AquaWatch Pathfinders: Earth Observation Sensor Design Simulator Testbed (End-to-End Simulator)

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Introduction

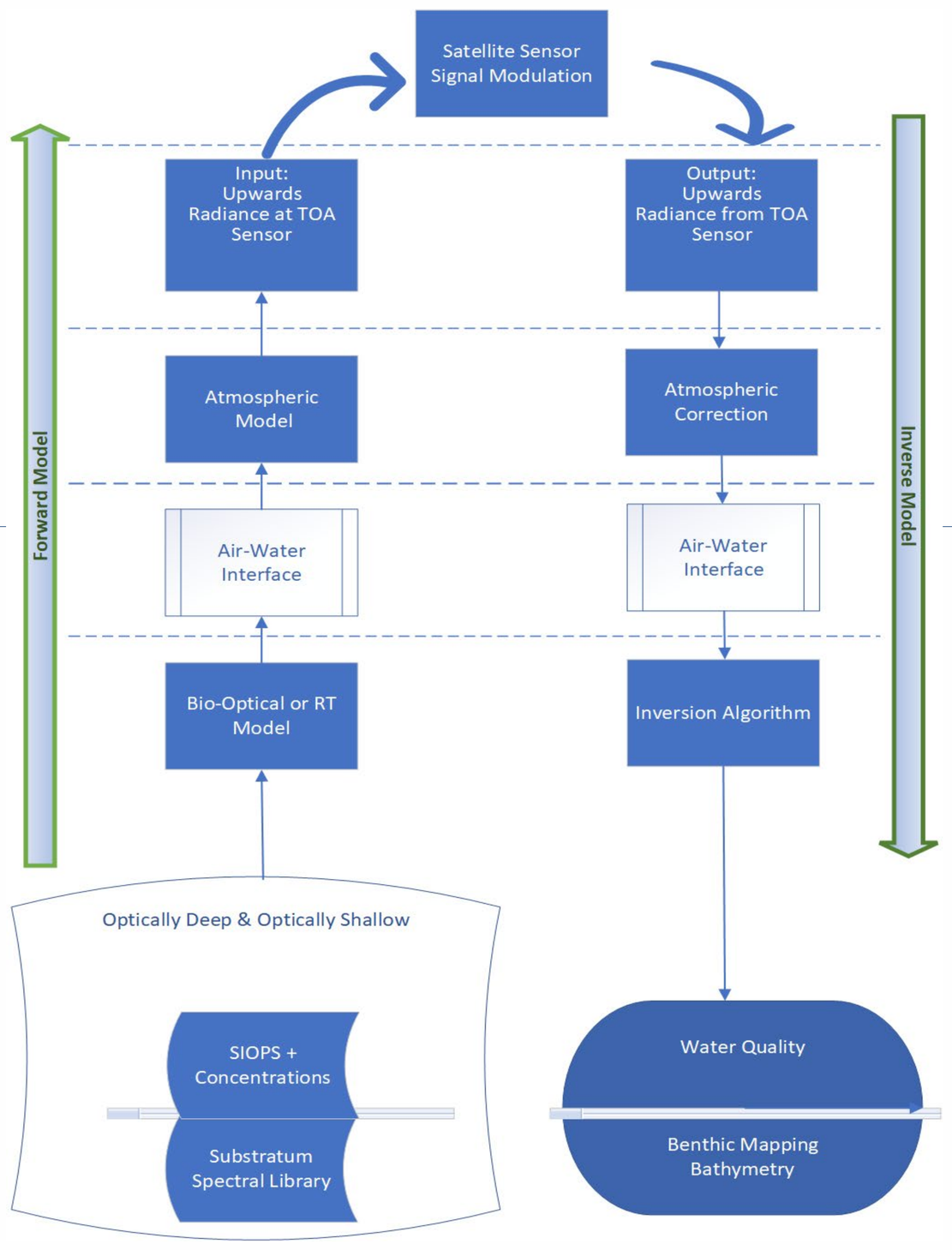
We introduce a prototype end-to-end Simulator for informing satellite sensor design for aquatic application: benthos, water and atmosphere forward simulating models, to generate input data to a top of atmosphere satellite sensor, software that enables hypothetical scene creation and sampling by an instrument model, and the inversion process used to create and validate value-added products from from top of atmosphere Earth observation data.

The Simulator is an excellent tool for investigating return on investment and user requirements in terms of product performance without requiring collection of airborne datasets or launching of satellite instruments. The consequences of design decisions can be comprehensively assessed without leaving your desk, facilitated through the Simulator.

Aims

This 1st stage of the testbed produced a prototype software suite for simulating and optimising the design of an earth observation sensor for coastal and inland aquatic environments, to measure aquatic ecosystem environmental variables related to water quality and shallow inland, coastal and coral reef benthic habitat parameters and to demonstrate some case studies.

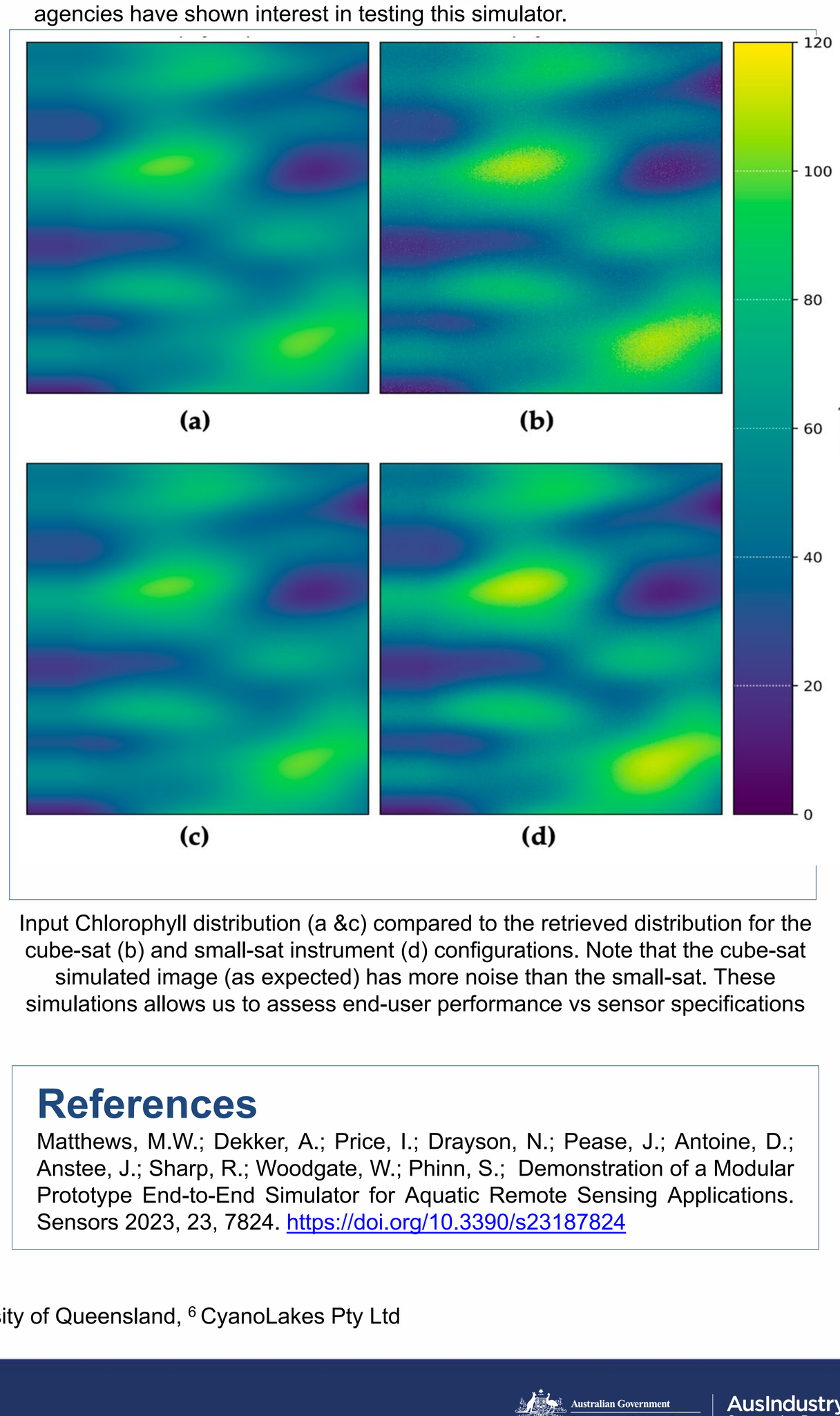
Methods: modular software suites for:



Results

This project has demonstrated an integrated end-to-end Simulator for informing satellite instrument design for aquatic applications. This includes water and atmosphere forward models to generate input data, software that enables hypothetical scene creation and sampling by an instrument model, and the inversion process used to create and validate value-added products from raw data from top of atmosphere.

A design trade-off study demonstrated how design decisions, driven by cost-related constraints, directly influences product resolution and quality. Thus, the Simulator is an excellent tool for investigating return on investment and user requirements in terms of product performance without requiring collection of airborne datasets or launching of satellite instruments. The consequences of design decisions can be comprehensively assessed without leaving your desk, facilitated through the Simulator. Several space agencies have shown interest in testing this simulator.



Input Chlorophyll distribution (a &c) compared to the retrieved distribution for the cube-sat (b) and small-sat instrument (d) configurations. Note that the cube-sat simulated image (as expected) has more noise than the small-sat. These simulations allows us to assess end-user performance vs sensor specifications

References

Matthews, M.W.; Dekker, A.; Price, I.; Drayson, N.; Pease, J.; Antoine, D.; Anstee, J.; Sharp, R.; Woodgate, W.; Phinn, S.; Demonstration of a Modular Prototype End-to-End Simulator for Aquatic Remote Sensing Applications. Sensors 2023, 23, 7824. https://doi.org/10.3390/s23187824

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