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

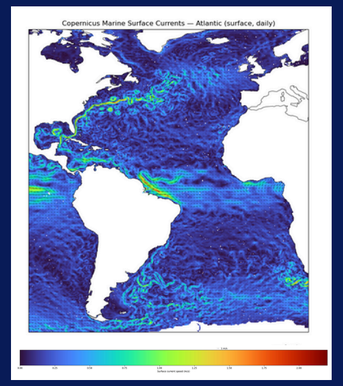
Millions of sharks are lost every year due to fishing and habitat degradation, yet we lack precise tools to understand their movement, foraging behavior, and the ecological role they play. Traditional satellite observations track ocean productivity, but they cannot reveal where top predators like sharks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

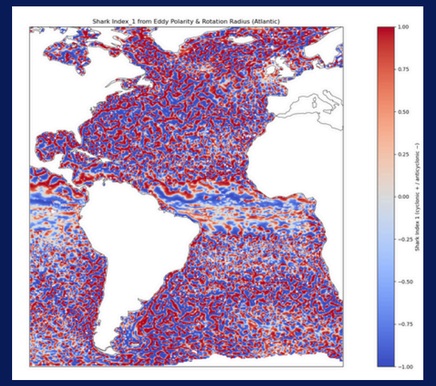
OUR DISTINCTIVE FEATURES

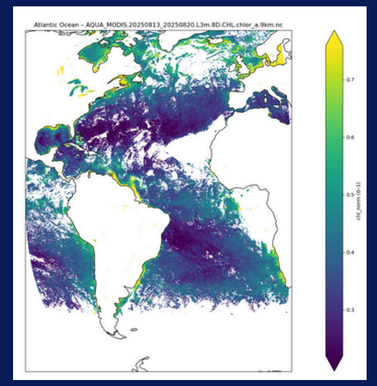
Combines imperial prediction with a new conceptual tag design.

- 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





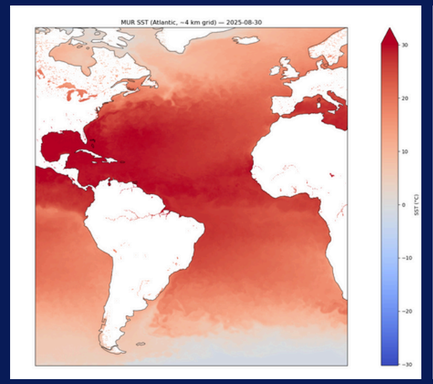


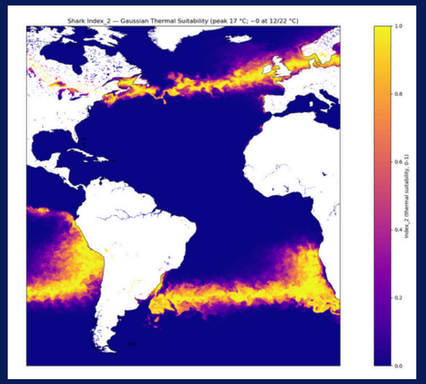
Data Inputs (NASA Satellite Layers):

- 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)

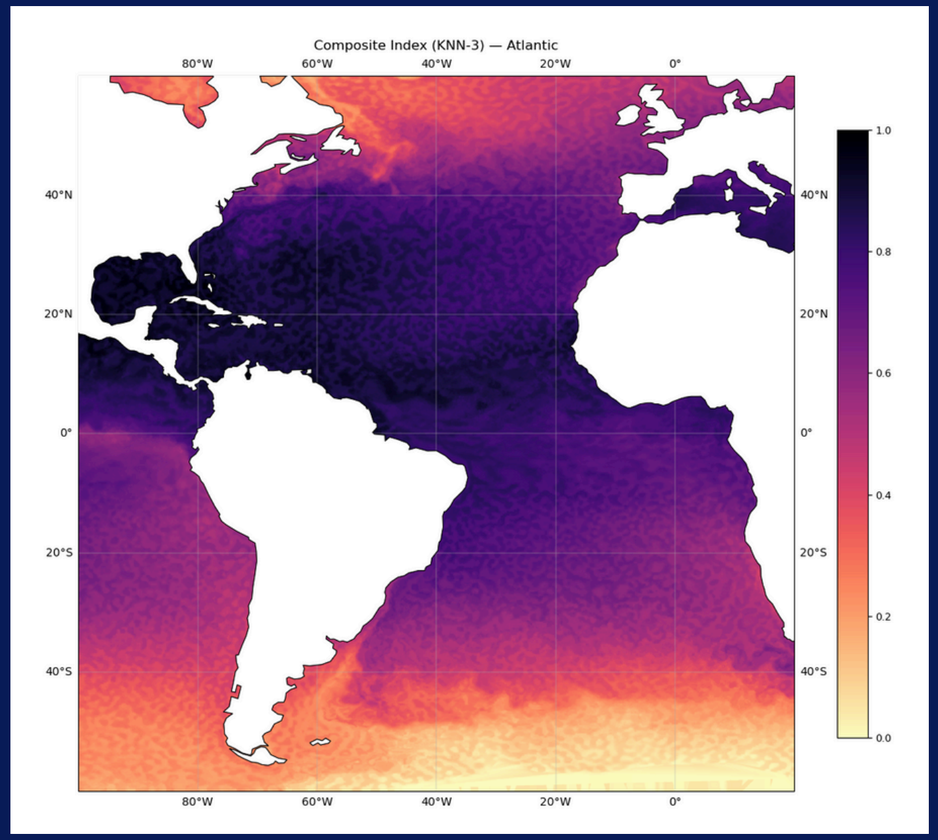




$$P(x,y) = W_{eddy} \times I_{eddy} + W_{pln} \times I_{pln} + W_{temp} \times I_{temp}$$

- 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:

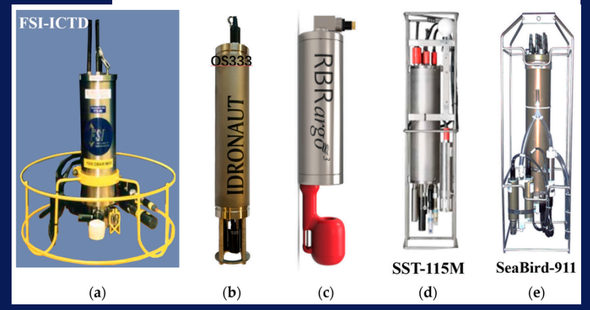
- Satellite data shows environmental suitability, not real shark activity
- Low temporal resolution — can't track short-term behavior (feeding, migration bursts)
- Gaps due to cloud cover or oceanic noise
- No biological validation — we don't know if sharks actually follow those predicted zones

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.

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

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."