Sobre la predicibilidad de algunos fenómenos mediterráneos: medicanes, rissagues

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"A way to make Europe"

- Medicanes. El caso Zorbas.
- Rissagues:
  - Predicción *subjetiva* (AEMET)
  - Predicción *objetiva/determinista/ensemble* (SOCIB)

About tropical-like cyclones in the Mediterranean: the Ionian Sea case of 28-29 September 2018

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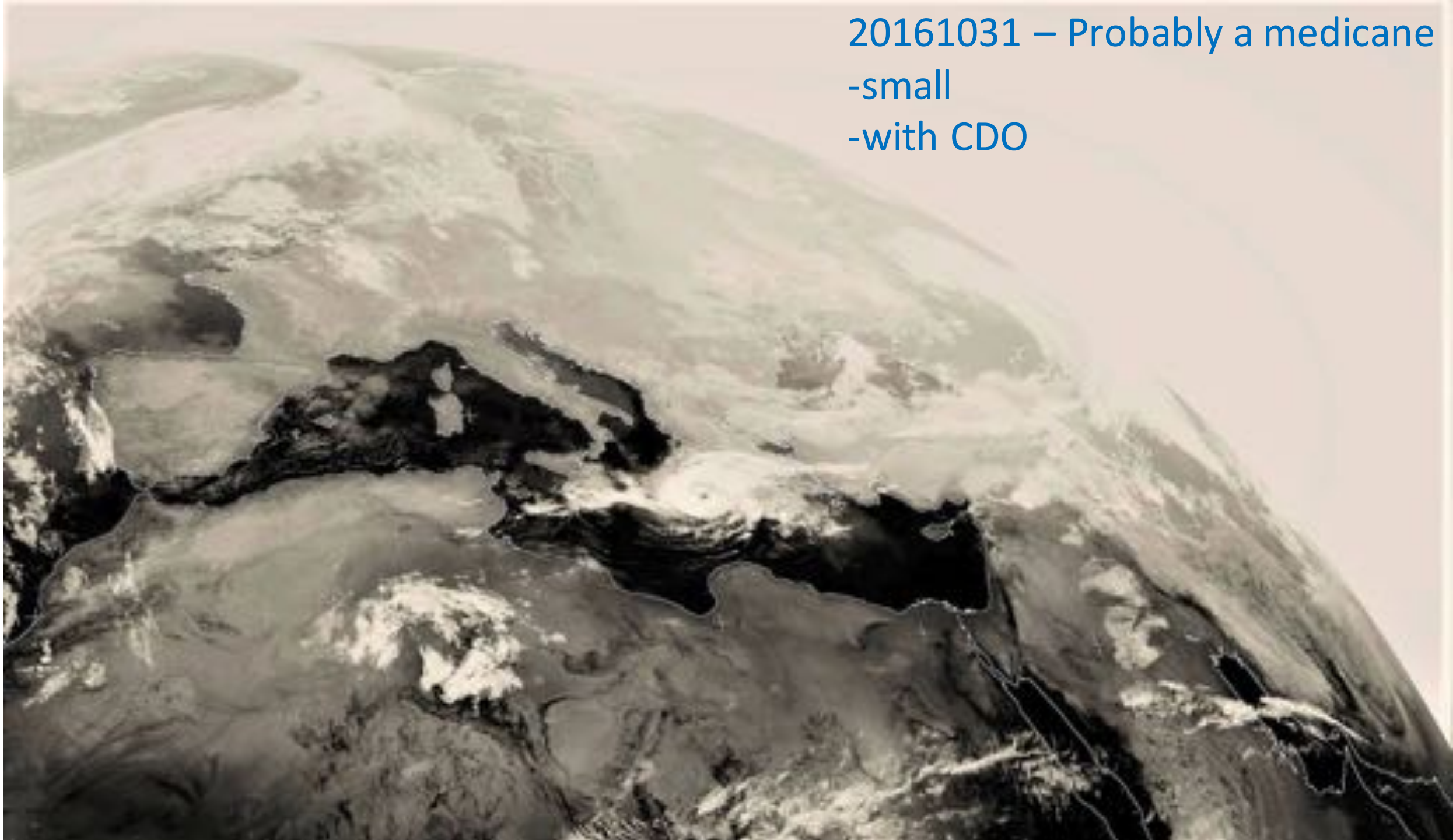
7ªMetMed – Palma – 4-6 March 2019

About the cyclogenetic mechanism of intense Mediterranean cyclones, there is a *continuous spectrum:*

Extratropical cyclone → *Hybrid/Subtropical* → *Tropical-like*
Baroclinic → → → → → → → → → → Diabatic (latent heat release)

What a *medicane* is ?
(*Medicane* = Mediterranean tropical-like cyclone, warm core cyclones, mini-cyclone)

Central dense overcast (CDO, according glossary NHC) (Tous & Romero, 2011, 2013; see Dvorak, 1975)
Characterisation (size, gradient, wind: ⌀ < 300 km, 1 hPa/10 km, w > f8, f10, f12 B) (Jansà, 2003)
Thermal structure (Hart diagrams: warm/warm/symmetric?) (Picornell et al., 2014, among other)
Cyclogenetic mechanism (purely diabatic? Diabatic process necessary but not enough? Baroclinic/diabatic synergism?)


20161031 – Probably a medicane
-small
-with CDO

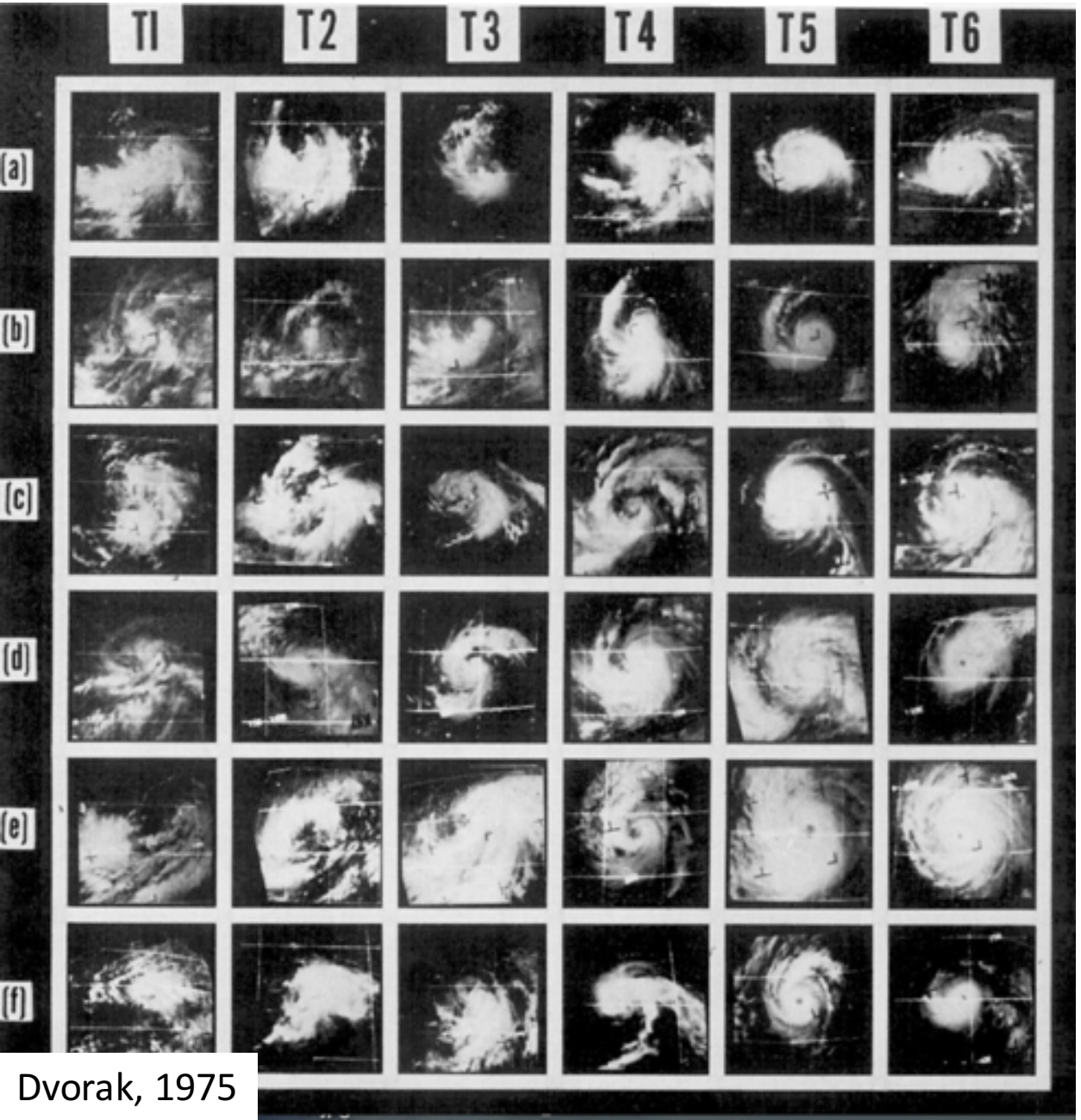
What is Zorbas, the Ionian Sea intense cyclone that developed from 27 to 29 September 2018?

Is it a *medicane*?

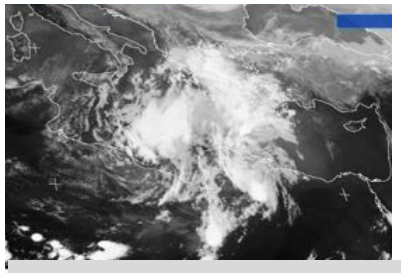
Ionian sea 28-29 Sep 2018 cyclone (Zorbas): Has it a ***central dense overcast***?

Pre-TS

Intense-TC



Dvorak, 1975



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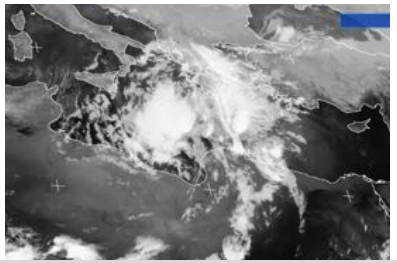

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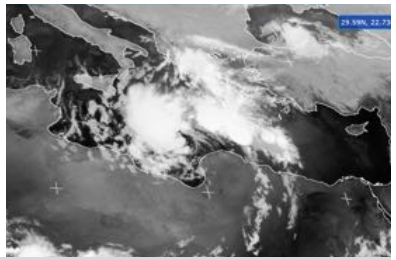

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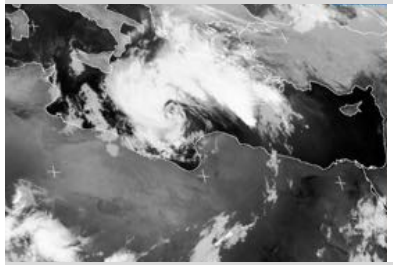
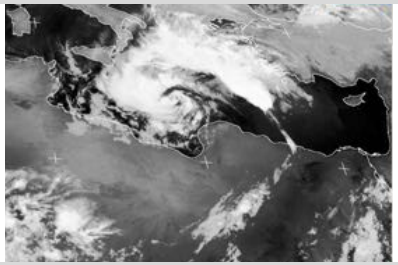


2800



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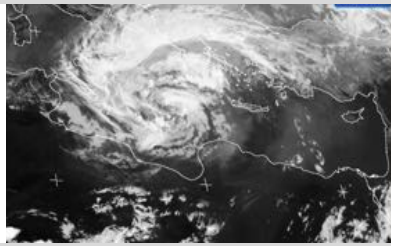

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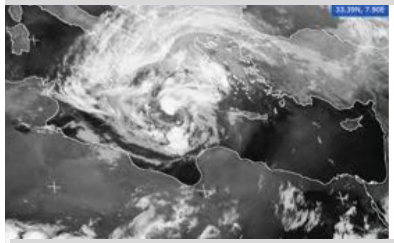

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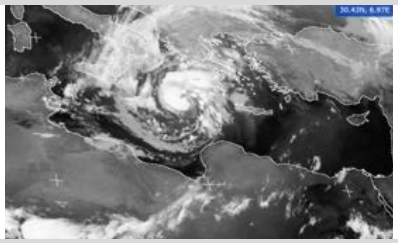

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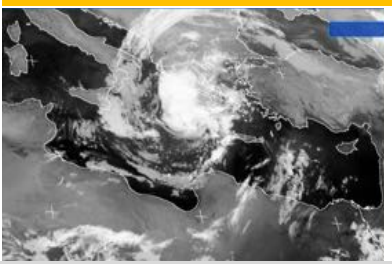
2900

Ionian sea 28-29 Sep 2016 cyclone (Zorbas): Has it a ***central dense overcast***?



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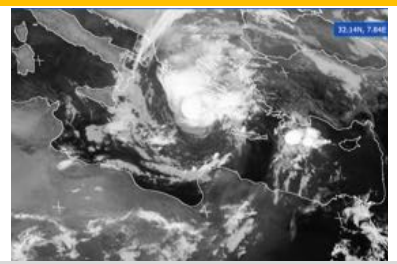


2906

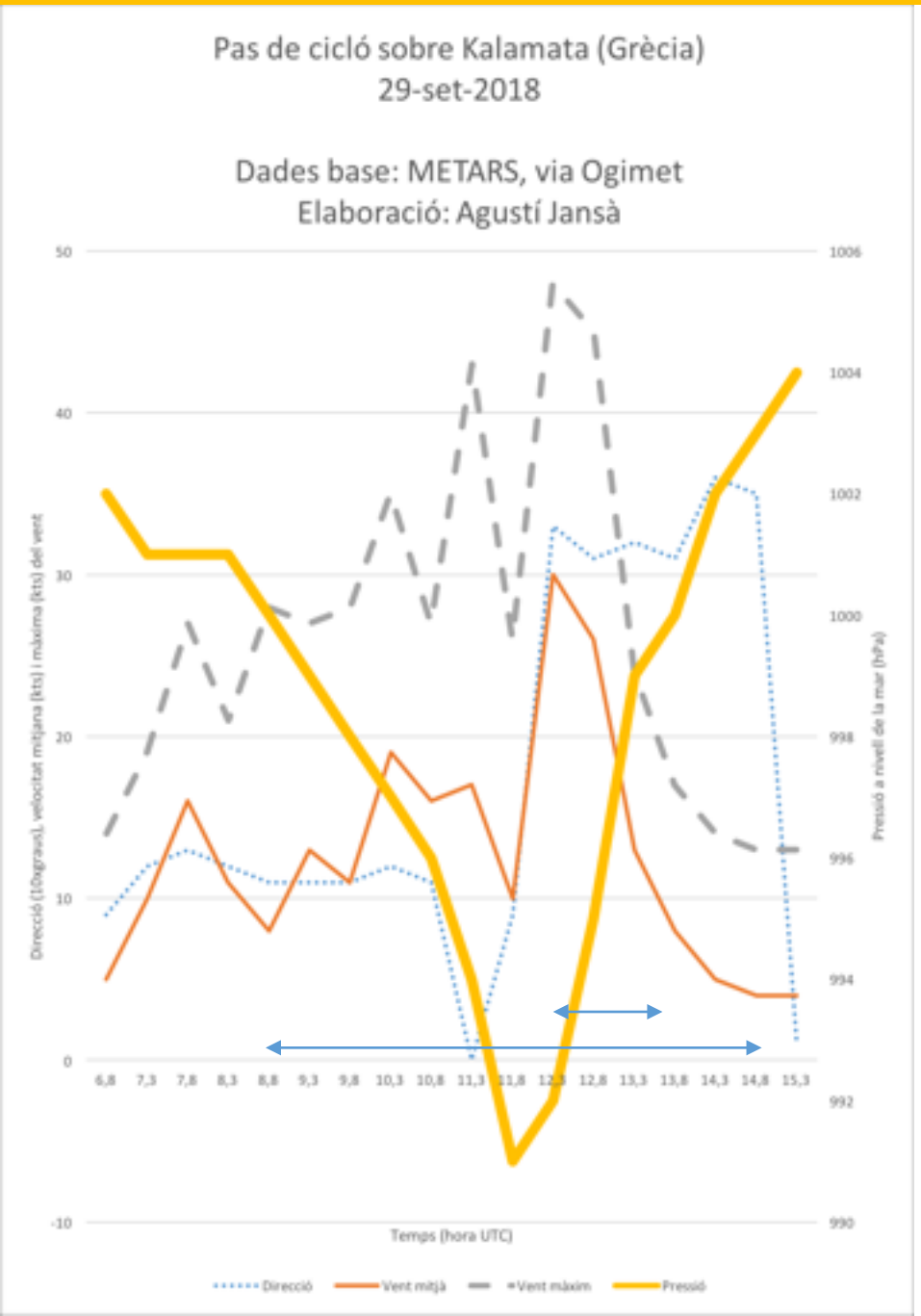
2909

2912

Quite clear **CDO** from 2821 to 2912.

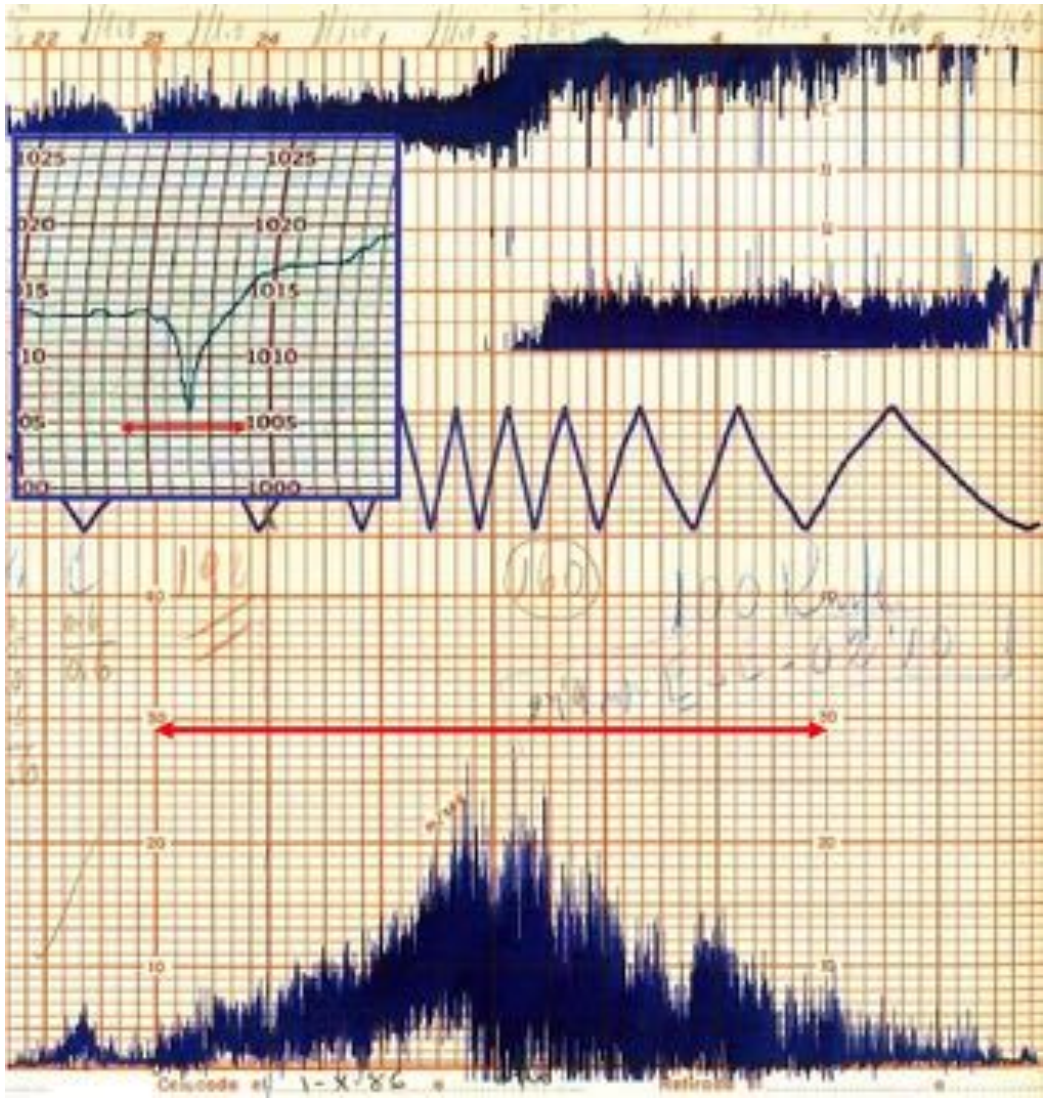
Possible **CDO** by 2800-2806.

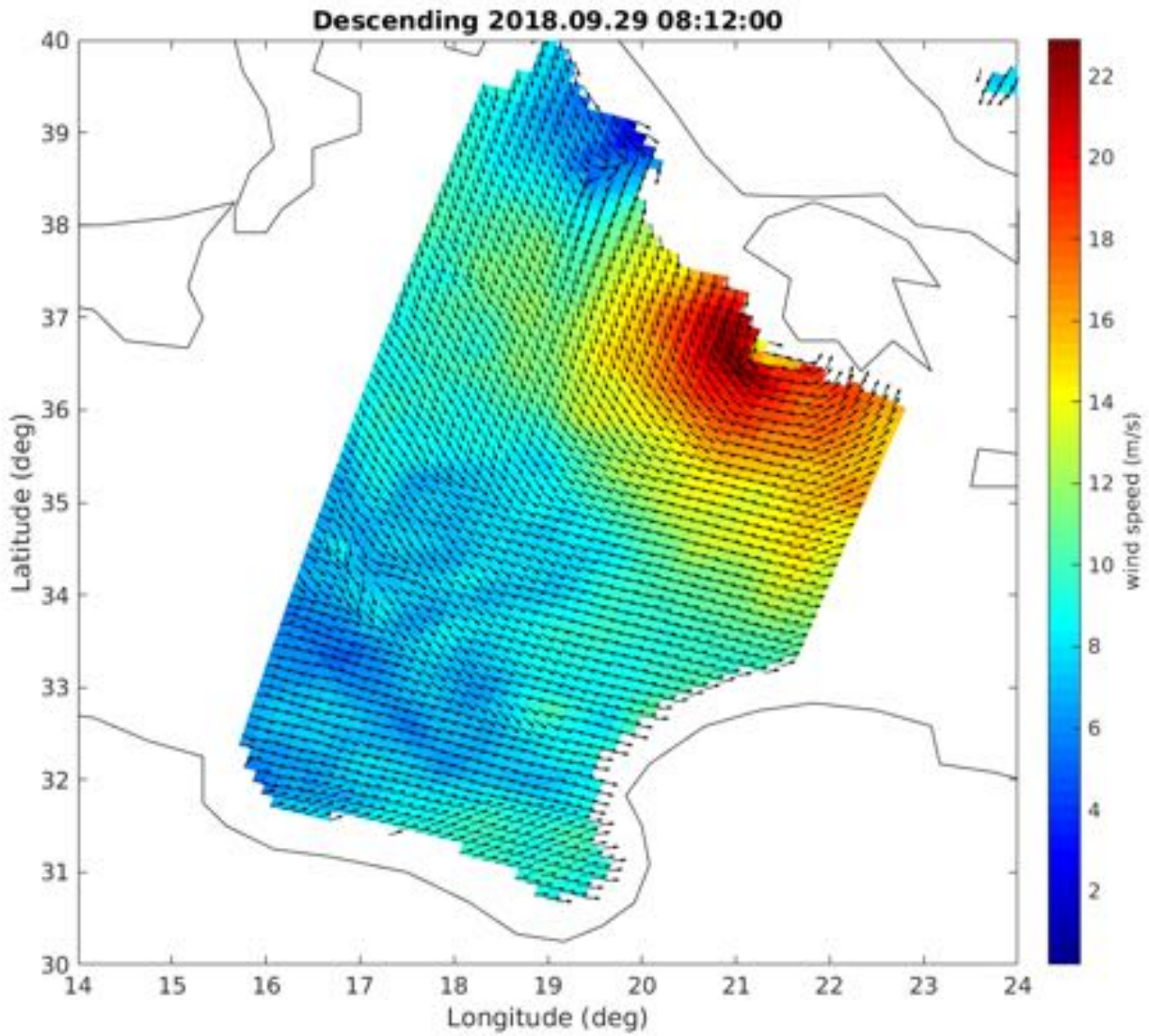
Does Zorba fit a medicane **characterisation (on land trace)?** (size, gradient, wind: ⌀ < 300 km, 1 hPa/10 km, w > f8, f10, f12 B)



Speed of translation (from satellite and tracking based on analyses):
22 km/h → 6 hrs ← → 132 km (⌀ ?? 150 km)
Gradient ~ 7 hPa / 1.5 h = 33 km ~ 2 hPa/10 km
Total △p = 13 hPa
Sustained wind (on land):
30 kts
(7 Beaufort)

A comparison:
Tropical-like cyclone
in Palma de Mallorca,
2 Oct 1986





Wind at sea → 22 m/s (8-9 Beaufort)
ASCAT image

(courtesy of Marcos Portabella)

A quick look to the cyclone evolution from ECMWF operational analyses

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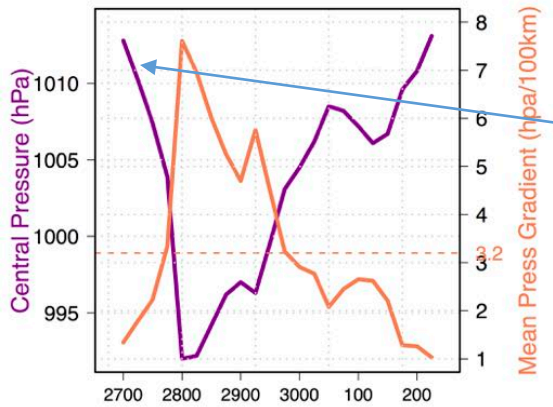
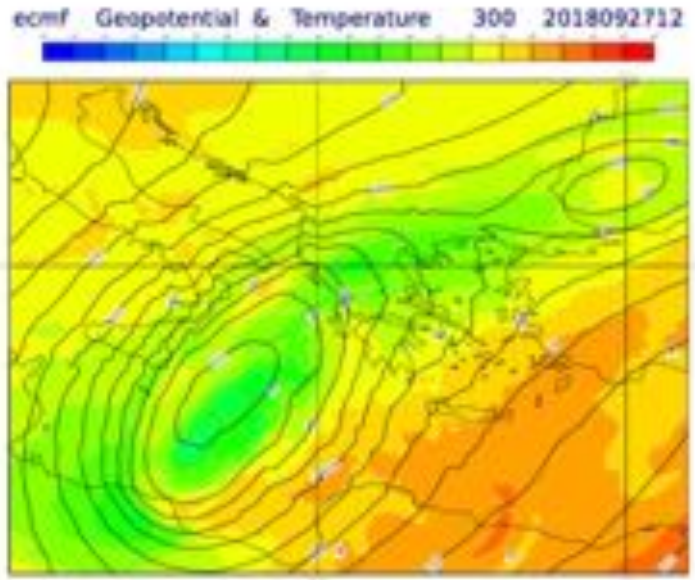
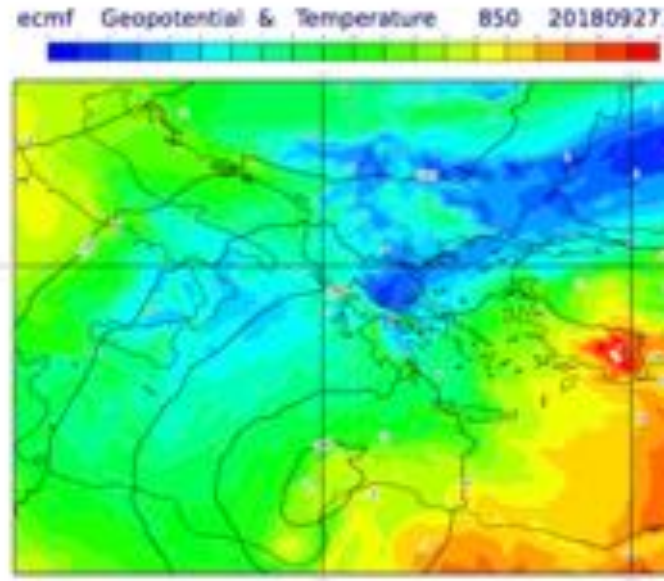
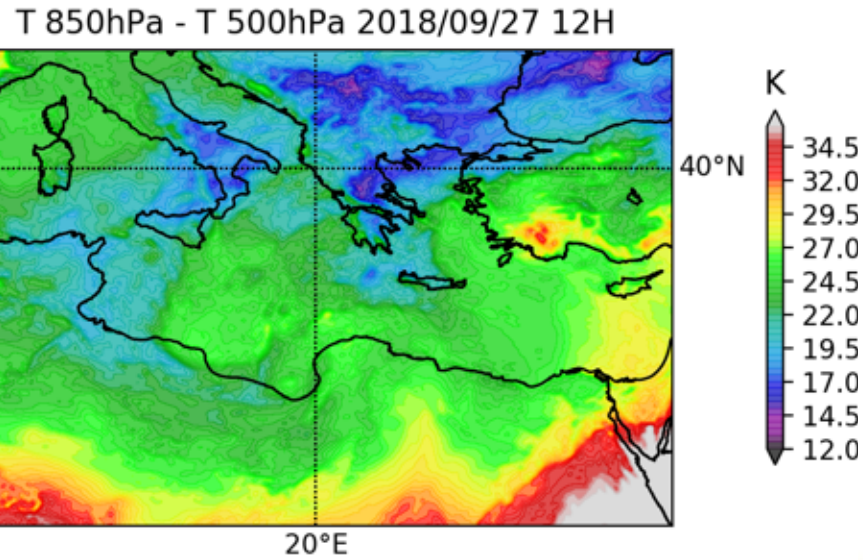
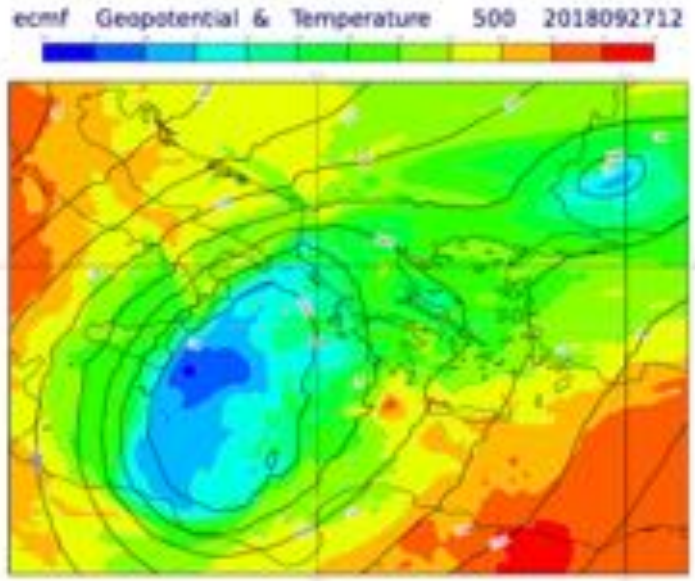


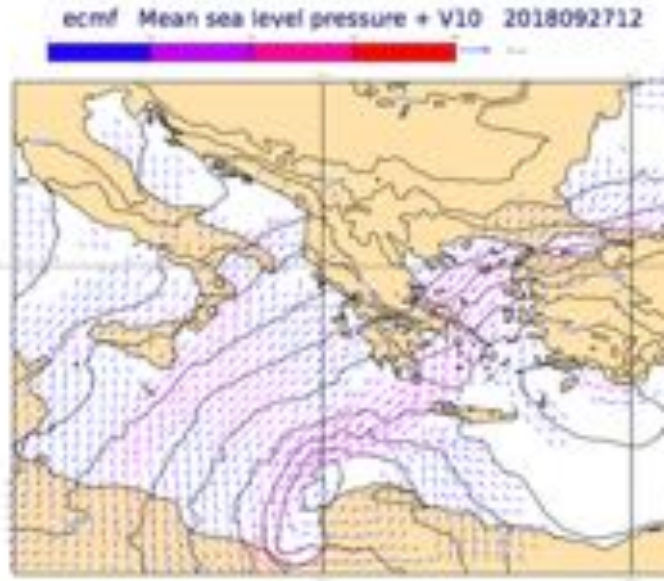
Baroclinic phase











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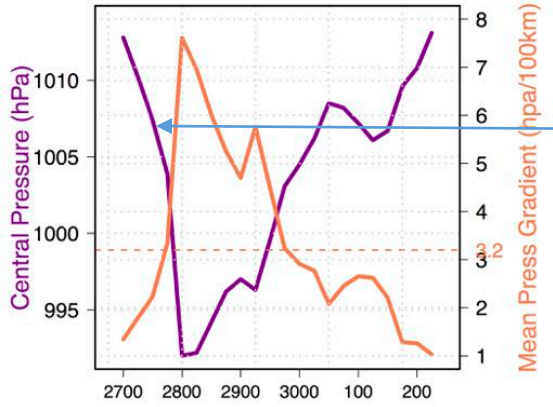
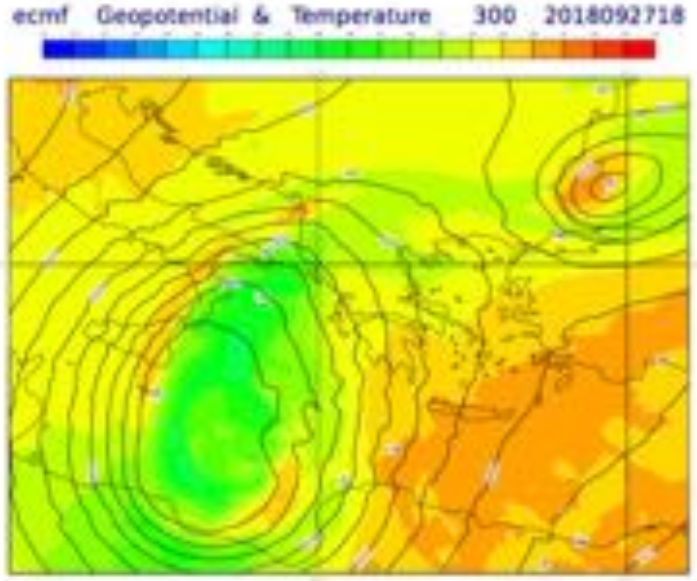
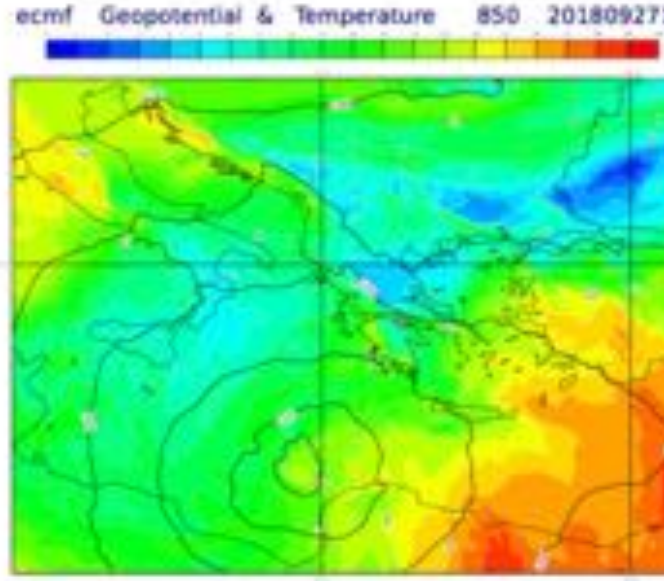
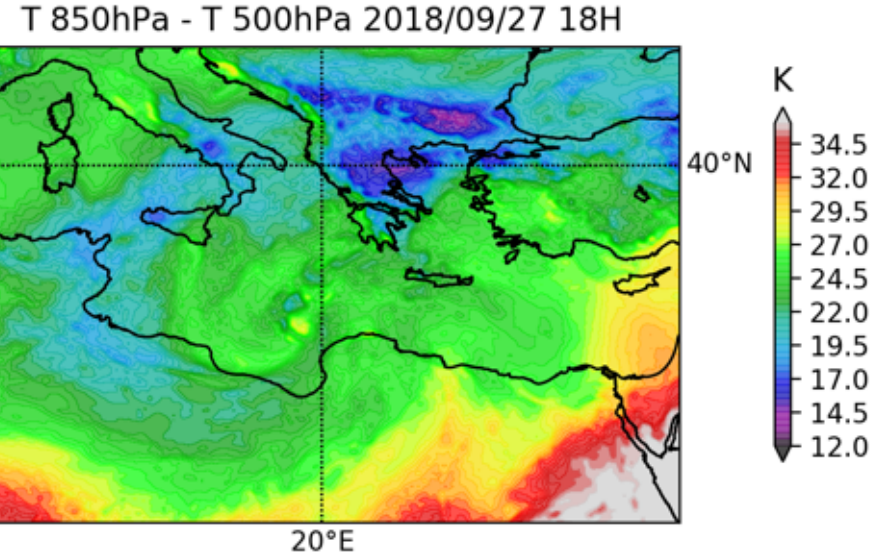
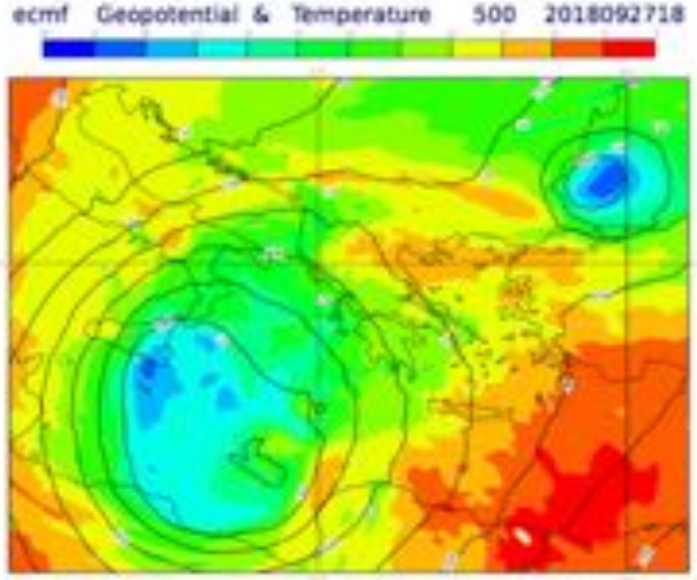


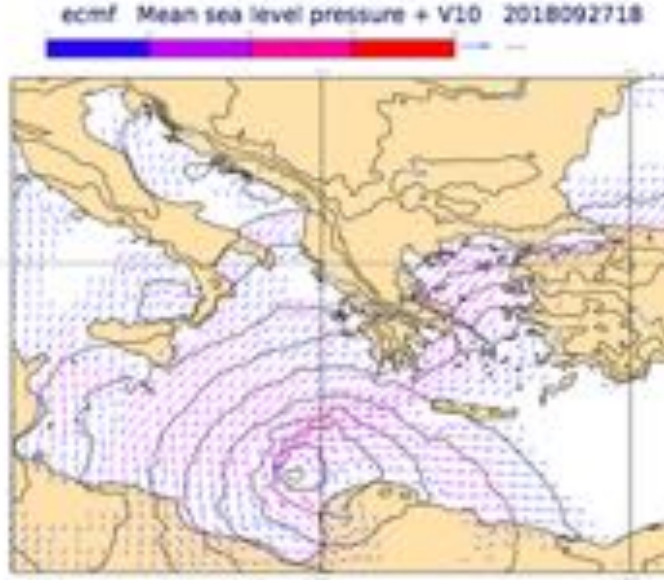
Baroclinic phase











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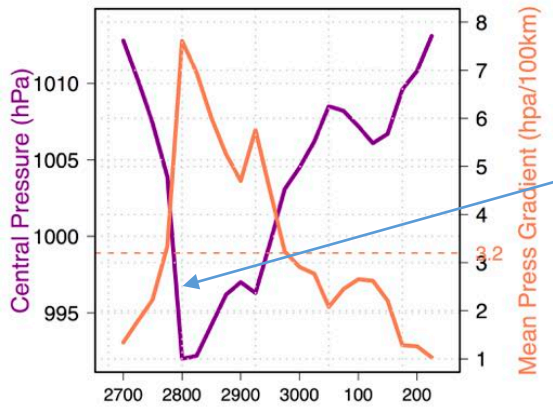
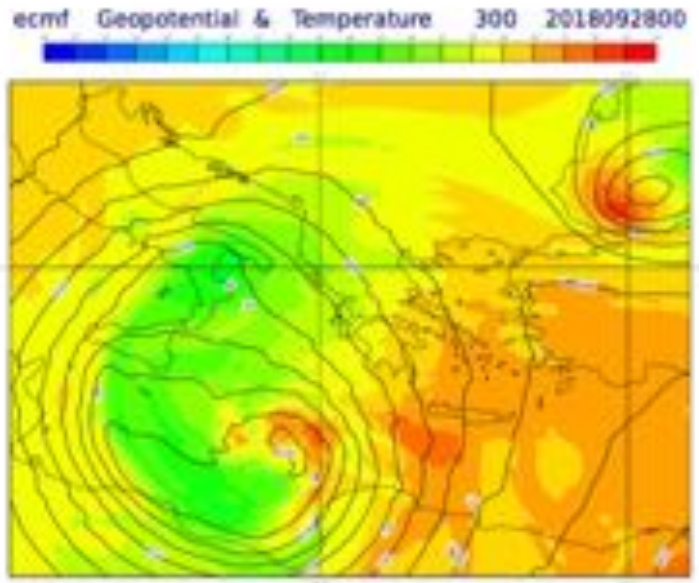
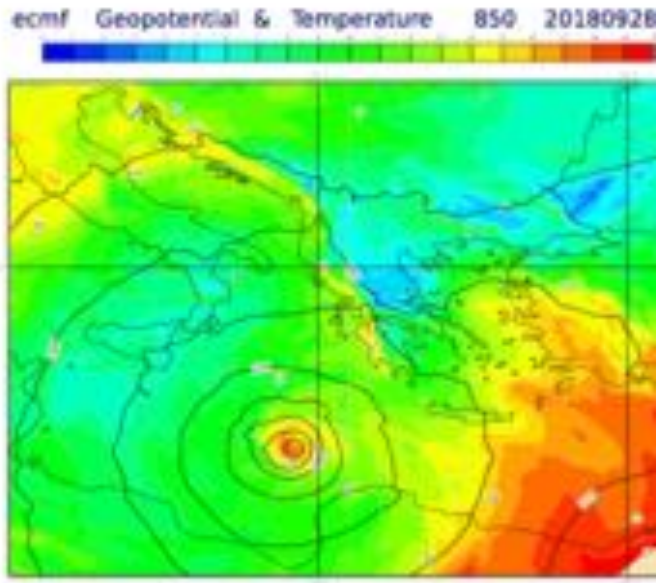
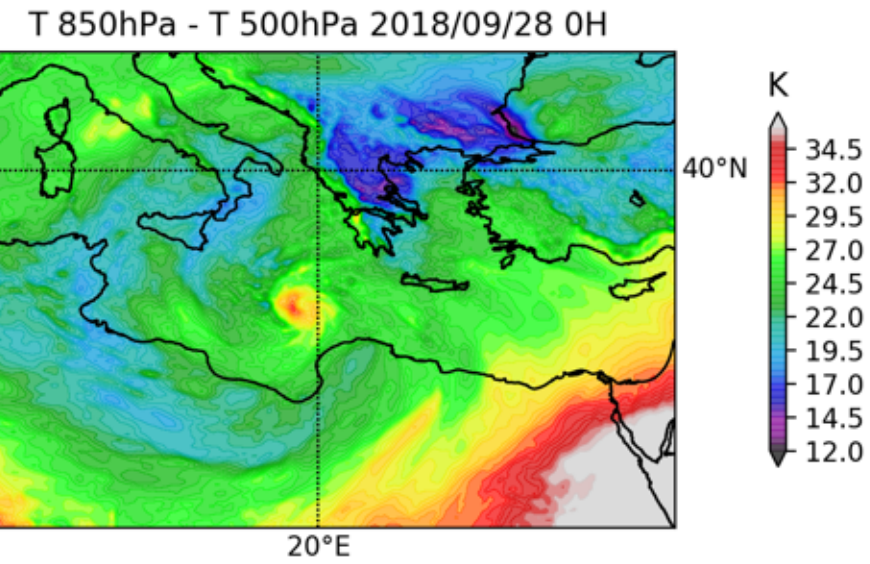
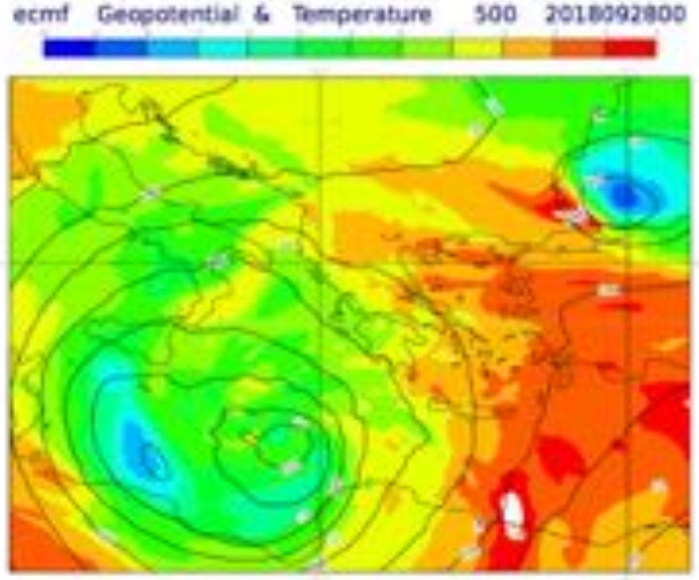


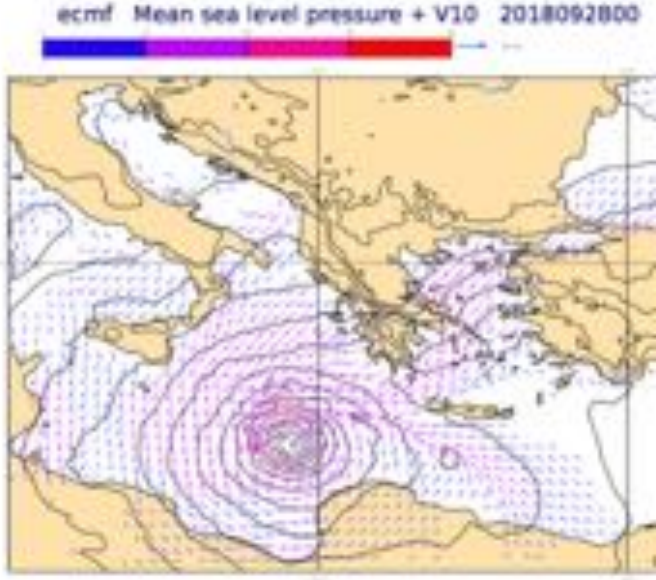
Sudden diabatic deepening











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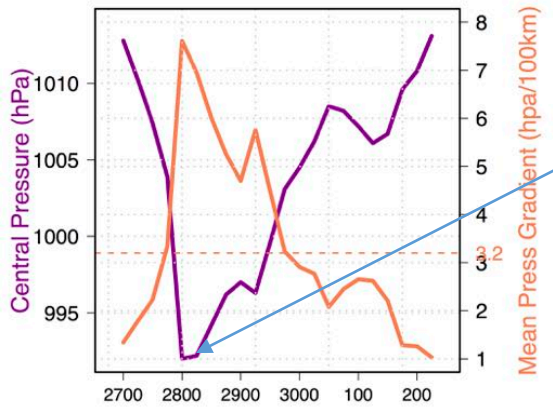
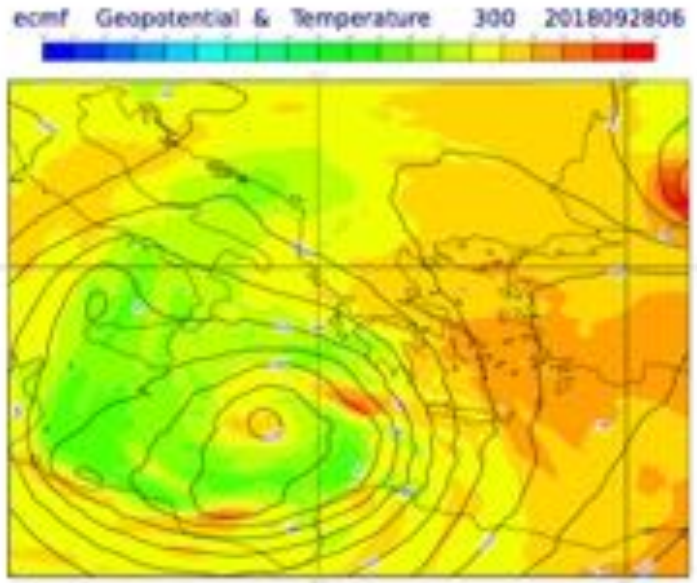
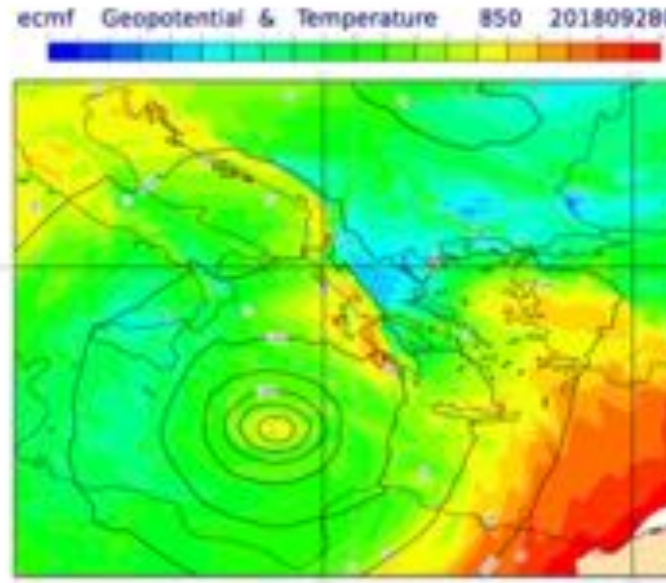
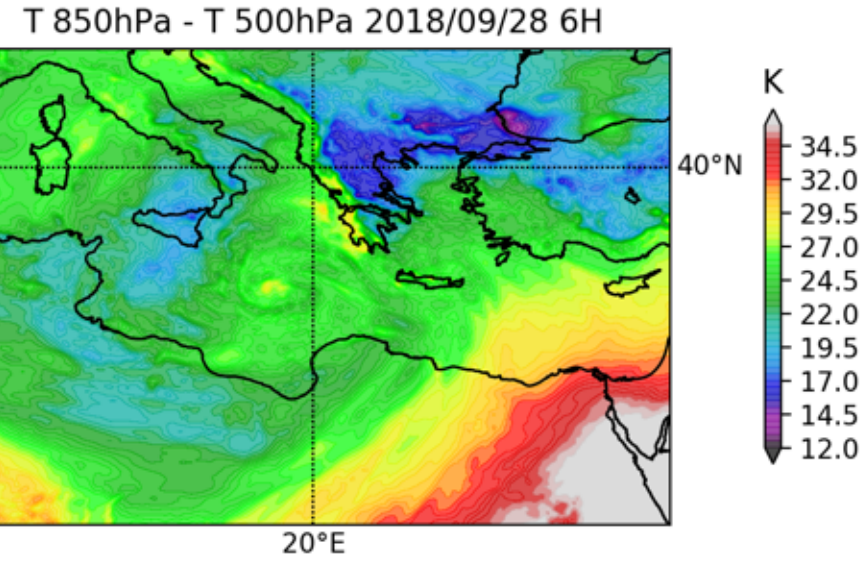
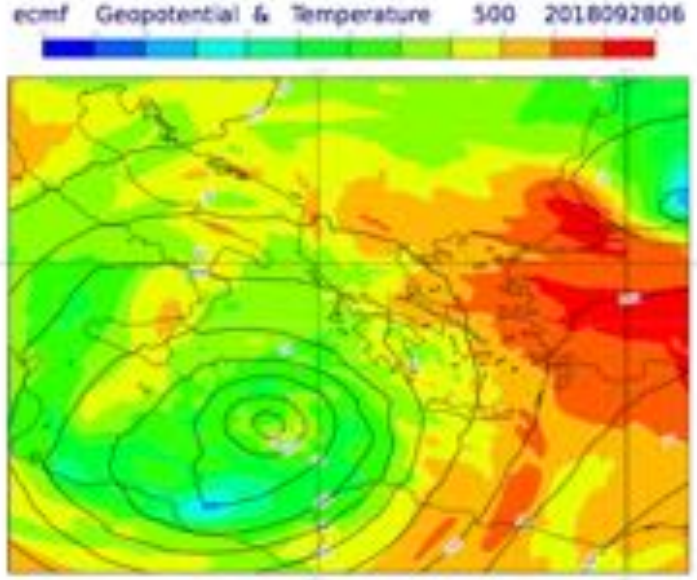


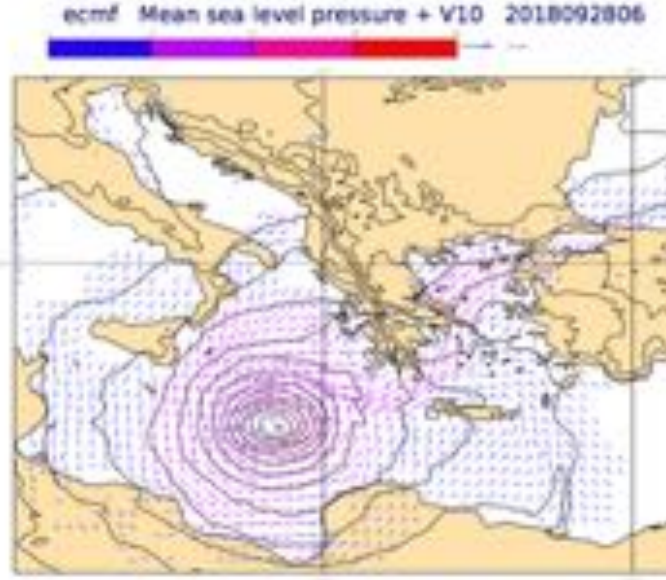
Inertial phase











A quick look to the cyclone evolution from ECMWF operational analyses

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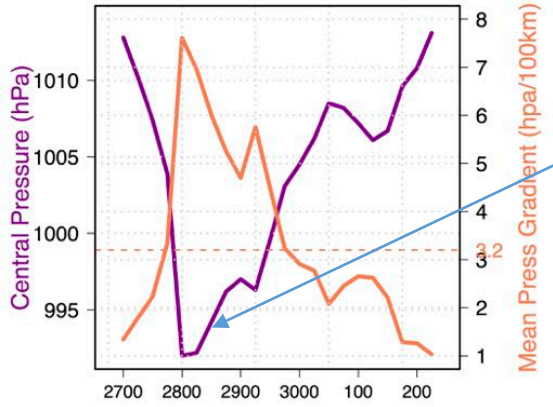

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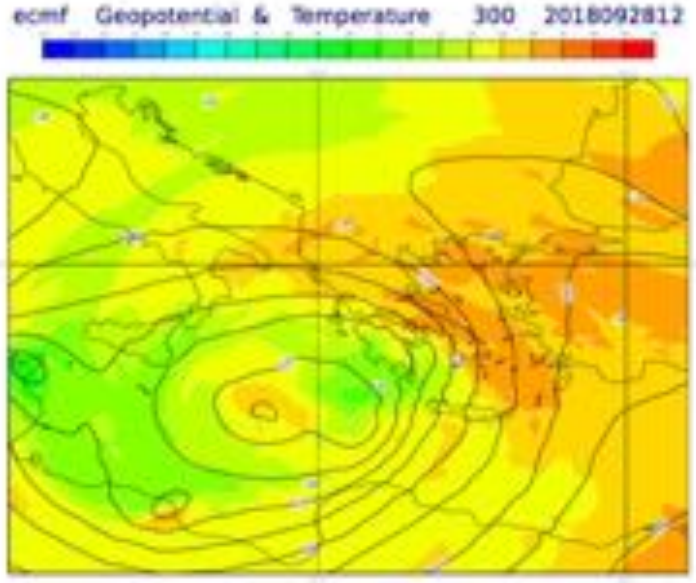

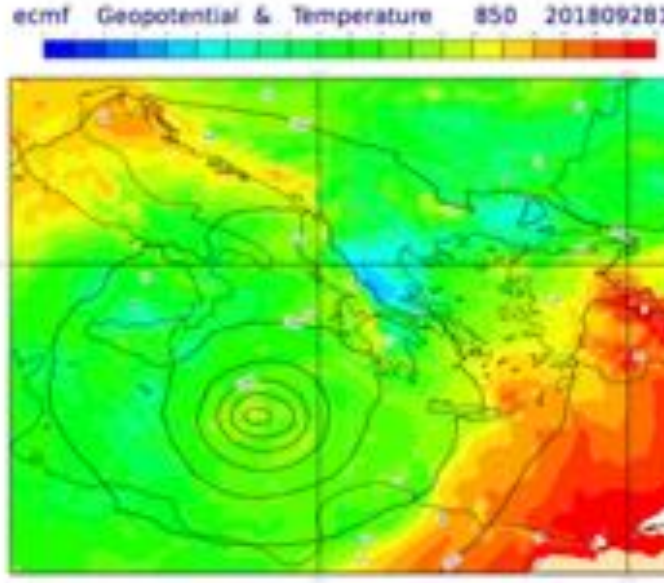

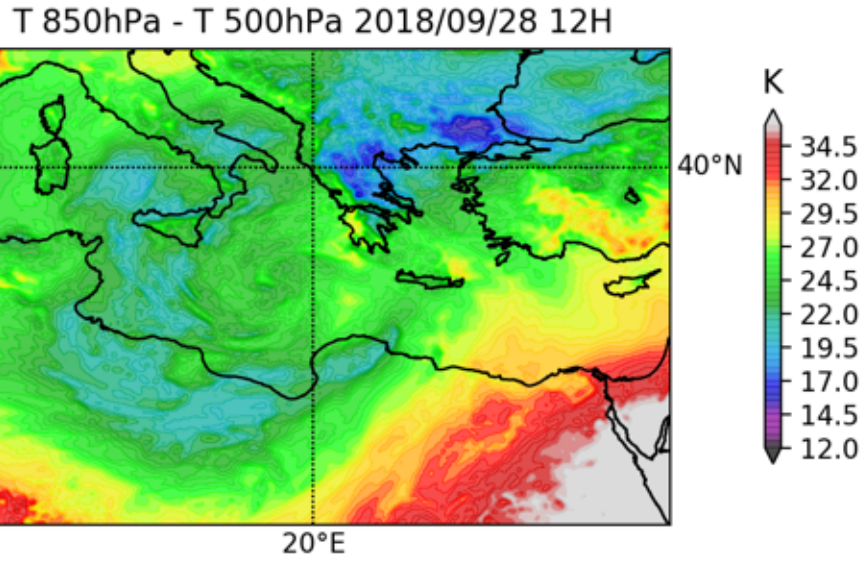

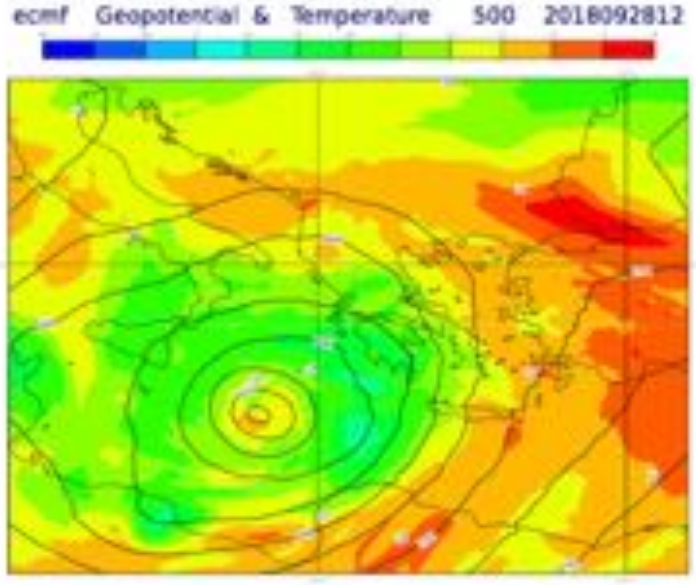

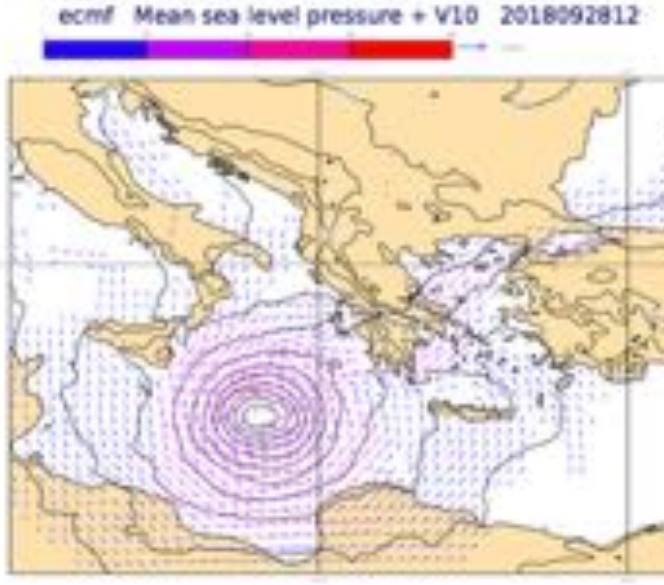

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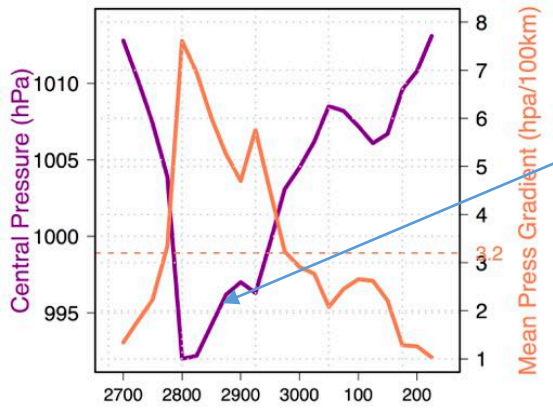

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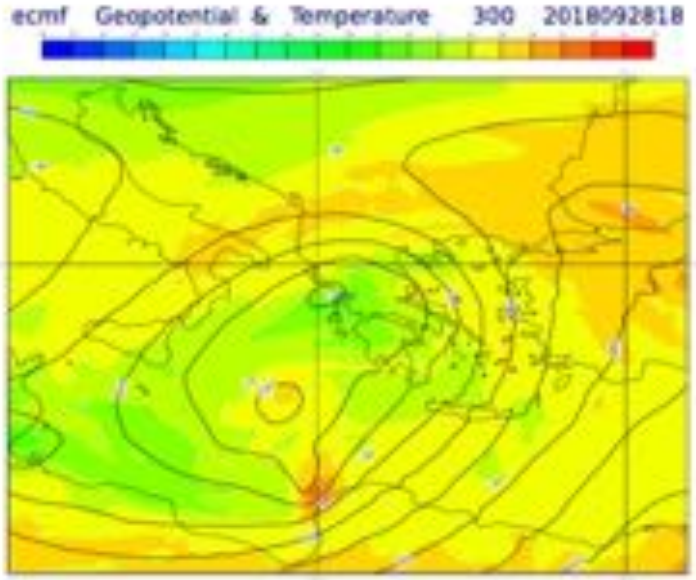

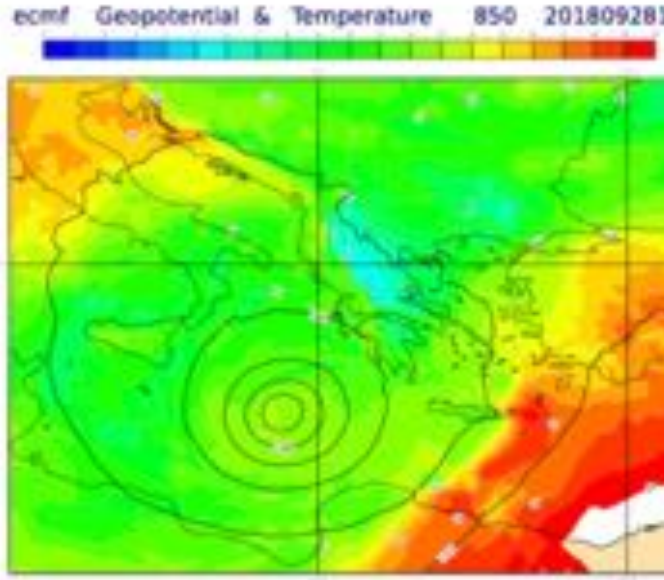

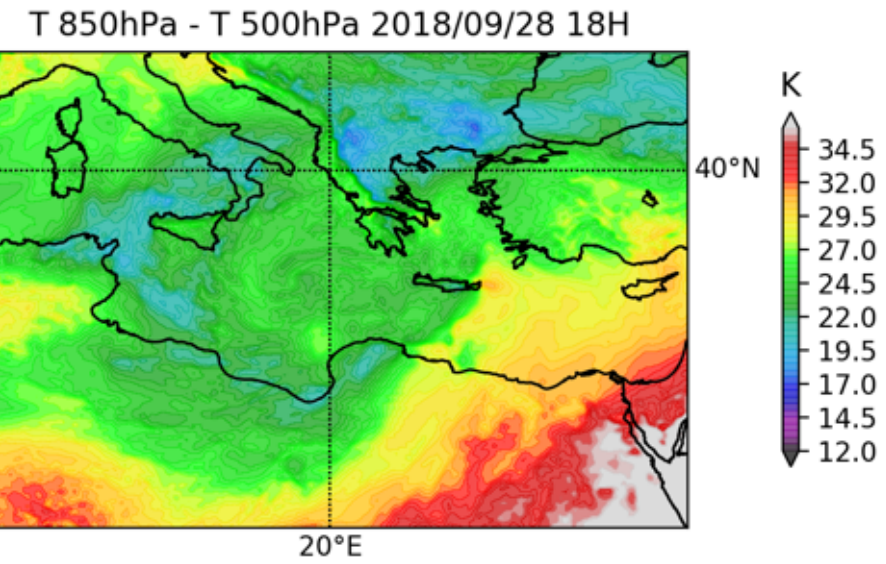

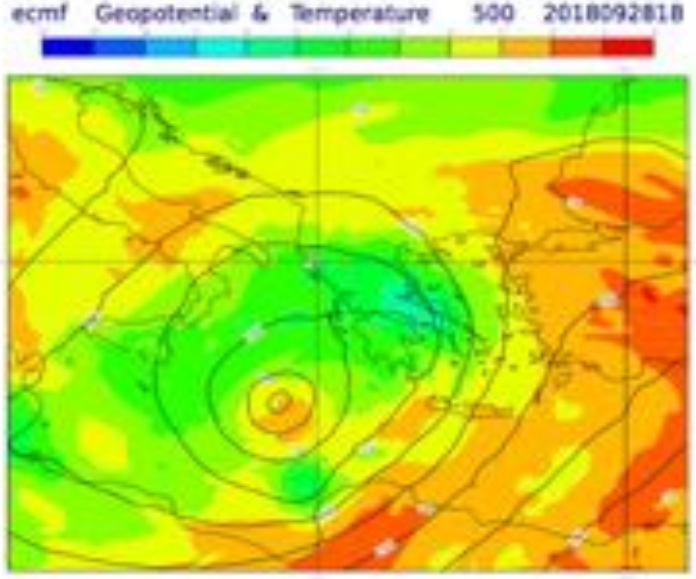

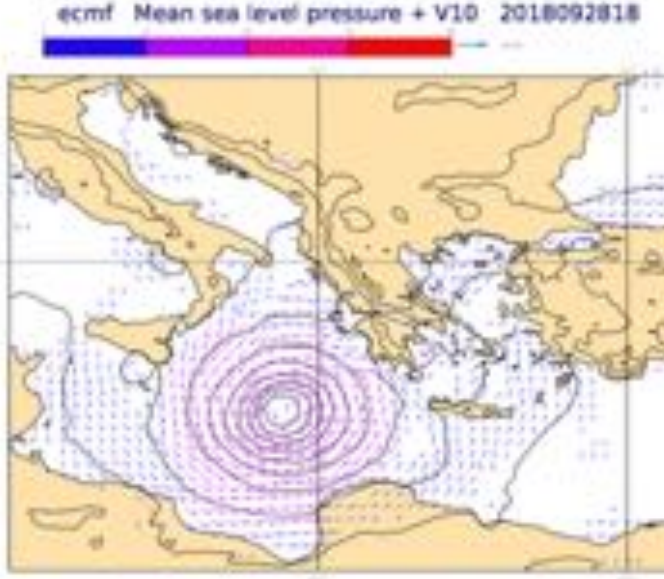

A quick look to the cyclone evolution from ECMWF operational analyses

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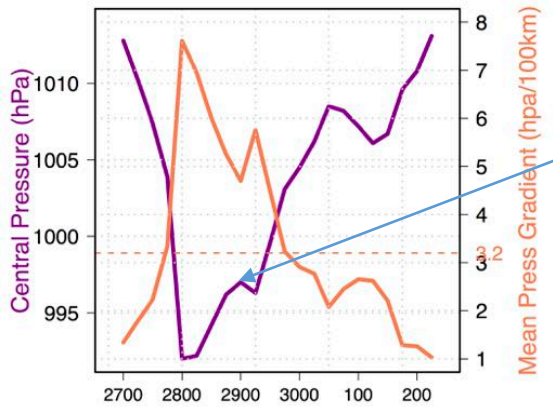
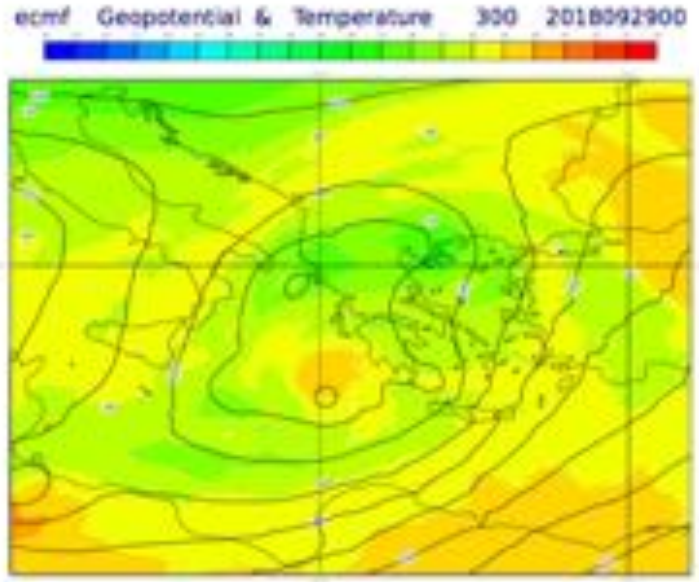
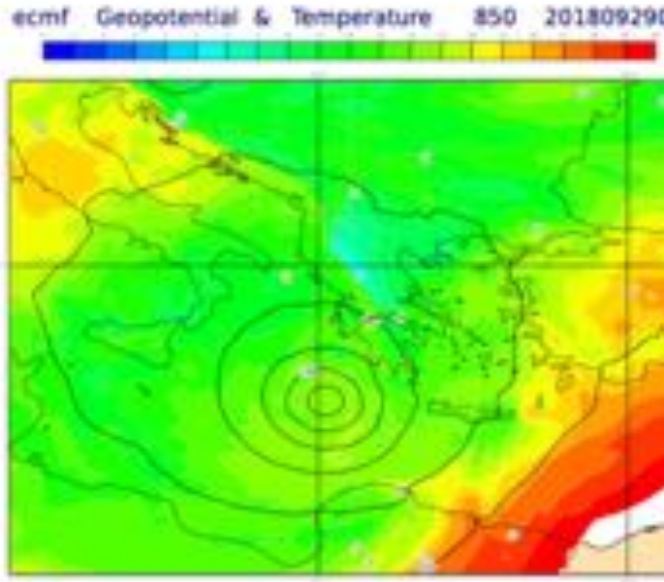
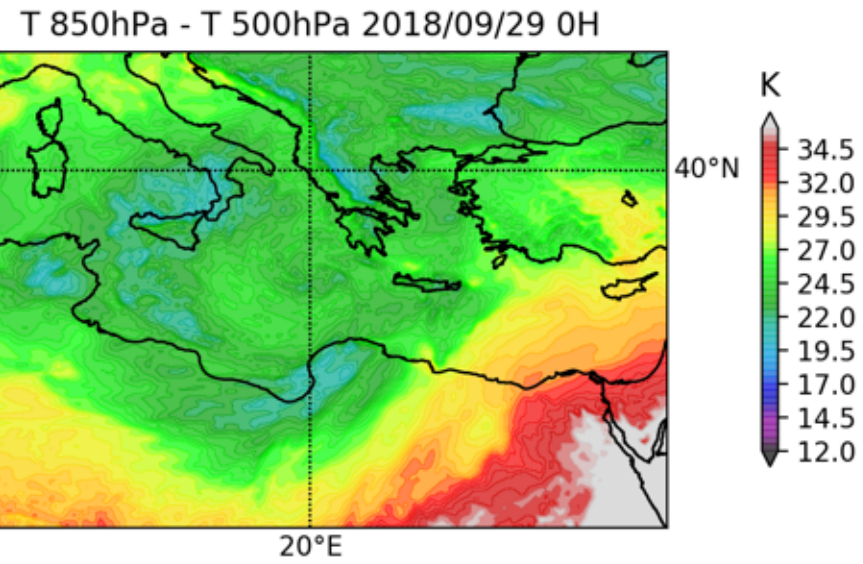
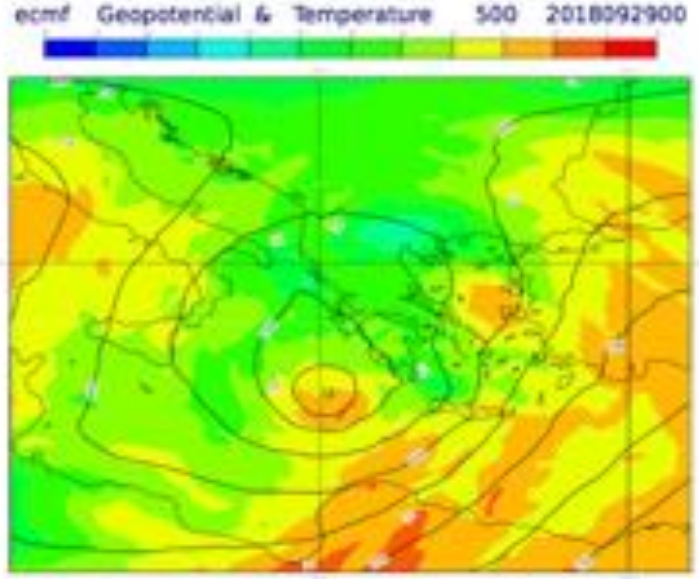


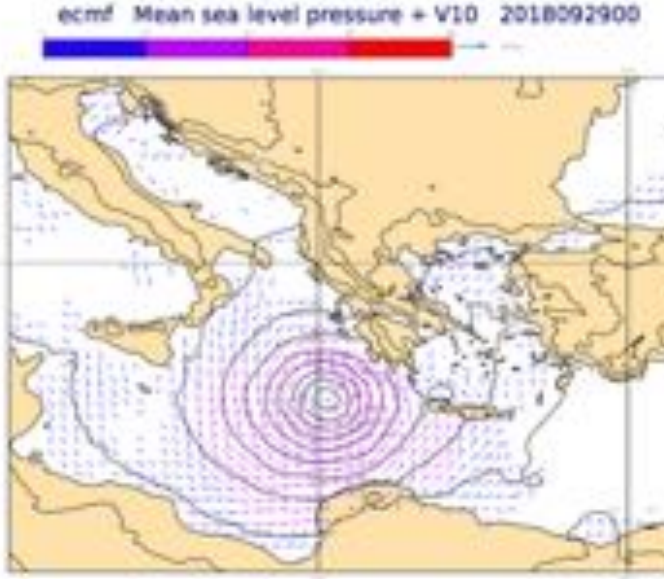
Inertial phase





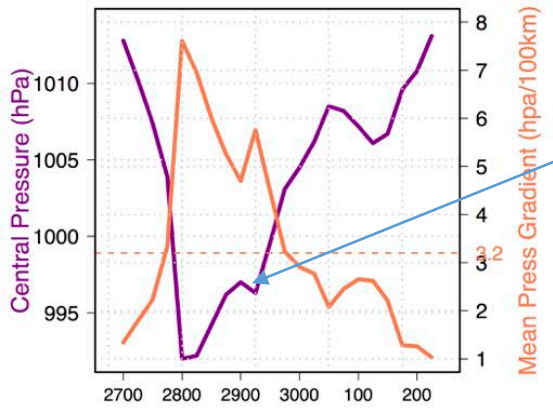




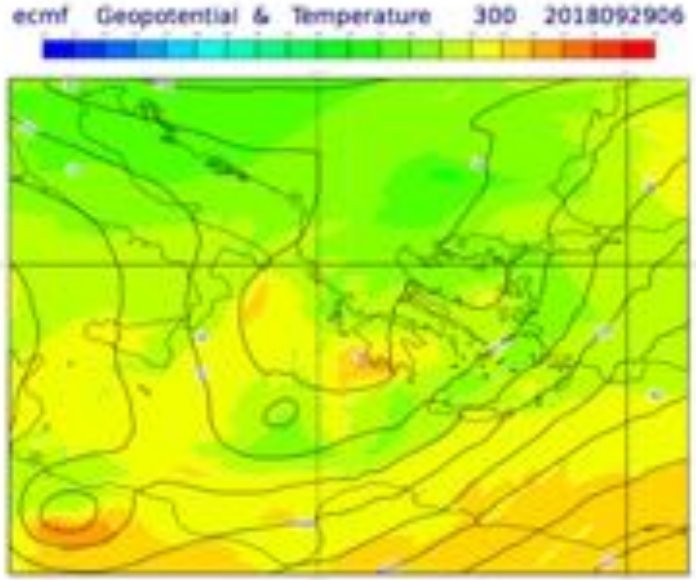


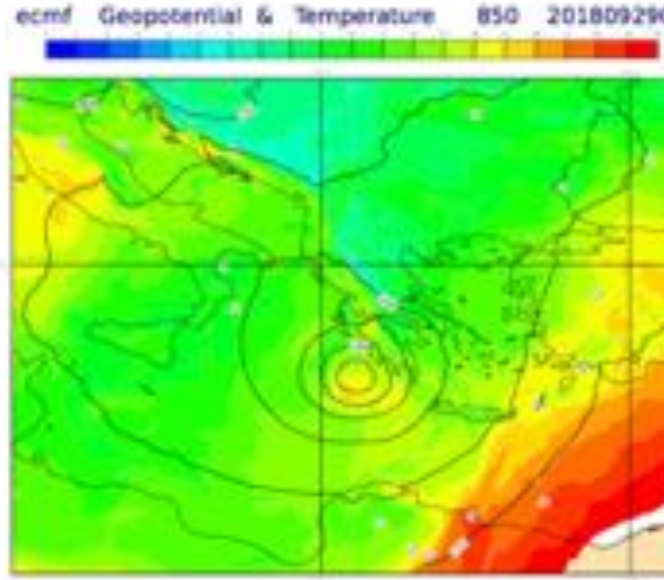
A quick look to the cyclone evolution from ECMWF operational analyses

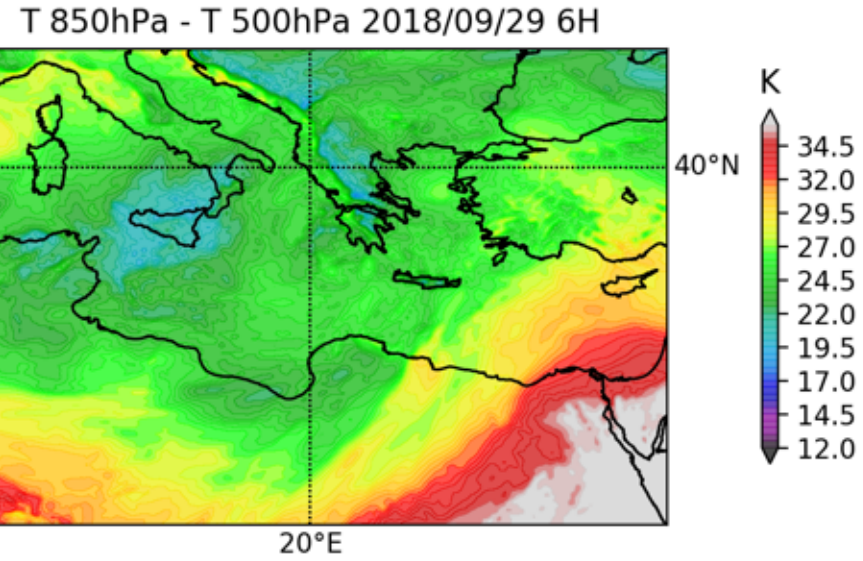
29 SEP 06UTC

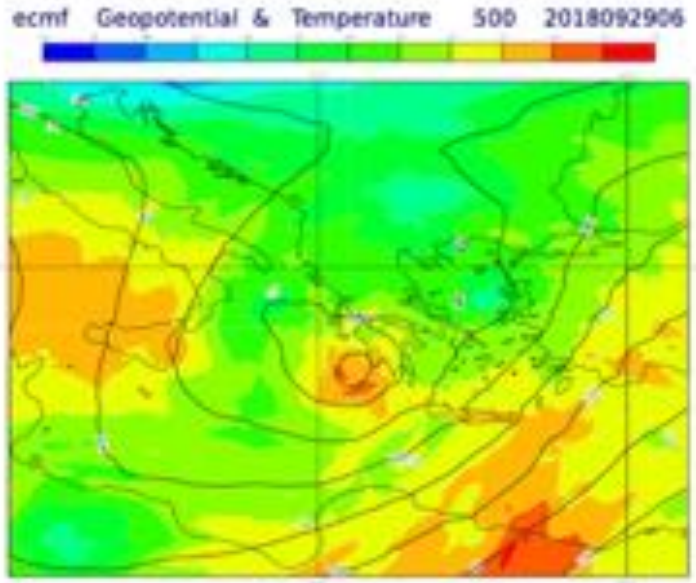


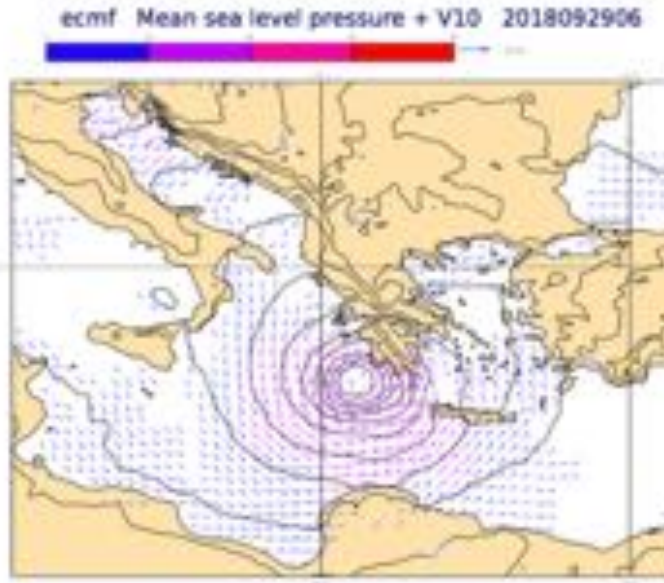
Second diabatic phase





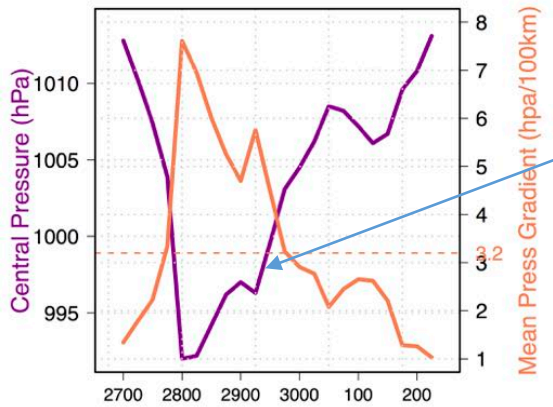




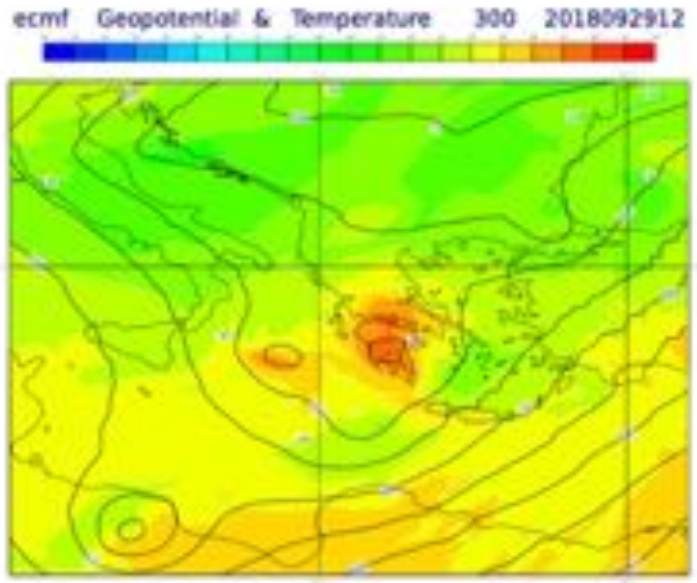


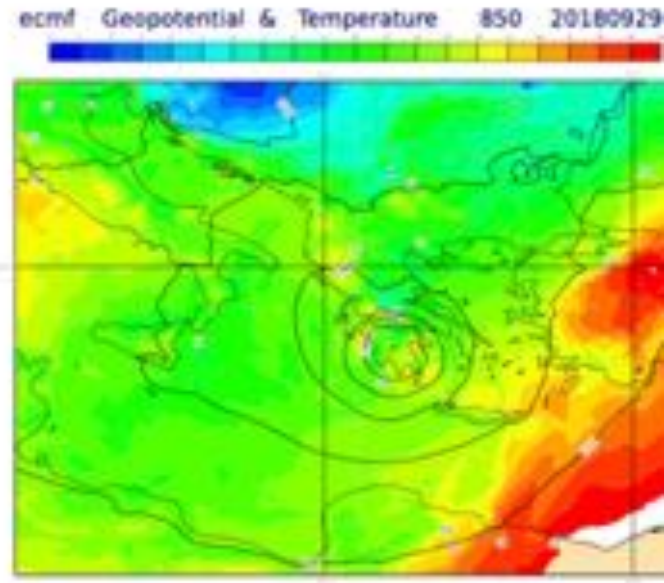
A quick look to the cyclone evolution from ECMWF operational analyses

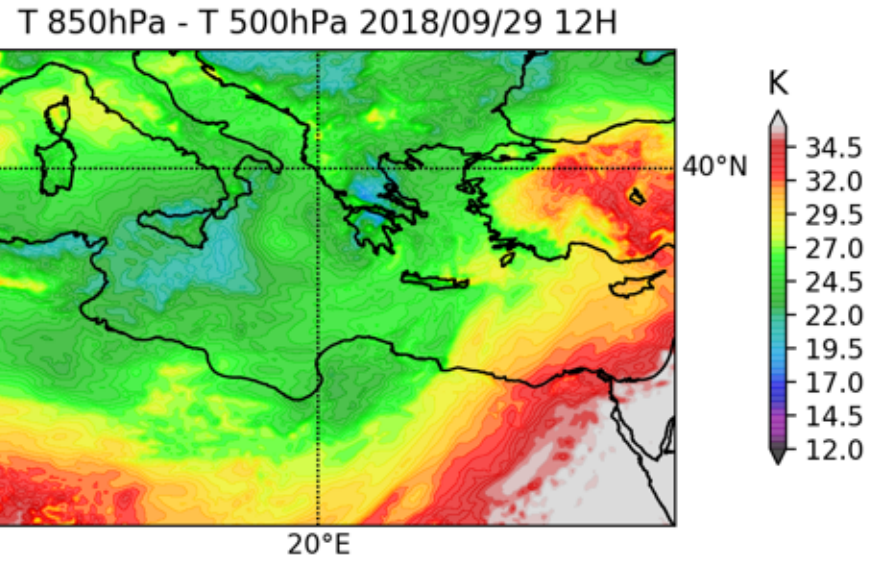
29 SEP 12UTC

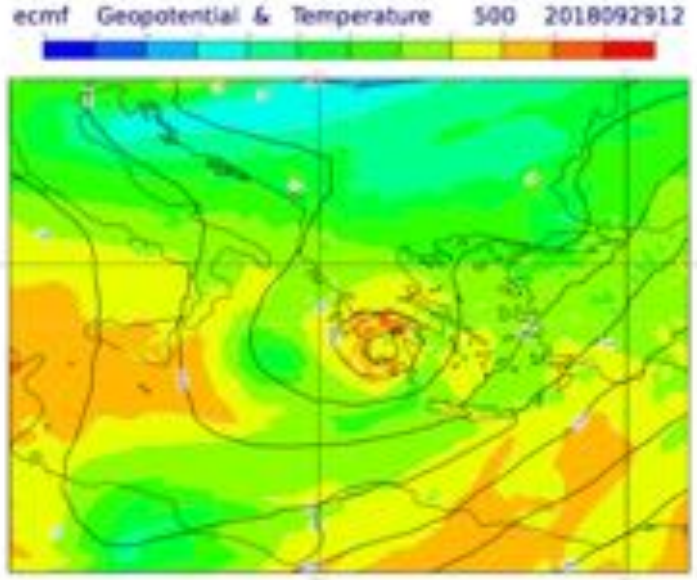


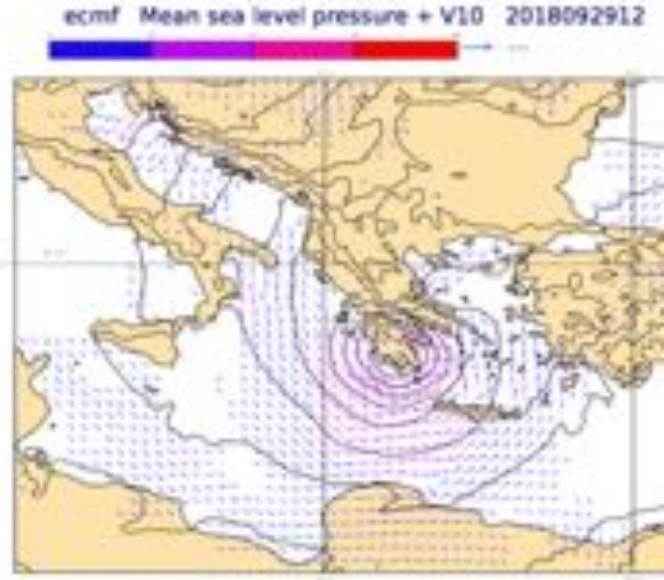
Disolution phase



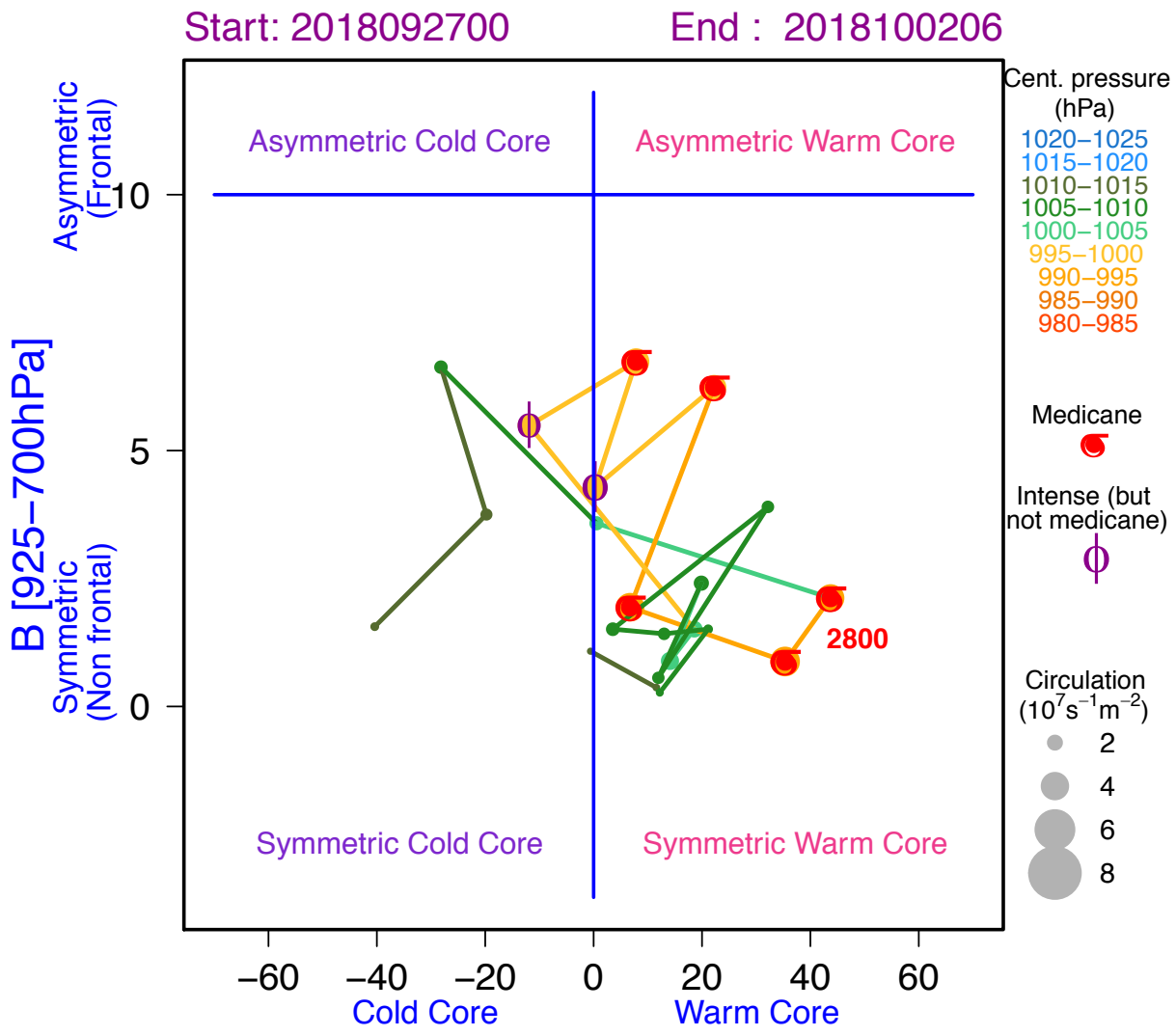


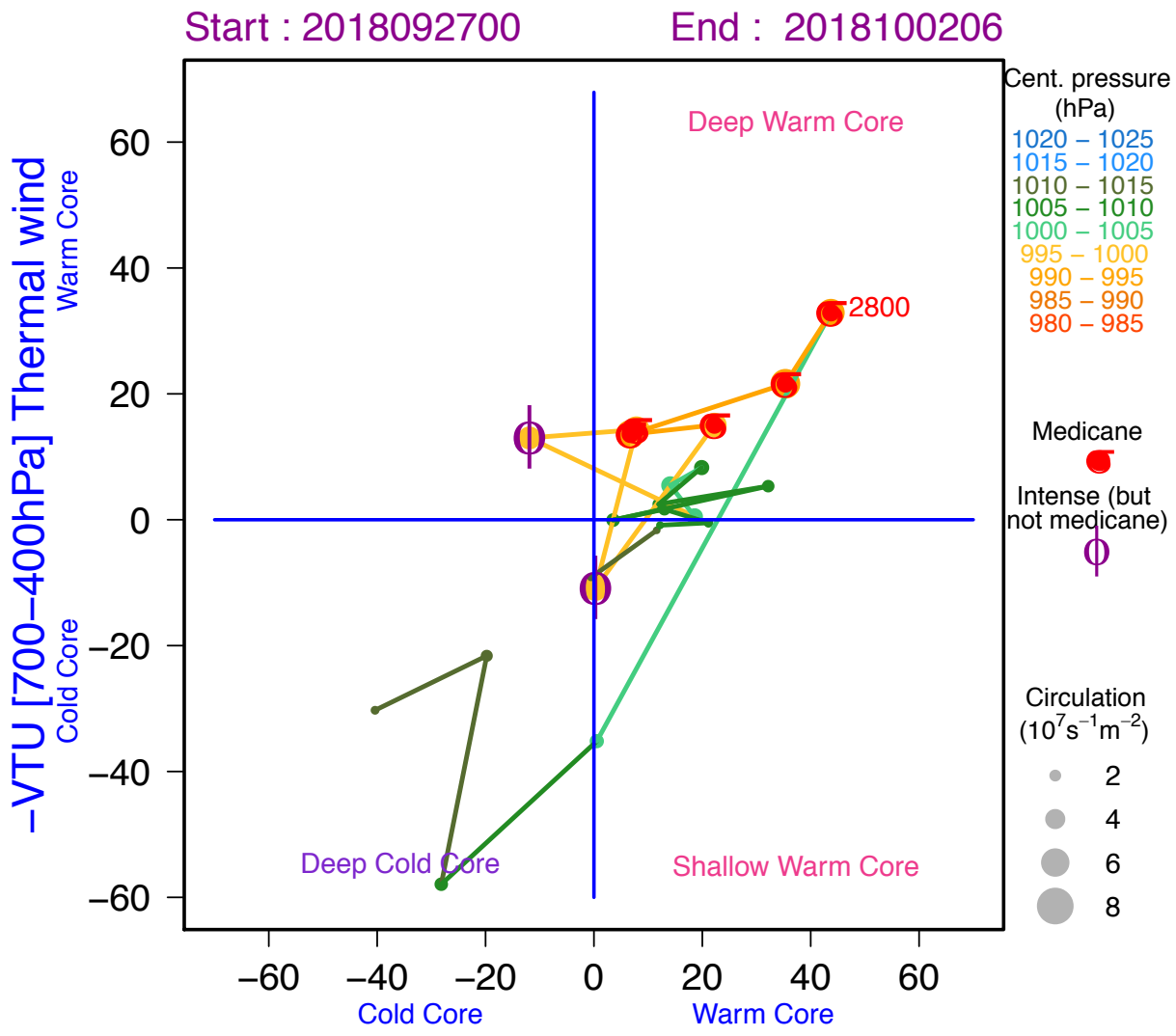




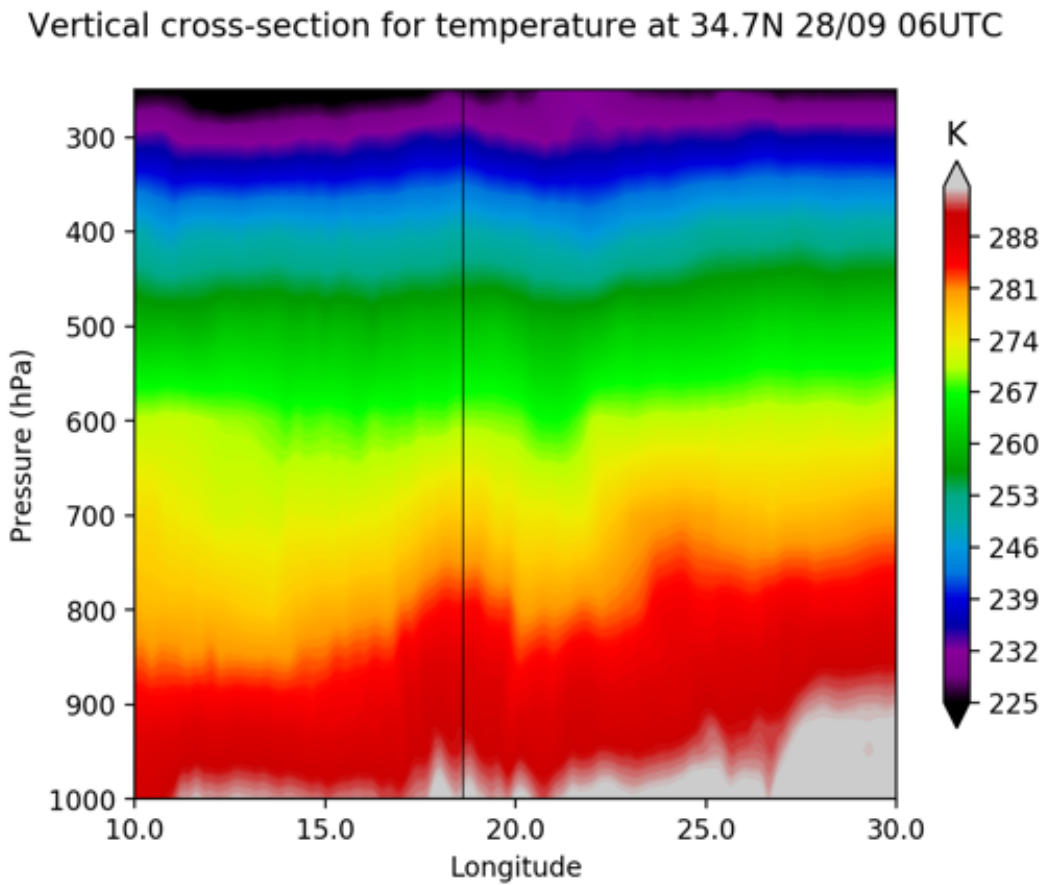


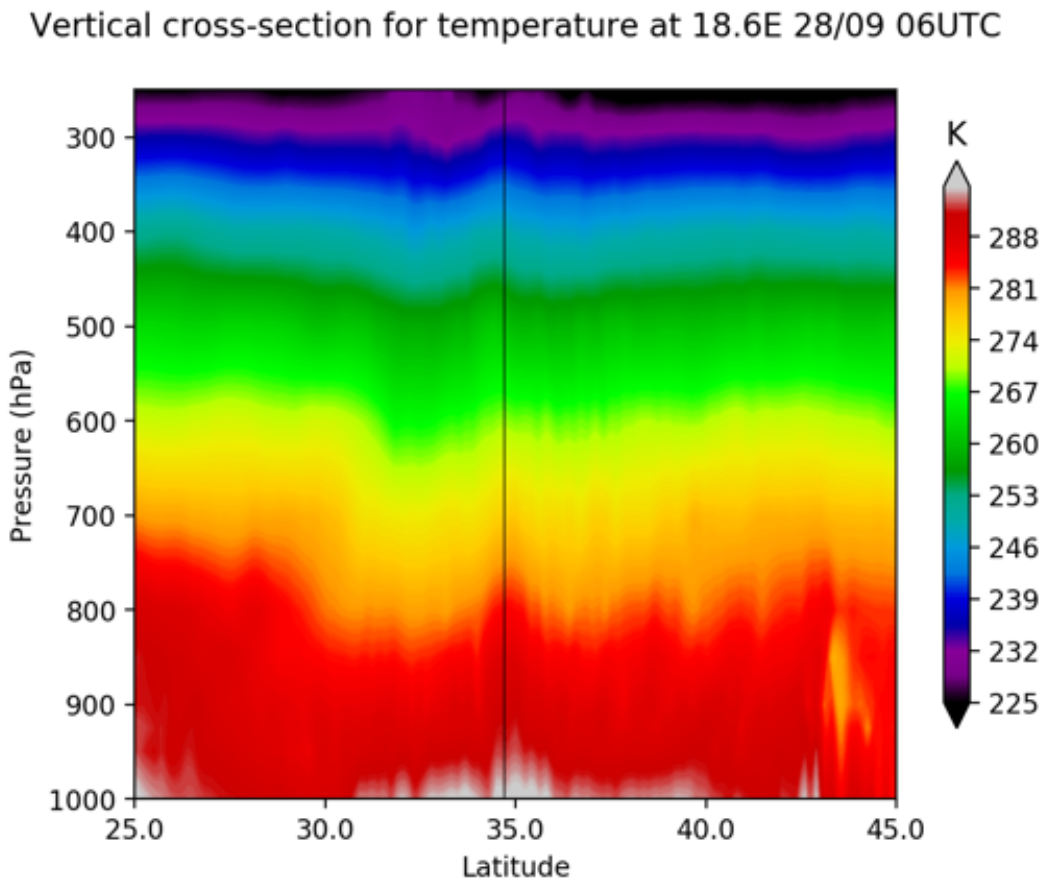
Thermal structure:
Hart's diagrams, adapted as in Picornell et al., 2014



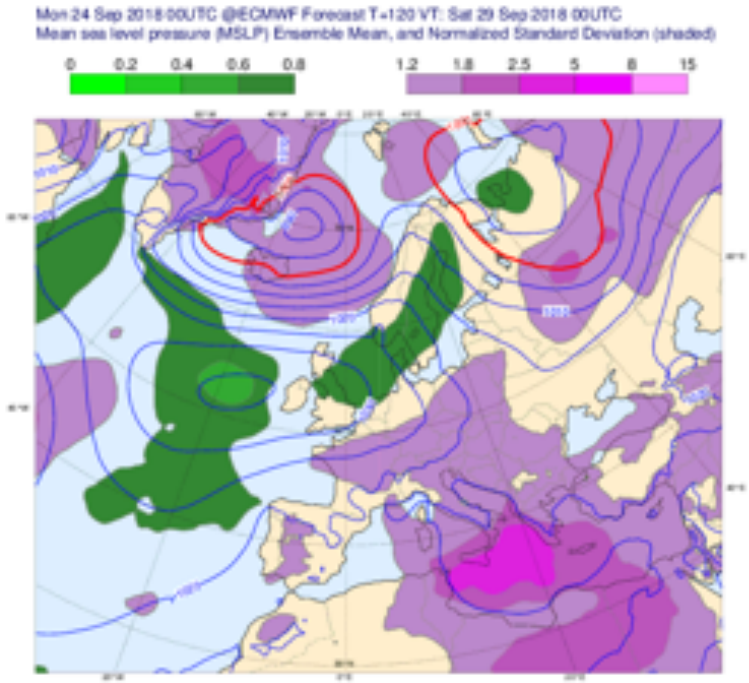


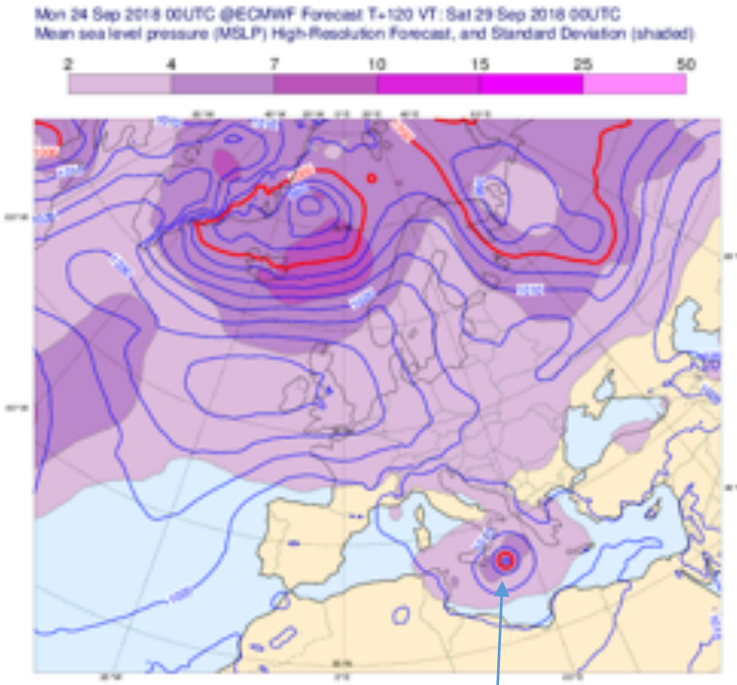
Thermal structure:
Vertical profile of temperature





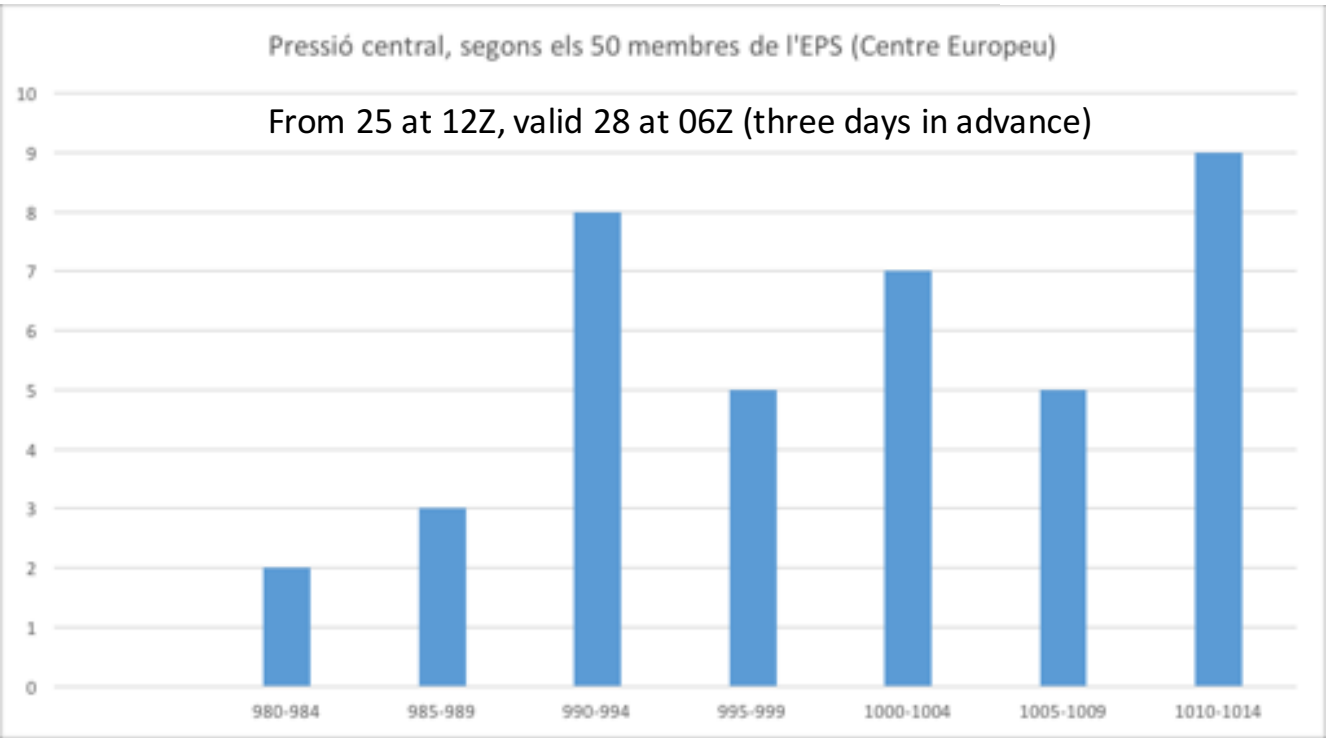
Predictability
Probabilistic: ECMWF EPS





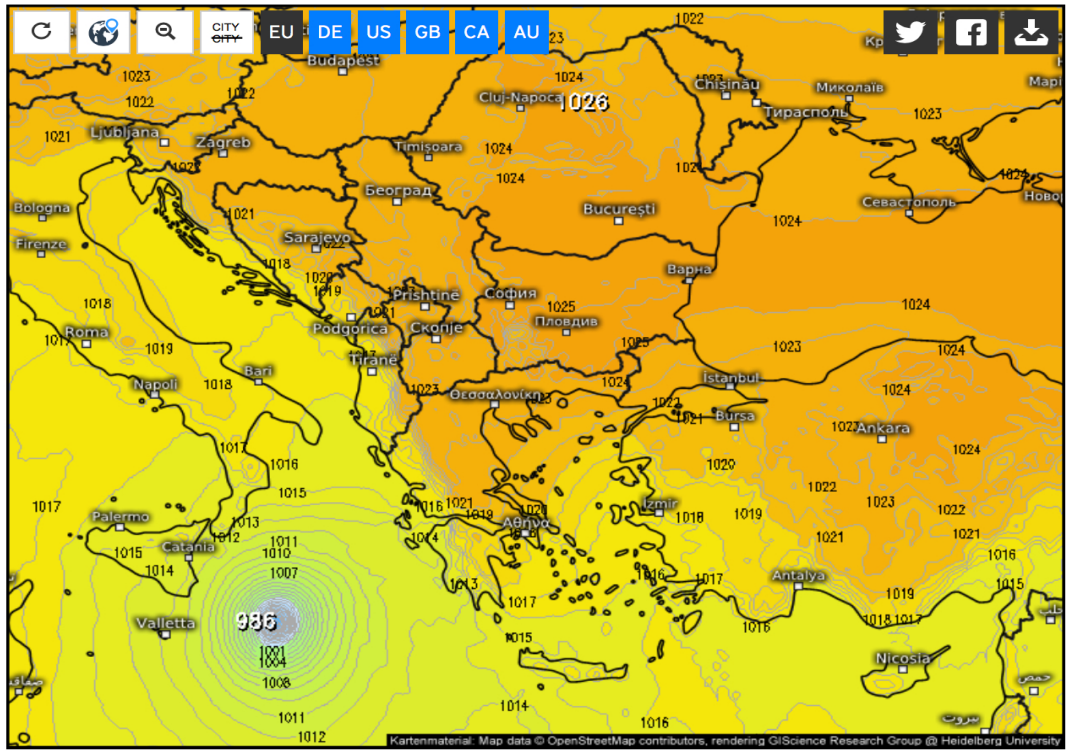
From 24 at 12Z, valid 29 at 06Z
(5 days in advance)

993 hPa



Even 4-5 days before members of the ECMWF EPS were able to anticipate a small and intense cyclone, not far from the later observed location, although the uncertainty is important

Predictability
Deterministic: ECMWF IFS forecast vs ECMWF analysis



Mean Sea Level Pressure (hPa)

Valid for
09/28/2018, 08:00am CEST

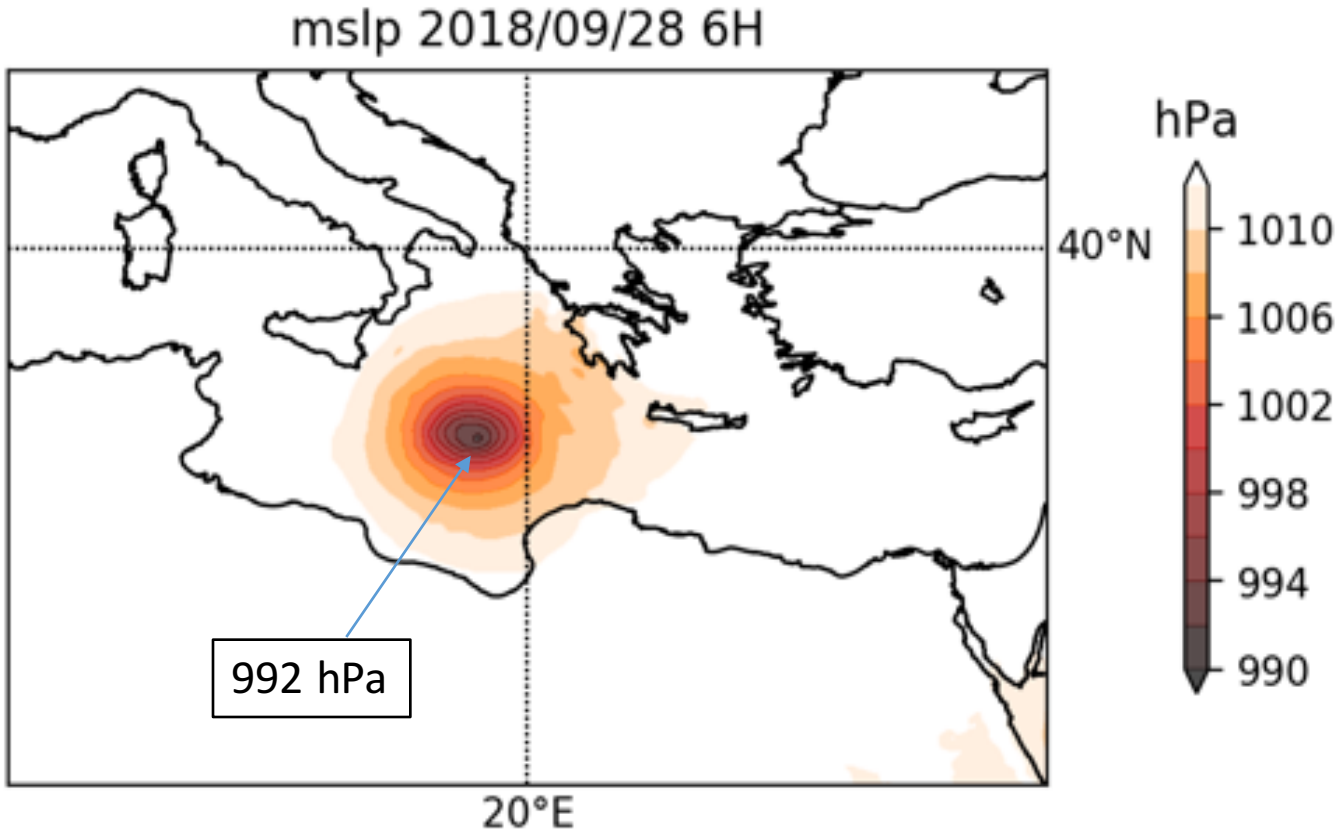
910 925 940 954 966 974 980 986 992 998 1004 1010 1016 1022 1028 1034 1040 1046 1058

Southeastern Europe
ECMWF/Global Euro HD (10 days) from 09/25/2018/00z

ECMWF meteologix.com

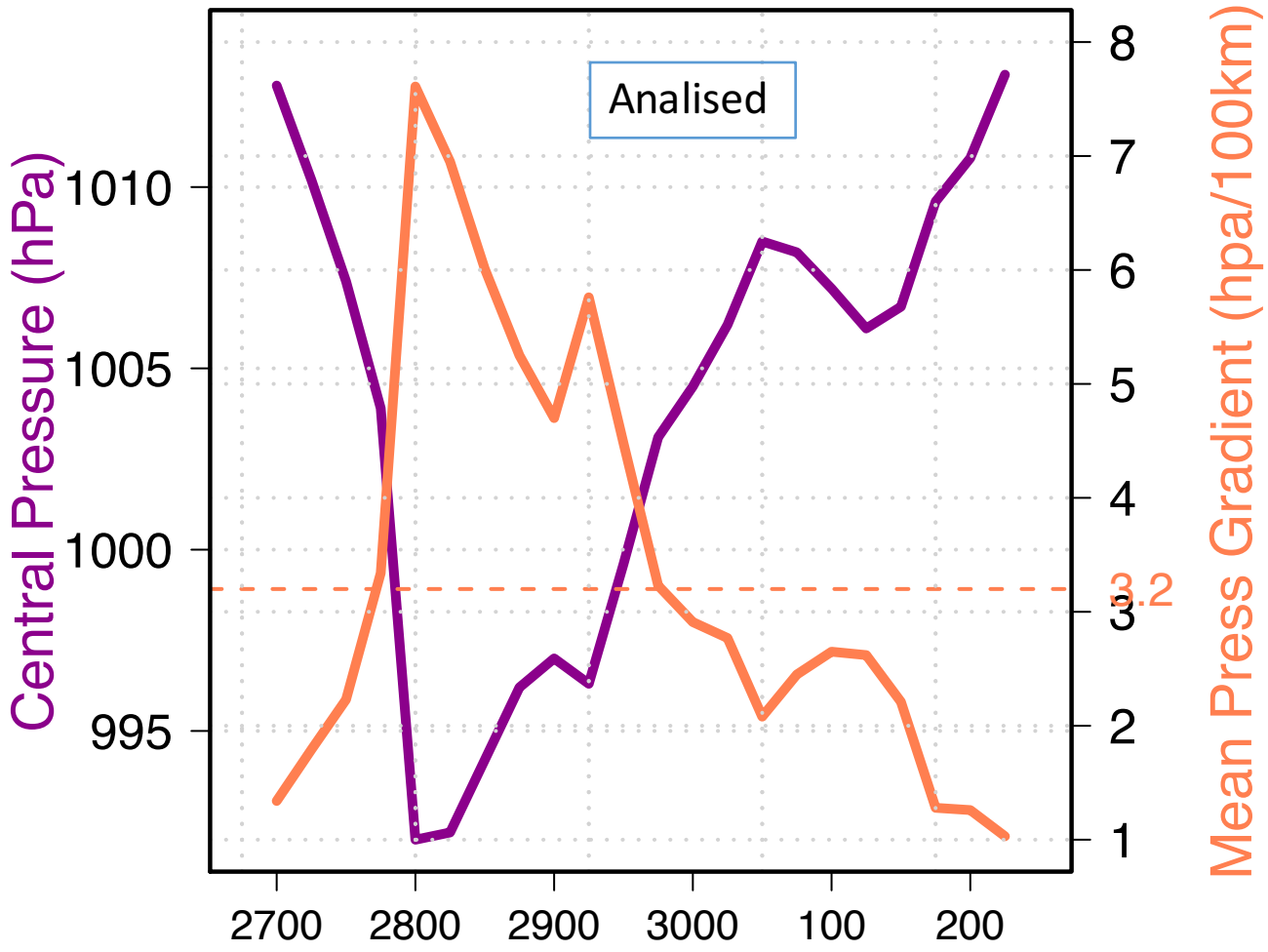
This service is based on data and products of the European Centre for Medium-range Weather Forecasts (ECMWF)

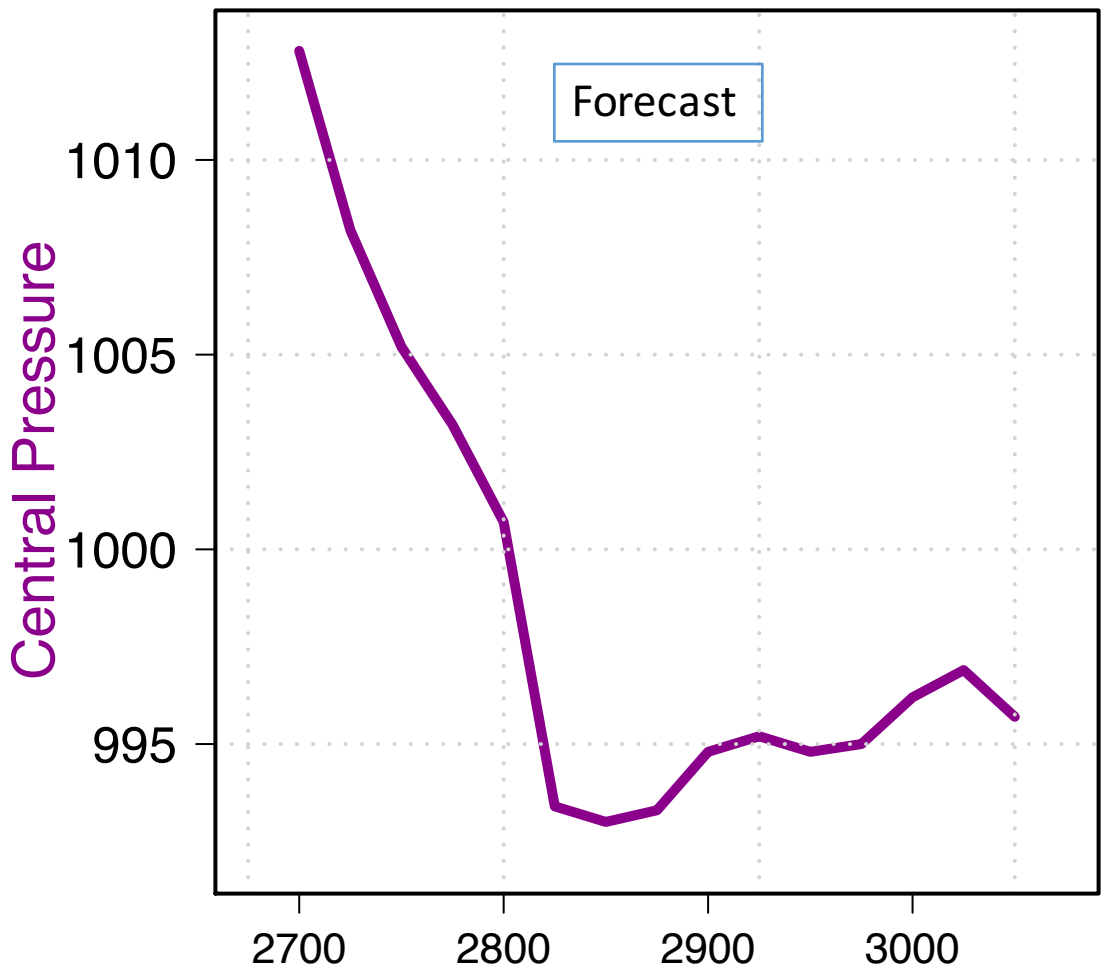
Update times: ca. 8:00am-9:00am and 8:00pm-9:00pm (parameters), 10:30am and 10:30pm (ensembles)



3 days in advance, the deterministic ECMWF forecasted cyclone is even deeper than the cyclone later analysed.
The location is not bad.

In the short range (from 2700), the EVMWF IFS deterministic is quite accurate, although some details are not perfect.





- Rissagues:
  - Predicción *subjetiva* (AEMET)
  - Predicción *objetiva/determinista/ensemble* (SOCIB)

Pioneering research on Balearic Islands *rissagues*

Agustí Jansà and Climent Ramis
Universitat de les Illes Balears (UIB), Palma (Spain)
e-mail: agusti.jansa@gmail.com

The First World Conference on Meteotsunamis
Split, Croatia, 8-11 May 2019

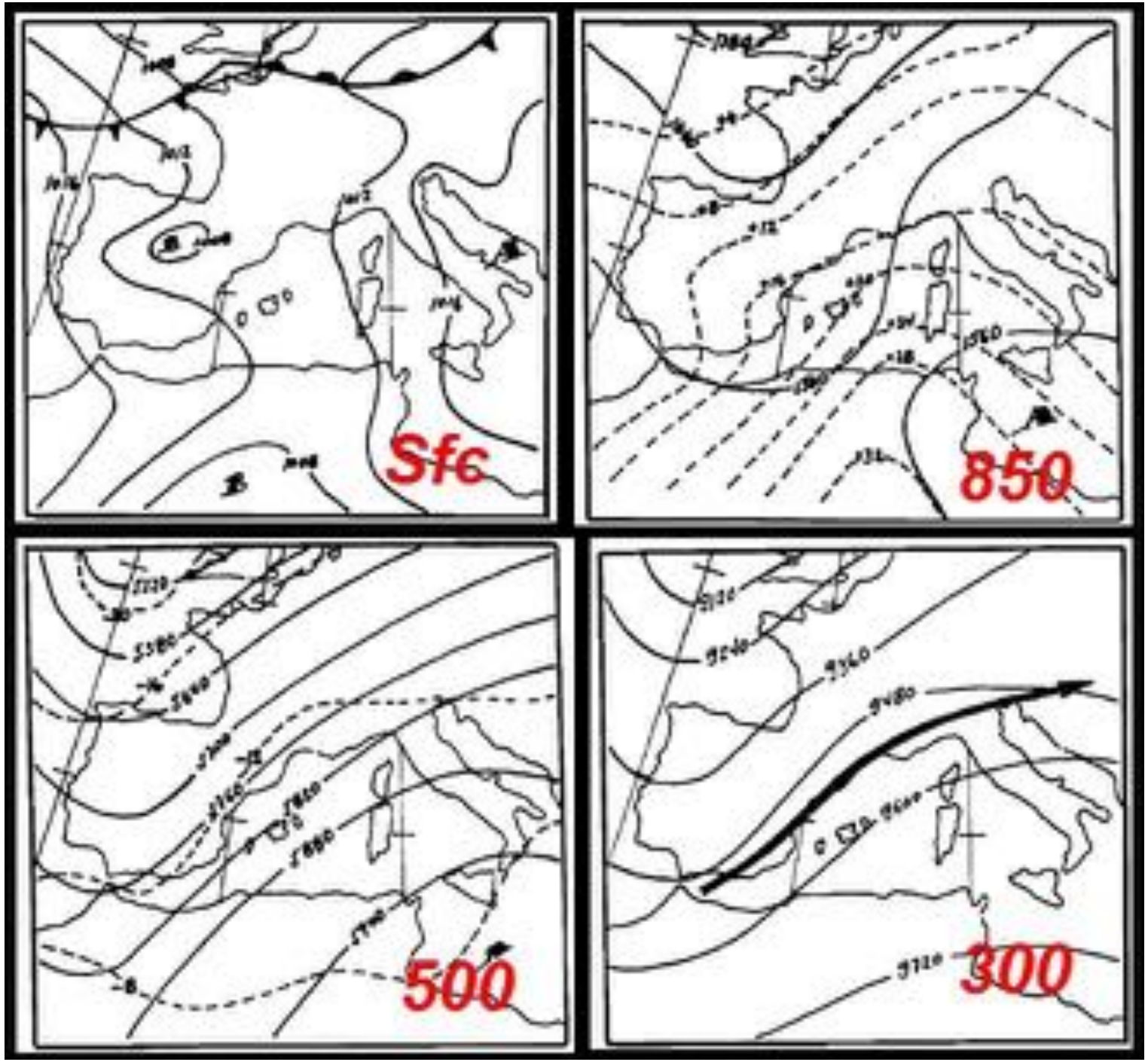
Sensitivity studies of Menorcan meteotsunamis under synthetic gravity wave forcing

Baptiste Mourre, Matjaz Ličer,
Charles Troupin, Agustí Jansà, Alejandro Orfila, Joaquín Tintoré

Evaluation of four years of daily predictions of the SOCIB Rissaga Forecasting System

Baptiste Mourre, Albert Builś,
Lola Gautreau, Benjamin Casas, Matjaz Ličer, Agustí Jansà, Bernat Amengual, Joaquín Tintoré

El fundamento de la predicción subjetiva AEMET de rissagues és la identificación de condiciones macro-meteo favorables, ya identificadas en Ramis&Jansà (1983), complementada con los resultados de Jansà (1986)



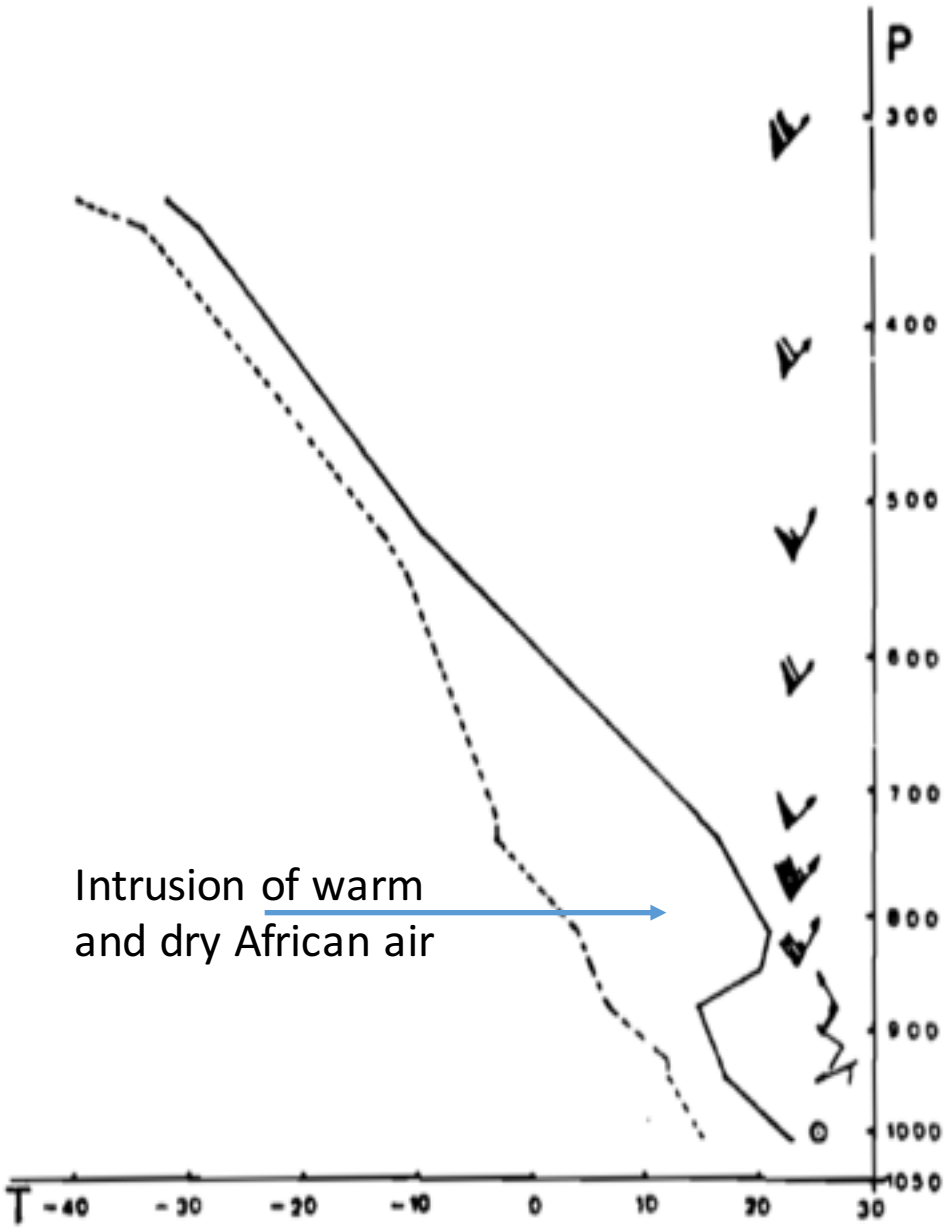


Fig. 8.—Sondeo termodinámico de Palma de Mallorca. 2 de julio de 1981 a 12 TMG.

Intrusion of warm and dry African air

Poor stability, strong SW wind, large vertical wind shear

Inversion layer

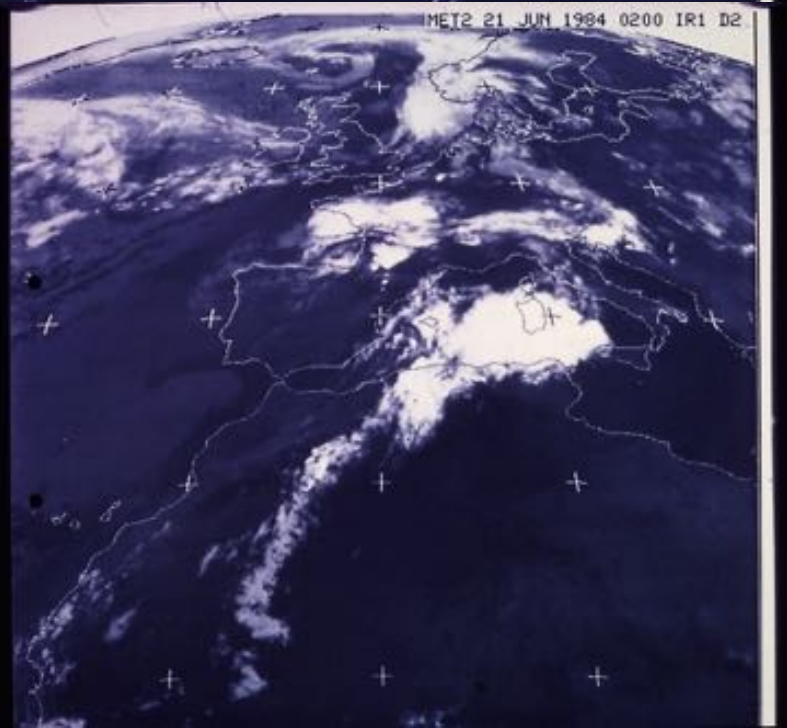
Mediterranean layer

The Ramis & Jansa 1983 thinking

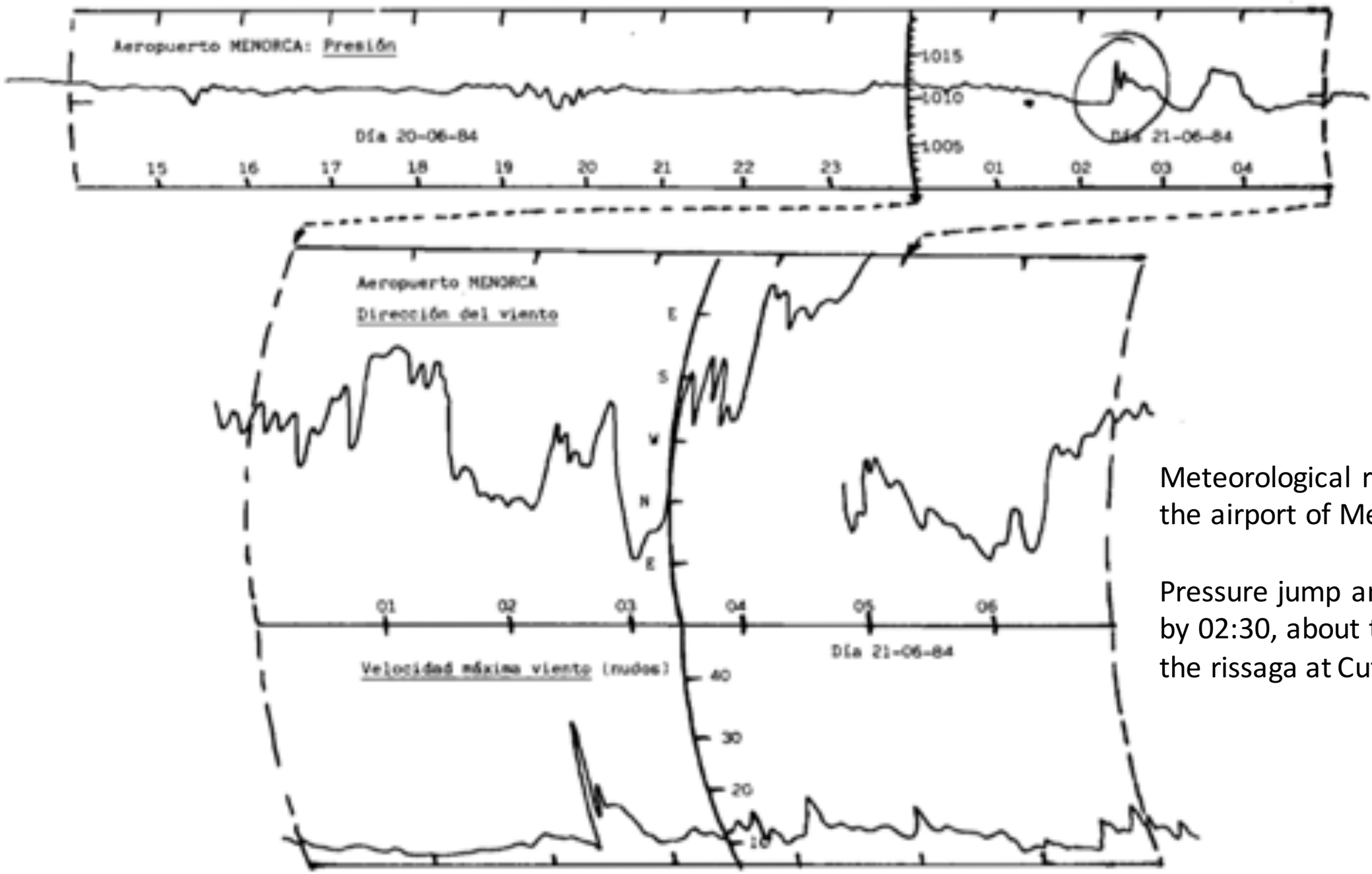
Gravity waves generation and amplification

The oscillation of the inversion layer produces surface atmospheric pressure oscillations

Marine response –long waves- amplified by port resonance



Gravity waves and convective nucleus
From 20 June 1984 at 23 UTC, to 21 June at 02 UTC



Meteorological registers at the airport of Menorca:

Pressure jump and wind gust by 02:30, about the time of the rissaga at Cutadella

Verification –through a contingency table- of a sample (2003-2006) of the analogical rissaga prediction service established in 1985 at the Spanish National Meteorological Service

Rissaga	Observed amplitude (when amplitude >= 30 cm)			
Forecast amplitude	30-75 cm	75-150 cm	> 150 cm	total
No forecast (< 30 cm)	4	1	1	6
30-75 cm	2	1	1	4
75-150 cm	9	11	4	24
> 150 cm	1	2	1	4
Total	16	15	7	38

Under-prediction

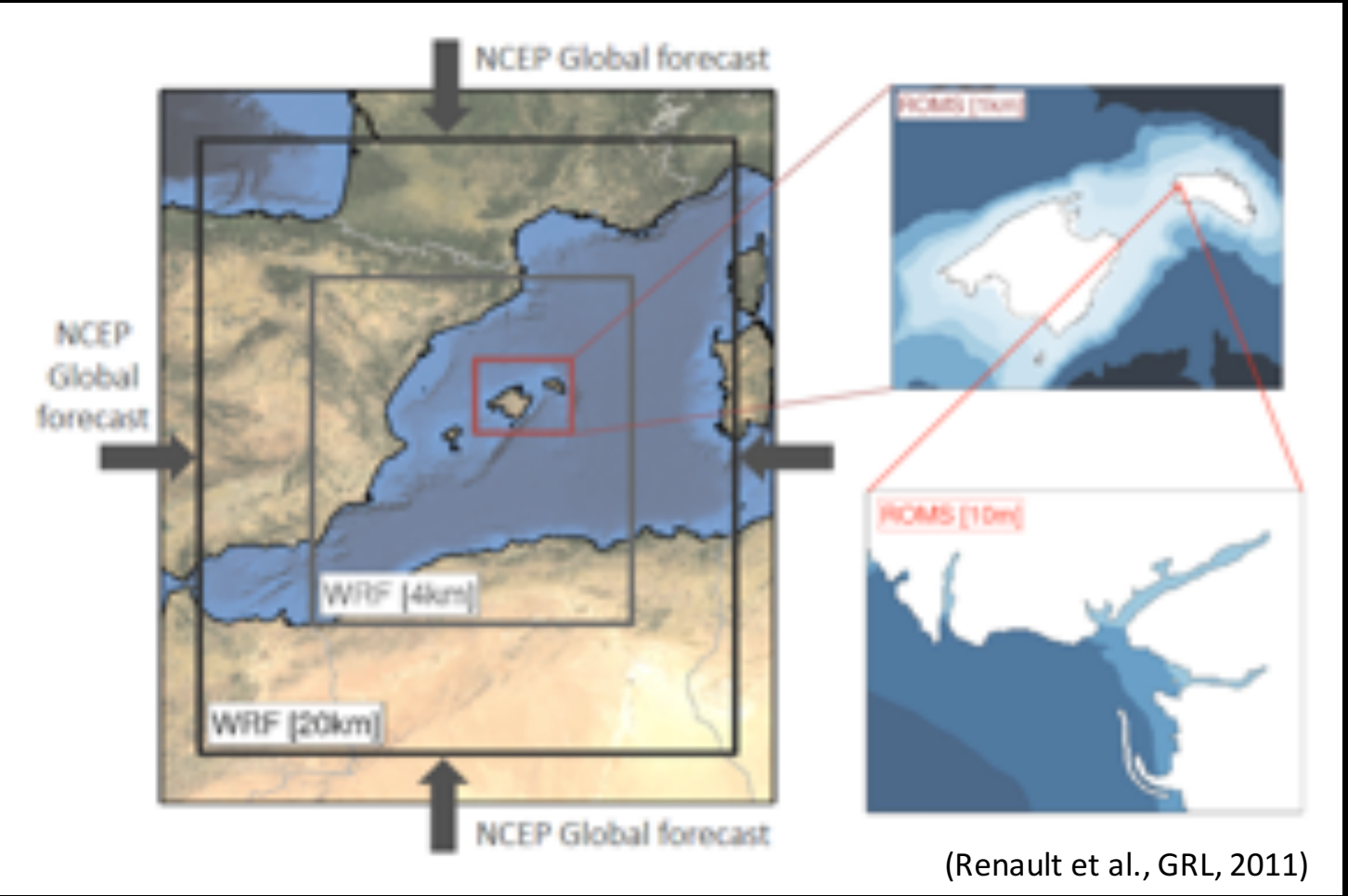
Correct prediction

Over-prediction

When rissaga (>30 cm) is observed:
Rissaga was not forecast: 16%
Rissaga was forecast: 84%

BRIFS - *Balearic RIssaga Forecasting System* (SOCIB)

Ocean-atmosphere modelling prediction system

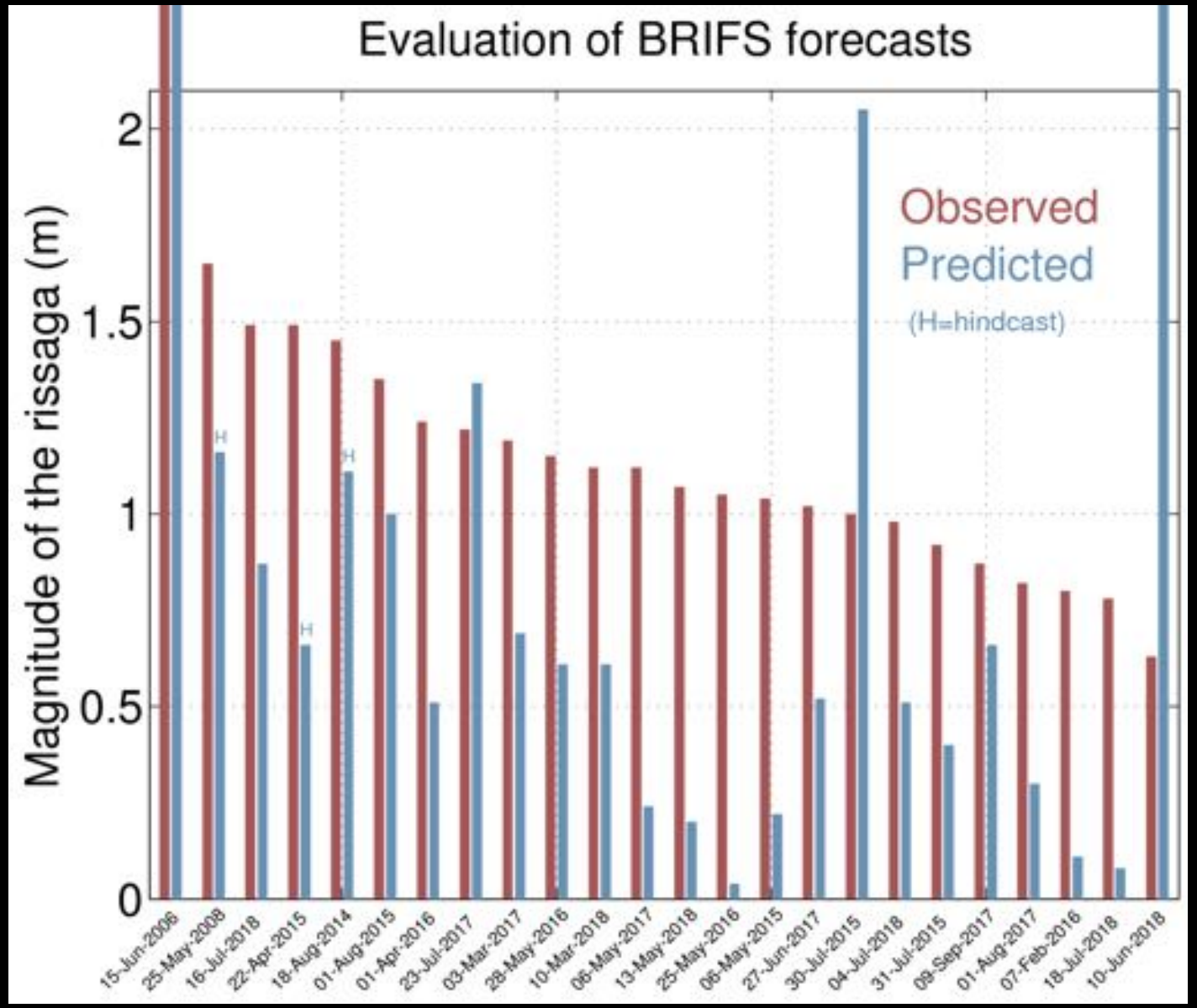


(Renault et al., GRL, 2011)

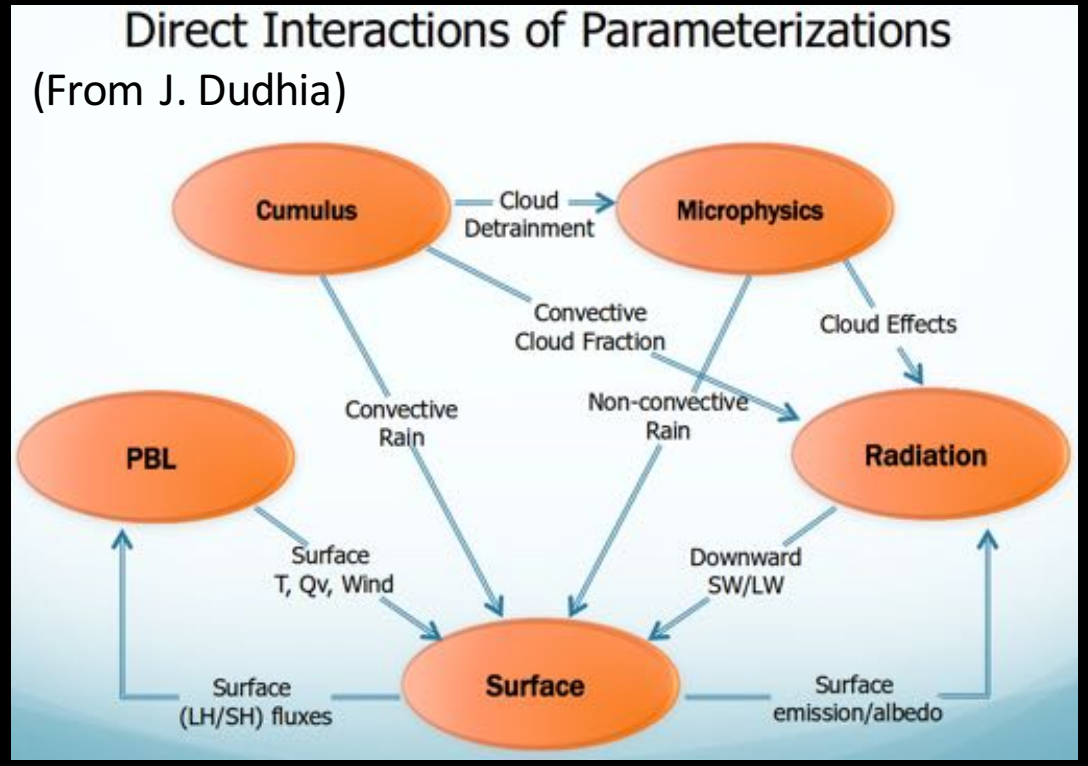
WRF: Weather Research and Forecasting Model
NCEP: National Centers for Environmental Prediction

ROMS: Regional Ocean Modeling System

BRIFS evaluation – *rissagues* > 0.7m



WRF sensitivity experiments – ensemble modelling



WRF 3.3.1
→ WRF 3.6.1

Radiation
1-2 Lw RRTM Sw Goddard
4 Lw&Sw RRTMG

Radiation calls frequency
4 4min
10 10min

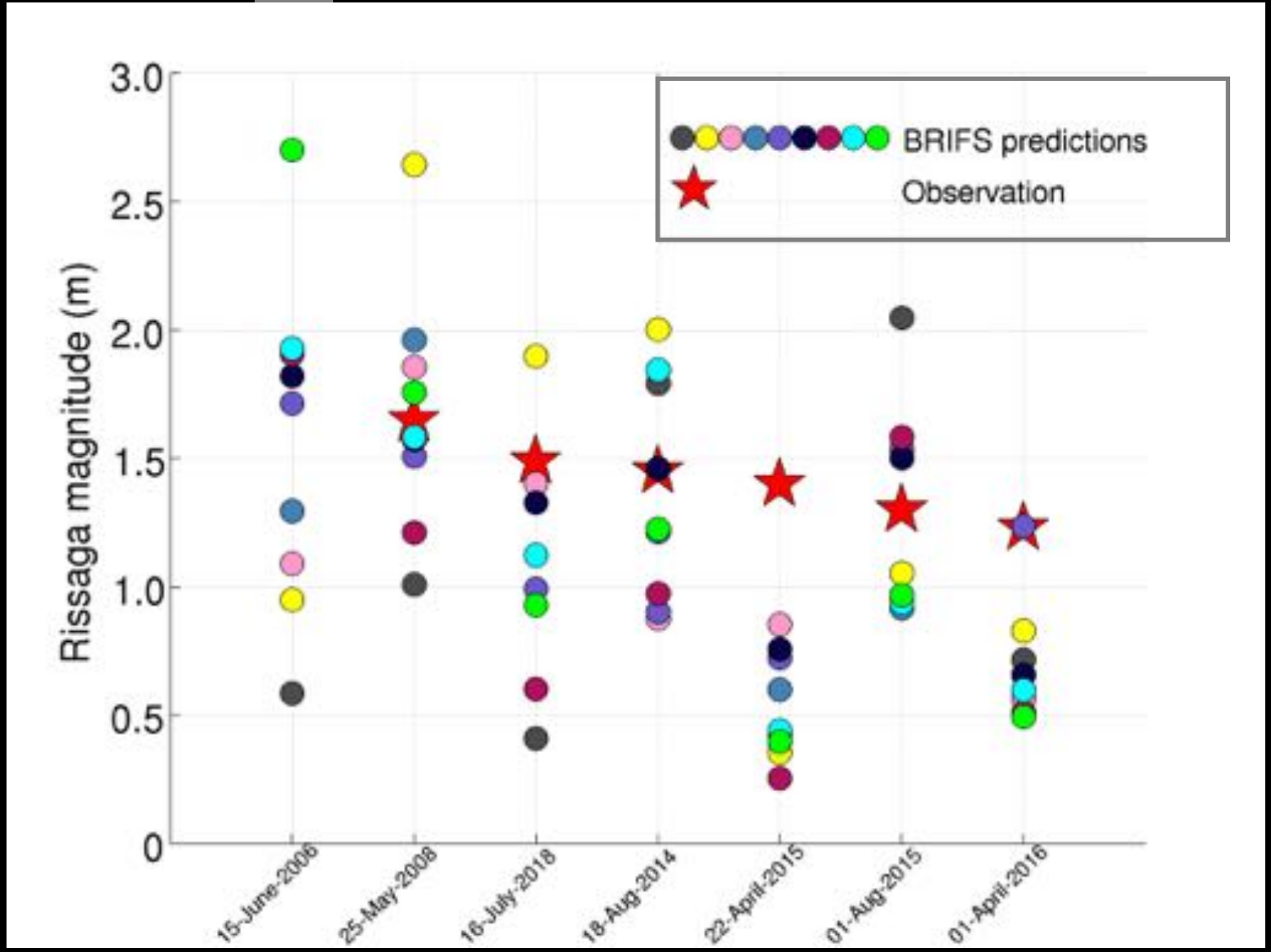
PBL
1 YSU
2 MYJ
5 MYNN3

Cumulus
1 Kain-Fritsch
3 Grell-Freitas
6 Tiedtke

Microphysics
6 WSM6
7 Goddard
8 Thompson

Radiation		Radiation dt		PBL			Cumulus			Microphysics		
1-2	4	4	10	1	2	5	3	1	6	8	7	6
●	●	★	★	■	■	■	◆	◆	◆	◀	◀	◀

WRF sensitivity experiments – ensemble modelling



Las predicciones deterministas de *medicanes* y de *rissagues* pueden ser buenas, pero incluyen un considerable nivel de incertidumbre que una complementaria predicción *ensemble*, probabilista, nos acota, al menos parcialmente

Moltes gràcies!
¡Muchas gracias!