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FOR EARTH SYSTEM RESEARCH
AND SUSTAINABILITY (CEN)

The Radiometric Calibration Drift of CrIS

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Photo: UHH/Lutsch

Agenda

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Introduction: Observations of the Moon With CrIS

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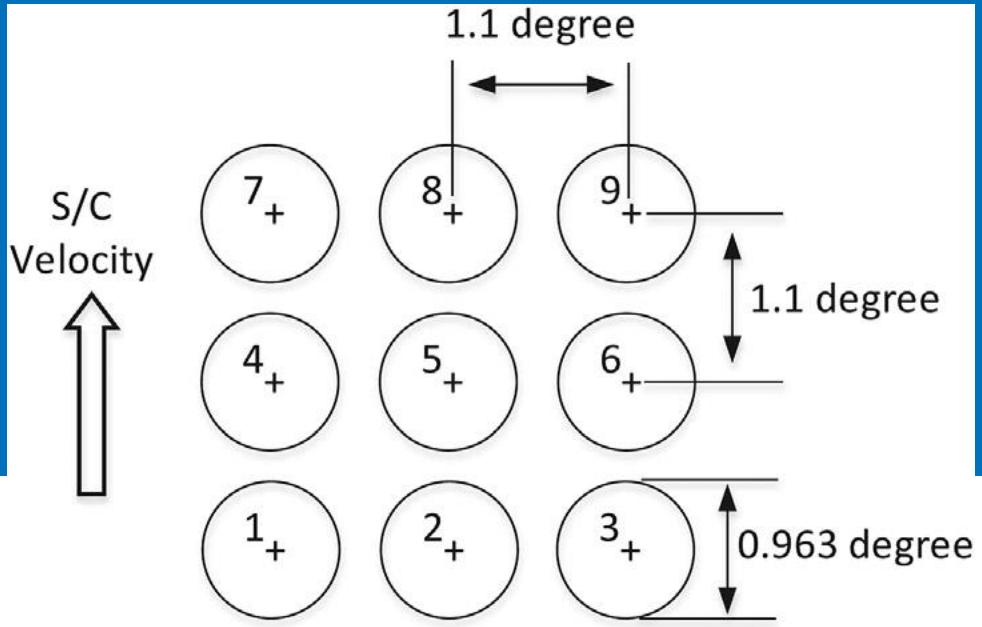
Photo: UHH/CLICCS

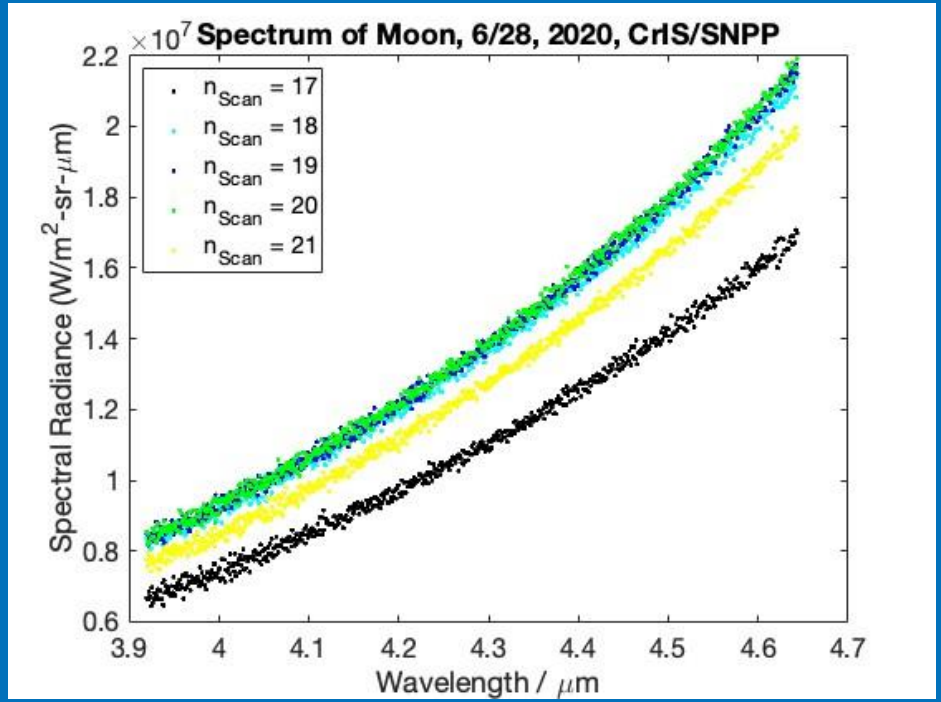
CrIS footprints in the sky

- Diameter of Moon: ≈ 0.5°
- Diameter can vary by up to 14%.
- DS and ICT fill the FOV ☞correction factor



Spectra From Consecutive Scans

- (Almost) same flux from Moon in 3 consecutive scans (8 sec apart, FOV 1)
- Moon very close to center of FOV in scan 19
- Compare to calculated angle between 🌜 and CrIS line-of-sight vector in ECI
- Discrepancy ≈2° or ≈2 min
- Pointing improvement (Likun Wang)



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Available Observations

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Photo: UHH/CLICCS

A Unique Dataset

Thousands of *Spectra (made available by Yong Chen)*

- 650 – 1095, 1210 – 1750, 2155 – 2550 cm^{-1}
  - SNPP since Oct 2011 (Dec 2014)
  - NOAA-20 since Nov 2017
- Several obs. in 2-4 FOVs per “Moon orbit“
  - 667 events with SNPP available
  - 326 events with NOAA-20

Only SW Presented Here

- SW is free of artifacts (Christiansen feature, “ringing”)
- SW receives similar fluxes from Moon as from Earth
- More to come…

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Methods: Making Different Observations Comparable

Photo: UHH/CLICCS

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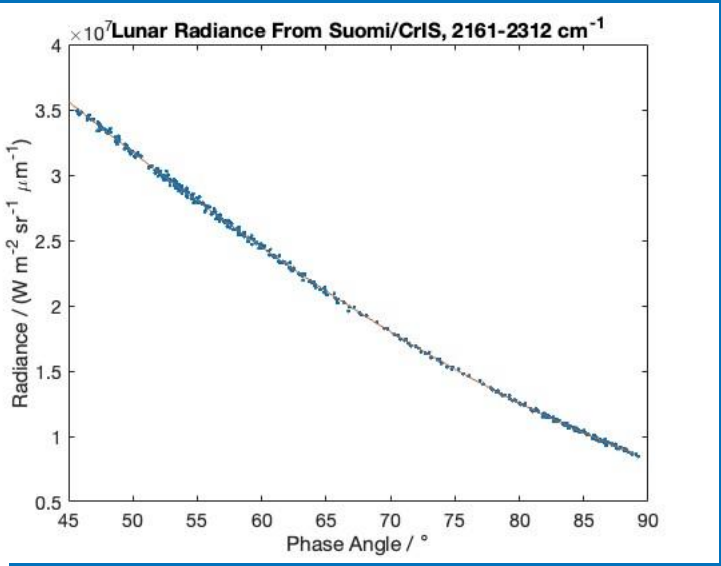
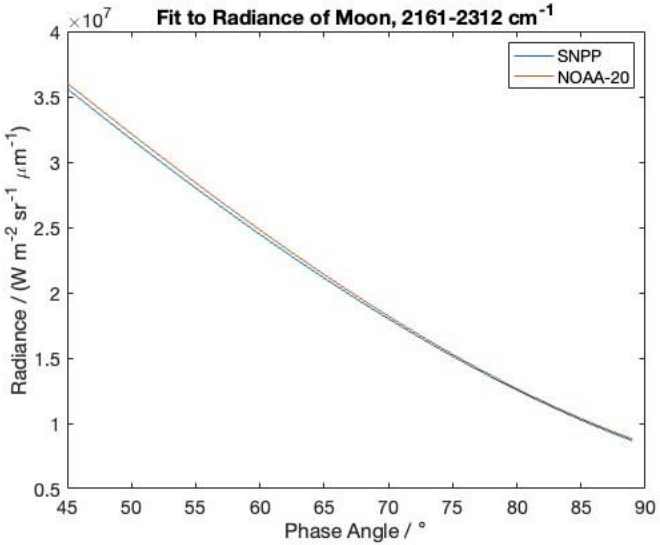
Radiance = f(phase angle)

- Radiance needs scaling by factor $(D_{FOV}/D_{moon})^2 \approx 3.4$
- $L_{2237}(45°) = 4.1 \times L_{2237}(90°)$
- CrIS on SNPP and NOAA-20 agree at First Quarter, but not at Waxing Gibbous.
- ☞ FOV probably equal
- SWIR not linear?





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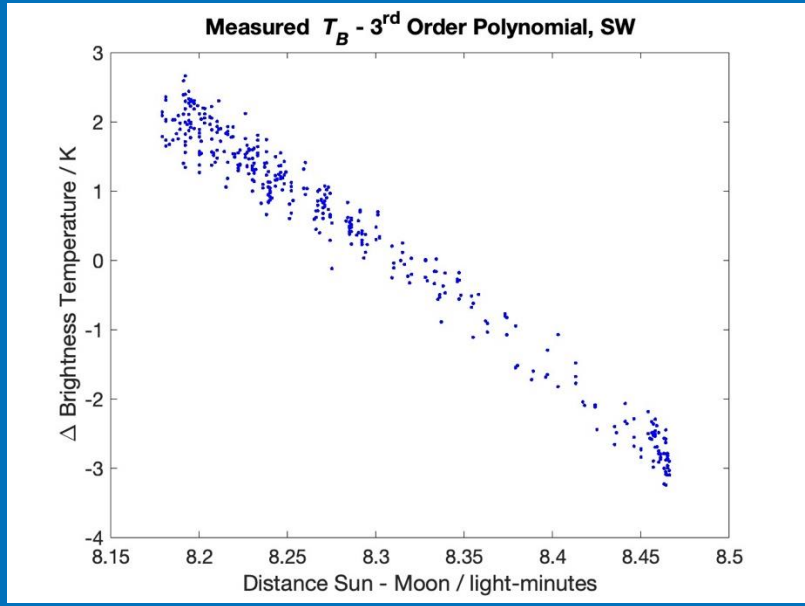
Radiance = f(distance Moon - Sun)

- Fit to Brightness temperature = f(phase angle) subtracted
- Wien approximation means ΔT_{Br} is equivalent to $\Delta L/L$.
- T_{Br} of Moon decreases with increasing distance from Sun.
- Slope of decrease differs from SNPP to NOAA-20 by only a few %.



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Results: Is There a Radiometric Calibration Drift of CrIS?

Photo: UHH/CLICCS

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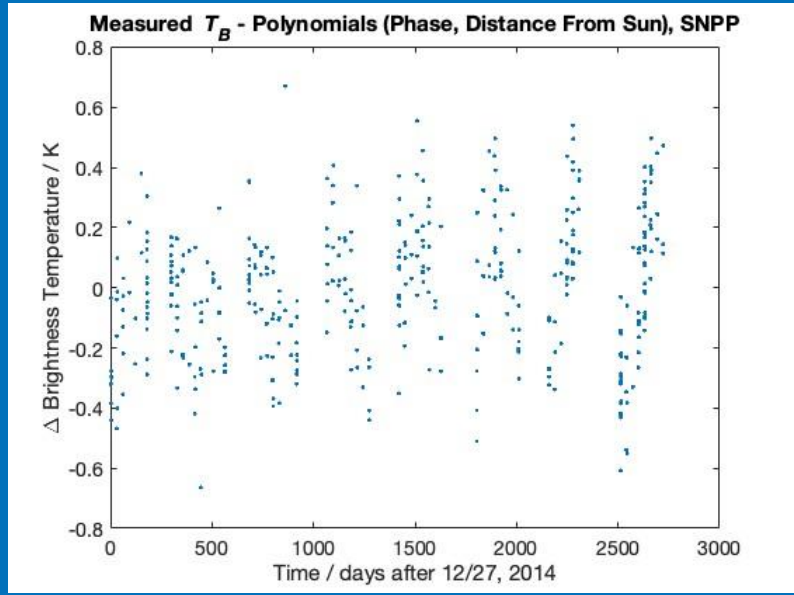
Measured Radiance = f(time)?

- Correlation between ΔT_{Br} and time is positive for either sat.
- Two-tailed probability for Pearson correlation coeff.:

SNPP has 0.00004

NOAA-20 has 0.3

- Confidence for presence of calibration drift $\approx 4\sigma$.
- Error > 0.1 K per decade (95% confidence) for SNPP



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Conclusions

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Photo: UHH/CLICCS

Characterisation of CrIS In-Flight With the Moon

- Pointing check in 2 directions far off Earth
- Bias between SNPP/N-20 as a function of flux
- Check of diameter of FOV
- Check of radiometric stability
  - ✓ Trend for SNPP ⚡ previous finding by x3
  - ✓ Lunar radiance is perfectly reproducible.
- IR spectrum of 🌙 with 0.2 K absolute accuracy
  - ✓ Empirical model of Moon as IR reference

Illustration: UHH/Vogiatzis

Open questions and discussion

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