South England Downbursts Part 1: 23 October 2022

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NOAA/NESDIS/STAR
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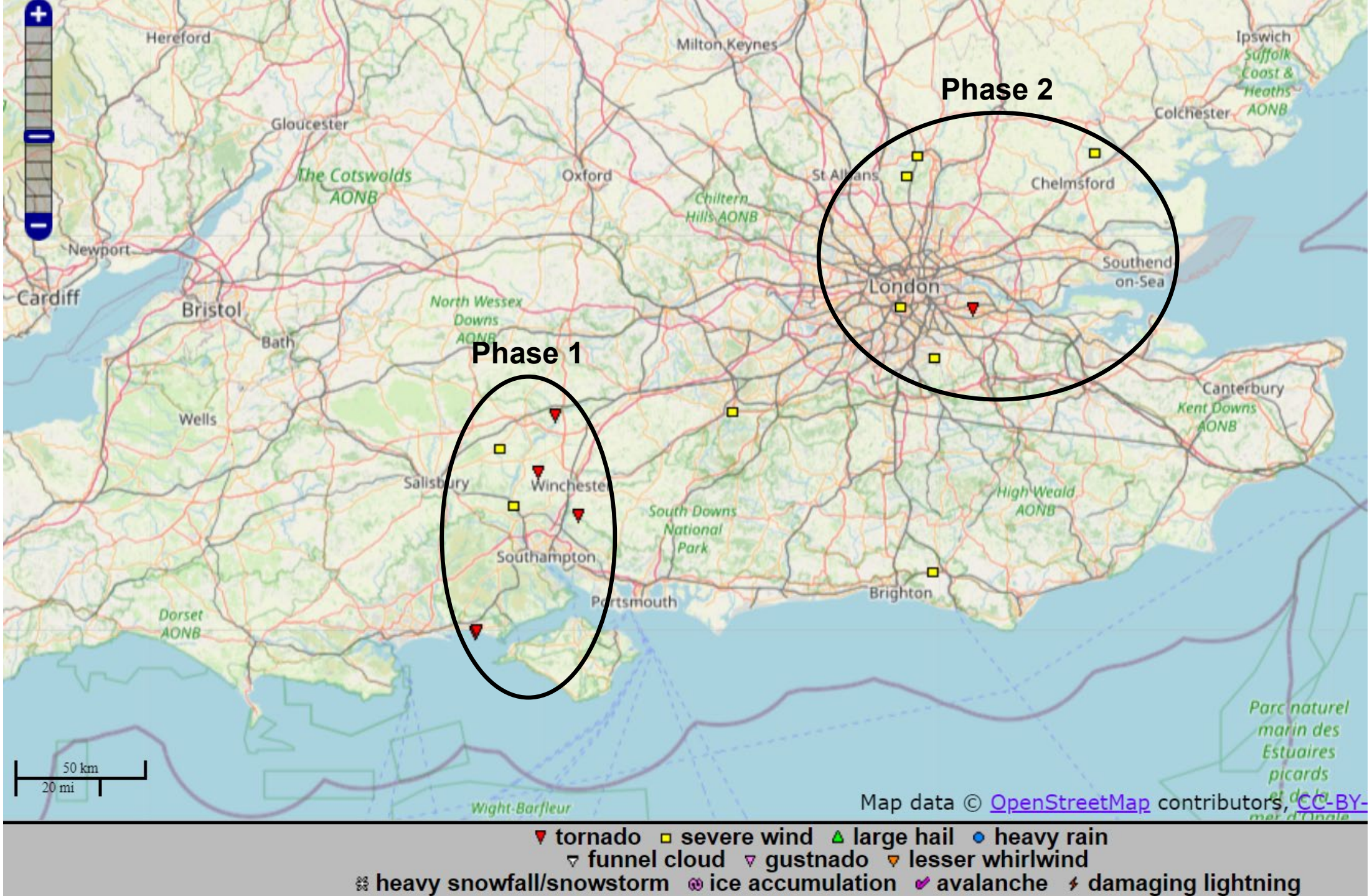
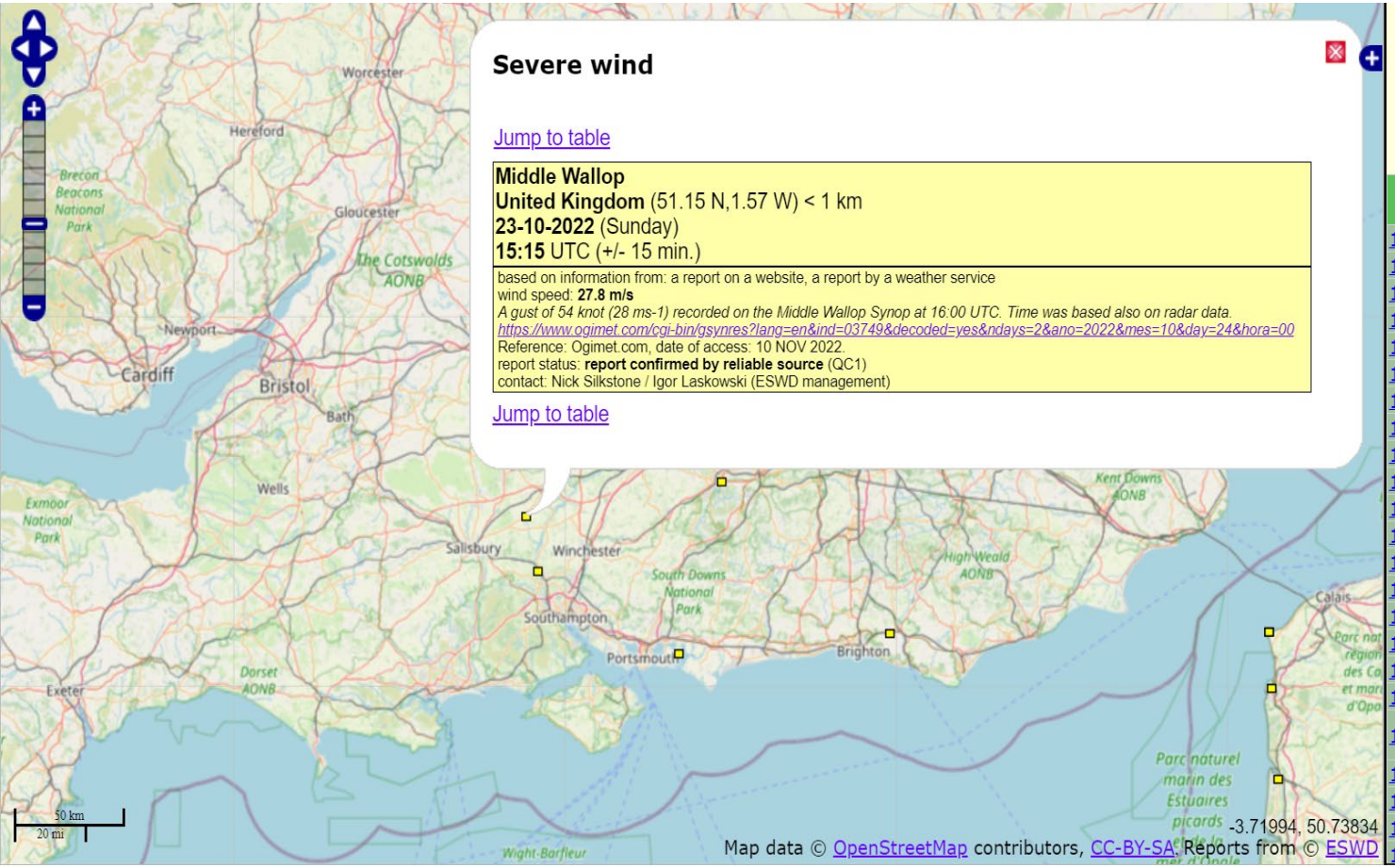
Matthew Clark, UK Met Office
David Flack, UK Met Office
Simon Culling, TORRO


Phase 2
Phase 1
Hereford
Gloucester
The Cotswolds AONB
Oxford
Milton Keynes
Chiltern Hills AONB
St Albans
Chelmsford
Colchester
Ipswich
Suffolk Coast & Heaths AONB
Newport
Cardiff
Bristol
Bath
North Wessex Downs AONB
London
Southend on-Sea
Wells
Salisbury
Winchester
Southampton
South Downs National Park
High Weald AONB
Canterbury
Kent Downs AONB
Portsmouth
Brighton
Dorset AONB
Wight-Barfleur
Parc naturel marin des Estuaires picards
50 km
20 mi
Map data © OpenStreetMap contributors, CC-BY-
tornado
severe wind
large hail
heavy rain
funnel cloud
gustnado
lesser whirlwind
heavy snowfall/snowstorm
ice accumulation
avalanche
damaging lightning

Downburst Wind Observation



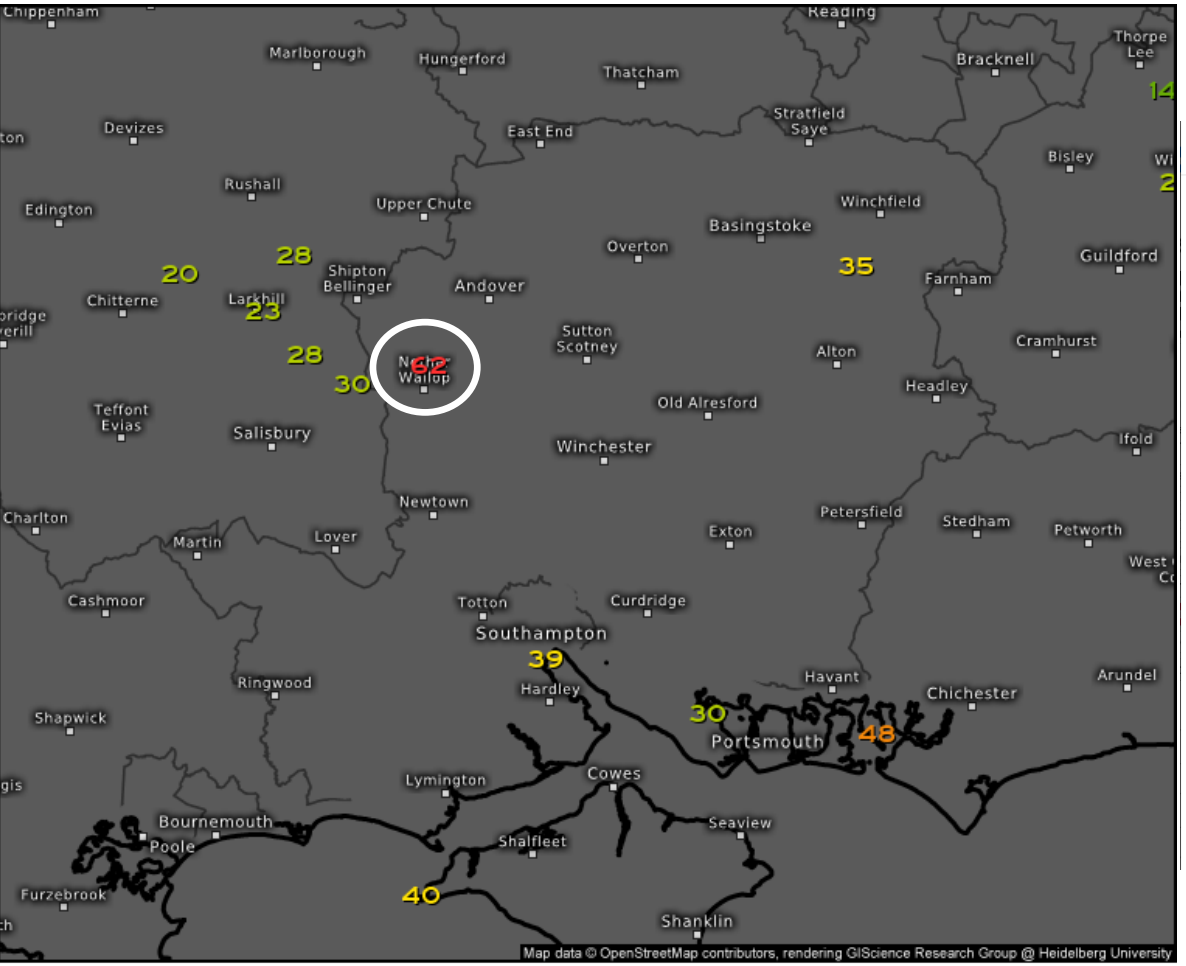
03749: Middle Wallop (United Kingdom)

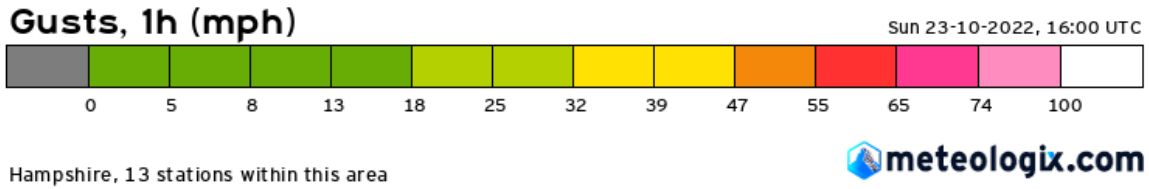
Latitude: 51-09N Longitude: 001-34W Altitude: 91 m.

Decoded synop data. (23:53 mean solar time)
Time interval: 2 days before 2022/10/24 at 00:00 UTC.

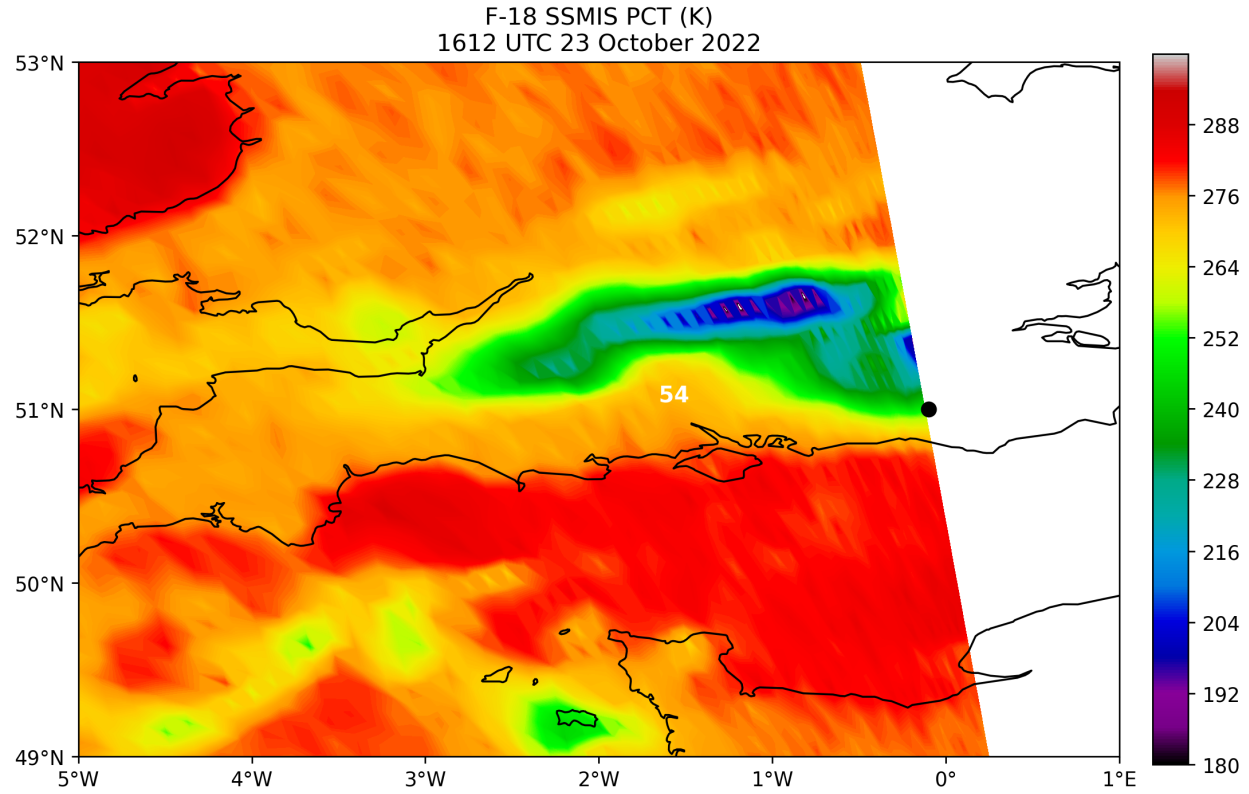
Date	T (C)	Td (C)	Hr %	Tmax (C)	Tmin (C)	ddd	ff kmh	Gust kmh	P0 hPa	P sea hPa	P Tnd	Prec (mm)	N t	N h	H Km	Vis km	WW	W1	W2
10/24/2022 00:00	12.5	12.1	97	-----	-----	W	9.3	18.5	982.3	993.0	-1.5	6.0/6h	7	7	0.1	45.0			
10/23/2022 23:00	13.3	12.5	95	-----	-----	SSW	11.1	42.6	982.3	993.0	-1.9	1.0/1h	8	8	0.1	11.0			
10/23/2022 22:00	12.9	12.3	96	-----	-----	SE	13.0	20.4	983.1	993.8	-2.2	1.0/1h	8	8	0.2	5.0			
10/23/2022 21:00	13.0	12.2	95	18.2	10.9	SSE	16.7	24.1	983.8	994.4	-2.0	19.0/12h	8	8	0.1	24.0			
10/23/2022 20:00	12.9	12.1	95	-----	-----	CAL	5.6	7.4	984.2	994.9	-0.9	0.0/1h	8	8	0.3	22.0			
10/23/2022 19:00	11.9	11.4	97	-----	-----	SSE	7.4	11.1	985.3	996.0	+0.0	0.0/1h	5	5	1.0	14.0			
10/23/2022 18:00	12.2	11.4	95	18.2	10.9	S	13.0	25.9	985.7	996.4	-0.5	23.0/12h	8	8	2.0	19.0			
10/23/2022 17:00	12.3	11.2	93	-----	-----	S	22.2	31.5	985.1	995.8	-1.6	0.0/1h	8	8	0.6	22.0			
10/23/2022 16:00	12.1	11.6	97	-----	-----	NE	5.6	100.1	985.3	996.0	-2.8	18.0/1h	8	8	0.1	75.0			
10/23/2022 15:00	16.3	13.3	82	-----	-----	SSE	13.0	27.8	986.1	996.7	-3.2	0.0/1h	8	8	1.5	23.0			
10/23/2022 14:00	17.8	13.1	74	-----	-----	SE	16.7	27.8	986.6	997.1	-3.2	0.0/1h	8	8	0.3	50.0			
10/23/2022 13:00	17.9	13.5	75	-----	-----	S	18.5	24.1	988.0	998.5	-1.7	0.0/1h	6	6	0.3	50.0			
10/23/2022 12:00	17.2	13.3	78	-----	-----	SSE	16.7	25.9	989.3	999.8	-0.3	5.0/6h	8	8	0.3	65.0			
10/23/2022 11:00	16.6	13.6	82	-----	-----	S	20.4	31.5	989.7	1000.3	-0.8	0.0/1h	5	5	0.2	65.0			
10/23/2022 10:00	16.1	14.1	88	-----	-----	SE	14.8	24.1	989.6	1000.2	-1.3	0.0/1h	2	2	0.2	45.0			
10/23/2022 09:00	14.7	14.1	96	15.2	13.9	E	14.8	22.2	989.5	1000.1	-2.0	8.0/12h	8	8	0.1	40.0			
10/23/2022 08:00	14.7	14.0	96	-----	-----	E	7.4	22.2	990.5	1001.1	-1.3	2.0/1h	8	8	1.5	18.0			
10/23/2022 07:00	14.8	14.1	96	-----	-----	S	9.3	29.7	990.8	1001.5	-1.2	2.0/1h	8	8	0.1	16.0			
10/23/2022 06:00	14.7	13.8	94	15.2	13.9	ESE	16.7	22.2	991.5	1002.2	-2.4	4.2/24h 3.0/12h	8	8	0.6	10.0			
10/23/2022 05:00	15.0	13.7	92	-----	-----	E	11.1	37.1	991.7	1002.4	-3.4	2.0/1h	8	8	1.5	35.0			
10/23/2022 04:00	14.9	13.8	93	-----	-----	E	18.5	25.9	992.0	1002.7	-4.2	0.0/1h	8	8	1.5	29.0			
10/23/2022 03:00	14.5	13.7	95	-----	-----	E	13.0	18.5	993.8	1004.5	-3.5	0.0/1h	8	8	1.0	22.0			
10/23/2022 02:00	14.6	13.8	95	-----	-----	E	9.3	14.8	995.0	1005.8	-2.9	0.0/1h	8	8	1.5	23.0			

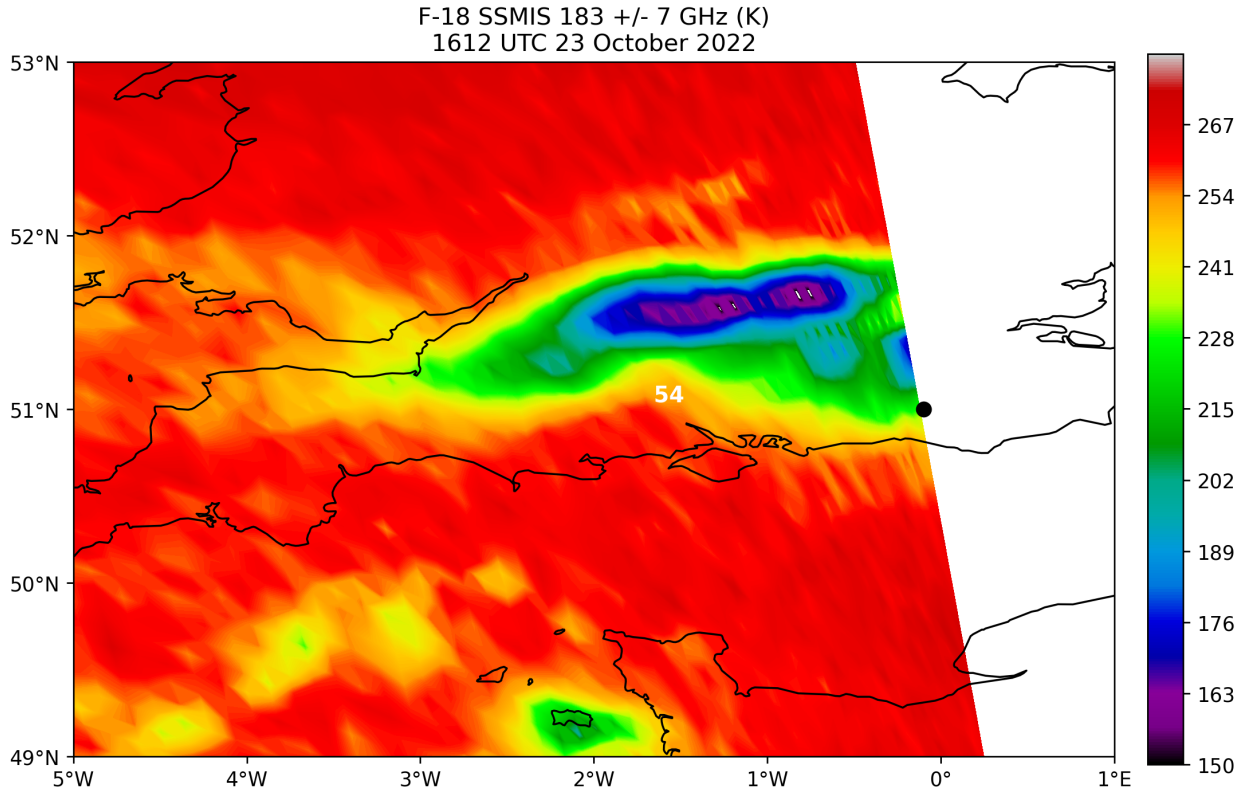
Downburst Wind Observation



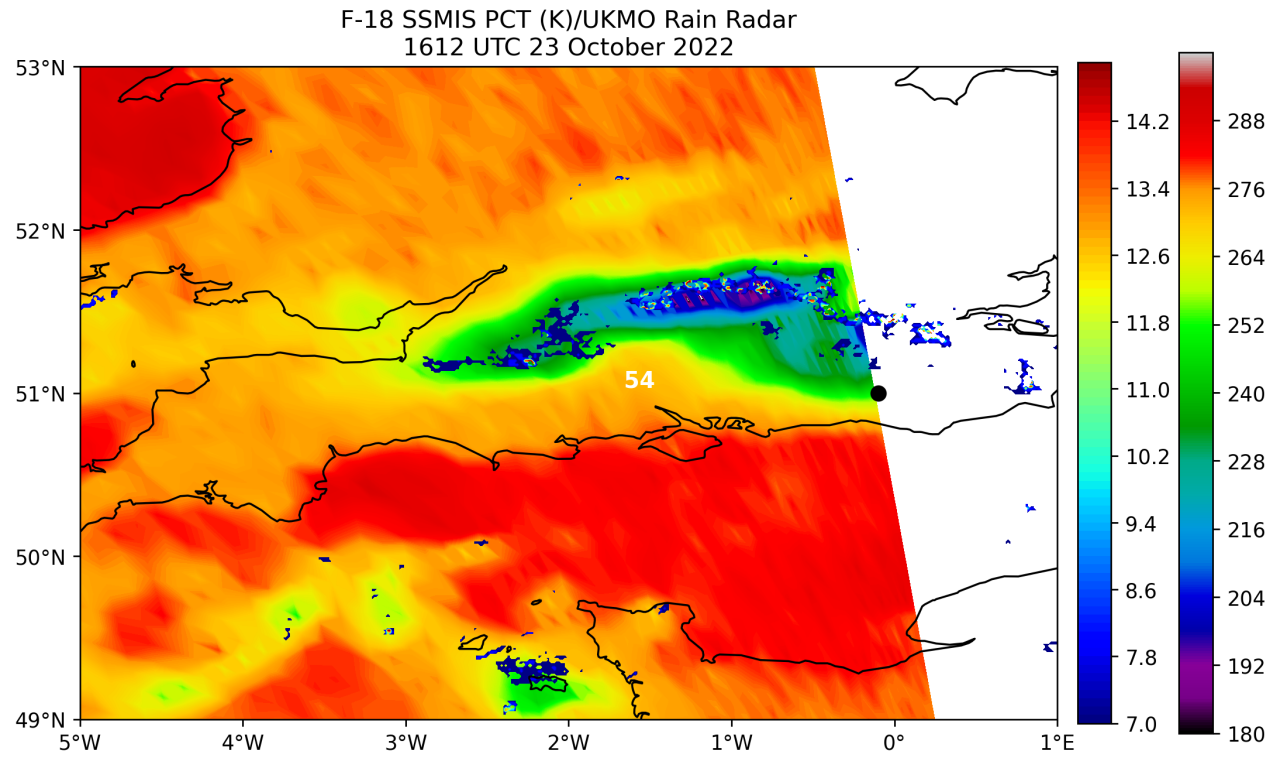


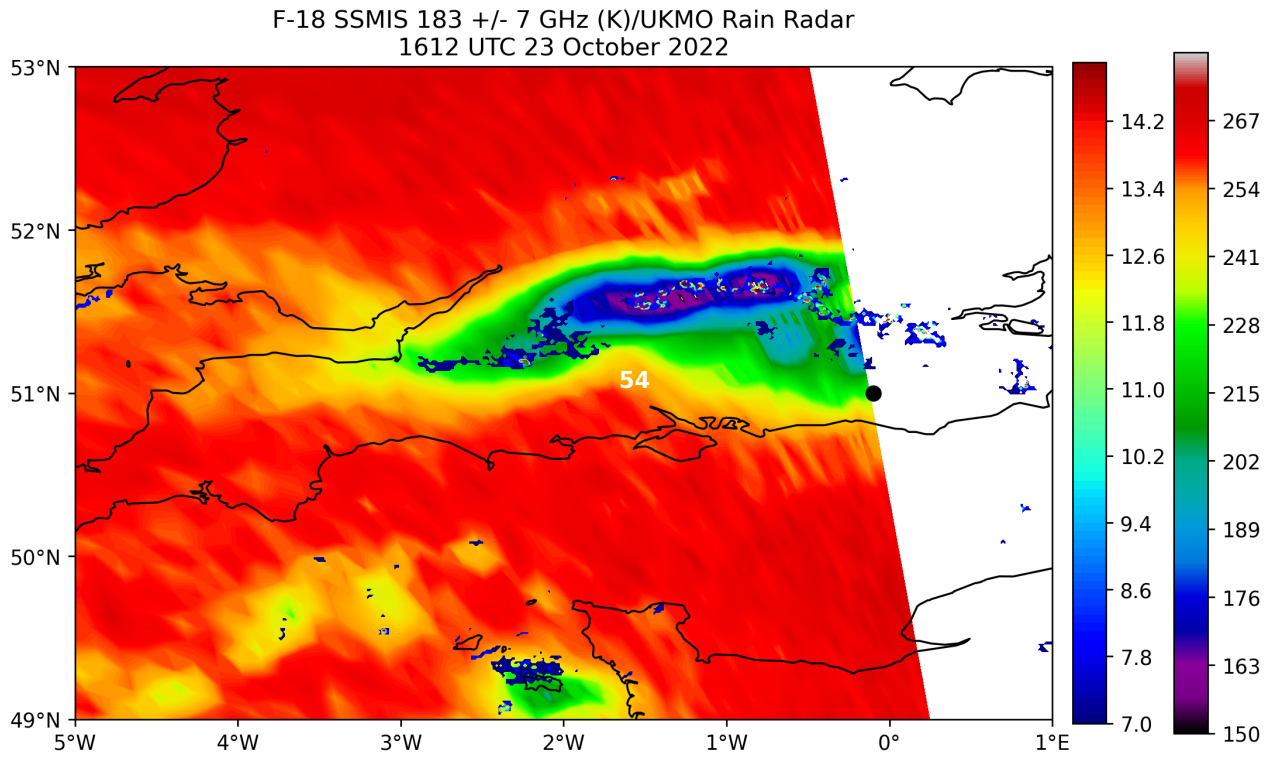
SSMIS Product Comparison



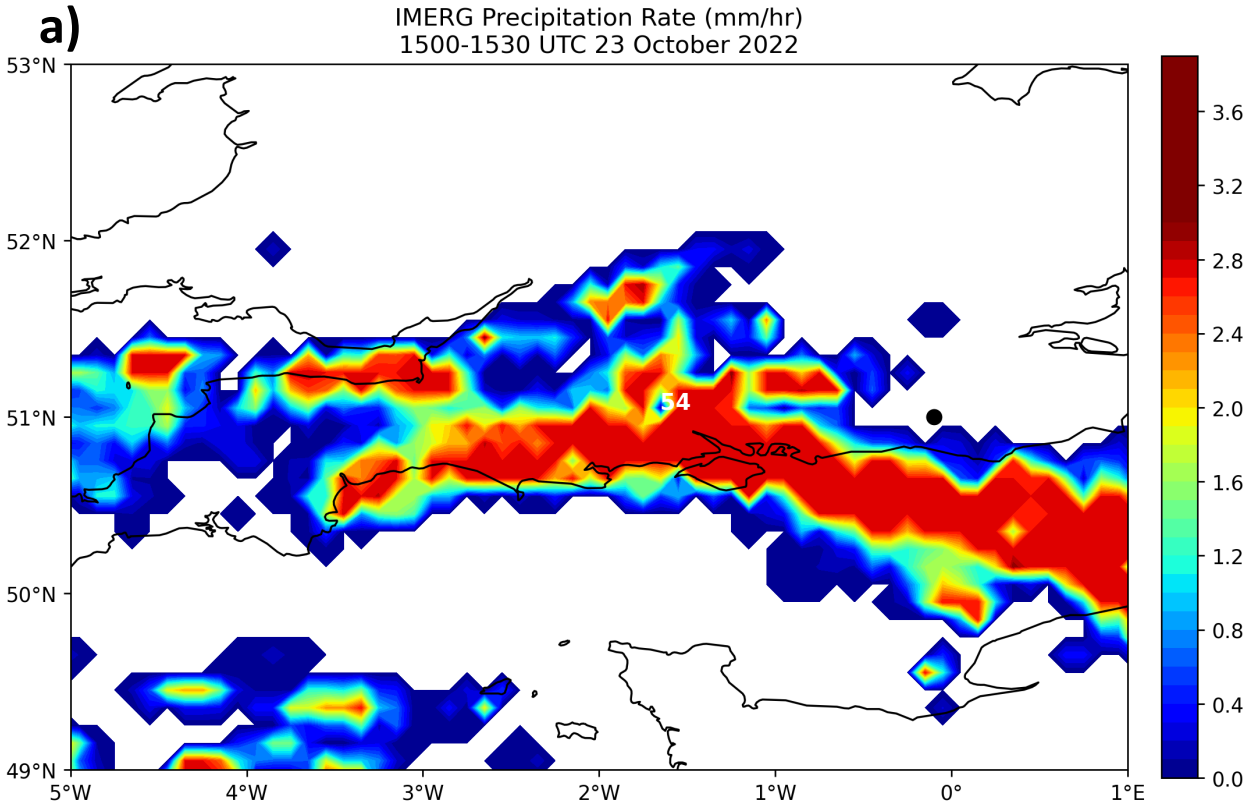


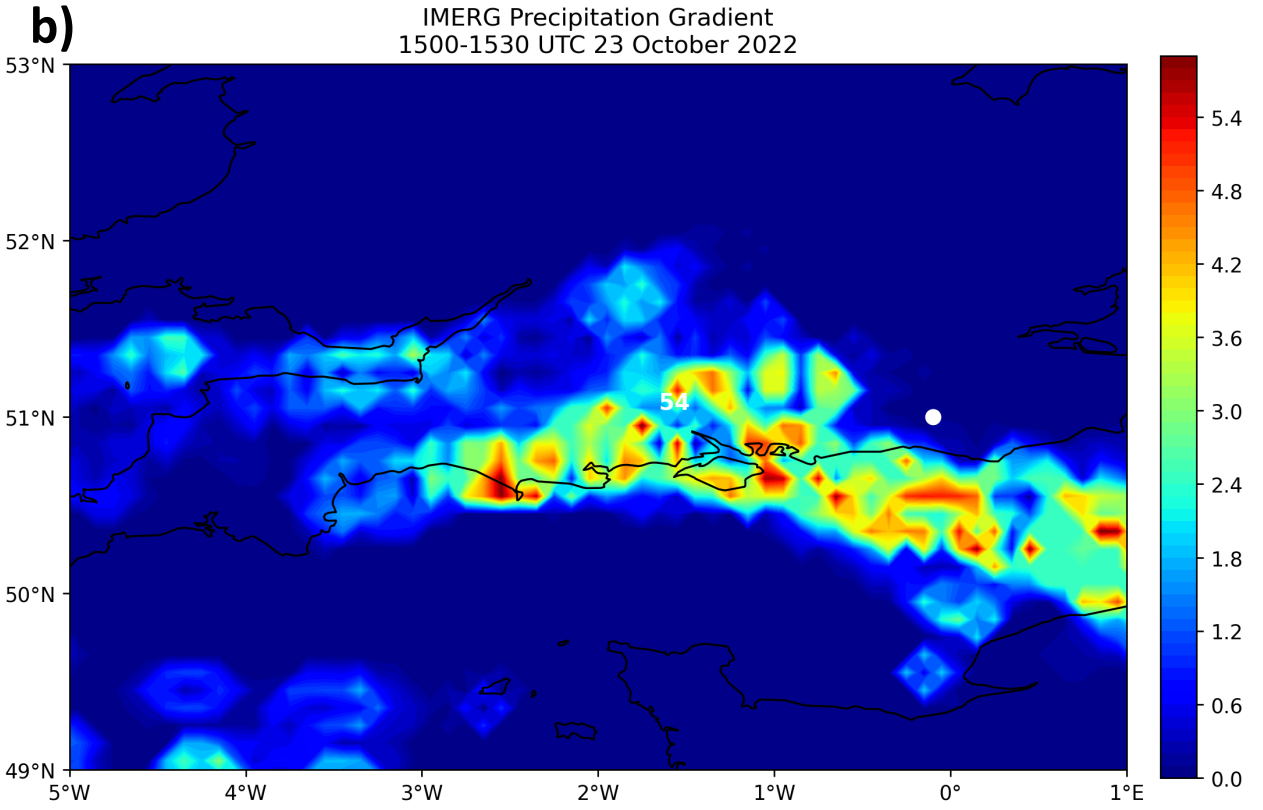
MW-Radar Comparison





IMERG Image Analysis: 1500 UTC





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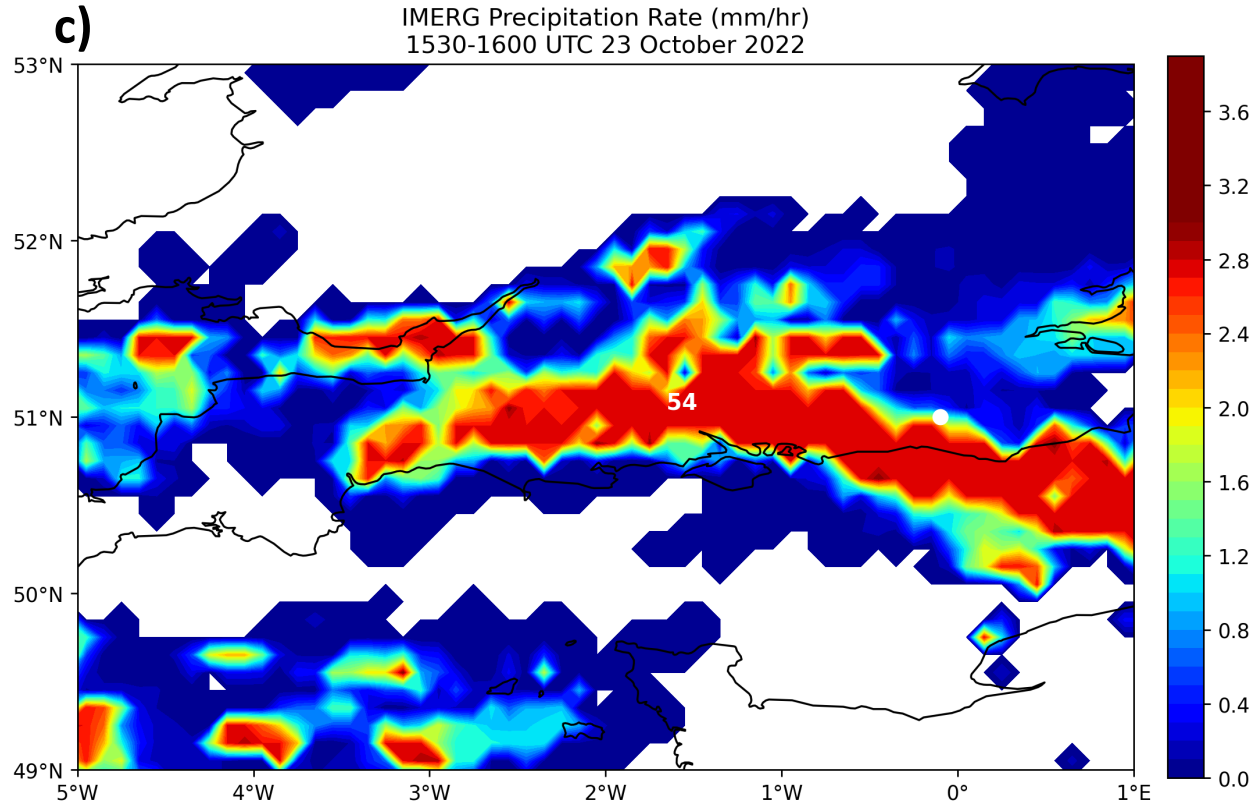
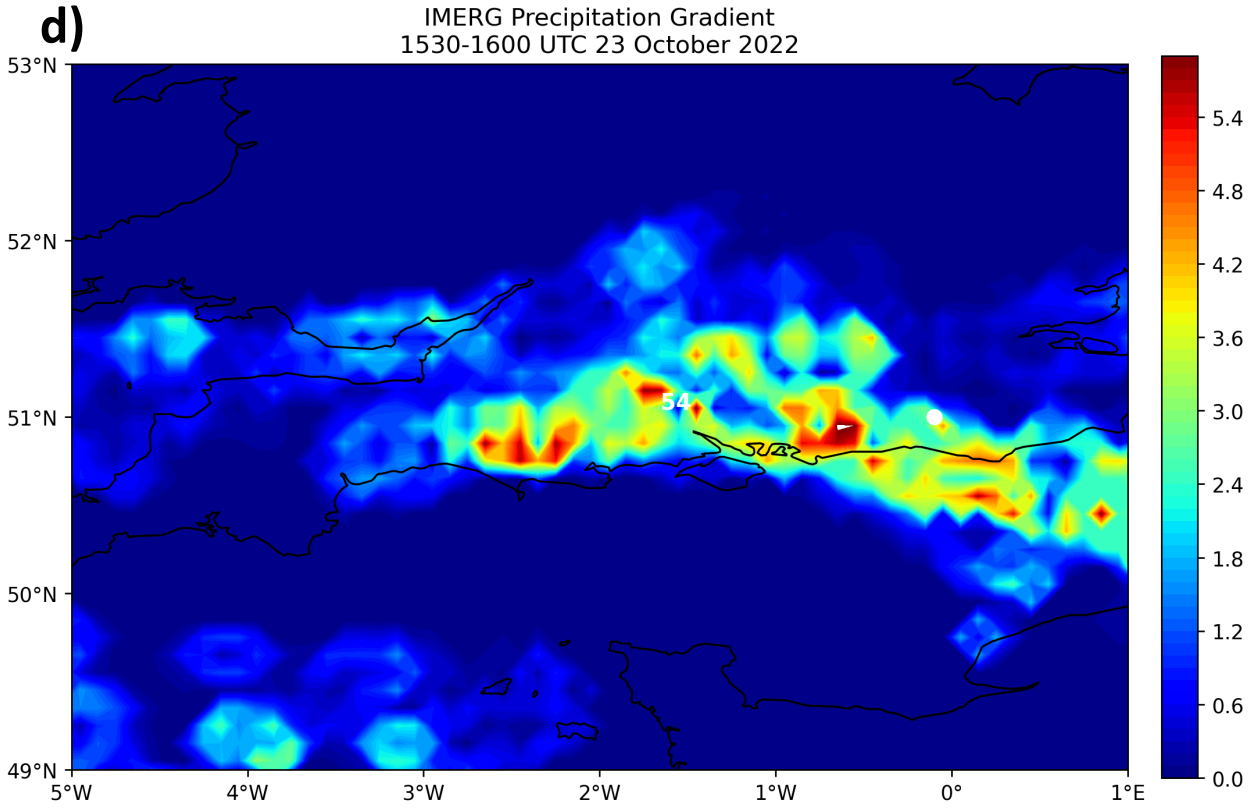
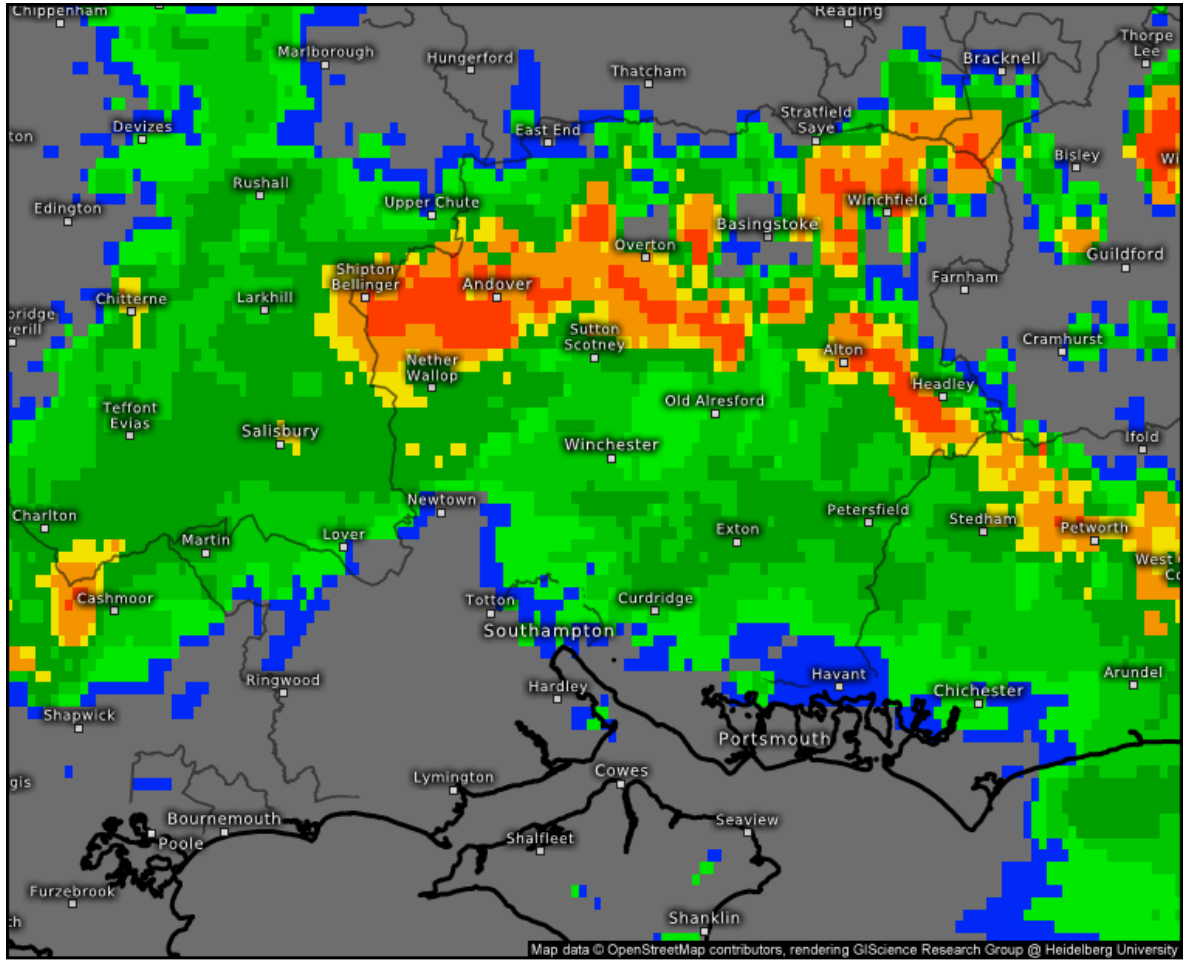
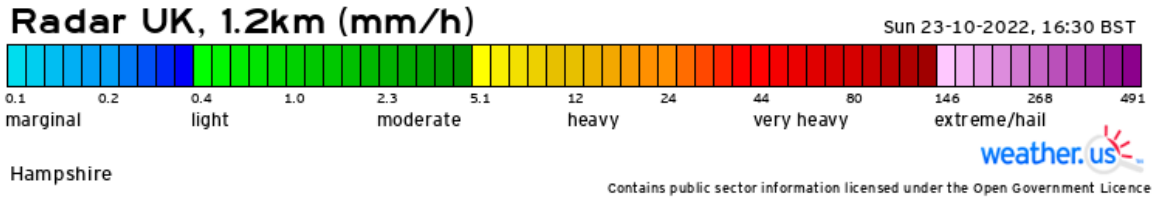
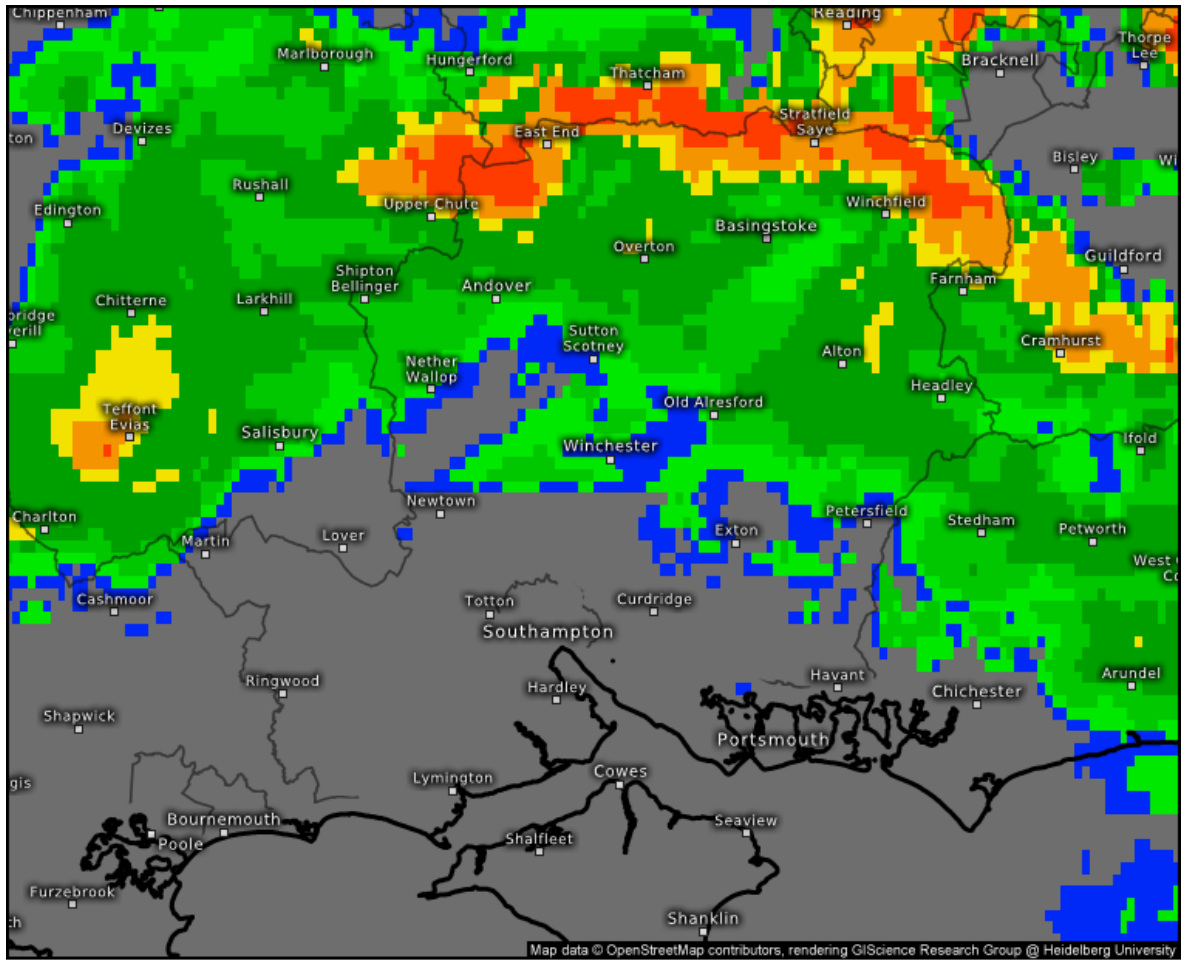


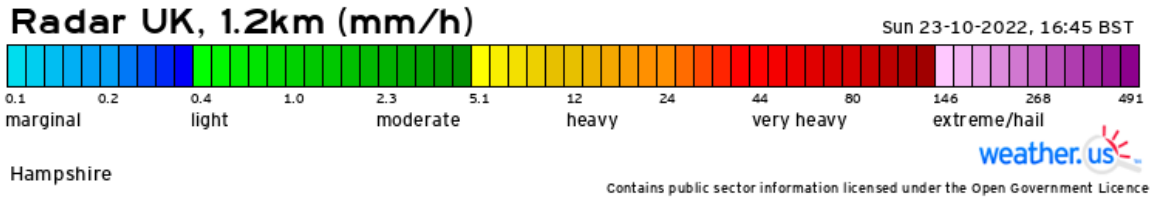


Radar Summary









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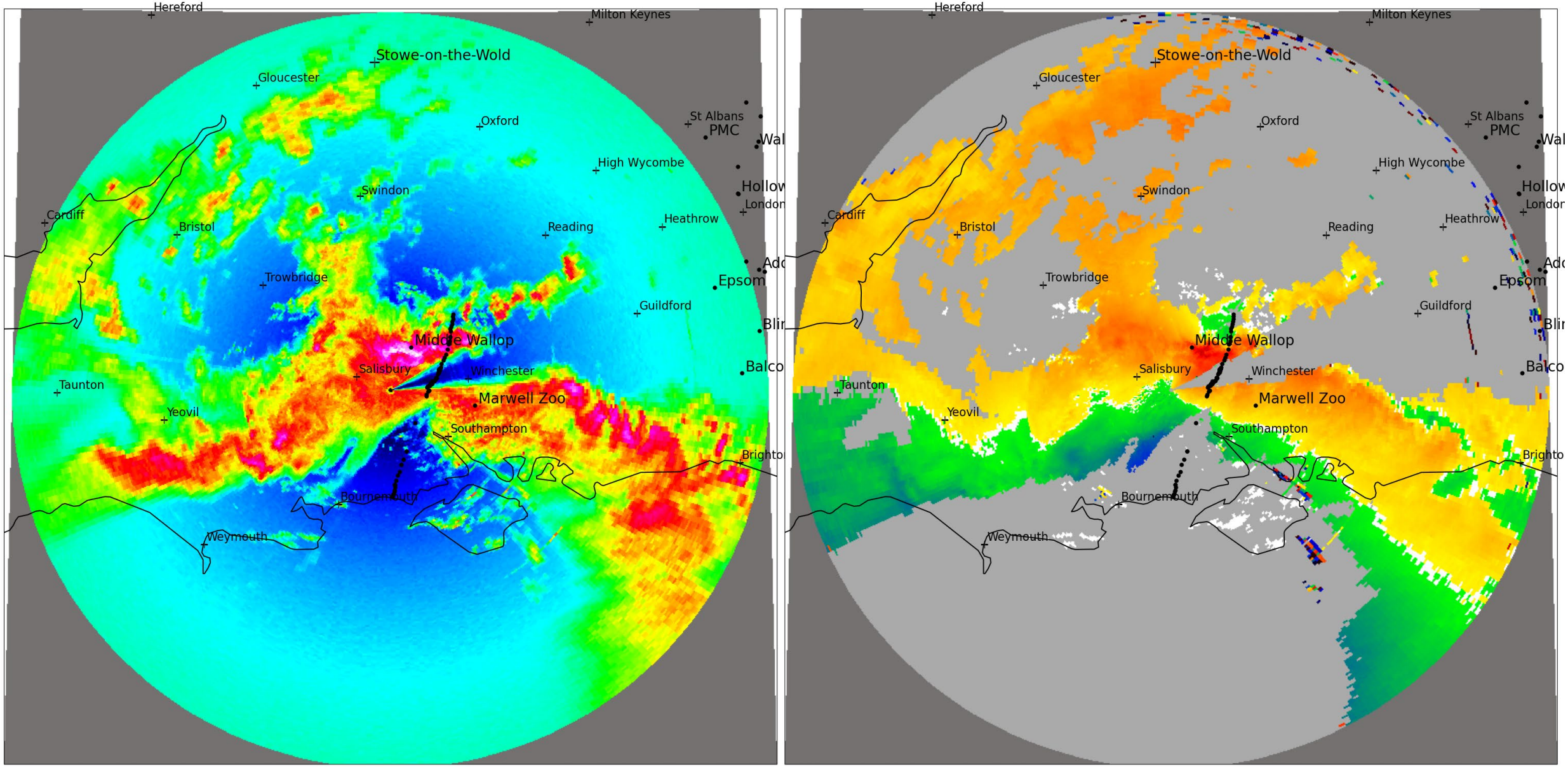
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Gloucester
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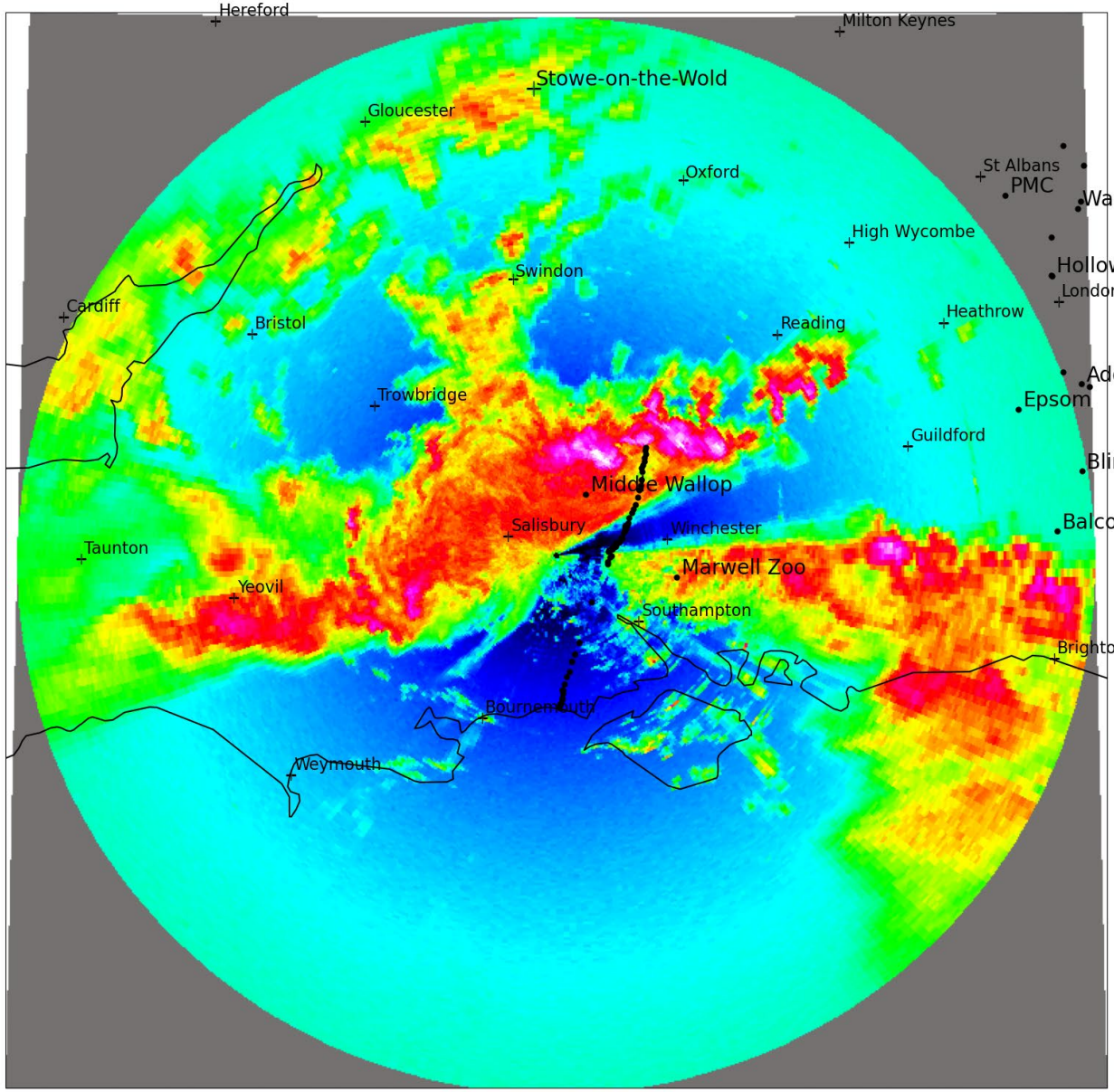
PMC
High Wycombe
Swindon
Cardiff
Bristol
Reading
Heathrow
Trowbridge
Epsom
Guildford
Middle Wallop
Salisbury
Winchester
Taunton
Marwell Zoo
Yeovil
Southampton
Bournemouth
Weymouth

1531 UTC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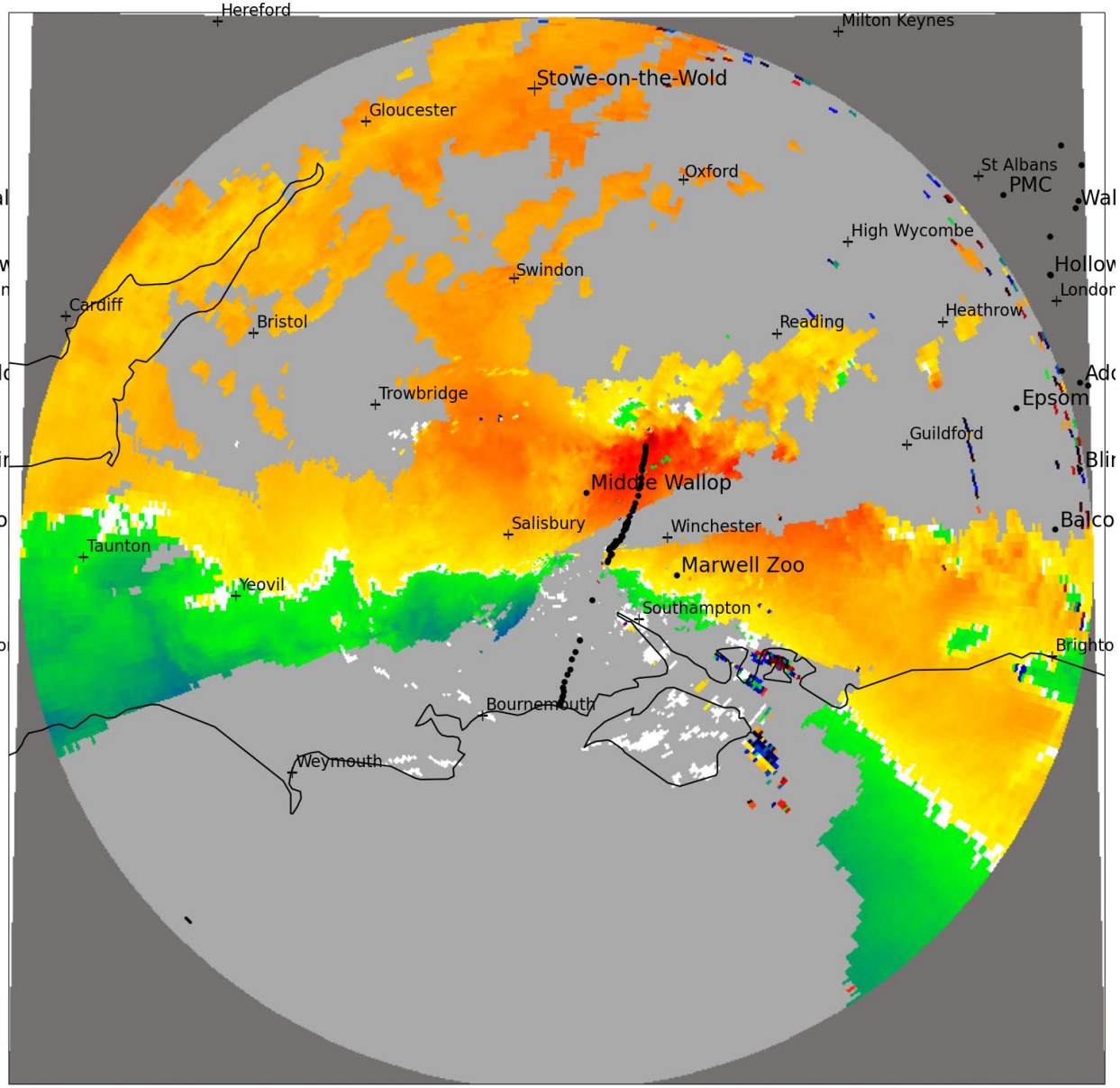
Southampton
Bournemouth
Weymouth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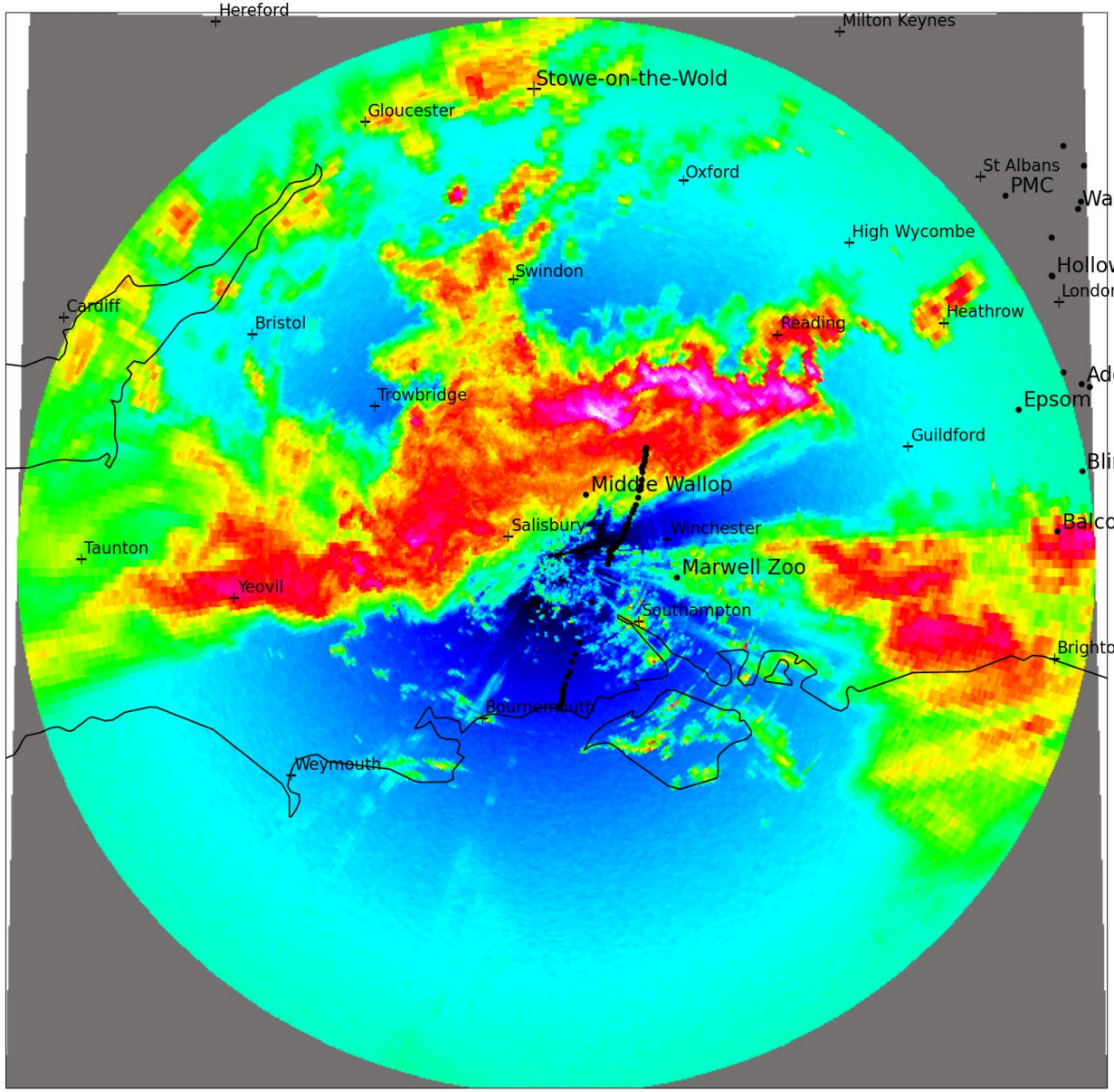
1541 UTC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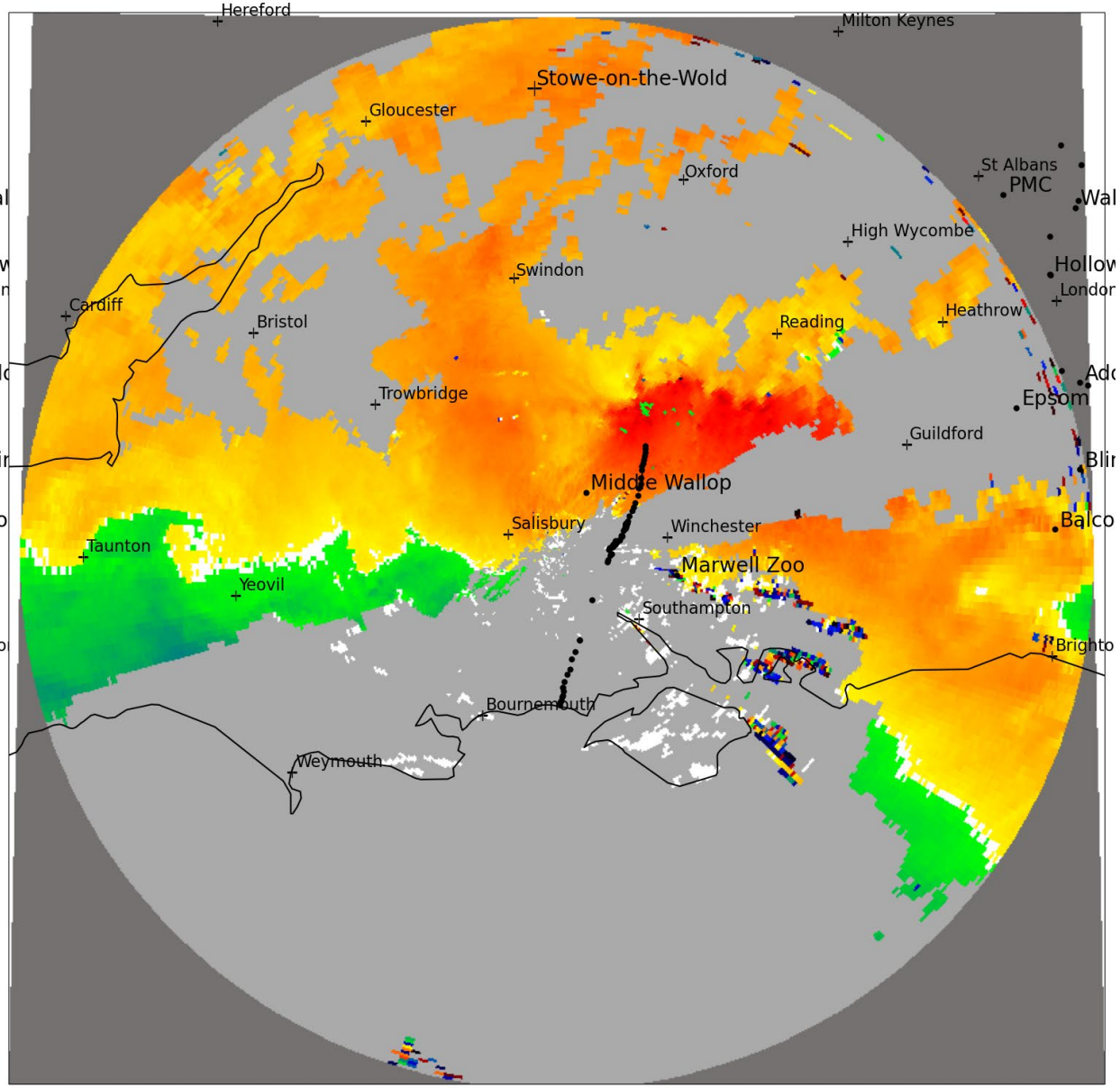
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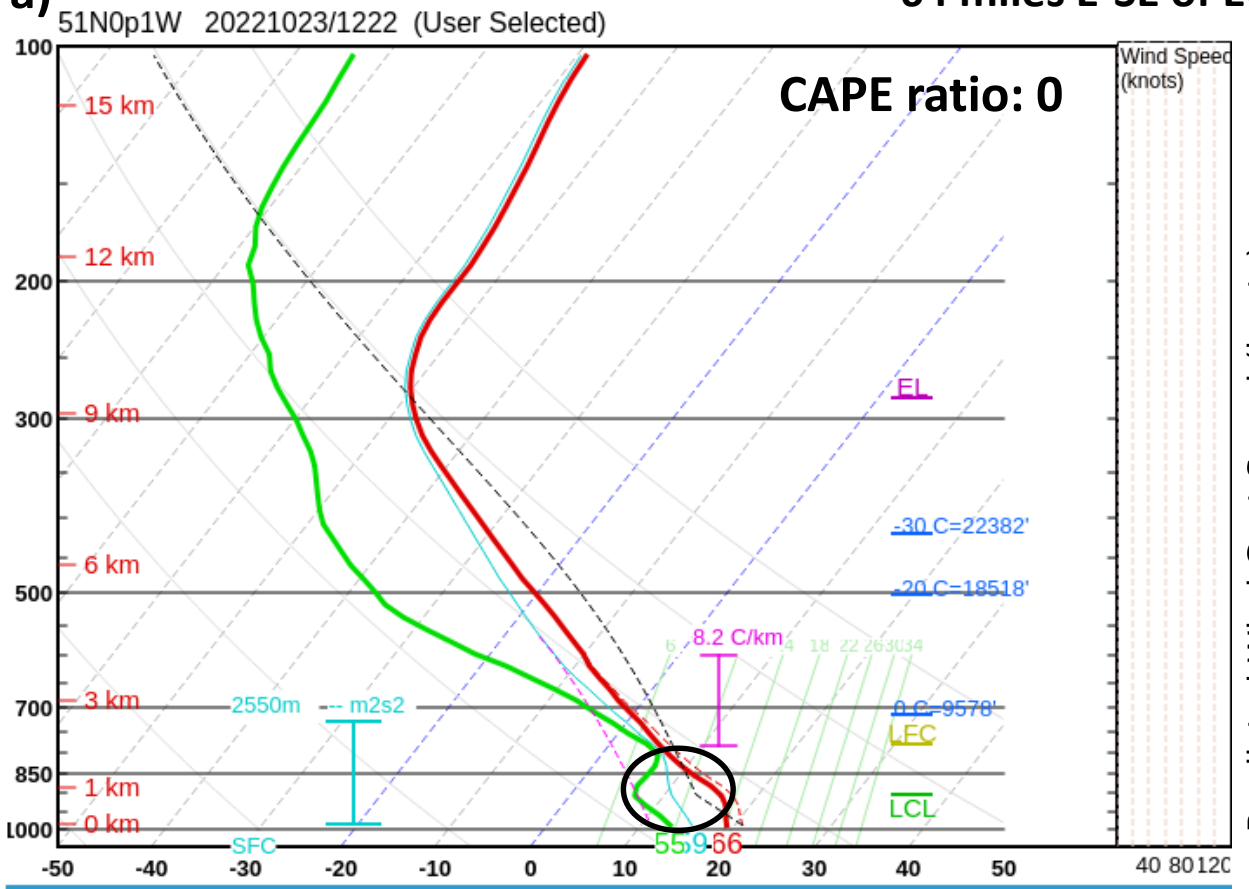
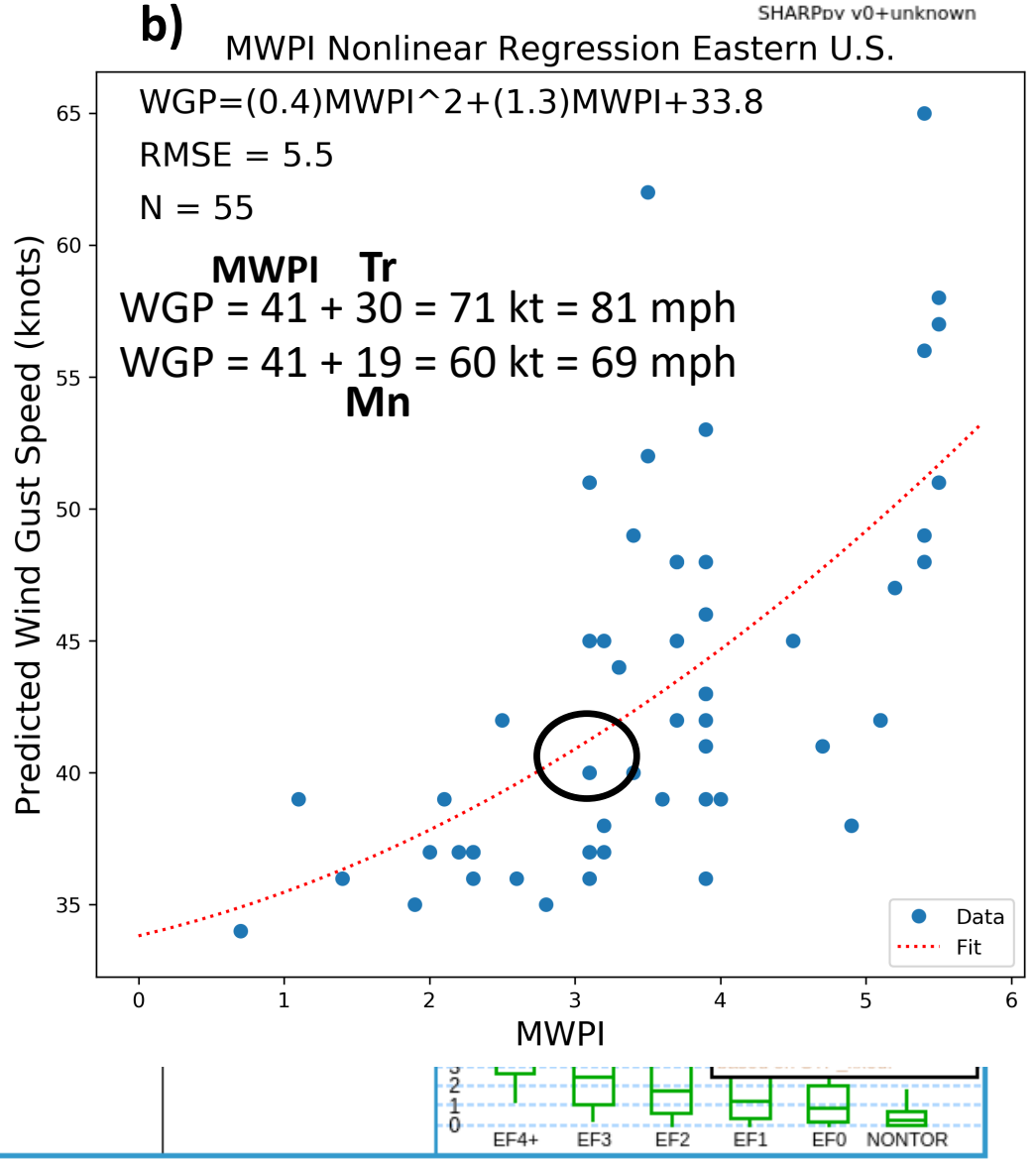
Epsom
Guildford
Middle Wallop
Salisbury
Winchester
Taunton
Marwell Zoo
Yeovil
Southampton
Bournemouth
Weymouth

NUCAPS Sounding: Sussex, UK

a) **64 miles E-SE of EGVP**

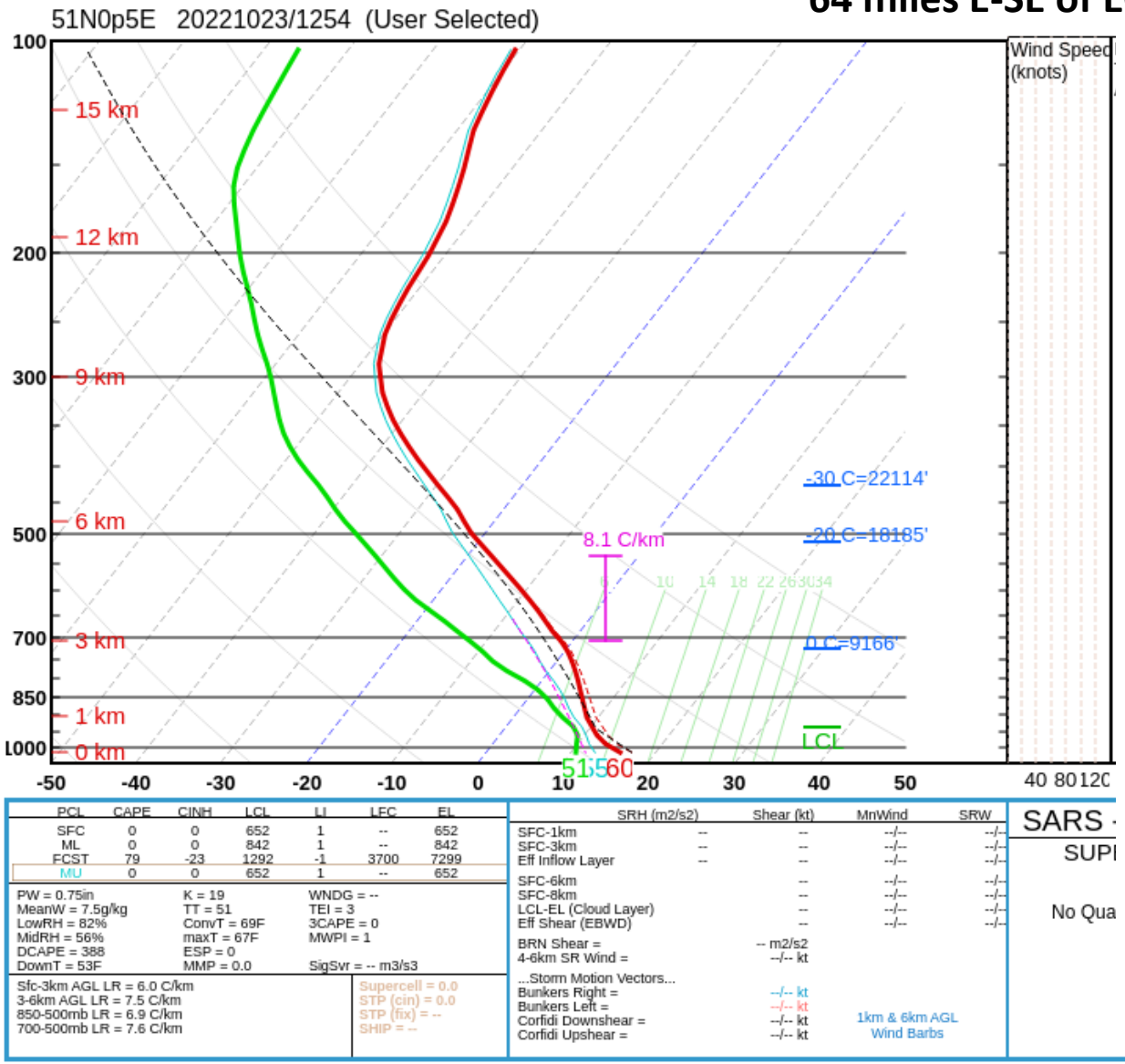


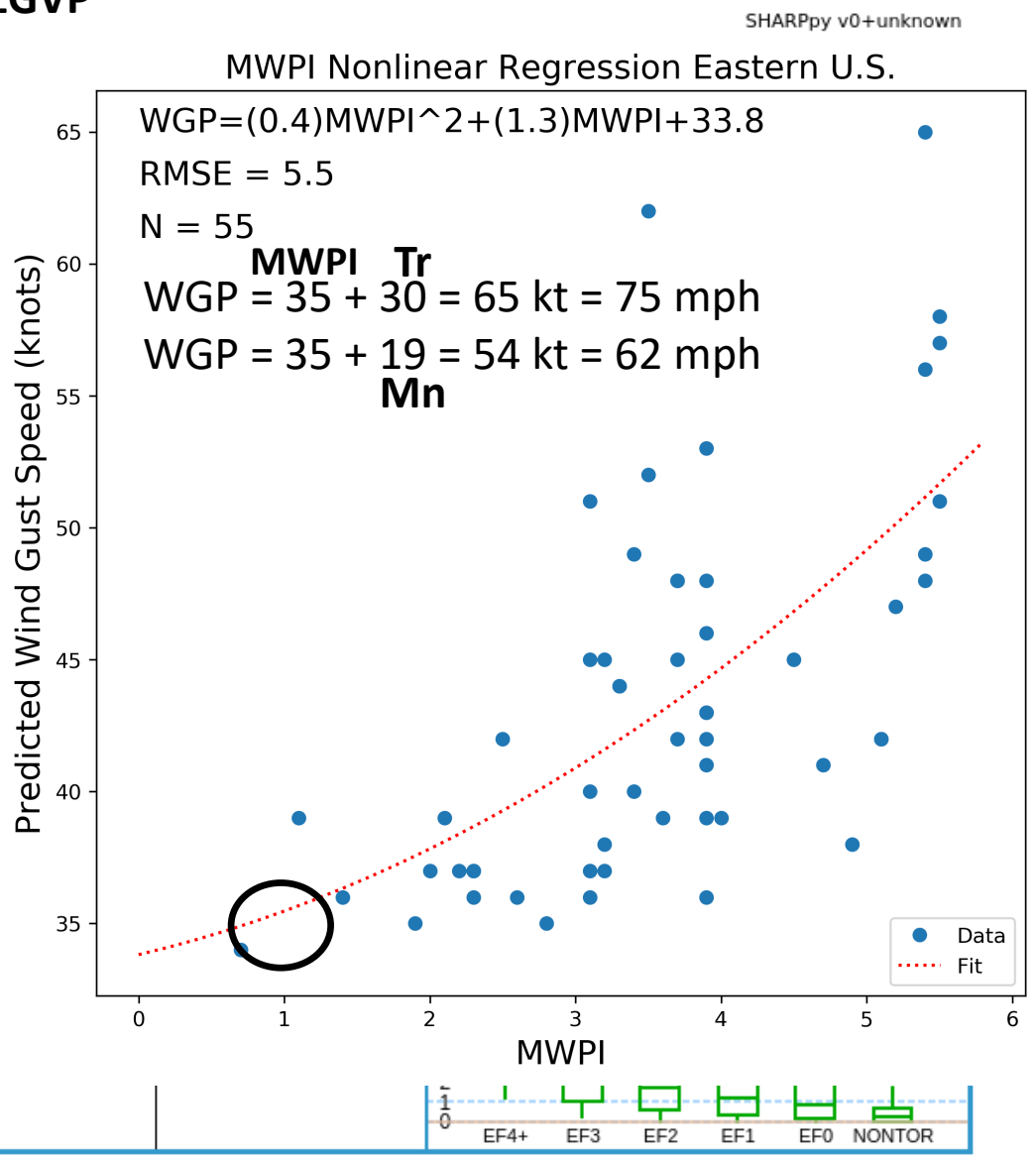
b)



AIRS Sounding: Sussex, UK

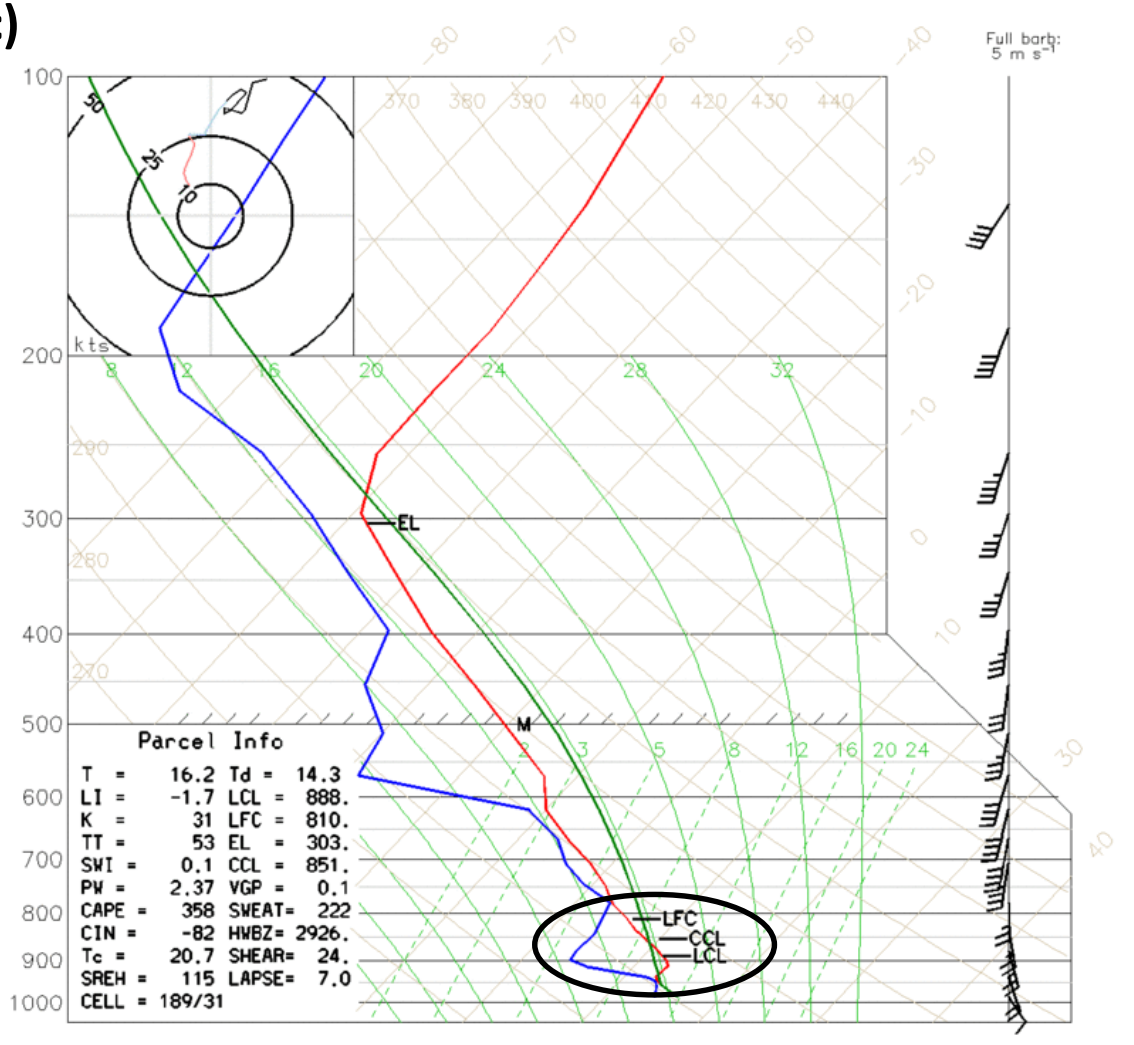
64 miles E-SE of EGVP





WRF Model-derived Sounding Comparison

c)



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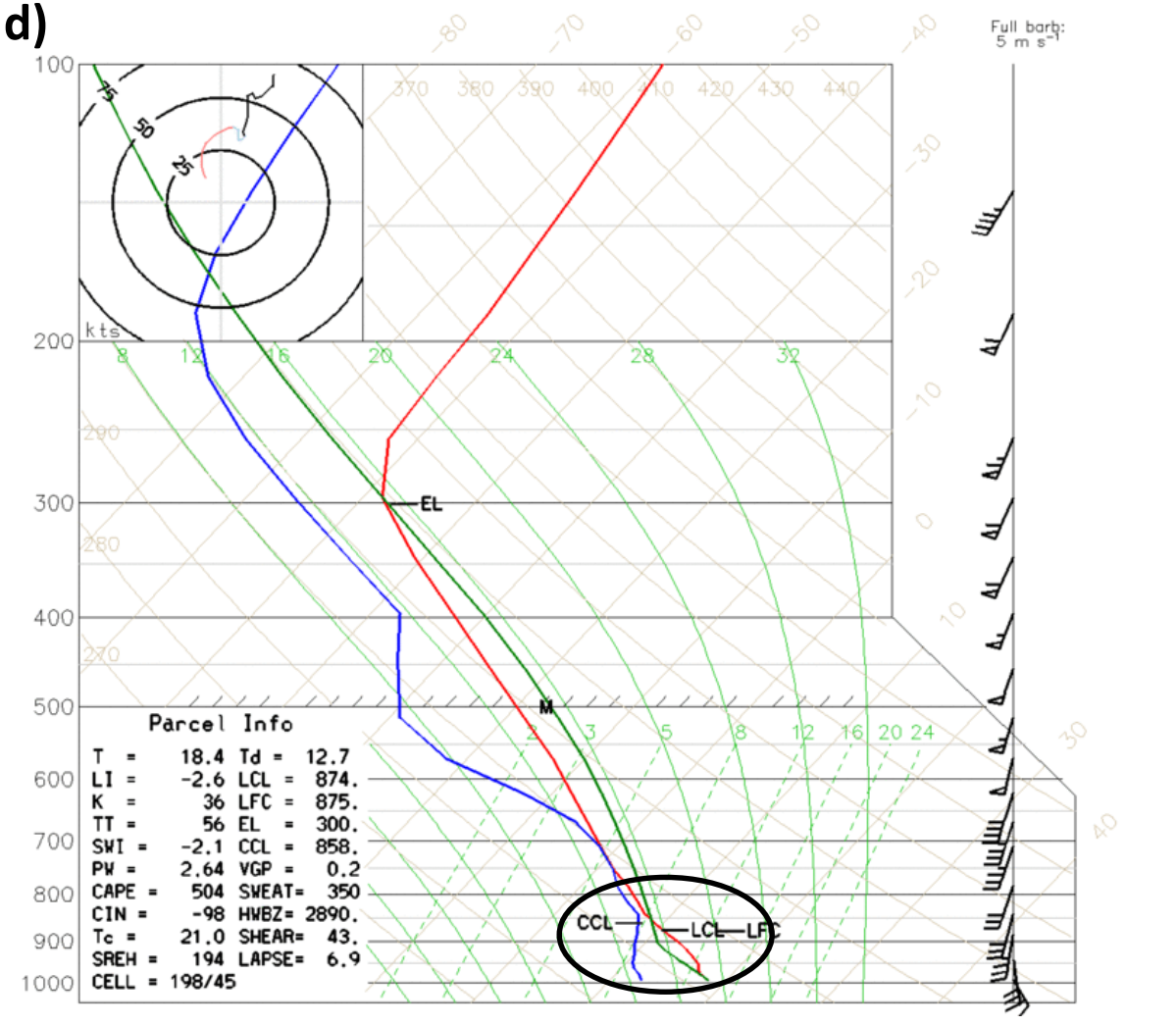
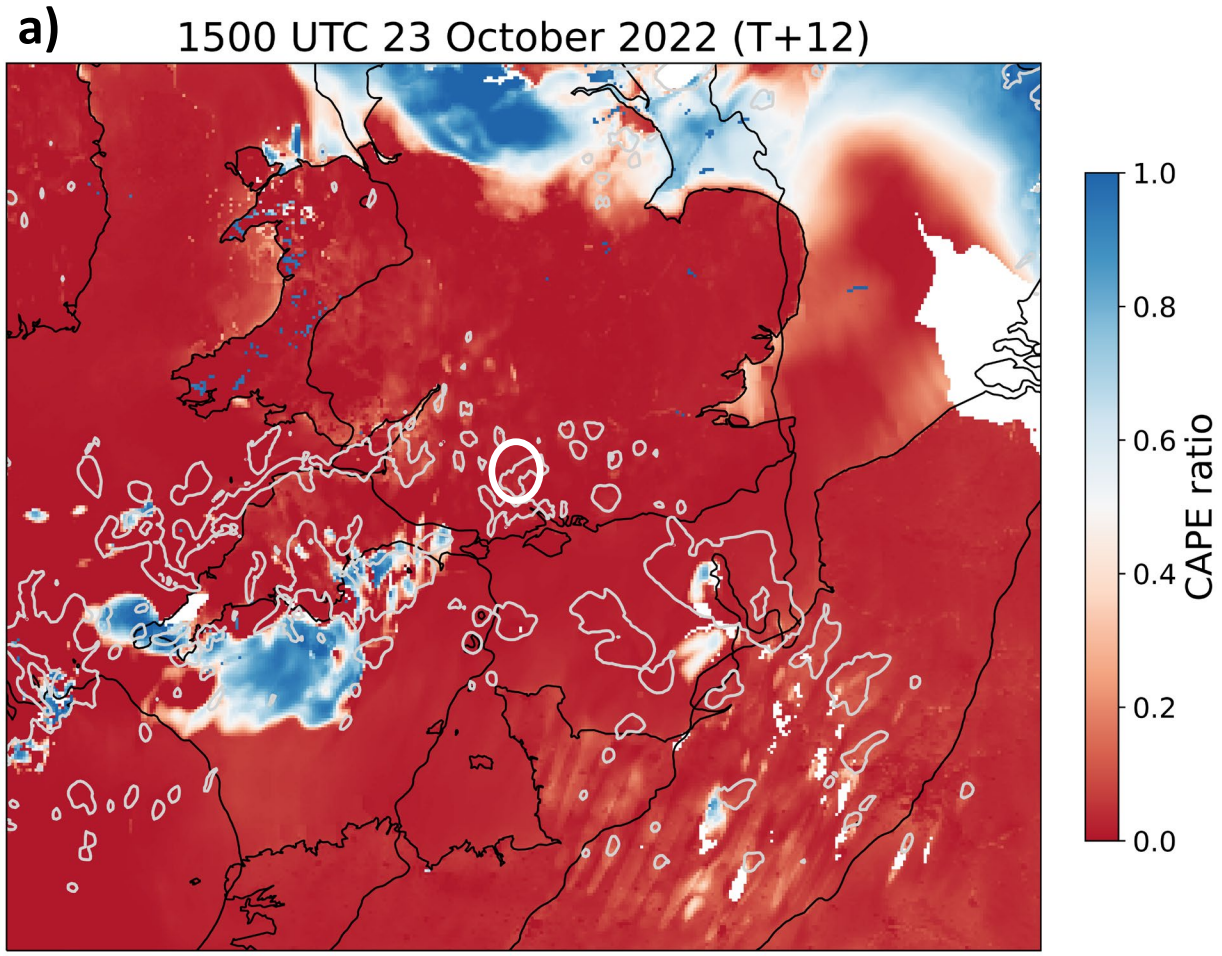
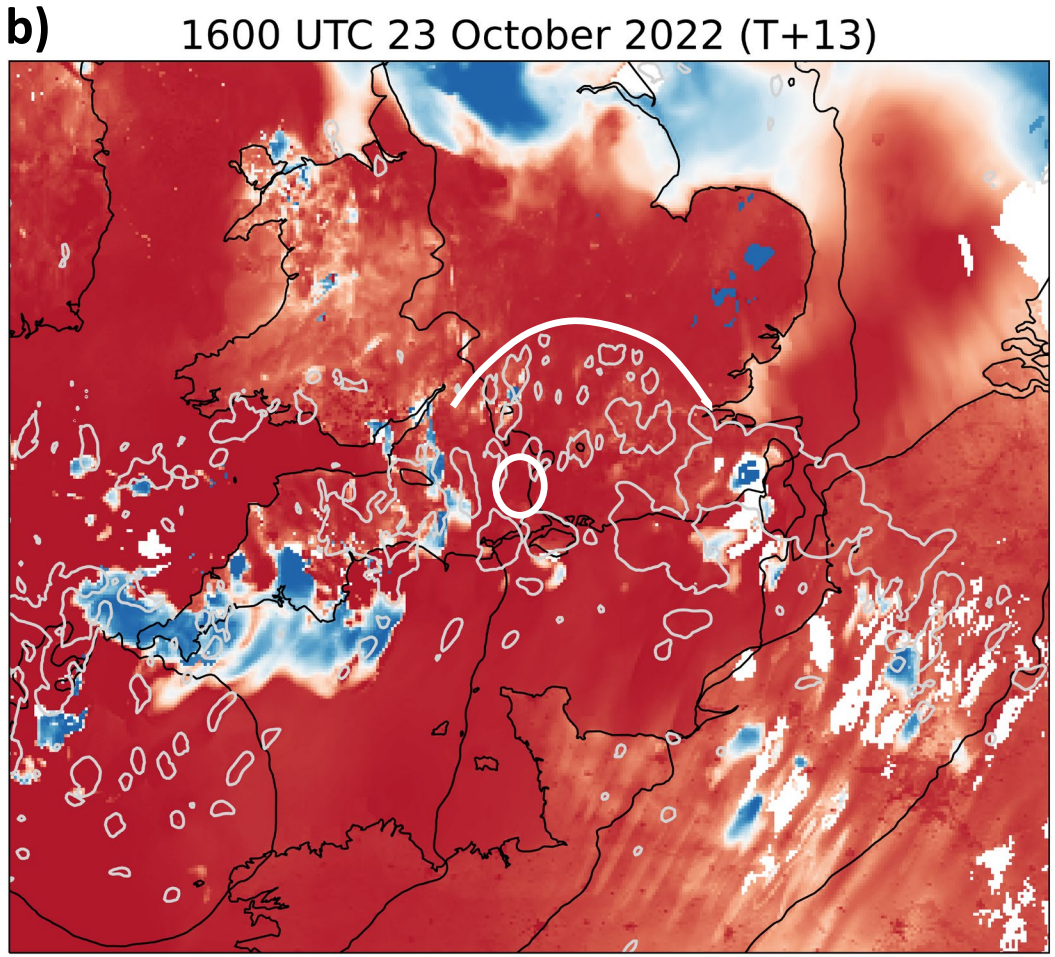
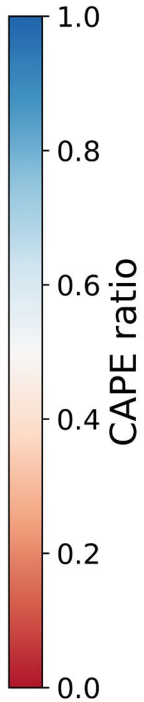


Elevated convection diagnostic: CAPE Ratio







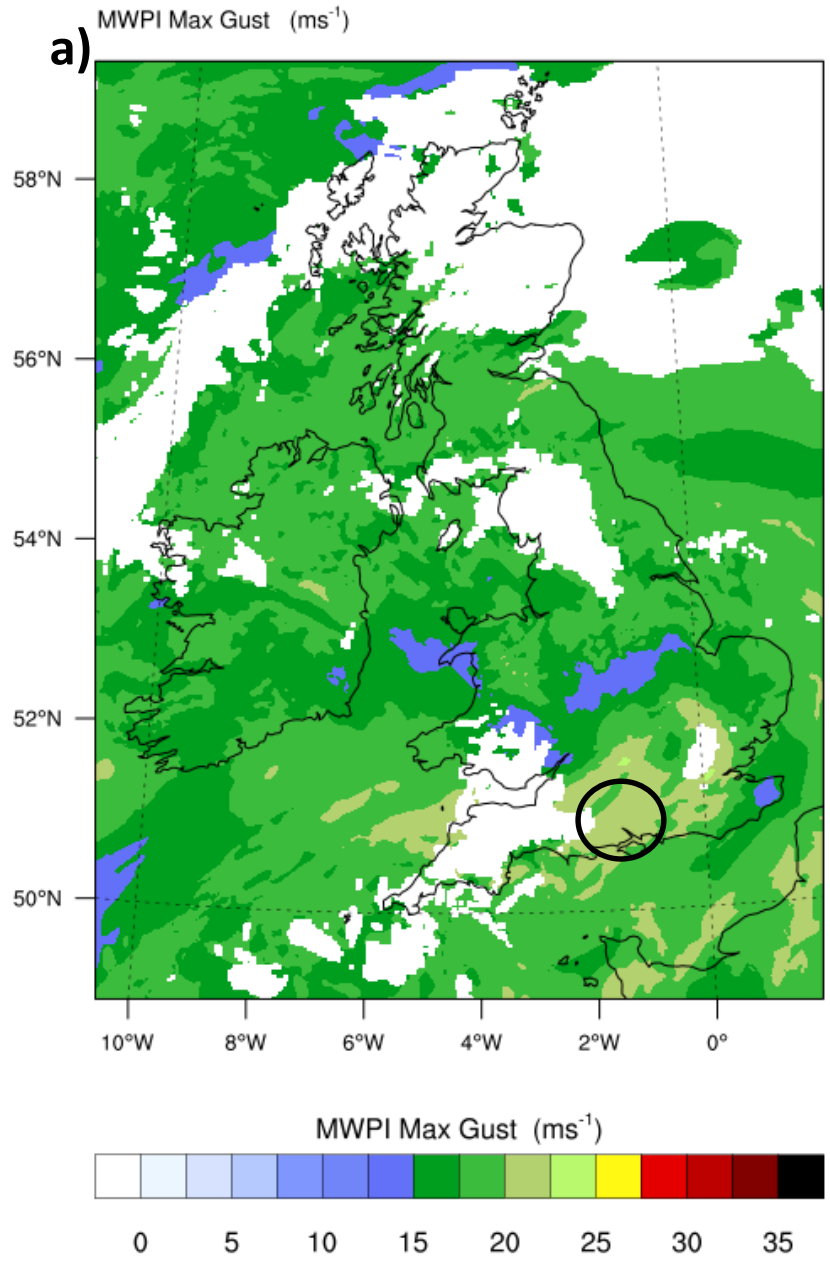
Microburst Potential Index Init: 2022-10-23_06:00:00 Valid: 2022102312

Microburst Potential Index Init: 2022-10-23_06:00:00 Valid: 2022102314

Microburst Potential Index Init: 2022-10-23_06:00:00 Valid: 2022102316

1222 UTC NUCAPS MWPI Max Gust = 21.1 ms^{-1}

a)



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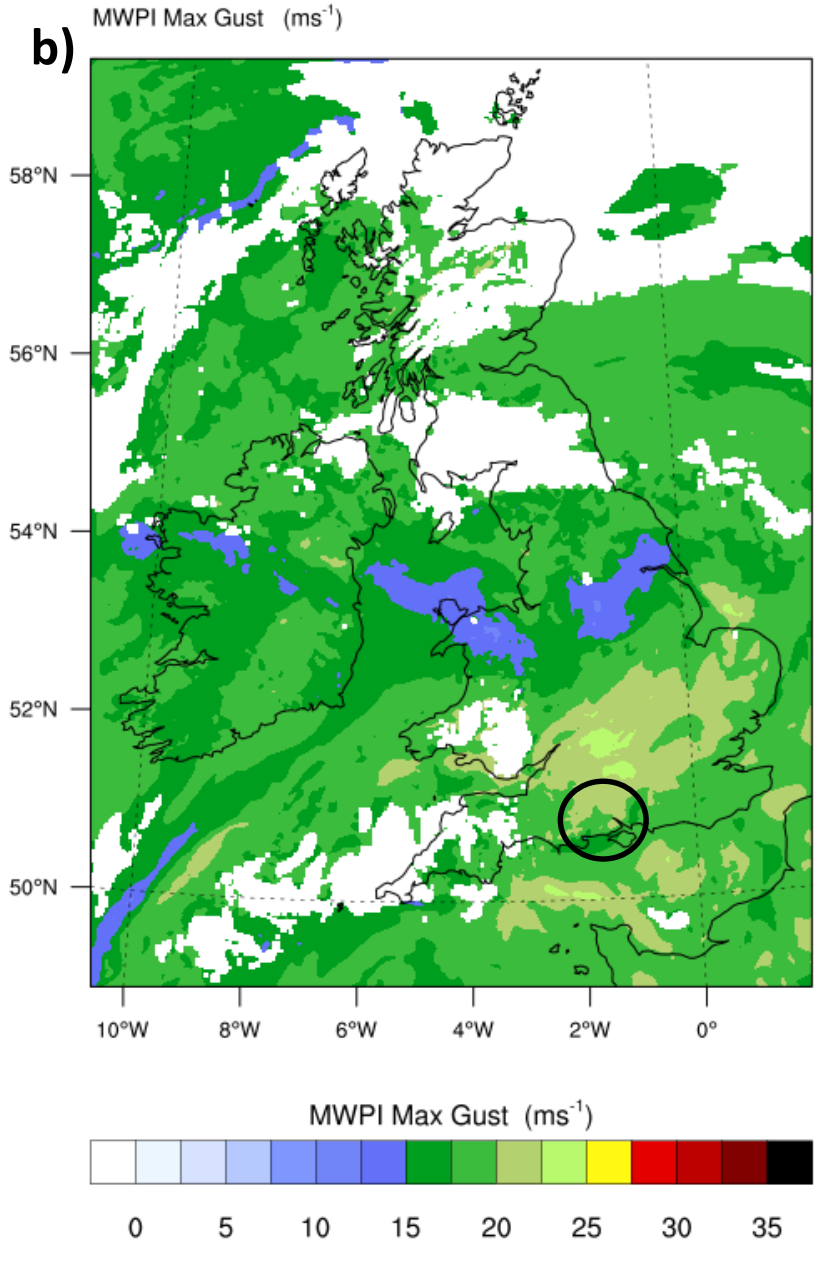
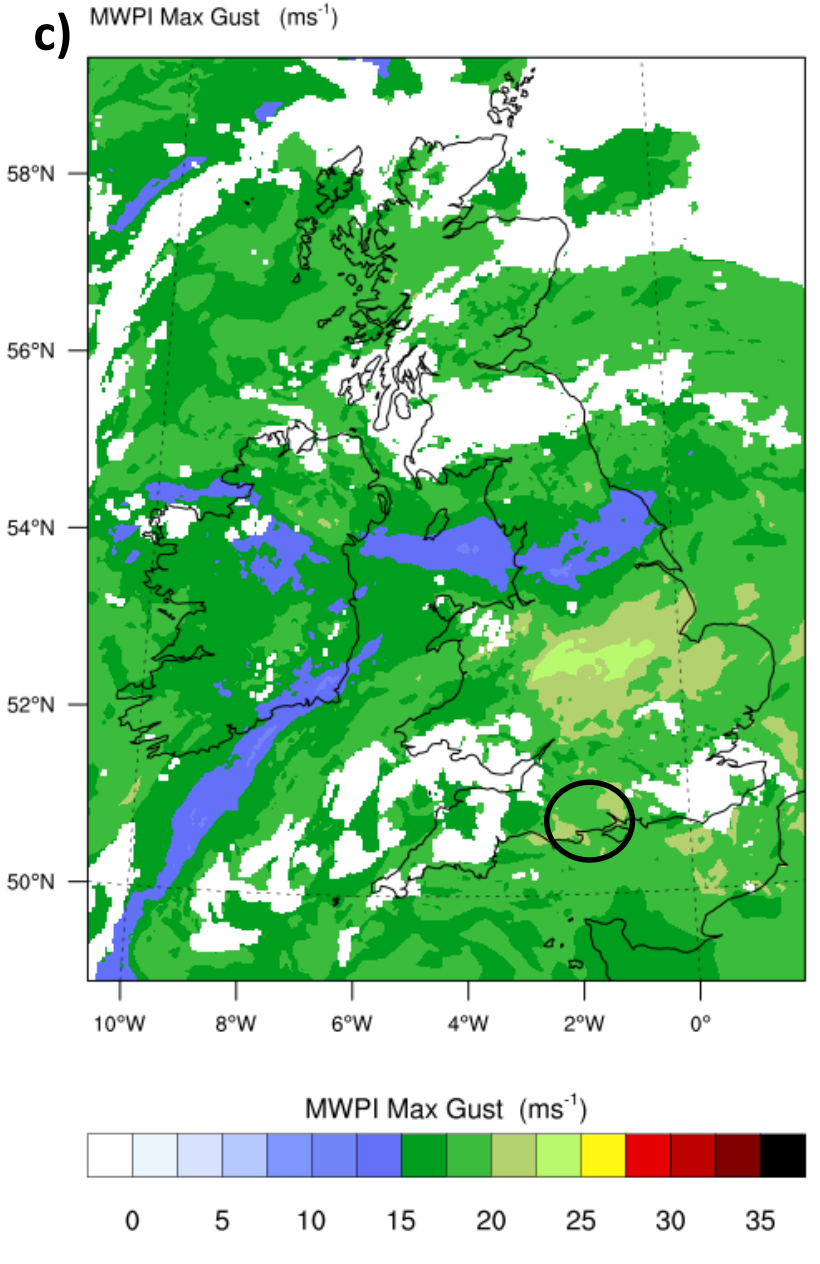
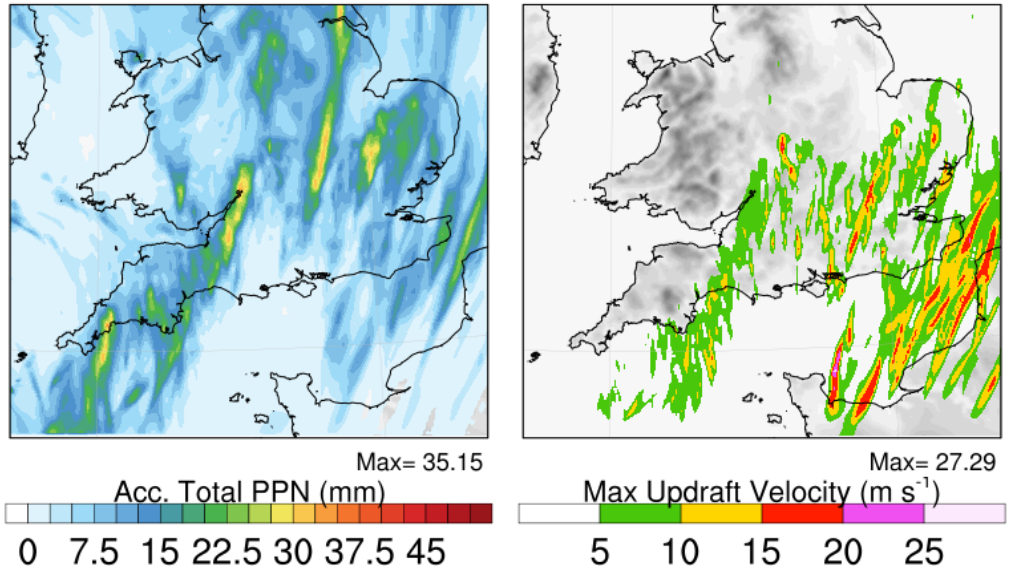


c)



uk3 D02 Diag: ppn

Init: 2022102306 UTC VT:12h



Max= 35.15

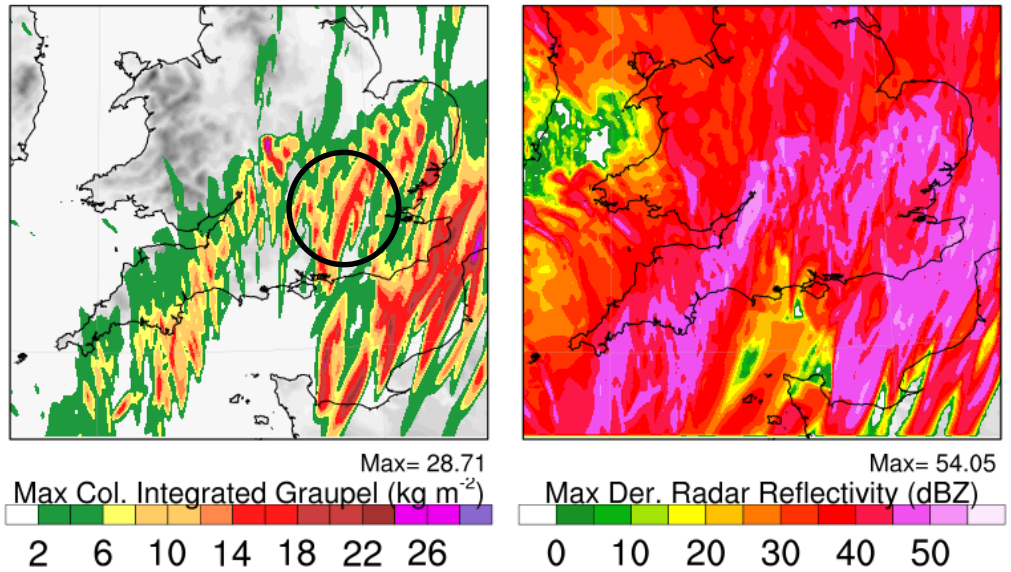
Acc. Total PPN (mm)

0 7.5 15 22.5 30 37.5 45

Max= 27.29

Max Updraft Velocity (m s^{-1})

5 10 15 20 25



Max= 28.71

Max Col. Integrated Graupel (kg m^{-2})

2 6 10 14 18 22 26

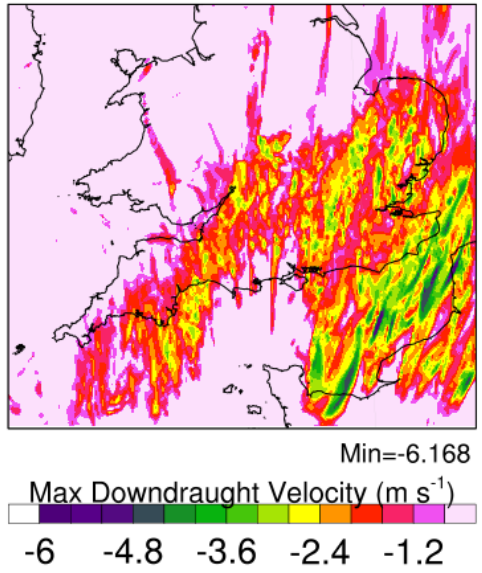
Max= 54.05

Max Der. Radar Reflectivity (dBZ)

0 10 20 30 40 50

uk3 D02 Diag: conv

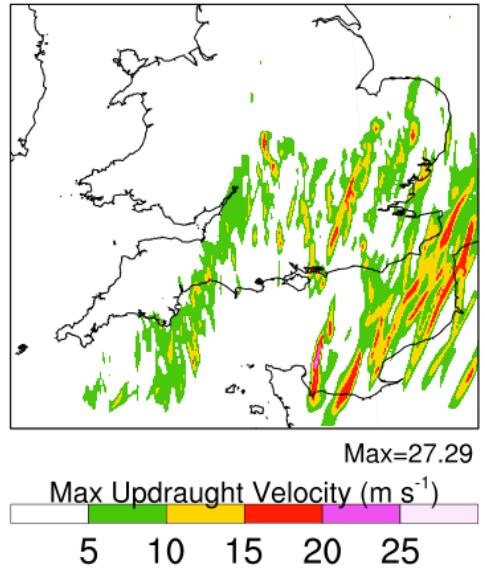
Init: 2022102306 UTC VT:12h



Min=-6.168

Max Downdraught Velocity (m s^{-1})

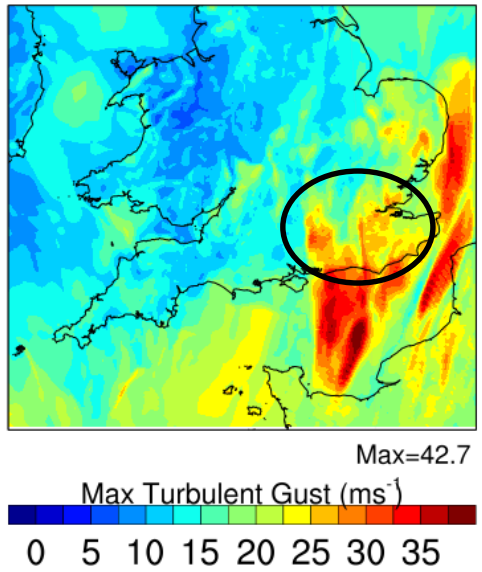
-6 -4.8 -3.6 -2.4 -1.2



Max=27.29

Max Updraught Velocity (m s^{-1})

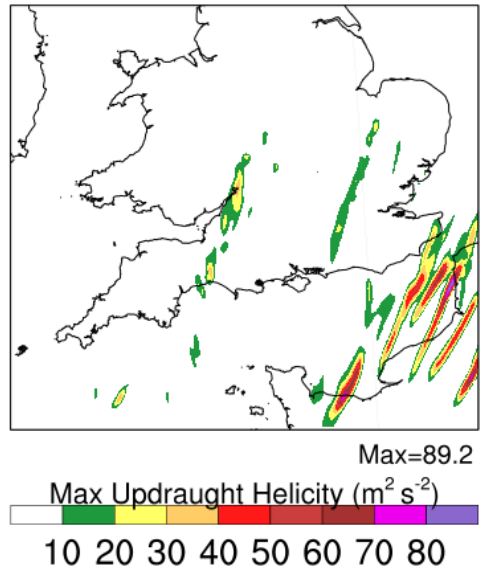
5 10 15 20 25



Max=42.7

Max Turbulent Gust (ms^{-1})

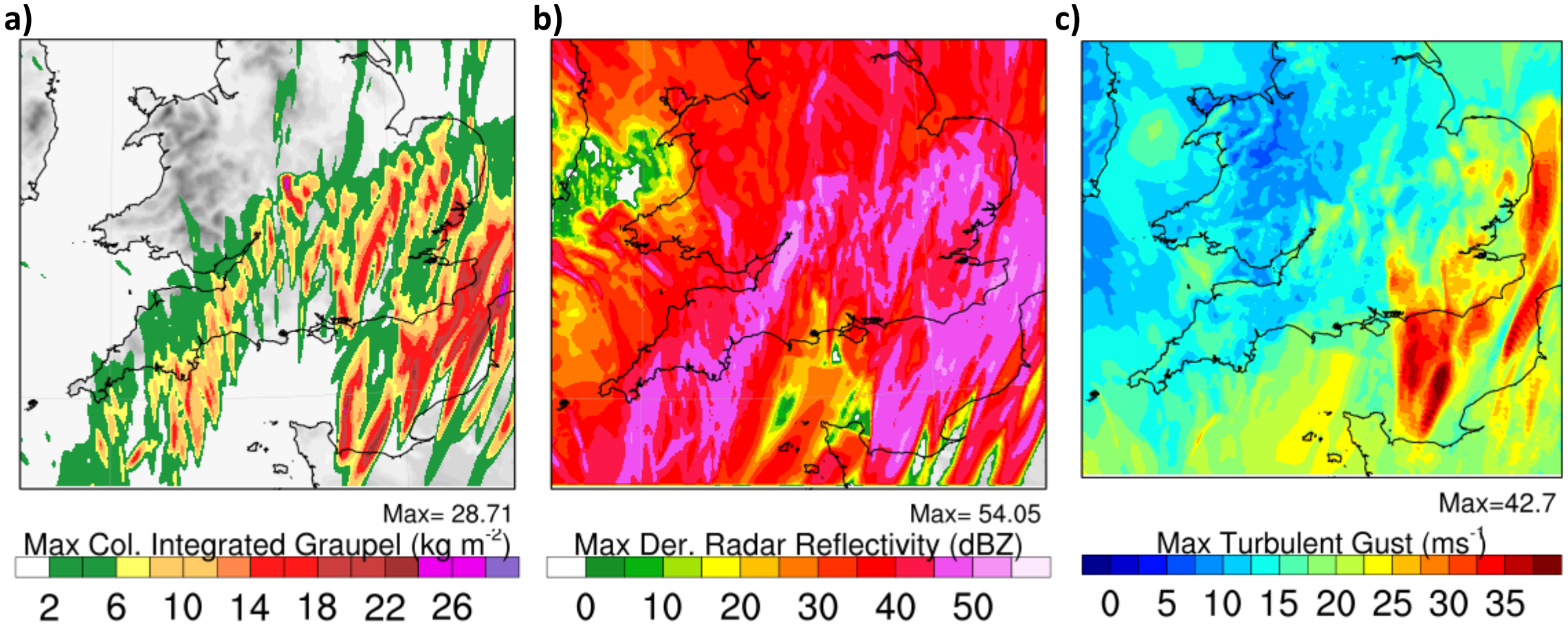
0 5 10 15 20 25 30 35



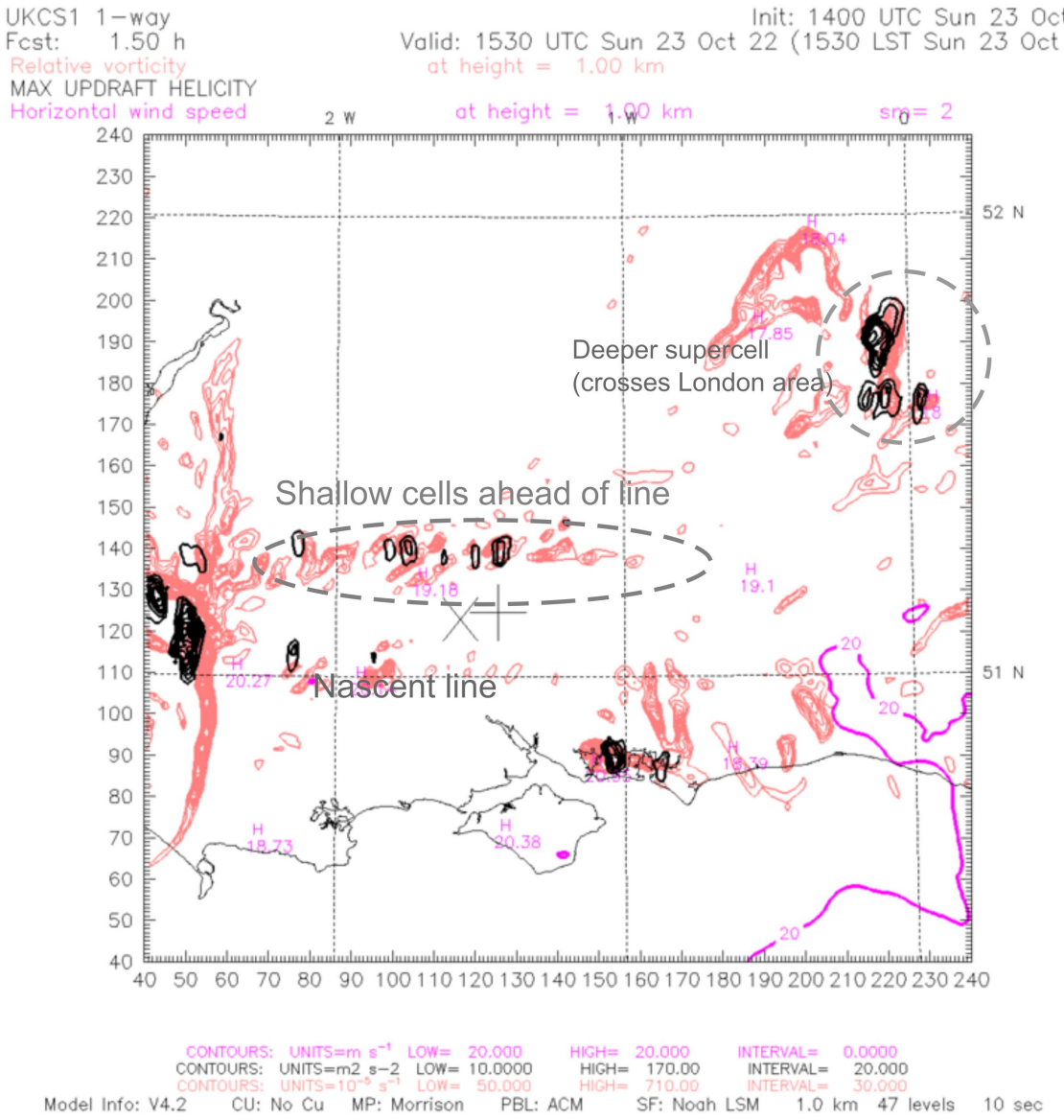
Max=89.2

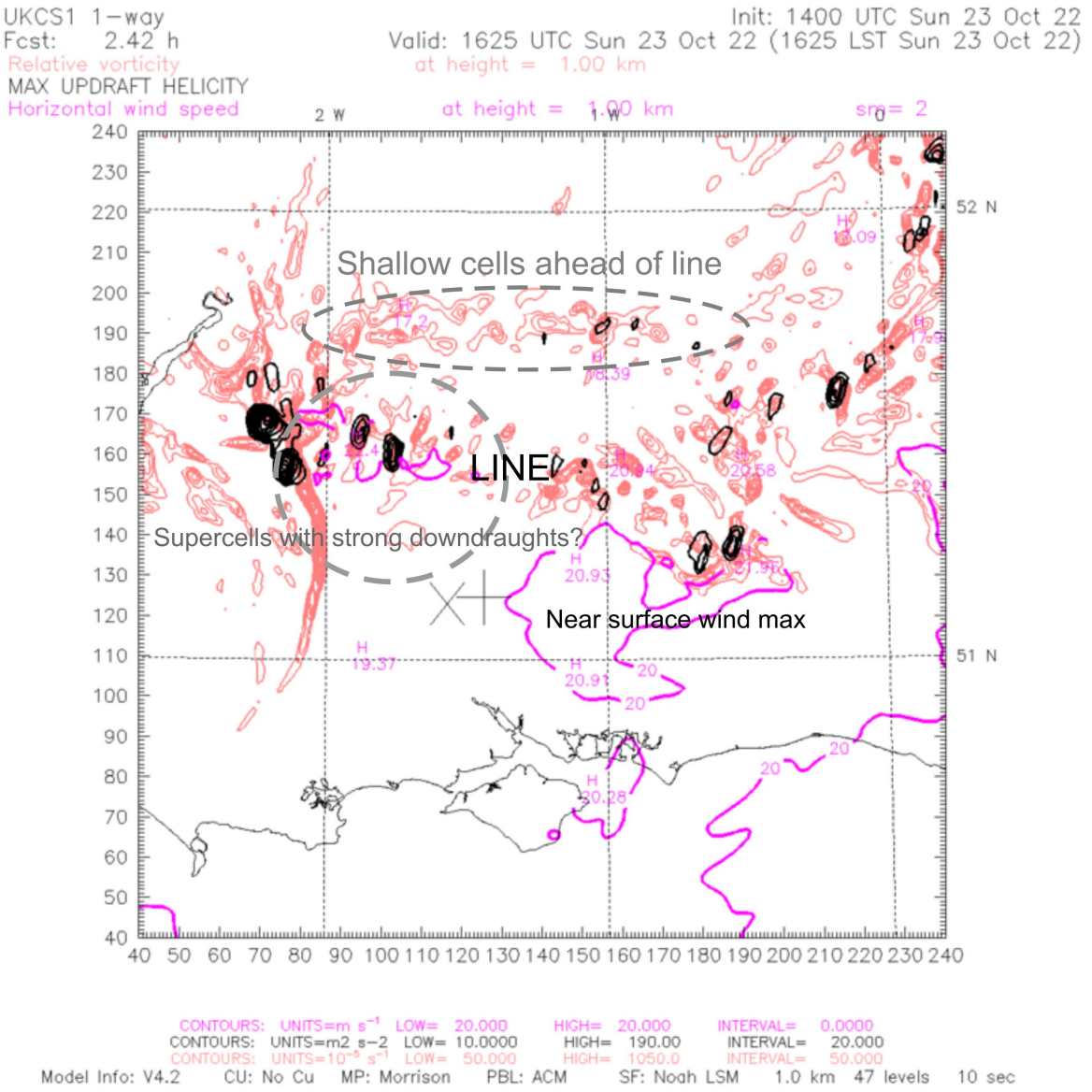
Max Updraught Helicity (m^2 s^{-2})

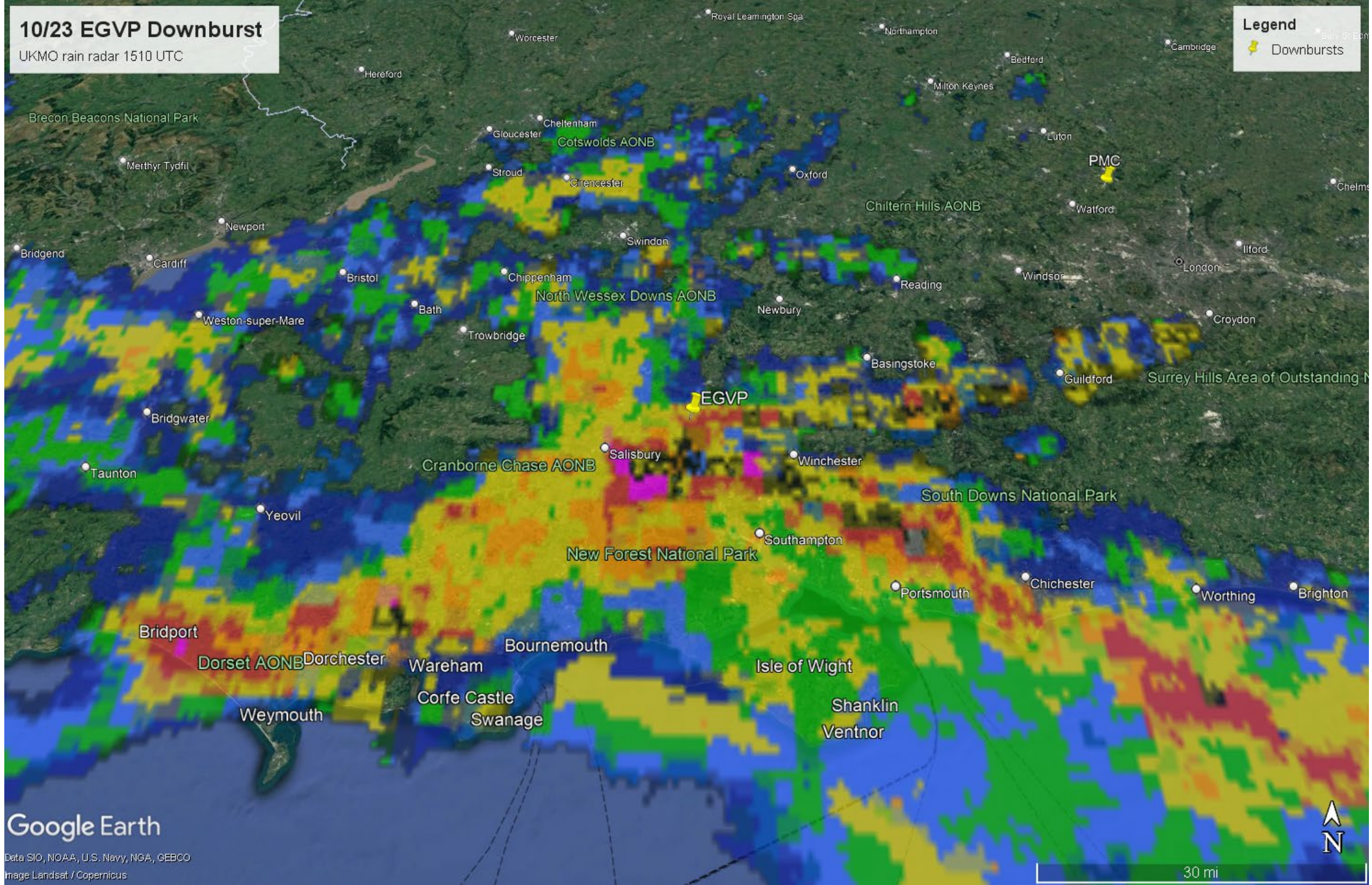
10 20 30 40 50 60 70 80


a)
b)
c)
Max= 28.71
Max Col. Integrated Graupel (kg m-2)
2 6 10 14 18 22 26
Max= 54.05
Max Der. Radar Reflectivity (dBZ)
0 10 20 30 40 50
Max=42.7
Max Turbulent Gust (ms-1)
0 5 10 15 20 25 30 35

1km WRF Sumulations: UKCS 1-way






10/23 EGVP Downburst
UKMO rain radar 1510 UTC
Legend
Downbursts
Royal Leamington Spa
Worcester
Northampton
Cambridge
Bedford
Hereford
Milton Keynes
Brecon Beacons National Park
Cheltenham
Gloucester
Cotswolds AONB
Luton
Merthyr Tydfil
Stroud
Cirencester
Oxford
PMC
Chiltern Hills AONB
Watford
Newport
Swindon
Bridgend
Cardiff
Bristol
Chippenham
Reading
Windsor
Ilford
London
North Wessex Downs AONB
Bath
Newbury
Weston-super-Mare
Trowbridge
Croydon
Basingstoke
Guildford
Surrey Hills Area of Outstanding N
EGVP
Bridgwater
Salisbury
Winchester
Cranborne Chase AONB
Taunton
South Downs National Park
Yeovil
Southampton
New Forest National Park
Chichester
Portsmouth
Worthing
Brighton
Bridport
Bournemouth
Dorset AONB
Dorchester
Wareham
Isle of Wight
Corfe Castle
Shanklin
Swanage
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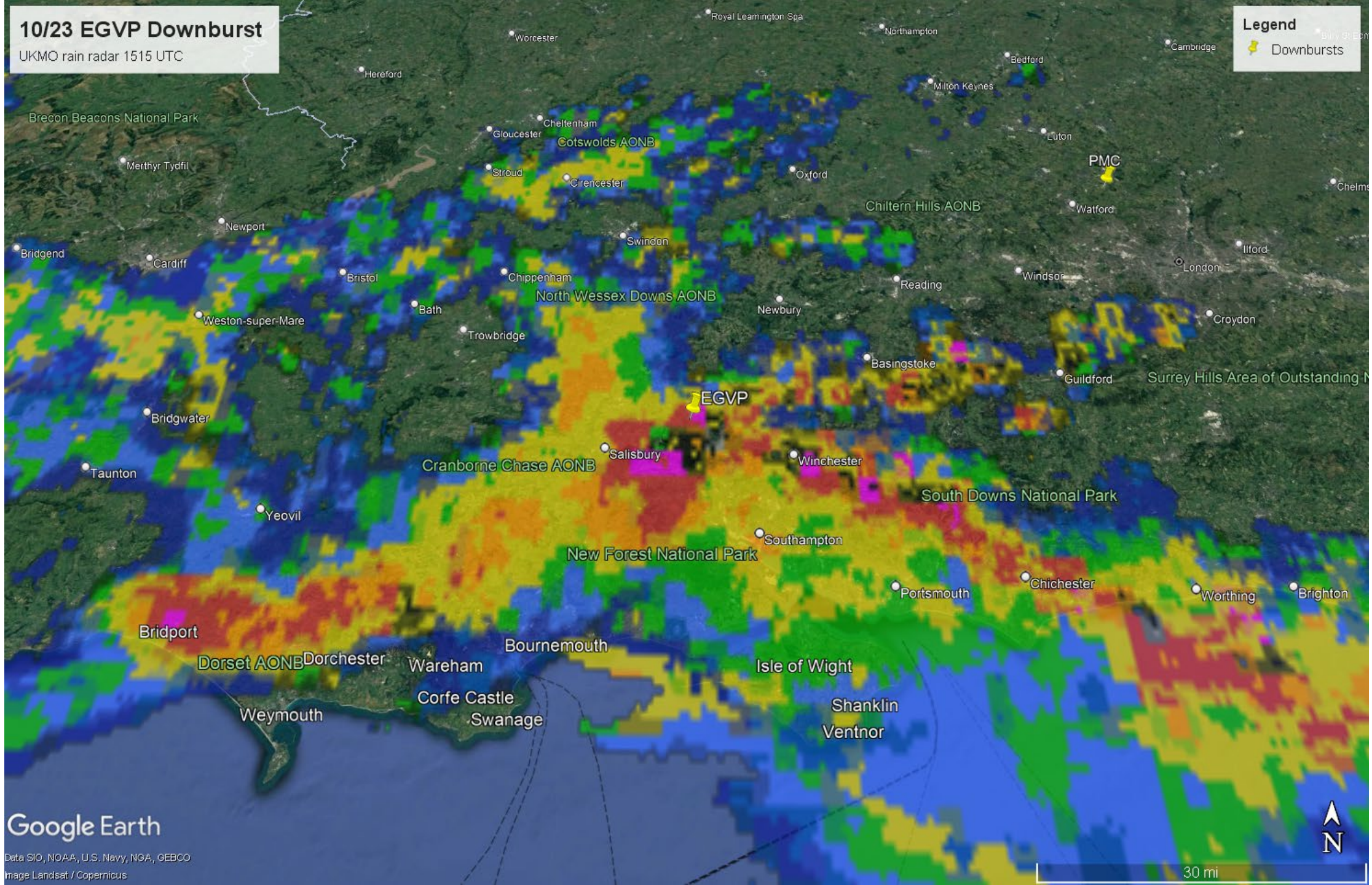
Ventnor
Google Earth
Data SIO, NOAA, U.S. Navy, NGA, GEBCO
Image Landsat / Copernicus
N
30 mi


10/23 EGVP Downburst
UKMO rain radar 1515 UTC
Legend
Downbursts
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Northampton
Cambridge
Bedford
Hereford
Milton Keynes
Brecon Beacons National Park
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Worthing
Brighton
Bridport
Bournemouth
Dorset AONB
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Wareham
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Corfe Castle
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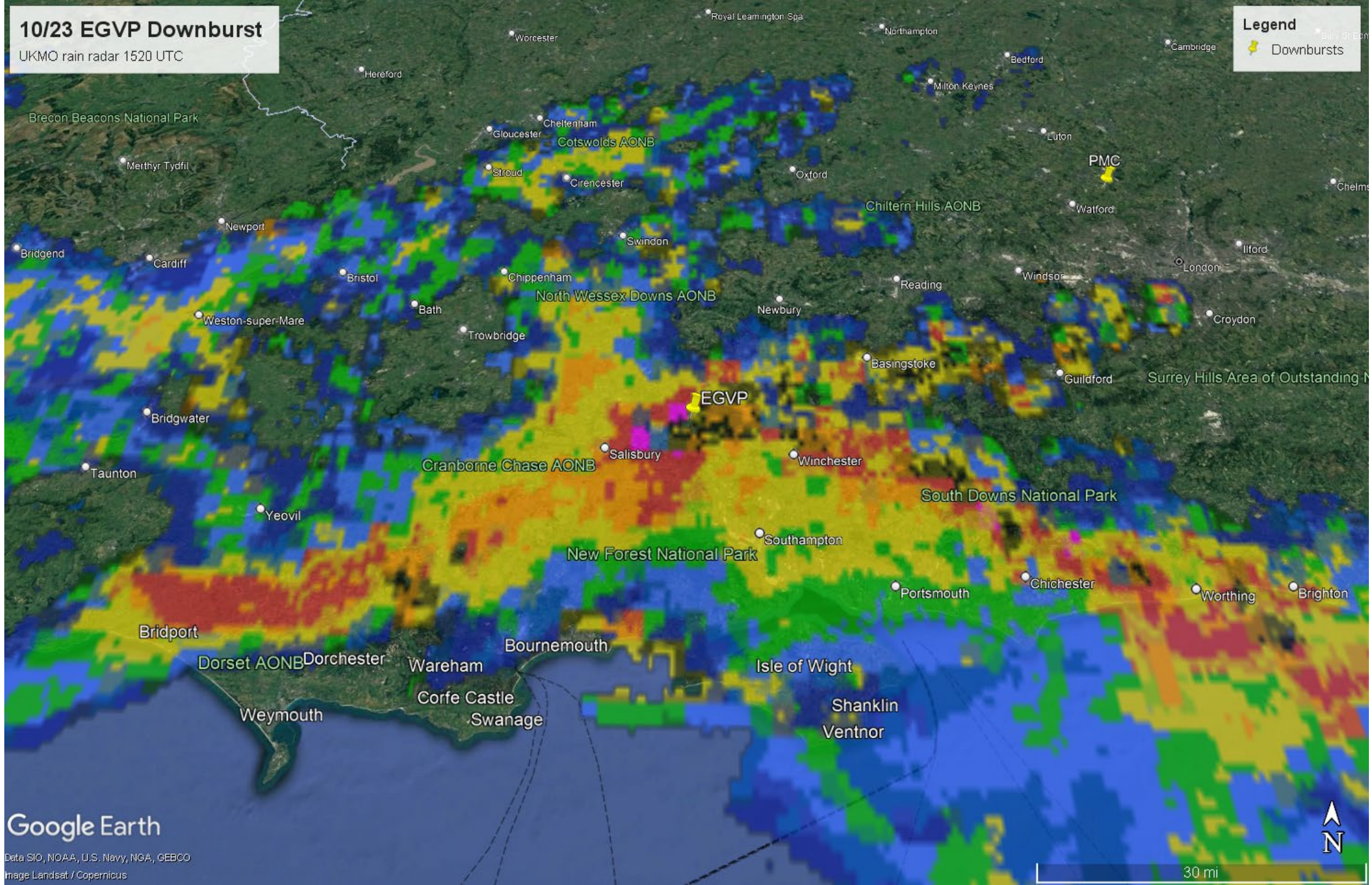
Weymouth
Swanage
Ventnor
Google Earth
Data SIO, NOAA, U.S. Navy, NGA, GEBCO
Image Landsat / Copernicus
N
30 mi


10/23 EGVP Downburst
UKMO rain radar 1520 UTC
Legend
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Google Earth
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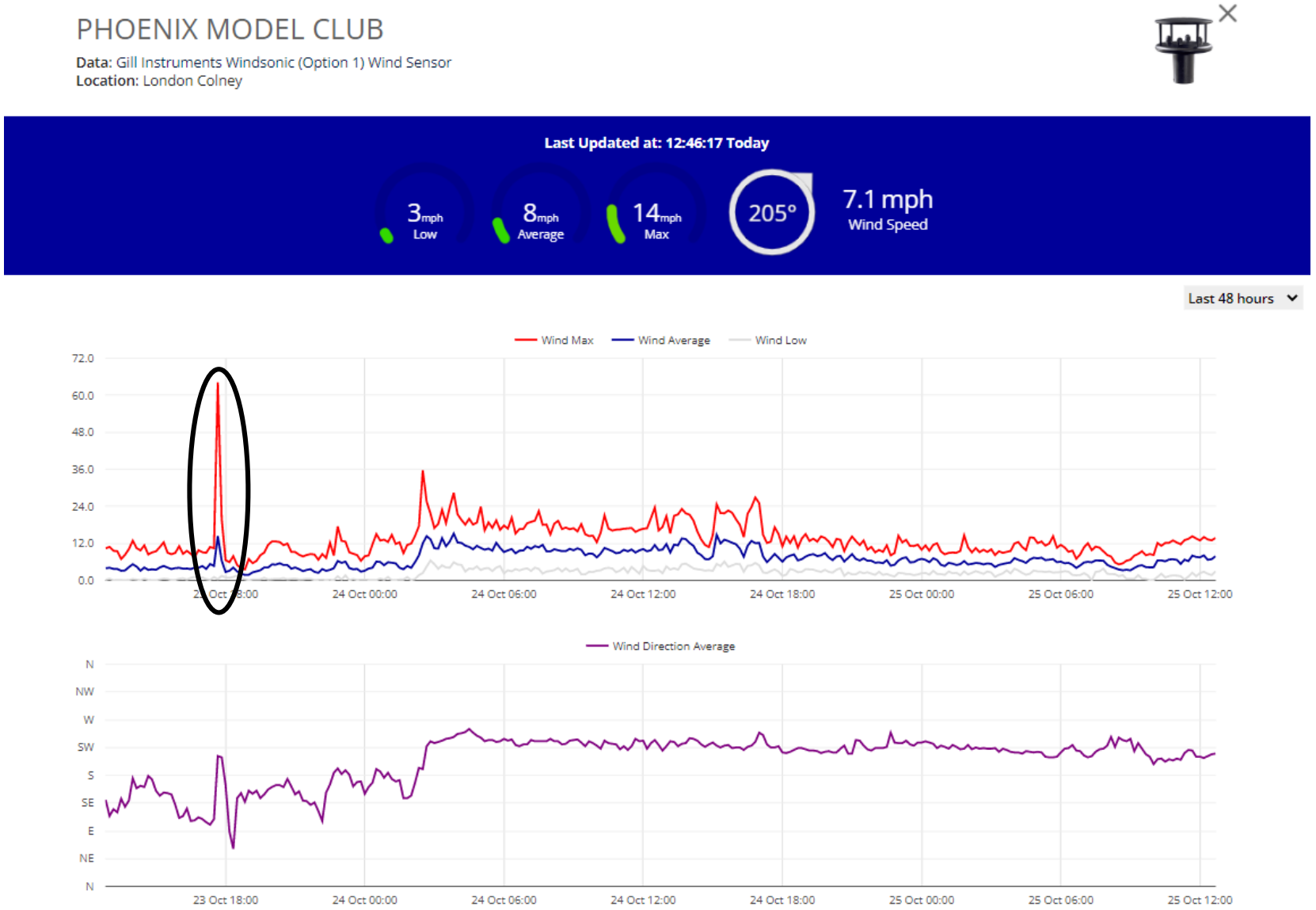
Image Landsat / Copernicus
N
30 mi

Downburst Wind Observation

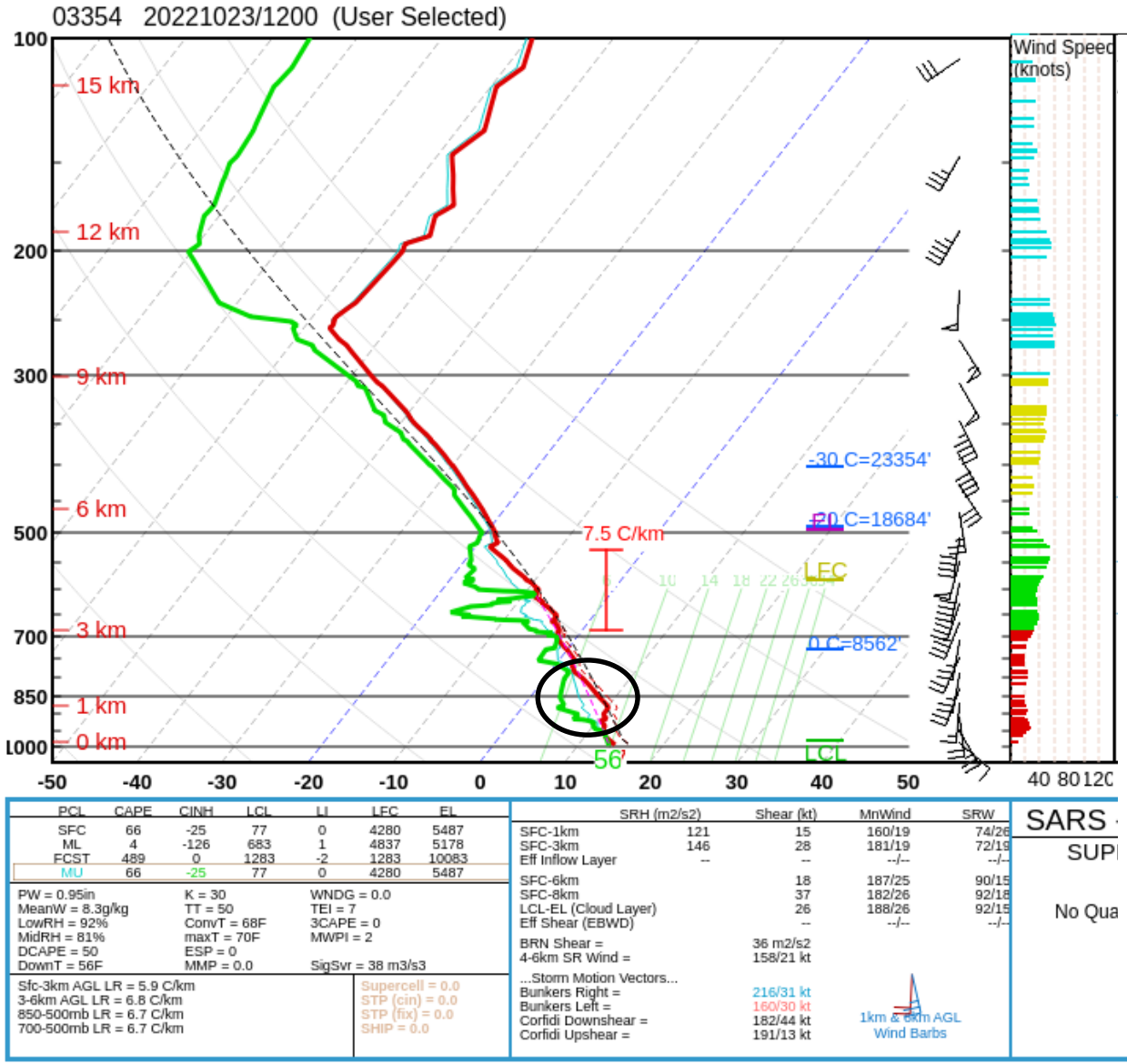


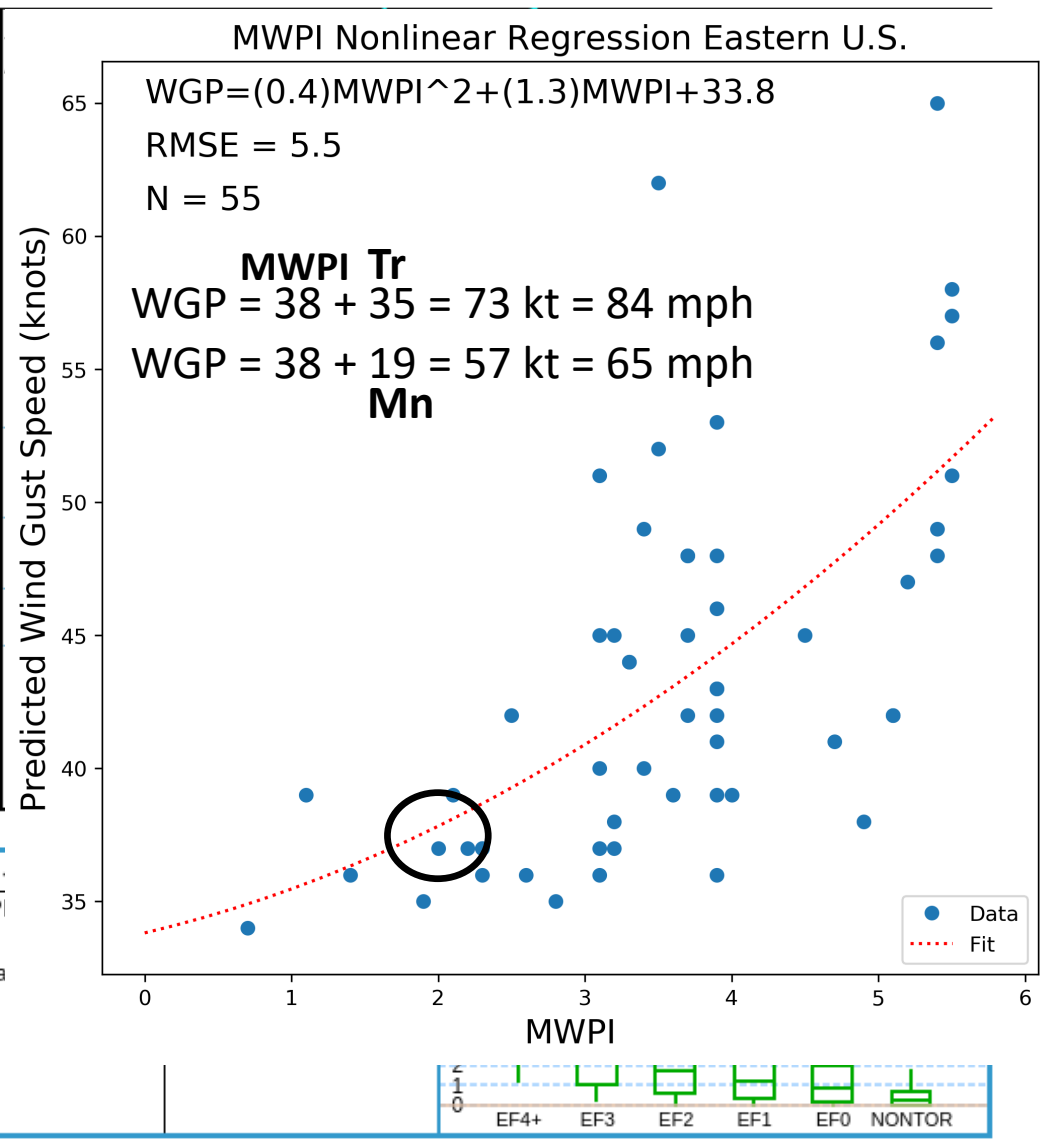
https://www.torro.org.uk/IPS/index.php?/topic/14022-20221023-wind-damage-hertford/

Courtesy of Simon Culling, TORRO and WeatherFile

RAOB Sounding: Nottingham, UK

91 miles N-NW of PMC

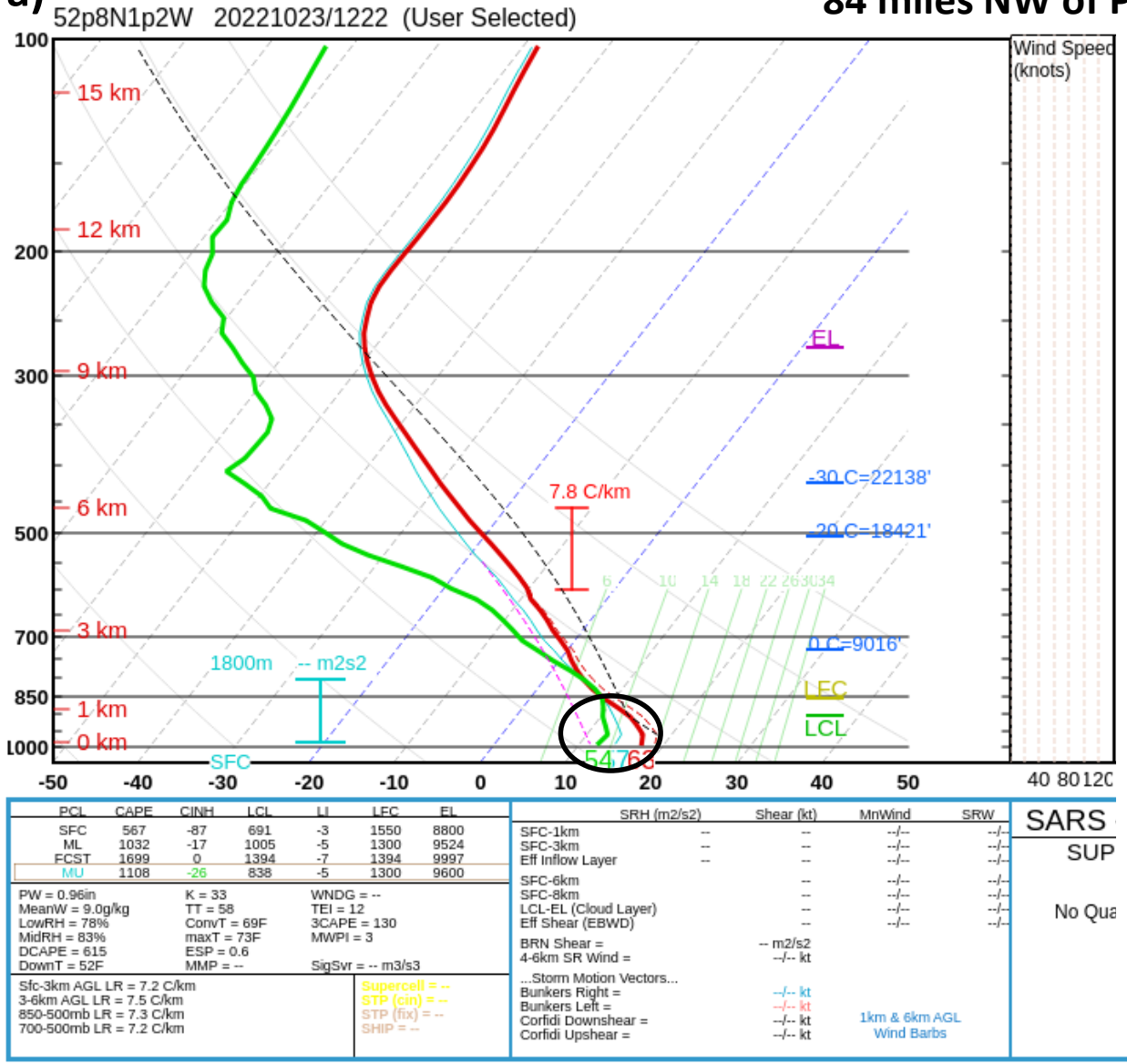




NUCAPS Sounding:
Loughborough, Leicestershire, UK

84 miles NW of PMC

a)



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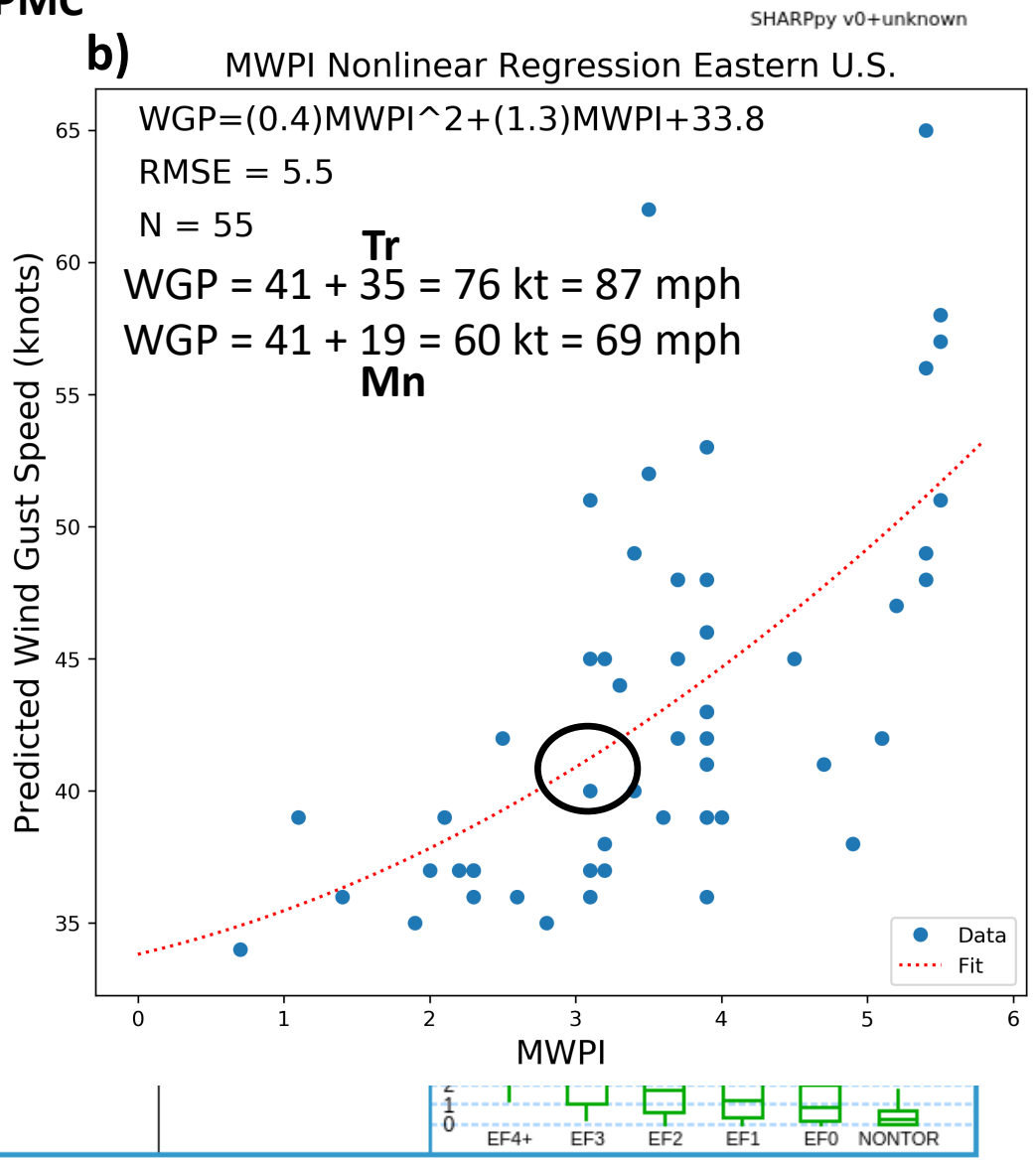
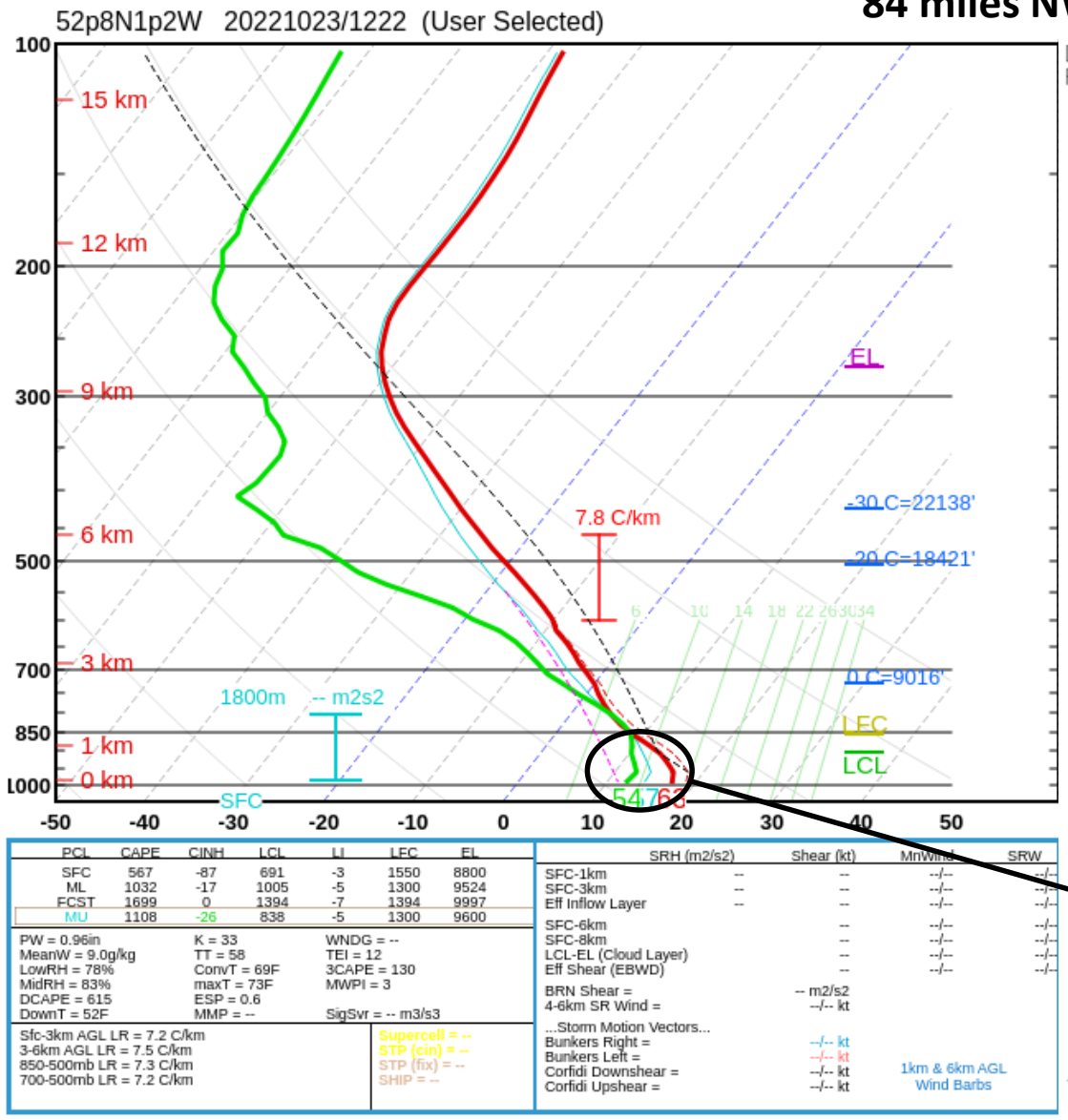
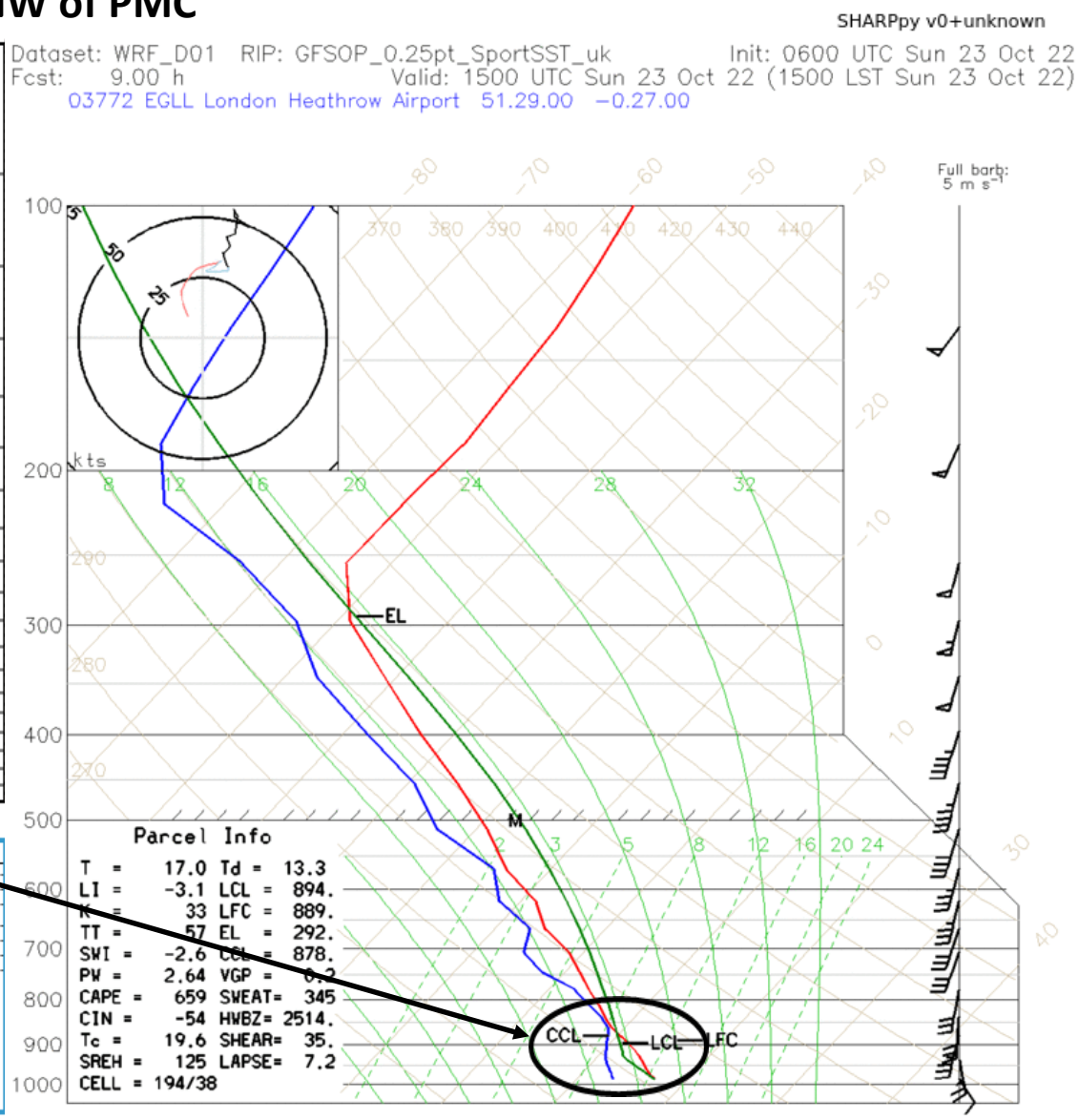


NUCAPS Sounding:
Loughborough, Leicestershire, UK

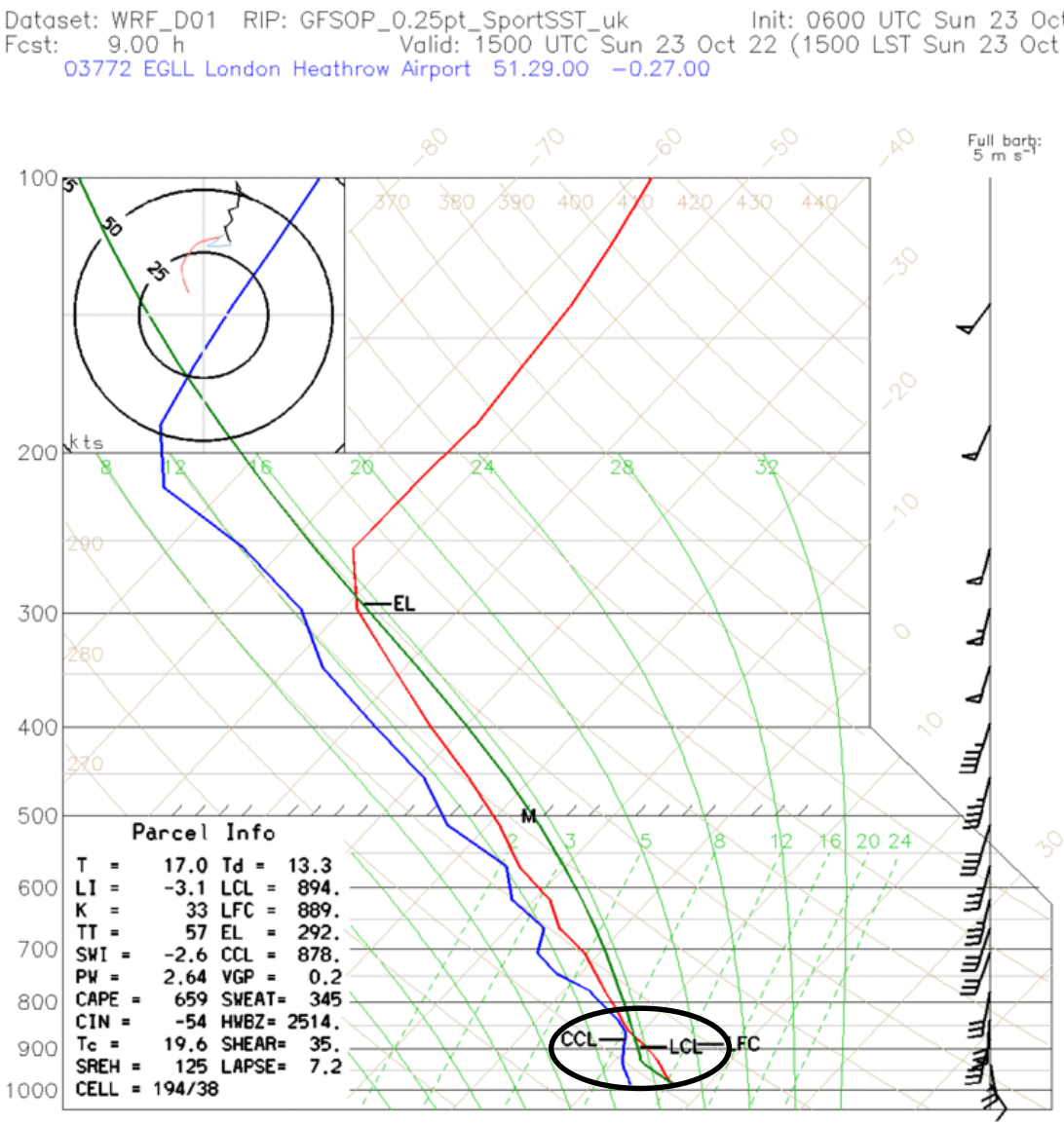
84 miles NW of PMC

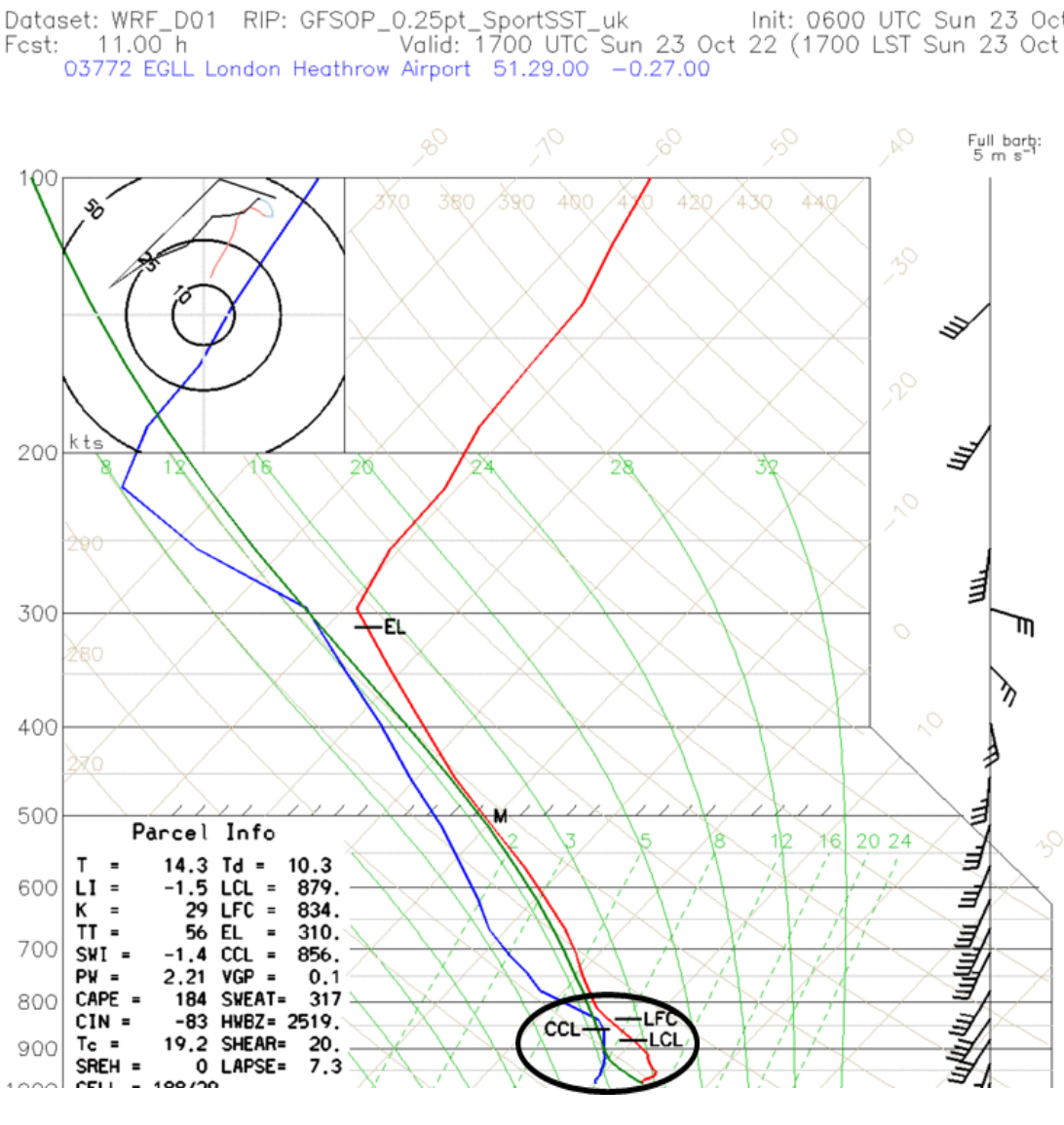




WRF Model-derived Sounding Comparison

Courtesy of David Smart, TORRO/UCL Hazard Centre

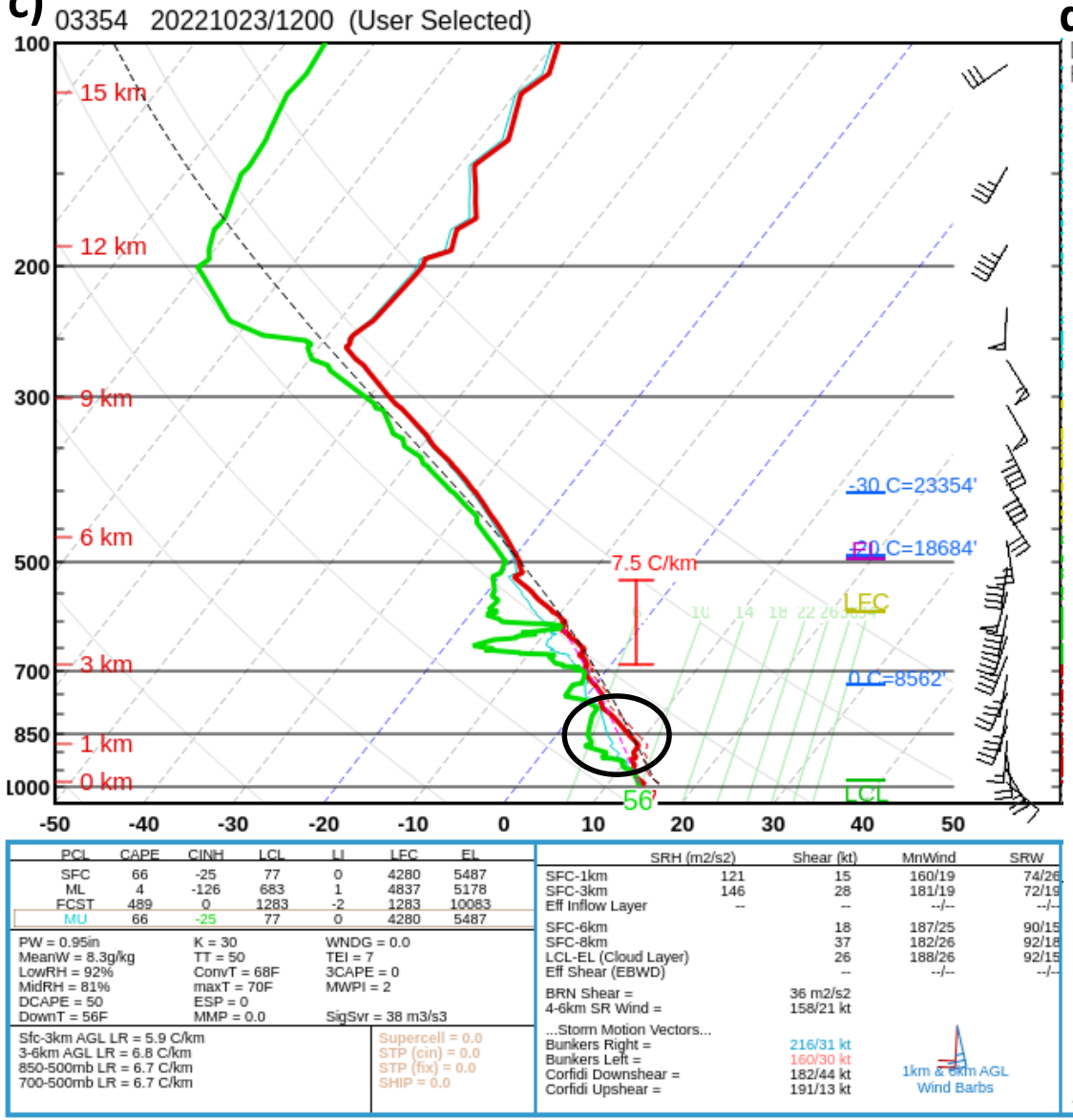




RAOB Sounding: Nottingham, UK

91 miles N-NW of PMC

c)



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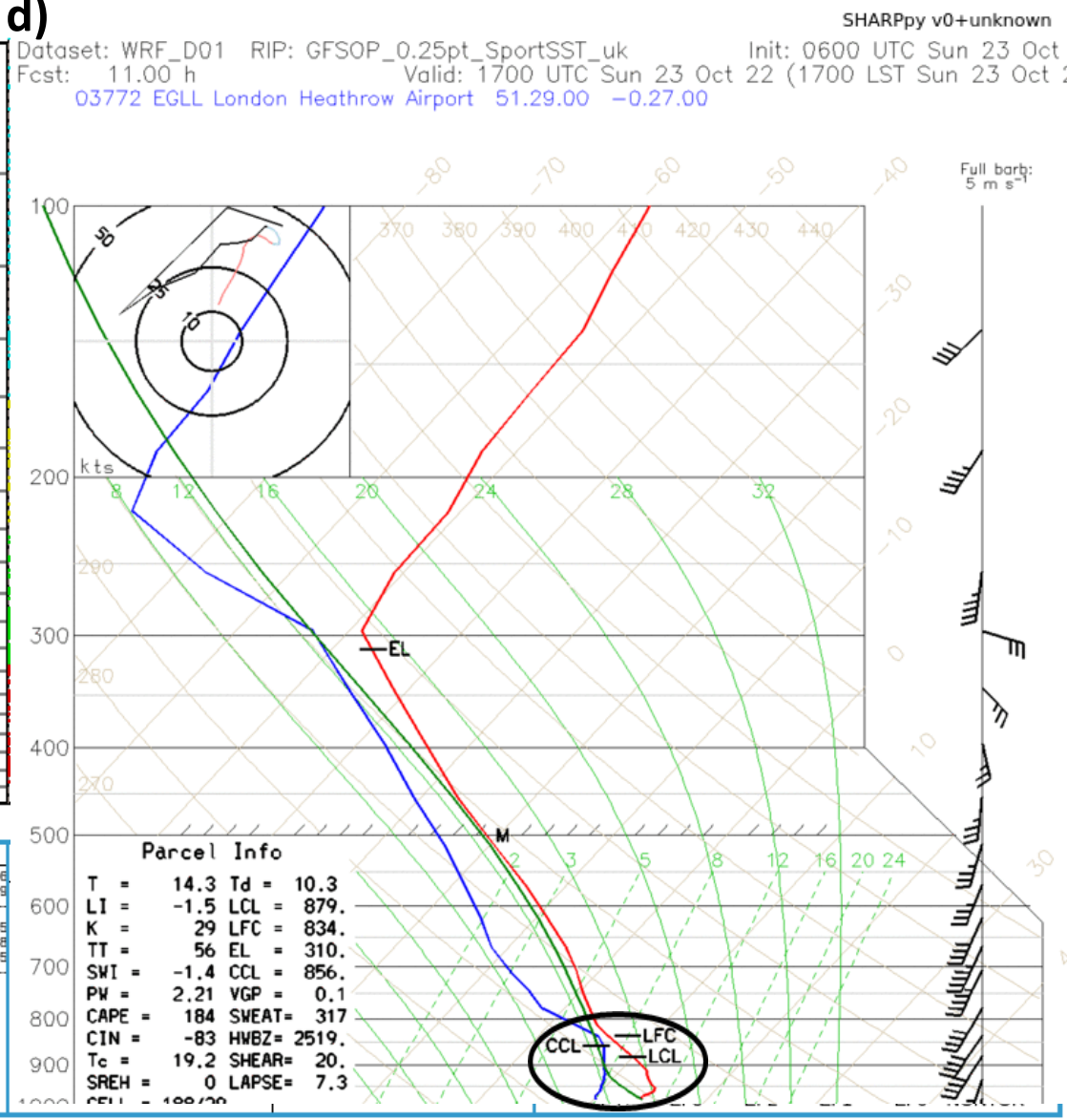
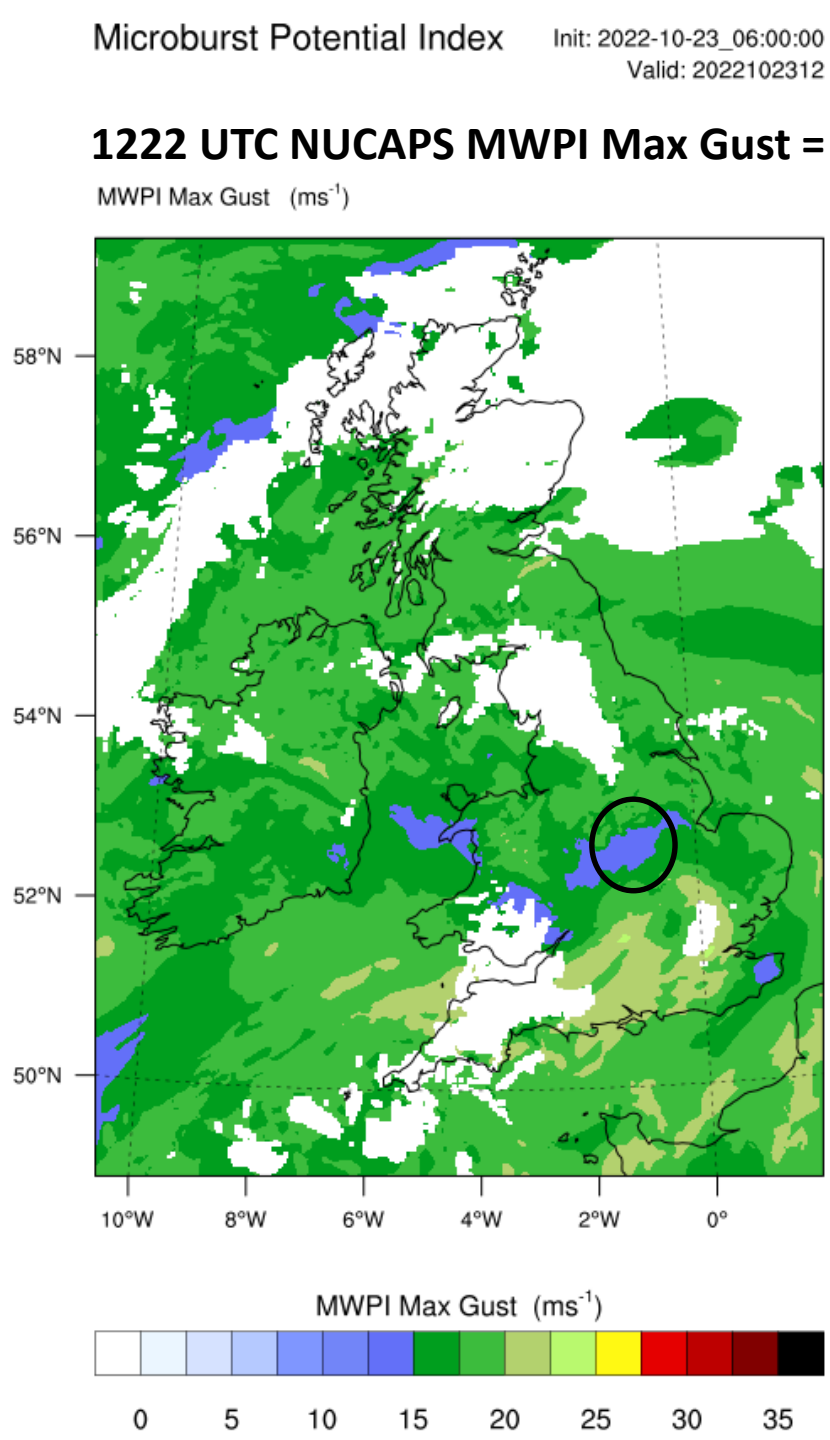
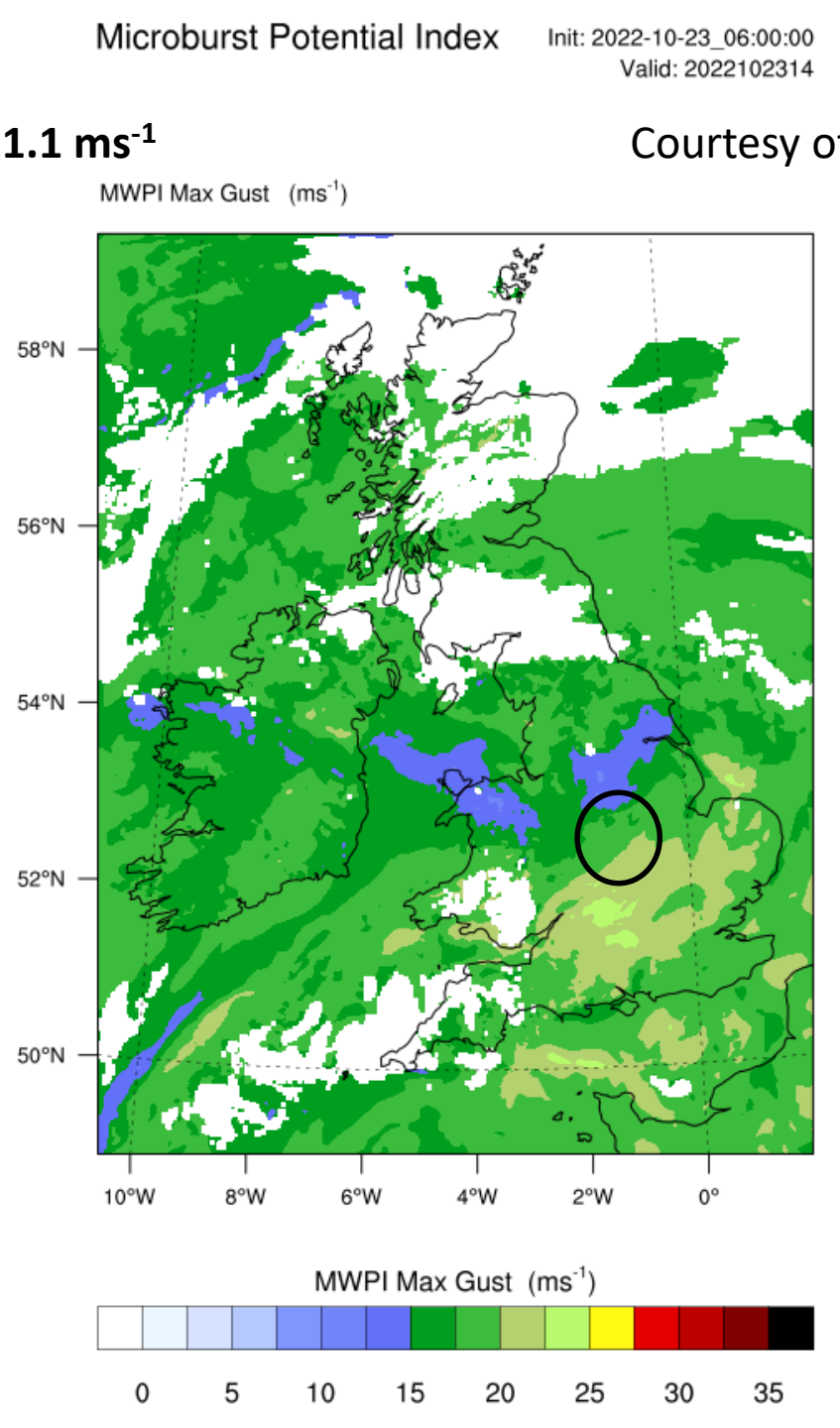
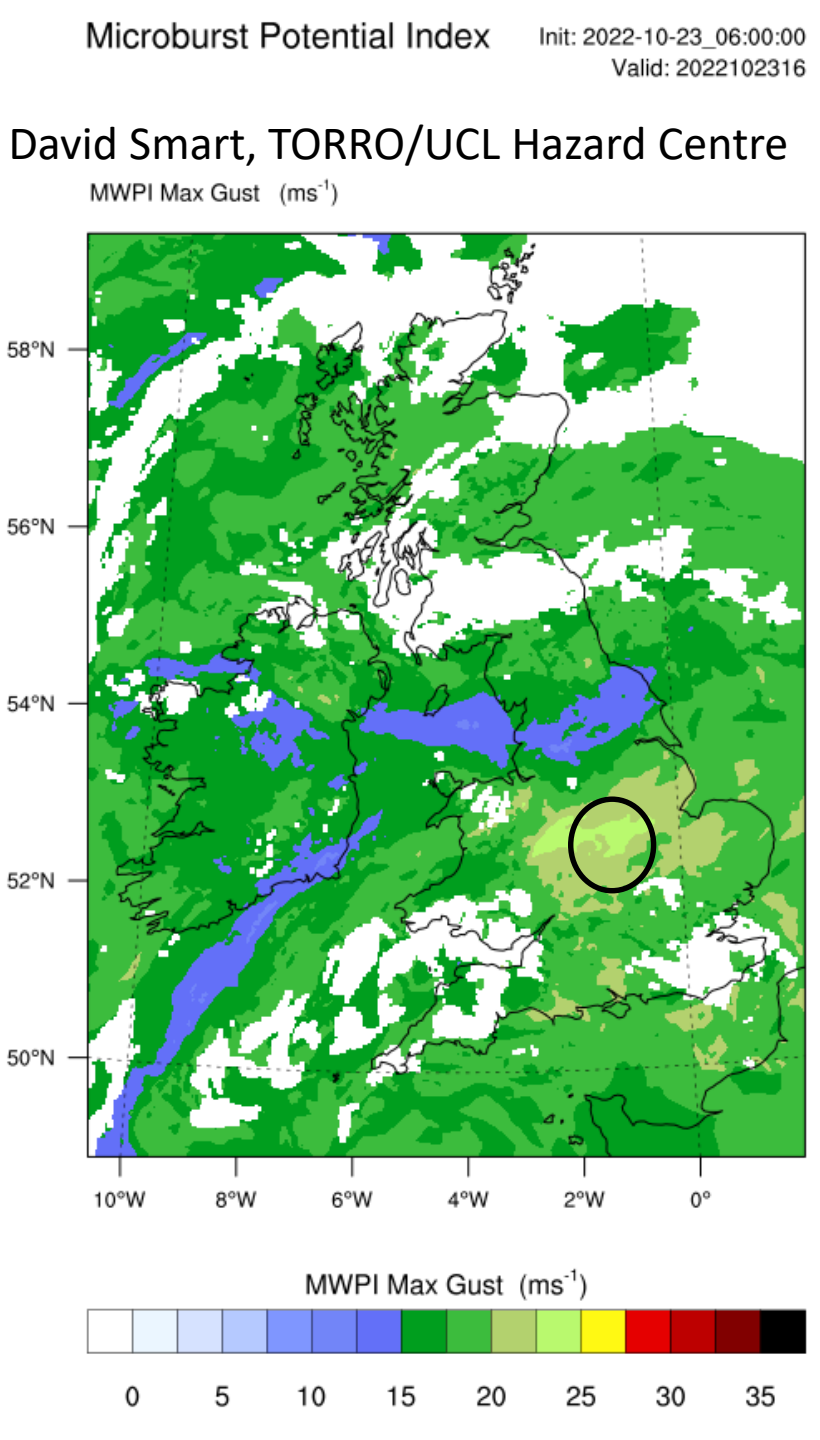




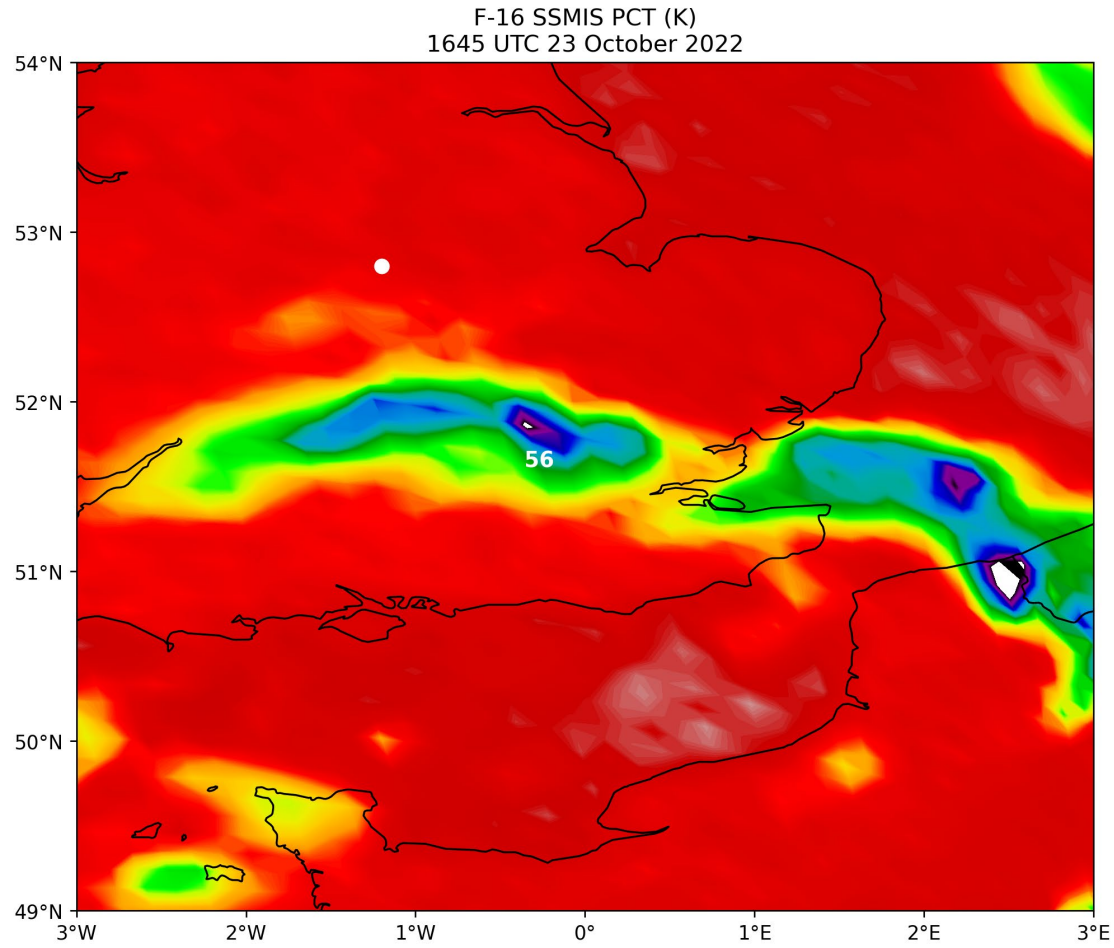


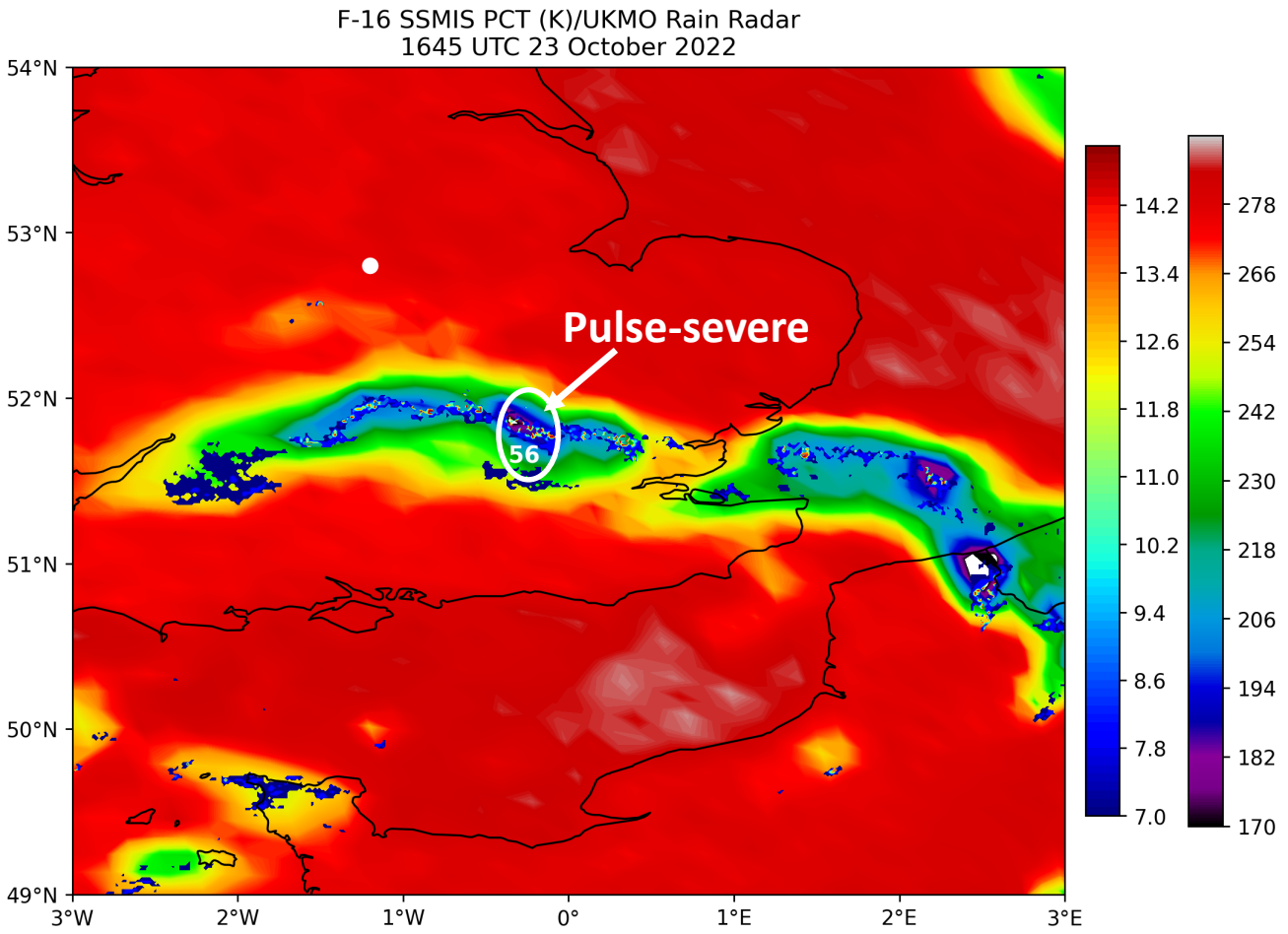


1222 UTC NUCAPS MWPI Max Gust = 21.1 ms^{-1}

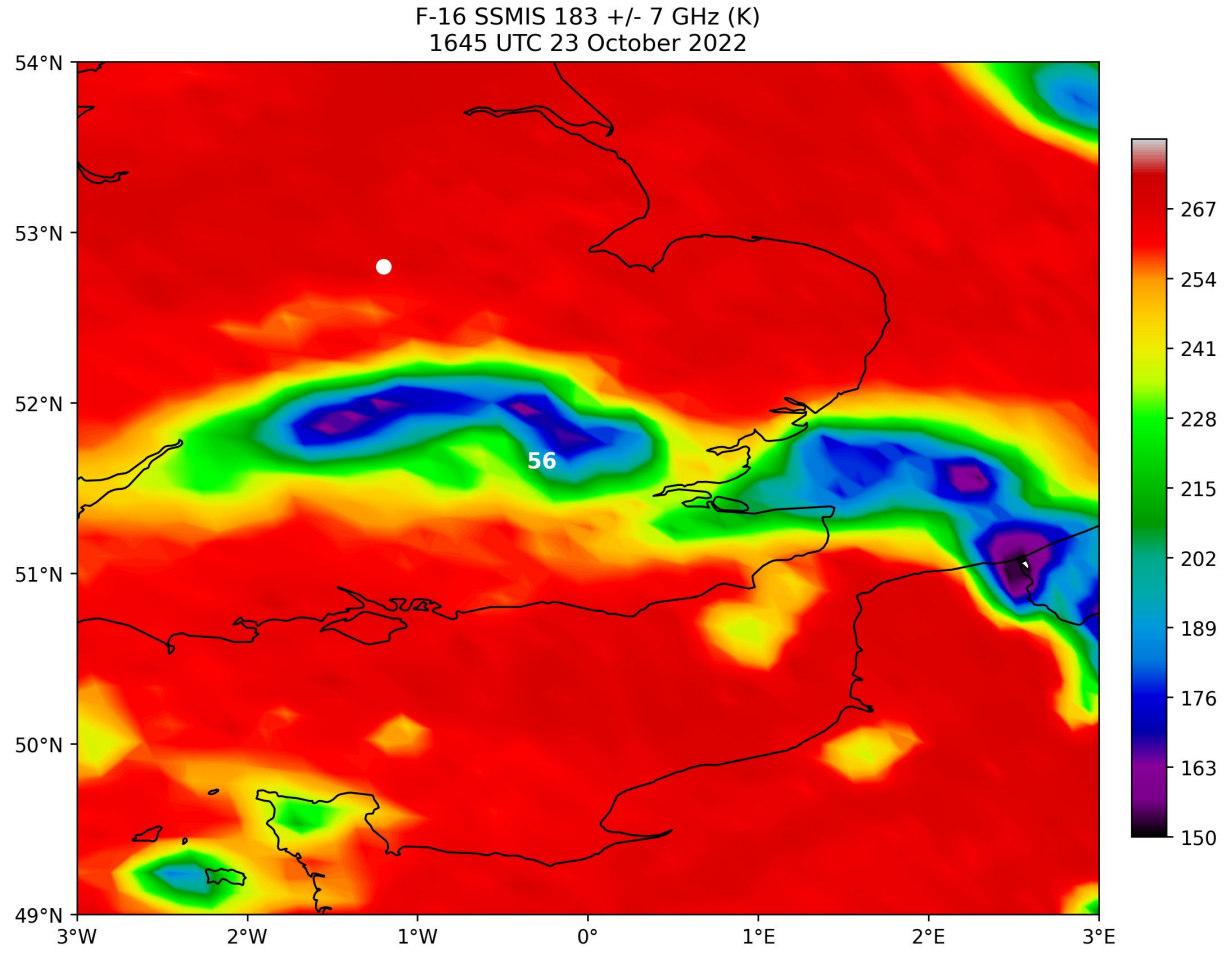
Courtesy of David Smart, TORRO/UCL Hazard Centre

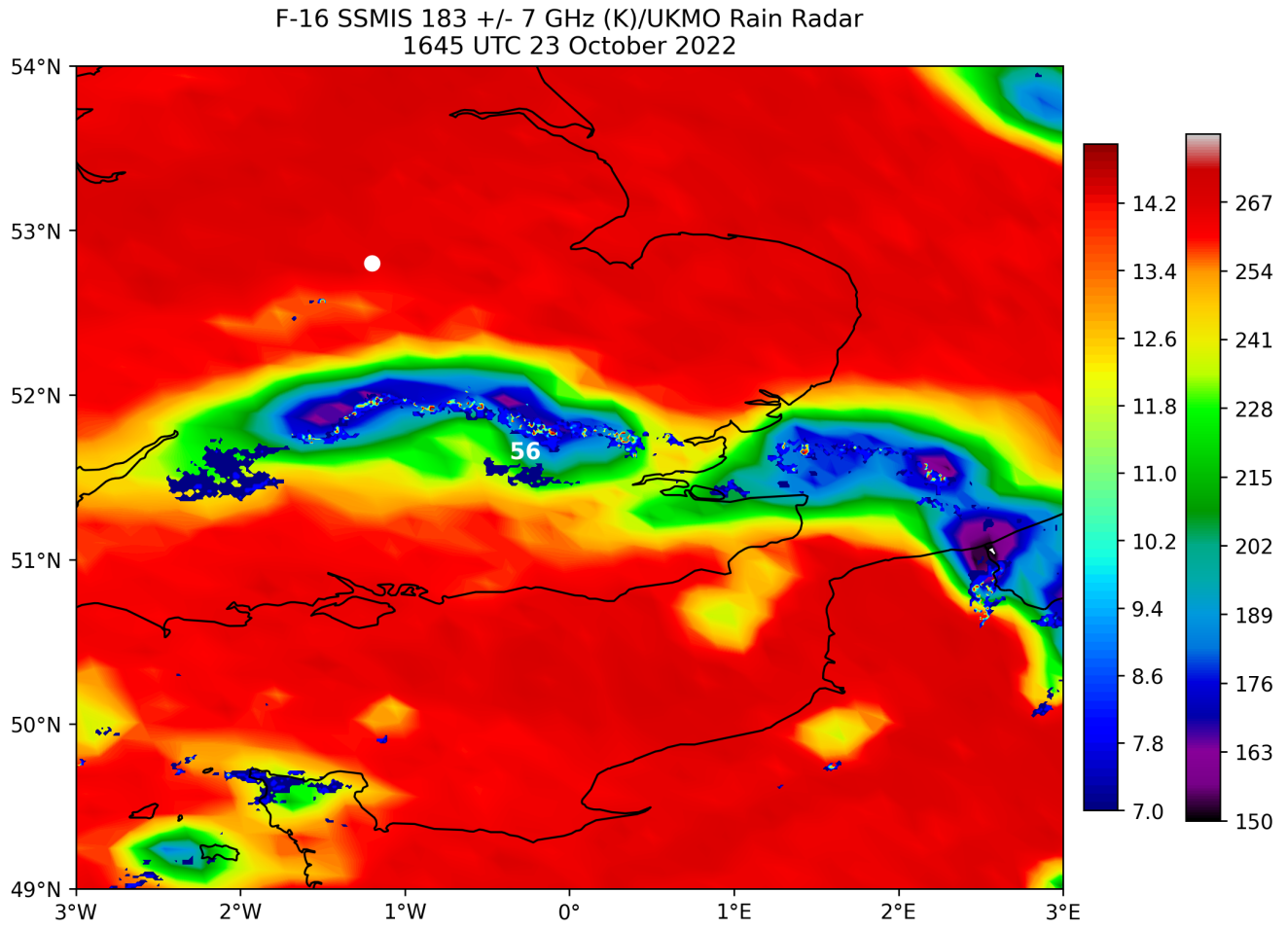
SSMIS-Radar Product Comparison



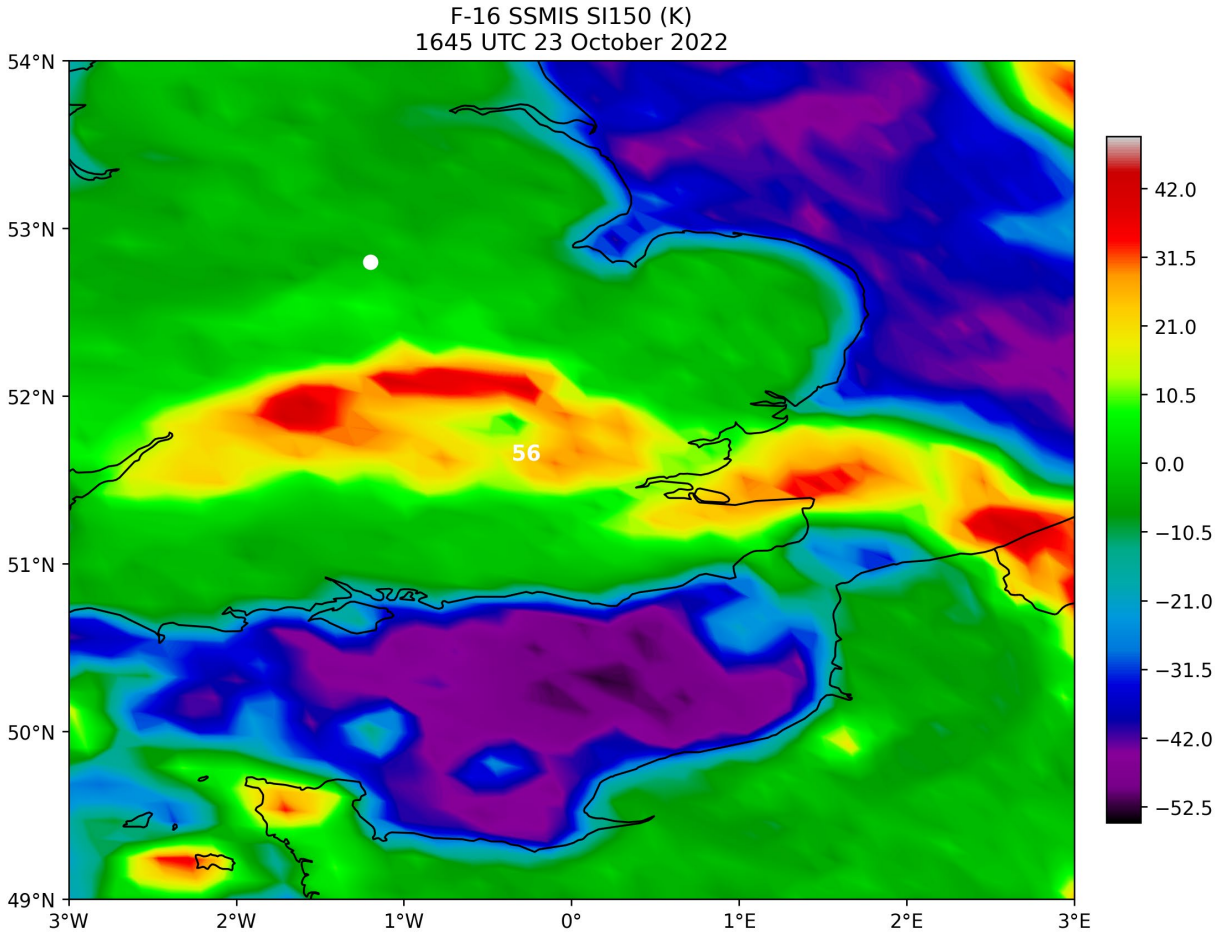


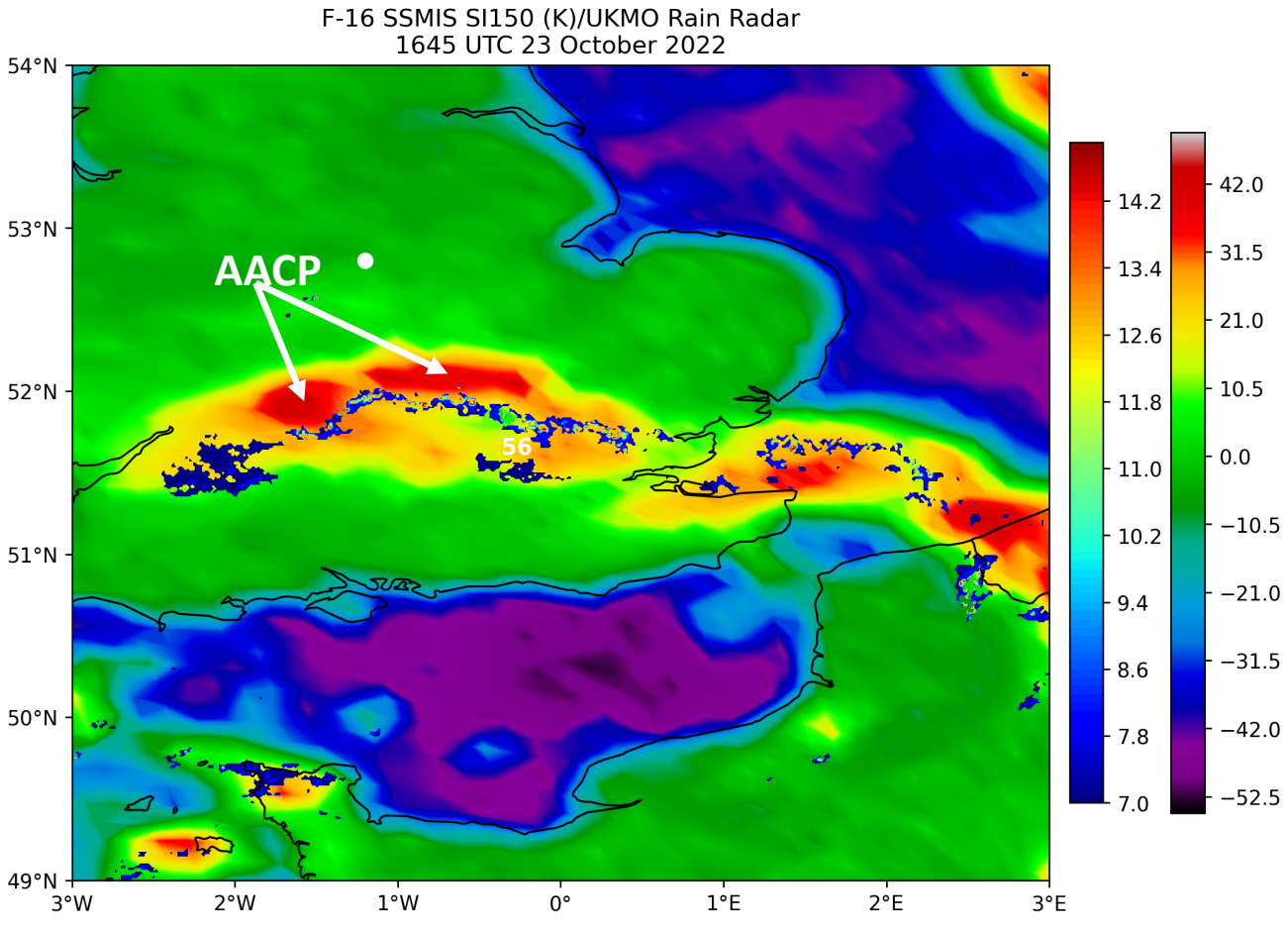
SSMIS-Radar Product Comparison





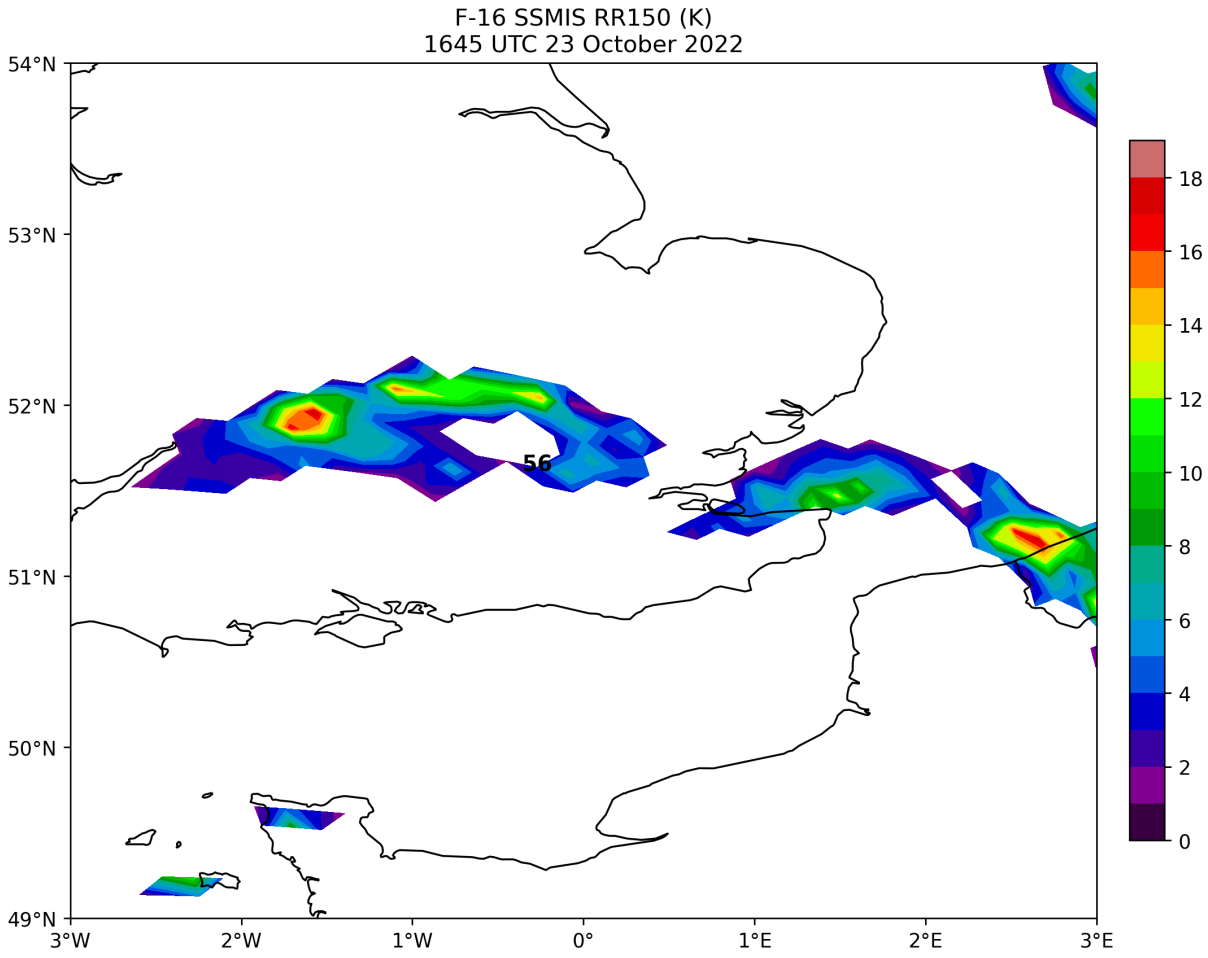
SSMIS-Radar Product Comparison

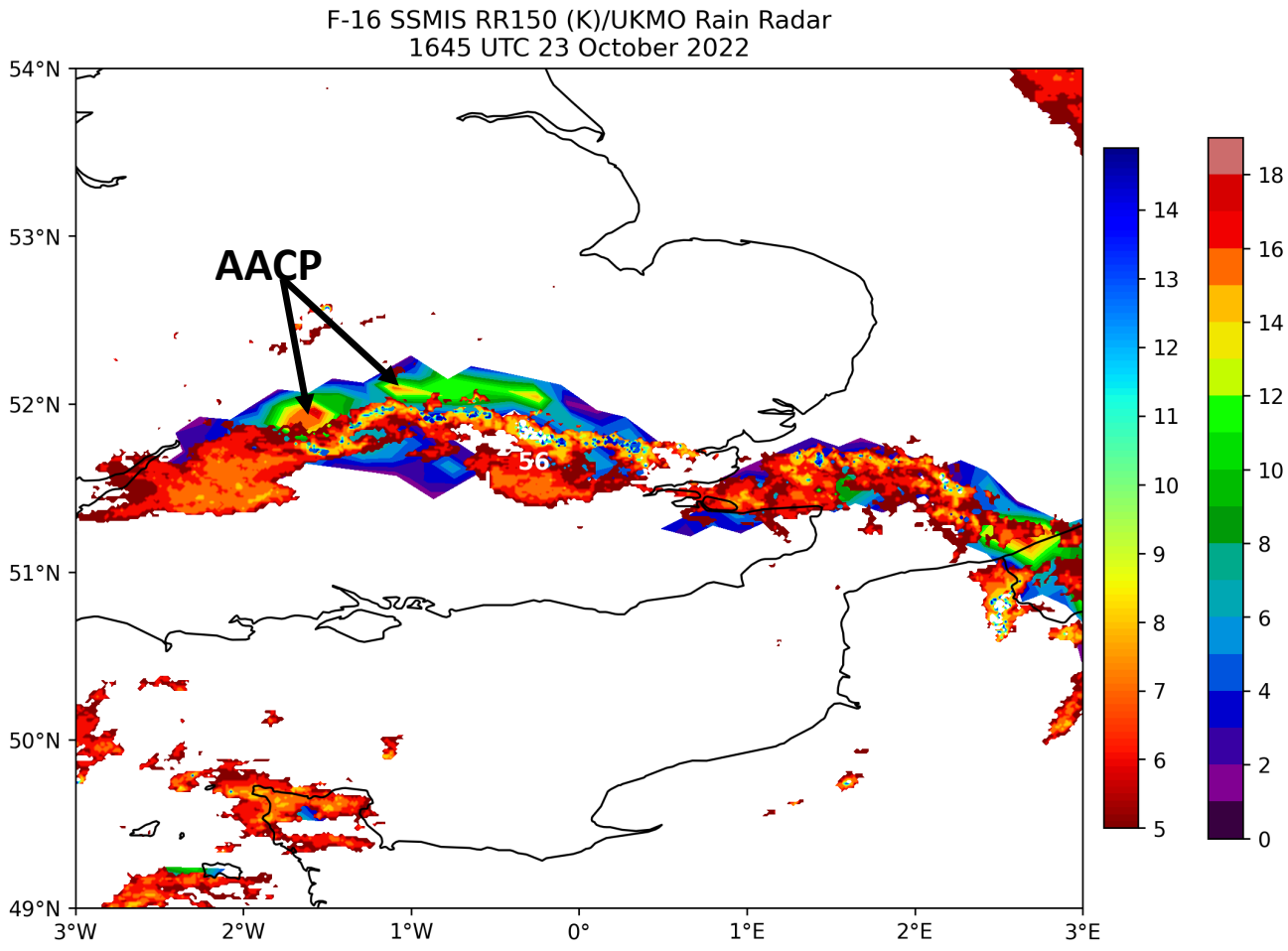




AACP: Above-anvil cirrus plume

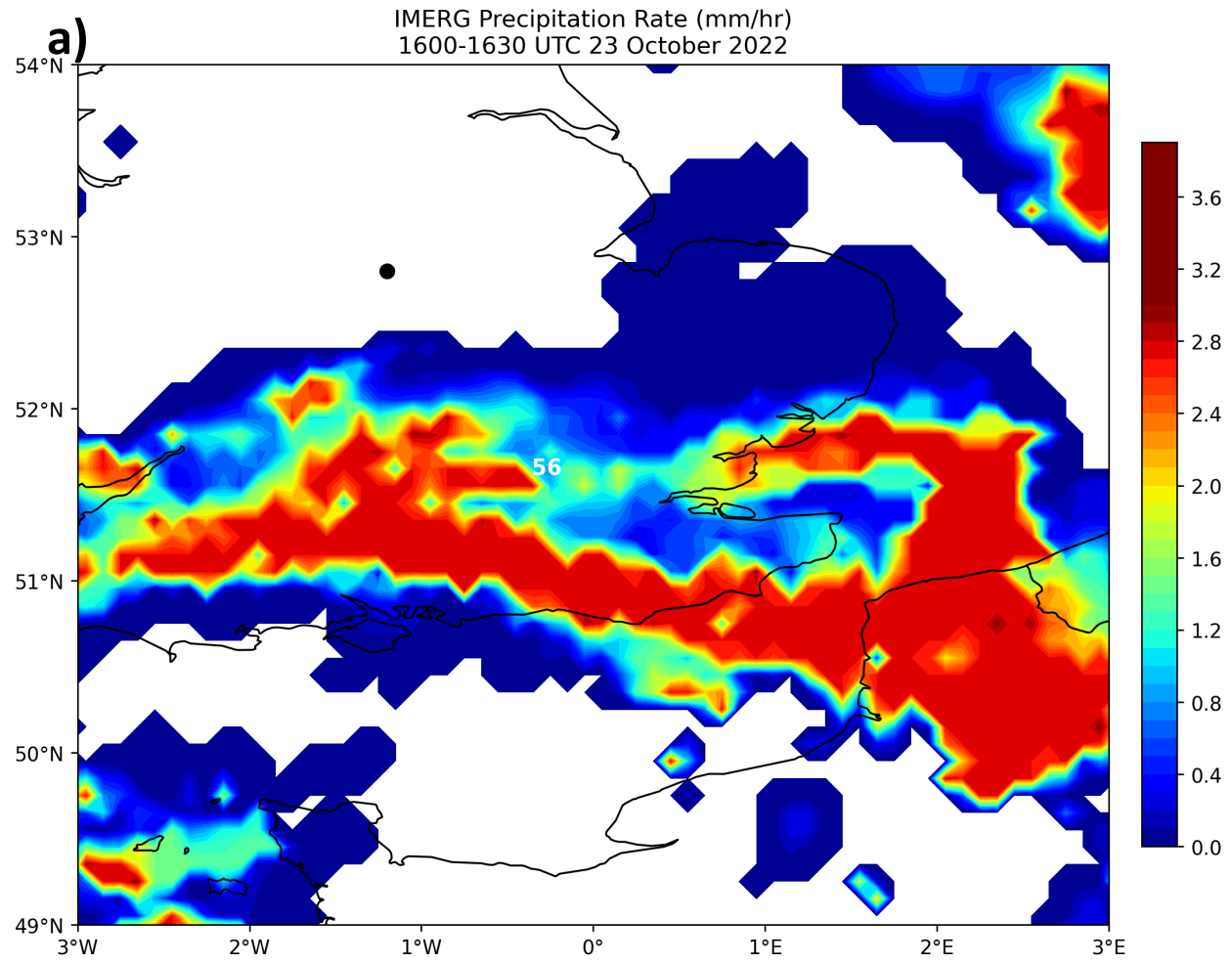
SSMIS-Radar Product Comparison

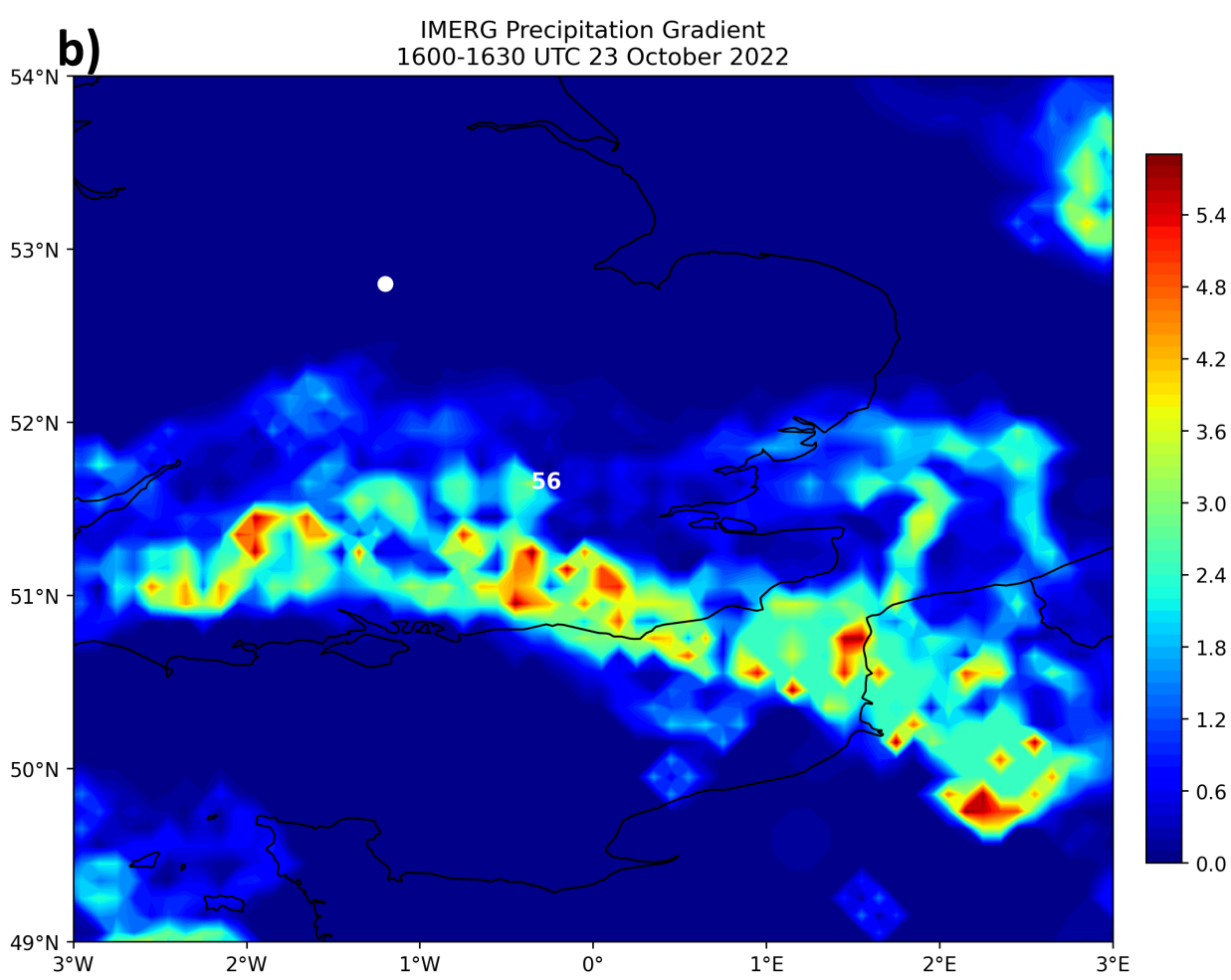




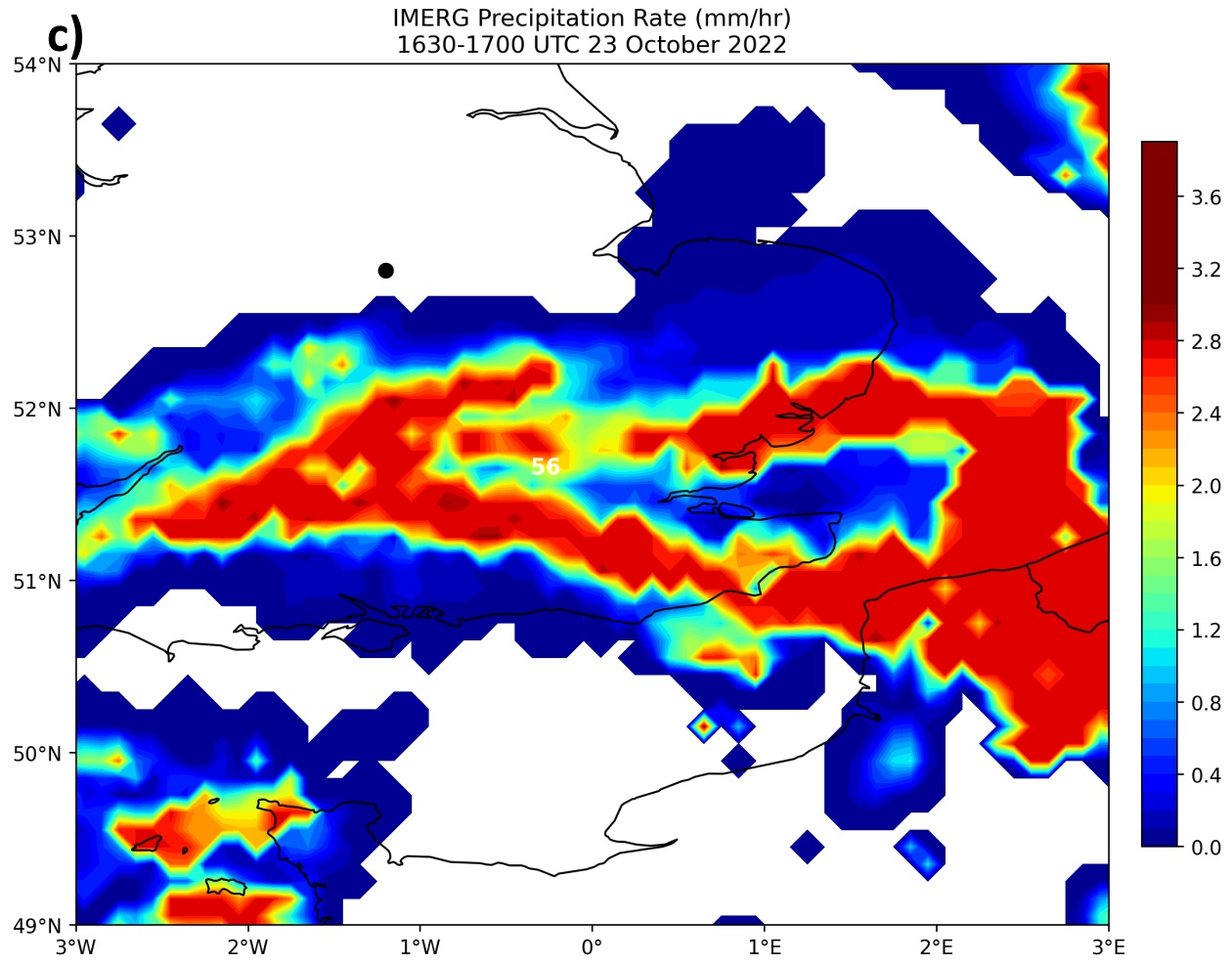
AACP: Above-anvil cirrus plume

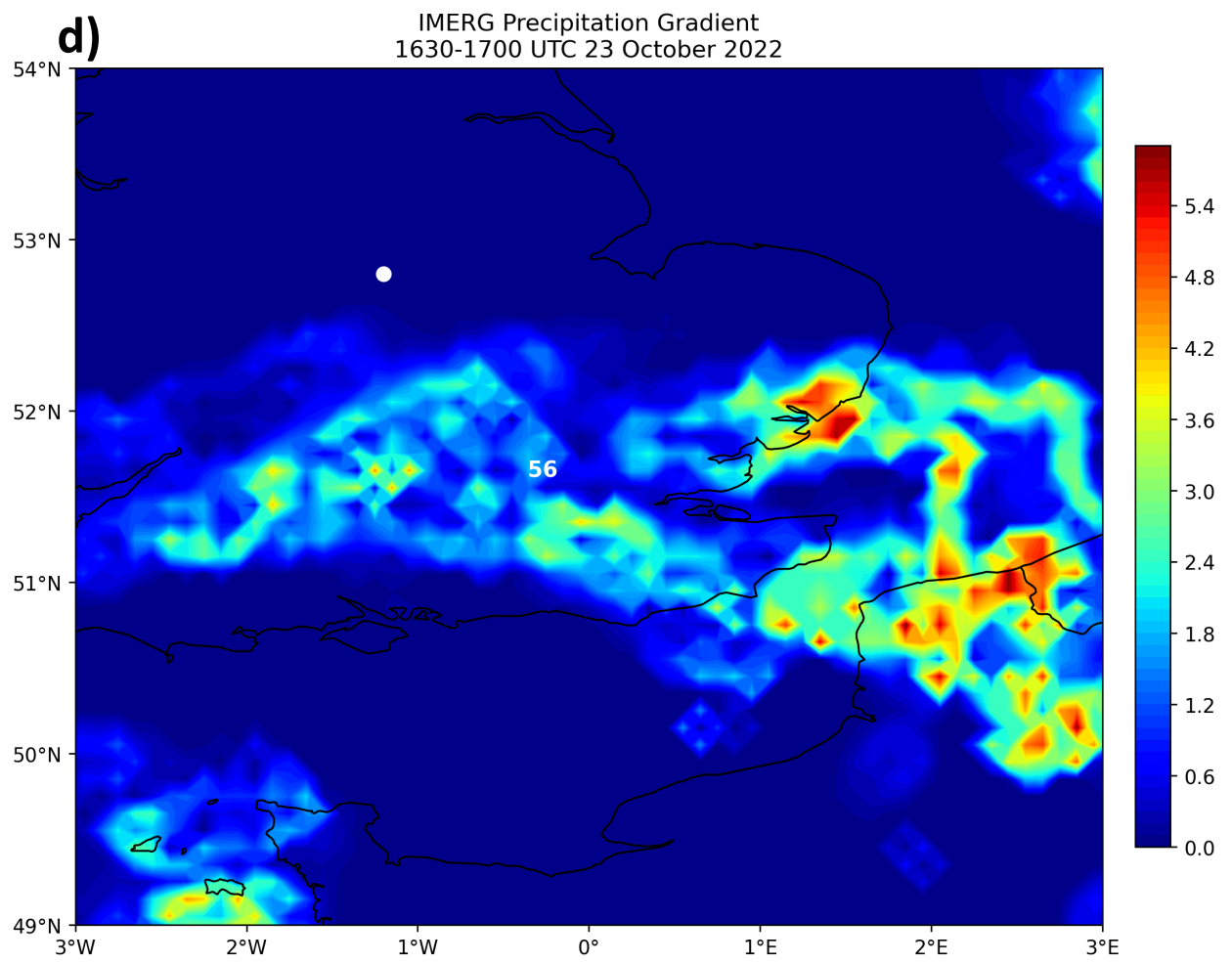
IMERG Image Analysis: 1600 UTC



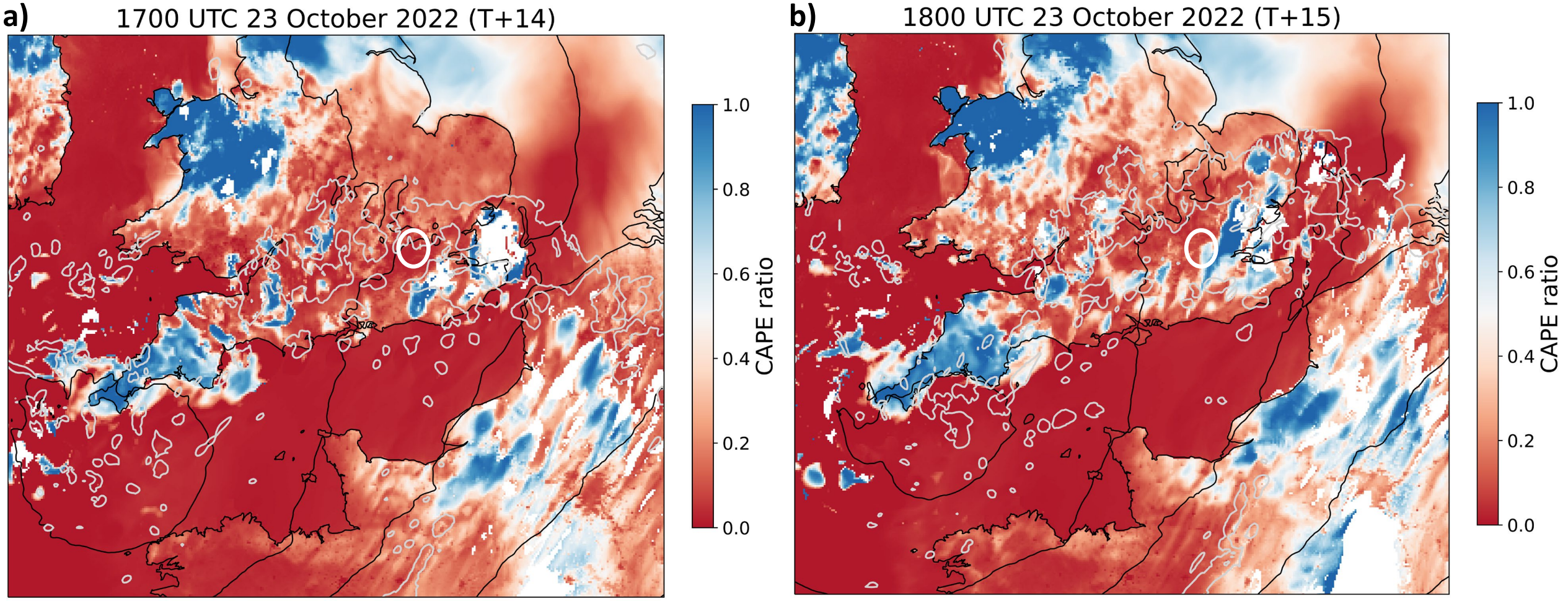


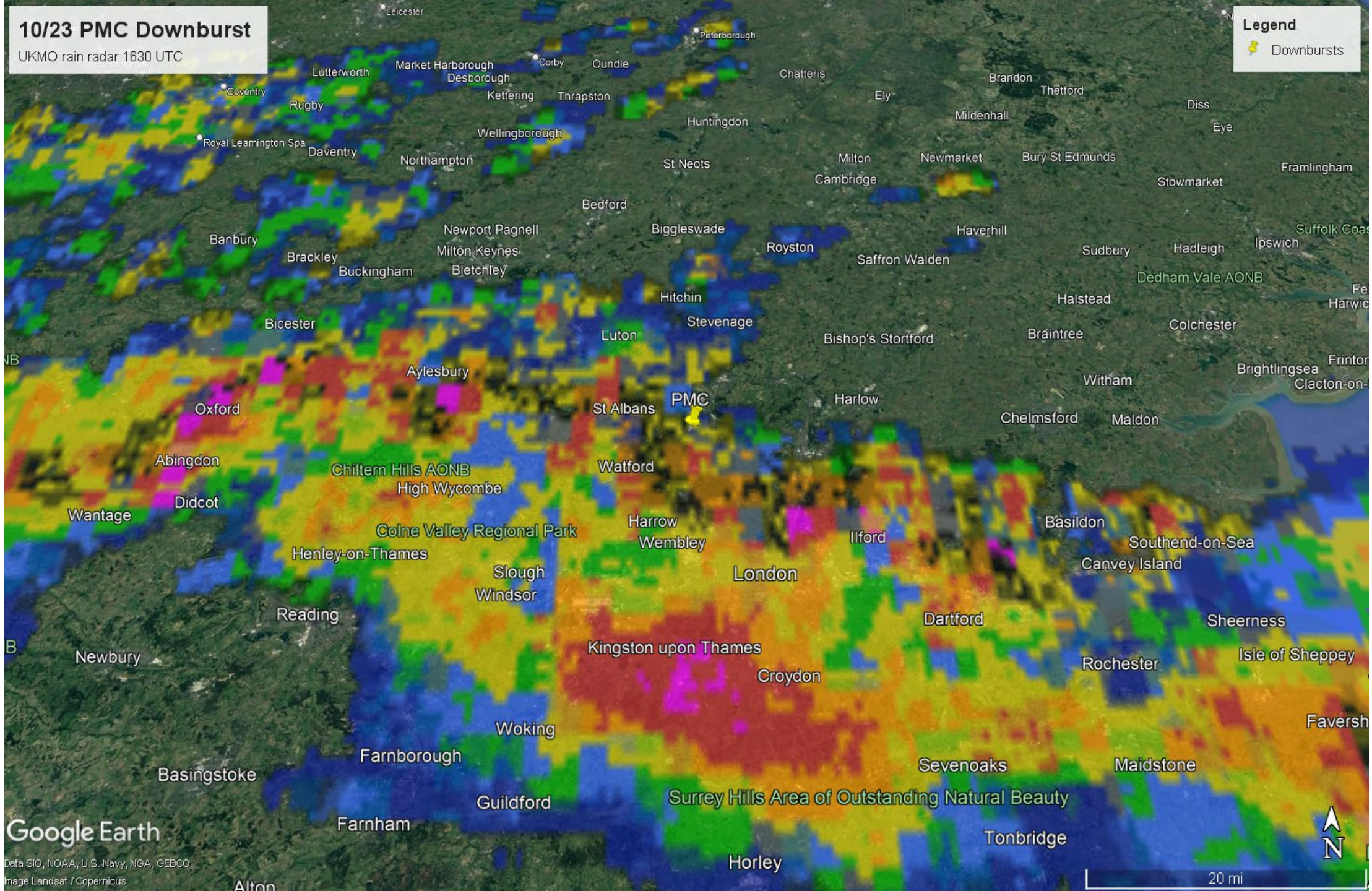
IMERG Image Analysis: 1630 UTC





Elevated convection diagnostic: CAPE Ratio




10/23 PMC Downburst
UKMO rain radar 1630 UTC
Legend
Downbursts
Leicester
Peterborough
Lutterworth
Market Harborough
Desborough
Corby
Oundle
Chatteris
Brandon
Thetford
Coventry
Rugby
Kettering
Thrapston
Ely
Diss
Mildenhall
Eye
Huntingdon
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Royal Leamington Spa
Daventry
Northampton
St Neots
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Cambridge
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Newport Pagnell
Biggleswade
Haverhill
Banbury
Brackley
Milton Keynes
Buckingham
Bletchley
Royston
Saffron Walden
Sudbury
Hadleigh
Ipswich
Dedham Vale AONB
Hitchin
Halstead
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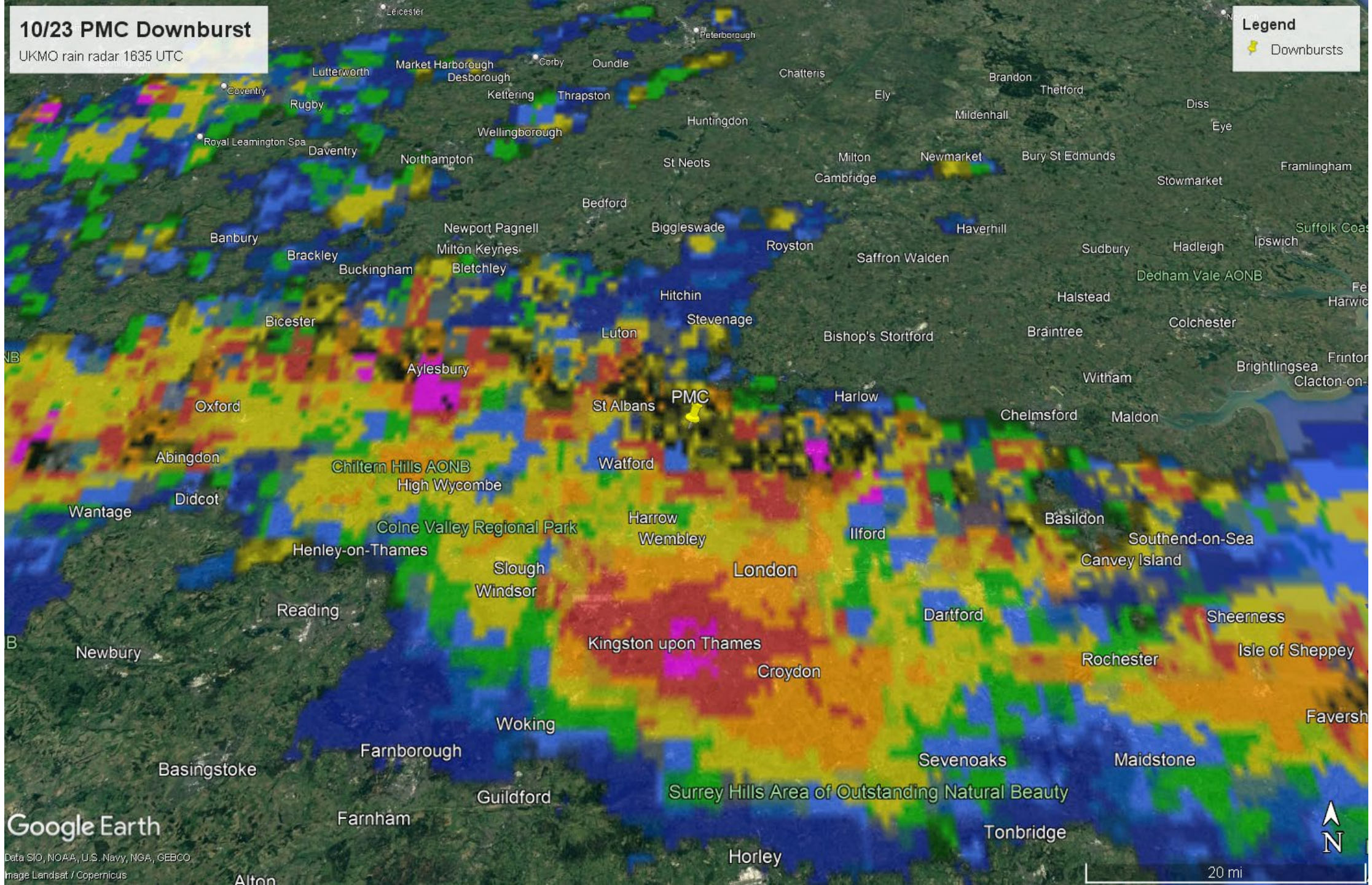
10/23 PMC Downburst
UKMO rain radar 1635 UTC
Legend
Downbursts
PMC
Leicester
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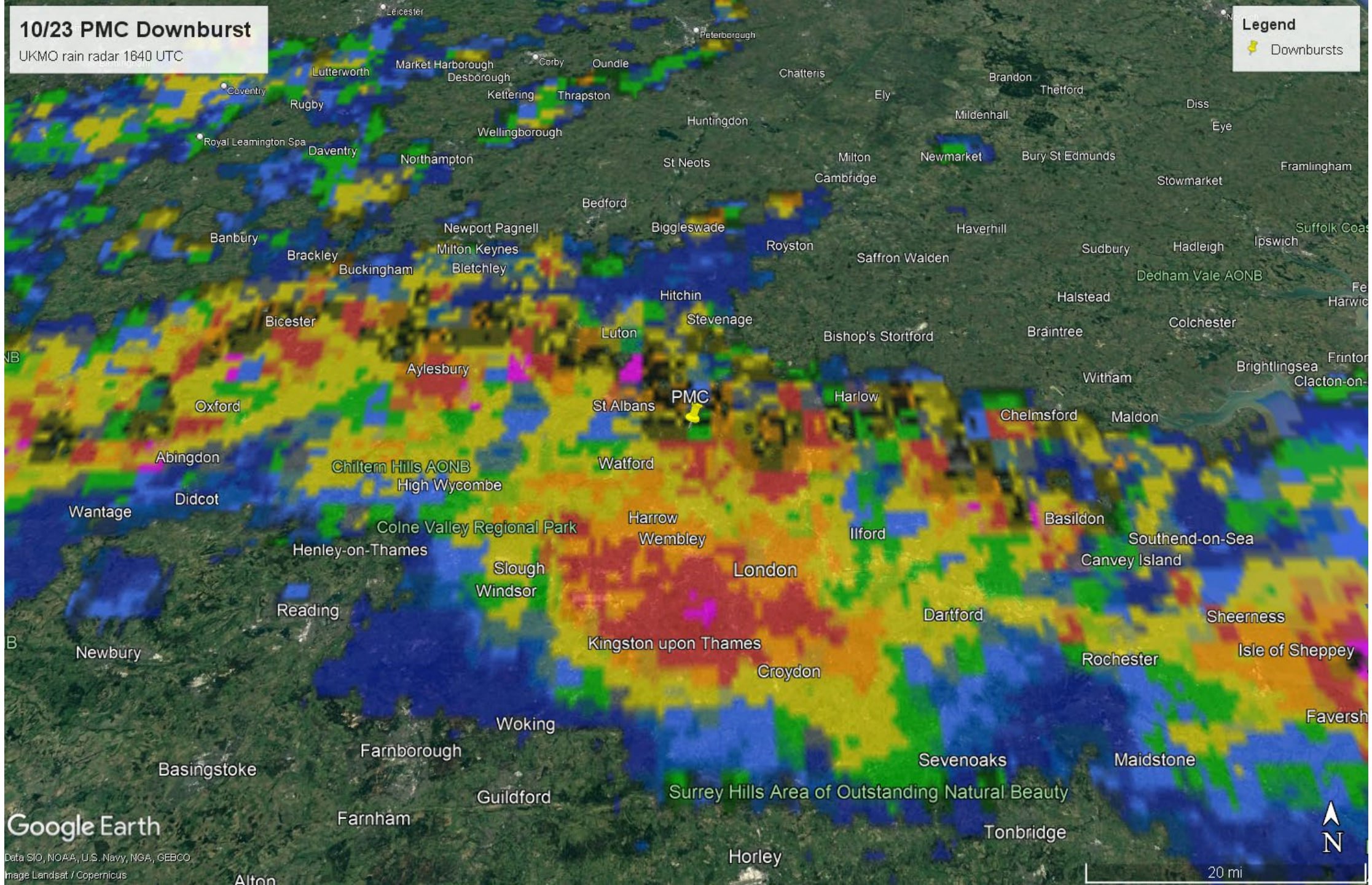
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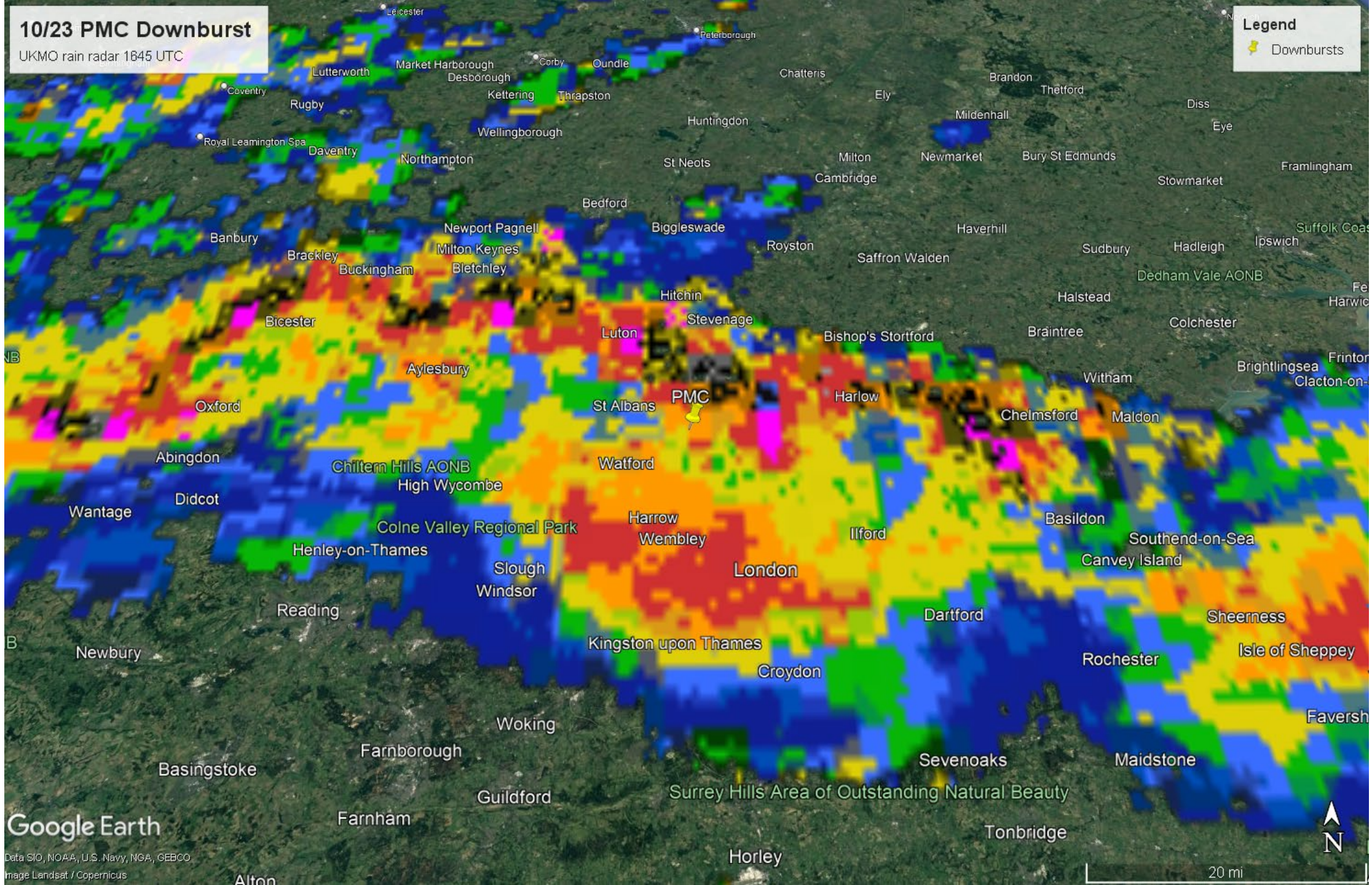
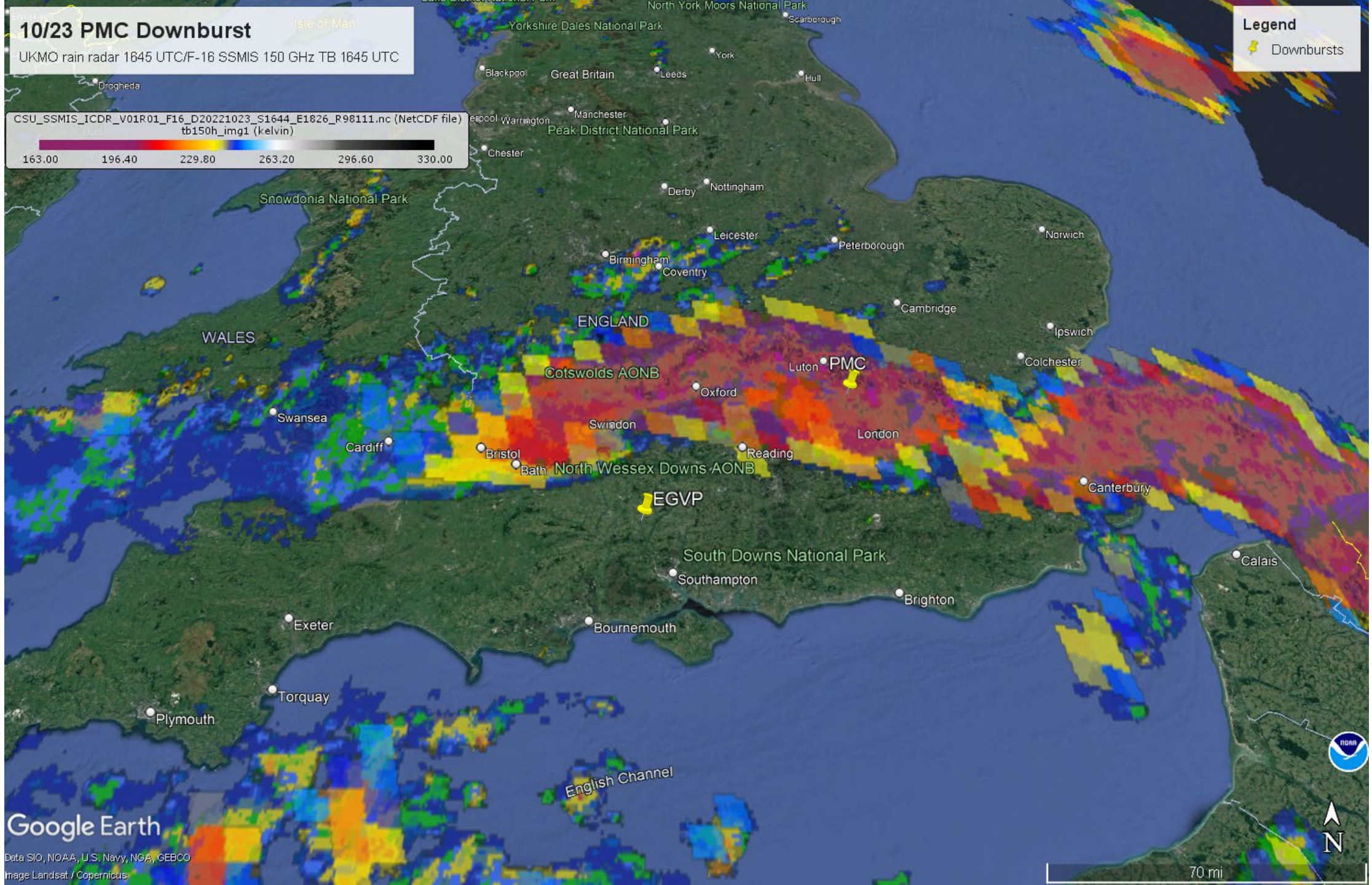
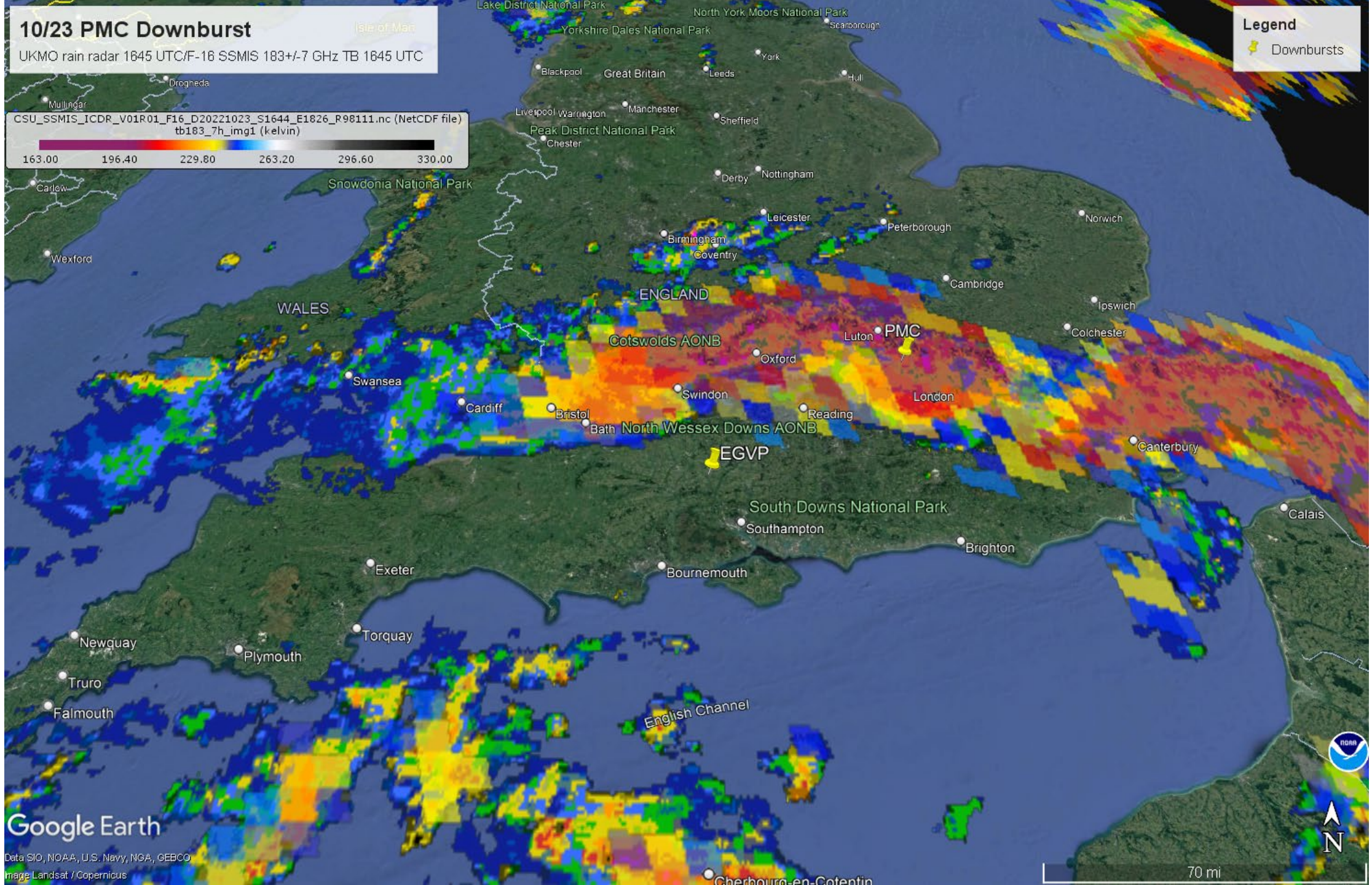
N
20 mi


10/23 PMC Downburst
UKMO rain radar 1645 UTC
Legend
Downbursts
PMC
Leicester
Peterborough
Lutterworth
Market Harborough
Desborough
Corby
Oundle
Coventry
Rugby
Kettering
Thrapston
Chatteris
Ely
Brandon
Thetford
Diss
Eye
Mildenhall
Huntingdon
Wellingborough
Royal Leamington Spa
Daventry
Northampton
St Neots
Milton
Newmarket
Bury St Edmunds
Framlingham
Stowmarket
Cambridge
Bedford
Biggleswade
Newport Pagnell
Milton Keynes
Bletchley
Buckingham
Brackley
Banbury
Royston
Haverhill
Saffron Walden
Sudbury
Hadleigh
Ipswich
Suffolk Coas
Dedham Vale AONB
Halstead
Braintree
Colchester
Hitchin
Stevenage
Luton
Bishop's Stortford
Bicester
Aylesbury
Brightlingsea
Clacton-on-
Witham
Harlow
Chelmsford
Maldon
Oxford
St Albans
Abingdon
Chiltern Hills AONB
Watford
High Wycombe
Didcot
Wantage
Harrow
Wembley
Ilford
Basildon
Southend-on-Sea
Canvey Island
Colne Valley Regional Park
Henley-on-Thames
Slough
Windsor
London
Reading
Dartford
Sheerness
Isle of Sheppey
Kingston upon Thames
Newbury
Rochester
Croydon
Woking
Farnborough
Basingstoke
Sevenoaks
Maidstone
Guildford
Surrey Hills Area of Outstanding Natural Beauty
Farnham
Tonbridge
Horley
Alton
Google Earth
Data SIO, NOAA, U.S. Navy, NGA, GEBCO
Image Landsat / Copernicus
N
20 mi


10/23 PMC Downburst
UKMO rain radar 1645 UTC/F-16 SSMIS 150 GHz TB 1645 UTC
Legend
Downbursts
CSU_SSMIS_ICDR_V01R01_F16_D20221023_S1644_E1826_R98111.nc (NetCDF file)
tb150h_img1 (kelvin)
163.00 196.40 229.80 263.20 296.60 330.00
North York Moors National Park
Yorkshire Dales National Park
Scarborough
York
Blackpool
Great Britain
Leeds
Hull
Drogheda
Manchester
Warrington
Peak District National Park
Chester
Derby
Nottingham
Snowdonia National Park
Leicester
Peterborough
Norwich
Birmingham
Coventry
Cambridge
ENGLAND
WALES
Ipswich
Luton
PMC
Colchester
Cotswolds AONB
Oxford
Swansea
Swindon
London
Cardiff
Bristol
Reading
Bath
North Wessex Downs AONB
Canterbury
EGVP
South Downs National Park
Calais
Southampton
Brighton
Exeter
Bournemouth
Torquay
Plymouth
English Channel
Google Earth
Data SIO, NOAA, U.S. Navy, NGA, GEBCO
Image Landsat / Copernicus
N
70 mi


10/23 PMC Downburst
UKMO rain radar 1645 UTC/F-16 SSMIS 183+/-7 GHz TB 1645 UTC
Legend
Downbursts
CSU_SSMIS_ICDR_V01R01_F16_D20221023_S1644_E1826_R98111.nc (NetCDF file)
tb183_7h_img1 (kelvin)
163.00
196.40
229.80
263.20
296.60
330.00
Lake District National Park
North York Moors National Park
Yorkshire Dales National Park
Scarborough
York
Blackpool
Great Britain
Leeds
Hull
Drogheda
Mullingar
Liverpool
Warrington
Manchester
Sheffield
Peak District National Park
Chester
Derby
Nottingham
Carlow
Snowdonia National Park
Leicester
Peterborough
Norwich
Birmingham
Coventry
Wexford
Cambridge
ENGLAND
WALES
Ipswich
Luton
PMC
Colchester
Cotswolds AONB
Oxford
Swansea
Swindon
London
Cardiff
Bristol
Reading
Bath
North Wessex Downs AONB
Canterbury
EGVP
South Downs National Park
Calais
Southampton
Brighton
Exeter
Bournemouth
Newquay
Torquay
Plymouth
Truro
Falmouth
English Channel
Google Earth
Data SIO, NOAA, U.S. Navy, NGA, GEBCO
Image Landsat / Copernicus
Cherbourg-en-Cotentin
N
70 mi

Summary

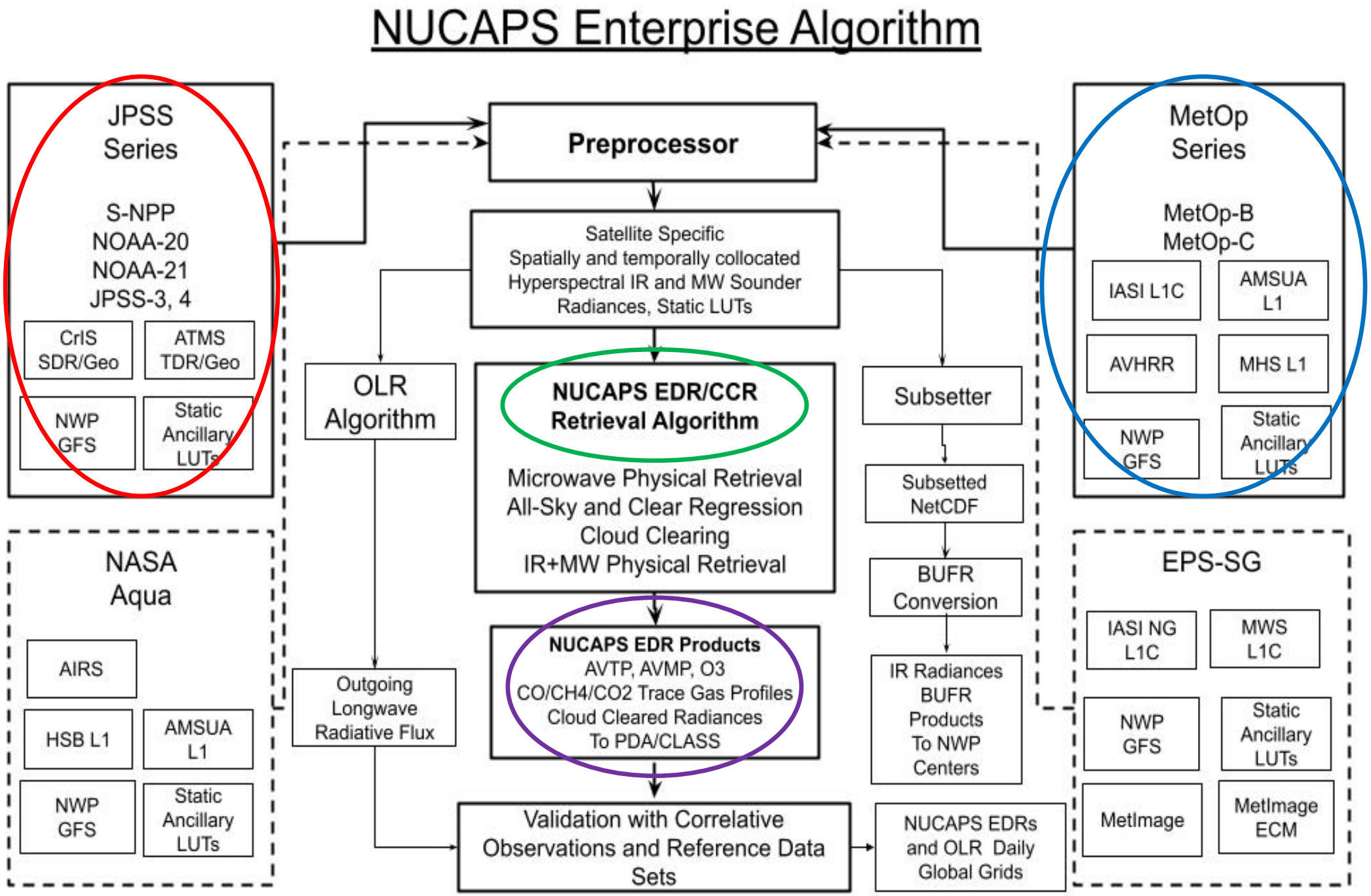
- During the afternoon of 23 October 2022, a quasi-linear convective system (QLCS) developed and intensified over the English Channel, and tracked north-northeastward into southern England, producing widespread damaging downburst winds.
- The most intense downbursts of the event occurred at:
  - Middle Wallop Airport, Hampshire (55 miles SW of London), with a wind gust of 54 kt (62 mph) recorded between 1500 and 1600 UTC and generated by a prominent bowing segment of the QLCS.
  - London Colney, Hertfordshire, with a wind gust of 56 kt (64 mph) recorded at 1640 UTC and generated by a pulse-severe cell east of the bowing segment of the QLCS.
- In general, the early afternoon (1222 UTC) NOAA-20 NUCAPS sounding qualitatively indicated the strongest signal for severe thunderstorm and downburst occurrence over southern England:
  - Resolved a shallow elevated mixed-layer that was detected by the closest downstream RAOB sounding at Nottingham.
  - Indicated larger lower-middle tropospheric temperature lapse rates and CAPE than the adjacent AIRS sounding.
  - NUCAPS surface temperature (66°F/18°C) matched exactly the temperature recorded at Herstmonceux, the closest observing station to the retrieval.

Summary

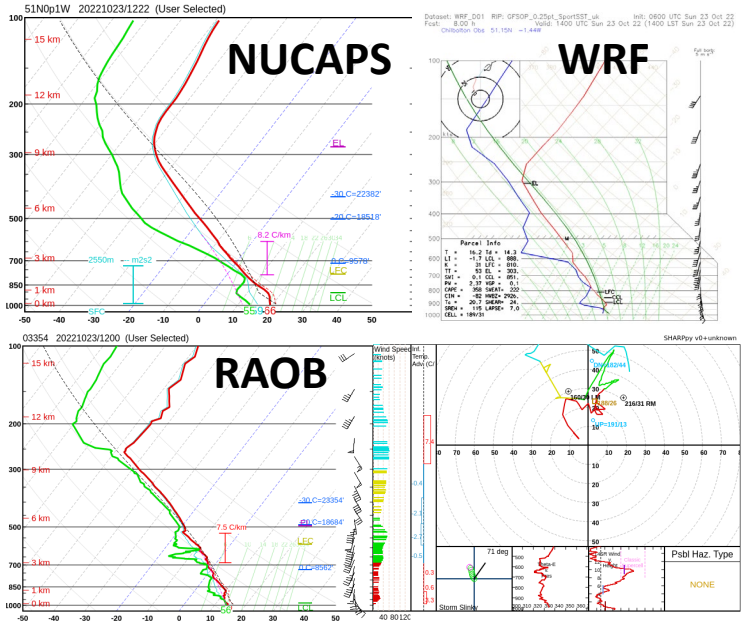
- Mapped SSMIS imagery with UKMO rain radar overlays and a mid-day NUCAPS sounding profile over Leicestershire, (~90 miles NW of London), provided the strongest signal for severe downburst winds in the pre-storm environment over the Midlands.
- Close agreement between the boundary layer structure ("inverted-V") as resolved by the NUCAPS soundings and WRF profiles and the MWPI gust potential as calculated from NUCAPS and the WRF model.
- Strong relationship between high rain rates as indicated by UKMO radar and the very low MW brightness temperatures (BTs) apparent in both the consecutive F-18 and F-16 overpasses.
- Low BTs also correspond well with the high integrated graupel values (slide 11), suggesting that intense downdrafts and resulting downbursts were forced by ice precipitation loading and melting, as well as unsaturated air entrainment into the mixed-phase precipitation core.

Supplemental Slides/Figures

Figure 2.

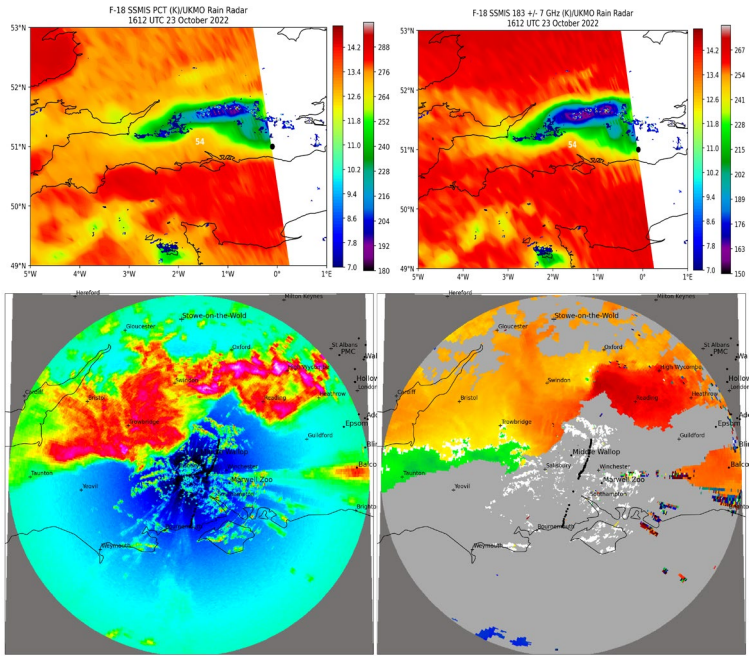

NUCAPS Enterprise Algorithm
JPSS Series
S-NPP
NOAA-20
NOAA-21
JPSS-3, 4
CrIS SDR/Geo
ATMS TDR/Geo
NWP GFS
Static Ancillary LUTs
Preprocessor
Satellite Specific
Spatially and temporally collocated
Hyperspectral IR and MW Sounder
Radiances, Static LUTs
OLR Algorithm
NUCAPS EDR/CCR Retrieval Algorithm
Microwave Physical Retrieval
All-Sky and Clear Regression
Cloud Clearing
IR+MW Physical Retrieval
Subsetter
MetOp Series
MetOp-B
MetOp-C
IASI L1C
AMSUA L1
AVHRR
MHS L1
NWP GFS
Static Ancillary LUTs
Subsetted NetCDF
BUFR Conversion
IR Radiances BUFR Products To NWP Centers
NASA Aqua
AIRS
HSB L1
AMSUA L1
NWP GFS
Static Ancillary LUTs
Outgoing Longwave Radiative Flux
NUCAPS EDR Products
AVTP, AVMP, O3
CO/CH4/CO2 Trace Gas Profiles
Cloud Cleared Radiances
To PDA/CLASS
EPS-SG
IASI NG L1C
MWS L1C
NWP GFS
Static Ancillary LUTs
MetImage
MetImage ECM
Validation with Correlative Observations and Reference Data Sets
NUCAPS EDRs and OLR Daily Global Grids

Thermodynamic Profiles



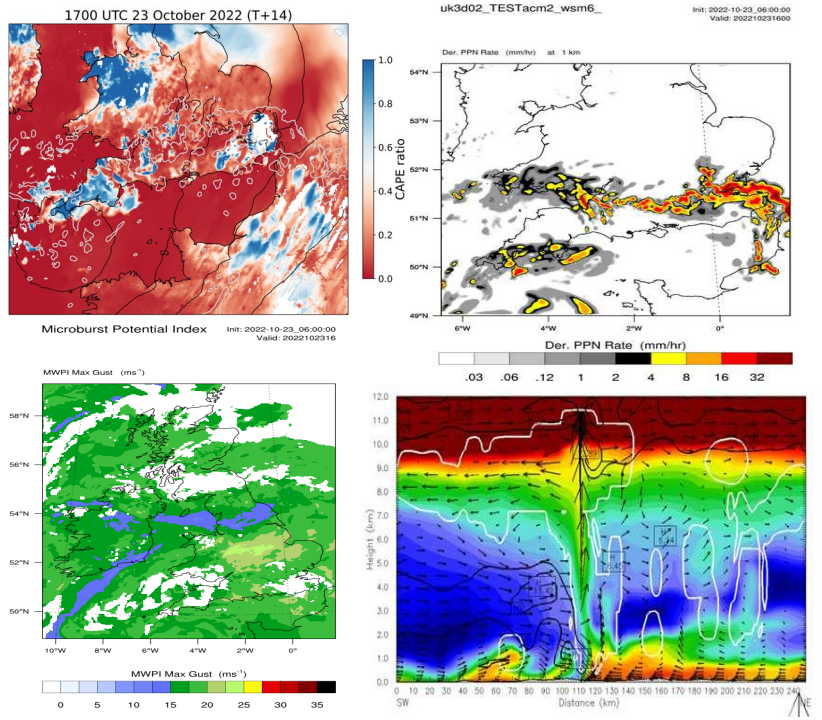
Thermodynamic patterns in pre-convective and storm environments: moisture stratification and convective instability.

Satellite/Radar Imagery



Microscale physical properties of downburst-producing convective storms: Storm morphology, precipitation vertical structure, type and intensity.

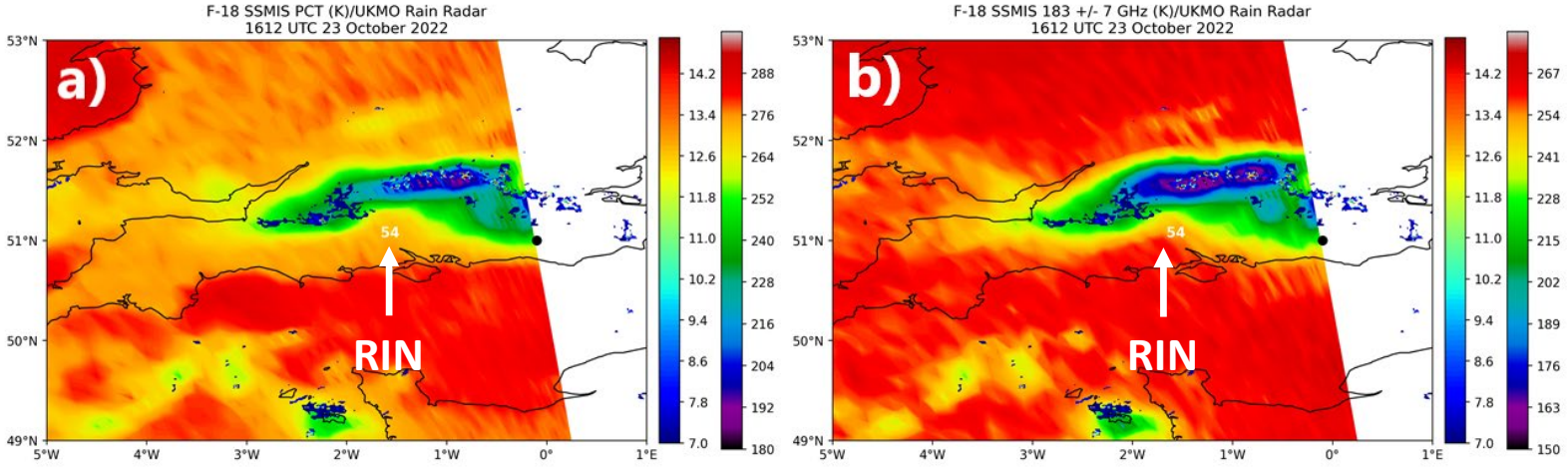
NWP Model Graphical Output



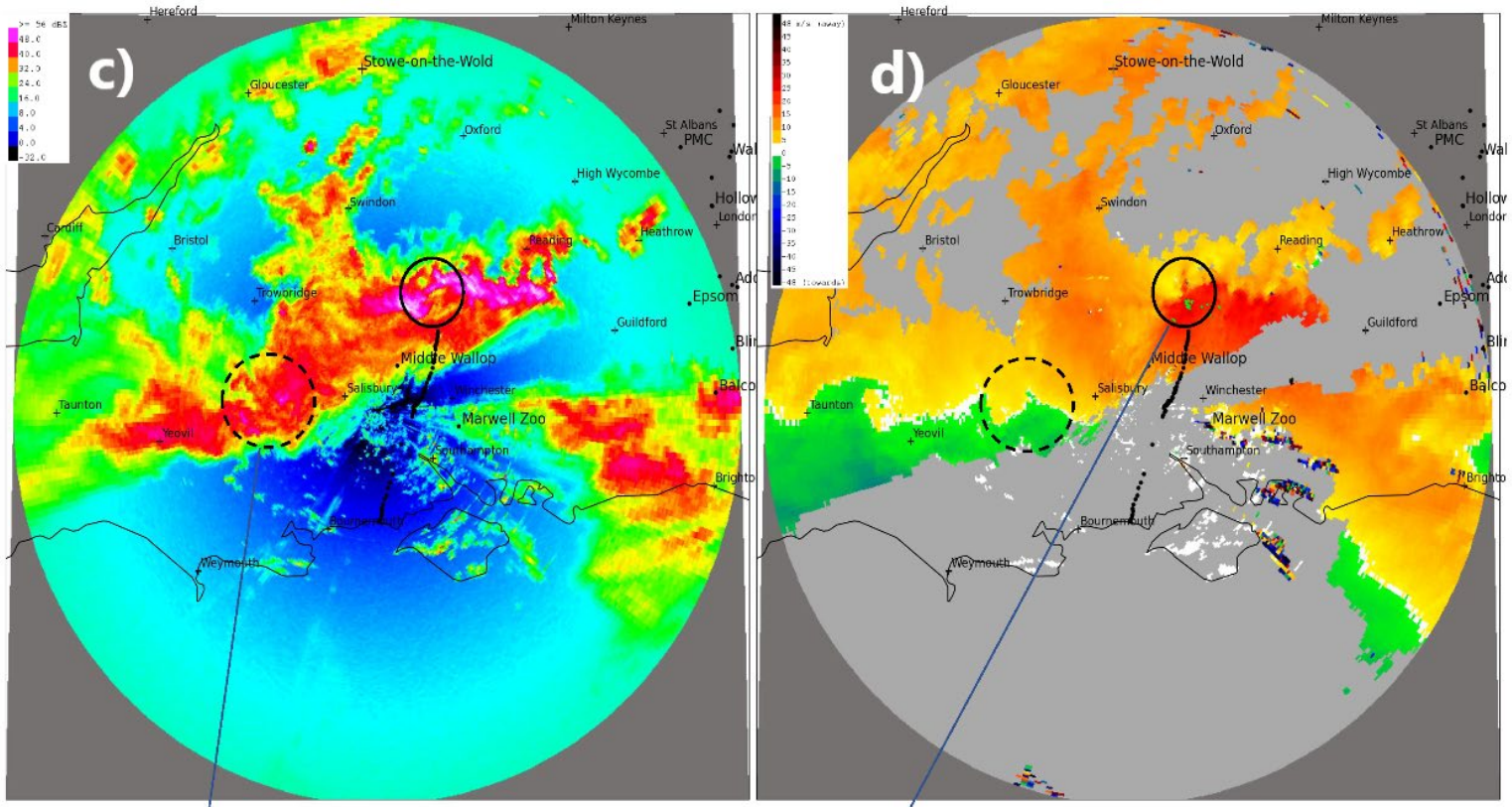
Simulation and analysis of dynamic properties: morphology, vertical structure, precipitation intensity, stability parameter evaluation.

Figure 3.

Figure 6.



1541 UTC



Residual cyclonic booked vortex (largely decayed)

Expanding area of rotation originating from earlier supercell merger

Figure 8.

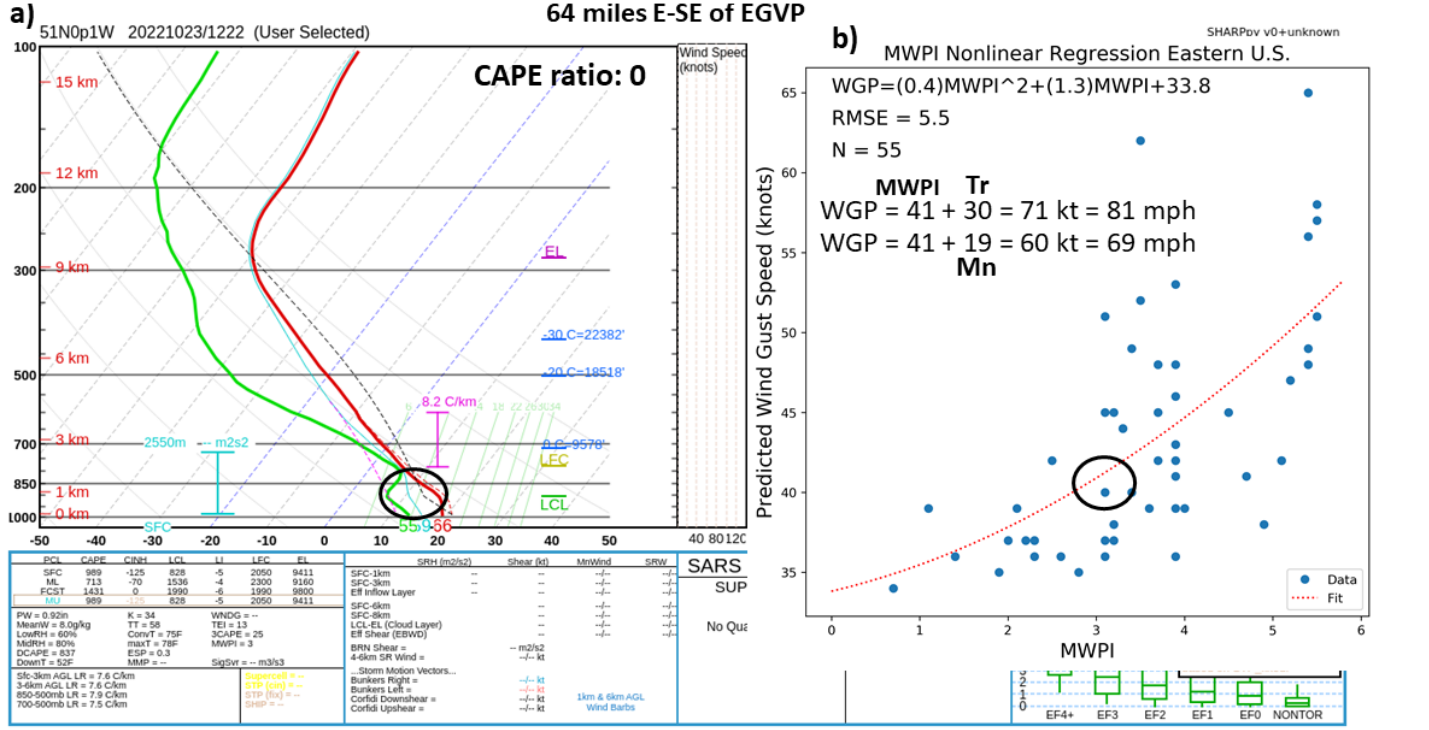
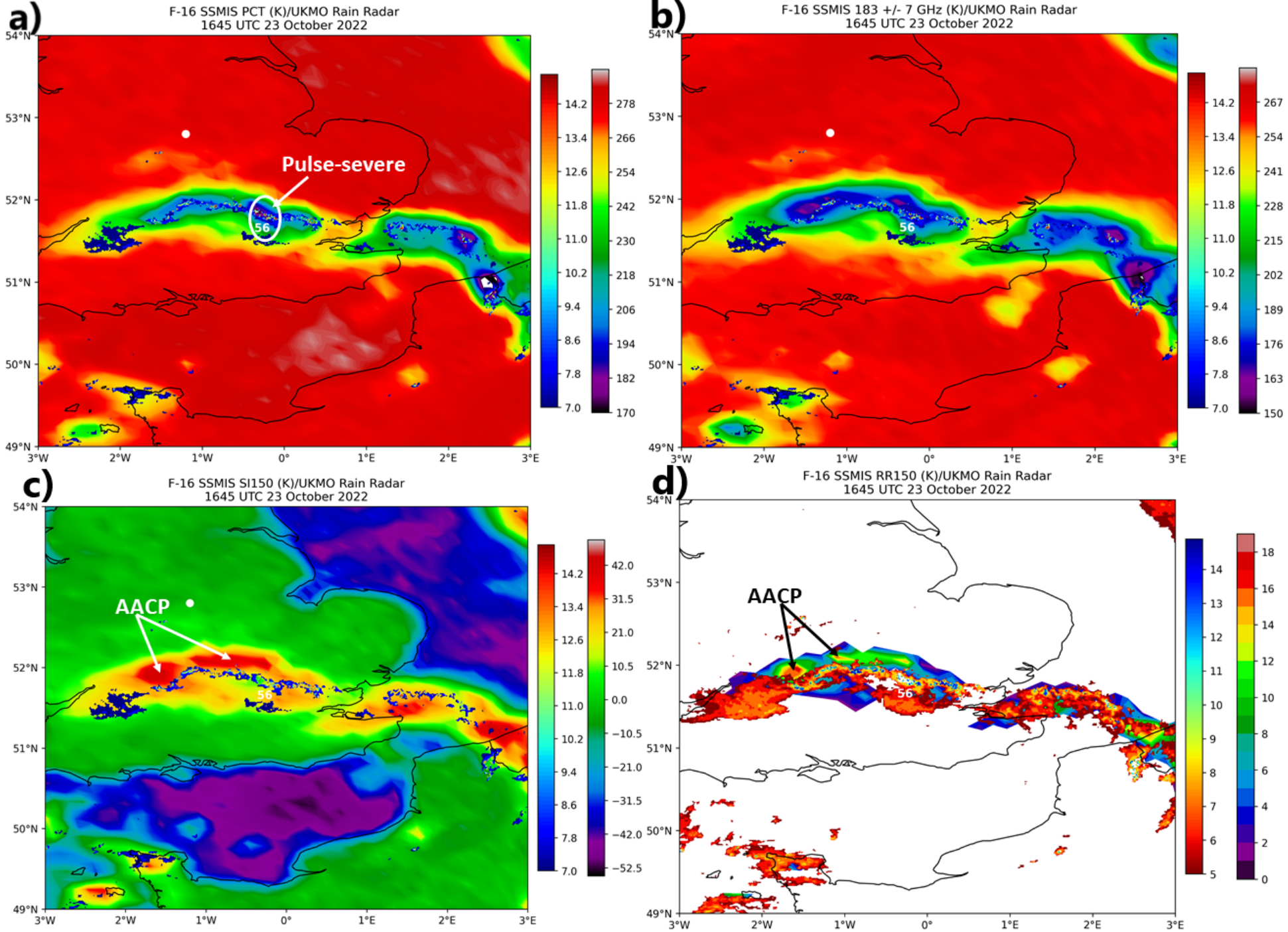
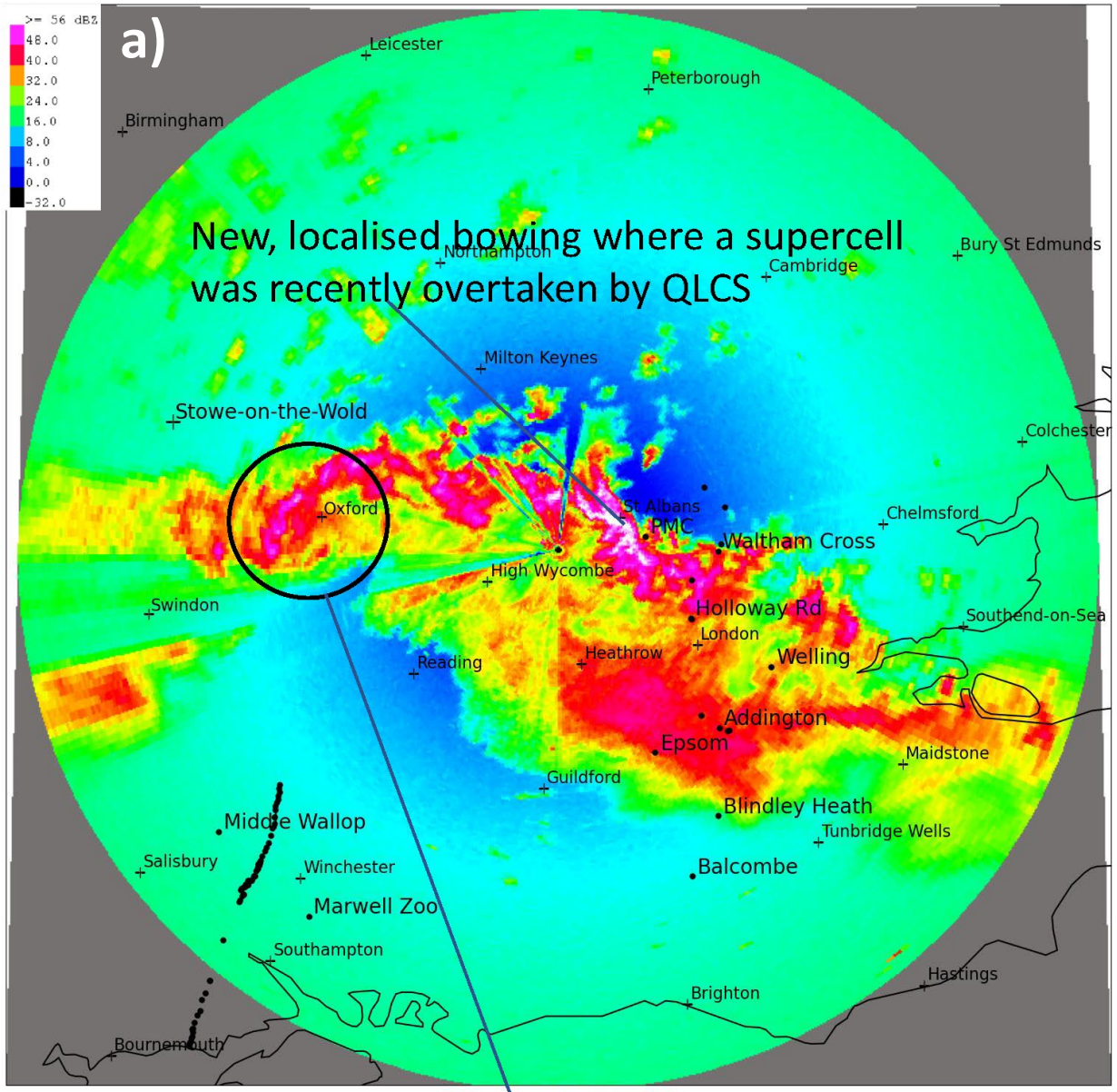
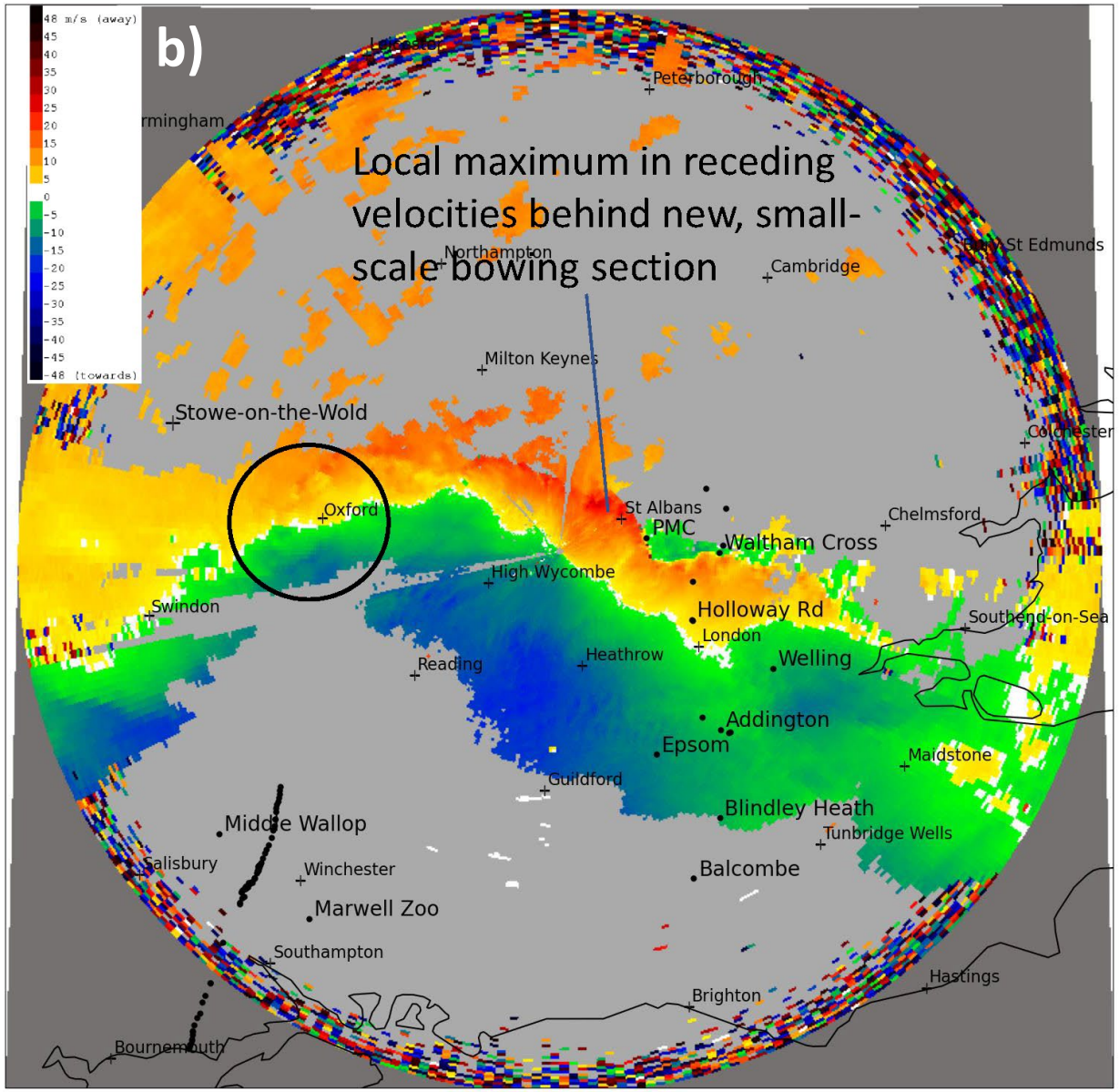

a)
51N0p1W 20221023/1222 (User Selected)
64 miles E-SE of EGVP
CAPE ratio: 0
15 km
12 km
9 km
6 km
3 km
1 km
0 km
EL
LFC
LCL
8.2 C/km
2550m
m2s2
SFC
Wind Speed (knots)
b)
SHARPpy v0+unknown
MWPI Nonlinear Regression Eastern U.S.
WGP=(0.4)MWPI^2+(1.3)MWPI+33.8
RMSE = 5.5
N = 55
MWPI Tr
WGP = 41 + 30 = 71 kt = 81 mph
WGP = 41 + 19 = 60 kt = 69 mph
Mn
Predicted Wind Gust Speed (knots)
MWPI
Data
Fit
EF4+
EF3
EF2
EF1
EF0
NONTOR
SARS
SUP
No Qua
Dataset: WRF_D01 RIP: GFSOP_0.25pt_SportSST_uk Init: 0600 UTC Sun 23 Oct 22
Fcst: 8.00 h Valid: 1400 UTC Sun 23 Oct 22 (1400 LST Sun 23 Oct 22)
Chilbolton Obs 51.15N −1.44W
Dataset: WRF_D01 RIP: GFSOP_0.25pt_SportSST_uk Init: 0600 UTC Sun 23 Oct
Fcst: 8.00 h Valid: 1400 UTC Sun 23 Oct 22 (1400 LST Sun 23 Oct
HERSTMONCEUX (03882) Lat 50.90N, Lon 0.32E
c)
Parcel Info
T = 16.2 Td = 14.3
LI = -1.7 LCL = 888.
K = 31 LFC = 810.
TT = 53 EL = 303.
SWI = 0.1 CCL = 851.
PW = 2.37 VGP = 0.1
CAPE = 358 SWEAT= 222
CIN = -82 HWBZ= 2926.
Tc = 20.7 SHEAR= 24.
SREH = 115 LAPSE= 7.0
CELL = 189/31
d)
Parcel Info
T = 18.4 Td = 12.7
LI = -2.6 LCL = 874.
K = 36 LFC = 875.
TT = 56 EL = 300.
SWI = -2.1 CCL = 858.
PW = 2.64 VGP = 0.2
CAPE = 504 SWEAT= 350
CIN = -98 HWBZ= 2890.
Tc = 21.0 SHEAR= 43.
SREH = 194 LAPSE= 6.9
CELL = 198/45

Figure 11.


a)
F-16 SSMIS PCT (K)/UKMO Rain Radar
1645 UTC 23 October 2022
Pulse-severe
56
b)
F-16 SSMIS 183 +/- 7 GHz (K)/UKMO Rain Radar
1645 UTC 23 October 2022
56
c)
F-16 SSMIS SI150 (K)/UKMO Rain Radar
1645 UTC 23 October 2022
AACP
56
d)
F-16 SSMIS RR150 (K)/UKMO Rain Radar
1645 UTC 23 October 2022
AACP
56
54°N
53°N
52°N
51°N
50°N
49°N
3°W
2°W
1°W
0°
1°E
2°E
3°E

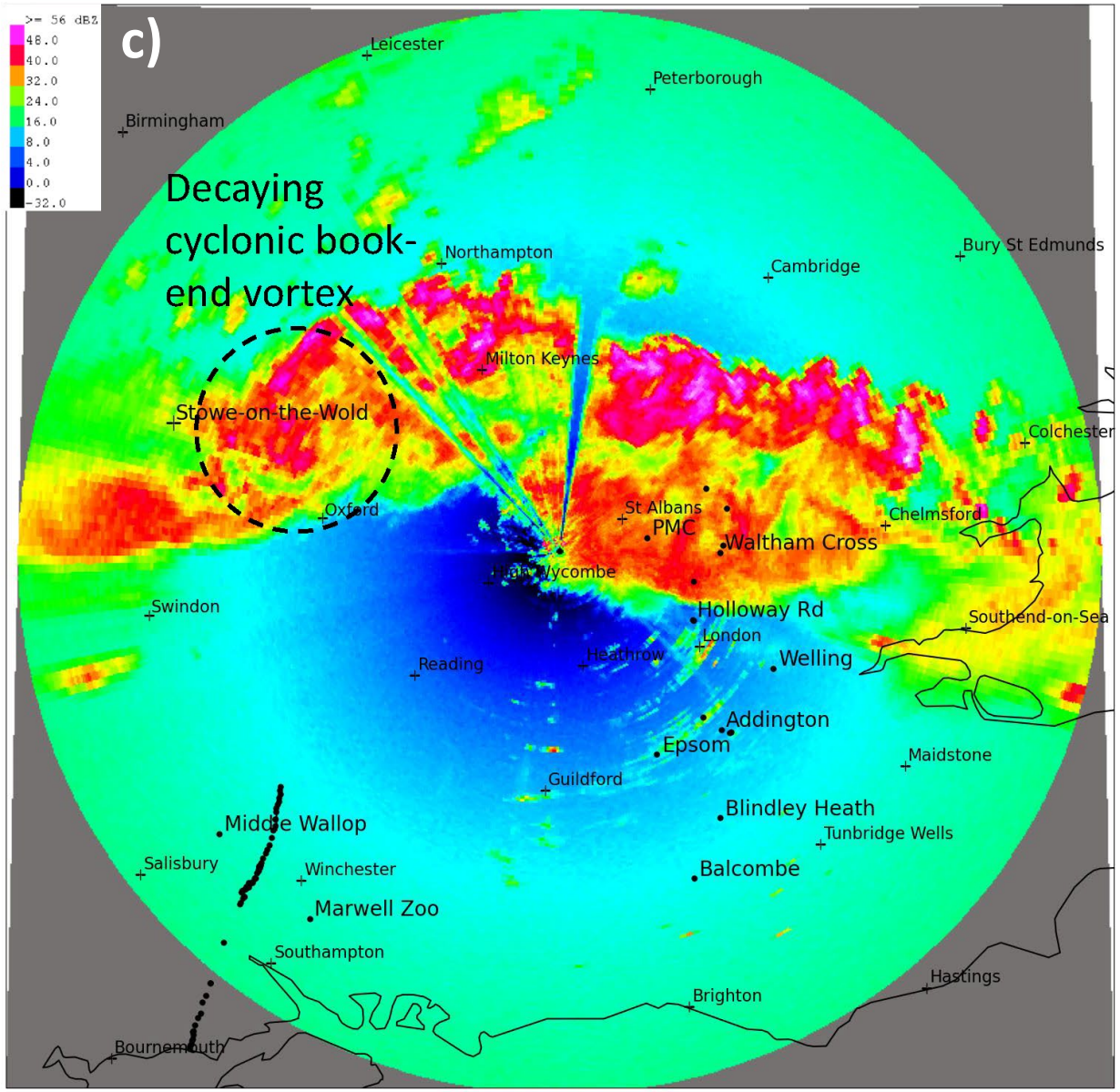
1631 UTC





Cyclonic book-end vortex, expanding and now weakening

1701 UTC


c)
>= 56 dBZ
48.0
40.0
32.0
24.0
16.0
8.0
4.0
0.0
-32.0
Decaying cyclonic book-end vortex
Leicester
Peterborough
Birmingham
Northampton
Cambridge
Bury St Edmunds
Milton Keynes
Stowe-on-the-Wold
Colchester
Oxford
St Albans
PMC
Waltham Cross
Chelmsford
High Wycombe
Swindon
Holloway Rd
Southend-on-Sea
London
Reading
Heathrow
Welling
Addington
Epsom
Maidstone
Guildford
Blindley Heath
Middle Wallop
Tunbridge Wells
Salisbury
Winchester
Balcombe
Marwell Zoo
Southampton
Hastings
Brighton
Bournemouth

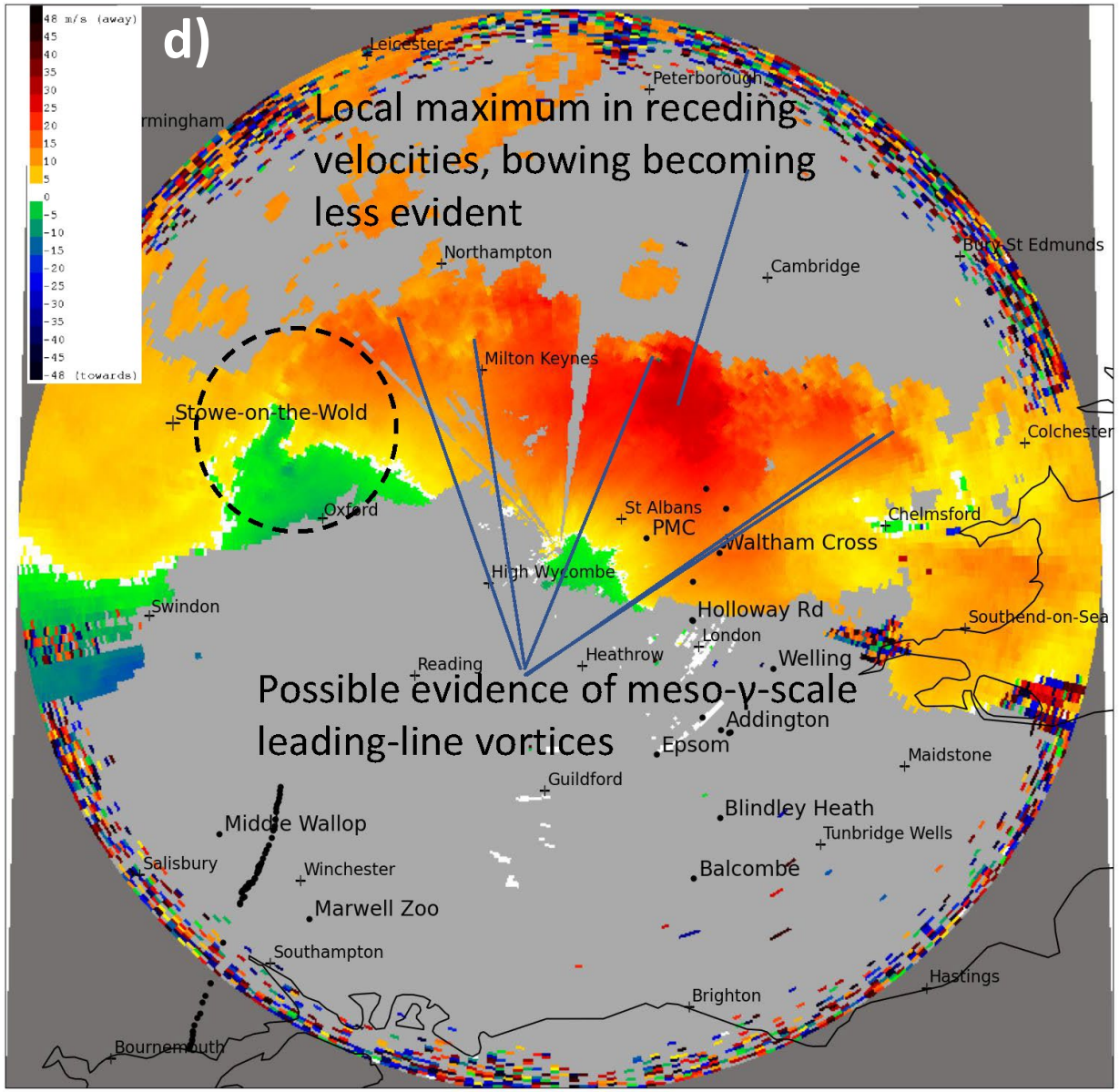
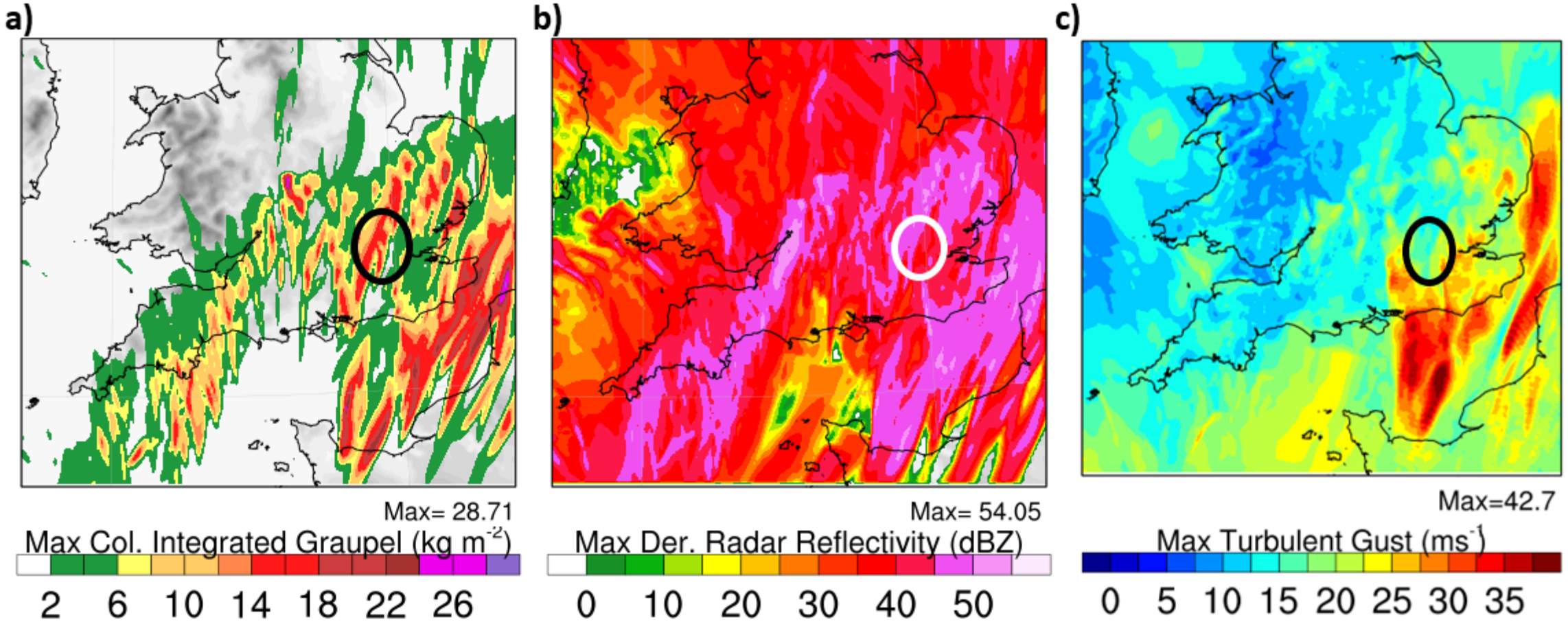

d)
48 m/s (away)
45
40
35
30
25
20
15
10
5
0
-5
-10
-15
-20
-25
-30
-35
-40
-45
-48 (towards)
Local maximum in receding velocities, bowing becoming less evident
Possible evidence of meso-γ-scale leading-line vortices
Leicester
Peterborough
Northampton
Cambridge
Bury St Edmunds
Milton Keynes
Stowe-on-the-Wold
Colchester
Oxford
St Albans
PMC
Waltham Cross
Chelmsford
High Wycombe
Swindon
Holloway Rd
Southend-on-Sea
London
Reading
Heathrow
Welling
Addington
Epsom
Maidstone
Guildford
Blindley Heath
Middle Wallop
Tunbridge Wells
Salisbury
Winchester
Balcombe
Marwell Zoo
Southampton
Hastings
Brighton
Bournemouth

Figure 16.


a)
b)
c)
Max= 28.71
Max Col. Integrated Graupel (kg m-2)
2 6 10 14 18 22 26
Max= 54.05
Max Der. Radar Reflectivity (dBZ)
0 10 20 30 40 50
Max=42.7
Max Turbulent Gust (ms-1)
0 5 10 15 20 25 30 35