CLARREO Pathfinder will observe the Moon as a secondary mission objective

Potential applications of CPF lunar measurements:
• lunar inter-calibration
  – using the Moon as a common target
• improved knowledge of lunar reflectance
  – for advancing development of lunar models

The radiometric quantity used for lunar calibration is spatially integrated irradiance
• requires observing the complete Moon disk
  – to be accomplished with CPF RS by scanning
• adds complexity to deriving measurements from line-scanning sensors
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The accuracy achievable for lunar irradiance measurements by CPF remains to be demonstrated
Technical issue — scan oversampling

• CPF Moon images will be composed of concatenated scan lines
• The 2-axis gimbal CPF pointing system means Moon scans will trace a curved path over the lunar disk

This leads to different oversampling for each lunar image pixel
  – oversampling correction is a matrix operation
  – the algorithm for generating the oversampling matrices is still in development
Technical issue — scan oversampling

• The oversampling factor is a critical component of lunar irradiance measurements from images:

\[ E_{\text{meas}} = \Omega_p \sum_{i}^{N} \frac{1}{\eta_i} L_i \]

- \( \Omega_p \) = pixel IFOV (solid angle)
- \( \eta_i \) = pixel oversampling factor
- \( L_i \) = pixel radiance
- \( N \) = # of pixels on Moon

• Each term on the right carries an uncertainty
  – radiometric calibration applies only to the pixel radiances \( L_i \)
  – combination of terms means lunar irradiance measurements cannot reach the same level of accuracy as the sensor radiometric calibration

• TBD: the level of uncertainty in CPF oversampling factors \( \eta_i \)

• Potential to develop cutting-edge techniques for measuring lunar irradiance
Application: lunar inter–calibration

- The Moon can be observed as a common target for multiple sensors
  - the lunar surface reflectance has exceptional photometric stability, better than $10^{-8}$ yr$^{-1}$

- Lunar inter-cal requires using a lunar model
  - the apparent lunar brightness changes continuously
    - relatively rapidly when viewed from orbit
  - all Moon observations have different geometries, thus different irradiances

- Inter-calibration of sensors to CPF using the Moon is technically feasible
  - CPF Science Planning System (SPS) can predict opportune observation events
  - uncertainties in lunar model predictions are reduced for closely matched view geometries
Application: lunar reference database

• The lunar calibration reference is a predictive model
  – to accommodate the continuously changing lunar brightness

• Lunar model development follows from extensive radiometric characterization measurements
  – minimum 3 years required to sample geometry variations
  – USGS ROLO observations spanned more than 8 years
    • dedicated observatory in Flagstaff, AZ

• Advances in lunar modeling need a new collection of high-accuracy measurements
  – to achieve absolute lunar calibration with sub-percent uncertainty

• Numerous opportunities for CPF to view the Moon are anticipated
  – potential to build up a substantial database of lunar irradiance measurements
Thank You!