Landsat Ecosystem Disturbance Adaptive Processing System (LEDAPS)

U.S. Geological Survey (USGS)

Earth Resources Observation and Science Center (EROS)

Sioux Falls, South Dakota, U.S.A.

LEDAPS Release Notes

=====================

LEDAPS 3.3.0 (March 7, 2018 – USGS EROS)

Overall

- Removed the ancillary Level-1 files (VER, GCP)
- Removed Pre-Collection processing code

=====================

LEDAPS 3.2.2 (January 17, 2018 – USGS EROS)

Overall

- Clarified the brightness temperature modifier as "top-of-atmosphere".

=====================

LEDAPS 3.2.1 (August 15, 2017 – USGS EROS)

Overall

- Clarified the error message for solar angles that are greater than 76 degrees. These are flagged as being too large for surface reflectance processing, but removed the phrase that indicated they are out of range.

=====================

LEDAPS 3.2.0 (June 1, 2017 – USGS EROS)

Overall

- Updated the XML short_name to support a 4-digit instrument identifier.

=====================

LEDAPS 3.1.3 (May 11, 2017 – USGS EROS)

Overall

- Supported --version for the applications and script.
- Fixed input.c in lndcal and lndsr to correctly handle the input data errors by returning false instead of true from the GetXMLInput function.
- Updated Makefiles to catch build errors in the for loops.

=====================

LEDAPS 3.1.2 (March 30, 2017 – USGS EROS)

Overall

- Modified lndpm to skip the auxiliary data checks if processing TOA/BT only, since the auxiliary data files are not needed for TOA/BT processing.
- Updated do_ledaps.py to support the above change to lndpm by passing in the flag for TOA/SR processing.
- Per-pixel angle bands are masked to match the band quality image extents, and therefore fill pixels in the band quality are masked as fill pixels in the per-pixel angle bands.
- Removed the "pull the sixs path from the lndsr executable" code. All our scripts and applications require called scripts and applications to be installed in the PATH, so the whole set and get sixs path functionality is not required. It was also problematic in the Docker environment.
- Updated the short_name and long_name for the RADSAT band to be more specific to RADSAT and consistent with L8 RADSAT.

=====================

LEDAPS 3.1.0 (February 3, 2017 – USGS EROS)

Overall

- Updated lndcal to change the band 6 brightness temp filenames to use bt_band6 instead of toa_band6.
- Updated lndcal to combine the TOA QA and band 6 QA (which identify fill and saturated pixels) into one QA band. In this case, any pixel that has fill for any band will be marked as fill. Previously reflectance and thermal fill values were treated separately.
- Updated lndsr and lndsrbm to use the new brightness temp band name.
- Updated lndsr to only read the single QA band and not expect two QA bands.

=====================

LEDAPS 3.0.0 (January 24, 2017 – USGS EROS)

Overall

- Updated lndcal to utilize the new Level-1 band names which were changed in espa-product-formatter to be more consistent with the Level-1 naming convention.
- Updated do_ledaps.py to identify Collection products and call the associated applications with the --process_collection command-line argument. If processing Collection products, then the per-

pixel angle bands are generated for band 4. This is the representative band for the per-pixel angle bands.

- Modified lndcal to utilize the per-pixel angle bands for the representative band in the TOA corrections for Collection products. These TOA-corrected products are fed into the lndsr code for surface reflectance corrections.

=====================

LEDAPS 2.8.0 (October 26, 2016 – USGS EROS)

Overall

- Updated lndsrbm.ksh with lndsrbm.py to provide better script handling and error checking.
- Added multithreading for lndsr, including a few other minor changes to improve performance.
- The number dark (NB_DARK), average dark (AVG_DARK), and standard deviation dark (STD_DARK) QA bands are not output and therefore have been removed since they are not used within the source code. line_ar_stats was used to feed these QA bands and that has been removed as well.
- Added support for the new QA band for Collection products, which is a bit-packed band.

=====================

LEDAPS 2.7.0 (July 29, 2016 – USGS EROS)

Overall

- Updated the valid_range to be a floating point versus long to match the new data type in the XML schema.
- Change scene_id to product_id in the output XML to match the new schema.
- Verified the code supports Albers for CONUS, Hawaii, and Alaska.
- Verified the code support for the new 4-character product type collection filenames.

=====================

LEDAPS 2.6.0 (May 16, 2016 – USGS EROS)

Overall

- Confirmed the L1T filenames are supported for both the legacy L1T filenames as well as the new Landsat Collection filenames.
- The SrInterpAtmCoef function in sr.c spends time computing 13 coefficients for the current pixel, however 4 of those coefficients are not used in the application (td_r, tu_r, S_r, rho_r). Instead, the coefficients from the 6S table are used for these variables. Therfore the interpolation of these variables is commented out to save processing time.
- The lndcal application handles "zooming" the thermal bands to the same resolution as the reflectance bands. This code is obsolete, given that the thermal and reflective bands are all the same resolution. The code which handles the zooming has been pulled from lndcal for easier maintenance.

======================

LEDAPS 2.5.0 (March 02, 2016 – USGS EROS)

Overall

- Removed calibrated_nt from being written for the band metadata (not used).
- Updated to support Albers products in addition to the current UTM and PS.
- Modified lndsrbm to call GCTP forward and inverse functions instead of duplicating the needed functions and defines from GCTP locally. This makes maintenance easier and addition of new projections cleaner. (Involves LS_geoloc.c and LS_geoloc_driver.c which generate geo2xy and xy2geo.)
- Updated to support the new L1T file naming convention.

======================

LEDAPS 2.4.0 (December 03, 2015 – USGS EROS)

Overall

- Updating scripts (LEDAPS apps and LEDAPS auxiliary apps) to use Python logging (originally print statements).
- Flagged scenes in lndsr with a solar zenith angle above 76 degrees as not able to process through to surface reflectance. These scenes can be processed through to TOA and BT (lndcal), however surface reflectance results for these low solar elevation angles are not reliable (lndsr). Also added a note in the do_ledaps.py script to indicate users should use process_sr=False for these scenes.
- Removed log file from lndpm (LogReport) since nothing was written to it.
- Removed --usebin from do_ledaps.py as the LEDAPS executables are expected to be in the PATH.
- Updated the Makefile.
- Updated RPM support.
- Provided top-level surface-reflectance script helper for ESPA processing.

======================

LEDAPS 2.3.1 (September 28, 2015 – USGS EROS)

Overall

- Indcal flags saturated pixels however lndsr processes those pixels the same all other valid pixels. Modifying lndsr to detect saturated pixels, flag them in the output product as such, and keep track of the number of saturated pixels in the lndsr stats output to the screen.
- Modified the update auxiliary files scripts (updatencep.py and updatetoms.py) to retry the file download in the event the wget fails.
- Updated convert_ozone.c to handle both OMI and pre-OMI lat/long min/max and step values instead of flagging OMI values as "unexpected". Added the scripts to the install section of the Makefile.

======================

LEDAPS 2.3.0 (May 13, 2015 – USGS EROS)

Indcal

- Modified the lndcal application to fix a round/up round down error. This will cause some scenes to have a difference by one when comparing to previously processed scenes.
- Modified lndcal to utilize the TOA reflectance coefficients and the thermal constants from the XML file if they exist (for post March 17th scenes). This causes differences by 1 in most of the bands, except band 6. Bands 1,2,3 sometimes have a little higher difference (i.e. up to a difference of 4 from my testing) when comparing to previously processed scenes.

======================

LEDAPS 2.2.1 (January 21, 2015 – USGS EROS)

Overall

- Fixed the reversed descriptions of the QA bands (except for land/water which was correct). This correct the values in the XML file, which then get duplicated in the HDF SDS attributes if the user requests a conversion to HDF.

======================

LEDAPS 2.2.0 (December 23, 2014 – USGS EROS)

Overall

- Modified the XML file to remove "fill_value" from the QA band metadata.
- Modified the XML file to add "<resample_method>."
- Added a check to the updatencep application to make sure the input NCEP variables are floating
- point and not int16, to better support the latest changes of NCEP products and to catch if the oldstyle
- NCEP products somehow enter the production stream.

======================

LEDAPS 2.1.0 (October 29, 2014 – USGS EROS)

Overall

- Switched the ANC_PATH environment variable name to LEDAPS_AUX_DIR to be more consistent with the Landsat 8 auxiliary pathname and to better identify the environment variable points to the LEDAPS auxiliary data.

lndsr

- Updated to modify the interpolation of the cloud diagnostics, particularly in areas of heavy cloud cover where the auxiliary 2m air temp values are needed/utilized to assist in the cloud and snow cover assessment. In these areas, the average band6 temperature is not available due to the lack of clear pixels from heavy cloud cover. The fix involved interpolating the 2m air temp independently of the band6 temperature, so that the 2m air temp is always interpolated even when there aren't any clear band6 values.
- Updated to work with the new NCEP variables as floating point values without scale factors and offsets.
- Updated 6S code to do error checking in the event that a file is not available to be opened/created. The error is caught and a message is printed. Updated lndsr code to use the bash shell instead of the sh shell to invoke the 6s command file. These mods were made in an attempt to prevent the temporary file error which occurs intermittently in ESPA.

lndsrbm

- Updated to work with the new NCEP variables as floating point values without scale factors and offsets.

bin

- Updated do_ledaps.py to support --process_sr "True"/"False" just like the do_l8_sr.py. This allows us to not run SR processing if it is not needed. If --process_sr is not provided on the command line, then it will be defaulted to "True" and SR processing will be performed.

ledapsAncSrc

- Modified the NCEP repackage executable in the ledapsAncSrc to process the newly released NCEP products. The NCEP products are in netCDF4 vs. netCDF3. The variables are now written as floating point vs. int16, and no longer have a scale factor or offset.

=======================

LEDAPS 2.0.0 (June 6, 2014 – USGS EROS)

Overall

- Input products are expected to be Landsat products from LPGS converted to the ESPA internal file format (see the Data Preprocessing section for more information).

- Output products are written in the ESPA internal file format (see the Data Postprocessing section for more information).
- Updated all the Makefiles to use install instead of cp.

lndpm

- Removed support in lndpm for any Landsat products other than LPGS products. Scenes previously processed through NLAPS are now available via LPGS. And, the UMD format previously supported is no longer utilized. At the very least, all those scenes should be available from LPGS. lndpm now reads the XML metadata file instead of the LPGS metadata file.
- Updated lndpm to use the espa-common error handling and included ESPA headers and comments for each routine in the file.
- Modified lndpm to pass the name of the XML file to the downstream apps in the parameter files.
- Also, lndcal no longer needs the .metadata.txt file, so that is no longer produced by lndpm

lndcal

- Modified lndcal to pull all the metadata information from the XML file instead of the .metadata.txt file.
- Modified lndcal to read raw binary products vs. GeoTIFF products.
- Removed any recalibration or DN map related code. The latest LPGS MTL files contain the gain/bias values and they are accurate, thus they will be used in the TOA reflectance computation.
- Brightness temperature values are now written in Kelvin vs. degrees Celsius. The valid range is 150 to 350 Kelvin and the scaling factor has been modified to be 0.1 (vs. the previous 0.01 for degrees Celsius). The fill value remains the same as previous products.

lndsr

- Modified lndsr to pull all the metadata information from the XML file instead of the HDF file.
- Modified lndsr to read raw binary products vs. HDF products.
- Handled appropriate changes to deal with the brightness temp change to Kelvin vs. degrees C.
- Replaced a few "/ 10000" with " 0.0001" (or similar) in the cloud processing routine to speed up the math.
- Updated all the Makefiles to use install instead of cp.

lndsrbm

- Modified lndsrbm to pull all the metadata information from the XML file instead of the HDF file.
- Modified lndsrbm to read raw binary products vs. HDF products.
- There is now no need to append band6 from lndth to lndsr, as it's already part of the overall raw binary product.
- Handled appropriate changes to deal with the brightness temp change to Kelvin vs. degrees C.
- Rewrote all of the FORTRAN routines as it doesn't play nicely with raw binary files, and to just clean things up and use C across the board.

lndapp

- Removed lndapp since it's no longer used for appending band6 to the lndsr product in lndsrbm.

========================

LEDAPS 1.3.1 (August 30, 2013 – USGS EROS)

----

lndcal

- Modified to validate that the output pixel values remain within the documented min/max TOA reflectance and brightness values.
- Modified to write the gain and bias values to the global metadata for the TOA reflectance and brightness temperature calculations.

lndsr

- Modified to copy the gain and bias values to the global metadata for the TOA reflectance and brightness temperature calculations.

=======================

LEDAPS 1.3.0 (July 31, 2013 – USGS EROS)

----

lndpm

- Modified to replace C++ style comments with C style comments.

lndcal

- Modifed the HDFEOSVersion to be pulled from the HDF-EOS include files versus being hard-coded. Also added an HDFVersion.

lndcsm

- Modifed the HDFEOSVersion to be pulled from the HDF-EOS include files versus being hard-coded. Also added an HDFVersion.

lndsr

- Modified to replace C++ style comments with C style comments.
- Modifed the HDFEOSVersion to be pulled from the HDF-EOS include files versus being hard-coded. Also added an HDFVersion.
- Fixed a bug for reading the ozone data for Ozone Monitoring Instrument (OMI). Previously the minimum, maximum, and delta latitude and longitude values were hard-coded, which created an issue as the resolution of the OMI platform is different from the pre-OMI platforms. The application has been updated to read the minimum and maximum latitude and longitude values from the HDF file dimensions, and to calculate the deltas from these dimensional arrays instead of hard-coding the values. The modification will support the upside down latitude values (see updates for ledapsAncSrc below) as well as the corrected latitude values.

lndsrbm

- Modified to replace C++ style comments with C style comments.

ledapsAncSrc

- Modified the update scripts to correctly write the latitude values for the ozone products. The ozone values in the baseline text files are actually in the order from southern latitudes to northern latitudes. The script has been converting the ozone data to be north to south on the output HDF files, but the latitudes were not being updated/flipped to correctly represent this.

- Ultimately, for LEDAPS, this wasn't an issue but more of a cosmetic change to make sure the auxiliary files contained correct information for the latitude and longitude dimensions.

======================

LEDAPS 1.2.2 (June 11, 2013 – USGS EROS)

----

general

- Added a license file for the public software license.

lndpm

- Modified to allow processing of Landsat 4 Thematic Mapper products, with exception of those processed through the National Landsat Archive Processing System (NLAPS).

======================

LEDAPS 1.2.1 (April 30, 2013 – USGS EROS)

----

lndcal

- Modified to output the upper left and lower right corner latitude/longitude coordinates so that South-up scenes can be identified. Scenes acquired during ascending orbit (such as over Antarctica) appear upside down, with North and South reversed. The North and South bounding coordinates accurately represent the northernmost and southernmost latitudes respectively, but the UL image corner will be more south than the LR corner. Comparing the UL and LR corners will allow the user to determine if the scene is reversed.

lndsr

- Modified to output the upper left and lower right corner latitude/longitude coordinates so that South-up scenes can be identified. Scenes acquired during ascending orbit (such as over Antarctica) appear upside down, with North and South reversed. The North and South bounding coordinates accurately represent the northernmost and southernmost latitudes respectively, but the UL image corner will be more south than the LR corner. Comparing the UL and LR corners will allow the user to determine if the scene is flipped.
- Adjusted the sun azimuth for polar scenes which are ascending/flipped. The sun azimuth is North-up, but these scenes are South-up. The azimuth is adjusted by 180 degrees when applied to South-up scenes.

======================

LEDAPS 1.2.0 (March 27, 2013 – USGS EROS)

----

lndpm

- Modified to utilize a single Version value version supporting two version tags with the same value. This new tag will be LEDAPSVersion. PGEVersion and ProcessVersion are no longer used.
- Modified LPGS and NLAPS WO sections to read the scene center time from the MTL or WO file and pass that time along as the ACQUISITION_TIME in the .metadata.txt file. Previously a time of 00:00:00.000Z was used instead of the actual scene time. This means that the lndsr and lndsrbm applications will have the actual scene time for processing versus approximating the scene time. The actual scene time should also be posted in the lndcal.hdf, lndth.hdf, and lndsr.hdf files with this change. The scene time is used to obtain the appropriate atmospheric correction information from the various auxiliary files. This modification will produce differences in the output surface reflectance values from previously processed scenes.
- Modified to support the processing of polar stereographic products (polar regions) for LPGS and NLAPS WO products.

lndcal

- Modified to utilize a single Version tag versus the current practice of having two tags with the same version number. LEDAPSVersion will be used. PGEVersion and ProcessVersion are no longer used.
- Modified the application to calculate and write the bounding coordinates as output metadata to the lndcal.hdf file, similar to the metadata in lndsr.hdf.
- Modified to read the acquisition time from the input metadata file and pass the acquisition time along for processing. If the date string is too long, then the last few digits from the seconds (acquisition time is in DMS) will be removed.
- Modified to support the processing of polar stereographic products, including reading the projection parameters from the input metadata file and writing those to the lndcal.hdf and lndth.hdf metadata.

lndsr

- Fixed the issue with the sun angles having an additional 0.5 incorrectly added to their value (leftover from integer rounding).
- Modified to utilize a single Version tag versus the current practice of having two tags with the same version number. LEDAPSVersion will be used. PGEVersion and ProcessVersion are no longer used.
- Modified to support the processing of polar stereographic products, including reading the projection parameters from the lndcal.hdf metadata.
- Removed NumberOfBands and BandNumbers fields from the lndsr HDF metadata. These fields only apply to the surface reflectance bands themselves and don't fully represent the final output bands for the lndsr product. These fields still remain in the lndcal.hdf and lndth.hdf products.
- Acquisition time is read from the lndcal.hdf metadata and used if available versus estimating the scene time.

lndsrbm

- Modified to support the processing of polar stereographic products, including reading the projection parameters from the lndsr.hdf metadata.
- Acquisition time is read from the lndsr.hdf metadata and used if available versus estimating the scene time.

- Cleaned up some of the print statements to make it more clear as to the information being printed.
- Added an internal/temporary file called geo_xy.ERROR to flag and catch errors in the geo2xy (lat/long to projection x/y) and xy2geo (projection x/y to lat/long) processing.

======================

LEDAPS 1.1.2 (January 2, 2013 – USGS EROS)

----

lndpm

- Added META_FILE field to the lndsr parameter file which provides the filename of the L1G/L1T metadata file, containing valuable information for some of the data users.

lndsr

- Modified the data fields in the output metadata to be one-based so they align with the metadata fields appended in lndapp.
- Modified the fill_QA band to flag pixels as fill if the pixel is fill in any of the reflective bands and not just band 1 as was the previous implementation.
- Added META_FILE field to the lndsr parameter file. This field is read and used for the output lndsr metadata.
- Added a global metadata tag called LPGSMetadataFile to keep track of the input LPGS metadata file used for processing the L1G/L1T product. This file contains information that will be of value to the downstream user.
- Modified the 6s processing to utilize descriptive filenames for the 6s command and 6s output files. These files are no longer deleted but instead are left for the user to review/utilize, if desired. These files are written to the local directory instead of /tmp.

lndapp

- Added band6_fill_QA as an additional quality band to be output in the surface reflectance product.

bin

- Modified do_ledaps.py to allow the user to call this script from any directory vs. the directory where the MTL file resides. The script will parse the directory from the MTL file and then change to that directory to process the data.

ledapsAncSrc

- Modified the update scripts to limit the number of retries to 5 in the case the ftp site is not available or due to a connection problem.

======================

LEDAPS 1.1.1 (December 6, 2012 – USGS EROS)

----

lndpm:

- Corrected spelling of SATTELITE to SATELLITE in the output metadata.txt file

lndcal:

- Corrected spelling of SATTELITE to SATELLITE in the output metadata.txt file

lndsr:

- Fixed a bug in cld_diags.std_b7_clear to be based on the sqrt of band 7 and not the band 6 temperature.

bin:

- Modified do_ledaps.py to be a class and to allow an -l or --logfile option to write the output to a log file.
- Added a findAncillary method to the Ledaps class to determine if the required EP/TOMS and NCEP REANALYSIS ancillary files exist for the specified year (all days) or year/DOY.

ledapsAncSrc:

- Added source code and scripts to download and process the NCEP and EP/TOMS ozone ancillary products.

======================

LEDAPS 1.1.0 (November 27, 2012 - USGS EROS)

- Developed do_ledaps Python script which provides error checking on each of the LEDAPS applications.
- Modified the LEDAPS applications to flag additional errors, like missing ancillary data, so that the Python script will catch these errors and exit with an error.
- Cleared fill/gap QA pixels such that QA pixels are never set 'on' for fill/gap pixels.
- Changed the name of the *.carbon_met.txt file to *.metadata.txt. The word "carbon" was residual from original development for North American Carbon Project (NACP).
- Added the units of 'meters' to the GCMDEM.hdf file, given that the units were missing from the file metadata.
- Placed the GCMDEM.hdf, GOLD.txt, GOLD_2003.txt, and GNEW.txt files on the LEDAPS Google Projects page for easy download. These files are required for processing in LEDAPS.

======================

LEDAPS 1.0.0 (October 24, 2012 - USGS EROS)

----

lndpm:

- lndcsm is no longer called as part of the surface reflectance processing; the internal surface reflectance cloud mask is used instead. Therefore the cloud snow/mask is no longer sent as a parameter for lndsr.
- Updated lndpm based on mods provided by Feng Gao from 1/18/2012.

- o restores the solar zenith angle bug fix from the past for NLAP_W0 format (Greg Ederer)
  - o fixes a bug when writing the UTM zone (south) into the ENVI hdr file (Greg Ederer)
  - o added processing for Landsat-4 TM (Feng Gao)
- Updated the metadata tags to work with the newly released LPGS metadata as well as continuing to support the old metadata tags.
- Cleaned up warning messages from compilation.
- Reset the version to 1.0.0 as this is our first official version of LEDAPS for the ESPA system.
- Changed the DataProvider to USGS/EROS.
-

lndcal:

- Modified calibration of band 6 to flag the saturated thermal pixels in the output brightness temperature product. This is consistent with flagging the saturated pixels in the reflective bands.
- Modified lndcal to write the QA bits for the lndth product (brightness temperature product), including appropriate metadata for the QA band. The QA bits include flags for both fill pixels and for saturated band 6 pixels, consistent with the QA bits for the reflective bands in the lndcal output.
- Cleaned up some compiler warnings and minor bugs when freeing some of the data arrays.
- Reset the version to 1.0.0 as this is our first official version of LEDAPS for the ESPA system.

lndcsm:

- Removed the source code from the repository since it is no longer used by the ESPA LEDAPS processing flow.

lndsr:

- Cleaned up some compiler warnings and minor bugs when freeing some of the data arrays.
- Updated the metadata output to include the surface reflectance based QA bits.
- Reset the version to 1.0.0 as this is our first official version of LEDAPS for the ESPA system.
- Removed lndcsm input for cloud mask. Will use only the internal cloud mask. QA bits are no longer output as a packed set of bits, but instead a separate band is written for the cloud, shadow, fill, etc. QA information and each pixel is either on or off.

lndsrbm:

- cmrbv1.0.f used a hard coded pixel size of 28.5. This has been modified to use the pixel size read from the scene metadata.
- updated to handle the new single QA bands vs. the previous packed bit QA band

bin:

- Modified do_ledaps.csh to no longer call lndcsm as part of the LEDAPS processing flow.

=======================

LEDAPS 0.0.0 (November 24 2011 – NASA GSFC/UMD)