

15th AGILE Science Workshop – ASI, Rome



# TGF and AGILE: an update

Alessandro Ursi  
(INAF-IAPS, Rome)

on behalf of the AGILE team

# The new AGILE TGF population

02 March 2009 → 23 March 2015 → 23 May 2017



# The new AGILE TGF population

02 March 2009 → 23 March 2015 → 23 May 2017

standard  
configuration

498 TGFs

# The new AGILE TGF population

02 March 2009 → 23 March 2015 → 23 May 2017

standard  
configuration

498 TGFs

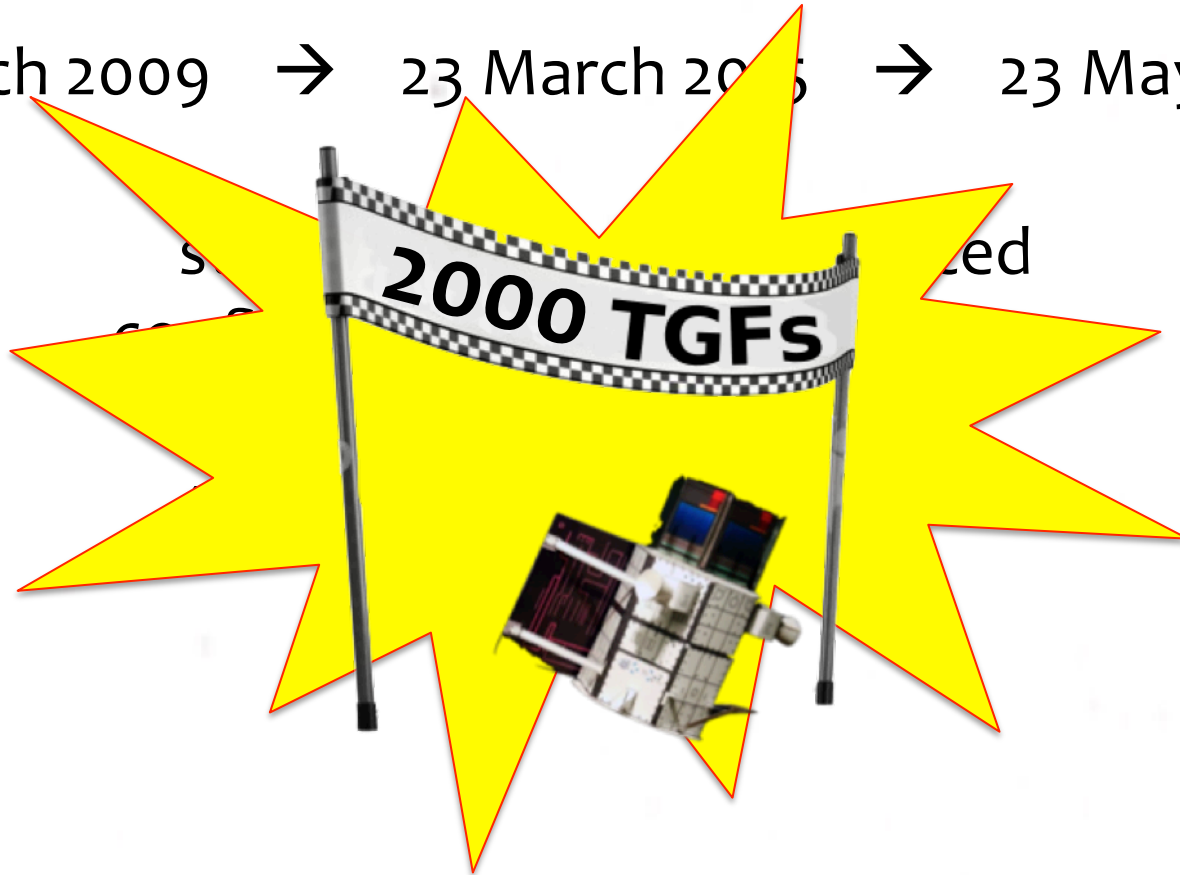
enhanced  
configuration

1500 TGFs

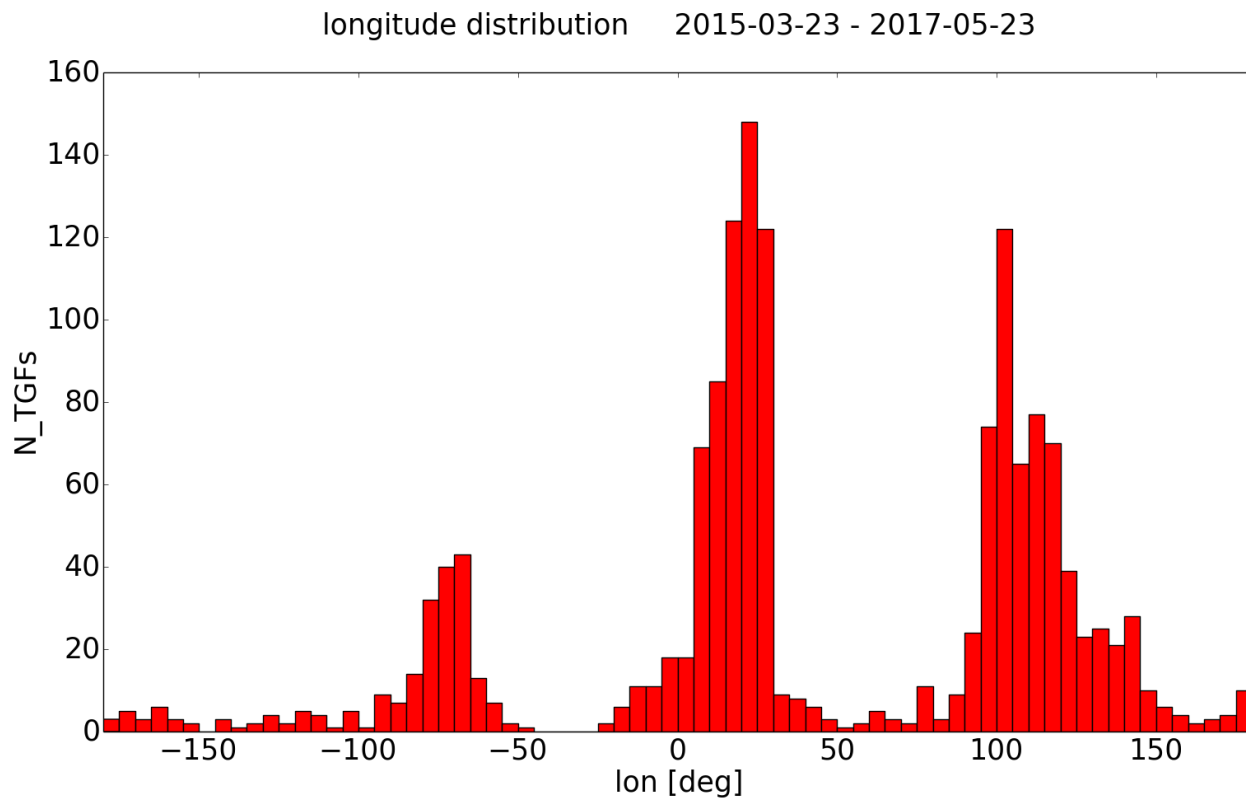


# The new AGILE TGF population

02 March 2009 → 23 March 2015 → 23 May 2017

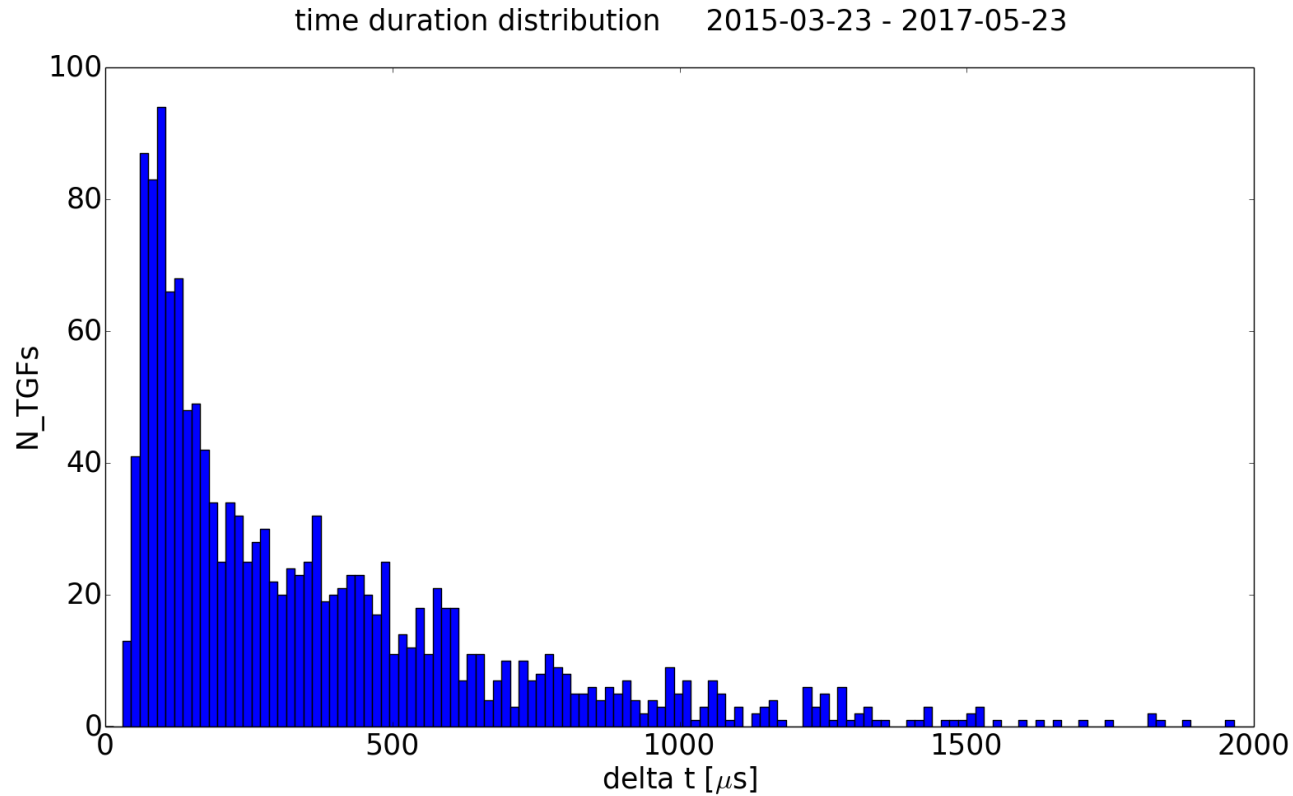


# The new AGILE TGF population

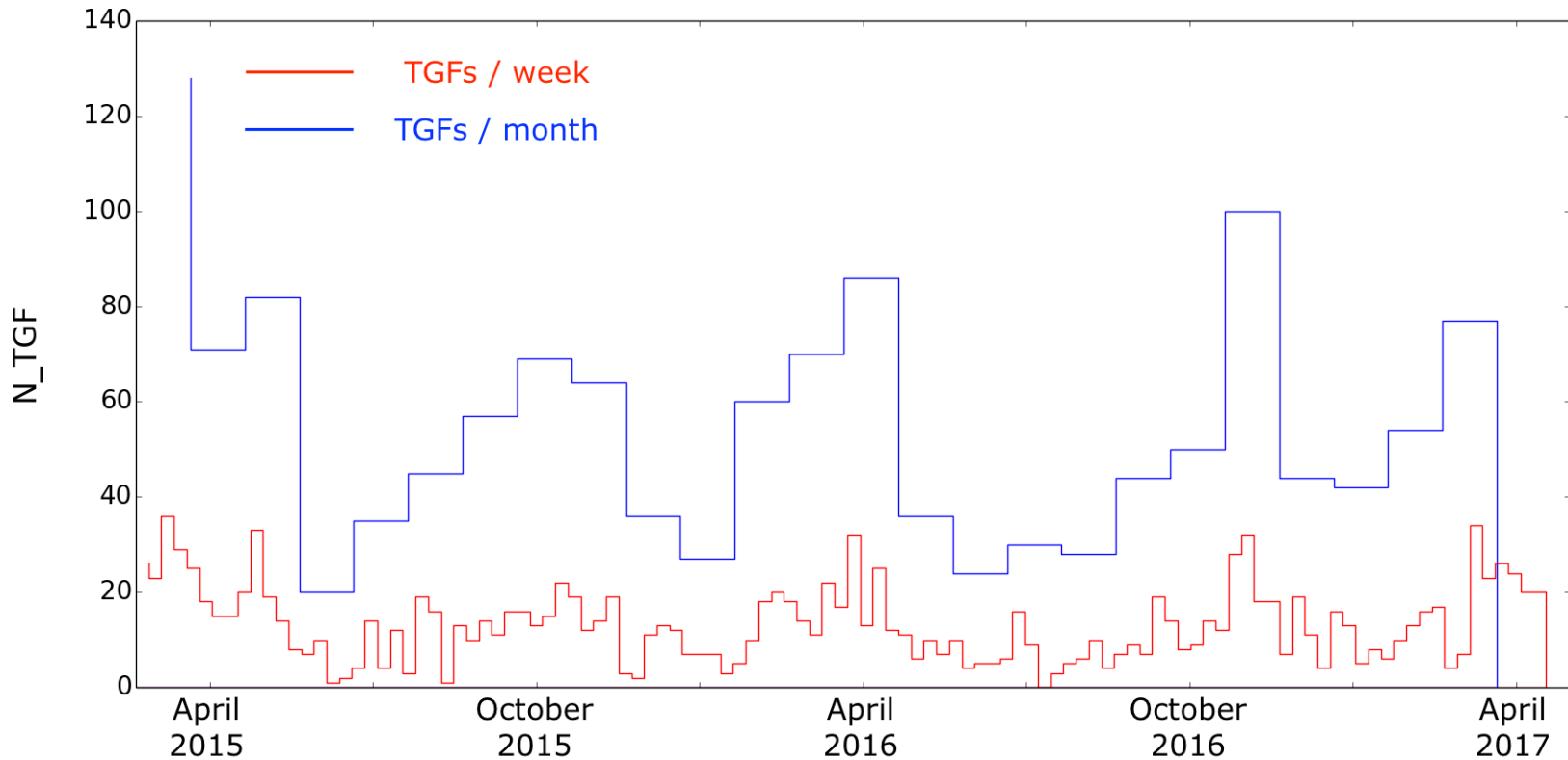




# The new AGILE TGF population

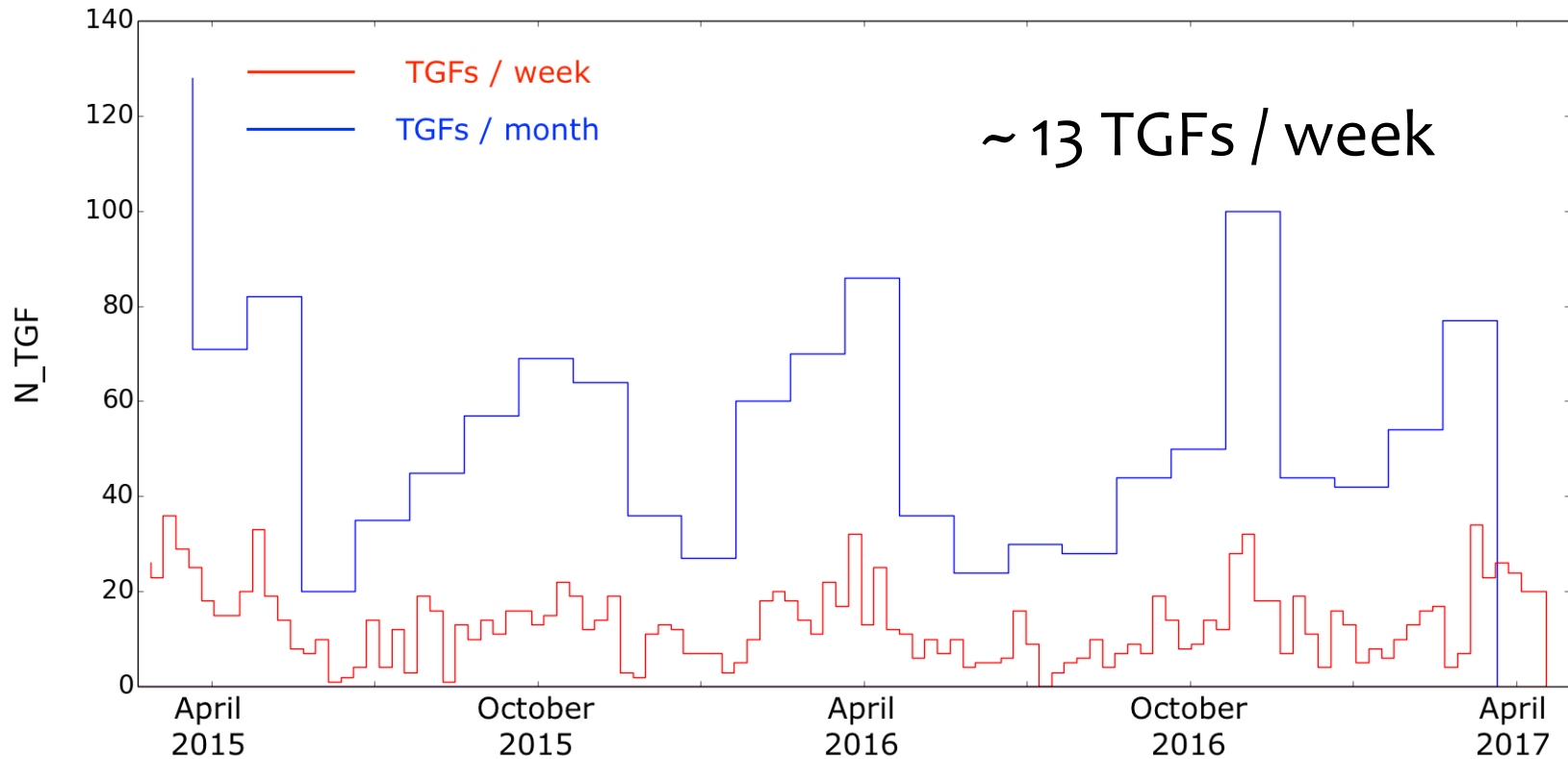


# The new AGILE TGF population



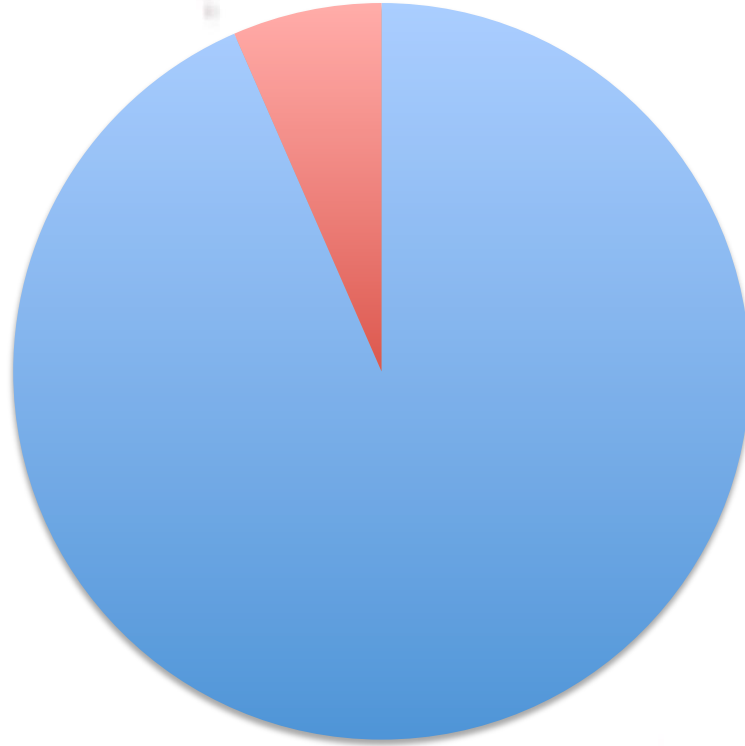


# The new AGILE TGF population



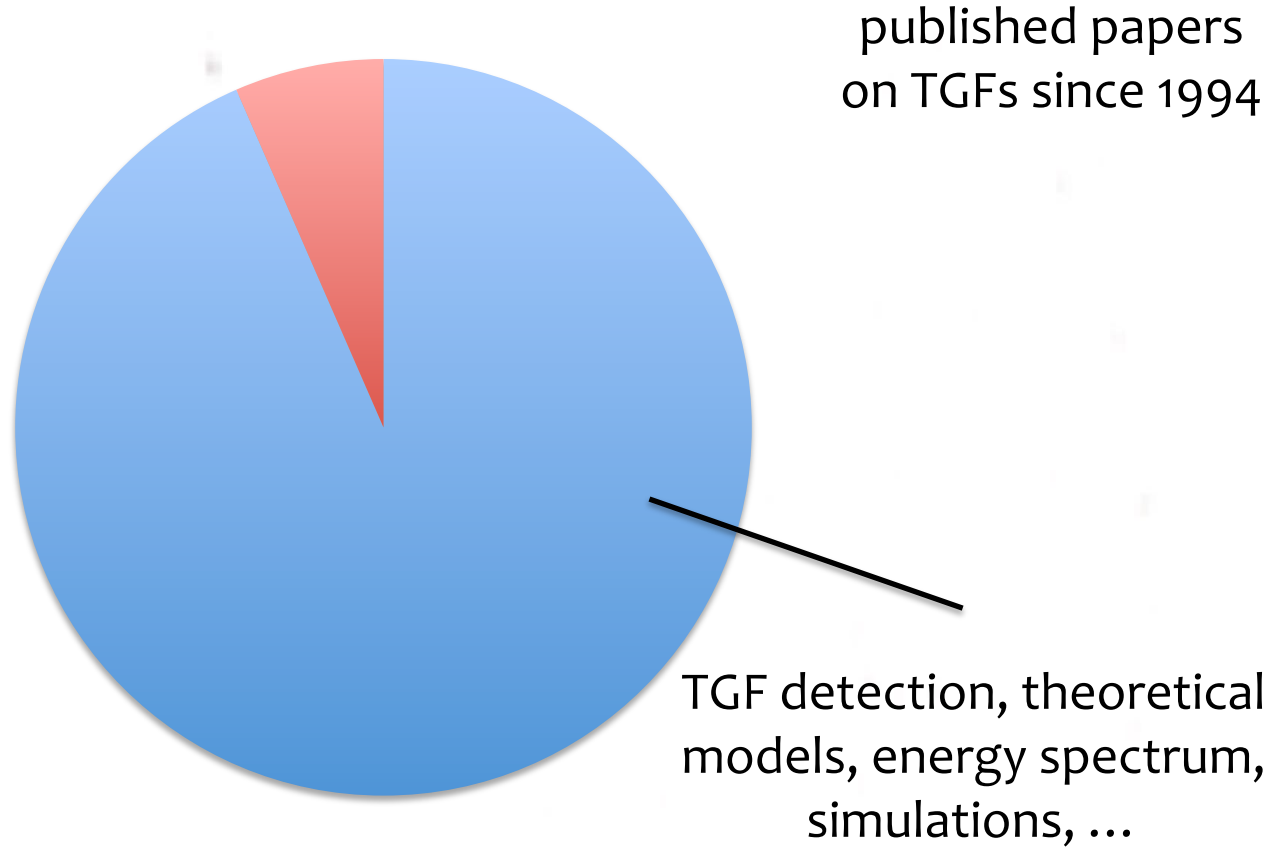
# TGFs and meteorology

published papers  
on TGFs since 1994





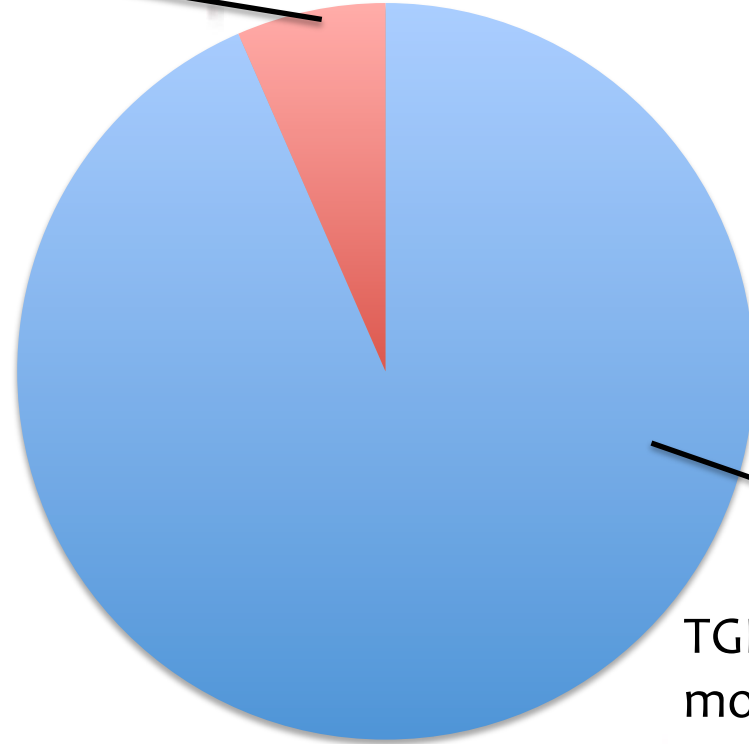
# TGFs and meteorology



# TGFs and meteorology

TGF climatology  
~ 7%

published papers  
on TGFs since 1994



TGF detection, theoretical  
models, energy spectrum,  
simulations, ...

# TGFs and meteorology

TGFs detected  
by AGILE

+

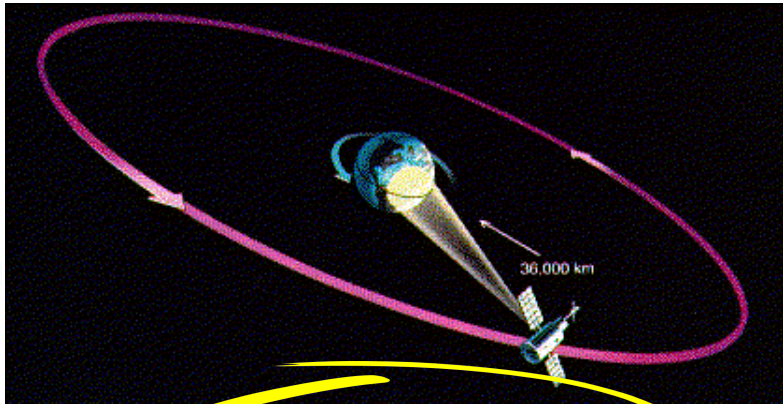
information  
by meteo satellites

# TGFs and meteorology

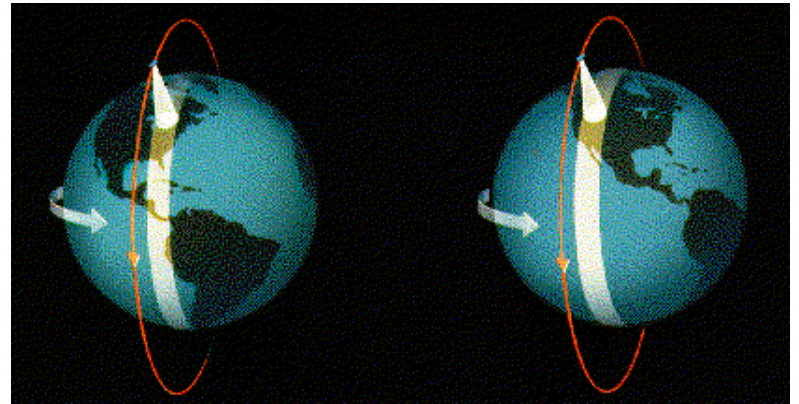
TGFs detected  
by AGILE

+

information  
by meteo satellites



geostationary satellites



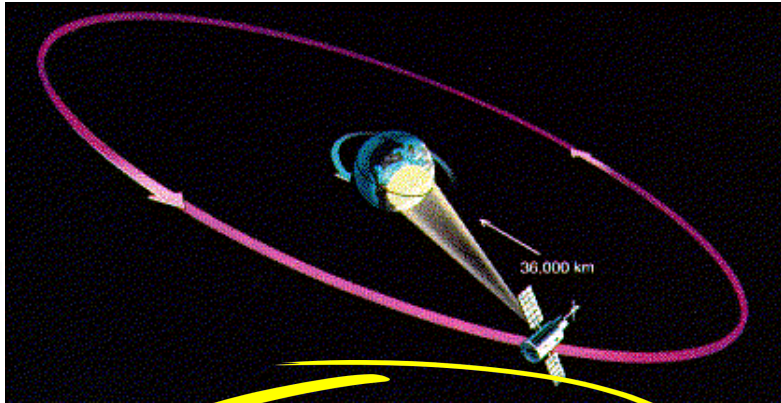
low earth orbit satellites

# TGFs and meteorology

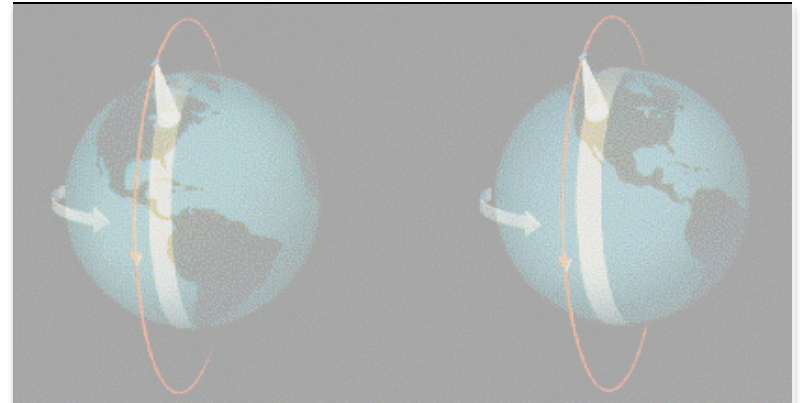
TGFs detected  
by AGILE

+

information  
by meteo satellites



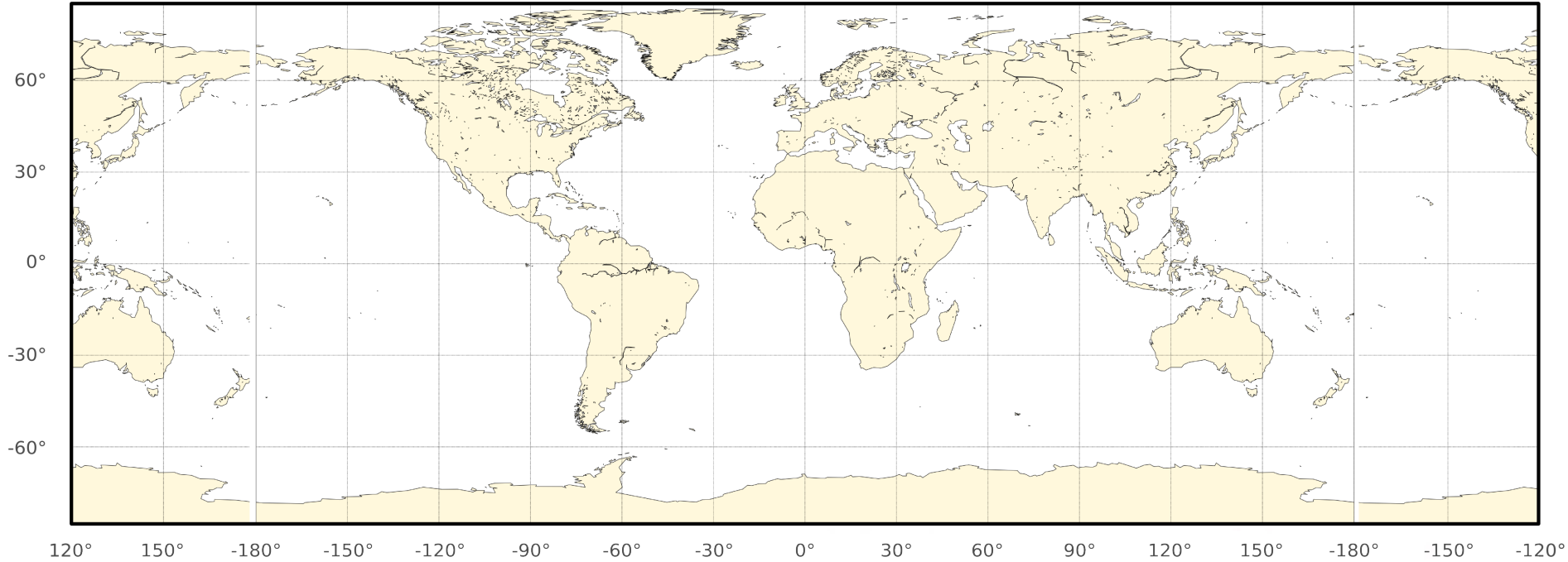
geostationary satellites



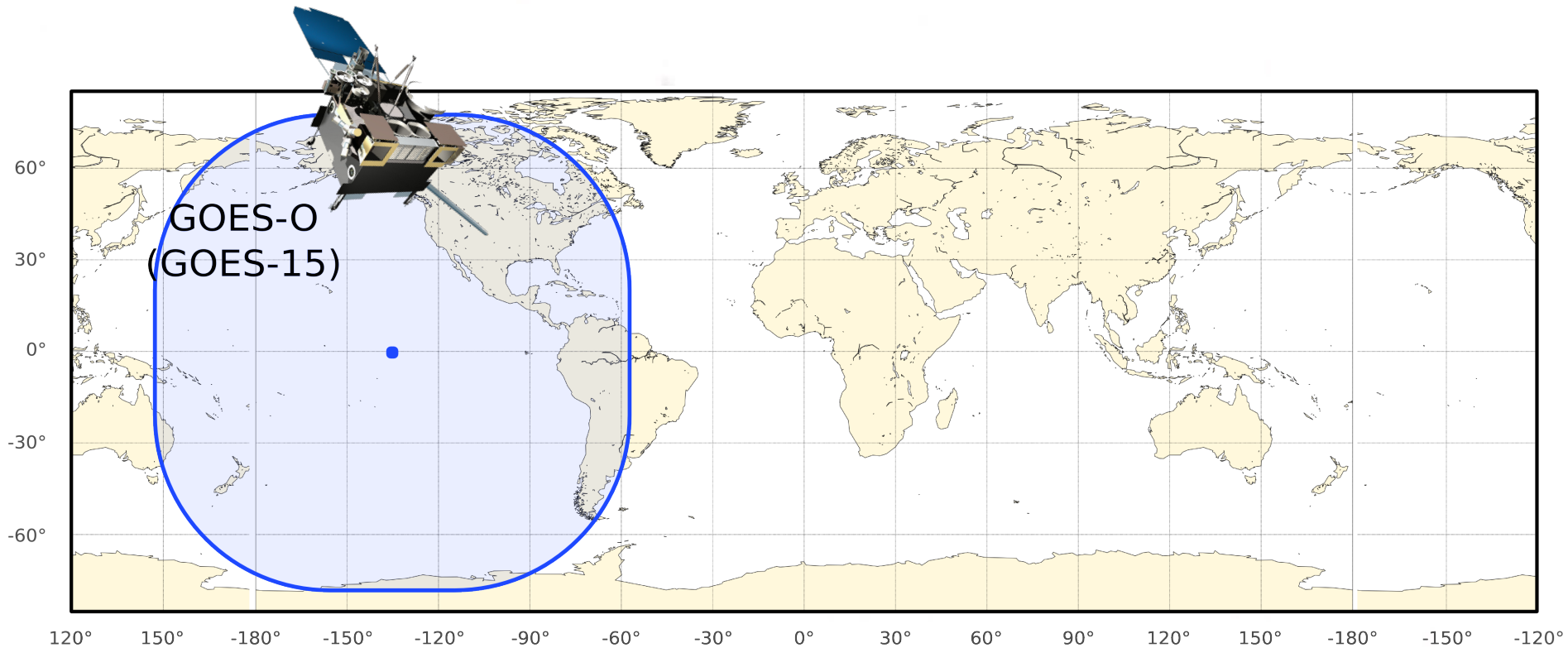
low earth orbit satellites



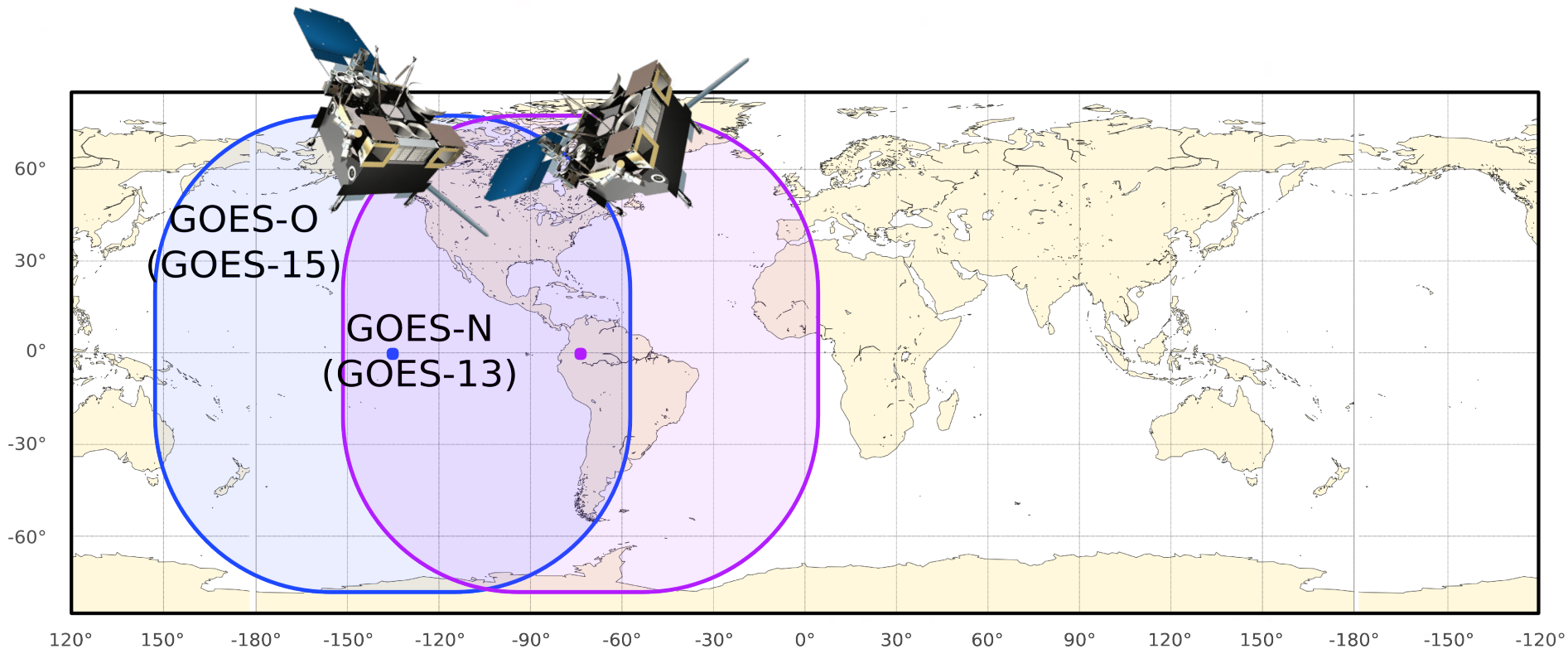
# TGFs and meteorology



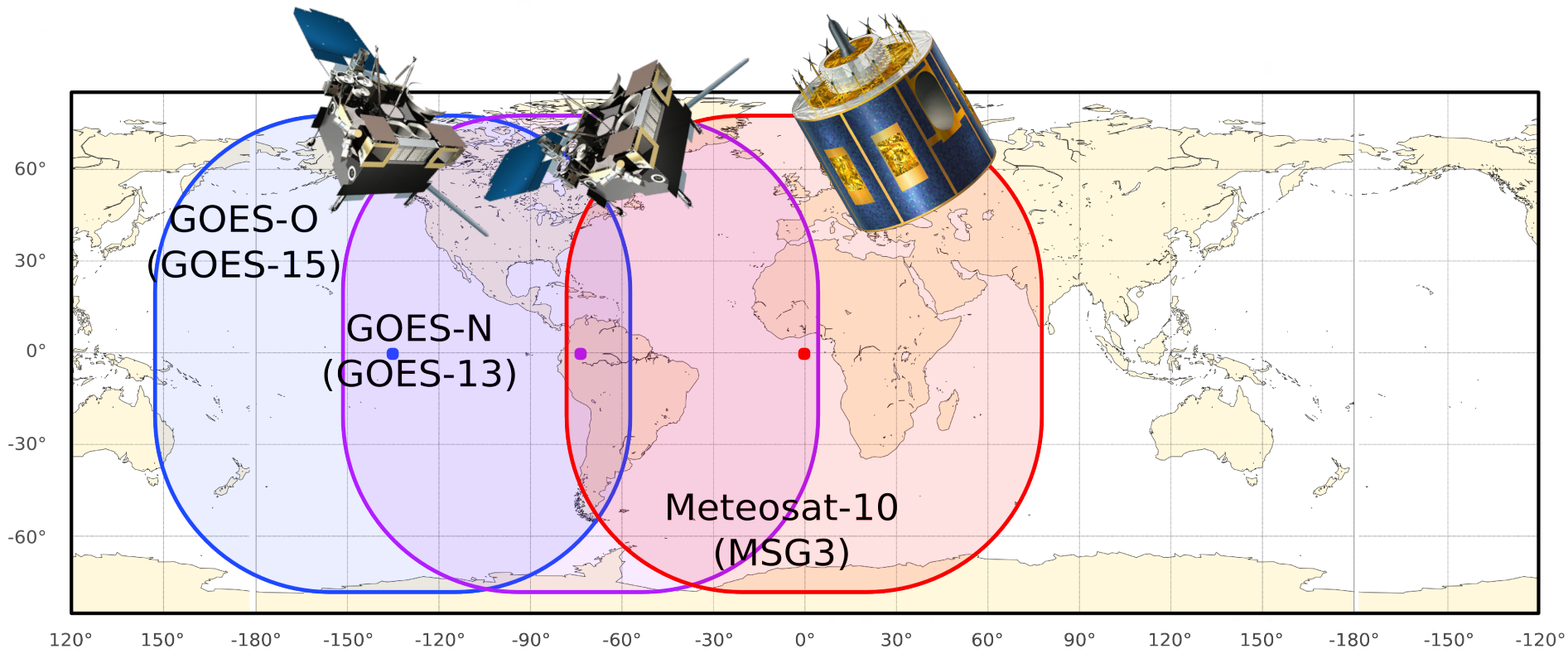
# TGFs and meteorology



# TGFs and meteorology

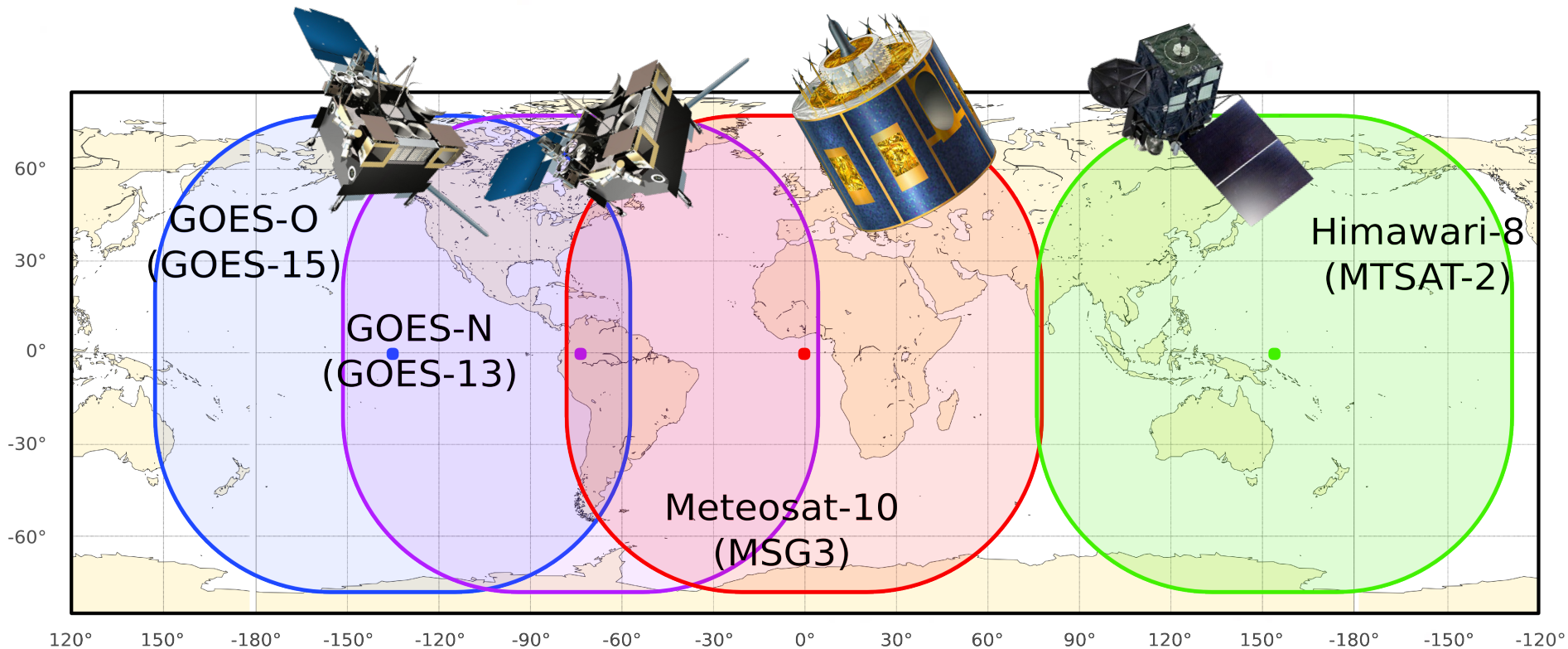


# TGFs and meteorology



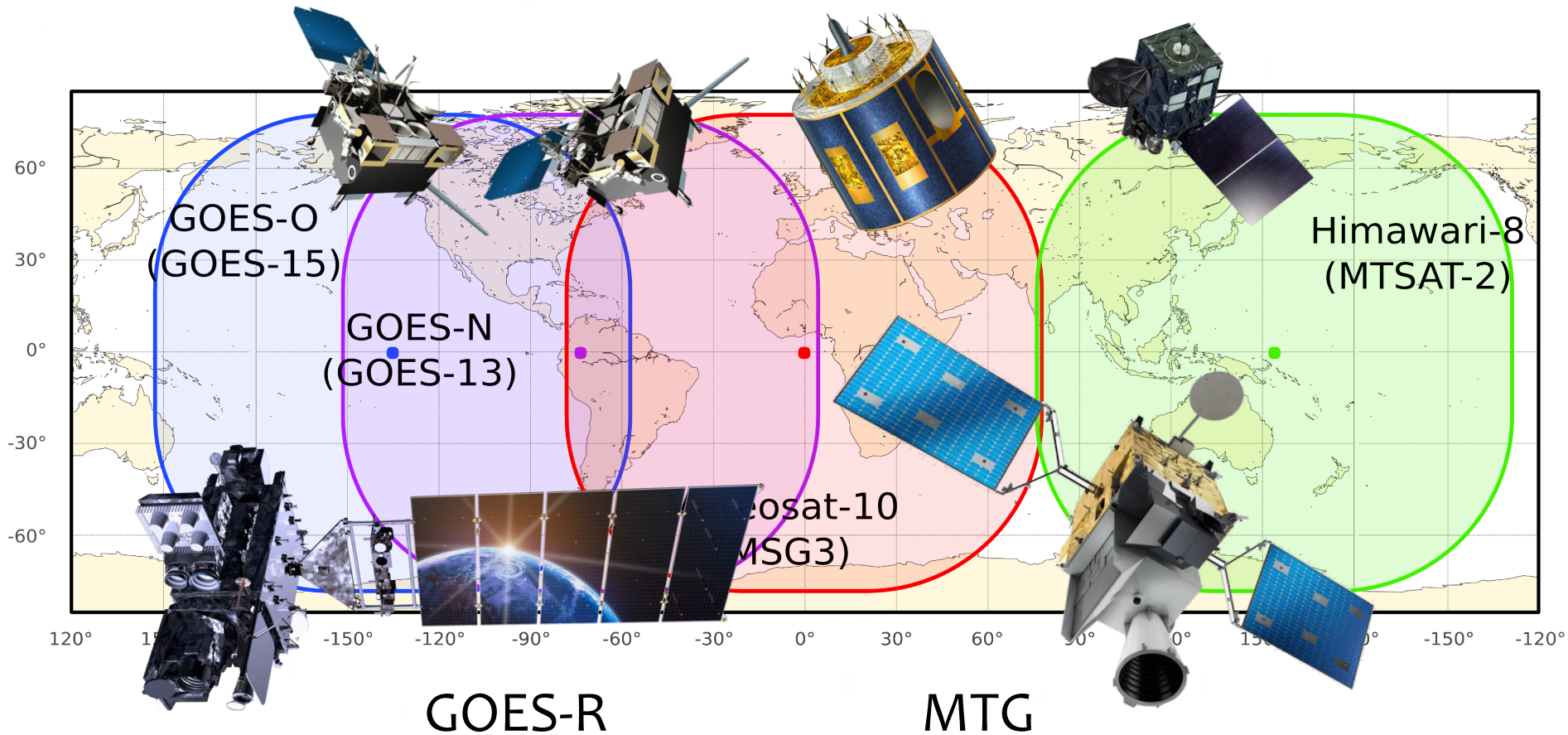


# TGFs and meteorology

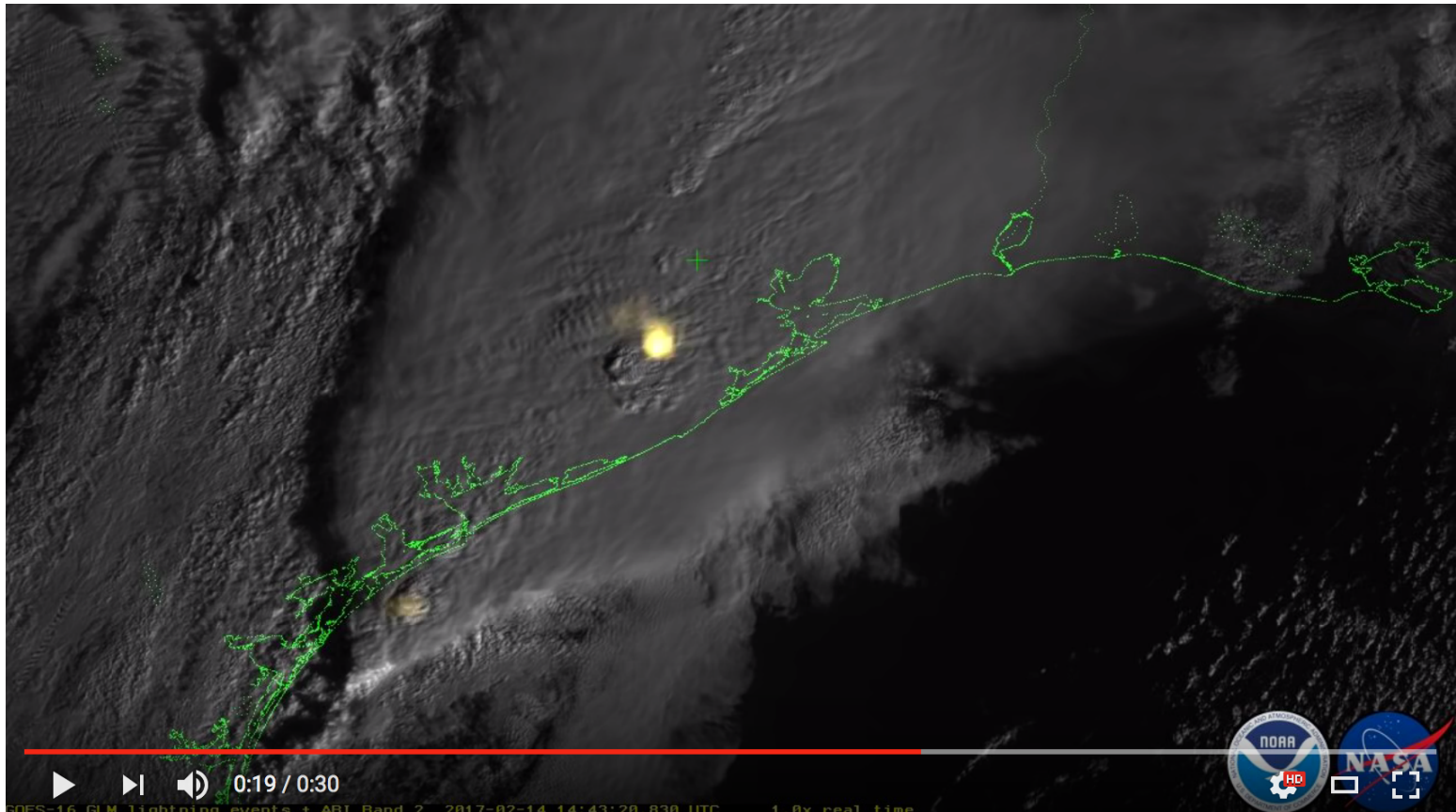




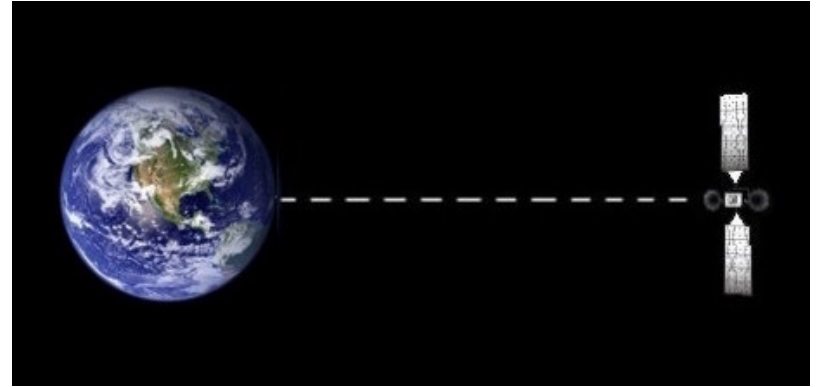
# TGFs and meteorology



# TGFs and meteorology

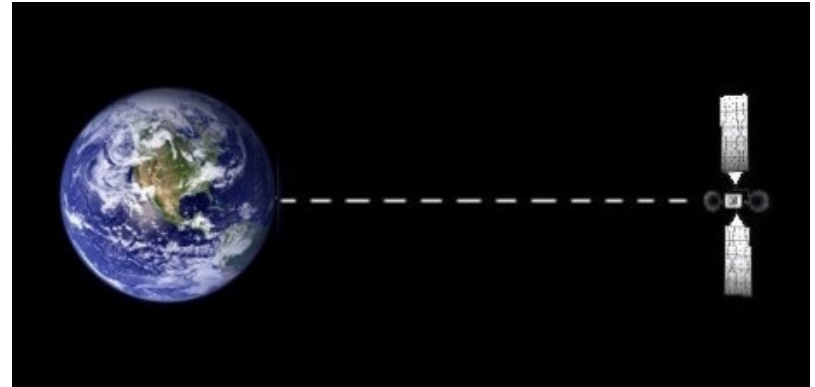
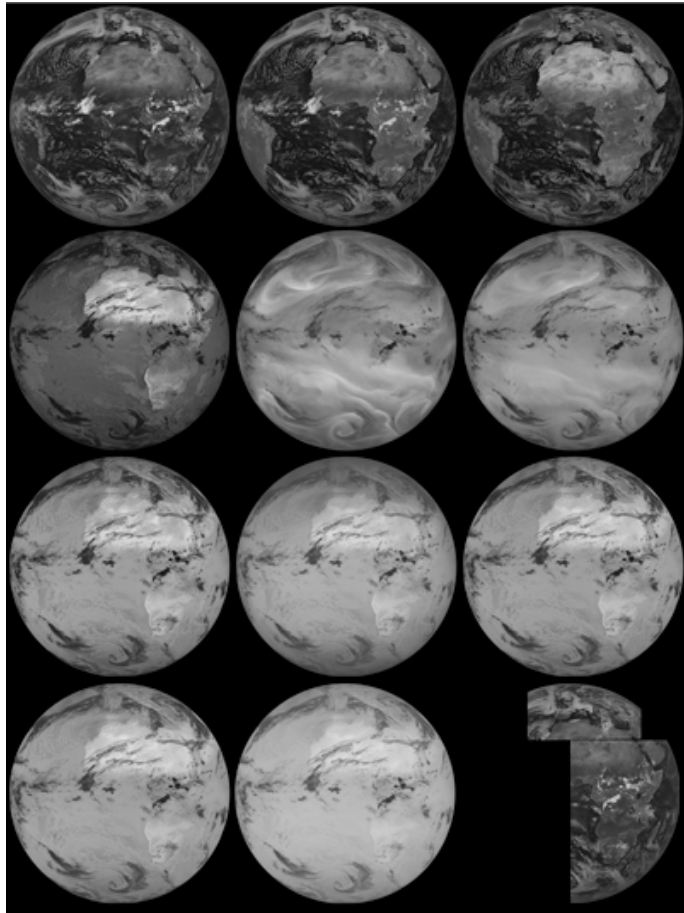


# TGFs and meteorology

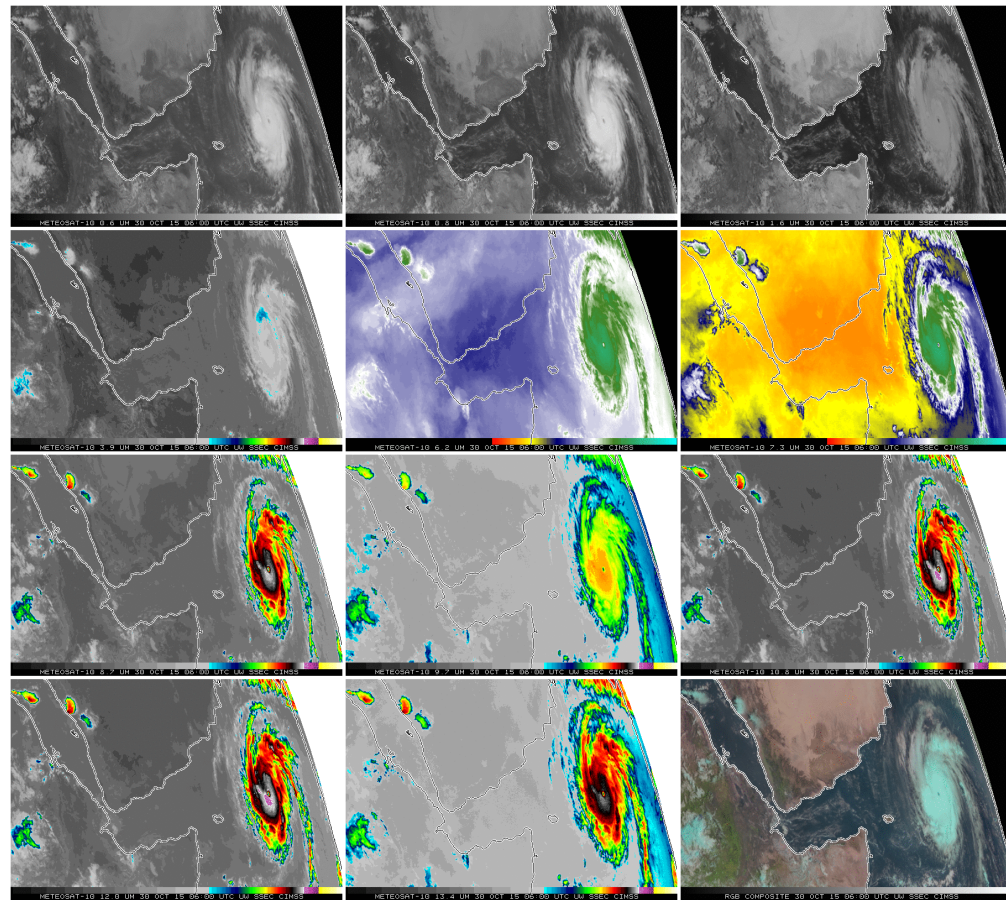
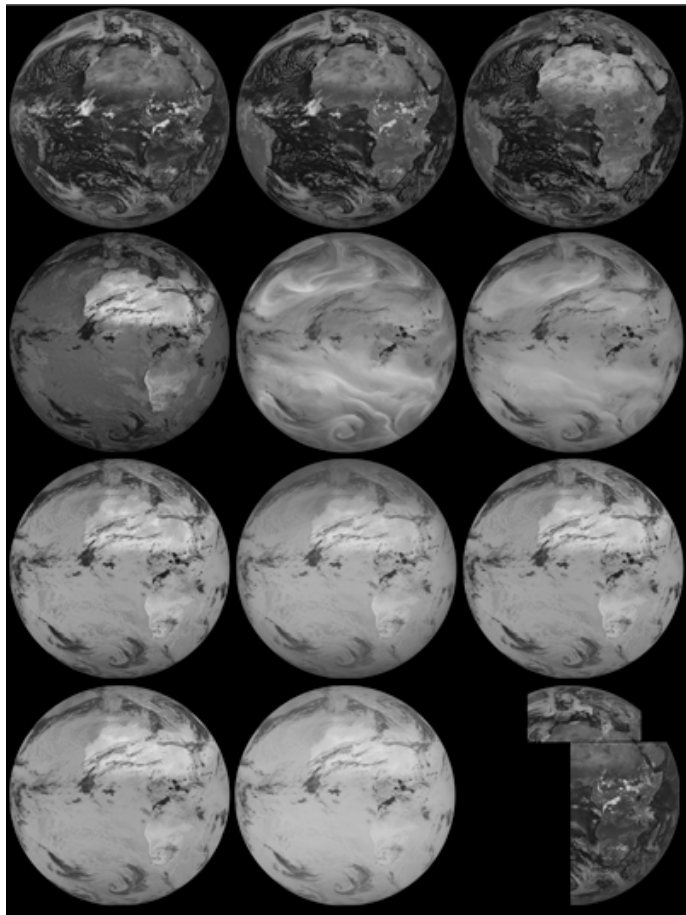




# TGFs and meteorology



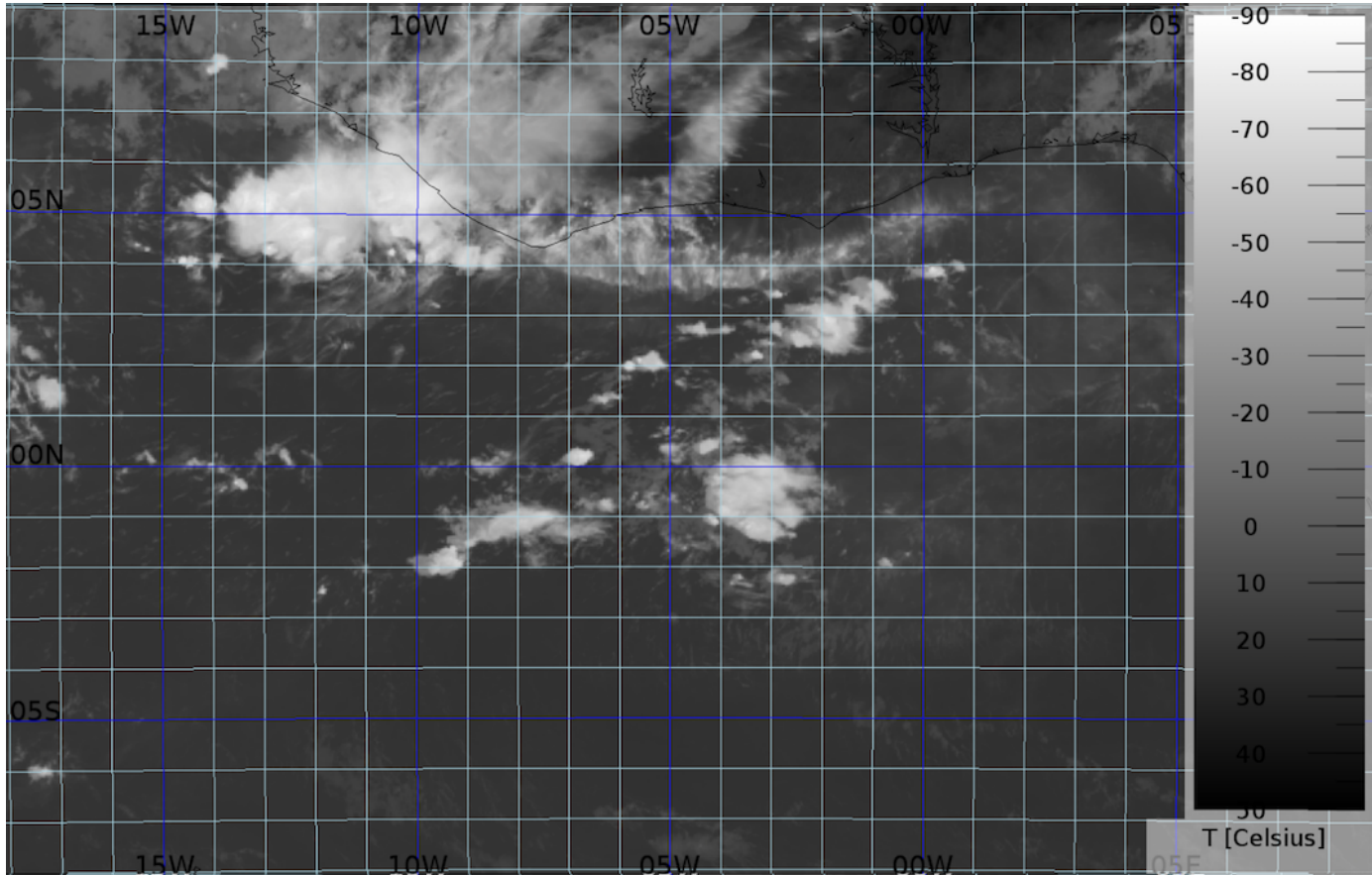
# TGFs and meteorology





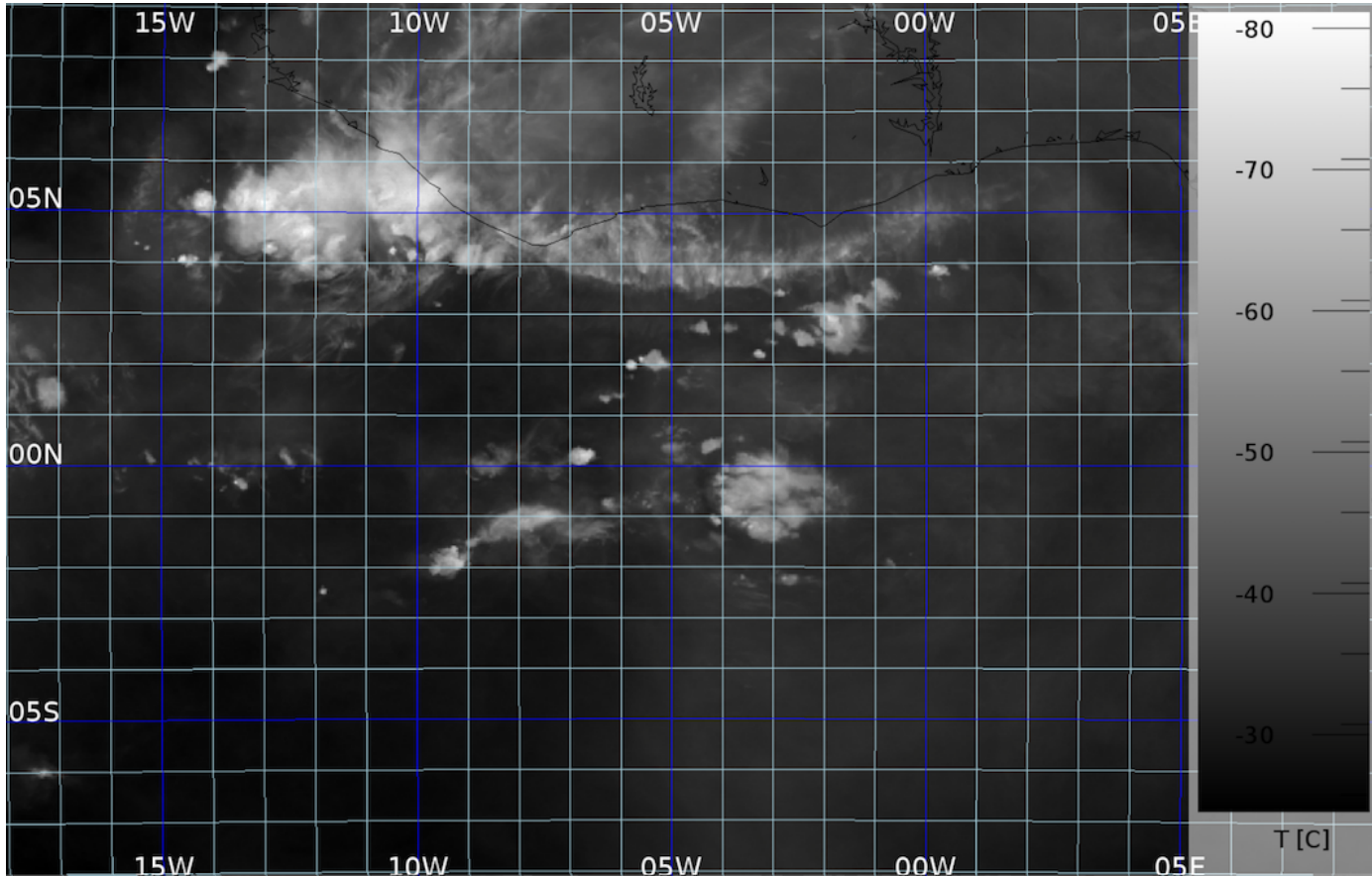
# TGFs and meteorology

IR  
3.9 $\mu\text{m}$

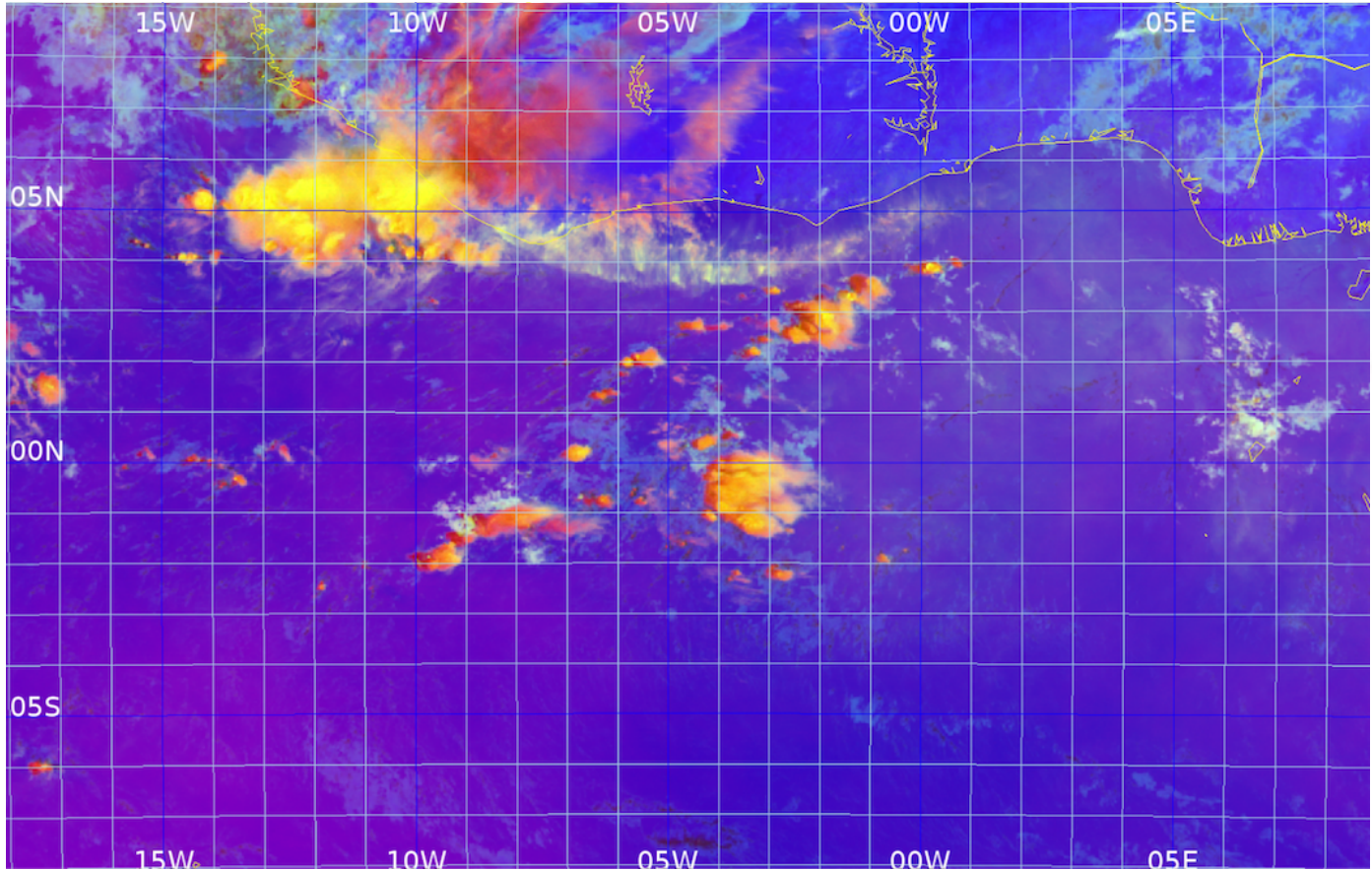


# TGFs and meteorology

IR  
10.8 $\mu\text{m}$



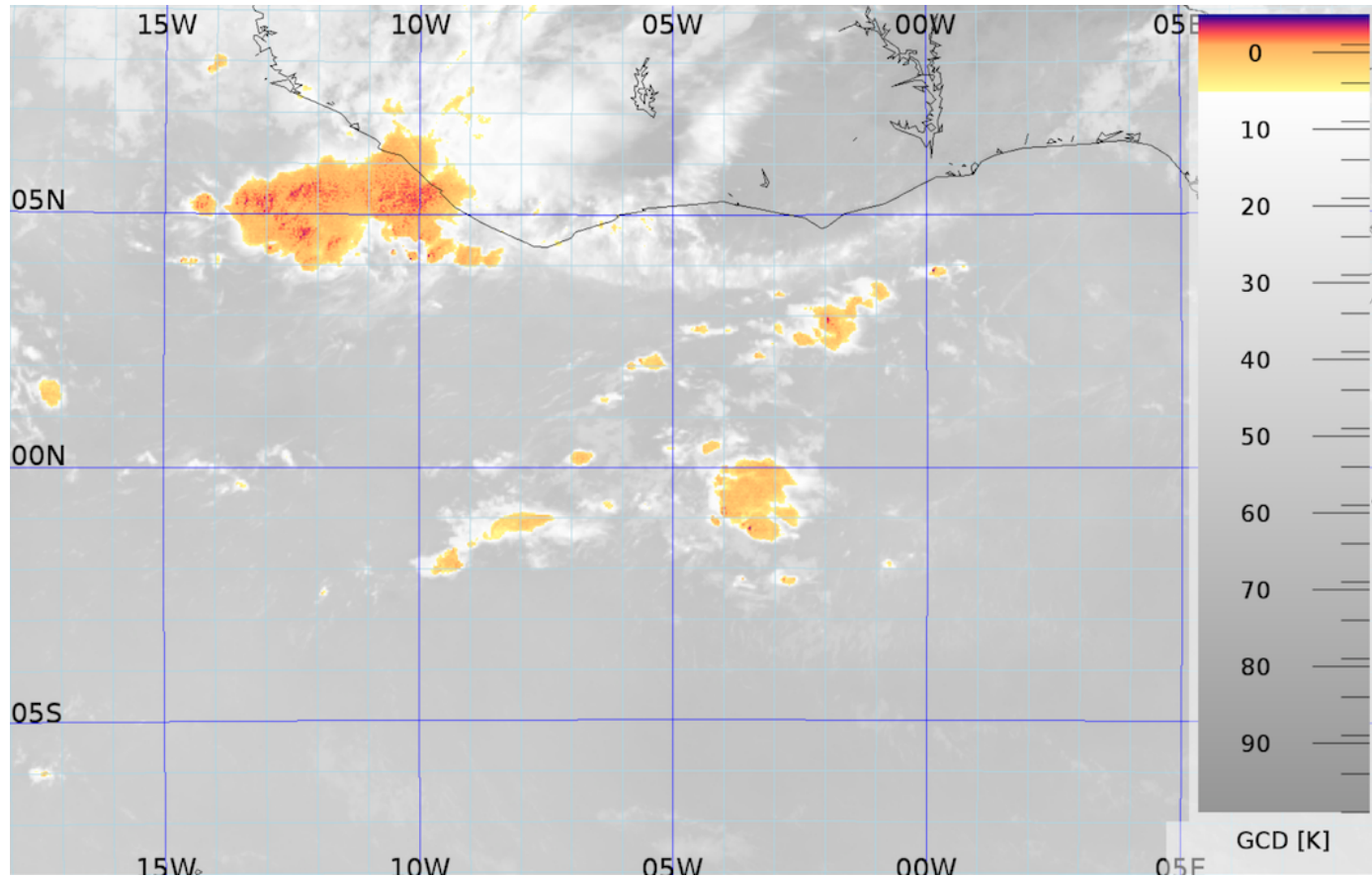
# TGFs and meteorology



severe  
Storm  
RGB



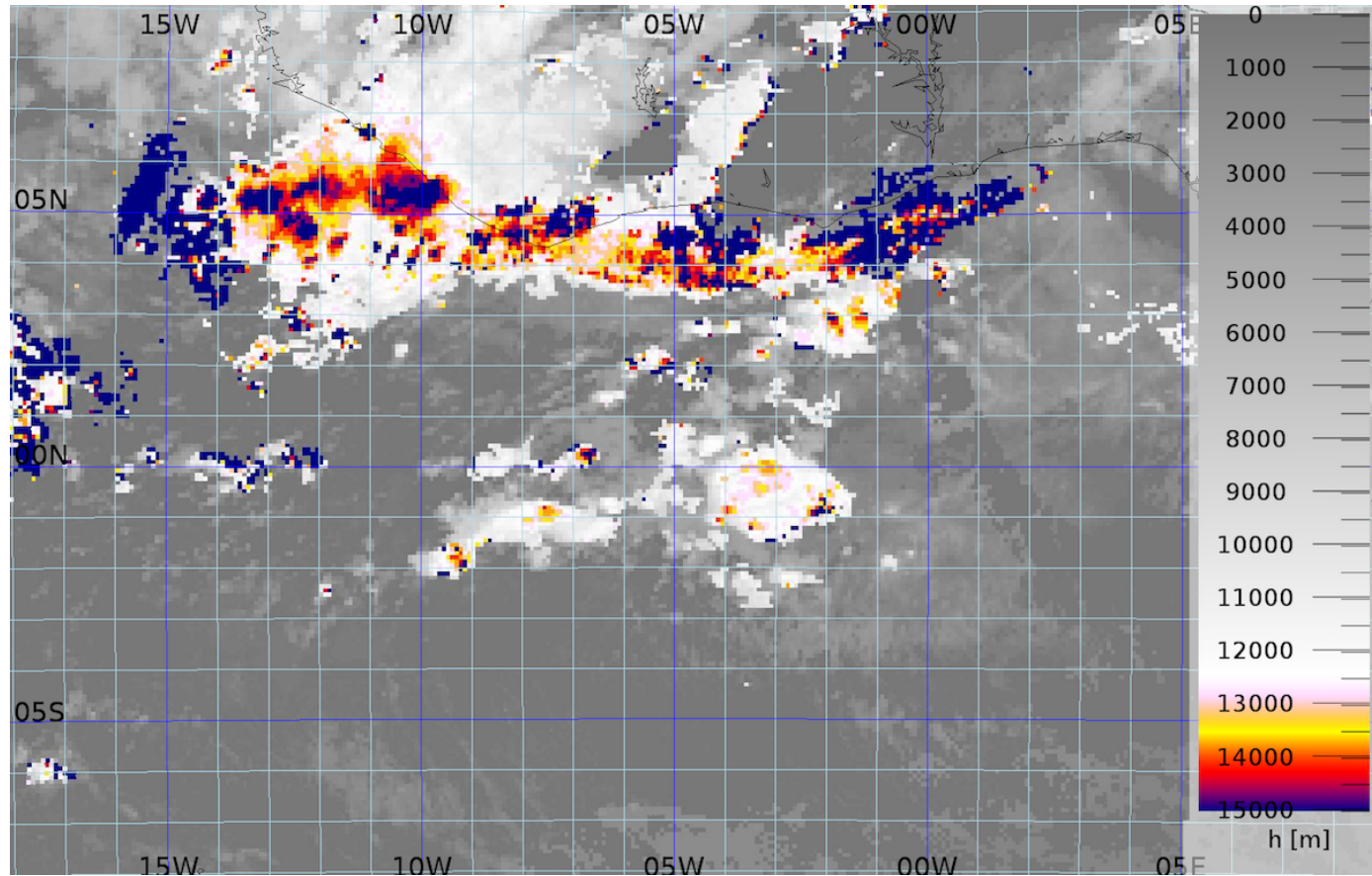
# TGFs and meteorology



GCD

# TGFs and meteorology

CTH



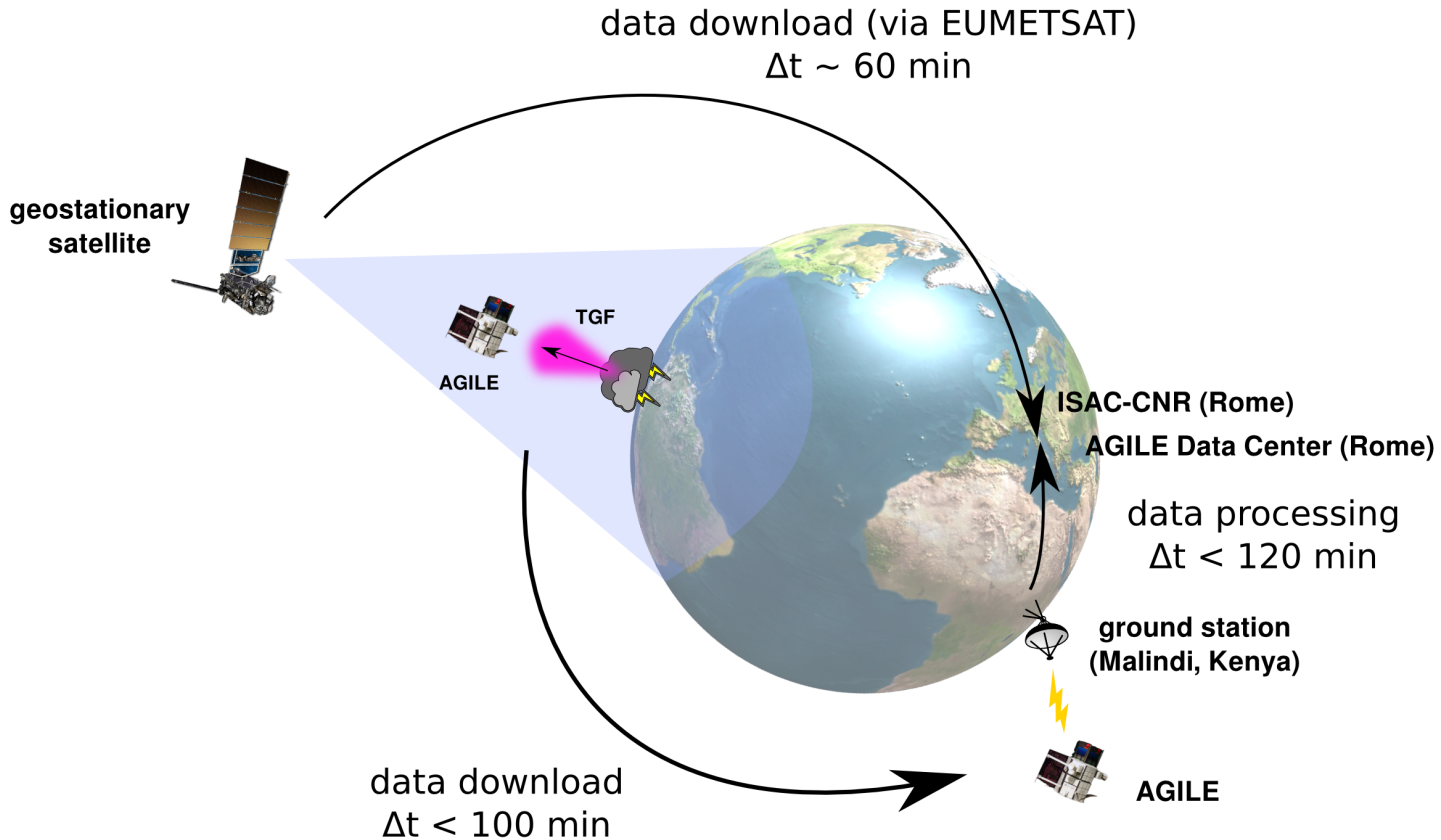
# TGFs and meteorology

CI interest field	Critical value
10.7- $\mu\text{m}$ $T_B$ (one score)	$<0^\circ\text{C}$
10.7- $\mu\text{m}$ $T_B$ time trend (two scores)	$<-4^\circ\text{C} (15 \text{ min})^{-1}$ $\Delta T_B (30 \text{ min})^{-1} < \Delta T_B (15 \text{ min})^{-1}$
Timing of 10.7- $\mu\text{m}$ $T_B$ drop below $0^\circ\text{C}$ (one score)	Within prior 30 min
6.5 (or 6.7)-10.7- $\mu\text{m}$ difference (one score)	$-35^\circ$ to $-10^\circ\text{C}$
13.3-10.7- $\mu\text{m}$ difference (one score)	$-25^\circ$ to $-5^\circ\text{C}$
12.0-10.7- $\mu\text{m}$ difference	$-3^\circ$ to $0^\circ\text{C}$ ( <i>GOES-11</i> )
6.5 (or 6.7)-10.7- $\mu\text{m}$ time trend (one score)	$>3^\circ (15 \text{ min})^{-1}$
13.3-10.7- $\mu\text{m}$ time trend (one score)	$>3^\circ (15 \text{ min})^{-1}$
12.0-10.7- $\mu\text{m}$ time trend	$>2^\circ (5 \text{ min})^{-1}$ ( <i>GOES-11</i> )

[Mecikalski et al., 2010]



# TGFs and meteorology



# TGFs and meteorology

## TGF ID

12/04/2015

12:11:44

(23.74°, -2.01°)

$E_{\max} = 6.70 \text{ MeV}$

# TGFs and meteorology

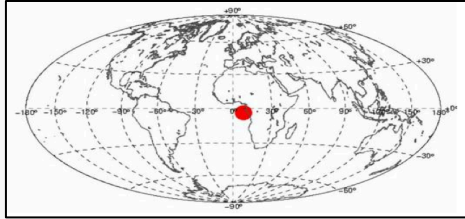
## TGF ID

12/04/2015

12:11:44

(23.74°, -2.01°)

$E_{\max} = 6.70 \text{ MeV}$



# TGFs and meteorology

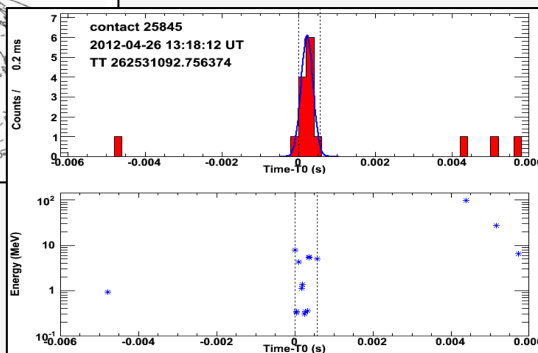
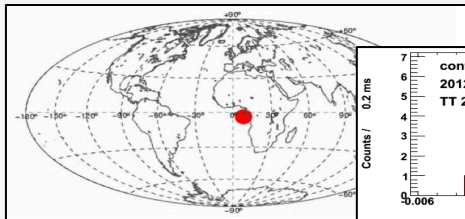
## TGF ID

12/04/2015

12:11:44

(23.74°, -2.01°)

$E_{\max} = 6.70 \text{ MeV}$



# TGFs and meteorology

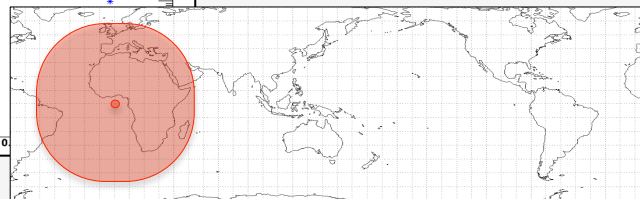
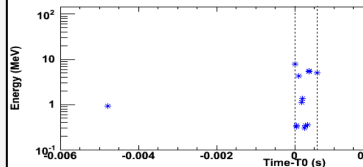
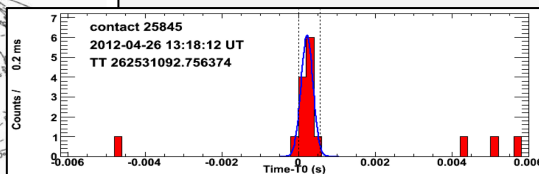
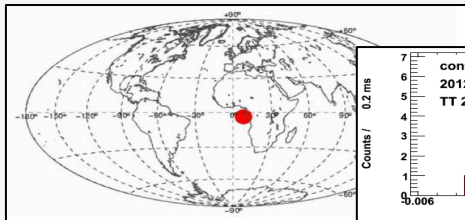
## TGF ID

12/04/2015

12:11:44

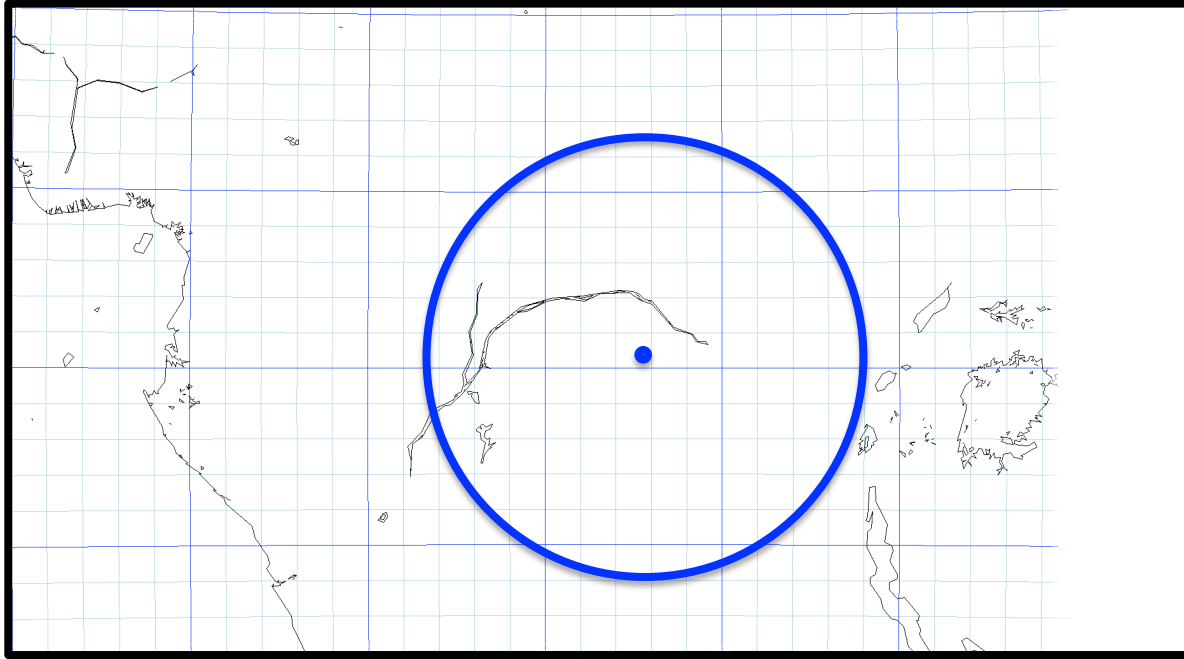
(23.74°, -2.01°)

$E_{\max} = 6.70 \text{ MeV}$

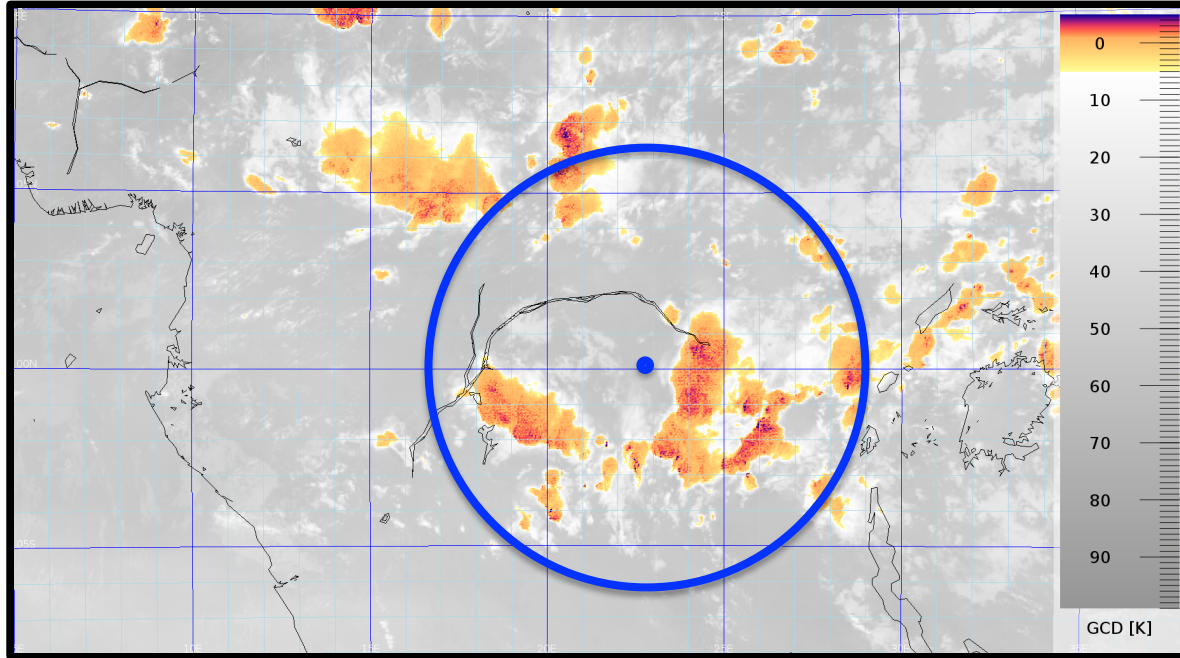




# TGFs and meteorology

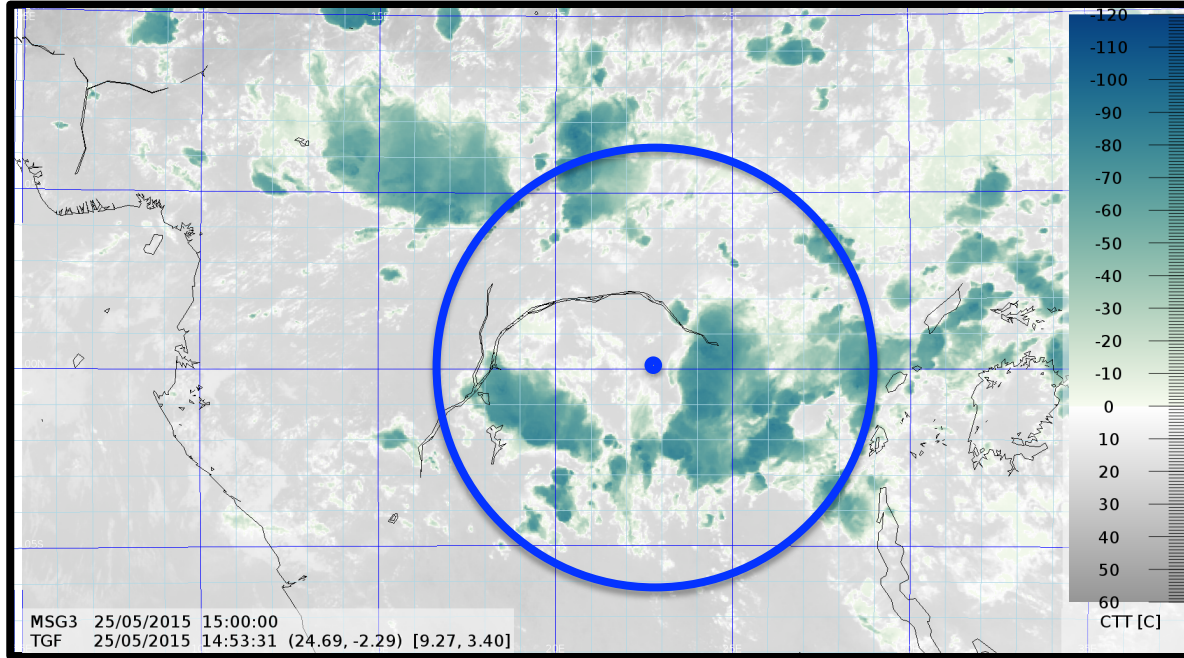


# TGFs and meteorology



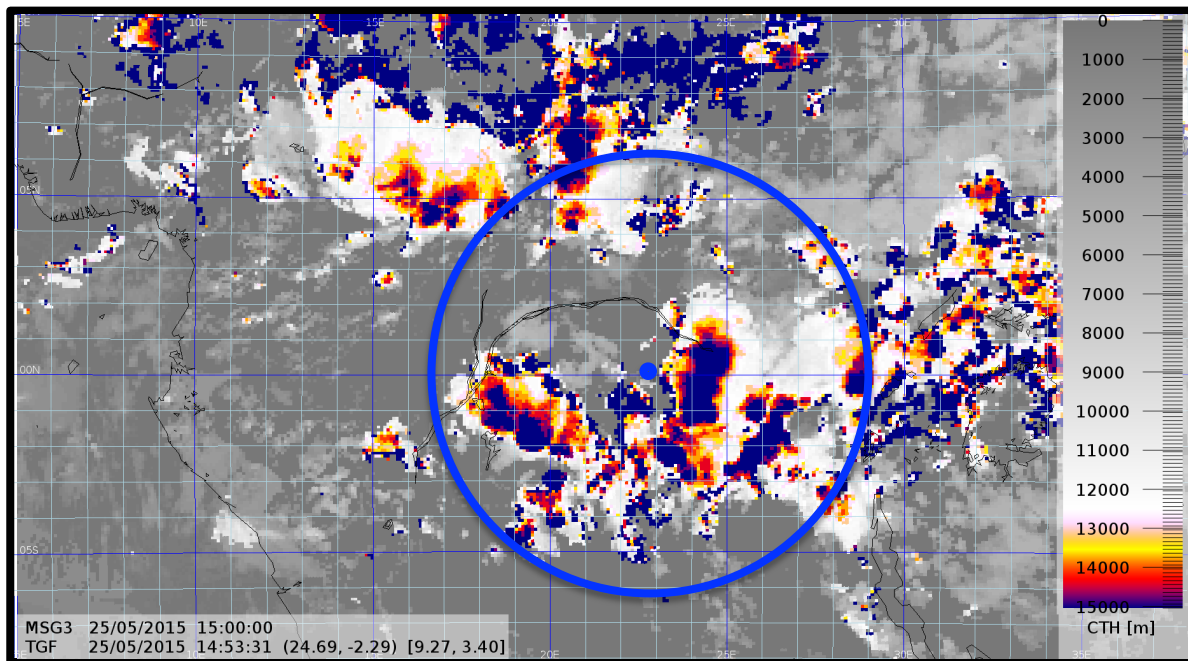
Global Convective  
Diagnostics (GCD)  
algorithm

# TGFs and meteorology



Cloud Top  
Temperature (CTT)

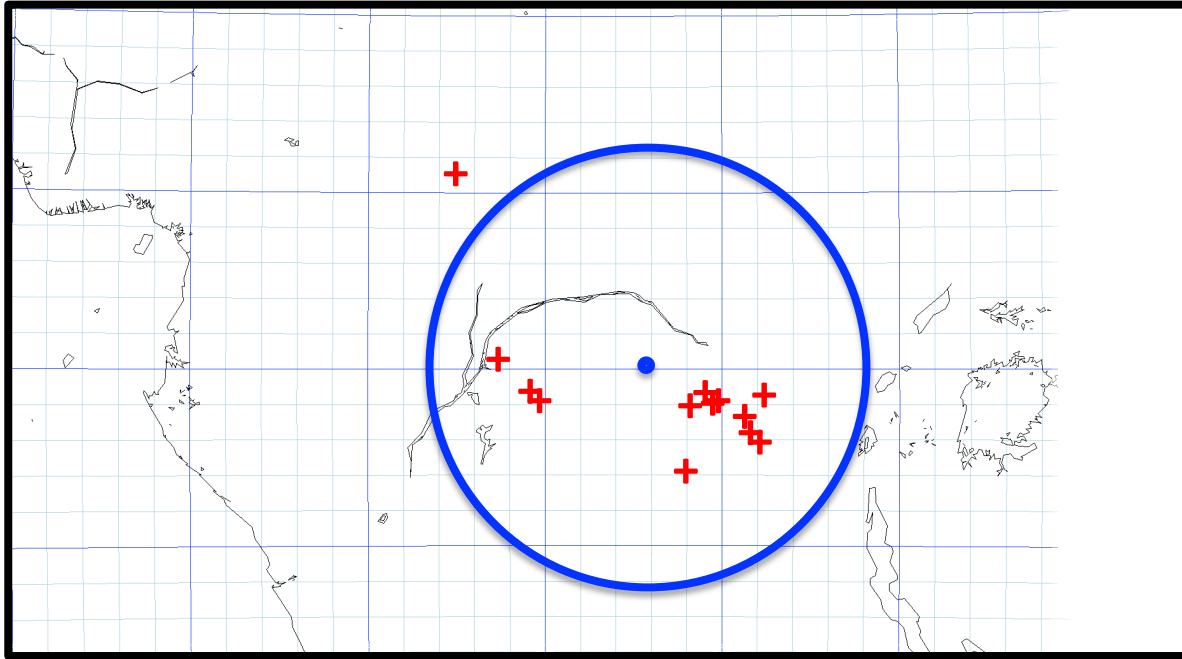
# TGFs and meteorology



Cloud Top Height  
(CTH)



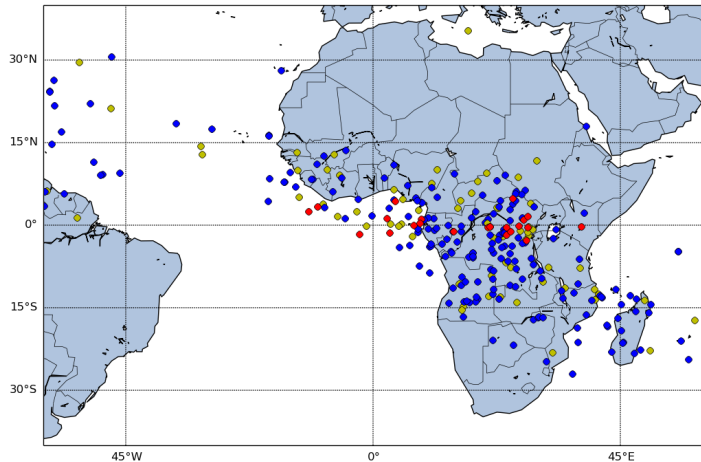
# TGFs and meteorology



sferics by  
lightning location  
networks

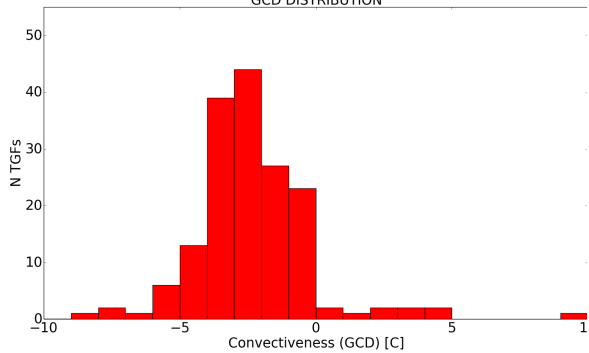
# TGFs and meteorology

TGFs with sferics

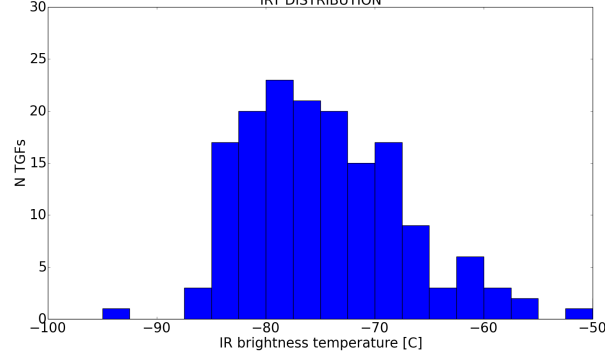


study of TGFs with associated  
sferic in the MSG region  
(work in progress)

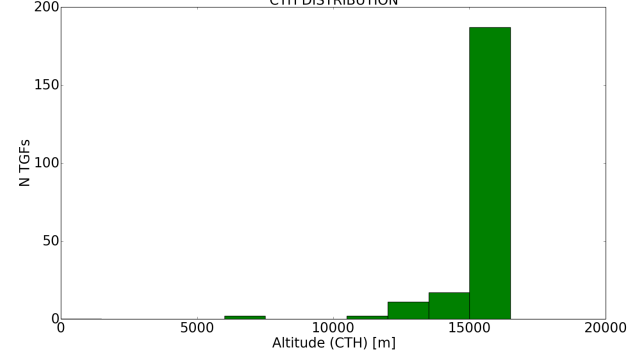
GCD DISTRIBUTION



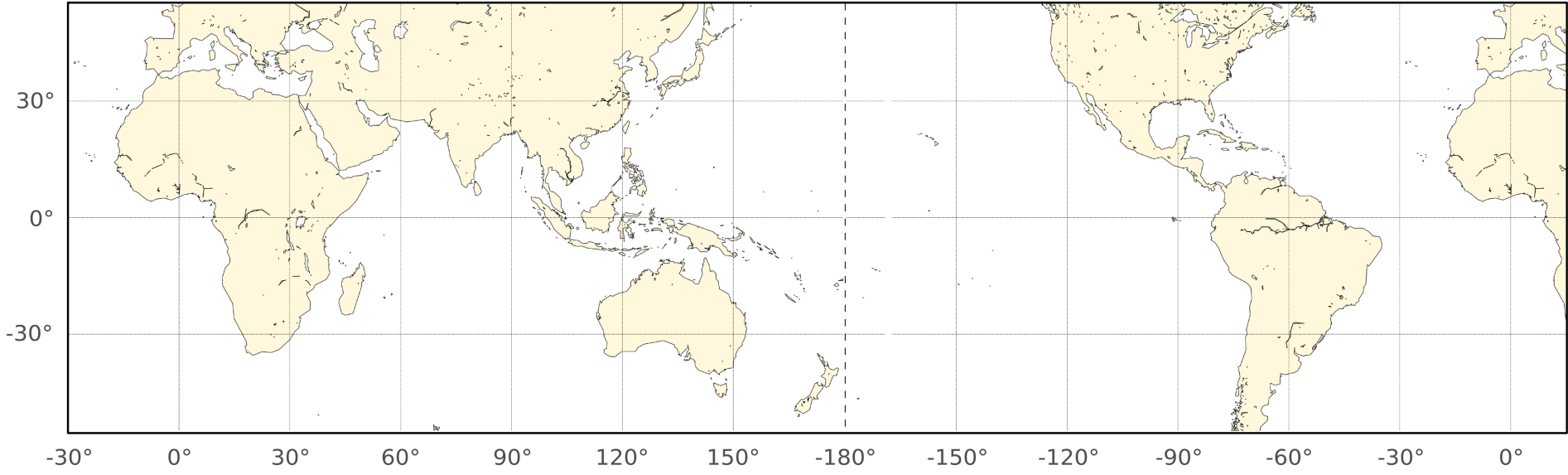
IRT DISTRIBUTION



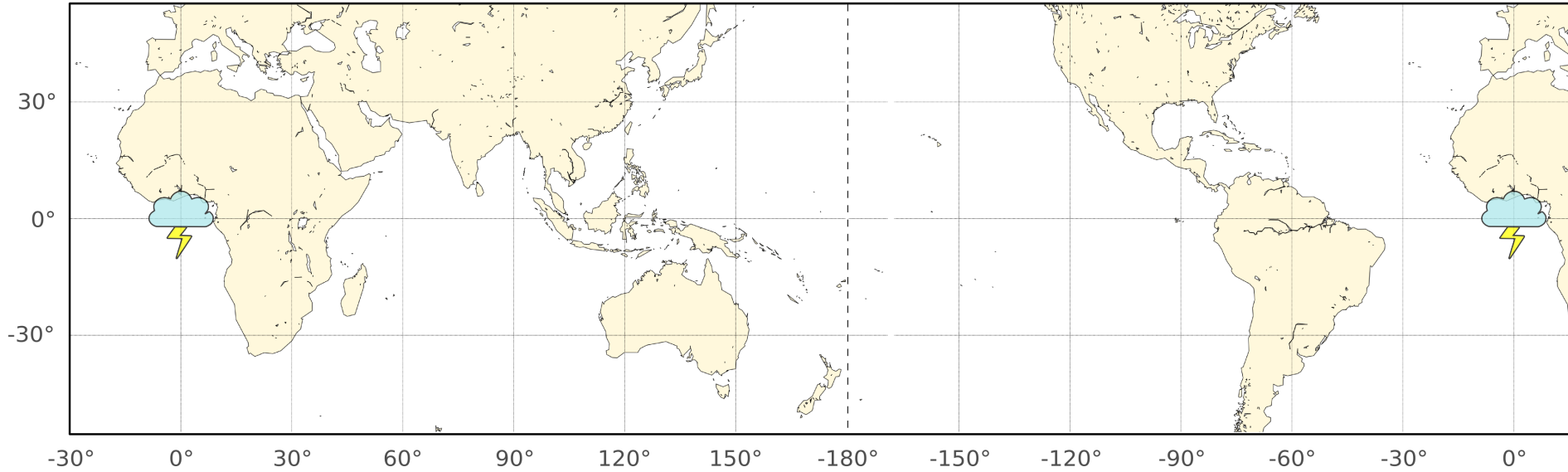
CTH DISTRIBUTION



# TGFs and meteorology

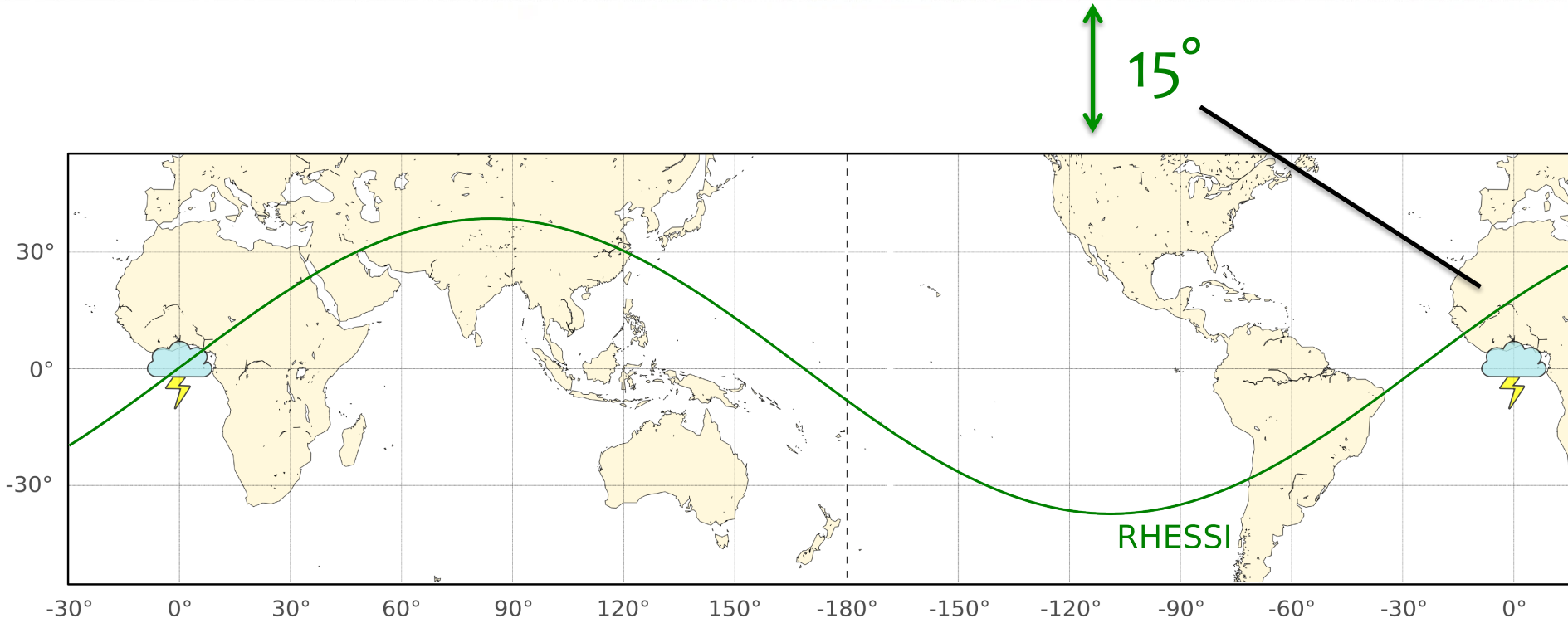


# TGFs and meteorology

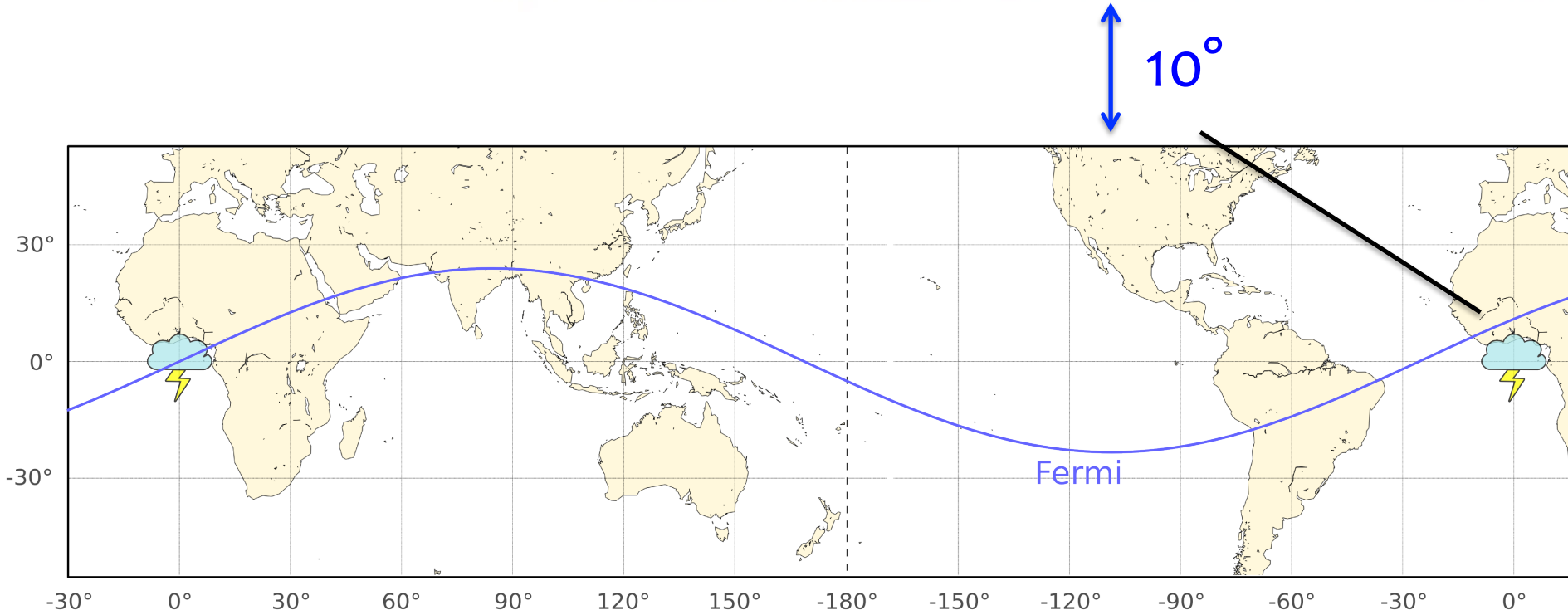




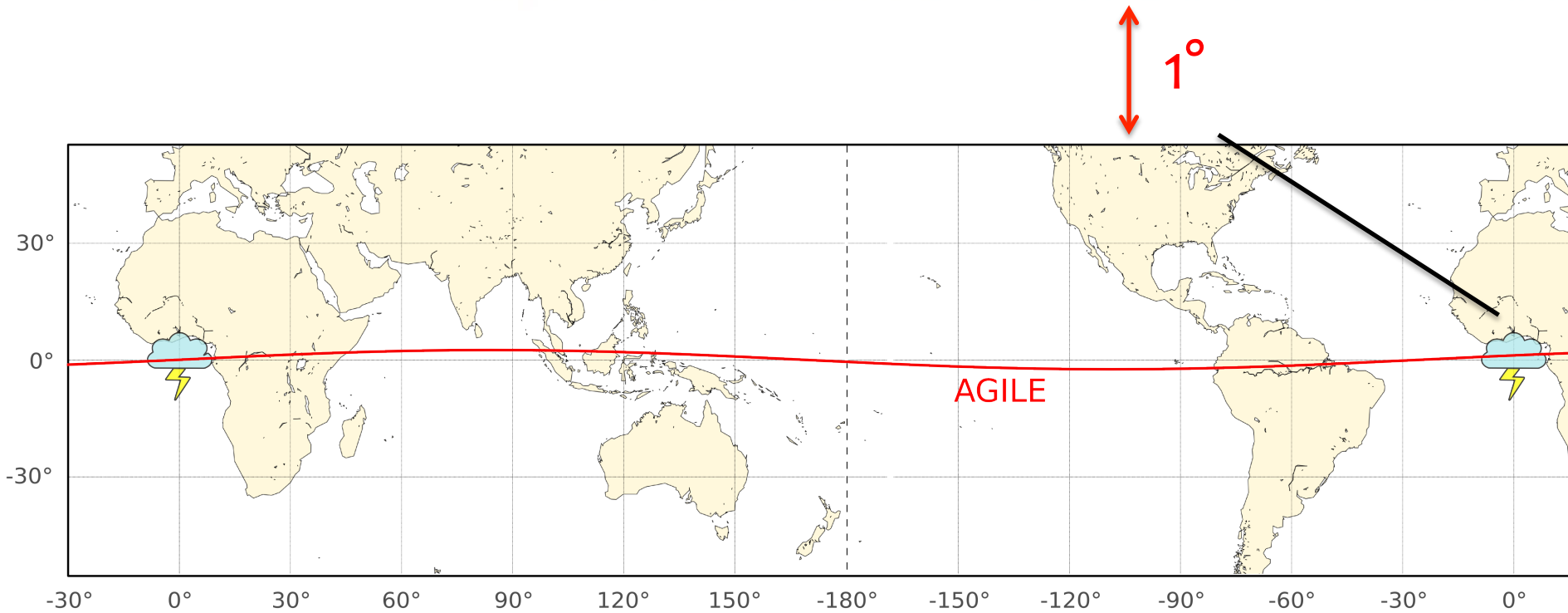
# TGFs and meteorology



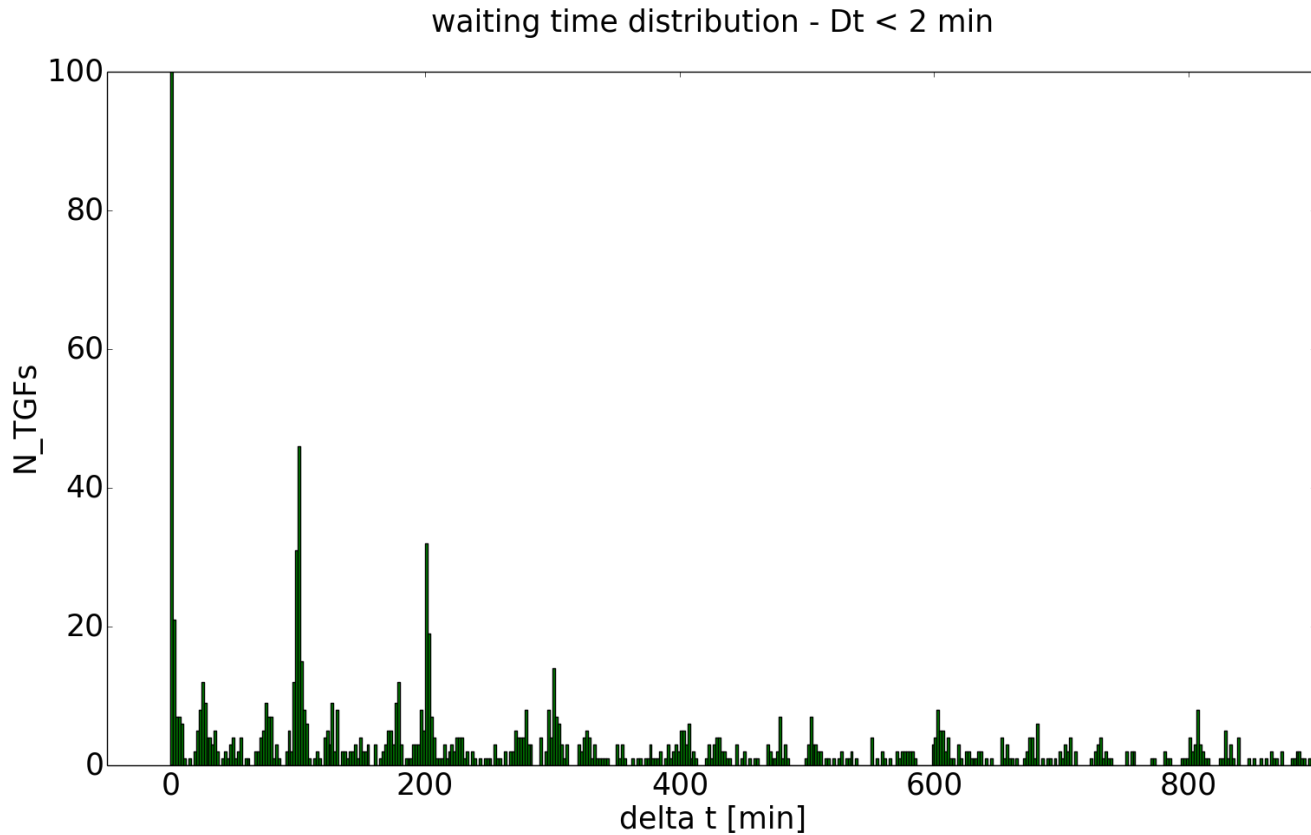
# TGFs and meteorology



# TGFs and meteorology



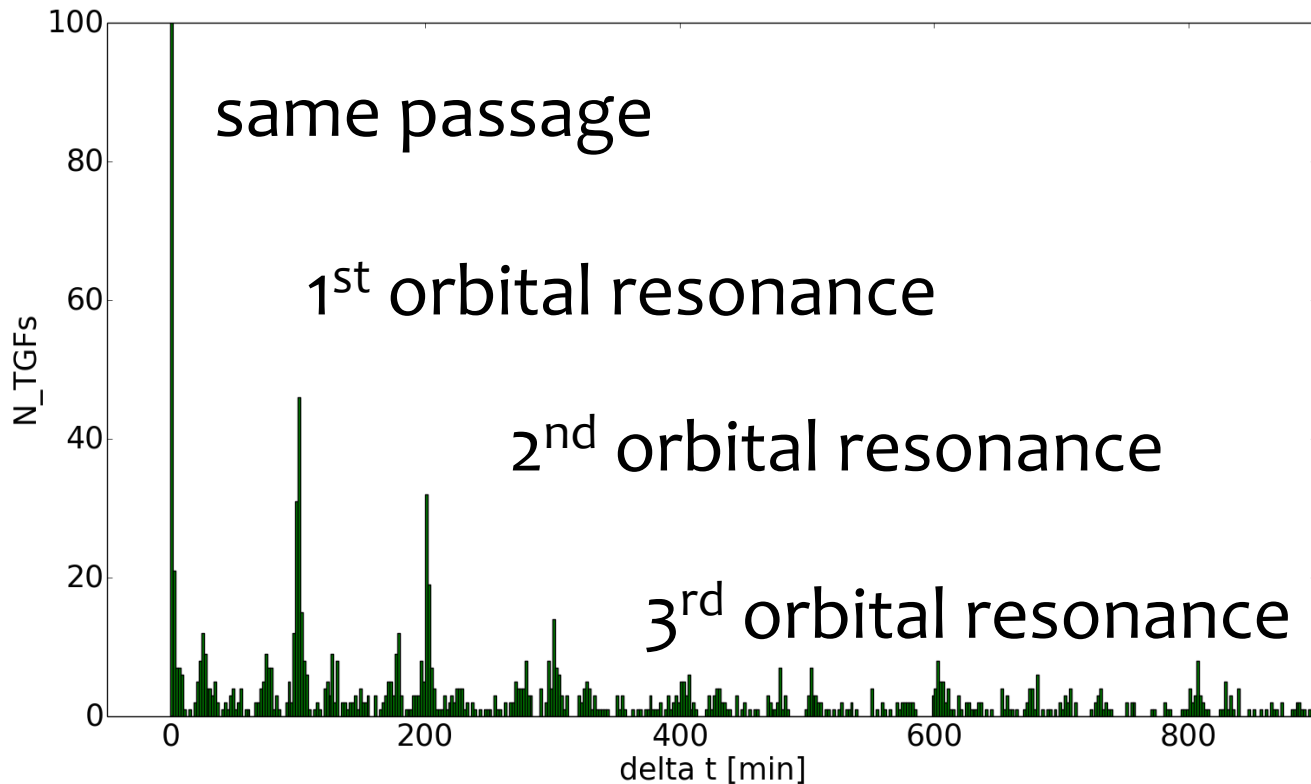
# TGFs and meteorology



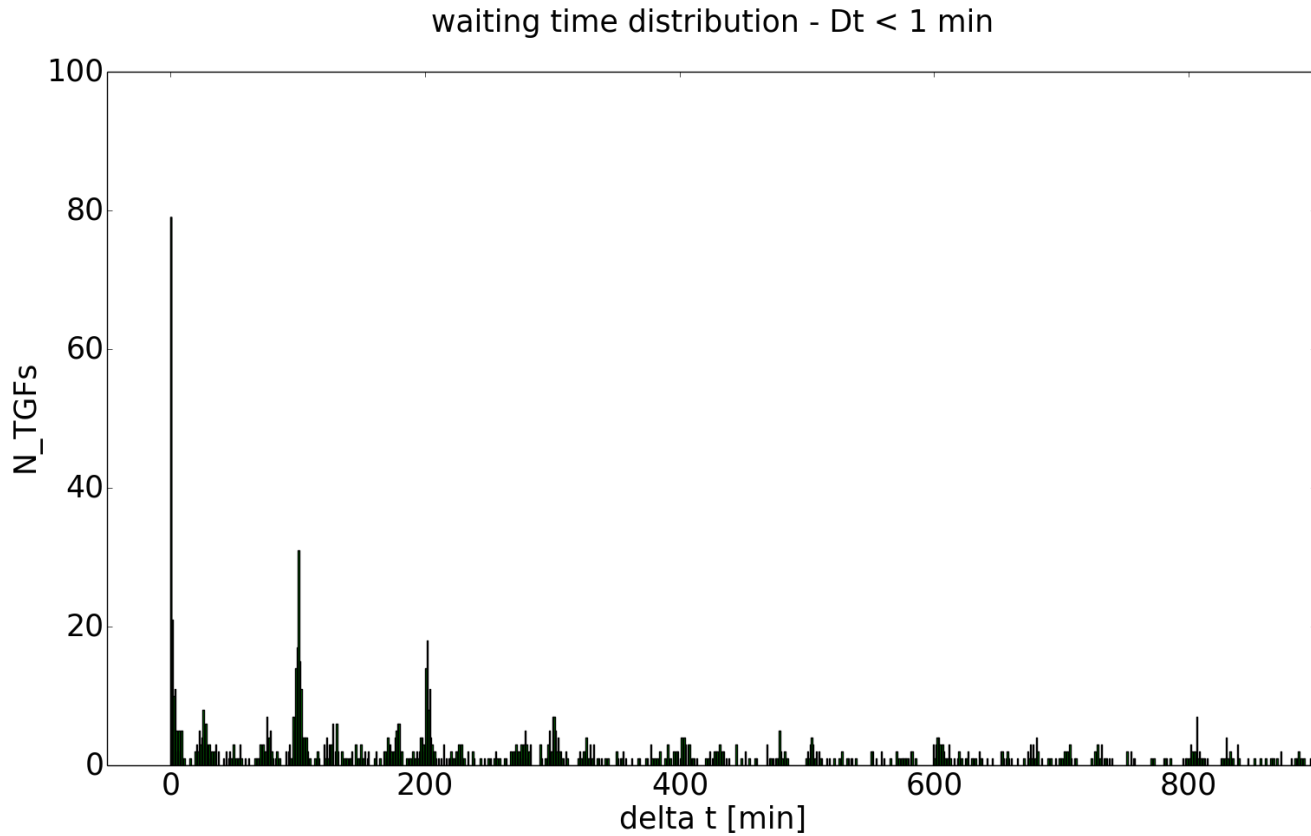


# TGFs and meteorology

waiting time distribution -  $Dt < 2$  min

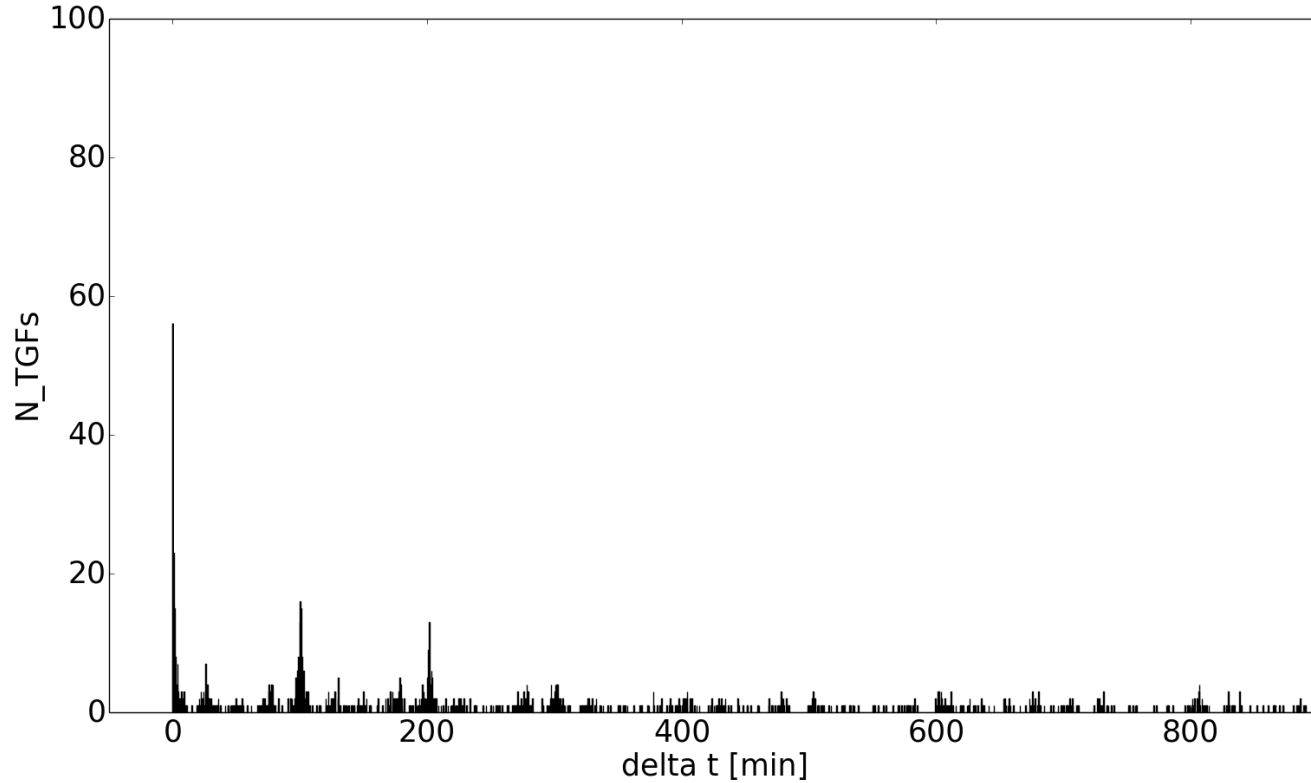


# TGFs and meteorology

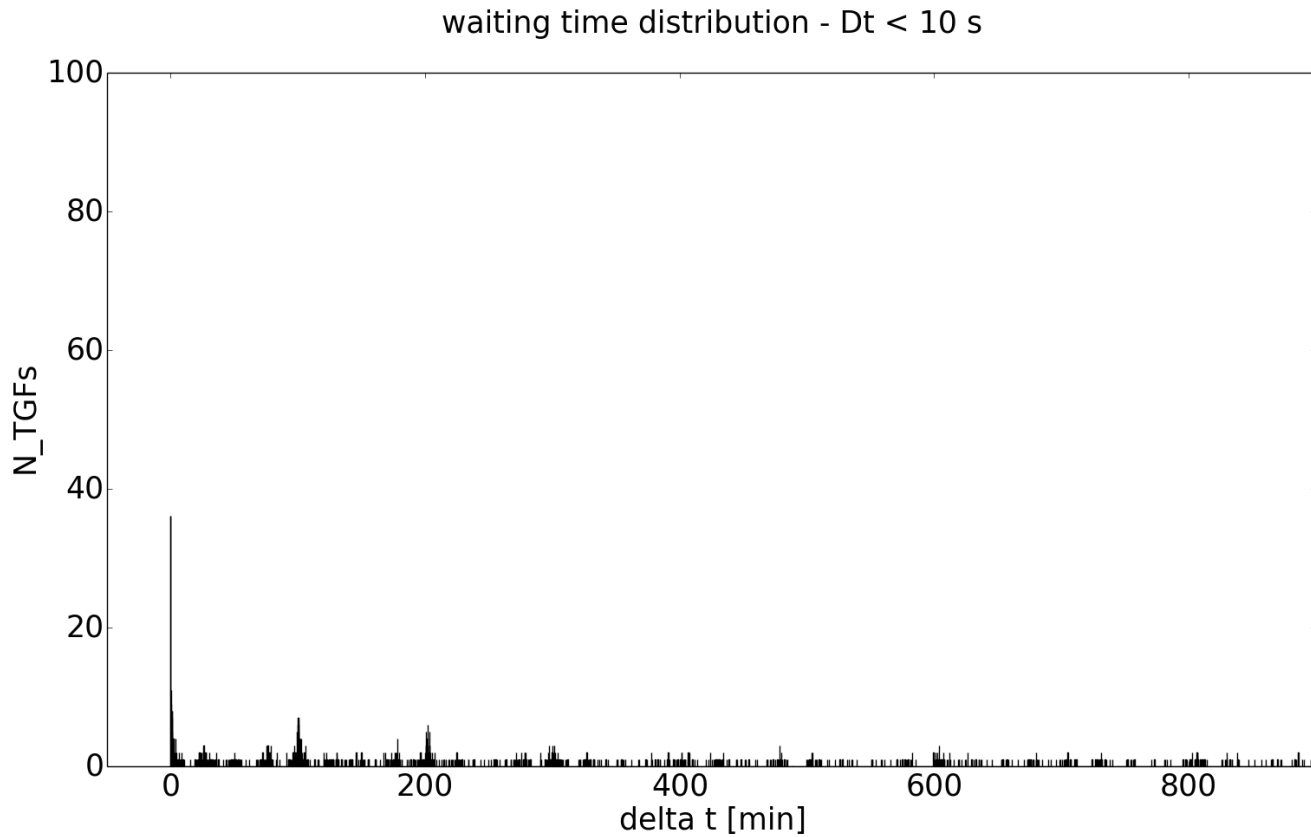


# TGFs and meteorology

waiting time distribution -  $Dt < 30$  s

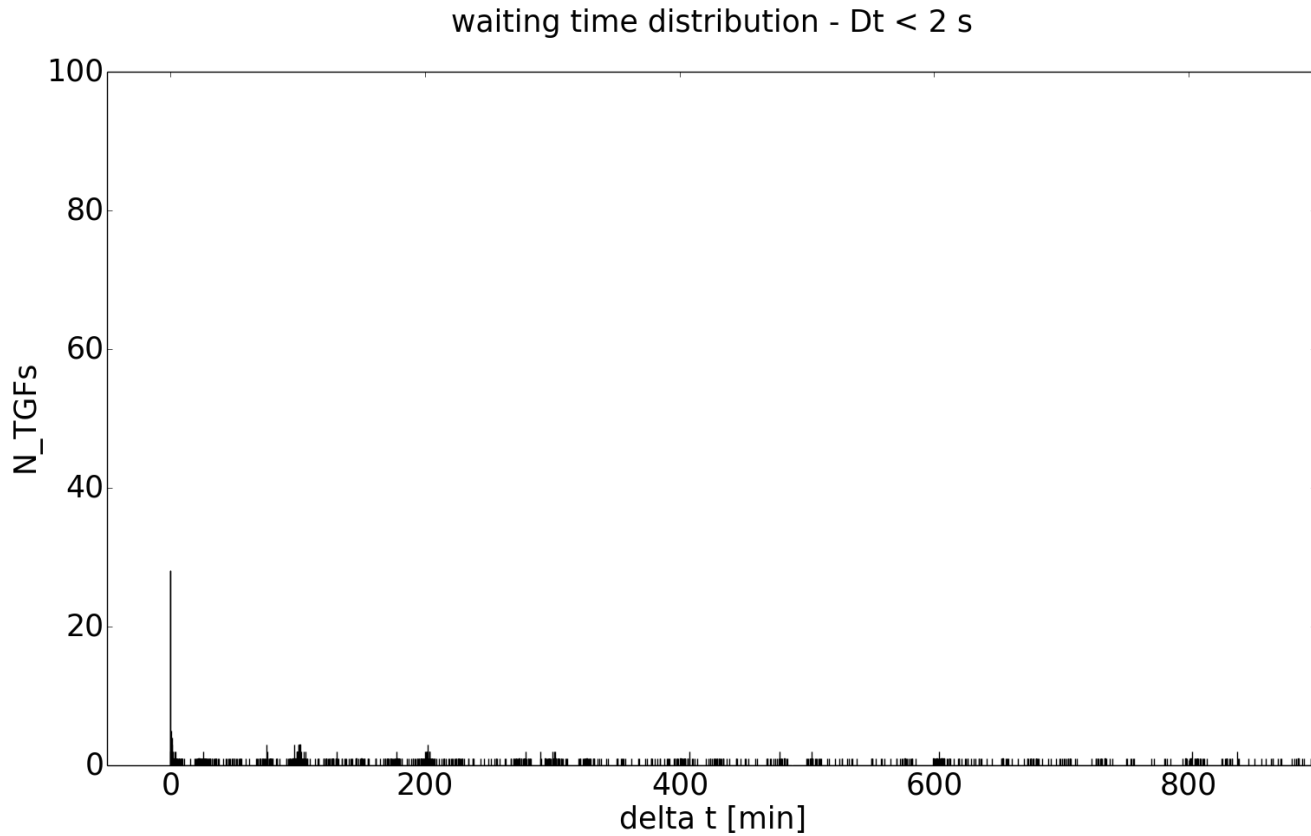


# TGFs and meteorology

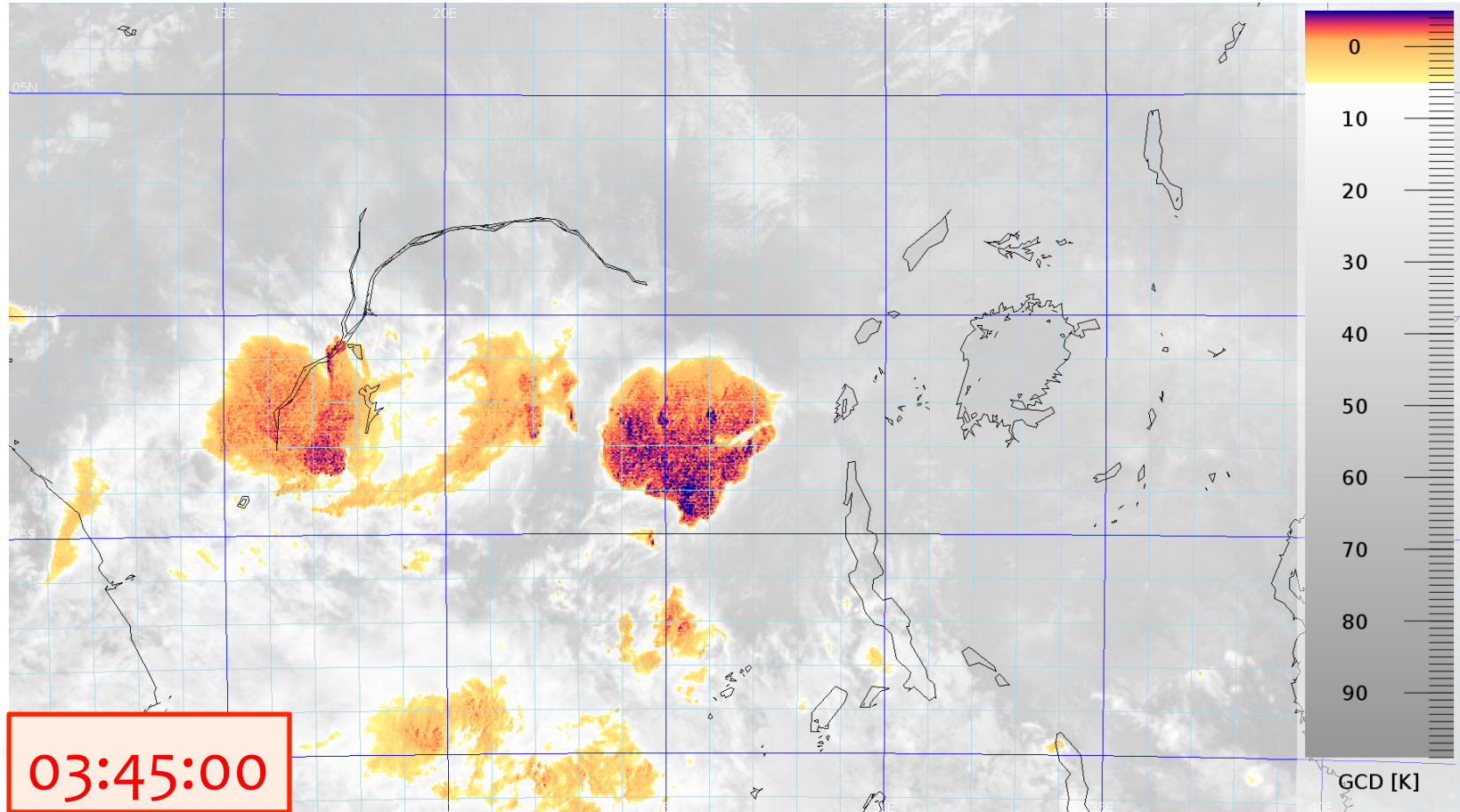




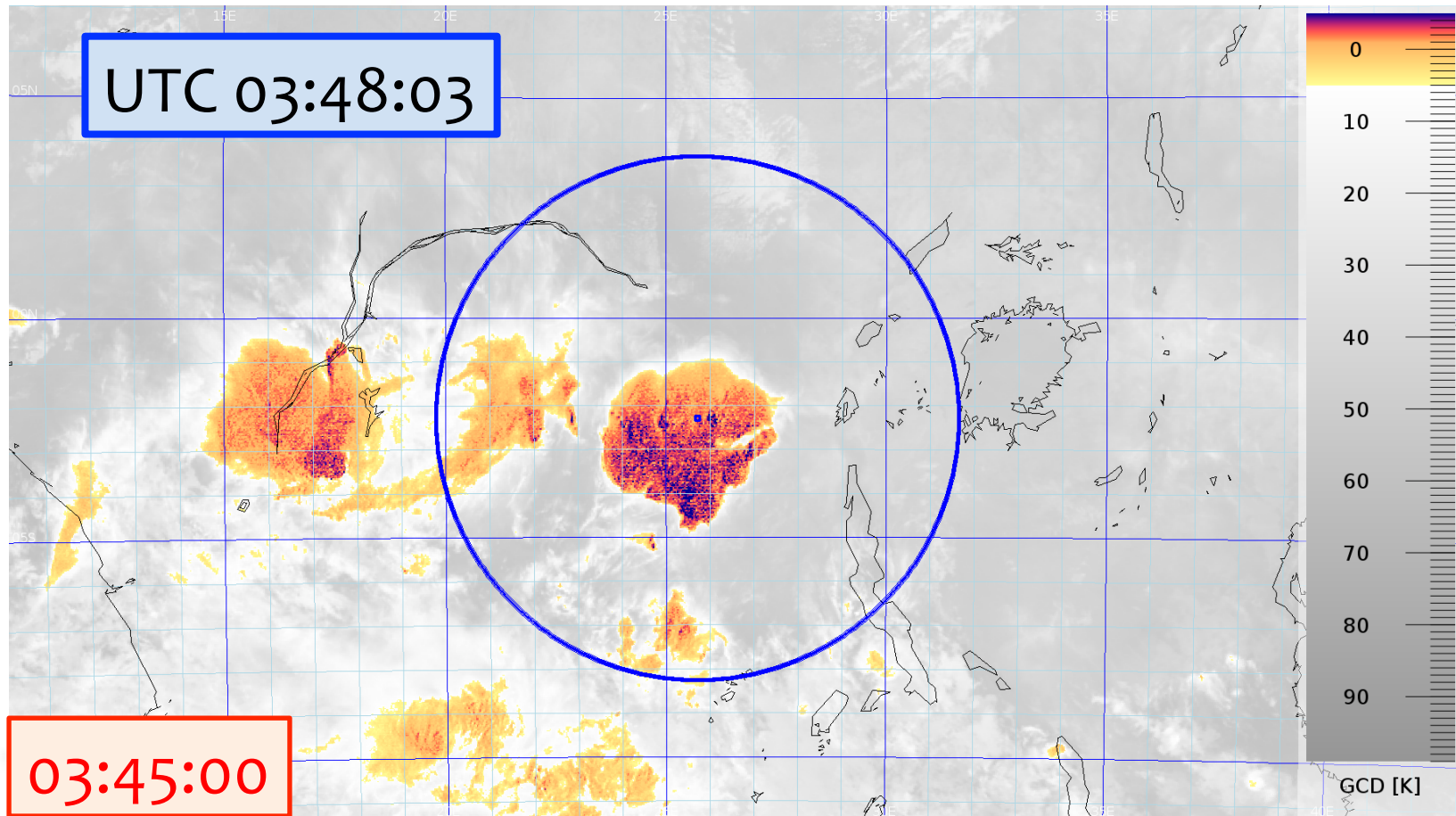
# TGFs and meteorology



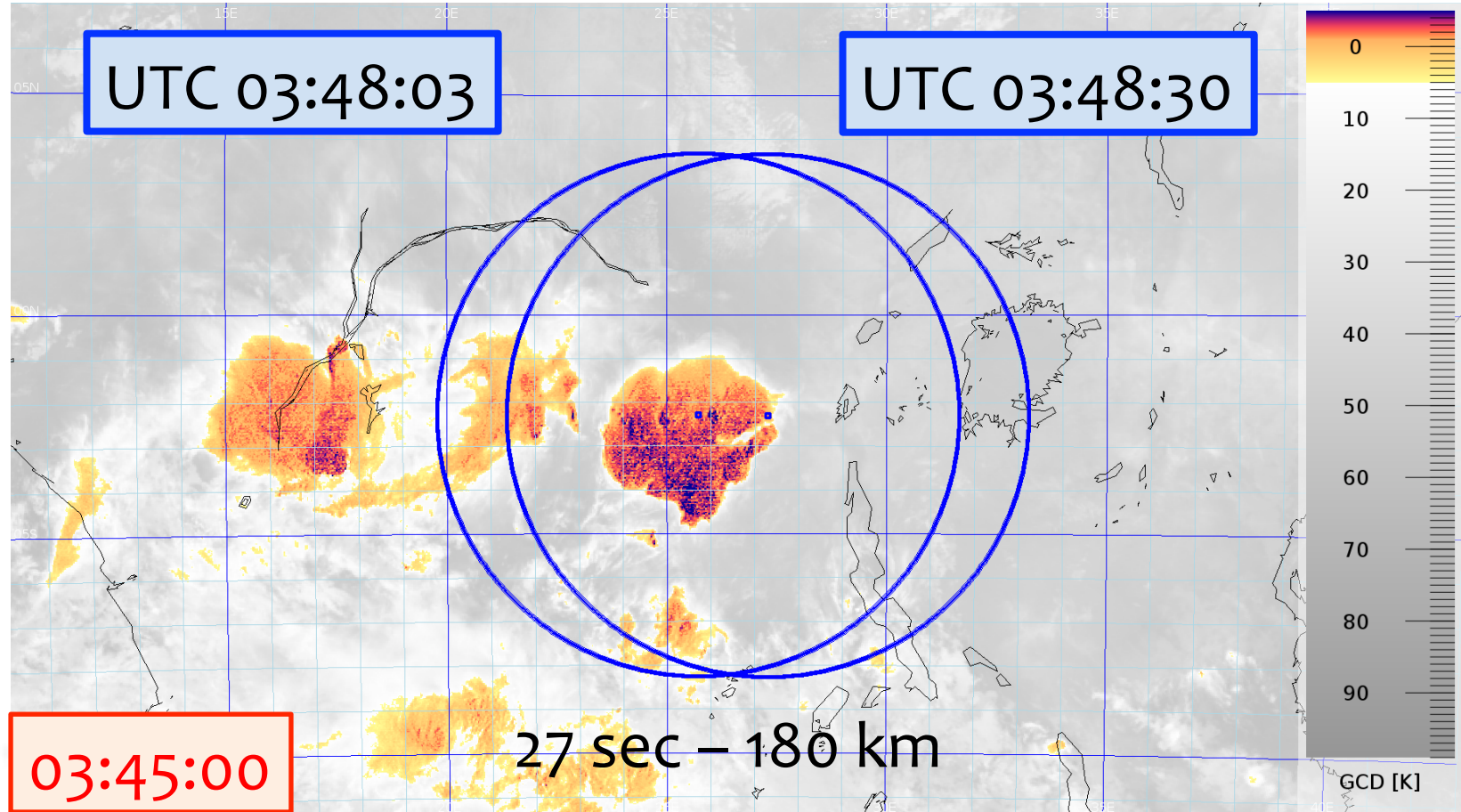
# TGFs and meteorology



# TGFs and meteorology

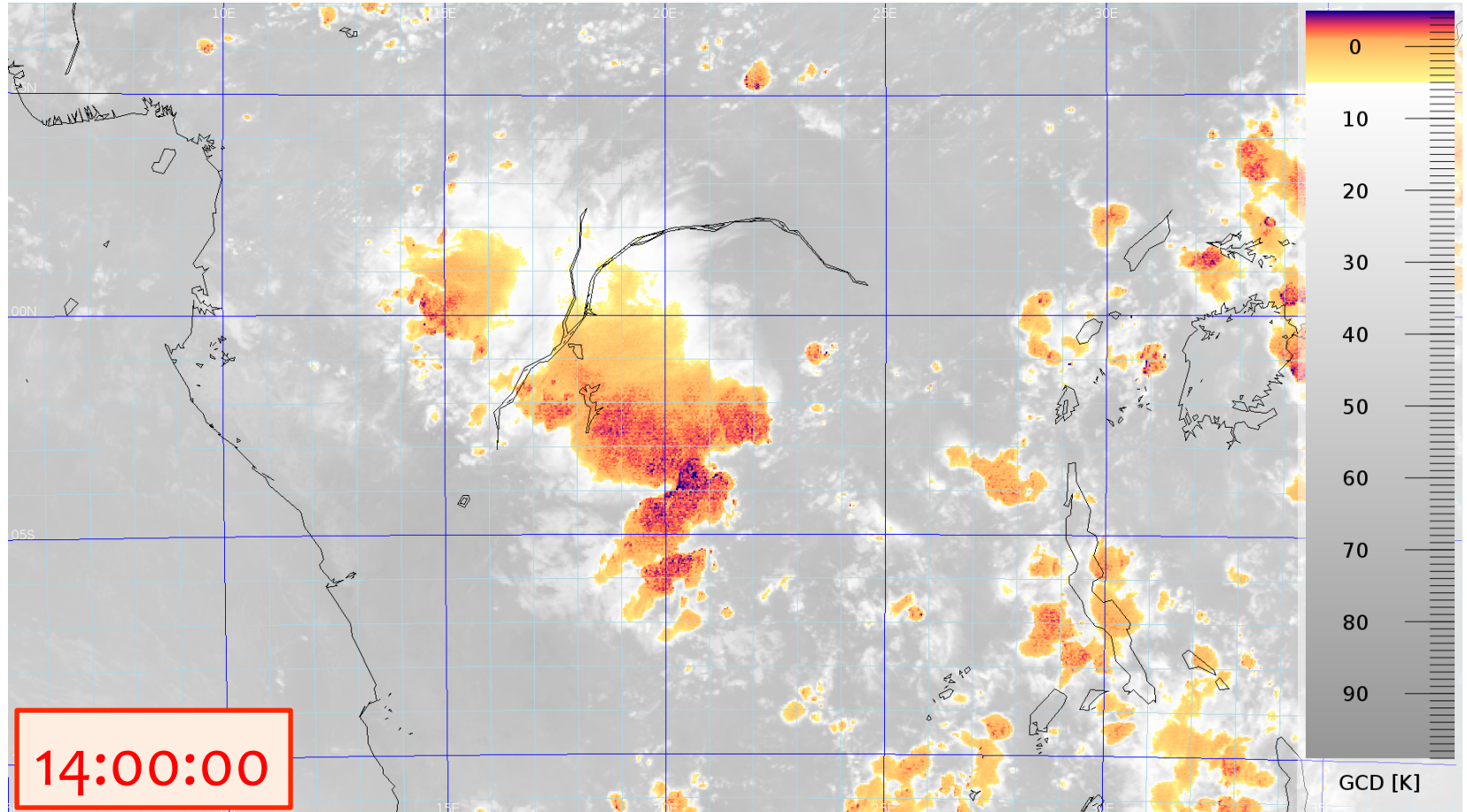


# TGFs and meteorology



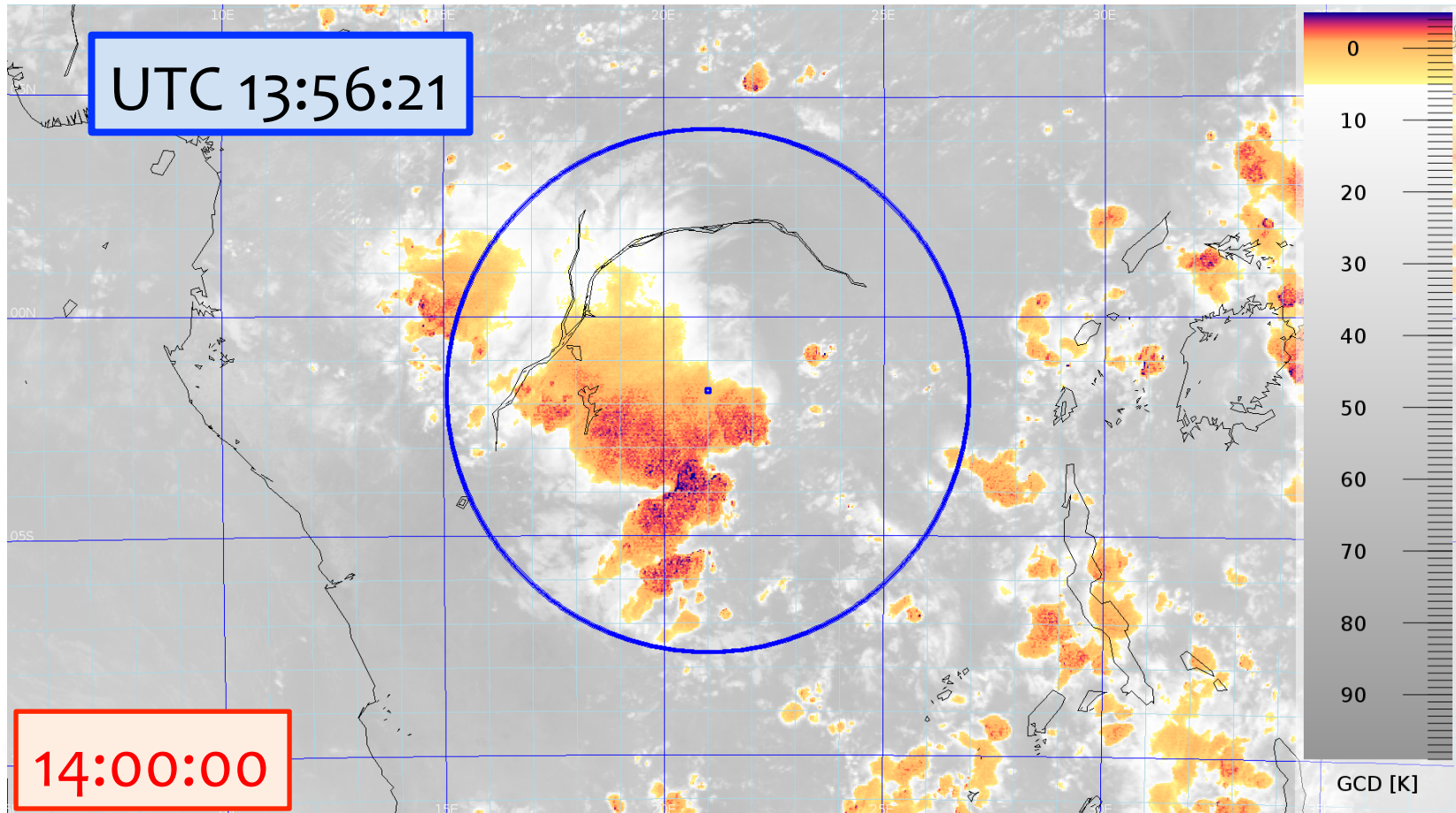


# TGFs and meteorology

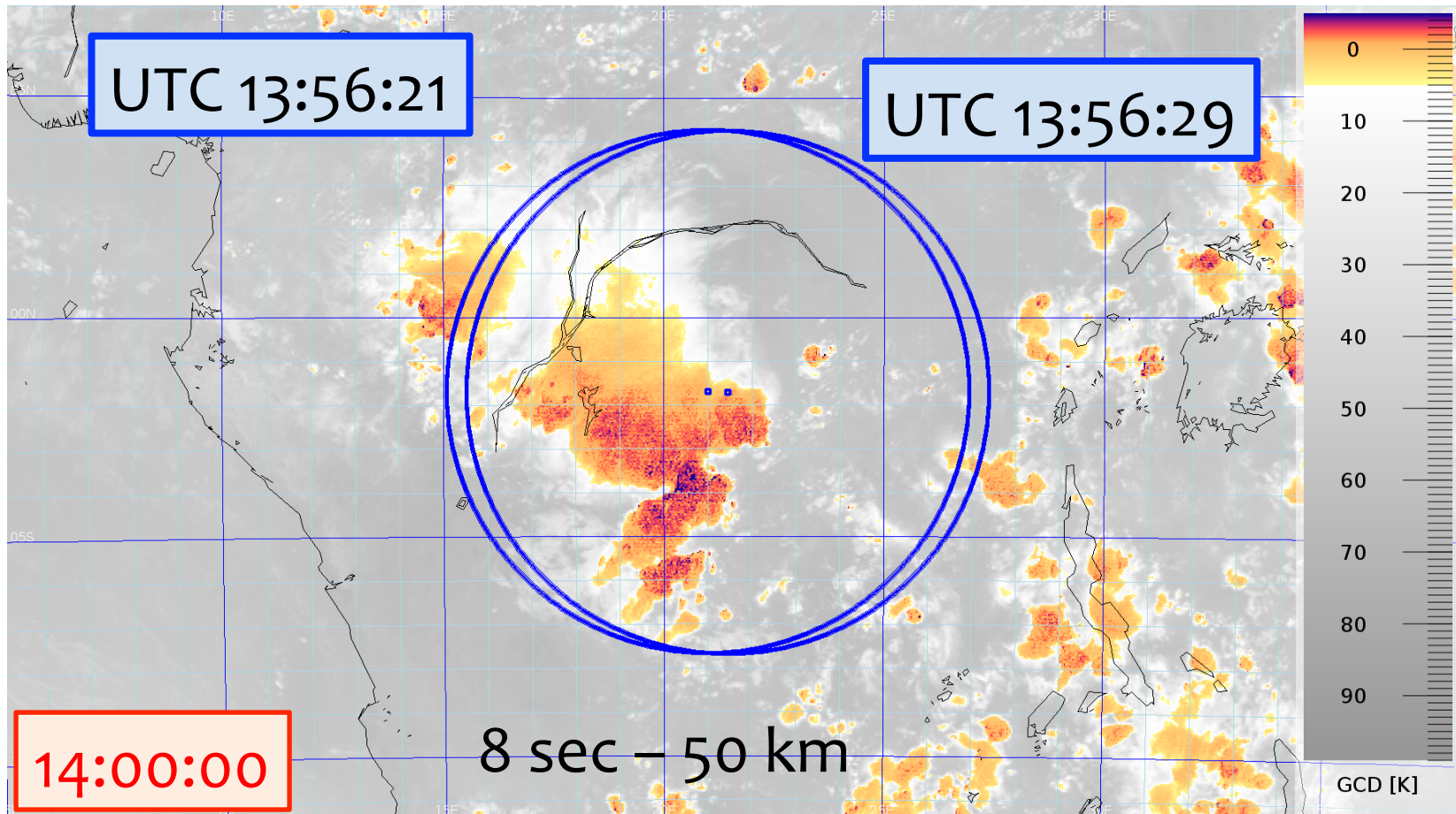




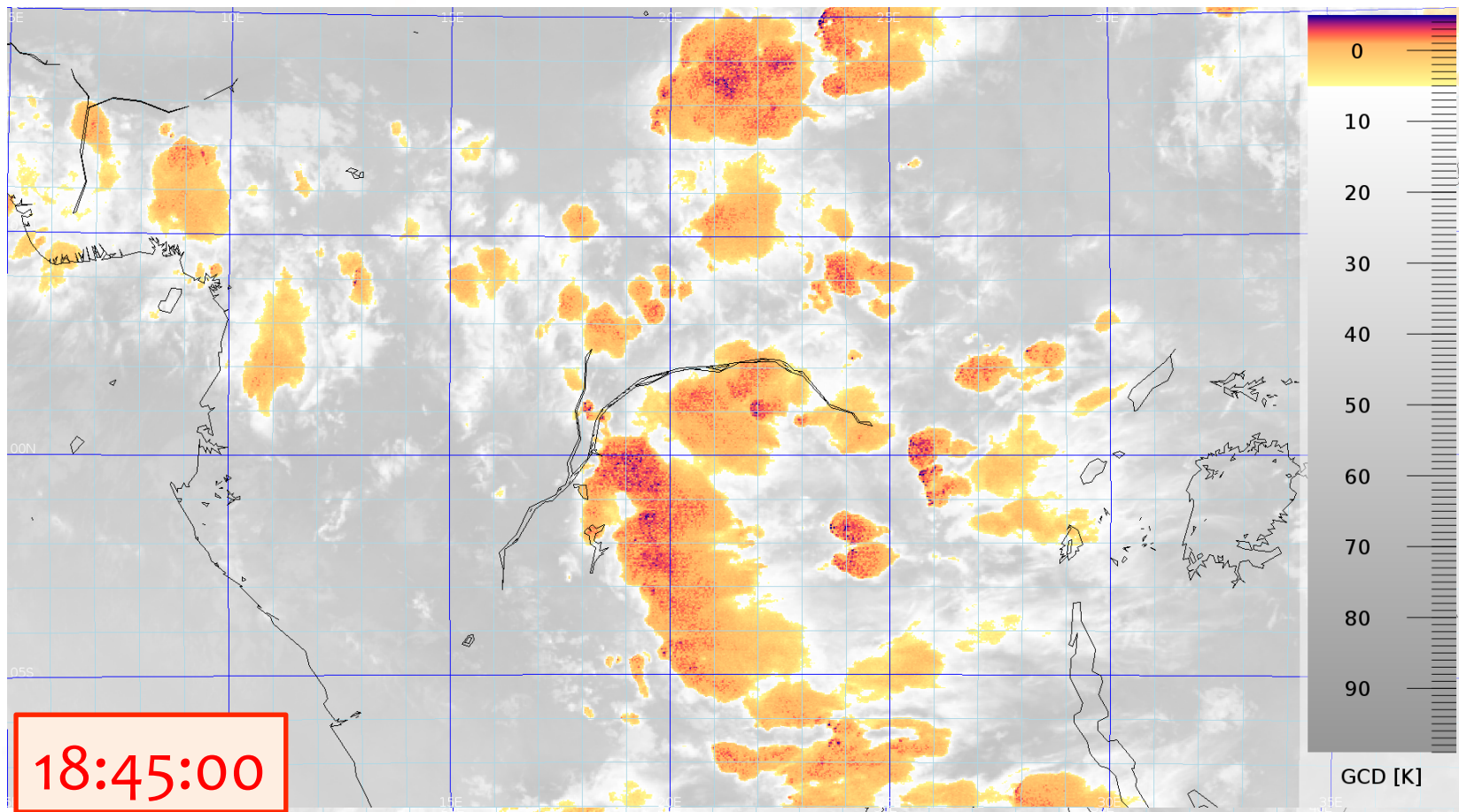
# TGFs and meteorology



# TGFs and meteorology

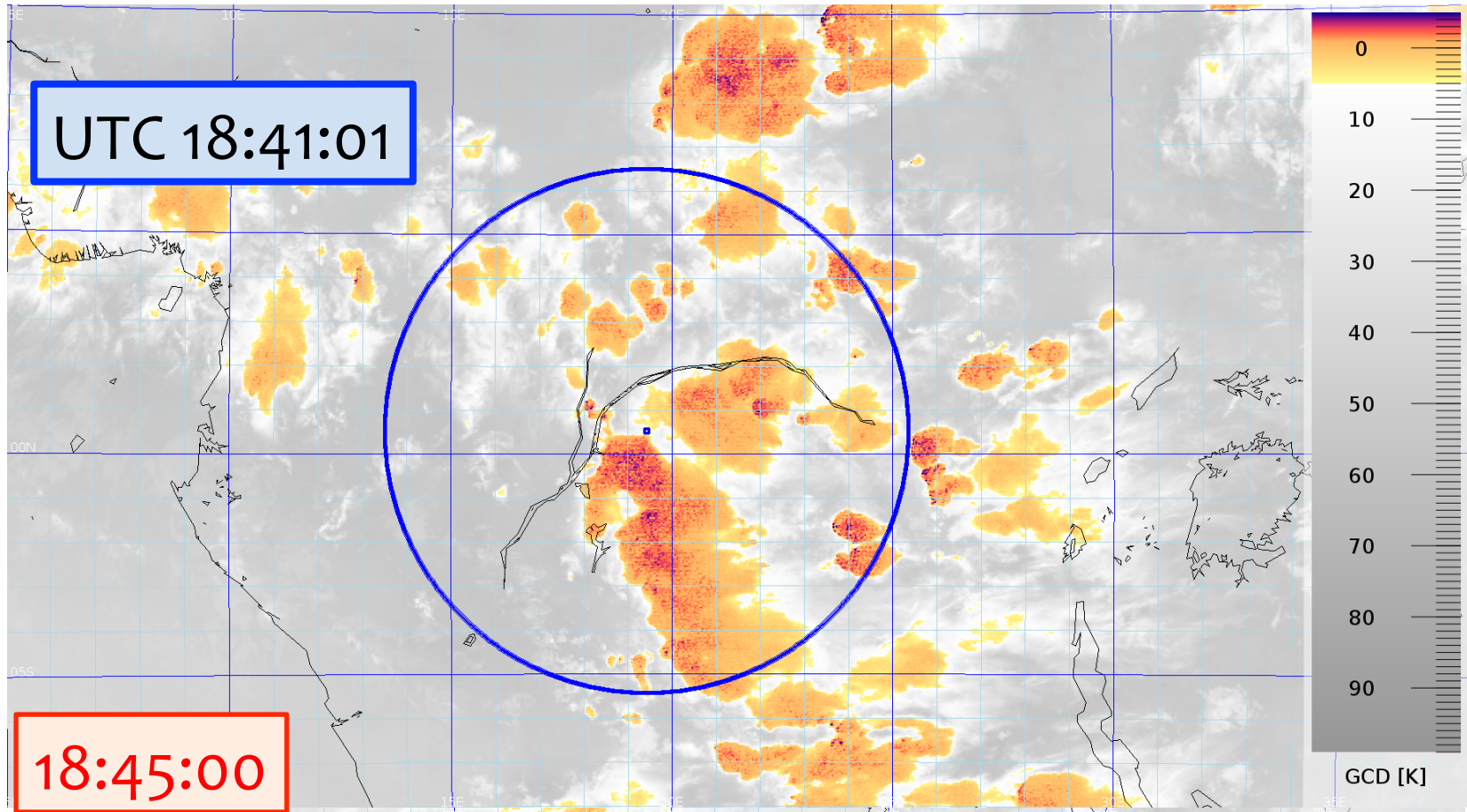


# TGFs and meteorology

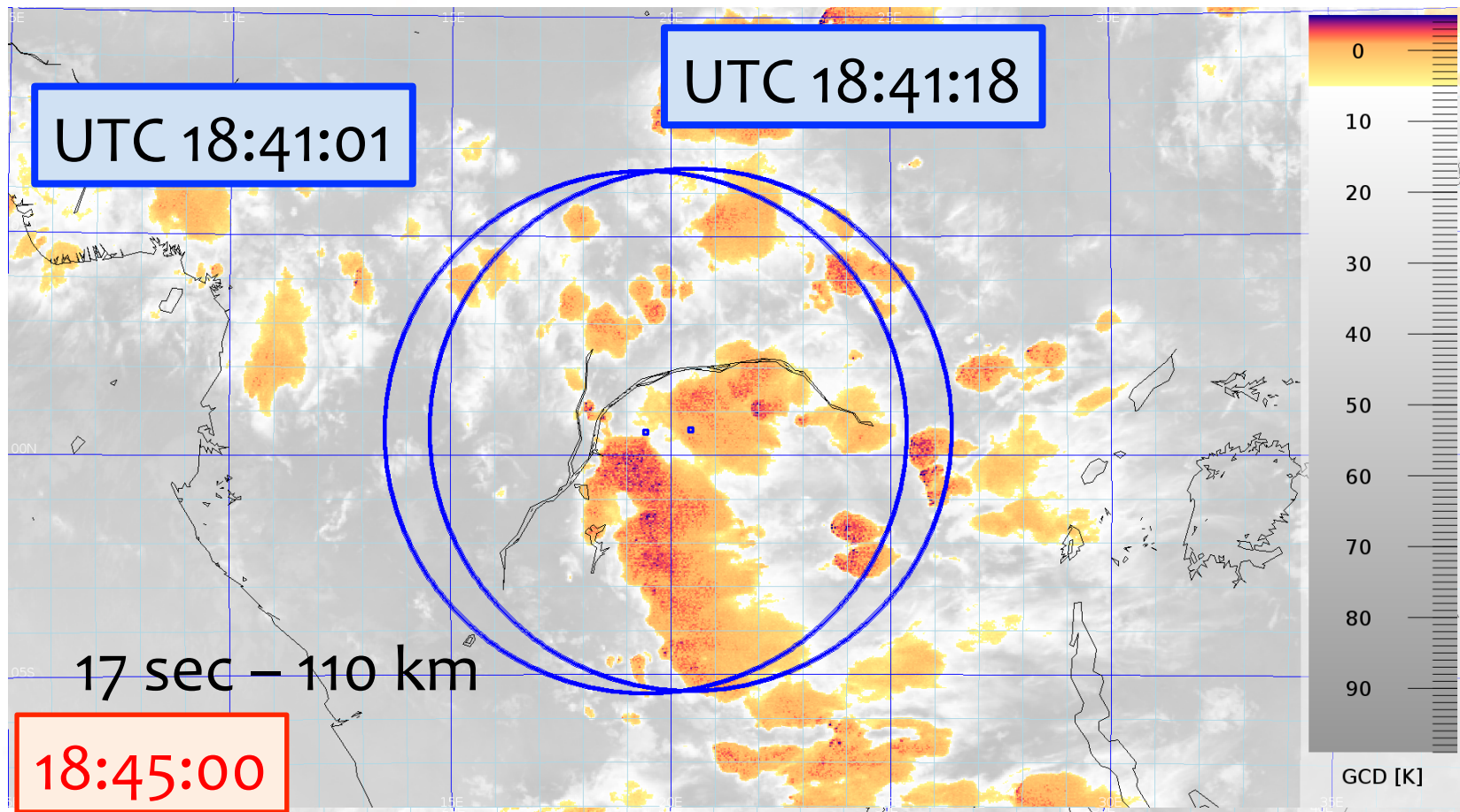




# TGFs and meteorology

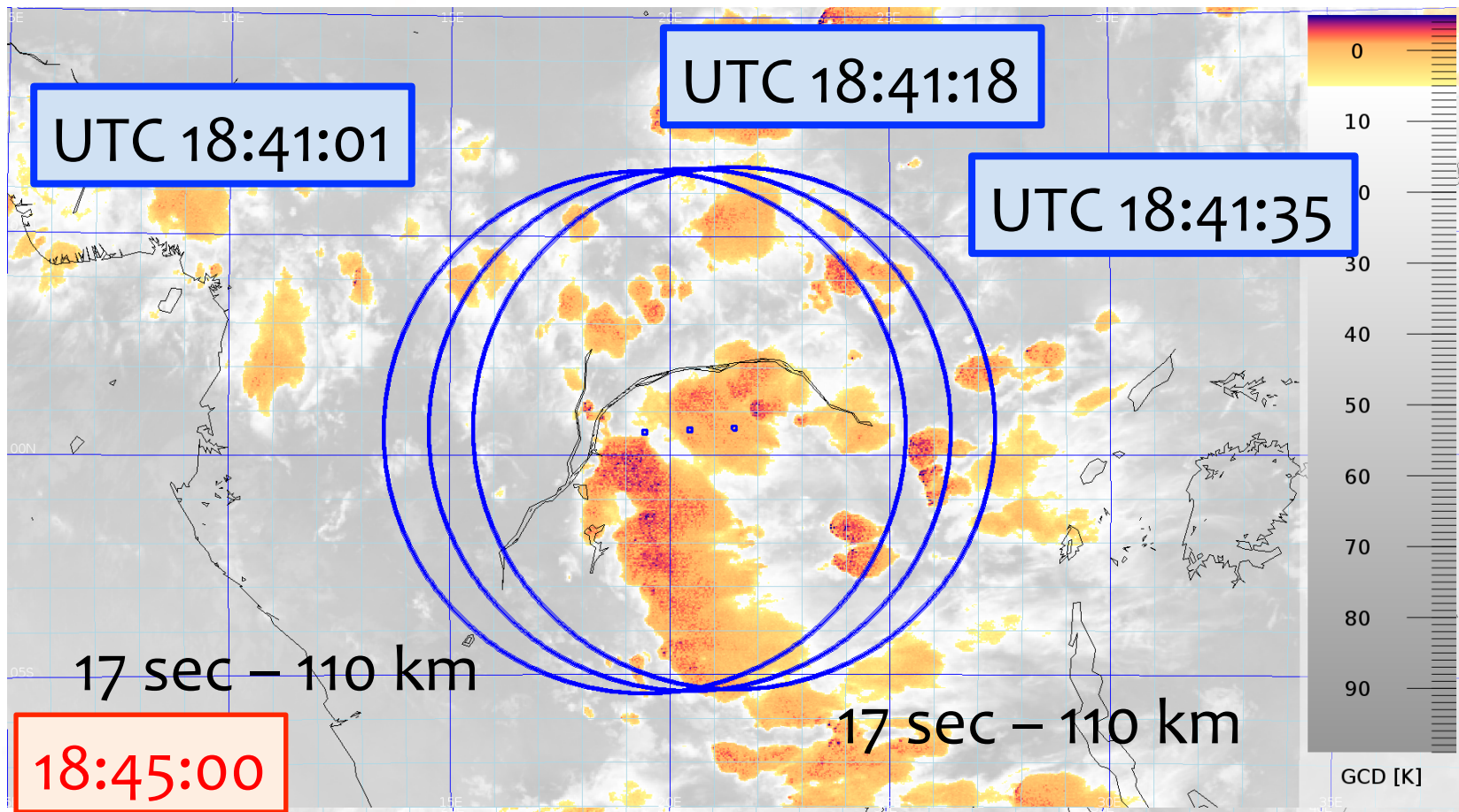


# TGFs and meteorology

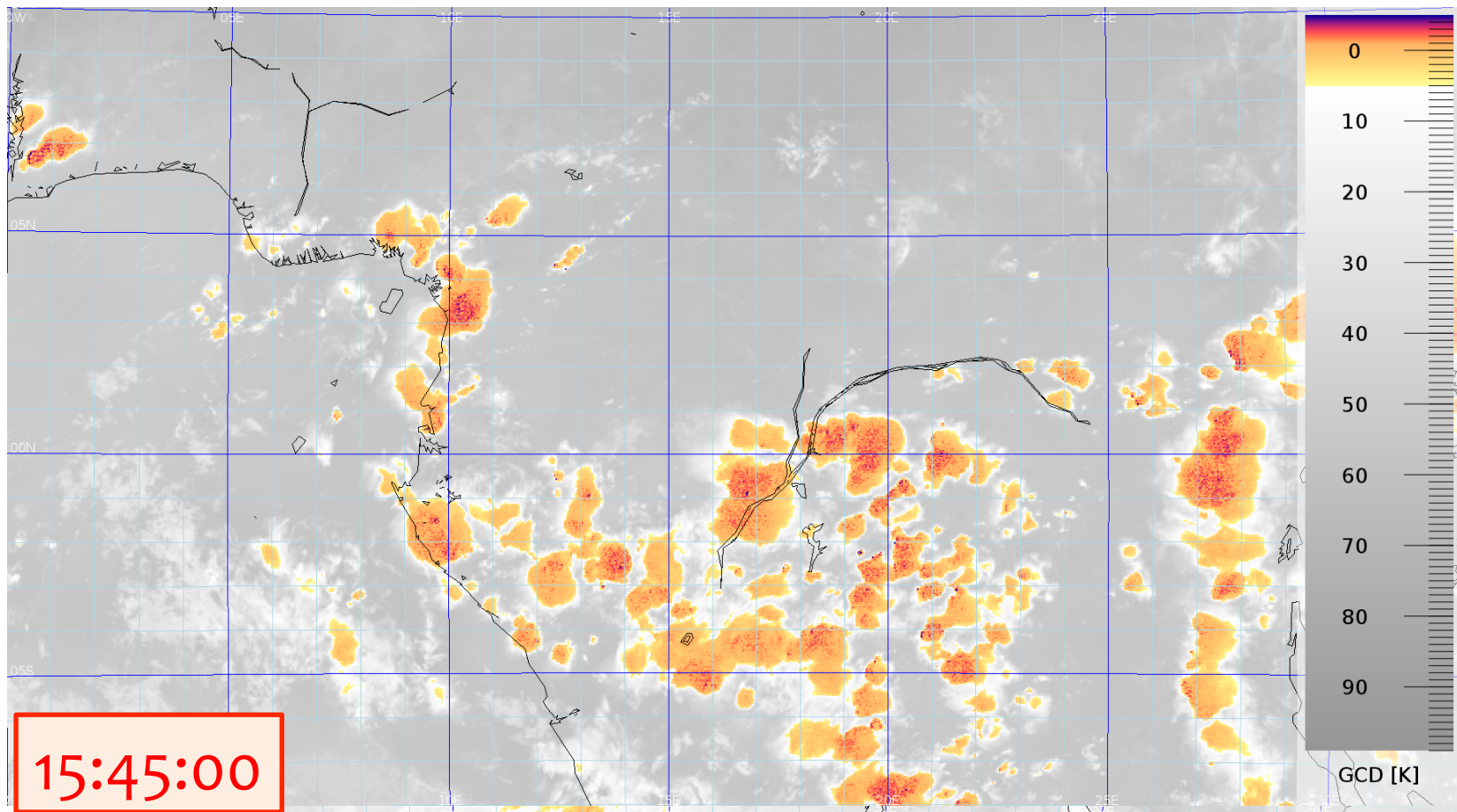




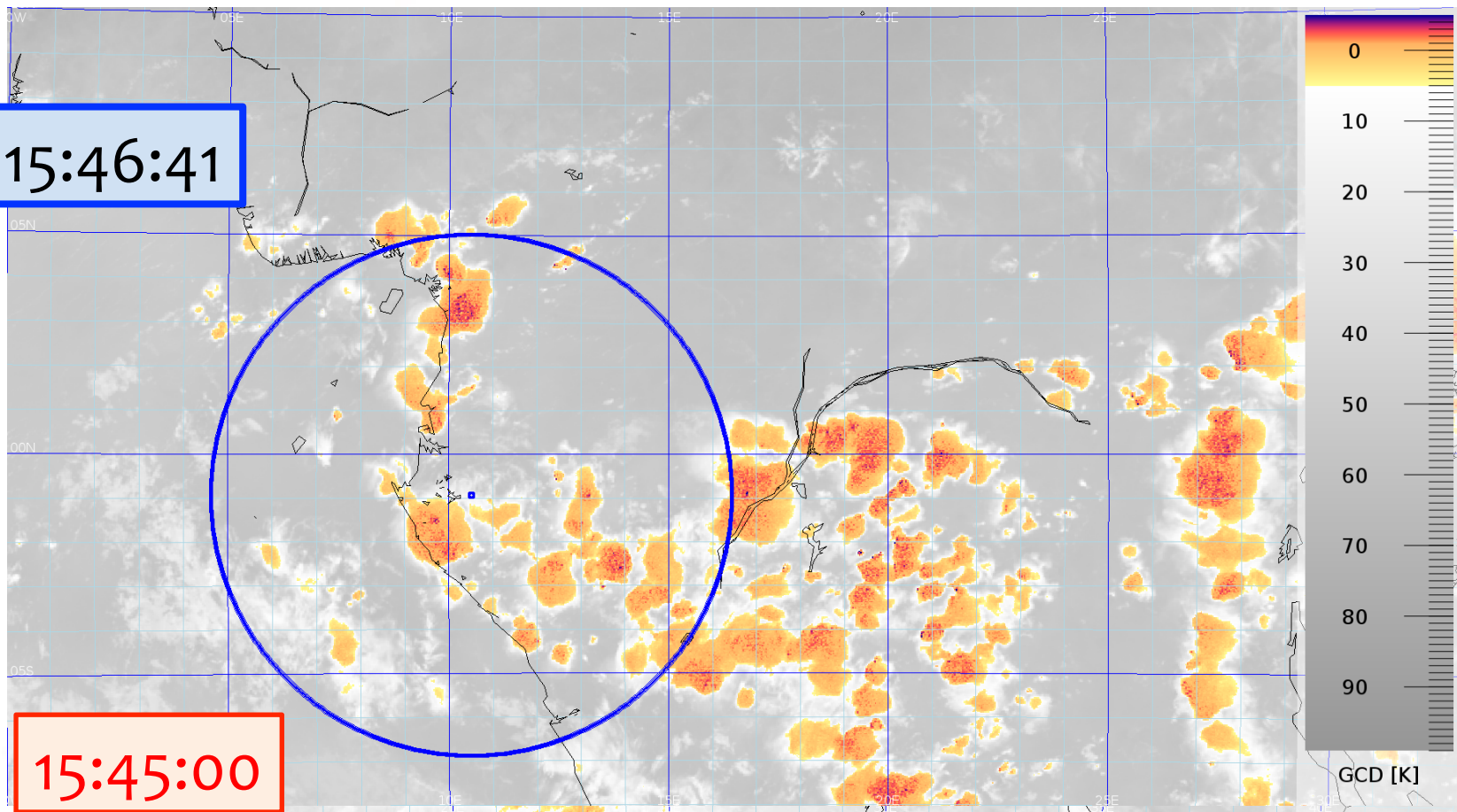
# TGFs and meteorology



# TGFs and meteorology

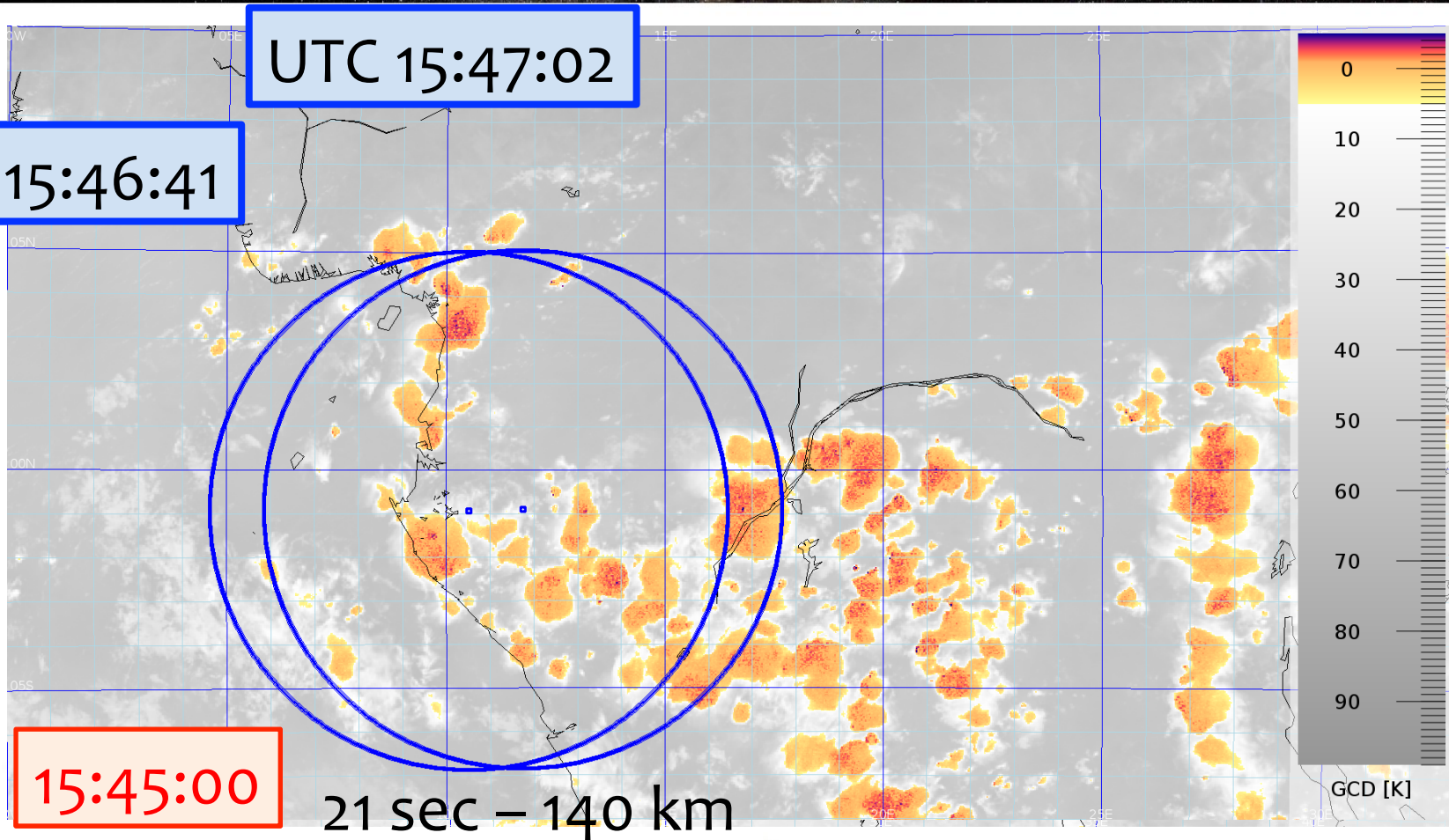


# TGFs and meteorology

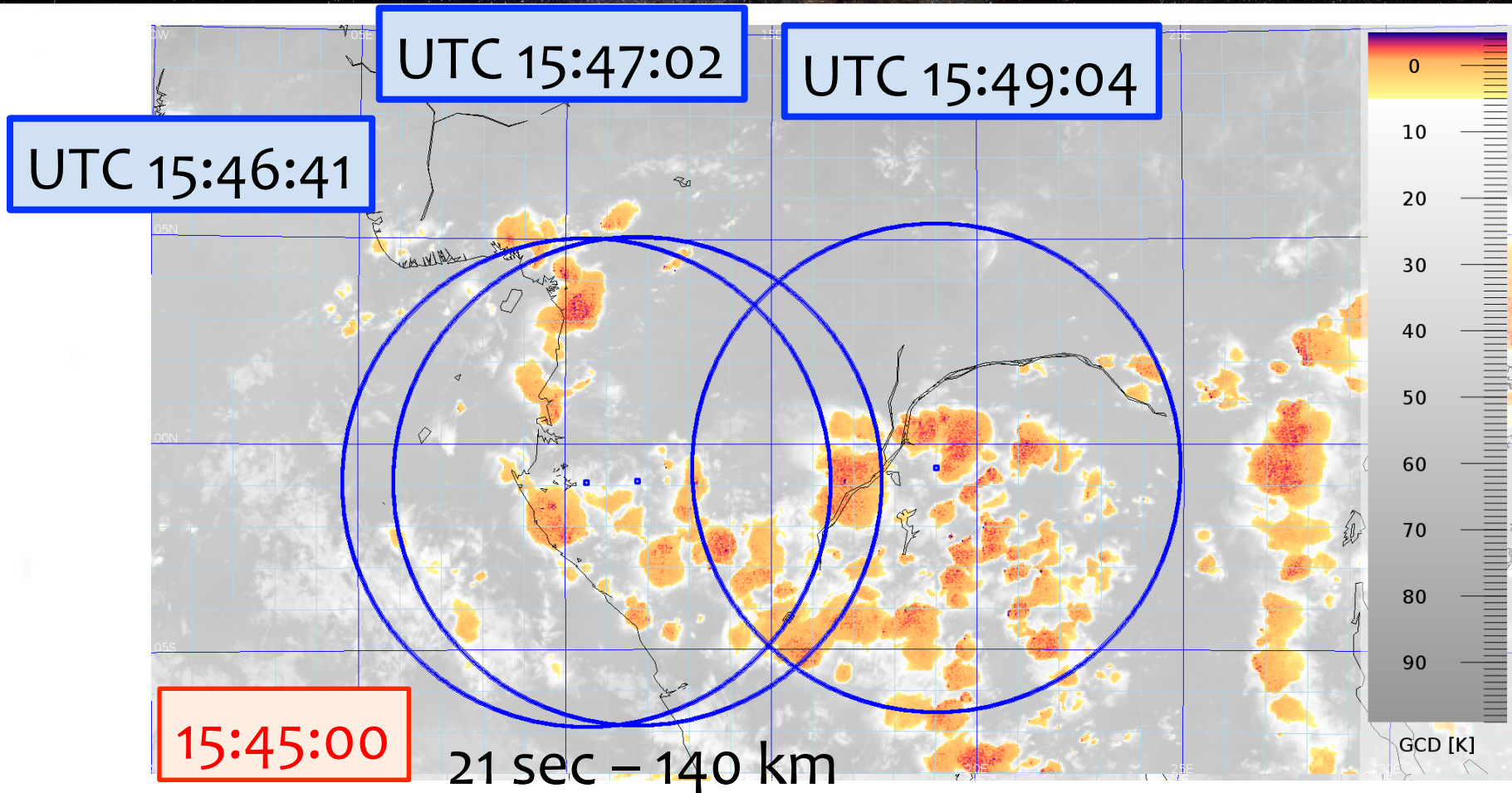




# TGFs and meteorology

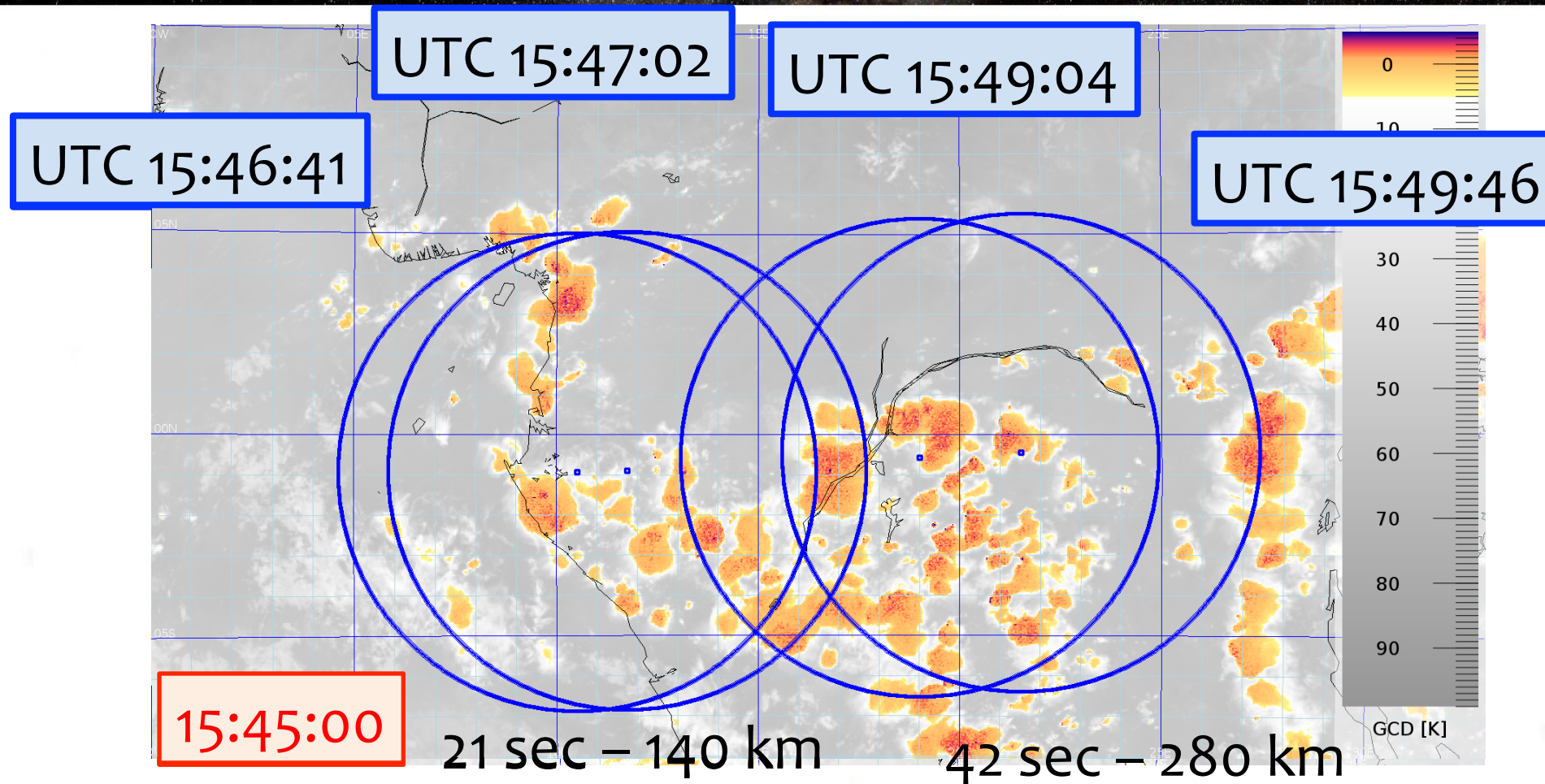


# TGFs and meteorology

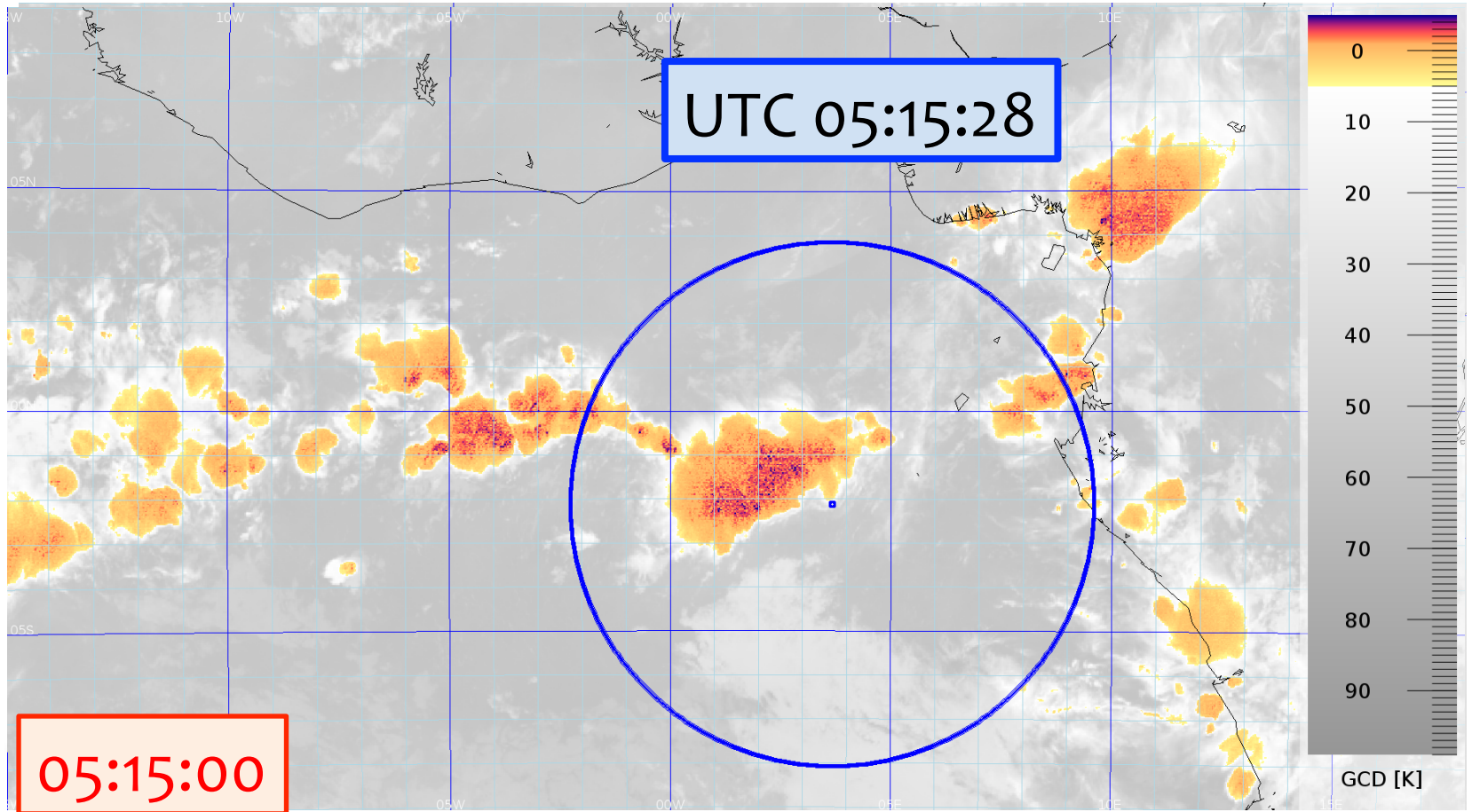




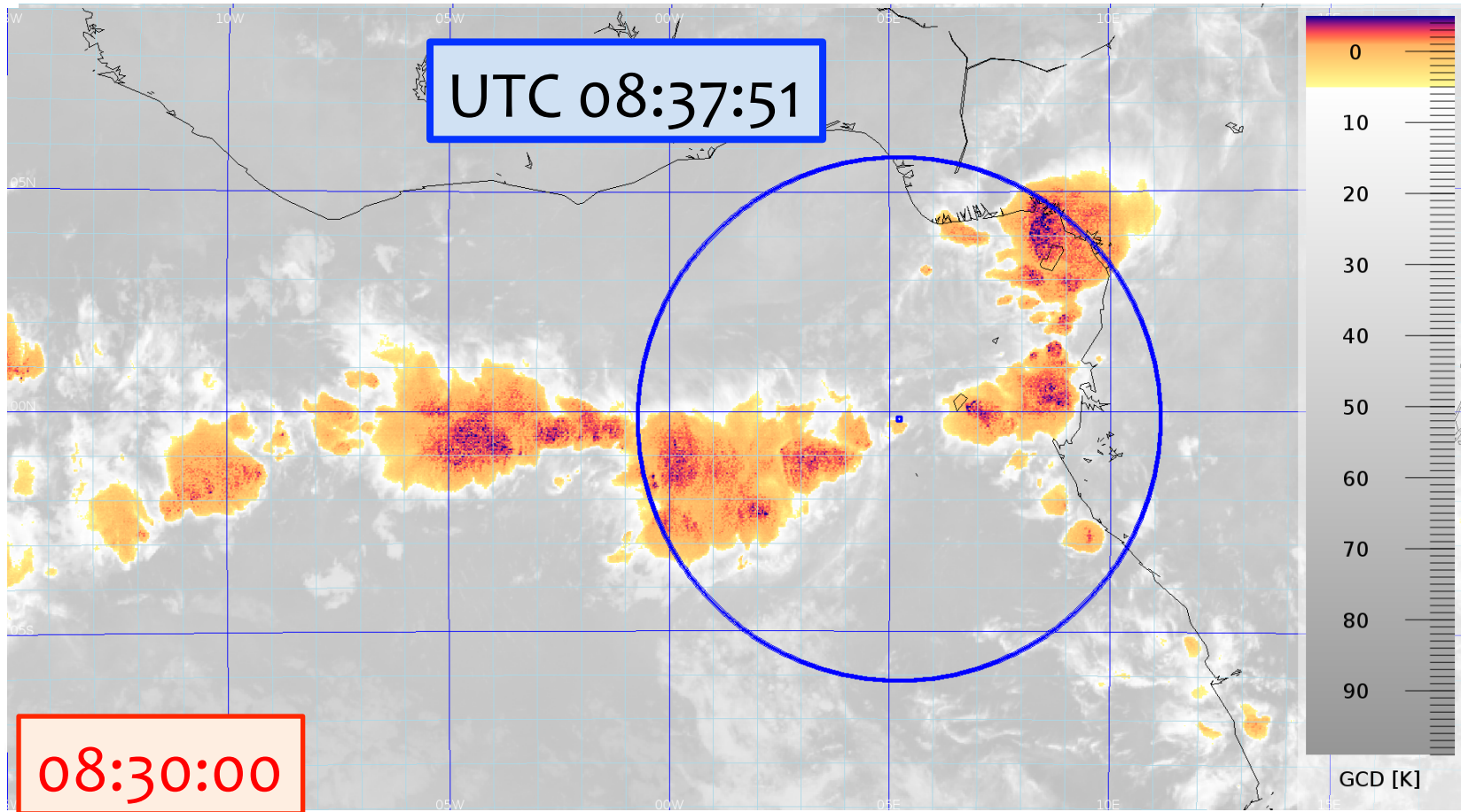
# TGFs and meteorology



# TGFs and meteorology

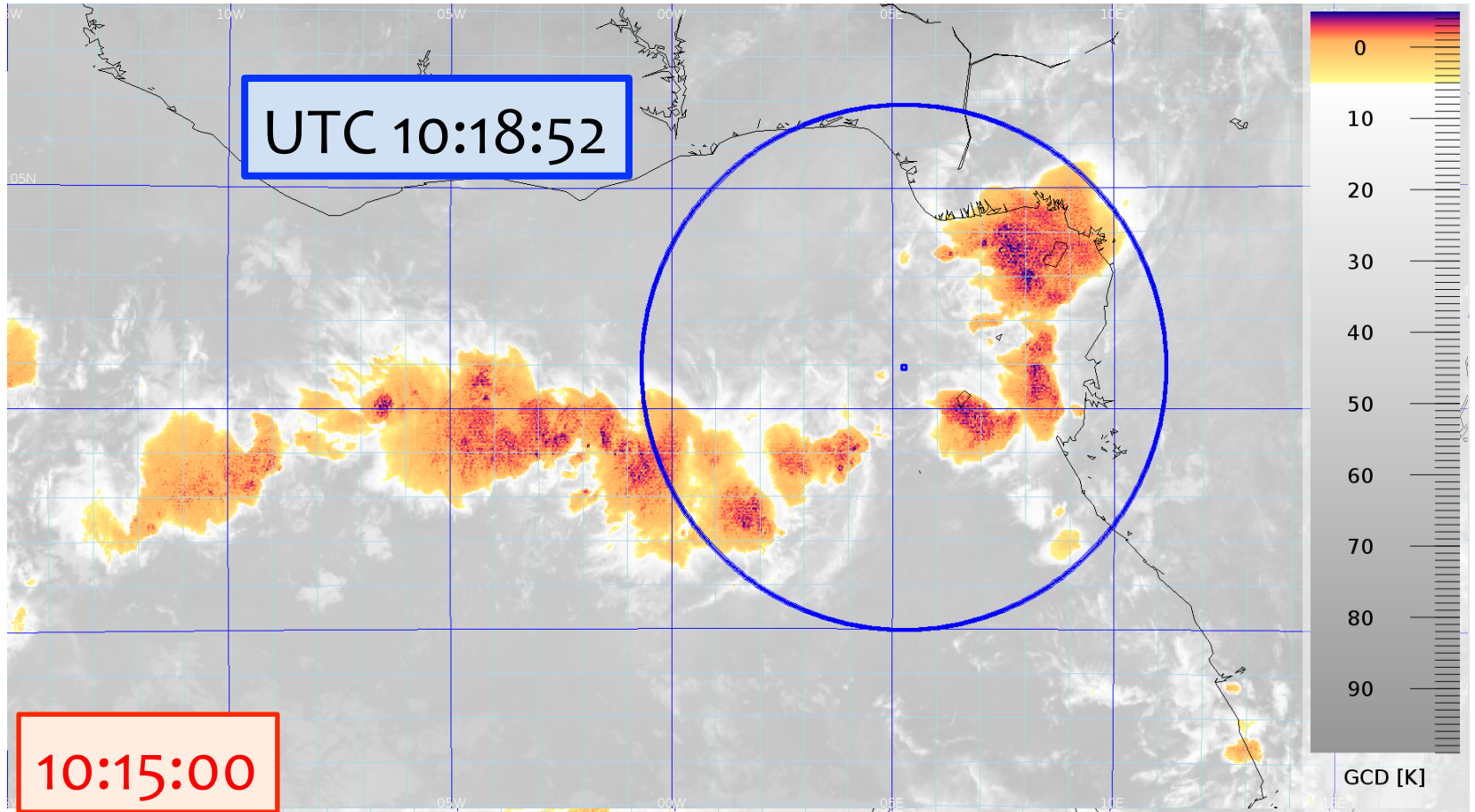


# TGFs and meteorology





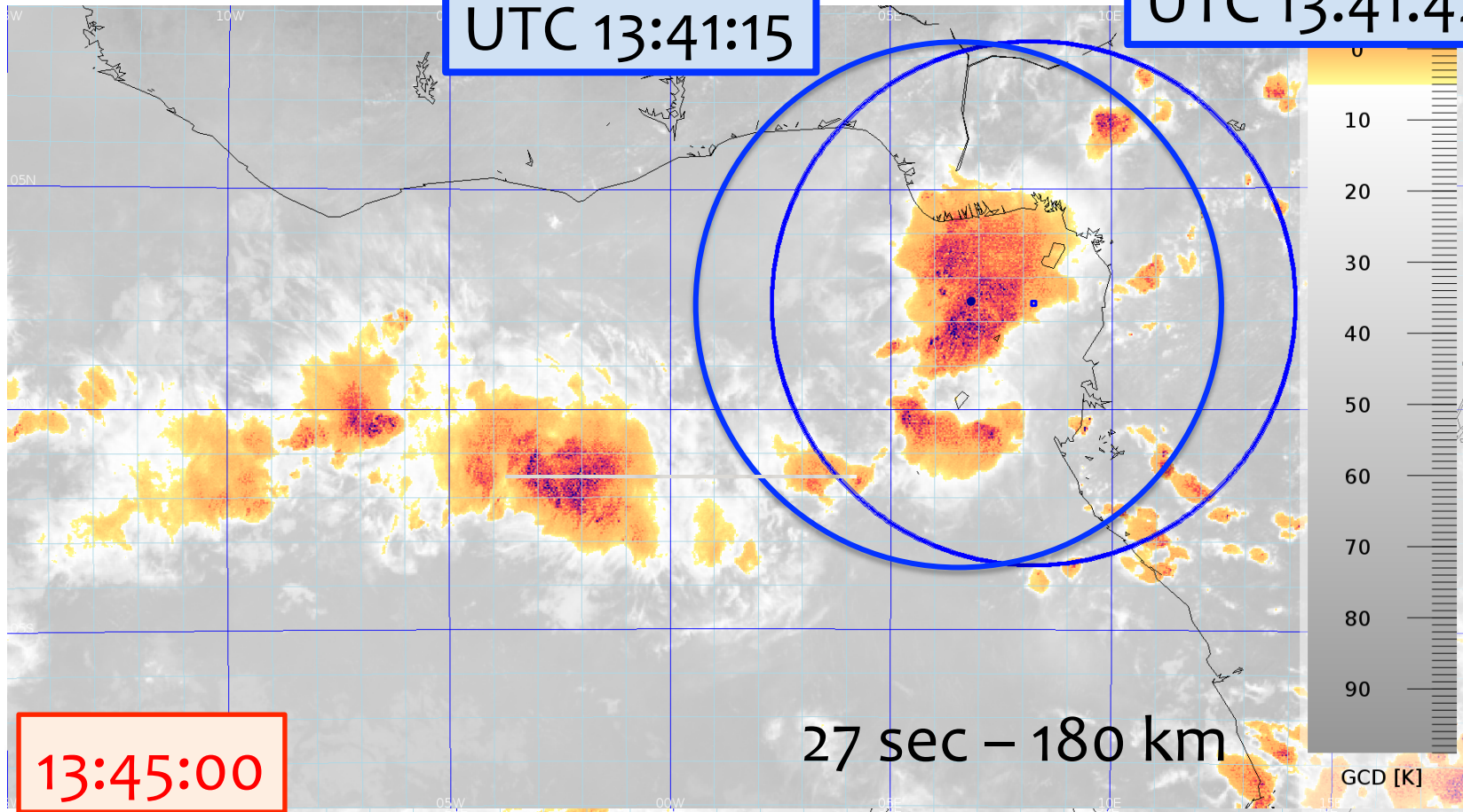
# TGFs and meteorology



# TGFs and meteorology

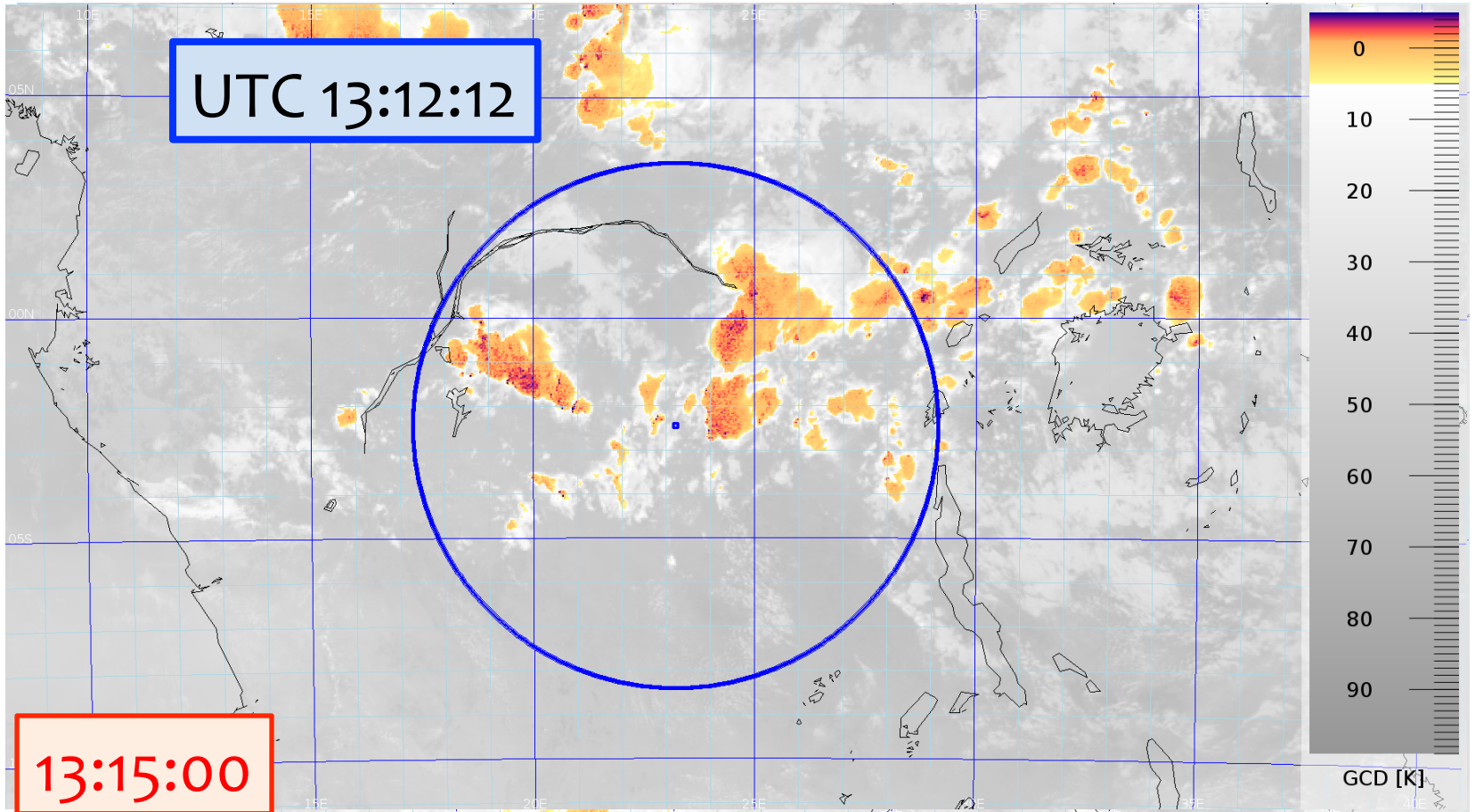
UTC 13:41:15

UTC 13:41:42

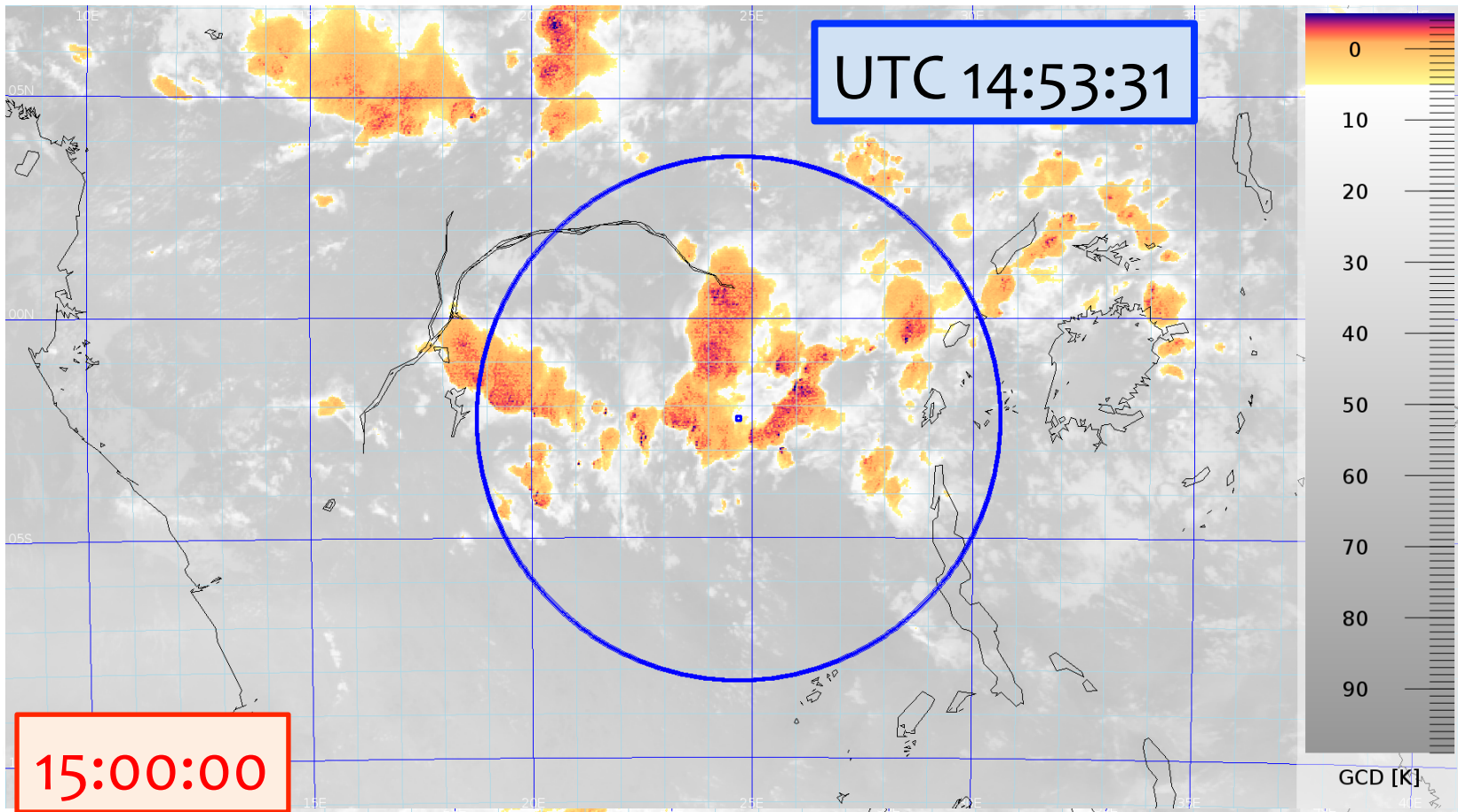




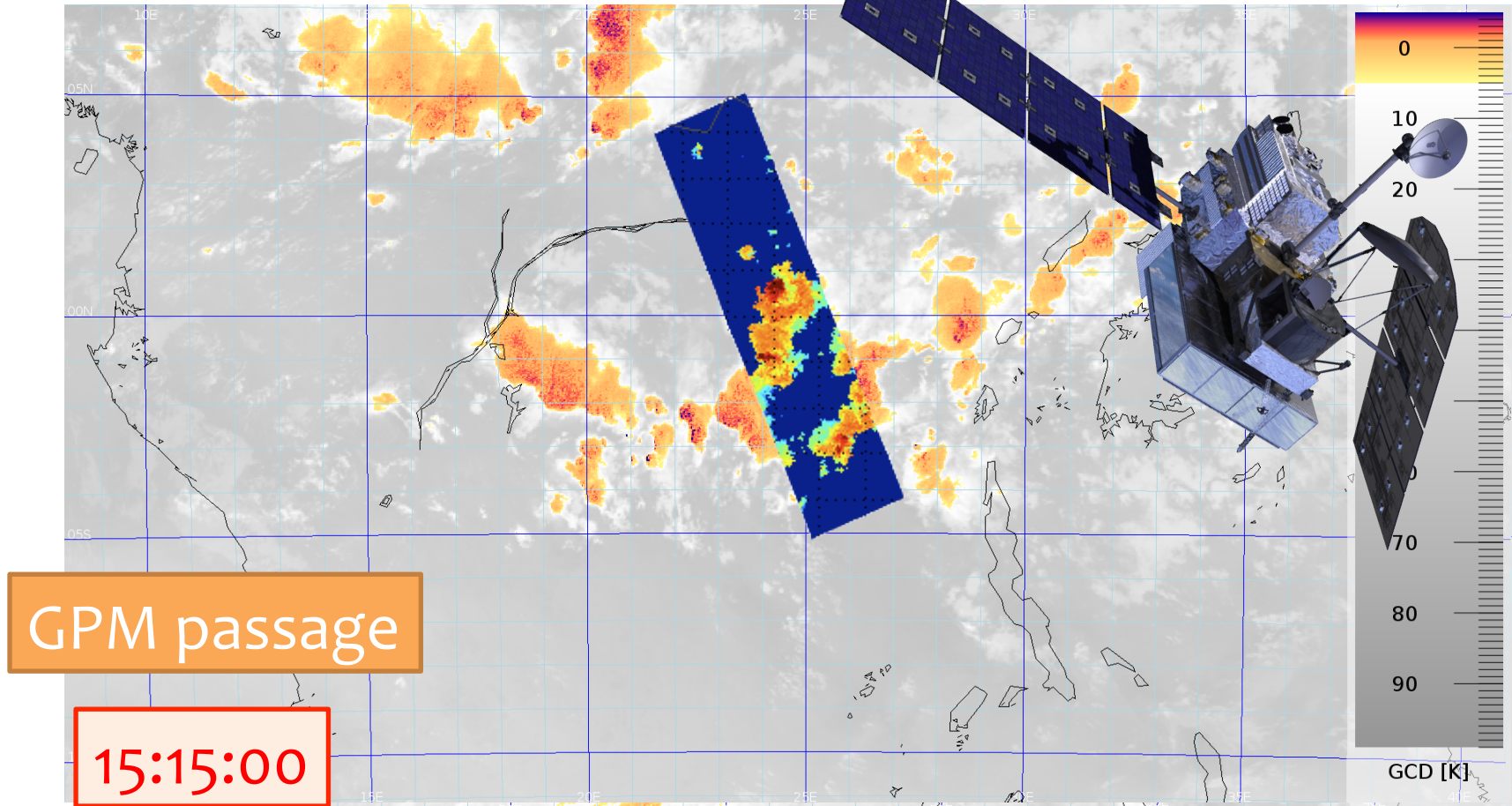
# TGFs and meteorology



# TGFs and meteorology

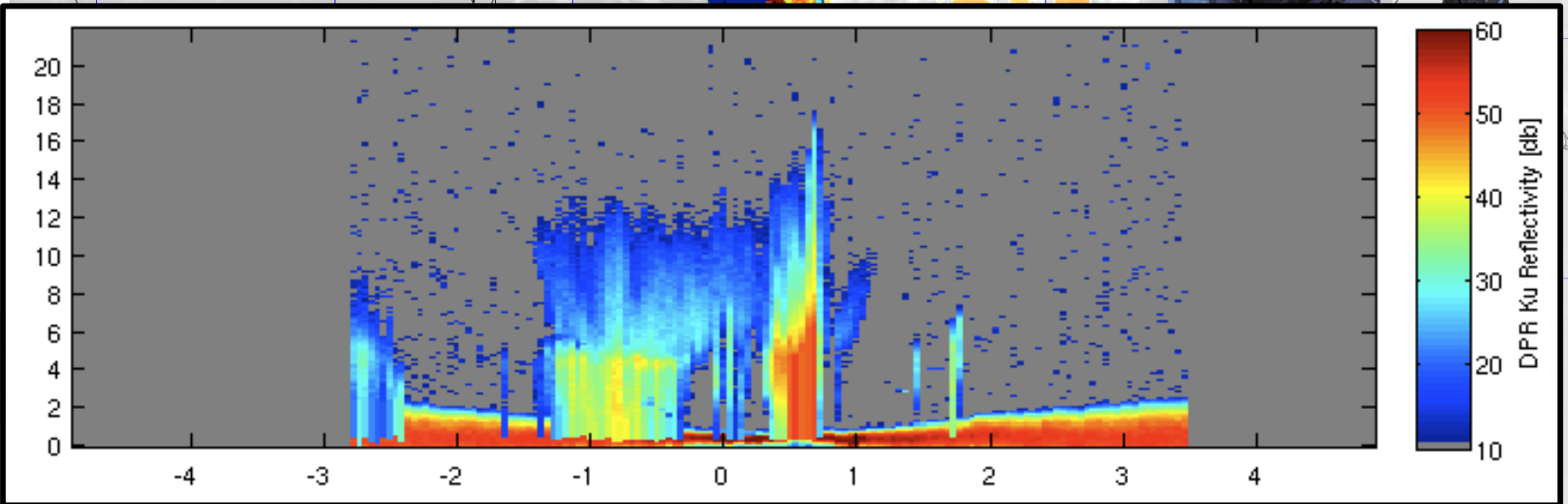
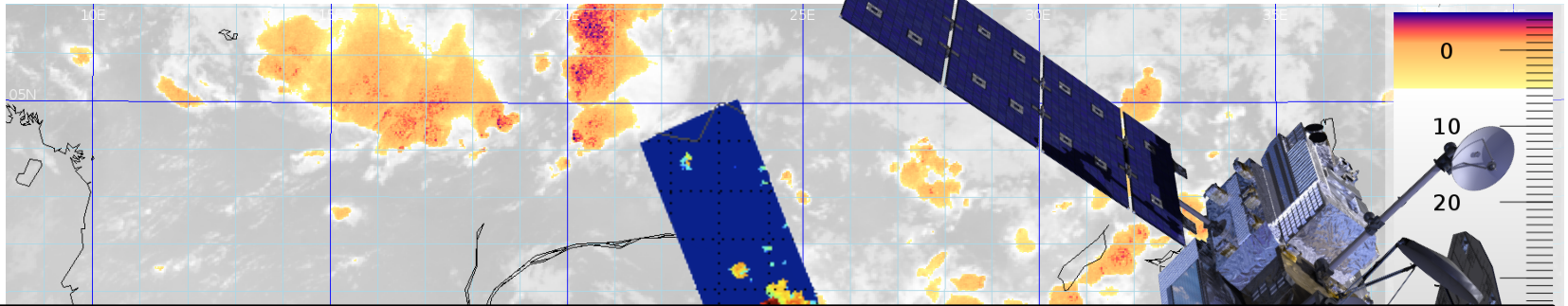


# TGFs and meteorology





# TGFs and meteorology



15:15:00

GCD [K]



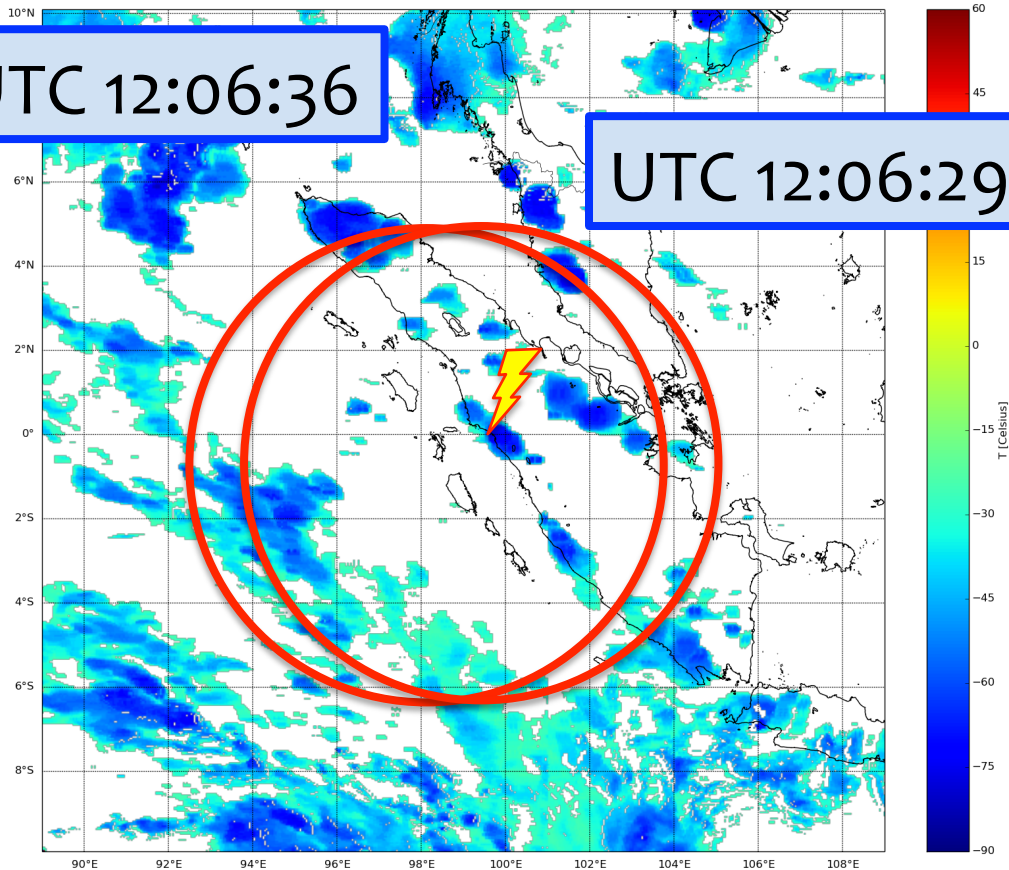
# TGFs and meteorology

- 30  $\mu$ s

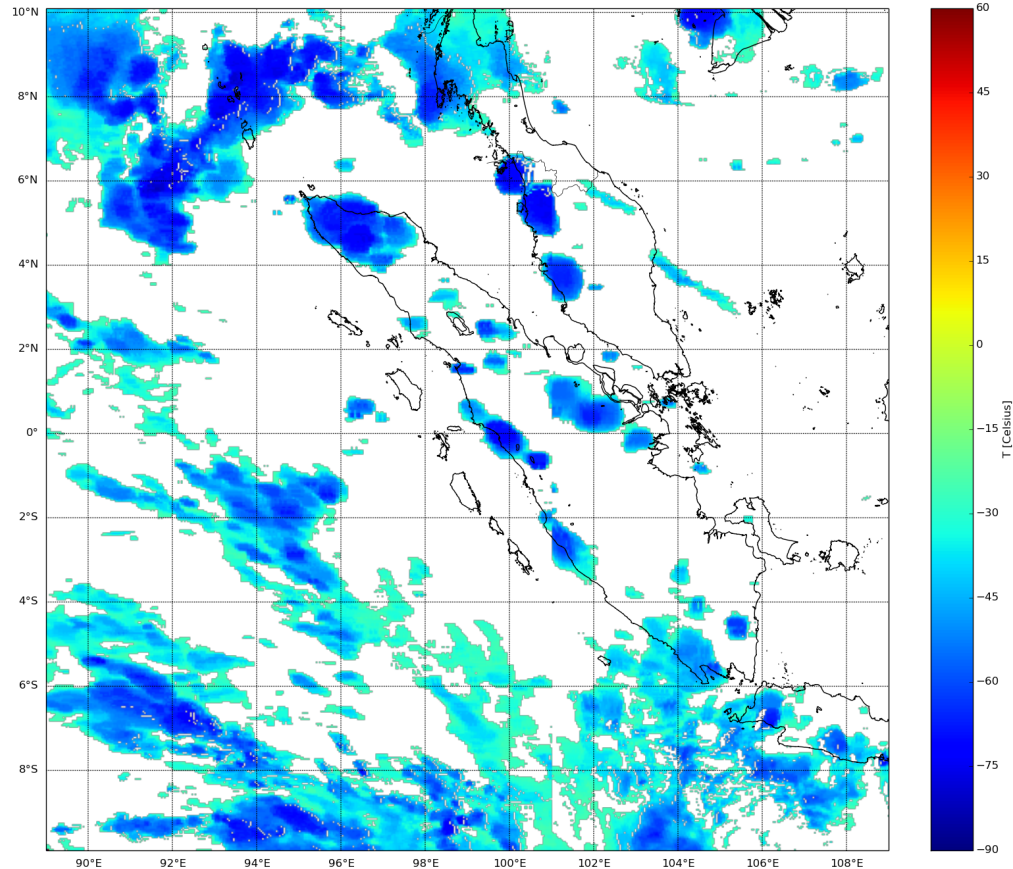
UTC 12:06:36

UTC 12:06:29

12:00:00

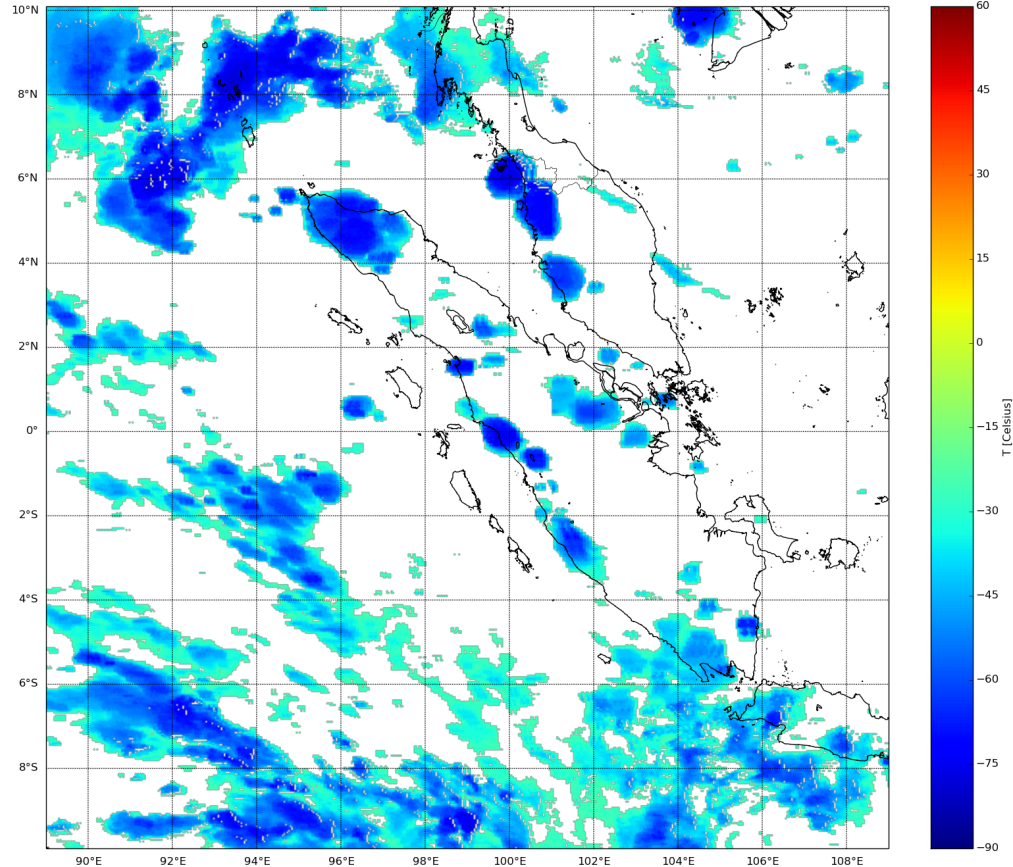


# TGFs and meteorology



12:30:00

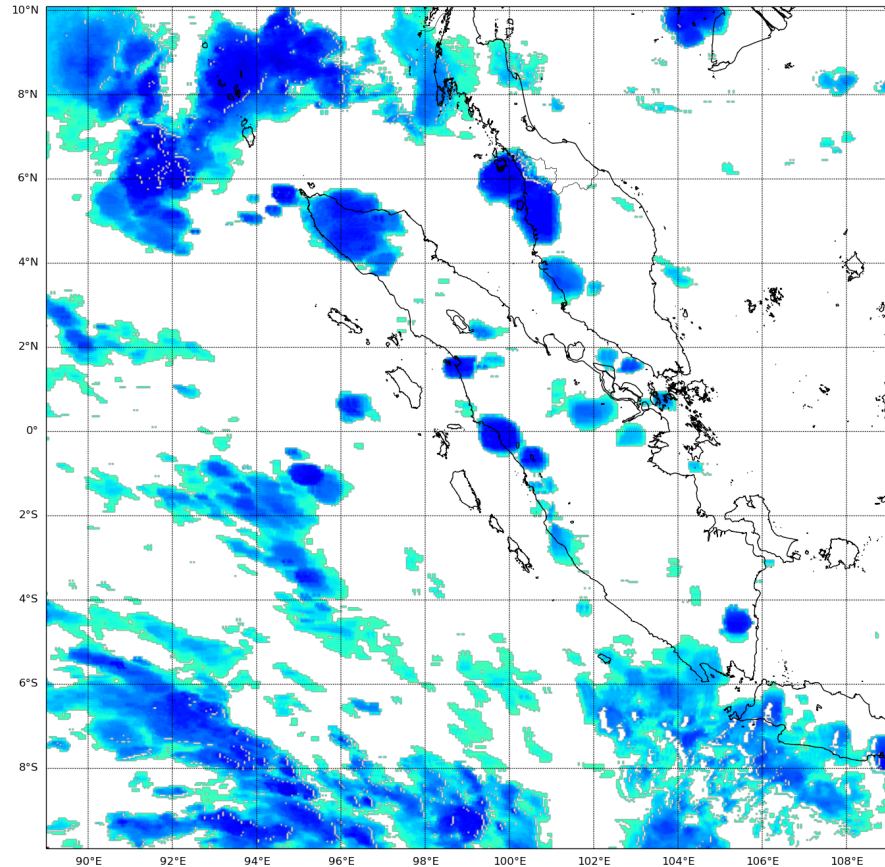
# TGFs and meteorology



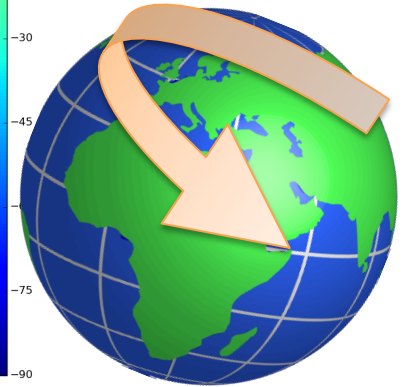
13:00:00



# TGFs and meteorology

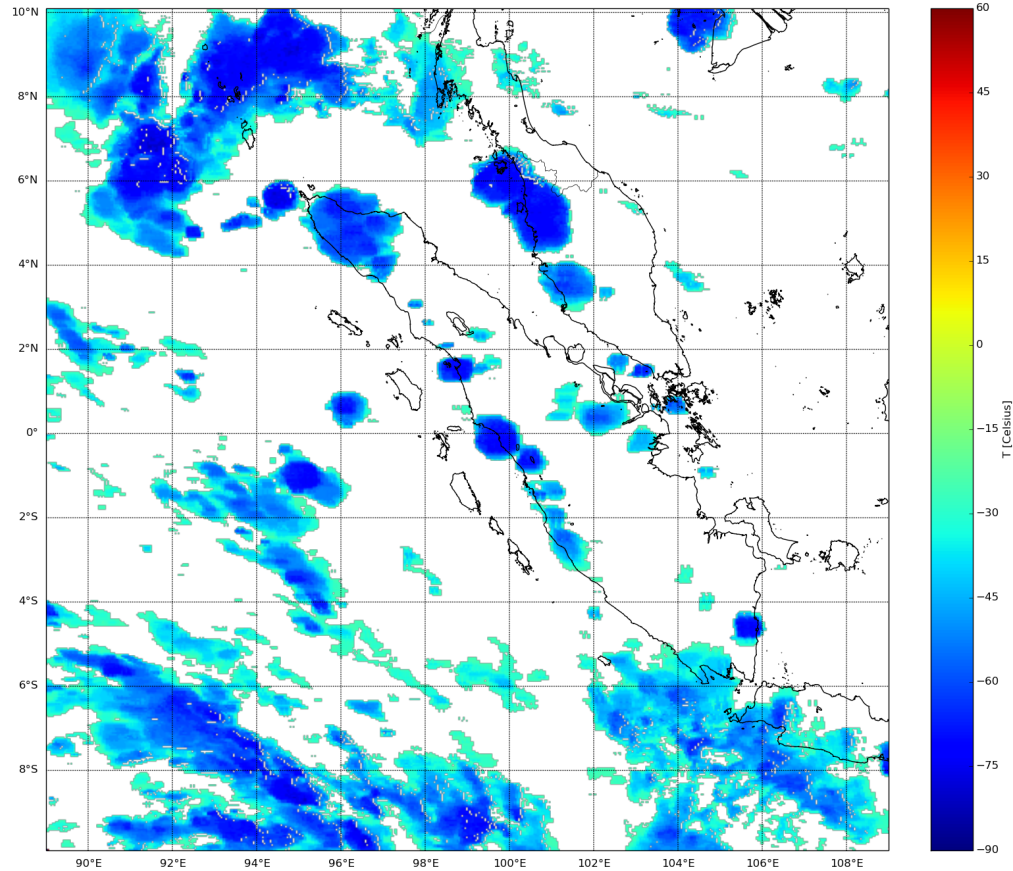


13:30:00



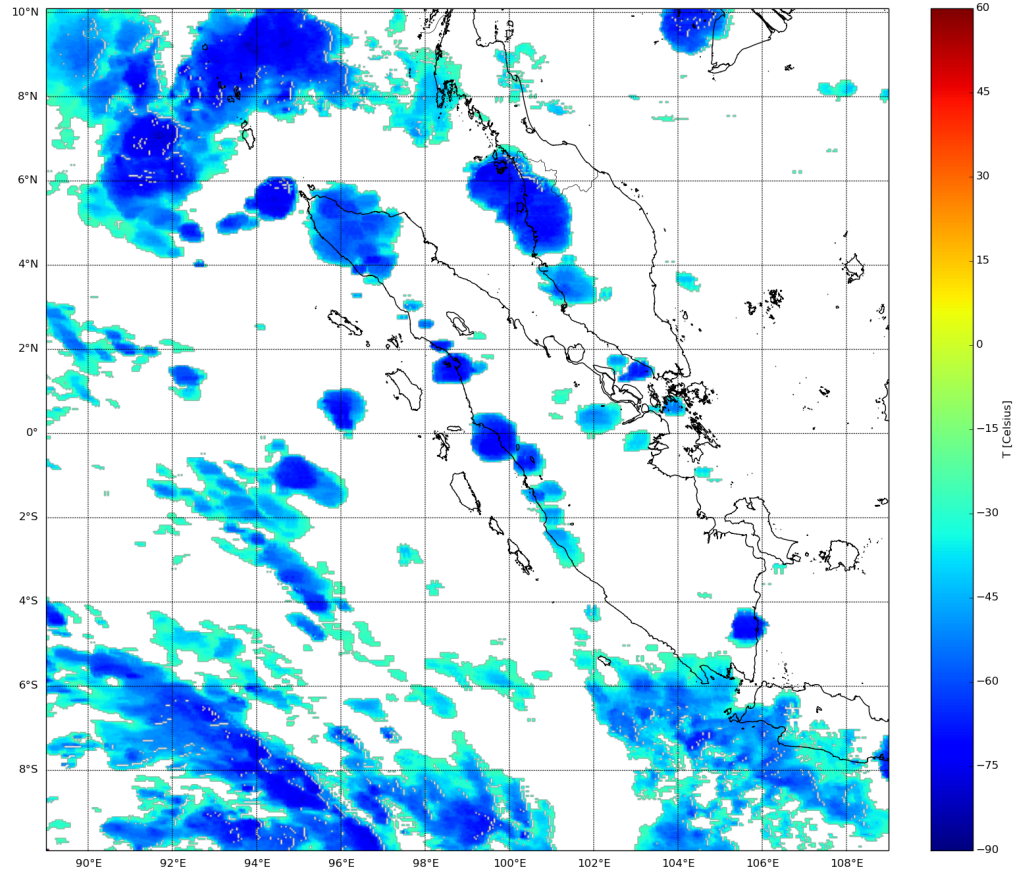


# TGFs and meteorology



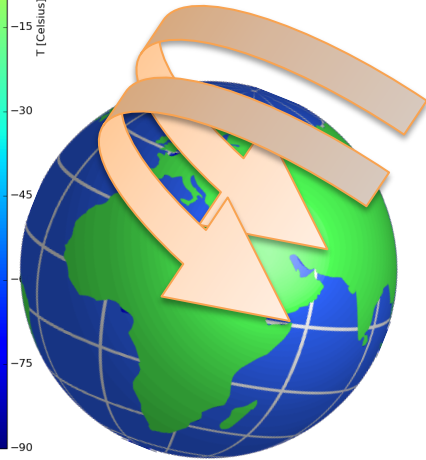
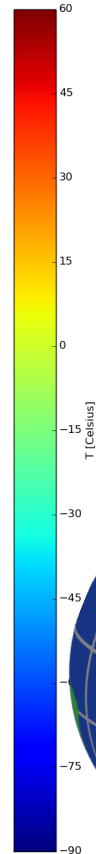
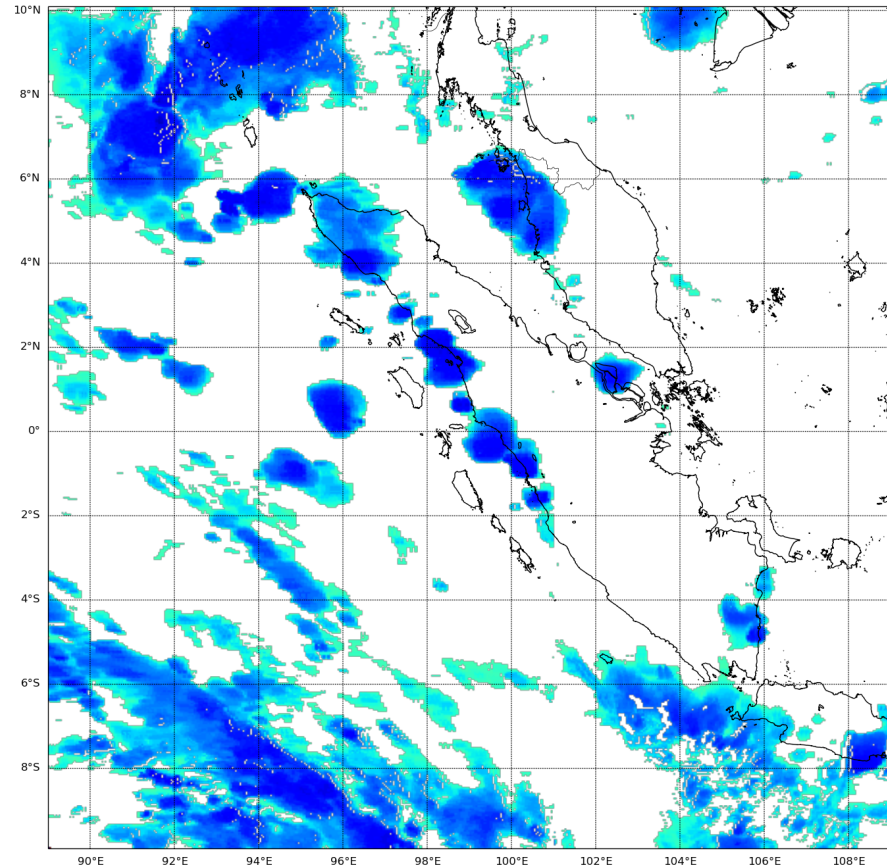
14:00:00

# TGFs and meteorology



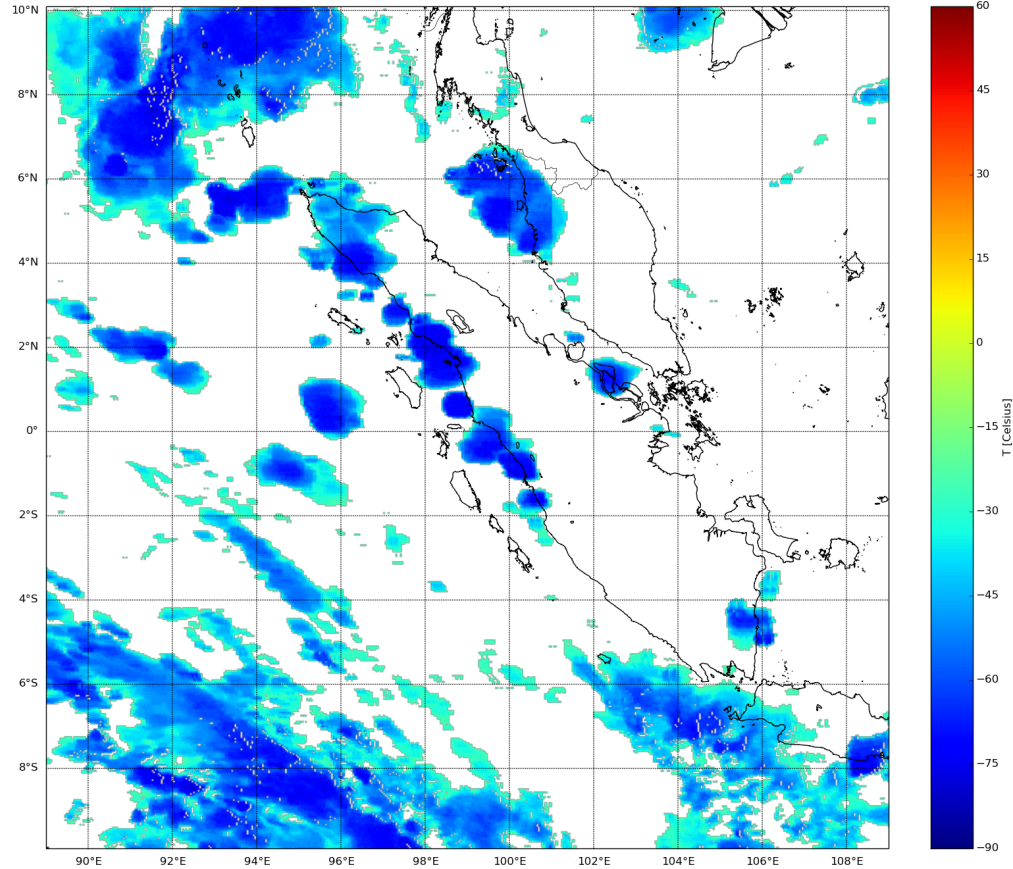
14:30:00

# TGFs and meteorology



15:30:00

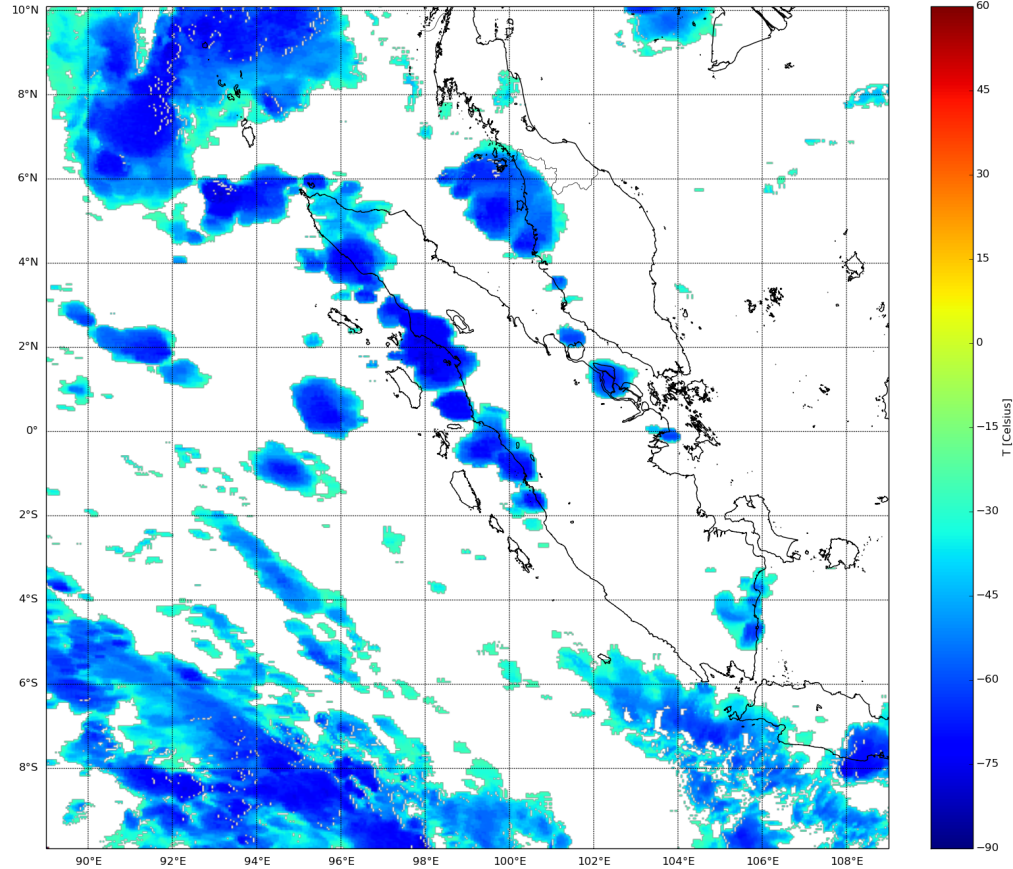
# TGFs and meteorology



16:00:00



# TGFs and meteorology



16:30:00

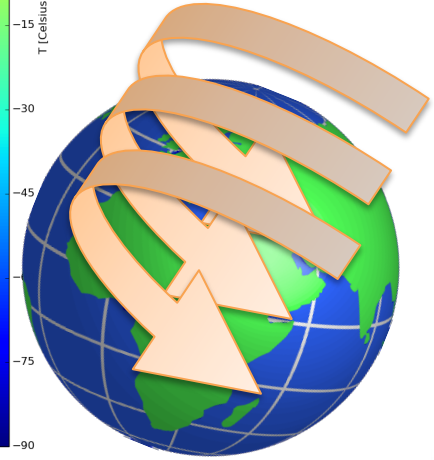
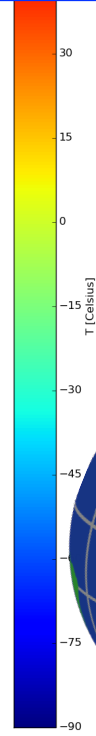
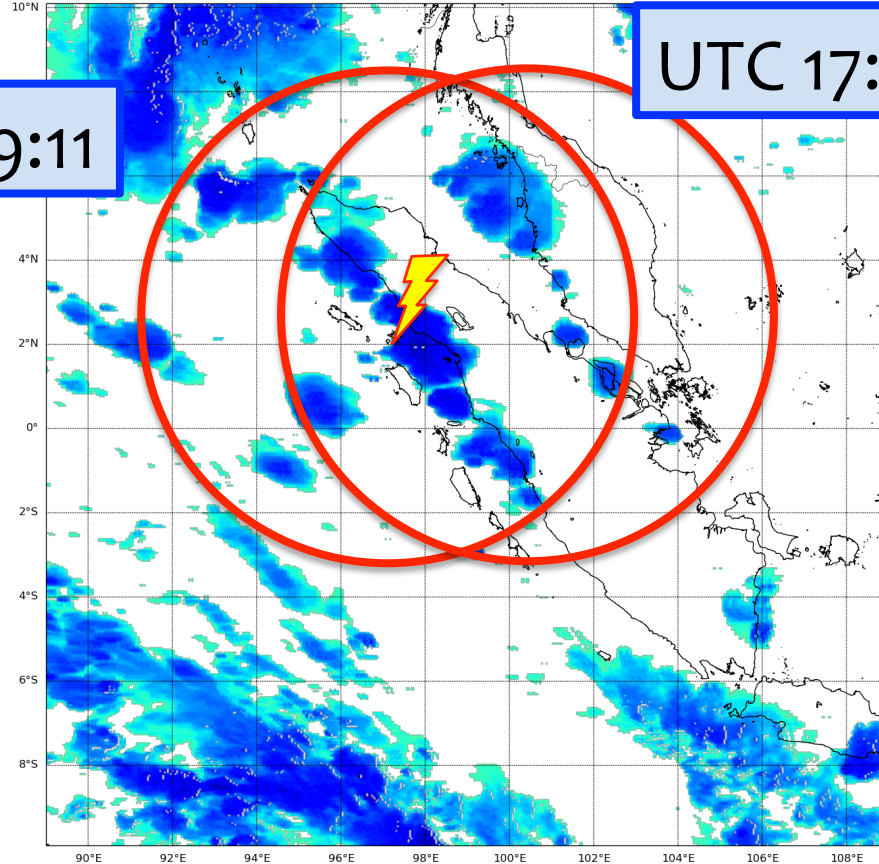
# TGFs and meteorology

UTC 17:09:11

UTC 17:09:54

+120  $\mu$ s

17:00:00





Thank you!

