AI-BASED MARINE DEBRIS AND ALGAE DETECTION WITH SEMI-SUPERVISED LEARNING

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Sentinel-2 image of a body of water containing marine litter windrows

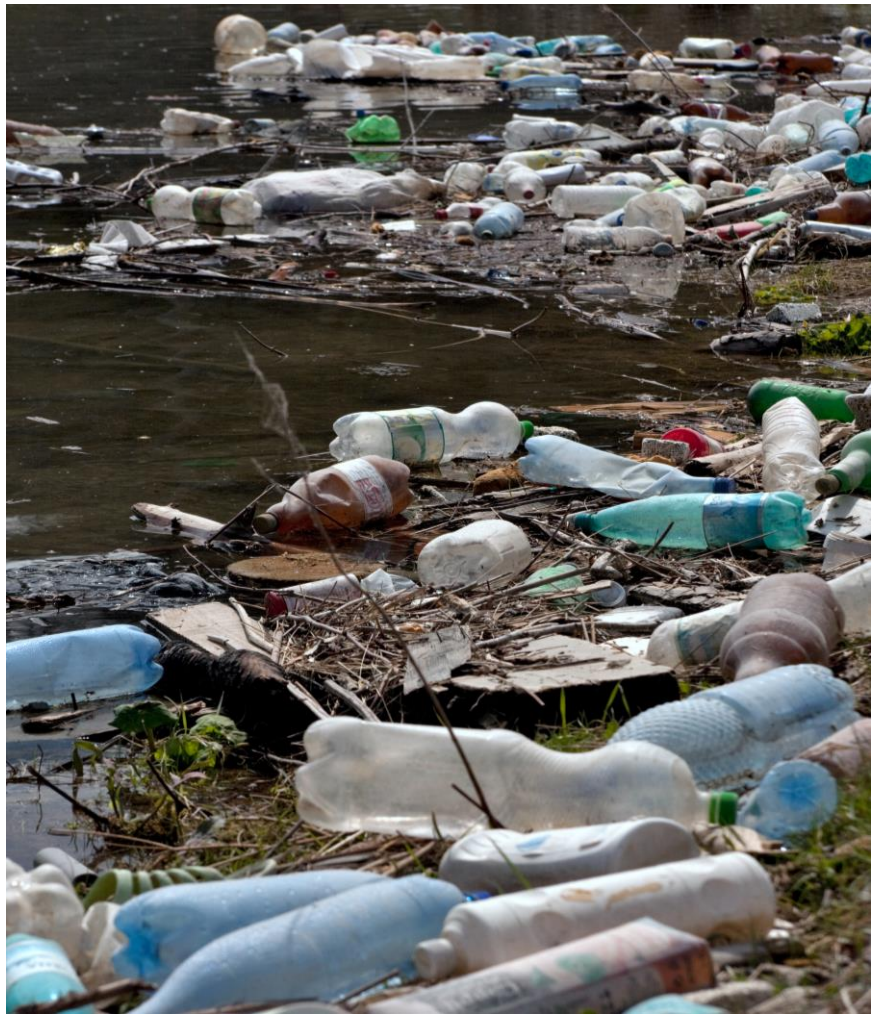
CLIMATE CHANGE AND MARINE LITTER ISSUES

Climate change influences the pathways of global marine litter (Lincoln, Susana, et al. 2022)

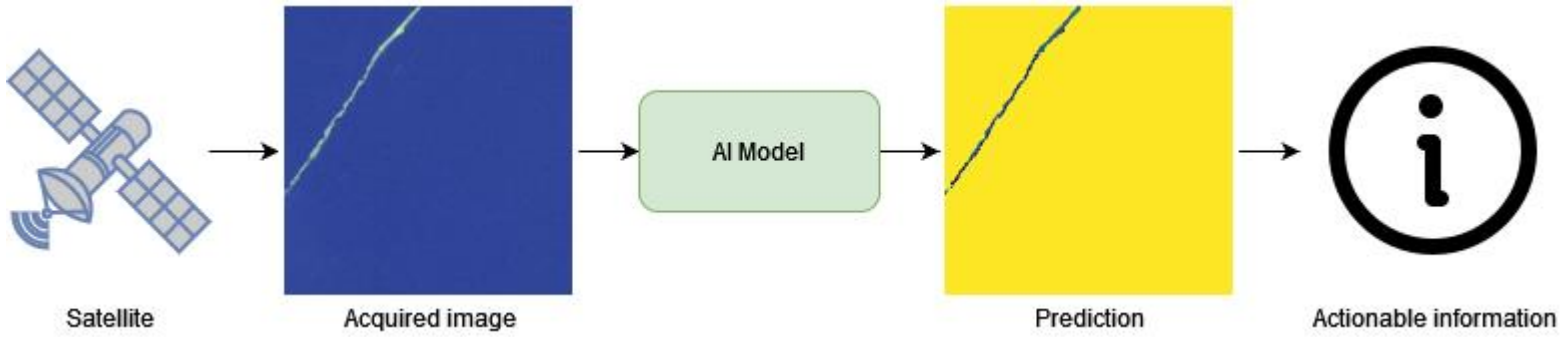
- Increased frequency and intensity of storms and flooding events
  - → Greater input of litter into the marine environment
  - → Harm to marine species (entanglement, ingestion)

Climate change and litter increase spread of invasive species (Lincoln, Susana, et al. 2022)

- Slow decomposition of marine litter
  - → vector of transportation for non-native species (algae, pathogens)
  - → damage to ecosystems



DETECTION OF MARINE DEBRIS AND ALGAE FROM SPACE



Actionable information:

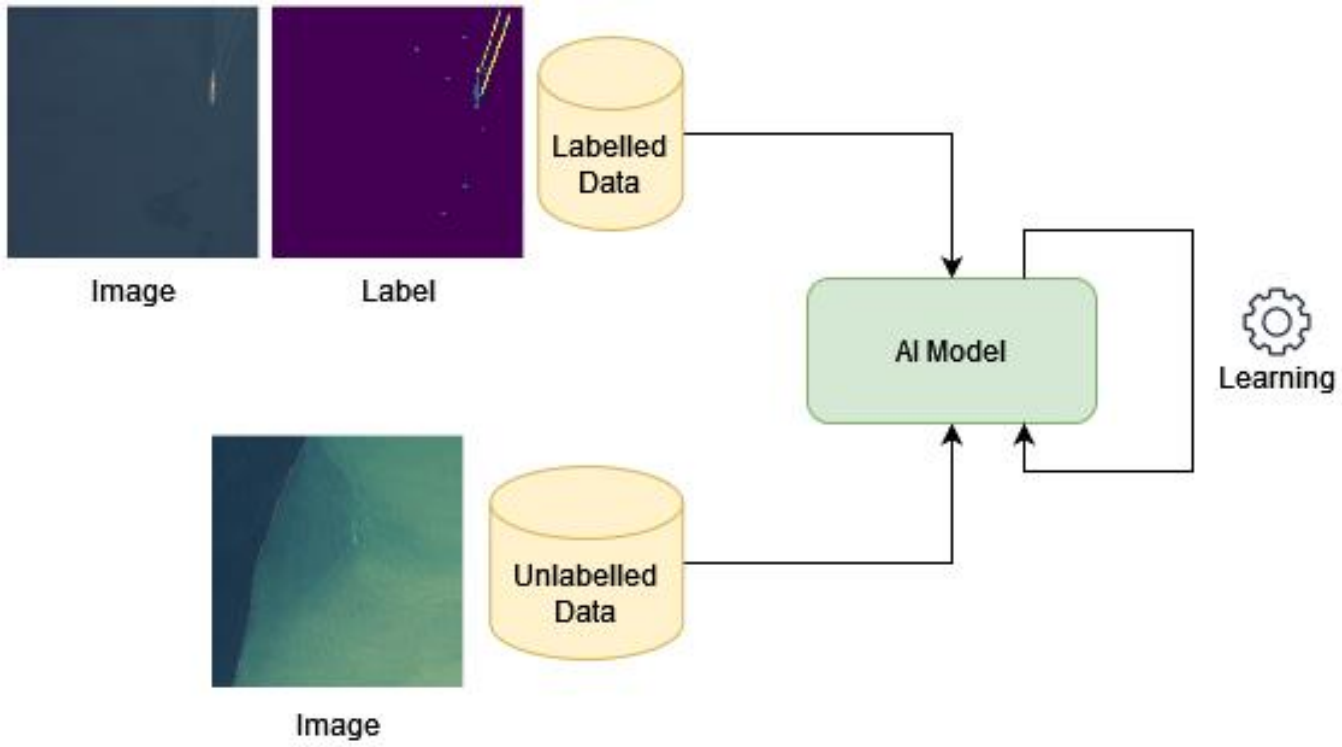
- Monitoring of marine debris and algae spread
- Alerts (position and quantity)

Data:

- MARIDA dataset (Kikaki, Katerina, et al. 2022)
  - 12 sites across the world
- Sentinel-2 Multispectral Instrument
  - Period: 2015-2021
  - 11-bands

MARIDA debris event sites, Kikaki, Katerina, et al. 2022.

LOW-COST TRAINING WITH SEMI-SUPERVISED LEARNING



Labelling multispectral data requires:

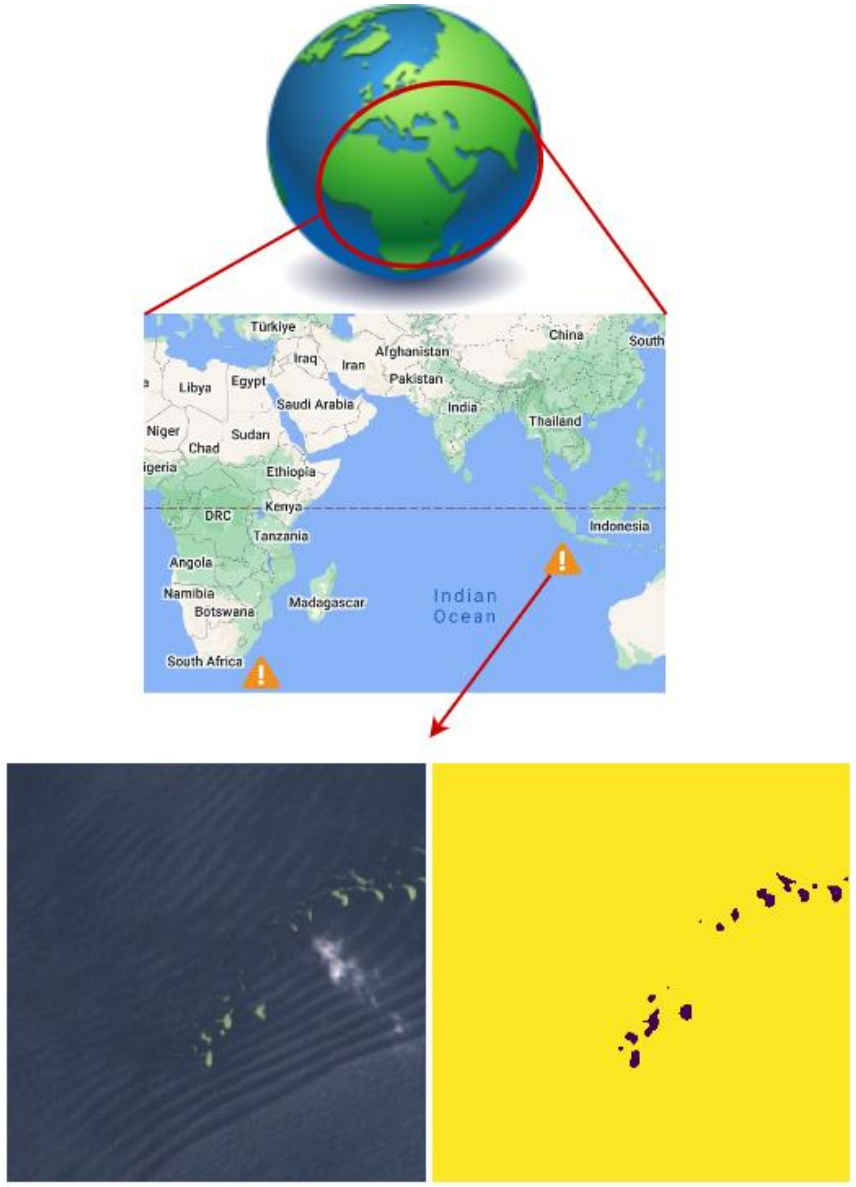
- Experts' annotations
- Time

Semi-supervised learning uses:

- Few labelled data
  - Lower cost (less developed countries and NGOs)
- Many unlabelled data
  - Easy to get
  - To adapt to different scenarios and places

ACTION AND FUTURE STEPS

- End goal → Removal of litter and of non-native species
- Test the model on new areas
  - Ask experts' validation
- Extend the model to work with other satellites
- Open-source world map
  - Visualization of predicted anomalies
    - Images, Position, Coverage
  - Notifications
    - Selection of areas of interests
  - Stakeholders: NGOs, start-ups, space agencies



CHALLENGES

- Marine litter and algae can move far away once detected
- It can take time to reach the site of interest

Solutions:

- Move the model onboard and use less-processed data
- Adapt the model to handle time-series
    - Predict where the marine litter/algae will move in the future

QUESTIONS?

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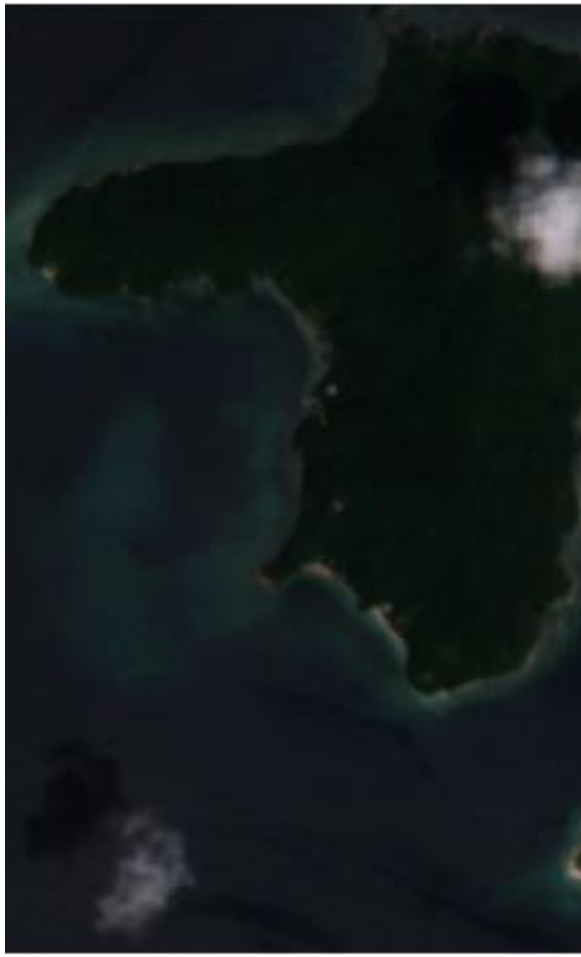

REFERENCES

[1] Lincoln, Susana, et al. "Marine litter and climate change: inextricably connected threats to the world's oceans." Sci. Total Environ. (2022): 155709.

[2] Deudero, Salud, and Carme Alomar. "Mediterranean marine biodiversity under threat: reviewing influence of marine litter on species." Mar. Pollut. Bull.98.1-2 (2015): 58-68.

[3] Kikaki, Katerina, et al. "MARIDA: A benchmark for Marine Debris detection from Sentinel-2 remote sensing data." PloS one 17.1 (2022): e0262247.