

Virginia Vernocchi (cycle XXXIV)

Supervisor: *Prof. Paolo Prati*

PhD-project title: *Environmental and health effects of nanoparticles and bio-aerosol suspended in the atmosphere*

Preliminary title of Thesis: *Assessment of toxicity of particulate matter in the nanometric range by an Atmospheric Simulation Chamber*

REPORT OF THE FIRST YEAR

- **SCIENTIFIC ACTIVITY**

During this first year of PhD my scientific activity has been divided into two different areas.

- **Optical and thermal-optical properties of atmospheric carbonaceous compounds**

Thermal-optical analysis are widely adopted for the quantitative determination of total (TC), Organic (OC) and Elemental (EC) Carbon in aerosol samples collected on quartz fibre filters. Nevertheless, the methodology presents several issues in particular about the artefacts related to the formation of pyrolytic carbon. It is usually neglected the uncertainty due to the possible presence of Brown Carbon (BrC) in the sample under analysis, i.e. the optically active fraction of OC produced by biomass burning and with characteristics intermediate between OC and EC.

The thermal-optical Sunset EC/OC analyzer unit presents in our laboratory has been modified, making possible the alternative use of the standard laser diode at $\lambda = 658$ nm or of a laser diode at $\lambda = 405$ nm, to monitor the optical transmittance during the thermal-optical analysis. The additional use of the 405 nm transmittance measurement provides valuable information about the composition of the sample (i.e. the presence of Brown Carbon (BrC)), as well as on the pyrolytic carbon formation.

The modified Sunset set-up was used in conjunction with the MWAA (Multi-Wavelength Absorbance Analyzer) instrument and its apportionment methodology to retrieve the MAC (Mass Absorption Coefficient) of Brown Carbon, at the two wavelengths of $\lambda = 635$ nm and $\lambda = 405$ nm, in a set of samples collected wintertime in a mountain site. Results were correlated with Levoglucosan concentrations determined on the same aerosol samples.

Carrying on my thesis work, where I had performed the first analysis on real samples using the new instrumental set-up, during the PhD I contributed to improve the data analysis of the results both from the testing phase on synthetic samples and of my thesis analysis. These results are published on a paper and were presented in a poster at ICCPA conference.

Adopting the same methodology, I replicated the analysis on a new set of samples. The additional step of this session of analysis were two comparisons. The first was between two of the main protocols used in the Sunset analyzer while the second was between unwashed and washed (with Milli-Q water that removes the water-soluble compounds) samples. These results were presented in a talk by P. Prati at EAC conference and will be presented at SIF conference by me.

- ChAMBRé

ChAMBRé, an atmospheric simulation chamber, is an exploratory platform which allows to study atmospheric processes under realistic but controlled, both chemical and physical, conditions, that could be maintained and monitored in real time for periods long enough to reproduce the realistic environments and to study interactions among their constituents.

My first objective was to learn how to work with ChAMBRé and with its connected instrumentation. In these terms, I collaborated on several kind of experiments. These experiments regards bacterial viability both in clean and polluted (NO – NO₂ gases) air, Secondary Organic Aerosol formation starting from α -pinene, lifetime determination of SiO₂ nano-spheres. In this way, I learnt how to control some ChAMBRé parameters and I familiarized with both the injection (i.e. Blaustein Atomizer) and analysis (i.e. Optical Particle Counter) instruments.

Results from these experiments were presented in a poster at EAC conference and will be presented in talk at SIF conference, both by S. G. Danelli.

Furthermore, I contributed to the calibration of Mass Flow Controllers and to the design and assembling of a flow control system used during injection in ChAMBRé. I started as well the design of a new optical system to be installed at ChAMBRé to irradiate the chamber volume with a proxy (in term of spectral composition and power per unit area) of the solar light.

- **PUBLICATIONS**

- Massabò, D., Altomari, A., Vernocchi, V., and Prati, P.: *Two-wavelength thermal-optical determination of Light Absorbing Carbon in atmospheric aerosols*, Atmos. Meas. Tech., 12, 3173-3182, 2019. <https://doi.org/10.5194/amt-12-3173-2019>.

- **CONFERENCES**

- **Poster** @ICCPA2019 (International Conference on Carbonaceous Particles in the Atmosphere), Vienna. *Two-wavelength thermal-optical determination of Black and Brown Carbon in atmospheric aerosols*: V. Vernocchi, D. Massabò, A. Altomari, P. Prati
- **Talk** @SIF2019 (105° Congresso Nazionale della Società Italiana di Fisica), L'Aquila. *Determinazione termo-ottica a più lunghezze d'onda di Elemental, Organic e Brown Carbon*: V. Vernocchi, M. Brunoldi, D. Massabò, P. Prati.

- **COURSES, EXAMS AND SCHOOLS**

- Analisi multivariata dei dati chimici (exam given)
- Statistica per analisi dati (exam expected to be given by October)
- “Basic Aerosol Science” – Summer School 2019, Universität Wien, Vienna

- **OTHER COURSES**

- Course on scientific communication skills (4 h)
Speaker: Roman Krahne (IIT)
- Environmental accounting (5 h)
Speaker: Sergio Ulgiati (UniParthenope)

- Capire e migliorare l'uso dell'analisi dati nella ricerca e l'insegnamento con JMP – Workshop (2 h)
Speakers: Volker Kraft and Paolo Chiappa (JMP Academic Team)

Genoa, 16/09/2019

A handwritten signature in black ink, appearing to read "Volker Kraft".