Meteosat Third Generation

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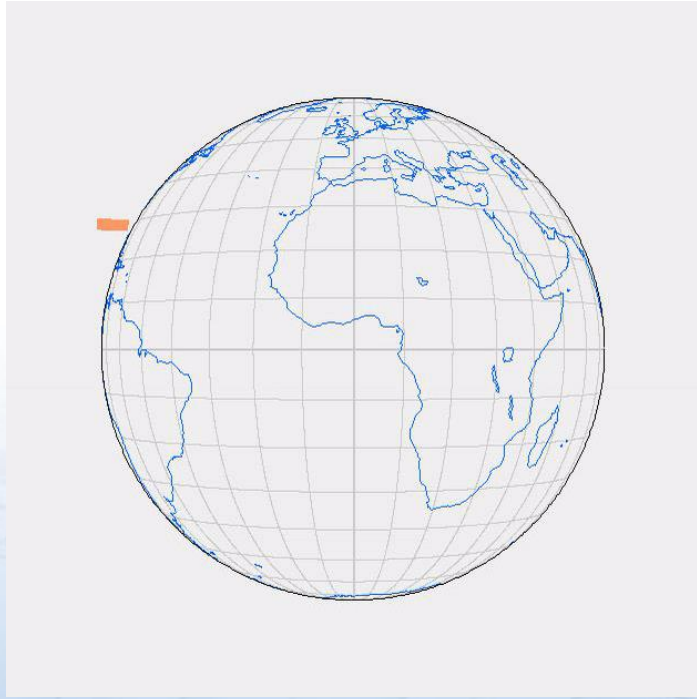
Meteosat Third Generation, Flexible combined imager (FCI)

CHANNEL	SPATIAL SAMPLING DISTANCE (SSD)
VIS 0.4	1.0 km
VIS 0.5	1.0 km
VIS 0.6	1.0 km; 0.5 km*
VIS 0.8	1.0 km
VIS 0.9	1.0 km
NIR 1.3	1.0 km
NIR 1.6	1.0 km
NIR 2.2	1.0 km; 0.5 km*
IR 3.8 (TIR)	2.0 km; 1.0 km*
WV 6.3	2.0 km
WV 7.3	2.0 km
IR 8.7 (TIR)	2.0 km
IR 9.7 (O_3)	2.0 km
IR 10.5 (TIR)	2.0 km; 1.0 km*
IR 12.3 (TIR)	2.0 km
IR 13.3 (CO_2)	2.0 km



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IMAGING

Advanced Baseline Imager

Ch. No.	Central λ (µm)	λ width (µm)	Resolution (km)
1	0.47	0.04	1.0
2	0.64	0.10	0.5
3	0.86	0.04	1.0
4	1.38	0.02	2.0
5	1.61	0.06	1.0
6	2.25	0.05	2.0
7	3.90	0.20	2.0
8	6.19	0.80	2.0
9	6.95	0.40	2.0
10	7.34	0.20	2.0
11	8.50	0.40	2.0
12	9.61	0.40	2.0
13	10.35	0.50	2.0
14	11.20	0.80	2.0
15	12.30	1.00	2.0
16	13.30	0.60	2.0

Flexible Combined Imager

Ch. No.	Central λ (µm)	λ width (µm)	Resolution (km)
1	0.44	0.06	1.0
2	0.51	0.04	1.0
3	0.64	0.05	1.0 (*0.5)
4	0.86	0.05	1.0
5	0.91	0.02	1.0
6	1.38	0.03	1.0
7	1.61	0.05	1.0
8	2.25	0.05	1.0 (*0.5)
9	3.80	0.40	2.0 (*1.0)
10	6.30	1.00	2.0
11	7.35	0.50	2.0
12	8.70	0.40	2.0
13	9.66	0.30	2.0
14	10.50	0.70	2.0 (*1.0)
15	12.30	0.50	2.0
16	13.30	0.60	2.0

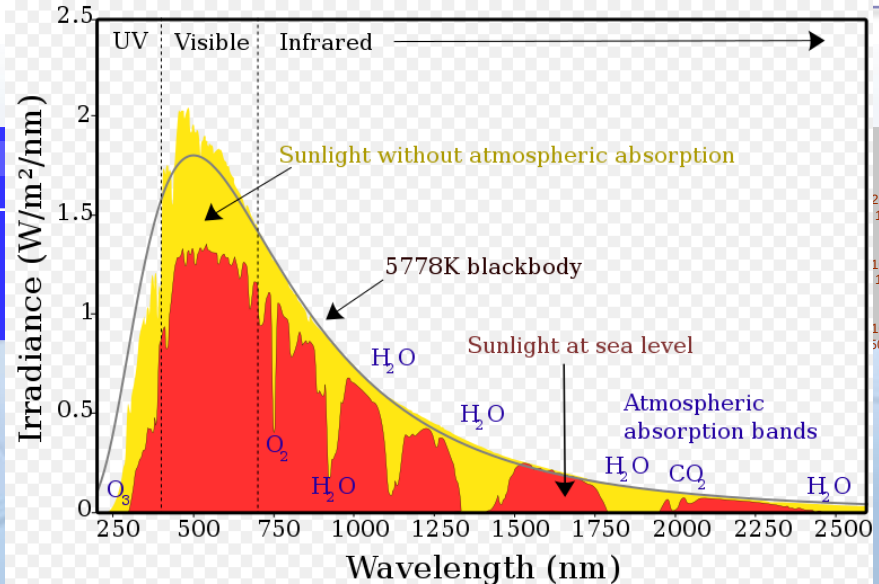
Advanced Himawari Imager

Ch. No.	Central λ (µm)	λ width (µm)	Resolution (km)
1	0.47	0.05	1.0
2	0.51	0.02	1.0
3	0.64	0.03	0.5
4	0.86	0.02	1.0
5	1.61	0.02	2.0
6	2.25	0.02	2.0
7	3.88	0.22	2.0
8	6.24	0.37	2.0
9	6.94	0.12	2.0
10	7.34	0.17	2.0
11	8.59	0.32	2.0
12	9.64	0.18	2.0
13	10.40	0.30	2.0
14	11.23	0.20	2.0
15	12.38	0.30	2.0
16	13.28	0.20	2.0

"Colloquial" channel name	Applications	Proxy instruments - λ(µm) / Res (km) SEVIRI SLSTR	MODIS	VIIRS	
Blue	aerosol, surface features	-	0.44/1.0	0.45/0.75	-
Green	aerosol, vegetation	-	0.55/0.5	0.55/0.75	0.55/0.5
Red	fog, insolation, winds	0.64/3.0	0.65/0.25	0.64/0.375	0.67/0.5
Veggie	vegetation, winds	0.81/3.0	0.86/1.0	0.87/0.375	0.86/0.5
Low-Level WV	water vapour, winds	-	0.91/1.0	-	
Cirrus	thin cirrus	-	1.38/1.0	1.38/0.75	1.38/0.5
NIR Phase	cloud phase, snow/ice	1.64/3.0	1.64/0.5	1.61/0.375	1.61/0.5
Particle Size	particle size, vegetation	-	-	2.25/0.75	2.25/0.5
Fire	microphysics, fires	3.92/3.0	3.75/1.0	3.74/0.375	3.74/1.0
Upper-Level WV	WV, winds, rainfall	6.25/3.0	-	-	-
Mid-Level WV	WV, winds, rainfall	-	6.72/1.0	-	-
Lower-Level WV	WV, winds, SO2	7.35/3.0	7.33/1.0	-	-
Cloud-Top Phase	cloud phase, SO2	8.70/3.0	8.55/1.0	8.55/0.75	-
Ozone	total O3, turbulence	9.66/3.0	9.73/1.0	-	-
Clean IR	SST, clouds temp	10.8/3.0	11.0/1.0	10.8/0.75	10.8/1.0
IR Longwave	SST, clouds temp, rainfall	-	-	11.5/0.375	-
Dirty IR	TPW, dust, ash	12.0/3.0	12.0/1.0	12.0/0.75	12.0/1.0
Co	air temp, cloud ght	13.4/3.0	13.3/1.0	-	-

MODUS OPERANDI:

✓	10 min	0.5 - 2.0 km	
2000 x 1000 km	2.5 min	0.5 - 2.0 km	
1000 x 1000 km	2.5 min	0.5 - 2.0 km	
1000 x 500 km	0.5 min	0.5 - 2.0 km	



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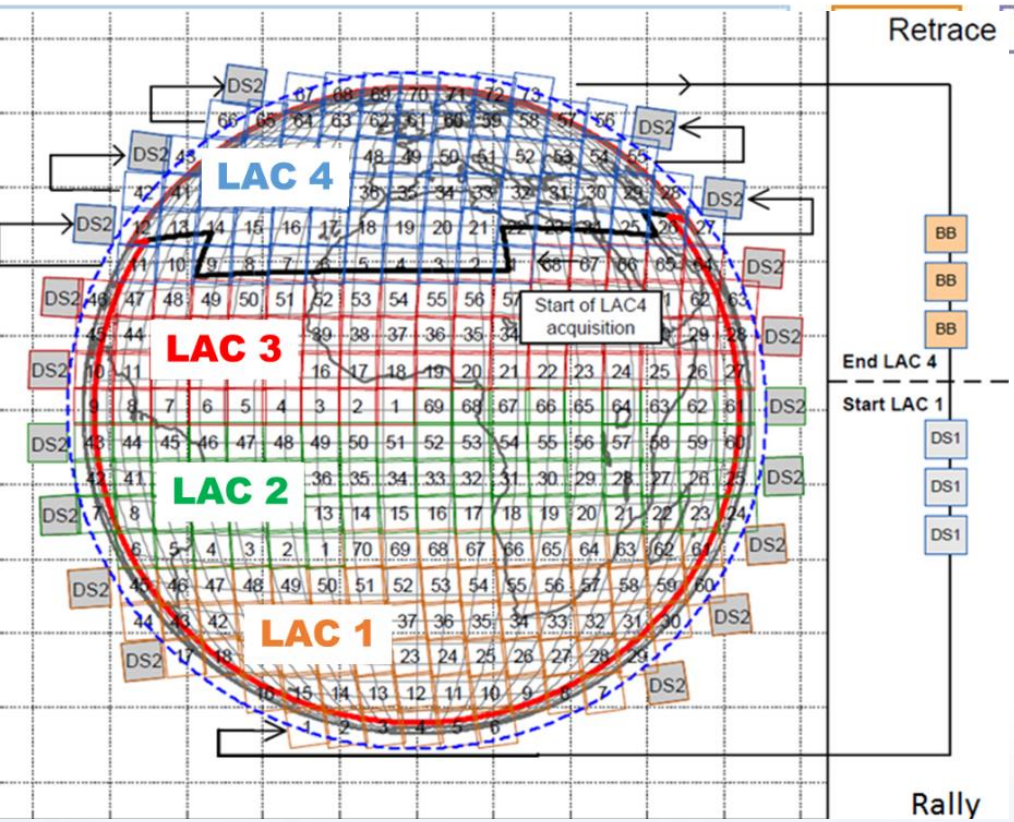
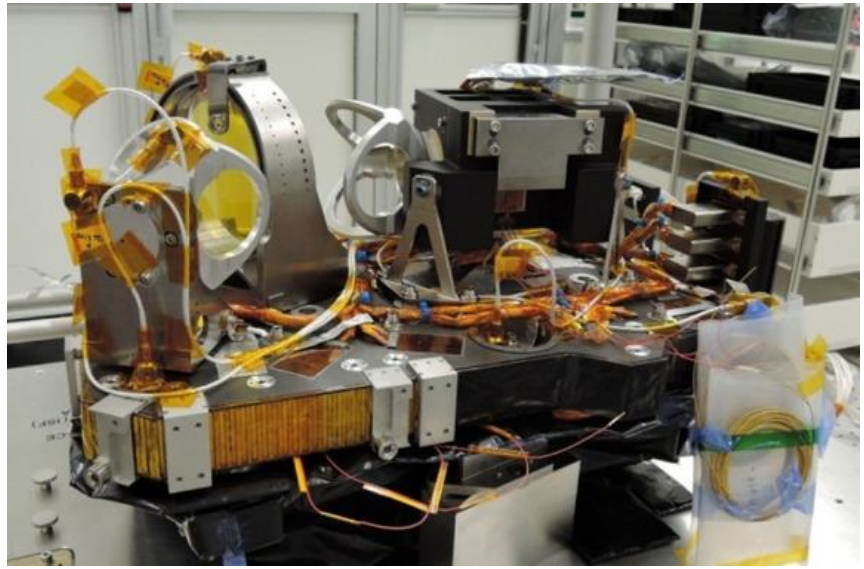
Meteosat Third Generation, Infrared sounder (IRS)





- Four separate LAC zones are defined and scanned sequentially
- One LAC is acquired within 15 minutes, consisting of overlapping dwells following a step and stare scan pattern.
- Each dwell consists of 160x160 pixels (spectral soundings), with 4 km spatial sampling distance at nadir.
- Europe (LAC4) is observed every 30 minutes
- MWIR: (4.44–6.25 µm) and LWIR: (8.26–14.70 µm).

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NEW GEO LIGHTNING MISSIONS

LIGHTNING DETECTION

	Pioneer instrument - LIS	Geostationary Lightning Mapper	Lightning Imager	Lightning Mapping Imager	Ground network - GLD360
Platform	TRMM/ISS	GOES-16	MTG-I	Feng-Yun-4	~
Orbit	LEO	GEO	GEO	GEO	~
Description	CCD camera operating at 777.4 nm (O2) to count flashes and measure their intensity	CCD camera operating at 777.4 nm (O2) to count flashes and measure their intensity	CCD camera operating at 777.4 nm (O2), flash counts and intensity measurement. Detection efficiency > 90 % for events of 10 µJ·m-2·sr-1 at 45° (day), 4 µJ·m-2·sr-1 (night). FAR < 2 s-1	CCD camera operating at 777.4 nm (O2) to count flashes and measure their intensity	A network of sensors operating in the Very Low Frequency (VLF) band and measuring horizontal magnetic fields of radio impulses generated by return strokes and large cloud pulses.
Scanning technique	Pushbroom, matrix array of 128 x 128 detectors, swath 600 km; each earth location observed continuously (every 2 ms) for about 90 s	Electronic, 3-axis stabilised satellite, single detector matrix	Electronic, 3-axis stabilised satellite, single detector matrix	Electronic, 3-axis stabilised satellite, single detector matrix	Fixed location, ground-Based detectors
Resolution	4 km	8 km at s.s.p. (sub-satellite point)	10 km	7.8 km at s.s.p.	2-3 km
Coverage /Cycle	Passes at ~ 100-min intervals with longer gaps once or twice per day. More regular coverage at 15°N and 15°S. On ISS: latitude coverage extended to 51.6°	Large fraction of the disk continuously observed (time resolution 2 ms)	Full disk continuously observed (time resolution ~ 2 ms)	Full disk continuously observed (time resolution ~ 2 ms)	Global

SOUNDING

	Proxy instrument - IASI	Proxy instrument - CrIS	Infra-Red Sounder	Geostationary Interferometric IRS
Platform	EPS-A/B/C	NOAA-20	MTG-S	Feng-Yun-4
Orbit	LEO	LEO	GEO	GEO
Description	Interferometer with 8461 channels, with one embedded IR imaging channel	Interferometer with three IR bands, 1305 channels in initial operation mode. Future operation mode will have 2211 channels with the same full spectral resolution in all three bands.	Interferometer with large detector arrays for simultaneous sounding of more pixels	MWIR/TIR interferometer with large detector arrays for simultaneous sounding of more pixels. 913 channels on the first flight unit, 1188 on follow-on flight units.
Scanning technique	Cross-track: 30 steps of 48 km ssp, swath 2130 km - Along-track: one 48-km line every 8 s	Cross-track: 32 steps of 48 km s.s.p., swath 2200 km - Along-track: one 48-km line every 8 s	Mechanical, bi-axial, 3-axis stabilised satellite, step-and-dwell of a detector matrix	Mechanical, bi-axial, 3-axis stabilised satellite, step-and-dwell of a detector matrix.
Resolution	4 x 12-km IFOV close to the centre of a 48 x 48 km2 cell (average sampling distance: 24 km)	3 x 3 14 km IFOV covering a 48 x 48 km2 cell (average sampling distance: 16 km)	4.0 km	Prototype flight 16 km, follow-on 8 km, at s.s.p.. Supporting VIS: 2 km at s.s.p.
Coverage /Cycle	Near-global coverage twice/day	Near-global coverage twice/day	Full disk in 60 min. Limited areas in correspondingly shorter time intervals	China area (5000 km x 5000 km) in 67 min. Mesoscale area (1000 km x 1000 km) in 35 min

NEW GEO SOUNDING MISSIONS

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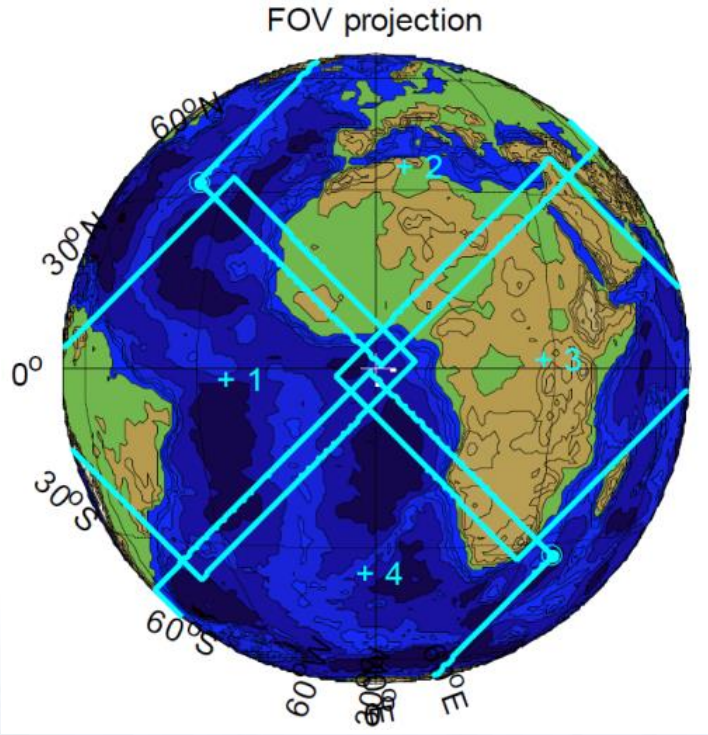
Meteosat Third Generation, Lightning imager (LI)



Events — what the instrument measures, a triggered pixel in the detector grid
Groups — neighbouring events in the same integration period (1 ms), representing a lightning stroke
Flashes — collection of groups in temporal and spatial vicinity (XX km, YY milliseconds), representing a lightning flash

The MTG-I LI instrument will complement the NOAA Geostationary Lightning Mapper (GLM) on the GOES-R and the GOES-S satellites and CMA Lightning Mapper onboard the FY-4 satellite series.

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Spectral response of the forest under (drought and) thermal stress

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France, 10March 17April 24May

rmany, 23 March 8April 17April 28April 24May

- Cloud
- Colour scale
- Average or minimum

Spain 6April 22May 2010

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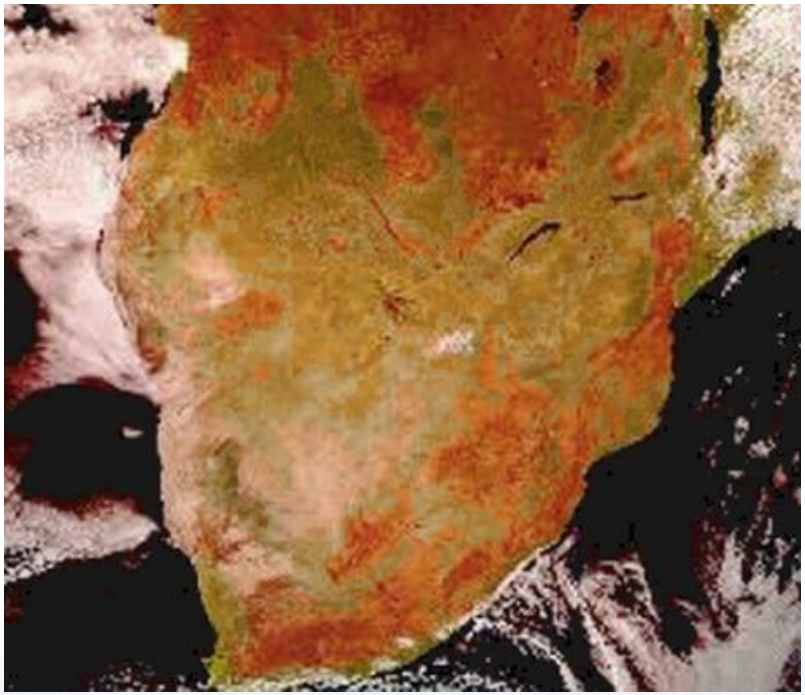
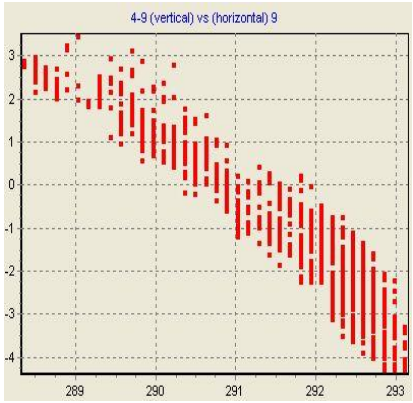
Suspicion based on imagery is not enough

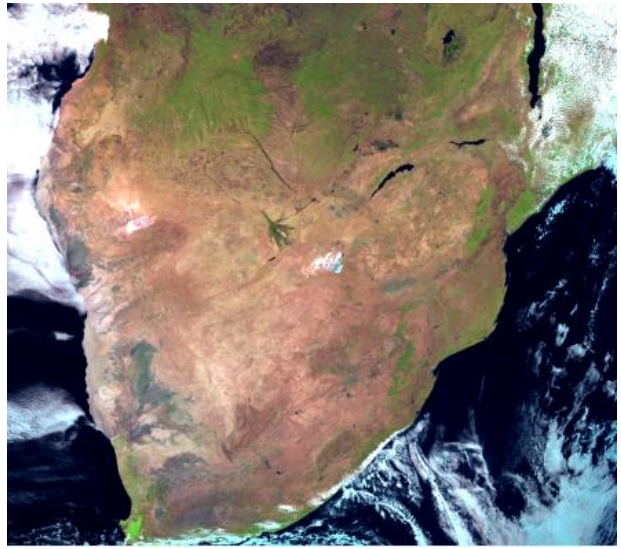


Hipothesis: “too dry”



Numeric analysis

Confirmation **or** refusal through statistical **analysis**



Correction of the **display** technique that generated the wrong assumption

The two images are identical, just differently **enhanced or processed**

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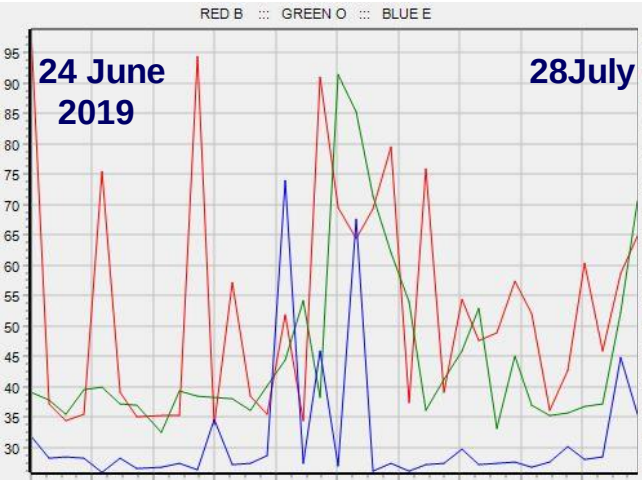
Evolution indicators from albedos and brightness temperatures



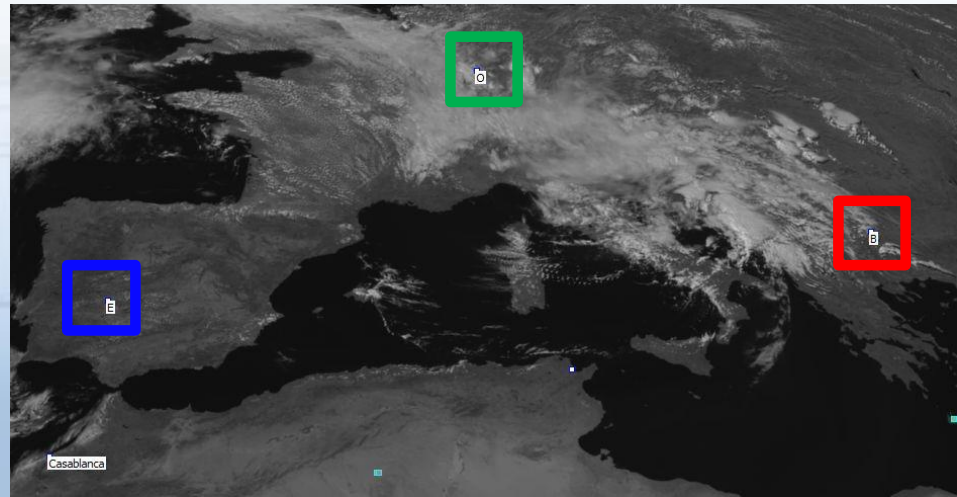
0.8µm (growth)

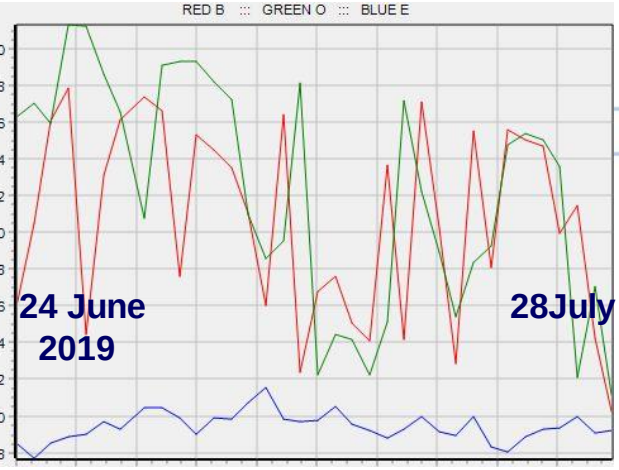
3.9µm (ground dryness)

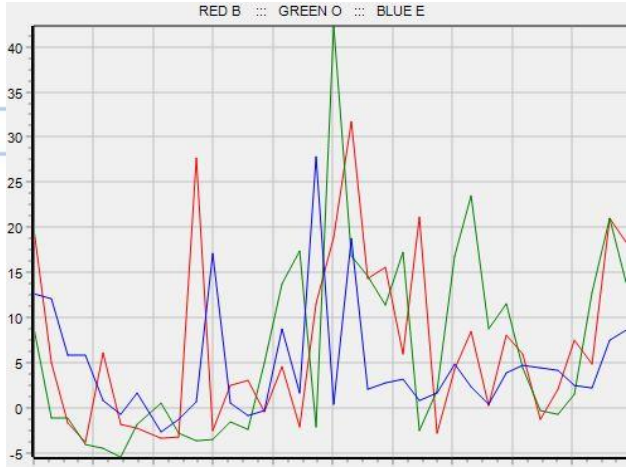
10.8µm (ground temperature)

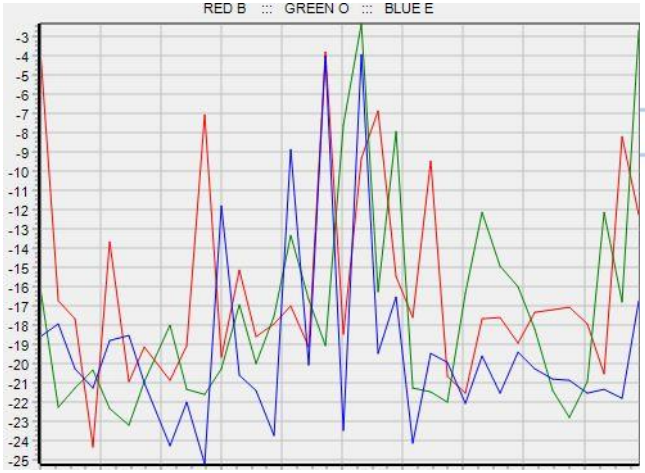
Open fields Low level forest Mountain forest

6.2µm (strong water vapour absorption)





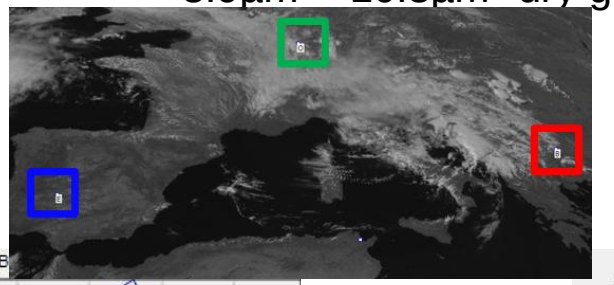




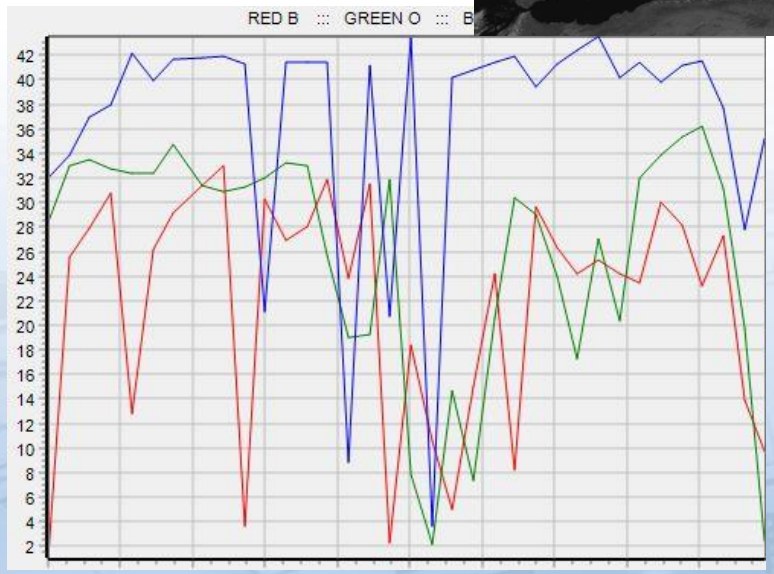
0.8µm – 0.6µm chlorophyl

3.9µm – 10.8µm dry ground

6.2µm – 7.3µm humid

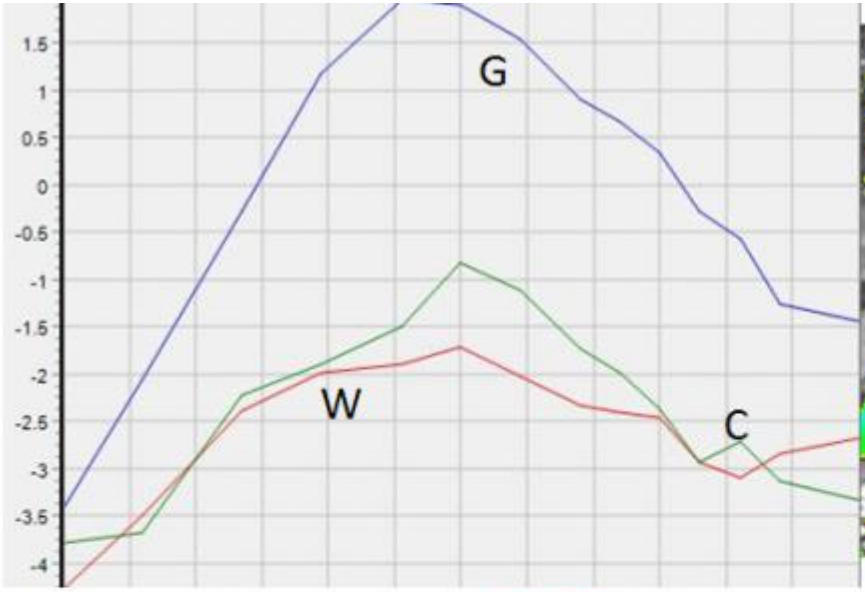


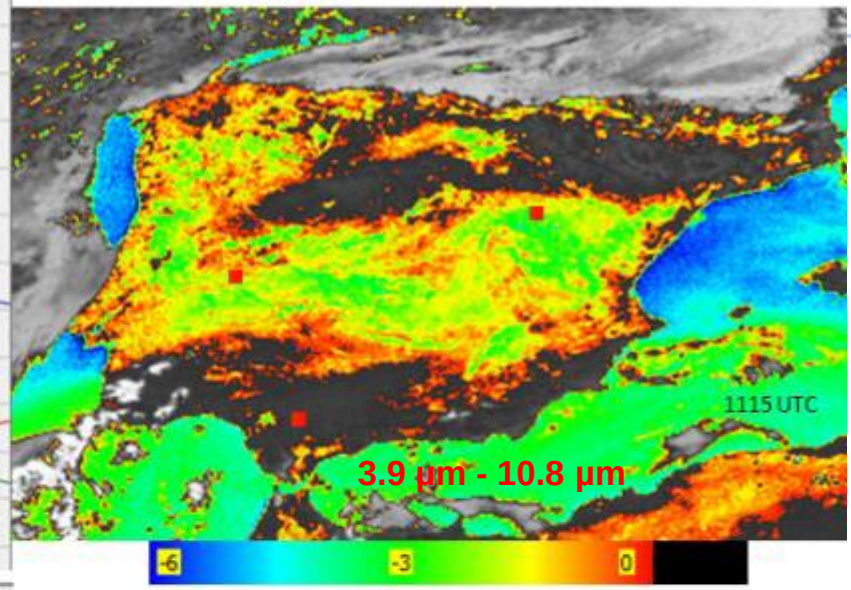
13.4µm – 10.8µm

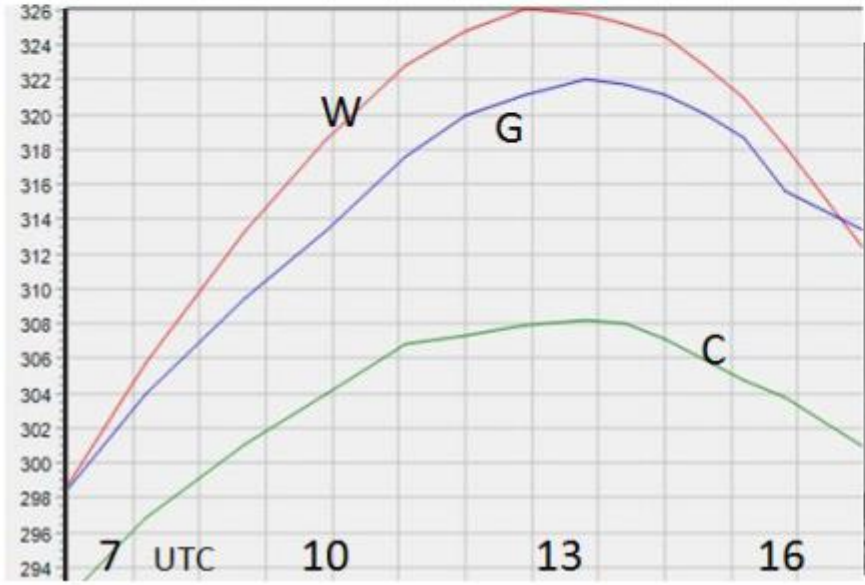


10.8µm – 12.0µm dry ground

Daily cycles for different soils







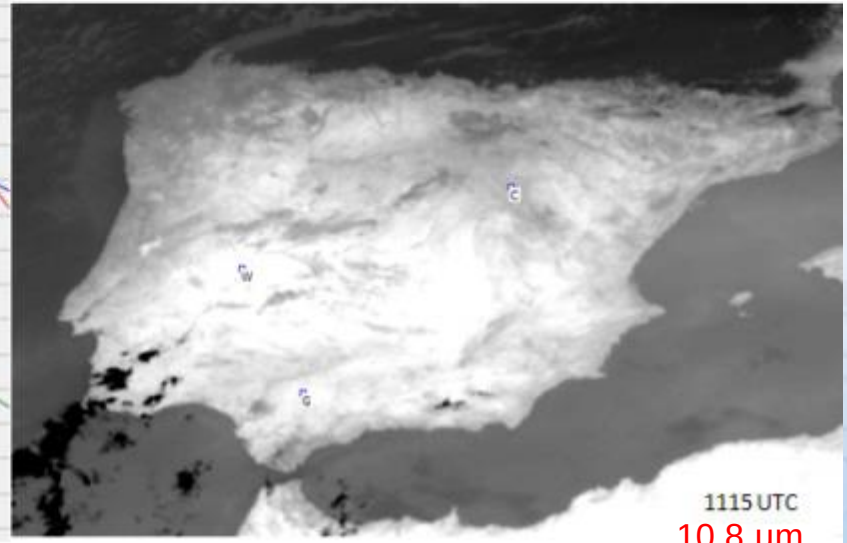
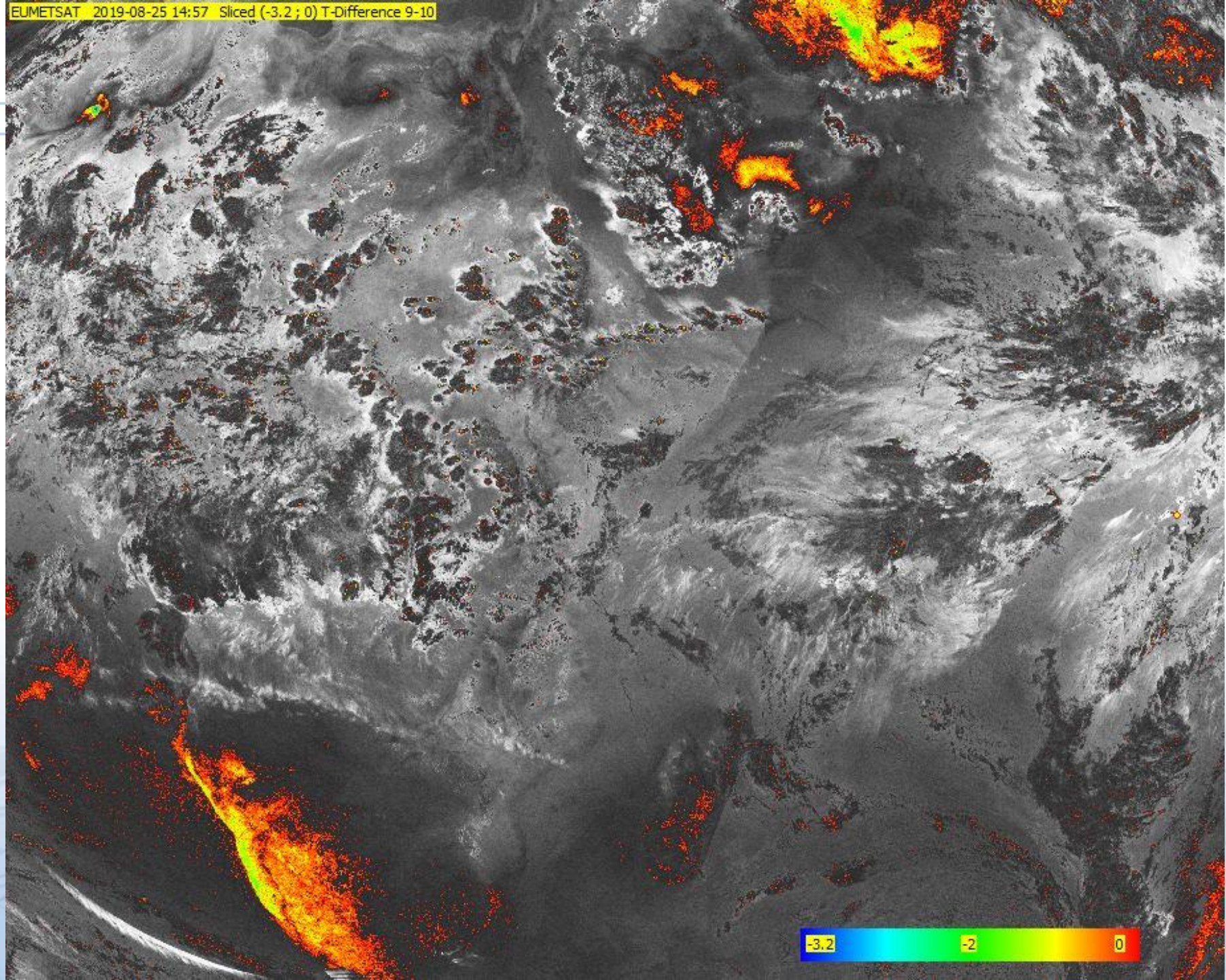
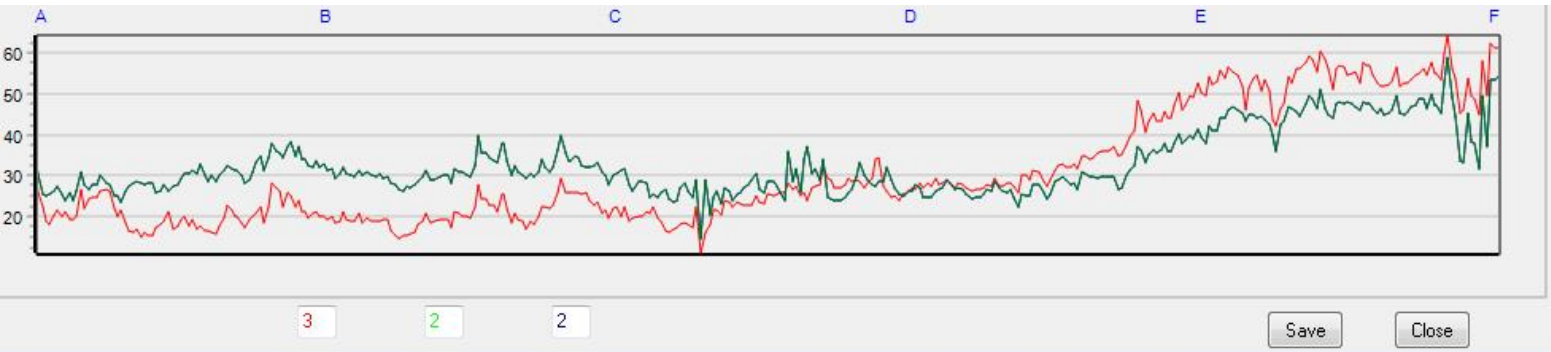
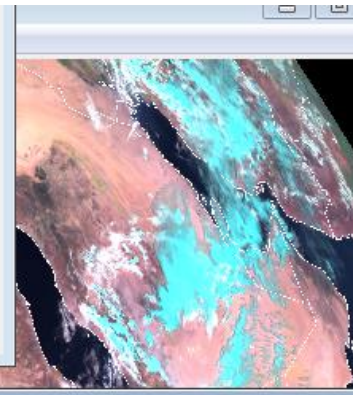


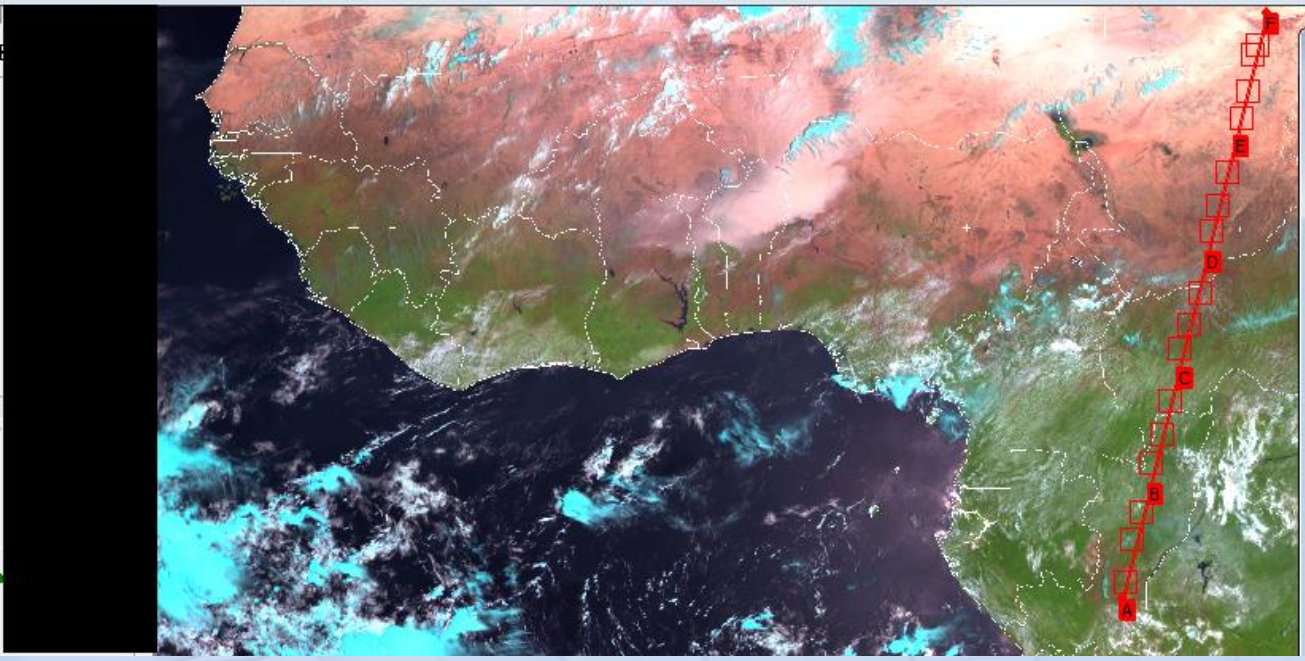
Figure 2: Daily evolution of 3.9 and 10.8µm temperatures for three Iberian locations.

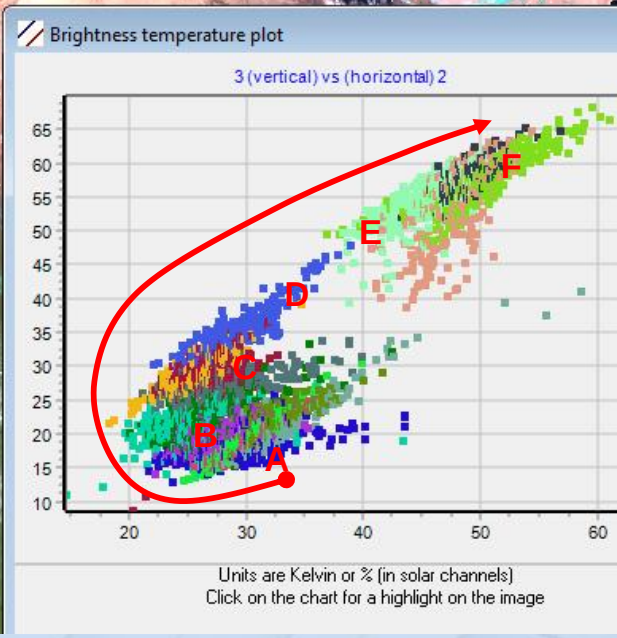

EUMETSAT 2019-08-25 14:57 Sliced (-3.2 ; 0) T-Difference 9-10
-3.2
-2
0

Comparison of 1.6µm and 0.8µm









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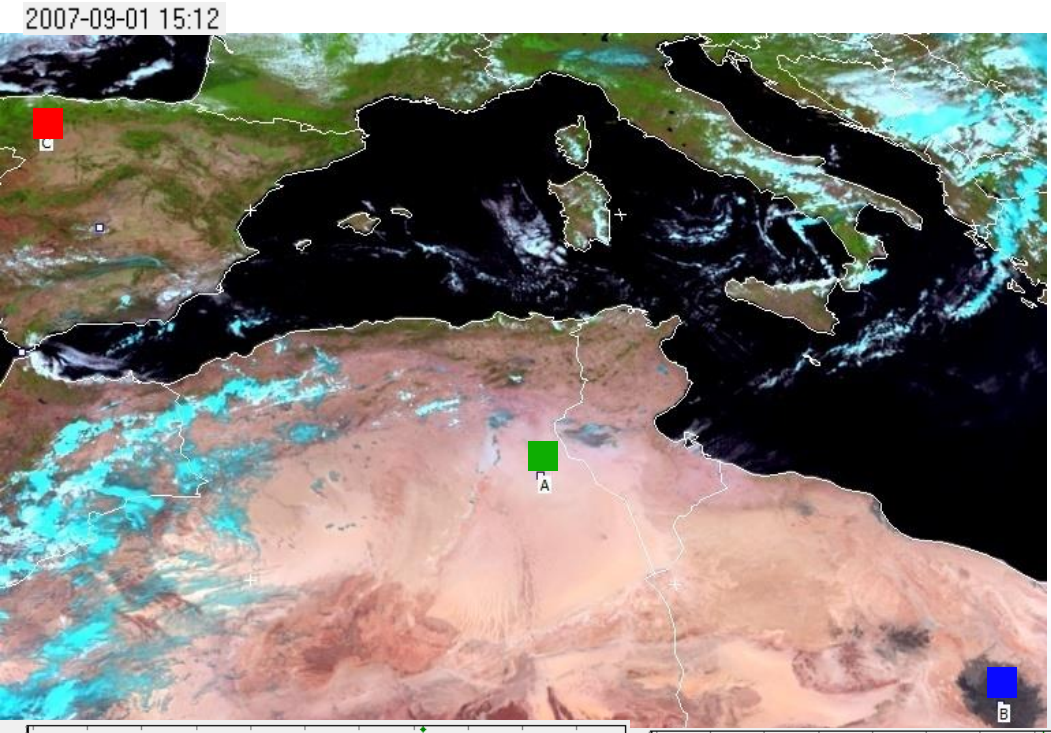
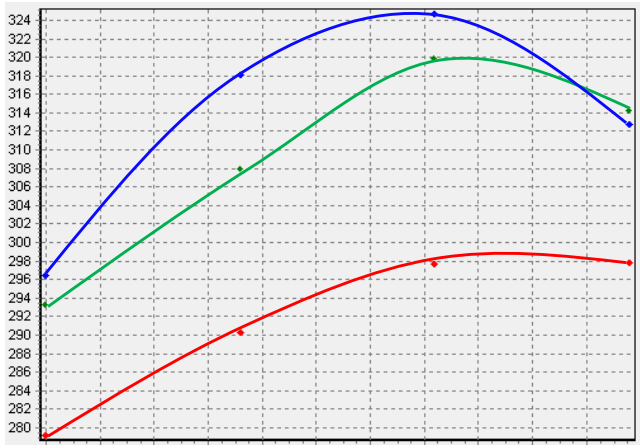
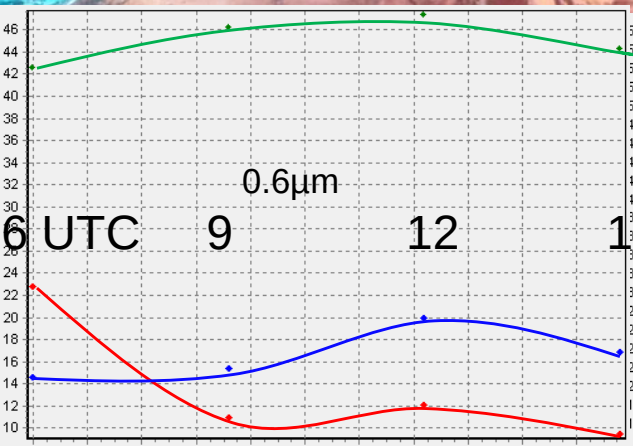
Channel reflectivities on soil

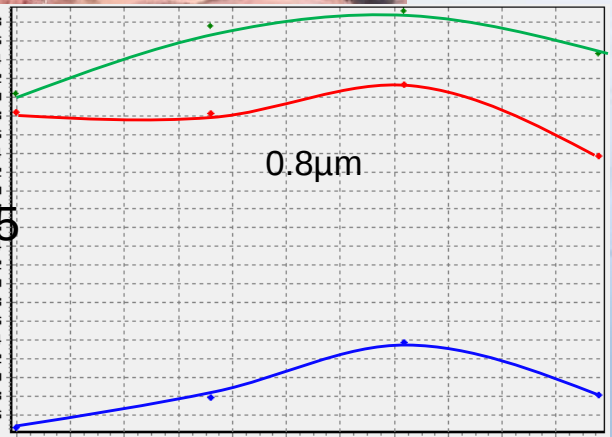


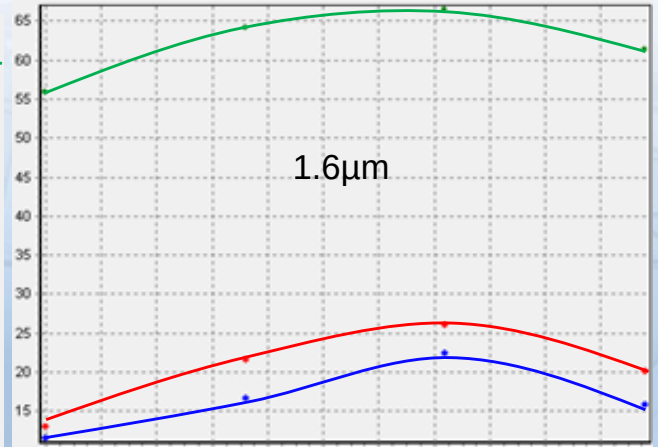


Evolution in the day of BT10.8µm and of % reflectivity at Meteosat solar channels

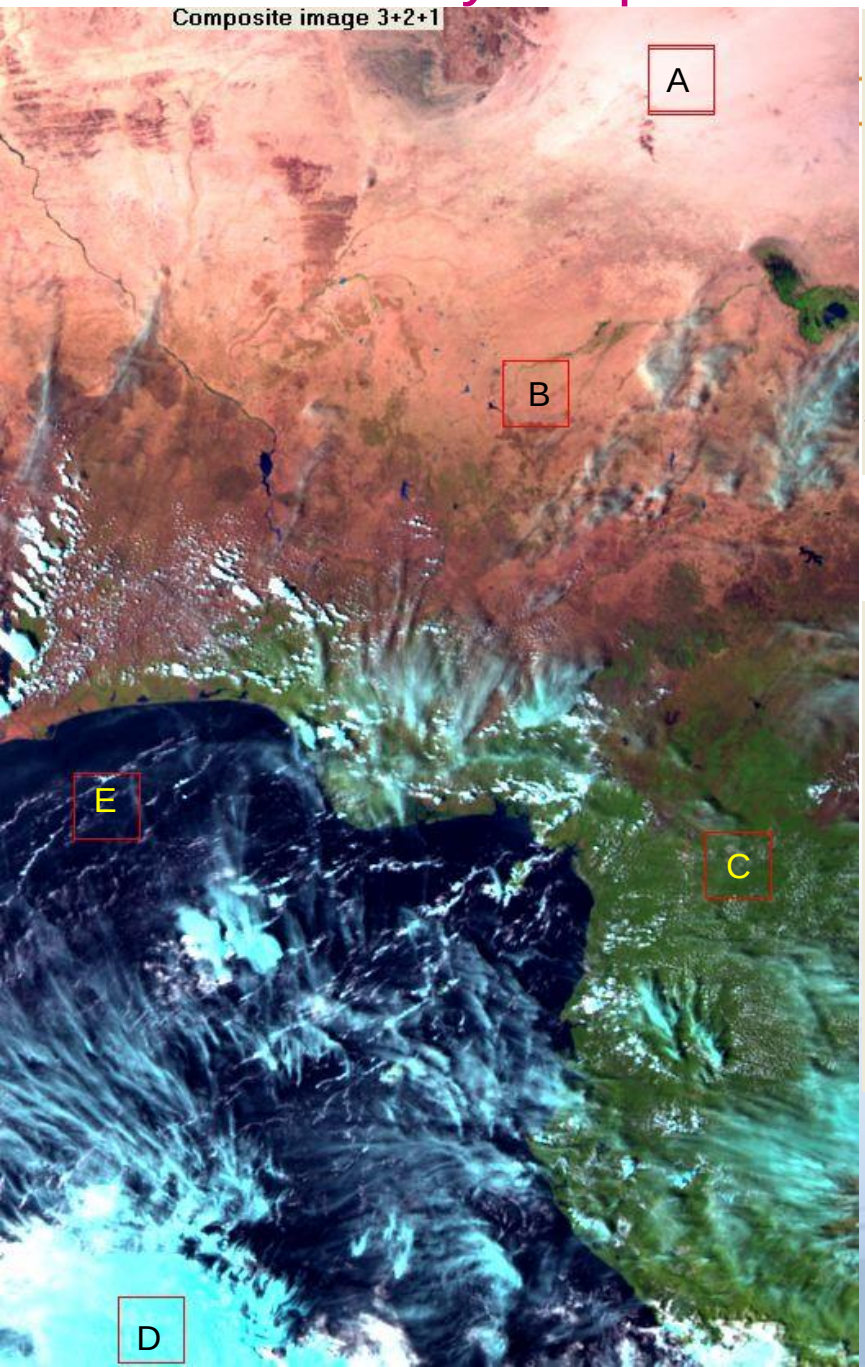
Simple reflectivity formula shows directionality in reflection for Sun-sat 90, 47, 15, 47
Solar: 77,41, 26, 54

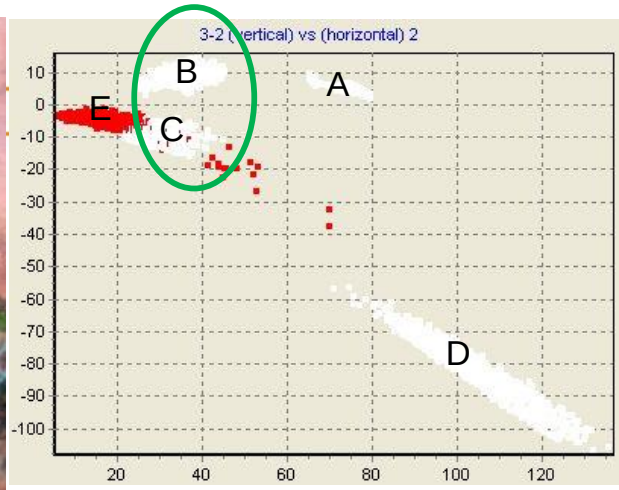




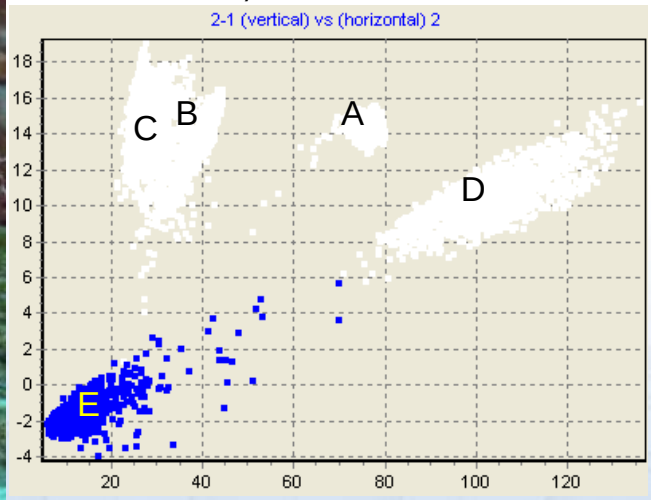


Added value by 1.6 µm





Now, 2-1 in vertical



Channel 1.6µm reflects better than 0.8µm on dry ground (B), but worse in vegetated areas (C)

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In-conclusions

- Peaks due to **cloud** (mainly in the middle of the period) blind the interpretation of soil status.
- Promising soil *characterisation* and soil *state* estimates from **3.9µm-10.8µm** and **1.6µm-0.8µm.**
- Insufficient knowledge on **emissivities**, which reflect better than LST the soil state or soil moisture.
- Statistically desirable a comparison for longer periods: **several summer** or drought seasons.
- Need of **precipitation** series to validate conclusions.
- Intuitive use of **evolution RGBs** for seasonal and inter-seasonal soil analysis.

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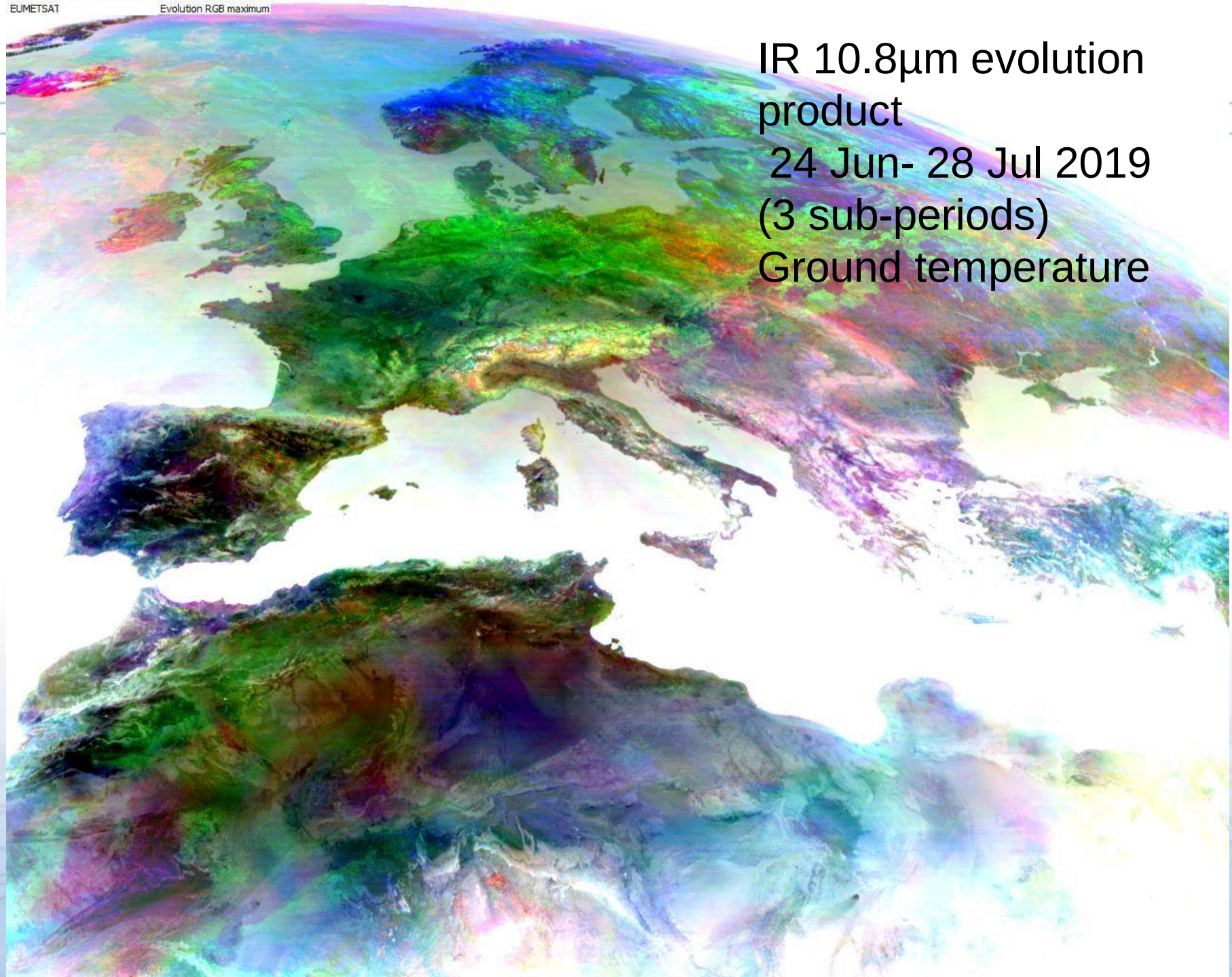

IR 10.8µm evolution product
24 Jun- 28 Jul 2019
(3 sub-periods)
Ground temperature