$PM_{2.5}$ source apportionment and transport cluster analysis in Gothenburg, Sweden

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Background: Source apportionment studies of PM are common and have either been performed as source region analyses (where the pollution originates from) or by source type (e.g. combustion, wood burning, sea salt, etc.). The first type use air mass back trajectories and the latter one uses source apportionment techniques such as PCA, CMD or PMF. However, by combining the two approaches it is possible to estimate the relative importance of emitters in different regions.

Methods: In this study we have collected one year of daily $PM_{2.5}$ samples in Gothenburg, Sweden and made elemental analysis of the samples using EDXRF. Source apportionment was carried out using Positive matrix factorisation (PMF) with the US EPA PMF5.0 software. The sources LRT, LRT-Pb (lead containing LRT), ship emissions, sombustion, marine, and resuspension were identified. We also calculated air mass trajectories using the HYSPLIT (version 4.9) model (Draxler, 1999). Six transport clusters were identified, South Scandinavia (S-Scandic), North Scandinavia (N-Scandic), Baltic Sea (BalticS), eastern Europe (E-Eur), UK/North Sea/Denmark (UK-NorthS-DK) and North Atlantic Ocean (N-Atlantic), as described in Tang *et al.* (2014). The frequency of occurrence was 28, 21, 107, 38, 76, and 91 days respectively.

Results and Discussion: From the PMF analysis we found that LRT is the dominating contributor to the $PM_{2.5}$ in Gothenburg, and across all transport clusters (Figure 1). LRT contributes 48 % of the total $PM_{2.5}$ in Gothenburg followed by ship emissions (20%) and combustion (19%).

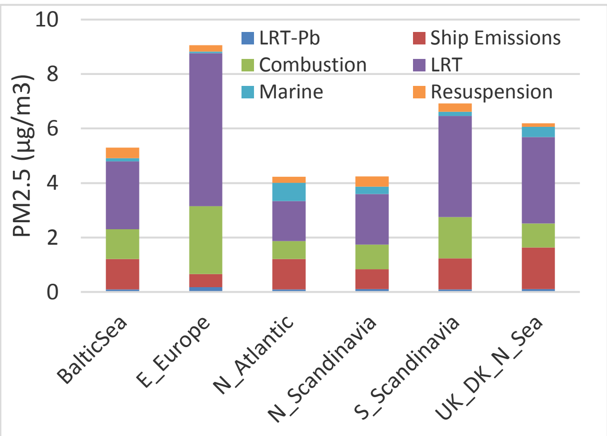

Figure 1. Mean source contribution to $PM_{2.5}$ from the six transport clusters.

The transport cluster associated with the highest $PM_{2.5}$ concentrations was E-Eur followed by S-Scandic, UK-NorthS-DK, and BalticS (Figure 1). After considering the frequency of the transport clusters during the study period, the transport clusters associated with the highest $PM_{2.5}$ concentrations were UK-NorthS-DK, S-Scandic and N-Atlantic, while E-Eur only contributed 9 % towards $PM_{2.5}$ concentrations (Figure 2).

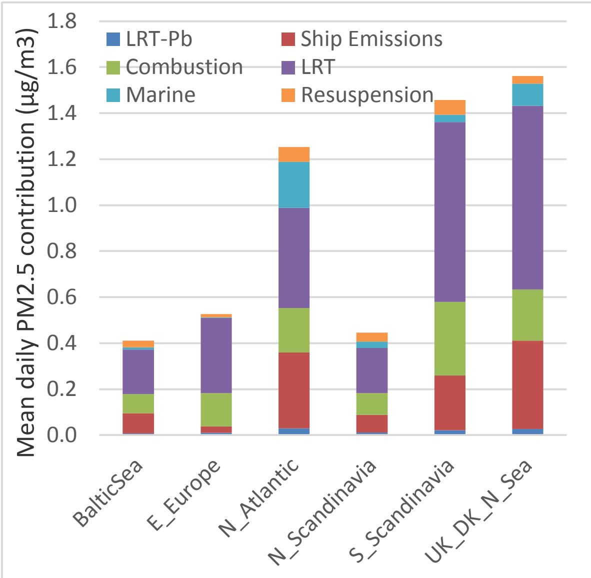

Figure 2. Mean daily source contribution to $PM_{2.5}$ from the six transport clusters. Number of days from each transport cluster were (from left to right) 28, 21, 107, 38, 76, and 91 days.

Draxler, R.R., 1999. HYSPLIT4 User's Guide. NOAA Tech. Memo. ERL ARL-230. NOAA Air Resources Laboratory, Silver Spring, MD.

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