Visualization of the MTG-IRS L2 data to enhance usage in nowcasting

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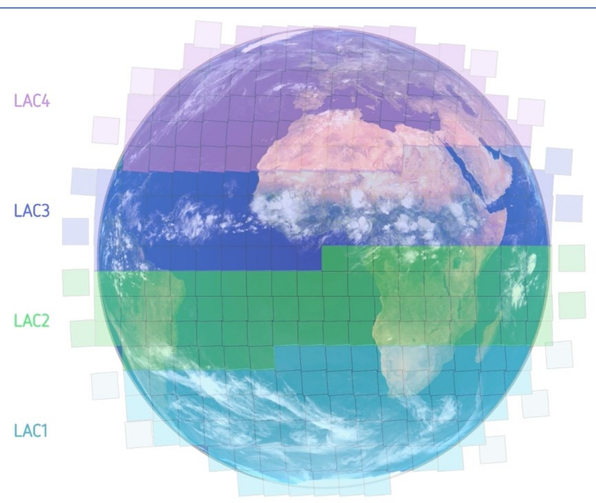
Introduction and motivation

The Infrared Sounder (IRS) onboard the MTG-S1 satellite was successfully launched on 1 July 2025. The IRS represents the first geostationary sounding instrument to perform measurements over Europe with a temporal resolution of 30 minutes. EUMETSAT will provide temperature and water vapour profiles, together with instability indices derived from these measurements, thereby offering complementary information to Numerical Weather Prediction (NWP) model outputs and radiosonde observations for nowcasting applications (https://www.eumetsat.int/hyperspectral-instability-monitoring-using-iasi).
To support user readiness, an IRS Level-2 (L2) test dataset has been released to facilitate familiarization with the data. This dataset was used to test various visualization methods.

IRS measurements:

Scanning in 'stop and stare' mode: IRS images an area - a dwell - of the Earth covered by the field of view, collecting in ~10 seconds 160x160 interferograms.
The Earth disc has been divided into four regions of interest called LACs (Local Area Coverage).
LAC4 covering Europe is scanned every 30 minutes.
No full disk concept.



Geographical distribution of the IRS dwells and LACs. Source: EUMETSAT.

IRS Level 2 data:

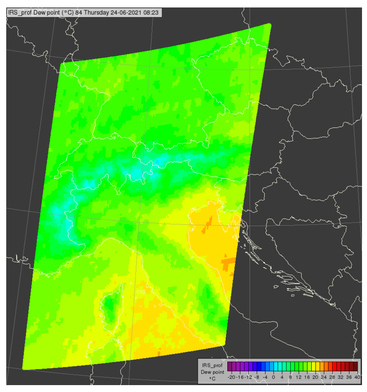
Atmospheric and surface variables are retrieved using the PWLR (Piece-Wise Linear Regression) statistical method. Instability indices calculated from the retrieved profiles are also provided in NetCDF format.
The most relevant variables for nowcasting include:

3D variables:
✓T and humidity profiles (101 levels)
✓T (40 levels) and Td (30 levels) profile error estimates

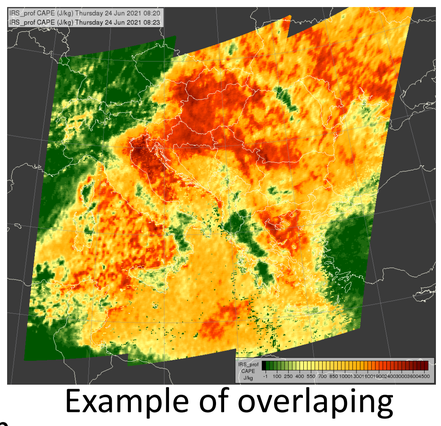
2D variables:
✓ Surface T, Humidity and error estimate
✓ Cloud information (status, height)
✓ Calculated parameters (SBCAPE, MUCAPE, MLCAPE,CIN, LI, KI,…)

Visualization of field variables

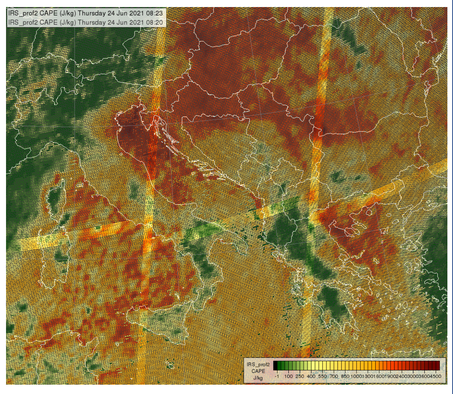
IRS L2 product will be processed and distributed in dwells. Each dwell contains 160x160 pixels which are retrieved from measuremets spanning 10 seconds. LAC4 which coveres Europe consists of 73 dwells.



Example of one dwell, 2m Dew point, 24.06.2021. 08:23:10-20 UTC.

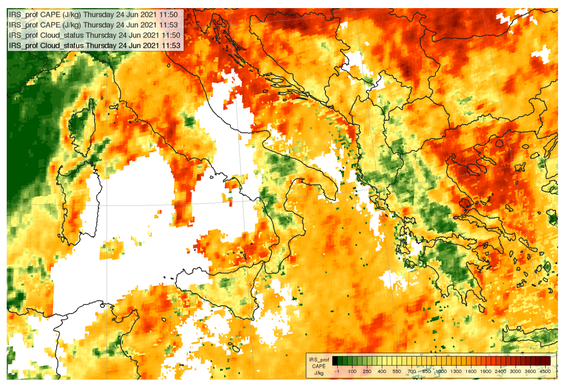


Example of overlaping dwells using 2 km cirles, SBCAPE, 24.06.2021. 08:20-23 UTC.

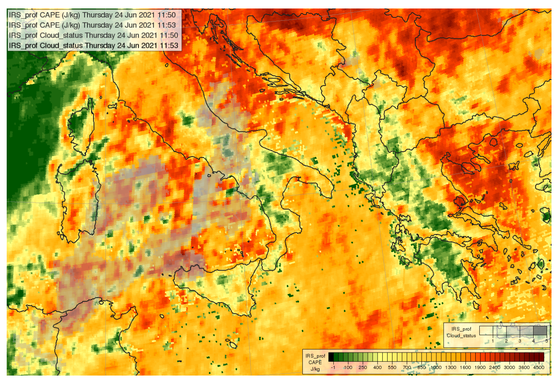


Example of 6 dwells overlaid on top of each other, SBCAPE, 24.06.2021. 08:20-23 UTC.

Adjacent dwells partially overlap along their edges. As a result, boundaries may be visible at the edges of the dwell images. One possible approach to mitigate these boundary effects is to apply averaging of the overlapping pixels.
Profiles over cloudy areas are included in the data files; however, the IR channels provide limited information in cloudy scenes, depending on the cloud's optical thickness and altitude. Using the Cloud Status parameter, cloudy areas can either be completely masked out or shaded according to the degree of cloud contamination, allowing partial information to be displayed for these regions.



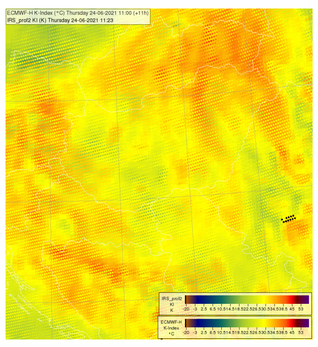
Example of cloudy areas completely masked.



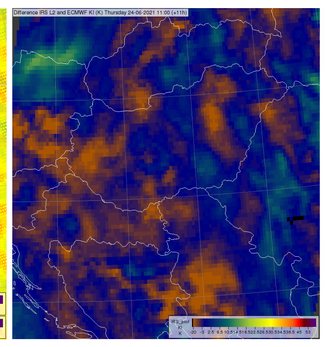
Example of cloudy areas shaded according to cloud contamination.

Visualization of variables with NWP data

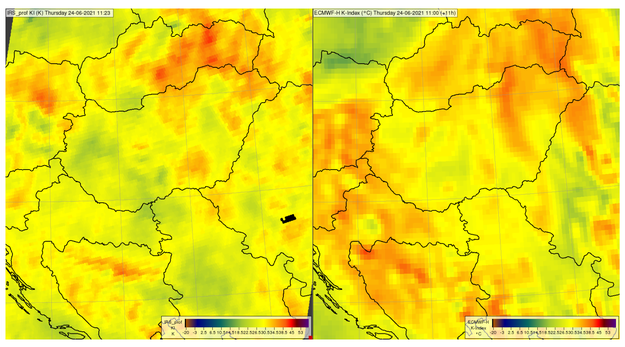
Previous studies using polar-orbiting sounding data have demonstrated that information from sounding instruments can be used to assess forecast reliability. In regions where forecasted and retrieved parameters differ significantly, the numerical model is more likely to exhibit inaccuracies. The ability to evaluate these datasets jointly in a fast and efficient manner will be crucial for operational applications.



IRS K-Index overlaid on top of ECMWF K-Index



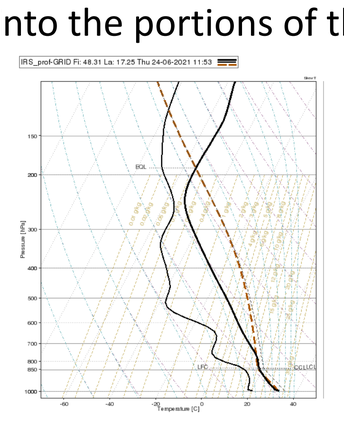
Difference between IRS and ECMWF K-Index



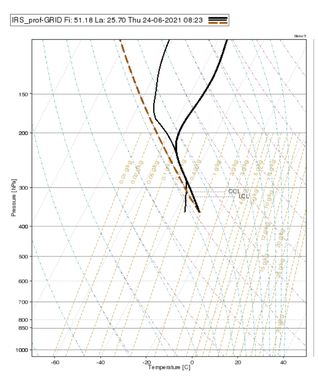
IRS K-Index 24.06.2021. 11:23 UTC (left) ECMWF K-Index valid at 11 UTC (right)

Visualization of 3D variables

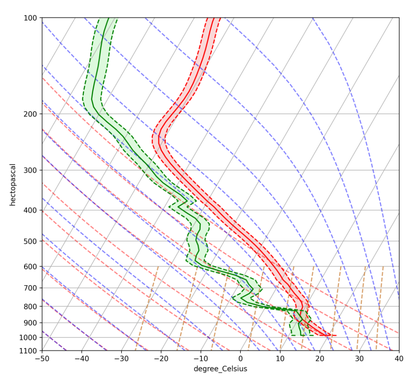
Three-dimensional temperature and humidity information can be visualized as fields at fixed pressure levels, similarly to instability indices, or represented using various forms of thermodynamic diagrams. The cloud information includes cloud-top pressure, which can be used to mask data below cloud layers. Additionally, error information is planned to be provided for several atmospheric layers, offering valuable insight into the portions of the profiles that are less reliable.



Example of a Skew-t diagram



Example of a masked profile below clouds.



Example of including costant error.

Conclusion

Visualization possibilities of future IRS L2 data through test product has been demonstrated. When analyzing temporal patterns over a larger domain, the merging of adjacent dwells is required, making the mitigation of border effects particularly important. Several possible approaches for visualizing IRS data in combination with NWP outputs have been presented. Incorporating cloud information and error estimates into the visualization provides a clearer understanding of the regions where the data are more reliable. Once real data become available, it will be important to carefully assess whether the data remain suitable for the intended application.

Feel free to fill out our questionnaire regarding visualization of IRS L2 test data:

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