

# How Does it Work: H RP2

#### PACE-TRAINING 2022

Presenter: Noah Sienkiewicz



### **WIMBC** Presentation Overview

#### HARP Family

- Inner workings of HARP
- Compositing of HARP image data
- Data results and campaigns
- Level 2 science output



#### **WORC** A brief history of Space Polarimeters



# **WINBC** HARP2's Place on PACE



UMBC HARP MultiAngular Capabilities

HARP provides views of a ground target from many different viewangles, revealing different scene characteristics



•60 angles at 670nm
•10 angles at other λ
•+/- 114 deg along
track
•94 deg cross track



AirHARP ACEPOL campaign data, May 25th 2017, credit H. Barbosa.

#### **WOMBC** How HARP Separates Intensity

Full resolution HARP images show the spectral "stripe filter" partitioning the CCD.

Madagascar Full Frame. Unsampled





The stripe filter can be adjusted by use of "line tables" to sub sample images for data bandwidth control.

#### 950 Madagascar Full Frame. Sampled W/ CAA

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# **WORC HARP Product: Pushbrooms**

- HARP "pushbrooms" are concatenate images of single CCD lines across the hundreds of images in a single "capture"
- A single HARP capture will generally consist of 600 700 frames, taken across 5 to 6 minutes (capture rate is 2 Hz)

#### Red nadir pushbroom



HARP Spectral Channels:

440 nm 550 nm 670 nm 870 nm

#### HARP-2 can provide spatial maps of climate-relevant properties



AirHARP Observation during ACEPOL 2017 Grand Canyon, AZ, October 27



Retrievals expected for broken, trade-wind, popcorn cumulus!

#### **WEARP** Measures Polarization



# **WUMBC** HARP Calibration Pipeline



# **WUMBC** ACEPOL: 9 flights, 41.3 hours







Public data release: <u>https://www-</u> <u>air.larc.nasa.gov/cgi-</u> <u>bin/ArcView/acepol</u>



#### UMBC Aerosol model fits the measured (I, Q, U)





(23-Oct-2017) (23-Oct-2017)

Solid circles are the AirHARP data points and black line is the GRASP fit Blue: 440nm band, Green: 550nm band, Red: 670nm band and Brown: 870nm band

## **WINBC** HARP Capture Map



# **WIMBC** HARP Capture Map



### **WHAC AirHARP L2 products**



Saharan Dust Leaving Africa





Multi-Angle CubeSat





June 13<sup>th</sup> 2020





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NOAA

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### BONUS

# **VMBC** PACE Mission Swath



- OCI and HARP2: 2650km Global coverage in 2 days
- HARP2 nadir: 1550km
- **SpexOne**: ~100 km



Thank you.

PACE







HARP measures (I, Q, U)<sub>scatt</sub> for every wavelength and every 0.30 -440nm pixel in up to 60 different viewing angles - 0.20 0.10 -Isca - Scattered I<sub>sca</sub> - Scattered I<sub>sca</sub> - Scattered 0.00 -I<sub>Inc</sub> - Incident Stokes vector Stokes vector Stokes vector Stokes vector M M View angle 1 View angle 2 View angle 3 -0.50 -HARP mom 0.25 -N/ 0.00 · Atmospheric gases HARP has up to 60 viewing angles and DoLP 0.50 4 wavelengths: 440, Aerosol particles 550, 670 and 870nm 0.00 Earth's surface(Land/Ocean) 70 120 170

Scattering Angle

# Preiminary L2 file example (AirHARP/HARP)

Name	Long Name	Туре	
🛯 🕍 09-Nov-2017T19-31_smoke_HSRL2_v3_sho	rt 09-Nov-2017T19-31_smoke_HSRL2_v3_short_strip_test	Local File	
Aerosol_Products	Aerosol_Products	<u></u>	
Se AE	Angstrom Exponent (440/870nm)	Geo2D	
aerosolVolumeConcentration	Aerosol volume concentration	Geo2D	
🕨 🔄 aodCoarse	Aerosol_Products/aodCoarse		
🕨 🔛 aodFine	Aerosol_Products/aodFine	-	
🔻 🔛 aodTotal	Aerosol_Products/aodTotal	22	
🗢 440nm	Total aerosol optical depth	Geo2D	
🗢 550nm	Total aerosol optical depth	Geo2D	
🗢 670nm	Total aerosol optical depth	Geo2D	
👙 870nm	Total aerosol optical depth	Geo2D	
🕨 🔛 IRI	Aerosol_Products/IRI	<u></u>	
🕨 🌄 PSD	Aerosol_Products/PSD		
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SF SF	Spherical Fraction	Geo2D	
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dateStr ISO8601	Date and time of the capture in IS08601 format	<u>-</u>	
Y Geolocation	Geolocation	<u></u> -	
GroundAltitude	Ground Altitude	Geo2D	
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🖕 chi2	Chi^2 from the GRASP fit	Geo2D	
Sec. RGB	RGB Matrix	Geo2D	
Surface Products	Surface Products	-	
► SBPDF	Surface Products/BPDF	<u></u>	
🔻 😂 BRDF	Surface Products/BRDF	-	
🕨 🎦 K0	Surface Products/BRDF/K0		
🔶 K1	BRDF parameter K1 (RossLi/RPV)	Geo2D	
Ф К2	BRDF parameter K2 (RossLi/RPV)	Geo2D	
	24		
	24		

#### Group "ViewingAngle"

In file "09-Nov-2017T19-31\_smoke\_HSRL2\_v3\_short\_s

Group full name: HARP\_Data/ViewingAngle

// group attributes: :long\_name = "Instrument Viewing Angle"; :units = "Degree";