Scientific Validation Report for Atlantic High Latitudes level 3 Radiative Flux products

OSI-301-b and OSI-302-b

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Document Change record

Document version	Software version	Date	Author	Change description
2.0-draft	5.3	05-12-2019	Amélie Neuville	New document to report the validation of the OSI-301-b and OSI-302-b products
2.0	5.3	12-02-2020	Steinar Eastwood	Minor updates after ORR review.

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1. Introduction

1.1. The EUMETSAT Ocean and Sea Ice SAF

The Satellite Application Facilities (SAFs) are dedicated centres of excellence for processing satellite data – hosted by a National Meteorological Service – which utilise specialist expertise from institutes based in Member States. EUMETSAT created Satellite Application Facilities (SAFs) to complement its Central Facilities capability in Darmstadt. The Ocean and Sea Ice Satellite Application Facility (OSI SAF) is one of eight EUMETSAT SAFs, which provide users with operational data and software products. More on SAFs can be read at www.eumetsat.int.

The objective of the OSI SAF is the operational near real-time production and distribution of a coherent set of information, derived from earth observation satellites, and characterising the ocean surface and the energy fluxes through it: sea surface temperature, radiative fluxes, wind vector and sea ice characteristics. For some variables, the OSI SAF is also aiming at providing long term data records for climate applications, based on reprocessing activities.

The radiative fluxes products includes longwave and shortwave downward irradiance at the surface. The longwave product is labelled Downward Longwave Irradiance (DLI) product, with identificator OSI-301-b. The shortwave product is labelled Surface Shortwave Irradiance (SSI) product, with identificator OSI-302-b. These two products replace the OSI-301 and OSI-302 products, motivated by algorithm improvements and new cloud mask (cf [RD.1]).

The OSI SAF consortium is hosted by Météo-France. The Atlantic High Latitude (AHL) radiative processing is performed at the High Latitude processing facility (HL centre), under the responsibility of the Norwegian Meteorological Institute.

1.2. Purpose and Scope of this document

The quality assessement of the OSI SAF OSI-301-b and OSI-302-b products is done before becoming an operational/pre-operational product distributed by the OSI SAF. This first assessement is explained in this scientific validation report. Then continuous monitoring of the product quality is done by the OSI SAF team and presented in the half-yearly operations reports available on the OSI SAF web site project documentation.

1.3. Target accuracy

The required accuracy of the Flux products are defined as monthly mean difference and standard deviation of the flux values compared with in situ measurements. Three requirement levels are defined in [AD.2].

- *Threshold* – The model user community gain no improved model performance using data of worse quality than this.
- *Target* – This is an intermediate quality level, between the two extremes (Threshold and Optimal), at which the product quality aim at.
- *Optimal* – The model user community can not gain from improvements in product quality beyond this level.

The validation of the OSI-301-b and OSI-302-b products will be compared with the target accuracy requirement.

	Treshold accuracy (%)		Target accuracy (%)		*Optimal accuracy* (%)	
	Mean diff	*Std*	Mean diff	Std	*Mean diff*	*Std*
DLI, OSI-301-b	*10*	*20*	5	10	*0*	*3*
SSI, OSI-302-b	*20*	*50*	10	30	*0*	*10*

Table 1: DLI and SSI quality requirements thresholds (from [AD.2]).

1.4. Reference and applicable documents

1.4.1. Reference documents

[RD.1] EUMETSAT OSI SAF
ATBD for Atlantic High Latitudes level 3 Radiative Flux products.
SAF/OSI/CDOP3/MET-Norway/SCI/MA/255, version 1.1, 05/12/2019

[RD.2] EUMETSAT OSI SAF
SVR for Atlantic High Latitudes level 3 Radiative Flux products.
SAF/OSI/CDOP3/MET-Norway/SCI/RP/372, version 2.0, 05/12/2019

[RD.3] EUMETSAT OSI SAF
PUM for Atlantic High Latitudes level 3 Radiative Flux products.
SAF/OSI/CDOP3/MET-Norway/TEC/MA/373, version 2.0, 05/12/2019

[RD.4] EUMETSAT OSI SAF
Half-Yearly Operations report
SAF/OSI/CDOP3/MF/TEC/RP/31, version 1.0, 04/09/2019

1.4.2. Applicable documents

[AD.1] EUMETSAT OSI SAF
Product Requirements Document
SAF/OSI/CDOP3/MF/MGT/PL/2-001, version 1.4, 20/12/2018

[AD.2] EUMETSAT OSI SAF
Service Specification Document
SAF/OSI/CDOP3/MF/MGT/PL/003, version 1.8, 08/07/2019

2. Validation data and method

The validation of the flux products OSI-301-b and OSI-302-b products is performed using a matchup database (MDB) containing in situ observations collocated with the satellite flux products in time and space.

The quality assessement is done against the target accuracy requirement defined in 1.3. The target accuracy corresponds to the desired preformance level (the breakthrough accuracy). If the values are not compliant to the target accuracy requirement, we consider that the product is still useful/useable as long as the values are compliant to the threshold requirement. The validation presented her is done for the period 20th August 2018 to 26th June 2019.

2.1. In situ data

2.1.1. Station description

The stations used in this validation are owned and operated by the Norwegian Meteorological Institute, Norwegian Institute of Bioeconomy Research (NIBIO), the Finnish Meteorological Institute (FMI), the Swedish Meteorological Institute (SMHI) and Deutscher Wetterdienst (DWD). Data from DWD and SMHI are extracted from WMO GTS, data from the other sources are received by email or through other direct connections. Note that we plan to include more stations in our validation at a later stage. New instruments are set up in Verlegenhuken station in Svalbard and irradiances measurements are expected to be available from summer 2020.

There are some differences in the stations used for SSI validation compared to DLI. The reason for this is partly the observation programme at stations, but also that SSI validation is more sensitive to station characteristics than DLI.

The stations used for quality assessment of the AHL flux products are shown in the following table:

Station	StId	Latitude	Longitude		Status
Apelsvoll	11500	60.70°N	10.87°E	SSI	In use, under examination due to shadow effects.
Løken	23500	61.12°N	9.07°E	SSI	Not used currently
Landvik	38140	58.33°N	8.52°E	SSI	In use
Særheim	44300	58.78°N	5.68°E	SSI	In use
Fureneset	56420	61.30°N	5.05°E	SSI	In use
Tjøtta	76530	65.83°N	12.43°E	SSI	In use
Ekofisk	76920	56.50°N	3.2°E	SSI, DLI	The station was closed due to change platforms in the position. Instrumentation is recovered and work in progress to remount equipment.
Holt	90400	69.67°N	18.93°E	SSI	Not used currently
Bjørnøya	99710	74.52°N	19.02°E	SSI, DLI	In use, Arctic station with snow on ground much of the year.
Hopen	99720	76.51°N	25.01°E	SSI, DLI	In use, Arctic station with snow on ground much of the year. Strong shadow effect by mountains.
Jan_Mayen	99950	70.93°N	-8.67°E	SSI, DLI	In use, Arctic station with snow on ground much of the year, volcanic ash deteriorates instruments in periods.
Schleswig	10035	54.53°N	9.55°E	SSI, DLI	In use
Hamburg-Fuhlsbuettel	10147	53.63°N	9.99°E	SSI, DLI	In use
Jokioinen	1201	60.81°N	23.501°E	SSI, DLI	In use. DLI was added to this station during the spring of 2016.
Sodankylä	7501	67.37°N	26.63°E	SSI, DLI	In use, temporarily disabled for SSI validation. Problems likely to be connected with snow on ground.
Kiruna	02045	67.85°N	20.41°E	SSI, DLI	Only DLI used so far. Unknown quality of the SSI observations
Visby	02091	57.68°N	18.35°E	SSI, DLI	Only DLI used so far. Unknown quality of the SSI observations
Svenska Högarna	02492	59.45°N	19.51°E	SSI, DLI	Only DLI used so far. Unknown quality of the SSI observations

Table 2: Validation stations that are currently used for AHL radiative fluxes quality assessment.

2.1.2. Computation of the daily in-situ radiative fluxes

We average the hourly station records to daily values. The station measurements may be disinterrupted, which lead to missing values. This usually happens during the night, but also during daytime. For each day, a linear interpolation was done to obtain those missing data, providing that at least 21 hourly data exist during this day. For SSI, days where hourly data are missing around the sunrise or sunset, are also rejected. The 24 hourly data per day are then averaged, so daily flux observation data are obtained.

2.1.3. List of the DLI stations and missing data

The pyrgeometer stations used for quality assessment of the AHL DLI product are selected stations from Table 2. The stations that are currently used are listed below, with in brackets, the number of missing or rejected days for the validation period used (21st August 2018 to 26th June 2019, i.e. 311 days), as well as the number of days where an interpolation was required and successfully done.

- Bjørnøya (5 missing/rejected days)
- Jan Mayen (no missing/rejected days)
- Hopen (5 missing/rejected days)
- Sodankylä (3 missing/rejected days, 11 days with interpolation)
- Jokioinen (no missing/rejected day, 28 days with interpolation)
- Schleswig (no missing/rejected day, 5 days with interpolation)
- Hamburg-Fuhlsbuettel (data only after January 2019, no missing/rejected day in 2019, 6 days with interpolation)
- Svenska Högarna (data only after January 2019, 128 missing/rejected days in 2019, 37 days with interpolation)
- Visby (data only after January 2019, 96 missing/rejected days in 2019, 50 days with interpolation)
- Kiruna (data only after January 2019, 53 missing/rejected days in 2019, 47 days with interpolation)

The validation presented here is thus done with only 6 stations for 2018, and 10 stations (whose 3 has a significant number of missing/rejected data) for 2019.

2.1.4. List of the SSI stations

The pyranometer stations used for validation of the AHL SSI product are selected stations from Table 2. The stations that are currently used are listed below, with in brackets, the number of missing or rejected days for the validation period used (21st August 2018 to 26th June 2019, i.e. 311 days), as well as the number of days where an interpolation was required and successfully done.

- Bjørnøya (5 missing/rejected days)
- Jan Mayen (no missing/rejected days)
- Hopen (5 missing/rejected days)
- Jokioinen (no missing/rejected day, 22 days with interpolation)
- Hamburg-Fuhlsbuettel (data only after January 2019, 5 days with interpolation)
- Apelsvoll (12 missing/rejected days, 11 days with interpolation)
- Tjøtta (10 missing/rejected days, 2 days with interpolation)
- Landvik (16 missing/rejected days, 5 days with interpolation)
- Særheim (19 missing/rejected days, 5 days with interpolation)

- Fureneset (16 missing/rejected days, 6 days with interpolation)

2.2. Satellite data product

The radiative fluxes that are validated in this report, are retrieved from AVHRR data collected by Metop-A, Metop-B and NOAA-19 satellites between 20th August 2018 and 26th June 2019. The radiative fluxes are computed on the satellite swath for each satellite passage (method described in [RD.1]). These radiative flux products are then resampled to a polar stereographic map projection with 5 km grid resolution. During this gridding process only the data which have confidence levels as excellent, good or acceptable are kept. The map projected passage products are then averaged into daily products in the same map projection, i.e. the OSI SAF Atlantic High Latitude DLI (OSI-301-b) and SSI (OSI-302-b) products. These products are the ones validated below.

2.3. Validation method

For a given day of the validation period and a given observation station, averages of the satellite estimates (OSI-301-b, OSI-302-b respectively) for the grid points located within a radius of 5km around the observation station are created. These daily values for the osisaf radiative fluxes are compared to the daily values observed for all stations.

The monthly statistics that are presented in Table 3 and Table 4 are for all stations together (ungrouped data statistics). Be aware that the statistics for the old product presented in Table 5 and Table 6 are calculated slightly different, using grouped data statistics. This sometimes gives a bit different results, but does not change the conclusion significantly.

3. Validation results

3.1. AHL DLI (OSI-301-b) validation results

The following table provides the AHL DLI quality results over the reporting period.

AHL DLI quality results from August 2018 to June 2019								
Month	Number of cases	Mean observed DLI in Wm^{-2}	Mean diff. in Wm^{-2} (*)	Mean diff. in % (req.: +/- 5%)	Mean diff. margin in % (**)	SD in Wm^{-2}	SD in % (req.: +/- 10%)	SD margin (***) in %
AUG. 2018	72	326.13	-1.13	-0.35	93.05	16.94	5.19	48.06
SEP. 2018	180	317.77	-0.89	-0.28	94.41	17.4	5.47	45.26
OCT. 2018	185	297.42	-2.72	-0.91	81.73	16.57	5.57	44.3
NOV. 2018	180	293.82	-6.74	-2.29	54.13	18.71	6.37	36.32
DEC. 2018	186	284.73	-5.4	-1.9	62.06	19.31	6.78	32.17
JAN. 2019	259	262.24	-1.46	-0.56	88.88	18.01	6.87	31.34
FEB. 2019	216	267.35	-2.01	-0.75	84.98	17.03	6.37	36.31
MAR. 2019	240	265.07	4.54	1.71	65.73	17.09	6.45	35.53
APR. 2019	236	279.17	1.66	0.59	88.12	18.97	6.79	32.06
MAI 2019	280	300.05	4.55	1.52	69.67	16.05	5.35	46.52
JUN. 2019	238	322.14	7.41	2.3	54	22.59	7.01	29.87

(*) Mean diff = mean (osisaf irradiance estimate - observed irradiance)
(**) Mean diff. margin = 100 * (1 - (|mean diff. / mean diff. req.|))
(***) SD margin = 100 * (1 - (SD / SD req.))
100 refers then to a perfect product, 0 to a quality just as required. without margin.
A negative margin indicates that the product quality does not fulfil the target requirement.
Green colour indicates the months for which the target requirements are fulfilled.

Table 3: OSI-301-b quality results from AUG. 2018 to JUN. 2019

3.2. AHL SSI (OSI-302-b) validation results

The following table provides the SSI quality results over the reporting period.

AHL SSI quality results from August 2018 to June 2019								
Month	Number of cases	Mean observed SSI in Wm^{-2}	Mean diff. in Wm^{-2} (*)	Mean diff. in % (req.: +/- 10%)	Mean diff. margin in % (**)	SD in Wm^{-2}	SD in % (req.: +/- 30%)	SD margin (***) in %
AUG. 2018	115	115.01	-0.95	-0.83	91.74	17.02	14.8	50.67
SEP. 2018	292	78.57	-3.8	-4.84	51.63	16.09	20.48	31.73
OCT. 2018	232	47.21	-4.72	-10.01	-0.07	10.49	22.21	25.96
NOV. 2018	118	18.01	-3.14	-17.42	-74.15	7.67	42.57	-41.9
DEC. 2018	24	13	-3	-23.04	-130.45	5.96	45.83	-52.76
JAN. 2019	98	20.87	-5.86	-28.08	-180.8	8.32	39.88	-32.93
FEB. 2019	205	38.48	-7.58	-19.7	-97.02	12.02	31.25	-4.15
MAR. 2019	313	70.01	-11.51	-16.44	-64.39	15	21.42	28.59
APR. 2019	319	156.97	-6.68	-4.25	57.46	20.76	13.23	55.91
MAI 2019	327	184.22	-11.69	-6.35	36.52	24.01	13.03	56.55
JUN. 2019	283	211.03	-6.28	-2.98	70.23	30.6	14.5	51.67

(*) Mean diff = mean (osisaf irradiance estimate - observed irradiance)
(**) Mean diff. margin = 100 * (1 - (|mean diff. / mean diff. req.|))
(***) SD margin = 100 * (1 - (SD / SD req.))
100 refers then to a perfect product, 0 to a quality just as required. without margin.
A negative margin indicates that the product quality does not fulfil the target requirement.
Green colour indicates months/values for which the target requirements are fulfilled.
Yellow colour indicates months/values for which the target requirements are partially or almost fulfilled.
Orange colour indicates months/values for which the target requirements are not fulfilled.

Table 4: OSI-302-b quality results over AUG. 2018 to JUN. 2019

4. Discussion

4.1. AHL DLI (OSI-301-b)

The OSI-301-b product fulfils the target requirement for all the presented months: the monthly mean difference is always under 5% and the standard deviation is always under 10%. The standard deviation is relatively constant over all the months (variations between 5.2% and 7.0%, 16.9 Wm^{-2} to 22.6 Wm^{-2}). The sign of the mean difference is variable, and no clear trend in the sign can neither be seen when looking at the statistics per station (not presented here) or the overall results in 3. The mean difference varies between -6.7 Wm^{-2} (-2.3% – November 2018) and 7.4 Wm^{-2} (2.3% – June 2019). We noticed a mean difference anomaly at the Hamburg-Fühlsbüttel station for the June month: the mean difference is of 28.8 Wm^{-2} (8.3%), which is higher than the mean difference values observed for the other months at Hamburg. We do not know the reason of this perturbation as the observational data used for this station is extracted from WMO GTS and detailed information on the station is lacking. WMO OSCAR is not giving any further information.

The quality of the OSI-301-b product is better than that of the OSI-301 product. Indeed, as reported in [RD.4] (validation table recalled in the annexe of this document, Table 5), the quality of the OSI-301 did not fulfil the requirements for August 2018 (for the mean difference) and June 2019 (for the mean difference and the standard deviation).

4.2. AHL SSI (OSI-302-b)

The OSI-302-b product fulfils the target requirement for the mean difference for 5 of the 11 months, and October 2018 is very close to fulfilling the requirements as well. For the standard deviation, the requirements are fulfilled for 7 of the 11 months. For December the SSI estimate validation is weak as it is based on only 24 cases.

It has to be noticed that the requirements for the autumn and winter months is difficult to achieve at high latitudes. In winter time the SSI values at high latitudes are very low. Thus the relative mean difference and the relative standard deviations get higher. The mean difference is actually of quite similar order of magnitude for all the months: it varies between -0.9 Wm^{-2} and -11.7 Wm^{-2}.

We notice that the mean difference is systematically negative: the OSISAF SSI values are lower than the values measured at the stations. This underestimation might be due to challenges related to snow covered surfaces and cloud effects (e.g. multiple reflections) or systematic misclassification of clouds by the cloud mask/type at high latitudes. The latter is hard to check since there is usually no information on cloud at the validation stations and problems with cloud masking will affect SSI stronger than DLI due to directional and multiple reflection effects. Once temporal and spatial effects on the bias are properly known and understood, the algorithm can be tuned to remove the systematic negative bias.

The standard deviation is between 6 Wm^{-2} and 30.6 Wm^{-2}. It is not clear why the standard deviation is so high in April, May and June. This might be due to difficulties to catch the high variability of the conditions in space and time. Indeed, during these months, the snow is melting, providing variation on how the light reflects on the soil. Furthermore, cloud cover generally is more fragmented in this period than later in the year. During this period, the sun is in addition high enough, so multiple reflections between the snow and the clouds may occur, a phenomena that is observed by solar energy productions sites in the northern part of Scandinavia (e.g. at the power plant in Piteå – Personal communication with Professor Tobias Bostrøm, UiT). We notice that the standard deviation in June in Hamburg-Fühlsbüttel is higher than that of the other months. As explained in 4.1 it might have been some perturbations around this station in June, but this alone can't explain the high standard deviation values of June.

The quality of the OSI-302-b product is better than that of the OSI-302 product. Indeed, as reported in [RD.4] (validation table recalled in the annex of this document, Table 6), the quality of the OSI-301 did not fulfil the target requirement about the mean difference for any of the months. For the standard deviation, the quality of the OSI-302 product fulfilled the target requirement for 5 of the 11 months.

4.3. Note about the number of cases

The number of cases shows the numbers of valid daily data where both observations and satellite retrievals are available. For instance, if we consider *m* stations having n_i valid daily data set of both flux observations and flux retrievals, then the number of cases is $n_1+\ldots+n_m$. The number of cases in this validation is not the same as that for the OSI-301/OSI-302 products (Table 6) as:

- The SSI retrieval is now not done when the solar zenith angle is lower than 80 degrees. Those SSI data are thus not counted, contrary to what was done for OSI-302 product. This explains why we have fewer data during the winter time, and why we have much fewer cases for SSI than for DLI

- We now use data collected by EARS while the data from both the local MET Norway receiving station and from EARS were used.

- In OSI-301/OSI-302 the data from the satellite NOAA-18 were also used. This satellite is ageing which could also explain some worse quality especially for SSI (since the visible channels degrades more than the infrared channels). It was therefore excluded from our retrieval. We thus have less frequent passages over the stations. In winter time when the days are very short there is thus less chance of having available satellite observations during the day time.

- Compared to the algorithm used to obtain the OSI-301/OSI-302 products, we apply a stricter criterium about the quality when gridding the data. This may lead to more missing daily data.

- The daily station data were not computed if less than 20 hourly data were available.

5. Conclusion

The OSI-301-b and OSI-302-b products have been validated and compared with the target requirement. The overall results for OSI-301-b and OSI-302-b are better than the current products OSI-301 and OSI-302. It is suggested to replace OSI-301/OSI-302 with OSI-301-b/OSI-302-b.

6. Annex

Validation tables for OSI-301/OSI-302 presented in [RD.4] are recalled hereafter, with added colors.

AHL DLI quality results from July 2018 to June 2019								
Month	Number of cases	Mean DLI in Wm^{-2}	Mean diff. in Wm^{-2}	Mean diff. in % (req.: +/- 5%)	Mean diff. margin in %(*)	SD in Wm^{-2}	SD in % (req.: +/- 10%)	SD margin (**) in %
JUL. 2018	297	345.02	8.89	6.67	-33.4	12.65	3.65	63.5
AUG. 2018	286	338.66	8.84	5.59	-11.8	11.65	3.44	65.6
SEP. 2018	298	319.98	7.38	4.59	8.2	13.68	4.28	57.2
OCT. 2018	310	299.53	2.24	2.18	56.4	15.54	5.22	47.8
NOV. 2018	297	296.36	-6.20	2.37	52.6	13.77	4.69	53.1
DEC. 2018	295	288.62	-8.21	2.88	42.4	13.60	4.76	52.4
JAN. 2019	307	262.43	3.22	1.61	67.8	16.36	6.29	37.1
FEB. 2019	277	268.70	3.16	1.83	63.4	16.17	6.14	38.6
MAR. 2019	297	263.35	-3.00	1.66	66.8	16.25	6.33	36.7
APR. 2019	281	274.96	-9.06	4.68	6.4	14.02	5.16	48.4
MAY 2019	302	298.37	-4.69	3.11	37.8	12.43	4.18	58.2
JUN. 2019	297	310.85	-20.52	9.63	-92.6	36.37	13.76	-37.6

(*) Mean diff. margin = 100 * (1 - (|mean diff. / mean diff. req.|))
(**) SD margin = 100 * (1 - (SD / SD req.))
100 refers then to a perfect product, 0 to a quality just as required. without margin.
A negative margin indicates that the product quality does not fulfil the target requirement.
Green colour indicates months/values for which the target requirements are fulfilled.
Yellow colour indicates months/values for which the target requirements are partially or almost fulfilled.
Orange colour indicates months/values for which the target requirements are not fulfilled.

Table 5: OSI-301 (AHL DLI) quality results for over JUL. 2018 to JUN. 2019 (from [RD.4]).

AHL SSI quality results from July 2018 to June 2019								
Month	Number of cases	Mean SSI in Wm^{-2}	Mean diff. in Wm^{-2}	Mean diff. in % (req.: +/- 10%)	Mean diff. margin in %(*)	SD in Wm^{-2}	SD in % (req.: +/- 30%)	SD margin(**) in %
JUL. 2018	305	209.09	-37.04	17.08	-70.8	24.79	12.92	56.9
AUG. 2018	281	119.50	-22.92	19.74	-97.4	25.36	22.06	26.5
SEP. 2018	295	73.96	-15.67	20.46	-104.6	19.54	27.15	9.5
OCT. 2018	305	33.64	-8.41	24.42	-144.2	16.07	43.02	-43.4
NOV. 2018	295	8.27	-3.31	18.80	-88.0	10.42	74.59	-148.6
DEC. 2018	300	3.23	-	-		-	-	-
JAN. 2019	431	12.09	6.67	38.42	-284.2	11.04	58.34	-94.5
FEB. 2019	389	34.25	14.76	29.28	-192.8	20.24	55.27	-84.2
MAR. 2019	417	77.91	24.74	32.15	-221.5	24.41	31.22	-4.07
APR. 2019	401	170.90	43.36	24.73	-147.3	31.39	18.67	37.8
MAY 2019	425	193.49	44.82	23.02	-130.2	37.62	19.53	34.9
JUN. 2019	403	223.07	51.85	23.35	-133.5	37.38	16.90	43.7

(*) Mean diff. margin = 100 * (1 - (|mean diff. / mean diff. req.|))
(**) SD margin = 100 * (1 - (SD / SD req.))
100 refers then to a perfect product, 0 to a quality just as required. without margin.
A negative margin indicates that the product quality does not fulfil the target requirement.
Green colour indicates months/values for which the target requirements are fulfilled.
Yellow colour indicates months/values for which the target requirements are partially or almost fulfilled.
Orange colour indicates months/values for which the target requirements are not fulfilled.

Table 6: OSI-302 (AHL SSI) quality results over JUL. 2018 to JUN. 2019 (from [RD.4]).