

Supplementary Materials: Synergistic Effects of Urban-Rural Divide on Outdoor Airborne Bioaerosol Diffusion: A Case Study in the Monsoon Region of China

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Table S1. Air PM concentration and Meteorological data of sampling sites with 9 land use types in FX city.

No.	Land Use Types	PM _{1.0} /PM _{2.5} /PM ₁₀ Concentration (µg/m ³)	WS (m/s) /WD	T(°C)/RH(%)	Atmosphere pressure (Kpa)
1	Railway station	39/70/134	3-4/S	3.06/41.3	99.23
2	Shopping square	21/35/64	0.5/WSS	9.73/34	99.51
3	Campus	62/120/202	0.39/EES	9.7/59	100.05
4	Residential Park	13/24/39	1.0/WWN	9.63/35.6	98.87
5	Farm land	12/25/33	0.05/N	5.28/43.5	99.32
6	Y artificial wet land	13/26/46	1.2/WWN	9.59/37	98.88
7	M artificial wetland	10/28/54	0.12/N	15.5/21	101.46
8	N natural wet land	4/8/11	0.05/N	9.43/34.5	99.26
9	FSSK reservoir	63/103/169	2.98/WSS	12.18/53.4	99.92

Table S2. Air PM concentration and meteorological data of sampling sites with 3 land use types in GZ city.

Land Use Types	PM _{1.0} /PM _{2.5} /PM ₁₀ Concentration (µg/m ³)	Wind speed/Wind direction	T(°C)/RH(%)	Atmosphere pressure (Kpa)
Subway station (Metro)	39/70/134	3-4/S	3.06/41.3	99.23
Citizens Park (Park)	13/24/39	1.0/WWN	9.63/35.6	98.87
Water reservoir (River/Wetland)	63/103/169	2.98/WSS	12.18/53.4	99.92

Table S3. Diversity, richness and bacterial concentration of sampling sites within sampling area atmospheres in GZ city and FX city.

No.	Land Use Types	Biological Diversity			
		Simpson Index	Shannon Index	Simpson Index	Shannon Index
				GZ City	FX City
1	Railway station (GTZ)	0.9592	6.673	0.9773	7.5824
2	Shopping mall (WD)				
3	Campus (NXQ)	0.9643	7.0133		
4	Citizen Park (YL)				
5	Farm land (NT)				
6	M wetland (FSSK)	0.9071	6.0417	0.9798	7.6629
	N wetland (NDH)				
7	Y wetland (YL)	0.9375	6.0499	0.971	7.0858
	Reservoir/				
	Streamway				
	Air	0.9734	6.915	0.9748	7.4213
	Water				
	Soil				

Table S4. Airborne cultivable fungal and bacterial species information in aerosol in FX city in 2021.

Genera	Species	Percent Identity (%)	GenBank Accession	Fungi /Bacteria	Sampling Site and Anderson Level
Bipolaris	<i>Bipolaris sorokiniana ND90Pr</i>	100%	EMD58209.1	fungi	FSSK-1-1-ITS
Fumigati	<i>Aspergillus fumigatus</i>	100%	KAH1333244.1	fungi	FSSK-4-1-ITS
Fumigati	<i>Aspergillus fumigatus</i>	100%	KAH1333244.1	fungi	FSSK-4-2-ITS
Fumigati	<i>Aspergillus fumigatus</i>	100%	KAH1333244.1	fungi	FSSK-4-4-ITS
Aspergillus	<i>Aspergillus awamori</i>	100%	GCB24478.1	fungi	FSSK-4-5-ITS
Fumigati	<i>Aspergillus fumigatus</i>	100%	KAH1333244.1	fungi	FSSK-4-6-ITS
Aspergillus	<i>Aspergillus awamori</i>	100%	GCB24478.1	fungi	FSSK-4-7-ITS
Bacillus	<i>Bacillus cereus</i>	100%	QDZ77395.1	bacteria	YMT-6-1-16S
Lactobacillus	<i>Staphylococcus epidermidis</i>	100%	ATQ59040.1	bacteria	YMT-6-1-16S
Bacillus	<i>Bacillus cereus</i>	98.68%	ARO16084.1	bacteria	CAMPUS-2-4-16S

Table S5. On-site monitored airborne cultivable fungal and bacterial species information in aerosol in campus of FX city in the winter of 2022.

City	Airborne bioaerosol concentration (CFU/m ³)	Temperature (°C)	Humidity (RH%)	Pressure (KPa)	PM1.0/PM2.5/PM10 (µg/m ³)	Sampling Time
FX	177	3.29	65.1	99.58	57/97/168	9:00 am, 24 November 2022
FX	225	4.72	75.0	99.41	77/147/255	14:00 pm, 24 November 2022
FX	247	3.75	78.4	99.20	86/154/264	18:40 pm, 24 November 2022
Mean concentration	216				73/133/229	

Table S6. On-site monitored airborne cultivable fungal and bacterial species information-based simulation boundary settings and outputs in CFD.

Specification of Sites		Boundary Settings of Inlet			Outputs of Inlet Averaged (N wind speed: 2.5 m/s)		
City/site	Referred bioaerosol concentration (CFU/m ³)	Temperature (°C)	Bioaerosol flow rate (g/s)	Bioaerosol emission velocity (m/s)	Bioaerosol diameter range (rosin-rammler)	Bioaerosol concentration C _m (kg/m ³)	Bioaerosol concentration C _c (CFU/m ³) *
FX/GTZ	1200	5	0.125	0.25	Min:4e-7, Medium:	4.12e-7	1214
GZ/DT	400	20	0.025	0.25	1e-5, Max:2.5e-6	4.30e-7	411

*: Bioaerosol concentration was transformed from the mass concentration based on Tables S1 and S2, in this study, a transform coefficient \bar{i} was assumed as 0.95 CFU/µg, based on an equation ($C_c = C_m \times \bar{i} \times 10^9$).

Table S7. Additional initial condition, operating condition and boundary condition of the GIS-CFD simulation in this study.

Initial Condition	Operating Condition	Boundary Condition	Else
Wind speed: 2.5 m/s	Viscous model: k-omega model	Inlet: velocity inlet	Exposure Risks Calculation Is based on Equations (1)–(3)
Wind direction: N	k-omega option: intermittency transition model, SST	Outlet: pressure outlet	
Temperature: 298 K	Discrete phase: on Fluid: air Internal particle: ash-solid	Time step size (s): 0.001; Number of Time steps: 10,000	
Emission velocity:0.25m/s	Interaction: Interaction with continuous phase	Time stepping method: fixed	

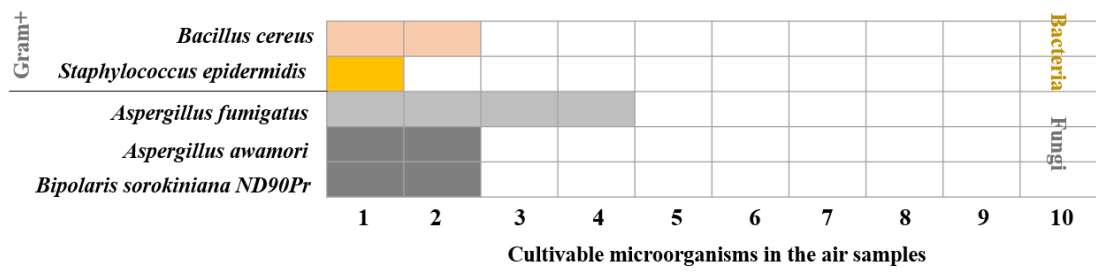


Figure S1. Frequency of isolation of dominant cultivable bacterial and fungi species in air samples of FX city.