

SATELLITE DATA FOR AVIATION

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Continuous Observations from the Geostationary Orbit



Measurement Background

All geostationary satellites carry so-called imaging instruments:

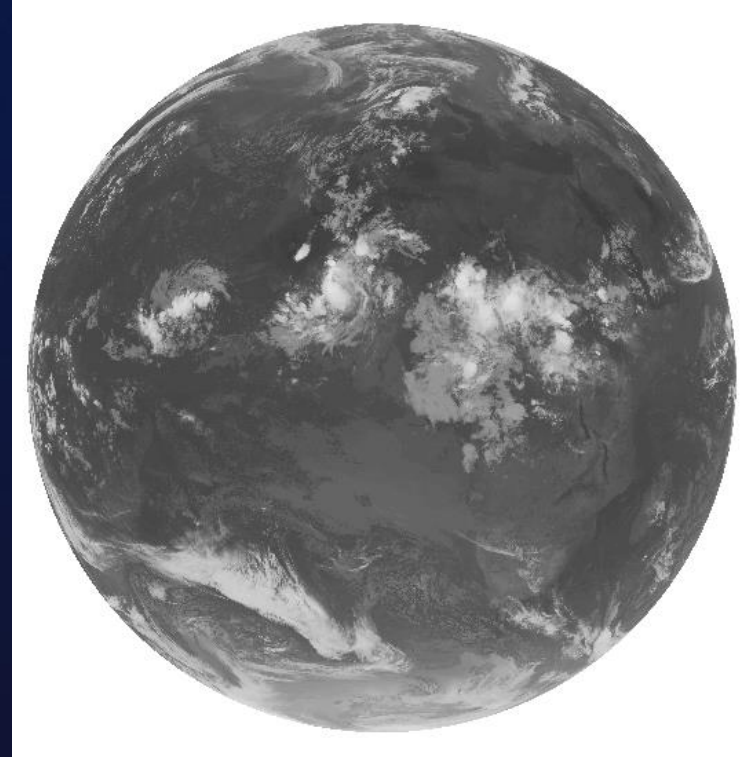
These are radiometers which measure

- the sunlight reflected by the earth-atmosphere system (in one or more selected wavelength regions)
- the thermal radiation emitted by the earth-atmosphere system (in several selected wavelength regions)

Example of a 24 Hour View



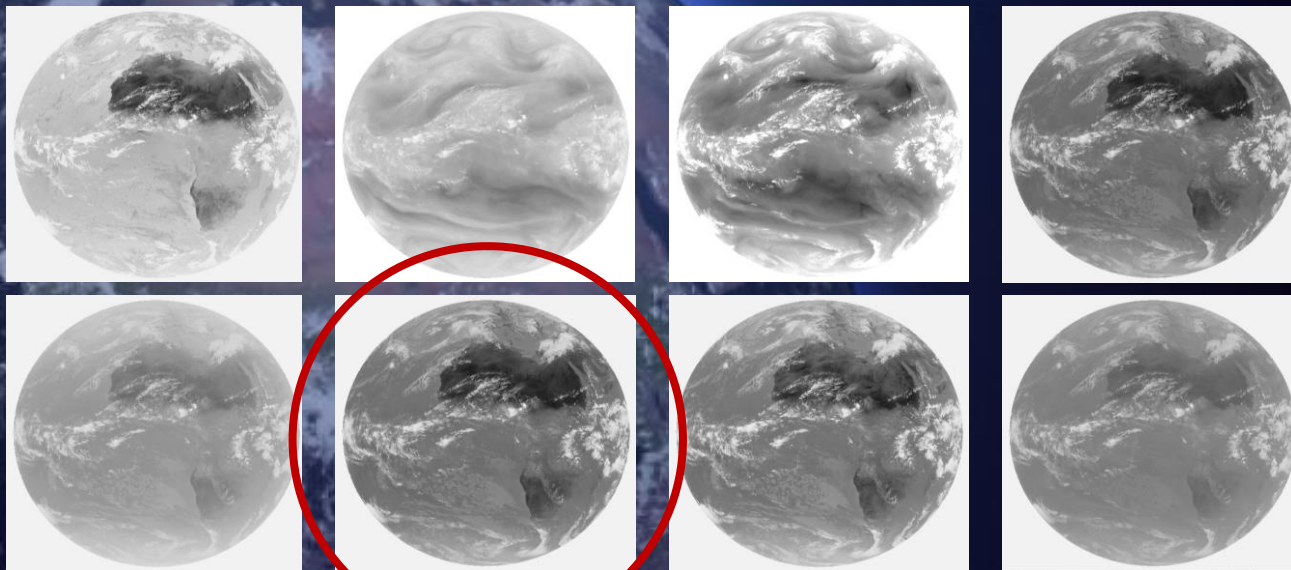
Solar channel at $\sim 0.6 \mu\text{m}$



Infrared channel at $\sim 10.8 \mu\text{m}$

Measurements in the Thermal Infrared

Weather satellites probe the atmosphere in a number of spectral regions (“channels”), as infrared data is modulated by the gases in the atmosphere, i.e. every channel carries information on a certain atmospheric layer, or on the surface and clouds.



Eight infrared
channels of
Meteosat-10

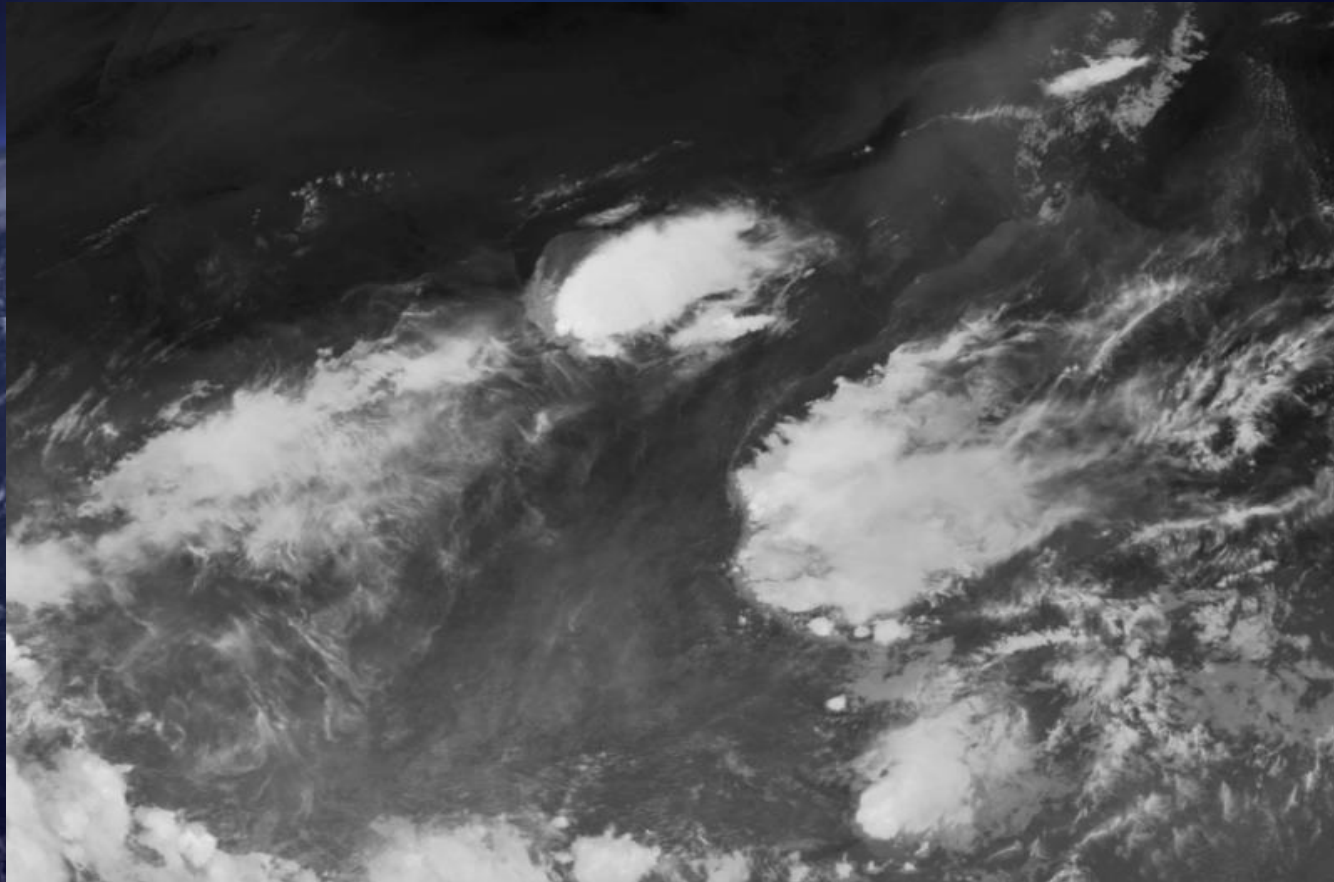
IR Window Channel

Measurements in the IR Window Region

- Measurement is hardly influenced by atmospheric gases
- Measured temperature is very close to actual surface or cloud top temperature
- This is especially true for (high) cloud tops with not much atmosphere above
- Measurement is taken in the maximum of the earth's thermal spectrum, i.e. measurement noise is small
- Instrument calibration here is easy as a lot of reference data exist (e.g. sea surface temperatures)
- IR window channels are available on all imaging instruments onboard meteorological satellites

Visualisations

Classical visualisation as a black-and-white image

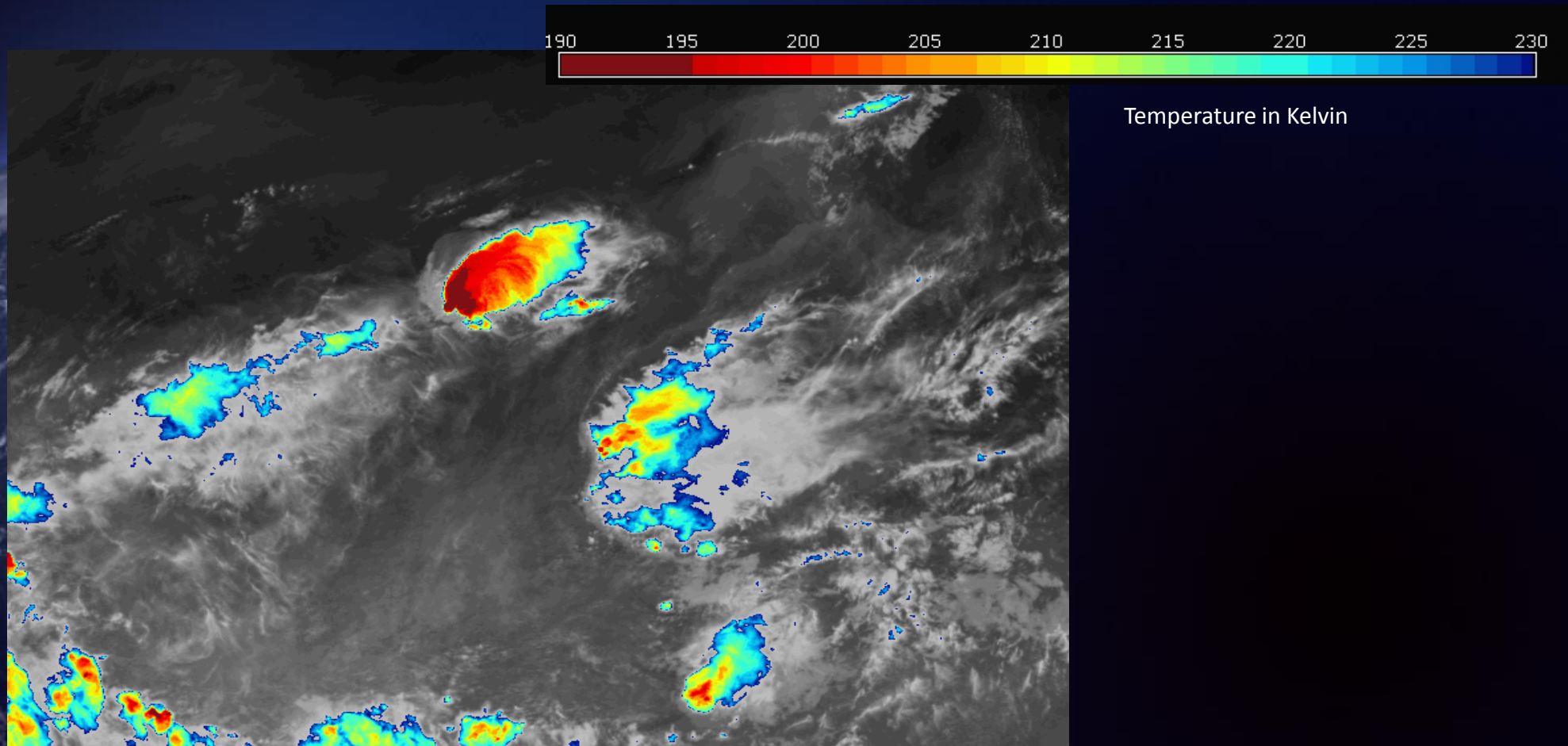


Low radiance
Low temperature

High radiance
High temperature

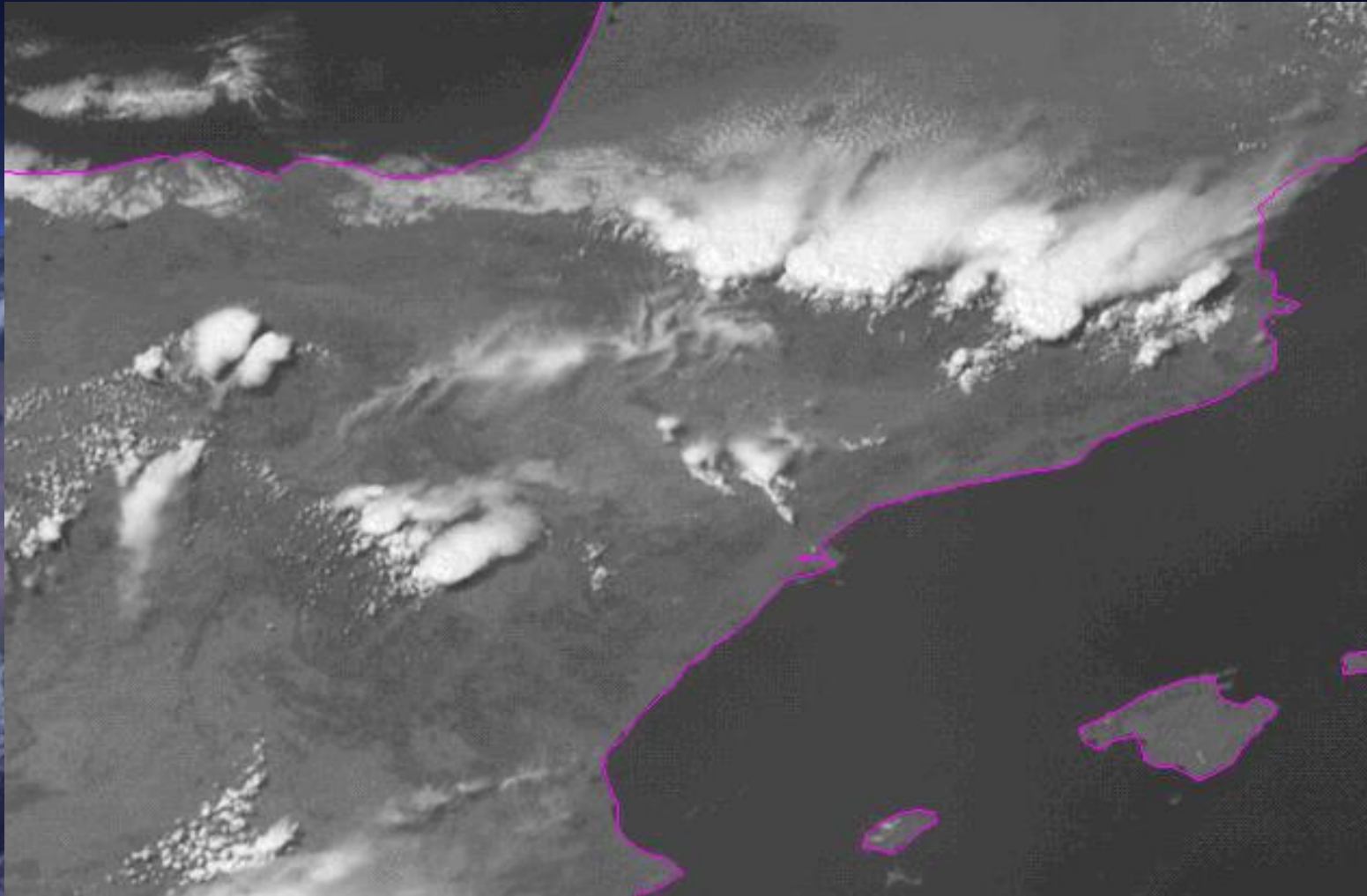
Visualisations

... or colour enhanced to better see cloud top temperatures



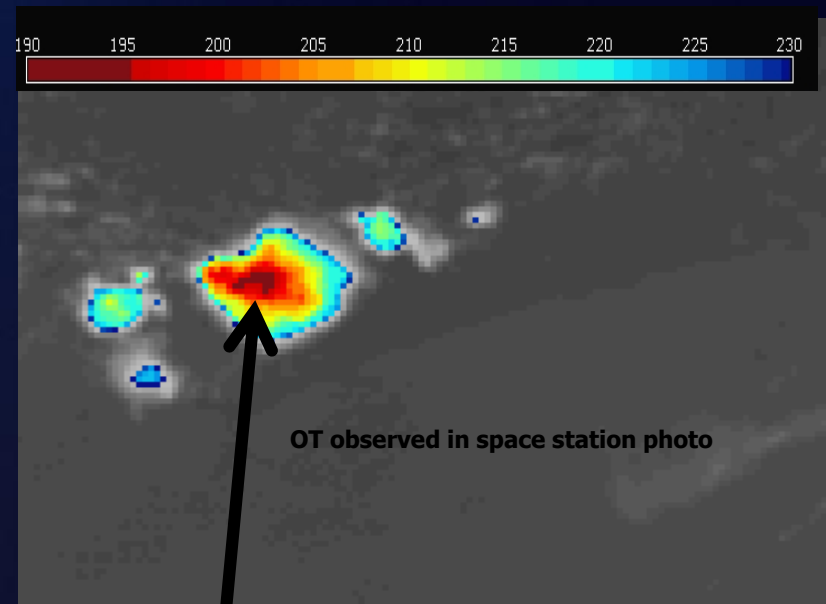
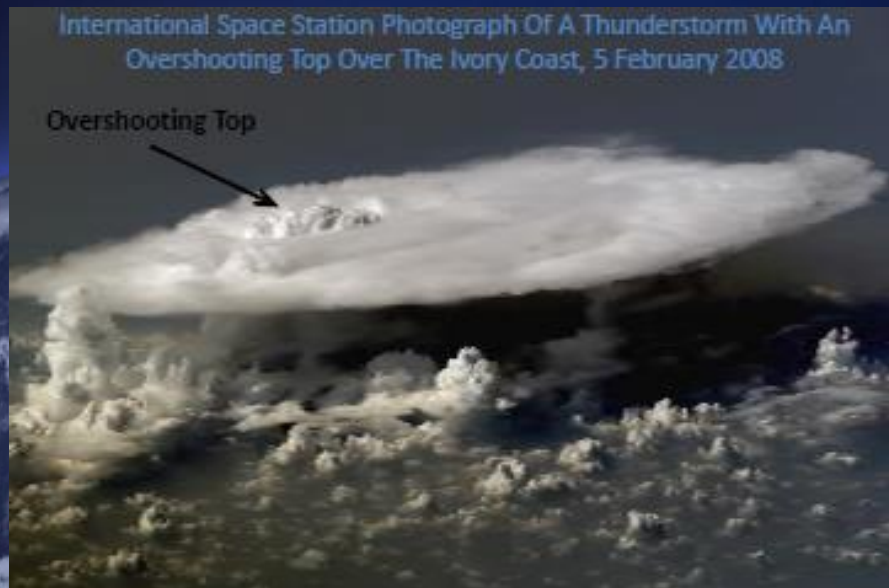
Overshooting Tops

Example of „bubbling“ storms, seen in 1 km visible channel



Overshooting Tops

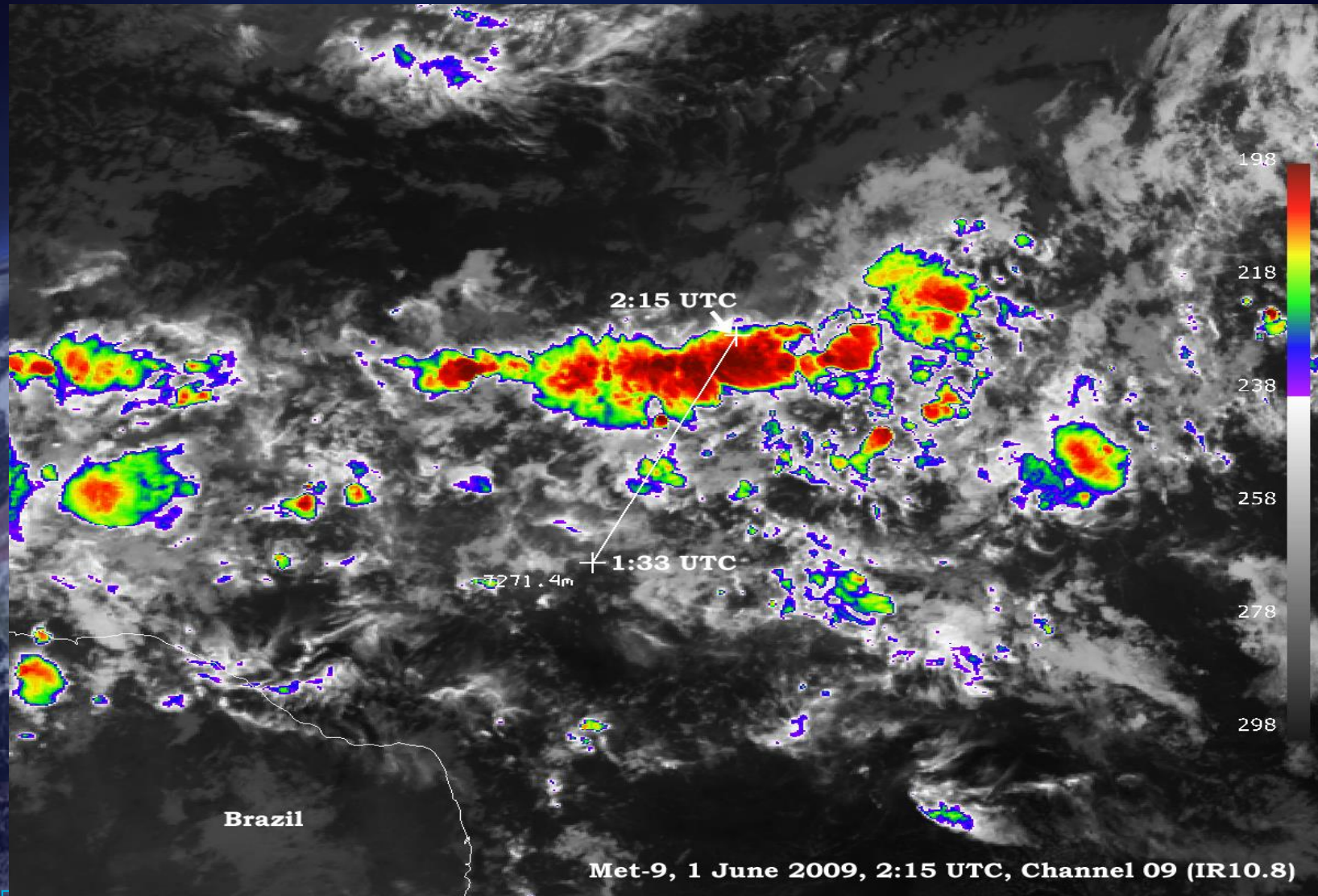
Definition: A domelike protrusion above a cumulonimbus anvil, representing the intrusion of an updraft



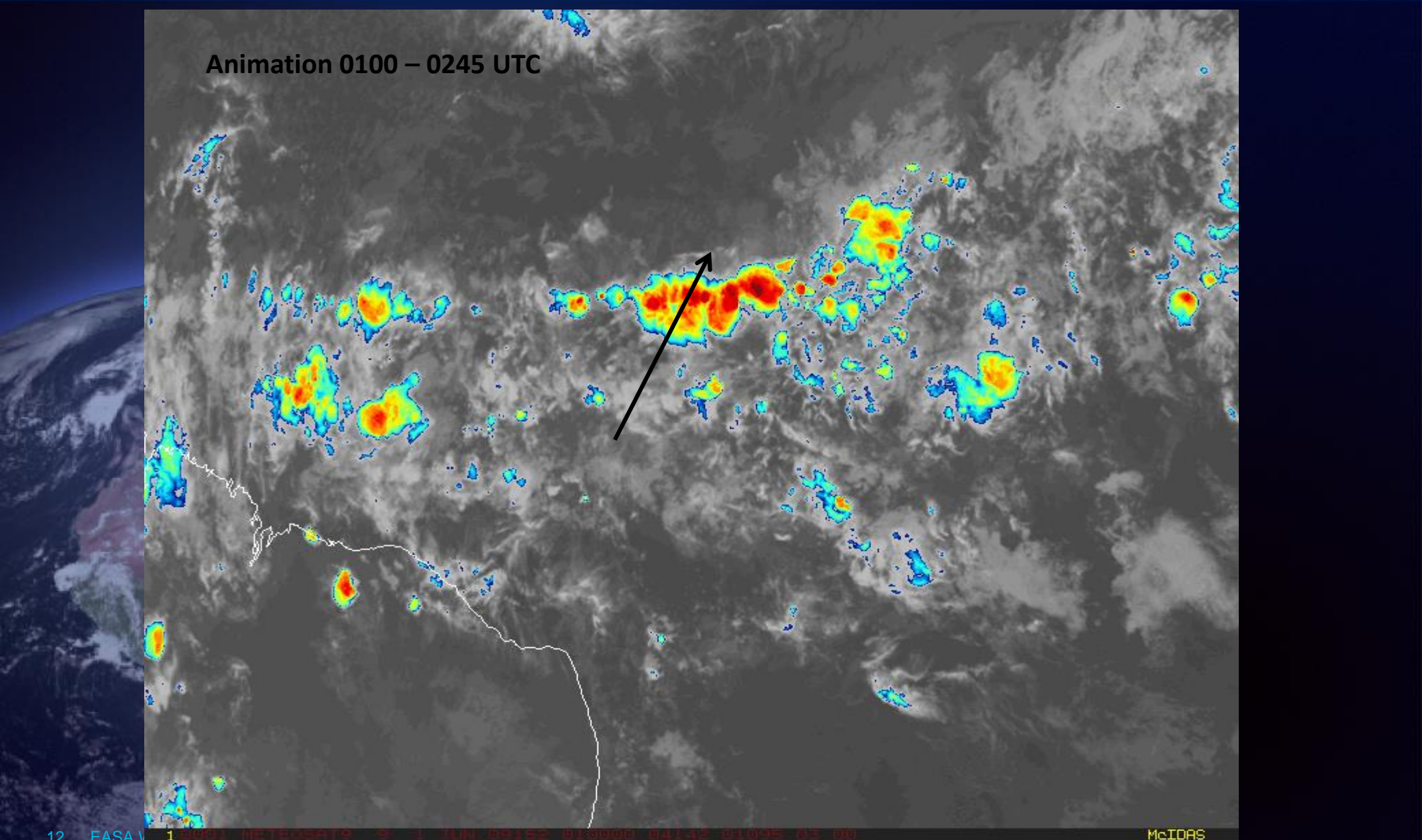
OTs are identified by local temperature minima in IR images

OTs are rather short-lived, so not every OT is captured by the satellite – however, any observed OT characterizes severe convection, and more OTs can be expected

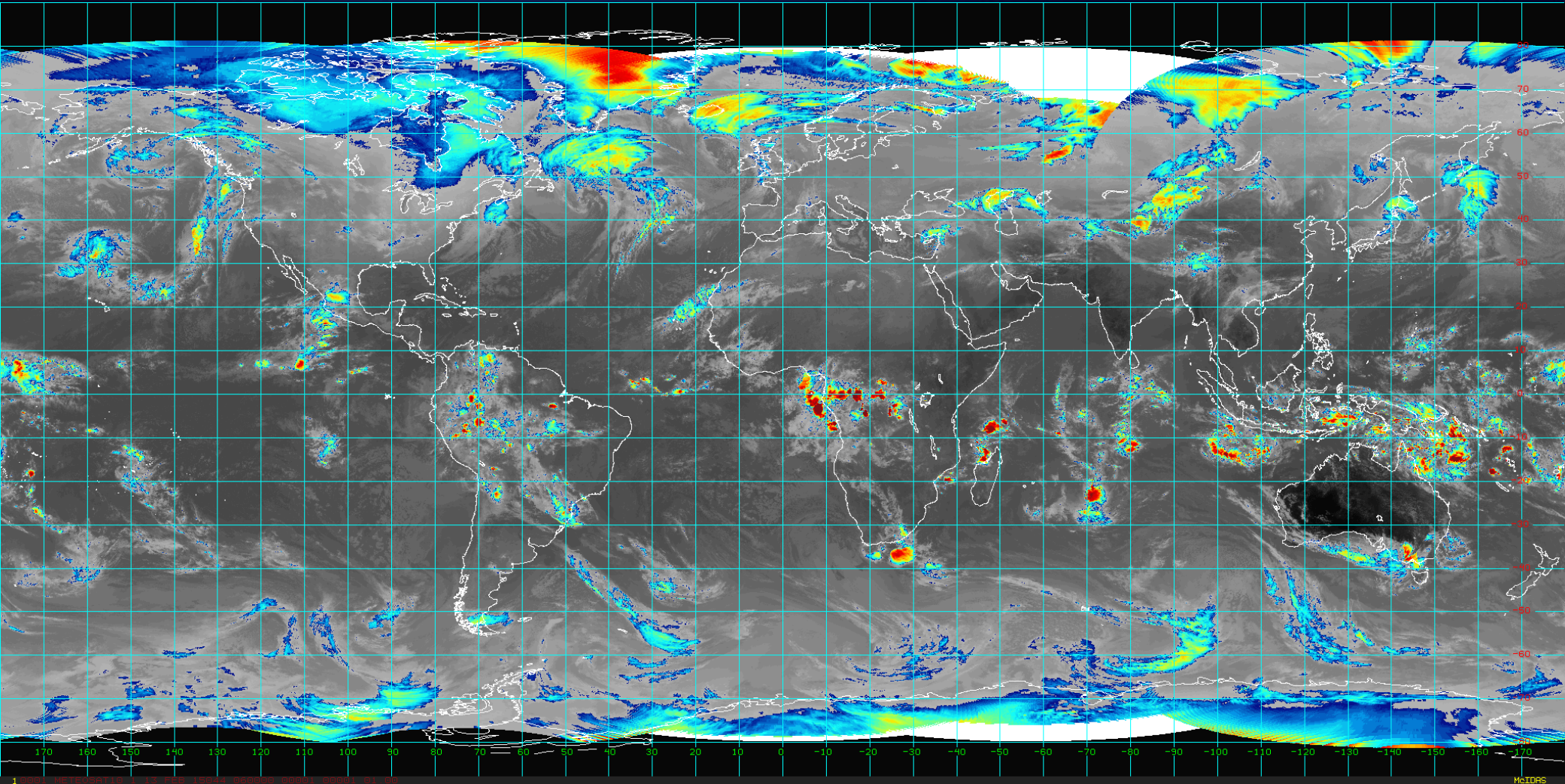
Example: Air France 447, 01 June 2009



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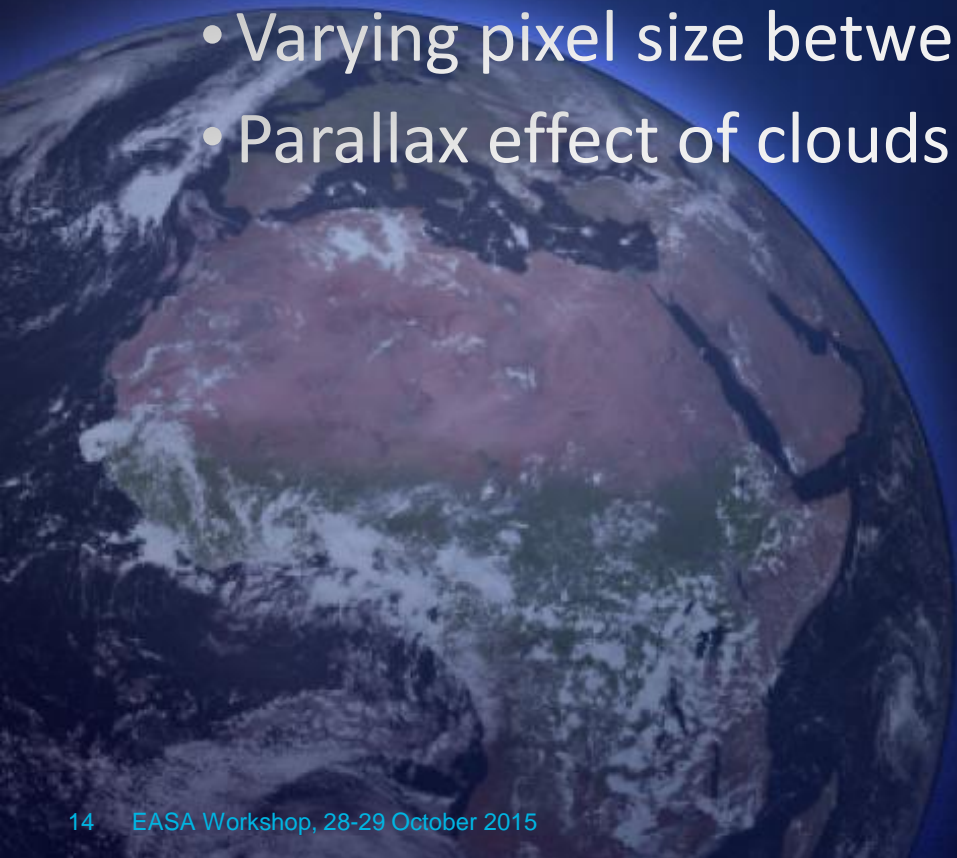
Global View – IR Composite (13 Feb 2015)



Issues

Due to the special viewing geometry, users of geostationary satellite data have to be aware of:

- Varying pixel size between centre and edge of image
- Parallax effect of clouds (can be corrected for!)



Data Availability

- EUMETSAT data are available ~5 minutes after the image section was scanned.
- Data can be received via EUMETCast, which is a DVB satellite based dissemination system.
- The data contain the actual image values (“counts”), the calibration coefficients to transform the counts into radiances.
- The transformation from radiance to temperature and the geo-location of each pixel are constant functions.
- Colour enhancements and e.g. parallax corrections would have to be done on the user side.

Data Size

- Meteosat-10: Full disc image, all 12 channels, as disseminated: ~ 280 Mbyte
- IR window channel, e.g. as an uncompressed jpeg, full disc: ~13 Mbyte
- IR window channel, e.g. European sector: 1.5 MByte

