The Marine Optical BuoY (MOBY) Radiometric Calibration and Uncertainty Budget for Ocean Color Satellite Sensor Vicarious Calibration

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ABSTRACT

For the past decade, the Marine Optical Buoy (MOBY), an autonomous radiometric buoy stationed in the waters off Lanai, Hawaii, has been the primary in-water oceanic observatory for the vicarious calibration of the U.S. satellite ocean color sensors SeaWiFS and MODIS. The MOBY vicarious calibration of these sensors supports international efforts to develop a global, multi-year time series of consistently calibrated ocean color data products. A critical component of the MOBY program has been establishing robust radiometric traceability to the International System of Units (SI); a detailed uncertainty budget is a core component of traceable metrology. We present the MOBY uncertainty budget for up-welling radiance. Consideration of the vicarious calibration uncertainty budget is important as next generation vicarious calibration sensors are being discussed because it gives information about how the resources for the vicarious calibration facility should be allocated and to what extent the measurements may be utilized to address climate change research.

MOBY top arm upwelling spectral radiance uncertainty from laboratory calibrations before and after each deployment (top panel), varies because optical components up to, and including the MOS are refurbished, cleaned, replaced, etc. when each buoy is recovered from its field deployment.

Internal stability sources (ex. incoherent lamp, top panel) measured during field deployments show the stability of MOBY-top 10 years of operation.

A.) Top arm upwelling spectral radiance uncertainty from laboratory calibrations before and after each deployment (top panel), varies because optical components up to, and including the MOS are refurbished, cleaned, replaced, etc. when each buoy is recovered from its field deployment.

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FUTURE RESEARCH

Determination of the uncertainty budget for the water-leaving spectral radiance, $E_w$, is the next step in our activities. Additional components to be considered are those associated with the uncertainty in depth, the immersion coefficients, and the uncertainty in $E_w$. The uncertainty in $E_w$, depends on the uncertainties in $I_u$, $S_u$, the vertical homogeneity of the water, depth, turb, and environmental conditions. The Type A uncertainty component for the in vivo values of $E_u$ is measured in the Type A uncertainty of the satellite gain coefficients that are derived from multiple matchups, but included in magnitude because the atmosphere dominates the satellite radiance. Thus thorough understanding of the MOBY uncertainty components may aid in the development of the satellite uncertainty budgets.

SUMMARY

We have presented a preliminary uncertainty budget for $E_u$ measurements that apply to a recent deployment, MOBY231. We have identified sources of bias that remain under investigation, with self-shading and changes in the stray light performance with time at the top of the list. Field experiments are required for self-shading work and a full stray light characterization of the current buoy is recommended at the NSF SIREU5 facility. We have a 10 year record of radiometric validation measurements for documenting and possibly correcting for bias in both the radiance and irradiance radiometric references standards. The next steps are to develop preliminary uncertainty budgets for $E_u$ and $E_w$ and to apply the analysis to the entire data set.

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