

DISCUSSION BRIEF

Alpha Zulu OceanOS™

An AI-Native Maritime Intelligence Platform for Sustainable Island Development

Supporting the Alpha Zulu RoPAC ZeroFF Programme

A strategic vision for AI-native maritime transport, ocean stewardship, food security and sustainable development in Caribbean Small Island Developing States.

“Every Alpha Zulu voyage carries more than cargo. It carries knowledge, opportunity and measurable progress towards a more resilient Caribbean.”

Prepared for discussion with Caribbean governments, universities, maritime and agricultural institutions, regional organisations, development partners and industry.

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1. Executive Summary

Marine decarbonisation offers Caribbean Small Island Developing States an opportunity that extends beyond replacing conventional propulsion. When zero-onboard-fossil-fuel vessels are combined with modern sensing, digital communications and artificial intelligence, scheduled inter-island transport can become intelligent regional infrastructure supporting commerce, food security, ocean stewardship, research, workforce development and public policy.

Alpha Zulu OceanOS™ is the proposed digital intelligence platform for that infrastructure. It complements the Alpha Zulu RoPAC ZeroFF Programme: RoPAC demonstrates reliable, scheduled, low- and zero-emission movement of passengers and palletised cargo; OceanOS

enables each voyage to generate, interpret and responsibly share operational, logistical and environmental knowledge.

OceanOS is not conceived as a closed proprietary application. It is an open, modular and interoperable ecosystem connecting vessels, ports, producers, markets, universities, governments and development partners. Its specialised Agentic AI capabilities would analyse information, coordinate workflows and present evidence-based recommendations. Physical AI would connect that intelligence to sensors and vessel systems in the real world, always under the authority of qualified masters, engineers and public institutions.

The platform would initially be tested through practical Alpha Zulu RoPAC operations. A focused pilot could demonstrate value in four connected areas:

- safe and energy-efficient vessel operations, maintenance and route planning;
- reliable agricultural logistics, cold-chain integrity and cargo traceability;
- routine ocean and weather observations from scheduled voyages; and
- verified evidence of emissions, trade, food-security and development outcomes.

This Brief presents a direction for collaborative development, not a completed technical blueprint. Governance, data rights, cybersecurity, scientific standards, financing and institutional responsibilities must be designed with participating Caribbean institutions. The immediate objective is to identify partners and a limited pilot capable of producing credible operational evidence before regional expansion.

2. The Regional Opportunity

The Caribbean Sea is the region's natural highway, yet inter-island supply chains remain fragmented and heavily dependent on extra-regional services. Moving a pallet of fresh produce between neighbouring islands can be less reliable and more expensive than importing comparable goods from outside the region. The consequences extend to farm incomes, food prices, manufacturing, disaster resilience, employment and the practical implementation of regional integration.

The region simultaneously faces rising sea temperatures, severe weather, coastal erosion, coral degradation, Sargassum influxes and changing marine ecosystems. These pressures require more frequent observation, stronger coordination and faster evidence-based decisions. Dedicated research and monitoring programmes remain essential, but their coverage is constrained by cost and vessel availability.

Scheduled commercial vessels can help address both challenges. Their primary purpose remains safe, reliable transport. However, a digitally connected vessel repeatedly travelling

established corridors can also collect consistent environmental observations, improve supply-chain visibility and create an operational record useful to researchers, regulators, investors and development partners. It becomes a ship of opportunity without ceasing to be a commercial ship.

Decarbonisation is therefore the point of departure rather than the final objective. Wind propulsion, electric drive, renewable energy, batteries, communications and onboard intelligence can reduce emissions and operating exposure while enabling a wider regional information network. The investment case can then recognise both commercial performance and measurable public value, without confusing the two.

3. The Alpha Zulu OceanOS™ Concept

Every voyage produces operational, cargo and environmental information. Much of it is currently isolated, inconsistently recorded or used only for a single purpose. OceanOS would provide the trusted digital framework through which appropriate information can be validated, analysed and converted into useful knowledge.

The platform would be built around five principles:

- Interoperability: connect with existing navigation, port, customs, meteorological, agricultural and research systems through open standards rather than duplicate them.
- Modularity: add vessels, sensors, analytical agents and institutional partners progressively without redesigning the whole platform.
- Human authority: preserve the legal and professional responsibilities of masters, engineers, scientists, regulators and data owners.
- Trust by design: incorporate cybersecurity, privacy, traceability, explainability and access controls from the outset.
- Caribbean capability: develop regional skills in maritime AI, engineering, data governance and applied research rather than create permanent technological dependence.

Information would be separated according to purpose and sensitivity. Vessel operators may require real-time engineering and navigation dashboards; producers and buyers may need cargo status and delivery information; researchers may receive quality-controlled and appropriately anonymised datasets; governments and development partners may require aggregated indicators. Participation would not imply unrestricted access to commercial, personal or sovereign data.

OceanOS would also create a consistent evidence chain. Data provenance, time, location, sensor quality, authorised amendments and AI-generated conclusions should be traceable.

This is essential if information is to support safety decisions, scientific analysis, regulatory reporting, climate-finance verification or development evaluation.

4. Agentic and Physical AI

Agentic AI is the intelligence layer: specialised software agents analyse information, coordinate tasks and recommend actions within defined authority. Physical AI connects this intelligence to the physical world through sensors, machinery and control interfaces. On an Alpha Zulu vessel, Physical AI could observe vessel motion, weather, energy use, equipment condition and cargo environment, while Agentic AI interprets those observations and advises the crew or shore team.

Illustrative agents include:

- a Voyage Agent combining forecasts, sea state, schedules and energy availability to recommend safe and efficient routing;
- a Cargo Agent matching bookings, pallet allocation, cold-chain requirements, capacity and destination demand;
- an Engineering Agent detecting anomalies, forecasting maintenance and optimising batteries, solar generation and electric propulsion;
- an Environmental Agent validating sensor observations and flagging unusual ocean, weather, debris or Sargassum conditions; and
- an Evidence Agent preparing traceable operational, emissions and development-performance reports for authorised users.

These agents would support rather than replace professional judgement. Navigation, safety, engineering, scientific interpretation and public policy remain the responsibility of qualified people and authorised institutions. Recommendations should show their evidence, assumptions and confidence level so users can question or reject them.

Learning across repeated voyages can improve forecasts, maintenance planning, cargo utilisation and route design. However, model performance must be monitored for error, bias and changing conditions. Caribbean universities and technical institutions should participate in testing, independent evaluation, workforce preparation and the development of rules appropriate to regional circumstances.

5. Food Security and Sustainable Logistics

Caribbean food insecurity is not solely a production problem; it is also a logistics problem. Seasonal surpluses may exist beside shortages, but unreliable sailings, weak cold chains,

fragmented booking and limited market information prevent producers and buyers from coordinating confidently. Perishable goods then suffer delay, loss and reduced value.

OceanOS could link crop availability, harvest timing, packaging, cargo reservations, vessel capacity, sailing schedules, destination demand and delivery status. AI-assisted forecasting could identify likely cargo flows, consolidate small consignments, reduce empty capacity and help producers plan for dependable market access. The objective is not to centralise commercial decisions, but to give participants timely information with which to make them.

Onboard monitoring could record temperature, humidity, ventilation and handling conditions, alert crews to deviations and provide traceability from loading to delivery. These records may strengthen quality assurance and support sanitary, phytosanitary and market-access requirements. More reliable schedules and better handling can reduce post-harvest loss, raise producer confidence and make regional sourcing more attractive to retailers and consumers.

The same network could support emergency logistics following hurricanes, volcanic events or other disruptions. Vessels, ports and cargo systems used every week for commerce would already possess relationships, route knowledge and operating data valuable during a crisis. Disaster capability should therefore be designed as a resilient extension of normal service, not as an isolated system activated only after an emergency.

6. Ocean Observation, Stewardship, Education and Research

Scheduled vessels operating consistent routes can complement existing scientific programmes by providing frequent observations across under-sampled sea lanes. Appropriate instruments may record sea-surface temperature, atmospheric pressure, humidity, wind, rainfall, waves and sea state. Crew reports or machine vision may, where scientifically appropriate, document Sargassum, floating debris, harmful algal blooms, navigational hazards or unusual marine events.

An Alpha Zulu observation package could combine Rutter's sigma S6 processing of the vessel's existing X-band radar with FLIR thermal and visible-light imaging and conventional meteorological, navigation and machinery sensors. Rutter modules such as WaMoS® II, Oil Spill Detection, Current Monitor™ and Small Target Surveillance can derive sea state, wave and surface-current measurements, identify and track oil slicks, and detect small or floating targets. FLIR long-wave infrared and visible-light cameras can provide day-and-night visual confirmation of oil, debris, people, vessels and other anomalies. OceanOS would correlate these independent observations into a common time- and position-referenced record, issue

alerts and preserve the source data needed for scientific review and Monitoring, Reporting and Verification (MRV). The systems remain complementary: radar supplies wide-area continuous observation; thermal and optical cameras support classification and confirmation; conventional sensors provide local measurements; and AI assists interpretation without replacing the master or qualified specialists.

The value lies in continuity and quality control. Repeated, geo-referenced measurements can reveal seasonal patterns and long-term change, but only if collection methods, calibration, metadata and validation meet agreed standards. OceanOS should therefore connect observations to established meteorological, oceanographic and research institutions rather than create a competing scientific authority.

A governed data environment would also support applied education and research. Maritime cadets, engineers, computer scientists, agricultural specialists and environmental researchers could work on real Caribbean problems involving vessel performance, renewable-energy integration, logistics, marine ecology, climate adaptation and AI. Commercial confidentiality, personal privacy and sovereign interests must be protected through appropriate access and anonymisation.

This creates a practical innovation pathway: researchers and industry identify a problem; a sensor, analytical method or operating practice is tested on a working vessel; results are independently assessed; and successful approaches are refined for wider use. The Caribbean thereby becomes a producer of maritime knowledge and technology, not merely a recipient.

7. Development Value and the Blue Economy

OceanOS would help make the wider value of intelligent maritime infrastructure visible and measurable. Relevant outcomes may include avoided onboard fossil-fuel use, schedule reliability, cargo moved, cold-chain performance, reduced food loss, increased regional sourcing, workforce training, research outputs and verified environmental observations. Indicators should be limited to those that can be credibly measured and attributed.

These outcomes align with regional priorities and several Sustainable Development Goals, particularly food security, clean energy, decent work, resilient infrastructure, responsible production, climate action, life below water and partnerships. The platform should not claim that each voyage independently achieves those goals. Its value lies in producing evidence showing how a reliable transport system contributes to defined outcomes over time.

For climate-finance institutions and development banks, this evidence can complement conventional transport economics. It may support evaluation of concessional finance, grants,

guarantees and technical assistance where wider benefits are real but not fully captured in freight revenue. Transparent measurement is also important for avoiding exaggerated environmental claims and maintaining investor and public confidence.

8. Partnerships, Governance and Pilot Pathway

OceanOS should be developed as a collaborative ecosystem rather than a centrally controlled regional programme. Governments provide policy, regulatory and public-accountability frameworks. Regional organisations convene and align initiatives. Universities and research institutions establish scientific integrity and independent evaluation. Vessel operators, producers, logistics providers and technology companies translate concepts into working systems. Development partners may contribute finance, capacity building and international knowledge exchange.

Governance must address data ownership, permitted use, cybersecurity, privacy, intellectual property, scientific standards, AI ethics, liability, procurement and long-term operating responsibility. National sovereignty and institutional mandates must be respected. Trust will depend less on declarations of openness than on clear rules showing who may access what information, for which purpose, under whose authority and with what accountability.

A phased pilot is the most credible path forward. The Alpha Zulu RoPAC ZeroFF Programme provides a real commercial environment in which a limited OceanOS capability can be tested. A first phase should select one corridor, one vessel, a defined group of cargo users, a small sensor package and a limited number of AI-supported workflows. Baseline measures should be agreed before service begins.

A practical pilot could proceed through four stages:

- Co-design: agree the use cases, partners, data responsibilities, safety boundaries and measures of success.
- Instrument and integrate: install validated sensors and connect only the operational systems required for the selected use cases.
- Operate and evaluate: collect evidence during scheduled commercial voyages and subject results to independent technical and scientific review.
- Scale selectively: retain capabilities that demonstrate value, correct those that do not, and expand by route, vessel or institutional partner only when justified.

Early discussion is therefore sought with UTT, MTCC-Caribbean, UWI and relevant agricultural, maritime, ocean-governance, CARICOM, private-sector, development-finance and international partners. The immediate questions are practical: which use cases create the greatest regional value; what existing systems should be connected; what minimum data

and governance standards are required; and which institution is best placed to lead each element?

9. Conclusion: An Invitation to Collaborate

Alpha Zulu OceanOS advances a focused proposition: a zero-onboard-fossil-fuel vessel can be more than a cleaner transport asset. Properly governed and digitally connected, it can also strengthen food logistics, generate useful ocean observations, support research and training, and provide credible evidence of sustainable-development outcomes.

The concept does not depend on autonomous ships, unrestricted data sharing or a single technology provider. It depends on reliable commercial service, disciplined measurement, human authority, open standards and institutions willing to collaborate around clearly defined problems. Its architecture should evolve from operational evidence rather than ambition alone.

The Alpha Zulu RoPAC programme offers an opportunity to begin at practical scale. If the pilot demonstrates that routine voyages can move cargo reliably while producing trusted knowledge and wider public value, the model can be adapted across Caribbean corridors and shared with other island and coastal regions.

The invitation is to shape that pilot together: to define the questions worth answering, the safeguards required, the evidence that will be credible and the partnerships capable of turning an AI-native maritime vision into useful Caribbean infrastructure.

Closing Reflection

The Caribbean Sea has always connected our islands. OceanOS asks how every voyage might also connect our knowledge, strengthen our stewardship and create lasting public value.