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Marco Zanatta

Nationality: Italian **Date of birth:**

Phone number: (+39) 0516399594 **Email address:**

m.zanatta@isac.cnr.it **Work:** Indirizzo: Via Piero Gobetti, 101 Room 508, 40129 Bologna (Italy)

ABOUT ME

Atmospheric aerosols and their interaction with the climatic system are my areas of specialization. I focus on studying soot particles generated by combustion processes, which are suspended in the atmosphere. Over the years, I have investigated the role of soot in various environmental systems, including the atmosphere, snow, and clouds. I have also adapted and developed technical and analytical methodologies to address four main scientific questions:

a) How is soot spatially distributed in the European atmosphere, and what are the primary sources and sinks?

b) To what extent does soot alter the radiative budget of the atmosphere through direct light absorption?

c) What are the properties that control the interaction of soot with clouds, and how do these interactions affect indirect soot forcing?

d) Does soot affect the radiative properties of snow?

EDUCATION AND TRAINING

Qualification maître de conférence

Ministère de l'Enseignement supérieur, de la Recherche et de l'Innovation [29/01/2020]

Country: France

PhD - Atmospheric Science

University of Grenoble Alps (France) - Paul Scherrer Institute (Switzerland) [30/09/2012 – 31/03/2016]

Website: https://www.univ-grenoble-alpes.fr/english/

Field(s) of study: Natural sciences, mathematics and statistics: *Earth sciences , Physics*

Final grade: - – **Level in EQF:** EQF level 8

Thesis: The black carbon in the European atmosphere: identification, transfert, deposition and impacts

Link: https://www.theses.fr/2016GREAU005

Atmospheric physics and chemistry

- Aerosol optical properties
- Aerosol-cloud interaction
- Continental atmospheric pollution

Development of analytical technique for atmospheric pollution quantification
Laboratory work
Deployment of instrumentation on field expeditions
Analysis of large dataset

Master degree - Analytical Chemistry

University of Pavia - Department of Chemistry [31/08/2009 – 30/11/2011]

Address: Via Sant'Agostino 4/a, 27100 Pavia (Italy)
Website: http://wcm-3.unipv.it/site/en/home.html
Field(s) of study: Natural sciences, mathematics and statistics: *Chemistry*
Final grade: 106/110 – **Level in EQF:** EQF level 7
Thesis: Analysis of black carbon in the snow

Advanced analytical-, organic-, inorganic-, physical-chemistry
Specialities: spectroscopy, nuclear magnetic resonance, environmental analytical chemistry
Extensive experience in chemical laboratory

Bachelor degree - General Chemistry

University of Pavia - Department of Chemistry [08/2006 – 30/09/2009]

Address: Via Sant'Agostino 1/a, 27100 Pavia (Italy)
Website: http://wcm-3.unipv.it/site/en/home.html
Field(s) of study: Natural sciences, mathematics and statistics: *Chemistry*
Final grade: 101/110 – **Level in EQF:** EQF level 6
Thesis: The photochemistry of snow

General chemistry
Inorganic chemistry
Organic chemistry
Analytical chemistry
Physical chelistry

WORK EXPERIENCE

Atmospheric research scientist

National Research Council - Institute of Atmospheric Sciences and Climate [24/07/2023 – Current]

City: Bologna
Country: Italy
Website: https://cimone.isac.cnr.it/
Name of unit or department: Institute of Atmospheric Sciences and Climate (ISAC) - **Business or sector:** Education

Investigate the variability of carbonaceous aerosol in the Po Valley region, with particular focus on the impact of boundary layer dynamics, interaction with clouds and weather anomalies:

- Supervision of long-term aerosol measurements at the Monte Cimone ACTRIS station
- Organization of international campaigns viw the ATMO-ACCESS program to the Monte Cimone ACTRIS station
- Co-supervision of PhD students within the ITINERS project
- Data treatment and interpretation

Atmospheric research scientist - Principal Investigator DFG fellowship

Institute of Meterological and Cliamate Research - Karlsruhe Institute of Technology [30/06/2021 – 23/07/2023]

Address: Hermann-von-Helmholtz-Platz 1, 76344 Karlsruhe (Germany)
Website: https://www.imk-aaf.kit.edu/index.php
Name of unit or department: Department Atmospheric Aerosol Research (IMK-AAF) - **Business or sector:** Education

Deutsche Forschungsgemeinschaft - Principal Investigator grant

During the project, the atmospheric conditions, including chemical composition, meteorology, and cloud presence, typical of the Arctic region will be reproduced in the AIDA (Aerosol Interactions and Dynamics in the Atmosphere) simulation chamber of the Karlsruhe Institute of Technology (Karlsruhe, Germany). The project aims to improve the parametrization of climate-relevant soot aerosol properties in the global atmospheric model CONART. As principal investigator, my task is to design the chamber experiments, supervise the measurements and the climatic calculations.

Atmospheric research scientist

Université Paris-Est-Créteil, Université de Paris, Institut Pierre Simon Laplace [31/10/2020 – 06/2021]

Address: Campus centre de l'UPEC 61 avenue du Général de Gaulle, 94010 Paris (France)
Website: http://www.lisa.u-pec.fr/en
Name of unit or department: Laboratoire Interuniversitaire des Systèmes Atmosphériques - **Business or sector:** Education
Link: https://www.youtube.com/watch?v=ndQ_rRo7Pd4

Simulation of physical and chemical processes in an atmospheric simulation chamber with a focus on soot particles

- Supervision of physical measurements
- Design of the simulation experiments

Atmospheric research scientist

Alfred Wegener Institute [31/05/2016 – 30/12/2019]

Address: Postfach 12 01 61, 27515 Bremerhaven - Potsdam (Germany)
Website: https://www.awi.de/en/
Email address: info@awi.de
Name of unit or department: Climate Sciences - Atmospheric Physics - **Business or sector:** Public administration and defence; compulsory social security
Links: https://www.youtube.com/watch?v=xwSedSD8i74 | https://www.youtube.com/watch?v=69OsRXEO7y4

Conduct research in the field of atmospheric science in the Arctic region with specific focus on soot aerosol:

- Airborne and ship-borne measurement of atmospheric pollutants
- Arctic expedition
- Data treatment and interpretation
- Project management with international partners

Applied research engineer

French National Centre for Scientific Research [31/12/2011 – 31/07/2012]

Address: UGA - IGE CS 40700, 38 058 Grenoble (France)
Website: https://www.ige-grenoble.fr/?lang=en
Email address: ige-contact@univ-grenoble-alpes.fr
Name of unit or department: Institute of Geophysics of the Environment - **Business or sector:** Professional, scientific and technical activities

Development of analytical method to measures pollutants in snow

- Laboratory work
- Instrumental deployment in the Arctic

SCIENTIFIC PROFILE

Specific research topics

- Quantification of mass absorption cross section of soot
- Lensing effect on soot optical properties
- Relationship between mixing and cloud activation of soot
- Ice nucleation ability of soot

- Impact of ageing on morphology and size of carbonaceous aerosol
- Quantification of soot in snow layer

Publication record

29 peer reviewed publications - 1260 citations - 19 H-index

- 5 first author publications
- Zanatta et al., 2016: ACTRIS European Aerosol Phenomenology-5, Atmos. Environ. **156 citations**

Co-author on two AMAP reports

- AMAP technical report 2019: EU Action on Black Carbon in the Arctic
- AMAP assessment 2021: Impacts of Short-lived Climate Forcers on Arctic Climate, Air Quality, and Human Health

Teaching

Supervision of 2 master thesis

Co-advisor of 2 PhD thesis

Research tools

In-situ aerosol instrumentation:

- Single particle spectrometers (SP2, UHSAS, OPCs)
- Absorption, scattering and extinction photometers (Aethalometer, MAAP, PAAS, PSAP, Nephelometer, CAPS)
- Cloud condensation particles counters (CCNC)
- Size, mas and density measurements (SMPS, APM)
- Snow measurements

Measuring platforms:

- Field (ACTRIS network)
- Aircraft (Polar-6)
- Ship (Polarstern)

Laboratory experiments:

- ATMO-ACCESS simulation chambers (CESAM, AIDA)
- Clean and cold chambers

PROJECTS

Italian Integrated Environmental Research Infrastructures System (ITINERIS)

[2023 – Current]

ITINERIS establishes Italy's Hub for Environmental Research, focusing on atmosphere, marine, biosphere, and geosphere studies. The work package 4, Atmosphere, aims to identify the the emerging pollution sources and the impact on they variability due to climatic anomalies on the Italian and Mediterranean region, with the final goal of reducing pollution and foreseeing mitigation and adaptation strategies in a changing climate.

Link: https://itineris.cnr.it/

Parametrization of the effects of atmospheric transport on absorption and hygroscopicity of black carbon particles in the Arctic (ARCTEx) – a new modelling-chamber approach

[2021 – Current]

Principal Investigator grant - Deutsche Forschungsgemeinschaft

During the project, the atmospheric conditions, including chemical composition, meteorology, and cloud presence, typical of the Arctic region will be reproduced in the AIDA (Aerosol Interactions and Dynamics in the Atmosphere) simulation chamber of the Karlsruhe Institute of Technology (Karlsruhe, Germany). The project aims

to improve the parametrization of climate-relevant aerosol properties in the global atmospheric model ICON-ART. As PI, my task is to design the chamber experiments, supervise the measurements and the climatic calculations."

Links: https://gepris.dfg.de/gepris/projekt/457895178?displayMode=print | https://www.imk-aaf.kit.edu/news_AIDArct_project.php

Arctic Amplification: Climate Relevant Atmospheric and Surface Processes, and Feedback Mechanisms (AC3) Transregional Collaborative Research Centre

[2016 – 2019]

Transregional Collaborative Research Centre - Deutsche Forschungsgemeinschaft

The AC3 project aims to identify, investigate, and evaluate the key processes contributing to Arctic amplification in particular with regard to Arctic mixed-phase clouds, and their interaction with surface parameters. I was responsible of all black carbon measurements during three Arctic field campaigns, performed onboard of the Polarstern research icebraker, on the Polar-6 research aircraft and at Station Nord research station Villum

Links: https://www.ac3-tr.de/ | https://www.youtube.com/watch?v=xwSedSD8i74

Climate impact of short-lived pollutants and methane in the Arctic (CLIMSLIP)

[2012 – 2014]

IPEV- ANR grant

The project aimed to identify the sources of anthropogenic pollution and quantify its role on Arctic cloud properties and aerosol

indirect radiative forcing. My task during the CLIMSLIP project was to perfrom black carbon measurements in the Arctic atmosphere and snow, to finally calculate raditive forcing of soot during arctic haze periods

SIMULATION CHAMBER EXPERIMENTS

ARCTEx - AIDA chamber

[2022]

Simulation of Arctic transport condition in AIDA chamber and quantification of optical properties and cloud activation of soot particles:

- Data treatment in progress

B2C - CESAM chamber

[2020 – 2022]

Quantification of optical properties of carbonaceous aerosol, direct measurements of black carbon properties under different aging conditions:

- Heuser et al., in preparation: Simulation chamber study of the spectral mass absorption, scattering, and extinction cross-sections (MAC, MSC, MEC) of fresh and aged combustion aerosols
- Renzi et al., in preparation: Investigation of the multiple scattering correction factor Cref for aethalometer AE31 and AE33 and its dependency on aerosol properties, relative humidity and wavelength

MOBILE PLATFORM OBSERVATIONS

ACLOUD - Airborne - Svalbard

[2017]

Measurement of black carbon in mixed phase clouds and activation calculations:

- Zanatta et al., submitted ACPD : Airborne investigation of black carbon interaction with low-level, persistent, mixed-phase clouds in the Arctic summer

PASCAL - Shipborne - Arctic Sea

[2017]

Quantification of soot in snow pack and implementation of new measuring techniques:

- Zanatta et al., 2021 : Technical note: Sea salt interference with black carbon quantification in snow samples using the single particle soot photometer

BALTex - Airborne - Baltic Sea

[2016]

Measurement of particle and gas emission in shipping lanes

- Zanatta et al., 2020: Airborne survey of trace gases and aerosols over the Southern Baltic Sea: from clean marine boundary layer to shipping corridor effect

FIELD CAMPAIGNS

PAMARCMiP - Villum station

[2018]

Measurement of rBC particles in the atmosphere and in the snow, quantification of snow physical

properties:

- Jäkel et al., 2021: Measurements and Modeling of Optical-Equivalent Snow Grain Sizes under Arctic Low-Sun Conditions
- Ohata et al., 2021: Arctic black carbon during PAMARCMiP 2018 and previous aircraft experiments in spring

BACCHUS - Zurich

[2015]

Impact of Biogenic versus Anthropogenic emissions on Clouds and Climate, soot measurements in urban

environment:

- Motos et al., 2019: Droplet activation behaviour of atmospheric black carbon particles in fog as a function of their size and mixing state

CLACE-3 - Jungfraujoch

[2013]

Ice nucleating activity of black carbon in mixed phase clouds:

- Kupiszewski et al., 2016: Ice residual properties in mixed-phase clouds at the high-alpine Jungfraujoch site

CLIMSLIP - Ny-Alesund

Black carbon measurements in the atmosphere and snow in the European Arctic

- Zanattea et al., 2018: Effects of mixing state on optical and radiative properties of black carbon in the European Arctic
- Jacobi et al., 20119: Deposition of ionic species and black carbon to the Arctic snowpack: combining snow pit observations with modeling

ACTRIS: background multi site

[2008 – 2011]

Analysis of long-term dataset of light absorption and mass concentration of soot particles on the ACTRIS

network:

- Zanatta et al., 2016: A European aerosol phenomenology-5: Climatology of black carbon optical properties at 9 regional background sites across Europe

PUBLICATIONS

Airborne investigation of black carbon interaction with low-level, persistent, mixed-phase clouds in the Arctic summer

[2023]

Zanatta et al., 2023 - Atmospheric Chemistry and Physics

Atmospheric concentrations of black carbon are substantially higher in spring than summer in the Arctic

[2023]

Juranyi et al., 2023 - Nature Communication

Atmospheric and Surface Processes, and Feedback Mechanisms Determining Arctic Amplification: A Review of First Results and Prospects of the (AC)3 Project

[2022]

Wendisch et al., 2022 - Bulletin of the American Meteorological Society

Regional characteristics of fine aerosol mass increase elucidated from long-term observations and KORUS-AQ campaign at a Northeast Asian background site

[2022]

Lim et al., 2022 - ELEMENTA

Technical note: sea salt interference with black carbon quantification in snow samples using the single particle soot photometer

[2021]

Zanatta et al., 2021 - Atmospheric Chemistry and Physics

AMAP Assessment 2021: Impacts of Short-lived Climate Forcers on Arctic Climate, Air Quality, and Human Health

[2021]

AMAP, 2021. Arctic Monitoring and Assessment Programme (AMAP)

Arctic black carbon during PAMARCMiP 2018 and previous aircraft experiments in spring

[2021]

Ohata et al., 2021 - Atmospheric Chemistry and Physics

Comparison of co–located rBC and EC mass concentration measurements during field campaigns at several European sites

[2021]

Pileci et al., 2021 - Atmospheric Measurement Techniques

Measurements and Modeling of Optical-Equivalent Snow Grain Sizes under Arctic Low-Sun Conditions

[2021]

Jäkel et al., 2021 - Remote Sensing

Add a description here...

Variability in the mass absorption cross section of black carbon (BC) aerosols is driven by BC internal mixing state at a central European background site (Melpitz, Germany) in winter

[2021]

Yuan et al., 2021 - Atmospheric Chemistry and Physics

Airborne survey of trace gases and aerosols over the Southern Baltic Sea: from clean marine boundary layer to shipping corridor effect

[2020]

Zanatta et al., 2020 - Tellus

The Arctic cloud puzzle: Using ACLOUD/PASCAL multiplatform observations to unravel the role of clouds and aerosol particles in Arctic amplification

[2020]

Wendisch et al., 2020 - Bulletin of the American Meteorological Society

Combining atmospheric and snow radiative transfer models to assess the solar radiative effects of black carbon in the Arctic

[2020]

Donth et al., 2020 - Atmospheric Chemistry and Physics

High Arctic aircraft measurements characterising black carbon vertical variability in spring and summer

[2019]

Schulz et al., 2019 - Atmospheric Chemistry and Physics

Droplet activation behaviour of atmospheric black carbon particles in fog as a function of their size and mixing state

[2019]

Motos et al., 2019 - Atmospheric Chemistry and Physics

The importance of the representation of air pollution emissions for the modeled distribution and radiative effects of black carbon in the Arctic

[2019]

Schacht et al., 2019 - Atmospheric Chemistry and Physics

A comprehensive in situ and remote sensing data set from the Arctic CLoud Observations Using airborne measurements during polar Day (ACLOUD) campaign

[2019]

Ehrlich et al., 2019 - Earth System Science Data

Infrared-absorbing carbonaceous tar can dominate light absorption by marine-engine exhaust

[2019]

Corbin et al., 2019 - Atmospheric Chemistry and Physics

Deposition of ionic species and black carbon to the Arctic snowpack: combining snow pit observations with modeling

[2019]

Jacobi et al., 2019 - Atmospheric Chemistry and Physics

EU Action on Black Carbon in the Arctic, 2019. Review of Observation Capacities and Data Availability for Black Carbon in the Arctic Region: EU Action on Black Carbon in the Arctic – Technical Report 1

[2019]

Tørseth et al., 2019 - AMAP report

Effects of mixing state on optical and radiative properties of black carbon in the European Arctic

[2018]

Zanatta et al., 2018 - Atmospheric Chemistry and Physics

Size-resolved mixing state of black carbon in the Canadian high Arctic and implications for simulated direct radiative effect

[2018]

Kodros et al., 2018 - Atmospheric Chemistry and Physics

Brown and black carbon emitted by a marine engine operated on heavy fuel oil and distillate fuels: optical properties, size distributions, and emission factors

[2018]

Corbin et al., 2018 - Journal of Geophysical Research

Trace Metals in Soot and PM2.5 from Heavy-Fuel-Oil Combustion in a Marine Engine

[2017]

Corbin et al., 2017 - Journal of the American Chemical Society

Source attribution of Arctic black carbon constrained by aircraft and surface measurements

[2017]

Xu et al., 2017 - Atmospheric Chemistry and Physics

A European aerosol phenomenology-5: Climatology of black carbon optical properties at 9 regional background sites across Europe

[2016]

Zanatta et al., 2016 - Atmospheric Environment

Ice residual properties in mixed-phase clouds at the high-alpine Jungfraujoch site

[2016]

Kupiszewski et al., 2016 - Journal of Geophysical Research

Refractory black carbon mass concentrations in snow and ice: method evaluation and inter-comparison with elemental carbon measurement

[2014]

Lim et al., 2014 - Atmospheric Measurement Techniques

Single Particle Soot Photometer intercomparison at the AIDA chamber

[2012]

Laborde et al., 2012 - Atmospheric Measurement Techniques

DIGITAL SKILLS

Igor pro / Panoply / Aerosol instrument softwares / Atmospheric Modelling

LANGUAGE SKILLS

Mother tongue(s): **Italian**

Other language(s):

English

LISTENING C2 **READING** C2 **WRITING** C1

SPOKEN PRODUCTION C2 **SPOKEN INTERACTION** C2

French

LISTENING C1 **READING** C1 **WRITING** B1

SPOKEN PRODUCTION C1 **SPOKEN INTERACTION** C1

German

LISTENING A2 **READING** A2 **WRITING** A1

SPOKEN PRODUCTION A2 **SPOKEN INTERACTION** A2

Levels: A1 and A2: Basic user; B1 and B2: Independent user; C1 and C2: Proficient user