The 3rd GRSS Student Grand Challenge

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Outline

1st GRSS Student Grand Challenge

2nd GRSS Student Grand Challenge

3rd GRSS Student Grand Challenge:

- The Theme
- Application and Selection Process
- Summary of the proposal
- Important Dates
- The “marine pollution” problem and posible solutions

Q&A

1st GRSS Student Grand Challenge (i)

The “grand challenge” is to design and implement an **end-to-end observing system based on drones or RPAS** to address a problem linked to strategic themes like the observation of the polar regions, precision farming, forest monitoring, desertification. This should include the definition of the problem to be addressed, the techniques that will be used, the **instrument concept** that will be implemented, the **data storage/transmission** system **AND** an **smart phone app to display the results interactively**

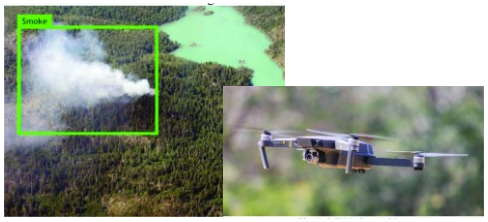
Technical Program

Session Detail

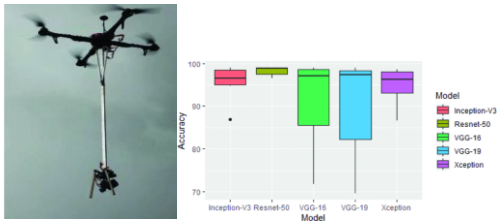
Session Title	**TH1.R2: GRSS Student Grand Challenge**
Presentation Mode	Oral
Session Time	Thursday, 01 August, 08:00 - 09:40
Location	Room 213

1st GRSS Student Grand Challenge (ii)

TH1.R2.1: DEVELOPMENT OF A SURVEILLANCE SYSTEM FOR FOREST FIRE DETECTION AND MONITORING USING DRONES , Saif Allauddin Md., Sai Kiran G., Raj Kiran G S S, Srinivas G, Uma Ratna Mouli G, and Vishnu Prasad P (Rangaraju Institute of Engineering and Technology)

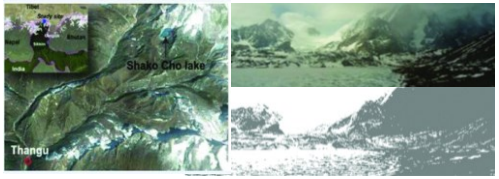


TH1.R2.2: MACHINE LEARNING APPLIED TO UAV IMAGERY IN PRECISION AGRICULTURE AND FOREST MONITORING IN BRAZILILIAN SAVANAH, David Robledo Di Martini, Everton Castelão Tetila, José Marcato Junior, Edson Takashi Matsubara, Henrique Siqueira, Amaury Antônio de Castro Junior, Márcio Santos Araujo, Carlos Henrique Monteiro, Hemerson Pistori, Veraldo Liesenberg (Federal University of Mato Grosso do Sul, Catholic University Dom Bosco, University of the State of Santa Catarina)

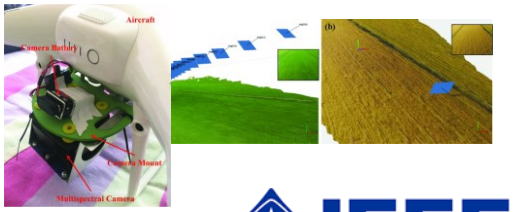


TH1.R2.3: MULTISENSORY SURVEILLANCE DRONE FOR SURVIVOR DETECTION AND GEOLOCALIZATION IN COMPLEX POST-DISASTER ENVIRONMENT, Budiman P.A. Rohman, Muhammad Bagus Andra, Hanif Putra, Dion Fandiantoro, Masahiko Nishimoto (Kumamoto University)

TH1.R2.4: DEVELOPMENT OF UAV BASED GLACIAL LAKE OUTBURST MONITORING SYSTEM, Swastika Chakraborty, Saurabh Das, Nirmal Rai, Anirban Patra, Aritra Dhar, Arnav Sadhu, Baishali Gautam, Pooja Verma, Anindita Singh, Chimila Sherpa, Lipika Karn (Sikkim Manipal Institute of Technology, IIT Indore, JIS College of Engineering,)



TH1.R2.5: A DRONE-BASED SENSING SYSTEM TO SUPPORT SATELLITE IMAGE ANALYSIS FOR RICE FARM MAPPING, Yiqing Guo, Xiuping Jia, David Paull, Junpeng Zhang, Adnan Farooq, Xiaolin Chen, Md. Nazrul Islam (University of New South Wales)



2nd GRSS Student Grand Challenge (i)

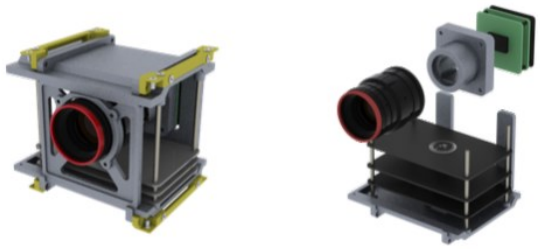
The 2nd GRSS Student Grand Challenge which will allow student teams to develop **Earth Observation payloads for a small satellite**. The winning payloads will be considered for integration into a CubeSat that will be developed at the National Space Science and Technology Center (NSSTC), Al Ain, United Arab Emirates (UAE) in collaboration with the YahSat Space Lab at Khalifa University, Abu Dhabi, UAE.

1. The student team from **Universitat Politècnica de Catalunya, Spain, supervised by Prof. Juan Ramos Castro** proposed developing a combination of payloads in small form factor for CubeSats. These include an L-band radiometer for monitoring ice thickness and soil moisture, a multispectral camera for monitoring vegetation, and a software defined radio for monitoring Radio Frequency Interference along with a deployable antenna system.

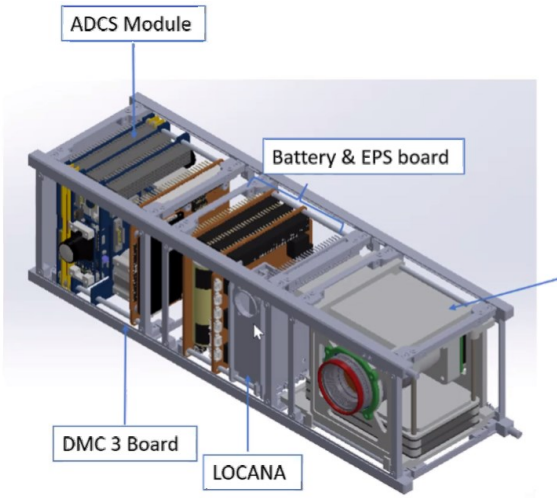
2. The student team from **Telkom University, Indonesia, supervised by Prof. Edwar** proposed development of a multispectral camera and a miniature spectrometer for atmospheric sensing.

3. In addition, the student team from **Kyushu Institute of Technology, Japan** will be partially funded. The team proposed to develop smart cameras with onboard classification capability to automatically detect the best quality images for downlinking.

2nd GRSS Student Grand Challenge (ii)
- Launch foreseen for Q2 2022



Alain Sat-1 Model



3rd GRSS Student Grand Challenge (i):

The Theme

The third edition of the Student Grand Challenge is a partnership between IEEE GRSS and the Van Allen Foundation (partnership foundation of the University of Montpellier and supports the Montpellier University Space Center).

"Novel Methods and Techniques to Detect and Track Marine Pollution and Litter"

3rd GRSS Student Grand Challenge (ii)

- **Detection and tracking marine pollution and litter worldwide** by the combination of various techniques, e.g. spectral signatures, AI, in situ data, merged datasets from existing satellite platforms, etc.

- **Direct detection remains problematic**, but **space techniques** are **likely to provide a significant contribution to increase current capacities**, mainly to improve spatial-temporal monitoring and reactivity (e.g. more intense pollution event, following a flood …).

- An effective solution could exploit the **combination of in situ monitoring** by **boats** and by **marine or aerial drones**, **modeling**, and **observations complementary to operational systems** (e.g. Copernicus satellites), integrating or augmenting the current **AIS** (Ship Tracking) system.
  - **In situ surveillance could** potentially **be piloted from space**.
  - **Models** would either be **based on past experiments or purely digital**.

- Such a system would bring into play a **dedicated fleet of nanosatellites** and **could involve local actors to deploy in situ solutions**.
  Emphasis is **on** the **contribution of space techniques**, but **call is open** to **numerical simulation studies**, **physics of measurement**, **laboratory or in situ measurements**, and the **application of AI** for the **recognition of polluted pixels**, or use of **sensors of opportunity**, etc.

3rd GRSS Student Grand Challenge (iii)

Application and Selection Process

- **Preliminary two-page form**, accessible at https://fondationvanallen.edu.umontpellier.fr/files/2021/03/Applicationform.pdf
  If necessary, at this stage, an interaction with the proposers may take place for clarification purposes.
  The two-page applications will be **evaluated by the Scientific Committee of the Van Allen Foundation and GRSS**. This assessment will permit the selection of a limited number of projects.

- Selected **teams will need to establish an IEEE GRSS student chapter in order to receive funding from IEEE GRSS**.

- See 'Important Dates' for details on the timeline.
  Information on how to set up a IEEE GRSS student chapter can be found here: www.grss-ieee.org/community/chapters/start-a-chapter/.
  The organizers will help with the paperwork for your chapter formation.

3rd GRSS Student Grand Challenge (iv)

Summary of the Proposal:

1.Background and Objectives: describe the background and objectives of the proposal

2.Technical Part: provide a description of the principle of the solution being proposed to reach the objectives, including potential problems and limitations, and a priori or auxiliary data required

3.Work Program: provide a description of the contents of the proposed work aimed at demonstrating the strength of the proposed solution, including the need for existing complementary data and observational or communication tools

4.Management: describe the overall team composition, including position of each team member, and CV of key personnel

5.Planning: provide a summary of the schedule and milestones of the proposed study

6.Deliverables: provide a list of the main expected outcomes of the study

7.Finance: describe the need for funding to perform the study, including internal and external resources and additional staff

8.Partnerships: provide a tentative list of scientific/technical/industrial partners and describe the proposer's interest into a partnership with the Van Allen Foundation and/or IEEE/GRSS.

3rd GRSS Student Grand Challenge (v)

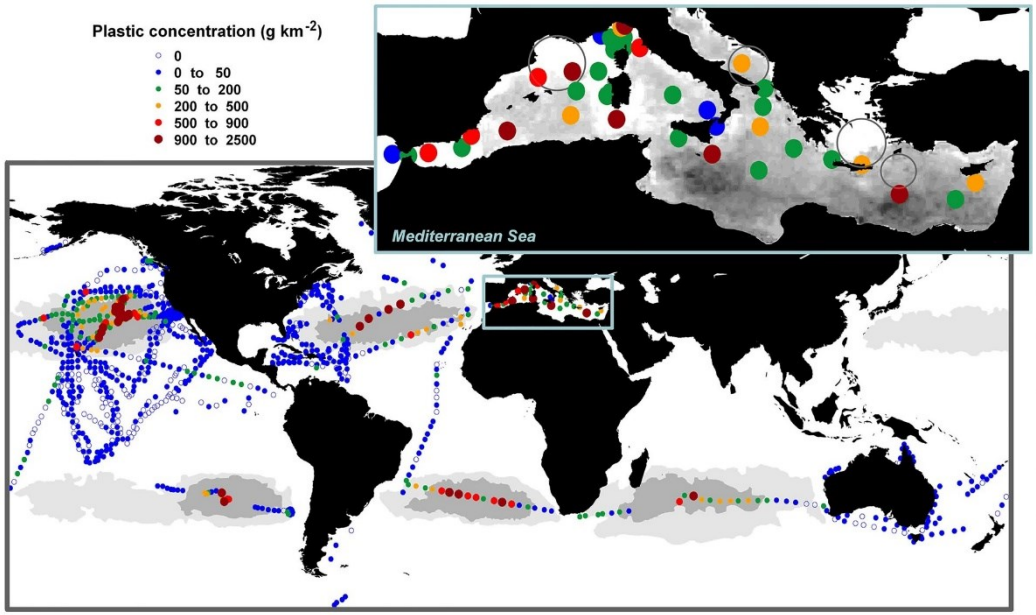
Important Dates

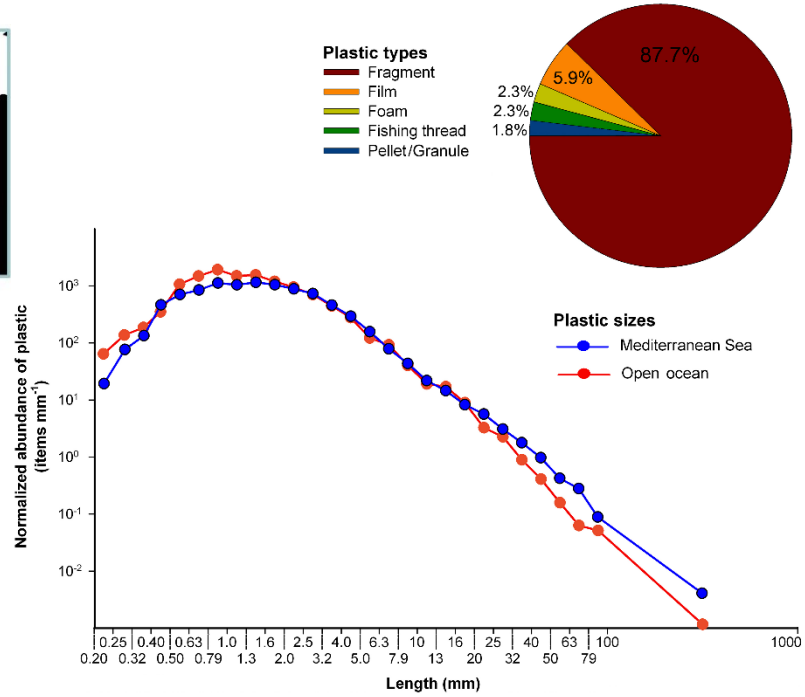
Date	Action
30 June	Call 2: Deadline for Submissions (Step 1)
15 July	Call 2: Announcement of Step 1 winners at IGARSS and on GRSS website
1 September	Formation request for IEEE GRSS student chapter due. Coordinate your chapter creation with the organizers.
1 October	IEEE GRSS student chapter formation completed. Initiation of transfer of funds.
1 November	Transfer of funds to IEEE GRSS student chapters completed.

Selected teams should allocate budget for a dedicated presentation at IGARSS 2023

3rd GRSS Student Grand Challenge (vi)

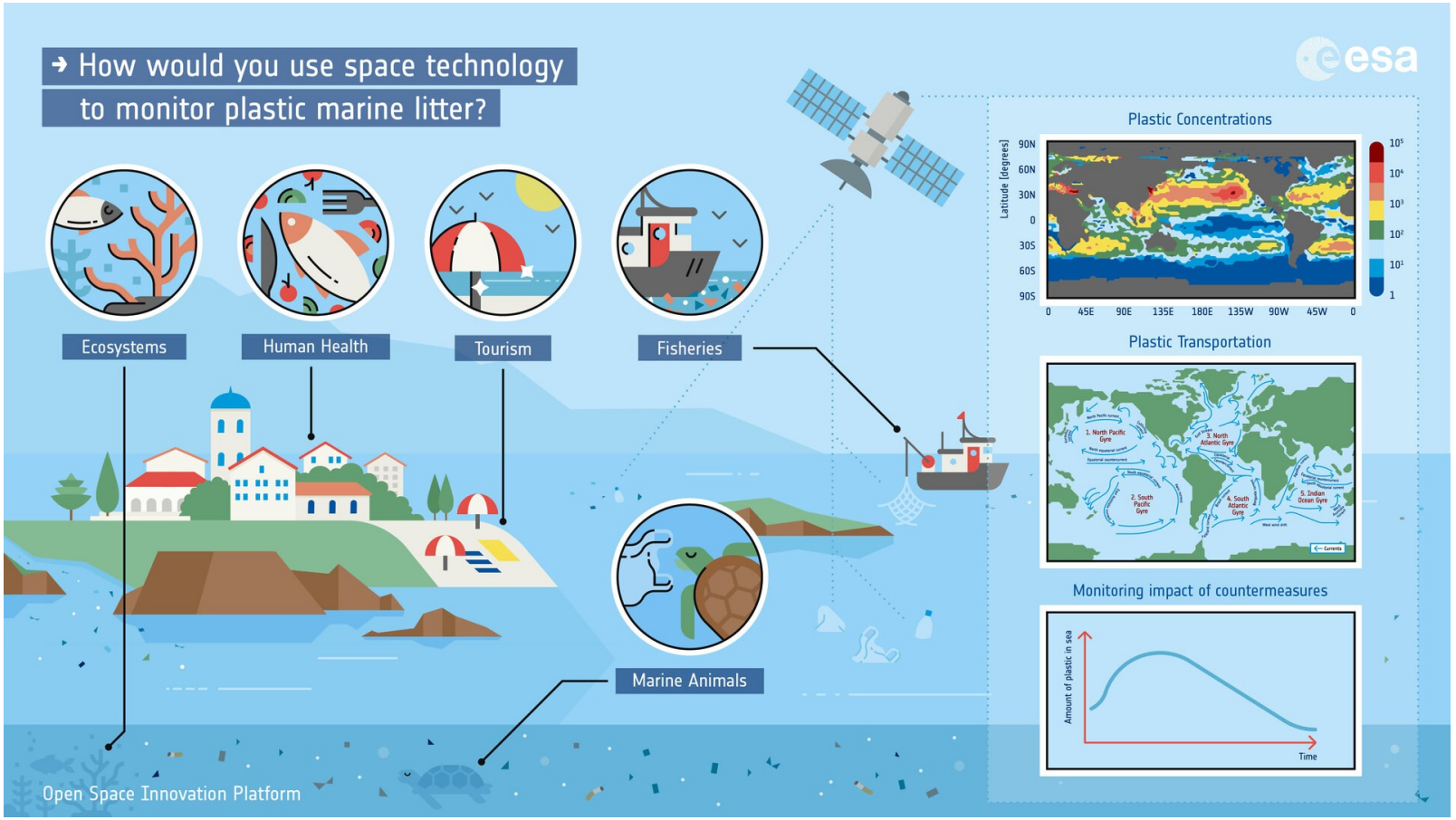
The “marine pollution” problem and posible solutions





© Cozar et al., “Plastic Accumulation in the Mediterranean Sea”, http://journals.plos.org/plosone/article?id=10.1371/journal.pone.0121762

3rd GRSS Student Grand Challenge (vii)



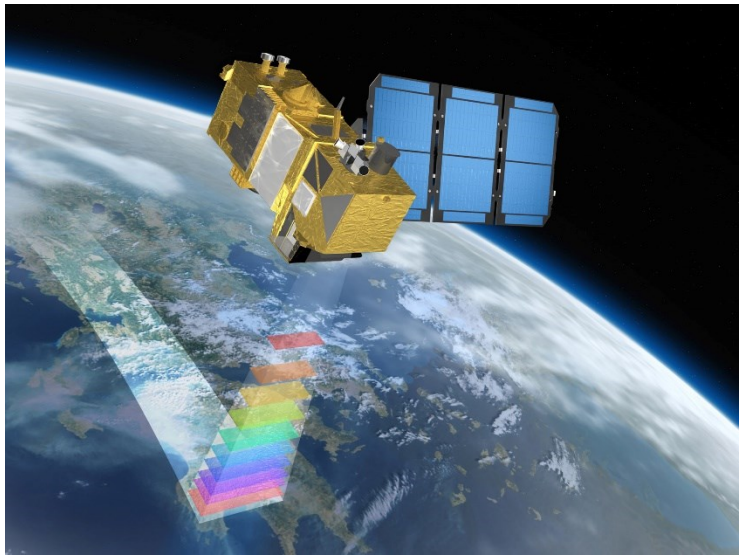
3rd GRSS Student Grand Challenge (viii):

Sample ESA projects for marine plastic detection using different approaches

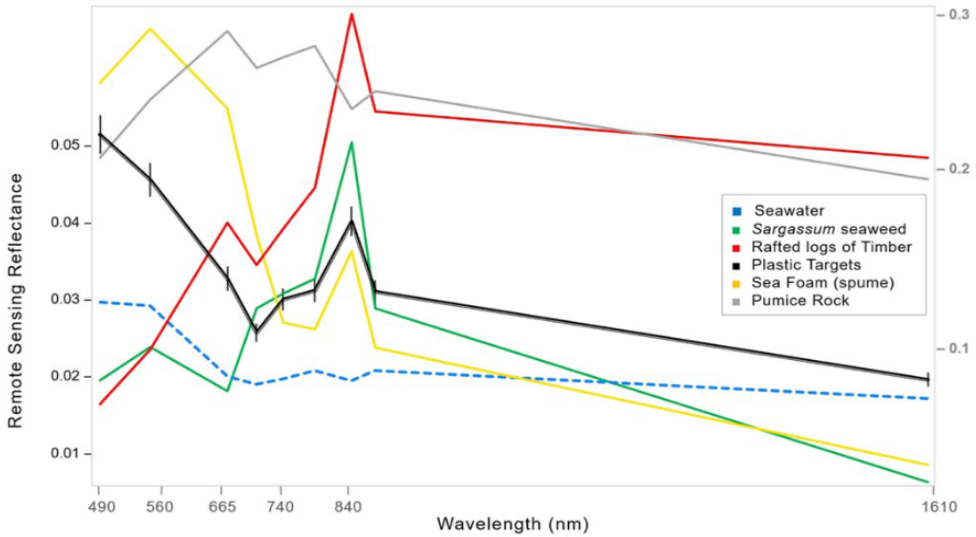
1. Using deep learning methods for plastic litter detection from satellite remote sensor

Capgemini Technology Services

The main objective of this project is to make it possible to automatically detect marine plastic litter patches in images from the Copernicus Sentinel-2 satellite using state-of-the-art deep learning methods (a subset of machine learning in artificial intelligence).



[https://www.esa.int/Enabling_Support/Preparing_for_the_Future/Discovery_and_Preparation/Implemented_OSIP_ideas_June_2020]



Sentinel-2 MSI bands from visible blue light at 490 nm, to short-wave infrared light at 1610 nm [https://www.nature.com/articles/s41598-020-62298-z.pdf]

3rd GRSS Student Grand Challenge (ix)

2. Hyperdrone: Development of spectroradiometric proxies of shoreline marine plastic debris for satellite validation using remotely piloted aircrafts

Plymouth Marine Laboratory, Scottish Association for Marine Science

Developing instruments and algorithms for satellite remote sensing of ocean plastic needs standardized global in situ observations. This project plans to develop a standardized indicator for in situ radiometric detection of plastic debris on the shoreline, with a view to being deployed globally on different platforms.

[https://www.esa.int/Enabling_Support/Preparing_for_the_Future/Discovery_and_Preparation/Implemented_OSIP_ideas_June_2020]

3rd GRSS Student Grand Challenge (x)

3. REACT: Crowdsourcing, Copernicus and hyperspectral satellite data for marine litter detection, quantification and tracking

Planetek Italia, National Technical University of Athens, ARPA Puglia

By fusing different types of satellite and in situ data, this project aims to develop a novel method to detect plastic litter at the shore or close to the shoreline, as well as offshore.

[https://www.esa.int/Enabling_Support/Preparing_for_the_Future/Discovery_and_Preparation/Implemented_OSIP_ideas_June_2020]

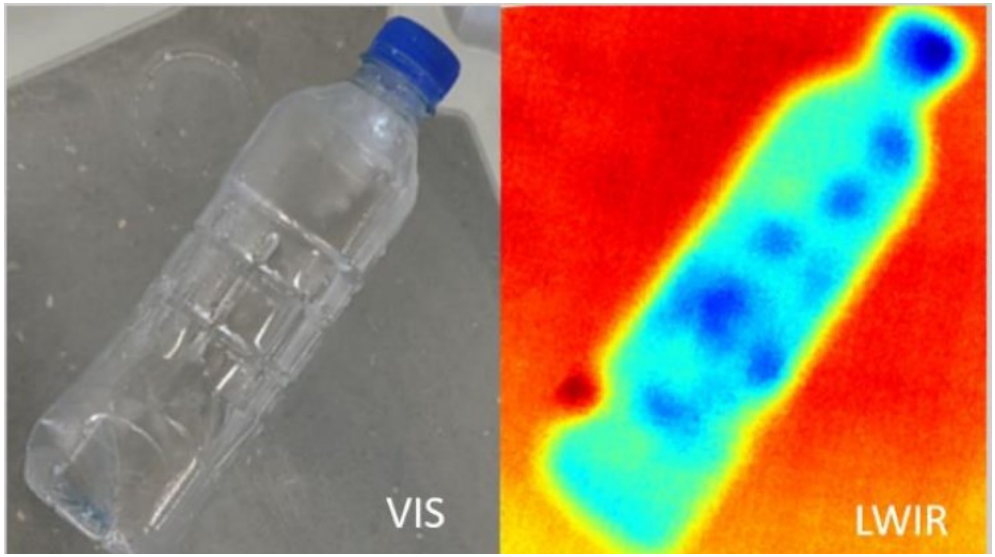
3rd GRSS Student Grand Challenge (xi)

4. TISPLALI: Thermal Infrared Sensing of marine Plastic Litter

North Highland College

Some plastic materials that are transparent in the optical spectrum may appear opaque in the thermal spectrum.

Consequences of sunlight and different air and sea temperatures on the TIR signal of plastic floating in water, to verify a thermal radiance model using imaging LWIR, NIR, and VIS colour cameras, a drone, and plastic targets deployed at sea



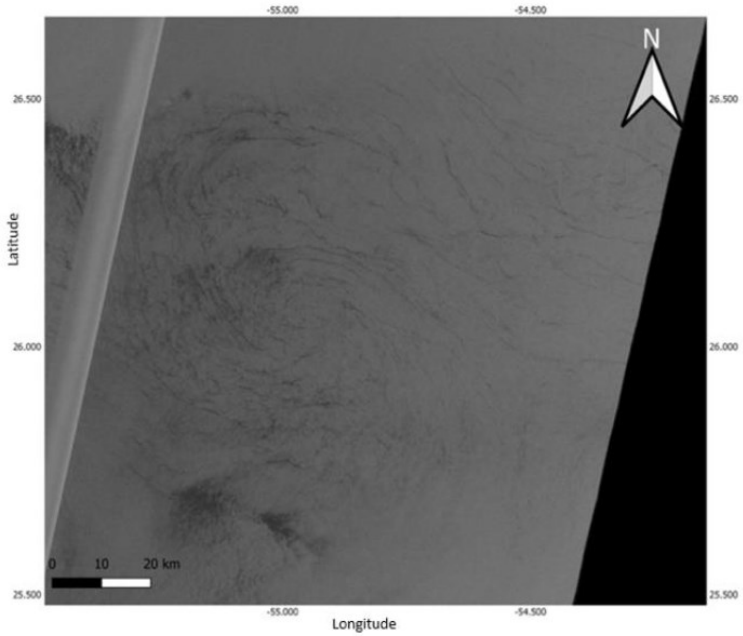
[https://esamultimedia.esa.int/docs/preparing_for_the_future/Discovery_marine_litter_results.pdf]

3rd GRSS Student Grand Challenge (xii)

5. PLASTICSURF

University of Stirling

3 pieces of research: a) Plastic in the ocean is heavily colonized by microbes; b) Microbes in water produce substances (surfactants) that dampen small waves; and c) Synthetic Aperture Radar (SAR) can identify surfactants as dark areas or stripes in images.



[https://esamultimedia.esa.int/docs/preparing_for_the_future/Discovery_marine_litter_results.pdf]

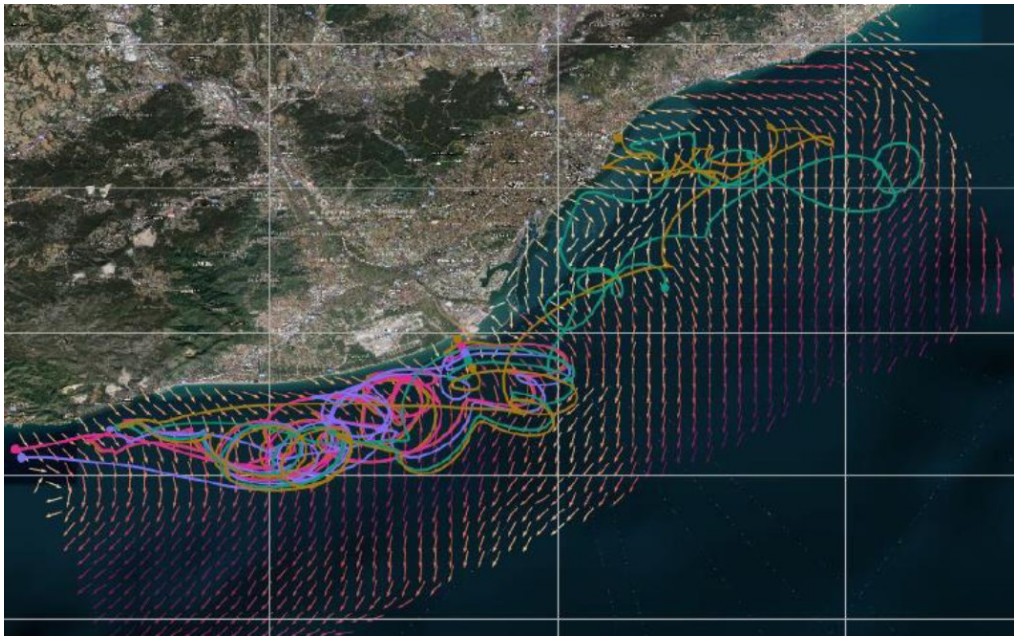
NOTE: Other techniques sensitive to sea surface roughness can also be applied, provided spatial resolution is enough

3rd GRSS Student Grand Challenge (xiii)

6. Prediction of plastic hot-spots in coastal regions using satellite derived plastic detection, cleaning data and numerical simulations in a coupled system

Polytechnic University of Catalonia, DHI GRAS

By combining satellite data on hydrodynamic variables, light reflectance and water quality with regional coastal models, this project will develop a system focused on identifying plastic hotspots in coastal waters and on the shore.



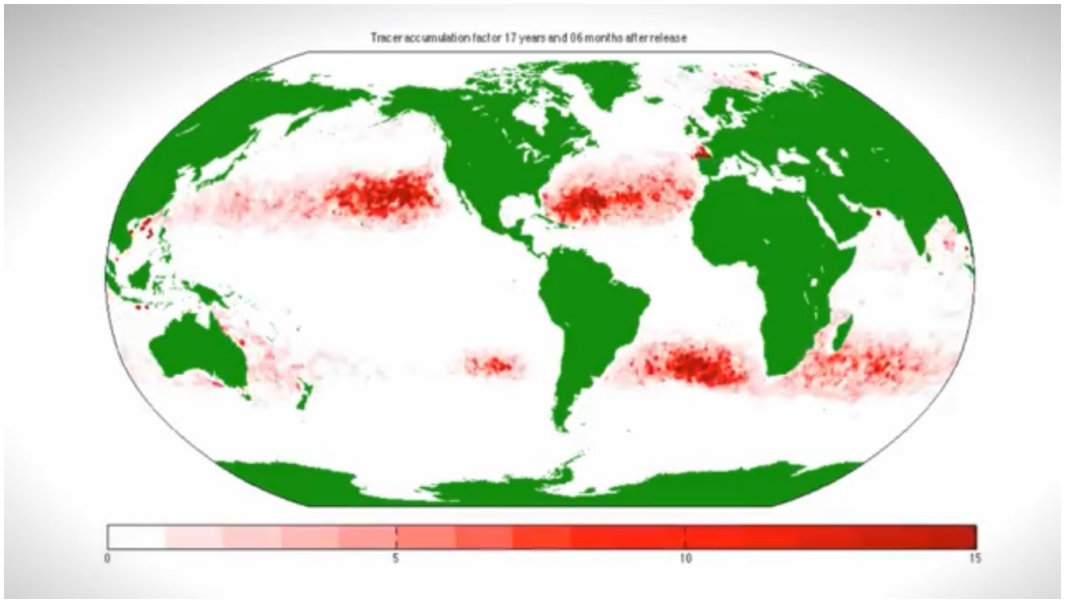
[https://www.esa.int/Enabling_Support/Preparing_for_the_Future/Discovery_and_Preparation/Implemented_OSIP_ideas_June_2020]

3rd GRSS Student Grand Challenge (xiv)

7. Marine litter aggregation forecast

Deep Blue Globe

Marine litter detection based on satellite remote sensing is becoming a reality but the current state of the art is not mature. This research study aims to use expertise in artificial intelligence solutions based on space technology to simulate and perform a plastic concentration forecast which would then be studied in more detail thanks to multispectral data from the Copernicus Sentinel-2 mission.



[https://www.esa.int/Enabling_Support/Preparing_for_the_Future/Discovery_and_Preparation/Implemented_OSIP_ideas_June_2020]

Thanks for your attention.

Any questions?