Product verification

Ad Stoffelen
Marcos Portabella (CSIC)
Anton Verhoef
Jeroen Verspeek
Jur Vogelzang
Maria Belmonte

scat@knmi.nl

OVWST, 18-20/05/'09
Quality Guidance

• Several products exist; how to guide our users?
• How to trade off processing options?
• Two main issues:
  – Sampling; not all sets have the same QC / coverage
  – Representativeness error, or, how smooth can an application accept the product to be

• Elaborated 2 tests for product comparison:
  ➢ Dual product collocation with a representative set of buoy data (kindly provided by ECMWF), or NWP data
  ➢ Spectral analysis (discussed at last OVWST with Ernesto)
### Buoy verification

#### SeaWinds 25-km product

<table>
<thead>
<tr>
<th></th>
<th># wind vectors</th>
<th>speed bias</th>
<th>stdev $u$</th>
<th>stdev $v$</th>
</tr>
</thead>
<tbody>
<tr>
<td>NOAA product, including <strong>outer swath</strong></td>
<td>3845</td>
<td>0.25</td>
<td>2.54</td>
<td>2.51</td>
</tr>
<tr>
<td>NOAA product, no outer swath data</td>
<td>3276</td>
<td>0.20</td>
<td>2.47</td>
<td>2.18</td>
</tr>
<tr>
<td>OSI SAF, no outer swath data</td>
<td>3061</td>
<td>-0.48</td>
<td>1.79</td>
<td>1.88</td>
</tr>
<tr>
<td>NOAA product, collocated OSI SAF</td>
<td>2954</td>
<td>0.15</td>
<td>2.19</td>
<td>1.99</td>
</tr>
<tr>
<td>OSI SAF, collocated with NOAA product</td>
<td>2954</td>
<td>-0.49</td>
<td>1.76</td>
<td>1.83</td>
</tr>
</tbody>
</table>

- Outer swath winds appear degraded in NOAA product
- OSI SAF winds verify better with buoys than NOAA does (in RMS)
- OSI SAF wind is biased low
- OSI SAF collocation much helps NOAA wind SD and bias (rain)
- NOAA QC has modest impact on OSI SAF product
Buoy verification

<table>
<thead>
<tr>
<th>SeaWinds 25-km product</th>
<th># wind vectors</th>
<th>speed bias</th>
<th>stdev u</th>
<th>stdev v</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>New NOAA, including outer swath</strong></td>
<td>4023</td>
<td>0.09</td>
<td>2.54</td>
<td>2.33</td>
</tr>
<tr>
<td><strong>New NOAA, no outer swath data</strong></td>
<td>3342</td>
<td>0.10</td>
<td>2.57</td>
<td>2.24</td>
</tr>
<tr>
<td><em><em>OSI SAF</em>, including outer swath data</em>*</td>
<td>3756</td>
<td>-0.49</td>
<td>1.84</td>
<td>1.95</td>
</tr>
<tr>
<td><em><em>OSI SAF</em>, no outer swath data</em>*</td>
<td>3033</td>
<td>-0.46</td>
<td>1.85</td>
<td>1.93</td>
</tr>
<tr>
<td><strong>OSI SAF, collocated with OSI SAF</strong></td>
<td>2926</td>
<td>-0.48</td>
<td>1.78</td>
<td>1.88</td>
</tr>
<tr>
<td><em><em>OSI SAF</em>, collocated with OSI SAF</em>*</td>
<td>2926</td>
<td>-0.48</td>
<td>1.78</td>
<td>1.87</td>
</tr>
</tbody>
</table>

- New NOAA product less QC and higher wind SD, bias slightly reduced
- OSI SAF wind is slightly degraded on basis of new NOAA, due to QC
- Outer swath similar quality as inner swath, due to 4 noise values

OVWST, 18-20/05/09
## OSI SAF 100-km product

<table>
<thead>
<tr>
<th></th>
<th># wind vectors</th>
<th>speed bias</th>
<th>stdev $u$</th>
<th>stdev $v$</th>
</tr>
</thead>
<tbody>
<tr>
<td>no MSS used</td>
<td>3156</td>
<td>-0.21</td>
<td>2.16</td>
<td>2.06</td>
</tr>
<tr>
<td>MSS used</td>
<td>3155</td>
<td>-0.25</td>
<td>2.03</td>
<td>2.06</td>
</tr>
<tr>
<td>MSS*, no outer swath data</td>
<td>3163</td>
<td>-0.23</td>
<td>2.11</td>
<td>2.07</td>
</tr>
<tr>
<td>MSS*, outer swath data</td>
<td>3925</td>
<td>-0.25</td>
<td>2.09</td>
<td>2.12</td>
</tr>
<tr>
<td>MSS collocated with MSS*</td>
<td>3038</td>
<td>-0.25</td>
<td>2.01</td>
<td>2.04</td>
</tr>
<tr>
<td>MSS* collocated with MSS</td>
<td>3038</td>
<td>-0.25</td>
<td>2.04</td>
<td>2.03</td>
</tr>
</tbody>
</table>

- MSS beneficial at 100 km (nadir)
- OSI SAF wind is slightly degraded on basis of new NOAA, due to QC
- Outer swath similar quality to inner swath, due to 4 noise values

OVWST, 18-20/05/'09
Bias due to $\sigma^0$ averaging

- 100-km product increases low speeds
- At coarser resolutions speeds should be lower instead?

Statistics - speed

- Average bias = -0.52, mean X val = 7.46, mean Y val = 6.94
- Average stdev = 1.09, correlation XY = 0.95
σ^0 distribution is steep for low values; a low value at a 25-km WVC most likely has a neighbour WVC σ^0 value that is higher; this removes low (extreme) values when averaging to 100 km

The wind vector distribution is flat for low values; a low 25-km WVC most likely has similarly low WVC neighbour amplitudes at varying direction; more low wind vector amplitudes are expected at 100 km

25-km GMF will not provide good 100-km winds!

We verified that noisier (>Kp) σ^0 data indeed provide speed bias as well
FFT detrending methods

- Over a few 1000 km the wind vector generally changes
- FFTs assume infinite periodic continuation of the series
- A step function between the last and first point of the series adds small-scale FFT noise
- This is aliasing of variance on scales beyond the FFT domain on the tail’s spectrum
Detrending

- A trend FFTs to $k^{-2}$
- Only first difference and matching first and last point by linear transform remove the large-scale aliasing on the FFT tail
SDP@25 (MSS)

- SeaWinds contains small scales down to 50 km
- Smooth decay, same for u and v
- Indication of noise floor, probably due to rain
- Similar to NOAA products
- \( k^{-2.1} \)
• Same period as SDP
• ASCAT contains more variance below 1000 km
• Less of a floor than SDP
• Small bump at 150-km scale in $u$
• $k^{-2.0}$
AWDP@12.5

- ASCAT contains small scales down to 25 km
- No noise floor
- Extended bump in $u$ at 100-km scale
- $k^{-1.9}$
Box AWDP@12.5

- Box averaging maintains more tail variance
- No apparent noise floor
- Buoy verification confirms this; see later presentation
- Still u bump, but at lower wavelength (?)
- $k^{-1.8}$, pretty close to -1.67 for 3D turbulence

Nastrom and Gage 1987
MSS ASCAT@12.5

- MSS smooths ASCAT box product
- Verification of MSS with buoys to be done
- 2DVAR spatial filter functions are being investigated with FFT approach

OVWST, 18-20/05/09
Conclusions

- Dual product collocation with buoys reveals clear relative quality characteristics
  - The SDP@25km product verifies better than NOAA
  - SDP@25km is about 0.4 m/s lower than ASCAT (0.5 m/s w.r.t. buoys)
  - NOAA rejects fewer WVCs than SDP, but accepted points do not verify well
  - SDP winds based on the new NOAA SeaWinds BUFR verify slightly worse, but provide good quality outer swath winds with SDP
  - NOAA outer swath winds are clearly degraded
  - MSS in SDP@100km OSI SAF notably reduces the wind component RMS with respect to buoy data
  - Wind-speed dependent bias correction for the products is ongoing
- FFT tool is applied to further quantify product characteristics
  - ASCAT contains more small-scale variance than SeaWinds products
  - ASCAT winds based on 12.5-km Box-averaged $\sigma^0$ product contains most variance
  - SeaWinds products show noise floor
  - ASCAT winds show bump in u component, not explained entirely by Hamming filter
- Work in progress

OVWST, 18-20/05/'09
www.knmi.nl/scatterometer

OVWST, 18-20/05/'09
ASCAT 25 compares best to buoys; ASCAT 25 compares best to ECMWF as well.

SeaWinds 25 is slightly noisier than ASCAT 25; SeaWinds 100 compares much better to ECMWF winds than SeaWinds 25.

Low-res products good for global NWP; Hi-res for ocean applications and nowcasting.
Experimental 12.5-km product

See yesterday’s talk
QuikSCAT vs ECMWF

OVWST, 18-20/05/09
ASCAT vs ECMWF

**Wind speed (m/s)**
- ECMWF
- Z0.625

- Node: all
- $N=2305231$
- $m_x=7.59$ $m_y=7.55$
- $s(y-x)=1.28$
- $\text{cor}_{xy}=0.94$

**Wind dir (deg)**
- ECMWF
- Z0.625

- Node: all
- $N=1965456$
- $m_x=177.57$ $m_y=177.86$
- $s(y-x)=15.75$
- $\text{cor}_{xy}=0.99$

**U comp. (m/s)**
- ECMWF
- Z0.625

- Node: all
- $N=2305231$
- $m_x=0.23$ $m_y=0.11$
- $s(y-x)=1.52$
- $\text{cor}_{xy}=0.97$

**V comp. (m/s)**
- ECMWF
- Z0.625

- Node: all
- $N=2305231$
- $m_x=0.75$ $m_y=0.72$
- $s(y-x)=1.62$
- $\text{cor}_{xy}=0.96$

OVWST, 18-20/05/09