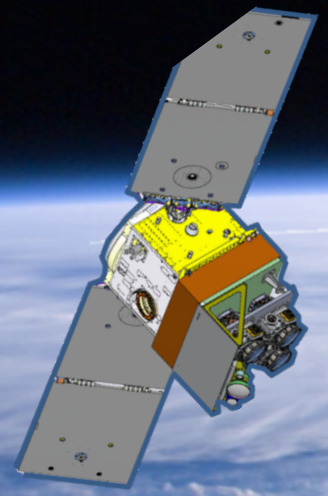
AIRPHOTON

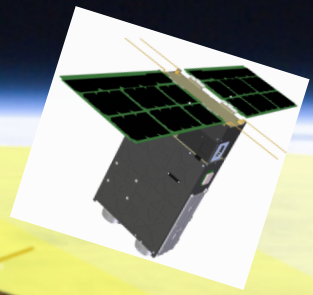
Innovative Technology for Earth and Space

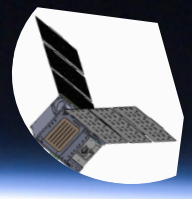
Satellite Payloads For Earth Observations

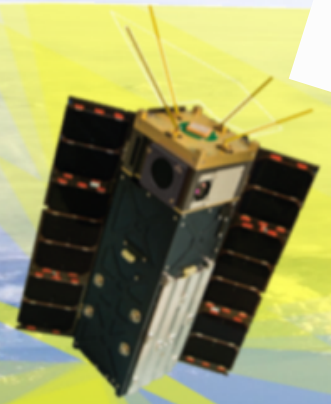
Our Mission:

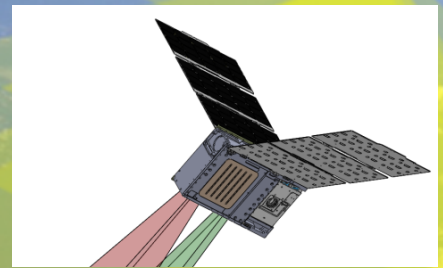
"Develop the next generation of space visionaries while building a high quality, state-of-the-art, and cost-effective satellite constellation for monitoring earth's most critical signals".

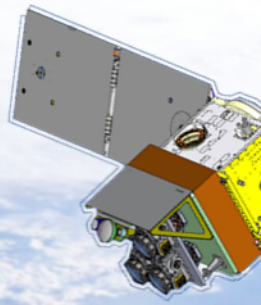












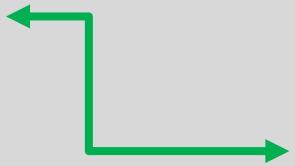
- Fires
- Pollution
- Hurricanes
- Water cycle
- Deforestation
- Climate

Philosophy of payload development for Earth Observations

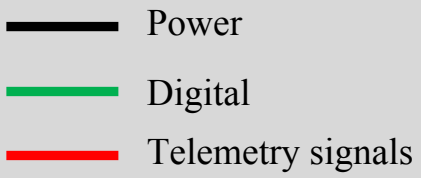
- Back-end components are modular, robust and integrated.
- A variety of front-end sensor packages can be paired with the back-end systems.
- This approach maximizes the quick, cost-effective production of state-of-the-art payloads for earth observations.

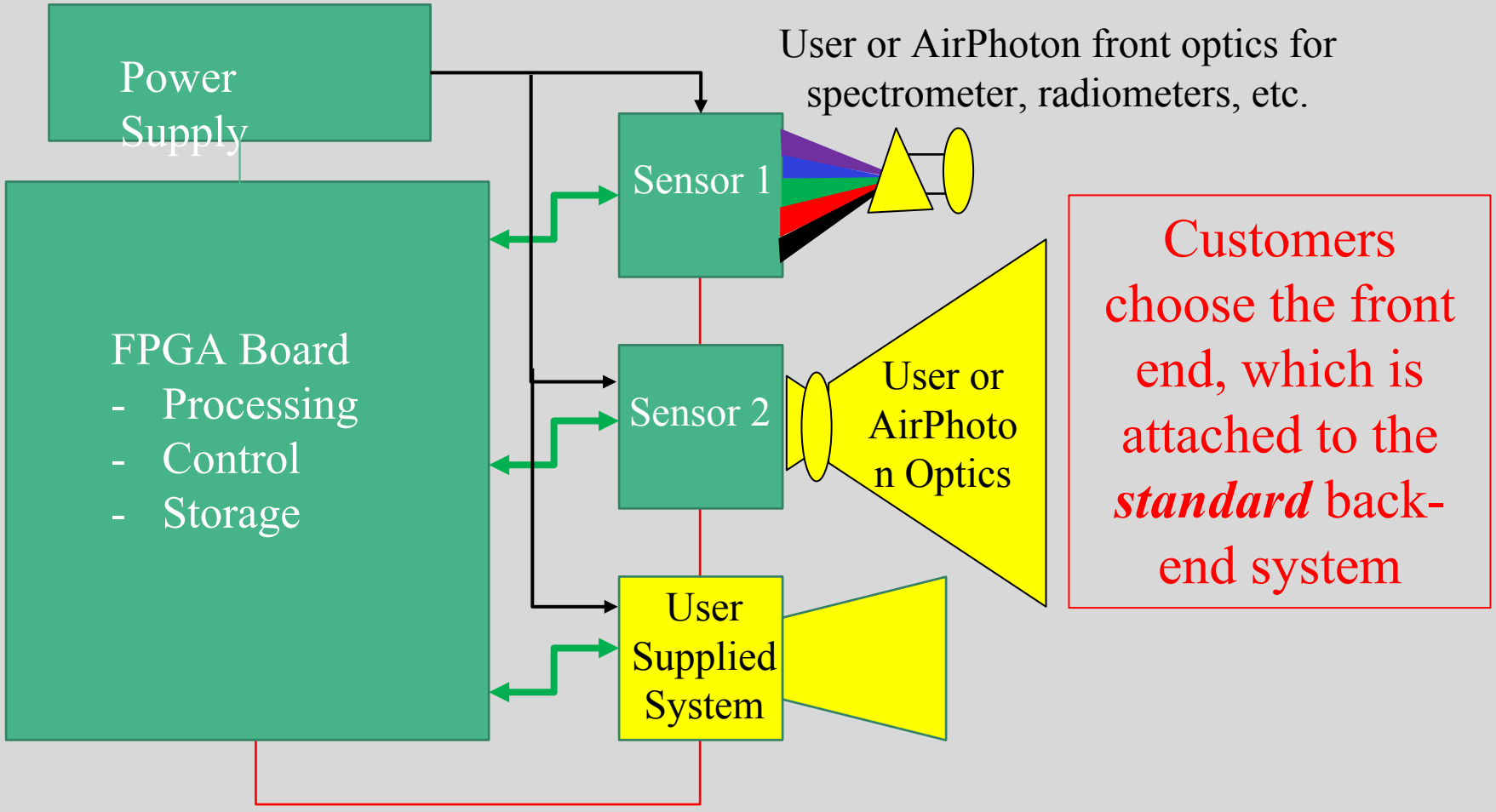
The modular/integrated/robust back end module is the truly innovative piece of our approach

Commands and data direct from/to Spacecraft using standardized command protocol



Multiple interfaces are implemented to improve accommodation in different spacecrafts.





Customers choose the front end, which is attached to the ***standard*** back-end system

Scalable Sensor Packages with Many Applications

Sensor 4 – UV-Visible

Sensor 3 – Short Wave IR

Sensor 2 – Thermal IR

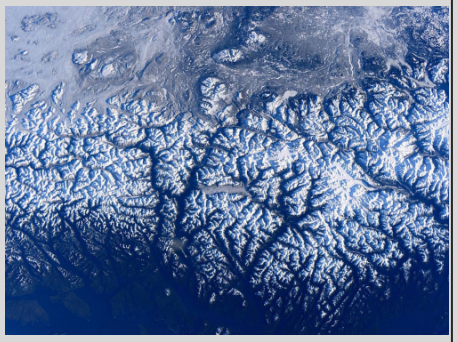
Sensor 1 – Midrange IR

Fires

Clouds & Weather

Air Quality

Land Use



Snow, Ice & Ocean

- A modular product line covering a wide range of measurement technologies, standardized back end electronics, and end-to-end software

Benefits:

- ***Much lower cost***
- ***Small satellites can be built and launched in about half the time as full-sized payloads***

AirPhoton's Partnership with the UMBC Earth and Space Institute

Dr. Vanderlei Martins

- Director of the UMBC Earth and Space Institute (ESI)
- Chief Technical Officer of AirPhoton

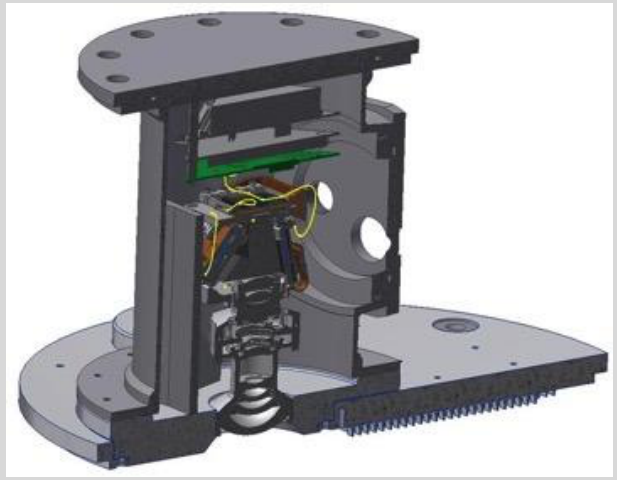
ESI and its design and engineering teams under the direction of Dr. Martins have built and launched successful Cubesat missions as well as advanced aircraft and ground-based measurement systems.

AirPhoton shares personnel and expertise with ESI allowing their research and development to be brought to commercial application in a timely and seamless manner.

Successful ESI Developments:

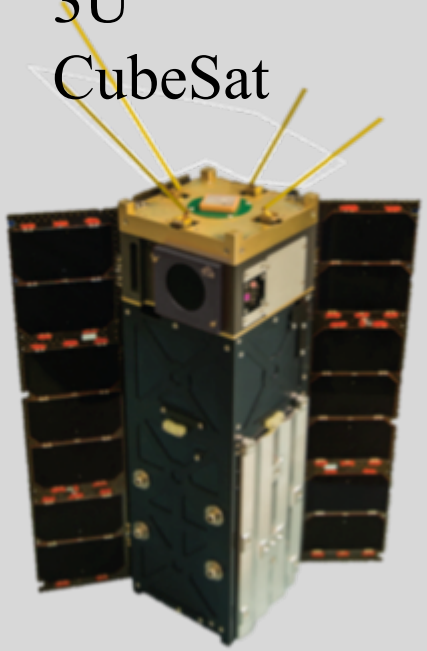
Air HARP

Airborne



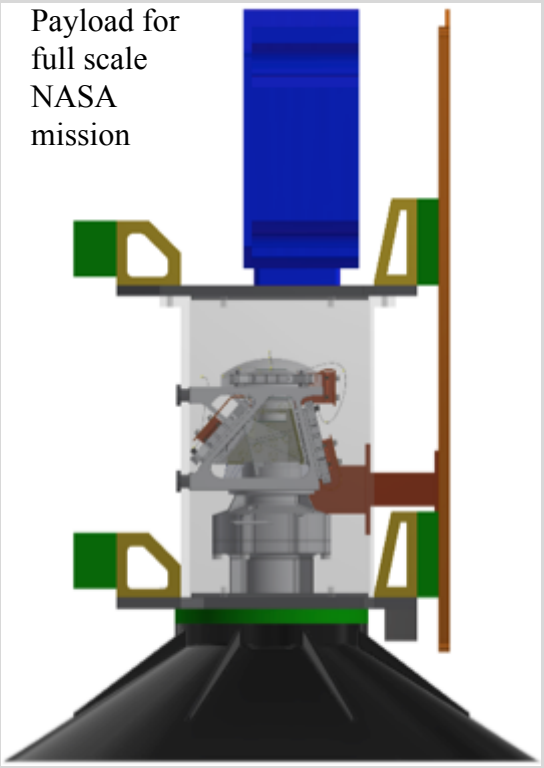
HARP CubeSat

3U CubeSat



HARP2 PACE

Payload for full scale NASA mission



HARP VNIR Telescope

Experienced Airphoton personnel and their partners know how to design & build small calibrated payloads

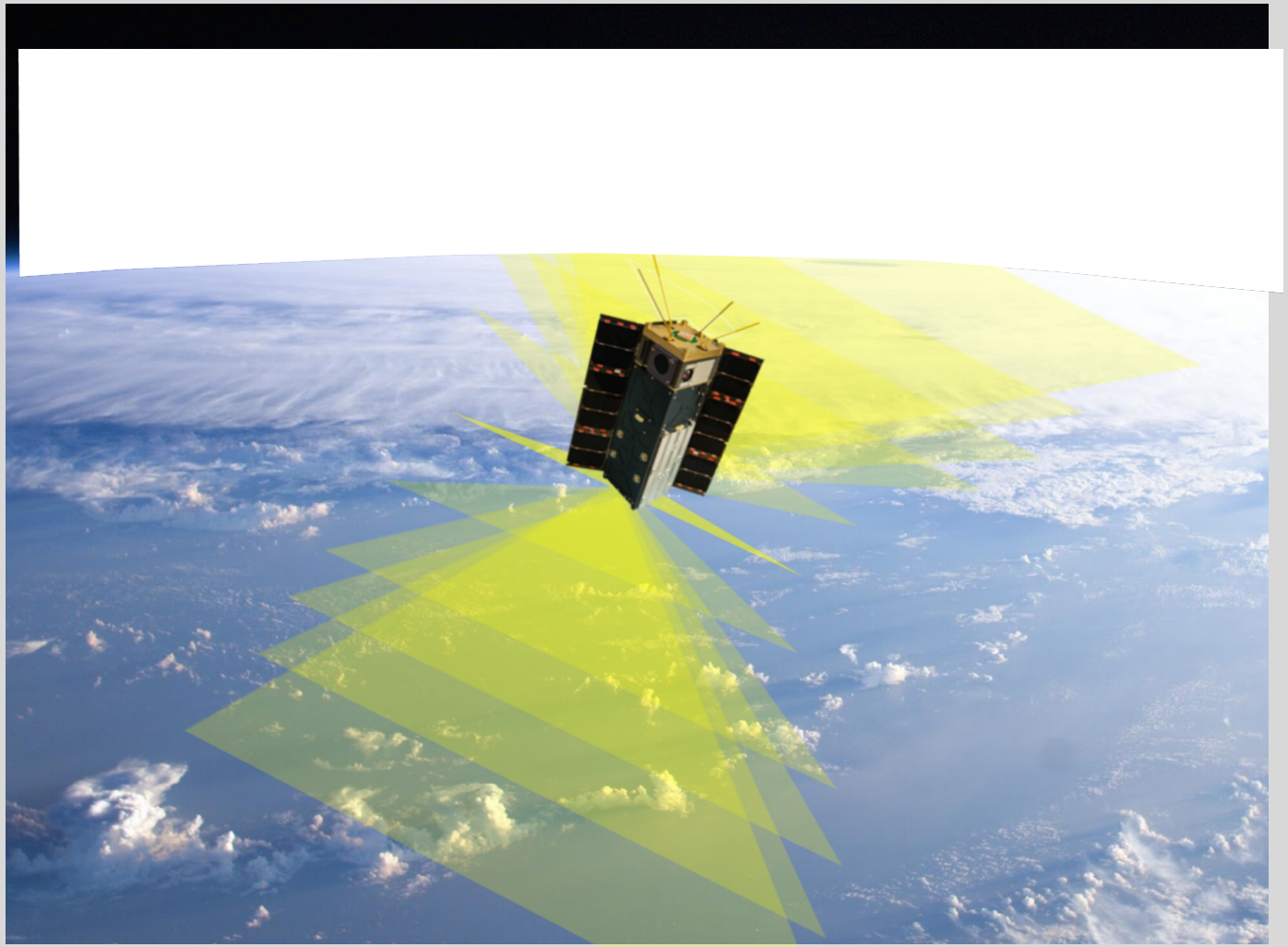
https://pace.oceansciences.org/mission.htm
https://directory.eoportal.org/web/eoportal/satellite-missions/h/harp

Hyper-Angle Rainbow Polarimeter
Currently in orbit collecting an advanced data set

HARP CubeSat

HARP Polarimeter Specs

- ISS orbit
- 60 angles for cloud bows
- 20 angles for aerosols
- 440, 550, 670, 870nm
- Nadir pixel resolution 400m
- Super pixel 2.5x2.5km
- 94 deg FOV X-track
- 114 deg FOV along track

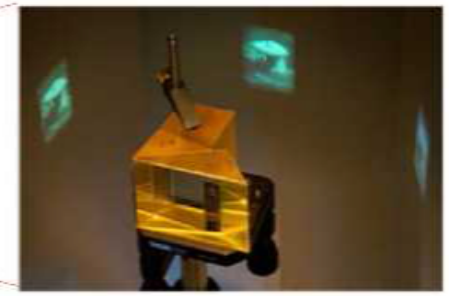


ESI Developments Implemented On HARP

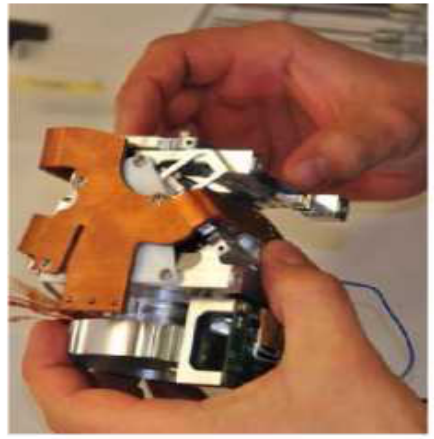
Proof of our Philosophy: Combining Modular Back-End With a Unique Front-End Sensor Package

UMBC Sensor

HARP Prism

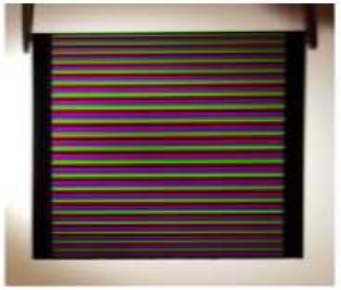


HARP VNIR Telescope



Wide FOV Optics

HARP Size



HARP Stripe Filter

Camera and FPGA Electronics

HARP Innovations Lead to Real Science

HARP Capabilities

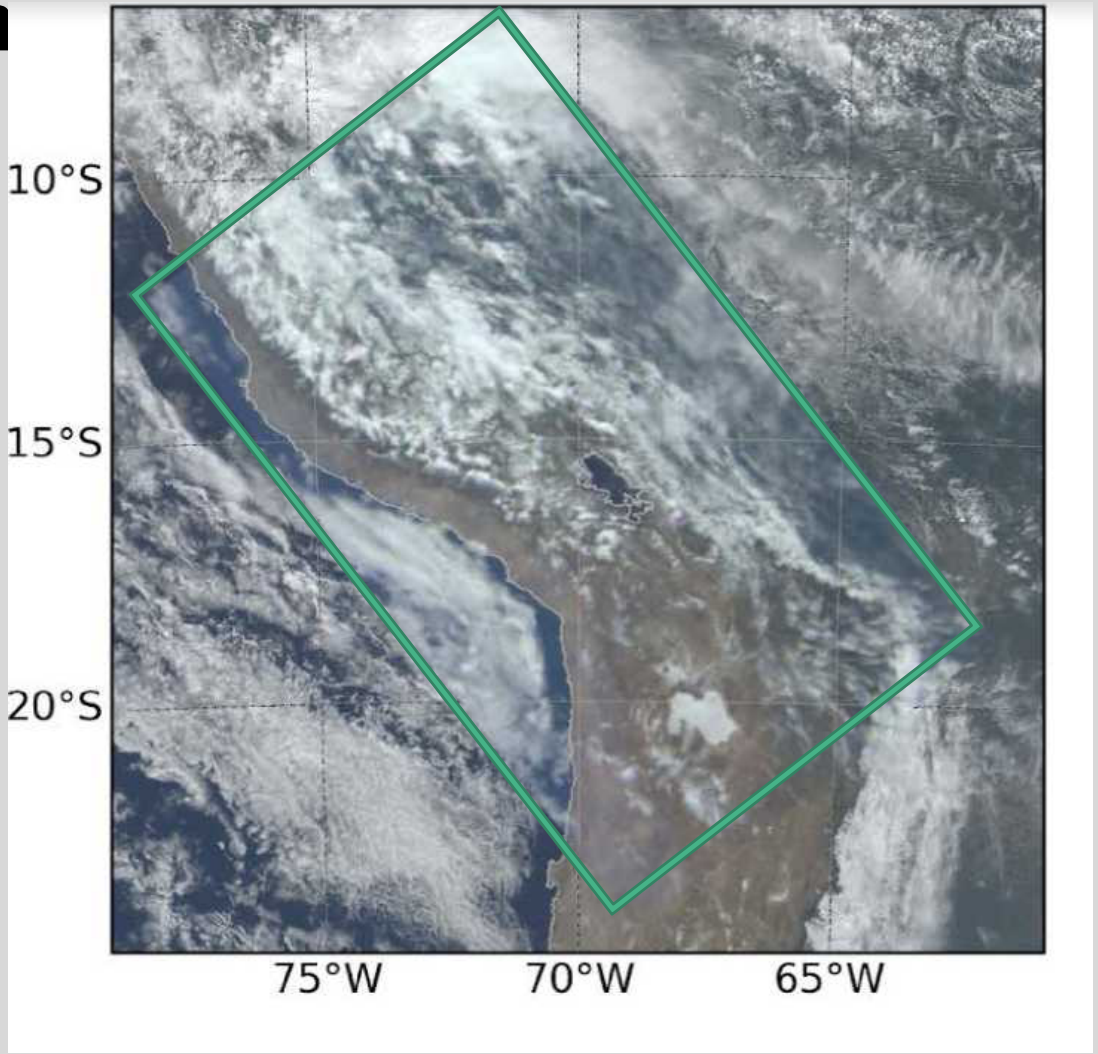
- Up to 60 viewing angles
- 440, 550, 670, 870nm
- 2.5km binned resolution
- 94 deg FOV X-track
- 114 deg FOV along track
- Polarization

Science Outcomes

- Aerosol measurements
- Cloud properties
  - cloud droplet size
  - droplet effective radius
  - droplet effective variance

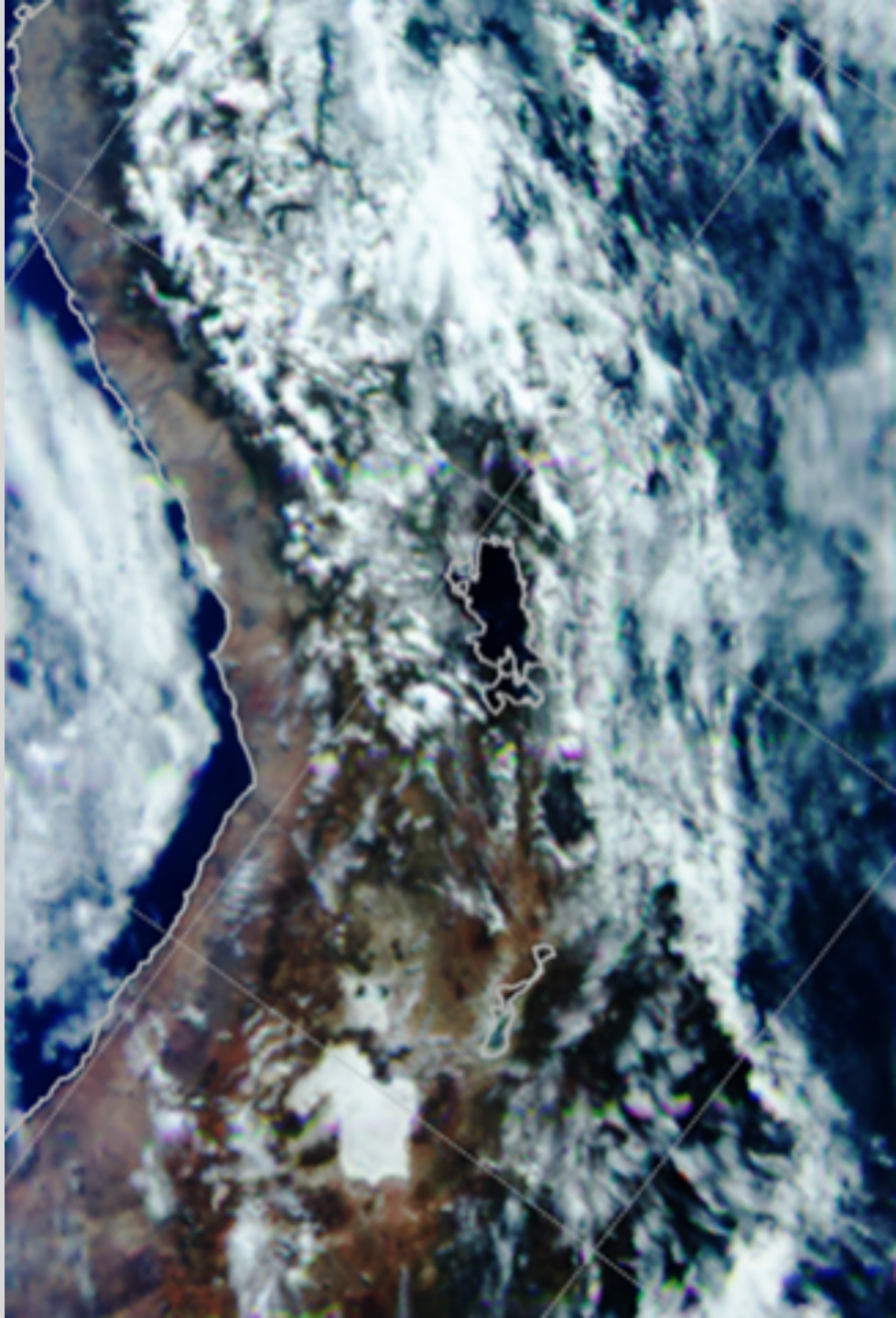
CubeSat High Perforn

A HARP Image is superimposed on data from NOAA's full-sized payload Advanced Baseline Imager.

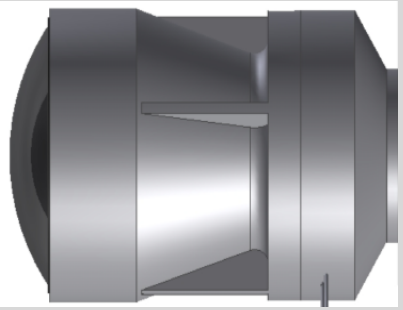


Satellite Design Portfolio

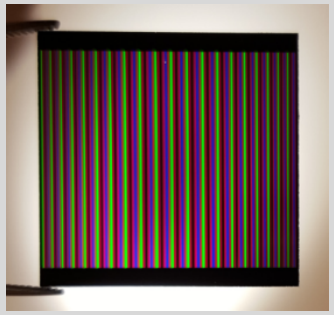
Concepts ready for commercialization



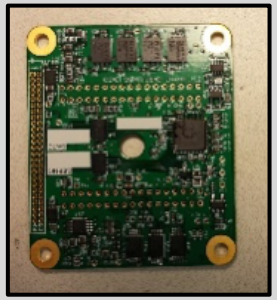
HARP Multi-Angle Sampling:



Wide FOV lens

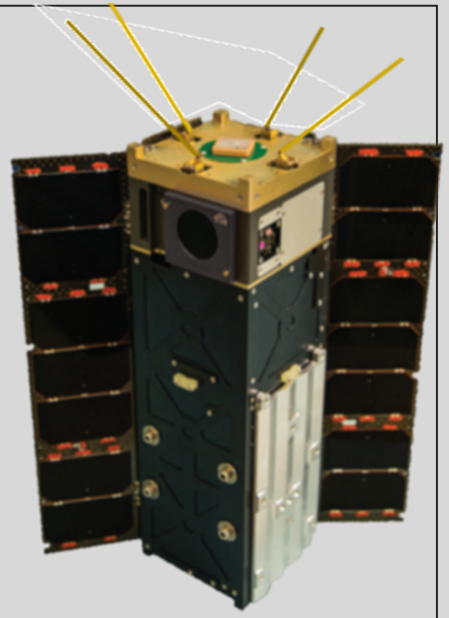


HARP Stripe filter produces up to 120 pushbrooms with different viewing angles

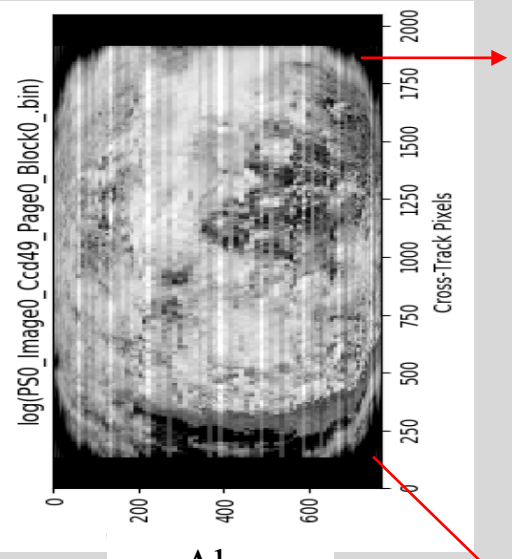


Camera Electronics

Digital interface and storage

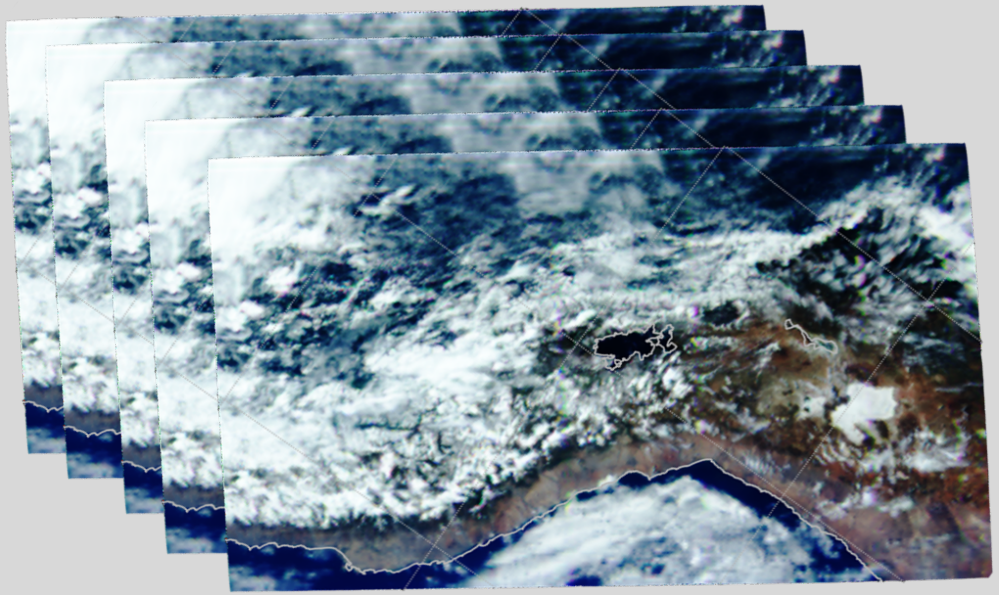


Spacecraft



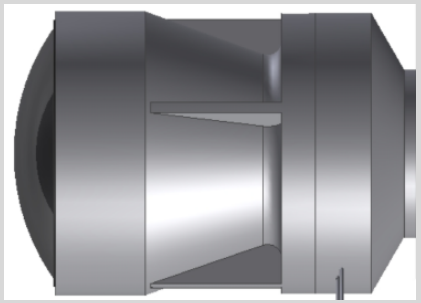
Along track rows

Multiple viewing angles

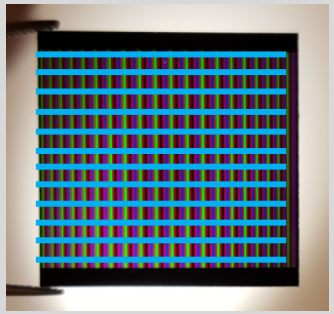


- HARP measurement
  - Multiwavelength/Multi-angle sampling (~75% of the information for GRASP retrievals)
  - Polarization (~25% of the information)
- HARP's Multiwavelength/multi-angle sampling can fit in 10x10x10cm payload
- HARP's proven electronics communicates directly to spacecraft computer

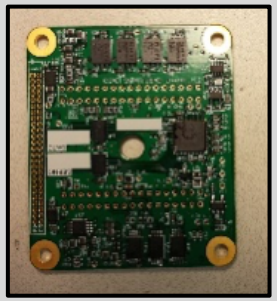
HARP-Lite Multi-Angle Polarimetric Sampling:



Wide FOV lens

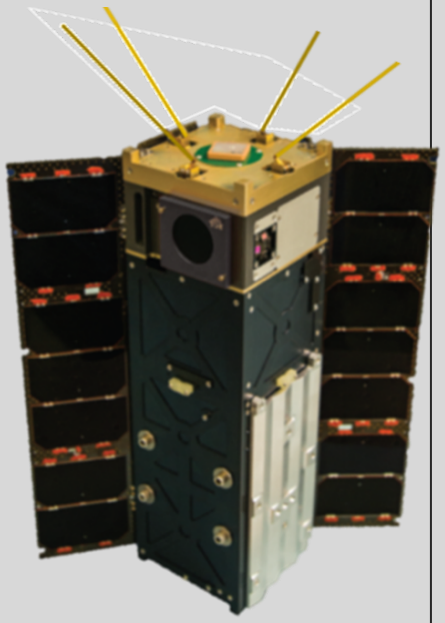


HARP –Lite Specialized filter will allow 3-wavelength multi-angle polarization with a single detector (low power/small form factor).



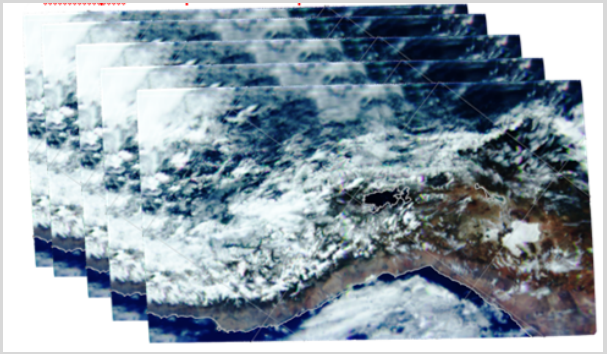
Camera Electronics

Payload computer

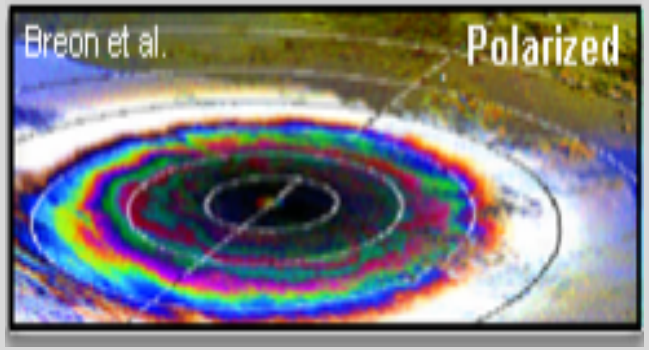


Spacecraft

HARP-Lite will allow for similar hyperangular capability as HARP CubeSat and POLDER like Cloud Raibow Images; All in a 1U form factor.



HARP Hyper-Angular Sampling

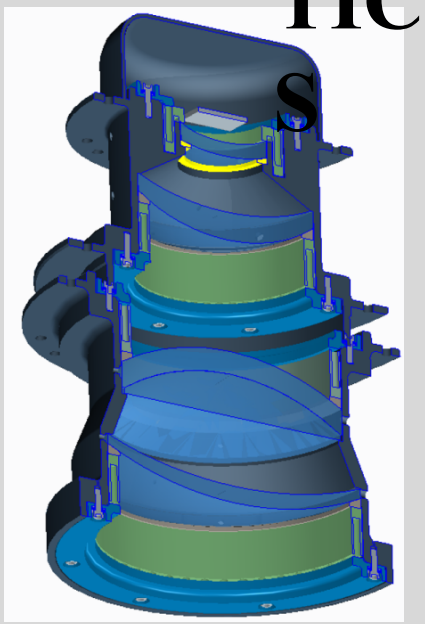


POLDER cloudbow images

- HARP LITE:
  - 3 wavelengths (~450, 550, 670nm)
  - 3 linear Polarizations
  - Wide FOV (~1000 km)
  - Hyper-Angular Sampling
  - 1U form factor

Feasible Payloads That Have Already Been Studied By Our Team:

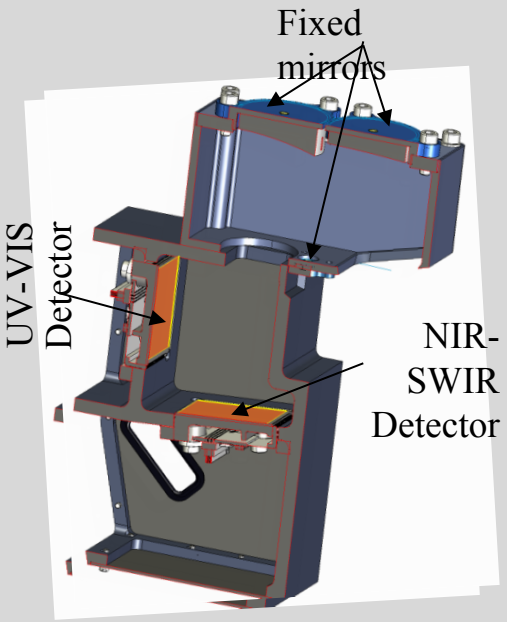
TICS

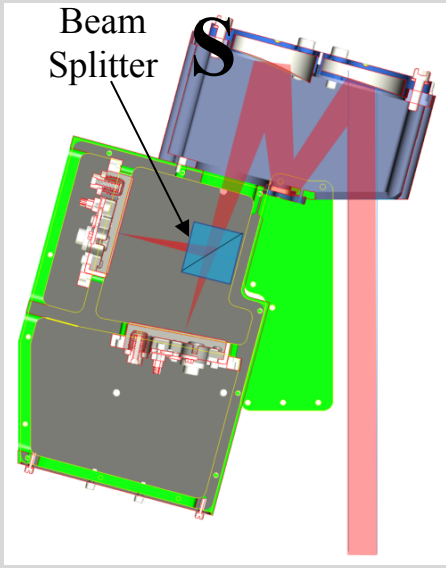


Thermal imager

Uncooled microbolometer detector

RCS

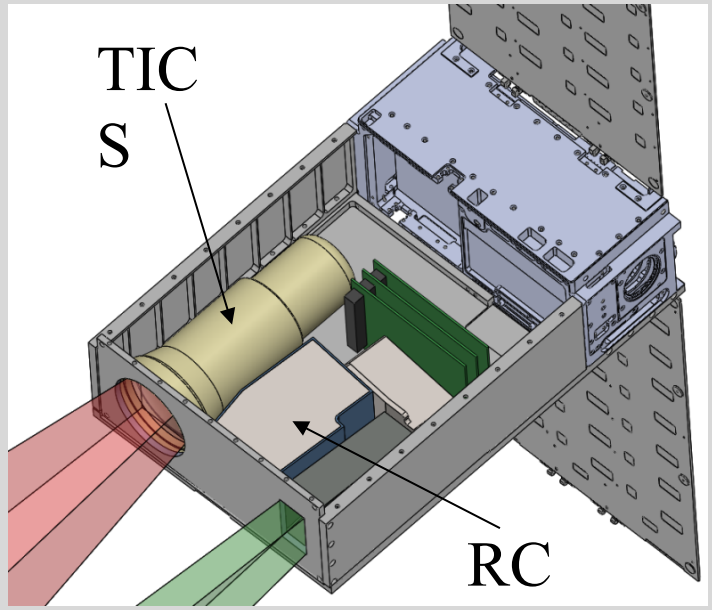




Reflective bands imager

UV-VIS detector – CCD or CMOS detector
NIR-SWIR detector – InGaAs up to 1.7µm or MCT up to 2.5µm

6U Spacecraft

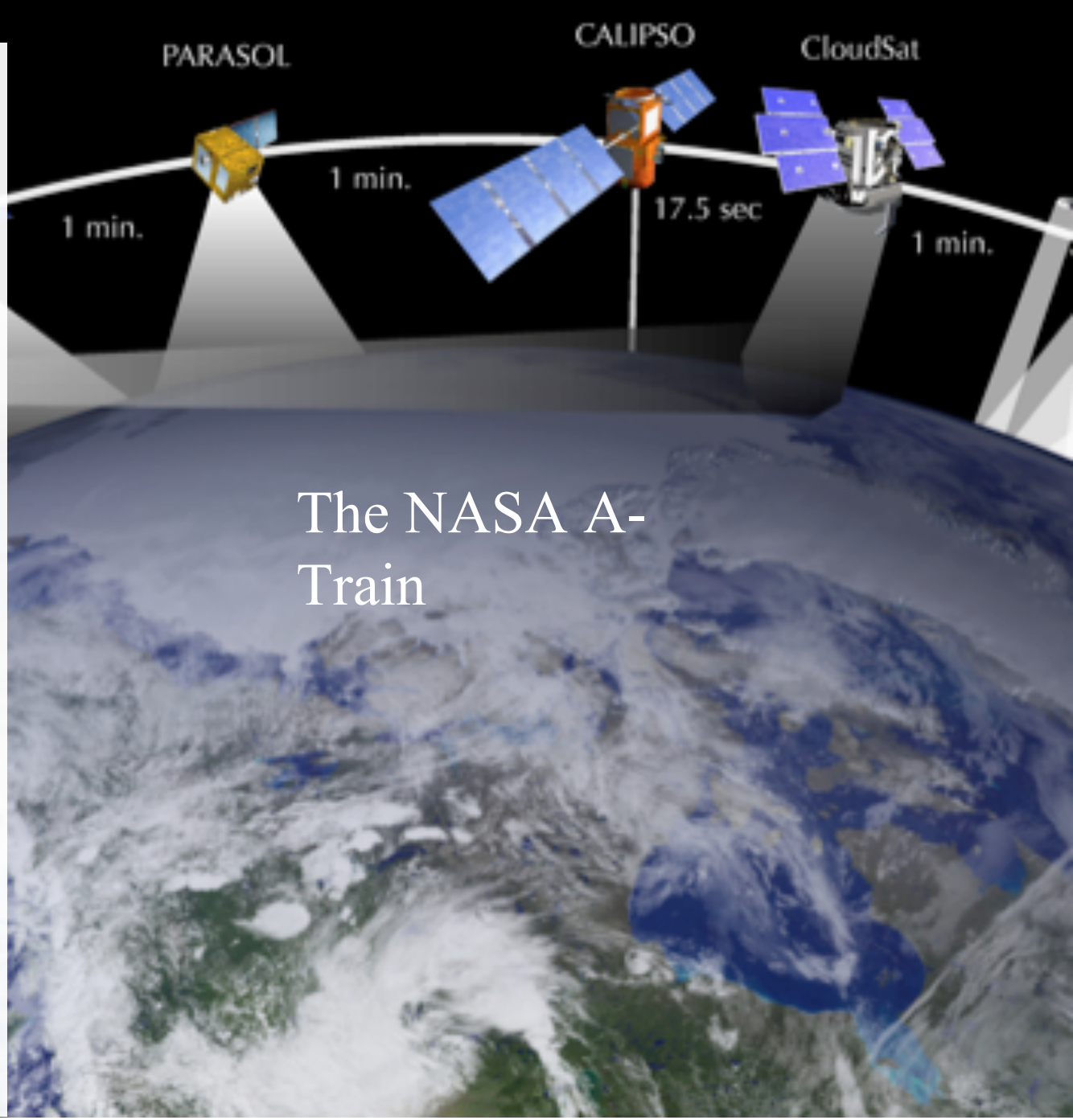


A combination of TICS and RCS fit in a 6U spacecraft covering from UV to TIR wavelengths

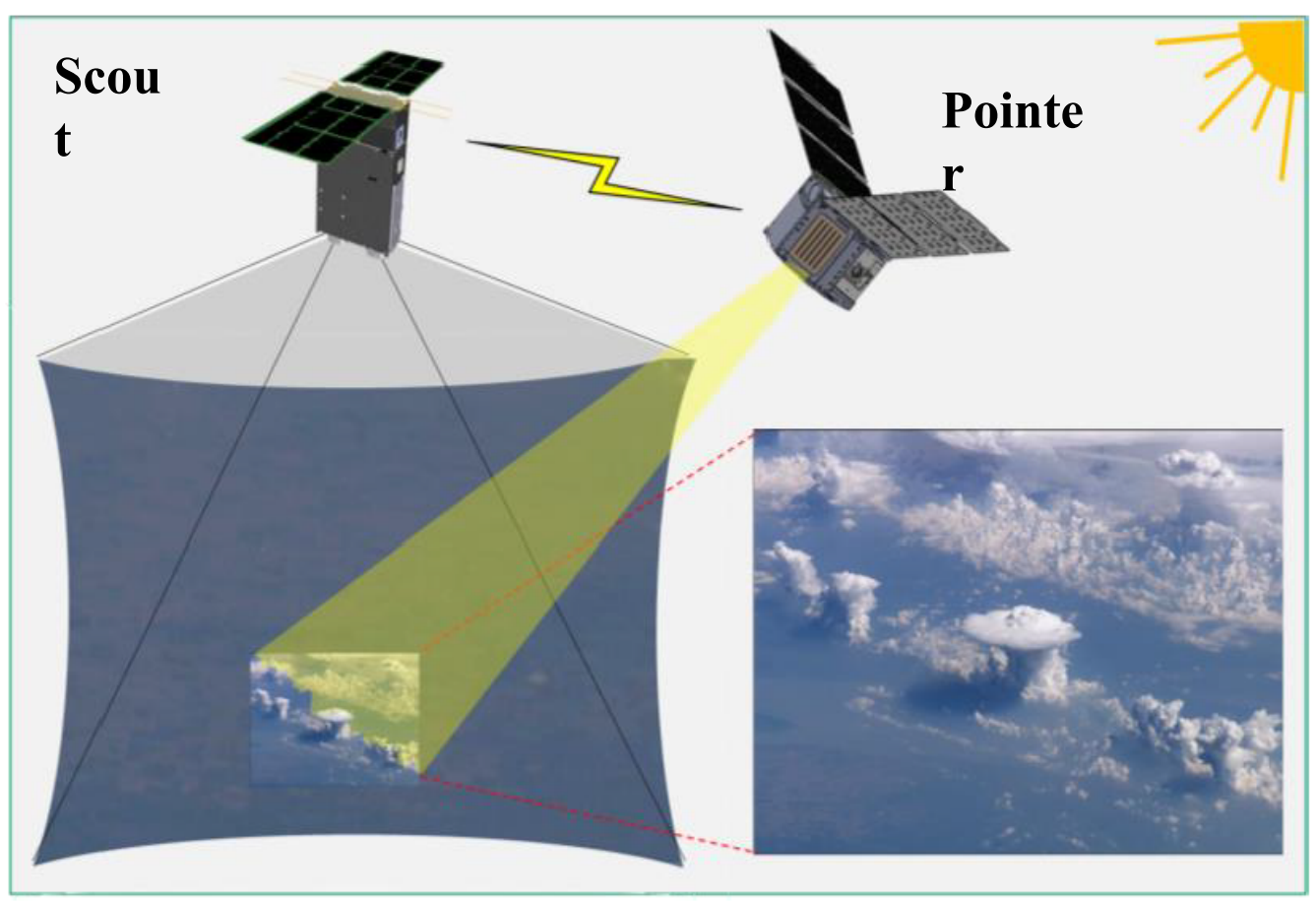
Earthline Constellation

Concept:

- A constellation of satellite sensors and platforms that reproduce and expand upon the capabilities of NASA's A-Train.
- A private-university partnership leveraging the advantages of each institution to steamline development, cut costs and maximize educational opportunity.
- Creative design based on the small satellite revolution and the growing industry that supports it.
- A commitment to producing scientific data that matches the quality of NASA's current archive and would interest NASA and other agencies with a possible data purchase.



Earthline Mission Conceptual Design: The Scout and the Pointer flying in formation



- The first satellite scans a broad region on Earth and uses AI to **scout** for and select regions of interest on the ground
- The first satellite sends coordinates to the second satellite that **points** at the target and performs high resolution/detailed measurements of variables of interest
- A current concept for these measurements has been estimated in ~$12M

Commercialization opportunities beyond the Earthline constellation

- The versatile systems proposed here allow for the fast development of universal payloads and has multiple application to different fields.
- AirPhoton will also develop a catalog of EO/IR front sensors that can be integrated to a single back end electronics and attend the demand of a variety of customers
- AirPhoton’s modular catalog of backend electronics and front-end sensors will allow customers to fast track the implementation of nanosatellite payloads that meet their measurement requirements.