

Recommendation for using MESSENGER DEMs with ISIS3 and GDAL-based Applications

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USGS

Differences in PDS and ISIS3 Cartographic Systems [1]

There several differences among the data formats and their respective definition of the map reference exist. These are: a) PDS and VICAR define the map reference in the image coordinate system with the y values increasing in line direction (down) and the x values increasing along the column direction (right). b) ISIS cube and GeoTiff define the position of the top left pixel in map coordinates of the respective map projection – where the map coordinate system originates in the map projection center and the y axis is pointed up (North) while the x axis is point to the right (East). c) Though the image coordinate $x=1$, $y=1$ is assigned to the center of the top left pixel among all mentioned file formats – PDS, Vicar, ISIS cube, and GeoTiff –, the point of reference in the PDS/VICAR format is the center of the top left pixel (image coordinates 1,1) while the point of reference for GeoTiff and ISIS Cube files is the actual edge of the image at the top left corner pixel (image coordinates 0.5, 0.5) (cf. Figure 1).

These definitions make a number of transformations necessary that need to be performed in the correct order. Otherwise a transformation results in a faulty translation of the map reference parameters between different file formats. This was in fact the case when importing a standard PDS map projected MOLA reference DTM into the USGS Isis software leading to the remaining one line and one sample offset between the data sets as mentioned before. An independent software strictly following the documented definitions was implemented which revealed the error in the mathematical realization of the reference transformations. The erroneous translation was communicated to the USGS and to the Geospatial Data Abstraction Library (GDAL), a commonly used translator library for geospatial raster and vector formats, that applied the same transformation parameters. GDAL already corrected their software implementation.

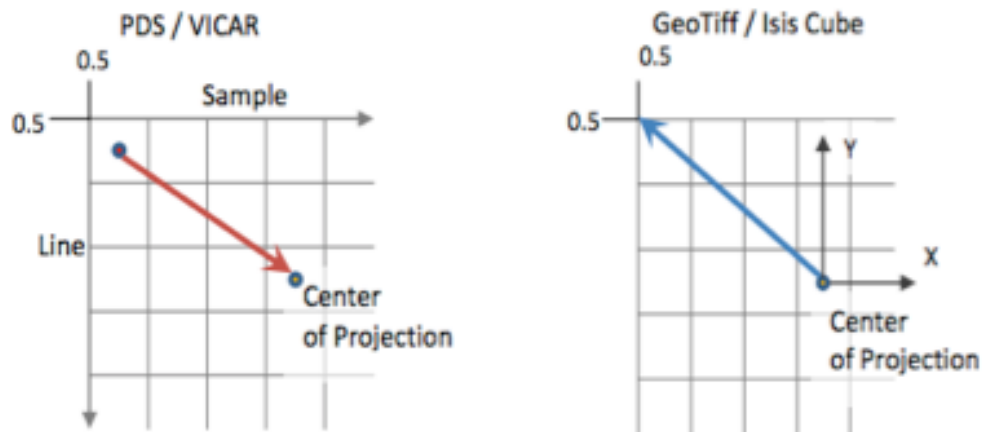


Figure 1. This figure shows the difference mapping schemes of PDS/VICAR and ISIS/GDAL.

(1) PDS image files (*.IMG):

Due to a PDS pixel offset anomaly (one pixel offset in both line and sample axis) within the ISIS3 PDS reader (prior to version 3.4.x??) and GDAL-based PDS reader (prior to version 1.11.4 and 2.0.2), use of the accompanying ISIS3 detached labels is recommended instead of the PDS label (see background below). To use the ISIS3 labels, simply copy the ISIS3 detached labels (along with related history files, from: EXTRAS/ISIS/) within the same directory as the associated PDS images.

For example, from this directory,
EXTRAS/ISIS/

copy the files MSGR_DEM_USG_EQ_I_V01.IMG.HISTORY.ISISCUBE and MSGR_DEM_USG_EQ_I_V01.IMG.LBL into this directory: DEM\GLOBAL\IMG

Now within ISIS3 or the GDAL-based applications, open the file MSGR_DEM_USG_EQ_I_V01.IMG.LBL to read the image.

(2) GeoJpeg2000 image files (*.JP2)

Due to the same offset issue discussed above, it is recommended for applications which support the GeoJpeg2000 format to use the *.JP2 files directly. The internal registration method within the GeoJpeg2000 format can be used independent of the PDS label. Thus, even though GDAL-based applications can load a Jpeg2000 image using the available PDS label, it is not currently recommended for applications using GDAL-base applications prior to GDAL version 1.11.4 or 2.0.2.

GeoJpeg2000 users should also rename the available *AUX.XML files to *.JP2.aux.xml. PDS (version 3) does not allow multiple file name extensions for archival so these file names must be manually updated by the user. For example, rename (before loading JP2 image into application): MSGR_DEM_USG_EQ_J_V01_AUX.XML to MSGR_DEM_USG_EQ_J_V01.JP2.aux.xml
This GDAL auxiliary file helps to more fully define the GeoJpeg2000 file (e.g. define NoData).

Background

All PDS labels in this archive contain correct values (pixel units) for projection offset keywords. However, in 2015, a PDS (version 3) pixel offset bug was found in the Integrated Software for Imagers and Spectrometers (ISIS3) and Geospatial Data Abstraction Library (GDAL). Because GDAL is used in several applications, this bug is also found in QGIS, Esri's ArcMap 10.4.x (and previous versions), Esri's ArcGIS Pro 1.0, and other GDAL-based applications.

For ISIS3, the issue was patched for the March 2016 release 15. If you are unable to upgrade to this version (or higher) of ISIS3, please use the recommendation above.

For GDAL, this issue was patched in September 2015 and pushed into GDAL versions 1.11.4 and 2.0.2. (<http://trac.osgeo.org/gdal/ticket/5941>). Applications built from these version (or higher) should be correct. Otherwise, or if you are unsure of version status, please use the recommendation above.

References:

[1] <http://www.hou.usra.edu/meetings/lpsc2016/pdf/1812.pdf>