Investigations of the spatial and temporal variations in organic aerosol sources within Europe using 23 long-term ACSM datasets

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Atmospheric aerosols are a mixture of gases and suspended liquid or solid particles, which not only cause serious adverse health effects, but can also reduce visibility, and interact with ecosystems and climate (IPCC, 2014). However, European countries are still suffering from poor air quality: 68% of air quality monitoring stations within Europe exceed the annual $PM_{2.5}$ value of the WHO guidelines (10 μg/m^3) (European Environment Agency, 2018). Organic aerosol (OA) is one of the major components of aerosols since it makes up 20 to 90% of the total submicron aerosol mass (Jimenez et al., 2009). The information of OA sources is extremely valuable for policymakers to design effective mitigation strategies for the air quality issues. In addition, comprehensive knowledge of the OA sources could provide more constraints in regional and even global climate or air quality models to improve their precision and accuracy.

Europe has a well-established monitoring network (24 countries), which has more than 50 Aerosol Chemical Speciation monitors, ACSMs (Aerodyne Research Inc., MA, USA). Among these stations, there are more than 23 datasets that have long-term (>1 year) measurements since 2016 (Figure 1). With the guidance of a standardized protocol for Positive Matrix Factorization (PMF) analysis, spatial and temporal variation of OA sources across Europe could be retrieved by applying novel source apportionment (SA) techniques (a-value approach, rolling mechanism, bootstrap re-sampling, and criteria-based selection) within SoFi Pro (Datalystica Ltd., Villigen, Switzerland), a state-of-the-art software developed by Canonaco et al. (in prep.).

These SA techniques have been tested by Canonaco et al. (in prep.) and Chen et al. (in prep.) in two Swiss datasets, which helps to structure the standardized protocol, including data preparation, step-by-step guidance of SA using rolling mechanism, etc.. This approach allows the users to retrieve a more stable, robust, and time-dependent PMF solution (considering the time-evolution of the source profiles) with comprehensive uncertainty assessments.

Eventually, this project will demonstrate an up-to-date, more comprehensive picture of OA sources regarding spatial and temporal variabilities within Europe. This work will be beneficial to air quality and climate modellers as well as policymakers.

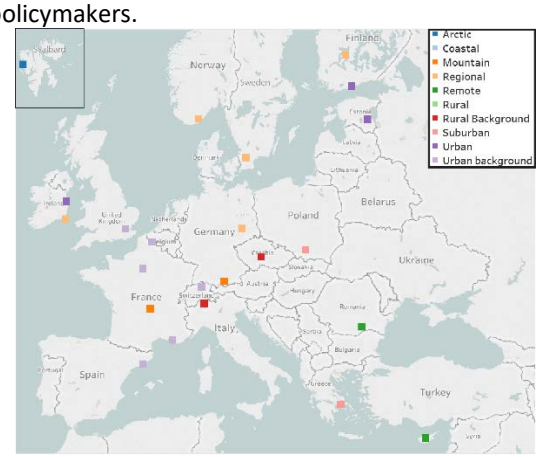

Figure 1 Map of the 23 ACSMs located in Europe, with >1 year of continuous measurements

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