# Scientific Operations and Data Processing for Wide-Angle Polarimetric Camera (PolCam) onboard Danuri

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## Introduction

- **Danuri**: South Korea's first lunar orbiter was launched on Aug. 5, 2022.
- **PolCam**: The wide-angle **Pol**arimetric **Cam**era is the first payload to measure the polarimetric properties of the Moon.
- It operated in high-resolution mode (about 35 m/pixel) from 1 Apr. to 30 Nov., 2023.
- We introduce
  (1) a brief overview of the operational progress until November this year,
  (2) the overall procedure of data processing software, and
  (3) data formats for the upcoming public release.

## Public Data Release

- The data is available from 1 Apr.
  (We operated test observation before Apr.)
- Format: PDS4 (Image & XML label)
- 2-D image data
  - ✓ Raw data
  - ✓ Longitude, Latitude,
  - ✓ Incidence, Emission, Phase angle

## Future Work

- Radiometric calibration
- Photometric calibration with lunar topography
- Level 2 data production
  - ✓ Maximum polarization ($P_{max}$)
  - ✓ Grain size distribution
  - ✓ Titanium distribution

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## Routine Operations

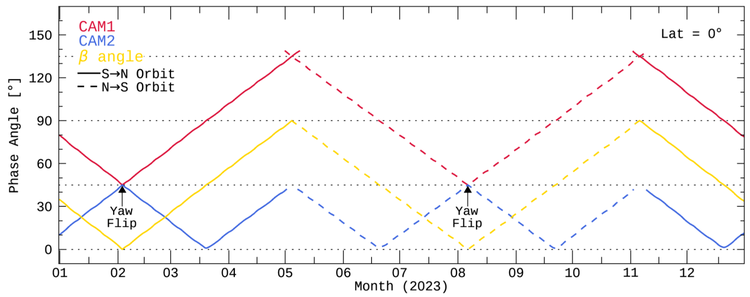



**Fig. 1**. Phase angle of the PolCam and sun-beta angle for one year.

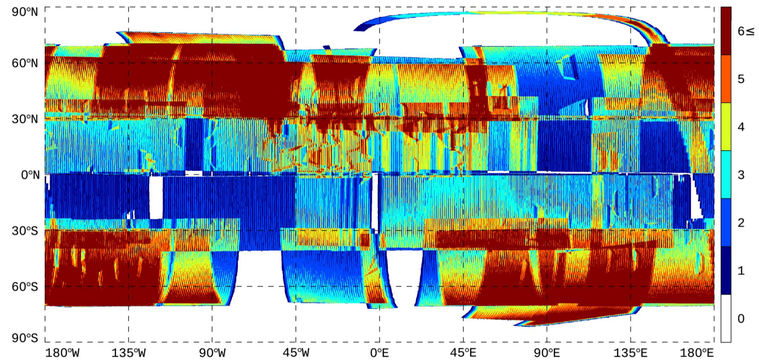
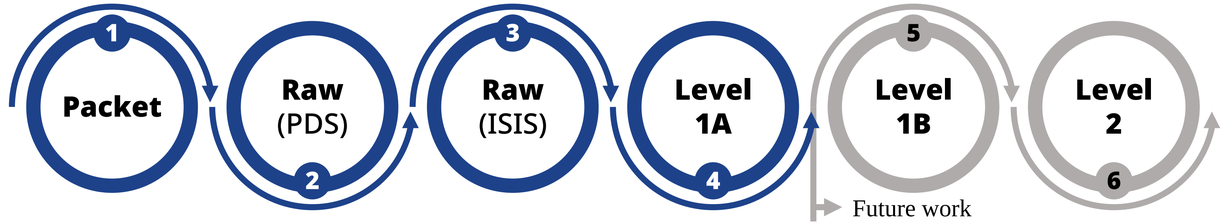



**Fig. 2**. The number of the PolCam observation on the lunar surface from 1 Apr. to 30 Nov., 2023.

## Data Processing Pipeline (with SPICE kernels)




All steps are being prepared to utilize both self-developed programs and ISIS software.

- Raw (PDS) & Level 2: IDL or Python programs
- Raw (ISIS): **polcam2isis** (ongoing work)
- Level 1A: phocube*, cam2map*
- Level 1B: photomet* (* ISIS application)

### 4 Geometric Correction

(with Digital Shape Kernel)

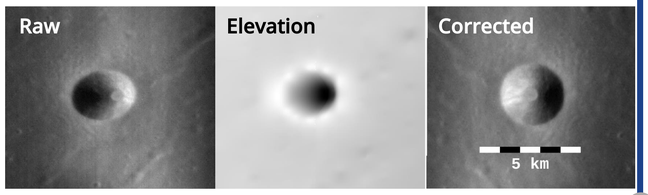



**Fig. 6**. Raw, elevation from Digital Shape Kernel (DSK), and geometric corrected data.

### 2 Flat-Field Correction

- Flats were generated with reference to the ISIS application, `lromakeflat`.

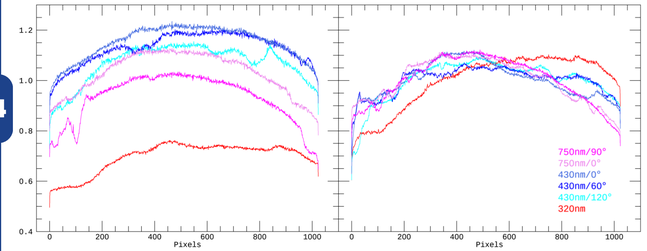
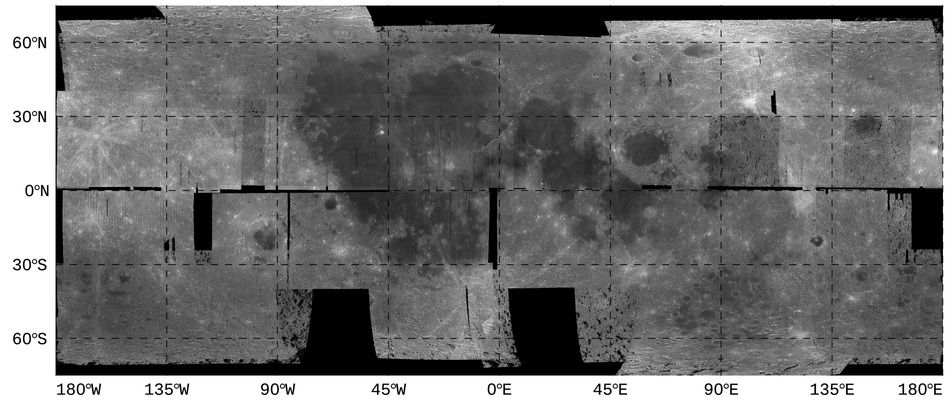



**Fig. 5**. Flats for each channel (Left) measured in a ground laboratory and (Right) created by observation data.

### 5 Global Mapping

- On developing the ISIS application…
  **`polcam2isis & camera model class`** of the PolCam

**Fig. 7**. Low resolution (32 ppd) map of channel 4 (430 nm band & 0° polarizer).




## Frame & Instrument Kernels Adjustment

### Tilted Angle

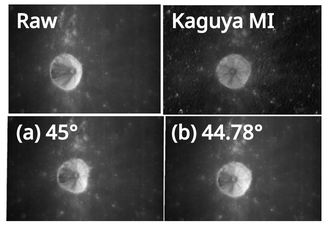



**Fig. 3**. Results for geometric correction (a) before and (b) after adjusting tilted angle from 45° (designed value) to 44.78° (estimated value).

### Field of View (FoV)

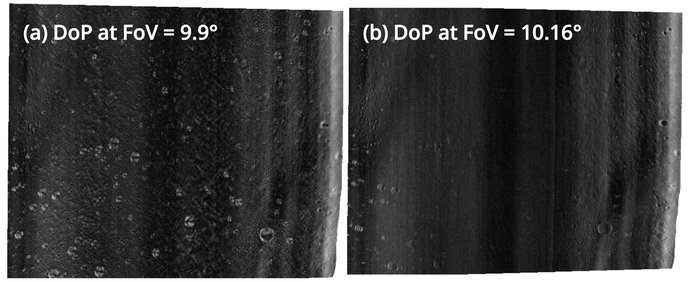



**Fig. 4**. Degree of Polarization (a) before and (b) after adjusting FoV from 9.9° (designed value) to 10.16° (estimated value).