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Atmospheric Chemistry and Physics Discussions

Interactive comment on "Wintertime aerosol dominated by solid fuel burning emissions across Ireland: insight into the spatial and chemical variation of submicron aerosol" *by* Chunshui Lin et al.

Anonymous Referee #1

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This study analyzes aerosol measurement data collected from four sites in Ireland during different winter periods. Aerosol sources were determined through PMF/ME2 analysis of the ACSM organic aerosol data. From these results, the authors discuss the spatial and chemical variations of PM1 in Ireland. The scope of this work fits well within ACP and the findings could have important implicates for air quality policies and mitigation strategies in Ireland. However, this manuscript has a major problem with its experimental section short of some crucial technical details. As a major focus of this work is source apportionment analysis of the ACSM data, it is imperative that the

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Discussion paper

manuscript provide thorough discussions on how the results are evaluated and justified. The current discussions are mostly qualitative and sometimes rather subjective. A systematic evaluation of different solutions and the decisions to choose should be provided. Important issues commonly associated with PMF/ME-2 source apportionment results, such as rotational ambiguity, mixing and splitting of factors, and uncertainties in source contribution estimations should also be examined and discussed. Further, relevant literatures on the PMF method and its applications in aerosol mass spectrometer data analysis should be cited as well.

Since the measurements were conducted in different years, how does the discussions on aerosol spatial variations affected by the fact that aerosol composition and concentration often change considerably from one year to another?

Line 15 on page 3, how was the "urban background site" defined, based on the distance from the city center or some other characteristics of the location?

Section 2.1, mention the distance between the Dublin and the Carnsore Point sites.

Line 10 -12 on page 4, please elaborate on the usage of the Jan 2016 BC data to infer the BC level in 2013, how exactly was it done and under what assumption?

Line 17 – 24 on page 4, the method for determining BCtr and BCwb needs better explanation. The current text is hard to make senses of. Particle absorptions are contributed by both black carbon and brown carbon species. What's the rationale for using absorptions at 470 nm and 880 nm to calculate BCtr and BCwb.

Line 18 -23 on page 4, be specific about the wavelengths used to calculate the AAE values as the number is probably dependent on the pair of wavelength chosen for the calculation.

The HOA discussions on page 6 and 7 need revision. The physical meaning of the HOA factor resolved in Dublin is a bit confusing and some of the discussions are unconvincing and problematic. Dublin is a large city, yet no morning traffic feature is visible in the

HOA diurnal plot. The much larger increase of HOA relative to BC increase at night suggests sources in addition to traffic. The authors jumped to the conclusion of oil heating being a major contributor to nighttime HOA but did not give proper justification. Also, given the large non-traffic influence on the HOA factor, the usage of the HOA/BCtr values to associate HOA with diesel emissions is too speculative. Related texts should be removed.

Page 7, Line 11-12, the sentence "The coal profile featured an f60 of nearly zero which was due to the complete decay of vegetation during coal formation." is difficult to comprehend. Please clarify. Also, an important tracer ion for coal burning OA is C9H7 at m/z 115. What's the behavior of this ion? Is it elevated in the coal burning OA factor?

Page 7, line 24 – 25, this sentence is out of context and the citation of Weimer et al. 2008 is incorrect. The spectra of OOA and BBOA from smoldering burning usually show considerable differences, such as f60 and f73. Weimer et al. mentioned the high m/z44 and little 60 and 73 in the OA spectra of automatic furnace, where the burning condition was unlikely smoldering. Besides, since OA emission is much reduced in the flaming combustion of biomass, gas CO2 contribution could significantly influence the acquired OA spectra. This issue has been discussed extensively in recent papers.

Page 8 line 13, what is identity of the sea salt fragmentation ion at m/z 83?

Figure 3 caption, spell out the differences between BCtr and BCwb.

Figure 5, how far apart are Dublin and Carnsore Point? Is there a basis to assume air pollutants are related between the two locations?

Figure S5, the big drop of r values at a = 0.4 suggests misassignment of the factors.

Figures S3-S5, S8, S9, specify which dataset in the figure caption.

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