中国中部汾渭盆地某市大气黑碳浓度移动监测、健康风险评估和来源分析

Mobile monitoring atmospheric Black Carbon concentrations, health risk assessment and source analysis in one city of the Fenwei Basin, in central China

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Background

Black carbon (BC) is one of the most harmful components in air pollutant, coming from combustion of fossil fuels and biomass.

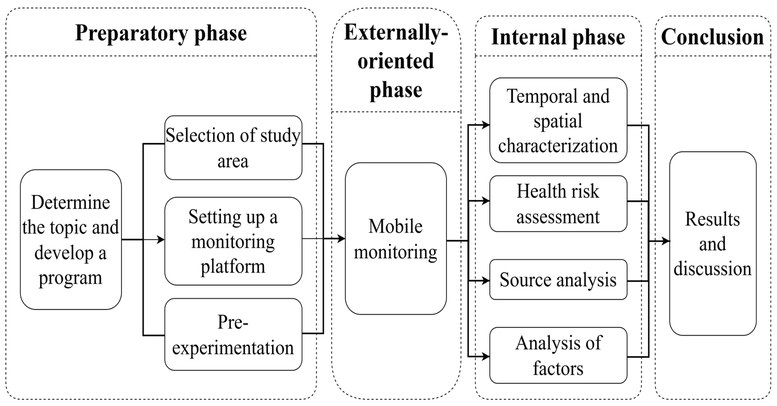
According to the Action Plan for Continuous Improvement of Air Quality issued by the State Council of China in 2023, the PM2.5 concentration in the Fenwei Plain will be reduced by 15% by 2025 compared to 2020, which makes the task of air quality improvement very urgent.

Current research on BC is dominated by remote sensing inversion and ground-based monitoring methods, with limited mobile monitoring to obtain high-resolution data on spatial gradients and time-varying features.

Objective

①Identify spatial and temporal distribution and hotspot areas of atmospheric BC in urban environments.
②Assess the health risk of atmospheric BC.
③Analyze the sources and influencing factors of atmospheric BC.

Technological route



Experimental procedure

Mobile monitoring

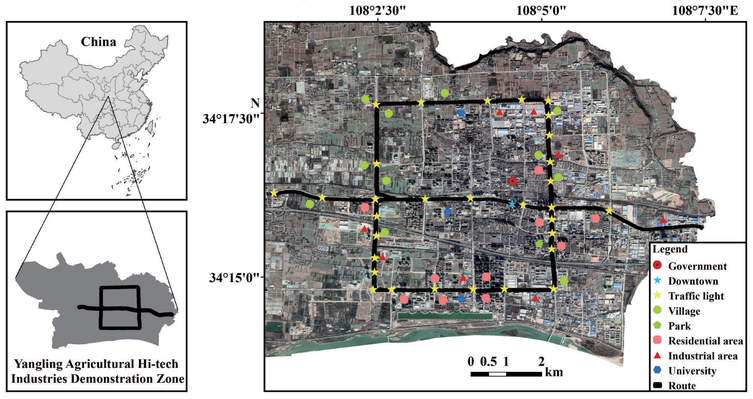


Fig. 1 Spatial distribution of the transect of black carbon concentration monitoring in Yangling

Mobile monitoring platform

Semantic segmentation

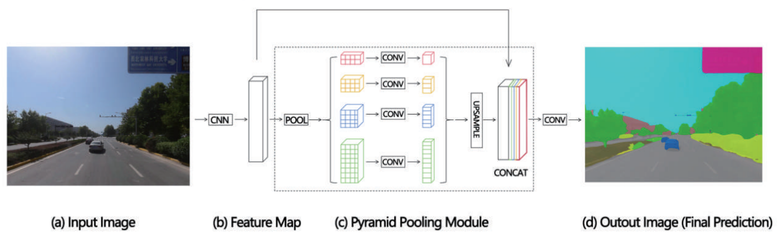


Fig. 2 Spatial distribution of the transect of black carbon concentration monitoring in Yangling

Practical software　ArcGIS　Origin　microAeth Manager

Results

Result1：Distributional characteristics in time and space

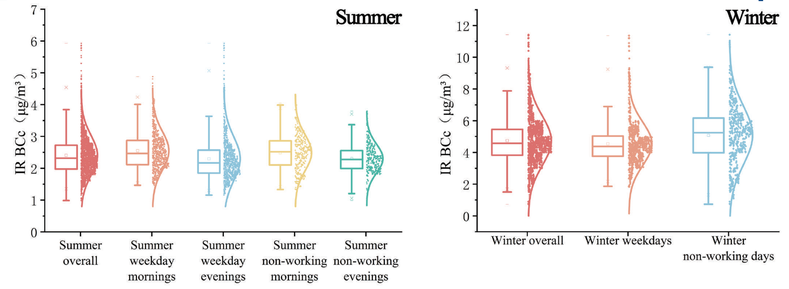


Fig. 3 Spatial distribution of the transect of black carbon concentration monitoring in Yangling

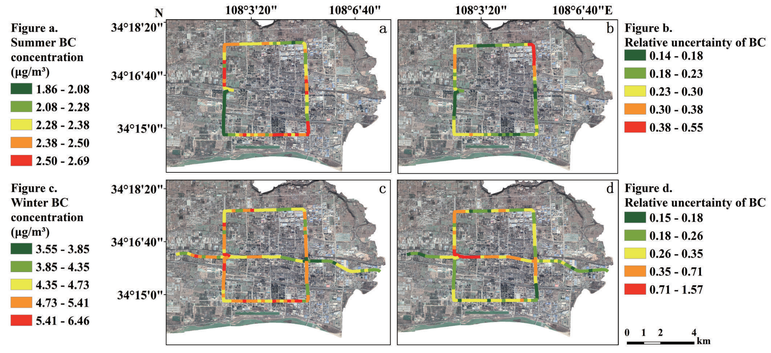


Fig. 4 Spatial distribution of atmospheric black carbon (BC) concentration and relative uncertainty in Yangling during summer (a-b) and winter (c-d).

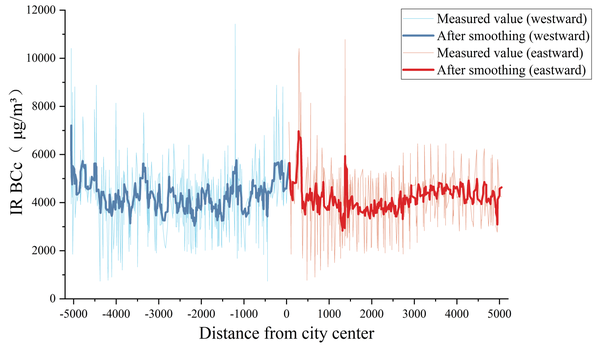


Fig. 5 Atmospheric black carbon (BC) distribution with different distances from city center.

Result2：Health risk evaluation

Tabel 1 BC Health risks expressed with N_{PSC}

	LBW	PLFD	CM	LC	Arithmetic mean
Summer overall	3.20±2.30	7.06±5.08	3.55±2.55	1.78±1.28	3.89±2.80
Summer weekday mornings	3.64±1.94	8.04±4.28	4.04±2.15	2.03±1.10	4.44±2.36
Summer weekday evenings	2.98±2.88	6.57±6.35	3.30±3.19	1.65±1.60	3.63±3.51
Summer non-working mornings	3.40±1.81	7.50±4.00	3.77±2.01	1.89±1.01	4.14±2.21
Summer non-working evevings	2.79±1.46	6.16±3.32	3.10±1.62	1.55±0.81	3.40±1.80
Winter overall	11.60±6.96	25.61±15.36	12.87±7.72	6.44±3.86	14.13±8.47
Winter weekday mornings	11.52±6.87	25.44±15.19	12.79±7.63	6.40±3.82	14.04±8.38
Winter non-working mornings	11.74±7.09	25.91±15.66	13.02±7.87	6.52±3.3.94	14.30±8.64

Result3：Source analysis

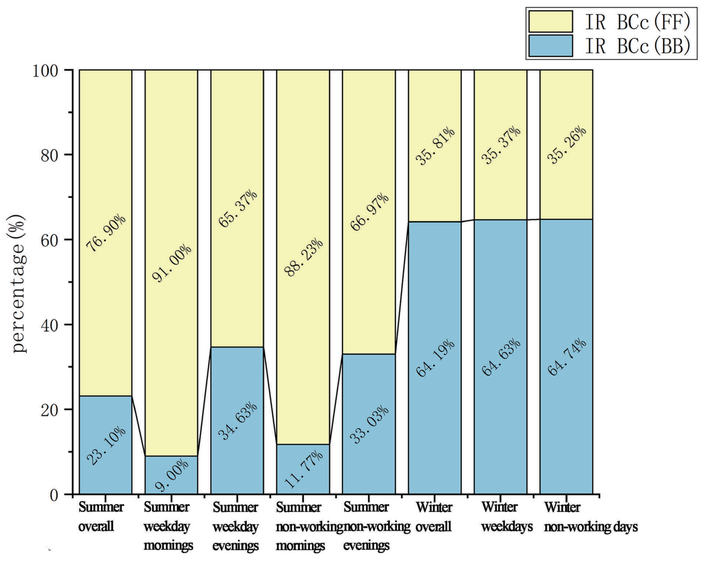


Fig. 6 Changes in BC sources in the study area during different time periods.

Result4：Potential factors

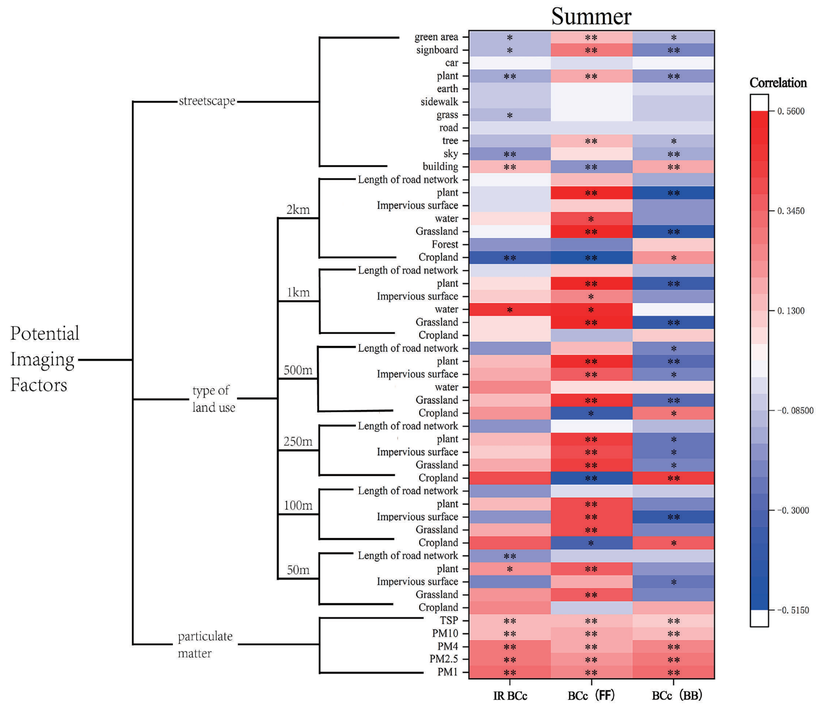


Fig. 7 BC concentrations correlate with various impact factors across buffers.

Fig. 8 Winter BC concentrations in urban areas correlate with impact factors at various buffer distances.

Conclusions

1. Near-surface BC concentrations were lower in the summer than in the winter and lower in the evening than in the morning in Yangling, while the difference between non-working days and working days was not significant.
2. There is a health risk of BC in Yangling, and this health risk is directly related to BC concentrations, with a greater impact on children.
3. BC sources in the Yangling. are primarily from fossil fuels in the summer and biomass fuels in the winter. The share of fossil fuels is higher in the morning than in the evening in summer. Differences in BC sources among weekday non-workdays were not significant.
4. There are a number of factors that influence the concentration of BC and its different components, in short, an environment that favors diffusion is more likely to result in lower BC concentrations.

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