



AVHRR Polar Winds Derivation at EUMETSAT: Current Status and Future Developments

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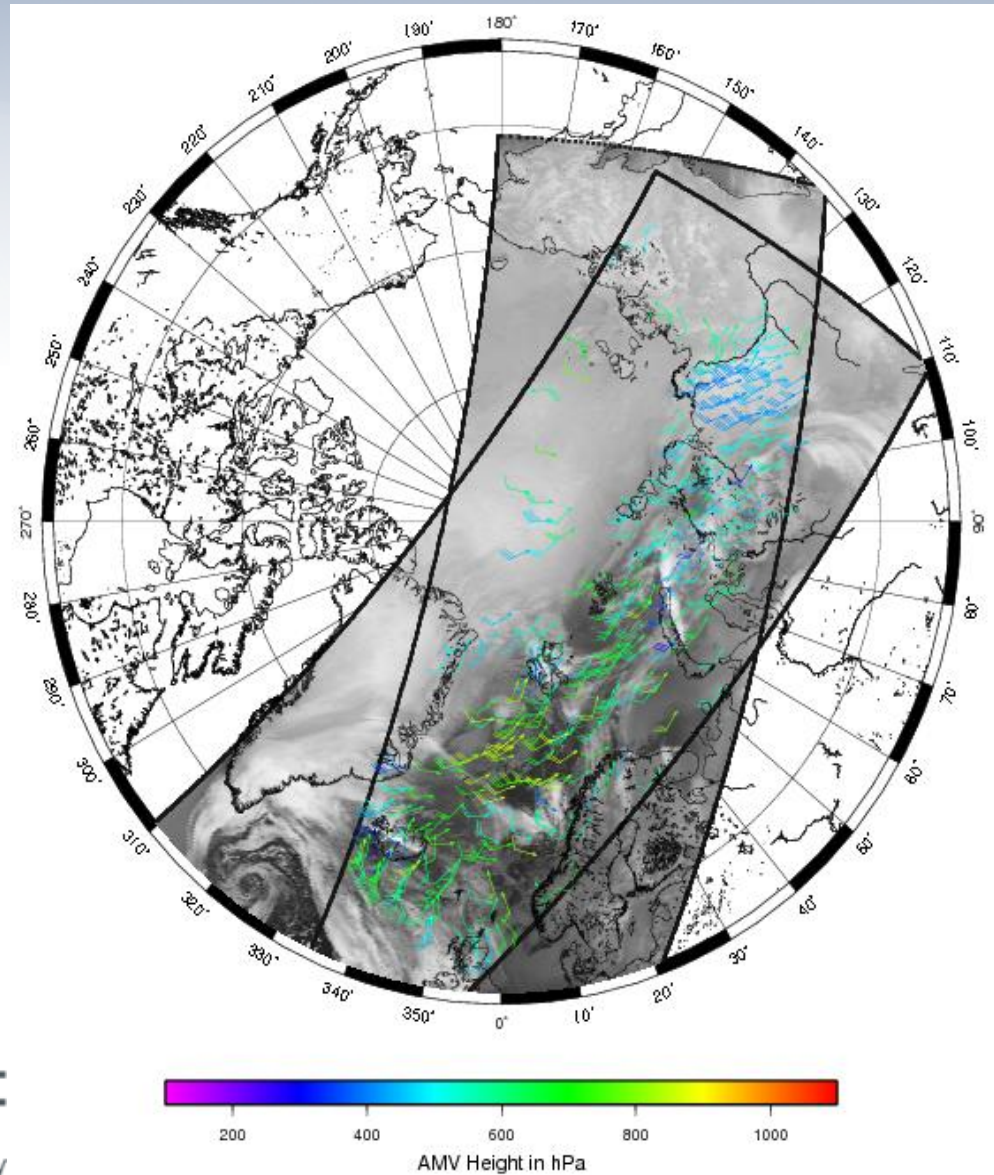


Background

- METOP-A polar orbiting satellite launched October 2006 (operated by EUMETSAT)
- EUMETSAT derives winds from AVHRR instrument
- All Level 2 wind products processed in NRT using 3 minute (PDU) slices of image data
- For each target PDU – map the 3 search PDUs in the previous orbit which overlap onto the target PDU
- Only use 2 orbits to produce the winds for each PDU



Background





Status at IWW10 Tokyo 2010

- Tracking between pairs of images (current and previous orbit)
- Height Assignment - IR window
 - no low-level correction
- Use of forecast guided winds
- Single (complete) orbit dump of data at Svalbaard
- EUM Polar Winds disseminated between 90 and 110 minutes after sensing time



Evolution since IWW10

- Demonstration dissemination (June 24th 2010)
- Upgrades for full operational v1.5 – EUMETCast and GTS (Jan 25th 2011)
- Minor modifications (Feb 24th 2011)
- Use of GRIB 2 forecast data (May 2011)
- Addition of McMurdo receiver station (June 2011)
- Ingestion of 3-hour forecast data (Nov 8th 2011)
- Major new release v2.0 (Dec 13th 2011)

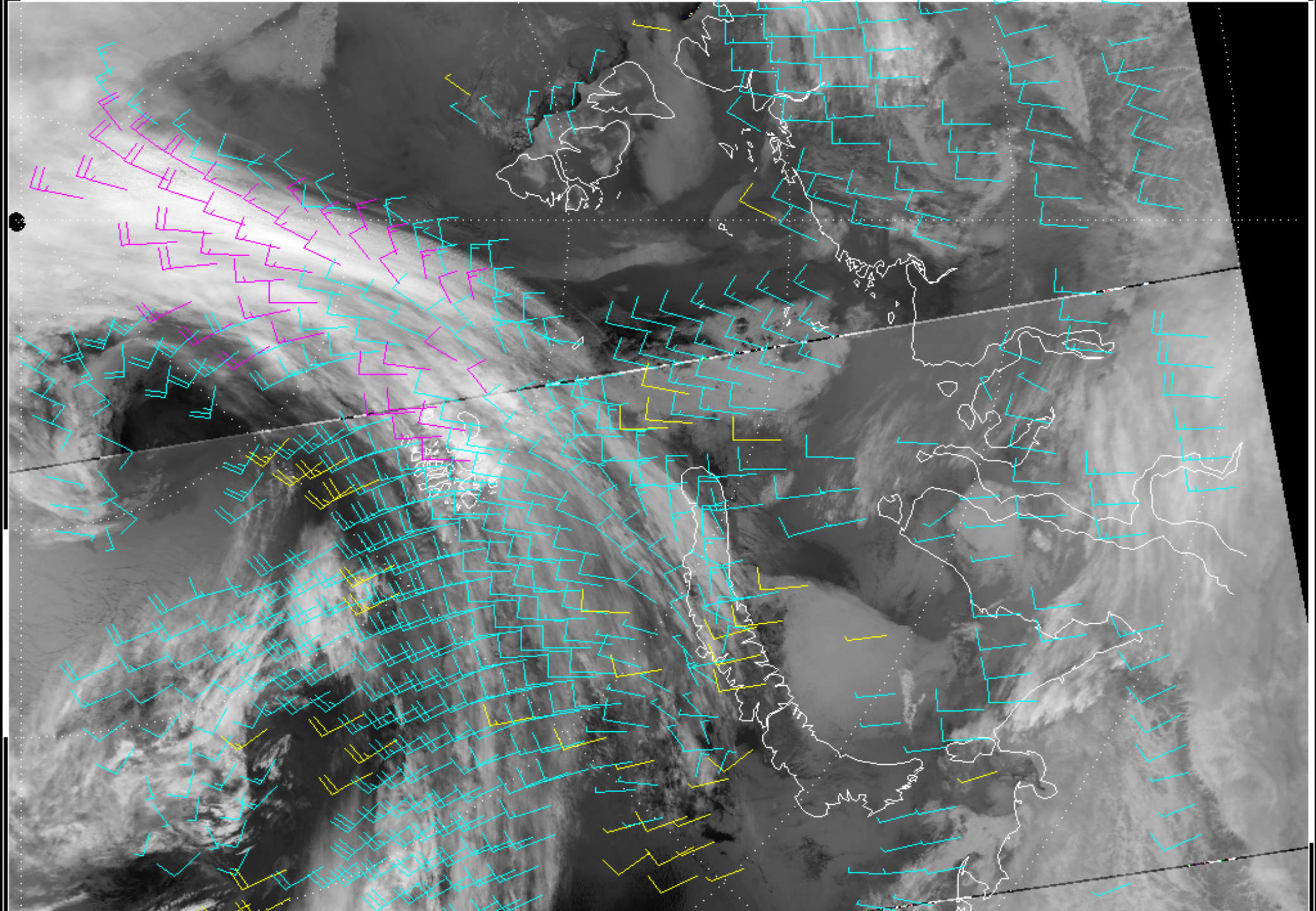


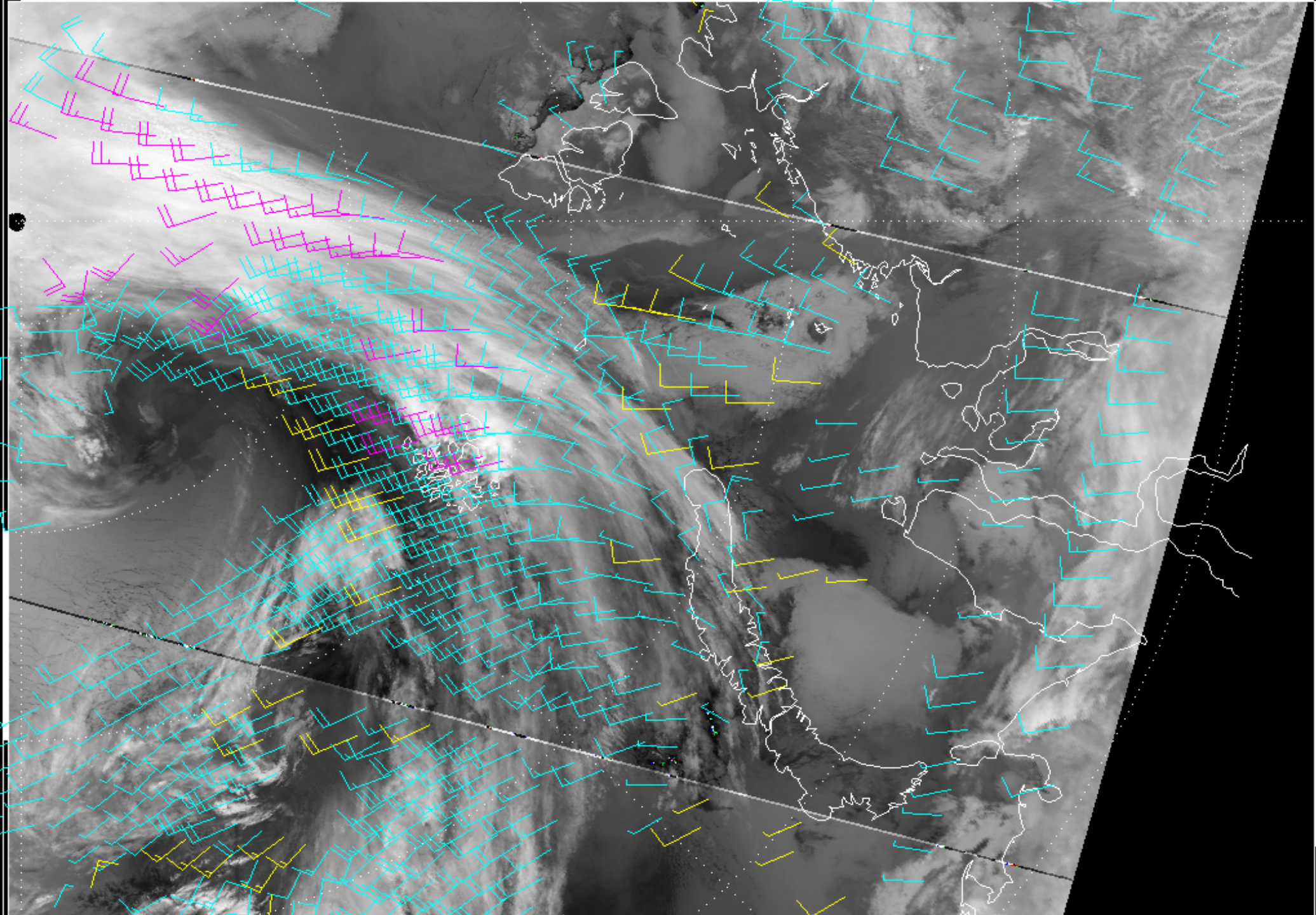
Main Upgrades for Operational Version v1.5

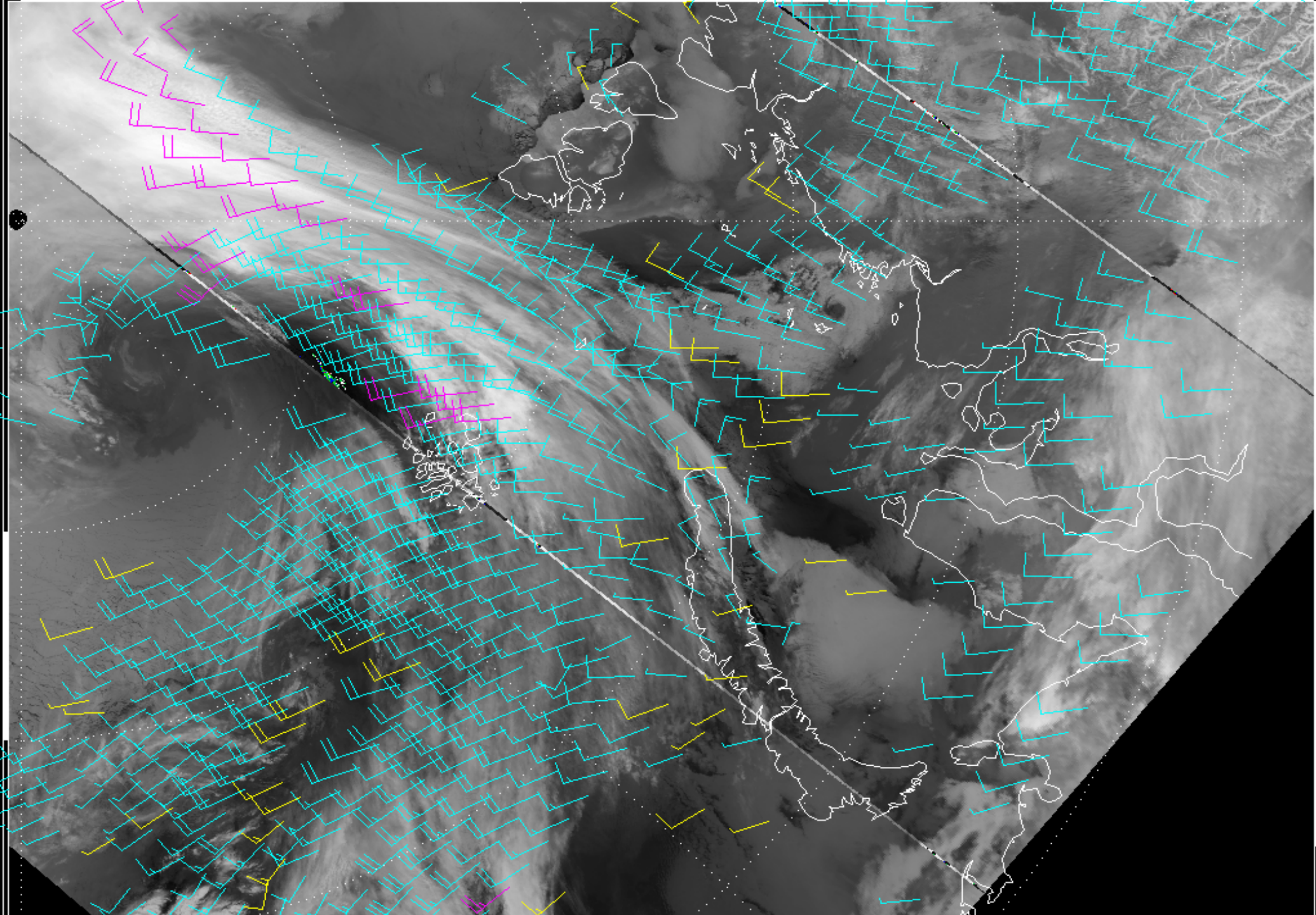
- Process winds at latitudes above and below 55/-55 degrees
- Use spanning forecast data sets instead of nearest match
- Increase wind density
- More meaningful representation of tracking and height QI

- Larger proportion of higher quality winds
- Lower departure statistics but still positive speed biases
- Distribution predominantly medium level (400 – 700 hPa)

- Full operational release via EUMETCast and GTS on January 25th 2011







Major New Release v2.0 – Main Changes

- Use collocated cloud top heights derived from the Metop-A IASI instrument (CO2 slicing method), when available
- Use cross-correlation contribution (CCC) method to relate the pixels selected for height assignment to the tracking
- Add parallax correction
- Filter out any targets if any part of the search area lies outside the PDU processing area
- Use “full-level”, instead of “half-level”, ECMWF forecast coefficients to apply to ECMWF forecast data

Validation - Arctic QI > 80

	Low Level (>=700 hPa)		Mid Level (700-400 hPa)		High Level (<=400 hPa)		All Levels	
	OLD	NEW	OLD	NEW	OLD	NEW	OLD	NEW
Speed Bias (m/s)	1.81	1.21	1.91	1.18	0.57	1.14	1.82	1.14
Speed RMS (m/s)	4.06	3.57	4.54	3.98	5.45	4.28	4.43	3.91
Direction Bias (deg)	0.44	2.51	0.66	0.49	2.26	-0.86	0.63	0.86
Direction RMS (deg)	16.00	18.41	12.77	13.75	10.96	10.04	13.83	14.70
Mean Spd AMV	16.64	15.43	21.62	20.21	29.23	26.51	20.33	19.53
Mean Spd Analysis	14.83	14.22	19.71	19.10	28.66	25.38	18.51	18.39
NRMS	0.27	0.25	0.23	0.21	0.19	0.17	0.24	0.21
Sample size	3002	2111	5909	5754	393	685	9268	8508
% of Winds	32	25	64	67	4	8	100	100

5 day period May 2011 : 060000Z and 120000Z 6 hour forecast

Validation - Antarctic QI > 80

	Low Level (>=700 hPa)		Mid Level (700-400 hPa)		High Level (<=400 hPa)		All Levels	
	OLD	NEW	OLD	NEW	OLD	NEW	OLD	NEW
Speed Bias (m/s)	1.93	1.32	1.43	0.97	-0.19	0.40	1.09	0.75
Speed RMS (m/s)	4.24	3.74	5.09	4.62	5.25	4.78	5.05	4.63
Direction Bias (deg)	-0.71	-1.82	0.18	0.01	-0.15	1.00	0.01	0.32
Direction RMS (deg)	12.81	11.31	13.96	15.50	14.55	17.12	14.00	15.98
Mean Spd AMV	18.42	17.82	24.72	23.68	27.81	28.53	24.82	25.37
Mean Spd Analysis	16.49	16.50	23.29	22.71	28.09	28.13	23.73	24.61
NRMS	0.26	0.23	0.22	0.20	0.19	0.17	0.21	0.19
Sample size	953	398	6554	2869	2237	2468	9714	5718
% of Winds	10	7	67	50	23	43	100	100

5 day period May 2011 : 060000Z and 120000Z 6 hour forecast

Validation

	ARCTIC All Levels QI > 80		ANTARCTIC All Levels QI > 80	
	OLD	NEW	OLD	NEW
Speed Bias (m/s)	1.14	0.75	2.57	1.58
Speed RMS (m/s)	5.62	4.81	5.58	4.26
Direction Bias (deg)	0.30	-0.51	-4.69	0.04
Direction RMS (deg)	14.95	28.20	19.28	14.55
Mean Spd AMV	26.11	25.04	23.36	20.68
Mean Spd Analysis	24.97	24.50	20.80	19.10
NRMS	0.23	0.20	0.27	0.22
Sample size	3080	2526	2511	2112



Validation v2.0 – Summary

- Reduction of winds - filtering out of targets with incomplete search areas
- Heights shifted slightly upwards in the atmosphere
- helped to reduce the fast wind bias
- Still a general fast speed bias
- Speed departure statistics are lower for NEW PPF
- Direction departure statistics are more variable

Validation – Use of IASI Heights

ARCTIC	Mid Level QI > 80		High Level QI > 80	
	All Heights	IASI Heights	All Heights	IASI Heights
Speed Bias (m/s)	1.18	1.22	1.14	1.14
Speed RMS (m/s)	3.98	4.08	4.28	4.28
Direction Bias (deg)	0.49	0.10	-0.86	-0.86
Direction RMS (deg)	13.75	12.14	10.04	10.04
Mean Spd AMV	20.21	20.81	26.51	26.51
Mean Spd Analysis	19.10	19.59	25.37	25.37
NRMS	0.21	0.21	0.17	0.17
Sample size	5754	4111	685	685

ANTARCTIC	Mid Level QI > 80		High Level QI > 80	
	All Heights	IASI Heights	All Heights	IASI Heights
Speed Bias (m/s)	0.97	0.97	0.40	0.37
Speed RMS (m/s)	4.62	4.67	4.78	4.81
Direction Bias (deg)	0.01	-0.07	1.00	0.88
Direction RMS (deg)	15.50	11.54	17.12	11.56
Mean Spd AMV	23.68	24.66	28.53	29.58
Mean Spd Analysis	22.71	23.68	28.13	29.21
NRMS	0.20	0.20	0.17	0.16
Sample size	2869	2496	2468	2197

5 day period May 2011 : 060000Z and 120000Z 6 hour forecast data

Arctic, IASI height assignment has been applied for 69% of the medium level winds and 99% of the high level winds.

Antarctic, IASI height assignment has been applied for 79% of the medium level winds and 72% of the high level winds

Validation – Use of IASI Heights

	ARCTIC All Levels QI > 80			ANTARCTIC All Levels QI > 80		
	OLD	NEW All	NEW IASI	OLD	NEW All	NEW IASI
Speed Bias (m/s)	1.14	0.75	0.80	2.57	1.58	1.72
Speed RMS (m/s)	5.62	4.81	5.11	5.58	4.26	4.53
Direction Bias (deg)	0.30	-0.51	-1.91	-4.69	0.04	-0.06
Direction RMS (deg)	14.95	28.20	15.71	19.28	14.55	11.15
NRMS	0.23	0.20	0.16	0.27	0.22	0.22

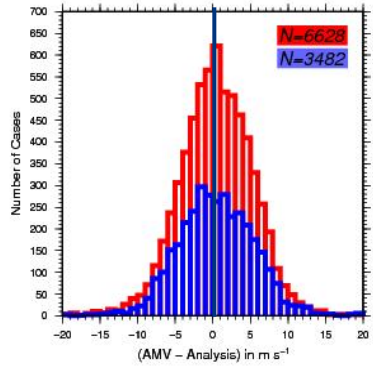
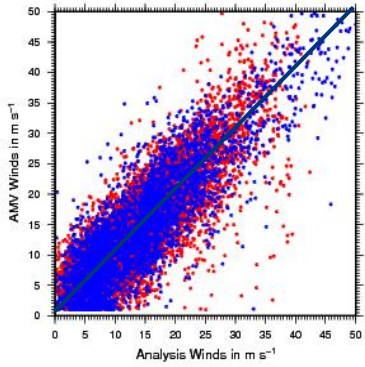
3 day period Nov 2011 : 060000Z and 120000Z 3 hour forecast data

- Use of IASI co-located heights improves wind quality**

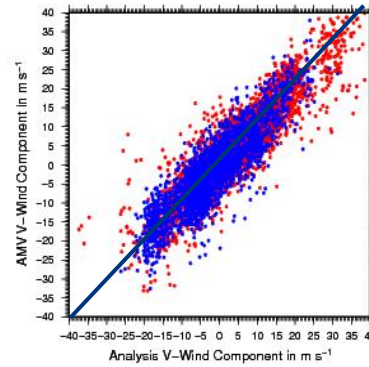
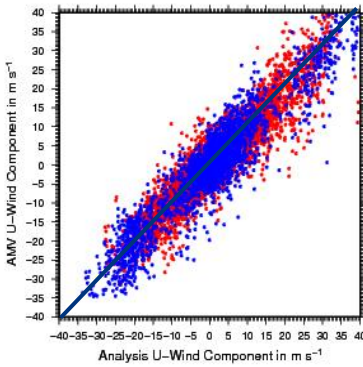
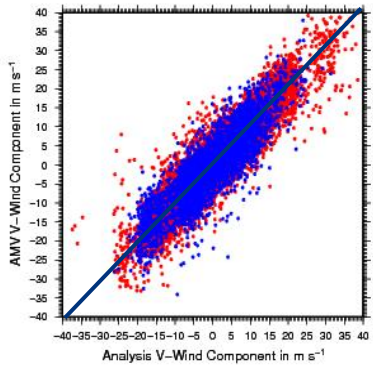
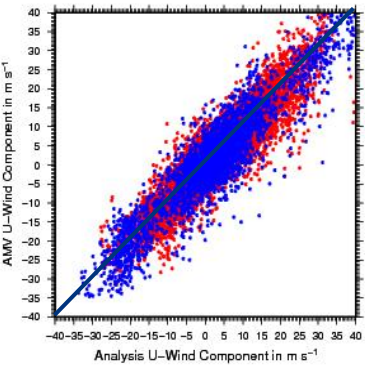
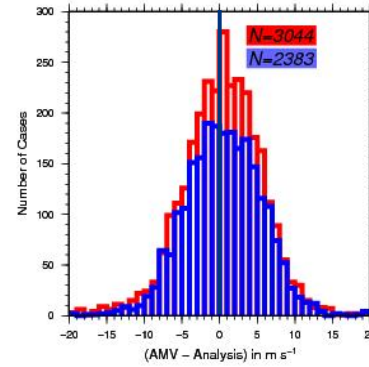
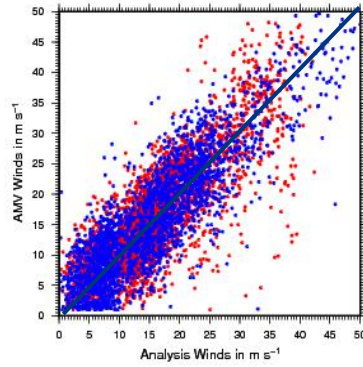


Validation – Use of IASI Heights

Metop-A AVHRR PPF v2.0 Winds vs. ANALYSIS May 9 2011 12:00 [All QI]



Metop-A AVHRR PPF v2.0 Winds vs. ANALYSIS May 9 2011 12:00 IASI [All QI]



Validation – Parallax Correction and Satellite Zenith Angle

- **Parallax correction** - no impact on wind departure statistics
- **Satellite zenith angle**
 - no speed bias and direction bias dependency
 - speed and direction RMS dependency (> 45 deg)
 - investigate further using long-term monitoring statistics (eg ECMWF, Met Office)



Validation – Timeliness

- OLD PPF the worst timeliness was typically 70 mins for two receiver station scenario
- NEW PPF the worst timeliness is generally either 80 mins or occasionally 140 minutes
- Within the 180 minute bench-mark level even for one receiver station scenario



Status Now

- Version 2.0 replaced Version 1.5 on Dec 13th 2011
- Operational dissemination on EUMETCast and GTS
- When available both IASI (CO2 slicing method) and IR window heights for each wind written to BUFR product
- Feedback welcomed from users: ECMWF, Met Office
 - IASI height assignment impact
 - satellite zenith angle dependency



Future Plans

- Metop B launch May 2012 – Metop A/B images
- Next software release incorporate dual Metop processing capability, scheduled mid-2012
- Handling of low level heights, inc. inversions
 - use Concordiasi drop-sonde Antarctic data set
- Correlation surface peak analysis
- Consider triplets (at least for consistency tests)



Use of Metop A and B Capability

- Tracking 50 minutes separation
- Increased global coverage
- EPS GS product processor configuration
 - Metop A ‘single mode’ , ie as current operational
 - Metop B ‘single mode’
 - ‘dual mode’ combining Metop A and B images
- Validation - use of co-located MSG winds
- Validation - external users 3 sets of parallel data



THAT' S ALL FOLKS !