Article

Synoptic Causes of Torrential Rainfall in the Balearic Islands (1941–2010)

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Abstract: This article determines the atmospheric situation for the 53 days where any weather station in the Balearic Islands detected torrential rain (equal to or above 200 mm in a single day) during the period 1941–2010. To do this, the synoptic charts for each day were analysed, classifying them in accordance with the types established by Martín Vide (1984) and, in addition, through the automatic synoptic classifications from Jenkinson and Collison (1977). The analysis results demonstrate the importance of cyclonic situations over the Western Mediterranean Basin linked to favourable altitude configurations (earlier presence of cut-off lows—DANA—or troughs). These atmospheric conditions contrast with those that predominate in nearby Mediterranean areas, such as the south-eastern coast of the Iberian Peninsula. Days with torrential rain on the Iberian coastline tend to coincide with easterly advections—a less common occurrence in the Balearics.

Keywords: Balearic Islands; torrential rain; synoptic situations; Jenkinson and Collison classification

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1. Introduction

Precipitation in the Mediterranean is characterised by wide inter- and intra-annual variability [1,2]. This translates into possible episodes where a single day exceeds 200 mm and, therefore, torrential conditions occur [3–7]. The salient territorial consequences of these extreme precipitations are floods [8–11]. This flooding leads to major erosion processes in areas with natural semi-arid conditions, deforestation, overgrazing and agricultural uses that are largely unconcerned with the environment. The phenomenon is not alien to the Balearic Islands due to its relatively central location in the Western Mediterranean Basin, lying equidistant from the areas where the centres of action most often form.

The surface circulation patterns linked to days with high-intensity precipitation [12–15] do not suffice to explain the key elements behind these storms, which are more linked to atmospheric circulation conditions in the middle layer than to surface isobaric conditions. For this reason, an additional classification method is provided for all 53 days where the 200 mm threshold was exceeded, in a broad period that covers the second half of the 20th and first decade of the 21st centuries. The method combines Jenkinson and Collison's [16] automatic classification with a manual synoptic classification proposed by Martín-Vide [17] for the Iberian Peninsula and nearby maritime sectors, which also includes information regarding topography at 500 hPa.

The Jenkinson and Collison automatic classification [16] consists essentially of a method that establishes the weather type based on the measurement of sea level atmospheric pressure over various points distributed within a grid of 10° longitude and 5° latitude, located around a central area to which they refer. To estimate weather types using this classification, eight input variables derived from surface pressure are needed: zonal and meridian components of geostrophic wind, wind direction and speed, zonal and meridian vorticity components, and total vorticity. By combining these variables

27 different weather types are established: 1 pure anticyclonic (A), 1 pure cyclonic (C), 8 pure advectives corresponding to the 8 wind directions (N, NE, E, SE, S, SW, W, NW), 8 cyclonic hybrid advectives (CN, CNE, CE, CSE, CS, CSW, CW, CNW), 8 anticyclonic hybrid advectives (AN, ANE, AE, ASE, AS, ASW, AW, ANW), and 1 undeterminate (U).

Objective classification methods are relatively common in studies on different cases in Mediterranean regions. In Spain, Martin-Vide [18] applied the Jenkinson and Collison method [16] to days of torrential rain in the eastern Spanish peninsula. Subsequently, Grimalt et al. [19] substantially broadened the geographic framework of analysis and obtained a wide catalogue of synoptic situations in the Western Mediterranean Basin through the same procedure for each of the days in the period between 1948 and 2009. Gilabert and Llasat [20] again used Jenkinson and Collison's methodology to catalogue atmospheric weather types linked to 261 flooding episodes in Catalonia (NE Spain) over the 1900–2010 period. Cordobilla and Martin-Vide [21] also used it for the specific case of the Muga River (Catalonia) over the 1971 to 2010 period. Specifically for Majorca (Balearic Islands), Llop-Garau and Alomar-Garau [22] objectively classified 49 episodes with precipitation over 200 mm/day between 1939 and 2001. The same authors [23] repeated the same process for precipitation of over 100 mm/day for the coastal strip of Catalonia and the Balearic Islands during the 1950–2005 period.

With regard to manual synoptic classification methods (subjective), Martin-Vide et al. [24] recently applied the method put forward by Martin-Vide [17] for 68 precipitation episodes of over 200 mm/day in the provinces of Alicante and Murcia (SE Spain) during the 1941–2017 period, combining the test with values from the Western Mediterranean Oscillation Index (WeMOi) for the same days. In reality, subjective classifications, whether for weather types or synoptic situations per se, were trialled for Spain and its regions by authors including Fernández [25], Clavero and Raso [26], Martin-Vide [17], Romero et al. [12], Capel-Molina [27] and Martin-Vide and Olcina [28].

The article is organised as follows: Section 2 establishes the objectives; the data and the study area are described in Section 3; Section 4 sets out the methodology; the results are detailed in Section 5; and Section 6 discusses the results and sets out some conclusions.

2. Objectives

The main aim of this study is to determine the synoptic situations that have produced torrential events of 200 mm/day or more in the Balearic Islands during the 70-year period between 1941 and 2010. Values above 200 mm normally correspond to flood episodes, and have usually been considered as a critical limit of torrential rainfall [7,8,22,24].

In order to achieve this, the following specific objectives were set: (1) construct a database of daily rainfall equal to or greater than 200 mm (torrential rain) somewhere in the Balearic Islands; (2) classify these days according to the objective classification from Jenkinson and Collison and the subjective classification of Martin-Vide [17]; and (3) compare the synoptic patterns of torrential precipitation in the Balearic Islands with the patterns in other regions in the Western Mediterranean Basin.

3. Area of Study and Data

The area of study is the Balearic archipelago, located to the west of the Western Mediterranean and with a relatively central position within the basin, especially the islands of Majorca and Minorca.

The archipelago has a total surface area of 4985 km², comprising four main islands split into two subsets: the Balearics in the narrowest sense (Majorca and Minorca), which are more maritime and further from the coast of the Iberian Peninsula; and the Pityusic Islands (Ibiza and Formentera), located further west and nearer to the continent. In addition, there is a set of minor islands (Figure 1).

From a climate perspective, the islands clearly correspond to Mediterranean conditions with total annual precipitation that highly contrasts between the islands and within each island territory, depending on their landforms. The less humid sectors are located to the

south of the Pityusic Islands in coastal areas, with total annual rainfall of around 350 mm. There is an increasing pluviometric slope from this minimum towards the northeast; consequently, almost 600 mm per year are recorded at sea level in Minorca. The presence of mountains changes this theoretical distribution and particularly impacts Majorca—the largest island whose highest ranges in the north record total annual rainfall of around 1400 mm.

Figure 1. The Balearic Islands in the Western Mediterranean Basin.

Average monthly rainfall shows a relatively similar rate to the central sector of the Mediterranean coast on the Iberian Peninsula. Autumn sees the highest level, followed by a relatively humid winter and spring values that show a marked drop from the month of April, leading to a clear low in July [29]. The daily pluviometric irregularity is highly noticeable, with the presence of many episodes with high precipitation values particularly in the mountain and eastern areas of Majorca [30], although they can also occur in other areas. Certain studies [13] that have analysed torrentiality in the aforementioned area were able to individually identify up to 422 days in Majorca where a weather station measured over 100 mm in 24 h during the period running from 1935 to 2006.

Our article uses rainfall data collected between 1941 and 2010 by the stations in the official Spanish AEMET observation network (Spanish Met Office), previously known as the INM (National Institute of Meteorology) and the SMN (National Meteorology Service). These institutions managed a relatively high number of functional rain observatories in the Balearic Islands over the period which, excluding the early 1940s, offered a relatively dense coverage for the island territory. Although the number of measurement spots has varied over time and thus makes the series less homogenous, this does not mean it is unsuitable for the purpose of the study which is focused on determining circulation patterns on days of torrential rain.

The original data from the institutional archives produced records that then underwent a filtering process. The days where the spatial consistency of precipitation distribution led us to believe that the records were displaced with regard to the true location of the storm were eliminated. Thus, the initial research for this article detected up to 60 days with precipitation exceeding 200 mm at a weather station; six of these were unified due to data displacement and one was removed due to a total lack of consistency.

Specifically, the allocation error for a single episode to two different days was spotted for the storms on 16 and 17 April 1942; 3 and 4 October 1957; 1 and 2 October 1973; 3 and 4 December 1975; 21 and 22 December 1979; and 14 and 15 November 2001. After performing the filtering process, the precipitation data were unified into a single day, respectively: 16 April 1942, 4 October 1957, 1 October 1973, 4 December 1975, 21 December 1979 and 14 November 2001, thus eliminating any duplications. One day on the initial list (27 February 1958) was removed. The data from the Son Torrella station showed a single marked maximum of 363 mm in a context of general rainfall across the island of Majorca where, in contrast, all other nearby observatories showed values ten times lower.

Finally, 53 dates were deemed suitable for the study, where precipitation was higher than 200 mm in one day at one of the weather stations located on the islands (see Appendix A). In this vein, an initial database was produced that showed a relative difference to previous analyses for days of torrential rain in the Balearics, such as those from Grimalt-Gelabert [8] and Llop-Garau and Alomar-Garau [22], the latter solely covering Majorca.

4. Methodology

The following steps were taken in the research process:

- Identifying the dates when a weather station in the Balearic Islands recorded precipitation equal to or above 200 mm/day during the period between 1941 and 2010.
- Filtering out possible spatial inconsistencies in the records, identifying incorrectly dated records and rectifying initial data. At the end of the process, a sample of 53 rainy days was collected with levels that equalled or surpassed the 200 mm/day limit (torrential rainfall).
- An analysis of the monthly and seasonal distribution of days with torrential rain.
- Obtaining pressure data for each of the aforementioned dates in a nine-point grid around the Western Mediterranean (Figure 2). Based on this information, the weather type was established in the sea basin in line with Jenkinson and Collison's methodology.
- Manual determination of the weather type for the days analysed by using Martin-Vide's [17] synoptic classification based on NOAA reanalysis plotting from the Wetterzentrale weather map portal. The situations mostly matched 1 of the 16 situations set out in the cited work, with four case outliers that were identified as belonging to two configurations that do not appear in said classification (NE advection and NE advection with DANA). Whilst following the practice of other work using the same classification [24], the term "gota fría" (cut-off low) [31,32] was replaced for the term DANA (Isolated Depression at High Levels).
- Characterising the synoptic situations whilst noting certain relevant features at continental scale, as well as atmospheric pressure in the area of study.
- Presenting a representative example (surface and 500 hPa chart) for each of the different synoptic situations matching days with 200 mm or more of rain in the Balearic Islands.
- Characterising the general synoptic conditions of torrential rainfall in the Balearic Islands.
- Comparing the results obtained with similar analyses of other nearby geographic areas, especially the Mediterranean coastline in the south-eastern Iberian Peninsula.

In order to establish the weather type based on Jenkinson and Collison's methodology, a nine-point grid in the western Mediterranean was selected, specifically at the intersection of the 35th, 40th and 45th parallels north with the 5th W, 5th E and 15th meridians east. Data on surface pressure were obtained for each of the intersections.

The corresponding calculations were used on the atmospheric pressure at these nine points to obtain the eight variables of the Jenkinson and Collison method. Based on the numerical results obtained, a weather type was established in line with the allocation laws for said method [16,19].

Martin-Vide's manual classification [17] was used for synoptic information. The charts used come from the plotting performed by the NOAA (USA), which can be viewed on the Wetterzentrale portal (www.wetterzentrale.de (accessed on 10 August 2021)) in the map

archive section. The combined surface and 500 hPa maps proved optimal for applying a manual classification of synoptic situations to the 53 analysed dates. The grid point value for 40th N and 5th E at a location slightly to the east of Minorca was taken as representative for surface pressure data for each of the dates.

Figure 2. Grid for using the Jenkinson and Collinson method.

5. Results

Figure 3 shows the location of the observatories that have recorded rainfall equal to or greater than 200 mm with an indication of the days on which they occurred. Appendix A lists the extreme episodes in chronological order.

5.1. Monthly and Seasonal Distribution of Torrential Rainfall

Torrential episodes are seasonally distributed and have a direct relationship to the spread of average annual precipitation (Table 1). Maximum concentration occurs in the three autumn months (SON) which amount to 62.26% of the days with extreme rainfall. Nevertheless, the specific weighting of the three winter weather months is also notable and, in this sense, 20.75% of significant episodes occurred between December and February. In turn, summer is characterised by a near total absence of storms, coinciding with minimum annual rainfall.

When looking at monthly-level analysis, the notable weighting of October and November is clear: two months where over half of the cases occur (54.72%).

5.2. Surface Weather Types

In terms of the weather type on days of torrential rain and adopting Jenkinson and Collinson classification (Table 2), there is a clear predominance of focused cyclonic situations (C) that themselves represent three quarters (75.5%) of all episodes. There are 11 instances of an advection or hybrid advection—CE, E, NE, ASE—(20.7%), meaning the weather type is U (undeterminate) in only two instances.

Nonetheless, it is important to state that where there is a pure, cyclonic or anticyclonic advection (11 days), they always show an easterly component: nine instances from the east and two that seem to be linked to a meridian component (NE or SE). There is a surprising presence of a situation categorised as anticyclonic and causing a torrential episode (also having an easterly advective component). In contrast, there is no torrential episode linked to a westerly component, whether cyclonic or pure advective. Finally, there is a very low weighting of indeterminate situations for the analysed days (two instances). This may

seem surprising if one considers that this weather type is highly notable in the western Mediterranean, accounting for 27% of the analysed days [19].

Figure 3. Meteorological observatories of the Balearic Islands with rainfall equal to or greater than 200 mm during the period 1941–2010. The table below indicates the official code of the observatory (CODE), the place name (PLACE NAME) and the IDs of the days on which 200 mm (DAYS ≥ 200) has been reached. The date to which each ID corresponds can be consulted in the table in the Appendix A.

Table 1. Monthly and seasonal distribution of the 53 days with over 200 mm of rainfall in the Balearic Islands.

Monthly			Seasonal		
Month	Days $\geq$ 200 mm	%	Season	Days $\geq$ 200 mm	%
January	3	5.7	Spring	8	15.1
February	1	1.9	Summer	1	1.9
March	4	7.5	Autumn	33	62.3
April	3	5.7	Winter	11	20.7
May	1	1.9	Total of episodes	53	100.0
June	1	1.9			
July	0	0.0			
August	0	0.0			
September	4	7.5			
October	16	30.2			
November	13	24.5			
December	7	13.2			
Total of episodes	53	100.0			

Table 2. Absolute and relative frequency of weather types according to Jenkinson and Collison's method applied to days with rainfall equal to or above 200 mm in the Balearic Islands.

Weather Type	Frequency	Frequency (%)
C (focused cyclonic situation)	40	75.5
CE (easterly cyclonic advection)	4	7.5
E (easterly advection)	5	9.4
NE (north easterly advection)	1	1.9
ASE (south easterly anticyclonic advection)	1	1.9
U (undeterminate)	2	3.8
	53	100.0

5.3. Weather Type Considering Topography at 500 hPa

Using Martin-Vide's synoptic classification [17] (Figure 4) provides the following situations and frequencies (Table 3). One can discern three configuration types with a near-equal number of days: firstly, those with a dynamic low (26.42%); secondly, those with a trough at altitude; and thirdly, those with an easterly advection where a DANA is present (the latter two types have the exact same weighting of 24.53%). With marked difference, there are also important advective situations with a north-easterly component, accompanied by a DANA (11.32%) or advections in the same direction without an associated isolated cold air front (5.66%). The remaining situations only occurred on a single day.

There are fundamentally two circumstances with regard to weather types on torrential days in the Balearics, considering topography at 500 hPa. Firstly, a predominance of situations with a DANA. If days with this type of configuration (advections with a DANA or a DANA with no advection) are added together, in addition to dynamic lows (i.e., lows on the surface and at 500 hPa), 36 days can be counted, i.e., 67.92% of all episodes. This weighting is significantly higher than for configurations linked to a trough without strangulation (24.53%). Only on a mere 8.55% of days is there no individualised centre of action in the middle layers of the atmosphere associated with a precipitation episode.

Figure 4. Representative examples of different synoptic situations on days with over 200 mm of rainfall in the Balearic Islands. Source: www.wetterzentrale.de (accessed on 10 August 2021).

Secondly, the predominance of situations centred on the area of study can be confirmed, both due to the presence of a low at all levels and to a configuration without a high flow accompanied by a trough in the middle layers. The easterly and north-easterly component is decisive on 22 days, although on only three of these (north-easterly advection) is there a flow without an accompanying favourable configuration at 500 hPa.

Lastly, the most common synoptic situation (dynamic low) is characteristic of winter, the season where half of all downpours linked to this atmospheric configuration have occurred.

Table 3. Synoptic situation according to Martin-Vide’s classification [17] and surface pressure on days of torrential rain in the Balearic Islands (1940–2010).

Synoptic Situation	Absolute Frequency	Frequency (%)	Surface Pressure (hPa) in Balearic Islands
Dynamic or Cold-core Low	14	26.4	1005.3
Trough	13	24.5	1012.9
Advection from the E with DANA	13	24.5	1014.4
Advection from NE with DANA	6	11.3	1011.3
Advection from the NE	3	5.7	1012.8
DANA to the SW	1	1.9	1020.2
DANA to the W	1	1.9	1014.1
DANA	1	1.9	1008.9
“Pantano Barométrico” (Barometric swamp) (Martin-Vide & Olcina, 2001) [28]	1	1.9	1018.3
	53	100.0	

5.4. Situations at a Regional Scale

If the described weather types are incorporated into a wider regional dynamic, there is a zonal flow blockage on most of the analysed days, occurring on 25 dates. The situations matching flow to a meridian component linked to a trough are also common, representing 22 dates. In contrast, the number of days where there is a cross situation (an area with low gradients between opposing baric centres) drops to six. As is to be expected, after verifying the lack of a westerly component on any torrential day, these situations are completely absent where there is a marked zonal flow.

5.5. Average Pressure

The average pressure at 40° N and 5° E in a central location in the western Mediterranean and near the east coast of Minorca was 1011.3 hPa (Table 4) for the dates analysed, slightly below what is considered normal. Nevertheless, it is noteworthy that a large number of torrential rain days (37.7%) occurred in circumstances where the pressure was above average sea level pressure, thus underscoring the importance of the atmospheric situation in the middle troposphere.

In short, pressure values show a link to the synoptic type outlined by Martin-Vide [17] (Table 3), whereby days with a situation matching a surface dynamic low show an average value of 1005.3 hPa—a value that is clearly below that of other common situations, such as troughs (1012.9 hPa), north-easterly advections with a DANA (1011.3 hPa) and easterly advections with a DANA (1014.4 hPa).

Table 4. Distribution of surface atmospheric pressure on days with torrential rain in the Balearic Islands (1940–2010).

Surface Pressure (hPa)	Num. of Days	%
<990	1	1.9
990–995	0	0.0
995–1000	2	3.8
1000–1005	6	11.3
1005–1010	14	26.4
1010–1015	17	32.1
1015–1020	6	11.3
1020–1025	6	11.3
>1025	1	1.9
	53	100.0

6. Discussion and Conclusions

In line with the results obtained, there are two factors that influence torrential rainfall in the Balearic Islands; one is the clear surface cyclogenesis that is especially active in the Western Mediterranean Basin [33] and the other is the presence of configurations that favour instability in the middle layers of the atmosphere (DANA and troughs). Isolated depression at high level configurations has a major impact on the creation of intense precipitation episodes. This may reach extreme instances such as in the SE Iberian Peninsula [24] where a specific synoptic situation, easterly advections accompanied by a DANA, underlie over half of all torrential days. Notwithstanding this, the presence of an isolated configuration is not as predominant in the Balearic Islands.

One can compare the torrential episodes in the Balearics with those analysed by Martin-Vide et al. [24] in the SE Iberian Peninsula that show similarities and differences between the two locations. The seasonal distribution for the number of episodes is very similar, with the autumn maximum standing out (62.3% in the Balearics and 69.1% in the SE Peninsula). Nevertheless, there is a greater weighting for winter episodes in the archipelago (20.7%) than on the continent (11.8%). This difference is substantiated at a monthly level with a high incidence of downpours in September in Murcia and Alicante (a month seeing up to 22.1% of episodes versus 7.6% in the Balearics). In contrast, torrential episodes are very common in the Balearics in December (13.2%), whereas they only account for a low 4.4% on the Iberian Peninsula.

The differences become much more significant at circulation level. The present article calculated the weather types corresponding to torrential days identified in the south-eastern Iberian Peninsula by Martin-Vide et al. [24]. If the Jenkinson and Collison types observed in the peninsula are compared with those found in the Balearics, one can note a contrast; downpours in the Balearics are mainly linked to lows over the western Mediterranean (75.5% of days). In turn, advective situations with an easterly component in the SE Iberian Peninsula are present on 63.2% of torrential days, whereas they only appear on 20.8% of days in the Balearics.

Where a comparison is made between the two geographic areas based on synoptic situations, several aspects can be discerned. The predominance of days with a DANA is slightly lower in the Balearics when compared to the SE Peninsula, since days where there is a dynamic low, plus advections with a DANA and situations with low gradients and a DANA represent 67.9% of all dates with over 200 mm of rain in the Balearic Islands. Meanwhile, this percentage rises to 72.1% for the SE Iberian Peninsula. Conversely, the influence from situations classified as troughs is slightly higher in the Balearics, occurring on 24.5% of all dates, whilst only representing 17.6% of those studied in the SE Iberian Peninsula. The situations that do not align with any of the circumstances above, i.e., days

where there is no trough or cold depression at altitude (accompanied on the surface by low baric gradients or advective situations) are slightly higher on the Iberian coast (10.3%) than in the Balearics (7.6%).

One should bear in mind that as islands, there is a possibility of humidity flows from other directions that do not necessarily correspond to easterly winds, as occurs on the eastern coast of the Peninsula. Indeed, Martin-Vide's classification [17] of atmospheric situations did not specifically account for island territories. Consequently, Martin-Vide's catalogue of synoptic situations had to be expanded for this article, adding a NE advection with a DANA—a common type in the Balearic Islands.

This singular feature of the Balearics in terms of different flow directions associated with torrentiality can also be seen in Catalonia [8], although the latter study looked at a less demanding precipitation limit (100 mm). The Catalan coast can receive considerable amounts of precipitation with south-westerly flows at altitude and south-easterly at surface level. In contrast, the aforementioned work states that NEs, which are particularly humid in the Balearics, rarely generate downpours in Catalonia, where there is no incident wind direction perpendicular to the coast. Therefore, the importance of the geographic factor is clear in the genesis of torrential episodes with highly contrasting realities between relatively nearby geographical spaces. The north-easterly component identified as a generator of significant precipitation in the Balearics was detected by Romero et al. [12], taking into account that the threshold for significant precipitation set by the authors was 50 mm simultaneously collected by a minimum number of stations.

In the specific case of Majorca, the results from this article partially coincide with those from Llop-Garau and Alomar-Garau's classification study [22], based on Jenkinson and Collison [16], with a pressure measurement point grid slightly towards the west. These authors link extreme precipitation to the predominance of synoptic situations with an easterly component, as well as those with a northerly component, associated with cyclonic centres located to the east of the Balearic archipelago, which do not have major pluviometric consequences on the Mediterranean coast of the Iberian Peninsula.

As a final conclusion, we found that there are common and differential elements between the SE Iberian Peninsula, the Catalan coast and the Balearic Islands. With regard to commonalities, the absolute predominance of storms linked to ideal situations at 500 hPa (DANAs or troughs) and the importance of an easterly component, i.e., extensive marine winds in the western Mediterranean, stand out. In terms of differences, there are both geographic and atmospheric distinctions. Due to their island nature and near-central location in the Western Mediterranean Basin, downpours in the Balearic Islands are linked to vertical lows, as well as north-easterly flows. In contrast, the Catalan coast may see significant precipitation with highly diverse circulations, even a subzonal component at altitude—a situation that never occurs in the other analysed territories. At an aerologic level, the huge rainstorms on the coast of the SE Iberian Peninsula are more clearly linked to DANAs, in contrast to the Balearics and Catalonia where extreme episodes are linked to troughs.

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Appendix A

Days with more than 200 mm of rain in the Balearic Islands.

ID	Date	Island	Station with Maximum Rainfall	CODE	Maximum Rainfall (mm)	Num. of Stations with Rain ≥ 200
1	17 April 1942	Majorca	Alqueria d'Avall	B253	270.0	2
2	26 November 1942	Majorca	Alqueria d'Avall	B253	202.0	1
3	20 November 1943	Majorca	Orient (Son Bernadàs)	B648	224.8	1
4	19 November 1945	Majorca	Artà	B520	224.3	1
5	11 October 1946	Majorca	Orient (Son Bernadàs)	B648	203.3	1
6	24 January 1948	Majorca	Can Serra (Pollença)	B745	200.0	1
7	21 November 1951	Majorca	Son Mas (Valldemossa)	B084	210.0	2
8	14 March 1955	Majorca	Can Serra (Pollença)	B745	222.3	1
9	04 October 1957	Majorca	Santanyí II	B407A	220.0	2
10	06 October 1958	Majorca	Can Serra (Pollença)	B745	220.4	1
11	07 October 1958	Majorca	Mortitx	B007	214.0	4
	07 October 1958	Minorca	Far Punta Nati	B849	207.4	1
12	08 October 1958	Majorca	Bàlitz d'Amunt	B049	243.4	8
13	17 November 1958	Majorca	Son Torrella (Escorca)	B684	225.4	1
14	08 June 1959	Majorca	Mortitx	B007	228.0	2
15	21 October 1959	Majorca	Sóller	B061	329.0	2
16	22 October 1959	Majorca	Son Torrella (Escorca)	B684	536.5	6
17	07 December 1960	Majorca	Míner Gran (Pollença)	B721	209.0	2
18	08 December 1960	Majorca	Comasema (Bunyola)	B646	224.0	3
19	30 November 1967	Majorca	Bàlitz d'Avall (Fornalutx)	B046	211.1	1
20	24 September 1971	Majorca	Estellencs Arraval	B094A	274.8	2
21	31 December 1972	Majorca	Son Torrella (Escorca)	B684	222.5	1
22	01 October 1973	Majorca	Mortitx	B007	283.0	14
23	17 February 1974	Majorca	Turixant d'Abaix (Escorca)	B029	200.0	2
24	29 March 1974	Majorca	Son Torrella (Escorca)	B684	275.4	7
25	30 March 1974	Majorca	Turixant d'Abaix (Escorca)	B029	205.0	2
26	26 October 1975	Formentera	Far de Formentera	B999	202.0	1
27	04 November 1975	Majorca	ses Pastores (Artà)	B630	220.0	2
28	18 September 1977	Ibiza	Can Palerm	B962	211.5	1
29	14 January 1978	Majorca	Esporles	B240	230.0	10
30	18 October 1978	Majorca	Son Torrella (Escorca)	B684	275.0	4
31	19 October 1978	Majorca	Lluc	B013	259.8	3

ID	Date	Island	Station with Maximum Rainfall	CODE	Maximum Rainfall (mm)	Num. of Stations with Rain $\geq$ 200
32	20 October 1978	Majorca	Biniforani Vell	B249A	261.0	2
33	01 March 1979	Majorca	Binirrossí	B057	263.0	5
34	21 December 1979	Majorca	Binirrossí	B057	304.0	4
35	27 December 1980	Majorca	Binirrossí	B057	215.0	2
36	22 April 1981	Majorca	Son Fuster (Alaró)	B654	210.0	1
37	15 November 1985	Ibiza	Santa Eulàlia	B964	281.0	1
	15 November 1985	Formentera	Far de Formentera	B999	201.0	1
38	29 September 1986	Majorca	Bàltx d'Avall (Fornalutx)	B046	212.4	1
39	06 September 1989	Majorca	Es Picot (Manacor)	B451	250.0	3
40	08 October 1990	Majorca	Rafal d'Ariant	B006B	250.0	6
41	09 October 1990	Majorca	Casa Nova	B022	230.0	1
42	05 October 1995	Majorca	es Cabanells Nous	B628	200.1	1
43	10 November 2001	Majorca	Lluc	B013	250.0	8
44	15 November 2001	Majorca	Lluc	B013	238.0	3
45	15 December 2001	Majorca	Lluc	B013	242.0	4
46	10 November 2005	Majorca	Ternelles (Pollença)	B757	200.0	1
47	30 January 2006	Majorca	Lluc	B013	265.5	6
48	14 April 2007	Majorca	es Marroig (Fornalutx)	B054	273.0	1
49	23 November 2007	Minorca	el Toro (es Mercadal)	B824	220.0	1
50	24 October 2008	Majorca	Albarca (Escorca)	B013A	230.0	1
51	27 November 2008	Majorca	es Marroig (Fornalutx)	B054	208.5	1
52	15 December 2008	Majorca	es Marroig (Fornalutx)	B054	296.0	12
53	03 May 2010	Majorca	Lluc	B013	235.0	4

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