

# Airport operations under intense dust storm conditions in Canary Islands

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Islands

AEMET

# OUTLINE



1. Introduction
2. Low visibility climatologies due to dust intrusions in airports
3. Synoptic mechanisms
4. Forecast and monitoring tools for dust intrusions. Generated products
5. An extreme event: the case study of 6th January 2002
6. Aeronautic procedures in cases of low visibility
7. Conclusions



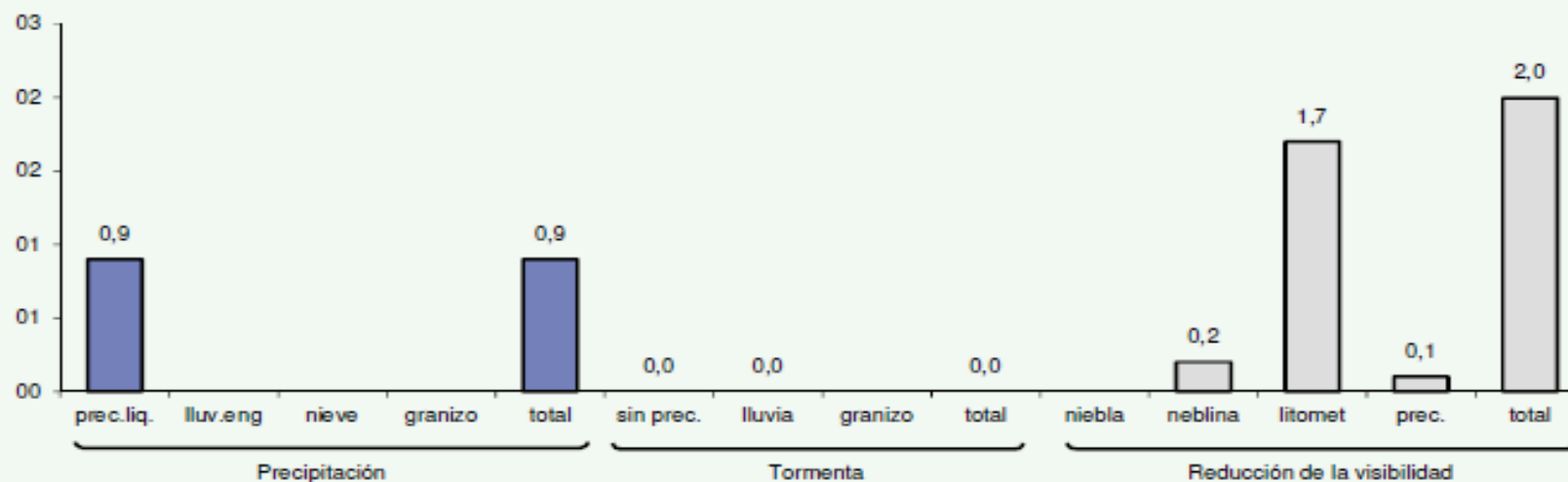
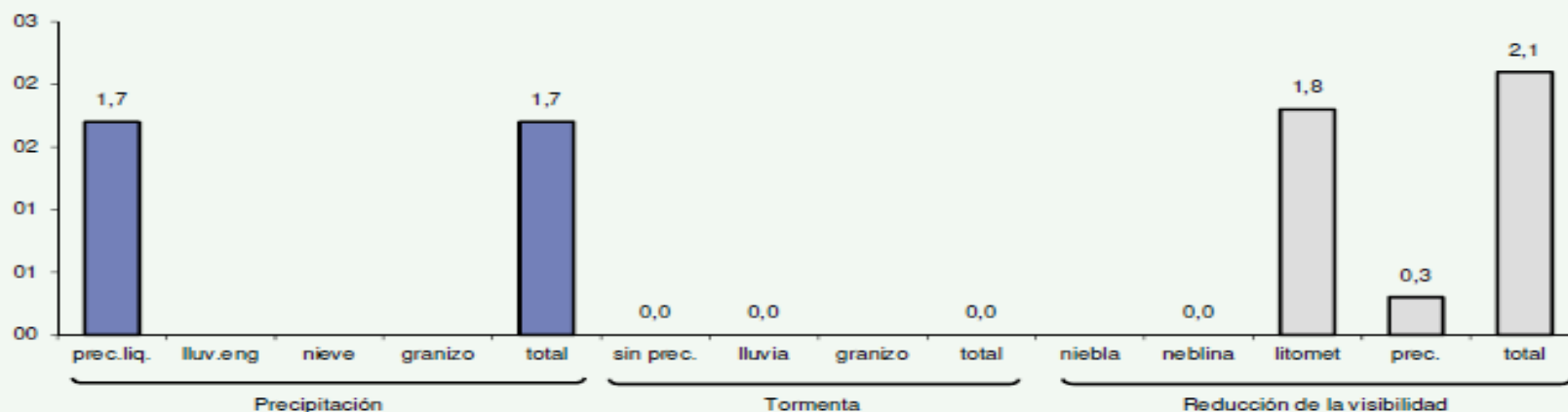
# INTRODUCTION



Closeness to one of the main dust source regions of the world

# CLIMATOLOGIES

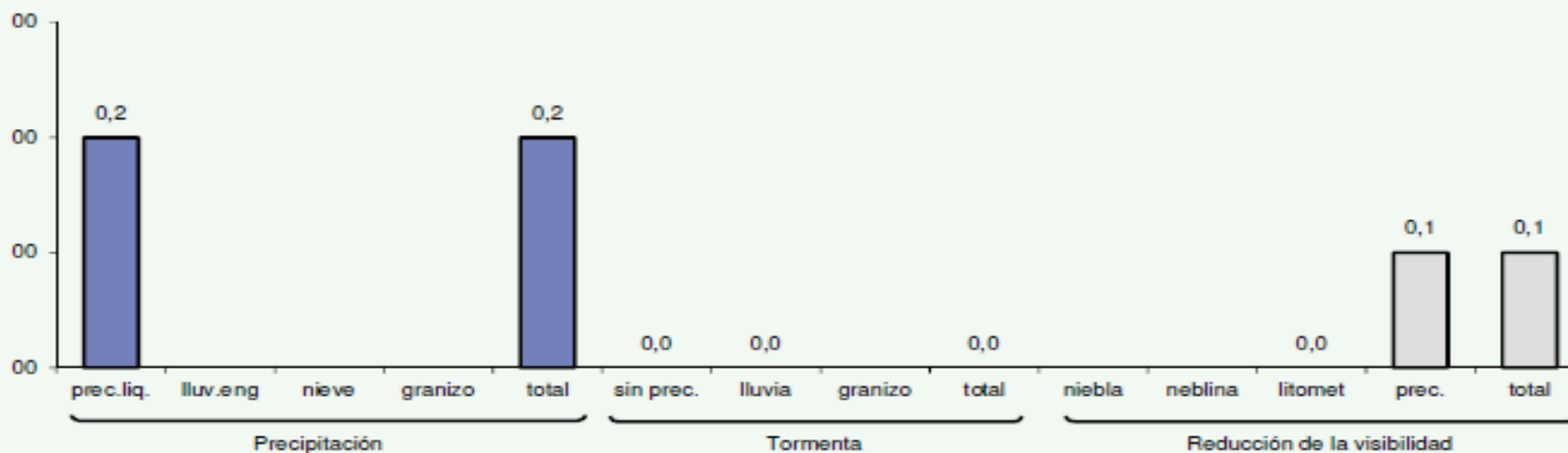
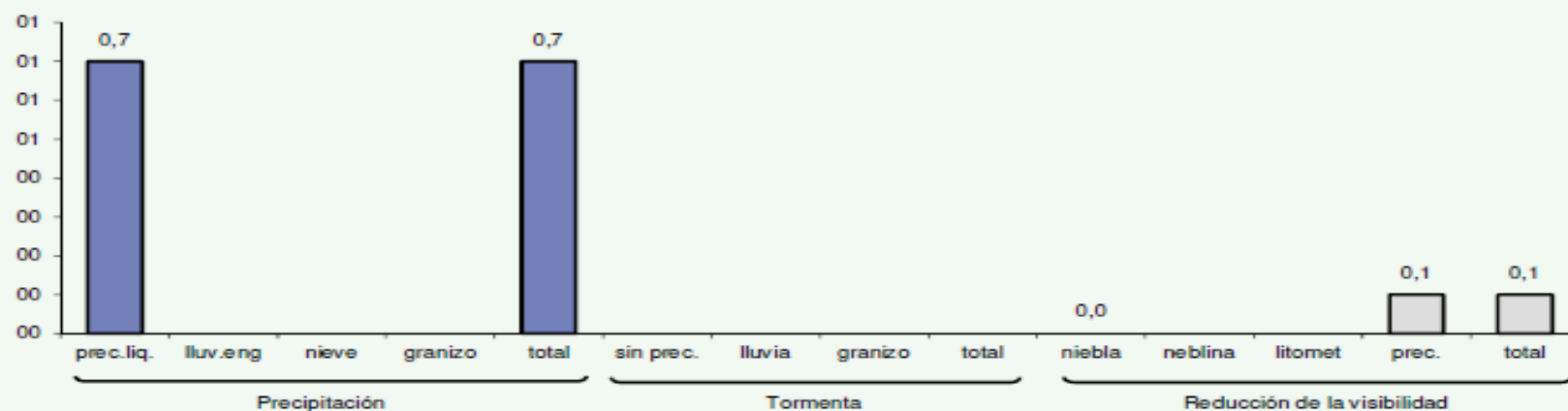
Frecuencia relativa (%) de ocurrencia de los fenómenos significativos del tiempo.



March 2002 - 2016

# CLIMATOLOGIES

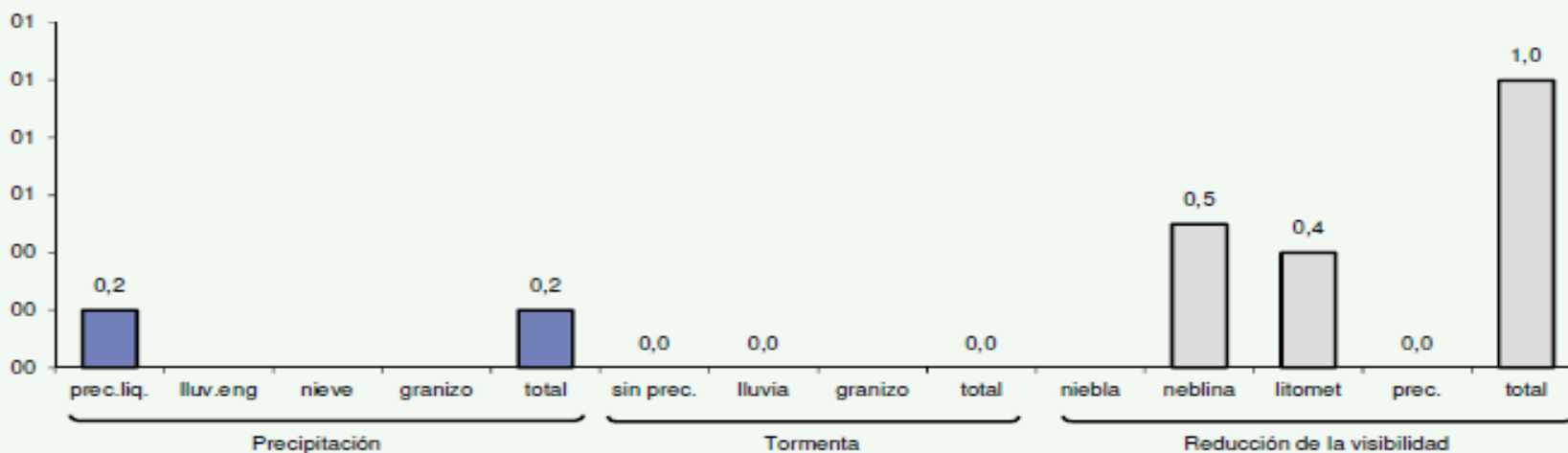
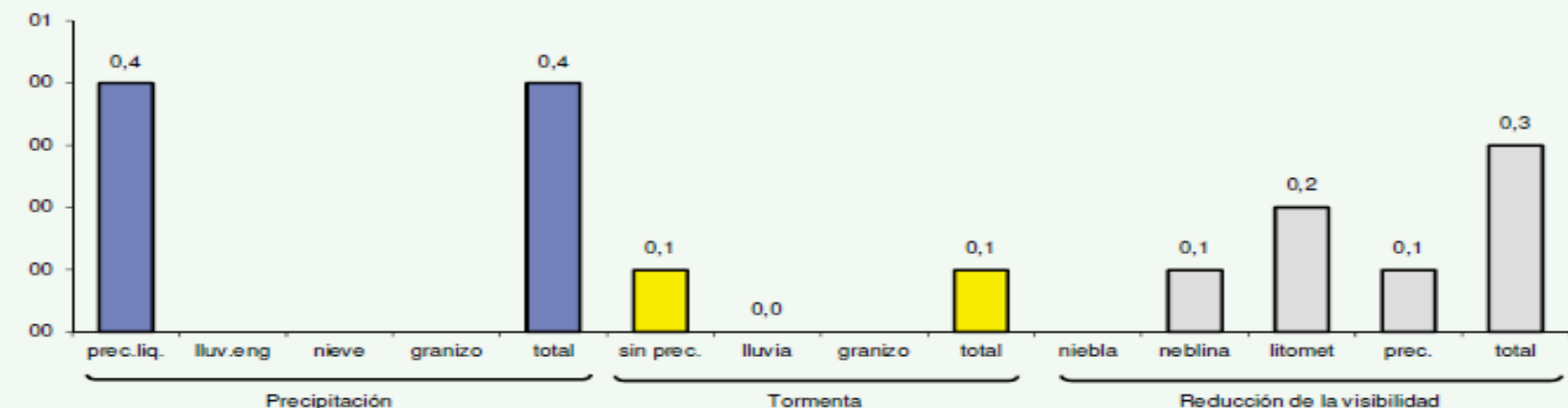
Frecuencia relativa (%) de ocurrencia de los fenómenos significativos del tiempo.



May 2002 - 2016

# CLIMATOLOGIES

Frecuencia relativa (%) de ocurrencia de los fenómenos significativos del tiempo.

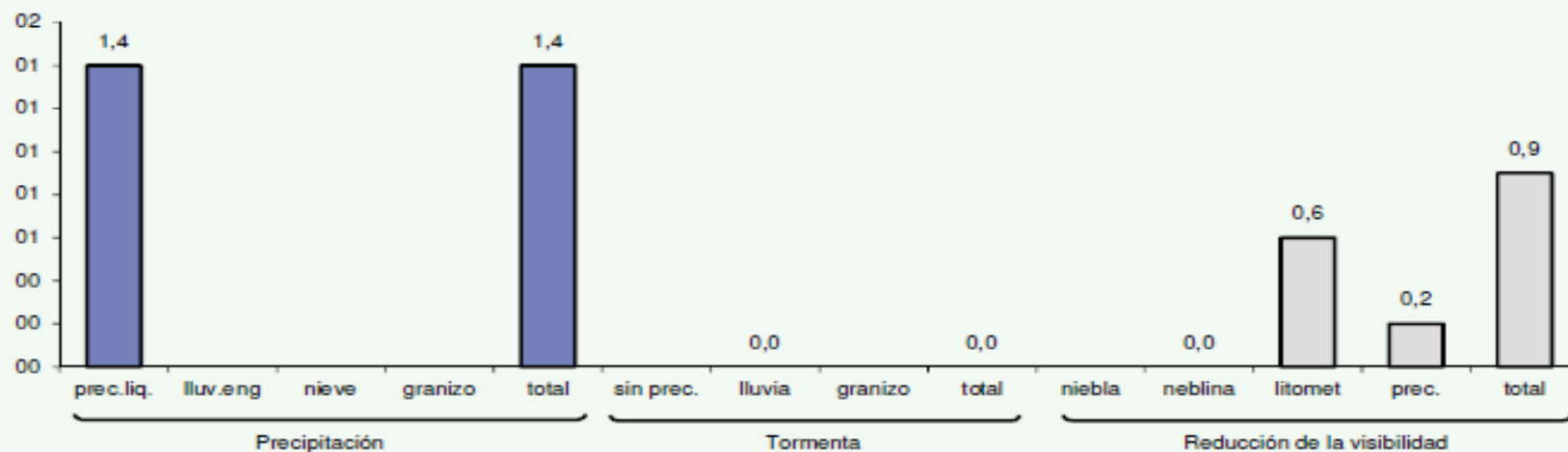
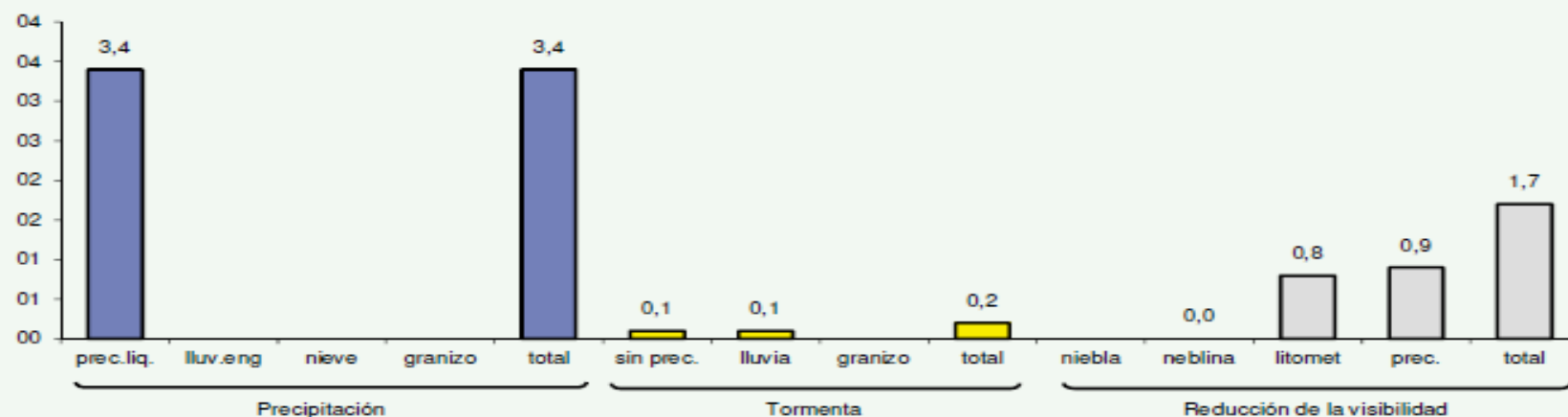


August 2002 - 2016



# CLIMATOLOGIES

Frecuencia relativa (%) de ocurrencia de los fenómenos significativos del tiempo.

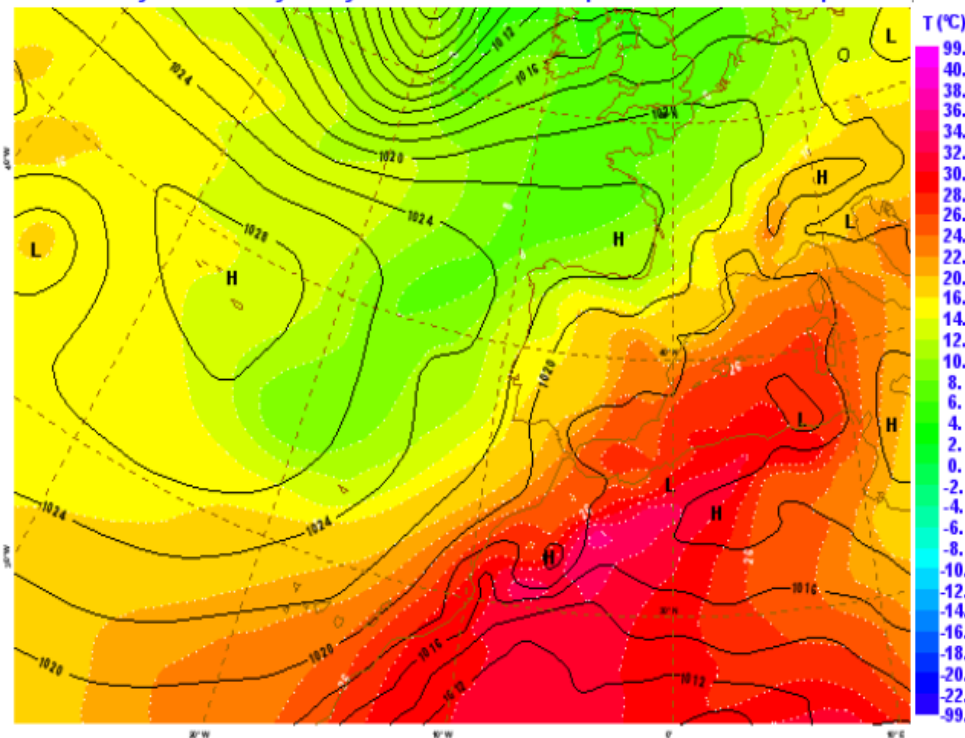


December 2002 - 2016

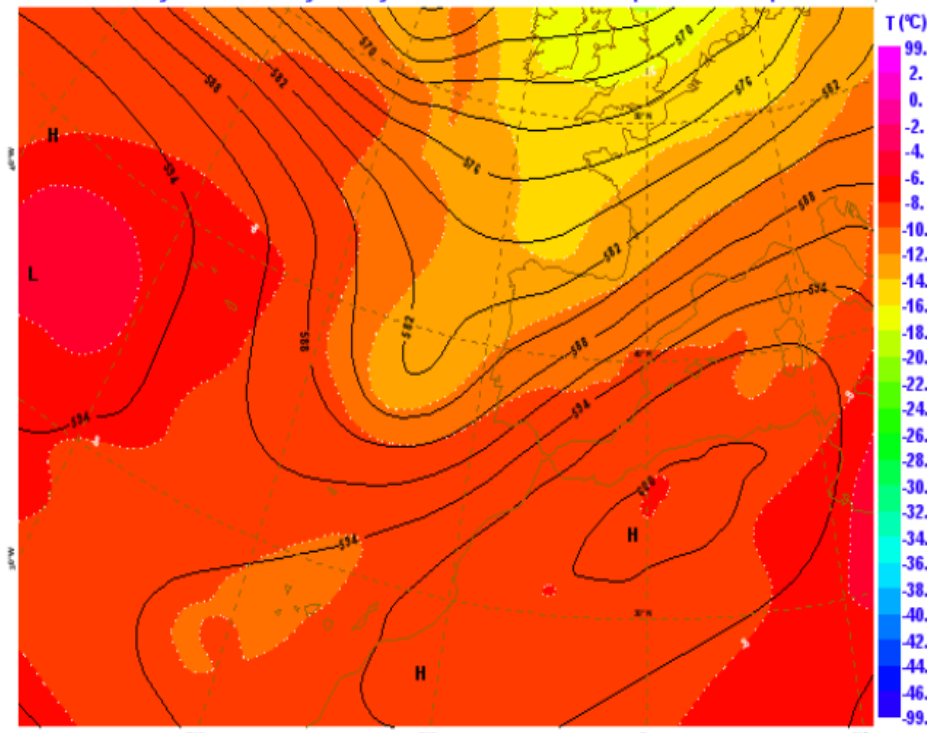
# SYNOPTIC MECHANISMS

## Summer situation

ECMWF Analysis VT: Tuesday 22 July 2003 12UTC 850hPa Temperature/ Mean sea level pressure



ECMWF Analysis VT: Tuesday 22 July 2003 12UTC 500hPa Temperature/ Geopotential



Dust intrusion in high levels



# SYNOPTIC MECHANISMS

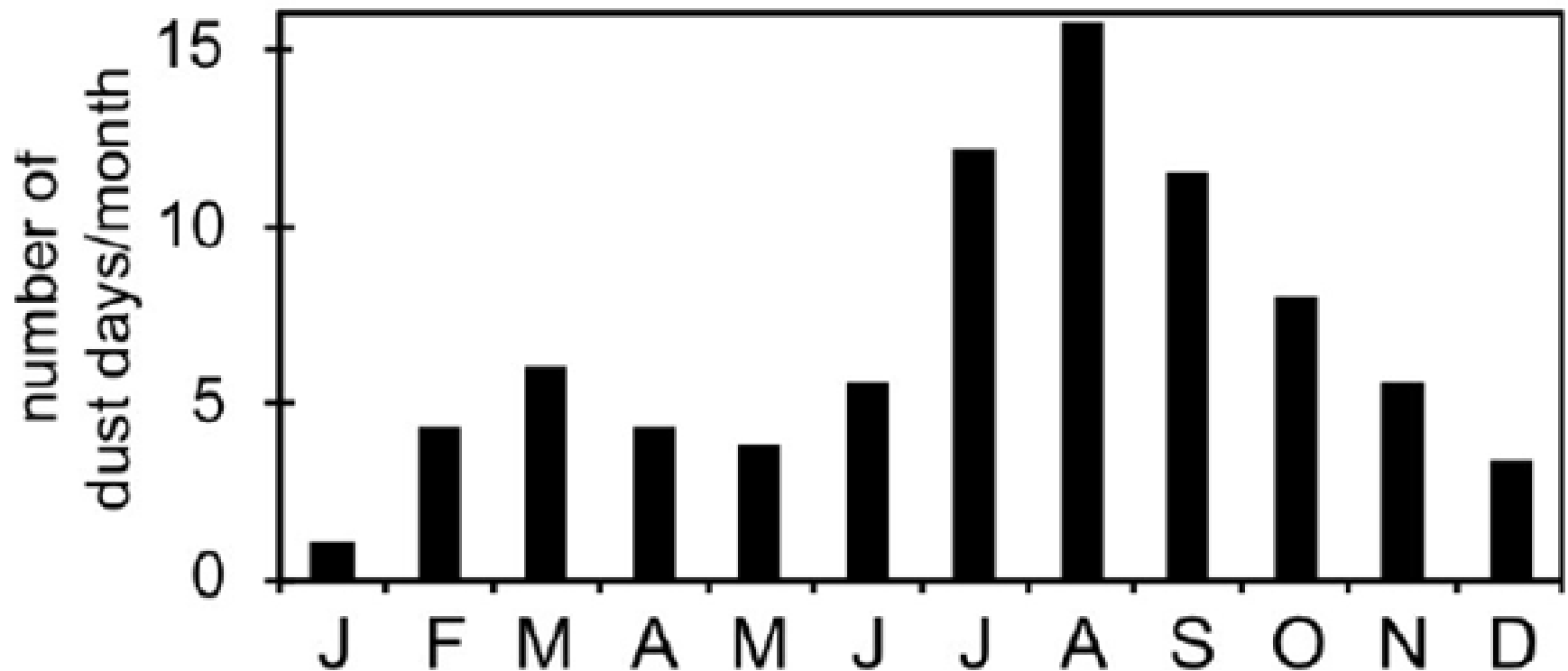
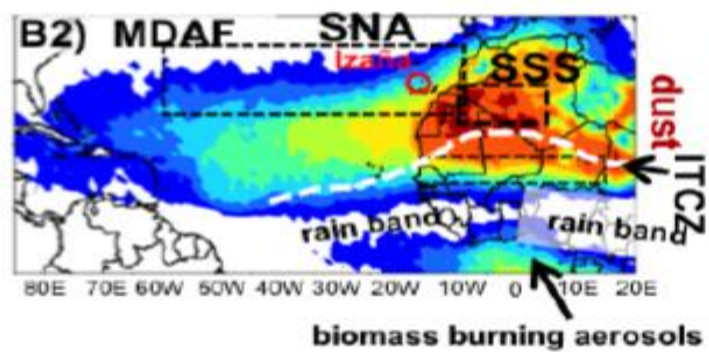
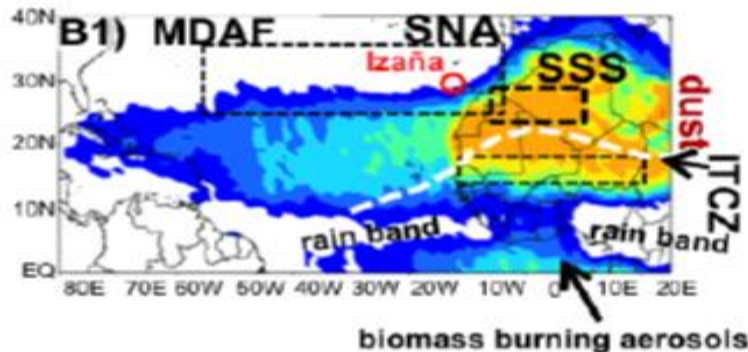
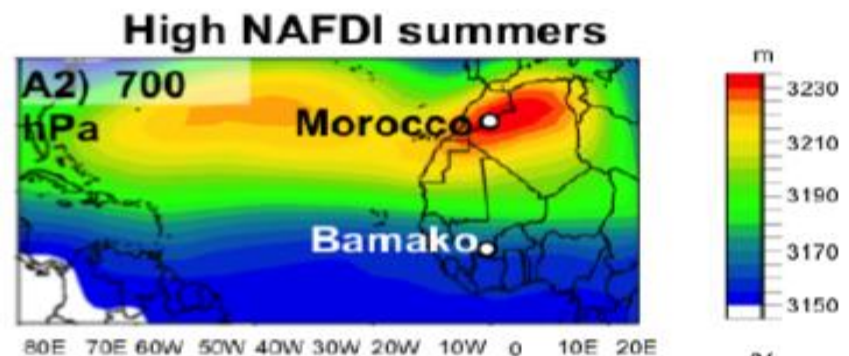
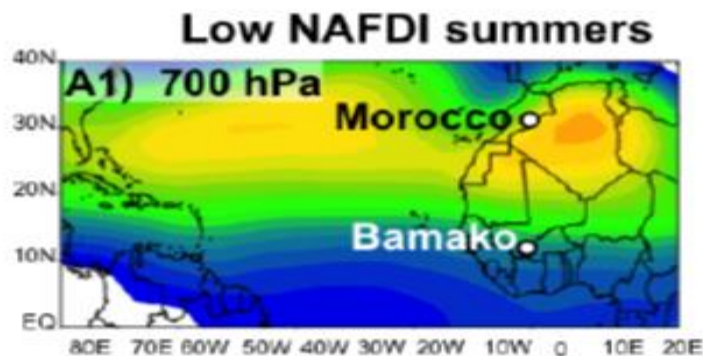
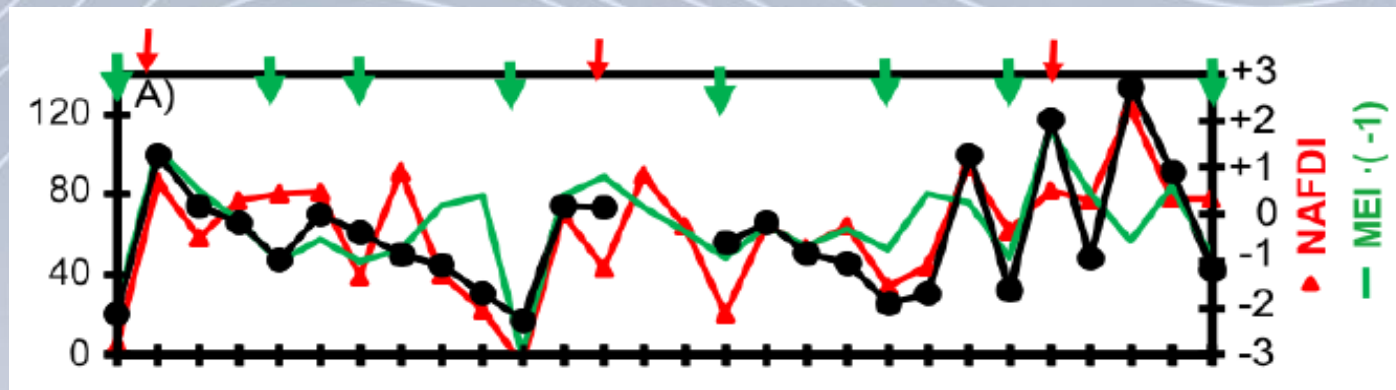


Figura 54: Frecuencia de eventos de polvo ( $>10 \mu\text{g}/\text{m}^3$ ) en Izaña en el periodo 1987–2014.

Measurements at 2400 m above sea level

# SYNOPTIC MECHANISMS



# SYNOPTIC MECHANISMS

## Winter situation

ECMWF Analysis VT: Tuesday 4 March 2003 12UTC 850hPa Temperature/ Mean sea level pressure

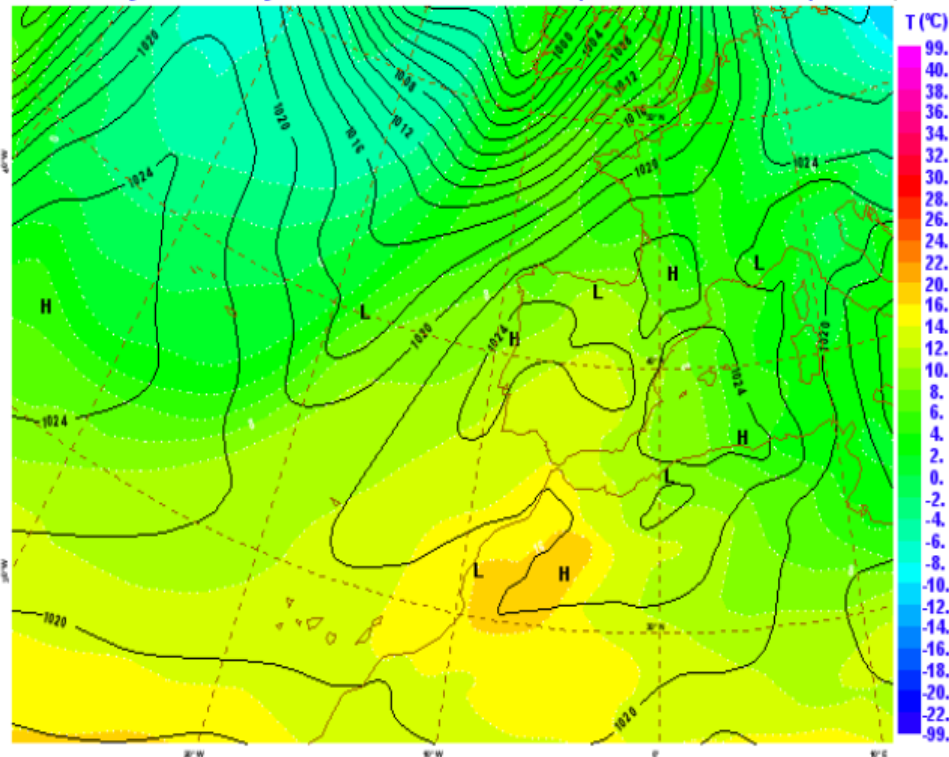


Figura 61: Análisis de superficie, 12 horas del 4 de marzo de 2003. (Fuente: AEMET)

ECMWF Analysis VT: Tuesday 4 March 2003 12UTC 500hPa Temperature/ Geopotential

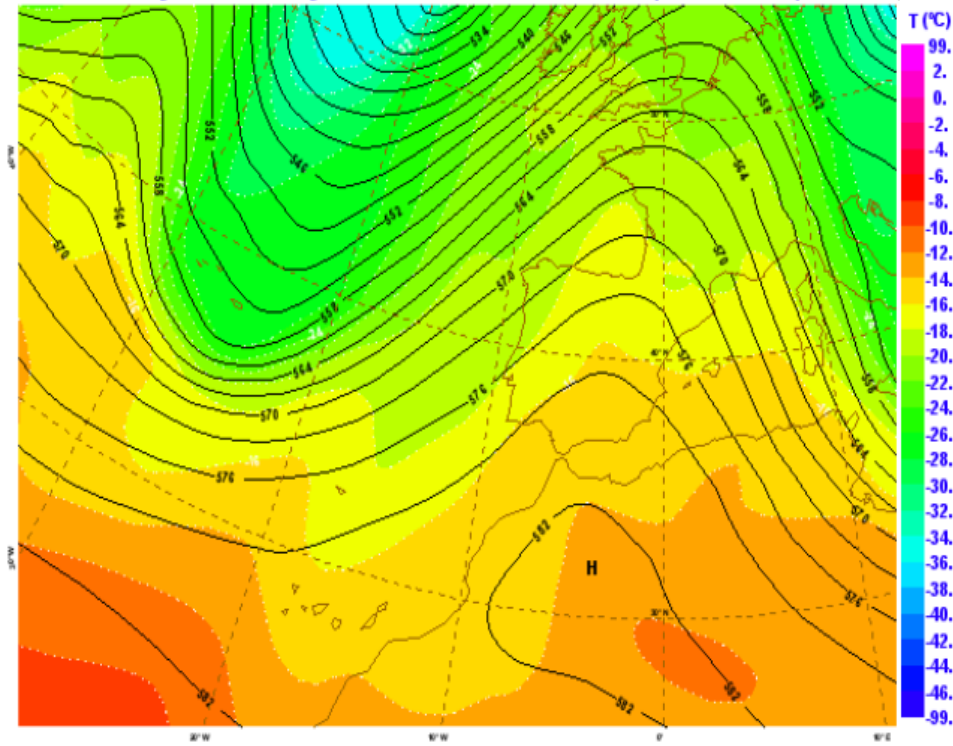
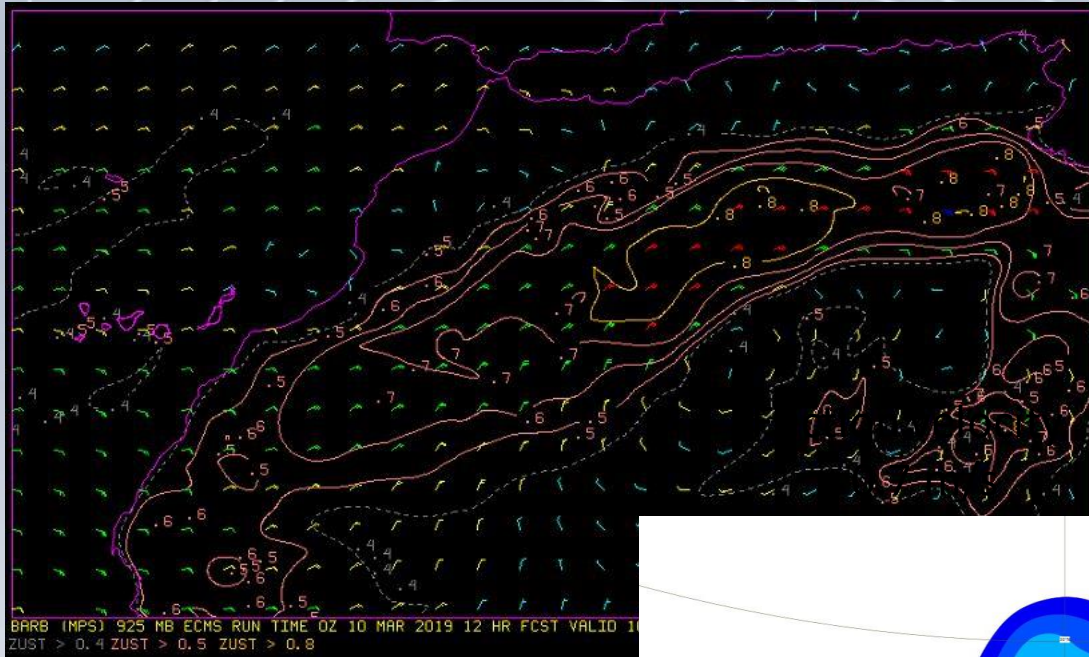


Figura 62: Análisis de 500 hPa, 12 horas del 4 de marzo de 2003. (Fuente: AEMET)

Dust intrusion in low levels



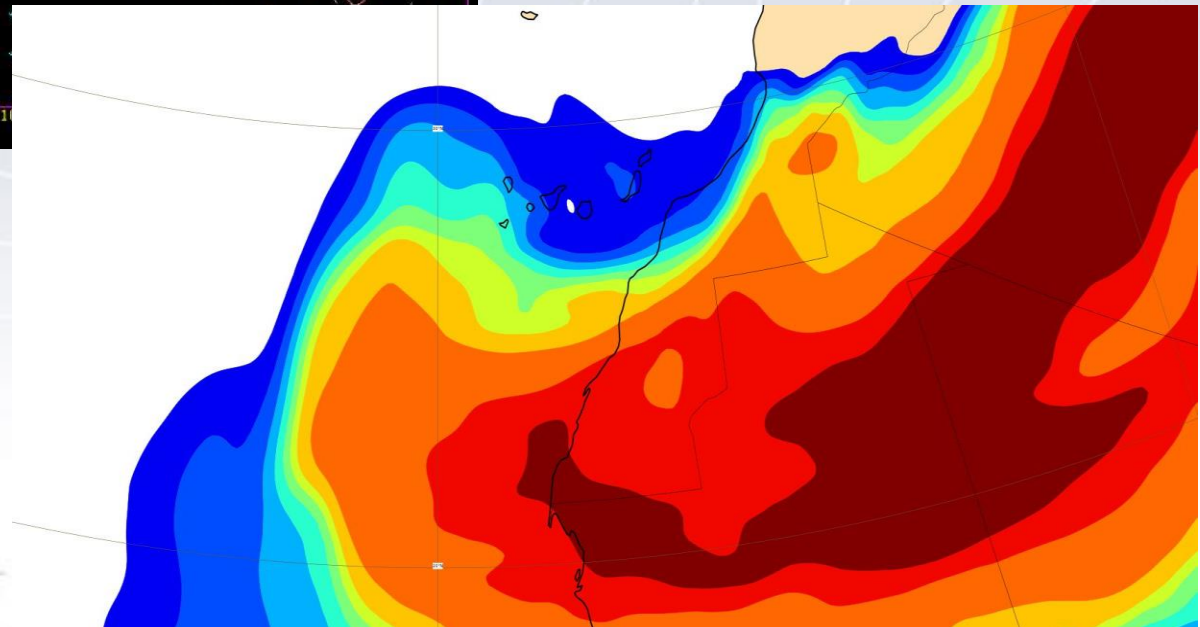
# FORECAST TOOLS



Friction velocity  
 $> 0.7 \text{ m/s}$   
(ECMWF)



Aerosol Optical Depth,  
AOD  
(CAMS)

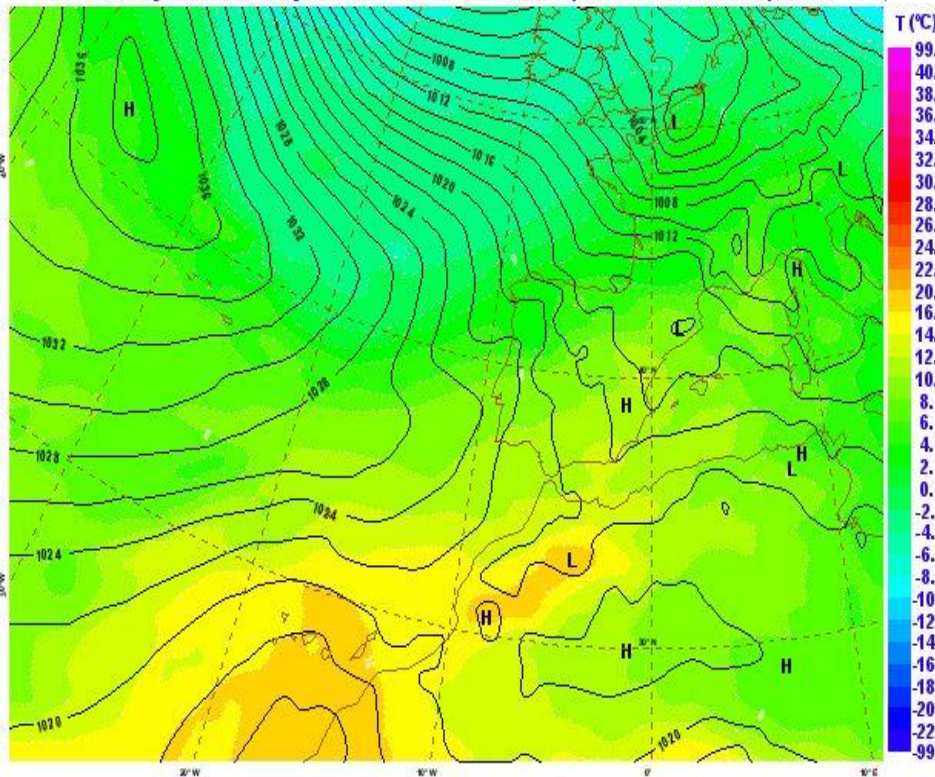




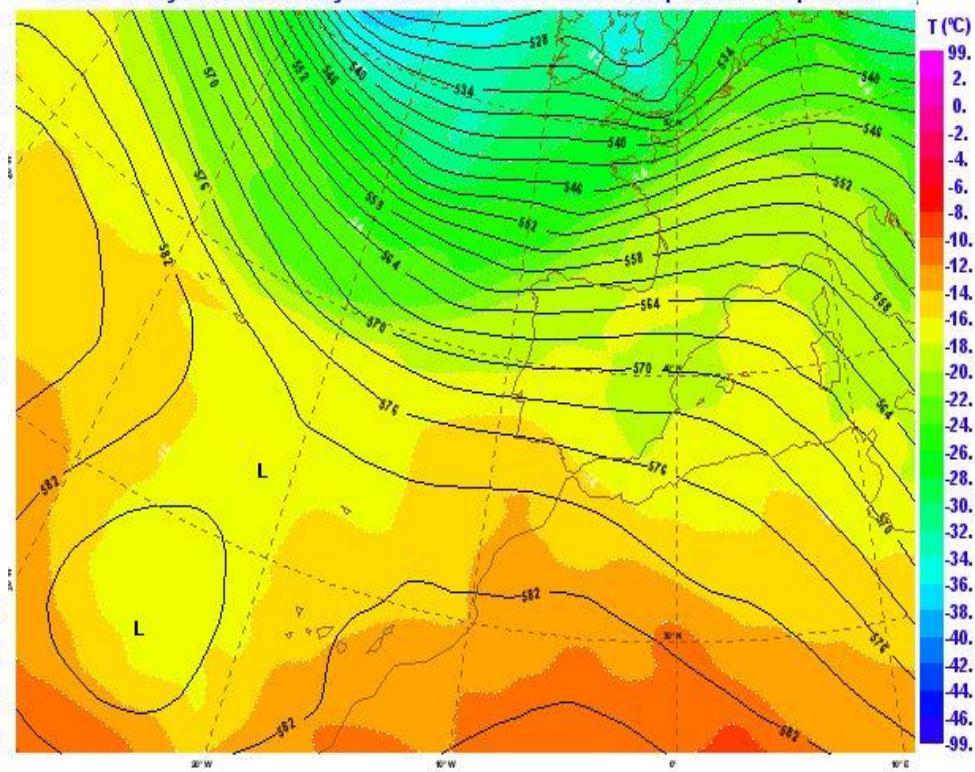
# FORECAST TOOLS

28th March 2018

ECMWF Analysis VT:Wednesday 28 March 2018 12UTC 850hPa Temperature/ Mean sea level pressure



ECMWF Analysis VT:Wednesday 28 March 2018 12UTC 500hPa Temperature/ Geopotential

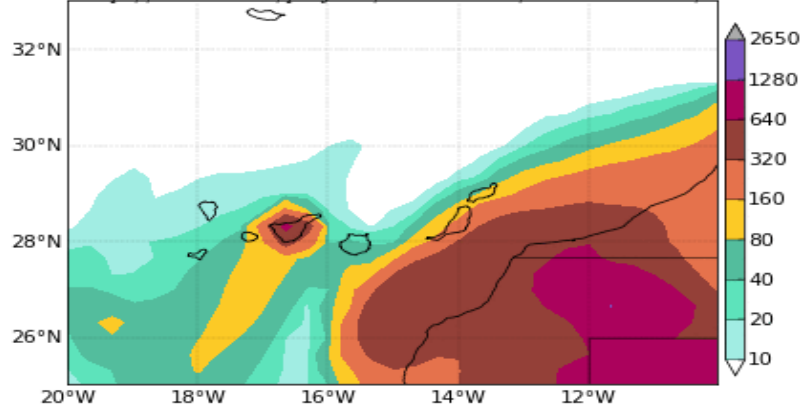


Will there be low visibility in the airports due to dust?

# FORECAST TOOLS

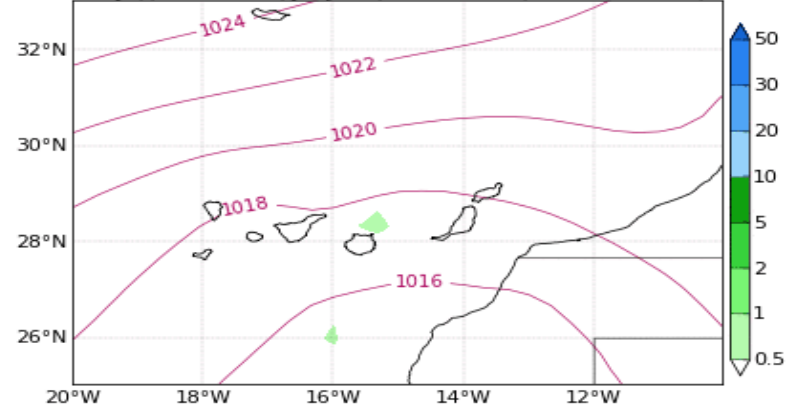
BSC-DREAM8b v2.0 Dust Low Level Conc. ( $\mu\text{g}/\text{m}^3$ )  
24h forecast for 12UTC 28 Mar 2018

<http://www.bsc.es/projects/earthscience/BSC-DREAM/>



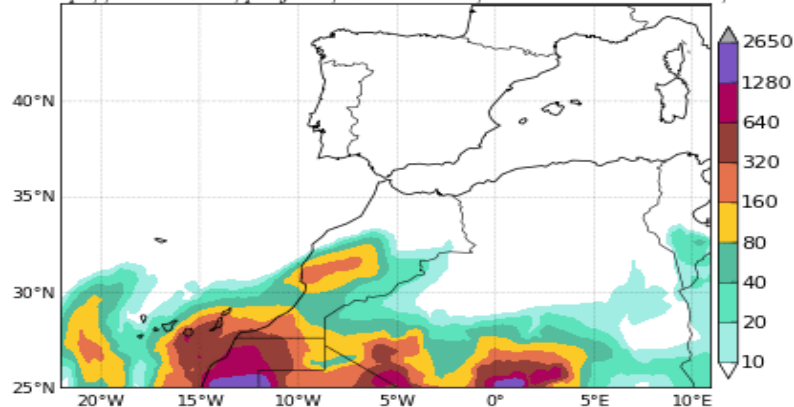
BSC-DREAM8b v2.0 6h Acc. Prec. (mm) and MSL Pres. (hPa)  
24h forecast for 12UTC 28 Mar 2018

<http://www.bsc.es/projects/earthscience/BSC-DREAM/>



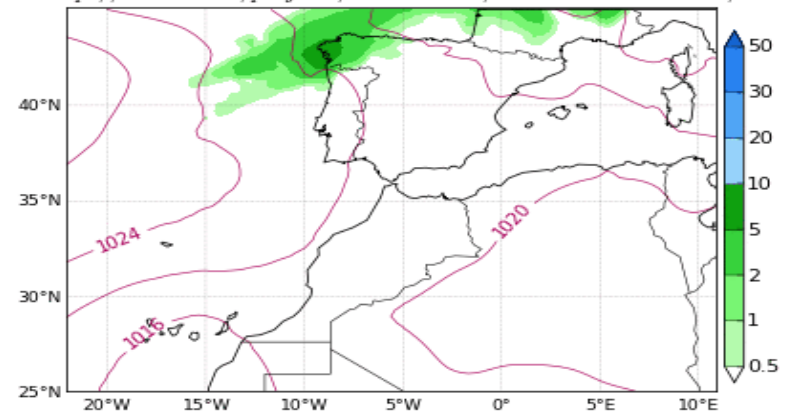
NMMB/BSC-Dust Dust Surface Conc. ( $\mu\text{g}/\text{m}^3$ )  
24h forecast for 12UTC 28 Mar 2018

<http://www.bsc.es/projects/earthscience/NMMB-BSC-DUST/>



NMMB/BSC-Dust 6h Acc. Prec. (mm) and MSL Pres. (hPa)  
24h forecast for 12UTC 28 Mar 2018

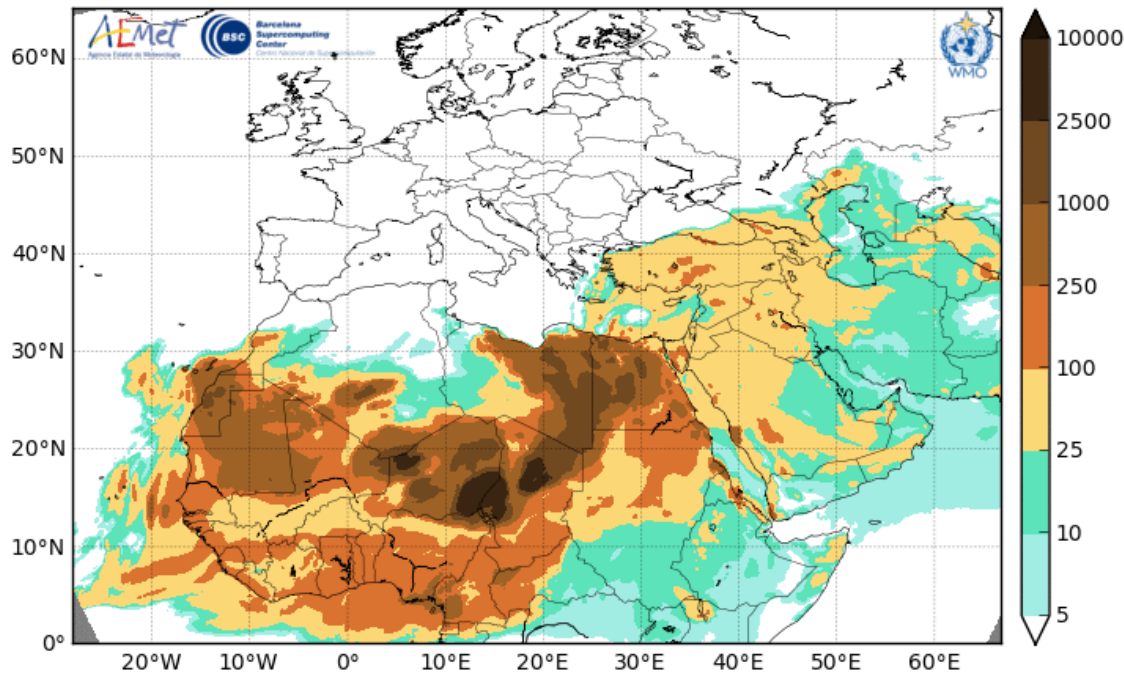
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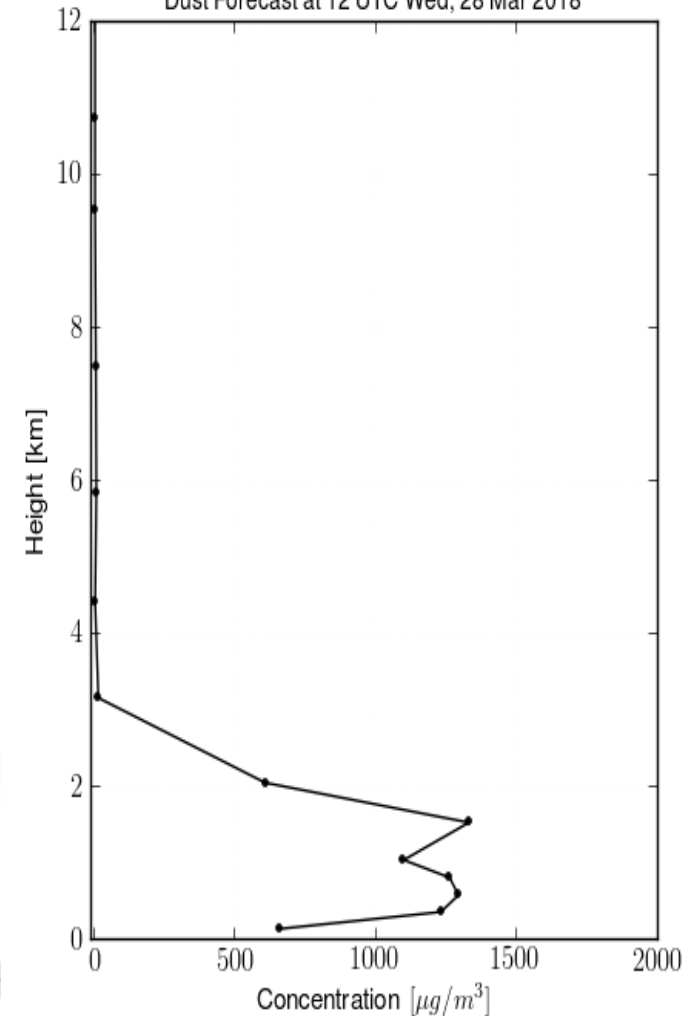


# FORECAST TOOLS

Barcelona Dust Forecast Center - <http://dust.aemet.es/>  
NMMB/BSC-Dust Res:  $0.1^\circ \times 0.1^\circ$  Dust Surface Ext. ( $\text{Mm}^{-1}$ )  
Run: 12h 27 MAR 2018 Valid: 12h 28 MAR 2018 (H+24)



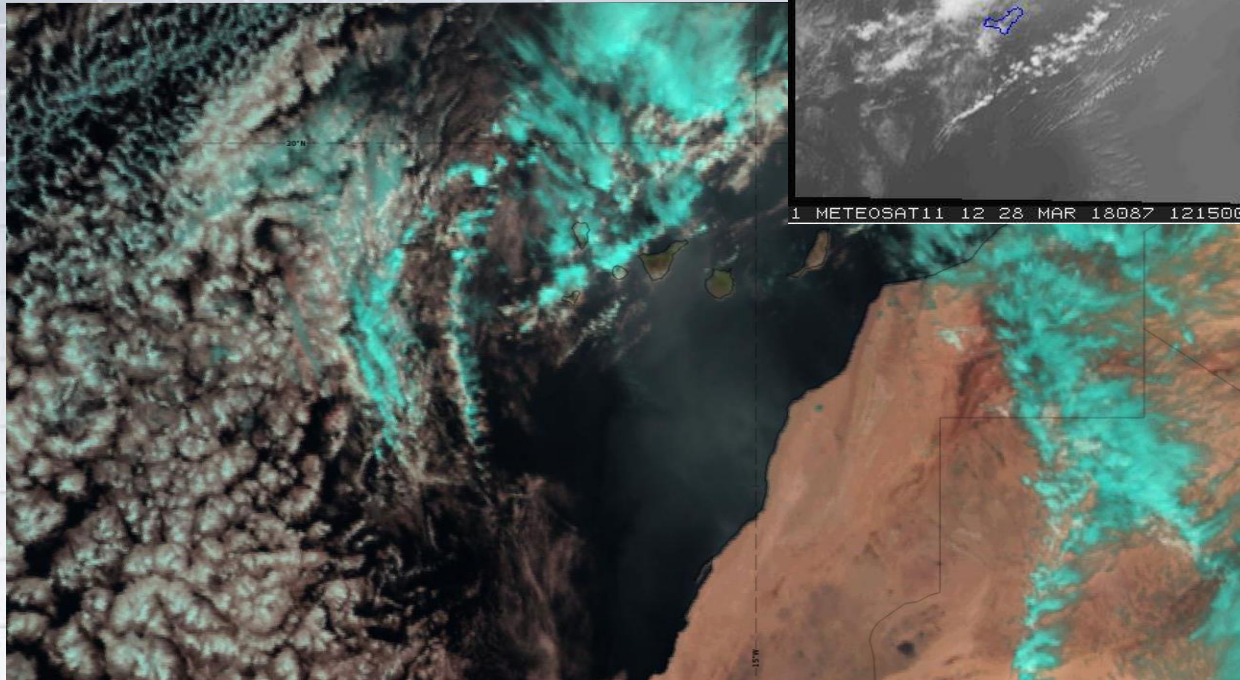
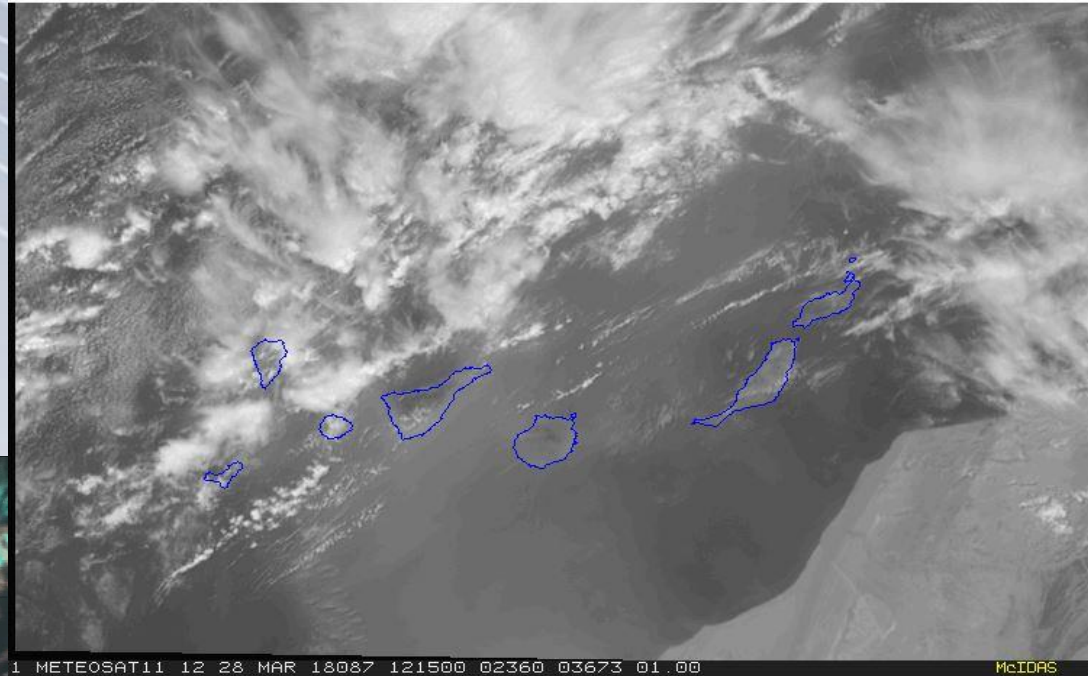
NMMB/BSC-Dust  
Fuerteventura-Airport: 13.86W, 28.45N  
Dust Forecast at 12 UTC Wed, 28 Mar 2018



Good predictor of surface visibility

# MONITORING TOOLS

HRV Satellite  
Image



Natural  
RGB



# GENERATED PRODUCTS



TAF GCRR 280800Z 2809/2909 05016KT **6000** NSC TX24/2814Z TN17/2906Z  
**PROB40 TEMPO 2809/2821 3000 HZ**  
PROB40 2810/2816 12009KT=

TAF GCFV 280800Z 2809/2909 VRB05KT **7000** NSC TX23/2814Z TN17/2906Z  
**PROB40 TEMPO 2809/2821 3000 HZ=**

TAF GCLP 280800Z 2809/2909 VRB05KT **7000** NSC TX24/2814Z TN17/2906Z  
**PROB40 TEMPO 2809/2903 3000 HZ**  
BECMG 2819/2821 35012KT=

TAF GCXO 280800Z 2809/2909 14009KT **7000** NSC TX24/2814Z TN13/2906Z  
**PROB40 TEMPO 2809/2909 3000 HZ**  
PROB30 TEMPO 2809/2816 14015G25KT=

TAF AMD GCXO 281159Z 2811/2909 14009KT **7000** NSC TX24/2814Z  
TN13/2906Z  
**PROB40 TEMPO 2811/2909 3000 HZ**  
**PROB30 TEMPO 2811/2821 1500 HZ**  
PROB30 TEMPO 2811/2816 14015G25KT=

TAF GCTS 280800Z 2809/2909 05009KT **7000** NSC TX25/2814Z TN19/2906Z  
**PROB40 TEMPO 2809/2909 3000 HZ=**

TAF AMD GCTS 281135Z 2811/2909 05009KT **7000** NSC TX25/2814Z  
TN19/2906Z  
**PROB40 TEMPO 2811/2909 3000 HZ**  
**PROB30 TEMPO 2811/2821 1500 HZ=**

TAF GCGM 280800Z 2809/2909 VRB05KT **7000** NSC TX24/2814Z TN18/2906Z  
**PROB40 TEMPO 2809/2909 3000 HZ=**

TAF COR GCLA 280801Z 2809/2909 02011KT **8000** NSC TX25/2814Z TN19/2906Z  
BECMG 2818/2820 32007KT  
**PROB40 TEMPO 2809/2909 3000 HZ=**

TAF GCHI 280800Z 2809/2909 02011KT **8000** NSC TX22/2814Z TN18/2906Z  
**PROB40 TEMPO 2809/2909 3000 HZ=**



**METAR GCXO 281400Z 16008KT 120V210 1100 R30/1600N R12/1500N  
HZ VV011 24/01 Q1019 NOSIG=**

**METAR GCTS 281400Z 09009KT 060V130 1400 1100SW HZ NSC 29/M00  
Q1016 NOSIG=**

# GENERATED PRODUCTS

## SÍMBOLOS Y UNIDADES

**V1** Visibilidad <1000 m

**V5** 1000m ≤ Visibilidad <5000m

**R** y **CB** implican turbulencia y engelamiento moderado o fuerte.

Frentes, centros de presión, isócoros y estado de la mar válidos para HH-3 y HH+3.

Consulte GAMET, AIRMET y SIGMET en vigor.

Altura de las olas, en metros

Temperatura del mar, en °C.

Altitud T=0°C

Todas las indicaciones verticales se dan en altitudes sobre el nivel del mar.

Visibilidades en metros

Velocidades en nudos

Presiones en hectopascales

Altitudes en hectopis

XXX: por encima de FL150.

## COMENTARIOS

1 LCA BKN CU SC  
030-035  
020-025

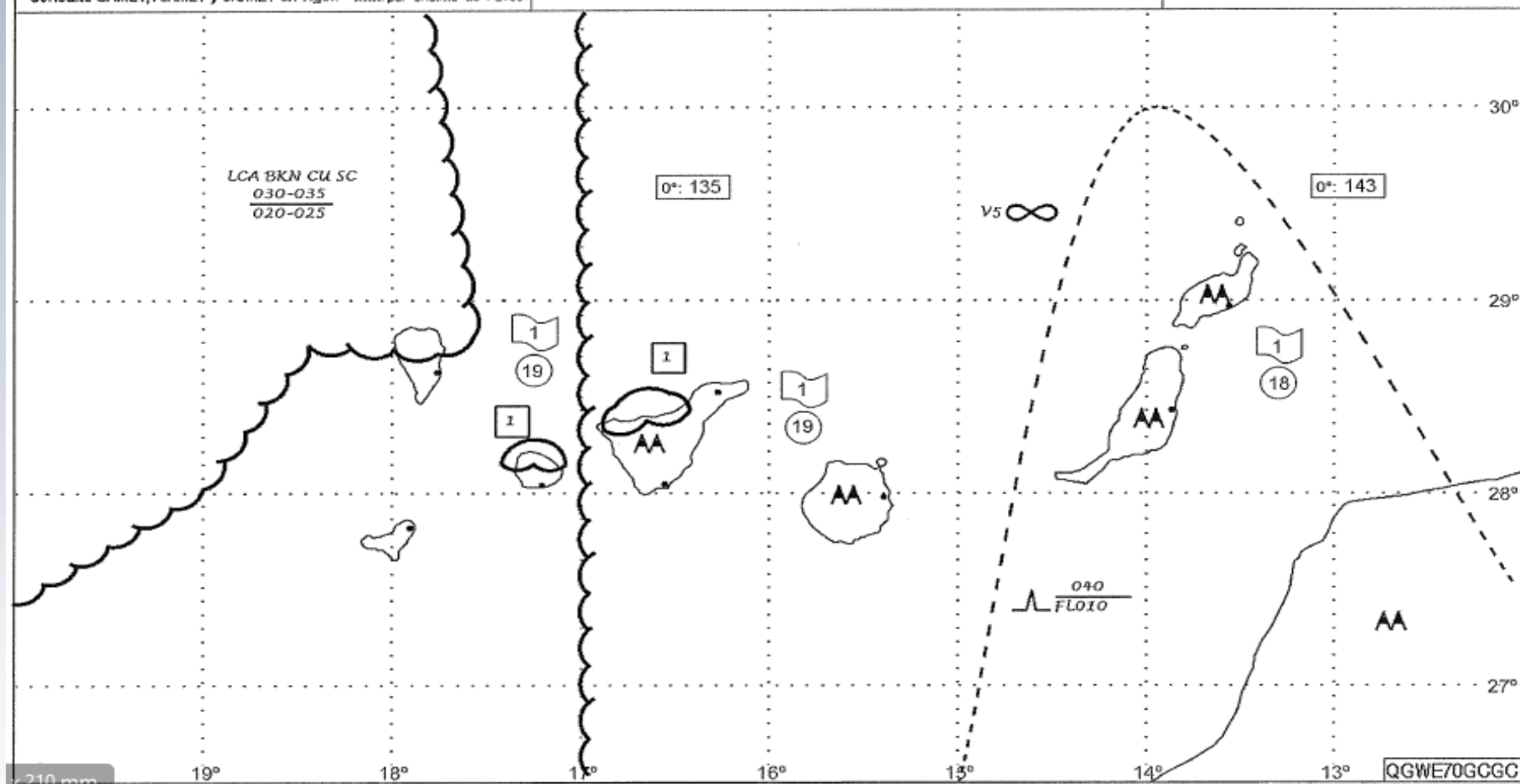


GOBIERNO DE ESPAÑA  
MINISTERIO PARA LA TRANSICIÓN ECOLÓGICA  
AGENCIA ESTATAL DE METEOROLOGÍA

Aemet  
Agencia Estatal de Meteorología

SIGWX  $\frac{150}{SFC}$  GCGC

VÁLIDO PARA HH (UTC): 00  
DD/MM/AA: 28/03/18



# GENERATED PRODUCTS



GOBIERNO  
DE ESPAÑA

MINISTERIO  
PARA LA TRANSICIÓN ECOLÓGICA

**Aemet**  
Agencia Estatal de Meteorología

## SÍMBOLOS Y UNIDADES

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Altura de las  
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Temperatura  
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Altitud T=0°C

Todas las indicaciones  
verticales se dan en  
altitudes sobre el nivel  
del mar.

Visibilidades en metros

Velocidades en nudos

Presiones en hectopascuales

Altitudes en hectopases

XXX: por encima de FL150

Frentes, centros de presión, isócoros y estado de  
la mar válidos para HH. Nubosidad y fenómenos  
significativos presentes entre HH-3 y HH+3.

Consulte GAMET, AIRMET y SIGMET en vigor.

## MENTARIOS

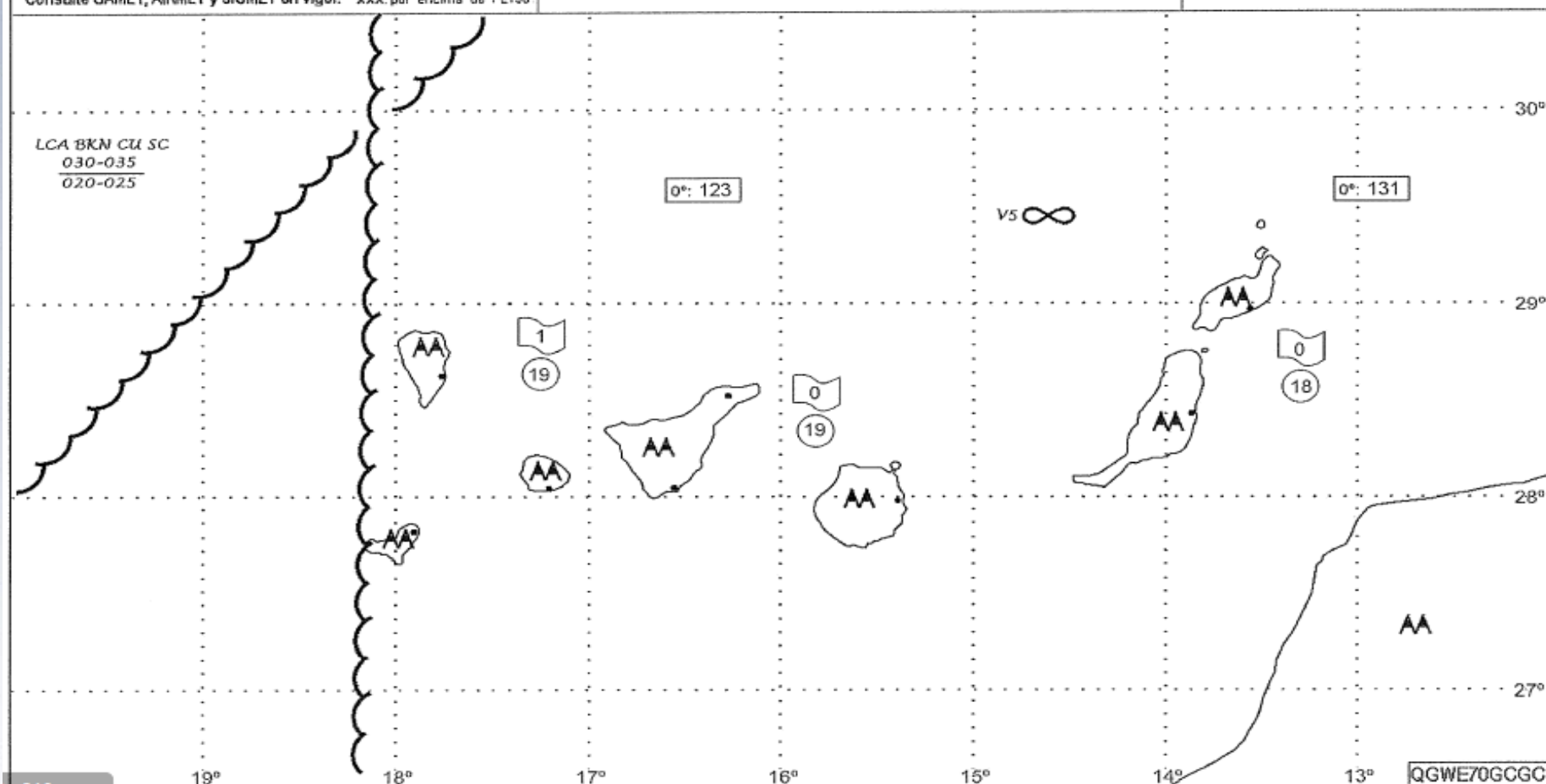


GOBIERNO  
DE ESPAÑA

**Aemet**  
Agencia Estatal de Meteorología

SIGWX 150  
SFC GCGC

VÁLIDO PARA HH (UTC): **12**  
DD/MM/AA: **28/03/18**





# AN EXTREME EVENT

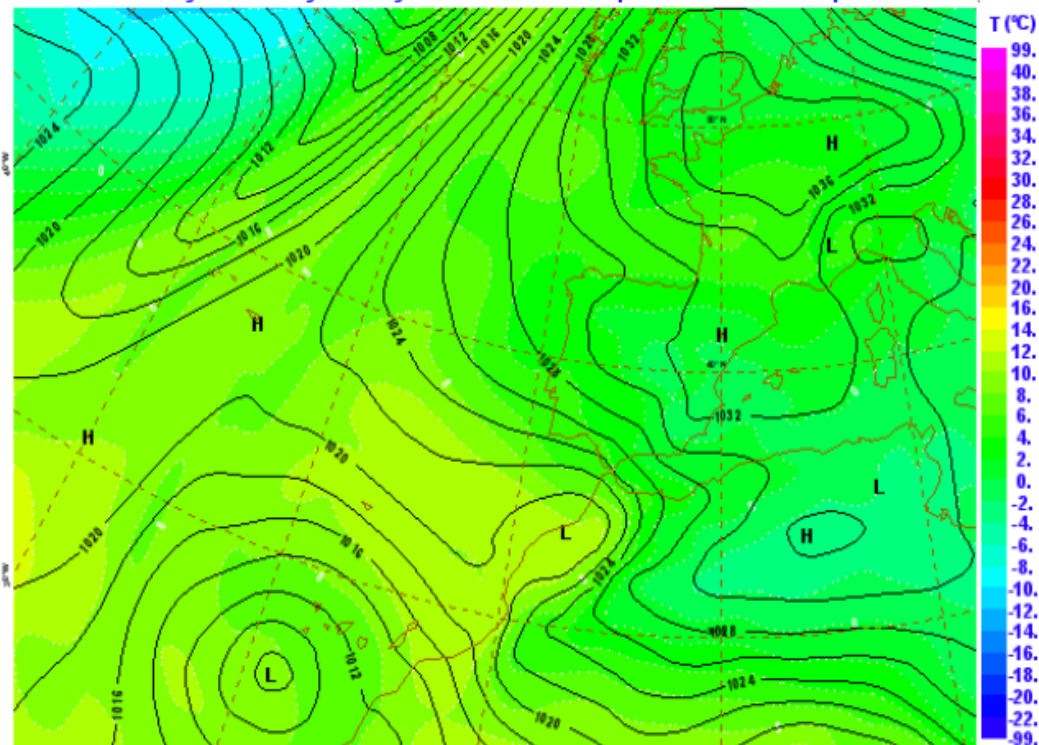


GOBIERNO  
DE ESPAÑA

MINISTERIO  
PARA LA TRANSICIÓN ECOLÓGICA

**Aemet**  
Agencia Estatal de Meteorología

ECMWF Analysis VT: Sunday 6 January 2002 12UTC 850hPa Temperature/ Mean sea level pressure



SA 06/01/2002 15:30-> GCLP 061530Z 11013KT 0050 R03/0900N HZ BKN025 20/10 Q1011=

SA 06/01/2002 16:00-> GCLP 061600Z 11015KT 0000 R03/0800N VV350 20/09 Q1011=

SA 06/01/2002 16:30-> GCLP 061630Z 10004KT 0050 R03/0650N HZ VV250 20/11 Q1011=

SA 06/01/2002 17:30-> GCLP 061730Z 10015KT 0050 R03/0800N HZ VV250 21/09 Q1011=

SA 06/01/2002 18:00-> GCLP 061800Z 10015KT 0050 R03/0900U HZ VV300 21/10 Q1011=



# AERONAUTIC PROCEDURES



<b>Fase I – PREAVISO</b>	$\leq 900$ m y tendencia a empeorar.
<b>Fase II – PARALIZACIÓN DE OPERACIONES</b>	$< 800$ m
<b>Fase III – REANUDACIÓN DE OPERACIONES</b>	$\geq 900$ m y tendencia a mejorar.

Lanzarote - GCRR

RESUMEN DE FASES DE ACTIVACIÓN DEL PROCEDIMIENTO	
FASES	Inicio: RVR / visibilidad (m)
Fase 0 – Prealerta.	$\leq 1.000$
Fase 1 – Cancelación de aterrizajes.	$\leq 600$
Fase 2 – Cancelación de despegues.	$\leq 400$
Fase 3 – Cancelación de Procedimiento PPOAM600.	$\geq 1000$

Fuerteventura - GCFV

# CONCLUSIONS

- Dust intrusions are favored in Canary Islands due to its closeness to one of the largest dust source regions of the world. The characteristic synoptic configuration for these episodes to happen is a high pressure over North Africa (easterly – southeasterly winds)
- In summer, dust intrusions tend to occur in high levels. The mechanism that controls such situations is the intensification of the African Dipole in 700 hPa (high correlation between dust concentration and the NAFDI index)
- In winter, the situations that may cause a significant visibility reduction in the airports occur. The position of the high pressure generates a more continental flow over the islands and in addition, the higher variability of the humid surface layer enhances the presence of dust in the low troposphere

# CONCLUSIONS



- Even if dust intrusions are very common in Canary islands, extreme episodes are quite infrequent. In fact, in the last 5 years we have only had 7 situations in which surface visibility was reduced below 3000 m (warning)
- Friction velocity is a proper index to quantify the lifting of dust from the desert, but transport is necessary afterwards. The extinction coefficient is a good predictor of surface visibility
- The Forecast Group of the Canary Islands is responsible of the alerts concerning severe dust intrusions, as well as the monitoring of such situations. In order to provide this service, we use some resources such as numeric models or satellite images, generating a series of products (low level maps, TAFs and warnings)
- In the event of a great surface visibility reduction, a series of procedures are started up in the airports of the Canary Islands. These may differ between airports, but usually a phase of pre – alert is declared when  $RVR < 1000$  m

# THANK YOU VERY MUCH

Contact: [cgonzaleza@aemet.es](mailto:cgonzaleza@aemet.es)