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Standard BYU ASCAT Land/Ice Image Products

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Microwave Earth Remote Sensing (MERS) Laboratory

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Abstract

The ASCAT scatterometer operating on the EUMETSAT-launched satellite MetOp-A measures the normalized radar cross section (σ^0) of the surface of the Earth in the C band. Like other scatterometers, ASCAT is designed to infer near-surface wind over the oceans. Also similar to previous scatterometers, the σ^0 data is useful in many land and ice studies. The Scatterometer Image Reconstruction (SIR) algorithm is used to reconstruct the true σ^0 characteristics of the Earth at an enhanced resolution. This report describes the standard ASCAT products generated by the Brigham Young University (BYU) Microwave Earth Remote Sensing (MERS) Laboratory. The data are distributed publicly as part of the NASA Scatterometer Climate Record Pathfinder project (`http://www.scp.byu.edu`).

1 Introduction

Polar-orbiting scatterometers are primarily designed to infer near-surface ocean winds by measuring the normalized radar cross-section (σ^0) at different azimuth angles. The utility of scatterometers is enhanced by applying the otherwise unused σ^0 data collected over land and ice to a variety of studies. This is facilitated by creating σ^0 images on a standardized grid.

This report describes the typical image products produced for the Scatterometer Climate Record Pathfinder (SCP) project. The background behind the image processing products is first presented, followed by information about ASCAT, a scatterometer recently added to the SCP project. Details about the standard ASCAT image products follow. Finally, further user notes about the ASCAT products are described. Appendices describing the SIR file format and a sample ASCAT product listing are included.

2 The SIR Algorithm and Related Image Products

Earth-orbiting scatterometers measure the normalized radar cross-section (σ^0) of the surface of the Earth. The σ^0 measurement made by the scatterometer can be modeled as a system that samples the "true" σ^0 characteristic of the Earth that is illuminated by the antenna footprint. This is expressed as

$$\sigma^0_{\text{measured}} = H\sigma^0 + \nu, \tag{1}$$

where H represents the sampling of the true σ^0 field and includes the measurement spatial response function, and ν is noise. At this point, no assumptions are made about the nature of the noise.

The σ^0 measurements of a scatterometer have associated data with each measurement, such as the geodetic location, incidence angle (with reference to the geodetic surface normal), and azimuth angle (with reference to north). The σ^0 and associated data is used for a variety of purposes, primarily including inferring ocean surface winds. The data can also be used to produce images for land/ice studies.

Over many areas of the Earth (with the notable exceptions of the ocean and a few land regions, such as parts of Antarctica), σ^0 values are largely azimuth-independent. We therefore discard the azimuth angle information for these areas. Also for many regions of the Earth, σ^0 (in dB space) is approximately a linear function of the incidence angle. We express σ^0 in the point-slope form as:

$$\sigma^0(\theta_i) = \mathcal{A} + \mathcal{B}(\theta_i - \theta_{\text{ref}}), \tag{2}$$

where θ_{ref} is some reference angle (historically a mid-swath value of 40° was used–we continue this convention for ASCAT processing). $\mathcal{A}$, measured in dB, is the value of σ^0 normalized to the reference angle (40°) and $\mathcal{B}$, measured in dB/° describes the dependence of σ^0 on θ_i. With this model, the challenge of visualizing scatterometer data has been reduced to finding $\mathcal{A}$ and $\mathcal{B}$ for some region of latitude and longitude.

The traditional imaging technique has been to "grid" a region of interest into a number of cells or bins. The value of each bin is the average of all σ^0 measurements whose center falls within the bin. This is essentially a two-dimensional histogram, weighted by the value of each measurement. We refer to this approach as the "gridded" image product.

By using the spatial response function corresponding to each σ^0 measurement and a higher-resolution grid (smaller bin size), an enhanced resolution image product is possible. Each σ^0 measurement is weighted by its spatial response function before it is considered for binning. The weighted binning process includes all measurements that cover the center of the bin. We term this approach the "AVE" image product.

Another procedure is to estimate the true σ^0 value based on the measured σ^0 and knowledge of the sampling operator in Eq. (1), H—essentially, an inverse of H is computed. The SIR (Scatterometer Image Reconstruction) algorithm performs such an estimate, using a modified iterative block-multiplicative algebraic reconstruction [1]. Performing the SIR algorithm on an AVE image produces the "SIR" image product. A 3x3 spatial filter is performed on the entire SIR image between iterations to reduce noise (a median filter is used for $\mathcal{A}$ and a mean filter is used for $\mathcal{B}$). Using SIR with filtering is the SIRF algorithm.

In order to improve the σ^0 estimation process, multiple overlapping passes of data are used. This improves the quality of the final SIR product but comes at the cost of reduced temporal resolution due to the time between neighboring scatterometer passes

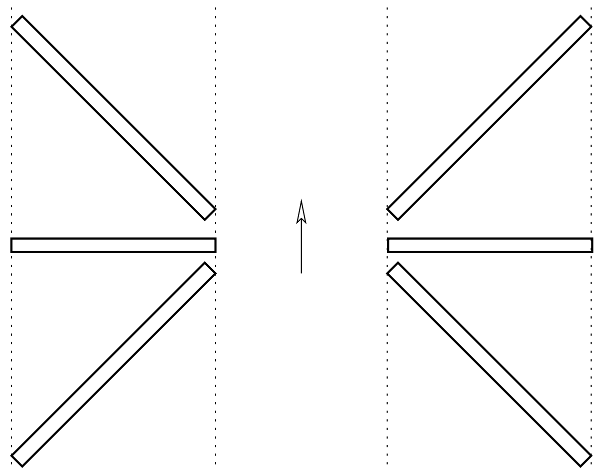


Figure 1: ASCAT has two 550 km swaths containing three beams each, oriented at 45, 90, and 135°. The illustration is approximate.

of the region of interest. The number of passes used and which passes selected depends on the size and location of the region, the date range used, the orbit of the platform, and the swath geometry of the scatterometer. What is used in the case of ASCAT is discussed below.

3 ASCAT

ASCAT (Advanced SCATterometer) is a dual-fan-beam C-band scatterometer operating at 5.255 GHz. The antennas are vertically-polarized only. Two swaths, separated by a nadir gap, contain three beams each, as shown in Fig. 1. ASCAT measures σ^0 of the surface of the Earth over an incidence angle range of roughly 33–60° [4]. Currently, an ASCAT instrument is deployed on the MetOp-A polar-orbiting satellite, launched in October 2006. It is anticipated that identical ASCAT instruments will be deployed on MetOp-B and MetOp-C in a few years.

As discussed above, the σ^0 and associated data are processed to generate (for some region of interest) $\mathcal{A}$ and $\mathcal{B}$ images using

$$\sigma^0 = \mathcal{A} + (\theta_i - 40°)\mathcal{B}, \tag{3}$$

where $\mathcal{A}$ and $\mathcal{B}$ are functions of the physical characteristics of the measured region. $\mathcal{A}$ is the σ^0 value normalized to 40° and $\mathcal{B}$ describes the slope of σ^0 as a function of θ_i.

ASCAT data as processed by EUMETSAT come in three products: SZO, SZR, and SZF. The SZO and SZR products contain spatially-averaged σ^0 measurements. 50 km resolution SZO data is generated on a 25 km grid, whereas 25 km resolution SZR data is generated on a 12.5 km grid. SZO and SZR data are not used for the SCP project. The SZF product is the finest resolution σ^0 measurements available for ASCAT and is at a resolution improved over the SZR data. The ASCAT SIRF image pixel resolution is chosen to be 4.45 km/pixel, with an effective resolution somewhat lower, due to variations in location and correlations in SZF data across the width of the swath. The

4.45 km/pixel resolution is chosen for compatibility with other scatterometer image products.

As discussed above, to create AVE and SIR image products, information about the spatial response function for each σ^0 measurement is required. This information is approximated for purposes of AVE and SIR imagery. The first approximation is to treat the response function as a binary mask, that is, all locations within some two-dimensional contour on the Earth equally contribute to the σ^0 value, and there is no contribution from areas outside this contour. This simplified approach has worked well with previous scatterometers [7]. Along-track beamwidth of each of the six antenna beams is known. Cross-track beamwidth for each measurement inside an antenna beam is approximated by taking the mid-point between adjacent measurements [5].

With these approximations in place, the spatial response function for each σ^0 measurement is approximated by a binary mask in a rectangular shape. These rectangular approximations are refered to as "slices." Figure 2 illustrates the slices for a few measurements in an antenna beam. The slices are widened by 0.2 km in either direction to allow some slice overlap. This reduces image artifacts caused by quantization errors when the slice shapes are mapped to the pixel grid.

4 Standard ASCAT Image Products

The standard ASCAT image products consist of SIR and AVE enhanced-resolution images, non-enhanced images, and other auxiliary products. A description of these follow. All products are stored in the BYU MERS SIR file format unless otherwise stated (see Appendix A for more details). ASCAT SCP image products and SIR format readers are available online at the SCP web and ftp sites, respectively `http://scp.byu.edu` and `ftp://scp.byu.edu`.

4.1 GRD files

Gridded image products are not resolution-enhanced and are produced in the conventional "drop-in-the-bucket" technique described previously. A 22.25 km/pixel resolution grid is used for the specified region and each bin or pixel is the average of all σ^0 measurements whose center falls within the pixel. Files with the extension `.grd` are produced with this technique.

4.2 NON files

Non-enhanced resolution imagery is also produced in the case of files with the `.non` extension. These files are the upscaled version of the gridded images to match the pixel resolution of AVE/SIR files. This aids in comparison of enhanced and non-enhanced imagery.

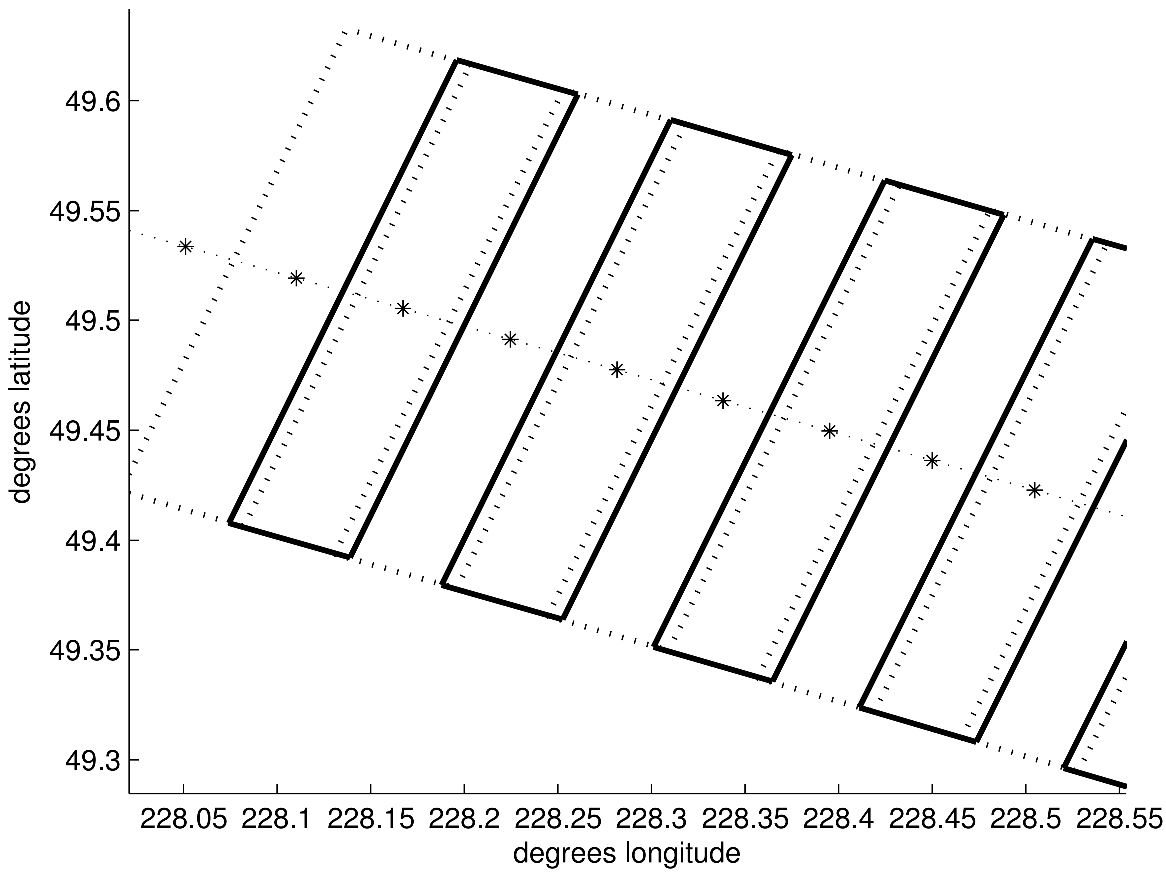


Figure 2: The approximate SZF measurement spatial response function contours (slices, shown in dashed and solid lines) calculated for locations of a few σ^0 measurements (asterisks) in one of the six ASCAT antenna beams. To emphasize the overlap of adjacent contours, the contours are alternatively plotted in dashed and solid lines.

Table 1: ASCAT SIR parameters

Number of iterations	35
$\mathcal{A}$ initialization	-15
$\mathcal{B}$ initialization	-0.25
$\mathcal{B}$ weighting factor	50

4.3 AVE files

The pixel grid used for enhanced-resolution imagery (AVE and SIR files) is set to 4.45 km/pixel. The approximate spatial response for each σ^0 measurement is computed and a weighted average of all σ^0 measurements for the pixel grid is output with the `.ave` extension.

4.4 SIR files

The SIR algorithm is initialized by the AVE processing. A number of iterations are performed to estimate the true σ^0 by inverting H, the sampling operation. The SIR algorithm has four tuning parameters, two of which are not currently used (see below, Section 5.3). Based on results of Monte Carlo simulations, the results that lead to the least amount of noise and error are summarized in Tab. 1 [5]. Between each iteration of SIR, a 3x3 modified median filter is used to reduce noise [9]. Outputs of the SIR algorithm are saved in `.sir` files.

4.5 Image regions

As with other scatterometer data in the SCP archives, regions of the Earth are defined by a number, name, and lat/lon coordinates defining the region boundaries. Most regions are produced using an equal-area Lambert projection. Polar regions use a polar stereographic projection. See Tab. 2 for the typical regions produced.

4.6 Product types

Each region has a number of product types available. These are identified by a one-character (case-sensitive) product type code in the filename (see A.1).

a: $\mathcal{A}$ value. σ^0 value in dB normalized to the 40° reference incidence angle.

b: $\mathcal{B}$ value. Slope of σ^0 (in dB) versus incidence angle.

C: count image. The number of σ^0 measurements which hit the pixel during the imaging interval.

E: mean reconstruction error in dB. The mean difference between each σ^0 measurement which hits the pixel and its forward projection ($\sigma^0 = \mathcal{A} + \mathcal{B}(\theta_i - 40°)$) based on the final $\mathcal{A}$ and $\mathcal{B}$ image estimates.

Table 2: Standard SCP product regions. The products are produced in a local radius equal-area Lambert projection, except for the Antarctic and Arctic regions (region numbers 100 and 110) which are produced in polar stereographic form.

Region Name		Lower-Left Corner		Upper-Right Corner		Region
Full	Short	Latitude	Longitude	Latitude	Longitude	Number
Amazon	Ama	-24.0	-80.0	7.0	-33.0	001
Antarctic	Ant	-90.0	-180.0	-52.0	180.0	100
Arctic	Arc	60.0	-180.0	90.0	180.0	110
Greenland	Grn	59.0	-74.0	84.5	-11.0	202
Alaska	Ala	50.0	-180.0	73.0	-130.0	203
Cntrl-Amer	CAm	5.0	-115.0	30.0	-57.0	204
North-Amer	NAm	25.0	-135.0	65.0	-50.0	205
South-Amer	SAm	-58.0	-83.0	15.0	-32.0	206
North-Afri	NAf	2.0	-20.0	40.0	65.0	207
South-Afri	SAf	-38.0	5.0	10.0	53.0	208
Siberia	Sib	50.0	60.0	75.0	180.0	209
Europe	Eur	35.0	-12.0	72.0	65.0	210
South-Asia	SAs	5.0	60.0	30.0	130.0	211
Chin-Japan	ChJ	25.0	60.0	55.0	150.0	212
Indonesia	Ind	-15.0	93.0	10.0	165.0	213
Australia	Aus	-48.0	110.0	-10.0	180.0	214
Bering Sea	Ber	50.0	135.0	75.0	-135.0	256

I: incidence angle standard deviation in °. The standard deviation is over all the σ^0 measurements which hit the pixel during the imaging interval.

J: mean incidence angle in °. The mean is over all the σ^0 measurements which hit the pixel during the imaging interval.

p: time image (in minutes from the start of the imaging interval). The time value reports the effective time center of the measurements used to compute the image [3, 10].

V: standard deviation of reconstruction error in dB. The standard deviation of the difference between each measurement which hits the pixel and its forward projection based on the final $\mathcal{A}$ and $\mathcal{B}$ image estimates. Useful for evaluating temporal variation in the surface, azimuth modulation, etc.

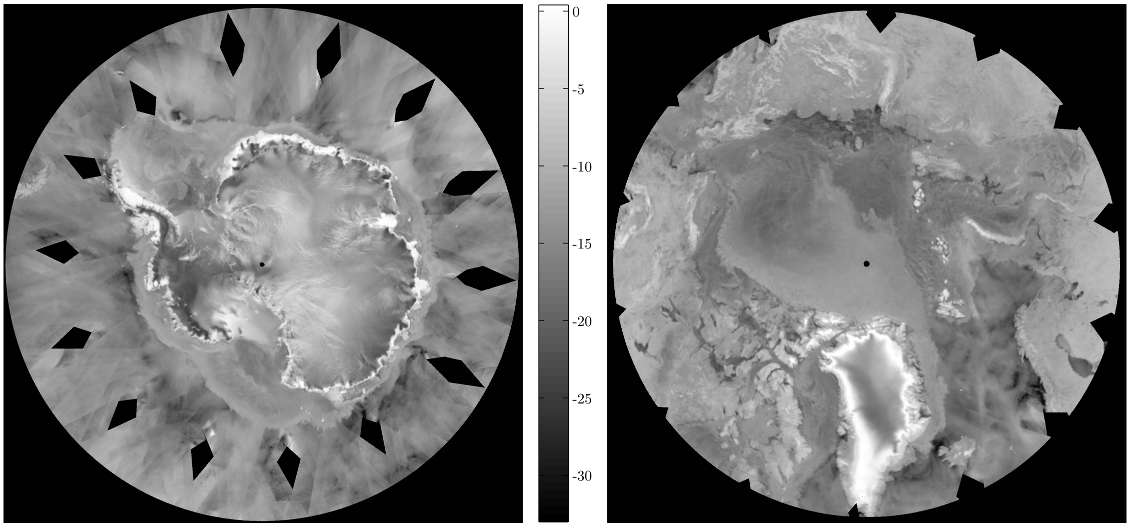
4.7 Date ranges

The spatial coverage of ASCAT and typical region size is such that multiple passes are required to obtain not only resolution enhancement but also to minimize gaps in the image from no data. Combining passes of data also temporally averages the region. In order to balance the tradeoff between high temporal resolution and maximum spatial coverage within a region, the following date ranges are used.

Two consecutive days of data are used for the polar regions (Ant, Arc). As a consequence of orbit geometry and swath size, 14 diamonds of no data are located at latitudes of about $\pm 55 - 62°$. See Section 5.1 for more details. Two-day images produced for SCP overlap by one day (e.g., images are produced covering days-of-year 111-112, 112-113, and 113-114). Figure 3 is an example of 2-day polar $\mathcal{A}$ SIR images.

Four consecutive days of data are used for two-day local time-of-day (LTD) images for the polar regions and for Greenland (Ant, Arc, Grn). Local time of day images take advantage of the fact that ASCAT measurements in polar regions are clustered such that they occur in the morning, midday, or evening of the location being measured. This permits resolution of diurnal features such as melting and reduces artifacts resulting from temporal variation in the surface response. For the northern hemisphere, a pass of ASCAT occurs in the midday and another pass in the evening. In the southern hemisphere, ASCAT passes in the morning and in the evening. Two-day LTD uses the corresponding passes of two consecutive days (the evening pass in one day and the evening pass of the next day, for example). Two-day LTD images are produced to maintain diurnal resolution while increasing the spatial coverage of one-day LTD images [6]. Four-day images overlap by two days (e.g., days-of-year 111-114, 113-116, 115-118 are produced). Figure 4 is an example of 2-day LTD $\mathcal{A}$ SIR images over Antarctica.

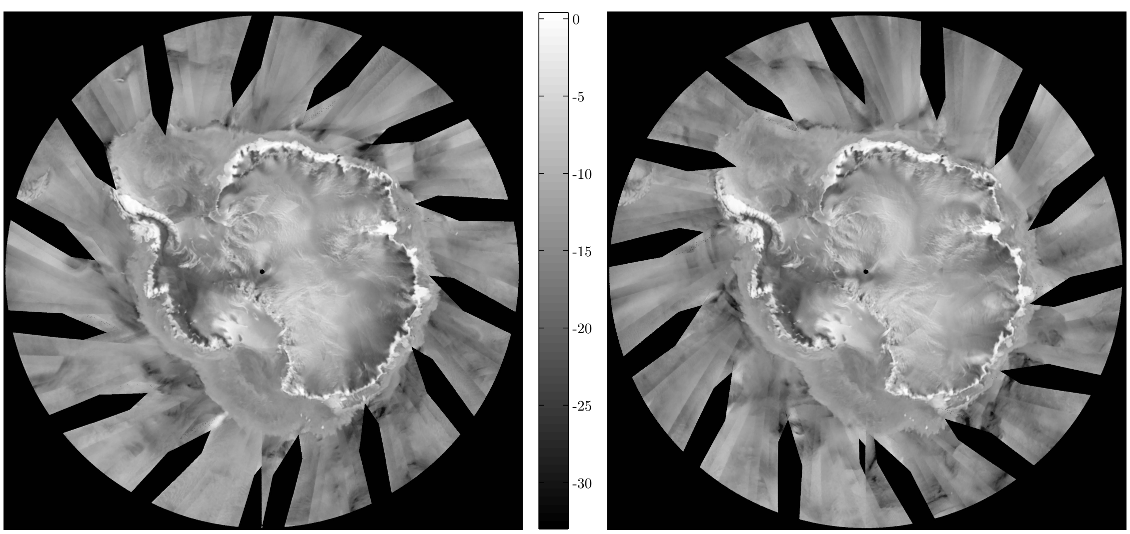
Five consecutive days of data are used for the remaining regions. With five days of data, each region is fully covered by ASCAT data. Five-day images overlap by two days (e.g., days-of-year 111-115, 113-117, 115-119 are produced). Figure 5 shows two sample 5-day regions. Table 3 gives the approximate file sizes for each region. Also



(a) Antarctic $\mathcal{A}$ SIR

(b) Arctic $\mathcal{A}$ SIR

Figure 3: Examples of polar $\mathcal{A}$ SIR images. The data is from JD 111-112, 2010 in both cases.



(a) Morning LTD $\mathcal{A}$ SIR

(b) Evening LTD $\mathcal{A}$ SIR

Figure 4: Examples of two-day LTD $\mathcal{A}$ SIR images over Antarctica. The data is from JD 111-114, 2010.

Table 3: ASCAT standard product date ranges and approximate file sizes for each region prior to gzipping. File size suffixes MiB and KiB are the binary megabyte ($1024^2 = 1048576$ bytes) and binary kilobyte (1024 bytes), respectively.

Region Name		Region	File Sizes		Days
Full	Short	Number	SIR/AVE/NON	GRD	Used
Amazon	Ama	001	1.7 MiB	17 KiB	5
Antarctic	Ant	100	7.2 MiB	75 KiB	2,4
Arctic	Arc	110	4.5 MiB	47 KiB	2,4
Greenland	Grn	202	1.1 MiB	12 KiB	4,5
Alaska	Ala	203	998 KiB	11 KiB	5
Cntrl-Amer	CAm	204	2.0 MiB	21 KiB	5
North-Amer	NAm	205	4.2 MiB	43 KiB	5
South-Amer	SAm	206	4.7 MiB	48 KiB	5
North-Afri	NAf	207	4.6 MiB	48 KiB	5
South-Afri	SAf	208	3.0 MiB	31 KiB	5
Siberia	Sib	209	2.7 MiB	28 KiB	5
Europe	Eur	210	3.1 MiB	32 KiB	5
South-Asia	SAs	211	2.5 MiB	26 KiB	5
Chin-Japan	ChJ	212	3.6 MiB	38 KiB	5
Indonesia	Ind	213	2.4 MiB	25 KiB	5
Australia	Aus	214	3.7 MiB	38 KiB	5
Bering Sea	Ber	256	2.0 MiB	21 KiB	5

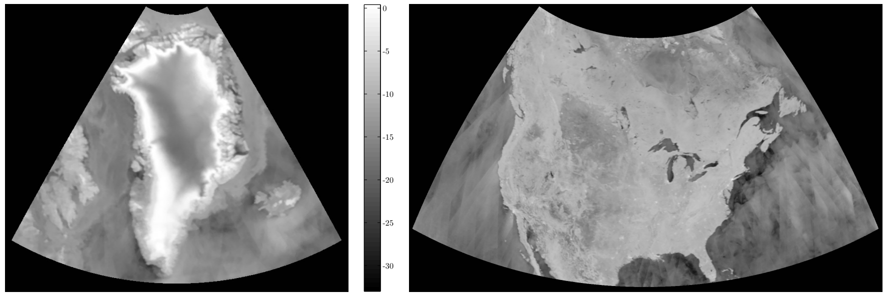
indicated for each region is how many days of data are used. Note that files hosted in the SCP archives are gzipped, compressing the file size.

5 User Notes

This section provides additional details regarding the processing of ASCAT SCP image products. Also included are known limitations and artifacts.

As discussed above, multiple passes of ASCAT data are used in order to obtain resolution-enhanced imagery and to acheive a greater spatial coverage for some region of interest. A critial assumption made both with ASCAT and with other scatterometer data in the SCP project is that the true σ^0 value of the surface doesn't change during the interval from one pass to the next. This assumption breaks down most notably over the oceans. The σ^0 value of the ocean surface is related to the roughness induced by near-surface winds. These winds are dynamic in both strength and direction and rarely are the same during the σ^0 sample intervals from one overhead pass to the next. As a consequence, imaging artifacts are frequently observed over the oceans.

Land and ice are more constant in σ^0 than the ocean, but even here diurnal features have been observed. For this reason, local time of day (LTD) processing as described above is used for polar regions. Non-polar regions are processed with ascending-only passes, descending-only passes, or both.



(a) Greenland $\mathcal{A}$ SIR (b) North America $\mathcal{A}$ SIR

Figure 5: Examples of five-day $\mathcal{A}$ SIR images. The data is from JD 111-114, 2010.

Currently SIR processing does not take into account azimuth angle dependence. Most land regions are azimuthally independent, but some regions (such as East Antarctica) do exhibit azimuth depedence. Artifacts may appear due to azimuth dependence over these regions.

5.1 Orbit geometry artifacts

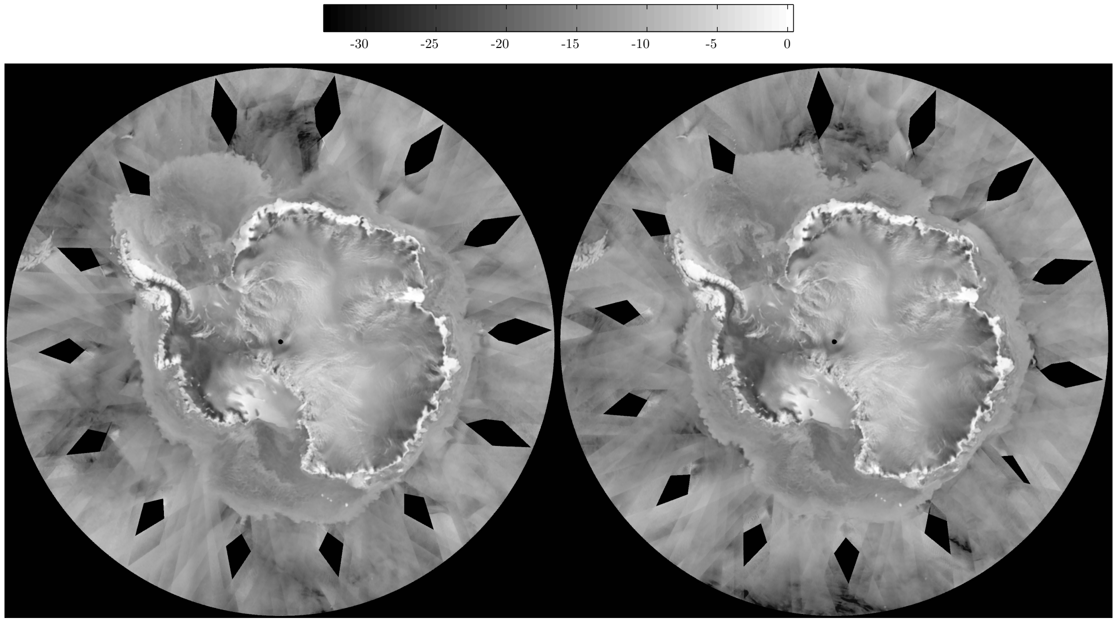
ASCAT operates on the MetOp-A platform, which has a 29-day exact-repeat and a 5-day near-repeat orbit [2]. A visible effect of processing ASCAT data for ranges less than 29 days is that the time series of images manifest edge artifacts that rotate during the sequence. Because all standard ASCAT image products span date ranges less than 29, this artifact is visible in all of the images. The effect is most visible over the oceans, but is sometimes visible over land as well.

A related artifact is found in Antarctic and Artic images. The spatial coverage of ASCAT over a two-day period is not sufficient to cover the entire region. This results in diamond-shaped gaps at latitudes of about $\pm 55 - 62°$. Because of the 29-day exact-repeat orbit, these gaps rotate in a time-series sequence of images. The cycle repeats every 29 days.

Another artifact is manifest in the polar regions, but is more noticable in Antarctic $\mathcal{A}$ and $\mathcal{B}$ images than the Arctic counterparts. At about $\pm 78°$ latitude, a circular edge is visible in many of the image products. This is due to the edge of the swath furthest from the pole—the swath never reaches a latitude higher than about $\pm 78°$. After combining n passes near the pole, this creates an n-sided polygon centered around the pole. As the number of passes increases, the sides in the polygon increase to approximate a circle. Similar circular edges centered around the poles occur from the edges of other swaths. These are most visible in I and J SIR images—the only visible circular edge in $\mathcal{A}$ and $\mathcal{B}$ images occurs at $\pm 78°$ latitude. Figure 7 illustrates this.

5.2 Incidence angle range

The six antenna beams of ASCAT measure σ^0 with an incidence angle (θ_i) ranging from approximately $3 - 58°$ (two middle beams) and $24 - 69°$ (four side beams). To reduce image artifacts and to maintain consistency with other scatterometer data, the



(a) JD 134-135, 2010 (b) JD 136-137, 2010

Figure 6: Examples of shifting gaps of coverage in Antarctic $\mathcal{A}$ SIR images.

incidence angle range is chosen such that

$$\theta_i \in \begin{cases} 34^\circ - 55^\circ & \text{for the two middle beams} \\ 34^\circ - 60^\circ & \text{for the four outer beams.} \end{cases} \tag{4}$$

5.3 $\mathcal{B}$ priors for AVE generation

The $\mathcal{A}$ and $\mathcal{B}$ initialization values are not used when the SIR algorithm is instead initialized with the non-homogeneous AVE results. However, the AVE images need to be modified before they are used for SIR in the case of 2- and 4-day images with ASCAT. If not enough σ^0 measurements are available for use in creating the AVE image pixel value, these pixels may have an inaccurate esimate of $\mathcal{B}$. Poor $\mathcal{B}$ estimates in turn cause $\mathcal{A}$ to be estimated poorly.

Due to the orbit geometry, locations with poor $\mathcal{B}$ estimation typically have accurate $\mathcal{B}$ estimates in a previous image. When the “good” $\mathcal{B}$ estimates of a different date range replace the “bad” $\mathcal{B}$ estimates, the resulting AVE better initializes SIR. The modification to the AVE algorithm is as follows.

The $\mathcal{A}$ and $\mathcal{B}$ AVE images are computed in the usual manner, but $\mathcal{B}$ pixels with an incidence angle standard deviation below a threshold of 3° are flagged for attention. With a low incidence angle variance, $\mathcal{B}$ is not estimated accurately. One or more previous $\mathcal{B}$ AVE images are loaded from a different date range, acting as a prior. The flagged pixels are replaced with the corresponding pixels in the prior(s). If a flagged pixel cannot be replaced with a prior value, a global mean $\mathcal{B}$ value is used instead. Finally, a 3x3 median filter is performed on the $\mathcal{B}$ AVE to smooth extreme values and the $\mathcal{A}$ AVE is recomputed using the new $\mathcal{B}$ AVE. The updated AVE images are then

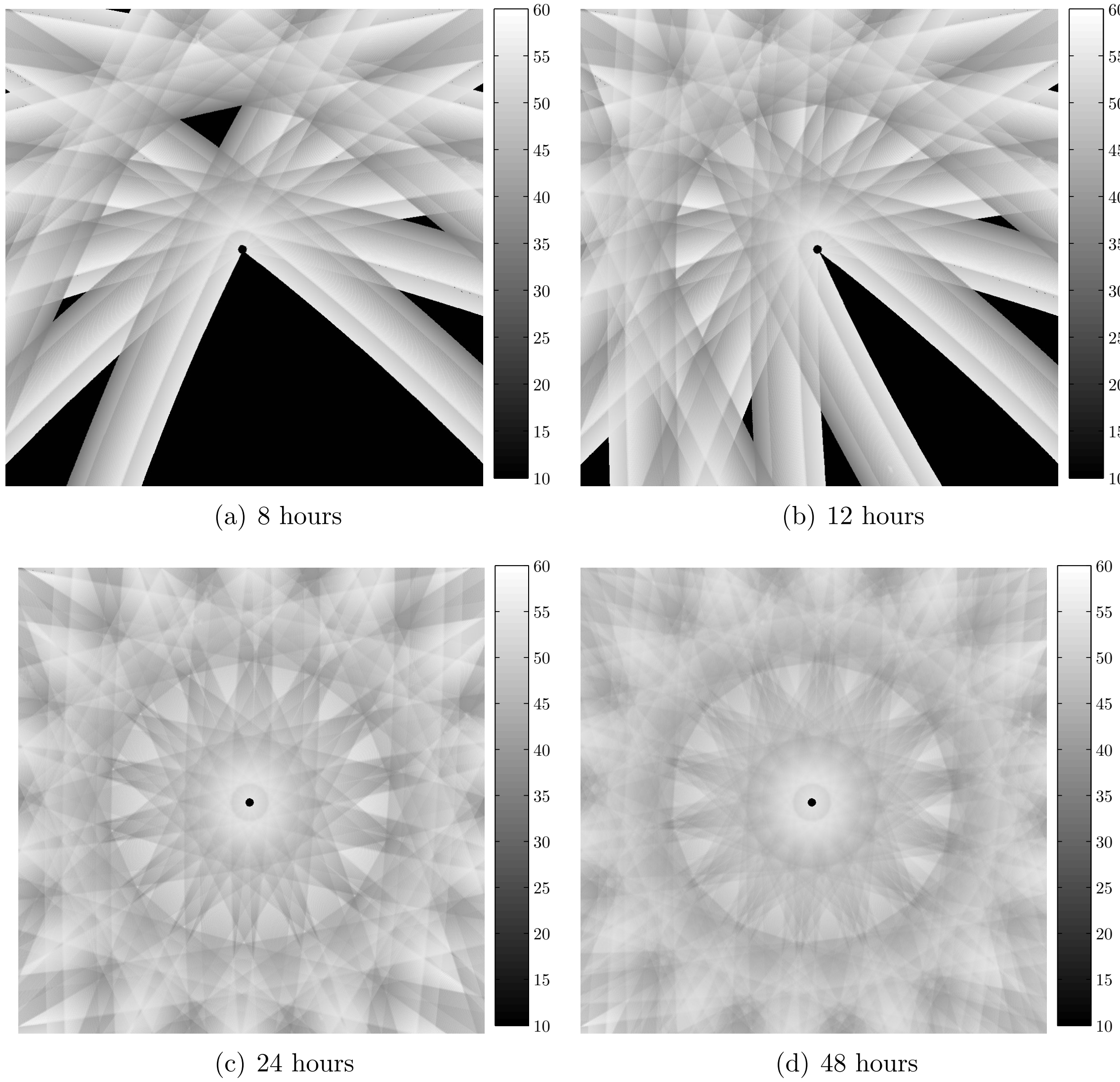


Figure 7: SIR images from data taken from JD 111-112, 2010 for the South Pole. Each figure uses a subset of the 48 hours of data to show the progression of the circular artifact. For improved clarity, J SIR images (mean incidence angle) are shown.

used to initialize SIR.

Using the outputs of the AVE processing to initialize SIR is consistent with the SIR implementation for QuikSCAT. The drawback to the modfied AVE generation process is the necessity of tracking $\mathcal{B}$ priors. Typically, two priors are needed to correct the majority of flagged pixels. Also, the priors must be "boot-strapped"—that is, several consecutive days must be processed with one day serving as the prior to the next, until the priors have all flagged pixels replaced by priors rather than filled in with the mean $\mathcal{B}$ value.

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A BYU SIR File Format[1]

The BYU MERS SIR image format was developed by the Brigham Young University (BYU) Microwave Earth Remote Sensing (MERS) laboratory to store a variety of types and projections of Earth images along with the information required to earth-locate the image pixels.

A SIR format file consists of one or more 512 byte headers followed by the image data and additional zero padding to ensure the file is a multiple of 512 bytes long. The file header record contains all of the information required to read the remainder of the file and the map projection information required to map pixels to lat/long coordinates on the Earth surface. The image pixel values generally represent floating point values and may be stored in one of three ways. The primary method is as 2 byte integers (with the high order byte first), though the pixels may be stored as single bytes or IEEE floating point values. Scale factors are stored in the header to convert the integer or byte pixel values to native floating point units. The image is stored in row-scanned (left to right) order from the lower left corner (which is the origin of the image) up through the upper right corner. By default, the location of a pixel is identified with its lower-left corner. The origin of pixel (1,1) is the lower left corner of the image. The array index n of the $(i, j)^{th}$ pixel where i is horizontal and j is vertical is given by $n = (j - 1) * N_x + i$ where N_x is the horizontal dimension of the image. The last pixel stored in the file is at (N_x, N_y).

The SIR file header contains various numerical values and strings which describe the image contents. For example, a no-data flag value is set within the header as well as the nominal display range and the minimum and maximum representable values. Optional secondary header records (512 bytes) can be used to store additional, non-standard information.

The standard SIR file format supports a variety of image projections including:

1. Rectangular array (no projection)
2. A rectangular lat/lon array
3. Two different types of Lambert equal-area projections which can be used in either non-polar or polar projections
4. Polar stereographic projections
5. EASE grid polar projection with various resolutions
6. EASE global projection with various resolutions

For the ASCAT products described here, only the rectangular lat/lon, Lambert, and polar stereographic projections are used.

Readers for the SIR file format are available in C, C++, FORTRAN, Matlab, and IDL/PVWAVE. Viewer and reader programs are available online from the BYU MERS web and anonymous ftp sites at URLs `http://scp.byu.edu/downloads.html` and

[1]Updated from [8]

`ftp://ftp.scp.byu.edu/software/`, respectively[2]. Documentation for these readers are located there. Sample files and various utility and display routines are also available. (Be sure to use binary ftp to transfer `.sir` files!)

A customized version of **xv** which reads `.sir` files and can convert images to other forms is also available on this site. Routines for display in Matlab and IDL/PV-Wave are available at the site. Adobe Photoshop can display the image data `.sir` file stored as two-byte integers. Read the file as 'raw', specify a 512 header and 16 bit data, and enter the image dimensions in pixels.

A.1 `SIR` Standard file name format for ASCAT

Where possible, a standardized file naming scheme for `SIR` format files is used, suitable for operating systems such as Linux/Unix, IRIX, VMS, and Windows. The general naming scheme is:

$$SENS - T - \mathbf{REG}\, YR - DY1 - DY2.RCN$$

where *SENS* is the four character sensor name—for ASCAT on MetOp-A, this value is mDEa, where D and E are defined in Tab. 4—, T is the one character image type code given in Tab. 5, **REG** is a region identifier string (some typical regions are listed in Tab. 8), *YR* is a two digit year code, *DY1* and *DY2* are the three digit Julian day-of-the-year start and stop dates of the data used to make the image, and *RCN* is the reconstruction type file extension given in Tab. 6. Optionally, additional file extensions may be appended to the standard name to denote a post-processed image (see Tab. 7). For ASCAT, the standard grid size is 4.45 km/pixel for SIR/AVE products and 22.25 km/pixel for GRD products. The SIRF (SIR with median Filtering) algorithm is used for ASCAT to improve the subjective quality of the image.

[2]The reader code may be copied and modified and freely distributed so long as (1) original or modified code is not redistributed for profit and (2) acknowledgment is made that the original code was obtained from the Microwave Earth Remote Sensing Laboratory at Brigham Young University, Provo, UT.

Table 4: Standard sensor string characters used in the standard file naming scheme

Symbol	Valid Values	Definition
D	s,a,d	Ascending/descending pass indicator
		s: All data used
		a: Ascending orbit pass data only used
		d: Descending orbit pass data only used
	m,n,e	Local time-of-day indicator
		m: Morning data only used
		n: Midday data only used
		e: Evening data only used
E	f,r	L1B resolution
		f: ASCAT SZF σ^0 measurements
		r: ASCAT SZR σ^0 measurements

Table 5: Selected standard type codes for `SIR` file names

T (type)	Description
a	$\mathcal{A}$ image (σ^0 in dB at reference incidence angle)
b	$\mathcal{B}$ image (slope of sigma-0 in dB/deg)
C	counts or hits (measurements) per pixel
E	average reconstruction error image (dB)
h	height (in m)
I	incidence angle standard deviation (in deg)
J	average incidence angle (in deg)
m	mask image
p	pixel time estimate (min from start of image interval)
V	reconstruction error standard deviation image (dB)
x	longitude image (deg)
y	latitude image (deg)
z	angle of grid w/respect to north (deg)
Z	pixel area (km^2)

Table 6: Standard reconstruction algorithm extensions for `SIR` file names

RCN	Reconstruction technique
.sir	SIR or SIRF algorithm
.ave	AVE image algorithm
.non	non-enhanced
.grd	gridded
.brw	low resolution gridded browse image

Table 7: Standardized extra file extensions for `SIR` file names. These are optional.

Extension	Description
.lmsk	land masked data image (ocean set to no-data value)
.lmask	land mask (0=Ocean, 1=land)
.mask	general mask image
.imsk	Ice masked image
.omsk	Ocean masked image
.dif	Difference image
.gz	gzipped file
.sr	Subregion extracted image
.ed	Manually edited image
.lmask	binary land mask image

Table 8: Standard three character region abbreviation strings for `SIR` file names

REG	Code Number	Description
Ama	001	Amazon
Ant	100	Antarctica
Arc	110	Artic
Grn	202	Greenland
Ala	203	Alaska
CAm	204	Central America
NAm	205	North America
SAm	206	South America
NAf	207	North Africa
SAf	208	South Africa
Sib	209	Siberia
Eur	210	Europe
SAs	211	South Asia
ChJ	212	China-Japan
Ind	213	Indonesia
Aus	214	Australia
Ber	256	Bering Sea

B Sample ASCAT Product Listing

The following is an example listing of the ASCAT products files produced by the BYU MERS lab. A five-day range of data is used. All ASCAT product files hosted on the SCP ftp are gzipped to minimize storage space and download time.

Ascending pass only

```
mafa-a-Ala10-001-005.ave
mafa-a-Ala10-001-005.grd
mafa-a-Ala10-001-005.non
mafa-a-Ala10-001-005.sir
mafa-a-Ama10-001-005.ave
mafa-a-Ama10-001-005.grd
mafa-a-Ama10-001-005.non
mafa-a-Ama10-001-005.sir
mafa-a-Aus10-001-005.ave
mafa-a-Aus10-001-005.grd
mafa-a-Aus10-001-005.non
mafa-a-Aus10-001-005.sir
mafa-a-Ber10-001-005.ave
mafa-a-Ber10-001-005.grd
mafa-a-Ber10-001-005.non
mafa-a-Ber10-001-005.sir
mafa-a-CAm10-001-005.ave
mafa-a-CAm10-001-005.grd
mafa-a-CAm10-001-005.non
mafa-a-CAm10-001-005.sir
mafa-a-ChJ10-001-005.ave
mafa-a-ChJ10-001-005.grd
mafa-a-ChJ10-001-005.non
mafa-a-ChJ10-001-005.sir
mafa-a-Eur10-001-005.ave
mafa-a-Eur10-001-005.grd
mafa-a-Eur10-001-005.non
mafa-a-Eur10-001-005.sir
mafa-a-Ind10-001-005.ave
mafa-a-Ind10-001-005.grd
mafa-a-Ind10-001-005.non
mafa-a-Ind10-001-005.sir
mafa-a-NAf10-001-005.ave
mafa-a-NAf10-001-005.grd
mafa-a-NAf10-001-005.non
mafa-a-NAf10-001-005.sir
mafa-a-NAm10-001-005.ave
mafa-a-NAm10-001-005.grd
mafa-a-NAm10-001-005.non
mafa-a-NAm10-001-005.sir
mafa-a-SAf10-001-005.ave
mafa-a-SAf10-001-005.grd
mafa-a-SAf10-001-005.non
mafa-a-SAf10-001-005.sir
mafa-a-SAm10-001-005.ave
mafa-a-SAm10-001-005.grd
mafa-a-SAm10-001-005.non
mafa-a-SAm10-001-005.sir
mafa-a-SAs10-001-005.ave
mafa-a-SAs10-001-005.grd
mafa-a-SAs10-001-005.non
mafa-a-SAs10-001-005.sir
mafa-a-Sib10-001-005.ave
mafa-a-Sib10-001-005.grd
mafa-a-Sib10-001-005.non
mafa-a-Sib10-001-005.sir
mafa-b-Ala10-001-005.ave
mafa-b-Ala10-001-005.grd
mafa-b-Ala10-001-005.non
mafa-b-Ala10-001-005.sir
mafa-b-Ama10-001-005.ave
mafa-b-Ama10-001-005.grd
mafa-b-Ama10-001-005.non
mafa-b-Ama10-001-005.sir
mafa-b-Aus10-001-005.ave
mafa-b-Aus10-001-005.grd
mafa-b-Aus10-001-005.non
mafa-b-Aus10-001-005.sir
mafa-b-Ber10-001-005.ave
mafa-b-Ber10-001-005.grd
mafa-b-Ber10-001-005.non
mafa-b-Ber10-001-005.sir
mafa-b-CAm10-001-005.ave
mafa-b-CAm10-001-005.grd
mafa-b-CAm10-001-005.non
mafa-b-CAm10-001-005.sir
mafa-b-ChJ10-001-005.ave
```

```
mafa-b-ChJ10-001-005.grd
mafa-b-ChJ10-001-005.non
mafa-b-ChJ10-001-005.sir
mafa-b-Eur10-001-005.ave
mafa-b-Eur10-001-005.grd
mafa-b-Eur10-001-005.non
mafa-b-Eur10-001-005.sir
mafa-b-Ind10-001-005.ave
mafa-b-Ind10-001-005.grd
mafa-b-Ind10-001-005.non
mafa-b-Ind10-001-005.sir
mafa-b-NAf10-001-005.ave
mafa-b-NAf10-001-005.grd
mafa-b-NAf10-001-005.non
mafa-b-NAf10-001-005.sir
mafa-b-NAm10-001-005.ave
mafa-b-NAm10-001-005.grd
mafa-b-NAm10-001-005.non
mafa-b-NAm10-001-005.sir
mafa-b-SAf10-001-005.ave
mafa-b-SAf10-001-005.grd
mafa-b-SAf10-001-005.non
mafa-b-SAf10-001-005.sir
mafa-b-SAm10-001-005.ave
mafa-b-SAm10-001-005.grd
mafa-b-SAm10-001-005.non
mafa-b-SAm10-001-005.sir
mafa-b-SAs10-001-005.ave
mafa-b-SAs10-001-005.grd
mafa-b-SAs10-001-005.non
mafa-b-SAs10-001-005.sir
mafa-b-Sib10-001-005.ave
mafa-b-Sib10-001-005.grd
mafa-b-Sib10-001-005.non
mafa-b-Sib10-001-005.sir
mafa-C-Ala10-001-005.grd
mafa-C-Ala10-001-005.sir
mafa-C-Ama10-001-005.grd
mafa-C-Ama10-001-005.sir
mafa-C-Aus10-001-005.grd
mafa-C-Aus10-001-005.sir
mafa-C-Ber10-001-005.grd
mafa-C-Ber10-001-005.sir
mafa-C-CAm10-001-005.grd
mafa-C-CAm10-001-005.sir
mafa-C-ChJ10-001-005.grd
mafa-C-ChJ10-001-005.sir
mafa-C-Eur10-001-005.grd
mafa-C-Eur10-001-005.sir
mafa-C-Ind10-001-005.grd
mafa-C-Ind10-001-005.sir
mafa-C-NAf10-001-005.grd
mafa-C-NAf10-001-005.sir
mafa-C-NAm10-001-005.grd
mafa-C-NAm10-001-005.sir
mafa-C-SAf10-001-005.grd
mafa-C-SAf10-001-005.sir
mafa-C-SAm10-001-005.grd
mafa-C-SAm10-001-005.sir
mafa-C-SAs10-001-005.grd
mafa-C-SAs10-001-005.sir
mafa-C-Sib10-001-005.grd
mafa-C-Sib10-001-005.sir
mafa-E-Ala10-001-005.sir
mafa-E-Ama10-001-005.sir
mafa-E-Aus10-001-005.sir
mafa-E-Ber10-001-005.sir
mafa-E-CAm10-001-005.sir
mafa-E-ChJ10-001-005.sir
mafa-E-Eur10-001-005.sir
mafa-E-Ind10-001-005.sir
mafa-E-NAf10-001-005.sir
mafa-E-NAm10-001-005.sir
mafa-E-SAf10-001-005.sir
mafa-E-SAm10-001-005.sir
mafa-E-SAs10-001-005.sir
mafa-E-Sib10-001-005.sir
mafa-I-Ala10-001-005.grd
mafa-I-Ala10-001-005.sir
mafa-I-Ama10-001-005.grd
mafa-I-Ama10-001-005.sir
mafa-I-Aus10-001-005.grd
mafa-I-Aus10-001-005.sir
mafa-I-Ber10-001-005.grd
mafa-I-Ber10-001-005.sir
mafa-I-CAm10-001-005.grd
mafa-I-CAm10-001-005.sir
mafa-I-ChJ10-001-005.grd
mafa-I-ChJ10-001-005.sir
mafa-I-Eur10-001-005.grd
```

```
mafa-I-Eur10-001-005.sir
mafa-I-Ind10-001-005.grd
mafa-I-Ind10-001-005.sir
mafa-I-NAf10-001-005.grd
mafa-I-NAf10-001-005.sir
mafa-I-NAm10-001-005.grd
mafa-I-NAm10-001-005.sir
mafa-I-SAf10-001-005.grd
mafa-I-SAf10-001-005.sir
mafa-I-SAm10-001-005.grd
mafa-I-SAm10-001-005.sir
mafa-I-SAs10-001-005.grd
mafa-I-SAs10-001-005.sir
mafa-I-Sib10-001-005.grd
mafa-I-Sib10-001-005.sir
mafa-J-Ala10-001-005.grd
mafa-J-Ala10-001-005.sir
mafa-J-Ama10-001-005.grd
mafa-J-Ama10-001-005.sir
mafa-J-Aus10-001-005.grd
mafa-J-Aus10-001-005.sir
mafa-J-Ber10-001-005.grd
mafa-J-Ber10-001-005.sir
mafa-J-CAm10-001-005.grd
mafa-J-CAm10-001-005.sir
mafa-J-ChJ10-001-005.grd
mafa-J-ChJ10-001-005.sir
mafa-J-Eur10-001-005.grd
mafa-J-Eur10-001-005.sir
mafa-J-Ind10-001-005.grd
mafa-J-Ind10-001-005.sir
mafa-J-NAf10-001-005.grd
mafa-J-NAf10-001-005.sir
mafa-J-NAm10-001-005.grd
mafa-J-NAm10-001-005.sir
mafa-J-SAf10-001-005.grd
mafa-J-SAf10-001-005.sir
mafa-J-SAm10-001-005.grd
mafa-J-SAm10-001-005.sir
mafa-J-SAs10-001-005.grd
mafa-J-SAs10-001-005.sir
mafa-J-Sib10-001-005.grd
mafa-J-Sib10-001-005.sir
mafa-p-Ala10-001-005.grd
mafa-p-Ala10-001-005.sir
mafa-p-Ama10-001-005.grd
mafa-p-Ama10-001-005.sir
mafa-p-Aus10-001-005.grd
mafa-p-Aus10-001-005.sir
mafa-p-Ber10-001-005.grd
mafa-p-Ber10-001-005.sir
mafa-p-CAm10-001-005.grd
mafa-p-CAm10-001-005.sir
mafa-p-ChJ10-001-005.grd
mafa-p-ChJ10-001-005.sir
mafa-p-Eur10-001-005.grd
mafa-p-Eur10-001-005.sir
mafa-p-Ind10-001-005.grd
mafa-p-Ind10-001-005.sir
mafa-p-NAf10-001-005.grd
mafa-p-NAf10-001-005.sir
mafa-p-NAm10-001-005.grd
mafa-p-NAm10-001-005.sir
mafa-p-SAf10-001-005.grd
mafa-p-SAf10-001-005.sir
mafa-p-SAm10-001-005.grd
mafa-p-SAm10-001-005.sir
mafa-p-SAs10-001-005.grd
mafa-p-SAs10-001-005.sir
mafa-p-Sib10-001-005.grd
mafa-p-Sib10-001-005.sir
mafa-V-Ala10-001-005.grd
mafa-V-Ala10-001-005.non
mafa-V-Ala10-001-005.sir
mafa-V-Ama10-001-005.grd
mafa-V-Ama10-001-005.non
mafa-V-Ama10-001-005.sir
mafa-V-Aus10-001-005.grd
mafa-V-Aus10-001-005.non
mafa-V-Aus10-001-005.sir
mafa-V-Ber10-001-005.grd
mafa-V-Ber10-001-005.non
mafa-V-Ber10-001-005.sir
mafa-V-CAm10-001-005.grd
mafa-V-CAm10-001-005.non
mafa-V-CAm10-001-005.sir
mafa-V-ChJ10-001-005.grd
mafa-V-ChJ10-001-005.non
mafa-V-ChJ10-001-005.sir
mafa-V-Eur10-001-005.grd
```

```
mafa-V-Eur10-001-005.non
mafa-V-Eur10-001-005.sir
mafa-V-Ind10-001-005.grd
mafa-V-Ind10-001-005.non
mafa-V-Ind10-001-005.sir
mafa-V-NAf10-001-005.grd
mafa-V-NAf10-001-005.non
mafa-V-NAf10-001-005.sir
mafa-V-NAm10-001-005.grd
mafa-V-NAm10-001-005.non
mafa-V-NAm10-001-005.sir
mafa-V-SAf10-001-005.grd
mafa-V-SAf10-001-005.non
mafa-V-SAf10-001-005.sir
mafa-V-SAm10-001-005.grd
mafa-V-SAm10-001-005.non
mafa-V-SAm10-001-005.sir
mafa-V-SAs10-001-005.grd
mafa-V-SAs10-001-005.non
mafa-V-SAs10-001-005.sir
mafa-V-Sib10-001-005.grd
mafa-V-Sib10-001-005.non
mafa-V-Sib10-001-005.sir
```

Descending pass only

```
mdfa-a-Ala10-001-005.ave
mdfa-a-Ala10-001-005.grd
mdfa-a-Ala10-001-005.non
mdfa-a-Ala10-001-005.sir
mdfa-a-Ama10-001-005.ave
mdfa-a-Ama10-001-005.grd
mdfa-a-Ama10-001-005.non
mdfa-a-Ama10-001-005.sir
mdfa-a-Aus10-001-005.ave
mdfa-a-Aus10-001-005.grd
mdfa-a-Aus10-001-005.non
mdfa-a-Aus10-001-005.sir
mdfa-a-Ber10-001-005.ave
mdfa-a-Ber10-001-005.grd
mdfa-a-Ber10-001-005.non
mdfa-a-Ber10-001-005.sir
mdfa-a-CAm10-001-005.ave
mdfa-a-CAm10-001-005.grd
mdfa-a-CAm10-001-005.non
mdfa-a-CAm10-001-005.sir
mdfa-a-ChJ10-001-005.ave
mdfa-a-ChJ10-001-005.grd
mdfa-a-ChJ10-001-005.non
mdfa-a-ChJ10-001-005.sir
mdfa-a-Eur10-001-005.ave
mdfa-a-Eur10-001-005.grd
mdfa-a-Eur10-001-005.non
mdfa-a-Eur10-001-005.sir
mdfa-a-Ind10-001-005.ave
mdfa-a-Ind10-001-005.grd
mdfa-a-Ind10-001-005.non
mdfa-a-Ind10-001-005.sir
mdfa-a-NAf10-001-005.ave
mdfa-a-NAf10-001-005.grd
mdfa-a-NAf10-001-005.non
mdfa-a-NAf10-001-005.sir
mdfa-a-NAm10-001-005.ave
mdfa-a-NAm10-001-005.grd
mdfa-a-NAm10-001-005.non
mdfa-a-NAm10-001-005.sir
mdfa-a-SAf10-001-005.ave
mdfa-a-SAf10-001-005.grd
mdfa-a-SAf10-001-005.non
mdfa-a-SAf10-001-005.sir
mdfa-a-SAm10-001-005.ave
mdfa-a-SAm10-001-005.grd
mdfa-a-SAm10-001-005.non
mdfa-a-SAm10-001-005.sir
mdfa-a-SAs10-001-005.ave
mdfa-a-SAs10-001-005.grd
mdfa-a-SAs10-001-005.non
mdfa-a-SAs10-001-005.sir
mdfa-a-Sib10-001-005.ave
mdfa-a-Sib10-001-005.grd
mdfa-a-Sib10-001-005.non
mdfa-a-Sib10-001-005.sir
mdfa-b-Ala10-001-005.ave
mdfa-b-Ala10-001-005.grd
mdfa-b-Ala10-001-005.non
mdfa-b-Ala10-001-005.sir
mdfa-b-Ama10-001-005.ave
mdfa-b-Ama10-001-005.grd
mdfa-b-Ama10-001-005.non
mdfa-b-Ama10-001-005.sir
```

mdfa-b-Aus10-001-005.ave
mdfa-b-Aus10-001-005.grd
mdfa-b-Aus10-001-005.non
mdfa-b-Aus10-001-005.sir
mdfa-b-Ber10-001-005.ave
mdfa-b-Ber10-001-005.grd
mdfa-b-Ber10-001-005.non
mdfa-b-Ber10-001-005.sir
mdfa-b-CAm10-001-005.ave
mdfa-b-CAm10-001-005.grd
mdfa-b-CAm10-001-005.non
mdfa-b-CAm10-001-005.sir
mdfa-b-ChJ10-001-005.ave
mdfa-b-ChJ10-001-005.grd
mdfa-b-ChJ10-001-005.non
mdfa-b-ChJ10-001-005.sir
mdfa-b-Eur10-001-005.ave
mdfa-b-Eur10-001-005.grd
mdfa-b-Eur10-001-005.non
mdfa-b-Eur10-001-005.sir
mdfa-b-Ind10-001-005.ave
mdfa-b-Ind10-001-005.grd
mdfa-b-Ind10-001-005.non
mdfa-b-Ind10-001-005.sir
mdfa-b-NAf10-001-005.ave
mdfa-b-NAf10-001-005.grd
mdfa-b-NAf10-001-005.non
mdfa-b-NAf10-001-005.sir
mdfa-b-NAm10-001-005.ave
mdfa-b-NAm10-001-005.grd
mdfa-b-NAm10-001-005.non
mdfa-b-NAm10-001-005.sir
mdfa-b-SAf10-001-005.ave
mdfa-b-SAf10-001-005.grd
mdfa-b-SAf10-001-005.non
mdfa-b-SAf10-001-005.sir
mdfa-b-SAm10-001-005.ave
mdfa-b-SAm10-001-005.grd
mdfa-b-SAm10-001-005.non
mdfa-b-SAm10-001-005.sir
mdfa-b-SAs10-001-005.ave
mdfa-b-SAs10-001-005.grd
mdfa-b-SAs10-001-005.non
mdfa-b-SAs10-001-005.sir
mdfa-b-Sib10-001-005.ave
mdfa-b-Sib10-001-005.grd
mdfa-b-Sib10-001-005.non
mdfa-b-Sib10-001-005.sir
mdfa-C-Ala10-001-005.grd
mdfa-C-Ala10-001-005.sir
mdfa-C-Ama10-001-005.grd
mdfa-C-Ama10-001-005.sir
mdfa-C-Aus10-001-005.grd
mdfa-C-Aus10-001-005.sir
mdfa-C-Ber10-001-005.grd
mdfa-C-Ber10-001-005.sir
mdfa-C-CAm10-001-005.grd
mdfa-C-CAm10-001-005.sir
mdfa-C-ChJ10-001-005.grd
mdfa-C-ChJ10-001-005.sir
mdfa-C-Eur10-001-005.grd
mdfa-C-Eur10-001-005.sir
mdfa-C-Ind10-001-005.grd
mdfa-C-Ind10-001-005.sir
mdfa-C-NAf10-001-005.grd
mdfa-C-NAf10-001-005.sir
mdfa-C-NAm10-001-005.grd
mdfa-C-NAm10-001-005.sir
mdfa-C-SAf10-001-005.grd
mdfa-C-SAf10-001-005.sir
mdfa-C-SAm10-001-005.grd
mdfa-C-SAm10-001-005.sir
mdfa-C-SAs10-001-005.grd
mdfa-C-SAs10-001-005.sir
mdfa-C-Sib10-001-005.grd
mdfa-C-Sib10-001-005.sir
mdfa-E-Ala10-001-005.sir
mdfa-E-Ama10-001-005.sir
mdfa-E-Aus10-001-005.sir
mdfa-E-Ber10-001-005.sir
mdfa-E-CAm10-001-005.sir
mdfa-E-ChJ10-001-005.sir
mdfa-E-Eur10-001-005.sir
mdfa-E-Ind10-001-005.sir
mdfa-E-NAf10-001-005.sir
mdfa-E-NAm10-001-005.sir
mdfa-E-SAf10-001-005.sir
mdfa-E-SAm10-001-005.sir
mdfa-E-SAs10-001-005.sir
mdfa-E-Sib10-001-005.sir

```
mdfa-I-Ala10-001-005.grd
mdfa-I-Ala10-001-005.sir
mdfa-I-Ama10-001-005.grd
mdfa-I-Ama10-001-005.sir
mdfa-I-Aus10-001-005.grd
mdfa-I-Aus10-001-005.sir
mdfa-I-Ber10-001-005.grd
mdfa-I-Ber10-001-005.sir
mdfa-I-CAm10-001-005.grd
mdfa-I-CAm10-001-005.sir
mdfa-I-ChJ10-001-005.grd
mdfa-I-ChJ10-001-005.sir
mdfa-I-Eur10-001-005.grd
mdfa-I-Eur10-001-005.sir
mdfa-I-Ind10-001-005.grd
mdfa-I-Ind10-001-005.sir
mdfa-I-NAf10-001-005.grd
mdfa-I-NAf10-001-005.sir
mdfa-I-NAm10-001-005.grd
mdfa-I-NAm10-001-005.sir
mdfa-I-SAf10-001-005.grd
mdfa-I-SAf10-001-005.sir
mdfa-I-SAm10-001-005.grd
mdfa-I-SAm10-001-005.sir
mdfa-I-SAs10-001-005.grd
mdfa-I-SAs10-001-005.sir
mdfa-I-Sib10-001-005.grd
mdfa-I-Sib10-001-005.sir
mdfa-J-Ala10-001-005.grd
mdfa-J-Ala10-001-005.sir
mdfa-J-Ama10-001-005.grd
mdfa-J-Ama10-001-005.sir
mdfa-J-Aus10-001-005.grd
mdfa-J-Aus10-001-005.sir
mdfa-J-Ber10-001-005.grd
mdfa-J-Ber10-001-005.sir
mdfa-J-CAm10-001-005.grd
mdfa-J-CAm10-001-005.sir
mdfa-J-ChJ10-001-005.grd
mdfa-J-ChJ10-001-005.sir
mdfa-J-Eur10-001-005.grd
mdfa-J-Eur10-001-005.sir
mdfa-J-Ind10-001-005.grd
mdfa-J-Ind10-001-005.sir
mdfa-J-NAf10-001-005.grd
mdfa-J-NAf10-001-005.sir
mdfa-J-NAm10-001-005.grd
mdfa-J-NAm10-001-005.sir
mdfa-J-SAf10-001-005.grd
mdfa-J-SAf10-001-005.sir
mdfa-J-SAm10-001-005.grd
mdfa-J-SAm10-001-005.sir
mdfa-J-SAs10-001-005.grd
mdfa-J-SAs10-001-005.sir
mdfa-J-Sib10-001-005.grd
mdfa-J-Sib10-001-005.sir
mdfa-p-Ala10-001-005.grd
mdfa-p-Ala10-001-005.sir
mdfa-p-Ama10-001-005.grd
mdfa-p-Ama10-001-005.sir
mdfa-p-Aus10-001-005.grd
mdfa-p-Aus10-001-005.sir
mdfa-p-Ber10-001-005.grd
mdfa-p-Ber10-001-005.sir
mdfa-p-CAm10-001-005.grd
mdfa-p-CAm10-001-005.sir
mdfa-p-ChJ10-001-005.grd
mdfa-p-ChJ10-001-005.sir
mdfa-p-Eur10-001-005.grd
mdfa-p-Eur10-001-005.sir
mdfa-p-Ind10-001-005.grd
mdfa-p-Ind10-001-005.sir
mdfa-p-NAf10-001-005.grd
mdfa-p-NAf10-001-005.sir
mdfa-p-NAm10-001-005.grd
mdfa-p-NAm10-001-005.sir
mdfa-p-SAf10-001-005.grd
mdfa-p-SAf10-001-005.sir
mdfa-p-SAm10-001-005.grd
mdfa-p-SAm10-001-005.sir
mdfa-p-SAs10-001-005.grd
mdfa-p-SAs10-001-005.sir
mdfa-p-Sib10-001-005.grd
mdfa-p-Sib10-001-005.sir
mdfa-V-Ala10-001-005.grd
mdfa-V-Ala10-001-005.non
mdfa-V-Ala10-001-005.sir
mdfa-V-Ama10-001-005.grd
mdfa-V-Ama10-001-005.non
mdfa-V-Ama10-001-005.sir
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mdfa-V-Aus10-001-005.grd
mdfa-V-Aus10-001-005.non
mdfa-V-Aus10-001-005.sir
mdfa-V-Ber10-001-005.grd
mdfa-V-Ber10-001-005.non
mdfa-V-Ber10-001-005.sir
mdfa-V-CAm10-001-005.grd
mdfa-V-CAm10-001-005.non
mdfa-V-CAm10-001-005.sir
mdfa-V-ChJ10-001-005.grd
mdfa-V-ChJ10-001-005.non
mdfa-V-ChJ10-001-005.sir
mdfa-V-Eur10-001-005.grd
mdfa-V-Eur10-001-005.non
mdfa-V-Eur10-001-005.sir
mdfa-V-Ind10-001-005.grd
mdfa-V-Ind10-001-005.non
mdfa-V-Ind10-001-005.sir
mdfa-V-NAf10-001-005.grd
mdfa-V-NAf10-001-005.non
mdfa-V-NAf10-001-005.sir
mdfa-V-NAm10-001-005.grd
mdfa-V-NAm10-001-005.non
mdfa-V-NAm10-001-005.sir
mdfa-V-SAf10-001-005.grd
mdfa-V-SAf10-001-005.non
mdfa-V-SAf10-001-005.sir
mdfa-V-SAm10-001-005.grd
mdfa-V-SAm10-001-005.non
mdfa-V-SAm10-001-005.sir
mdfa-V-SAs10-001-005.grd
mdfa-V-SAs10-001-005.non
mdfa-V-SAs10-001-005.sir
mdfa-V-Sib10-001-005.grd
mdfa-V-Sib10-001-005.non
mdfa-V-Sib10-001-005.sir

All passes

msfa-a-Ala10-001-005.ave
msfa-a-Ala10-001-005.grd
msfa-a-Ala10-001-005.non
msfa-a-Ala10-001-005.sir
msfa-a-Ama10-001-005.ave
msfa-a-Ama10-001-005.grd
msfa-a-Ama10-001-005.non
msfa-a-Ama10-001-005.sir
msfa-a-Aus10-001-005.ave
msfa-a-Aus10-001-005.grd
msfa-a-Aus10-001-005.non
msfa-a-Aus10-001-005.sir
msfa-a-Ber10-001-005.ave
msfa-a-Ber10-001-005.grd
msfa-a-Ber10-001-005.non
msfa-a-Ber10-001-005.sir
msfa-a-CAm10-001-005.ave
msfa-a-CAm10-001-005.grd
msfa-a-CAm10-001-005.non
msfa-a-CAm10-001-005.sir
msfa-a-ChJ10-001-005.ave
msfa-a-ChJ10-001-005.grd
msfa-a-ChJ10-001-005.non
msfa-a-ChJ10-001-005.sir
msfa-a-Eur10-001-005.ave
msfa-a-Eur10-001-005.grd
msfa-a-Eur10-001-005.non
msfa-a-Eur10-001-005.sir
msfa-a-Grn10-001-005.ave
msfa-a-Grn10-001-005.grd
msfa-a-Grn10-001-005.non
msfa-a-Grn10-001-005.sir
msfa-a-Ind10-001-005.ave
msfa-a-Ind10-001-005.grd
msfa-a-Ind10-001-005.non
msfa-a-Ind10-001-005.sir
msfa-a-NAf10-001-005.ave
msfa-a-NAf10-001-005.grd
msfa-a-NAf10-001-005.non
msfa-a-NAf10-001-005.sir
msfa-a-NAm10-001-005.ave
msfa-a-NAm10-001-005.grd
msfa-a-NAm10-001-005.non
msfa-a-NAm10-001-005.sir
msfa-a-SAf10-001-005.ave
msfa-a-SAf10-001-005.grd
msfa-a-SAf10-001-005.non
msfa-a-SAf10-001-005.sir
msfa-a-SAm10-001-005.ave
msfa-a-SAm10-001-005.grd
msfa-a-SAm10-001-005.non

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msfa-a-SAm10-001-005.sir
msfa-a-SAs10-001-005.ave
msfa-a-SAs10-001-005.grd
msfa-a-SAs10-001-005.non
msfa-a-SAs10-001-005.sir
msfa-a-Sib10-001-005.ave
msfa-a-Sib10-001-005.grd
msfa-a-Sib10-001-005.non
msfa-a-Sib10-001-005.sir
msfa-b-Ala10-001-005.ave
msfa-b-Ala10-001-005.grd
msfa-b-Ala10-001-005.non
msfa-b-Ala10-001-005.sir
msfa-b-Ama10-001-005.ave
msfa-b-Ama10-001-005.grd
msfa-b-Ama10-001-005.non
msfa-b-Ama10-001-005.sir
msfa-b-Aus10-001-005.ave
msfa-b-Aus10-001-005.grd
msfa-b-Aus10-001-005.non
msfa-b-Aus10-001-005.sir
msfa-b-Ber10-001-005.ave
msfa-b-Ber10-001-005.grd
msfa-b-Ber10-001-005.non
msfa-b-Ber10-001-005.sir
msfa-b-CAm10-001-005.ave
msfa-b-CAm10-001-005.grd
msfa-b-CAm10-001-005.non
msfa-b-CAm10-001-005.sir
msfa-b-ChJ10-001-005.ave
msfa-b-ChJ10-001-005.grd
msfa-b-ChJ10-001-005.non
msfa-b-ChJ10-001-005.sir
msfa-b-Eur10-001-005.ave
msfa-b-Eur10-001-005.grd
msfa-b-Eur10-001-005.non
msfa-b-Eur10-001-005.sir
msfa-b-Grn10-001-005.ave
msfa-b-Grn10-001-005.grd
msfa-b-Grn10-001-005.non
msfa-b-Grn10-001-005.sir
msfa-b-Ind10-001-005.ave
msfa-b-Ind10-001-005.grd
msfa-b-Ind10-001-005.non
msfa-b-Ind10-001-005.sir
msfa-b-NAf10-001-005.ave
msfa-b-NAf10-001-005.grd
msfa-b-NAf10-001-005.non
msfa-b-NAf10-001-005.sir
msfa-b-NAm10-001-005.ave
msfa-b-NAm10-001-005.grd
msfa-b-NAm10-001-005.non
msfa-b-NAm10-001-005.sir
msfa-b-SAf10-001-005.ave
msfa-b-SAf10-001-005.grd
msfa-b-SAf10-001-005.non
msfa-b-SAf10-001-005.sir
msfa-b-SAm10-001-005.ave
msfa-b-SAm10-001-005.grd
msfa-b-SAm10-001-005.non
msfa-b-SAm10-001-005.sir
msfa-b-SAs10-001-005.ave
msfa-b-SAs10-001-005.grd
msfa-b-SAs10-001-005.non
msfa-b-SAs10-001-005.sir
msfa-b-Sib10-001-005.ave
msfa-b-Sib10-001-005.grd
msfa-b-Sib10-001-005.non
msfa-b-Sib10-001-005.sir
msfa-C-Ala10-001-005.grd
msfa-C-Ala10-001-005.sir
msfa-C-Ama10-001-005.grd
msfa-C-Ama10-001-005.sir
msfa-C-Aus10-001-005.grd
msfa-C-Aus10-001-005.sir
msfa-C-Ber10-001-005.grd
msfa-C-Ber10-001-005.sir
msfa-C-CAm10-001-005.grd
msfa-C-CAm10-001-005.sir
msfa-C-ChJ10-001-005.grd
msfa-C-ChJ10-001-005.sir
msfa-C-Eur10-001-005.grd
msfa-C-Eur10-001-005.sir
msfa-C-Grn10-001-005.grd
msfa-C-Grn10-001-005.sir
msfa-C-Ind10-001-005.grd
msfa-C-Ind10-001-005.sir
msfa-C-NAf10-001-005.grd
msfa-C-NAf10-001-005.sir
msfa-C-NAm10-001-005.grd
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msfa-C-NAm10-001-005.sir
msfa-C-SAf10-001-005.grd
msfa-C-SAf10-001-005.sir
msfa-C-SAm10-001-005.grd
msfa-C-SAm10-001-005.sir
msfa-C-SAs10-001-005.grd
msfa-C-SAs10-001-005.sir
msfa-C-Sib10-001-005.grd
msfa-C-Sib10-001-005.sir
msfa-E-Ala10-001-005.sir
msfa-E-Ama10-001-005.sir
msfa-E-Aus10-001-005.sir
msfa-E-Ber10-001-005.sir
msfa-E-CAm10-001-005.sir
msfa-E-ChJ10-001-005.sir
msfa-E-Eur10-001-005.sir
msfa-E-Grn10-001-005.sir
msfa-E-Ind10-001-005.sir
msfa-E-NAf10-001-005.sir
msfa-E-NAm10-001-005.sir
msfa-E-SAf10-001-005.sir
msfa-E-SAm10-001-005.sir
msfa-E-SAs10-001-005.sir
msfa-E-Sib10-001-005.sir
msfa-I-Ala10-001-005.grd
msfa-I-Ala10-001-005.sir
msfa-I-Ama10-001-005.grd
msfa-I-Ama10-001-005.sir
msfa-I-Aus10-001-005.grd
msfa-I-Aus10-001-005.sir
msfa-I-Ber10-001-005.grd
msfa-I-Ber10-001-005.sir
msfa-I-CAm10-001-005.grd
msfa-I-CAm10-001-005.sir
msfa-I-ChJ10-001-005.grd
msfa-I-ChJ10-001-005.sir
msfa-I-Eur10-001-005.grd
msfa-I-Eur10-001-005.sir
msfa-I-Grn10-001-005.grd
msfa-I-Grn10-001-005.sir
msfa-I-Ind10-001-005.grd
msfa-I-Ind10-001-005.sir
msfa-I-NAf10-001-005.grd
msfa-I-NAf10-001-005.sir
msfa-I-NAm10-001-005.grd
msfa-I-NAm10-001-005.sir
msfa-I-SAf10-001-005.grd
msfa-I-SAf10-001-005.sir
msfa-I-SAm10-001-005.grd
msfa-I-SAm10-001-005.sir
msfa-I-SAs10-001-005.grd
msfa-I-SAs10-001-005.sir
msfa-I-Sib10-001-005.grd
msfa-I-Sib10-001-005.sir
msfa-J-Ala10-001-005.grd
msfa-J-Ala10-001-005.sir
msfa-J-Ama10-001-005.grd
msfa-J-Ama10-001-005.sir
msfa-J-Aus10-001-005.grd
msfa-J-Aus10-001-005.sir
msfa-J-Ber10-001-005.grd
msfa-J-Ber10-001-005.sir
msfa-J-CAm10-001-005.grd
msfa-J-CAm10-001-005.sir
msfa-J-ChJ10-001-005.grd
msfa-J-ChJ10-001-005.sir
msfa-J-Eur10-001-005.grd
msfa-J-Eur10-001-005.sir
msfa-J-Grn10-001-005.grd
msfa-J-Grn10-001-005.sir
msfa-J-Ind10-001-005.grd
msfa-J-Ind10-001-005.sir
msfa-J-NAf10-001-005.grd
msfa-J-NAf10-001-005.sir
msfa-J-NAm10-001-005.grd
msfa-J-NAm10-001-005.sir
msfa-J-SAf10-001-005.grd
msfa-J-SAf10-001-005.sir
msfa-J-SAm10-001-005.grd
msfa-J-SAm10-001-005.sir
msfa-J-SAs10-001-005.grd
msfa-J-SAs10-001-005.sir
msfa-J-Sib10-001-005.grd
msfa-J-Sib10-001-005.sir
msfa-p-Ala10-001-005.grd
msfa-p-Ala10-001-005.sir
msfa-p-Ama10-001-005.grd
msfa-p-Ama10-001-005.sir
msfa-p-Aus10-001-005.grd
msfa-p-Aus10-001-005.sir

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msfa-p-Ber10-001-005.grd
msfa-p-Ber10-001-005.sir
msfa-p-CAm10-001-005.grd
msfa-p-CAm10-001-005.sir
msfa-p-ChJ10-001-005.grd
msfa-p-ChJ10-001-005.sir
msfa-p-Eur10-001-005.grd
msfa-p-Eur10-001-005.sir
msfa-p-Grn10-001-005.grd
msfa-p-Grn10-001-005.sir
msfa-p-Ind10-001-005.grd
msfa-p-Ind10-001-005.sir
msfa-p-NAf10-001-005.grd
msfa-p-NAf10-001-005.sir
msfa-p-NAm10-001-005.grd
msfa-p-NAm10-001-005.sir
msfa-p-SAf10-001-005.grd
msfa-p-SAf10-001-005.sir
msfa-p-SAm10-001-005.grd
msfa-p-SAm10-001-005.sir
msfa-p-SAs10-001-005.grd
msfa-p-SAs10-001-005.sir
msfa-p-Sib10-001-005.grd
msfa-p-Sib10-001-005.sir
msfa-V-Ala10-001-005.grd
msfa-V-Ala10-001-005.non
msfa-V-Ala10-001-005.sir
msfa-V-Ama10-001-005.grd
msfa-V-Ama10-001-005.non
msfa-V-Ama10-001-005.sir
msfa-V-Aus10-001-005.grd
msfa-V-Aus10-001-005.non
msfa-V-Aus10-001-005.sir
msfa-V-Ber10-001-005.grd
msfa-V-Ber10-001-005.non
msfa-V-Ber10-001-005.sir
msfa-V-CAm10-001-005.grd
msfa-V-CAm10-001-005.non
msfa-V-CAm10-001-005.sir
msfa-V-ChJ10-001-005.grd
msfa-V-ChJ10-001-005.non
msfa-V-ChJ10-001-005.sir
msfa-V-Eur10-001-005.grd
msfa-V-Eur10-001-005.non
msfa-V-Eur10-001-005.sir
msfa-V-Grn10-001-005.grd
msfa-V-Grn10-001-005.non
msfa-V-Grn10-001-005.sir
msfa-V-Ind10-001-005.grd
msfa-V-Ind10-001-005.non
msfa-V-Ind10-001-005.sir
msfa-V-NAf10-001-005.grd
msfa-V-NAf10-001-005.non
msfa-V-NAf10-001-005.sir
msfa-V-NAm10-001-005.grd
msfa-V-NAm10-001-005.non
msfa-V-NAm10-001-005.sir
msfa-V-SAf10-001-005.grd
msfa-V-SAf10-001-005.non
msfa-V-SAf10-001-005.sir
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msfa-V-Sib10-001-005.non
msfa-V-Sib10-001-005.sir
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