous flow of lightning data will be critical in operational applications and crucial in climate and atmospheric physics research.

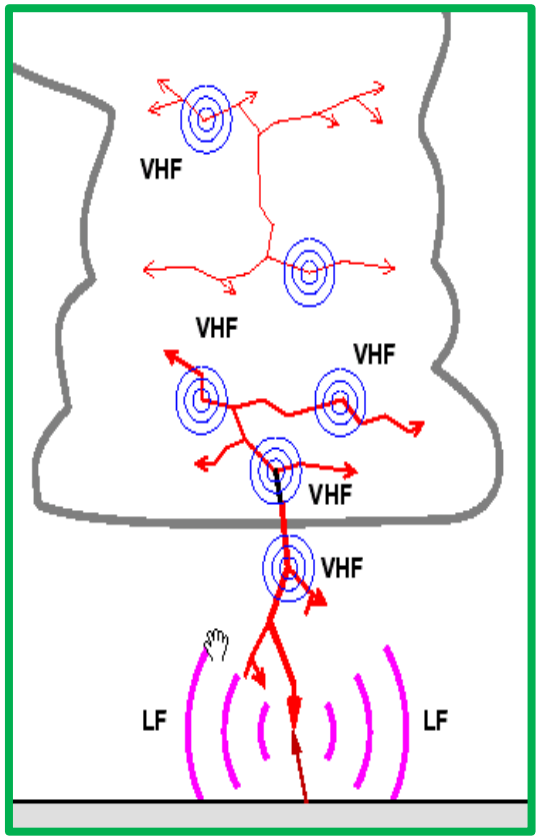


- **Operational use of lightning detection**

Lightnings: the phenomena we want to observe

To do lightning observation several remote sensing technique could offer a contribution to decision making in ops.

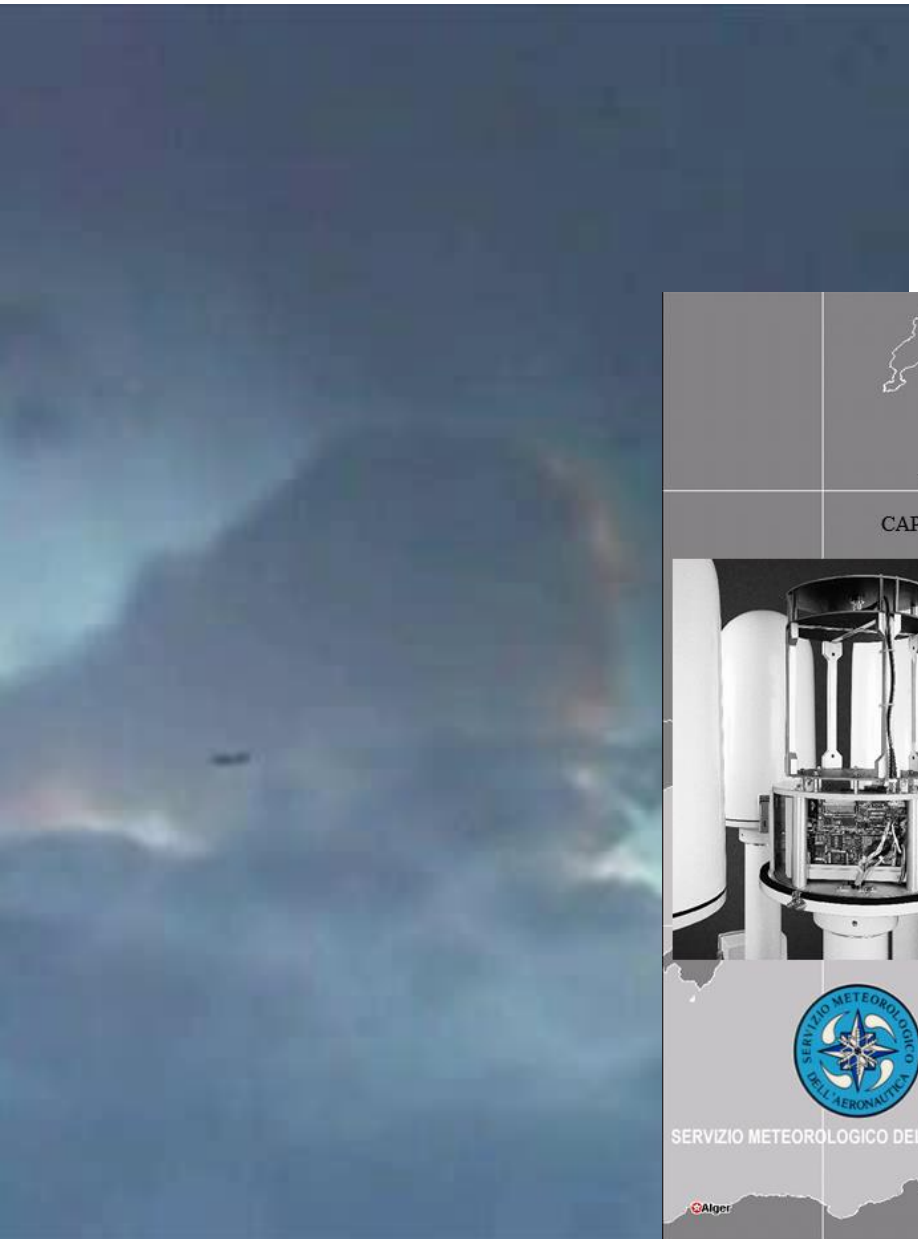
De facto the only operational feasible obs today is LF radio measurement, by a network of dedicated sensors with baselines in the 100-400 km range.



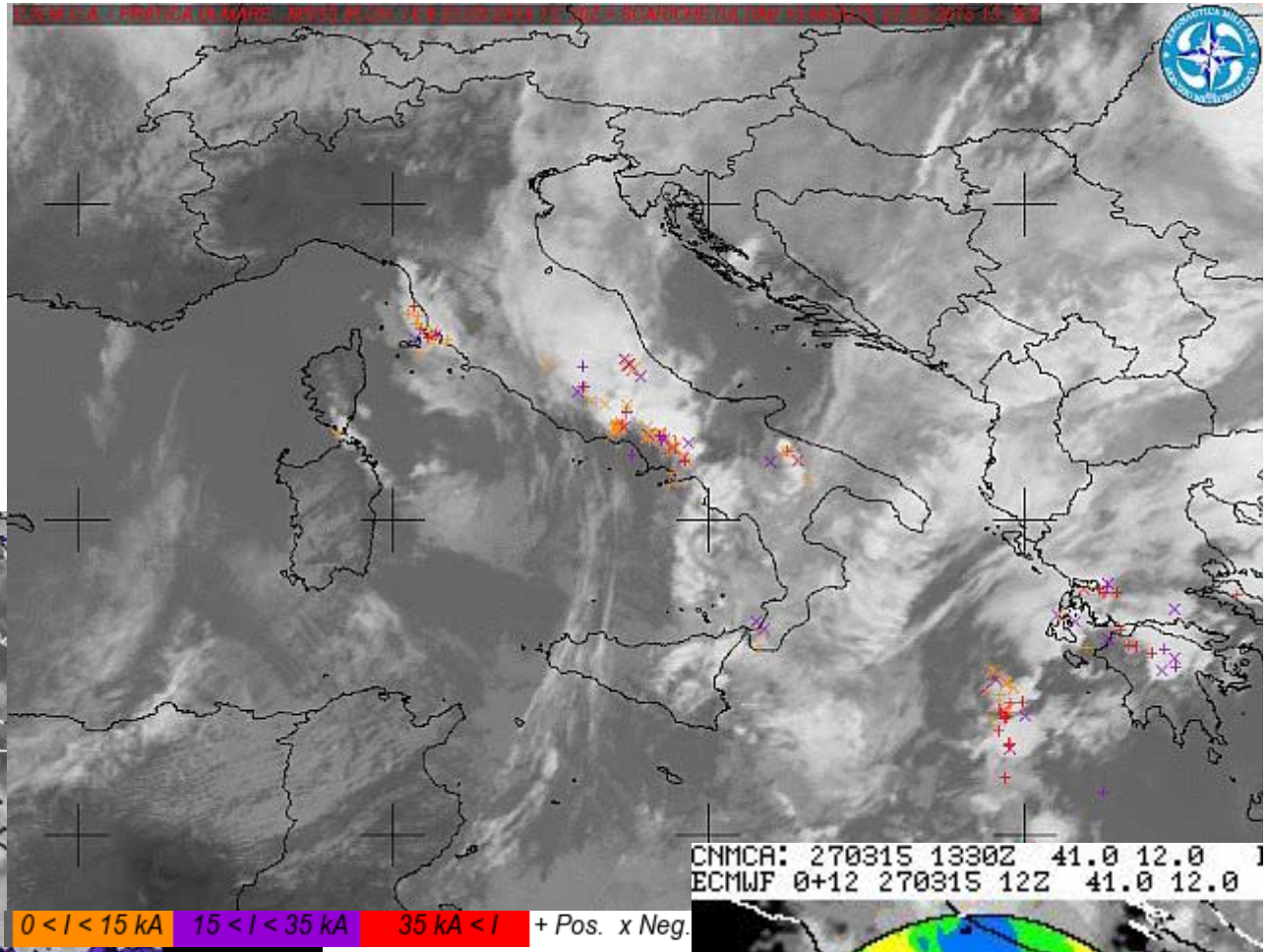
Lightnings: the phenomena we want to observe

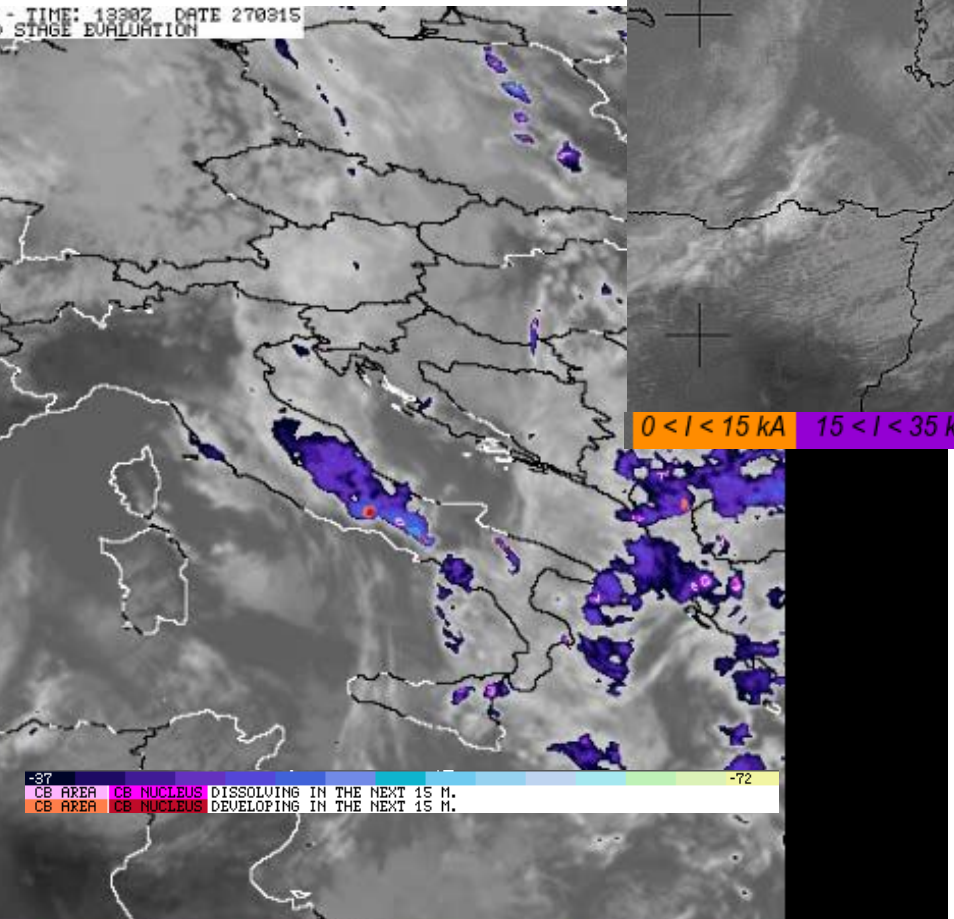
Italian Air Force

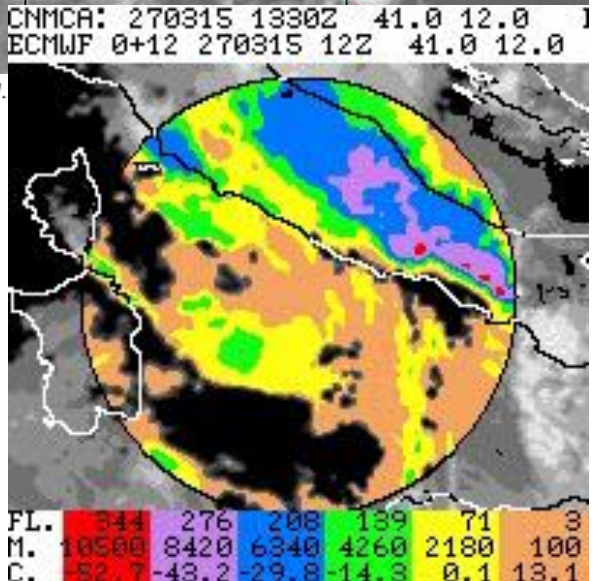
LAMPINET Lightning Network



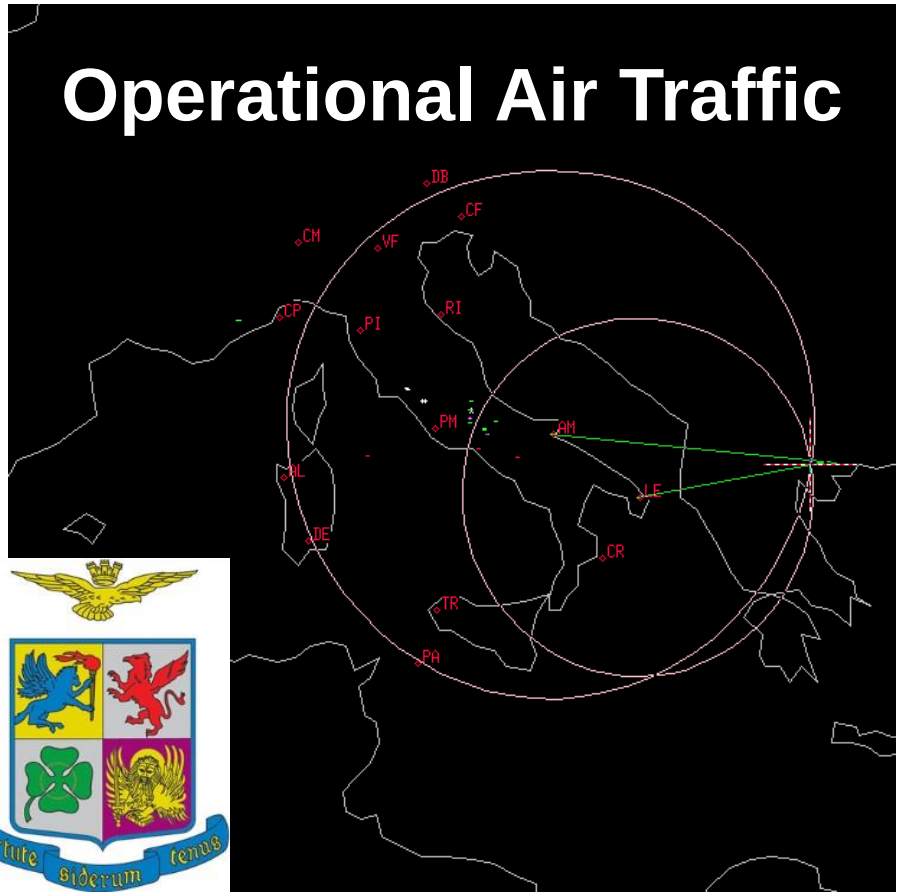
Lightnings detection and operational forecasting







Operational Air Traffic

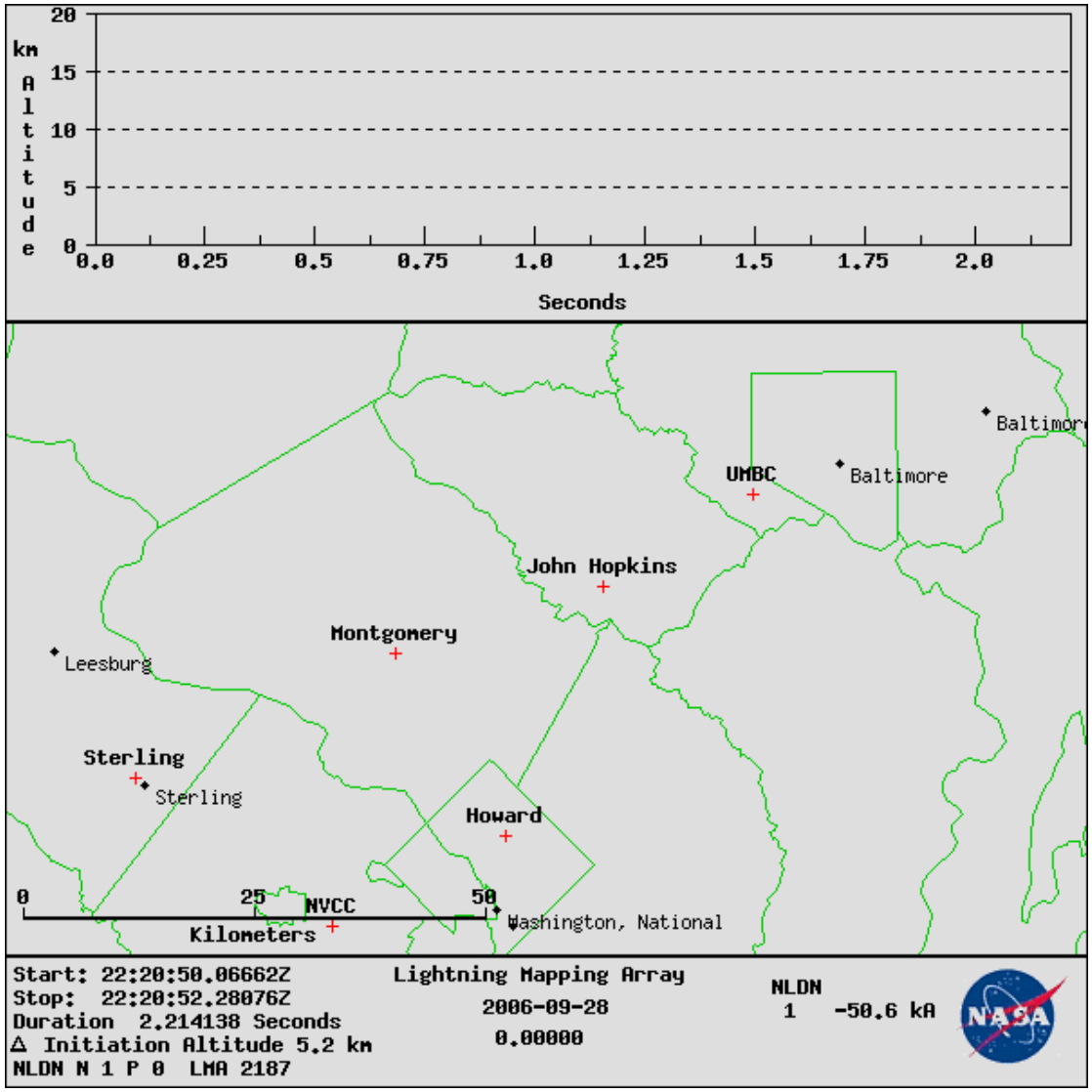


General Aviation Traffic

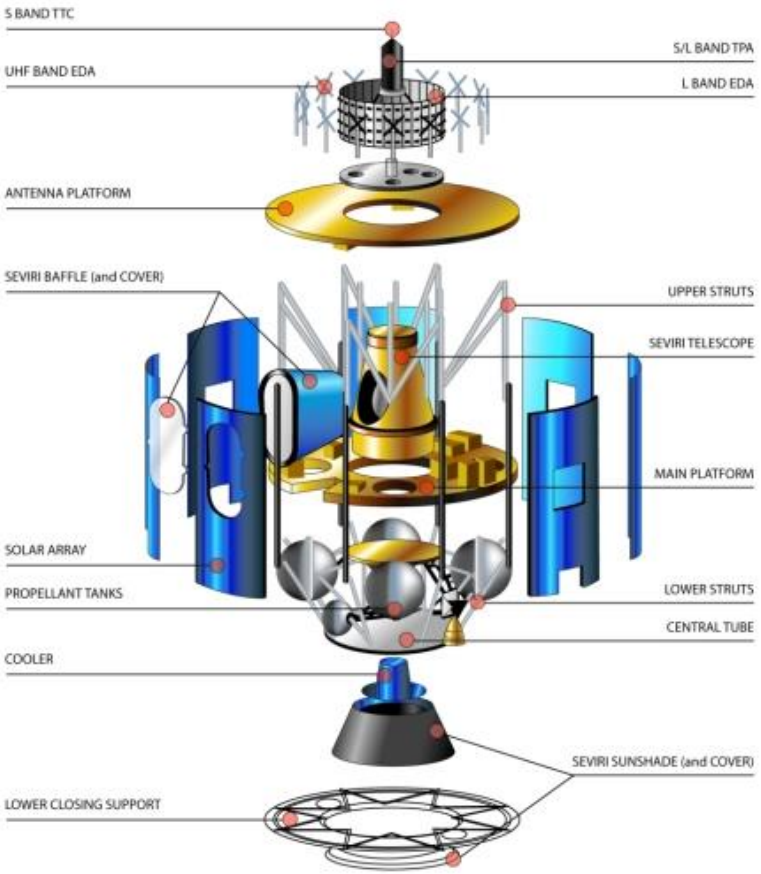
- **MTG Lightning Imager**

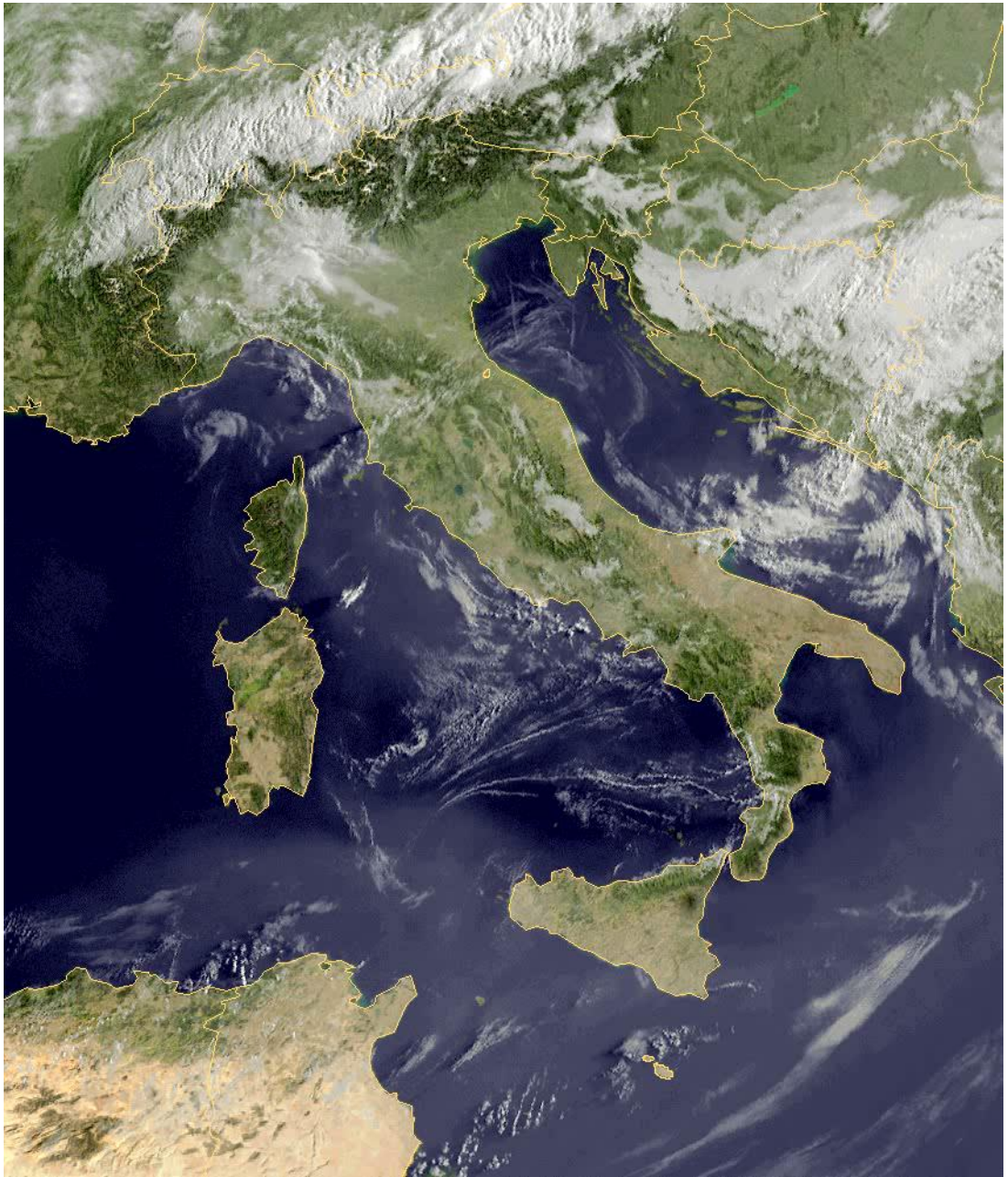
Lightnings: phenomena we want to observe

User Requirement: detect lightning, better, over wide areas without the need of VHF? Space-based geostationary obs.



Actual Meteosat Second Generation Spinning Enhanced Visible and InfraRed Imager (MSG-SEVIRI)





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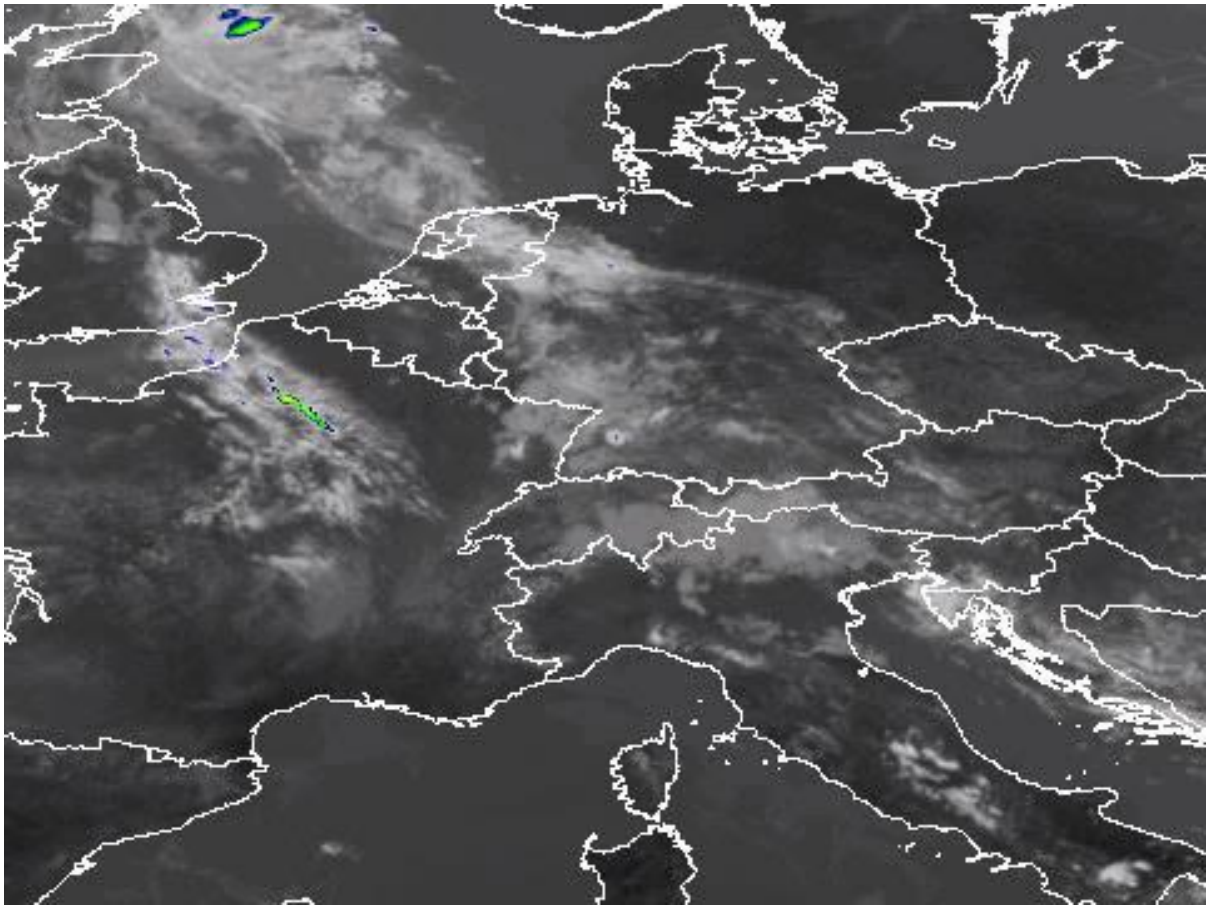
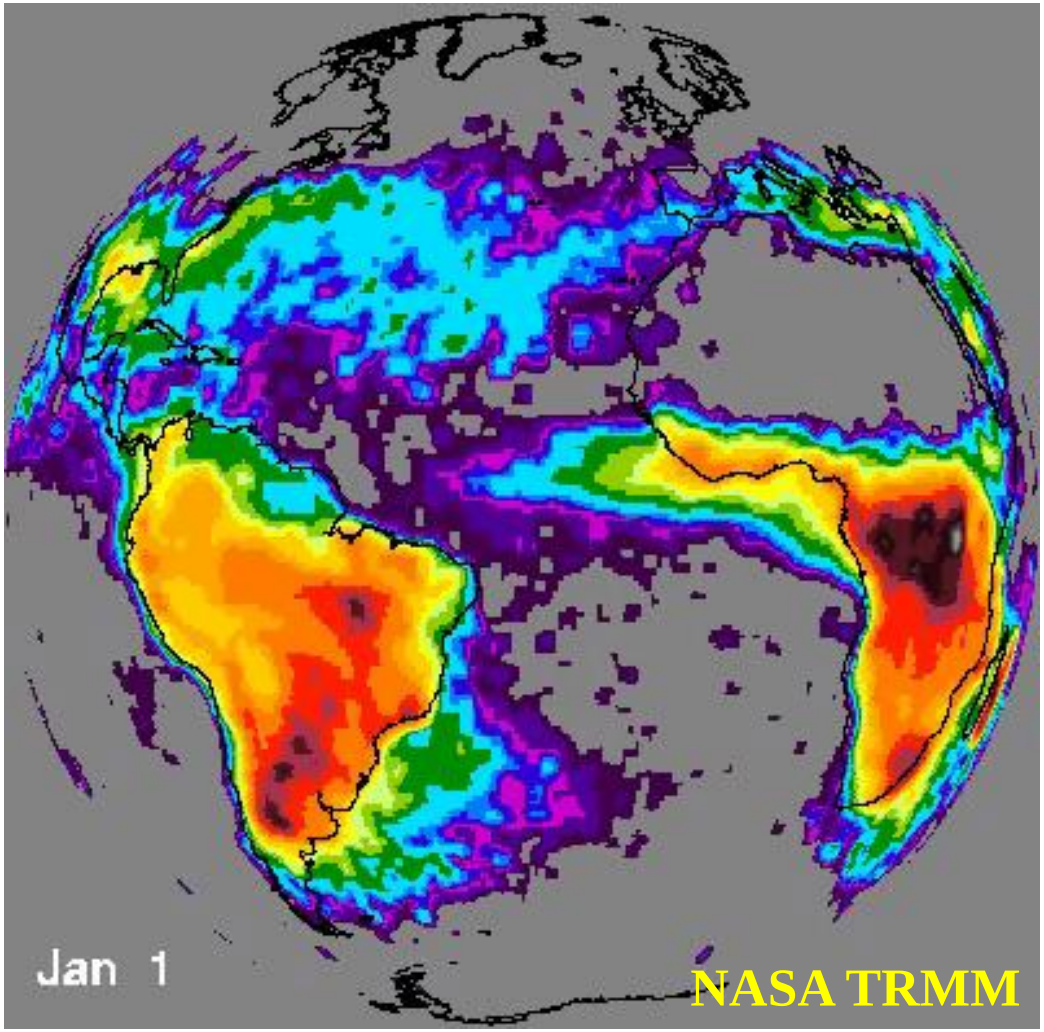
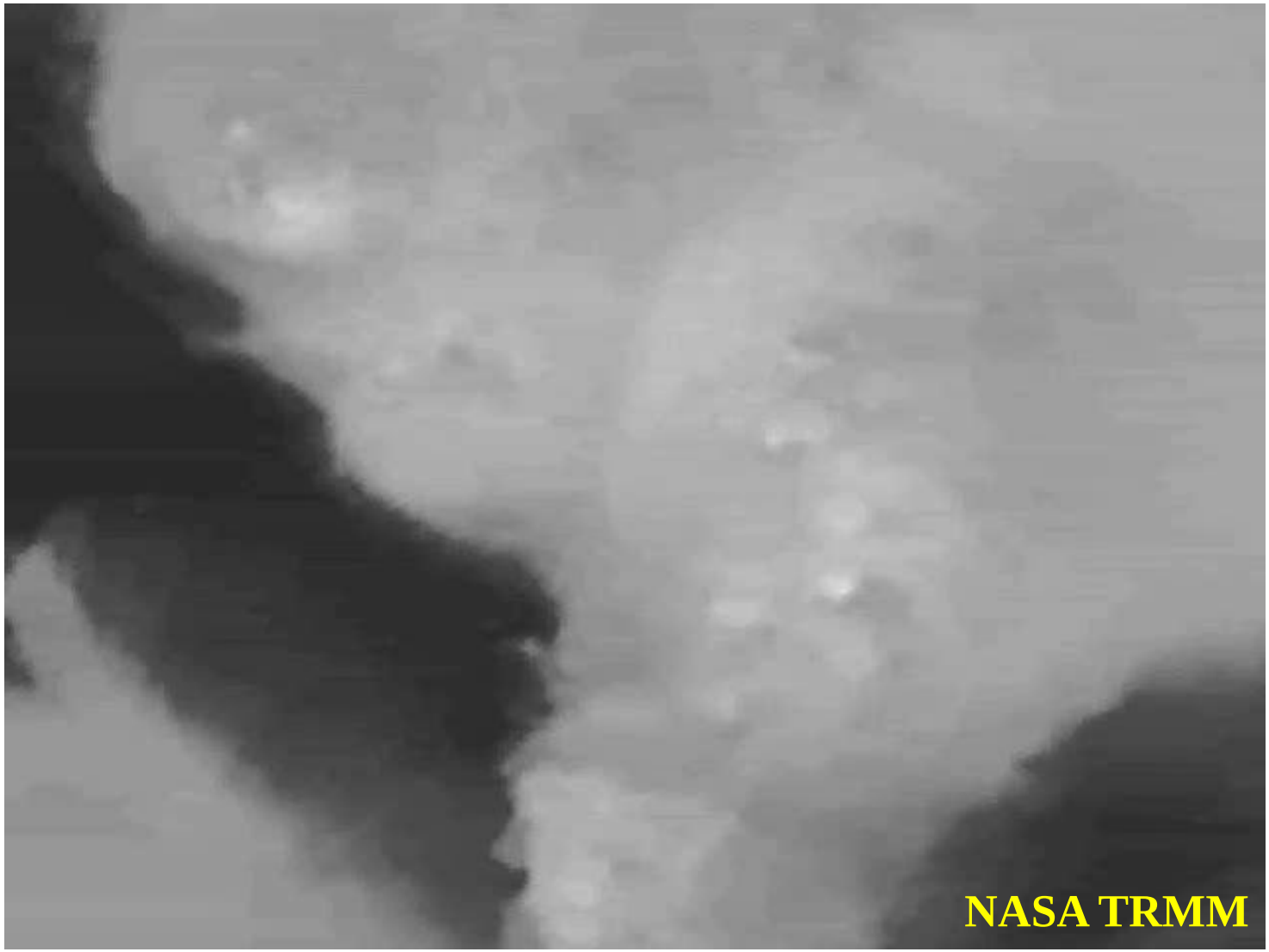


Operational Decision Making

Lightning observations driving in future Numerical Weather Prediction models similarly to atmospheric sounding



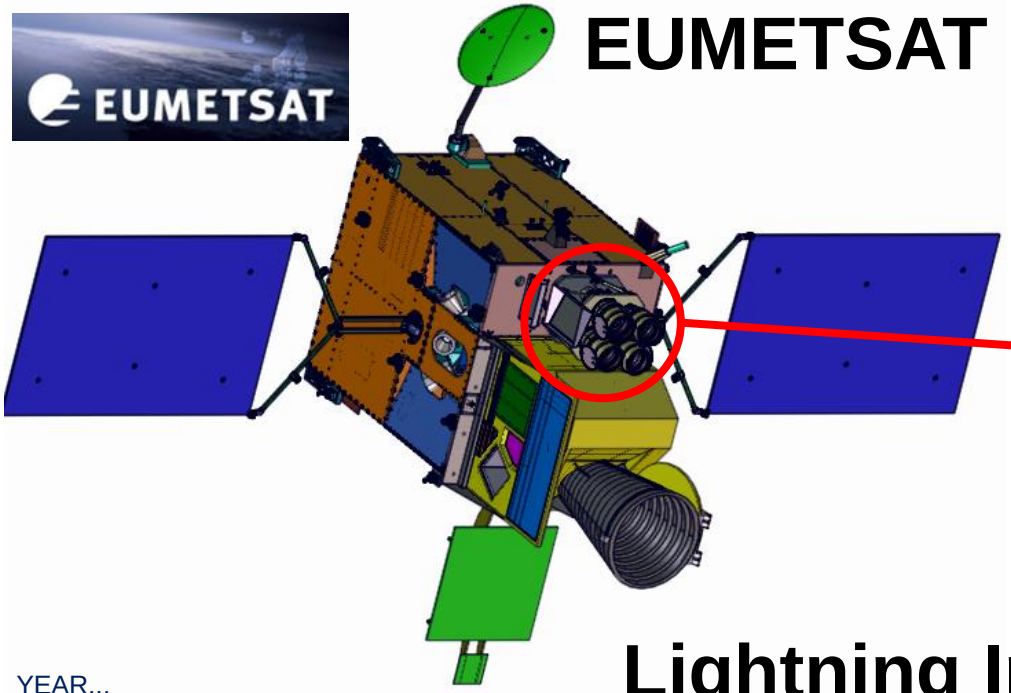
Lightning obs and MicroWave obs both passive and active

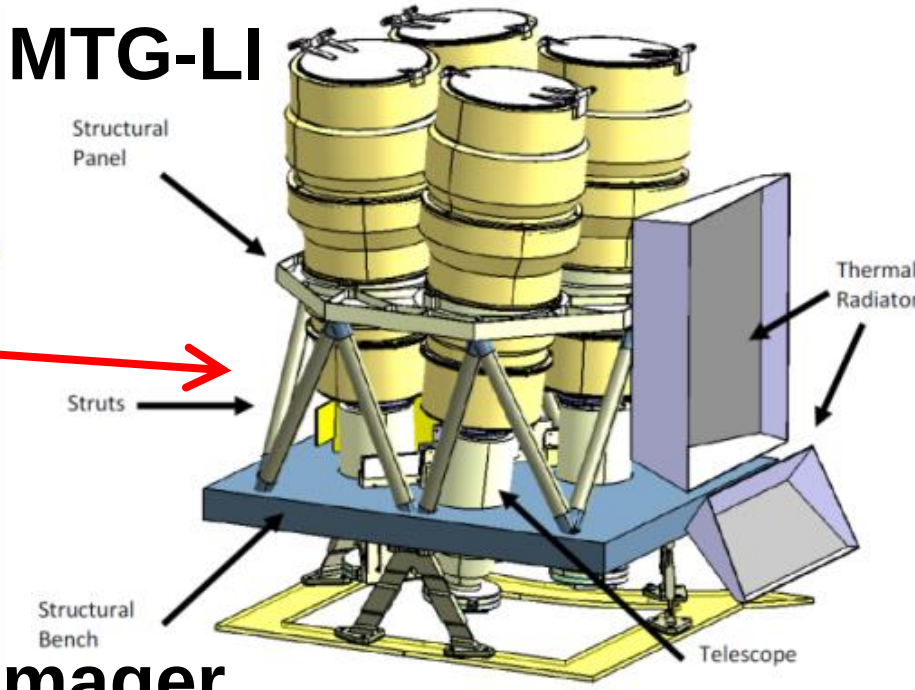


EUMETSAT MTG-LI
Lightning Imager

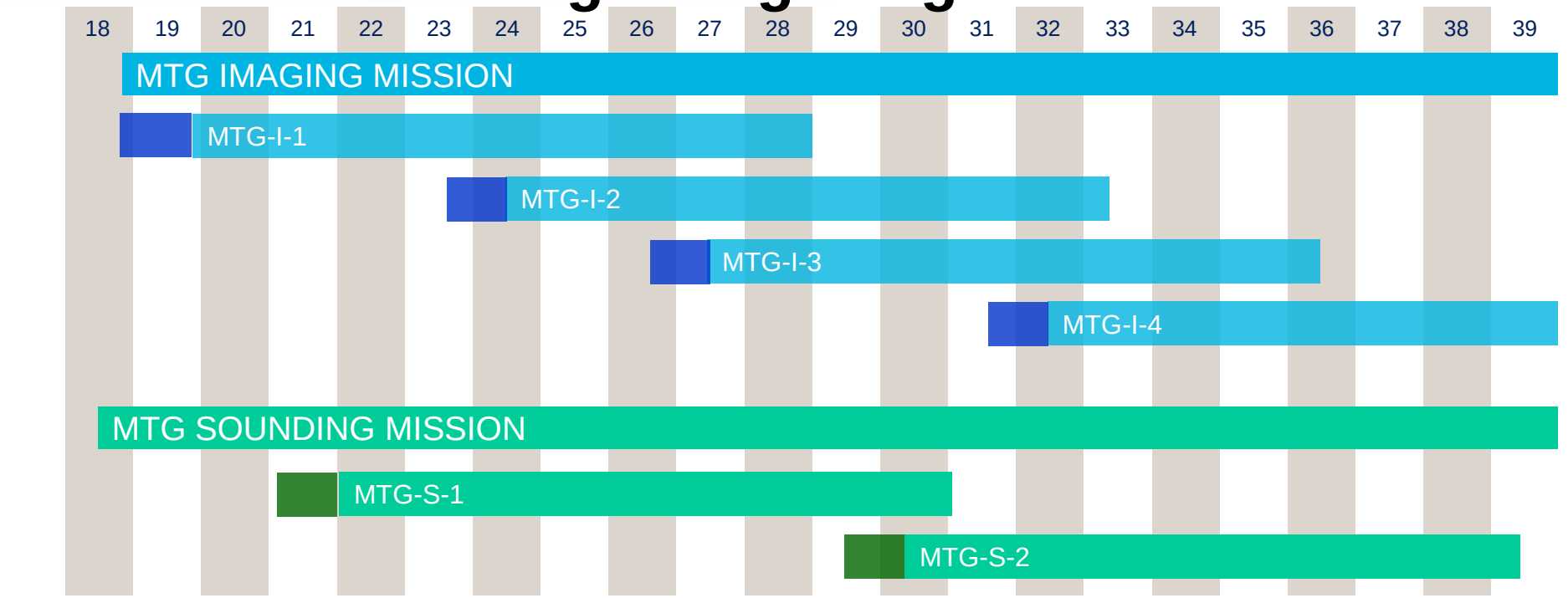
Basic user requirement: a geostationary optical homogeneous and continuous lightning observation, delivering information on location and strength of lightning flashes to the users with high timeliness, 30 seconds possibly less, in 30-150 seconds records, less than 10 km spatial resolution, without false alarm at clustered flashes level (L2).

EUMETSAT MTG-LI





Lightning Imager



MTG-LI, by Selex ES - Firenze - Italy

Algorithm Theoretical Basis Document (ATBD) for L2 processing of the MTG Lightning Imager. The LI mass is about 110 kg, the average power consumption <300 W, the data rate is < 30 Mbps. The covered percentage of the total visible earth disc amounts to about 86%.

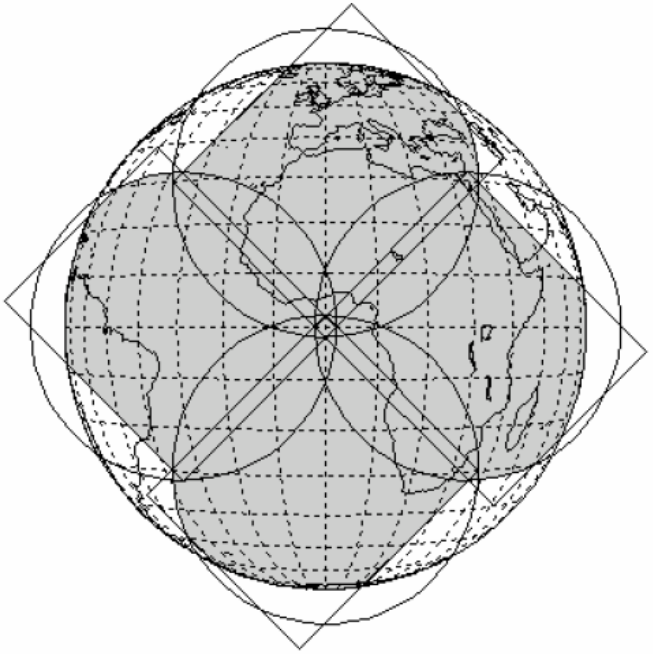
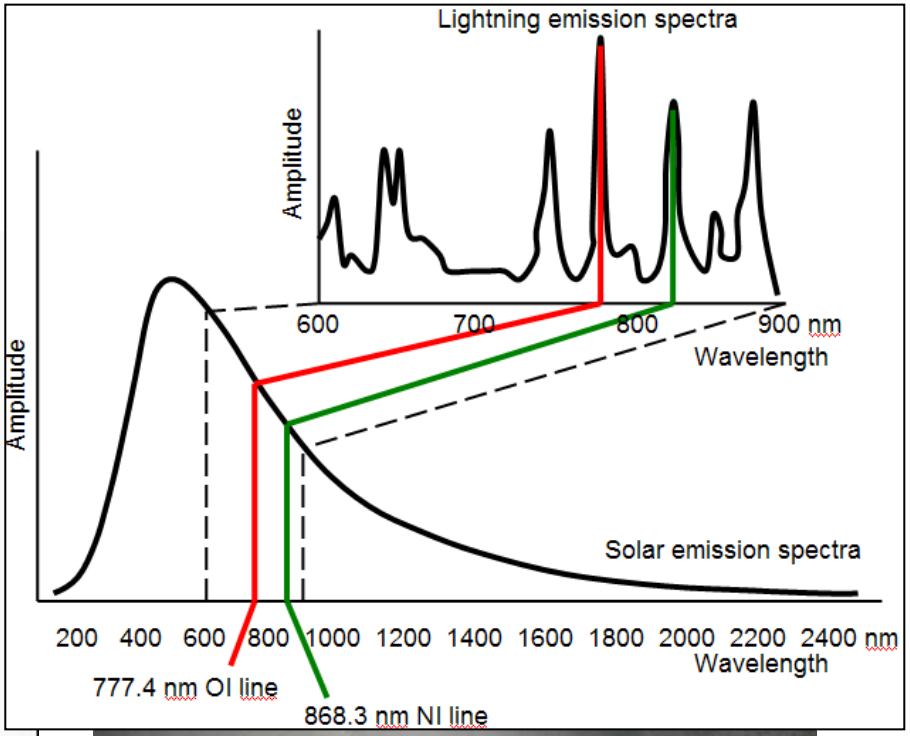
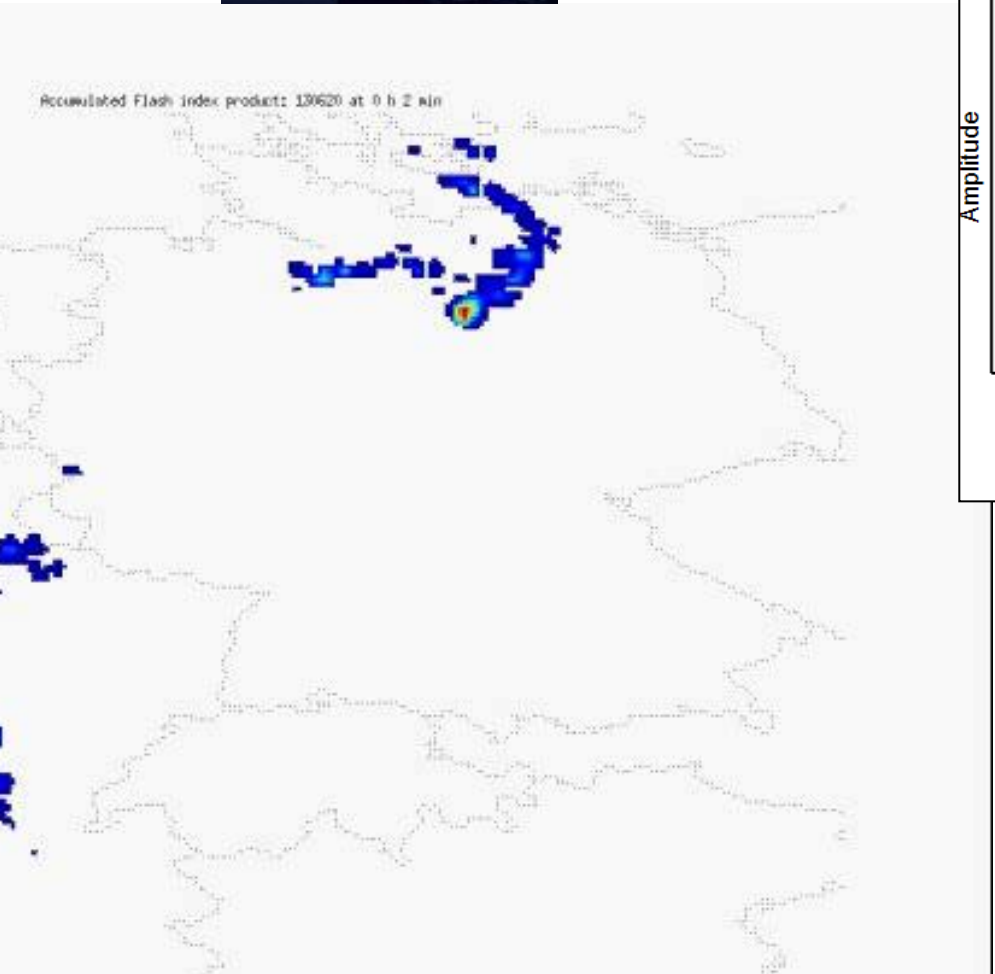


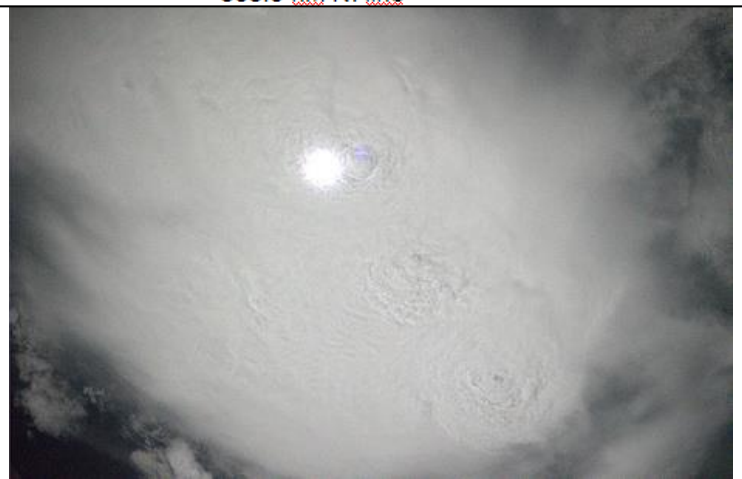
Figure 5. Schematic picture of the LI optical bench.

MTG-LI design

Near infrared signal 777.4 nm OI line observation

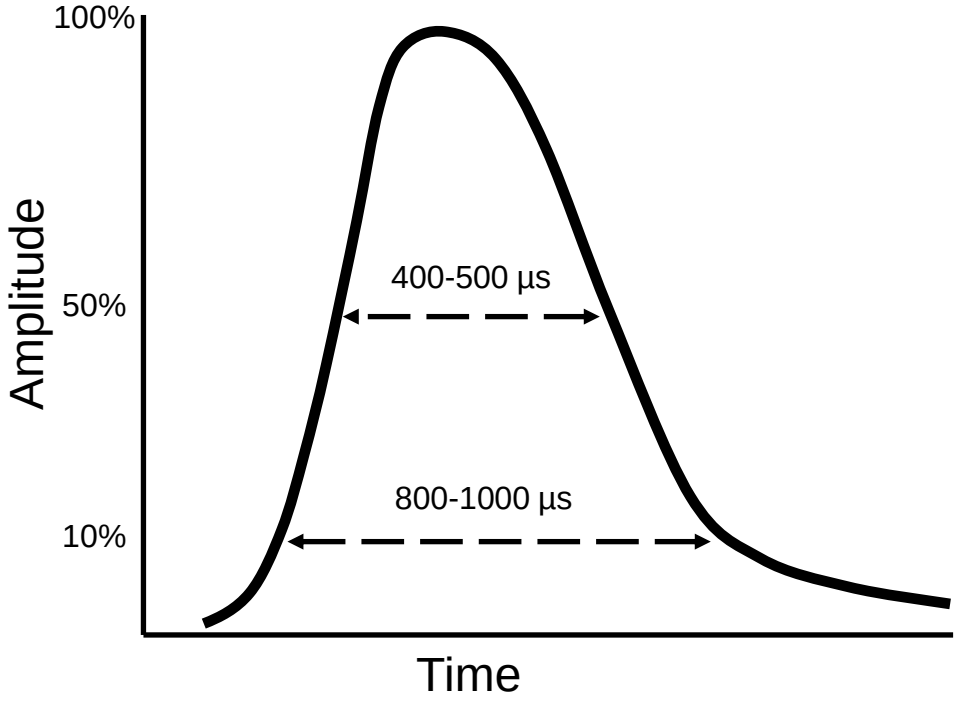


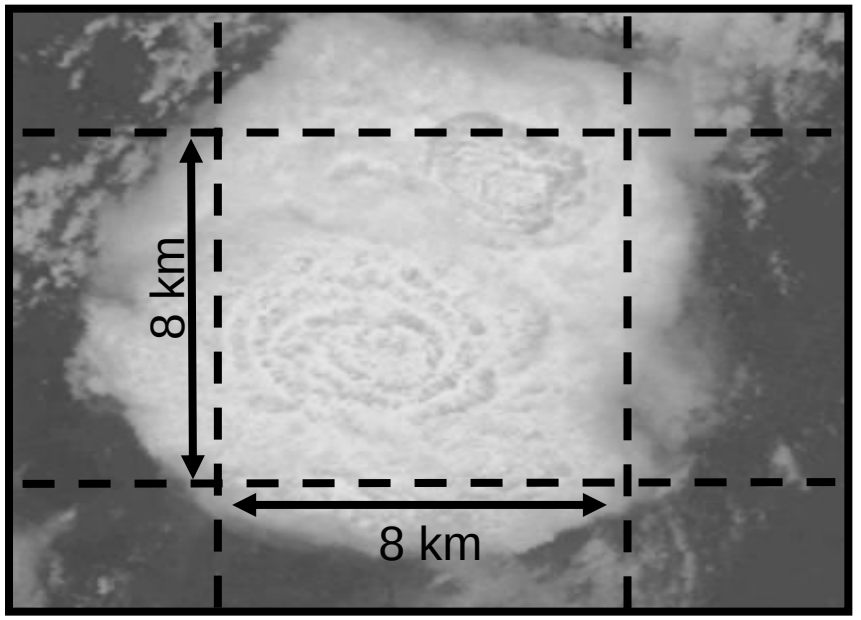




MTG-LI design

Further user requirements



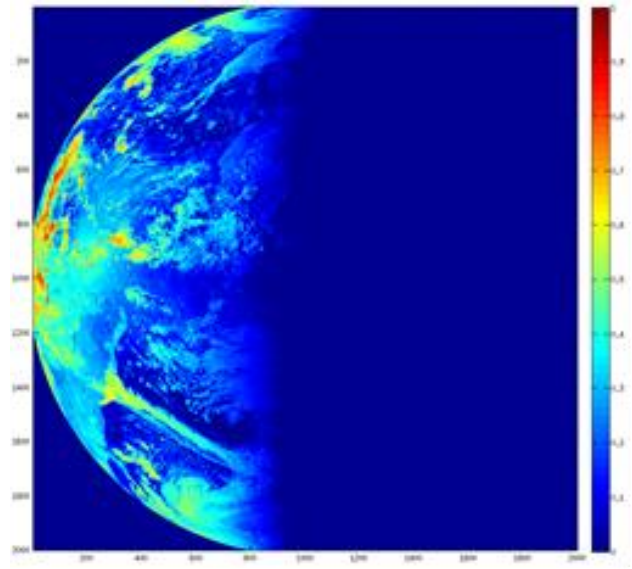


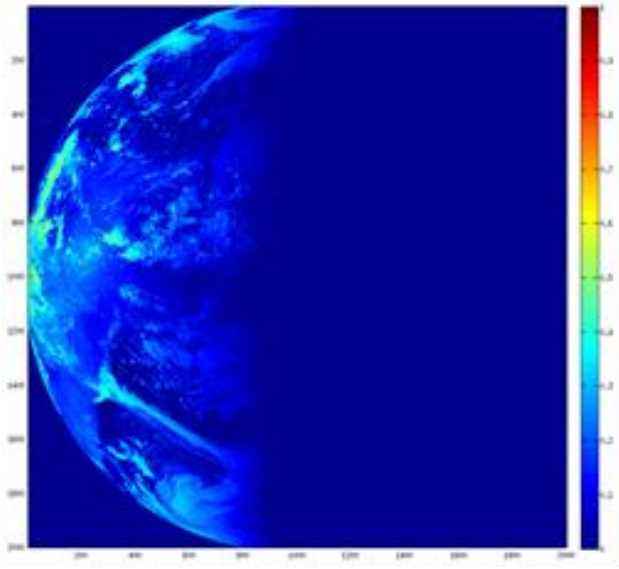
The detector is a CMOS matrix designed for the best performances. Narrow filters for 777.4 nm are at top of optics to eliminate background signal. Integration time is 1 ms (varying) to minimize pulse splitting among frames and to reduce background noise. 8 km spatial sampling.

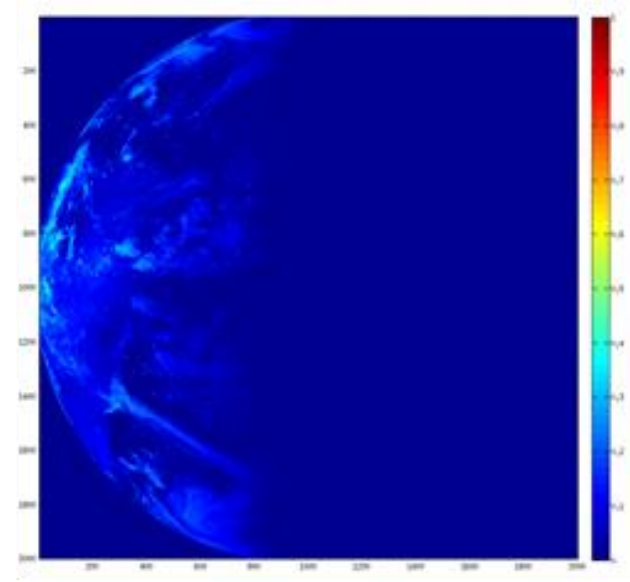
MTG-LI processing

Adjustable thresholding in H24 functioning

4.7 µJ/m2/sr 7.0 µJ/m2/sr 10.0 µJ/m2/sr







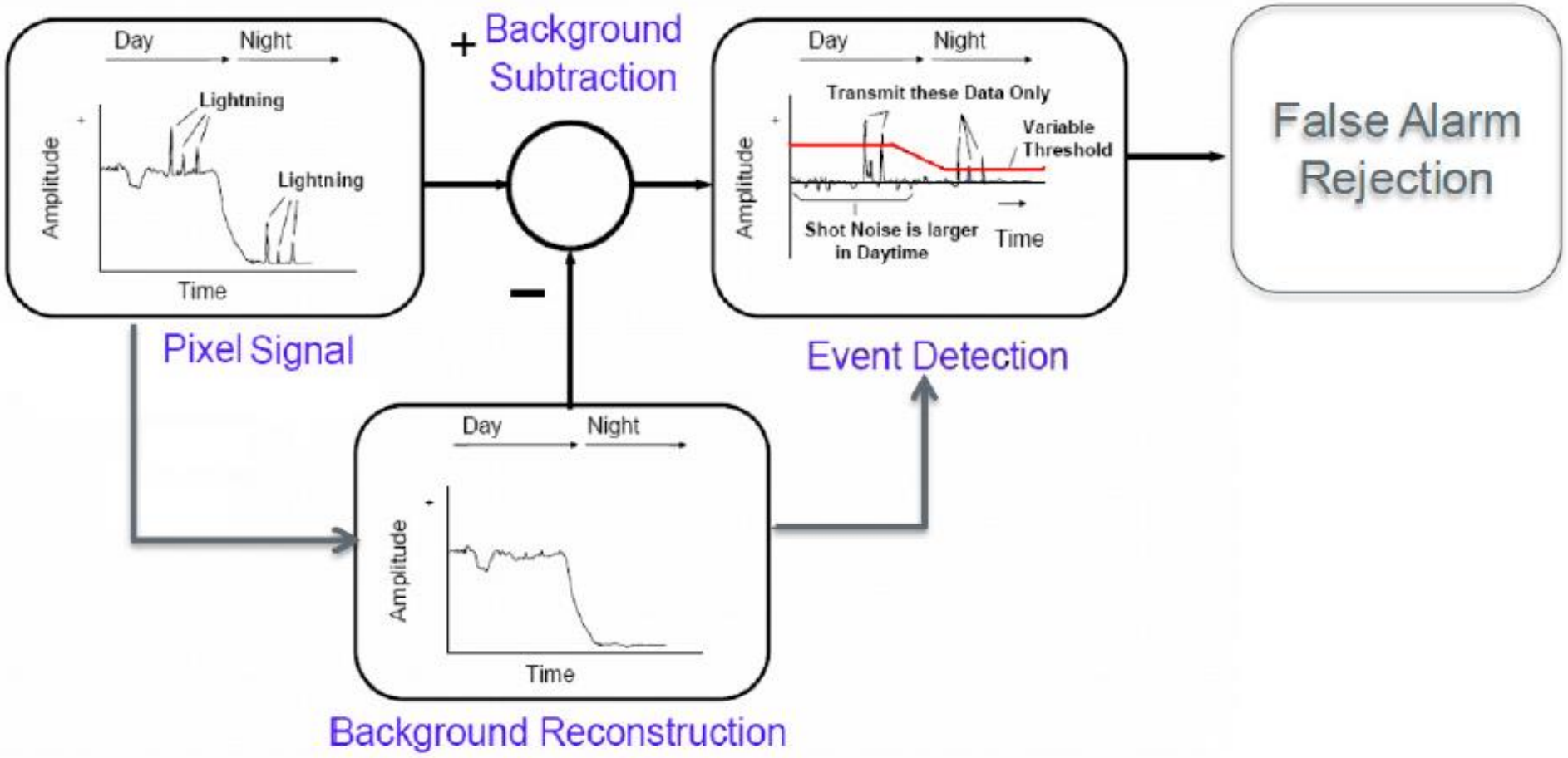
Safe enough from noise sources.

1. Internal Noise.
   a. Electronic noise
   b. Thermo-mechanical noise
   c. Ghost noise
   d. Stray light noise

2. External Noise.
   e. Cloud radiation
   f. Sun glint and Solar eclipse
   g. Particles flux
   h. Jitter

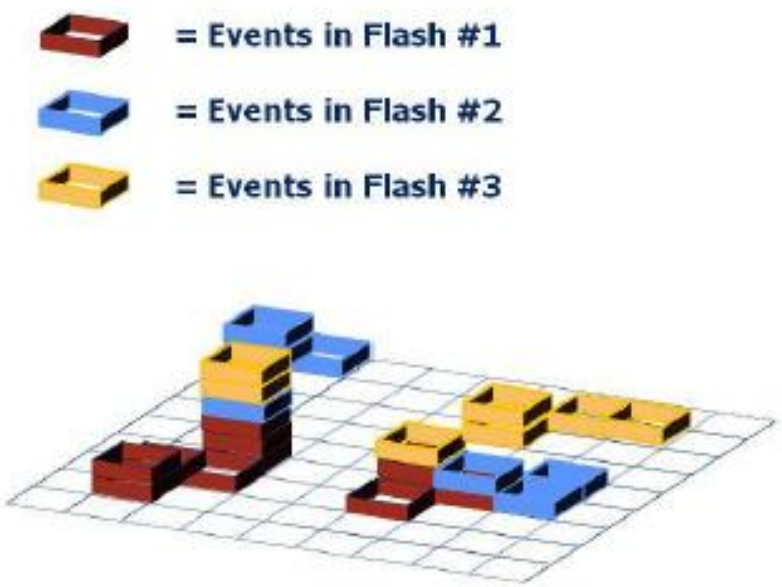
MTG-LI processing

Noise reduction partially done onboard, by on-the-fly thresholding by onboard background averaging. False events rejection finalized in the ground segment.



MTG-LI processing

removal of false events and accumulation algorithms



Event count in the 30 sec buffer (still in LI grid)

2	1							
						1	1	
					2			
							1	
		6			3	2	1	
	1	1			1			
	2							

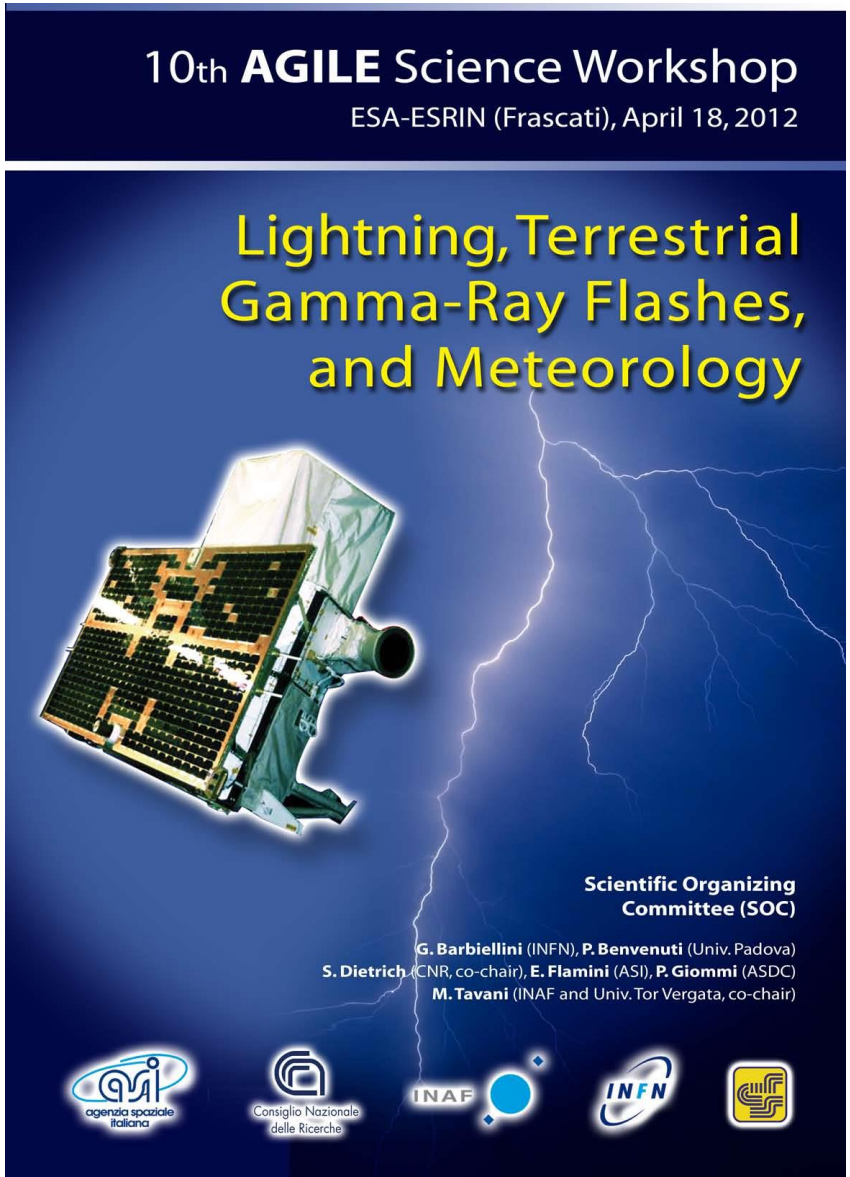
Flash count in the 30 sec buffer (still in LI grid)

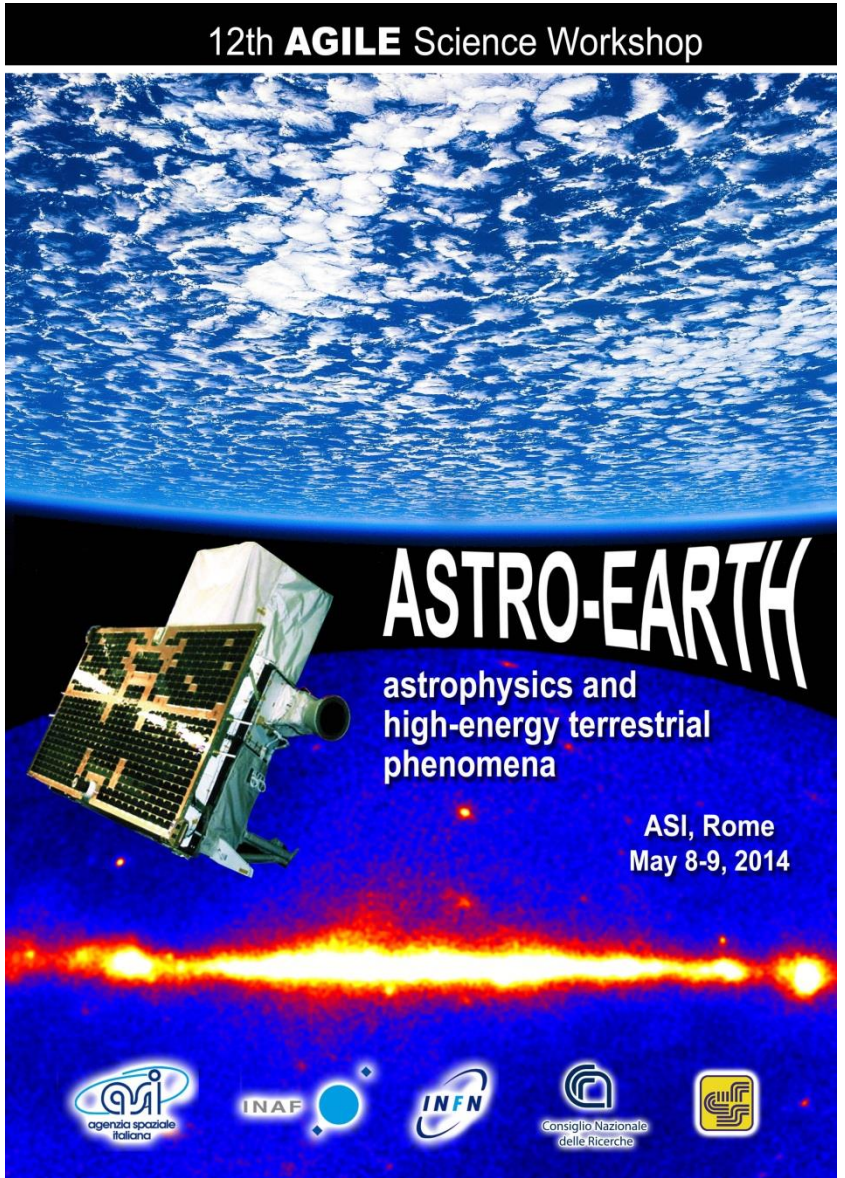
1	1							
						1	1	
					1			
							1	
		3			2	2	1	
	1	1			1			
	1							

Figure 28. Example of the accumulated flash index principle. Left, flashes #1, #2, and #3 of 3 during the 30 second buffer. Right, the cumulative event and flash counts in the buffer. Data on the right are still in the LI grid and have not been resampled to the IR grid.

- **Possible common interest**

Lightning, TGF and Meteorology
A new lightning mission for AGILE





Draft Agenda

Joint MTG LI Mission Advisory Group & GOES-R GLM S workshop

27-29 May, 2015

Centro Alti Studi per la Difesa (CASD),

Piazza della Rovere, 83, 00165 Rome, Italy

The Joint MTG LI & GOES-R GLM workshop will be held on 27-29 May 2015 plenary meeting will commence at 13:00 on 27 May 2015.

- **Day 1, Day 2 and morning of Day 3 (until lunch) are for all part**
- **Day 3 afternoon participation is only for LI and GLM science t**

Day 1: Wednesday 27 May 2015		
Opening session		
13:00	• Logistics & opening remarks • Objectives of the workshop	*Jochen Gra*
13:10	**Welcoming address from USAM**	*Brig. Gen.*
13:20	**MTG and GOES-R status**	*Rolf Stuhlm*
13:30	**MTG LI: instrument and mission status**	*Philip Will*
Algorithm session		
13:50	**MTG LI: L0-L1b algorithm concepts and status, filtering algorithm development update**	*Marcel Do*
14:10	**MTG LI: L2 concepts & algorithms**	*Jochen Gra*
14:30	**Use of LI proxy data for user readiness experiments**	*Antti Mäke*
14:50	*Coffee break*	

9:00	**Corsica LMA**	*Eric Defer*
9:15	**Efforts relating to LMA flash size and flash energy**	*Eric Bruning*
9:30	**LMA data and transient luminosity from high speed video recording of lightning at the Ebro Valley Laboratory in Spain + LMA in Colombia**	*Ferran Fabro, Nicolau Pineda*
10:00	*Coffee break*	
10:30	**ASIM**	*Torsten Neubert*
10:50	**TARANIS**	*Thomas Farges*
11:10	**AGILE gamma ray space telescope: Outlook on collocating gamma ray flashes and tropospheric thunderstorms**	*Marco Tavani*
11:30	**Assimilation of lightning data into NWP**	*Philippe Lopez*
11:50	**LTG DA work with the NSSL WRF**	*Dan MacGorman*
12:10	**Lightning NOx (LNOx)**	*Bill Koshak*
12:30	**Discussion on session talks & wrap-up for discussion with full attendance**	*All*
13:00	*Lunch*	
End of program for non-LI/GLM science team members		
Session for LI/GLM science team discussions and wrap-up		
14:00	**Wrap-up of meeting and next steps**	*All*
16:00 (latest)	*End of meeting*	

Conclusions

I have presented Meteosat Third Generation Lightning Imager (MTG-LI) that will be in space end 2018.

Lightnings are a threat but not all types of atmospheric electrical activity have an impact on operations, depending on user requirement and assets.

The observation of the phenomena, of any kind above troposphere, with events that eventually do or do not interfere with an industrial or operational activity, could bring useful information to fully describe atmosphere status.

In the coming years, the link between the Research and Operational communities will be surely stronger.

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ASI Headquarters, Rome

Meteosat Third Generation Lightning Imager

Thanks

Grazie

Daniele Biron

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