Ku-band Radar

Summary

The Ku-band Radar data set contains L1B Geolocated Radar Echo Strength Profiles over Greenland, Canada, the Arctic Ocean, and Antarctica taken with the CReSIS Ku-band Radar.

The L1B data set includes echograms with measurements for time, latitude, longitude, elevation, as well as flight path charts and echogram images.

The Ku-band radar data have been collected on an ongoing basis since 2009 using grant funding from NASA and NSF. The most recent data were collected as part of the NSF Science and Technology Center grant (ANT-0424589) and the NASA Operation IceBridge field campaign (NNX10AT68G).

The data are stored in MATrix LABoratory (MATLAB) files with associated JPG, CSV, and PNG files.

The data are available at ftp://ftp.cresis.ku.edu/ and http://ftp.cresis.ku.edu/. These two sites serve the same data, but use the ftp (port 21) and http (port 80) protocols respectively.

FAQ

The most convenient way to browse the imagery quickly is through the JPG files in the images directory.

The quickest way to plot the whole dataset is to look at the browse files (KML or CSV) for the whole season in the kml and csv directories respectively.

The standard L1B files are in the CSARP_qlook directory. These are located in ftp://ftp.cresis.ku.edu/kuband/{$season_name}/.

For the highest quality and most complete browsing of the data, use the Matlab image browser at ftp://ftp.cresis.ku.edu/picker/. The guide for the picker also explains the picking process.

Mathworks MAT file readers for C and IDL including documentation from Mathworks are located at ftp://ftp.cresis.ku.edu/mat_reader/.

Data Organization

The radar data are divided into segments. A segment is a contiguous dataset where the radar settings do not change. A day is divided into segments if the radar settings were changed, hard drives were switched, or other operational constraints required that the radar recording be turned

off and on. The segment ID is YYYYMMDD_SS where YYYY is the 4-digit year (e.g. 2011), MM is the 2-digit month from 1 to 12, DD is the 2-digit day of the month from 1 to 31, and SS is the segment number from 0 to 99. Segments are always sorted in the order in which the data was collected. Generally SS starts with 1 and increments by 1 for each new segment, but this is not always the case: only the ordering is guaranteed to match the order of data collection.

Each segment is broken into frames (analogous to satellite SAR scenes) to make analyzing the data easier. Frames span 33 seconds covering 4 to 5 km dependent upon aircraft speed. Currently frames are aligned with raw data files (frame number matches raw file index), but this may not always be the case for future missions. Once the frame boundaries are defined, they will not change from one release to the next or one processing method to the next. The frame ID is a concatenation of the segment ID and a frame number and follows the format YYYYMMDD_SS_FFF where FFF is the frame number from 000 to 999. Generally the FFF starts with 0 or 1 and increments by 1 for each new frame, but this is not always the case: only the ordering is guaranteed to match the order of data collection.

In a data casting sense, the data granule for L1B data is the frame.

File Descriptions

On the ftp.cresis.ku.edu/kuband page, L1B are in the Ku-band radar folder (kuband), arranged by Season ID (e.g. 2011_Greenland_P3). Since L1B files are specific to a season and contain only Ku-band radar data, these files are stored together in the season ID folders under the directory Ku-band.

L1B products

CSARP_{$processing_type}/{$segment_id}/Data{$image_id}_{$frame_id}.mat

For each data frame there may be many different L1B products depending on how waveforms, and channels are combined and how the processing is done. More details about the standard outputs are given in the Methods section. An example filename is:

CSARP_qlook/20110516_01/Data_0110516_01_006.mat

The {$processing_type} is a string. Currently the only processing type is qlook.

The {$segment_id} is explained in the Data Organization section.

The {$image_id} is a string which is always empty at this point.

The {$frame_id} is explained in the Data Organization section.

The file format is Matlab .MAT version 6.

images/{$segment_id}/{$frame_id}_HHmmss_{0maps,1echo}.jpg

For each data frame there is a flight path file (0map) and an echogram file (1echo). The background images for 1) sea ice flights are the Bremen sea ice concentration maps in the projection that is used by the Geotiff's from this site, or 2) Landsat-7 natural color imagery in polar stereographic format (70 deg true scale latitude, -45 deg longitude is center for Greenland/Canada and -71 deg true scale latitude, 0 deg longitude is center for Antarctica). A few example filenames are:

images/20110507_01/20110507_01_001_110941_0maps.jpg
images/20110507_01/20110507_01_001_110941_1echo.jpg

HHmmss is the GPS time stamp for the first range line in the image where HH is 00-23 hours, mm is 00-59 minutes, and ss is 00-59 seconds.

The echograms are generated from the qlook data product.

The file format is JPEG.

L2 products

csv/{$segment_id}/Data_{$frame_id}_HHmmss.csv

FILES NOT CURRENTLY AVAILABLE.

Contains the ice surface and layering information. There is one file per data frame. An example filename is:

csv/20110407_06/Data_20110407_06_001_151055.csv

HHmmss is the GPS time stamp for the first range line in the csv file where HH is 00-23 hours, mm is 00-59 minutes, and ss is 00-59 seconds.

The file format is comma separated variable (CSV).

csv/Data_{$segment_id}.csv

FILES NOT CURRENTLY AVAILABLE.

These files are provided for ease of download and file transfer. They are the same format as the individual data frame CSV files. These files have all the individual frames from the segment concatenated together. An example filename is

csv/Data_20110331_09.csv

csv/{$season_id}.csv

FILES NOT CURRENTLY AVAILABLE.

These files are provided for ease of download and file transfer. They are the same format as the individual data frame CSV files. These files have all the individual frames from the whole season concatenated together.

The {$season_id} is a string that is formatted as YYYY_location_platform, YYYY is the 4-digit year *of when the season began*, location is the geographic location (e.g. Greenland or Antarctica), and platform is the airborne system used (e.g. P3, TO, DC8, Ground).

An example filename is:

csv/2011_Greenland_P3.csv

csv/Browse_Data_{$segment_id}.csv

The same as the segment CSV file except only the first point is taken from each frame to keep the file size small.

csv/Browse_Data_20110331_09.csv

layerData/{$segment_id}/Data_{$frame_id}.mat

For each data frame there is a layer data file. This file contains the full layer information for the ice surface and any other layers that have been picked *and is required by the image browser/layer picker*. An example filename is:

CSARP_layerData/20110516_01/Data_20110516_01_006.mat

The file format is Matlab .MAT version 6.

Browsing Files

kml/Browse_Data_{$segment_id}.kml

KML versions of the segment browsing CSV files.

{$radar_id}_param_{$season_id}.xls

This spreadsheet file allows all of the radar and processing parameters to be browsed conveniently. These parameters are encapsulated in the L1B data files, but this spreadsheet provides another way to access this information. An example filename is:

kuband_param_2011_Greenland_P3.xls

The {$radar_id} is a string containing the radar ID which is one of icards, mcrds, mcords, or mcords2.

General utilities and documents

ftp://ftp.cresis.ku.edu/gps_ins/

See guide in this folder for more details. The individual GPS/INS files are stored with this naming convention:

{$season_id}/gps_YYYYMMDD.mat

A few examples are:

2011_Greenland_P3/gps_20110507.mat
2011_Greenland_P3/gps_20110516.mat

The file format is Matlab .MAT version 6.

ftp://ftp.cresis.ku.edu/matlab_MAT_reader/

Matlab MAT file reader for Matlab, C, and IDL. See guide in this folder for more details.

ftp://ftp.cresis.ku.edu/picker/

Echogram browsing tool (currently requires Matlab). See guide in this folder for more details

ftp://ftp.cresis.ku.edu/geographic_search/

Basic geographic search tool (currently requires Matlab). Convenient for searching all of the seasons of data and listing all of the frames and segments of interest.

ftp://ftp.cresis.ku.edu/loader/

Echogram loader tool (currently requires Matlab). See guide in this folder for more details. This tool has not been released yet since it is an alpha version, but is available upon request.

ftp://ftp.cresis.ku.edu/segy/

SEGY and SEG2 converter tool (currently requires Matlab). See guide in this folder for more details. This tool has not been released yet since it is an alpha version, but is available upon request.

ftp://ftp.cresis.ku.edu/rds/kuband_readme.doc

The most recent version of this readme file.

Segments and Frames

The data are divided into segments. A segment is a contiguous dataset where the radar settings do not change. A day is divided into segments if the radar settings were changed, hard drives were switched, or other operational constraints required that the radar recording be turned off and on. All data from a particular segment are stored in a directory with the following nomenclature YYYYMMDD_SS where YYYY is the year, MM is the month, DD is the day, and SS is the segment. Segments are always sorted in the order in which the data was collected.

Each segment is broken into frames to make analyzing the data easier. Currently frame boundaries align with raw data files. This will not always be the case, but typically a frame represent a few kilometers of data. The frame ID uses the following format YYYYMMDD_SS_FFF.mat where FFF is the frame number.

L1B Matlab Files

Data filenames start with "Data_" followed by the frame ID.
* Data_20091224_01_001.mat

Each Matlab (.mat) file has the following variables:

Name	Data
Size/Axes	M by N float32 array where M is fast time and N is slow time
Units	Represents relative received power (Watts)
Range	No restrictions
Null Value	NaN
Description	Radar echogram data. The data may be truncated. Presence of the Truncate_Bins variable indicates data has been truncated. Lack of the Truncate_Bins variable indicates data has *not* been truncated.

Name	Time
Size/Axes	M_{ALL} by 1 double vector where M_{ALL} is fast time
Units	Seconds
Range	Full double range
Null Value	NA
Description	Fast time (zero time is *approximately* the beginning of the transmit event)

Name	Depth
Size/Axes	M_{ALL} by 1 double vector where M_{ALL} is fast time
Units	Meters
Range	Full double range
Null Value	NA
Description	Range axis with the origin at the median of the Surface values in this frame and assuming a dielectric of 1.53 (Depth = (Time - median(Surface)) * c/2/sqrt(1.53))

Name	Truncate_Bins (only available when data is truncated)
Size/Axes	M by 1 double vector where M is fast time
Units	NA
Range	Integer from 1 to M_{ALL}
Null Value	NA
Description	These are the indices into the Time and Depth vectors for which the Data is available.

Name	Truncate_Mean (only available when data is truncated)
Size/Axes	N by 1 double vector where N is slow time
Units	NA
Range	No restrictions
Null Value	NA
Description	Represents a mean of the noise power for the truncated range bins before the surface return. When no range bins were truncated before the surface return the value is NaN.

Name	Truncate_Median (only available when data is truncated)
Size/Axes	N by 1 double vector where N is slow time
Units	NA
Range	No restrictions
Null Value	NA
Description	Represents a median of the noise power for the truncated range bins before the surface return. When no range bins were truncated before the surface return the value is NaN.

Name	Truncate_Std_Dev (only available when data is truncated)
Size/Axes	N by 1 double vector where N is slow time
Units	NA
Range	No restrictions
Null Value	NA
Description	Represents a standard deviation of the noise power for the truncated range bins before the surface return. When no range bins were truncated before the surface return the value is NaN.

Name	GPS_time
Size/Axes	1 by N double vector where N is slow time
Units	Seconds
Range	Full double range
Null Value	NA
Description	GPS time when data were collected (seconds since Jan 1, 1970 00:00:00). This is the ANSI C standard.

Name	Latitude
Size/Axes	1 by N double vector where N is slow time
Units	Degrees
Range	-90 to +90
Null Value	Not a Number (indicates that no GPS information is available)
Description	WGS-84 geodetic latitude coordinate. Always referenced to North. Represents the location of the origin of the trajectory data which is generally not the radar's phase center, but some other point on the aircraft (e.g. the GPS antenna or the INS).

Name	Longitude
Size/Axes	1 by N double vector where N is slow time
Units	Degrees
Range	-180 to +180
Null Value	Not a Number (indicates that no GPS information is available)
Description	WGS-84 geodetic longitude coordinate. Always referenced to East. Represents the location of the origin of the trajectory data which is generally not the radar's phase center, but some other point on the aircraft (e.g. the GPS antenna or the INS).

Name	Elevation
Size/Axes	1 by N double vector where N is slow time
Units	Meters
Range	Full double range
Null Value	Not a Number (indicates that no GPS information is available)
Description	Referenced to WGS-84 ellipsoid. Positive is outward from the center of the Earth. Represents the location of the origin of the trajectory data which is generally not the radar's phase center, but some other point on the aircraft (e.g. the GPS antenna or the INS).

Name	Elevation_Correction (only available when data is elevation compensated)
Size/Axes	1 by N double vector where N is slow time
Units	Range bins
Range	Integer
Null Value	NA
Description	Represents the number of zeros that were inserted during elevation compensation for each range line to simulate near-level flight. These zeros are not included in the truncation noise statistics.

Name	Surface
Size/Axes	1 by N double vector where N is slow time
Units	Seconds
Range	Full double range
Null Value	Not a Number (indicates that no surface information is available)
Description	Estimated two way propagation time to the surface from the collection platform. This uses the same frame of reference as the Time variable. This information is sometimes used during compression to determine the range bins that can be truncated.

Name	*param* (multiple variables with a name containing the string "param")
Size/Axes	NA, data structures
Units	NA
Range	NA
Null Value	NA
Description	Contains: 1) Radar and processing settings, 2) Processing software version and time stamp information. Fields of structures are not static and may change from one version to the next.

L2 Matlab Files

Name	GPS_time
Size/Axes	1 by N double vector where N is slow time
Units	Seconds
Range	Full double range
Null Value	NA
Description	GPS time when data were collected (seconds since Jan 1, 1970 00:00:00). This is the ANSI C standard.

Name	Latitude
Size/Axes	1 by N double vector where N is slow time
Units	Degrees
Range	-90 to +90
Null Value	Not a Number (indicates that no GPS information is available)
Description	WGS-84 geodetic latitude coordinate. Always referenced to North. Represents the location of the radar echogram data phase center. It may not be the actual measurement location due to motion compensation

Name	Longitude
Size/Axes	1 by N double vector where N is slow time
Units	Degrees
Range	-180 to +180
Null Value	Not a Number (indicates that no GPS information is available)
Description	WGS-84 geodetic longitude coordinate. Always referenced to East. Represents the location of the radar echogram data phase center. It may not be the actual measurement location due to motion compensation

Name	Elevation
Size/Axes	1 by N double vector where N is slow time
Units	Meters
Range	Full double range
Null Value	Not a Number (indicates that no GPS information is available)
Description	Referenced to WGS-84 ellipsoid. Positive is outward from the center of the Earth. Represents the location of the radar echogram data phase center. It may not be the actual measurement location due to motion compensation
Name	layerData{layer_idx}
Size/Axes	1 x P cell array of structures, where P is the number of layers
Units	NA
Range	NA
Null Value	NA
Description	The first layer (layer_idx = 1) is the ice surface. For the depth sounder, the second layer (layer_idx = 2) is the ice bottom.

Name	layerData{layer_idx}.name
Size/Axes	character array, arbitrary length
Units	NA
Range	NA
Null Value	NA
Description	Name of the layer ("surface" and "bottom" are reserved for ice surface and ice bottom respectively)

Name	layerData{layer_idx}.value{pick_idx}
Size/Axes	1 by 2 cell array of structures
Units	NA
Range	NA
Null Value	NA
Description	There are two pick types: the manual picks are stored in pick_idx = 1 and the automated picks are stored in pick_idx = 2.

Name	*layerData{ layer_idx}.value{pick_idx}.data*
Size/Axes	1 by N double vector
Units	Seconds
Range	Full double range
Null Value	Not a Number (indicates that no surface information is available for this particular index and pick type)
Description	Estimated two way propagation time to the layer from the collection platform.

Name	*layerData{ layer_idx}.quality*
Size/Axes	1 by N double vector
Units	NA
Range	1, 2, or 3
Null Value	NA
Description	Quality level of the data (1-3), 1 represents high confidence, 2 represents low confidence or large error bars, and 3 represents a derived or estimated result based on information beyond just the present data frame

Theory of Measurements:

The snow and kuband radars use a frequency modulated continuous wave (FMCW) architecture (Carrara 1995). This is done to reduce the required sampling frequency of the ADC and is possible when the range gate is limited. Currently, the range gate is limited to low altitude flights to achieve the full bandwidth. In these FMCW radars, a long chirp signal is generated (~250 μs) which sweeps linearly in frequency from the start frequency to the stop frequency. This signal is transmitted and also fed to a mixer in the receiver to be used to demodulate the received signal. Signals outside the range gate are suppressed by the intermediate frequency (IF) filter and aliased by the system.

The dominant scattered signal is the specular or coherent reflection from the air-snow surface and shallow layers beneath this. A bistatic antenna configuration is used to provide isolation between the transmit and receive paths which is important because the FMCW system receives while transmitting and too little isolation means that the direct path from the transmitter to the receiver will be too strong and saturate the receiver. The antennas are mounted so that the main beam is pointed in the nadir direction to capture the specular surface and layer reflections.

The pulse repetition frequency (PRF), or along-track sampling rate, does not necessarily capture the full Doppler bandwidth for point scatterers without aliasing. However, since the target energy is mostly coherent, it occupies only a small portion of the Doppler spectrum so that the undersampling in along-track is not generally a problem. Since the coherent portion of the surface and layer scattering is the primary signal of interest, to lower the data rate, presumming is used which effectively low pass filters and decimates the Doppler spectrum.

The narrow beamwidth of the antennas which have a fixed pointing direction means that when the aircraft rolls beyond ~10 deg, the specular reflection falls outside the main lobe of the antennas and therefore the signal strength is reduced.

Radar System

The following tables list the nominal properties of the radar system. A Pasternack Enterprises PE 9854-20 20 dB standard gain horn antenna is used with the Ku-band radar.

	Frequency Spectrum (GHz)	Pulse Duration (µs)	Transmit Power (W)	Noise Figure (dB)	Antenna Beamwidth Along x Cross (deg)
2009 Antarctica TO					19 x 19
2009 Antarctica DC8	14-16	130-270			19 x 19
2010 Antarctica DC8	13-17	240			19 x 19
2010 Greenland P3	12.5-13.5				19 x 19
2011 Greenland TO	13-16 15.5-17.5	250			19 x 19
2011 Greenland P3	13-16.5	250			19 x 19
2011 Antarctica DC8	13-17	250			19 x 19

	Pulse Repetition Frequency (Hz)	Hardware Averages	Polarization Along-track
2009 Antarctica TO			E-plane
2009 Antarctica DC8	3000	4	E-plane
2010 Antarctica DC8	2000	4	E-plane
2010 Greenland P3	2000	4	E-plane
2011 Greenland TO	2000	4	E-plane
2011 Greenland P3	2000	4	E-plane
2011 Antarctica DC8	2000	4	E-plane

Range Gate

The FMCW radar captures the full signals from a window in time after the transmission. Signals arriving before or after the window are suppressed and *alias back into the window.* A mapping of the aliasing effect is shown in the figure below for a desired time gate corresponding to 1000 to 2000 ft. Note how 1000 to 2000 ft actual range maps perfectly to measured range, but all other actual ranges are also mapped into the same 1000 to 2000 ft. For example, if a signal arrives from 2100 ft it will be upside down and at 1900 ft. The signal will also be attenuated by the time gate filter since it lies outside the pass band from 1000 to 2000 ft.
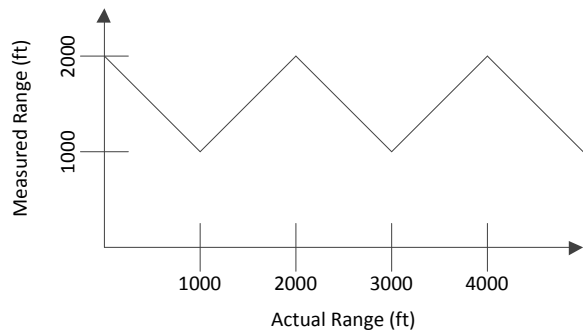
L1B Processing Steps:

The following processing steps are performed.

1. Set digital errors to zero (error sequences are 4 samples in length and occur once every few thousand range lines)
2. Synchronization of GPS data with the radar data using the UTC time stored in the radar data files
3. Conversion from quantization to voltage at the ADC input
4. Removal of DC-bias by subtracting the mean
5. The quick look output is generated using presumming or unfocused SAR processing for a total of 16 coherent averages which includes hardware and software averages. If the pulse repetition frequency (PRF) is 2000 Hz, the new effective PRF is 125 Hz.
6. A fast-time FFT is applied with a Hanning window to convert the raw data into the range domain (analogous to pulse compression). The data are flipped around based on the Nyquist zone.
7. A high pass filter is applied in the along-track to remove coherent noise
8. A 1 range-bin by 5 along-track-range-line boxcar filter is applied to the power detected data and then decimated in along-track by 5.
9. The quick look output is used to find the ice surface location (fully automated).
10. The output is then elevation compensated (with radar range bin accuracy) and then truncated in fast time based on the data posting settings in the parameter spreadsheet.

For a discussion on the elevation compensation, see the snow radar readme.

Loading Data with Elevation Compensation and Fast-Time Truncation

See the snow radar readme for an example of how to load the data.

Resolution and Error Bounds

For a flat surface, the range resolution is:

$$\frac{k_t c}{2Bn}$$

where B is the bandwidth and is nominally 3500 MHz (13 to 16.5 GHz), n is the index of refraction for the medium, c is the speed of light in a vacuum, and $k_t = 1.5$ is due to the

application of a Hanning time-domain window to reduce the range sidelobes of the chirped transmit waveform. Note that the bandwidth for a particular segment can be determined by reading the param_radar structure in the echogram data file or by looking at the parameter spreadsheet values f0, f1, and fmult and doing the following calculation

B = (param_radar.f1-param_radar.f0)*param_radar.fmult

The range resolution for several indices of refraction is given in this table.

Index of Refraction	Range Resolution (cm)	Medium
1	6.4	Air
sqrt(1.53)	5.2	Snow
sqrt(3.15)	3.6	Solid ice

The index of refraction can be approximated by $n = (1 + 0.51\rho_{snow})^3$ where ρ_{snow} is the density of the snow in grams per cm^3. In the data posting, a dielectric of 1.53 is used which corresponds to a snow density of 0.3 g per cm^3 (Warren 1999).

In the along-track dimension, the raw data before any hardware or software coherent averages have a resolution derived in the same manner as the cross-track resolution. However, a basic form of focusing is applied called unfocussed synthetic aperture radar (SAR) processing (also known as stacking or coherent averaging). If all affects are accounted for, the data may be coherently averaged to a SAR aperture length of $L = \sqrt{\dfrac{H\lambda_c}{2}}$ or for H = 500 m and a center frequency of 14.75 GHz, they may be averaged to a length of 2.25 m. The resolution turns out to be approximately equal to this with the exact definition given below. However, these data are only coherently averaged 16 times which includes both hardware and software averaging, and decimated by this same amount. At a platform speed of 140 m/s this is an aperture length, L, of 1.12 m (the sample spacing is likewise 1.12 m). Therefore the actual resolution is less fine. It is approximately given by

$$\sigma_{x,SAR-qlook} = H \tan\left(\sin^{-1}\left(\frac{\lambda_c}{2L} \right) \right).$$

For H = 500 m, the along-track resolution is 4.54 m.

A 1 range-bin by 5 along-track-range-line boxcar filter is applied to the power detected data and then decimated in the along-track by 5 so the data product has an along-track sample spacing of 5.6 m.

For a smooth or quasi-specular target (e.g. internal layers), the primary response is from the first Fresnel zone. Therefore, the directivity of specular targets effectively creates the appearance of a cross-track resolution equal to this first Fresnel zone. The first Fresnel zone is a circle with diameter given by

$$\sigma_{y,\text{Fresnel-limited}} = \sqrt{2(H + T/\sqrt{3.15})\lambda_c} \ ,$$

where H is the height above the air/ice interface, T is the depth in ice of the target, and λ_c is the wavelength at the center frequency. The table below gives the cross-track resolution for this case.

Center Frequency (MHz)	Cross-track Resolution H = 500 m T = 0 m (m)
14750	4.5

For a rough surface with no appreciable layover, the cross-track resolution will be constrained by the pulse-limited footprint, which is approximately

$$\sigma_{y,\text{pulse-limited}} = 2\sqrt{\frac{(H + T/\sqrt{3.15})ck_t}{B}} \ .$$

The table below gives the cross-track resolution with windowing.

Bandwidth (MHz)	Cross-track Resolution H = 500 m T = 0 m (m)
3500	16.0

For a rough surface where layover occurs, the cross-track resolution is set by the beamwidth, β_y, of the antenna array. The antenna beamwidth-limited resolution is

$$\sigma_{y,\text{beamwidth-limited}} = 2\left(H + \frac{T}{\sqrt{3.15}}\right)\tan\left(\frac{\beta_y}{2}\right)$$

where β is the beamwidth in radians, H is the height above ground level, and T is the depth in ice of the target.

The antenna installed in the bomb bay of the P-3, the wing roots of the DC-8, and the nadir port of the TO is a Pasternack Enterprises 9854-20 standard gain horn antenna. The E-plane of the antenna is aligned in the along-track. The approximate beamwidths are 19 deg in along-track and 19 deg in cross-track. The footprint is a function of range

$$\sigma = 2H \tan\left(\frac{\beta}{2}\right)$$

where β is the beamwidth in radians and H is the height above ground level. For $H = 500$ m, the footprint is 167 m in along-track and 167 m in cross-track.

System loop sensitivity calculations section is not completed.

Season Specific Information

The data are not radiometrically calibrated. This means that they are not converted to some absolute standard for reflectivity or backscattering analysis. We are working on data processing and hardware modifications to do this.

The data have not been motion compensated. We are working on data processing modifications to do this.

2009 Antarctica DC8

This section is not completed.

Field Team

Principle Investigator: Chris Allen
Radar Installation: Chris Allen, Keith Lehigh, Ben Panzer
Radar Operation: Victor Jara, Ben Panzer
Data Processing: William Blake, Keith Lehigh, Ben Panzer
Data Backups and IT: Keith Lehigh, Ben Panzer
Post Data Processing (for this release): Not released yet

2009 Antarctica TO

This section is not completed.

Field Team

Principle Investigator: Prasad Gogineni
Radar Installation: Cameron Lewis, Fernando Rodriguez-Morales
Radar Operation: Carl Leuschen, Cameron Lewis
Data Processing: Carl Leuschen, Cameron Lewis, Logan Smith
Data Backups and IT: Chad Brown, Keith Lehigh
Post Data Processing (for this release): Not released yet

2010 Greenland DC8

This section is not completed.

Field Team

Principle Investigator: Carl Leuschen
Radar Installation: Reid Crowe, Carl Leuschen, Ben Panzer, Fernando Rodriguez-Morales
Radar Operation: Reid Crowe, Ben Panzer
Data Processing: Reid Crowe, Ben Panzer
Data Backups and IT: Jenett Tillotson

Post Data Processing (for this release): Aqsa Patel

2010 Greenland P3

This section is not completed.

Field Team

Principle Investigator: Carl Leuschen
Radar Installation: Reid Crowe, Cameron Lewis, Carl Leuschen, Ben Panzer, Fernando Rodriguez-Morales
Radar Operation: Reid Crowe
Data Processing: Reid Crowe
Data Backups and IT: Chad Brown
Post Data Processing (for this release): Aqsa Patel

2010 Antarctica DC8

This section is not completed.

Field Team

Principle Investigator: Carl Leuschen
Radar Installation: Austin Arnett, Ben Panzer, Fernando Rodriguez-Morales
Radar Operation: Ben Panzer
Data Processing: Ben Panzer
Data Backups and IT: Chad Brown, Dan Hellebust
Post Data Processing (for this release): Aqsa Patel

2011 Greenland TO

This section is not completed.

Field Team

Principle Investigator: Prasad Gogineni
Radar Installation: Reid Crowe, Daniel Gomez, Fernando Rodriguez-Morales
Radar Operation: Daniel Gomez
Data Processing: Daniel Gomez
Data Backups and IT: Chad Brown
Post Data Processing (for this release): Not released yet

2011 Greenland P3

Known Issues

The accum, snow, and kuband data acquisition systems have a known issue with radar data synchronization with GPS time. When the radar system is initially turned on, the radar system acquires UTC time from the GPS NMEA string. If this is done too soon after the GPS receiver has been turned on, the NMEA string sometimes returns GPS time rather than UTC time. GPS time is 15 seconds ahead of UTC time during this field season. The corrections for the whole day

must include the offset (-15 second correction). GPS corrections have been applied to all of the data using a comparison between the accumulation, snow, and kuband radars which all have independent GPS receivers. A comparison to geographic features and between ocean surface radar return and GPS elevation is also made to ensure GPS synchronization. GPS time corrections are given in the vector worksheet of the parameter spreadsheet. This issue is closed.

Coverage

This section is not completed.

Field Team

Principle Investigator: Carl Leuschen
Radar Installation: Reid Crowe, Carl Leuschen, Cameron Lewis, Ben Panzer, Kevin Player, Fernando Rodriguez-Morales
Radar Operation: Reid Crowe, Ben Panzer
Data Processing: John Paden, Ben Panzer
Data Backups and IT: Dan Hellebust, Justin Miller
Post Data Processing (for this release): Dravid Joseph, John Paden, Ben Panzer, Aqsa Patel

2011 Antarctica DC8

There are no known issues with the data.

Field Team

Principle Investigator: Carl Leuschen
Radar Installation: Austin Arnett, Jilu Li, John Paden, Ben Panzer, Kevin Player
Radar Operation: Ben Panzer
Data Processing: Shashanka Jagarlapudi, John Paden, Ben Panzer
Data Backups and IT: Matt Standish
Post Data Processing (for this release): Shashanka Jagarlapudi, John Paden, Ben Panzer

2011 Antarctica TO

This section is not completed.

Field Team

Principle Investigator: Prasad Gogineni
Radar Installation: Reid Crowe, Daniel Gomez, Fernando Rodriguez-Morales
Radar Operation: Daniel Gomez
Data Processing: Daniel Gomez
Data Backups and IT: Justin Miller
Post Data Processing (for this release): Not released yet

2012 Greenland P3

This field season is not over yet.

Field Team

Principle Investigator: Carl Leuschen
Radar Installation: Carl Leuschen, Aqsa Patel, Kevin Player
Radar Operation: Aqsa Patel
Data Processing: John Paden, Logan Smith, Theresa Stumpf
Data Backups and IT: Erik Cornet
Post Data Processing (for this release): Not released yet

Acknowledgement and Citing the Data:

Whenever the data are used, please include the following acknowledgement:

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Please cite data according to NSIDC standard.

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Contacts

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