

ROSETTA-Ice Project

3 Campaign Seasons

2015-2016

2016-2017

2017-2018

43 Total Flights

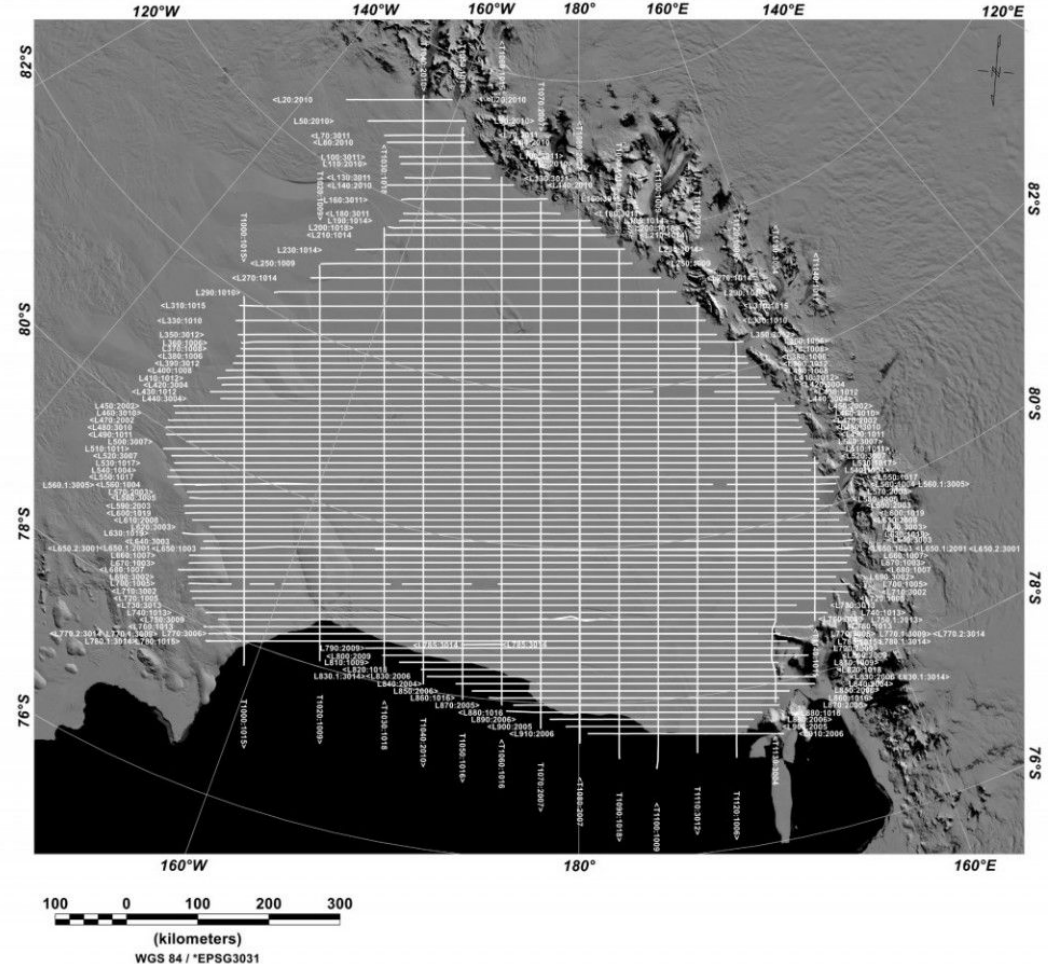
~60,000 km (lines)

Radar Instruments:

IcePod →

Deep ICE (DICE) Radar

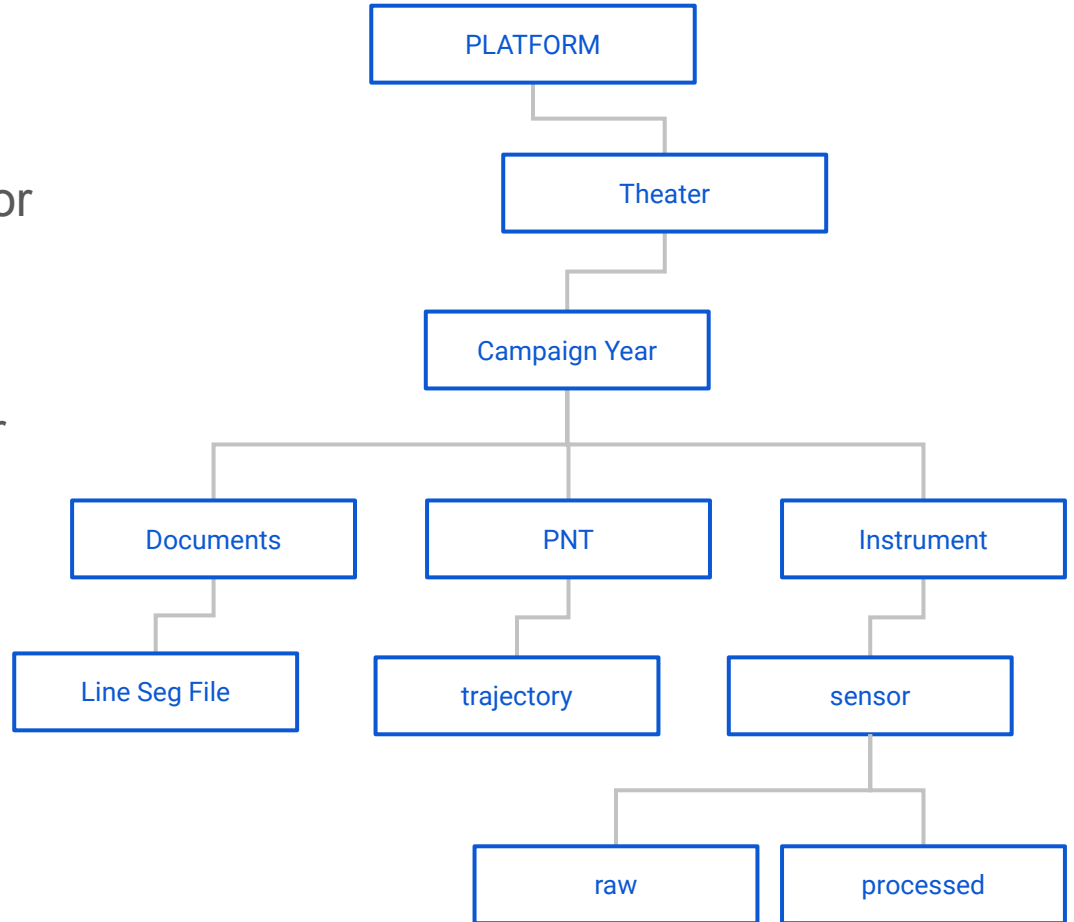
Shallow Ice Radar (SIR)



Data Archive Structure

Overarching directory structure for data archiving at LDEO.

Processed data occasionally contains additional directories for various processed data levels.



Headers for ALL Raw Data Files:

These headers are created as needed when signal is transmitted. Headers will be regenerated if there is brief signal loss, upon signal re-transmission.

Headers are named in the following format and contain the following information:

Theater ID _ Flight Number _ UTC YYYYMMDD _ UTC hhmmss _ 0000 . head

- Institution Name:
- UTC Date and Time of Header Creation: YYYYMMDD_hhmmss
- Pod Operator: Initials of IcePod Operator during flight
- Campaign ID: Theater Abbreviation & Number of IcePod Deployment to Theater (AN for Antarctica & ##)
- Flight Number: ### Beginning From 001
- Comments: Line Numbers, Flight Plans, Flight Numbers, etc.

Deep ICE (DICE) Radar

Phase Coherent Pulsed-Chirp VHF Radar Sounder

Chirp Length: 1 μ s and 3 μ s

Bandwidth: 60 MHz

Center Frequency: 188 MHz

Resolution: Depth: <2 m | Along-track: 0.6 m

Maximum Depth Penetration: ~ 5 km

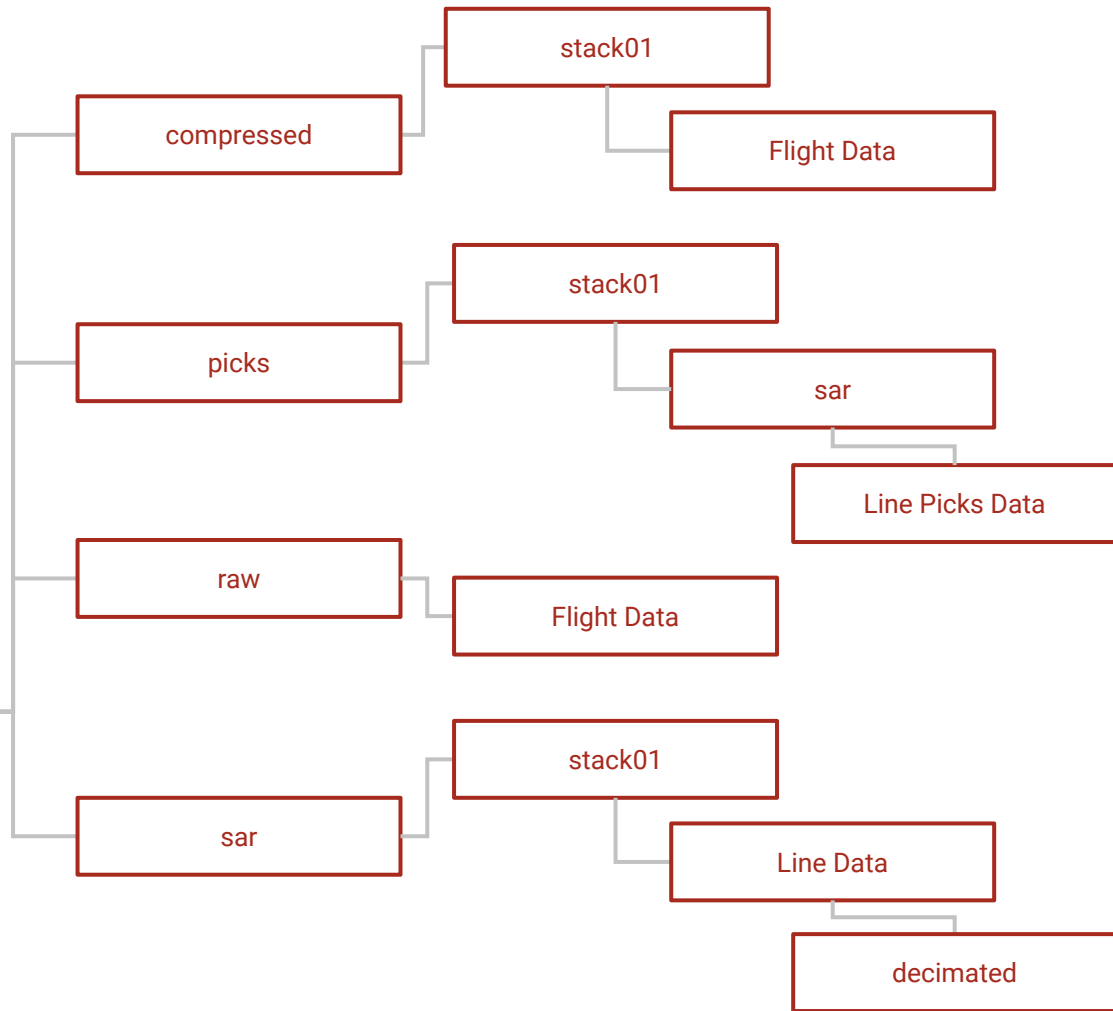
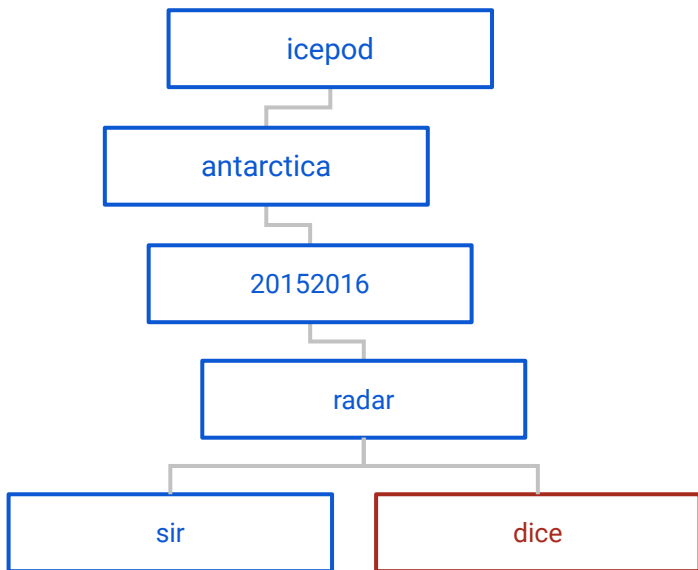
Total Data Collected: 60,000 Line km

raw	compressed	sar	decimated
Level 0 Header Raw Data Signal 10 Second Flight Data	Level 1 1 μ Ch1 & 3 μ Ch1 1 μ Ch2 & 3 μ Ch2 Config File Unfocused & Geolocated Data 1 Minute Flight Data	Level 1a 1 μ Ch1 & 3 μ Ch1 Config File Sar Processed Stack 01 8 Seconds ROSETTA-Ice Grid Line Data	Level 2 1 μ Ch1 & 3 μ Ch1 Config File 5 Minute (Averaged) Frame No. Identifier Added Corrections for Picking ROSETTA-Ice Grid Line Data

ROSETTA-Ice Project Campaign Seasons

2015 2016	2016 2017	2017 2018	2015 2016	2016 2017	2017 2018	2015 2016	2016 2017	2017 2018	2015 2016	2016 2017	2017 2018
2.875 TB	1.383 TB	1.532 TB	17.409 TB	3.903 TB	6.106 TB	7.245 TB	4.945 TB	5.025 TB	450.00 GB	287.50 GB	312.50 GB

DICE Data Structure



DICE Filename Structure

Flight Data

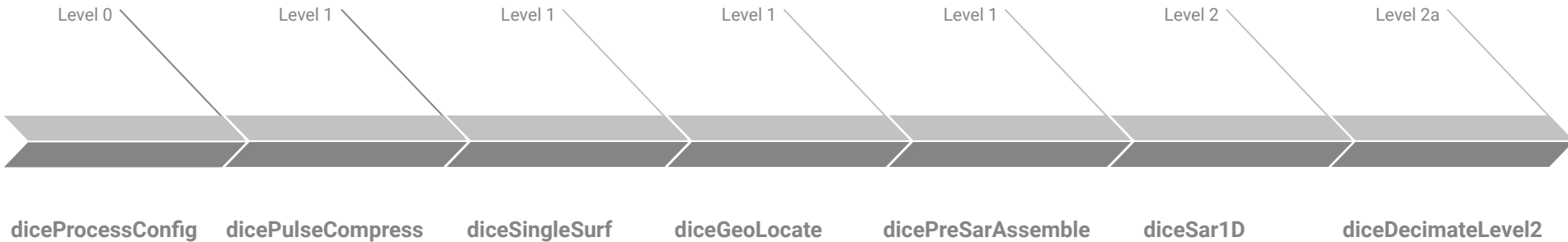
Theater ID	Flight No.	UTC Date	UTC Time	Pulse / Channel Frequency	Process Level	Sensor Type	[file format]
Antarctica (AN) + IcePod Deployment No. (##)	Flight Number (100#) = No. Times Deployed in Same Season (1) + No. of Flight (00#)	YYYY MM DD of Sample Collection	HH MM SS of Sample Collection	Pulse & Channel Configuration	Processing Level ID	Name or Abbreviation of Sensor Name for which this data belongs	Either .raw or .mat

Line Data

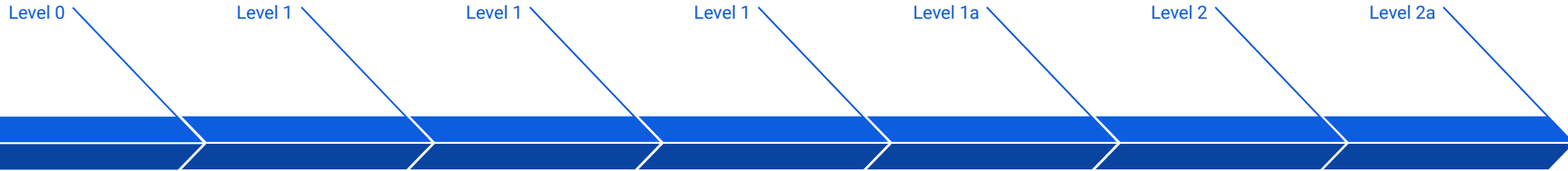
Campaign ID	ROSETTA-Ice Grid Line No.	UTC Date	UTC Time	Pulse / Channel Frequency	Process Level	Sensor Type	[file format]
Rosetta (RS) + Project Deployment No. (##)	L for E-W Grid Lines T for N-S Tie Lines Grid Numbers increase by 10	YYYY MM DD of Sample Collection	HH MM SS of Sample Collection	Pulse & Channel Configuration	Processing Level ID	Name or Abbreviation of Sensor Name for which this data belongs	Usually .mat

DICE Processing (diceProcess.m)

`diceProcess.m` This is the top level function for processing Deep Ice Radar data. This script calls all functions required to process selected lines. All configurations for processing are set in "`diceProcessConfig.m`".



DICE Processing (diceProcess.m)



diceProcessConfig

Configuration Settings:
2500ft elevation,
dataPath, Pulse
Channel, Season #,
Sensor Type, Chirp
Period & Bandwidth,
GPS & PNT data, etc.

Reads 10-Second Raw
.dice Files

dicePulseCompress

Parse 10-Sec Raw
files, low pass filter,
remove frequencies,
convolve reference
chirp with data,
stacking, etc.

Creates 1-Minute
Level 1 Mat Files.

diceSingleSurf

Parse Level 1
Geolocated data,
identify surface reflector
from selected Channel,
generate index variable
with location of surface
reflector within data.

Amends 1-Minute
Level 1 Mat Files

diceGeoLocate

Parse Level 1 Pulse
Compressed data to
stitch w/ Geolocation.

Amends 1-Minute
Level 1 Mat Files

dicePreSarAssemble

Rearrange Level 1 data
so each file contains
the same number of
echoes required for
SAR Processing -
specified in
diceProcessConfig.

Creates 'tmp' Folder w/
new Level 1 Mat Files

diceSar1D

Parse PreSar Level 1
data. Computes
migration curve using
surface by default and
ice refractive index.
Three files loaded at a
time to remove edge
effects.

Creates 8-Second Level
2 Mat Files

diceDecimateLevel2

Averages, decimates, and
concatenates 1-Minute
Level2 Files to create
5-Minute Level2a mat files
for Bed Picking.
Appends Filename w/
Frame No.
5-Minute Period determined
in diceProcessConfig.m

Creates 5-Minutes
Level 2a Mat Files w/ Frame
Number

Shallow Ice Radar (SIR)

Frequency Modulated Continuous Wave (LFMCW)

Chirp Length: 1 μ s

Bandwidth: 600 MHz

Center Frequency: 2 GHz

Resolution: Depth: 0.25 m | Along-track: 4 m

Maximum Depth Penetration: ~ 450 m

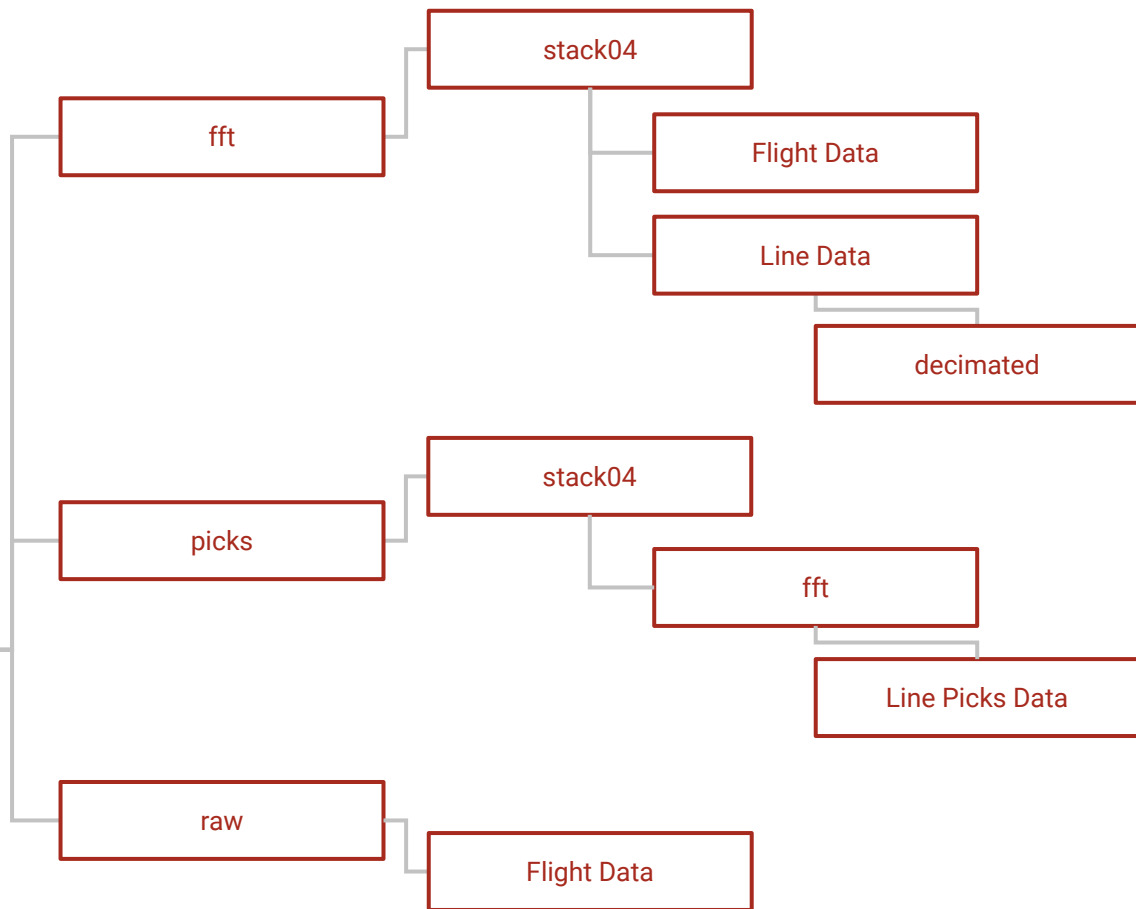
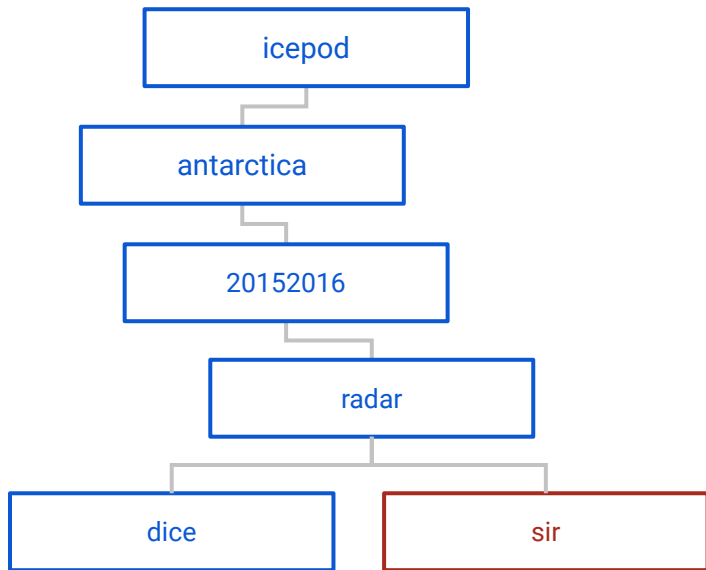
Total Data Collected: 60,000 Line km

raw	fft	decimated
Level 0 Header Raw Data Signal 10 Second Flight Data	Level 1 FFT & Geolocated Data Stack 04 1-Minute Flight Data ROSETTA-Ice Grid Line Data	Level 1a 5-Minute (Averaged) Frame No. Identifier Added Corrections for Picking ROSETTA-Ice Grid Line Data

ROSETTA-Ice Campaign Seasons

2015 2016	2016 2017	2017 2018	2015 2016	2016 2017	2017 2018	2015 2016	2016 2017	2017 2018
4.166 TB	1.941 TB	2.471 TB	5.445 TB	3.304 TB	2.160 TB	1.368 TB	831.6 GB	543.6 GB

SIR Data Structure



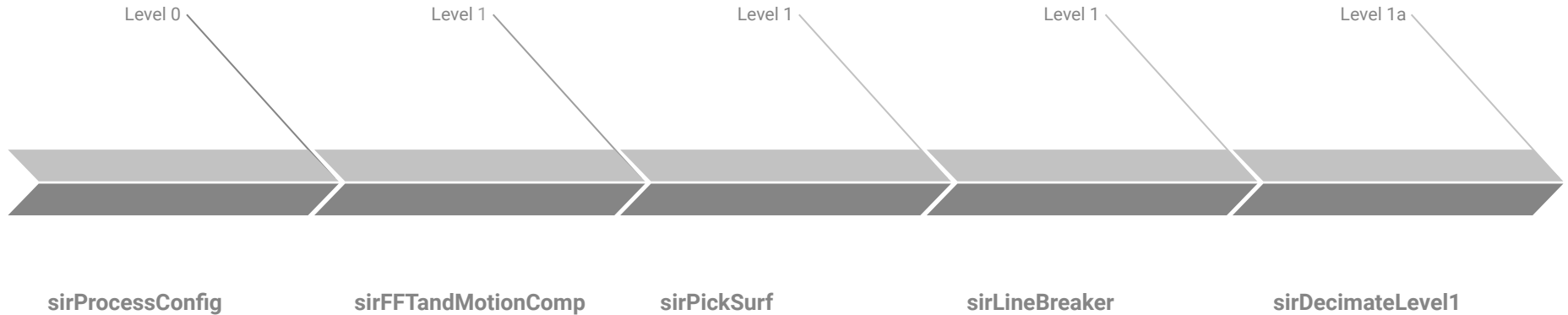
SIR Filename Structure

Flight Data						
Theater ID	Flight No.	UTC Date	UTC Time	Process Level	Sensor Type	[file format]
Antarctica (AN) + IcePod Deployment No. (##)	Flight Number 100# = No. Times Deployed in Same Season (1) + No. of Flight (00#)	YYYY MM DD of Sample Collection	HH MM SS of Sample Collection	Processing Level ID	Name or Abbreviation of Sensor Name for which this data belongs	Either .raw or .mat

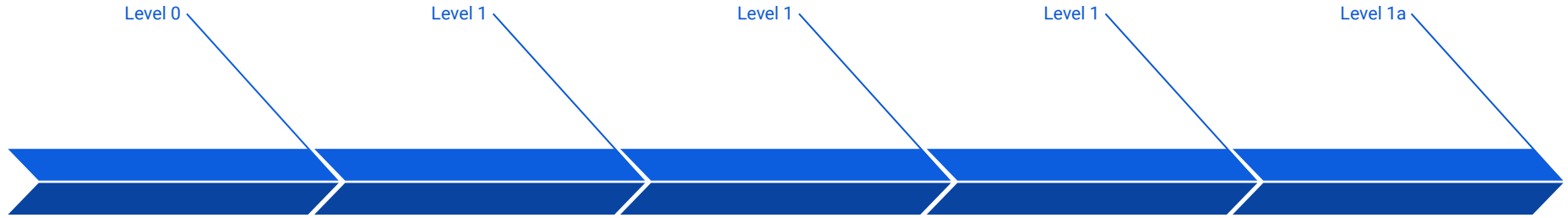
Line Data						
Campaign ID	ROSETTA-Ice Grid Line No.	UTC Date	UTC Time	Process Level	Sensor Type	[file format]
Rosetta (RS) + Project Deployment No. (##)	L for E-W Grid Lines T for N-S Tie Lines Grid Numbers increase by 10	YYYY MM DD of Sample Collection	HH MM SS of Sample Collection	Processing Level ID	Name or Abbreviation of Sensor Name for which this data belongs	Usually .mat

SIR Processing (sirProcess.m)

sirProcess.m is the top level function for processing Shallow Ice Radar data. This script calls all functions required to process selected lines. All configurations for processing are set in "sirProcessConfig.m".



SIR Processing (sirProcess.m)



sirProcessConfig

Configuration Settings: 2500ft elevation, dataPath, FFT type, Season Number, Sensor Type, Chirp Period & Bandwidth, GPS & PNT data, etc.

Reads 10-Second Raw .sir Files

sirFFTandMotionComp

Parse raw data, FFT, Geolocation, Motion Compensation, rvp correction, along-track dc signal removal, remove mean, stacking, etc.

Creates 1-Minute Level 1 Mat Files

sirPickSurf

Parse Level 1 Geolocated data, identify surface reflectors, generate index variable with location of reflectors in data.

Amends 1-Minute Level 1 Files

sirLineBreaker

Break 1-Minute Level 1 Files from Flights to Lines. Loads ROSETTA-Ice Line Segment File and splits accordingly.

Duplicates and Renames 1-Minute Level 1 Files

sirDecimateLevel1

Averages, decimates, and concatenates 1-Minute Level1 Files to create 5-Minute Level1a mat files for Bed Picking. Appends Filename w/ Frame No. 5-Minute Period determined in sirProcessConfig.m

Creates 5-Minutes Level 1a Files w/ Frame Number

Line Segment Files

These files are housed within season directories in a 'projectlines' directory. Line Segment files contain the start and end times of all ROSETTA-Ice Grid Lines and their associated Flights within the season. Initially written in ASCII format and then converted into .mat file to be read by processing scripts.

These files are named in the following format and contain the following information:

ICEPOD _ Season Years _ LINES . txt

- FlightNum
- LineNum
- StartUTCDate
- StartUTCtime
- StartUnixTime
- StopUTCDate
- StopUTCtime
- StopUnixTime
- StartLatitude
- StartLongitude
- StartH-EI
- StopLatitude
- StopLongitude
- StopH-EI
- Project

GPS & PNT Trajectory Files

These PNT & GPS Trajectory Files are collected from a Novatel Span SE L1/L2 GPS Receiver on board the IcePod, and processed using Reigl Software. SPAN processing generates ASCII format files, which are then converted into .mat for processing.

These files are named in the following format and contain the following information:

Theater ID _ Flight Number _ UTC YYYYMMDD _ Sensor Name _ Product Level _ Processing Profile . txt

- Datum (WGS84)
- Antenna Height
- Antenna Lever Arms
- Body to Sensor Rotations
- UTC Offset
- UTCTime (MM/DD/YYYY)
- UTCTime (sec)
- UTCTime (HHMMSS.sss)
- UTCTime (unixtime)
- Latitude (degrees)
- Longitude (degrees)
- H-Ell (meters)
- Pitch (degrees)
- Roll (degrees)
- Heading (degrees)

Picking Radar

Radar Picking uses MatLab scripts loosely based on MCoRDS Picking Scripts.

pickConfig.m

Data Input & Output Paths
Input: 5-Minute Mat Files
Frame Numbers
Start & End Files to Pick
Pick Type
Visualization Window
Additional Parameters

picker_Master.m

Filter Data
Window Data
Imports Config File
Setup Output File Structure
Auto Picker Selects Surface
Auto Picker Sets Horizon:
Rising, Falling, or Peak

Picked Data

Directory w/ Picker Name & Version of Pick

Frame-By-Frame JPGs:
No Picks & Picks Overlain

Frame-By-Frame .Mat Files:
All Variables from 5-Minute Mat Files

Stitched Survey Line .Mat Files
Lightly Reduced in Data.
Most Variables from 5-Min

Stitched Survey Line ASCII Files
“Essential” Variables For Distribution

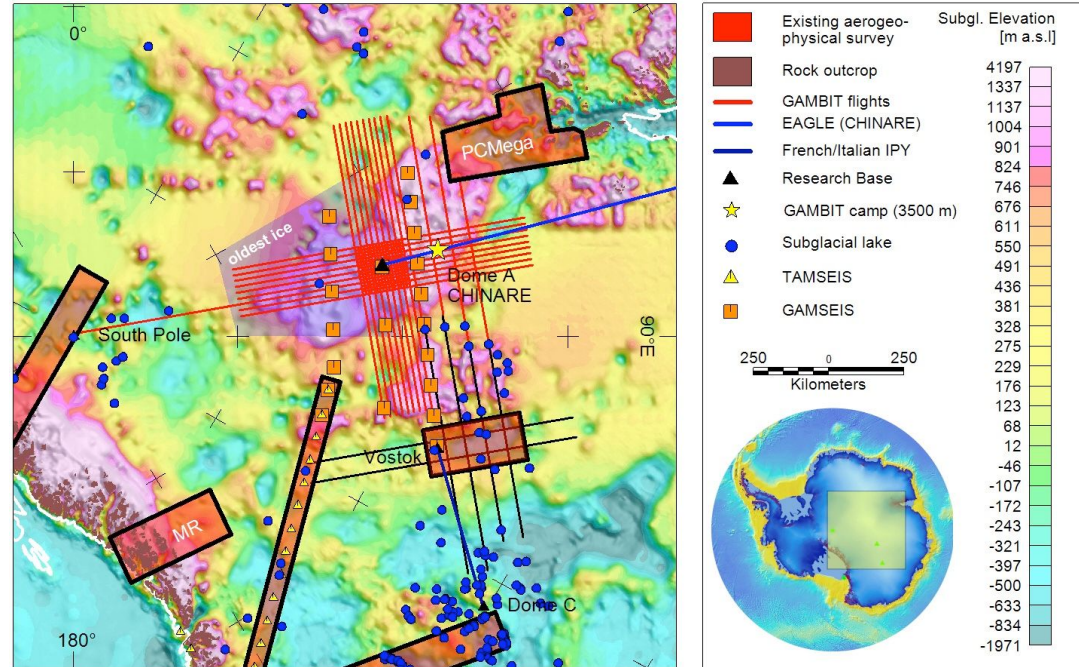
picker_ui.m

Enables Keystroke Toggling
Picking Boundaries / Params
Pick Vertices
Smooth Pick Lines
Delete Recent Pick Vertices

picker_display.m

Display Filters:
Greyscale, Differenced,
Greyscale Inverted, Smoothed
Figure Axes
Set Surface to Zero on Y-Axis
Along-track Distance (km)
Picking Borders / Params

AGAP-GAMBIT Project



AGAP-GAMBIT Radar (CReSIS?)

Ultra Wideband Radar

Bandwidth: 500 - 2,000 MHz | 600 - 900 MHz

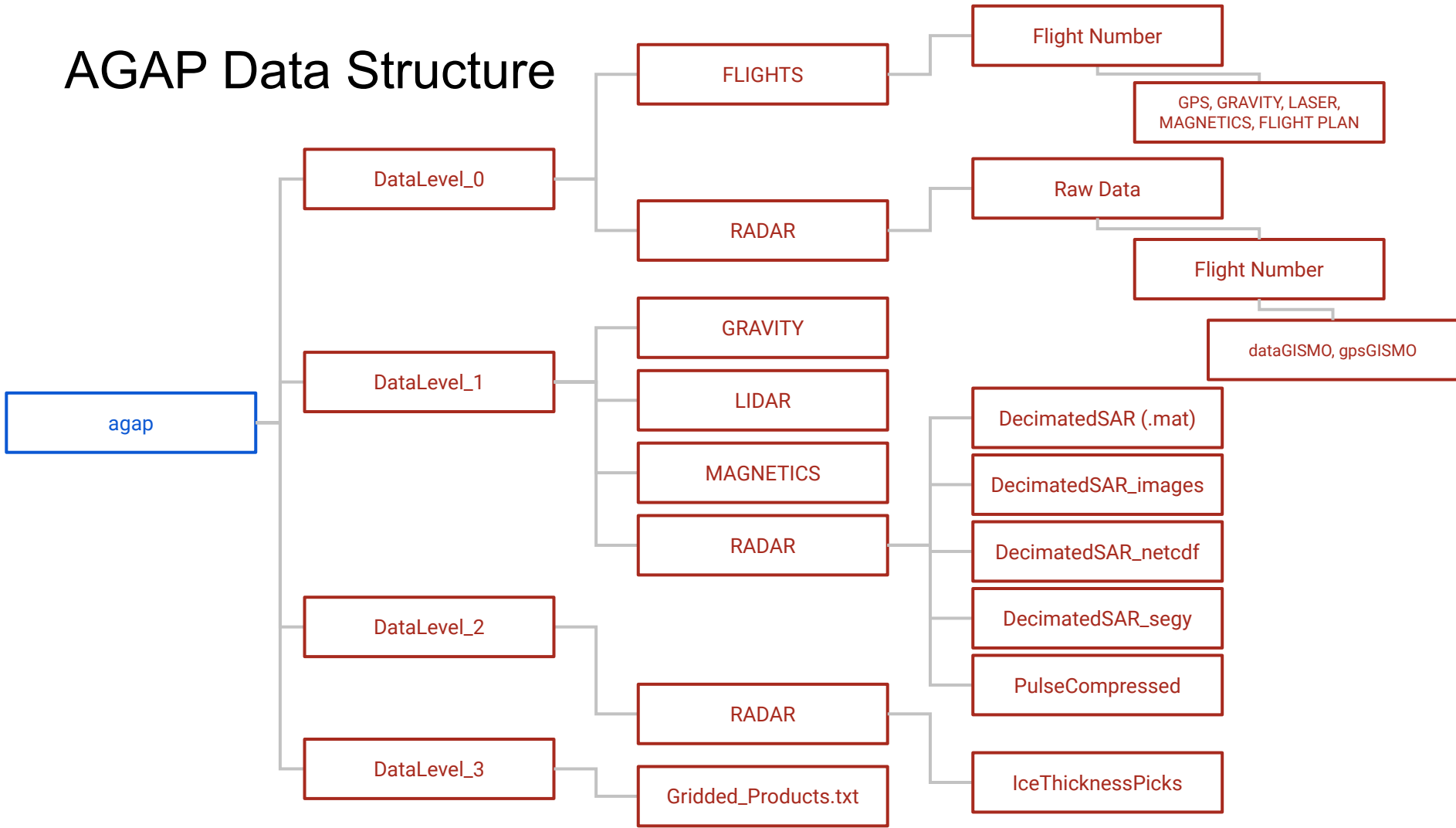
Center Frequency: 150 MHz

Resolution: Depth: 150 m at 0.1 m | Depth: 150 m at 0.6 m

Total Data Collected: 55,000 Line km

DataLevel_0		DataLevel_1		DataLevel_2			DataLevel_3
Level 0 Raw Data Signal Geolocated Data (MAT-Files) ~30 Second (?) Flight Data No Header		Level 1 (MAT-Files) Pulse Compressed (Unfocused) 1D - SAR Processed 1 Minute Flight Data & Survey Lines ReadMe Files Available		Level 2 Ice Thickness Picks Derived From Level 1 Product Consolidated Picks CSV, XYZ, SHP Line-By-Line Picks SHP			Level 3 Gridded Products Currently MIA
Raw Data (.raw)	Geolocated Data (.mat)	Pulse Compressed (.mat)	1D - SAR (.mat, .netcdf, & .segy)	Consolidated Picks (.csv, .xyz)	Consolidated Picks (.shp)	Line-By-Line Picks (.shp)	N/A
7.790 TB	← included	3.269 TB	504 GB	3.93 GB	3.60 GB	3.75 GB	N/A

AGAP Data Structure



All data is currently housed on an internal archive server called “hestia”
Maintains intricate, overly specific directory and file naming structure.

ROSETTA processing scripts are held on an internal GITLab server.

Select Data is hosted on an external server called “wonder” and can be accessed via [ROSETTA-Ice Data Page | PGG @ LDEO](https://pgg.ldeo.columbia.edu/data/rosetta-ice) (pgg.ldeo.columbia.edu/data/rosetta-ice) or [AGAP-GAMBIT | PGG @ LDEO](https://pgg.ldeo.columbia.edu/data/agap-gambit) (https://pgg.ldeo.columbia.edu/data/agap-gambit)

We do not currently have a map server or 3-D interpretation either
Alexandra Boghosian working to get ROSETTA radar into HoloLens...
So... maybe one day soon!

Seasons of data

Rosetta DICE - XX line km - YY TB

Rosetta SIR - XX line km - YY TB

AGAP? - XX line km - YY TB

Question about seasons: are formats and acquisition parameters the same for all seasons (but different for each radar) - I think this is the case

YES - not testing season, can adjust H-Ell window for high alt flights... don't need this detail likely

DICE

.mat files

File size

File segment duration (5 mins?)

SIR

.mat files

File size

File segment duration (5 mins?)

Processing scripts

- Done in matlab - master script and subscripts

- SIR and DICE data arranged in consistent project-specific format on server

- Data for RS seasons all in “version 2” (different from test seasons)

- How long to process a flight on regular server?

Processing inputs

- Data

- PNT trajectory - standard format we output for Rosetta (same each time - right?)

- Line endings table