Event Week on Aviation Meteorology
Balloon forecasting

Ab Maas

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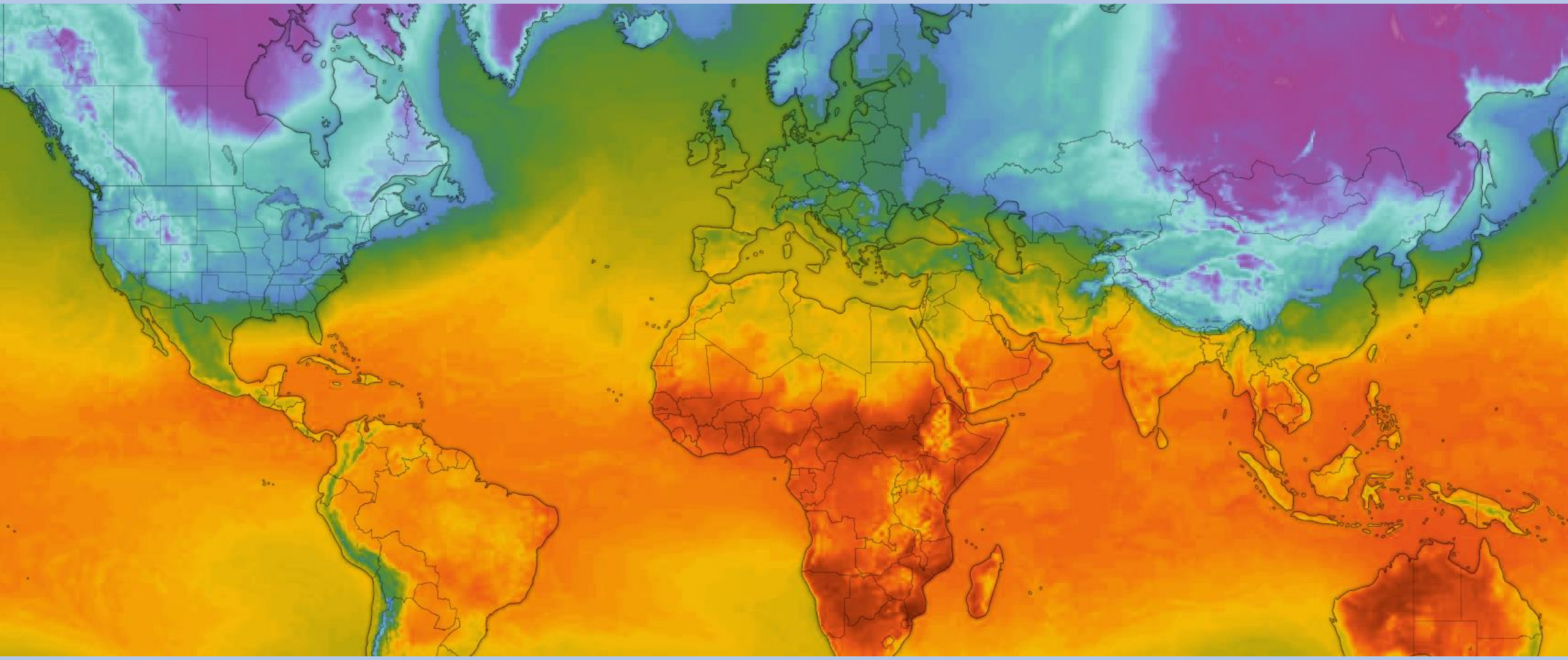
Where are you from??



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2 main types of balloons

Hot air balloons
General Aviation (GA)

Hot air balloons fly as a result of a hotter air temperature inside the envelope than outside.

Mostly in day time under VFR

In summer only a few hours after sunrise and in the hours before sunset.

In winter time during the whole day

In most cases not more than 1 hour to 2 hours flight

Tethered Balloons

Special shapes

Hybrid Balloons

Gas balloons
General Aviation (GA)

Gas balloons fly as a result of a lifting gas in their envelopes

Fly under VFR and IFR

Can fly in day and night time

Flight duration can vary between a few hours and several days.

World record: 160 hours and 34 minutes

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2 types of balloons

Hot air balloons

500 – 18.000 m³(645 – 23220 kg/m³)
1 to >20 passengers

Two Burners

Propane Gas

For decending:
Disk-shaped flap called a *parachute vent*

Gas balloons

+/- 1000 m³

1- 4 passengers

Filled with Hydrogen or Helium

Valve voor decending and landing

Sand for ascending

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2 types of balloons

Hot air balloons

Can fly only in stable weather condition

No convection, No precipitation

No thermals

Wind speed limit at the ground 10 kt
At 500 ft <15 kt during landing

No wind gusts

Gas balloons

Light convection

Light termals

Wind speed limit at the ground 10 – 15kt

Can fly during night (IFR)

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No convection

Flexible material envelope

More rigid material envelope

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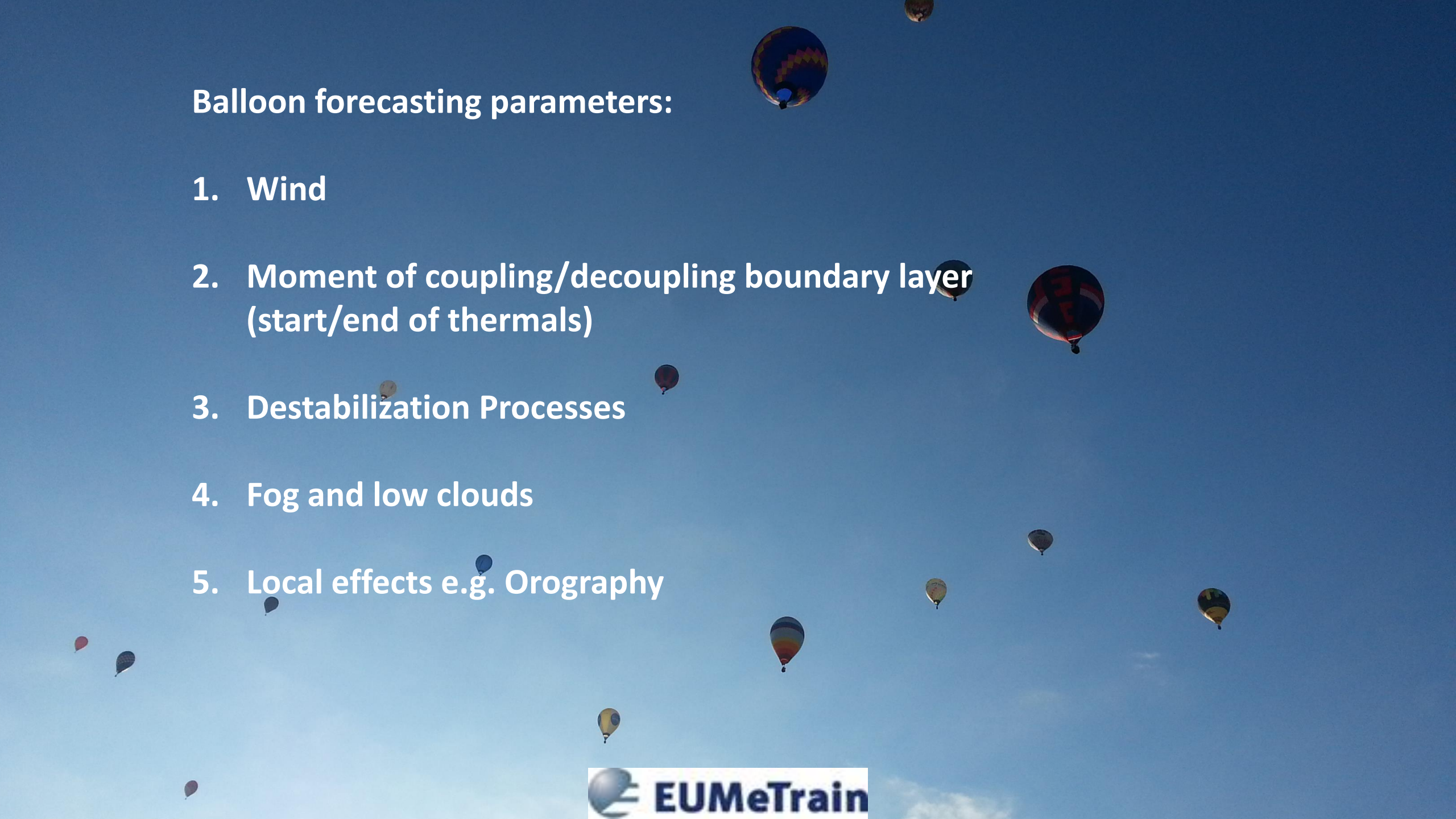
Because of the flexible and light material of the envelope especially hot air balloons are very sensitive for wind, wind gusts and thermals.

Therefore they only start and land within conditions where the boundary layer is decoupled completely from the higher atmosphere.

Forecasting the moment of coupling/decoupling is of great importance for the safety of ballooning.



Balloon forecasting parameters:

1. Wind
2. Moment of coupling/decoupling boundary layer (start/end of thermals)
3. Destabilization Processes
4. Fog and low clouds
5. Local effects e.g. Orography

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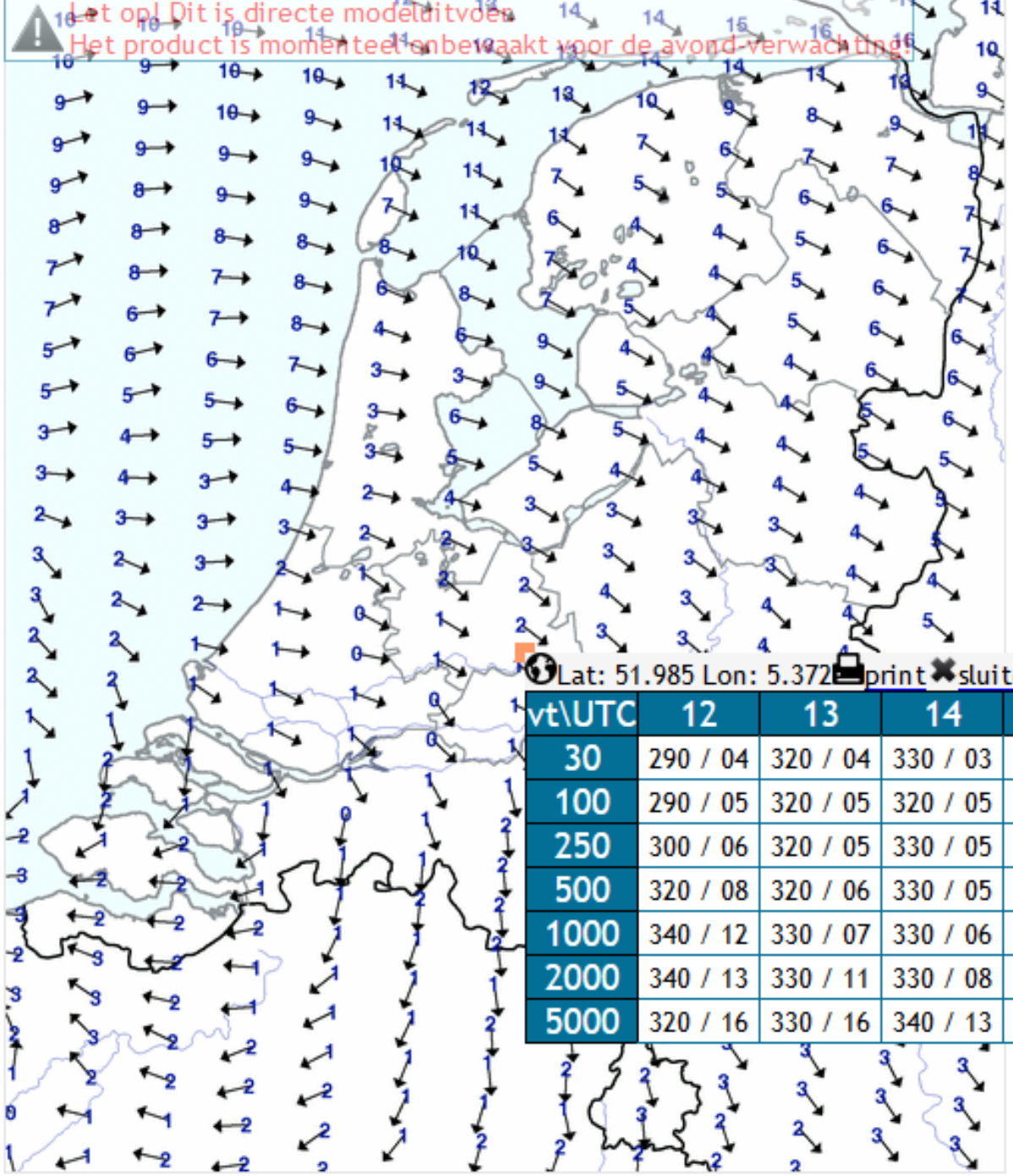
Wind

Wind

Balloon forecasting parameters:

Hirlam Hres model



Lat: 51.985 Lon: 5.372 print sluiten (versleepbaar)

vt\UTC	12	13	14	15	16	17
30	290 / 04	320 / 04	330 / 03	300 / 01	260 / 01	230 / 01
100	290 / 05	320 / 05	320 / 05	310 / 03	250 / 03	250 / 02
250	300 / 06	320 / 05	330 / 05	310 / 04	270 / 03	250 / 02
500	320 / 08	320 / 06	330 / 05	320 / 04	290 / 04	260 / 03
1000	340 / 12	330 / 07	330 / 06	320 / 06	300 / 04	290 / 04
2000	340 / 13	330 / 11	330 / 08	320 / 06	300 / 05	290 / 05
5000	320 / 16	330 / 16	340 / 13	340 / 10	340 / 07	350 / 05

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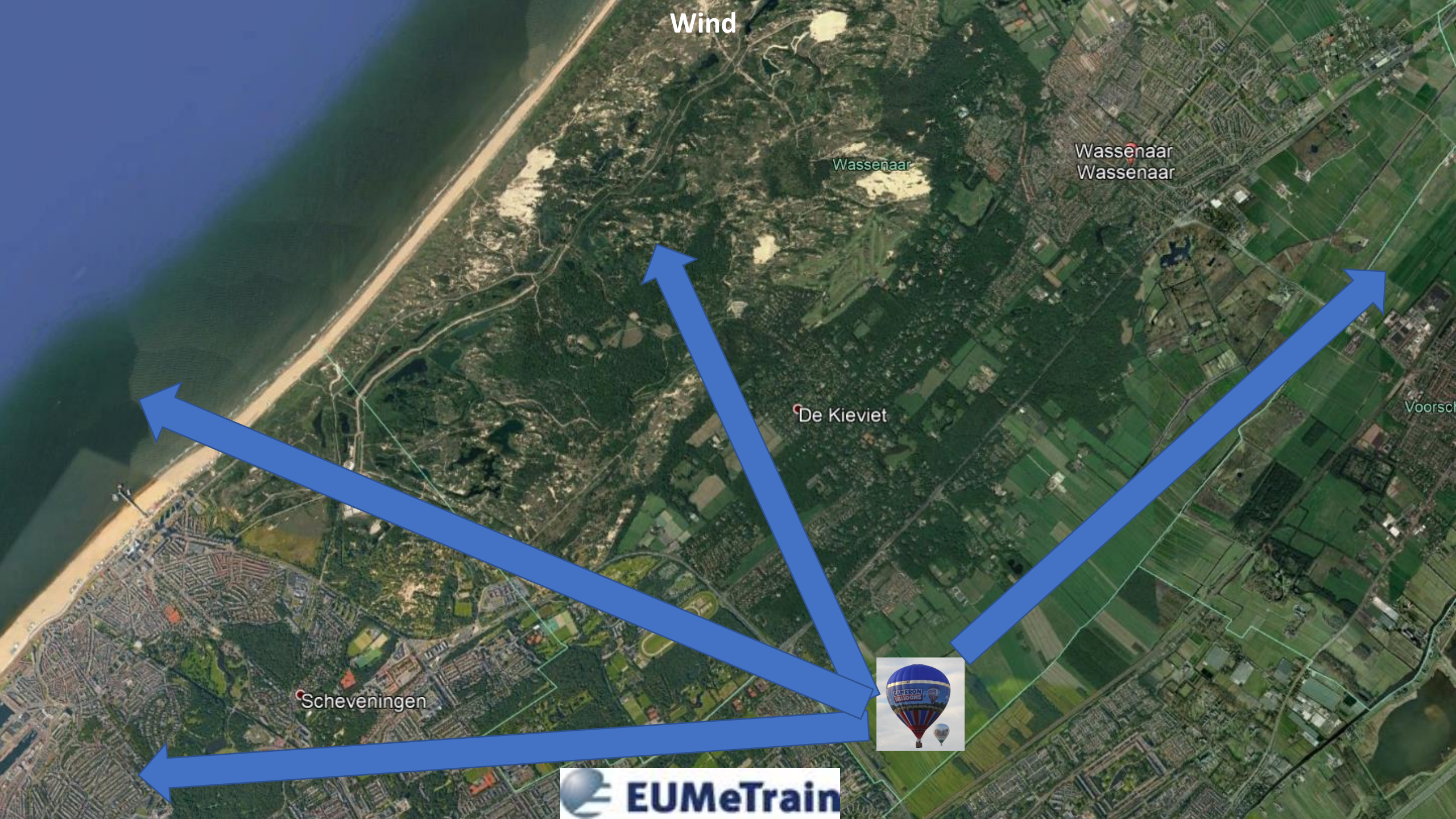
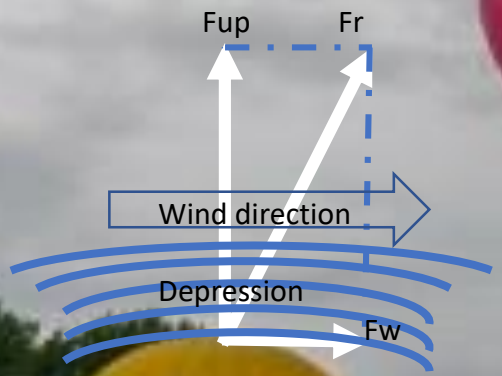

Wind
Wassenaar
Wassenaar
Wassenaar
De Kieviet
Scheveningen
EUMeTrain

Wind

False Lift



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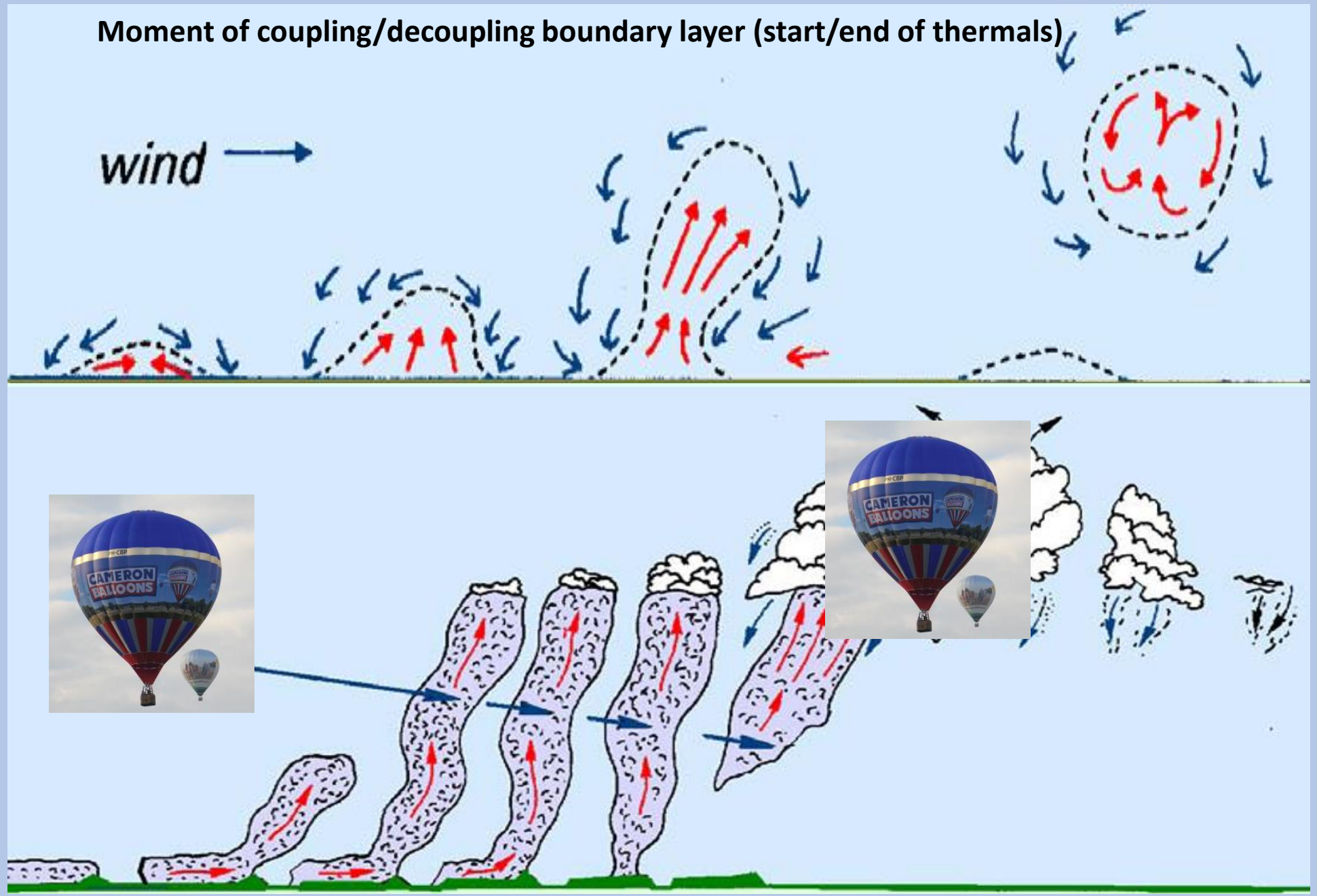
Moment of coupling/decoupling boundary layer (start/end of thermals)



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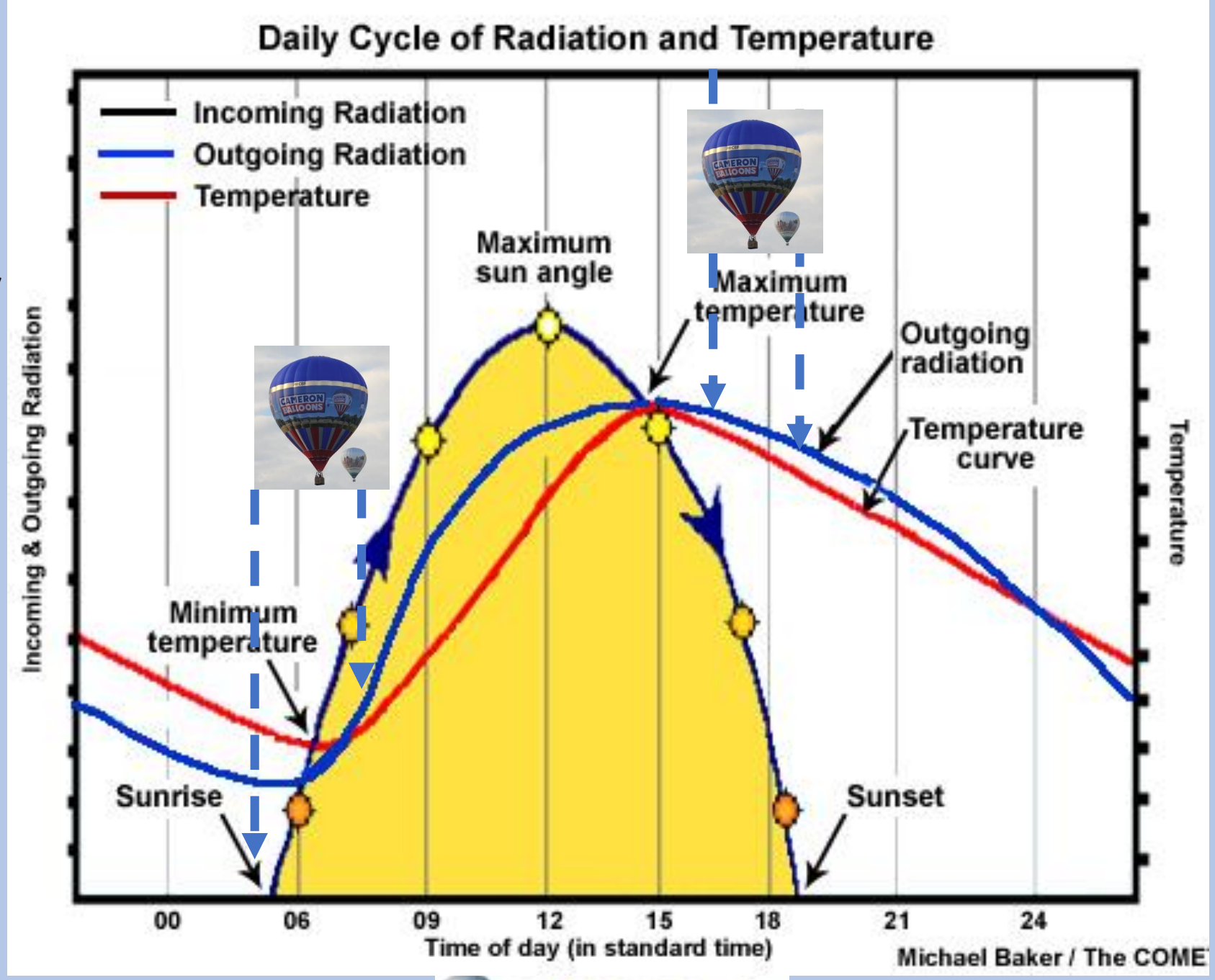
Moment of coupling/ decoupling boundary layer (start/end of thermals)



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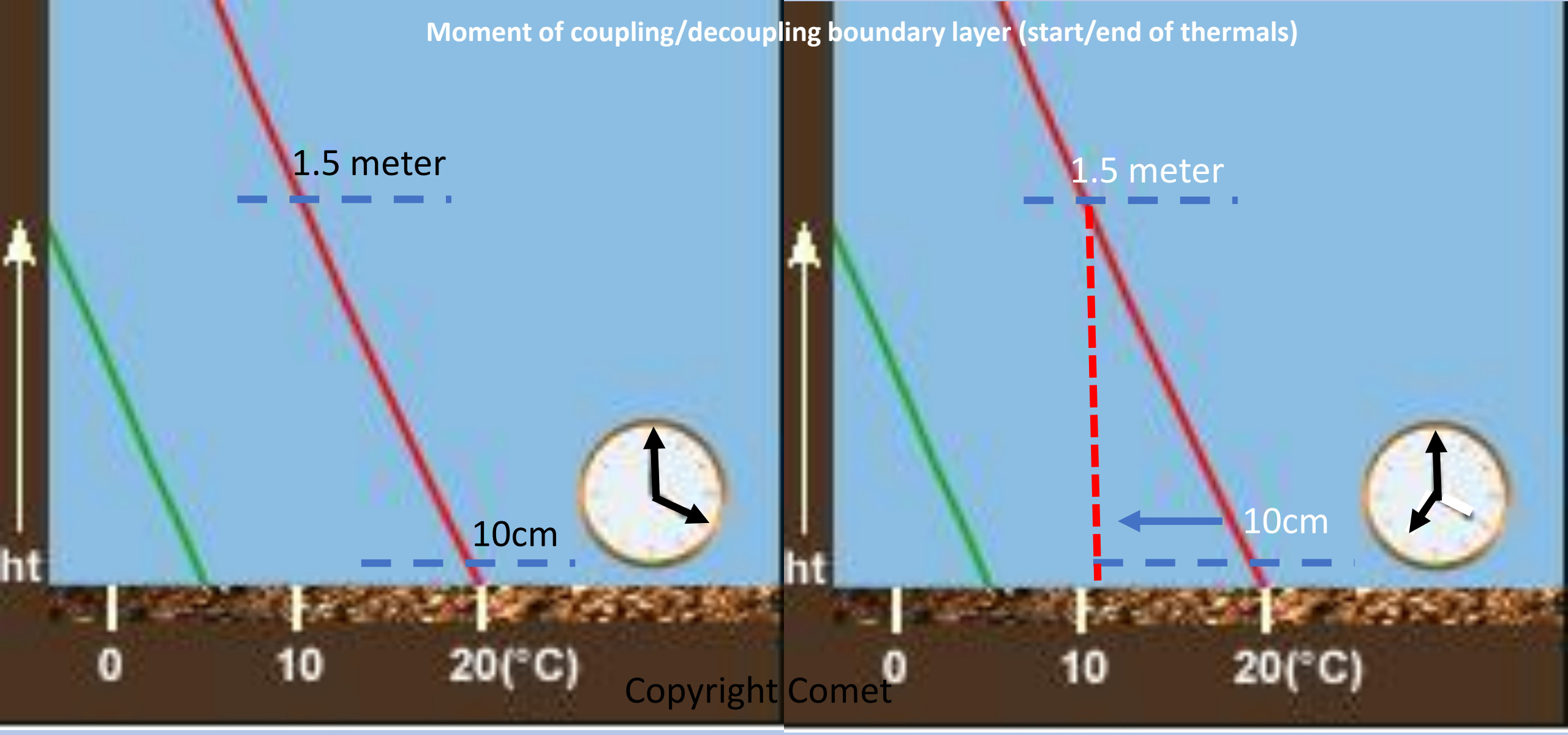
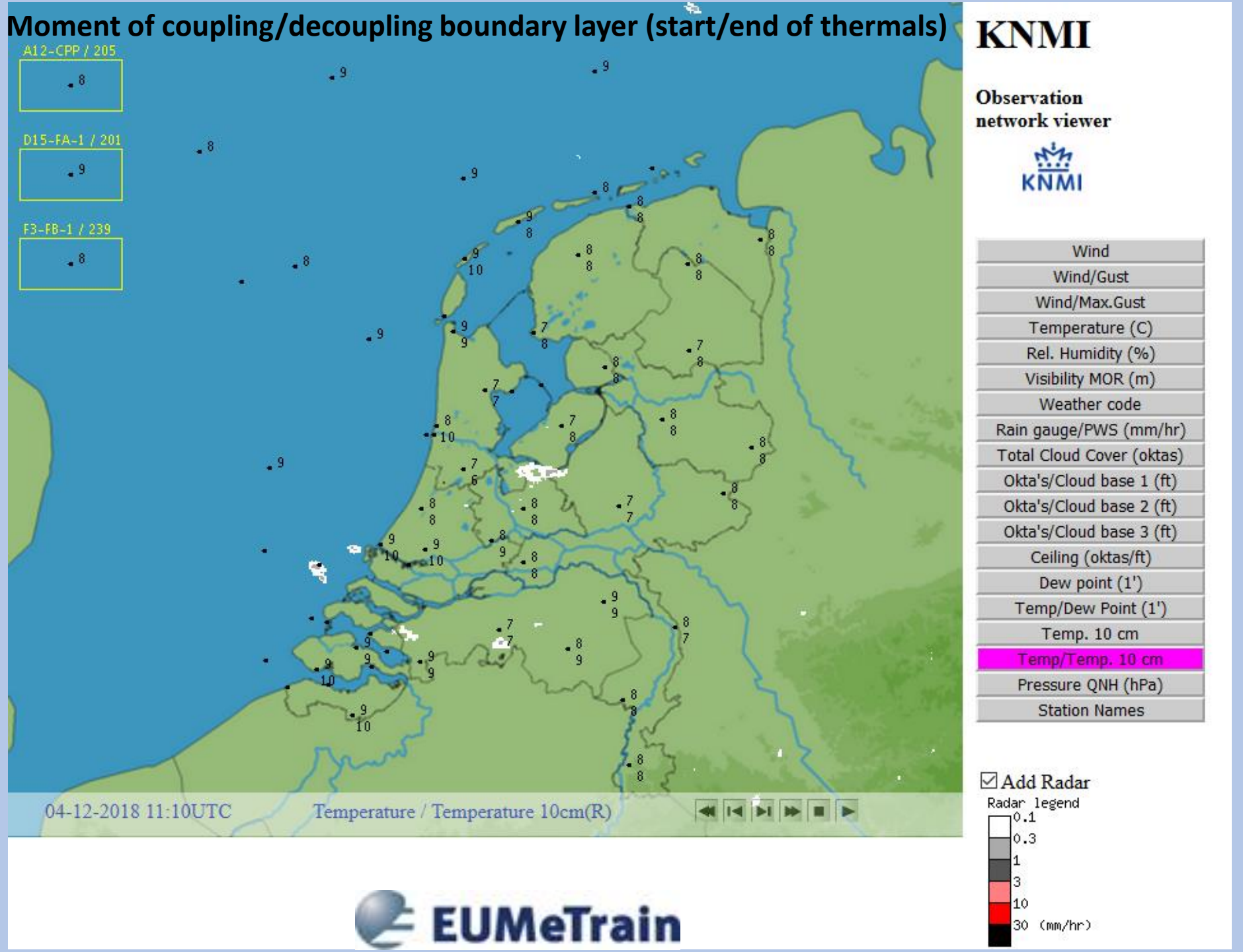


Stabilization of the boundary layer, rule of thumb T = T10 cm

Moment of coupling/decoupling boundary layer (start/end of thermals)

Radar combined with T1.5m and T 10cm



Moment of coupling/decoupling boundary layer (start/end of thermals)

Longer turbulent over woods and cities (Urban Heath Island)

Joris van der Haagen
The forest in The Hague with a view on Palace Huis ten Bosch

Johannes Vermeer
View of Delft

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Cloudiness

Rapid Scan

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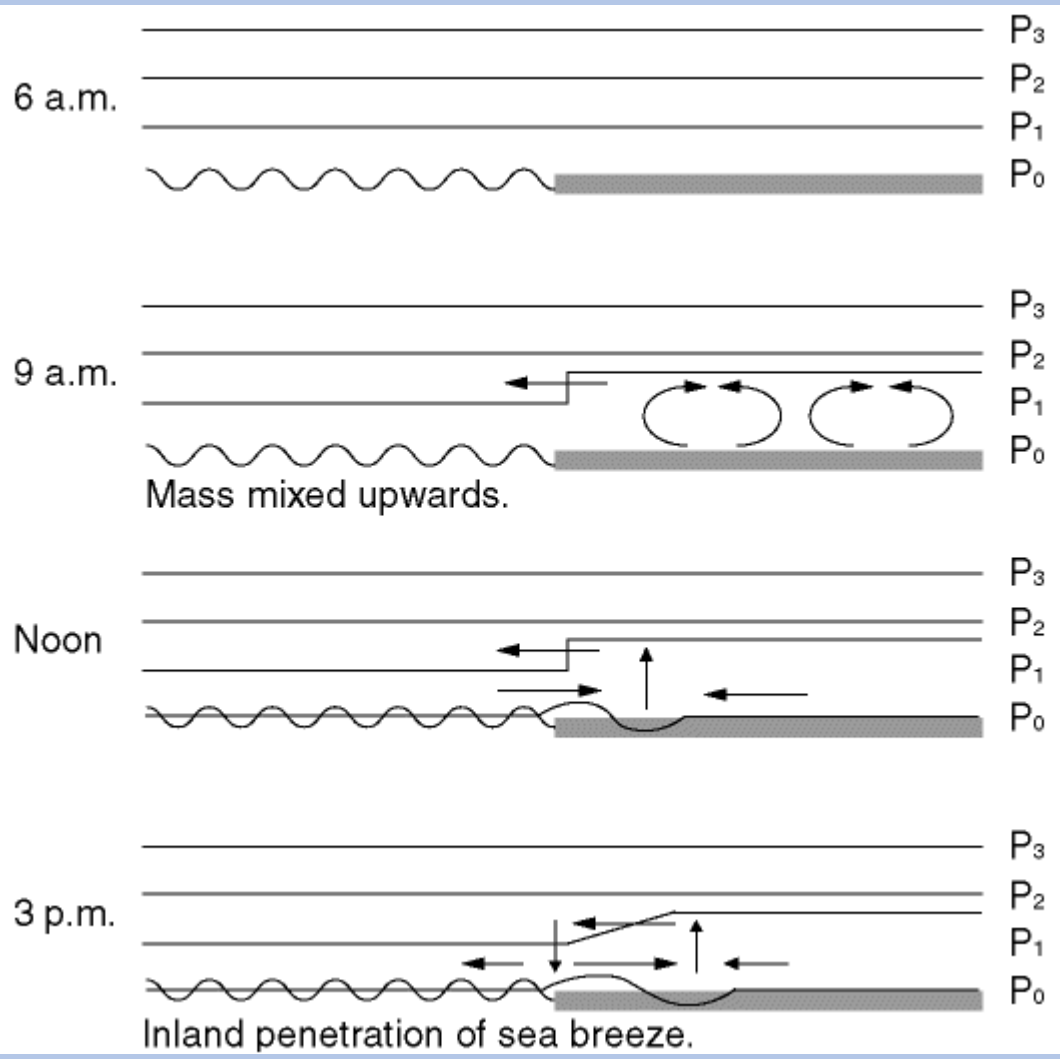
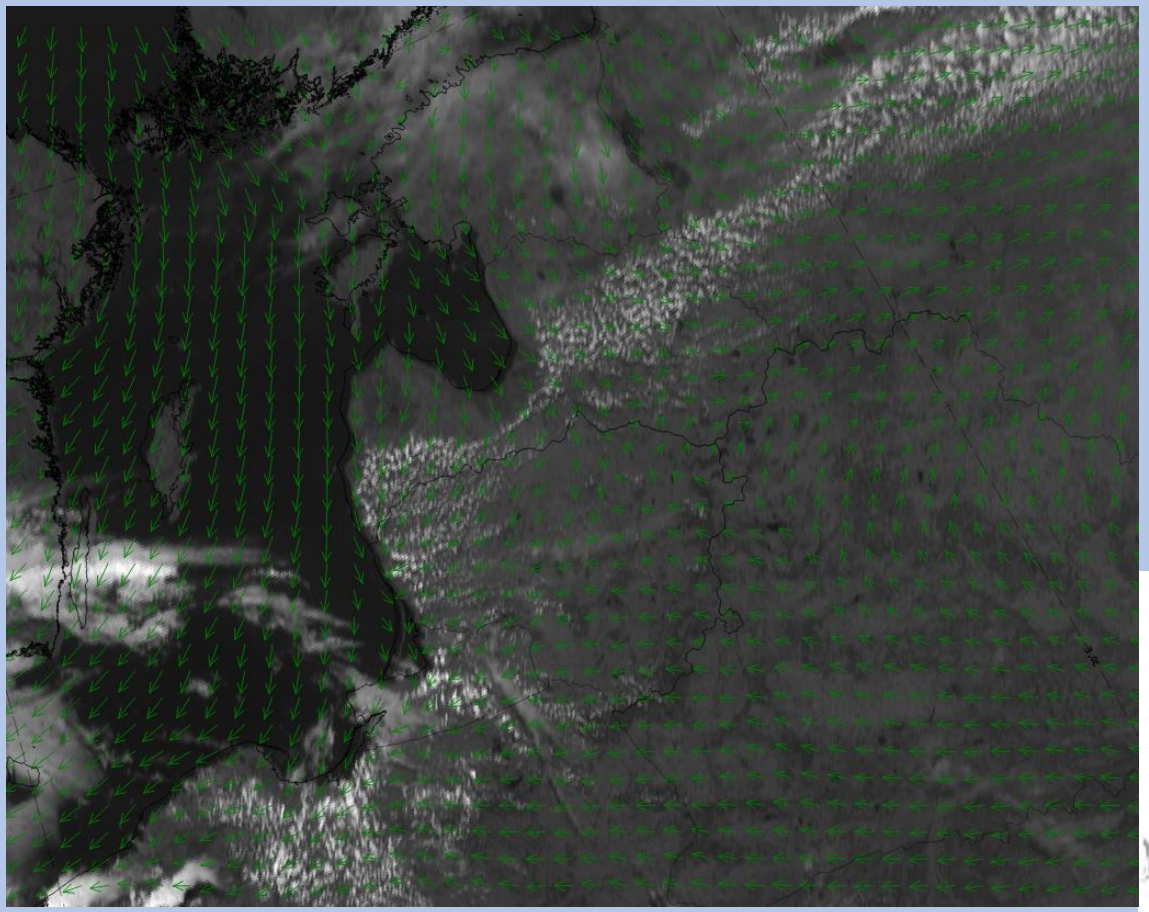
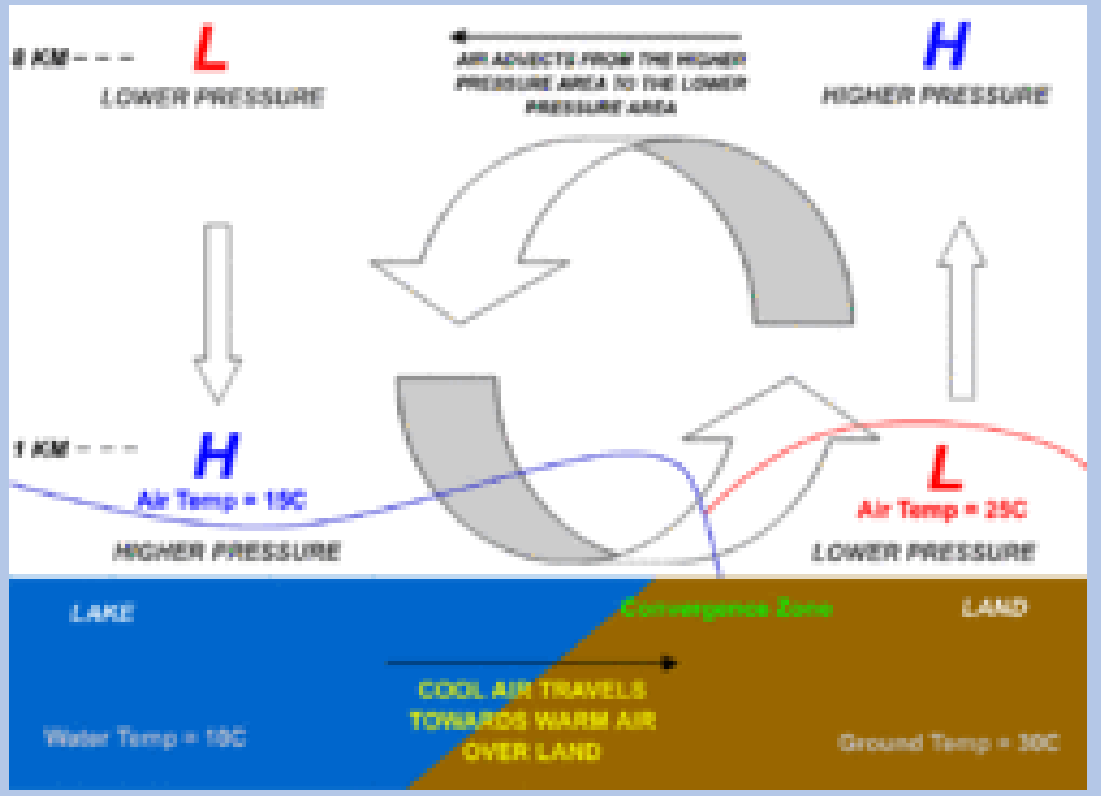
Destabilization Processes
Sea breeze

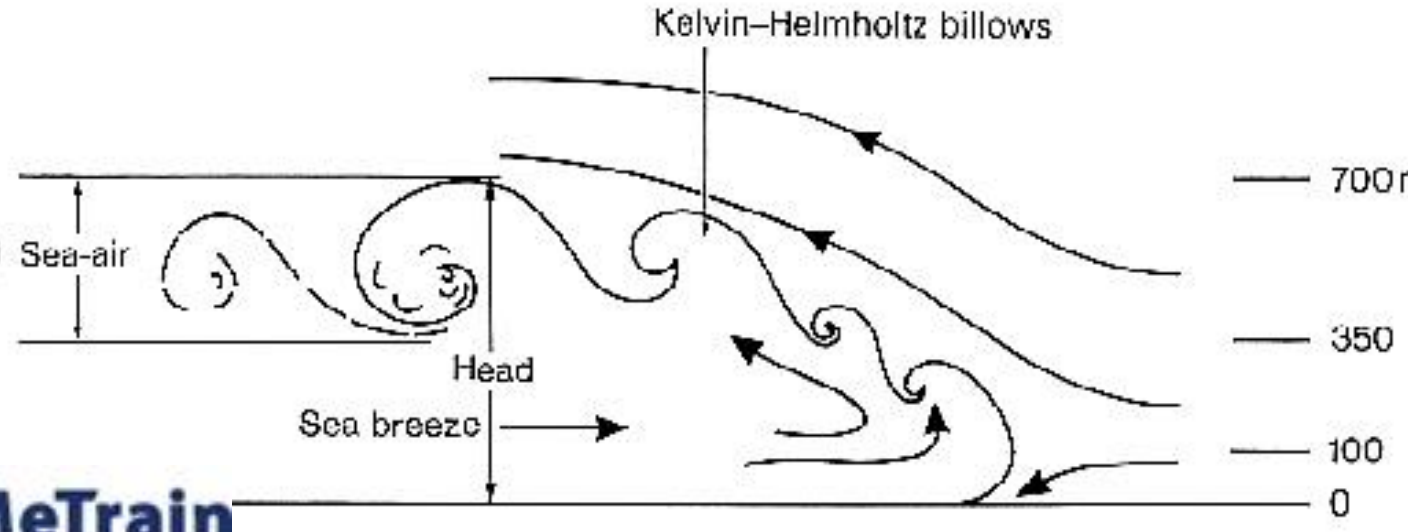


Destabilization Processes
Sea breeze



27/05 2018 12utc





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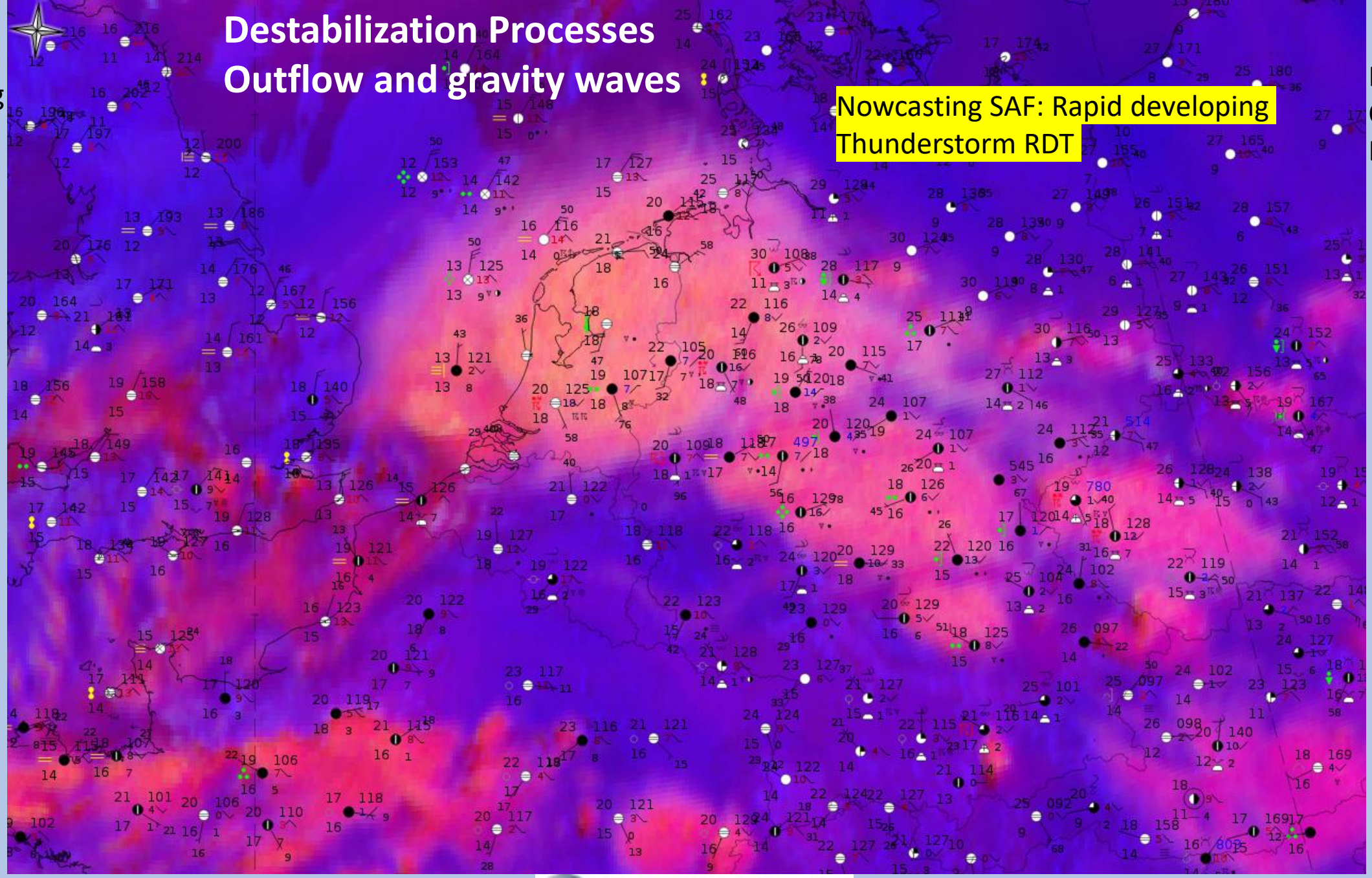
Monitoring heavy convection 29/05/ 2018 18UTC

Destabilization Processes
Outflow and gravity waves



Meteosat Convection RGB

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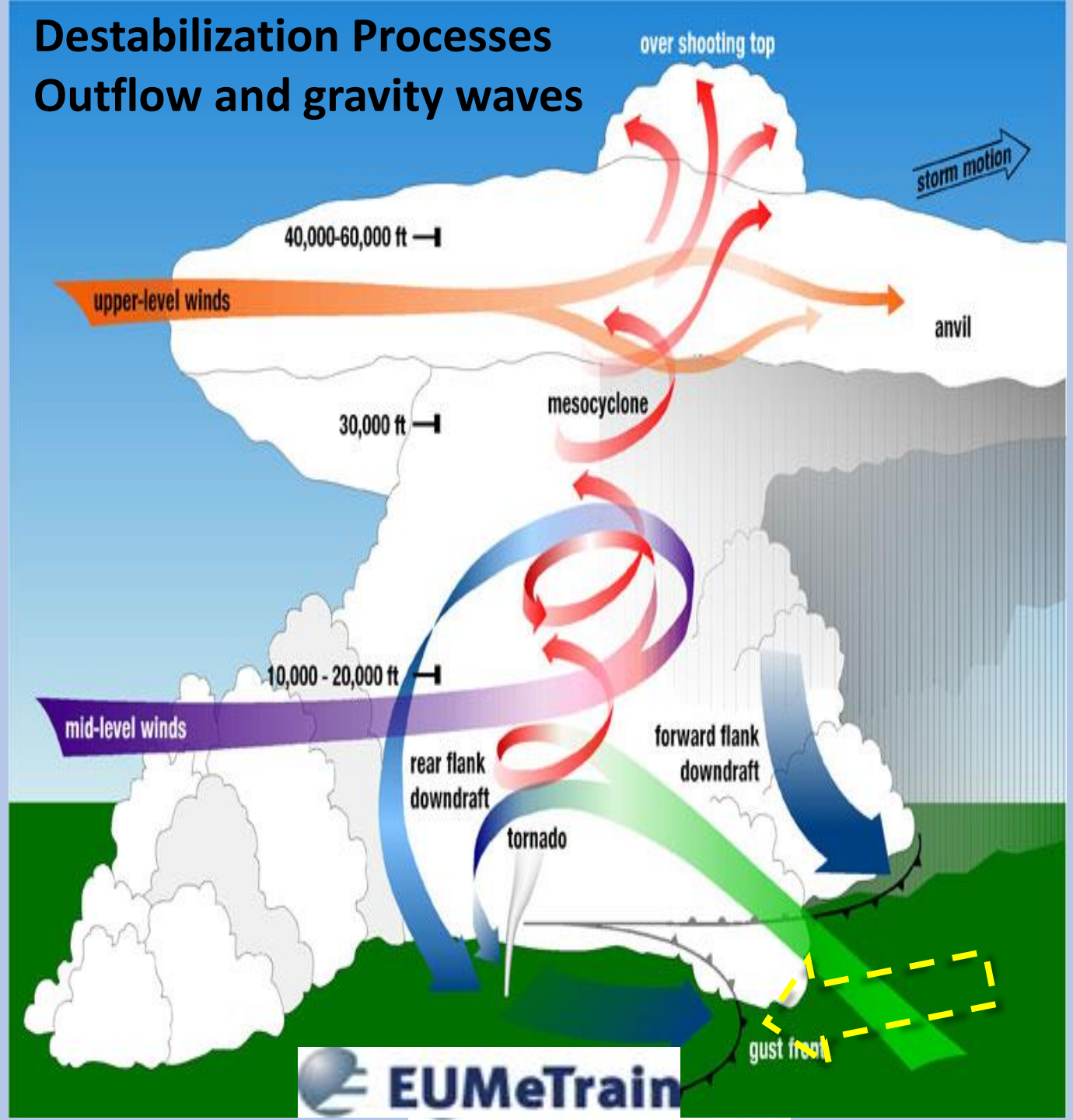
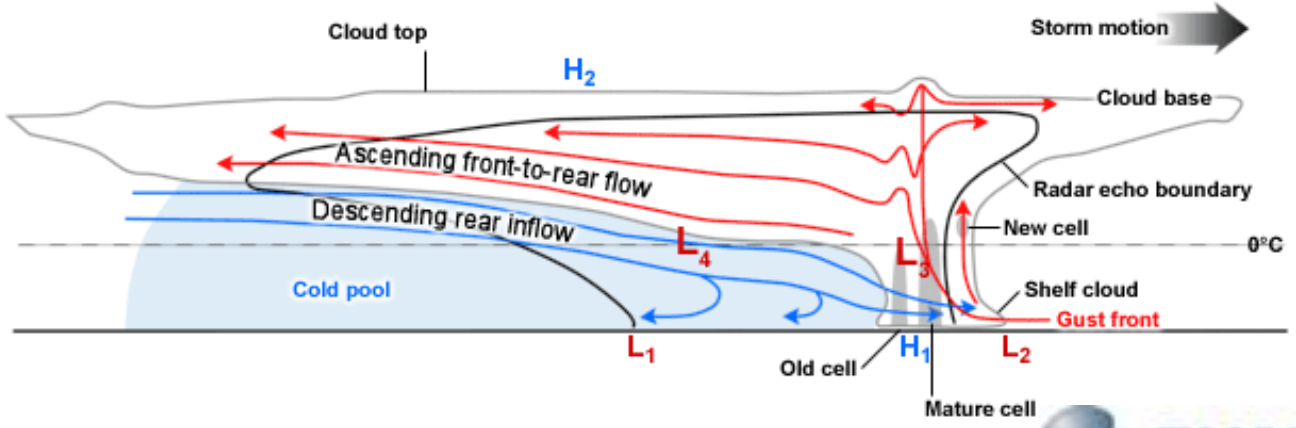
Destabilization Processes
Outflow and gravity waves



Destabilization Processes
Outflow and gravity waves



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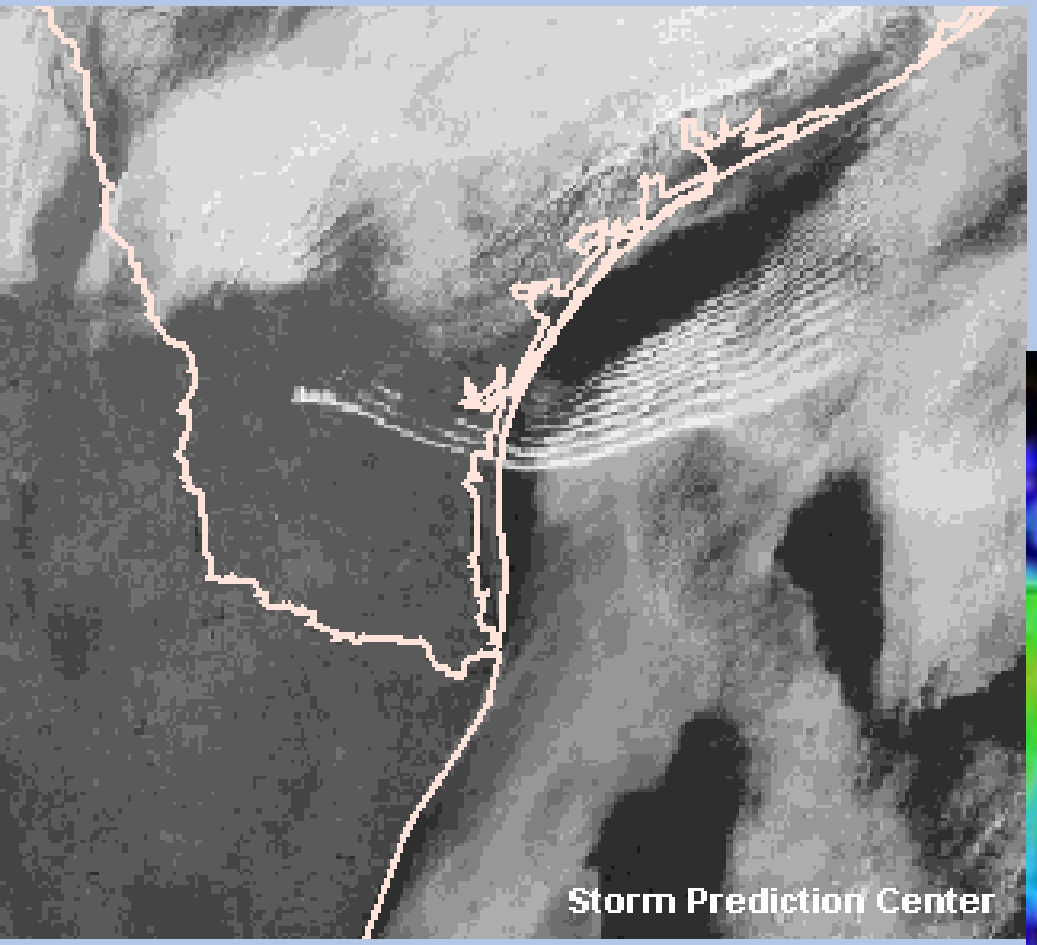
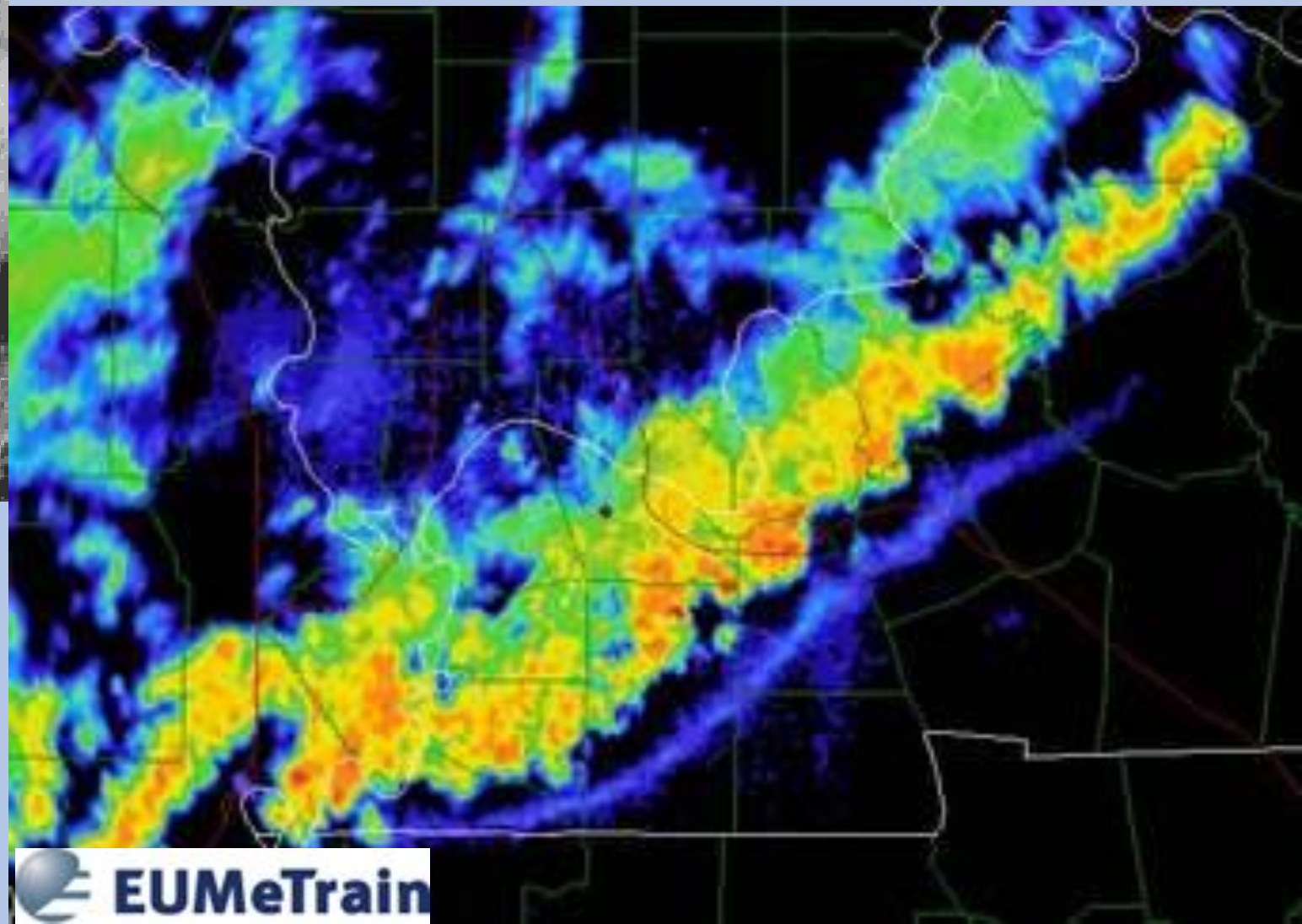
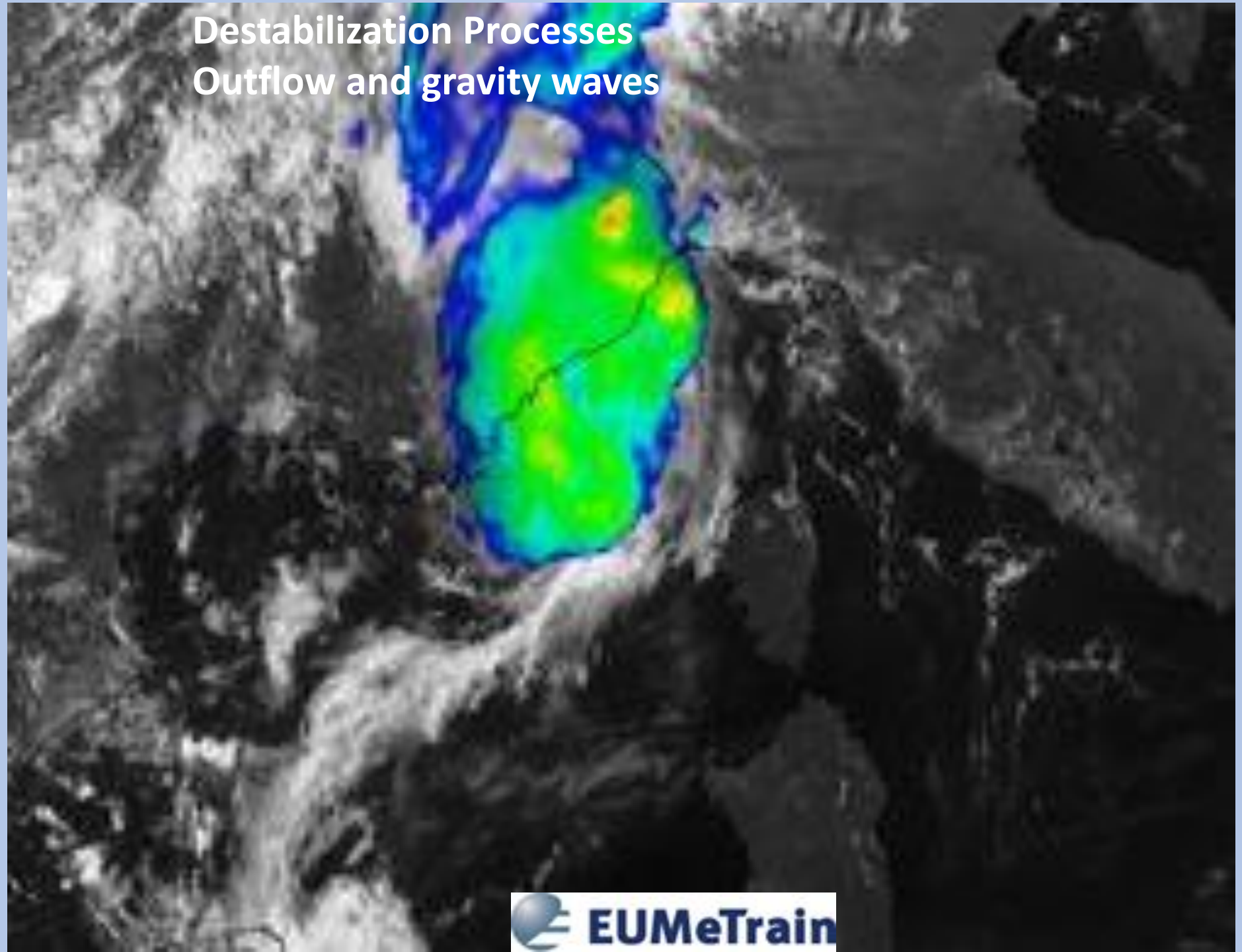
Destabilization Processes
Outflow and gravity waves





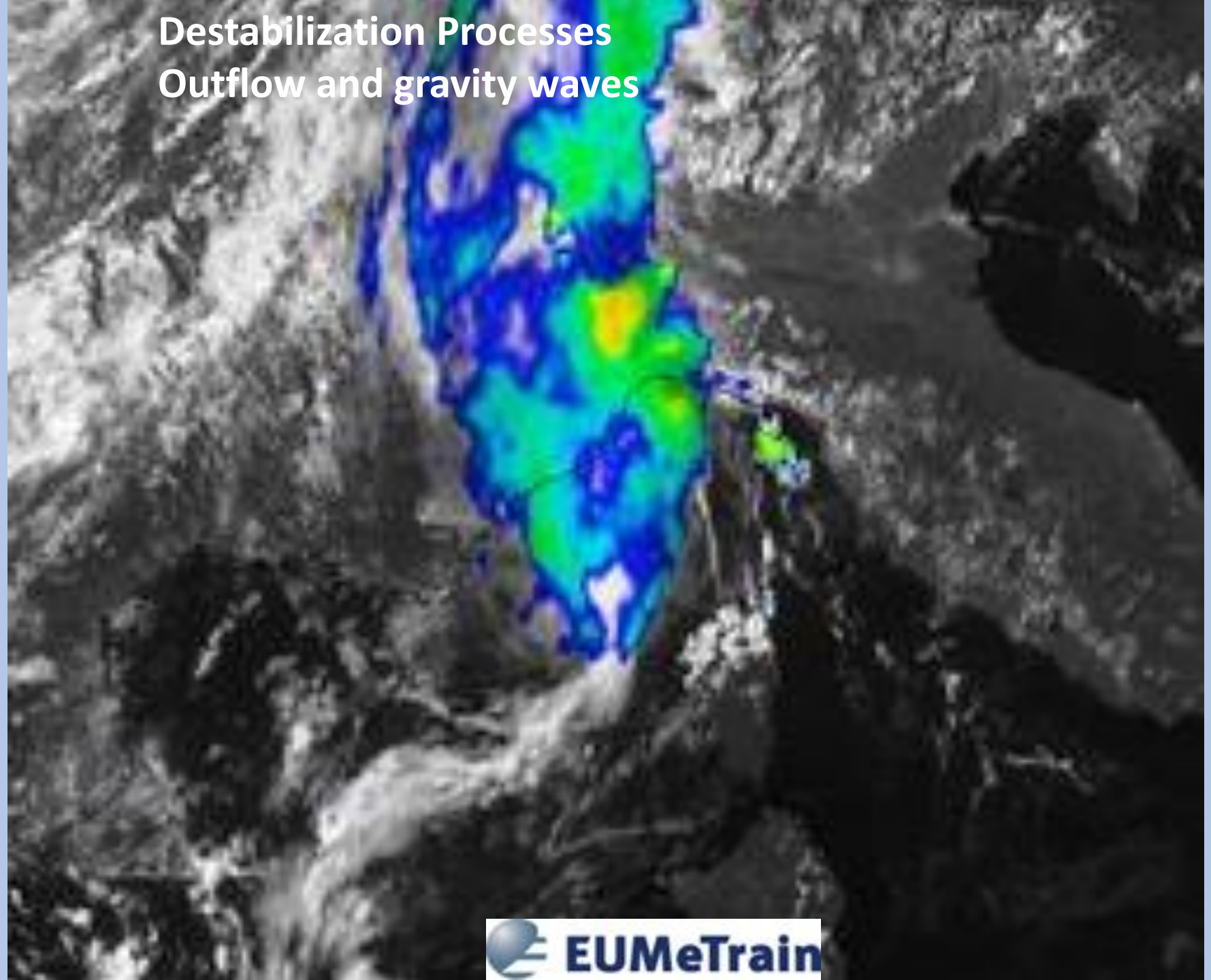
Monitoring:
Duo Pol Radar
Rapid Scan

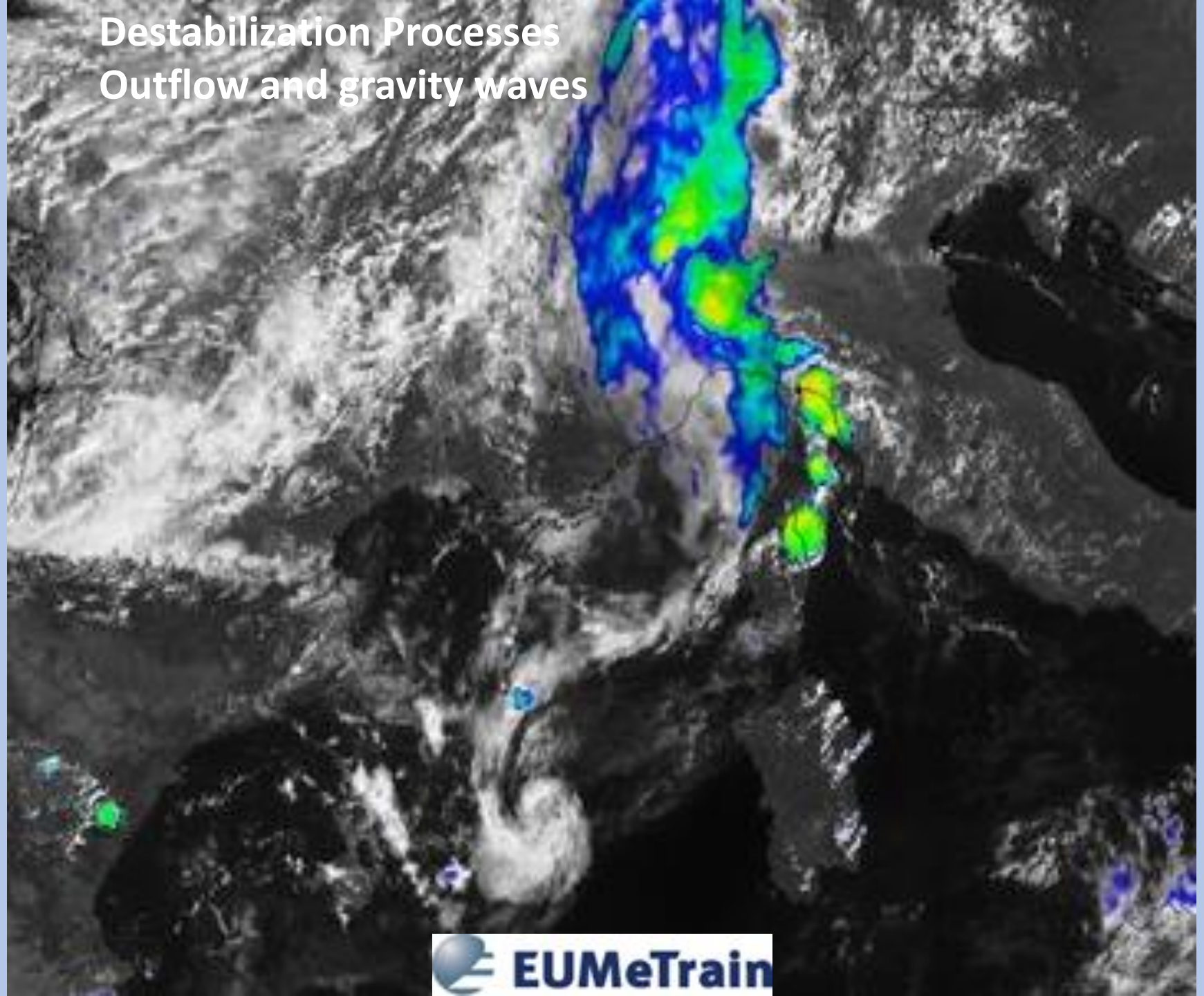
Destabilization Processes
Outflow and gravity waves

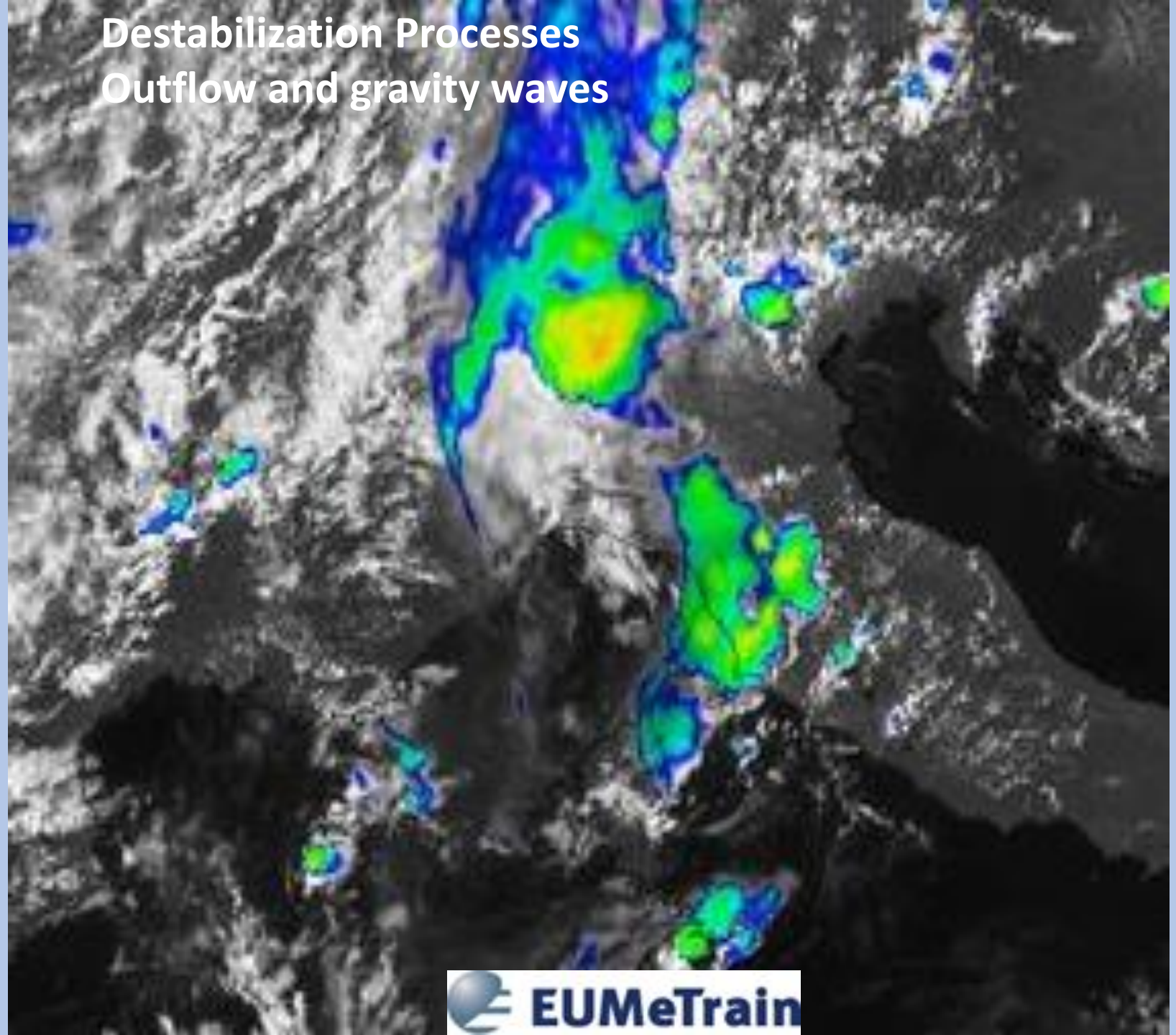


13/08 2018
1115 LT

EUMeTrain


Destabilization Processes
Outflow and gravity waves
13/08 2018
1215 LT
EUMeTrain


Destabilization Processes
Outflow and gravity waves
13/08 2018
1315 LT
EUMeTrain


Destabilization Processes
Outflow and gravity waves
13/08 2018
1415 LT
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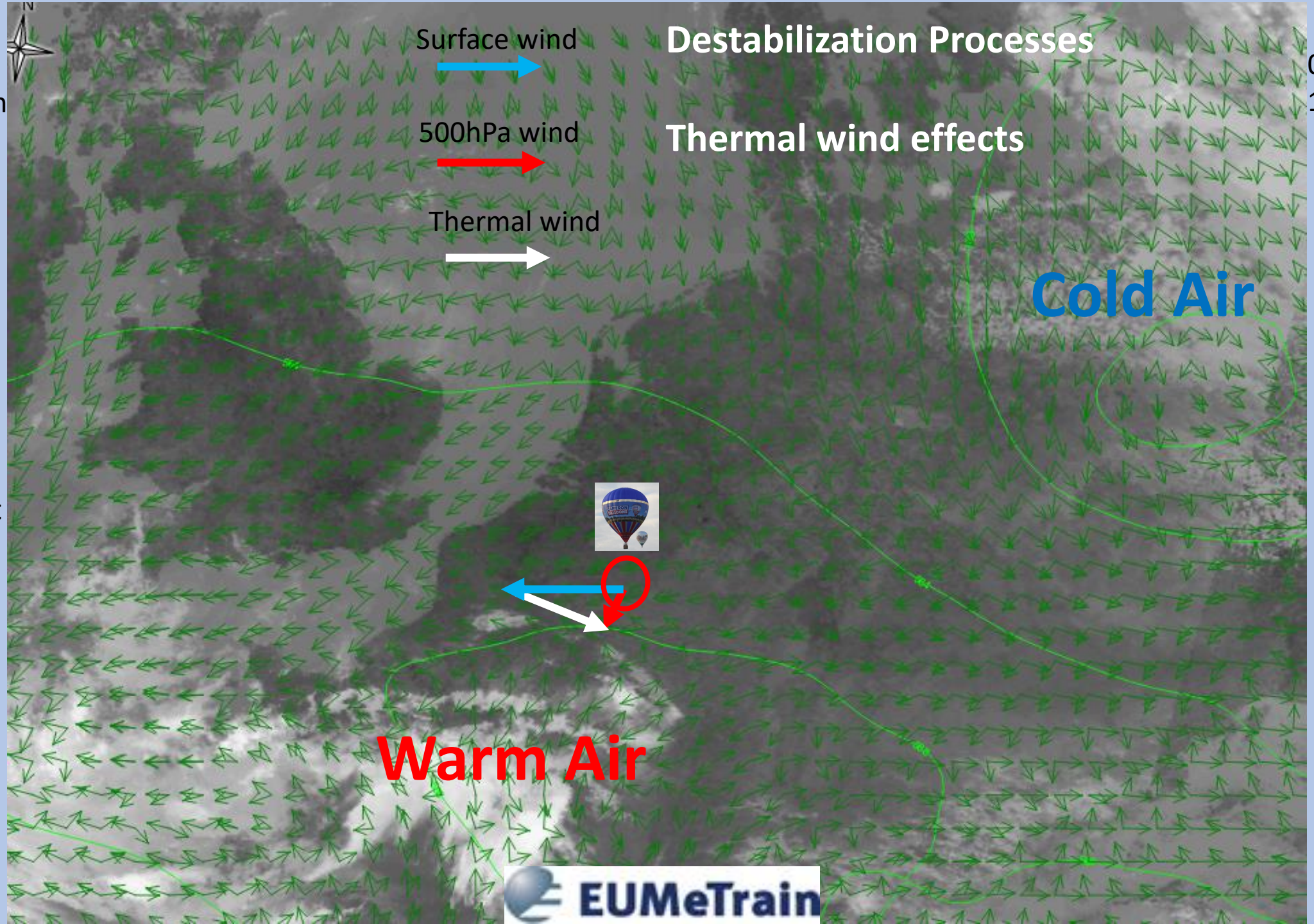
Vector Substraction

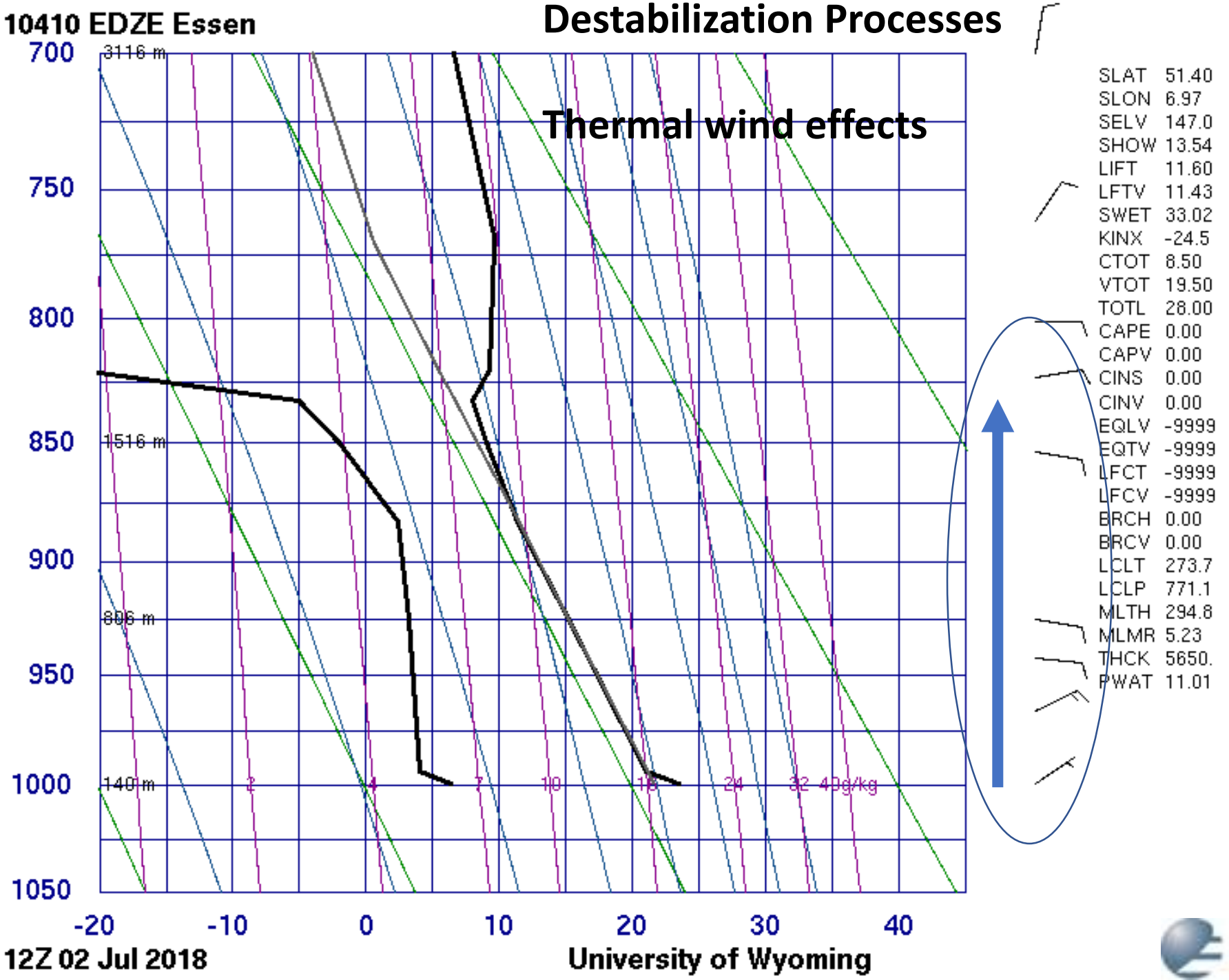
Wind at certain pressure level minus surface wind is the thermal wind in that layer



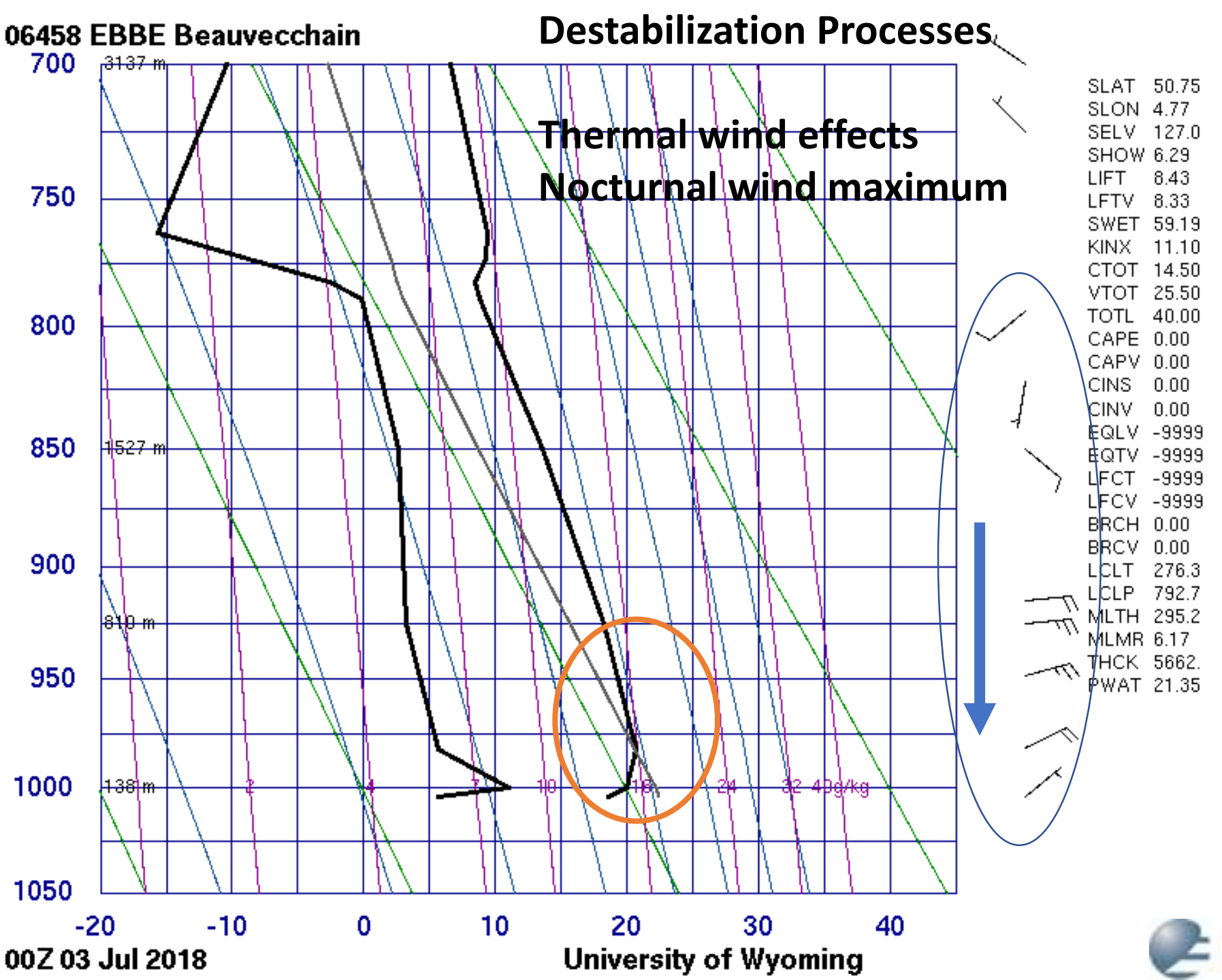
02 July 2018
12UTC

Destabilization Processes

Thermal wind effects



Destabilization Processes



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Destabilization Processes

Nocturnal wind maximum

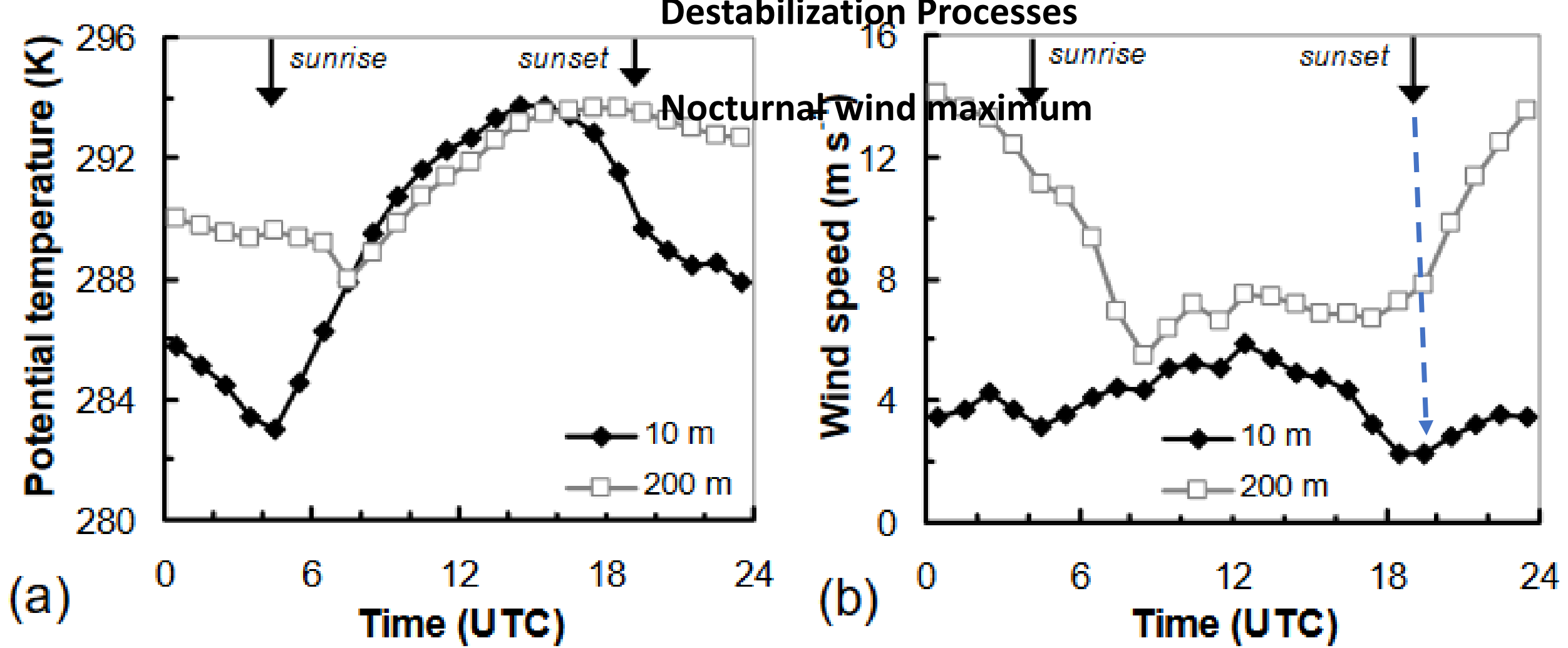
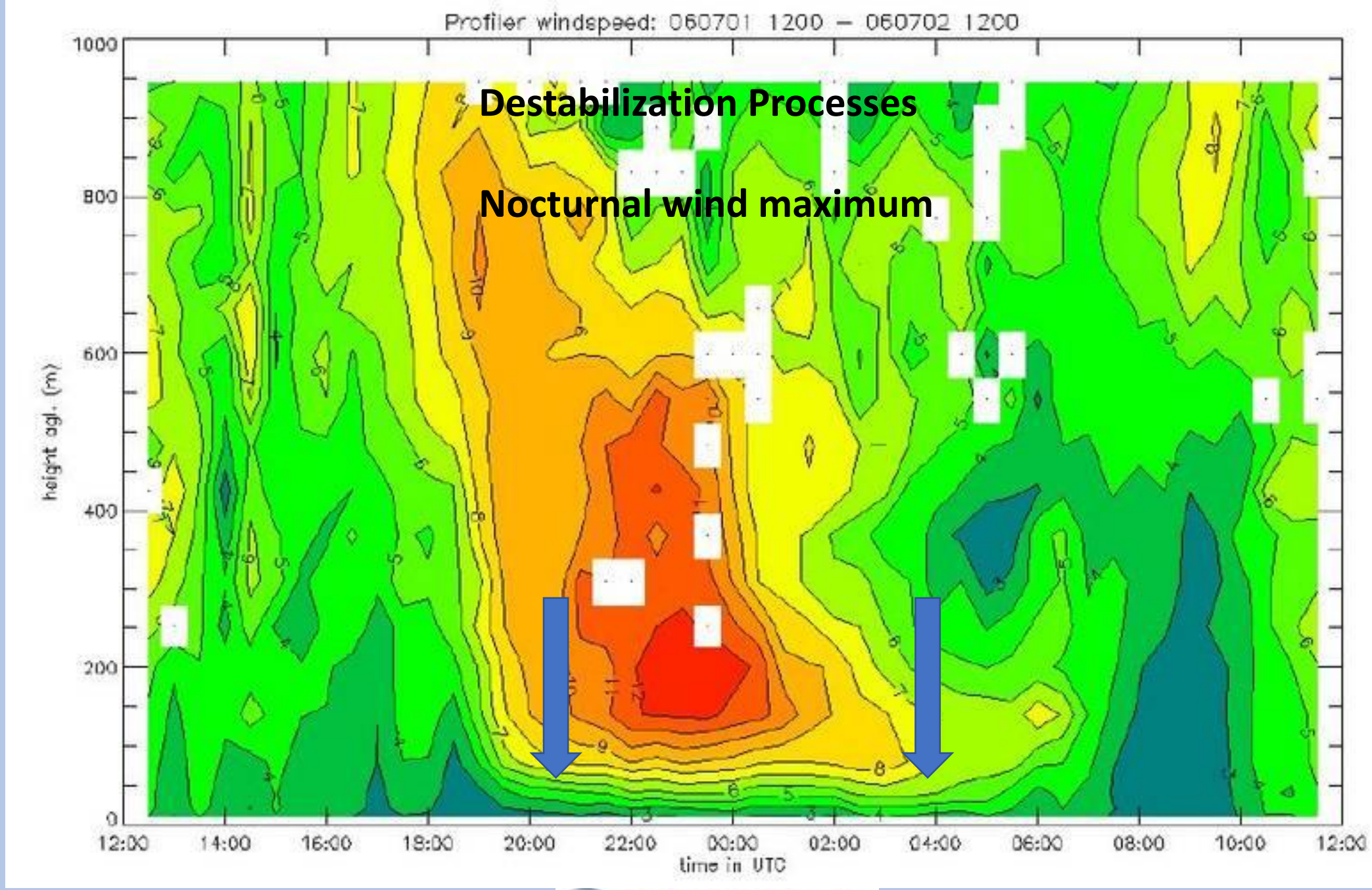
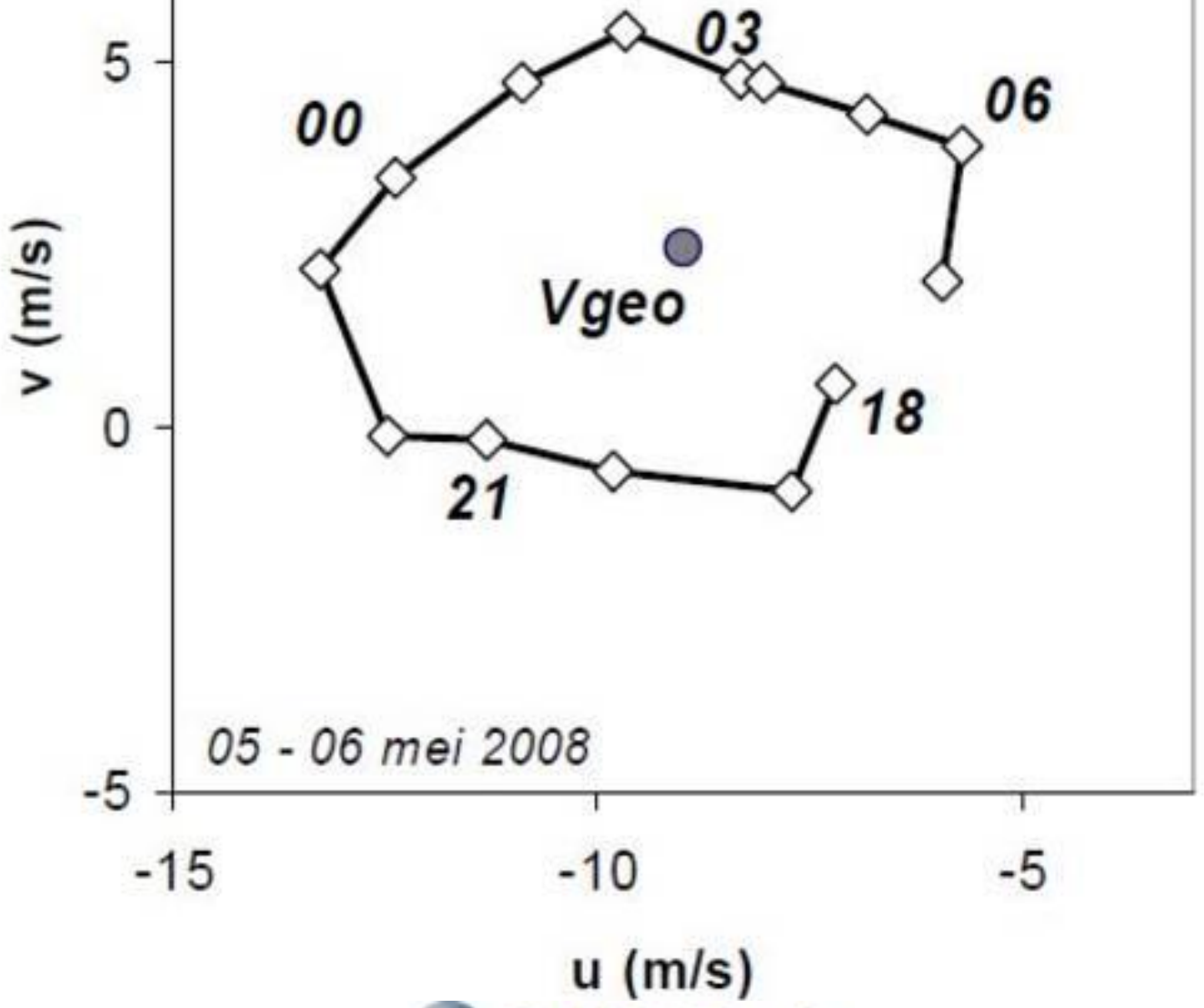


Figure 1.1: Diurnal cycle of potential temperature (a) and wind speed (b) as observed on 5 May 2008 at 10 and 200 m height in the Cabauw tower.


Profiler windspeed: 060701 1200 – 060702 1200
Destabilization Processes
Nocturnal wind maximum
height agl. (m)
1000
800
600
400
200
0
12:00
14:00
16:00
18:00
20:00
22:00
00:00
02:00
04:00
06:00
08:00
10:00
12:00
time in UTC

Destabilization Processes

Nocturnal wind maximum



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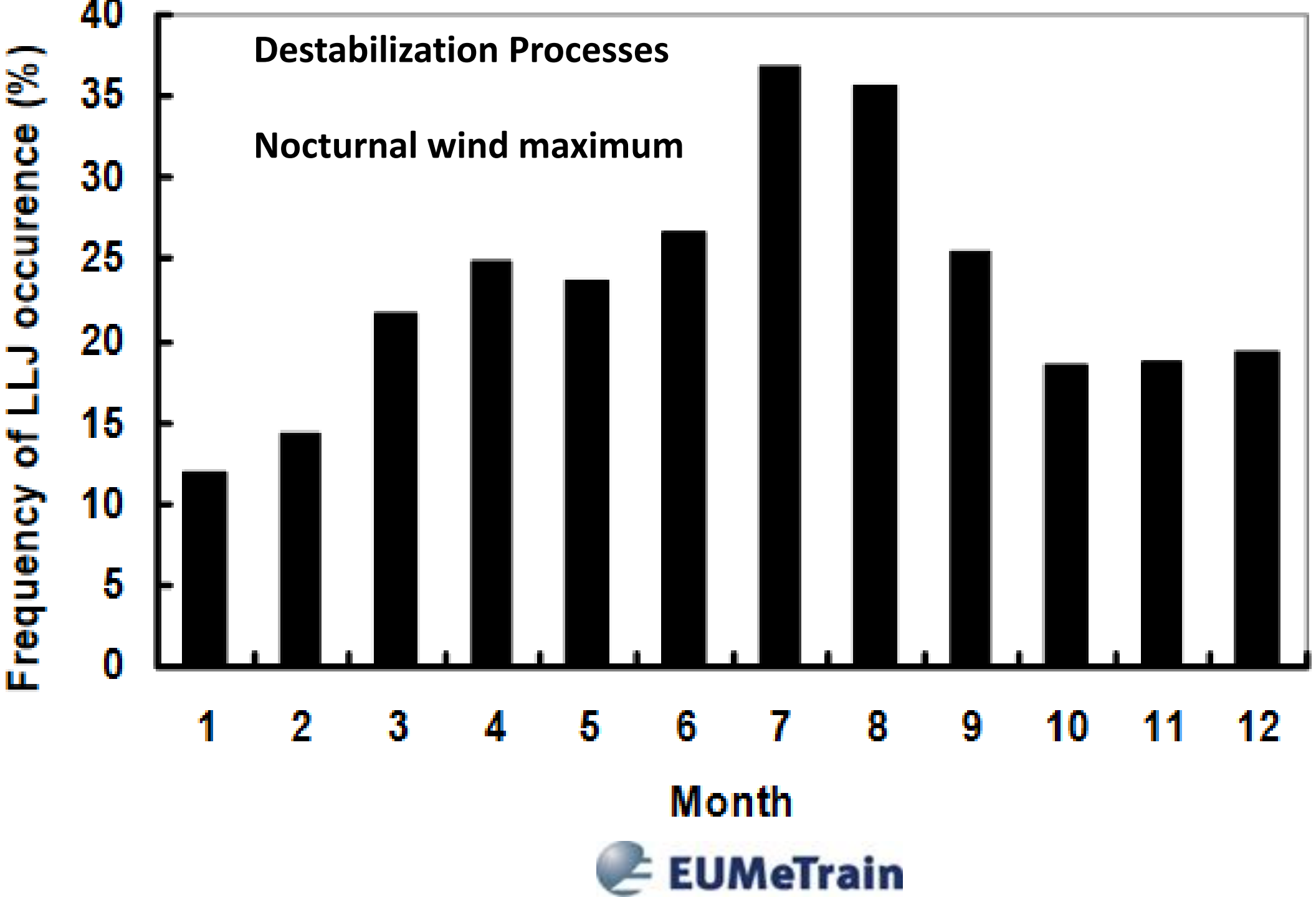
Destabilization Processes
Nocturnal wind maximum
Frequency of LLJ occurence (%)
0
5
10
15
20
25
30
35
40
1
2
3
4
5
6
7
8
9
10
11
12
Month

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Fog and low clouds

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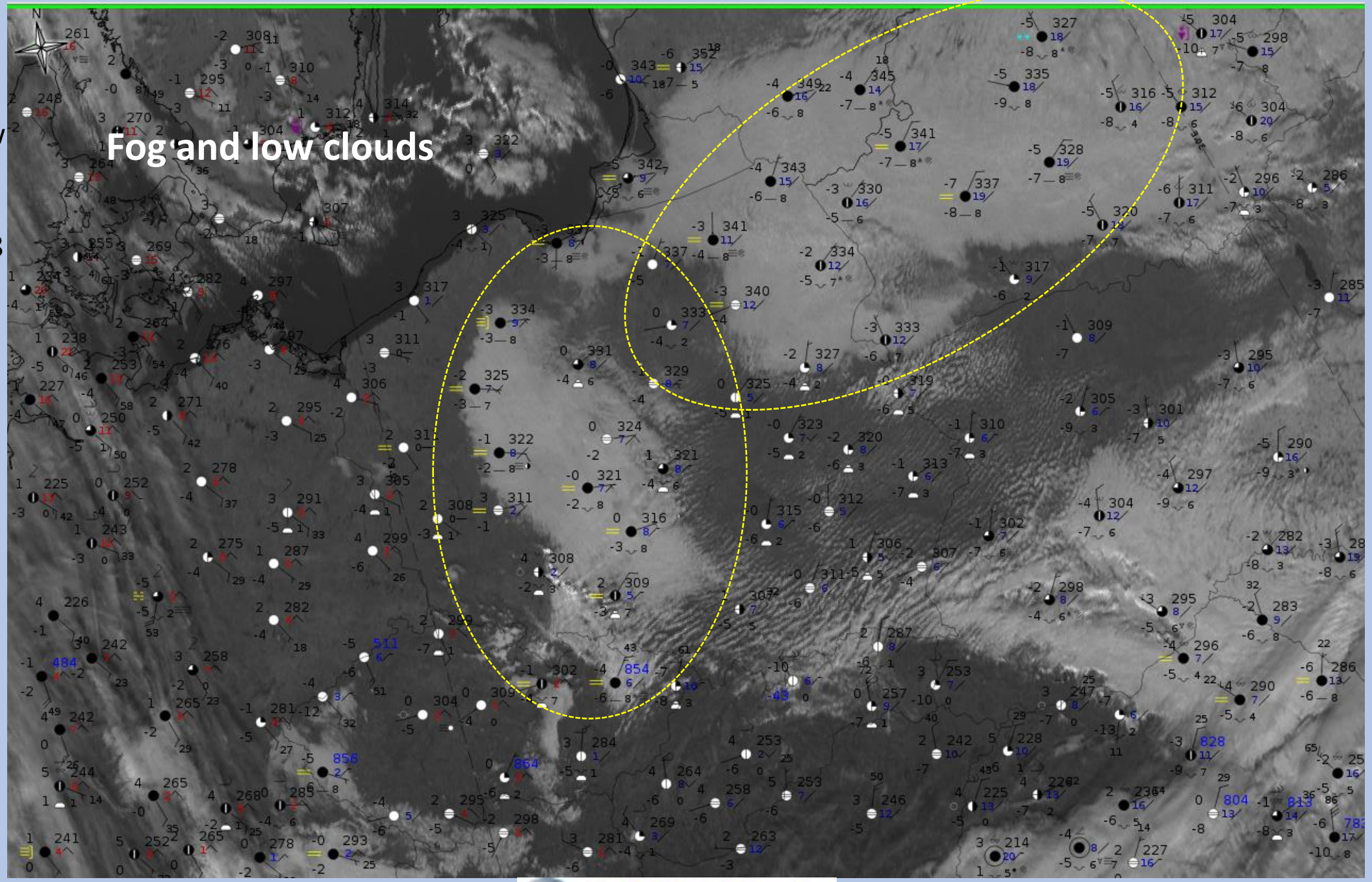
Monitoring fog and low clouds

28/11 2018
12 UTC



Meteosat HRV

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Monitoring fog and low clouds

28/11 2018
06 UTC

Fog and low clouds

Night micro physics RGB

Colour	Channel (difference)	Physically relates to	Smaller contribution to the signal of	Larger contribution to the signal of
Red	IR12.0–IR10.8	Cloud optical thickness	Thin clouds	Thick clouds
Green	IR10.8–IR3.9	Cloud phase	Thin ice clouds	Thick fog/water clouds
Blue	IR10.8	Cloud top temperature Land sea temperature	Cold clouds	Warm surface Warm clouds

Notation: IR: infrared, number: central wavelength of the channel in micrometer.

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Ballooning in Hilly or Mountainous areas

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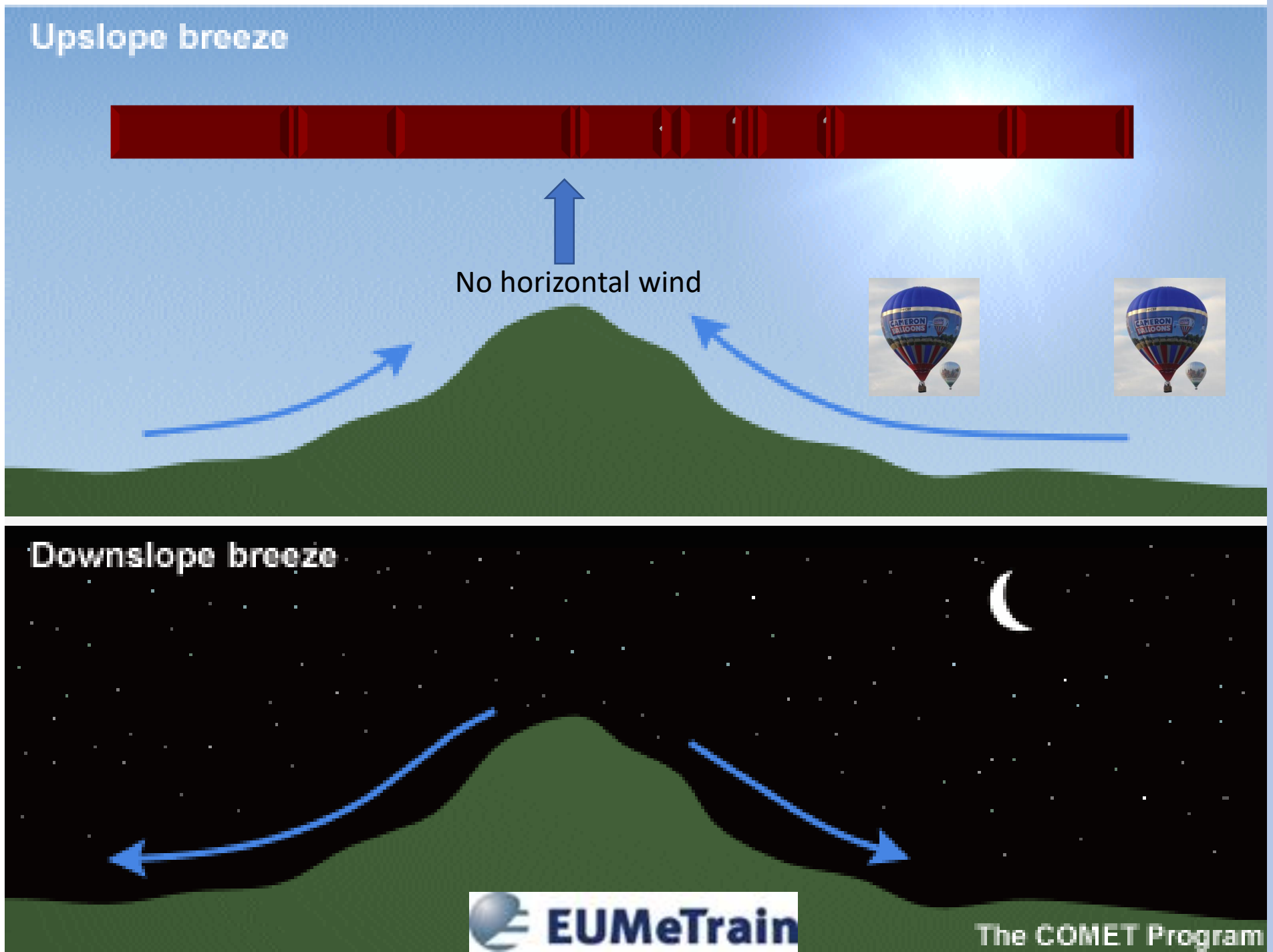
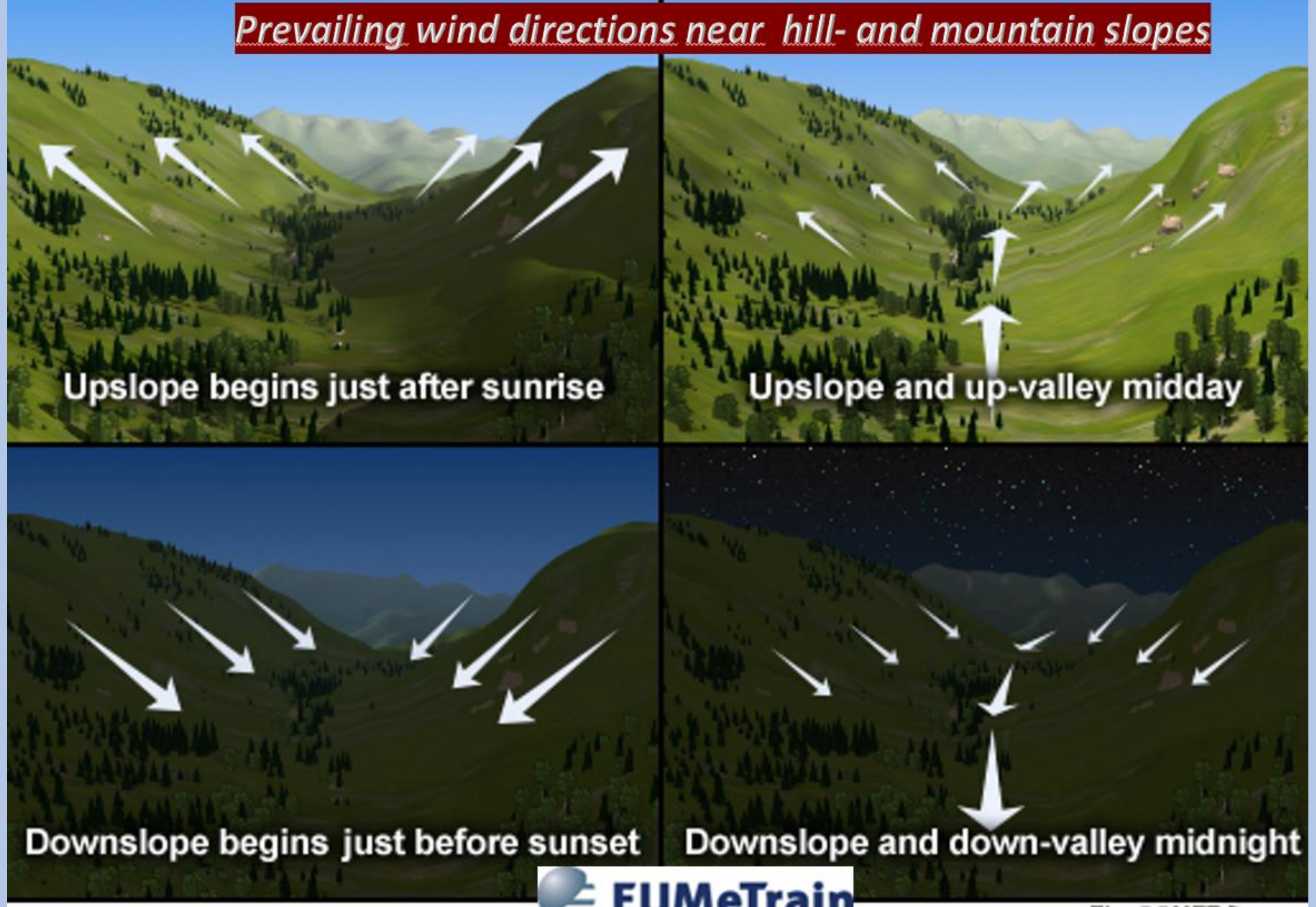
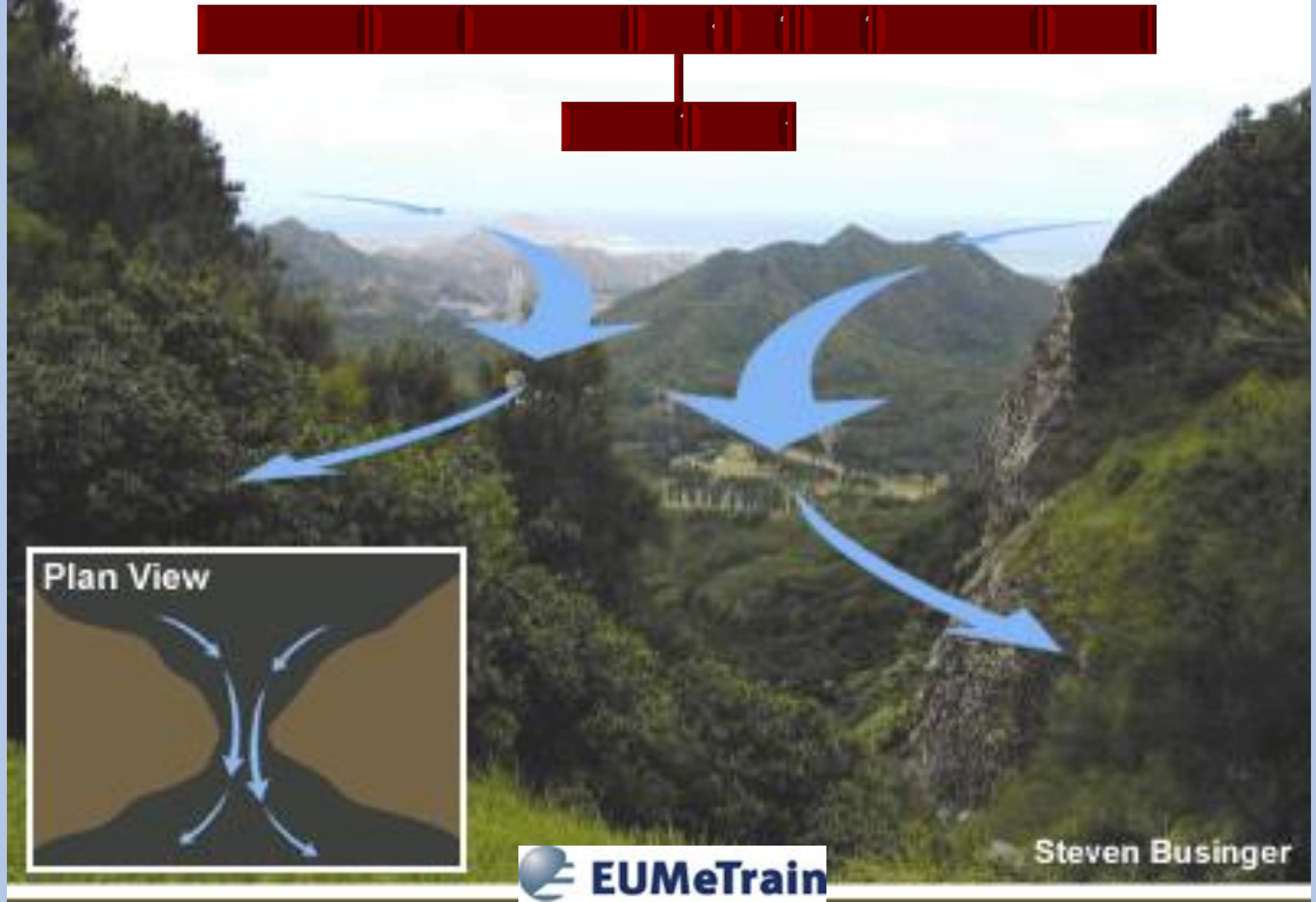

Upslope breeze
No horizontal wind
Downslope breeze
EUMeTrain
The COMET Program

Prevailing wind directions near hill- and mountain slopes




Plan View
Steven Businger
EUMeTrain

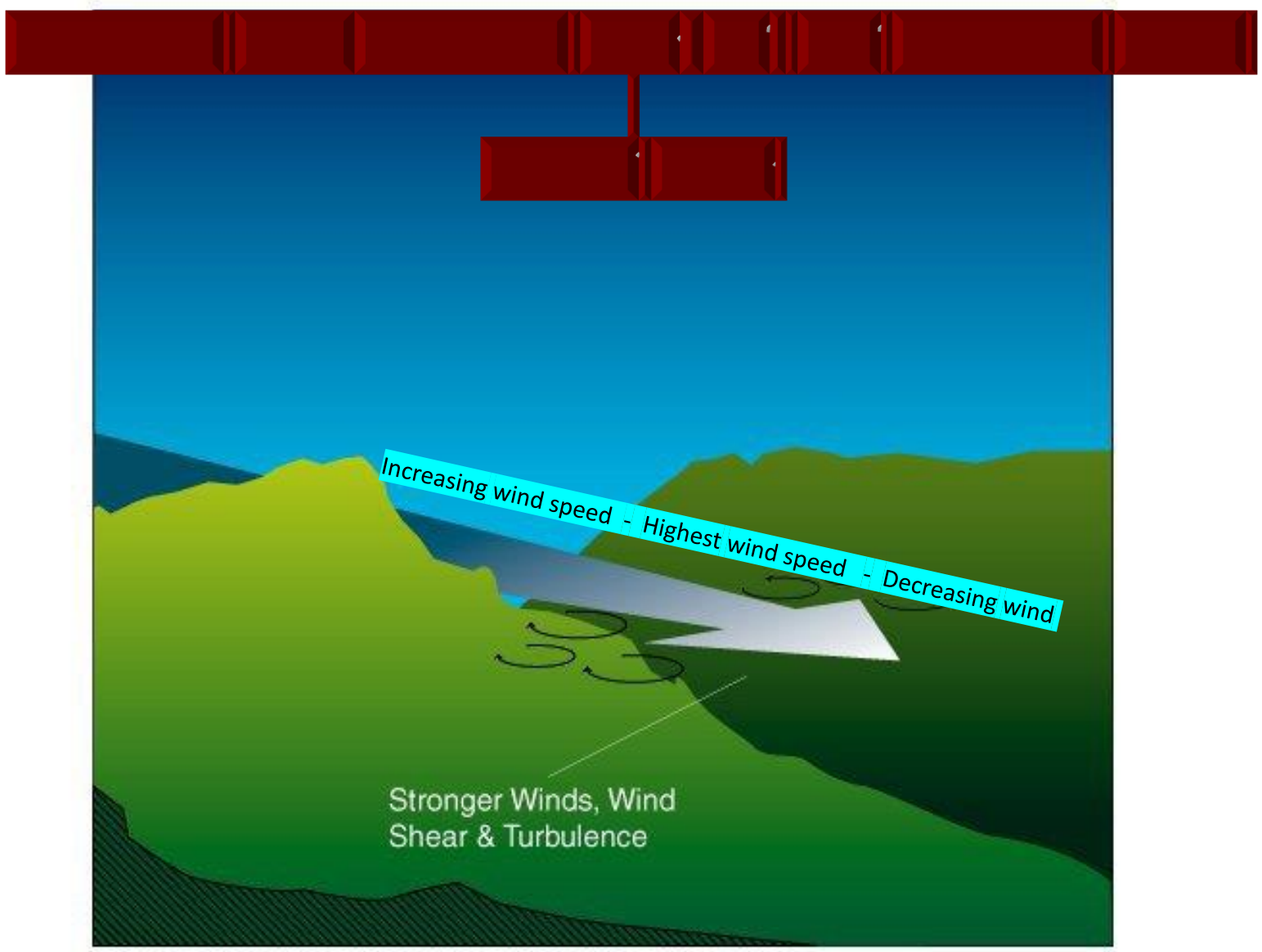


FIG 12-06B

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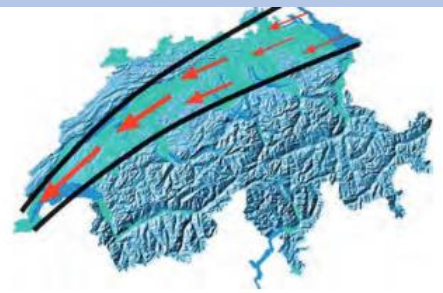
Bise



Mountain crossing and turbulence

- 20kt
- Rule of thumb:
- Safe Separation from Mountain top:
- 100 ft per kt
- Example: wind at top 50 kt
- Then 5000 ft separation from top

Gasballoon races Gordon Bennett

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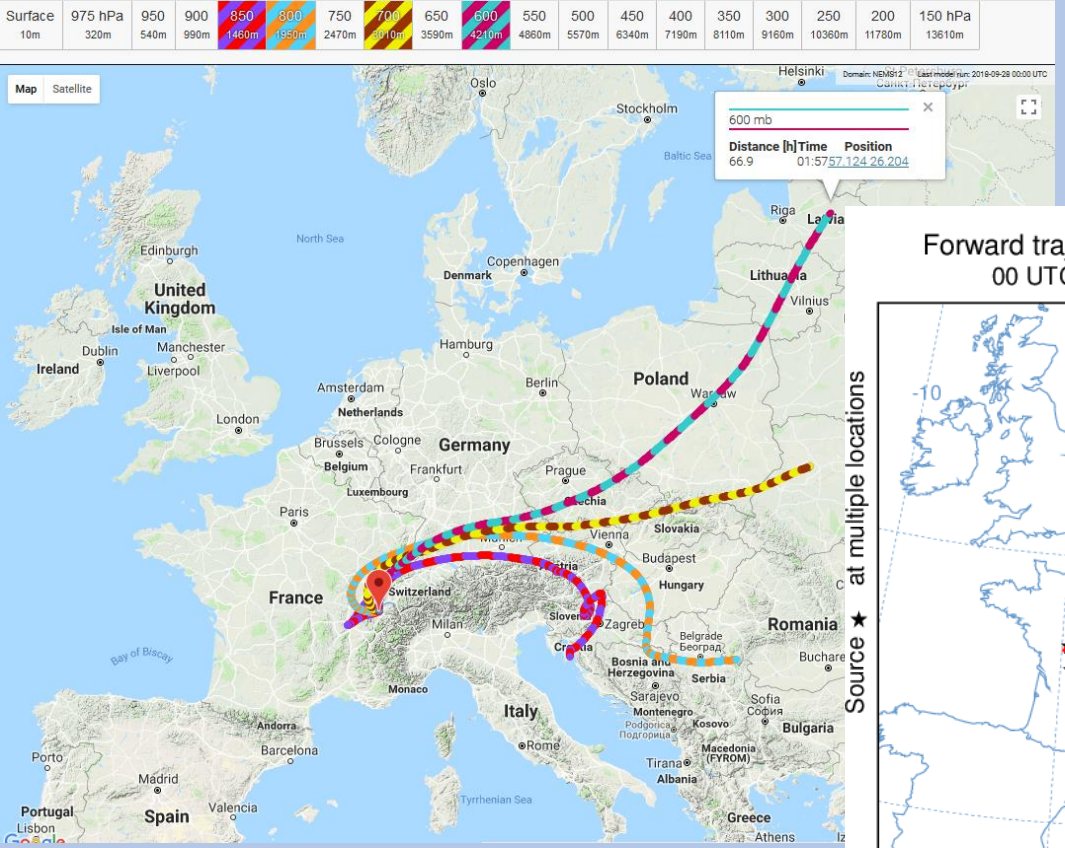
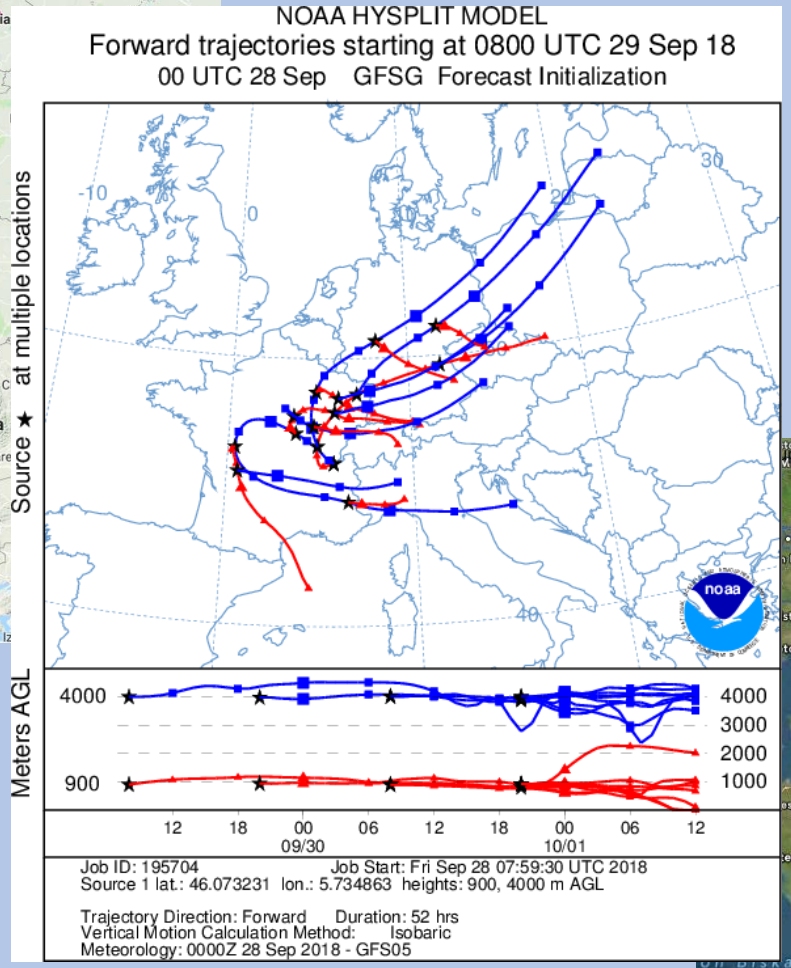
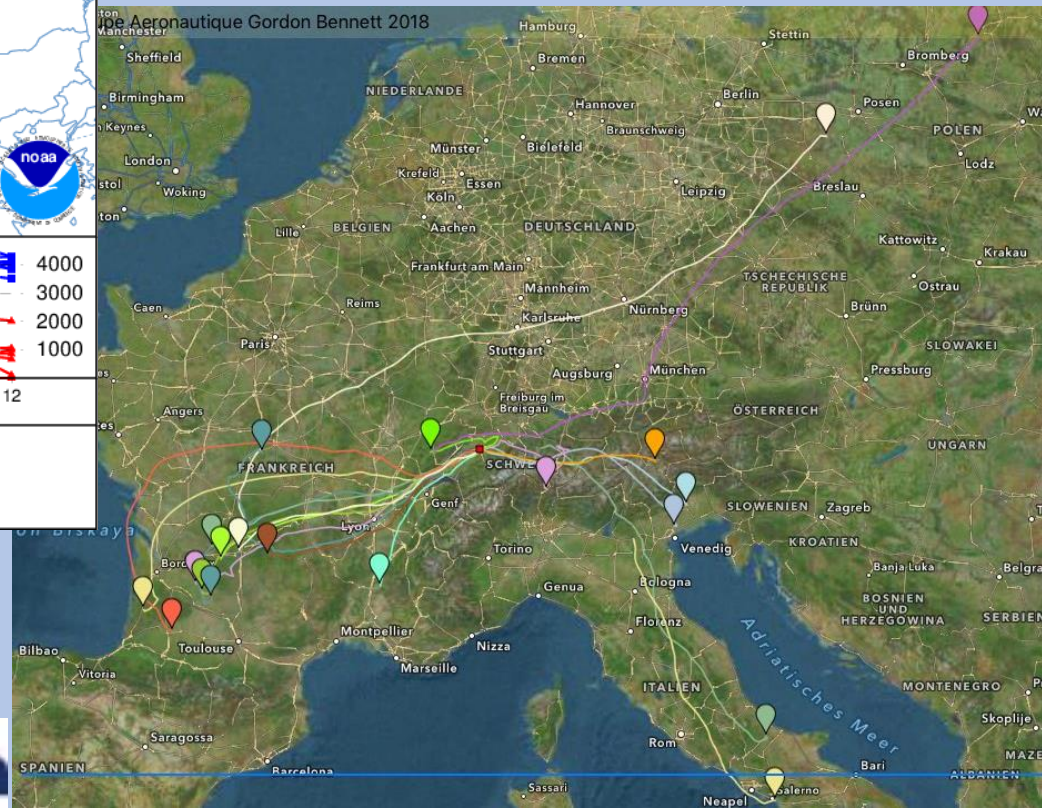
Gasballoon races Gordon Bennett







Trajectories and tracks

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Hot air balloon contests
Monitoring the wind in the lower layers
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Wind reader
Theodolite

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Thank you for your attention