Supplementary Material

# S1 supplementary information of Formula 8

1. The calculation basis of this model is based on the soil pollutant accumulation pattern, which were shown in the formula S1 [1]:

Ci = Ci,0 + R×E (S1)

Where Ci is the Concentration of heavy metals in soil, mg/kg; Ci,0 is the regional soil background value, mg/kg; E is the annual input of polluted heavy metals, mg/kg; R is the residual rate of the heavy metal in soil, %.

In this study, we assume that annual inputs of heavy metals in soil except for atmospheric deposition are in dynamic equilibrium with migration. Hence the value of Ci,0 remained unchanged. Ci,0 is the heavy metals concentration in surface soil, and the values were based on the measured data. The annual residue rate R has a greater impact on the prediction of cumulative increment, and considering that heavy metals are not easily migrated in soil, 95% is chosen for calculation [2].

2. After n years, the concentration of the heavy metal in soil can be calculated as the following formula:

Ci,n = Ci,0+ E ×R×$\frac{1-R^{n}}{1-R}$ (S2)

3. Only considering the cumulative effect of atmospheric dust reduction on soil heavy metals, E can be expressed as:

E=$\frac{\left(C\_{i(ad)}∙Q\right)}{ρ∙h∙\left(1-f\right)+Q}$ (S3)

Where *Ci**(ad)*represents the concentration of the metal *i* in atmosphere deposition, mg/kg; *Q* is the annual atmospheric deposition flux, kg/m2·a; ρ is the soil bulk density, 1200 kg/m³; *n* is accumulation time, a; *h* is the thickness of the topsoil, 0.2 m, *f* is the soil moisture content, 15%. The soil bulk density and soil moisture content were based on the measured data.

4. Namely, we can obtain the result:

Ci = Ci,0+ $\frac{\left(C\_{i}∙Q\right)}{ρ∙h∙\left(1-f\right)+Q}$ ×R×$\frac{1-R^{n}}{1-R}$ (S4)

***References***

[1] Technical principles and methods for environmental impact assessment. 1992. Beijing: Peking University Press.

[2] Liang, J., Feng, C., Zeng, G., Zhong, M., Gao, X., Li, X., He, X., Li, X., Fang, Y., Mo, D.,

2017. Atmospheric deposition of mercury and cadmium impacts on topsoil in a typical coal mine city, Lianyuan, China. Chemosphere 189, 198–205.



**Supplementary Figure 1.** The time series of heavy metals concentration in atmospheric deposition in KY, DW and HG.

Table S1 Concentrations of metals in atmospheric deposition

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| Element | KY | DW | HG | Average | Background value |
| Al/(%) | 3.04±2.39 | 4.06±2.74 | 3.51±2.73 | 3.53±2.62 | 6.72±1.00 |
| Fe/(%) | 4.32±0.96 | 4.95±1.89 | 13.55±3.98 | 7.61±4.96 | 2.82±0.69 |
| Cd/(mg·kg-1) | 5.07±1.33 | 6.85±4.28 | 8.28±3.81 | 6.73±3.60 | 0.06±3.57 |
| Cr/(mg·kg-1) | 101.94±100.58 | 143.95±133.11 | 166.83±116.93 | 137.57±119.06 | 65.40±1.33 |
| Cu/(mg·kg-1g) | 94.86±51.72 | 106.79±39.08 | 120.43±112.50 | 107.35±74.65 | 21.00±1.34 |
| Mn/(mg·kg-1) | 1 029.10±236.13 | 1 171.26±381.29 | 1 576.92±649.98 | 1 259.09±506.61 | 592.00±1.30 |
| Ni/(mg·kg-1) | 62.41±42.12 | 80.77±55.59 | 73.24±49.39 | 72.14±9.23 | 28.70±1.46 |
| Pb/(mg·kg-1) | 198.88±123.68 | 223.92±118.20 | 249.11±120.77 | 223.97±20.97 | 20.50±1.36 |
| Zn/(mg·kg-1) | 1 031.83±214.77 | 1 190.32±547.09 | 1 092.69±395.05 | 1 104.95±408.39 | 71.90±1.49 |
| As/(mg·kg-1) | 33.83±7.69 | 39.81±13.14 | 44.85±6.61 | 39.51±10.48 | 12.80±1.44 |

Background Value means the representative values of Background Values of Soil Elements in Hebei Province.