ECSS2025
12th European Conference on Severe Storms
Utrecht, Netherlands – 17 to 21 November 2025

Integrated use of MTG satellite and radar data for nowcasting storms:
A case study from Istanbul Airport

Melek ERDAL[1] and Gizem HODOĞLU[2]

[1,2]Turkish State Meteorological Service, Istanbul Airport Meteorology Office, 34283, Arnavutkoy, İstanbul, TÜRKİYE.

[3]İstanbul Technical University, Eurasia Institute of Earth Sciences, 34467, Maslak, İstanbul, TÜRKİYE.

ABSTRACT

Accurate nowcasting of convective storms is vital for safe and efficient airport operations.
This study analyzes the 20–21 September 2024 Istanbul Airport storm using EUMETSAT MTG satellite data combined with ground-based radar observations.
Infrared and RGB air-mass imagery revealed upper-level dynamics and cloud-top cooling, while radar reflectivity captured the storm's vertical evolution.
The integration of satellite, radar, and model data through the ESSL Weather Data Displayer improved the interpretation of convective structure and timing.
Findings highlight the benefits of multi-platform data for real-time aviation forecasting.

INTRODUCTION

Convective storms affected **Istanbul Airport (LTFM; 41.27° N, 28.75° E)** between **20–21 September 2024**. The event is analyzed using EUMETSAT MTG satellite, ESSL Weather Data Displayer, ICON-EU model, and TSMS radar observations.
Thunderstorm activity began around 16:00 UTC on 20 September and persisted intermittently until 10:00 UTC on 21 September 2024, producing frequent lightning, strong gusts, and moderate to heavy rainfall. The integration of satellite, radar, and model data through the ESSL Weather Data Displayer improved the interpretation of convective structure and timing.

DATA AND METHODOLOGY

Weather radar data from the Turkish State Meteorological Service (TSMS) were used to monitor the convective system over Istanbul Airport on 20–21 September 2024.
MAX reflectivity at 21:00, 22:30, and 04:00 UTC shows the eastward progression of intense convective cells across the Marmara region and the airport vicinity.

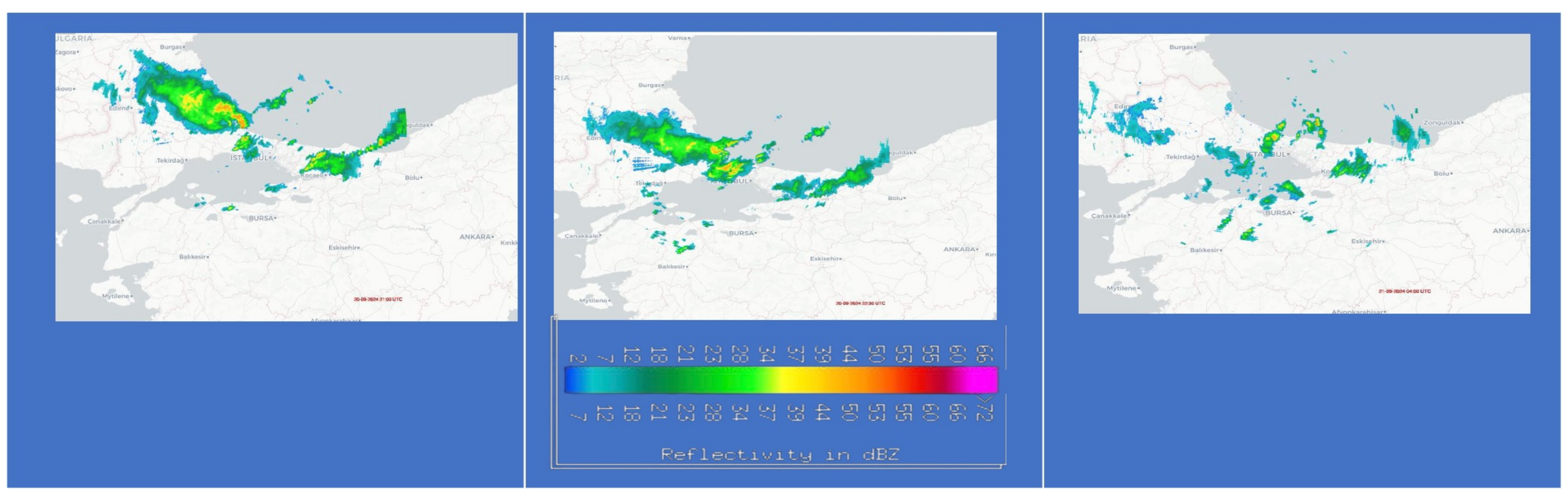

Figure 1. *Istanbul radar maximum reflectivity (MAX) composites at* ***21:00 UTC and 22:30 UTC (20 Sep)*** *and* ***04:00 UTC (21 Sep 2024)***.

While severe convective storms in the United States typically develop under high CAPE (>2000 J/kg) and moderate shear, European storms, as shown by Púčik et al. (2015), often form in environments with much lower CAPE (500–800 J/kg) but stronger shear (>15 m/s). Kahraman et al. (2017) found that Turkey lies between these regimes, featuring slightly higher CAPE and weaker low-level shear. The Istanbul Airport case examined here reflects this transitional character, combining moderate CAPE and strong shear typical of the European severe storm pattern.

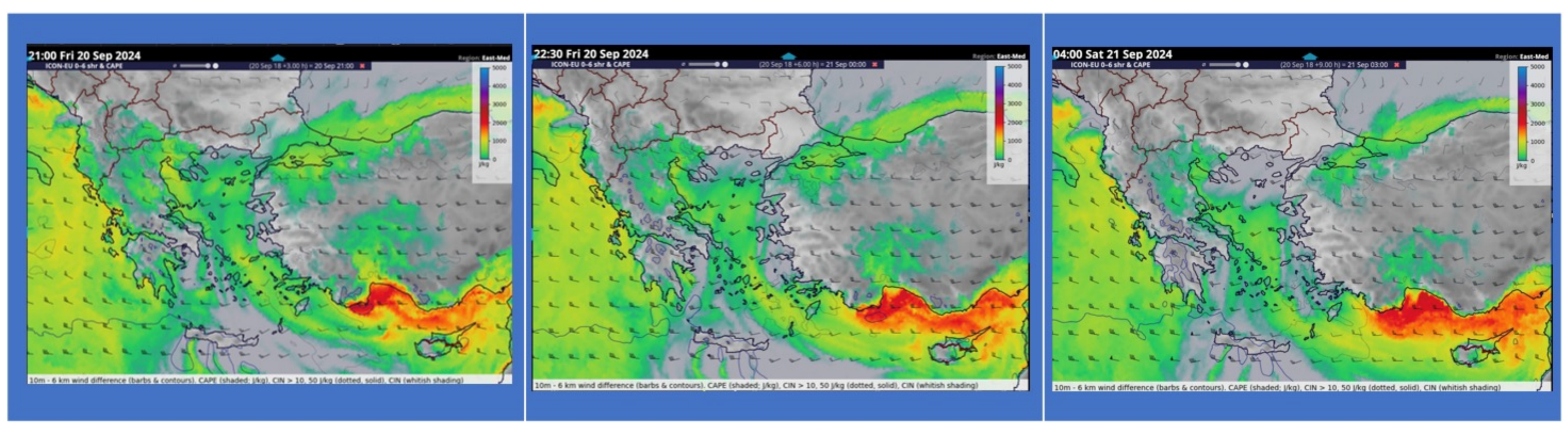

Figure 2. *Evolution of CAPE (shaded, J kg^{-1}) and 10 m–6 km wind shear (barbs and contours) from ICON-EU forecasts over the Marmara region at* ***21:00 UTC and 22:30 UTC (20 Sep)*** *and* ***04:00 UTC (21 Sep 2024)***.

Table 1. Evolution of CAPE–shear and convective environment over Istanbul Airport (20–21 Sep 2024).

Time (UTC)	CAPE Range (J/kg)	0–6 km Shear (m/s)	Convective Environment
20 Sep 2024 – 21:00	≈ 800 – 1200	10 – 14	Elevated instability south of the Marmara Sea, sufficient shear for organized convection approaching Istanbul.
20 Sep 2024 – 22:30	≈ 600 – 1000	12 – 16	Peak convective activity over northern Thrace; favorable CAPE-shear overlap supports severe TSRA near LTFM.
21 Sep 2024 – 04:00	≈ 300 – 700	8 – 12	Decreasing instability and weakening shear; convective cells become scattered and short-lived.

Table 2. METAR and SPECI observations reported at Istanbul Airport on 20-21 September 2024.

LTFM 202050Z 06014KT 9999 -TSRA FEW018CB BKN022 23/15 Q1017 RESHRA BECMG TL2130 NSW RMK RWY17L 06015KT RWY34L 05011KT RWY16R 05013KT RWY36 06014G24KT RWY18 06015KT =
LTFM 202220Z 10007KT 020V130 4000 +TSRA SCT017CB BKN022 18/17 Q1017 NOSIG RMK RWY17L 04014KT RWY34L 07009KT 030V090 RWY16R 02013KT RWY36 05010G21KT 340V080 RWY18 04012G22KT =
LTFM 210050Z 30012KT 270V330 9999 -SHRA VCTS FEW017CB BKN022 18/16 Q1017 RETSRA NOSIG RMK RWY17L 30008KT 250V010 RWY34L 30011KT RWY16R 29005KT 210V360 RWY36 VRB06KT RWY18 VRB06KT =
LTFM 210356Z VRB02KT 8000 2800E +TSRA SCT017CB BKN022 18/16 Q1017 BECMG TL0440 NSW RMK RWY17L 29008KT 260V350 RWY34L 31005KT 260V350 RWY16R VRB02KT RWY36 VRB05KT RWY18 VRB05KT =

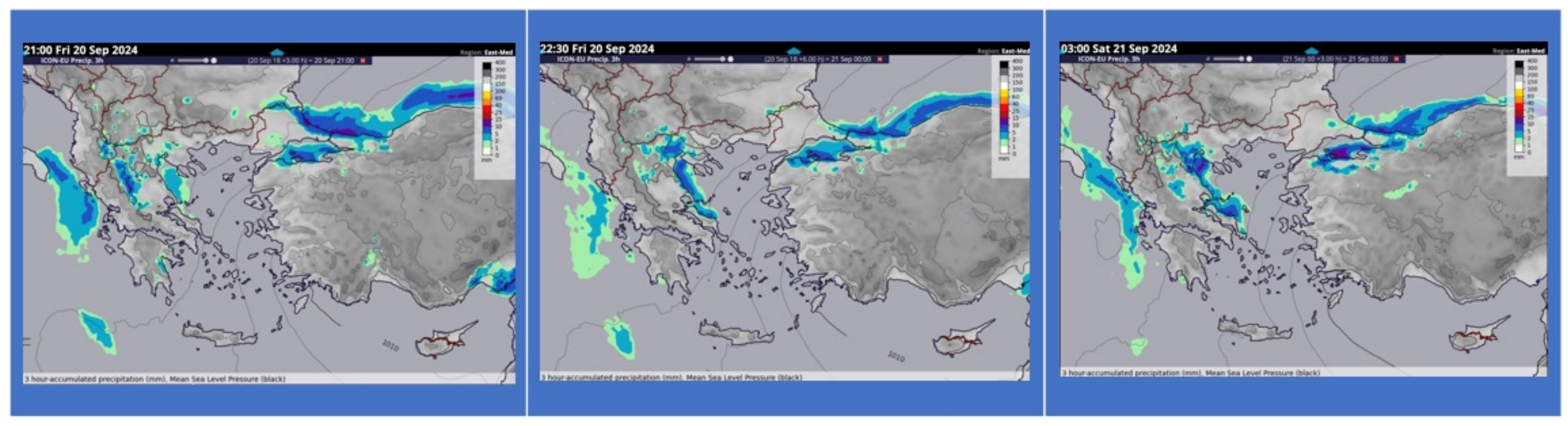

Figure 3. *Evolution of 3-hour accumulated precipitation (mm) and mean sea level pressure (hPa; black contours) from ICON-EU forecasts at 21:00 UTC and 22:30 UTC (20 Sep) and 03:00 UTC (21 Sep 2024).*

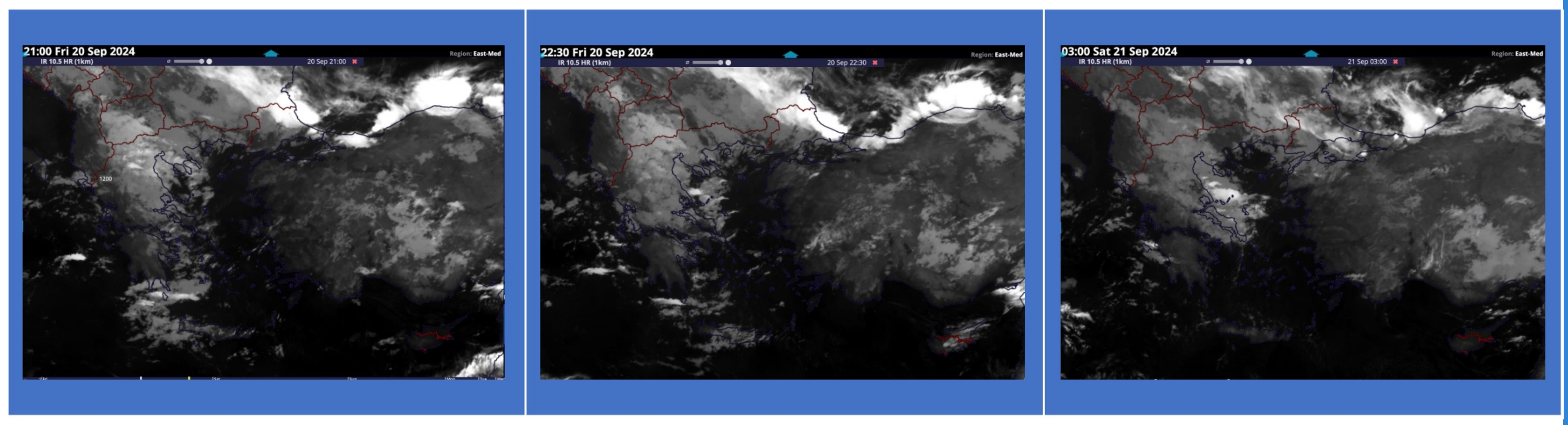

Figure 4. *Infrared 10.5 HR satellite imagery at 21:00 UTC and 22:30 UTC (20 Sep) and 03:00 UTC (21 Sep 2024) showing the progression of convective cloud tops over the Istanbul Airport (LTFM) region.*

MTG FCI IR 10.5 µm imagery showing progressive cloud-top cooling and expansion of the convective system near Istanbul Airport between 21:00 and 22:30 UTC.
By 03:00 UTC on 21 September 2024, the cloud tops gradually warmed to around −55 °C as the system weakened and shifted eastward, marking the decay phase of the storm.
The coldest cloud tops reached approximately −65 °C at 22:30 UTC, consistent with radar reflectivity > 55 dBZ near LTFM.

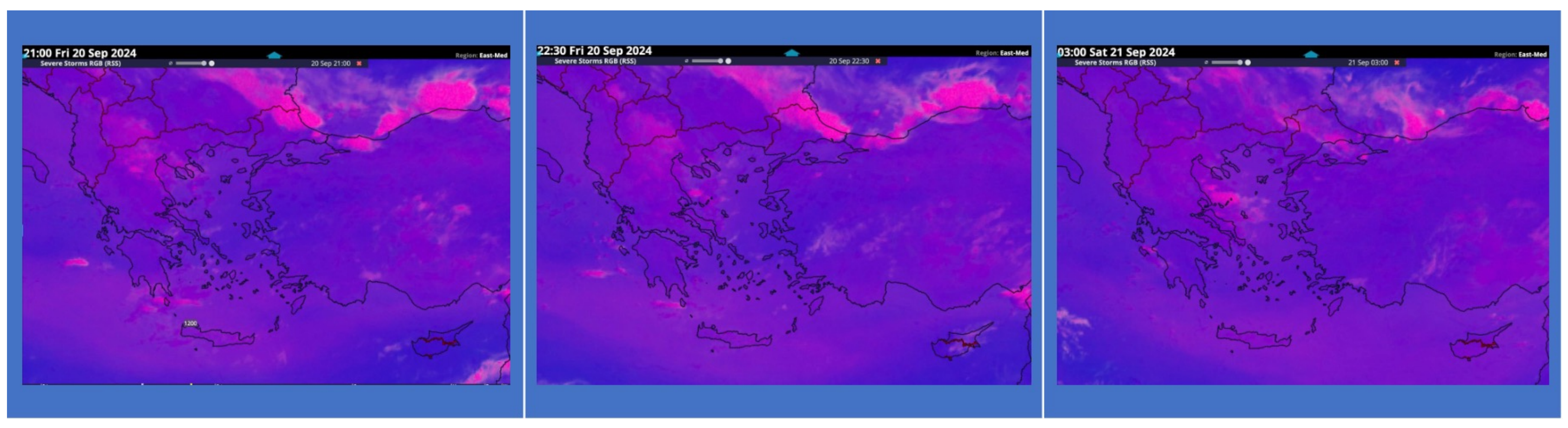

Figure 5. *Detection of Deep Convective Clouds using Severe Storms RGB (RSS) at 21:00 UTC and 22:30 UTC (20 Sep) and 03:00 UTC (21 Sep 2024).*

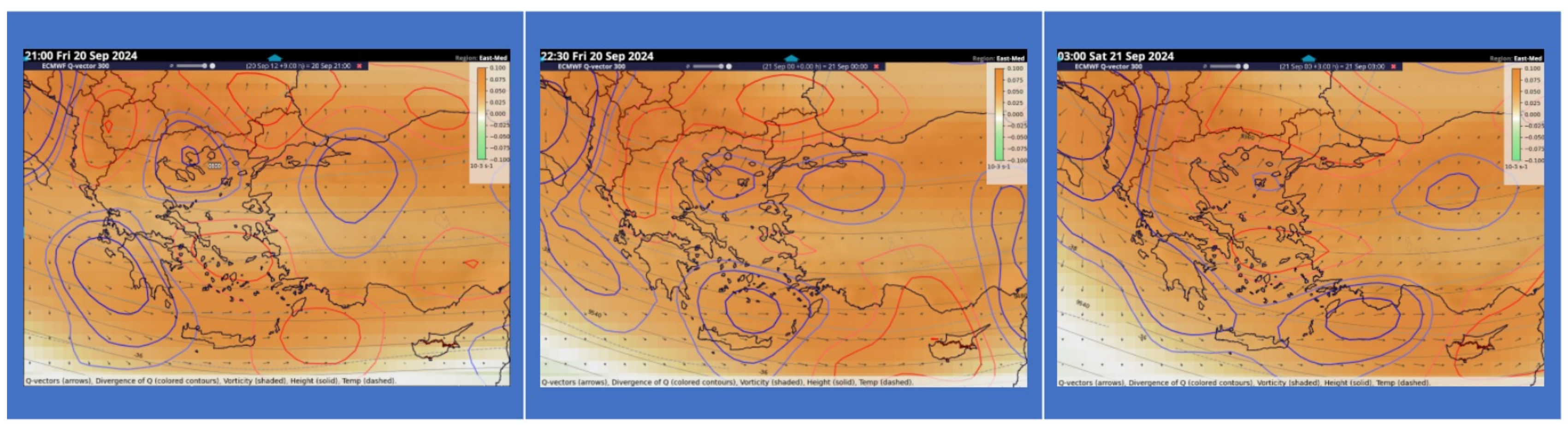

Figure 6. *ESSL Displayer analysis of 300 hPa ECMWF Q-vector divergence and vorticity at 21:00 UTC and 22:30 UTC (20 Sep) and 03:00 UTC (21 Sep 2024).*

CONCLUSION

During 20–21 September 2024, a multicellular convective system developed over Istanbul Airport under moderate instability and strong shear.
Combined radar reflectivity and MTG imagery (IR 10.5 µm and Severe Storms RGB) captured progressive cloud-top cooling and organized convection, while ECMWF-derived Q-vector divergence indicated upper-level dynamic support.
The integrated use of satellite, radar, and model data through the ESSL Weather Data Displayer enhanced real-time interpretation of convective evolution, highlighting the benefits of MTG products for operational aviation nowcasting.

ACKNOWLEDGMENTS

Data sources: ESSL Weather Data Displayer, TSMS Weather Radar, EUMETSAT MTG imagery.
Special thanks to ESSL and TSMS for providing access to data and operational support.

REFERENCES

Kahraman, A., Kadioglu, M., & Markowski, P. M. (2017). Severe Convective Storm Environments in Turkey. *Monthly Weather Review*, *145*(12), 4711-4725. https://doi.org/10.1175/MWR-D-16-0338.1

Púčik, T., Groenemeijer, P., Rýva, D., & Kolář, M. (2015). Proximity Soundings of Severe and Nonsevere Thunderstorms in Central Europe. *Monthly Weather Review*, *143*(12), 4805-4821. https://doi.org/10.1175/MWR-D-15-0104.1