Operational use of Atmospheric Motion Vectors at ECMWF

Claire Delsol, Niels Bormann, Graeme Kelly, Lueder von Bremen, Jean-Noël Thépaut and Peter Bauer

ECMWF, Reading, UK
Outline

1) Overview of operationally assimilated AMVs
2) AVHRR AMVs
3) Direct-broadcast MODIS AMVs
4) FY-2C AMVs
5) MISR AMVs
1) Overview of operationally assimilated AMVs

ECMWF Data Coverage (all obs DA) AMV
09April2008 06 UTC
Total number of obs = 374104
2) AVHRR AMVs

- CIMSS-derived polar AMVs from AVHRR from NOAA-15, -16, -17, -18.
- No WV channel on AVHRR, so IR winds and height assignment only.
- Assimilation experiments:
  - 12-hour 4DVAR
  - Resolution: T511L60 (~40 km, model), T159 (~125 km, analysis)
  - 1 January 2007 – 14 February 2007 (45 forecasts)

- Control: Conventional observations + NOAA-18 AMSU-A
- AVHRR: As Control, but plus AVHRR winds
  - AMVs used over land above 400 hPa, over sea/ice above 700 hPa.
- MODIS: As Control, but plus MODIS winds
  - IR AMV usage as for AVHRR;
  - WV AMVs used over land above 400 hPa, over sea/ice above 550 hPa.
2) AVHRR AMVs: Coverage

Number of used winds (all levels), 1 Jan – 14 Feb 2007:

AVHRR N.Pole

AVHRR S.Pole

MODIS N.Pole (IR & WV)

MODIS S.Pole (IR & WV)
2) AVHRR AMVs

- Statistics for used AMVs over Antarctica for AVHRR and MODIS (IR & WV).

- AVHRR winds show larger departures and worse biases against the FG than MODIS winds.
2) AVHRR AMVs

- Normalised differences in RMS of 48-hour forecast errors for the 500 hPa geopotential
3) Direct broadcast MODIS AMVs

Number of obs

04.00 extraction time for early delivery

Red: db MODIS
Blue: NESDIS MODIS

00Z cycle
20080309

9th International Winds Workshop
3) Direct broadcast MODIS AMVs

NESDIS MODIS winds and direct broadcast MODIS winds for 6-hour cycle around 1 Dec 2007 12 Z with early cut-off time.
4) FY-2c AMVs

FY-2C (105° E) AMVs:

- 2 channels: IR and mixWV
- QI 1 and QI 2

Passive monitoring expt: T159 L91 (IFS cycle 32r3) 1 month Dec 2007

Mean windspeed departures

- <400hPa QI 1 > 80
4) FY-2c AMVs

QI 1 > 80

FY-2C

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MET-7

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Zonal mean speed bias

9th International Winds Workshop
5) MISR AMVs

- Comparison of Terra-MISR AMVs against model FG for 6 days (24-29 Oct 2006). Data kindly provided by Roger Davies.
- MISR-winds are based on multi-angle VIS and near-IR images; use stereographic height assignment.
- Geometric heights for MISR winds were converted to pressure using the FG.
- Statistics are based on MISR winds labelled “good” and “very good”; no difference in monitoring statistics was noted between the two categories.
- Sample of MISR winds is relatively low (~30500 over 6 days).
- Statistics also compared against “conventional” AMVs from GOES11/12, MET5/8, MODIS (QI > 60).
5) MISR AMVs: Zonal mean speed bias against FG

Speed biases similar to “conventional” AMVs, despite theoretically better height assignment.
5) MISR AMVs: Zonal mean MVD against FG

MVD slightly larger compared to “conventional” AMVs.
5) MISR AMVs: Collocation with Met-8

Time difference < 15 min
Horizontal difference < 50 km

Assigned pressure MISR vs Met-8

Red: Met-8 has lower vector difference to FG
Blue: MISR has lower vector difference to FG
+ - Met-8 IR; Δ – Met-8 VIS

MISR Bias = 0.33 m/s
RMS = 5.6 m/s

Met-8 Bias = 0.06 m/s
RMS = 3.3 m/s

FG speed [m/s]
MISR speed [m/s]
Met-8 speed [m/s]
Summary

- AVHRR AMVs show somewhat poorer monitoring statistics and coverage compared to MODIS AMVs, but encouraging forecast impact in a system with limited use of other satellite observations.
- Db MODIS AMVs have a more timely arrival time – better coverage for early delivery stream. Assimilation trial to be conducted shortly.
- FY-2C AMVs contain large biases – especially in the high level Extra-Tropics. Will be monitored passively in operations.
- MISR winds show a quality similar to “conventional” AMVs; speed biases are surprisingly similar, despite better height assignment for the MISR winds. However less data.
### AMV denial experiment • 12 Dec 2007-12 Jan 2008 • Neutral in Extra-tropics
- Forecast impact in Tropics

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* +ve = positive including AMVs
Radiosondes
Expt (ezho) : no amvs  Control (ezh9): amvs

Reduction in standard deviation
Slight increase in bias?