Latest cal/val assessment of v2.1 L1/L2 data

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Outline

• Revisiting
  – v2.1 L1/L2 timeseries plots
  – v2.1 NBRCS vs incidence angle relationship
• A look at v2.1 L2 wind performance
• Summary and Observations
(L1) Roll, NBRCS, Noise Floor,
(L2) Wind speed bias, std, MSS timeseries
per observatory per antenna

Note: data from block IIF sp. excluded (to be consistent with latest L2)
Bin averaged
Sigma0/les/wind_speed/mss vs incidence angle
separated by antenna and observatory
for a fixed ecmwf wind speed bin (6-6.5 m/s)
ALL PRNs except block IIF -- $6 \leq U_{10} \leq 6.5$ m/s -- fds_sample_flags bit 0 unset -- time period: Jan-Apr 2018 -- a21.d21
May-Aug 2018

σ°  LES  U_{10}  mss  Rx Gain

ALL PRNs except block IIF—6≤u_{10}≤6.5 m/s—fds_sample_flags bit 0 unset—time period: May–Aug 2018—a21.d21
σ°  LES  U₁₀  mss  Rx Gain

Sep-Nov 2018

ALL PRNs except block IIF—6≤u₁₀≤6.5 m/s—fds_sample_flags bit 0 unset—time period: Sep-Nov 2018—a21.d21
A look at v2.1 L2 performance compared to ECMWF, HWRF, and preliminary NOAA L2 winds\(^{(1)}\)

Two periods selected for analysis:

- Aug 1 - Sep 30 2017
- Aug 1 - Oct 15 2018

(1)

- ‘track-wise’ wind retrieval method (more details provided at either upcoming GNSS+R or IGARSS conference)
- **ALL** PRNs included
- using fds GMF (for global wind analysis)
- using yslf GMF (for tropical cyclone wind analysis)
- no statistical correction applied
Currently used L2 GMFs (v2.1)
ECMWF vs. CyGNSS (2017)

all FMs | All blocks | Time period: Aug 1–Sep 30 2017

ECMWF

CyGNSS (NOAA)

CyGNSS (L2)
ECMWF vs. CyGNSS (2018)

all FMs | All blocks | Time period: Aug 1–Oct 15 2018

- ECMWF
- CyGNSS (NOAA)
- CyGNSS (L2)
Bias/Std with ECMWF L2 vs. NOAA 2017/2018
CyGNSS NOAA - 2017

all FMs | All blocks | Time period: Aug 1–Sep 30 2017 | NOAA dataset | Applied flag: snr > 1 dB and −2<roll<2 deg
CyGNSS L2 - 2018

all FMs | All blocks | Time period: Aug 1–Oct 15 2018 | L2 dataset | Applied flag: fds_sample_flags bit 0 unset and range_corr_gain > 3
CyGNSS NOAA - 2018

All FMs | All blocks | Time period: Aug 1–Oct 15 2018 | NOAA dataset | Applied flag: snr > 1 dB and -2 < roll < 2 deg
2017 vs. 2018
CyGNSS L2 - 2017

all FM | All blocks | Time period: Aug 1–Sep 30 2017 | L2 dataset | Applied flag: fds_sample_flags bit 0 unset and range_corr_gain > 3

[Map and diagrams showing the comparison between CyGNSS and ECMWF]
CyGNSS L2 - 2018

all FMs | All blocks | Time period: Aug 1–Oct 15 2018 | L2 dataset | Applied flag: fds_sample_flags bit 0 unset and range_corr_gain > 3
CyGNSS NOAA - 2017

all FM{s} | All blocks | Time period: Aug 1–Sep 30 2017 | NOAA dataset | Applied flag: snr > 1 dB and −2<roll<2 deg
CyGNSS NOAA - 2018

all FMs | All blocks | Time period: Aug 1–Oct 15 2018 | NOAA dataset | Applied flag:snr > 1 dB and −2<roll<2 deg
Bias/Std with HWRF L2 vs. NOAA
All basins (2018)
CyGNSS L2 - 2017

all FM s | All blocks | Time period: Aug 1–Sep 30 2017 | L2 dataset | Applied flag:ysf_l_sample_flags bit 0 unset and range_corr_gain > 3
CyGNSS NOAA - 2017

all FMs | All blocks | Time period: Aug 1–Sep 30 2017 | NOAA dataset | Applied flag:snr > 1 dB and −2<roll<2 deg
CyGNSS NOAA - 2018

all FMs | All blocks | Time period: Aug 1–Oct 15 2018 | NOAA dataset | Applied flag: snr > 1 dB and -2<roll<2 deg
2017 vs. 2018
CyGNSS NOAA - 2017

all FMs | All blocks | Time period: Aug 1–Sep 30 2017 | NOAA dataset | Applied flag: snr > 1 dB and -2<roll<2 deg
CyGNSS NOAA - 2018

all FMs, All blocks, Time period: Aug 1–Oct 15 2018, NOAA dataset, Applied flag: snr > 1 dB and -2<roll<2 deg
CyGNSS L2 - 2017

all FMs | All blocks | Time period: Aug 1–Sep 30 2017 | L2 dataset | Applied flag:yslf_sample_flags bit 0 unset and range_corr_gain > 3
# Statistical Summary

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<tr>
<th></th>
<th>Aug-Sep 2017</th>
<th>Aug-mid Oct 2018</th>
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<tbody>
<tr>
<td><strong>Against ECMWF</strong></td>
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<tr>
<td><strong>Bias [m/s]</strong></td>
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<tr>
<td>NOAA</td>
<td>-0.18</td>
<td>-0.20</td>
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<tr>
<td>L2</td>
<td>-0.0037</td>
<td>0.66</td>
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<tr>
<td><strong>Std [m/s]</strong></td>
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<td></td>
</tr>
<tr>
<td>NOAA</td>
<td>1.62</td>
<td>1.64</td>
</tr>
<tr>
<td>L2</td>
<td>1.76</td>
<td>1.87</td>
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</table>

<table>
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<tr>
<th></th>
<th>Aug-Sep 2017</th>
<th>Aug-mid Oct 2018</th>
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</thead>
<tbody>
<tr>
<td><strong>Against HWRF</strong></td>
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<tr>
<td><strong>Bias [m/s]</strong></td>
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</tr>
<tr>
<td>NOAA</td>
<td>-1.84</td>
<td>-3.61</td>
</tr>
<tr>
<td>L2</td>
<td>-1.51</td>
<td>-0.33</td>
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<tr>
<td><strong>Std [m/s]</strong></td>
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<td></td>
</tr>
<tr>
<td>NOAA</td>
<td>5.16</td>
<td>5.63</td>
</tr>
<tr>
<td>L2</td>
<td>6.58</td>
<td>8.12</td>
</tr>
</tbody>
</table>
Observations and recommendations:

• NBRCs still noticeably high during high roll manoeuver, particularly on the starboard side
  • Consequence: L2 winds/mss are affected during these periods

Possible recommendations:

• Include a flag in L2 data to identify high roll data
• Noticeable **upward** trend in L2 wind bias/std and mss timeseries starting ~Sep 2017. More pronounced after Sep 2018
  • *may be related to increase in Noise Floor across all instruments*
• Given the same observatory, L2 wind biases are quite different (~0.5-1 m/s) between antenna
• Aforementioned trends are also noticeable when L1/L2 variables are plotted as a function of incidence angle (note: FM#5 shows the worst performance as time evolves)
Additional Observations

• Globally,
  • L2 winds statistics are OK on a global scale (particularly in 2017) most likely due to the implementation of ‘CDF matching technique’
  • however, wind speed correlation in the lat/lon space is poor at times
  • performance worsens over time
  • increased sigma0 trends show little effect on preliminary NOAA L2 winds

• In TC wind analysis,
  • Comparing 2017 vs. 2018, standard deviation against HWRF went from 6.58 to 8.12 m/s. Quite large increase.
  • Bias actually decreased. Yet, bias/std on lat/lon grid is very noisy

• Future works
  • Refine ‘track wise’ wind retrieval using our in house geophysical model function
  • Careful L2 analysis on a storm by storm basis vs. SFMR/HWRF/sensors, etc…
Additional slides
STARBOARD

sand031 time period: 2018/05/01 - 2018/05/20 STARBOARD FM#01 6<ECMWF<6.5m/s block I

-2<roll<2deg

mean: 13.84dB

-25<roll<−10deg

mean: 14.70dB
Bin averaged Sigma0 vs incidence angle separated by antenna and observatory

ALL PRNs except block IIF—6≤wind≤6.5m/s—time period: May–Dec 2017

v2.0

v2.1 beta

sand035

sand036

v2.1

3D altitude dependent LUT for scattering area

NF correction to both NBRCS and LES

3D altitude+NF corr.

This might be the cause of the L2 performance degradation previously noted

01/14/2019
D/A conversion from Rx power cal. was removed