Keeping it SiMPLER: Sensing Marine Plastic Litter using Earth Observation in River Outflows

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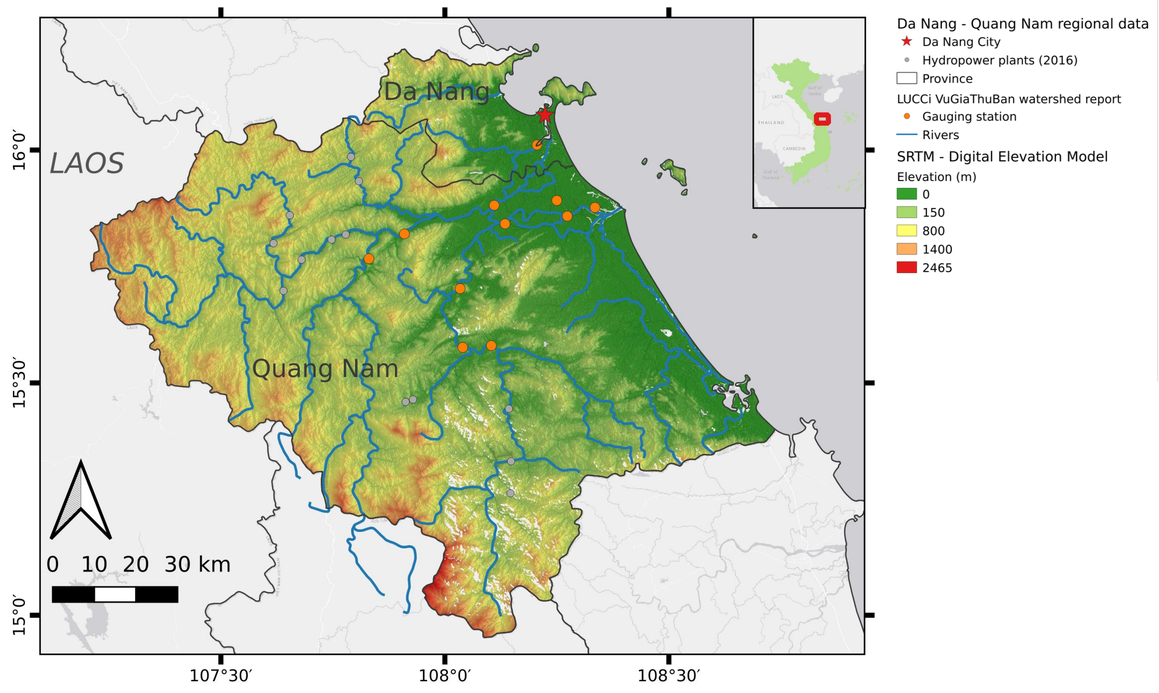
Aim

Develop and validate new Earth Observation (EO) approaches quantifying river input of marine plastic debris into coastal waters, specifically macro- and microplastic flux rates over time. Rivers flowing into oceans have been identified as one of the largest land-based plastic debris inputs to marine plastic pollution budgets, with Southeast Asian rivers contributing an estimated two thirds input to the annual global marine plastic debris budget. Project study area is the medium-sized river system in Da Nang, Vietnam, but developed algorithms will be designed with an eye towards scalability to other Southeast Asian river systems.



Challenges

EO detection algorithms focus primarily on floating macroplastic detection in optically simple water bodies, such as the open ocean and relatively clear coastal waters. River mouths are characterized by often highly turbid and optically-complex waters, thus posing additional difficulties for remote sensing detection of water constituent concentrations. EO detection of microplastics poses additional challenges, including:

- microplastic concentrations often not sufficiently high to change water surface optical reflectance signal
- strong absorption of infrared light, required for positive identification of hydrocarbons, within the water's surface

This suggests that most promising path to an EO algorithm for river mouth microplastic quantification will be dependent on using a proxy water surface signal, such as Suspended Particulate Matter (SPM) for detection.

In situ sampling has been delayed due to COVID-19 travel restriction, all results are thus purely theoretical thus far.

Collaborations working in parallel on the Da Nang river system

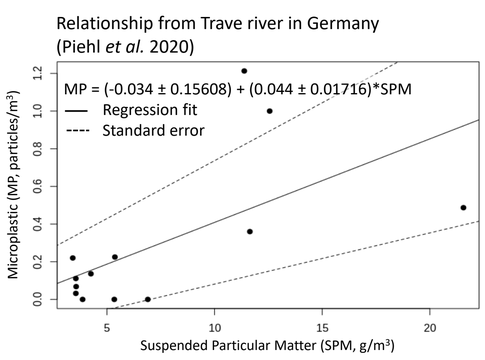
ACCORD — Addressing Challenges of Coastal Communities through Ocean Research for Developing Economies

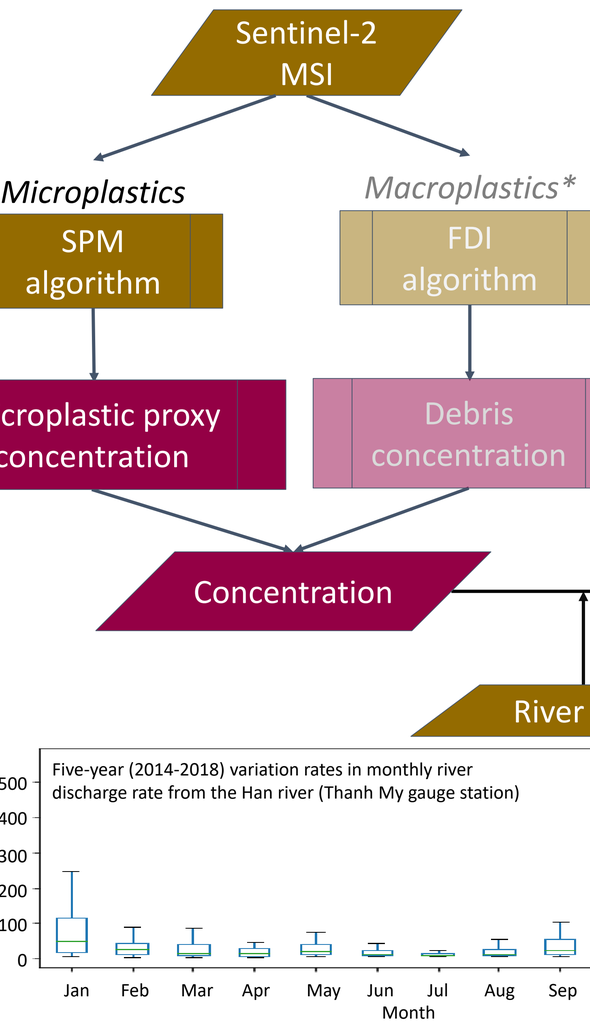
Provide partner countries with improved capability for integrated and sustainable management of marine activities, help build resilient marine and coastal socio-ecological system and support growing Blue Economies.

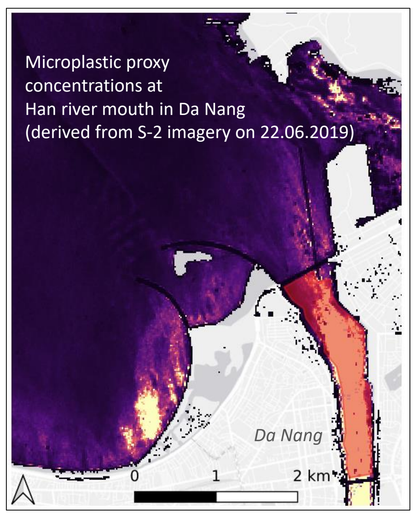
FRONTAL

Development of risk detection prototype algorithm for marine plastic debris accumulated at oceanographic fronts. The approach combines advanced optical and radar processing techniques with front detection algorithms and dispersion models. The hypothesis that fronts aggregate floating plastics is supported by results from the ESA-OPTIMAL study – more details presented in **MICRO 2020 talk 334346**.

Theoretical basis for intended flux quantification algorithm





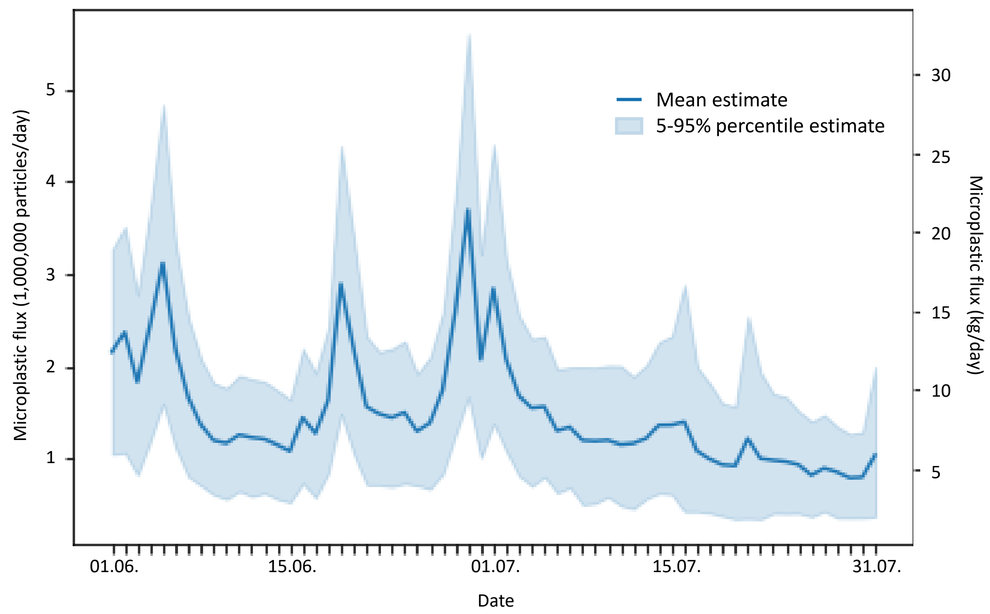


Existing relationship
Existing 3rd party dataset
New relationship
New dataset

*Only microplastic work presented here

Included uncertainties
- Conversion SPM to proxy MP concentrations
- 5-year variation estimate in river discharge
- Conversion microplastic particle conc. (#/day) to mass (kg/day)

Estimated daily river microplastic flux rates for June/July 2019

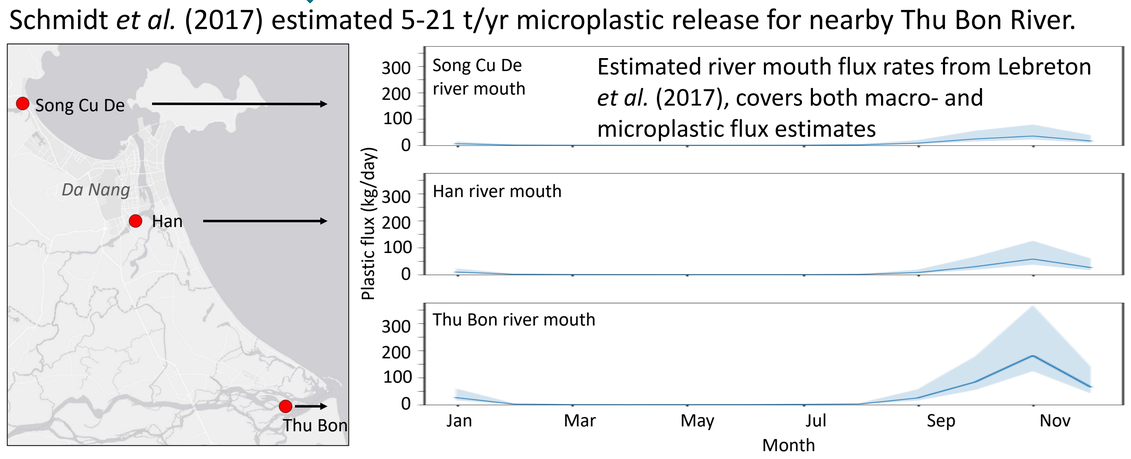


Currently estimated 3 t/yr microplastic being released from Han River

Vicarious validation

Uncertainties needing better clarification
- Develop regionally calibrated SPM algorithm
- Annual variation in SPM concentration
- Establish regional SPM to microplastic relationship
- Seasonal variations in microplastic concentration

Schmidt *et al.* (2017) estimated 5-21 t/yr microplastic release for nearby Thu Bon River.



Next steps

In situ sampling plans have been significantly changed due to the COVID-19 pandemic, with onsite field campaign activities currently rescheduled for 2021. Simplified data collection activities with local partners, sampling for both macro- and microplastics as well as water quality parameters, will allow for greater temporal coverage such as seasonal variability. Model parameterization will be further expanded once data become available, thus allowing for improved uncertainty estimates in modelled river flux rates. Macroplastic flux rate calculation was not covered in this poster but will in part utilize methods laid out in Biermann *et al.* (2020).

Stakeholder engagement

Local stakeholders will be equipped with simplified techniques for plastic pollution measurement and reporting. Data generated by local monitoring agencies can be used for satellite validation into the future, thus contributing to study sustainability beyond the scope of the current project.

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