The Spectral Ocean Color (SPOC) Small Satellite Mission: Developing an Adjustable Multispectral Imager

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Mission Overview

The SPectral and Ocean Color (SPOC) Satellite shall acquire moderate resolution imagery across a wide range of spectral bands to monitor coastal ecosystems and ocean color. SPOC will acquire image data between 433 and 866 nm to monitor 1) coastal wetlands status, 2) estuarine water quality including wetland biophysical characteristics and phytoplankton dynamics, and 3) near-coastal ocean productivity. SPOC shall use multispectral remote sensing techniques to quantify vegetation health, primary productivity, ocean productivity, suspended sediments, and organic matter in coastal regions.

Mission Objectives

1) SPOC shall acquire moderate resolution imagery of coastal ecosystems and ocean color
2) SPOC shall acquire image data between 433 and 866 nm
3) SPOC shall use multispectral imaging products to monitor coastal wetlands status, estuarine water quality including wetland biophysical characteristics and phytoplankton dynamics, and near-coastal ocean productivity
4) SPOC shall train students in STEM related fields by having them investigate optimal data transmission techniques, geo-reference imagery for mapping, conduct photogrammetric processing of images acquired from the satellite, develop community outreach programs, and learn general aerospace manufacturing/ testing/designing skills

Figure 1: SSRL members performing hardware acceptance

Mission Success Criteria

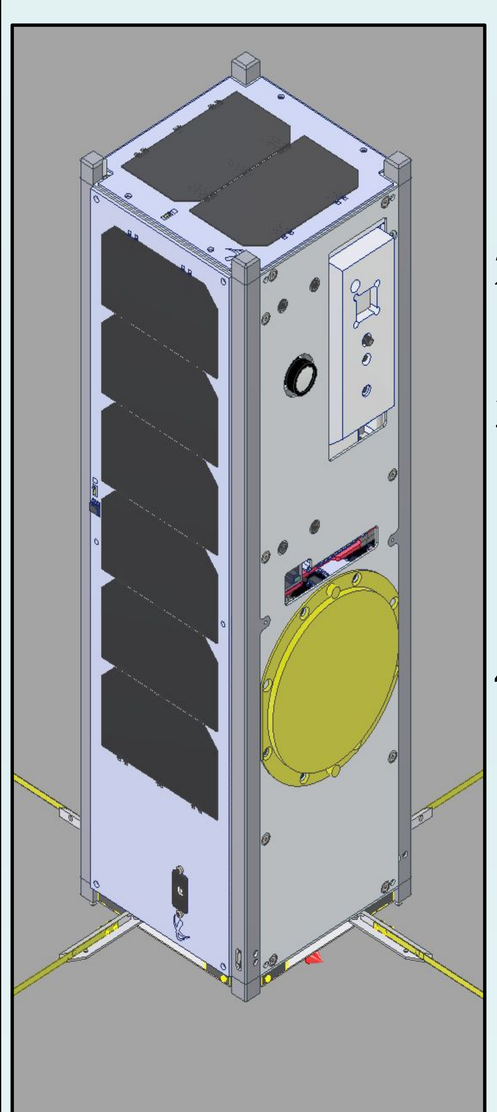

Figure 2: SPOC

1) **Min:** Image one coastal target with a minimum spatial resolution of 240m.
   Full: Scan the same coastal target 5 times with a minimum spatial resolution of 150m.
2) **Min:** Acquire images with spectral resolution of 50nm.
   Full: Acquire images with spectral resolution of 10nm.
3) **Min:** 30 students shall be directly involved for at least two semesters.
   Full: 75 students shall be directly involved for at least two semesters.
4) **Min:** Give five community outreach presentations, mentor two local high school students, and five space news/educational podcasts.
   Full: Give twenty community presentations, mentor five local high school students, host two workshops, release ten satellite related instructional YouTube videos, and twenty space news/educational podcasts.

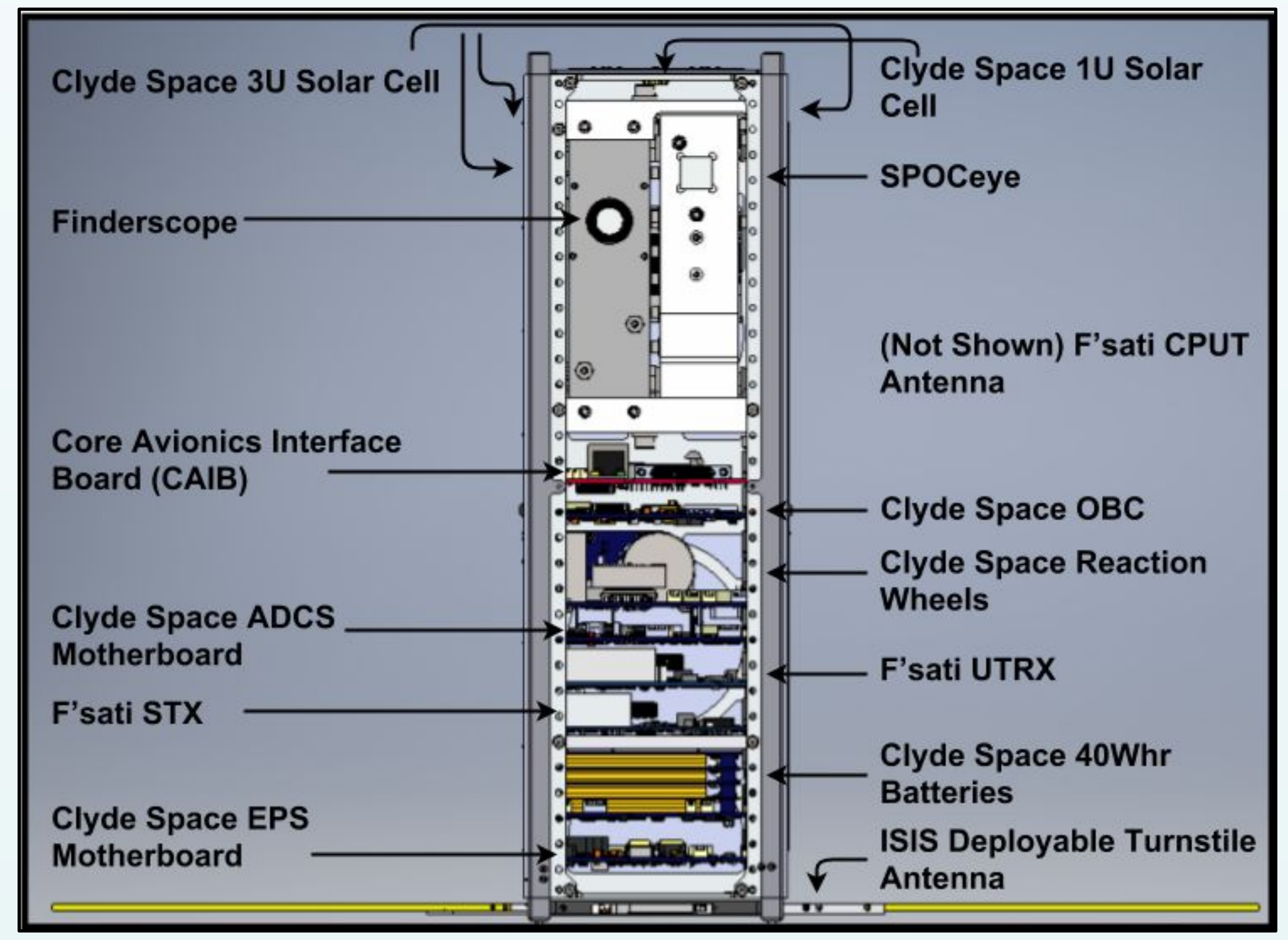

Figure 3: Labelled interior view of the SPOC satellite

Concept of Operations

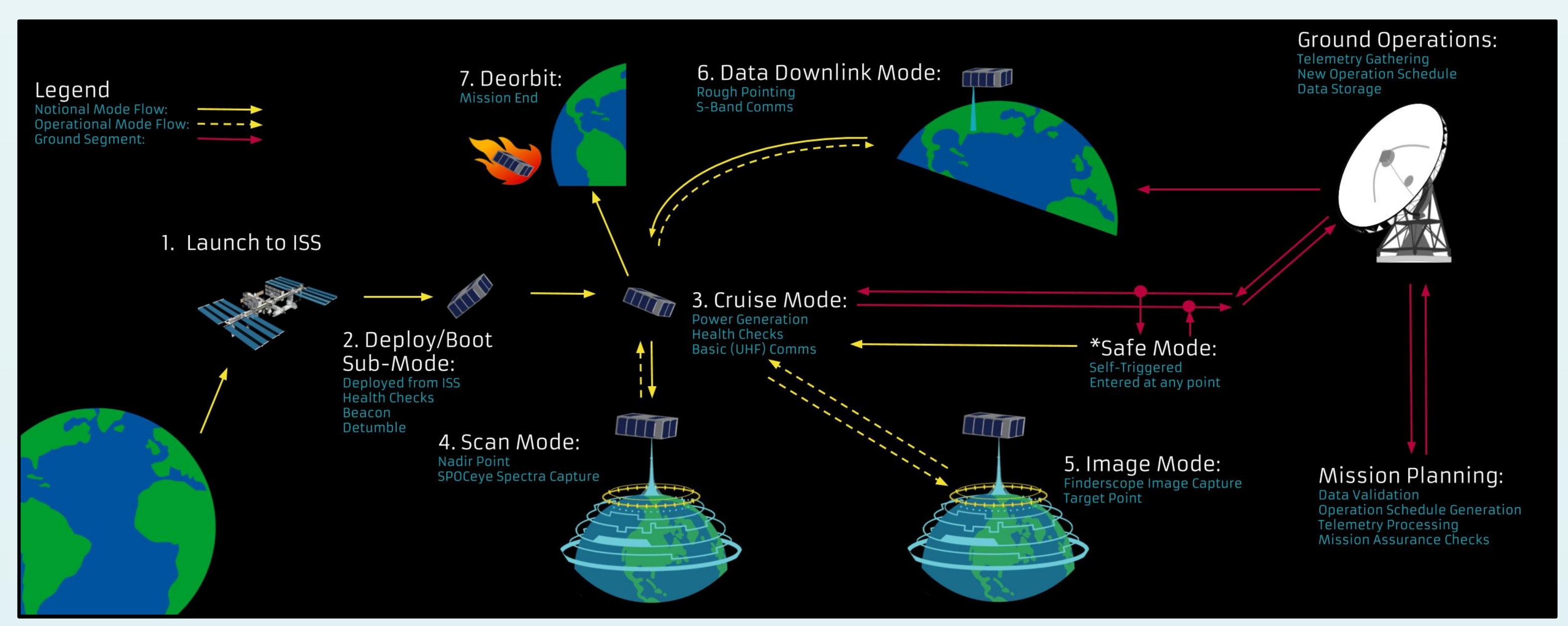

Figure 4: SPOC CONOPS diagram

To enable the safe operations of the SPOC satellite, we also have developed the Center for Orbiting Satellite Mission Operations (COSMO) for all critical communications to and from the satellite. The capabilities of the system are as follows:

- Software Defined Radio
  - 10 MHz - 500 MHz Tx
  - 10 MHz - 6 GHz Rx
- Hardware Defined Radio
  - VHF/UHF/S amateur bands
  - Packet radio operations

Figure 5: COSMO location

The SPOC Payload: SPOCeye

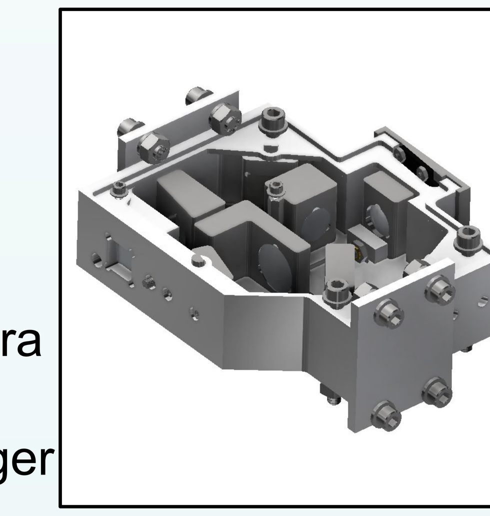

Figure 6: SPOCeye

Payload Overview

- Optical layout designed by Cloudland Instruments
- Diffraction grating based hyperspectral camera
  - 433-866 nm
- Operated as an adjustable multispectral imager
  - 16 adjustable bands
- Focus on coastal wetland status near-coastal ocean productivity.

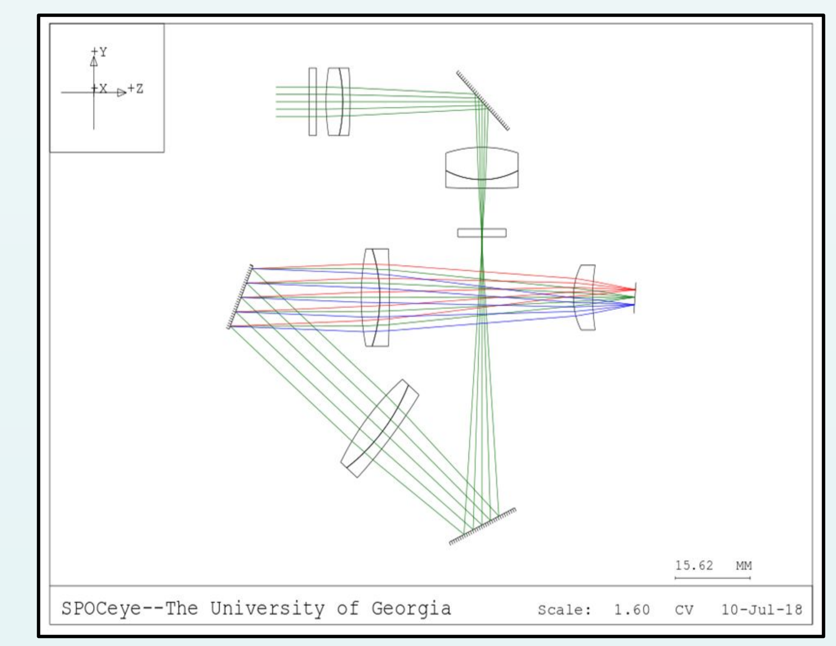

Figure 7: Optical Design

Current Payload Status

- Optical bench constructed
- Engineering Design Unit (EDU) under expected January
- Flight Unit expected March

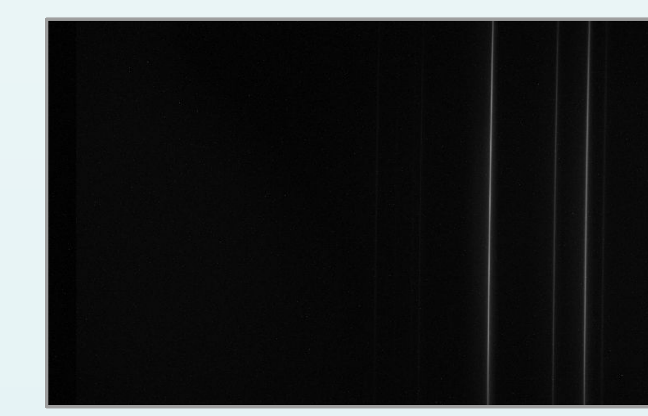

Figure 8: Helium spectra obtained August 2018

SPOC Status and Conclusion

- Passed the Critical Design Review July 2018
- All flight non-payload hardware is scheduled to arrive January
- Currently finalizing the licensing process

The SPOC mission has enabled an undergraduate and faculty team to design a scientific mission, and create infrastructure at the University of Georgia to continue space innovations.

Figure 9: University of Georgia Small Satellite Research Laboratory

Acknowledgments

- NASA Undergraduate Student Instrument Project
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- University of Georgia Center for Teaching and Learning

For more information about CubeSats, the Small Satellite Research Laboratory (SSRL), our missions, visit www.smallsat.uga.edu.