A Global Lunar Digital Terrain Model in 100 m Resolution Derived from LROC Images

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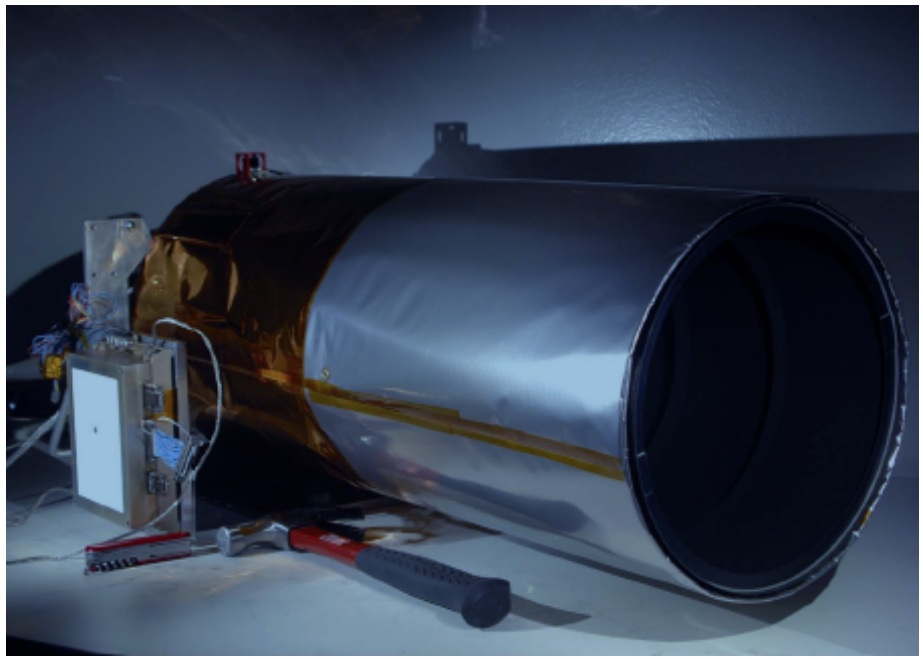
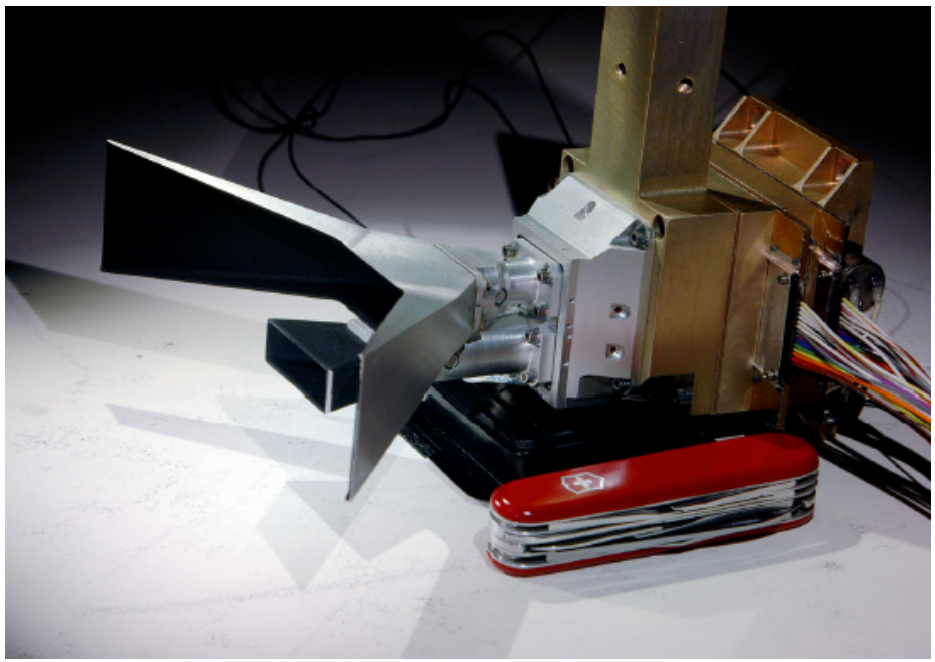
LRO Cameras (LROC)

- LRO in science mission: polar, circular ~50 km orbit



NAC
Line Scanner



WAC
„Pushframe“ Imager

LROC WAC Data

- WAC obtaining images almost continuously, 60-90 m/pix
- chose WAC filter 5 (600 nm): has near-nadir viewing
- typical WAC image strip: ~50 km width, ~400 km length
- overlap of WAC strips from adjacent orbits:
  - typical overlap @ equator: 50%
    (increasing towards higher latitudes)
  - typical stereo angle @ equator: 30°
    (decreasing towards higher latitudes)

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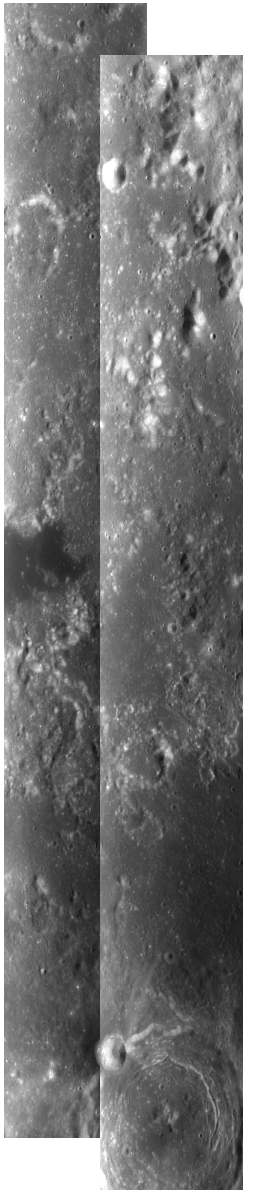

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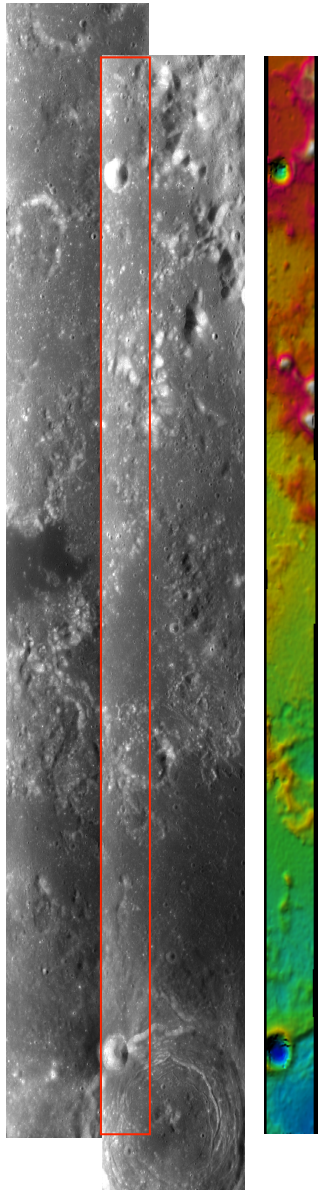
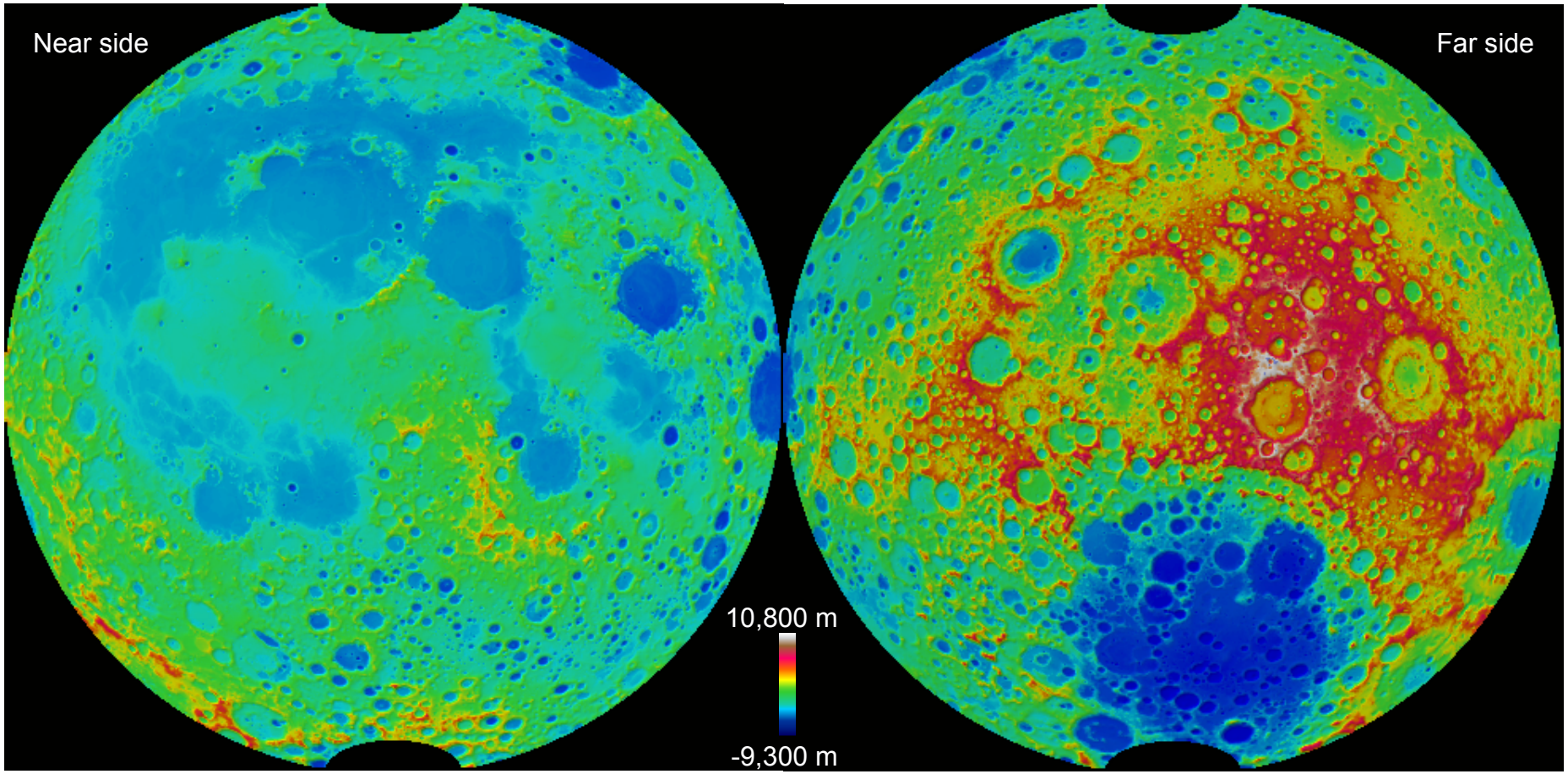
=> overall excellent conditions for systematic stereo processing and good prospects for global uniform (!) topographic coverage



Current GLD100, 100 m grid (public release @ LPSC2011)



Based upon ~50,000 LROC WAC stereo models

GLD100 Characteristics / LOLA Comparisons

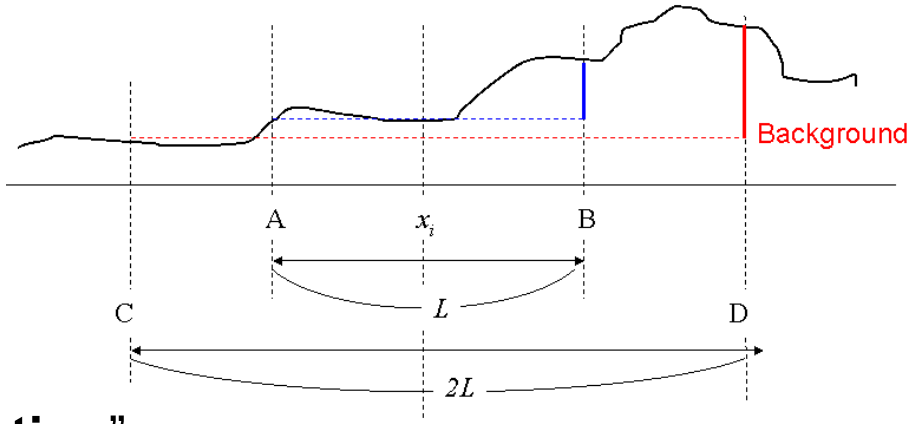
- GLD100: 60 billion data points (15 points per grid cell)
- 50,000 stereo models
- GLD100 limited to latitudes < 80° (owing to illumination conditions)
- LOLA cross-over analysis has been crucial for LRO orbit determination, from which all LRO instruments benefit
- Mean difference between GLD100 and LOLA heights: 4 m, 1-s RMS= 23 m (1/3 of WAC pixel)

Applications: Mapping of surface roughness and search for suitable landing sites

Studies of Surface Roughness

"**RMS differential slope**":

$$\theta(L) = \arctan\left[\frac{\nu(L)}{L}\right]$$



L: Baseline

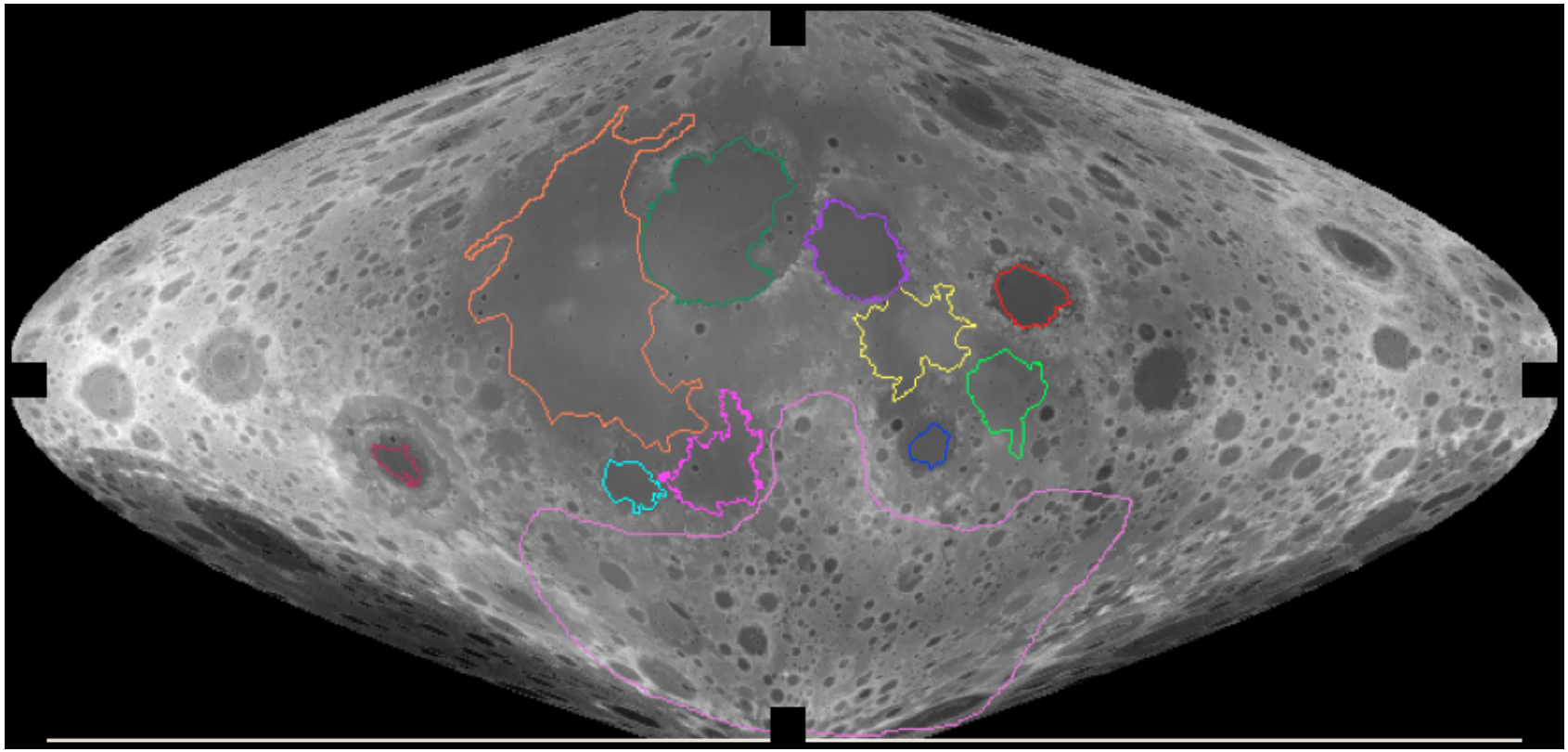
where "**RMS differential height deviation**" $\nu(L)$ is

$$\nu(L) = \sqrt{\frac{1}{n}\sum_{i=1}^{n}\left[(h_A - h_B) - \frac{1}{2}(h_C - h_D)\right]^2}$$

Yokota et al., Kaguya Team Meeting, Jan 2010

- Shepard M. K. et al. (2001), *JGR,* 106, E12, 32777-32796.
- Kreslavsky M. A. and Head J. W. (2000), *JGR,* 105, E11, 26,695-26,711.

- compute roughness at 3 different scales, 1-km, ½-km, 300-m; classify mare terrains according to roughness
- to be presented at LPSC 2011 (Robinson et al., 2011)



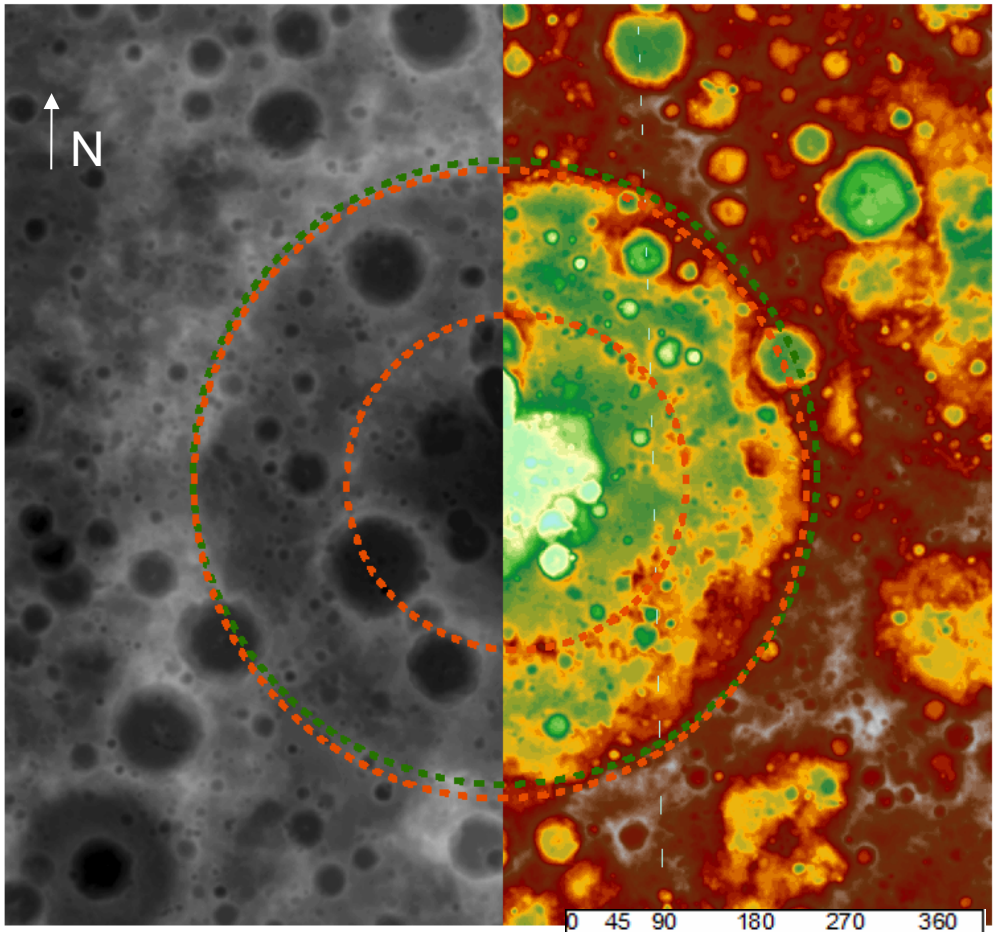
Applications: Search for Lunar basins

- major landforms dominating Lunar morphology, important time markers, and contributors to Lunar thermal history
- methods:
  - visual inspection of grey-scale and color-coded DTMs
  - inspection of shaded DTMs
  - search for rings by analysis of polynomial function fits
  - matched filters
  - histograms and hypsograms

Example: Freundlich-Sharonov

Grey scale and
Color-coded DEMs
to resolve
low-wavelength
topography

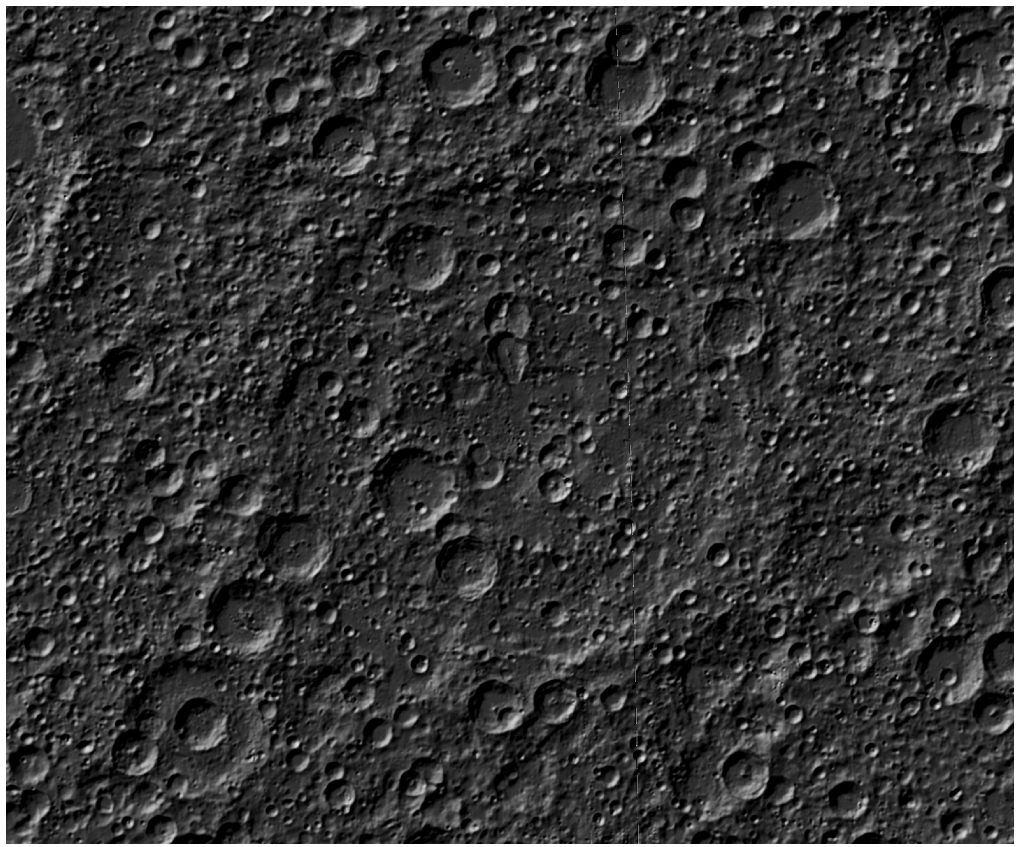
- location: 18°N,175°E
- diameter: 600 km
- measured rims
  I. a=605km b=590km
  II. a=325km b=320km



Shaded Reliefs

Artificially shaded reliefs to resolve high-resolution detail, such as rims

- different illumination directions used to avoid observational bias



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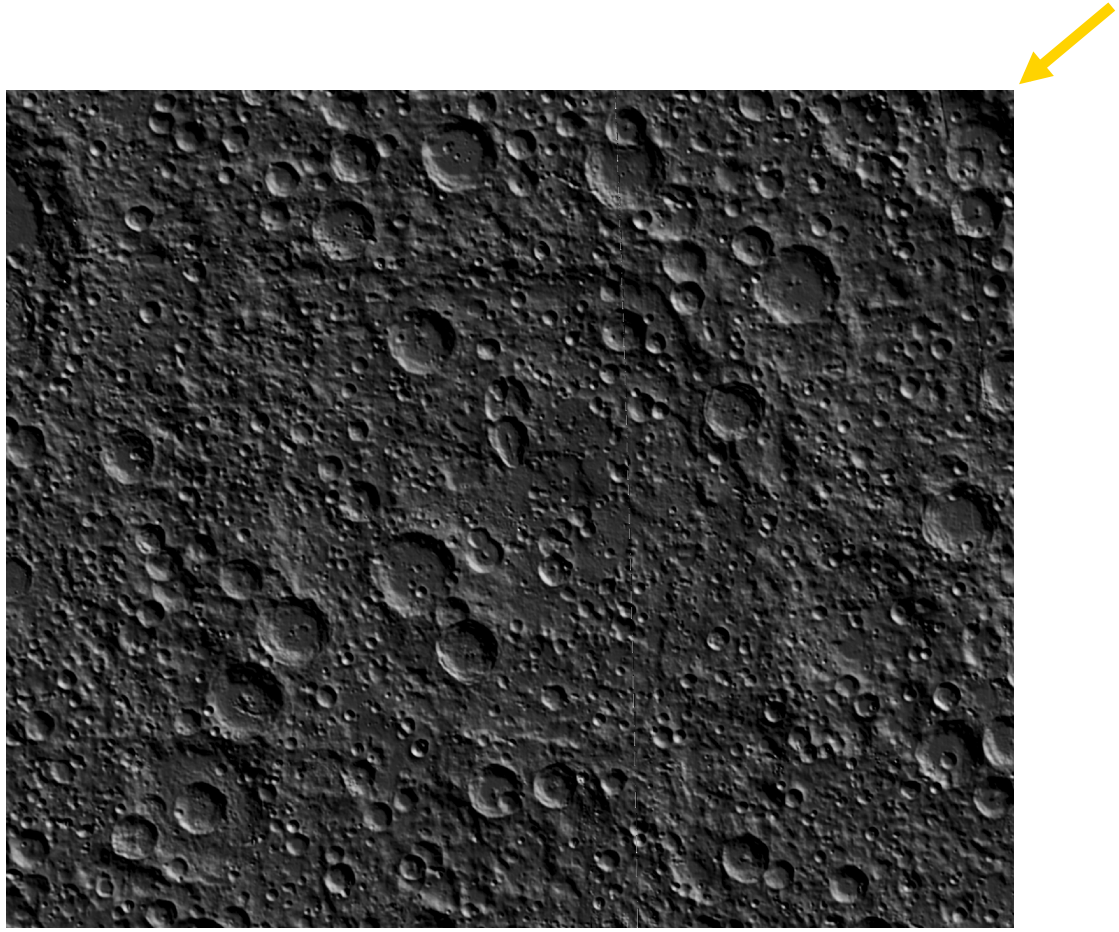
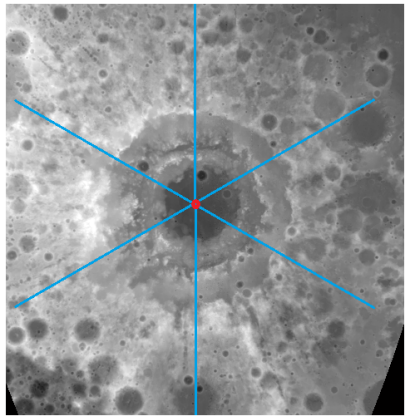
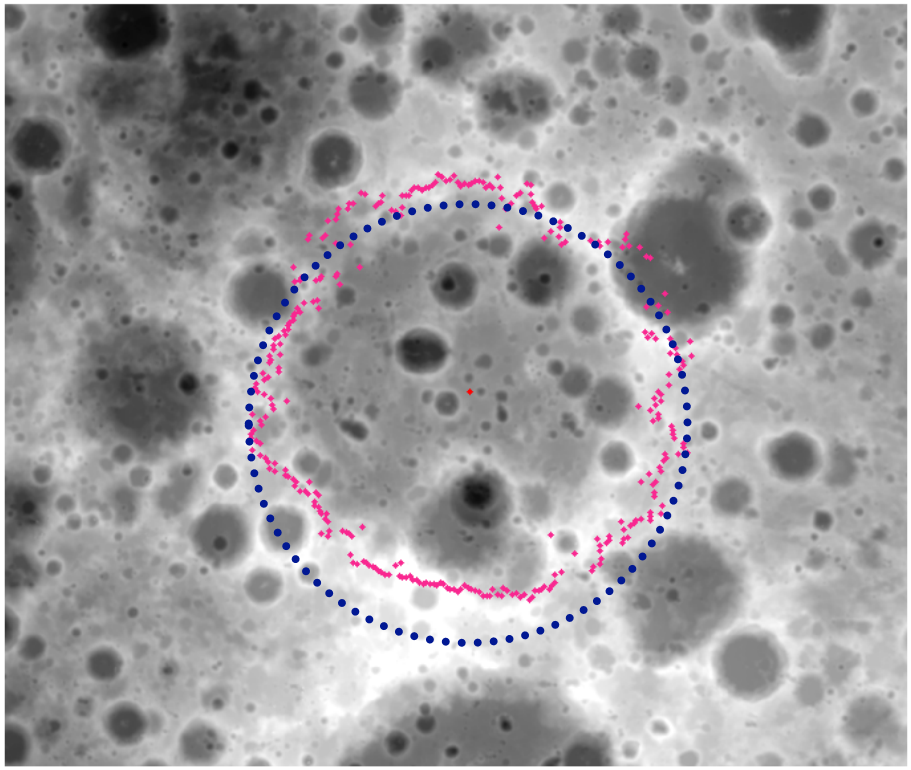


Example: Freundlich-Sharonov

Search for rings

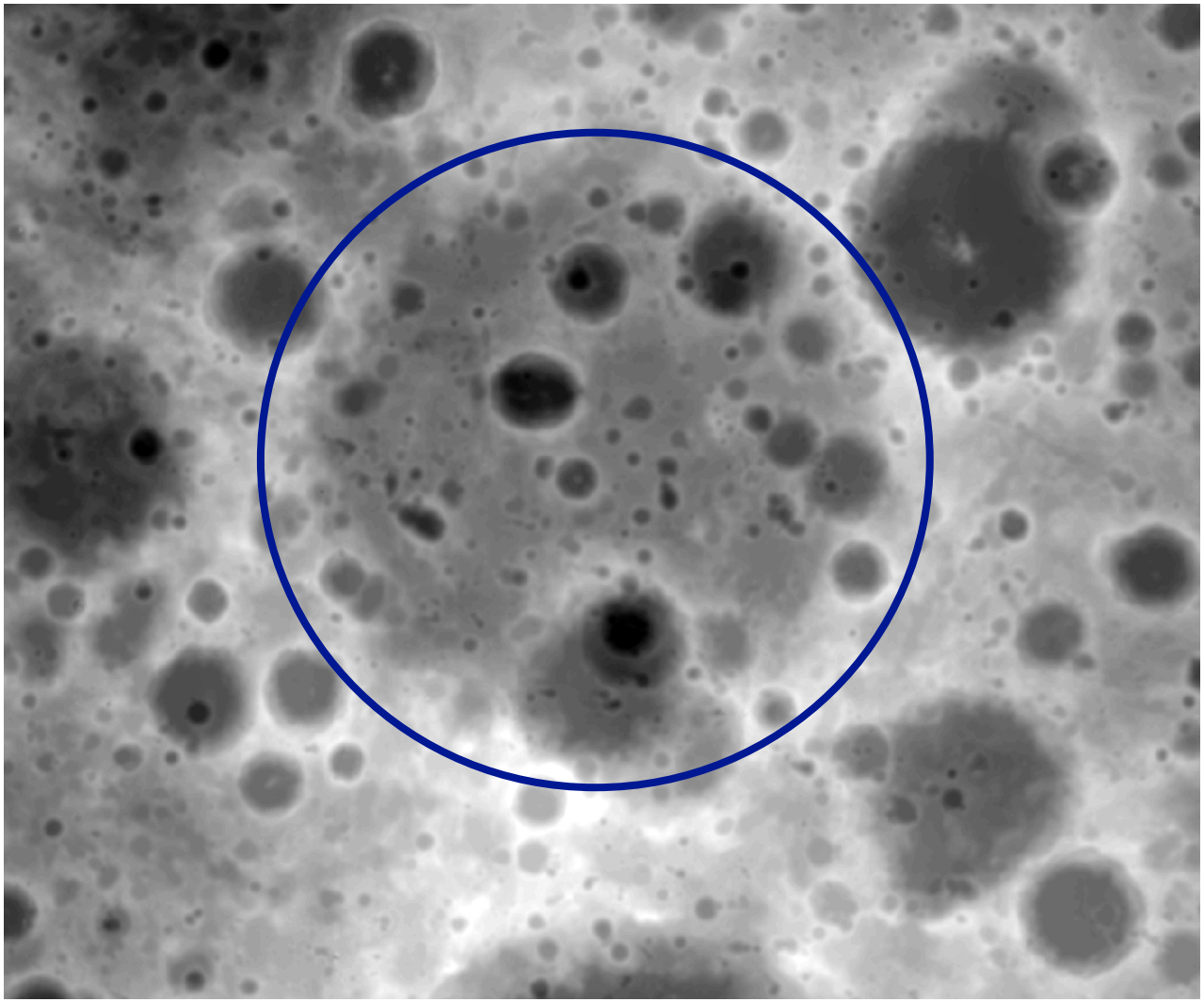
- draw radial profiles across basin, fit polynomial functions
- find local maxima
- rim diameter (circular / elliptic) found by fit



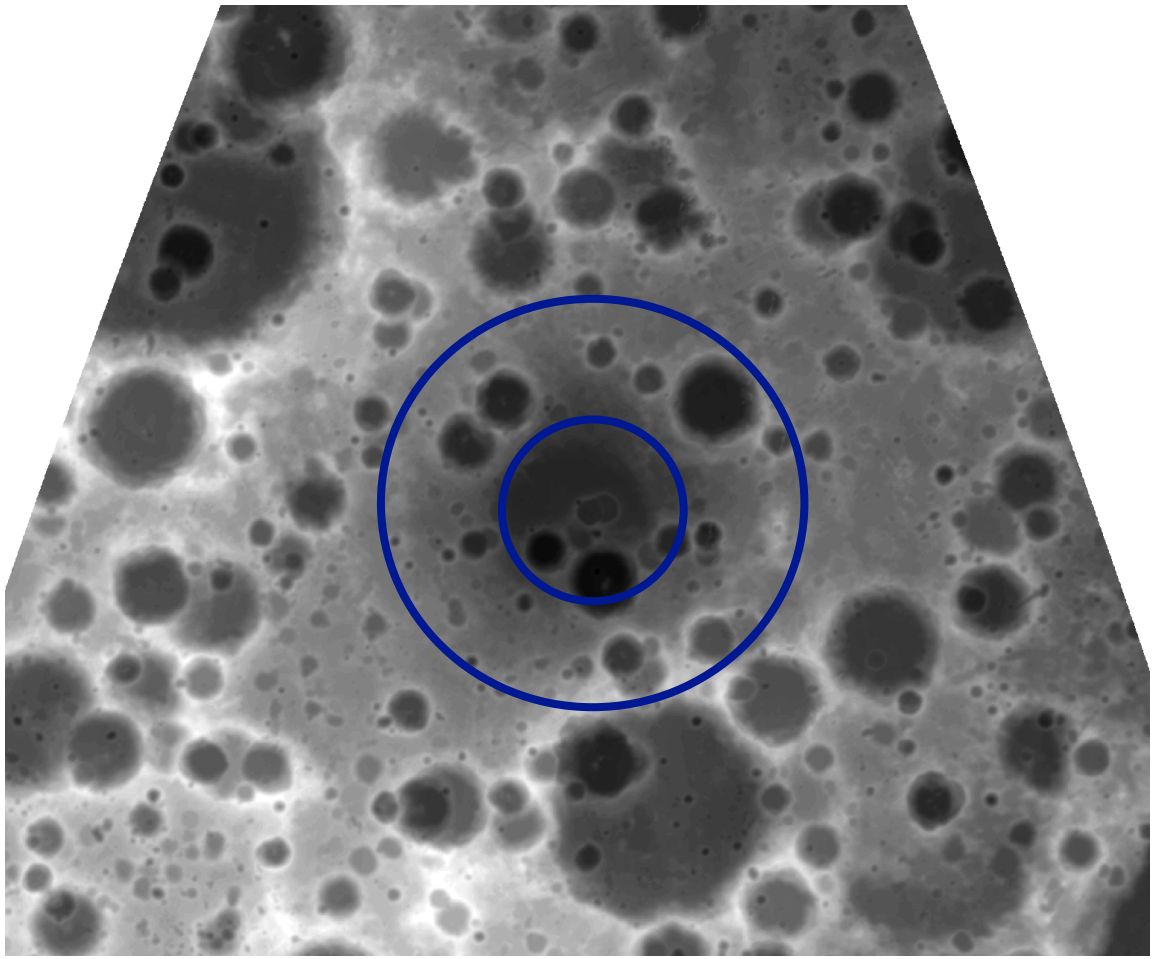


Example: Dirichlet-Jackson

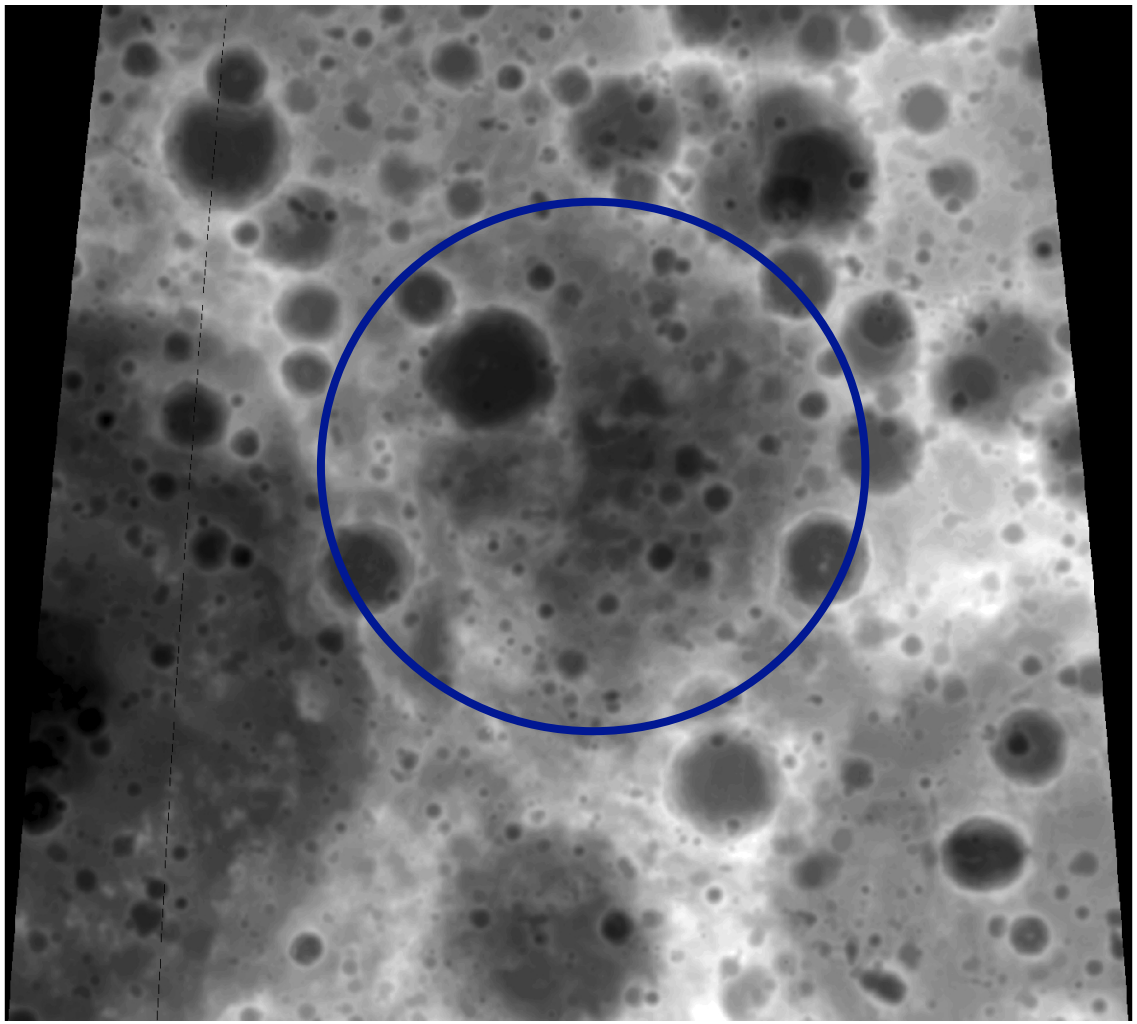
Dirichlet-Jackson



Coulomb-Sarton



Fitzgerald-Jackson



Thank you for your attention!