

MABEL L2A Release 008

Standard Data Product

Version 1.0, 10/24/2012

David W. Hancock III, Jeffrey E Lee

Introduction

Release 008 MABEL L2A products are created by Version 1.6 of the MABEL processing software.

This release note focuses on changes specific to the MABEL L2A products. Please see the **MABEL Release 008 Software Change and Release Note** (located in the MABEL Repository) for information regarding changes/improvements to the Release 008 L2A software.

The format of the Release 008 L2A Products has changed from Release 007. For this reason, the "l2a_format_version" global attribute has been updated to "1.2".

There are changes to the structure and content of the L2A product. The major changes include:

- Metadata has been totally revamped to include ECS-style structured metadata as well as enhanced CF-style global attributes. Product users are encouraged to use the CF-style global attributes whenever possible since the ECS-style metadata will be replaced by ISO19115-style metadata in a future release. The relevant attributes within the structured metadata are duplicated in the global attributes.
- The "flight_parameters" group is now HDF5 attribute-based (as opposed to dataset-based).
- Most attributes are now lower case and (in many cases) include a corresponding description (_desc).
- The L1B HDF5 products should be readable with NetCDF software.
- Dimension scales (DS*) have been added to improve NetCDF compatibility. Dimension scales define array dimensions in terms of a physical measurement. Dimension scale datasets begin with "DS".
- The "ancillary_data" group was created to span the gap between metadata and science parameters. This group is attribute-based, may contain subgroups, and contains such information as MABEL constants, temporal span of the granule, geographical span of the granule, and various parameters used during generation of the product.
- The granule epoch (gps_sec_offset) is now an attribute attached to "ancillary_data".
- The "quality_assessment" group has been reorganized to use arrays instead of single datasets for multi-statistic parameters (ie: counters, min/mean/max/stdev). A dimension scale (DS_packet_counts, DS_statistics) is provided to identify each array dimension.
- Improved geolocation. The ICESat-2 Project Science Office provided improved calibration values computed by analyzing calibration maneuvers performed during the Greenland/Iceland flights.

- Significantly improved multi-source DEM. The DEM value is now taken from the “best available” selection from (in order) GIMP, GMTED2010, DTU10 mean sea surface, or EGM96. The “dem_flag” dataset indicates the source of each DEM measurement.
- Added a reference track location indicating the nadir position of the aircraft.
- The improved DEM has enabled the incorporation of a smaller photon range window. This range window adjusts according to land/water determination. For land, the range is -100 to +1000m about the DEM. For water, the range is -100 to +100m about the DEM. This should reduce the size of the L2A granules.
- A per-shot noise rate value, determined using the number of photons within a noise range window, has been added.
- A preliminary relative apparent reflectance value has been added. This parameter has not been fully validated.

Input Products

The primary inputs to MABEL L2A data are the Release 008 MABEL L1B products, multiple DEMs, and sub-setted Meteorological GRIB files. The input MABEL L1B product is described in the document **MABEL Release 008 L1B Standard Data Product** located in the MABEL repository

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 L2A Data Usage

The L2A Release 008 data product is useful for scientists who wish to learn how to use altimeter photon counting instrument data. It is also useful as an example of HDF5-formatted aircraft data and can serve as a basis for development team comments regarding missing items, ways to improve the groupings, and improving the descriptions.

This product is also an initial prototype of ICESat-2 data and comments are welcome.

MABEL L2A Data Notes

Version 8 products have the following notes/caveats:

1. L2A data files were generated from Release 008 MABEL L1B data files. All errors/caveats applied to the L1B (and L1A) data equally apply to L2A. Please see the

corresponding **MABEL Release 008 L1B Standard Data Product** document. This document is located in 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 and L2A products are missing as well.
3. Transmit time was not applied to the UTC time in the computation of location. It will be included future releases
4. The included Apparent Reflectance computation is considered preliminary. It has not been fully validated.
5. The ICESat-2 Project Science Office provided improved calibration values computed by analyzing calibration maneuvers performed during the Greenland/Iceland flights.
6. photon_id is implemented as channel number, shot number and a received photon counter which resets to 0 when the shot_num increments. This combination of parameters should be sufficient to identify each photon individually.
7. The Altimeter window for reporting elevations over land is 1 km above and 100 m below the reference DEM. The Altimeter window for reporting elevations over water is 100 m above and 100 m below the reference DEM. The aircraft nadir lat and long from the reference track is used for the DEM measurements for all channels.
8. The L2A data are corrected for aircraft motion and beam angle.
9. Altimeter histograms of 3 meter bin size are for 500 meters above and 100 meters below the DEM computed for every 200 MABEL shots. These have not been fully evaluated.
10. Atmosphere histograms of 30 meter bin size are for 14 km above and 1 km below the DEM computed for every 400 MABEL shots. These have not been fully evaluated.

File Naming/Versioning

The MABEL H5 file naming convention is as follows:

```
mabel_LLL_YYMMDDTHMMSS_RRR_V.h5
```

Where:

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

YYMMDD=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_l2a_20101211T004500_008_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 008 MABEL L2A products were created by the V1.6 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.

L2A Product Data Description

The HDF5 file is hierarchically structured with groups for Metadata, Ancillary Data, Quality Assessment, Flight Parameters, Altimetry, Atmosphere, Photon, Novatel_INS, TOF, and MET (Meteorological) data. The Altimeter and Atmosphere groups are further sub-divided into measurement-specific groups. The Photon group is sub-divided into channel groups. The sub-groups are described in detail below.

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).

The Altimeter and Atmosphere groups are summaries of segments of data based on a pre-determined number of shots. Start and End Delta times for each segment are stored within the Time subgroup in each respective group.

For each data Group, parameters are stored in individual HDF5 datasets. Using separate datasets allows 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.

For each informational Group (Metadata, Ancillary Data), parameters are stored as group-attached attributes. The HDFGroup recommended the use of attributes since they are more appropriate for informational data.

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 | grep Group`). METADATA subgroups have been edited for brevity.

```
/ Group
/METADATA Group
/METADATA/COLLECTIONMETADATA Group
/METADATA/INVENTORYMETADATA Group
/altimetry Group
/altimetry/app_refl Group
/altimetry/app_refl/channelxxx Group
/altimetry/dem_drm Group
/altimetry/histogram Group
/altimetry/histogram/channelxxx Group
/ancillary_data Group
/ancillary_data/apparent_reflectance Group
/ancillary_data/general Group
/ancillary_data/geolocation Group
/ancillary_data/histograms Group
/ancillary_data/photon_range_window Group
/ancillary_data/segment_sizes Group
/ancillary_data/streak_removal Group
/atmosphere Group
/atmosphere/histogram Group
/atmosphere/histogram/channelxxx Group
/flight_parameters Group
/met_corr Group
/novatel_ins Group
```

```

/novatel_ins/attitude      Group
/novatel_ins/flags         Group
/novatel_ins/geolocation   Group
/novatel_ins/location      Group
/novatel_ins/solar_angle   Group
/novatel_ins/time          Group
/photon                    Group
/photon/channelxxx         Group
/quality_assessment        Group
/quality_assessment/channel Group
/quality_assessment/channel/channelxxx Group
/quality_assessment/summary Group
/tofl                       Group
/tofl/osc_corr             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
Hertz	Nominal data rate of parameter
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

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.