AN OVERVIEW OF 10 YEARS OF RESEARCH ACTIVITIES ON AMVs AT EUMETSAT

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and

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P. Dubuisson (LOA), G. Seze (LMD), R. Oyama (JMA) E.H. Sohn (KMA), J. Garcia-Pereda (AEMET), N. Bormann (ECMWF), A. Hernandez (AEMET), A. Horvath (TROPOS), R.G. Negri (INPE)...etc.

IWW12, Copenhagen, Denmark, 16-20 June 2014

EUMETSAT

AN OVERVIEW OF MORE THAN 10 YEARS OF RESEARCH ACTIVITIES ON AMVs AT EUMETSAT

- ✓ MSG 1 was just launched
- ✓ People were really excited about the new capabilities of SEVIRI
- ✓ HA problem expected to be solved/understood very quickly

Many AMV height assignment methods computed

Too many… ???

- EBBT method : chan at 10.8 μm,
- 2 STC config. : chan 10.8 and 6.2 μm; channels 10.8 and 7.3 μm
- 2 IRW config. : chan 10.8 and 6.2 μm; channels 10.8 and 7.3 μm
- 3 CO2 slicing method config. : chan at 10.8 and 13.4 μm, chan at 12.0 and 13.4 μm, chan at 10.8, 12 and 13.4 μm.
- Inversion method at low levels
- Cloud Base Height Method at low levels
- -…

No 'magic' keys or combinations of methods have been found.

Something crucial was missing in our strategy:
We did not know the truth !!

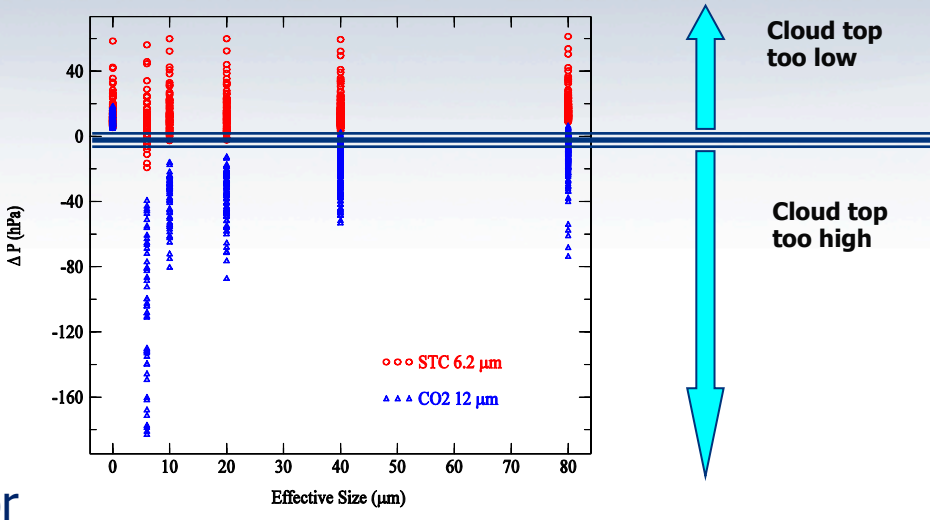
How to know the correct altitude ?

Two important studies initiated:

- ✓ Test the sensitivity of the semi-transparent correction methods using simulated MSG radiances
  - → Collaboration with P. Dubuisson (LOA), 2005
- ✓ Compare the AMV HA against collocated A-train observations
  - → External study, G. Sèze and J. Pelon (LMD), 2006

Main Conclusions

- STC and CO2 methods retrieve correct pressure within few hPa in ideal thick case
- Methods are very sensitive to several atmospheric parameters, and performances are really poor for thin clouds.
- STC generally more accurate and more robust for grey clouds, but more sensitive to natural noise coming from geophysical data.
- CO2 slicing depends on the cloud microphysics
- Multilayer situations can not be treated using such methods.



ΔP = P(retrieved) – P(simulation)

Sèze, G., S. Marchand, J. Pelon and R. Borde, (2008), A comparison of AMV cloud top pressure derived from MSG with space-based Lidar observations', Ninth Int. Winds Workshop, Annapolis, USA.

Main Conclusions

✓ SIGNIFICANT DIFFERENCES BETWEEN AMV AND CALIOP PRESSURE LEVELS FOR HIGH CLOUDS WITH CO2 METHOD

- Good agreement for upper layer (100hPa), degraded to about 100 hPa at 300 hPa

✓ BETTER RESULTS WITH IR/WV METHODS BUT LIDAR MAY BIAS TOWARDS UPPER ALTITUDE (ONLY CLOUD ALTITUDE USED)

✓ MIDDLE CLOUDS : POOR AGREEMENT

✓ LOW CLOUDS :

- Inversion correction methods give good agreement between AMVs and CALIOP lowest cloud top
- Results from cloud base assignment methods (2 and 5) are closer to CALIOP cloud base observations

Then…

I was then convinced of the following:

- ✓ We must use the most accurate CTH method available
  - → Test and use the 'new' OCA pixel based product.

- ✓ We must select carefully the pixels used for HA
  - → Investigate link between tracking and HA. CCC method

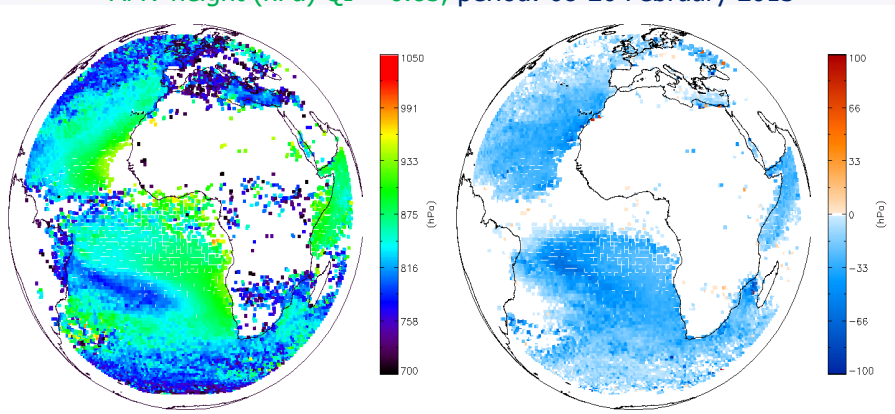
Borde R., and R. Oyama, (2008), 'A Direct Link between Feature Tracking and Height Assignment of Operational Atmospheric Motion Vectors', Ninth Int. Winds Workshop, Annapolis, USA

CCC method

✓ Implemented at EUMETSAT in september 2012

Borde, R., M. Doutriaux-Boucher, G. Dew, M. Carranza, 2014: A Direct Link between Feature Tracking and Height Assignment of Operational EUMETSAT Atmospheric Motion Vectors. J. Atmos. Oceanic Technol., 31, 33–46.

AMV height (hPa) QI > 0.85, period: 08-26 February 2013



Consequences:

- ➢ Improvement at high and mid-levels
- ➢ Degradation at low levels,
  - → Patch implemented in March 2013

  See Manuel's talk

✓ Implemented in NWCSAF HRW software in 2011

J. García-Pereda, R. Borde, and R. Randriamampianina, 'Latest developments in NWC SAF Resolution Winds (HRW) product', Eleventh Int. Winds Workshop, Auckland, New-Zealand, 2012.

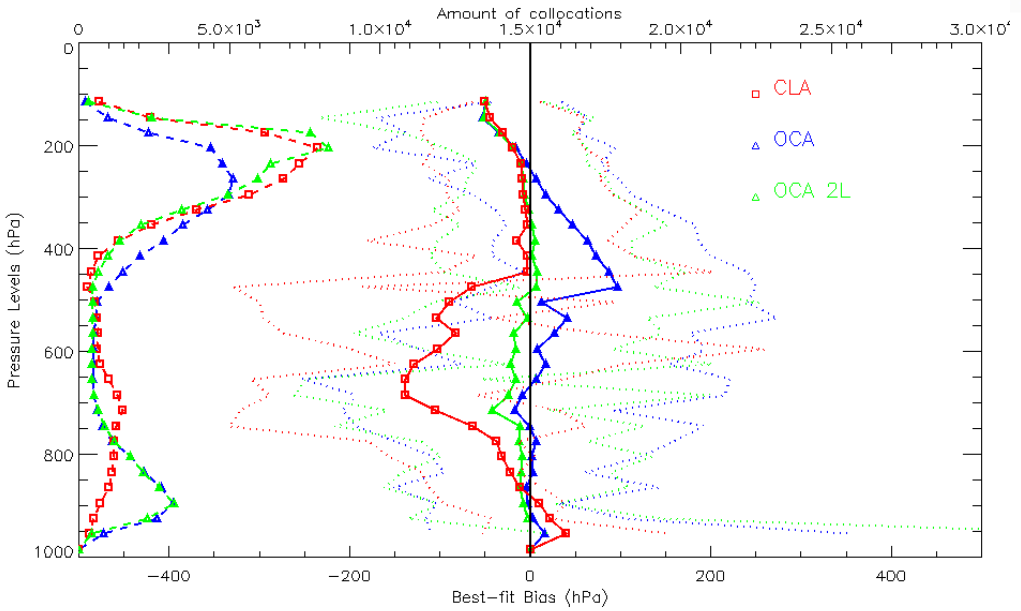
Use of OCA 2 layers

✓ Tested at EUMETSAT using prototype software

Borde, R. and, P. Watts, 'Potential of the two layer OCA product to improve the AMV heights', Proc. EUMETSAT User Conference, Sopot, Poland, 2012

Results:

- Results better using OCA 2L
- But slow speed bias larger at HL with OCA 2L than with OCA ???
- It appeared really difficult to improve best-fit and speed bias at HL in same time.

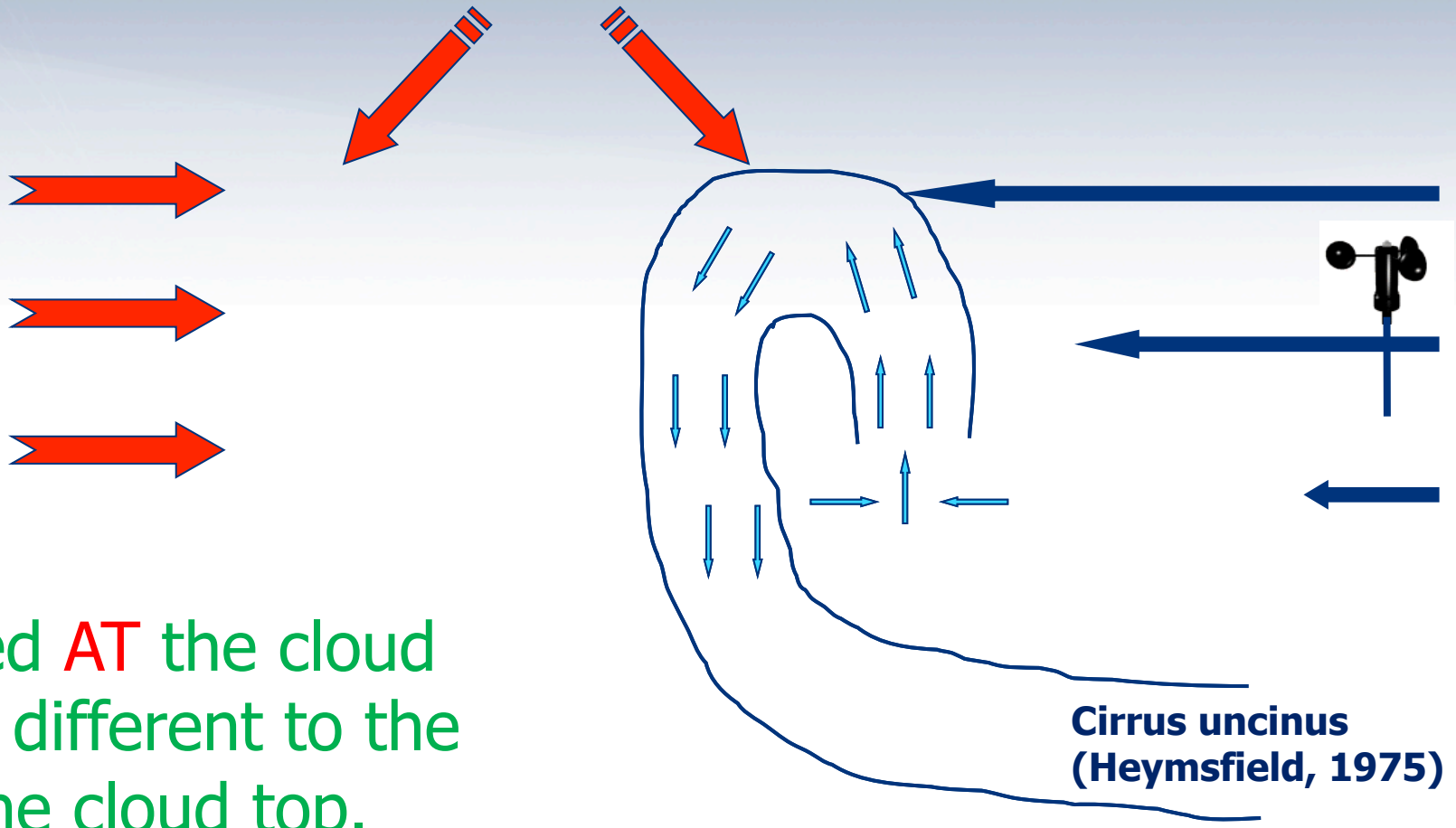


→ What does it mean ?

Possible explanation…

Nearly the same shape…

…but not the same wind speed within the cloud…



Cirrus uncinus (Heymsfield, 1975)

So the speed AT the cloud top may be different to the speed OF the cloud top.

Use of simulated images, 2010
External study, ECMWF, See Angeles's talk.

✓ Collaboration between EUMETSAT, ECMWF and CIMSS

Bormann et al., 2014: Atmospheric Motion Vectors from Model Simulations. Part I: Methods and Characterization as Single-Level Estimates of Wind. J. Appl. Meteor. Climatol., 53, 47–64

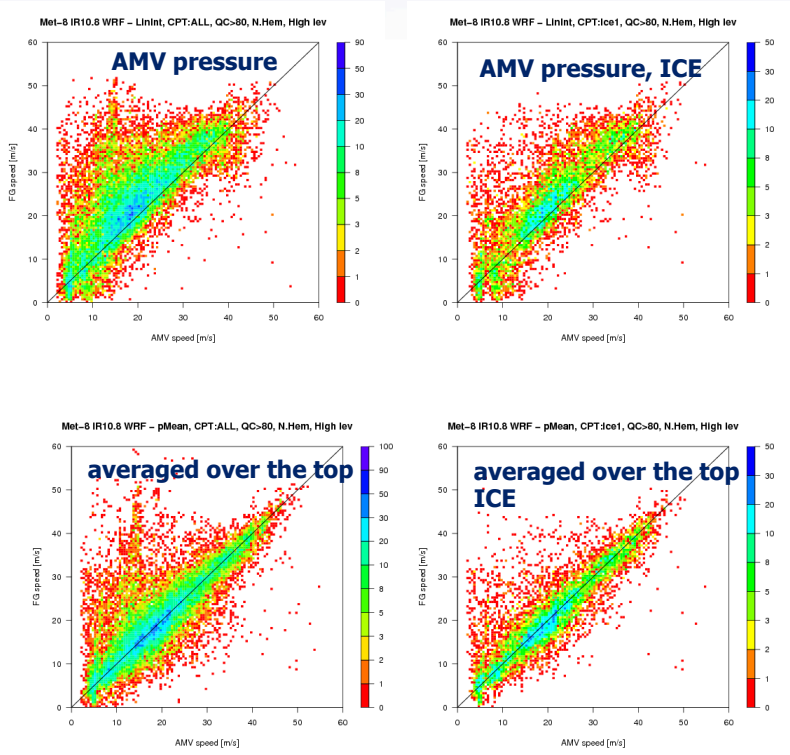
Hernandez-Carrascal and Bormann, 2014: Atmospheric Motion Vectors from Model Simulations. Part II: Interpretation as Spatial and Vertical Averages of Wind and Role of Clouds. *J. Appl. Meteor. Climatol.*, **53**, 65–82.

IR10.8, with a model-independent QI > 80 %

Some interesting results:

- Better agreement doing averaging, but quite small.
- Large improvement re-assigning AMVs to lower heights.
- At High Levels, AMVs more representative at a level within the cloud.
- At Low Levels, AMVs more representative of a wind average over the layer.
- ...Etc.

→ CTH probably not the best parameter !!



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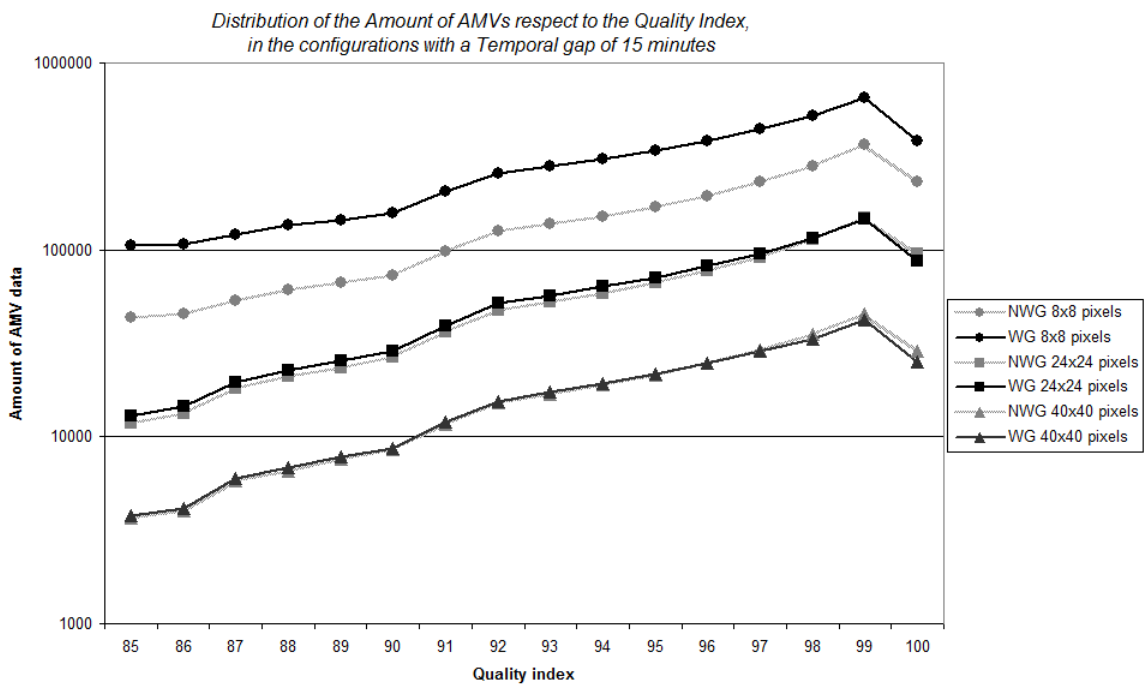
Use of NWCSAF HRW for testing, 2011 AEMET, external study, see Javier's talk

✓ Test the impact of the use of 'wind guess' on AMV tracking

Borde, R., J. García-Pereda, 2014: Impact of Wind Guess on the Tracking of Atmospheric Motion Vectors. J. Atmos. Oceanic Technol., 31, 458–467.

- Use of wind guess impacts AMVs extraction.
- Very large impact when using small target boxes.
- NBias and NRMS smaller without using the guess.
- Better to limit the use of the FC model in AMV extraction.



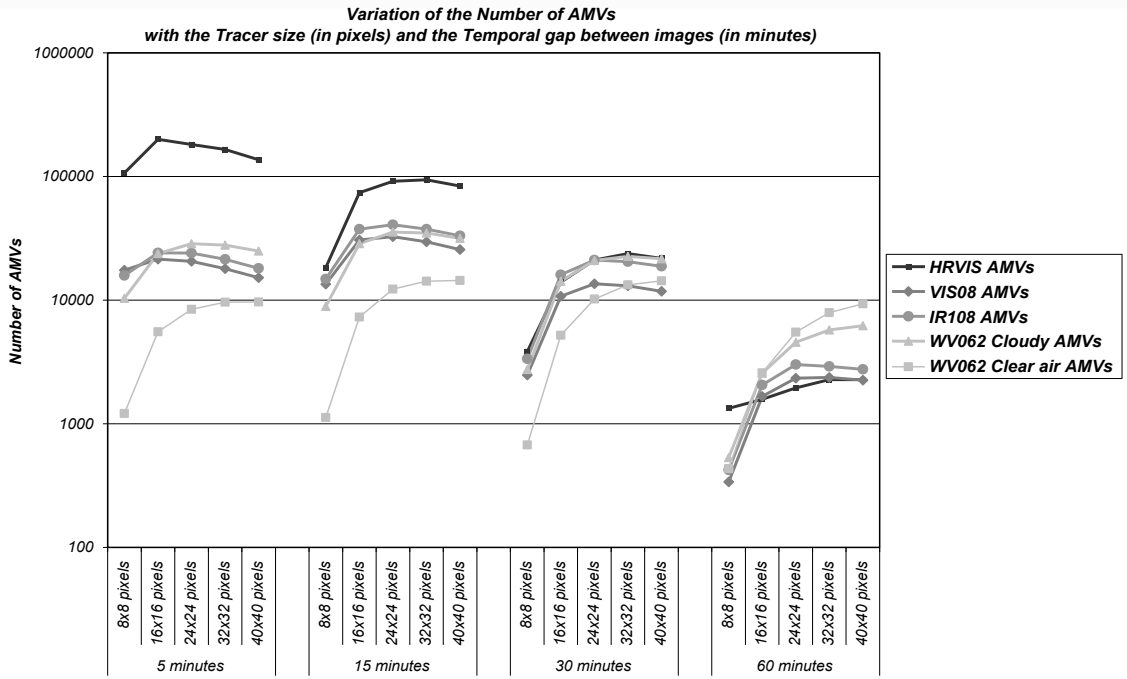
Use of NWCSAF HRW for testing, 2011 AEMET, external study, see Javier's talk

✓ Test the impact of target box sizes and temporal gap on AMV;
following the work by Sohn and Borde, 2008

J. Garcia-Perreda and Borde R., 2014, 'The impact of the Tracer size and the Temporal gap between images in the extraction of Atmospheric Motion Vectors, To be published into J.

- Close relationships between target box, temporal gap, size/lifetime of feature tracked, and quality of the tracking.

- Very difficult to define optimized configuration that improve all the parameters.



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AVHRR winds

- ✓ Single Metop polar winds, 2010
  - ➢ Use image pairs to increase the coverage area.
  - ➢ Last version in May 2014

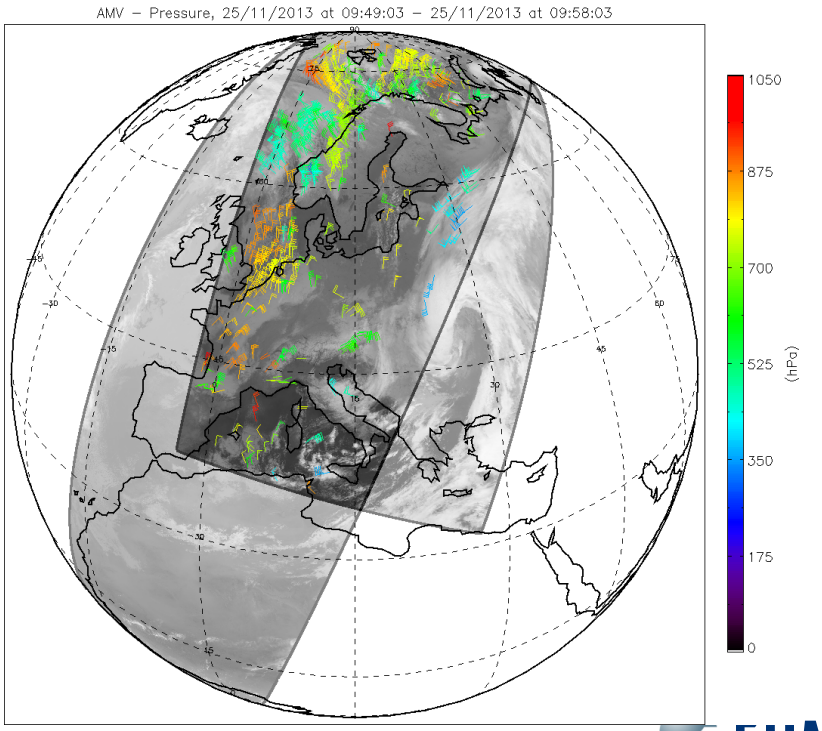
→ Quality has improved, planned to be assimilated at ECMWF

See Kirsti's talk,

- ✓ Dual Metop winds, 2014
  - ➢ Global coverage area.
  - ➢ Operational July 2014

See Olivier's talk, this session

See Akos Horvath poster



AVHRR winds
Some interesting questions for the future…

- ✓ Possibility to derive 'correct' information using only image pairs
  - ➢ Good agreement with other wind observations.

- ✓ Strange feature of QI estimation observed between single and dual Metop winds

Use of vector consistency like: $$dV = \frac{dx}{dt}$$

If dt is divided by 2., dV is artificially multiplied by 2. !!!

→ This feature probably impacts also RSS AMVs.

→ Needs to revisit the QI estimation.

Main general lessons learned

- ✓ Do the right thing to do the things rights !
- ✓ Consider sounded scientific principles and methods
- ✓ Stop comfort fine tuning
  - Limited to very short term improvements
  - Nearly impossible to improve then
- ✓ CTH probably not always the most appropriate parameter for AMVs
- ✓ Avoid the use of the model reference in the algorithms when possible.

Some prospectives for futur investigations at EUMETSAT

- ✓ Set HA using microphysics info. See Manuel's talk
- ✓ Investigate how to account the scaling properties of the natural wind fields:
  - In the tracking (nested tracking ?)
  - for comparisons/validation against other wind Obs.
- ✓ Revisit the QI definition, what is a good quality AMV ?
- ✓ Revisit the use of optical flow methods for MTG IRS humidity fields.

Thanks