EUMETSAT Short Courses:
Spot atmospheric convection from satellite
What satellite data is used in convection analysis

12 May 2021

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EUMETSAT

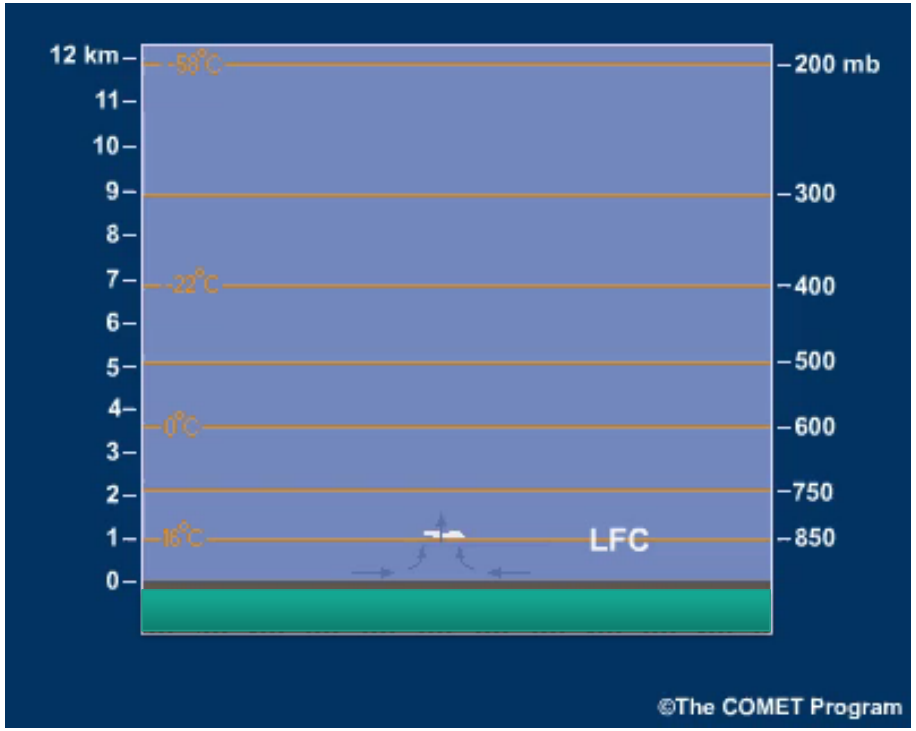
For technical issues, please send a message in the chat box to **Support**.
For **Q&A**: go to Slido.com – event code: **#EUMSC14**

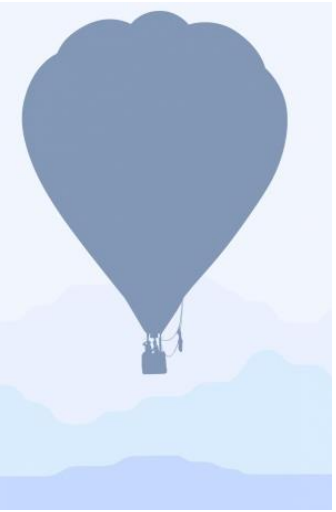
The purpose of convection?

Vertical mixing!

Vertical mixing!

Stages of convection?

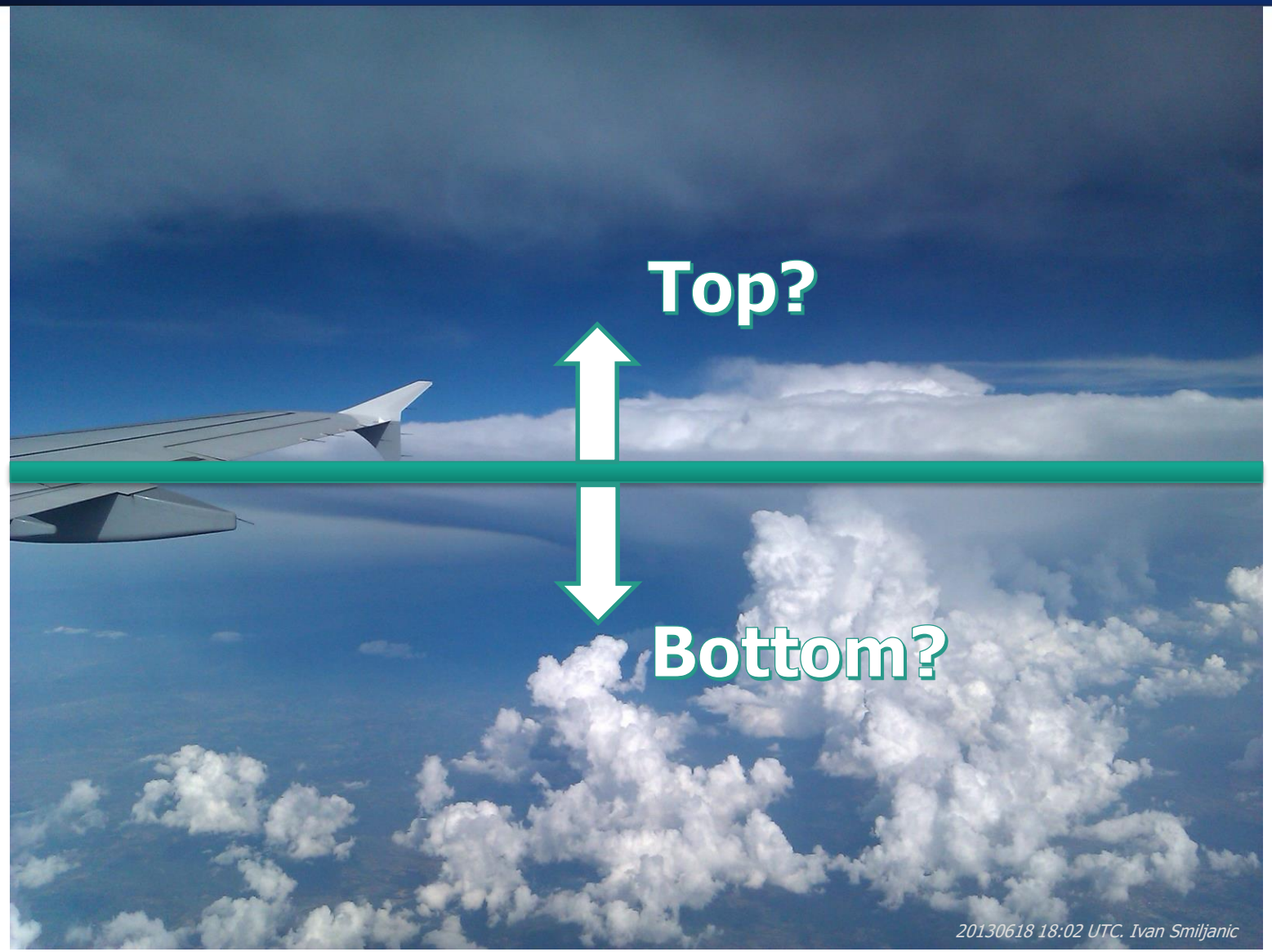




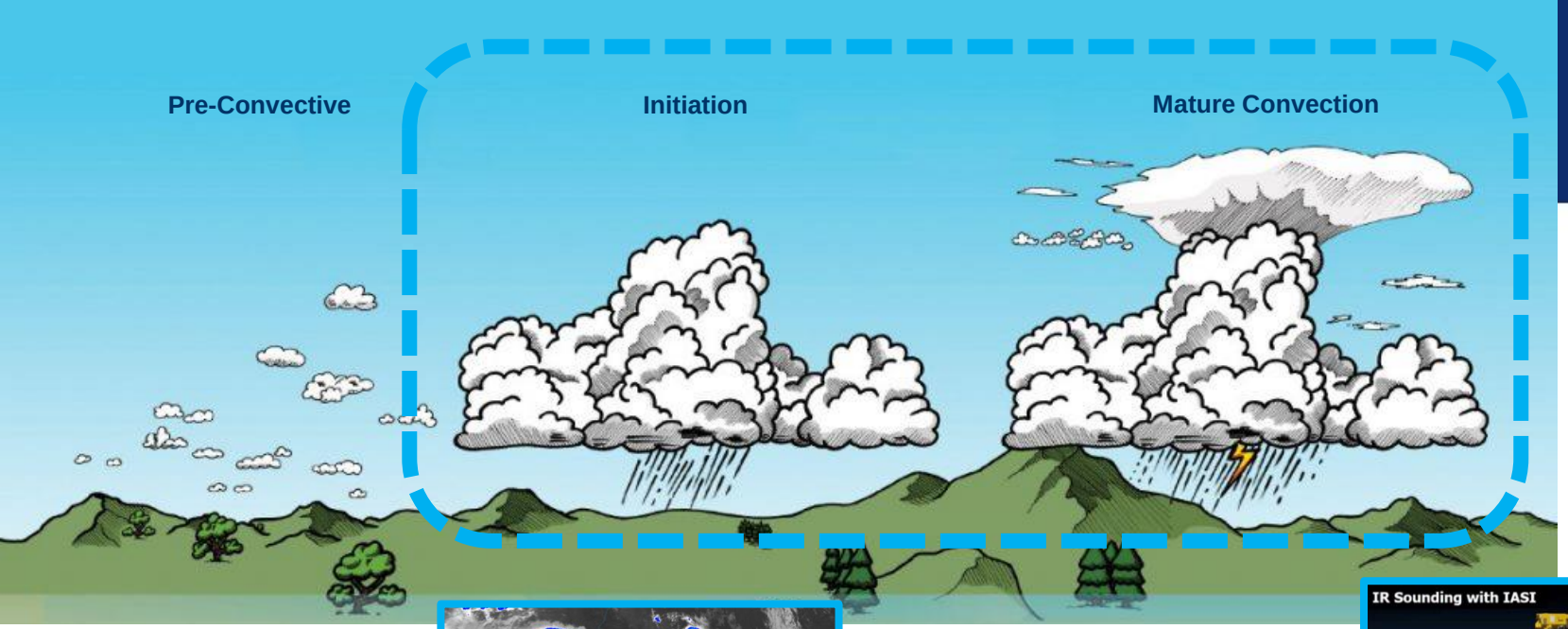
What do we see?

What does the satellite see?

(Sli.do Q5) Which part do we want to really assess?



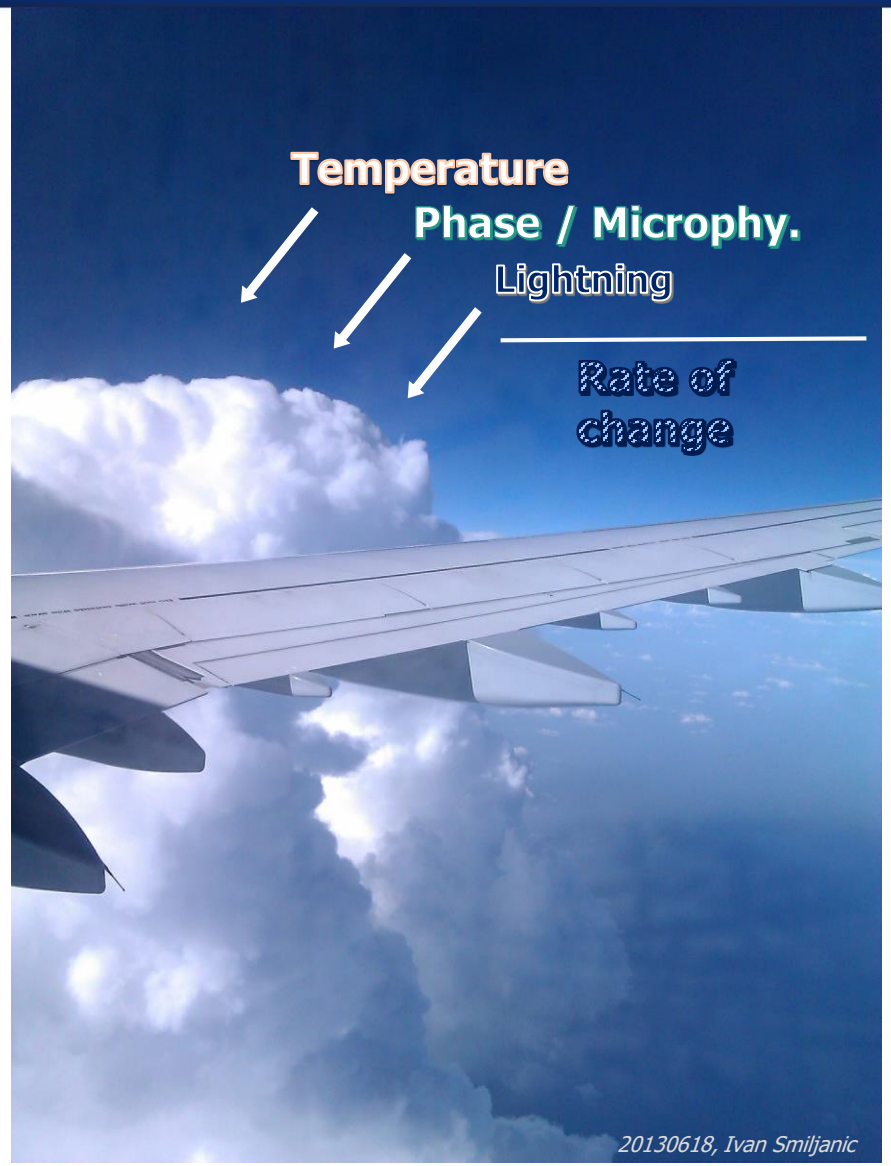
Products…


Pre-Convective
Initiation
Mature Convection

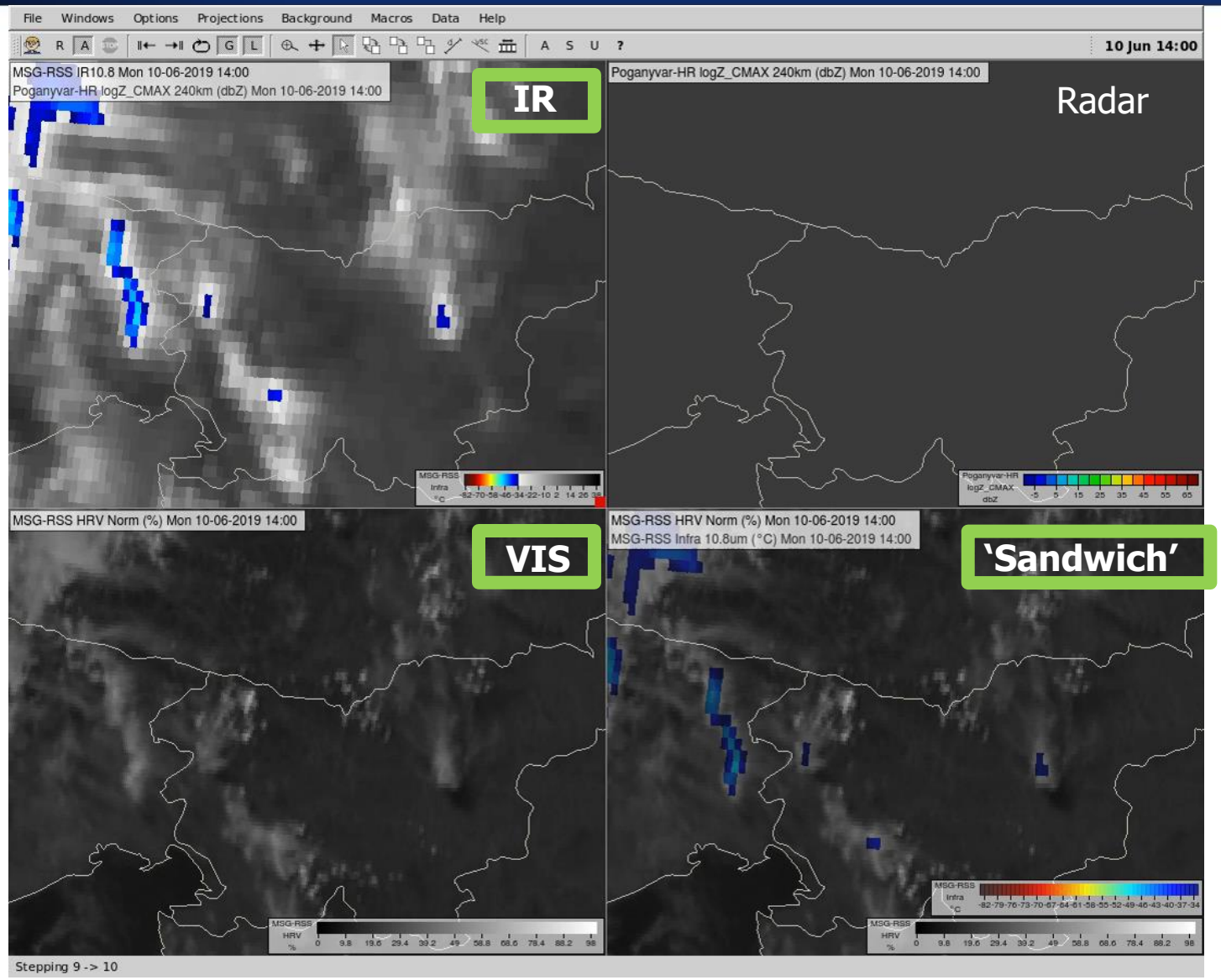
IR Sounding with IASI
2018-05-11 01:16UTC

II. Convective Initiation

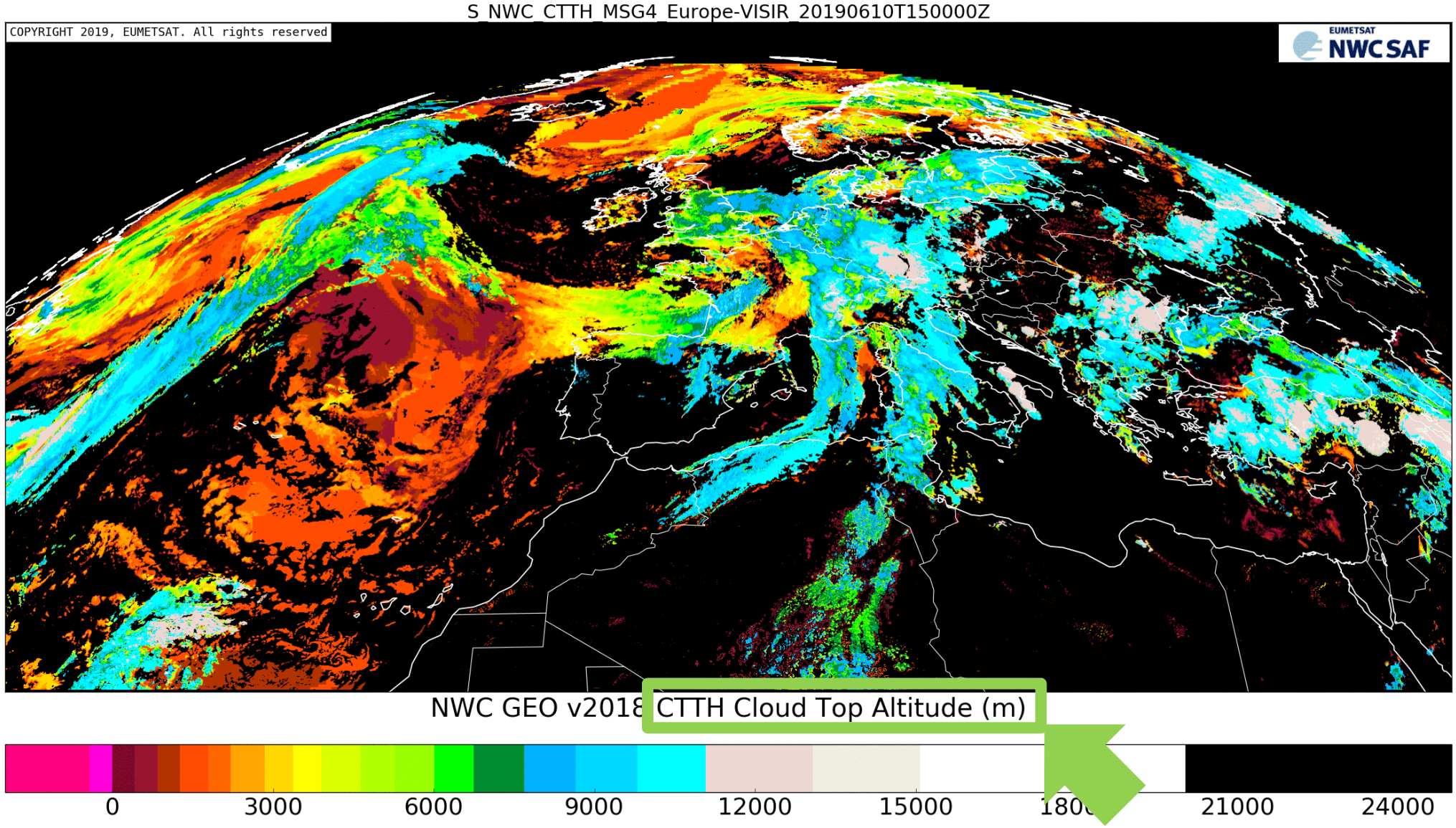
INSTABILITY – Once the convection is triggered…



INSTABILITY – Cloud growth and glaciation



INSTABILITY – Cloud growth and glaciation



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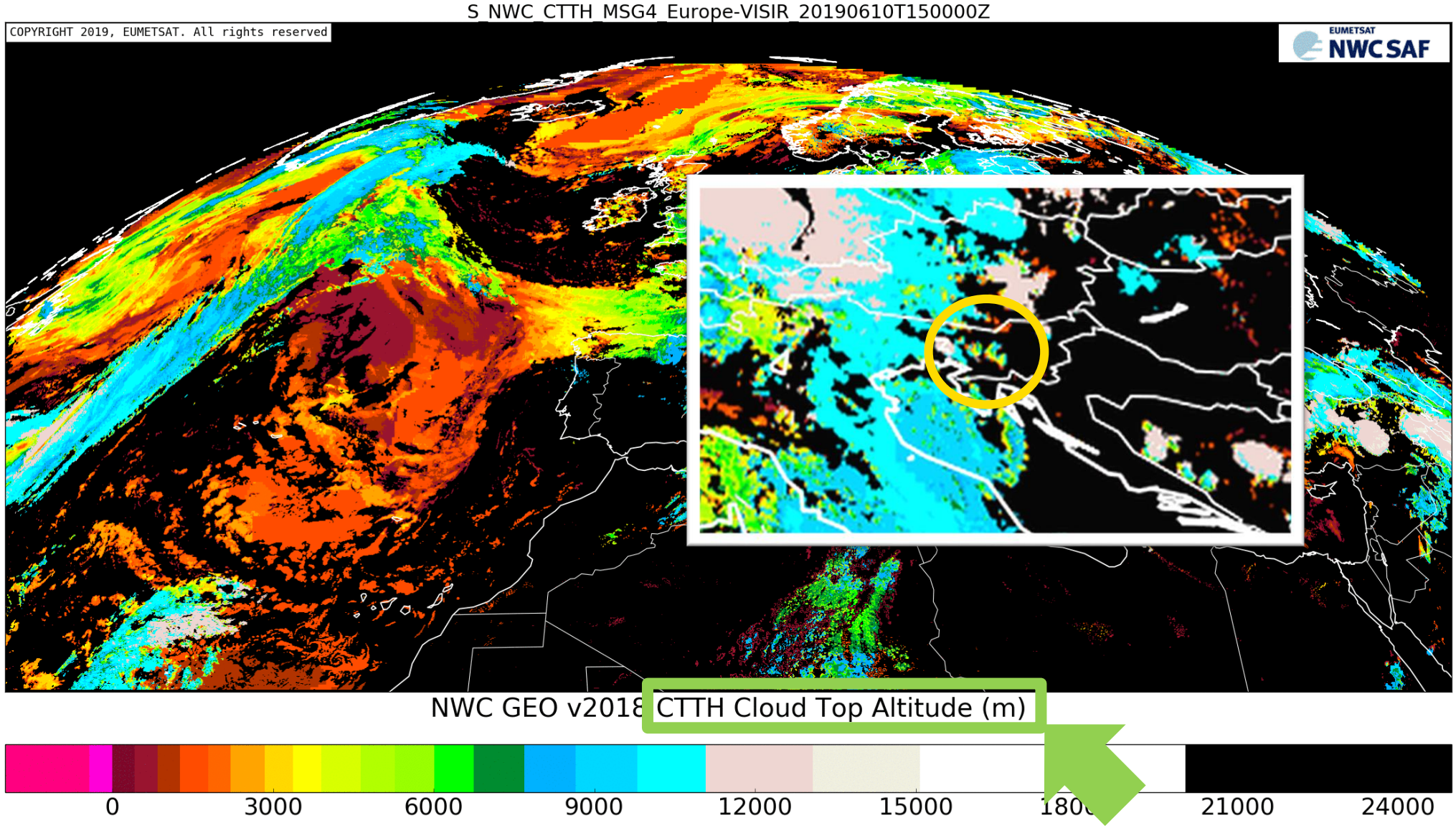
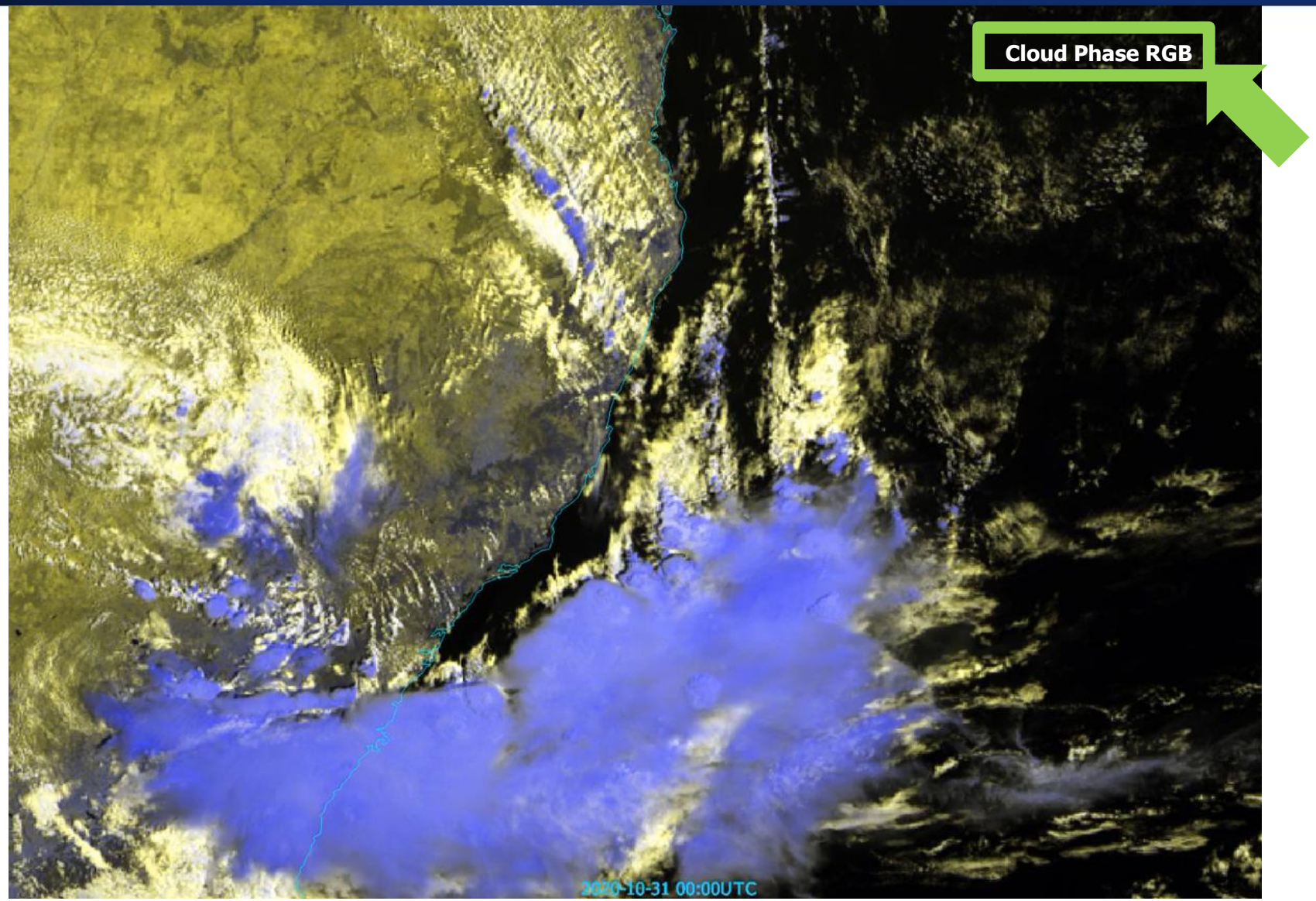
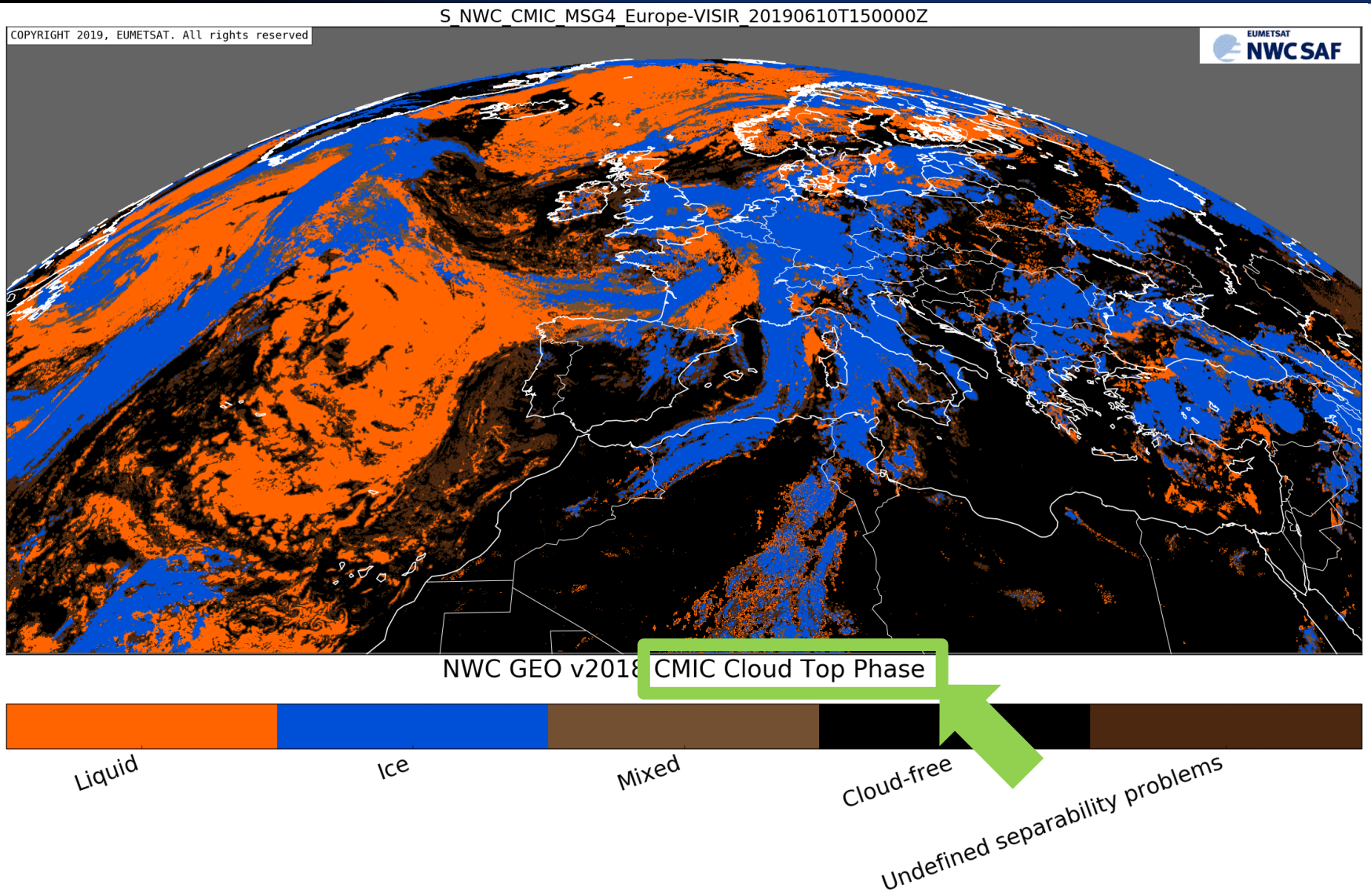


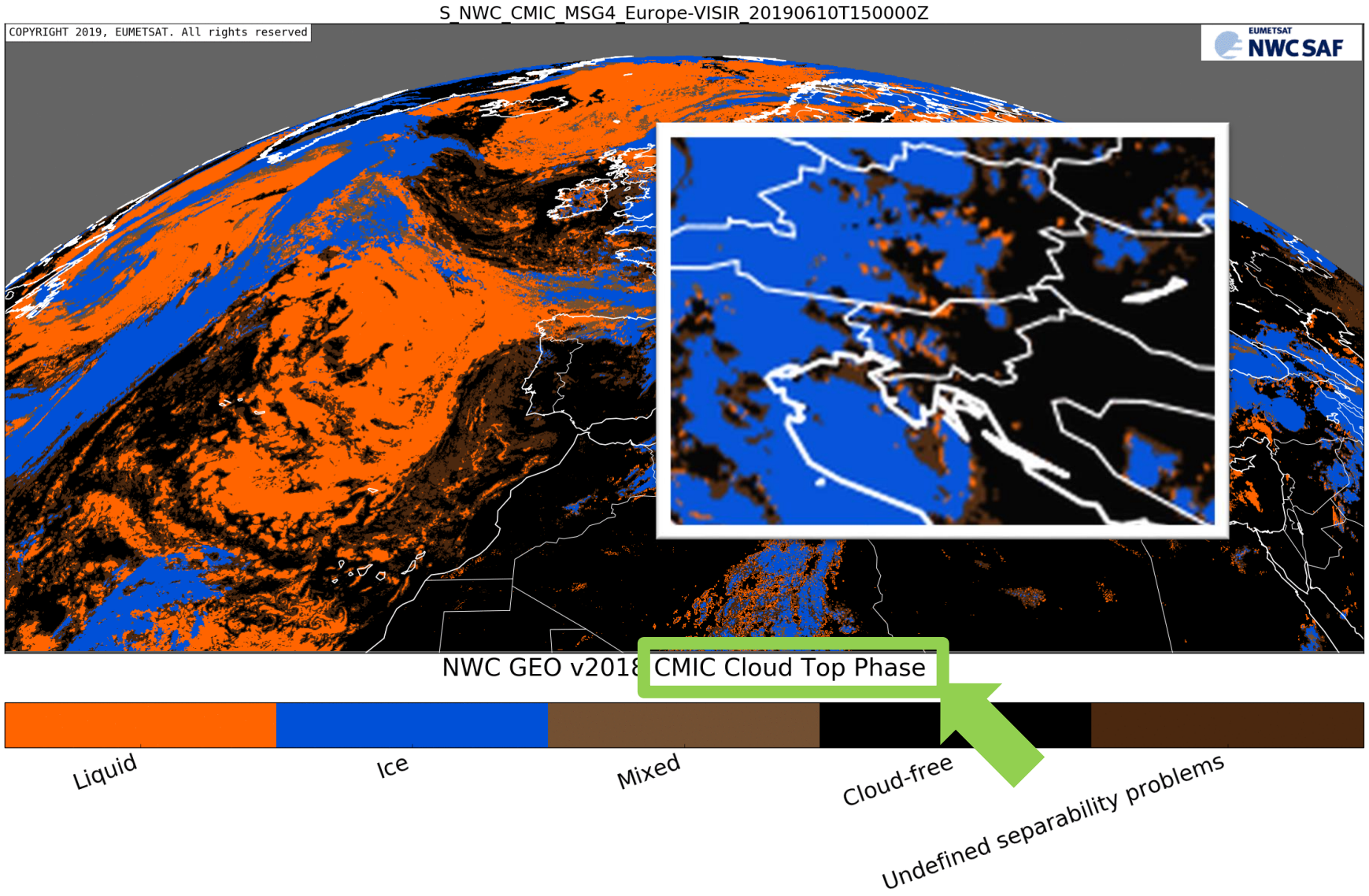
INSTABILITY – Cloud growth and glaciation



INSTABILITY – Cloud growth and glaciation



INSTABILITY – Cloud growth and glaciation



INSTABILITY – Lightning activity

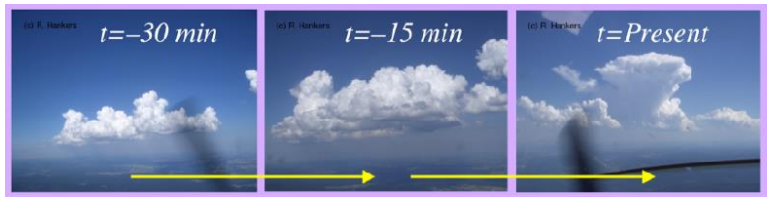
Convective initialisation over North Dakota - 28 June 2018 19:50UTC

band C02 - VIS0.64

band C14 – IR11.2

- First flash at 19:50UTC during convective initialisation of a new storm
- Dark-blue in the false-coloured IR indicates top temperature colder than 236K (-37°C), i.e. below level of spontaneous freezing of supercooled cloud drops

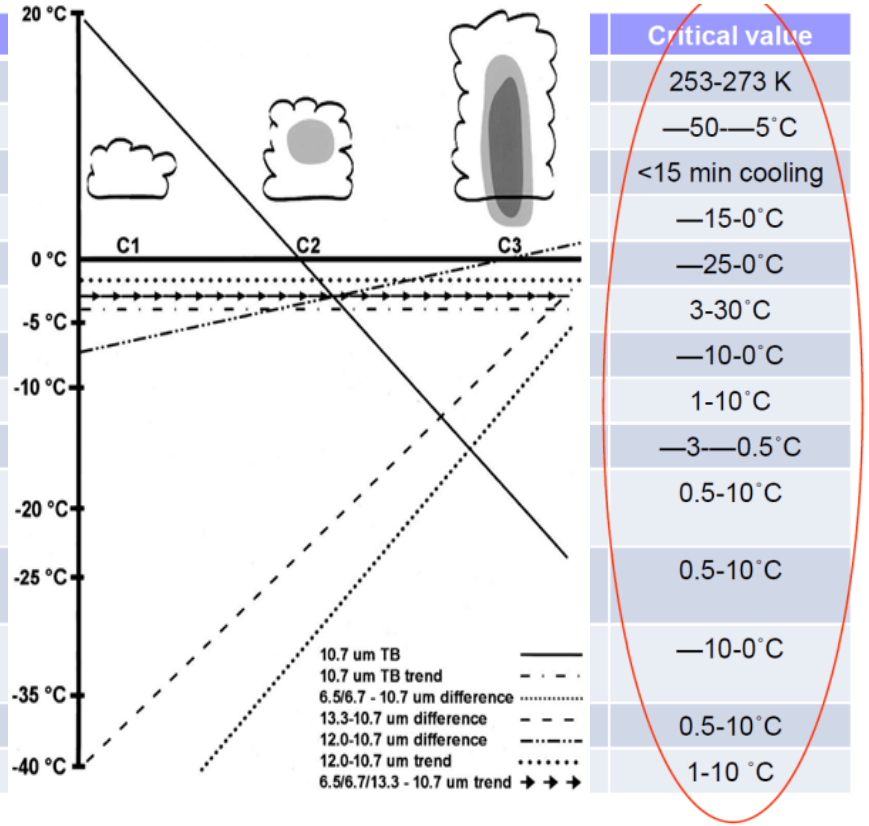
INSTABILITY – CI (Convective Initiation) Product



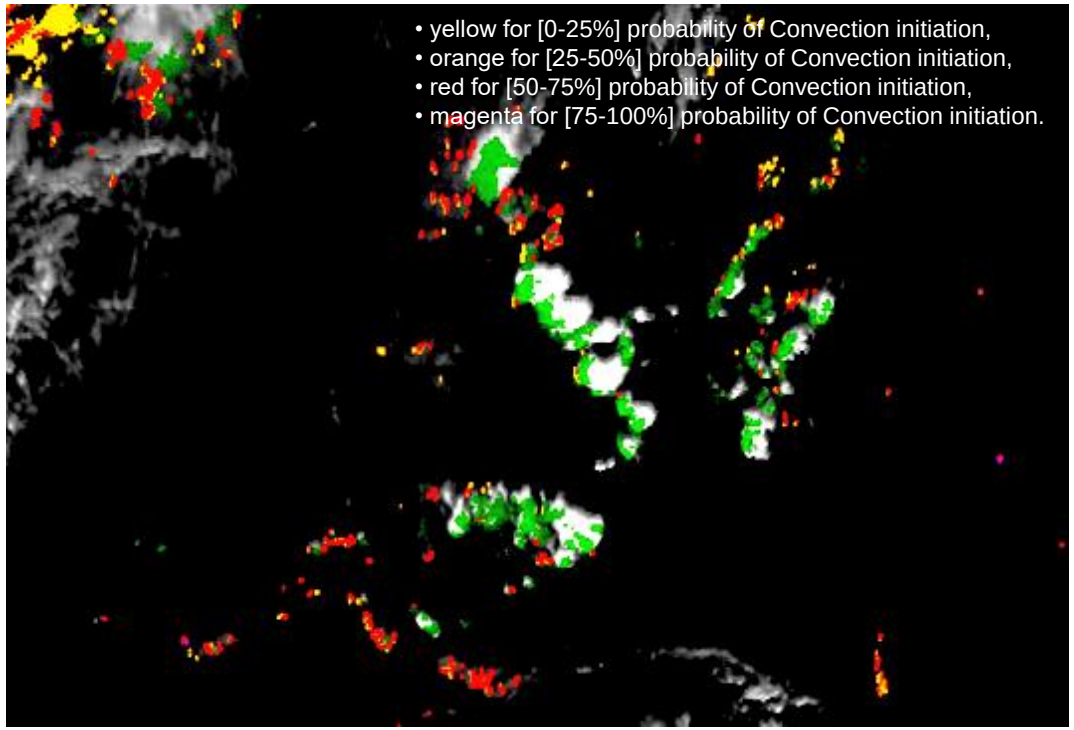
> Probability for a cloudy pixel to become a thunderstorm?

Mecikalski at al. 2010

Interest fields	Critical value
10.8 µm TB	253-273 K
10.8 µm TB 15 min trend	—50-—5˚C
10.8 µm TB 30 min trend	<15 min cooling
6.2-7.3 µm difference	—15-0˚C
6.2-10.8 µm difference	—25-0˚C
6.2-10.8 µm 15 min trend	3-30˚C
8.7-10.8 µm difference	—10-0˚C
8.7-10.8 µm30 min trend	1-10˚C
12.0-10.8 µm difference	—3-—0.5˚C
12.0-10.8 µm 15 min trend	0.5-10˚C
12.0-10.8 µm 30 min trend	0.5-10˚C
Tri-channel difference [(8.7-10.8)-(10.8-12.0)]	—10-0˚C
Tri-channel 15 min trend	0.5-10˚C
Tri-channel 30 min trend	1-10 ˚C

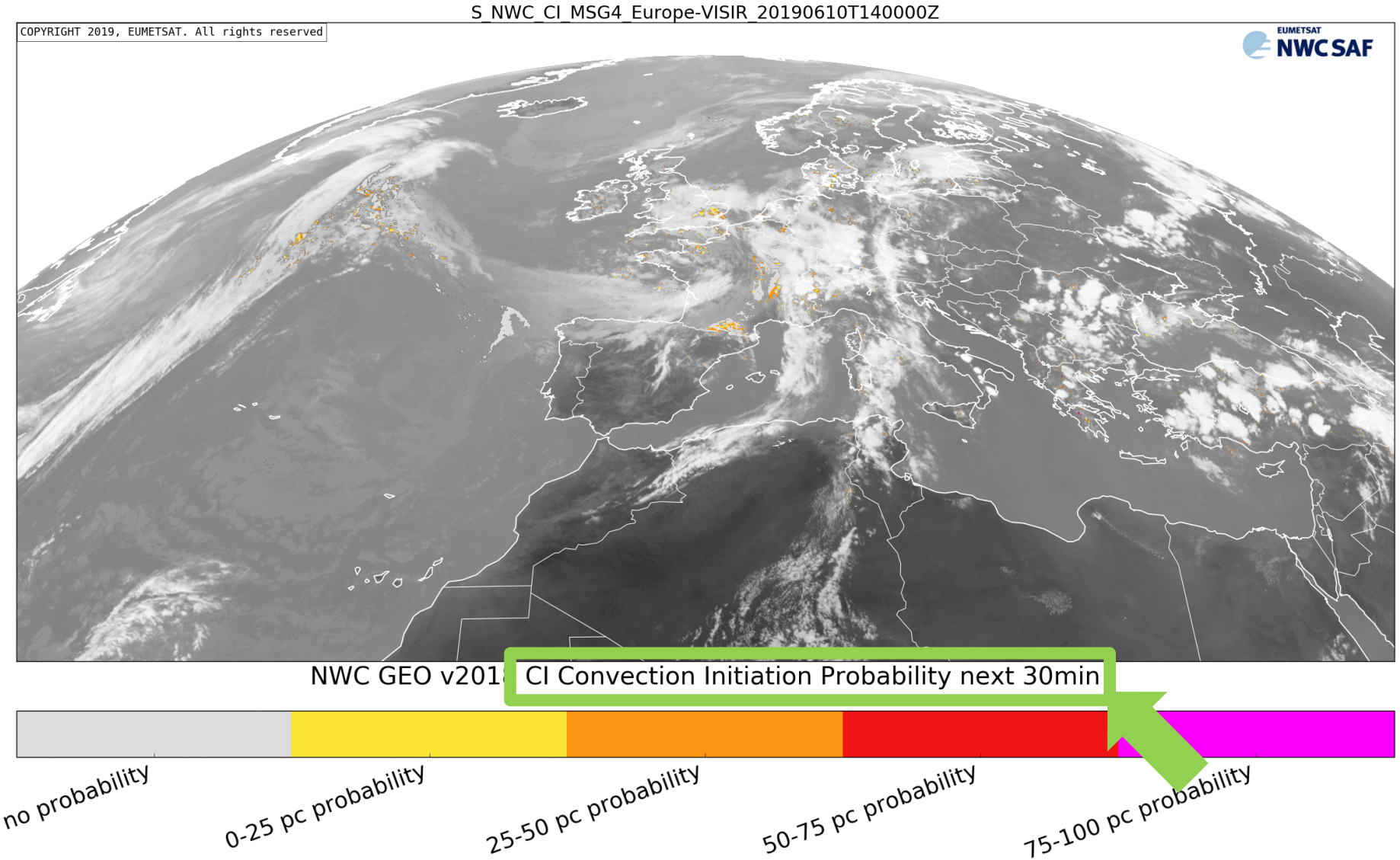


Critical values is not fixed ➔ need to be regionally tunned



Main limitations of the product?
- In cases of cold air masses (fast-moving fractional clouds)
- High FAR inherent to CI, particularly at the edges of cold cloud systems
- Lack of validation

INSTABILITY – CI (Convective Initiation) Product



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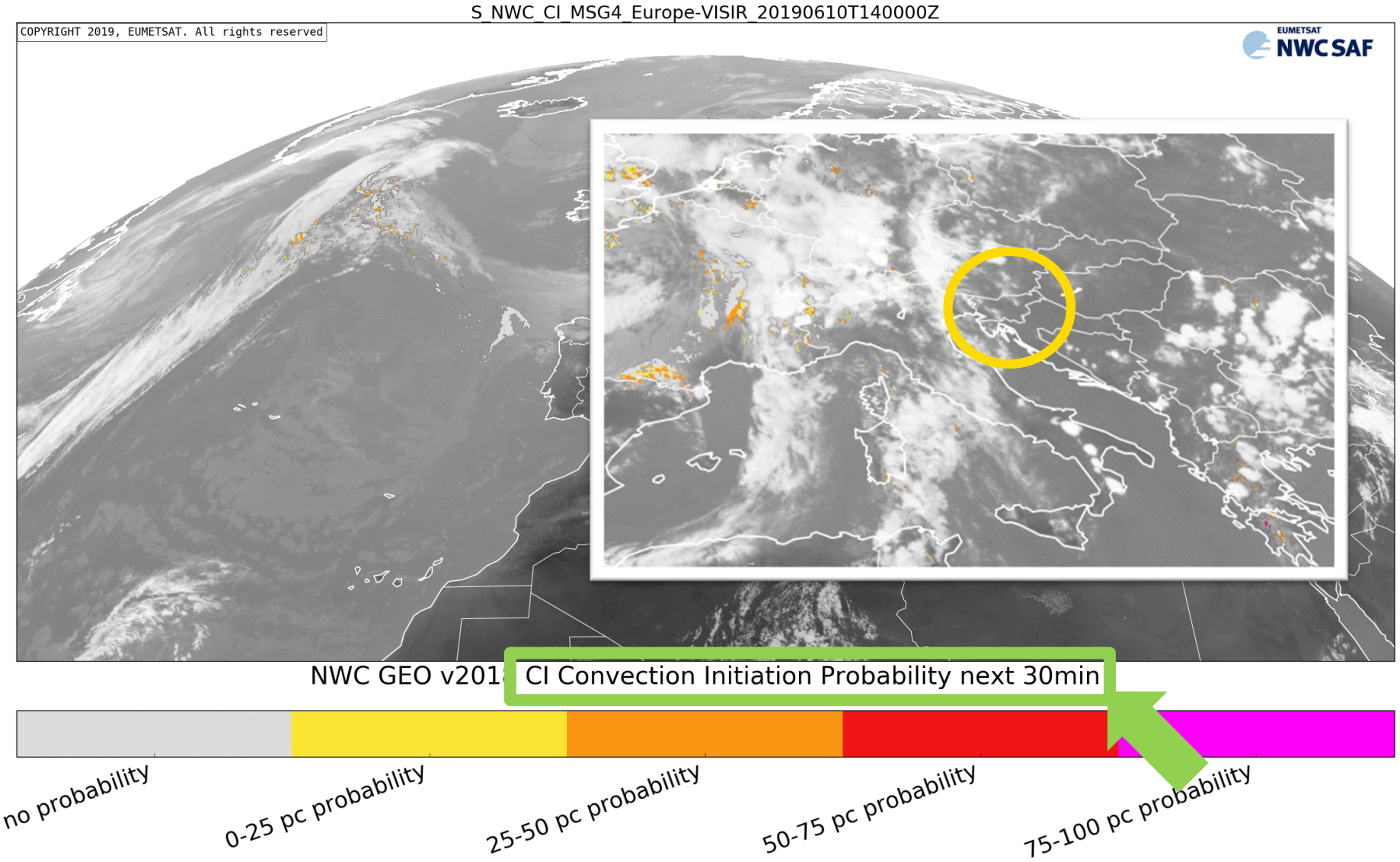
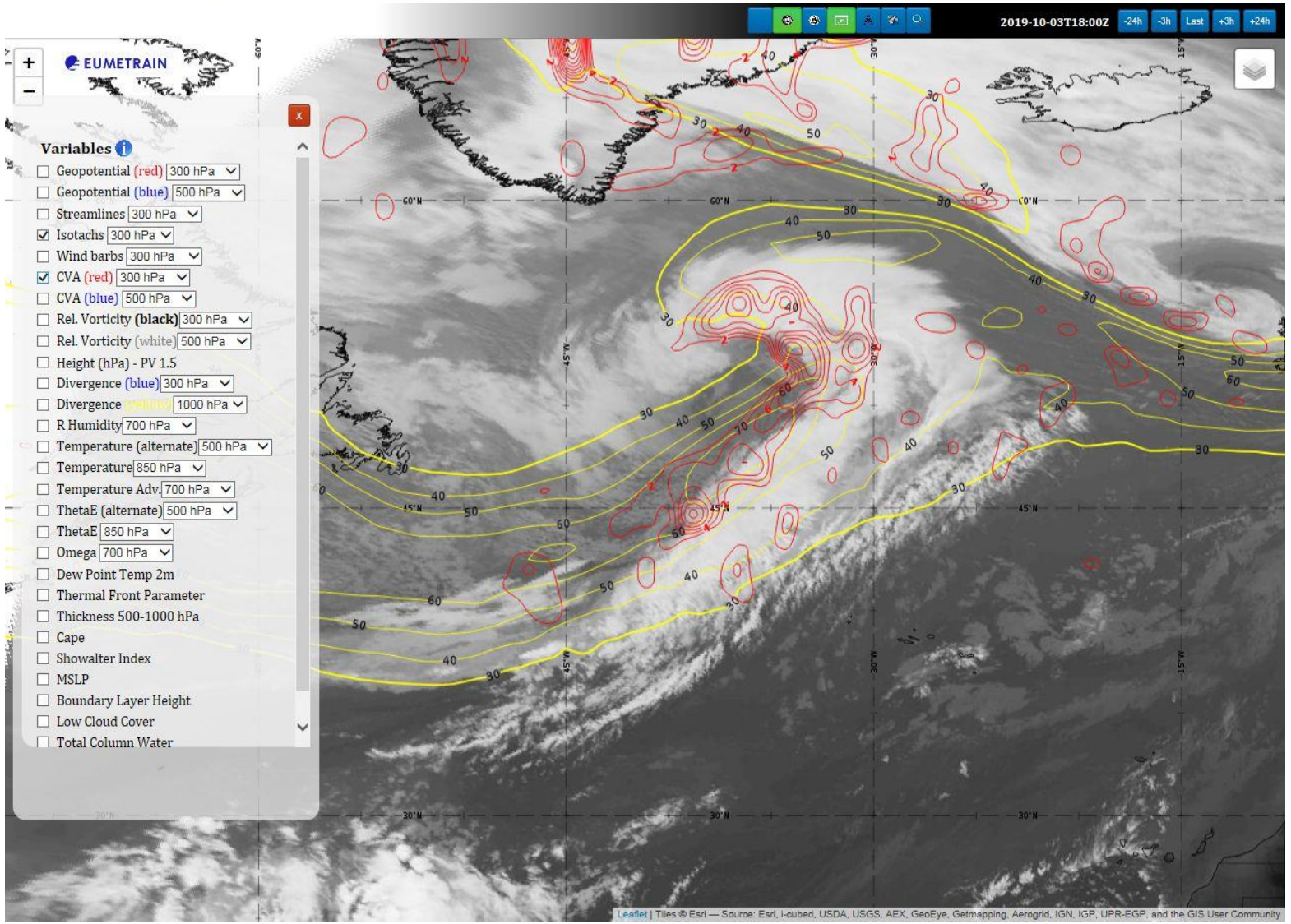
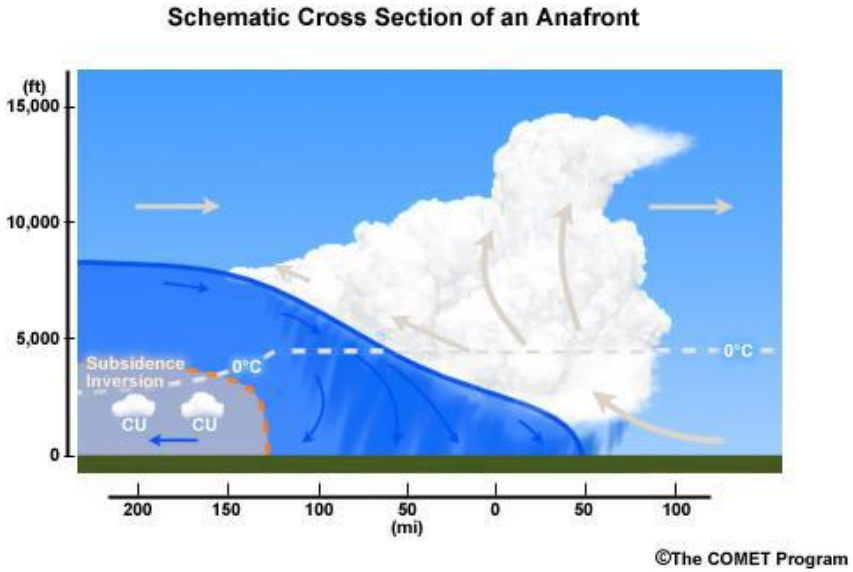


LIFT

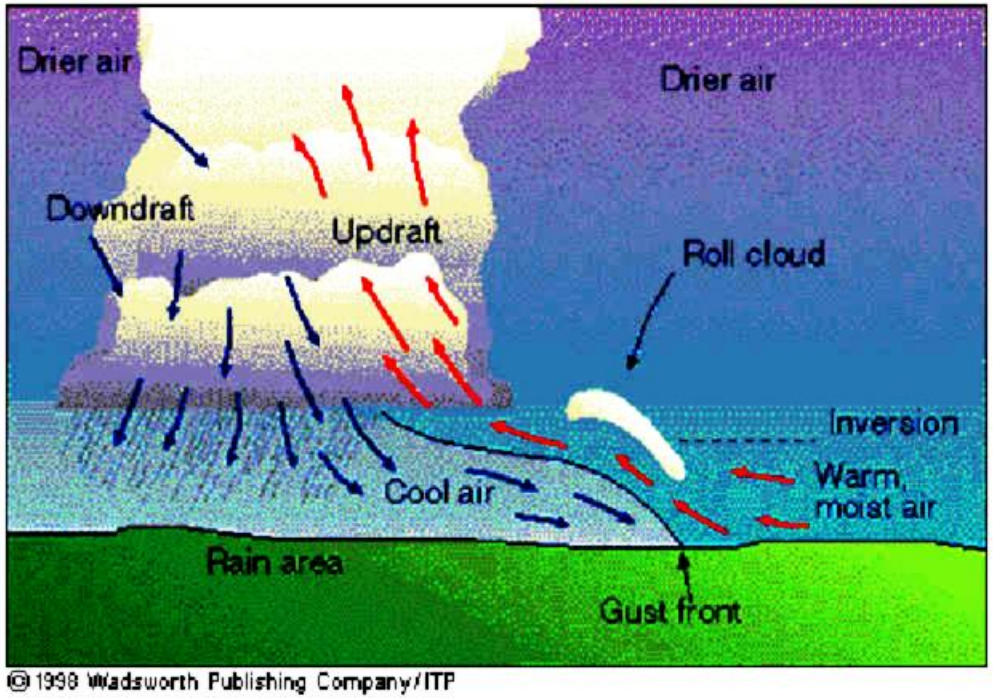
LIFT – Synoptic



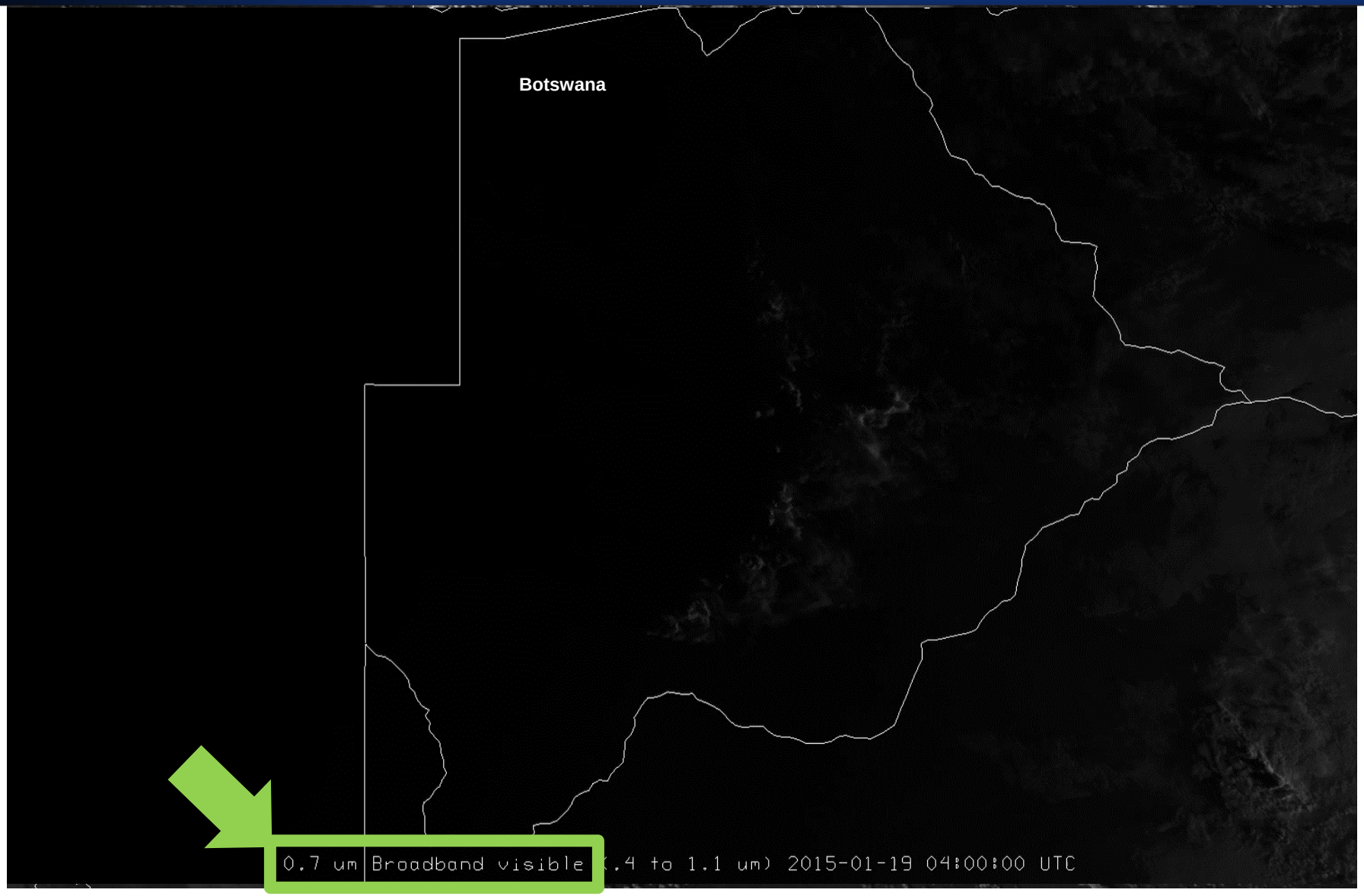
- Frontal instability



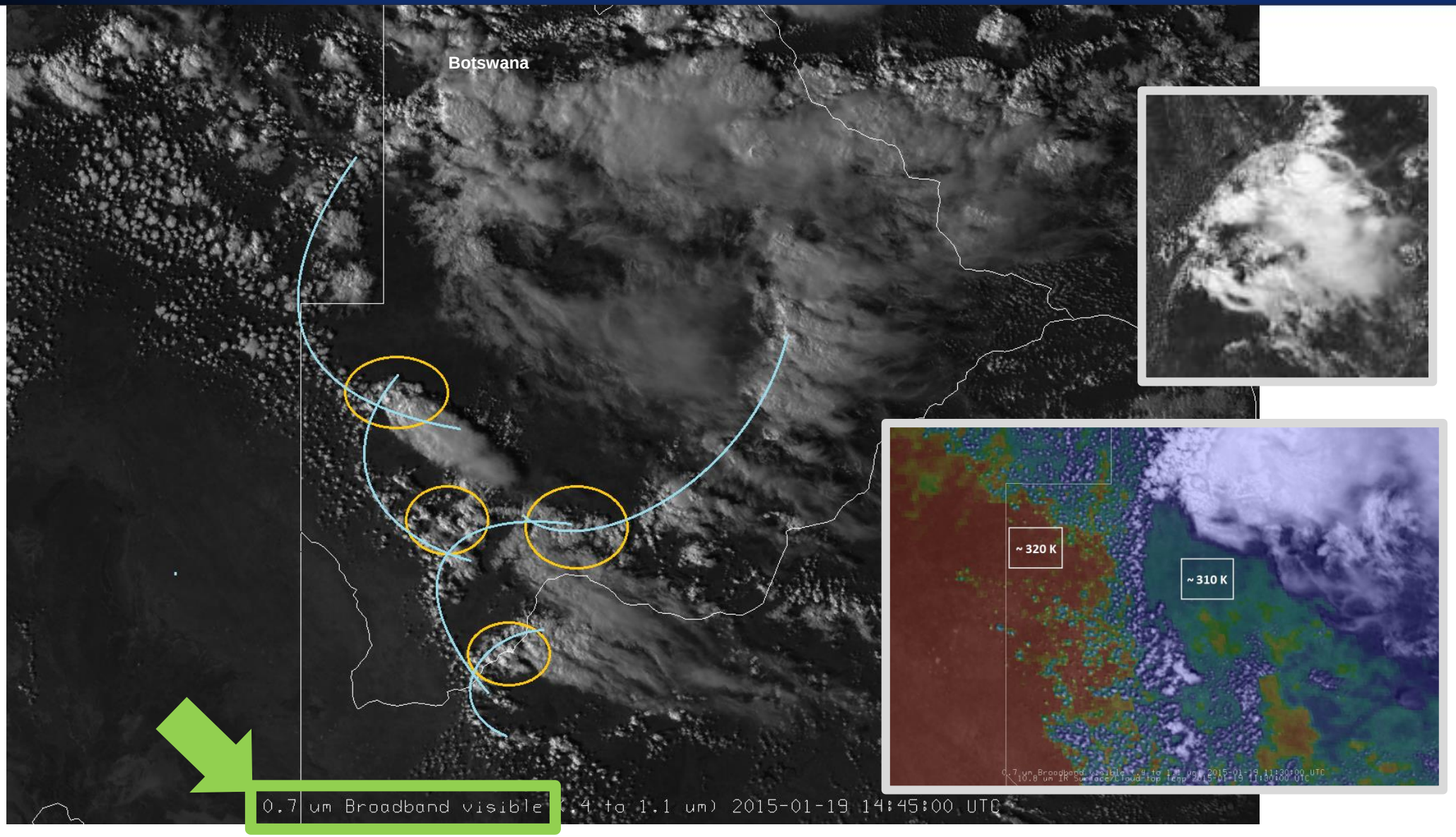
LIFT – Mesoscale - Outflow ‘fronts’



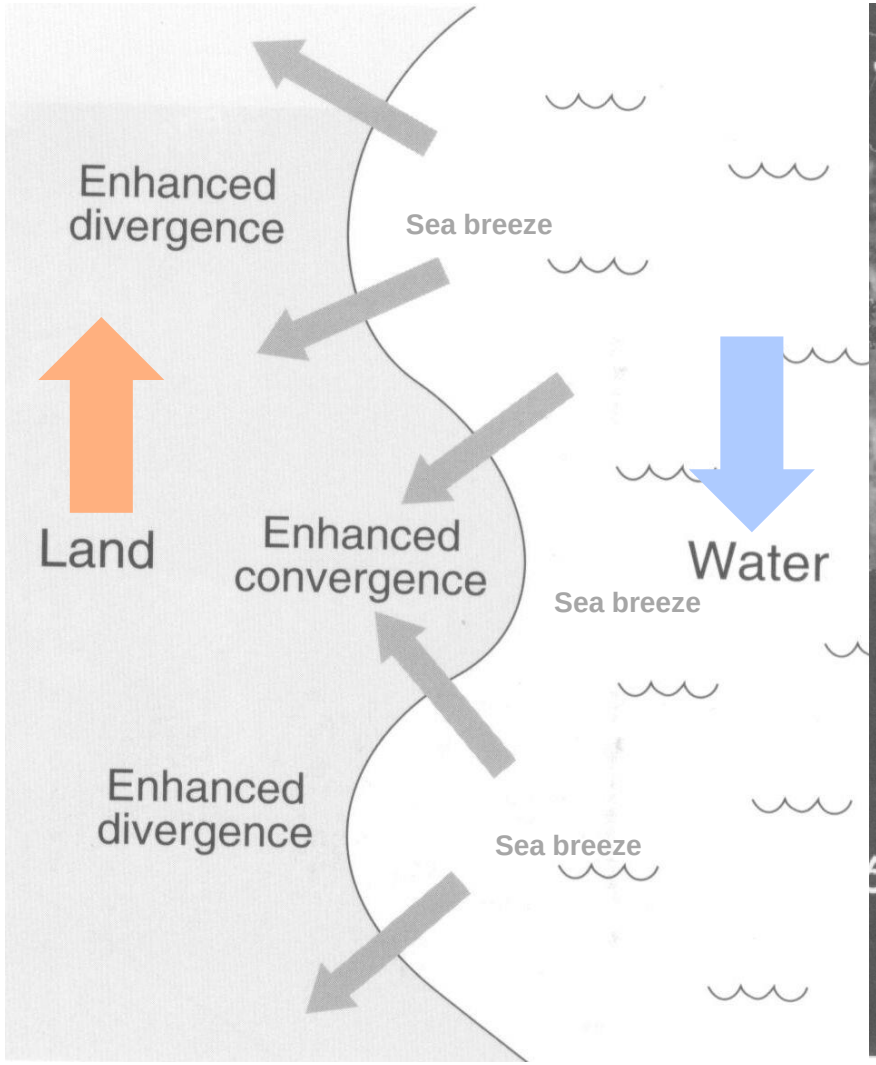
LIFT – Outflow boundaries

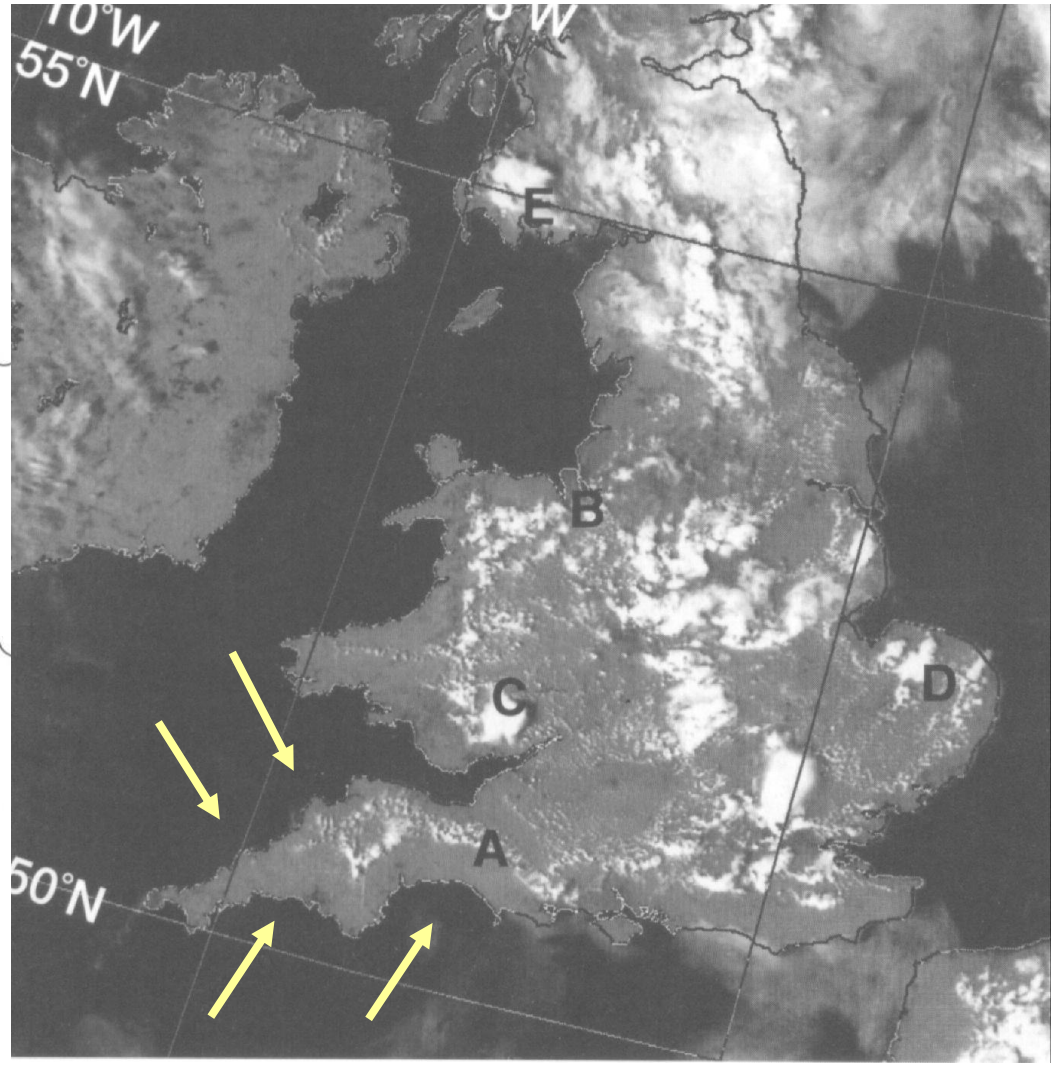


LIFT – Outflow boundaries



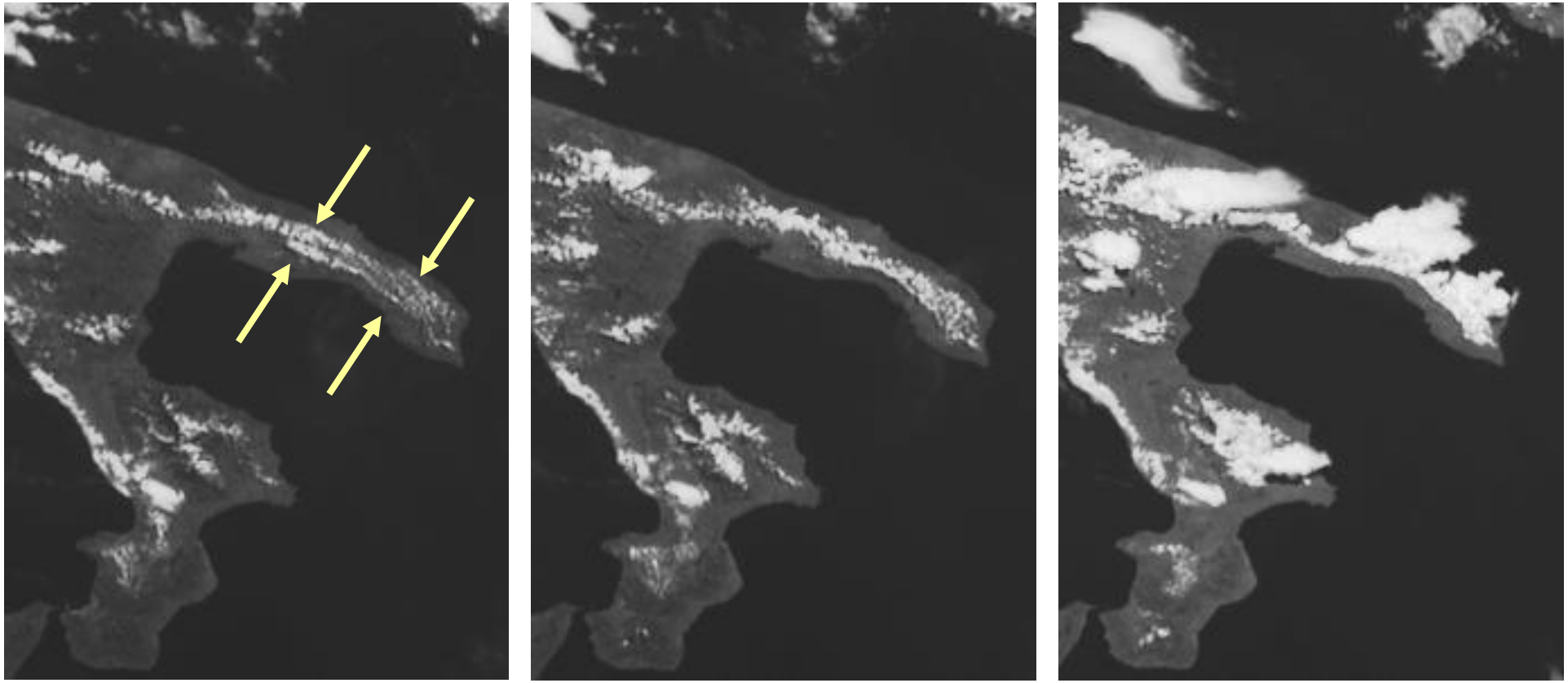
LIFT – Convergence lines





LIFT – Convergence lines

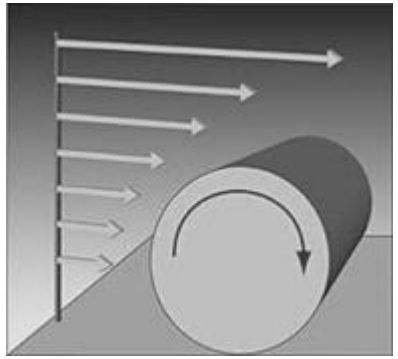
Seabreeze Convergence, Southern Italy (Salento)

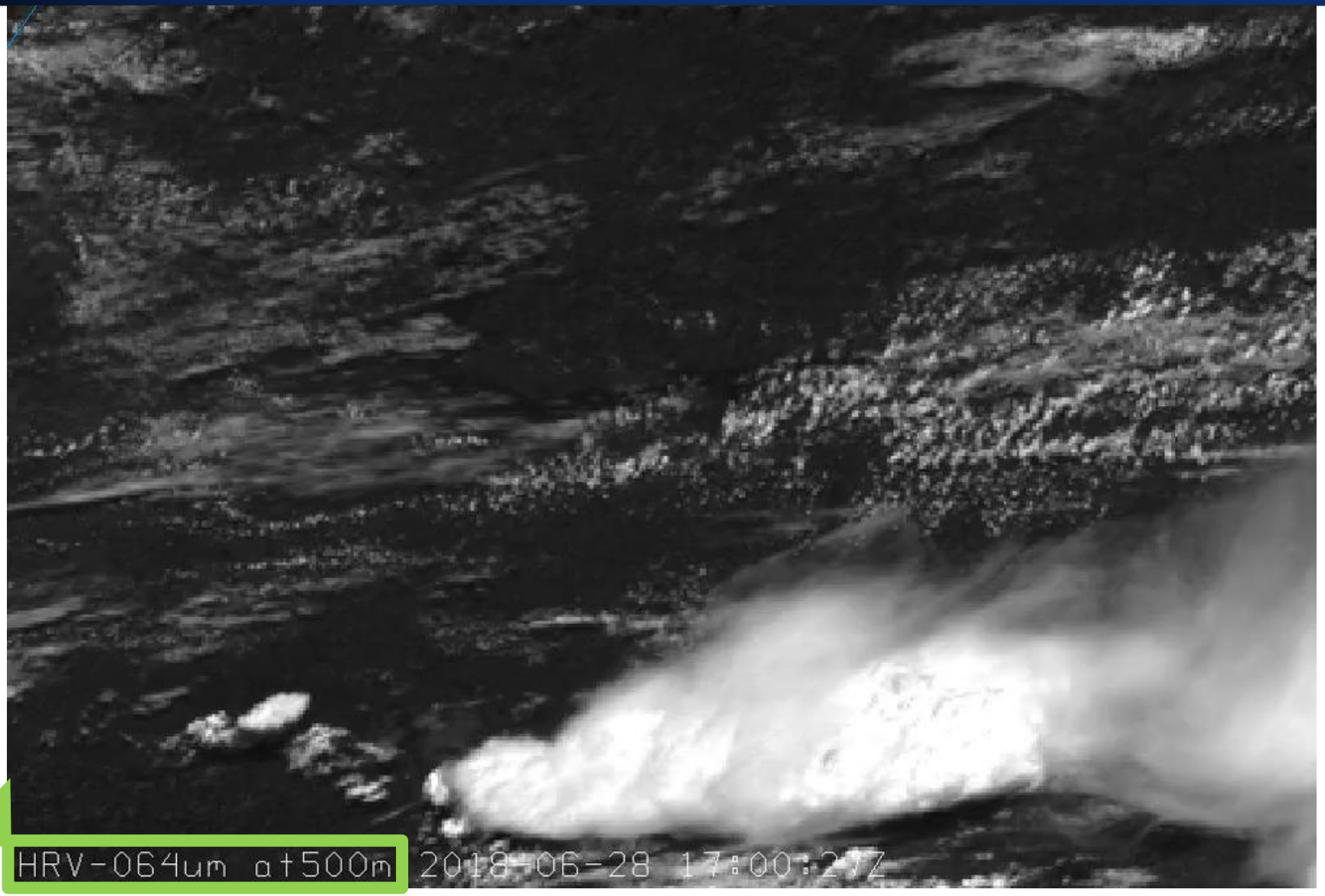


09:05 UTC 09:40 UTC 10:55 UTC

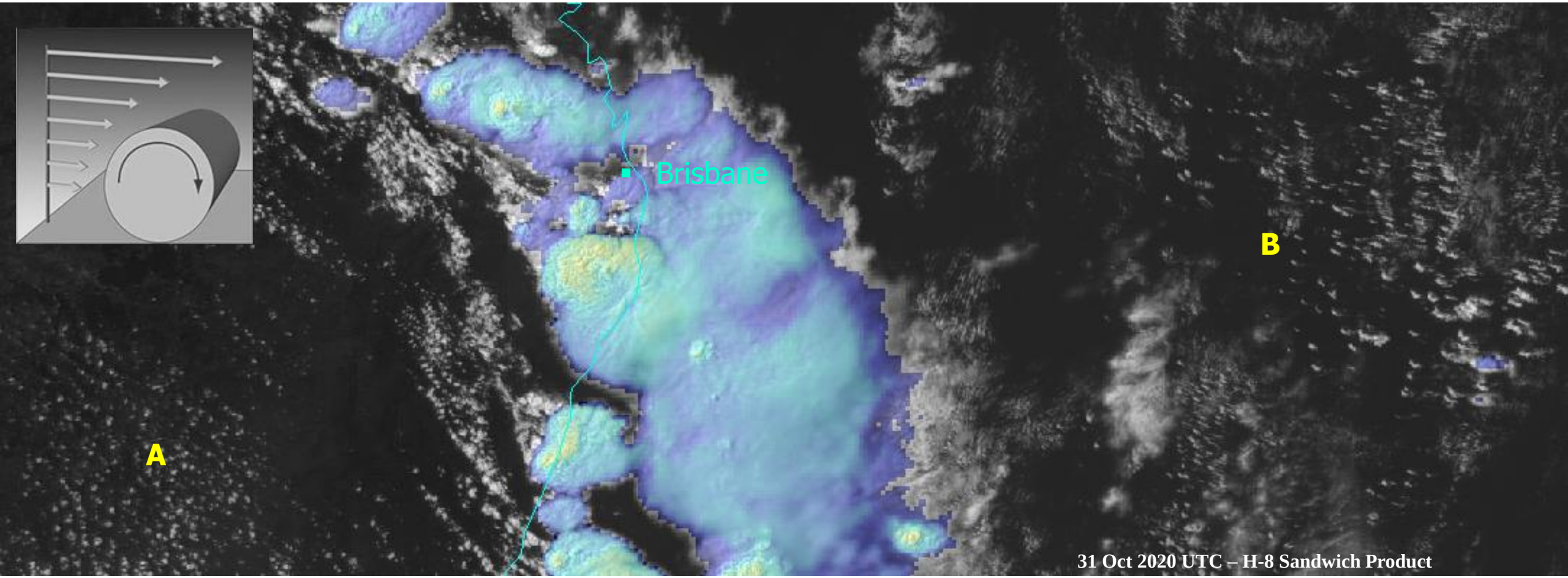
12 June 2007, HRV Channel (Met-8 Rapid Scans)

WIND – Support and Inhibition by a shear

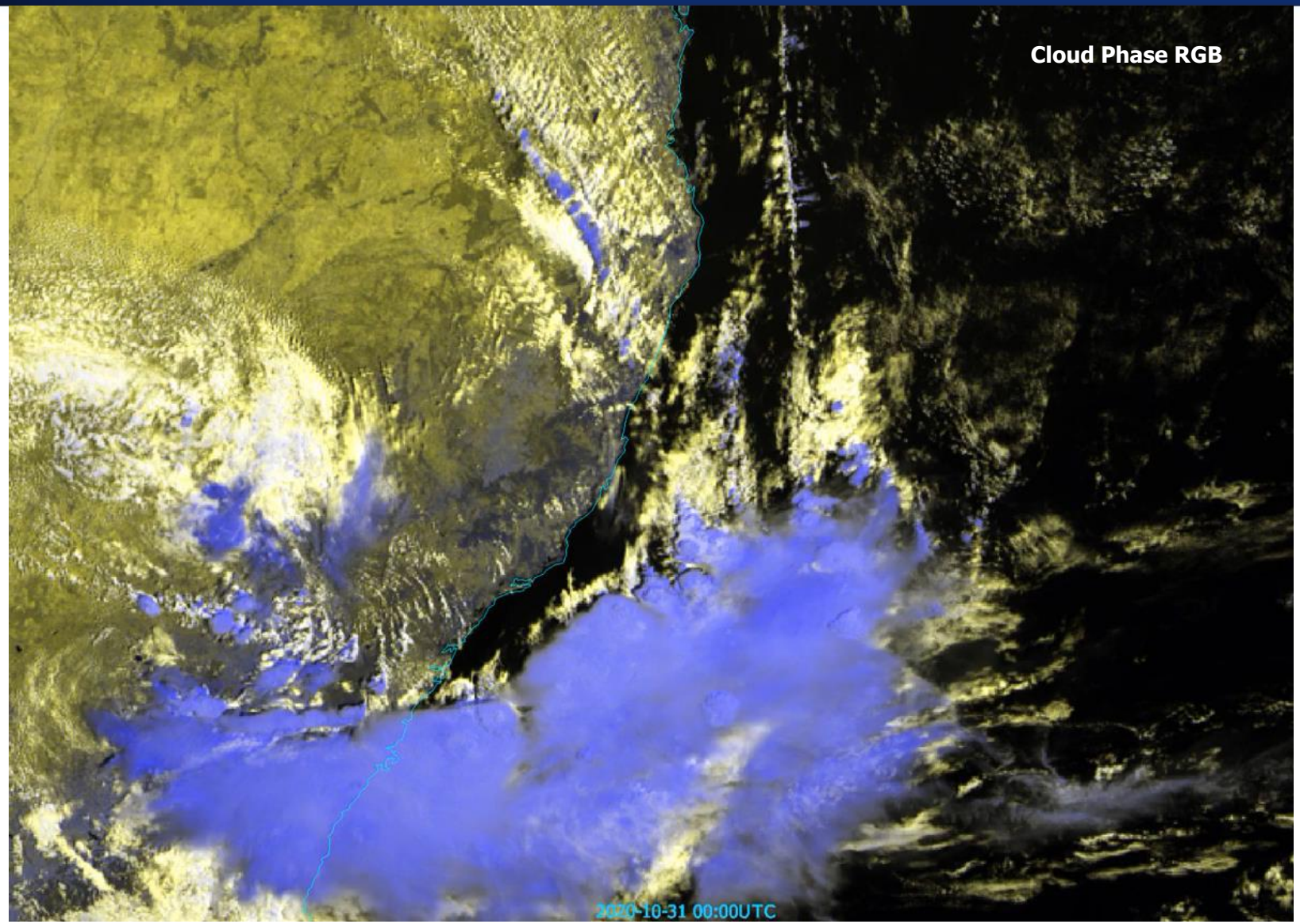




(Sli.do Q6) Where is the stronger wind shear?



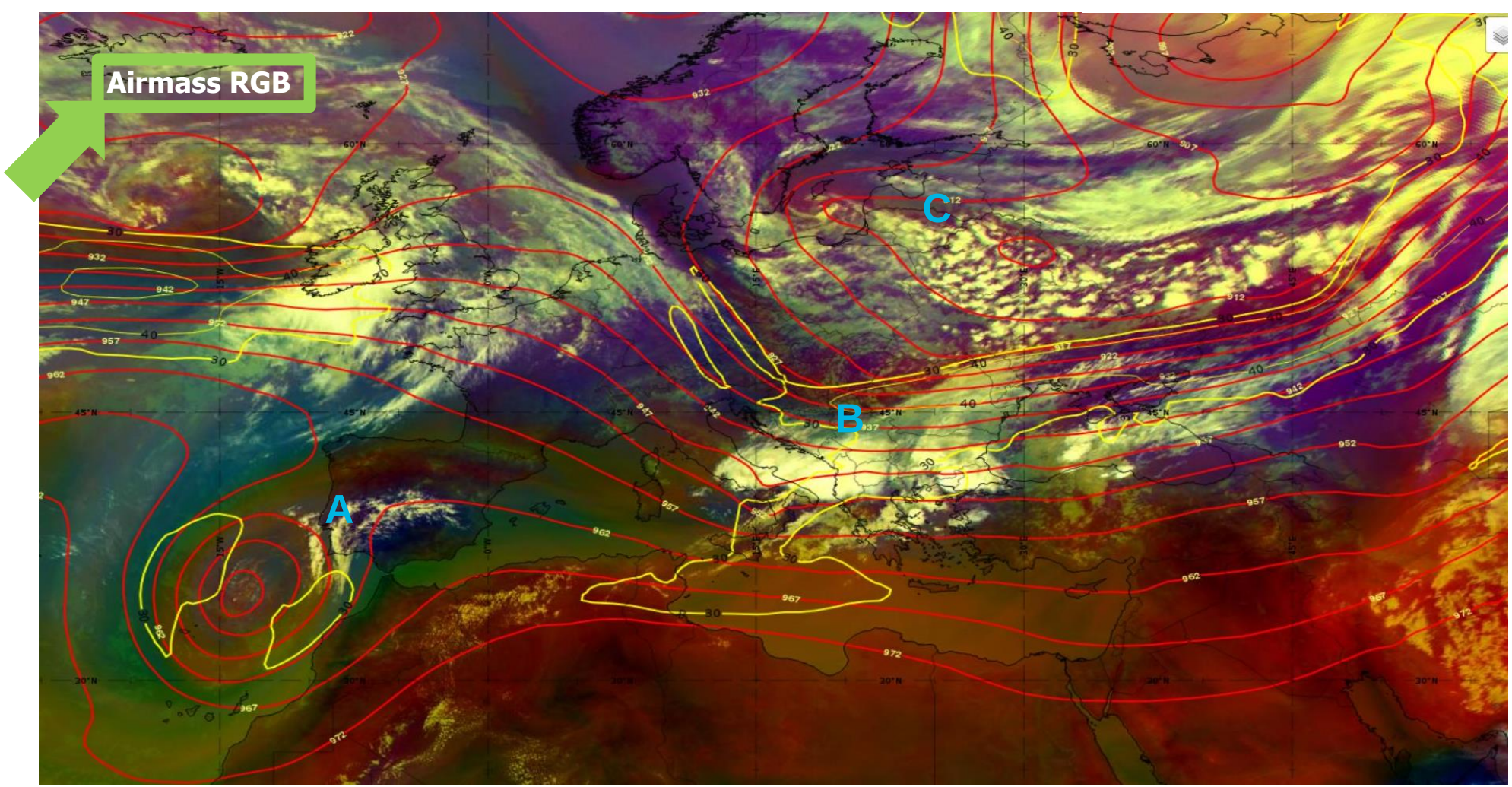
(Sli.do Q6) Where is stronger shear?



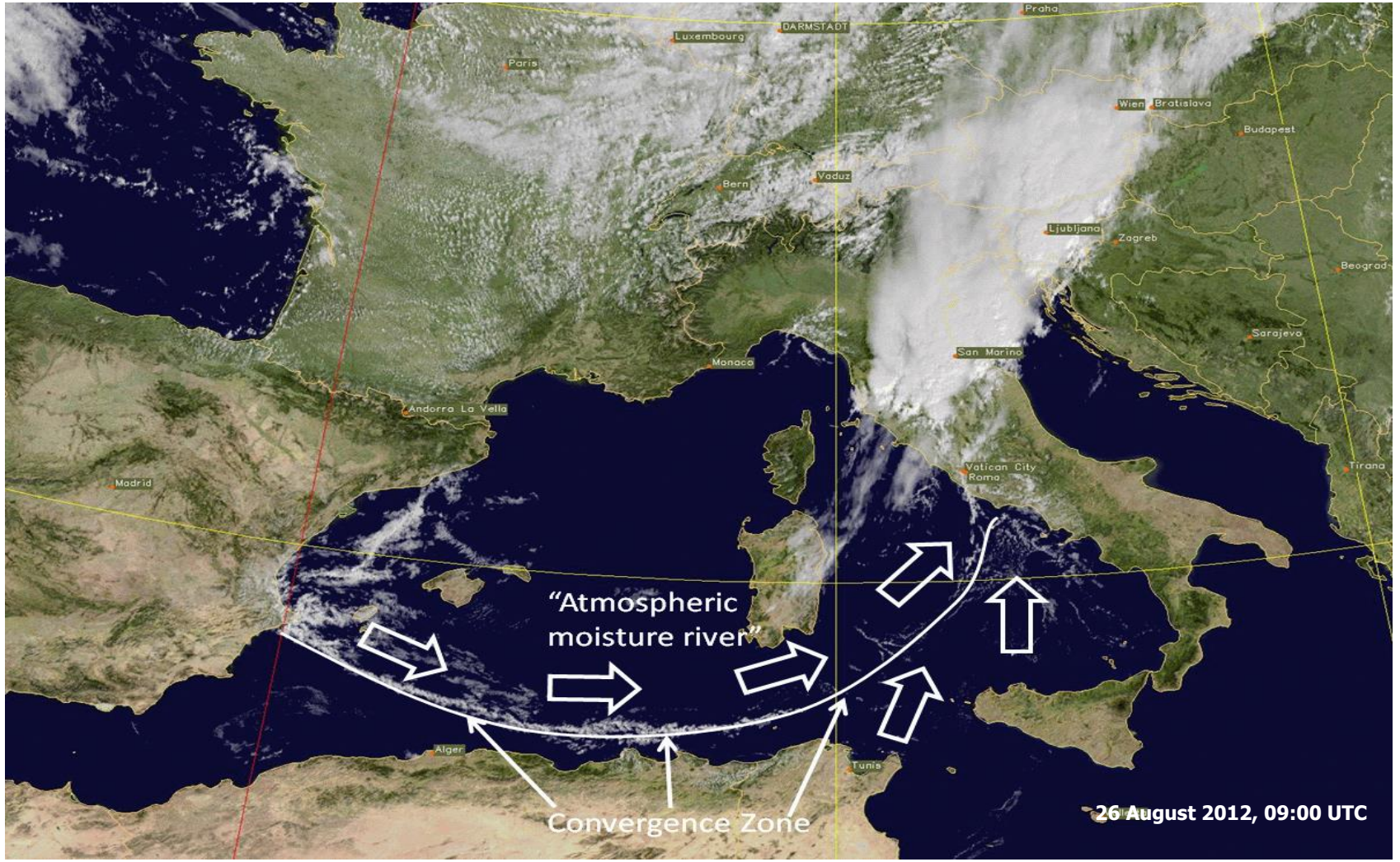
III. Mature Convection

Environment – Synoptic forcing

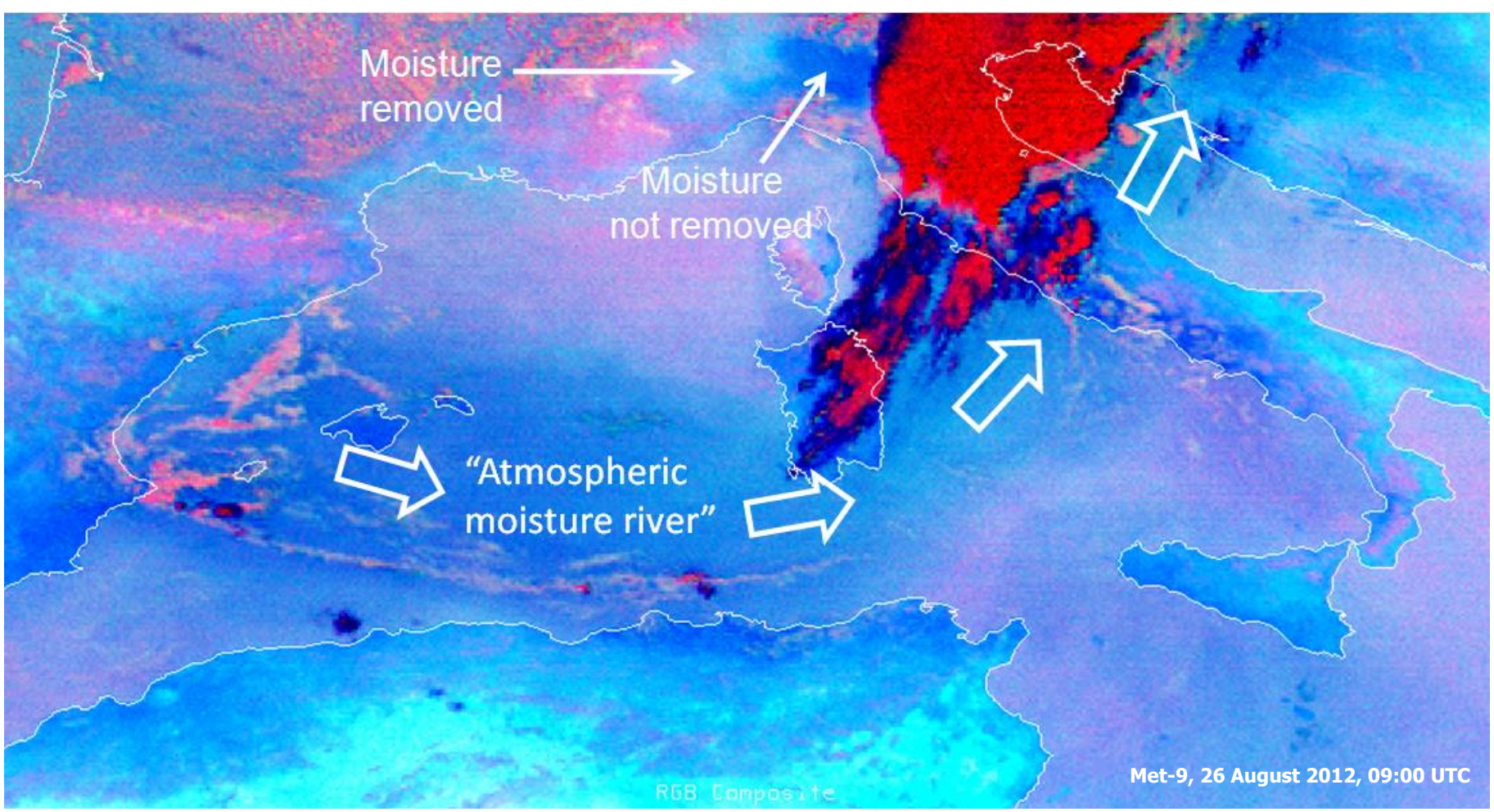
Will convection survive?



Environment – Moisture dynamics

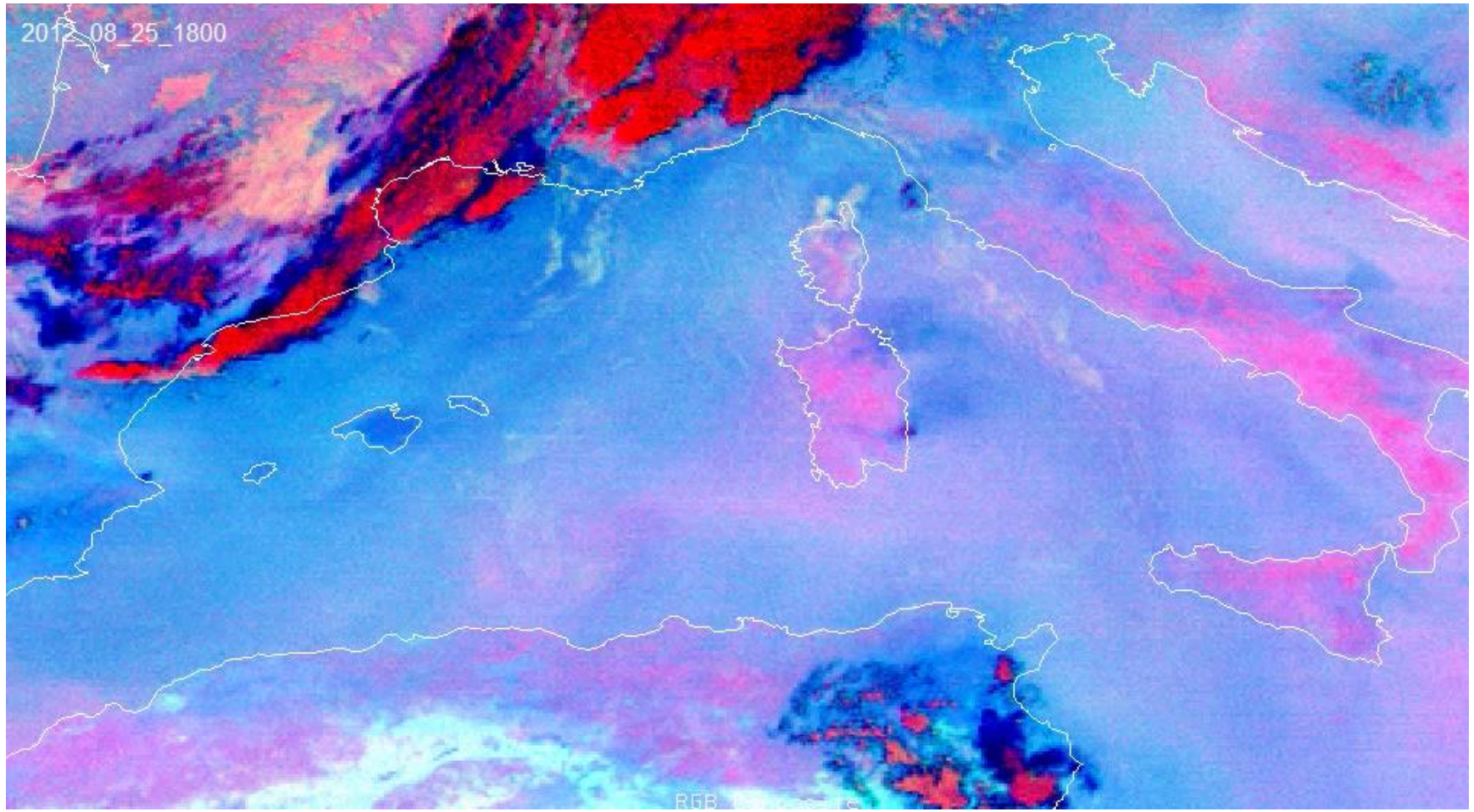


Environment – Moisture dynamics

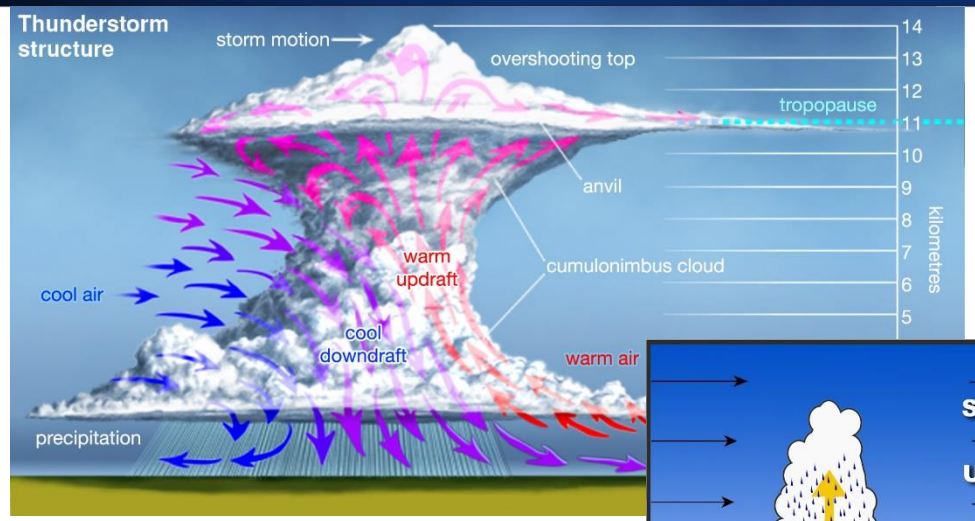


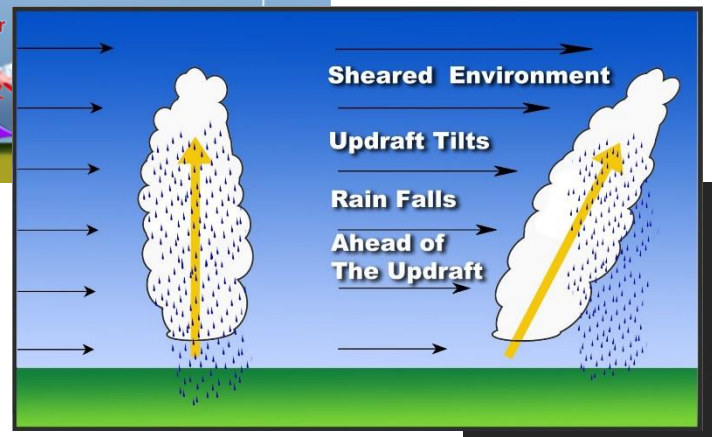
Environment – Moisture dynamics

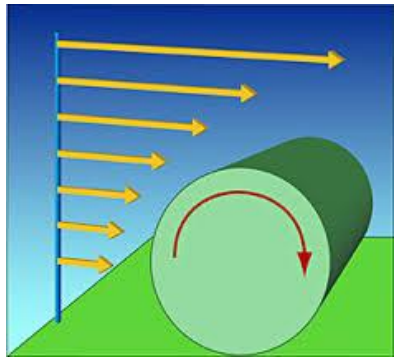
Dust RGB

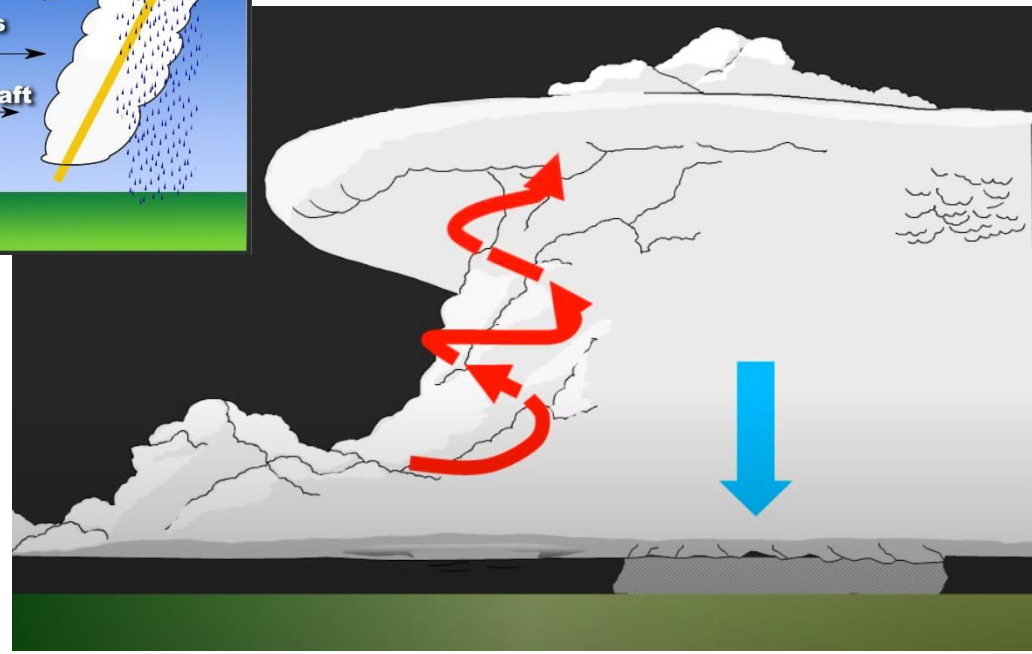


Environment – Wind dynamics

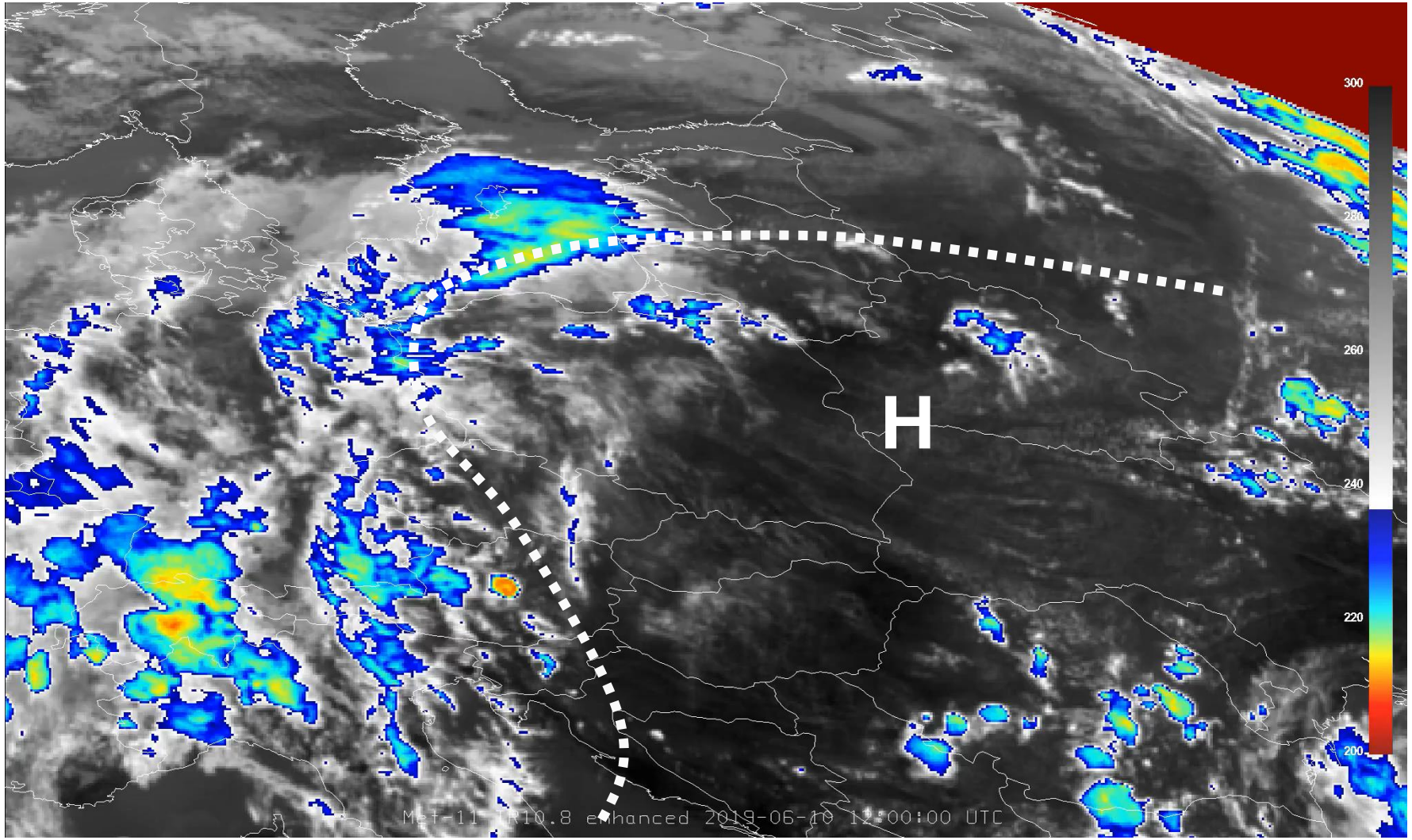


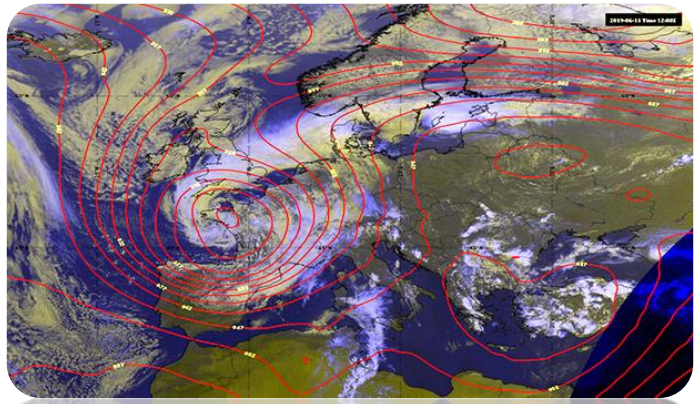






Environment – Wind dynamics





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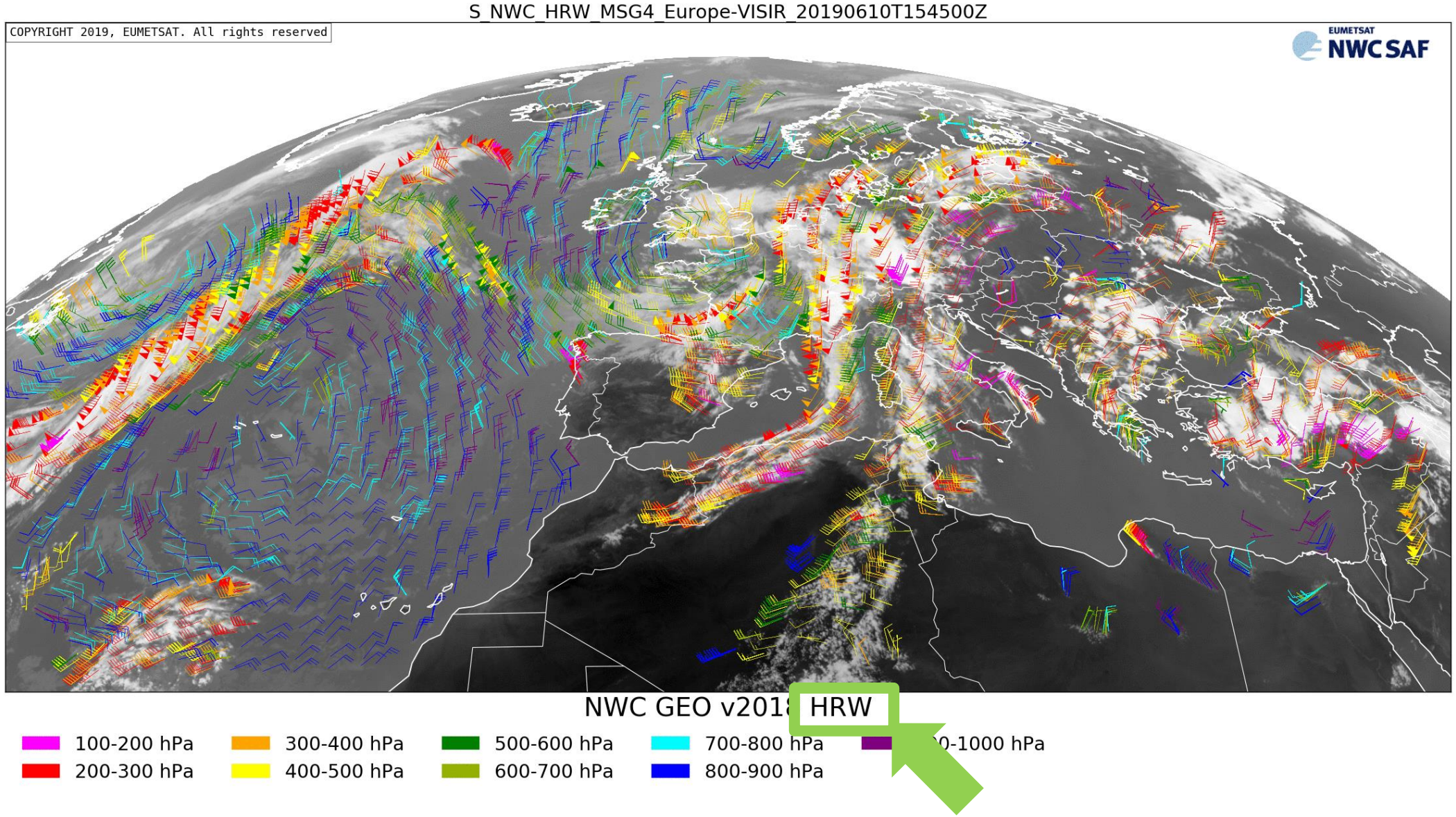
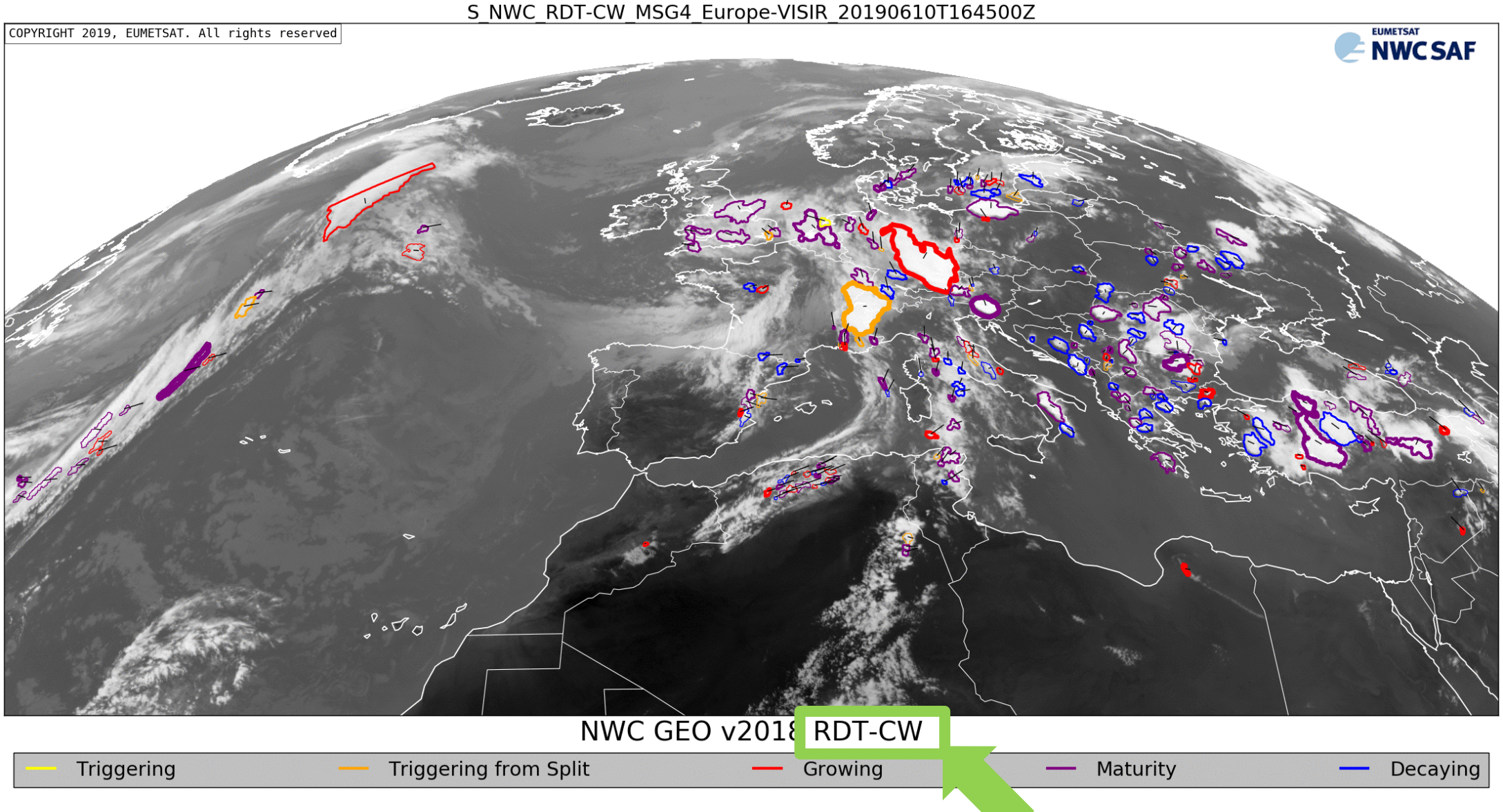
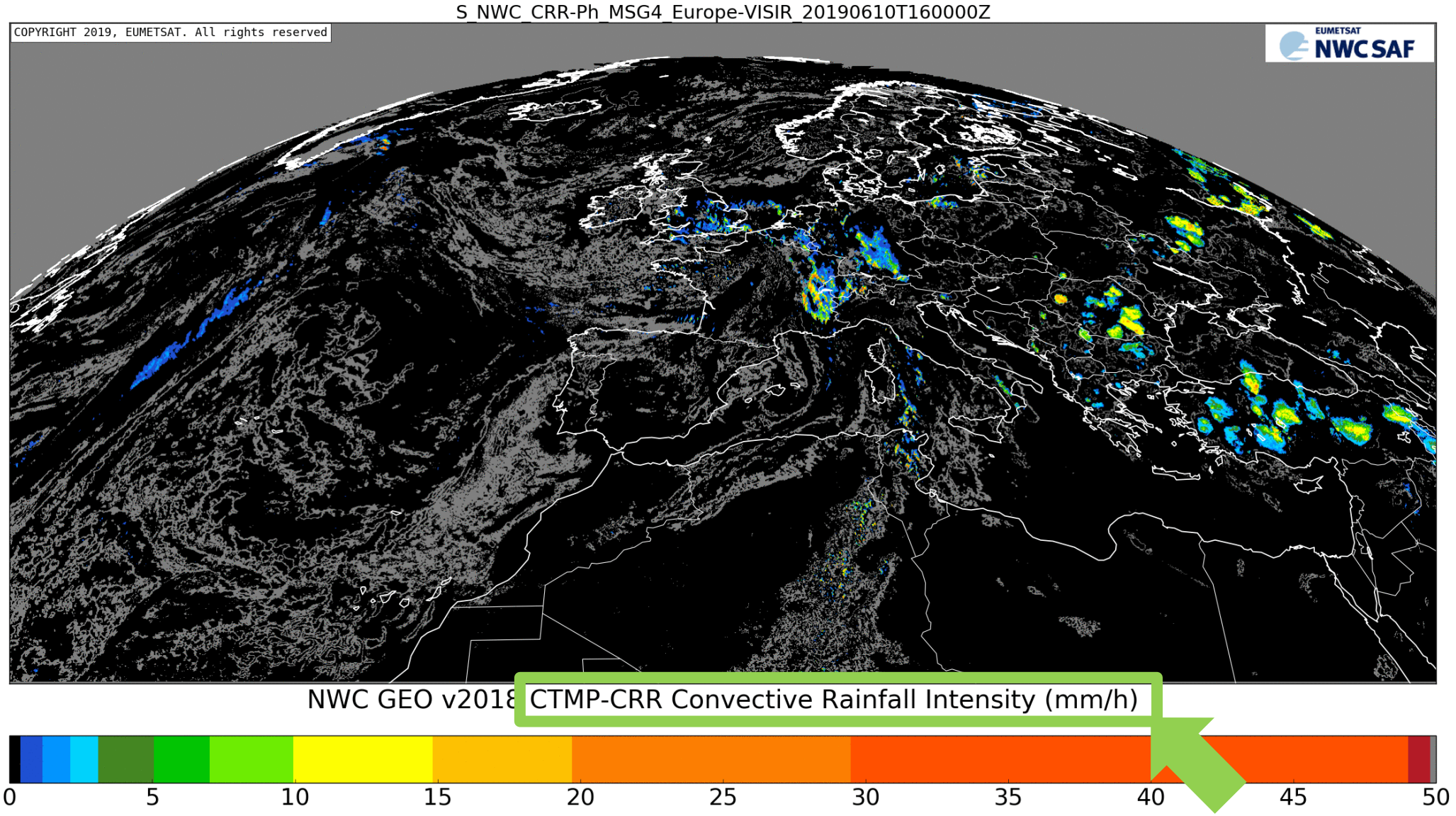


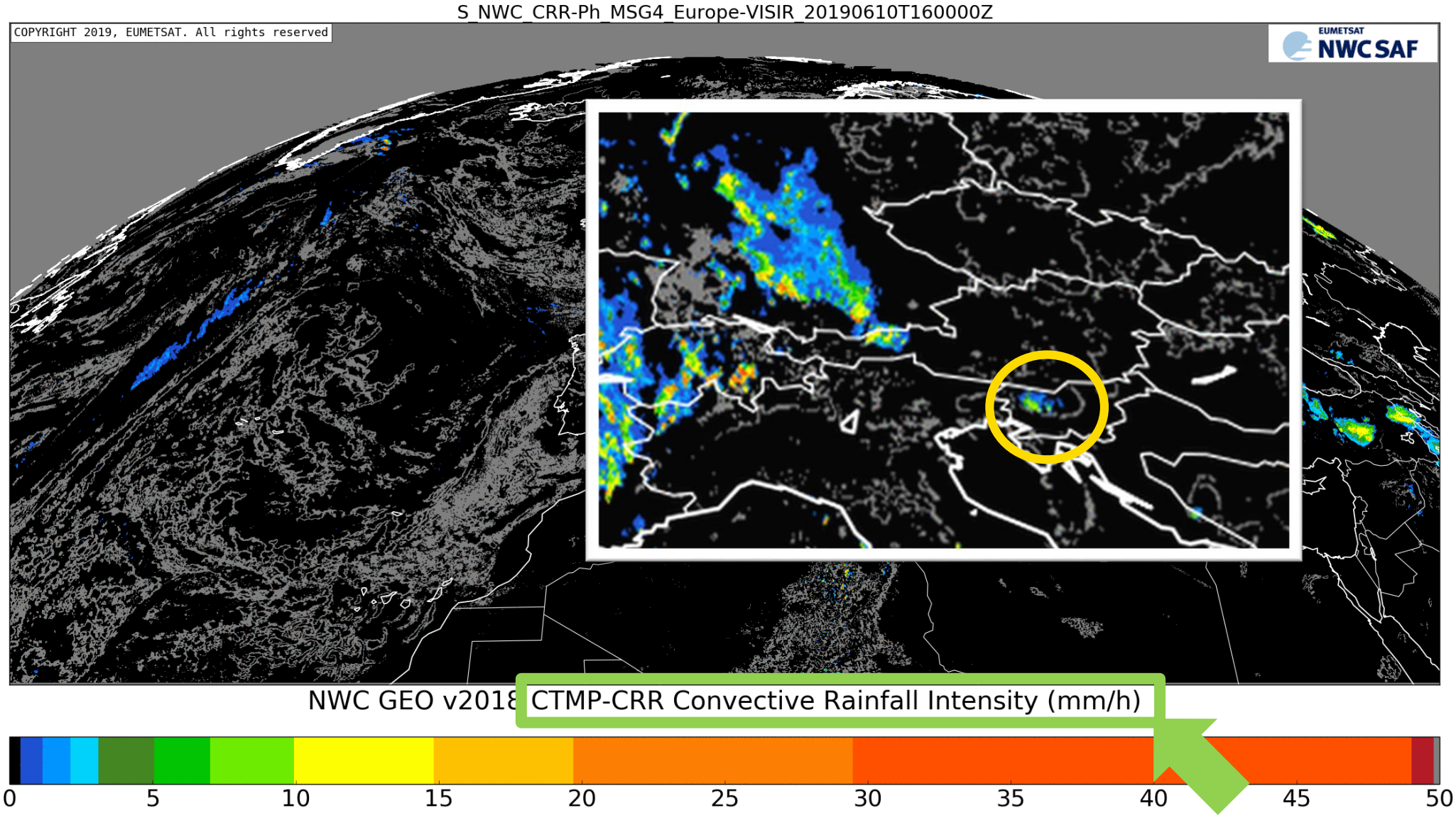
Storm dynamics – Automated tracking



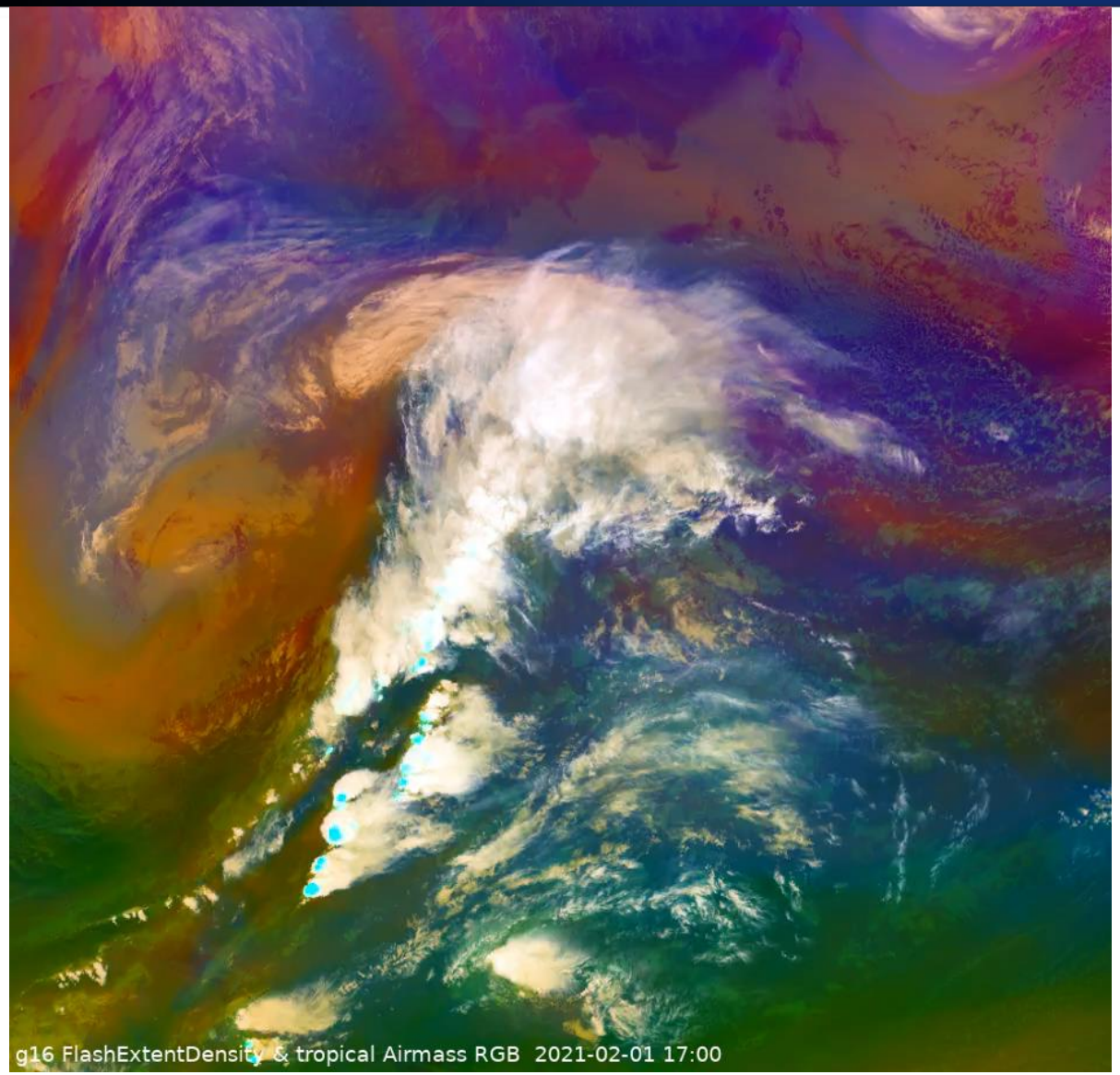
Storm dynamics – Hazards



Storm dynamics – Hazards

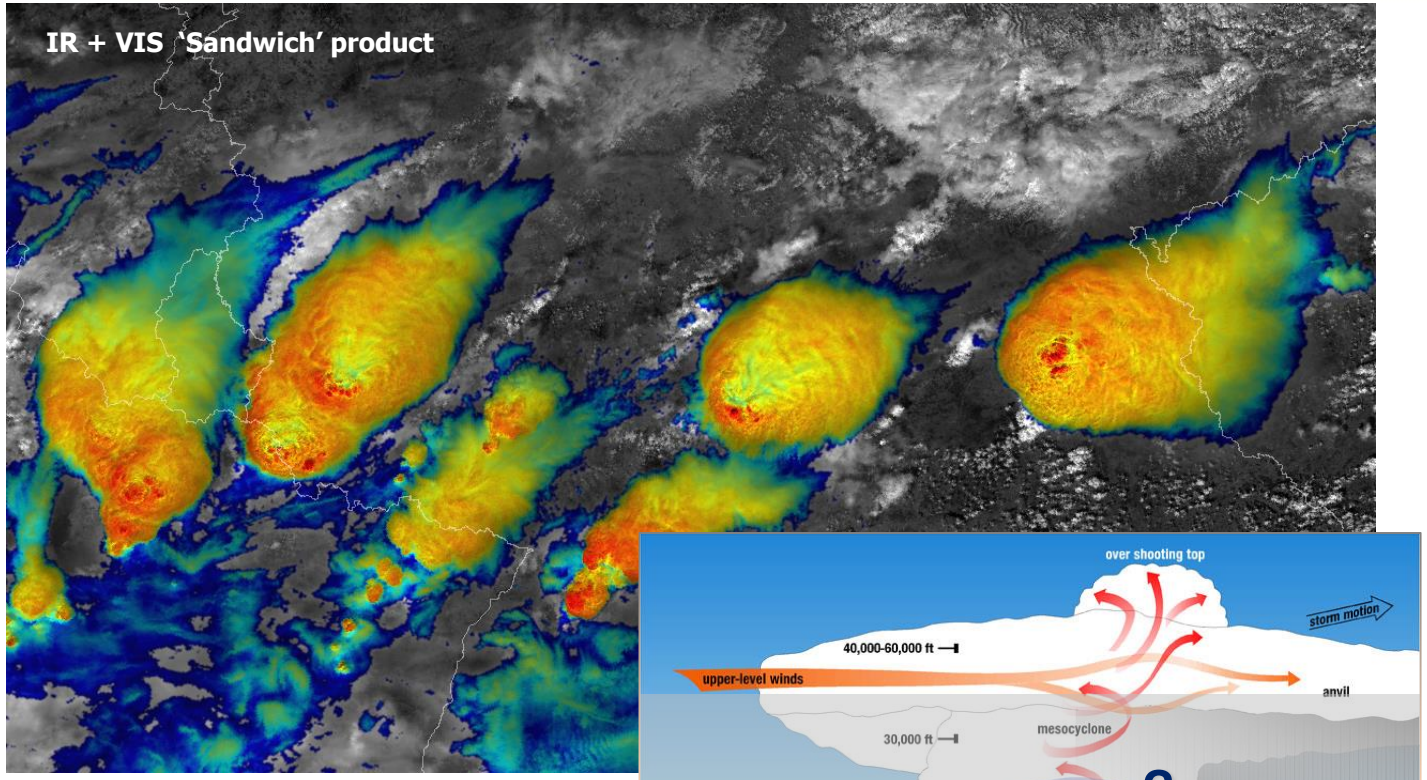


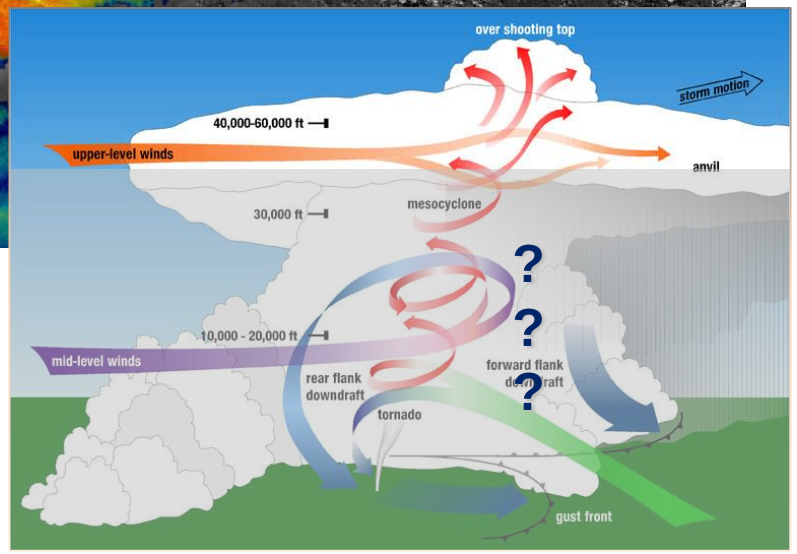
Storm dynamics – Lightning dynamics



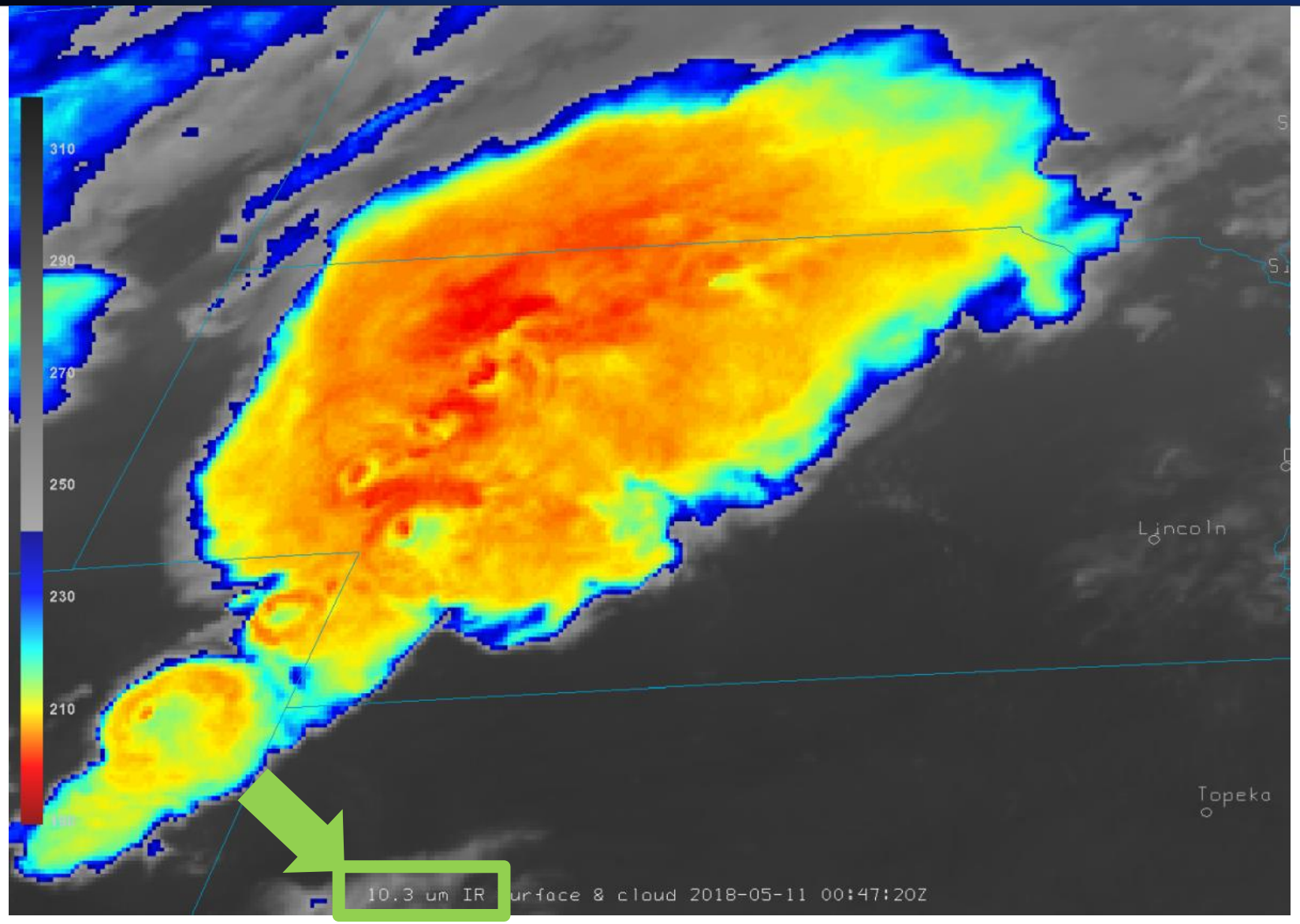
- Low-pressure area over northeastern US and adjoining Canada region
- Extended cold conveyor belt along the US east coast with embedded electric activity
- Some flashes occur also in the back of the conveyor belt
- **Lightning jumps indicator of upcoming hazards** (e.g. hail)

Cloud top features



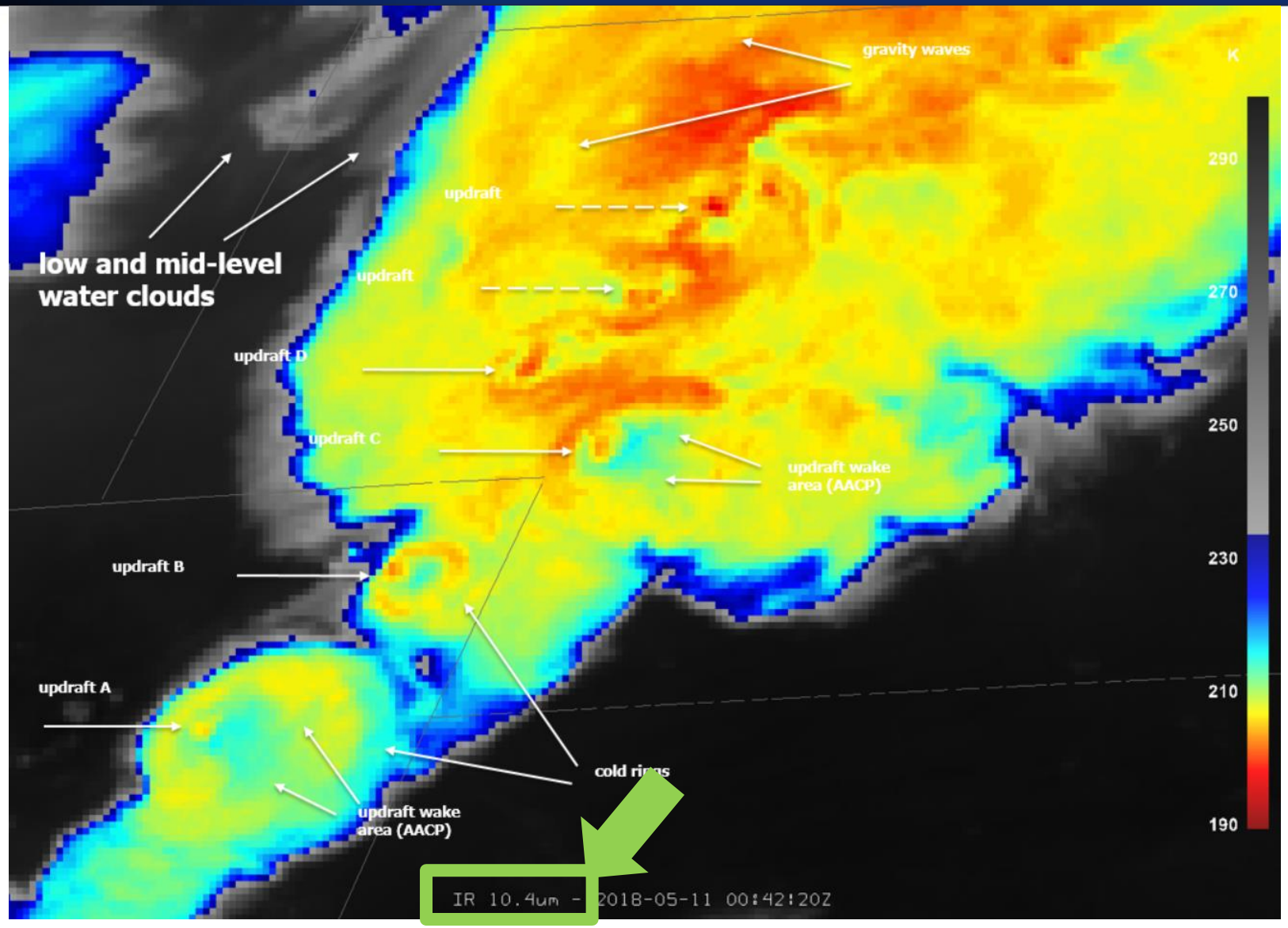


(Sli.do Q7) Cloud top features – how many updrafts?



Nebraska, USA
- 11 May 2018

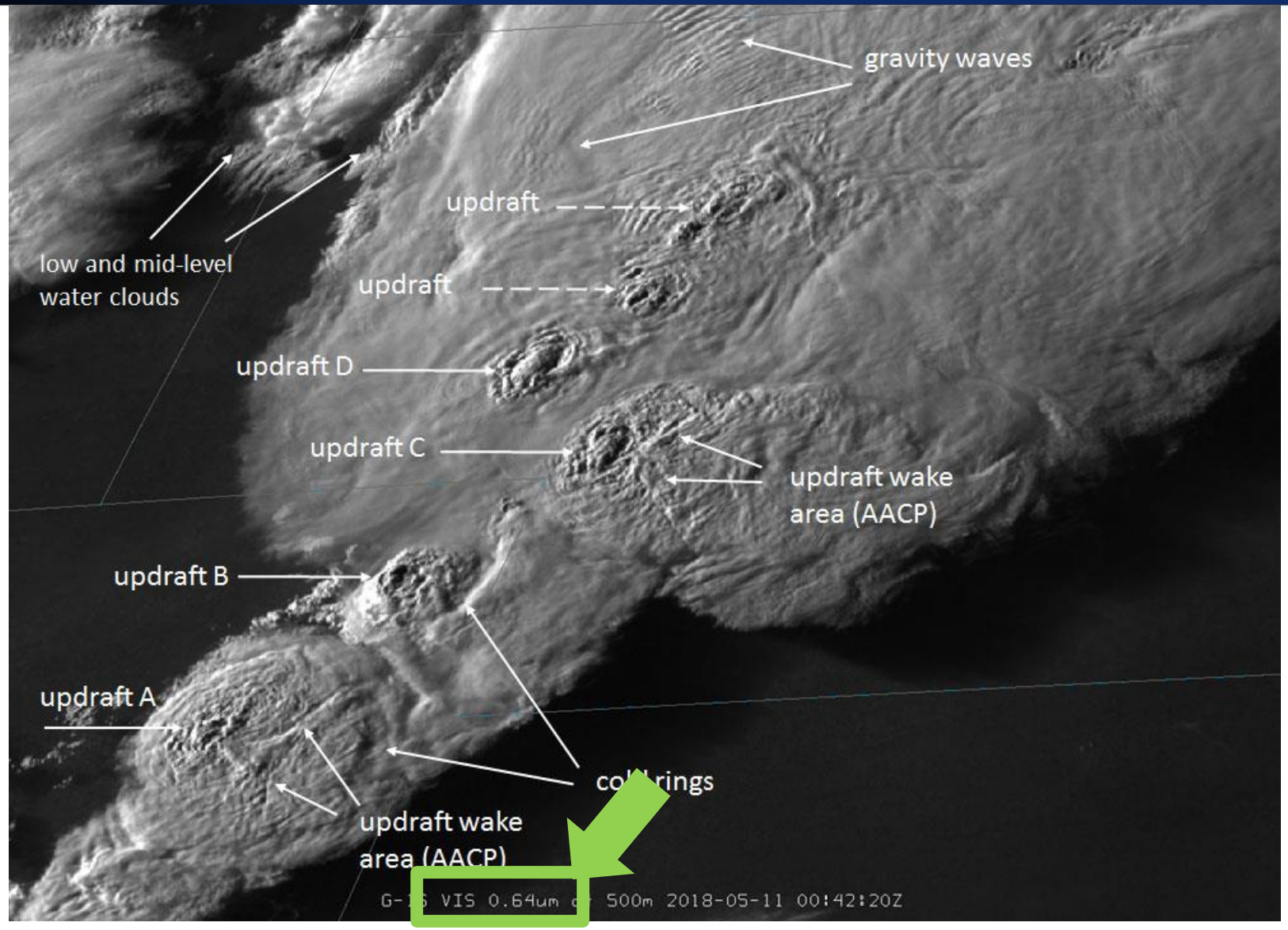
Cloud top features



Nebraska, USA
- 11 May 2018

=> Temperature field not the best proxy for cloud height (less for more vigorous updrafts!)

Cloud top features

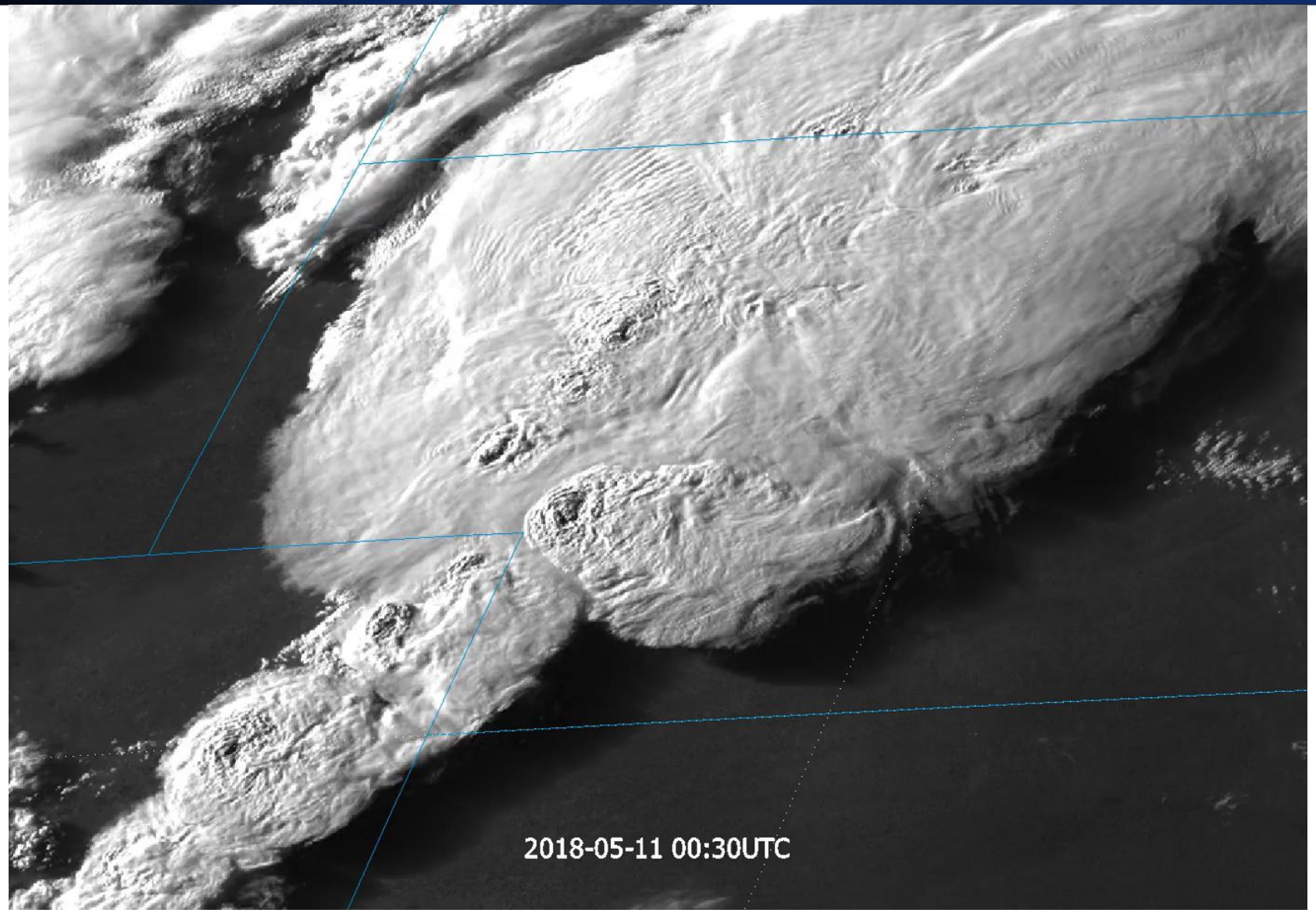


Nebraska, USA
- 11 May 2018

=> Temperature field not the best proxy for cloud height (less for more vigorous updrafts!)

=> Physical appearance reveals high quality information for assessment of storm intensity:
- OT shape and size
- Gravity waves
- Wave braking and jumping;
- AACP
- Jumping cirrus
- Pancake clouds#
- 'Ship waves'
- ….

Cloud top features



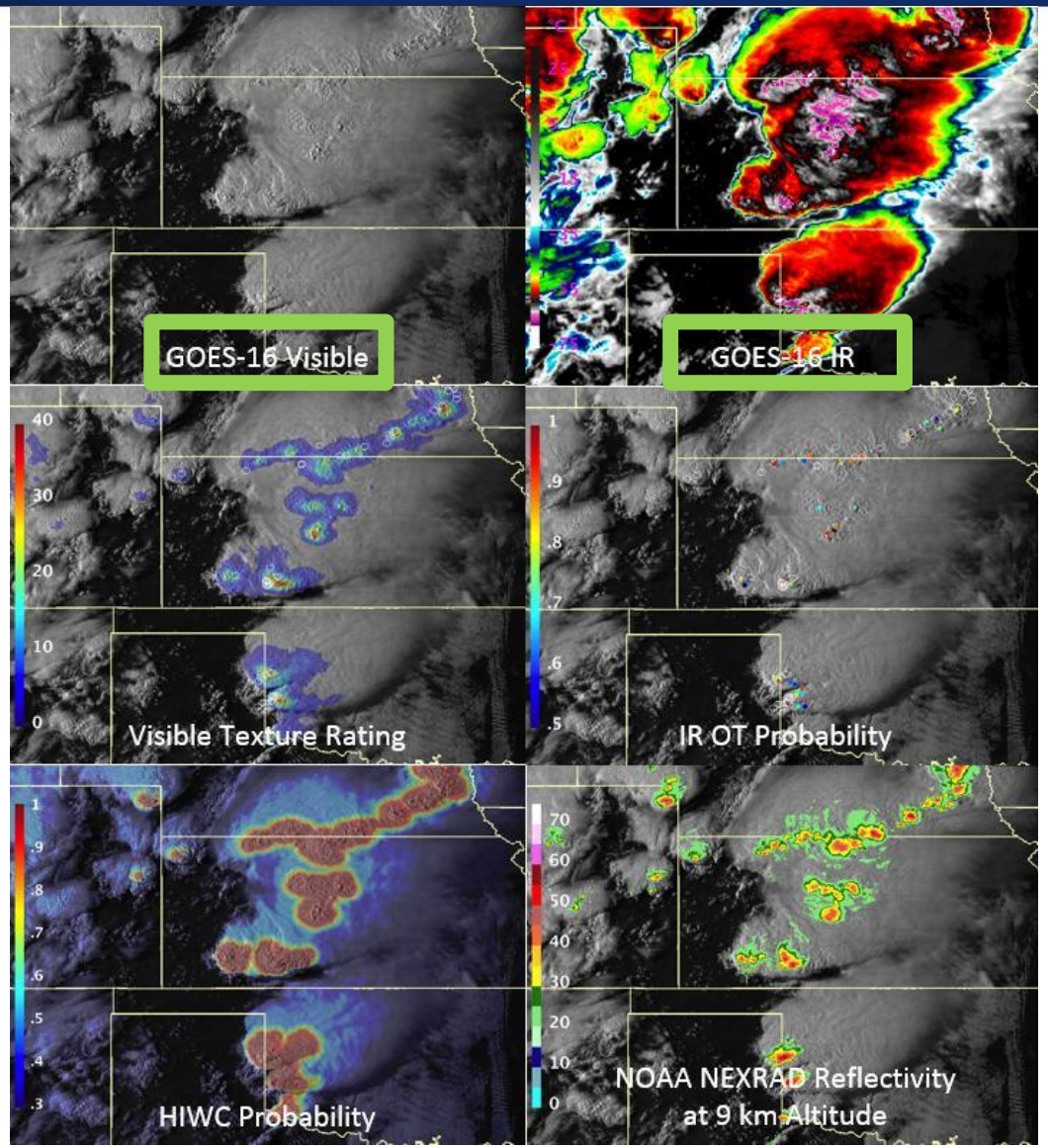
Nebraska, USA
- 11 May 2018

=> Best seen in motion

=> Temperature field not the best proxy for cloud height (less for more vigorous updrafts!)

=> Physical appearance reveals high quality information for assessment of storm intensity:
- OT shape and size
- Gravity waves
- Wave braking and jumping;
- AACP
- Jumping cirrus
- Pancake clouds#
- 'Ship waves'
- ….

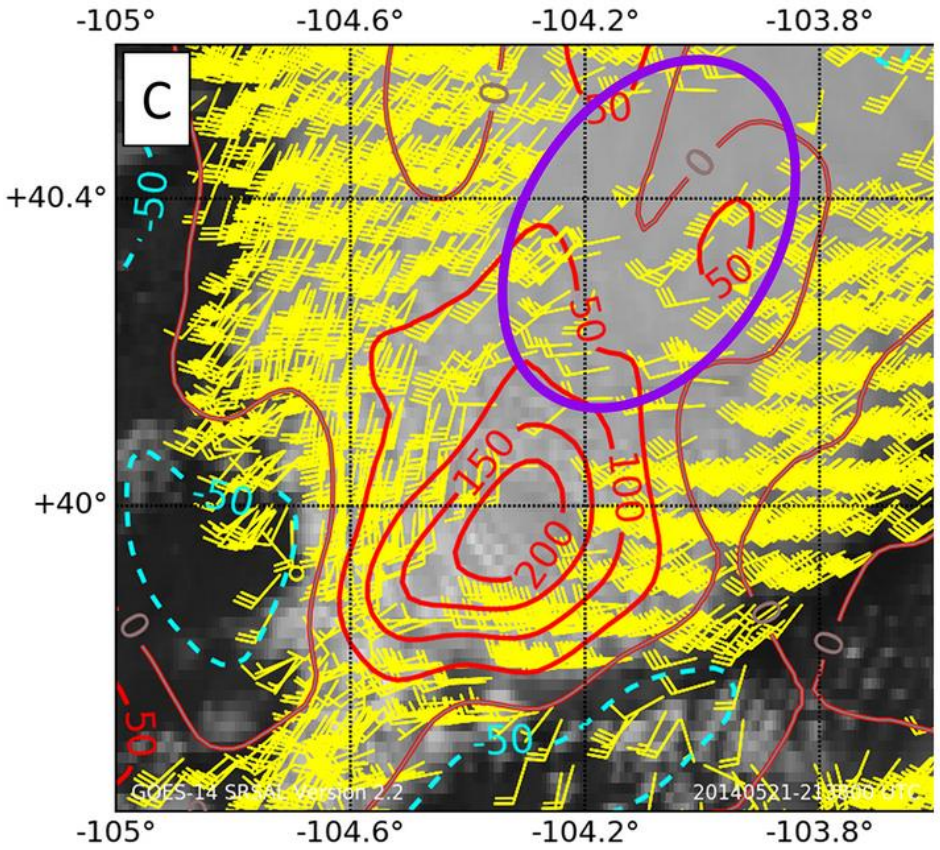
Cloud top features – detected features



=> FCI perspective: **Spatial + Temp**. resolution advancements

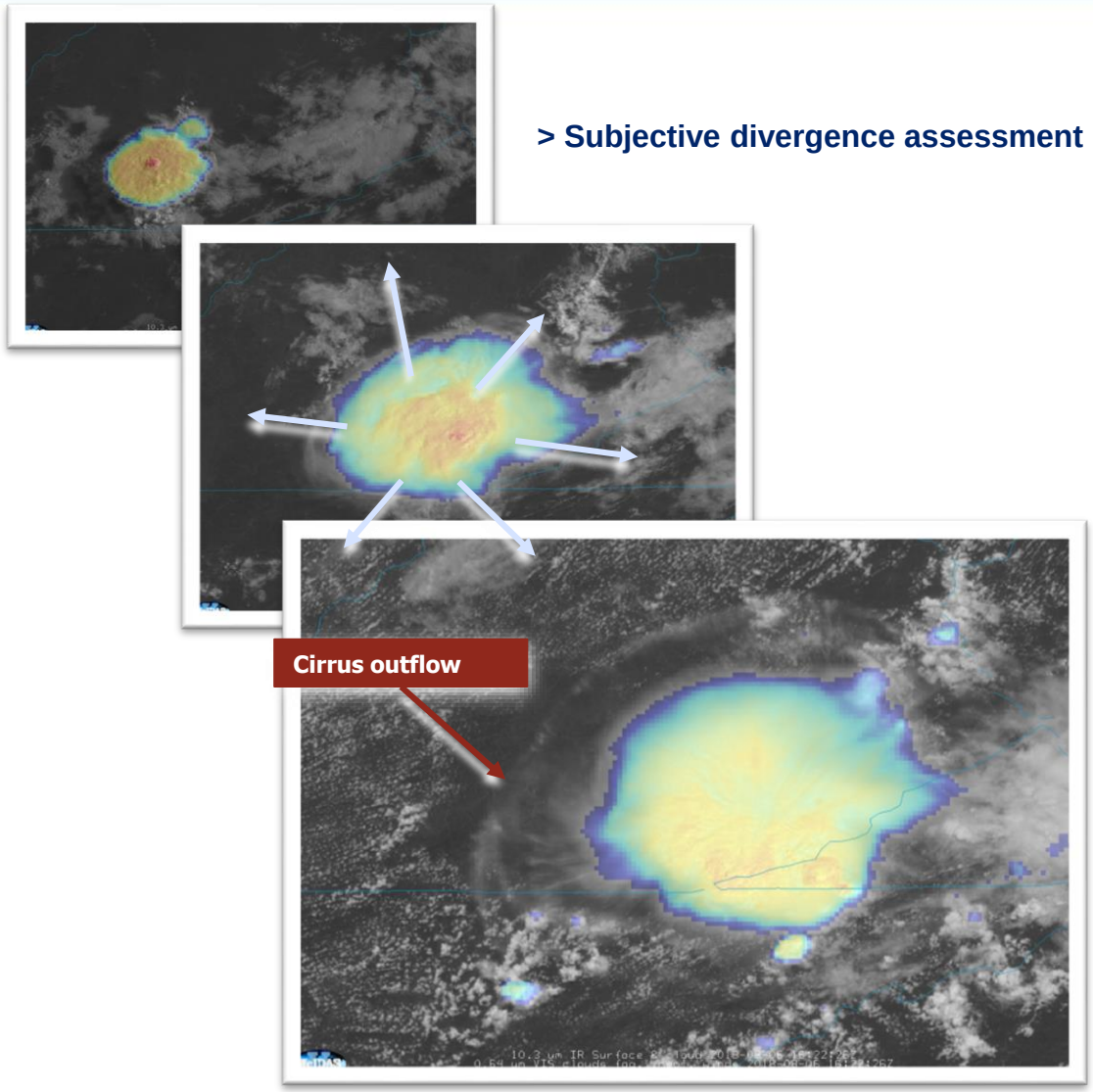
Upper-level divergence

> Automated divergence assessment



c. Jason M. Apke; John R. Mecikalski; Kristopher Bedka; Eugene W. McCaul, Jr.; Cameron R. Homeyer; Christopher P. Jewett

> Subjective divergence assessment



=> Anvil growth as a **proxy for upper level divergence** process

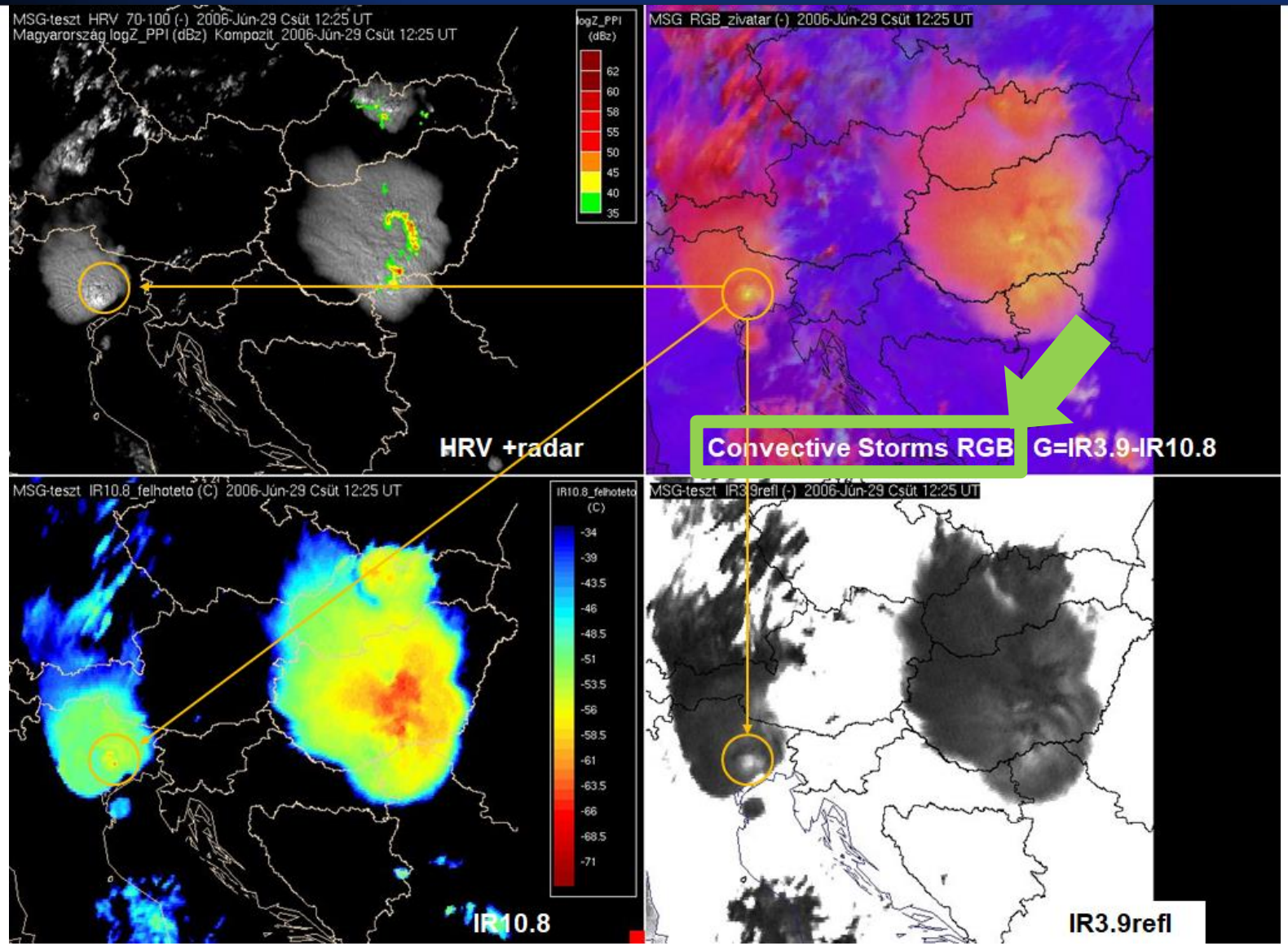
=> **Thin cirrus ring** in case of very abrupt vertical (turned into horizontal) flow

=> **Divergence indicate variations in anvil dynamics** and related vertical motions beneath

=> Out of **different satellite-related products**, storm top divergence seems to be the best discriminator

=> Meaningful only with advanced temporal/spatial resolution -> **FCI**

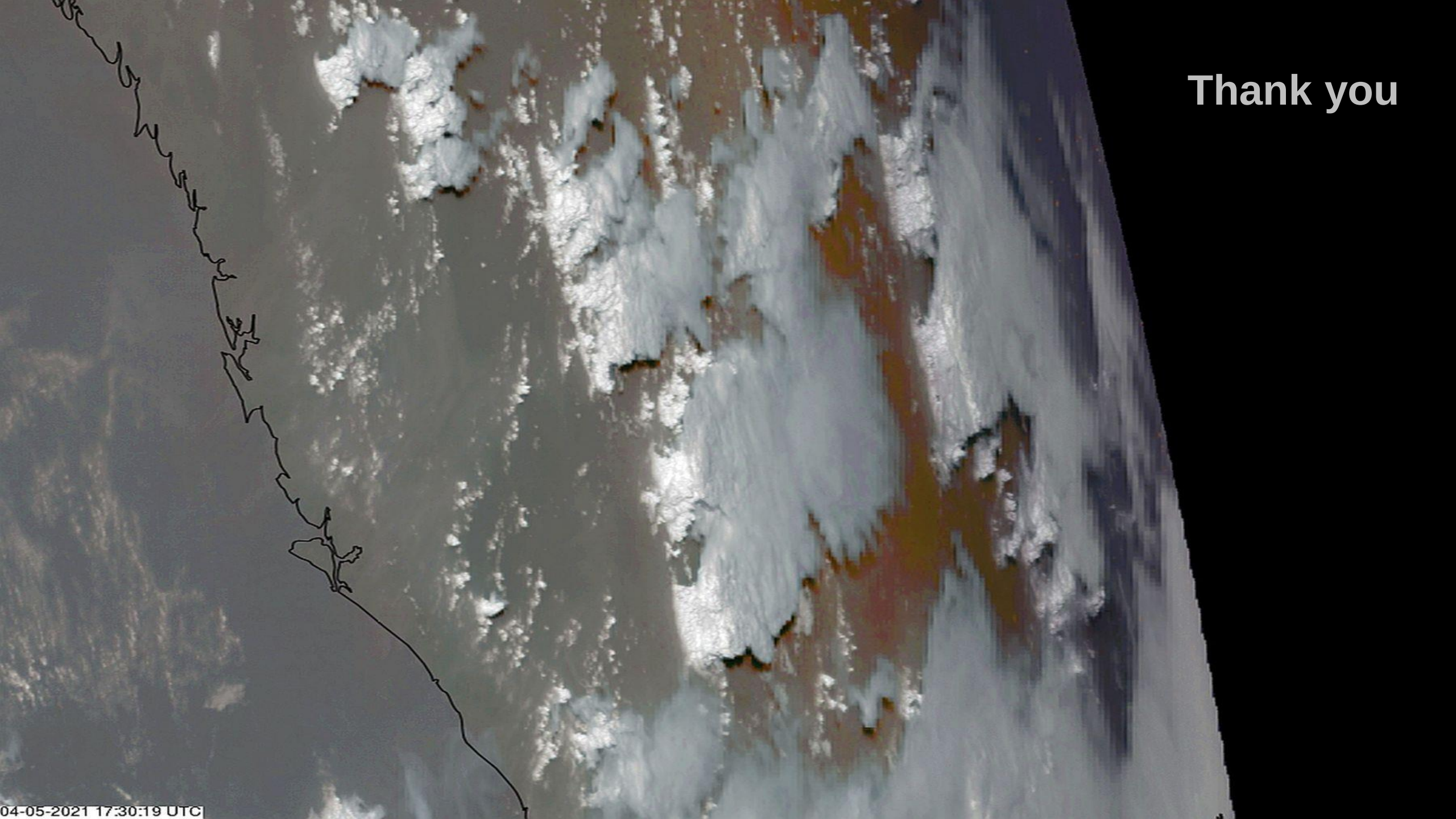
Cloud microphysics



c. Maria Putsay

=> Small ice particles reflect more in IR3.9 (particle size sensitivity)

=> IR3.9 has both solar and IR contribution to the signal


Thank you
04-05-2021 17:30:19 UTC