



HARP: Hyper-Angular Rainbow Polarimeter CubeSat

PI: J. Vanderlei Martins¹,

Science and Algorithm team: Brent McBride¹, Xiaoguang (Richard) Xu¹,
Noah Sienkiewicz¹, Anin Puthukkudy¹, Henrique Barbosa², Lorraine Remer¹

Payload Design Leads: Roberto Fernandez-Borda¹, Dominik Cieslak¹

Spacecraft team: Tim Neilsen³, Ryan Martineau³, Cameron Weston³

1- UMBC Earth and Space Institute and JCET-UMBC/NASA GSFC

2- University of Sao Paulo

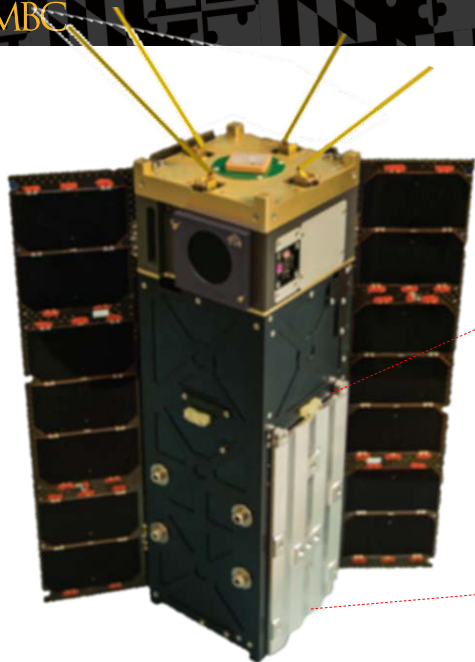
3- Space Dynamics Lab (SDL)



UMBC

HARP CubeSat Technologies

NASA-ESTO InVEST Program



SDL Spacecraft

Launched: Nov 2nd, 2019
ISS Deployment: Feb 19th, 2020
First light: April 15th, 2020

UMBC Sensor



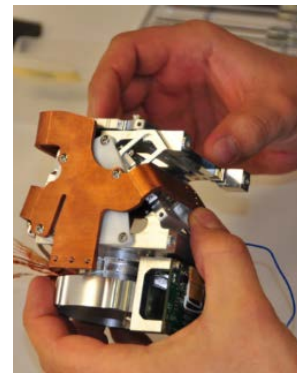
Wide FOV
Optics

HARP Prism

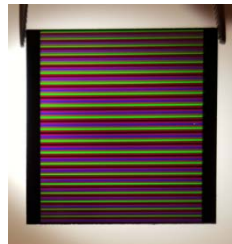


I, Q, U

HARP VNIR Telescope

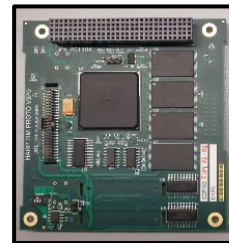


3U size

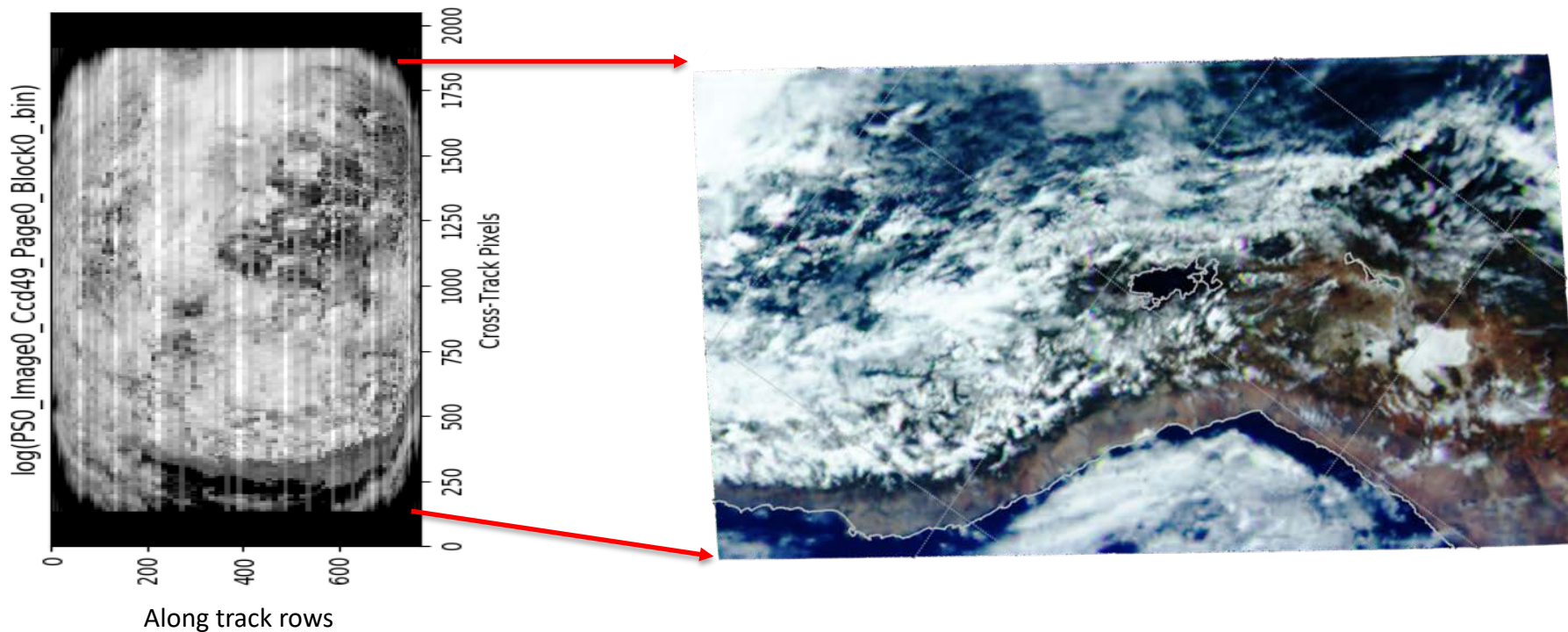


HARP Stripe Filter

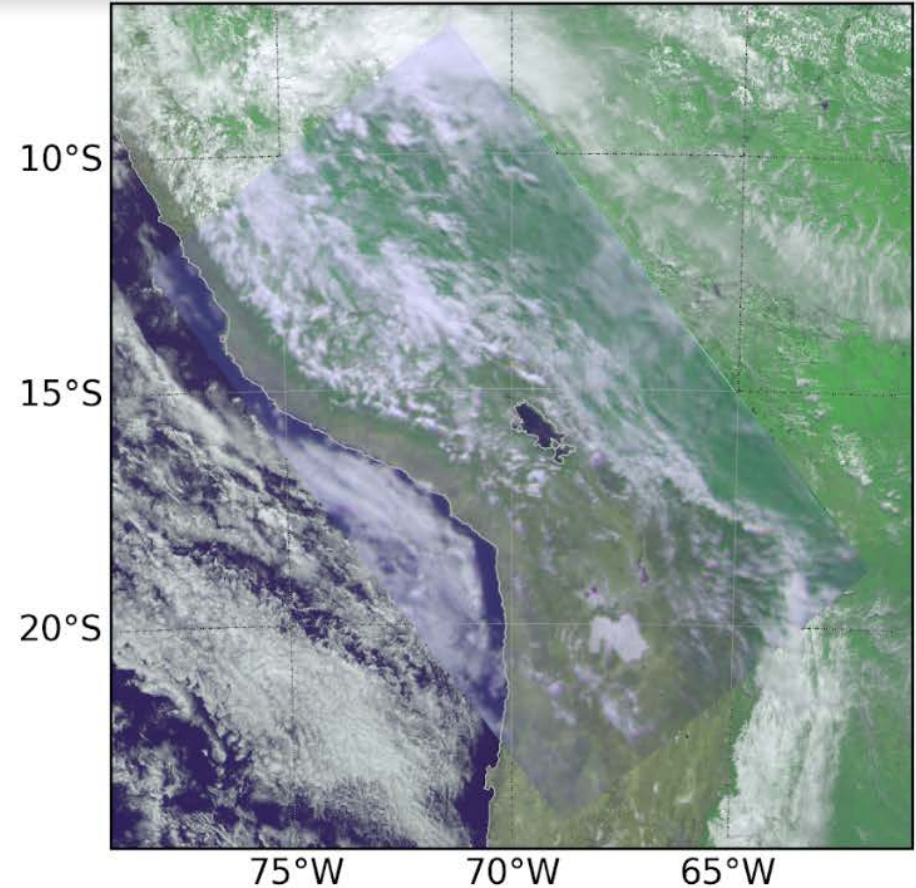
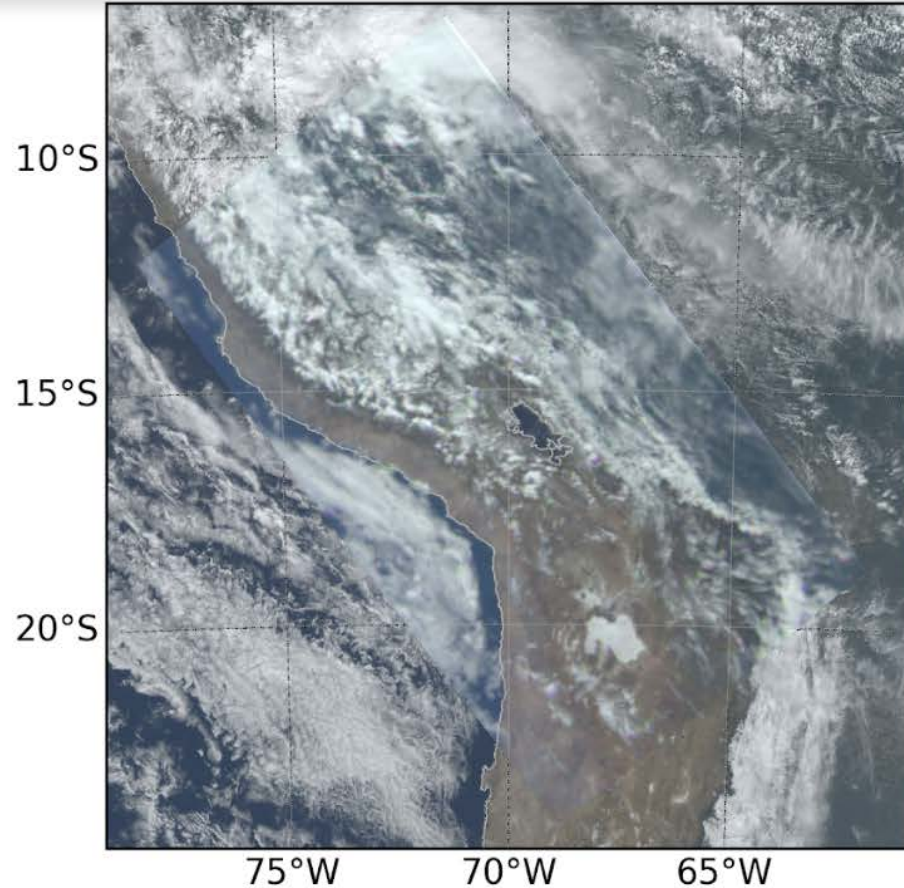
Camera and FPGA Electronics

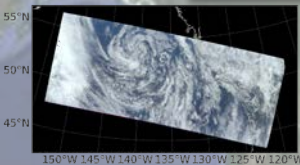


Original HARP images



HARP Image on top of GOES 16 - ABI

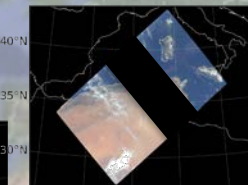




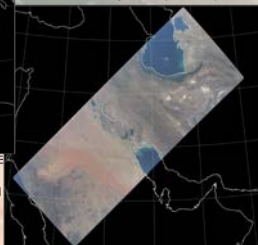
06/11
23:28:55

150°W 145°W 140°W 135°W 130°W 125°W 120°W

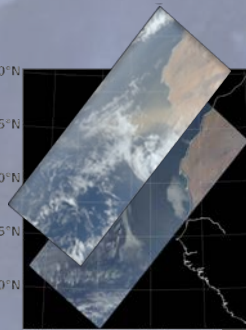
06/13
12:42:15



06/14
5:21:31



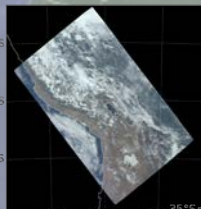
06/13
9:09:47



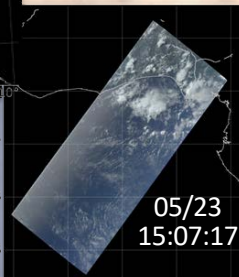
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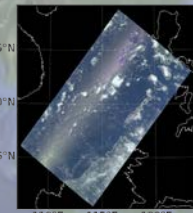
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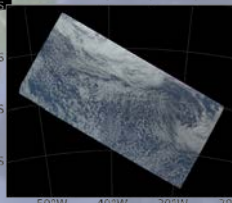
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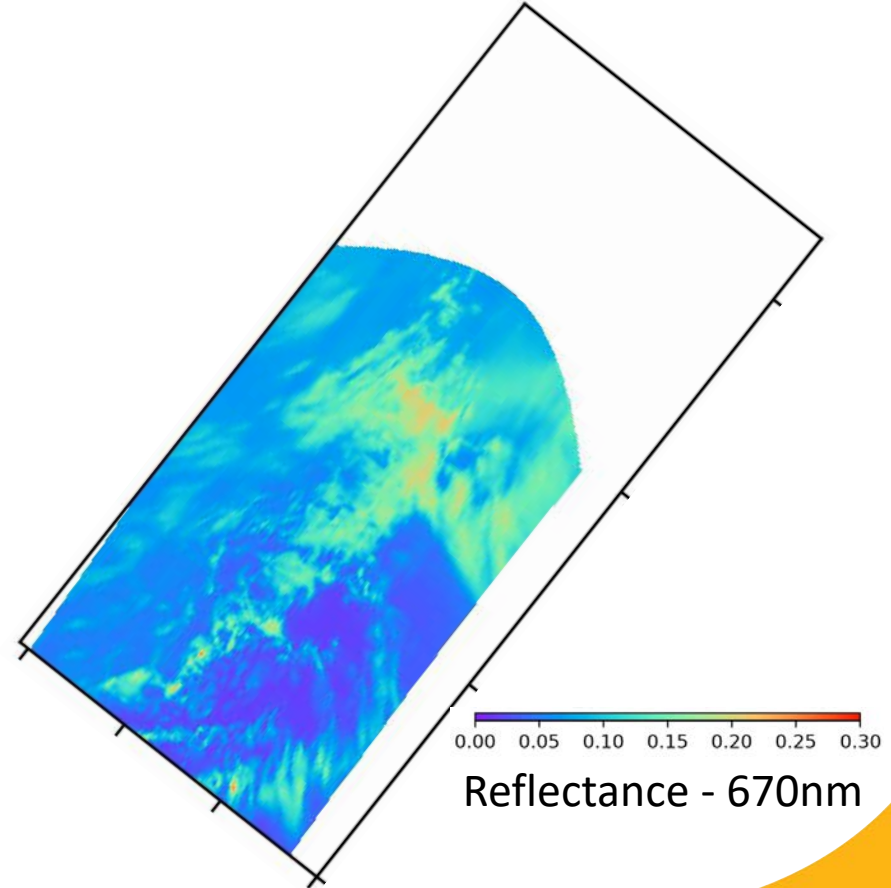
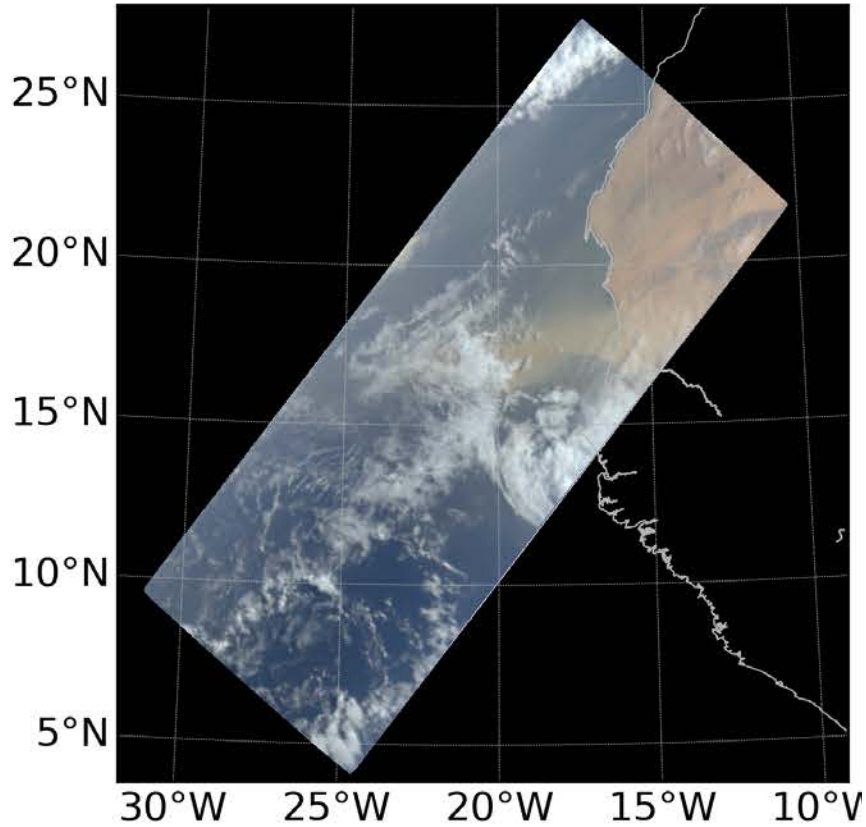


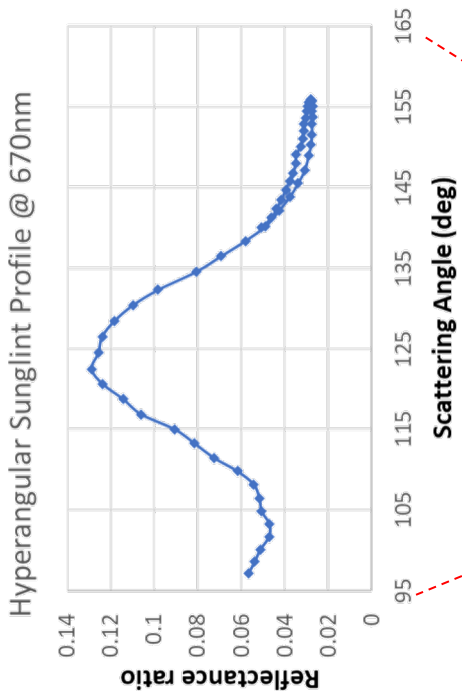
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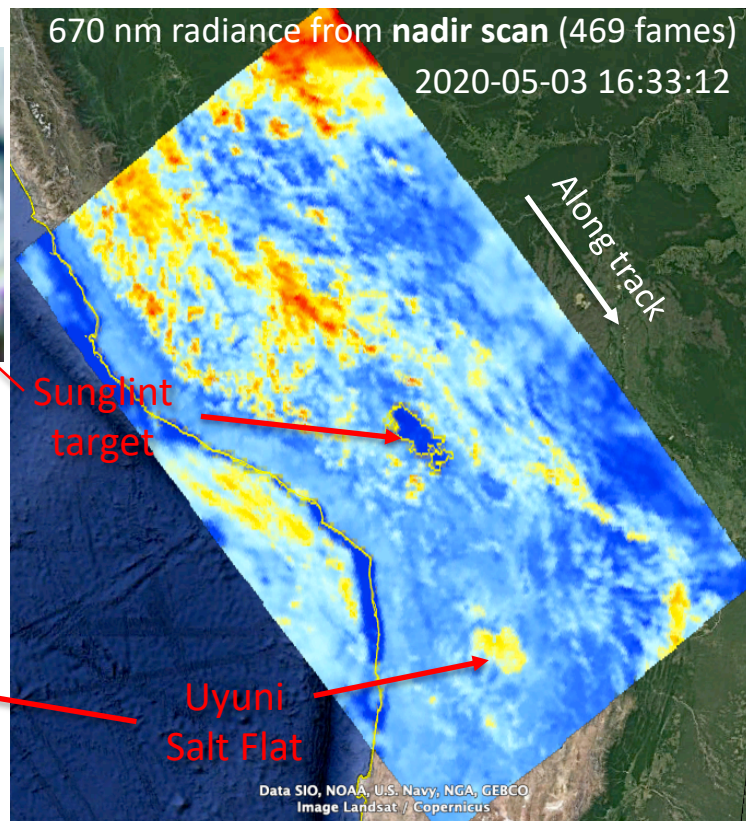
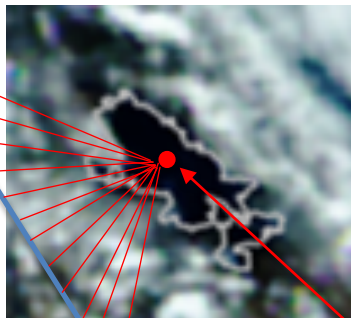
05/06
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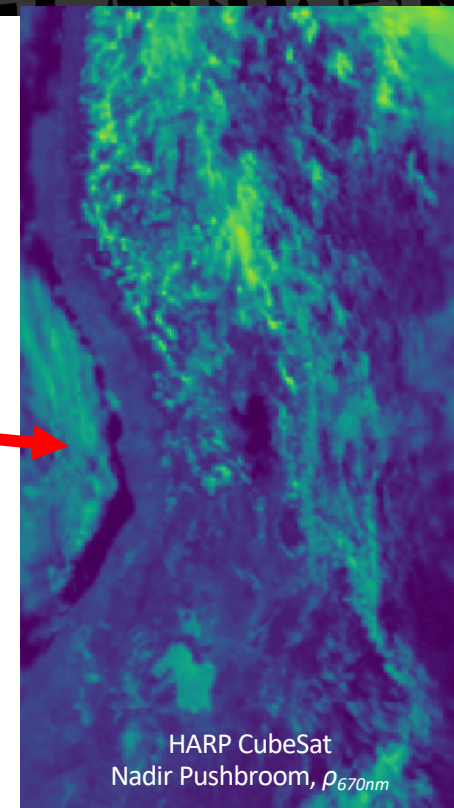
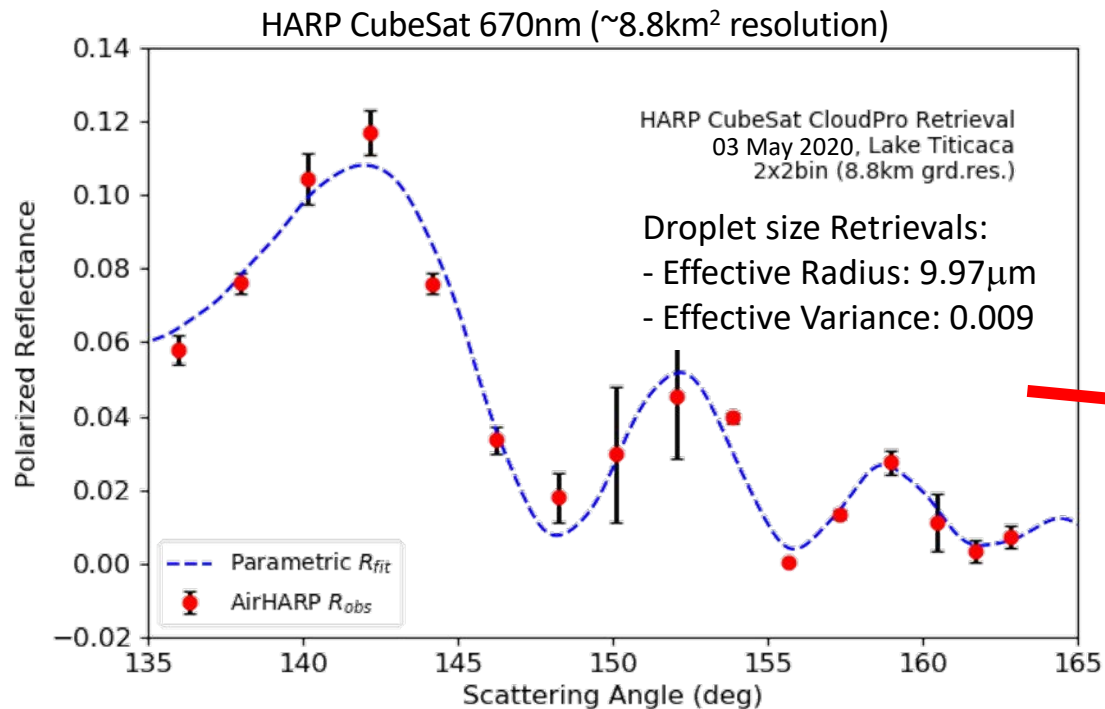




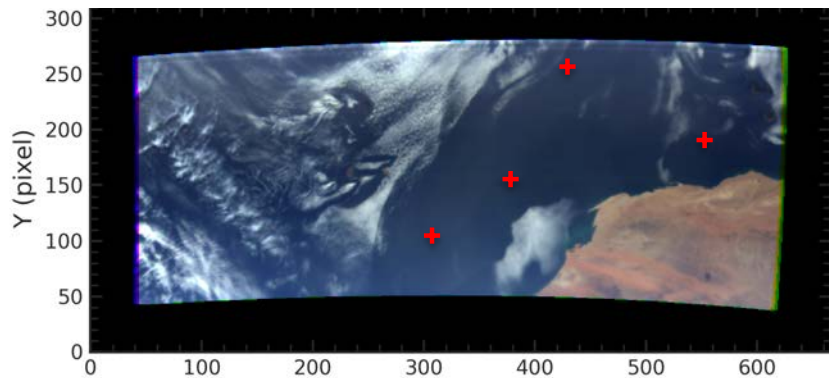
Hyper-Angular sampling



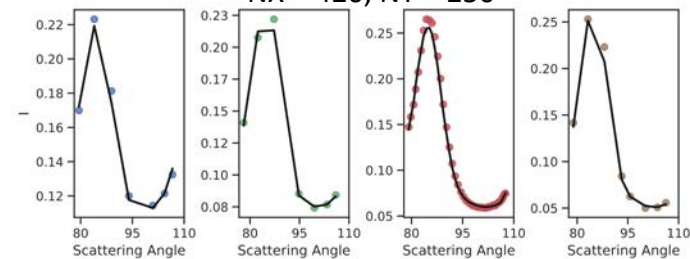
First Hyper-Angular Cloudbow Retrieval from Space



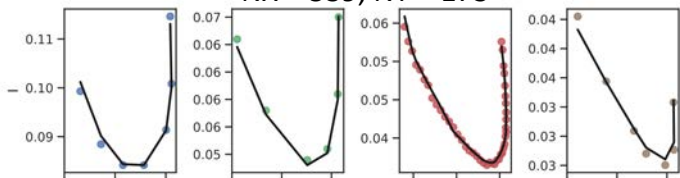
- *HARP holds the first demonstration of a Hyper-Angular cloudbow retrieval from Space*
- *Retrieval is performed at the pixel level*



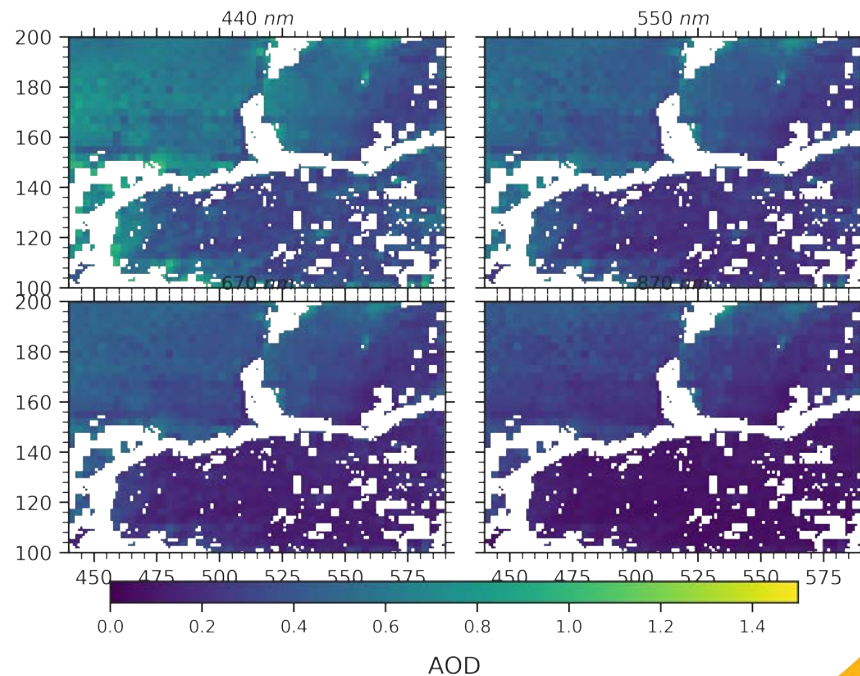
NX = 420, NY = 250



NX = 539, NY = 173



Preliminary retrieval attempt with Radiance and Degree of linear Polarization

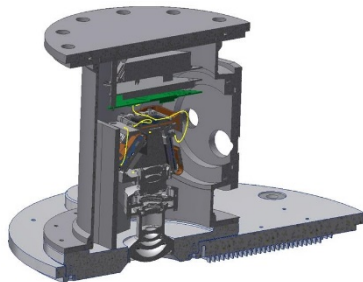




The HARP Polarimeter Family



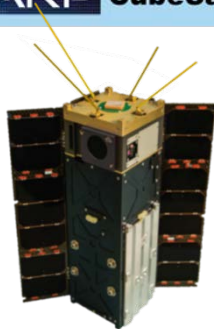
Air HARP



Airborne System

- Frequent Ground calibration
- ~40m resolution
- Potential for HARP2 Cal/Val
- Has flown two successful flight campaigns

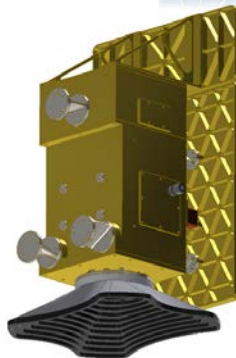
HARP CubeSat



Launched to ISS Nov 2nd, 2019 Deployment Jan 2020

- 4 km resolution
- Limited data set: 1 snapshot/day
- No calibrator onboard/only vicarious

HARP2 PACE

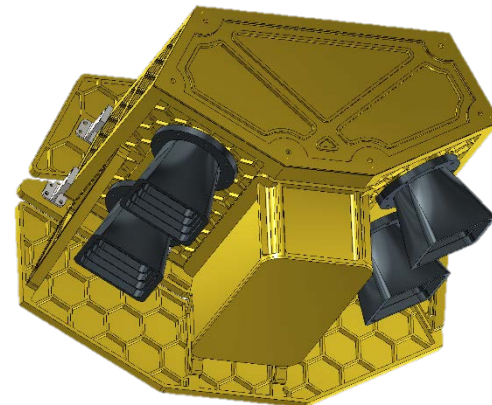


Launch: 2022-23

- Improved SNR
- Better calibration features
- ~3 km resolution
- Global coverage in 2 days

HARP2 UV-SWIR

Concept Under Development



New Concept Under Study

- Extended Wavelength range
- Improved SNR
- Full calibration features
- ~0.5km resolution

Current Projects

Thank you.