



ECological supporting for traffic Management
in cOastal areas By using an IntelLIgenT sYstem



AXIS 4: Maritime Transport
Objective 4.1: Improve the
quality, safety and
environmental sustainability of
marine and coastal transport
services and nodes by
promoting multimodality in the
Programme area

Common publications on International scientific journals

Institute of Atmospheric Science and Climate of the
National Research Council (ISAC-CNR)

Ca' Foscari University of Venice, University of Rijeka

Version: Final

Distribution: public

Date: 30 September 2019

WP 2: Communication and capitalization

ACT 2.7: Publication of scientific articles

CONTRIBUTED TO THIS WORK

Daniela Cesari	Institute for Atmospheric Science and Climate of the National Research Council (ISAC-CNR)
Marianna Conte	Institute for Atmospheric Science and Climate of the National Research Council (ISAC-CNR)
Fabio M. Grasso	Institute for Atmospheric Science and Climate of the National Research Council (ISAC-CNR)
Eva Merico	Institute for Atmospheric Science and Climate of the National Research Council (ISAC-CNR)
Daniele Contini	Institute for Atmospheric Science and Climate of the National Research Council (ISAC-CNR)
Elena Gregoris	Ca' Foscari University of Venice / Institute of Polar Science of the National Research Council (ISP-CNR)
Elisa Morabito	Ca' Foscari University of Venice
Elena Barbaro	Institute of Polar Science of the National Research Council (ISP-CNR)
Matteo Feltracco	Ca' Foscari University of Venice
Giuseppa Toscano	Ca' Foscari University of Venice
Boris Mifka	Department of Physics, University of Rijeka
Velimir Zubak	Environmental Health Department, Teaching Institute of Public Health
Dario Kontošić	Environmental Health Department, Teaching Institute of Public Health
Paula Žurga	Environmental Health Department, Teaching Institute of Public Health
Marjana Mezlar	Environmental Health Department, Teaching Institute of Public Health
Dajana Odorčić	Environmental Health Department, Teaching Institute of Public Health
Ana Alebić-Juretić	University of Rijeka- Faculty of Medicine, Environmental Health Department

INTRODUCTION

Innovative results of the ECOMOBILITY project will be disseminated and shared within the scientific community according to WP2 Task 2.7. This activity consists in common publications on international scientific journals about the methodological approach, chemical analysis and results of the activities carried out within the duration of the project. Potential common paper contents with the draft of abstracts and keywords, reported in the Annexes, will be illustrated in this deliverable.

DESCRIPTION OF PUBLICATIONS

Specifications of research articles, in terms of scope, data and results to be presented, were discussed during the skype meeting held on the 3rd of September 2019 with the participation of all partners (see “Minutes of the partner Skype meeting for data post-processing”). The meeting was explicitly devoted to discuss post-processing procedures and how the data could be used in scientific publications. ECOMOBILITY partners decided to produce four common papers in total, dealing with different aspects of project implementation, described separately in the following.

Two papers will be coordinated by ISAC – CNR (PP2) and they are in preparation. The first one will be based on high-temporal resolution measurements of particle concentration in number and mass (in different sizes ranging from 0.01 to 32 μm) and relative meteorological parameters, taken in both experimental sites (Venice and Rijeka). Furthermore, since the same instrumental setup was used, a possible comparison with previous works performed in Adriatic harbours, like Brindisi and Venice, will be reported, estimating ship traffic contribution in each port-city. The second study could be focused on elemental and organic carbon (EC, OC) determinations carried out from size segregated particulate samples collected in both sites by a 10-stages micro-orifice impactor (MOUDI 110NR) equipped with quartz fiber filters. Results of both campaigns will be compared and discussed interpreting the differences observed in the two

sites. This will be one of the few studies in speciation of carbonaceous aerosol in different size ranges, obtaining size distribution of EC and OC in a harbour area. In fact, the most scientific literature aims to characterize particulate (PM_{10} or $PM_{2.5}$) without analyzing chemical components distribution in function to particle size.

The last two publications have been coordinated by University Ca' Foscari of Venice (LP) and University of Rijeka (PP3). In one of these, a complete chemical analysis (major ions, trace metals, and carbonaceous species) of size-segregated samples collected in Venice was performed followed by the application of the PMF (Positive Matrix Factorization) receptor model to investigate the contributions of the different sources acting on the area putting in evidence the weight of shipping compared to the other sources. The second paper is based on a similar post-processing applied to the size-segregated samples collected in Rijeka.

ANNEX

Abstracts of papers submitted to scientific journals

LIST OF CONTRIBUTIONS

A1 – An inter-comparison of size segregated carbonaceous aerosol collected by low-volume impactor in the port-cities of Venice (Italy) and Rijeka (Croatia)

A2 – Comparison of the impact of ships to size-segregated particle concentrations in two harbour cities of northern Adriatic Sea

A3 – Chemical characterization and source apportionment of size-segregated aerosol in the port-city of Venice (Italy)

A4 – Characterization of airborne particulate fractions from the port city of Rijeka, Croatia

Atmospheric Pollution Research

An inter-comparison of size segregated carbonaceous aerosol collected by low-volume impactor in the port-cities of Venice (Italy) and Rijeka (Croatia)

--Manuscript Draft--

Manuscript Number:	
Article Type:	Research Paper
Keywords:	carbonaceous aerosol, carbon size distributions, OC/EC, WSOC, port-cities.
Corresponding Author:	Daniela Cesari, Ph.D. Istituto di Scienze dell'Atmosfera e del Clima Consiglio Nazionale delle Ricerche ITALY
First Author:	Daniela Cesari, Ph.D.
Order of Authors:	Daniela Cesari, Ph.D. Eva Merico Adelaide Dinoi Andrea Gambaro Elisa Morabito Elena Gregoris Ana Alebić-Juretić Dajana Odorčić Dario Kontošić Boris Mifka Daniele Contini
Abstract:	<p>The knowledge of the size-resolved chemical composition of carbonaceous aerosols is essential, when studying their sources and environmental impacts. Size-segregated analysis of organic and elemental carbon in aerosol are scarce, especially in coastal areas stressed by emissions from human activities and with complex interactions between anthropogenic and natural emissions. Aiming to fill this lack of information, a study of aerosol size segregated samples was undertaken between 2018 and 2019, using a MOUDI impactor. Measurements were performed in two port-cities of Northern Adriatic Sea, Venice (Italy) and Rijeka (Croatia). A thermal-optical analysis (EUSAAR2) allowed elemental and organic carbon determination (EC, OC) in different size ranges. For Rijeka site, the water soluble organic carbon content (WSOC) has been analysed. OC and EC average concentrations in Venice were $3.16 (\pm 0.97)$ and $0.40 (\pm 0.13)$ $\mu\text{g}/\text{m}^3$, while in Rijeka were $2.48 (\pm 0.65)$ and $0.37 (\pm 0.08)$ $\mu\text{g}/\text{m}^3$. The OC size distributions were bimodal at both sites, with an accumulation and a coarse mode. EC showed a bimodal distribution in Rijeka, a single fine mode in Venice. The EC/TC ratio was large in the fine mode at both sites, however, in Rijeka non-negligible values were found in coarse fraction suggesting possible contributions from resuspension of carbon-loaded dust and mixing of anthropogenic particles with sea spray. The analysis of the ratio WSOC/OC as function of particle size showed a total value of $0.51 (\pm 0.12)$ with an increase in the coarse fraction likely due to contributions of water soluble carbon from sea spray and biogenic emissions.</p>

Manuscript Details

Manuscript number

Title Comparison of the impact of ships to size-segregated particle concentrations in two harbour cities of northern Adriatic Sea

Article type Research Paper

Abstract

Sustainability of shipping sector is a matter of debate in scientific community aimed to minimize both climate and health effects, maintaining its potential economic contribution to the development of coastal areas. Detailed information on in-harbour shipping contribution to size segregated particles in coastal cities are scarce. In this work, particle number and mass size distributions (size range 0.01-31 μm) were measured at high temporal resolution (1 minute) in two coastal cities of northern Adriatic Sea: Venice (Italy) and Rijeka (Croatia). Size distributions allowed focus in three size ranges: nanoparticles (diameter $D < 0.25 \mu\text{m}$); fine particles ($0.25 < D < 1 \mu\text{m}$), and coarse particles ($D > 1 \mu\text{m}$). Absolute concentrations were larger in Venice for all size range. Daily trends of concentrations showed a large influence of local meteorology and boundary-layer dynamics in Venice and a contribution of road transport larger (in relative terms) in Rijeka. The contributions of shipping were significantly larger in Venice mainly because of the larger ship traffic. Maximum impact was on nanoparticles 7.4% (Venice) and 1.8% (Rijeka), the minimum was on fine range 1.9% (Venice) and $< 0.2\%$ (Rijeka) and intermediate values were found in the coarse fraction 1.8% (Venice) and 0.5% (Rijeka). Contribution of shipping to mass concentration was not distinguishable from uncertainty in Rijeka ($< 0.2\%$ for PM₁, PM_{2.5}, and PM₁₀) and was about 2% in Venice. Relative contributions as function of particles size show remarkable similitudes: a maximum for nanoparticles, a quick decrease and a successive secondary maximum (2-3 times lower than the first) in the fine range. For larger diameters, the relative contributions reach a minimum at 1-1.5 μm and there is a successive increase in the coarse range.

Keywords particle size distributions; nanoparticles; shipping impacts; ship traffic; harbour pollution

Corresponding Author EVA MERICO

Corresponding Author's Institution Institute of Atmospheric Sciences and Climate, National Research Council of Italy (ISAC-CNR)

Order of Authors EVA MERICO, Marianna Conte, Fabio Massimo Grasso, Daniela Cesari, ANDREA GAMBARO, Elisa Morabito, Elena Gregoris, Salvatore Orlando, Ana Alebic-Juretic, Velimir Zubak, Boris Mifka, Daniele Contini

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Manuscript Details

Manuscript number

Title Chemical characterization and source apportionment of size-segregated aerosol in the port-city of Venice (Italy)

Article type Research Paper

Abstract

The particle size distribution of particulate matter, major ions, trace metals, and carbonaceous species concentration were studied in Venice (Italy), in the framework of the ECOMOBILITY project (ECOLOGICAL supporting for traffic Management in cOastal areas By using an InteLLigenT sYstem, Interreg Italy-Croatia). Aerosol was collected with a 10-stages MOUDI cascade impactor, on quartz fibre filters, including the inlet and the backup filter. After the gravimetric analysis, filters were divided in three parts and each piece underwent a different analytical procedure: i) half of the filter was microwave digested and analysed for trace metals; ii) a square part of the filter was used for carbonaceous species determination; iii) the remaining filter was extracted in ultrasonic bath to quantify ionic species. In literature, most works focus on a smaller number of size stages, or more limited analysed chemicals. The aim of this work is to perform a detailed overview of the chemical composition of aerosol and its particle size distribution, in order to carry out a source apportionment of aerosol in the urban area of Venice. Specifically, this work is proposed to fill the gap of the knowledge about the size distribution of various sources of airborne particulate matter, including shipping emission. Source apportionment was conducted using two different approaches: i) approximate formulae; ii) PMF applied to two datasets: coarse ($>1 \mu\text{m}$) and fine-nano particles ($<1 \mu\text{m}$). Sea spray aerosol was found mainly in the coarse fraction. The fine fraction was dominated by secondary inorganic aerosol and organic aerosol. Primary anthropogenic aerosol increased as particle dimension decreased. For the first time, the contribution of shipping emission was investigated using chemical tracers on different size ranges below $1 \mu\text{m}$ and reaching nanoparticles ($<0.1 \mu\text{m}$). The primary contribution of ship traffic was higher in fine and nanoparticles, with respect to the coarse ones, reaching the maximum value in nanoparticles (average 7% on particles mass).

Keywords Size-segregated aerosol; source apportionment; PMF; ship traffic; MOUDI

Manuscript category Atmospheric chemistry

Corresponding Author Elena Gregoris

Corresponding Author's Institution Ca' Foscari University of Venice

Order of Authors Elena Gregoris, Elisa Morabito, Elena Barbaro, Matteo Feltracco, Giuseppa Toscano, EVA MERICO, Fabio Massimo Grasso, Daniela Cesari, Marianna Conte, Daniele Contini, ANDREA GAMBARO

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Supplementary Material.pdf [Supplementary Material]

Manuscript Number:

Title: Characterization of airborne particulate fractions from the port city of Rijeka, Croatia

Article Type: Research Paper

Keywords: ship emission; airborne particulates; metals; ions; carbonaceous species; desert dust

Corresponding Author: Professor Ana Alebic-Juretic,

Corresponding Author's Institution:

First Author: Ana Alebic-Juretic

Order of Authors: Ana Alebic-Juretic; Paula Zurga; Dario Kontosic; Dajana Odorcic; Boris Mifka; Marijana Mezlar; Eva Merico; Fabio M Grasso; Marianna Conte; Daniele Contini

Abstract: The aim of this work was characterization of airborne particulates in the port city of Rijeka in order to evaluate impact of ship emissions on air quality. Samples of airborne particulates were collected with a ten stages cascade impactor during two campaigns: autumn and spring. A total of 16 weekly samples were analyzed on mass concentration, ions, metals and carbonaceous species (EC, OC, WSOC). Distribution of airborne fractions showed a bimodal trend, with two maxima: one in coarse, and other in fine fraction. Source apportionment using PMF receptor model identified six sources of airborne particulates in Rijeka: crustal, biomass burning, sea salt, traffic /metal industry, combustion/SIA and HFO burning, i.e. ship emission (contribution 3%). The contribution of ship traffic to primary emission of particulate matter, using vanadium as tracer, indicated a twofold increase for PM10 and PM2.5 relative to 2012-14. An unusual desert dust event was registered in autumn campaign.

Research Data Related to this Submission

There are no linked research data sets for this submission. The following reason is given:

Data will be made available on request