MEDITERRANEAN TROPICAL CYCLONE REPORT

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Tropical Storm Ciprian
16-20 October 2022

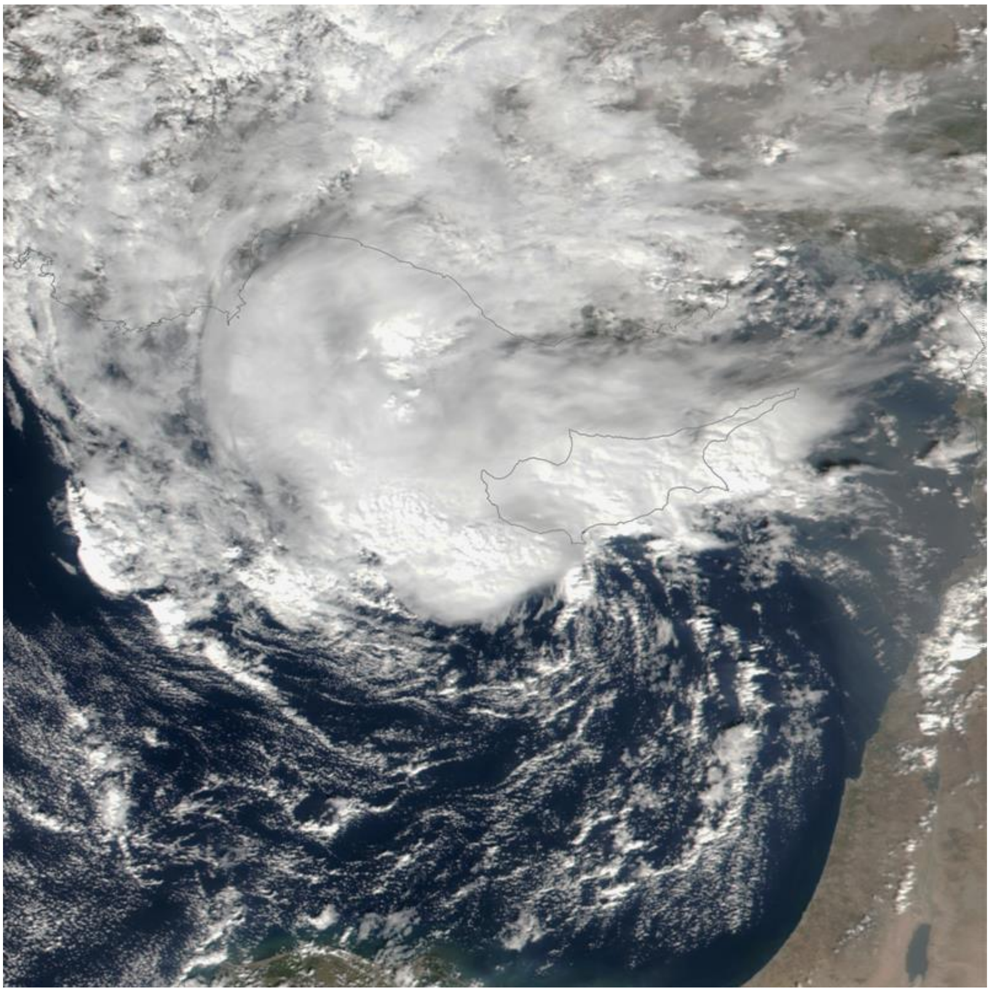

Image: NASA

Ciprian (own-named) was a weak, short-lived tropical storm which meandered near Cyprus for some days and caused heavy rains in the Eastern Mediterranean regions.

Synoptic history

On 11 October a weak low-pressure area developed over the far Western Mediterranean Sea which moved to east. The cyclone was mostly convective with ill-defined frontal features and larger clusters of heavy thunderstorms which led to flash floods in some areas across the West and Central Mediterranean Sea. The system reached the area of Crete on 15 October where a new surface low developed south of the island that initially moved northeastward. In midday another large mesoscale convective system formed associated with the cyclone which affected East Crete, the surrounding islands, and the southwestern coastline of Turkey. A line of strong thunderstorms also developed on the east-northeast side of the cluster which was visible on the Turkish radar measurements from *Mugla* very well (Fig. 3). From the late afternoon hours, the low-level center of the cyclone became more evident on radar and satellite images, and it turned to southeast. However, the convection steadily weakened and almost totally diminished near the center in the second half of the night. At this time, a second convective system formed more northeast, partially associated with the first system's outflow boundary, which affected Cyprus and the southern parts of Turkey.

In the morning hours of 16 October, convection started to redevelop near the cyclone's center, however it displaced to the northeast quadrant due to the persistent southwesterly shear. In addition, the earlier large convective cluster gradually collapsed, and the cyclone lost its frontal appearance, which signed the subtropical transition was completed around 1200 UTC. In the evening hours, a large thunderstorm system with cloud top temperature around -55 °C, locally below -60 °C formed on the northeast side of the circulation, however this also weakened and moved away toward Cyprus in the second half of the night. After Ciprian became subtropical, it moved northeastward well southwest of the island, but in the late morning hours of 17 October it turned northward and approached the western edge of Cyprus in the afternoon hours. In addition, new, but shallower convection with cloud top temperature around -45, -50 °C redeveloped just north of the center and thanks to the temporarily weaker vertical wind shear it already remained in connection with it and steadily expanded. By 1200 UTC the low-level circulation moved under the convection and upper-level outflow also improved a lot, especially on the northwest and north side which indicated the cyclone made tropical transition. Ciprian reached its best structural appearance in a few hours later and the radar images of Antalya also showed a classic tropical structure with an eye-like feature and outer rainbands which wrapped around the center (Fig. 4).

In the evening hours the convection started to collapse due to dry air intrusion from south and the reinvigorating wind shear. The outer rainbands almost completely dissipated, except a stronger one on the north, northwest side which lasted until the late-night hours, and the inner core also became much more disorganized with only weak showers. The cyclone turned west, then southwestward at this time and moved away from Cyprus. During daytime of 18 October Ciprian consisted of a well-defined low-level swirl with scattered showers around a center and in the morning occasionally a few, weak and sheared thunderstorm on the north-northeast side (Fig. 5). Around 1600 UTC stronger thunderstorms with cloud top temperature temporarily around -55, -60 °C and maximum radar intensity around 55-60 dBz developed in the northeast quadrant which lasted about 6 hours but thereafter it was not significant convective activity associated with the cyclone until the next morning. Around 0800 UTC, a new convective burst started just north-northeast of the center that produced sustained deep convection with cloud top temperatures around -60, -65 °C for about 10 hours, while the Turkish radar again showed maximum intensity around 55-60 dBz in the strongest cells (Fig. 6). On this day, the low turned back to northeast and approached Cyprus, but since the intense convection was sheared to northeast, it only briefly affected the island. Ciprian finally made landfall in West Cyprus, near Paphos around 2030 UTC but the convection already dissipated by this time. Although some thunderstorms still redeveloped north of the center later, they were not as strong and sustain than earlier, also were mainly just north of the island. The cyclone passed through Cyprus in the night hours and by the morning of 20 October the low-level circulation became more asymmetrical and elongated. Since somewhat organized, deep convection did not return, Ciprian became post-tropical by 0600 UTC and dissipated by the evening hours.

Meteorological statistics

Ciprian spent its almost entire lifetime over the open water, except a few hours on 19-20 October when it crossed Cyprus, so surface wind and pressure (Tabl. 2) data were limited, and ship reports (Tabl. 3) were also available mainly from its extratropical and subtropical stage. The precipitation data's availability was however better, especially from Crete and the surrounding islands (Tabl. 4.a) as well as from Cyprus (Tabl. 4.b). ASCAT (Fig. 7) and SMAP measurements also helped the estimation of the cyclone's intensity.

Winds and pressure

On 15 and 16 October, when Ciprian still was extratropical, it produced large area of wind around gale-force west of the center, in the region of Crete and the Aegean Sea. At this time many stations reported wind gusts between 65-90 km/h (35-50 kt) and in *Kythira* the 10-min. sustained wind reached 59 km/h (32 kt) at 1200 UTC 15 October. Ships measured 10-min. sustained winds around 65-75 km/h (35-40 kt) around the cyclone's center, mostly on its western side too. At 0700 UTC 16 October ship 'EUMDE17' reported 96 km/h (52 kt) wind father west, however, it seemed too high since another ship '9XLHEBZ' measured only 69 km/h (37 kt) wind in the same area within an hour. Based on surface report from East Crete and nearby ship's measurements the cyclone steadily deepened on 15 October when the large thunderstorm cluster developed over the center, the central pressure fell to 1002-1003 hPa. However, available reports suggested the pressure rose to about 1008-1009 hPa by the end of 16 October, during the cyclone's subtropical transition. The wind speed also decreased a bit, and Ciprian likely weakened to a depression for a short time in the morning hours of 17 October. Although some ship still measured sustained winds around 65-70 km/h (35-40 kt) at this time, they were quite far from the cyclone's center.

When Ciprian became tropical later on 17 October, it likely intensified some and it is estimated that the cyclone became a 65 km/h (35 kt) tropical storm by 1200 UTC and peaked with 75 km/h (40 kt) winds 6 hours later, but there were no direct measurements what confirm it. An ASCAT-B pass measured maximum winds of 55 km/h (30 kt) at 1927 UTC, when the convection already collapsed, but this measurement confirmed the tropical transition with compact, symmetrical wind field. SMAP showed maximum winds of 54 km/h (29 kt) at 0401 UTC 17 October and 60 km/h (32 kt) at 0437 UTC and 1536 UTC 18 October, while an ASCAT-C pass 57 km/h (31 kt) at 0813 UTC 19 October. Based on these data, the cyclone's intensity likely fluctuated near the borderline of the depression and storm category, and it was briefly a tropical storm with winds around 65 km/h (35 kt) when stronger convection occurred – in the evening hours of 18 October and from the late morning hours to evening on 19 October. At 2000 UTC 19 October, near the time of the landfall, *Paphos* reported pressure of 1010 hPa. Surface observations and later ASCAT measurements indicated that Ciprian likely weakened back into a depression at the landfall and wind speed gradually decreased further until the dissipation.

Rainfall

Ciprian caused high amount of rain over the East Mediterranean region. In Crete and surrounding islands, the most rain fell on 15 October from the large convective system. The daily rain amount reached 157.6 mm in *Aghios*, 123.8 mm in *Asi Gonia* and 105.4 mm in *Moni Toplou*, and the first 2 places (in reverse order) also got the highest amounts of precipitation from the cyclone with values of 202.0 mm and 180.6 mm. Although the cyclone moved well away from the island on 16 October, the persistent northerly wind still caused orographic rainfalls on the north side of Crete and in its mountains until 18 October, the total rain amount locally reached 50-90 mm in these 3 days. The torrential rains on 15 and 16 October led to major flash floods in Crete which caused significant damages and killed at least 2 people.

The convective systems associated with the cyclone locally already caused larger amount of rain in Cyprus on 15 and 16 October. In the first day the daily amount reached 55.0 mm in *Paphos airport* and 53.6 mm in *Empa*. Generally, the most rain fell on 17 October, when Ciprian approached the island and caused heavy thunderstorms. *Ormidaia* reported 79.0 mm, *Sia* 76.7 mm and *Larnaca airport* 70.2 mm rain on this day. On the next 3 days the precipitation amounts were much smaller, except the extreme northwest and north parts of Cyprus what were affected by some intense thunderstorm on 19 and 20 October. *Sea Caves / Peyia* got 78.0 mm rain on the first day. Flash floods also occurred in Cyprus, mostly on 17 October, but it did not cause as much damages as in Crete. On this day, a waterspout made landfall in *Ayia Napa* beach (without significant destruction) and another one was filmed near *Paphos*.

Storm surge

Since Ciprian was small and weak, it did not cause much ripple, the maximum significant wave heights (SWH) were mostly around 1.0-1.5 m (4-6 feet) near its center based on the few available satellite measurements. However, widespread, stronger northerly winds behind the cyclone, farther west caused SWH of around 3-4 m (10-13 feet) near Crete from 15 October until early 18 October.

Reanalysis data

Ciprian had been analyzed by ECMWF-ERA5 high-resolution reanalysis data. The examined parameters were 300 hPa divergence and winds (Fig. 8), 925 hPa geopotential and 850 hPa vertical speed (Fig. 9), 850 hPa equivalent potential temperature and wind (Fig. 10), 500-1000 hPa thickness and 850 hPa relative vorticity (Fig. 11), 200-1000 hPa thickness and 300 hPa potential vorticity (Fig. 12) and vertical cross-sections of potential vorticity (Fig. 13). The analysis expanded from 0000 UTC 14 October to 2100 UTC 20 October. However, only two images are listed here. The first one is at 1200 UTC 15 October, when a large cluster of thunderstorm formed near Crete – except the two thickness maps which show the 1500 UTC data, when a weak warm core appeared. The second one is at 1500 UTC 17 October, when Ciprian was near to its peak intensity – except the 300 hPa wind and divergence map which shows the 1200 UTC data, when the upper-level conditions were still favorable before the wind shear arrived. An animation of all reanalysis maps is available here:

https://www.youtube.com/watch?v=HdbfJC4YbVw

The cyclone developed under favorable synoptic condition in its extratropical phase. As the weak low-pressure area approached Greece from northwest on 14 October, an upper-level shortwave trough also reached the area which was visible both on the 300 hPa wind and thickness maps. The favorable jet streams position enhanced the upper-level divergence over the low and positive potential vorticity also advected to the area which helped the cyclone’s strengthening on 15 October. In addition, on the 850 hPa equivalent potential temperature (EPT) map a warm conveyor belt located in the warm sector that transported warm, moist air to the cyclone’s center, where the first large thunderstorm cluster formed. However, behind it dryer, cooler air arrived from northwest and wrapped into the cyclone’s core in the second half of the day, contributed to the collapsing of the convection near the center. The remnant of the warm conveyor belt moved farther east and helped the development of the new convective system. As Ciprian strengthened on 15 October, the relative vorticity at 850 hPa became stronger and it concentrated much more into the cyclone’s center with spiral bands around it. When the heavy thunderstorms developed, the 850 hPa vertical velocity also increased temporarily, but weakened soon thereafter. Likely due to convective heating, weak warm core appeared on both thickness maps after 1200 UTC and associated whit this positive low-level potential vorticity anomaly also started to develop in the cyclone’s center on the vertical cross-section.

In the afternoon hours of 15 October, a weak upper-level low formed over the cyclone within the larger trough which slowly moved away to northeast, then dissipated on 16 October day, but still caused favorable divergence aloft. During this day the warm core also gradually diminished on both thickness maps. In line of the convective organization, the 850 hPa EPT and vertical velocity initially had the highest values east of the surface low, where the large thunderstorm system existed in the first part of the day. However, EPT started to increase near the center by midday and warmer areas gradually wrapped around it in the afternoon and evening hours, but a small colder spot remained in the center until 0900 UTC 17 October. In this period, smaller areas of higher vertical velocity appeared just northeast and north of the center associated with the pulsating convection, while the 925 hPa geopotential field became much more symmetrical than earlier. The 300 hPa potential vorticity weakened a bit by 16 October, but it remained near or above the cyclone until the end of 17 October and likely still had some positive effects for the cyclone. On the latter day the cyclone's potential vorticity tower extended upward but it remained quite weak. The 850 hPa relative vorticity did not change much compared to the previous days, it had a concentrated maximum in the center with spiral bands around it. By midday of 17 October, dry air finally mixed out from the center based on 850 hPa EPT maps and the EPT values remained high until the cyclone's dissipation. From the evening hours to the next morning, weak warm core appeared again on 500-1000 hPa thickness map but it was not visible in the 200-1000 hPa range. In the first half of 17 October a weak poleward outflow channel developed north of Ciprian at 300 hPa which enhanced the divergence and contributed to the convective organization. However, from the afternoon strong west to southwesterly upper-level flow with wind speeds temporarily around 30 m/s positioned above the cyclone and lasted until early 20 October, causing high vertical wind shear. Thanks to this, the low started to weaken slowly from the evening of 17 October, which reflected in almost all parameters. Both the 850 hPa relative vorticity and vertical velocity gradually decreased, and although the minimum values of the 925 hPa geopotential did not change much, the gradient around the cyclone's center became even lower. A bit surprisingly, the deep, sustained convection of 19 October did not show up in any of the parameters.

Table 1 Best track for Ciprian, 15-20 October 2022

Day/Time [UTC]	Latitude [°N]	Longitude [°E]	Pressure [hPa]	Wind speed [km/h *(kt)*]	Stage
15 / 0000	36.0	22.1	1006	55 *(30)*	extratropical
15 / 0600	34.0	26.5	1003	55 *(30)*	”
15 / 1200	35.0	26.6	1002	65 *(35)*	”
15 / 1800	34.4	27.0	1002	75 *(40)*	”
16 / 0000	34.0	27.1	1003	75 *(40)*	”
16 / 0600	32.9	27.8	1004	75 *(40)*	”
16 / 1200	32.5	29.3	1006	65 *(35)*	subtropical storm
16 / 1800	32.7	30.4	1008	65 *(35)*	”
17 / 0000	33.1	31.3	1009	65 (35)	”
17 / 0600	33.4	32.3	1009	55 *(30)*	subtropical depression
17 / 1200	34.5	32.3	1008	65 *(35)*	tropical storm
17 / 1800	34.7	31.8	1006	75 *(40)*	”
18 / 0000	34.7	31.2	1007	65 *(35)*	”
18 / 0600	34.4	30.4	1007	65 *(35)*	”
18 / 1200	33.9	30.2	1008	55 *(30)*	tropical depression
18 / 1800	33.9	30.4	1007	65 *(35)*	tropical storm
19 / 0000	33.9	30.5	1008	55 *(30)*	tropical depression
19 / 0600	34.1	31.1	1008	55 *(30)*	”
19 / 1200	34.6	31.6	1007	65 *(35)*	tropical storm
19 / 1800	34.7	32.1	1008	65 *(35)*	”
20 / 0000	34.8	32.8	1009	55 *(30)*	tropical depression
20 / 0600	34.8	33.9	1010	45 *(25)*	post-tropical
20 / 1200	35.4	34.9	1011	35 *(20)*	”
20 / 1800					dissipated
17 / 1800			1006	75 *(40)*	minimum pressure and maximum wind
19 / 2030			1009	55 *(30)*	landfall near Paphos

Table 2 Selected surface winds and pressure observation

Location	Minimum sea level pressure		Maximum surface wind speed		
	Day/Time [UTC]	Pressure [hPa]	Day/Time [UTC]	Sustained (10-min) [km/h *(kt)*]	Gust [km/h *(kt)*]
Kythira (Greece)	15 / 0300	1008.4	15 / 0300	52 *(28)*	91 *(49)*
Sitia (Gr. / Crete)	15 / 1010	1003.6			
Kasos (Gr. / Crete)			15 / 1100		63 *(34)*
Moni Toplou (Gr. / Crete)	15 / 1140	1003.7			
Kythira (Greece)	15 / 1200	1009.4	15 / 1200	59 *(32)*	82 *(44)*
Ierapetra (Gr. / Crete)	15 / 1240	1003.3			
Finokalia (Gr. / Crete)			15 / 1300		71 *(38)*
Karpathos Airport (Grece)	15 / 1350	1005.0			
Milos (Greece)	15 / 1800	1012.5	15 / 1800	35 *(19)*	76 *(41)*
Plaka (Gr. / Crete)			15 / 1920		69 *(37)*
Akrotiri (Cyprus)			17 / 0750	37 *(20)*	
Paphos Airport (Cyprus)	17 / 1200	1009.5	15 / 1200	35 *(19)*	70 *(38)*
Paphos Airport (Cyprus)	19 / 2000	1010.0			
Paphos Airport (Cyprus)			19 / 2200	37 *(20)*	
Larnaca Airport (Cyprus)	20 / 0500	1010.0			

Table 3 Selected ship reports

Day/Time [UTC]	Ship call sign	Latitude [°N]	Longitude [°E]	Wind dir/speed [km/h *(kt)*]	Pressure [hPa]
15 / 0200	RTJ6XHM	34.8	25.6	080 / 22 *(12)*	1007.1
15 / 0500	9HA4960	35.2	27.0	080 / 33 *(18)*	1003.0
15 / 0800	RTJ6XHM	34.7	26.6	070 / 46 *(25)*	1004.6
15 / 1300	PBKH	35.3	25.1	010 / 50 *(27)*	1008.3
15 / 2300	PBKH	37.0	24.0	020 / 74 *(40)*	1015.3
16 / 0300	RTJ6XHM	34.4	30.4	220 / 65 *(35)*	1009.6
16 / 0400	EUMDE17	32.9	28.0	230 / 65 *(35)*	1005.5
16 / 0500	EUMDE17	33.0	27.6	240 / 43 *(23)*	1004.0
16 / 0700	EUMDE17	33.1	27.3	360 / 96 *(52)*	1007.9
16 / 0740	9XLHEBZ	33.3	26.7	360 / 69 *(37)*	1010.0
16 / 1200	BATFR23	32.6	29.6	250 / 39 *(21)*	1007.1
16 / 2000	EUMDE06	32.1	31.2	230 / 61 *(33)*	1010.9
16 / 2000	9HA4330	32.2	29.6	320 / 37 *(20)*	1008.5
17 / 0100	EUMDE06	32.5	29.4	010 / 65 *(35)*	1011.7
17 / 0400	EUMDE06	32.8	28.3	360 / 72 *(39)*	1013.4
17 / 1800	C6UA2	34.8	30.7	330 / 39 *(21)*	1014.4
18 / 1100	C6WK7	34.3	30.3	010 / 83 *(41)*	1021.0
20 / 0000	C6UA2	34.0	33.4	250 / 48 *(26)*	1009.9

Table 4.a Selected surface rainfall observation (in Crete and surrounding islands)

Location	Rain on 15 Oct. [mm]	Rain on 16 Oct. [mm]	Rain on 17 Oct. [mm]	Rain on 18 Oct. [mm]	Total rain [mm]
Asi Gonia	123.8	45.2	11.2	21.8	202.0
Aghios	**157.6**	23.0	0.0	0.0	180.6
Sebronas (mount.)	98.0	30.0	11.4	**38.2**	177.6
Kouremenos*	85.9	**88.4**	0.3	0.0	174.6
Askyfou (mount.)	62.0	36.6	18.4	30.0	147.0
Spili	92.8	29.8	10.2	11.8	144.6
Neapoli	69.4	70.0	1.0	0.2	140.6
Samaria (mount.)	73.4	52.2	6.0	3.0	134.6
Potamoi (mount.)	80.6	33.6	15.8	3.0	133.0
Anogeia (mount.)	59.6	40.0	14.0	15.2	128.8
Tzermiadon (mount.)	70.8	14.0	25.8	11.2	121.8
Kakopetros	74.8	18.4	3.6	24.8	121.6
Therisos	53.4	13.6	12.0	36.8	115.8
Moni Toplou	105.4	0.2	0.0	0.0	105.6
Kalo Chorio*	83.6	19.0	0.0	0.0	102.6
Heraclion / east	89.2	0.0	0.0	0.0	89.2
Sitia	88.8	0.2	0.0	0.0	89.0
Tourloti*	80.8	7.4	0.0	0.0	88.2
Finokalia	78.4	7.6	0.8	0.0	86.8
Fourfouras	49.6	20.0	5.8	1.0	76.4
Plaka / Elounda	54.4	18.4	2.0	0.0	74.8
Ierapetra	56.6	6.6	0.0	0.0	63.2
Orino*	33.6	25.6	2.0	0.0	61.2
Heraclion / west	50.0	0.0	0.2	0.2	50.4
Masiá*	0.0	1.8	**46.3**	0.3	48.4
Kattavia	17.6	24.4	0.0	0.0	42.0
Emponas	23.0	15.6	0.0	0.0	38.6
Sisi	37.2	0.0	0.2	0.0	37.4
Lindos	33.6	0.8	0.0	0.0	34.4
Kasos	29.0	2.0	0.0	0.0	31.0

** Data from a personal weather station*

Table 4.b Selected surface rainfall observation (in Cyprus)

Location	Rain on 15 Oct. [mm]	Rain on 16 Oct. [mm]	Rain on 17 Oct. [mm]	Rain on 18 Oct. [mm]	Rain on 19 Oct. [mm]	Rain on 20 Oct. [mm]	Total rain [mm]
Empa*	53.6	**37.1**	43.2	0.0	19.5	0.0	153.4
Sea Caves / Peyia*	14.0	22.3	18.5	0.0	**78.0**	0.0	132.8
Paphos airport	**55.0**	20.6	41.3	0.0	9.9	0.0	126.8
Peyia*	18.5	22.8	26.7	4.1	42.4	0.0	114.5
Sia*	1.5	32.5	76.7	0.0	1.8	0.0	112.5
Ormideia*	0.0	30.0	**79.0**	0.0	0.8	0.2	110.0
Paphos*	32.7	22.1	22.6	0.0	20.6	0.0	98.0
Lefke	4.6	21.7	15.0	**15.8**	18.2	8.4	83.7
Larnaca airport	0.8	10.0	70.2	0.2	0.4	1.0	82.6
Yesilirmak	1.6	16.8	7.5	0.0	22.5	**30.1**	78.5
Miliou*	24.9	14.7	19.6	2.5	9.7	2.0	73.4
Latsia*	0.0	24.9	47.2	0.3	0.0	0.0	72.4
Peristerona*	22.9	17.7	19.6	1.0	8.7	0.2	70.1
Limassol*	2.7	23.0	34.3	0.0	6.9	0.0	66.9
Larnaca*	0.0	26.0	38.6	0.0	0.0	0.0	64.6
Morphou	0.6	9.3	25.0	0.0	21.0	5.9	61.8
Famagusta / Ammocho	0.0	16.1	40.7	0.0	1.7	1.8	60.3
Athalassa	0.4	17.0	35.0	0.0	0.0	0.0	52.4
Akdeniz	1.0	28.2	7.4	0.0	3.0	11.4	51.0
Lefkoniko	0.0	8.0	35.2	0.0	0.0	0.0	43.2
Moni*	0.3	19.5	17.1	0.3	5.4	0.0	42.6
Akrotiri	4.2	21.2	10.8	0.0	2.2	0.0	38.4
Tymbu / Nicosia	0.2	17.0	20.0	0.0	0.0	0.0	37.2
Iskele	0.0	15.5	10.0	0.0	10.8	0.0	36.3
Gecitkale	0.0	19.7	14.0	0.0	0.2	0.0	33.9
Kyrenia	0.5	9.8	14.4	0.0	0.0	0.0	24.7
Ayia Napa*	0.3	5.6	4.1	0.0	0.0	2.3	12.3

** Data from a personal weather station*

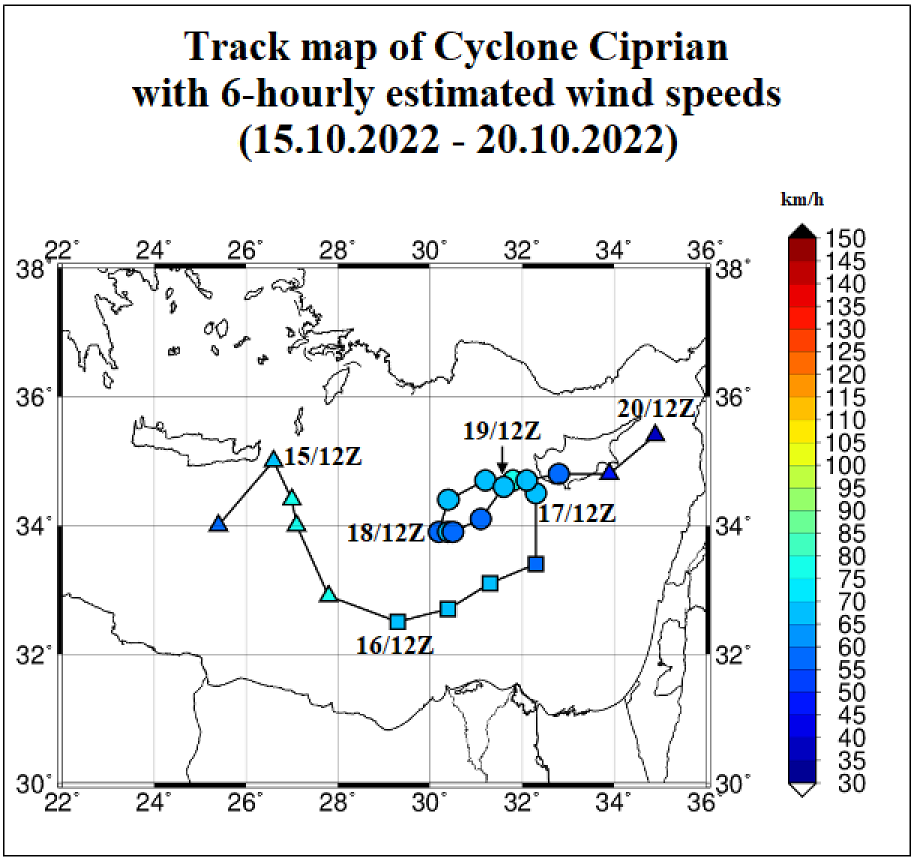

Figure 1. Best track positions for Tropical Storm Ciprian, 15-20 October 2022. The triangles mean extratropical, the squares subtropical and the circles tropical stage. The colors represented the estimated wind speeds (from Table 1) at the actual time. The position based on satellite images and ECMWF reanalysis.

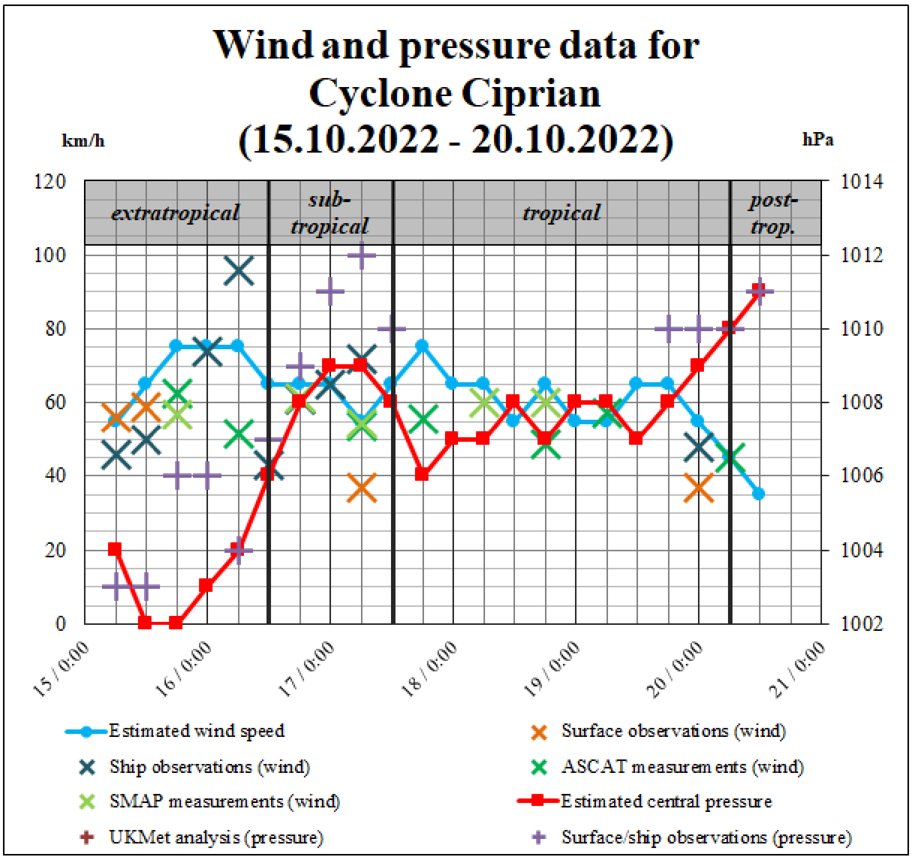

Figure 2. Selected wind and pressure observations with estimated maximum sustained wind and minimum central pressure for Tropical Storm Ciprian, 15-20 October 2022. The stated 6 hourly data mean the maximum sustained wind within a 3-hour interval around the marked time in case of all measurements.

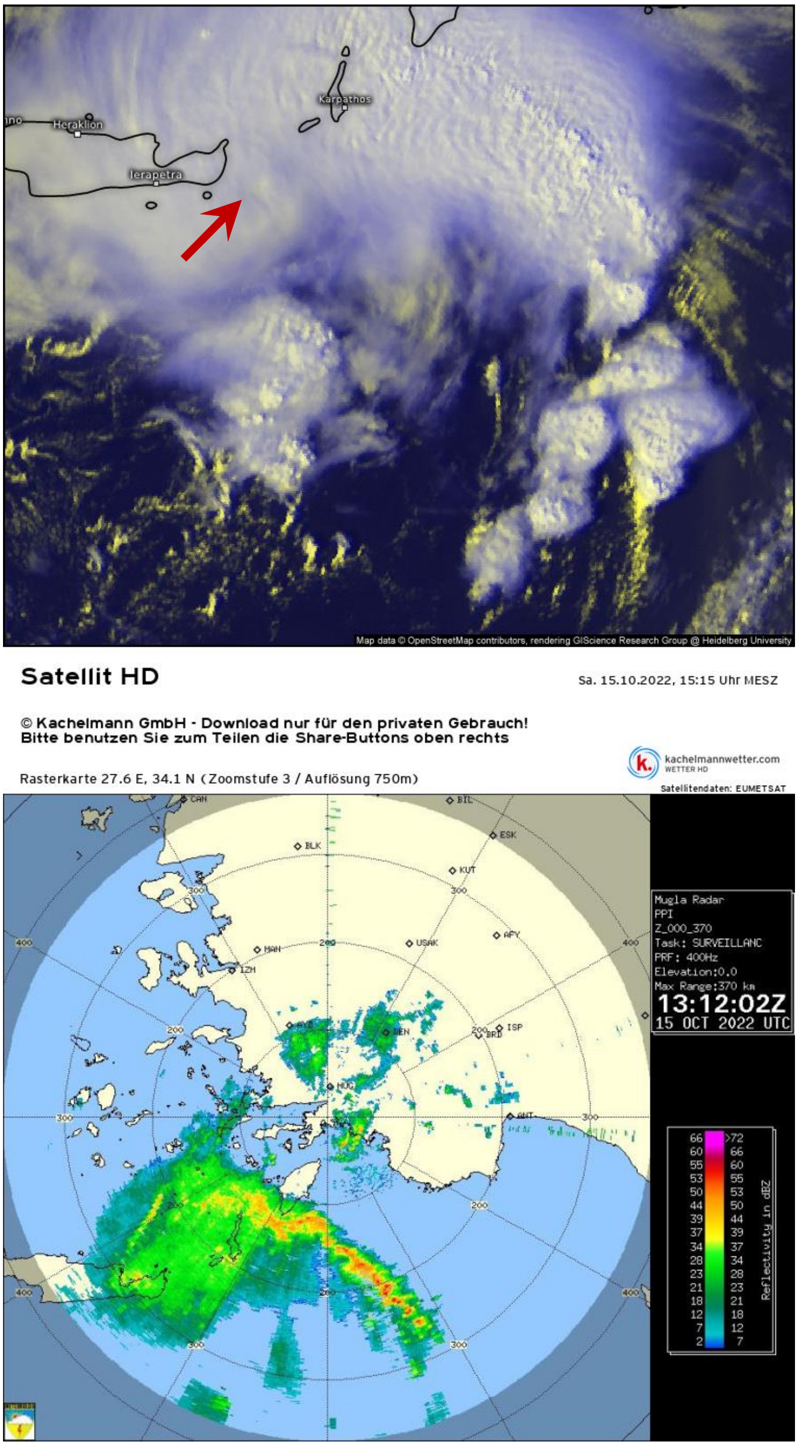

Figure 3. Visible (RGB) satellite image and radar image of Ciprian at 1315 UTC and 1312 UTC 15 October. At this time, a large mesoscale convective system with a strong linear band to east-northeast developed around the cyclone’s center (signed by red arrow) which caused heavy rains in East Crete, the nearby islands and Southwest Turkey. *Source: EUMETSAT / Kachelmannwetter, Turkish State Meteorological Service*

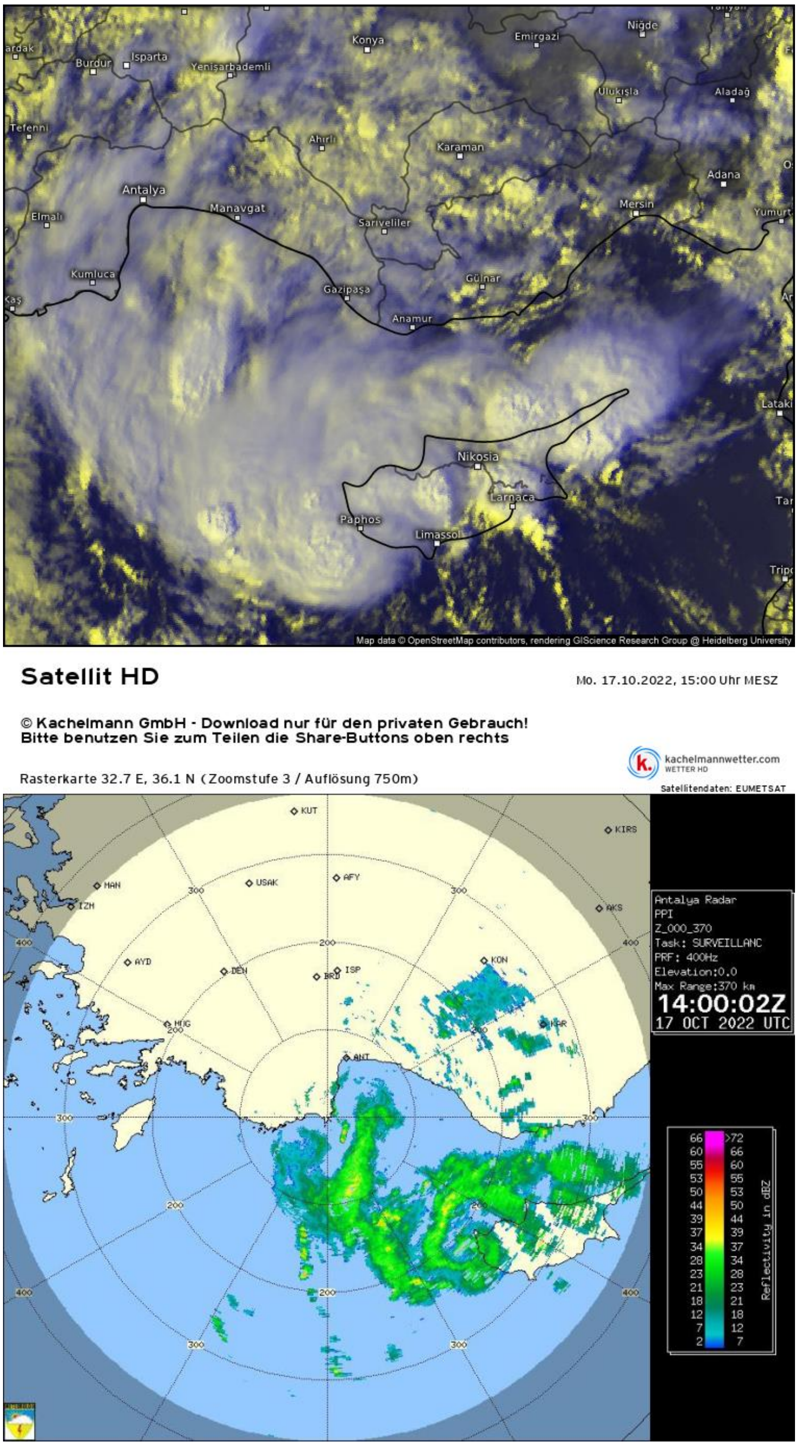

Figure 4. Visible (RGB) satellite image and radar image of Ciprian at 1300 UTC and 1400 UTC 17 October. The cyclone had the most organized structure at this time with a small central dense overcast, an eye-like feature and curved outer rainbands. A well-defined upper-level outflow also developed, especially to northwest and north. *Source: EUMETSAT / Kachelmannwetter, Turkish State Meteorological Service*

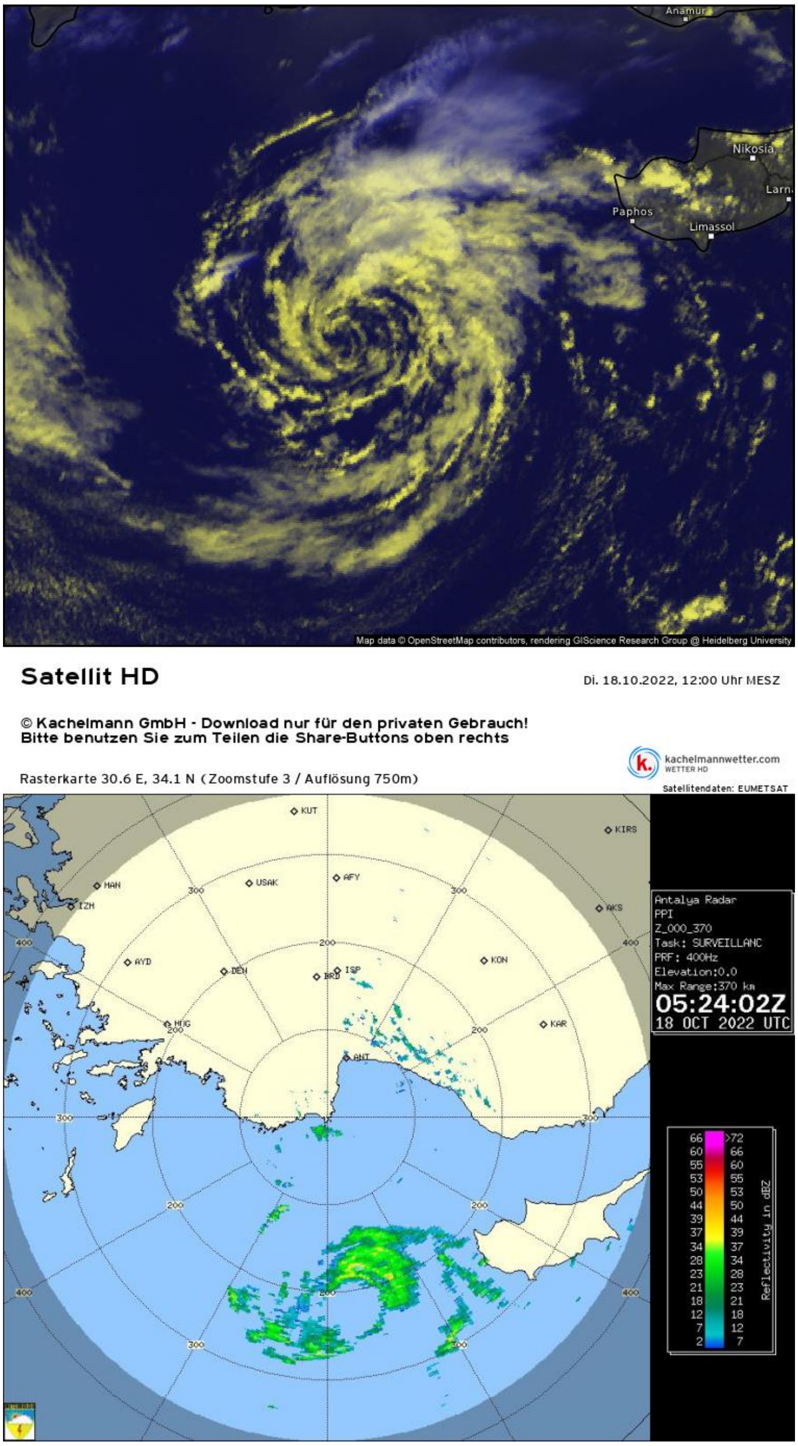

Figure 5. Visible (RGB) satellite image and radar image of Ciprian at 1000 UTC and 0524 UTC 18 October. After the cyclone moved away from Cyprus, it gradually weakened, but its low-level circulation remained well-defined. *Source: EUMETSAT / Kachelmannwetter, Turkish State Meteorological Service*

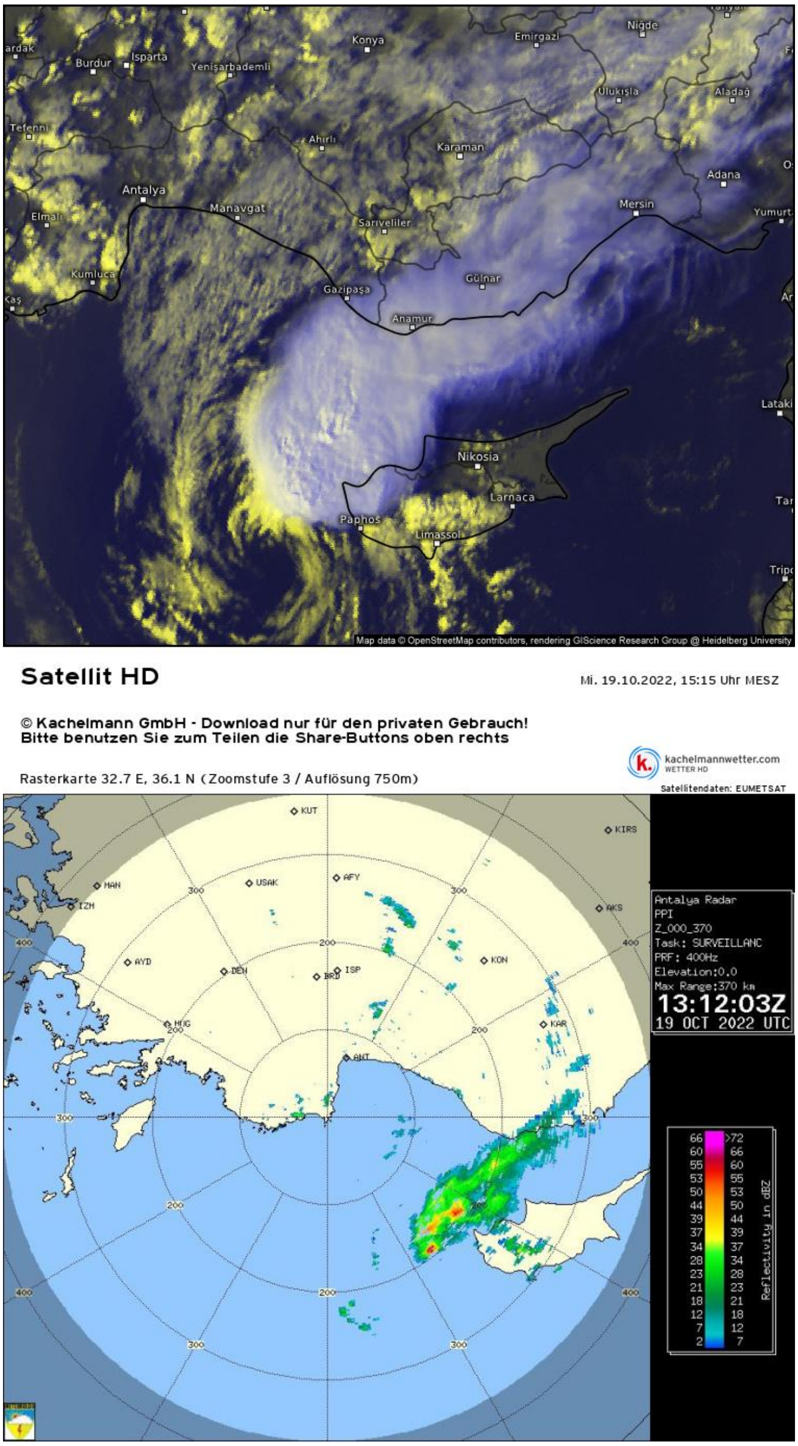

Figure 6. Visible (RGB) satellite image and radar image of Ciprian at 1315 UTC and 1312 UTC 19 October. As the cyclone approached Cyprus once again, sustained, deep convection with intense thunderstorms returned, but it concentrated into the northeast quadrant due to the persistent, strong wind shear. *Source: EUMETSAT / Kachelmannwetter, Turkish State Meteorological Service*

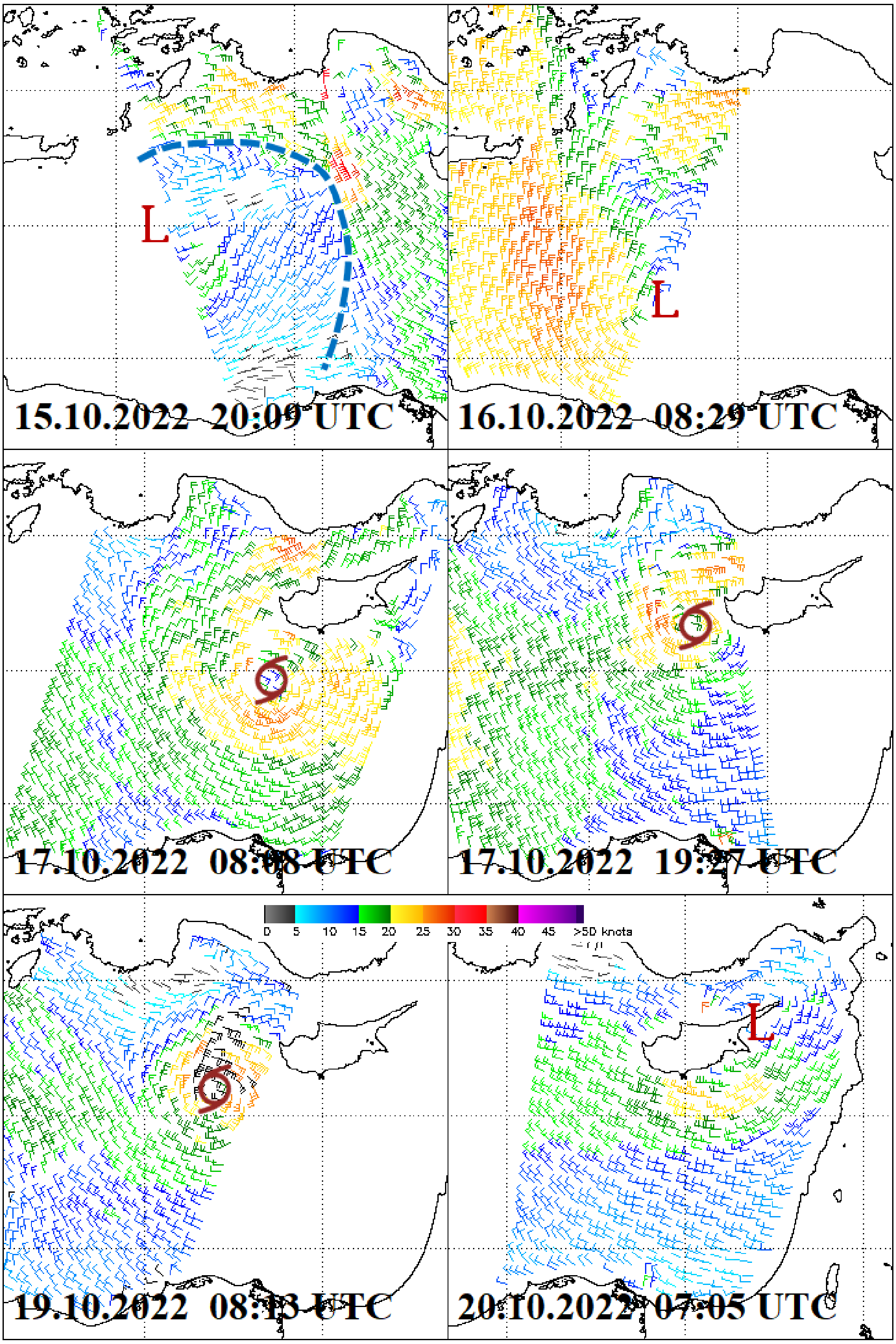

Figure 7. Satellite-based wind data of Ciprian between 15-20 October measured by ASCAT-A and ASCAT-B sensors. *Source: NOAA NESDIS*

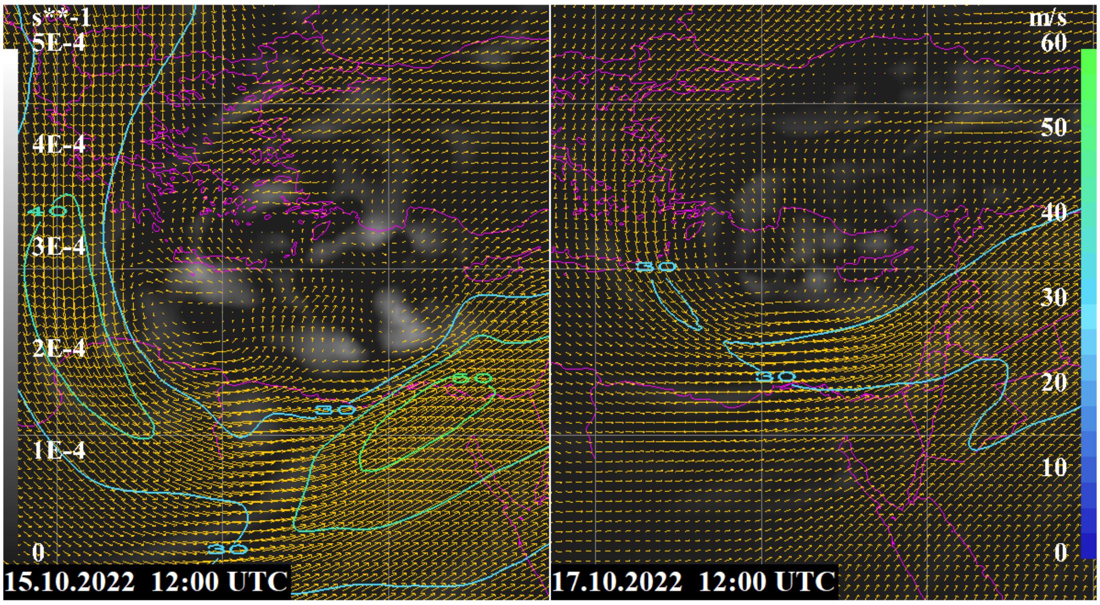

Figure 8. 300 hPa divergence (shaded) and winds (vectors and contours per 10 m/s from 30) over the Eastern Mediterranean Sea at 1200 UTC 15 October and 1200 UTC 17 October. *Data source: ECMWF/Copernicus*

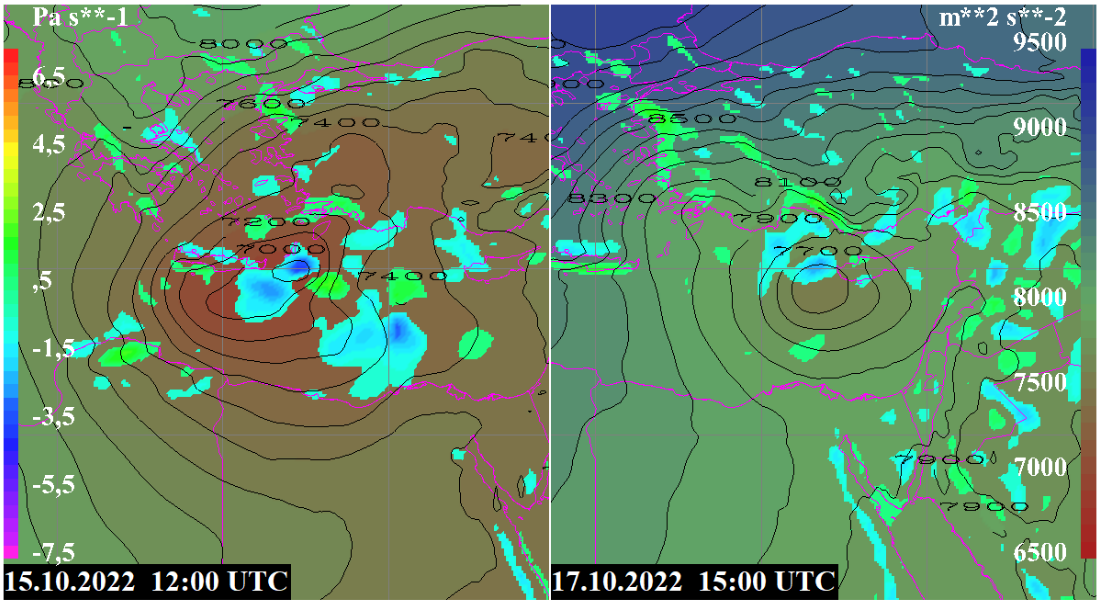

Figure 9. 925 hPa geopotential (shaded with black contours) and 850 hPa vertical speed (shaded patches, without the -0,5 to 0,5 Pa/s range) over the Eastern Mediterranean Sea at 1200 UTC 15 October and 1500 UTC 17 October. *Data source: ECMWF/Copernicus*

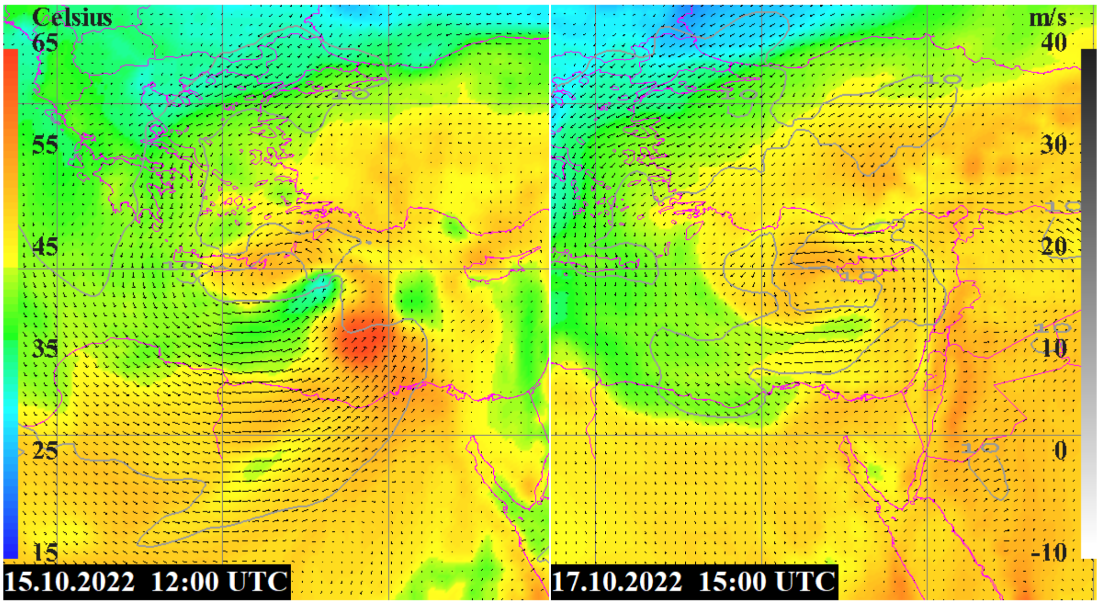

Figure 10. 850 hPa equivalent potential temperature (shaded) and winds (vectors and contours per 10 m/s) over the Eastern Mediterranean Sea at 1200 UTC 15 October and 1500 UTC 17 October. *Data source: ECMWF/Copernicus*

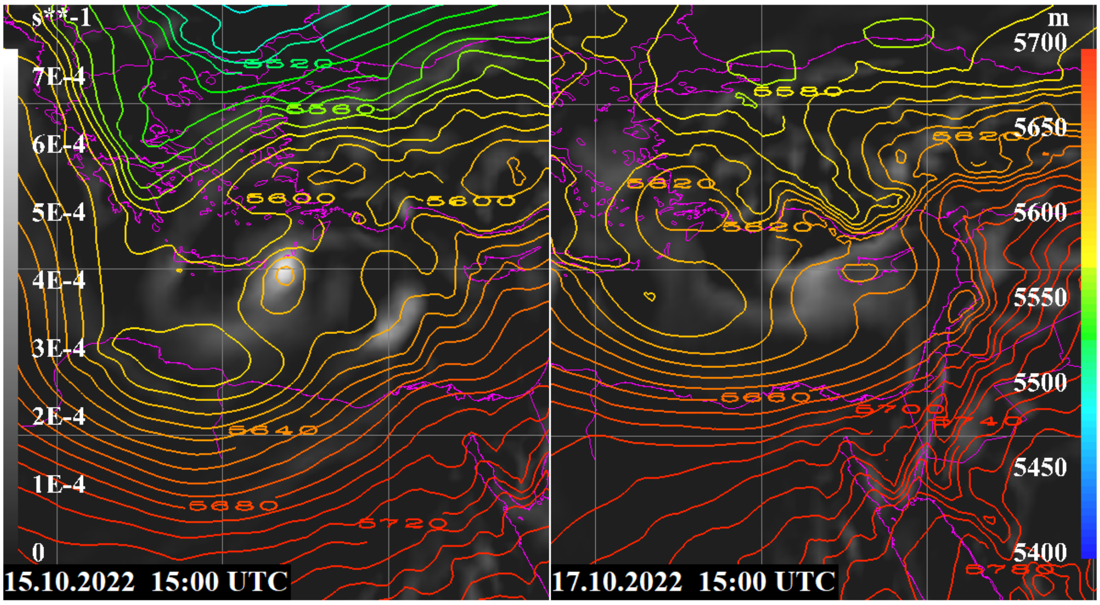

Figure 11. 500-1000 hPa thickness (contours per 10 m) and 850 hPa relative vorticity (shaded) over the Eastern Mediterranean Sea at 1500 UTC 15 October and 1500 UTC 17 October. *Data source: ECMWF/Coperncus*

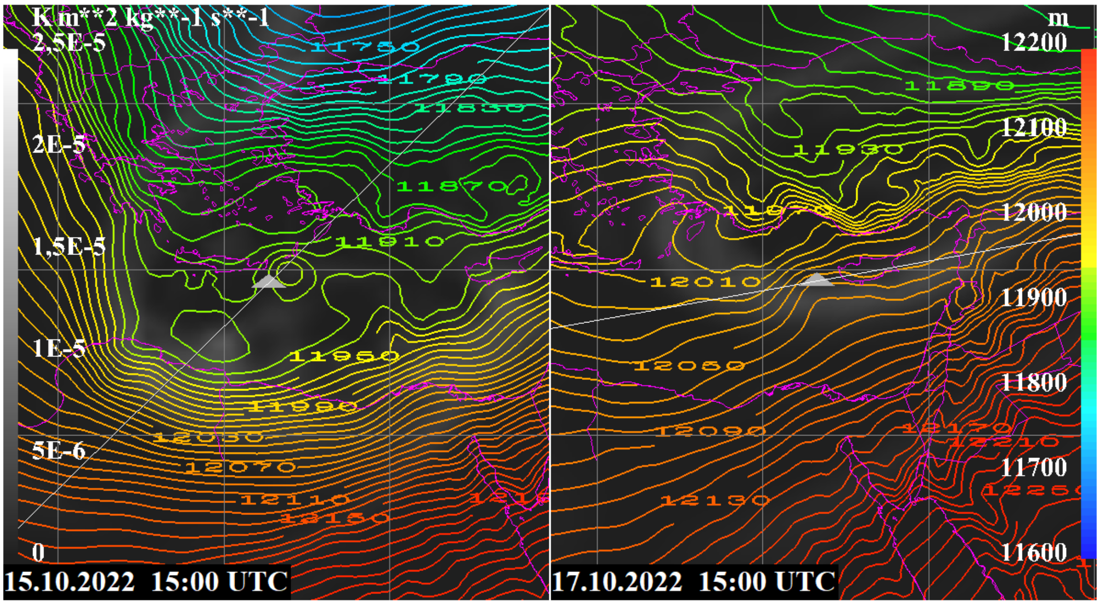

Figure 12. 200-1000 hPa thickness (contours per 10 m) and 300 hPa potential vorticity (shaded) over the Eastern Mediterranean Sea at 1500 UTC 15 October and 1500 UTC 17 October. *Data source: ECMWF/Copernicus*

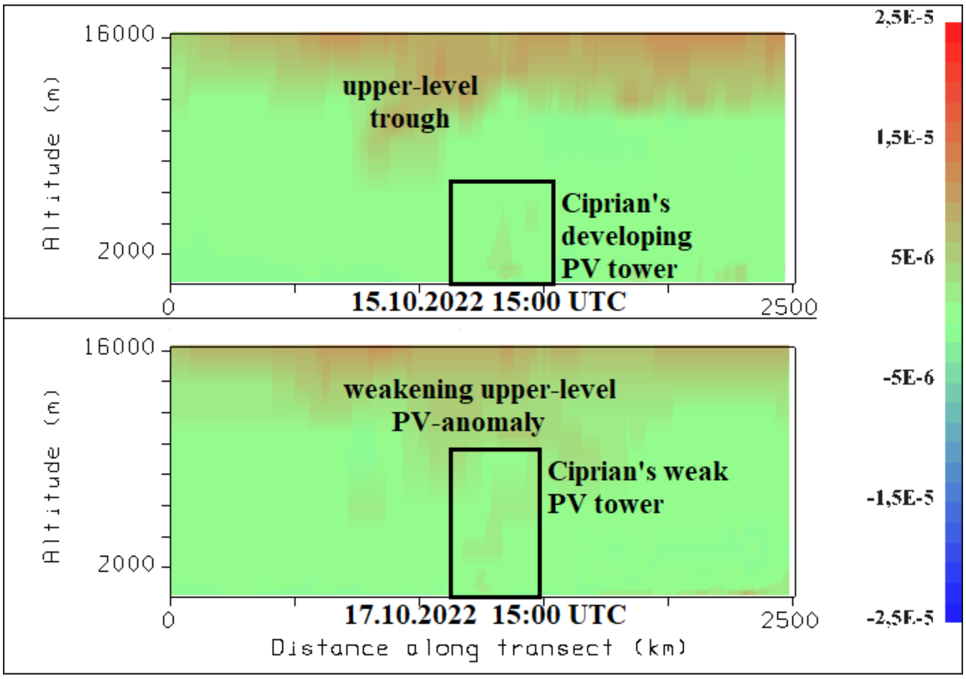

Figure 13. Potential vorticity vertical crosses through the center of Ciprian and its environment at 1500 UTC 15 October and 1500 UTC 17 October. The cross-sections marked with thin white lines on Figure 12. *Data source: ECMWF/Copernicus*