



Operational use of NWC SAF AMV package in the Met Office mesoscale forecasting system

*Graeme Kelly, Peter Lean, Crispian Batstone,
and James Cotton.*



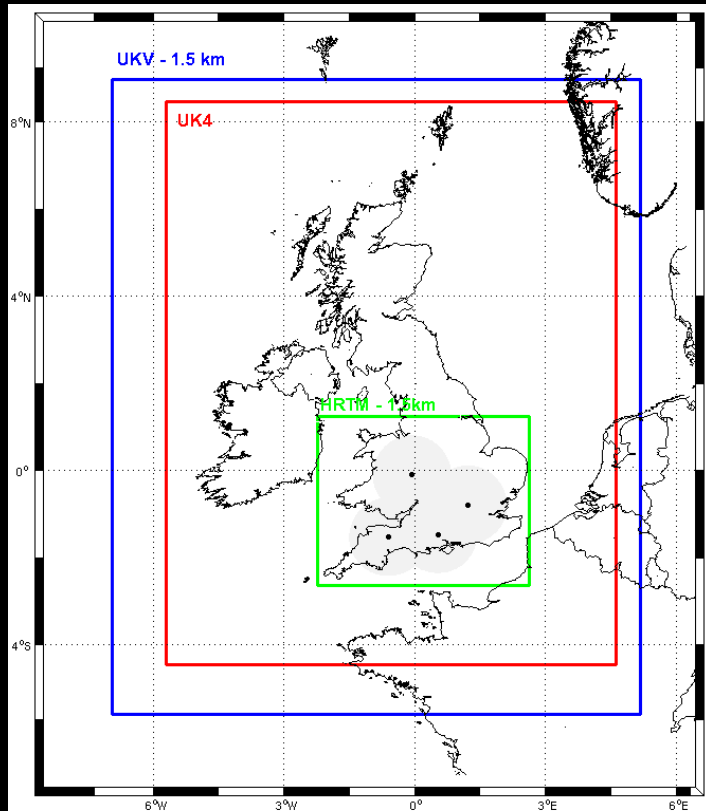
OVERVIEW

- Satellite derived Atmospheric Motion Vectors (AMVs) have given positive benefit to the Global and Regional NWP forecasts for many years, however their use in Nowcasting and mesoscale forecasting systems has been limited due large AMV tracking boxes and timeliness.
- This NWCSAF package allows AMVs to be produced with smaller tracking boxes producing AMVs that are more suitable. In addition the NWCSAF package can be run locally over a small region to provide AMVs within a few minutes of the satellite image reception.

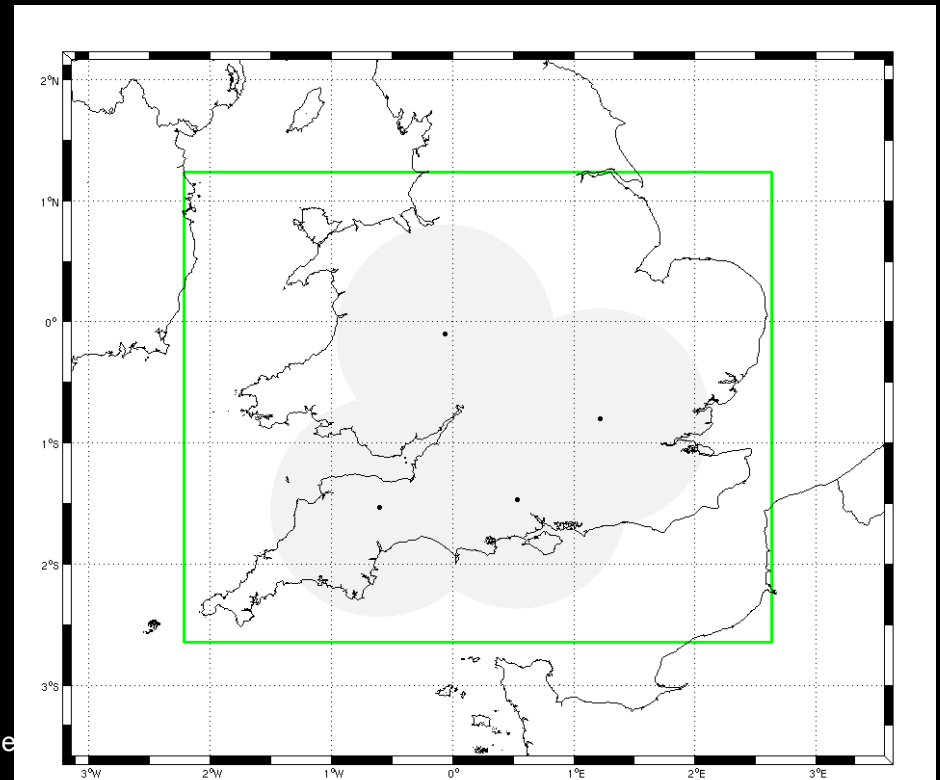


UKV, UK4 & Nowcasting Model Domains

Model	Resolution	VAR	Time Window	Cycling	Forecast Length
UKV	4 km / 1.5km	3D-Var /3km	3 hr	3 hr	T+36
South UK Fixed	1.5 km	4D-Var 1.5/3km	1 hr	1 hr	T+6 or T+12



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UKV 1.5km DA cycling

- 8 three-hour cycles per day**
- Data times for long (t+36) forecasts 03, 09, 15, 21 UTC**
 - Observation cut-off hh+ 30min**
 - Lateral boundaries from Global model**
- Intermediate cycles at 00, 06, 12, 18 UTC**
 - Observation cut-off hh+ 2hr 40min**
 - Lateral boundaries from hh Global run**



New web monitoring

UK AMVs monitoring page

Continuously updating images for the past 24 hours generated from the SAFNWC/MSG nowcasting software are shown on this page. Two plots can be viewed side by side, and compared using a slider tool (bottom).

Select hour for left plot:

0	1	2	3	4	5	6	7	8	9	10	11
12	13	14	15	16	17	18	19	20	21	22	23

Select minute:

0	15
30	45

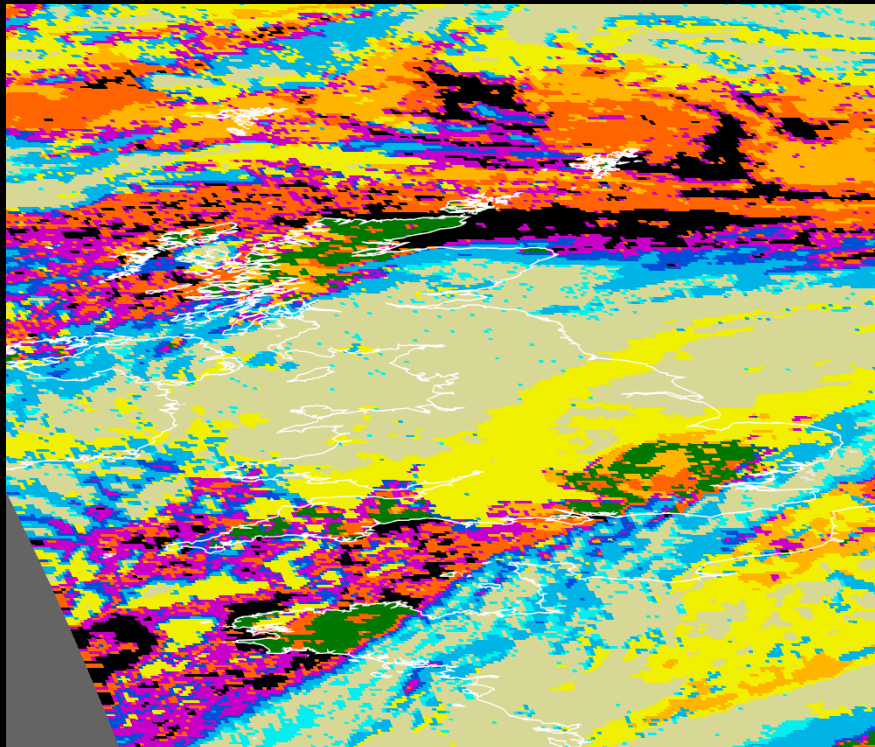
Plot type for left plot:

HRV	IR108	WV62	CT	CTP	CTH
CTT	HRV_AMV_Upper	HRV_AMV_Lower	IR108_AMV_Upper	IR108_AMV_Lower	WV62_AMV_Upper

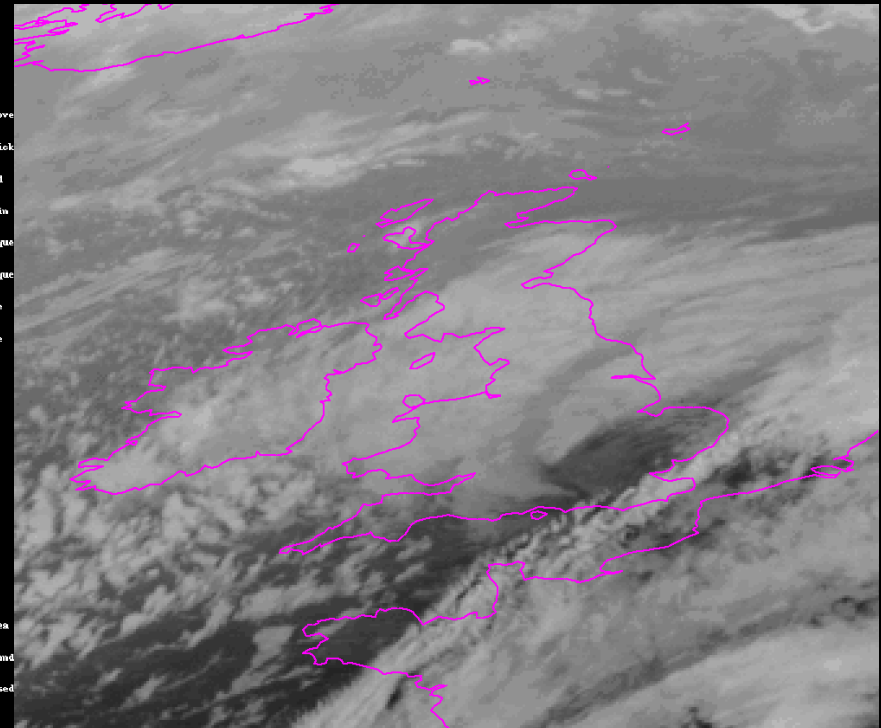


NWCSAF CLOUD PRODUCT

St Jude day storm



2013-10-28 06:00:00 SARFVC PAR02



10001 METEOSAT8 8 28 OCT 13301 060000 00405 04257 01 00

MOLINS

Meteosat 8 cloud type 06z 28 OCT

Meteosat 8 channel 9 06z 28 OCT



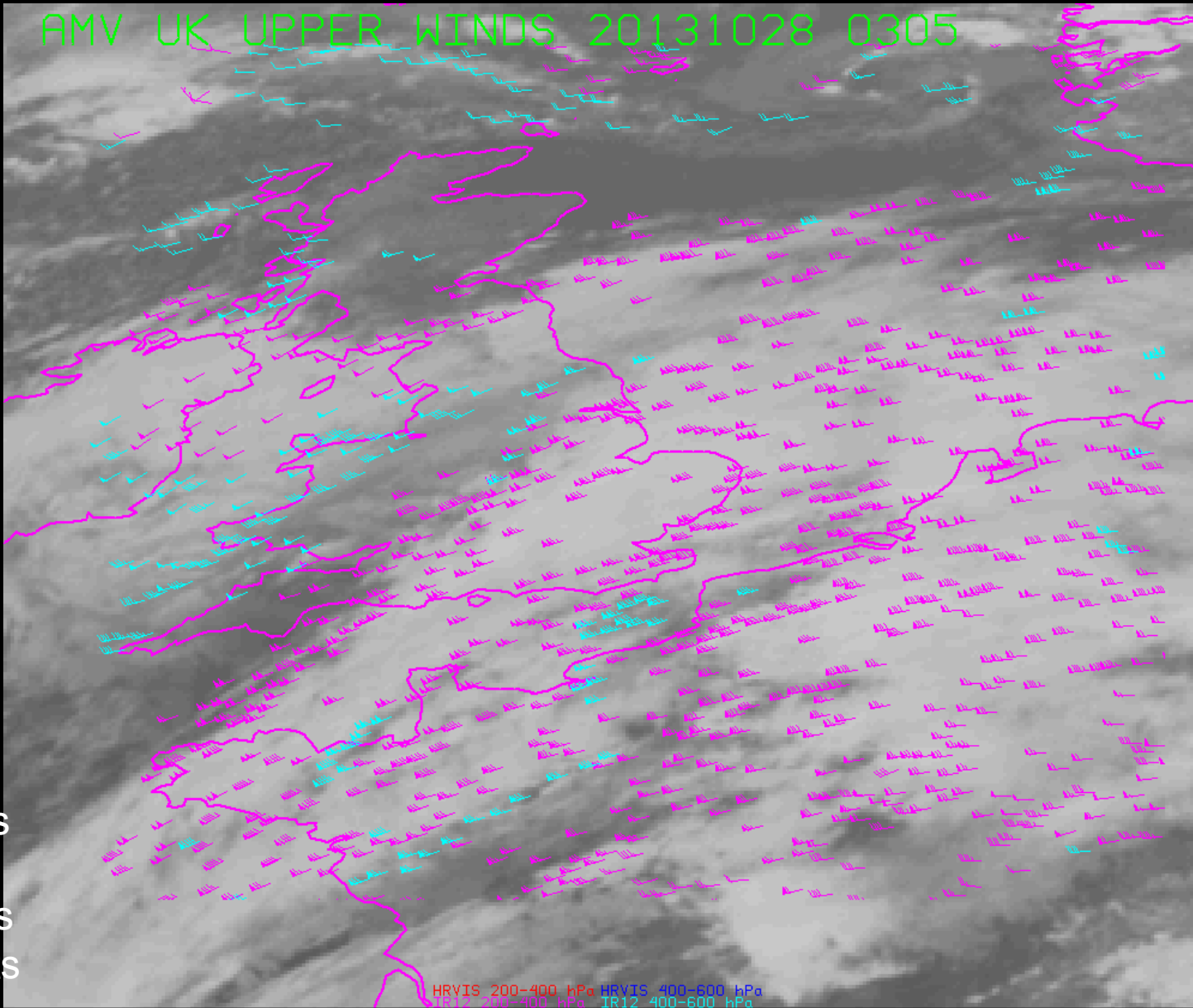
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RAPID SCAN
M8 5 MINUTE
UKAMVs

During the
passage of the
St JUDE day
storm
2013 OCT 2013
0305-0855

All UKAMVs

- Blue 0-30kts
- Yellow 31-60kts
- Green 61-90kts
- Red 91-120kts
- Navy 121-150kts





Met Office

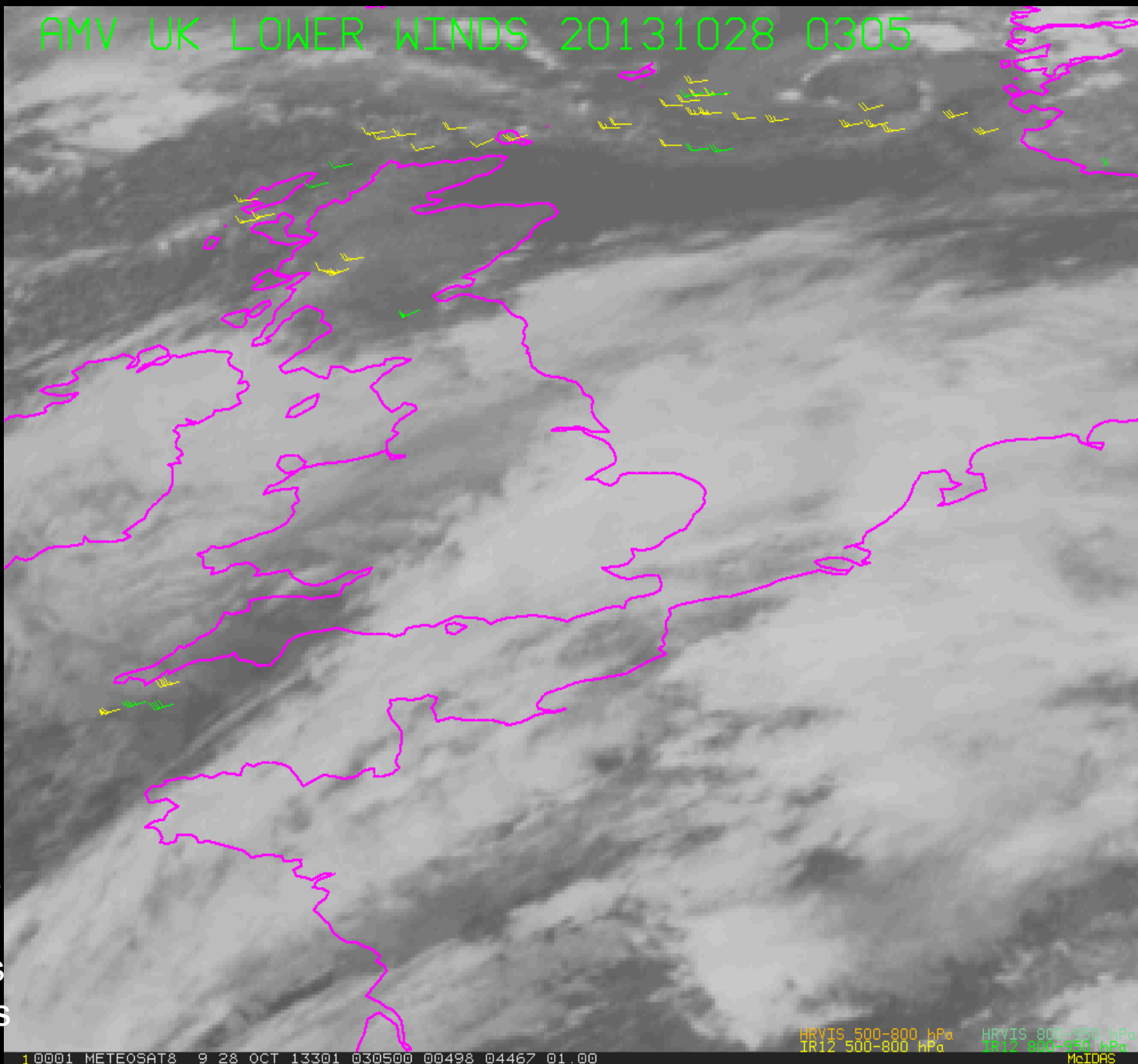
RAPID SCAN
M8 5 MINUTE
UKAMVs

During the
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2013 OCT
2013
0305-0855

All UKAMVs

Blue	0-30kts
Yellow	31-60kts
Green	61-90kts
Red	91-120kts
Navy	121-150kts



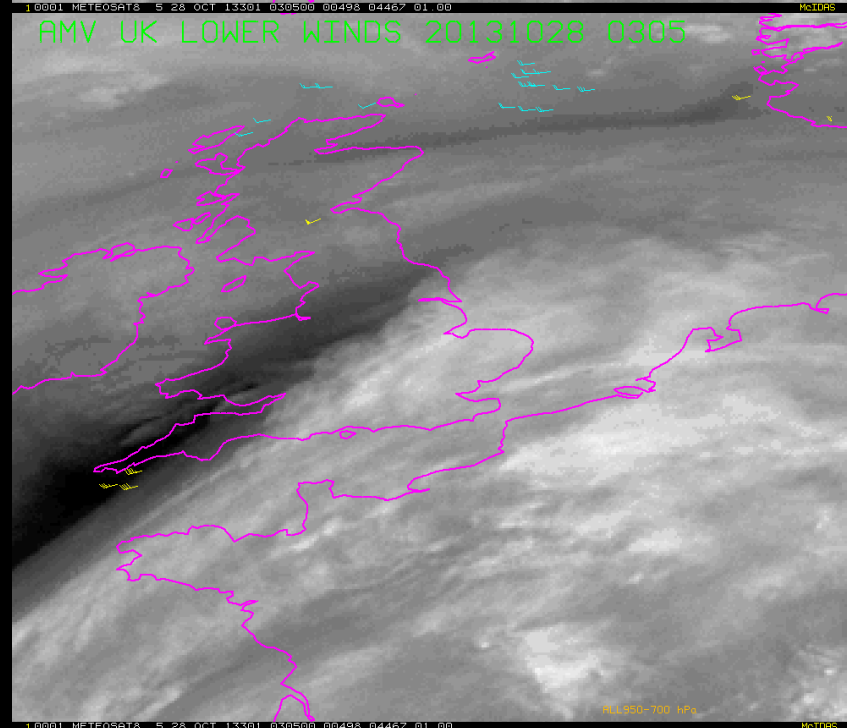
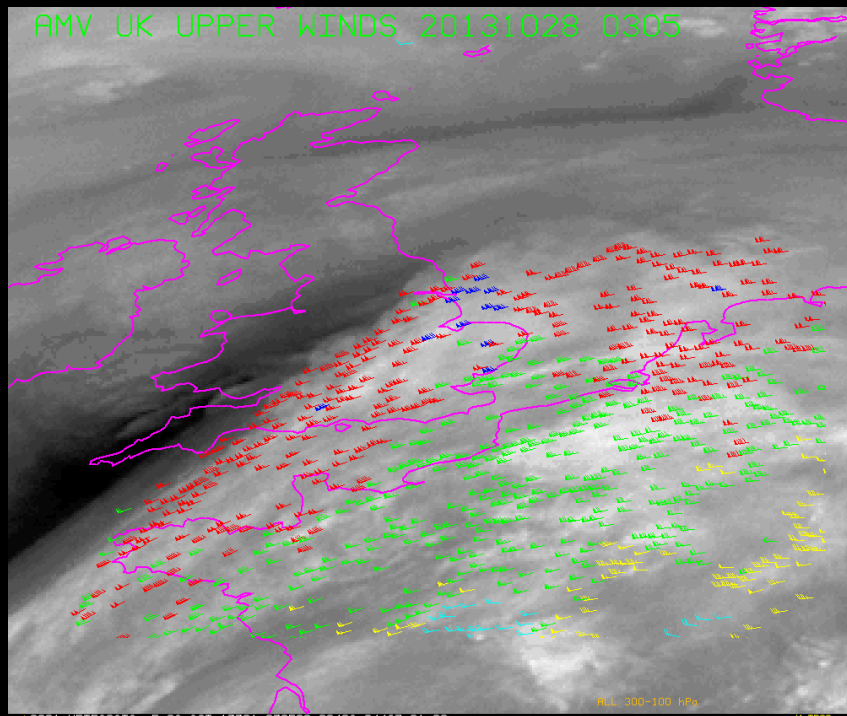
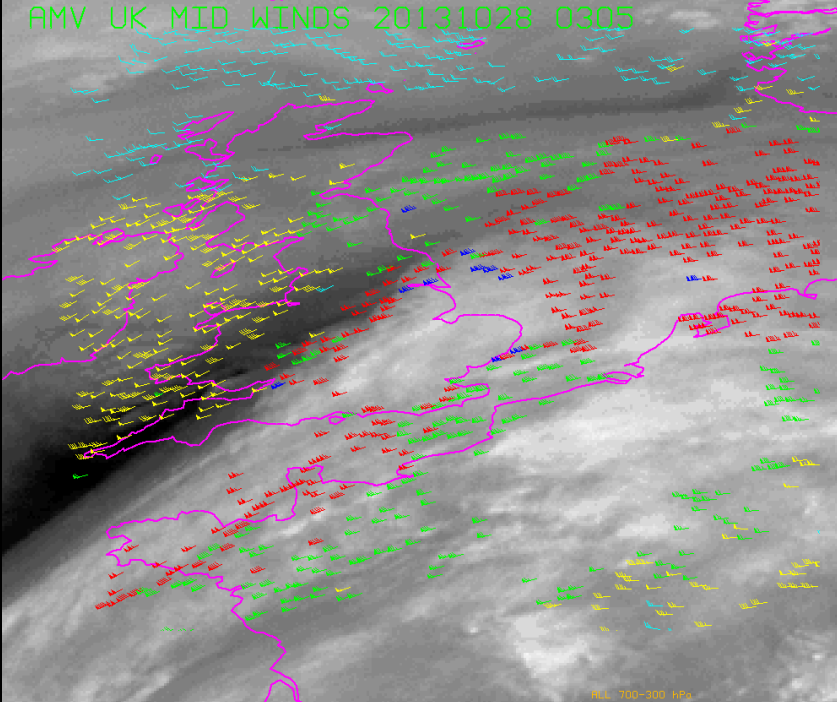


RAPID SCAN M8 5 MINUTE UKAMVs

All UKAMVs
increasing speed

- Blue 0-30kts
- Yellow 31-60kts
- Green 61-90kts
- Red 91-120kts
- Navy 121-150kts

During the passage of
the
St JUDE day storm
2013 OCT 2013
0305-0855





Forecast impact

- The NWCSAF AMV package (v2011) was initially setup in research mode and some NWP trials were run 28 days.
- The results were essentially neutral using the current AMV setup for EUMETSAT AMVs. A number of 7 day trials were run with various settings of the time and space thinning parameters.
- The results appeared to degrade if the thinning was reduced below 20km and the time window was larger than one hour. In addition the sensitivity to various setting of AMV QI were tested.



Forecast impact

- A 28day NDP 4DVAR was run with the rapid scan MSG imagery producing AMVs from every second image. AMVs were sent to Met Office data base and available for all times slots for 4DVAR with 45min data cut-off.
- Given the small region of the NDP over southern England it was not surprising that there was no significant impact of AMVs but this experiment useful to check feasibility of the setup and check AMV could be processed quickly enough to meet the data cut off time.
- The UKV data assimilation is in the of process of being upgraded to 4DVAR.



Met Office

UK Index Metric for forecast verification

Element	ETS Threshold
1.5m Visibility	200m, 1000m, 5000m
6 hour ppn accumulation	0.5mm, 1.0mm, 4.0mm
Cloud Cover	0.3, 0.6, 0.8
Cloud Base Height	100m, 500m, 1000m
1.5m Temperature	$\frac{1-RMS^2}{RMS^2(pst)}$
10m wind	$\frac{1-RMS^2}{RMS^2(pst)}$

- ETS Equitable Threat Score
 - RMS root mean square
 - Weighted Basket of Indices
 - 6 elements
 - Combo of **ETS** & **RMS** scores
-
- UK4 Impact trials verified to **T+24** at **00, 06, 12, 18 UTC**



UKV 15 Nov 2012 to 31 Dec 2012

Parameter	Control Data	Test Data	Test - Control
0Z 6Z 12Z 18Z	Mean ETS	Mean ETS	Wted ETS Diff
Surface Visibility	0.067	0.070	0.060
6 hr Precip Accum	0.325	0.327	0.043
Total Cloud Amount	0.223	0.223	-0.001
Cloud Based Height (3/8 Cover)	0.052	0.052	0.006

Parameter	Control Data	Test Data	Test - Control
0Z 6Z 12Z 18Z	Mean Skill	Mean Skill	Wted Skill Diff
Surface Temp	0.647	0.647	-0.007
Surface Wind	0.629	0.629	-0.003

Total Weighted Score (%)
 Control Case = 36.121
 Test Case = 36.221
 Test - Control = 0.099 (0.28 % change)



Forecast impact

- Following the installation of the NWCSAF package (v2012) AMVs could now be calculated from additional MSG channels including water vapour.
- A series of three 40day trials were run with the new package to testing thinning (20km and 10km) and temporal thinning (30min and 60min) with the UKV suite.
- The best UKV trial (20km and 30min thinning) it trial was then extended to 47 days.
- A further 30 day trial run with an updated version of NWCSAF package.



The best of three UKV 40 day trials extended to 47 days

Parameter	Control Data	Test Data	Test - Control
0Z 6Z 12Z 18Z	Mean ETS	Mean ETS	Wted ETS Diff
Surface Visibility	0.069	0.072	0.045
6 hr Precip Accum	0.333	0.336	0.057
Total Cloud Amount	0.232	0.232	-0.006
Cloud Based Height (3/8 Cover)	0.053	0.053	0.004

Parameter	Control Data	Test Data	Test - Control
0Z 6Z 12Z 18Z	Mean Skill	Mean Skill	Wted Skill Diff
Surface Temp	0.641	0.640	-0.014
Surface Wind	0.632	0.632	-0.003

Total Weighted Score (%)
 Control Case = 36.374
 Test Case = 36.457
 Test - Control = 0.083 (0.23 % change)



Met Office

NWP assimilation trials using a lower assigned height

- Results demonstrated that lowering assigned height by around 40hPa gives an improved fit to the model background.
- Easy-win : no changes required to observation operator
- NWP assimilation trial setup:
 - 2 weeks Nov 2013.
 - UKV 3d VAR, 3 hour cycling.
 - Lowered all assigned heights by 40hPa
- +ve impact on tropospheric winds during t+0 – t+12h
- broadly neutral for other variables.

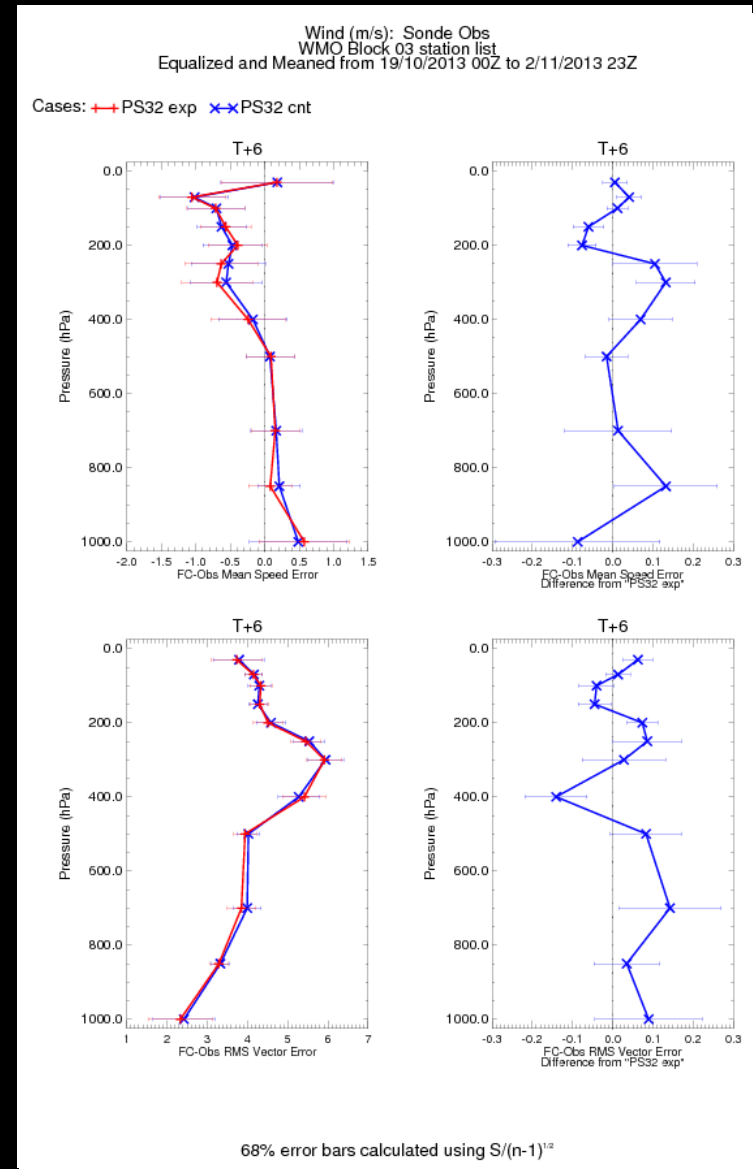




Table of monthly stats in UKV region. Height bias (40 hPa) lower was introduced to UK AMVs after March 2014

	2013 DEC	2014 JAN	2014 FEB	2014 MAR	2014 APR	2014 MAY
UK BIAS	-3.38	-2.99	-2.68	-1.31	-1.31	-0.42
EUM BIAS	-3.93	-3.61	-3.23	-3.04	-2	-2.33
UK STD	5.34	5.39	5.1	4.36	4.37	4.08
EUM STD	6.86	6.59	6.13	6.97	4.70	5.01
UK NUM	807017	64456	553310	533615	728237	574661
EUM NUM	19323	12030	12546	14059	15502	14932

Note: from March clear improvement in BIAS and STD for UK AMVs
after the reduction of 40 hPa



Adjusted AMV lowering AMV heights by 40 hPa 28 Sept 2013 to 28 Oct 2013

AMV's usage above 400hPa

Parameter	Control Data	Test Data	Test - Control
0Z 6Z 12Z 18Z	Mean ETS	Mean ETS	Wted ETS Diff
Surface Visibility	0.046	0.050	0.069
6 hr Precip Accum	0.290	0.290	0.000
Total Cloud Amount	0.193	0.195	0.014
Cloud Based Height (3/8 Cover)	0.177	0.179	0.019

Parameter	Control Data	Test Data	Test - Control
0Z 6Z 12Z 18Z	Mean Skill	Mean Skill	Wted Skill Diff
Surface Temp	0.601	0.602	0.012
Surface Wind	0.589	0.589	0.002

Total Weighted Score (%)

Control Case	=	34.229
Test Case	=	34.345
Test - Control	=	0.116 (0.34 % change)



Forecast impact of adding extra AMV's (900-401) hPa over sea. (28 Sept 2013 to 28 Oct 2013)

AMV's usage above 400hPa

(forecast control use amv's > 400hpa adjusted heights by 40 hPa)

Parameter	Control Data	Test Data	Test - Control
0Z 6Z 12Z 18Z	Mean ETS	Mean ETS	Wted ETS Diff
Surface Visibility	0.036	0.043	0.135
6 hr Precip Accum	0.249	0.248	-0.030
Total Cloud Amount	0.173	0.174	0.012
Cloud Based Height (3/8 Cover)	0.166	0.168	0.020

Parameter	Control Data	Test Data	Test - Control
0Z 6Z 12Z 18Z	Mean Skill	Mean Skill	Wted Skill Diff
Surface Temp	0.617	0.617	-0.004
Surface Wind	0.560	0.560	0.016

Total Weighted Score (%)

Control Case = 32.615

Test Case = 32.765

Test - Control = 0.149 (0.46 % change)



Forecast impact of adding extra AMV's (900-401) hPa over sea and adjusted AMV's above 400 hPa (28 Sept 2013 to 28 Oct 2013)

AMV's usage above 400hPa
(forecast control use amv's > 400hpa adjusted heights by 40 hPa)

Parameter	Control Data	Test Data	Test - Control
0Z 6Z 12Z 18Z	Mean ETS	Mean ETS	Wted ETS Diff
Surface Visibility	0.029	0.043	0.277
6 hr Precip Accum	0.246	0.248	0.021
Total Cloud Amount	0.173	0.174	0.010
Cloud Based Height (3/8 Cover)	0.166	0.168	0.020

Parameter	Control Data	Test Data	Test - Control
0Z 6Z 12Z 18Z	Mean Skill	Mean Skill	Wted Skill Diff
Surface Temp	0.617	0.617	-0.008
Surface Wind	0.560	0.560	0.004

Total Weighted Score (%)

Control Case = 32.441

Test Case = 32.765

Test - Control = 0.323 (1.00 % change)



Final comments

1. In January 2014 the locally produced AMVs, using the NWCSAF package, replaced the EUMETSAT AMVs in the operational UKV data assimilation.
2. In March 2014 the UK AMVs > 400 hPa assigned heights were reduced by 40 hPa .
3. The use of UK AMVs over sea >900 hPa has been successfully tested and has been introduced to the operational UKV data assimilation.
4. Testing of UK AMVs will begin in the near future using 4DVAR.