Floating Litter and its Oceanic TranSport Analysis and Modelling (FLOTSAM)

Working Group proposal submitted to SCOR April 2017

Prepared by:

Chair: Stefano Aliani
Institute Marine Science CNR, Italy
Email: stefano.aliani@ismar.cnr.it

Vice chair: Kara Lavender Law
Sea Education Association, USA
Email: klavender@sea.edu

Vice chair: Nikolai Maximenko
University of Hawaii, USA
Email: maximenk@hawaii.edu

Vice chair: Erik Van Sebille
Utrecht University, Netherlands
Email: e.vansebille@uu.nl

1. Summary

In October 2015, the G7[1] Science Ministers highlighted marine debris as a major ocean health issue. A number of international working groups have focused on ocean plastics, although the amount of plastic floating at the sea surface remains an open question, including knowledge about its origins, where it is accumulating, and its transport pathways. It is a complex oceanographic problem for a variety of reasons, including challenges in sampling in situ and remotely, as well as in modelling at a variety of space and time scales.

In this working group (WG) we plan to address the problem of floating litter in the open ocean at global scale by disentangling coastal processes (with their short timescales) from the open ocean low-frequency processes. The major objectives of this WG are to:

- identify gaps in our knowledge of the near-surface ocean dynamics that may affect litter distribution and transport;
- improve future marine litter modelling capabilities;
- evaluate existing and emerging remote sensing technologies that can be applied to detect marine litter in the open ocean;
- improve awareness of the scientific understanding of marine debris, based on better observations and modelling results.

Bringing together scientists with expertise in plastic marine debris with those focused on ocean observations, remote sensing, and numerical modelling will create a powerful collaboration for the understanding of marine debris.
We propose one chairperson and 3 vice chairs, each responsible for a specific objective. There are 10 Full members and 9 Associated members from a total of 13 different countries.

2. Background and motivation for the working group

2.1 The importance of environmental plastic pollution and current knowledge gaps

Contamination by man-made debris is increasingly reported in marine habitats around the world. An estimated 70-80% of marine litter is made of plastic polymers, and that percentage is probably much higher at the sea surface of the open ocean. Because they do not readily biodegrade, plastics may persist in the marine environment for years to decades or longer, longer than the time-scales of many of the ocean processes typically considered in physical oceanography. An estimated ~8 million metric tons of mismanaged plastic waste entered the oceans from land in 2010 (Jambeck et al. 2015),

[1] https://www.bmbf.de/files/English_version.pdf
http://www.icsu.org/news-centre/news/pdf/Report%20to%20G7%20SMins%20on%20FOSs.pdf

with additional sources including natural disasters (Maximenko et al., 2015) and accidents (Trinanes et al., 2016), and inputs are expected to rise with the continued acceleration in global plastics production (Plastics Europe 2016).

Marine litter poses a variety of environmental and socioeconomic risks, which will be mitigated only with a substantial, sustained and integrated effort from individuals, industry, governments, and intergovernmental organizations at local to regional and global scales. In October 2015 the G7 Science Ministers highlighted marine litter, especially plastics, as a major ocean health issue, and the International Association for the Physical Sciences of the Ocean (IAPSO) and the Scientific Committee on Oceanic Research (SCOR) published conclusions regarding those issues and recommendations for future action by G7 countries (Thompson and Maximenko, 2016).There is no single solution; rather, a variety of local and regional solutions will be required to effect change (Hardesty et al. 2017).

Marine litter occurs all over the world from densely inhabited to remote areas, from the seafloor to surface waters. However, our knowledge of the abundance and distribution of plastic in the open ocean is limited, with most prior work having focussed on floating microplastics (millimeter-sized particles and smaller) measured with plankton nets.

Floating microplastic debris is found in seas around the world, from oceanic subtropical gyres (e.g. the so-called 'garbage patches') where concentrations exceed 600,000 pieces per km^2 (Law et al. 2010), to inner seas (e.g. Suaria et al. 2016, Chubarenko et al. 2016, Chubarenko and Stepanova, 2017) to more remote regions such as the waters of the Arctic (Cozar et al., 2017, Bergmann et al., 2016) and the Antarctic (Barnes et al., 2010; Ryan et al., 2014), where far fewer plastic particles are observed. It has become clear that humanity's discarded litter is spreading throughout our seas and oceans (e.g., Pham et al., 2014; Jambeck et al., 2015; GESAMP, 2016) and ocean models of surface transport predict that marine debris should ultimately be expected everywhere (Van Sebille et al., 2015).

A number of international working groups have focused on ocean plastics, but the focus is often on impacts of plastics to marine organisms and ecosystems. With the goal to assess the risks of plastic debris, they frequently highlight the need for increased knowledge about its abundance, distribution and transport. A necessary step is to get an estimate of the amount of plastic in the ocean, including knowledge about its origins, where it is accumulating, and its transport pathways. This is a complex problem for a variety of reasons, including challenges in sampling, both in situ and remotely, as well as in modelling.

If 8M tons of plastic are added to the ocean annually and plastic is expected to be around for decades or even centuries, why don't we find these large amounts in the ocean (e.g. Ryan, 2015)? Estimates of floating litter to date only tally up to order of 100,000 tons of floating microplastics (Cozar et al, 2014, Eriksen et al. 2014, van Sebille

et al., 2015), with only an order of 10,000 tons removed by coastal clean-ups [1]. What missing knowledge can explain this multiple order of magnitude mismatch? Emerging research in physical oceanography may help elucidate marine debris distribution patterns and transport processes. Bringing together scientists with expertise in plastic marine debris with those focused on ocean observations, remote sensing, and numerical modelling in a single SCOR working group will create a powerful collaboration that will advance our understanding of marine debris in the open ocean.

2.2 The Challenge

The major challenge of this WG is to explain the distribution patterns, trends, and pathways of plastics in the open ocean.

Limitations of our understanding of the transport of floating plastics result from technical gaps as well as gaps in our knowledge of the near-surface ocean dynamics. These gaps include:

- coarse vertical and time resolution of debris modelling
- high-frequency processes and their non-linear interactions (Stokes drift, inertial oscillations, diurnal cycle in the upper-ocean stratification),
- lack of data on critical parameters (e.g. fluxes) that could support next-generation models of plastics at sea, and limited observations of surface currents (remote or in situ) that could help calibrate/validate such models.

In addition, there is a dearth of knowledge on the typical features of marine debris, including floating lifetime, settling, fragmentation, degradation, and ingestion by organisms, which may alter the debris properties affecting its transport. Questions to be addressed include:

- How variable is marine litter composition in time?
- How big are the differences in the composition between different regions?
- What characteristics of plastic debris should be used in models (different degradation and fragmentation rates for different polymers, average particle size, etc.)?
- How does the composition of microplastics correspond to the composition of macroplastics?
- How do the dispersion and physics that apply to floating debris differ between macroplastic, microplastic and nanoplastic?
- What are the roles and impacts of the biological pump on transfer of pollutants to deep waters at different scales?
- What are the temporal trends in composition of microplastics associated with changes in macroplastic production?

Drift models have been used to describe marine litter distribution and transport, but improvements are required to adequately simulate pathways of marine debris ranging in size from microplastics to large objects. This includes improved models of ocean motion and definition of the dynamics of buoyant objects in a turbulent sheared flow, together with characterization of properties of plastic debris.

Distribution of floating marine litter has been studied since the 1970s using plankton net tows and visual selection of plastic particles in collected samples. Preliminary efforts have been made to standardize collection procedures and sample analysis protocols. Yet global, or even regional, in situ sampling at high resolution is not feasible, which calls for development of remote sensing instruments. At present, only optical data are readily available and they are only capable of detecting very large debris items.

Prospective satellites and airborne sensors may be able to measure various indices related to plastics and other types of floating debris and quantify their abundance on the ocean surface. The scientific recognition on this topic is still in its infancy and the key issues to be addressed and the full potential of remote sensing are still to be fully discussed in the scientific community. In 2016, the European Space Agency (ESA) released a call for proposals on remote sensing of Marine Litter (RESMALI). In the same year, the US National Aeronautics and Space Administration (NASA) sponsored a workshop on Mission Concepts for Marine Debris Sensing[2] and included marine debris research in the scope of NASA's Interdisciplinary Research in Earth Science (IDS) program[3]. Satellite remote sensing can best contribute to the marine debris field through new missions to measure surface velocities, as well as implementation of existing and development of new sensors (optical, hyper-spectral, SAR, etc.) to track larger objects or detect the presence and quantify the concentration of smaller particles.

In the proposed WG we plan to:

- address the problem of floating litter at the global scale by disentangling coastal processes (with their short timescales) from the open ocean low-frequency processes.
- improve the application of ocean circulation models to the drift of debris at sea.
- assess and promote the use of remote sensing tools to study floating debris at sea.

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[1]http://www.oceanconservancy.org/our-work/marine-debris/2016-data-release/2016-data-release-1.pdf

[2] http://iprc.soest.hawaii.edu/NASA_WS_MD2016/

[3] https://nspires.nasaprs.com/external/viewrepositorydocument/cmdocumentid=498140/solicitationId=%7BE4A477E6-5A41-B75E-5DA8-61724BC35768%7D/viewSolicitationDocument=1/A.28%20IDS%20Amend%2034.pdf

2.3 Why a SCOR Working Group?

This is the first effort to address the problem of marine litter in a SCOR WG. The proposed focus on debris in the open ocean from the physical oceanography perspective is new and makes this WG unique. The presence of a scientifically sound and competent voice on the topic is needed to fill knowledge gaps. By focusing expertise and resources into an international community effort, we will be able to deliver much-needed knowledge of marine debris in offshore waters that are mostly out of our sight, but in the heart of the global ocean.

We have already seen capability and willingness in the scientific community working on marine debris to work together in international WGs – some of the proposed members of this SCOR WG are also members of other, non-physics, international WGs – and we see SCOR as the proper environment to transform these recommendations into a more detailed, effective and cutting-edge improvement in knowledge.

This SCOR working group will assemble a diverse set of ocean scientists to work jointly towards delivering a set of clear objectives that will have wide impact and resonance across the larger ocean scientific communities.

These communities are diverse and include physical oceanographers specializing in relevant dynamics and using in situ observations and remote sensing, experts in marine plastic debris and modellers who attempt to synthesize the theory and the data and summarize the overall knowledge of the marine system.

Because of the broad involvement from several different disciplines and because of the specific focus on the marine litter problem, the multi-disciplinary and international work we propose would be difficult to support through national agencies, private foundations or other international organizations.

3. Terms of reference

(Objective 1) Identify gaps in our knowledge of the near-surface ocean dynamics that may affect litter distribution and transport.
Vice Chair: Kara Lavender Law

Gaps that will be explored will include, but not be limited to, improved mixed layer parameterizations and refined vertical and time resolution of ocean circulation models, inclusion of high-frequency processes and their non-linear interactions (Stokes drift, inertial oscillations, and diurnal cycle in the upper-ocean stratification). The WG will address the absence of data on critical parameters (e.g., fluxes) that are needed to support next-generation models, as well as the shortage in observations of surface currents (remote or in situ) that could help calibrate/validate models. We will also discuss marine litter parameters that can characterize non-homogenous distribution and behaviour, floating lifetime, settling, fragmentation, degradation, and ingestion by marine life that can increase the power of debris drift modelling. The results of WG discussions will be presented in a synthetic paper in an open-access, peer-reviewed journal publication.

(Objective 2) Improve future marine litter modelling capabilities.
Vice Chair: Erik Van Sebille

The group will select a set of software and computing platforms (e.g., Python, R, Matlab, Ferret etc.) and models (MITgcm, MOM, POM, NEMO, ROMS, etc.) in order to identify a platform to lead the development of new tracking tools, taking into account the very rapid development of ultra-fine-resolution global ocean hydrodynamics simulations (which will reach $1/60^{o}$ global resolution within the foreseeable future). The group will then agree on a common set of model metrics and diagnostics required to evaluate model performance, as well as a reference database from the observations. Platform leaders will be responsible for writing the code, which will be tested against a common model. Open-source scripts and codes will be made available to the ocean science community.

(Objective 3) Evaluate existing and emerging remote sensing technologies that can be applied to marine litter in the open ocean.
Vice Chair: Nikolai Maximenko
The working group will identify parameters important for understanding and modeling of the dynamics of marine litter that can be derived from variables measured by present satellite missions and from emerging remote sensing technologies. Inter-calibration of remote and in situ observations will be discussed in the context of a consolidated marine debris observing system.

(Objective 4) Improve awareness of the scientific understanding of marine debris, based on better observations and modelling results.
Chair: Stefano Aliani
The working group will aim to advance awareness on the topic through open sessions at scientific meetings and through the WG webpage. Open access scientific papers will be delivered as well as outreach actions through the media.

4. Work Plan

To deliver Objective 1,
we will identify gaps in knowledge of the near-surface ocean dynamics that may affect litter distribution and transport. We will utilize expertise within the working group to discuss key aspects of the state of plastic debris in the open ocean, especially focusing on those critical gaps in knowledge to understand the global distribution and transport of marine plastics. This will be expedited by close dialogue between modellers and observationalists within the working group. A peer-reviewed paper will be published in an open-access journal to report WG recommendations for studying plastics in the ocean from a multidisciplinary perspective.

To deliver Objective 2,
we will discuss governing equations in a unified mathematical notation and default parameter values or ranges necessary for parameterization, and test these across a subset of models. As part of this effort, we will produce consensus initialization fields that can be used by the global ocean modelling community, as well as open-source scripts and codes dedicated to marine litter modelling.

To deliver Objective 3,
we will review existing and emerging remote sensing technologies that can be used to measure marine debris floating on the ocean surface or distributed in the upper ocean. We will also review relevant activity of national space agencies, as well as published research reports utilizing remotely sensed data to study marine debris, and we will formulate requirements for future satellite missions.

To deliver Objective 4,
we will synthesize and publish our findings to improve awareness of scientists, the public, and policymakers. We will create a website and start social media dissemination. An open session at relevant international conferences dedicated to students, young scientists, journalists and NGO will be organized. This information will be helpful input to achieving the pollution sub-goal of Oceans 2030 Sustainable Development Goal #14.

Timeline

We expect that our Working Group will start working in September 2017, right after receiving the decision from SCOR.

As a part of our activity, we plan to hold annual WG meetings. To maximize impact of this SCOR WG and optimize costs for Associated Members, we will combine funding available from SCOR with other sources and will hold group discussions during other ocean science-related meetings.

Month 1-6: Sep 2017 - Feb 2018
Web meetings with Chair and Vice Chairs to define details and plans of year 1 activity. Discussions on web page design and subgroups (SG) structure.

Month 7-12: Mar - Aug 2018
The first SCOR working group meeting will focus on drafting an optimal roadmap to progression of all tasks. This meeting will involve all members in planning activities; selected experts will be tasked and sub-groups will be assembled.
Our first meeting could be linked to the Sixth International Marine Debris Conference (6IMDC) that will be held in San Diego, California, USA from March 12-16, 2018. Locations for future meetings will be set at that time.
A first Writing Team (WT1) will be set up to write the short presentation article of this WG. (Deliverable 1 in Section 5). A second WT (WT2) will prepare the text for a web site and web discussion platform available for accredited worldwide students (Deliverable 2) and launch the site.

Month 13-18: Sep 2018 - Feb 2019
The second working group meeting will be timed to coincide with the 2018 AGU Fall Meeting or other similar major conference. During the meeting, a special discussion session open to students will be organized. Preliminary results from sub-group activities will be presented and reviewed by the entire WG. The website will be update (Deliverable 3).

Months 19-24: Mar - Aug 2019
The WG will continue remote work on all objectives.

Month 25-35: Sep 2019 - Jul 2020
The WG will finalize results and disseminate them to the broader scientific community. Remote discussion will continue on about the key processes controlling marine debris

dynamics and phenomena identified in observations and models. Sub-groups write up the analysis of key processes. The website will be updated and meeting report written and submitted (Deliverable 4).

Month 36: Aug 2020
Final symposium. Co-sponsorship will be sought from other organizations identified in due course. The aim of the symposium will be to highlight progress made in the linking of observational work (satellite and in-situ) with modelling, and also including extending the theory of marine litter distribution and transport.
We will complete final website updates and submit the meeting report publication (Deliverable 5 and 6). We will present results at scientific meetings and submit papers to peer-reviewed scientific journals (Deliverable 7).

5. List of Deliverables

(D1) Introduction of this SCOR WG in a short article in Eos or elsewhere. Contribution from WT1.

(D2) Construction of a website to manage contributions from all sub groups, including a web discussion platform for accredited worldwide students and experts. Contribution from WT2.

(D3) Annual meeting report (including session open to students) and update of the website.

(D4) Peer reviewed paper(s) to disseminate results of WG sub-groups.

(D5) Annual meeting report and update of website.

(D6) Final symposium report and update of website.

(D7) Peer-reviewed papers and presentations at scientific meetings.

6. Capacity building

Skills and knowledge that will be shared in this WG pertain to a number of subjects: field sampling and marine instrumentation, data homogenization, oceanography, remote sensing and modelling. A large community of experts from different regions of the world will gather and share skills to enhance knowledge.

The partnerships include experts on plastics in the ocean as well as experts on specific ocean processes that affect ocean plastics. This results in a two-way capacity building between experts in oceanography and in plastic marine debris, and may encourage those who have not previously applied their ocean physics expertise to debris to continue this work beyond the WG itself. Our vision is also to broaden the dialogue between modellers and observationalists/ experimentalists by bringing together these groups in a focused forum of this working group.

A major tool for knowledge transfer will be through international workshops, a website and journal articles, but we expect to achieve longevity through fostering a new community of skilled ocean scientists from both developed and developing nations.

A global community of young scientist working on marine debris will be developed also via an open discussion session at one of the Ocean Sciences Meetings. We also believe that the open web discussion platform will enhance the development of a competent new generation of scientists working on open ocean marine debris.

A meeting will possibly be held in an emerging country, also including some basic training for local scientists. The POGO SCOR Visiting Fellowship program will be considered to support people from low-income countries to learn techniques related to marine debris in one of the institutions of WG members. We will also endorse the possibility for partners to include the POGO Fellowships for Shipboard Training in their activity at sea.

7. Composition of Working Group

This SCOR WG has 10 Full and 9 Associate members that combine together state-of-the-art skills in marine debris modelling and remote sensing as well as in situ experimental observations. Two associated members are experts in theoretical physical oceanography.
The Full Members are responsible for the delivery of the four objectives (each led by an assigned vice-chair) and the Associate Members provide important input from the complementary fields.
Our Full members represent 9 different nations, including emerging nations, with a total of 13 nations involved including Associated members. Moreover, we include one early career researcher as vice chair, and another as Associate member which will aid their career development.
We propose one chairman and 3 vice chairs from different disciplines, each of them being responsible for a specific WG objective.

7.1 Partnership:

Name	Gender	Place of work	Expertize	Status
Stefano Aliani	M	CNR ISMAR ITA	Chair – In situ observation	FULL
Nikolai Maximenko	M	Univ Hawaii USA	Vice chair Remote sensing	FULL
Bertrand Chapron	M	IFREMER FRA	Remote sensing	FULL
Victor Martinez-Vicente *	M	Plymouth Marine Lab UK	Remote sensing	FULL
Yi Chao	M	Remote Sensing Solutions, Inc. USA	Remote sensing	Associate
Erik van Sebille *	M	Univ. Utrecht NED	Vice chair modelling	FULL
Atsuhiko Isobe	M	Kyushu Univ JPN	modelling	FULL
Irina Chubarenko	F	Univ Moscow RUS	modelling	Associate
Laurent Lebreton *	M	modellinghouse NZL	modelling	Associate
Miguel Morales Maqueda	M	Univ Newcastle UK	modelling	Associate
Christophe Maes	M	LPO-IRD, Brest FRA	modelling	Associate

Kara Lavender Law	F	Sea Education Association USA	Vice chair In situ observation	FULL
Peter Ryan	F	Univ CapeTown RSU	In situ observation	FULL
Won Joon Shim	M	KIOST KOR	In situ observation	FULL
Martin Thiel	M	UCN CHL	In situ observation	FULL
Melanie Bergmann	M	AWI GER	In situ observation	Associate
Denise Hardesty	M	CSIRO AUS	In situ observation	Associate

Tobias Kukulka,	M	Univ Delaware USA	Theoretical physical oceanography	Associate
Baylor Fox-Kemper	M	Brown Univ USA	Theoretical physical oceanography	Associate

* is for young scientists.

Observers/ stakeholders			
Joao Sousa	IUCN	M	Joao.SOUSA@iucn.org
Georg Hanke	EU-JRC	M	georg.hanke@jrc.ec.europa.eu
Nancy Wallace	NOAA	F	nancy.wallace@noaa.gov
Paolo Corradi	ESA	M	Paolo.Corradi@esa.int

8. Working group contributions

Stefano Aliani is in charge of the coordination as chair of this WG and of Objective 4. He has experience on observational data on marine litter distribution and in situ measurements of oceanographic processes. He is section head at Institute Marine Science of CNR in Lerici, Italy. He led/participated to many cruises worldwide and has considerable experience in data collection. He is involved in developing new quality control methods and protocols for in situ marine litter assessment.

Kara Lavender Law is in charge of the objective on in situ observations of marine debris as vice chair (O1). She is Research Professor of Oceanography at Sea Education Association (SEA), where she has published analyses of SEA's two long-term data sets on floating open ocean microplastics. She carries out research on SEA's 30-year archive of microplastics to understand what the physical and chemical characteristics of the debris might reveal about the transformation and fate of ocean plastics. She is also the co-PI of the National Center for Ecological Analysis and Synthesis (NCEAS) Marine Debris working group, which has published on the input of plastics to the ocean from land-based waste; on the global abundance of floating plastics; and a critical review of the biological and ecological impacts of debris.

Erik Van Sebille is in charge of the objective (O2) on modelling of plastic litter pathways as vice chair. He is an Early Career Scientist who has won the 2016 Outstanding Young Scientist Award from the European Geosciences Union's Ocean Division, and has recently been awarded a European Research Council Starting Grant on a five-year project 'Tracking Of Plastic In Our Seas'. He has worked extensively with marine ecologists to map the risk of plastic to marine life, and has been part of the GESAMP Working Group on microplastics. He has testified for UK Parliament on the impact of microbeads on the marine environment, and the effects of a potential ban of these materials.

Nikolai Maximenko is in charge of objective on remote sensing of marine debris as vice chair (O3). He is an established Oceanographer with expertise in ocean circulation and air-sea interaction physical dynamics and develops applications, such as drift models of marine debris. In his research, he combines in situ observations with satellite products to study multi-scale ocean debris. Maximenko is a member of NASA Ocean Surface Topography, Ocean Salinity and Salinity Processes in the Upper Ocean Regional Study Science Teams.

Bertrand Chapron will provide his multi-year experience on the combined use of space-borne ocean remote sensing measurements. He is senior scientist at Ifremer, co-responsible for the ESA Sentinel 1 (a and b) algorithms and scientific validation of ocean (wind, wave and current) products, co- and/or principal investigator in several other ESA (SMOS salinity mission, OceanGasFlux, GlobCurrent), member of NASA and CNES

science and definition teams (SWOT and CFOSAT, Altika missions), and working on potential future space-borne instrument to provide ocean surface currents (Doppler off-nadir altimeter SKIM, multi-azimuth optical glitter GLISTERO).

Atsuhiko Isobe will provide a numerical model of microplastics using observed data for validation. He has been the principal investigator of three plastic-debris research projects sponsored by the Environmental Research and Technology Development Fund of Ministry of the Environment, Japan, and conducted field surveys of macroplastics and microplastics, around East Asian seas, North/South Pacific, and the Southern Ocean. Also, he and his group have conducted numerical modeling for pelagic marine debris including microplastics in these research projects.

Peter Ryan has studied marine plastics since the 1980s. He will provide his multi-year experience on field and laboratory assessments of the abundance, distribution and composition of macrolitter at sea, as well as experiments on the rates of sinking through biofouling.

Victor Martinez-Vicente will contribute the working group with a review on current techniques for plastic litter detection from satellites. He is principal scientist in the RESMALI proposal submitted by Plymouth Marine Laboratory to the European Space Agency. He is an Early Career scientist that focuses on validation of satellite observations and on developing new products from remote sensing. To do so, he has developed in-situ and laboratory techniques for characterising the optical properties of particles in the ocean, leading to novel phytoplankton Carbon algorithms.

Won Joon Shim will provide his expertise on distribution of microplastics in water and sediment and their fate including weathering and fragmentation in the environments. He is a principal research scientist at Korea Institute of Ocean Science and Technology and currently co-leads a national research project for environmental risk assessment of microplastics in coastal zone including microplastic monitoring in multi-media.

Martin Thiel will provide his 15 years' experience on field and laboratory studies on marine litter, especially about its distribution and composition at sea. He will also contribute to capacity building through citizen science program Cientificos de la Basura ("litter scientists", www.cientificosdelabasura.cl) in which schools from the entire Chilean coast are participating in scientific research on marine litter. He is Professor of Marine Biology at Facultad de Ciencias del Mar, Universidad Católica del Norte (UCN)

9. Relationship to other programmes and SCOR working groups

9.1 Other SCOR Working Groups

This SCOR WG will interface well with current SCOR Working Group 149 (Changing Ocean Biological Systems - COBS) when they address the presence of multiple drivers altering marine living resources and ecosystem services. We will also interface on producing a glossary of terms and guide for policy-makers to better understand the role of plastics as one of the multiple drivers of change in biological systems.

We will also interface with SCOR Working Group 150 (Translation of Optical Measurements into particle Content, Aggregation & Transfer- TOMCAT) for the part about remote sensing of debris and polymer characterisation usually performed by FTIR or Raman spectroscopy.

9.2 Other Programmes

GESAMP WG40
GESAMP is the Group of Experts of the Scientific Aspects of Marine Environmental Protections and is sustained by UN, UNEP, FAO, UNESCO, IOC, UNIDO, WMO IMO IAEA and UNDP. Working Group 40 is about “sources, fate and effects of micro-plastics in the marine environment – a global assessment”. This SCOR WG is the obvious consequence of GESAMP recommendations when they address the importance to assess distribution and transport of microdebris. Some members of this WG are also members of GESAMP, and plan to bring those general recommendations into a more detailed and active stage.

SCAR
The Scientific Committee on Antarctic Research (SCAR) is a committee of International Council for Science dedicated to Antarctic science. Recently marine debris has been found in Antarctica. The source is necessarily from industrialized countries and this SCOR WG will interact with SCAR providing information about ocean transport and accumulation of debris, the ultimate challenge for Antarctic marine research. The possibility to create a SCAR WG dedicated to marine debris will be assessed as a product of this SCOR- WG.

MARPOL - IMO
MARPOL 73/78 is one of the most important international marine environmental conventions. It was developed by the International Maritime Organization in an effort to minimize pollution of the oceans and seas, including dumping, oil and air pollution. The

objective of this convention is to preserve the marine environment in an attempt to completely eliminate pollution by oil and other harmful substances and to minimize accidental spillage of such substances. This WG will interact with IMO exchanging information on ship-based plastic pollution.

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Appendix 1 (5 papers per full member)

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Appendix 2 (endorsements)

UNITED STATES DEPARTMENT OF COMMERCE
National Oceanic and Atmospheric Administration
NATIONAL OCEAN SERVICE
Office of Response and Restoration
Silver Spring, Maryland 20910

Dear Dr. Aliani,

I am writing in support of your proposal for a SCOR working group entitled, "Floating Litter and its Oceanic TranSport Analysis and Modelling" (FLOTSAM). Our mission at the Marine Debris Division of the National Atmospheric and Oceanic Administration (NOAA) is "to investigate and prevent the adverse impacts of marine debris" through research, education, and outreach, and we value collaboration and coordination with a multitude of stakeholders to achieve this mission.

The work proposed in the FLOTSAM working group addresses some of the fundamental questions about the distribution, transport, and fate of floating plastic marine litter, and is novel in bringing together scientists with expertise in physical oceanography theory, numerical modeling, and remote sensing, with others who have extensive experience collecting and analyzing environmental data on the abundance and behavior of plastics in the marine environment. This working group will engage researchers new to the study of marine litter, and as such has the potential to significantly advance our scientific understanding of this contaminant and, ultimately, to better inform intervention and prevention strategies.

We are pleased to support the FLOTSAM working group by serving as external advisors, and by helping to disseminate the scientific outcomes to the broader marine debris community.

Sincerely,

Nancy Wallace
Director, Marine Debris Program
Office of Response & Restoration
National Ocean Service

University of East Anglia

Faculty of Science
School of Environmental Sciences

University of East Anglia
Norwich NR4 7TJ
United Kingdom

Email:@uea.ac.uk
Tel: +44 (0) 1603 593117

Web:www.uea.ac.uk

20 April 2017

To Whom It May Concern

On behalf of the European Office of Future Earth I would like to express our interest in the proposed by SCOR WG FLOTSAM (Floating Litter and its Oceanic TranSport Analysis and Modelling). The problem of marine debris is one of the major concerns for global sustainability, and we would want to encourage research in this area. The WG will lead to improved knowledge on the distribution and fate of plastic in the open ocean, particularly by the focus on temporal trends in composition of microplastics, associated with changes in macro-plastic production, and the use of modelling to project the effects of future changes in societal plastic use. This new knowledge will bring a direct benefit for the long term management of the oceans and their sustainability in line with the UN Sustainable development Goals.

I look forward to the output of the Working Group and I am sure that Future Earth can offer a variety of mechanisms to disseminate the outcome of the work of the group to a wide audience.

Yours sincerely

Professor Tim Jickells
Director Future Earth Europe
Director Centre for Ocean and Atmospheric Sciences
Email: T.Jickells@uea.ac.uk