Challenge Stream #3: Around the Water

Name: **CoaSight** (Coast + Insight)

Empower – Accessible – Sustainable

*“Coastlines define our planet, but their future depends on us. CoaSight transforms satellite insights into actionable data, empowering communities to safeguard our shores before they're lost forever.”*

**Why is CoaSight Important?**

1. Limited Accessibility of Government Data:

* While organizations like the **USGS** and **NOAA** collect vast amounts of shoreline data, these datasets are often **difficult for the general public to access and interpret**.
* Many datasets are either raw or technical, requiring expertise to analyze, leaving residents and small-scale stakeholders unable to benefit directly.
* The USGS acknowledges that **"technical and scientific shoreline data are not readily usable by non-experts"** (USGS, 2023).

1. Lack of Personalized Warnings for At-Risk Residents:

* Governments do not have mechanisms to **identify individuals or communities living in erosion-prone areas** or provide them with **timely, personalized warnings** about shoreline retreat.
* This gap puts residents, farmers, and small businesses at risk of sudden economic and environmental losses.
* A study published in **Nature Communications (2021)** emphasizes that **"coastal erosion disproportionately impacts marginalized populations with limited resources to adapt."**

1. User-Friendly Insights for Local Decision-Makers:

* Tools like CoaSight empower local residents and farmers to independently assess their risk by simply providing their location. This eliminates reliance on complex government reports and enables **quick, actionable insights**.
* Historical data, depletion rates, and future predictions are delivered in an easily understandable format to aid proactive decision-making.
* The **Intergovernmental Panel on Climate Change (IPCC, 2022)** highlights that **"accessible data visualization tools are critical for public engagement and adaptive planning in coastal resilience efforts."**

**What Does CoaSight Provide?**

CoaSight is a tool designed to make shoreline data easy to understand and useful for people who live near the coast or depend on it. It helps residents, farmers, and small businesses assess how erosion might affect them, without needing to be experts in data or science.

**What Does CoaSight Provide?**

1. Clear Risk Assessments:

* Just enter your location, and CoaSight gives you a risk score that explains how erosion might impact your area—whether it’s your home, farm, or business.

1. Trends and Predictions:

* CoaSight shows how the shoreline has changed over the years and predicts where it’s likely to be in the future. This helps users plan ahead and take action if needed.

1. Practical Advice:

* Along with the data, CoaSight suggests simple steps you can take to protect your property or reduce erosion risks.

1. Interactive Maps and Graphs:

* Users can explore easy-to-read maps and charts that highlight erosion trends and at-risk zones for their specific location.

**How CoaSight Works: Tools and Technologies**

1. Collecting Satellite Data with Google Earth Engine

* CoaSight starts by using **Google Earth Engine (GEE)** to pull satellite images from Sentinel-2, which offers clear and detailed imagery of Earth's surface. A polygon is drawn around the area you’re interested in, like a section of coastline, and the tool extracts multiple images from different times.  
  To ensure accuracy, it filters for images with low cloud coverage (less than 20%), so you’re working with the clearest visuals possible.

1. Processing the Images

* The extracted images, originally in **GeoTIFF format**, are converted to **JPG** for easier analysis. Tools like **Rasterio**and **NumPy** handle resizing and standardizing the images, so they’re ready for processing.

1. Finding the Shoreline with Canny Edge Detection

* CoaSight uses **Canny Edge Detection**, a method for identifying edges in an image, to find the boundary between land and water. By processing each image, it highlights where the shoreline is at different points in time.

1. **Measuring Changes Over Time**

* Once the shorelines are detected, CoaSight calculates how they’ve shifted:
  + **X and Y Position Changes**: Tracks how far the shoreline has moved horizontally and vertically.
  + **Total Depletion**: Measures how much land has been lost over time.
  + **Annual Retreat Rate**: Calculates how quickly the shoreline is receding every year.

1. **Visualizing the Data**

* Using **Matplotlib**, CoaSight creates graphs and overlay images to show trends. For example:
  + Shoreline retreat is plotted over time to see how fast erosion is happening.Overlay maps combine all the years to give a complete picture of long-term changes.

1. **Predicting Future Changes**

* By analyzing past trends, CoaSight predicts future shoreline positions and depletion rates. For instance, it estimates where the shoreline might be by 2030, helping users plan for what’s ahead.

**Future Improvements**

* CoaSight can grow by integrating additional data from NOAA or ERRDAP like:
  + **Soil composition** to understand erosion resistance.
  + **Vegetation data** to assess natural protective barriers.
  + **Environmental factors** such as tides, wind, water acidity, and humidity to provide a fuller picture of what’s causing erosion.