Validation of Satellite-Derived Surface Wind Fields

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Overview

• Data and processing
• QuikSCAT/WindSAT
  – Overall comparison
  – Spatial variability
  – Temporal variability
• Summary of statistics
• Future analysis
## Data

<table>
<thead>
<tr>
<th>Satellite</th>
<th>In situ</th>
</tr>
</thead>
<tbody>
<tr>
<td>• QuikSCAT</td>
<td>• NDBC – ?? (28)</td>
</tr>
<tr>
<td>• WindSAT</td>
<td>• TAO – ~70(55)</td>
</tr>
<tr>
<td>• ASCAT – when available</td>
<td>• PIRATA – 17(13)</td>
</tr>
<tr>
<td></td>
<td>• JMA – 3(3)</td>
</tr>
<tr>
<td></td>
<td>• ORS – 3+2(1)</td>
</tr>
<tr>
<td></td>
<td>• VOS – 3</td>
</tr>
</tbody>
</table>

July 5-7, 2006

OVWST
Processing

- QuikSCAT L2B – All quality flags checked except high and low winds, WVCs 3 – 74.
- WindSAT EDR – All quality flags checked except high and low winds.
- Selected vectors within 25 km and 10 minutes.
- Deep water buoys flagged according to source.
In situ data

Buoy locations

July 5-7, 2006

OVWST

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QuikSCAT

All buoys

QuikSCAT wind speed (m/s)

Buoy wind speed (m/s)

Bias: 0.090
RMSE: 1.038
Count: 159670

QuikSCAT wind direction

Buoy wind direction

Bias: -1.663
RMSE: 24.657

July 5-7, 2006
OVWST
Wind speed bias (m/s), TMI SST
QuikSCAT SST dependence
WindSAT

All buoys

Bias: -0.100
RMSE: 2.027
Count: 23042

Bias: 2.794
RMSE: 42.253

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WindSAT

Wind speed bias (m/s)

July 5-7, 2006  OVWST

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WindSAT

Wind speed bias (m/s), TMI SST

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OVWST
WindSAT SST dependence

Sea Surface Temperature Dependence

Wind Speed Difference

Wind Direction Difference

Count

July 5-7, 2006
OVWST
QuikSCAT temporal variability

July 5-7, 2006

OVWST
WindSAT temporal variability

- WS/All buoys
- WS/NDBC buoys
- WS/TAO buoys
- WS/PIRATA buoys

July 5-7, 2006

OVWST

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<table>
<thead>
<tr>
<th>Satellite</th>
<th>Count</th>
<th>Speed Bias (m/s)</th>
<th>Speed RMS</th>
<th>Direction Bias (°)</th>
<th>Direction RMS</th>
</tr>
</thead>
<tbody>
<tr>
<td>QuikSCAT</td>
<td>159670</td>
<td>0.09</td>
<td>1.04</td>
<td>-1.66</td>
<td>24.66</td>
</tr>
<tr>
<td>U&gt;3 m/s</td>
<td>145882</td>
<td>0.03</td>
<td>0.96</td>
<td>-1.66</td>
<td>19.42</td>
</tr>
<tr>
<td>U&gt;5 m/s</td>
<td>118366</td>
<td>-0.05</td>
<td>0.91</td>
<td>-1.69</td>
<td>15.55</td>
</tr>
<tr>
<td>WindSAT</td>
<td>23042</td>
<td>-0.10</td>
<td>2.03</td>
<td>-2.79</td>
<td>42.25</td>
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<tr>
<td>U&gt;3 m/s</td>
<td>20966</td>
<td>-0.25</td>
<td>1.96</td>
<td>-2.92</td>
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<td>U&gt;5 m/s</td>
<td>16948</td>
<td>-0.46</td>
<td>1.97</td>
<td>-3.18</td>
<td>34.27</td>
</tr>
</tbody>
</table>

July 5-7, 2006  
OVWST  

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Summary

• QuikSCAT
  – Continues to perform well
  – Spatial variability in TAO bias
  – Seasonal variability in speed bias
  – General trend toward smaller direction bias
  – Positive trend in significant wave height

• WindSAT
  – Good overall performance
  – High RMSE
  – Unable to determine spatial or temporal variability in speed or direction
  – Negative trend in wave height
Future work

• Continue collocating all available QuikSCAT, SeaWinds, WINDSAT data and include ASCAT winds when available.
• Determine spatial and temporal variability using wavenumber spectra and Empirical Orthogonal Functions.
• Perform statistical vector wind inter-comparison between each satellite.
• Evaluate the temporal variability of satellite-derived surface winds at three open Ocean Reference Stations and operational buoys.
• Evaluate spatial distribution of bias in satellite vector winds along VOS ship tracks.
Ocean Reference Stations

WHOI buoys

Bias: 0.050
RMSE: 0.762
Count: 1279

Bias: 1.991
RMSE: 12.436

July 5-7, 2006
Questions?
Buoy groups (U > 0 m/s)

<table>
<thead>
<tr>
<th>Satellite</th>
<th>Count</th>
<th>Speed Bias (m/s)</th>
<th>RMS Bias (°)</th>
<th>Direction RMS</th>
</tr>
</thead>
<tbody>
<tr>
<td>QS/NDBC</td>
<td>63797</td>
<td>0.07</td>
<td>1.02</td>
<td>-3.63</td>
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<tr>
<td>TAO</td>
<td>79888</td>
<td>0.09</td>
<td>1.06</td>
<td>-0.57</td>
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<tr>
<td>PIRATA</td>
<td>13176</td>
<td>0.19</td>
<td>0.95</td>
<td>-0.10</td>
</tr>
<tr>
<td>JMA</td>
<td>1552</td>
<td>0.18</td>
<td>1.21</td>
<td>6.58</td>
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<tr>
<td>WS/NDBC</td>
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<td>-0.11</td>
<td>2.61</td>
<td>-7.14</td>
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<tr>
<td>TAO</td>
<td>11855</td>
<td>-0.13</td>
<td>1.50</td>
<td>0.35</td>
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<tr>
<td>PIRATA</td>
<td>6937</td>
<td>0.14</td>
<td>1.38</td>
<td>0.01</td>
</tr>
</tbody>
</table>
WindSAT

Wind direction bias (deg)
WindSAT

Wave Height Dependence

Wind Speed Difference

Wind Direction Difference

Count

All NDBC