OSI SAF

Product Validation Report

The Southern Hemisphere Sea Ice Products

Version 1.0

September 2011

Document reference: SAF/OSI/CDOP/met.no/SCI/RP/153

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1. Introduction

1.1 Overview

This report covers the work undertaken as part of the OSI SAF CDOP Visiting Scientist scheme, titled "Validation of the OSI SAF sea ice products in the Antarctic", OSI SAF reference CDOP-SG07-VS01.

The work was carried out in 2011 by Andreas Cziferszky of the British Antarctic Survey (BAS), Cambridge, UK, in consultation with Steinar Eastwood of the Norwegian Meteorological Institute (met.no), Oslo, Norway. It consisted of the structural analysis of the relevant datasets (see below), developing methods for comparing available datasets against each other, implementing these methods using ITT's IDL scientific programming environment, analyzing datasets covering five months of data in total, as well as writing this report

1.2 Project description

The existing EUMETSAT Ocean & Sea Ice Satellite Application Facility (OSI SAF) sea ice products (see 1.3 and 1.4 below) are generated from different sources and instruments including the Special Sensor Microwave Imager (SSM/I), the Advanced Microwave Scanning Radiometer-EOS (AMSR-E), and the Advanced Scatterometer on the meteorological operational platform (ASCAT-MetOp). These observations are supplemented with forecasting parameters obtained from the European Centre for Medium-Range Weather Forecasts (ECMWF).

So far the southern hemisphere products have been validated routinely against the 2-weekly ice products provided by the National Ice Center (NIC) and summarized in a report published in March 2007 (see OSISAF report, 2007). The NIC ice charts cannot be regarded entirely independent from the OSI SAF product because of the common use of SSM/I data. To overcome this problem and to have a second completely unrelated reference dataset this project is using manually interpreted sea ice edge data from Envisat ASAR WSM (wide swath mode) imagery. These are generated by BAS outside the scope of this project at a spatial resolution of 1 km, compared to 10 km spatial resolution of the relevant OSI SAF sea ice products (see 1.5 below).

At present OSI SAF delivers three global sea ice products in operational mode: the sea ice edge, the sea ice type, and the sea ice concentration product. For the Northern hemisphere there is also an ice drift product available. The sea ice type product is a priori excluded from this work since the high resolution dataset produced by BAS gives no information at all about the ice type. The OSI SAF sea ice edge and the sea ice concentration products are included in this analysis work (the latter one with considerable limitations, further discussed later on). A brief introduction of the products considered in this project is given below.

1.3 The OSI SAF sea ice edge product

The sea ice edge product indicates, whether a given grid point is covered by ice or not. A grid point can have one out of six classifications:

- 0: No Data
- 1: Ice Free
- 2: Open Ice (35-70% concentration)
- 3: Closed Ice (70-100% concentration)
- 9: Over land
- 10: Unclassified

The main grid and map projection properties for the southern hemisphere products are given below (taken from Eastwood et al. 2009).

Gird resolution:	10 km
Size:	790 columns,830 lines
Lower left corner:	41.5015°S, 135.0000°W
Map projection:	Polar stereographic
Latitude of true scale:	70°S
Central meridian:	0 °
Ellipsoid axis:	6 378 273.0m x 6 356 889.44891m

Table 1: OSI SAF sea ice products grid definition

It is important to note that the grid properties for the OSI SAF sea ice products differ from the MyOcean grid properties and therefore grid transformations have to be carried out prior to data analysis. Further information regarding the sea ice edge product, particularly concerning the algorithms used, can be obtained from Breivik et al. 2001, and from the OSI SAF Sea Ice Product Manual, Eastwood 2009.

1.4 The OSI SAF sea ice concentration product

The sea ice concentration product indicates the areal fraction of sea ice of a given grid point. A grid point may have a value within the range below:

- 0.0 – 100.0: Area fraction of ice
- NaN: Over Land / Unclassified / No data

These values differ from those described in Eastwood 2009 due to an updated version of the OSI SAF sea ice concentration product for the netCDF file format. The updated version (product version 2.2) is used for this project.

Grid properties are equal to those of the sea ice edge product. Again, further information can be obtained from Breivik et al. 2001, and from the OSI SAF Sea Ice Product Manual, S. Eastwood 2009.

1.5 The MyOcean Southern Hemisphere High-Res Sea Ice Edge Product

1.5.1 Product characteristics

The Southern Hemisphere high resolution sea ice edge product generated by BAS is used as the reference dataset in this project. Up to the time of writing it has been produced sporadically starting in January 2011 as a pre-operational product. It is envisaged that this product will become part of the MyOcean SIWTAC product portfolio before the end of 2011. Although it is not officially a MyOcean product at the time of writing, it is being referred to as the 'MyOcean-SH-HR' product throughout this document (or just the 'MyOcean' product for simplicity).

The MyOcean-SH-HR product is a manually interpreted product based on Envisat ASAR WSM (wide swath mode) single polarization (HH) images. It is compiled for key areas of the Southern Ocean encompassing the Antarctic continent. At the moment these key areas include the coasts of the Antarctic Peninsula as well as the Weddell Sea, where most Antarctic shipping activities are taking place. Due to limited resources as of 2011 the temporal coverage is variable and focused on the Antarctic summer season, again constrained by peak shipping activities.

The grid properties are different compared to the OSI SAF products, both in terms of spatial resolution and map projection:

Grid resolution:	1 km
Size:	Variable, defined by the Envisat WSM scene
Lower left corner:	Variable, defined by the Envisat WSM scene
Map projection:	Polar stereographic
Latitude of true scale:	90°S
Central meridian:	0°
Sphere radius:	6 371 000.0 m

Table 2: MyOcean-SH-HR product grid definition

Valid grid cell values are:

- 0: No Data
- 1: Open water
- 2: Ice
- 9: Over land
- 10: Unclassified

1.5.2 Product examples

For a better understanding of this product two examples are given below.

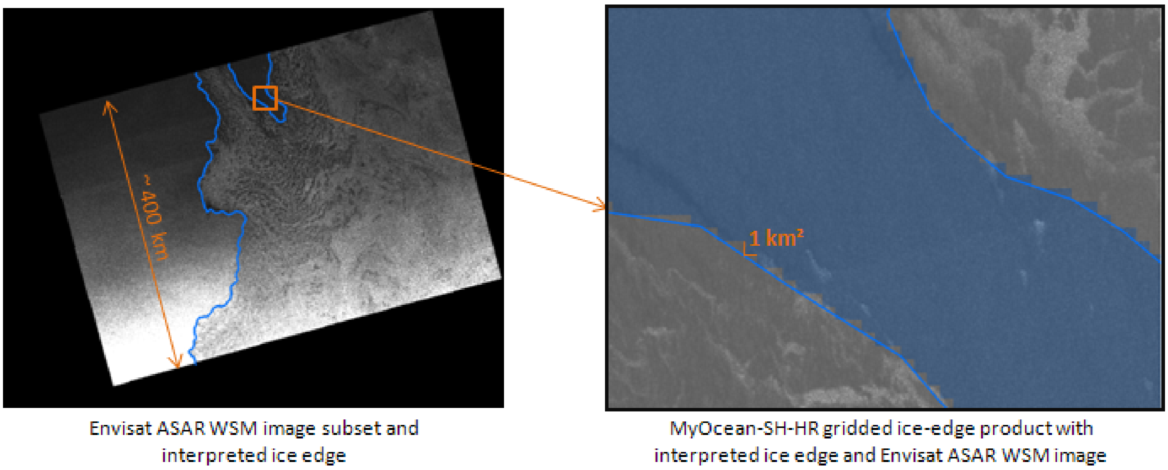


Figure 1: MyOcean-SH-HR product example 1

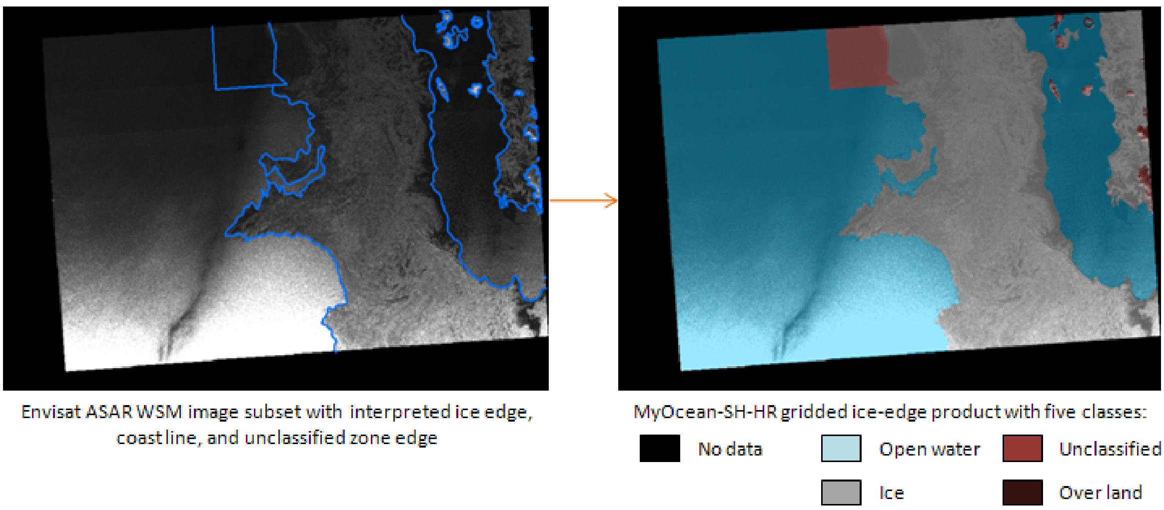


Figure 2: MyOcean-SH-HR product example 2

1.5.3 Product limitations

Due to the nature of the product and its differences compared to the OSI SAF products there are a number of limitations which need to be considered when discussing the results of the comparison. A short summary of key differences is given below. They are also presented in more detail in Chapter 3: Discussion and Conclusions.

- Manual interpretation of single polarization ASAR image
- ASAR image is the only source of information - no additional information products considered for the interpretation

- Only one class of ice cover (in contrast to two classes implemented by the OSI SAF ice edge product)
- Ice concentration is not explicitly compiled (although the ratio between ice/no ice can be used as a measure for ice concentration when re-sampling the product to a coarser resolution)
- Emphasis of the product is on identifying the northern most occurrence of ice in order to support Antarctic shipping. Complex ice/no ice patterns occurring further south (within the sea ice zone) are not always considered.
- The interpretation generates a snapshot of ice conditions at the time of image acquisition (in contrast to the 24 hour validity of the OSI SAF sea ice products)

2. Validation Methodology

The validation process is a combined 3-stage workflow visualized in Figure 3. Each stage requires a number of input files and/or auxiliary data. Processing is implemented in IDL and results in distinct output files described in Appendix A. The various processing steps are described in the next chapters.

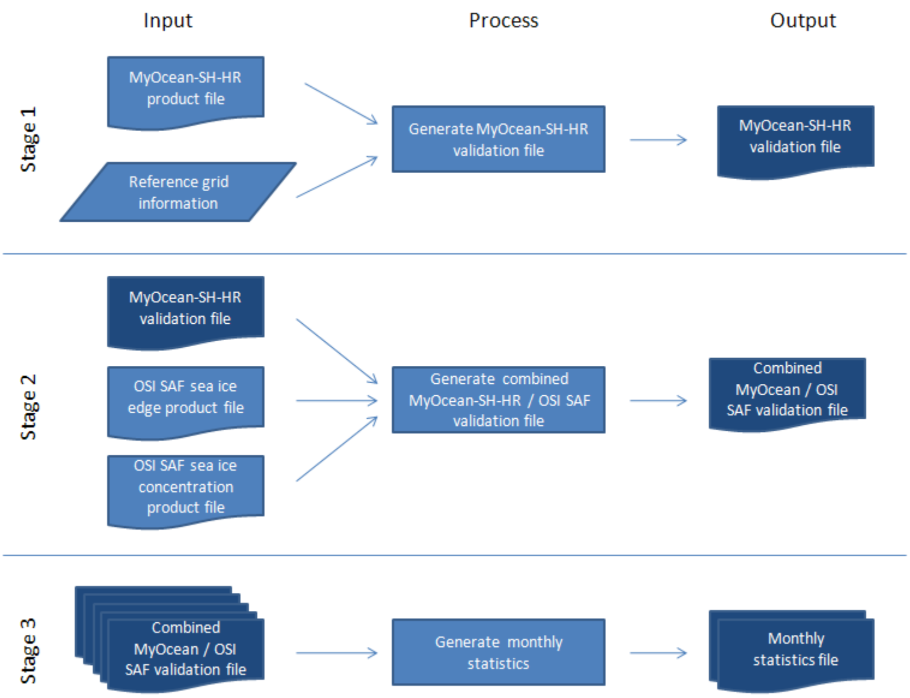


Figure 3: Validation workflow

Stage 1 and Stage 2 are kept separate in an effort to be flexible and modular for potential upcoming requirements, e.g. using the MyOcean-SH-HR product to validate products implemented in different grids/map projections. Additionally this separation avoids the need for the OSI SAF products to exist at the time of generating the MyOcean validation file.

Stage 3 generates the final result which is a netCDF file including statistical parameters characterizing the performance of the ice edge products over the period of one month.

2.1 Generating the MyOcean-SH-HR validation file

Generating the MyOcean-SH-HR validation file is the first stage in the validation process and can be performed without any OSI SAF sea ice products available. The purpose of this stage is to generate a data file which is down-sampled and re-projected to match the grid characteristics of the OSI SAF sea ice edge products. Input data for this process are:

- The high resolution MyOcean-SH-HR netCDF file (produced by BAS), against which the lower resolution OSI SAF sea ice products will be compared
- Auxiliary data describing the OSI SAF sea ice product's map projection and grid (=validation grid). This information can be regarded fixed for the validation of the OSI SAF products, but may vary for other products. See Appendix A.1 for a detailed file definition.

2.1.1 Grid mapping

The MyOcean-SH-HR product and the OSI SAF sea ice products are implemented in different map projections and grids (see Table 1: OSI SAF sea ice products grid definition and Table 2: MyOcean-SH-HR product grid definition). Therefore the first step has to map every pixel of the higher resolution MyOcean-SH-HR pixel to exactly one coarser resolution OSI SAF product grid cell (further referred to as the *validation grid*). This is achieved by transforming each MyOcean-SH-HR pixel centre coordinate to the OSI SAF map projection and then deciding within which OSI SAF grid cell this pixel center is contained. For each OSI SAF grid cell the number of MyOcean-SH-HR grid cells within each of the five MyOcean categories is counted and stored for further use.

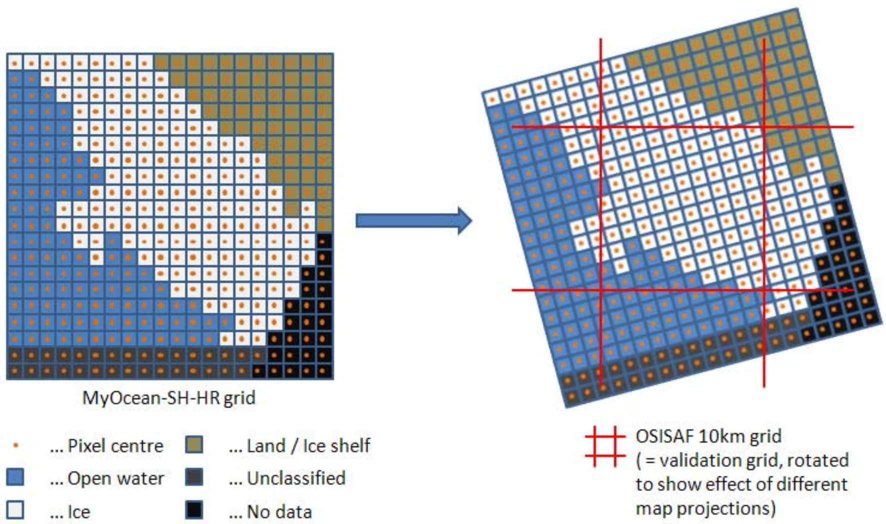


Figure 4: Matching up grid cells between OSI SAF and MyOcean product

2.1.2 Validation file extent

The extent of the MyOcean-SH-HR validation file is chosen such that it represents the smallest rectangular validation grid area possible including all MyOcean-SH-HR cells.

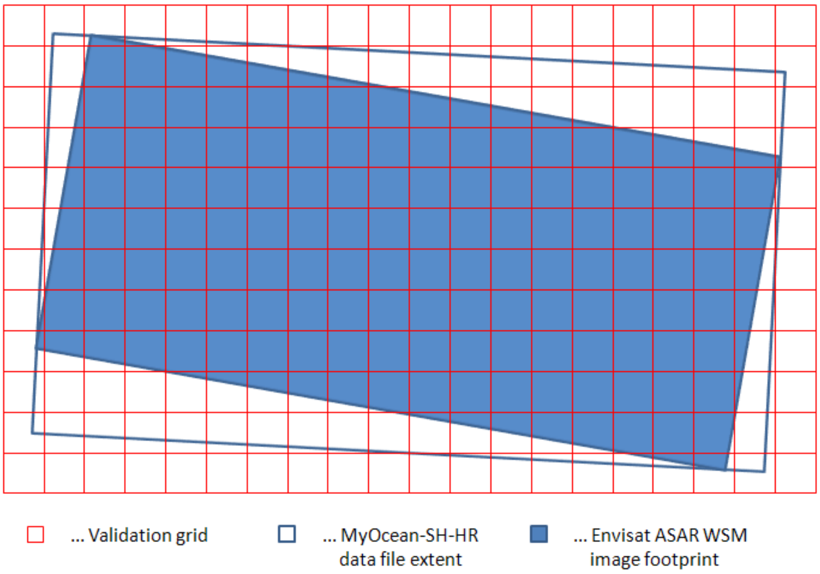


Figure 5: MyOcean-SH-HR validation file extent

2.1.3 Validation file variables

For each validation grid cell a number of variables is calculated and stored within the MyOcean-SH-HR validation file. Additionally some global metadata is added as well. Variables and global attributes are described in the tables below. The actual netCDF file structure can be found in Appendix A.2.

Variable name	Data type	Description
`count_nodata`	Long (signed 32bit)	Number of MyOcean-SH-HR pixels contained for class 'No data'
`count_water`	Long	Number of MyOcean-SH-HR pixels contained for class 'Open water'
`count_ice`	Long	Number of MyOcean-SH-HR pixels contained for class 'Ice'
`count_land`	Long	Number of MyOcean-SH-HR pixels contained for class 'Over land / ice shelf'
`count_unclass`	Long	Number of MyOcean-SH-HR pixels contained for class 'Unclassified'
`count_total`	Long	Total number of MyOcean-SH-HR pixels contained
`ice_edge_val`	Short (unsigned 8bit)	Predominant class - defined according to decision tree below, **Figure 6**.
`ice_conc_val`	Short	Ratio between the 'ice' and the 'open water' class (can be seen as a measure for sea ice concentration derived from the MyOcean-SH-HR product). This value is only defined and calculated for cells having `ice_edge_val = {'ice' | 'open water'}`: $ice\_conc\_val = \frac{count\_ice}{count\_ice + count\_water}$

Table 3: Validation file variables

Calculating the `ice_edge_val` parameter follows the decision tree shown below. The sum of count_nodata + count_noclass must not exceed 10% of the total number of pixels per validation grid cell. The 10% cut off value is chosen arbitrary in an attempt to only included validation grid pixels in the statistics which are composed of at least 90% of valid source data (= water or ice or land) pixels.

If multiple classes have got the same count values then the priority for defining the `ice_edge_val` value follows '`water`' > '`ice`' > '`land`'.

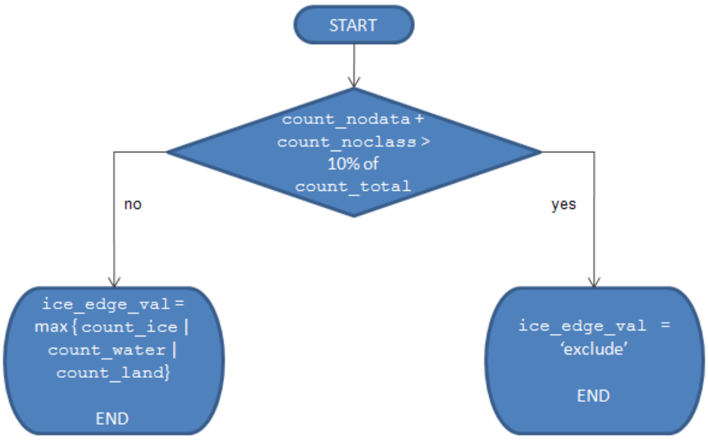


Figure 6: Decision tree for the ice_edge_val parameter

Below illustration shows six sample cells for calculating the ice_edge_val variable in line with above decision tree.

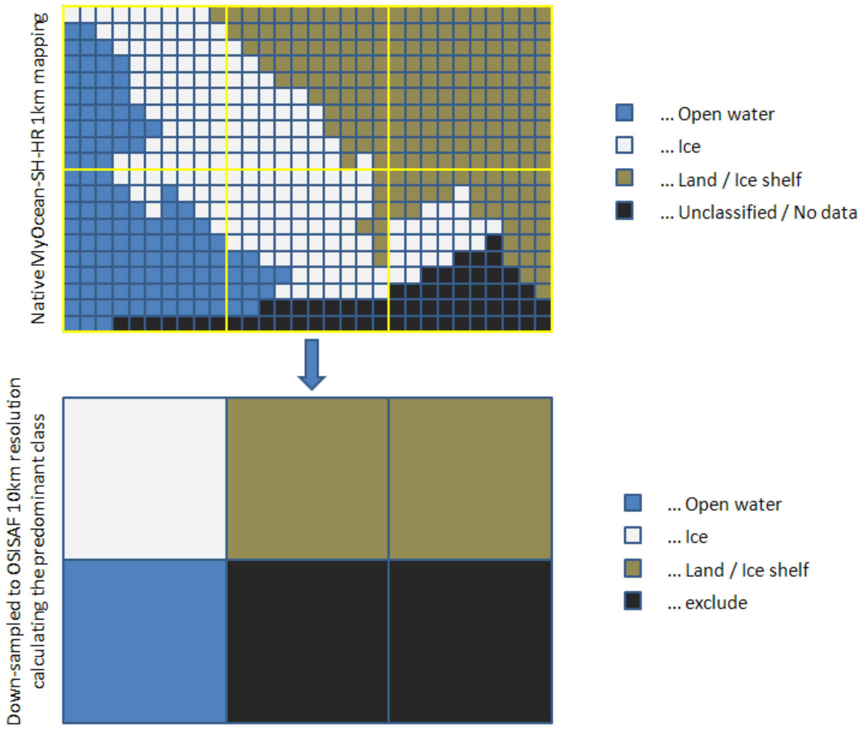


Figure 7: Sample ice_edge_val mapping

2.1.4 Validation file global attributes

In addition to the per-pixel variables discussed above, a number of global statistics values are calculated and stored as global attributes in the netCDF output file.

Attribute name	Data type	Description
`total_water`	Long	Total count of MyOcean-SH-HR pixels in 'water' class
`total_ice`	Long	Total count of MyOcean-SH-HR pixels in 'ice' class
`total_land`	Long	Total count of MyOcean-SH-HR pixels in 'land' class
`total_exclude`	Long	Total count of MyOcean-SH-HR pixels not in 'ice' or 'water' class

Table 4: Validation file global attributes

2.2 Generating the combined MyOcean/OSISAF validation file

Stage 2 extracts the grid cell values of the OSI SAF sea ice edge and sea ice concentration products falling within the data extent of the MyOcean validation file and which were produced for the time the Envisat ASAR WSM scene was acquired. Input datasets for this stage include:

- The MyOcean-SH-HR validation file (output of Stage 1 – described in 2.1)
- The OSI SAF sea ice edge product for the 24hour period which includes the MyOcean-SH-HR source data acquisition time
- The OSI SAF sea ice concentration product for the 24hour period which includes the MyOcean-SH-HR source data acquisition time

The combined validation file's map projection, grid parameters and extent are the same as for the MyOcean-SH-HR validation file.

2.2.1 Combined validation file variables

The combined validation file includes variables copied from the MyOcean validation file (Table 3), variables copied from the according OSI SAF sea ice product files (Table 5), and variables derived from these three products (Table 6).

Variable name	Data type	Description
`ice_edge_osi`	Byte	The `ice_edge` variable taken from the OSI SAF ice edge product
`confidence_level_edge_osi`	Byte	The `confidence_level` variable taken from the OSI SAF ice edge product
`ice_conc_osi`	Short	The `ice_conc` variable taken from the OSI SAF ice concentration product
`confidence_level_conc_osi`	Byte	The `confidence_level` variable taken from the OSI SAF ice concentration product

Table 5: Combined validation file variables copied from OSI SAF products

Variable name	Data type	Description
`include`	Byte	1 .. include cell in statistics 0 .. exclude cell in statistics
`on_edge_val`	Byte	Cells on the MyOcean ice edge (= all `ice` cells, for which the 3x3 operator contains at least one `water` cell. Values: 0 Cell NOT on the ice edge; 1 Cell on the ice edge
`on_edge_osi`	Byte	Cells on the OSI SAF ice edge (= all `ice` cells, for which the 3x3 operator contains at least one `water` cell. Values: 0 Cell NOT on the ice edge; 1 Cell on the ice edge

Variable name	Data type	Description
dist_to_edge_val	Float	Euclidian distance in pixels to closest MyOcean on_edge_val (=1) cell. Only defined if there is no no_data/unclassified pixel closer nearby
dist_to_edge_osi	Float (32bit)	Euclidian distance in pixels to closest OSISAF on_edge_osi (=1) cell. Only defined if there is no no_data/unclassified pixel closer nearby
dist_to_edge	Float	Euclidian distance in pixels from every OSISAF pixel on the ice edge (on_edge_osi = 1) to closest MyOcean pixel on the ice edge (on_edge_val = 1)
avg_dist_to_edge	Float (scalar)	Average of dist_to_edge over all cells with dist_to_edge defined
avg_ice_conc_on_edge	Float (scalar)	Average of ice_conc_osi over all cells with dist_to_edge defined

Table 6: Combined validation file variables calculated from OSI SAF & MyOcean

Defining the ice-edge and calculating the distance–to–ice-edge fields

Identifying the ice edge in both the MyOcean-SH-HR and the OSI SAF ice edge product and ultimately calculating a 'distance to ice edge' value (= how far is the OSI SAF ice edge pixels away from the nearest MyOcean-SH-HR ice edge pixel) gives a good proxy for how much the two dataset's ice edge are deviating.

It is important to note that Euclidian distances based on the map projection of the OSISAF- ice concentration products are used for calculating distances. For better understanding, simplification, and improved comparability the errors introduced by not using spherical geometry are neglected.

The algorithm for finding the ice edge and calculating the distances to the ice edge is shown below:

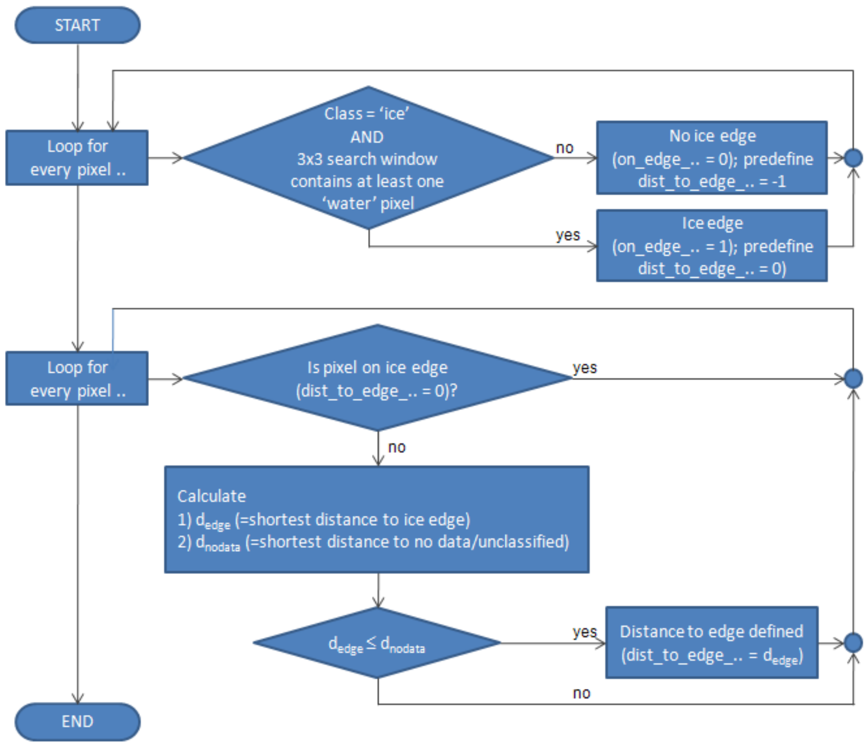


Figure 8: Identifying ice edge & calculating distance to edge pixels

Once the ice edge distance variables `dist_to_edge_val` and `dist_to_edge_osi` are calculated, the `dist_to_edge` variable can be derived. This variable holds the Euclidian distance in pixels from every OSISAF pixel on the ice edge (`on_edge_osi` = 1) to the closest MyOcean pixel on the ice edge (`on_edge_val` = 1) and can be seen as a measure for the separation between the ice edges.

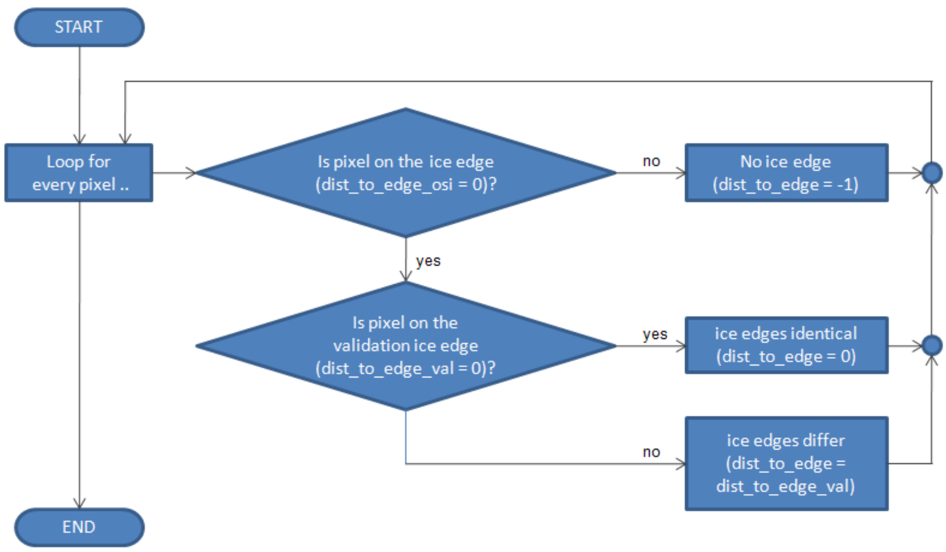


Figure 9: Calculating `dist_to_edge` variable

Calculating shortest distance values

For both algorithms shown above shortest distances between grid cells with certain properties need to be calculated. In these scenarios the size of the dataset's dimensions allow for 'brute force' methods for calculating the shortest distances. First a matrix of distance values of the size of the relevant dataset is generated. Then the matrix is moved along the input dataset grid cells to identify the shortest distances.

Calculating `include` variable

For calculating statistics at a later stage, all pixels which qualify for a cell-by-cell comparison of ice and water need to be identified. To achieve this all the open water/sea ice pixels in the `ice_edge_val` variable (originating from the MyOcean-SH-HR validation product) as well as in the `ice_edge_osi` variable (originating from the OSI SAF ice edge product) are identified and combined using a logical AND operation. All pixels <> 1 are flagged to be excluded from statistic calculations. The 'open ice' and 'closed ice' classes of the OSI SAF sea ice edge product are treated as one 'ice' class.

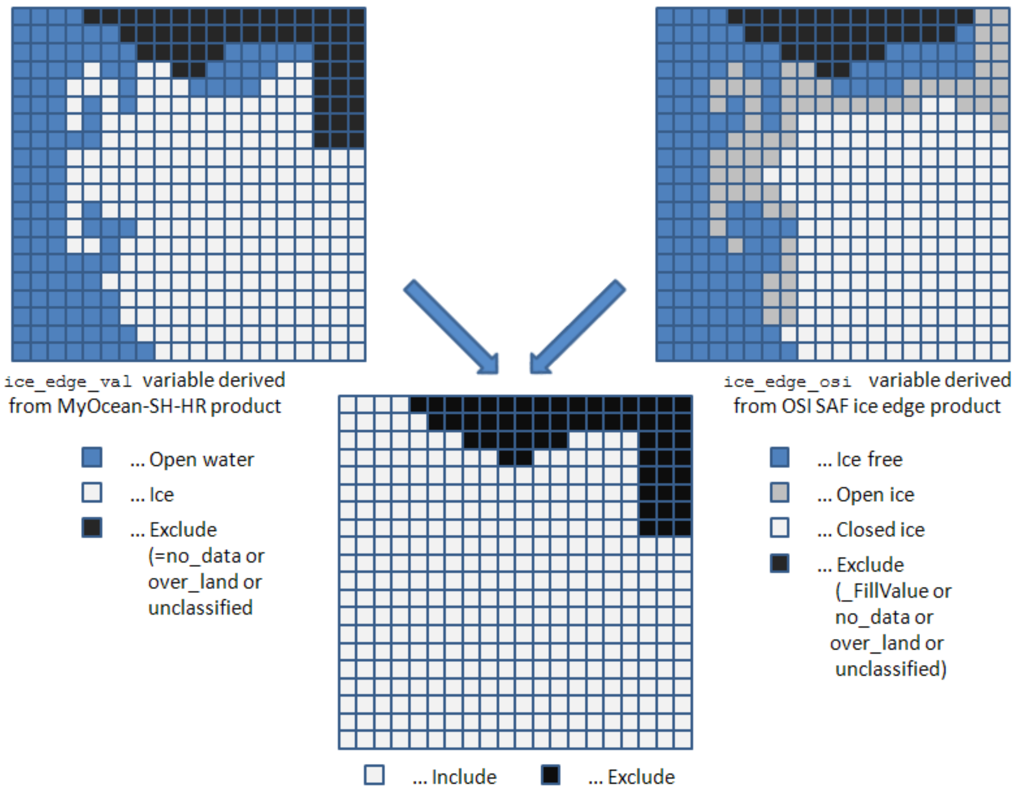


Figure 10: Calculating the `include` variable

2.2.2 Combined validation file global attributes and statistics

Some global statistical values are included in the output netCDF file (see also Appendix A.3) for both the OSI SAF Sea Ice Edge product and the OSI SAF Ice Concentration product.

Attribute name	Data type	Description
`count_ice_ice`	Long	Total count of pixels where class = 'ice' in both the `ice_edge_val` and the `ice_edge_osi` variable
`count_water_water`	Long	Total count of pixels where class = 'water' in both the `ice_edge_val` and the `ice_edge_osi` variable

Attribute name	Data type	Description
count_water_ice	Long	Total count of pixels where ice_edge_val = 'water' AND ice_edge_osi = 'ice' (OSI SAF ice edge is over estimated)
count_ice_water	Long	Total count of pixels where ice_edge_val = 'ice' AND ice_edge_osi = 'water' (OSI SAF ice edge is under estimated)
count_relevant	Long	Total count of relevant pixels $count\_relevant = count\_ice\_ice + count\_water\_water + count\_water\_ice + count\_ice\_water$
percent_relevant	Float	Percentage of relevant pixels $percent\_relevant = \frac{count\_relevant}{number\_of\_pixels}$
agree	Float	Percentage of identical ice and water class pixels $agree = \frac{count\_ice\_ice + count\_water\_water}{count\_relevant}$
agreeConf0	Float	Percentage of identical ice and water class pixels where confidence_level_edge_osi= 0
agreeConf1	Float	Percentage of identical ice and water class pixels where confidence_level_edge_osi= 1
agreeConf2	Float	Percentage of identical ice and water class pixels where confidence_level_edge_osi= 2
agreeConf3	Float	Percentage of identical ice and water class pixels where confidence_level_edge_osi= 3
agreeConf4	Float	Percentage of identical ice and water class pixels where confidence_level_edge_osi= 4
agreeConf5	Float	Percentage of identical ice and water class pixels where confidence_level_edge_osi= 5
osi_over	Float	Percentage of pixels overestimated by OSI SAF $osi\_under = \frac{count\_water\_ice}{count\_relevant}$
osi_under	Float	Percentage of pixels underestimated by OSI SAF $osi\_under = \frac{count\_ice\_water}{count\_relevant}$

Table 7: Combined validation file global attributes

2.3 Generate monthly statistics

Monthly statistics are generated based on a collection of individual combined validation files all of which are covering the same calendar month. Results are written into a netCDF file, one per calendar month.

2.3.1 Monthly statistics file variables

The following table shows the variables included in the monthly statistics netCDF. Only one variable, `input_data_dist`, has a geospatial extent. All other variables are scalars.

Variable name	Data type	Description
`input_data_dist`	Short	Spatial distribution of input files considered in the monthly statistics netCDF file.
`count_relevant`	Float (scalar)	Total number of relevant pixels over all input files (`ice` or `open water`) considered in statistics
`count_agree`	Float (scalar)	Total number of pixels over all input data sets which are in agreement comparing OSISAF and MyOcean datasets
`agree`	Float (scalar)	Percentage of `agree` pixels over all relevant pixels and products
`avg_agree`	Float(scalar)	Average of individual validation products `agree` value
`stdev_agree`	Float (scalar)	Standard deviation of individual products `agree` value
`avg_agree_conf`	Float	Average of agree pixels binned into OSISAF confidence levels [0-5]
`stdev_agree_conf`	Float	Standard deviation of agree pixels binned into OSISAF confidence levels [0-5]
`max_agree`	Float (scalar)	Maximum of individual products `agree` value
`min_agree`	Float (scalar)	Minimum of individual products `agree` value
`count_osi_over`	Float (scalar)	Total number of pixels over all products where OSISAF over-estimates
`osi_over`	Float (scalar)	Percentage of `osi_over` pixels over all relevant pixels and products
`avg_osi_over`	Float (scalar)	Average of individual products `osi_over` values
`stdev_osi_over`	Float (scalar)	Standard deviation of individual products `osi_over` values
`count_osi_under`	Float (scalar)	Total number of pixels over all products where OSISAF under-estimates
`osi_under`	Float (scalar)	Percentage of `osi_under` pixels over all relevant pixels and products
`avg_osi_under`	Float (scalar)	Average of individual products `osi_under` values
`stdev_osi_under`	Float (scalar)	Standard deviation of individual products `osi_under` values

Variable name	Data type	Description
avg_dist_to_edge	Float (scalar)	Average of individual products average Euclidian distance in pixels from every OSISAF pixel on the ice edge (=on_edge_osi) to closest MyOcean pixel on the ice edge (=on_edge_val)
stdev_dist_to_edge	Float (scalar)	Standard deviation of individual products average Euclidian distance in pixels from every OSISAF pixel on the ice edge (=on_edge_osi) to closest MyOcean pixel on the ice edge (=on_edge_val)
avg_ice_conc_on_edge	Float (scalar)	Average of individual products average OSISAF ice concentration on MyOcean ice edge
stdev_ice_conc_on_edge	Float (scalar)	Standard deviation of individual products average OSISAF ice concentration on MyOcean ice edge

Table 8: Monthly statistics file variables

2.3.2 Monthly statistics file global attributes

Global attributes of the monthly statistics file are shown below:

Attribute name	Data type	Description
source_files_count	Short	Number of combined validation files included in the monthly statistics
source_files	Text	List of combined validation files included in the monthly statistics

Table 9: Monthly statistics file global attributes

Determining the spatial distribution of input files (`input_data_dist`)

The `input_data_dist` variable indicates the frequency of how often the area of a certain grid cell has been analyzed by MyOcean-SH-HR products over the period of one month. For every single MyOcean-SH-HR product, the count of the `input_data_dist` variable is increased by 1 for all grid cells covered by this product (see **Figure 11** for results).

3. RESULTS

3.1 Monthly statistics results

As a precursor to this project a number of MyOcean-SH-HR (pre-operational) sea ice edge products have been generated at the British Antarctic Survey. Products have been generated for January, February, March, June, and July 2011. The distribution was chosen such that Antarctic summer and winter months are both covered.

The MyOcean-SH-HR products were analyzed and combined with the OSI SAF sea ice products according to the methodology described in Chapter 2. As a last step the monthly statistics were compiled. The following table shows relevant variables and global attributes of each of the monthly statistics files.

Parameter	Jan	Feb	Mar	Jun	Jul
source_files_count	52	39	57	73	65
count_relevant	114209	76149	124761	187315	169438
count_agree	103641	72043	119171	181921	161428
avg_agree	0.915	0.944	0.947	0.971	0.951
stdev_agree	0.076	0.035	0.045	0.025	0.035
max_agree	0.993	0.998	1	0.999	0.995
min_agree	0.606	0.860	0.815	0.883	0.795
count_osi_over	968	790	642	823	903
avg_osi_over	0.009	0.013	0.005	0.004	0.005
stdev_osi_over	0.010	0.016	0.006	0.006	0.006
count_osi_under	960	3316	4948	4571	7107
avg_osi_under	0.076	0.043	0.048	0.025	0.043
stdev_osi_under	0.079	0.036	0.047	0.025	0.036
avg_dist_to_edge	1.82	1.33	1.41	0.985	1.24
stdev_dist_to_edge	1.65	1.19	1.31	0.66	0.77
avg_ice_conc_on_edge	19.9	21.7	18.4	26.9	21.5
stdev_ice_conc_on_edge	14.8	13.5	11.0	12.5	7.24

Table 10: Monthly statistics summary

3.2 Geospatial distribution

Two constraints were influencing the choice of Envisat ASAR WSM scenes for generating MyOcean-SH-HR validation products:

- the current location of the sea ice edge
- the area with most Antarctic shipping activities

While the first constraint is obvious the later constraint is dictated by limited time resources for generating the MyOcean-SH-HR products and therefore emphasis is put on the waters around the Antarctic Peninsula as well as on the Weddell Sea. The spatial distribution and the number of MyOcean-SH-HR products for each month are shown below.

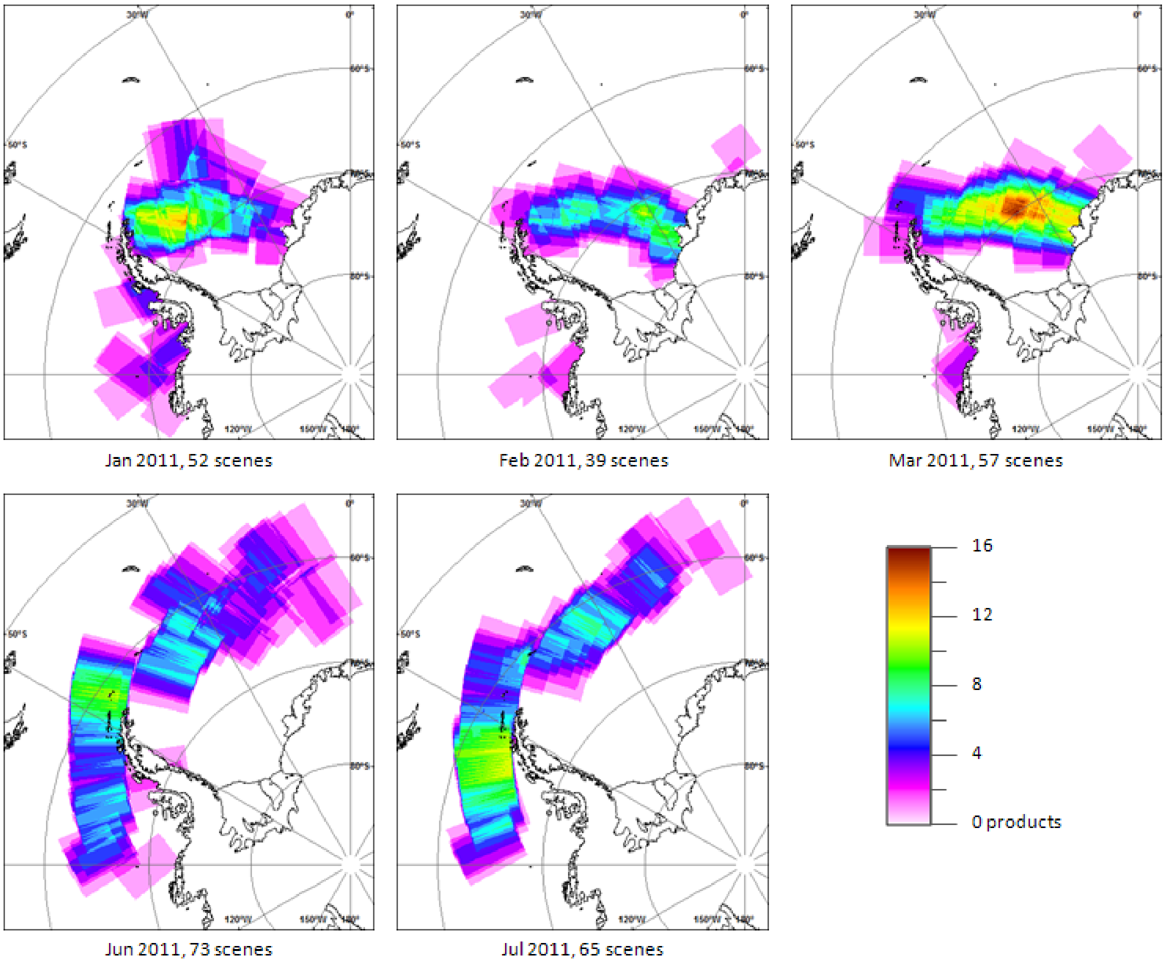


Figure 11: Spatial distribution of MyOcean-SH-HR validation data

4. DISCUSSION AND CONCLUSIONS

In general the agreement between the OSI SAF sea ice products and the MyOcean-SH-HR product is according to what is to be expected. No anomalies or outliers could be identified and the results are consistent throughout the representative number of samples. Monthly trends are minimal with slightly better overall results for the period of June 2011 (although it has to be considered, that this is the month with the highest number of samples).

Various parameters and their relationship to the OSI SAF products are discussed below in more detail.

4.1 OSI SAF sea ice edge product

4.1.1 Parameter 'agree'

The 'agree' parameter indicates the percentage of pixels, which have the same water/ice classification in both the OSI SAF product and the MyOcean-SH-HR product. The correlation is generally very good with monthly averages being well over 90%. A minor seasonal trend can be identified showing slightly higher agreement in the freeze periods of the winter months likely to be caused by the existence of a more distinct ice edge.

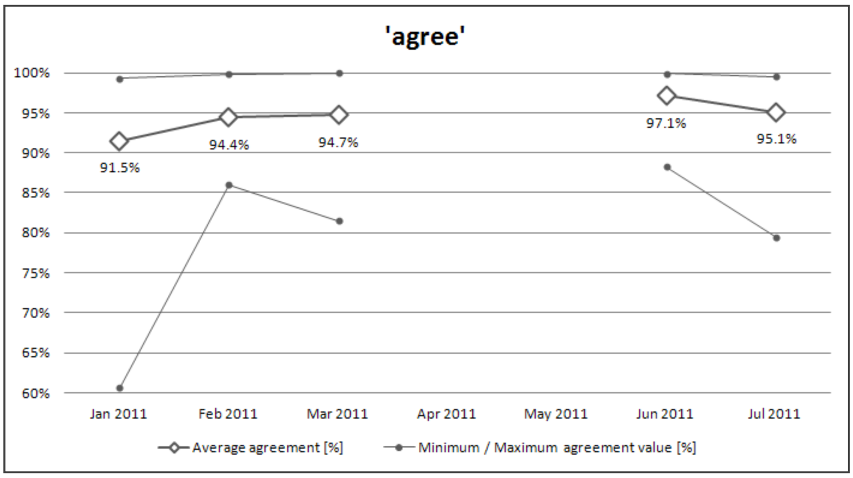


Figure 12: Monthly statistics for parameter 'agree'

In addition to the general analysis of grid cell agreement, an analysis was performed in respect of the confidence levels of the OSI SAF ice_edge variable. For each grid cell of the OSI SAF sea ice edge product the 'confidence_level' variable gives an indication about the reliability of the 'ice_edge' variable. Values range from 1 (Erroneous) to 5 (Excellent).

The percentage of agreement was calculated for each of the five confidence levels. The a priori assumption is that the higher the confidence level, the higher the average agreement of the pixels. This assumption can only be partially verified as shown in Figure 13. Although agreement for confidence level 1 (=lowest) and level 5 (=highest) perform as expected, agreement for confidence levels 2-4 seem to be uncorrelated to the level of confidence.

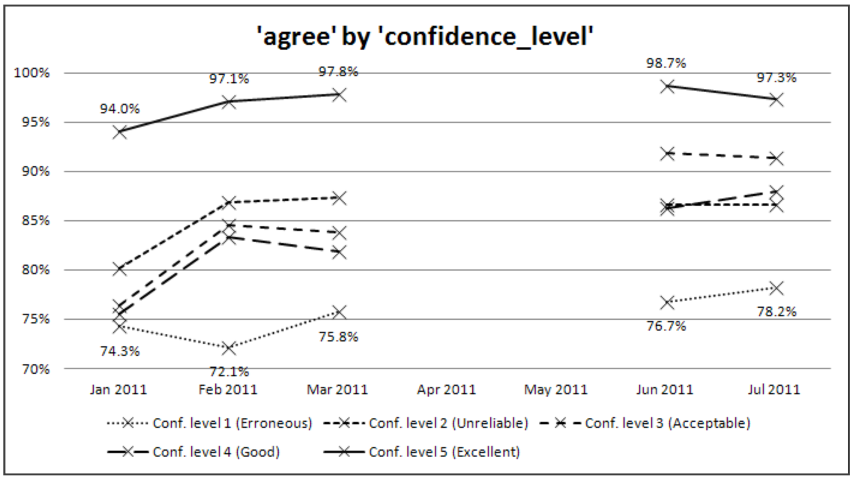


Figure 13: Monthly statistics for parameter 'agree' per confidence level

4.1.2 Parameters 'osi_over' and 'osi_under'

These parameters indicate whether the OSI SAF product tends to over-estimate or under-estimate existence of sea ice. Overall the results for both of these parameters are consistent throughout the test period. The 'osi_under' parameter shows a slight trend in being lower over the winter months compared to the summer months. This is in accordance with the trend shown by the 'agree' parameter.

The results also show that under-estimates occur more frequently than over-estimates. The most likely explanation for this phenomenon is the grid cell classification for the OSISAF sea ice edge product. The 'open ice' class is defined as 35-70% sea ice concentration and therefore the OSI SAF sea ice edge product is not set up to show areas of ice concentration lower than 35%. In contrast, due to the manual interpretation nature of the MyOcean-SH-HR product, it is possible for this product that areas of sea ice concentration of less than 35% are classified as 'ice'.

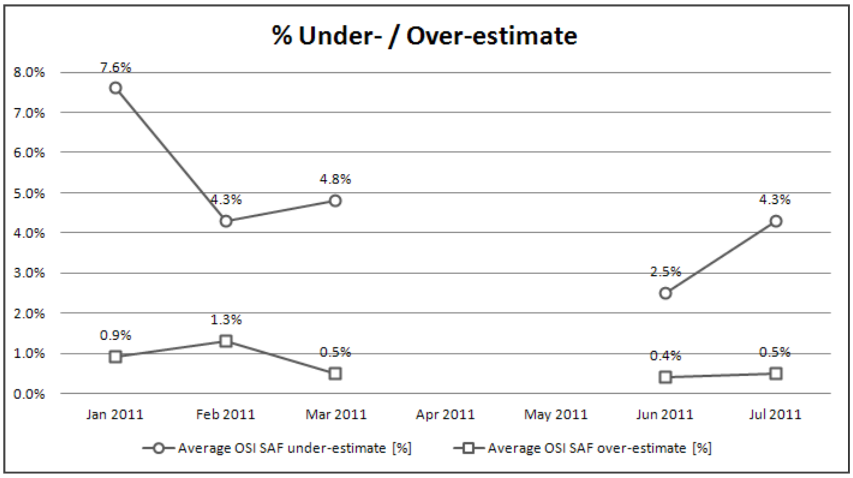


Figure 14: Monthly statistics for parameter 'osi_under' and 'osi_over'

The results also suggest that the OSISAF sea ice edge product under-estimates percentage is higher in austral summer months compared to austral winter months. Two explanations seem to be plausible for this phenomenon: The absence of melt ponds on the sea ice surface during winter months (the OSI SAF sea ice edge product would tend to classify melt ponds as 'open water' if big enough), and the absence of loose pack ice with low ice concentration and therefore the existence of a better defined ice edge in winter months (see discussion regarding 35% ice edge in previous paragraph).

4.1.3 Parameter 'dist_to_edge'

This parameter indicates the average Euclidian distance in pixels from every OSI SAF pixel, which was identified to be part of the ice edge, to the closest MyOcean-SH-HR validation product pixel (at 10km grid cell size), which again has been identified to be part of the ice edge. The lower the average distance the better the general correlation between the two products.

The pixel size for the validation products is 10km and therefore the 'dist_to_edge' parameter has to be multiplied with this unit to get real-world distances. The Euclidian distances are calculated from grid cell centers to grid cell centers.

The results for this parameter are in accordance with the 'agree' parameter (which is drawn on the secondary axis for easier reference in below chart).

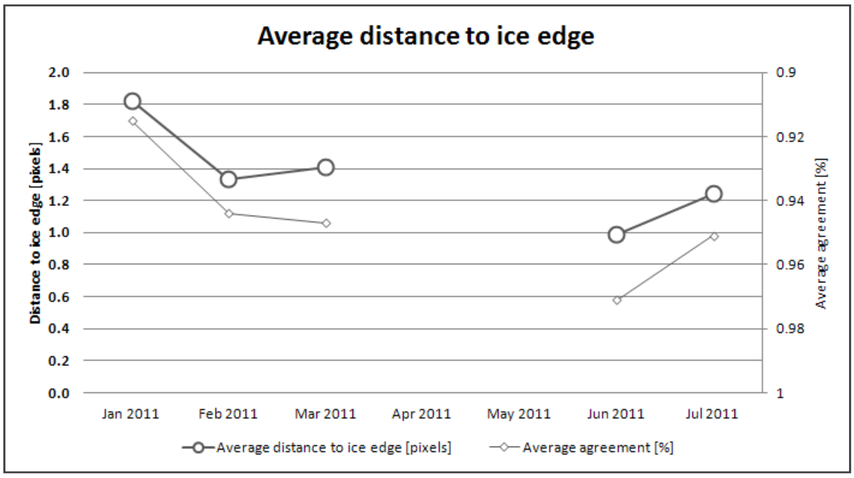


Figure 15: Monthly statistics for parameter 'dist_to_edge'

4.2 OSI SAF sea ice concentration product vs. MyOcean-SH-HR

Overall the MyOcean-SH-HR product is not well suited to be compared against the OSI SAF sea ice concentration product or vice versa. Although a sea ice concentration value for the MyOcean-SH-HR product is derived during the re-sampling process in Stage 1, it is obvious that this value is going to be 50% on average for grid cells on the sea ice edge and is therefore meaningless in this context.

4.2.1 Parameter 'ice_conc_on_edge'

The statistical parameter that is generated though is the average OSI SAF sea ice concentration for MyOcean-SH-HR pixels being part of the ice edge. The results are fairly consistent showing average OSI SAF sea ice concentrations of roughly 22% for MyOcean-SH-HR sea ice edge pixels (although with a high standard deviation of between 7 and 14%).

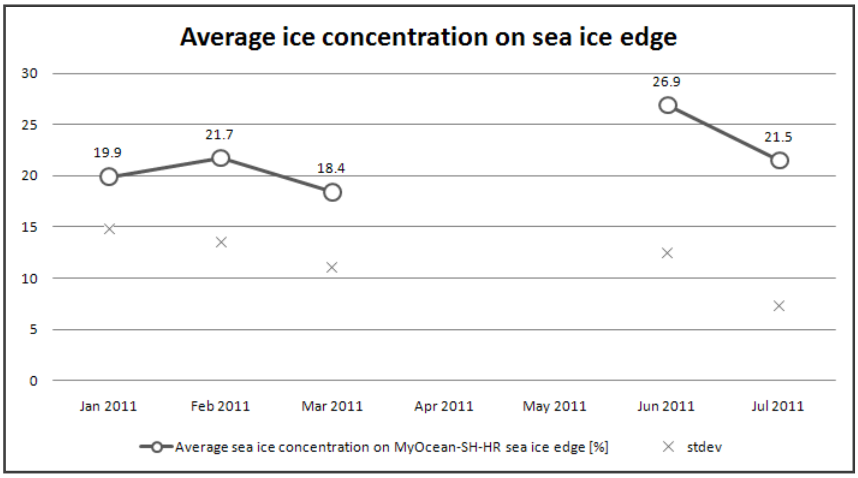


Figure 16: Monthly statistics for parameter 'conc_on_ice_edge'

4.3 Limitations

The results of this project are influenced by various limitations of the MyOcean-SH-HR sea ice edge product and have to kept in mind when discussing these results. While a short summary was already given in 1.5.3, a more detailed examination is given below

4.3.1 Manual interpretation

The MyOcean-SH-HR product is compiled by manually interpreting the sea ice edge based on Envisat ASAR WSM single polarization (HH) imagery. The target grid resolution is 1km. While this resolution easily meets the accuracy of the digitized feature in cases when the ice edge is well defined, the accuracy can fall well below the target resolution when the ice edge is fuzzy, due to the amount of interpretation freedom the analyst has.

Also different analysts might digitize fuzzy features differently and while the re-sampling process in Stage 1 from a 1km to a 10km grid should be enough to eliminate most discrepancies introduced by individuals, such differences cannot be ruled out completely.

4.3.2 Source datasets

Envisat ASAR WSM single polarization imagery is used as a single source for the interpretation process. Limitations exist when using single polarization SAR images for sea ice detection and classification, and therefore miss-interpretations cannot be ruled out, especially due to the fact that no additional data sources are being used for double checking.

It also has to be noted that the source swaths used for interpretation are routinely subsetted by BAS to swath lengths of roughly 600km to ease handling of the data. Due to limitations in resources available to BAS for generating the MyOcean-SH-HR product, the analyst has to manually select which swath-subset containing the sea ice edge he/she is going to interpret, thus potentially biasing the results (in contrast to being given all source images or a random selection of them covering the same location).

4.3.3 Ice classification

The MyOcean-SH-HR classifies only one class of ice unrelated to the observed ice concentration. This is constrained by BAS's endeavor to generate a high resolution product most useful for shipping in the Southern Ocean. Hence non ice-strengthened ships (mostly operated by tour operators and sailing yachts) are considered where any contact with sea ice can be dangerous. The measure of sea ice concentration is therefore a secondary problem.

Also of secondary importance are open water features (resulting in ice edges) located much further south than the northern-most sea ice edge. Therefore complex ice/no ice patterns occurring far south are not always considered (although the manual source dataset selection process outlined in 4.3.2 combined with the footprint size of the swath subsets should avoid including such regions in the analysis anyway).

This ice classification differs from the ice classification used for the OSI SAF sea ice edge product, which uses two classes of sea ice ('open' – 35-70%, and 'closed' – 70-100%) and therefore implicitly contains two types of sea ice edges. In this project both ice classes were treated as one, which is acceptable in this case. One limitation arises due to the fact that the OSI SAF ice edge product defines 35% as the minimum ice concentration for ice to be classified as 'ice'. This is different to how the MyOcean-SH-HR ice edge is defined (see above) and consequences are well reflected in the 'osi_under' parameter. The difference in ice classification is more apparent in the austral summer months, where the ice edge definition is potentially vaguer than in the winter months due to melting patterns (see 4.1.2).

4.3.4 Ice concentration

Ice concentration is not interpreted in the MyOcean-SH-HR product although it is implicitly generated during the re-sampling process in Stage 1. Limitations already covered in 4.2.

4.3.5 Timeline

The timelines for the MyOcean-SH-HR and the OSISAF sea ice products differ significantly. While the OSI SAF sea ice products are generated for a 24hour validity period (from 00:00 to 23:59 the next day), the MyOcean-SH-HR products are a snapshot with a certain timestamp based on the acquisition date of the source image. Strong winds and rapid temperature changes can potentially change the sea ice conditions such that they are noticeable even on a coarse 10km resolution grid.

Unfortunately due to the Envisat acquisition plan it was not possible to produce two MyOcean-SH-HR products being less than 24 hours apart and covering the same area of the sea ice edge. This comparison could potentially have shown effects of this problem.

The acquisition times of the Envisat ASAR WSM source images used for MyOcean-SH-HR product generation are not evenly distributed over a day (24 hour period) – most of them are acquired in the early morning hours. This influence has therefore to be considered as a source of error which is not going to be averaged out over the number of MyOcean-SH-HR samples. The following table shows the distribution of image acquisition times (= MyOcean-SH-HR valid time).

Month	00:00 – 06:00	06:00 – 12:00	12:00 – 18:00	18:00 – 24:00
Jan 2011	52%	37%	11%	0%
Feb 2011	82%	18%	0%	0%
Mar 2011	95%	5%	0%	0%
Jun 2011	99%	1%	0%	0%
Jul 2011	98%	0%	0%	2%

Table 11: MyOcean-SH-HR source image acquisition time distribution

4.3.6 Land mask

Due to algorithmic requirements (sensors are being used with a footprint of between 12 and 50km), the OSI SAF products are using a land-mask which in places reaches well into open water areas beyond the 10km distance imposed by the grid resolution of the products. Thus they are not containing any information about sea ice in the vicinity of the Antarctic coastline which is one of the areas the MyOcean-SH-HR product is mostly concentrating on. In contrast the MyOcean-SH-HR product is using a land mask derived from the SCAR ADD (see references) which resolution is well below the 1km grid resolution of the product.

The OSI SAF products can therefore not be used for scientific or operational applications in the vicinity of the Antarctic coastline and nothing can be said about its potential performance in these areas.

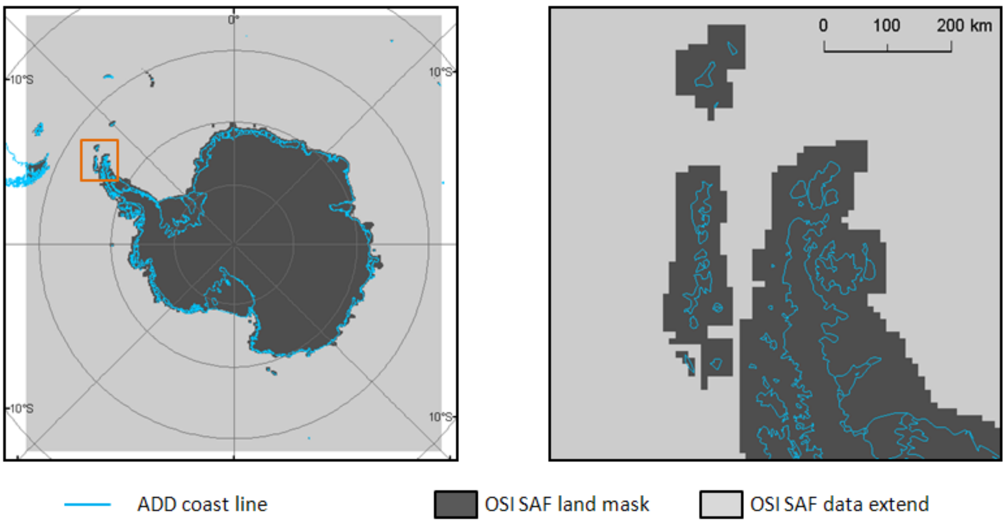
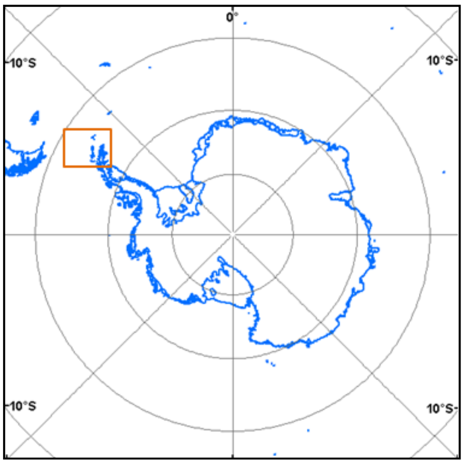


Table 12: OSISAF land mask limitations

4.4 Selected comparisons and discussion

4.4.1 Discussion 1 – Very good agreement



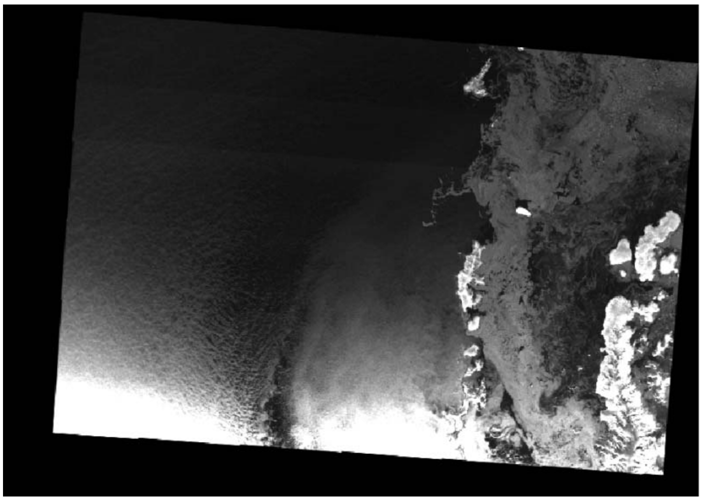


Figure 17: Envisat ASAR WSM source image

Validation dataset:
ice_edge_hr_sh_20110610_032945_4_valc.nc

agree: 99.9%
osi_over: 0%
osi_under: 0.1%
avg_dist_to_edge: 0.23px

Discussion:
This scene shows a fairly well defined and easy to interpret ice edge. The excessive land mask of the OSI SAF product facilitates the very good 'agree' value since it acts as a natural boundary for the ice edge.

The actual ice edges used for calculating the avg_dist_to_edge value is only a couple of pixels long and located between the OSI SAF land masks. The avg_dist_to_edge is therefore very low.

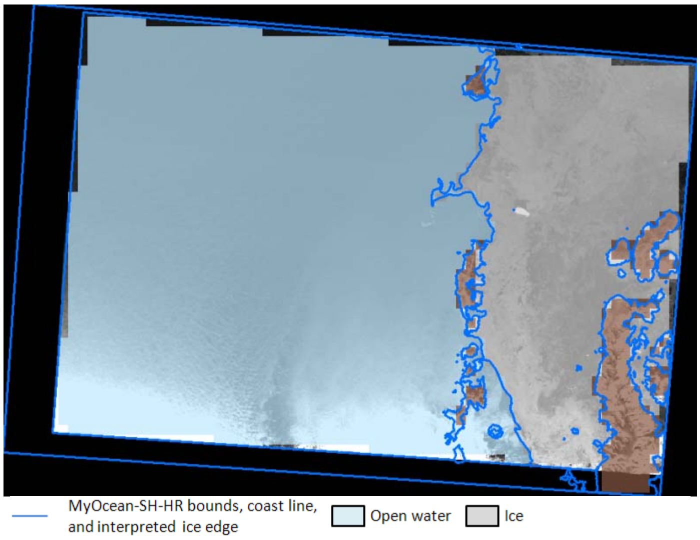


Figure 18: MyOcean-SH-HR ice classification with ice edge

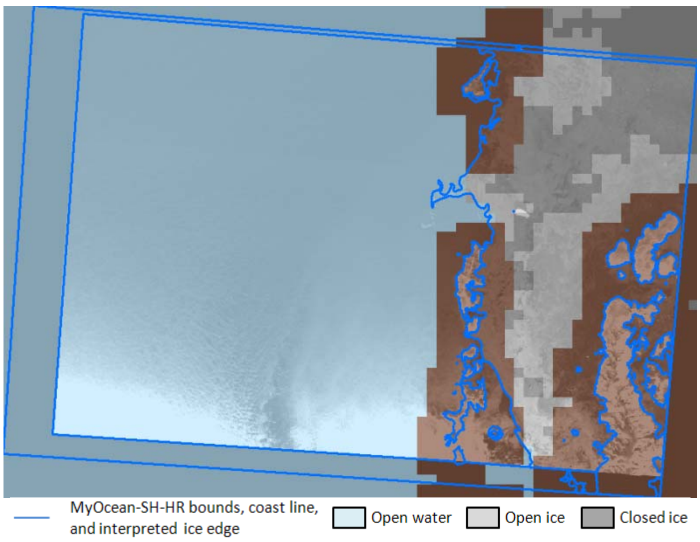
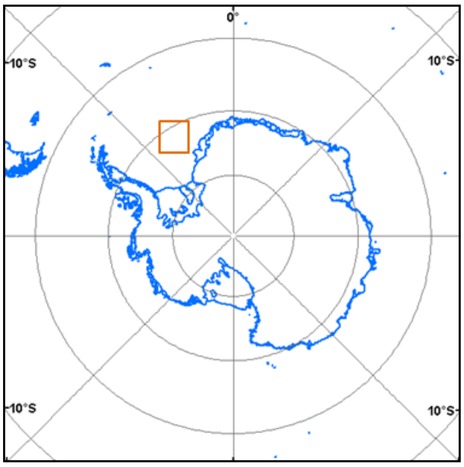


Figure 19: OSISAF sea ice edge classification

4.4.2 Discussion 2 –Average agreement with over-average OSISAF over estimate



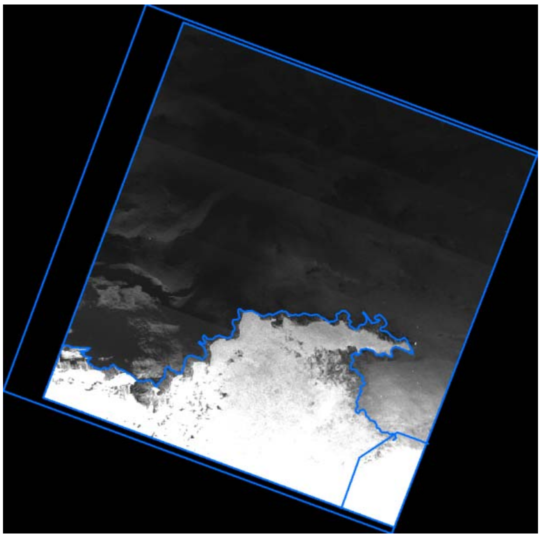


Figure 20: Envisat ASAR WSM source image

Validation dataset:
ice_edge_hr_sh_20110217_023159_2_valc.nc

agree: 93.8%
osi_over: 6.0%
osi_under: 0.2%
avg_dist_to_edge: 1.47px

Discussion:
Overall the agreement percentage in this scene is average. Unusual is the clear over estimation of the ice class by the OSI SAF product.

The reason for this effect can be a combination of the different timelines of the OSI SAF and MyOcean-SH-HR products in combination with strong winds which seem to show up in the ASAR image giving the open water some texture typical for storms. The difference between the early morning acquisition time of the ASAR image (2:31) and the nominal valid time for the OSI SAF product (12:00) could be enough for the sea ice to change when exposed to storms. The ASCAT Surface Wind fields for this location and time indeed show high surface winds of up to 12m/s (http://apdrc.soest.hawaii.edu/datadoc/ascat.php).

Remark: the area in the lower right corner is classed 'unclassified' in the MyOcean product due to low contrast

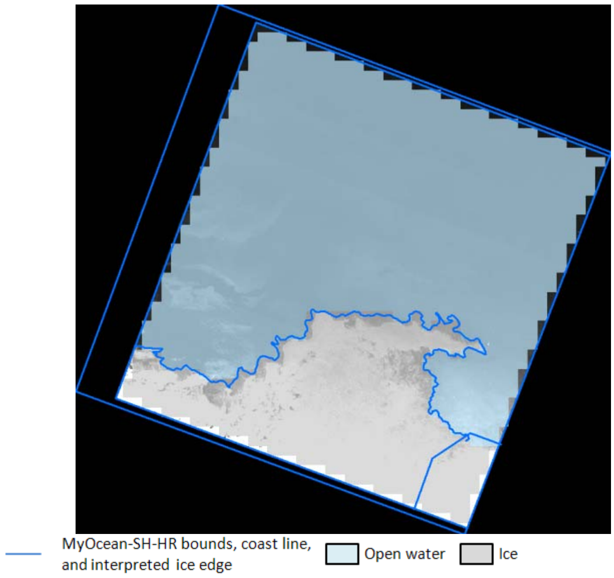


Figure 21: MyOcean-SH-HR ice classification with ice edge

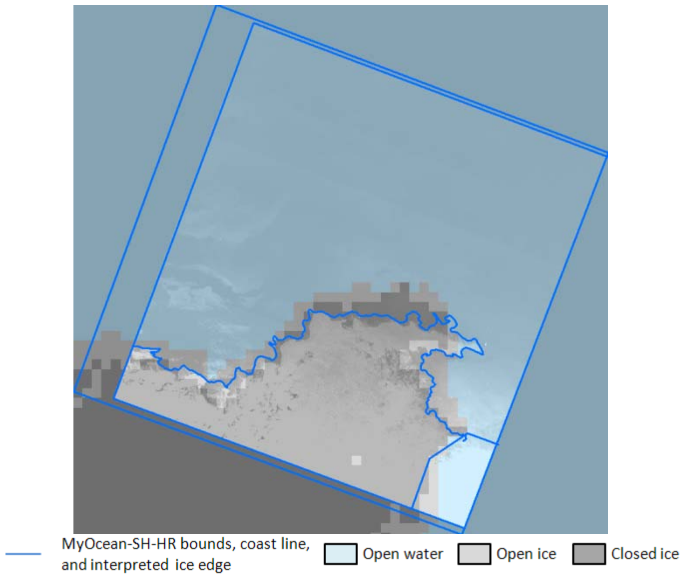
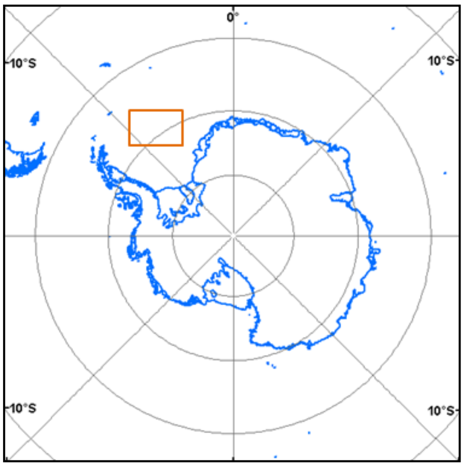


Figure 22: OSISAF sea ice edge classification

4.4.3 Discussion 3 –Very low agreement



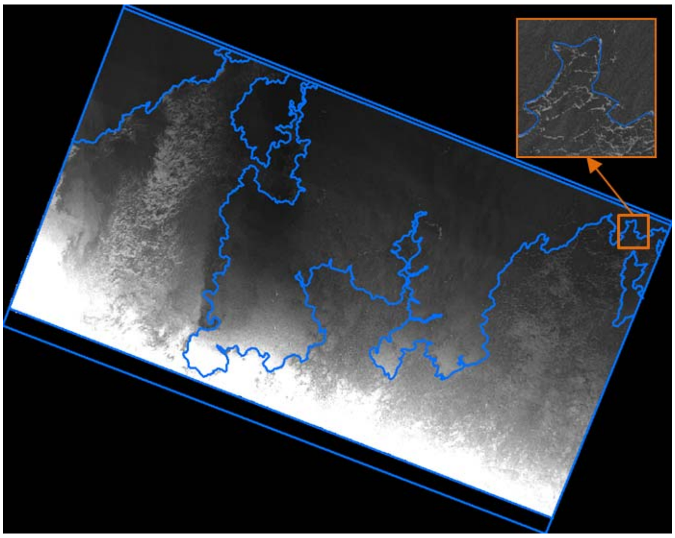


Figure 23: Envisat ASAR WSM source image

Validation dataset:
ice_edge_hr_sh_20110110_022234_2_valc.nc

agree:	60.6%
osi_over:	0%
osi_under:	39.4%
avg_dist_to_edge:	5.3px

Discussion:

In this scenario the ice conditions show very low ice concentration in most parts of the image. As discussed in (Ref 4.3.3) the difference in the definition of the ice classes can cause this rather extreme effect.

Ice can clearly be identified throughout the MyOcean-SH-HR ice class although the ice concentration is low - most likely below 35% (=minimum ice concentration for the OSI SAF product to be classified as ice) for the majority of the scene. See inset in **Figure 23** for characteristics of ice.

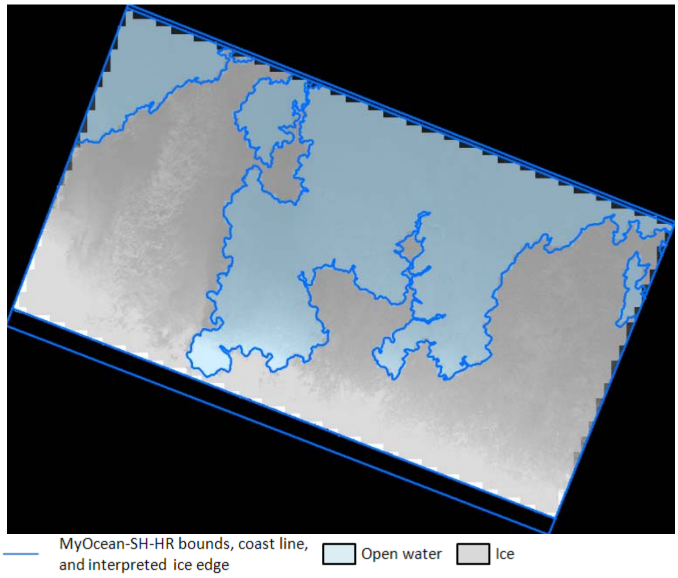


Figure 24: MyOcean-SH-HR ice classification with ice edge

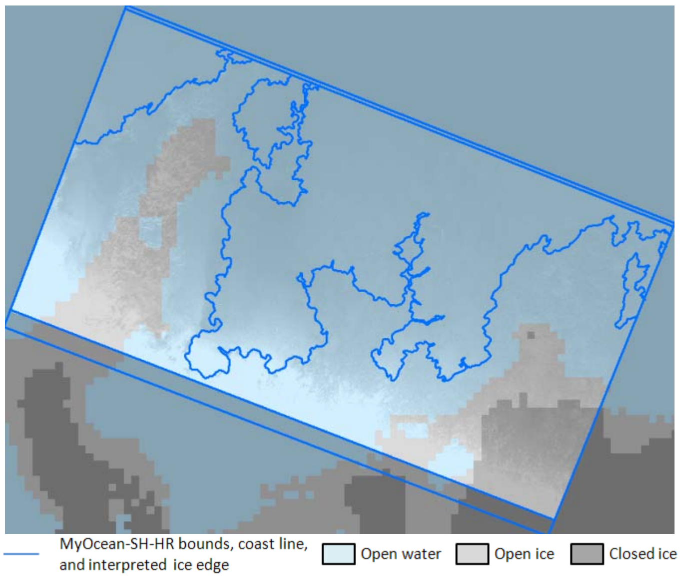
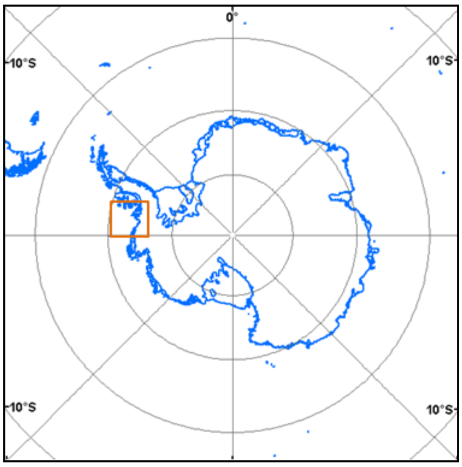


Figure 25: OSISAF sea ice edge classification

4.4.4 Discussion 4 –Average agreement with heightened OSISAF under-estimate



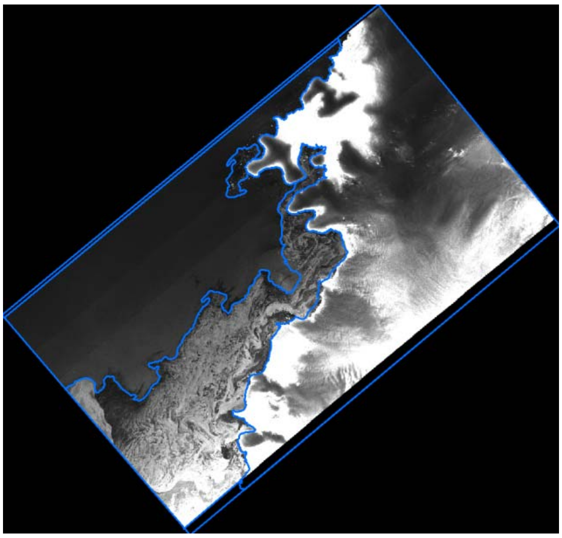


Figure 26: Envisat ASAR WSM source image

Validation dataset:
ice_edge_hr_sh_20110326_063245_3_valc.nc

agree:	92.3%
osi_over:	0.1%
osi_under:	7.6%
avg_dist_to_edge:	0.86px

Discussion:

In some parts of this scene no clear ice edge line can be identified. The OSI SAF product fails to identify two areas of low ice concentration (again caused by the 35% cut off value for the ice class). The OSI SAF under-estimate parameter is therefore fairly high.

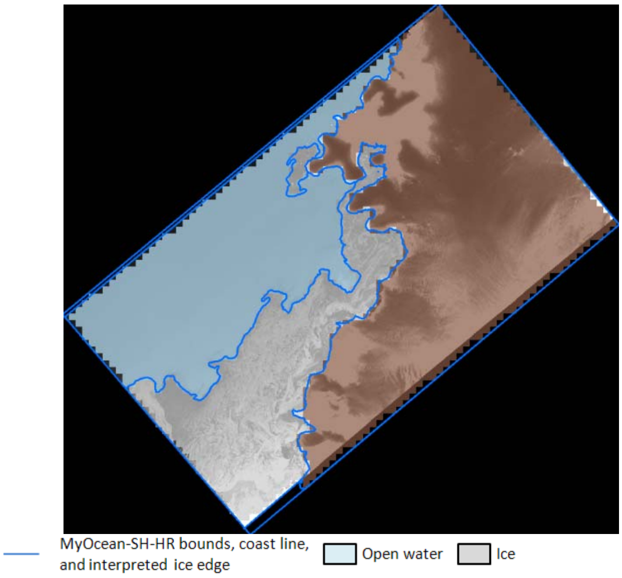


Figure 27: MyOcean-SH-HR ice classification with ice edge

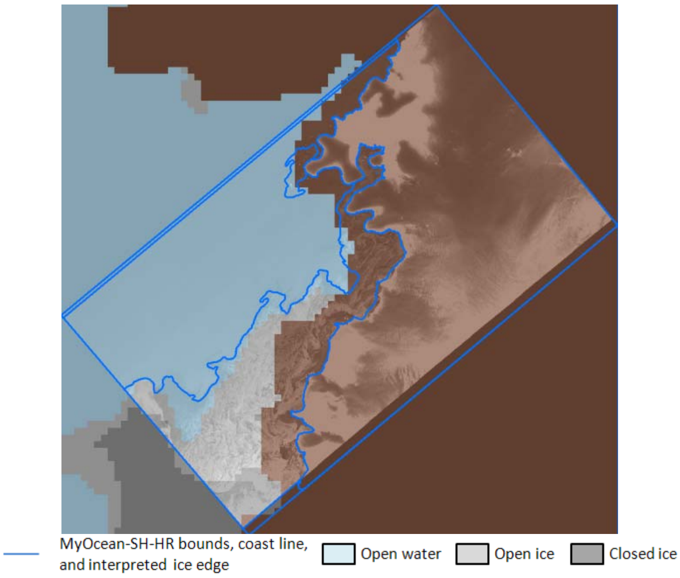


Figure 28: OSISAF sea ice edge classification

APPENDIX A: File formats

A.1 Validation grid definition file

The grid definition file is a simple text file describing the polar stereographic (at this time only) map projection as well as the grid in which the validating product (the OSI SAF sea ice product) is defined. The parameters are defined line by line in the following order:

Line number	Description	Proj4 equivalent parameter name
1	String/name describing the projection	n/a
2	Map projection (always ‘stere’ for OSISAF)	+proj
3	Reference ellipsoid major axis (in meters)	+a
4	Reference ellipsoid minor axis (in meters)	+b
5	Latitude of origin	+lat_0
6	Latitude of true scale	+lat_ts
7	Central meridian	+lon_0
8	False easting	+x_0
9	False northing	+y_0
10	Grid resolution (in meters)	n/a
11	Projected lower left corner x-ordinate (pixel center)	n/a
12	Projected lower left corner y-ordinate (pixel center)	n/a

Table 13: Validation grid file definition

A validation grid definition file for the southern hemisphere OSI SAF sea ice products is given here:

```
Polar stereographic projection true at 70°S
stere
6378273.0
6356889.44891
-90.0
-70.0
0.0
0.0
0.0
10000.0
-3945000.0
-3945000.0
```

Note: Projected lower left corner coordinate rounded. GDAL’s gdaltransform command shown below:

```
>gdaltransform -s_srs "EPSG:4326" -t_srs "+proj=stere +a=6378273 +b=6356889.44891 +lat_0=-90
+lat_ts=-70 +lon_0=0"
-135 -41.5015
-3945003.24120561 -3945003.24120561 0
```

A.2 MyOcean-SH-HR validation file

The netCDF file format standard version 3.5 is used for implementing the MyOcean-SH-HR validation file. According to the specification in 2.1 issuing a `ncdump -h` shows the following file structure for the validation file:

```
netcdf ice_edge_hr_sh_20110720_040330_4_val {
dimensions:
    time = 1 ;
    xc = 72 ;
    yc = 51 ;

variables:
    long time(time) ;
        time:long_name = "reference time of sea ice file" ;
        time:standard_name = "time" ;
        time:units = "seconds since 1981-01-01 00:00:00 UTC" ;
        time:calendar = "gregorian" ;
    float yc(yc) ;
        yc:axis = "Y" ;
        yc:long_name = "y-coordinate of projection (northings)" ;
        yc:standard_name = "projection_y_coordinate" ;
        yc:units = "m" ;
    float xc(xc) ;
        xc:axis = "X" ;
        xc:long_name = "x-coordinate of projection (eastings)" ;
        xc:standard_name = "projection_x_coordinate" ;
        xc:units = "m" ;
    float lat(yc, xc) ;
        lat:long_name = "Latitude coordinate" ;
        lat:standard_name = "latitude" ;
        lat:units = "degrees_north" ;
    float lon(yc, xc) ;
        lon:long_name = "Longitude coordinate" ;
        lon:standard_name = "longitude" ;
        lon:units = "degrees_east" ;
    char crs ;
        crs:grid_mapping_name = "Polar stereographic projection true at 70S" ;
        crs:straight_vertical_longitude_from_pole = 0.f ;
        crs:latitude_of_projection_origin = -90.f ;
        crs:standard_parallel = -70.f ;
        crs:false_easting = 0.f ;
        crs:false_northing = 0.f ;
        crs:proj4_string = "+proj=stere +a=6378273.0 +b=6356889.4 +lat_0=-90.0000
+lat_ts=-70.0000 +lon_0=0.00000" ;
    long count_nodata(time, yc, xc) ;
        count_nodata:long_name = "count_nodata" ;
        count_nodata:units = "1" ;
        count_nodata:coordinates = "lon lat" ;
        count_nodata:grid_mapping = "crs" ;
        count_nodata:source = "British Antarctic Survey" ;
        count_nodata:missing_value = -1 ;
        count_nodata:_FillValue = -1 ;
        count_nodata:valid_min = 0 ;
        count_nodata:valid_max = 9999999 ;
        count_nodata:comment = "total count of reference dataset no-data pixels
contained in validation grid cell" ;
    long count_water(time, yc, xc) ;
        count_water:long_name = "count_water" ;
        count_water:units = "1" ;
        count_water:coordinates = "lon lat" ;
        count_water:grid_mapping = "crs" ;
        count_water:source = "British Antarctic Survey" ;
```

```
        count_water:missing_value = -1 ;
        count_water:_FillValue = -1 ;
        count_water:valid_min = 0 ;
        count_water:valid_max = 9999999 ;
        count_water:comment = "total count of reference dataset water pixels contained
in validation grid cell" ;
    long count_ice(time, yc, xc) ;
        count_ice:long_name = "count_ice" ;
        count_ice:units = "1" ;
        count_ice:coordinates = "lon lat" ;
        count_ice:grid_mapping = "crs" ;
        count_ice:source = "British Antarctic Survey" ;
        count_ice:missing_value = -1 ;
        count_ice:_FillValue = -1 ;
        count_ice:valid_min = 0 ;
        count_ice:valid_max = 9999999 ;
        count_ice:comment = "total count of reference dataset ice pixels contained in
validation grid cell" ;
    long count_land(time, yc, xc) ;
        count_land:long_name = "count_land" ;
        count_land:units = "1" ;
        count_land:coordinates = "lon lat" ;
        count_land:grid_mapping = "crs" ;
        count_land:source = "British Antarctic Survey" ;
        count_land:missing_value = -1 ;
        count_land:_FillValue = -1 ;
        count_land:valid_min = 0 ;
        count_land:valid_max = 9999999 ;
        count_land:comment = "total count of reference dataset land pixels contained in
validation grid cell" ;
    long count_unclass(time, yc, xc) ;
        count_unclass:long_name = "count_unclass" ;
        count_unclass:units = "1" ;
        count_unclass:coordinates = "lon lat" ;
        count_unclass:grid_mapping = "crs" ;
        count_unclass:source = "British Antarctic Survey" ;
        count_unclass:missing_value = -1 ;
        count_unclass:_FillValue = -1 ;
        count_unclass:valid_min = 0 ;
        count_unclass:valid_max = 9999999 ;
        count_unclass:comment = "total count of unclassified reference dataset pixels
contained in validation grid cell" ;
    long count_total(time, yc, xc) ;
        count_total:long_name = "count_total" ;
        count_total:units = "1" ;
        count_total:coordinates = "lon lat" ;
        count_total:grid_mapping = "crs" ;
        count_total:source = "British Antarctic Survey" ;
        count_total:missing_value = -1 ;
        count_total:_FillValue = -1 ;
        count_total:valid_min = 0 ;
        count_total:valid_max = 9999999 ;
        count_total:comment = "total count of reference dataset pixels contained in
validation grid cell" ;
    short ice_edge_val(time, yc, xc) ;
        ice_edge_val:long_name = "ice_edge_val" ;
        ice_edge_val:units = "1" ;
        ice_edge_val:coordinates = "lon lat" ;
        ice_edge_val:grid_mapping = "crs" ;
        ice_edge_val:source = "British Antarctic Survey" ;
        ice_edge_val:missing_value = 0s ;
        ice_edge_val:_FillValue = 0s ;
        ice_edge_val:valid_min = 1s ;
        ice_edge_val:valid_max = 10s ;
        ice_edge_val:comment = "Validation sea ice edge. Values: 0 No data; 1 ice free;
2 sea ice; 9 on land or ice shelf; 10 unclassified" ;
    short ice_conc_val(time, yc, xc) ;
        ice_conc_val:long_name = "ice_conc_val" ;
```

```
        ice_conc_val:standard_name = "sea_ice_area_fraction" ;
        ice_conc_val:units = "%" ;
        ice_conc_val:coordinates = "lon lat" ;
        ice_conc_val:grid_mapping = "crs" ;
        ice_conc_val:source = "British Antarctic Survey" ;
        ice_conc_val:missing_value = 255s ;
        ice_conc_val:_FillValue = 255s ;
        ice_conc_val:valid_min = 0s ;
        ice_conc_val:valid_max = 100s ;
        ice_conc_val:comment = "Validation sea ice concentration. Values: 0 .. 0% sea
ice concentration; 100 .. 100% sea ice concentration; 255 .. n/a" ;

// global attributes:
        :title = "Sea ice validation file derived from MyOcean ice_edge_hr_sh product" ;
        :product_name = "ice_edge_hr_sh_val" ;
        :product_status = "preoperational" ;
        :abstract = "A sea ice edge validation file derived from the MyOcean
ice_edge_hr_sh product and downsampled to 10000.000m resolution" ;
        :keywords = "Sea Ice, Remote Sensing" ;
        :area = "Southern Hemisphere" ;
        :creation_date = "2011-08-30 10:01:43 UTC" ;
        :valid_date = "2011-07-20 04:03:30 UTC" ;
        :produced_date = "2011-08-30" ;
        :PI_name = "Andrew H. Fleming" ;
        :distribution_statement = "Free" ;
        :netcdf_version_id = "3.5" ;
        :product_version = "0.2" ;
        :satellite = "Envisat" ;
        :sensor = "ASAR" ;
        :spatial_resolution = "10000.000" ;
        :source_file = "ASA_WSM_1PNPDE20110720_040330_000003923104_00363_49084_9163.N1"
;
        :institution = "British Antarctic Survey" ;
        :contact = "polarview@bas.ac.uk" ;
        :total_water = 172083 ;
        :total_ice = 105002 ;
        :total_land = 1701 ;
        :total_exclude = 98410 ;
}
```

A.3 Combined MyOcean / OSI SAF validation file

The netCDF file format standard version 3.5 is used for implementing the combined MyOcean/OSISAF validation file. According to the specification in 2.2 issuing a `ncdump –h` shows the following file structure for the validation file:

```
netcdf ice_edge_hr_sh_20110720_040330_4_valc {
dimensions:
    time = 1 ;
    xc = 72 ;
    yc = 51 ;

variables:
    long time(time) ;
        time:long_name = "reference time of sea ice file" ;
        time:standard_name = "time" ;
        time:units = "seconds since 1981-01-01 00:00:00 UTC" ;
        time:calendar = "gregorian" ;
    float yc(yc) ;
        yc:axis = "Y" ;
        yc:long_name = "y-coordinate of projection (northings)" ;
        yc:standard_name = "projection_y_coordinate" ;
        yc:units = "m" ;
    float xc(xc) ;
        xc:axis = "X" ;
        xc:long_name = "x-coordinate of projection (eastings)" ;
        xc:standard_name = "projection_x_coordinate" ;
        xc:units = "m" ;
    float lat(yc, xc) ;
        lat:long_name = "Latitude coordinate" ;
        lat:standard_name = "latitude" ;
        lat:units = "degrees_north" ;
    float lon(yc, xc) ;
        lon:long_name = "Longitude coordinate" ;
        lon:standard_name = "longitude" ;
        lon:units = "degrees_east" ;
    char crs ;
        crs:grid_mapping_name = "Polar stereographic projection true at 70S" ;
        crs:straight_vertical_longitude_from_pole = 0.f ;
        crs:latitude_of_projection_origin = -90.f ;
        crs:standard_parallel = -70.f ;
        crs:false_easting = 0.f ;
        crs:false_northing = 0.f ;
        crs:proj4_string = "+proj=stere +a=6378273.0 +b=6356889.4 +lat_0=-90.0000
+lat_ts=-70.0000 +lon_0=0.00000" ;
    long count_nodata(time, yc, xc) ;
        count_nodata:long_name = "count_nodata" ;
        count_nodata:units = "1" ;
        count_nodata:coordinates = "lon lat" ;
        count_nodata:grid_mapping = "crs" ;
        count_nodata:source = "British Antarctic Survey" ;
        count_nodata:missing_value = -1 ;
        count_nodata:_FillValue = -1 ;
        count_nodata:valid_min = 0 ;
        count_nodata:valid_max = 9999999 ;
        count_nodata:comment = "total count of reference dataset no-data pixels
contained in validation grid cell" ;
    long count_water(time, yc, xc) ;
        count_water:long_name = "count_water" ;
        count_water:units = "1" ;
        count_water:coordinates = "lon lat" ;
        count_water:grid_mapping = "crs" ;
        count_water:source = "British Antarctic Survey" ;
```

```
        count_water:missing_value = -1 ;
        count_water:_FillValue = -1 ;
        count_water:valid_min = 0 ;
        count_water:valid_max = 9999999 ;
        count_water:comment = "total count of reference dataset water pixels contained
in validation grid cell" ;
    long count_ice(time, yc, xc) ;
        count_ice:long_name = "count_ice" ;
        count_ice:units = "1" ;
        count_ice:coordinates = "lon lat" ;
        count_ice:grid_mapping = "crs" ;
        count_ice:source = "British Antarctic Survey" ;
        count_ice:missing_value = -1 ;
        count_ice:_FillValue = -1 ;
        count_ice:valid_min = 0 ;
        count_ice:valid_max = 9999999 ;
        count_ice:comment = "total count of reference dataset ice pixels contained in
validation grid cell" ;
    long count_land(time, yc, xc) ;
        count_land:long_name = "count_land" ;
        count_land:units = "1" ;
        count_land:coordinates = "lon lat" ;
        count_land:grid_mapping = "crs" ;
        count_land:source = "British Antarctic Survey" ;
        count_land:missing_value = -1 ;
        count_land:_FillValue = -1 ;
        count_land:valid_min = 0 ;
        count_land:valid_max = 9999999 ;
        count_land:comment = "total count of reference dataset land pixels contained in
validation grid cell" ;
    long count_unclass(time, yc, xc) ;
        count_unclass:long_name = "count_unclass" ;
        count_unclass:units = "1" ;
        count_unclass:coordinates = "lon lat" ;
        count_unclass:grid_mapping = "crs" ;
        count_unclass:source = "British Antarctic Survey" ;
        count_unclass:missing_value = -1 ;
        count_unclass:_FillValue = -1 ;
        count_unclass:valid_min = 0 ;
        count_unclass:valid_max = 9999999 ;
        count_unclass:comment = "total count of unclassified reference dataset pixels
contained in validation grid cell" ;
    long count_total(time, yc, xc) ;
        count_total:long_name = "count_total" ;
        count_total:units = "1" ;
        count_total:coordinates = "lon lat" ;
        count_total:grid_mapping = "crs" ;
        count_total:source = "British Antarctic Survey" ;
        count_total:missing_value = -1 ;
        count_total:_FillValue = -1 ;
        count_total:valid_min = 0 ;
        count_total:valid_max = 9999999 ;
        count_total:comment = "total count of reference dataset pixels contained in
validation grid cell" ;
    short ice_edge_val(time, yc, xc) ;
        ice_edge_val:long_name = "ice_edge_val" ;
        ice_edge_val:units = "1" ;
        ice_edge_val:coordinates = "lon lat" ;
        ice_edge_val:grid_mapping = "crs" ;
        ice_edge_val:source = "British Antarctic Survey" ;
        ice_edge_val:missing_value = 0s ;
        ice_edge_val:_FillValue = 0s ;
        ice_edge_val:valid_min = 1s ;
        ice_edge_val:valid_max = 10s ;
        ice_edge_val:comment = "Validation sea ice edge. Values: 0 No data; 1 ice free;
2 sea ice; 9 on land or ice shelf; 10 unclassified" ;
    short ice_conc_val(time, yc, xc) ;
        ice_conc_val:long_name = "ice_conc_val" ;
```

```
        ice_conc_val:standard_name = "sea_ice_area_fraction" ;
        ice_conc_val:units = "%" ;
        ice_conc_val:coordinates = "lon lat" ;
        ice_conc_val:grid_mapping = "crs" ;
        ice_conc_val:source = "British Antarctic Survey" ;
        ice_conc_val:missing_value = 255s ;
        ice_conc_val:_FillValue = 255s ;
        ice_conc_val:valid_min = 0s ;
        ice_conc_val:valid_max = 100s ;
        ice_conc_val:comment = "Validation sea ice concentration. Values: 0 .. 0% sea
ice concentration; 100 .. 100% sea ice concentration; 255 .. n/a" ;
    byte ice_edge_osi(time, yc, xc) ;
        ice_edge_osi:long_name = "ice_edge_osi" ;
        ice_edge_osi:_FillValue = '\377' ;
        ice_edge_osi:grid_mapping = "crs" ;
        ice_edge_osi:coordinates = "lat lon" ;
        ice_edge_osi:comment = "Sea ice edge OSI SAF product. Value: 1 ice_free; 2
open_ice; 3 closed_ice" ;
    byte confidence_level_edge_osi(time, yc, xc) ;
        confidence_level_edge_osi:long_name = "confidence_level_edge_osi" ;
        confidence_level_edge_osi:valid_min = '\1' ;
        confidence_level_edge_osi:valid_max = '\5' ;
        confidence_level_edge_osi:grid_mapping = "crs" ;
        confidence_level_edge_osi:coordinates = "lat lon" ;
        confidence_level_edge_osi:comment = "Sea ice edge confidence level OSI SAF
product. Values: 0 Unprocessed; 1 Erroneous; 2 Unreliable; 3 Acceptable; 4 Good; 5
Excellent" ;
    short ice_conc_osi(time, yc, xc) ;
        ice_conc_osi:long_name = "ice_conc_osi" ;
        ice_conc_osi:standard_name = "sea_ice_area_fraction" ;
        ice_conc_osi:units = "%" ;
        ice_conc_osi:_FillValue = -999s ;
        ice_conc_osi:valid_min = 0s ;
        ice_conc_osi:valid_max = 10000s ;
        ice_conc_osi:grid_mapping = "crs" ;
        ice_conc_osi:coordinates = "lat lon" ;
        ice_conc_osi:scale_factor = 0.0099999998f ;
        ice_conc_osi:add_offset = 0.f ;
        ice_conc_osi:comment = "Sea ice concentration level OSI SAF product" ;
    byte confidence_level_conc_osi(time, yc, xc) ;
        confidence_level_conc_osi:long_name = "confidence_level_conc_osi" ;
        confidence_level_conc_osi:valid_min = '\1' ;
        confidence_level_conc_osi:valid_max = '\5' ;
        confidence_level_conc_osi:grid_mapping = "crs" ;
        confidence_level_conc_osi:coordinates = "lat lon" ;
        confidence_level_conc_osi:comment = "Sea ice concentration confidence level OSI
SAF product. Values: 0 Unprocessed; 1 Erroneous; 2 Unreliable; 3 Acceptable; 4 Good; 5
Excellent" ;
    byte include(time, yc, xc) ;
        include:long_name = "include" ;
        include:valid_min = '\0' ;
        include:valid_max = '\1' ;
        include:grid_mapping = "crs" ;
        include:coordinates = "lat lon" ;
        include:comment = "Exclude / include mask for cell inclusion in global
statistics. Values: 0 Exclude cell in statistics; 1 Include cell in statistics" ;
    byte on_edge_val(time, yc, xc) ;
        on_edge_val:long_name = "on_edge_val" ;
        on_edge_val:valid_min = '\0' ;
        on_edge_val:valid_max = '\1' ;
        on_edge_val:grid_mapping = "crs" ;
        on_edge_val:coordinates = "lat lon" ;
        on_edge_val:comment = "Cells on the MyOcean ice edge (= all class \"ice\" cells
for which the 3x3 operator contains at least one class \"water\" cell. Values: 0 Cell
NOT on the ice edge; 1 Cell on the ice edge" ;
    byte on_edge_osi(time, yc, xc) ;
        on_edge_osi:long_name = "on_edge_osi" ;
        on_edge_osi:valid_min = '\0' ;
```

```
        on_edge_osi:valid_max = '\1' ;
        on_edge_osi:grid_mapping = "crs" ;
        on_edge_osi:coordinates = "lat lon" ;
        on_edge_osi:comment = "Cells on the OSISAF ice edge (= all class \"ice\" cells
for which the 3x3 operator contains at least one class \"water\" cell. Values: 0 Cell
NOT on the ice edge; 1 Cell on the ice edge" ;
    float dist_to_edge_val(time, yc, xc) ;
        dist_to_edge_val:long_name = "dist_to_edge_val" ;
        dist_to_edge_val:_FillValue = -1.f ;
        dist_to_edge_val:grid_mapping = "crs" ;
        dist_to_edge_val:coordinates = "lat lon" ;
        dist_to_edge_val:scale_factor = 10000.f ;
        dist_to_edge_val:comment = "Euclidian distance in pixels to closest MyOcean on
ice edge cell (=dist_to_eddu_val). Only defined if there is no noData/unlcassified pixel
closer nearby" ;
    float dist_to_edge_osi(time, yc, xc) ;
        dist_to_edge_osi:long_name = "dist_to_edge_osi" ;
        dist_to_edge_osi:_FillValue = -1.f ;
        dist_to_edge_osi:grid_mapping = "crs" ;
        dist_to_edge_osi:coordinates = "lat lon" ;
        dist_to_edge_osi:scale_factor = 10000.f ;
        dist_to_edge_osi:comment = "Euclidian distance in pixels to closest OSISAF on
ice edge cell (=dist_to_eddu_osi). Only defined if there is no noData/unlcassified pixel
closer nearby" ;
    float dist_to_edge(time, yc, xc) ;
        dist_to_edge:long_name = "dist_to_edge" ;
        dist_to_edge:_FillValue = -1.f ;
        dist_to_edge:grid_mapping = "crs" ;
        dist_to_edge:coordinates = "lat lon" ;
        dist_to_edge:scale_factor = 10000.f ;
        dist_to_edge:comment = "Euclidian distance in pixels from every OSISAF pixel on
the ice edge (=on_edge_osi) to closest MyOcean pixel on the ice edge (=on_edge_val)" ;
    float avg_dist_to_edge ;
        avg_dist_to_edge:long_name = "avg_dist_to_edge" ;
        avg_dist_to_edge:unit = "km" ;
        avg_dist_to_edge:comment = "Average euclidian distance in pixels from every
OSISAF pixel on the ice edge (=on_edge_osi) to closest MyOcean pixel on the ice edge
(=on_edge_val)" ;
    float avg_ice_conc_on_edge ;
        avg_ice_conc_on_edge:long_name = "avg_ice_conc_on_edge" ;
        avg_ice_conc_on_edge:unit = "%" ;
        avg_ice_conc_on_edge:comment = "Average ice concentration of MyOcean/validation
dataset ice edge pixels on OSI SAF ice concentration" ;

// global attributes:
        :title = "Combined sea ice validation file derived from MyOcean ice_edge_hr_sh
and the OSI SAF osi_saf_ice_edge product" ;
        :product_name = "ice_edge_hr_sh_valc" ;
        :product_status = "preoperational" ;
        :abstract = "A combined sea ice edge validation file including downsampled
MyOcean high resolution and OSISAF low resolution date for comparison/validation
purposes" ;
        :keywords = "Sea Ice, Remote Sensing" ;
        :area = "Southern Hemisphere" ;
        :creation_date = "2011-09-20 12:55:05 UTC" ;
        :valid_date = "2011-07-20 04:03:30 UTC" ;
        :produced_date = "2011-08-30" ;
        :PI_name = "Andrew H. Fleming" ;
        :distribution_statement = "Free" ;
        :netcdf_version_id = "3.5" ;
        :product_version = "1.0" ;
        :spatial_resolution = "10000.000" ;
        :institution = "British Antarctic Survey" ;
        :contact = "polarview@bas.ac.uk" ;
        :total_water_val = 172083 ;
        :total_ice_val = 105002 ;
        :total_land_val = 1701 ;
        :total_exclude_val = 98410 ;
```

```
        :source_file_1 = "ice_edge_hr_sh_20110720_040330_4_val.nc" ;
        :source_file_2 = "ice_edge_sh_polstere-100_multi_201107201200.nc" ;
        :source_file_3 = "ice_conc_sh_polstere-100_multi_201107201200.nc" ;
        :count_ice_ice = 632 ;
        :count_water_water = 1422 ;
        :count_water_ice = 33 ;
        :count_ice_water = 231 ;
        :count_relevant = 2318 ;
        :percent_relevant = 0.63126361f ;
        :agree = 0.8861087f ;
        :agreeConf0 = 0.f ;
        :agreeConf1 = 0.73949581f ;
        :agreeConf2 = 0.84942085f ;
        :agreeConf3 = 0.84594595f ;
        :agreeConf4 = 0.67948717f ;
        :agreeConf5 = 0.92493296f ;
        :osi_over = 0.014236411f ;
        :osi_under = 0.099654876f ;
        :avg_dist_to_edge = 1.3043182f ;
        :avg_ice_conc = 16.949623f ;
}
```

A.4 Monthly statistics file

Again the netCDF file format convention version 3.5 is used for implementing the OSISAF/MyOcean monthly statistics. In line with the methodology and specification described in 2.3 `ncdump –h` shows the following file structure for the validation file:

```
netcdf valstats_2011_07 {
dimensions:
    xc = 340 ;
    yc = 432 ;
    conf = 6 ;

variables:
    float yc(yc) ;
        yc:axis = "Y" ;
        yc:long_name = "y-coordinate of projection (northings)" ;
        yc:standard_name = "projection_y_coordinate" ;
        yc:units = "m" ;
    float xc(xc) ;
        xc:axis = "X" ;
        xc:long_name = "x-coordinate of projection (eastings)" ;
        xc:standard_name = "projection_x_coordinate" ;
        xc:units = "m" ;
    float lat(yc, xc) ;
        lat:long_name = "Latitude coordinate" ;
        lat:standard_name = "latitude" ;
        lat:units = "degrees_north" ;
    float lon(yc, xc) ;
        lon:long_name = "Longitude coordinate" ;
        lon:standard_name = "longitude" ;
        lon:units = "degrees_east" ;
    char crs ;
        crs:grid_mapping_name = "Polar stereographic projection true at 70S" ;
        crs:straight_vertical_longitude_from_pole = 0.f ;
        crs:latitude_of_projection_origin = -90.f ;
        crs:standard_parallel = -70.f ;
        crs:false_easting = 0.f ;
        crs:false_northing = 0.f ;
        crs:proj4_string = "+proj=stere +a=6378273.0 +b=6356889.4 +lat_0=-90.0000
+lat_ts=-70.0000 +lon_0=0.00000" ;
    short input_data_dist(yc, xc) ;
        input_data_dist:long_name = "input_coverage" ;
        input_data_dist:_FillValue = 0s ;
        input_data_dist:valid_min = '\0' ;
        input_data_dist:grid_mapping = "crs" ;
        input_data_dist:coordinates = "lat lon" ;
        input_data_dist:comment = "Distribution of input files considered in monthly
statistics" ;
    float count_relevant ;
        count_relevant:long_name = "count_relevant" ;
        count_relevant:comment = "Total number of relevant pixels (_ice_ or _open
water_) considered in statistics" ;
    float count_agree ;
        count_agree:long_name = "count_agree" ;
        count_agree:comment = "Total number of pixels over all input data sets in
agreement comparing OSISAF and MyOcean datasets" ;
    float agree ;
        agree:long_name = "agree" ;
        agree:unit = "%" ;
        agree:comment = "Percentage of agree pixels over all relevant pixels and
products" ;
    float avg_agree ;
        avg_agree:long_name = "avg_agree" ;
```

```
        avg_agree:unit = "%" ;
        avg_agree:comment = "Average of individual validation products agree percentage"
;
    float stdev_agree ;
        stdev_agree:long_name = "stdev_agree" ;
        stdev_agree:unit = "%" ;
        stdev_agree:comment = "Standard deviation of individual validation products
agree percentage" ;
    float avg_agree_conf(conf) ;
        avg_agree_conf:long_name = "avg_agree_confidence_levels" ;
        avg_agree_conf:unit = "%" ;
        avg_agree_conf:comment = "Average of individual validation products OSISAF
confidence level binned agree percentage" ;
    float stdev_agree_conf(conf) ;
        stdev_agree_conf:long_name = "stdev_agree_confidence_levels" ;
        stdev_agree_conf:unit = "%" ;
        stdev_agree_conf:comment = "Standard deviation of individual validation products
OSISAF confidence level binned agree percentage" ;
    float max_agree ;
        max_agree:long_name = "max_agree" ;
        max_agree:unit = "%" ;
        max_agree:comment = "Maximum of individual validation products agree percentage"
;
    float min_agree ;
        min_agree:long_name = "min_agree" ;
        min_agree:unit = "%" ;
        min_agree:comment = "Minimum of individual validation products agree percentage"
;
    float count_osi_over ;
        count_osi_over:long_name = "count_osi_over" ;
        count_osi_over:comment = "Total number of pixels over all input data sets where
OSISAF over estimates" ;
    float osi_over ;
        osi_over:long_name = "osi_over" ;
        osi_over:unit = "%" ;
        osi_over:comment = "Percentage of OSISAF over estimate pixels over all relevant
pixels and products" ;
    float avg_osi_over ;
        avg_osi_over:long_name = "avg_osi_over" ;
        avg_osi_over:unit = "%" ;
        avg_osi_over:comment = "Average of individual validation products OSISAF over
estimate percentage" ;
    float stdev_osi_over ;
        stdev_osi_over:long_name = "stdev_osi_over" ;
        stdev_osi_over:unit = "%" ;
        stdev_osi_over:comment = "Standard deviation of individual validation products
OSISAF over estimage percentage" ;
    float count_osi_under ;
        count_osi_under:long_name = "count_osi_under" ;
        count_osi_under:comment = "Total number of pixels over all input data sets where
OSISAF under estimates" ;
    float osi_under ;
        osi_under:long_name = "osi_under" ;
        osi_under:unit = "%" ;
        osi_under:comment = "Percentage of OSISAF under estimate pixels over all
relevant pixels and products" ;
    float avg_osi_under ;
        avg_osi_under:long_name = "avg_osi_under" ;
        avg_osi_under:unit = "%" ;
        avg_osi_under:comment = "Average of individual validation products OSISAF under
estimate percentage" ;
    float stdev_osi_under ;
        stdev_osi_under:long_name = "stdev_osi_under" ;
        stdev_osi_under:unit = "%" ;
        stdev_osi_under:comment = "Standard deviation of individual validation products
OSISAF under estimage percentage" ;
    float avg_dist_to_edge ;
        avg_dist_to_edge:long_name = "avg_dist_to_edge" ;
```

```
        avg_dist_to_edge:unit = "km" ;
        avg_dist_to_edge:comment = "Average of individual products average euclidian
distance in pixels from every OSISAF pixel on the ice edge (=on_edge_osi) to closest
MyOcean pixel on the ice edge (=on_edge_val)" ;
    float stdev_dist_to_edge ;
        stdev_dist_to_edge:long_name = "stdev_dist_to_edge" ;
        stdev_dist_to_edge:unit = "km" ;
        stdev_dist_to_edge:comment = "Standard deviation of individual products average
euclidian distance in pixels from every OSISAF pixel on the ice edge (=on_edge_osi) to
closest MyOcean pixel on the ice edge (=on_edge_val)" ;
    float avg_ice_conc_on_edge ;
        avg_ice_conc_on_edge:long_name = "avg_ice_conc_on_edge" ;
        avg_ice_conc_on_edge:unit = "%" ;
        avg_ice_conc_on_edge:comment = "Average of individual products average ice
concentration of MyOcean/validation dataset ice edge pixels on OSI SAF ice
concentration" ;
    float stdev_ice_conc_on_edge ;
        stdev_ice_conc_on_edge:long_name = "stdev_ice_conc_on_edge" ;
        stdev_ice_conc_on_edge:unit = "km" ;
        stdev_ice_conc_on_edge:comment = "Standard deviation of individual products
average ice concentration of MyOcean/validation dataset ice edge pixels on OSI SAF ice
concentration" ;

// global attributes:
        :title = "Monthly statistics for OSISAF/MyOcean high-res sea ice validation
products" ;
        :product_name = "monthly_stats_ice_edge_val" ;
        :abstract = "Monthly statistics for combined sea ice validation files derived
from OSISAF and MyOcean-SH_HR sea ice products" ;
        :keywords = "Sea Ice, Remote Sensing" ;
        :area = "Southern Hemisphere" ;
        :valid_date = "7/2011" ;
        :produced_date = "2011-09-20 15:12:58 UTC" ;
        :PI_name = "Andrew H. Fleming" ;
        :institution = "British Antarctic Survey" ;
        :contact = "polarview@bas.ac.uk" ;
        :distribution_statement = "Free" ;
        :netcdf_version_id = "3.5" ;
        :product_version = "1.0" ;
        :spatial_resolution = 10000.f ;
        :source_files_count = 65s ;
        :source_files = "ice_edge_hr_sh_20110701_022056_3_valc.nc;
ice_edge_hr_sh_20110701_035958_4_valc.nc; ice_edge_hr_sh_20110702_014433_3_valc.nc;
ice_edge_hr_sh_20110702_050233_4_valc.nc; ice_edge_hr_sh_20110703_024725_3_valc.nc;
ice_edge_hr_sh_20110703_024725_4_valc.nc; ice_edge_hr_sh_20110704_003141_3_valc.nc;
ice_edge_hr_sh_20110704_021103_3_valc.nc; ice_edge_hr_sh_20110704_035004_4_valc.nc;
ice_edge_hr_sh_20110705_013457_3_valc.nc; ice_edge_hr_sh_20110706_005741_3_valc.nc;
ice_edge_hr_sh_20110706_023734_3_valc.nc; ice_edge_hr_sh_20110706_041628_4_valc.nc;
ice_edge_hr_sh_20110707_020133_3_valc.nc; ice_edge_hr_sh_20110707_034007_4_valc.nc;
ice_edge_hr_sh_20110708_044251_4_valc.nc; ice_edge_hr_sh_20110709_004834_3_valc.nc;
ice_edge_hr_sh_20110709_022741_3_valc.nc; ice_edge_hr_sh_20110709_040638_4_valc.nc;
ice_edge_hr_sh_20110710_015135_3_valc.nc; ice_edge_hr_sh_20110710_051227_2_valc.nc;
ice_edge_hr_sh_20110711_011446_3_valc.nc; ice_edge_hr_sh_20110711_025406_4_valc.nc;
ice_edge_hr_sh_20110711_043259_4_valc.nc; ice_edge_hr_sh_20110712_003704_4_valc.nc;
ice_edge_hr_sh_20110712_035649_4_valc.nc; ice_edge_hr_sh_20110712_053512_4_valc.nc;
ice_edge_hr_sh_20110713_000157_3_valc.nc; ice_edge_hr_sh_20110713_014122_3_valc.nc;
ice_edge_hr_sh_20110713_032027_4_valc.nc; ice_edge_hr_sh_20110714_024415_4_valc.nc;
ice_edge_hr_sh_20110714_042308_4_valc.nc; ice_edge_hr_sh_20110715_002830_3_valc.nc;
ice_edge_hr_sh_20110715_235128_3_valc.nc; ice_edge_hr_sh_20110716_044935_4_valc.nc;
ice_edge_hr_sh_20110717_023425_4_valc.nc; ice_edge_hr_sh_20110717_041320_4_valc.nc;
ice_edge_hr_sh_20110718_033659_4_valc.nc; ice_edge_hr_sh_20110718_051559_4_valc.nc;
ice_edge_hr_sh_20110719_012129_3_valc.nc; ice_edge_hr_sh_20110719_030047_4_valc.nc;
ice_edge_hr_sh_20110719_043943_4_valc.nc; ice_edge_hr_sh_20110720_004459_3_valc.nc;
ice_edge_hr_sh_20110720_040330_4_valc.nc; ice_edge_hr_sh_20110720_054155_4_valc.nc;
ice_edge_hr_sh_20110721_014809_3_valc.nc; ice_edge_hr_sh_20110721_050609_4_valc.nc;
ice_edge_hr_sh_20110722_025058_4_valc.nc; ice_edge_hr_sh_20110722_042950_4_valc.nc;
ice_edge_hr_sh_20110723_021437_3_valc.nc; ice_edge_hr_sh_20110723_035339_4_valc.nc;
ice_edge_hr_sh_20110723_053203_4_valc.nc; ice_edge_hr_sh_20110724_013812_3_valc.nc;
```

```
ice_edge_hr_sh_20110724_031720_4_valc.nc; ice_edge_hr_sh_20110725_010150_3_valc.nc;
ice_edge_hr_sh_20110725_042001_4_valc.nc; ice_edge_hr_sh_20110726_020446_3_valc.nc;
ice_edge_hr_sh_20110726_034341_4_valc.nc; ice_edge_hr_sh_20110726_052210_4_valc.nc;
ice_edge_hr_sh_20110727_030730_4_valc.nc; ice_edge_hr_sh_20110727_044626_4_valc.nc;
ice_edge_hr_sh_20110728_023247_3_valc.nc; ice_edge_hr_sh_20110728_041011_4_valc.nc;
ice_edge_hr_sh_20110729_033350_4_valc.nc; ice_edge_hr_sh_20110730_043634_4_valc.nc; " ;
}
```

APPENDIX B: Detailed statistics for Jan, Feb, Mar, Jun, and Jul 2011

The following section lists the results for all combined validation files.

B.1 January 2011

File	count_ relevant	percent_ relevant	agree	osi_over	osi_- under	avg_dist to_edge	avg_ice_ conc
ice_edge_hr_sh_20110102_120615_4_valc.nc	267	0.046	0.865	0.030	0.105	0.804	42.913
ice_edge_hr_sh_20110103_031826_4_valc.nc	2444	0.577	0.725	0.000	0.275	6.857	9.592
ice_edge_hr_sh_20110104_105328_2_valc.nc	2882	0.674	0.921	0.040	0.039	8.038	14.002
ice_edge_hr_sh_20110104_105328_3_valc.nc	2664	0.621	0.741	0.000	0.259	4.850	7.872
ice_edge_hr_sh_20110105_034435_2_valc.nc	1058	0.306	0.969	0.002	0.029	1.789	38.387
ice_edge_hr_sh_20110106_044704_5_valc.nc	1975	0.419	0.992	0.002	0.006	0.375	30.862
ice_edge_hr_sh_20110106_062746_3_valc.nc	1175	0.173	0.958	0.033	0.009	0.592	53.405
ice_edge_hr_sh_20110107_104340_2_valc.nc	2500	0.626	0.906	0.002	0.093	1.808	11.785
ice_edge_hr_sh_20110108_015611_3_valc.nc	2378	0.339	0.893	0.007	0.100	0.000	1.243
ice_edge_hr_sh_20110109_025849_4_valc.nc	2434	0.514	0.919	0.009	0.072	0.899	11.830
ice_edge_hr_sh_20110110_022234_3_valc.nc	3146	0.498	0.606	0.000	0.394	5.299	2.994
ice_edge_hr_sh_20110110_103352_2_valc.nc	2205	0.578	0.883	0.000	0.117	2.496	6.945
ice_edge_hr_sh_20110110_121452_3_valc.nc	461	0.097	0.976	0.017	0.007	0.428	38.224
ice_edge_hr_sh_20110111_032512_4_valc.nc	2377	0.601	0.818	0.003	0.180	2.585	13.066
ice_edge_hr_sh_20110111_113816_2_valc.nc	2326	0.458	0.829	0.000	0.171	3.551	5.100
ice_edge_hr_sh_20110112_110021_2_valc.nc	2782	0.620	0.944	0.000	0.056	1.616	2.943
ice_edge_hr_sh_20110112_110021_3_valc.nc	2672	0.596	0.914	0.009	0.076	2.299	12.756
ice_edge_hr_sh_20110113_021245_2_valc.nc	1973	0.307	0.873	0.002	0.126	1.956	8.918
ice_edge_hr_sh_20110113_021245_3_valc.nc	3147	0.479	0.887	0.000	0.113	2.163	4.727
ice_edge_hr_sh_20110113_102406_2_valc.nc	2725	0.779	0.932	0.000	0.068	2.270	5.653
ice_edge_hr_sh_20110113_102406_3_valc.nc	2626	0.766	0.880	0.000	0.120	2.659	4.265
ice_edge_hr_sh_20110114_031524_4_valc.nc	2672	0.620	0.767	0.001	0.232	4.247	2.893
ice_edge_hr_sh_20110114_063311_4_valc.nc	1350	0.203	0.973	0.004	0.022	0.255	36.304
ice_edge_hr_sh_20110115_055843_3_valc.nc	1259	0.221	0.932	0.009	0.059	0.636	28.439
ice_edge_hr_sh_20110116_034325_1_valc.nc	1109	0.328	0.965	0.032	0.003	1.150	26.857
ice_edge_hr_sh_20110116_133549_2_valc.nc	2980	0.423	0.979	0.003	0.018	0.808	23.431
ice_edge_hr_sh_20110117_030536_3_valc.nc	2797	0.618	0.956	0.004	0.039	1.577	8.256
ice_edge_hr_sh_20110117_030536_4_valc.nc	2763	0.603	0.887	0.014	0.098	1.972	10.011
ice_edge_hr_sh_20110118_122137_3_valc.nc	748	0.153	0.976	0.004	0.020	0.313	37.340
ice_edge_hr_sh_20110119_033156_4_valc.nc	2397	0.648	0.869	0.006	0.124	3.884	15.205
ice_edge_hr_sh_20110119_114509_2_valc.nc	1963	0.381	0.899	0.006	0.096	3.194	11.596
ice_edge_hr_sh_20110120_025541_3_valc.nc	2475	0.601	0.962	0.004	0.034	1.396	12.998
ice_edge_hr_sh_20110120_025541_4_valc.nc	2406	0.566	0.904	0.011	0.085	1.110	12.266
ice_edge_hr_sh_20110120_110717_3_valc.nc	2830	0.571	0.940	0.019	0.042	2.146	21.877
ice_edge_hr_sh_20110121_103051_3_valc.nc	2630	0.737	0.948	0.005	0.046	1.129	17.190
ice_edge_hr_sh_20110121_121151_2_valc.nc	593	0.102	0.976	0.000	0.024	0.000	0.000
ice_edge_hr_sh_20110122_032209_3_valc.nc	2777	0.677	0.986	0.006	0.008	0.911	26.108

File	count_ relevant	percent_ relevant	agree	osi_over	osi_- under	avg_dist to_edge	avg_ice_ conc
ice_edge_hr_sh_20110122_032209_4_valc.nc	2573	0.627	0.894	0.019	0.087	1.939	15.918
ice_edge_hr_sh_20110122_095500_3_valc.nc	2647	0.834	0.977	0.017	0.006	1.136	30.249
ice_edge_hr_sh_20110123_060458_3_valc.nc	1189	0.186	0.953	0.008	0.039	0.777	46.678
ice_edge_hr_sh_20110124_102106_3_valc.nc	2619	0.775	0.969	0.026	0.005	1.450	23.906
ice_edge_hr_sh_20110124_134238_2_valc.nc	2972	0.427	0.974	0.003	0.023	0.817	37.317
ice_edge_hr_sh_20110126_023800_1_valc.nc	1837	0.327	0.934	0.011	0.056	1.002	10.583
ice_edge_hr_sh_20110127_034022_3_valc.nc	2541	0.752	0.933	0.021	0.045	1.521	37.262
ice_edge_hr_sh_20110128_030409_2_valc.nc	2652	0.599	0.982	0.003	0.015	0.582	16.860
ice_edge_hr_sh_20110128_030409_3_valc.nc	2737	0.629	0.854	0.020	0.126	1.483	19.096
ice_edge_hr_sh_20110128_062521_2_valc.nc	2581	0.371	0.988	0.005	0.007	0.464	34.953
ice_edge_hr_sh_20110129_022806_2_valc.nc	1731	0.515	0.943	0.014	0.043	1.200	14.799
ice_edge_hr_sh_20110129_072859_1_valc.nc	1210	0.182	0.993	0.002	0.004	0.276	69.134
ice_edge_hr_sh_20110130_033033_3_valc.nc	2679	0.730	0.922	0.025	0.053	1.421	23.835
ice_edge_hr_sh_20110131_025444_1_valc.nc	1688	0.380	0.908	0.005	0.088	2.122	13.883
ice_edge_hr_sh_20110131_025444_2_valc.nc	2587	0.593	0.983	0.006	0.011	0.403	23.799

Table 14: Combined validation product statistics - Jan 2011

B.2 February 2011

File	count_ relevant	percent_ relevant	agree	osi_over	osi_- under	avg_dist to_edge	avg_ice_ conc
ice_edge_hr_sh_20110202_113232_2_valc.nc	2250	0.542	0.928	0.013	0.060	1.310	16.585
ice_edge_hr_sh_20110203_105704_1_valc.nc	2192	0.613	0.897	0.005	0.097	0.980	7.140
ice_edge_hr_sh_20110204_115815_2_valc.nc	1665	0.309	0.921	0.000	0.079	5.782	2.871
ice_edge_hr_sh_20110207_001911_2_valc.nc	1484	0.386	0.980	0.000	0.020	0.640	6.508
ice_edge_hr_sh_20110208_030133_1_valc.nc	2203	0.442	0.860	0.010	0.130	2.154	23.314
ice_edge_hr_sh_20110208_062213_2_valc.nc	2406	0.354	0.993	0.005	0.002	0.222	45.452
ice_edge_hr_sh_20110209_022502_1_valc.nc	1205	0.251	0.945	0.003	0.051	1.600	6.984
ice_edge_hr_sh_20110209_022502_2_valc.nc	2512	0.515	0.982	0.016	0.002	0.867	48.108
ice_edge_hr_sh_20110210_032730_1_valc.nc	1115	0.296	0.897	0.020	0.083	1.148	17.832
ice_edge_hr_sh_20110210_032730_3_valc.nc	2696	0.720	0.899	0.005	0.095	3.000	13.456
ice_edge_hr_sh_20110210_064853_1_valc.nc	1047	0.158	0.955	0.032	0.013	0.605	44.518
ice_edge_hr_sh_20110211_043003_1_valc.nc	924	0.250	0.961	0.011	0.028	0.696	24.180
ice_edge_hr_sh_20110212_035431_1_valc.nc	2027	0.689	0.927	0.003	0.069	1.868	15.804
ice_edge_hr_sh_20110213_031742_2_valc.nc	2646	0.659	0.975	0.008	0.017	1.016	29.668
ice_edge_hr_sh_20110213_031742_3_valc.nc	2720	0.677	0.937	0.017	0.046	1.439	10.831
ice_edge_hr_sh_20110214_024135_2_valc.nc	2381	0.526	0.980	0.011	0.009	0.519	32.194
ice_edge_hr_sh_20110214_024135_3_valc.nc	2233	0.487	0.996	0.000	0.004	0.000	0.000
ice_edge_hr_sh_20110215_034403_1_valc.nc	1039	0.307	0.893	0.010	0.097	1.151	9.956
ice_edge_hr_sh_20110215_052311_3_valc.nc	1411	0.234	0.998	0.000	0.002	0.167	40.403
ice_edge_hr_sh_20110216_030751_2_valc.nc	3002	0.624	0.971	0.025	0.004	0.664	29.441
ice_edge_hr_sh_20110216_030751_3_valc.nc	2847	0.591	0.940	0.003	0.057	1.836	17.297
ice_edge_hr_sh_20110217_023159_2_valc.nc	1508	0.481	0.938	0.060	0.002	1.467	36.281
ice_edge_hr_sh_20110218_033416_1_valc.nc	1142	0.315	0.893	0.006	0.101	1.337	11.691
ice_edge_hr_sh_20110218_065544_1_valc.nc	1005	0.149	0.988	0.007	0.005	0.321	39.653
ice_edge_hr_sh_20110219_025827_1_valc.nc	2079	0.411	0.921	0.026	0.052	0.886	21.313
ice_edge_hr_sh_20110219_025827_2_valc.nc	3038	0.586	0.943	0.004	0.053	0.789	12.468
ice_edge_hr_sh_20110220_022142_2_valc.nc	2596	0.504	0.987	0.012	0.000	0.644	38.648
ice_edge_hr_sh_20110221_064208_1_valc.nc	597	0.108	0.977	0.017	0.007	0.563	32.617
ice_edge_hr_sh_20110222_024826_1_valc.nc	1804	0.330	0.906	0.016	0.078	0.903	13.138
ice_edge_hr_sh_20110222_024826_2_valc.nc	3029	0.550	0.981	0.019	0.000	0.761	47.668
ice_edge_hr_sh_20110224_031508_2_valc.nc	3082	0.651	0.927	0.002	0.071	2.339	15.183
ice_edge_hr_sh_20110224_031508_3_valc.nc	2447	0.511	0.933	0.000	0.067	3.458	6.560
ice_edge_hr_sh_20110225_023828_2_valc.nc	1546	0.511	0.931	0.001	0.068	1.443	13.132
ice_edge_hr_sh_20110226_034114_1_valc.nc	1492	0.441	0.936	0.012	0.052	1.365	15.957
ice_edge_hr_sh_20110226_034114_3_valc.nc	2158	0.642	0.949	0.000	0.051	4.821	13.795
ice_edge_hr_sh_20110227_030446_1_valc.nc	1113	0.256	0.931	0.041	0.028	0.780	17.804
ice_edge_hr_sh_20110227_030446_2_valc.nc	2648	0.598	0.985	0.005	0.011	0.445	31.024
ice_edge_hr_sh_20110227_030446_3_valc.nc	2684	0.617	0.937	0.001	0.061	1.431	8.167
ice_edge_hr_sh_20110228_004917_1_valc.nc	176	0.039	0.915	0.074	0.011	0.396	29.502

Table 15: Combined validation product statistics - Feb 2011

B.3 March 2011

File	count_ relevant	percent_ relevant	agree	osi_over	osi_- under	avg_dist to_edge	avg_ice_ conc
ice_edge_hr_sh_20110301_033109_3_valc.nc	2679	0.726	0.899	0.003	0.099	5.138	12.694
ice_edge_hr_sh_20110302_025458_1_valc.nc	954	0.228	0.871	0.000	0.129	0.600	5.016
ice_edge_hr_sh_20110302_025458_2_valc.nc	2208	0.529	0.960	0.009	0.031	0.531	22.550
ice_edge_hr_sh_20110303_035728_1_valc.nc	1112	0.340	0.853	0.004	0.143	2.709	12.073
ice_edge_hr_sh_20110304_014245_1_valc.nc	945	0.217	0.842	0.000	0.158	3.287	1.656
ice_edge_hr_sh_20110304_032122_2_valc.nc	2643	0.683	0.983	0.017	0.000	1.188	47.364
ice_edge_hr_sh_20110304_032122_3_valc.nc	2380	0.615	0.847	0.000	0.153	4.844	7.624
ice_edge_hr_sh_20110305_024527_1_valc.nc	1941	0.351	0.968	0.016	0.016	0.551	15.571
ice_edge_hr_sh_20110305_024527_2_valc.nc	3039	0.550	0.982	0.013	0.005	0.646	24.981
ice_edge_hr_sh_20110306_034821_1_valc.nc	2414	0.676	0.942	0.000	0.058	1.832	8.392
ice_edge_hr_sh_20110306_034821_3_valc.nc	1573	0.435	0.940	0.000	0.060	6.617	4.420
ice_edge_hr_sh_20110307_031201_1_valc.nc	2296	0.483	0.943	0.006	0.051	1.110	14.030
ice_edge_hr_sh_20110307_031201_2_valc.nc	3048	0.641	0.956	0.001	0.042	1.527	18.273
ice_edge_hr_sh_20110307_031201_3_valc.nc	2747	0.581	0.952	0.000	0.048	2.058	6.966
ice_edge_hr_sh_20110308_023529_2_valc.nc	2681	0.484	0.985	0.006	0.008	0.386	26.873
ice_edge_hr_sh_20110309_033755_3_valc.nc	2609	0.761	0.961	0.003	0.035	2.278	8.955
ice_edge_hr_sh_20110310_030207_1_valc.nc	2150	0.430	0.965	0.007	0.028	0.787	22.806
ice_edge_hr_sh_20110310_030207_2_valc.nc	3036	0.593	0.960	0.002	0.038	0.988	8.262
ice_edge_hr_sh_20110310_030207_3_valc.nc	2873	0.570	0.924	0.000	0.076	2.516	0.746
ice_edge_hr_sh_20110311_022543_2_valc.nc	2519	0.517	0.954	0.001	0.045	1.609	6.891
ice_edge_hr_sh_20110311_040452_1_valc.nc	2356	0.668	1.000	0.000	0.000	0.000	0.000
ice_edge_hr_sh_20110312_033029_2_valc.nc	2033	0.653	0.923	0.011	0.065	2.176	8.292
ice_edge_hr_sh_20110313_025215_1_valc.nc	2081	0.393	0.900	0.005	0.096	1.008	17.634
ice_edge_hr_sh_20110313_025215_2_valc.nc	3039	0.568	0.990	0.001	0.009	0.351	37.332
ice_edge_hr_sh_20110313_025215_3_valc.nc	2956	0.539	0.977	0.002	0.021	0.793	7.848
ice_edge_hr_sh_20110314_021541_1_valc.nc	686	0.165	0.885	0.001	0.114	0.988	16.454
ice_edge_hr_sh_20110314_021541_2_valc.nc	2105	0.499	0.977	0.010	0.013	0.609	26.611
ice_edge_hr_sh_20110315_031817_1_valc.nc	1167	0.291	0.863	0.001	0.136	1.695	15.760
ice_edge_hr_sh_20110315_031817_2_valc.nc	2649	0.660	0.997	0.000	0.003	0.229	26.891
ice_edge_hr_sh_20110315_031817_3_valc.nc	2723	0.678	0.903	0.001	0.096	2.297	10.536
ice_edge_hr_sh_20110316_024219_2_valc.nc	2152	0.561	0.976	0.005	0.019	0.564	20.231
ice_edge_hr_sh_20110317_020610_1_valc.nc	1933	0.316	0.930	0.003	0.067	1.202	13.764
ice_edge_hr_sh_20110318_030826_3_valc.nc	2254	0.577	0.934	0.001	0.065	1.074	11.284
ice_edge_hr_sh_20110319_023219_1_valc.nc	1618	0.277	0.863	0.000	0.137	2.500	13.398
ice_edge_hr_sh_20110319_023219_2_valc.nc	3042	0.507	0.977	0.001	0.023	0.852	20.411
ice_edge_hr_sh_20110320_015601_2_valc.nc	2643	0.410	0.967	0.000	0.033	2.133	9.503
ice_edge_hr_sh_20110321_025900_2_valc.nc	3037	0.583	0.970	0.027	0.003	0.859	29.721
ice_edge_hr_sh_20110322_022233_1_valc.nc	1249	0.256	0.933	0.008	0.059	1.224	19.096
ice_edge_hr_sh_20110322_022233_2_valc.nc	2514	0.509	0.982	0.004	0.014	0.505	21.055
ice_edge_hr_sh_20110323_032500_2_valc.nc	2639	0.679	0.995	0.001	0.003	0.513	46.587
ice_edge_hr_sh_20110323_064242_3_valc.nc	1085	0.158	0.951	0.018	0.030	0.533	34.194
ice_edge_hr_sh_20110324_024908_1_valc.nc	2025	0.377	0.949	0.001	0.050	3.159	17.635

File	count_ relevant	percent_ relevant	agree	osi_over	osi_- under	avg_dist to_edge	avg_ice_ conc
ice_edge_hr_sh_20110324_024908_2_valc.nc	3040	0.559	0.987	0.000	0.013	0.535	31.357
ice_edge_hr_sh_20110325_053005_3_valc.nc	308	0.057	0.974	0.006	0.019	0.444	21.898
ice_edge_hr_sh_20110326_031542_2_valc.nc	3088	0.653	0.969	0.009	0.022	1.321	15.391
ice_edge_hr_sh_20110326_031542_3_valc.nc	2528	0.537	0.975	0.008	0.017	1.648	27.592
ice_edge_hr_sh_20110326_063245_3_valc.nc	1152	0.167	0.923	0.001	0.076	0.856	21.994
ice_edge_hr_sh_20110327_023912_1_valc.nc	1837	0.327	0.978	0.011	0.011	0.523	22.241
ice_edge_hr_sh_20110327_023912_2_valc.nc	3036	0.535	0.980	0.003	0.017	0.751	27.120
ice_edge_hr_sh_20110328_020303_1_valc.nc	1980	0.315	0.975	0.021	0.004	0.523	30.449
ice_edge_hr_sh_20110328_034134_4_valc.nc	1656	0.496	0.998	0.000	0.002	0.000	0.000
ice_edge_hr_sh_20110328_065931_3_valc.nc	932	0.135	0.815	0.001	0.183	3.746	11.495
ice_edge_hr_sh_20110329_030549_2_valc.nc	3035	0.609	0.988	0.006	0.006	0.327	35.461
ice_edge_hr_sh_20110329_030549_3_valc.nc	2828	0.571	0.978	0.014	0.008	0.728	21.119
ice_edge_hr_sh_20110330_004932_2_valc.nc	2050	0.369	0.974	0.000	0.025	0.992	21.677
ice_edge_hr_sh_20110330_022935_1_valc.nc	1469	0.354	0.976	0.007	0.017	0.806	27.250
ice_edge_hr_sh_20110330_022935_2_valc.nc	1989	0.473	0.983	0.010	0.007	0.434	34.712

Table 16: Combined validation product statistics - Mar 2011

B.4 June 2011

File	count_ relevant	percent_ relevant	agree	osi_over	osi_- under	avg_dist to_edge	avg_ice_ conc
ice_edge_hr_sh_20110601_040122_3_valc.nc	1740	0.582	0.999	0.000	0.001	0.167	61.260
ice_edge_hr_sh_20110601_054109_3_valc.nc	1912	0.420	0.972	0.003	0.025	0.250	20.499
ice_edge_hr_sh_20110602_014428_2_valc.nc	3109	0.437	0.993	0.003	0.004	0.516	33.233
ice_edge_hr_sh_20110602_032304_4_valc.nc	2400	0.448	0.882	0.001	0.117	2.784	14.234
ice_edge_hr_sh_20110602_050200_4_valc.nc	2761	0.605	0.987	0.001	0.012	0.835	39.406
ice_edge_hr_sh_20110603_024654_3_valc.nc	2561	0.538	0.943	0.002	0.056	0.746	16.413
ice_edge_hr_sh_20110603_024654_4_valc.nc	2561	0.564	0.916	0.008	0.077	0.844	10.680
ice_edge_hr_sh_20110604_003103_2_valc.nc	2875	0.417	0.927	0.001	0.072	2.871	15.572
ice_edge_hr_sh_20110604_021029_3_valc.nc	1992	0.542	0.974	0.000	0.026	0.500	4.797
ice_edge_hr_sh_20110604_034928_4_valc.nc	2950	0.421	0.945	0.002	0.053	1.030	21.029
ice_edge_hr_sh_20110605_013431_2_valc.nc	3059	0.420	0.977	0.016	0.006	1.078	32.002
ice_edge_hr_sh_20110605_031316_4_valc.nc	2133	0.551	0.976	0.001	0.023	2.089	14.594
ice_edge_hr_sh_20110605_045210_4_valc.nc	2545	0.496	0.969	0.018	0.013	0.870	23.860
ice_edge_hr_sh_20110606_055426_4_valc.nc	2795	0.480	0.991	0.006	0.003	0.328	42.901
ice_edge_hr_sh_20110607_002108_2_valc.nc	2960	0.428	0.968	0.004	0.028	1.131	22.761
ice_edge_hr_sh_20110607_033934_4_valc.nc	3080	0.418	0.979	0.001	0.019	1.144	23.646
ice_edge_hr_sh_20110607_051835_4_valc.nc	2048	0.547	0.997	0.000	0.002	0.273	33.863
ice_edge_hr_sh_20110608_030326_4_valc.nc	2858	0.365	0.987	0.013	0.000	0.841	43.866
ice_edge_hr_sh_20110609_022710_3_valc.nc	476	0.116	0.985	0.000	0.015	1.766	15.343
ice_edge_hr_sh_20110609_054430_4_valc.nc	2801	0.383	0.987	0.005	0.008	0.577	26.592
ice_edge_hr_sh_20110610_015113_3_valc.nc	2665	0.450	0.986	0.012	0.002	0.687	29.774
ice_edge_hr_sh_20110610_032945_4_valc.nc	2825	0.443	0.999	0.000	0.001	0.231	29.397
ice_edge_hr_sh_20110611_011440_3_valc.nc	2707	0.409	0.995	0.000	0.004	0.365	34.799
ice_edge_hr_sh_20110611_043224_3_valc.nc	3132	0.414	0.994	0.000	0.006	0.574	41.209
ice_edge_hr_sh_20110612_003632_4_valc.nc	2745	0.543	0.982	0.001	0.017	0.978	31.450
ice_edge_hr_sh_20110613_000029_3_valc.nc	2770	0.422	0.982	0.001	0.018	0.995	23.462
ice_edge_hr_sh_20110613_014012_3_valc.nc	2795	0.473	0.986	0.000	0.014	0.661	35.071
ice_edge_hr_sh_20110613_014012_4_valc.nc	2128	0.569	0.973	0.001	0.026	1.157	12.630
ice_edge_hr_sh_20110613_031958_4_valc.nc	2483	0.408	0.983	0.002	0.016	0.843	30.319
ice_edge_hr_sh_20110614_010451_2_valc.nc	2771	0.525	0.976	0.003	0.021	0.447	38.395
ice_edge_hr_sh_20110614_024346_3_valc.nc	2272	0.587	0.974	0.000	0.026	0.000	7.311
ice_edge_hr_sh_20110615_002659_4_valc.nc	3019	0.451	0.980	0.011	0.009	0.787	25.724
ice_edge_hr_sh_20110615_020721_3_valc.nc	2204	0.562	0.985	0.002	0.013	0.832	33.347
ice_edge_hr_sh_20110616_031350_2_valc.nc	2532	0.493	0.890	0.001	0.109	1.342	9.049
ice_edge_hr_sh_20110616_062723_4_valc.nc	2601	0.523	0.972	0.000	0.028	2.079	14.666
ice_edge_hr_sh_20110617_023354_3_valc.nc	3110	0.421	0.962	0.000	0.038	1.218	11.382
ice_edge_hr_sh_20110617_041243_4_valc.nc	2794	0.480	0.987	0.004	0.009	0.421	25.025
ice_edge_hr_sh_20110618_015658_3_valc.nc	1946	0.588	0.994	0.000	0.006	0.450	48.833
ice_edge_hr_sh_20110618_051526_4_valc.nc	3103	0.430	0.997	0.003	0.000	0.300	38.079
ice_edge_hr_sh_20110619_012113_3_valc.nc	2414	0.557	0.990	0.007	0.003	0.340	37.531
ice_edge_hr_sh_20110619_030017_3_valc.nc	3121	0.422	0.962	0.001	0.037	1.436	21.397
ice_edge_hr_sh_20110619_030017_4_valc.nc	1831	0.534	0.978	0.002	0.020	3.414	52.343

File	count_ relevant	percent_ relevant	agree	osi_over	osi_- under	avg_dist to_edge	avg_ice_ conc
ice_edge_hr_sh_20110619_043908_4_valc.nc	2540	0.467	0.931	0.016	0.054	1.407	23.390
ice_edge_hr_sh_20110620_004447_3_valc.nc	2526	0.549	0.946	0.001	0.053	2.975	15.247
ice_edge_hr_sh_20110620_040251_4_valc.nc	2785	0.513	0.966	0.017	0.018	1.439	26.893
ice_edge_hr_sh_20110620_054123_4_valc.nc	2925	0.422	0.920	0.000	0.080	1.703	11.184
ice_edge_hr_sh_20110621_014805_3_valc.nc	3001	0.389	0.968	0.000	0.032	1.577	18.042
ice_edge_hr_sh_20110621_032639_4_valc.nc	3062	0.406	0.978	0.001	0.021	0.792	24.776
ice_edge_hr_sh_20110621_050535_4_valc.nc	676	0.142	0.938	0.022	0.040	0.657	23.694
ice_edge_hr_sh_20110622_025028_3_valc.nc	2566	0.522	0.935	0.004	0.062	1.393	17.608
ice_edge_hr_sh_20110622_025028_4_valc.nc	2781	0.424	0.985	0.001	0.014	0.487	33.639
ice_edge_hr_sh_20110622_042914_4_valc.nc	2777	0.434	0.954	0.031	0.015	1.487	26.458
ice_edge_hr_sh_20110623_021405_3_valc.nc	3080	0.403	0.980	0.001	0.019	1.001	14.976
ice_edge_hr_sh_20110623_053132_4_valc.nc	1976	0.538	0.985	0.010	0.005	0.500	55.977
ice_edge_hr_sh_20110623_235807_3_valc.nc	2854	0.369	0.984	0.003	0.013	0.661	29.408
ice_edge_hr_sh_20110624_013809_3_valc.nc	1800	0.536	0.986	0.001	0.013	0.866	62.362
ice_edge_hr_sh_20110624_031652_4_valc.nc	3024	0.396	0.992	0.003	0.006	0.464	28.216
ice_edge_hr_sh_20110624_045545_3_valc.nc	2839	0.427	0.973	0.000	0.027	1.333	18.633
ice_edge_hr_sh_20110624_045545_4_valc.nc	2781	0.519	0.981	0.014	0.005	0.906	34.734
ice_edge_hr_sh_20110625_005914_4_valc.nc	2165	0.560	0.946	0.003	0.051	1.031	12.589
ice_edge_hr_sh_20110626_002352_4_valc.nc	2634	0.554	0.981	0.007	0.013	0.674	25.775
ice_edge_hr_sh_20110626_020413_3_valc.nc	2807	0.475	0.957	0.004	0.039	1.473	19.386
ice_edge_hr_sh_20110626_034308_4_valc.nc	2534	0.567	0.981	0.002	0.017	1.039	24.954
ice_edge_hr_sh_20110627_012812_3_valc.nc	2512	0.560	0.967	0.012	0.022	0.451	29.589
ice_edge_hr_sh_20110627_030700_4_valc.nc	2450	0.442	0.991	0.001	0.009	0.623	25.673
ice_edge_hr_sh_20110628_005109_3_valc.nc	2755	0.570	0.990	0.009	0.001	0.779	49.123
ice_edge_hr_sh_20110628_023047_3_valc.nc	2636	0.523	0.979	0.006	0.015	0.580	27.045
ice_edge_hr_sh_20110628_040935_4_valc.nc	2421	0.557	0.926	0.002	0.071	0.860	10.066
ice_edge_hr_sh_20110629_001448_3_valc.nc	2289	0.562	0.990	0.000	0.010	0.801	22.542
ice_edge_hr_sh_20110629_033320_4_valc.nc	2736	0.557	0.989	0.010	0.001	0.620	42.326
ice_edge_hr_sh_20110630_011816_3_valc.nc	2533	0.515	0.959	0.003	0.038	0.549	21.481
ice_edge_hr_sh_20110630_025712_4_valc.nc	2904	0.408	0.965	0.001	0.035	1.081	22.028
ice_edge_hr_sh_20110630_043601_4_valc.nc	2362	0.555	0.983	0.003	0.014	1.500	20.672

Table 17: Combined validation product statistics - Jun 2011

B.5 July 2011

File	count_ relevant	percent_ relevant	agree	osi_over	osi_- under	avg_dist to_edge	avg_ice_ conc
ice_edge_hr_sh_20110701_022056_3_valc.nc	2789	0.499	0.986	0.006	0.008	0.523	41.592
ice_edge_hr_sh_20110701_035958_4_valc.nc	2833	0.444	0.969	0.006	0.025	1.232	12.191
ice_edge_hr_sh_20110702_014433_3_valc.nc	2562	0.499	0.961	0.005	0.033	1.083	22.008
ice_edge_hr_sh_20110702_050233_4_valc.nc	3086	0.394	0.941	0.000	0.059	3.058	11.059
ice_edge_hr_sh_20110703_024725_3_valc.nc	2813	0.483	0.906	0.001	0.093	3.142	8.567
ice_edge_hr_sh_20110703_024725_4_valc.nc	2541	0.446	0.965	0.000	0.035	1.557	16.870
ice_edge_hr_sh_20110704_003141_3_valc.nc	3073	0.420	0.967	0.001	0.032	1.596	18.950
ice_edge_hr_sh_20110704_021103_3_valc.nc	2555	0.417	0.968	0.002	0.030	0.883	19.991
ice_edge_hr_sh_20110704_035004_4_valc.nc	2033	0.584	0.945	0.000	0.055	0.949	11.641
ice_edge_hr_sh_20110705_013457_3_valc.nc	2551	0.543	0.957	0.004	0.040	0.671	21.785
ice_edge_hr_sh_20110706_005741_3_valc.nc	2536	0.428	0.972	0.010	0.019	0.828	31.992
ice_edge_hr_sh_20110706_023734_3_valc.nc	2816	0.436	0.970	0.000	0.030	1.177	25.650
ice_edge_hr_sh_20110706_041628_4_valc.nc	2556	0.461	0.979	0.000	0.021	0.821	22.388
ice_edge_hr_sh_20110707_020133_3_valc.nc	2674	0.543	0.858	0.000	0.142	3.830	9.512
ice_edge_hr_sh_20110707_034007_4_valc.nc	2765	0.416	0.970	0.006	0.025	0.724	24.596
ice_edge_hr_sh_20110708_044251_4_valc.nc	2642	0.539	0.946	0.004	0.050	1.559	14.241
ice_edge_hr_sh_20110709_004834_3_valc.nc	2568	0.583	0.940	0.032	0.028	1.354	31.816
ice_edge_hr_sh_20110709_022741_3_valc.nc	2693	0.426	0.986	0.006	0.008	0.422	22.765
ice_edge_hr_sh_20110709_040638_4_valc.nc	2359	0.678	0.906	0.013	0.081	0.821	19.447
ice_edge_hr_sh_20110710_015135_3_valc.nc	2970	0.429	0.967	0.000	0.033	0.783	19.560
ice_edge_hr_sh_20110710_051227_2_valc.nc	3112	0.408	0.982	0.006	0.012	0.626	23.193
ice_edge_hr_sh_20110711_011446_3_valc.nc	2831	0.443	0.960	0.000	0.040	1.902	13.281
ice_edge_hr_sh_20110711_025406_4_valc.nc	2311	0.571	0.968	0.003	0.029	0.985	15.393
ice_edge_hr_sh_20110711_043259_4_valc.nc	2633	0.506	0.940	0.002	0.058	1.451	15.453
ice_edge_hr_sh_20110712_003704_4_valc.nc	2508	0.605	0.921	0.007	0.071	0.793	21.261
ice_edge_hr_sh_20110712_035649_4_valc.nc	3086	0.394	0.983	0.002	0.015	1.819	18.536
ice_edge_hr_sh_20110712_053512_4_valc.nc	3024	0.440	0.984	0.003	0.013	0.590	26.368
ice_edge_hr_sh_20110713_000157_3_valc.nc	2543	0.526	0.883	0.000	0.117	3.878	9.838
ice_edge_hr_sh_20110713_014122_3_valc.nc	2465	0.617	0.946	0.010	0.044	0.595	23.427
ice_edge_hr_sh_20110713_032027_4_valc.nc	2066	0.574	0.928	0.008	0.064	1.966	17.417
ice_edge_hr_sh_20110714_024415_4_valc.nc	2526	0.464	0.977	0.002	0.021	0.582	25.168
ice_edge_hr_sh_20110714_042308_4_valc.nc	2752	0.420	0.972	0.023	0.005	0.984	31.514
ice_edge_hr_sh_20110715_002830_3_valc.nc	2604	0.556	0.945	0.007	0.048	1.117	14.613
ice_edge_hr_sh_20110715_235128_3_valc.nc	2557	0.553	0.974	0.007	0.019	0.567	29.193
ice_edge_hr_sh_20110716_044935_4_valc.nc	3207	0.409	0.977	0.015	0.008	1.050	28.144
ice_edge_hr_sh_20110717_023425_4_valc.nc	2318	0.631	0.886	0.014	0.100	1.304	16.950
ice_edge_hr_sh_20110717_041320_4_valc.nc	2957	0.427	0.948	0.001	0.050	1.092	23.659
ice_edge_hr_sh_20110718_033659_4_valc.nc	2836	0.444	0.976	0.000	0.024	1.147	19.546
ice_edge_hr_sh_20110718_051559_4_valc.nc	2535	0.494	0.975	0.000	0.025	1.032	28.143
ice_edge_hr_sh_20110719_012129_3_valc.nc	2100	0.493	0.938	0.005	0.058	1.198	26.959
ice_edge_hr_sh_20110719_030047_4_valc.nc	2560	0.581	0.944	0.023	0.033	1.200	23.741
ice_edge_hr_sh_20110719_043943_4_valc.nc	2809	0.489	0.984	0.005	0.010	0.552	38.884

File	count_ relevant	percent_ relevant	agree	osi_over	osi_- under	avg_dist to_edge	avg_ice_ conc
ice_edge_hr_sh_20110720_004459_3_valc.nc	2283	0.666	0.795	0.000	0.205	1.558	10.968
ice_edge_hr_sh_20110720_040330_4_valc.nc	2956	0.433	0.963	0.001	0.036	1.270	21.016
ice_edge_hr_sh_20110720_054155_4_valc.nc	2672	0.486	0.935	0.001	0.063	1.428	14.362
ice_edge_hr_sh_20110721_014809_3_valc.nc	2841	0.445	0.985	0.008	0.006	0.577	37.721
ice_edge_hr_sh_20110721_050609_4_valc.nc	2392	0.580	0.972	0.003	0.025	1.134	25.237
ice_edge_hr_sh_20110722_025058_4_valc.nc	2667	0.427	0.958	0.019	0.023	0.620	32.397
ice_edge_hr_sh_20110722_042950_4_valc.nc	2510	0.606	0.948	0.008	0.044	0.802	23.965
ice_edge_hr_sh_20110723_021437_3_valc.nc	2822	0.471	0.983	0.002	0.015	0.596	27.146
ice_edge_hr_sh_20110723_035339_4_valc.nc	2054	0.611	0.870	0.008	0.122	2.979	18.106
ice_edge_hr_sh_20110723_053203_4_valc.nc	2978	0.447	0.957	0.001	0.042	1.100	20.836
ice_edge_hr_sh_20110724_013812_3_valc.nc	2513	0.553	0.964	0.000	0.035	2.102	22.566
ice_edge_hr_sh_20110724_031720_4_valc.nc	2554	0.528	0.939	0.005	0.056	2.060	19.328
ice_edge_hr_sh_20110725_010150_3_valc.nc	1821	0.438	0.968	0.012	0.020	1.147	31.658
ice_edge_hr_sh_20110725_042001_4_valc.nc	2439	0.630	0.891	0.005	0.104	1.966	16.780
ice_edge_hr_sh_20110726_020446_3_valc.nc	2103	0.573	0.942	0.009	0.049	0.705	19.869
ice_edge_hr_sh_20110726_034341_4_valc.nc	2575	0.557	0.962	0.002	0.037	1.044	12.383
ice_edge_hr_sh_20110726_052210_4_valc.nc	2351	0.640	0.967	0.003	0.030	0.584	20.885
ice_edge_hr_sh_20110727_030730_4_valc.nc	2719	0.545	0.995	0.000	0.005	0.463	25.363
ice_edge_hr_sh_20110727_044626_4_valc.nc	2625	0.513	0.953	0.001	0.046	2.155	11.086
ice_edge_hr_sh_20110728_023247_3_valc.nc	2209	0.667	0.952	0.003	0.046	1.164	21.906
ice_edge_hr_sh_20110728_041011_4_valc.nc	2675	0.483	0.979	0.004	0.016	0.542	25.120
ice_edge_hr_sh_20110729_033350_4_valc.nc	2494	0.613	0.967	0.006	0.027	0.489	23.664
ice_edge_hr_sh_20110730_043634_4_valc.nc	2430	0.640	0.935	0.013	0.052	0.624	15.817

Table 18: Combined validation product statistics - Jul 2011

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