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Source apportionment of $PM_{2.5}$ at a regional background site in North China using PMF linked with radiocarbon analysis: insight into the contribution of biomass burning

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Test S1

Uncertainty of PMF modeling was usually estimated by bootstrapping (BS), displacement (DISP), and bootstrapping with displacement (BS-DISP). As shown in table S1, the percentage of BS factors assigned to each base case factor ranges from a low value of 93% for sea salt to a high of 100% for vehicle emission, traffic emission, industrial process, mineral dust and coal combustion; and there are no unmapped BS factors. About DISP, after strong-weighted species were displaced, no factors swaps were reported for any of the allowed dQ_{max} examined by the model (fixed 4, 8, 16. 32 in this study). Besides, only two and one factors swaps were found for sea salt and biomass burning, respectively, for each allowed dQ_{max} examined by modeling (fixed 0.5, 2, 4. 8 for BS-DISP analysis in this study), while no factors swaps were found in other factors. All these error estimates results were well within the range of stable solution of PMF model, demonstrating the effectiveness of the model results in this study.

Table S1 Percentage of BS factors assigned to each base case factor with a correlation threshold of 0.6

Boot Factor	Vehicle emission	Traffic dust	Ship emission	Industrial process	Biomass burning	Mineral dust	Coal combustion	Sea salt	Unmapped
1	100	0	0	0	0	0	0	0	0
2	0	100	0	0	0	0	0	0	0
3	0	0	96	0	4	0	0	0	0
4	0	0	0	100	0	0	0	0	0
5	0	0	0	0	99	0	0	1	0
6	0	0	0	0	0	100	0	0	0
7	0	0	0	0	0	0	100	0	0
8	0	0	0	0	7	0	0	93	0

Table S2 Statistics of $PM_{2.5}$ chemical components on the Qimu Island during the sampling period

Species	Mean ± std. (μg m^{-3})	Range (μg m^{-3})	Species	Mean ± std (ng m^{-3})	Range (ng m^{-3})
$PM_{2.5}$	77.6 ± 59.3	12.7 – 305	Fe	408 ± 285	7.12 – 1588
SO_4^{2-}	14.2 ± 18.0	1.37 – 96.2	Zn	107 ± 142	5.56 – 987
NO_3^-	11.9 ± 16.4	0.270 – 87.1	Pb	88.4 ± 85.7	3.02 – 412
NH_4^+	3.11 ± 2.14	0.610 – 10.1	Mn	29.3 ± 28.0	1.38 – 108
Cl^-	2.06 ± 1.78	0.100 – 8.90	Cu	9.08 ± 11.4	0.03 – 77.6
K^+	0.961 ± 0.84	0.07 – 3.95	Ti	7.72 ± 7.34	0.01 – 30.7
Na^+	0.430 ± 0.25	0.05 – 1.58	As	6.61 ± 7.86	0.67 – 43.4
Ca^{2+}	0.379 ± 0.22	0.07 – 1.32	Ni	4.28 ± 2.30	1.68 – 13.8
Mg^{2+}	0.03 ± 0.03	0.01 – 0.17	V	3.90 ± 2.47	0.450 – 12.5
OC	6.85 ± 4.81	0.810 – 21.3	Cd	1.82 ± 4.06	0.04 – 25.9
EC	4.90 ± 4.11	0.800 – 19.6	Co	0.240 ± 0.180	0.01 – 0.73