Tropical Convection over Morocco: Forecasting and Monitoring

BOUGHANEM SOUKAINA

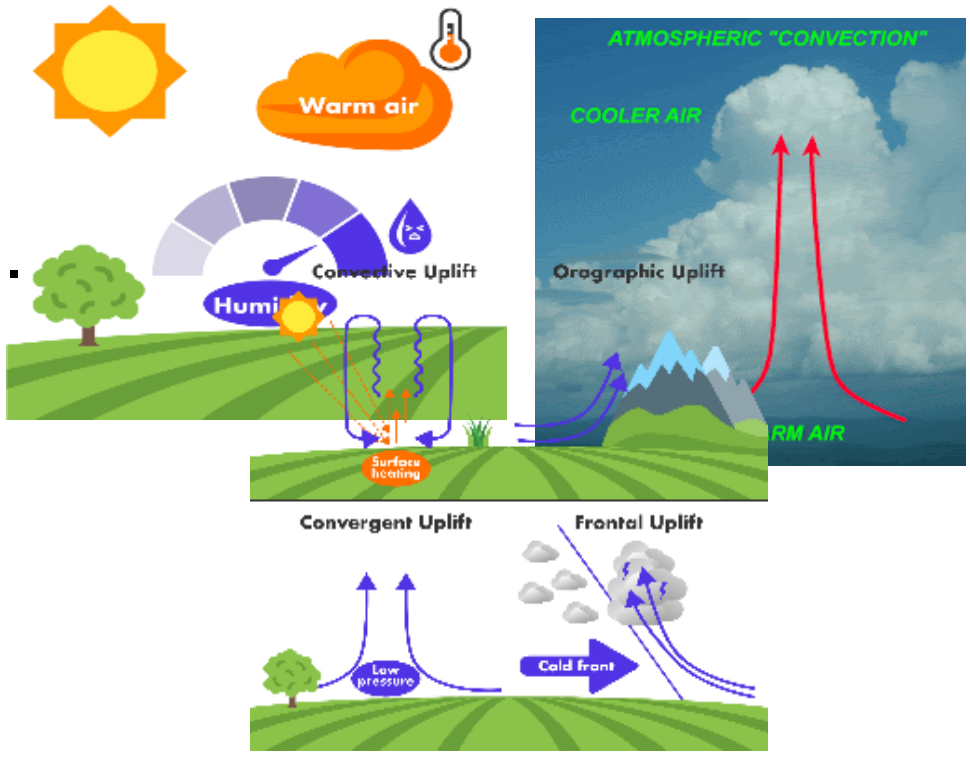
DGM

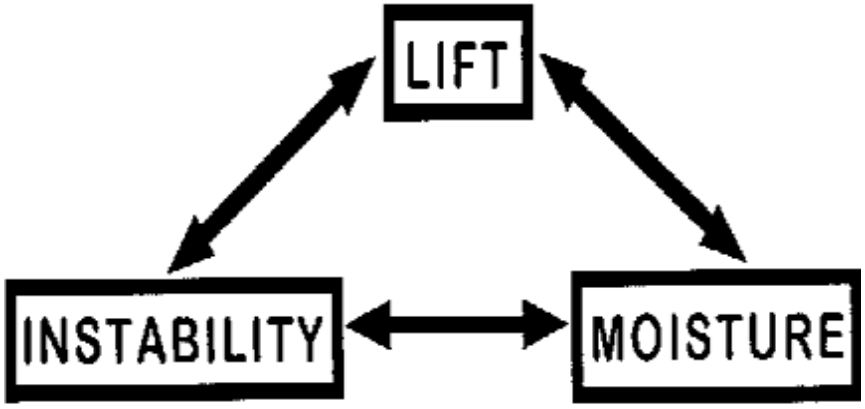
20/10/2026

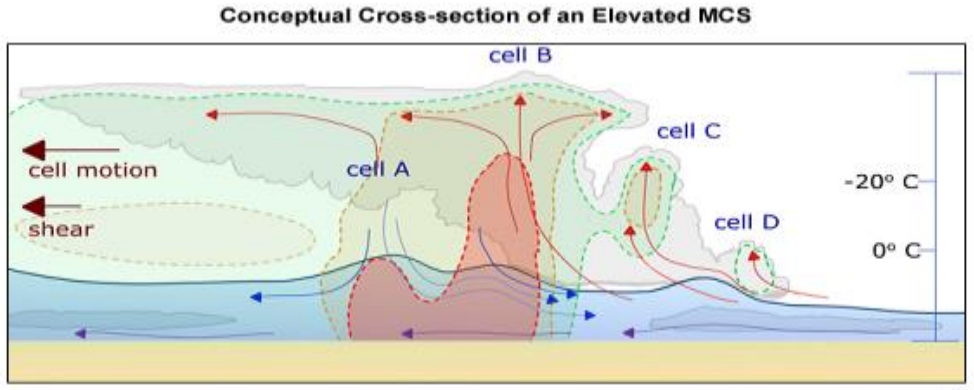
IN THEORY…

The main ingredients for convection in tropical and adjacent regions :

1. A source of moisture.
2. An unstable atmosphere.
3. Lifting of the air mass.
4. Vertical wind shear.

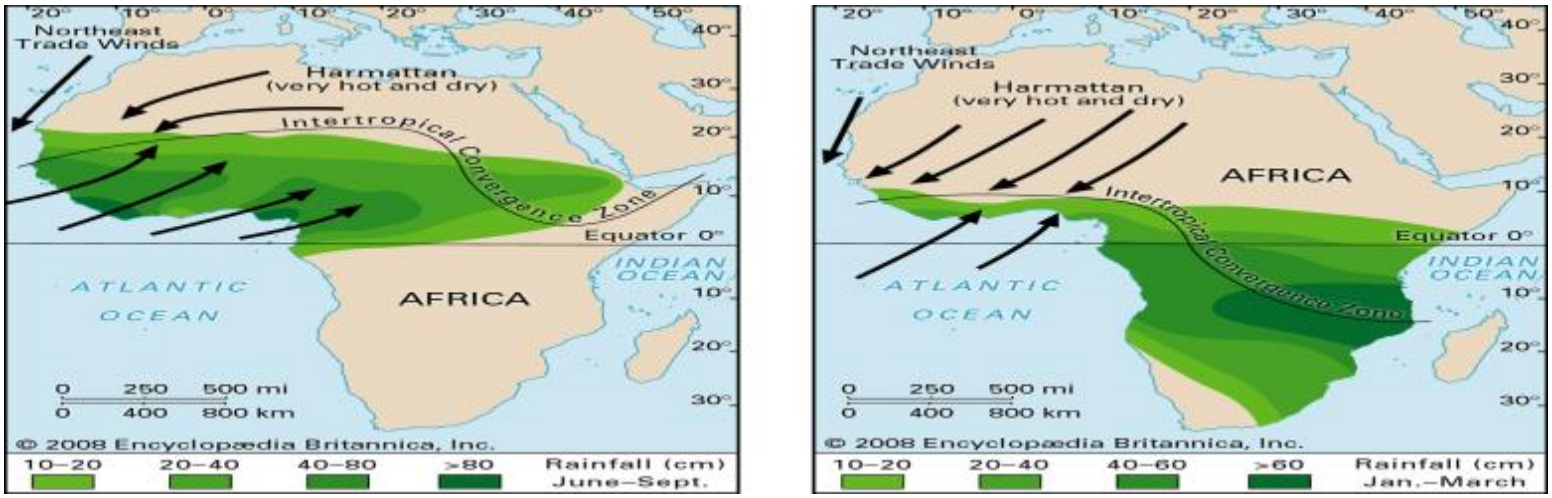






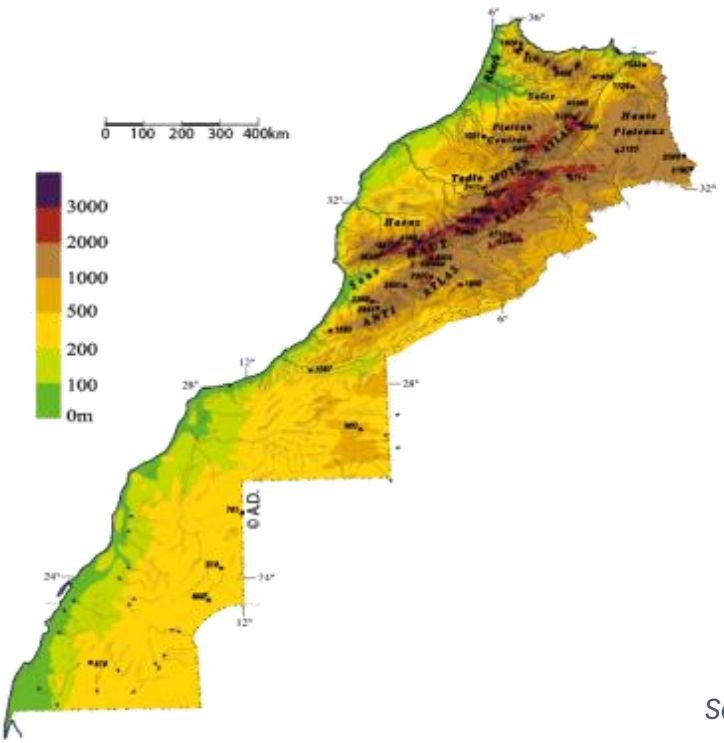
NOAA

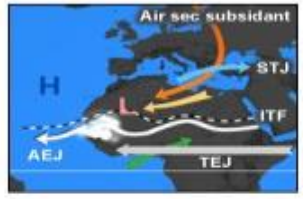
MANSOON AND ITCZ/ITF

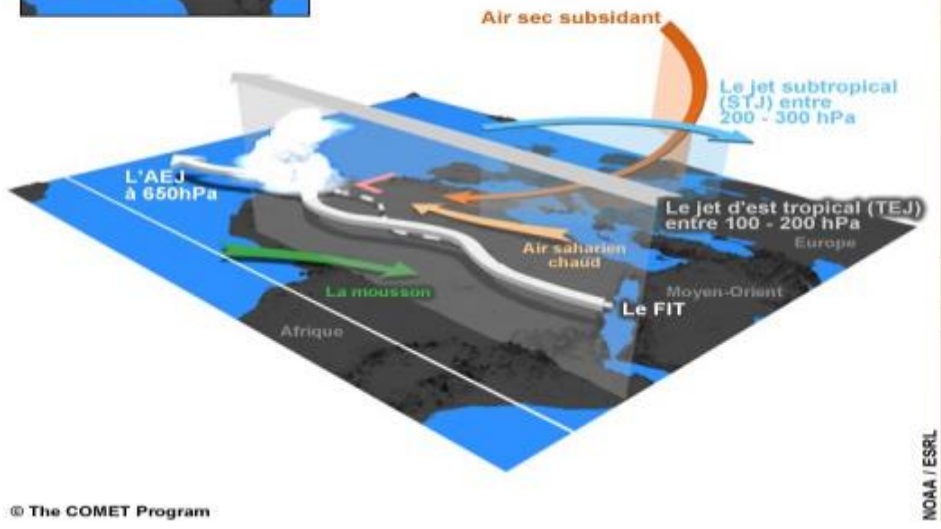


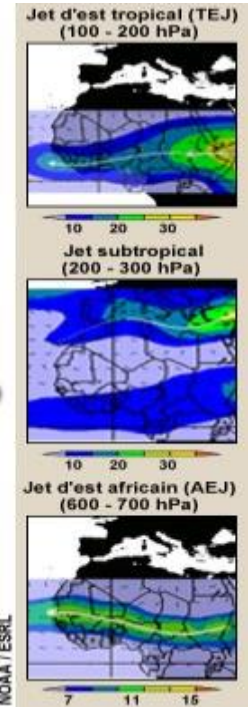
THE WEST AFRICAN MONSOON SYSTEM

Encyclopædia Britannica, Inc. (2008). Illustration of African monsoon wind patterns and seasonal rainfall distribution



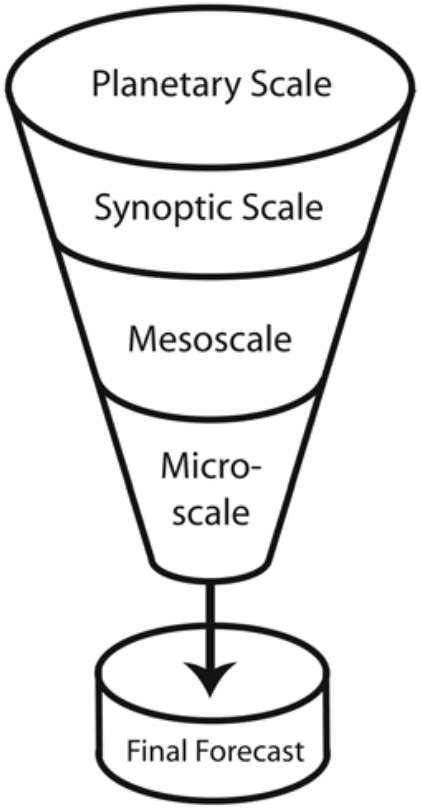




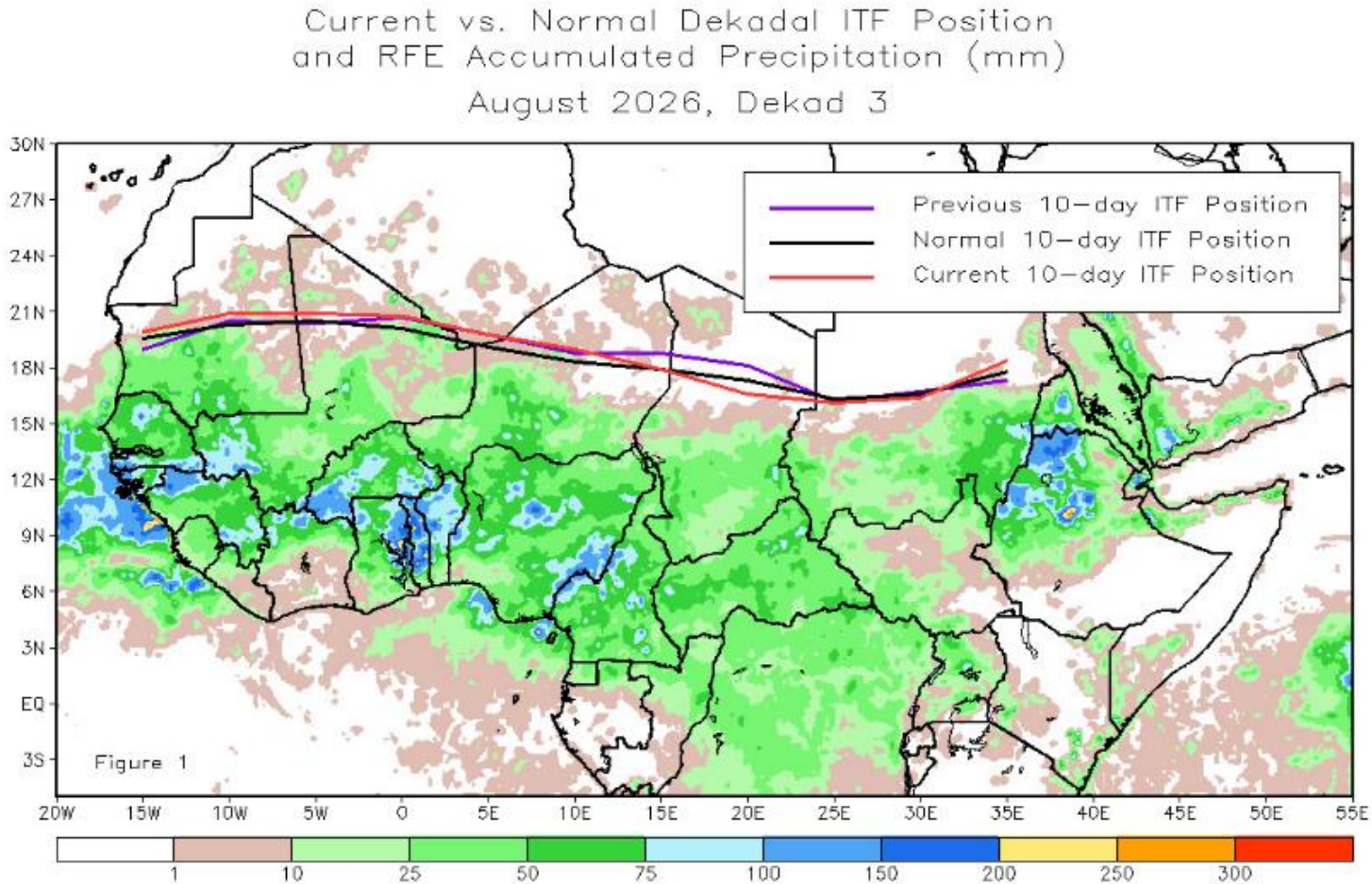


Source: COMET® Website https://learn.meted.ucar.edu. © 1997-2025 University Corporation for Atmospheric Research.

SYNOPTIC ANALYSIS



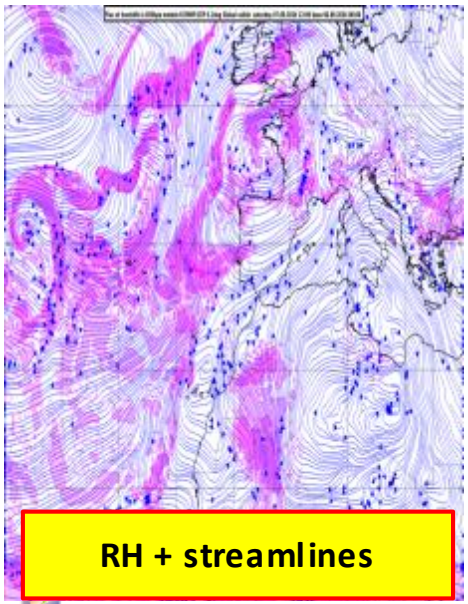
THE FORECAST FUNNEL
(after Snellman 1982)



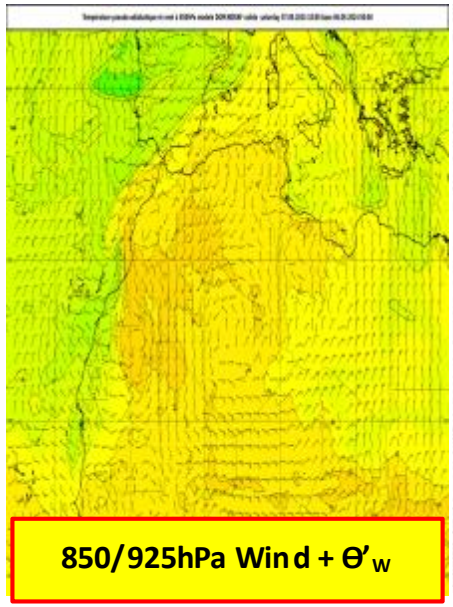
Having an overv
effective analysis
thermal paramete

https://www.cpc.ncep.noaa.gov/products/international/itf/itcz.shtml

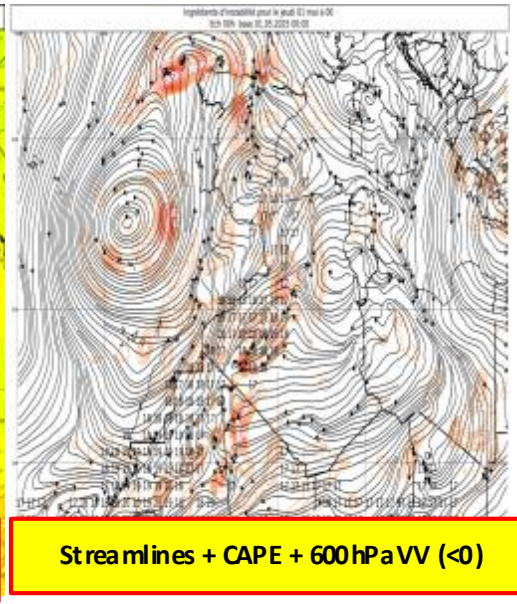
MESO-SCALE ANALYSIS



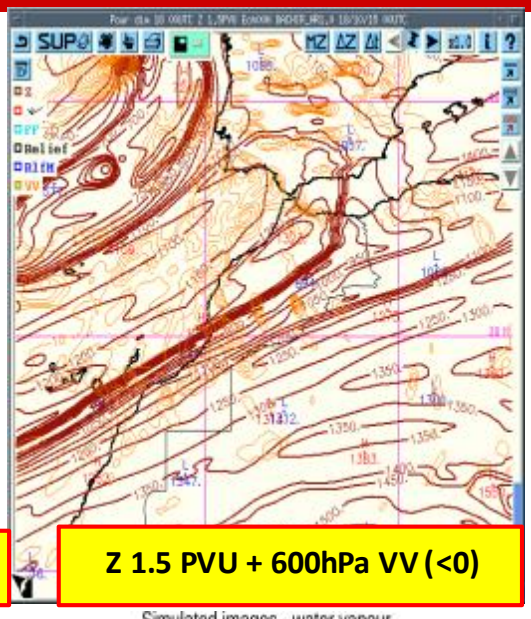
RH + streamlines



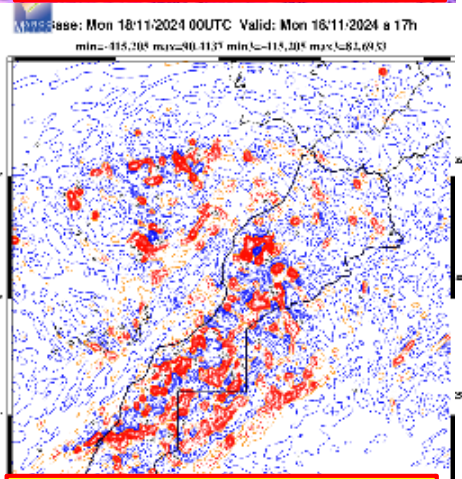
850/925hPa Wind + Θ'_w



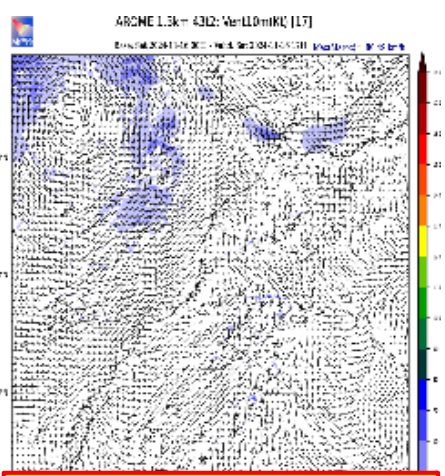
Streamlines + CAPE + 600hPa VV (<0)



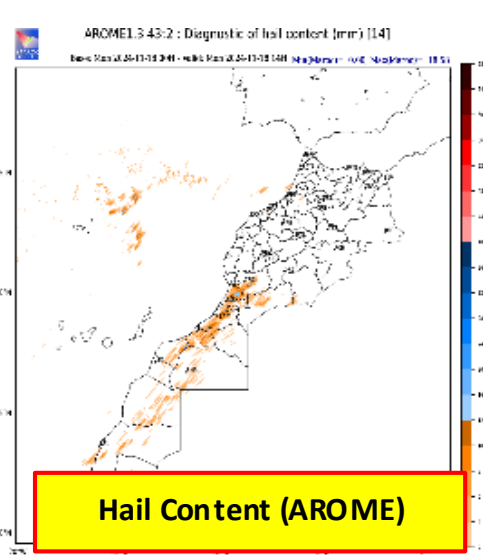
Z 1.5 PVU + 600hPa VV (<0)



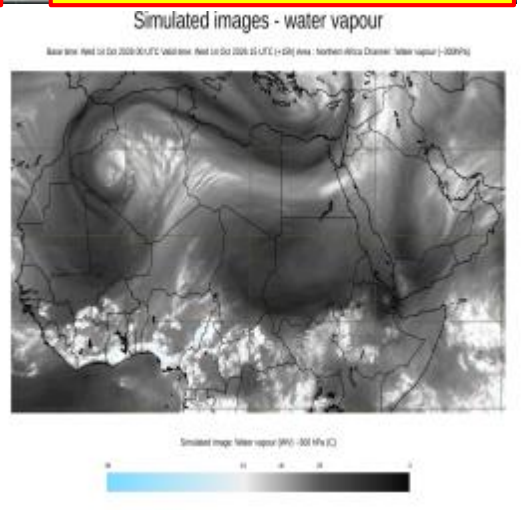
600hPa VV



10m mean wind and gust



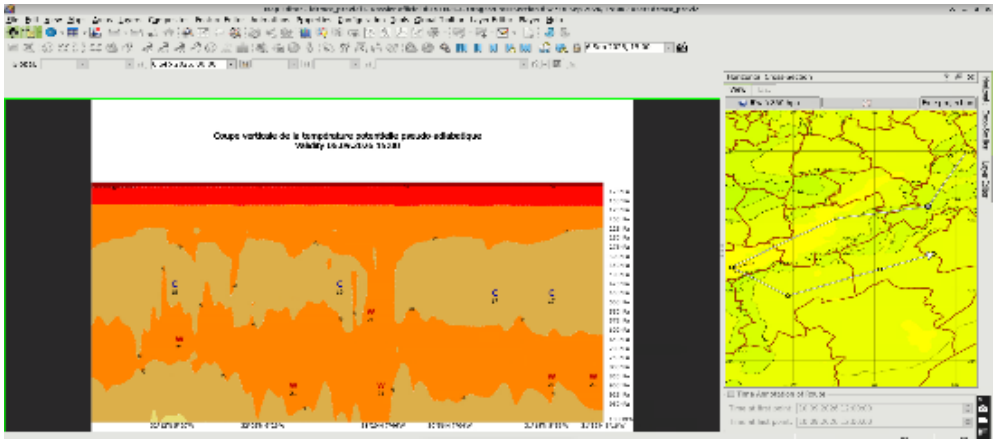
Hail Content (AROME)

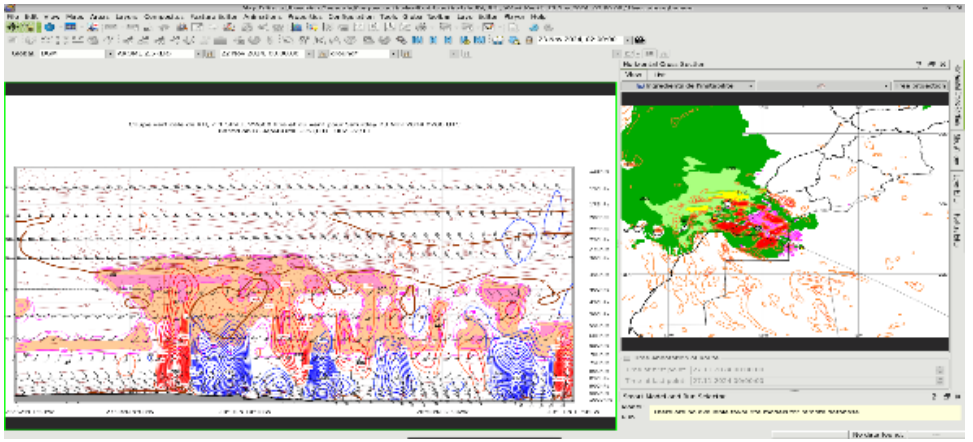


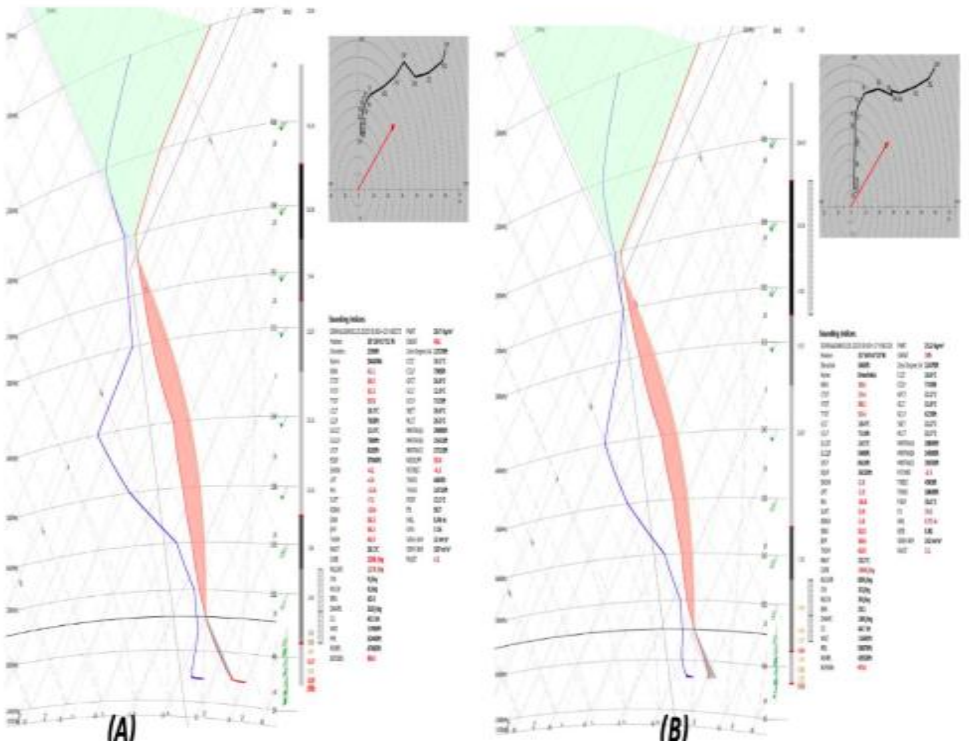
Simulated satellite imagery (IR10.8 & WV 6.2)

The mesoscale analysis of such convective parameters enables a more detailed assessment of the potential development and intensification of convective systems. It complements the overall synoptic-scale view by providing a better understanding of the spatial distribution of atmospheric instability, the areas favorable for thunderstorm initiation, and their potential intensity and associated hazards, such as heavy rainfall, strong wind gusts, and hail..

AEROLOGICAL ANALYSIS : FORECAST SOUNDINGS, CROSS SECTIONS, HODOGRAPHS AND INSTABILITY INDICES







Roaming Profile

Upper profile | Temperature | Wind | Height | Indices | Wind/Temp | Temp/Hum

Forecasted Thermodiagram DGM/AROME 2.5 (LR)/25.11.2024 00:00/+30 h/34°13'N 6°31'W

THERMODYNAMIC INDICES

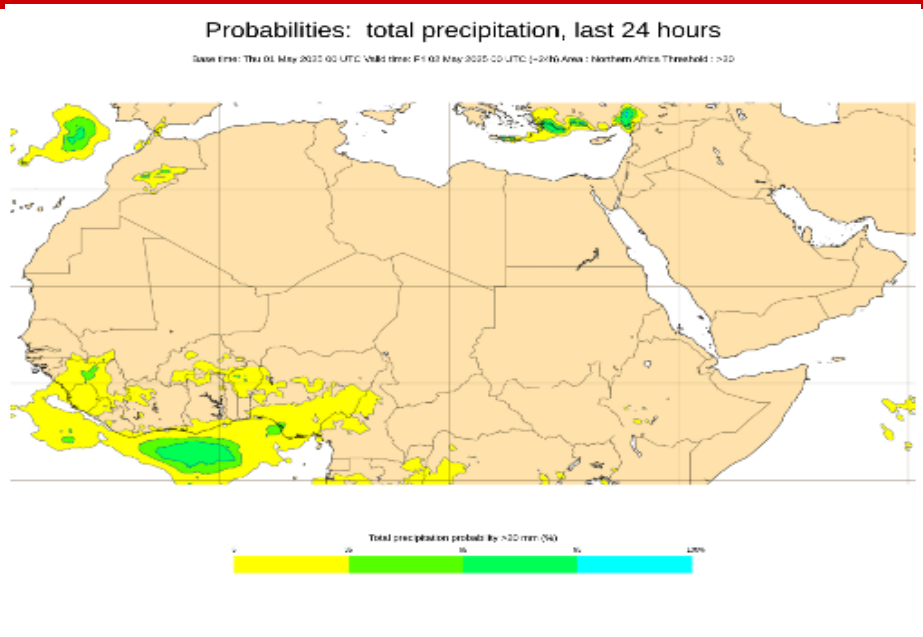
Index	Value	Moderate	Severe
Showalter	4.6	4.0	-4.0
Lifted	2.9	-3.0	-5.0
Modified Lifted	-3.6	-3.0	-5.0
Surface Lifted	3.6	-3.0	-5.0
K Index	20.4	20.0	
Thomson	17.5	30.0	35.0
Jefferson	24.1	27.0	28.0
KO Index	-1.1	6.0	2.0
S Index	33.9	40.0	46.0
Total Totals	43.7	45.0	55.0
SWEAT	140	300	400
BOYDEN	96.8	94.0	95.0
CAPE (J/kg)	-469	1001	2001
MLCAPE (J/kg)	8	1001	2001
CIN (J/kg)	0		
MLCIN (J/kg)	408		
MPL (ft)	13420		
MLMPL (ft)	15920		
SBCT (°C)	---		
MLCT (°C)	30.4		
Bulk Richardson Number	-3.7		
Rackliff	26.4	29.0	30.0
Potential Instability	0.6	3.0	-2.0
Fog Point (°C)	---	50.0	100.0
Fog Stability	27.8	55.0	31.0
Hail size (in)	---	0.50	
Cross Totals	15.0	18.0	24.0
Vertical Totals	28.6	24.0	26.0
Wetbulb Zero Level (ft)	9570	3555	605
Precipitatable Water Amount (kg/m²)	23.9	32.0	45.0

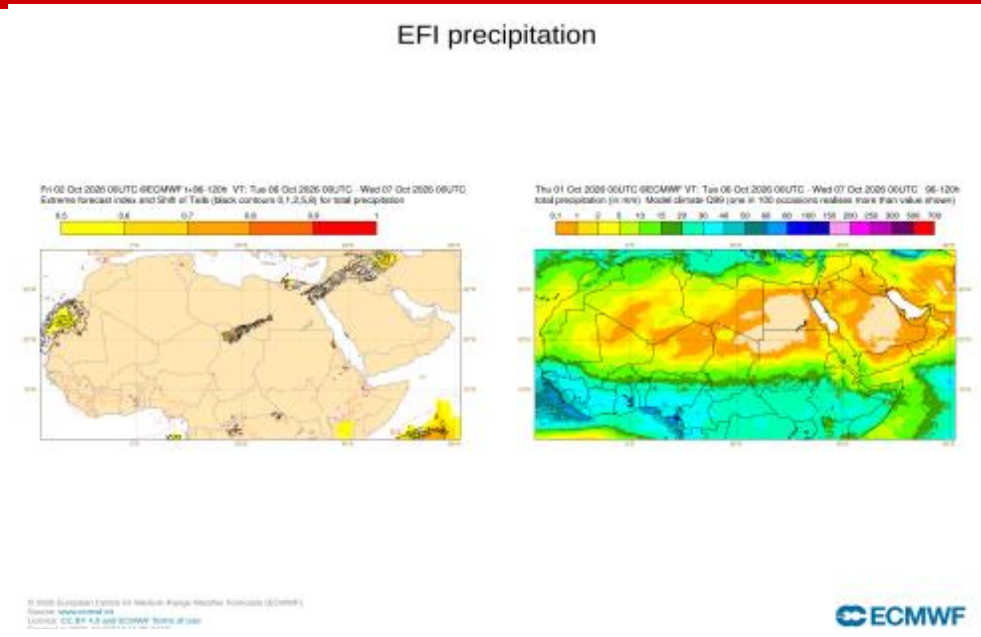
Type: From Model

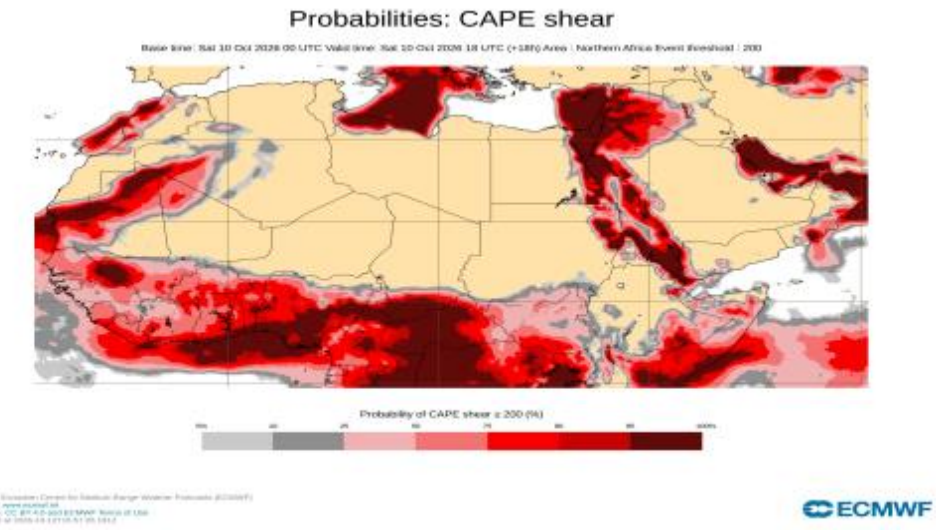
Location 34°13'N 6°31'W
Validity 26.11.2024 06:00 [+30:00h]
Model DGM/AROME 2.5 (LR)
Run 25.11.2024 00:00

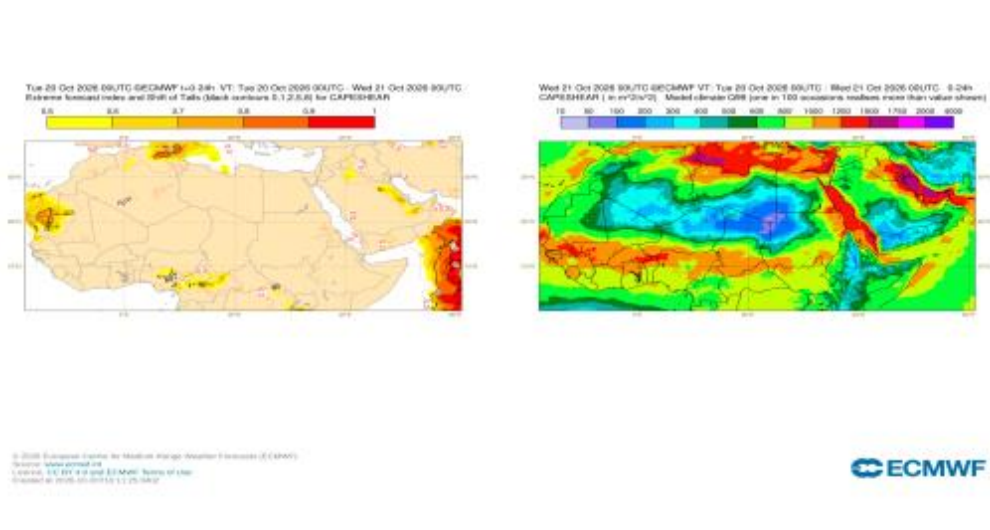
The goal here is to assess the vertical structure of the atmosphere and anticipate the type, intensity and evolution of convective storms.

ENSEMBLE FORECASTING : PROBABILITIES AND EXTREME FORECAST INDICES



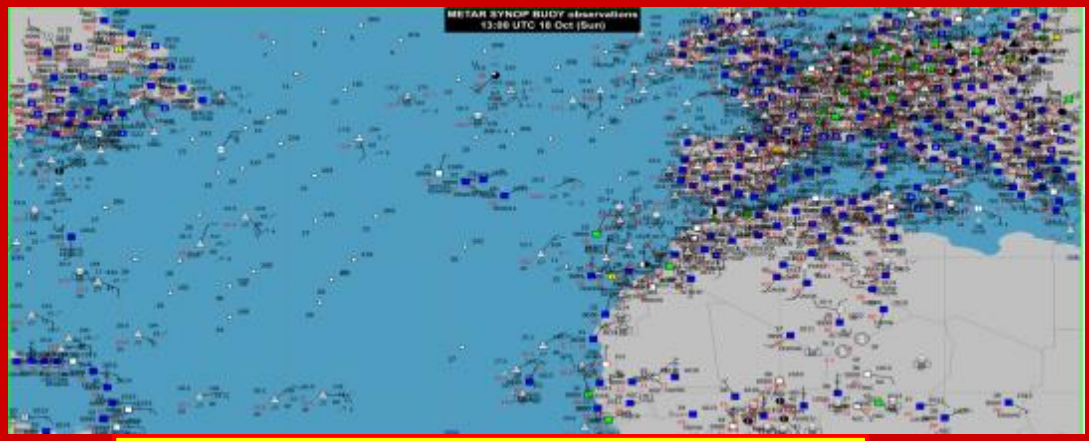




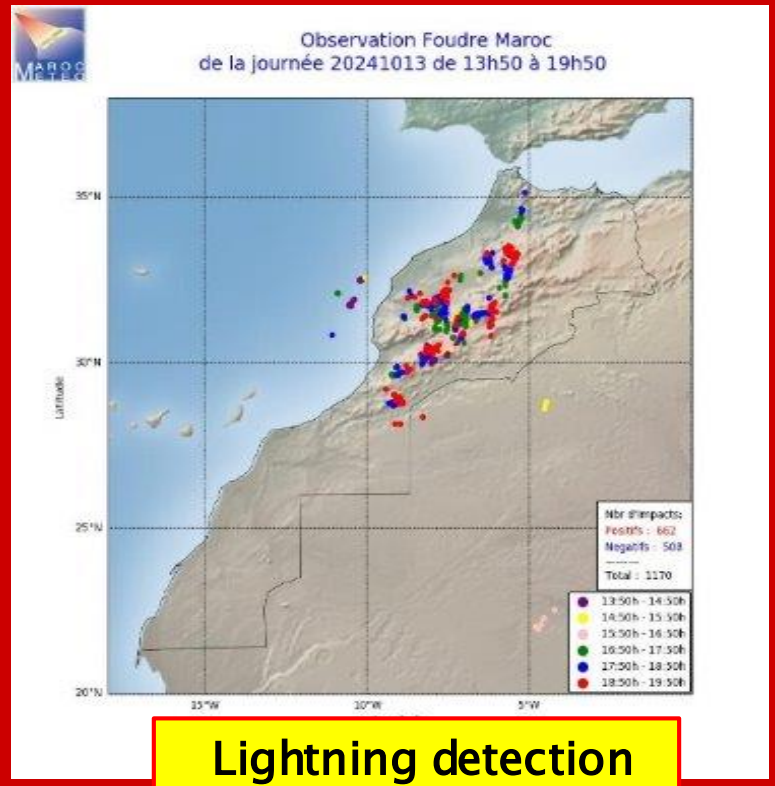


ECMWF : https://charts.ecmwf.int/

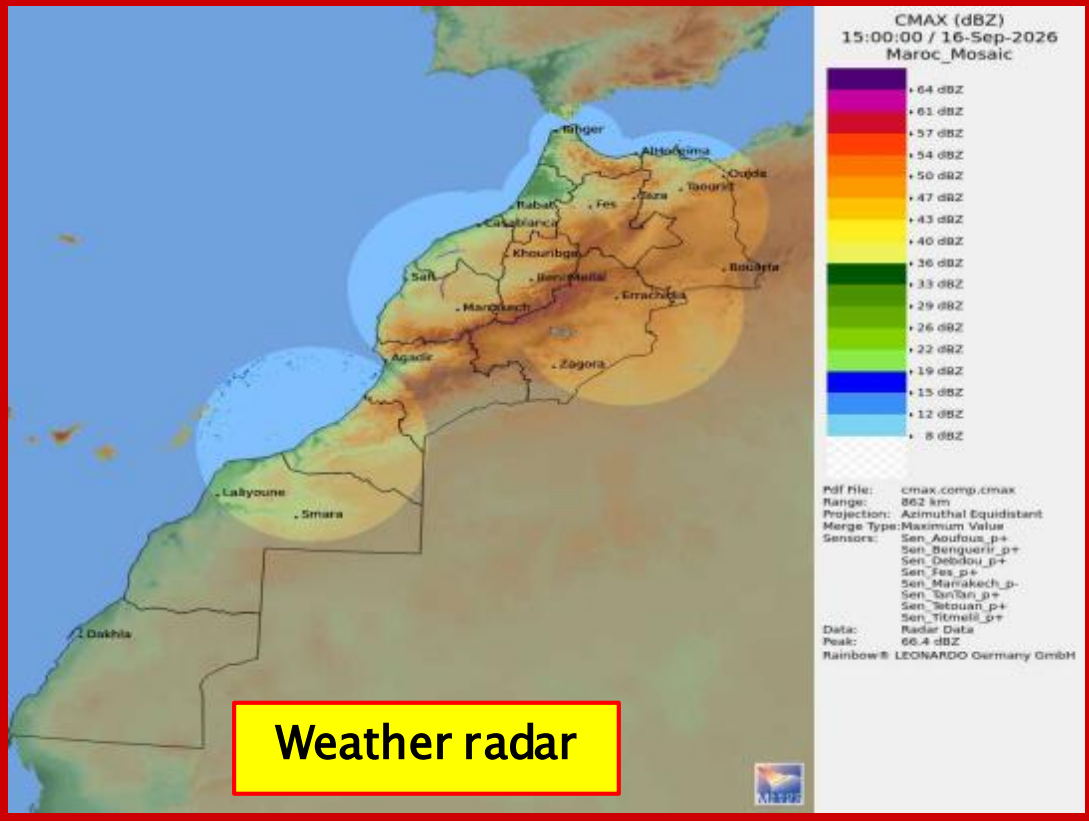
OBSERVATIONAL DATA



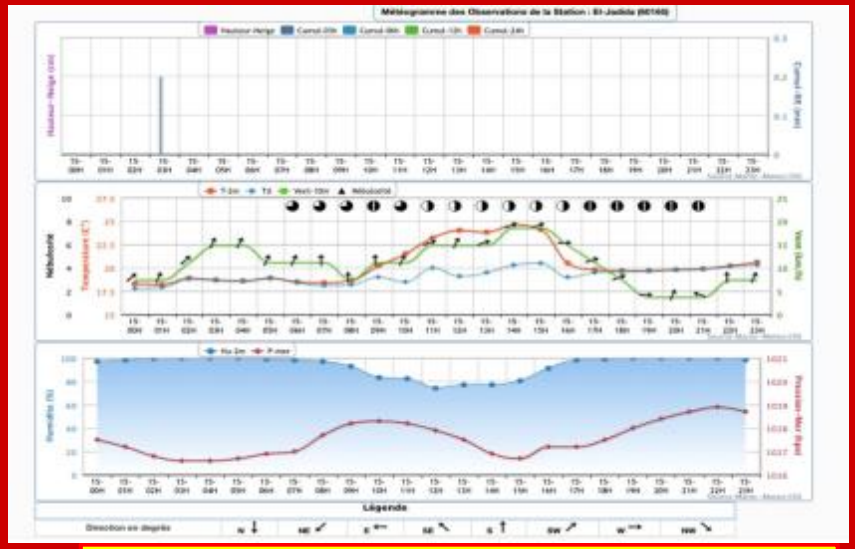
Surface observations



Lightning detection

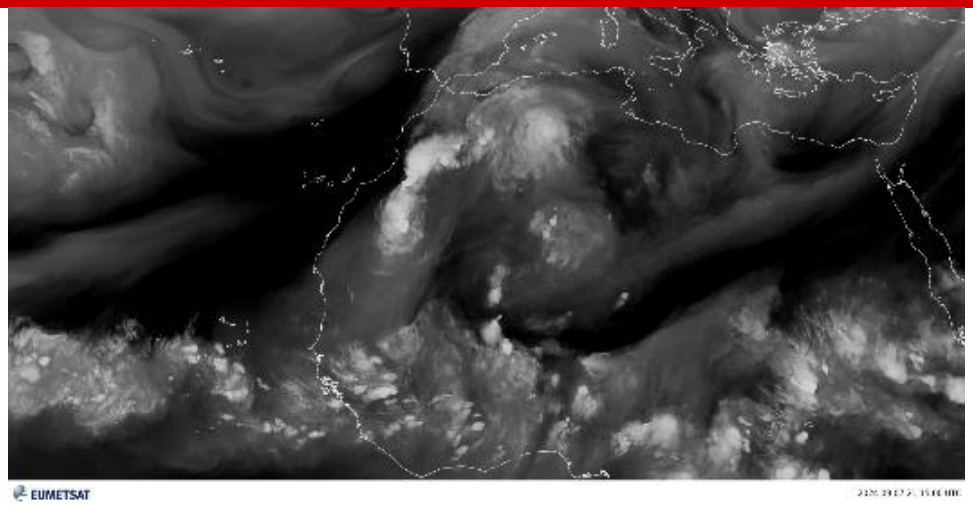


Weather radar

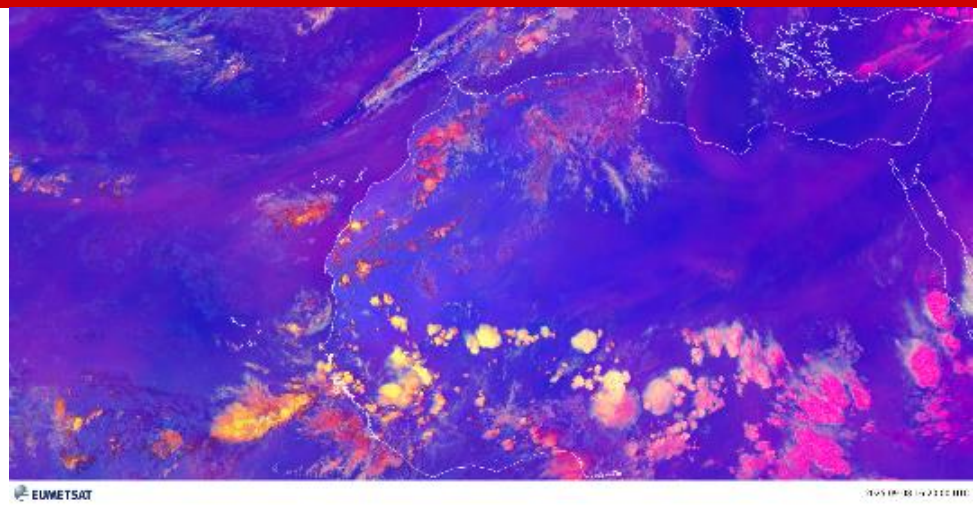


Surface observations

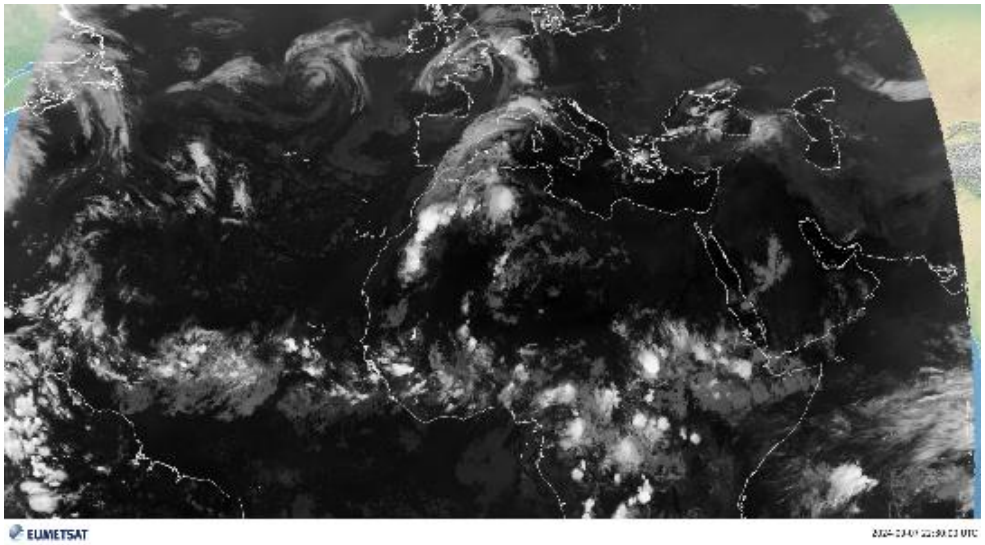
SATELLITE IMAGERY



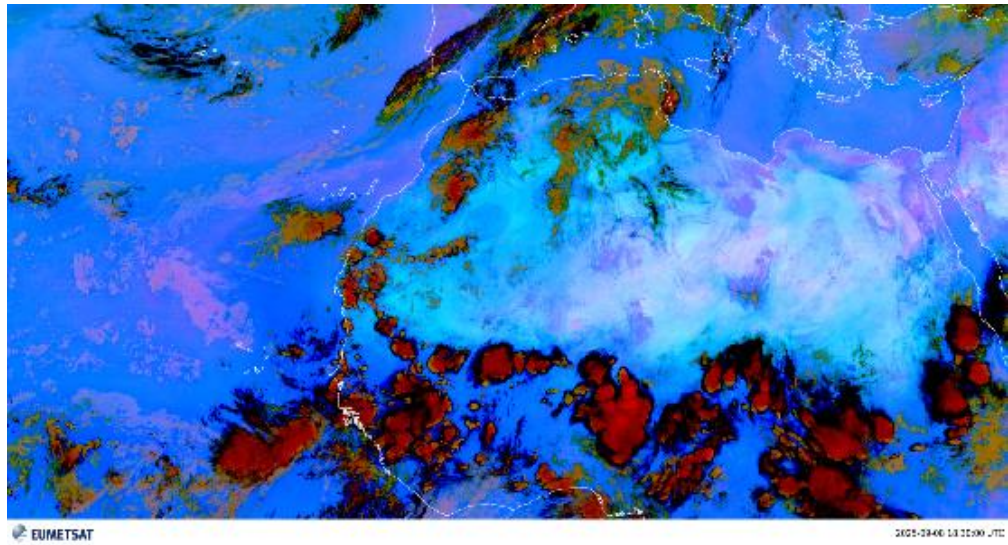
WV 6.2



Severe Convection RGB



IR 10.8

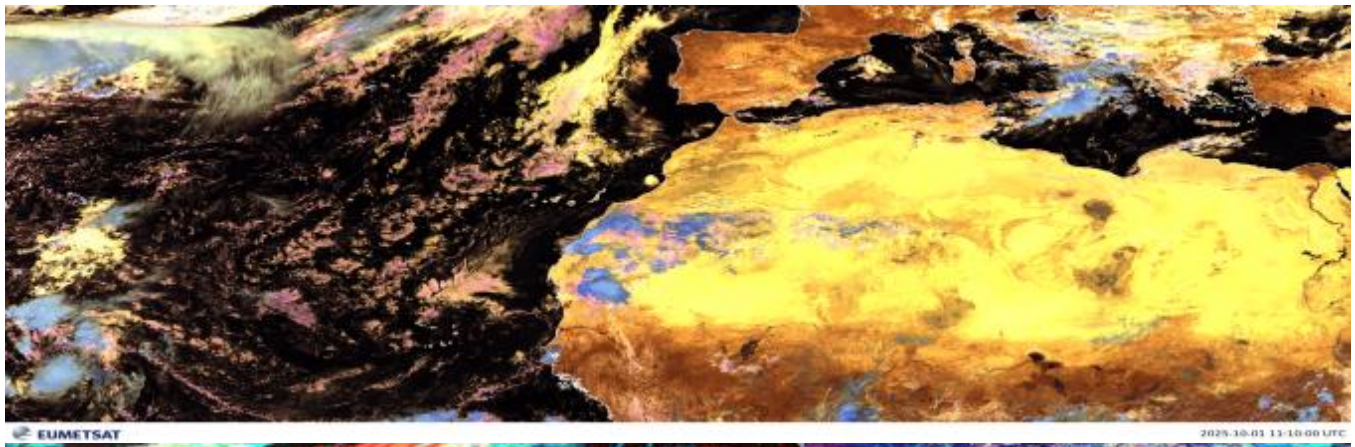


Dust RGB

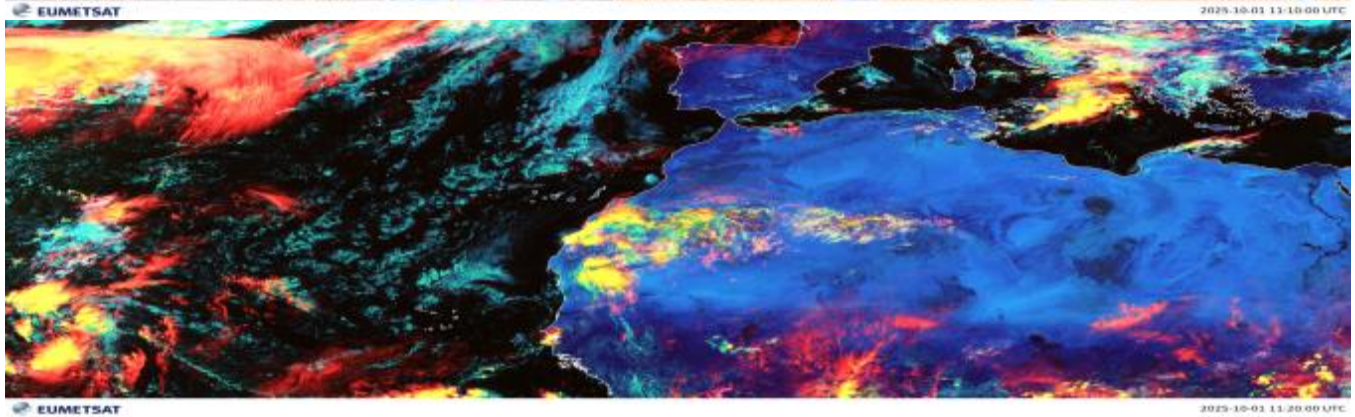
- Partage public - Fichiers - Nextcloud Météo-France
- https://user.eumetsat.int/resources/user-guides/mtg-africa-data-service-guide

SATELLITE IMAGERY – MTG

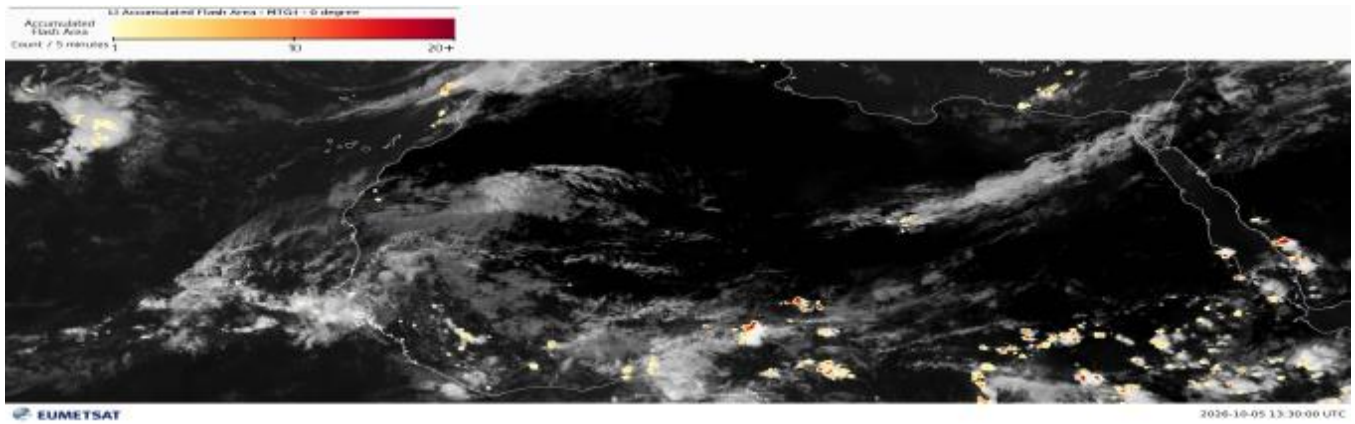
Cloud Phase RGB



Cloud Type RGB

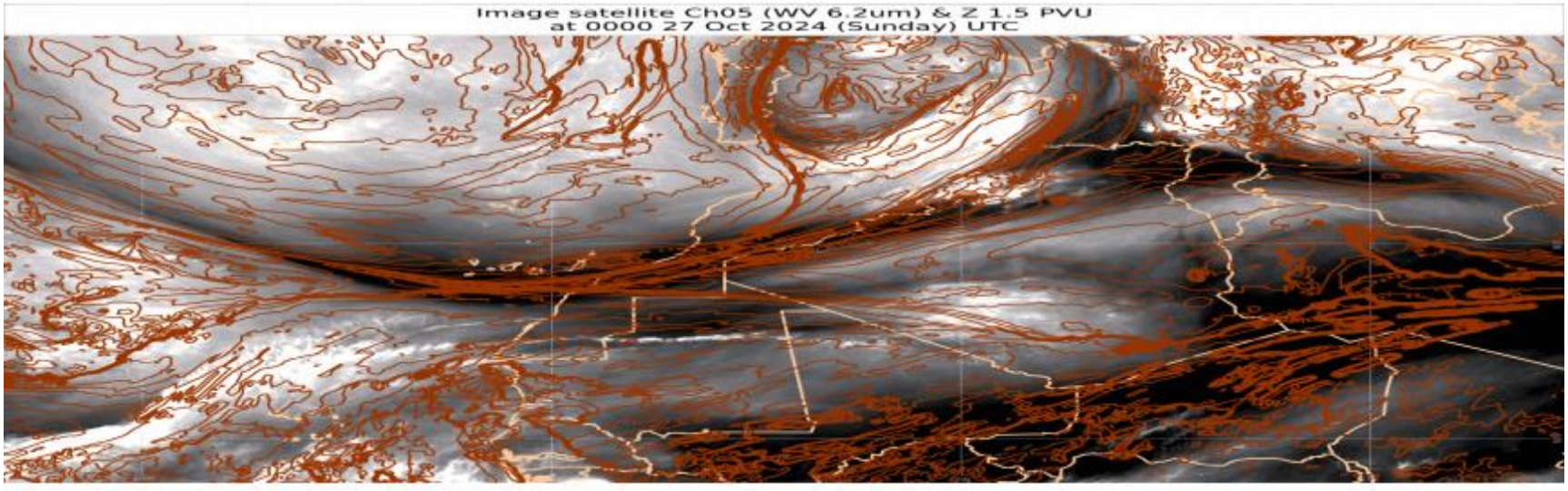


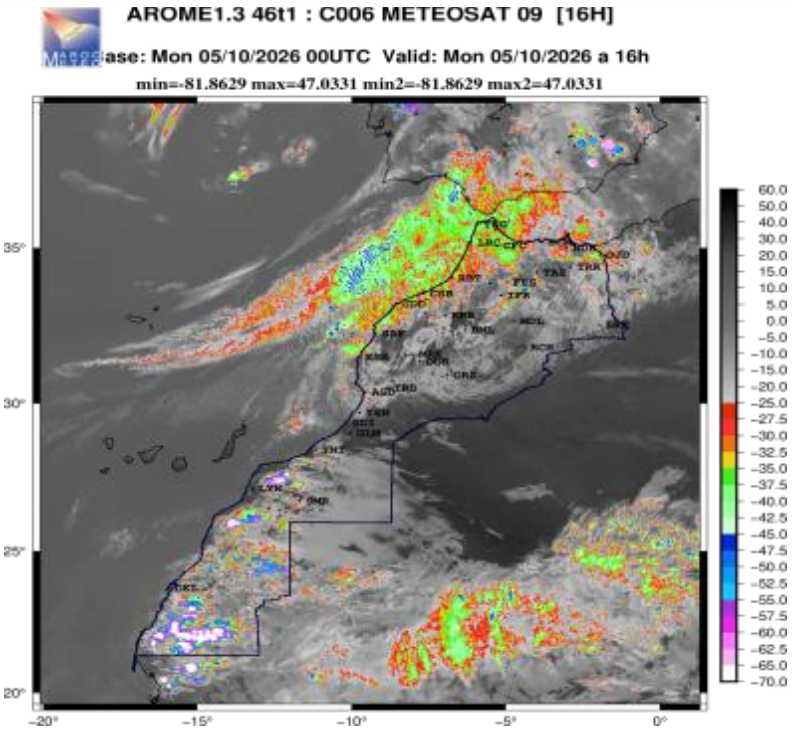
LI accumulated flash area



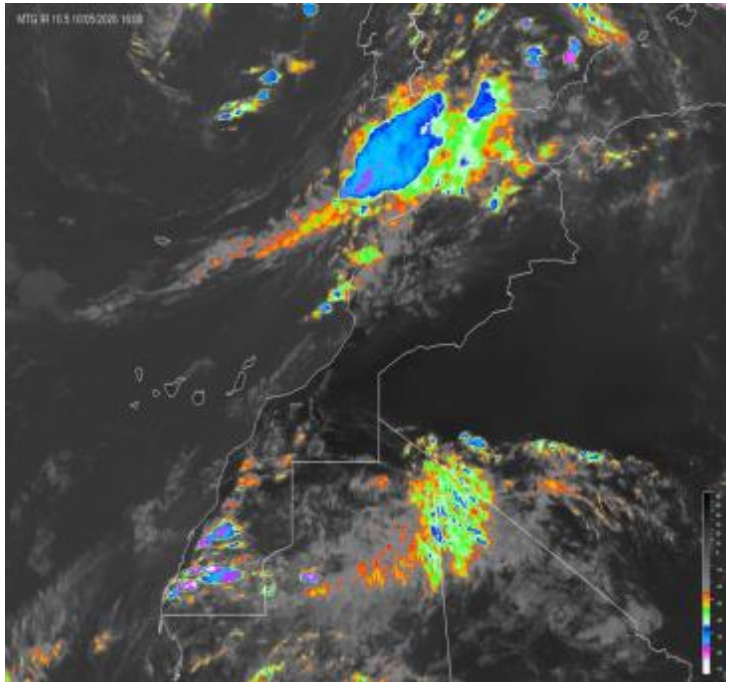
https://view.eumetsat.int/productviewer?v=default#

Large-scale model calibration: comparing model forecasts with corresponding satellite observations.

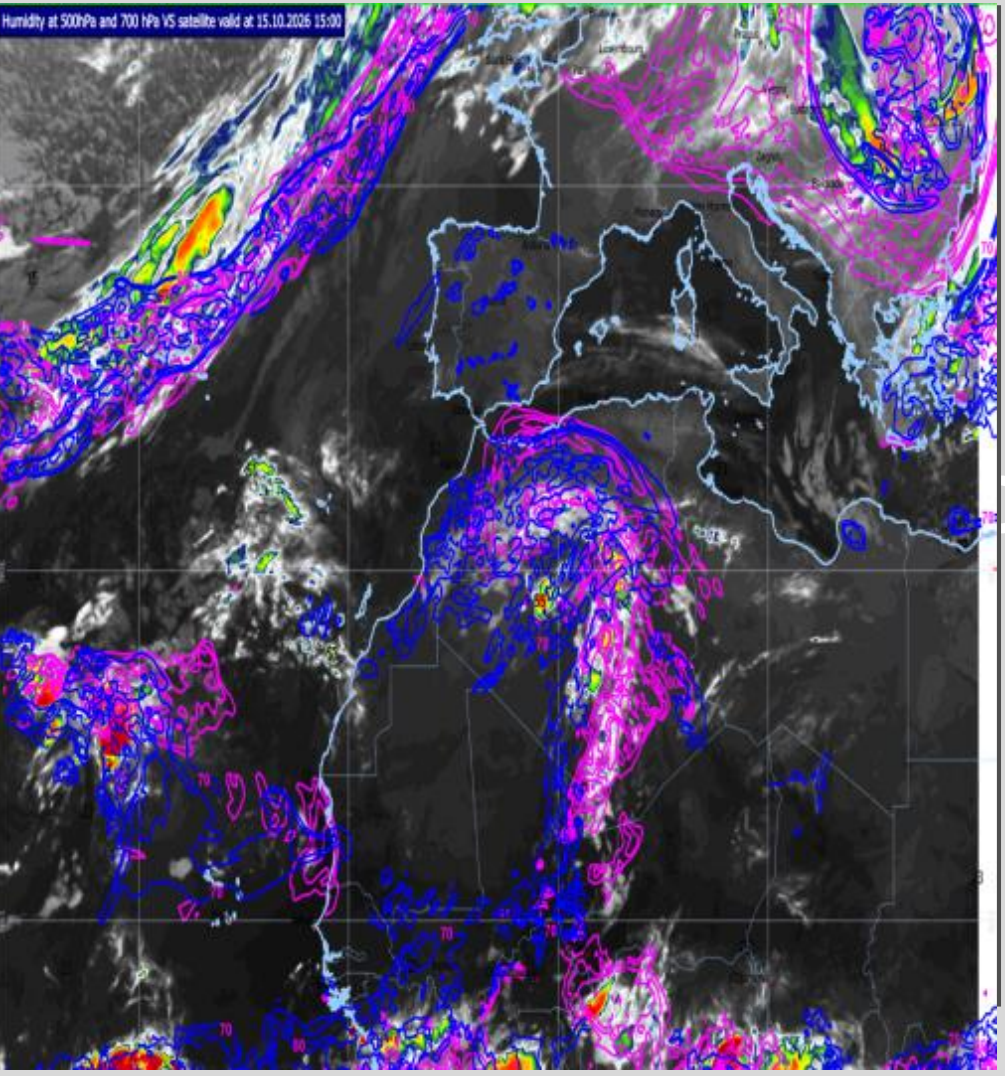


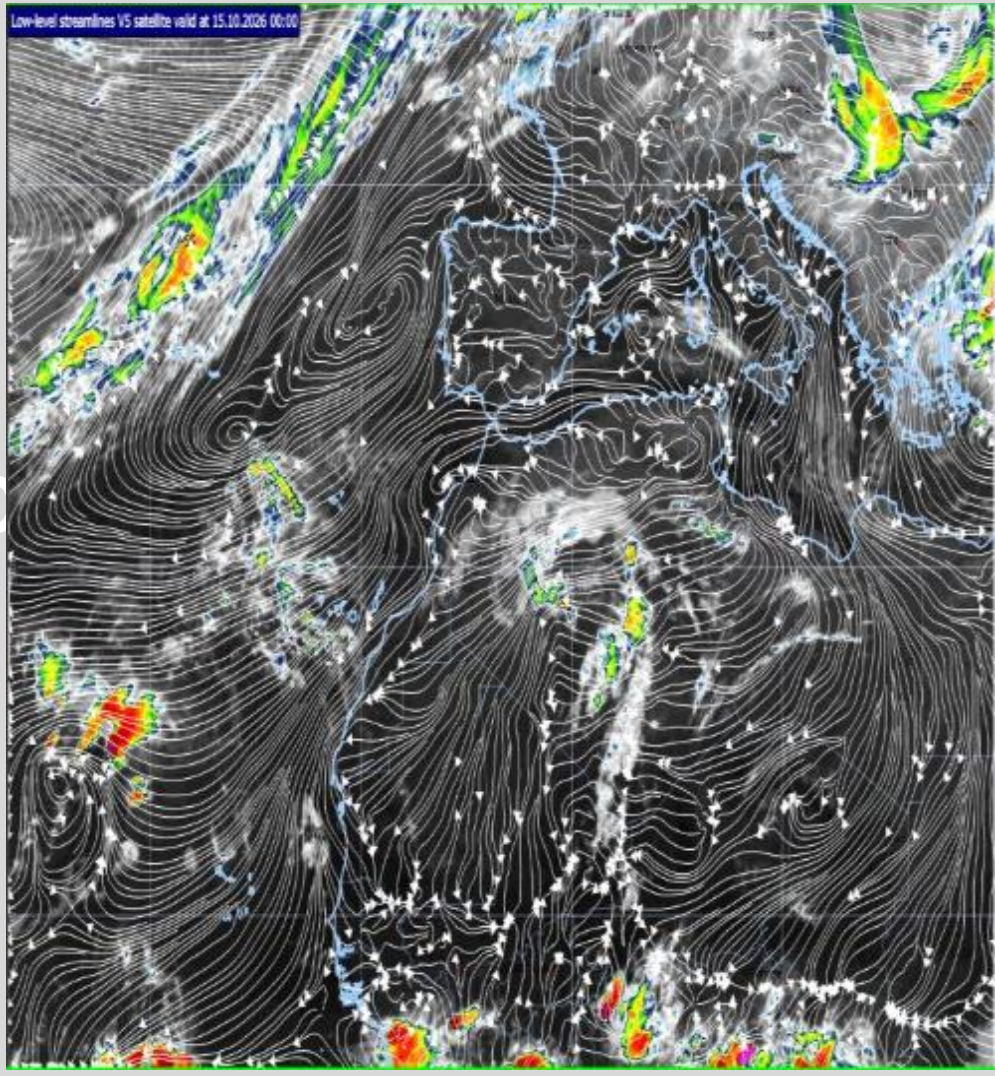


VS



Large-scale model calibration: comparing model forecasts with corresponding satellite observations.





FUSION PRODUCTS

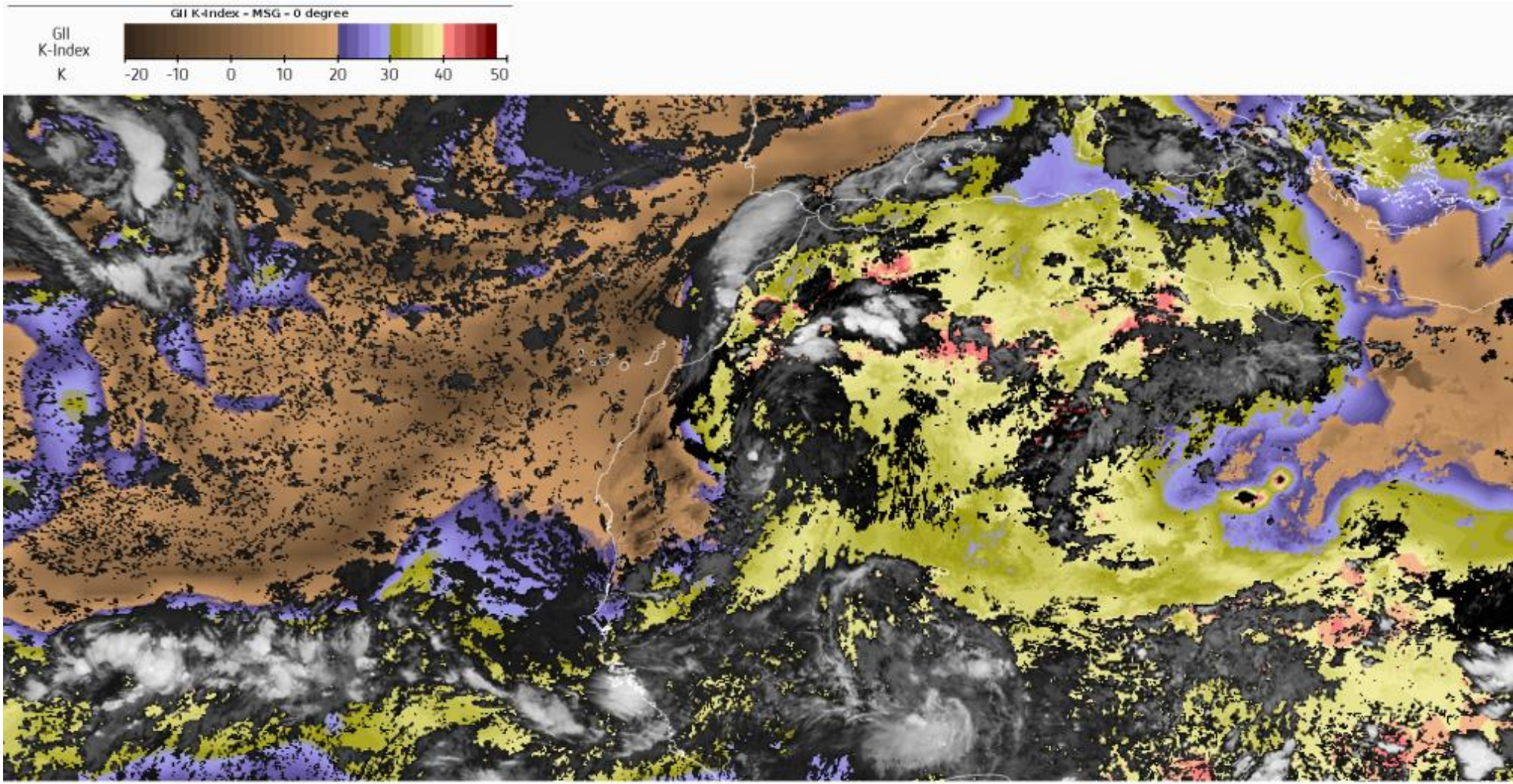
- The SAF NWC (Satellite Application Facility for Nowcasting and Very Short Range Forecasting) provides tools and software based on satellite imagery, used for producing customized forecasts up to 12 hours ahead (https://www.nwcsaf.org/).

- The products combine data from active satellites, model data, satellite data from other agencies, and more.

- Product Usage Guide: https://www.nwcsaf.org/web/guest/practical-guide, https://www.nwcsaf.org/web/guest/guide_to_forecasters

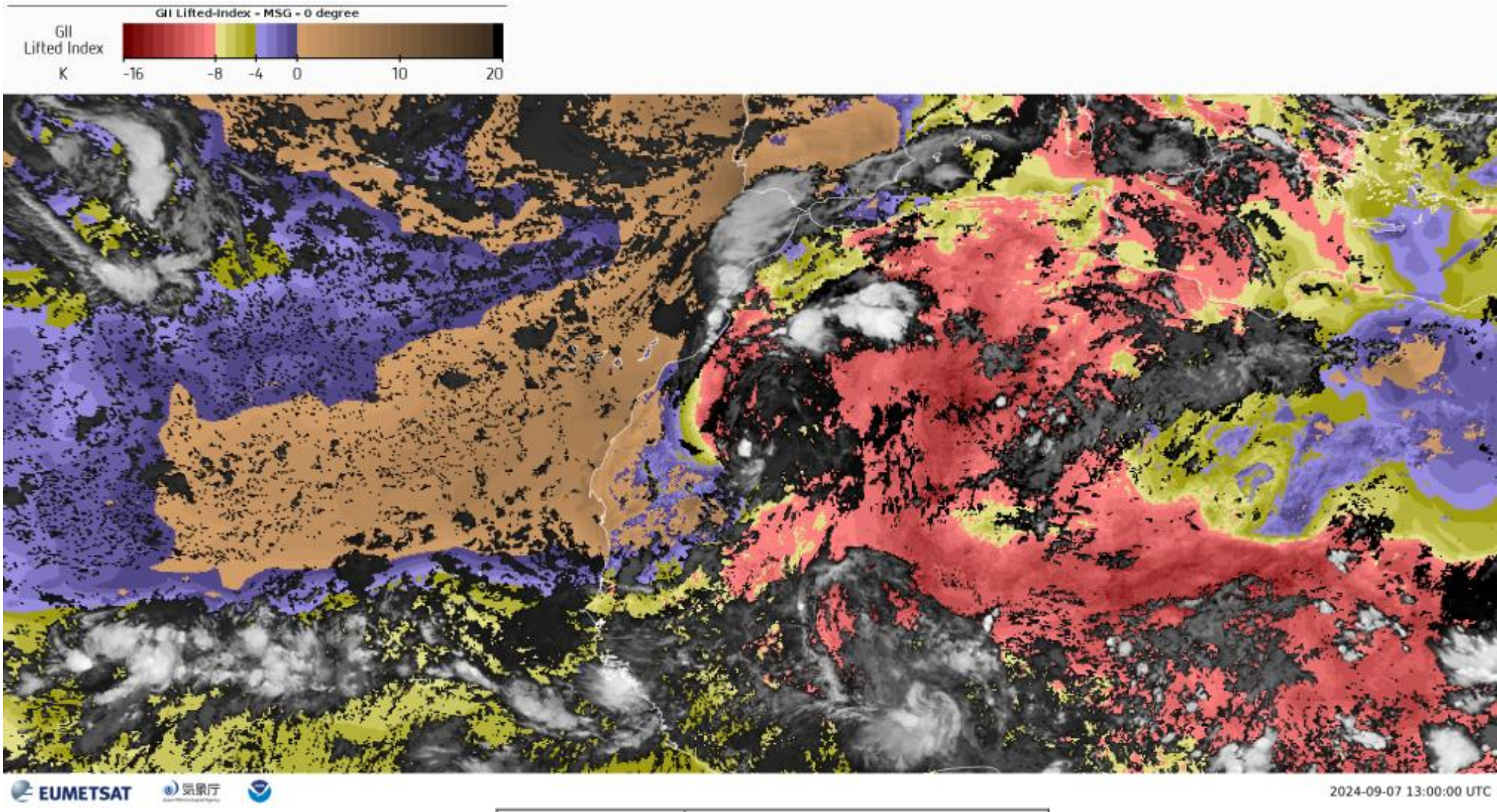
EUMETSAT NWC SAF

1- iSHAI: Stability Analysis Imagery - Pre-convective environment
K Index



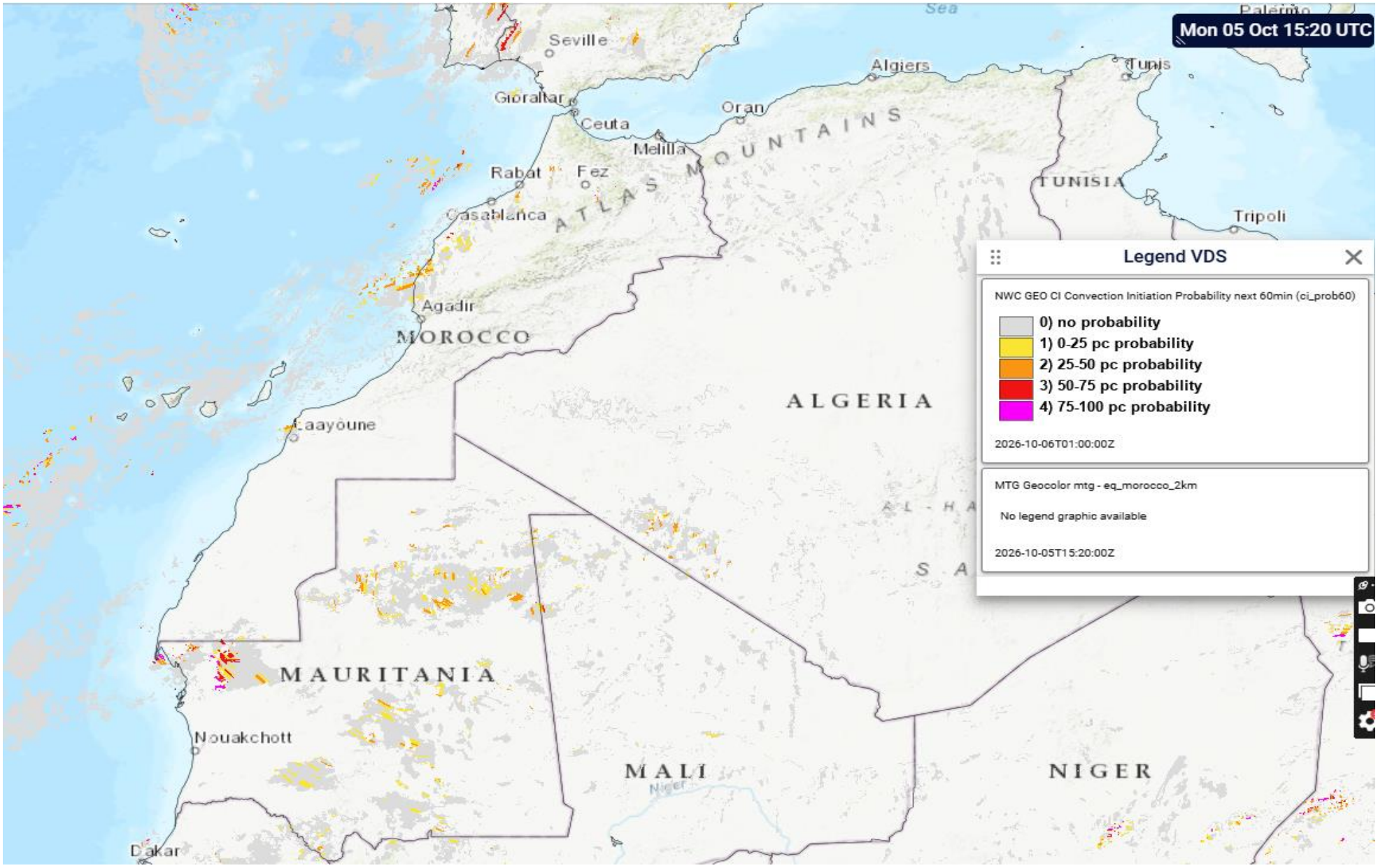
K-Index value	Storm probability
v < 15	≈0%
15 < v <= 20	< 20%
21 < v <= 25	20 – 40 %
26 < v <= 30	40 – 60 %
31 < v <= 35	60 – 80 %
36 < v <= 40	80 – 90 %
v > 40	> 90 %

1- iSHAI: Stability Analysis Imagery - Pre-convective environment Lifted Index



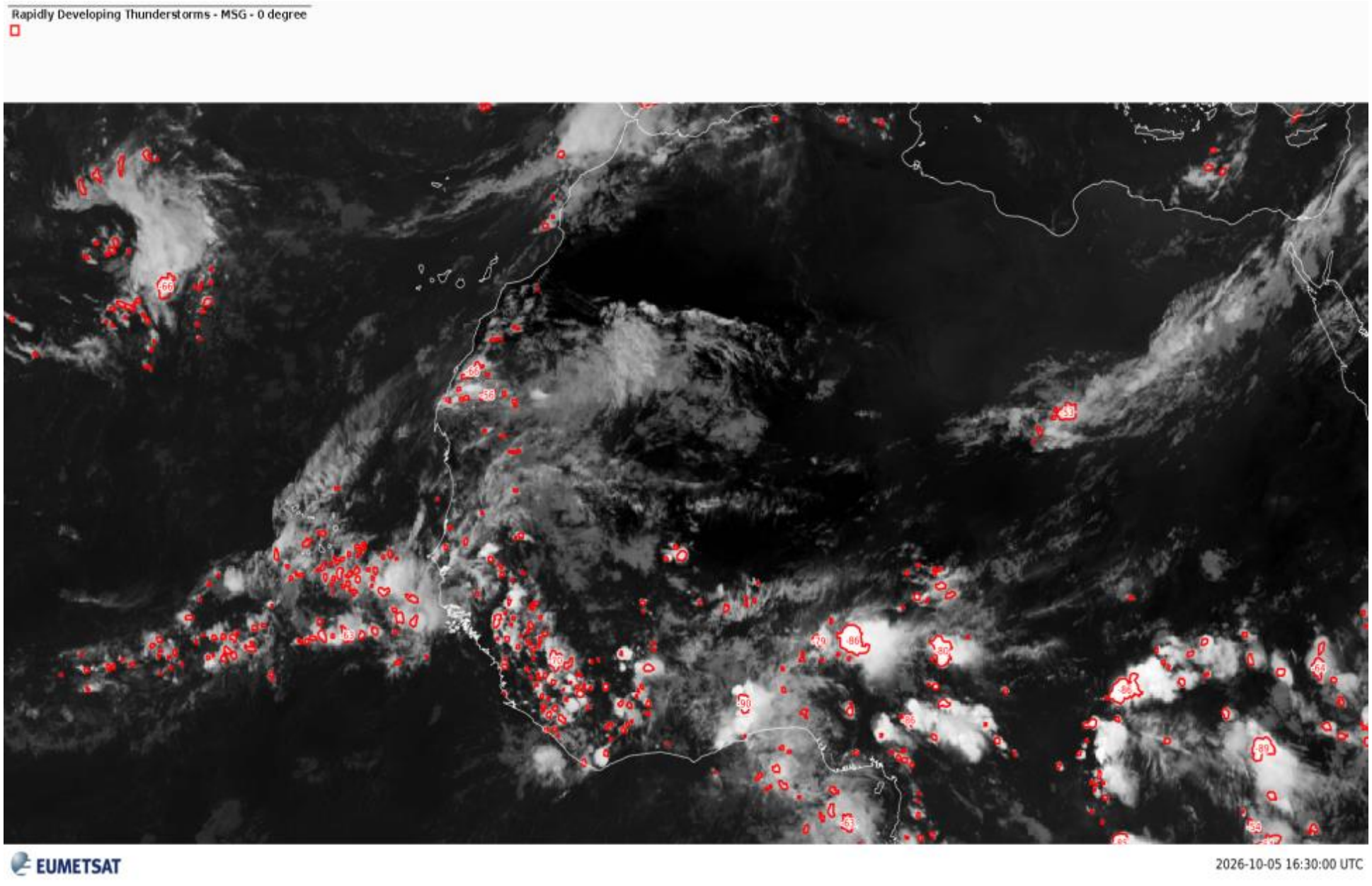
LI value	
V > 0	Stable
-3 <= v < 0	Slightly Unstable
-6 <= v < -3	Unstable
-9 <= v < -6	Very Unstable
v < -9	Extremely Unestable

2- CI : Convection Initiation Probability in the next 30/60/90 minutes



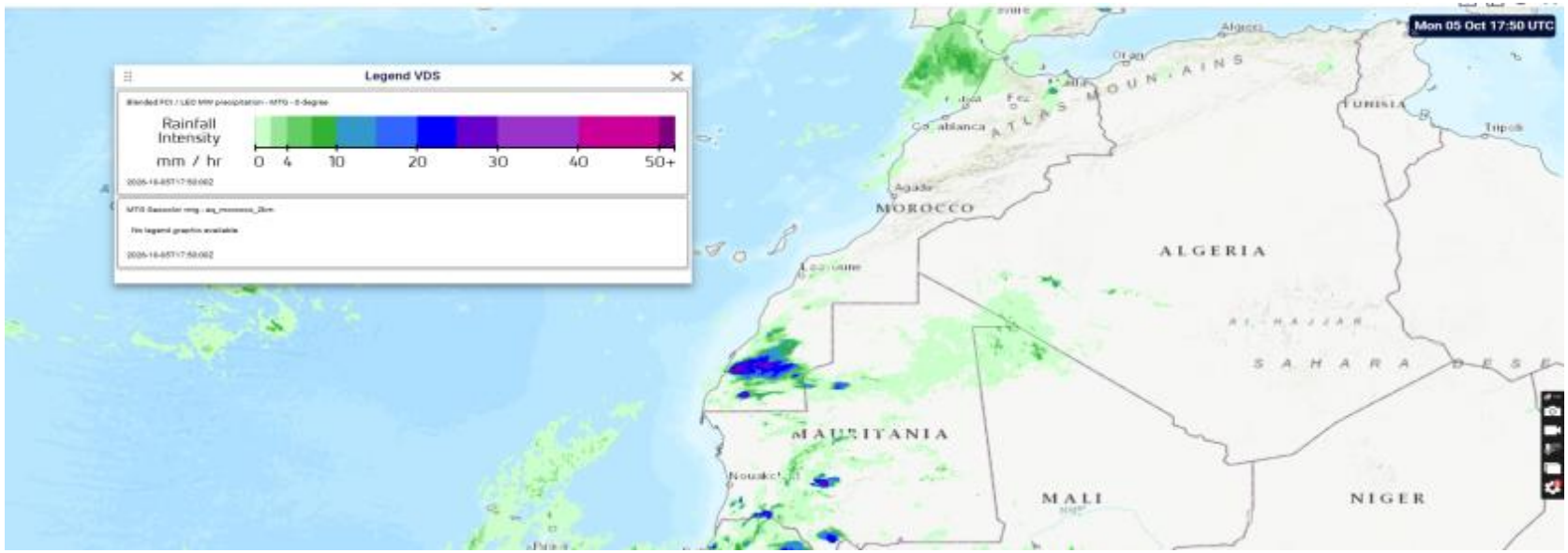
https://vlab.marocmeteo.ma/

3- RDT: Rapidly Developing Thunderstorms

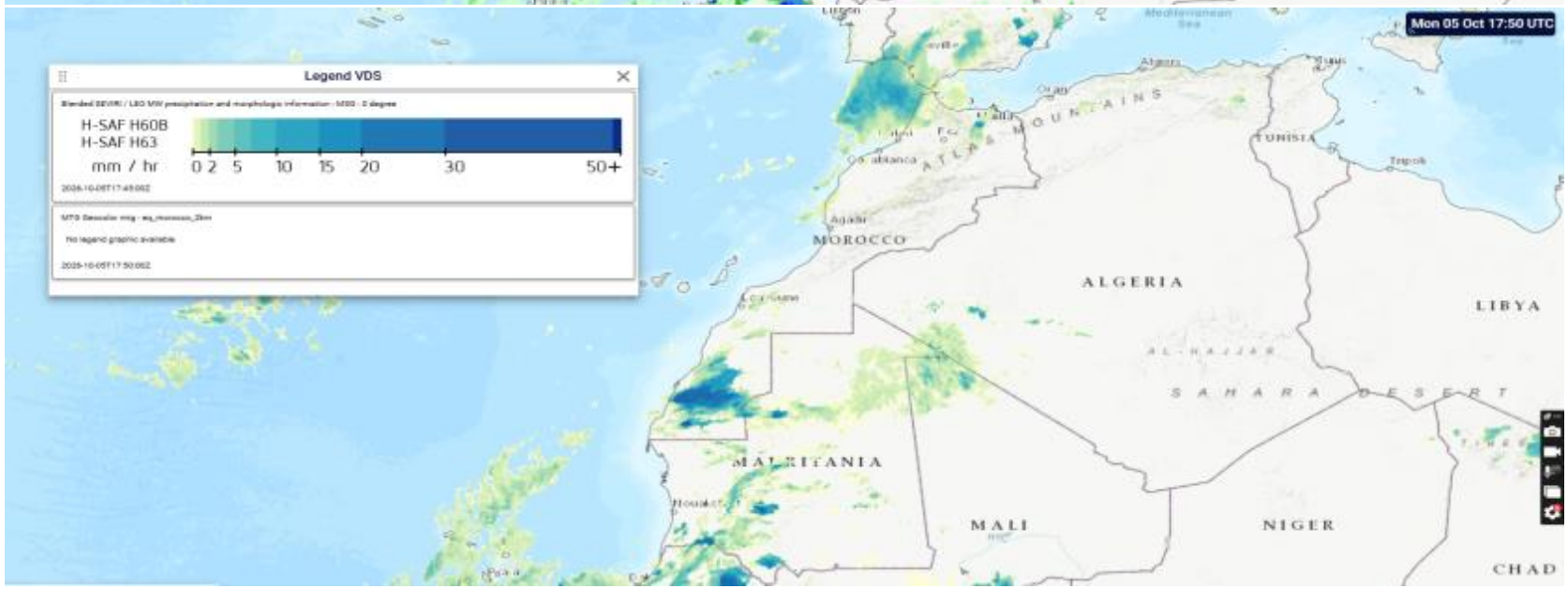


3- Precipitation Estimation : HSAF H60B/H40B

HSAF H40B

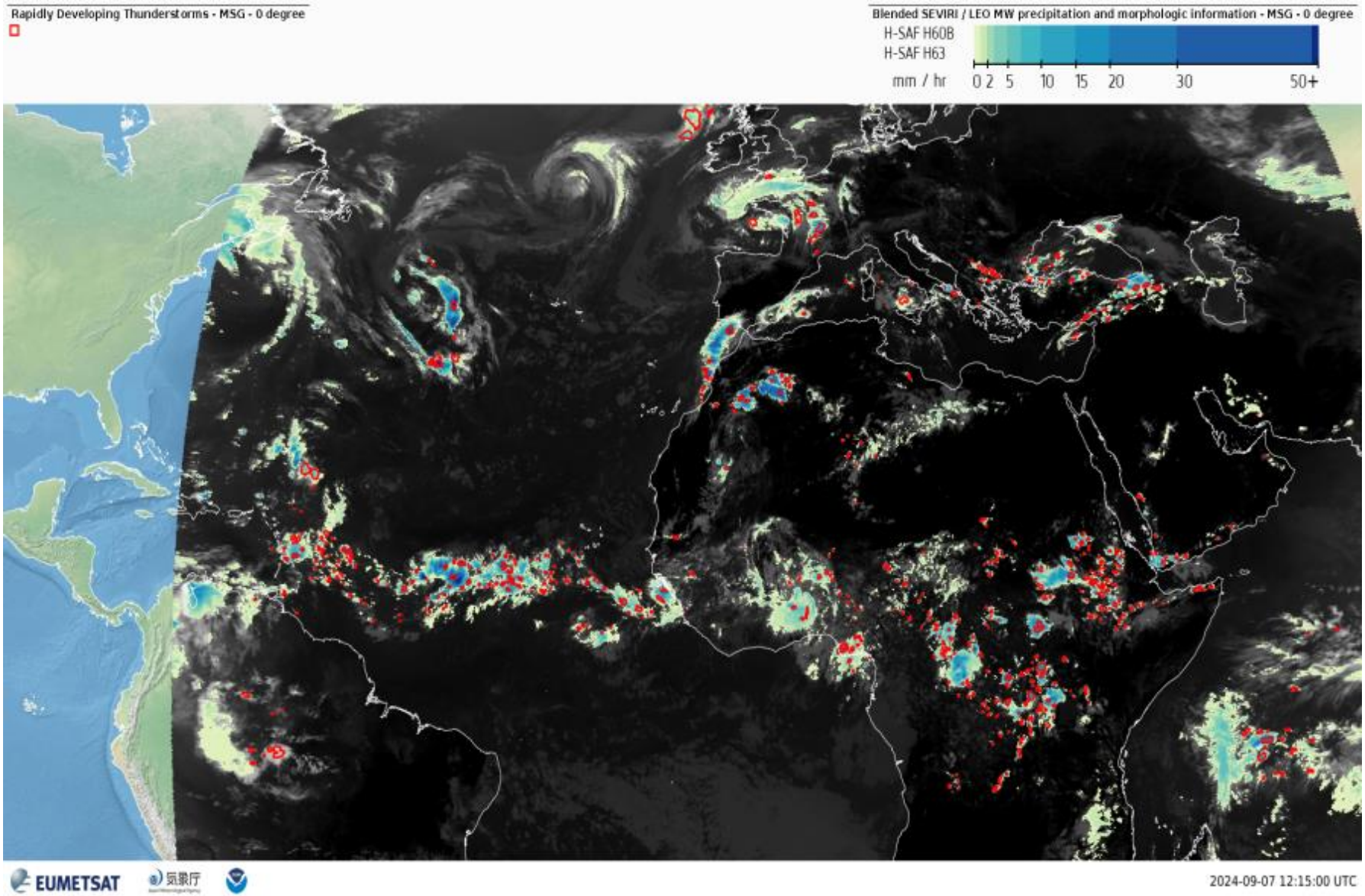


HSAF H60B

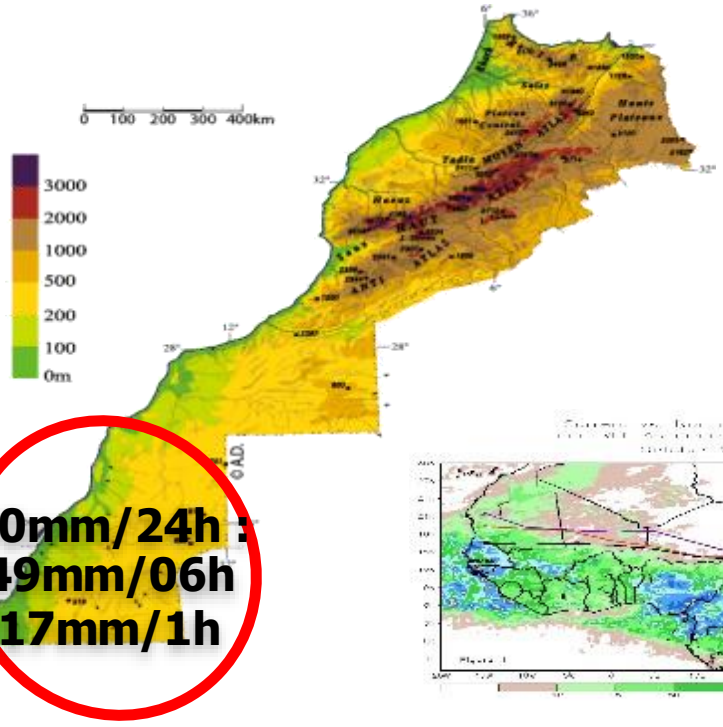


https://vlab.marocmeteo.ma/

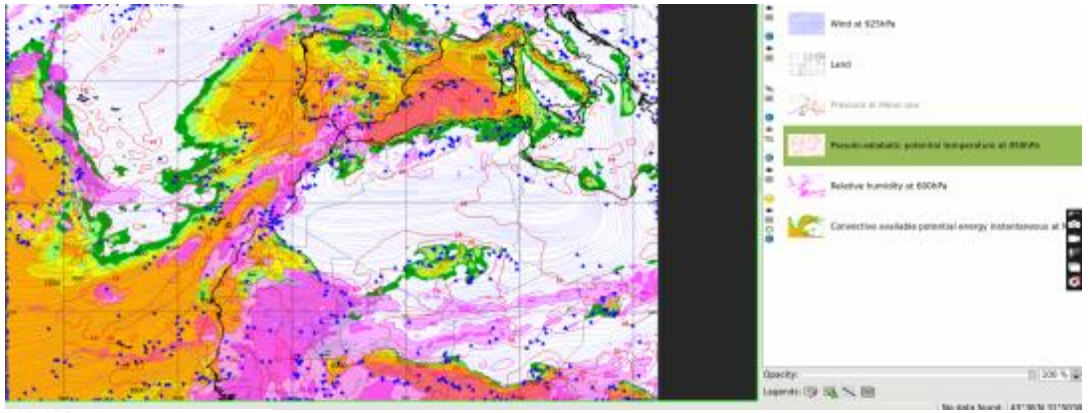
RDT + H60B

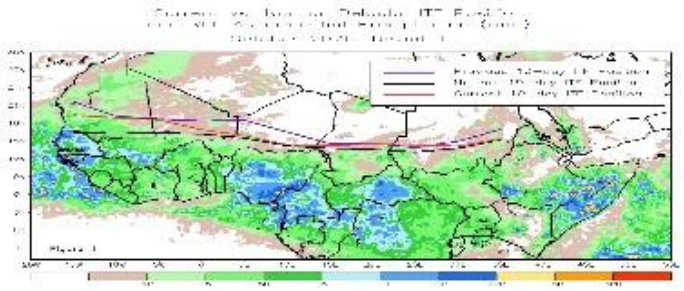

Rapidly Developing Thunderstorms - MSG - 0 degree
Blended SEVIRI / LEO MW precipitation and morphologic information - MSG - 0 degree
H-SAF H60B
H-SAF H63
mm / hr
0.2 5 10 15 20 30 50+
EUMETSAT
2024-09-07 12:15:00 UTC

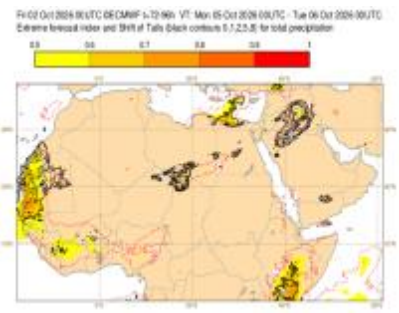
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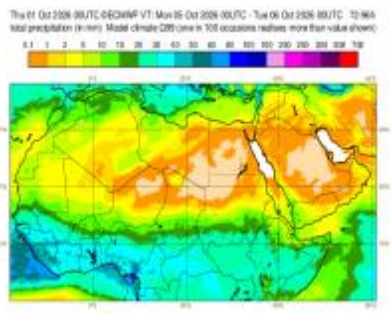


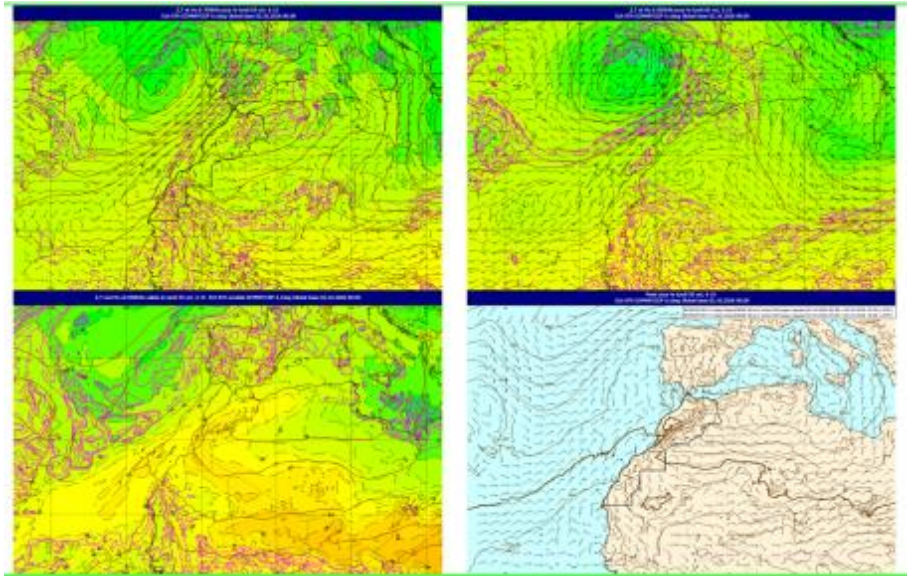
70mm/24h :
49mm/06h
17mm/1h

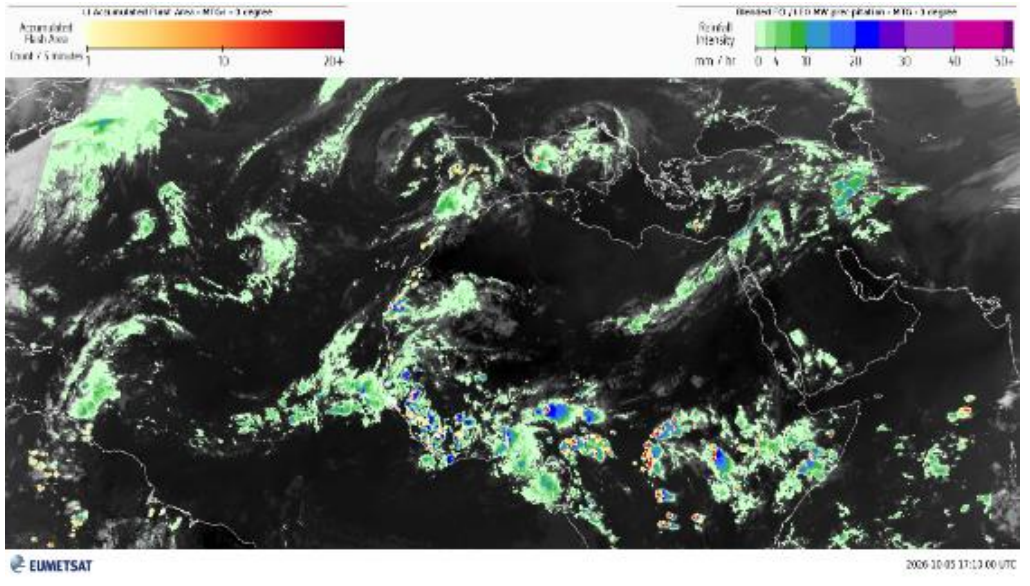






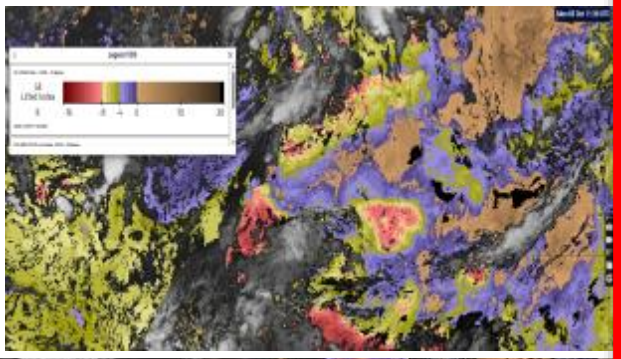


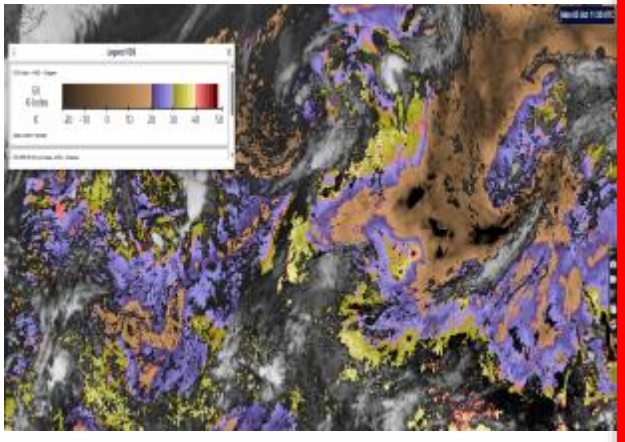




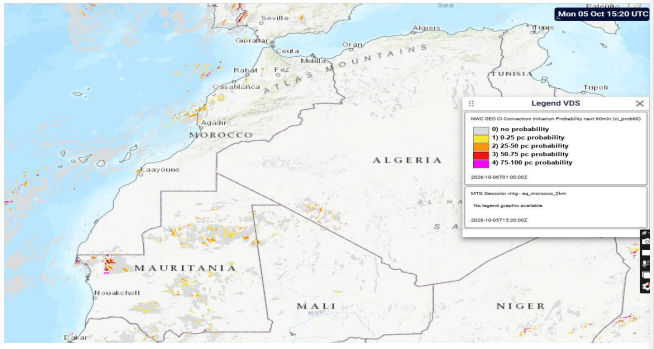
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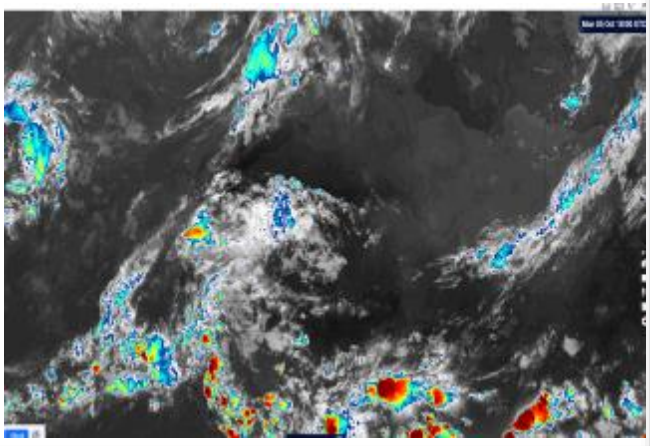
Pre-convective environment



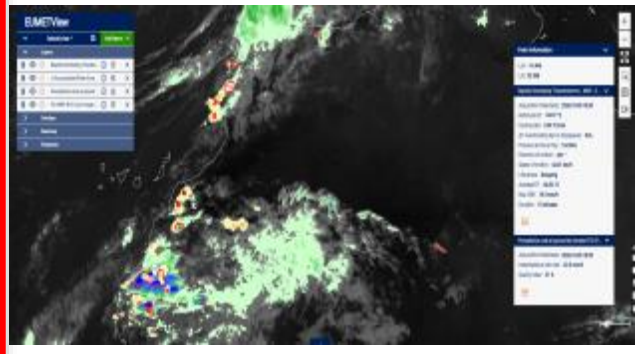


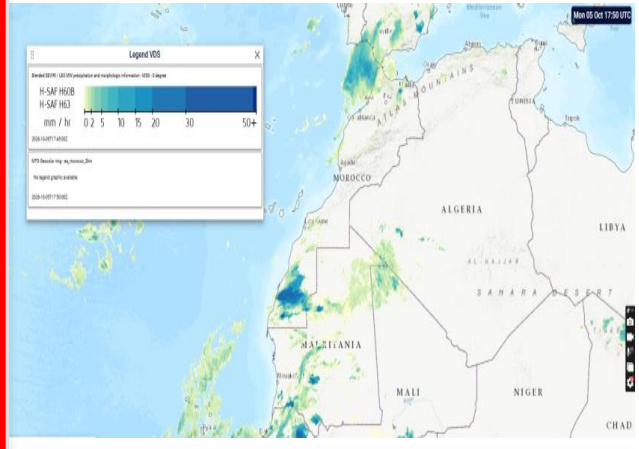
Convection initiation

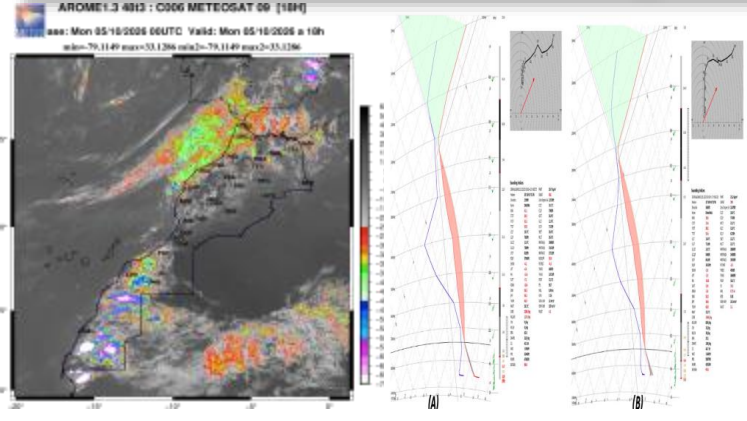


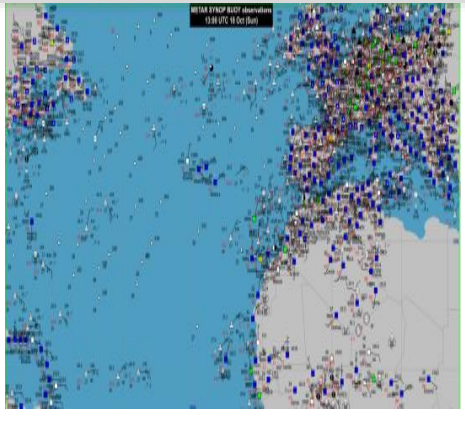


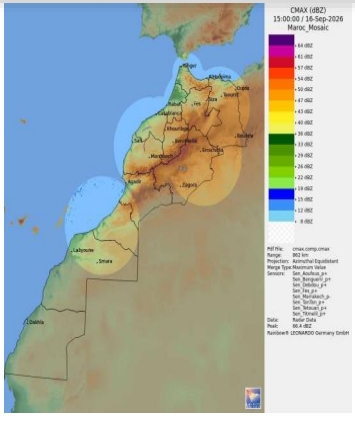
Maturity of convection

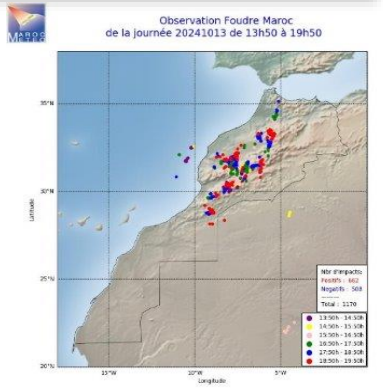












Thanks

for your attention