PLANKTON, AEROSOL, CLOUD, OCEAN ECOSYSTEM (PACE)

MISSION UPDATE

Ivona Cetinić
(slides by Jeremy Werdell and PACE team)
NASA GSFC/USRA

Extend key systematic **ocean** biological, ecological, & biogeochemical climate data records, as well as **cloud** & **aerosol climate data records**

Make **new global measurements of ocean color** that are essential for understanding the global carbon cycle & ocean ecosystem responses to a changing climate

Collect **global observations of aerosol & cloud properties**, focusing on reducing the largest uncertainties in climate & radiative forcing models of the Earth system

Level 1 required (~threshold) products

Water-leaving reflectance	Aerosol optical thickness
Chlorophyll-a	Aerosol fine mode fraction
Phytoplankton absorption	Liquid / ice cloud optical thickness
NAP+CDOM absorption	Liquid / ice cloud effective radius
Particulate backscattering	Cloud layer detection ($\tau < 0.3$)
Diffuse attenuation	Cloud top pressure ($\tau > 3$)
Fluorescence line height	Shortwave radiation effect

Uncertainty requirements accompany all L1 req'd data products (i.e., we need quantitative validation of all of these products)

Improve our understanding of how **aerosols influence ocean ecosystems & biogeochemical cycles** and how **ocean biological & photochemical processes affect the atmosphere**

Extend key systematic **ocean** biological, ecological, & biogeochemical climate data records, as well as **cloud** & **aerosol climate data records**

Make **new global measurements of ocean color** that are essential for understanding the global carbon cycle & ocean ecosystem responses to a changing climate

Collect **global observations of aerosol & cloud properties**, focusing on reducing the largest uncertainties in climate & radiative forcing models of the Earth system

Incomplete list of advanced (~baseline) products

Carbon stocks & fluxes	Liquid / ice cloud water path
Phytoplankton pigments	Polarimeter-specific products
Phytoplankton physiology	Applied sciences-specific products
Community structure (PFTs)	Land data products (TBD)
Productivity	Your very favorite data product that
PAR, light attenuation, water quality	I forgot to list (*so plz don't ask*)

Improve our understanding of how **aerosols influence ocean ecosystems & biogeochemical cycles** and how **ocean biological & photochemical processes affect the atmosphere**

PACE includes:

A UV-SWIR imaging spectrometer

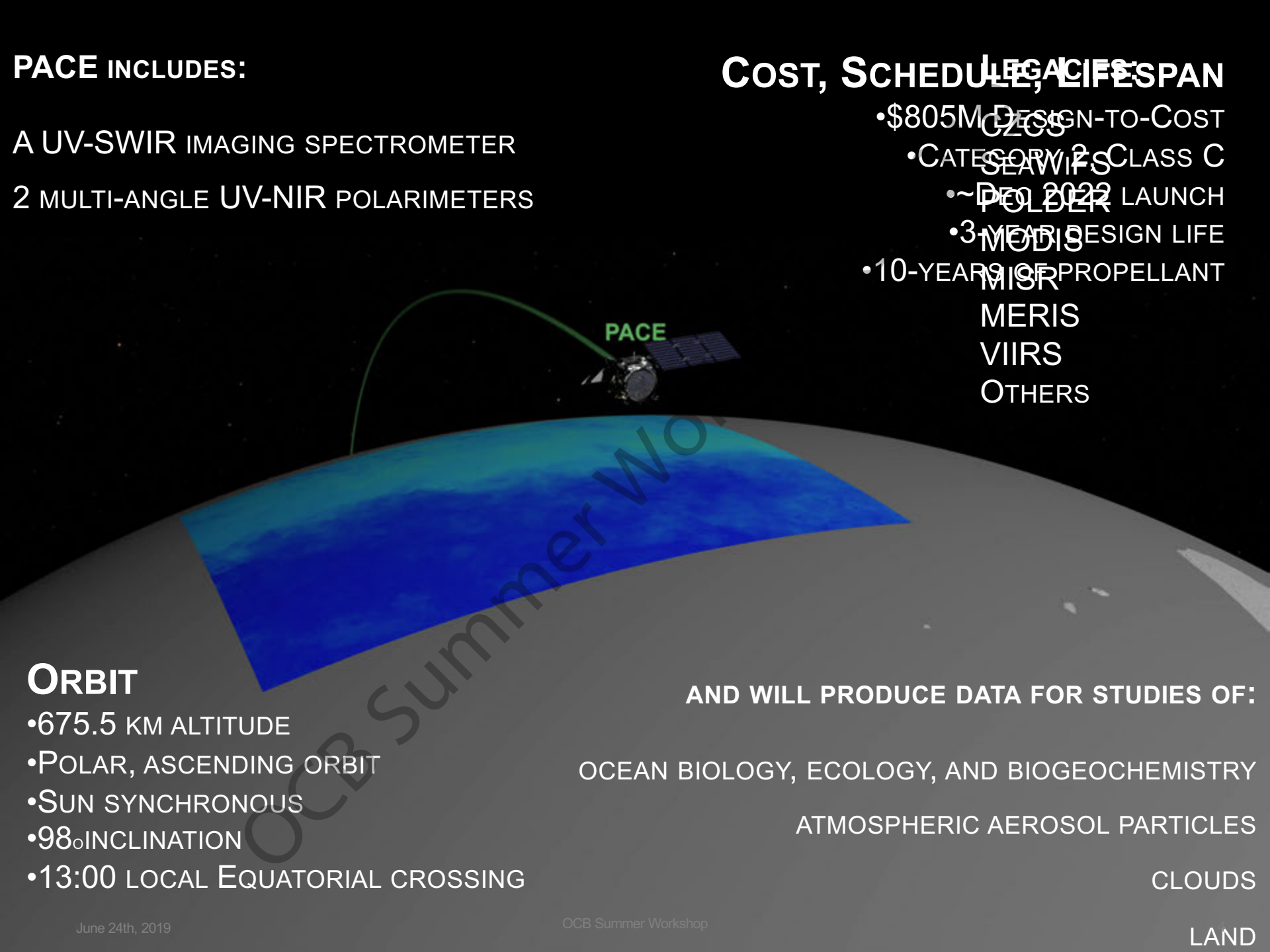
2 multi-angle UV-NIR polarimeters

Cost, Schedule, Lifespan

- $805M Design-to-Cost
- Category 2, Class C
- ~Dec 2022 launch
- 3-year design life
- 10-years of propellant

Legacies:

CZCS
SeaWiFS
POLDER
MODIS
MISR
MERIS
VIIRS
Others



Orbit

- 675.5 km altitude
- Polar, ascending orbit
- Sun synchronous
- 98$_o$ inclination
- 13:00 local Equatorial crossing

And will produce data for studies of:

Ocean biology, ecology, and biogeochemistry

Atmospheric aerosol particles

Clouds

Land

Extend key systematic **ocean** biological, ecological, & biogeochemical climate data records, as well as **cloud** & **aerosol climate data records**

Make **new global measurements of ocean color** that are essential for understanding the global carbon cycle & ocean ecosystem responses to a changing climate

Collect **global observations of aerosol & cloud properties**, focusing on reducing the largest uncertainties in climate & radiative forcing models of the Earth system

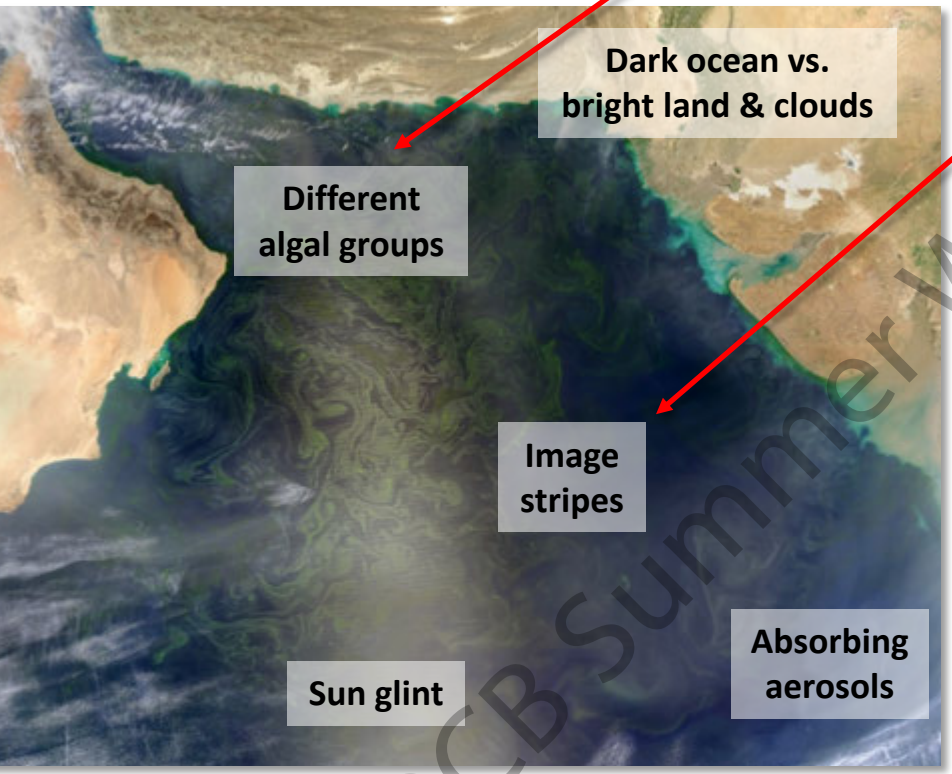
GSD of 1 ± 0.1 km^2 at nadir

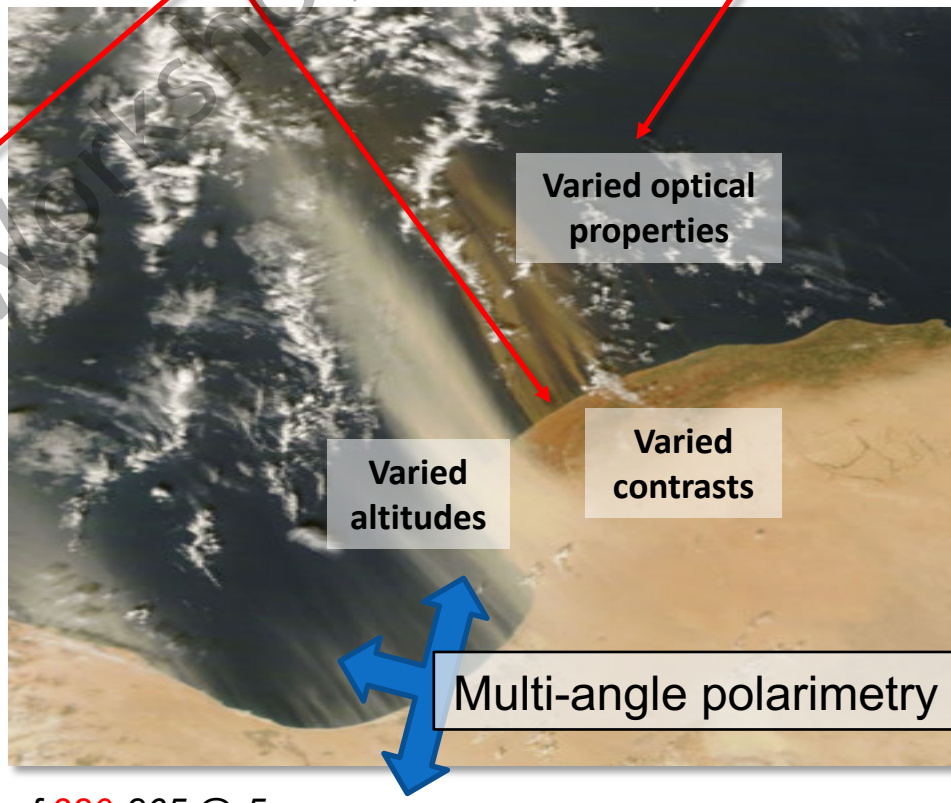
Twice-monthly lunar calibration & onboard solar calibration (daily, monthly, dim)

Spectral range from 350-865 @ 5 nm

Instrument performance requirements

940, 1038, 1250, 1378, 1615, 2130, 2260 nm





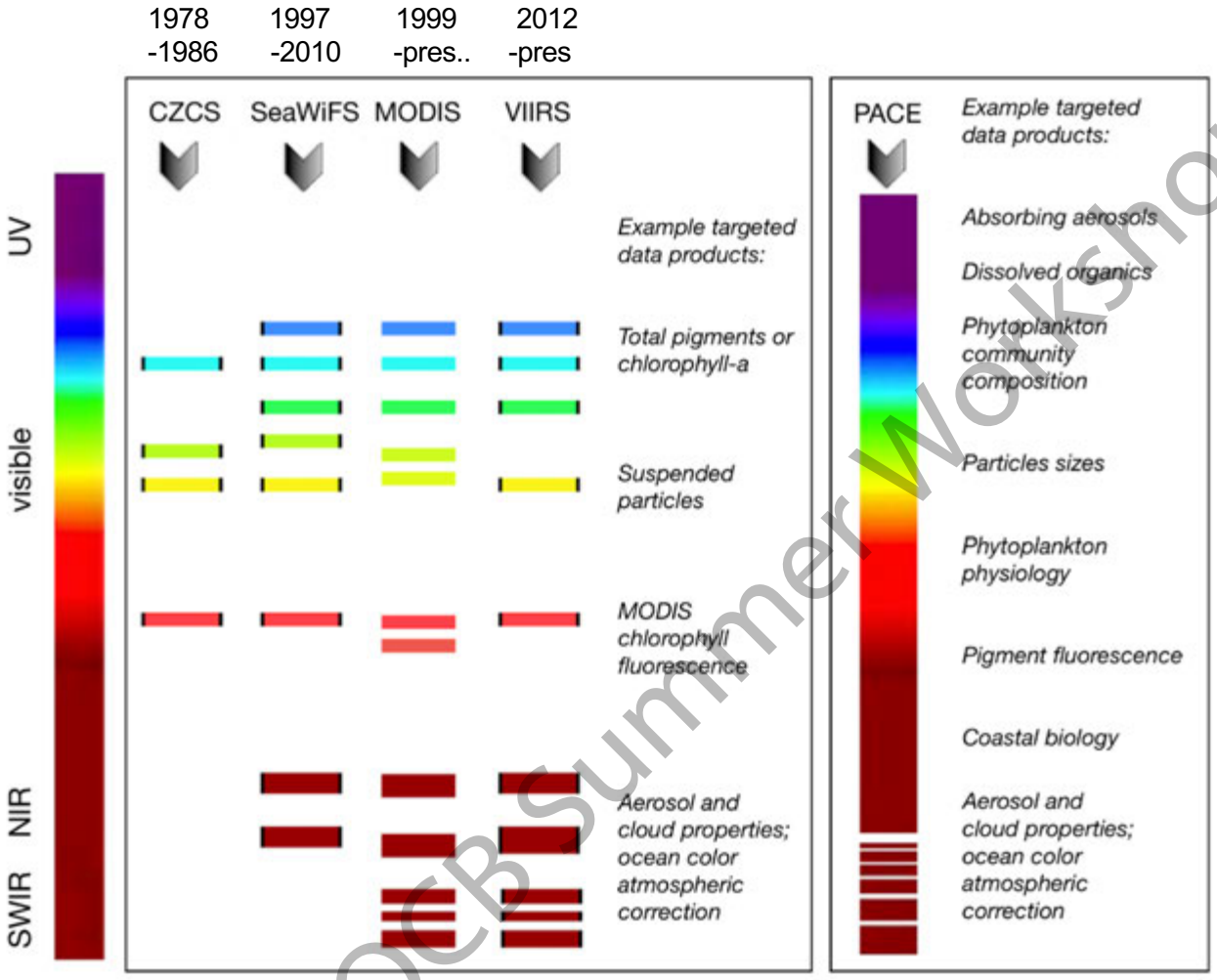
Tilt ± 20°

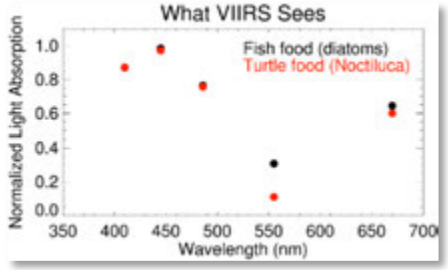
Spectral range goal of 320-865 @ 5 nm

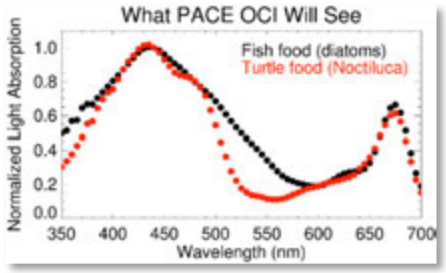
Improve our understanding of how **aerosols influence ocean ecosystems & biogeochemical cycles** and how **ocean biological & photochemical processes affect the atmosphere**

OCEAN COLOR INSTRUMENT (OCI)

MOVING FROM MULTI-SPECTRAL RADIOMETRY TO SPECTROSCOPY



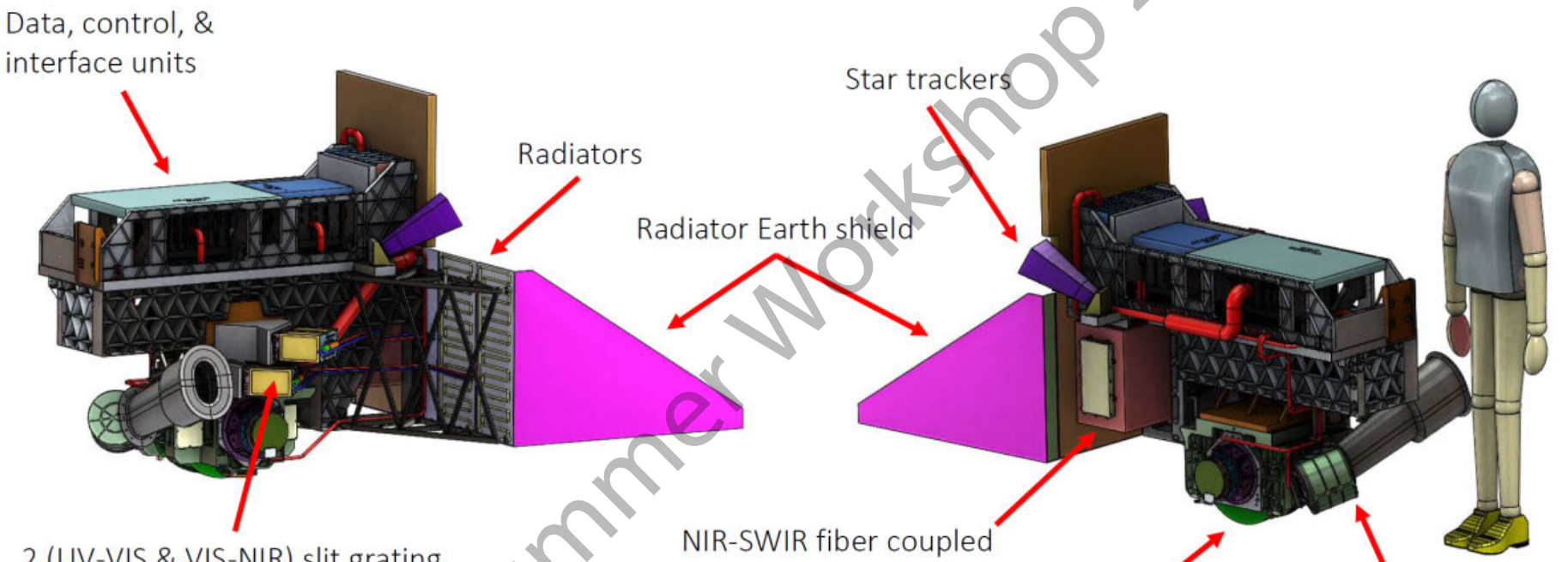




Photos by: Joaquim Goes, LDEO; Linda Armbrecht, abc.com.au

OCEAN COLOR INSTRUMENT (OCI)

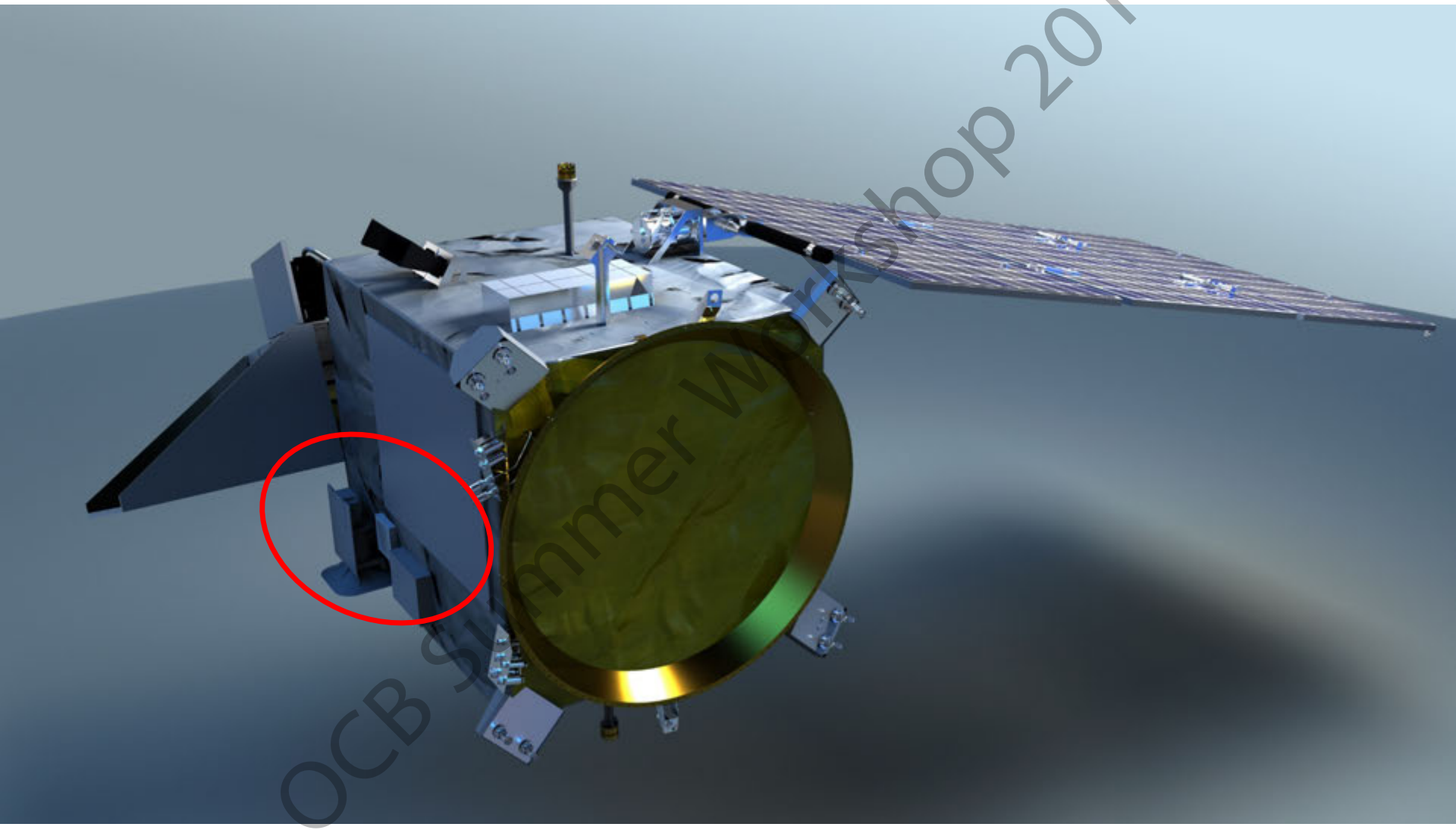
SCANNING CONCEPT FOLLOWS SEAWIFS AND VIIRS HERITAGE



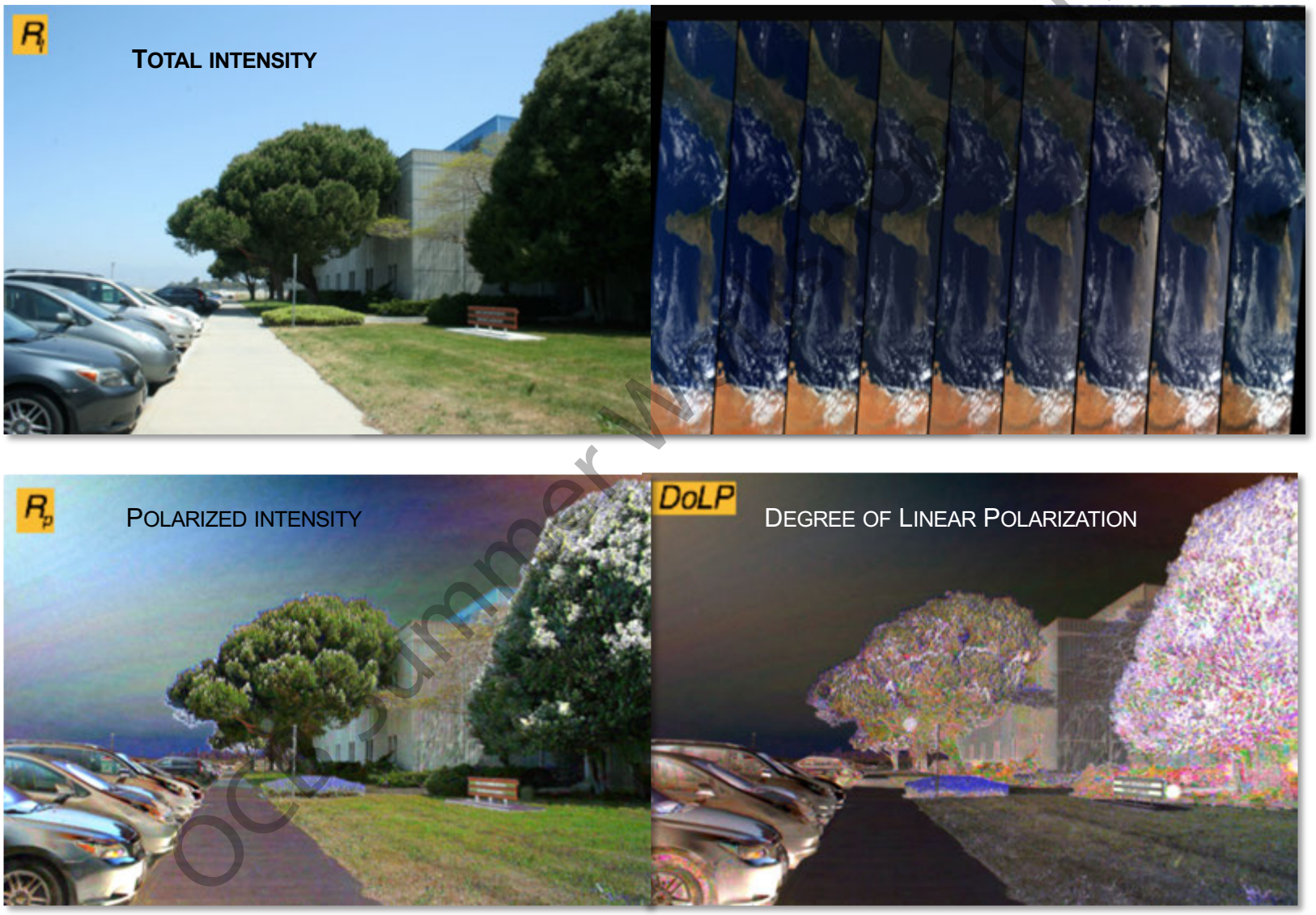
270 kg, 315 W, 13 Mbps up to 40 Mbps (CBEs)

OCI is tilted by ±20° to avoid sun glint

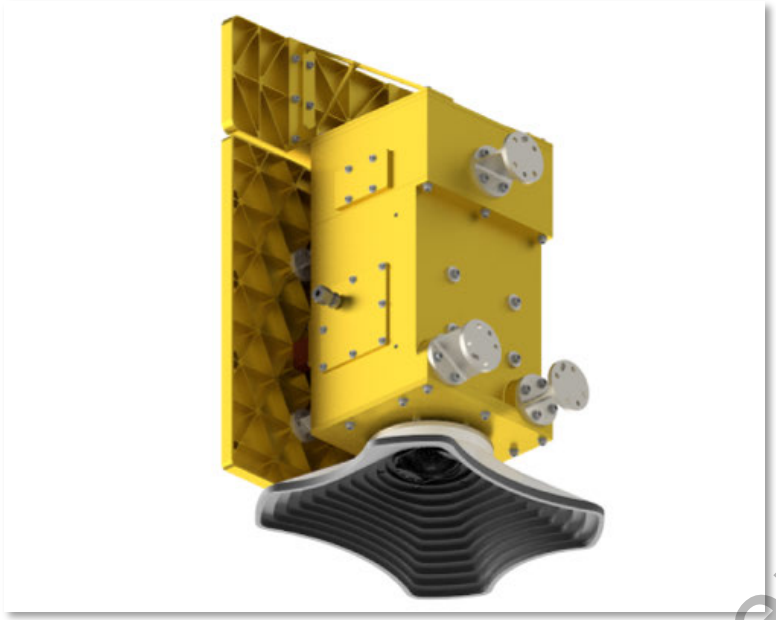
MULTI-ANGLE POLARIMETRY

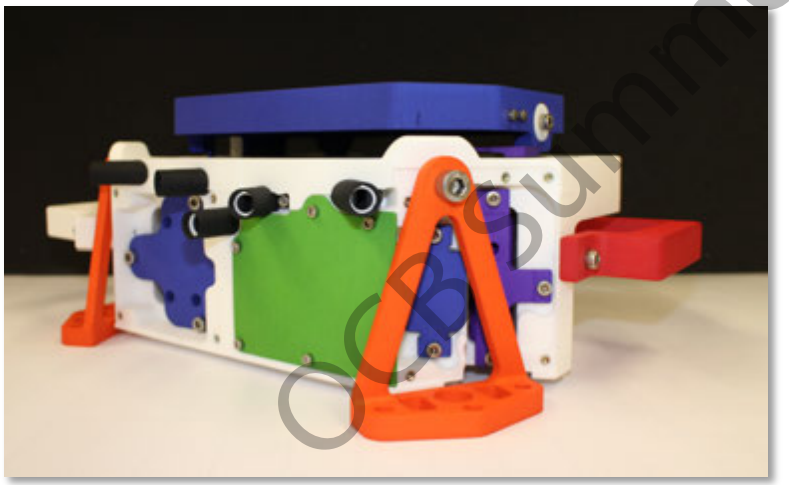


MULTI-ANGLE POLARIMETRY ADDS DIMENSIONS OF INFORMATION



TWO POLARIMETERS – HARP2 AND SPEXONE



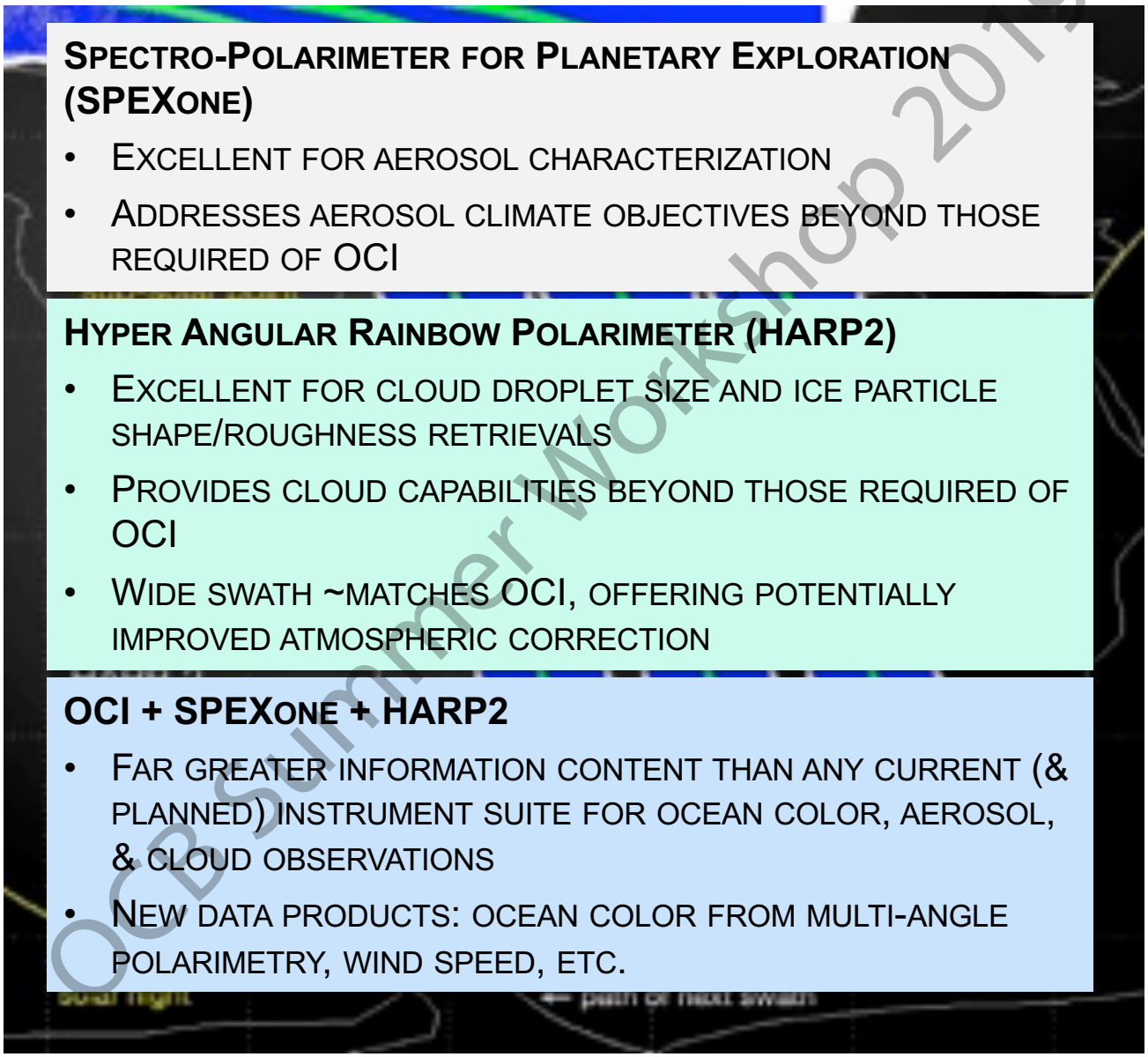


SPEXONE AND HARP2 ARE CONTRIBUTED INSTRUMENTS

	HARP-2	SPEXone
UV-NIR range	440, 550, 670, 870 nm	Continuous from 385-770 nm in 5 nm steps
SWIR range	None	None
Polarized bands	All	Continuous from 385-770 nm in 15-45 nm steps
Number of viewing angles [degrees]	10 for 440, 550, 870 nm; 60 for 670 nm [spaced over 114°]	5 [-57°, -20°, 0°, 20°, 57°]
Swath width	±47° [1556 km at nadir]	±4.5° [106 km at nadir]
Global coverage	2 days	30+ days
Ground pixel	3 km	2.5 km
Heritage	AirHARP, Cubesat	AirSPEX

AND, THEY WILL PROVIDE AN EXCELLENT PROOF OF CONCEPT FOR ATMOSPHERIC CORRECTION, AEROSOL, & CLOUD RETRIEVALS

OCI-POLARIMETRY SYNERGY



SPECTRO-POLARIMETER FOR PLANETARY EXPLORATION (SPEXONE)

- EXCELLENT FOR AEROSOL CHARACTERIZATION
- ADDRESSES AEROSOL CLIMATE OBJECTIVES BEYOND THOSE REQUIRED OF OCI

HYPER ANGULAR RAINBOW POLARIMETER (HARP2)

- EXCELLENT FOR CLOUD DROPLET SIZE AND ICE PARTICLE SHAPE/ROUGHNESS RETRIEVALS
- PROVIDES CLOUD CAPABILITIES BEYOND THOSE REQUIRED OF OCI
- WIDE SWATH ~MATCHES OCI, OFFERING POTENTIALLY IMPROVED ATMOSPHERIC CORRECTION

OCI + SPEXONE + HARP2

- FAR GREATER INFORMATION CONTENT THAN ANY CURRENT (& PLANNED) INSTRUMENT SUITE FOR OCEAN COLOR, AEROSOL, & CLOUD OBSERVATIONS
- NEW DATA PRODUCTS: OCEAN COLOR FROM MULTI-ANGLE POLARIMETRY, WIND SPEED, ETC.

Mission phases (what happens next)?

Phase B – preliminary design & technology completion (passed PDR, June 2019)

Phase C – final design & fabrication (Aug 2019)

All mission elements must pass Critical Design Reviews (CDR) (~Dec 2019)
Preceded by series of sub-element Engineering Peer Reviews (EPRs)

Project & HQ Science + OBPG Science Data Processing:

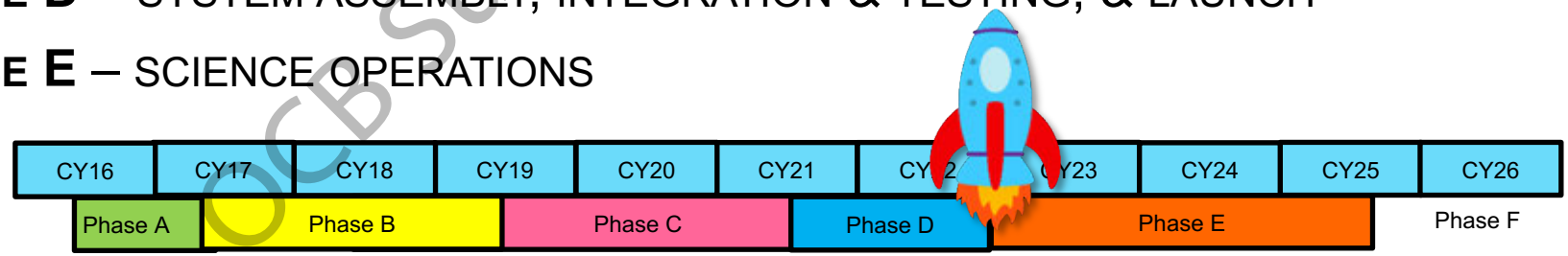
respond to element issues (study, charge/retreat, provide therapy)

implement science capabilities (plans for cal, val, algs, processing, documentation, etc.)

Interact with newly formed Science Teams

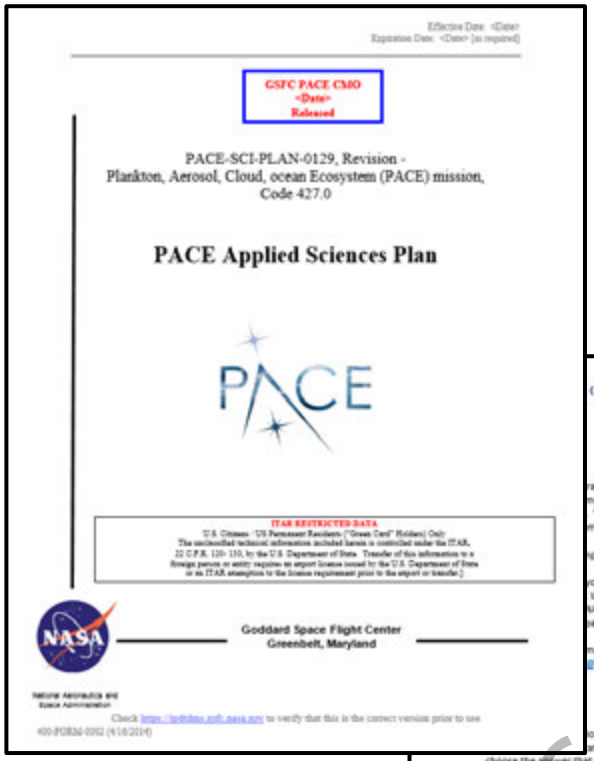
Phase D – system assembly, integration & testing, & launch

Phase E – science operations



WANT TO PLAY?

MISSION APPLICATIONS PLAN



GSFC PACE CM0
<Date>
Released

PACE-SCI-PLAN-0129, Revision -
Plankton, Aerosol, Cloud, ocean Ecosystem (PACE) mission,
Code 427.0

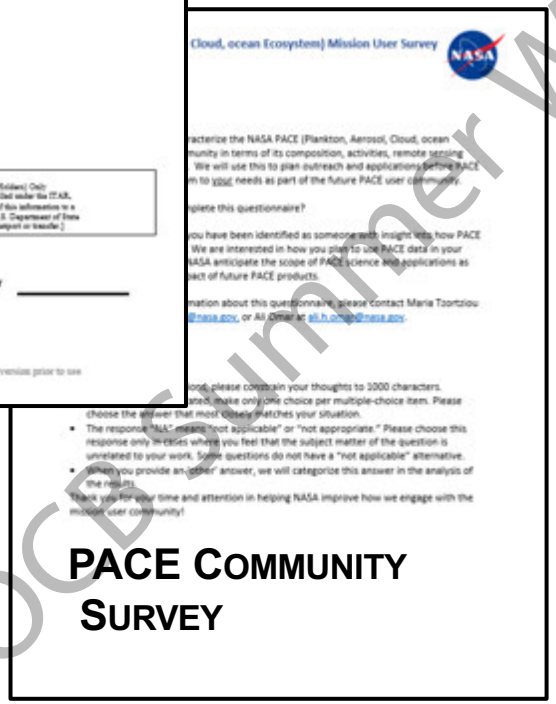
PACE Applied Sciences Plan

PACE

ITAR RESTRICTED DATA

Goddard Space Flight Center
Greenbelt, Maryland

Air Quality and Human Health



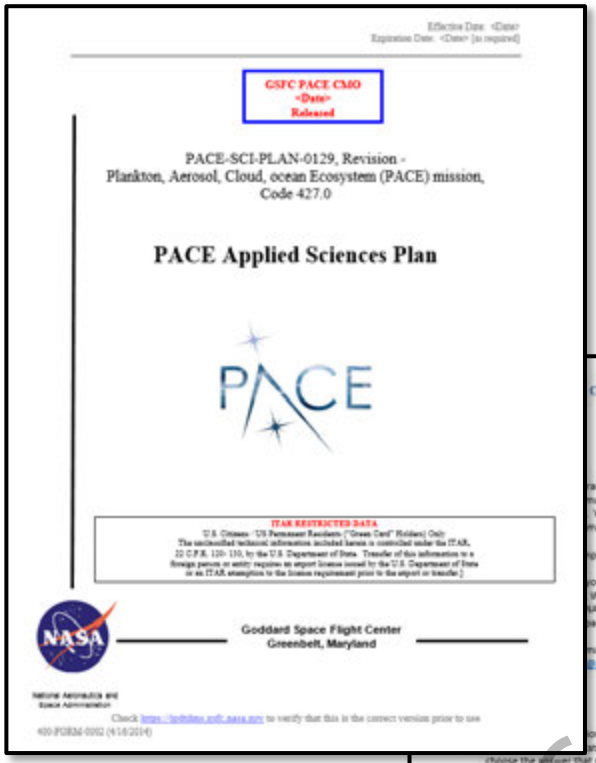
Cloud, ocean Ecosystem) Mission User Survey

PACE COMMUNITY SURVEY

MARIA TZORTZIOU

WANT TO PLAY?

MISSION APPLICATIONS PLAN


GSFC PACE CM0
<Date>
Released

PACE-SCI-PLAN-0129, Revision -
Plankton, Aerosol, Cloud, ocean Ecosystem (PACE) mission,
Code 427.0

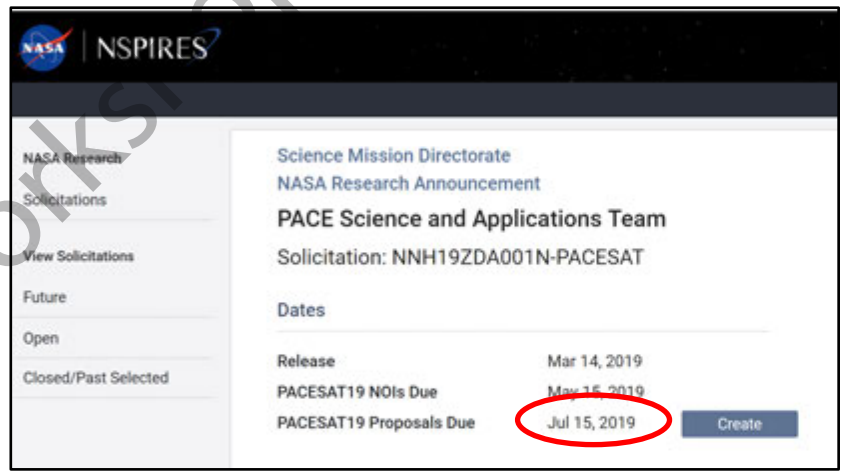
PACE Applied Sciences Plan

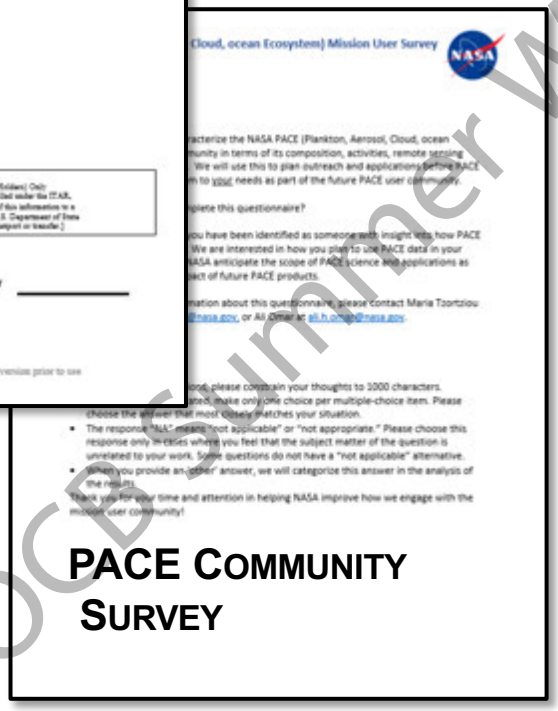
PACE

ITAR RESTRICTED DATA

Goddard Space Flight Center
Greenbelt, Maryland

PACE SCIENCE AND APPLICATION TEAM




Cloud, ocean Ecosystem) Mission User Survey

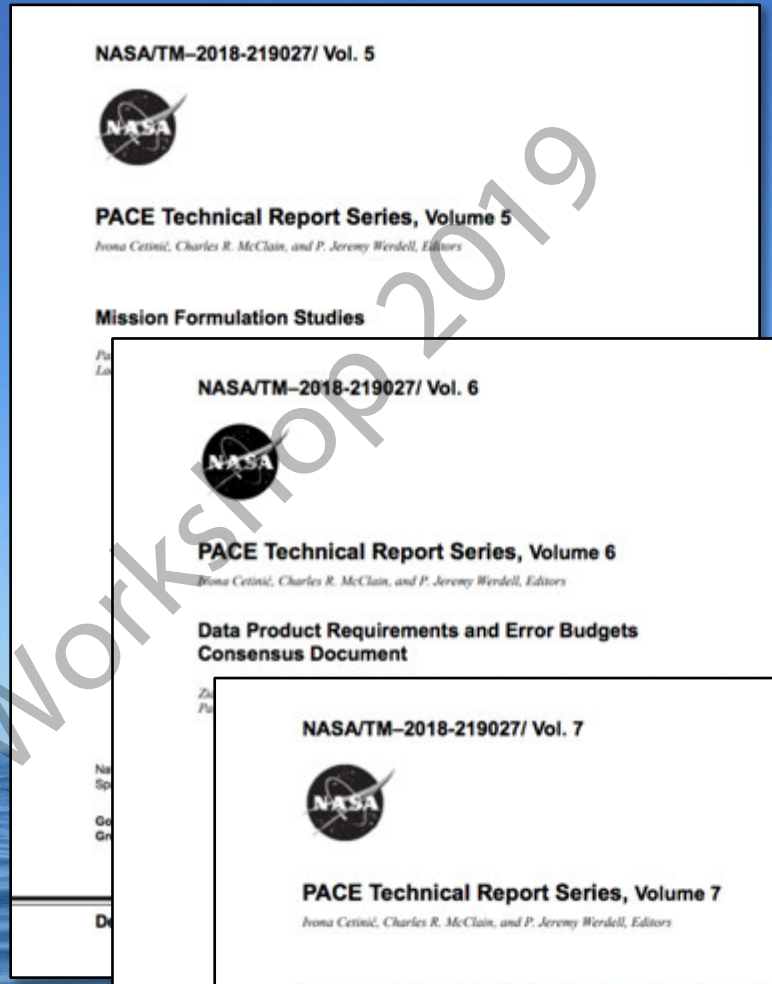
MARIA TZORTZIOU

PACE COMMUNITY SURVEY

PAULA BONTEMPI

LEARN MORE ABOUT

PACE



LEARN MORE ABOUT

https://pace.gsfc.nasa.gov
@NASAOcean (Twitter)
@NASAOcean (Facebook)

FOR THE FIRST TIME IN ~2 DECADES, OUR SCIENCE COMMUNITY WILL HAVE AN OBSERVATORY THAT IT CAN *GROW INTO* …