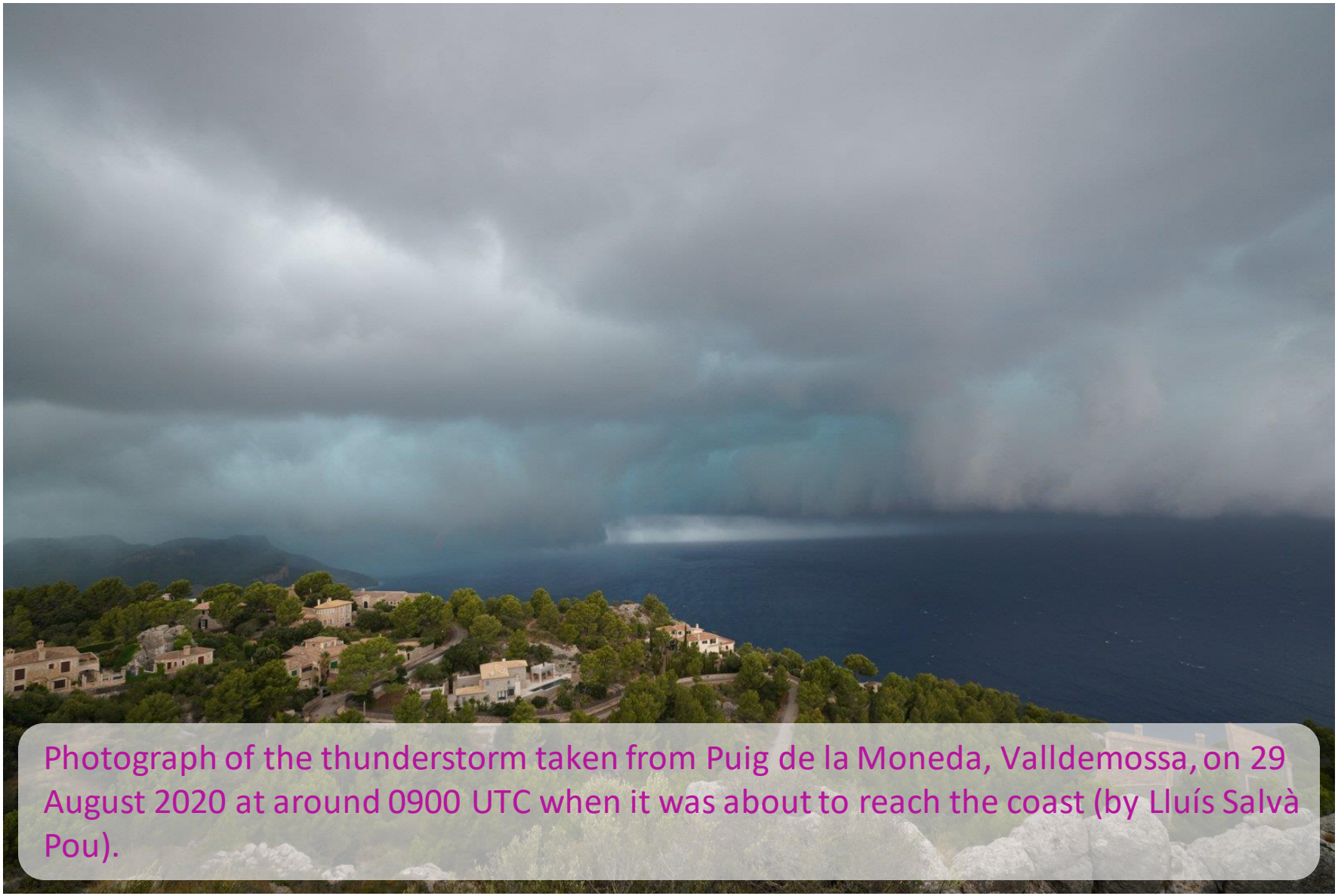
The 29 August 2020 event in the Balearic Islands

Exploring severe weather environments with CM1 simulations

Maria del Mar Vich and Romu Romero

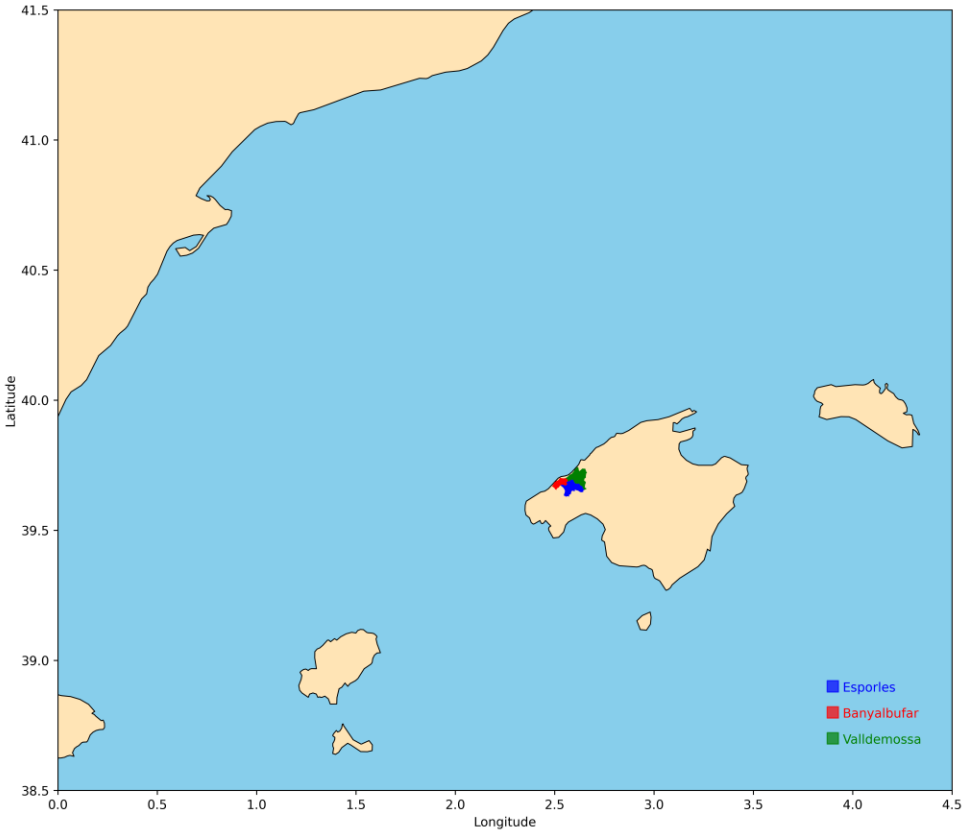
9th International Conference on Meteorology and Climatology of the Mediterranean (MetMed)
Genoa (Italy), 22-24 May 2023

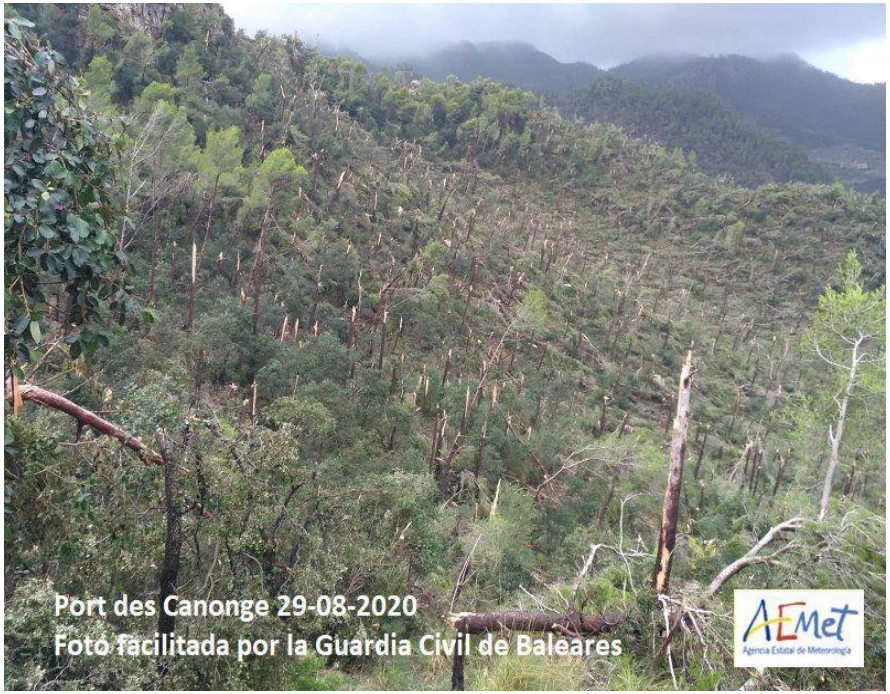
The event



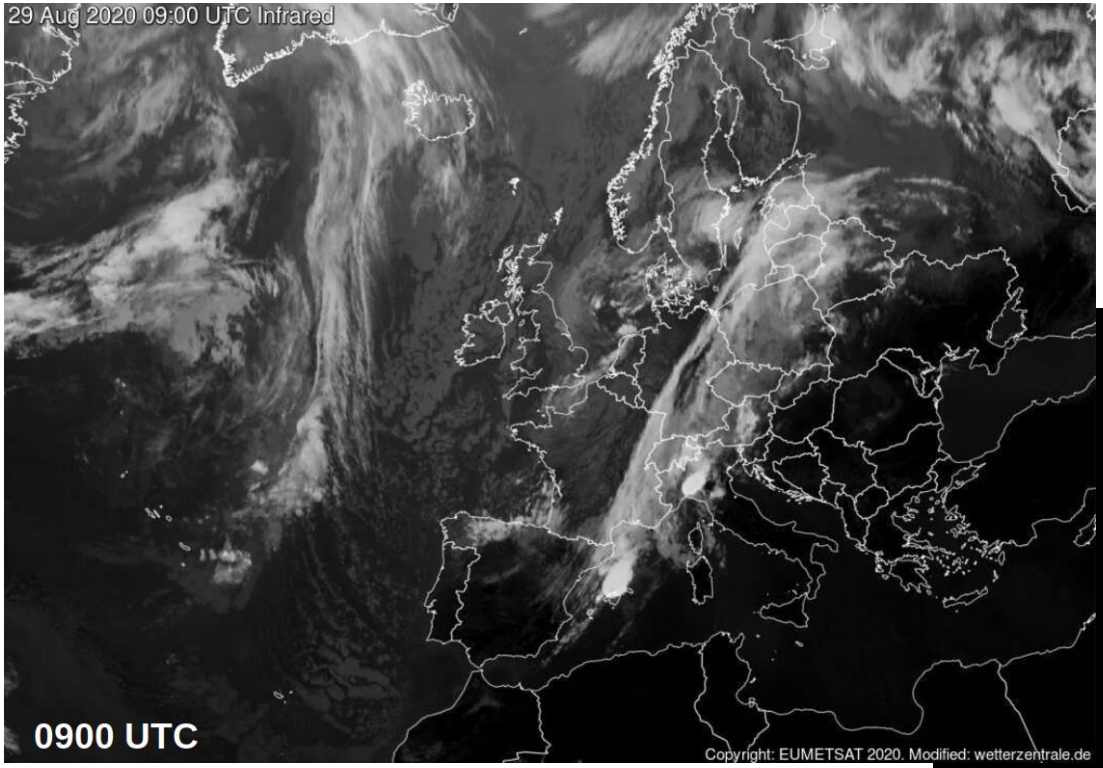
Photograph of the thunderstorm taken from Puig de la Moneda, Valldemossa, on 29 August 2020 at around 0900 UTC when it was about to reach the coast (by Lluís Salvà Pou).

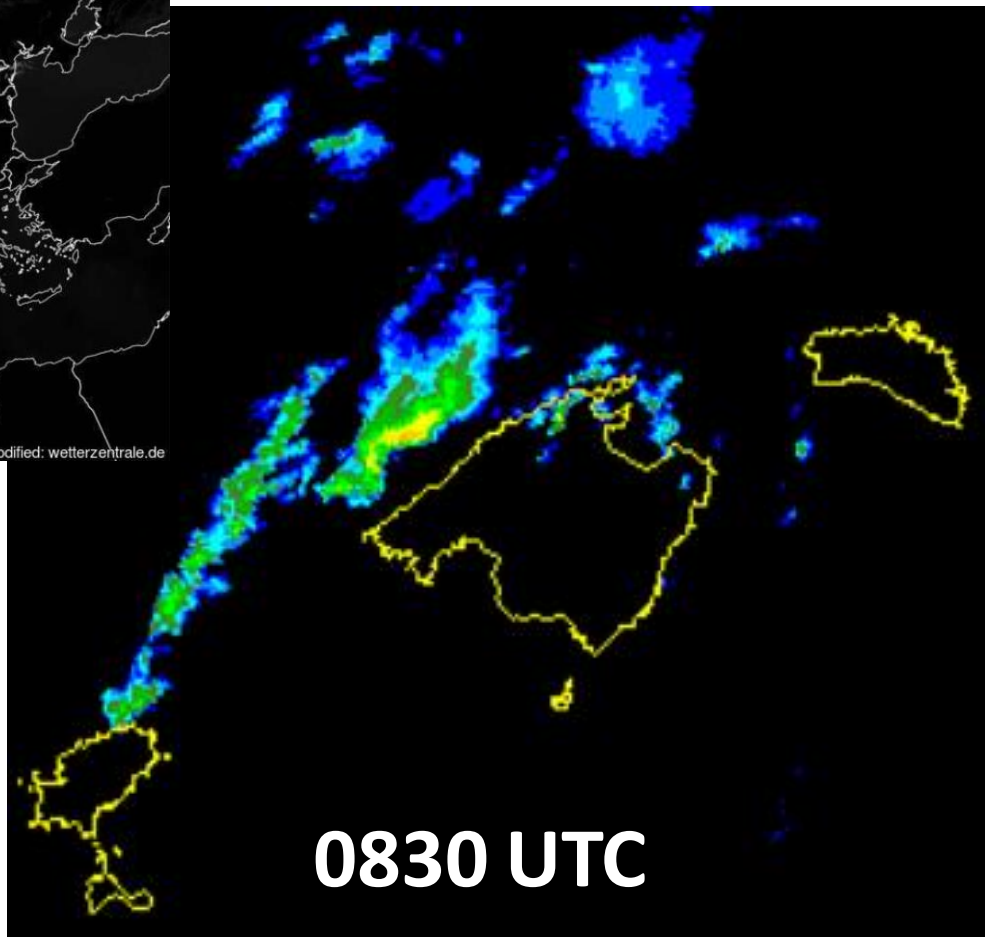
The event


41.5
41.0
40.5
40.0
39.5
39.0
38.5
Latitude
0.0
0.5
1.0
1.5
2.0
2.5
3.0
3.5
4.0
4.5
Longitude
Esporles
Banyalbufar
Valldemossa


Port des Canonge 29-08-2020
Foto facilitada por la Guardia Civil de Baleares
AEMet
Agencia Estatal de Meteorología

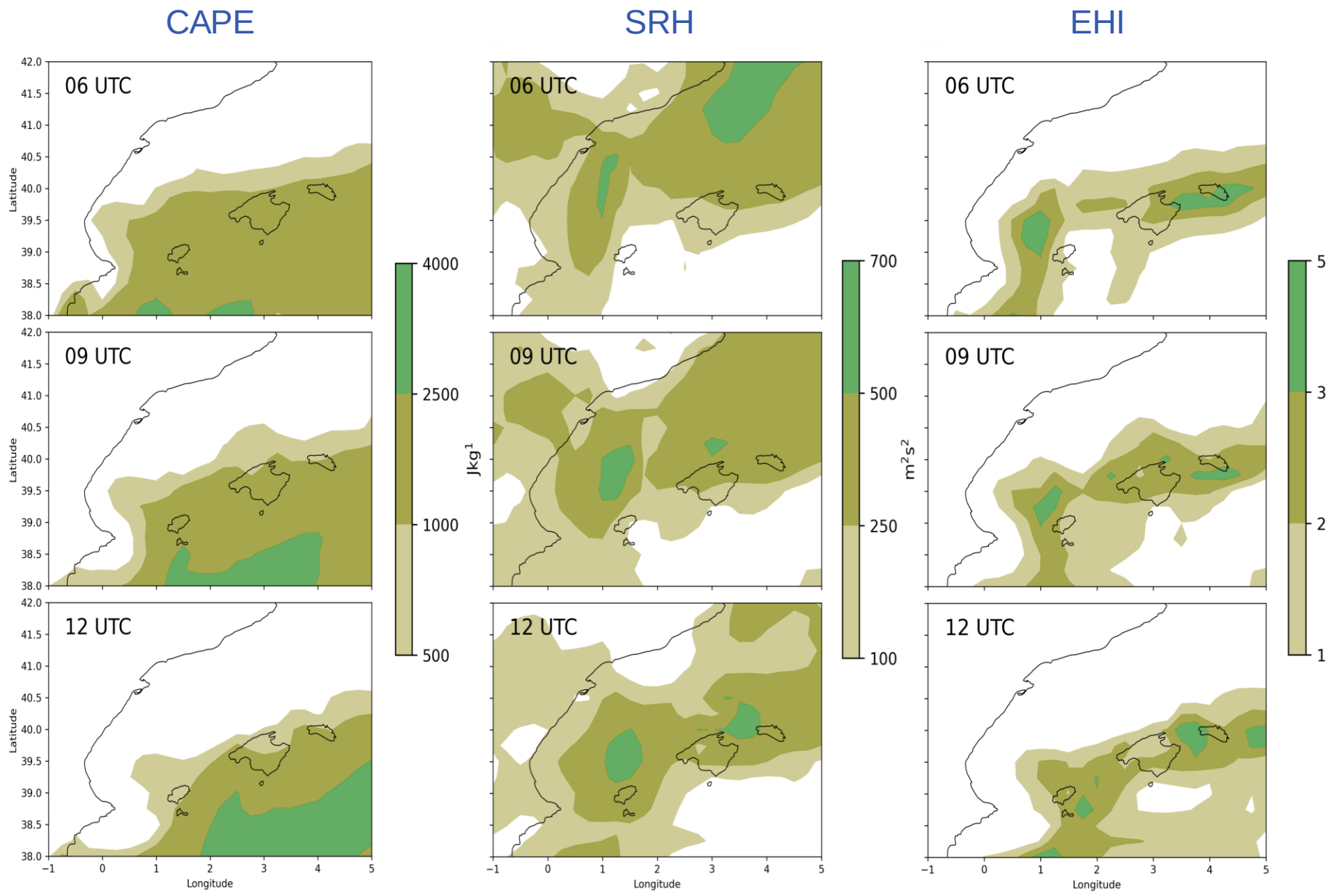
The event


29 Aug 2020 09:00 UTC Infrared
0900 UTC
Copyright: EUMETSAT 2020. Modified: wetterzentrale.de


0830 UTC

GFS forecast issued on
29 August 2020 at 00 UTC

The event

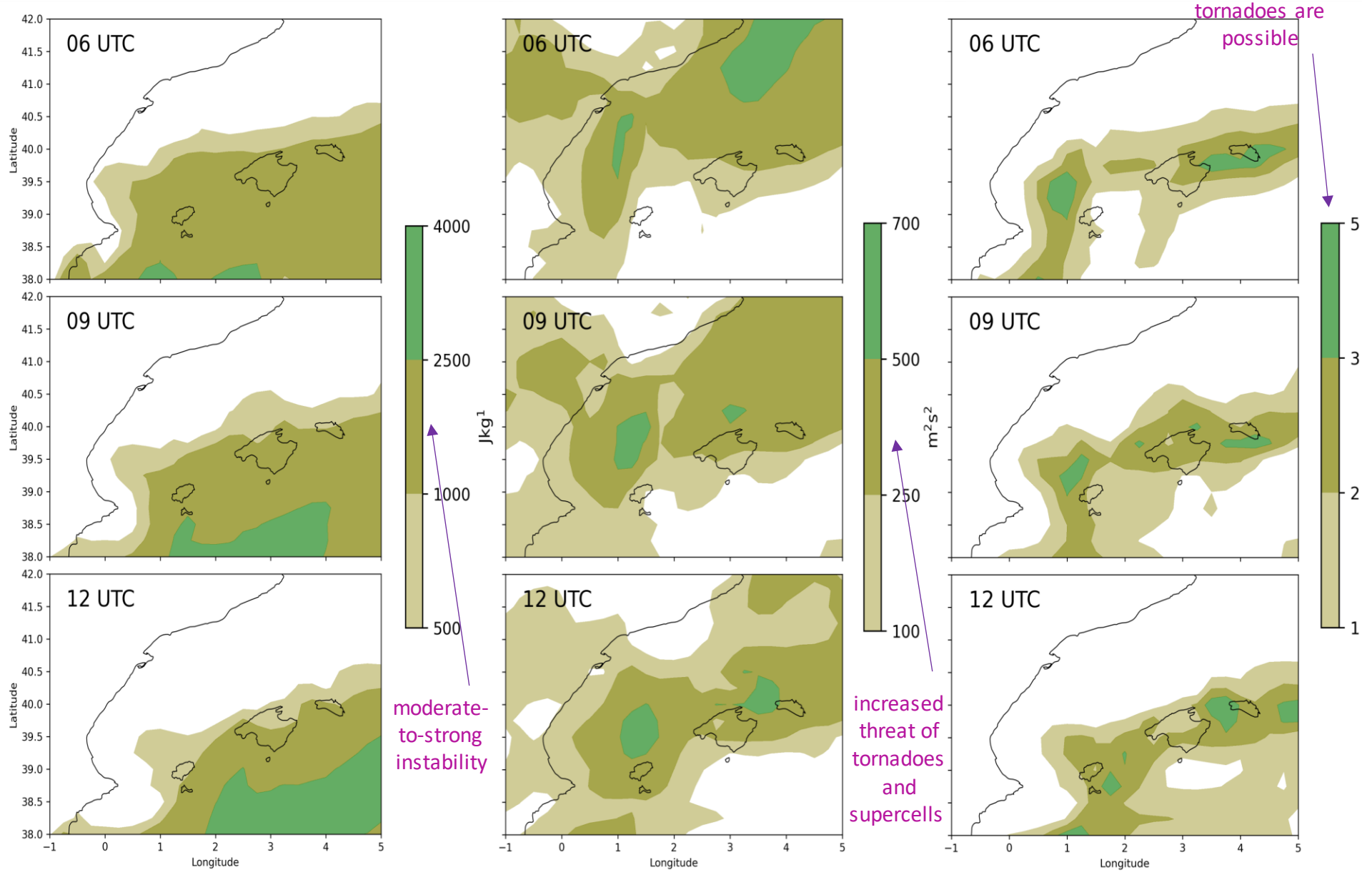


GFS forecast issued on
29 August 2020 at 00 UTC

The event

> 1 indicate supercell potential

1 to 5 suggest that EF2 and/or EF3 tornadoes are possible



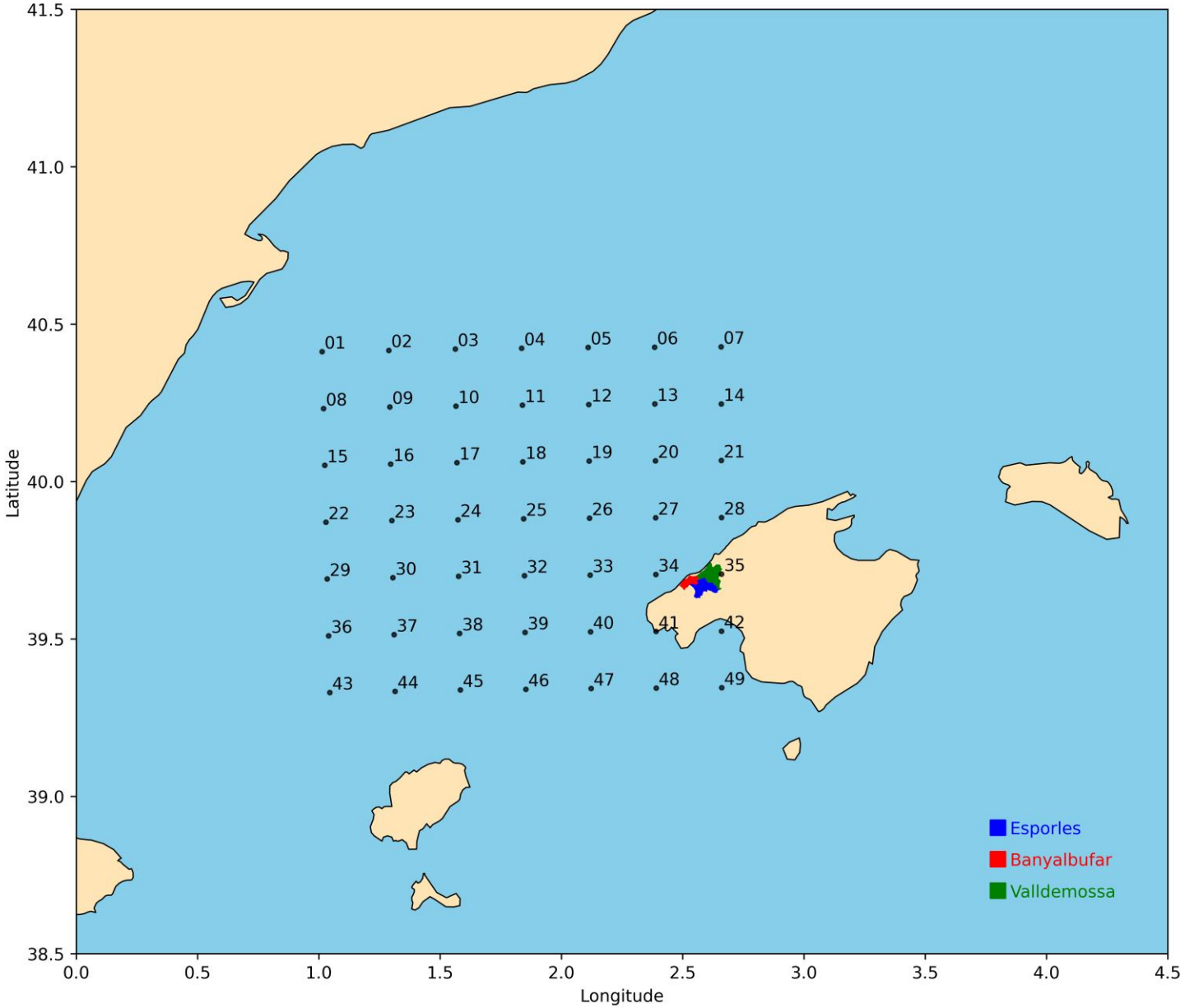
The experiment

The environment of 29 August 2020 has the potential to support convective development

But, will it occur?

And if it does, where will it develop, and how severe will it be?

The experiment



The experiment

The CM1 model

Designed by George Bryan (NCAR) primarily for **idealized research**, particularly for **deep moist convection** (i.e., thunderstorms), so it is a good tool to assess the **convective potential of an environment**.

3D, non-hydrostatic, non-linear, cloud-resolving, idealized model

- No data assimilation
- Uses a **horizontal constant field for the base state**
- **Adds perturbations** to base state, like a warm bubble, a cold blob or a forced convergence

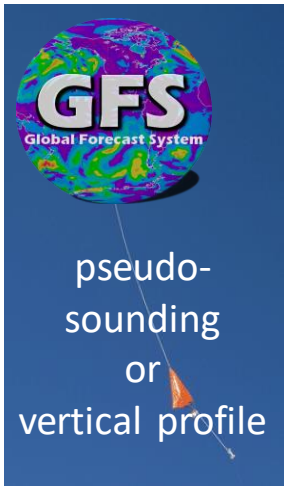
Benefits of using CM1

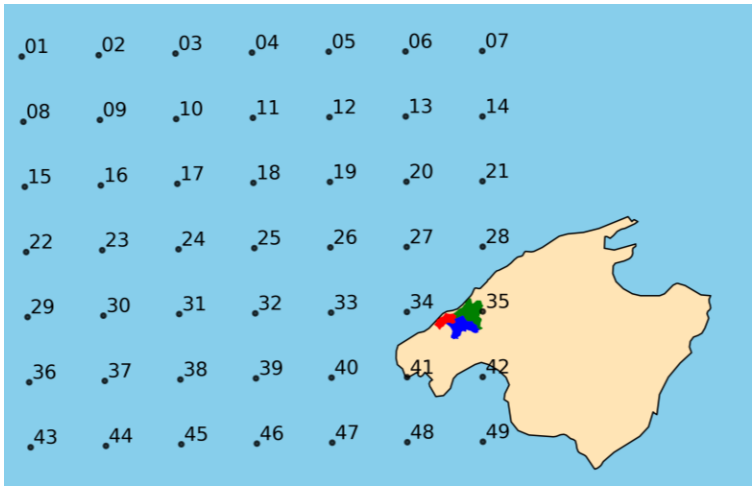
- Conserves mass and energy better than others modern cloud models
- Faster and uses less memory than other models for idealized studies
- Very flexible, can be used for a large variety of studies

The experiment

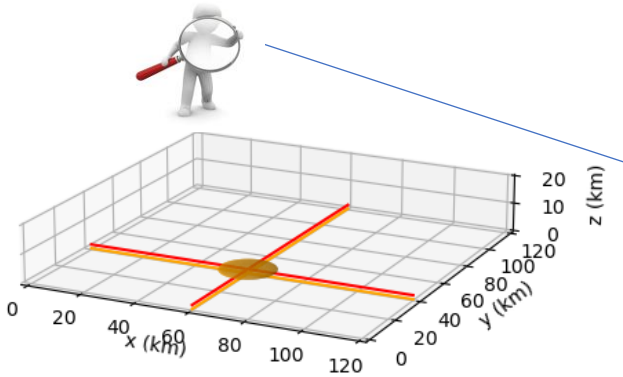
Based state defined by:

GFS forecast
issued on
29 August 2020
at 00 UTC

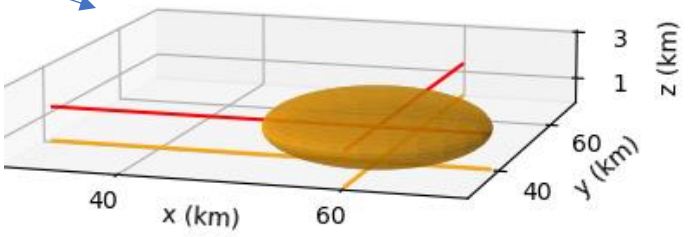




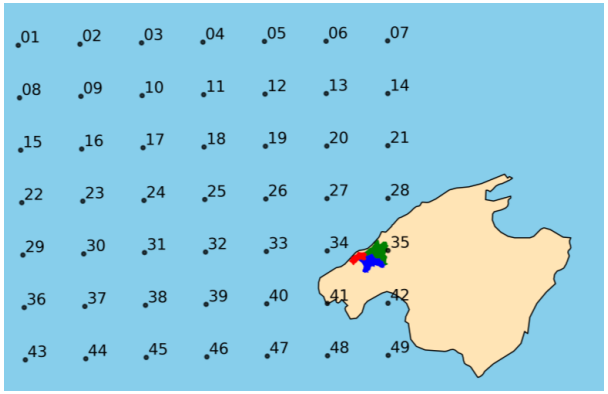
Domain and Trigger:



Duration of the simulation: 3 h



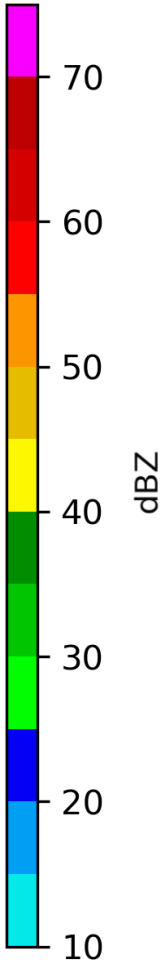
The results



a) 30 min

03 UTC

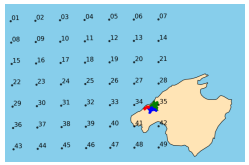
01	02	03	04	05	06	07
08	09	10	11	12	13	14
15	16	17	18	19	20	21
22	23	24	25	26	27	28
29	30	31	32	33	34	35
36	37	38	39	40	41	42
43	44	45	46	47	48	49



Maximum Reflectivity (dBZ)

The results

Maximum Reflectivity (dBZ)



a) 30 min

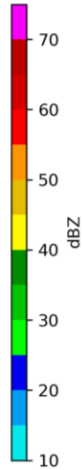
b) 100 min

c) 180 min

03 UTC

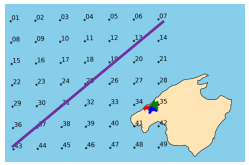
06 UTC

09 UTC



The results

Maximum Reflectivity (dBZ)



a) 30 min

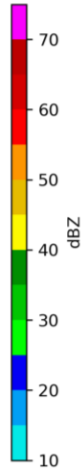
b) 100 min

c) 180 min

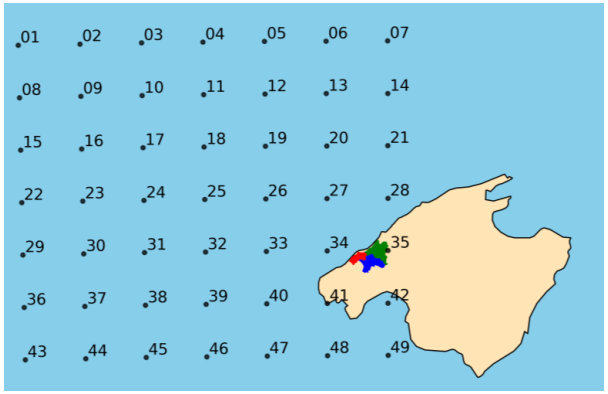
03 UTC

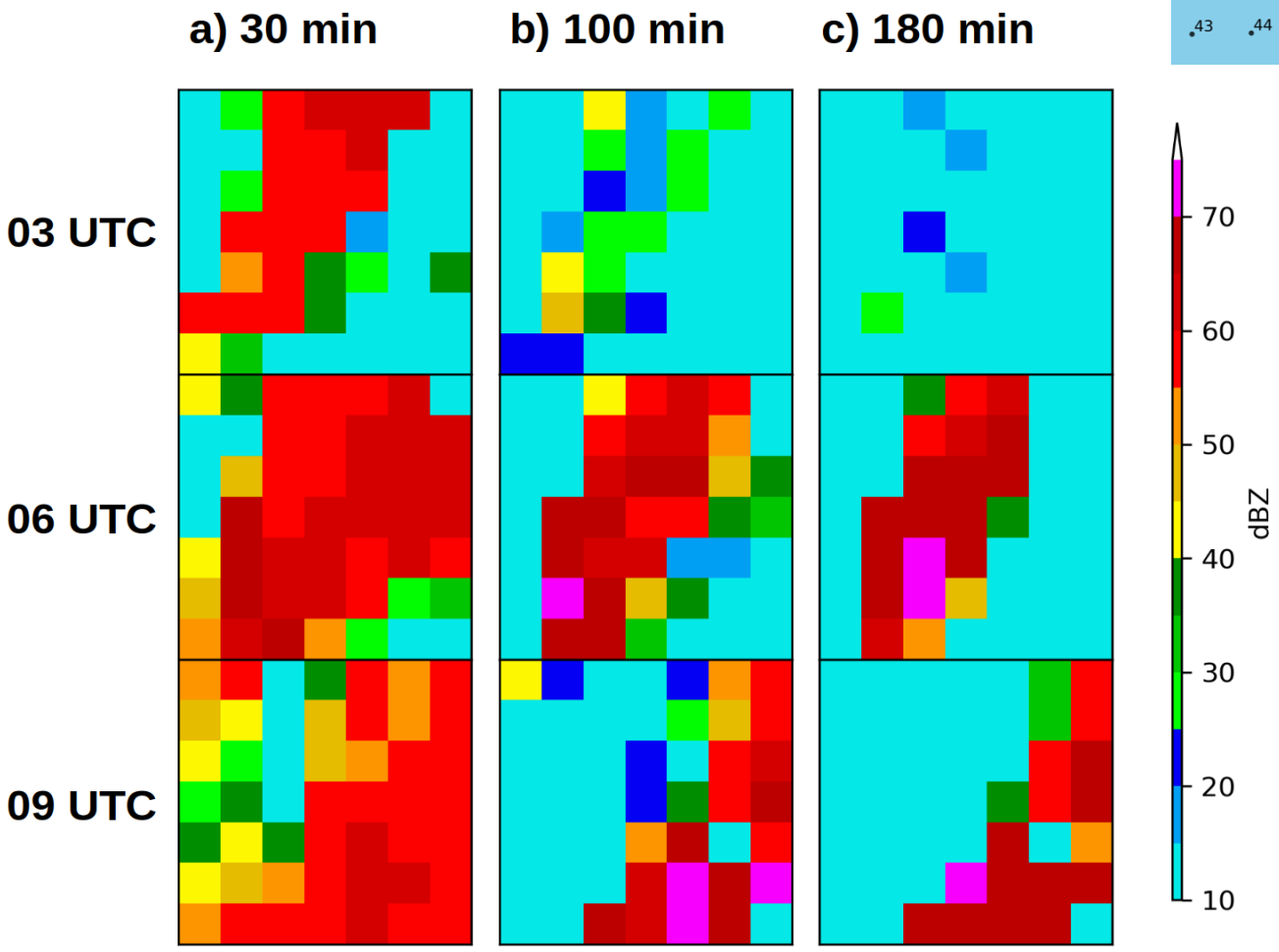
06 UTC

09 UTC



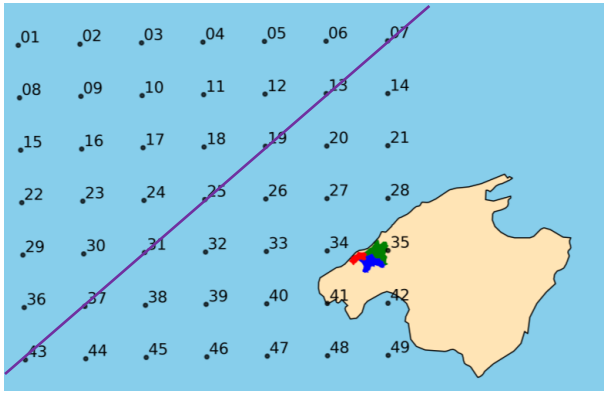
The results

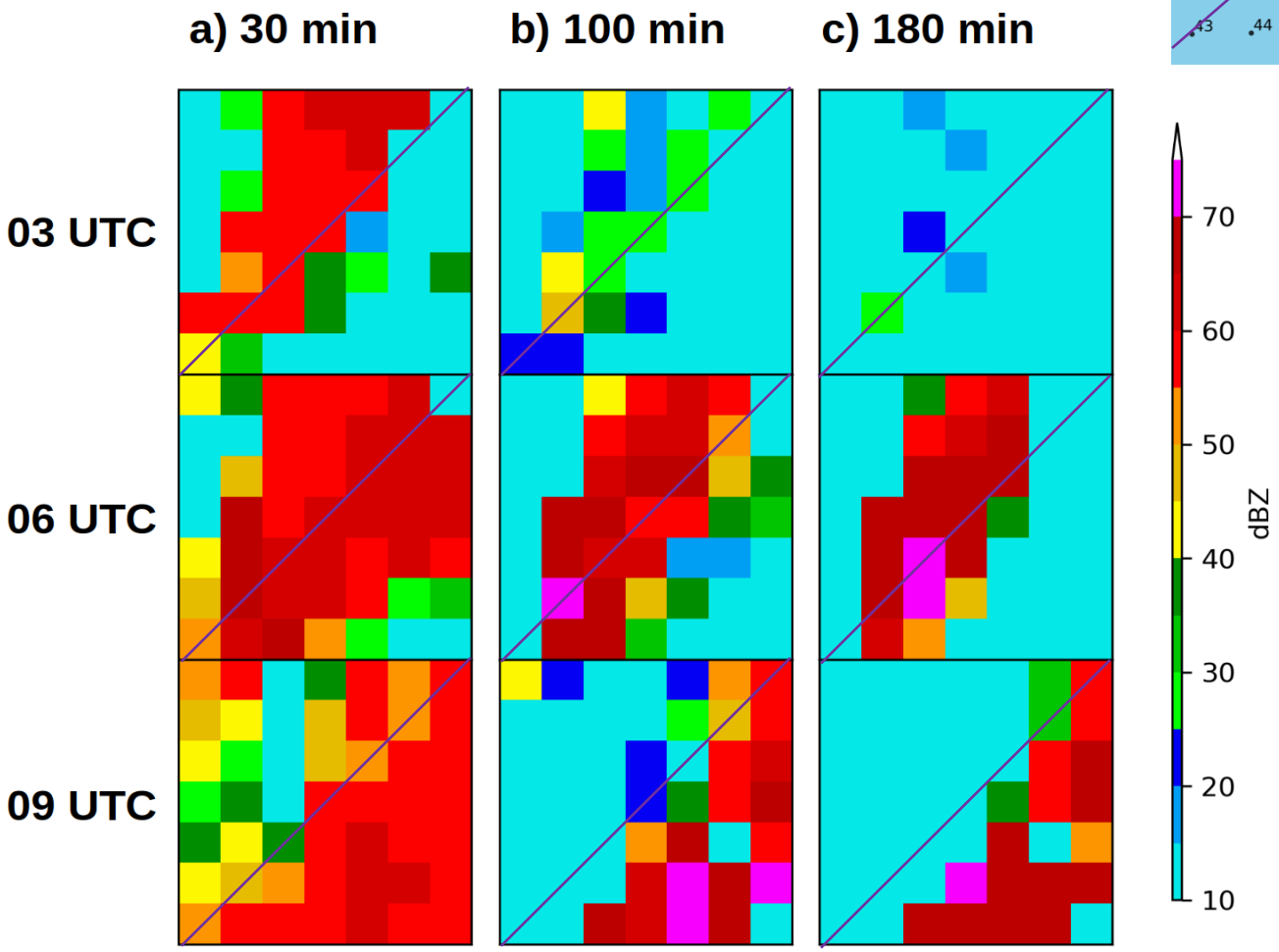




Maximum spatial value of the reflectivity (dBZ)

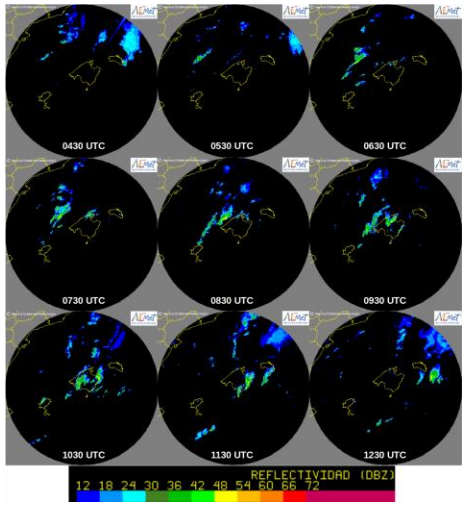
The results



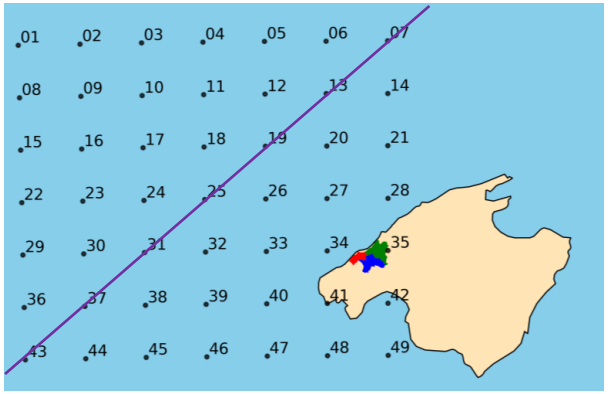


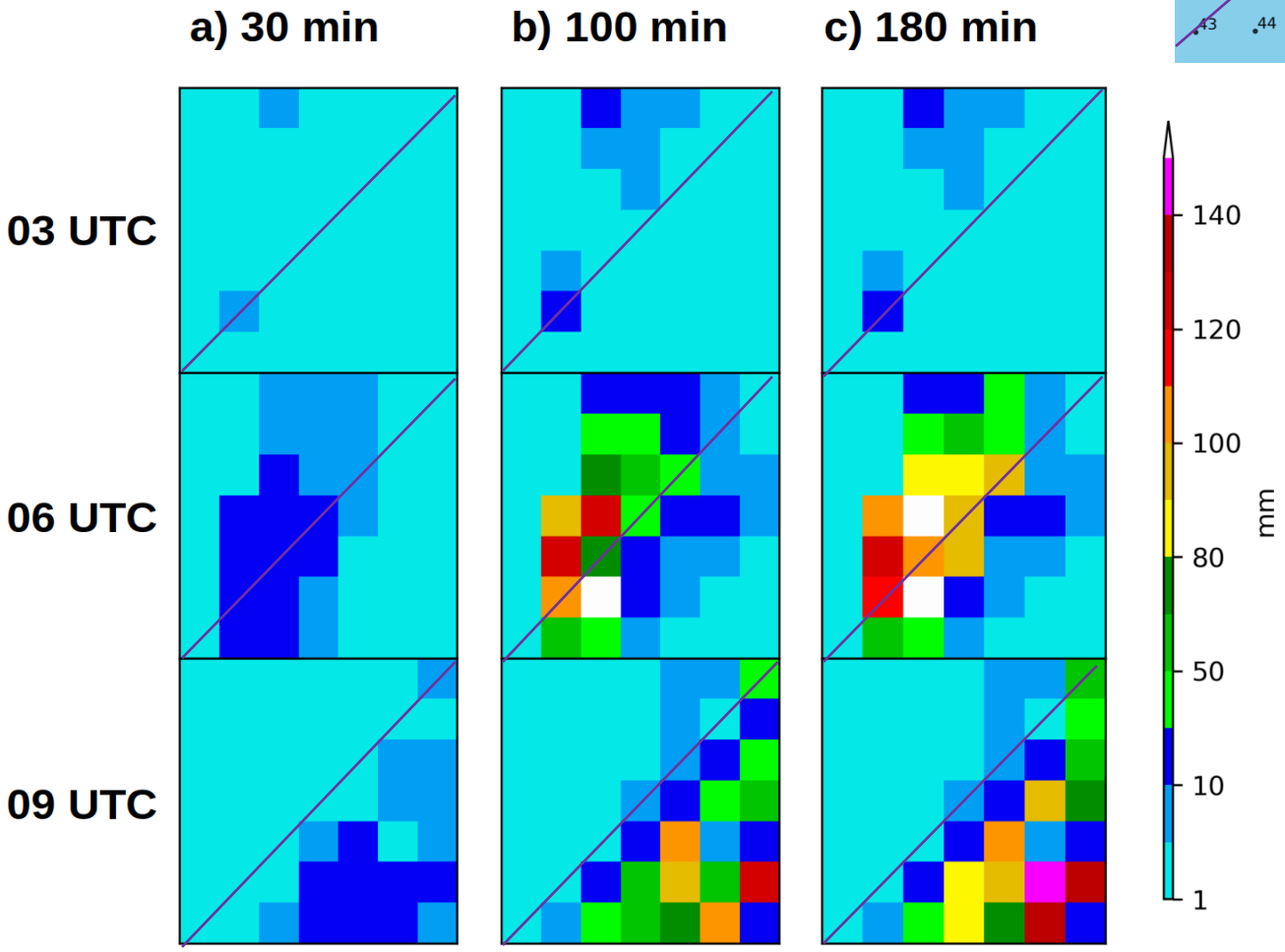
Maximum spatial value of the reflectivity (dBZ)

Hourly series from the Mallorca radar (dBZ)



The results





Maximum spatial value of total accumulated rainfall (mm)

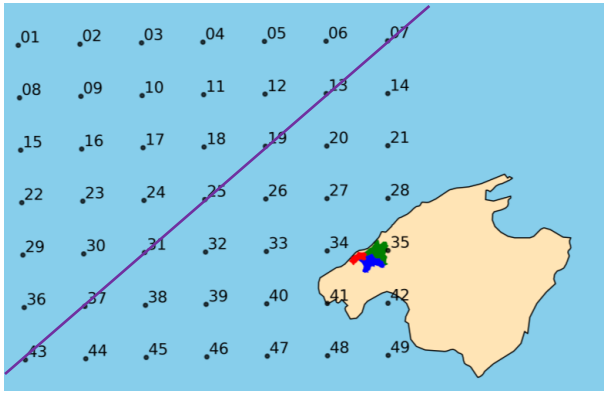
values of total rain

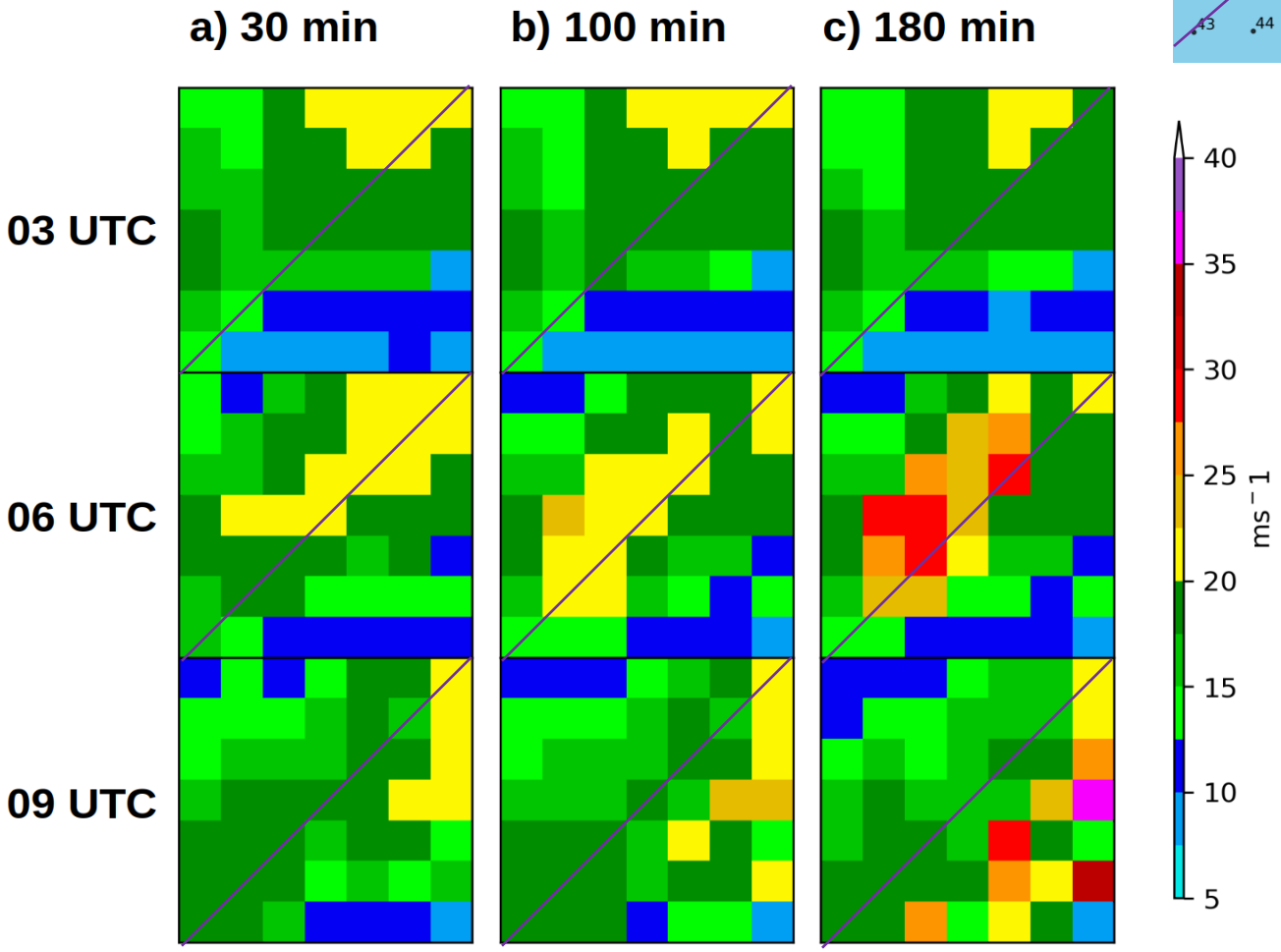
and

geographical location of the affected areas

in accordance with observations of the event

The results





The maximum spatial value of the surface wind (ms^{-1})

geographical location of extreme winds

and

speed values

in reasonable agreement with observations of the event

Existing records show winds of approximately 47 m s^{-1} (≈ 170 km h^{-1})

The conclusions

- The **severe convective environment** of the **29 August 2020 event** is **well captured** by the **GFS forecasts** fields issued at 00 UTC.

- **CAPE, SRH and EHI** indexes **alone do not provide** definite information on the effective likelihood of a **supercell**, its path or its severity.

- A **CM1-based strategy** can provide **useful details** about possible **convective structures** and offers **valuable insights** on **convective structure location** and **severity**

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AGENCIA ESTATAL DE INVESTIGACIÓN

Spanish Ministerio de Ciencia e Innovación
Agencia Estatal de Investigación of Spain

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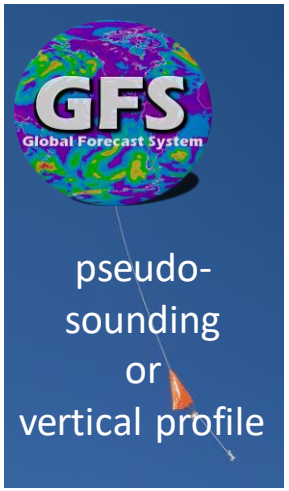
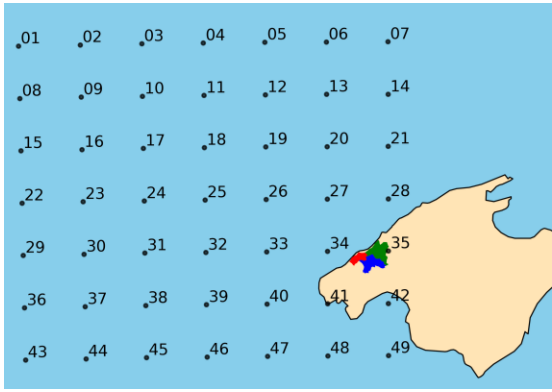
The experiment

Model version	**CM1** r20.2
Horizontal domain size	120 km x 120 km
Horizontal resolution	1 km x 1 km
Vertical domain depth	20 km
Vertical resolution	0.5 km
Integration time	10800 s (3 h)
Large time step	6 s
Domain x-motion	5m/s
Domain y-motion	0 m/s

Based state defined by:



GFS forecast issued on 29 August 2020 at 00 UTC



Triggering:

- Warm bubble
- 10 km horizontal radius
- 1.4 km vertical radius
- 60 km center of the bubble in x-direction
- 40 km center of the bubble in y-direction
- 1.4 km center of the bubble above ground