

Characterization of winter organic and inorganic aerosols in Galway, Ireland with an Aerosol Chemical Speciation Monitor

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An Aerodyne Aerosol Chemical Speciation Monitor (ACSM) was deployed in NUI Galway, Ireland (Figure 1a) for characterization of winter organic and inorganic aerosols. The non-refractory submicron aerosol (NR-PM₁) species, i.e., organics, sulfate, nitrate, ammonium, and chloride were measured in situ at a time resolution of 30 min from 16 October to 23 November, 2015. As shown in Figure 1b and 1c, meteorology (wind direction and wind speed) plays an important role in causing the variations in NR-PM₁ concentrations. Clean Atlantic air masses usually feature high wind speed thus lead to a decrease in NR-PM₁. While high aerosol loadings are associated with low wind speed.

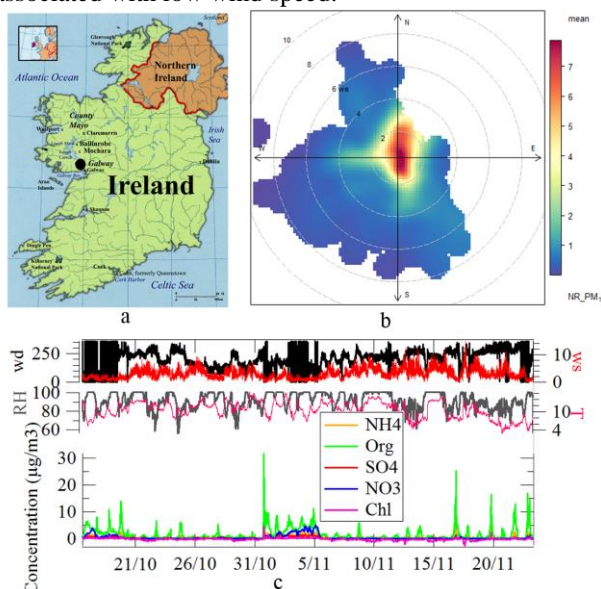


Figure 1. (a) The location of NUI Galway are shown in the Ireland map and marked by a solid black dot; (b) The concentration of NR-PM₁ associated with wind rose; (c) Meteorological parameters (wind direction, wind speed, relative humidity and temperature) and aerosol mass concentration of Organics, sulfate, nitrite, ammonium and chloride.

It is worth noting that negative chloride values are associated with high wind speed air masses from Atlantic Ocean and might be a result of sea salt effects. In contrast, positive chloride values are associated with the air masses from east due to ammonium chloride contribution. Organic aerosols (OA) dominate NR-PM₁ (60% of NR-PM₁ mass). Positive matrix factorization (PMF) analysis with the multiline engine (ME-2) was then conducted on the ACSM organic mass spectral data set.

Preliminary, three OA components were identified, including peat burning-like organic aerosols (POA) (41% of the organic aerosol mass), biomass burning-like organic aerosols (BBOA) (29%) and oxygenated organic aerosols (OOA) (30%). The time series of OOA correlates well with sulfate and nitrate with a Pearson's R of 0.82 and 0.83 respectively, indicating its regional sources. The OOA factor presents the least-marked diurnal variation of all factors, peaking mainly during nighttime and likely driven mainly by boundary layer dynamics and possibly chemical processing. The use of peat for residential heating is related to the access to local source of turf and high density of peatland in west Ireland. The diurnal variation of POA prevailing during night conforms that POA is contributed by residential heating. The profile of BBOA is similar to that reported by Ng et al. (2011). BBOA peaks in the evening like POA, indicating its residential heating sources. The source apportionment of OA suggests that low burning efficiency of wood and peat results in a significant contribution to NR-PM₁ aerosol mass despite their minor use in residential heating (70% and 40% of the total OA mass and NR-PM₁ mass, respectively). Further detailed PMF analysis will be performed to investigate the absence of HOA or SV-OOA sources.

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Ng, N. L., Herndon, S. C., Trimborn, A., Canagaratna, M. R., Croteau, P. L., Onasch, T. B., Sueper, D., Worsnop, D. R., Zhang, Q., Sun, Y. L., and Jayne, J. T., *Aerosol Science and Technology*, 45, 780-794, 10.1080/02786826.2011.560211, 2011.

Dall'Osto, M., Ovadnevaite, J., Ceburnis, D., Martin, D., Healy, R. M., O'Connor, I. P., Kourtchev, I., Sodeau, J. R., Wenger, J. C., and O'Dowd, C., 13, 4997-5015, 10.5194/acp-13-4997-2013, 2013.