Multi-wavelength Ocean Profiling and Atmospheric Lidar

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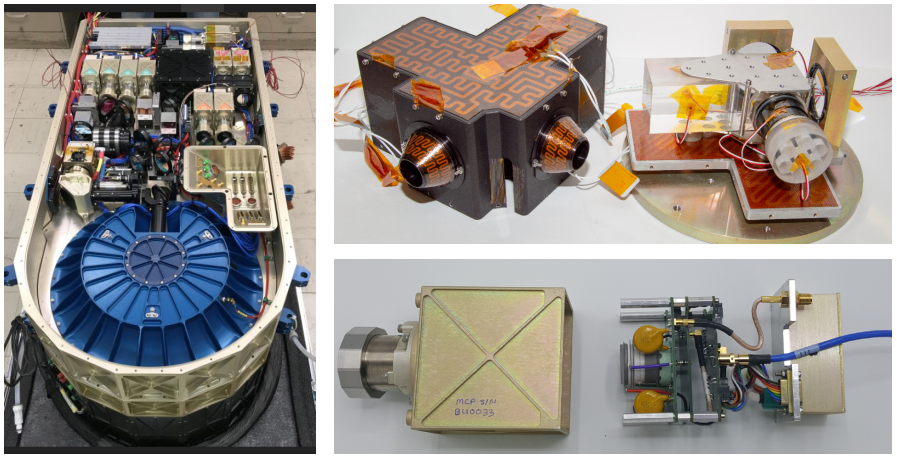
Objective

- Advance ocean remote sensing by enabling 3-D observations of global plankton stocks, colored dissolved organic matter, and mixed layer depths in order to:
  - Reduce uncertainty in global CO_2 budget.
  - Improve ocean dynamical models and Earth system models.
  - Improve predictions of ocean ecosystem response to climate change.
- Optimize existing multi-wavelength (355, 532, 1064 nm) High Spectral Resolution Lidar (HSRL) system for ocean profiling at two wavelengths (355 and 532 nm). Current HSRL-2 measures particle backscatter coefficients at 355, 532, and 1064 nm and extinction coefficients at 355 and 532 nm.



Above: HSRL lidar with ocean and aerosol channels. Above right: flight interferometer. Bottom right: detector package for the high-speed ocean surface return.

Accomplishments

- Developed ocean lidar detection technology that sufficiently suppresses subsurface signal artifacts arising from laser reflection from the ocean surface when operating in nadir-viewing mode. Past airborne lidars avoid these artifacts via pointing off-nadir by over 10 degrees, which is not a practical solution for space implementations.
- Developed and optimized a pressure-tuned off-axis Michelson interferometer as an HSRL optical filter.
- Designed and implemented new aft-optics receiver for HSRL-2 that is optimized for atmosphere and ocean profiling at 355 and 532 nm and includes the capability for measuring chlorophyll and CDOM fluorescence. Receiver improves upon atmospheric capability by providing higher vertical resolution for in-cloud extinction profiling and maintains 1064-nm capability.
- Designed, built, and developed software for a new instrument data acquisition and control system. System achieved 1 m vertical resolution and implemented shot-by-shot detector gate timing via FPGA context-sensitive processing of real-time lidar signals and other signal processing functions.
- Integrated the new lidar receiver and data acquisition/control system with original HSRL-2 laser subsystem and demonstrated measurement capability via ground and flight tests.
- Demonstrated both ocean and cloud/aerosol remote sensing with 1 m resolution.
- Deployed the new ocean-capable HSRL-2 on the CAMP^{2}Ex mission in the Philippines.

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TRL_{in}= 3 **TRL_{out}= 6**