

Exploring severe weather environments with CM1 simulations.

The event of 29 August 2020 in the Balearic Islands

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Universitat
de les Illes Balears



The event

29 August 2020

Puig de la Moneda de Valldemosa
@Lluiss_SP, 6 - 10 UTC



The event

29 August 2020

Mallorca

Banyalfubar, Esporles, ...



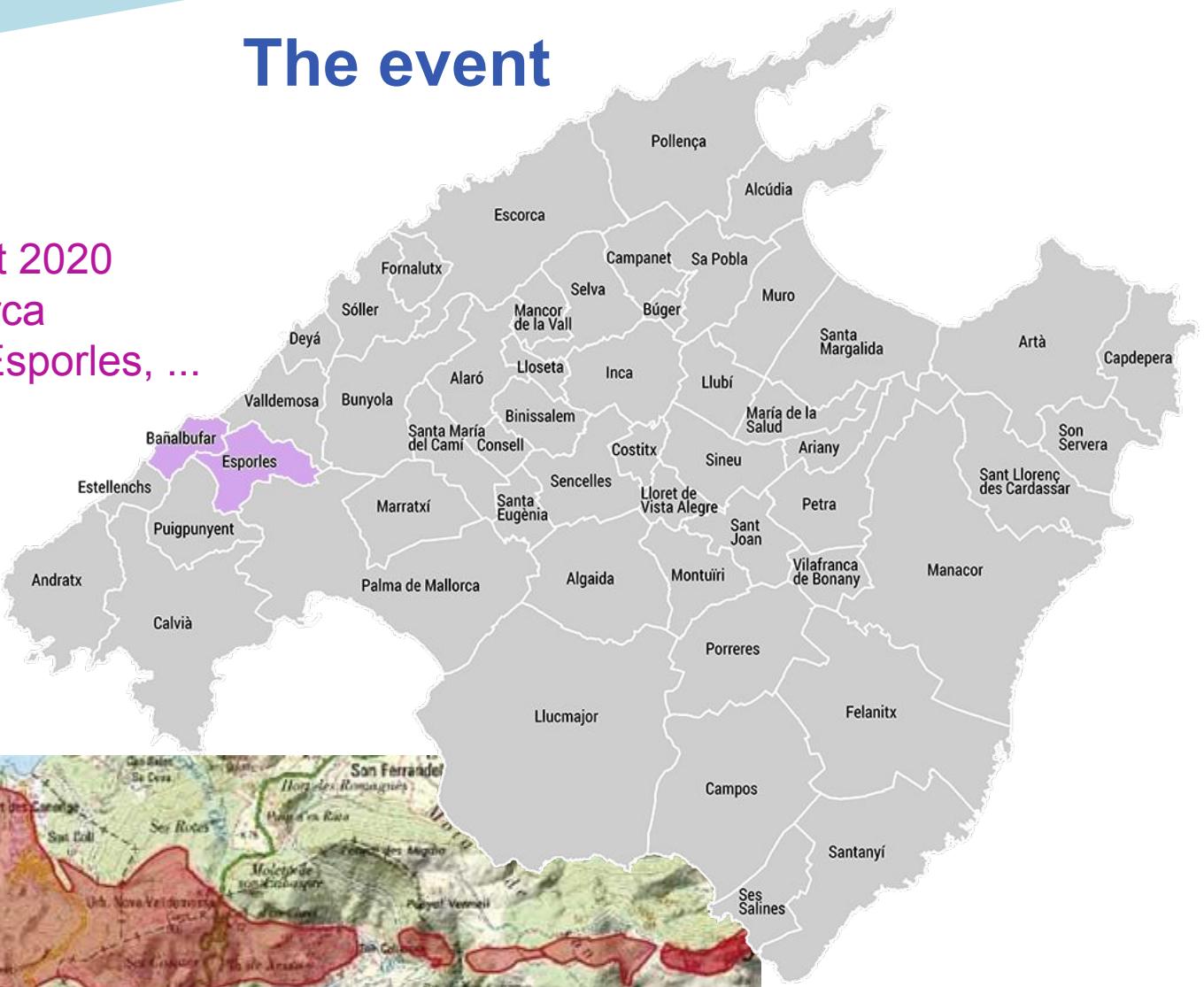
Port des Canonge 29-08-2020

Foto facilitada por la Guardia Civil de Baleares



The event

29 August 2020
Mallorca
Banyalfubar, Esporles, ...

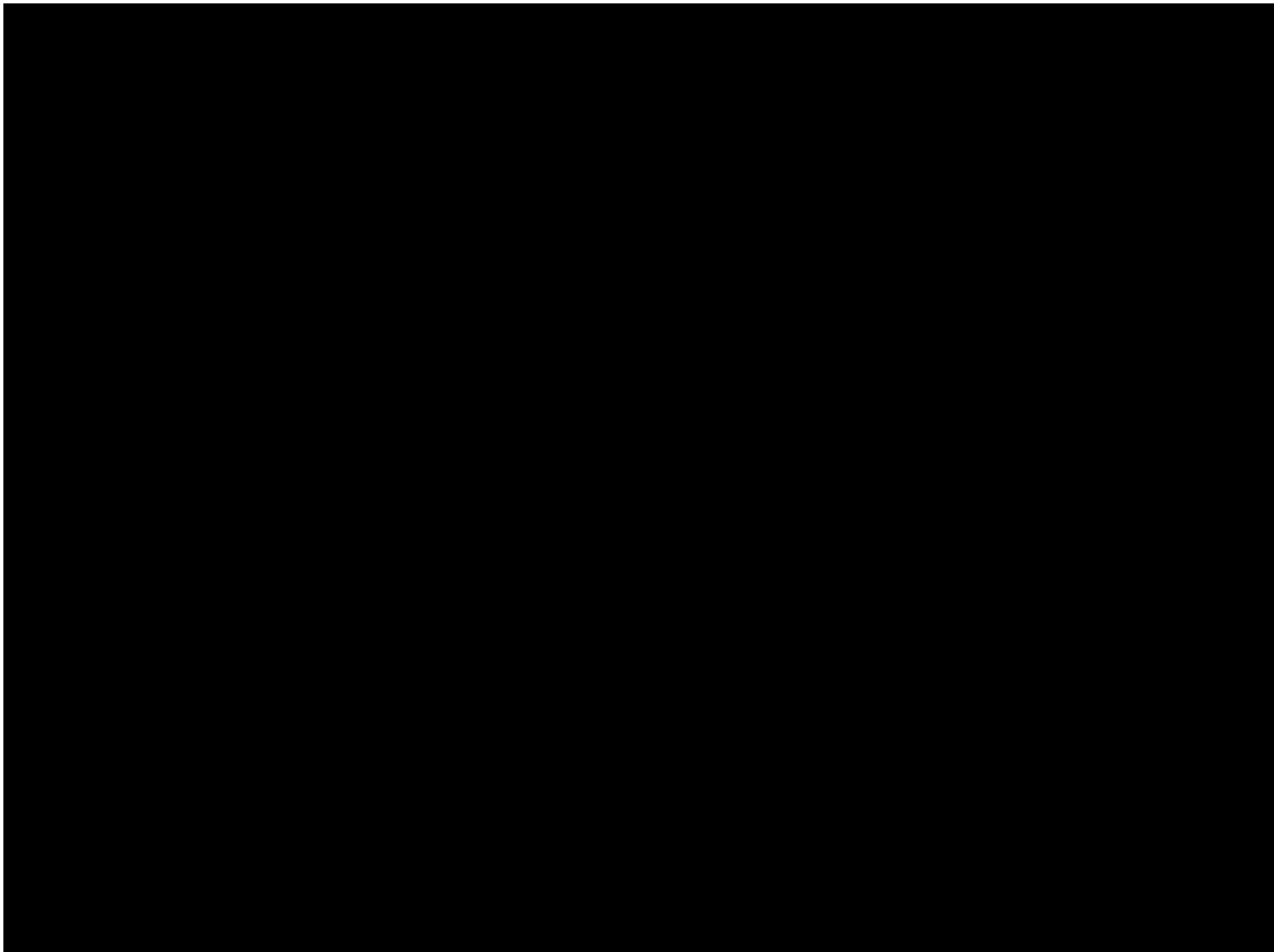


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The event

Infrared

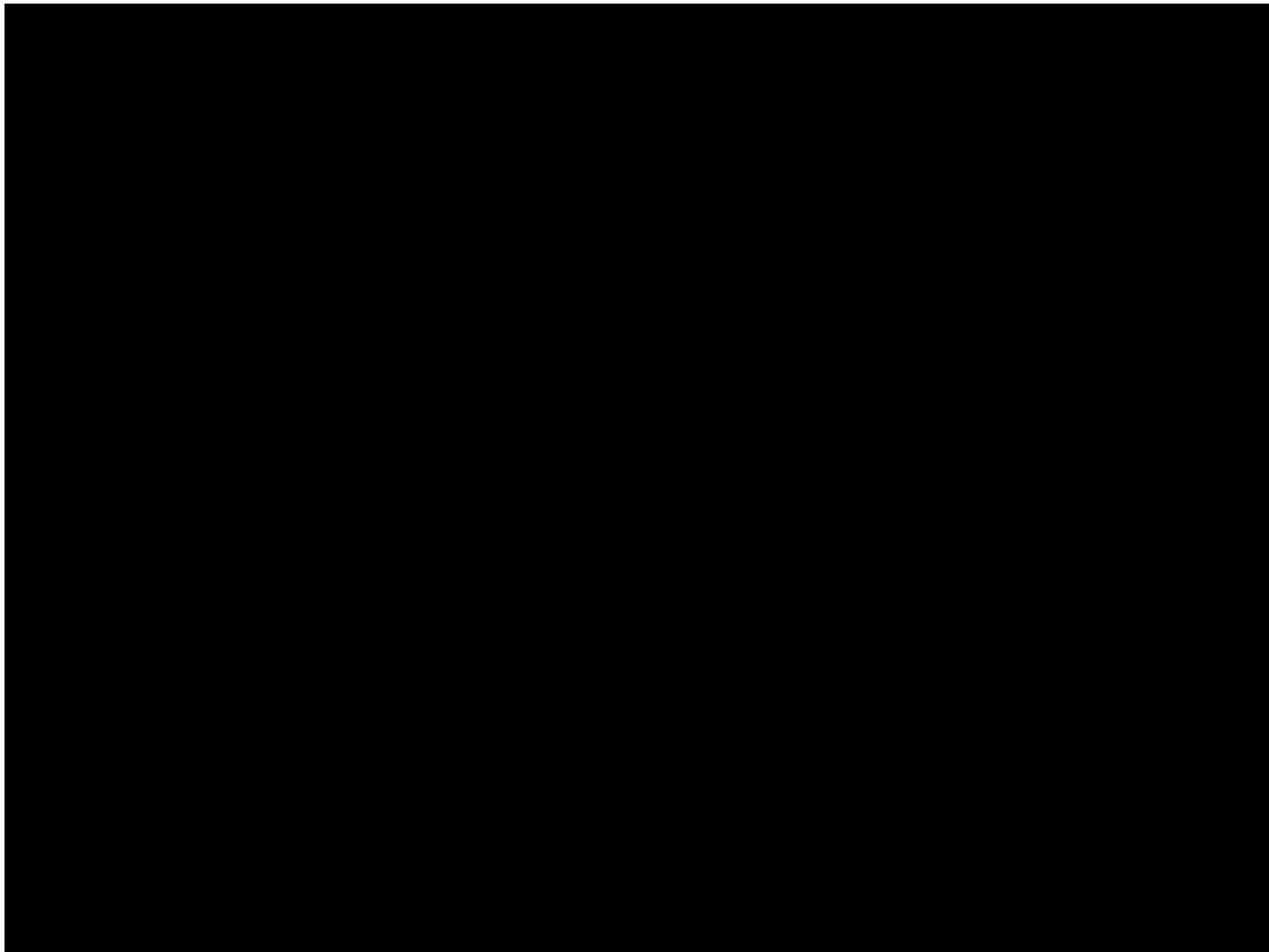


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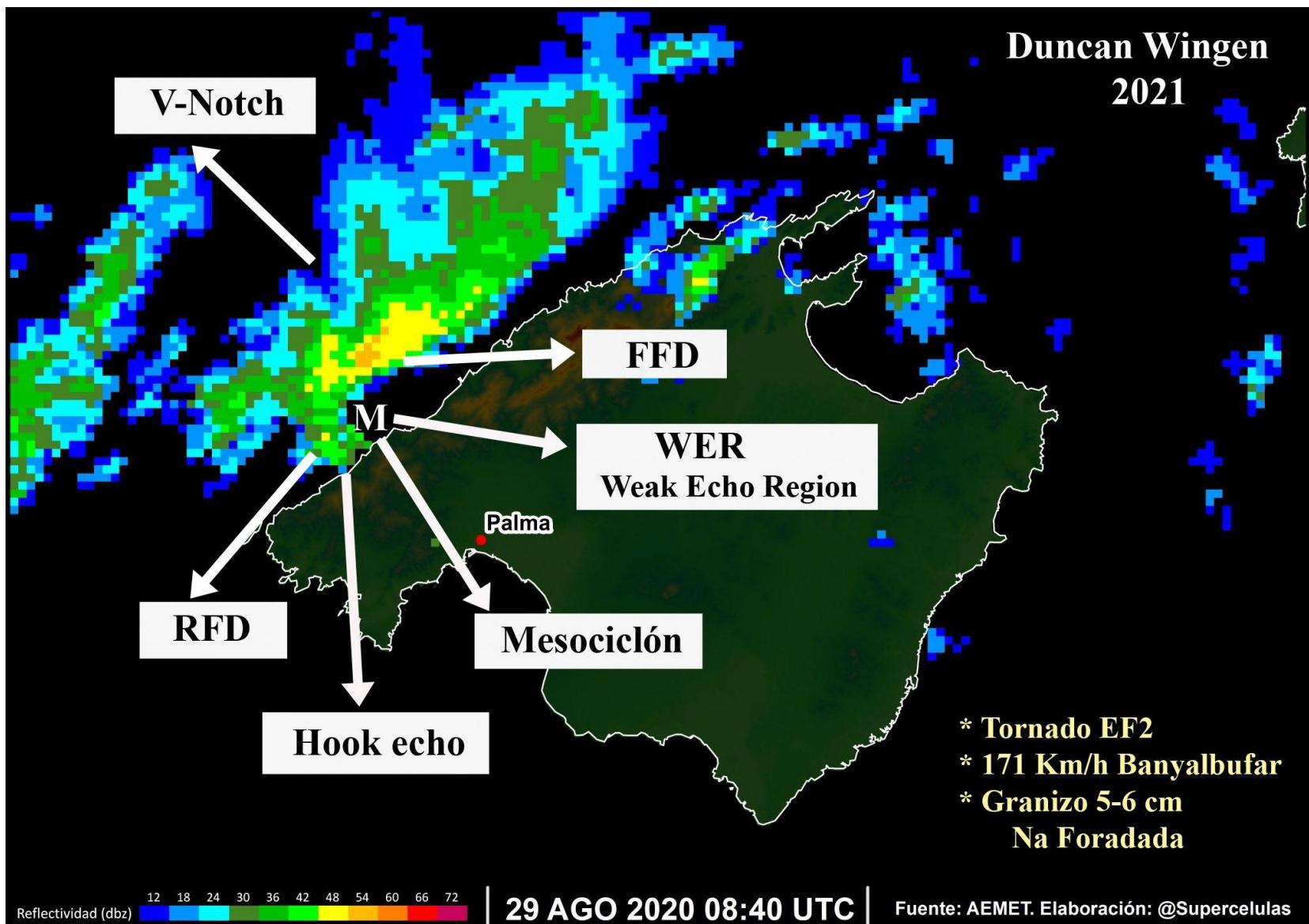
The event

Radar

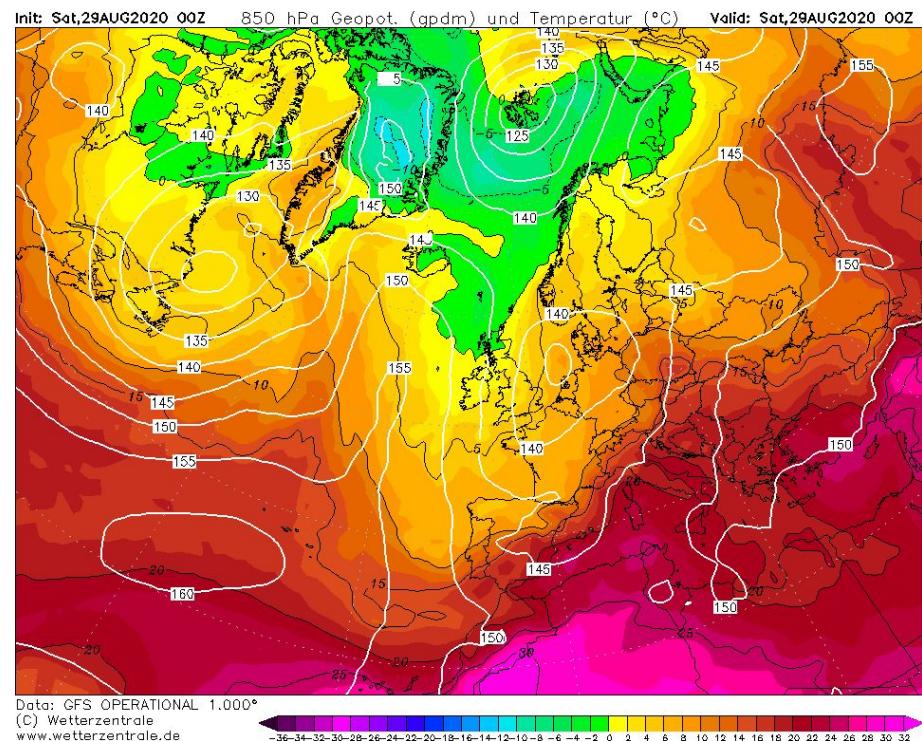
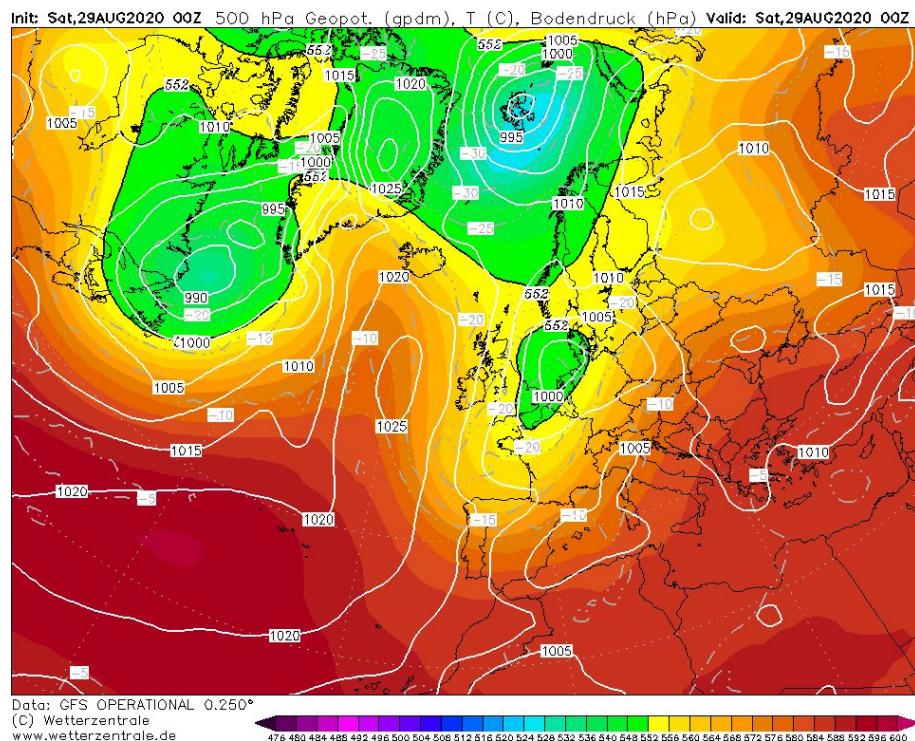


The event

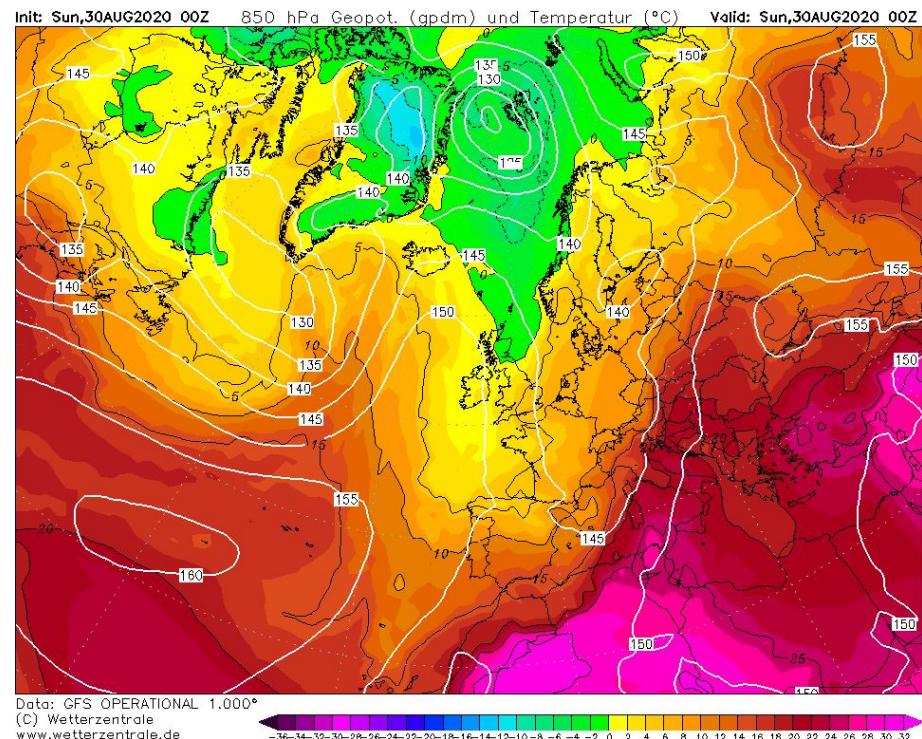
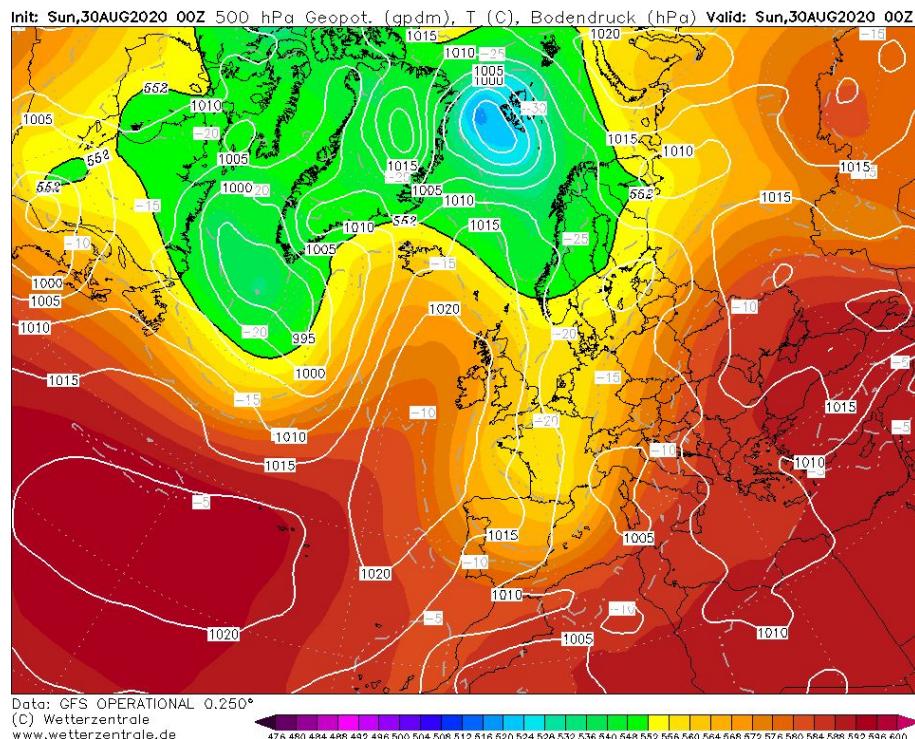
Radar



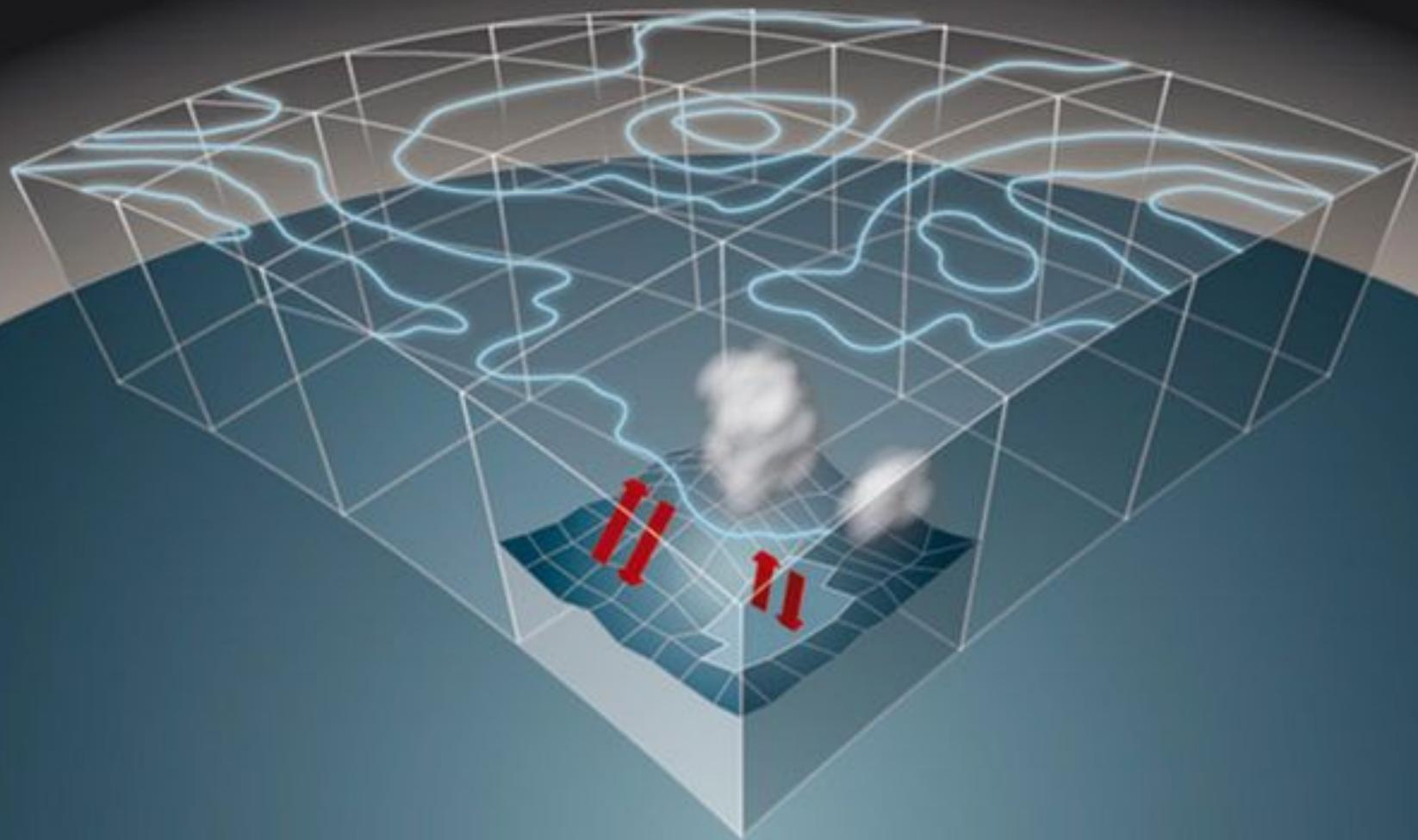
The event



The event



The model



The model

CM1

Created by George Bryan (NCAR)

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 (e.g. warm bubble, cold blob, forced convergence)

Benefits of using CM1

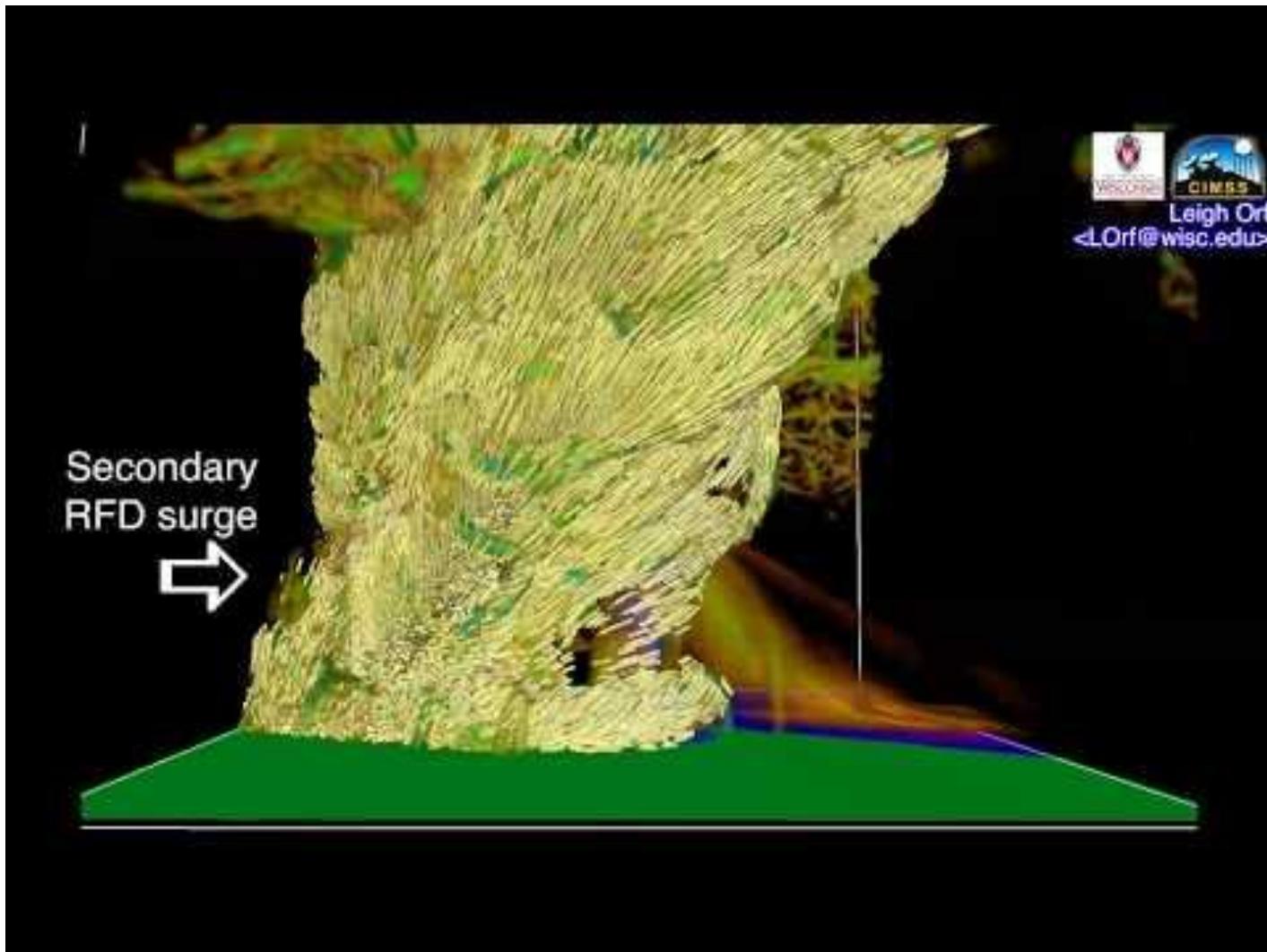
Conserves mass and energy better than others modern cloud models

Faster and uses less memory than other models for idealized studies

Very flexible, can be used for a large variety of studies

The model

CM1



The model

CM1

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 hr)

Large time step: 6 s

Domain x-motion: 5 m/s

Domain y-motion: 0 m/s

The model

CM1

Initialization:

warm bubble

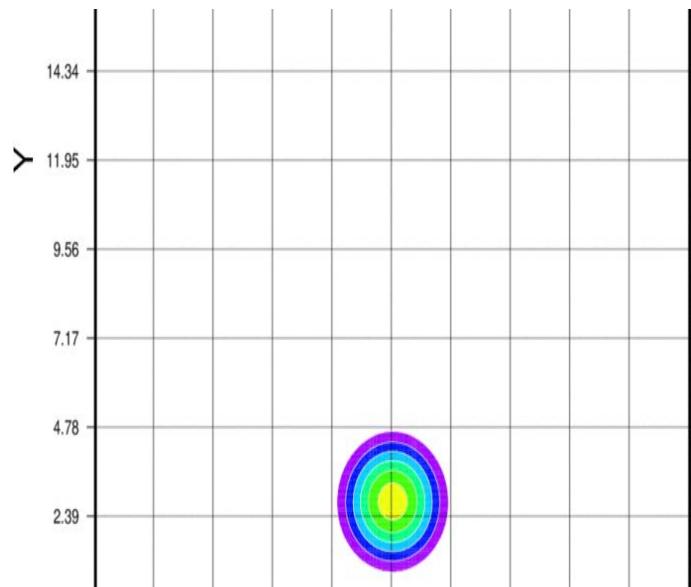
10 km horizontal radius

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

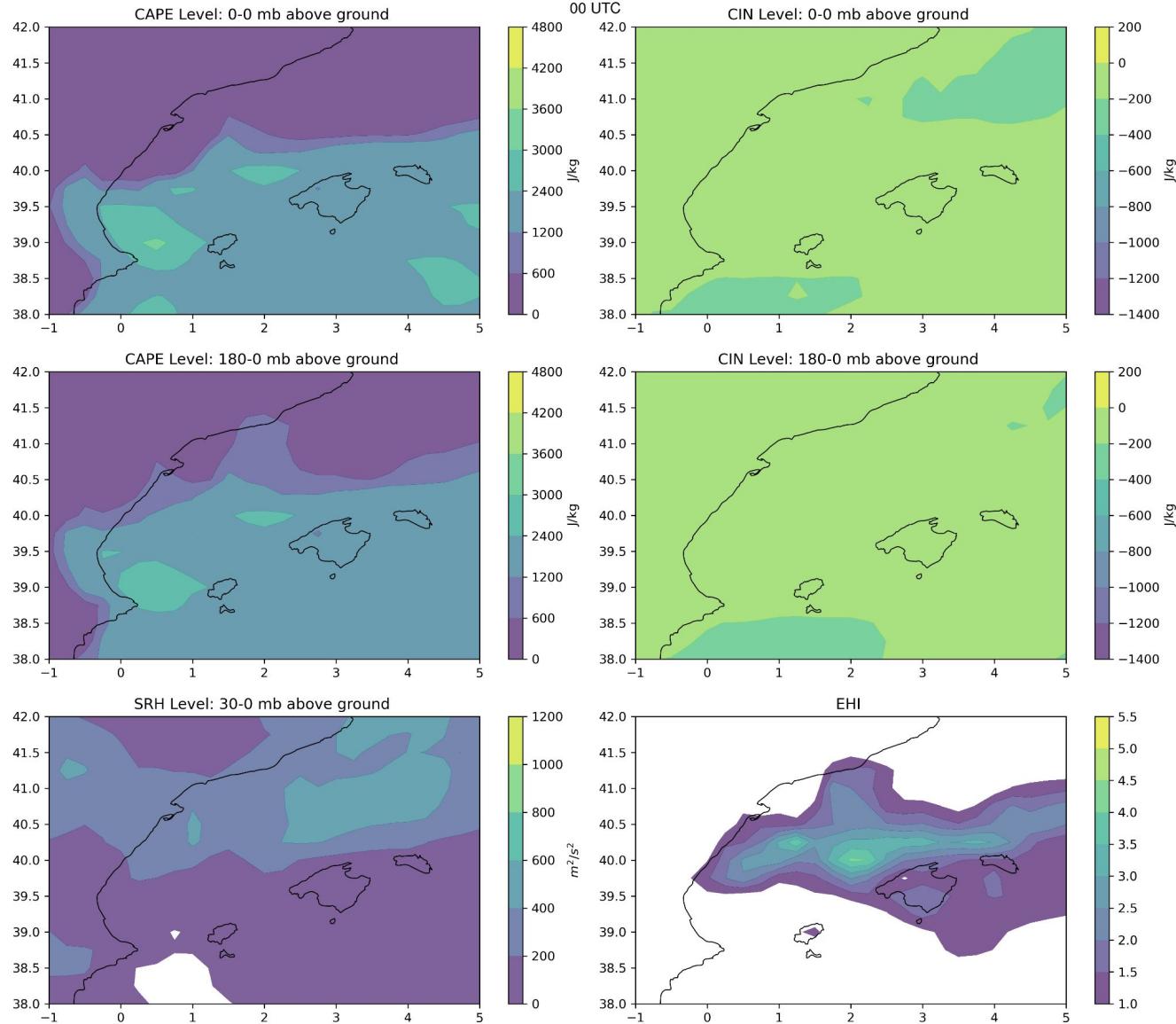


http://aaron.boone.free.fr/asp_tests.html

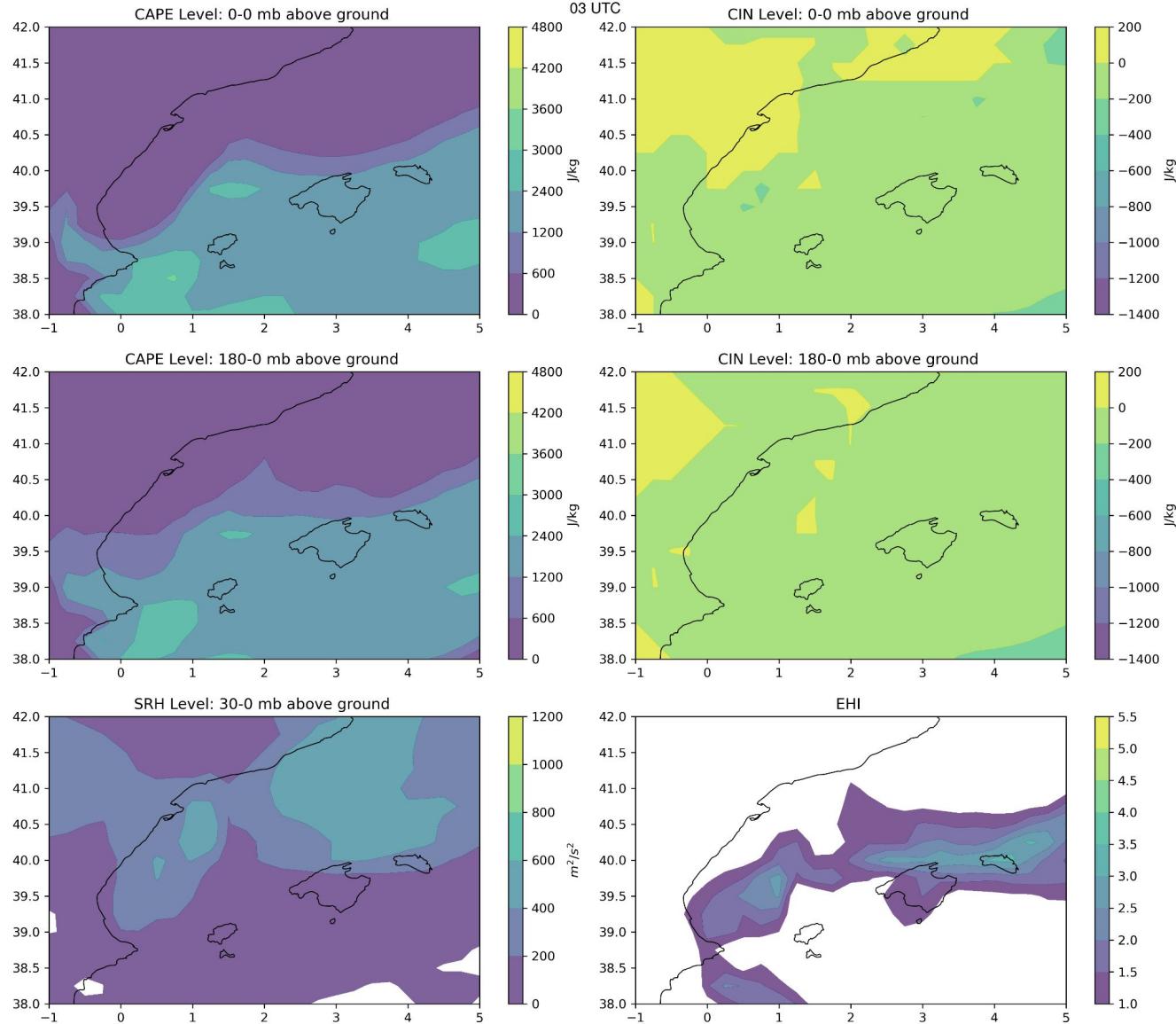
The experiment

```
Building diversion of /boot/fixup_cd.dat to /usr/share/rpikernelhack/fixup_cd.dat ...
Building diversion of /boot/fixup_db.dat to /usr/share/rpikernelhack/fixup_db.dat ...
Building diversion of /boot/fixup_x.dat to /usr/share/rpikernelhack/fixup_x.dat ...
Building diversion of /boot/bootcode.bin to /usr/share/rpikernelhack/bootcode.bin ...
Building diversion of /boot/start4.elf to /usr/share/rpikernelhack/start4.elf ...
Building diversion of /boot/start4cd.elf to /usr/share/rpikernelhack/start4cd.elf ...
Building diversion of /boot/start4db.elf to /usr/share/rpikernelhack/start4db.elf ...
Building diversion of /boot/start4x.elf to /usr/share/rpikernelhack/start4x.elf ...
Building diversion of /boot/fixup4.dat to /usr/share/rpikernelhack/fixup4.dat ...
Building diversion of /boot/fixup4cd.dat to /usr/share/rpikernelhack/fixup4cd.dat ...
Building diversion of /boot/fixup4db.dat to /usr/share/rpikernelhack/fixup4db.dat ...
Building diversion of /boot/fixup4x.dat to /usr/share/rpikernelhack/fixup4x.dat ...
Adding diversion of /boot/LICENCE.broadcom to /usr/share/rpikernelhack/LICENCE ...
Unpacking raspberrypi-bootloader (1.20201201-1) over (1.20201201-1) ...
Preparing to unpack .../18-libxml2_2.9.4+dfsg1-7+deb10u1_armhf.deb ...
Unpacking libxml2:armhf (2.9.4+dfsg1-7+deb10u1) over (2.9.4+dfsg1-7+deb10u1) ...
Preparing to unpack .../19-plexmediaserver_1.21.0.3711-b509cc236_armhf.deb ...
plexmediaserver install: Pre-installation Validation.
plexmediaserver install: Pre-installation Validation.
Unpacking plexmediaserver (1.21.0.3711-b509cc236) over (1.21.0.3711-b509cc236) ...
Getting up bluez-firmware (1.2-4+rpt7) ...
Getting up libpulse0:armhf (12.2-4+deb10u1+rpi2) ...
Getting up nistro-info-data (0.41+deb10u3) ...
Getting up atheros (1:20190114-1+rpt10) ...
Getting up free (1:20190114-1+rpt10) ...
(trigger activated)
Unpacking plexmediaserver (1.21.0.3711-b509cc236) ...
plexmediaserver install: Pre-installation Validation.
```

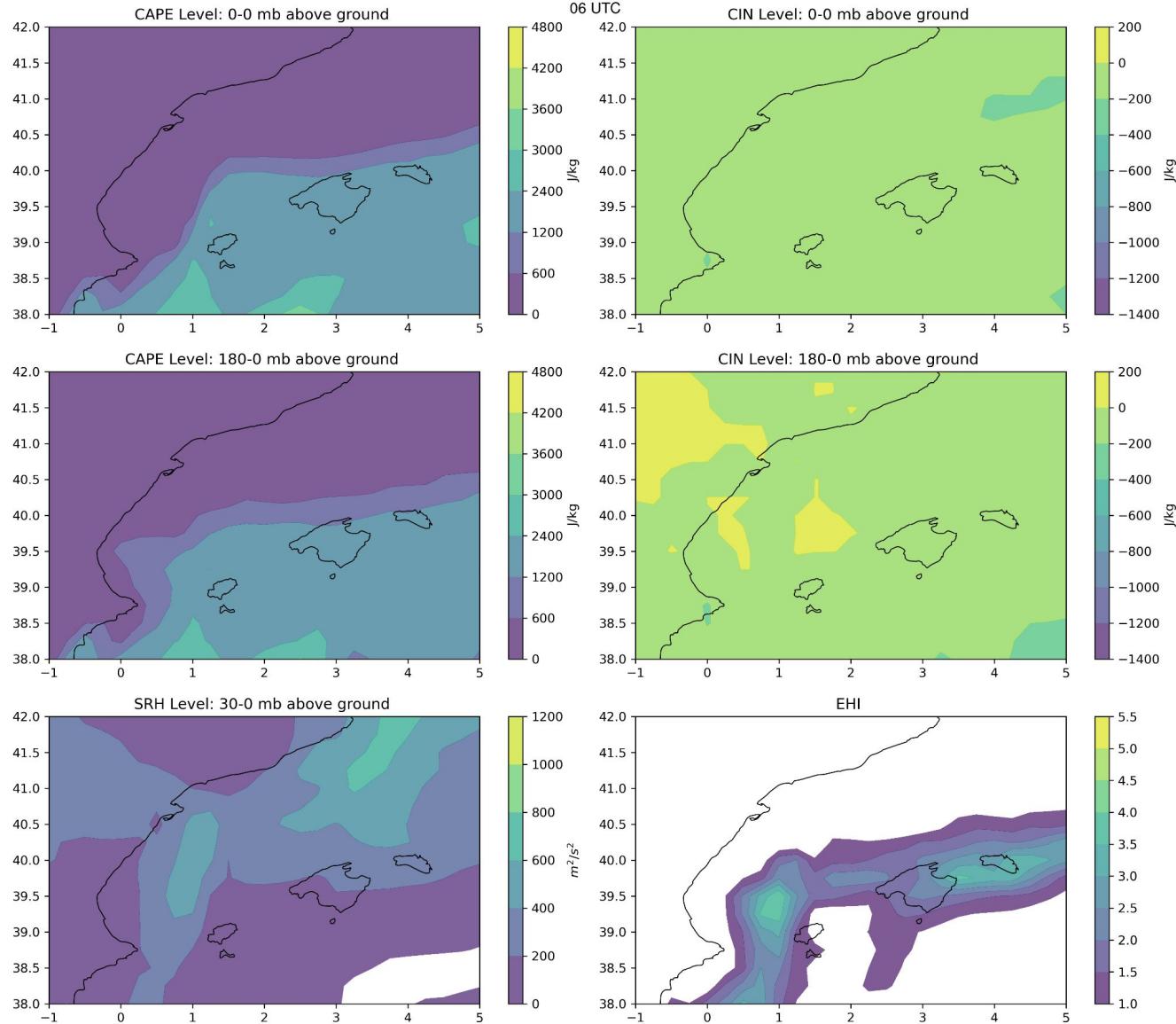
The experiment



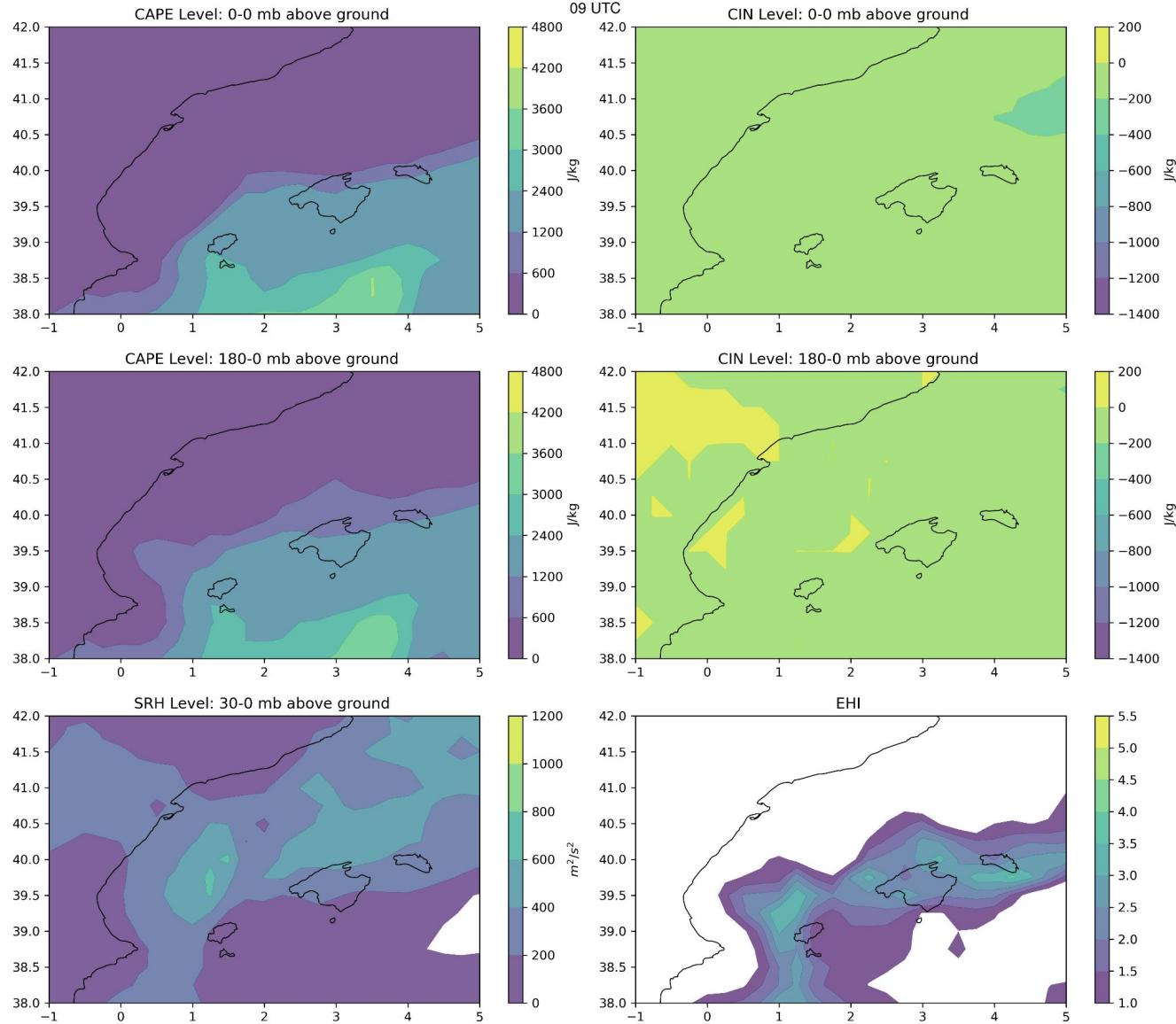
The experiment



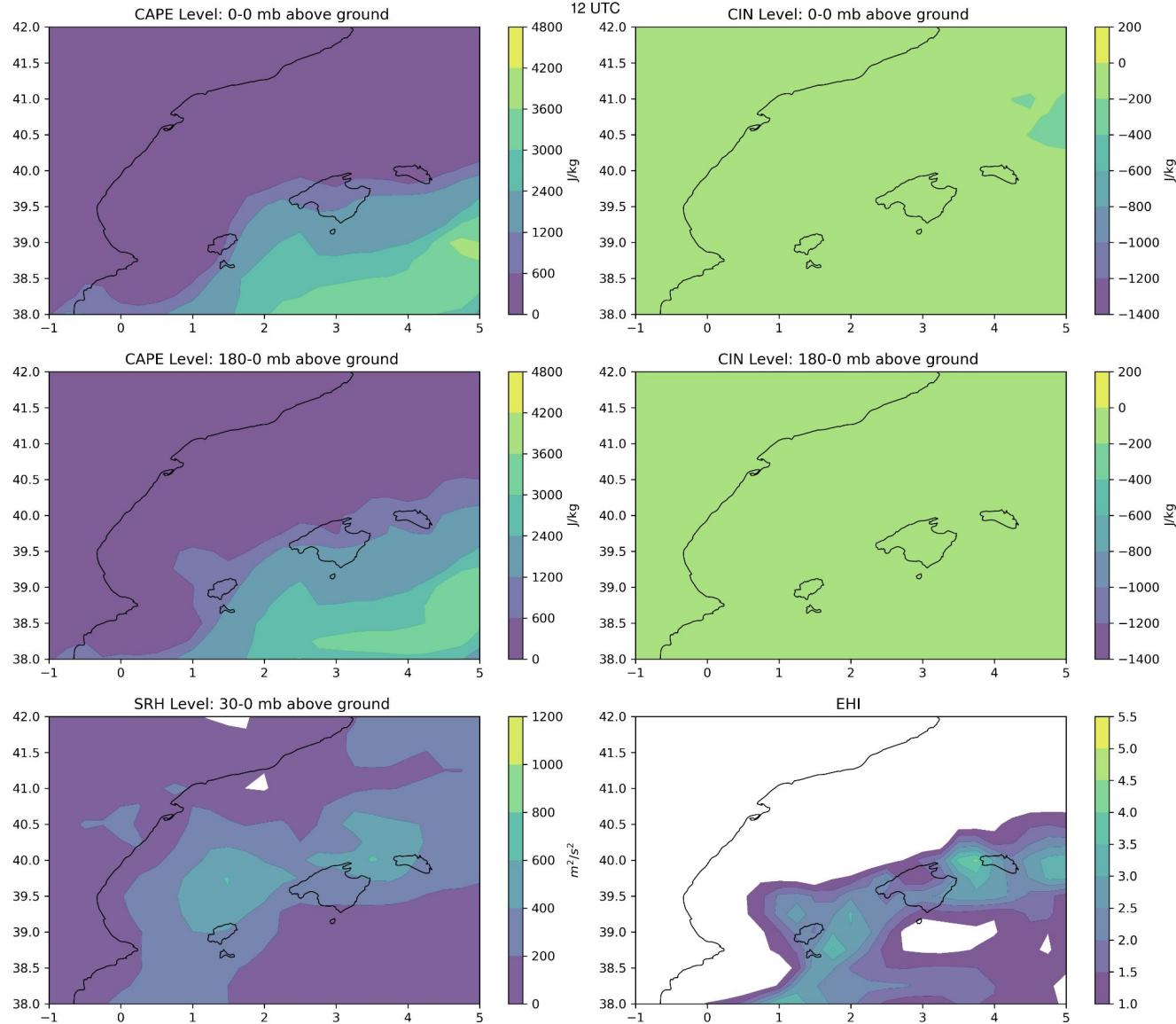
The experiment



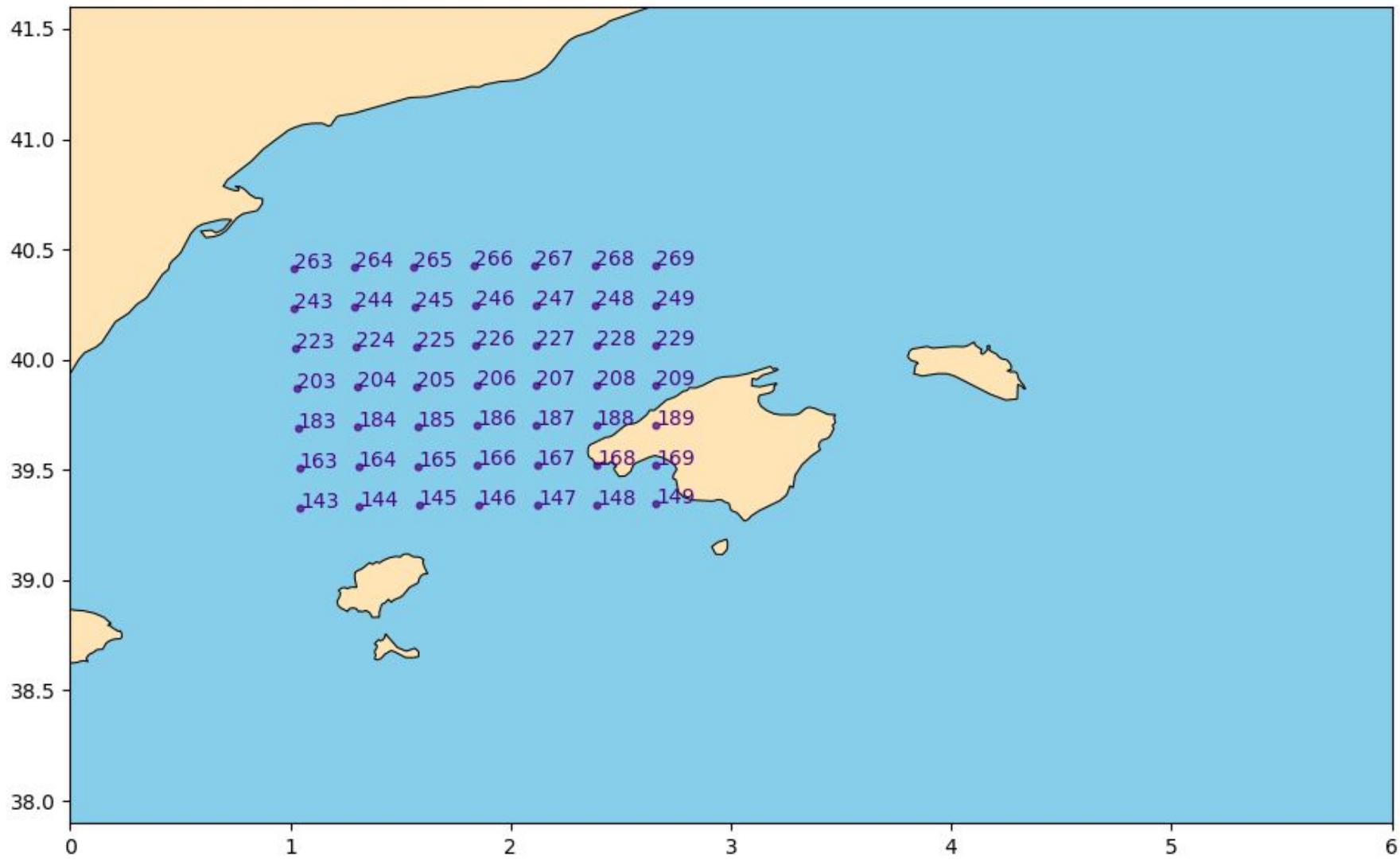
The experiment



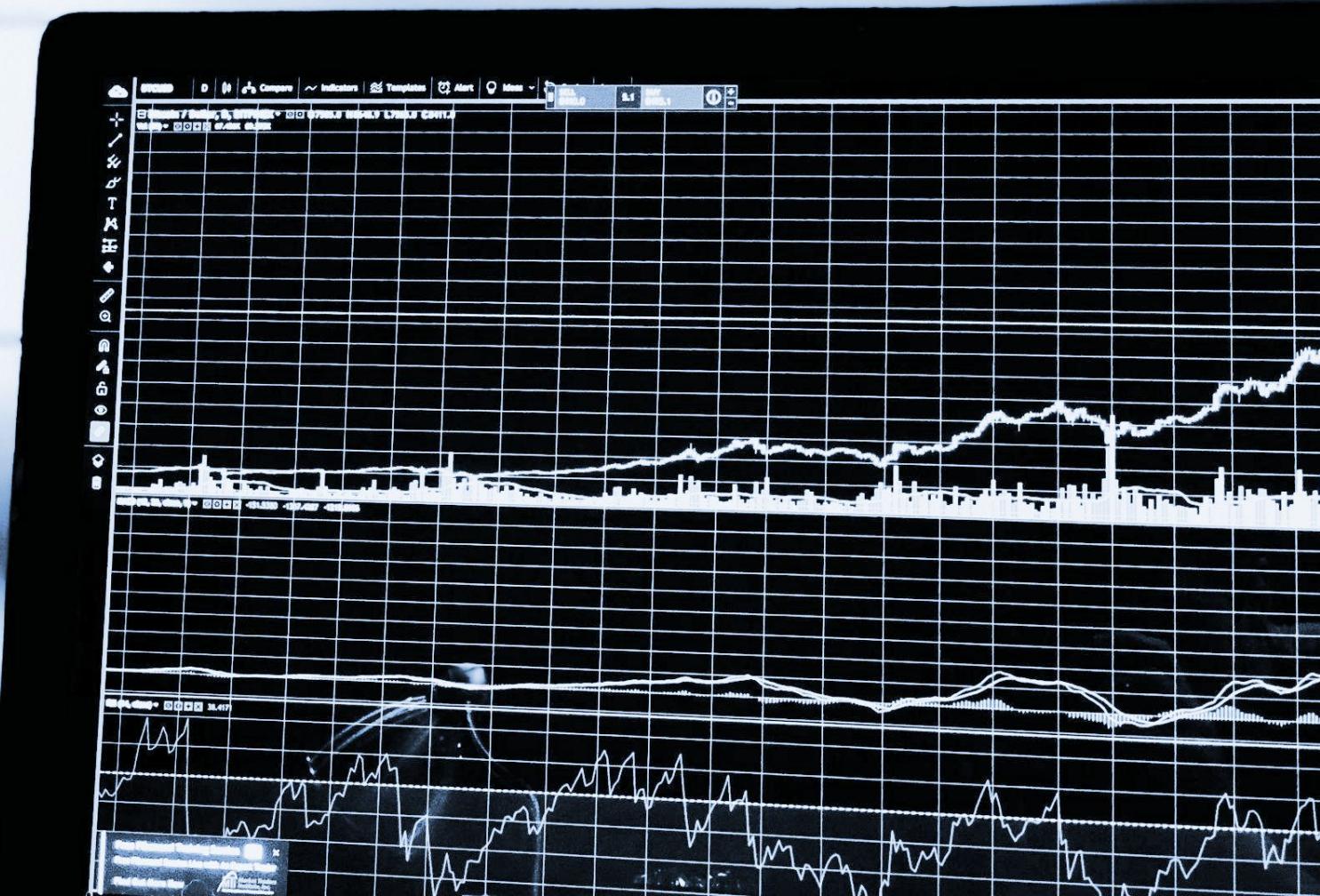
The experiment



The experiment



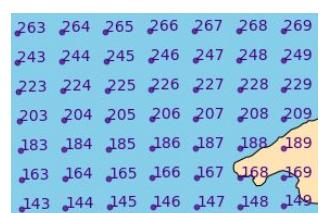
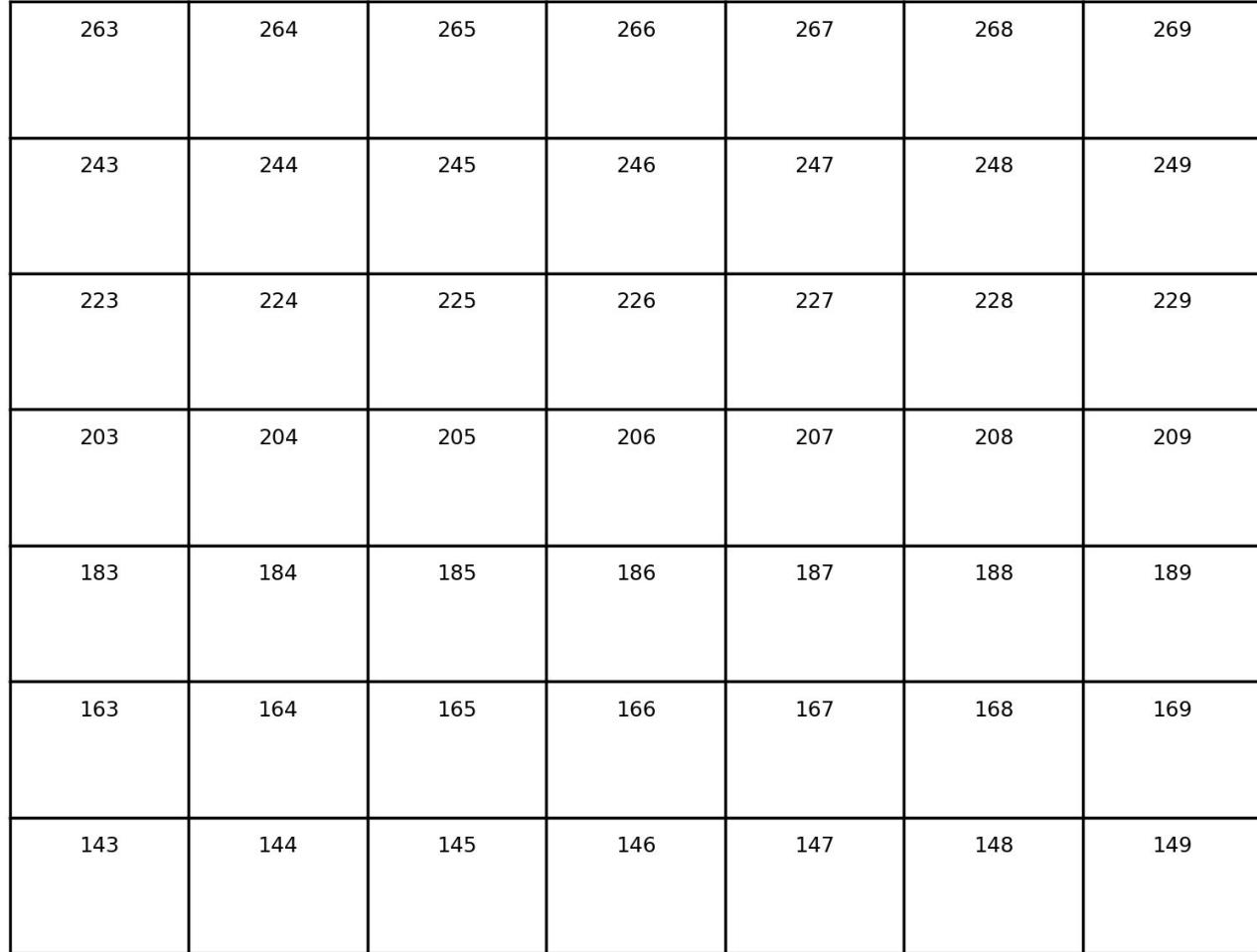
The results



The results

03 UTC

DBZ MAX - 0 minutes

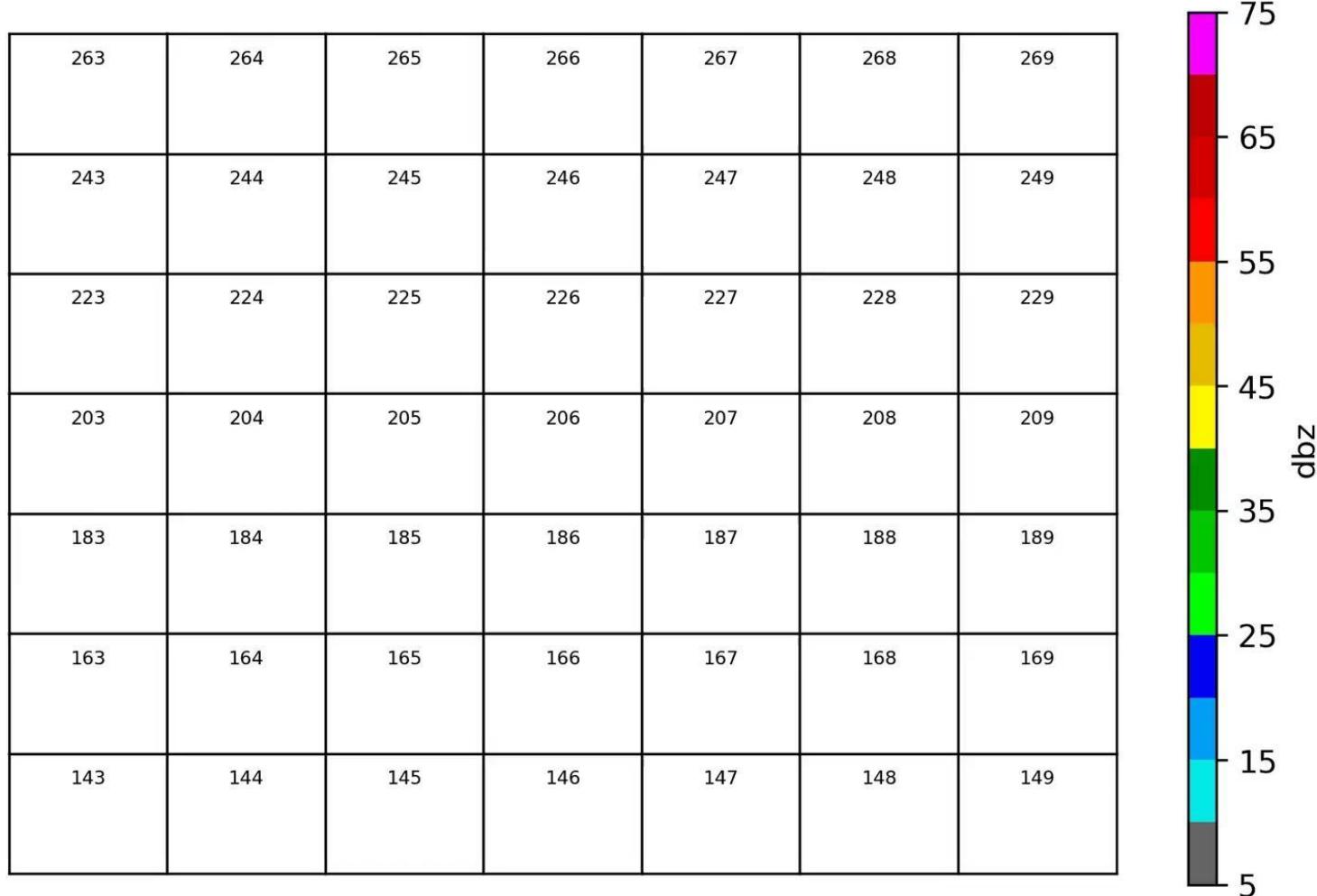


The results

03 UTC



DBZ MAX - 0 minutes

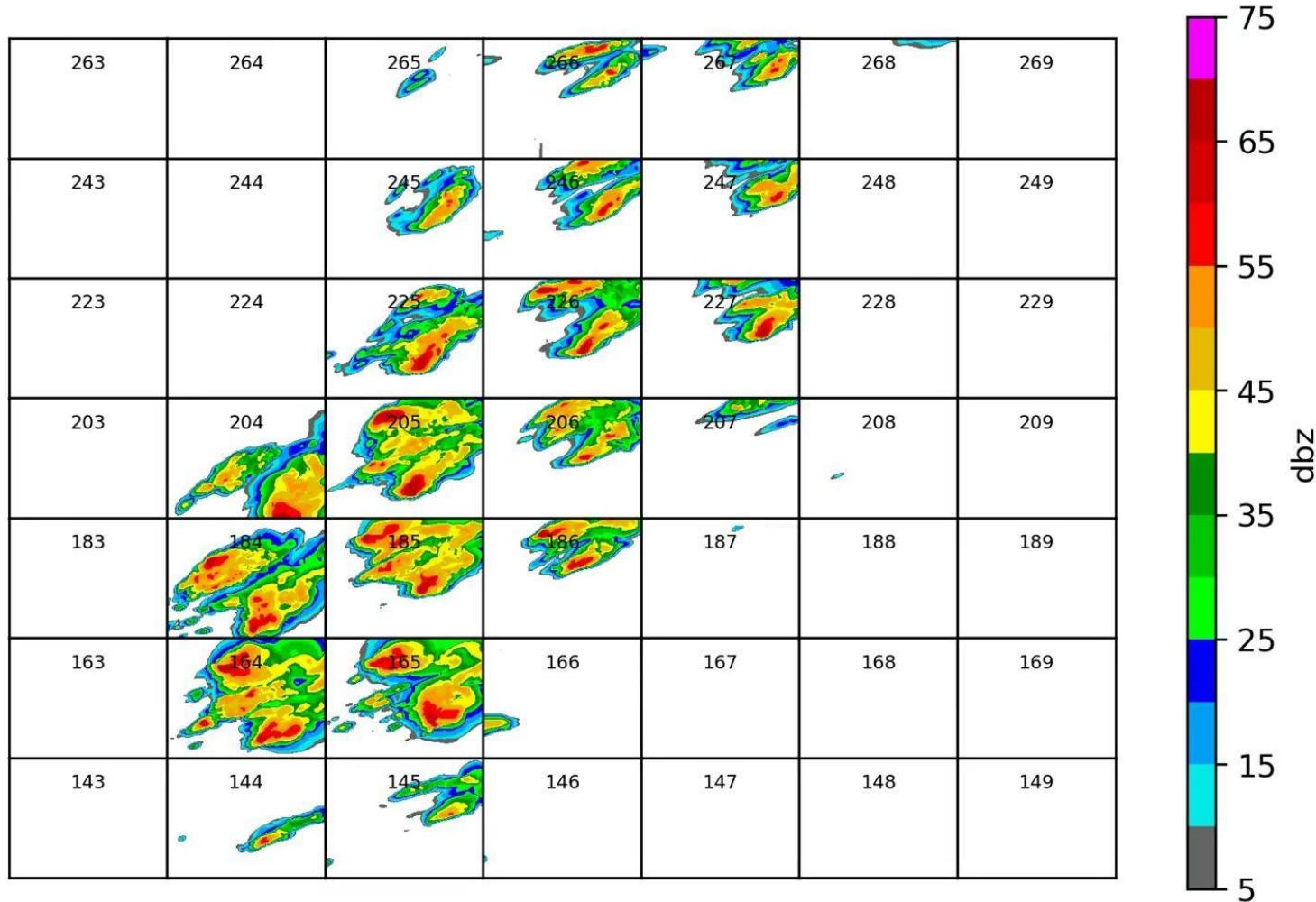


The results

06 UTC

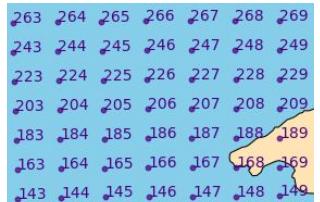
263 264 265 266 267 268 269
243 244 245 246 247 248 249
223 224 225 226 227 228 229
203 204 205 206 207 208 209
183 184 185 186 187 188 189
163 164 165 166 167 168 169
143 144 145 146 147 148 149

DBZ MAX - 160 minutes

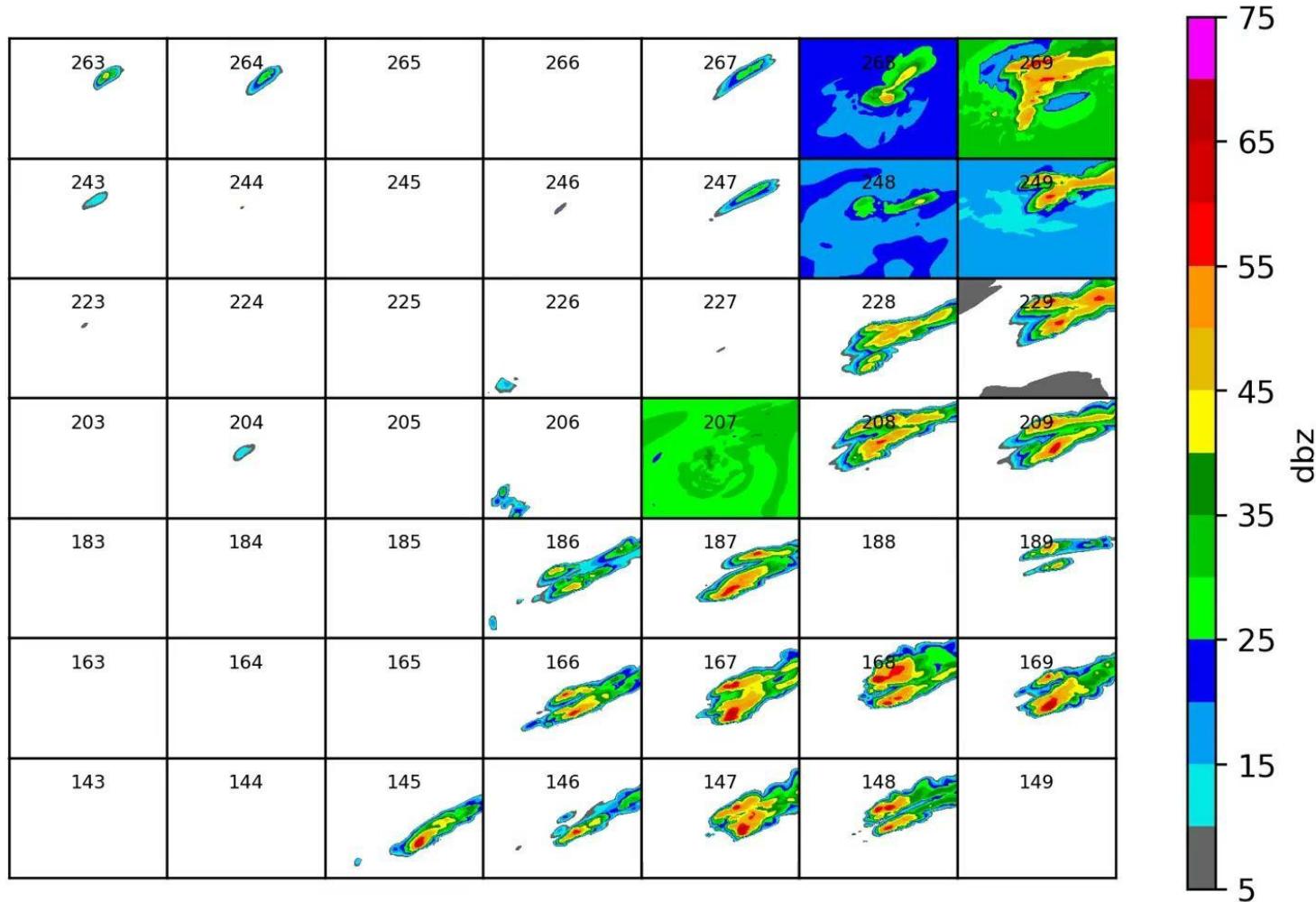


The results

09 UTC

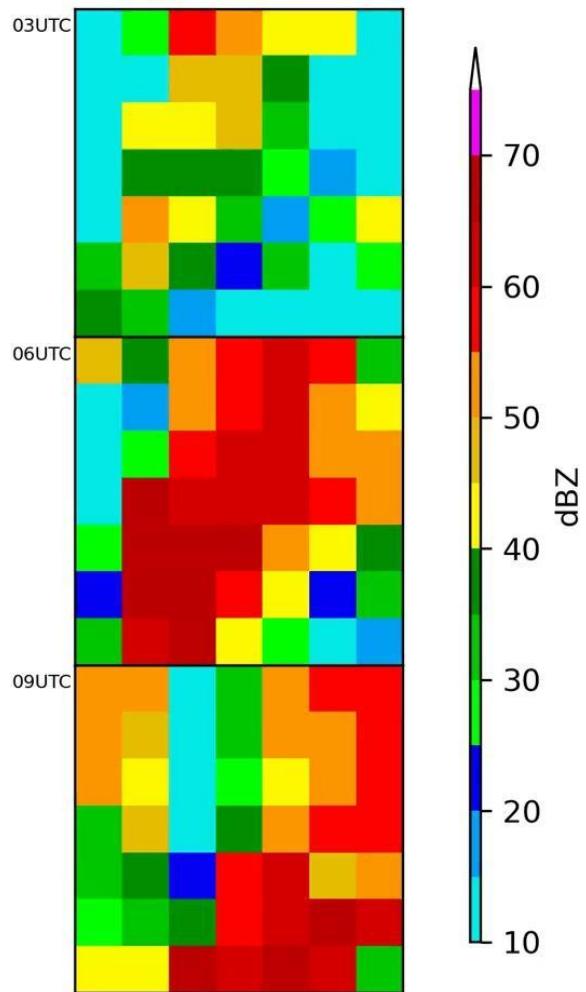


DBZ MAX - 90 minutes

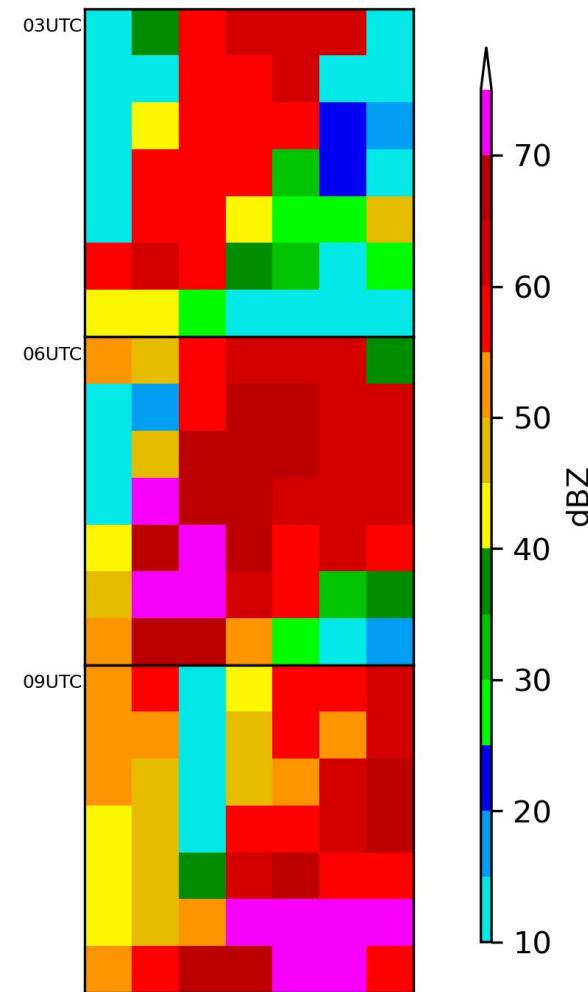


The results

GFS - tram 1h - t: 50 minutes
max composite reflectivity



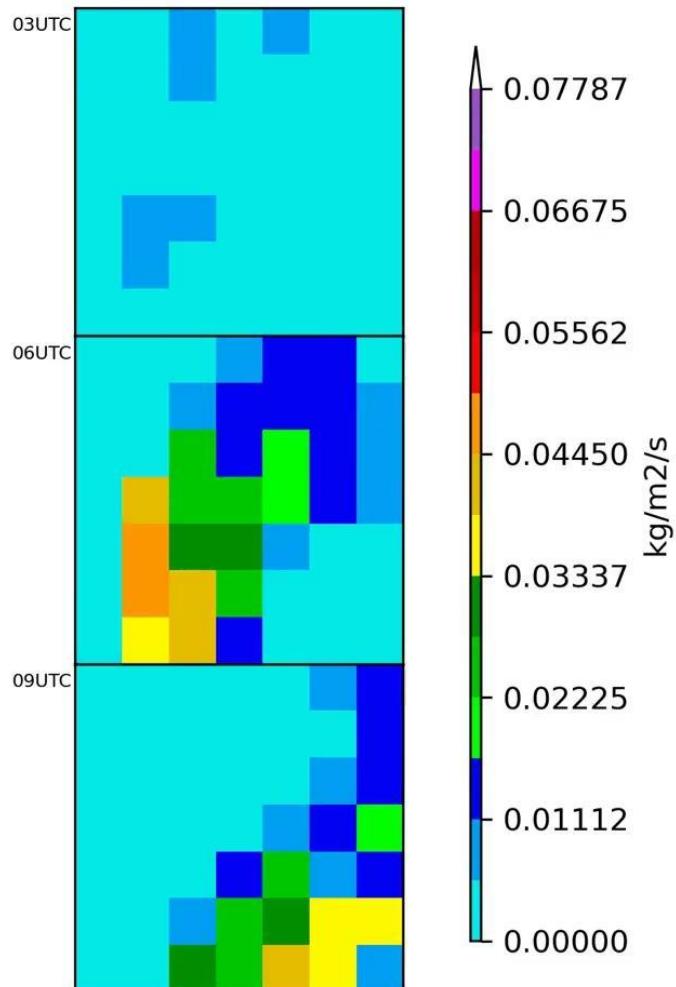
GFS - tram 1h - MAX
max composite reflectivity



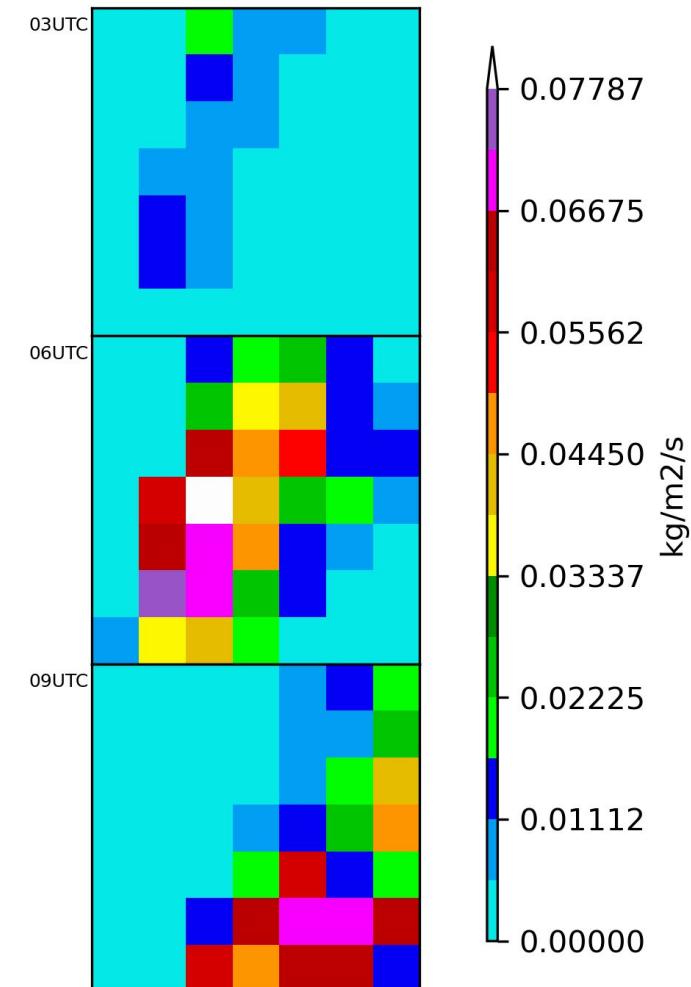
263 264 265 266 267 268 269
243 244 245 246 247 248 249
223 224 225 226 227 228 229
203 204 205 206 207 208 209
183 184 185 186 187 188 189
163 164 165 166 167 168 169
143 144 145 146 147 148 149

The results

GFS - tram 1h - t: 40 minutes
surface precipitation rate



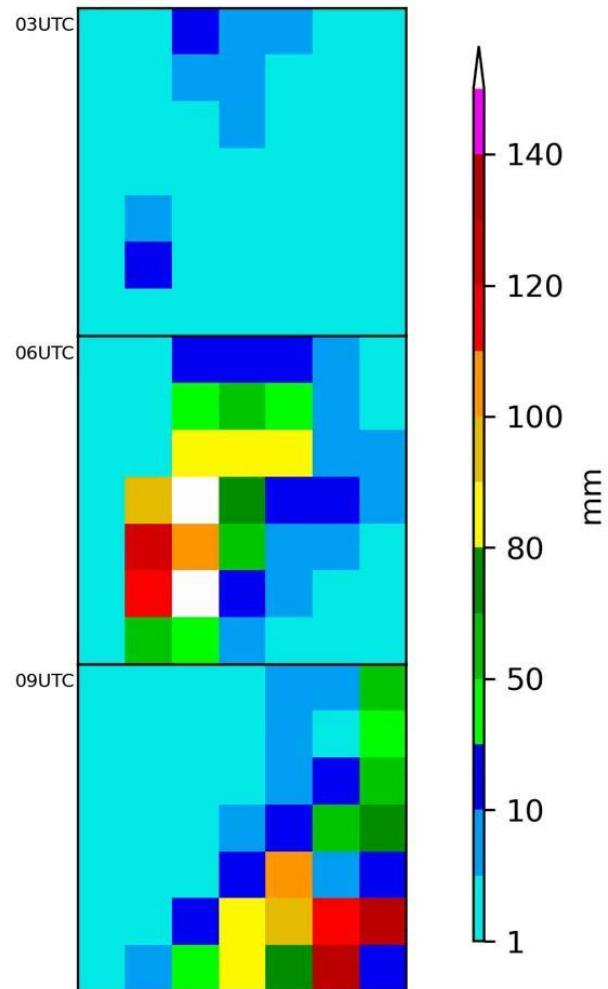
GFS - tram 1h - MAX
surface precipitation rate



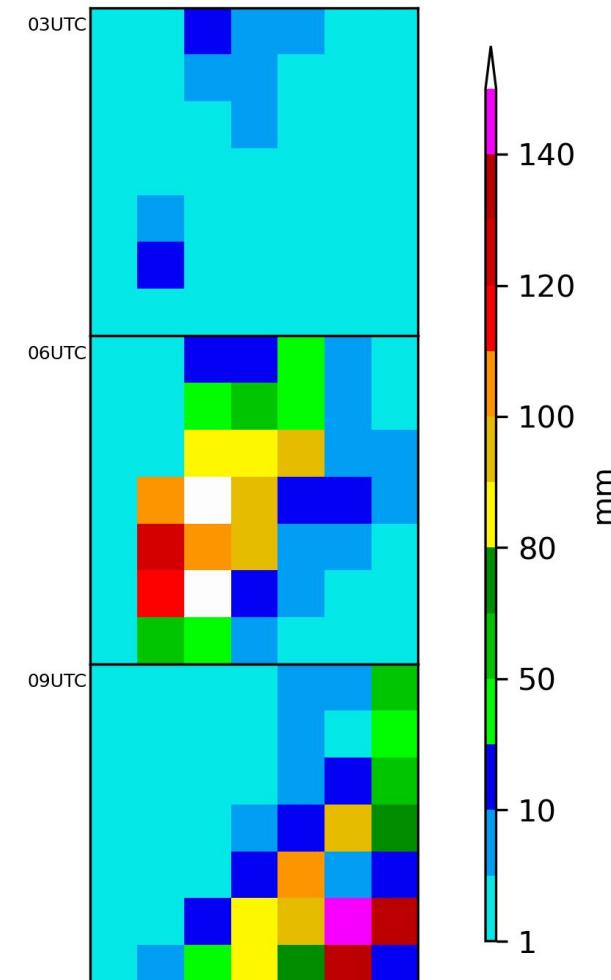
263 264 265 266 267 268 269
243 244 245 246 247 248 249
223 224 225 226 227 228 229
203 204 205 206 207 208 209
183 184 185 186 187 188 189
163 164 165 166 167 168 169
143 144 145 146 147 148 149

The results

GFS - tram 1h - t: 150 minutes
accumulated surface rainfall



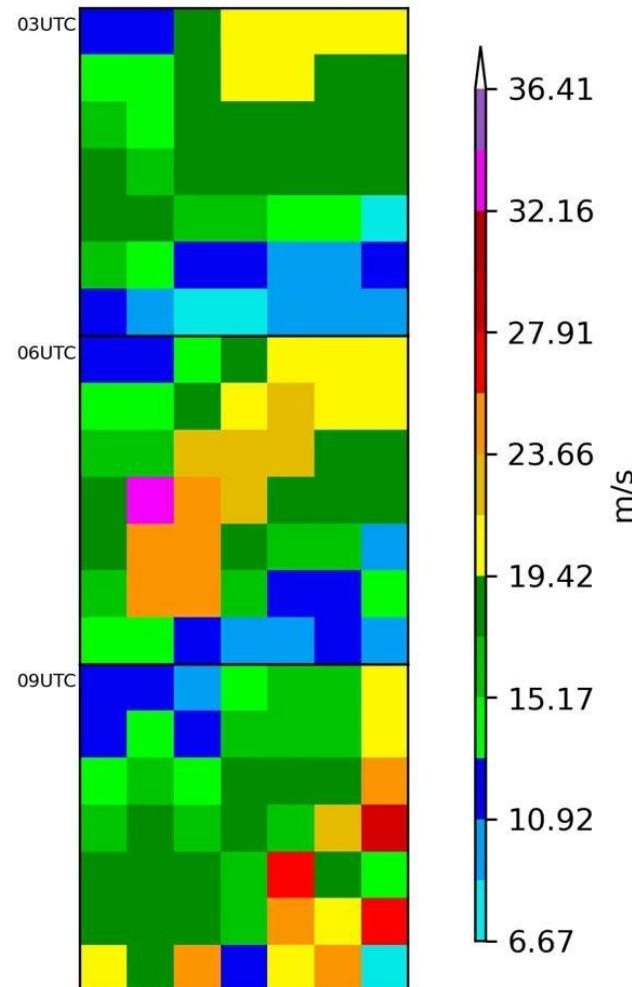
GFS - tram 1h - MAX
accumulated surface rainfall



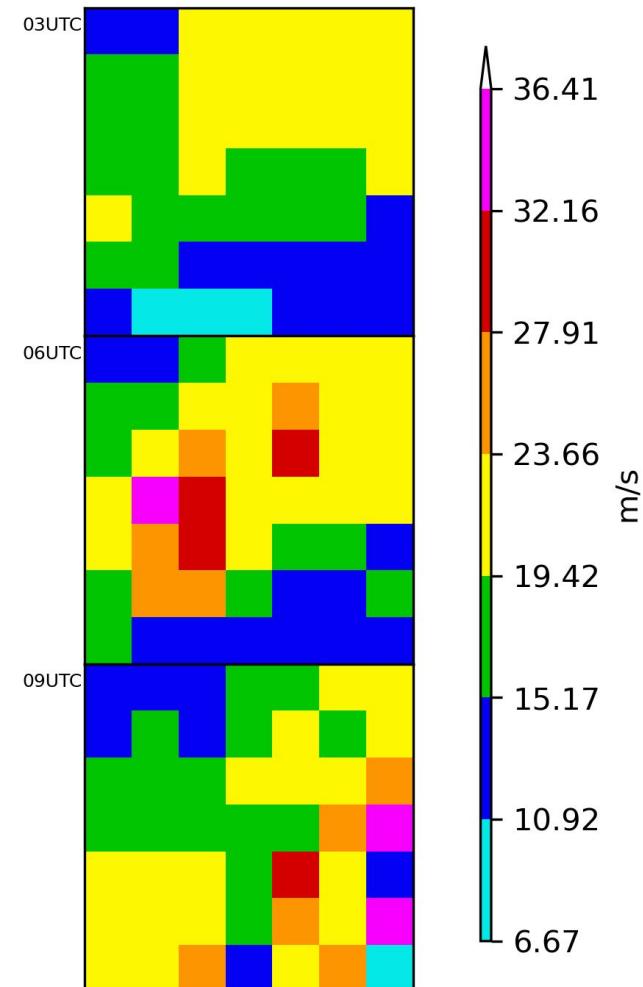
263 264 265 266 267 268 269
243 244 245 246 247 248 249
223 224 225 226 227 228 229
203 204 205 206 207 208 209
183 184 185 186 187 188 189
163 164 165 166 167 168 169
143 144 145 146 147 148 149

The results

GFS - tram 1h - t: 150 minutes
max wind at surface



GFS - tram 1h - MAX
max wind at surface

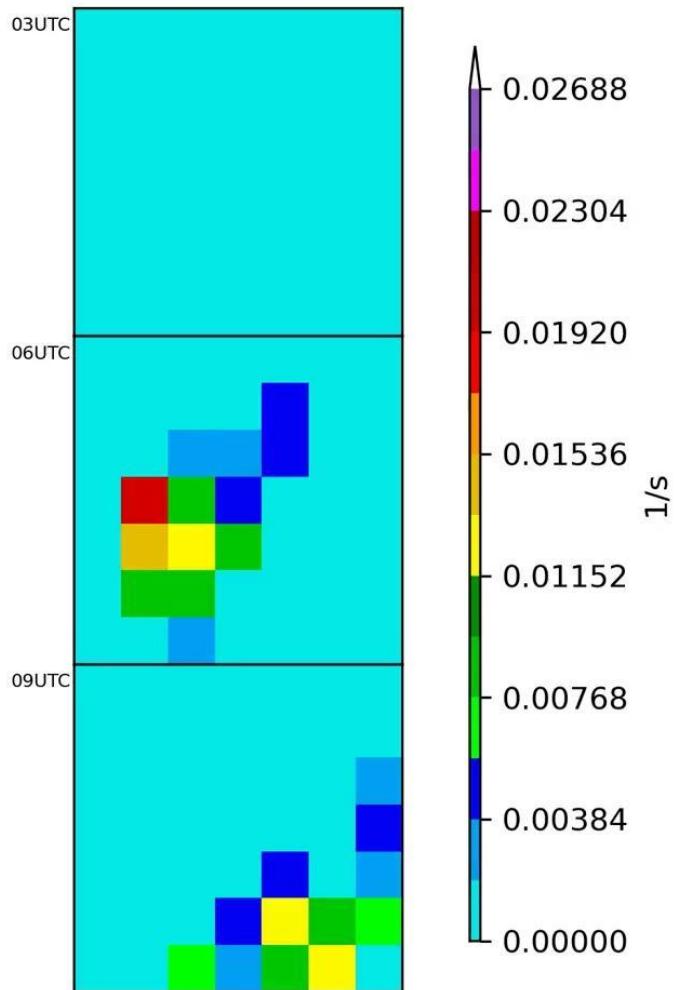


263	264	265	266	267	268	269
243	244	245	246	247	248	249
223	224	225	226	227	228	229
203	204	205	206	207	208	209
183	184	185	186	187	188	189
163	164	165	166	167	168	169
143	144	145	146	147	148	149

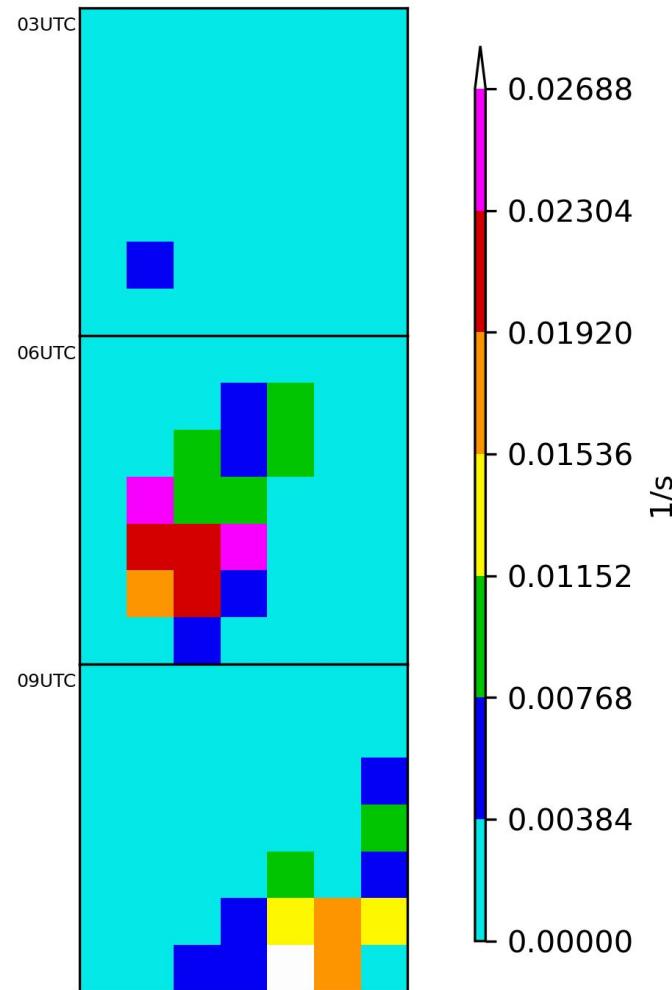
263 264 265 266 267 268 269
243 244 245 246 247 248 249
223 224 225 226 227 228 229
203 204 205 206 207 208 209
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163 164 165 166 167 168 169
143 144 145 146 147 148 149

The results

GFS - tram 1h - t: 140 minutes
max vert vorticity at lowest model level

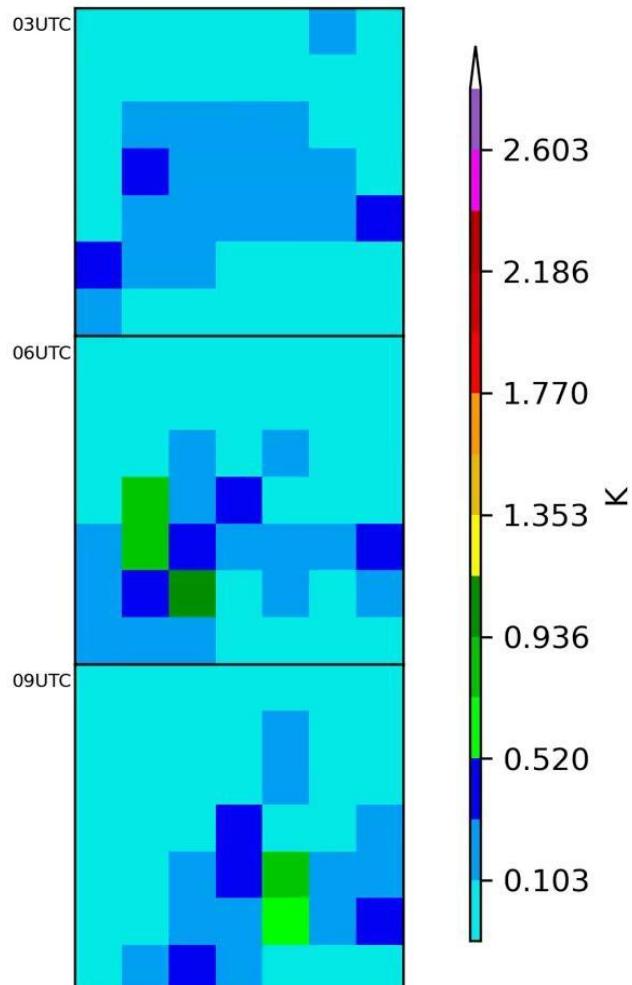


GFS - tram 1h - MAX
max vert vorticity at lowest model level

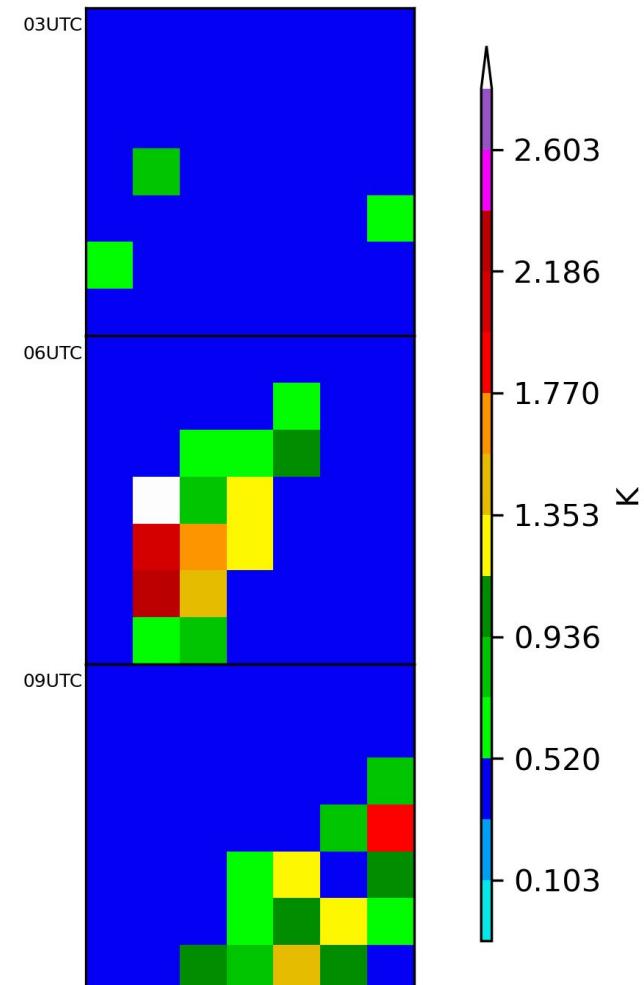


The results

GFS - tram 1h - t: 90 minutes
max pot. temp. pert. at lowest model lev



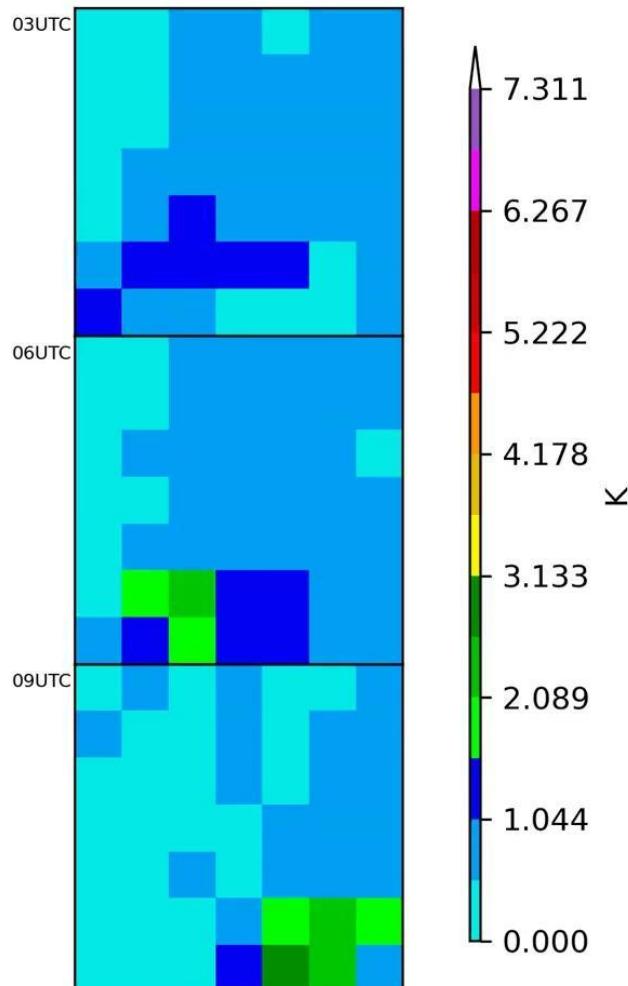
GFS - tram 1h - MAX
max pot. temp. pert. at lowest model lev



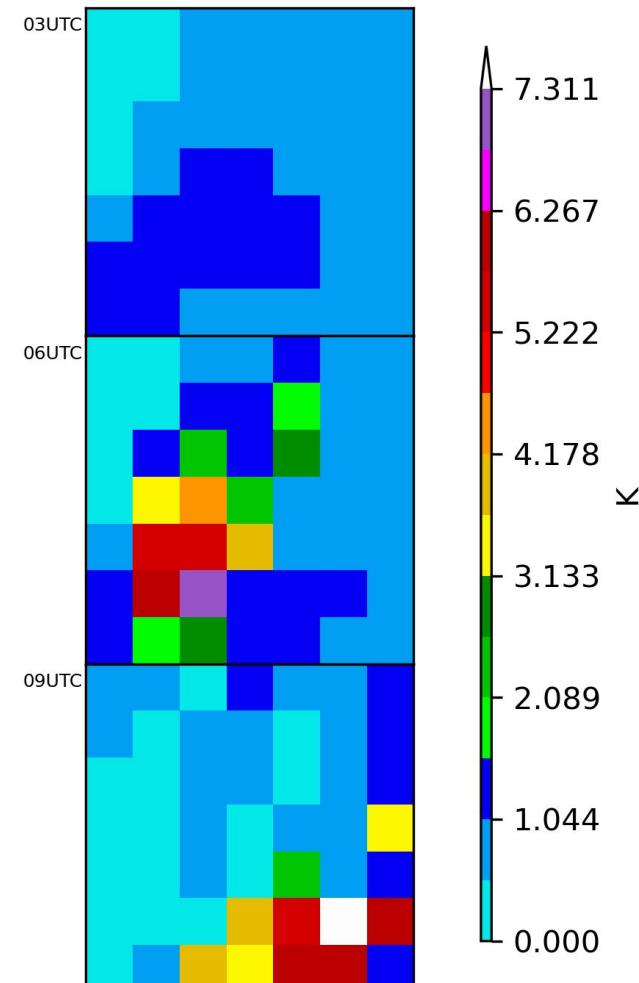
263	264	265	266	267	268	269
243	244	245	246	247	248	249
223	224	225	226	227	228	229
203	204	205	206	207	208	209
183	184	185	186	187	188	189
163	164	165	166	167	168	169
143	144	145	146	147	148	149

The results

GFS - tram 1h - t: 60 minutes
min pot. temp. pert. at lowest model lev



GFS - tram 1h - MAX
min pot. temp. pert. at lowest model lev



263 264 265 266 267 268 269
243 244 245 246 247 248 249
223 224 225 226 227 228 229
203 204 205 206 207 208 209
183 184 185 186 187 188 189
163 164 165 166 167 168 169
143 144 145 146 147 148 149

The conclusion



The conclusions

The CM1 model fed with pseudo-radiosounding to characterize the base state and a warm bubble as a trigger mechanism is able to provide accurate information regarding the **convective potential of an environment**.

Applying this strategy to several spatial points at several times, we can:

- effectively determine **the location**, in space and time, of convective environments and **how they evolve**.
- **quantify the convective potential** through several indicators like composite reflectivity, maximum ground wind velocity or maximum vertical wind velocity.

The end

That's all Folks!

The results

Reflectivitat max
Parate
Rain
W max a 3 km
Wind sfc
Vorticitat a nivells baixos

The results

Max

Max (70-180 min)

80-90 min