



# Reprocessing of atmospheric motion vectors at EUMETSAT

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# ERA-CLIM(2)

## European Reanalysis of Global Climate Observations

EUMETSATs contribution, reprocessing of:

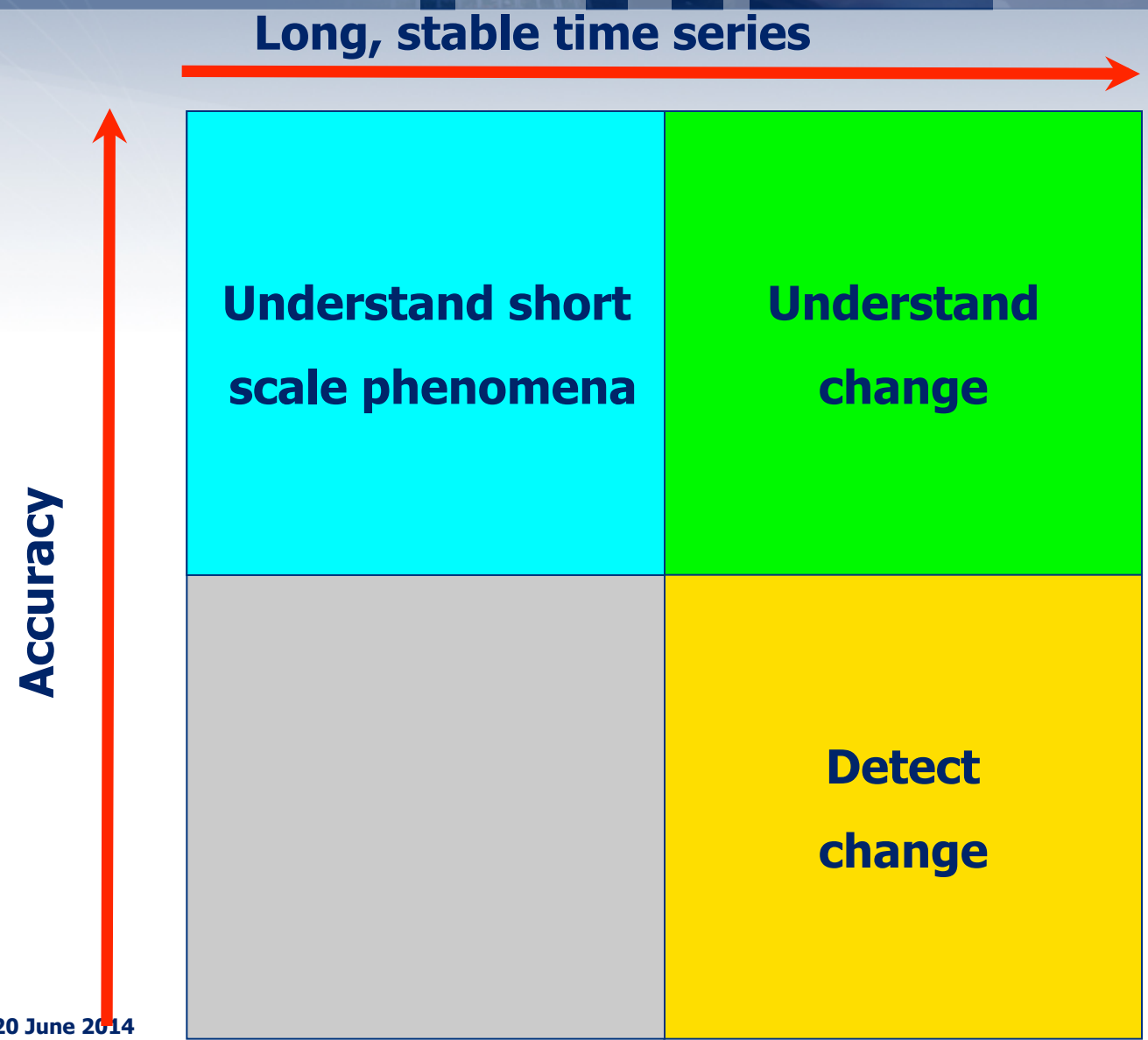
- **AVHRR Atmospheric Motion Vectors (✓)**
- Radio Occultation bending angles
- ASCAT Level 1 data products ✓ **LEO**
- Combined GOME-2 & IASI ozone columns
- SSM/T2 and AMSU-B/MHS radiance data
- **METEOSAT Atmospheric Motion Vectors (✓)**
- Clear and All Sky Radiance ✓ **GEO**
- Geostationary radiance data (referenced to IASI)



<http://www.era-clim.eu/>



# Why do we reprocess satellite data?





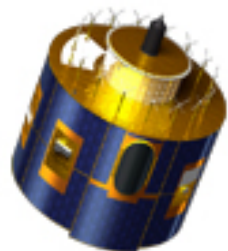
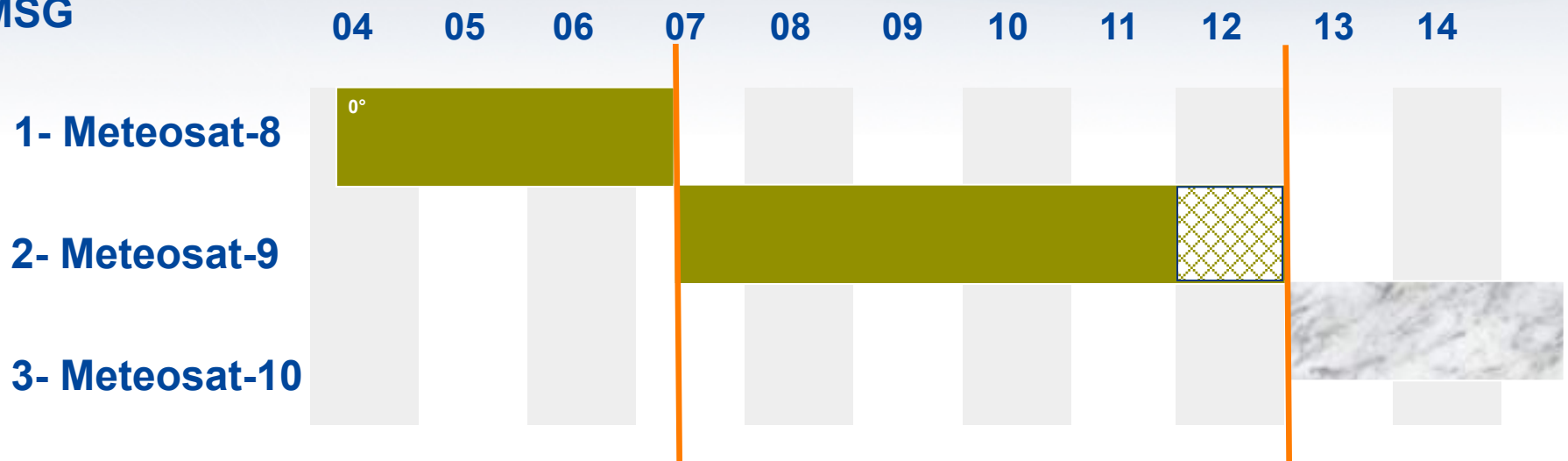
# Geostationary AMVs



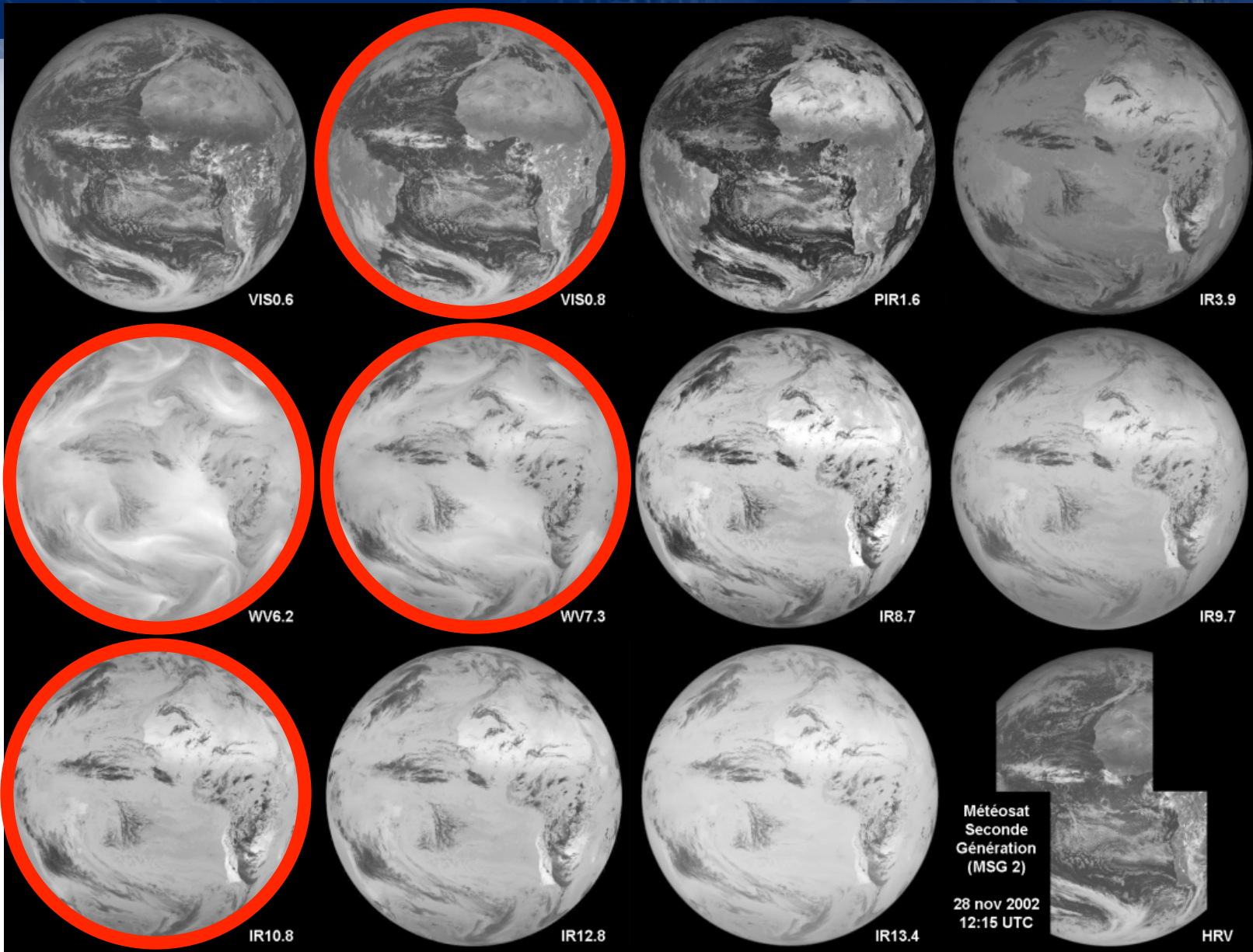


# MSG satellites used for the MPEF reprocessing

MSG



# SEVIRI instrument on MSG, 12 channels, 15 min intervals

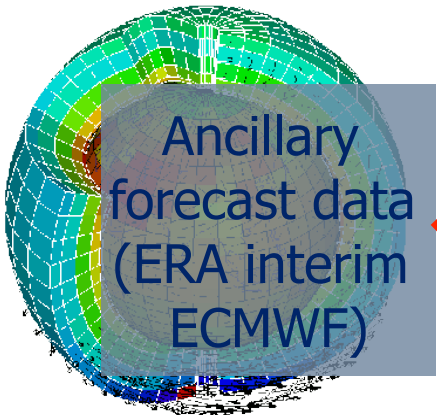




# The Geostationary reprocessing system, RMPEF



SEVIRI lev1.5 images



Ancillary forecast data (ERA interim ECMWF)

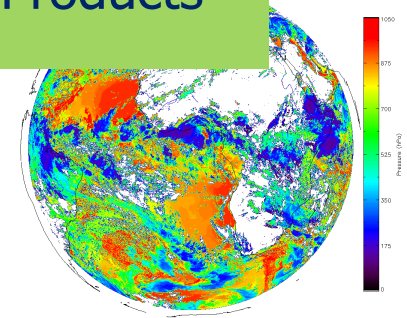


MPEF algorithm (version from 2013)



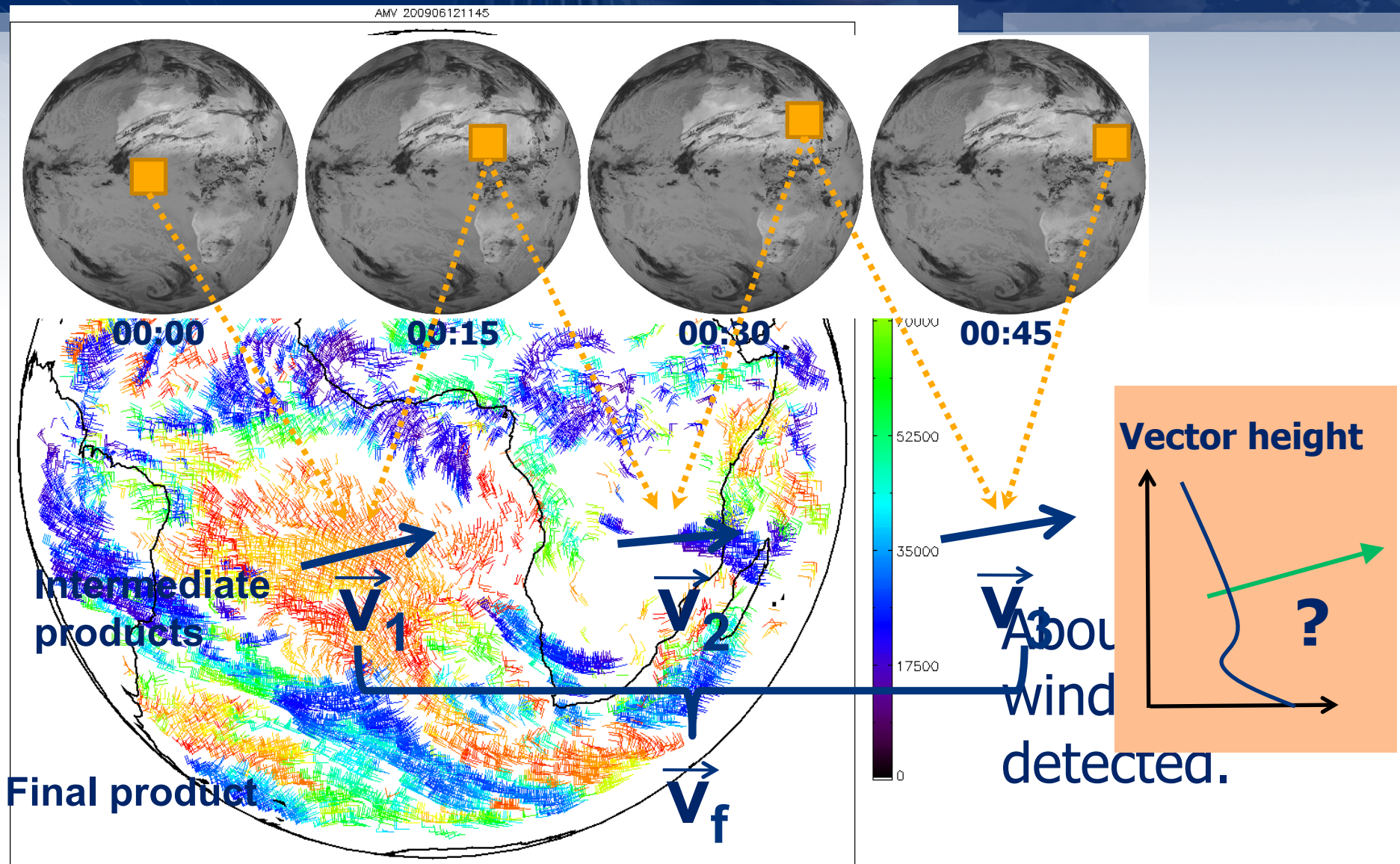
Archive

Products

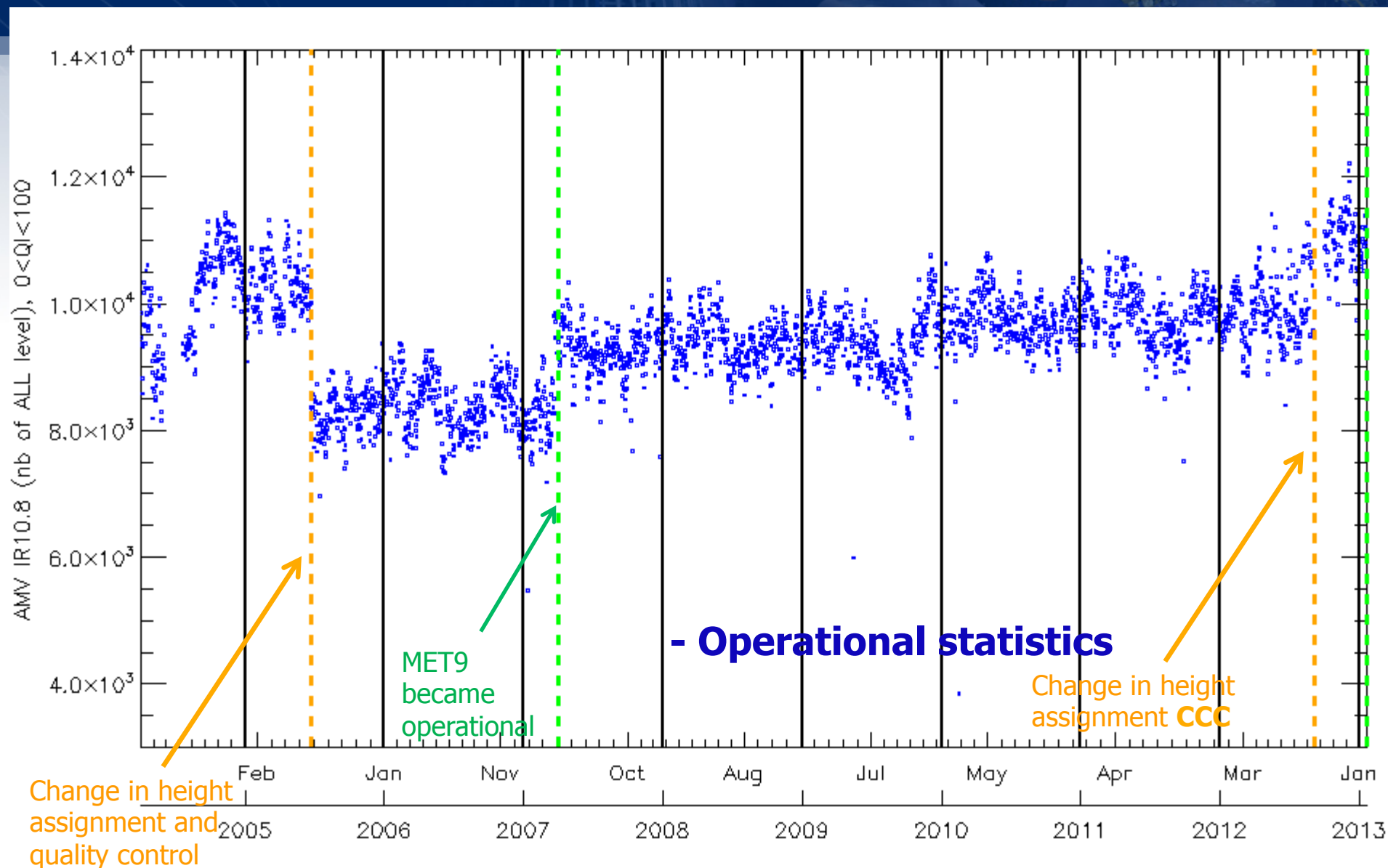




# Atmospheric wind vectors AMV derivation



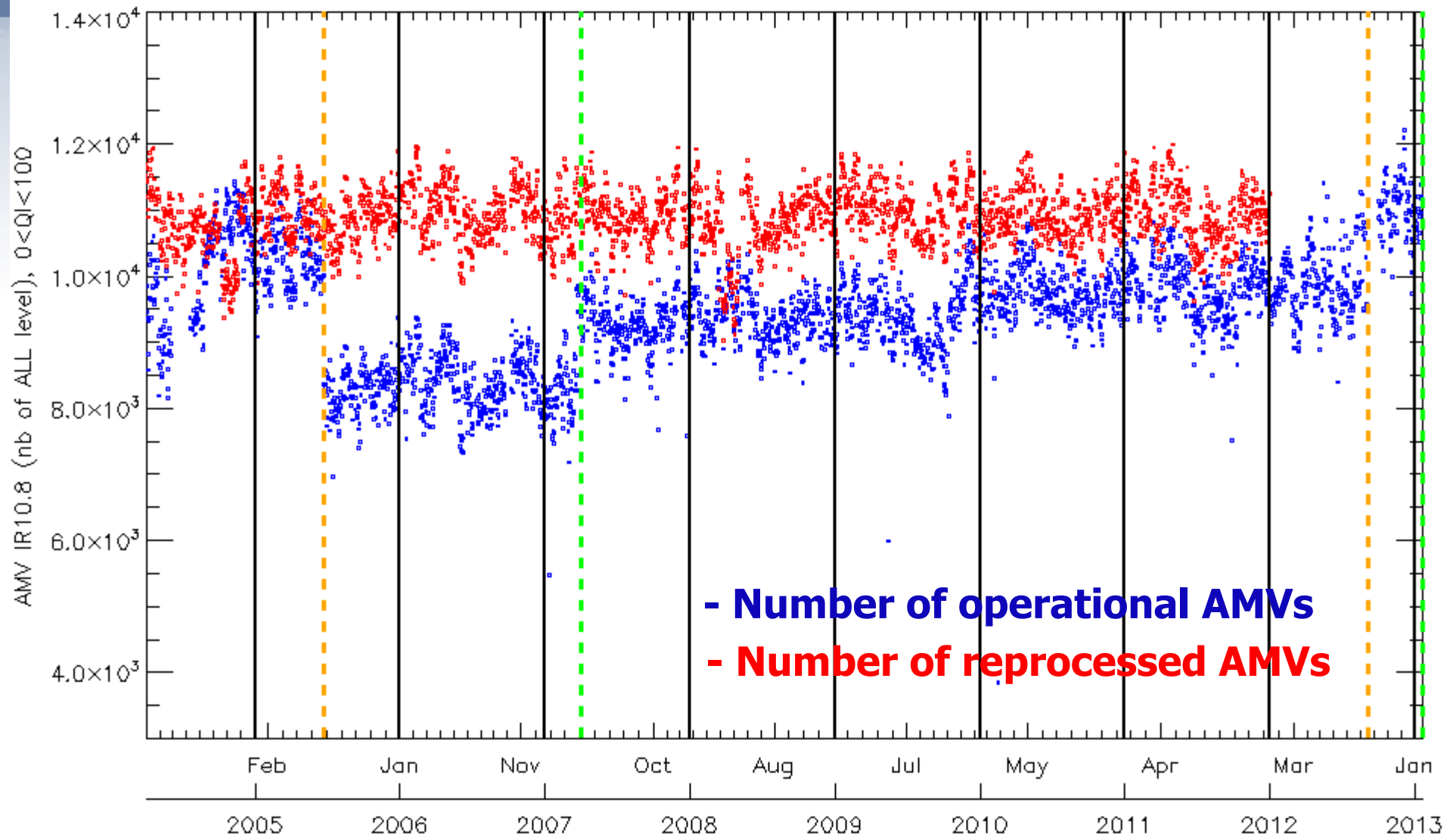
# Operational monitoring, time series of the number of derived AMVs per hour



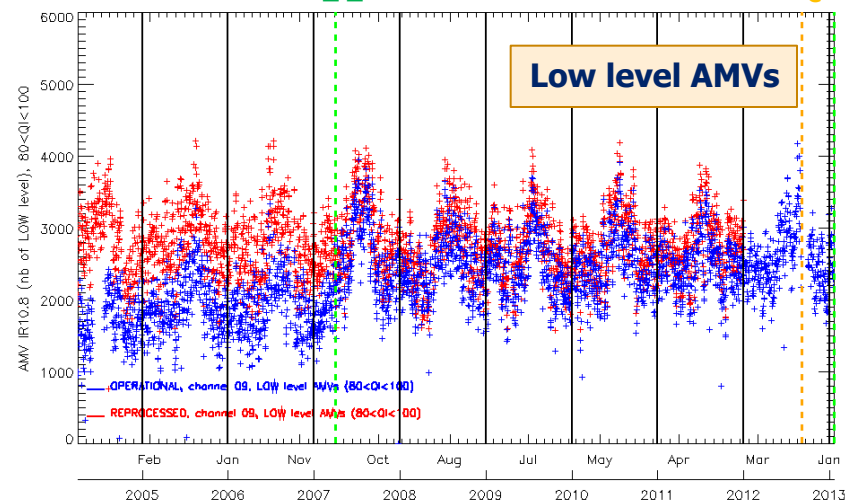
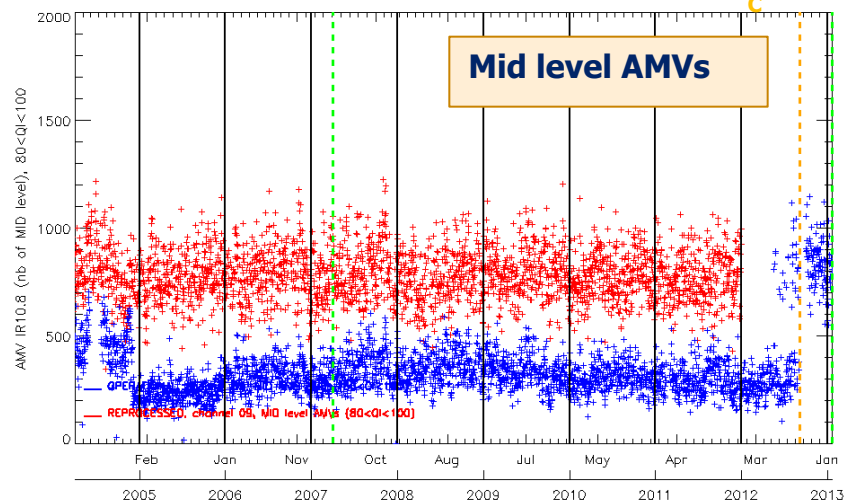
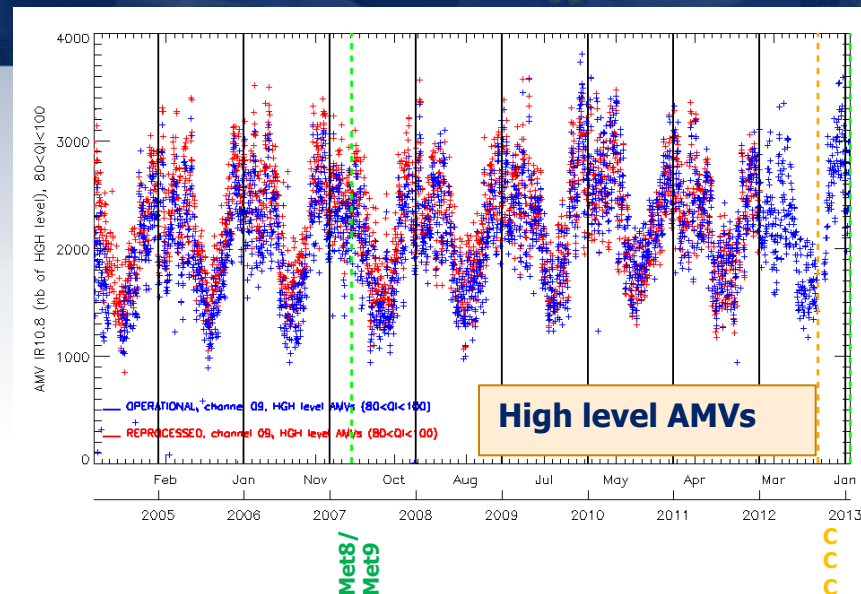
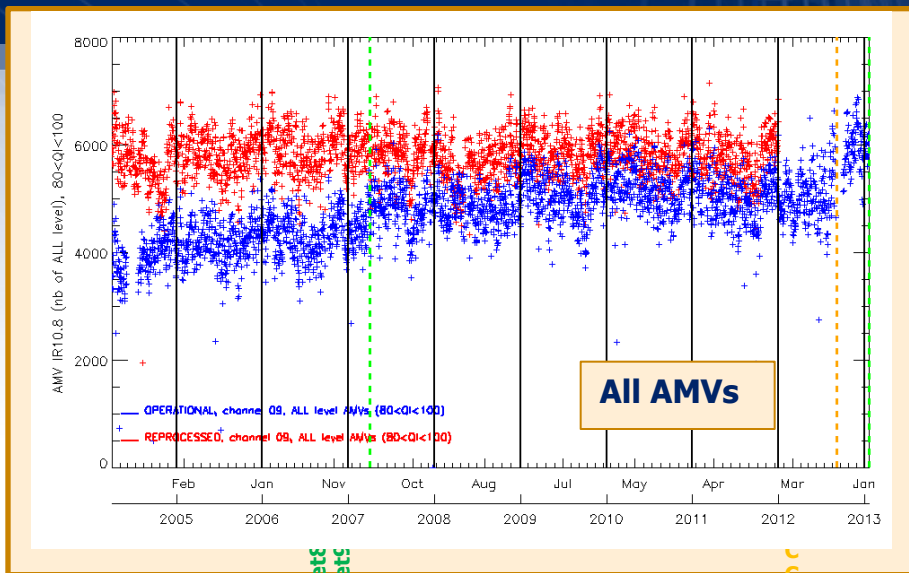




# Clear benefit of the reprocessing



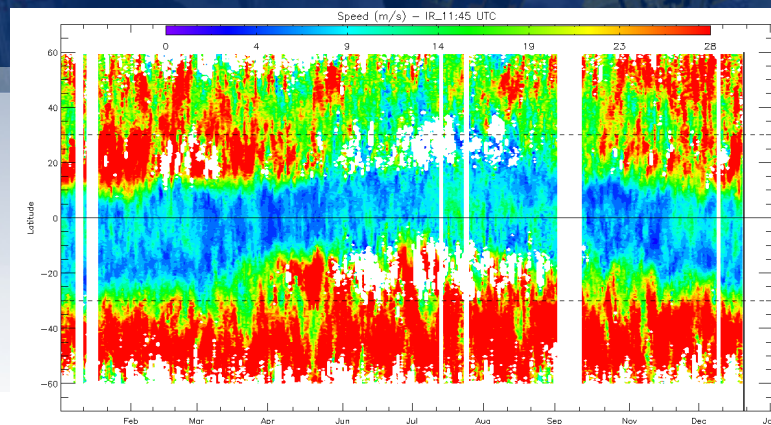
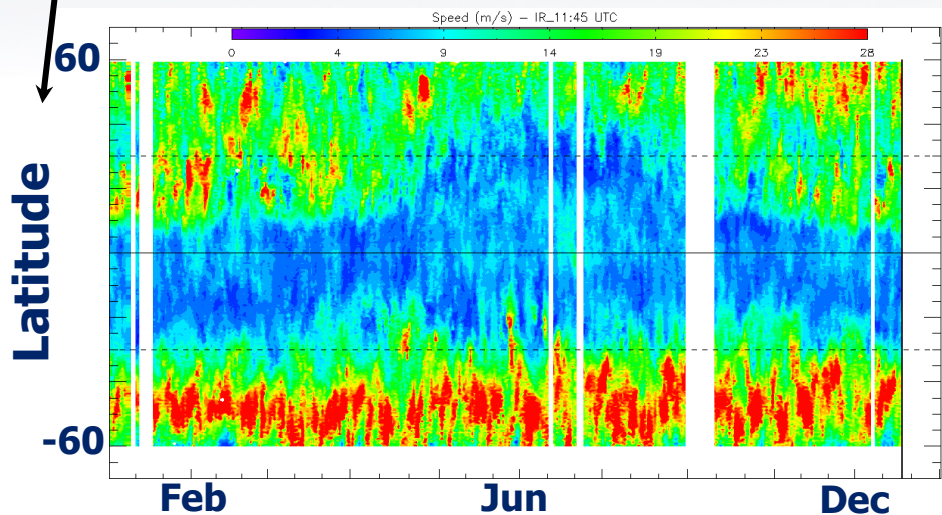
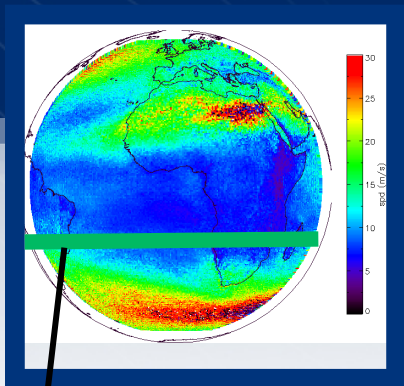
# Excellent AMVs (80<QI<100)



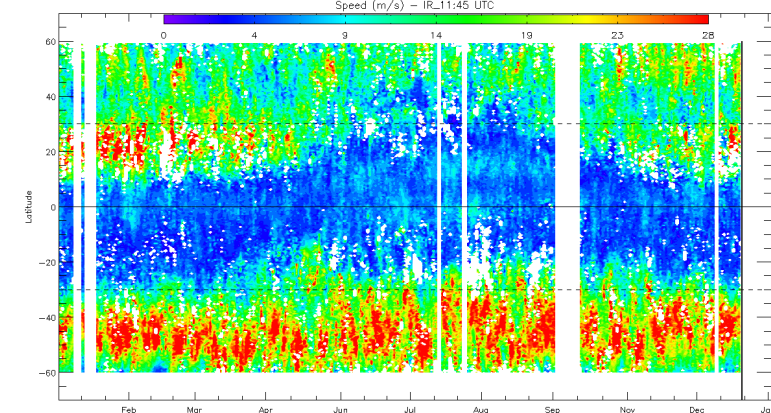
**Number of reprocessed AMVs**

**Number of operationally produced AMVs**

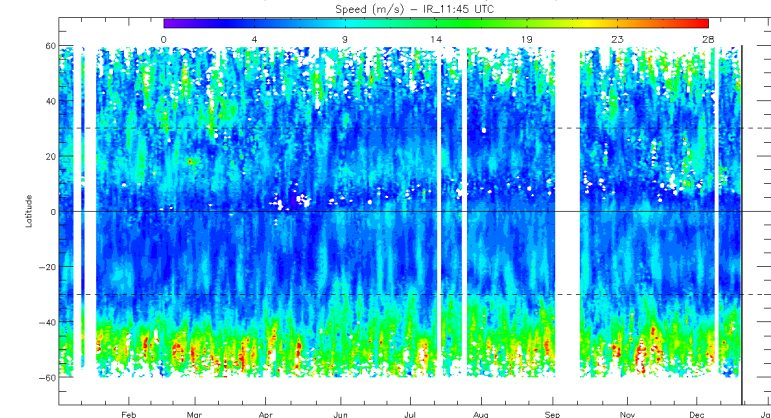
# AMV speed - Monthly averaged, 2006, 11:45UTC



**High**  
(0-400hPa)



**Mid**  
(400-700 hPa)



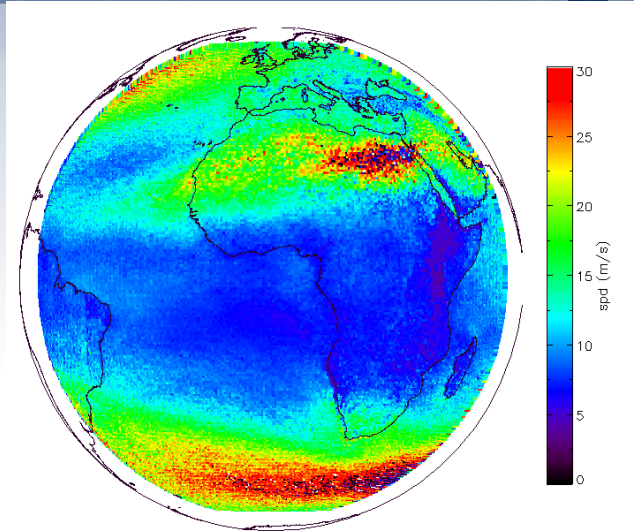
**Low**  
(700-1050 hPa)

**JMETSAT**

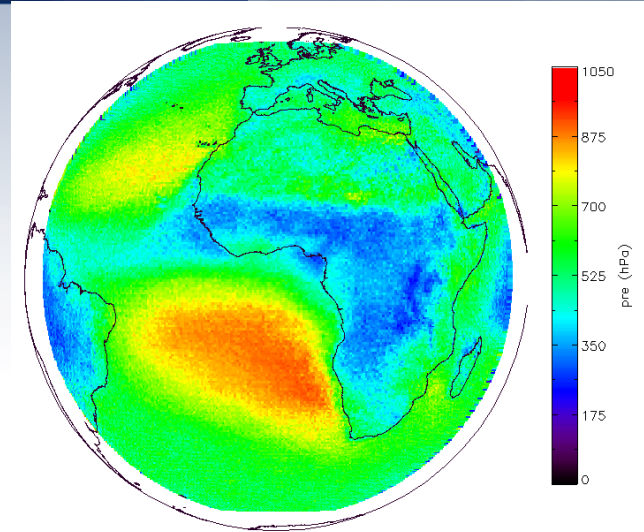




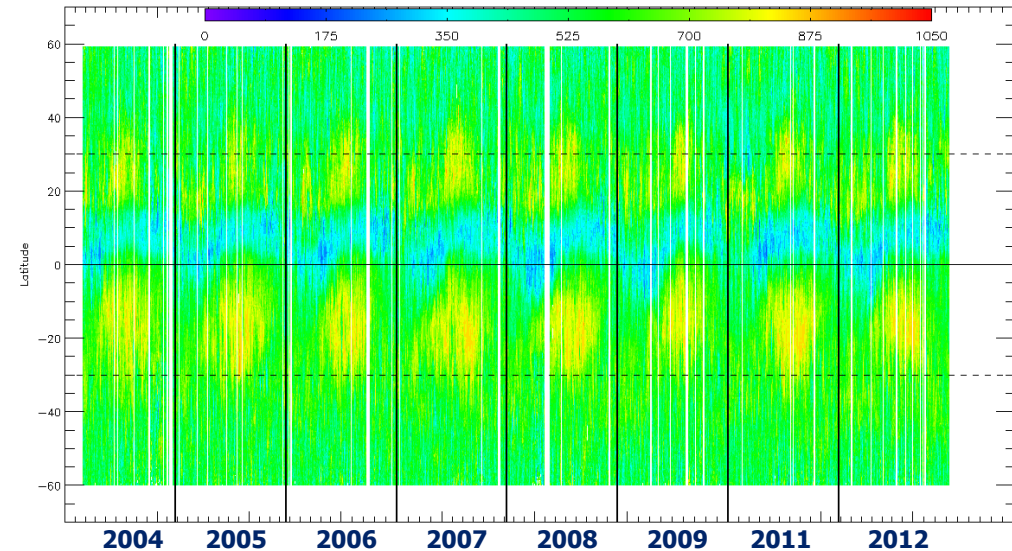
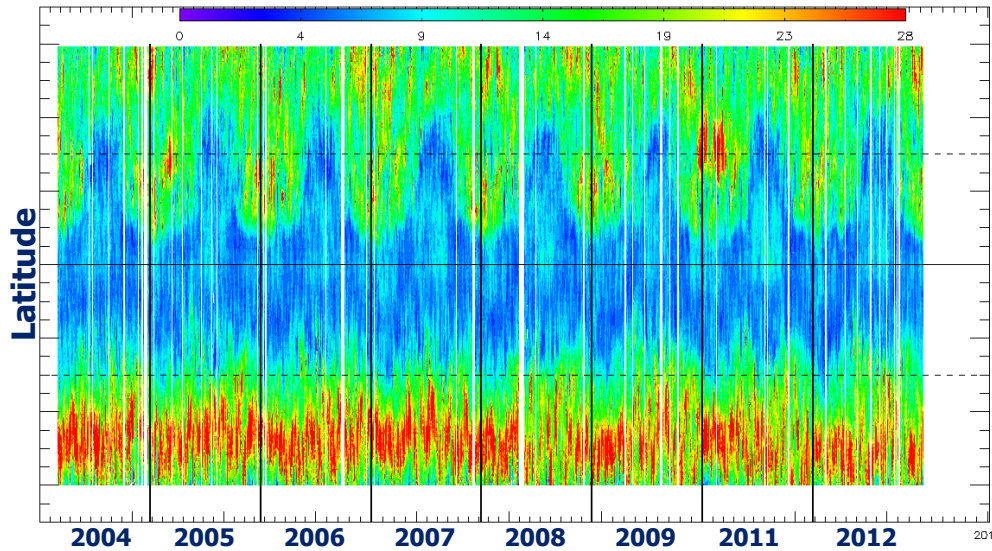
# Time series over the MSG reprocessed period 2004 - 2012



Speed (m/s)

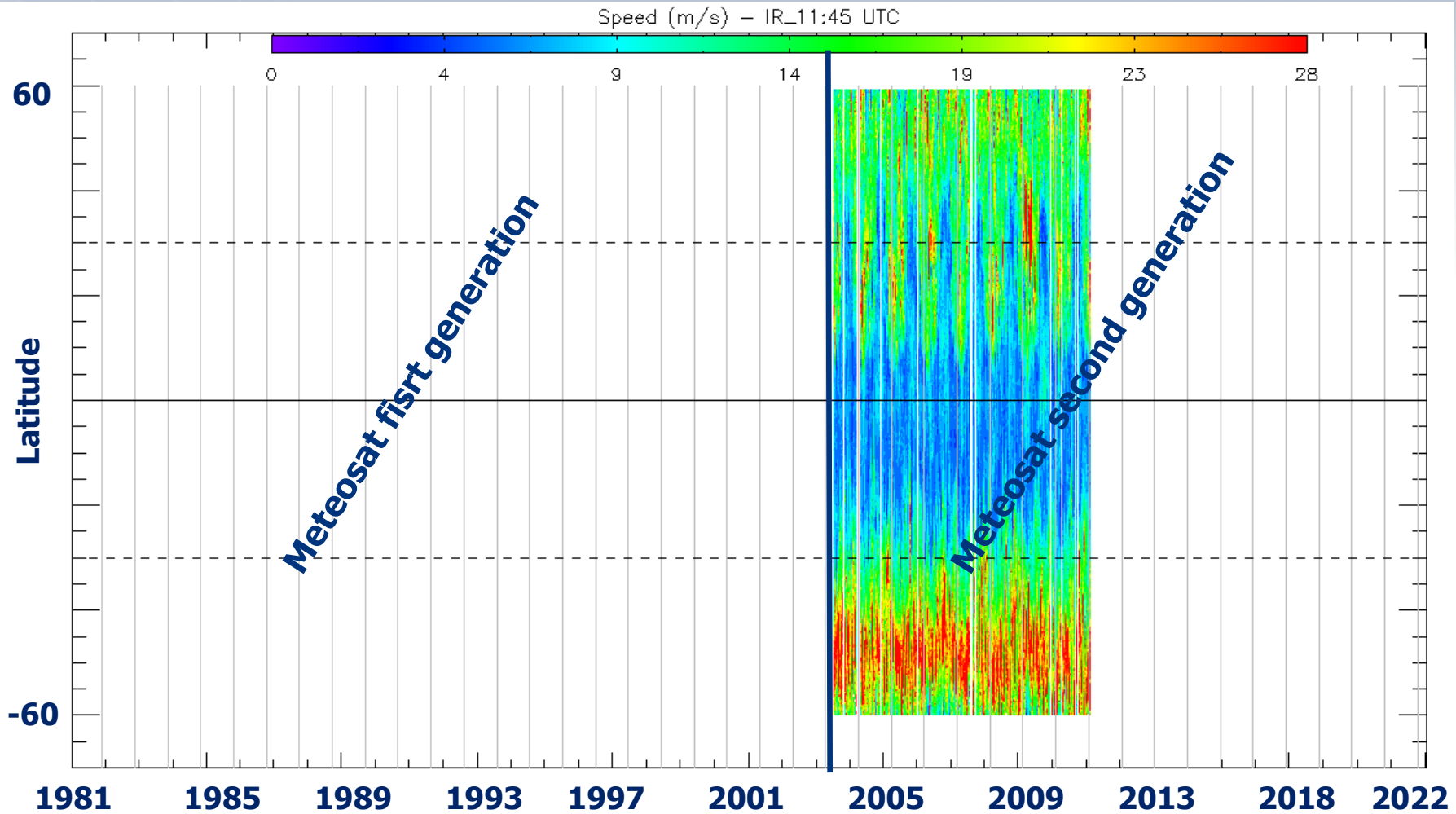


Pressure (hPa)





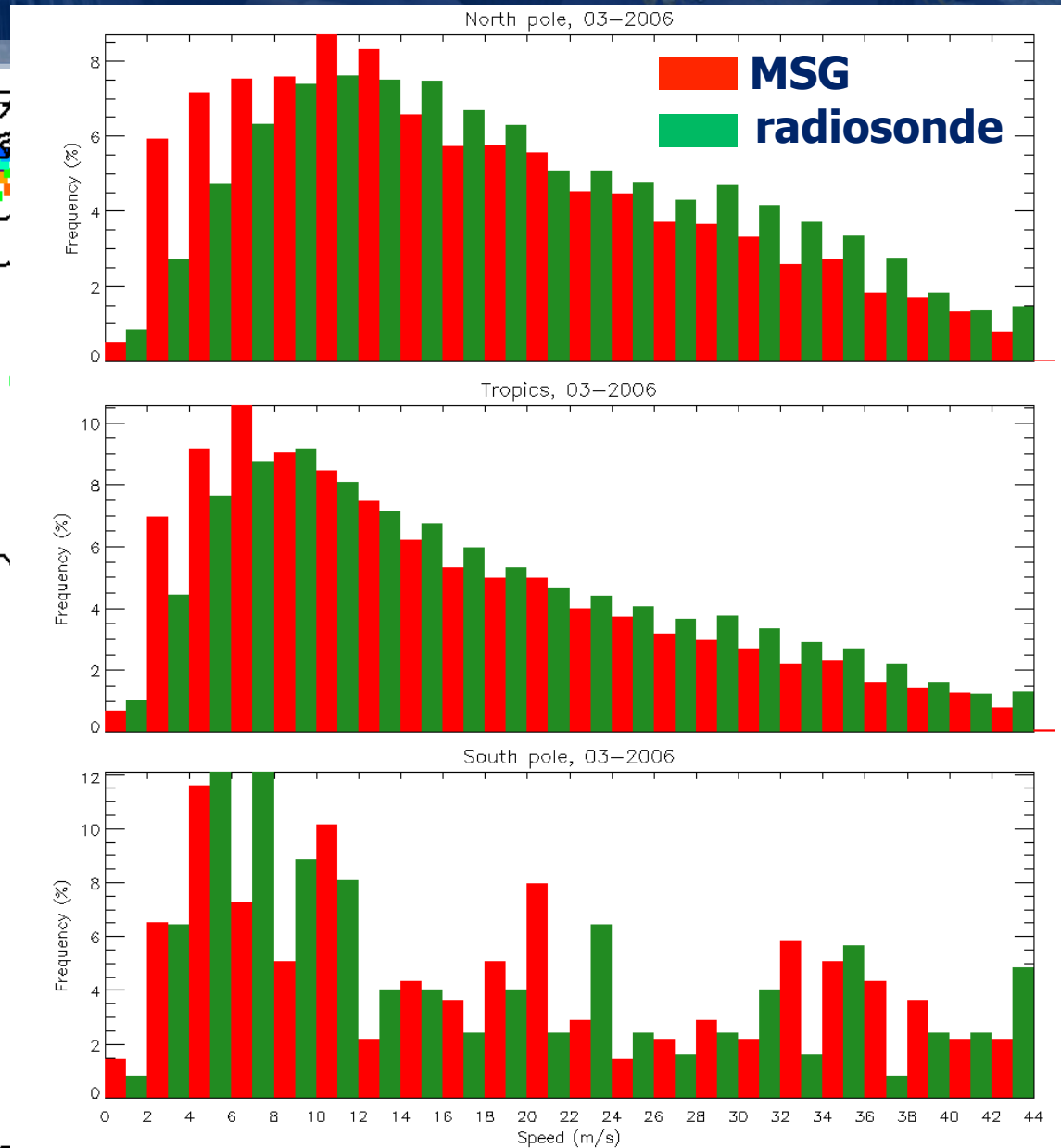
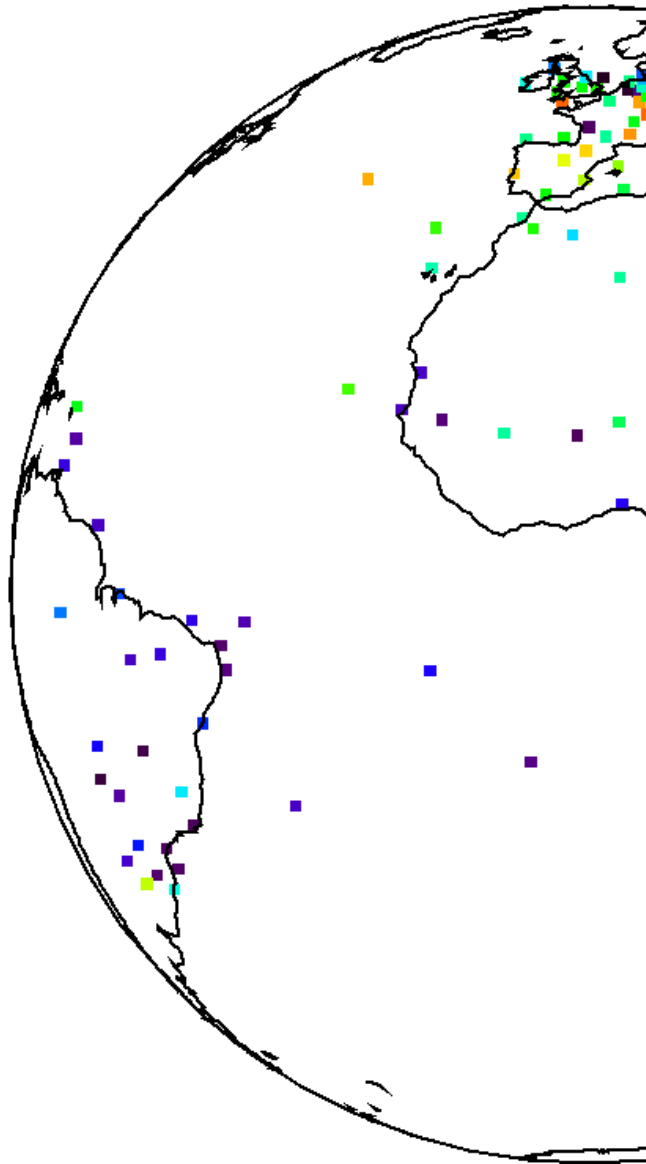
...and in a few years from now, the complete series...







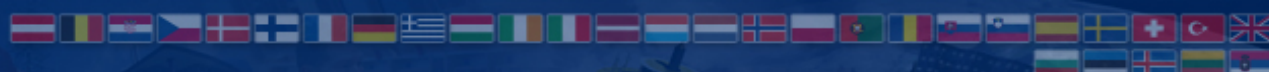
# March 2006 – RAOB sonde /MSG (8084 raobs)



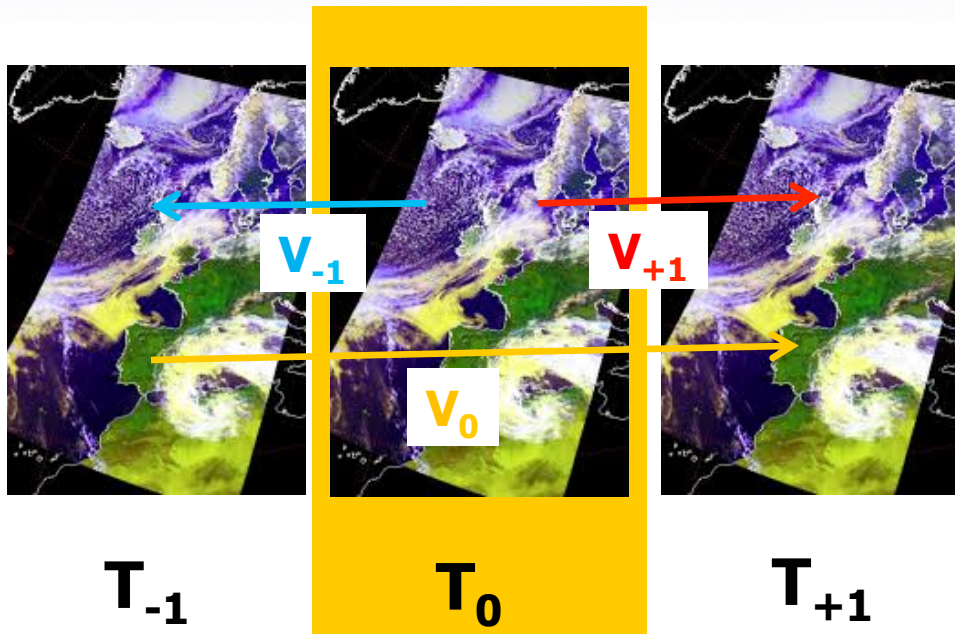
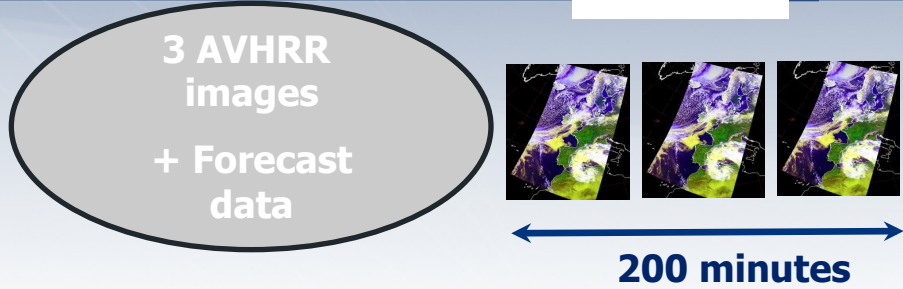


# Polar AMVs

# Processing

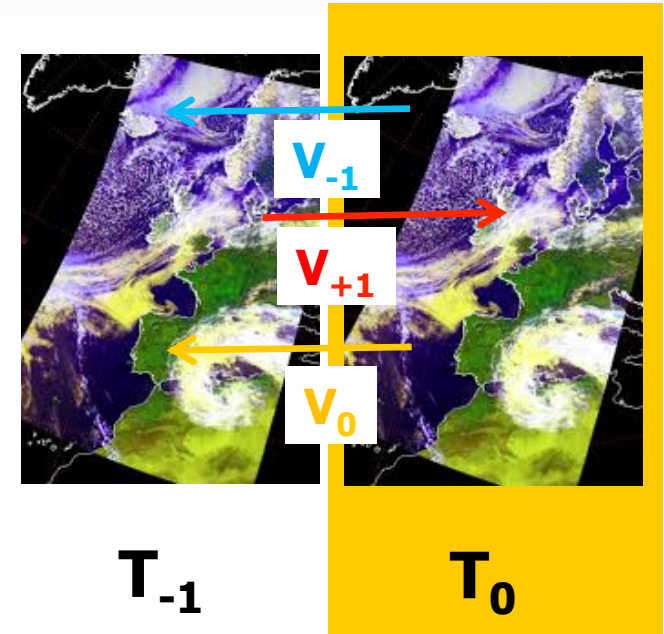
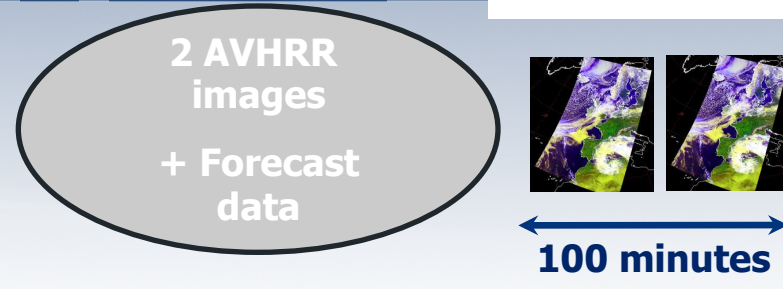


## CIMSS



$$V_0 = (V_{-1} + V_{+1})/2$$

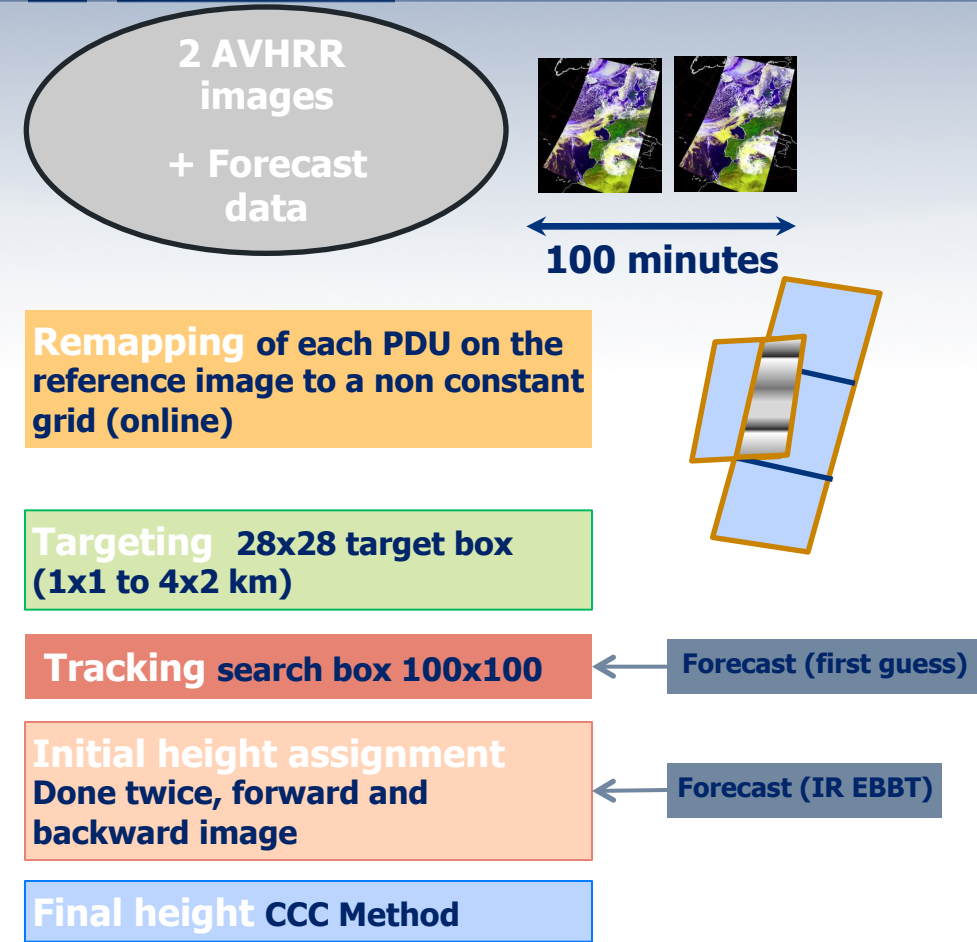
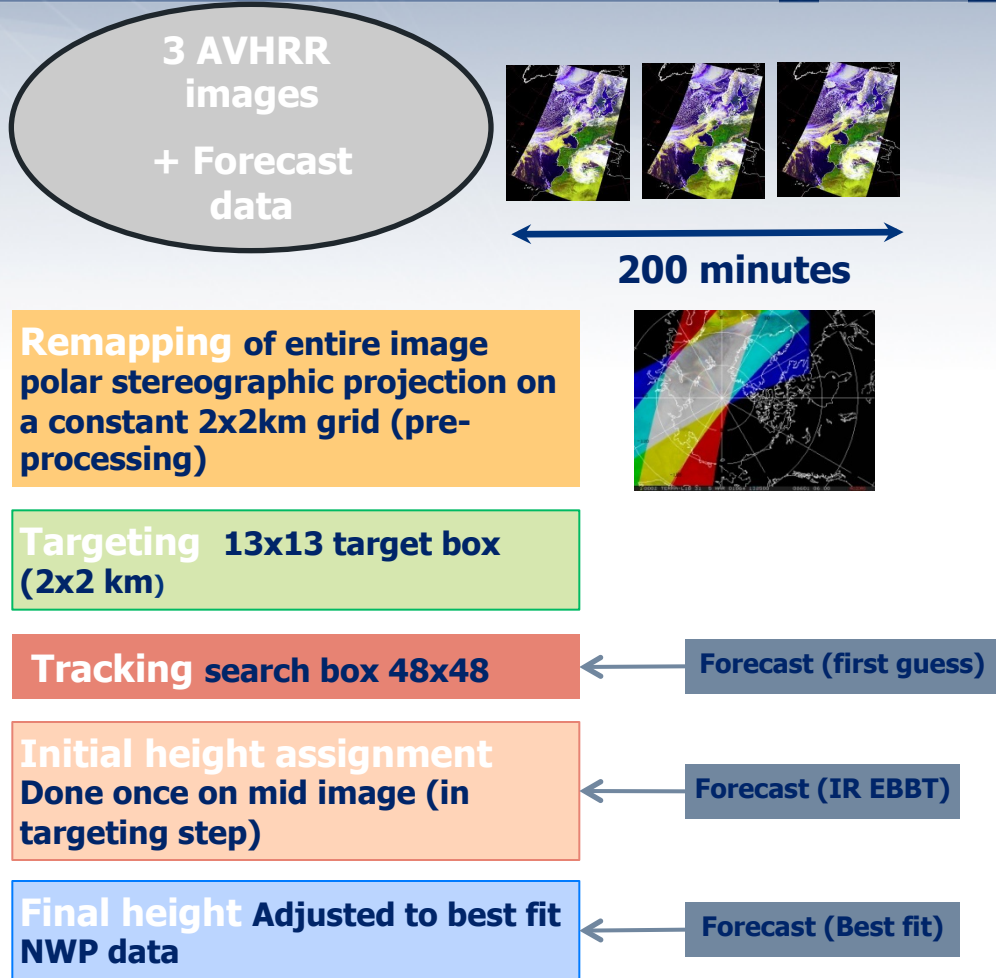
## EUMETSAT



$$V_0 = V_{-1}$$



# Processing





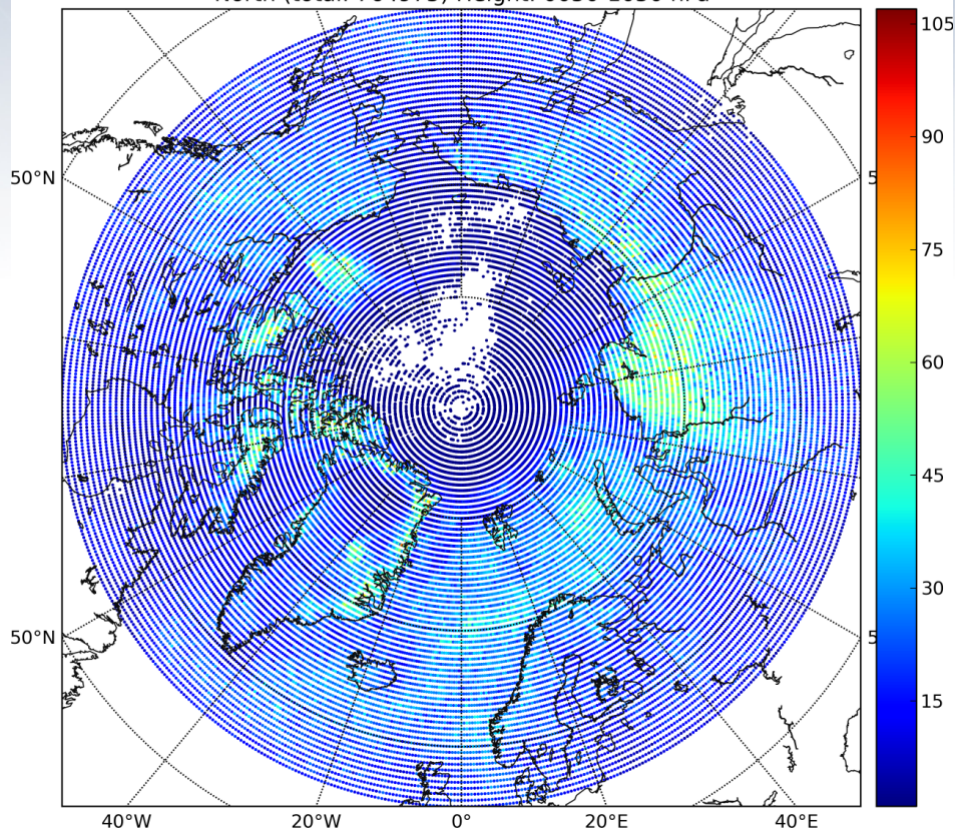
	EUMETSAT	CIMSS	New EUMETSAT
Forecast data –ERA-interim	T, u, v	T, u, v, specific humidity	
Resolution	0.5°x0.5°	1°x1°	
Vertical levels	60 model levels	12 pressure levels	
EBBT derivation using the forecast	Screening from the top to bottom	Screening from top to bottom	
AMV derivation			
Processing area	±55° latitude from the poles	±65° latitude from the poles	50° latitude from the poles
Number of orbits used	two	three	
Tracking - target	Based on AVHRR resolution, so change according to the location (1 – 2 km).	Remapped on a fixed grid (resolution: 2km)	Remapped over the entire search area
Target box	28x28	13x13	
Search box	100x100	48x48	Ponderated search box size
Tracking	AVHRR level 1b cloud mask is used. Only cloudy pixels are tracked.	The coldest pixel is used irrespectively of any cloud mask product.	
Height assignment			
	NWP profile IASI height if available	NWP profile Best fit adjustment Cloud based (le Marshall)	-T inversion - tropopause calculation
QI			
	Backward and forward tracking	3 images consistency (2 vectors)	
Time stamp	Last image (image 2 of 2)	Middle image (image 2 of 3)	





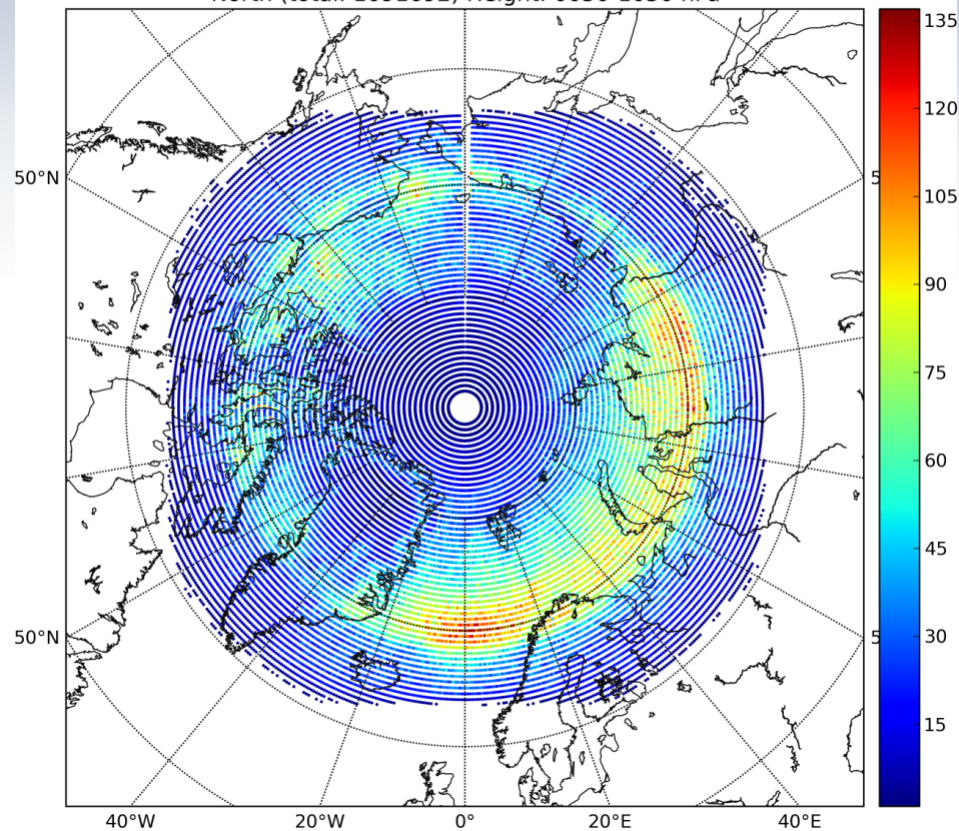
# Spatial distribution of AMVs

Number of AMVs - 20080101 - 20080131 - Operational AMV QI > 50  
North (total: 764975) Height: 0050-1050 hPa



**EUMETSAT AVHRR**

Number of AMVs - 20080101 - 20080131 - Prototype AMV QI > 50  
North (total: 1091692) Height: 0050-1050 hPa



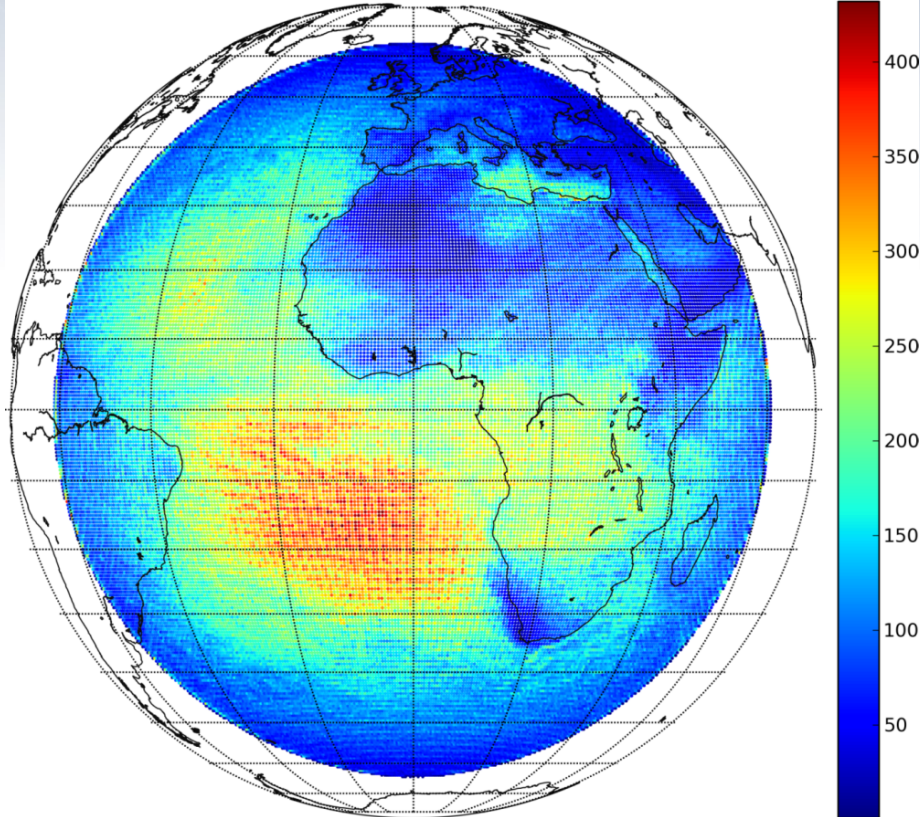
**CIMSS AVHRR**





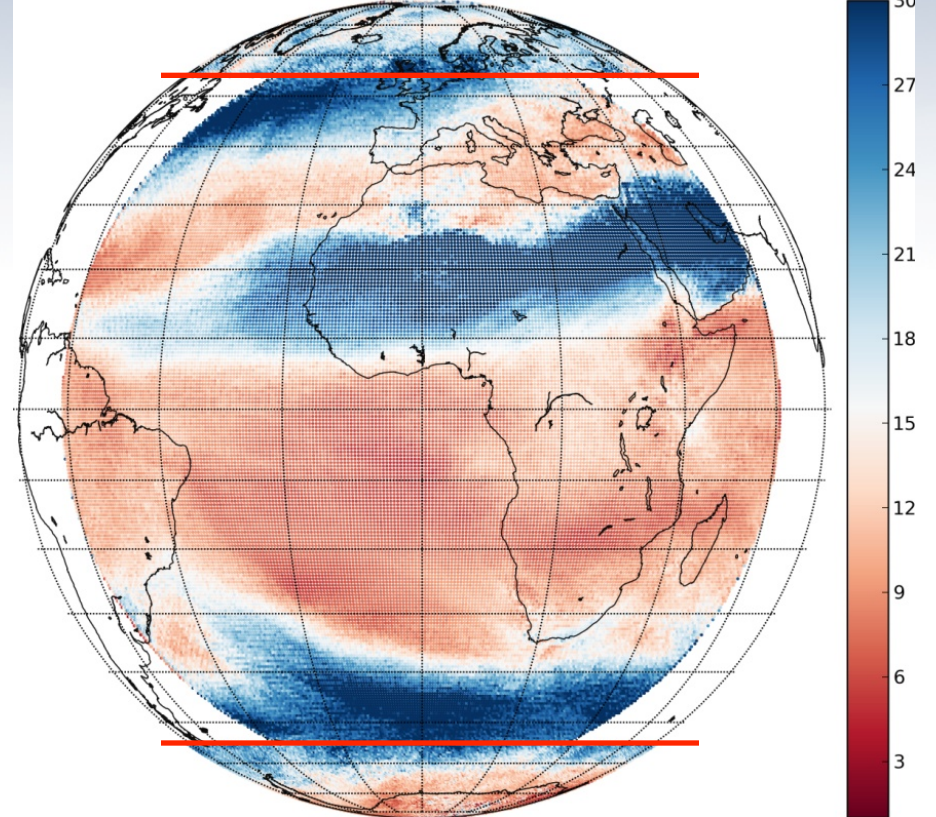
# Spatial distribution of AMVs

Number of AMVs - 20080101 - 20080131 - MSG IR QI > 50  
GEO (total: 7265872) Height: 0050-1050 hPa



**EUMETSAT MSG**

Mean Speed - 20080101 - 20080131  
ops - msg GEO



**Overlap EUMETSAT MSG – AVHRR**

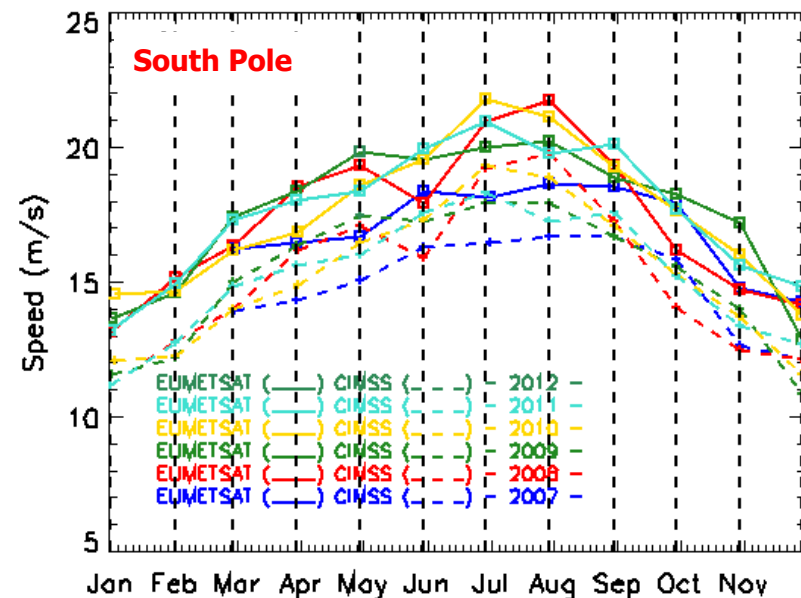
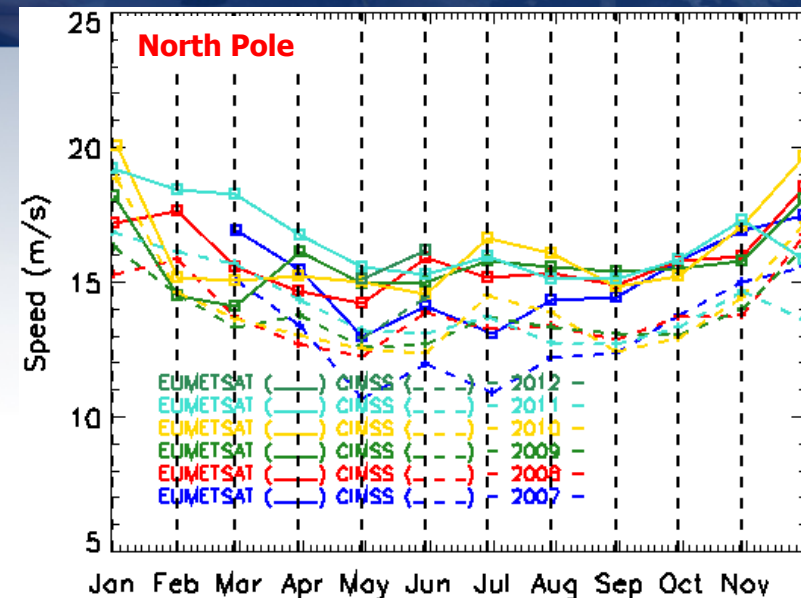
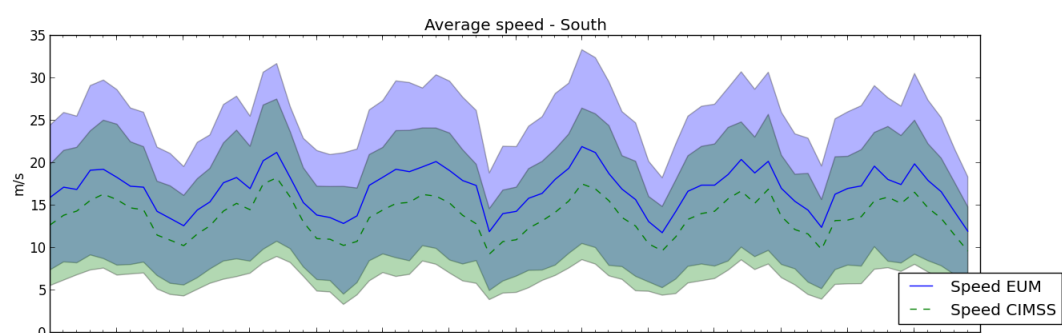
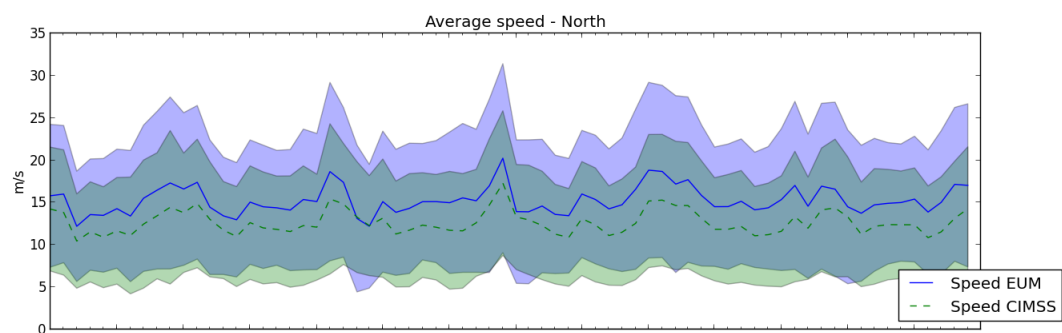
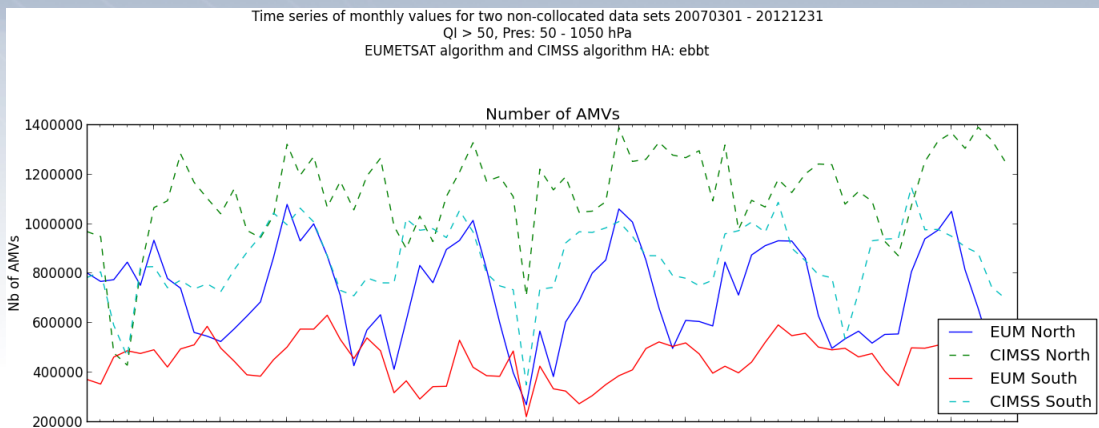


# AVHRR AMVs time series – speed (2007 - 2012)

Number of AMVs

Avg. Speed North Pole

Avg. Speed South Pole



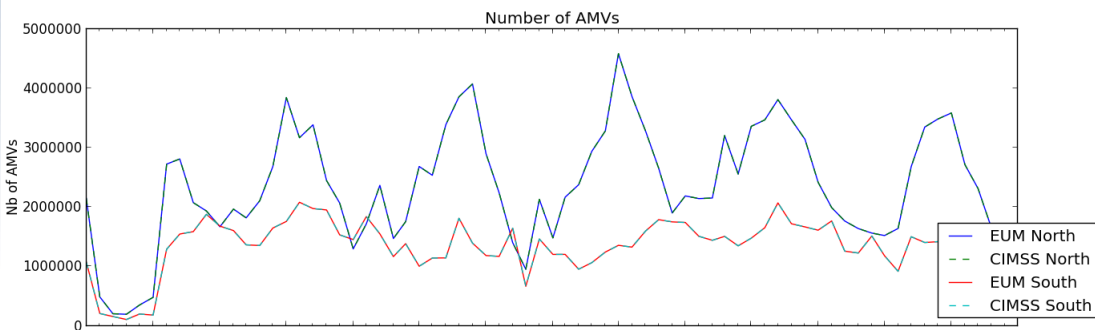




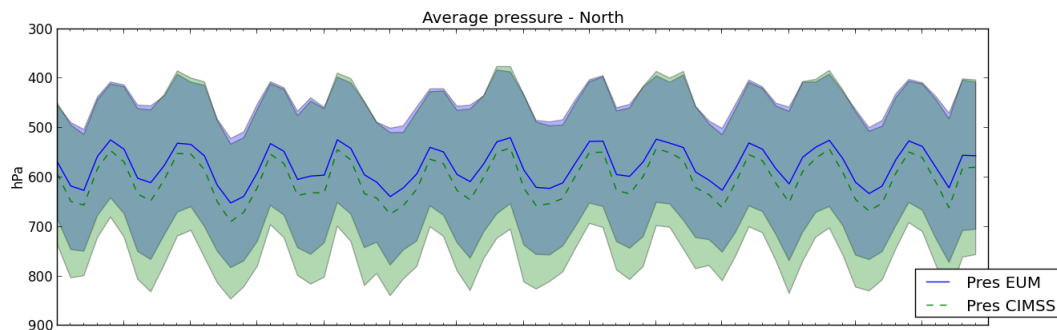
# AVHRR AMVs time series – pressure (2007 - 2012)

Time series of monthly values for two non-collocated data sets 20070301 - 20121231  
 Q1 > 50, Pres: 50 - 1050 hPa  
 EUMETSAT algorithm and CIMSS algorithm HA: ebbt

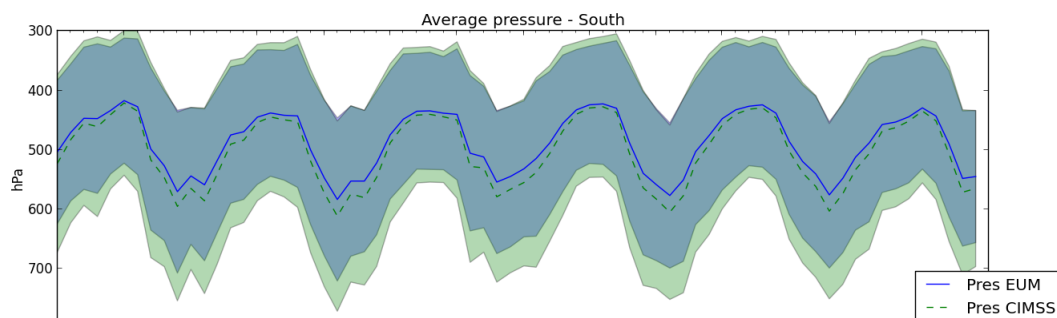
Number of AMVs



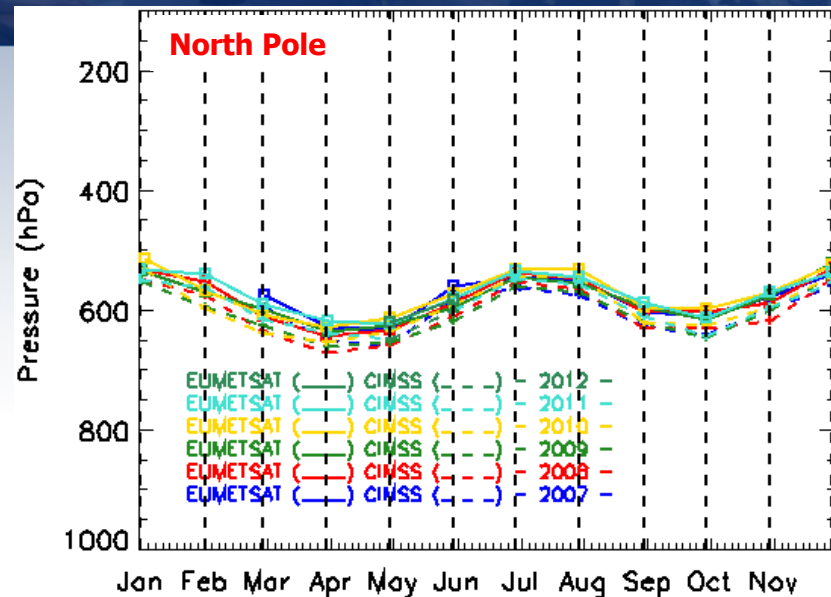
Avg. pressure North



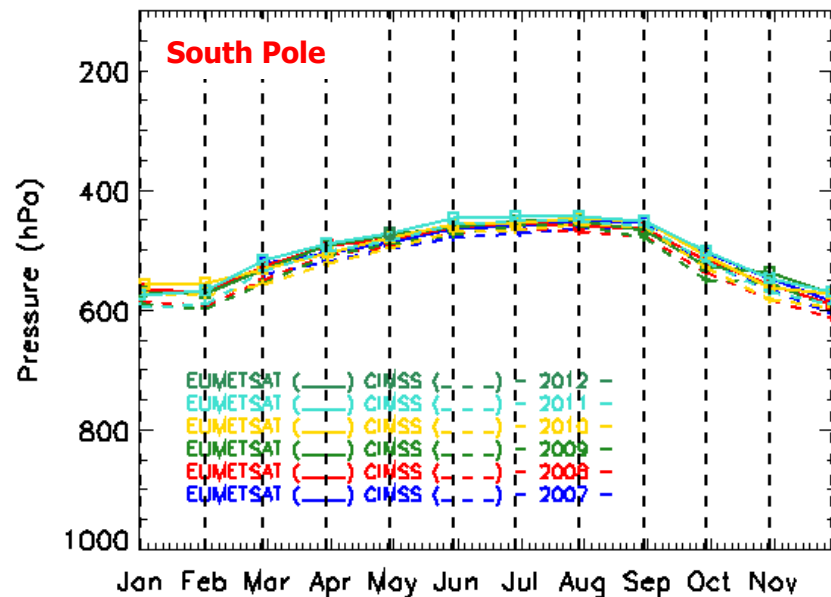
Avg. pressure South



North Pole



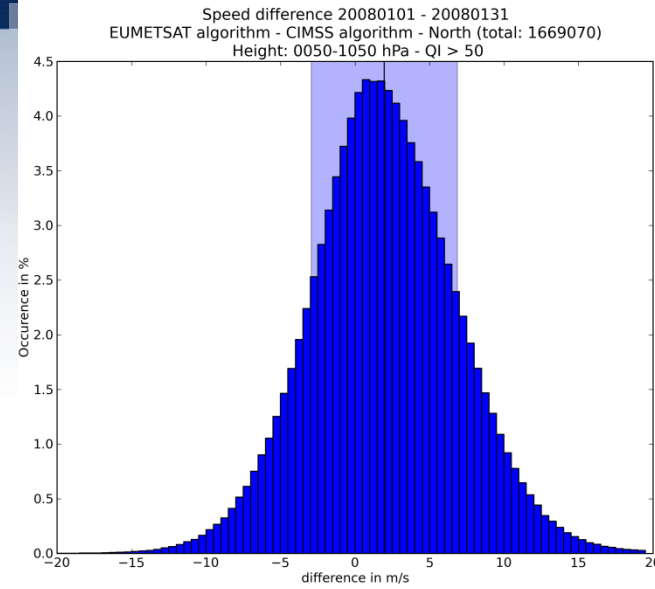
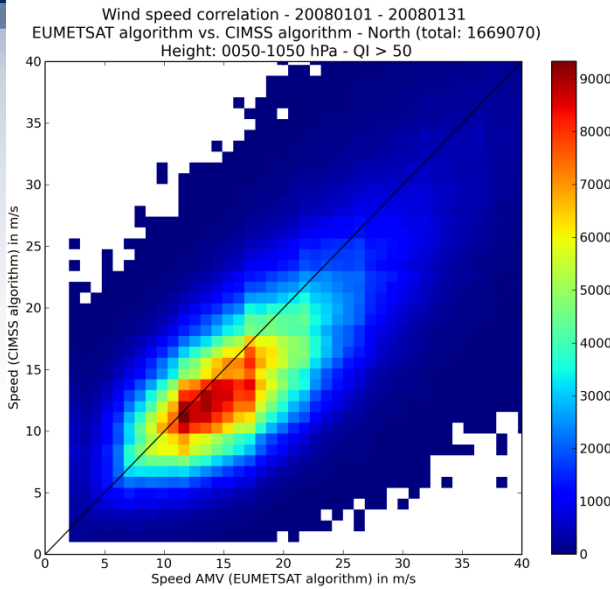
South Pole



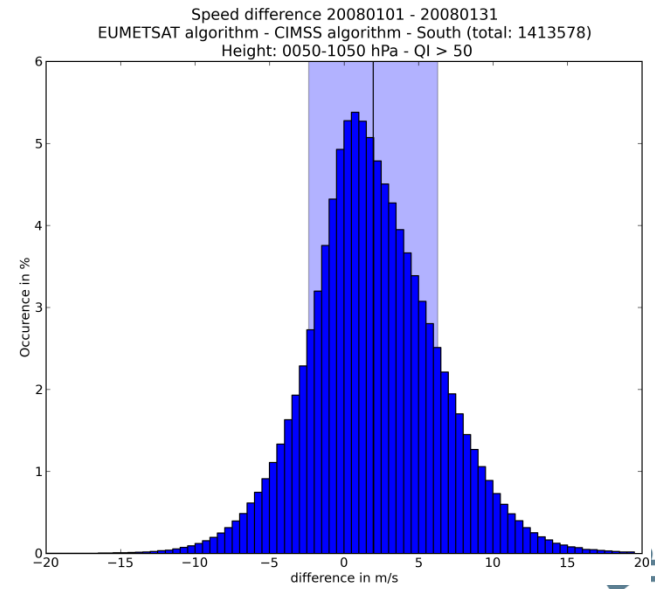
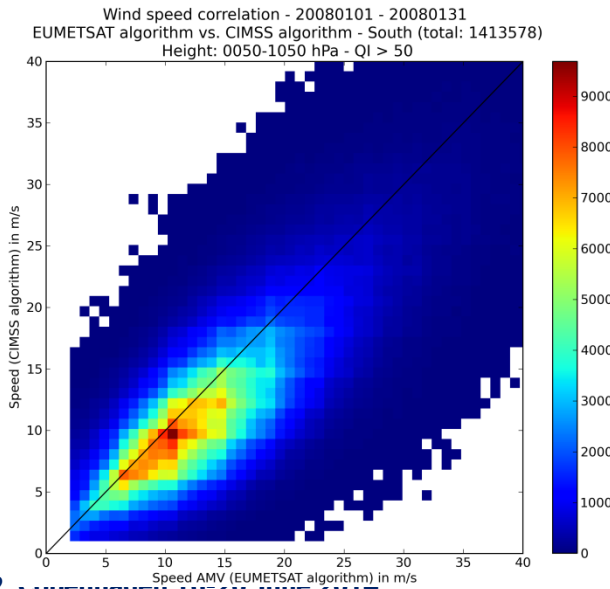


# EUMETSAT - CIMSS – collocation (speed) – Jan 2008

**NORTH POLE**



**SOUTH POLE**

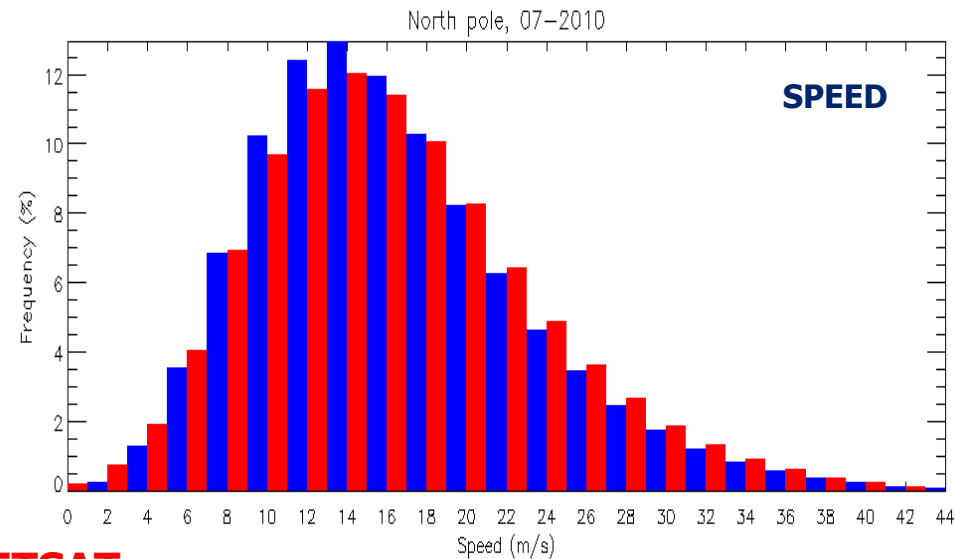
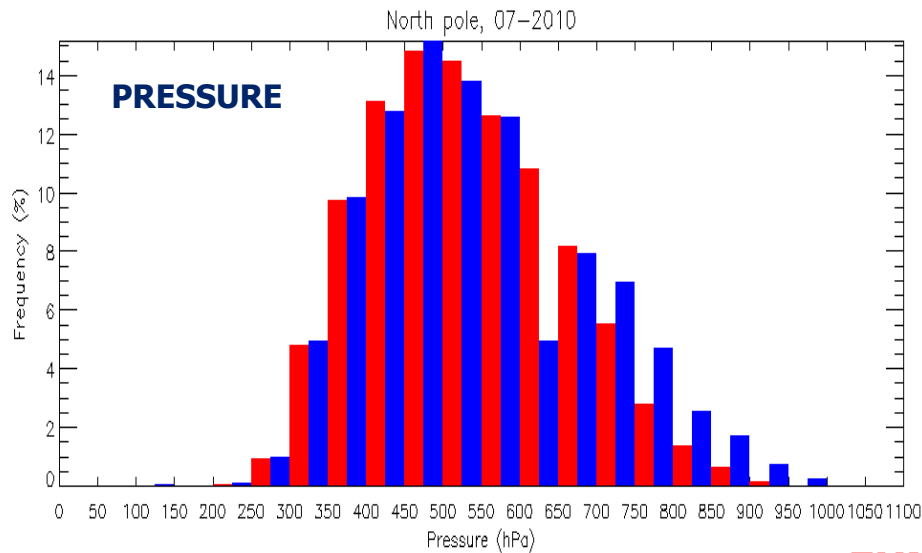






# EUMETSAT and CIMSS collocated AMVs for July 2010

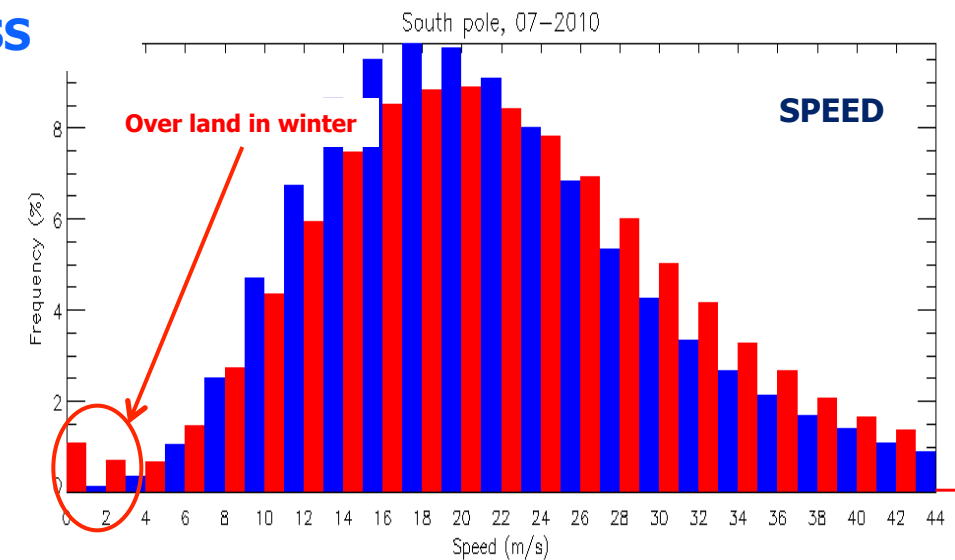
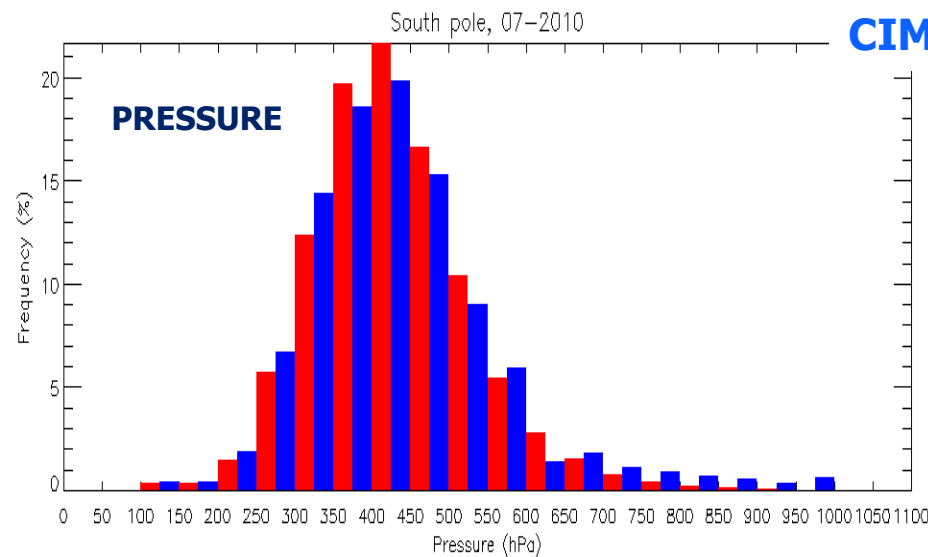
NORTH POLE



EUMETSAT

CIMSS

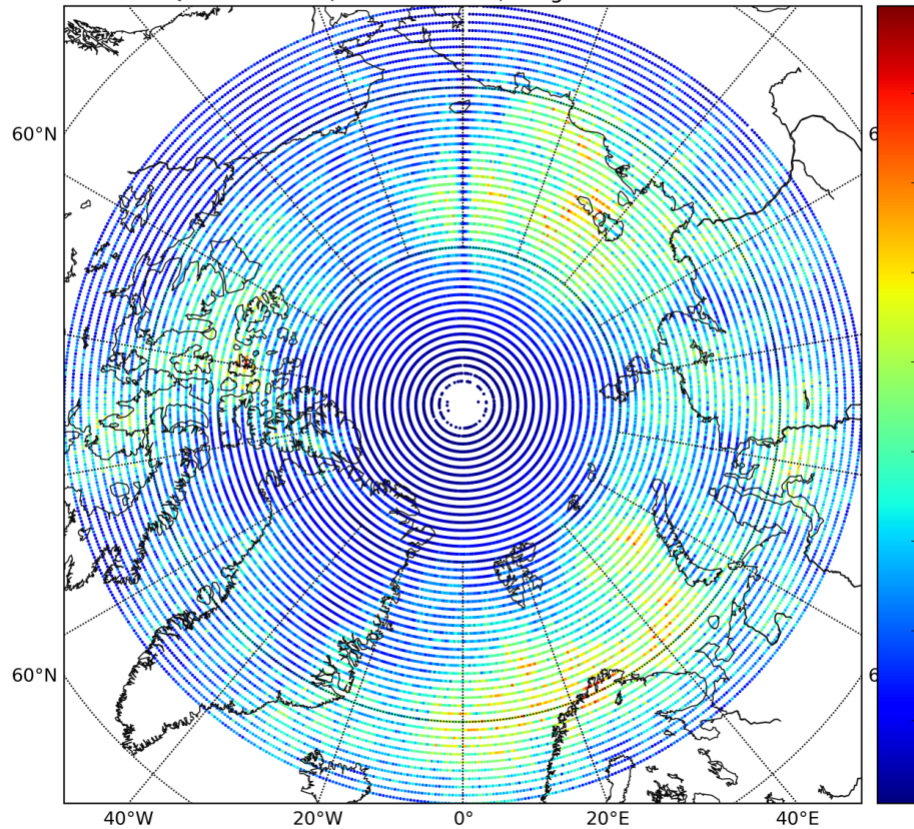
SOUTH POLE





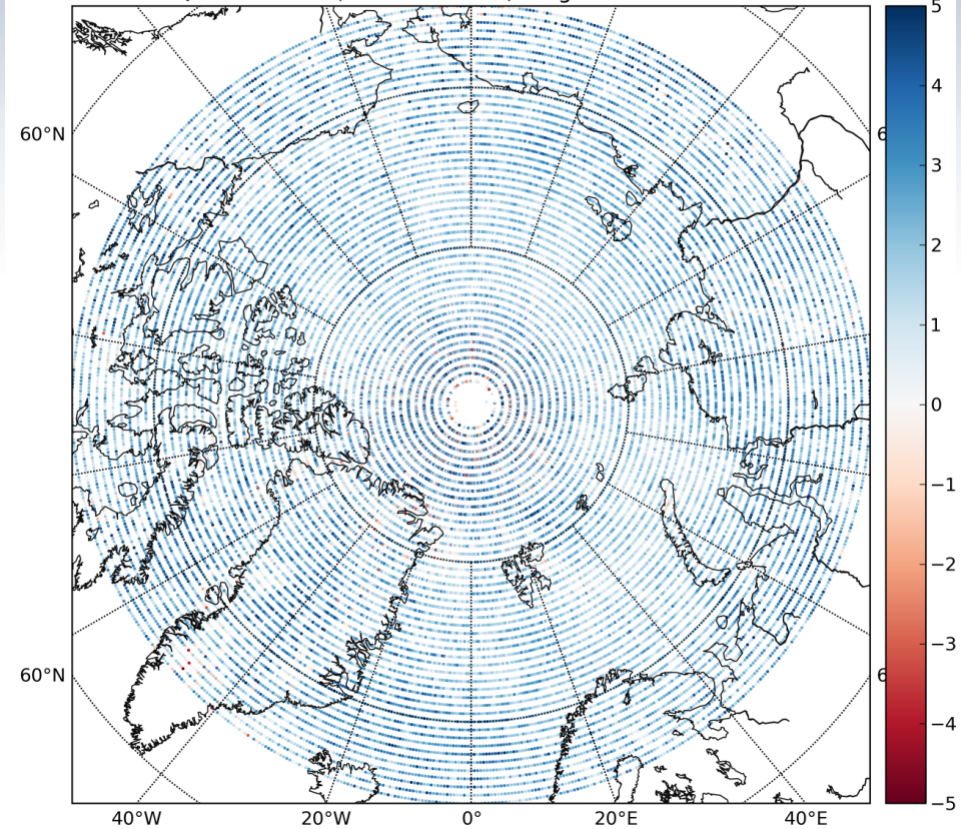
# EUMETSAT - CIMSS gridded statistics (1)

Number of collocations - 20080501 - 20080531 - EUMETSAT algorithm - CIMSS algorithm  
QI > 50 North (total: 2876641) Height: 0050-1050 hPa



**Collocations**

Average Speed diff - 20080501 - 20080531 - EUMETSAT algorithm - CIMSS algorithm  
QI > 50 North (total: 2876641) Height: 0050-1050 hPa



**Speed difference  
EUM - CIMSS**

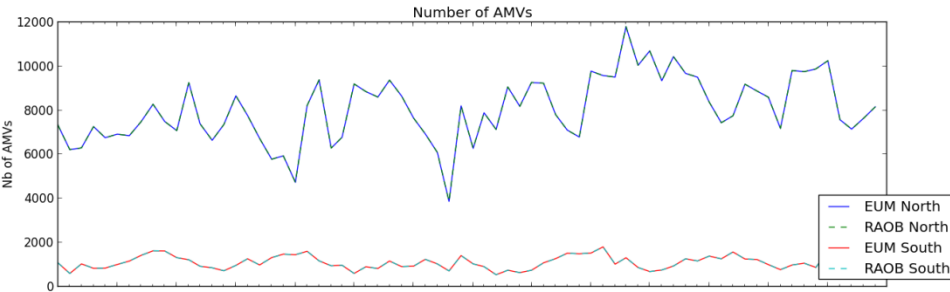


# AVHRR AMV speed against radiosonde (2007 – 2012)



Time series of monthly values for two non-collocated data sets 20070301 - 20121231  
 QI > 50, Pres: 50 - 1050 hPa  
 EUMETSAT algorithm and RAOCORE HA: ebbt

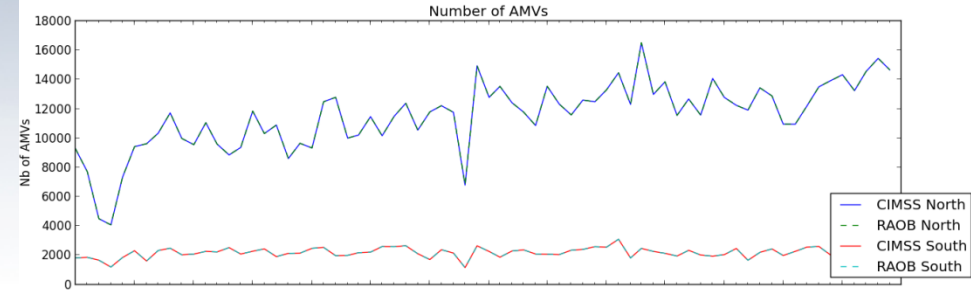
**EUMETSAT**



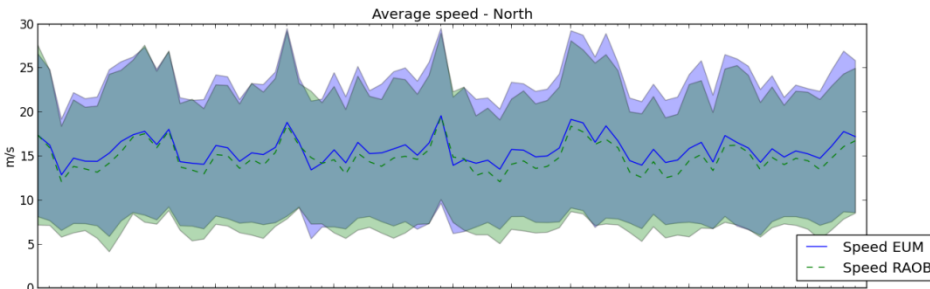
Number of AMVs

Time series of monthly values for two non-collocated data sets 20070301 - 20121231  
 QI > 50, Pres: 50 - 1050 hPa  
 CIMSS algorithm and RAOCORE HA: ebbt

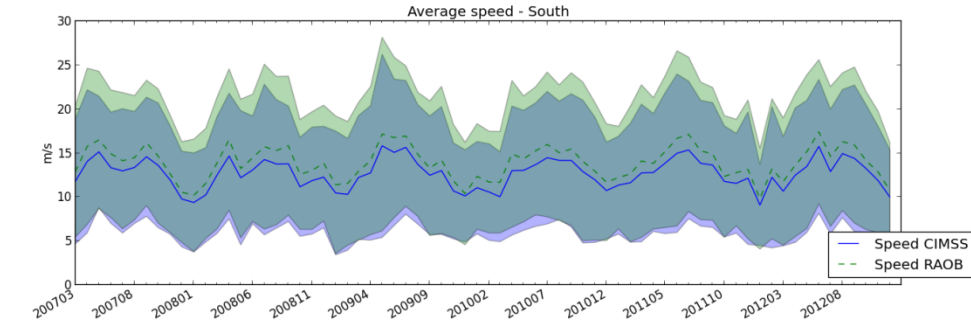
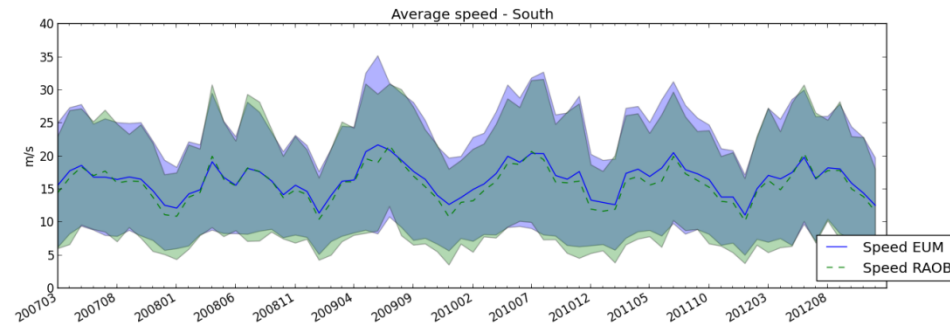
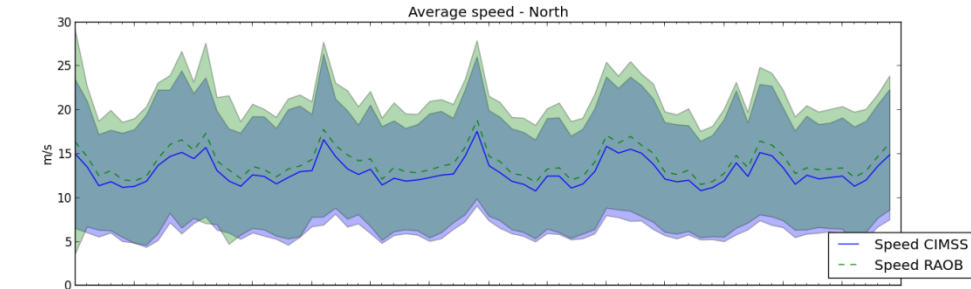
**CIMSS**



Avg. Speed North Pole



Avg. Speed South Pole



Collocation criteria: distance: <100km; time <100 minutes



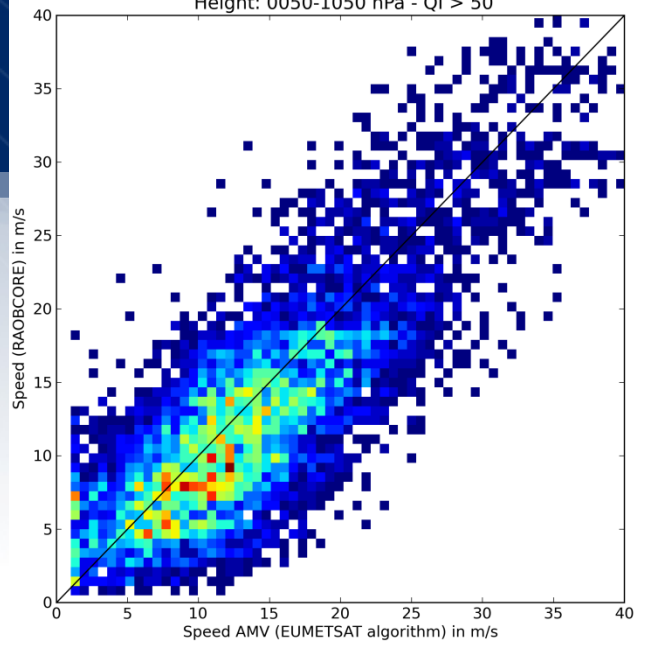
# Inst radiosonde

## EUMETSAT

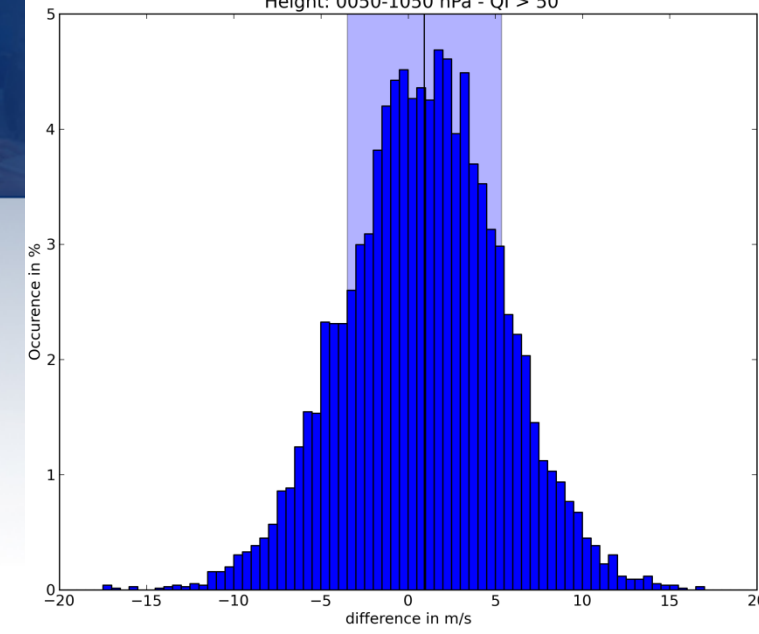
### May 2008

## CIMSS

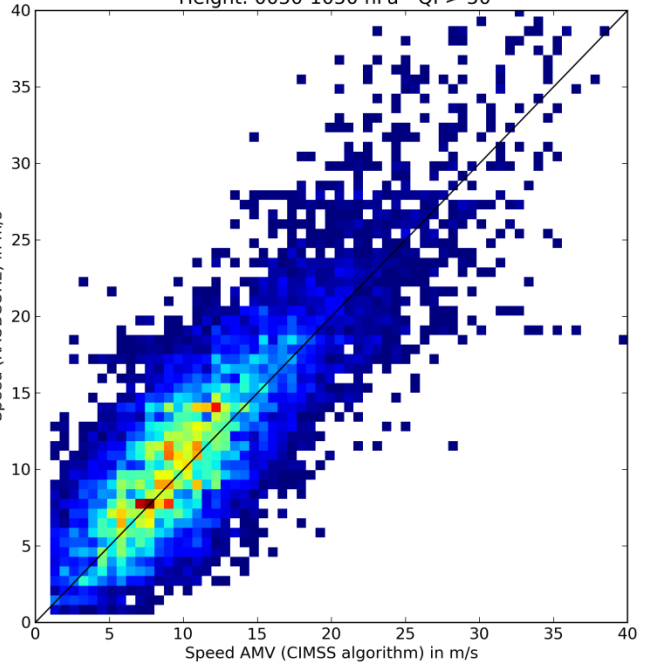
Wind speed correlation - 20080501 - 20080531  
EUMETSAT algorithm vs. RAOBCORE - North (total: 7574)  
Height: 0050-1050 hPa - QI > 50



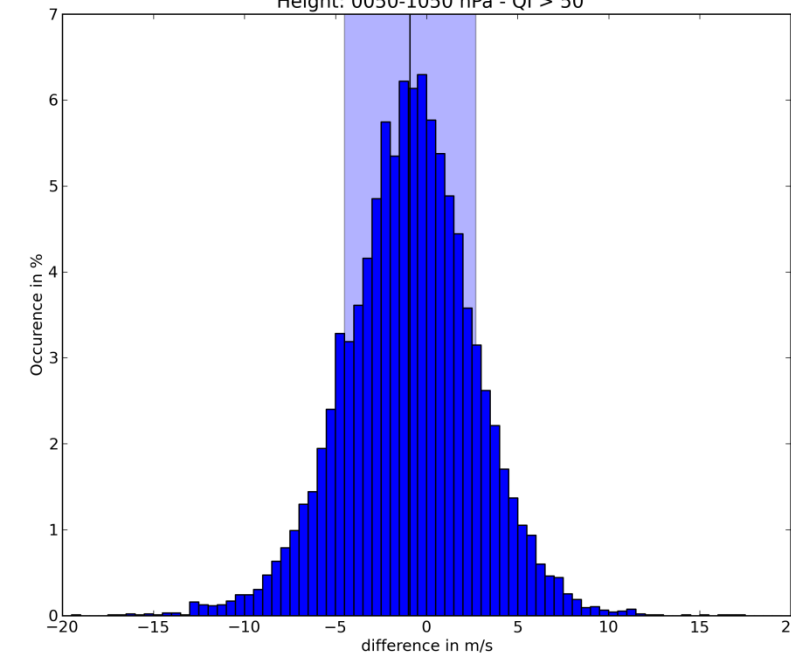
Speed difference 20080501 - 20080531  
EUMETSAT algorithm - RAOBCORE - North (total: 7574)  
Height: 0050-1050 hPa - QI > 50



Wind speed correlation - 20080501 - 20080531  
CIMSS algorithm vs. RAOBCORE - North (total: 9506)  
Height: 0050-1050 hPa - QI > 50



Speed difference 20080501 - 20080531  
CIMSS algorithm - RAOBCORE - North (total: 9506)  
Height: 0050-1050 hPa - QI > 50





# SUMMARY





# Summary of EUMETSAT MSG-SEVIRI wind reprocessing

- MSG winds have been reprocessed at EUMETSAT with the latest available algorithm (2004-2012).
- MSG reprocessing leads to a stable and homogeneous dataset. The dataset is useful and can be used for climate studies, reanalyses, ...
- The reprocessing is planned to be extended backward for Meteosat first generation (as soon as the algorithm to process the first generation satellite with a CCC-like algorithm exists at EUMETSAT).
- The reprocessing could potentially be repeated using other algorithms.



# Summary – METOP-AVHRR (2007 – 2012)

- EUMETSAT data set:
  - Covers the jet region
  - Overlap with geostationary satellites
  - higher wind speeds
- CIMSS data set:
  - smaller regional coverage
  - better agreement with radio sonde and NWP data
  - Height adjusted to best fit with NWP background
- No large geographical differences
- No trend over the years
- Extend data sets to 2013
- Use latest EUMETSAT algorithm for entire period