A flexible, Automated, Processing and Decision System to Support Ocean Color Satellite Vicarious Calibration Using Hyperspectral Radiometric Instrumentation on Autonomous Profiling Floats.

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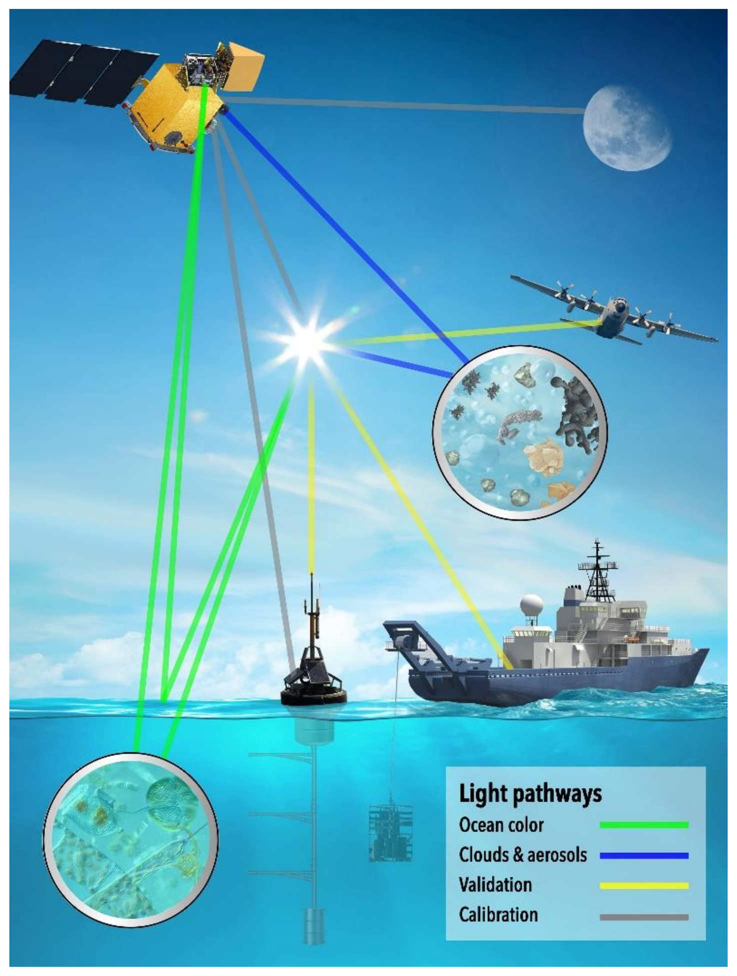
ABSTRACT

Ocean color satellites require routine in-orbit verification and system vicarious calibration (SVC) to maintain accuracy over the mission lifetime and between satellites. A spatially extensive network of vicarious calibration match-up data points would aid in reducing vicarious calibration uncertainty of ocean color satellites. To enable this network, we have developed a new approach to ocean color satellite vicarious calibration and validation that combines accurate, reliable and stable hyperspectral radiometric instruments with autonomous profiling float technologies to provide an unattended means for vicarious calibration over periods of years in the open ocean. Advances in robotic sampling platforms over the past 2 decades has brought about a definitive change in the way ocean data is collected and provide a new opportunity to combine sensing technologies with autonomous platforms. Autonomous floats are now ubiquitously used to monitor the worlds physical and biogeochemical conditions with high vertical resolution with the established Argo and BGC-Argo programs. In parallel with these technological advances have been advances in modelling efforts to track, predict and even optimize float deployment locations for improved research and event based monitoring. Our current efforts build off of these extensive works to revolutionize the concept and operation of SVC in situ programs while addressing quality data assurance. Our conceptual approach is to enable an automated control, processing and decision support system to acquire SVC data that is of the highest quality. Elements required for this system span float configuration and mission tools, to data processing systems, to predictive models. In combining these elements, we aim to establish a continuous in situ program that is optimized for producing the highest quality and quantity of in situ matchup data for SVC purposes while minimizing the cost of data acquisition. We present our conceptual approach and elucidate advanced processing techniques needed to enable such an approach.

HyperNAV: An autonomous profiling float for ocean color satellite vicarious calibration (SVC)

- High accuracy ***in situ* radiometric** measurements provide the principal source of truth for tracking ocean color satellite sensors
- SVC is the process of combining ocean color satellite sensor data with in situ radiometric measurements and models to determine the on-orbit satellite calibration factors.
- HyperNAV was developed to support NASA's PACE mission and new hyperspectral ocean color satellite sensor (to be launched in late 2022) for SVC
- HyperNAV: highly accurate, high spectral resolution, low uncertainty, radiance sensors integrated with an autonomous float platform
- Advantages of using profiling floats for SVC purposes
    - Full water column profiles of radiometric/optical properties
    - Reduced bio-fouling via parking the float at depth (> 500m)
    - Easy to deploy/recover – portable
    - Obtain accurate radiometric measurements at sea surface (minimize extrapolation errors)
    - Full suite of physical/optical measurements



SVC Requirements

- Atmospheric aerosols in the region of the in situ data collection must be or maritime origin (non absorbing, low aerosol optical thickness)
- Sea Surface should be free of whitecaps (low wind speeds)
- Water leaving radiance should be uniform over spatial scales larger than the pixel resolution of the satellite sensor
- Cloud free conditions
- Low in-water bio-optical property complexity and concentrations.
- Low spatial variability in the in water optical properties.
- *In situ* data acquisition must coincide with the satellite overpass (+/- 1 hour)

Key Challenge for using floats for SVC

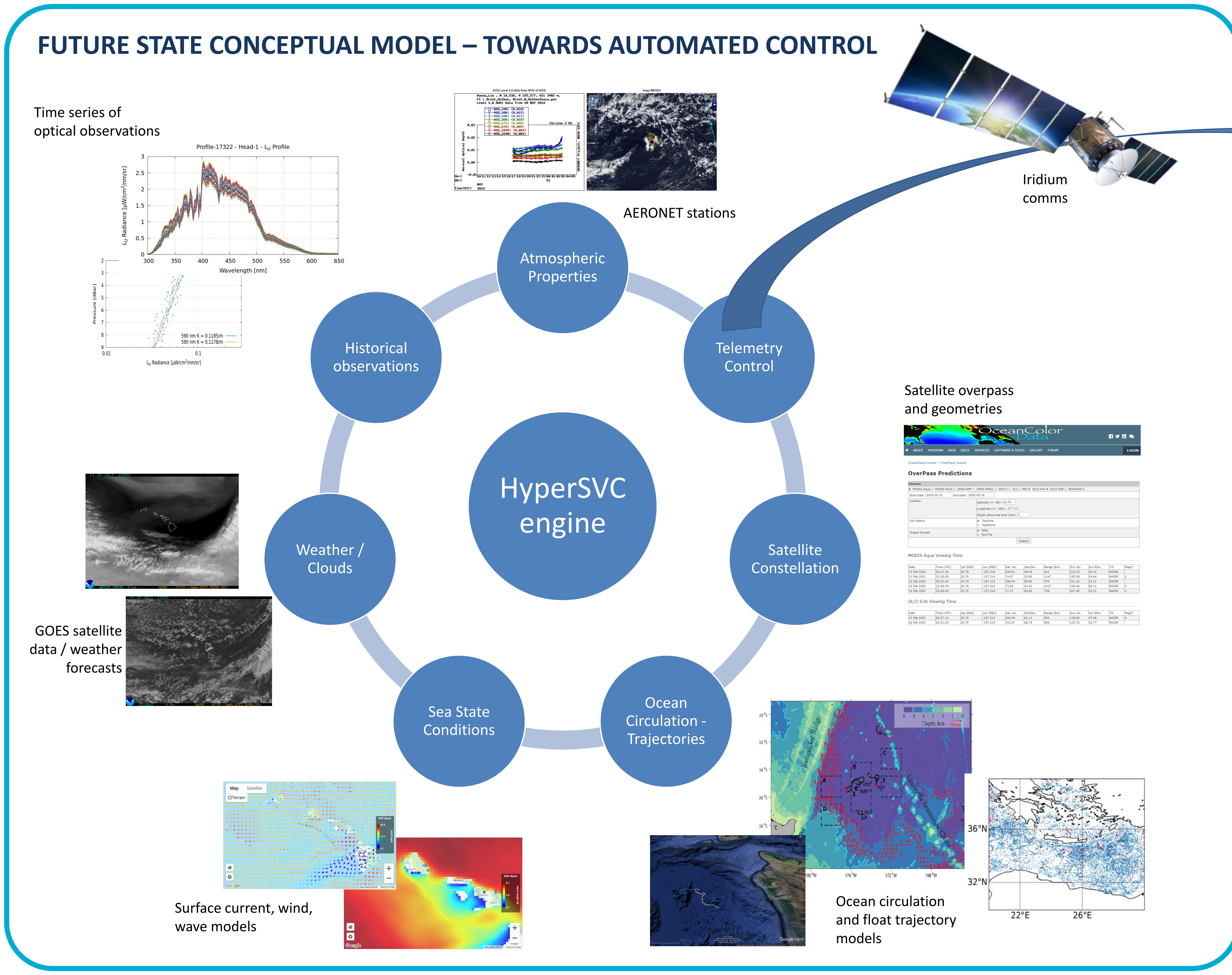
- Floats can only transmit and receive data when the float has surfaced
- Atmospheric and Ocean conditions can vary (time and space)
- Floats drift slowly at depth – not static location

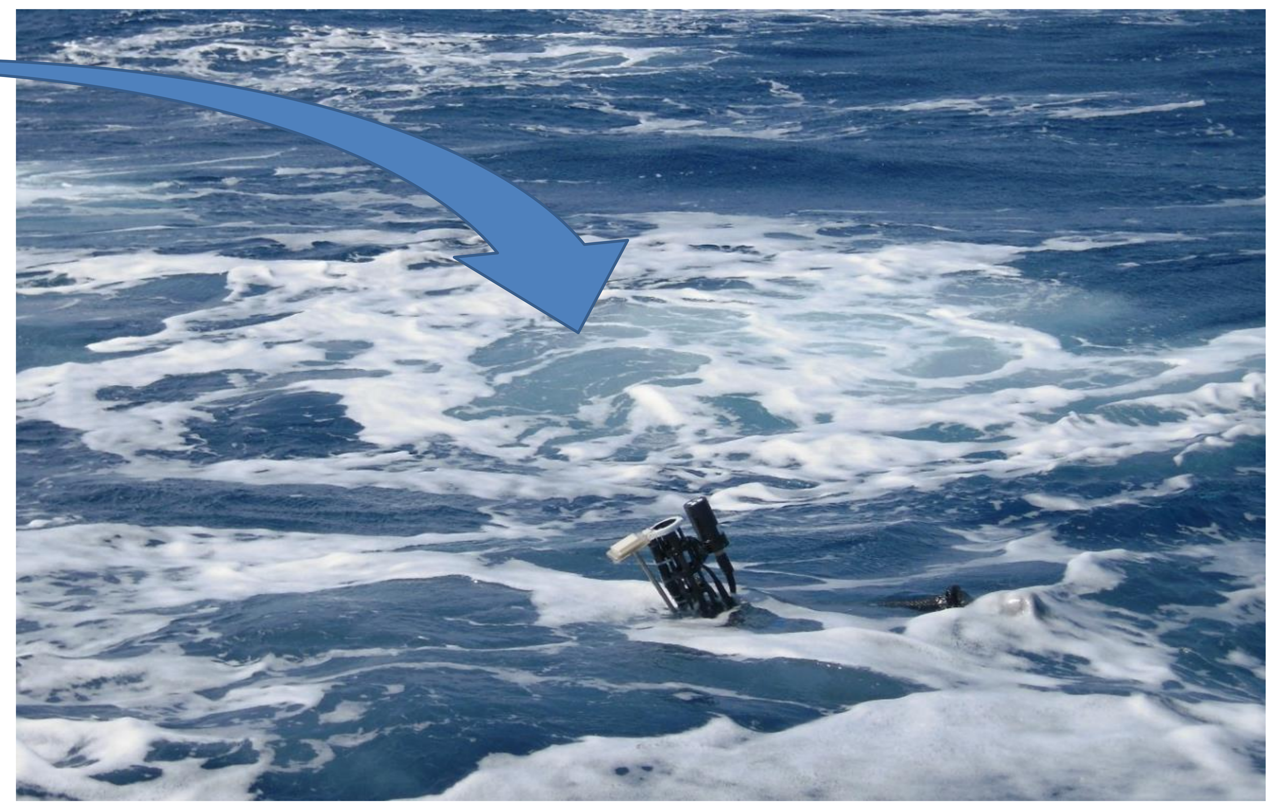
So when should the float undertake a profile and obtain data that meets the all of the requirements for SVC purposes?

- Every day and hope that the sky/ocean are clear? Need lots of power!!
- Hire operators of the float to continuously monitor atmospheric conditions, determine satellite overpass schedules, and predict float trajectory.

Better way: Develop prediction system that optimizes in situ data collection for SVC that can automatically command (operate) the HyperNAV float.

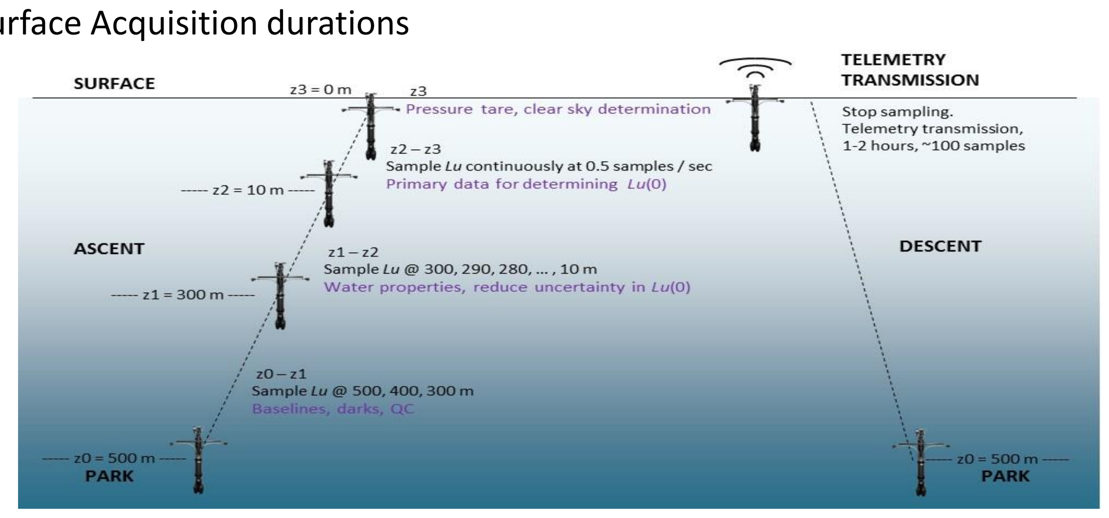
FUTURE STATE CONCEPTUAL MODEL – TOWARDS AUTOMATED CONTROL





Prediction system Delivers Info to the float

- Next mission configuration to the HyperNAV float
- Profiling schedule
- Park depths
- Estimated trajectory / location
- Surface Acquisition durations



Interested in Collaborating?

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