ASMET African Satellite Meteorology Education and Training

Identifying Clouds using Satellite Imagery

Matshidiso Mogale- SAWS

14 May 2024

ASMET

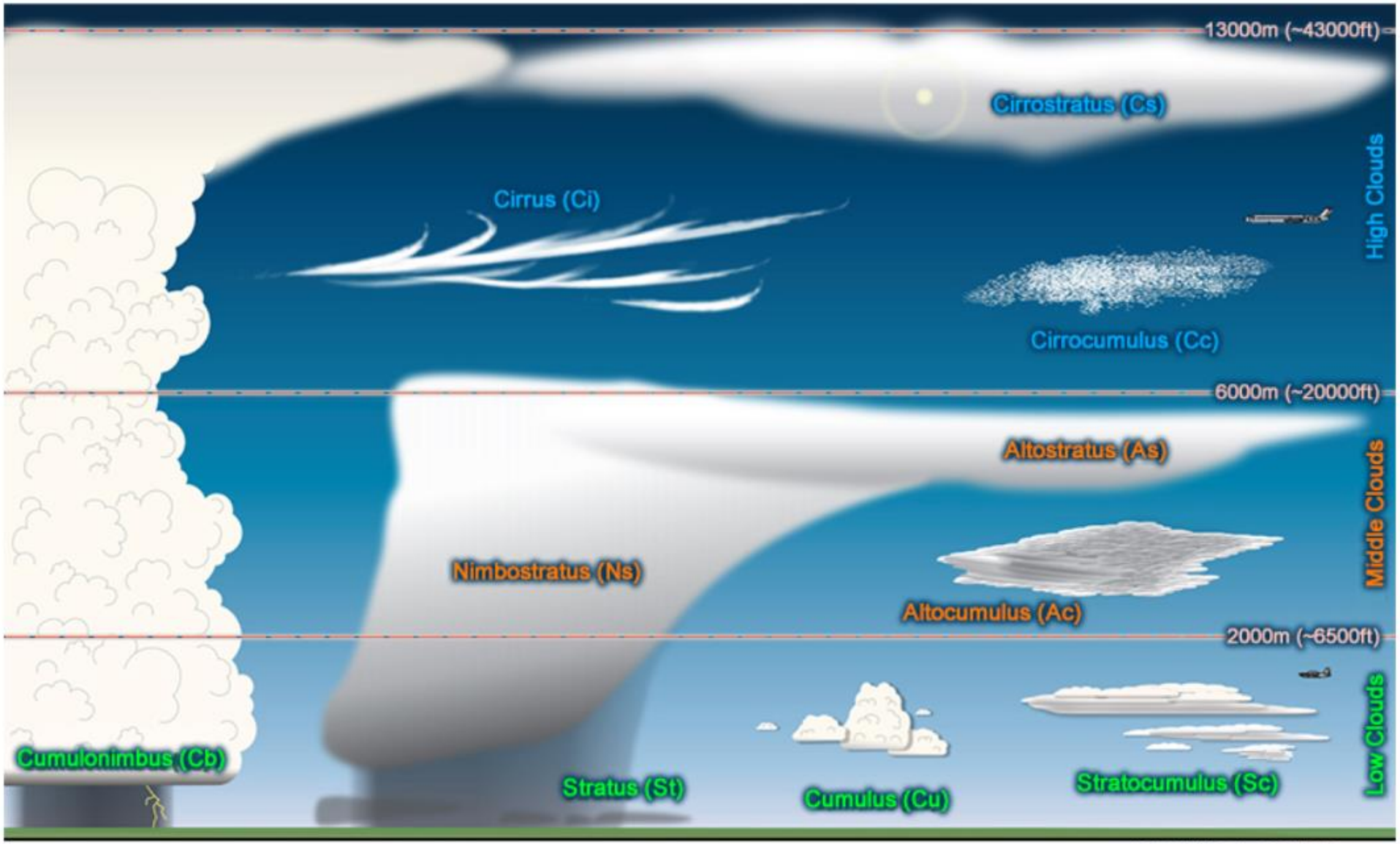
In this presentation:

1. Cloud Types
2. Convective VS Stratiform clouds
3. How to identify clouds using a Satellite imagery
4. Identifying clouds by thickness
5. Identifying clouds by cloud top heights

How well do you know your clouds?

Clouds

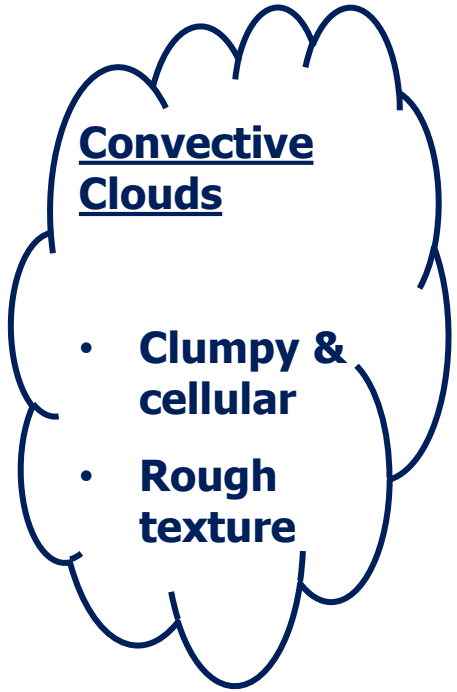
1. Cloud Types

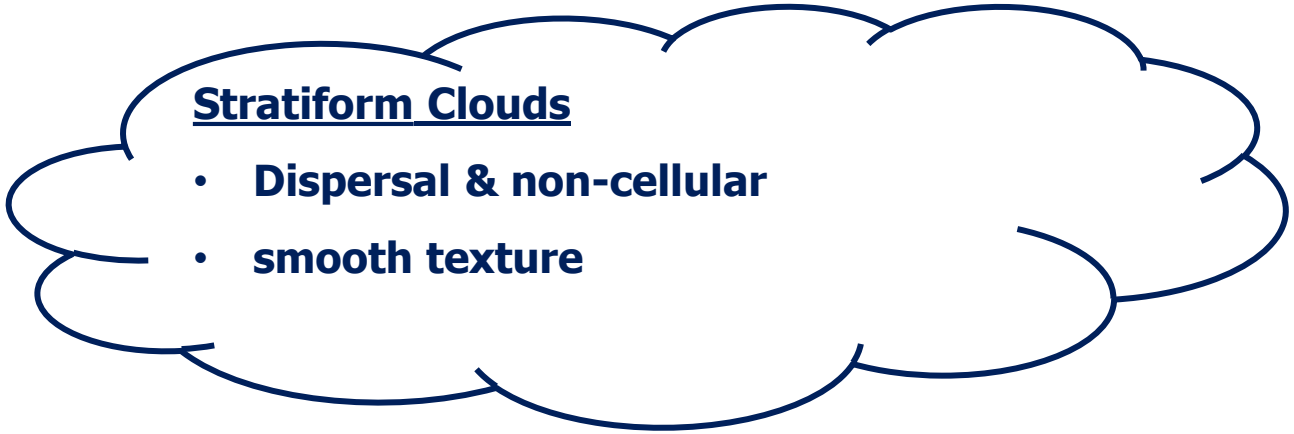


2. Convective VS stratiform clouds

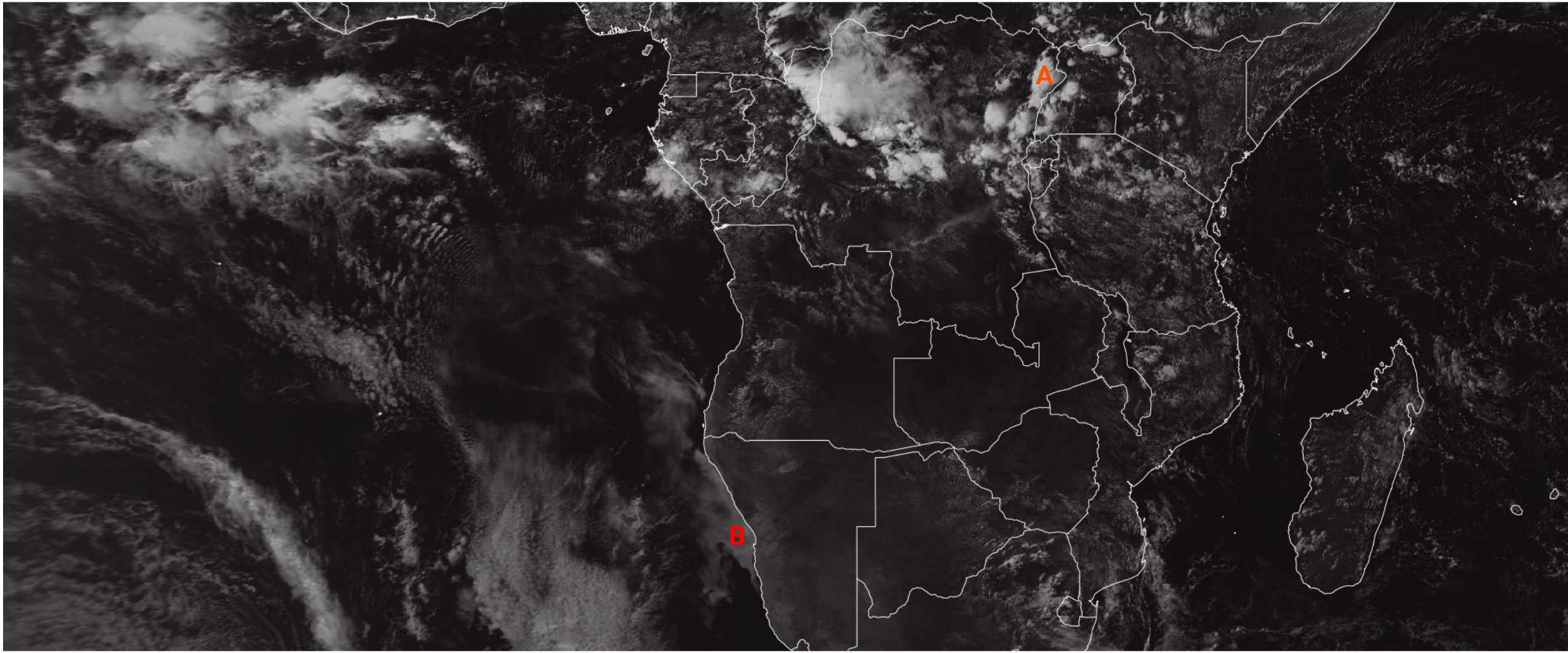
Convective Clouds	Stratiform Clouds
Form in unstable conditions	Form in stable conditions
Grow vertically	Layered, grow horizontally
Large vertical extent, small horizontal extent	Small vertical extent, large horizontal extent

On the satellite Imagery, these clouds will appear:





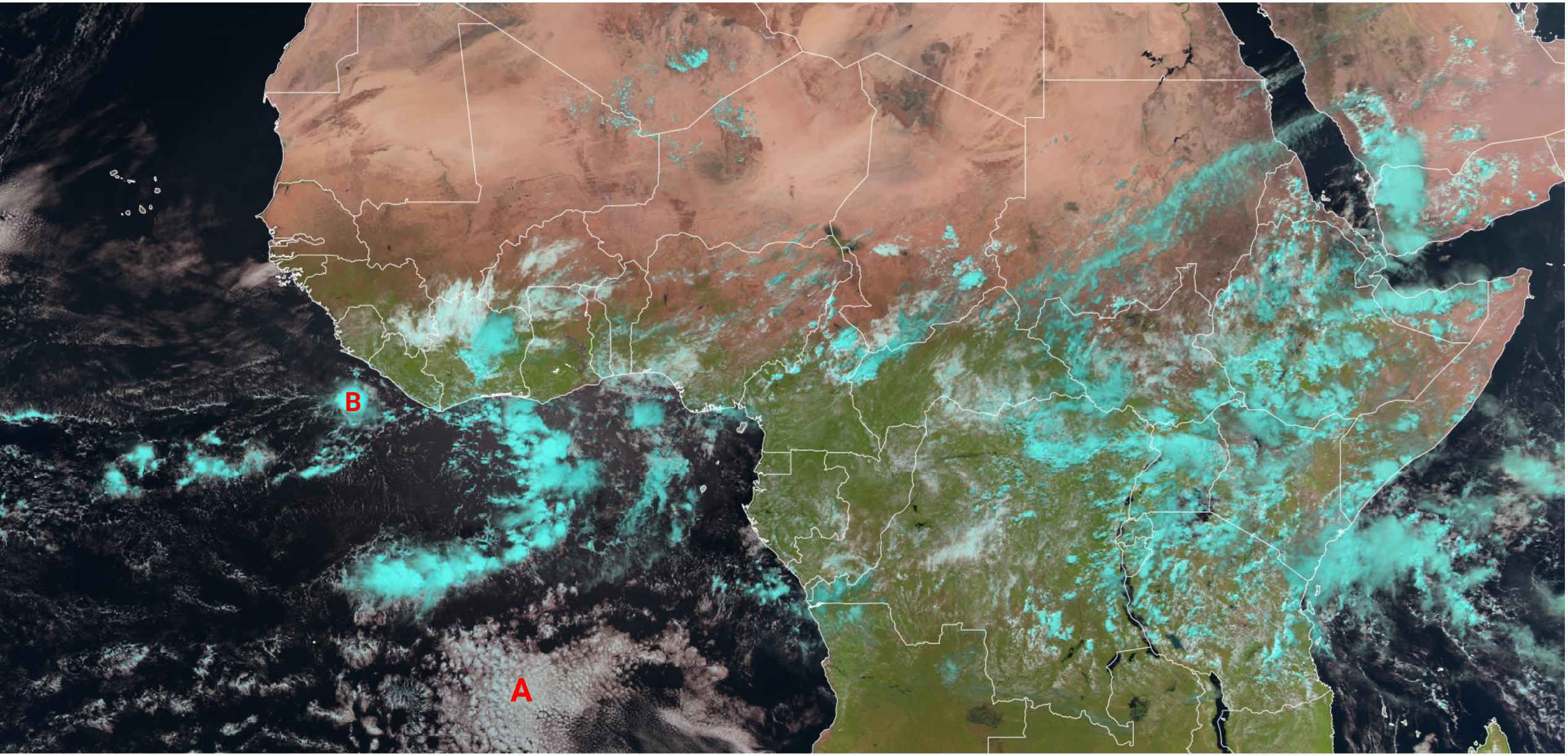
VIS 0.6



EUMETSAT

2023-05-09 12:00:00 UTC

Natural Color



EUMETSAT

2023-04-30 12:00:00 UTC

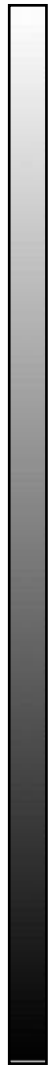
3. How to identify clouds using a Satellite Imagery?

1. Thickness
2. Cloud Top Height
3. Texture
4. Shape
5. Microphysics

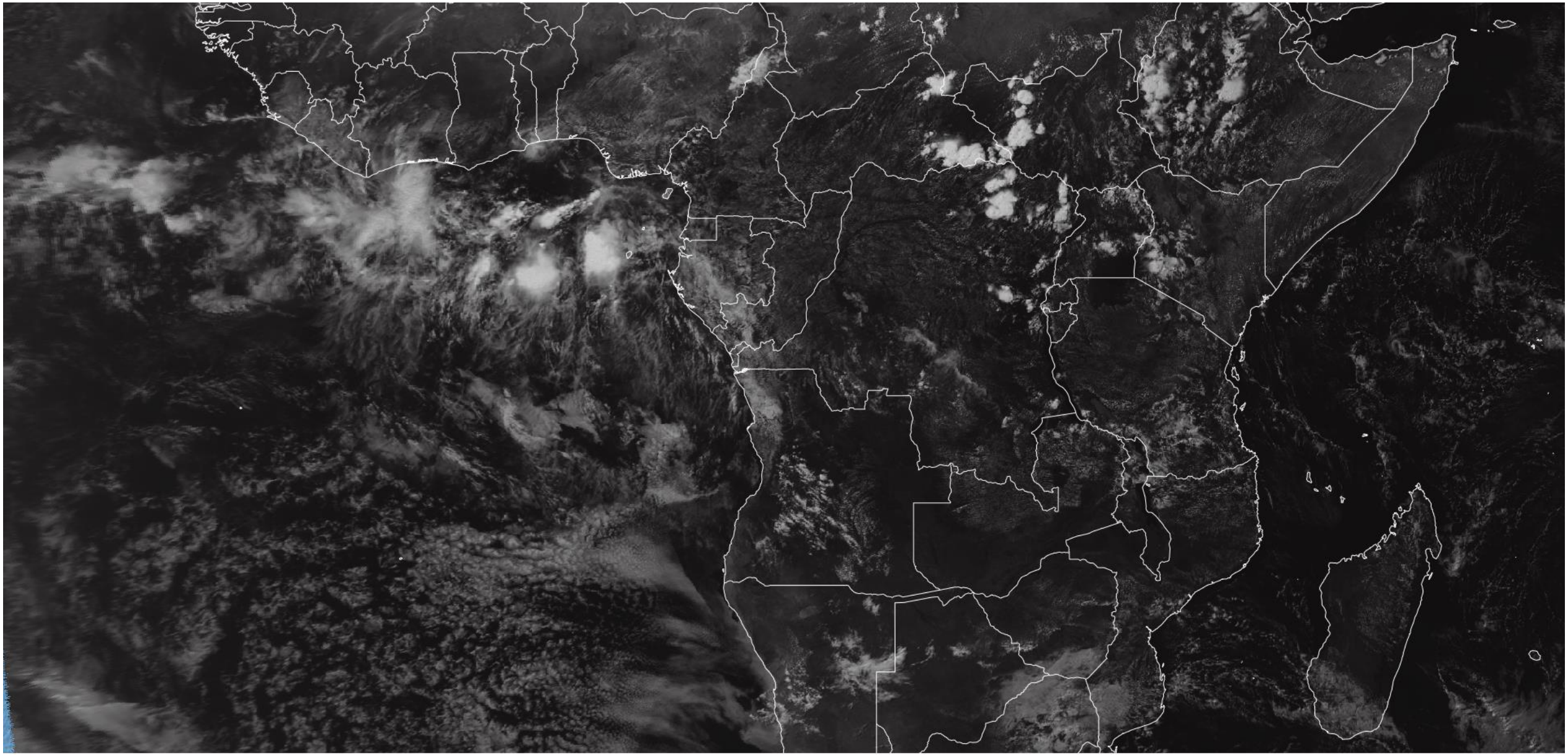
4. IDENTIFYING CLOUDS BY THICKNESS

Identifying clouds by thickness

- Visible Channels are the most useful products to determine cloud thickness.
- The brightness of clouds indicates its thickness
- Opaque vs Translucent:
  - Opaque clouds= thick clouds
  - Translucent/semi-transparent= thin clouds



VIS 0.6



EUMETSAT

2023-05-16 12:00:00 UTC

Identifying clouds by thickness

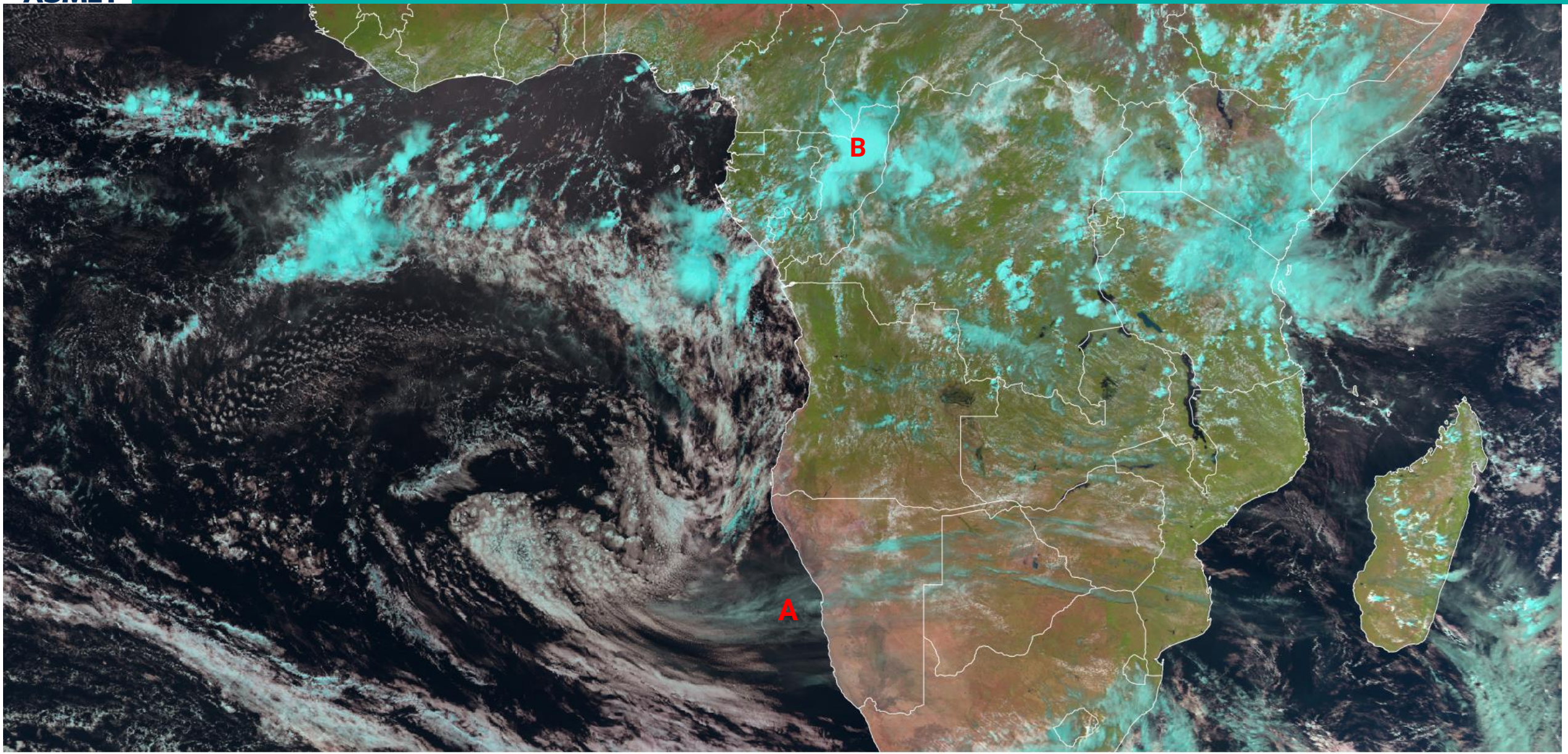
- Natural Colors RGB is also useful in determining cloud thickness.

Colour	Channel	Physically relates to	Smaller contribution to the signal of	Larger contribution to the signal of
Red	NIR1.6	Cloud phase Snow cover	Ice clouds Snow covered land/sea ice	Water clouds
Green	VIS0.8	Cloud optical thickness Green vegetation	Thin clouds	Thick clouds Snow covered land Vegetation
Blue	VIS0.6	Cloud optical thickness Green vegetation	Thin clouds Vegetation	Thick clouds Snow covered land Vegetation

- Also helps to know cloud types:

Type	Thickness	Appearance
Cumulonimbus	**Thick**	Deep cyan
Cumulus	**Variably thick**	Cyan
Stratus	**Variably thin**	Very light cyan to white
Cirrus	**Thin**	Light cyan & translucent

Natural Color



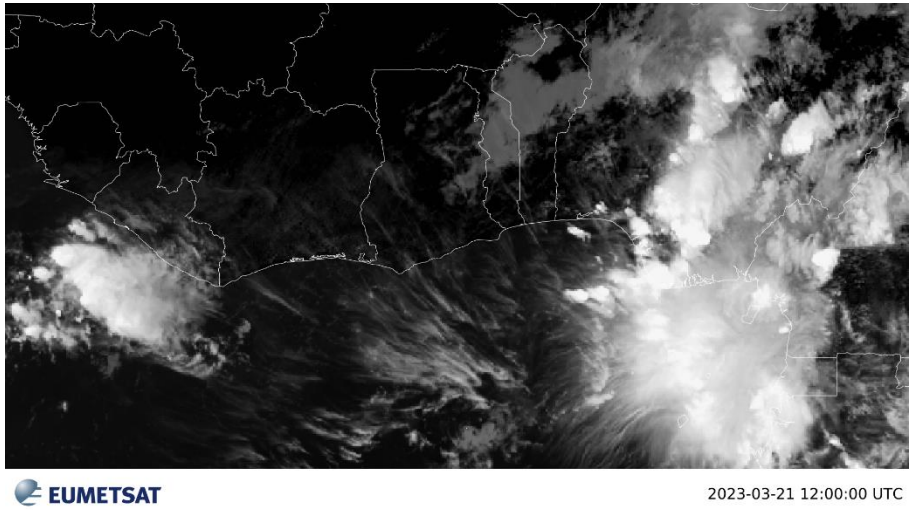
EUMETSAT

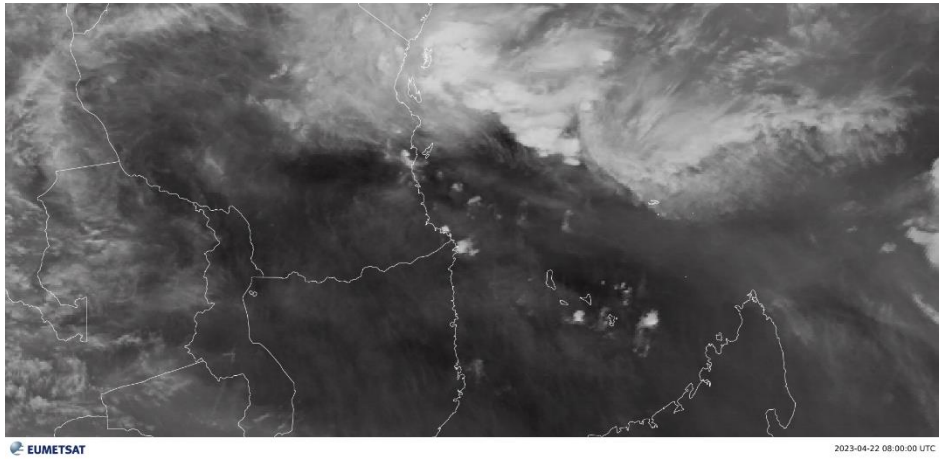
2023-04-22 12:15:00 UTC

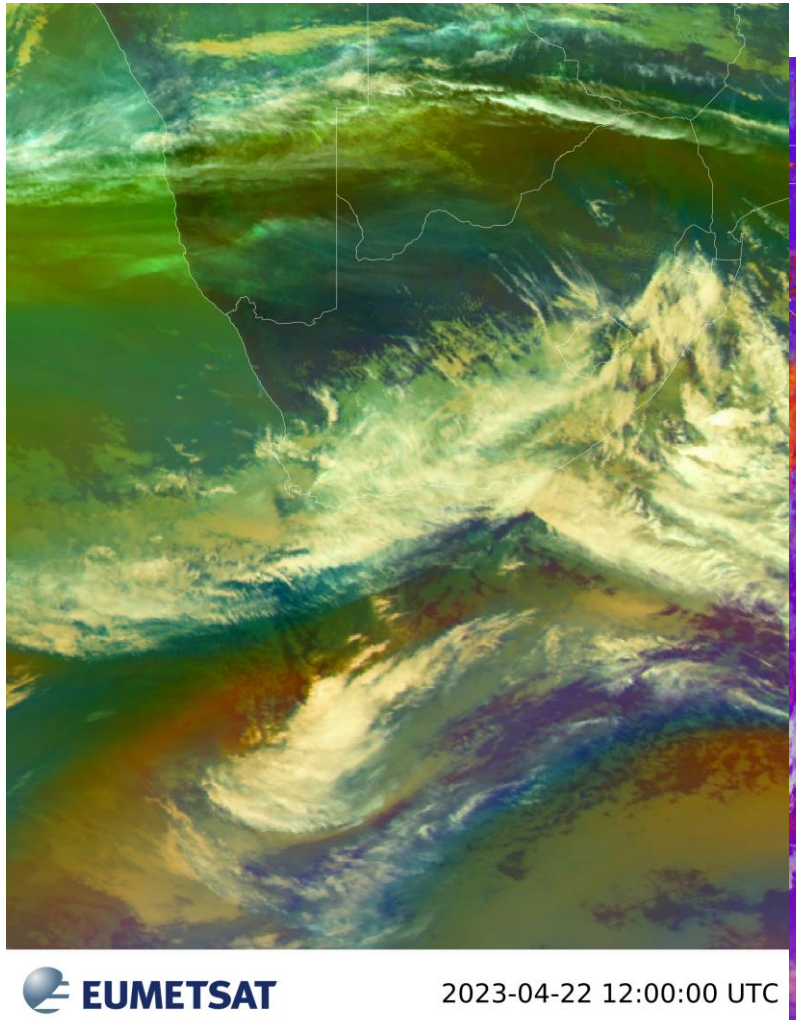
Identifying clouds by thickness: Challenges

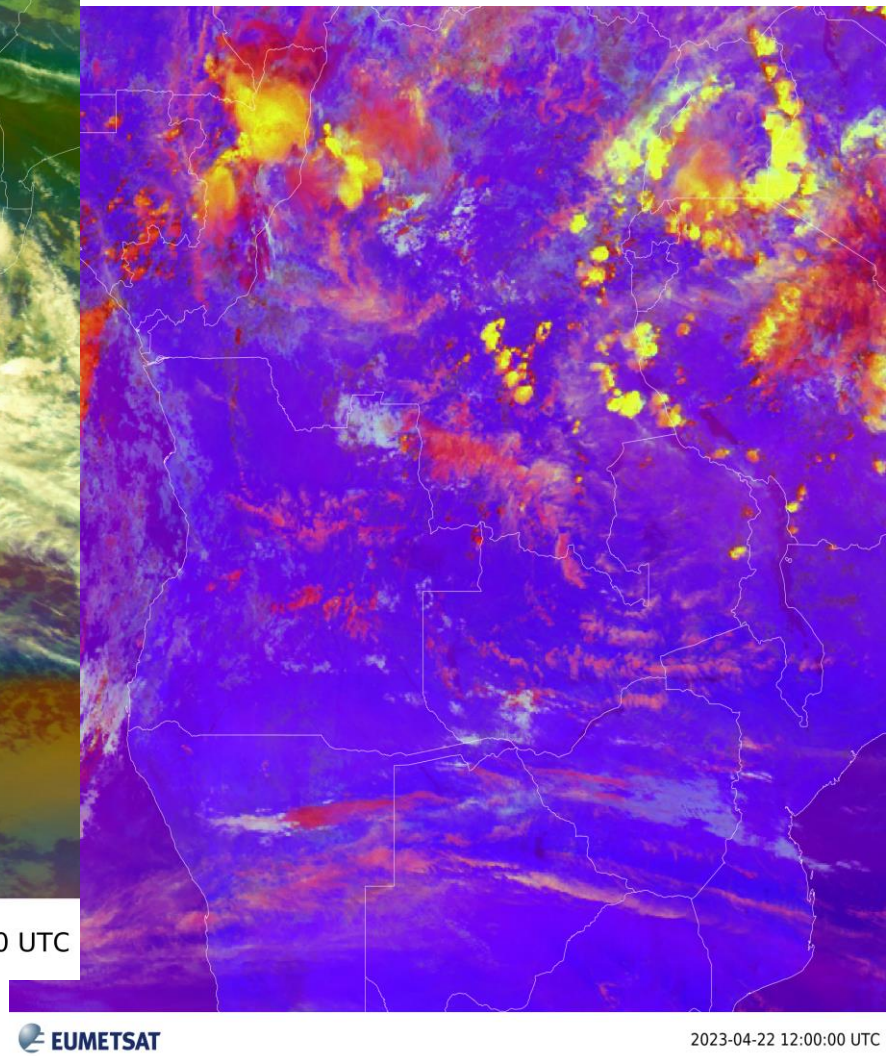
- Difficult to identify thickness of all clouds on other products because of channel composition:
  - Infrared imagery: thermal based, best for cloud top temperatures, best to determine thickness by cloud type and other features.
  - Water Vapour: difficult to determine cloud edges & surface features
  - Severe Convective RGB: tailor made for convective storms, difficult to pick up some low-stratiform clouds.
  - Airmass RGB: suitable for distinguishing air masses hence difficult to determine surface features

Identifying clouds by thickness: Challenges









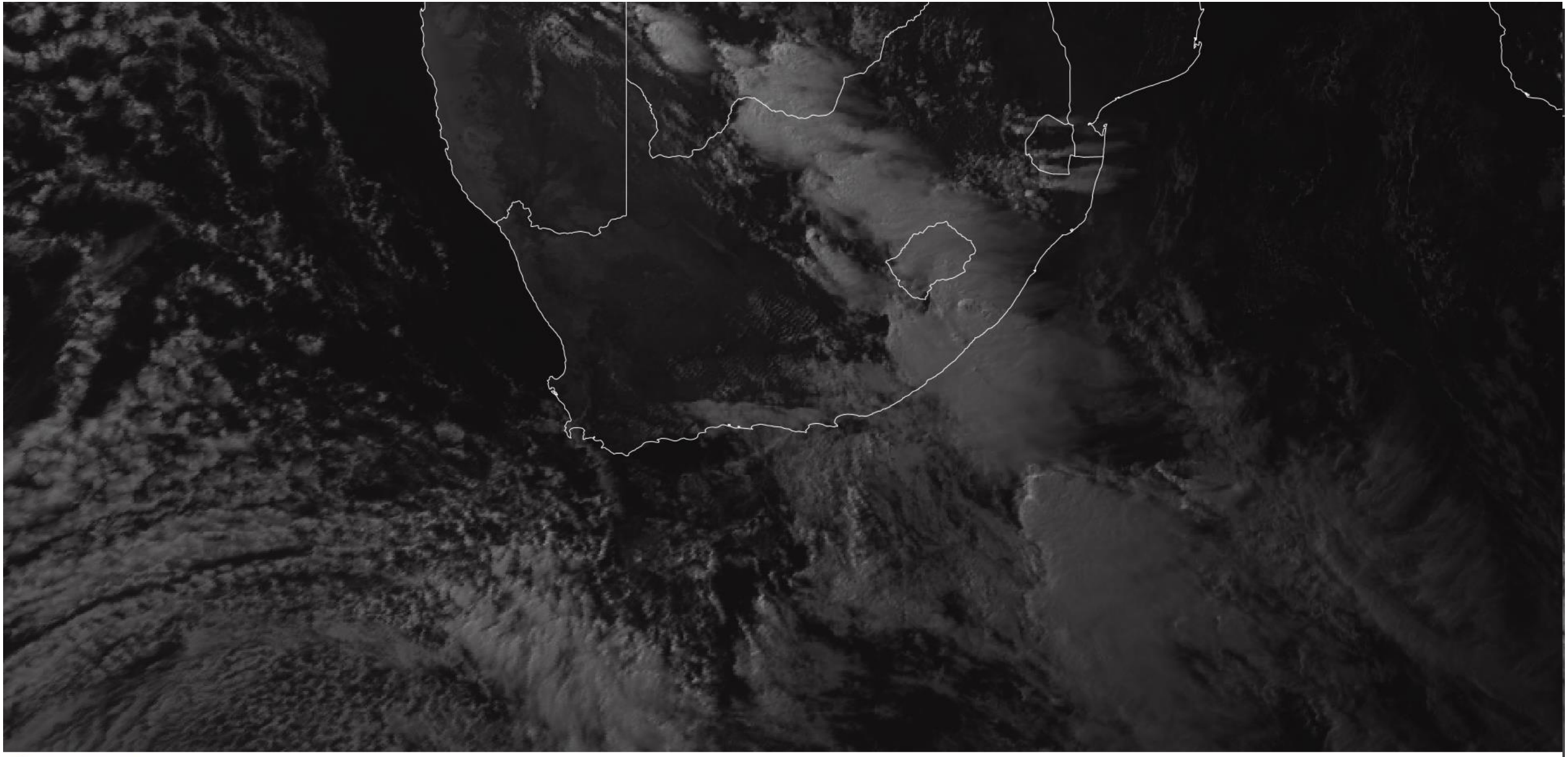
5. IDENTIFYING CLOUDS BY CLOUD TOP HEIGHTS

Identifying clouds by cloud top heights

- Easy way is to use visible channels to determine cloud type based on its texture & shape as discussed
- The cloud type tells its height.
- Sun angle affects interpretation of the clouds:
  - Can make clouds dramatically different at different times of the day
  - Can help with shadows

ASMET

VIS 0.6

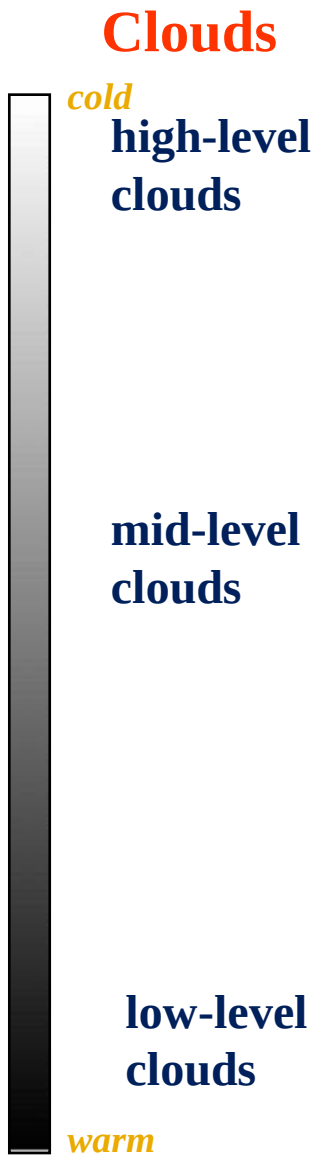


EUMETSAT

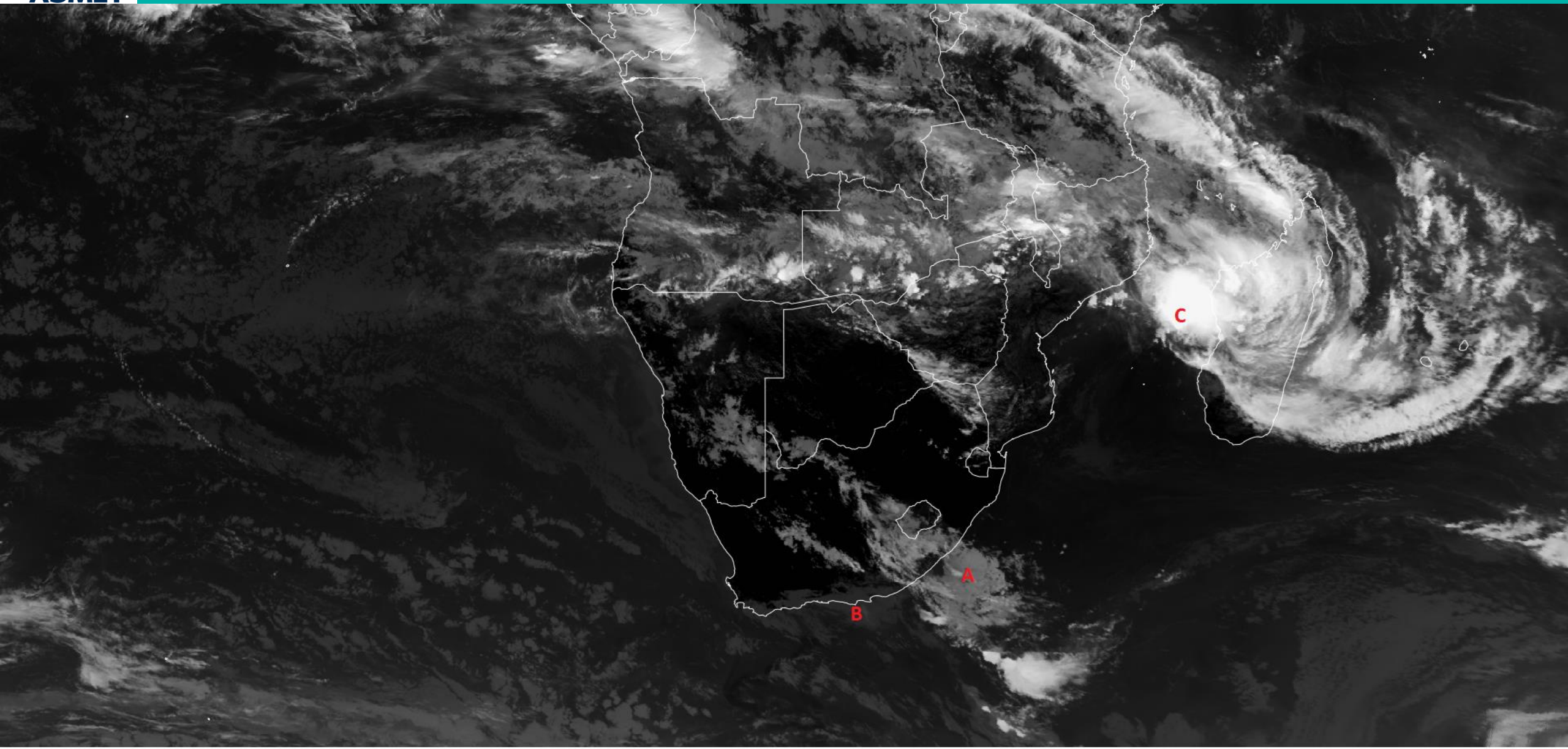
2023-04-09 14:00:00 UTC

Identifying clouds by cloud top heights

- Quantitate way to determine cloud height is by using Infrared images to determine cloud top temperatures:
  - **Brighter colours**= colder temperatures=higher cloud tops
  - **Darker colours**= warmer temperatures= lower cloud tops
- Also works with the water vapour channel for convective clouds penetrating into the mid and high levels.



IR 10.8

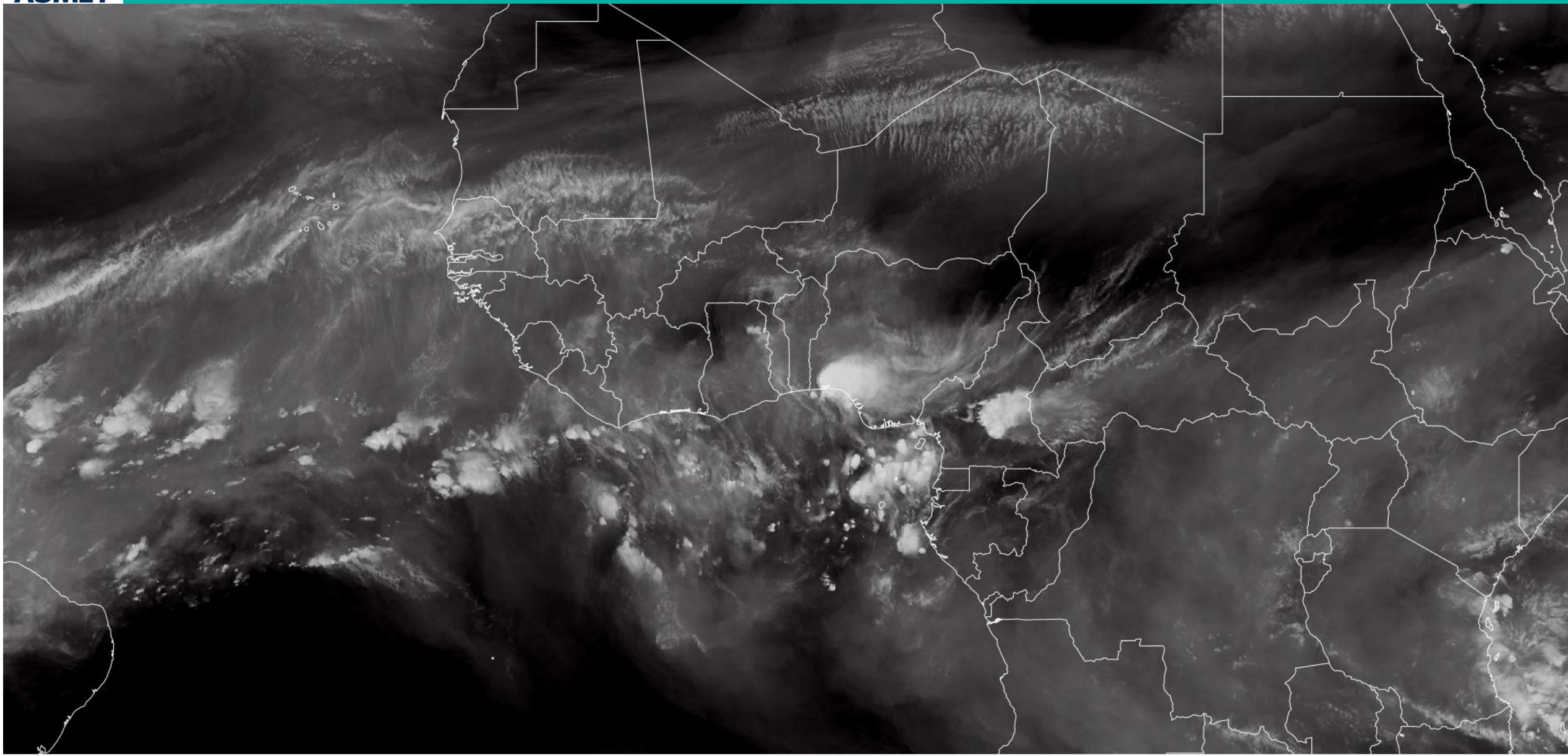


EUMETSAT

2023-01-22 09:30:00 UTC

ASMET

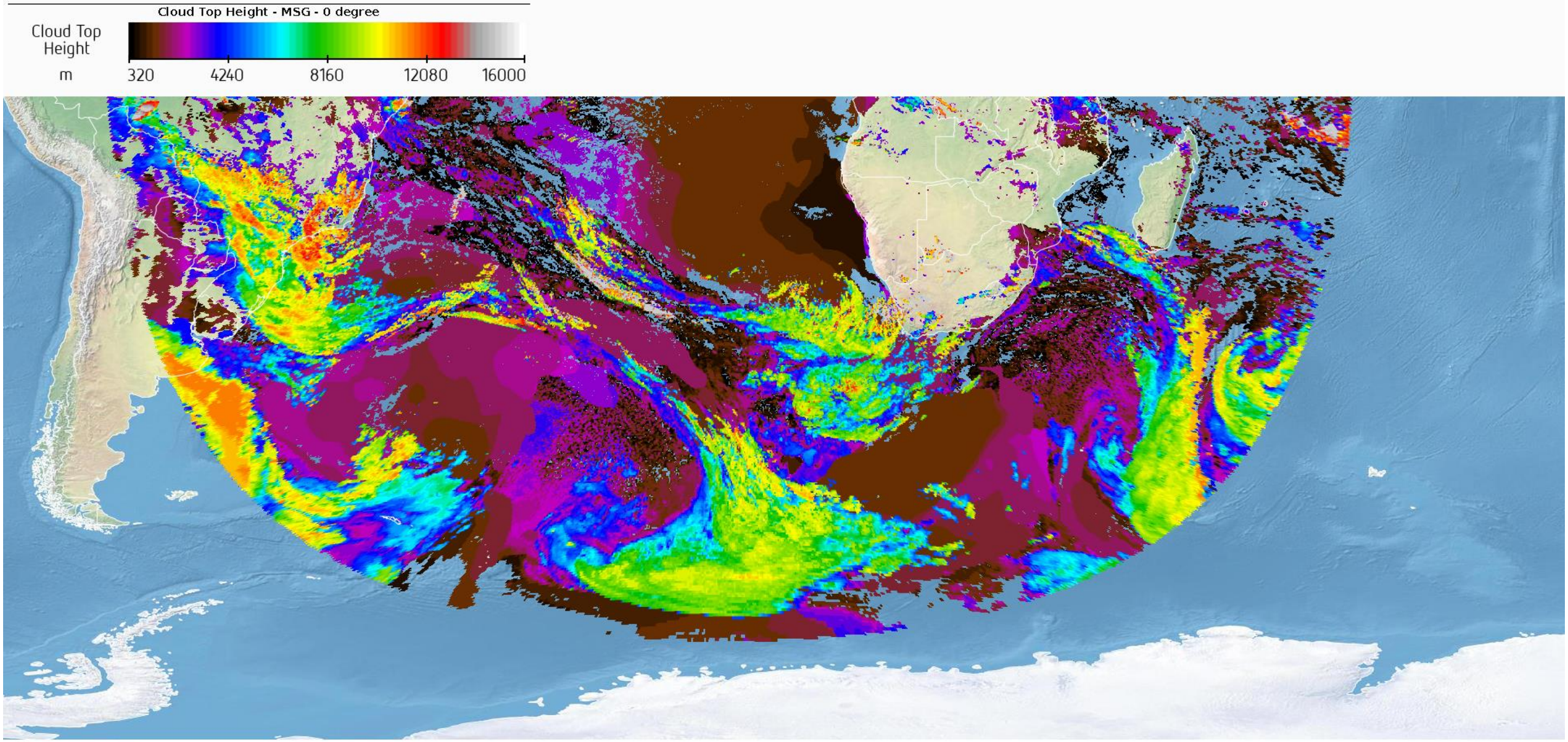
WV 6.2



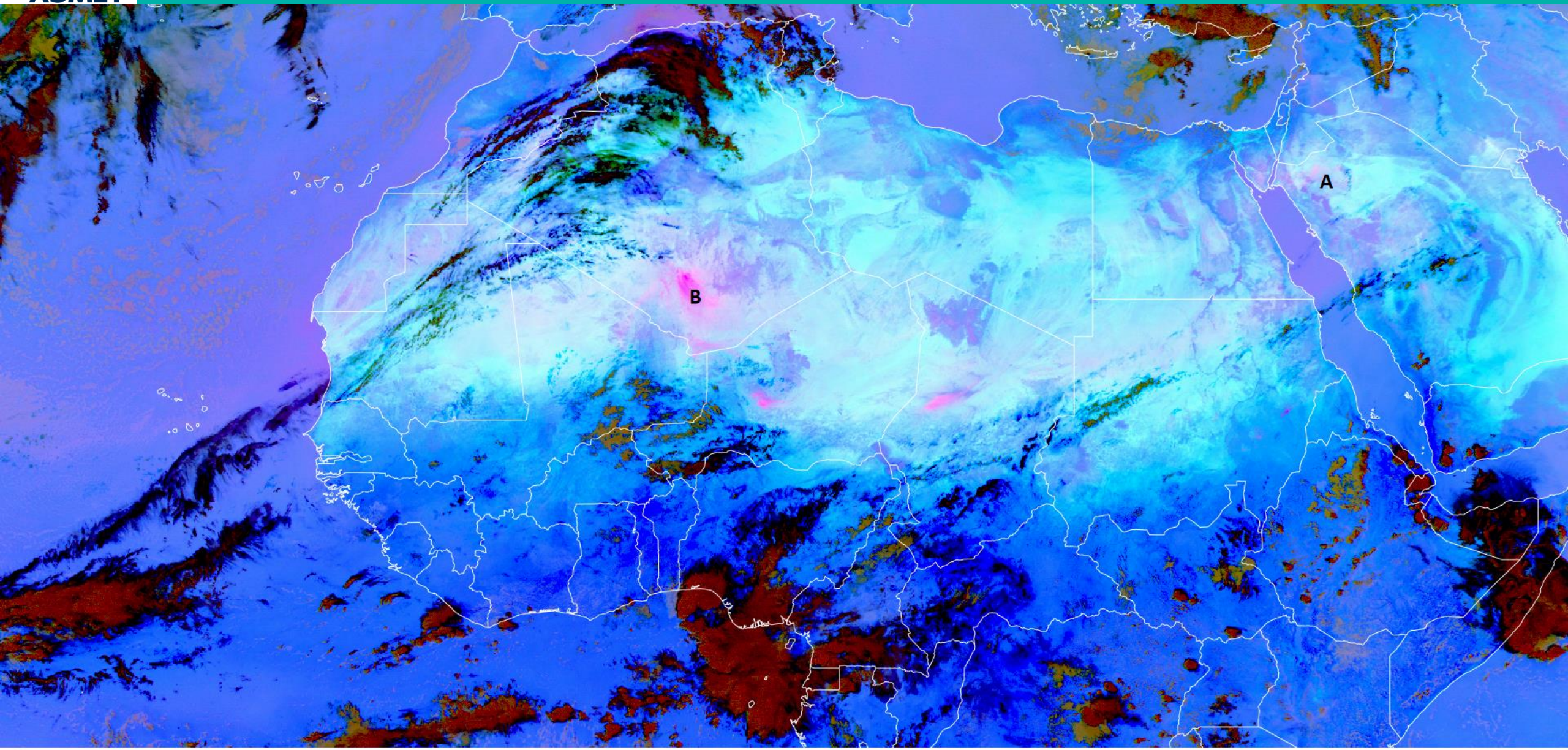
EUMETSAT

2023-04-19 09:15:00 UTC

Visualised Products: Cloud Top Height



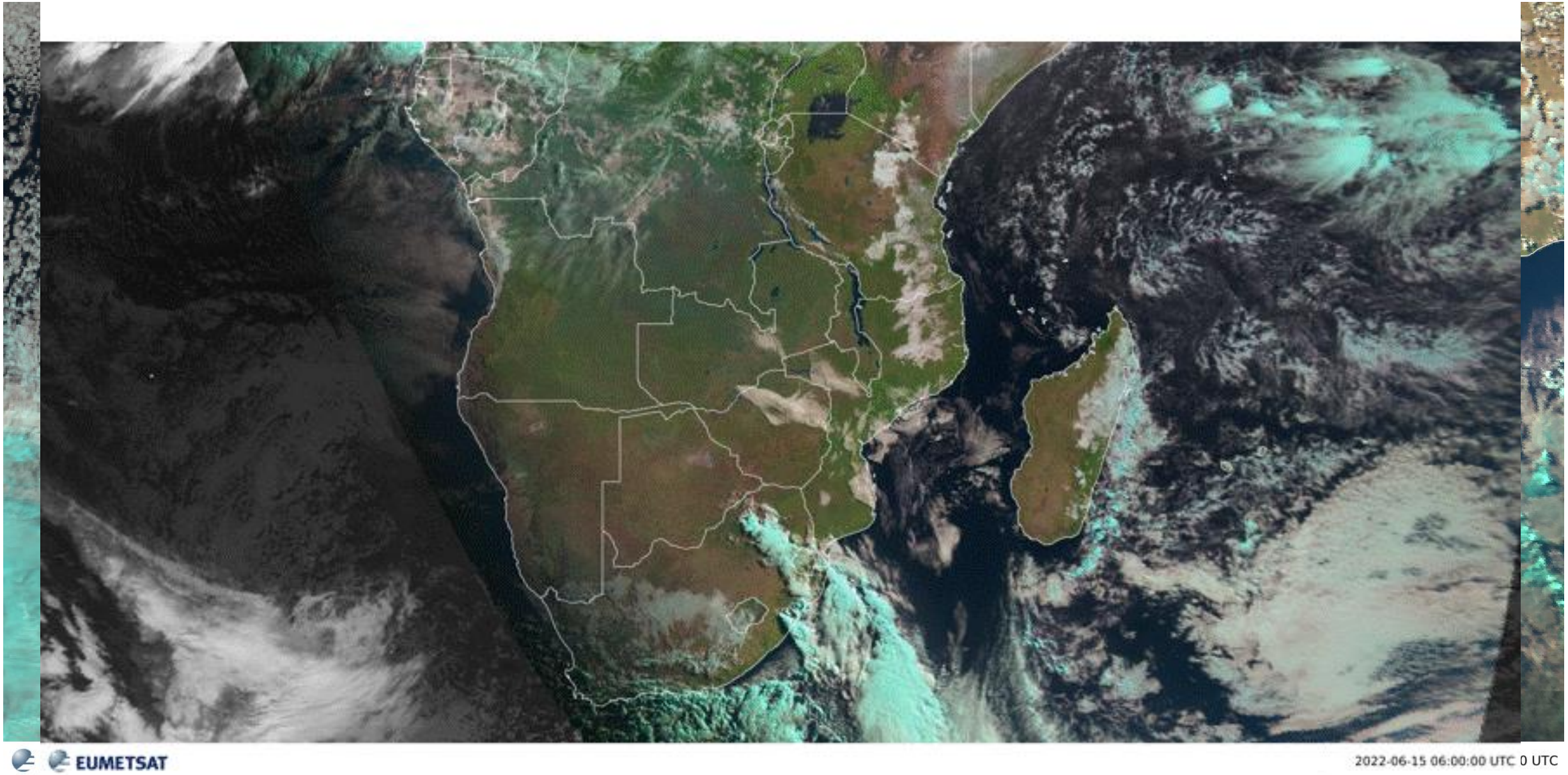
Identifying Dust cloud thickness using Dust RGB



Identifying clouds by cloud top heights: Challenges

- Difficult to differentiate clouds that are overlapping:
  - Example: snow and clouds have similar brightness
  - Best to animate & look out for other features
- Difficult interpreting areas where there are thin upper clouds with clouds underneath:
  - The entire cloud band will average out cloud temperatures to be warmer- the assumption would be that we dealing with clouds at a lower altitude

Identifying clouds by cloud top heights: Challenges



Identifying clouds: Day microphysics RGB

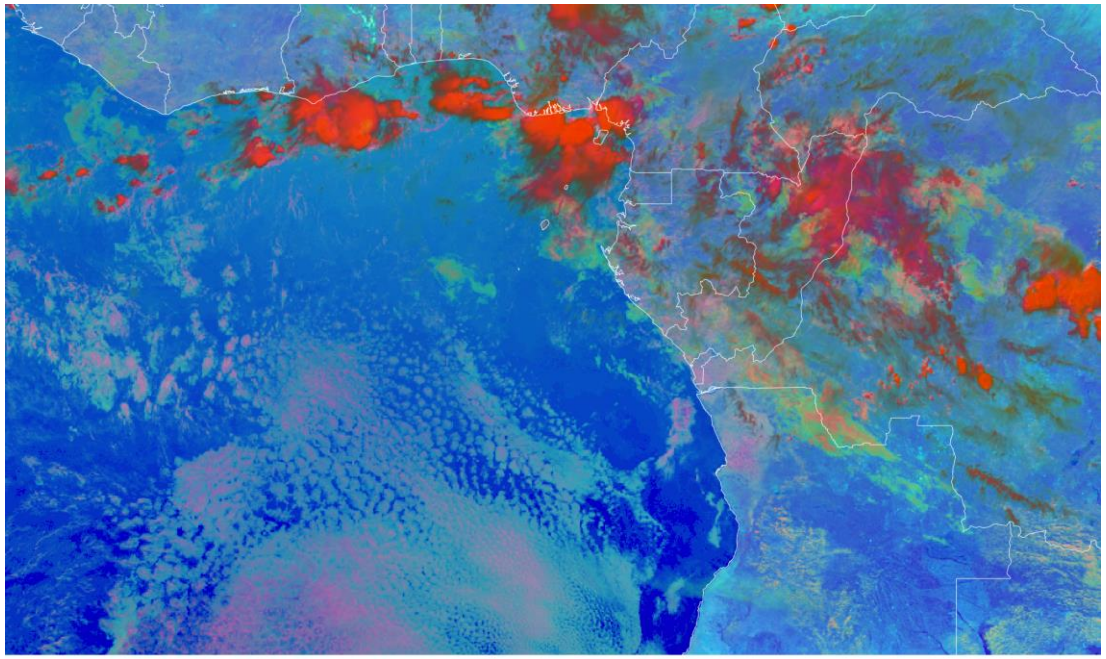
- Useful RGB for cloud identification:

R = Channel 02 (VIS0.8)
G = Channel 04r (IR3.9, solar component)
B = Channel 09 (IR10.8)

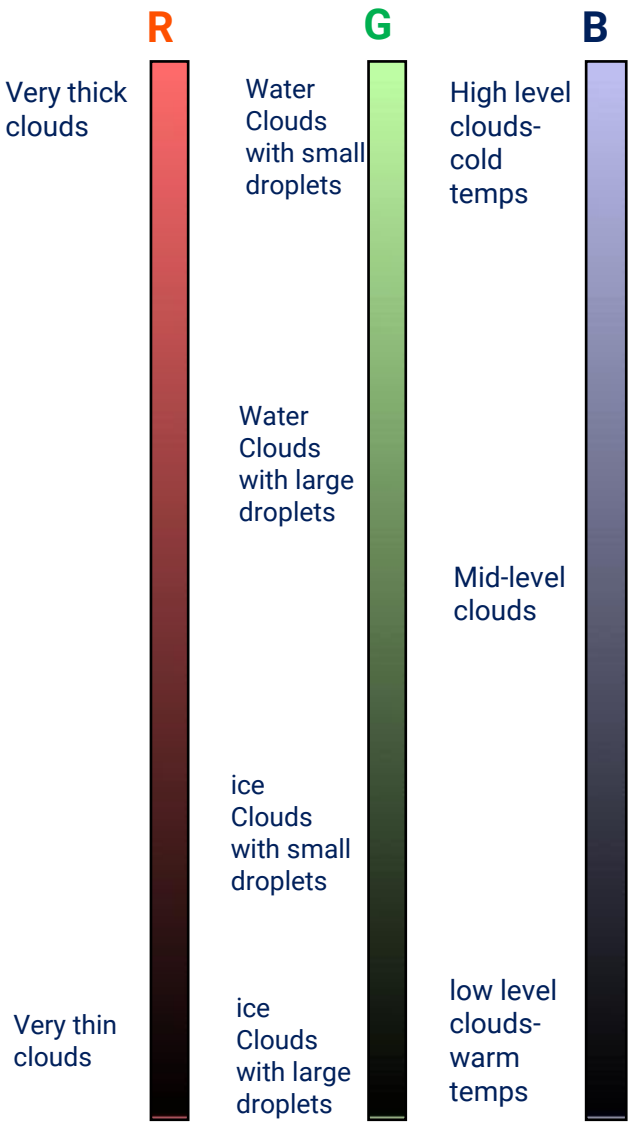
Red: Cloud depth and amount of cloud water and ice, provided by the visible reflectance at 0.8 μm.

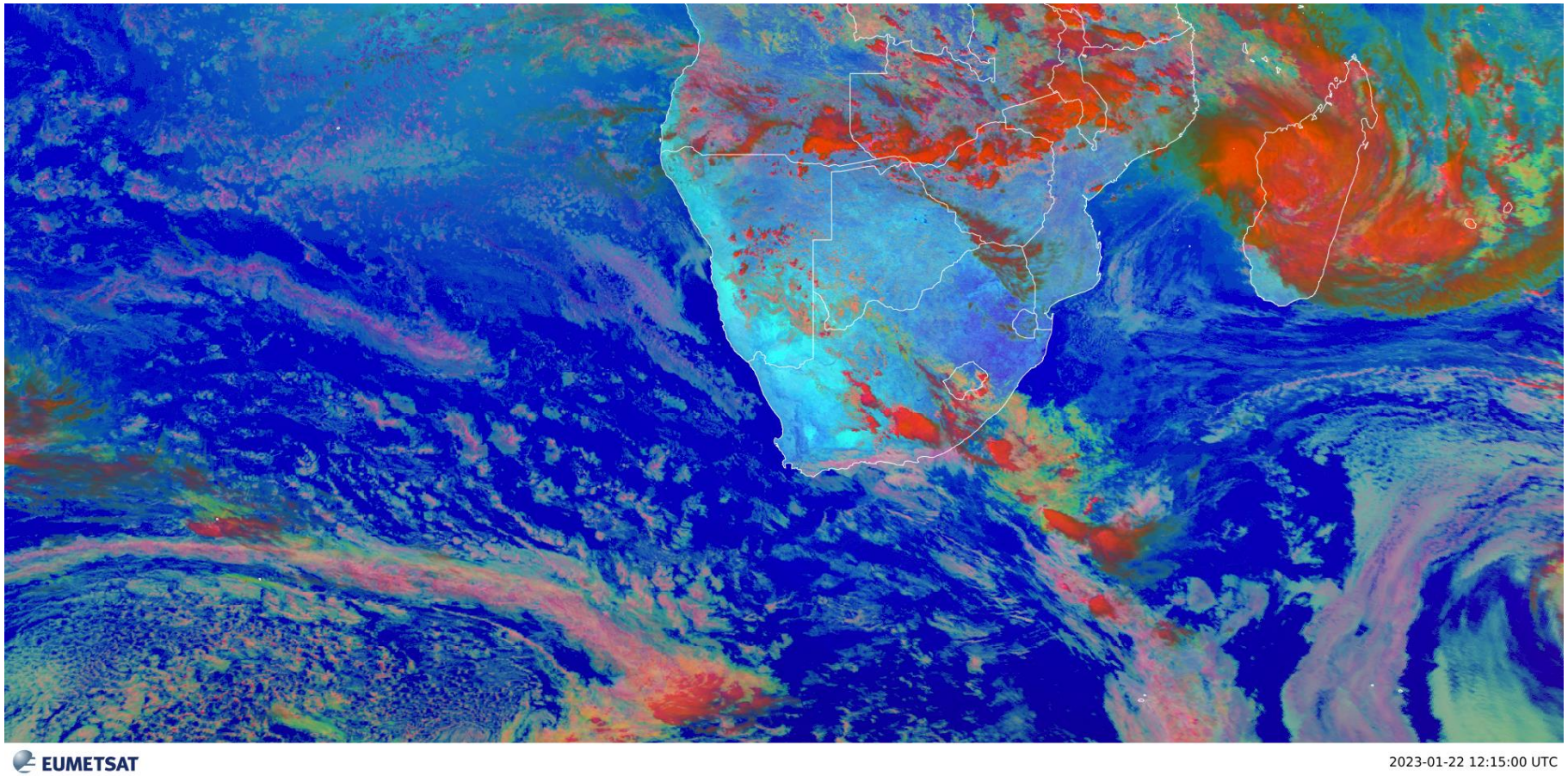
Green: Cloud particle size and phase, approximated by the 3.9 μm solar reflectance component.

Blue: Temperature, provided by the 10.8 μm channel.



Day Microphysics RGB





ASMET

..... NEXT: Identifying convection, fog/low clouds & Dust