

# The Lunar Mapping and Modeling Project

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# Project Background and Overview

- LMMP was initiated in 2007 to help in making the anticipated results of the LRO spacecraft **useful** and **accessible** to Constellation
- The LMMP is managing and developing a suite of lunar mapping and modeling tools and products that support the Constellation Program (CxP) and other lunar exploration activities
- In addition to the LRO Principal Investigators, relevant activities and expertise that had already been funded by NASA was identified at ARC, CRREL (Army Cold Regions Research & Engineering Laboratory), GSFC, JPL, & USGS
- LMMP is a cost capped, design-to-cost project (Project budget was established prior to obtaining Constellation needs)

# Customers

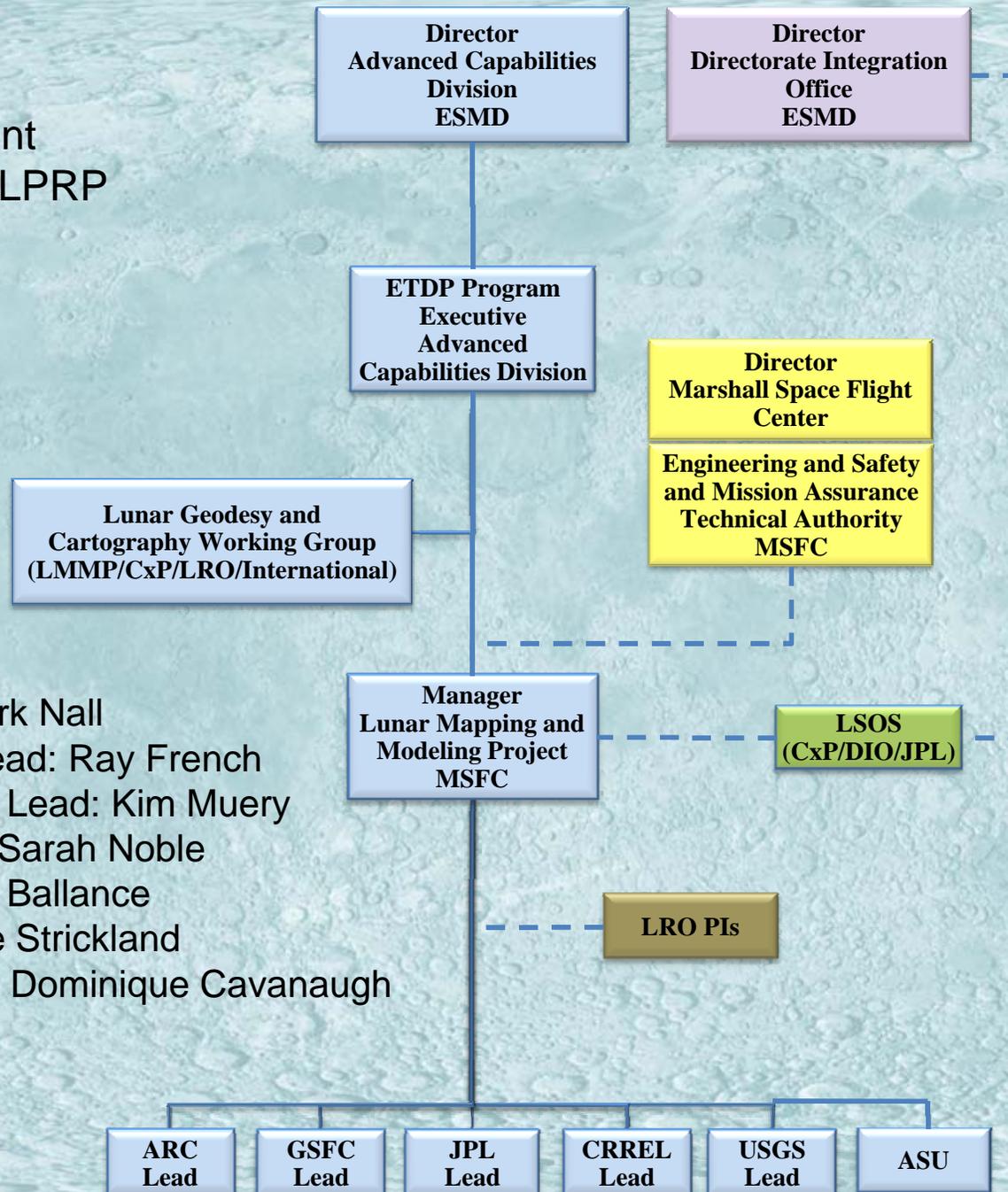
- **Main customer is the Constellation program**  
The information provided through LMMP will assist them in:
  - planning tasks in the areas of landing site evaluation and selection
  - design and placement of landers and other stationary assets
  - design of rovers and other mobile assets
  - developing terrain-relative navigation (TRN) capabilities
  - assessment and planning of science traverses
- **Other customers**
  - Science community
  - Commercial community (e.g. GLXP teams)
  - Education/Public Outreach community

Management  
Structure Post LPRP

FY 2010-11

**MSFC Team:**

- Project Manager: Mark Nall
- Project Integration Lead: Ray French
- Project Development Lead: Kim Muery
- Project Scientist: Dr. Sarah Noble
- Chief Engineer: Judy Ballance
- S&MA TA: Rosalynne Strickland
- Scheduling and Risk: Dominique Cavanaugh



# LMMP Team

ARC

- Regional Apollo visible base imagery mosaics
- Regional DEMs
- EPO web-based neo-geography interfaces

USGS

- Local/site visible base imagery mosaics
- Regional/polar visible base imagery mosaics
- Local/site DEMs

JPL

- Visualization system infrastructure, web portal and interoperable GIS infrastructure
- Local/site DEMs (stereo photoclinometry)
- Hazard assessment maps (including slope maps)

ASU

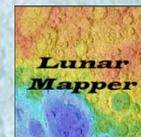
- Local/site DEMs

CRREL

- Web-based visualization system digital overlay tools

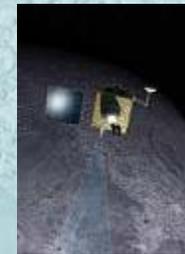
GSFC

- Desktop visualization client – Integrated Lunar Information Architecture for Decision Support



# Data Sources

- LRO
- M3
- Kaguya (gravity model)
- Apollo (metric & panoramic cameras)
- Clementine
- Prospector



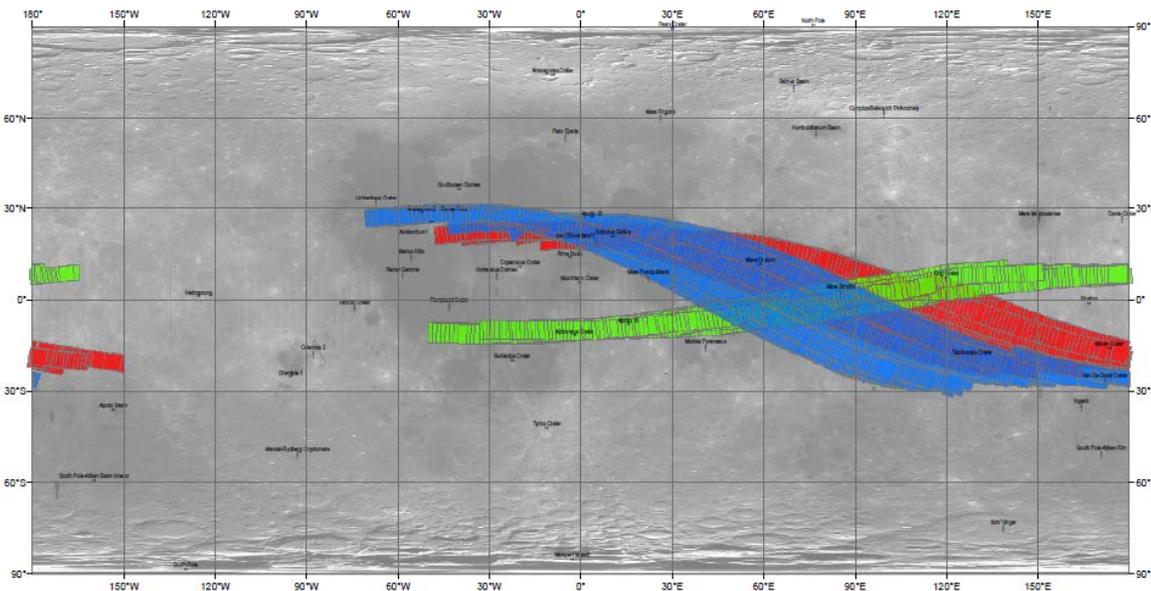
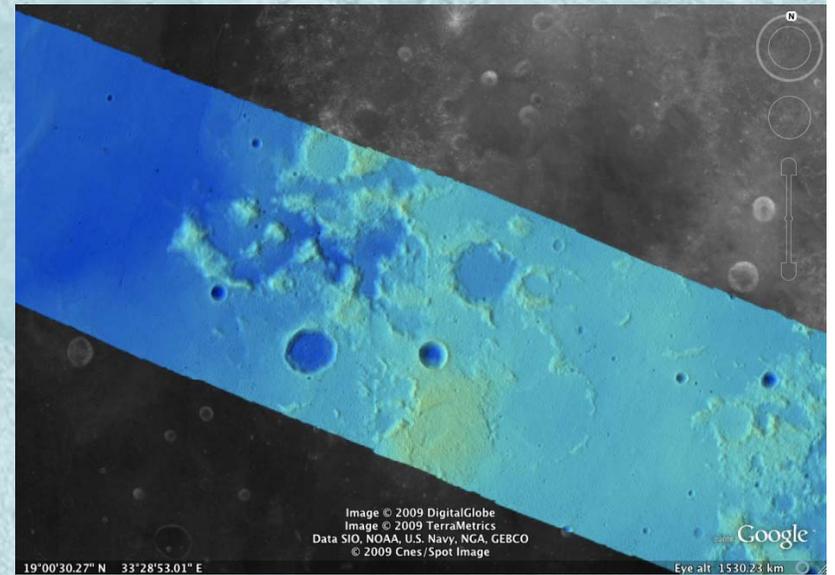
# Data Products

- “Passthrough”
  - e.g. LOLA DEM, Clementine, Prospector, gravity model, lighting model
- Modify
  - e.g. mosaicking basemap, georeferencing local images
- Create...

# Created Products - DEMs

Regional DEMs using scanned Apollo metric camera data

Covers ~18% of the Moon  
(low latitudes)

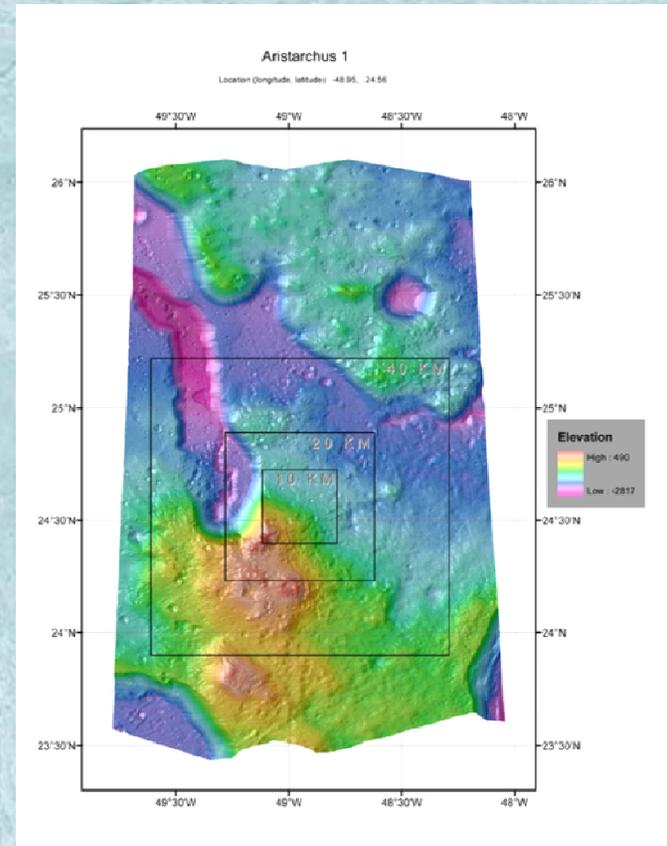
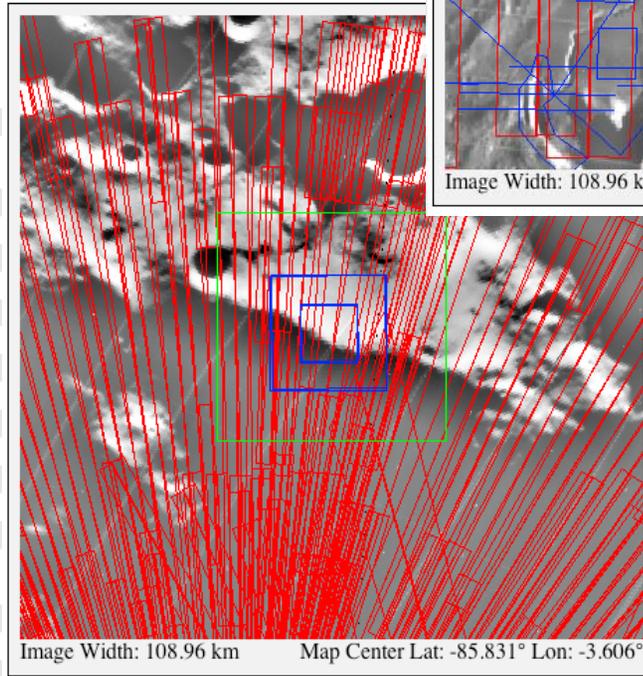
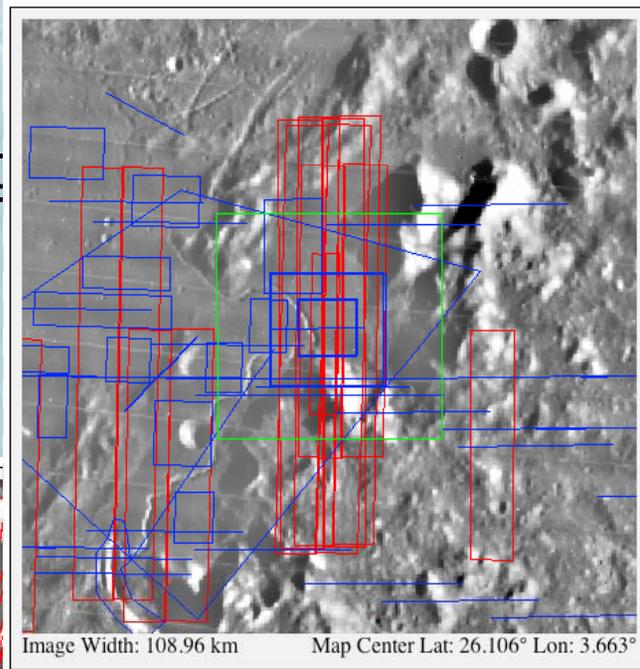


Small section of DEM from orbit 33. DEM resolution ~40m/pixel

Map showing coverage of metric camera data

# DEMs

Local DEMs  
from LOLA  
NAC covering  
the 50 CxP  
regions of  
interest

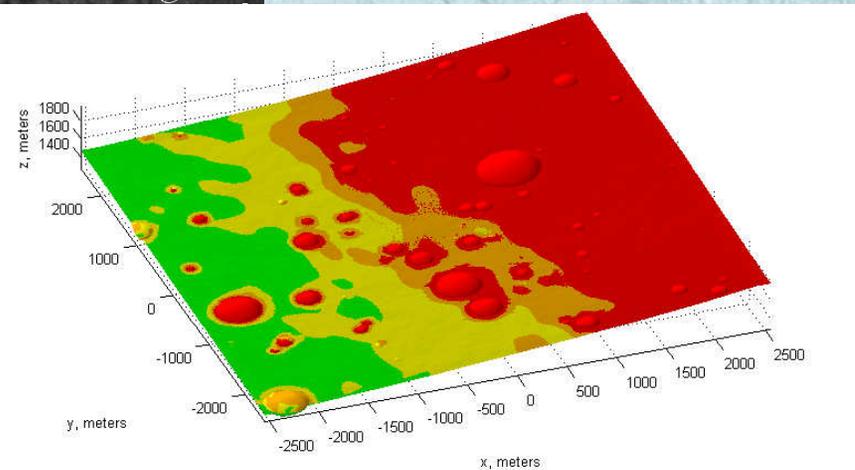
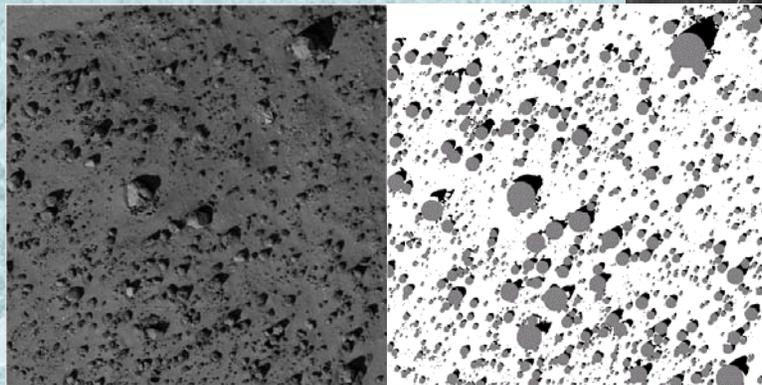
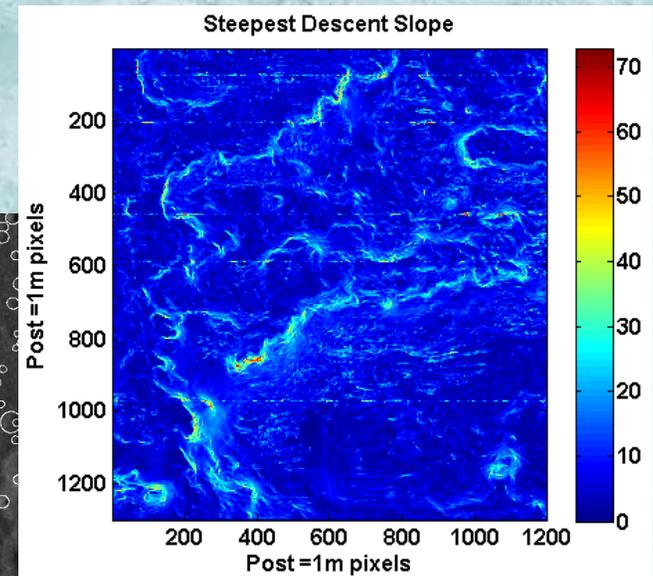
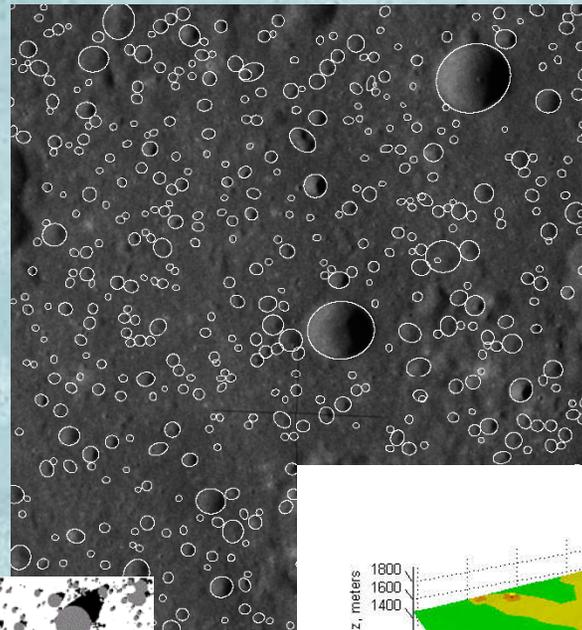


Preliminary USGS Aristarchus  
Plateau (DEM 1) from JSC/ASU  
Apollo Pan Cam Scans

Malapert (left) and Ap 15 (right) ROIs showing  
in **red** the NAC images acquired through the 1<sup>st</sup>  
month of mapping orbit

# Created Products - Hazard Maps

- Craters
- Boulders
- Slopes
- Surface Roughness



# Data Products Process

Produce preliminary data products

In some cases using Apollo or other historic data

Hold process validation audits

These have occurred

Acquire final data sets from LRO teams.

Adjust methods, if necessary.

Produce final products

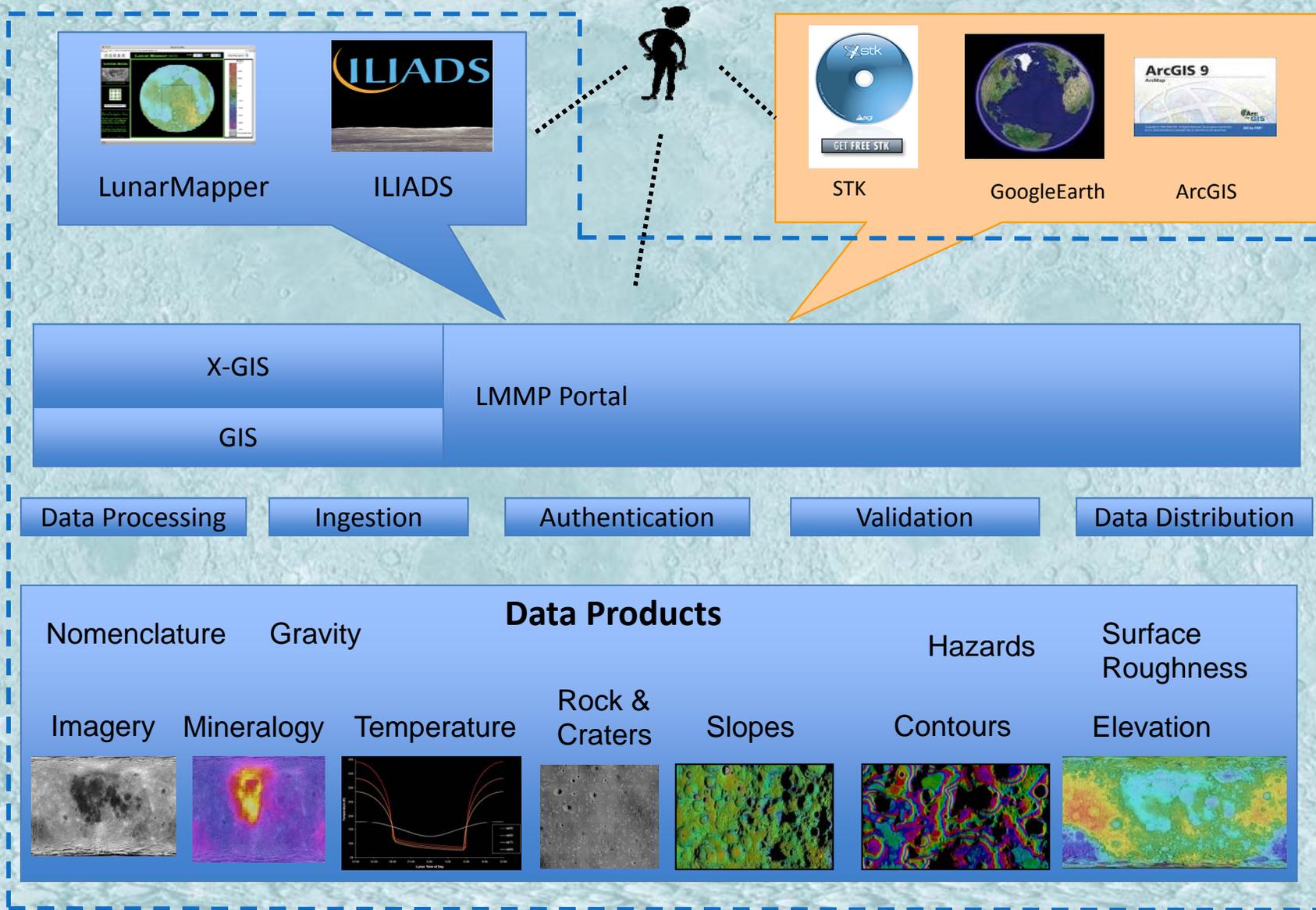
Ingest into LMMP system

Hold final product validation audits

To insure that products are of high quality, display correctly, and meet CxP's needs

Release to Public (or where appropriate, CxP internal use)

# LMMP System



# Portal



HOME

BROWSE

TOOLS

Logout Sarah K Noble



**Info** [X]

Latitude : 17.099250°

Longitude : 61.367091°

**Distance**

**Maps** [X]

Base Maps   **Layers**

ULCN 2005 DEM

**LO**

LO3

**Lunar Prospector**

Potassium

Thorium

**Search** [X]

**General**   **Nomenclat...**   **Rocks**

Search Value

Extent

N.

W.  E.

S.

**Search**   **Clear Results**   **Results**



# Lunar Mapper

**Mapper Tab**  
Landing Sites

Pan Factor: 25 %

Scale 1: ~307.6 K

30.67 ~Cen x / lon  
20.25 ~Cen y / lat

30.49730, 20.46637

User Name:  Portal Login  
Password:

**Lunar Mapper** Beta 0.9p  
Lunar Mapping and Modeling Project (LMMP)

**Landing Sites**

Apollo 17

Manmade Objects

Sites of Interest (a)

Sites of Interest (b)

Apollo 17

KILOMETERS  
0 6

**Mapper Tab**  
Map Layers

Pan Factor: 25 %

Scale 1:

35037 ~Cen x / lon  
47439 ~Cen y / lat

-81545.41016,  
74724.12109

User Name:  Portal Login  
Password:

**Layer Settings**

Base Layer Server  
UMN MapServer (CGI)

Map Projection  
South Stereographic

Nomenclature Overlay  
Separate Labels

Custom Map Overlays  
South Pole Hydrogen

Update Layers

Base Layer

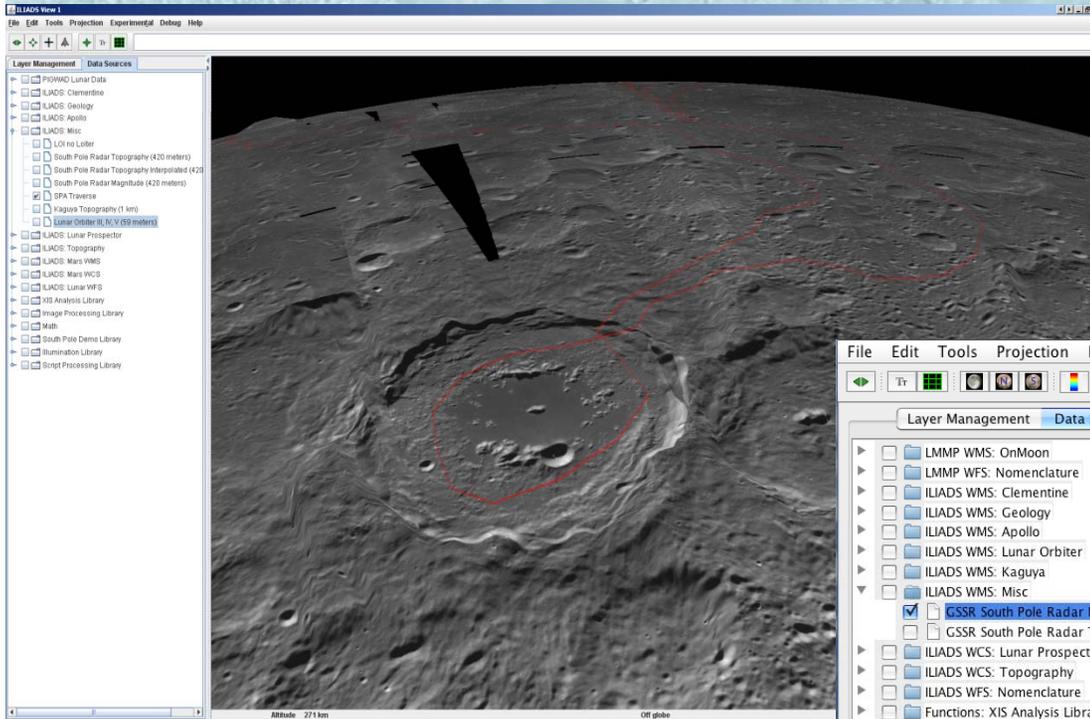
- Clementine UVVIS
- Lunar Orbiter (LO)

Overlays

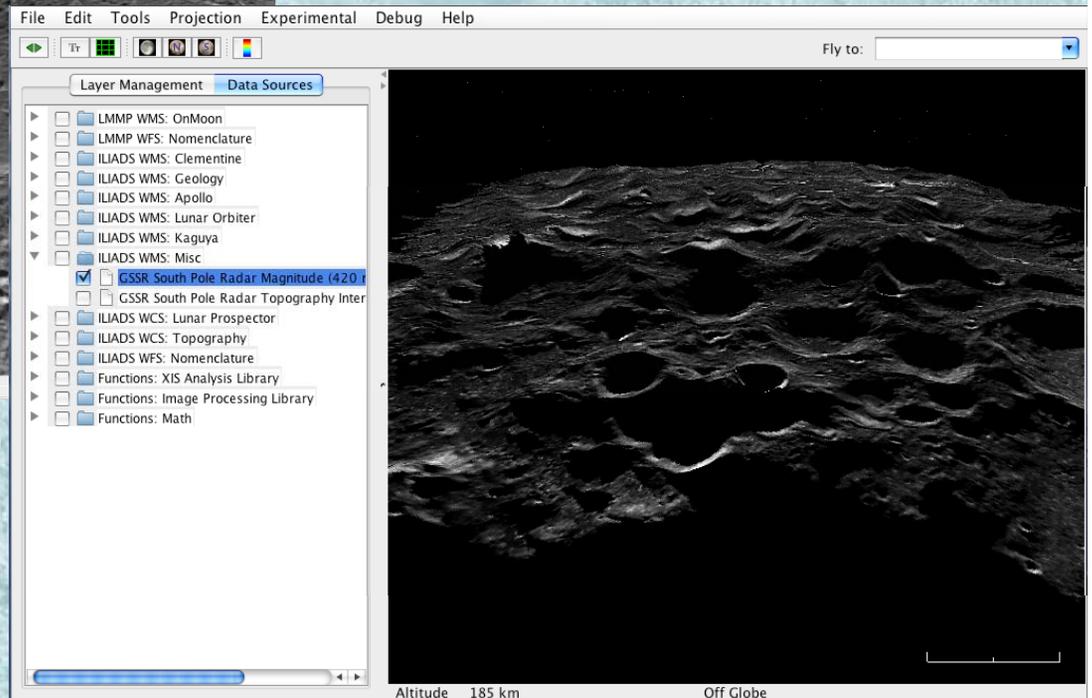
- ~Permanent Shadows
- Hydrogen Abundance
- Hydrogen Depth
- SP Crater Labels
- Map Annotations

0 0 No Overview Map

# Integrated Lunar Information Architecture for Decision Support (ILIADS)

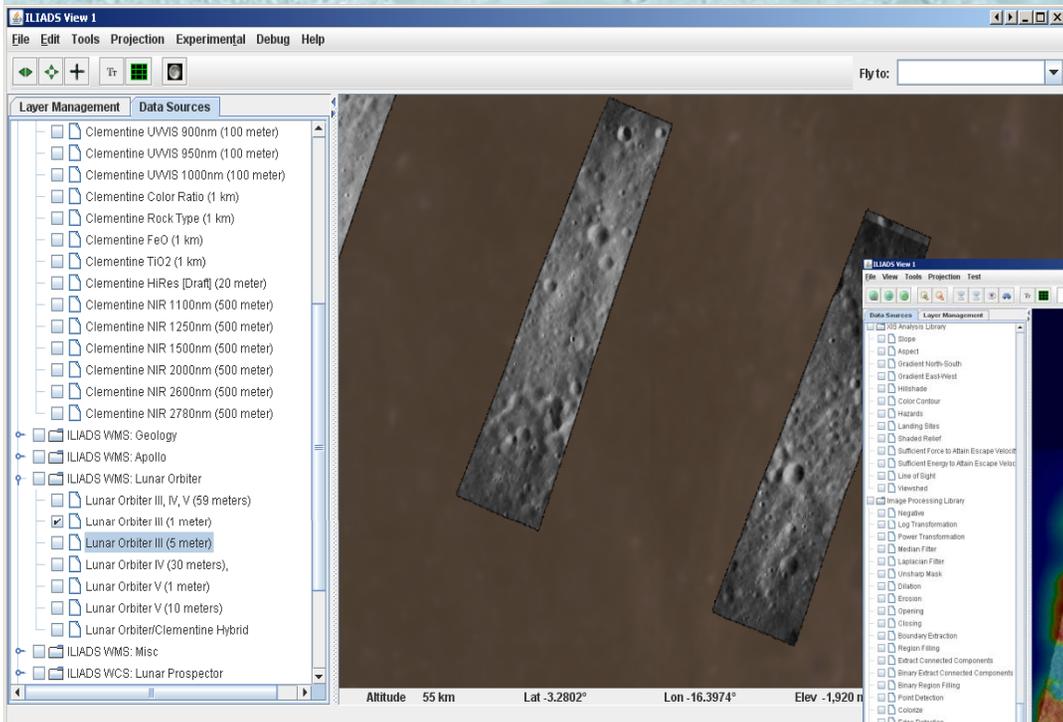


Lunar Surface Traverse Tool (oblique view)

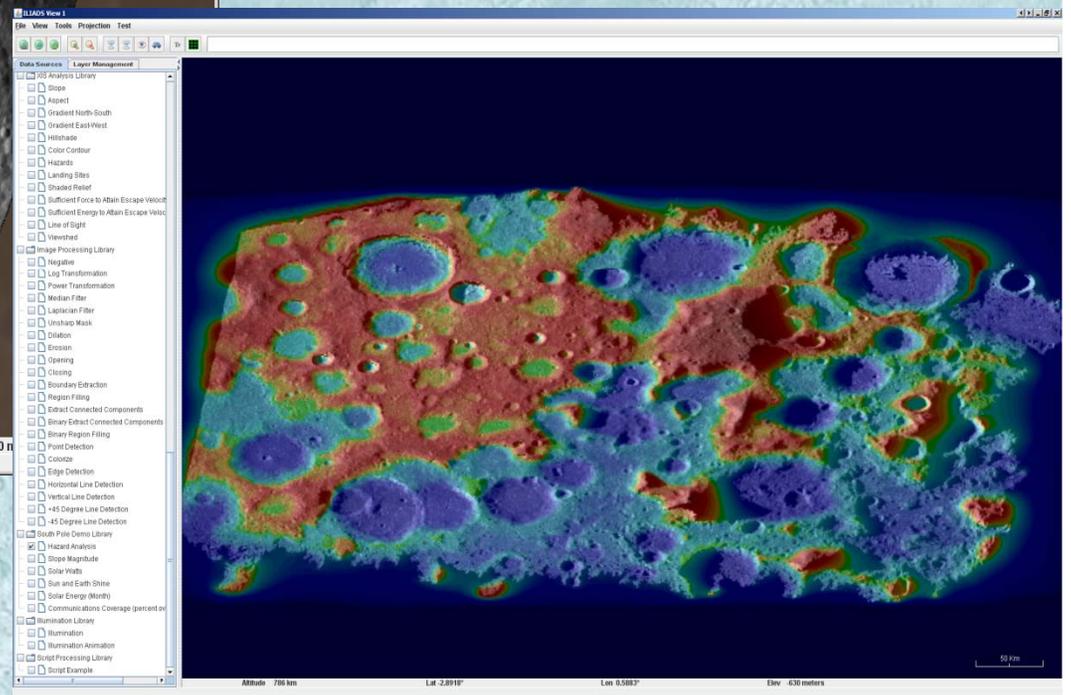


Goldstone Radar of South Pole (oblique view)

# Integrated Lunar Information Architecture for Decision Support (ILIADS)



Clementine with high-res Lunar Orbiter



South Pole hazard analysis (surface roughness)

# LMMP Milestones

- Apr 2009 – Formulation review
- Jun 2009 – LRO launched!
- Jun 2009 – Requirements review
- Aug-Sep 2009 – Individual product process validation audits
- Sep 2009 – Preliminary System design audit
- Dec 3<sup>rd</sup> 2009 – Beta release of Mapper, ILIADS, Portal, infrastructure and content
- Late 2010/Early 2011 – Version 1 release