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Comparative study on Polychlorinated dibenzo-p-dioxins (PCDDs) and Polychlorinated dibenzofurans (PCDFs) in soil and vegetation from Arctic, Antarctic, and Tibetan Plateau

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The distribution of PCDD/Fs and their adverse effects on ecologically vulnerable polar region are getting more and more attentions, which are reflected by recently blooming studies on different environmental media in Arctic, Antarctic, and Tibetan Plateau. Soil and vegetation in all above three polar regions were sampled to detect local PCDD/Fs distribution in this study. Then an exploratory comparison of PCDD/Fs concentration and toxicity[for better comparison, we calculated International Toxic Equivalency Quantities values(I-TEQ)] was conducted. Finally FLEXPART model was introduced to explore potential pollution sources of PCDD/Fs.

Results show that the measured concentrations of PCDD/Fs in both soil and vegetation in polar areas are one or more orders of magnitude lower than in any other parts of the world. Soils in Tibet Plateau present the highest PCDD/F concentrations [mean: 26.22 pg/g (0.37 pg I-TEQ/g); range 2.43∼73.28 pg/g (0.06∼0.65 pg I-TEQ/g)], followed by those in Arctic [mean: 9.97 pg/g (0.33 pg I-TEQ/g); range 3.55∼16.60 pg/g (0.16∼0.62 pg I-TEQ/g)] and those in Antarctic [mean: 2.18 pg/g (0.02 pg I-TEQ/g); range 0.49∼6.72 pg/g (0∼0.06 pg I-TEQ/g)] ($P_{Npar} < 0.05$). This concentration sequence in soil can be also applied to samples of vegetation ($P_{Npar} < 0.05$). The average PCDD/F concentrations in vegetation collected in Tibetan Plateau, Arctic and Antarctic are 39.23 pg/g [0.83 pg I-TEQ/g, range 3.49∼102.53 pg/g (0.45∼1.42 pg I-TEQ/g)], 24.62 pg/g [1.70 pg I-TEQ/g, range 8.62∼35.51 pg/g (1.05∼2.33 pg I-TEQ/g)] and 15.17 pg/g [0.47 pg I-TEQ/g; range 0∼32.59 pg/g (0∼1.07 pg I-TEQ/g)], respectively.

A comparison of observed and modeled concentrations among the three poles shows that (1) no obvious pollution sources were found within PCDD/F atmospheric transport pathway to Arctic and Antarctic, thus PCDD/F occurrence in polar regions probably comes from the global distillation and condensation, which is in agreement with other studies. Therefore, protecting ecologically fragile polar region from the adverse effects of PCDD/Fs needs global efforts. (2) Concentrations of PCDD/Fs in Antarctic are lower than those in Arctic, possibly because the southern hemisphere is less polluted than the northern Hemisphere. Thus the concentration of PCDD/Fs in Antarctic can be used as the background reference. (3) Unlike Arctic and Antarctic, the India and Nepal might be the significant pollution sources for Tibet Plateau, this is one of the possible reasons which cause the highest level of PCDD/Fs than the other two polar areas.