MVP (Minimum Viable Product) Scope

Users

citizen scientists,

remote-sensing experts,

enable scientists to better detect plastics utilizing remote sensing data

policy makers

regulators

to use this information to effectuate change.

We have to limit the scope to a part of the sea instead of focusing efforts for collecting data. We can make the method work and extend it over more data as it is available.

Data to be collected must have

1. location
2. Time stamp
3. source - satellite/vessel/plane/amateur etc. - this will help us in understanding the field of view and area of the affected sea and debris.
4. distance - source to debris

We will start with satellite image data. Then make it work and later expand it to vessel image data and tabular data. The data collected needs to be correlated with time and location to avoid redoing the analysis and amplify the signal.

We will collect satellite image data mostly near usa.

Possible Analysis

we can calculate the size of the debris as part of the sea area visible

We can track the number of debris over months to predict future values and give warning (what kind - be specific - disappearing surface fast - green/yellow/red signal).

We can track the debris in the image over months and store its location to track its path (with direction) from source to destination.

we can show this path as arrows on a world map as we have location data.

we can track fauna movement over months (detection of birds, animals) and track the progress and predict the warning (what??? - e.g., disappearing numbers fast - green/yellow/red signal)

Model

Automatically classify the pixel as plastic or not plastic using the features (12 bands + FDI + NDVI) combination or removal

Using Naive Bayes

+ If time permits using Mask R CNN deep learning model (to mark the area)

Naive bayes can see only one pixel and tell if it is plastic or not

Deep learning models can learn the structure to predict whether the whole area is plastic or not.

These 2 models can be used in conjunction with each other.

100X100 km2 patch with 10m resolution

T1 - patch 1 - 0.1%

T2 - patch 1 - 0.15%

…

T12 patch 1 - 0.2%

T1 to T12 for each month (1st day)

Run our ML code to mark the plastic

Calculate total pixel of plastic (n*10*10/1000) = total plastic area (PA)

Total area we know - 100X100 km2 (TA)

Ratio = PA/TA

UI/Output

We can use

apache superset (where to setup - Sunil's laptop or aws??? Check if nasa can provide some aws credits) - https://superset.apache.org/

Or d3.js charting library (I personally think superset can be quite good rather than developing UI from scratch).

Datasets

1. CYGNSS - NOAA (Data used by michigan university for microplastic tracking)
   UI - http://bmcnoldy.rsmas.miami.edu/cygnss/
   Reading - ttps://news.engin.umich.edu/2021/06/tracking-ocean-microplastics-from-space/ https://www.nasa.gov/feature/esnt2021/scientists-use-nasa-satellite-data-to-track-ocean-microplastics-from-space

CYGNSS - radar measurements data from 8 satellites

NOAA wind speed - independent wind speed

Usage idea -

Working backward, the team looked for places where the ocean was smoother than expected given the wind speed, which they thought could indicate the presence of microplastics.

“We’d been taking these radar measurements of surface roughness and using them to measure wind speed, and we knew that the presence of stuff in the water alters its responsiveness to the environment,” Ruf said. “So I got the idea of doing the whole thing backward,

using changes in responsiveness to predict the presence of stuff in the water.”

Using independent wind speed measurements from NOAA, the team looked for places where the ocean seemed less rough than it should be given the wind speed. They then matched those areas up with actual observations from plankton trawlers and ocean current models that predict the migration of microplastic. They found a high correlation between the smoother areas and those with more microplastic.

Data download links

sentinel 2 ocean data

Using sentinel 2 data

Understanding Sentinel 2 data -

https://www.nature.com/articles/s41598-020-62298-z

(https://www.youtube.com/watch?v=ylT4J6wCctQ&ab_channel=Enthought)

https://www.mdpi.com/article/10.3390/rs13081598?type=check_update&version=2

Access the data

https://scihub.copernicus.eu/dhus/#/home

https://sentinel.esa.int/web/sentinel/sentinel-data-access

https://www.youtube.com/watch?v=J8heVTBNRRk&ab_channel=WTAJNews

we can detect debris

https://scihub.copernicus.eu/dhus/#/home

https://sentinels.copernicus.eu/web/sentinel/sentinel-data-access

https://www.copernicus.eu/en/accessing-data-where-and-how/conventional-data-access-hubs

https://scihub.copernicus.eu/gnss/#/home

https://scihub.copernicus.eu/

CYGNSS

https://podaac-opendap.jpl.nasa.gov/opendap/allData/cygnss/L2/contents.html

NOAA

https://podaac-opendap.jpl.nasa.gov/opendap/allData/cygnss/L2/noaa/v1.1/contents.html

Ocean surface wind speed animation of the CYGNSS Level 3 Climate Data Record Version 1.0

https://podaac.jpl.nasa.gov/animations/Ocean_surface_wind_speed_CYGNSS_L3_Climate_Data_Record_V1.0

Scope 2 = MVP + Extra scope 1

Presenting the data using mobile app (MITAPPInventor - https://appinventor.mit.edu/)

Data - Addition of vessel image data

Data fusion with satellite data based on location and time

Scope 3 = Scope 2 + Tabular data

Hosting superset on aws

Data - tabular data

Data fusion based on location and time

Rough work (Ignore)

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1. Data

Image

Text/Table format

2. Logic

When classifying the data, please include a

timestamp,

location,

depth, and

note/description - whether it is a single item of debris, patch, or filament.

Monitor

Debris

Detect

Debris problem

Predict

where it will move

path/direction prediction

how much more debris

3. Users

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Possible data sets

- Please consider utilizing citizen science data from apps.
    - Search the app store for “Debris Tracker.”
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- Potential keywords you may search: global forest watch, ocean scan, debris tracker

References

https://www.mdpi.com/journal/remotesensing/special_issues/rs_plastic

Quantifying Floating Plastic Debris at Sea Using Vessel-Based Optical Data and Artificial Intelligence

Abstract

Despite recent advances in remote sensing of large accumulations of floating plastic debris, mainly in coastal regions, the quantification of individual macroplastic objects (>50 cm) remains

challenging. Here, we have trained an object-detection algorithm by selecting and labeling footage of floating plastic debris