



Supplement of

The role of dust mineral composition in atmospheric radiation and pollution in North China: new insights from EMIT and two-way coupled modeling

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Supplement

Table S1. Model setups and inputs for the WRF-CHIMERE model.

		WRF-CHIMERE
Domain	Horizontal grid spacing	27 km (165 × 87)
configuration	Vertical resolution	33 levels
Physics	Shortwave radiation	RRTMG
parameterization	Longwave radiation	RRTMG
	Cloud microphysics	Thompson
	PBL	YSU
	Cumulus	Grell-Freitas
	Surface	Monin-Obukhov
	Land surface	Noah LSM
	Icloud	Xu-Randall method
Chemistry	Aerosol mechanism	SAM
scheme	Aerosol size distribution	Sectional (10 bins)
	Aerosol mixing state	Core-Shell
	Gas-phase chemistry	MELCHIOR2
	Photolysis	Fast-JX with cloud effects
Emission	Dust emission	Kok
Input data	Meteorological ICs and BCs	FNL
	Chemical ICs and BCs	LMDZ-INCA

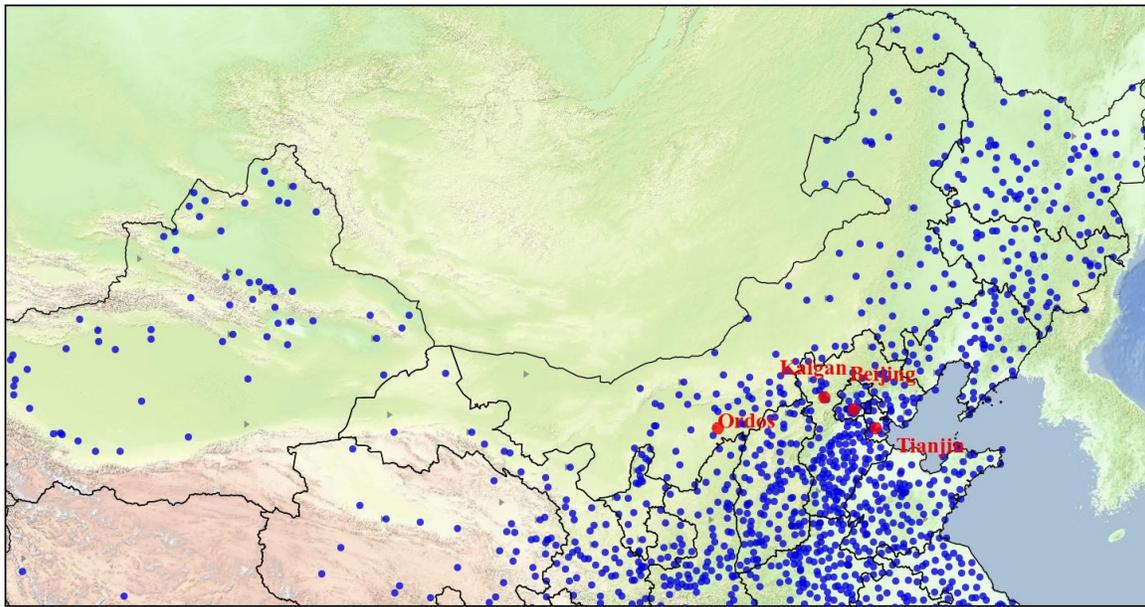
Table S2. Domain-averaged PM₁₀ concentrations with 95% confidence intervals simulated using different dust mineralogy atlases with and without ARI effects.

Scenario	PM ₁₀ (μg m ⁻³)
Dust_NO	533.81 [0.28, 5962.95]
Dust_ARI	653.29 [0.28, 7120.49]
N2012_default_NO	529.32 [0.74, 5784.02]
N2012_default_ARI	679.85 [0.74, 7484.01]
N2012_EMIT_NO	526.05 [0.74, 5663.86]
N2012_EMIT_ARI	655.61 [0.74, 6926.42]
J2014_default_NO	529.25 [0.74, 5750.11]
J2014_default_ARI	686.19 [0.74, 7463.57]

J2014_EMIT_NO	516.23 [0.74, 5501.87]
J2014_EMIT_ARI	607.22 [0.74, 6325.16]

Table S3. Domain-averaged ΔPM_{10} and ΔO_3 with 95% confidence intervals for different dust mineralogy atlases comparing ARI and NO simulations.

Scenario	ΔPM_{10} ($\mu g m^{-3}$)	ΔO_3 ($\mu g m^{-3}$)
Dust_ARI – Dust_NO	119.48 [-27.63, 1408.39]	-46.52 [-63.38, -31.74]
N2012_default_ARI – N2012_default_NO	156.94 [-18.63, 1735.68]	-46.37 [-63.41, -31.60]
N2012_EMIT_ARI – N2012_EMIT_NO	147.65 [-22.36, 1623.48]	-46.48 [-63.40, -31.58]
J2014_default_ARI – J2014_default_NO	150.53 [-20.12, 1707.75]	-46.62 [-63.46, -31.65]
J2014_EMIT_ARI – J2014_EMIT_NO	129.56 [-23.42, 1462.55]	-46.56 [-63.36, -31.61]



- ▶ Solar radiation monitoring station
- Meteorological monitoring station
- Air quality monitoring station

Figure S1. Simulation domain and locations of meteorology and air quality monitoring stations.

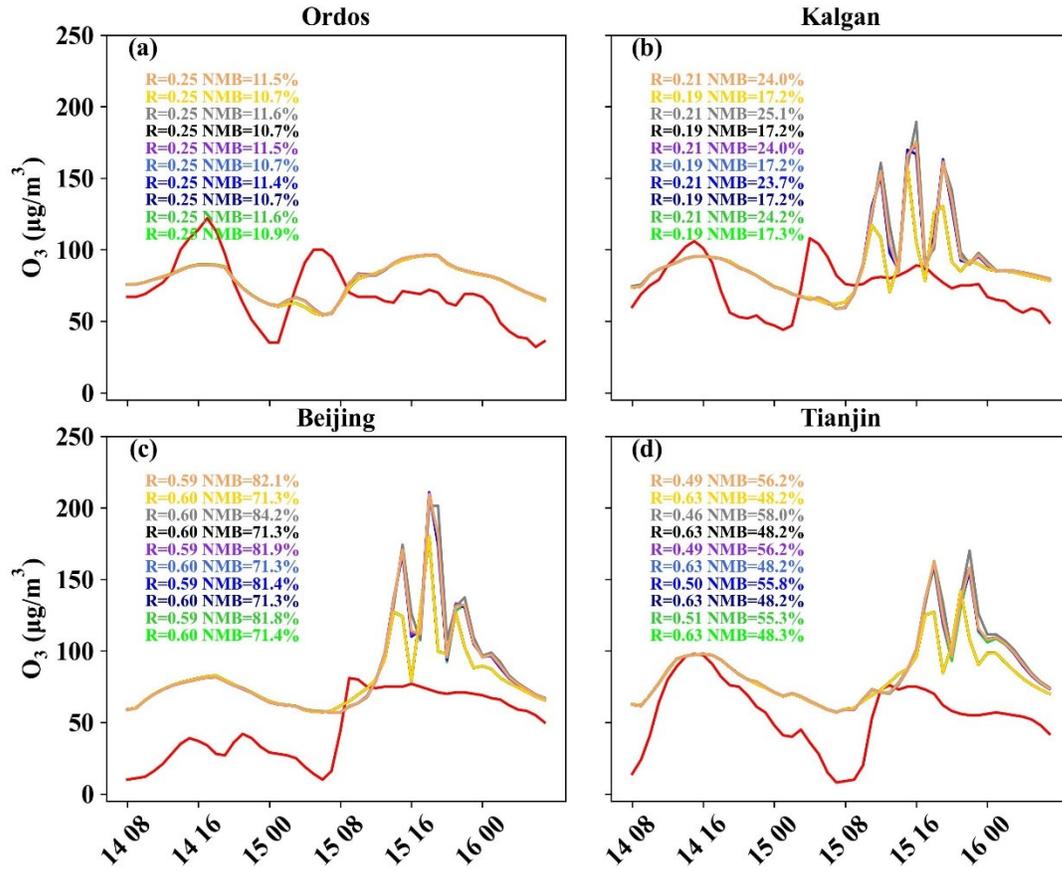
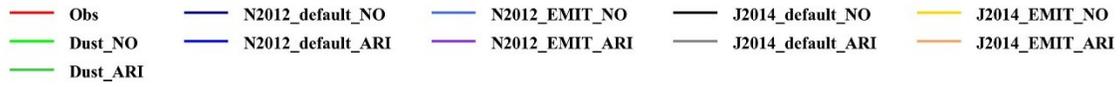


Figure S2. Statistical metrics between observed and simulated O₃ concentrations by different scenario simulations.

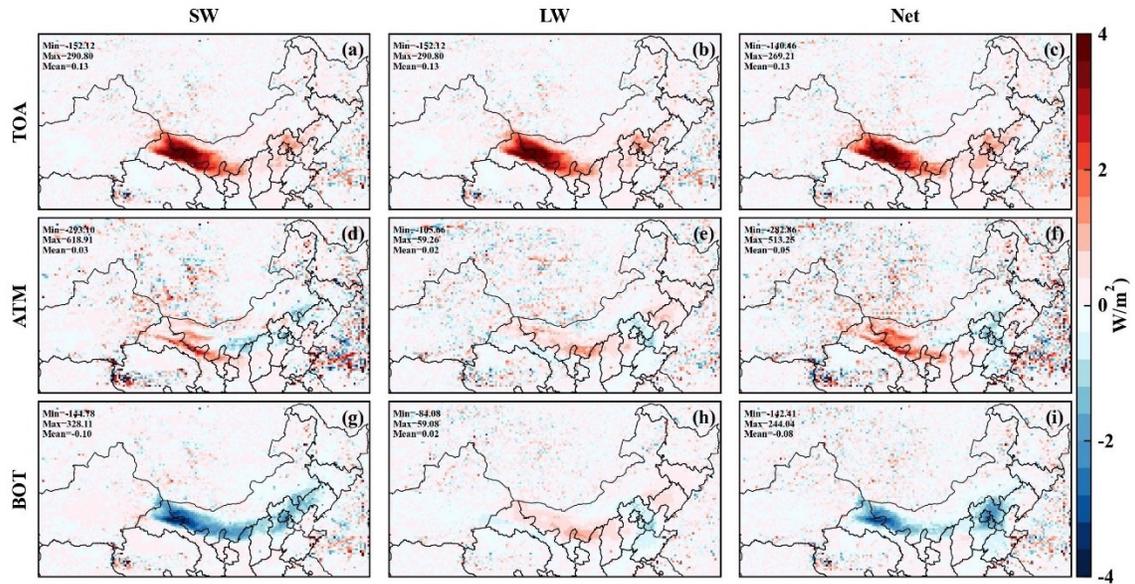


Figure S3. Difference between TOA, ATM and BOT radiation forcings with considering J2014 and N2012 mineralogical dust compositions (i.e., N2012_Default) enabling ARI effects.

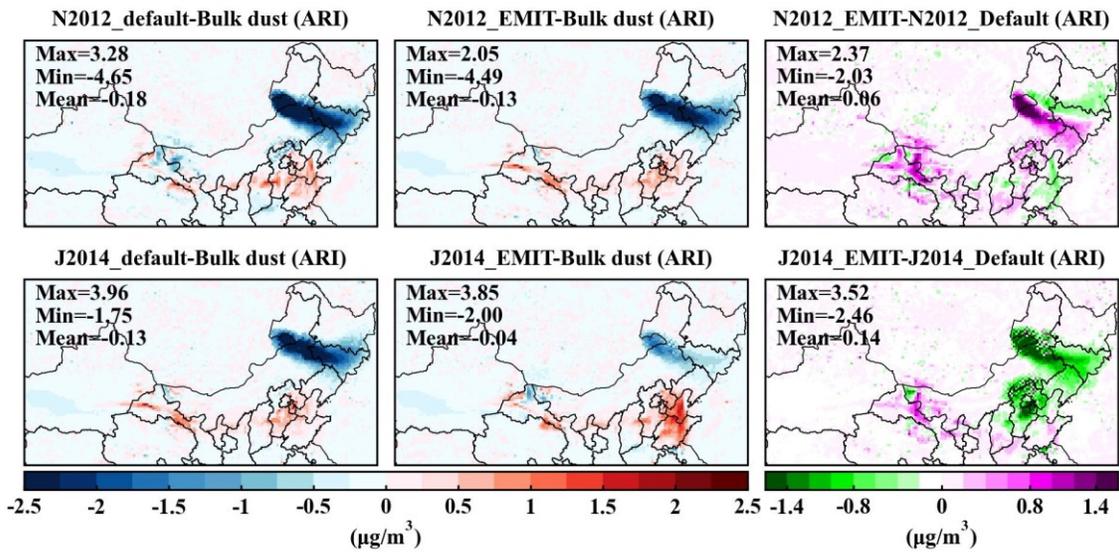


Figure S4. Difference in O₃ concentrations considering bulk dust and various dust mineralogy atlases that enable ARI effects.

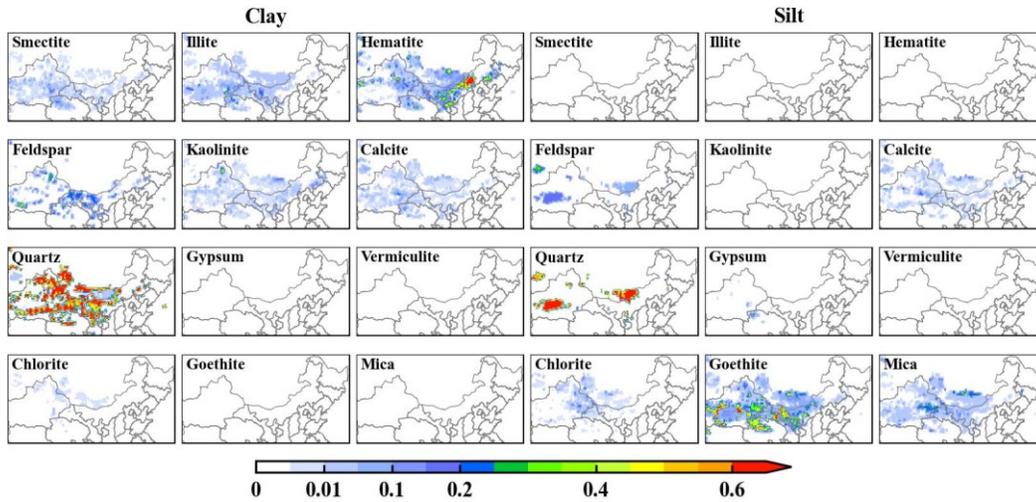


Figure S5. Spatial distribution of content for the different mineral dust species in the silt and clay fraction of the soil for J2014 with EMIT satellite data.

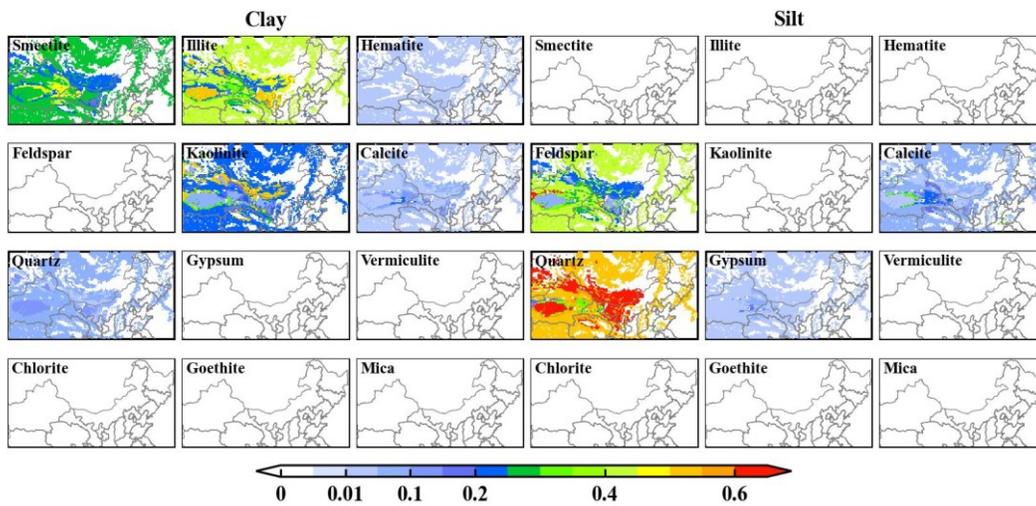


Figure S6. Spatial distribution of content for the different mineral dust species in the silt and clay fraction of the soil for original N2012 mineralogical data.

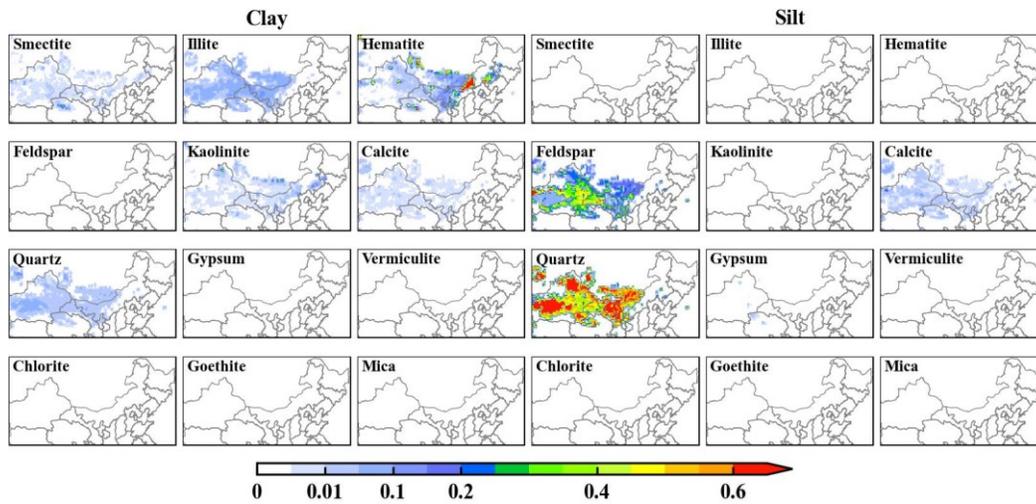


Figure S7. Spatial distribution of content for the different mineral dust species in the silt and clay fraction of the soil for N2012 with EMIT satellite data.