



Single Particle Analysis by Combined Chemical Imaging to Study Episodic Air Pollution Events in Vienna

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The aerosol composition of a city like Vienna is characterized by a complex interaction of local emissions and atmospheric input on a regional and continental scale. The identification of major aerosol constituents for basic source appointment and air quality issues needs a high analytical effort. Exceptional episodic air pollution events strongly change the typical aerosol composition of a city like Vienna on a time-scale of few hours to several days. Analyzing the chemistry of particulate matter from these events is often hampered by the sampling time and related sample amount necessary to apply the full range of bulk analytical methods needed for chemical characterization. Additionally, morphological and single particle features are hardly accessible.

Chemical Imaging evolved to a powerful tool for image-based chemical analysis of complex samples. As a complementary technique to bulk analytical methods, chemical imaging can address a new access to study air pollution events by obtaining major aerosol constituents with single particle features at high temporal resolutions and small sample volumes. The analysis of the chemical imaging datasets is assisted by multivariate statistics with the benefit of image-based chemical structure determination for direct aerosol source appointment. A novel approach in chemical imaging is combined chemical imaging or so-called multisensor hyperspectral imaging, involving elemental imaging (electron microscopy-based energy dispersive X-ray imaging), vibrational imaging (Raman micro-spectroscopy) and mass spectrometric imaging (Time-of-Flight Secondary Ion Mass Spectrometry) with subsequent combined multivariate analytics.

Combined chemical imaging of precipitated aerosol particles will be demonstrated by the following examples of air pollution events in Vienna: Exceptional episodic events like the transformation of Saharan dust by the impact of the city of Vienna will be discussed and compared to samples obtained at a high alpine background site (Sonnblick Observatory, Saharan Dust Event from April 2016). Further, chemical imaging of biological aerosol constituents of an autumnal pollen breakout in Vienna, with background samples from nearby locations from November 2016 will demonstrate the advantages of the chemical imaging approach. Additionally, the chemical fingerprint of an exceptional air pollution event from a local emission source, caused by the pull down process of a building in Vienna will unravel the needs for multisensor imaging, especially the combinational access. Obtained chemical images will be correlated to bulk analytical results. Benefits of the overall methodical access by combining bulk analytics and combined chemical imaging of exceptional episodic air pollution events will be discussed.