

Analysis of the cooling episode in Western Romania in the first half of April 2025 using upper troposphere maps

Analiza episodului de răcire din vestul României în prima jumătate a lunii aprilie 2025 cu ajutorul hărților din troposfera superioară

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ABSTRACT

The first decade of April was characterised by particularly cold weather with minimum temperatures that were daily or even monthly records. The cooling of the weather occurred starting on April 6 and lasted until after April 10, producing late frost with dramatic effects for the farmers. The effects of the night frosts were disastrous for fruit and vegetable growing, as well as beekeeping. The study presents a comparative analysis of April 5 and 6 to capture the dynamics of the upper atmosphere involved in this strong late cooling process. The dynamics of the surface water were influenced significantly by the upper atmosphere; thus, understanding the maps improves the weather prediction models. The entrance regions of the jet streaks, isentropic lift, frontogenesis, and some degree of instability simultaneously determined an upward motion.

Keywords: late frosts, potential vorticity, relative vorticity, dynamic tropopause level, jet streak

REZUMAT

Prima decadă a lunii aprilie a fost caracterizată de o vreme deosebit de rece, cu temperaturi minime care au constituit recorduri zilnice sau chiar lunare. Răcirea vremii a avut loc începând cu 6 aprilie și a durat până după 10 aprilie, producând înghețuri târzii cu efecte dramatice pentru agricultori. Efectele înghețurilor nocturne au fost dezastruoase pentru pomicultură și legumicultură, precum și pentru apicultură. Studiul prezintă o analiză comparativă a zilelor de 5 și 6 aprilie pentru a surprinde dinamica atmosferei superioare implicată în acest puternic proces de răcire târzie. Dinamica apei de suprafață a fost influențată semnificativ de atmosfera superioară; astfel, înțelegerea hărților îmbunătățește modelele de predicție meteorologică. Regiunile de intrare ale curenților jet, portanța izentropică, frontogeneza și un anumit grad de instabilitate au determinat simultan o mișcare ascendentă.

Cuvinte cheie: înghețuri târzii, vorticitate potențială, vorticitate relativă, nivel dinamic al tropopauzei, curenți jet

BACKGROUND

It is well known that climatic extremes are affecting agricultural production at both the global (Beillouin et al., 2020; Vogel et al., 2019; Sivakumar, 2018) and local levels (Mircov et al., 2024) from both quantitative and qualitative perspectives (Mihuț et al., 2024). The most dramatic effects of climate extremes are affecting the small and subsistence farmers (Moura Cardoso do Vale et al., 2020).

The night frosts in the first half of April 2025 caused significant damage in orchards in Western Romania (Dragomir, 2025), with fruit growers reporting production losses of 90% (Chwoika, 2025). Beekeepers were also dramatically affected by the low temperatures in April 2025, reporting losses in bee brood (Agromedia, 2025). Additionally, the bees were unable to start pollen and nectar harvesting due to the low temperatures and absence of flowers (Opinia Timișoarei, 2025).

In the following are presented summaries of maximum and minimum temperature records from the National Meteorological Administration (2025) for western Romania (data measured in local meteorological stations from the counties Timiș, Caraș-Severin, Arad, Bihor and Hunedoara), from 6th, 7th and 10th April 2025, for a better understanding of this study.

Our area of interest is located in western Romania and comprises five counties (Bihor, Arad, Caras-Severin, Timis, and Hunedoara). All the relief units from plain to mountains with altitudes over 2100 m are found in the area (Figure 1), where the meteorological stations (Table 1) are placed, from where the climatic data used in the present study.

On April 6, 2025, the temperature values decreased significantly (on average by 10-16 [ZP1.1][R1.2]°C) compared to the previous day, the weather becoming particularly cold for the first decade of April. The sky was cloudy, more pronounced temporarily during the day. There were precipitations that were also of a shower nature, especially in the form of snow, sleet and sleet in smaller areas in Crișana and mixed isolated in Banat.

In the mountains, it snowed sleet. The wind temporarily intensified in the west, southwest, centre and east, with speeds of 180-234 m/s, and at altitudes higher than 1700 m in the Southern Carpathians, there were gusts of 288-360 m/s. The maximum temperatures were generally 7-12 °C below the multiannual averages, and the minimum ones were on average 5-10 °C lower than the norms of the period. From the second part of the night, frost occurred on relatively large areas in Crișana and locally in Banat, while on smaller areas, ground frost was observed (National Meteorological Administration, 2025).

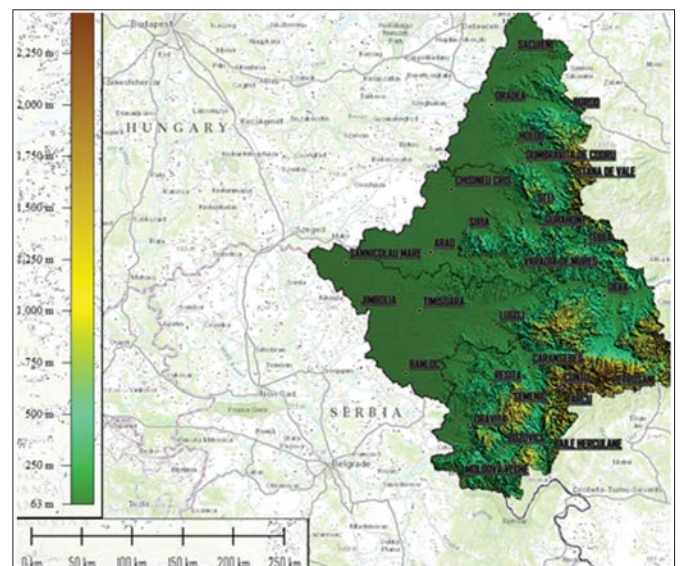


Figure 1. Location of the study area and the positioning of the meteorological stations (processed after SAGA-GIS, 2015)

The maximum temperatures listed here represent the lowest daily values from the entire series of observations on this calendar date at the weather stations: Tarcu (-11.0 °C compared to the record of -9.1 °C), Caransebes (5.5 °C compared to the record of 6.3 °C), Stana de Vale (-3.9 °C compared to the record of -2.7 °C), Resita (5.1 °C compared to the record of 6.1 °C), Cuntu (-6.6 °C compared to the record of -4.1 °C), Semenic (-6.6 °C compared to the record of -5.5 °C), Parang (-5.9 °C compared to the record of -4.5 °C), Oravita (5.3 °C compared to the record of 5.6 °C).

Table 1. Meteorological stations considered in the study (county, altitude and relief units)

Meteorological Station/County	Altitude (m a.s.l.)	Relief unit
Oradea (Bihor)	136	plain
Sacuieni (Bihor)	124	plain
Borod (Bihor)	334	hill
Holod (Bihor)	163	hill
Dumbravita de Codru (Bihor)	337	hill
Stana de Vale (Bihor)	1108	mountain
Arad (Arad)	117	plain
Chisineu Cris (Arad)	96	plain
Gurahont (Arad)	177	depressional corridor
Siria Cetete (Arad)	473	hill
Varadia de Mures (Arad)	156	depressional corridor
Deva (Hunedoara)	240	hill
Tebea (Hunedoara)	273	depressional corridor
Timisoara (Timis)	86	plain
Jimbolia (Timis)	79	plain
Lugoj (Timis)	124	plain
Sannicolau Mare (Timis)	85	plain
Banloc (Timis)	83	plain
Resita (Caras-Severin)	279	hill
Baile Herculane (Caras-Severin)	190	hill
Moldova Veche (Caras-Severin)	92	depressional corridor
Bozovici (Caras-Severin)	256	depression
Oravita (Caras-Severin)	309	hill
Cuntu (Caras-Severin)	1456	mountain
Semenic (Caras-Severin)	1432	mountain
Vf Tarcu (Caras-Severin)	2180	mountain

The minimum temperatures listed here represent the lowest daily values from the entire series of observations on this calendar date at the weather stations: Țarcu (-11.0 °C compared to the record of -9.1 °C), Caransebes (5.5 °C compared to the record of 6.3 °C), Stana de Vale (-3.9 °C compared to the record of -2.7 °C), Resita (5.1 °C compared to the record of 6.1 °C), Cuntu (-6.6 °C compared to the record of -4.1 °C), Semenic (-6.6 °C compared to the record of -5.5 °C), Parang (-5.9 °C compared to the record of -4.5 °C), Oravita (5.3 °C compared to the record of 5.6 °C), the series of observations on this calendar date at the weather stations: Varadia de Mures (-6.7 °C compared to the record of -5.6 °C), Gurahont (-6.7 °C compared to the record of -5.2 °C, Borod (-6.2 °C compared to the record of -5.8 °C), Holod (-5.3 °C compared to the record of -5.0 °C). The minimum temperature listed here represents the lowest monthly values from the entire series of observations on this calendar date at the station Gurahont (-6.7 °C compared to the record of -5.7 °C). The minimum temperature recorded at the weather station Borod (-6.2 °C) was equal to the lowest values from the entire series of observations (National Meteorological Administration, 2025).

On April 7, 2025, the weather remained particularly cold for the first decade of the month. The sky was temporarily cloudy, and there was light precipitation; in small areas in Crișana, there was mainly snowfall. In the mountains, it snowed lightly in places, and at very high altitudes, there was snow transport. The wind blew weakly and moderately, temporarily with intensifications in the southwestern extremity of the territory, with speeds of 162 ... 198 m/s, and on the mountain ridges, the gusts were 288 ... 306 m/s. There is a layer of snow in the mountains. The maximum temperatures were 10 °C below the multiannual averages in most of the country. In the morning and in the second part of the night, frost occurred locally; on small areas, there was frost on the ground, and fog formed in isolated places (National Meteorological Administration, 2025).

The maximum temperature listed here represents the lowest daily values from the entire series of observations

on this calendar date at the weather station Sannicolau Mare (6.1 °C compared to the record of 6.2 °C). The minimum temperatures listed here represent the lowest daily values from the entire series of observations on this calendar date at the weather stations: Tebea (-7.8 °C compared to the record of -5.7 °C), Varadia de Mures (-8.2 °C compared to the record of -6.3 °C), Gurahont (-5.7 °C compared to the record of -4.6 °C), Baile Herculane (-3.4 °C compared to the record of -1.8 °C), Lugoj (-5.8 °C compared to the record of -4.7 °C) Chisineu Cris (-6.7 °C compared to the record of -6.1 °C), Stana de Vale (-10.5 °C compared to the record of -9.9 °C), Resita (-4.7 °C compared to the record of -4.2 °C), Deva (-7.3 °C compared to the record of -4.8 °C), Moldova Veche (-3.8 °C compared to the record of -3.7 °C). The minimum temperature recorded at the Caransebes weather station (-5.8 °C compared to the record of -5.8 °C) was equal to the lowest daily value in the entire series of observations on this calendar date. The minimum temperatures listed here represent the lowest monthly values in the entire series of observations on this calendar date at the Varadia de Mures weather station (-8.2 °C, compared to the record of -6.9 °C) (National Meteorological Administration, 2025).

On April 10, 2025, the weather was windy and cold, even particularly cold for this time of year, and the deviation of maximum temperatures from the climatological averages was generally 8-9 °C. The sky was temporarily cloudy, and precipitation was widespread in all regions, especially during the day. These were in the form of snow in the mountains, mixed with rain in Crișana, and rain in Banat. Precipitation was mainly in the form of showers. In the mountains, a new layer of snow of 5-10 cm was deposited. The wind blew weakly and moderately, temporarily with intensifications, especially in the afternoon and evening, throughout the country (gusts generally of 216...288 m/s, and at high altitudes, in the Southern Carpathians, of over 360 ... 432 m/s (up to 518.4 m/s at Țarcu Peak), there was also a blizzard in the mountains, but in limited areas and in lower relief areas; there were also storms, recorded at the Chișineu Criș meteorologi-

cal stations. There is a layer of snow in the mountains. The maximum temperatures ranged from 2 °C to 15 °C, and the minimums were between -12 °C and 2 °C. In the morning and at night, frost was present in Banat and in more limited areas of Crişana. (National Meteorological Administration, 2025).

The maximum temperatures listed here represent the lowest daily values from the entire series of observations on this calendar date at the stations: Dumbravita de Codru (3.9 °C compared to the record of 6.4 °C), Borod (5.7 °C compared to the record of 6.2 °C), and Holod (7.5 °C compared to the record of 8.0 °C). The minimum temperatures listed here represent the lowest daily values from the entire series of observations on this calendar date at the stations: Ţebea (-4.9 °C compared to the record of -3.9 °C), Bozovici (-4.8 °C compared to the record of -2.7 °C), Caransebes (-4.3 °C compared to the record of -3.9 °C), Lugoj (-5.3 °C compared to the record of -3.6 °C), Borod (-4.7 °C compared to the record of -3.9 °C), Banloc (-5.2 °C compared to the record of -3.4 °C), Resita (-3.8 °C compared to the record of -1.6 °C), Deva (-4.5 °C compared to the record of -4.4 °C), Moldova Veche (-3.5 °C compared to the record of 0.4 °C) (National Meteorological Administration, 2025).

The purpose of the present study is to analyse the upper atmosphere dynamic maps, which display the movement and behaviour of the upper layers of the atmosphere, including the thermosphere and ionosphere. The analysis of these maps is crucial for the understanding of the weather patterns, climate change, and space weather effects.

MATERIAL AND METHODS

The 300 hPa pressure level is a common altitude for studying upper-level weather patterns because it is often near the level of the jet stream. Jet streams are fast-flowing air currents in the upper atmosphere that can influence surface weather. Shear vorticity (a component of relative vorticity) at 300 hPa is a valuable tool for identifying the axes of jet streams. Jet streams are characterised by strong winds, and the change in wind

speed on either side of the jet core creates areas of cyclonic (left side) and anticyclonic (right side) shear vorticity (Morgan and Nielsen, 1998). Vorticity maxima and minima at 300 hPa are associated with the development and intensification of weather systems, such as cyclones and anticyclones. Positive vorticity indicates cyclonic (counter-clockwise) rotation and is often associated with areas of low pressure and rising air. Negative vorticity indicates anticyclonic (clockwise) rotation and is often associated with areas of high pressure and sinking air (Bluestein, 1993). By analysing the 300 hPa relative vorticity field, we can gain valuable insights into the dynamics of the upper atmosphere and improve the forecasts of weather systems and their associated impacts. The jet stream core at 300 hPa is often associated with a potential vorticity (PV) anomaly, particularly one with a value of 1.5 PVU or higher. This area of high PV concentration within the jet stream is a key indicator of the jet's position and strength, and it can be used to diagnose and predict weather patterns. The 300 hPa pressure level (approximately 30,000 feet) is often near the core of the jet stream, making it a good level for analysing jet stream characteristics. This pressure level (approximately 30,000 feet) is often near the core of the jet stream, making it a good level for analysing jet stream characteristics. Analysing PV at 300 hPa is useful for (Appenzeller and Davies, 1996):

- Identifying jet stream position and strength: The location of the high PV core closely aligns with the jet stream axis.
- Diagnosing weather systems: PV anomalies associated with jet streaks can influence the development of weather systems, such as cyclones and fronts.
- Predicting severe weather: Changes in PV can be linked to changes in atmospheric stability and vertical motion, which can influence the development of severe thunderstorms and other convective events.

In essence, the 300 hPa PV field provides valuable information about the jet stream's location, strength, and potential impact on weather patterns.

RESULTS AND DISCUSSION

In this study, 300 hPa Potential Vorticity and 300 hPa Relative Vorticity from ECMWF and EUMeTrain composite overlays were used, along with a satellite airmass RGB image, a height of PVU=1.5, and EUMeTrain composite overlays of isotachs and wind barbs at 300 hPa, on April 5, 12 UTC (Figure 2). These two side-by-side maps show upper-level dynamics on April 5, 2025, at 12 UTC, which are crucial for diagnosing the jet stream and vorticity structure associated with the cold frontal system affecting Belgrade and the Balkans.

On the left map (Figure 3), the 300 hPa Potential Vorticity (PVU) – Jet Stream Core contours are shown in magenta, highlighting the jet stream structure. A strong

jet streak curves cyclonically over Central Europe, with a clear trough axis over Germany, the Czech Republic, and Slovakia. The jet streak extends southeastward toward Serbia, indicating dynamic forcing aloft (Andrei et al. 2019). This upper-level trough aligns well with the tropopause gradient and cold air advection we saw earlier. On the right map (Figure 3), 300 hPa Relative Vorticity (s^{-1}) – Upper-Level Spin is shown, with warm colours (orange/red) indicating regions of positive vorticity, representing strong upper-level lifting potential. A pronounced vorticity maximum is centred over Western Ukraine, with a trailing band over the Balkans. This supports strong cyclonic curvature and upper divergence over Belgrade during this timeframe.

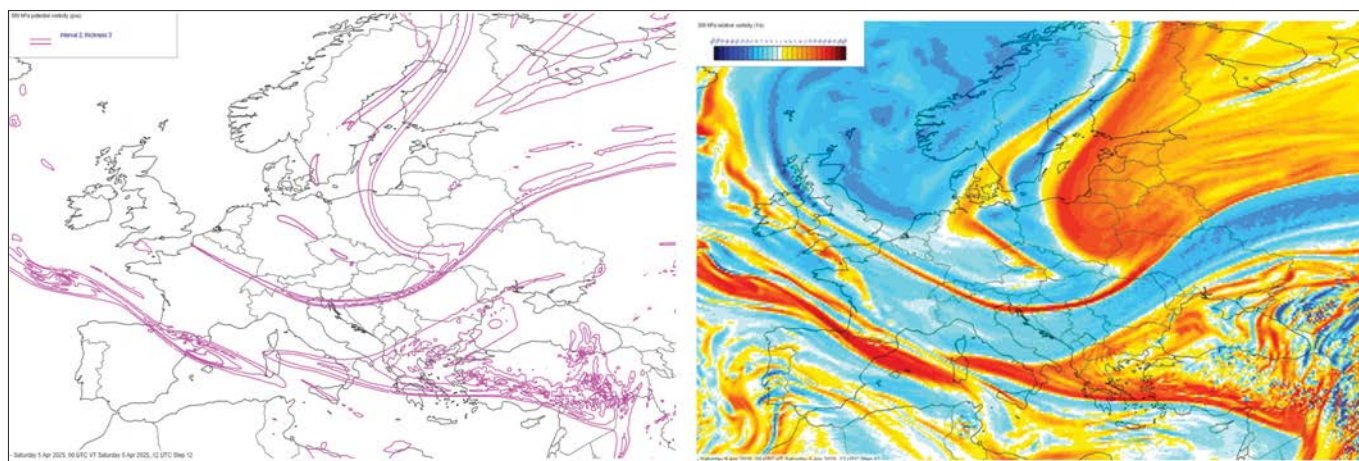


Figure 2. 300 hPa Potential Vorticity (PVU) – Jet Stream Core and 300 hPa Relative Vorticity (s^{-1}) – Upper-Level Spin (ECMWF) on April 5, 12 UTC (Meteorological Satellite Data Training, 2025)

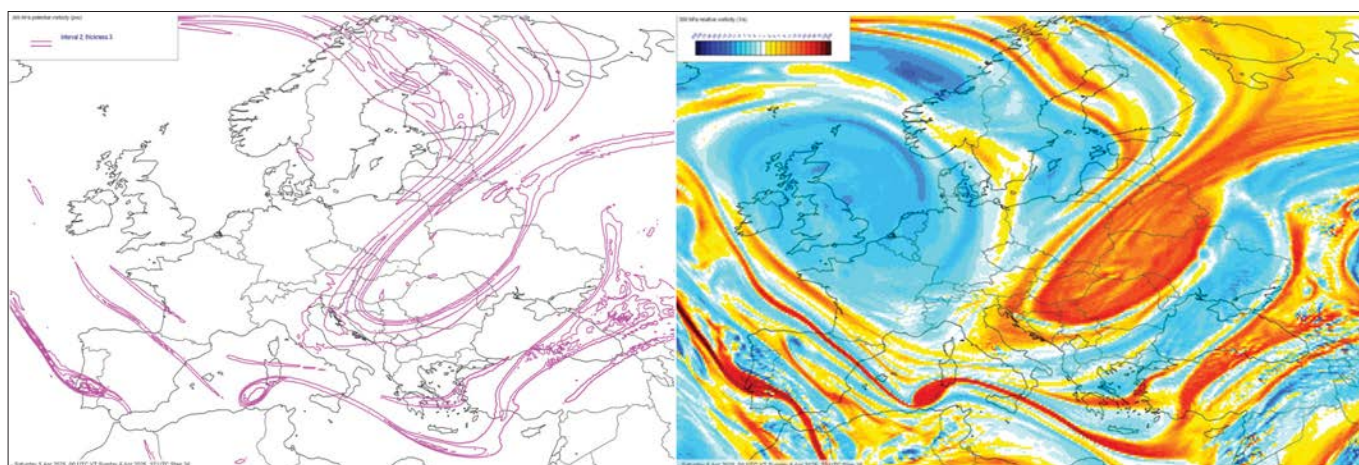


Figure 3. 300 hPa Potential Vorticity (PVU) – Jet Stream Core and 300 hPa Relative Vorticity (s^{-1}) – Upper-Level Spin (ECMWF) on April 6, 12 UTC (Meteorological Satellite Data Training, 2025)

These maps confirm the presence of a potent upper-level jet streak and PV anomaly over Eastern Europe. Belgrade lies just downstream of the upper trough, which favours divergence aloft and upward motion, supporting surface cyclogenesis, cold frontal forcing and elevated instability (Rowe and Hitchman, 2020).

These two side-by-side maps (Figure 3) show upper-level dynamics on 6 April 2025 at 12 UTC. The left panel displays 300 hPa Potential Vorticity (PVU), with magenta contours tracing regions of dynamic tropopause intrusion (typically ≥ 1.5 PVU). A well-defined PV streamer curves south-eastward from Central Europe into the Balkans. The core of this PV anomaly extends over western and central Romania, while Belgrade lies on its southwestern edge. This configuration strongly supports upper-level subsidence and drying behind the frontal boundary \rightarrow consistent with post-frontal air mass. On the right panel, 300 hPa Relative Vorticity (s^{-1}) shows a striking vorticity maximum centred over western Romania, indicative of a deep upper-level trough. Belgrade is now located west of the vorticity maximum, under subsiding air, which contributes to atmospheric stabilisation. Broad anticyclonic curvature develops over Italy and the Adriatic, further confirming the eastward progression of the upper trough.

The jet-level PV intrusion is tightly coupled with strong positive vorticity advection downstream - classic structure of a mature trough. On April 5, Belgrade was near the jet entrance and PV gradient (favourable for lift). By April 6, the system shifted eastward; Belgrade transitioned into the dry, stable post-frontal zone.

The cold front that passed over Belgrade in early April 2025 was characterised by significant upper-level dynamics, marked by jet streaks, tropopause gradients, and vorticity maxima. The system involved a strong frontal boundary with dynamic upper-level support, leading to a sharp temperature drop, enhanced instability, and a subsequent stabilisation phase post-front. Potential Vorticity (PV) values indicated a dynamic upper-level low with cyclonic curvature over Central Europe. The vorticity maximum was situated over Ukraine and Roma-

nia, aligning with the cold front's position and signalling strong upper-level support for the frontal passage. On 6th April 2025, 12Z, Potential Vorticity showed that the upper-level low had shifted eastward, with subsidence now dominating the region. Vorticity maxima over Romania and Moldova confirmed upper-level divergence in the wake of the front, leading to drying and stabilisation over Belgrade.

Jet Stream Dynamics (April 5, 2025, 12Z) magenta contours on the PV map (Figure 4) revealed a strong jet streak moving eastward, aligned with the frontal system. The jet stream's entrance region (over Germany and Poland) was associated with strong upward motion, aiding in frontal development and enhancing the system's intensity. On April 6, 2025, 12Z, the jet streak moved eastward, with a broad ridge developing over Italy, signalling reduced lift and further stabilisation in the wake of the cold front.

Pre-Front (April 5, 2025) Belgrade was situated in a region of high moisture, with significant upper-level dynamics pushing the cold front eastward. The jet stream and PV structure indicated dynamic lift and potential for strong frontal passage. Post-Front (April 6, 2025) After the passage of the front, the atmosphere became very dry, with temperatures dropping sharply (Appenzeller and Davies, 1996). The upper-level PV structure showed a shift to subsidence, with positive vorticity moving eastward and dry air filling the region. Belgrade experienced the tail-end of the upper trough, confirming the cold, dry air mass associated with the cold front (Martin, 1998).

EUMeTrain composite overlays a satellite airmass RGB image with upper-level dynamic fields, offering a rich visual summary of the cold front system over Europe on April 5, 2025, at 12 UTC (Figure 4).

Satellite Imagery (Airmass RGB) with red/brown shades show stratospheric air with high potential vorticity as a sign of dry intrusions and dynamic tropopause folding, green/yellow bands show warm, moist tropical air likely associated with frontal cloud bands and white/blue areas indicate high, thick clouds (deep convection or frontal lifting).

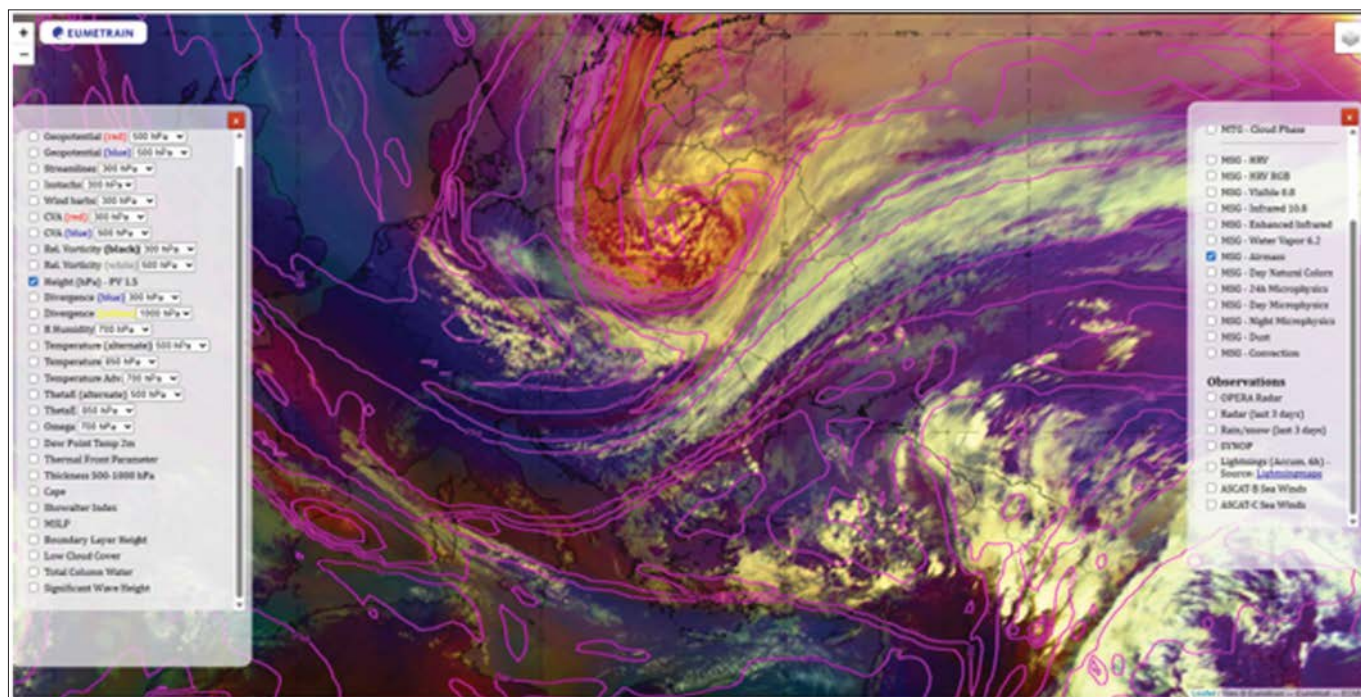


Figure 4. EUMeTrain composite overlays a satellite airmass RGB image, Height of PVU = 1.5, on April 5, 12 UTC (Meteorological Satellite Data Training, 2025)

Over Central and Eastern Europe, the contrast between dry air wrapping and moist ascending air clearly marks the upper-level structure of the cold front.

Overlaid Fields - magenta Contours (Height of PVU=1.5) show the dynamic tropopause level. Tropopause dips southward over Central Europe - classic upper-level trough. Tightly packed PV height contours are associated with intense jet streaks and upper-level forcing, located just ahead of the dry air intrusion, embedded in strong upward motion and vorticity advection (Table 2). This confirms earlier maps showing an active cold frontal passage, deep lifting mechanisms resulting from upper-level jet-trough interaction, cloud development,

and precipitation, consistent with HRV and airmass satellite frames.

Such a satellite-PV combo is excellent for explaining how stratospheric air interacts with tropospheric systems (Santurette and Joly, 2002) and can visually anchor the meteorological evolution.

This satellite-dynamics overlay (April 6, 2025, 12 UTC) (Figure 5) reveals the mature stage of the synoptic system (Bader et al., 1995) that affected Central and Eastern Europe. It captures the post-frontal evolution and confirms the eastward shift of dynamic forcing seen in previous diagnostics. Dry Intrusion (reddish/purple shades) has rotated cyclonically and now fully wraps

Table 2. Overlaid fields: feature – description – implication

Feature	Description	Implication
Airmass RGB	Dry intrusion + moist cloud band	Classic cold front structure
PV Height (magenta)	Tropopause dip over Central–Eastern Europe	Strong upper trough
Overall, Jet – Trough Placement	Left exit jet region over Serbia	Ascent → frontal weather

around the system core – a hallmark of an occluded mature cyclone (Browning, 1997). Warm conveyor belt cloud plume (bright yellow/white) extends from the southern Balkans to Ukraine – signals elevated frontal zones and moisture advection (Clark et al., 2020). The frontal boundary has clearly moved east of Serbia, confirmed by cloud clearance and subsiding air.

The dynamic fields interpretation (Table 3)[ZP2.1][R2.2] from Figure 5 is presented below. PVU = 1.5 (magenta contours) now curves north-eastward over western Ukraine and the Black Sea. This confirms the eastward migration of the dynamic tropopause and upper trough axis. Cyclonic curvature of PV contours and vorticity reveals a strongly wrapped jet streak with divergence downstream, sustaining lift over Moldova, Ukraine, and western Russia. Over Serbia and the Central Balkans: behind PV max, one can find an area of subsidence, stabilization, and post-frontal stratiform cloud.

On April 5, 2025, 12 UTC, a strong southwesterly jet streak is present over Central Europe, with wind speeds exceeding 70–90 kt (Figure 6). Jet curvature exhibits a distinct trough–ridge pattern, with a cyclonic jet exit region located over Serbia and the Balkans. Dynamic forcing [ZP3.1][R3.2] shows that Serbia lies within the left exit region of the jet, favouring strong upper-level divergence and upward motion – a classic setup for frontal development and active weather (Clark et al., 2009). Implication: supports the onset of clouds, precipitation, and destabilisation associated with the advancing cold front. Isotachs (red–yellow bands): Wind speed contours in knots: the strongest winds (≥ 70 knots) arc from Italy north-eastward across Ukraine and western Russia. Wind barbs and streamlines indicate the jet orientation and flow direction. A curved jet streak (Moore and Vanknowe, 1992) spans Moldova and Ukraine, indicating right entrance/exit regions.

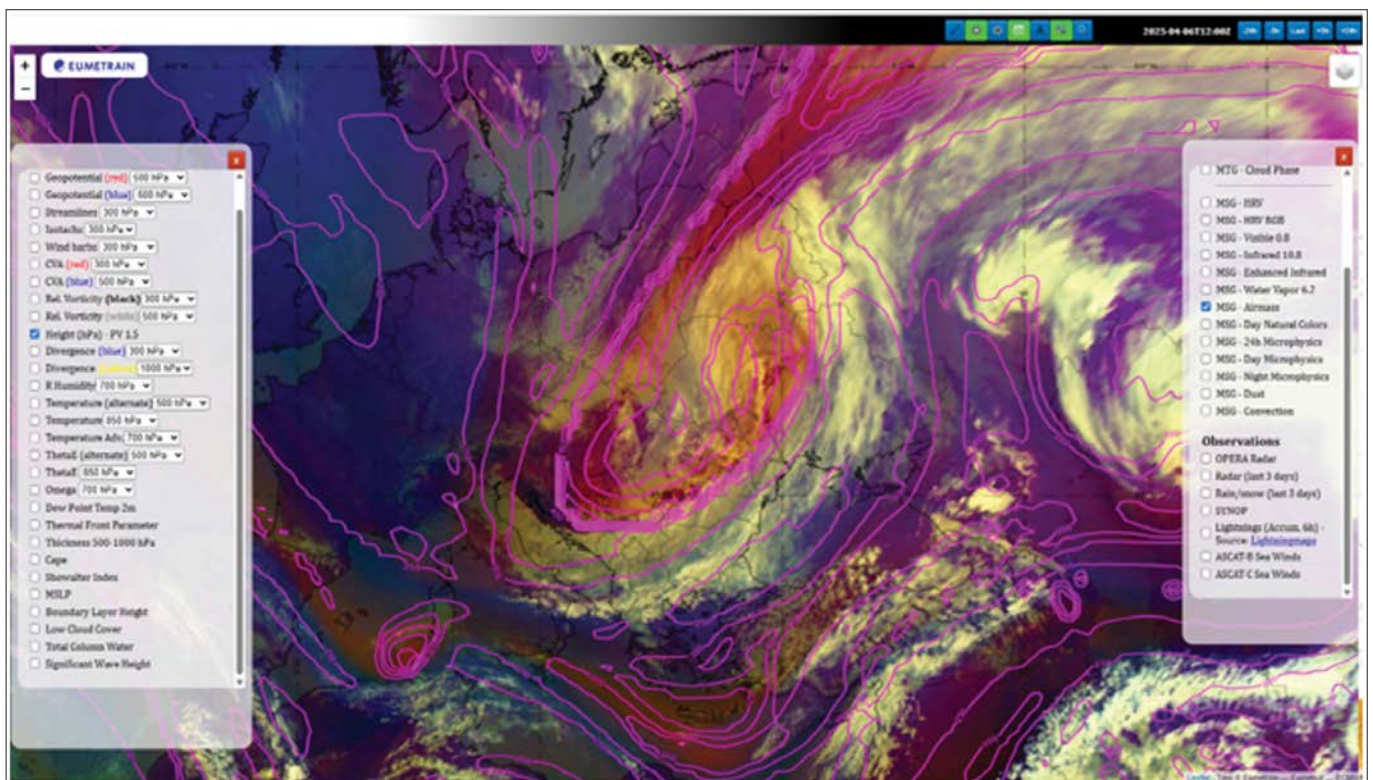


Figure 5. EUMeTrain composite overlays a satellite air mass RGB image, Height of PVU = 1.5, on April 6, 12 UTC (Meteorological Satellite Data Training, 2025)

Table 3. Dynamic Fields Interpretation

Date/Time	Upper-Level PV/Trough Axis	Main Frontal Forcing	Serbia Conditions
5 April 12 UTC	Entering Serbia from the NW	Strong ascent, pre-frontal	Cloudy, moist, dynamically active
6 April 12 UTC	Over Ukraine – Black Sea	Active front now east	Post-frontal, drying, cloud clearing

Thermal Wind Gradient (colour shading) implies temperature advection and potential baroclinic zones. Romania and Ukraine are in the left exit region of a strong anticyclonic jet streak. This region typically supports subsidence aloft, but coupled with lower-level convergence, it can enhance frontal lift.

On April 6, 2025, 12 UTC, the system is mature and has shifted east. Jet Core Movement [ZP4.1] shows the jet has migrated eastward, now arching over Ukraine and southern Russia, with wind maxima still above 80–90 kt (Figure 7). Serbia’s position [ZP5.1] is now under a weakened upper-level flow, well behind the jet core and trough axis (Janach, 2015). Dynamic forcing [ZP6.1] in the

region is under subsidence and post-frontal conditions, with reduced support for vertical motion (Dolaptchiev and Klein, 2009). Implication: confirms the system’s passage; weather calms as stabilization sets in and cloudiness diminishes (Kington and Ley, 1999).

Isotachs show the high-speed core of the upper-level jet now stretching from the eastern Balkans into southern Russia and the eastern Black Sea, wind barbs/streamlines: indicate widespread zonal flow has resumed behind the trough (Reiter, 1987), with some residual curvature to the east of Romania, jet core has shifted significantly east, with Serbia and much of Central Europe now under weakened flow and subsidence (Table 4).

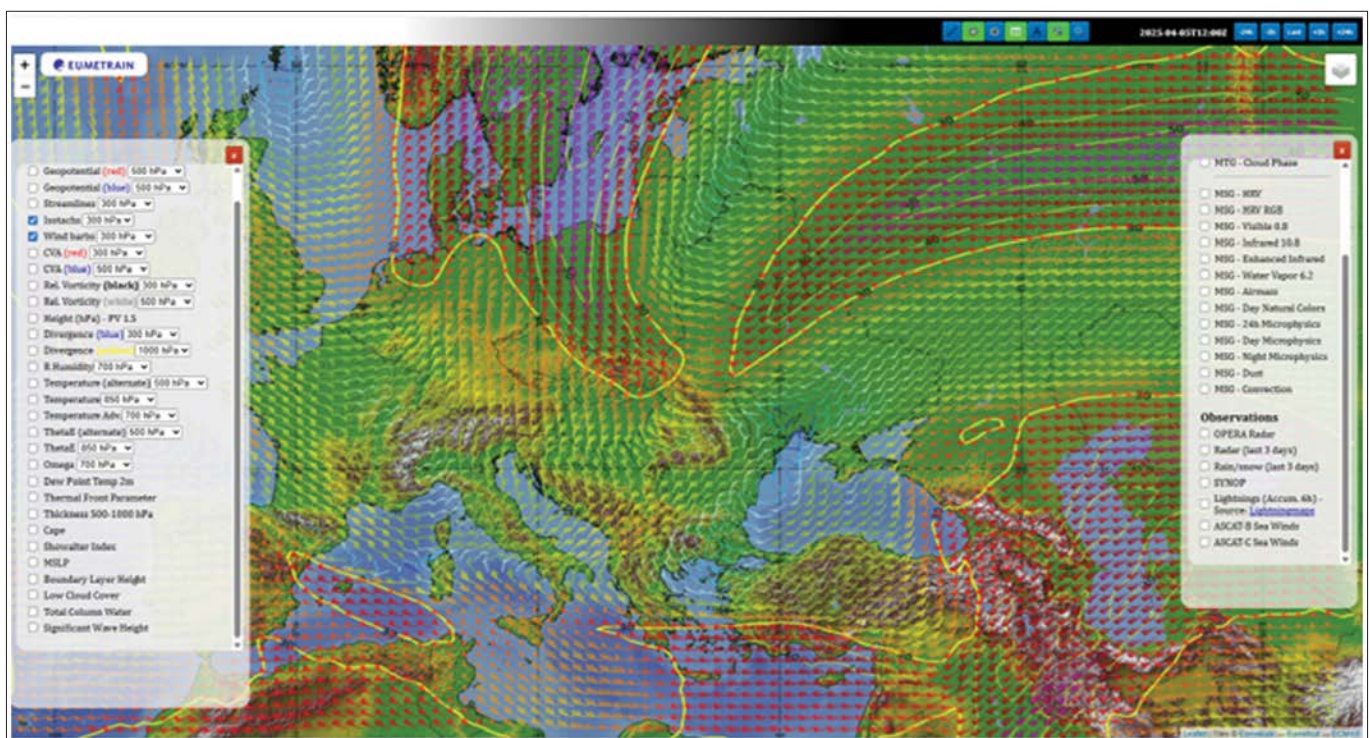


Figure 6. EUMeTrain composite overlays Isotachs, Wind barbs at 300 hPa, on April 5, 12 UTC (Meteorological Satellite Data Training, 2025)

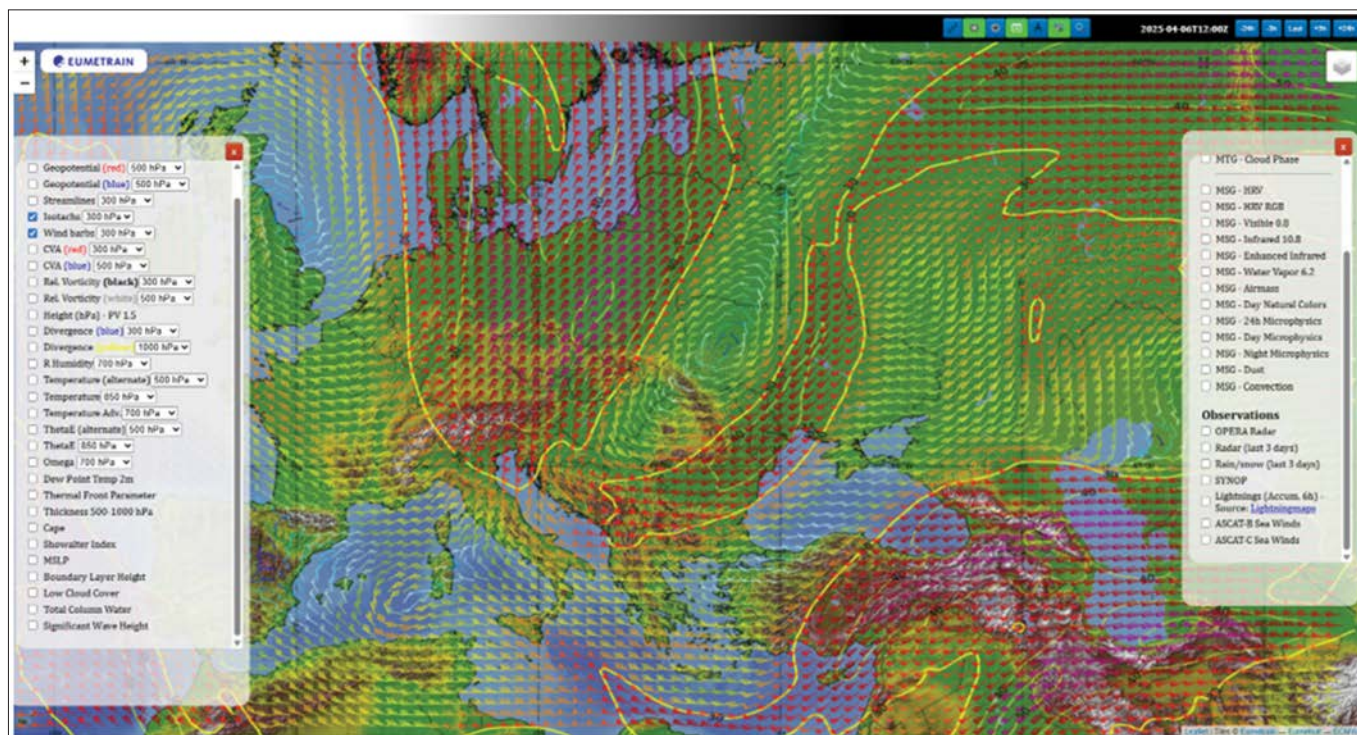


Figure 7. EUMeTrain composite overlays Isotachs, Wind barbs at 300 hPa, on April 6, 12 UTC (Meteorological Satellite Data Training, 2025)

Table 4. Interpretation of the Isotachs features

Feature	Observation	Interpretation
Jet core	East of Romania and Ukraine	The system matured and moved downstream
Wind speeds (Serbia)	Weakening (under 40 kt)	Post-frontal, stable conditions
Trough curvature	Over Russia	Trough axis well east → air mass settling in the west
Divergence zone	Over western Russia (right jet entrance)	Still supports lift far from the Balkans

Serbia is now entirely outside the zone of upper-level forcing, confirming the frontal passage is complete. Cloud cover and instability have decreased significantly, as also indicated by HRV and Airmass satellite imagery. The jet's eastward exit supports the clearing trend and stabilisation (Schneider, 2006).

CONCLUSIONS

Upper atmosphere dynamic maps display the movement and behaviour of the upper layers of Earth's atmosphere, including the thermosphere and ionosphere.

These maps are crucial for understanding weather patterns, climate change, and space weather effects. They show wind patterns, temperature variations, and other dynamic processes that influence conditions both in the upper atmosphere and at the surface. Upper atmosphere dynamics significantly influence surface weather, so understanding these maps helps improve weather prediction and models. Entrance regions of jet streaks, isentropic lift, frontogenesis, and some degree of instability all work together in a complicated manner to cause upward motion.

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