

# Notes and Errata Regarding the PDS3-to-PDS4 Migration of Deep Space Program Science Experiment (Clementine-1) Data Archived at the PDS Geosciences Node

PDS Geosciences Node

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## Notes

All Clementine-1 data sets are archived as part of NASA's Planetary Data System (PDS). These data sets were originally archived under the PDS3 standard, and the PDS Nodes hosting Clementine-1 archives are actively migrating these archives to the PDS4 standard. Hereinafter, these notes apply specifically to the Clementine-1 gravity and topography models and lidar archives at the PDS Geosciences Node.

All data products in these archives at the Geosciences Node are already PDS4-compliant, so there was no need to alter the data files. The PDS3 archive volumes remain intact; no files have been removed. The only two changes are (1) minor edits to aareadme.txt and (2) the addition of PDS4 labels and documentation files. The minor edits to aareadme.txt comprise (a) the addition of a brief note at the beginning of the file directing the reader to the PDS4 readme file in the bundle root directory and (b) updates to the contact information for the Geosciences Node. In the data directories, the metadata in PDS3 labels have been copied to PDS4 labels, so that each data product now has both a PDS3 and a PDS4 label.

Instead of the data sets and archive volumes in PDS3, products in PDS4 are organized into collections and bundles. A collection is a set of related products, which may be data products, document products, browse products, miscellaneous products, etc. A bundle is a set of related collections.

For these Clementine-1 archives, a PDS4 bundle has been defined for each of the two PDS3 volumes. Each bundle has one or more data collections and one or more document collections. The LIDAR bundle also has a miscellaneous collection that holds the PDS3 index table. The table below shows the correspondence between PDS3 volumes and PDS4 bundles.

### ***PDS4 Bundles and Corresponding PDS3 Volumes and Data Sets***

<b>Archive</b>	<b>PDS4 Bundle LID</b>	<b>PDS3 Volume ID</b>	<b>PDS3 Dataset ID</b>
Gravity and Topography Models	urn:nasa:pds:clementine1_gravity_and_topography	CL_8XXX	CLEM1-L-RSS-5-GRAVITY-V1.0, CLEM1-L-LIDAR-5-TOPO-V1.0
LIDAR Data	urn:nasa:pds:clementine1_lidar	CL_9XXX	CLEM1-L-LIDAR-3-TOPO-V1.0

A bundle is identified by a file named bundle\_\*.xml (where \* is some character sequence) in the root directory of a volume; this PDS4 label describes the bundle and lists the collections that belong to it. A collection, in turn, is identified by a PDS4 label named collection\_\*.xml in a subdirectory. The file collection\_\*\_inventory.csv is found in the same directory as the collection label and lists the products that belong to that collection. Each product also has its own PDS4 label named \*.xml.

Every bundle, collection, and product in PDS4 has a Logical Identifier (LID) that is guaranteed to be unique throughout the PDS. The LID is defined in the PDS4 label using the <logical\_identifier> tag. For data products, the LID is analogous to PRODUCT\_ID in a PDS3 label.

Not every PDS3 component has a PDS4 counterpart. Namely, PDS3 readme (aareadme.txt), volume description (voldesc.cat), catalog info (catinfo.txt), map (dsmap.cat), person (person.cat), document info (docinfo.cat), and index info (indxinfo.txt) files do not have PDS4 labels. The PDS4 readme (readme\_\*.txt) file has no separate PDS4 label, but is referenced by the bundle file.

## Errata

The following errors and anomalies were discovered during the migration process. If errors were found in the original PDS3 labels, they were corrected in the PDS4 labels where possible. If errors were found in the data files, they were left unchanged.

1. **Model grid storage scheme.** All gravity and topography models are stored as grids with the southwest corner (near 90° S, 0° E) first, after which values are stored sequentially eastward until reaching the southeast corner (near 90° S, 360° E), at which point the stored sequence advances northward by a grid cell height and values are again stored sequentially eastward from 0° E. Additionally, values are bundled into blocks of 10, so that the values for a single latitude span multiple lines. The details of this storage scheme were not included in the original PDS3 labels but have been added to the PDS4 labels, for clarity and completeness.
2. **Vertical orientation of model images.** This west-to-east then south-to-north storage also extends to the image versions of the models. Although the primary west-to-east ordering is conventional, the secondary south-to-north ordering is opposite the standard convention. By default, these images would therefore appear south-up. To override this default behavior, the <disp:vertical\_display\_direction> in each image's PDS4 label is set to Bottom to Top. At the time of writing, this display setting is honored by both PDS4 Viewer v1.3 ([https://sbnwiki.astro.umd.edu/wiki/PDS4\\_Viewer](https://sbnwiki.astro.umd.edu/wiki/PDS4_Viewer)) and the Geospatial Data Abstraction Library (GDAL) v3.6.1 (<https://gdal.org>). Software that do not honor <disp:vertical\_display\_direction> will display these images as south-up and any associated coordinates may be incorrect.
3. **Standard reference sphere for model images.** All image products are stored as latitude–longitude grids. For images of the two topography models (topogrd1.img and topogrd2.img), these grids were associated with a slightly oblate spheroid of equatorial radius 1738 km in the PDS3 labels, and for images of all gravity models (\*.img), the grids were associated with a sphere of radius 1738 km in the PDS3 labels. In the <cart:Cartography> section of the PDS4 labels, we have replaced both of these reference ellipsoids with the standard International Astronomical Union (2015) lunar sphere, with radius 1737.4 km. We also updated the <comment> in the <File\_Area\_Observational> section correspondingly. The data were not modified.
4. **UTC time missing trailing “Z”.** The first field of each LIDAR data table contains a UTC date-time but lacks the trailing “Z” character required in PDS4 for ASCII\_Date\_Time\_YMD\_UTC. Therefore, these fields are instead identified as ASCII\_Date\_Time\_YMD.
5. **Asterisks in LIDAR tables.** Each LIDAR data table contains some values that are stored only as asterisks, such as “\*\*\*\*\*”. In total, 372 lines have such all-asterisk values, and each affected line has the all-asterisk values in the same four fields: right ascension, declination, twist, and predicted slant range. The affected lines represent 0.3% of all 107,558 records across the four LIDAR data tables, and most (93.5%) affected lines occur in one of two uninterrupted blocks:

1994-03-24T18:55:03.924 to 1994-03-24T19:06:19.882 and 1994-05-02T01:20:13.975 to 1994-05-02T01:50:37.448.