MABEL L1B Release 010
Standard Data Product

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Introduction

Release 010 MABEL L1B products are created by Version 2.0.1 of the MABEL processing software.

This release note focuses on changes specific to the MABEL L1B products. Please see the **MABEL Release 010 Software Change and Release Note** (located in the MABEL Repository) for information regarding changes/improvements to the Release 010 L1B software.

The format of the Release 010 L1B Products has changed from Release 008. For this reason, the attribute "/identifier_product_format_version" has been updated to "2.0".

There are changes to the structure and content of the L1B product. The major changes include:

- The "gps_sec_offset" parameter was renamed to "granule_gps_epoch" to more accurately identify that value as a per-granule epoch. For ICESat-2, there will be a single "ICESat-2 Epoch" to which all time values within all granules are referenced.

- The "flight_parameters" group is now populated with HDF5 compact datasets (rather than attributes). The use of compact datasets allows the flight_parameters to be self-describing. This is not possible when using attributes.

- Additional "flight_parameters" information was added, including geolocation-related biases and placeholders for TBD laboratory-measured transmit efficiency and pulse shape information. Due to the way the HDF5 file is designed, the channel-associated arrays have dimensions of 50. The datasets "num_channels_532" and "num_channels_1064" identify the number of values filled within each array.

- Platform information was added under the "flight_parameters" to identify the platform (aircraft) to which MABEL is attached.

- Added a placeholder, within "flight_parameters" for a per-channel pulse shape. This is not currently filled with valid information.

- The "ancillary_data" group is now populated with HDF5 compact datasets (rather than attributes). The use of compact datasets allows the ancillary_data parameters to be self-describing. This is not possible when using attributes.

- Additional "novatel_ins" parameters were included to improve geolocation. In addition, since the format of the input Novatel INS file has changed several times over the course of MABEL operations, invalid values are used to indicate when certain data are not available. Check the "FillValue" attribute of each parameter to determine the "invalid value".

- Improved the descriptions of "delta_time_start" and "delta_time_stop" to indicate that the start times are inclusive and stop times are exclusive.

- Added "data_rate" attributes to each group in order to define the data rates of the parameters within each group.

- Descriptions of the several parameters were improved.

- Several metadata values were improved.

- Non-standard "standard_names" were removed.

Input Products

Release 010 MABEL L1A products and Interpolated Novatel INS L1A products are the primary inputs to L1B processing. The MABEL L1A product is described in the document **MABEL Release 010 L1A Standard Data Product** located in the MABEL repository. Documentation for the Novatel INS L1A input product is TBD.

Repository

The MABEL data, documentation and example code are available at the following URL:

> http://icesat.gsfc.nasa.gov/icesat2/data/mabel/mabel_docs.php

Access Constraints

The following access constraint statement was approved by the ICESat-2 Project Office and included in the Metadata of each product file:

"Data may not be reproduced or distributed without including the CitationForExternalPublication for this product included in this Metadata. Data may not be distributed in an altered form without the written permission of the ICESat-2 Science Project Office"

MABEL L1B Data Usage

MABEL L1B HDF5 files contain the calibrated range measurements by channel, Novatel INS parameters, metadata extracted from the day-by-day flight log and QA (Quality Assurance) statistics for some of the parameters. These data are organized within HDF Groups. A product data description follows later in this document. The L1B calibrated range is the L1A raw range minus channel-specific fiber lengths. Other corrections to range may be needed but not known at the present time.

This product is considered preliminary and of limited use to the general public. In general the MABEL data is very clean, consistent and should be excellent for use after calibration and location are applied.

The L1B Release 010 data product could be used for people to learn how to access data from an HDF5 file and to provide the development team comments on missing items, ways to improve the groupings, and improving the descriptions. The geolocated data have a different grouping and any user of MABEL data will likely desire to have the location and calibrated elevations that are present on the L2A product. This product is also an initial prototype of ICESat-2 data and comments are welcome.

MABEL L1B Data Notes

Release 010 products have the following notes/caveats:

1. L1B data files were generated from Release 010 L1A data files. All errors/caveats applied to the L1A data equally apply to L1B. Please see the corresponding **MABEL**

Release 010 L1A Standard Data Product document. This document is located on the MABEL repository.

2. Some L1A products were not created due to errors in the data or errors in the processing code. The corresponding L1B products are missing as well.

3. The L1B ranges are corrected for channel-specific fiber lengths, but other channel biases may still exist. Future missions may perform full path-length calibrations.

4. The L1B data are not corrected for aircraft motion or beam angle. This correction occurs during L2 processing. Geolocated data are present on L2+ products.

File Naming/Versioning

The MABEL H5 file naming convention is as follows:

```
mabel_LLL_YYYMMDDTHHMMSS_RRR_V.h5
```

Where:

LLL=level of product (ie: l1a, l1b)

YYYMMDD=year month day of requested granule start time

HHMMSS=hours minutes seconds of requested granule start time

RRR=Release number (further explained below)

V=Version number (further explained below)

Example:

mabel_l1b_20101211T004500_010_1.h5

The MABEL product versioning scheme uses Release and Version numbers. The Release is an instance of the MABEL product corresponding to a specific version of the MABEL processing software. (For example, the Release 010 MABEL L1B products were created by the V2.0.1 MABEL processing software.) The version field specifies the instance of the Release processed/reprocessed by the same version of software.

Example Code

Example IDL and Fortran code is provided at the MABEL repository.

L1B Product Data Description

The HDF5 file is hierarchically structured with groups for Metadata, Ancillary Data, Quality_Assessment, Flight_Parameters, Range, and Novatel_INS data. The Range group is further sub-divided by channel number. The Novatel_INS group is sub-grouped to reflect the data grouping of the source Novatel INS file.

Data rates of individual groups differ, so the delta time (time since the start of the file) is stored within each group to enable time-alignment of data within different groups. Storing different-rate data within separate groups allows us to avoid the issue of fill data and saves significant amounts of storage space (a real issue with large data sets such as this).

For each data Group, parameters are stored in individual HDF5 datasets. The reason for this is that using separate datasets allow us to attach parameter-level metadata attributes to each parameter. If the parameters were stored in the same dataset, it would be more difficult to attach the metadata attributes.

The HDF5 file is configured for HDF5 chunking and internal gzip compression.

Data Groups

The HDF5 groups are as follows (derived from h5ls –r file l grep Group). METADATA subgroups have been edited for brevity.

```
/                           Group
/METADATA                   Group
/METADATA/COLLECTIONMETADATA Group
/METADATA/INVENTORYMETADATA Group
/ancillary_data             Group
/ancillary_data/general     Group
/flight_parameters          Group
/housekeeping               Group
/novatel_ins                Group
/novatel_ins/attitude       Group
/novatel_ins/covariance     Group
/novatel_ins/ecef           Group
/novatel_ins/flags          Group
/novatel_ins/geolocation    Group
/novatel_ins/rms            Group
/novatel_ins/solar_angle    Group
/novatel_ins/sta            Group
/novatel_ins/time           Group
/novatel_ins/velocity       Group
/quality_assessment         Group
/quality_assessment/along_track Group
/quality_assessment/along_track/channel Group
/quality_assessment/packet_counts Group
/quality_assessment/packet_counts/channel Group
/quality_assessment/summary Group
/quality_assessment/summary/channel Group
/range                      Group
/range/channel              Group
/tof                        Group
/tof/osc_corr               Group
/tof/status                 Group
```

Parameter-Level Metadata

The following attributes are attached and filled for each parameter. Some of these attributes may seem redundant but are present for future NetCDF/CF convention compliance.

Name	Description
Coordinates	Field to be used on x-axis for plotting. (Placeholder for future NetCDF/CF compliance.)
Datatype	The HDF5 data type
Description	Description of data parameter
contentType	ISO content type classification
Label	HDF5 label identifying the data element.
Long_name	Descriptive name (useful for plot labels)

Name	Name of data parameter
Rank	Number of array indices (one-dimensional array=rank 1, two-dimensions=rank 2)
Source	Source of data parameter. Includes computational details, if appropriate.
Standard_name	CF-compliant standard name
Units	Physical units of data

Granule-Level Metadata

The metadata, flight_parameters, quality_assessment, and range groups contain metadata, flight parameters, quality assessment, and calibrated derived range parameters, respectively. Within the range group, there are subgroups (channelxx) for each channel of data detected. The Novatel_ins group is subdivided into grouped-elements based on the format of the INS input file.

Parameter-Level Metadata

The following attributes are attached and filled for each parameter. Some of these attributes may seem redundant but are present for future NetCDF/CF convention compliance.

Granule-Level Metadata

Granule-level metadata is a mixture of ECHO-style structured metadata and CF-style global attributes. The structured metadata is more complete and computer-friendly; the global attributes are simpler and more human-friendly. Data users are encouraged to use global attributes whenever possible since the structured metadata will be replaced by ISO19115 equivalents in a future release.

Data Dictionary

HTML and PDF versions of the L1B data dictionary are provided at the MABEL repository:

http://icesat.gsfc.nasa.gov/icesat2/data/mabel/mabel_docs.php