

MEDITERRANEAN TROPICAL CYCLONE REPORT

Written by:
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Subtropical Storm Blas
11-14 November 2021

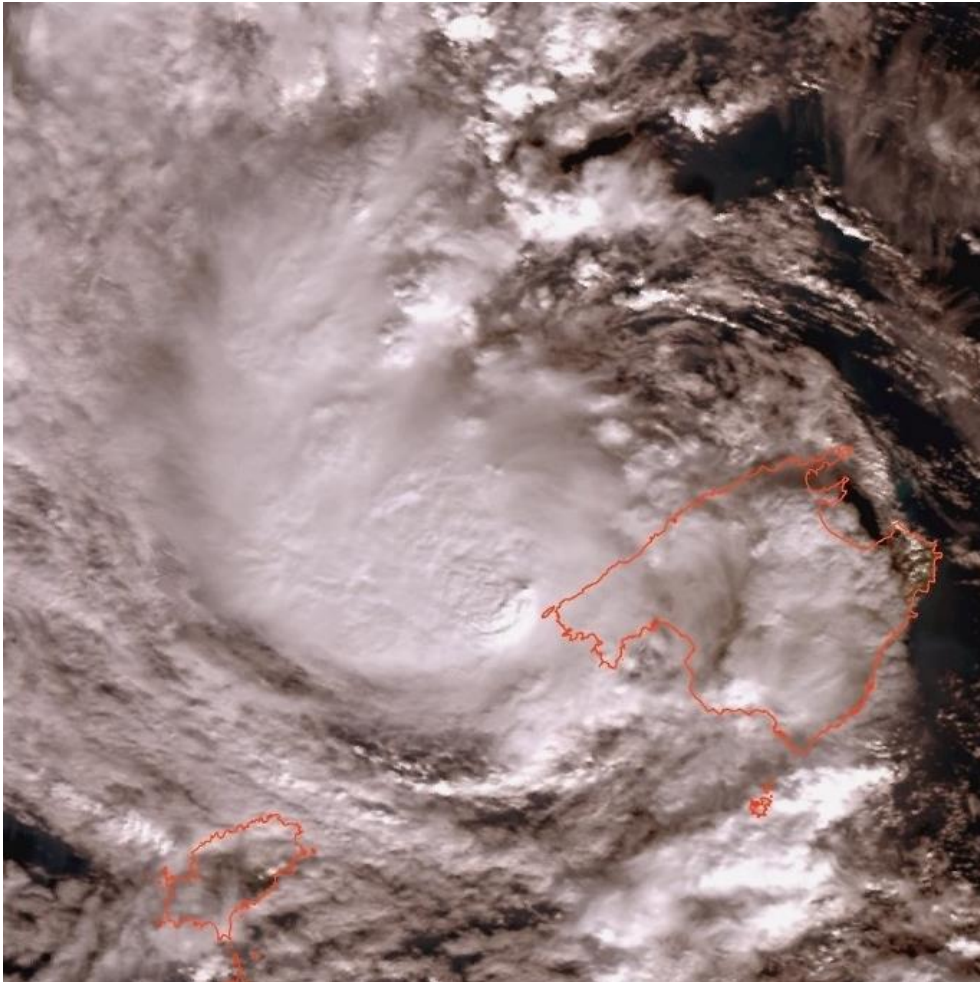


Image: ESA / Sentinel-3

Blas (named by the Italian Meteorological Service) was a small, complex cyclone which remained in connection with a larger upper- to mid-level level low and fluctuated between non-tropical and subtropical stages as it meandered near the Balearic Island, Sardinia and Corsica.

Synoptic history

In the first days of November – when the previous storm, Apollo dissipating over Turkey – a deep-layer trough with a strong cold front reached the Western Mediterranean Sea, where a secondary low formed and moved through Italy. On 2 November, another wave of cold airmass reached West Europe which led to cyclogenesis over France, and a secondary low again developed over the Gulf of Genoa in the next day. This cyclone had a very long frontal zone line from North Africa to Central Europe, connected with a subtropical jet stream in a forward side of a large upper-level trough, and on 6 November a secondary low formed along it over the Western Mediterranean Sea. Thanks to the upper-level trough, cold air aloft enhanced the instability, thus the cyclone initially had widespread convection in its central region, partially associated with the occlusion front.

In the next days the cyclone's structure did not change much: it consisted of the moderately separated central feature with pulsating convection which meandered between Sardinia and the Balearic Island, and large areas of frontal cloudiness mainly east to it. On 9 November the upper-level trough cut off from the westerlies and transformed into a large upper-level low that remained nearly stationary over the cyclone in the next days. On 10 November the fronts started to weaken and detach much more from the center, where the convection temporarily increased, but it did not become organized yet. However, around 0600 UTC 11 November, a very small cluster of thunderstorms with cloud top temperature around -50 , -55 °C formed over the center and persisted through much of the day (Fig. 3). Since the cyclone – which got the name 'Blas' around this time – still had connection to the upper-level low, it became subtropical. Around midday, the small low partially affected the west side of Mallorca Island, and thereafter the convection temporarily weakened, but new burst developed mainly east and north of the center as Blas slowly moved away to south. In the night hours a well-defined mid- to upper-level vortex approached the cyclone from east, which also generated a secondary low in the surface for a short time (see ASCAT passes in the next chapter). This feature disrupted the small cyclone's circulation which temporarily became very elongated, almost opened up into a trough, while the convection also became much more disorganized and driven by the upper-level low. Based on this, Blas probably even degenerated into a post-tropical low a while in the daytime of 12 November, but since around 1700 UTC a new burst of deep convection with cloud top temperature around -55 , -60 °C redeveloped on the east side of the cyclone and persisted through the night hours (Fig. 4), it was left as subtropical depression in the whole day. In the night hours Blas remained in

connection with the upper-level low as it moved southwestward from north to west of the cyclone, and it also likely helped the convection with some enhancement of the upper-level divergence. Thanks to the reorganization, Blas became subtropical storm again around 1800 UTC. After 0300 UTC 13 November, the convection started to weaken again as it wrapped to the north side of the low, and totally dissipated by 0800 UTC. Since only very shallow convective cells appeared around the well-defined low-level circulation thereafter, Blas became a post-tropical cyclone (Fig. 5).

Later that day, another upper-level low approached the Gulf of Genoa, which led to the genesis of a weak extratropical low in that area. Thanks to this feature's streaming, Ex-Bals started to move eastward in the night hours. The more favorable upper-level flow supported the redevelopment of the convection, which totally wrapped around the center by the late morning hours (Fig. 6). However, it was shallower than earlier with cloud top temperature around only, -45 , -50 °C. Based on satellite images, Blas already had some interaction with the extratropical low's developing frontal zone, but it remained more separate until the late-night hours, thus, it became subtropical in second time between 0600 UTC 14 November and 0000 UTC 15 November. The cyclone affected the south parts of Sardinia with almost landfall near *Capo Carbonara* at 1300 UTC and gradually turned northeastward, then northward in the eastern periphery of the extratropical low. After 0000 UTC the cyclone became embedded within the frontal while its low-level circulation elongated north to south based on the later ASCAT passes. Thanks to the synoptic support – mainly the stronger upper-level divergence –, the convection temporarily strengthened in the second half of the night, the coldest cloud top's temperature reached the values between -55 and -60 °C. After 0600 UTC the convection weakened quickly and displaced to northwest, while the remained low-level circulation became absorbed into the extratropical cyclone's flow.

Meteorological statistics

Blas spent most of its lifetime over the open water, but sometimes moved closer to the Balearic Islands and on 14-15 November to Sardinia, Corsica and Italy, so surface wind and pressure (Tabl. 2) as well as precipitation (Tabl. 4) data were available from these areas. Ship reports (Tabl. 3), ASCAT (Fig. 7) and SMAP measurements also helped the estimation of the cyclone's intensity.

Winds and pressure

When the cyclone formed as extratropical, it already produced winds around 75-80 km/h (40 kt) in a large area, mainly on the north and west side of the circulation. These values were confirmed by surface measurements from the Balearic Islands, ship reports and satellite measurements. The wind did not change much from 6 to 8 November but based on ship reports and the UK Met Office analysis, the central pressure steadily decreased to about 1006 hPa. *Capdepera* and *Sierra de Alfàbia* occasionally reported 10-min. sustained winds of 65-80 km/h (35-40 kt) and wind gusts of 100-110 km/h (50-55 kt) between the morning hours of 6 and 7 November. Blas temporarily weakened a bit on 9 November, followed by a strengthening phase on the next day. The ship ‘BATFR18’ reported wind of 83 km/h (45 kt) at 1800 UTC while a SMAP pass also measured wind of 86 km/h (46 kt) at 1705 UTC. Besides, the central pressure also dropped a few more hPa at this time. The cyclone’s intensity remained the same until the morning hours of 11 November, when the cyclone completed its subtropical transformation, confirmed by a SMAP wind data of 83 km/h (45 kt) at 0640 UTC. Thanks to this, Blas reached the peak intensity immediately after its transition, around 0600 UTC with wind of about 85 km/h (45 kt) and pressure of 1004 hPa.

Thereafter, the storm started to weaken gradually, and all the measurements indicated it became a subtropical depression by 12 UTC 12 November. However, as the deep convection returned in the evening hours, some slight restrengthening occurred at night and Blas regained its storm status with wind around 65 km/h (35 kt). This was confirmed by a report from ship ‘VRTU9’ at 0000 UTC 13 November. After the morning hours, when the convection collapsed and the low degenerated to post-tropical, all measurement showed decreasing wind speed again, except the SMAP, which still indicated wind of 67-69 km/h (37 kt) at 0615 UTC and 1717 UTC but based on the cyclone’s structure these seemed too high. On 14 November Blas quickly restrengthened as convection returned and wrapped around the center. An ASCAT pass measured maximum wind near 55 km/h (30 kt) at 0811 UTC, however, direct wind measurements unfortunately were not available after this time, when the cyclone likely reached its secondary peak with winds of at least 75 km/h (40 kt) at 1200 UTC. At this time, *Capo Carbonara*’s airport reported QNH pressure of 1004 hPa while pressure in the area of *Cagliari* decreased to only 1008 hPa which indicated tight pressure gradient in the cyclone’s center.

Rainfall

Since Blas was embedded in the circulation of the larger upper- to mid-level low which stalled over the Western Mediterranean Sea for many days, it was impossible to separate the rain amount from the small subtropical storm and the larger vortex, so the data in Tabl. 3 include the total rain amounts of these complex weather event. However, this report does not contain the additionally rain summaries of the new cyclonic system which absorbed Blas on 15 November and affected these areas until 17-18 November. Thanks to its long-lasting meandering around a same place, the cyclone caused high amount of rain in the Balearic Islands, and locally also in Sardinia and Corsica during its 10-days (extratropical and subtropical) lifetime. The most rain fell in the mountainous region of Mallorca Islands, where the total summary exceeded 300 mm: it fell 361,0 mm rain in *Sierra de Alfàbia* and 320,4 mm in *Lluc* – it worth to be note that there was a several hours long data outage in the latter city on 10 and 11 November, so the real precipitation amount was likely even higher there. In *Sierra de Alfàbia* the daily amount reached 90,9 mm on 9 November and 120,7 mm on 10 November, while in *Lluc* 101,2 mm on 9 November. Blas also caused 130,0 mm and 81,0 mm rain in *Cagliari / Elmas* on 14 and 15 November, where the total amount reached 279,0 mm. Otherwise, the 10-day summary of precipitation were around 100 mm in the most place of the Balearic Islands, in the southern and eastern side of Sardinia and the eastern side of Corsica. Additionally, similar values were measured locally on the mainland of Italy. The heavy rains led flash floods and mudslides, especially on the elevated regions.

Storm Surge

Blas was small and weak in its subtropical phases, so it did not cause much ripple, the maximum significant wave heights (SWH) were mostly around 1.5-2 m (5-7 feet) from 11 November based on satellite measurements. However, in the extratropical phase between 6 and 10 November, SWH of around 3-4.5 m (10-15 feet) occurred in a larger area around the cyclone's center.

Reanalysis data

Blas 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 6 November to 2100 UTC 15 November. However, only two images are listed here: the first one is at 1500 UTC 11 November, when Blas had the best structure shortly after its peak intensity, and second one at 1200 UTC 14 November, when the cyclone regenerated into a subtropical storm for a short time. An animation of all reanalysis maps is available here:

<https://www.youtube.com/watch?v=ot3pi-vSN1EW>

The cyclone developed under classic extratropical conditions: an elongated upper-level trough stretched toward the Western Mediterranean Sea from northeast with significant upper-level positive potential vorticity anomaly, and the cyclogenesis was forced further by temporarily strong upper-level divergence associated with the jet stream around the trough and high temperature difference between the northwest and southeast side of the low. The environment did not change much until 8 November, while the center of the occluding cyclone remained under the middle of the upper-level low within a low-shear environment. In addition, parts of the warm conveyor belt at 850 hPa gradually wrapped into the center and the 850 hPa relative vorticity slowly became more concentrated and stronger there. Occasionally stronger patches of updrafts also appeared on the 850 hPa vertical velocity maps. These conditions helped Blas to generate and maintain convection in its central region. On 9 November warm core started to develop both on 500-1000 hPa and 200-1000 hPa thickness maps which became more apparent on the next day. However, 850 hPa equivalent potential temperature (EPT), relative vorticity and updraft positions suggested that the low still had connection with the decaying frontal zones around it. On the 850 hPa EPT maps a dry intrusion also appeared around 1200 UTC which temporarily disrupted the cyclone's warm core, but it became stronger again from the evening hours.

By 11 November the cyclone's center became more concentrated and isolated with well-defined warm core, 850 hPa relative vorticity maximum and moderately strong updrafts, but it still connected to the weakening upper-level low and the remnants of the potential

vorticity streamer which has been wrapping around the cyclone since 9 November, so the reanalysis confirmed it was rather subtropical than tropical. On 12 and 13 November a newly formed, smaller-scale upper-level low moved around the cyclone from northeast to southwest which initially caused upper-level convergence over it, followed by a short divergent phase in the night hours, when some deep convection redeveloped. From the morning hours of 13 November, the upper-level flow became more convergent again and vertical wind shear also increased and in line with the fast collapse of the convection the 850 hPa vorticity and updrafts as well as the warm core also weakened, the latter especially on the 200-1000 hPa thickness maps. On 14 November, when Blas regenerated for a short time, reanalysis maps showed no development but rather a further weakening. The warm core was just barely detectable on the thickness maps while these and the 850 hPa EPT maps also showed cold advection from northwest. In addition, the 850 hPa relative vorticity and the central warm area of the 850 hPa EPT became increasingly elongated and later it connected to the vorticity area of a new extratropical low over the Gulf of Genoa and Blas almost merged with this cyclone in the evening hours according to the 925 hPa geopotential. So, despite the well-defined structure on the satellites, synoptically the storm's redevelopment was ill-defined. Blas always remained in connection with the upper-level lows over and around it and its potential vorticity anomalies, and it never developed distinct low-level potential vorticity anomaly which would have been visibly on the vertical cross-sections.

Table 1 Best track for Blas, 6-16 November 2021

Day/Time [UTC]	Latitude [°N]	Longitude [°E]	Pressure [hPa]	Wind speed [km/h (kt)]	Stage
06 / 0000	37.3	3.7	1011	75 (40)	extratropical
06 / 0600	37.1	3.6	1011	75 (40)	”
06 / 1200	37.0	3.3	1010	75 (40)	”
06 / 1800	37.0	3.9	1010	75 (40)	”
07 / 0000	37.9	5.3	1010	75 (40)	”
07 / 0600	38.0	5.5	1009	75 (40)	”
07 / 1200	38.7	5.2	1008	75 (40)	”
07 / 1800	38.3	6.7	1008	75 (40)	”
08 / 0000	38.6	7.5	1008	75 (40)	”
08 / 0600	38.9	5.9	1008	75 (40)	”
08 / 1200	38.4	6.4	1007	75 (40)	”
08 / 1800	38.5	7.6	1007	75 (40)	”
09 / 0000	39.1	7.5	1006	75 (40)	”
09 / 0600	38.7	6.6	1006	65 (35)	”
09 / 1200	38.7	5.3	1006	65 (35)	”
09 / 1800	38.5	4.2	1007	65 (35)	”
10 / 0000	38.0	3.4	1007	65 (35)	”
10 / 0600	38.2	4.2	1006	75 (40)	”
10 / 1200	38.8	5.3	1005	75 (40)	”
10 / 1800	39.6	4.8	1004	85 (45)	”
11 / 0000	40.2	4.0	1004	85 (45)	”
11 / 0600	40.3	3.1	1004	85 (45)	subtropical storm
11 / 1200	39.5	2.4	1005	75 (40)	”
11 / 1800	39.4	2.4	1006	65 (35)	”
12 / 0000	38.9	2.5	1006	65 (35)	”
12 / 0600	38.4	2.7	1007	65 (35)	”
12 / 1200	37.9	3.3	1008	55 (30)	subtropical depression
12 / 1800	37.9	4.3	1008	55 (30)	”
13 / 0000	38.2	5.2	1007	65 (35)	subtropical storm
13 / 0600	38.6	5.1	1007	65 (35)	”
13 / 1200	38.8	5.2	1008	55 (30)	low
13 / 1800	38.8	5.5	1008	55 (30)	”
14 / 0000	38.5	6.2	1008	55 (30)	”
14 / 0600	38.4	7.6	1007	55 (30)	subtropical depression
14 / 1200	38.9	9.3	1004	75 (40)	subtropical storm
14 / 1800	39.9	10.7	1005	75 (40)	”
15 / 0000	41.3	11.1	1007	65 (35)	low
15 / 0600	42.7	9.6	1008	65 (35)	”
15 / 1200					dissipated
11 / 0600			1004	85 (45)	minimum pressure and maximum wind
14 / 1200			1004	75 (40)	minimum pressure and secondary wind maximum

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)]
Menorca / Mahon (Sp. / Baleares)			06 / 0800	63 (34)	79 (43)
Capdepera (Sp. / Baleares)			06 / 0900	76 (41)	101 (55)
Menorca / Mahon (Sp. / Baleares)			06 / 1000	61 (33)	87 (47)
Skikda (Algeria)	06 / 1500	1009.8			
Sierra de Alfabia (Sp. / Baleares)			06 / 2200	58 (31)	108 (58)
Menorca / Mahon (Sp. / Baleares)			07 / 0000	65 (35)	95 (51)
Sierra de Alfabia (Sp. / Baleares)			07 / 0400	79 (43)	112 (60)
Capo Bellavista (It. / Sardinia)	07 / 1600	1009.0			
Capo Caccia (It. / Sardinia)	08 / 1600	1008.0			
Capdepera (Sp. / Baleares)			09 / 0800	65 (35)	83 (45)
Menorca / Mahon (Sp. / Baleares)			09 / 1000	57 (31)	76 (41)
Capdepera (Sp. / Baleares)			09 / 1400	38 (21)	83 (45)
Menorca / Mahon (Sp. / Baleares)	09 / 1500	1008.5			
Porto Colom (Sp. / Baleares)	09 / 1700	1008.9			
Sierra de Alfabia (Sp. / Baleares)			10 / 0300	47 (25)	72 (39)
Menorca / Mahon (Sp. / Baleares)	10 / 2000	1005.8			
Menorca / Mahon (Sp. / Baleares)	11 / 0000	1007.2			
Sierra de Alfabia (Sp. / Baleares)			11 / 0400	54 (29)	94 (51)
P. De Mal. / Son S. J. (Sp. / Baleares)	11 / 1100	1008.2	11 / 1100	48 (26)	61 (33)
Palma De Mallorca (Sp. / Baleares)	11 / 1200	1007.8			
Porto Colom (Sp. / Baleares)			11 / 1700	43 (23)	65 (35)

Sierra de Alfabia (Sp. / Baleares)			11 / 1900	32 (17)	76 (41)
Capdepera (Sp. / Baleares)			12 / 2000	43 (23)	61 (33)
Sierra de Alfabia (Sp. / Baleares)			13 / 0200	58 (31)	86 (46)
Capdepera (Sp. / Baleares)			13 / 1400	47 (25)	54 (29)
Capo Carbonara (It. / Sardinia)	14 / 1155	1007.9	14 / 1155	39 (21)	61 (33)
Capo Carbonara (It. / Sardinia)	14 / 1255	1004			
Capo Bellavista (It. / Sardinia)	14 / 1800	1008.8			
Ponza (Italy)			15 / 0100	48 (26)	63 (34)
M. Calamita (Italy)	15 / 0600	1004.5	15 / 0600	65 (35)	

Table 3 **Selected ship reports**

Day/Time [UTC]	Ship call sign	Latitude [°N]	Longitude [°E]	Wind dir/speed [km/h (kt)]	Pressure [hPa]
06 / 1600	EUMDE10	36.7	1.2	280 / 80 (43)	1014.6
09 / 0600	2ICI3	37.9	5.9	330 / 13 (7)	1007.3
09 / 1100	S6DU7	37.7	5.7	340 / 43 (23)	1009.0
09 / 1900	BATFR23	40.9	4.2	050 / 54 (29)	1015.5
10 / 0300	BATFR23	37.9	3.3	040 / 46 (25)	1008.0
10 / 0400	BATFR18	38.7	2.5	040 / 65 (35)	1011.6
10 / 1100	ADFBKUM	37.0	3.8	250 / 65 (35)	1011.4
10 / 1800	BATFR18	40.1	5.2	090 / 83 (45)	1006.7
10 / 2200	BATFR23	38.3	3.4	270 / 65 (35)	1013.6
11 / 0200	BATFR23	39.6	3.6	260 / 57 (31)	1009.5
11 / 0300	BATFR23	40.0	3.7	270 / 46 (25)	1007.3
11 / 0500	BATFR23	40.6	4.0	140 / 61 (33)	1010.6
11 / 1800	EUCFR08	39.8	0.9	010 / 65 (35)	1013.4
12 / 0900	EUCDE40	37.6	3.3		1010.5
12 / 1500	DHPG2	37.6	4.7	230 / 54 (29)	1010.9
12 / 1800	EUMDE31	37.2	4.2	210 / 57 (31)	1009.9
13 / 0000	VRTU9	37.1	4.2	230 / 65 (35)	1011.5
14 / 0300	BATFR23	38.9	8.3	210 / 46 (25)	1009.8
14 / 1300	EUMDE10	37.7	9.9	110 / 115 (62)	1010.2
14 / 1900	BATFR23	37.9	9.7	270 / 46 (25)	1012.9

Table 4 Selected surface rainfall observation

Location	Rain on 6 Nov. [mm]	Rain on 7 Nov. [mm]	Rain on 8 Nov. [mm]	Rain on 9 Nov. [mm]	Rain on 10 Nov. [mm]	Rain on 11 Nov. [mm]	Rain on 12 Nov. [mm]	Rain on 13 Nov. [mm]	Rain on 14 Nov. [mm]	Rain on 15 Nov. [mm]	Total rain [mm]
Sierra de Alfabia (Sp. / Balears)	2.7	0.3	10.9	90.9	120.7	22.6	59.4	8.1	13.0	32.4	361.0
Lluc (Sp. / Balears)	0.0	3.2	8.9	101.2	13.0*	4.7*	104.0	31.8	19.8	33.8	320.4
Mallorca / Mehon (Sp. / Balears)	18.7	21.6	2.7	44.5	24.1	8.5	5.3	0.0	7.9	35.8	169.1
Muro (Sp. / Balears)	0.0	1.0	0.2	31.8	32.4	11.2	21.8	0.0	28.4	6.4	133.2
Es Mercadal (Sp. / Balears)	3.2	9.8	0.4	24.2	43.6	3.0	14.0	0.0	13.6	18.2	130.0
Artà, Moli d'en Leu (Sp. / Balears)	1.0	2.0	1.0	28.4	28.8	2.4	18.0	0.0	16.6	25.0	123.2
Sa Pobla - Sa Canova (Sp. / Balears)	2.2	1.2	4.0	33.6	33.4	8.0	19.4	0.0	8.8	11.0	121.6
Sóller (Sp. / Balears)	0.4	0.0	10.0	41.0	17.8	10.4	22.8	2.4	9.0	3.4	117.2
Palma de Mallorca / Uni. (Sp. / Balears)	0.0	0.0	0.8	22.8	36.2	19.6	10.4	2.0	18.6	6.8	117.2
Llucmajor (Sp. / Balears)	0.0	0.0	0.0	0.2	6.2	65.8	3.6	1.0	20.6	8.0	105.4
Palma de Mallorca (Sp. / Balears)	0.0	0.0	0.1	24.3	23.6	32.4	8.3	0.2	9.8	3.1	101.8
Mallorca – Son Bonet (Sp. / Balears)	0.0	1.0	0.6	27.4	17.6	20.4	9.0	0.0	12.6	4.2	92.8
Banyalbufar (Sp. / Balears)	0.0	0.0	4.0	17.8	25.6	7.4	14.2	1.0	18.4	2.0	90.4
Porreres (Sp. / Balears)	0.5	0.9	0.9	23.8	5.2	25.0	5.5	0.2	16.1	5.5	83.6

Porto Colom (Sp. / Balears)	0.8	1.6	0.0	14.4	6.0	5.2	1.6	0.0	39.0	9.6	78.2
Artà, Colonia Sant Pere (Sp. / Balears)	0.2	1.4	0.4	40.0	9.0	0.6	7.2	0.0	0.4	2.0	61.2
Ibiza / Es Cododa (Sp. / Balears)	1.4	0.0	0.0	21.8	7.6	7.8	4.9	1.1	0.0	0.9	45.5
Cagliari / Elmas (It. / Sardinia)	16.0	0.8	9.0	29.0	0.0	8.2	2.0	3.0	130.0	81.0	279.0
Capo Carbonara (It. / Sardinia)	13.6	1.2	0.5	16.2	0.6	33.0	0.2	1.0	15.6	77.0	158.9
Decimomannu (It. / Sardinia)	14.0	0.3	3.1	38.0	0.0	3.2	1.0	1.0	33.0	46.0	139.6
Olbia / Costa Smeralda (It. / Sardinia)	0.0	0.4	4.7	47.8	21.0	48.0	1.0	0.0	2.6	5.2	130.7
Capo Bellavista (It. / Sardinia)	9.6	0.0	18.0	14.0	0.2	28.0	12.8	0.0	13.2	19.4	115.6
Capo Caccia (It. / Sardinia)	13.0	0.0	0.4	8.0	0.6	1.2	10.4	0.0	7.0	1.6	42.2
Solenzara (Fr. / Corsica)	0.2	0.4	19.8	71.9	27.6	31.9	2.8	0.0	58.3	0.0	212.9
Allistro (Fr. / Corsica)	0.4	0.2	0.2	0.4	0.0	0.0	6.3	53.0	60.8	0.0	121.3

* Daily data are incomplete due to a several hours long outage

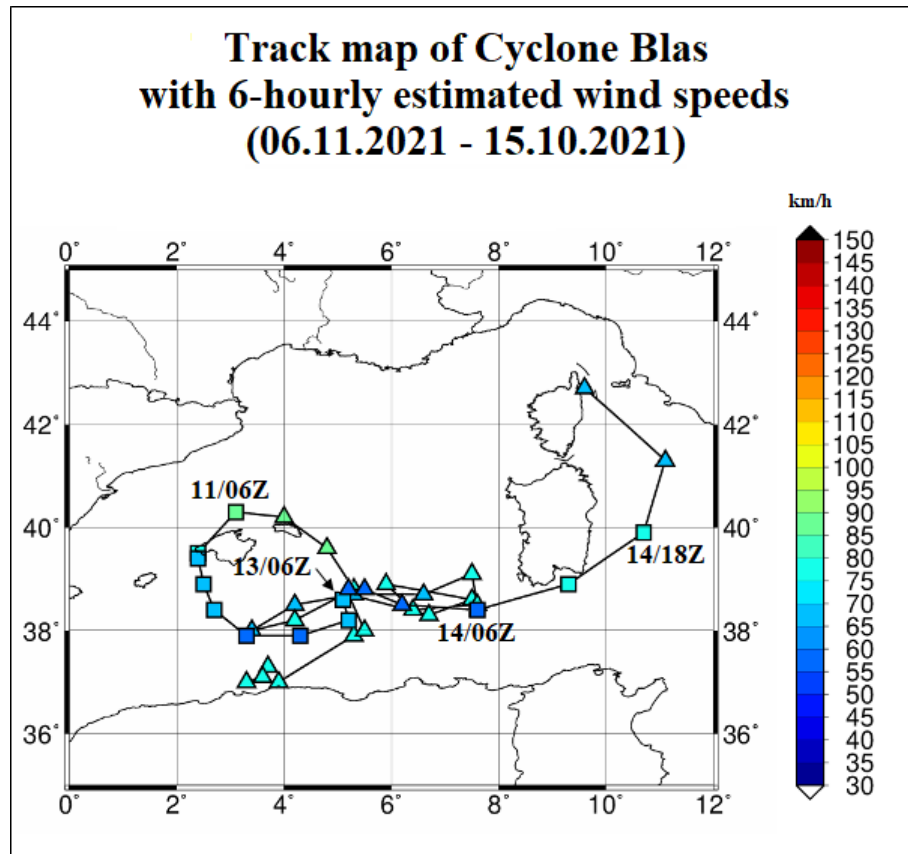


Figure 1. Best track positions for Tropical Storm Blas, 6-15 November 2021. The triangles mean extratropical and the squares subtropical stage. The colors represented the estimated wind speeds (from Table 1) at the actual time. The position based on satellite images and ECMWF reanalysis. Due to an erratic track in the extratropical phases, only the initial and final times of the two subtropical parts are shown.

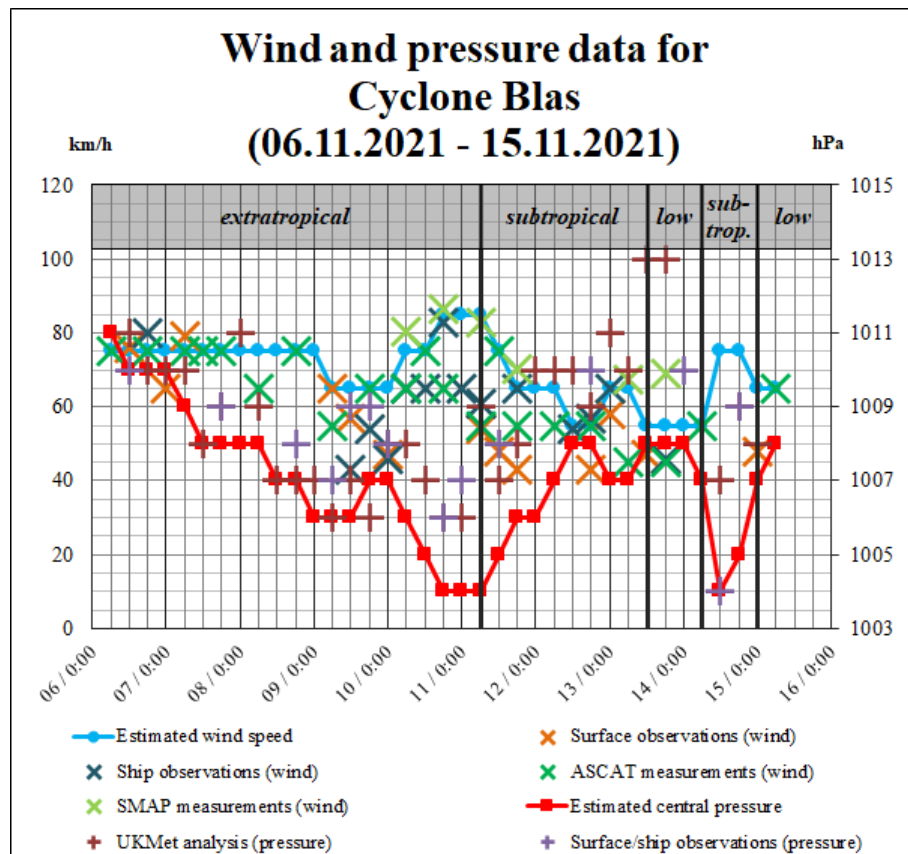


Figure 2. Selected wind and pressure observations with estimated maximum sustained wind and minimum central pressure for Subtropical Storm Blas, 6-15 November 2021. The stated 6 hourly data mean the maximum sustained wind within a 3-hour interval around the marked time in case of all measurements.

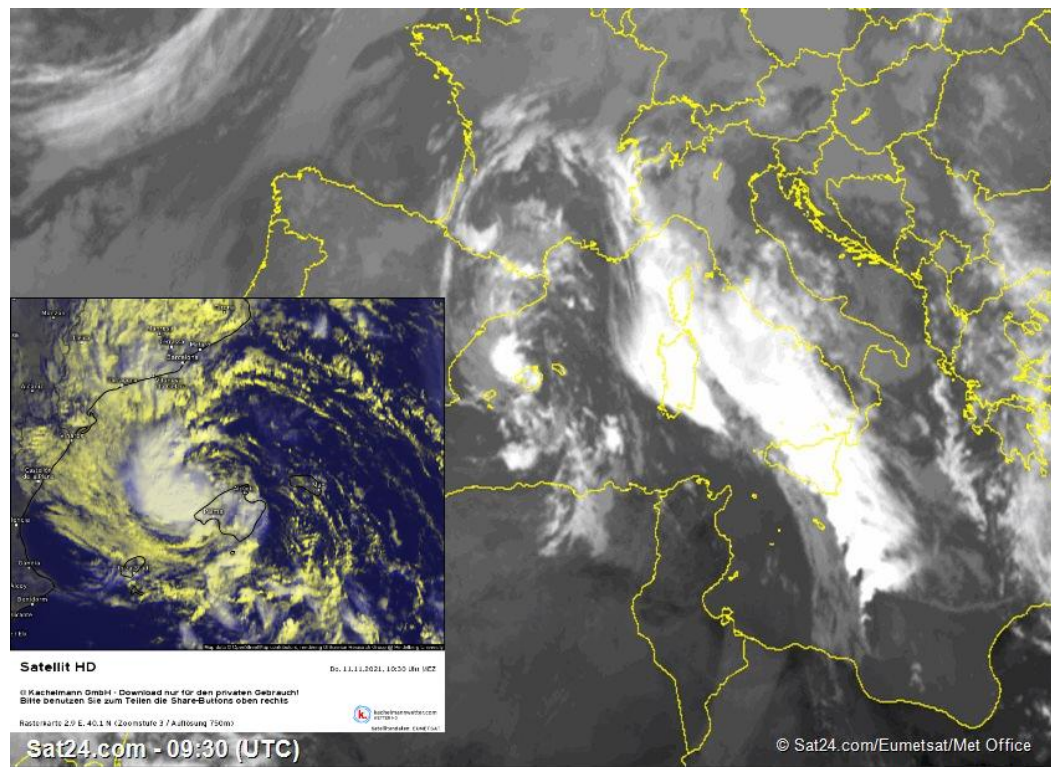


Figure 3. Infrared and visible (RGB) satellite images of Blas at 0930 UTC 11 November. The cyclone had its best structural appearance around this time as a small, but well-defined convective system, detached from the fronts. *Source: EUMETSAT / Sat24.com, Kachelmannwetter*

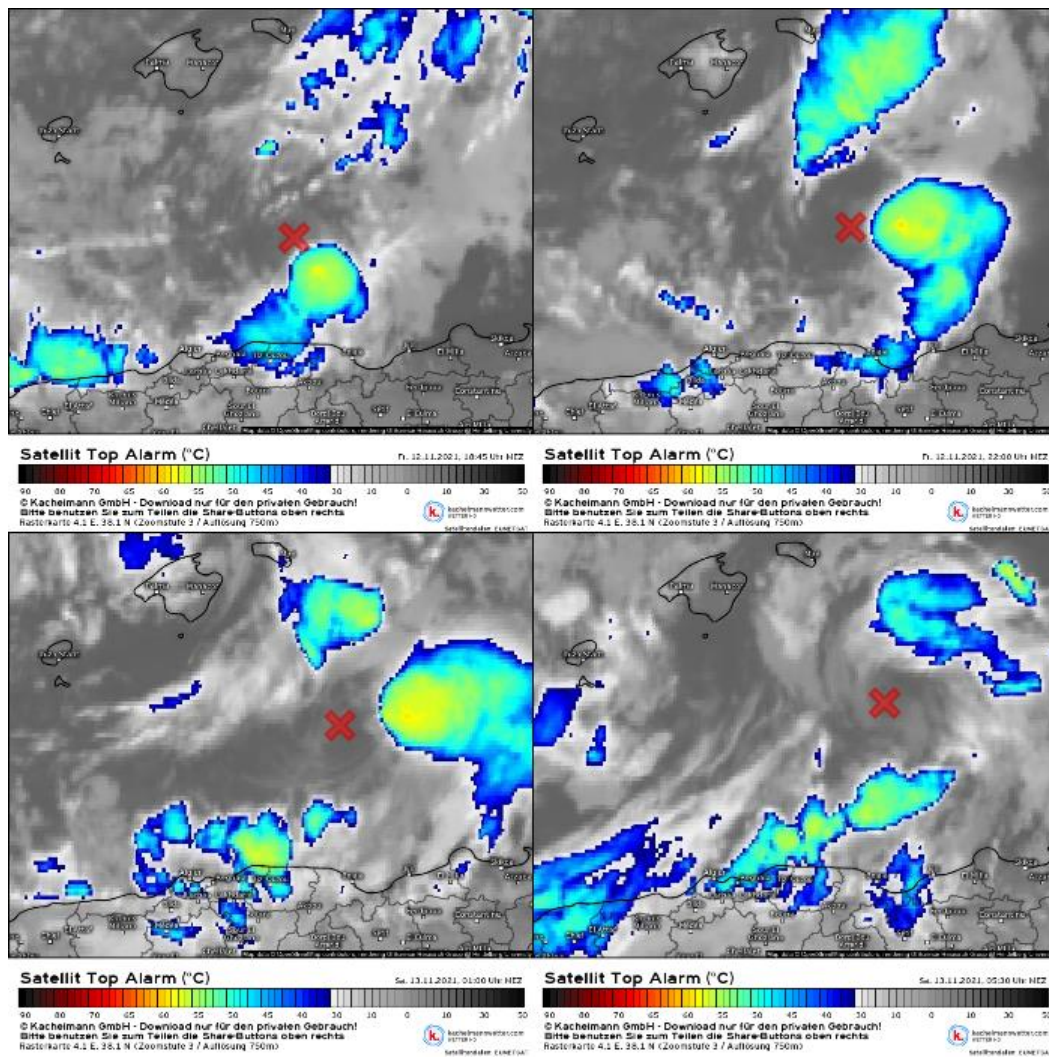


Figure 4. Cloud top temperature satellite images of Blas at 1745 UTC, 2100 UTC 12 November and 0000 UTC, 0430 UTC 13 November. Deep convection temporarily redeveloped on the east side of the cyclone at this time, however, Blas was connected to a southwestward moving upper-level low which initially located northward, later westward of the cyclone. The red X marks the estimated center positions. *Source: EUMETSAT / Kachelmannwetter*

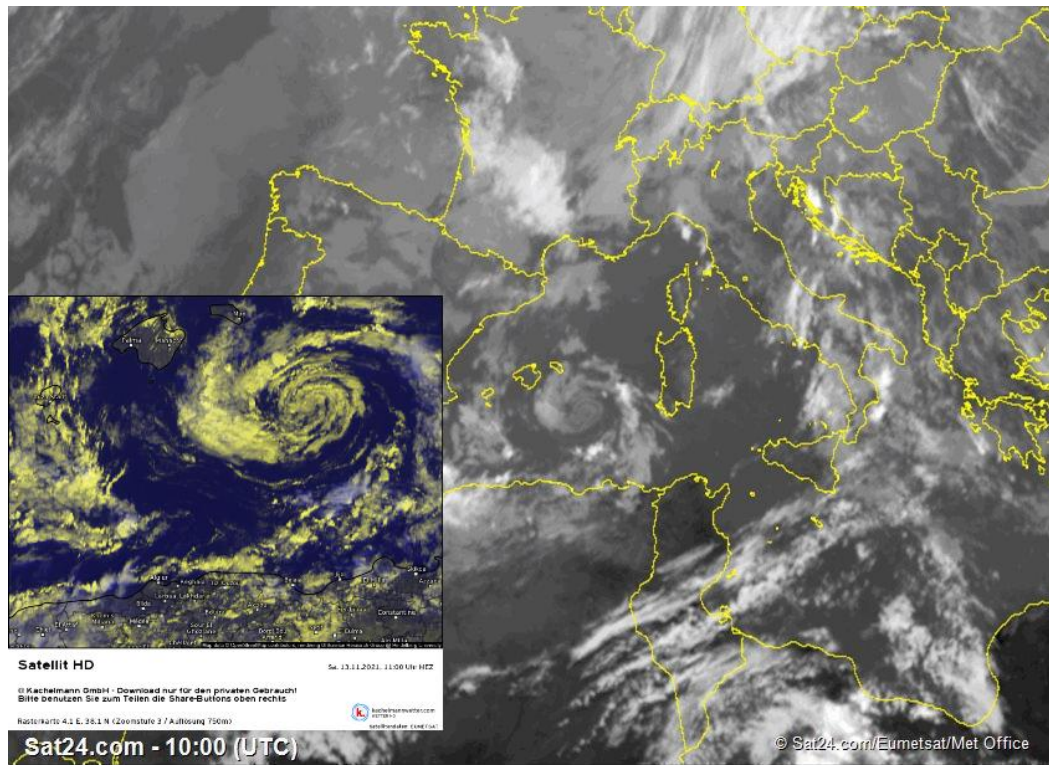


Figure 5. Infrared and visible (RGB) satellite images of Blas at 1000 UTC 13 November. Although the low-level circulation of the cyclone became more defined in the night hours, it lost all deep convection in the early morning hours. *Source: EUMETSAT / Kachelmannwetter*

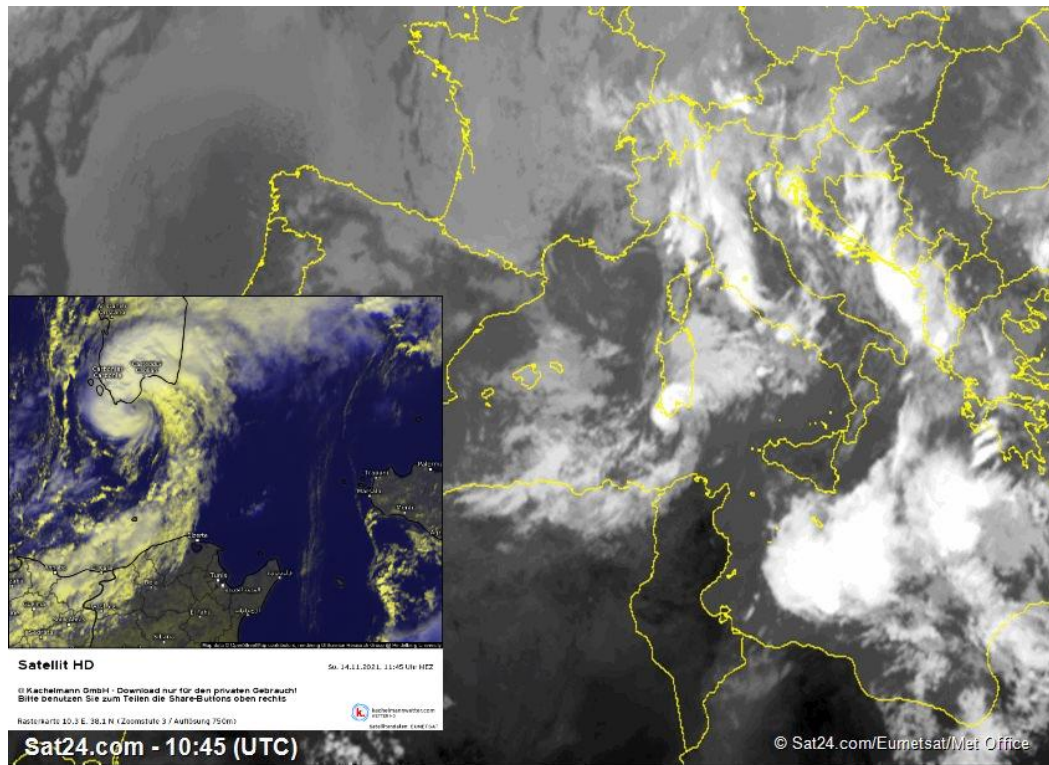


Figure 6. Infrared and visible (RGB) satellite image of Blas at 1045 UTC 14 November. Moderate convection redeveloped and wrapped around the center by this time, but the small low increasingly became embedded in the flow of a larger-scale synoptic system. *Source: EUMETSAT / Kachelmannwetter*

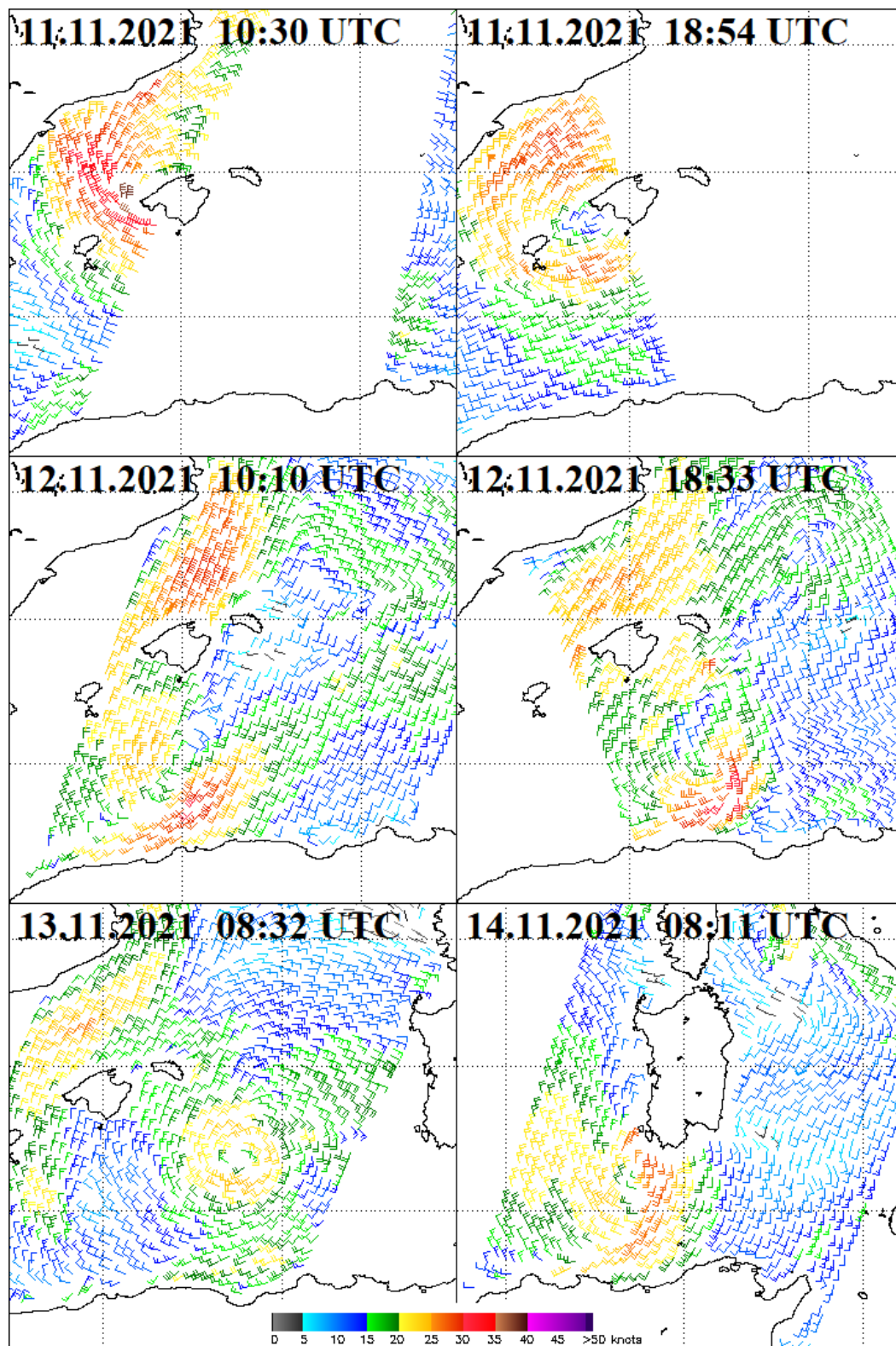


Figure 7. Satellite-based wind data of Blas between 11-14 November measured by ASCAT-A and ASCAT-B sensors. *Source: NOAA NESDIS*

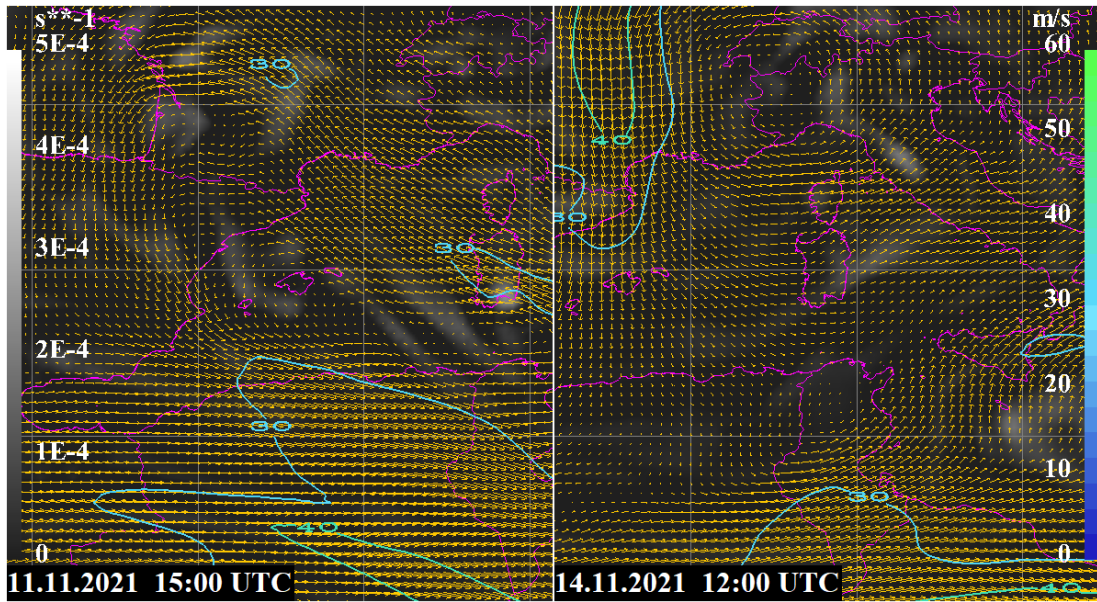


Figure 8. 300 hPa divergence (shaded) and winds (vectors and contours per 10 m/s from 30) over the Western Mediterranean Sea at 1500 UTC 11 November and 1200 UTC 14 November. *Data source: ECMWF/Copernicus*

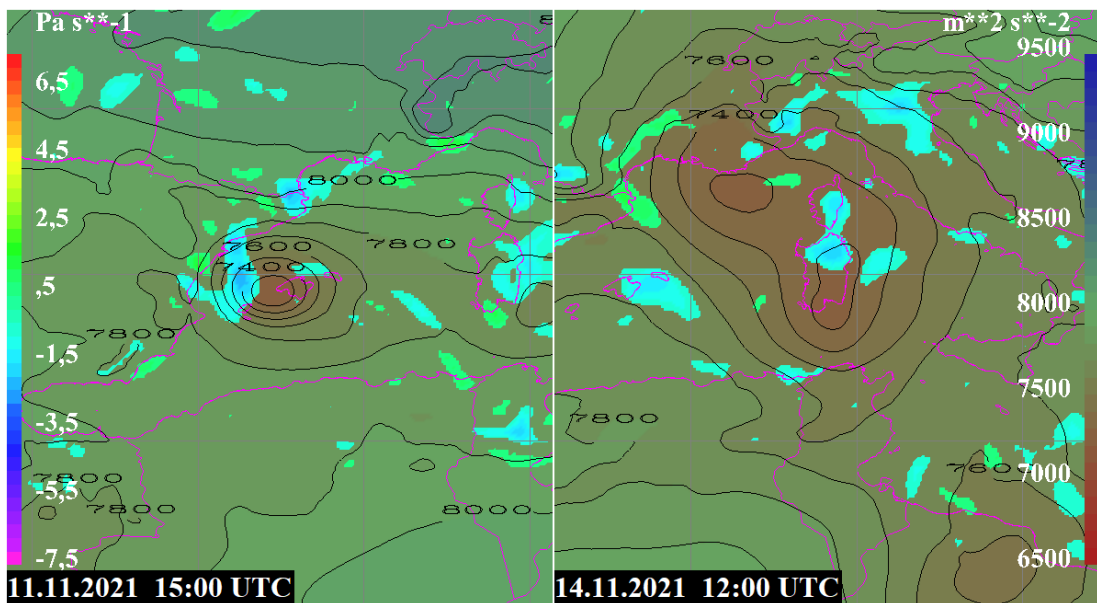


Figure 9. 925 hPa geopotential (shaded with black contours) and 850 hPa vertical speed (shaded patches, without the -0,5 to 0,5 Pa/s range) over the Western Mediterranean Sea at 1500 UTC 11 November and 1200 UTC 14 November. *Data source: ECMWF/Copernicus*

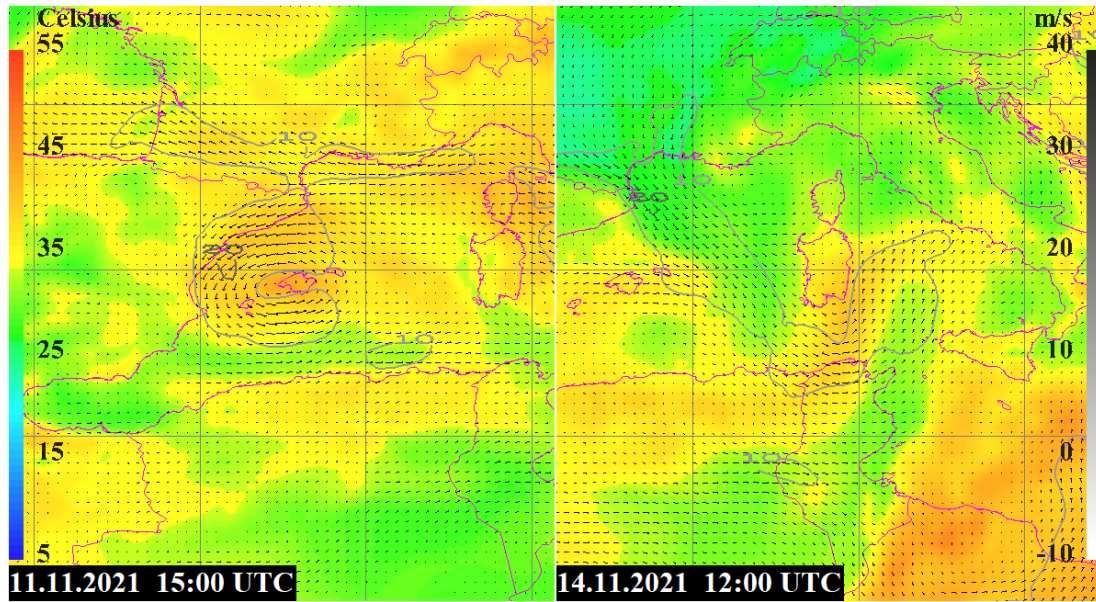


Figure 10. 850 hPa equivalent potential temperature (shaded) and winds (vectors and contours per 10 m/s) over the Western Mediterranean Sea at 1500 UTC 11 November and 1200 UTC 14 November. *Data source: ECMWF/Copernicus*

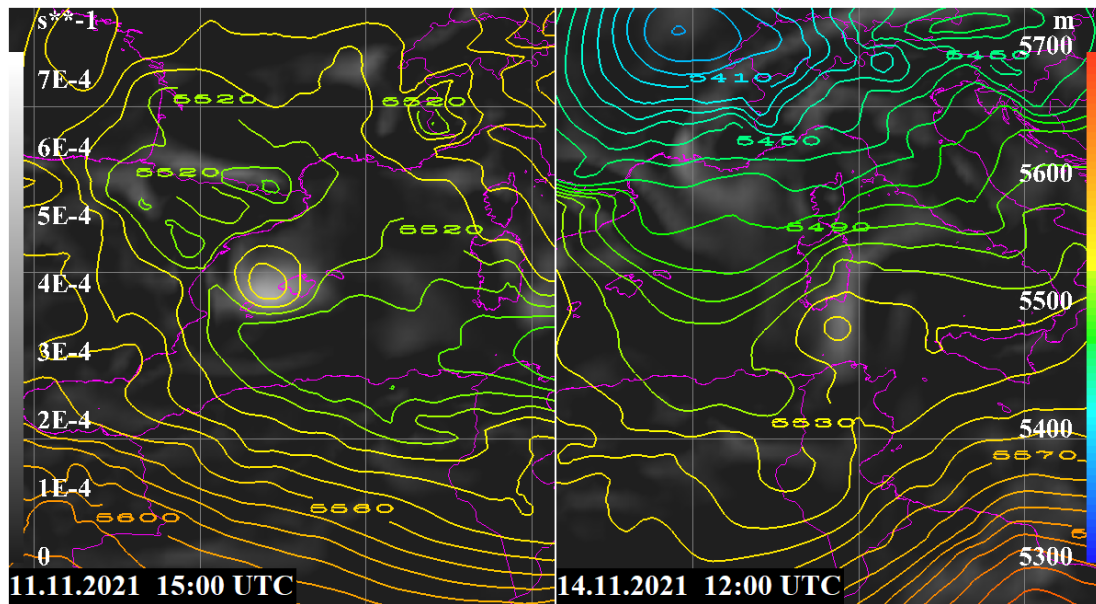


Figure 11. 500-1000 hPa thickness (contours per 10 m) and 850 hPa relative vorticity (shaded) over the Western Mediterranean Sea at 1500 UTC 11 November and 1200 UTC 14 November. *Data source: ECMWF/Copernicus*

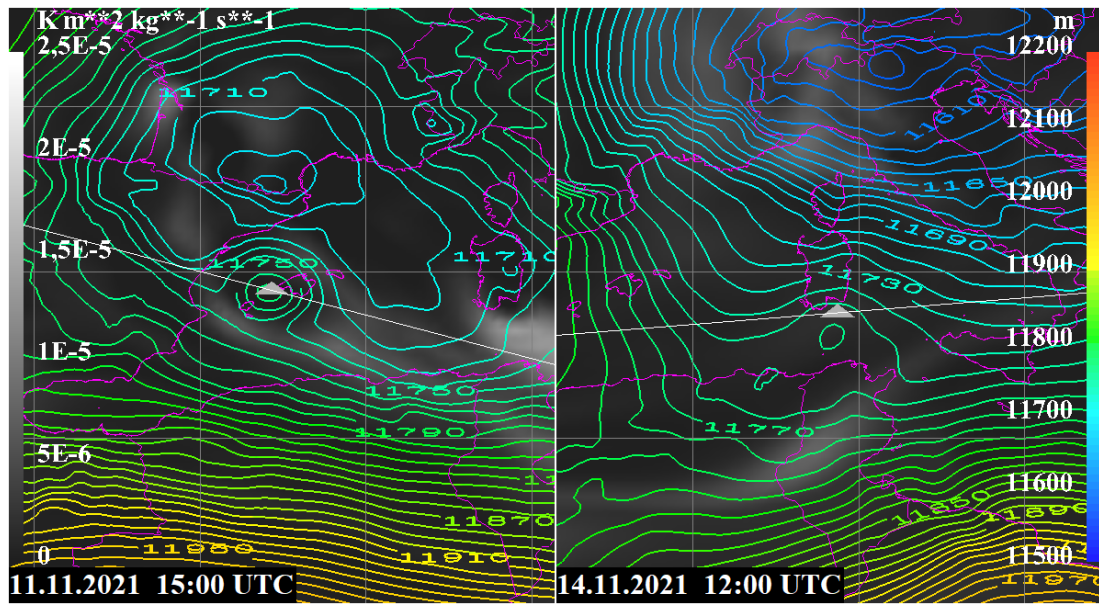


Figure 12. 200-1000 hPa thickness (contours per 10 m) and 300 hPa potential vorticity (shaded) over the Western Mediterranean Sea at 1500 UTC 11 November and 1200 UTC 14 November. *Data source: ECMWF/Copernicus*

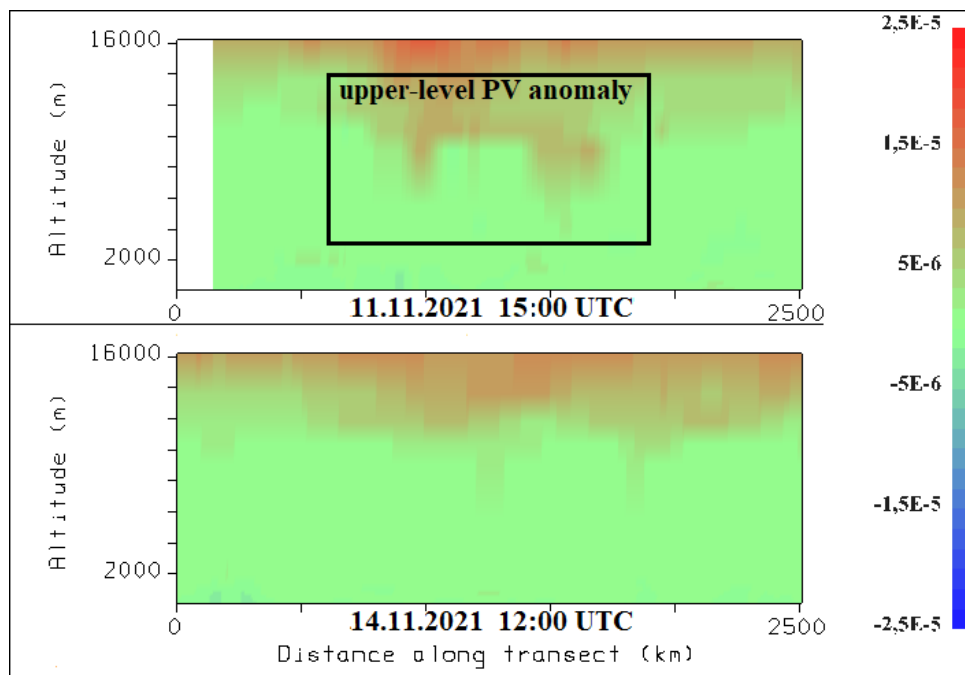


Figure 13. Potential vorticity vertical cross-sections through the center of Blas and its environment at 1500 UTC 11 November and 1200 UTC 14 November. The cross-sections marked with thin white lines on Figure 12. *Data source: ECMWF/Copernicus*