Blue
pulse 2025

SHARK

— FROM SPACE

Create a mathematical framework for identifying sharks and predicting their foraging habitats using NASA satellite data

NASA INTERNATIONAL® SPACE APPS CHALLENGE

CHALLENGE

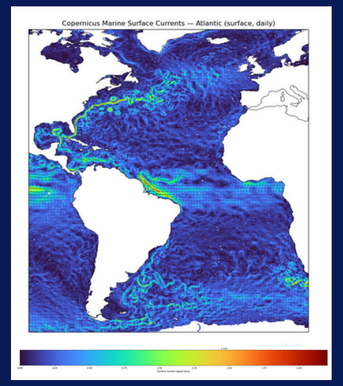
Millions of sharks are lost every year due to fishing and habitat degradation, yet we lack precise tools to understand their movement, foraging behavior, and the ecological role they play. Traditional satellite observations track ocean productivity, but they cannot reveal where top predators like sharks hunt, what they eat, or how they interact with dynamic ocean features.

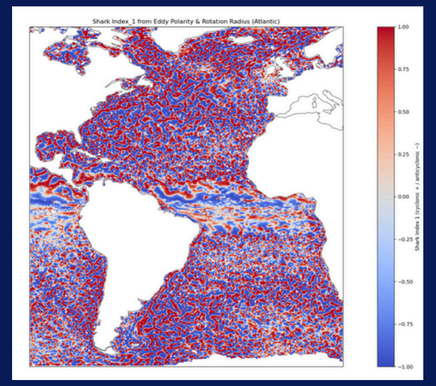
OUR DISTINCTIVE FEATURES

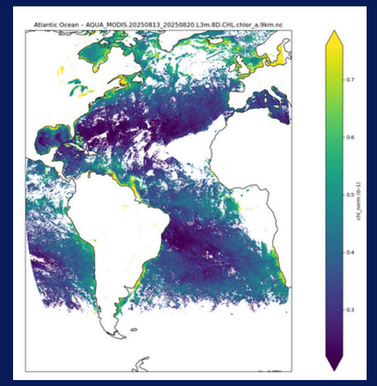
Combines imperial prediction with a new conceptual tag design.

- Integration of NASA satellite data directly into movement models.
- A hydrodynamic tag design optimized for multi-sensor integration, energy consumption, and position determination.
- Predictive model that identifies future foraging zones instead of just past movement.

A MODEL FOR SHARK PROBABILITY MAPPING





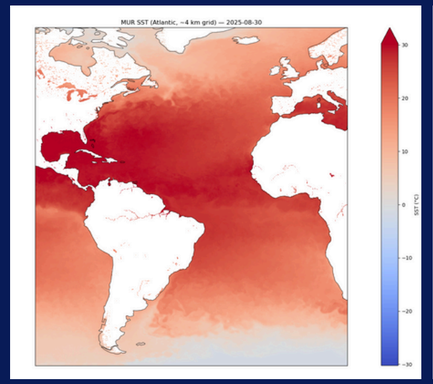


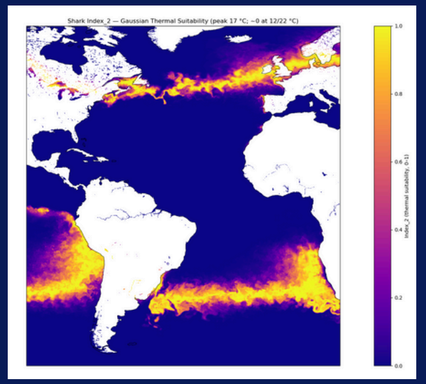
Data Inputs (NASA Satellite Layers):

- Sea Surface Temperature (SST) — preferred temperature range

(MUR SST — JPL GHRSST Sea Surface Temperature)

- Chlorophyll Concentration — food availability & plankton blooms (MOANA — PACE OCI Level-4 Monthly Product)
- Kinetic Eddies (SSH) — dynamic zones where prey and sharks cluster(CMEMS Global Multi-Observation Surface Currents)

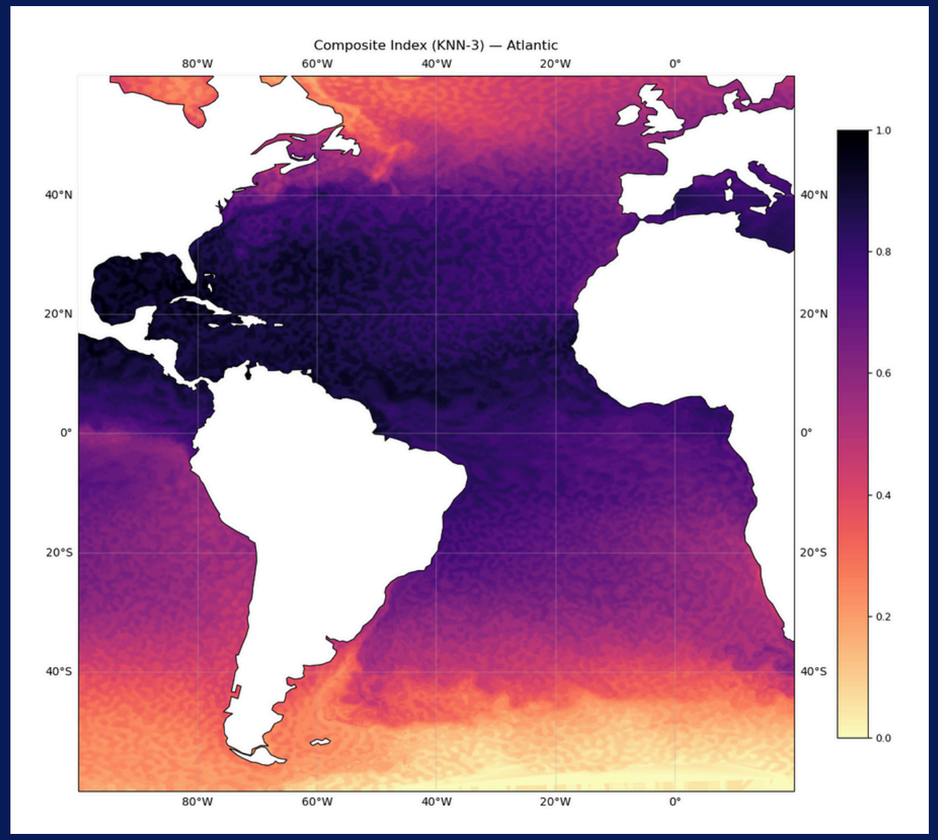




$$P(x,y) = W_{eddy} \times I_{eddy} + W_{pln} \times I_{pln} + W_{temp} \times I_{temp}$$

- Each variable is normalized (0–1).
- Values close to 1 → high probability of shark presence.

- **Heat map showing likely shark habitats**
- **Data layer for researchers & fishers to minimize accidental encounters**



BRIDGING THE GAP

From Satellite Prediction to Real Behavior

Limitations:

- Satellite data shows environmental suitability, not real shark activity
- Low temporal resolution — can't track short-term behavior (feeding, migration bursts)
- Gaps due to cloud cover or oceanic noise
- No biological validation — we don't know if sharks actually follow those predicted zones

WE NEED REAL-WORLD BEHAVIORAL DATA — MOVEMENT, ENERGY, FEEDING EVENTS — TO VALIDATE AND REFINE OUR MODEL.

THAT'S WHY WE DESIGNED THE SMART TAG: A MODULAR SENSOR SYSTEM TO COLLECT GROUND-TRUTH DATA DIRECTLY FROM SHARKS.

HOW IT WORKS

- **Data Fusion:** Combining tag data (GPS, depth, temp) with NASA satellite variables.
- **Modeling** Using mathematical and empirical data to detect movement patterns.
- **Validation** – Comparing model predictions with known tracking datasets.

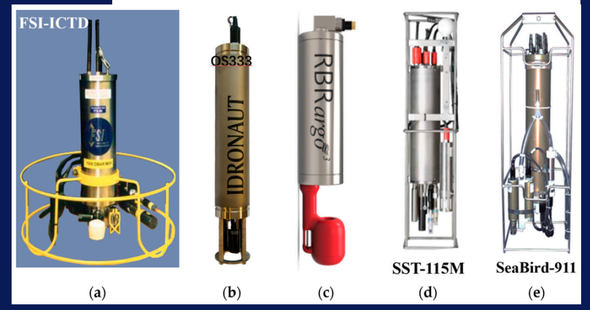
BASED ON PROVEN OCEANOGRAPHIC VARIABLES INFLUENCING SHARK BEHAVIOR.

CAN BE REPLICATED AND EXPANDED USING OPEN NASA DATA.

BUILT TO ALIGN WITH REAL TAGGING WORKFLOWS

SMART SHARK TAG

generation before:
Limited Data Scope
Low Temporal Resolution
Power and Bandwidth Constraints
No Integration with Satellite Models



Our tag combines high-performance sensors and a hydrodynamic structure for efficient, real-time behavioral monitoring.

Core Sensors:

- IMU (200–400 Hz) — detects bursts of motion, feeding events
- CTD sensor — measures depth, temperature, salinity
- Magnetometer — supports trajectory reconstruction
- GPS (Fast-Lock) — quick position fixes during surfacing

Optional Modules:

- Hydrophone — captures ambient & prey interaction sounds
- Low-light camera — triggered during feeding events
- Power System: Long-life lithium microcell, energy-optimized architecture
- Data Link: Local storage + satellite / wireless sync on surfacing

TURNING SCIENCE INTO ACTION

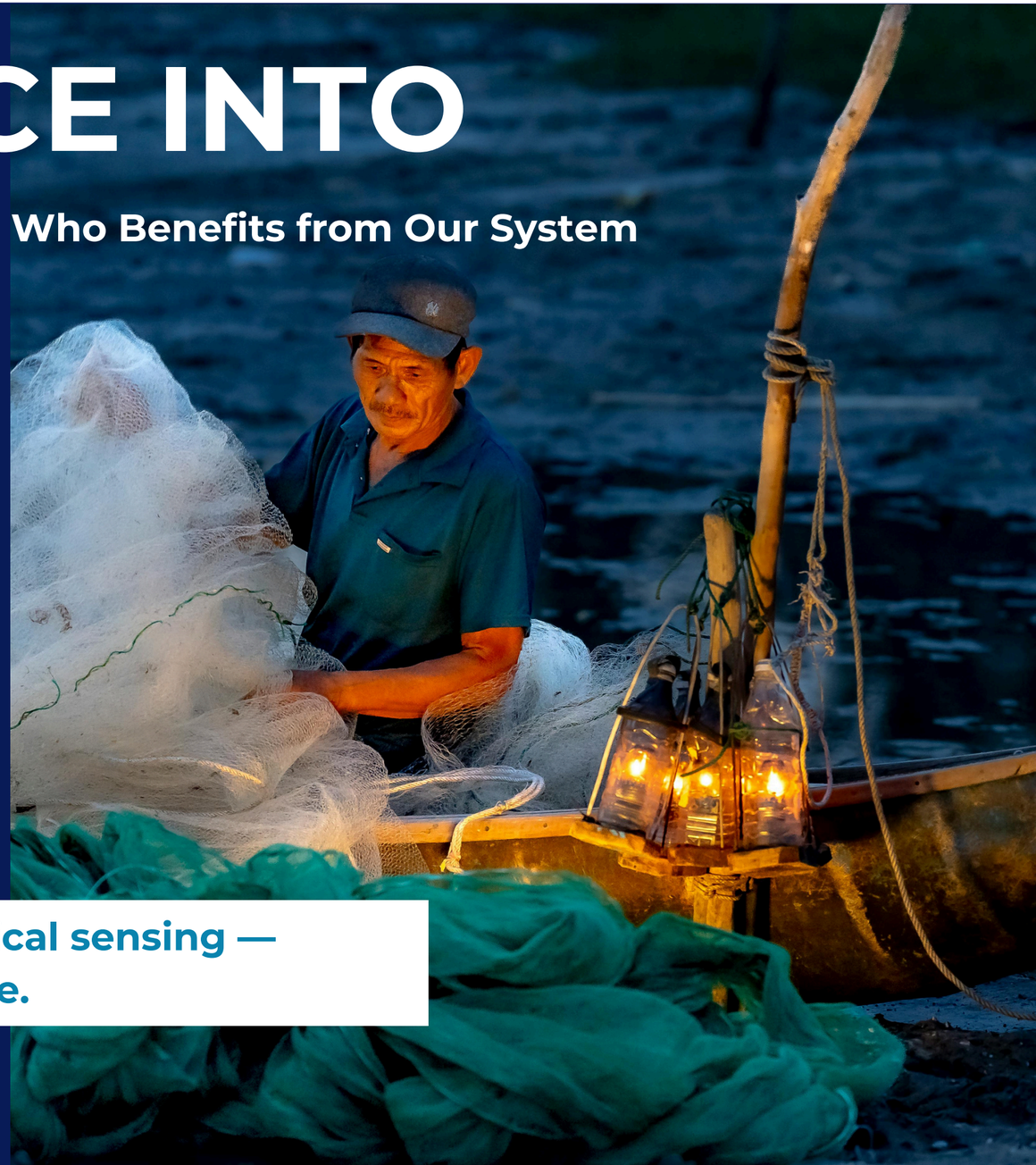
Who Benefits from Our System

Clients:

- Oceanographic agencies (NASA, NOAA, OceanX)
- Universities & marine research labs
- Environmental NGOs (WWF, Sea Shepherd)

Users:

- Marine biologists & conservation scientists
- Environmental policymakers
- Fishery managers & coastal authorities



We merge satellite-based ocean data with biological sensing — no existing solution combines both at global scale.

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Key Partners

- NASA Earth Science Division.
- Universities and ocean research institutes.
- Sensor and IoT hardware manufacturers.
- NGOs and government agencies involved in marine conservation.

Key Activities

- Developing and validating the mathematical model using NASA satellite data.
- Designing, assembling, and testing the smart marine tag.
- Integrating field-collected and satellite data for behavioral analysis.
- Building cloud dashboards and visualization tools.

Key Resources

- NASA Earth Observation datasets (MODIS, VIIRS, SSH).
- AI and mathematical modeling frameworks.
- Hardware components: sensors, microcontrollers, GPS modules, power systems.
- Multidisciplinary team (data scientists, marine biologists, engineers).

Value Proposition

- A mathematical model based on NASA satellite data (plankton density, sea surface temperature, ocean kinetic energy) that predicts shark presence probability across the ocean.
- A modular smart tag that collects in-situ biological and environmental data (depth, motion, sound, temperature) to verify and refine the model.
- By merging space-based and real-time field data, the system enables high-accuracy mapping of shark habitats, behaviors, and potential fishing risks.

customer Relationships

- Research collaboration and data-sharing agreements.
- Online dashboard for probability maps and behavioral data visualization.
- Custom model calibration for specific shark species or regions.

Channels

- Web-based platform with access to models and datasets.
- API integration for research or monitoring systems.
- Scientific conferences, marine tech expos, and open data repositories.

Customer Segments

- Research organizations and space agencies (NASA, NOAA, OceanX).
- Wildlife conservation groups (WWF, Sea Shepherd).
- Fisheries management authorities and sustainable fishing companies.
- Universities and marine data research institutions.

Cost Structure

- Hardware manufacturing (sensor modules, waterproof housing).
- Data processing, cloud storage, and computational costs.
- R&D and prototype testing.
- Maintenance and calibration of deployed tags.

Revenue Streams

- Subscription access to habitat prediction maps and data dashboards.
- Research partnerships and funded collaborations.
- Selling or licensing tag hardware to institutions.
- Consultancy for sustainable fishing and marine policy design.

PROTECTING SHARKS MEANS PROTECTING THE OCEAN'S BALANCE

Sharks are the architects of marine balance — yet millions are lost each year before we even understand their behavior.
By decoding their movements with space technology, we can protect entire ecosystems, not just one species.

"We are Blue Pulse — a family team driven by curiosity, technology, and love for the ocean."