Environmental Computational Science and Earth Observation Laboratory

Master thesis subject

Segmentation of Marine Debris with a Few-Shot Learning Model

Context

Marine litter is one of the permanent pollutants of the marine ecosystem, consisting of anthropogenic waste, such as plastic bottles, cigarettes and toys, discharged into the ocean via rivers, lakes or extreme weather events. Marine litter is growing into a serious threat to biodiversity and human life and an increasingly important environmental issue that needs to be addressed at a global scale by strong and effective action plans. Regarding the human-linked pollution, growing body of evidence points to a broad range of detrimental effects of floating debris pollution. Nearly 700 marine species are known to have ingested or become entangled in macroplastic [Gall et al., 2015]. Moreover, marine debris not only endangers the livelihoods of those relying on marine resources, it also causes significant health issues for animals and humans who consume seafood that contain toxic micro and nano plastics [Lau et al., 2020].

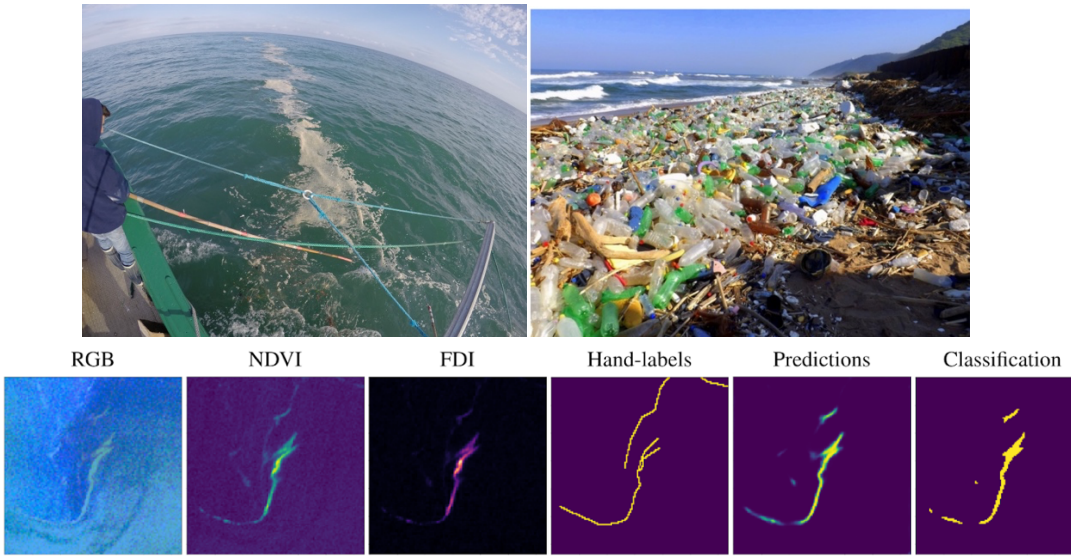

Figure 1: Left : “Fishing for Litter” from Ruiz et al., 2020 in the Bay of Biscay, France. Image credits. Oihane C. Basurko. Right: Marine Litter Polution on Cuttings Beach, South Africa, image credit: Lisa Guastella. Bottom : Model Predictions from our U-Net segmentation model [Mifdal et al., 2020, Carmo et al., 2020]

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Detection and Cleanup

Companies and NGOs, such as The OceanCleanup or The SeaCleaners, are working on ship-based collection and processing facilities to gather marine litter aggregated on the sea surface on coastal regions. However, any effective collection effort of marine litter requires an accurate detection to inform ship and crew on the most likely presence of marine litter in a specific area before any collection campaign can be started.

We work on the detection of floating objects on Sentinel-2 images over coastal areas as a first step towards the detection of marine litter on a large scale. We want to deploy an available few-shot learning model on the problem of marine debris detection on each available satellite image.

Challenges

- False-positive predictions on coastline, ships, clouds.
- Diverse nature of floating objects: seafoam, plastic, algae.
- Incomplete/Inaccurate labels.

Objectives

- Familiarise with a provided floating object deep learning implementation in pytorch
- Identify and conceptualize a solution to one of the challenges.
- Design and implement a solution and test its effectiveness qualitatively and quantitatively.

Requirements and practical info

- Background in machine/deep learning is welcome.
- Programming skills in Python.
- The thesis will be supervised from the Sion campus.
- Access to parallel computing resources is provided.

Literature

- Gall, S. C., & Thompson, R. C. (2015). The impact of debris on marine life. *Marine pollution bulletin*, *92*(1-2), 170-179.
- Lau, W. W., Shiran, Y., Bailey, R. M., Cook, E., Stuchtey, M. R., Koskella, J. & Palardy, J. E. (2020). Evaluating scenarios toward zero plastic pollution. *Science*, *369*(6510), 1455-1461.
- R. Carmo, J. Mifdal, M.Russwurm (2021). Detecting Macro Floating Objects on Coastal Water Bodies using Sentinel-2 Data. Oceans 2021 Conference
- Mifdal, J., Longépé, N., & Rußwurm, M. (2021). Towards Detecting Floating Objects on a Global Scale with Learned Spatial Features Using Sentinel 2. ISPRS Annals of the Photogrammetry, Remote Sensing and Spatial Information Sciences, 3, 285-293.
- Ruiz, I., Basurko, O. C., Rubio, A., Delpey, M., Granado, I., Cózar, A. (2020). Litter windrows in the south-east coast of the Bay of Biscay: an ocean process enabling effective active fishing for litter. Frontiers in Marine Science, 7, 308.

Contact

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