Evaluation of Upgraded MISR Stereo Motion Vectors

Ákos Horváth • Leibniz Institute for Tropospheric Research, Leipzig, Germany

11th International Winds Workshop • 20-24 February 2012, Auckland, New Zealand
MISR Stereo Motion Vectors
- TC_STEREO v. F99_198
- Paths 150 – 230
- Wind quality ≥ 3

MSG2 Cloud Motion Vectors
- Visible & infrared CMVs
- Quality Indicator without first guess ≥ 80

- 1 year of data (2008)
- Dlat and Dlon ≤ 0.5°
- Dtime ≤ 15 min
- Closest in height
- 225,155 wind pairs
- 70.4-km MISR SMVs

Lonitz and Horváth, JGR, 2011
Dependency on QI – Number of Matches

MISR highest-quality vs. Meteosat-9

Number of matched pairs (x1E5)
Dependence on QI – N-S Wind RMSD

MISR highest-quality hi-res vs. Meteosat-9

MISR domain mean hi-res vs. Meteosat-9

MISR low-res vs. Meteosat-9

N-S wind RMSD (m/s)
Hi-res – Low-res MISR SMV Differences

- E-W wind mean diff. (m/s)
- N-S wind mean diff. (m/s)
- Wind speed mean diff. (m/s)
- Height mean diff. (km)
SMV-CMV Comparison – Global Mean Statistics

**E-W bias**
- **all**: low-res -0.42, hi-res -0.34
- **ocean**: low-res -0.39, hi-res -0.32
- **land**: low-res -0.70, hi-res -0.57

**E-W rmsd**
- **all**: low-res 2.50, hi-res 2.77
- **ocean**: low-res 2.43, hi-res 2.72
- **land**: low-res 3.03, hi-res 3.13

**E-W corr**
- **all**: low-res 0.97, hi-res 0.96
- **ocean**: low-res 0.97, hi-res 0.96
- **land**: low-res 0.95, hi-res 0.95

**N-S bias**
- **all**: low-res -1.12, hi-res -0.03
- **ocean**: low-res -1.05, hi-res 0.04
- **land**: low-res -1.71, hi-res -0.62

**N-S rmsd**
- **all**: low-res 4.23, hi-res 3.09
- **ocean**: low-res 4.06, hi-res 2.86
- **land**: low-res 5.41, hi-res 4.58

**N-S corr**
- **all**: low-res 0.84, hi-res 0.89
- **ocean**: low-res 0.85, hi-res 0.91
- **land**: low-res 0.74, hi-res 0.78

**No significant change in E-W comparison, but significant improvement in N-S comparison.**
Change in SMV-CMV Mean Difference (‘Bias’)  
hi-res – low-res MISR
Change in SMV-CMV N-S Wind RMSD and Correlation

significant reduction in rmsd and increase in correlation
Distribution of SMV-CMV Vector Differences

MISR N-S wind bias and height error aliasing are clearly visible. MISR N-S wind bias and height error aliasing largely disappear.
Meridional Variation of SMV-CMV Comparison

**High-Level Clouds (θ>3 km)**

- Mean wind difference (m/s)
- Wind rmsd (m/s)
- Wind correlation

**Latitudes**
- E-W (East-West)
- N-S (North-South)

**Legend**
- Low-res MISR
- Hi-res MISR
MISR Ground Retrievals – Surface Elevation

MISR height

-150
-120 -90
-60 -30
0 30
60 90
120 150

DEM height

-150
-120 -90
-60 -30
0 30
60 90
120 150

MISR-DEM height difference

-150
-120 -90
-60 -30
0 30
60 90
120 150

height bias = -19 m   height rmsd = 190 m
MISR Ground Retrievals – Cross-Swath Bias

\[ \text{MISR}_{\text{low-res}} \text{ cross-swath domain index} \]

\[ \text{MISR}_{\text{hi-res}} \text{ cross-swath domain index} \]

<table>
<thead>
<tr>
<th>Direction</th>
<th>Bias (m/s)</th>
<th>Sdev (m/s)</th>
</tr>
</thead>
<tbody>
<tr>
<td>E-W (low-res)</td>
<td>-0.06</td>
<td>0.70</td>
</tr>
<tr>
<td>N-S (low-res)</td>
<td>-0.13</td>
<td>1.95</td>
</tr>
<tr>
<td>E-W (hi-res)</td>
<td>-0.14</td>
<td>0.61</td>
</tr>
<tr>
<td>N-S (hi-res)</td>
<td>+0.43</td>
<td>1.74</td>
</tr>
</tbody>
</table>

\[ \text{E-W}_{\text{low-res}} \text{ bias} = -0.06 \text{ m/s} \]
\[ \text{E-W}_{\text{hi-res}} \text{ bias} = -0.14 \text{ m/s} \]
\[ \text{N-S}_{\text{low-res}} \text{ bias} = -0.13 \text{ m/s} \]
\[ \text{N-S}_{\text{hi-res}} \text{ bias} = +0.43 \text{ m/s} \]

\[ \text{E-W}_{\text{low-res}} \text{ sdev} = 0.70 \text{ m/s} \]
\[ \text{E-W}_{\text{hi-res}} \text{ sdev} = 0.61 \text{ m/s} \]
\[ \text{N-S}_{\text{low-res}} \text{ sdev} = 1.95 \text{ m/s} \]
\[ \text{N-S}_{\text{hi-res}} \text{ sdev} = 1.74 \text{ m/s} \]
SMV-CMV Comparison – Cross-Swath Bias

hi-res MISR

- ground bias

MISR

low-res

cross-swath domain index

-4 -3 -2 -1 0 1

SMV-CMV wind difference (m/s)

0 200 400 600 800 1000

SMV-CMV height difference (m)

E-W N-S height

MISR

western eastern

MISR

low-res

MISR

high-res

- ground bias

west east
large increase in N-S wind correlation, slight decrease in E-W wind correlation
SMV-CMV Comparison – Bias and RMSD Profiles

large decrease in N-S wind mean difference and rmsd
MISR SMV – Meteosat-9 CMV Height Comparison

Lonitz and Horváth, JGR, 2011
MISR Ground Retrievals – Bias Profile

![Graphs showing MISR ground retrieval 'wind' bias and DEM ground elevation profiles.](image)
Von Kármán Vortex Street
Jan Mayen Island, 6 June 2001
Von Kármán Vortex Street
Jan Mayen Island, 6 June 2001

4.4-km wind residuals after mean wind removal (K. Mueller, C. Moroney)