

# Joachim wind storm case study.

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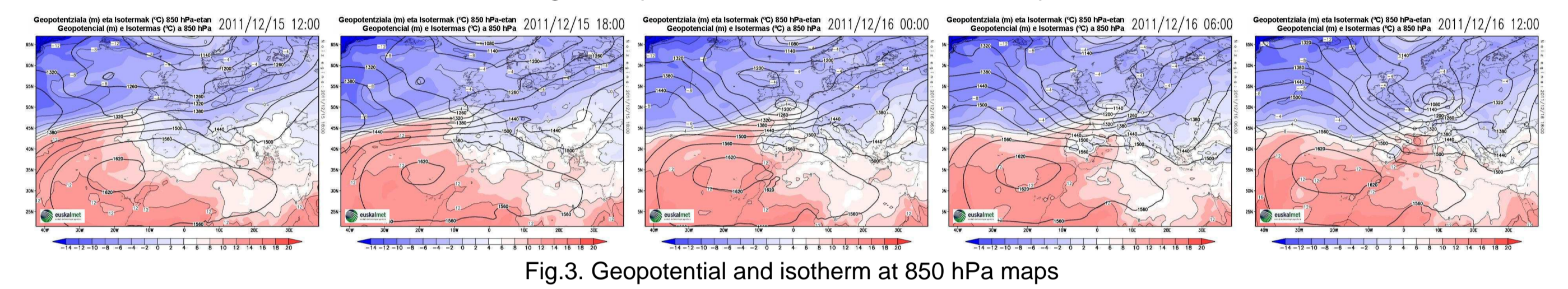
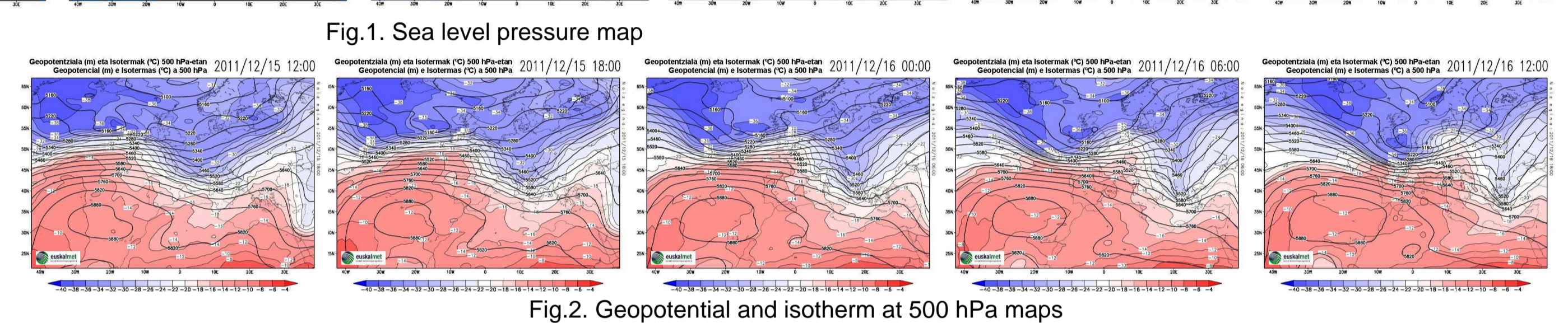
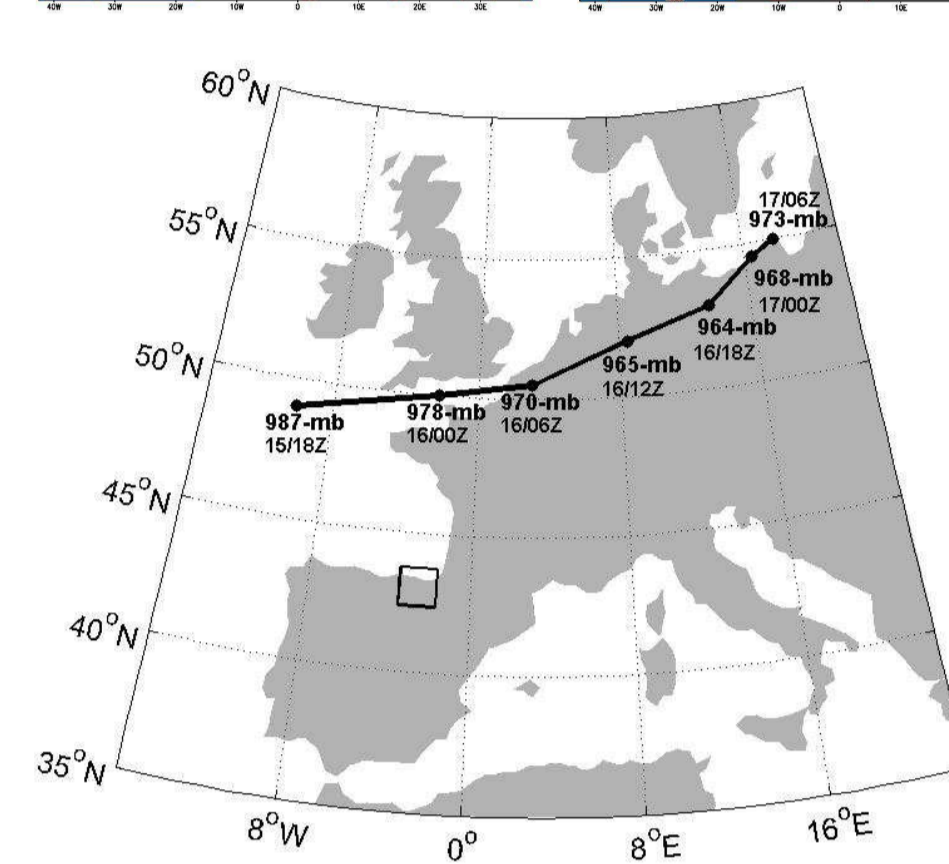
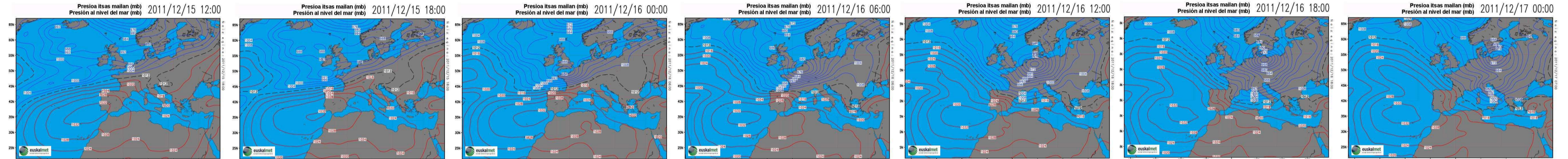
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## Introduction

In the early hours of December 16, 2011 a low pressure centre, with quick displacement and deepening, crosses the English Channel. This extratropical cyclone, named Joachim, generates a significant wind storm in the Bay of Biscay. The night of December 15, very intense wind are observed, the highest values are registered on the morning of day 16, above all in the west part of the territory with southwest hurricane gusts in numerous exposed areas and very strong gusts in non-exposed areas. From noon, the wind veers to northwest direction, coinciding with the entrance of the cold front associated to the depression, gradually decreasing the wind force. Maritime conditions worse significantly, generating heavy swell with significant wave heights around 7 m. In this paper we present some aspects related with this severe weather episode, including synoptic and mesoscale features from numerical analysis, satellite and AWS data collected in Basque Country area.

## Synoptic information

During the afternoon of December 15 and morning of day 16, an Atlantic cyclone deepens quickly and moves from southern British Isles towards continental Europe (see Fig.1), generating a strong pressure gradient over the north of Iberian Peninsula (see Fig.5). Two associated fronts, first warm and then cold, pass over Basque country (see Fig.7). This cyclone (Joachim) is formed on afternoon of December 15, in Fig.6 can be seen the moment of cyclone high activity in the RGB air mass MSG image. The pressure values of its centre decrease about 30 mb in 24 hours, fulfilling the explosive cyclogenesis criteria. A minimum pressure of 964 mb is reached in its displacement eastwards on December 16 in the afternoon, when it was located between Germany and Poland (see Fig.4). Cyclone dissipates on December 22. In medium and high levels there is strong pressure gradient too, although flux in high levels is not totally coincident with surface flux. Strong temperature gradients in the 850 hPa and 500 hPa level maps are observed (see Fig.2 and Fig.3). These patterns favour the cyclone quick formation.

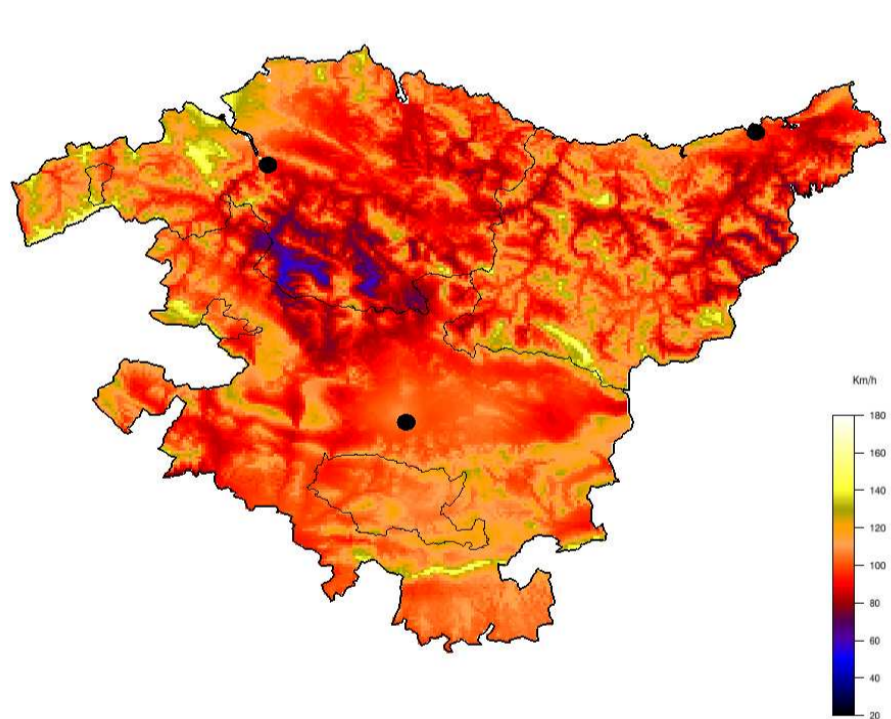
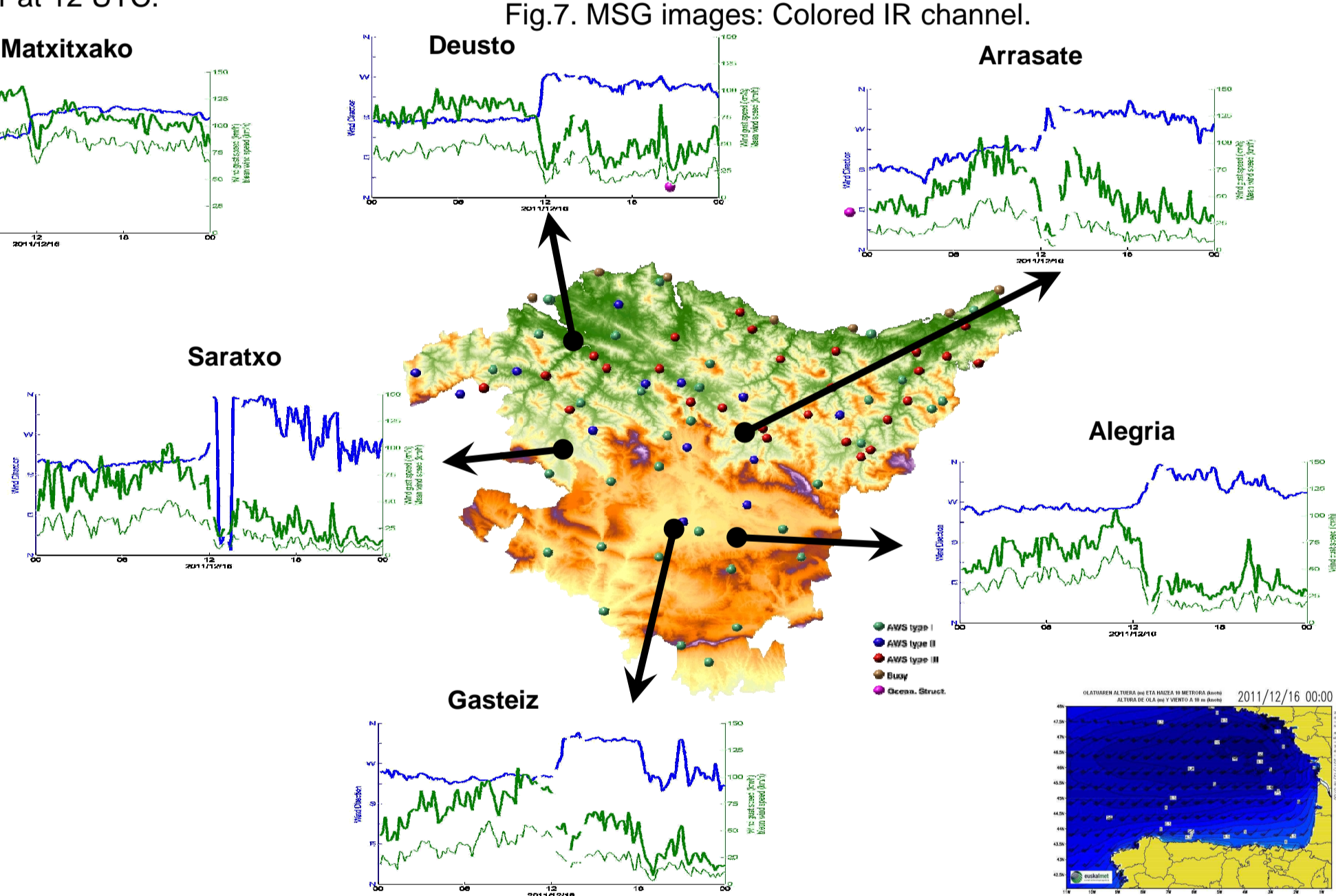
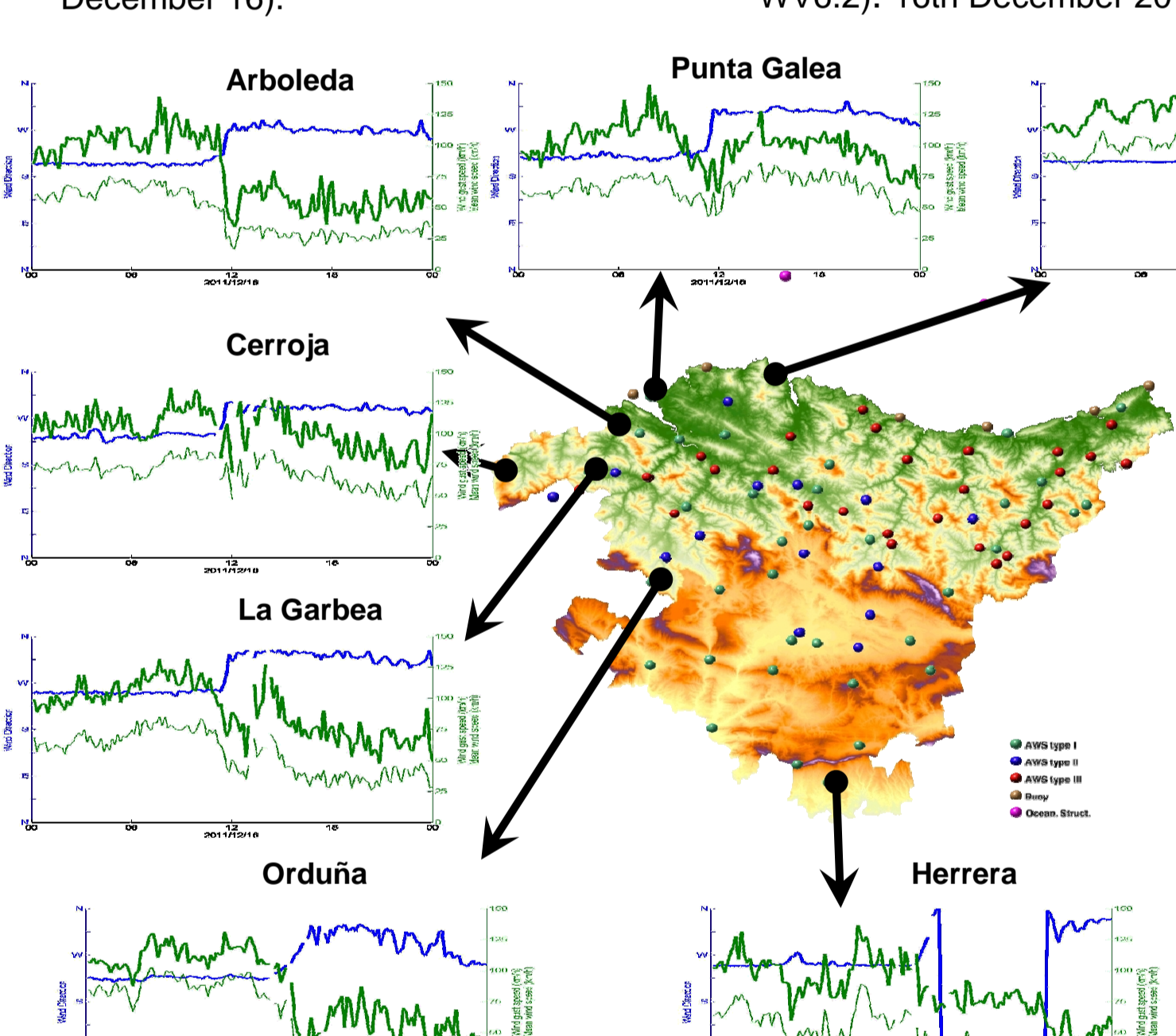
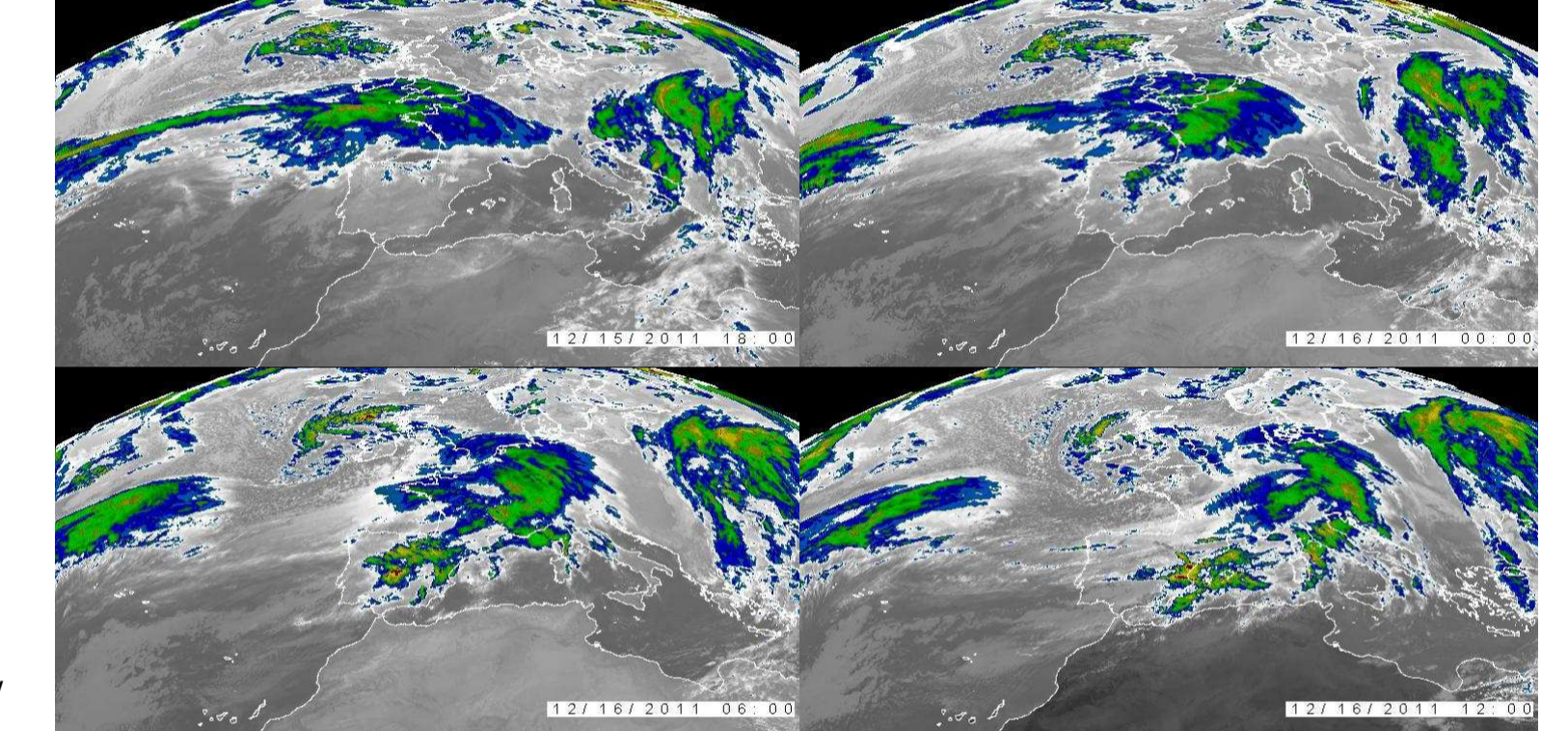
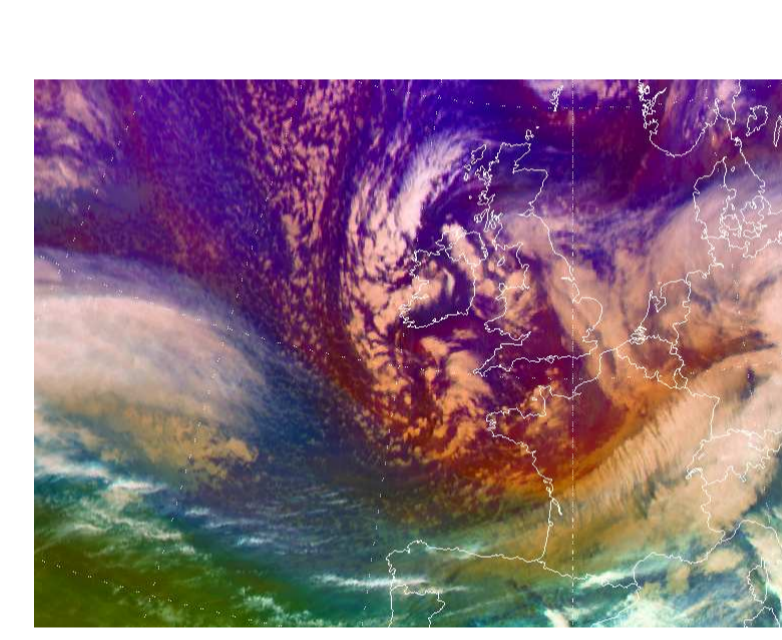
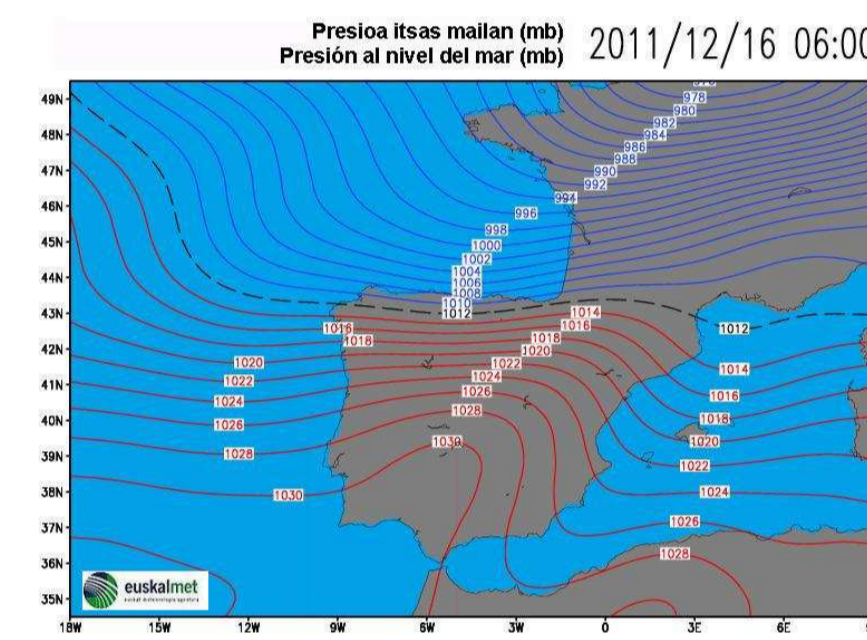


## Episode description

During the December 15 evening, westerly winds begins to intensify specially at the end of the day, with wind gusts that surpass 100-120 km/h in exposed areas and 80-100 km/h in no-exposed areas. The maximum wind gust, for exposed areas, is registered in Matxitxako station with 125,2 km/h, and for no-exposed areas is remarkable Zegama station with 108 km/h maximum wind gust.

In the early hours of December 16, the southwest winds intensify reaching the highest values of the episode. The maximum wind gusts are registered in western and southern exposed areas of Basque Country (see Fig.8). Is remarkable Punta Galea station with 148,9 km/h and Gasteiz station, within unexposed areas stations, with 108,9 km/h. From noon, wind turn to northwest direction decreasing intensity, although the wind gusts in exposed area, above all in coastal stations, are exceeded the 100-110 km/h values. (see Table.1, Fig.9 and Fig.10)

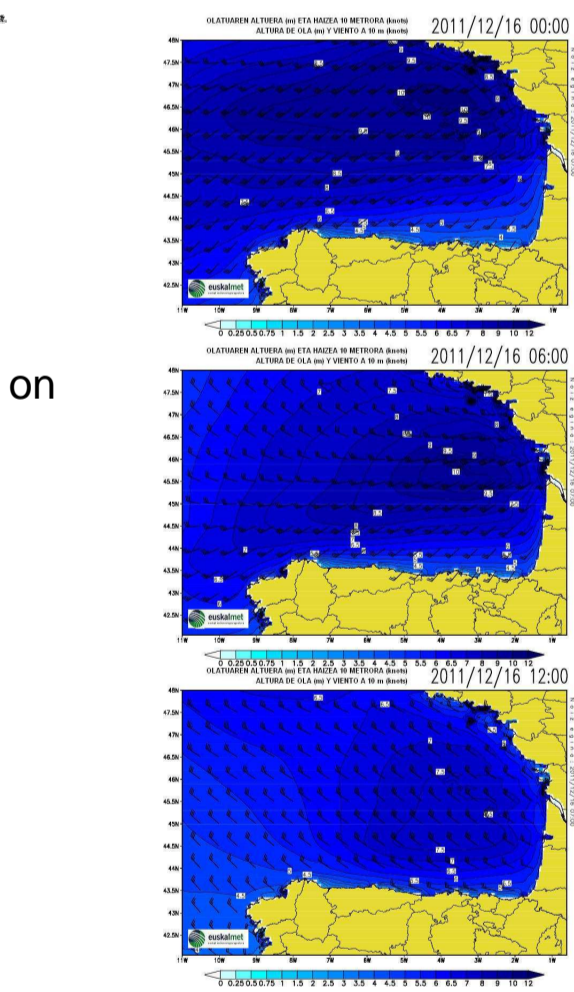
The maritime conditions worse, with significant wave heights about seven meters (see Fig.11), within a synoptic patterns showing a strong zonal flow where the cyclone is generated. In addition, this synoptic pattern favours high fetch.



AWS exposed	Max wind gust (km/h)	AWS non-exposed	Max wind gust (km/h)
Punta Galea	149.0	Navarete	114.5
Matxitxako	142.6	Treño	113.4
Arbolea	139.3	Arasate	109.6
Cerroja	136.8	Alegria	105.5
Herrera	136.1	Saratxo	104.4
La Garbea	131.4	Deusto	101.9
Orduneta	131.4	Paganos	101.5
Orduña	131.0	Ordizia	100.1
Kanoldia	129.6	Aikaute	97.9
Oiz	128.2	Zambiana	97.2
Santa Clara	121.7	Zegama	96.8
Esluñza	119.5	Bidana	95.4
Hiar	118.8	Mungia	91.4
Zaldiaran	118.1	Zuzutel	88.9
Zarauz	117.0	Iuneta	87.5
Rotag	115.6	Dano	86.8
Iuneta	115.2	Sabalerria	85.3
Jostibel	113.9	Etxaga	84.2
Gasteiz	108.7	Artzaga	83.5
Urdola	99.7	Espejo	81.0
Almike	98.6		
Miramón	92.9		

Wind gusts registered are significantly lower than the observed in latest similar events that affected Basque Country, which exceeded 150 km/h in some areas, e.g. during Xynthia event 228 km/h were measured in a mountainous area of the west (Orduña). In Joachim event no station register wind gusts superior to 150 km/h; the highest value, 149 km/h, was recorded in Punta Galea station, located on Basque Country western coast.

AWS	16/12/2011	27/02/2010	24/01/2009	27/12/1999
Lidio	64	83	101	101
Gasteiz	109	135	118	107
Zaldiaran	118	143	132	127
Zambiana	97	122	126	101
Navarete	114	139	135	104
Pia	149	149	132	141
Gasteiz	91	101	127	117
Dano	97	92	103	106
Oiz	128	174	158	177
La	131	161	164	168
Garbea	100	150	96	99
Urdola	131	228	154	126
Barazar	---	99	114	125
Orduneta	111	133	167	168
Jostibel	114	133	167	168
Zarauz	117	126	124	150
Arasate	107	134	91	105
Bidana	95	120	123	115



## Conclusions

**Trajectory:** The Joachim cyclone trajectory is placed in relative high latitudes. Wind gusts registered in the Basque Country are mainly due to the gradient pressure, configured inside the intense zonal circulation between cyclone and high pressure areas at the south of Iberian Peninsula, rather than directly to the explosive cyclogenesis effect.  
**Observations:** The most affected area is the west of Basque Country, with southwest wind gusts greater than 140 km/h in exposed areas and 100-110 km/h in unexposed areas.

**Sea state:** During the days of cyclone generation an intense zonal circulation with high fetch, favour heavy swell that affect Basque Coast with significant wave heights around 7 metres.  
**Damages in Basque Country:** 9 people are injured by waves and falling objects, 26 flights were cancelled at Basque Airports, the roof of a warehouse, located in an industrial park, collapse falling on 8 cars. The warning issued and actions taken were essential to avoid further damage.  
**Damages in the rest of Europe:** The windstorm caused major damages in much of Western Europe. Wind gusts surpassed 200 km/h in some areas. Affected areas were British Isles, Spain, France, Belgium, Netherlands, Switzerland, Germany, Czech Republic and Poland. In Brittany the ship TK Bremen was blown aground. In France at least 400,000 people were without power. In Switzerland a train was derailed by a tree, roofs and trees were blown away and all navigation on the Swiss lakes was closed. Air traffic was affected.

**Comparison with previous explosive cyclogenesis:** Cyclone Joachim moves relatively far from the Basque Country, to a lesser extent than in the latest explosive cyclogenesis events affecting Basque Country: in the case of Xynthia (February 27, 2010) and Klaus (January 23-24, 2009) the trajectories are much closer with wind gusts considerably higher.

## Aknowledgements

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