Finanziato dall'Unione europea
NextGenerationEU
Ministero dell'Università e della Ricerca
Italiadomani
PIANO NAZIONALE DI RIPRESA E RESILIENZA

multi-Risk sciEnce for resilienT commUnities undeR a changiNgclimate

Codice progetto MUR: PE00000005 – F83C22001660002

Deliverable title: Design of dataset

Deliverable ID: 4.2.2
Due date: 30/11/2024 Submission date: 24/12/2024

AUTHORS

Laura Gaggero[1], Laura Cutroneo[1], Marco Capello[1], Emanuele Magi[1], Marina Di Carro[1], Sonia Manzo[2]

[1] University of Genoa
[2] ENEA C.R. Portici

Technical references

Project Acronym	RETURN
Project Title	multi-Risk sciEnce for resilienT commUnities undeR a changiNg climate
Project Coordinator	Domenico Calcaterra UNIVERSITA DEGLI STUDI DI NAPOLI FEDERICO II domcalca@unina.it
Project Duration	December 2022 – November 2025 (36 months)
Deliverable No.	DV4.2.1 - Report on sources and scale of source of environmental degradation
Dissemination level	PU
Work Package	WP4.2 - Setting the scene on environmental degradation stressors in terrestrial and marine environment
Task	T4.2.1 - Identification and mapping of source and scale of processes and sites critically relevant from exposure to chemical/physical/biological stressors, also considering climate change and extreme events, and their compound-occurrence and effects
Lead beneficiary	UNIGE, Laura Gaggero, Marco Capello, Emanuele Magi, Laura Cutroneo
Contributing beneficiary/ies	UNIGE, UNINA, ENEA

PU = Public
PP = Restricted to other programme participants (including the Commission Services)
RE = Restricted to a group specified by the consortium (including the Commission Services) CO = Confidential, only for members of the consortium (including the Commission Services)

Document history

		Lead contributor	
0.1	20.11.2024	Laura Gaggero, Laura Cutroneo	First draft
0.2			Critical review and proofreading
0.3			Edits for approval
1.0			Final version

Abstract

1. Introduction

The WP2 of the VS4 project focuses on identifying and mapping sources of environmental stressors. The University of Genoa (UniGe), in collaboration with the ENEA research group engaged in WP4.4, chose the Port of Genoa as a study site because it is an intersection of natural and man-made environmental impacts. The area acts as a sink for both natural and anthropogenic clastic and chemical inputs.

2. Physiographic and Geological Constraints

The Port of Genoa is located in a cyclogenesis-active area where climate change has exacerbated environmental impacts. Recent floods and sea storms have significantly affected the port, leading to new infrastructure projects to mitigate these impacts.

3. Ongoing Infrastructure Projects

Three major projects are underway:

1. New Breakwater Construction: This involves dredging sediment and reusing materials from the existing breakwater.
2. Gronda Highway Bypass: This project includes the disposal of drilling mud and sediment, potentially introducing asbestos fibers into the marine environment.
3. Under-Port Tunnel: This involves filling some of the port quay with excavated material for new cargo and container docks.

4. Environmental Monitoring and Stressors

A new monitoring protocol is being developed for various contaminants and ecotoxicological effects. The Port Authority is actively engaged in environmental monitoring of these projects.

5*. Infrastructures and Methods*

- Pre-existing Infrastructures: The monitoring utilizes a vessel to reach fixed stations within the port for sampling.
- Laboratory Facilities: The University of Genoa hosts laboratories equipped for asbestos analysis and other environmental monitoring.
- Micro-Raman Spectroscopy: Used for identifying organic and inorganic phases.
- Passive Sampling (PS): Conducted with Diffusive Gradients in Thin films (DGT) for mercury and metals, Semi-Permeable Membrane Device (SPMD) and Polar Organic Chemical Integrative Sampler (POCIS) for organic contaminants.

6. Analytical Methods

Sediments

Sample Preparation: Sediments were separated into coarse and fine fractions using wet sieving and analyzed further with a Coulter Counter® Multisizer 3. The coarse fraction was classified into size categories from very fine sand to gravel.

Metal Analysis: Sediment samples for metal analysis were oven-dried, sieved, and finely ground. Trace metal content was determined using microwave-assisted acid digestion and analyzed with ICP-MS. Mercury (Hg) analysis was performed using an automated Hg analyzer.

Asbestos Analysis: Sediments were sampled and prepared for asbestos analysis to distinguish between natural and anthropic contributions. Preparation followed specific guidelines and involved detailed mineral characterization using techniques like optical microscopy, SEM-EDS, and XR Powder Diffraction.

Elemental Analysis: Major and trace elements were analyzed using procedures involving lithium metaborate–tetraborate fused glass discs and ICP-MS.

Seawater

Organic Chemical Analysis: Organic chemicals in seawater and sediments were analyzed using high sensitivity chromatography coupled with mass spectrometry (GC-MS, LC-MS/MS, UPLC-MS/MS).

SPMD Extraction: Membranes were extracted and analyzed for PAHs, PCBs, and OCPs. POCIS samplers were used for semi-polar compounds, followed by extraction and analysis.

Innovative Samplers: A new protective material was tested alongside standard POCIS for resilience and efficiency in sampling organic contaminants.

Ecotoxicological Assays: Performed on seawater samples and sediment elutriate using bioassays with algae and crustaceans.

7. Design of the Dataset

The dataset includes physical parameters of seawater, chemical compositions, and mineralogical associations along a 10 km coastal strip and within the port environment.

Table of contents

List of figures

List of tables

1. State of the Art

1.1 Introduction

Within VS4, the WP2 aims at the Identification and mapping of source and scale of processes and sites critically relevant from exposure to chemical/physical/biological stressors, also considering climate change and extreme events, and their compound-occurrence and effects.

The RU at UniGe addressed the site of the Port of Genoa (Fig. 1), under the following rationales: i) it represents a frontier between natural and anthropic sources of environmental impact ii) the area acts as a sink for natural and man-made clastic input (Fig. 2), as well as iii) a sink for chemical man-made input derived from the tens of discharge points flowing in the rivers and streams networks (Fig. 3).

Figure 1: Geographic setting of the Port of Genoa area, and of present-day infrastructures.

Figure 2: Sketch map of the present use destination of port areas.

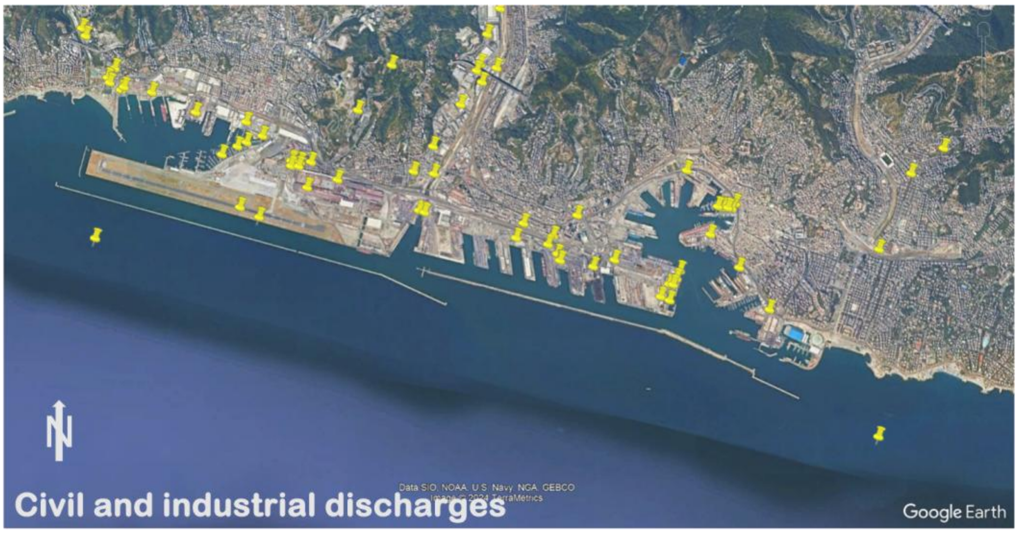


Figure 3: location of civil and industrial discharge / vents in the river network and in seawater.

1.2 Physiographic and geological constraints of the area

A variegated stack of Alpine and Apennine Units overlies the coast belt, accounting for the ophiolite – derived compositional contribution to sediments, and tracing the benchmark for sediment and water composition (Fig. 4).

Figure 4: Excerpt of the geological map of the inland of the coastline (source ISPRA, CARG project).

The Port of Genoa is geographically located on the northern side of one of the most active areas of cyclogenesis in Europe (Ligurian Sea), in which climate changes have highlighted new trends and new phenomena that can negatively impact the port basin and the surrounding environment (Fig. 5). Examples of this are the floods that occurred in recent years [Capello et al., 2015; Faccini et al., 2025] and the destructive sea storms of 2018 [Cutroneo et al., 2021] and 2023 which also damaged the current breakwater of the port.

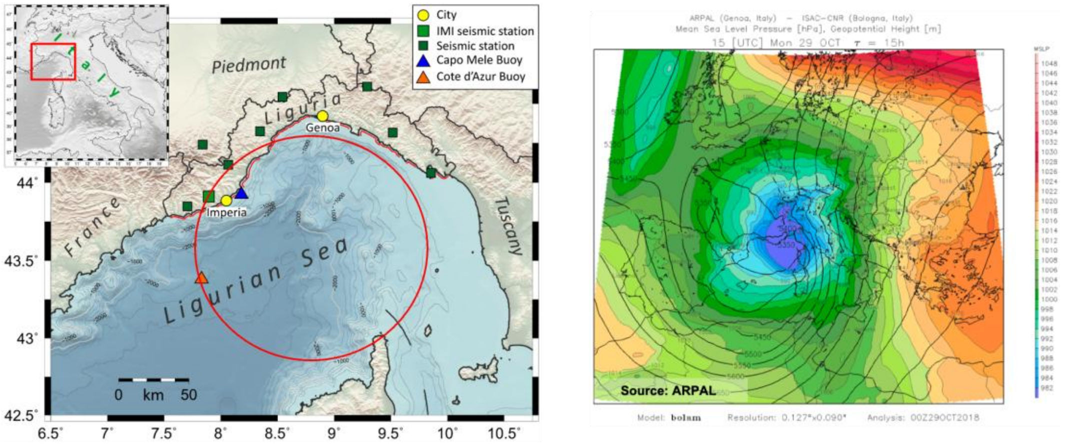


Figure 5. The Gulf of Genoa is located at the northern tip of the Ligurian Sea, a most important cyclogenetic area of the Mediterranean Sea, (as, e.g. the Gulf of Lion). This causes the frequent formation of low pressures in the basin and particular meteorological conditions. The topography of Liguria is characterized by the Apennine and Alpine ranges close to the coast, cut by narrow valleys mostly perpendicular to the coast. This generates specific meteorological scenarios, at the scale of a few km related with extreme events as floods and seastorms.

The Port Area, starting from May 2023, is involved in several major activities of construction of maritime and land infrastructures and materials reuse or storage. 1) The first project is the construction of new breakwater of the port which will rest on seabed up to 50 m deep and will allow the entrance of latest generation ships inside the port (the breakwater construction is controlled by the Environmental Monitoring Plan drawn up by the DISTAV of the University of Genoa and based on the Descriptors of the Marine Strategy Framework Directive); the project involves dredging sediment from the port and destroying part of the existing breakwater with the reuse of the dredged sediment and material from the old breakwater to fill caissons of the new breakwater. 2) The second project is the construction of the highway bypass “Gronda” that will avoid transit across the city of Genoa; in this case, the project includes the dumping of drilling mud and sediment from green rocks directly into a purpose-built fill within the Port of Genoa via a slurry pipeline, which could therefore discharge a significant amount of chrysotile (more generally, asbestos fibers) into the marine port environment. 3) The third project is the construction of the under-port tunnel which will connect the east to the west of the city, bypassing the center; the project involves filling some of the port quay with excavated material to create new docks for cargo and container handling.

At the Port site, environmental (chemical, physical, biological) stressors are clearly identified, and comparable with those from low impact coastal areas to the east and to the west. The project activities include the creation of a new monitoring protocol for several traditional and emerging contaminants (metals, asbestos fibers, organic microcontaminants, drugs, pesticides and other) and ecotoxicological effect. Here we report on the joint methodologies created by the collaboration of different partners involved in the project and the preliminary results obtained in the pilot site of the Port of Genoa (NW Italy).

The characterization of stressors proceeds through a bimonthly leg of sampling and analyses aiming at a short-term picture (the Return time frame) and to a ten-years representation by the integration of existing dataset retrieved under national and Eu (Interreg, mostly, and LIFE+) programs.

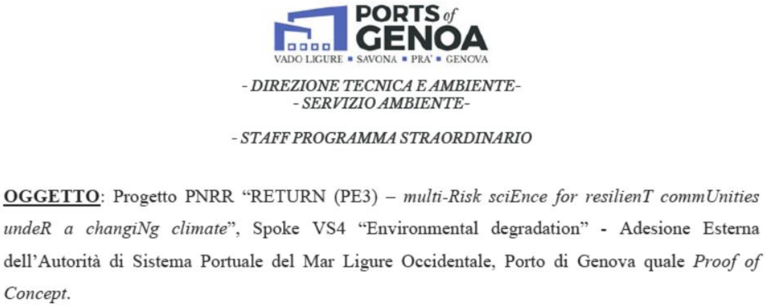
1.3 Bridges to other NRRP initiatives

The characterization of geologic and fluid matrices supports interaction with the following NRRP initiatives:

- within Return the VS 1, WP 1.4 WP 1.4 – Coastal flooding under environmental and climatic changes.
- Within Return the VS 4, WP 4.4
- Within NBFC, spoke 2, Sea

1.4 Administrative framework

The Port areas are accessed under the MoU between the Port Authority and the University of Genova, already active for technical purposes and implemented for the Return research programme (Fig. 6, Deliverable D.4.2.1).



PORTS of GENOA
VADO LIGURE ▪ SAVONA ▪ PRA' ▪ GENOVA

- DIREZIONE TECNICA E AMBIENTE-
- SERVIZIO AMBIENTE-

- STAFF PROGRAMMA STRAORDINARIO

OGGETTO: Progetto PNRR "RETURN (PE3) – *multi-Risk sciEnce for resilienT commUnities undeR a changiNg climate*", Spoke VS4 "Environmental degradation" - Adesione Esterna dell'Autorità di Sistema Portuale del Mar Ligure Occidentale, Porto di Genova quale *Proof of Concept.*

Figure 6. Heading of the MoU between Port Authority and the University of Genova, allowing access to sensitive areas and data publication.

The Port Authority is deploying an intense activity directed to the environmental control of ongoing projects, whose balance of dredging and dumping is summarized in Figures 7a, b, and 8.

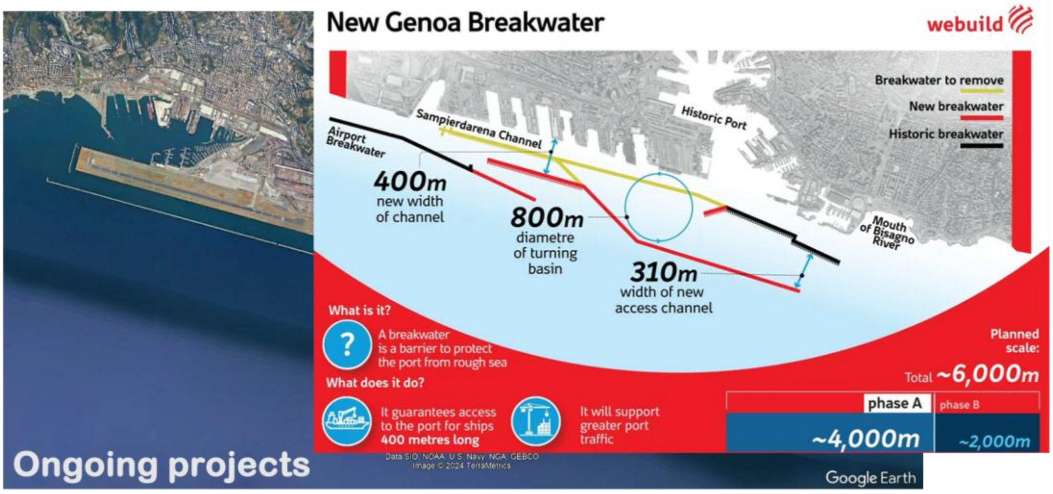


Figure 7a. Sketch of the new Genoa Breakwater.

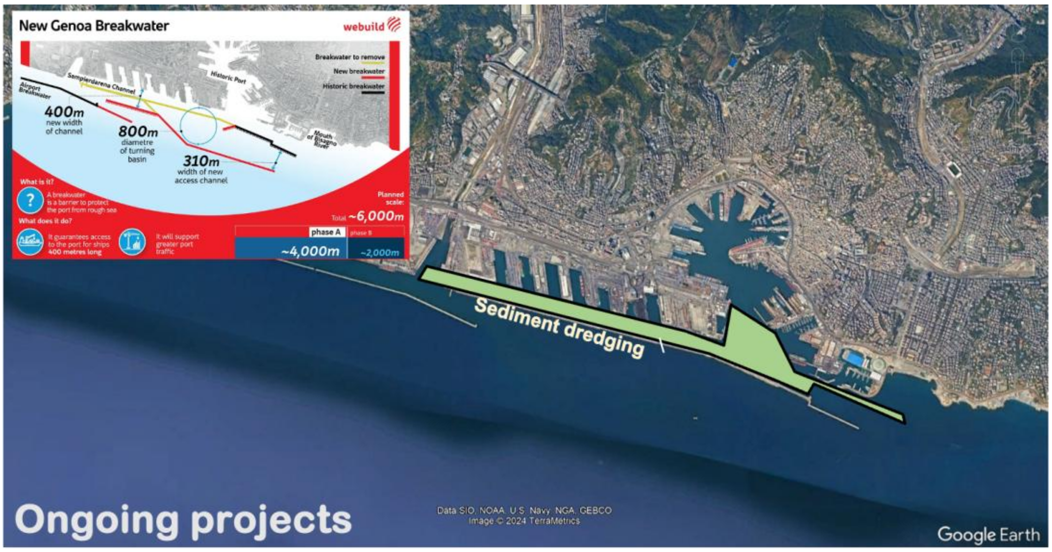


Figure 7b. Sketch of the new Genoa Breakwater: the green area represents the basin to be dredged.

Figure 8. Sediments dredged from basin 7b, and the debris issued from the slurry duct will be dumped in the yellow area to enlarge the airport.

2. Infrastructures and methods

2.1 Pre-existing infrastructures

The sampling takes advantage of a vessel to navigate inside the port area to reach the fixed stations and deploy the monitoring tools available for reaching the sites. Twenty-one fixed monitoring stations are regularly accessed to retrieve passive data and samples (Fig. 9).

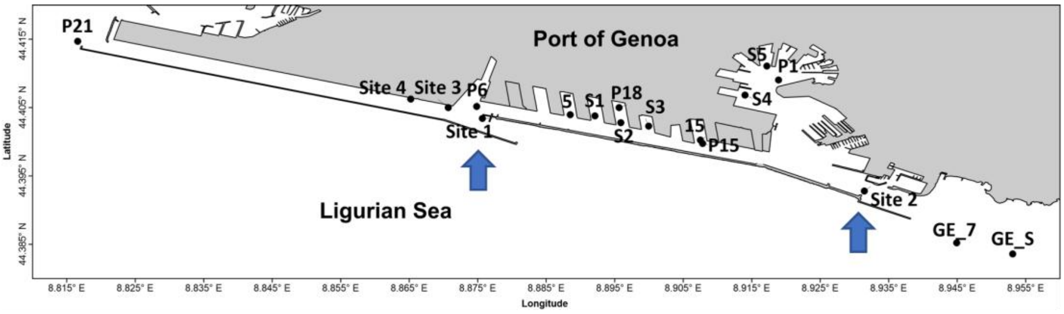


Figure 9. Sampling sites along the inner and at the outer limit of the port.

The Department of Earth, Environmental and Life Sciences (DISTAV) of the University of Genoa, Italy hosts a laboratory equipped with analytic facilities for the qualitative and quantitative determination of Asbestos and characterization of geomaterials. The laboratory is appointed to the Health Ministry and supports environmental monitoring for large infrastructures.

The Micro-Raman spectroscopy is carried out at the Department of Earth, Environmental and Life Sciences (DISTAV) of the University of Genoa, Italy. Micro-Raman spectroscopy allows the univocal (and fast) identification of organic (plastic) and inorganic (particles and fibers) phases, providing information on the different vibrational modes of molecules. Micro-Raman scattering measurements are conducted with a Horiba Jobin-Yvon Explora_Plus single monochromator spectrometer (HORIBA, Longjumeau, France) (with a grating of 2400 groove/mm) equipped with an Olympus BX41 microscope (HORIBA, Longjumeau, France). Raman spectra were excited by the 532 nm line. The spectrometer was calibrated to the silicon Raman peak at 520.5 cm-1. The spectral resolution was ~2 cm-1 and the instrumental accuracy in determining the peak positions was ~0.56 cm-1. Raman spectra were collected in the spectral ranges of 100–1100 cm-1 and 3000–3800 cm-1 for 15 s, averaging over 10 accumulations.

Semi-Permeable Membrane Device (SPMD) and Polar Organic Chemical Integrative Sampler (POCIS) for lipophilic and hydrophilic compounds, respectively, are deployed for 21 days. Passive sampling (PS) is based on mass transfer due to the different chemical potentials of analytes between water and the collection medium inside the sampler [Vrana et al., 2005]. The association of active and passive sampling systems allows detecting contaminants below the ng/L concentration. Sediment and water sampling are carried out conducted at the beginning and at the end of the PS deployment.

Organic contaminants (in particular, PAHs, PCBs, and OPCs) a Gas Chromatography–Mass Spectrometry (GC-MS) (Agilent 7890A–5975C) was used.

Diffusive Gradients in Thin films (DGT) for mercury and metals are deployed for 7 days. The analysis of metals was conducted using inductively coupled plasma mass spectrometry (ICP-MS, Agilent 7800), while total mercury (Hg) content was determined using an automated mercury analyzer (AMA-254, FKV).

Agilent 7800 is the ICP MS instrument present at DCCI-UniGE.

2.2 Return Infrastructures

The analytical facilities were implemented by the UHR FE-SEM Tescan Clara, installed at DISTAV- UniGE, shared with UniGe researchers in Return Spoke 3. Within Return Spoke 4, the instrument is dedicated to the characterization of fibers, particulate and microplastics (WP5).

High Resolution Inductively Coupled Plasma Mass Spectrometry (HR-ICP-MS) by Themo Fisher installed at DCCI-UniGE is the facility dedicated to environmental chemical monitoring of seawater.

2.3 Implementation of original POCIS samplers

A new protective membrane of polyester polymers is being experimented with the aim of including the more hydrophobic compounds in the target range, obtaining a more complete sample in one step. Conventional (PES – equipped) POCIS samplers are jointly deployed for comparative field tests.

3. Sampling strategy

3.1 Sediments

Bottom sediments are sampled in the proximity of the fixed stations by using a dredge sampler (Fig. 10). The complete sampling for all parameters and analytes on both matrices started at Sites 1 and 2, then was incremented to all stations in Figure 9.

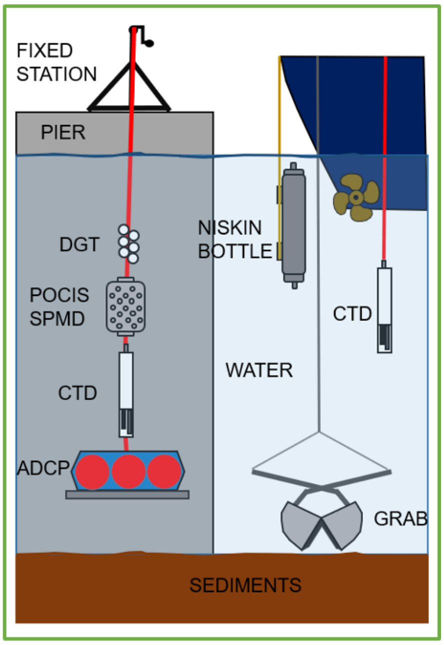


Figure 10. Sketch presentation of sampling tools of bottom sediments and of seawater.

3.2 Seawater

Physical-chemical parameters of the water column and dynamics were measured by fixed and mobile instruments (Fig. 10). Fixed monitoring stations (Site 1 and Site 2) are deployed on the internal part of the port breakwater at 7 m-depth and continuously measure. Fixed stations are equipped with a multiparametric probe (CTD, Idromarambiente) with temperature, turbidity and dissolved oxygen sensors, and a horizontal acoustic Doppler current profiler (H-ADCP WorkHorse 300 kHz, RD Instruments) for current velocity and direction measurement. A portable CTD (Idromarambiente) and vertical current meter (V-ADCP WorkHorse 300 kHz, RD Instruments) were used by monitoring vessel for measurements of temperature, salinity, turbidity, dissolved oxygen and chlorophyll-a and dynamics in the water column (from the sea surface to the bottom) near the fixed station.

Seawater samples were filtered by 0.45 µm membrane filters (Millex-HA, Merck) and acidified with 1 % HNO3 during the sampling and then, analyzed in laboratory by ICP-MS (Agilent 7800).

Organic contaminants are sampled by two different passive samplers, Semi-Permeable Membrane Device (SPMD) and Polar Organic Chemical Integrative Sampler (POCIS) for lipophilic and hydrophilic compounds, respectively; they are deployed for 21 days. Passive sampling (PS) is based on mass transfer due to the different chemical potentials of analytes between water and the collection medium inside the sampler [Vrana et al., 2005]. The synergy between active and passive sampling systems will allow the detection of contaminants at levels below the ng/L. For this purpose, alongside the PS, sediment and water sampling has been conducted at the beginning and at the end of the PS deployment.

DGTs (Diffusive Gradients in Thin-films) for the measurements of metals (Cd, Cr, Cu, Fe, Ni, Pb and Zn), As and Hg were deployed for 7 days (from 15 to 22 December). Immediately after the retrieval from seawater, the devices were rinsed with Milli-Q water; successively, in laboratory, the metals were eluted from the binding gel in 1 ml of 2M HNO3. The elution extracts were diluted with Milli-Q water and trace metal analysis was carried out by using ICP-MS (Agilent 7800). A blank resin was always considered. DGT performance was evaluated according to the method used by Zhang and Davison (1995). The concentrations of metals measured by DGT, in two replicates, were calculated using equations and parameters provided by Davison (2013). Analysis of total mercury concentrations in DGT units was performed using AMA 254 mercury analyzer: the chelating resin was removed from the device and directly analyzed without further preparations. A blank resin was analyzed in the same conditions, and its mercury content was always subtracted to the mercury concentrations measured for the samples.

4. Analytical methods

4.1 Sediments

An aliquot of sediment (30 to 50 grams) was used for sample size analysis. Firstly, the coarse fraction (Ø > 63 µm) was separated from the fine fraction (63 < Ø < 125 µm) by wet sieving (63 µm mesh sieve). The coarse fraction was dry processed with a battery of sieves and divided in classes between very fine sand (63 < Ø < 125 µm) to very coarse sand (1000 < Ø < 2000 µm) and gravel (Ø > 2000 µm). The fine fraction was analyzed by Coulter Counter® Multisizer 3 (Beckman

Coulter, Inc.) and divided in clay (∅ < 4 μm), fine silt (4 < ∅ < 16 μm), mean silt (16 < ∅ < 30 μm), and coarse silt (30 < ∅ < 63 μm).

Sediments aliquots used for metal analyses (except Hg) were oven-dried (40°C) and then, sieved to 2 mm and finely ground. The determinations of trace metal content (except Hg) in sediments were obtained by a microwave-assisted acid digestion procedure, using an acid mixture of HNO_3, HF and H_2O_2, followed by the chemical analyses performed by an ICP-MS instrument (Agilent 7800). Sample sediments for Hg analyses were air-dried in a fume hood and Hg determination in sediments was carried out by the automated Hg analyzer FKV AMA-254.

For the determination of polycyclic aromatic hydrocarbons (PAHs) and polychlorinated biphenyls (PCBs), sediment samples were extracted using an Accelerated Solvent Extractor (ASE 200, Dionex) with a 1:1 (v/v) acetone:n-hexane mixture. Prior to extraction, internal standards were added to each sample. The resulting extract was transferred to a separatory funnel with 20 mL of ultrapure water and shaken to facilitate phase separation and removal of acetone. The organic phase was then dried over anhydrous sodium sulfate, followed by volume reduction and fractionation through a 3 g silica column, according to the same procedure used for passive sampler extracts.

Ecotoxicological assays were performed on sediment elutriates, which were extracted by centrifuging sediment samples at 13,000 rpm (22,000×g) for 45 minutes at room temperature using an Eppendorf 5810 R centrifuge (rotor radius = 11.5 cm) and polycarbonate centrifuge bottles.

The sediment sampling addressed at investigation for fibrous minerals was carried out at the two fixed stations together with the other samplings, but also at other points distributed inside and outside the harbor to characterize the sediments and obtain information on the entire basin. The sediments taken between November 2023- November 2024 were prepared for the quantitative analysis of asbestos to discriminate the natural vs. anthropic contribution to the harbor environment.

The preparation of samples followed the prescription of MD 120/2017. The analytical determinations are carried out on the powder with a grain size spectrum of <0.100 mm obtained by milling of a representative subsample with a grain size of ≤20 mm. The preparation is detailed and discussed in [Militello et al., 2018].

The mineral characterization on fine-grained sediments was based on reflected optical microscopy (OM), SEM-EDS, to identify the fibrous and EPM minerals and distinguish the phase morphology, composition and microtextures. The microscopic mineral identification was carried out on gold-coated dusts dispersed on membranes was conducted at 2500× magnification, 20 kV of acceleration voltage, by SEM-EDS methodology using a Vega 3 XML TESCAN (Brno, Czech Republic) equipped with an energy-dispersive X-ray spectroscopy AZtec 2.4 by Oxford

Instruments, installed at the Department of Earth, Environment and Life Sciences, University of Genoa. The elemental analysis of minerals was acquired with a counting time of 30 seconds.

The morphological characterization was carried out on gold-sputtered samples and viewed using the UHR FE-SEM Tescan Clara, HV, 5 keV, 300 pA, in-beam axial detector.

The phase identification by XR Powder Diffraction was carried out by the Rigaku Miniflex diffractometer equipped with a HPAD (HyPix-400 MF 2D) hybrid pixel array detector and a 600W X-ray source at the DCCI, University of Genova.

Major and trace elements were analyzed at the Activation Laboratories Ltd (ActLabs), Canada. Loss on ignition (LOI) values were determined by gravimetric methods. The analytical procedure involved preparation of lithium metaborate–tetraborate fused glass discs, with subsequent analysis by inductively coupled plasma mass spectrometry (ICP-MS). ActLabs completed internal checks on the accuracy and precision of the data, by analysis of reference standards and duplicate analysis of each sample.

4.2 Seawater

Organic chemicals are analyzed through high sensitivity instrumentations, mainly based on the coupling of chromatography to mass spectrometry, in particular: GC-MS (Agilent 7890A-5975C), LC-MS/MS (Agilent 1200-6430 LC-QQQ) and UPLC-MS/MS (Xevo G2-XS-QTOF, Waters).

Regarding SPMD, the membranes are extracted twice for 24 h with 300 mL n-hexane containing internal standards. The two extracts are dried passing through anhydrous sodium sulfate. The n-hexane is reduced in volume using a vacuum rotary evaporator. The 1 mL sample is eluted in a 3 g silica column with firstly 10 mL of n-hexane and then 20 mL of n-hexane:dichloromethane (1:1). The two different eluted are analyzed for polycyclic aromatic hydrocarbons (PAHs), polychlorinated biphenyls (PCBs), and organochlorine pesticides (OCPs).

POCIS are well suited for semi-polar compounds, belonging to different classes of emerging contaminants (pharmaceuticals, estrogens, UV-filters, PFAS, stimulants, artificial sweeteners, etc.). In this case, the sampler is opened, and the sorbent is transferred into a glass cartridge which is eluted using 20 mL of MeOH and 5 mL of DCM : IPA (80:20 v/v). The obtained eluate is then reduced to dryness on a rotary evaporator (Rotavapor® R-100, BUCHI, Switzerland), reconstituted in 1 mL of methanol and filtered through a 0.2 µm hydrophilic PTFE filter [Benedetti et al., 2022]. Appropriate dilutions are performed before LC-MS/MS analysis, to detect and possibly quantify the highest possible number of emerging contaminants.

In parallel to POCIS deployments, we are also investigating the potential use of a more resistant material to play the role of the protective membrane in POCIS. In fact, the PES membranes are quite fragile, and various studies in the literature reported the destruction of field-deployed POCIS devices, especially when seawater is studied. A new protective material, constituted of polyester polymers, is used instead of the standard PES membrane to prepare a POCIS-like samplers. The latter are deployed alongside the standard POCIS in one of the considered sites of the Port of Genoa and will enable the field-comparison in the sampling and quantitation of organic contaminants. The POCIS-like samplers are expected also to extend the range of target compounds to more hydrophobic ones, without introducing any further step in the processing procedure.

DGT performance was assessed according to the procedure outlined by Zhang and Davison (1995). Metal concentrations (n = 2 replicates per site) were calculated using equations and parameters reported by Davison (2016).

For total mercury (Hg) analysis, the chelating resin was removed and analysed directly using an AMA 254 Hg analyser, with no further sample preparation. Blank resins were analysed under identical conditions, and their Hg content was subtracted from the measured sample values to correct for background levels.

The ecotoxicological assays were performed on seawater samples and sediment elutriate. For the preparation of sediment elutriate, synthetic seawater [ASTM, 1994] was added to the sediment in the ratio 4:1 (volume/dry weight) and placed in a shaker for 1 h at room temperature [ASTM, 1994]. Then, the mixture was centrifuged at 3,000 rpm (1,000×g) for 20 min and filtered (Ø 0.45 μm). Pore water was prepared by centrifugation of sediments at 13,000 rpm (2.2× 104 g) for 45 min at room temperature in an Eppendorf centrifuge (5810 R; r=11.5) using polycarbonate bottles. For aqueous samples, a bioassay battery, consisting of four different species representing different trophic levels, algae *Dunaliella tertiolecta*, crustacean *Artemia salina*, was chosen.

D. tertiolecta test - The chronic test was carried out according to ISO 10253:2016. Bioassays were performed using dilutions of elutriate and seawater sample. Artificial seawater [ASTM, 1994] was used for the dilution of samples.

The samples were placed in sterilized glass flasks, in triplicate. An algal suspension at a concentration of 1×106 cells/mL was prepared. Then, an aliquot of algal suspension was added to each replicate to reach the final concentration of 1×104 cells/mL. Culture medium has been utilized as negative control (six replicates). The test flasks were placed in a thermostatic chamber at 20 °C with a light source in the 7,000– 8,000-lux range for 72 h. The cell density of each sample was measured after 72 h by the Burker chamber. EC50 was calculated for each sample, and the maximum growth inhibition percentage was estimated in the case EC50 was not computable.

Artemia salina test - A. salina cysts were hatched by using the procedure described in [APAT-IRSA-CNR, 2003]. The encysted organisms were first hydrated in a volume of artificial seawater (Instant Ocean 3 % m/v) for 1 h at 25 °C at 3,000–4,000 lx. Then, the cysts were incubated for 24 h in the dark at the same temperature. Acute toxicity test (96 h) was conducted according to [APAT-IRSA-CNR, 2003]. Ten nauplii were transferred in a beaker with 40 mL of sample.

Each sample was tested in triplicate. The negative control consisted of six replicates of artificial seawater. The treatments were incubated at 25 °C with a light regime of 14:10 h light/dark. No food was provided during the exposure. Every 24 h, the number of the live individuals was recorded. The effect percentage for each sample was calculated with respect to the control.

5 Design of the dataset

The dataset aims include physical parameters of seawater, chemical compositions, qualitative and quantitative mineralogical associations, aiming at the representation of the geological matrices and of the seawater, over a 10 km length transect on the coastal strip and particular in the port environment.

6 Data restitution

6.1 Tables

Custom designed spreadsheets are dedicated to physical, chemical and mineralogical parameters (Tables 1, 2, 3, external attach). Sampling sites are GPS referred, with the date and the time of acquisition is present.

6.2 Thematic maps

The drawing of thematic maps for physical parameters and the analytes is under construction. At present concentrations of selected analytes are evidenced on the sampling sites map (Fig. 11).

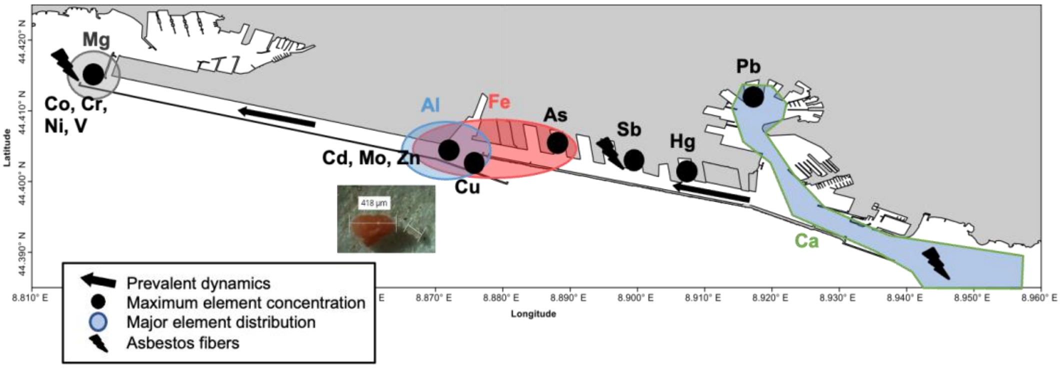


Figure 11. Preliminary elaboration of elemental abundances on the sampling map.

References

APAT-IRSA-CNR: Metodo 8060. Metodo di valutazione della tossicità acuta con Artemia sp. In: APAT-IRSA-CNR, Metodi analitici per le acque, Manuali e Linee Guida 29/2003, Volume Terzo, 1043-1049 (2003).

ASTM: American Standard for Testing Materials. West Conshohocken (1994).

Benedetti, B., Baglietto, M., MacKeown, H., Scapuzzi, C., Di Carro, M., Magi, E.: An optimized processing method for polar organic chemical integrative samplers deployed in seawater: Toward a maximization of the analysis accuracy for trace emerging contaminants. J. Chromatogr. A 1677, 463309 (2022). https://doi.org/10.1016/j.chroma.2022.463309

Capello, M., Cutroneo, L., Ferretti, G., Gallino, S., Canepa, G.: Changes in the physical characteristics of the water column at the mouth of a torrent during an extreme rainfall event. J. Hydrol. 541(A), 146-157. https://doi.org/10.1016/j.jhydrol.2015.12.009

Cutroneo, L., Ferretti, G., Barani, S., Scafidi, D., De Leo, F., Besio, G., Capello, M.: Near Real-Time Monitoring of Significant Sea Wave Height through Microseism Recordings: Analysis of an Exceptional Sea Storm Event. J. Mar. Sci. Engin. 9(3), 319 (2021). https://doi.org/10.3390/jmse9030319

Davison, W. (Ed.) Diffusive gradients in Thin-Films for environmental measurements. Cambridge University Press [2016].

Faccini, F., Luino, F., Sacchini, A., Turconi, L.: The 4th October 2010 flash flood event in Genoa Sestri Ponente (Liguria, Italy). Dis. Adv. 8, 1-14 (2015).

Militello, G.M., Bloise, A., Gaggero, L., Lanzafame, G., and Punturo, R.: Multi-Analytical Approach for Asbestos Minerals and Their Non-Asbestiform Analogues: Inferences from Host Rock Textural Constraints. Fibers 7, 42 (2019). doi.org/10.3390/fib7050042

Vrana, B., Allan I.J., Greenwood, R., Mills, G.A., Dominiak, E., Svensson, K., Knutsson, J., Morrison, G.: Passive sampling techniques for monitoring pollutants in water. TrAC. 24(10), 845-868 (2005). https://doi.org/10.1016/j.trac.2005.06.006

Zhang and Davison, Performance Characteristics of Diffusion Gradients in Thin Films for the in-Situ Measurement of Trace Metals in Aqueous Solution, Anal. Chem. 67, 3391-3400 (1995).