

## **NEREUS Project: Harnessing Satellite Technology to Combat IUU Fishing**

NEREUS is a cutting-edge maritime surveillance initiative designed to tackle Illegal, Unreported, and Unregulated (IUU) fishing in the Western Indian Ocean. Developed by the Mauritius Research and Innovation Council (MRIC) in partnership with the Surrey Space Centre (UK) and funded by the UNDP Ocean Innovation Challenge, NEREUS represents a technological and strategic leap in the sustainable management of marine resources.

Through a powerful combination of Synthetic Aperture Radar (SAR), Automatic Identification System (AIS) data, and Artificial Intelligence (AI), NEREUS offers a comprehensive monitoring solution that strengthens enforcement, protects biodiversity, and supports the livelihoods of coastal communities.

### **The Problem: Widespread Overfishing and Limited Enforcement**

IUU fishing is a global crisis. In regions like the Western Indian Ocean, rich in high-value species like tuna, surveillance and enforcement capacity remain limited. Rising IUU risk indicators reflect the severity of the challenge. Traditional approaches are unable to monitor vast marine territories in real-time, making illegal activity difficult to detect and prosecute.

NEREUS was developed to provide a game-changing solution that enables national authorities and regional bodies to monitor, detect, and respond to IUU activity using space-based assets.

### **The Solution: A Three-Workflow System for Maritime Surveillance**

NEREUS integrates three powerful workflows, delivering past, present, and future insight into maritime activities:

i. *Dark Heatmap Generation (Offline)*

Identifies IUU hotspots through multi-temporal SAR and AIS data analysis. The resulting heatmaps reveal patterns of non-transmitting vessels (dark ships), guiding enforcement operations and long-term strategy.

ii. *Enhanced Maritime Situational Picture (Near Real-Time)*

Delivers rapid detection of discrepancies between current SAR and AIS data, triggered by heatmap findings. This operational tool enhances situational awareness and supports real-time decision-making.

iii. *Ship Trajectory Prediction (Near Real-Time)*

A state-of-the-art deep learning model predicts vessel movements up to 2.5 hours ahead, including uncertainty estimations. It detects abnormal behaviors and supports satellite tip-and-cue tasking. In field tests, the model successfully predicted a vessel stranding 2.5 hours before it occurred.

Together, these workflows offer full temporal coverage, enabling more accurate anomaly detection, smarter resource allocation, and better-informed decision-making.

### **Key Impacts and Achievements**

#### *Environmental Protection*

- Revealed previously undetected overfished zones (e.g., Saya de Malha Bank).
- Provided fisheries-independent data to inform sustainable catch limits.

### *Economic Return*

- Estimated return of \$31 for every \$1 invested, by preventing losses and improving monitoring.

### *Capacity Building*

- Trained 150 global delegates, including 50 locals, and established a radar dataset valued over \$2.3M.

### *Policy Influence*

- Demonstrated how satellite data can support area-based tuna catch limits—encouraging more effective regional management approaches.

### Support to Artisanal Fisheries

- Indirectly aids over 3,000 artisanal fishers, helping safeguard food security, livelihoods, and cultural heritage through better management of inshore and offshore waters.

### **Scalability Pathways**

#### i. *Thematic Scale-Up*

NEREUS is being explored for expanded applications:

- Insurance Compliance Verification: Using vessel behavior data to support due diligence processes by insurers.
- Parametric Insurance for Artisanal Fishers: Triggering compensation when industrial catch thresholds are exceeded.
- Catch Alerting: Generating species-specific alerts when catch limits risk being exceeded, provided catch limits are defined by EEZ or region rather than country/flag.

While the first two are already attracting funder interest, the third requires a policy shift and is a recommendation for future adoption.

#### ii. *Technology Readiness Level (TRL) Scale-Up*

NEREUS is progressing from prototype to operational deployment. Live demos are underway with collaborators such as Skylight, marking the first steps toward full operational use.

#### iii. *Capillarity Scale-Up*

Long-term plans include deploying NEREUS across multiple surveillance platforms globally. Conversations with Skylight and Global Fishing Watch are ongoing.

### **Sustainability Plan and Future Steps**

To ensure long-term success, several actions have been initiated:

- Funding Applications: Proposals submitted to the Pew Charitable Trust, Horizon 2020, and the FCDO for scaling-up initiatives.
- Expanding Partnerships: Collaborations are growing locally and internationally, with the FCDO, IORA, UNODC, and others.

- **Ongoing Capacity Building:** Past training recordings are hosted on the MRIC Space Mauritius website, and new training events are being planned in collaboration with the Department of Continental Shelf and local universities.
- **Global Dissemination:** NEREUS will be featured at major scientific and policy forums, including IEEE IGARSS 2024, UNESCO LMEs Consultation, and International Space Week.
- **Policy Integration:** Dark heatmaps and fisheries-independent indicators can inform white papers and evaluate the effectiveness of IUU mitigation strategies.

### **Lessons Learned**

Local engagement proved essential to NEREUS' success. Community input directly influenced project priorities, such as selecting the Saya de Malha Bank as a pilot site. Building trust among stakeholders took time, but sharing visual evidence, such as heatmaps and predictive outputs, helped drive institutional buy-in.

The project also highlighted the need for continuous cross-sector dialogue and reinforced the value of integrating technical, policy, and societal perspectives into the design and implementation of surveillance tools.

### **Catalyzed Financing and Resources Mobilized**

Thanks to its credibility and strategic design, NEREUS has mobilized over \$2.6 million in in-kind and direct support, including:

- Satellite data from NovaSAR, Capella, JAXA, ESA, and Satellite Vu
- Technical support from University of Surrey, MRIC, and Skylight
- Live demonstration support from the Mauritius National Coast Guard

### **Conclusion**

NEREUS represents a transformative step forward in space-based ocean governance. It delivers real-time intelligence, fosters policy reform, empowers vulnerable communities, and offers an innovative model for replicable, sustainable marine surveillance.

By uniting cutting-edge technology with inclusive partnerships and a strong Theory of Change, NEREUS is helping to secure the future of our oceans—one satellite image at a time.

**[[Click here to download the full report](#)]**