In water protocols

Current Protocols

NASA/TM-2003-

Ocean Optics Protocols For Satellite Ocean Color Sensor Validation, Revision 4, Volume III:

Radiometric Measurements and Data Analysis Protocols

Chapter 2

In-Water Radiometric Profile Measurements and Data Analysis Protocols.

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Best practices

- Avoid ship shadow somehow….
- Correct for self-shading
- preferably 6-8 samples/meter
- Dark measurements should be obtaiend with each measurement (possibly temperature dependent).
- Temperature should be measured on detector mounting surfaces (instrument should be allowed to equilibrate).
- Corect for clouds – surface irradiance (Es).
- Deal with focusing/defocusing near surface

Current Protocols

- Surface irradiance measurements should also be made, the protocols say the instrument should be gimbaled but also warn that a bad gimbal can actually cause more problems.
- Protocol mentions having the Es instrument floating away from the ship…but above water as a solution
- The in-water instruments should have tilt and roll indicators, particularly for Ed and Eu, less important for Lu.

Current Protocols

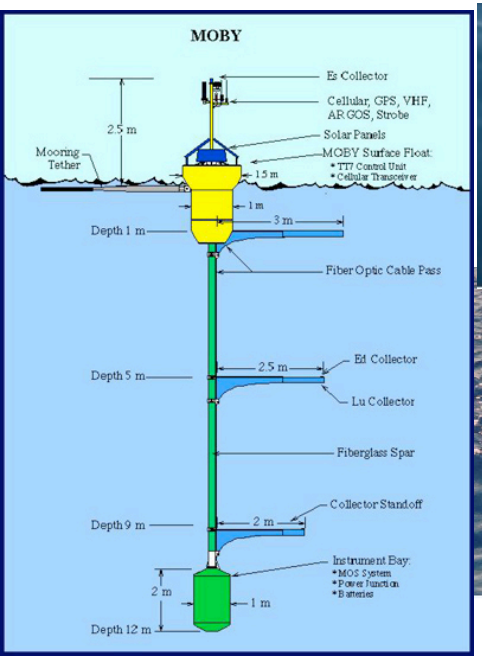
- Things to worry about:
  - Instrument self shadowing
  - Inelastic scattering varying with depth
  - Bandwidth (when greater than 5nm need to account for strongly changing absorption within the band).
  - Extrapolation to the surface (Klu).
  - Transmission through the surface to compute Lw

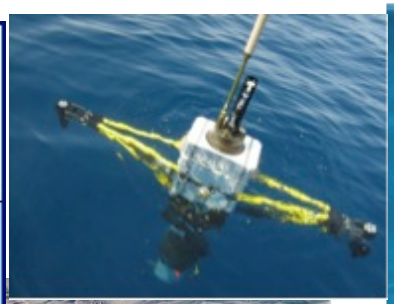
How to compute the correct K-functions to use in extrapolations?

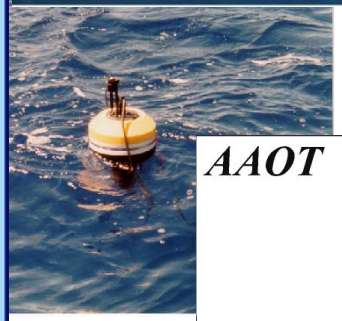
$$\chi^2 = \sum_{i=1}^{N} \left(\frac{model_i - data_i}{uncertainty_i} \right)^2 = \sum_{i=1}^{N} \left(\frac{Ae^{-Kz_i} - data_i}{uncertainty_i} \right)^2$$

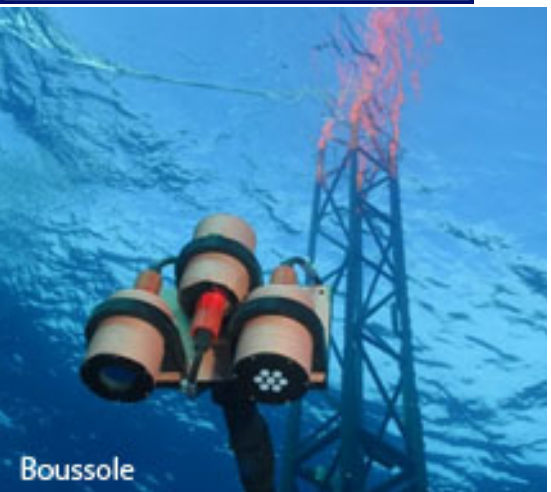
Current systems

Fixed depth:

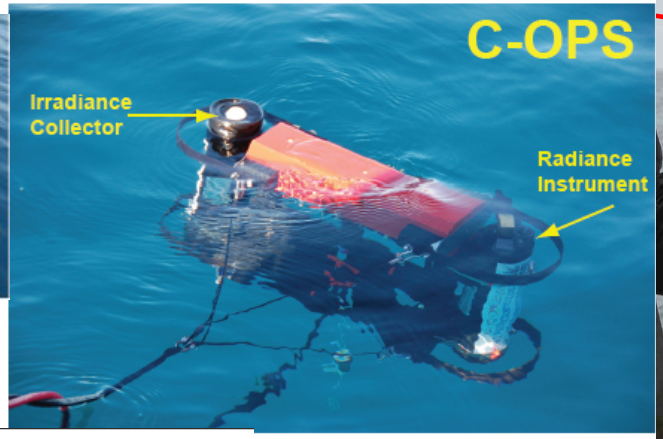


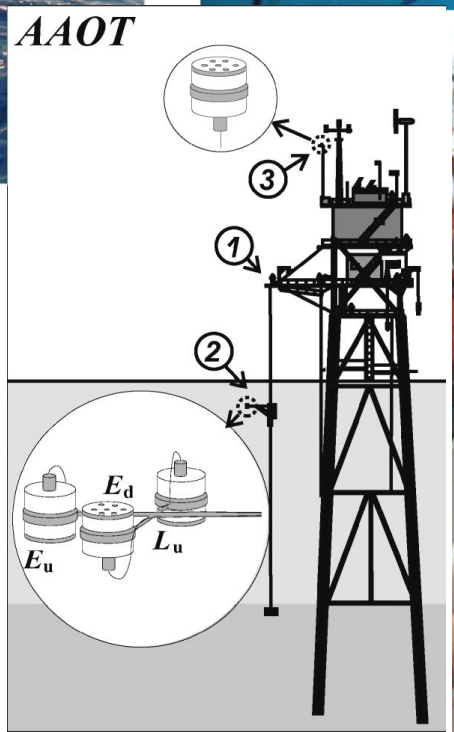






Profiling systems:





New protocols

- 4 main methods to get Lw, the first two get increased depth resolution in different manner
  - Slow drop, implemented with C-OPS and profiling floats.
  - Multicast, implemented with min-Pro, micro-Pro, and Hyper-pro.
  - Fixed depth buoy systems (MOBY-Boussole, HTSRB)

What are really the open questions?

- Objective selection of extrapolation intervals;
- Depth resolution requirements for the different quantities (Lu, Ed, Eu) – in optical depths;
- Limits of subsurface extrapolations through linear fits of log transformed data, versus actual exponential fits;
- Minimization of perturbing effects by deployment superstructures;
- Use of tilt-compass units for both reference and in-water radiometers;
- Operational corrections (or at least minimization schemes) for inelastic contributions beyond 560 nm;
- Application of self-shading (adding effects of scattering and skylight)
- , temperature, immersion and cosine corrections;
- Operational corrections for BRDF effects.

Sky blocked approaches to measure Lw:

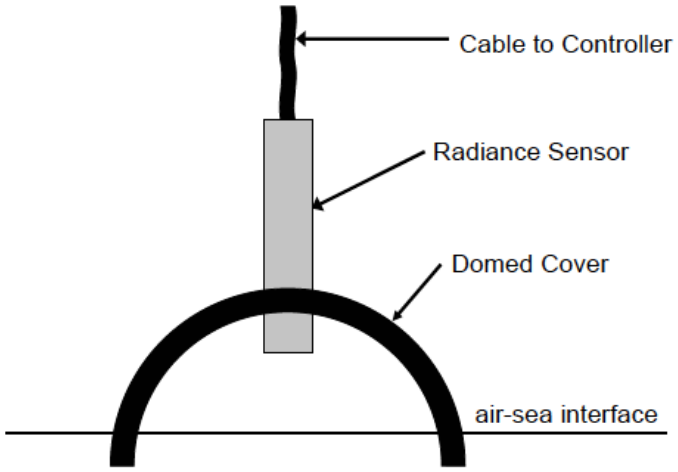
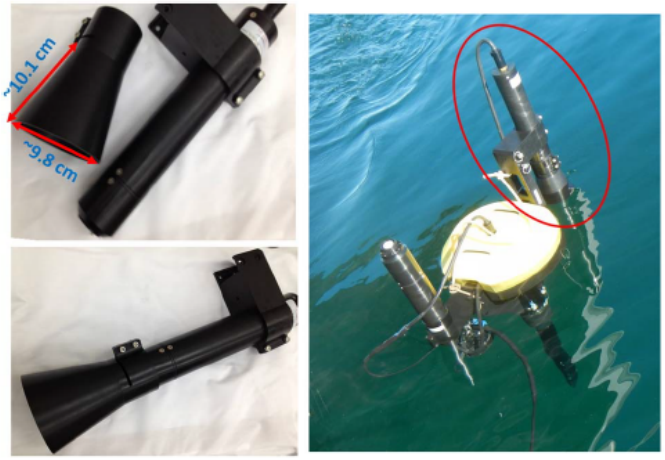


Fig. 1. Schematic diagram of the proposed domed-cover method.

Tanaka et al., 2006, AO



Lee et al., 2013, AO

Approach removes the necessity to deal with reflected sky light and with crossing the interface.

However:

1. Need to quantify self shading by dome/cone.
2. Problem with splashes when surface ocean is rough, and wrong characterization of the interface.