Presentation of the Africa dissemination baseline

Manufacturer consultation

on processing and visualization

of MTG-Africa data and products

received via EUMETCast Africa

Visioconference, 15th March 2021, Denis FAYARD

Agenda

1. Scope
2. MTG Programme overview
   - Lightning: a new service
   - Imaging: MSG continuity with improvements
3. Dissemination: challenges, summary, differences
   - FCI Level 1c, RGB (local vs central, LI, FCI Level 2)
   - SAF current status (central and NWCSAF)
4. Bibliography / Conclusion
5. Discussions / Questions?

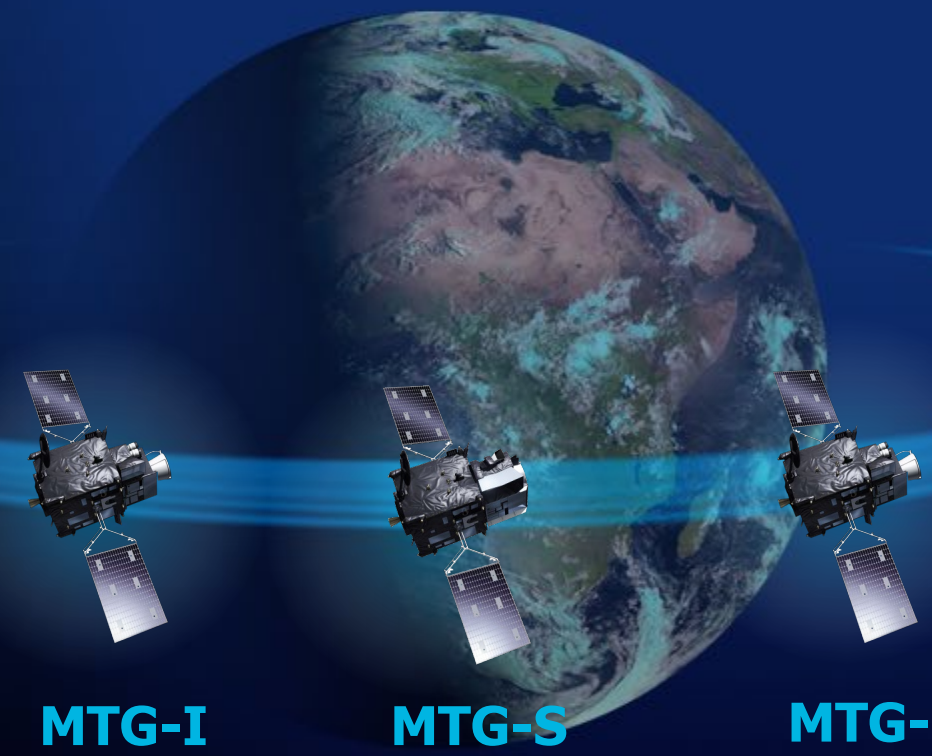
1. Scope

- To provide an overview of the MTG specific aspects of the dissemination via EUMETCast Africa:
  - To the reception station and display system manufacturers to support the adaptation of their systems
  - For users relying on Ecast-Africa only. Not targeting users:
    - located in North Africa (EUMETCast Europe) or
    - connected to EUMETCast terrestrial (only a few users)
- To answer manufacturers' questions
- To get a feedback on the feasibility / interest

2. Meteosat Third Generation (MTG): Full operational configuration

- Hyperspectral infrared sounding mission (InfraRed Sounder – IRS)
  - 3D weather cube: temperature, water vapour, O3, every 30 minutes over Europe
- Air quality monitoring and atmospheric chemistry in synergy with Copernicus Sentinel-4 instrument (UVN)

✓ **Continuity**
✓ **Innovation**



MTG-I Rapid Scan Service

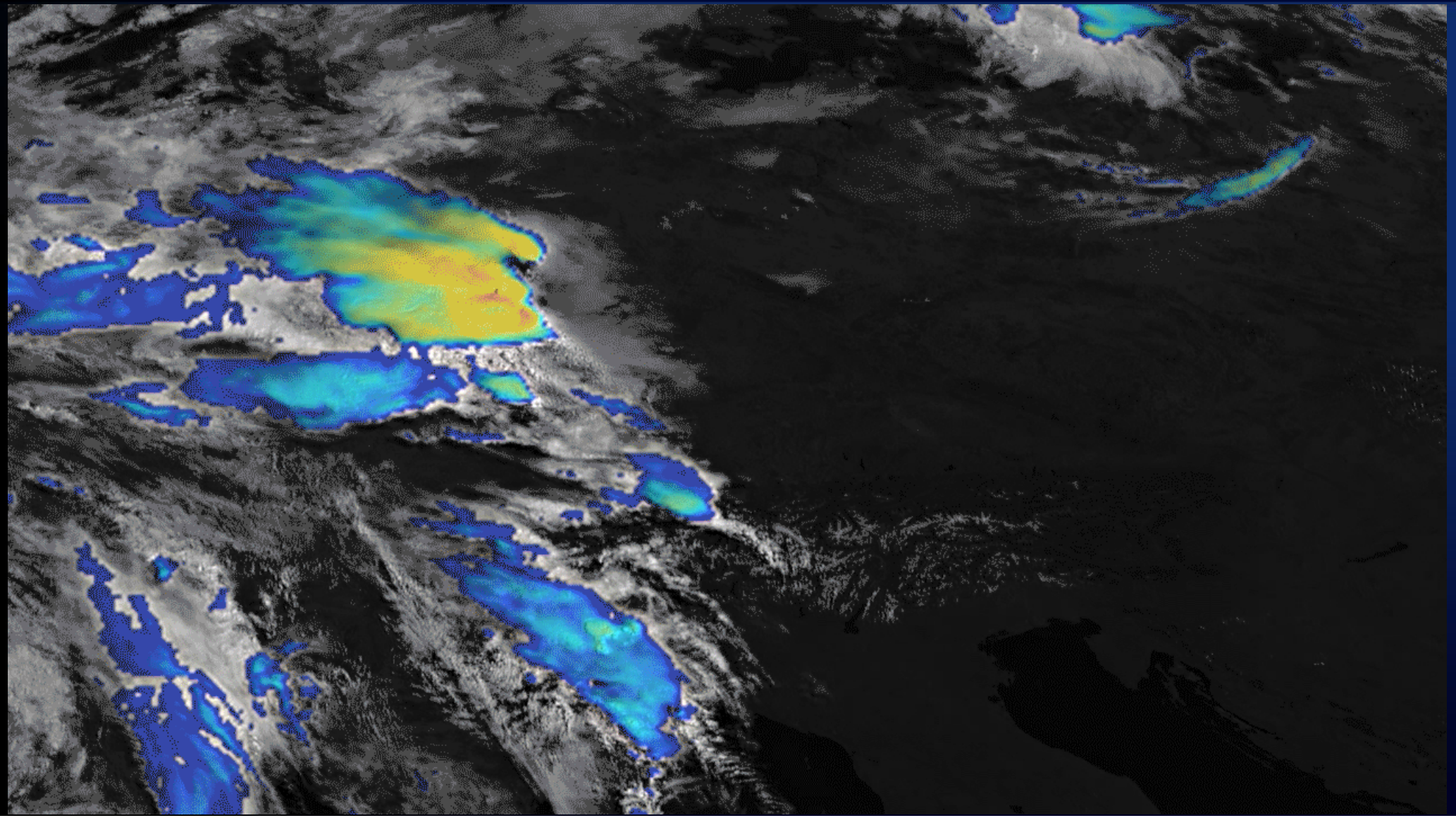
MTG-S Sounding Service

MTG-I Full Scan Service

Imagery mission implemented by two MTG-I satellites

- Flexible Combined Imager (FCI):
  - Full disc imagery every 10 minutes in 16 bands
  - Fast imagery of Europe and North Africa every 2.5 minutes
- New Lightning Imager (LI)

2. MTG enhances current capability for nowcasting of severe weather



2. MTG – Contribution to predicting high-impact weather

Cloud Height

Bright sky / Humidity convergence / convective instability

IRS

Development of convective clouds

IRS + FCI

Anticipate storms

LI

Time

2. MTG Spectral imaging mission: enhanced continuity of MSG

2. MTG - higher resolution imagery

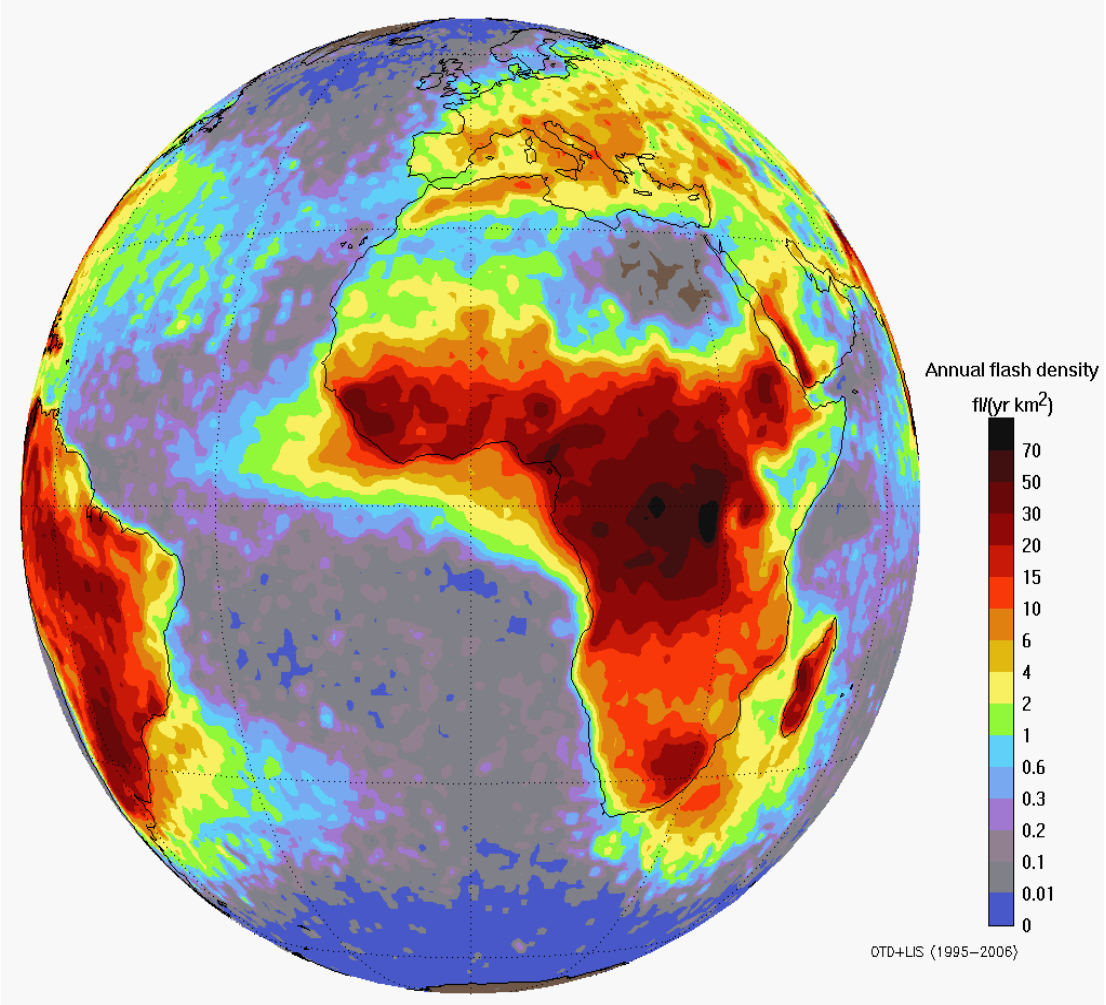
Natural colour RGB 3 km

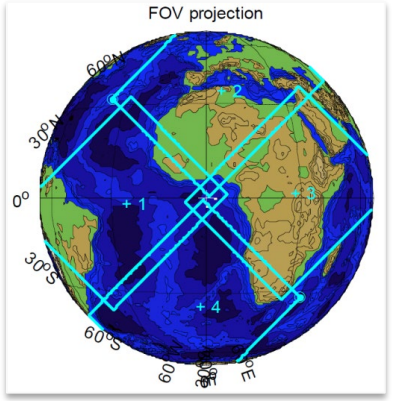
True colour RGB 1 km

Example of ash detection, SEVIRI Natural Colour RGB, 12:15 UTC, 26 November 2006 (left), MODIS True Colour RGB, 12:20 UTC, 26 November 2006

2. MTG: Lighting imaging mission

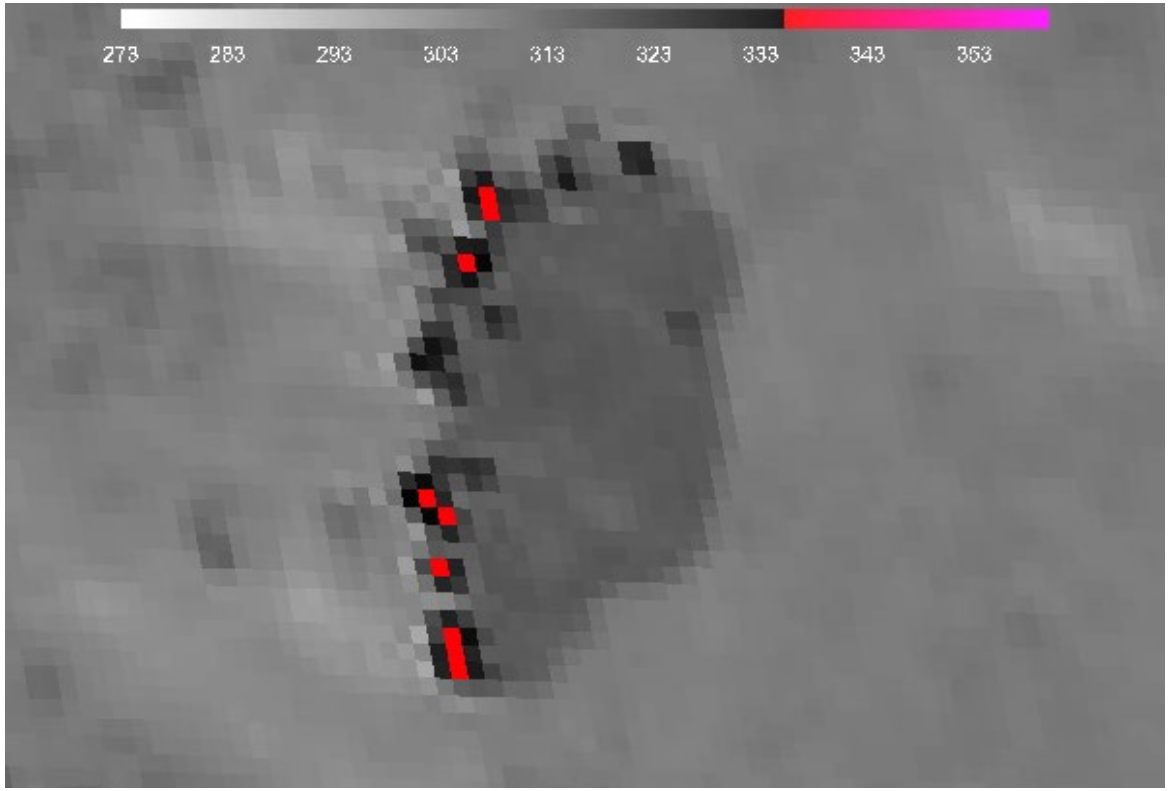
Flash density in the MTG LI field of view



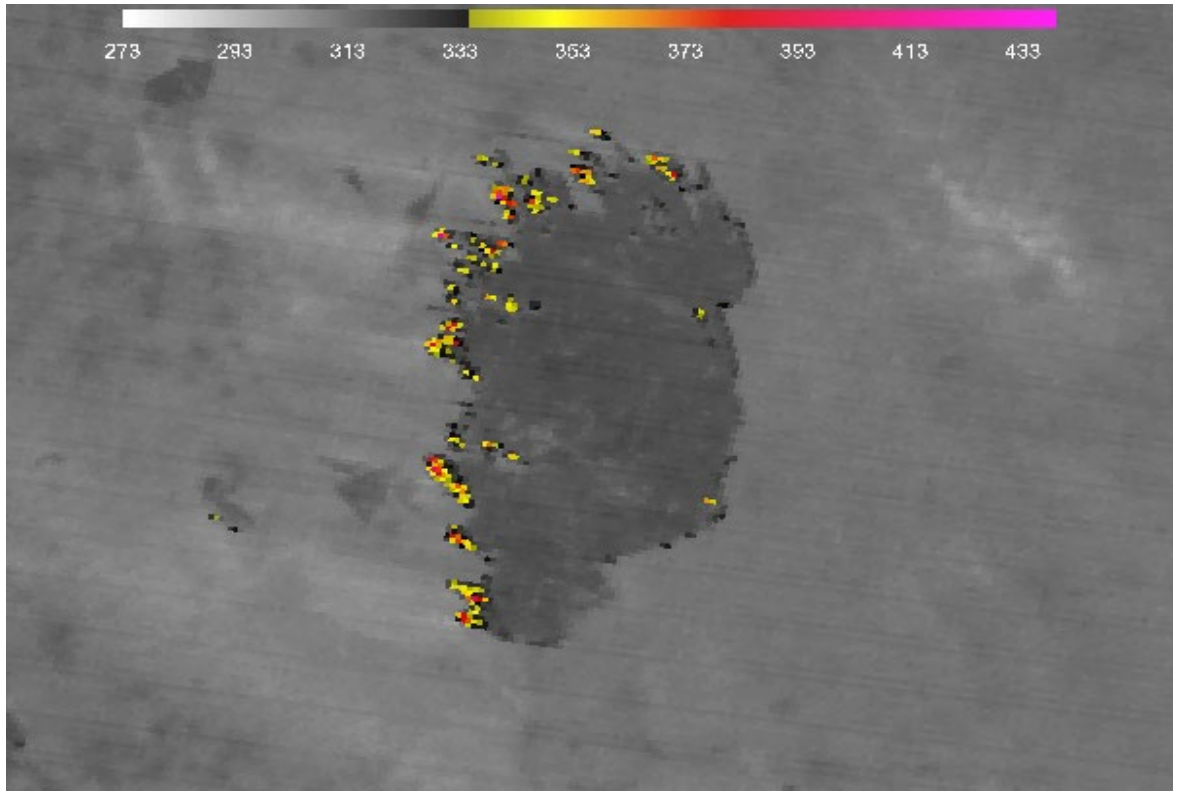


- Very high flash density over sub-Saharan Africa
- Total lightning can be a precursor of severe weather, with a lead time of tens of minutes
- MTG LI measures total lightning, whereas ground-based networks are mostly sensitive to cloud-to-ground lightning

2. MTG – Detecting and monitoring Fires



Current (MSG-SEVIRI IR3.9 @09:00 UTC)



FUTURE (MTG like MODIS IR3.9 @08:55)

Botswana, 29 August 2008.
Higher spatial and temporal resolution; more sensitive 3.9μm and new 2.2μm channel for improved fire detection

2.1 MTG Lighting Imager Service description

- The Lighting Imager on board the satellite detects the combined flashes:
  - Cloud-to-Cloud / Inter-Cloud (IC)
  - Cloud-to-Ground (CG);
  - With a higher Detection Efficiency at night than during the day, i.e. weaker lightning signals are detectable at night
- The service:
  - The “LI Accumulated Flash Area” product present the result in a synthetic way
  - Deliver information on location and strength of lightning flashes
  - Mapped on a 2x2 km grid
  - Image refreshed every 30s (see accelerated animation on next slide)

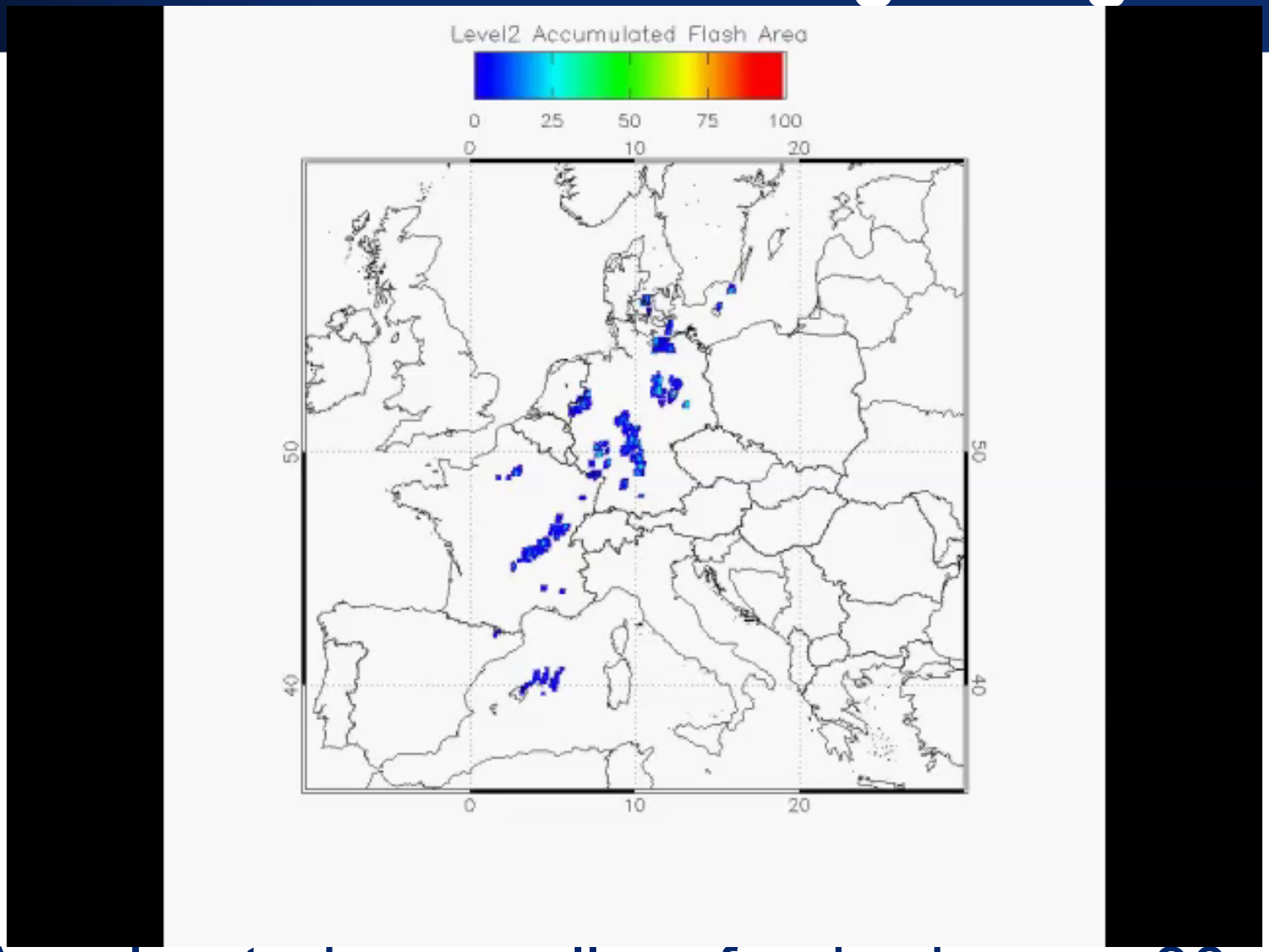
Main benefit from MTG:

- Homogeneous (whole disc)
- Continuous observations
- Short timeliness (< 1 minute)
- Observing total lightning (CG + IC)

Example of use:

- Warnings
- Development (Intensity/Movement) of active convective areas
- Lifecycle of storms
- Lightning climatology
- Chemistry (NOx production)

2.1 MTG service: Lightning

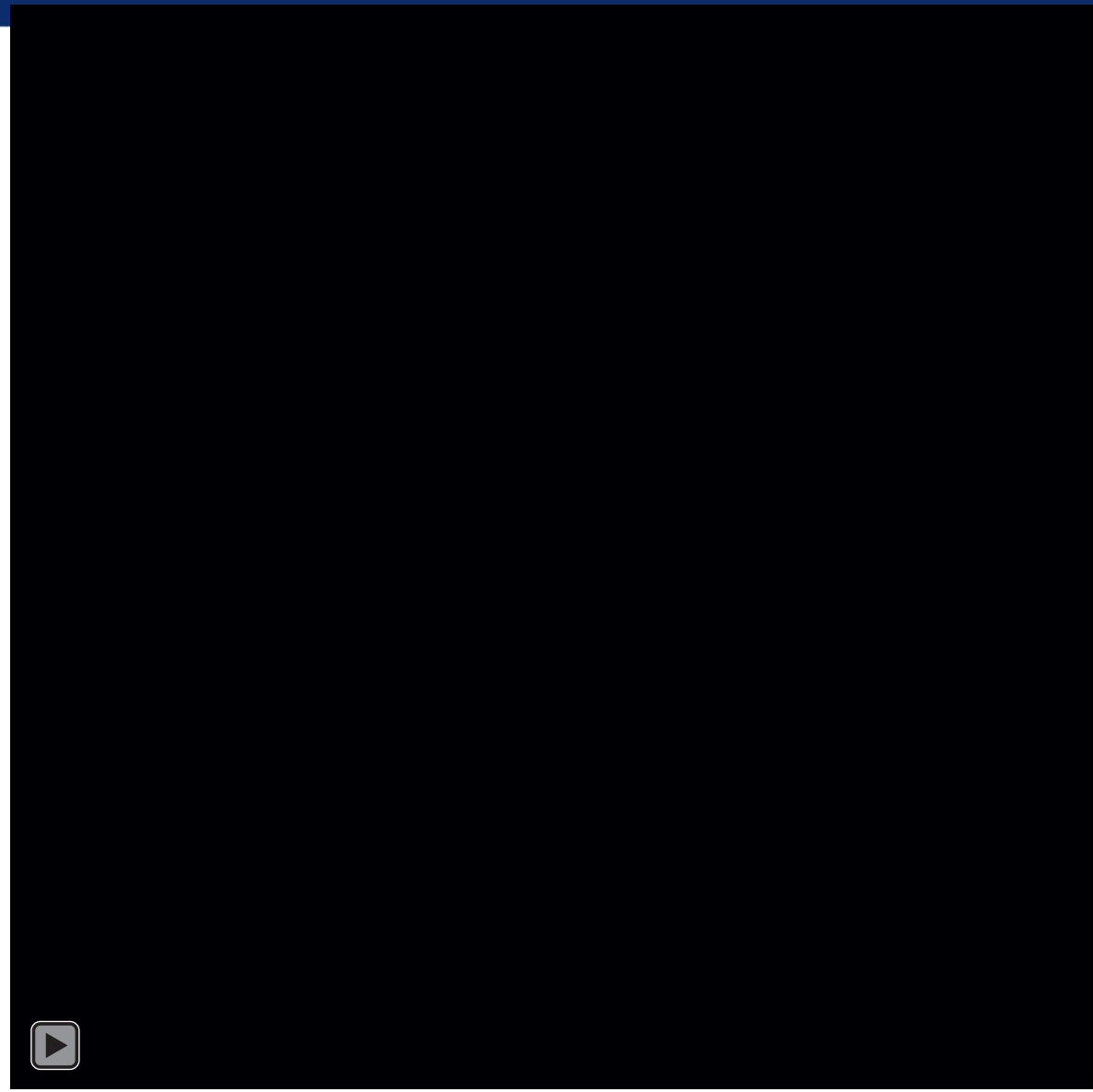


Accelerated, normally refreshed every 30s

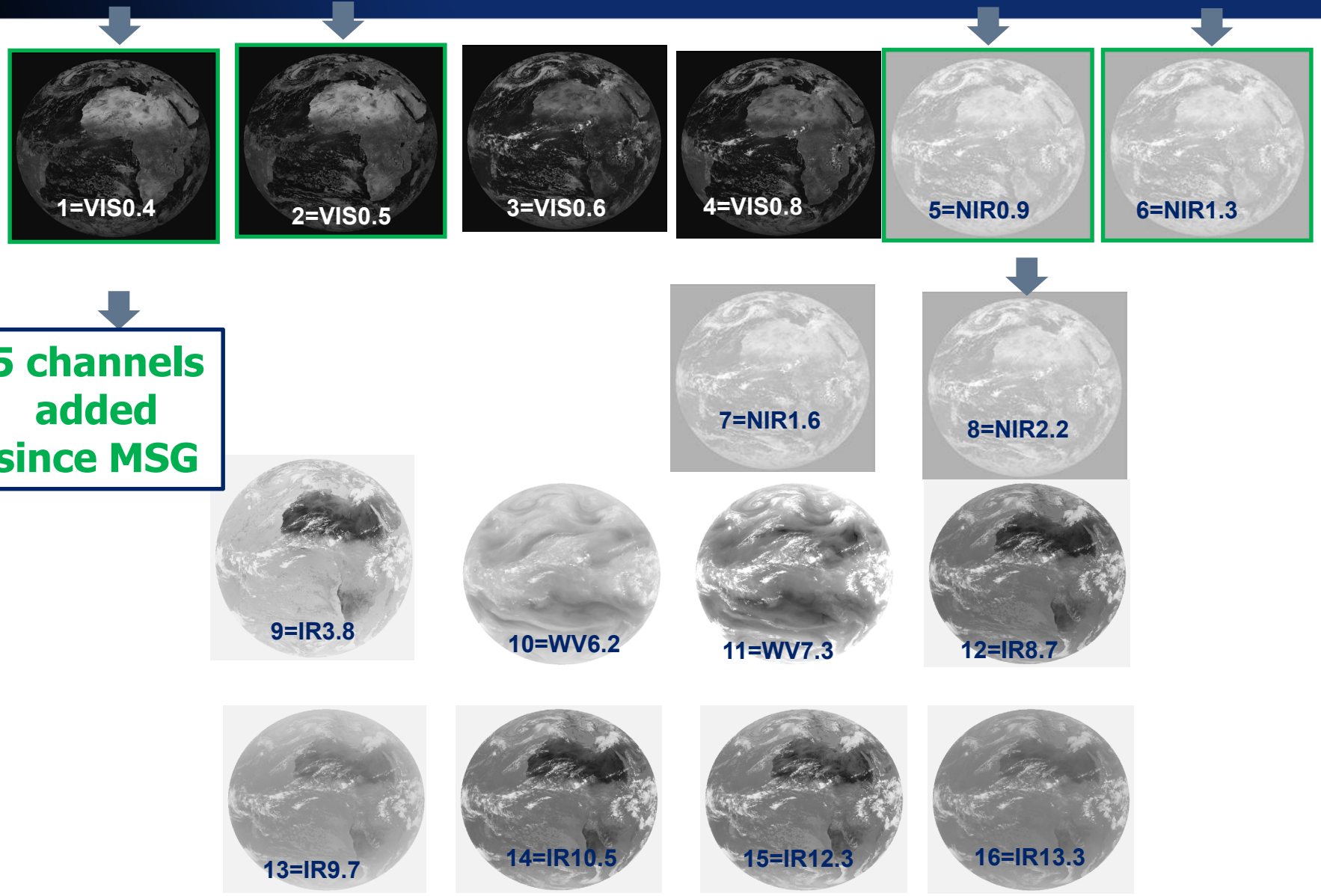
2.2 MTG FCI : the continuity of MSG with improvement

2.2 Main improvements MTG vs MSG for imager (FCI)

- Better spectral resolution:
  - from 11/12 to 16 channels
- More frequent:
  - 10 min vs 15 min
- Increased dynamic:
  - 12 bits vs 10
- Better spatial resolution:
  - from 3x3km to 1x1km visible & 2x2km infrared



2.2 MTG: Spectral bands of FCI image onboard MTG-I



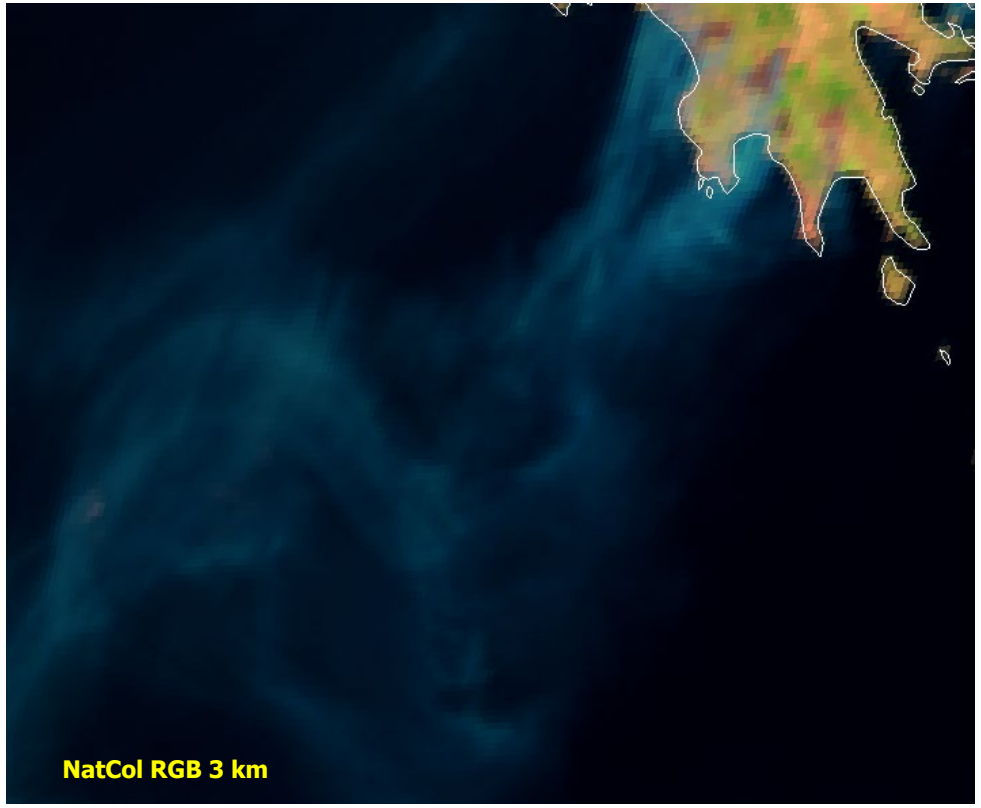
2.2 Benefit of better temporal resolution

- Earlier detection of:
  - important new phenomena (e.g. a new convective cell)
  - important changes in the already ‘ongoing’ processes
- Smoother – nicer animations
- Easier to follow, understand the rapid processes
- Help to study phenomena with short lifetime
- Easier to diagnose storm types
- More suitable for studying them together with radar and lightning data

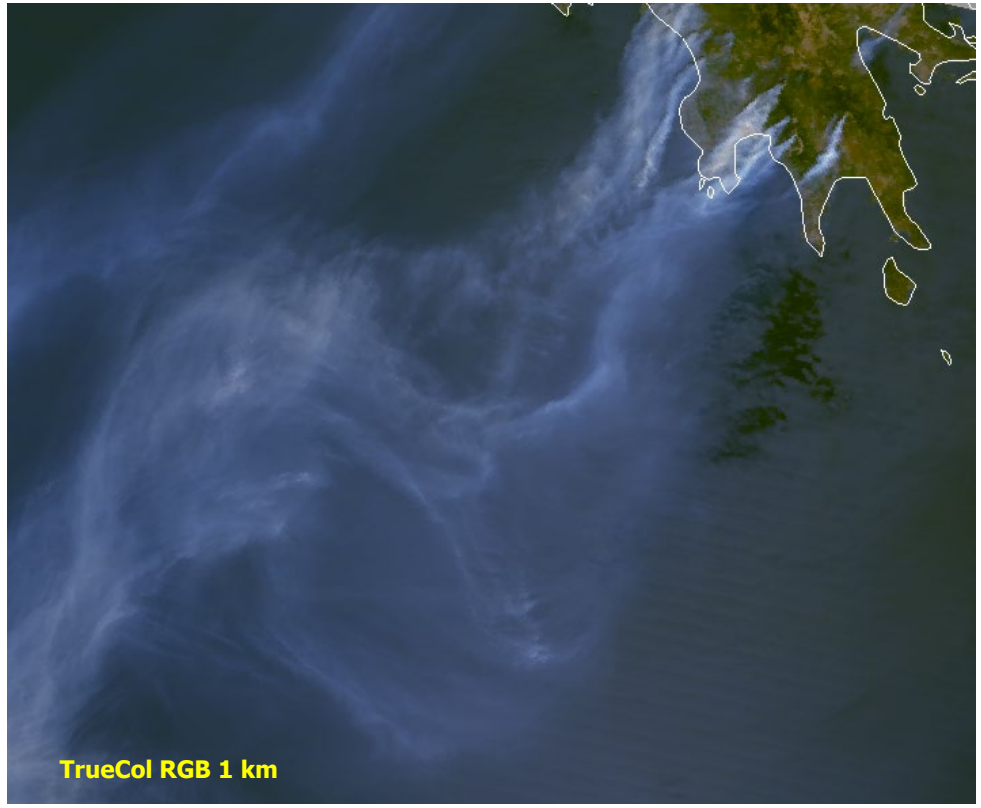
2.2 MTG-I: smoke detection

26 August 2007

MSG SEVIRI (11:00 UTC)



MTG like: MODIS (09:35 UTC)



Impact of enhanced spatial resolution and adding of more solar channels

2.2 MTG-I: Fires in USA, GOES-16 ABI, Fire Temperature RGB

6 March 2017

...MTG higher resolution provides better pin-pointing of fires

=> better decision tools for emergency services

3. The dissemination challenges

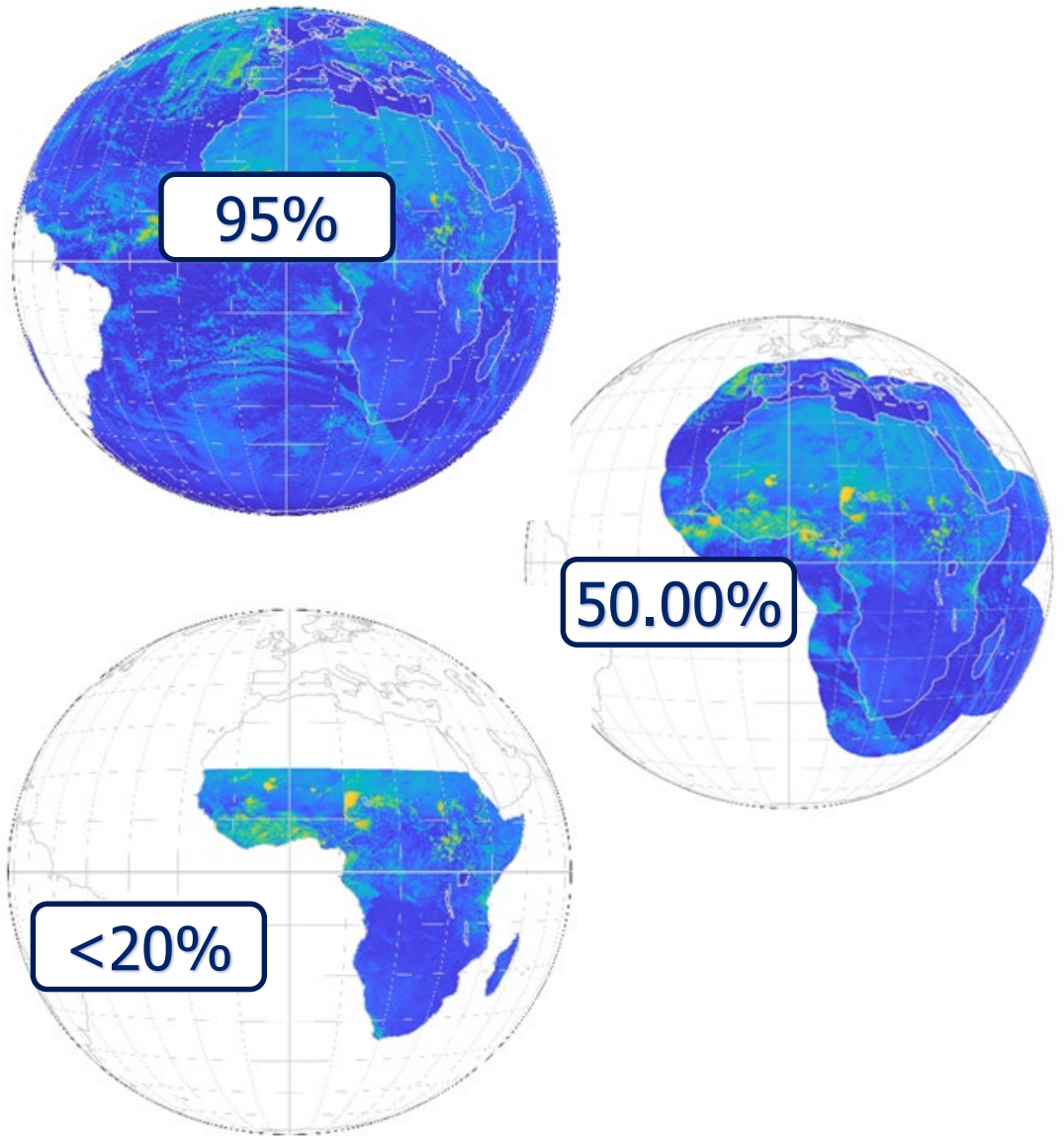
- Bandwidth limitation prevents the users of EUMETCast Africa to receive all the above data:
  - reducing space sampling, sampling frequency, or the number of channels disseminated and geographical crop allows to save bandwidth (target around 4Mbps).
  - agreed with RAIDEG & EUM Council to prioritise continuity of the benefits achieved today with MSG while introducing some MTG innovation
- Infrastructure
  - data access capacity need to be increased (more Bandwidth to receive the data, more storage…)
  - equipment to process the data (PUMA station) need to be upgraded and software to visualise the data shall be updated
- Personnel
  - training on new data and products, training on how to use them in operational services (e.g. nowcasting, forecasting, aviation…)
  - training on maintenance and sys. administration

3 Dissemination baseline summary

- The baseline for EUMETCast Africa includes:
  - The 16 MTG FCI channels at MSG resolution (3x3km)
    - Coverage and periodicity of channels tuned to the needs
  - Four centrally produced RGB at 1x1km, with tailored coverage
  - True color RGB at 3x3km, over full disc
  - Continuity of HRV at 1x1km, over Africa
  - Lightning accumulated flash area
  - Fire L2 product
  - A TBD subset of SAF L2 products (including some centrally generated by NWCSAF)
  - GII: Global Instability Index
- Growth potential should more bandwidth become available:
  - Improved periodicity / coverage for FCI Level 1 channels
  - Addition of a subset of Optical Cloud Analysis (OCA) Level 2 products
  - More SAF products

3. The coverage is tailored to the needs

- Cropping dramatically reduces dissemination bandwidth
- There are different crops per FCI L1c channel and for each RGB
- Tailored taking into account the application areas
- The coverage masks consist of a static array of true/false Boolean per pixel
- Configurable even during commissioning or operations
- Sizing details available in [AfricaPUG]



3.1 Datasets for FCI Level 1

- FCI L1c - Tuned MSG continuity with MTG innovation:
  - Coverage (and periodicity) of individual channels adjusted to the needs
    - e.g only Land or sub-sahara or full disc …
    - to reduce data rate in view of including MTG innovation
  - MSG like channels every 10 minutes (MSG is 15 minutes) except WV6.3 and WV7.3 at 20 minutes (slower evolution)
  - MTG new channels disseminated at a lower frequency and reduced coverage
  - SSD of 3x3km (like MSG)
- HRV continuity (0.6)
  - with permanent Africa coverage (MSG is a North / South band shifted twice a day)

3.1 Europe vs Africa main differences for FCI L1c

Characteristic	EUMETCast Africa		EUMETCast Europe / TER
	FCI 1C 3KM	FCI 1C 1KM	FCI 1C FDHSI
Periodicity (RC)	8 channels @10mn, 2 @20mn , 3 @30mn, others x4/day MSG=15mn	10 minutes	10 minutes
Nb of Products per Repeat Cycle (RC)	Up to 16 products (1 per FCI 1C channel)	1 product (vis_06)	1 product (containing all 16 channels)
SSD	Like MSG: 3x3km	1x1km	2x2, 1x1
Coverage	Tailored to the needs per channel		Full disc
Pixel coding / format	12 bits per pixel (MSG is 10) / NetCdf		
Nb of Chunks/RC	No chunk (a single file per product)		40 chunks + 1 trailer
Chunks Content	Each file contains data of a single channel		Each chunk contains a subset of 16 channels
Processing/Storage	Only the channels of interest / see [AfricaPUG]		All channels /see [MTGDIS]

3.2 Locally generated RGB

- The RGB can be generated locally:
  - i.e. in the reception station by the visualization SW
  - periodicity and coverage depends of the contributing channels
  - SSD 3x3km
  - Complemented by central RGBs

Those channels allow the following local RGB		
RGB	**Periodicity [min]**	**Coverage**
Airmas	20	Disc but no America
24h micro	10	Africa + 1650 km offshore
Day micro	30	Africa + 1650 km offshore
Night micro	10	Disc but no America
Severe Conv	20	Disc but no America
Natural Color	10	Disc but no America
Snow	10	Disc but no America
Fire temp	30	Disc but no America
True Color	few/day	Subsahara land only
Cloud phase	30	Disc but no America
Dust	10	Africa + 1650 km offshore
Cloud type	30	Disc but no America

3.3 Dissemination of centrally generated RGB

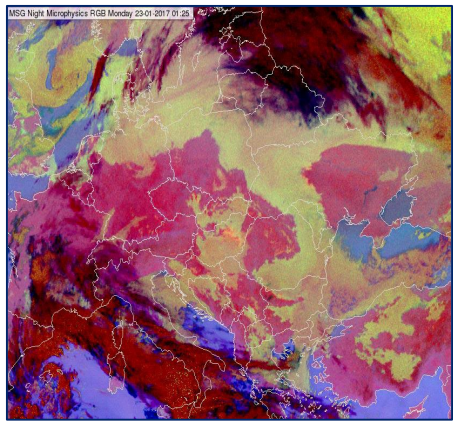
The following RGBs are generated centrally before dissemination:

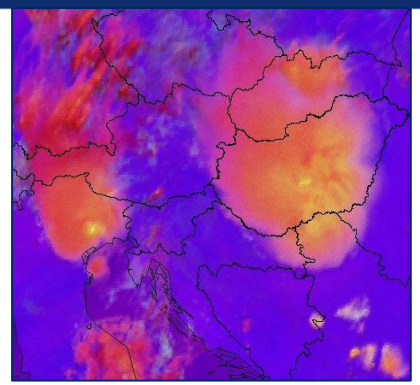
- To benefit of MTG improvement,
- Mostly with full resolution (SSD 1x1km) and periodicity tune to needs
- To overcome local generation restrictions (e.g. true color)
- Takes into other products available (e.g. FIRE product vs Fire RGB)

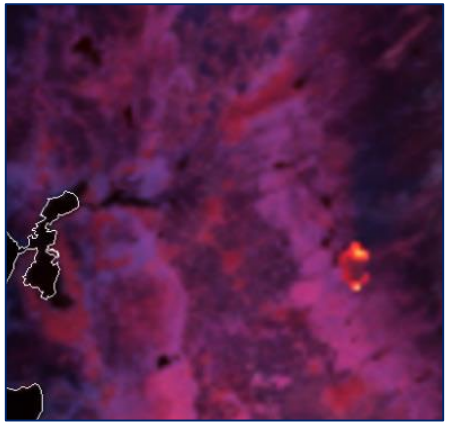
Dissemination proposal	Resolution [km]	Area	Periodicity [min]
Severe Storm (convection) RGB	1	Subsahara + 20 km off cost	10
Night Microphysics (Fog) RGB	1	Subsahara + 20 km off cost	20
True Color RGB	3	GEO Full Disc	20
Fire temperature RGB	1	Subsahara land only	30
Cloud phase RGB	1	Subsahara + 20 km off cost	10

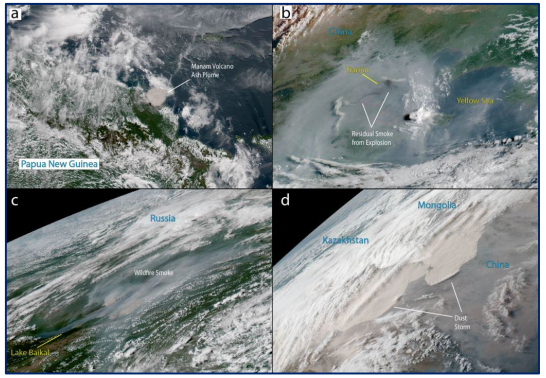
3.2 Dissemination of centrally generated RGB

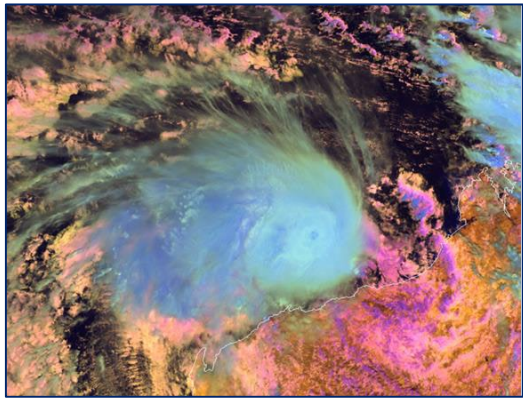
- Severe Convection (Storms)
- Night Microphysics (Fog/low Clouds)
- True Colour
- Fire Temperature
- Cloud Phase











3.3 LI and FCI Level 2 Products

Lightning:

- Accumulated (over 30s) Flash Area @2x2km
- *Accumulated_flash_area* value at the location [x,y] in FCI IR grid

FCI level 2 baseline:

- Native FIRE: @10mn & 2km
- Subset of native GII: @10mn & 6km, coverage TBD ➔ for convection
- SAF: FCI only (placeholder to be tuned later)

Not considered:

- ASR, CRM, CLM: ➔ input to NWP models, received via other means.

Option (if enough bandwidth):

- A subset of Optimal Cloud Analysis (OCA) which contains essential CLM information

3.4 SAF current status (central and NWCSAF)

- NWC-SAF in reception station not feasible
  - would require complex SW adaptation (e.g. file format, chunking, channel resolution of 3x3, coverage & periodicity configurable per channel).
- The list of disseminated SAF products is not yet finalized.
  - The chapter 7 of [AfricaPUG] provides a list of candidates.
- For MSG, NWCSAF software is executed centrally (in EUM).
  - Dissemination of the resulting products (e.g. RDT)
- Same approach foreseen for MTG
  - NWC SAF support needed for tailoring/configuring the NWCSAF
  - Streamlined products to reduce the volume (e.g. no forecast only diagnosis, remove 2D image, remove lat/lon plan, subsahara + 1650km off-shore, lossless compression…)
  - To answer the African Users main needs.

4. Bibliography

- [AfricaPUG] and [MTGDIS] available on website
  - contain also reference to other relevant documents
  - embed ncML files provide the format
- These ncML files:
  - Describe the content of the customised product files
  - In the NetCDF Markup Language (NcML) using XML syntax.
  - Only for those products specific to EUMETCast Africa

4. Conclusions

- EUMETCast Africa remains the primary dissemination mean for users in Africa (subsahara)
- EUMETCast terrestrial provides all data to users having the capacity to get connected to National Research and Education Network (NREN) that offer sufficient connectivity (see https://www.africaconnect3.net/african-nrens/) or a good internet connectivity
- EUMETCast Africa baseline approved by EUMETSAT Council based on RAIDEG recommendations : [MTGDIS]
- Highly optimised in term of bandwidth (compression, coverage, periodicity)
- More data can be disseminated if more bandwidth become available.
- Coverage and periodicity can be tuned -> flexibility required at station SW level
- Baseline is documented in [AFRICAPUG]
- Continuity of NWCSAF products for Africa will be implemented by processing centrally and distribute its tailored products

5. Discussions / Questions?

- Thank you for listening
- Interested manufacturers may:
  - Raise questions to obtain clarification of the document [AfricaPUG]
  - Make observation on the feasibility / “implementability” at reception stations level
  - ….
- now or in written form after the meeting using ops@eumetsat.int with subject “MTG Africa consultation”

End of presentation