A REAL TIME PIPELINE TO LINK METEOROLOGICAL DATA TO TGFS DETECTED BY AGILE

Alessandro Ursi

Rome, May 26th 2015

Collaboration:

- the AGILE Team
- Institute of Atmospheric Sciences and Climate (ISAC – CNR)

  S. Dietrich, D. Casella, P. Sanò, M. Petracca
- Italian Air Force

General concept

TGFs detected by AGILE

+

information by meteo satellites

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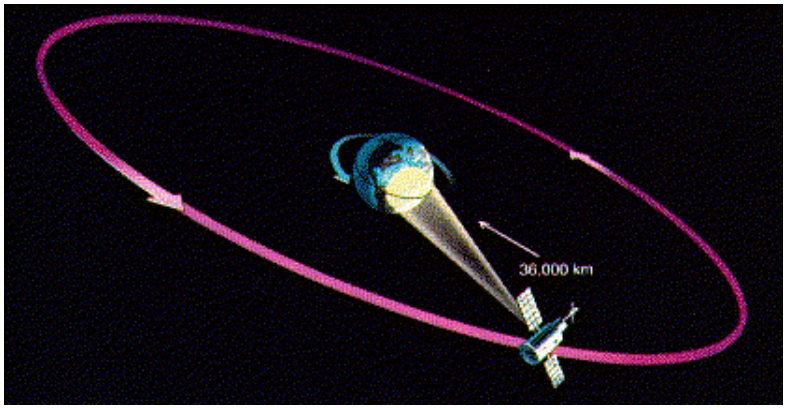
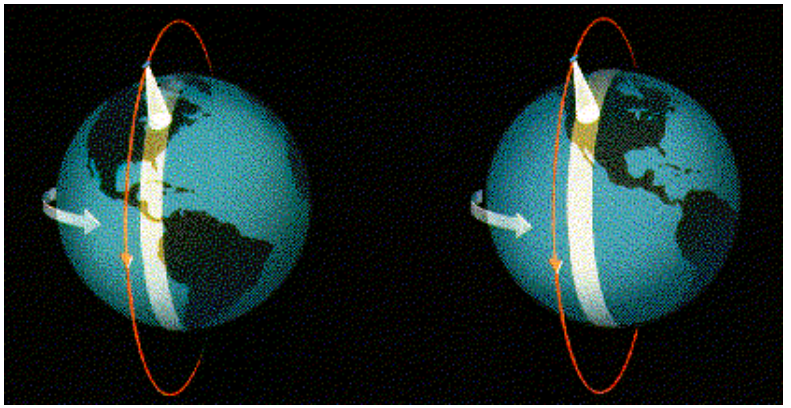


geostationary satellites



low earth orbit satellites

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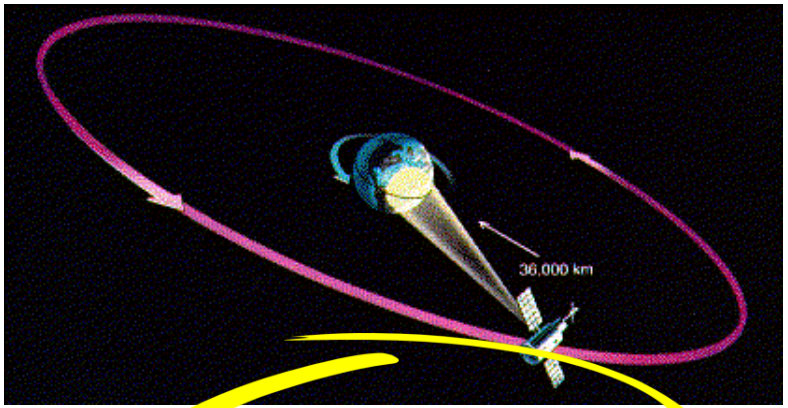

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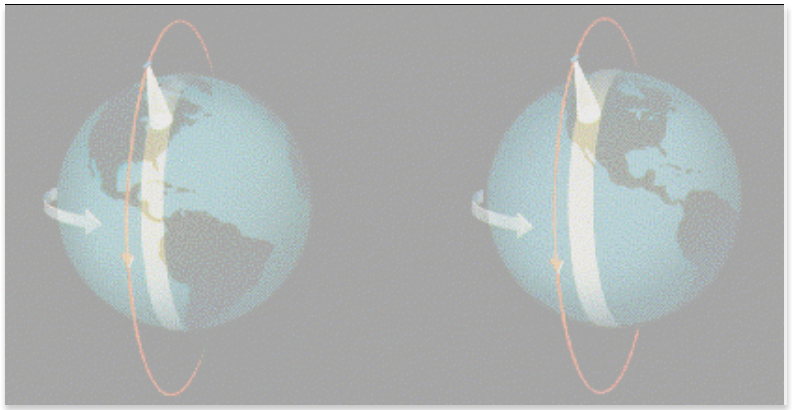

low earth orbit satellites

General concept

TGFs detected by AGILE

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information by meteo satellites

- Cloud Top Altitude (CTA)
- Atmospheric Motion Vectors (AMV)
- Multi-sensor Precipitation Estimate (MPE)
- CLoud Analysis (CLA)
- Global Convective Diagnostics (GCD)
- IR 10.8 μm
- WV 6.2 μm

General concept

TGFs detected by AGILE + information by meteo satellites

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} **Global Convective Diagnostics (GCD)**

deep convection is present

if GCD = T_b^{IR}-T_b^{WV} ≤ 1 K

General concept

TGFs detected by AGILE

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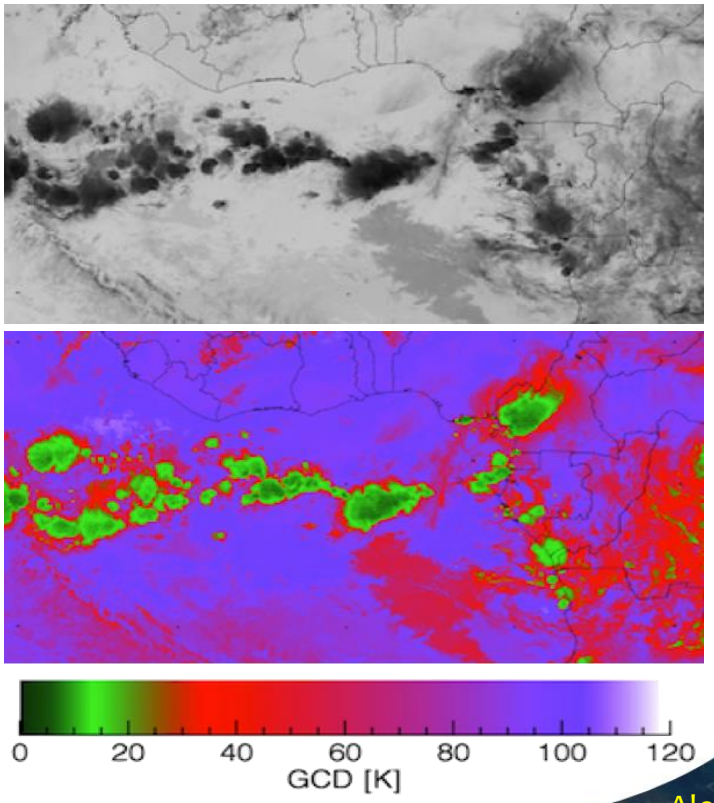


Motivations...

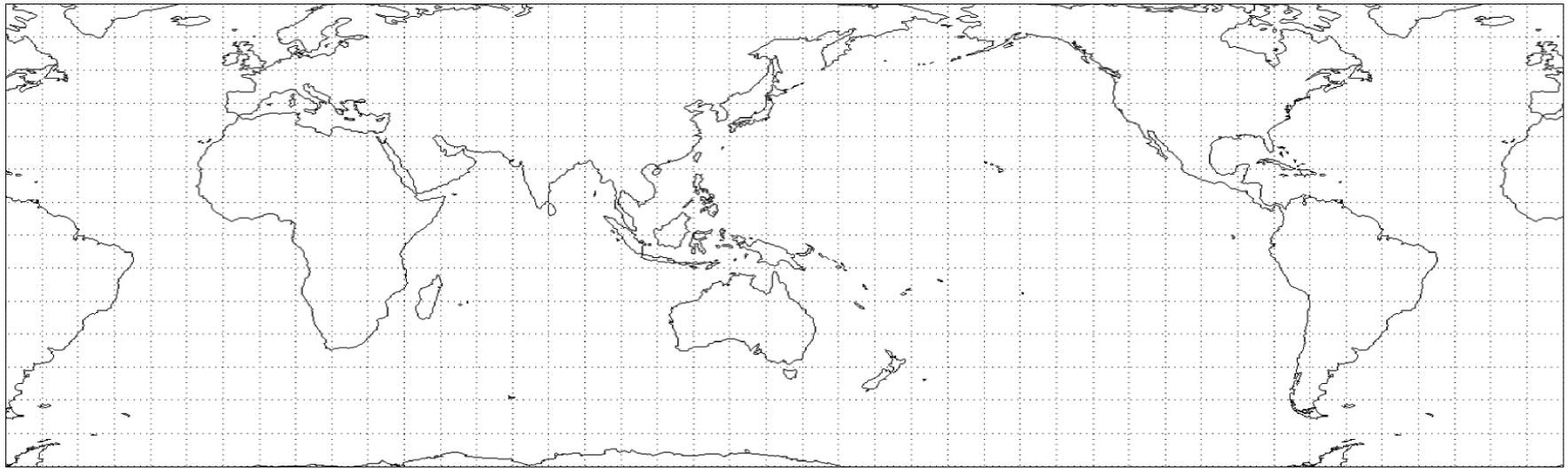
1) check of convection within the TGF production region

2) first time follow-up of the TGF-producing thundercloud

3) specific class of thunderstorms producing TGFs

4) real time (= as-fast-as-possible) service to alert aircraft networks

Global meteorological coverage



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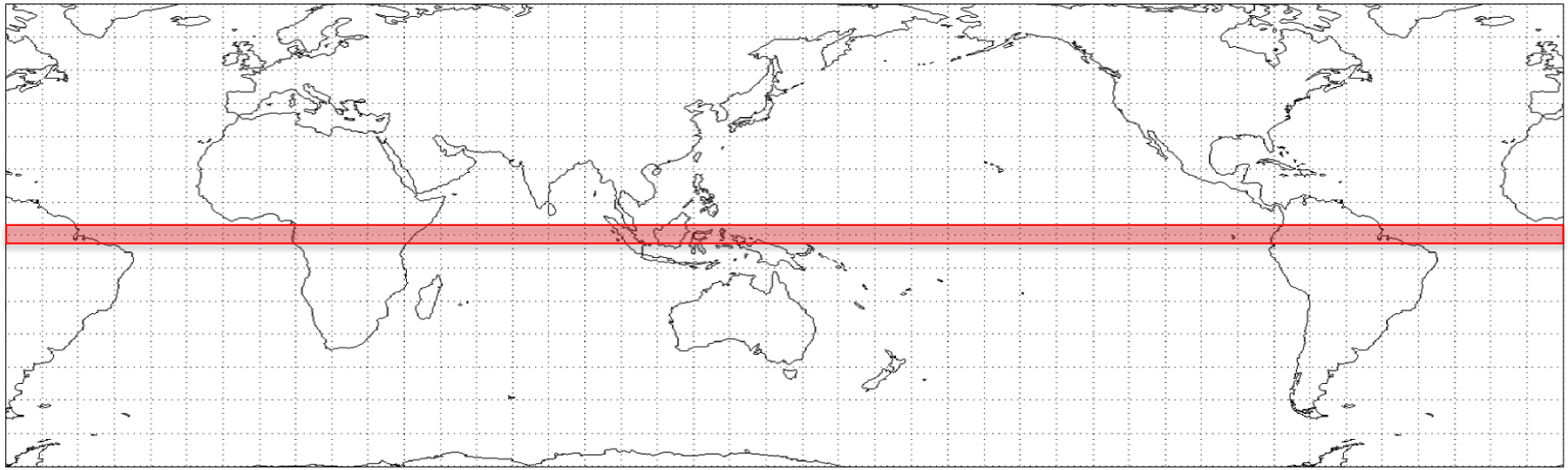
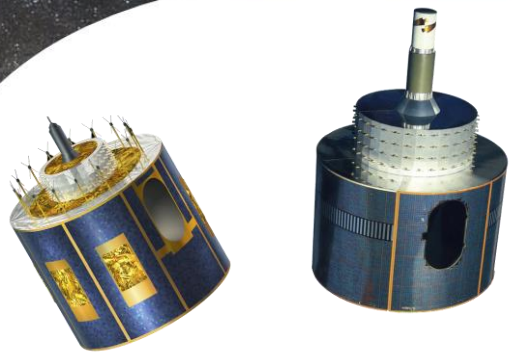
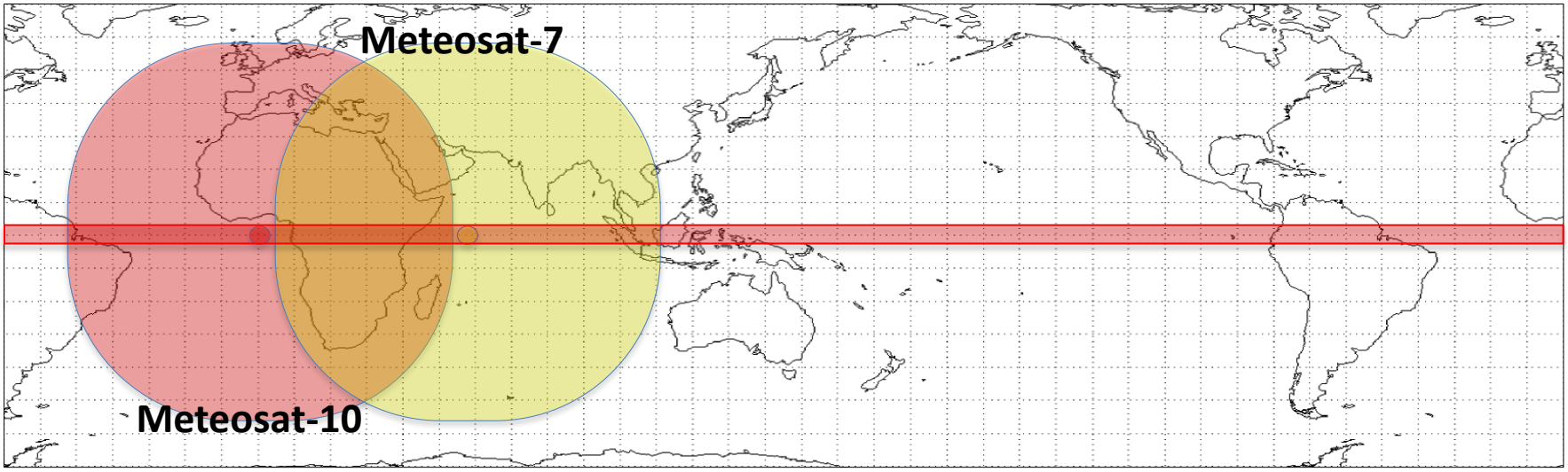


AGILE satellite

whole orbit ~ 90'

Global meteorological coverage





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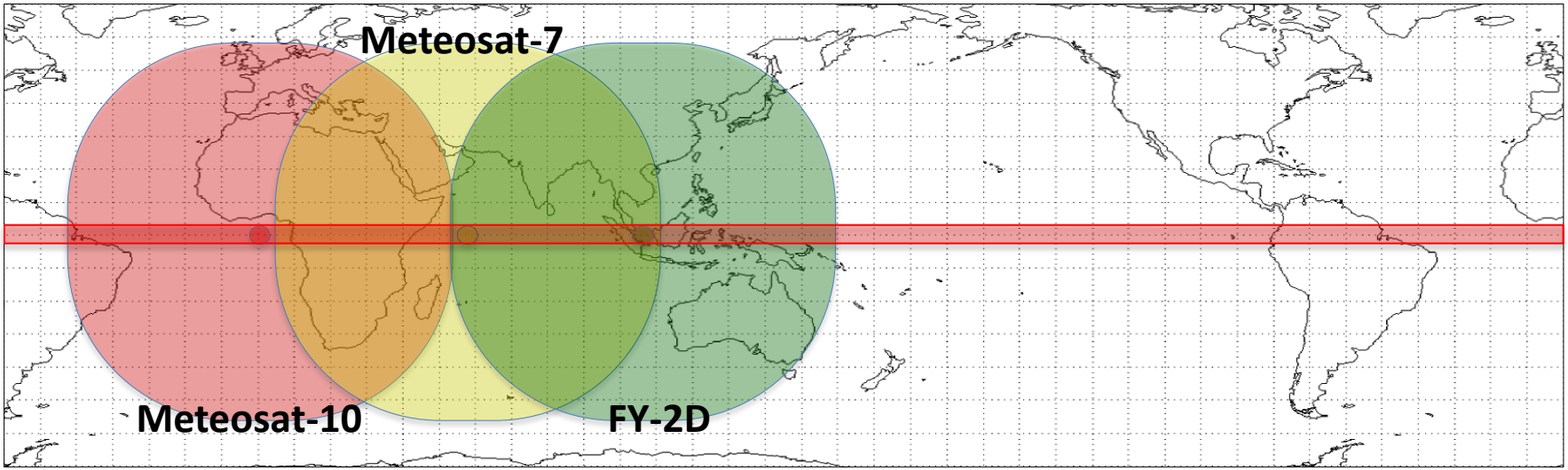

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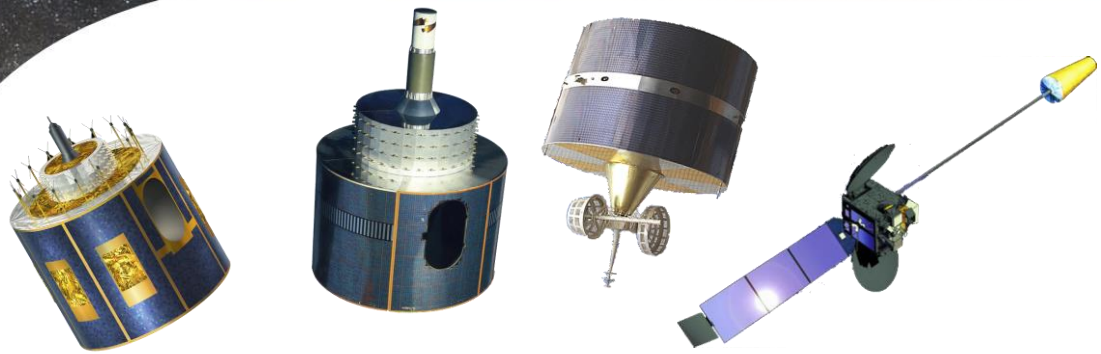

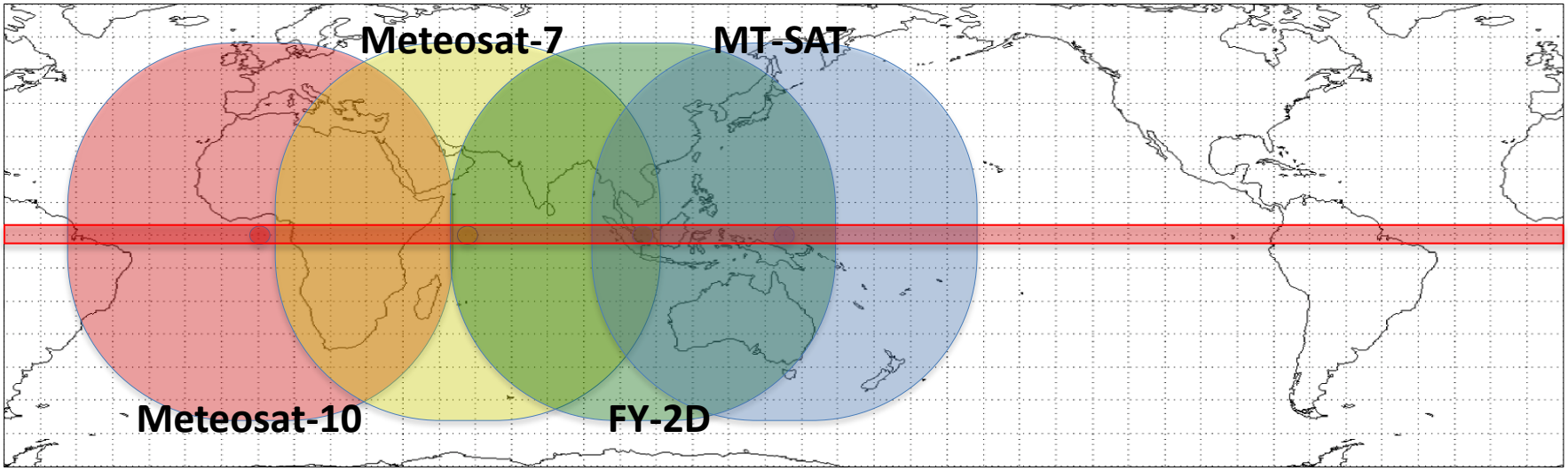

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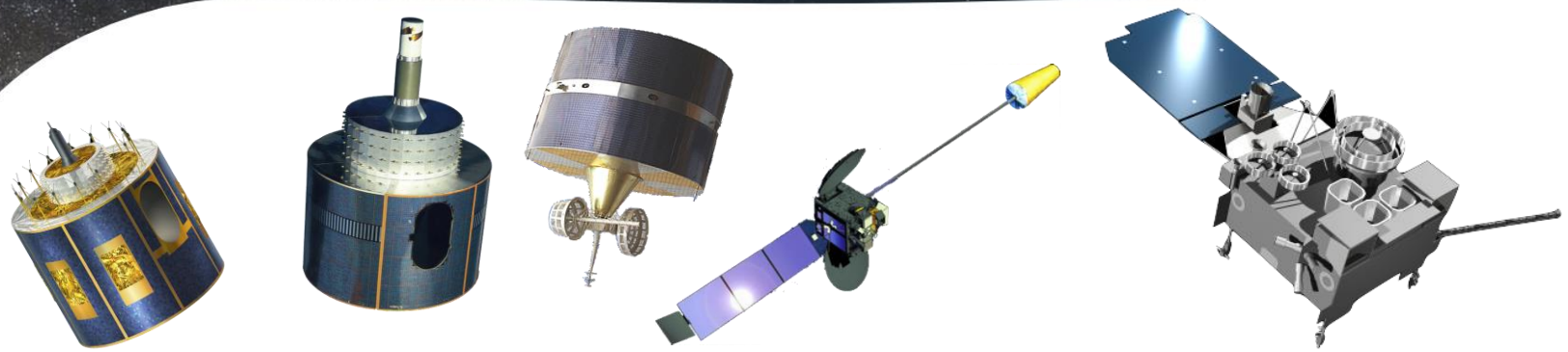
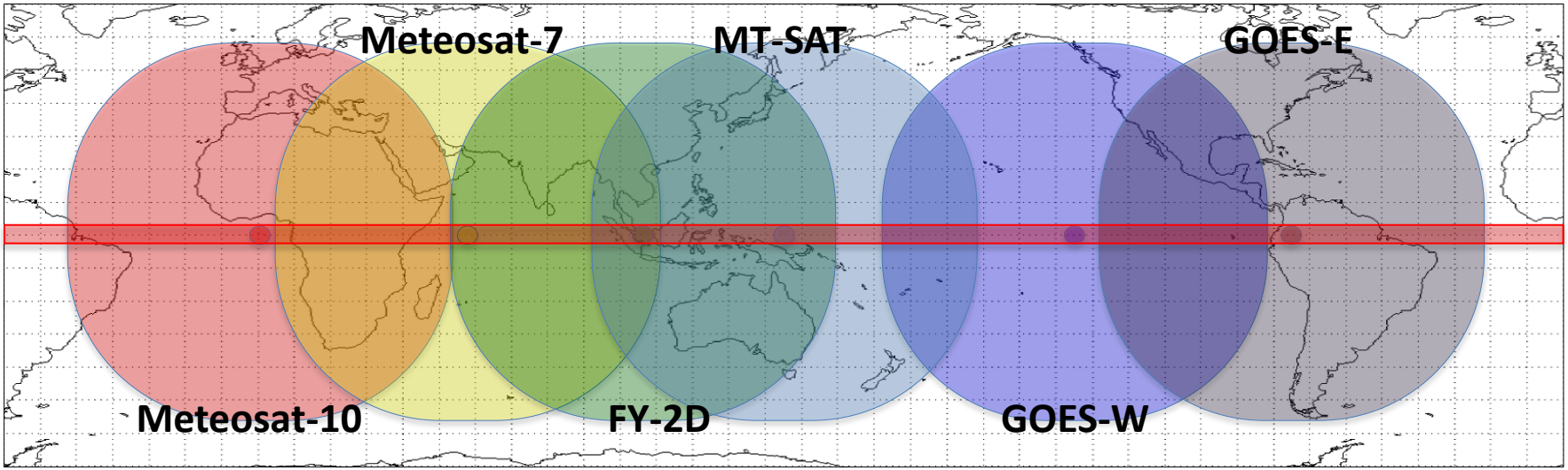
Global meteorological coverage





AGILE satellite

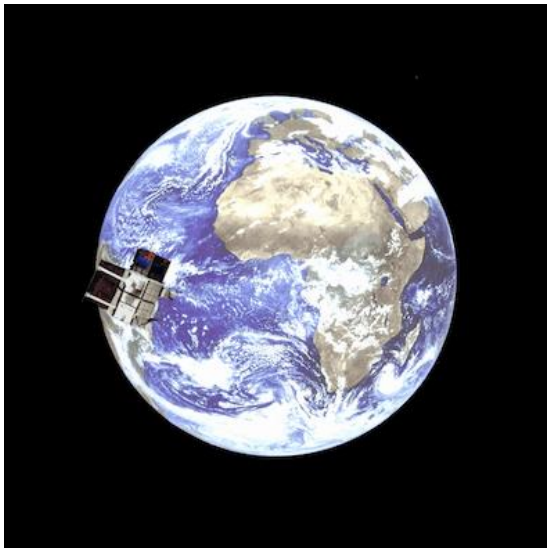
whole orbit ~ 90'

Geostationary meteorological satellites

data available every ~ 15'÷30'

How does it work?

new data every ~ 90'



AGILE data packets

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orbit 41179 12/04/2015
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How does it work?

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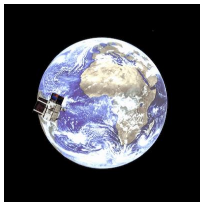
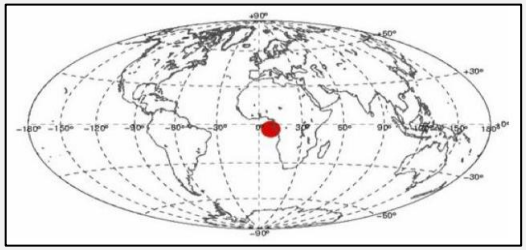
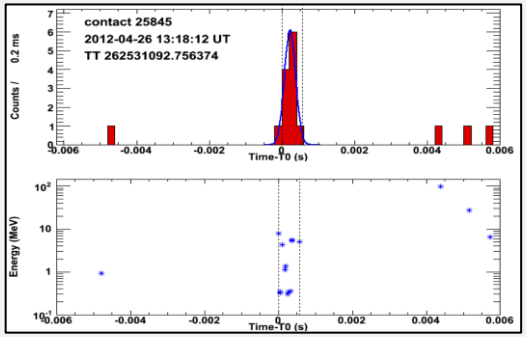


search algorithm - off line quest for TGFs

TGF profile

dat: 12/04/2015
ti ne: 12:11:44
g eo: 23.74° -2.01°
E(max) = 6.70 MeV





1

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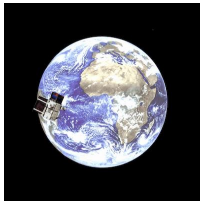

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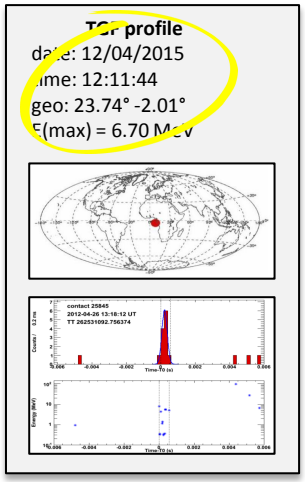
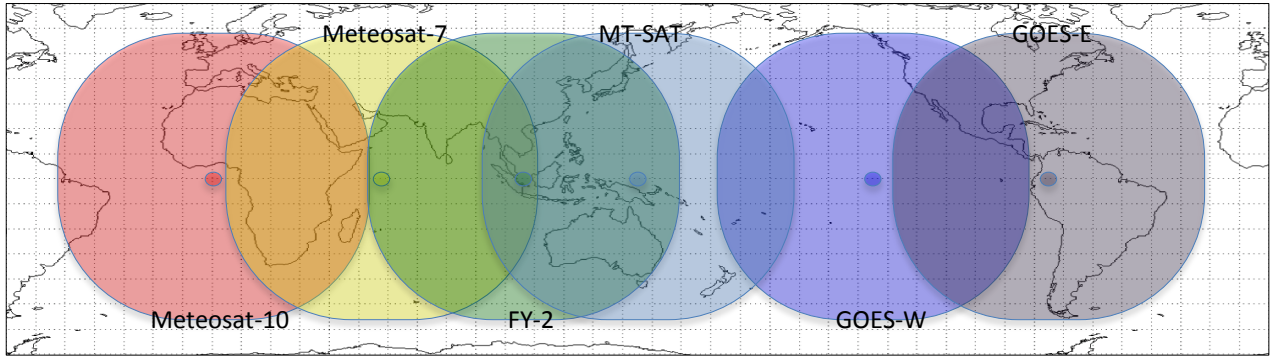
off line quest for TGFs



2



CNR antenna data buffer – 5 days meteo data from geostat. satellites

longitude	satellite	Δt
-60° ÷ 60°	Meteosat 10	15'
0° ÷ 120°	Meteosat 7	15'
50° ÷ 170°	Feng Yun 2	30'
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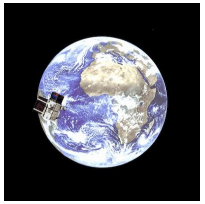

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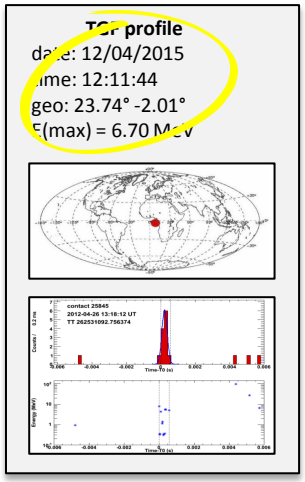

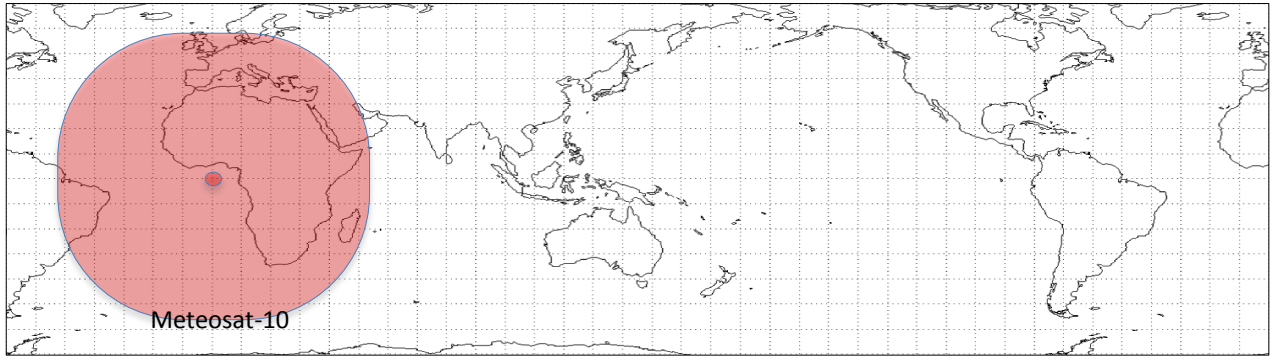

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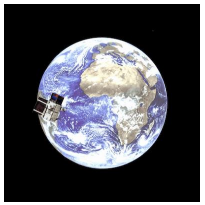

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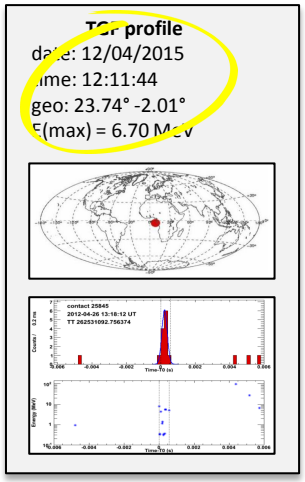

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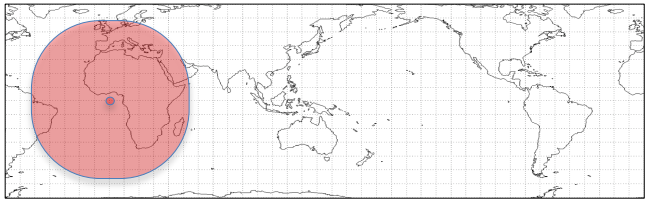
meteo data from CNR antenna



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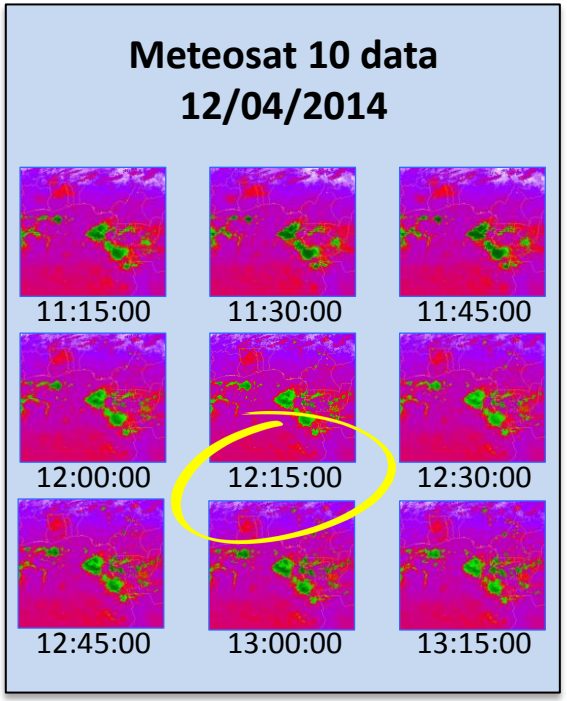

search for the nearest images in time

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How does it work?

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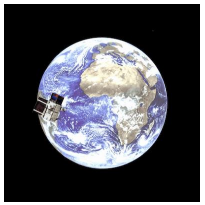

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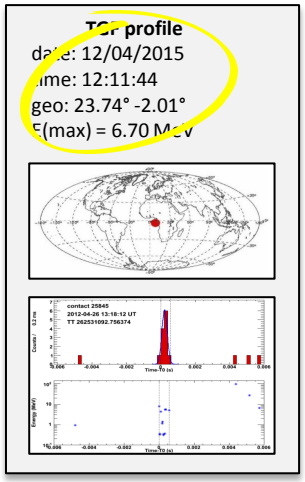
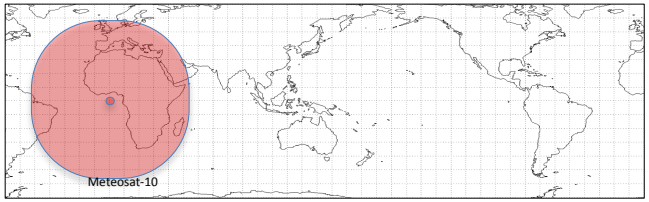


2

meteo data from CNR antenna



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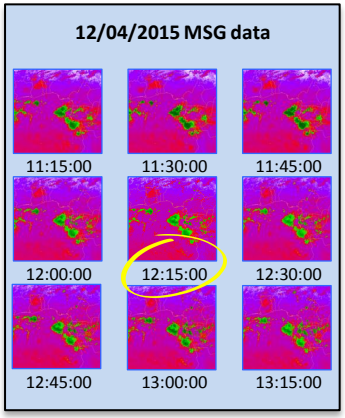

4

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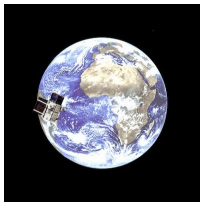

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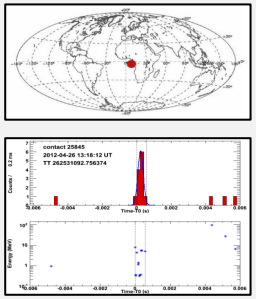
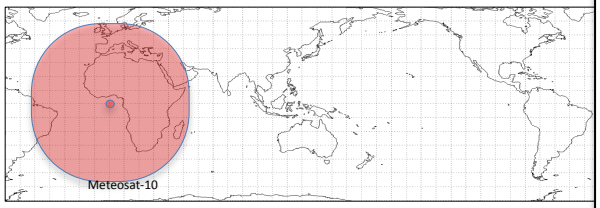


2

meteo data from CNR antenna



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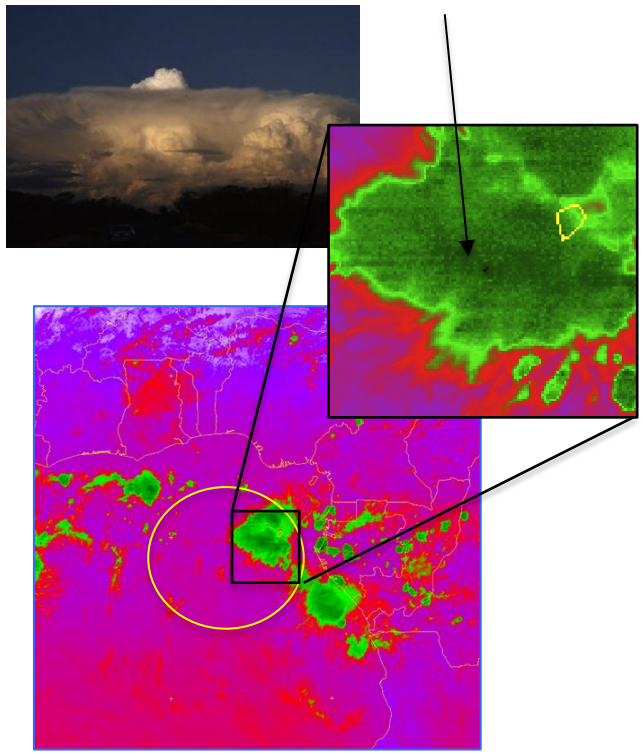
overshooting top



4

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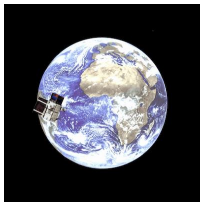
A real time pipeline to link meteorological data to TGFs detected by AGILE

13th AGILE Science Workshop "AGILE: 8 and counting", May 26th 2015

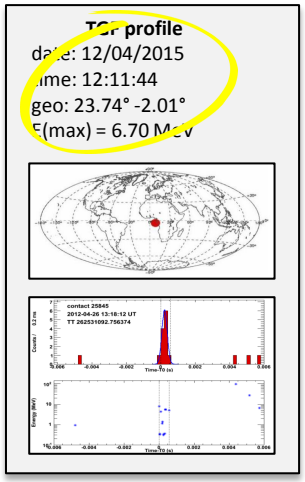
How does it work?

new data every ~ 90'



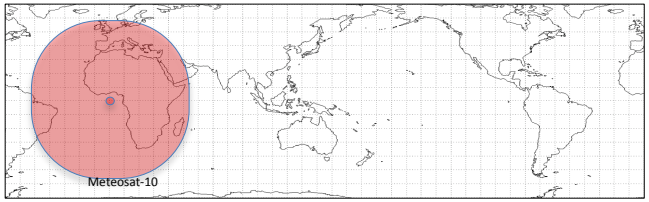
1

off line quest for TGFs



2

meteo data from CNR antenna



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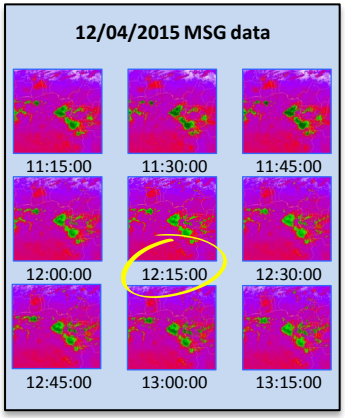
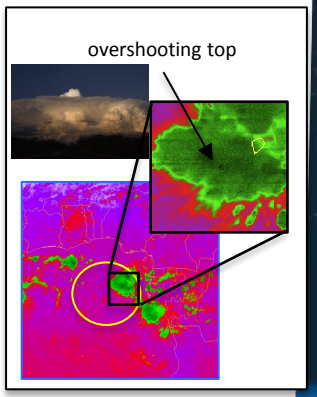
3

search for the nearest images



4

final product



5

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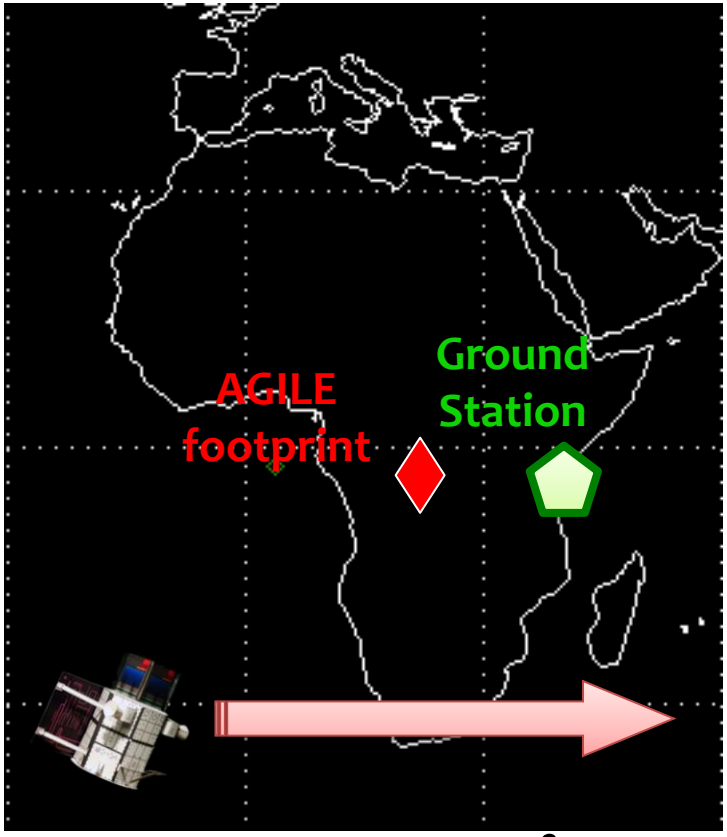
"AFAP" meteo correlation



~ 19°

~ 5 mins

TGF 20150522 (few days ago...)

orbit: 041759

UTC: 16:13:50

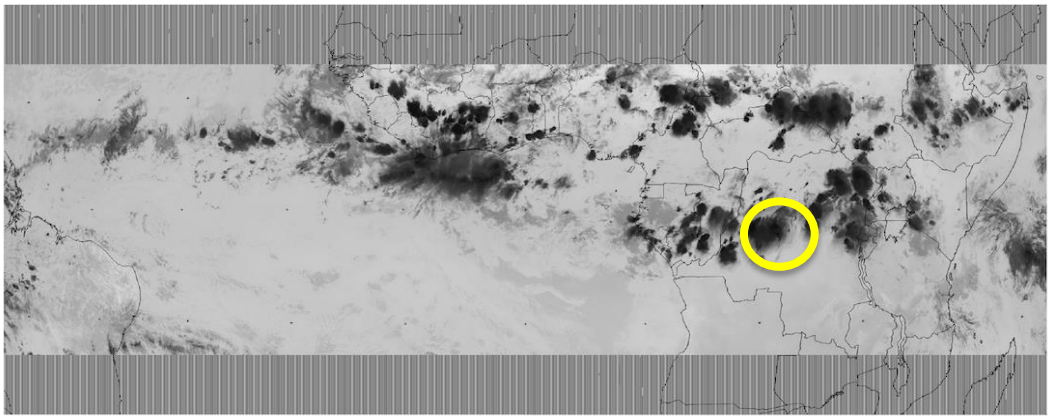
geo: 21.55°, -2.40°

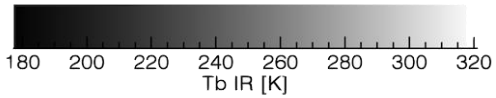
Info on timing

time (event)	16:13:50
time (data packet)	17:12:00
time (MSG3)	16:15:00
time (TOTAL)	17:20:00

Some examples: real time correlation

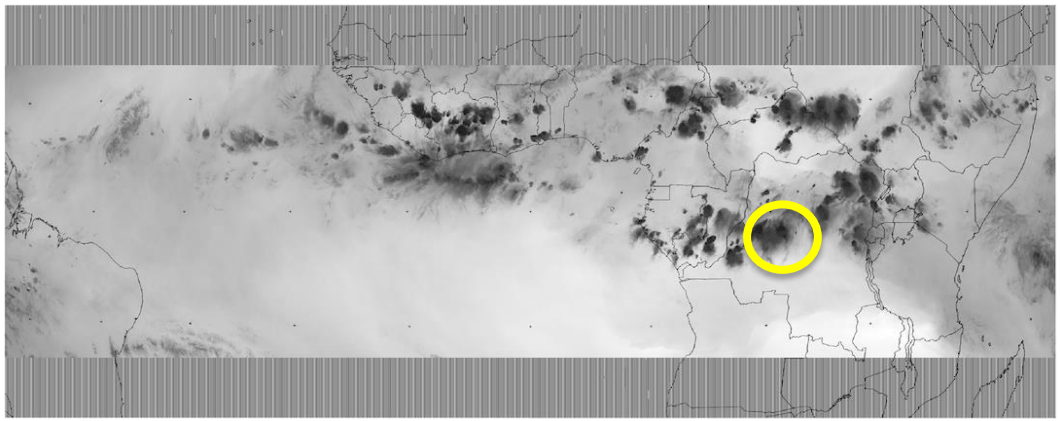
22/05/2015 16:15

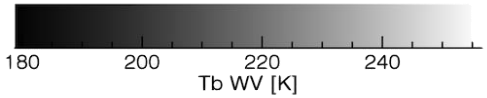




IR channel

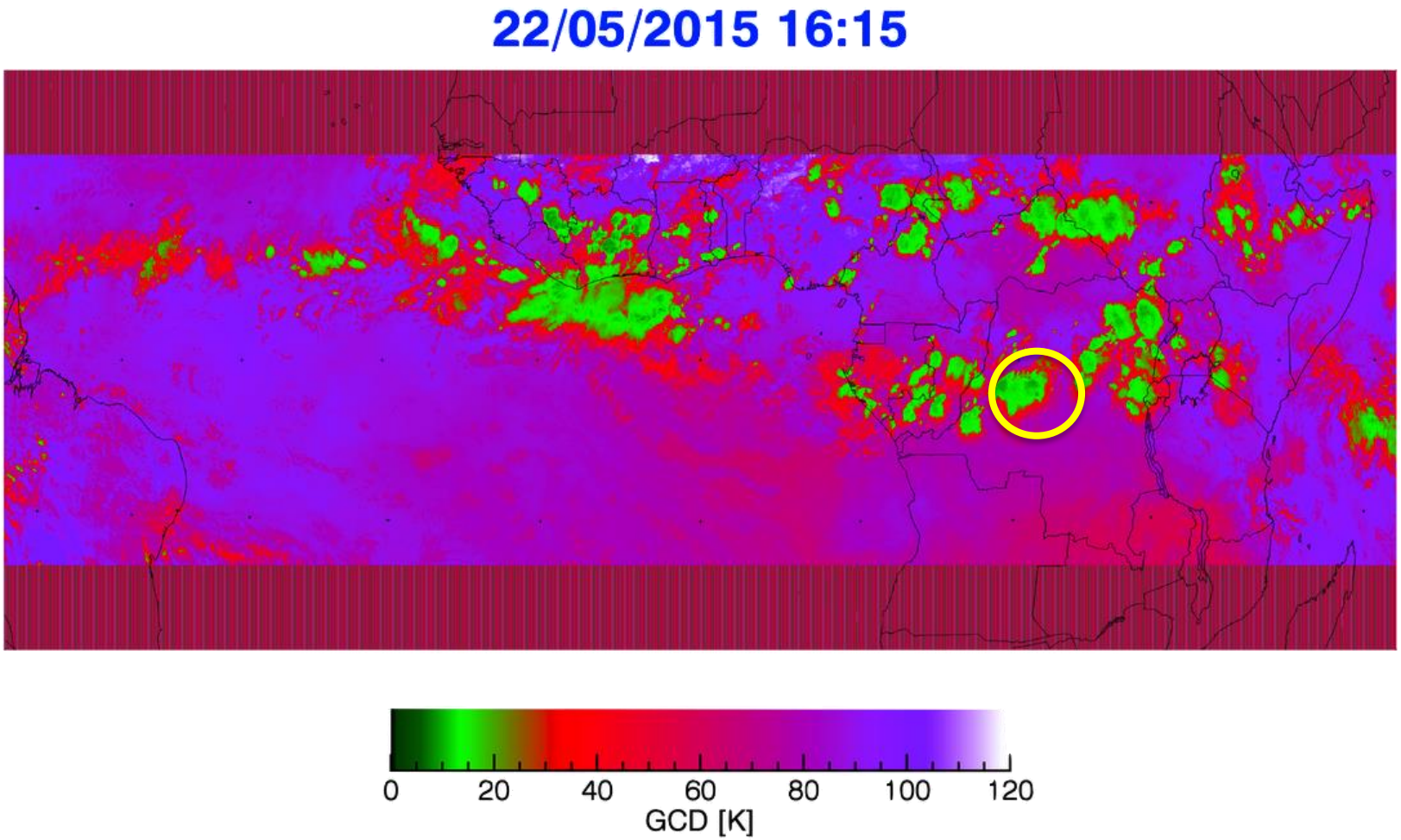
22/05/2015 16:15





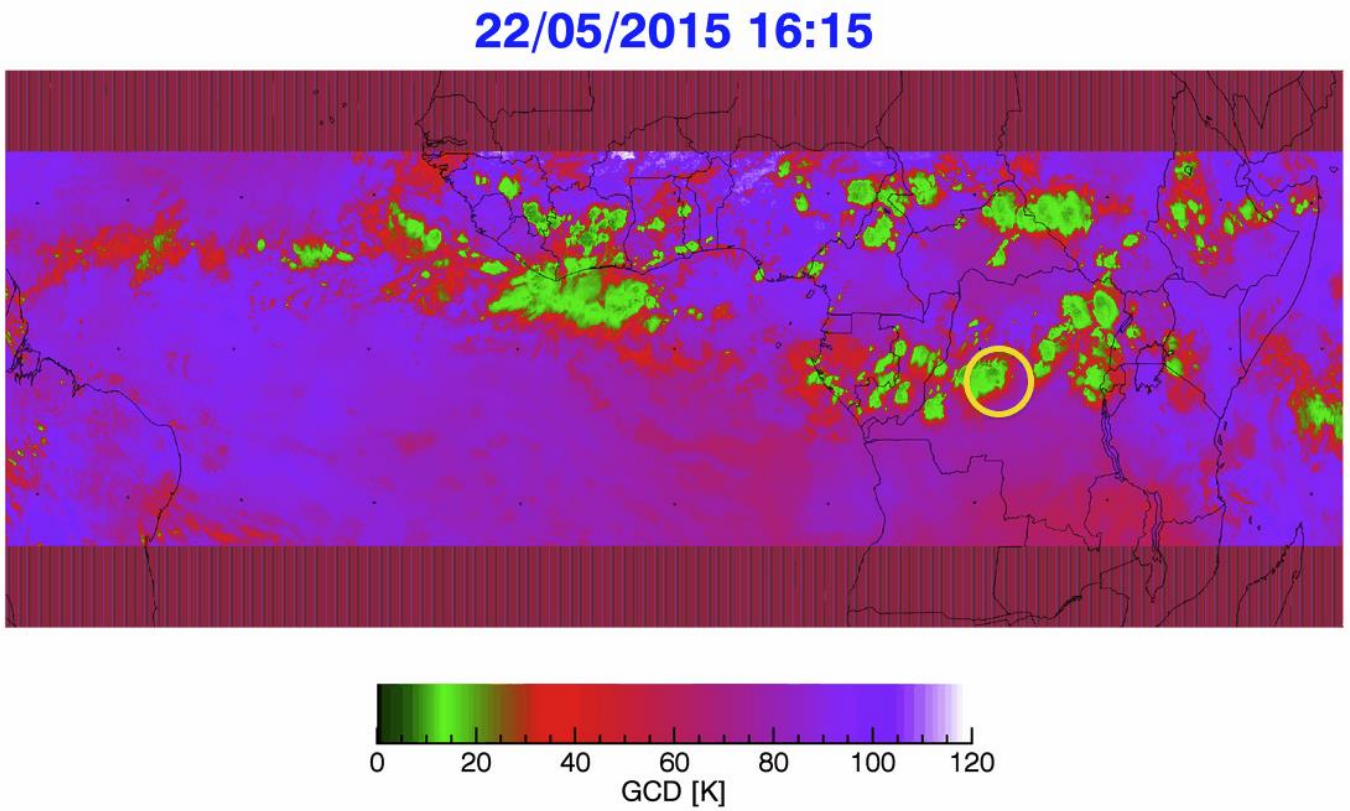
WV channel

Some examples: real time correlation



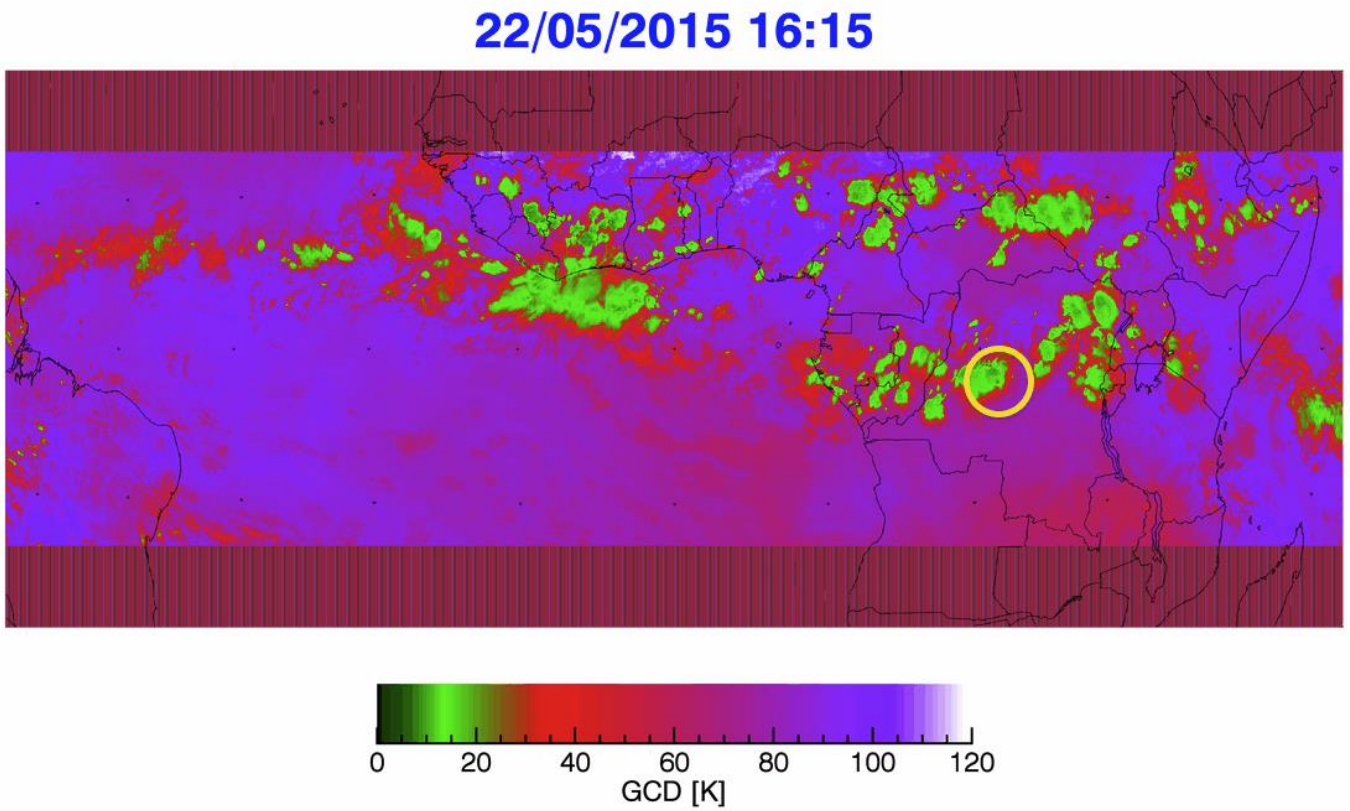
Some examples: real time correlation

16:15 → 17:45

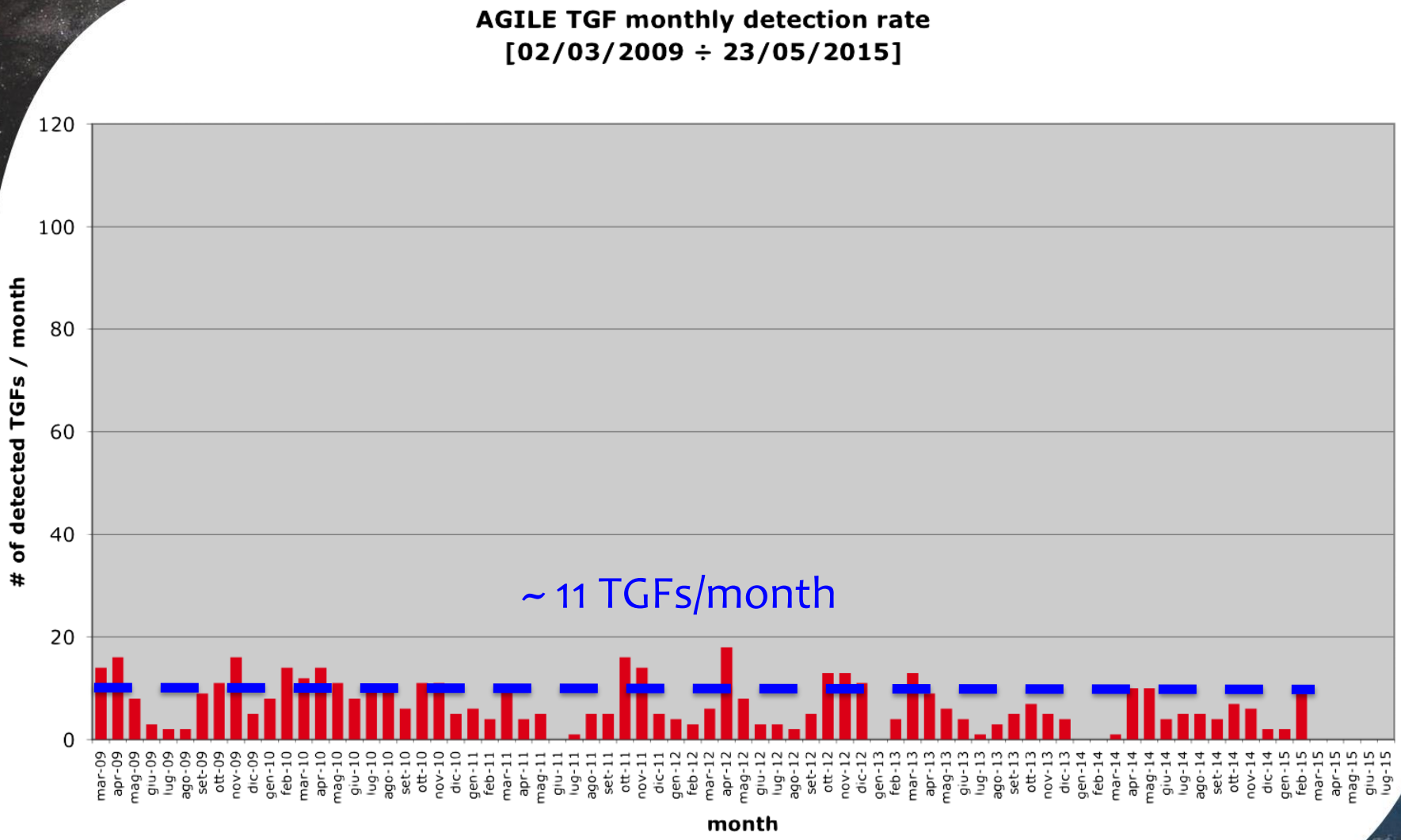


Some examples: real time correlation

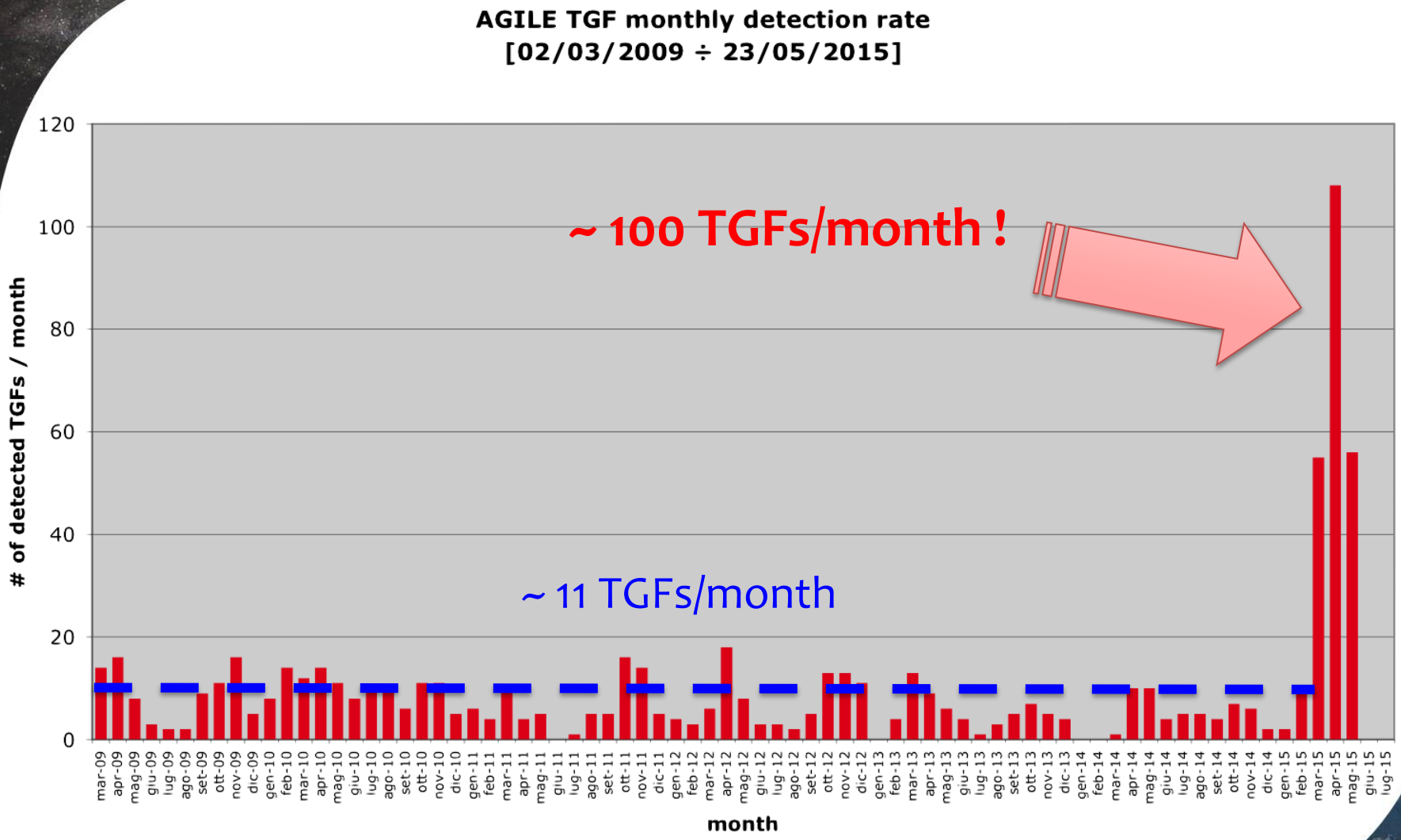
15:00 ← 16:15



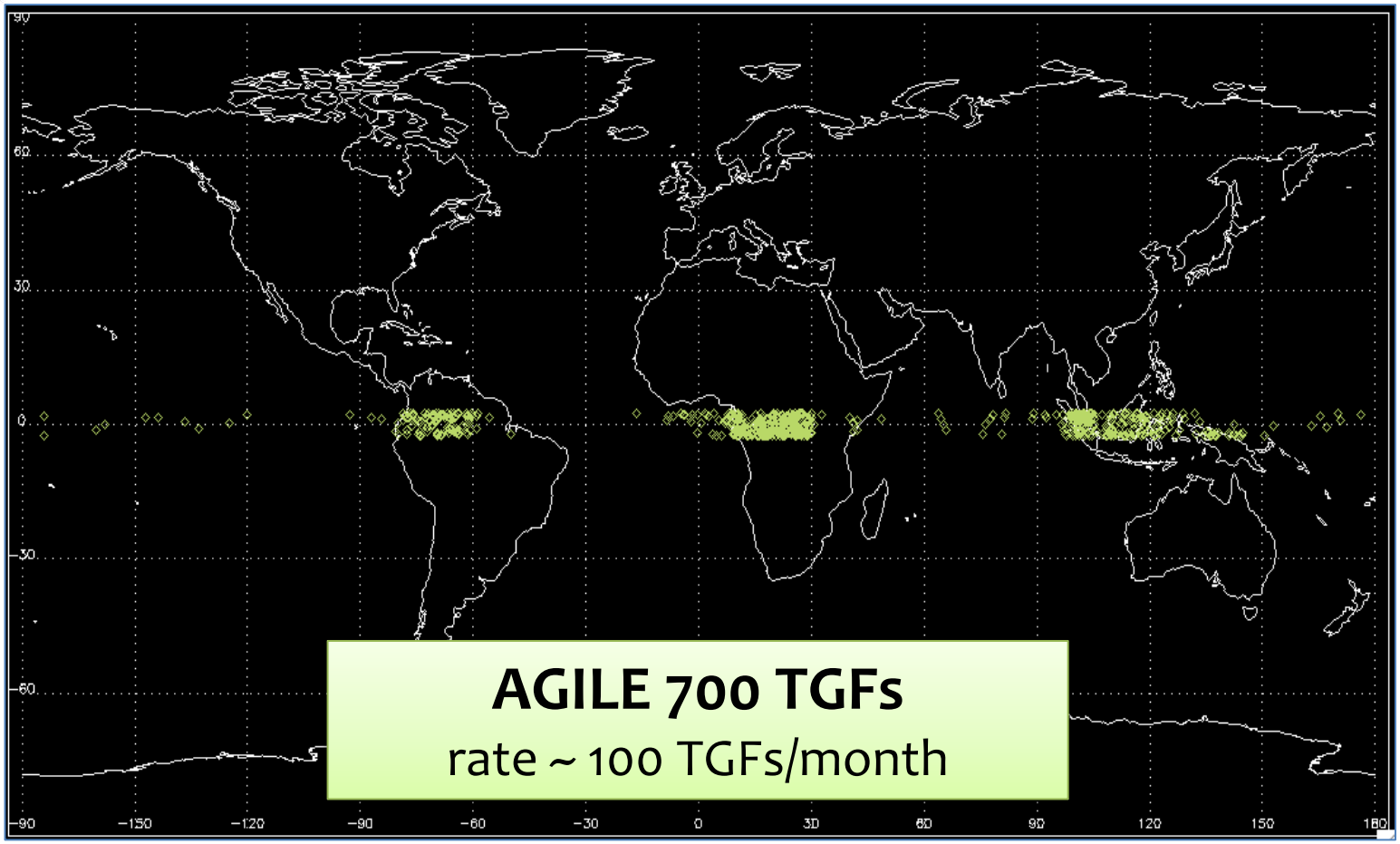
AGILE new TGF detection rate



AGILE new TGF detection rate



AGILE new TGF detection rate



AGILE new TGF detection rate

we expect to reach
1000 TGFs in ~ 3 months!

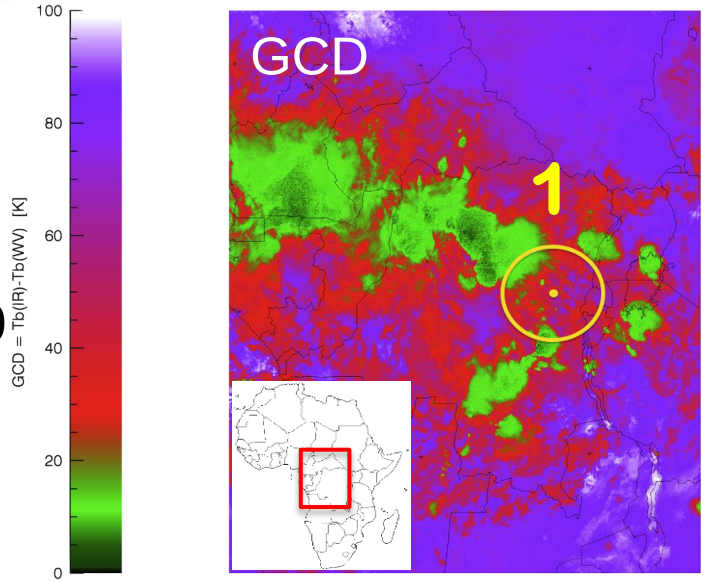
AGILE new TGF detection rate

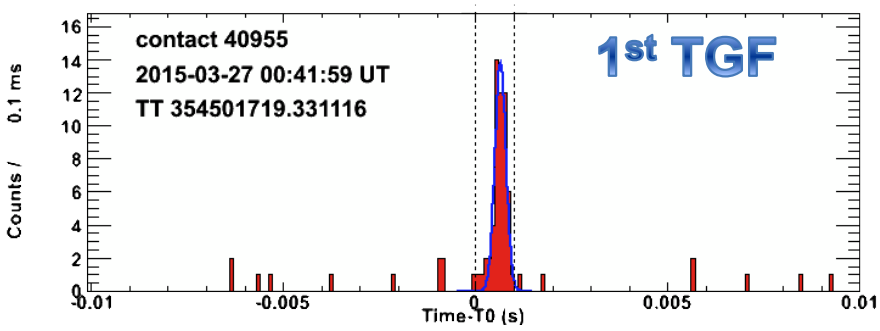
# TGF	dd-mm-yyyy	hh:mm:ss	lon (deg)	lat (deg)	Δt (hh:mm:ss)	Δlon (deg)
…	…	…	…	…		
562	8-04-2015	13:56:21	21,01	-1,70	**0:00:08**	**0,45**
563	8-04-2015	13:56:29	21,46	-1,72		
…	…	…	…	…		
583	13-04-2015	12:06:36	99,78	-1,65	**0:00:17**	**1,00**
584	13-04-2015	12:06:53	100,78	-1,62		
…	…	…	…	…		
606	19-04-2015	15:46:41	10,53	-0,95	**0:00:21**	**1,23**
607	19-04-2015	15:47:02	11,76	-0,90	**0:02:02**	**7,25**
608	19-04-2015	15:49:04	19,01	-0,58	**0:00:42**	**2,52**
609	19-04-2015	15:49:46	21,53	-0,46		
…	…	…	…	…		
…	…	…	…	…		
517	27-03-2015	0:41:59	27,47	-2,41	**1:40:05**	**-3,18**
518	27-03-2015	2:22:04	24,29	-2,02		
…	…	…	…	…		
585	13-04-2015	17:09:11	98,51	1,39	**0:00:43**	**2,60**
586	13-04-2015	17:09:54	101,11	1,48	**1:39:47**	**-4,32**
587	13-04-2015	18:49:41	96,79	2,10		

Some examples: "multiple" TGFs

Example 1

UTC
00:42:40

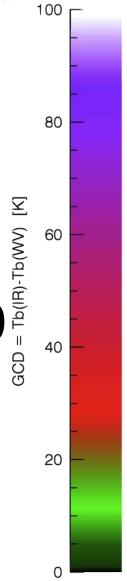


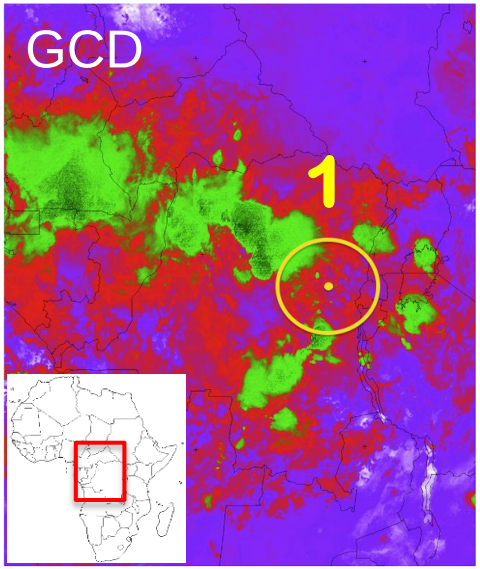


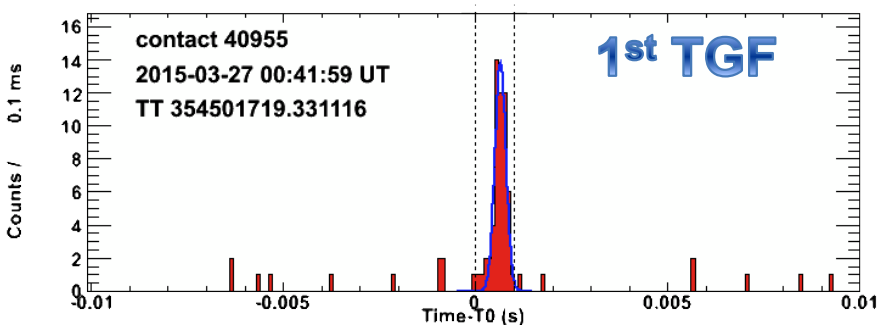
Some examples: "multiple" TGFs

Example 1

UTC 00:42:40

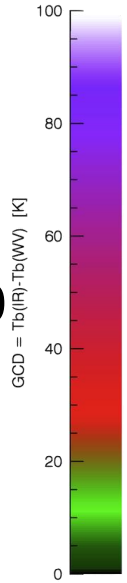


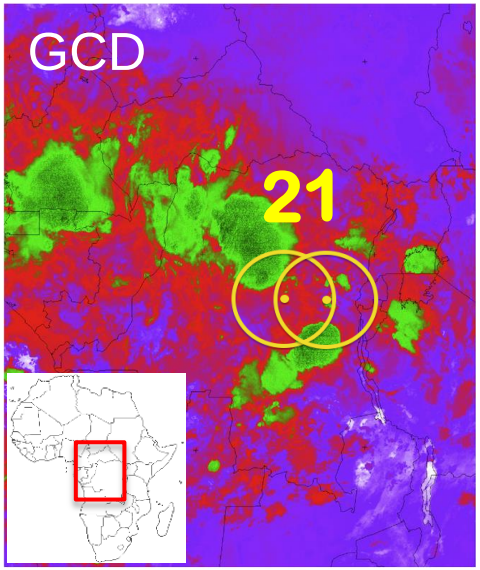


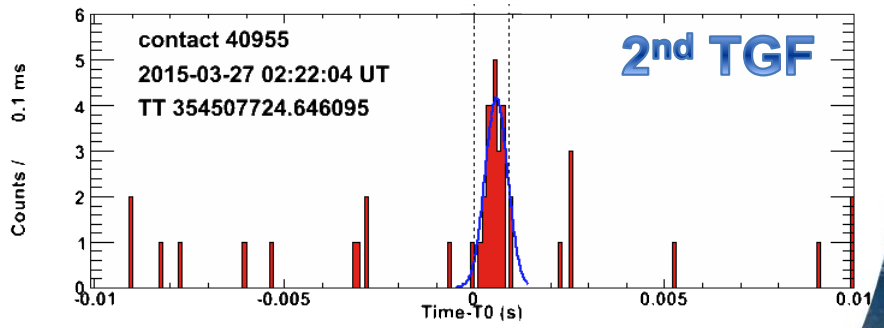


1 orbit

UTC 02:27:40



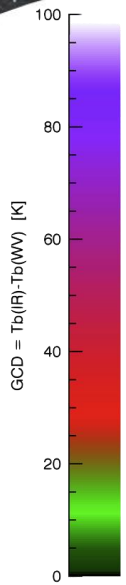


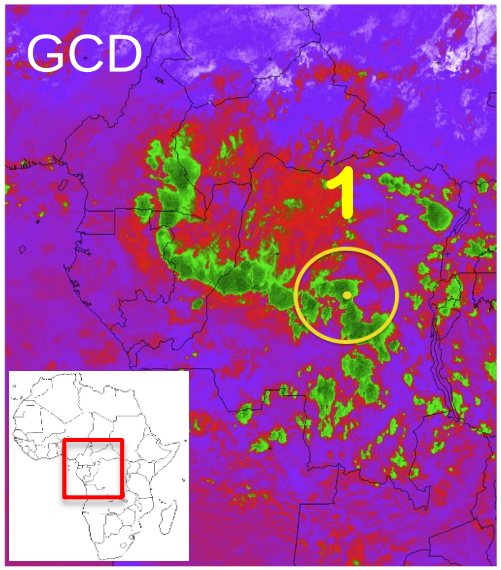


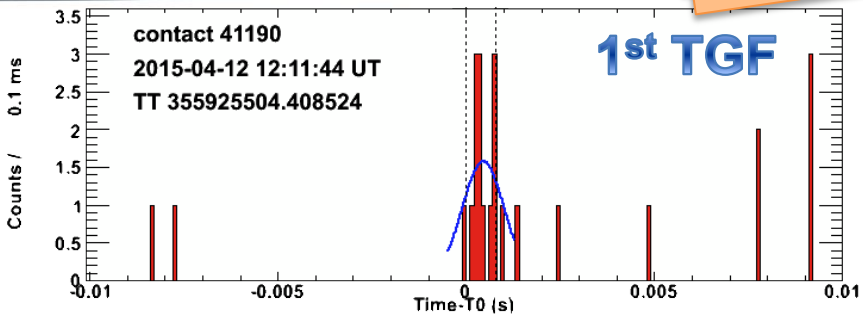
Some examples: "multiple" TGFs

Example 2

UTC
12:12:40



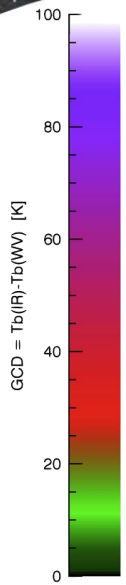


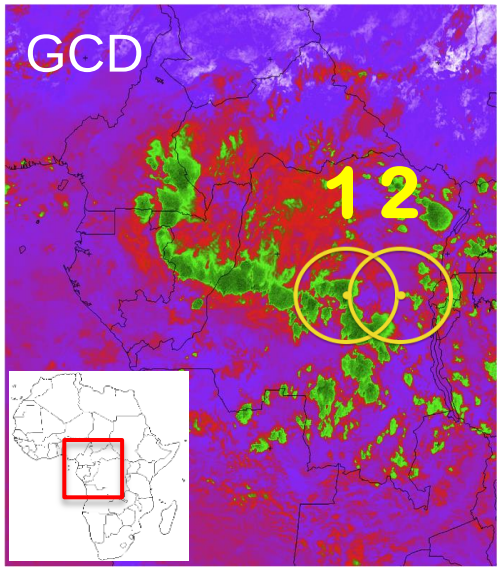


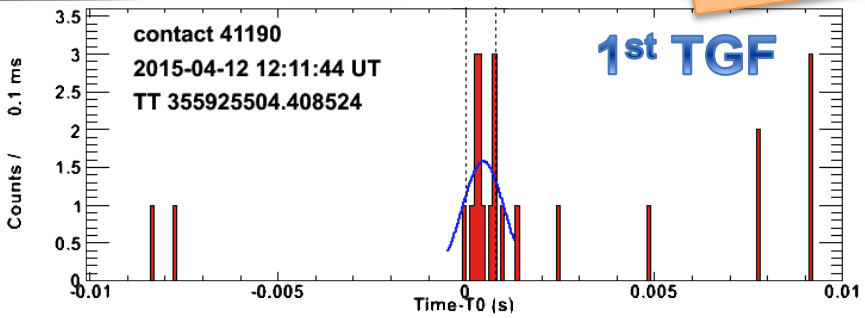
Some examples: "multiple" TGFs

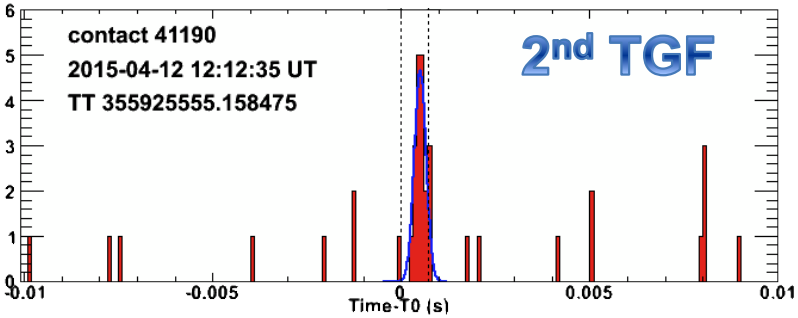
Example 2

UTC
12:12:40









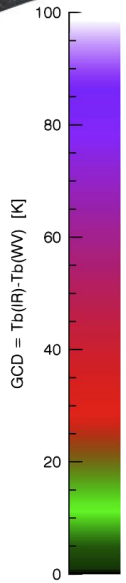
Some examples: "multiple" TGFs

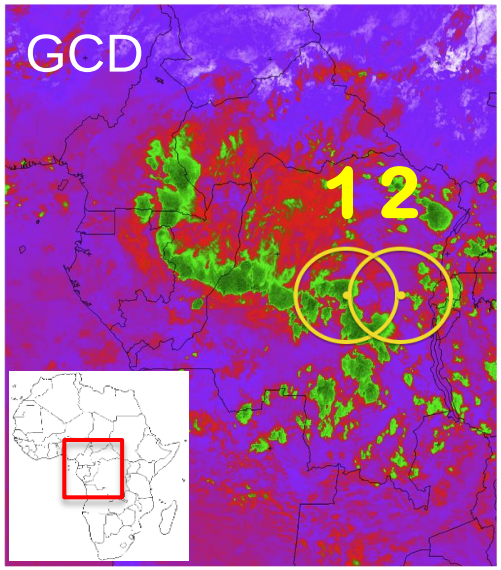
Example 2

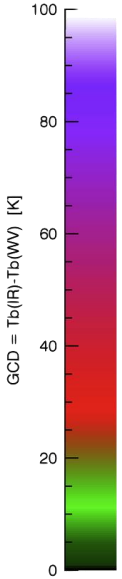
UTC 12:12:40

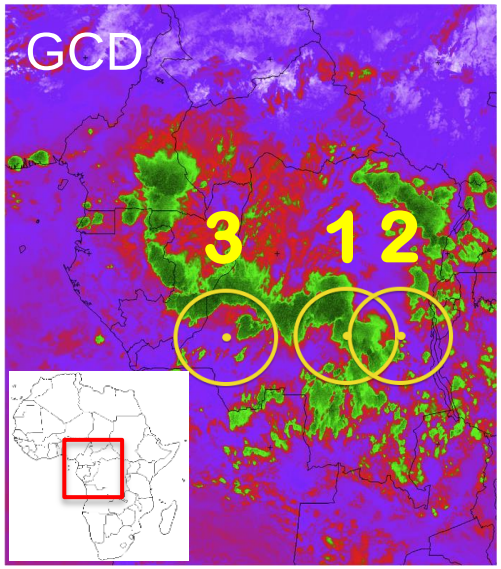
1 orbit

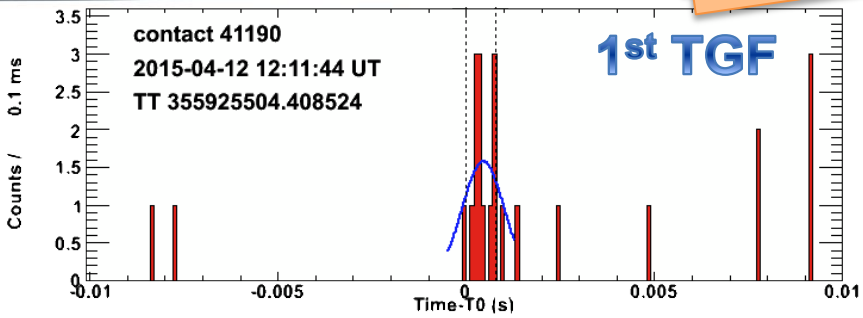
UTC 13:57:41

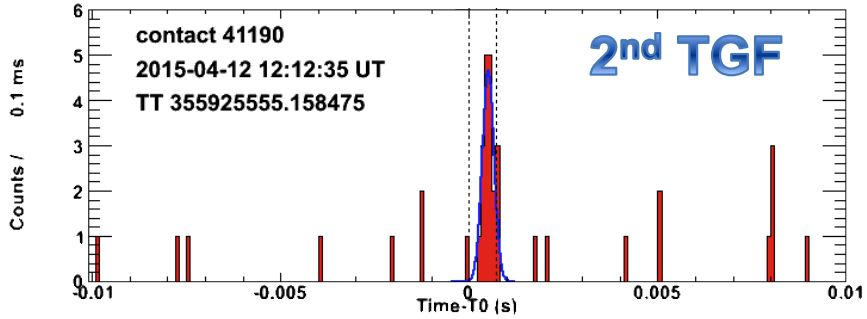


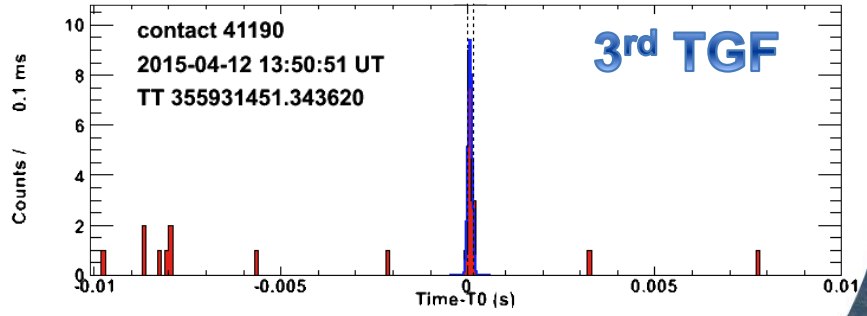








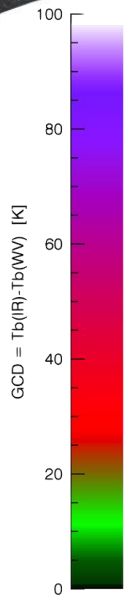


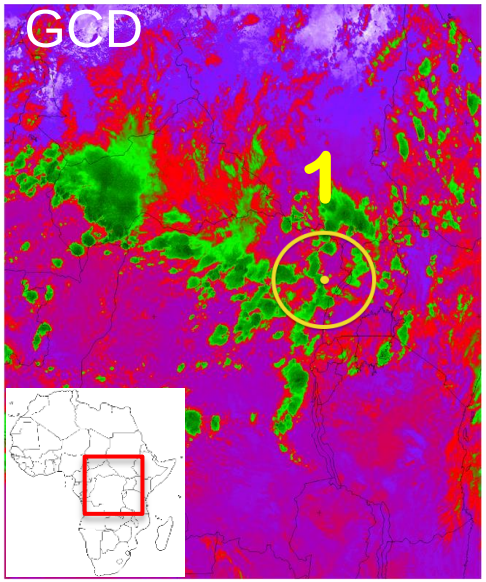


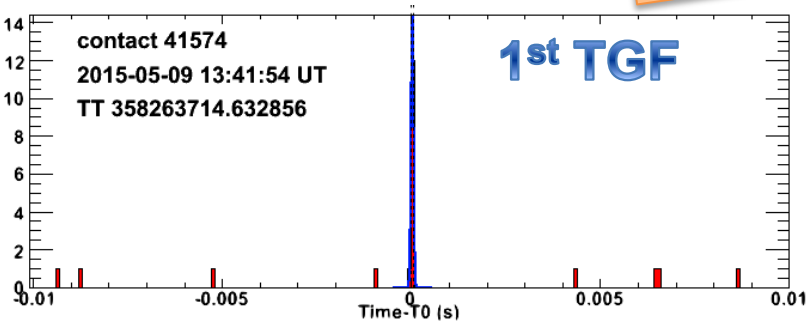
Some examples: "multiple" TGFs

Example 3

UTC
13:42:40







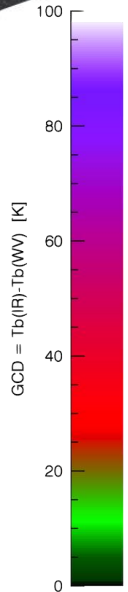
Some examples: "multiple" TGFs

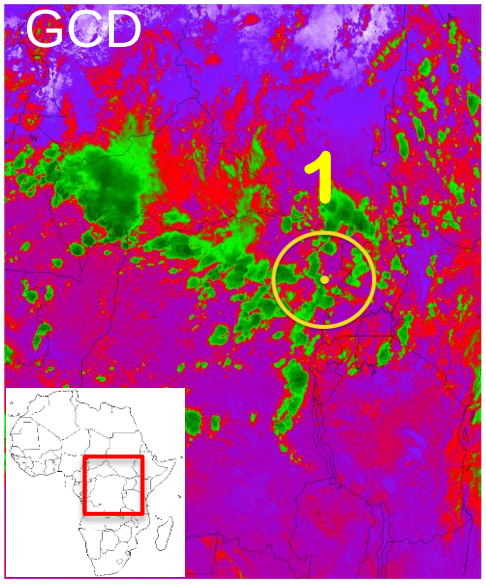
Example 3

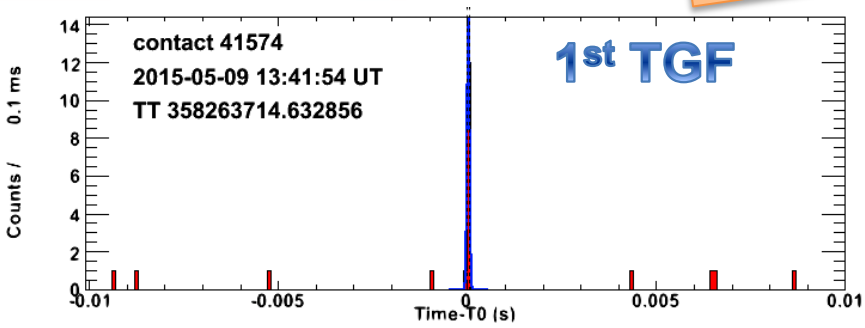
UTC
13:42:40

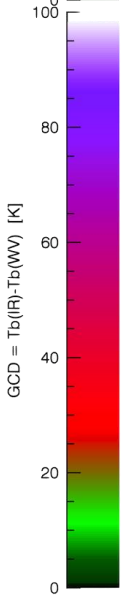
1 orbit

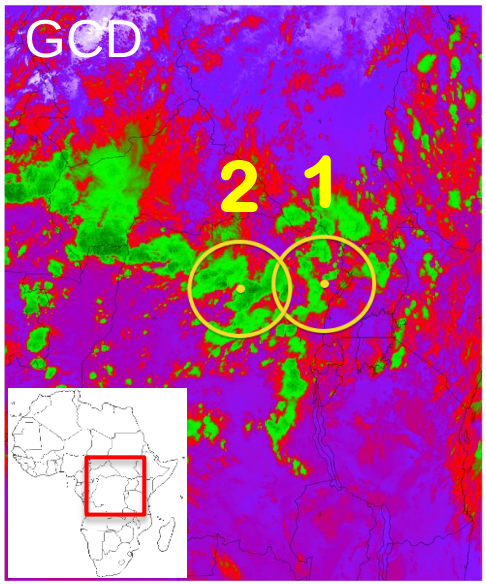
UTC
15:27:40

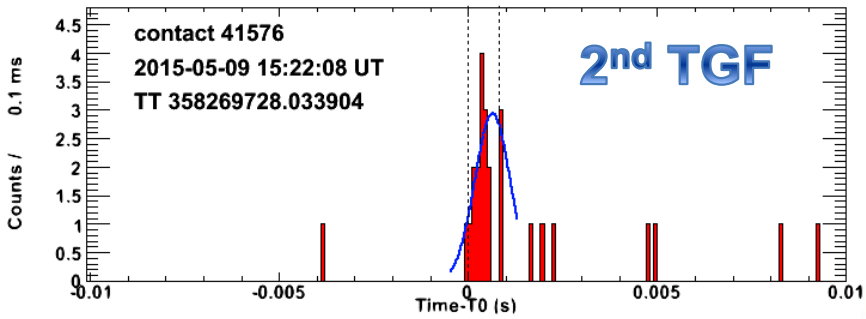








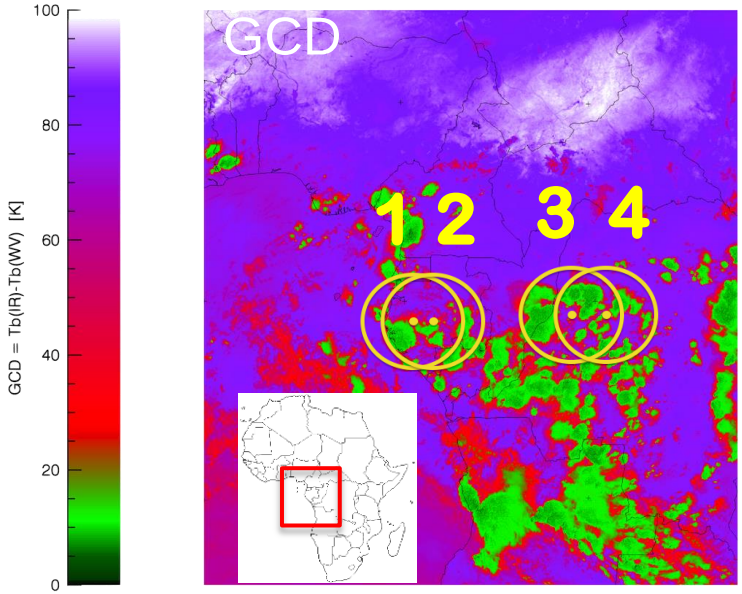


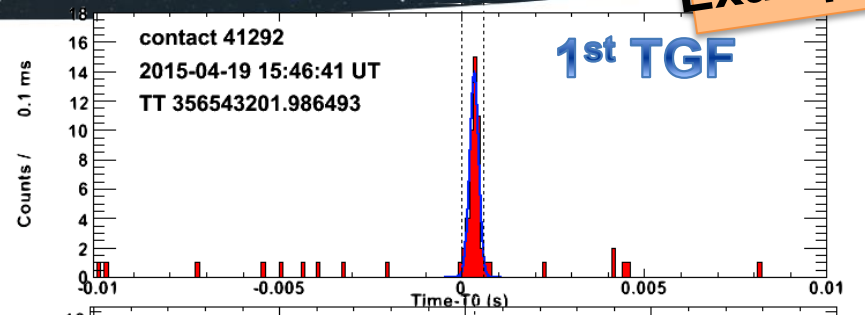


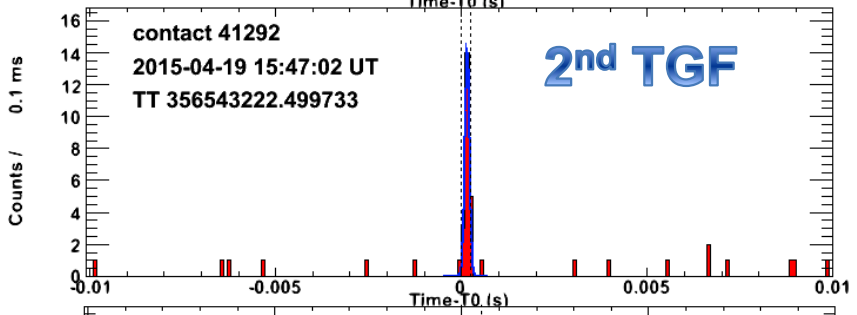
Some examples: "multiple" TGFs

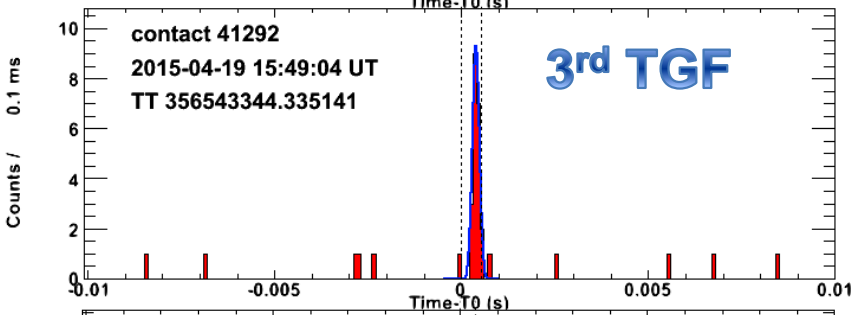
Example 4

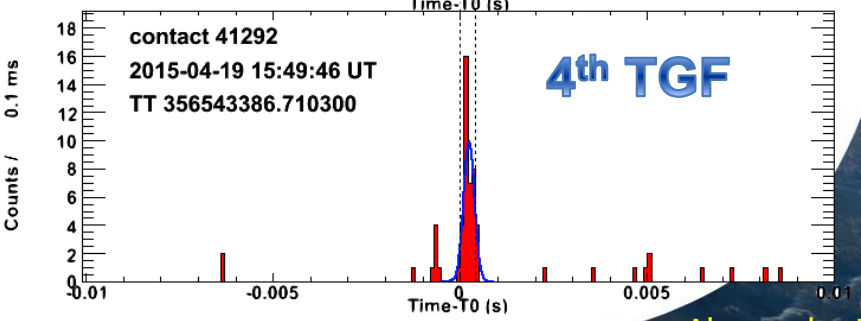
UTC
15:42:40











Conclusions and future perspectives

Conclusions:

• we can provide very fast meteorological information about the TGF-producing
thunderstorm (cloud top altitude, temperature and presence of convection)
• we have now a meteorological data buffer continuously downloading data by
geostationary satellites with a global equatorial coverage

Future perspectives:

• improve the pipeline and the TGF-meteo algorithm
• exploit data by polar satellites (TRMM, GPM, ...)
• study meteorological historical data to better characterize the TGF-producing
thunderstorms

Alessandro Ursi
A real time pipeline to link meteorological data to TGFs detected by AGILE
13th AGILE Science Workshop "AGILE: 8 and counting", May 26th 2015