WINDSTORM XYNTHIA: OVERVIEW AND COMPARISON WITH OTHER EXPLOSIVE CYCLOGENESIS CASES AFFECTING BASQUE COUNTRY.

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I. INTRODUCTION

On February 27th 2010 the zonal circulation is undulated creating favourable conditions for the cyclogenesis at the southwest area of the Iberian Peninsula. The generated cyclone deeps quickly, with pressure values compatible with the definition of explosive cyclogenesis, reaching pressure minimums of 967 mb. The system moves north-eastward into the Cantabric Sea on the next days. Xynthia quickly travels over Bay of Biscay, affecting Basque Country area on late 27th early 28th February, surpassing the French coast at 06 UTC of 28th.

Generally, strong extratropical cyclones created by explosive cyclogenesis (cyclone deeps very quickly) are generated with a high frequency in cold season in higher latitudes, exceptionally can be created in low latitudes, when two air masses with characteristics very different meet. In fact, Basque Country has been affected two consecutive years by two extratropical cyclones (2009 Klaus and 2010 Xynthia). To find out the previous similar event we must go back to the 1999 year, when a cyclone called Martin left three people dead.

II. PRESENTATION OF RESEARCH

In this work we present a study of Xynthia event, focusing on main characteristics of its formation and evolution including some local aspects and a comparison with other severe windstorms cases that had affected the Basque Country area in the past.

We focus on comparisons with other similar events that have affected Basque Country. Particularly we compare with Klaus and Martin events, two relatively recent and similar episodes that in the Xynthia case.

The most severe wind storm in the Iberian Peninsula happened in the 1941 February 15th-16th, is in synoptic scale the most violent on XX century. This phenomena is originated, after the deepening of a strong depression in the northwest of Iberian Peninsula, with pressure central values lower than 960 mb.

This situation has large similarities with Xynthia event, the cyclone trajectories are similar. In spite of the magnitude of the cyclone-event of 1941, there is not much information due to the year in which occurred and because of the destruction caused by the strong winds. Anyway, the wind gusts in San Sebastian could have been about 180 km/h or more. In Santander city several information sources agree with wind gusts about 200 km/h. The values are not known exactly since strong winds destroy the anemometers. In the Xynthia event are observed wind gusts above these values, especially in mountain areas; in Orduña station were registered 228 km/h (maximum wind gust measured for mountain areas of the Basque County AWS network). Talking about cyclone effects, in the 1941 event, the most devastating effect was the big fire on Santander city, the strong south winds and the high degree of turbulence made virtually impossible control the fire. In Xynthia event, some fires happened although not become significant.

In the last years the most singular episodes are: Martin (1999), Klaus (2009) and Xynthia (2010), the latter two in a short period of time (1 year). The three events satisfy the explosive cyclogenesis criteria, affecting in an evident way in the Basque Country, west northwest gusts in Martin and Klaus events and south gusts in Xynthia event affecting especially the mountain areas of Basque Country interior zone.

1999 December 27th. A depression deepens in an extraordinary way in the Cantabric Sea due to an explosive cyclogenesis, originating intense southwest winds, with a later northwest rotation, when the maximum gusts surpassing 150-160 km/h in coastal places.

During the 2009 January 23rd, 24th days the extratropical cyclone Klaus crosses the Cantabric Sea from West to East, affecting directly the Cantabric coast population. Specifically in the Basque Country hurricane force gusts produce several material losses. The stronger winds begin the 23rd in the afternoon, west-southwest winds that intensifies at the end of the day, which specially blows in the interior areas and in mountainous interior areas due to the topography and wind direction. In exposed areas 120 km/h and 100 km/h in no-exposed areas are exceeded. The 24th day, when the cyclone arrives France, the wind begin to rotate towards the west-northwest in the early morning, blowing with special intensity in the coast and in mountainous areas in the north zone. The hurricane force gusts going on surpassing 150 km/h values in exposed zones. In no-exposed zones are about 100-120 km/h.

The two events (Klaus-Martin) are similar, but we can mark some details.

The Klaus trajectory is more southern arriving to the southwest of France, Martin arrives France in the south of Brittany region (see fig 1). The pressure minimum that reach Martin cyclone is 970 mb, decreasing 23 mb in 24 hours. Klaus deepens 30 mb in 24 hours, reaching 963 mb.

Klaus-Martin events present similar values of the maximum wind gusts in whole territory. In south stations ("yellow values") the gusts are stronger in the Klaus event (see table 1).

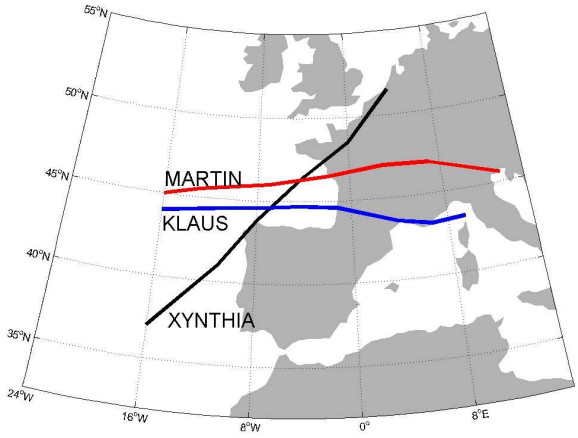

FIG. 1: Track of Martin (1999 December 27th), Klaus (2009 January 24th) and Xynthia (2010 February 27th).

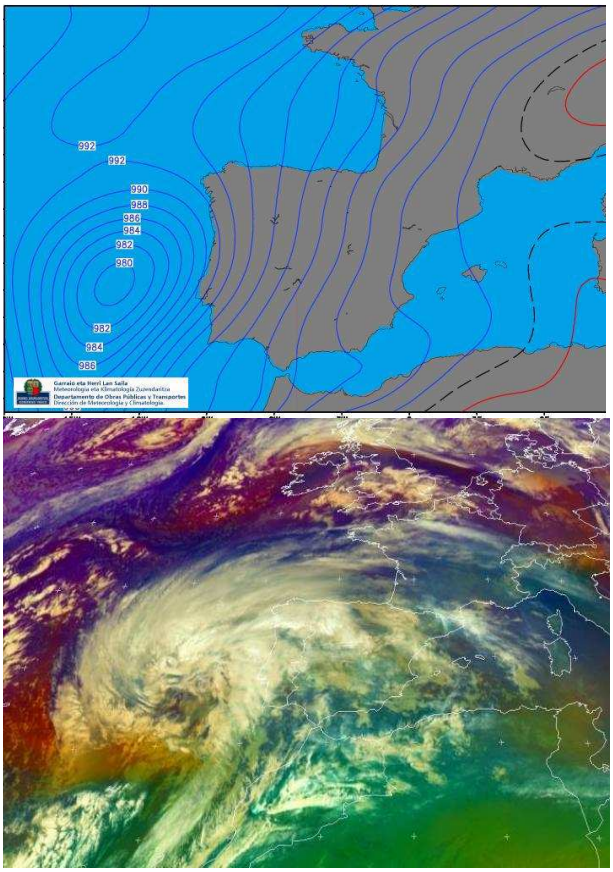

FIG. 2: Xynthia cyclone. Sea level pressure and Meteosat RGB composition (WV6.2-WV7.3 / IR9.7 – IR10.8 / WV6.2) at 06 UTC (2010 February 27th)

Stations	Maximum Gusts (km/h)		
	27/02/2010 XYNTHIA	27/12/1999 MARTIN	24/01/2009 KLAUS
Llodio	83	101	101
Vitoria-Gasteiz	135	107	118
Zaldiaran	143	127	132
Iturrieta		94	123
Kapildui	131	128	----
Zambrana	122	101	126
Navarrete	139	104	135
Pta. Galea	149	141	132
Mungia	101	117	127
Derio	92	106	103
Oiz	174	177	158
La Garbea	161	168	164
Urkiola	150	99	96
Barazar	99	125	114
Orduña	228	126	154
Jaizkibel	133	167	158
Zarautz	126	124	150
Arrasate	134	91	105
Bidania	120	123	115

TABLE I: Most significant data registered on Basque Country automatic stations.

February 27, 2010, extratropical cyclone Xynthia is generated by an explosive cyclogenesis, in the Atlantic Ocean, in southwest from Iberian Peninsula (see fig 2). Deeps 29 mb in 24 hours, reaching its centre pressure minimums values of 967 mb in time of maximum activity.

The Xynthia trajectory differs in a significant way from Martin and Klaus trajectories (see fig 1). Klaus and Martin moves from west to east, while Xynthia have a trajectory southwest-northeast, moving over the sea at the west of Iberian Peninsula, when the minimum pressure values of 967 mb is reached the cyclone is located in the vicinity of Galicia region, moving finally towards the north-east part of France over Cantabric Sea.

The measured data show the virulence of Xynthia especially in high areas and places in the interior, where in several stations are exceeded the values registered in the previous cases (see table 1). In this occasion the least affected area is the coast, The maximum wind gusts are observed with southerly winds, first south-easterly wind being the east part of Basque Country the most affected (Ordizia: 140 km/h) and later south-westerly winds, registering the maximum values in the west of Basque Country (Orduña: 228 km/h, Cerroja: 176,4 km/h, Punta Galea: 148,9 km/h). During the 28th early morning the wind veer to west without traces of intensification.

Xynthia event effects are different to Martin and Klaus effects, since maximum gusts are southerly and not westerly as happen in the two previous events. With south winds and depending in the exact direction of wind

canalizations high degree of turbulence are produced, implying large deviation from gusts values to average winds.

Xynthia not affect greatly the sea state, due to southwest-northwards cyclone trajectory the wind have not a large distance over sea, also the cyclone quick displacement over Cantabric Sea, not permit the necessary time to generate significant swell.

In terms of caused damages there are some differences. In Basque country, in the Klaus and Xynthia events there were considerable material damages, without human losses, taking into account that, in the two cases, the authorities took appropriate measures due to the red severe weather warning issued and the period of maximum incidence was in nocturnal hours. During Martin episode 3 people died and worst part of Martin happened in the Christmas day afternoon

In the rest of Europe with Xynthia the consequences were fatal, more than 60 people died. Especially at the French Atlantic coast, the high wind speeds caused a temporary sea level increase of up to around 1,50 m. The arrival time of Xynthia in this area, in the night from February 27 to 28 just coincided with a spring tide and barometric tide, resulting in extended flooding. So, the most part of deaths were produced in France by drowning due to the flooding.

III. CONCLUSIONS

The highest wind gust register is observed in the Xynthia event (228 km/h in Orduña), exceeding the previous measurements in Martin and Klaus events. Although, synoptically Xynthia is not the deepest cyclone, the maximum affectation is produced with southerly winds; affecting, with a high degree of turbulence, the high areas of the interior. In these areas the registers exceed the values observed in previous events. In Xynthia event, the coastal area was affected but to a lesser extent, since the wind not veers to west-northwest with intensification, quite the contrary due to the Xynthia trajectory. Between Klaus and Martin, Klaus cyclone is synoptically more powerful with a trajectory further south, so wind gust registers are superior in the most part of Basque Country. In Martin event, in coastal areas, a larger intensification is observed due to a mesoscale forcing in the wind veer produced by local characteristics. In the three events 120 km/h gust values are surpassed in many locations, exceeding extensively the 150 km/h.

In synoptic scale Klaus cyclone become deeper, although Xynthia cyclone deeps in nearly values too.

The wind gust intensities are 50-70 km/h larger comparing with mean wind velocities in the three events, in Xynthia case there is, locally, a higher degree of turbulence with southerly winds.

In Klaus and Martin events the trajectories are similar; moving from west to east, while in Xynthia case is from southwest to northeast. Differences in trajectories imply different effects in maritime conditions, with low effect in Xynthia case.

Analyzing the material and human damages must be taking into account the period of the day when happen the event. Klaus and Xynthia events take place in night hours, together with the exceptional safety measures applied by authorities there are not human losses in Basque Country. In Martin case 3 people died.

IV. AKNOWLEDGMENTS

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