Observational and numerical study of a giant hailstorm in Attica, Greece, on October 4, 2019

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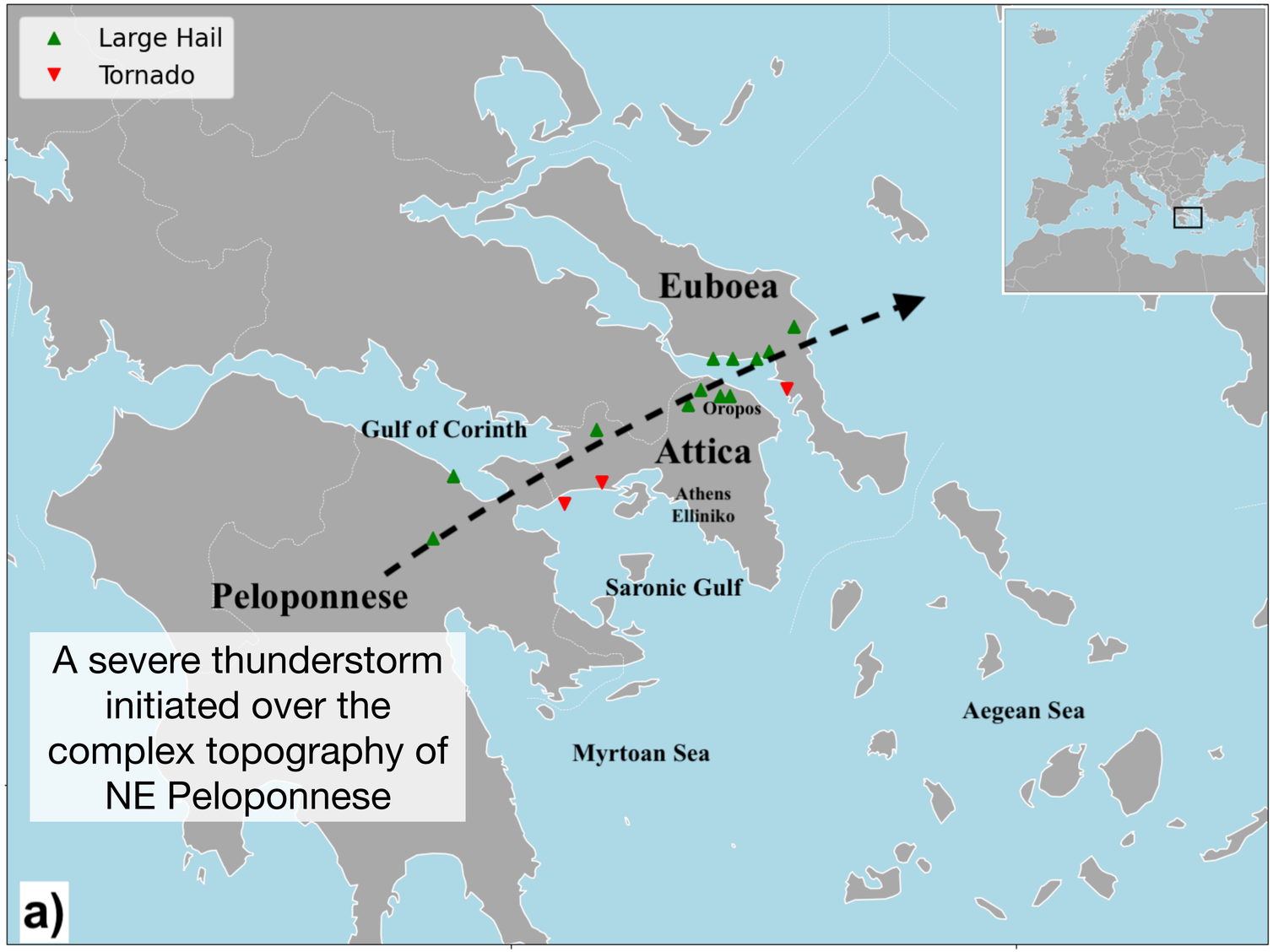
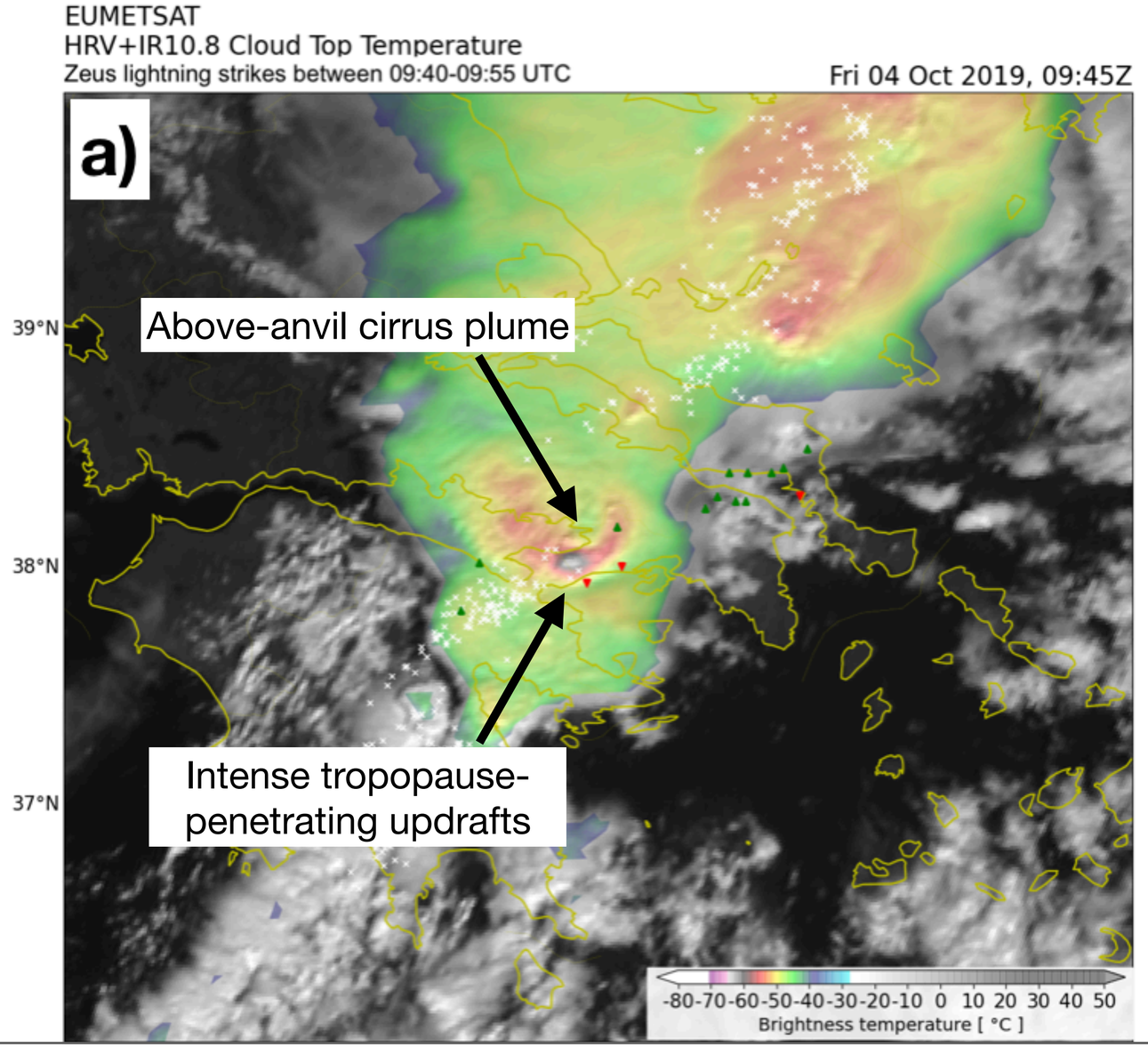
Hail and tornado reports

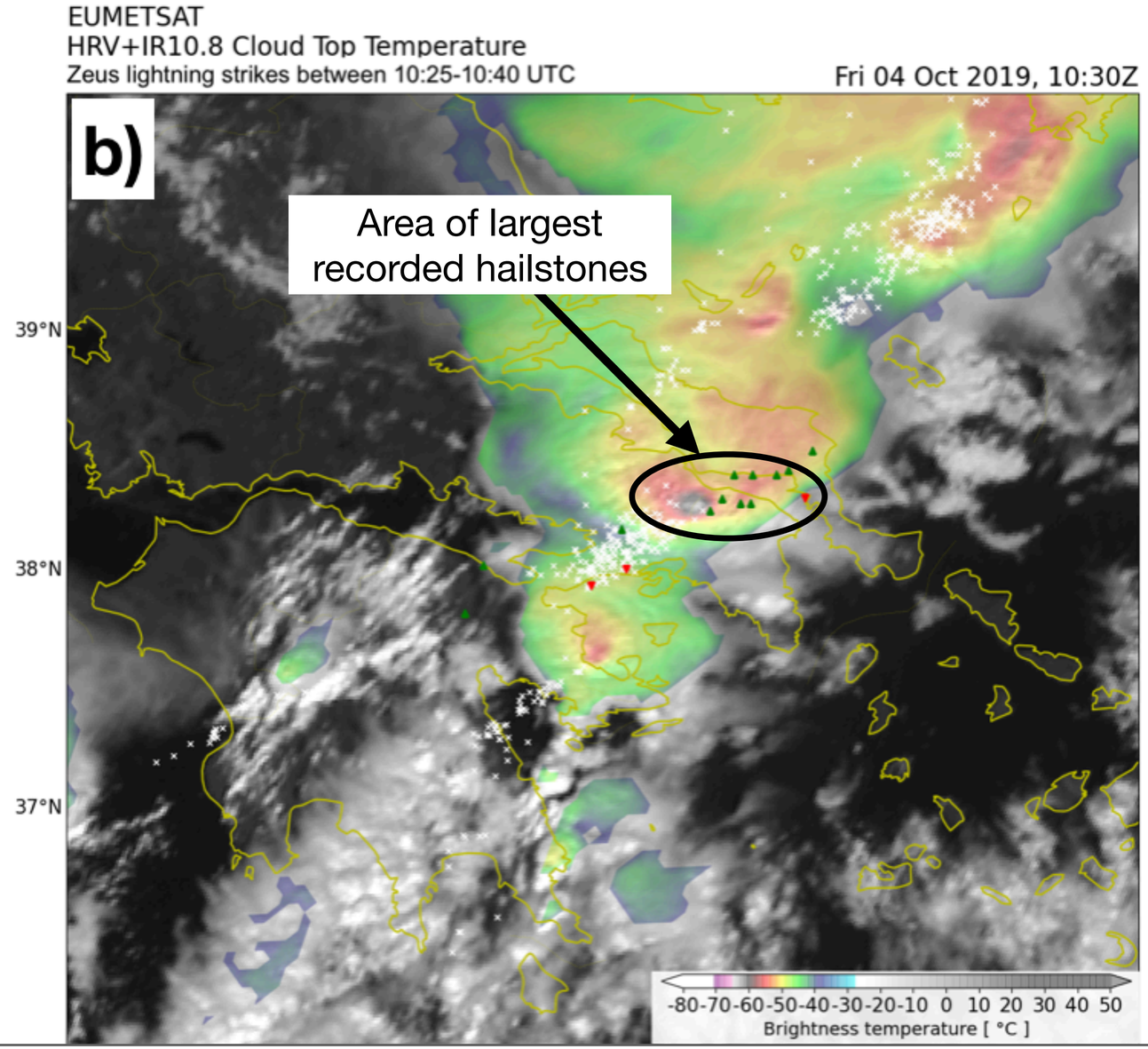


Giant hailstones in Oropos, Attica

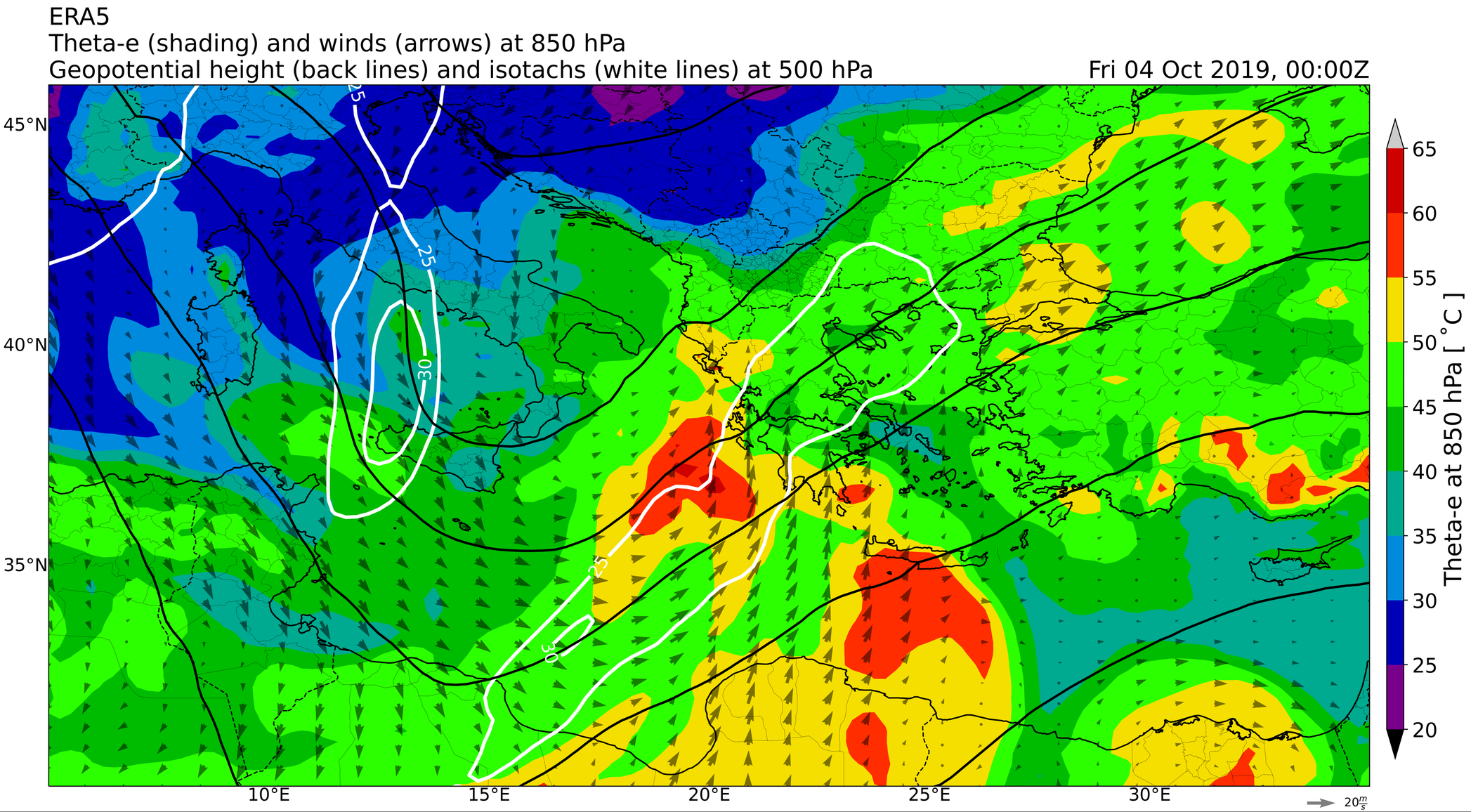
SEVIRI view of the severe convective storm



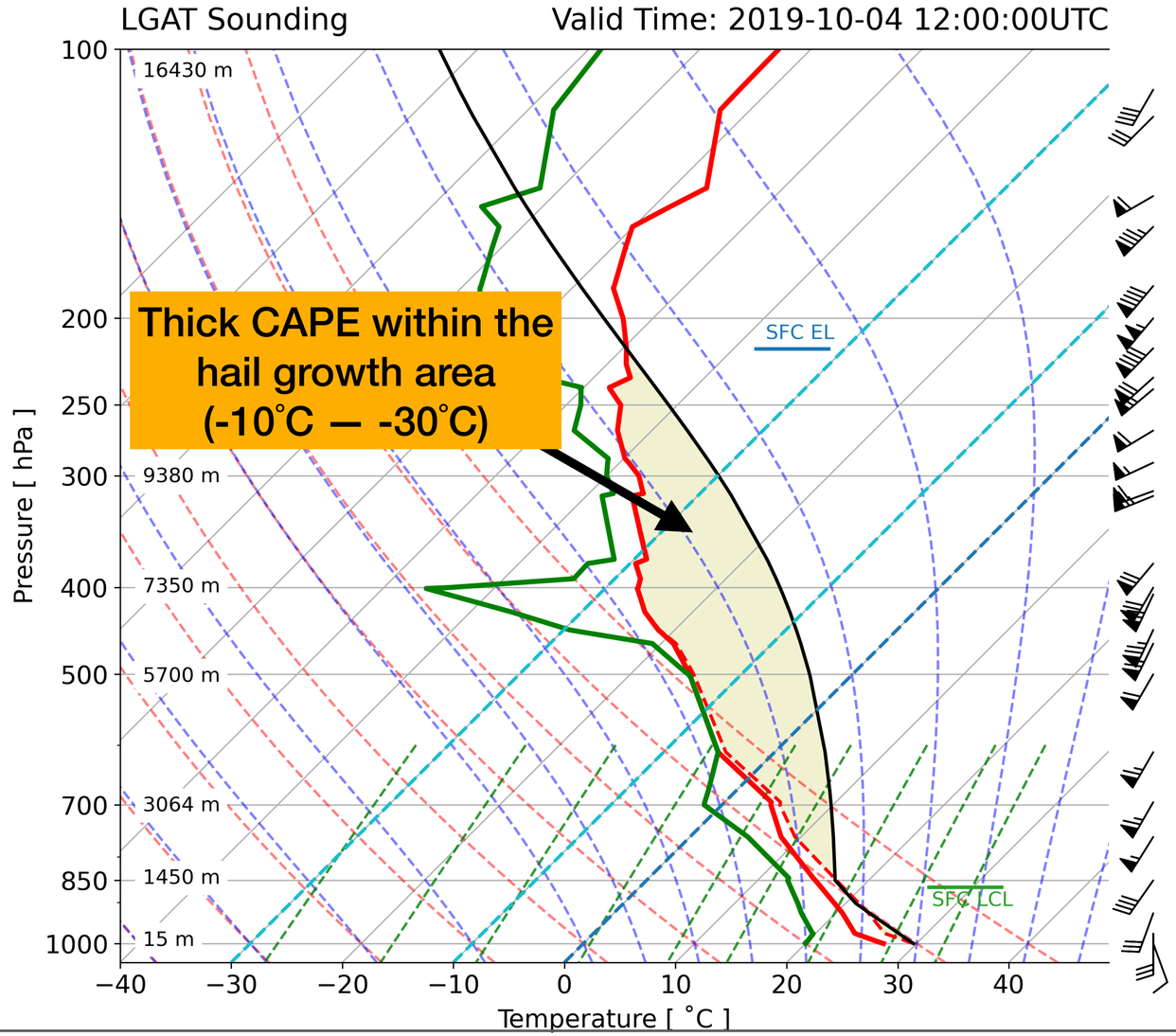
SEVIRI view of the severe convective storm



Synoptic conditions



Observed mesoscale conditions



SBCAPE = 2981 J/kg
MLCAPE = 2773 J/kg
MUCAPE = 2981 J/kg

SBCIN = 0 J/kg
MLCIN = -33 J/kg
MUCIN = 0 J/kg

SBLCL = 868 hPa
MLLCL = 878 hPa
MULCL = 868 hPa

SB EL = 11574 m
ML EL = 11388 m
MU EL = 11574 m

BS0-6 km = 30 m/s
BS0-3 km = 30 m/s
BS0-1 km = 13 m/s

SFC LI = -10 ˚C
ML LI = -10 ˚C
MU LI = -10 ˚C

Lapse rate 850-500 hPa = 7.0 ˚C/km
Bunkers right = 226/45 kn
Bunkers left = 193/53 kn

TT index = 57
K index = 36 ˚C
SCP = 13.6
STP = 2.3

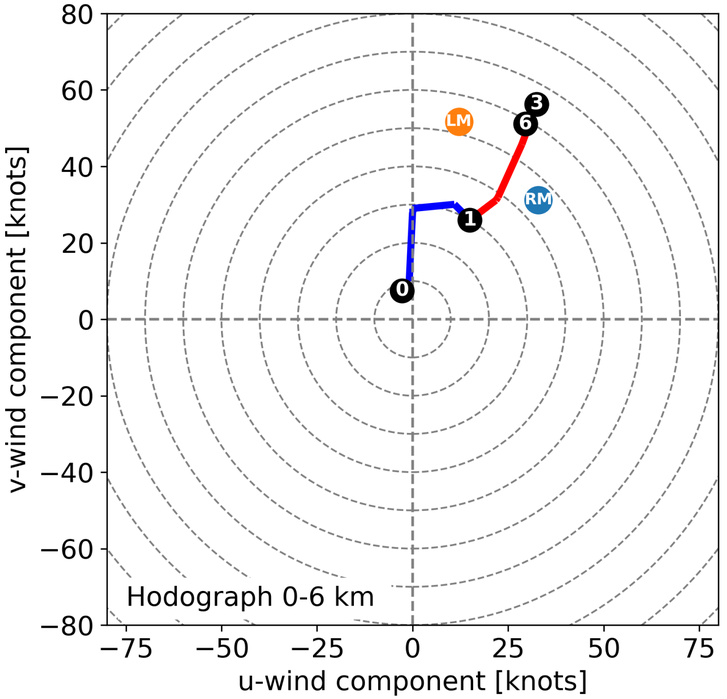
WMAXSHEAR_SB = 2386 m^2/s^2
WMAXSHEAR_ML = 2301 m^2/s^2
WMAXSHEAR_MU = 2386 m^2/s^2

SREH 0-1 km = 147 m^2/s^2
SREH 0-3 km = 227 m^2/s^2
EHI 0-1 km = 2
EHI 0-3 km = 4

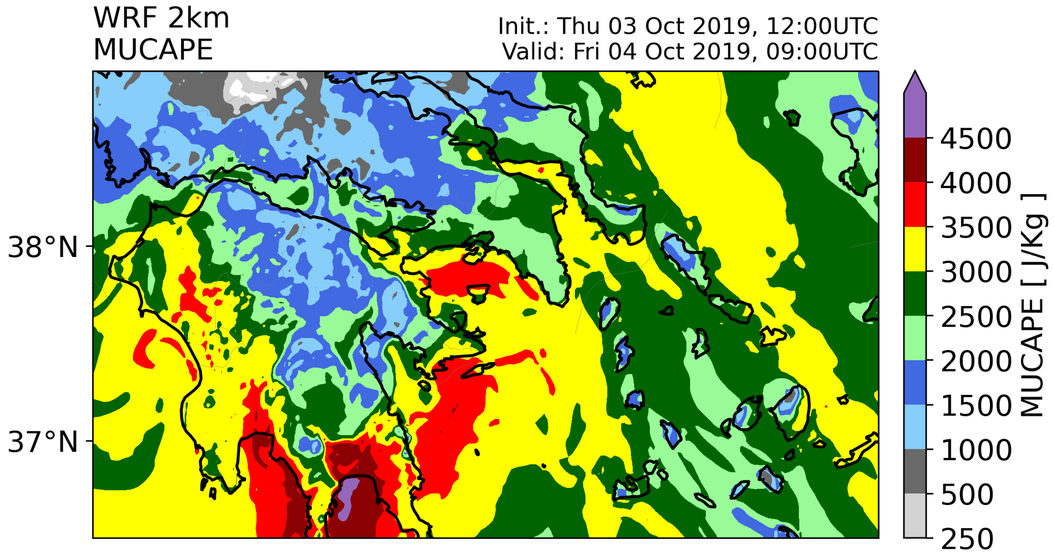
T 500 hPa = -14.7 ˚C
T 700 hPa = 4.4 ˚C
T 850 hPa = 15.2 ˚C

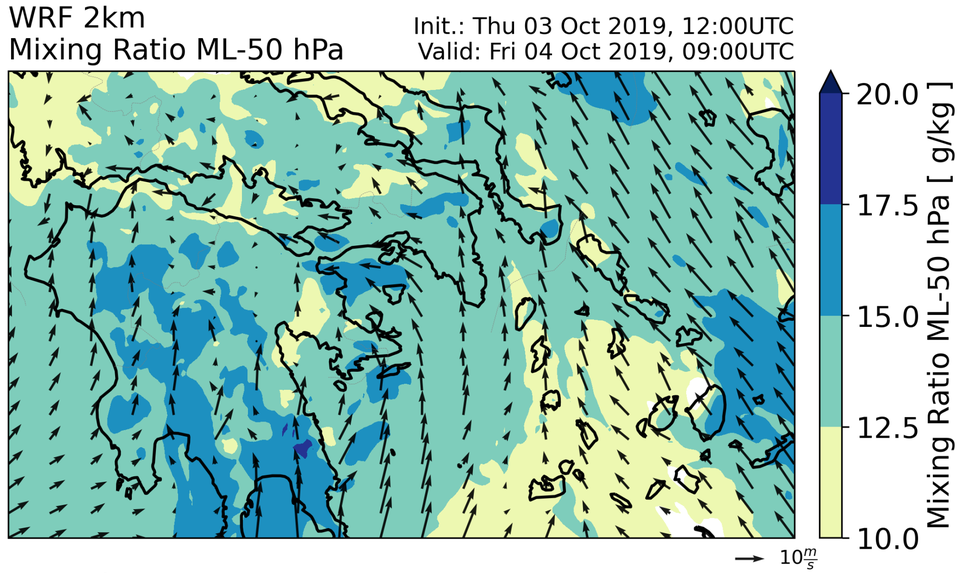
TH 1000-500 = 5685 gpm
TH 1000-700 = 3049 gpm
TH 1000-850 = 1435 gpm

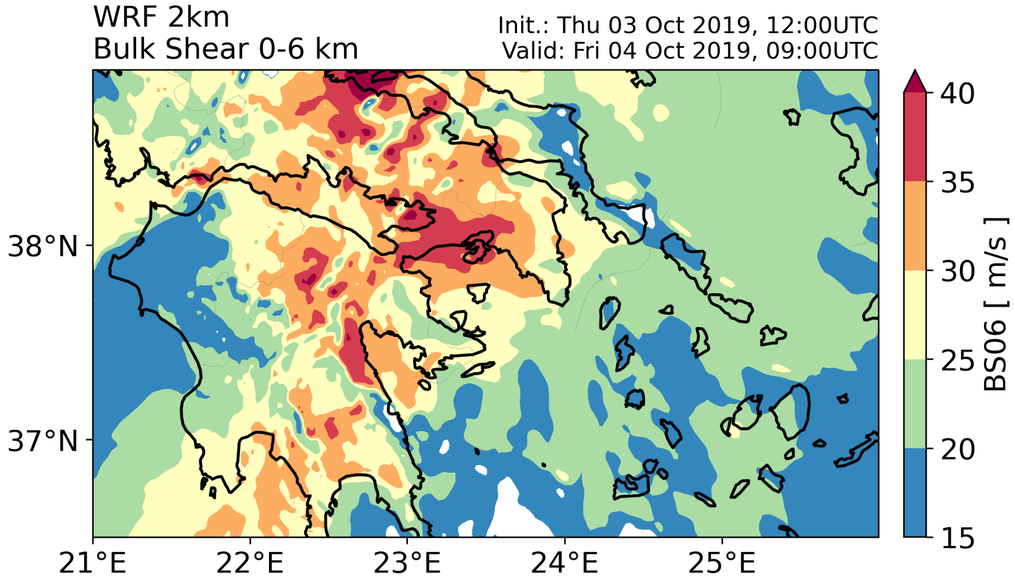
Freezing level = 3573 m
PW = 42 mm

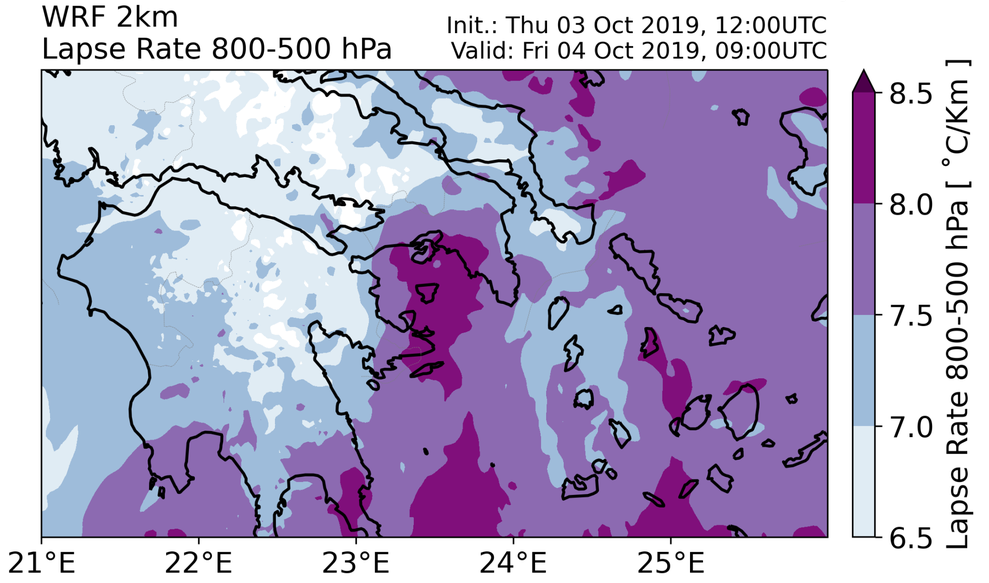


Simulated mesoscale conditions

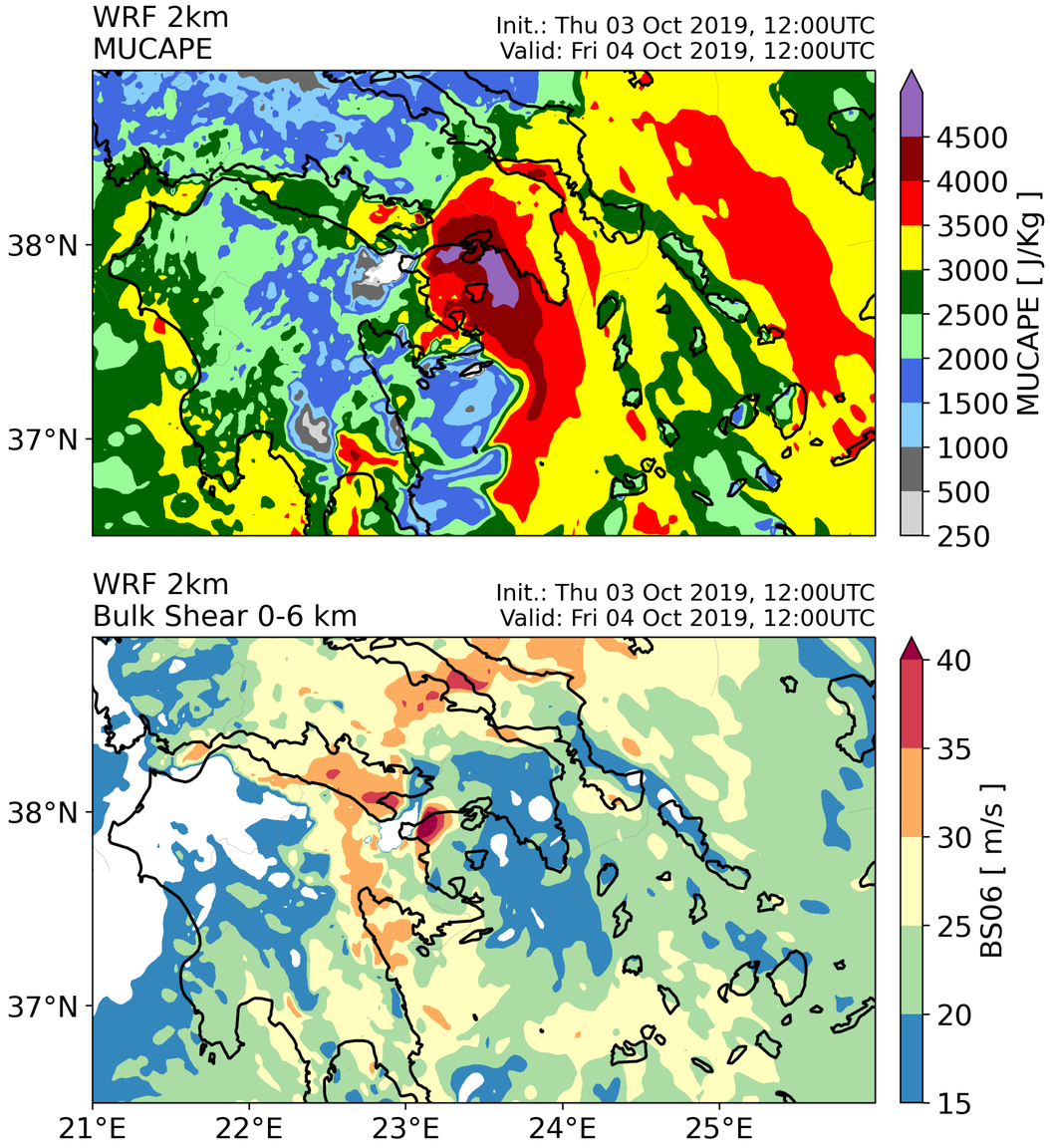


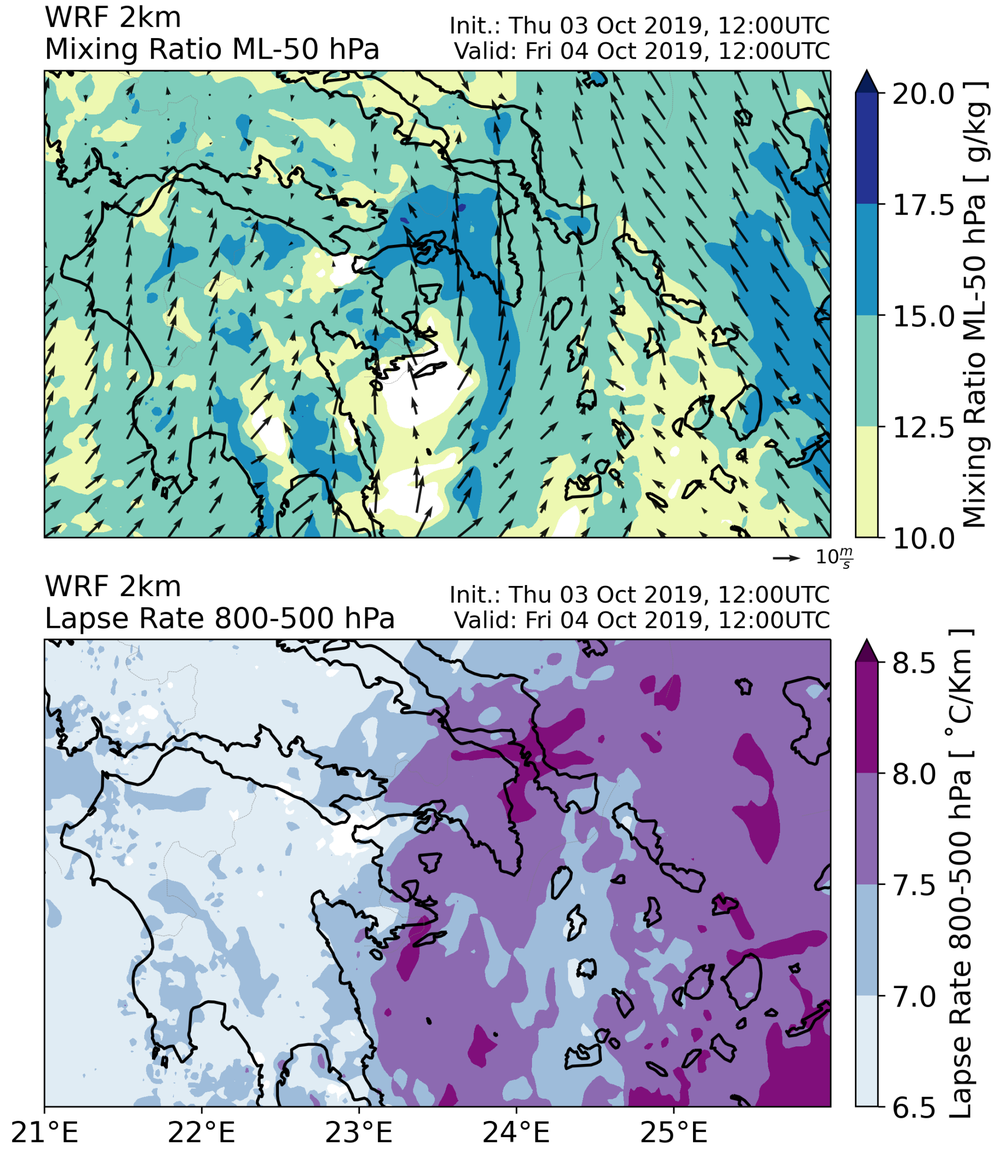






Simulated mesoscale conditions





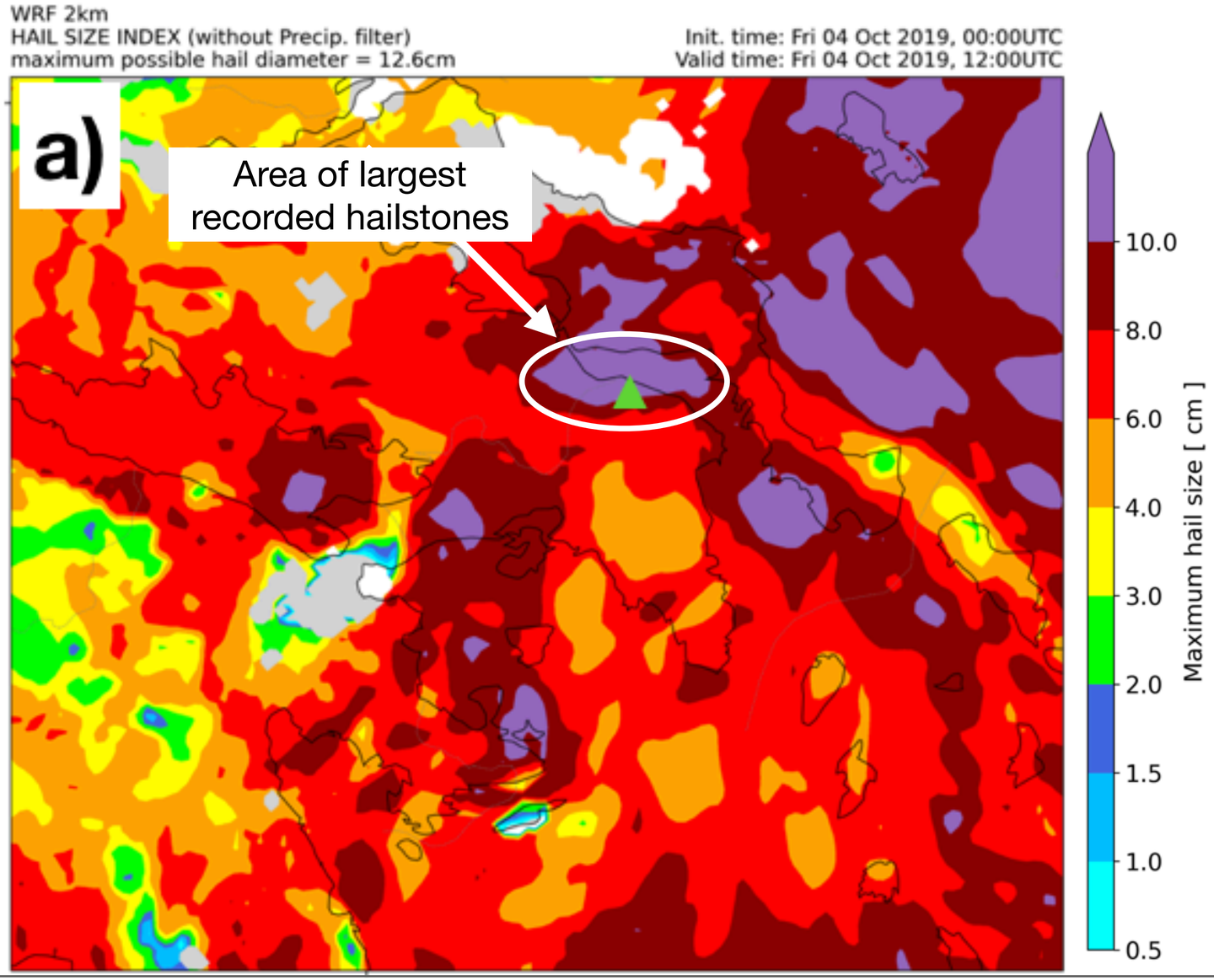
Forecasting hail size

We use Hail Size Index (HSI) developed by Taszarek:

$$HSI = \frac{\sqrt{10(CAPE-200)} \times (BS-5) \times (7000-FL+LCL)}{194000} \times \sqrt{EL \times \frac{(LR-4)^2}{10000000}}$$

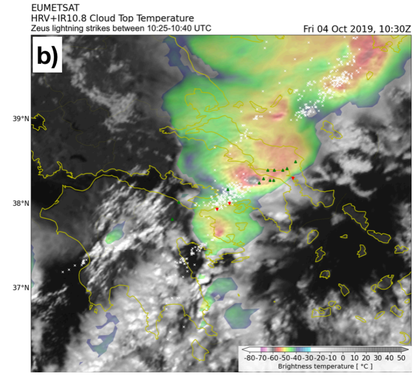
See also:
Taszarek et al., 2017 and
Czernecki et al. (2019)

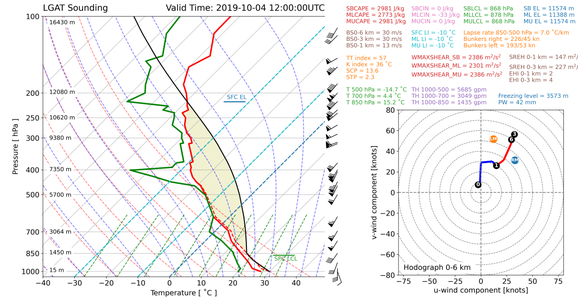
Forecasting hail size

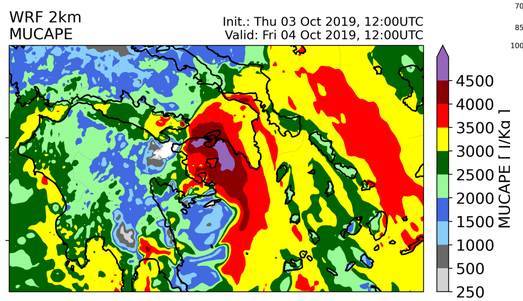


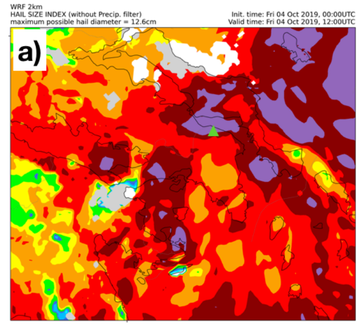
Summary and conclusions

- Long lived severe thunderstorm initiated over the complex topography of NE Peloponnese produced numerous large hail reports along its path
- High resolution simulations were able to reproduce the mesoscale environment
- Using a hail size diagnostic tool we quantify the maximum potential hail size
- We find spatially qualitatively and quantitatively consistent results to observations
- This work illustrates the added value of using diagnostic tools over an ensemble of high resolution simulations for predicting severe convective events & developing early warning systems
- Further work needs to be done in the direction of evaluating such diagnostic tools given the increased number of severe convective reports in databases (ESWD) which allows a forecast verification









Papavasileiou et al. (under review in Atmospheric Research)

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