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QUALITY INFORMATION DOCUMENT

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For the Global Ocean Wind Products

WIND_GLO_WIND_L3_NRT_OBSERVATIONS_012_002

WIND_GLO_WIND_L4_REP_OBSERVATIONS_012_003

Issue: 1.5

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CHANGE RECORD

Issue	Date	§	Description of Change	Author	Validated By
1.0	2013-02-05	All	Creation of the document, Wind QUID split up from the SIW QUID.	Tilly Driesenaar, Abderrahim Bentamy	Ad Stoffelen
1.1	2013-02-28	All	Corrections after QuARG review	Tilly Driesenaar, Abderrahim Bentamy	Ad Stoffelen
1.2	2015-09-01	all	Change format to fit CMEMS graphical rules. Introduce references to CMEMS.	B. Hackett	L. Crosnier
1.3	2015-12-09	all	Change product ID from CLIM to REP	B. Hackett	
1.4	2016-01-19		Updated L3 product info	Jos de Kloe	B. Hackett
1.5	2016-04-04	1.3, 2.1, 2.3	Added EAN numbers	Jos de Kloe	B. Hackett A. Melet

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1 EXECUTIVE SUMMARY

1.1 Products covered by this document

This document describes the quality of the global ocean near-real-time daily L3 wind product (WIND_GLO_WIND_L3_NRT_OBSERVATIONS_012_002) and the global ocean wind REProcessed (WIND_GLO_WIND_L4_REP_OBSERVATIONS_012_003).

The WIND_GLO_WIND_L3_NRT_OBSERVATIONS_012_002 product contains daily gridded L2 scatterometer wind vector observations. The input L2 observations are made available by the operational Ocean and Sea Ice Satellite Application Facility (OSI SAF) of EUMETSAT. The product is produced by KNMI and disseminated by the CMEMS Ocean and Sea Ice Thematic Assembly Centre (OSI TAC).

The WIND_GLO_WIND_L4_REP_OBSERVATIONS_012_003 product contains time series of monthly averaged wind variables calculated over global oceans, estimated from daily global scatterometer wind fields. The wind variables include monthly averaged wind speed, zonal and meridional wind components and wind stress amplitude. The product is produced and disseminated by the CMEMS OSI TAC.

Product	*Product description*	*Production unit, PU*	*Dissemination unit DU*
WIND_GLO_WIND_L4_REP_OBSERVATIONS_012_003	Global ocean wind REP (time series) L4	SIW-IFREMER-BREST-FR	SST-CNR-ROMA-IT
WIND_GLO_WIND_L3_NRT_OBSERVATIONS_012_002	Global ocean wind L3	SIW-KNMI-DEBILT-NL	SST-CNR-ROMA-IT

Table 1 : OSI TAC Wind products and partner roles.

1.2 Summary of the results

The L3 Wind Product is based on the extensively calibrated, validated and monitored L2 wind products of the EUMETSAT Ocean and Sea Ice Satellite Application Facility (OSI-SAF) . The qualification of the Global Ocean L3 Wind product consists of checking of the correct functioning of the gridding procedure by the inspection of individual cases and by buoy collocations for a period of one year (2009). In addition ocean drag needed to calculate wind stress has been related to stress equivalent wind in the ECMWF ERA INTERIM model.

The qualification study shows that the L3 Wind product processing works correctly and the level of accuracy is similar to the L2 accuracy as shown by the buoy collocations. The accuracy level is better than 2 m/s in wind component RMS with a bias of less than 0.5 m/s in wind speed (following OSI-SAF requirements). The L3 ASCAT 25km product meets these requirements for the period considered (January to December 2009).

The wind stress calculation follows closely the relations used by the ECMWF ERA INTERIM wave model, but is still somewhat simplified because sea state is not taken into account.

The quality of the resulting wind fields is monthly investigated trough comprehensive comparisons with monthly-averaged wind estimated derived from buoy measurements. No systematic departures are depicted and for most wind variables (wind speed, wind direction wind stress amplitude and components) the associated errors, estimated by root mean square differences (buoy – satellite), are lower than 1m/s and 20° for wind speed and direction, respectively. A significant bias is found for buoy wind speeds less than 4m/s. Monthly scatterometer winds tend to be slightly overestimated compared to in-situ data due to spatial representation and binning.

The validation of the monthly L4 REP product is mainly based on the comparison with monthly ECMWF wind estimates over global ocean. The latter tend to be underestimated with respect to satellite data. The overall mean difference time series do not exhibit any significant trend.

1.3 Estimated Accuracy Numbers

The accuracy levels of the Global Ocean L3 Wind products are better than 2 m/s in wind component RMS, with a bias of less than 0.5 m/s in wind speed.

For the wind stress field included in the L3 Wind products we report the difference between the simple linear drag relation as used for the L3 wind product and the more complete ECMWF ERA Interim model. This gives differences in wind stress between 5 and 17 percent.

The accuracy of L4 monthly wind product is characterised by associated errors lower than 1m/s and 20° for wind speed and direction, respectively. For low wind speeds (buoy wind speed <4 m/s) a significant bias is found due to the spatial representation of scatterometer wind at low wind conditions.

2 PRODUCTION SUBSYSTEM DESCRIPTION

The OSI TAC is a multi-mission integration activity. The main tasks to fulfil are:

- provide real-time, delayed mode update operations for L3, and L4 data products for SST, Sea Ice and Wind.
- provide data for long-term sea ice and surface wind monitoring data (REProcessed).
- provide quality control, validation and error characterization of data products and services.

This document describes the Wind part of the OSI TAC. Sea Ice and SST are described in separate documents.

2.1 L3 Global Ocean wind

The global ocean L3 wind product consists of L2 scatterometer ocean wind vectors which are interpolated to a regular lat-lon grid with fixed spacing. The global ocean L3 wind product contains different datasets depending of satellite, grid spacing and whether the data is originating from ascending or descending passes. The L3 grid spacing depends on the resolution of the input L2 product. The input L2 products are operational products from the EUMETSAT OSI-SAF produced at KNMI. The production of the CMEMS L3 global ocean L3 wind product is also done by the OSI SAF production system at KNMI (Production Centre). The resulting NetCDF product files are then made available by the CMEMS Information System at CNR.

The various datasets of the global ocean L3 wind product in CMEMS and the L2 products they are based on are listed in Table 1. The various OSI SAF L2 wind products are visualized and fully described at http://www.knmi.nl/scatterometer. As new satellite instrument data will become available within the OSI-SAF, the CMEMS L3 functionality will be added and the CMEMS portfolio extended.

Table 1 Overview of datasets in the global ocean L3 product and their origin

L3 wind dataset	Satellite	Instrument	L2 wind product
GLO-WIND_L3-OBS_METOP-A_ASCAT-25_ASC GLO-WIND_L3-OBS_METOP-A_ASCAT-25_DES	METOP-A	ASCAT	25 km
GLO-WIND_L3-OBS_METOP-A_ASCAT-12_ASC GLO-WIND_L3-OBS_METOP-A_ASCAT-12_DES	METOP-A	ASCAT	12.5 km coastal
GLO-WIND_L3-OBS_METOP-B_ASCAT-25_ASC GLO-WIND_L3-OBS_METOP-B_ASCAT-25_DES	METOP-B	ASCAT	25 km
GLO-WIND_L3-OBS_METOP-B_ASCAT-12_ASC GLO-WIND_L3-OBS_METOP-B_ASCAT-12_DES	METOP-B	ASCAT	12.5 km coastal
GLO-WIND_L3-OBS_Oceansat-2_OSCAT-50_ASC GLO-WIND_L3-OBS_Oceansat-2_OSCAT-50_DES	Oceansat-2	OSCAT	50 km

The L3 product is derived from the L2 wind product by a gridding tool nc_L2_to_L3 which interpolates the wind vector cell measurements to a regular lat-lon grid. The measurements from ascending and descending passes are gridded into separate datasets. The gridding procedure is a bilinear interpolation technique within triangles spanned up by observation points and interpolated observations, using Gouraud shading techniqe.

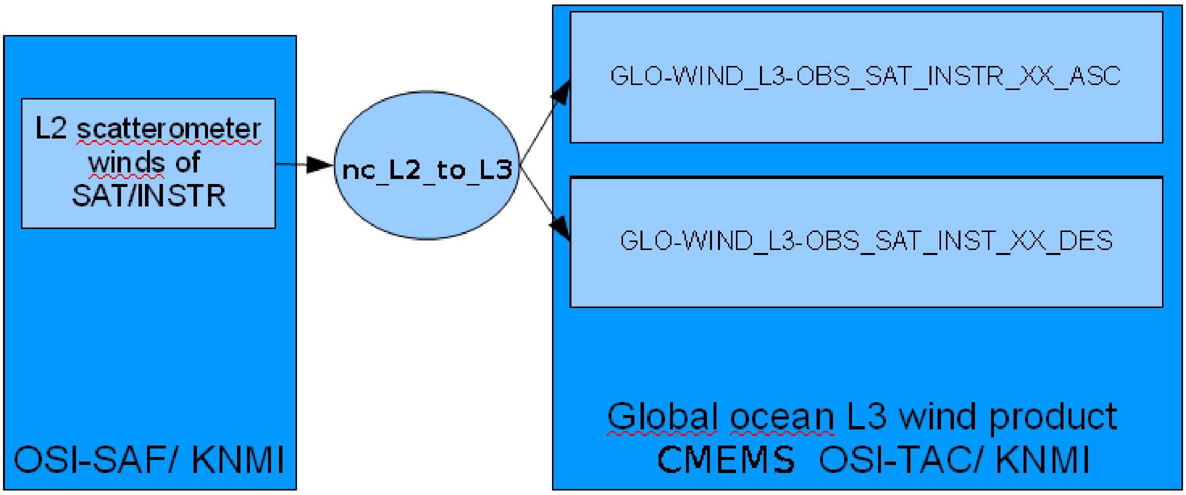
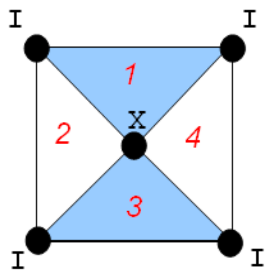


Figure 1 Schematic view of the L3 processing procedure for scatterometer" INST" on satellite "SAT".

The gridding procedure is using triangles which are constructed from the centre of each measured Wind Vector Cell (WVC) and two interpolation points. Any information from WVC's from previous passes is discarded in these triangles.



The interpolation points are constructed in the following way to ensure as much coverage as possible:

1. If 4 surrounding WVC are available an interpolation point is constructed in the middle of the WVC's by means of interpolation:

```
6   X   X   X   -   X   X   X          X: measured WVC
5     I   I   -   -   I   I            I: interpolated values
4   X   X   X   X   X   X   X
3     I   I   I   I   I   I
2   X   X   X   X   X   X   X
```

2. Extend swath to the left and fill gaps by extrapolation of two interpolation points to the right:

```
6   X   X   X   -   X   X   X          I: interpolated values
5 I   I   I   -   I   I   I               in this step
4   X   X   X   X   X   X   X
3 I   I   I   I   I   I   I
2   X   X   X   X   X   X   X
```

3. Extend swath to the right and fill gaps by extrapolation of two interpolation points to the left:

```
6   X   X   X   -   X   X   X          I: interpolated values
5 I   I   I   I   I   I   I   I           in this step
4   X   X   X   X   X   X   X
3 I   I   I   I   I   I   I   I
2   X   X   X   X   X   X   X
```

4. Extend swath before the first row of WVC's and after the last row of WVC's and fill lacking interpolation points within the swath by extrapolation of two interpolation points after, respectively before:

```
7 I   I   I   I   I   I   I   I
6   X   X   X   -   X   X   X          I: interpolated values
5 I   I   I   I   I   I   I   I             in these steps
4   X   X   X   X   X   X   X
3 I   I   I   I   I   I   I   I
2   X   X   X   X   X   X   X
1 I   I   I   I   I   I   I   I
```

5. Fill all interpolation points with wind component u and v values by interpolation from the available surrounding WVC measurements. Only the WVC’s that passed KNMI Quality Control are used.

For each constructed triangle, all gridpoints in that triangle get a u and v value based on the observation value and the interpolated values at the triangle corners (see *Figure 2*). For this bilinear interpolation the Gouraud shading technique is used (also known as linear interpolation on barycentric coordinates in a triangle).

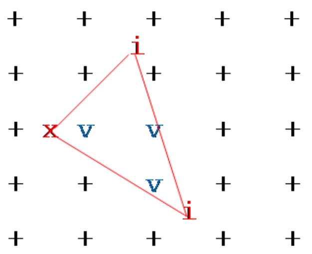


Figure 2 Illustration of gridpoints that are filled with bilinear interpolated values of u and v in the triangle spanned up by an observation point (WVC) and two interpolated observation points.

2.2 L4 Global ocean wind REP

The reprocessing refers to time series of monthly averaged wind variables calculated over global oceans. It is estimated from daily global wind fields calculated from ASCAT scatterometer retrieval onboard METOP-A satellite. It consists of six variables including monthly averaged wind speed, zonal and meridional wind components, wind stress amplitude and the associated components. They are calculated as arithmetic means of ASCAT daily wind analyses. The gridded daily wind and wind stress fields have been estimated over global oceans from Metop/ASCAT retrievals using objective method. The analyses use standard products ASCAT L2b during the period April 2007 to present. ASCAT retrievals occurring during April 21, 2007 to November 20, 2008 are calculated as real winds. They are converted to equivalent neutral winds using bulk parameterisation Coare3.0 (Fairall *et al*, 2003). Coare3.0 parameterization is also used for wind stress estimations. They are calculated over ASCAT swaths from retrievals. The resulting fields are estimated as equivalent neutral-stability 10-m daily winds, and have spatial resolutions of 0.25° in longitude and latitude. The objective method aims to provide daily-averaged gridded wind speed, zonal component, meridional component, wind stress and the corresponding components at global scale. The error associated to each parameter, related to the sampling impact and wind space and time variability, is provided too. More details about data, objective method, computation algorithm may be found in (Bentamy *et al*, 2011). For monthly calculation purpose, only valid daily data available within each month of the period 2007 trough 2011 are used. The monthly winds are estimated at each grid point (0.25°×0.25°) from at least 25 daily values available at the same grid point. The associated root mean square (rms) values are also calculated at each grid point and used as quality control variable.

2.3 L3 wind stress calculation

Scatterometer and model stresss equivalent wind results are used to calculate ocean wind stress according to the standard formula:
$\tau = C_{D10} \langle \rho \rangle |U_{10s}| U_{10s}$
In which we use a standard average air density value for $\langle \rho \rangle$ of 1.225 kg/m^3 and a drag coefficient C_{D10} which is determined from the ECMWF ERA INTERIM model by fitting a line to a full year of data (see figure 3). The resulting line is characterised by the equation
$C_{D10}(U_{10s}) = aU_{10s} + b$
In which $a = 7.94 \times 10^{-5}$ and $b = 6.12 \times 10^{-4}$.
For reference, also the previously used constant value is indicated by a horizontal black line.

No global reference data is currently available that could be used to derive true Estimated Accuracy Numbers for wind stress. However, as a first estimate we can report the difference between the simple linear approach used in the current L3 wind product and the more complete model used in the ECMWF ERA Interim model. Taking one standard deviation in drag coefficient as error estimate, this can be translated to the error estimates in wind stress as shown in Table 2. It should be noted that this estimate is only the result of comparing two models, and may be an underestimate of the actual errors.

Table 2: difference between wind stress (Tau) in the current L3 wind product and wind stress in the ERA Interim model for one year of data (2012). An average standard deviation is reported for 5 m/s bins, and also the relative std. compared to the wind stress itself is given.

U10s	0-5 m/s	5-10 m/s	10-15 m/s	15-20 m/s	20-25 m/s	25-30 m/s
Avg. Tau	0.0062	0.083	0.30	0.75	1.50	2.4
Avg. Std Tau	0.0006	0.005	0.02	0.07	0.18	0.4
%	9.7	5.5	6.8	9.3	12.0	16.9

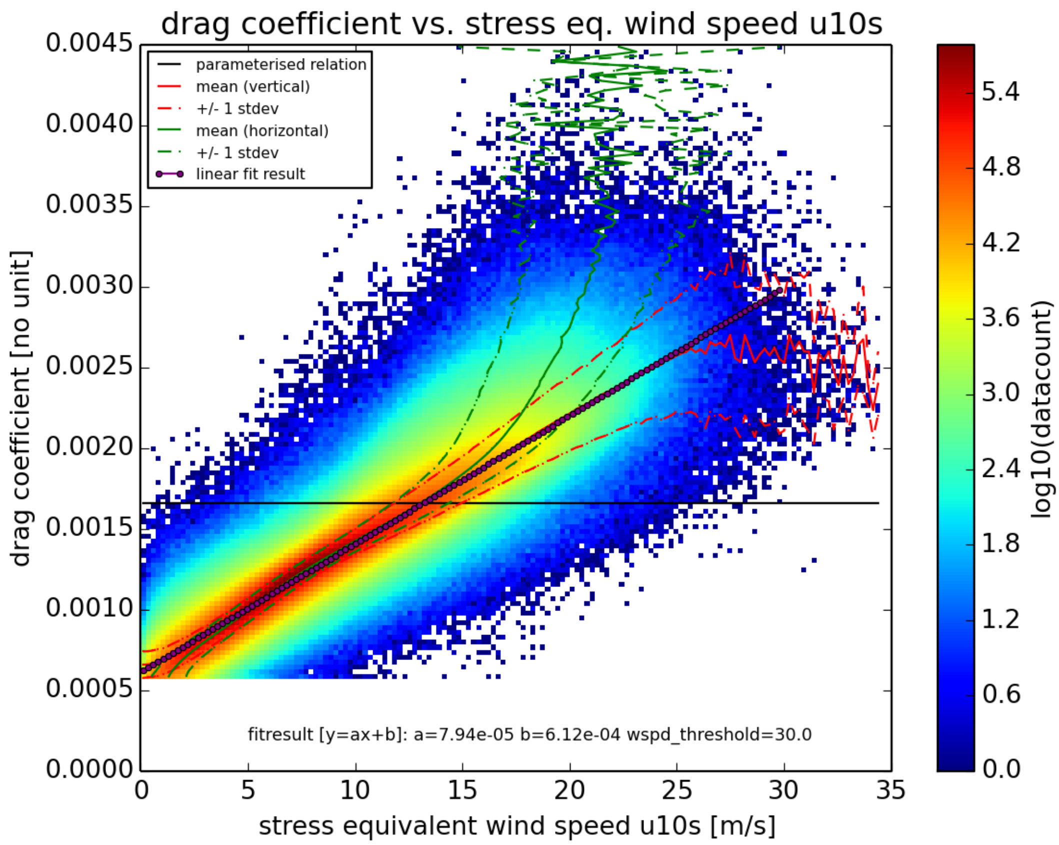


Figure 3: relation between U10s and drag as calculated by the ECMWF ERA INTERIM wave model for the full year 2012.

2.4 Equivalent neutral model wind derivation

The background model wind in the L3 wind product is given as stress equivalent wind. This way it can better be compared to the scatterometer wind which is a stress equivalent wind by definition because the CMOD function used to derive it has no atmospheric information.

To provide the possibility to users to also derive the equivalent neutral wind from the fields in the product, the air density ρ is also provided as field. With this information the following equation can be applied to derive the equivalent neutral model wind from the stress equivalent model wind:

$$U_{10,en} = \sqrt{\frac{\langle\rho\rangle}{\rho}} U_{10s}$$

3 VALIDATION FRAMEWORK

Validation is a continuous on going activity to characterize accuracy and quality of the delivered sea ice and wind products. It is mainly based on operational data, but can be supported by campaign data.

Each PU is responsible for validation of their products. The OSI TAC Validation activities are for the most based on what is already implemented at the partners' institutes and has shown to be useful.

Description of validation data and procedures and link to validation results for each product are given in the next sections.

3.1 L3 Global Ocean Wind

The qualification of the Level 3 scatterometer wind product with catalogue product name WIND_GLO_WIND_L3_NRT_OBSERVATIONS_012_002 as reported in the Scientific Qualification Report of this product consists of two parts:

1. Verification that the products are gridded correctly
2. Verification that the products are CF-1.4 compliant

The qualification, validation and quality monitoring of the L2 wind product is done in the framework of the Ocean and Sea Ice SAF, a.o., through comprehensive comparisons with hourly winds from moored buoy data and collocated ECMWF winds as obtained from the ECMWF MARS archive (see www.knmi.nl/scatterometer). ASCAT L2 qualification and validation is scientifically described in Vogelzang et al., 2011, and Verspeek et al., Vogelzang et al., Verhoef et al., Portabella et al. (rain), and Belmonte et al. (sea ice), all in the IEEE Transactions on Geoscience and Remote Sensing July 2012. The data of approximately 140 moored buoys spread over the oceans (most of them in the tropical oceans and near Europe and North America) are used.

The correct working of the gridding procedure has been tested by applying the same buoy comparison procedure on the gridded measurements in the L3 netCDF files. Plots are provided showing contoured histograms of the buoy winds versus the gridded scatterometer winds (speed, direction, u and v components), as well as bias and standard deviation. This has been done for one year of data (2009). The results are compared with the results from the L2 buoy comparisons.

Also the results from a direct collocation comparison between L2 and L3 scatterometer winds are shown.

The effect of the gridding procedure is investigated qualitatively for a typical case with overlapping passes and partly missing data.

Table 3 Summary of metrics used in the assessment

Name of Metric	Description	Supporting metric from OSI-SAF verification	Status
Number of collocations	Number of collocated buoy measurements with L2 and L3 scatterometer measurements		
Bias of wind speed difference	Bias of buoy-L3 wind speed difference	Bias of buoy-L2 wind speed difference	Done
Std.Dev. of wind speed difference	Std.Dev. of buoy-L3 wind speed difference	Std.Dev. of buoy-L2 wind speed difference	Done
Bias of E-W wind component difference	Bias of buoy-L3 east-west wind component difference	Bias of buoy-L2 east-west wind component difference	Done
Std.Dev. of E-W wind component difference	Std.Dev. of buoy-L3 east-west wind component difference	Std.Dev. of buoy-L2 east-west wind component difference	Done
Bias of N-S wind component difference	Bias of buoy-L3 north-south wind component difference	Bias of buoy-L2 north-south wind component difference	Done
Std.Dev. of N-S wind component difference	Std.Dev. of buoy-L3 north-south wind component difference	Std.Dev. of buoy-L2 north-south wind component difference	Done

3.2 L4 Global ocean wind REP

The subsystem performance and associated product quality are scientifically assessed in the following way:

- Determination of L4 wind products accuracy through comprehensive comparisons with monthly winds from moored buoy data. The latter are derived from various buoy networks: NDBC/NOAA (Atlantic, Pacific oceans), UK Met Office and Météo-France (Atlantic and Mediterranean Sea), TAO (Tropical Pacific), PIRATA (Tropical Atlantic), and RAMA (Indian Ocean). More than 170 buoy raw data are routinely collected, investigated, and collocated in space and time with monthly satellite estimates. The main statistical parameters, including the first four conventional moments and the linear regression parameters, are estimated and provided. The differences between buoy and V2 wind products are investigated according to geographical locations (e.g. off-shore, coastal, high-latitudes, mid-latitudes and tropical areas).
- The quality of each monthly L4 wind product is assessed based on comparisons with spatially collocated ASCAT (when available) retrievals occurring during same month. The former are performed over global ocean to characterize V2 and scatterometer wind speed and direction agreements.

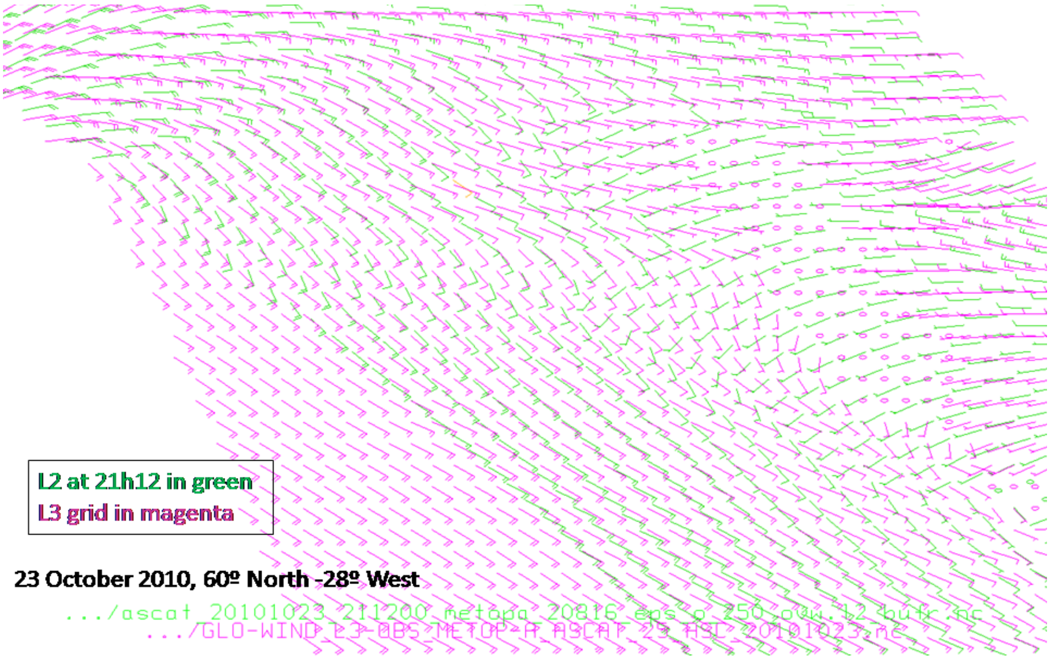
- Determination of global monthly maps of differences between L4 wind product and monthly ECMWF estimates (calculated from 6-hourly analyses) for wind speeds, zonal and meridional components. Maps illustrate the bias, rms difference and correlation coefficient spatial patterns.
- Summary of the results characterising L4 wind product (wind speed, zonal and meridional components) and ECMWF analysis. Time series of bias, rms, and correlation coefficient averaged over global ocean are set up and made available.
- Scatterplots and the related statistical parameters (bias, rms, correlation, linear regression coefficients) illustrating the comparison between L4 global ocean wind and available and validated buoy wind speeds and directions.
- Quality control of each netcdf file's geophysical content is performed based on the calculation of the statistical parameters characterizing the difference between V2 wind speed and direction data and the related ECMWF analysis. Only files such as the difference frequency exceeding three times of standard deviations is higher than 10% are checked. According to the finding, the blended wind field could be reprocessed.
- Quality control of each netcdf file's geophysical content is performed based on the calculation of the statistical parameters characterizing the difference between V2 wind speed and direction data and the related ECMWF analysis. Only files such as the difference frequency exceeding three times of standard deviations is higher than 10% are checked. According to the finding, the blended wind field could be reprocessed.

4 VALIDATION RESULTS

4.1 L3 Global ocean wind

The validation study shows that the L3 Wind product processing works correctly and the level of accuracy is very similar to the L2 accuracy as shown by the buoy collocations. The accuracy level is better than 2 m/s in wind component std.dev. with a bias of less than 0.5 m/s in wind speed (following OSI-SAF requirements). The L3 ASCAT 25km product meets these requirements for the qualification period considered (January to December 2009).

An example how the gridding routing deals with overlapping passes is shown in Figure 4.



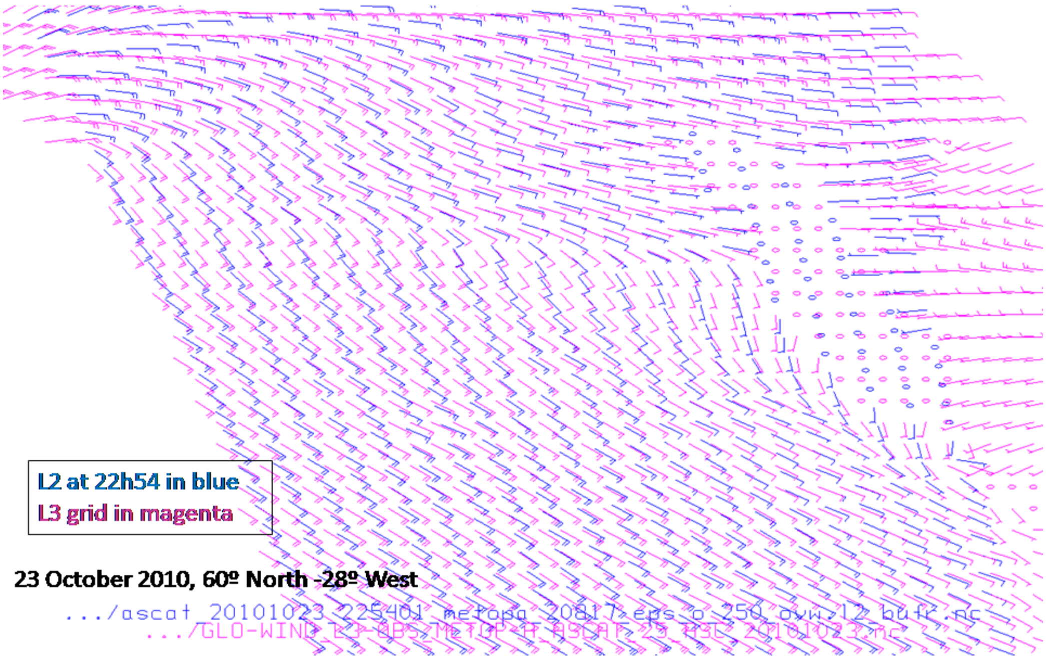


Figure 4 In the gridding procedure the information from the latest pass is used, and older information is discarded, even if the new pass does not contain valid measurements.The top figure shows the gridding result in magenta and an older pass in green. The bottom figure shows gridding result in magenta and the latest pass data in blue.

The comparison of the buoy collocation studies for L2 and L3 observation is summarized in Figure 5 and Figure 6. The monthly average of the speed bias is systematically slightly larger (more negative) for the L3 wind product (with a difference of about 0.07), but the L3 bias follows the fluctuations of the L2 biases. The difference between L2 and L3 bias in the u- and v-component is very small. The difference in monthly and yearly average of the standard deviations of speed and u- and v-components is also very small.

The scatterplots of one year of buoy collocations for L2, resp. L3 are shown in Figure 7, resp. Figure 8 and the resulting average bias and standard deviation of speed, u and v-component are summarized in Table 4.

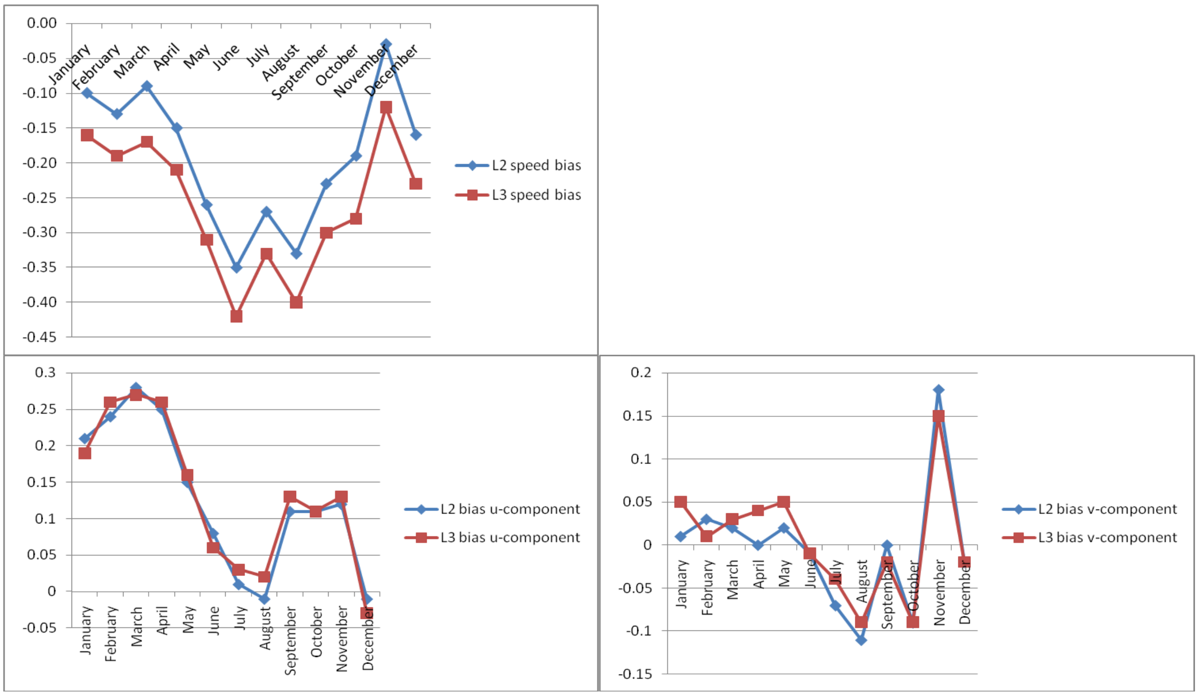


Figure 5 Buoy collocation results for L2 and L3 ASCAT 25km windproduct over 2009: average bias of speed (top) and u and v-component (bottom).

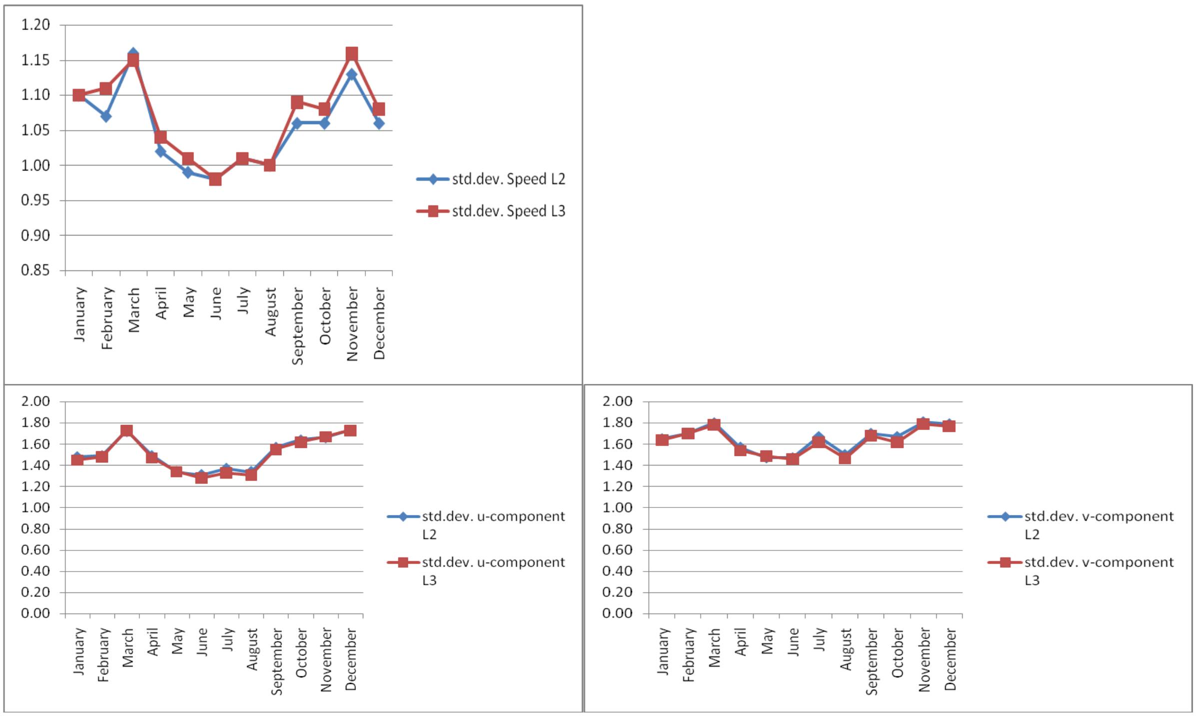


Figure 6 Buoy collocation results for L2 and L3 ASCAT 25km windproduct over 2009: average standard deviation of speed (top) and u and v-component (bottom).

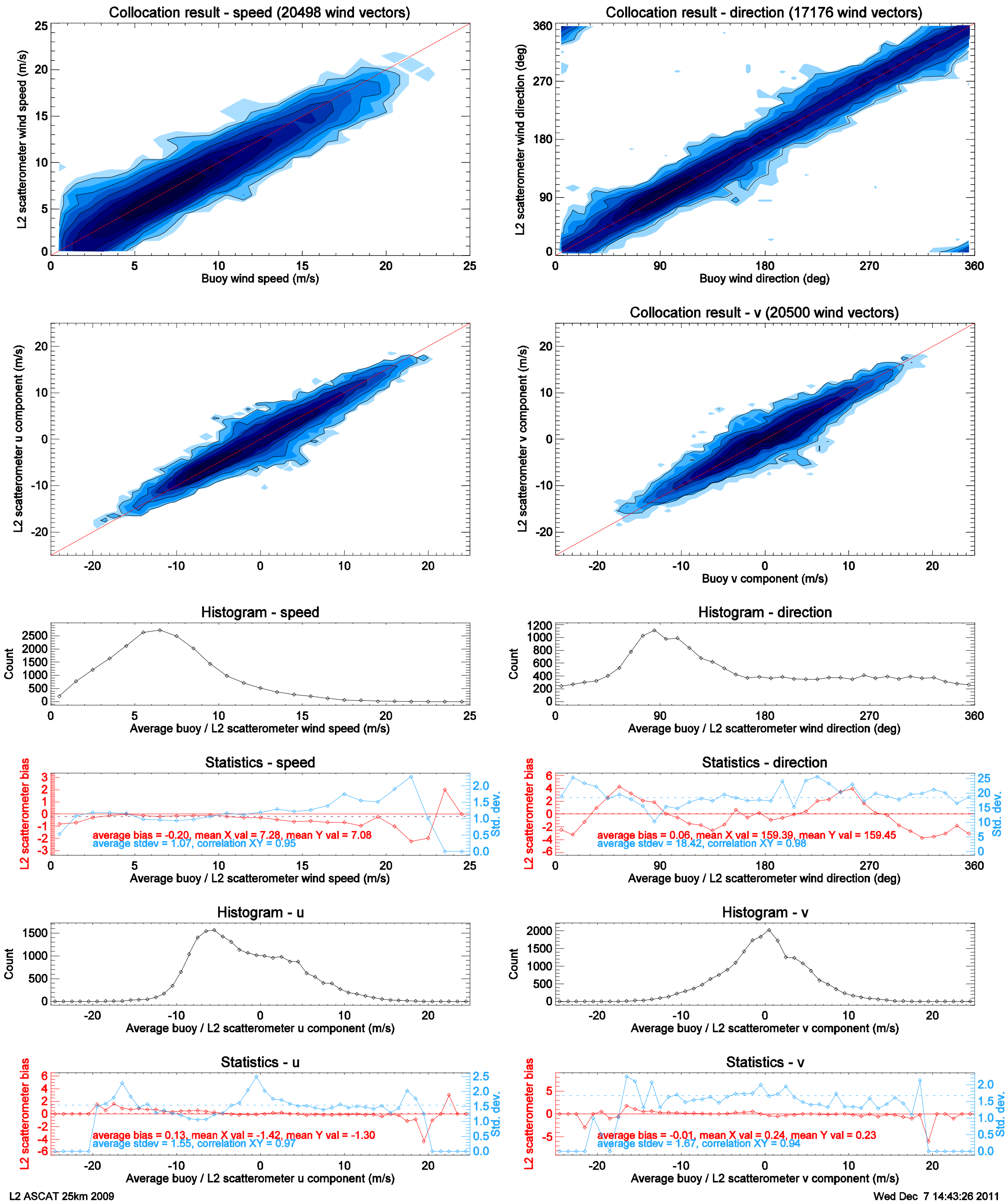


Figure 7 L2 ASCAT 25km wind product buoy collocation results for year 2009

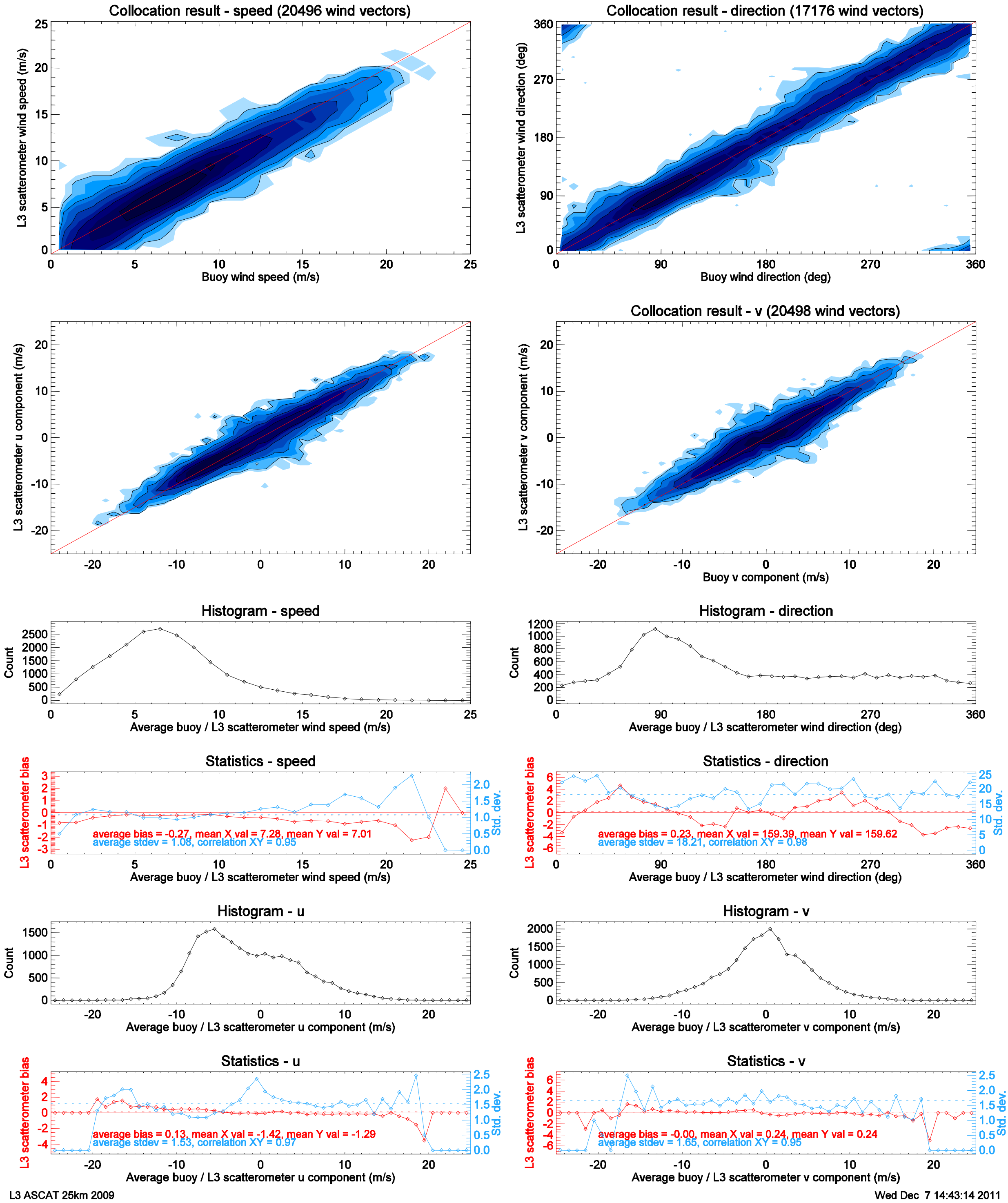


Figure 8 L3 ASCAT 25km wind product buoy collocation results for year 2009

Table 4 Buoy collocation results for L2 and L3 ASCAT 25km wind product over 2009: average bias and standard deviation of speed, u and v-component.

2009	bias speed (m/s)	bias u-component (m/s)	bias v-component (m/s)	std.dev. speed (m/s)	std.dev. u-component (m/s)	std.dev. v-component (m/s)
L2	-0.20	0.13	-0.01	1.07	1.55	1.67
L3	-0.27	0.13	0.00	1.08	1.53	1.65

In addition a collocation study between the L2 and L3 product has been performed, using pairs of L2 and L3 measurements with the same buoy measurement (in fact a triple collocation). Figure 8 provides the scatterplots for one year of collocations. The plots show a high correlation for the L2 and L3 speed, direction, u- and v-wind components of 0.99 and 1.0.

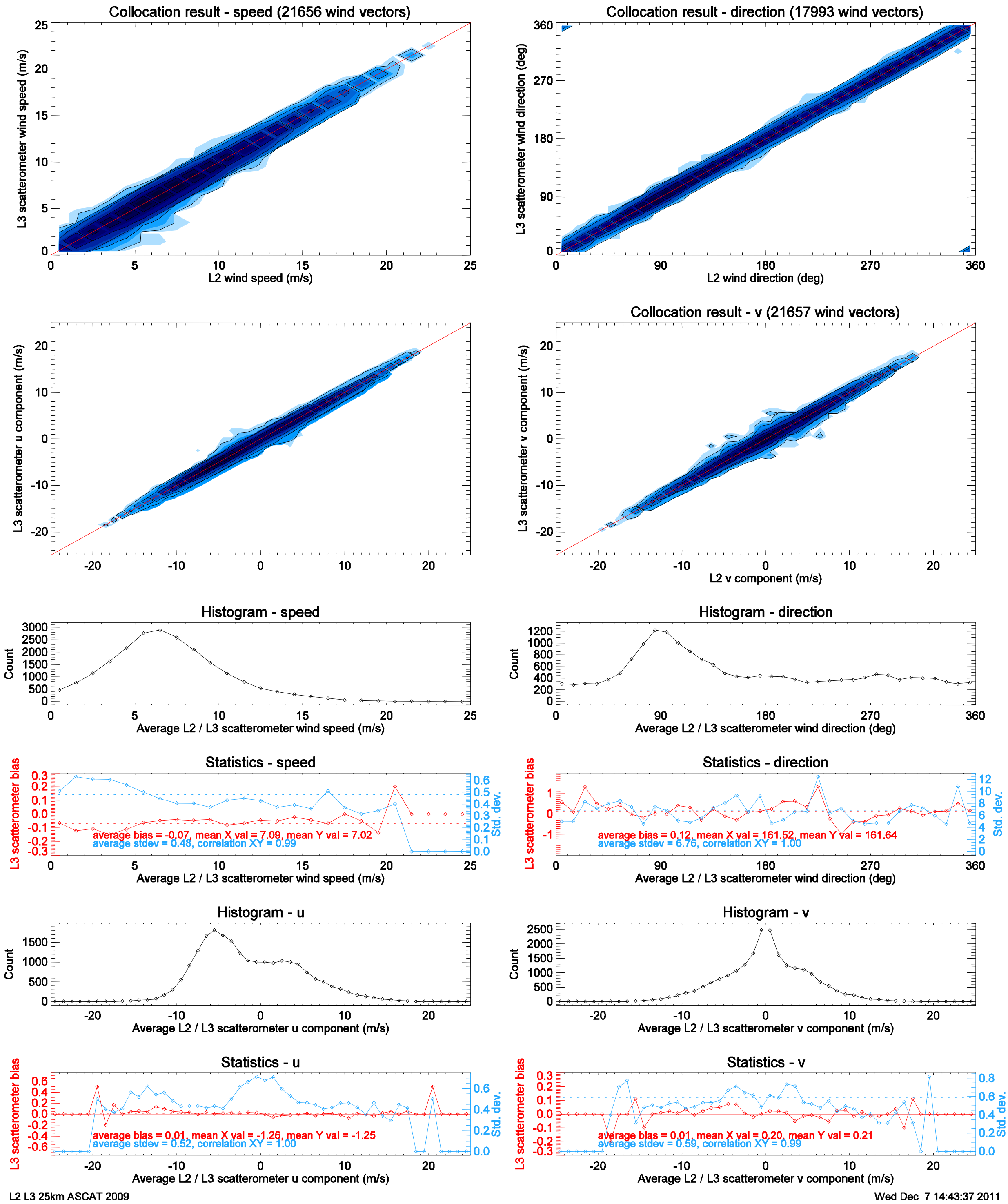


Figure 9 Collocation results of L2 and L3 ASCAT 25km wind product for year 2009

4.2 L4 Global ocean wind REP

The quality of the resulting wind fields is monthly investigated through comprehensive comparisons with monthly-averaged wind estimated derived from buoy measurements. No systematic departures are depicted and for most wind variables (wind speed, wind direction wind stress amplitude and components) the associated errors, estimate as root mean square differences (buoy – satellite), are lower than 1m/s and 20° for wind speed and direction, respectively. A significant bias is found for buoy wind speeds less than 4m/s. Monthly scatterometer winds tend to be slightly overestimated compared to in-situ data due to different spatial representation and binning. The validation is mainly based on the comparison with monthly ECMWF wind estimates over global ocean. The latter tend to be underestimated with respect to satellite data. The overall mean difference time series do not exhibit any significant trend.

Figure 10 and Figure 11 show the main statistical parameters characterizing the accuracy of L4 wind product.

No systematic departures are depicted and for most wind variable bins, the collocated data are close to the perfect line. The associated errors are lower than 1 m/s and 20° for wind speed and direction, respectively. The significant bias is found for buoy wind speeds to be less than 4 m/s. Indeed, scatterometer wind speeds tend to be slightly overestimating compared to in-situ data, especially at lower wind speeds, due to differences in spatial representation and binning effects. Table 5 summarizes the related statistical parameters: mean (Bias) and standard deviation (Std) of buoy minus blended data, scalar and vector correlation coefficients (Cor) for wind speed and direction, respectively. The overall statistics indicate that the monthly scatterometer wind fields compare well to averaged buoy data. The RMS differences do not exceed the scatterometer specifications, for wind speed and direction, respectively.

Table 5 Statistical parameters of differences between monthly buoy (NDBC, TAO, PIRATA, RAMA) and scatterometer surface wind speeds and directions estimated for 2008 – 2010 period.

		Wind Speed			**Wind Direction**		
	Length	*Bias (m/s)*	*Std (m/s)*	*Cor*	*Bias (deg)*	*Std (deg)*	*Vector Cor*
NDBC	1942	-0.24	0.82	0.89	-5	18	1.79
Tropical	5681	0.12	0.99	0.87	-4	18	1.61

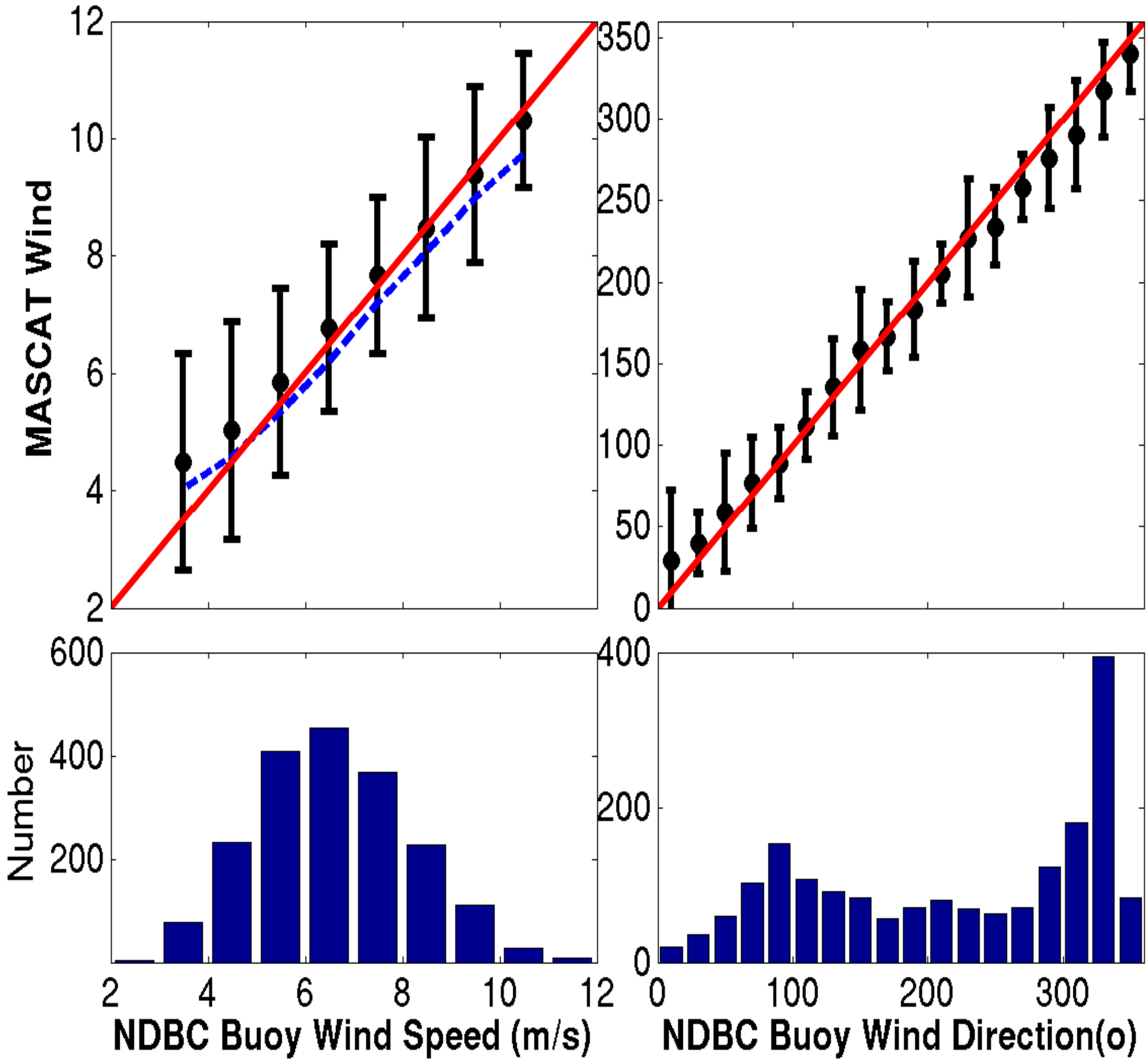


Figure 10 Comparison of monthly wind speeds (left column) and wind direction (right column) from scatterometer versus NDBC buoy winds. Figures on top show comparison results for the buoy wind speed binned in 1 m/s and 20° bins. The dashed blue line indicates the results obtained for the 1m/s binned scatterometer wind speeds. One standard deviation values estimated for each bin are also shown.

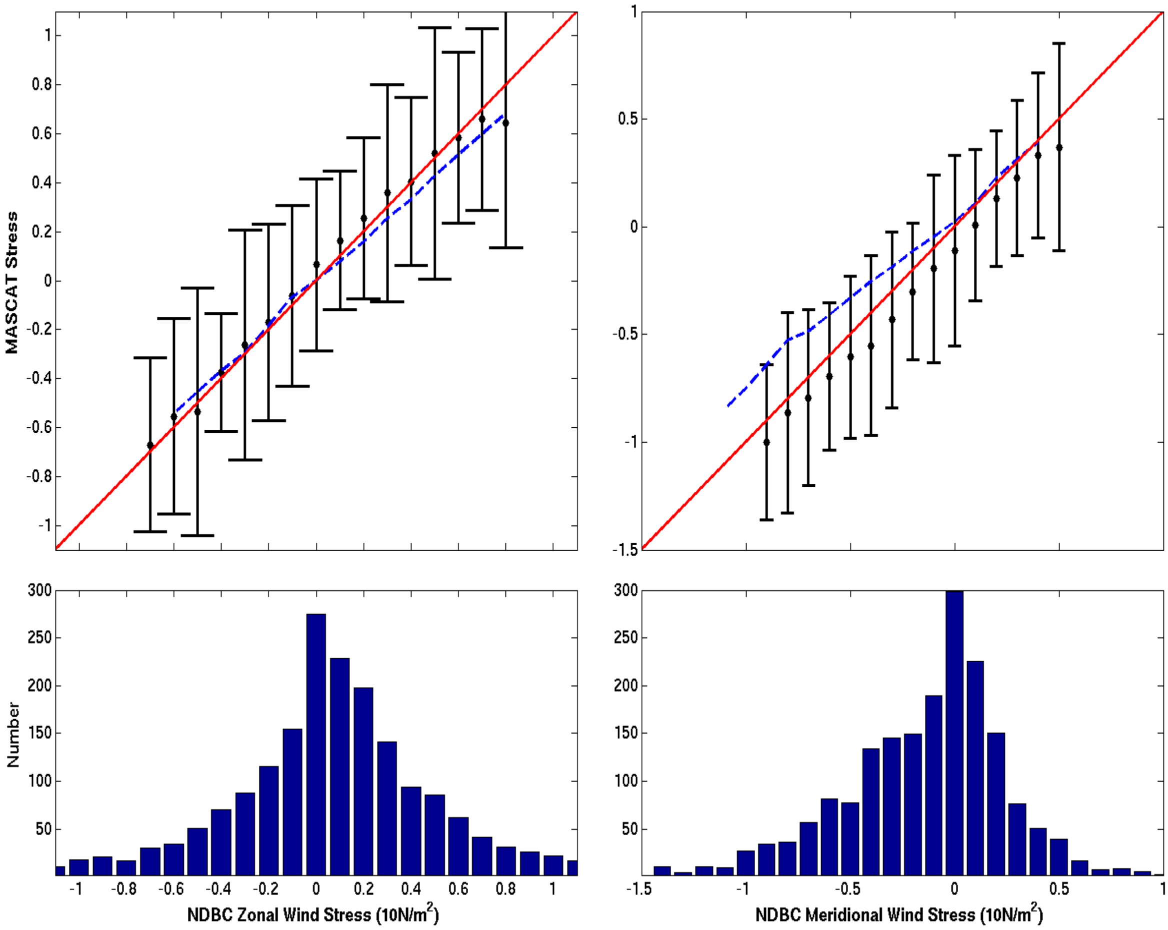


Figure 11 Comparison of monthly zonal wind stress (left column) and meridional wind stress (right column) from scatterometer versus NDBC buoy winds. Figures on top show comparison results for the buoy wind binned in 0.01 N/m² . The dashed blue line indicates the results obtained for the 0.01 N/m² binned scatterometer winds. One standard deviation values estimated for each bin are also shown.

5 QUALITY CHANGES SINCE PREVIOUS VERSION

There have been no quality changes since the previous version of the Wind Products version of the QUID.

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