

Working Group report

WG number : 1

Targeted Societal Outcome : A Clean Ocean

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Ocean Decade Definition of the Outcome: Society generates a vast range of pollutants and contaminants including marine debris, plastic, excess nutrients, anthropogenic underwater noise, hazardous chemicals, organic toxins, and heavy metals. These pollutants and contaminants derive from a wide variety of land and sea-based sources, including point and non-point sources. The resulting pollution is unsustainable for the ocean and jeopardises ecosystems, human health, and livelihoods. It is critical to fill urgent knowledge gaps and generate priority interdisciplinary and co-produced knowledge on the causes and sources of pollution and its effects on ecosystems and human health. This knowledge will underpin solutions co-designed by multiple stakeholders to eliminate pollution at the source, mitigate harmful activities, remove pollutants from the ocean, and support the transition of society into a circular economy. Increases in anthropogenic activities such as land and seaborne research, tourism and fishing) are all resulting in increased risk to the SO marine environment. In order to mitigate these risks we need to have a clear understanding of the current levels of anthropogenic pollutants.

Identify regional challenges that need to be overcome to achieve Southern Ocean priorities ([cfr report](#)) over the next 10 years in the context of your appointed Societal Outcome.

Research challenges (purely scientific) :

- ***Challenge R1: Understand the extent of pollution: Identify the sources, sinks, and dynamics of pollutants.***
 - R1.1 Determine baseline knowledge of distribution and concentrations of current marine pollutants in polar species and the abiotic environment.
 - R1.2 Increase data coverage to better understand the spatial (vertical and horizontal) and temporal distribution of pollutants of interest or concern in order to identify sources, processes, and accumulation “hotspots”.
 - R1.3 Identify local sources (e.g., around research stations) and external sources (e.g. ocean currents and atmospheric transport).
 - R1.4 Investigate processes involved in the remobilization of contaminants in the marine environment (e.g., sea ice, ice shelves, or marine sediments).
 - R1.5 Understand the effect of the specific Antarctic environmental conditions (e.g., physical isolation caused by Antarctic Circumpolar Current, low temperatures, seasonal light regime, sea ice, seasonal ozone depletion and UV radiation) on the distribution, degradation and sinking rates of contaminants.
 - R1.6 Develop interactive 3d model of pollutants distribution and movements to predict future scenarios.

- ***Challenge R2: Assess the effects of pollution on the natural world: understand how pollutants affect Southern Ocean biota and ecosystems***
 - R2.1 Identify the main pollutant pathways (e.g., POPs, heavy metals, microplastics) subject to trophic transfer and evaluate potential bioaccumulation and biomagnification in upper trophic levels.
 - R2.2 Understand which of these pollutants present the greatest threat and identify toxicity thresholds for key species.
 - R2.3 Investigate the multi stressors impact of different types of pollutants: how/if interaction of pollutants generate additive, antagonist or synergistic stressors, which are the most sensitive species, and what does it mean for population dynamics?
 - R2.4 Address how pollutants can combine with other climatic stressors (e.g. climate change, other - ocean acidification, etc.) to produce lower biological thresholds in vulnerable species and ecosystems.
 - R2.5 Understand how increased anthropogenic noise from vessel operations, aircraft, construction, and other anthropogenic sources may affect marine life.
 - R2.6 Use ecotoxicogenomic approaches to identify biological and genetic adaptation strategies that may provide resilience to environmental contaminants.
 - R2.7 Determine levels of antimicrobial resistance in areas of high impact and understand the potential implications for Antarctic species. Understand the extent and mechanisms by which diseases spread between Antarctic species (e.g. cholera in penguins, SARS transmission) (*link to WG2*)
 - R2.8 Investigate the main health risks for humans and animal populations of pollution in Antarctic environments (e.g. accumulation in commercially fished species, black water and waste from stations) (*link to WG3*)
 - R2.9 Investigate what is the role of / if contaminants have a role in the decreasing trends for populations/ species (e.g. what is the role of contaminants in the total impacts on marine species?)
- ***Challenge R3: Prevent and recover from environmental damages***
 - R3.1 Develop a comprehensive inventory of existing sites and sources of contamination-work with COMNAP cross cutting theme.
 - R3.2 Investigate how to facilitate remediation of contaminated sites at a large scale and low cost (e.g., improved understanding of microbial/fungal bioremediation of pollutants under conditions of low temperature and limited oxygen and water availability).
 - R3.3 Work with national programs to inform further development of response plans for emergencies, including drift models that take into account ice-oil interactions.
 - R3.4 Assess how physical and social changes at the global scale (e.g., strengthening westerlies, increased urban development in the southern hemisphere) will change the distribution and concentrations of pollutants within the SO.

Logistical and technical challenges (funding, infrastructure, data accessibility, etc.)

- ***Challenge L1: Transition to a greener industry***
 - L1.1 Work with Southern Ocean stakeholders including those involved in tourism, fishing and research to identify and understand what is required to reduce greenhouse gas emissions.
 - L1.2 Work with COMNAP to identify how research stations can further improve the handling of solid and liquid waste, including black and grey water waste streams, food scraps, and combustible items.

- L1.3 Evaluate the diverse range of current practices for supply of materials / food and other items into Southern Ocean (e.g. reduce packaging, circular economy).
- **Challenge L2: Identify methods needed to improve detection of contaminants**
 - L2.1 Improve the use of ships of opportunity to increase monitoring.
 - L2.2 Identify and develop novel technologies to address pollutants for which existing methods of contaminants are not or cannot be applied in Antarctica.
 - L2.3 Support new technological development to improve pollution detection and environmental disaster response, e.g., remote data sensors.
 - L2.4 Work with Southern Ocean stakeholders to identify improvements in methodologies and procedures to prevent and recover from environmental damage caused by accidents and failures in Antarctic operations
- **Challenge L3: Increase international coordination**
 - L3.1 Improve access to samples, data and methods across the Antarctic
 - L3.2 Encourage guidelines (best practises) for monitoring the level of pollutants.
 - L3.3. Generate a specific platform to identify key data gaps by compiling existing observations for different spatial and temporal scales
 - L3.4 Identify most efficient supply and transport chains for reducing Carbon footprint of working in the Antarctic and southern ocean, share best practice collected by and between polar programs
 - L3.5 Deliver research to inform decision-making on pollution issues by international policy-makers

Uptake challenges (effective communication between stakeholders, engaging the public)

- **Challenge U1: Developing strategy to deal with pollution events – both local and larger scale**
 - U1.1 Identify key stakeholders we need to involve in the project
 - U1.2 Reinforce a dialogue between national operators to promote a coordinate effort to reduce the sources of pollutants
 - U1.3 Agree with partners which data gaps are most urgent and most feasible to address
 - U1.4 Coordinate research across national programs, international funding, transdisciplinary focus.
- **Challenge U2: Engagement**
 - U2.1 Engage researchers and policy-makers in an ongoing dialogue - on science and policy needs
 - U2.2 Involvement of public in citizen science projects. E.g. Tourists to SO in collaboration with IAATO operators; and also wider global public in big data analysis projects (e.g. Polar Citizen Science Collective <http://polarcollective.org> ; Zooniverse <https://www.zooniverse.org/projects/penguintom79/penguin-watch> and <https://cse.umn.edu/college/news/count-seals-antarctica-comfort-your-couch>)

- U2.3 Ensure diversity and inclusivity. Facilitate involvement of ECRs, and underrepresented groups to ensure we balance the current Northern Hemisphere/ first world bias.

Identify tangible actions that would be able to address these challenges. Delineate the scope of suggested actions (leading organisation, involved stakeholders, funding, timeline, implementation).

Action 1

Name of Action	Determine baseline knowledge of distribution and concentrations of current marine pollutants
Related challenge	R1.1
Short description	Evaluate spatial distribution and temporal trends for contaminants in Antarctica and identify where gaps are (geographical and which contaminants). Look at the Arctic (www.amap.no) and wider maritime regions for best practice on assessment of contaminants.
Key stakeholders to consider	SOOS (https://www.soos.aq), ANTOS, (https://www.scar.org/science/antos/home/) IMPACT https://www.scar.org/science/impact/home/ , SOPOPP (https://www.griffith.edu.au/griffith-sciences/southern-ocean-persistent-organic-pollutants-program), CCAMLR
Timeline	Short to medium term. Start of decade
Potential resources	SOOS, national monitoring programs, research projects
Other comments	Nominate a group of researchers who perform the study.

Action 2

Name of Action	Kick off Workshop to understand the extent of pollution, address research/ technological/data gaps, assess existing capacity knowledge and discuss the Clean Ocean decade's strategy.
Related challenge	All
Short description	Preliminary workshop to identify gaps in knowledge, identify current observing and measuring facilities/equipment and /or representation of key stakeholders we need to engage with
Key stakeholders to consider	Representatives of CCAMLR; CEP; COMNAP; IAATO, ANTOS; Ant-ICON; SCAR science themes, ASOC (Antarctic Southern Ocean Coalition), national representatives
Timeline	Short term. Start of decade
Potential resources	SCAR AG - Plastic AG, IMPACT AG/
Other comments	Potential involvement of NGO (e.g. WWF; Pew Foundation; Nat Geo)

Action 3

Name of Action	Produce a best practices document for collecting and monitoring pollutants
Related challenge	L3.1, L3.2, U1.4, U1.3
Short description	The document has to include best practices to collect and monitor key pollutants at sea, nearshore and bases. The best practise will facilitate coordination across international researchers to enable sharing of methods.

Key stakeholders to consider	SCAR; IAATO; COMNAP;
Timeline	Long Term
Potential resources	https://www.comnap.aq/documents/comnap-scar_env_monitoring_handbook_jun2000.pdf https://www.gov.gs/docsarchive/Environment/Whaling%20Stations/Grytviken%20Whaling%20Station%20CMP_FINAL_lowres.pdf
Other comments	Nominate a working group of researchers who perform the action.

Action 4

Name of Action	Generate an international online portal to compile existing observations for different spatial and temporal scales
Related challenge	R1.1, R1.2, R1.3, R2.1- R2.8, L1.3, L1.4, L3.6, U1.3, U1.4
Short description	The online portal will identify key data gaps and promote the implementation of data coverage by coordinating effort to and share collect key data and identify current situation and what is missing
Key stakeholders to consider	Antarctic data managers, SCAR Antarctic Biodiversity Portal (Biodiversity.aq) SCAR, EPB, IAATO.
Timeline	Long Term
Potential resources	Antarctic Environments Portal (https://environments.aq) SCAR Antarctic Biodiversity Portal (Biodiversity.aq) SCAR Environmental data portal https://www.scar.org/resources/ref-data-environmental-research/ https://litterbase.awi.de

Other comments	Other examples of good spatial data presentation EU Litterwatch https://www.eea.europa.eu/themes/water/europes-seas-and-coasts/assessments/marine-litterwatch UN Environment Programme World Conservation Monitoring Centre https://data.unep-wcmc.org (lots of different data layers) IUCN https://www.iucn.org/resources/issues-briefs/marine-plastics
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Action 5

Name of Action	Generate an interactive pollutants Risk Map
Related challenge	R1.1, R1.2, R1.3, R2.1- R2.8, L1.3, L3.6, L1.4, U1.4, U1.4
Short description	The Risk Map will be a tool for policy maker and environmental agencies to promote target action. The Risk Map will accounts for type of pollutants, pollutants concentration, potential impact for biota, and potential multi-stressor effects as well as possible control processes to offset the risks of pollution. The map will be assessed and implemented in the time.
Key stakeholders to consider	SOOS; IMO (https://www.imo.org); IAATO; ATMS-CEP; Antarctic Data Managers; Oceanic modellers; ANTOS
Timeline	Long Term
Potential resources	SOOS plastic database
Other comments	

Action 6

Name of Action	Generate a dedicated science-engineer forum (also relates to suggested actions 3& 9)
Related challenge	R1.2; R1.5
Short description	Investigate/ develop novel techniques for pollution monitoring. For example to expand the use of remote sensors and platforms
Key stakeholders to consider	SCOR, SOOS
Timeline	2022
Potential resources	https://earthdata.nasa.gov/learn/sensing-our-planet/fathoming-antarctica
Other comments	For debate- Should we be including ESA /NASA (or equivalent) - to try to get better satellite coverage - Who would know about this ? Any other ideas? Is there a case for multiple national funding agencies (from ATS member states.g. NSF, NERC..etc) to develop a transnational remote sensing programme? - No idea if it is feasible

Action 7

Name of Action	Investigate the possibility of and plan common, international research projects
Related challenge	R1.1, R1.2, R1.3, R2.1-R2.z
Short description	Investigate possible common calls for research projects. Based on the identified research challenges, national research projects, national monitoring, national field expeditions.

Key stakeholders to consider	SOOS, SCAR science themes
Timeline	Long term
Potential resources	
Other comments	Possible call to be organised under the auspices of Belmont Forum.

Rank suggested actions in order of priority while taking into account feasibility and timeline. The highest ranking actions will be included in the Southern Ocean Action Plan and will most likely require additional notes.

Order of priority	Action number & name
1	Kick off Workshop to understand the extent of pollution, address research/ technological/data gaps, assess existing capacity knowledge and discuss the Clean Ocean decade's strategy.
2	Determine baseline knowledge of distribution and concentrations of current marine pollutants
3	Generate a dedicated science-engineer forum
4	Generate an international online portal to compile existing observations for different spatial and temporal scales
5	Generate an interactive pollutants Risk Map
6	Produce a best practices document for collecting and monitoring pollutants
*	Investigate the possibility of and plan common, international research projects *High priority but potentially to be considered as cross cutting themes action

Describe already-existing activities and stakeholders who are presently working towards resolving these challenges.

Stakeholders: ATS-CEP (Antarctic Treaty System's Committee for Environmental Protection); SCAR (including Plastics-AG, IMPACT, ANTOS) European Polar Board (reducing environmental footprint of plastics Antarctic logistics), SCOR (FLOTSAM WG), SOOS, ASOC (Antarctic Southern Ocean Coalition), IAATO, COMNAP, IMO

Existing activities: SOOS plastics database - Has been presented to ATS-CEP; CCAMLR- beach monitoring, COMNAP/SCAR environmental management handbook IAATO, Environmental guidelines, ANTOS- Nearshore monitoring, SCAR Antarctic Biodiversity Portal ([Biodiversity.aq](https://biodiversity.aq)), SCAR Environmental Data Portal <https://environments.aq>

If you have any further comments/suggestions, please describe them below :

Other potential action:

- Multidisciplinary modelling workshop- New models or incorporating new parameters into existing models to investigate pollutants distribution and movements and to predict future scenarios

Cross cutting themes action:

- Develop international funding call focus on coordinated, multinational research program to promote common transnational research projects to facilitate access in the SO
- Network international platforms to implement data coverage by coordinating effort to collect data and deployment of autonomous platforms.

***** Don't forget to have a look and comment on the reports of other Working Groups. *****