🌊 Full Framework Overview (English Version)

The model is trained using **general, global oil-spill scenarios** (various oceans + numerical simulations).
Taean is *not* used for training — instead, it is used afterward as a **hold-out test case** to evaluate how well the model generalizes.

The three-model architecture remains the same:

1️⃣ Prediction Model

Purpose
Predict how oil will spread over the next *N* hours anywhere in the world, given currents, wind, oil type, and initial conditions.

Training Data

- Large-scale numerical simulations and historical spill events
    - NOAA GNOME, OpenDrift, global reanalysis data
    - Diverse coastlines, depths, tides, winds, and oil properties
- Important:
    - **Taean conditions are intentionally excluded from training**
    - Taean acts as an unseen test region

How Taean is used

- After training is complete:
    - Feed Taean coordinates
    - Reanalysis wind/current fields for 2007

    - Initial spill location and volume

- The model makes predictions **without any retraining**

- We then compare:
  Real Taean spread pattern vs. Model prediction
  → Evaluating generalization (zero-shot performance)

2️⃣ Response / Strategy Model

Purpose
Given the predicted spread, determine *when / where / how much cleanup resources* should be deployed.

Training Data & Environment

- Again, trained on non-Taean scenarios

- Numerous synthetic episodes:

    - “Resource allocation → resulting oil spread”

- Methods:

    - Reinforcement learning environments

    - Numerical diffusion models

    - Mixed policies (random / heuristic / optimized) to generate diverse experience

How Taean is used

- Taean spill is fed into the trained models:

    - Prediction model outputs future spread

    - Response model proposes:

        - Where to send vessels

        - Where to place booms
        - Where to apply dispersants
- Comparison:
    - **Actual 2007 Taean response** vs **AI-derived response**
- Both strategies are passed into the recovery model to compare outcomes

Note:
You may adjust Taean-specific environmental parameters,
but **you do NOT fine-tune or retrain the model using Taean data.**

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3 Cleanup & Ecological Recovery Model

Purpose
Estimate long-term environmental differences between cleanup strategies (actual vs AI-based):

- Residual oil quantity
- TOC / DO levels
- Biological recovery time
- PAH/TPH degradation
- Formation of MOS/MOSS, etc.

Training Data

- Long-term datasets from various regions:
    - Post-cleanup DO/TOC time series
    - Residual oil decay
    - Bio-degradation rates

    - Ecological stress indicators
    - None of these include Taean

How Taean is used

- Inputs:
    - Taean initial state + “Actual 2007 response”
    - Taean initial state + “AI response”
- Outputs:
    - Month-1 / Month-6 / Year-1 recovery index
    - Total recovery time
- From this:
    - Statements such as
      “With AI involvement, recovery time could be reduced from X years → Y years
      and contaminated area reduced by Z%.”

🎯 Summary: Taean’s Role = Testbed (Not Training Data)

Training phase

- Global + multi-region numerical simulations
- Taean intentionally excluded to avoid overfitting
- Ensures the model learns *general principles* rather than region-specific quirks

Evaluation phase

- After training, Taean is used as an unseen example

- Zero-shot / domain-generalization test
- We compare:
    - Spread accuracy
    - Response optimization
    - Long-term recovery differences

Outcome

- Shows that
  “Our model is not overfitted to a single region;
  it generalizes across diverse marine environments.”