Visualizing tropospheric humidity using differential water vapor transmittance between the 0.91 and 0.85 µm FCI channels

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Introduction

The Flexible Combined Imager (FCI) instrument on board of the MTG generation has been equipped with a channel in the near-infrared, centered at a wavelength of 0.914 µm.

Any such radiation is quite strongly absorbed by atmospheric water vapour, on its path from the sun to the earth, or after being reflected by the earth to a satellite that can detect it.

The more atmospheric water vapor, the more absorption.

By comparing the 0.914 µm channel with a nearby channel that has very little absorption, we can infer the total amount of water vapour along the path of the light.

Hans-Peter Roesli found out that the ratio of the two channels is a good proxy for water vapour. ESSL pioneered visualizing this using an intuitive colourscale at EUMETSAT-ESSL testbeds.

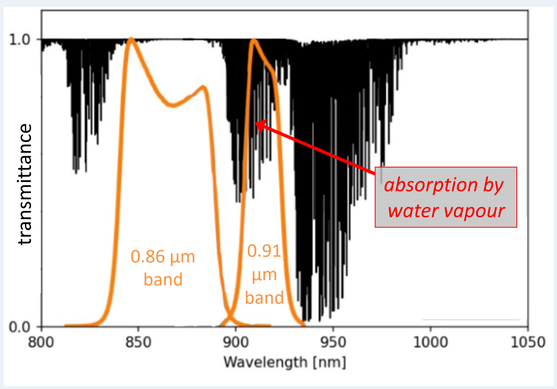


Figure adapted from Jan El Kassar (FU-Berlin)

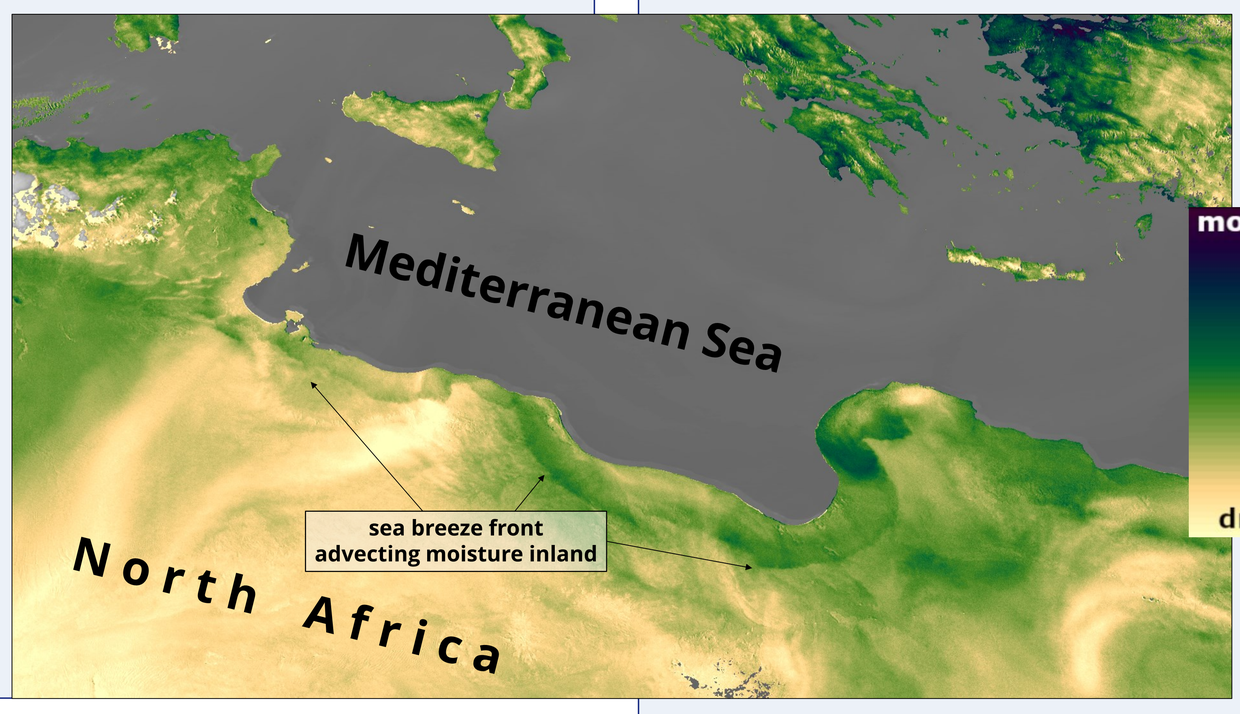
Use for severe storm forecasting

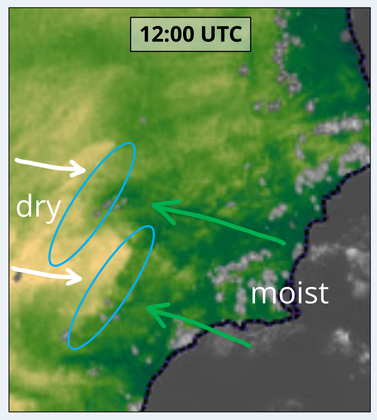
The imagery can be used to indicate the presence of sufficient moisture to ascertain adequate buoyancy for a convective storms.

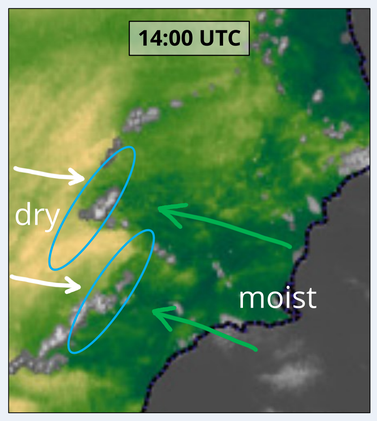
In addition, sharp **air-mass boundaries between humid and dry air are indicative of localized confluence**, and often convergence: regions of mesoscale upward motion, that can lift low-level air to their level of free convection and lead to **storm initiation**.

Evolution of moisture imagery on 7 July 2025 across Southeast Spain.

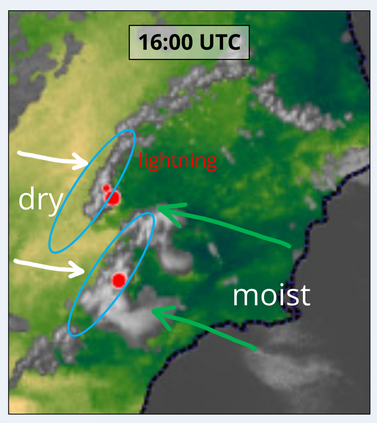
This shows how areas where dry and moist air converge become regions of storm initiation.

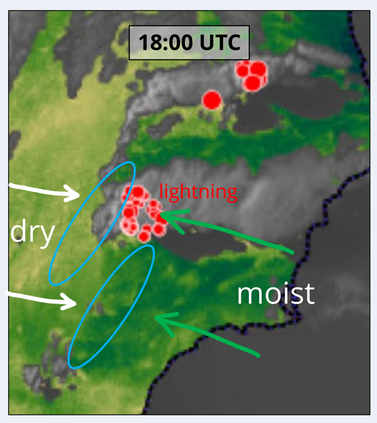






time

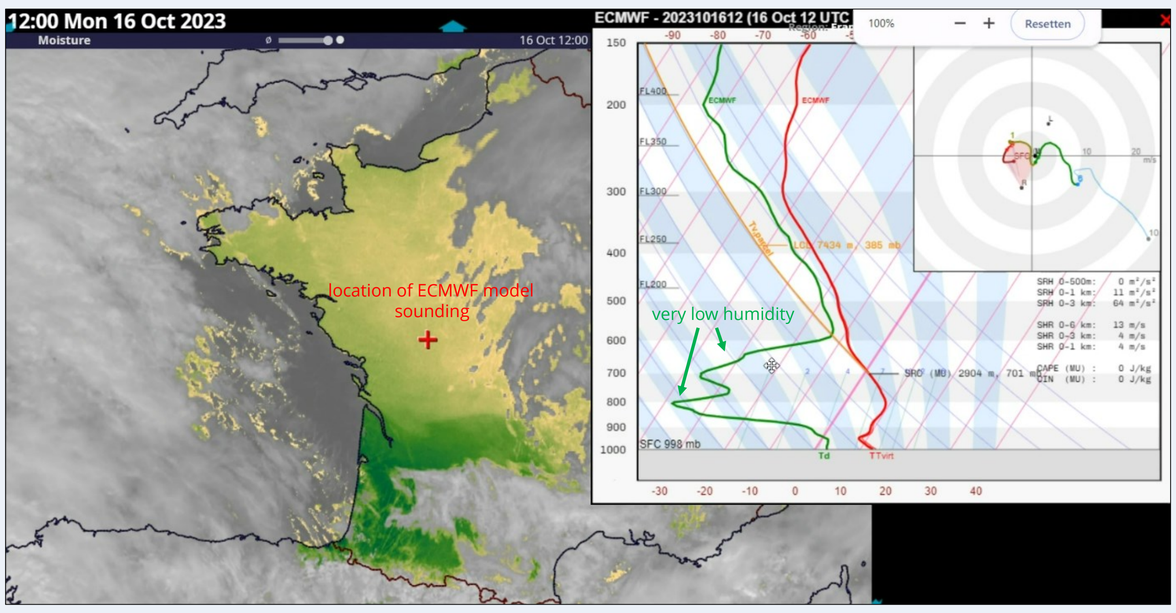


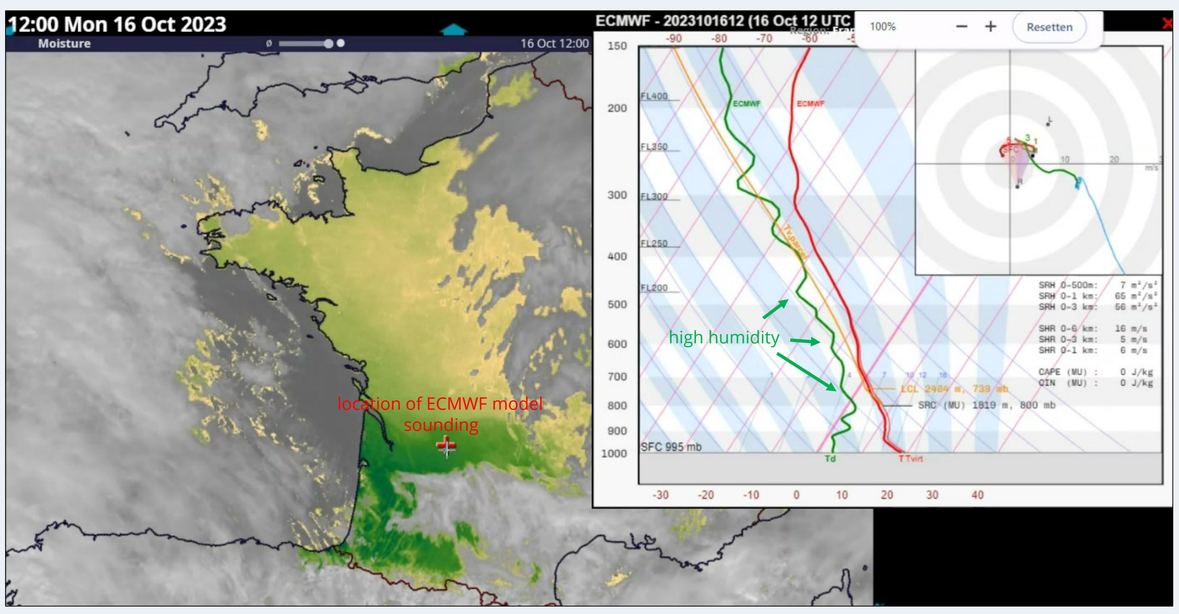


Properties of the moisture imagery:

- Can be used to infer some regions of future convective initiation, as it can indicate:
  - low-level boundaries with confluence
  - advection of mid-level dry or humid air
- Needs calibration to be used in a quantitative sense
- Combination with (future) IRS data has a good chance of delivering accurate observation-based atmospheric profiles of humidity
- Does not deliver accurate information of atmospheric water vapour over water surfaces
- Correction for sun angle and viewing angle is not easy and has until now been done heuristically by ESSL

Total moisture





The ratio imagery shows the total moisture along the path, not just the moisture near the earth's surface. The example above shows how, with similar humidity at the surface, a dry layer above the surface massively influences the resulting ratio.

There is a great potential in combining the ratio imagery with upcoming data from the Infrared Sounder (IRS). The strength of the IRS is in measuring the vertical distribution of moisture, but with limited accuracy near the surface. This is where the ratio product can optimally complement it.

Acknowledgements and code availability

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