EUMETSAT OSI SAF
OCEAN AND SEA ICE

OSI-SAF MR ice drift and Ice surface temperature performance from Metop-A and Metop-B AVHRR

Medium resolution sea ice drift (OSI-407 series)

High latitudes L2 sea and sea ice surface temperature (OSI-205 series)

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Gorm Dybkjaer

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Scope of the document

The scope of this report is to evaluate the transition from Metop-A to Metop-B AVHRR sensor data as input data to the production of the OSI-SAF MR ice drift (OSI-407) and ice surface temperature (OSI-205) products and to show that there is a consistent product performance at the transition to Metop-B.

Quality assesments of the ice drift and ice surface temperature products are performed by comparison with in-situ drifters and subsequently an intercomparison of the quality assesment statistics generated for the two products from Metop-A AVHRR sensor data and Metop-B AVHRR sensor data in an overlap period in May to August 2017 has been carried out. The results are presented and evaluated below.

1. Medium resolution sea ice drift (OSI-407 series)

1.1. Quality assessment dataset

Quality assessment is performed by collocation of the drift vectors with the trajectories of in situ drifters. The method is described in the OSI-SAF half-year validation report.

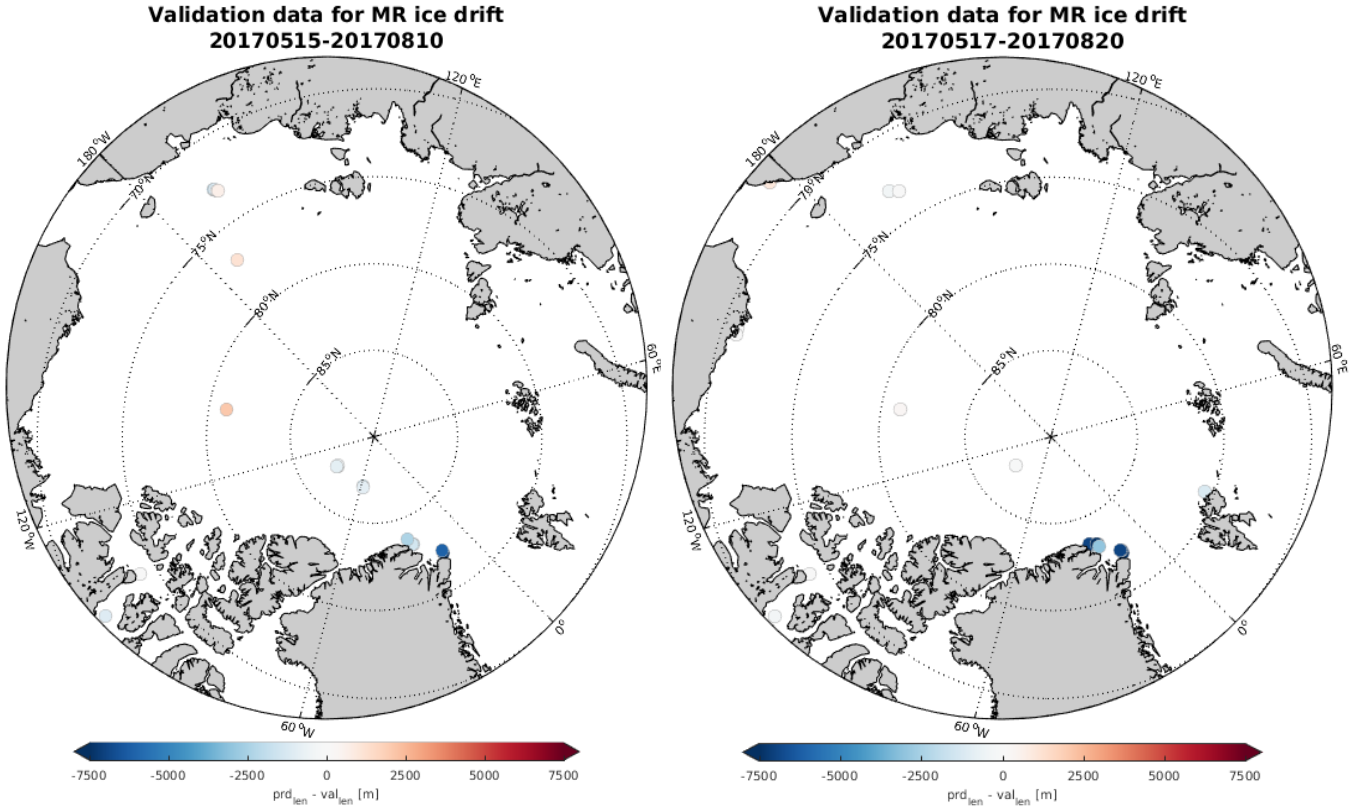
The Medium Resolution Sea Ice Drift product comprises two production modes, a summer mode from May to August, and a winter mode from September to April. These modes are using Visible (AVHRR channel 2) and Thermal Infra-Red (AVHRR channel 4), respectively.

The dataset used in this performance analysis covers the summer period (Visible mode) from May to August 2017.

The product requirements for the MR ice drift product on threshold accuracy, target accuracy and optimal accuracy is 5 km, 2 km and 1 km yearly standard deviation, respectively.

1.2. Quality assessment statistics

Tables 1 and 2 below, show selected error statistics from comparison of Metop-A and Metop-B ice drift products respectively, against drifting buoys. Bias (x-bias, y-bias) and standard deviation of errors (x-std, y-std) are shown, in meters, for the 2 perpendicular drift components (x, y). Statistics from the best fit between OSI-407 and buoy data are shown as slope of fit (α), intersect (beta) and correlation coefficient (rho). N, indicate the number of data *pairs* that are applied in the error statistics.



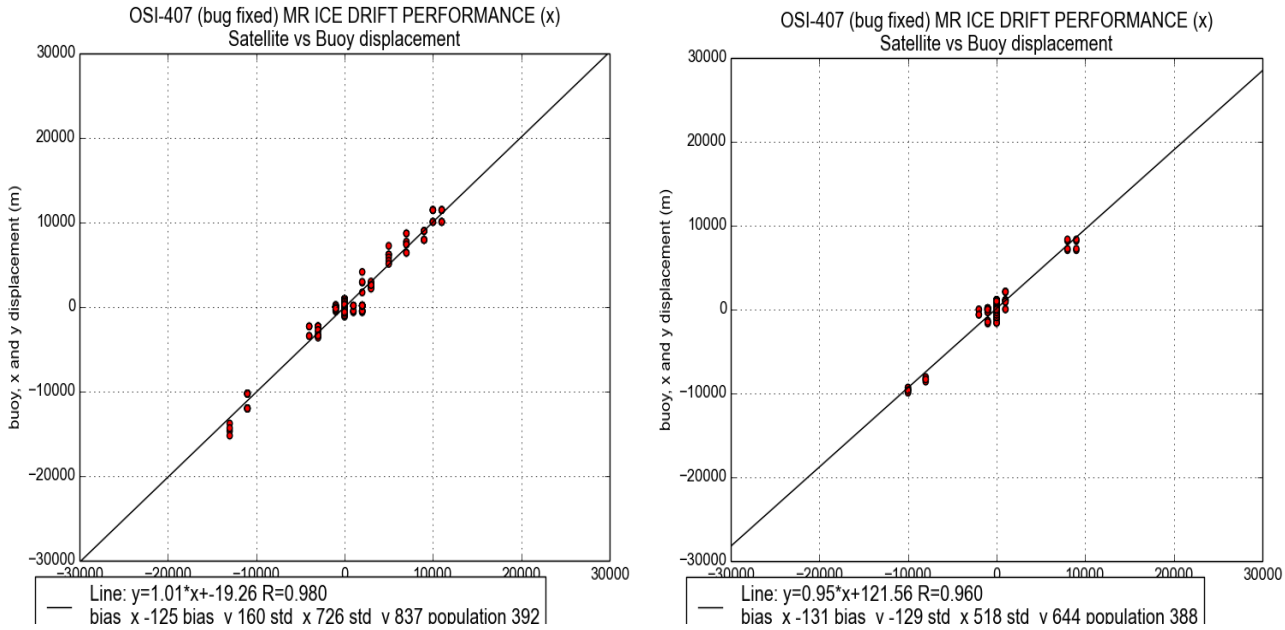
Location of GPS drifters for the quality assessment period (MAY. 2017 to AUG. 2017) for match-up with Metop-A [left] and Metop-B [right]. The shade of each symbol represents the difference (prod-ref) in drift length in meters.

Month	b(X) [m]	b(Y) [m]	σ(X) [m]	σ(Y) [m]	α	β [m]	ρ	N
MAY. 2017	953	13	457	715	1.10	-375	0.99	32
JUN. 2017	-410	420	640	906	0.91	63	0.94	216
JUL. 2017	62	-197	599	570	1.02	69	0.99	144
AUG. 2017	-	-	-	-	-	-	-	-
All four months	-125	160	726	837	1.01	-19	0.98	392

Tableau 1: Metop-A based MR sea ice drift product (OSI-407) performance, MAY. 2017 to AUG. 2017

Month	b(X) [m]	b(Y) [m]	σ(X) [m]	σ(Y) [m]	α	β [m]	ρ	N
MAY. 2017	326	496	192	126	0.98	-520	0.99	8
JUN. 2017	-174	-86	556	653	0.93	127	0.97	236
JUL. 2017	32	-203	504	695	0.46	18	0.428	80
AUG. 2017	-	-	-	-	-	-	-	-
All four months	-131	-129	518	644	0.95	122	0.96	388

Tableau 2: Metop-B based MR sea ice drift product (OSI-407) performance, MAY. 2017 to AUG. 2017



Scatterplots of match-up ice drift from GPS drifters for the quality assessment period (MAY. 2017 to AUG. 2017) for match-up with Metop-A [left] and Metop-B [right] ice drift products.

1.3. Comments

Semi-automatic quality control (based on threshold on maximum buoy drift, visual inspection on drift scatter plots (buoy vs. satellite) and inspection of extreme outliers) has been carried out for the comparison data period of May-August 2017. A number of extreme outliers has been disqualified from the validation data, based on visual inspection of the buoy locations;

- Buoy ID 48633 supposedly grounded on the shore in Alaska on 20170603-20170607.
- Buoy ID 48642 supposedly grounded on the shore in Alaska on 20170603-20170728.
- Buoy ID 48726 supposedly grounded on the shore at Bering Strait on 20170606.
- Buoy ID 48769 supposedly grounded in the Canadian Archipelago on 20170606-20170702.
- Buoy ID 48770 supposedly stock in consolidated ice north of Greenland 20170517-20170810.

After having disqualified the above mentioned buoys, the quality assessment dataset consisted of match-ups for Metop-A and the Metop-B sensor data with 6 different buoys each, 5 of them being the same buoys. In August there was overlap of Metop-B with only one buoy and this buoy reported drift below 1km/day. Corresponding satellite ice drift was reported to be zero. Thus, statistics could not be calculated for this month. There was no overlap of Metop-A with qualified buoys in August.

May and June show reasonably good correspondence with buoy drift for both Metop-A and Metop-B ice drift products, despite a limited number of match-ups in May. July also show good correspondence between buoy and Metop-A products. For Metop-B, all measured ice drifts in July – both from satellite and buoy – where <1km/day, thus making it difficult to calculate meaningful statistics and resulting in low correspondence. Bias and Std for Metop-A data and Metop-B data are comparable for all separate months and all values are below 1km, thus meeting the general product requirement target accuracy of 2 km on (yearly) standard deviation.

2. Ice surface temperature (in OSI-205 series)

2.1. Quality assessment dataset

Quality assessment is performed by collocation of the ice surface temperature product with temperature data from in situ drifters. The method is described in detail in the OSI-SAF half-year validation report.
The Level 2 HL SST/IST (OSI-205) is derived from polar satellites data, currently from Metop-A.
The OSI-205 is a high latitude SST and global ice surface temperature (IST) and marginal ice zone surface temperature product. SST data from OSI-205 will be added at the next HYR reporting for the full period of OSI-205 operation.
The IST accuracy requirements given by the Product Requirement Document are split into two: Namely, for in situ IR radiometers, and for traditional in situ buoy data. The reason for this is discussed in the ATBD for OSI-205. Here only validation results for OSI-205 vs traditional buoy data (air temperatures) are shown. Target accuracy requirement on IST Std and bias (in Kelvin degrees) is 3.0 and 3.5 respectively. Threshold accuracy requirements is 4.0 and 4.5 respectively.

2.2. Quality assessment statistics

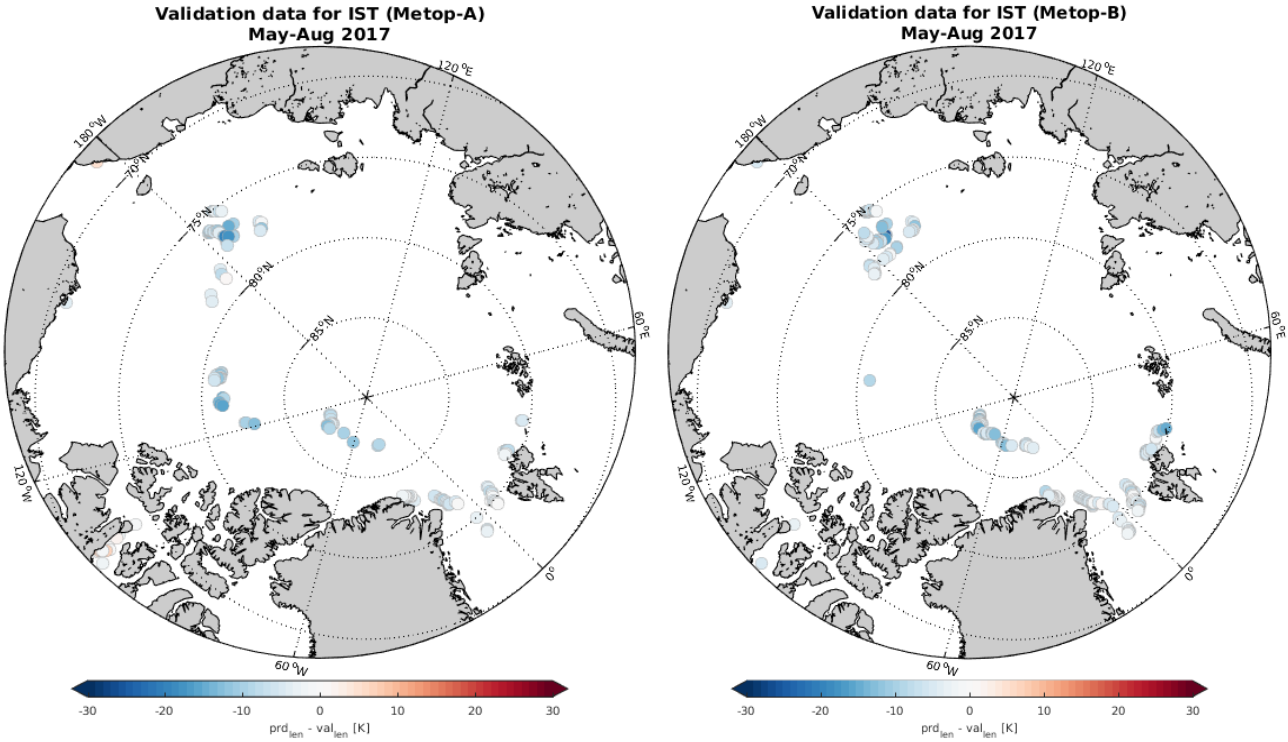
The following tables and figures provide the monthly mean quality results over the reporting period. Conventional measures as Standard Deviation of errors (Std) and bias are calculated for monthly averages for both day- and nighttime (table values) and all day (graph). Where quality levels 4 and 5 are included in the data that are stratified by day and night data and only best quality data (ql 5) are used in the all-day-quality graph. Daytime is defined for data with sun-zenith angles smaller than 90 degrees and nighttime data is defined for sun-zenith angles greater than 110 degrees. In situ observations and the centre of the OSI-205 level-2 pixel must be within 3 km of each other and observation times must be within 15 minutes.
Table 3 and 4 below, show selected error statistics against drifting buoys. Bias and standard deviation of errors are shown, in degrees. Statistics from the best fit between OSI-205 and buoy data are shown as slope of fit (α), intersect (beta) and correlation coefficient (rho). N, indicate the number of data that are applied in the error statistics.

Month	b	σ	α	β	ρ	N
MAY. 2017	-4.24	2.30	0.34	178	0.32	429
JUN. 2017	-5.26	0.40	0.00	270	0.00	32
JUL. 2017	-	-	-	-	-	-
AUG. 2017	-	-	-	-	-	-
All four months	-4.31	2.24	0.36	173	0.33	461

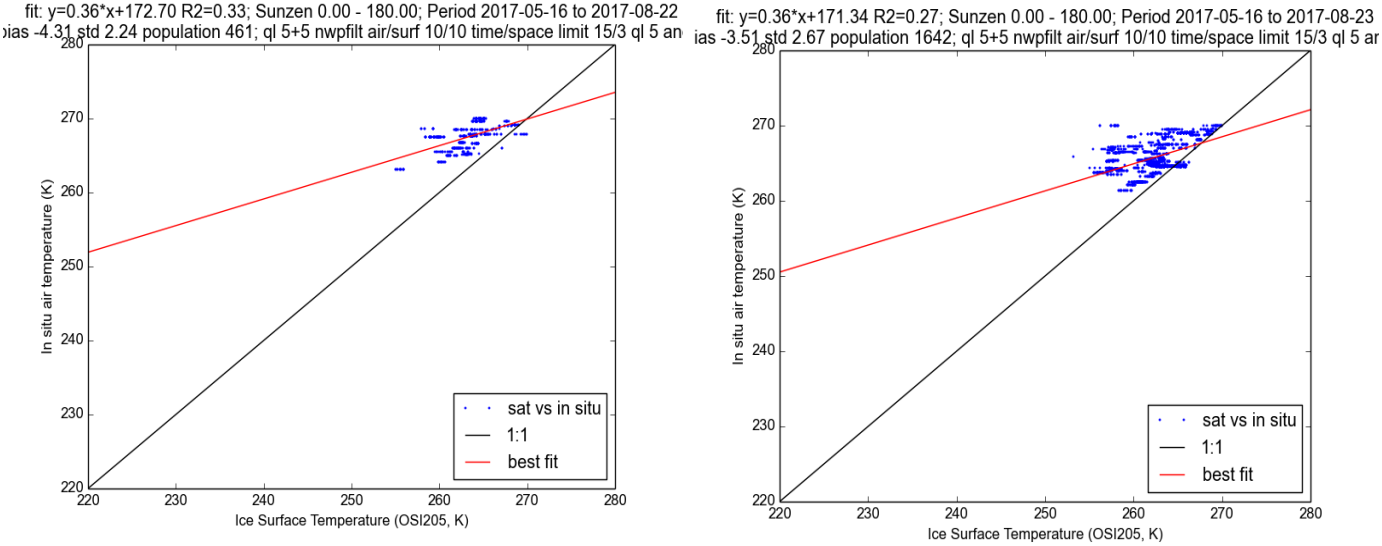
Tableau 3: Metop-A based MR ice surface product (OSI-205) performance, MAY. 2017 to AUG. 2017

Month	b	σ	α	β	ρ	N
MAY. 2017	-3.56	2.68	0.34	177	0.23	1602
JUN. 2017	-1.69	1.19	0.11	240	0.98	40
JUL. 2017	-	-	-	-	-	-
AUG. 2017	-	-	-	-	-	-
All four months	-3.51	2.67	0.36	171	0.27	1642

Tableau 4: Metop-B based ice surface product (OSI-205) performance, MAY. 2017 to AUG. 2017



Location of GPS drifters for the quality assessment period (MAY. 2017 to AUG. 2017) for match-up with Metop-A [left] and Metop-B [right]. The shade of each symbol represents the difference (prod-ref) in ice surface temperature in Kelvin degrees.



Scatterplots of match-up ice surface temperature from GPS drifters for the quality assessment period (MAY. 2017 to AUG. 2017) for match-up with Metop-A [left] and Metop-B [right] ice surface temperature (OSI-205) products.

2.3. Comments

Semi-automatic quality control based on threshold on maximum buoy drift, visual inspection on drift scatter plots (buoy vs. satellite) and inspection of extreme outliers, has been carried out for the

comparison data period of May-August 2017. A number of extreme outliers has been disqualified from the validation data, based on visual inspection of the buoy data and locations;

- Buoy ID 48633 supposedly grounded on the shore in Alaska on 20170516 (also excl. from the OSI-407 quality assessment)
- Buoy ID 26571 due to reporting extreme values in Fram Strait 20170516-20170523.

After having disqualified the above mentioned buoys, the quality assessment dataset consisted of match-ups for Metop-A and the Metop-B sensor data with the same 6 individual buoys. The Metop-B data set has three times as many qualified match-ups than the Metop-A data set. A reason for this, is likely to be found in the overlap between buoy locations with satellite swath data. Quality control on in-situ data was applied with eg. criteria for the maximum temperature difference between buoy and NWP data. Also, only data with quality level 5 was used in the quality assessment. This decreases the amount of in-situ data qualified for comparison. For July and August - being summer months of limited ice cover and a limited number of available buoys - there was not enough qualified in-situ data to calculate meaningful statistics. Due to a short comparison period in summer, the temperatures only span an interval of 10-15 K. This 'clustering' of the temperature data - as evident in the scatter plots – results in a low correlation on the linear fit to data.
Despite these limitations in the assessment, the validation results show that the Std for the Metop-B data is lower than that for the Metop-A data and within the threshold accuracy. Bias for the Metop-B and Metop-A data is comparable (Metop-A data performing slightly better than Metop-B data) and within the target accuracy. The accuracy requirements applies for the product performance on an yearly average and thus is only mentioned here for reference.

3. Conclusion

Evaluation of the quality assesment from Metop-A and Metop-B data as input to the OSI-SAF MR ice drift (OSI-407) and ice surface temperature (OSI-205) products show that the quality assessment statistics are comparable for the two input data sources and thus ensuring a consistent product performance at a future transition to Metop-B.
The Metop-A and Metop-B overlap period coincides with the summer mode of the production chain and the NH summer sea ice extent/limited number of buoys, which is not ideal for a season stand-alone quality assessment. Despite limited amount of in-situ data for comparison, both the bias and Std either meets or are close to meeting the general product requirement on accuracy on a *yearly* average.