Estimates of **AMVs Errors** using **MISR CMVs** and **Data Assimilation Diagnostics** in **GRAPES**

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Estimates of AMVs obs. Error

- Using MISR
  - Height Assignment
  - Wind \((u,v)\) Differences
- Using DA Diagnosis
  - Desroziers diagnostics: Monitoring of Obs. Error
  - FSO: Forecast sensitivity to observation
- Impact of AMVs on NWP in GRAPES
  - Height Adjustment: best fit pressure
  - Impacts
- Conclusions and discussions
Multi-angle Imaging SpectroRadiometer

Attributes

• 400 km swath, pushbroom
• 443, 550, 670, 865 nm channels
• 275 m – 1.1 km sampling
• 7 minutes to view the same scene from all 9 cameras
Collocation of MISR and AMVs:
Dlat and Dlon ≤ 0.5°
Dtime ≤ 15 min
Closest in height
Filter out MISR clearsky winds
(*Katrin Lonitz and Akos Horvath, 2010)
CTH(AMV)

- Height of AMVs
CTH(AMV) - CTH(MISR)
$U(AMV) - U(MISR)$

- $U$ difference
V(AMV)-V(MISR)

- V difference
Height correction: the best fit pressure

- Height(pessure) Correction of Observed AMVs to Minimize the following Cost Function:

\[ J(p) = \frac{1}{2} \left[ \left( \frac{u_o - u_b(p)}{U_e} \right)^2 + \left( \frac{v_o - v_b(p)}{V_e} \right)^2 + \left( \frac{p - p_o}{P_e} \right)^2 \right] \]

- Parameter:

\[ U_e = V_e = 3.0 \text{m/s}, \quad P_e = 50 \text{hPa} \]
Impact of Height correction of METEOSAT AMVs on Analysis, A CASE: 2009080612

Shaded: \( U(\text{grapes}_\text{xa}) - U(\text{EC}) \)
Contour: \( U(\text{grapes}_\text{ha}) - U(\text{grapes}_\text{xa}) \)

![Map of 300hPa](image)

\[
J(p) = \frac{1}{2} \left[ \left( \frac{u_o - u_b(p)}{U_e} \right)^2 + \left( \frac{v_o - v_b(p)}{V_e} \right)^2 + \left( \frac{p - p_o}{P_e} \right)^2 \right]
\]
Geometrical interpretation of analysis

- Practical Implementation
  - Multi. Variable and Obs.
  - QC
    \[(e^o)^2 = d_a^o * d_b^o > 0\]
  - Monitoring of Obs. Error
    \[[d_b^o]_i = [d_a^o]_i + [d_b^a]_i\]
  - based on O-B and O-A
  - Easy to use

\[
E[d_a^o (d_b^o)^T] = R
\]

The diag. of R:
\[(e^o)^2 = d_a^o * d_b^o\]

HC: Height Correction

2011080112

H(P0)-H(P1)
P0: assigned height
P1: corrected height

Before HC: U_obs_Error

After HC: U_obs_Error

Tracking Error?
Height Correction
2009080112

- With DA diagnosis:
  Larger Ue → O-B, O-A

Before height correction
Diagnosis of U error

After height correction
Diagnosis of U error
**AMVs obs. Error**

Reduction of Error in the Height Assignment?
By the best fit height?

2011080112

**Before HC**

**O-B**

**Obs. Error**

**After HC**
AMVs obs. error

Before HC

After HC

Pressure(hPa)

U obs. error(m/s)

Euo, Unit/m/s

Pressure(hPa)
Milestone of GRAPES-Var

Serial Regional P3DVAR (pressure coordination) In 2001

Serial Global P3Dvar In 2005

Parallel Global P3Dvar In 2008

Serial Regional 4Dvar In 2005

Parallel Regional 4Dvar In 2005

Serial regional M3Dvar In 2005

Serial Global M3var In 2010

Parallel Global 4Dvar In 2010

Serial Global 4Dvar In 2010

Parallel Global 4Dvar In 2011

Observations assimilated

- Conventional obs. (TEMP, SYNOP, SHIPS, SATOB, AIRCRAFT)
- AMSU (NOAA15/16/17/18/19/METOP)
- GPS/RO (COSMIC)
- RADAR (wind and refractivity)
- GPS/PW
- TC Bogus
Impact of AMVs on Forecast in GRAPES

- **Baseline+AMVs**: positive
- **Control+AMV_HA**: positive

Baseline: Sonde+Airep+Synop+ships+COSMIC
Control: Baseline+AMVs+AMSUs

Resolution: 1 degree, 33 Level

![Graph showing the impact of AMVs on forecast in GRAPES](image-url)
5 day ACC

CAMS/CMA

GLOBAL

N.H.

S.H.

- Baseline + AMVs: positive
- Control + AMV_HA: positive
Impacts of AMVs on Forecast

N.H.

S.H.
Conclusions and Discussions

- Comparisons of MISR and AMVs
  - CTH: more information about the FOV needed
  - Samples are limited

- Evaluate the quality of AMVs using data assimilation diagnosis
  - Reasonable results
  - Monitoring: find out the questionable AMVs

- The best fit height: height correction
  - Positive on forecast
  - Reduce the obs. error

- Forecast sensitivity to observation, ongoing work
  - Adjoint based monitoring of the quality of AMVs