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Lunar Data Products Quality

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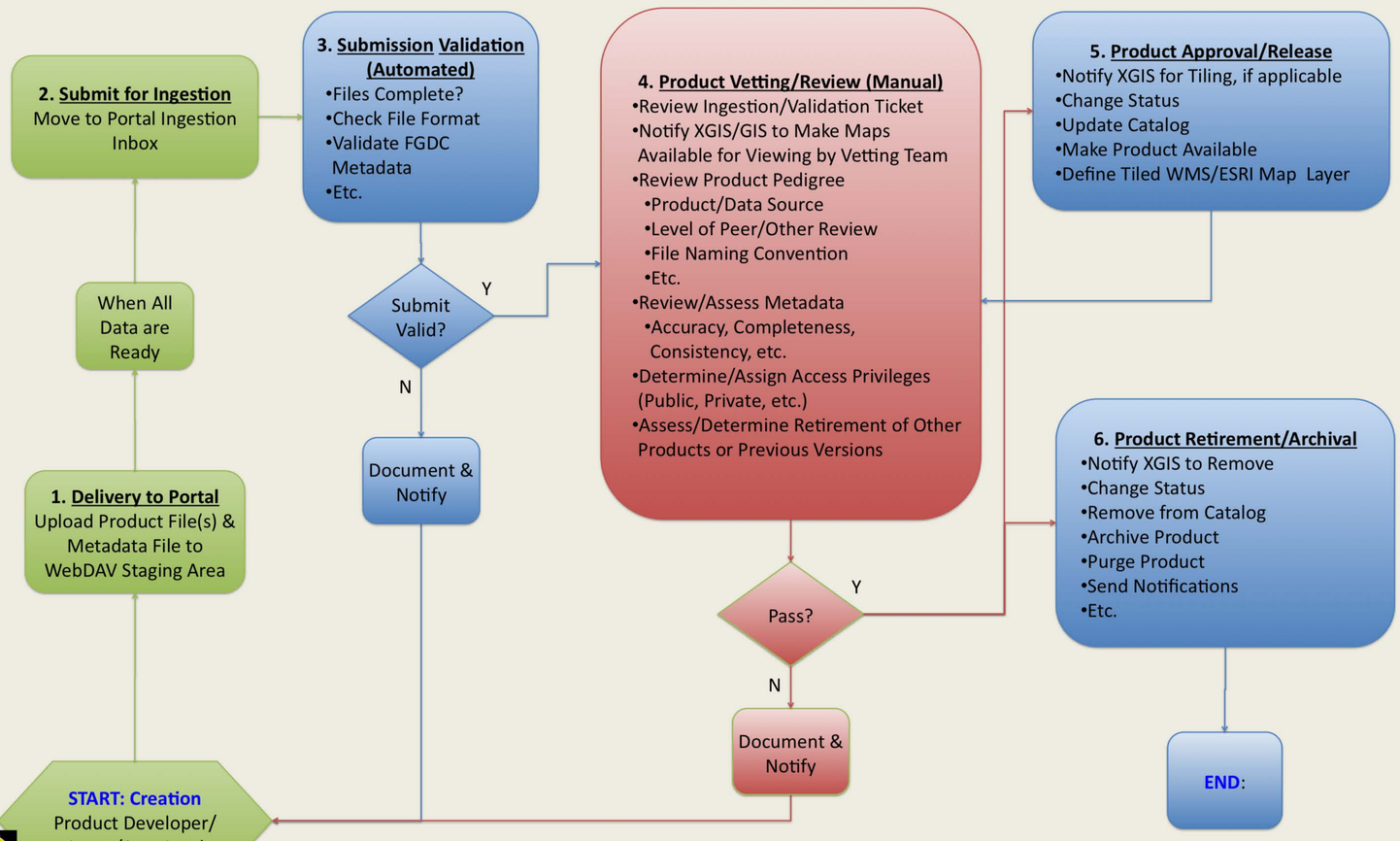
Abstract

NASA's long-term exploration goals include return to manned missions to the Moon that will culminate in a permanent manned station on the Moon. Prior to embarking on such a mission, architectural trades and system designs will be facilitated by well-characterized and geo-registered maps and models of the Moon. The Lunar Mapping and Modeling Project (LMMP) led by the Marshall Space Flight center (MSFC) is responsible for guiding the development of an information system to provide these maps and models.

Our team at Jet Propulsion Laboratory (JPL) has taken on the key role in the development of the LMMP interoperable geo information system's underlying infrastructure, including aggregation of lunar data, from the Apollo era to the latest instruments on the LRO spacecraft into a central repository, management of lunar data, as well as a single portal that is one of the most comprehensive lunar research websites to date for access to the lunar maps and products by scientists and the general public. Needless to say, the quality of these data products and information is utmost important to the users.

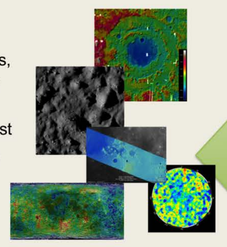
To ensure the highest quality of our data products and information, two stages of data product validation occur within LMMP. First, the project has established a Verification and Validation methodology in which verification provides objective evidence to show that the data products requirements are achieved and validation confirms that the products meet their intended purpose. Secondly, all products and their metadata must be examined thoroughly at the vetting stage after being ingested into the system, where the vetting components look at and access each product within the infrastructure through its curation/ vetting services to ensure that the product is indeed a quality product upon release.

LMMP Ingestion/Vetting/Review/Release Process Flow

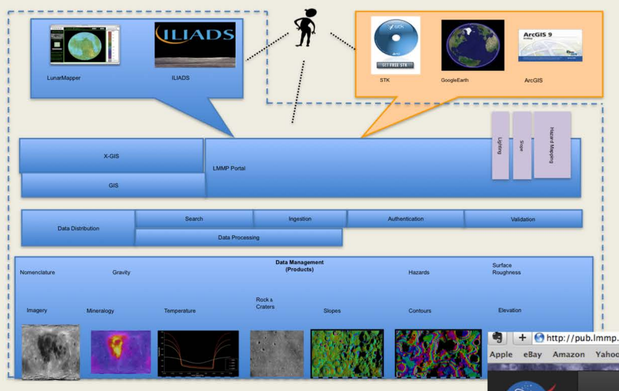


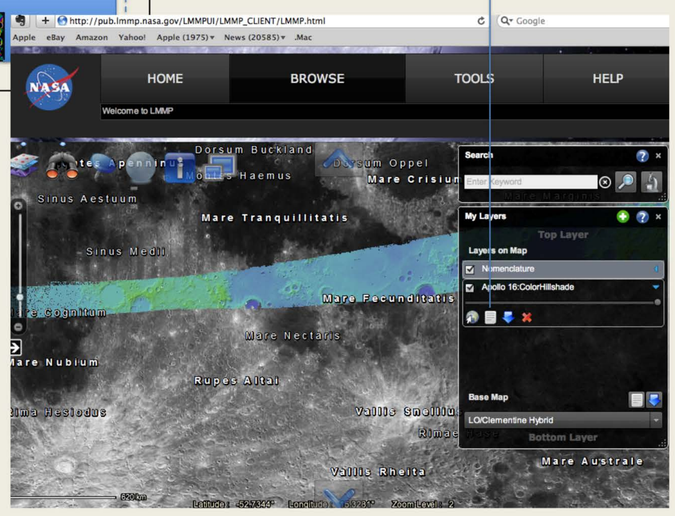
LMMP data products

- Gravity model
- Imagery
  - Global & Regional maps
  - Local sites of interest
- DEMs - elevation, contours & slopes
  - Global & Regional maps
  - Local sites of interest
- Hazards - craters, boulders, slopes, roughness, integrated hazard maps & statistical distributions
  - Global nomenclature set
  - Local maps and statistics for sites of interest
- Resources – mineralogy, hydrogen, water ice, thermal & lighting
  - Global maps
  - Polar regions



LMMP Architecture Overview





Data Quality Information Example: Apollo 16 Metric Cam DEM ColorHillshade

Data_Quality_Information:
Attribute_Accuracy_Report:
Precision data is provided at each pixel and is available for download. A visual representation of the precision data is available in the Confidence Map.
Logical_Consistency_Report:
The Apollo 16 DEM precison maps are generated using the elevation expected data standard deviation of all the available Apollo 16 DEM files. The DEM confidence maps represent at each pixel various labels and precision levels as described here: 0 = NoDATA, 1 = shadow, 2 = saturated, 3 = suspicious (edge, corner etc), 4 = interpolated/ extrapolated (e.g. from neighbor pixels), 10 - 14 = value range of confidence derived from the precision maps (linear fit from poor 10 to very good 14), 15 = manually edited. The precision values of the A16 DEM zone are captured by the following files: a16_Prec_4E_2N_1024PPD.tif ..a16_prec_180W_18N_1024PPD.tif
Completeness_Report:
The accuracy and precision of digital elevation map is lower in areas where the images where corrupted by noise in the camera path or scanning artifacts. While the effect of image noise is reduced by the our robust stereo matching algorithm some of the artifacts remain present in the final product. Other areas of low precision and accuracy include shadow regions where stereo correlation has poor quality and areas along the image boundaries.
Horizontal_Positional_Accuracy_Report:
Horizontal Accuracy is computed in terms of the standard deviation of the ULCN2005 control network.
Horizontal_Positional_Accuracy_Value: 20
Horizontal_Positional_Accuracy_Explanation:
Horizontal accuracy is computed using Vison Workbench and Ames Steeo Pipeline packages. Horizontal Accuracy is computed in terms of the standard deviation of the ULCN2005 control network.
Vertical_Positional_Accuracy_Report:
Vertical Accuracy is computed as the standard deviation of the elevation values from the laser altimetry data where LOLA data is available.
Vertical_Positional_Accuracy_Value: 40
Vertical_Positional_Accuracy_Explanation:
Vertical Accuracy is calculated using Vision Workbench and Ames Stereo Pipeline packages. Vertical accuracy is computed as the standard deviation of the computed digital elevation values from the laser altimetry data where LOLA data is available.
Lineage/Originator:
Robinson M. S., Lawrence S. J., Close W., Bode R., Grunsfeld J. M., Ingram R., Jefferson L., Locke S., Mitchell R., Scarsella T., White M., Hager M. A., Mackwell S., Watters T. R., Bowman-Cisneros E., Danton J., Speyerer E., Dam A., Calarco A. and Garvin J. B.M.
Publication_Date: 20080314
Title: The Apollo Digital Image Archive
Geospatial_Data_Presentation_Form: URL
Online_Linkage: <http://apollo.sese.asu.edu>
Type_of_Source_Media: Apollo 16 Metric Camera Images

For More Information Contact: Emily.S.Law@jpl.nasa.gov
Please visit LMMP website @ http://lmmp.nasa.gov

The LMMP project is managed at the Marshall Center and is a collaborative development effort across NASA and other organizations, including NASA's Ames Research Center at Moffett Field, Calif.; NASA's Goddard Space Flight Center in Greenbelt, Md.; NASA's Jet Propulsion Laboratory (JPL) in Pasadena, Calif.; the United States Geological Survey in Flagstaff, Ariz.; the U.S. Army Engineer Research and Development Center's Cold Regions Research and Engineering Laboratory in Hanover, N.H.; Arizona State University in Tempe; and the University of Arizona in Tucson.
The data curation and vetting system capabilities are part of the LMMP infrastructure and portal development activities carried out at the JPL, California Institute of Technology, under a contract with the NASA.