

**Investigation of monitoring method for POPs
concentration in ambient air using passive air sampler
and application to multimedia model**

**Concentration prediction on congener of
dioxin in Hyogo Prefecture, Japan**

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Background

- **Toxic substances give damages to human health. Such toxic substances accumulate and spread to environment media.**
- **Multimedia Model is useful to simulate secular changes of toxic substance concentration in environment media.**



Aim

- **The aim of this study is**
 - **To develop Multimedia Model.**
 - **To predict dioxins concentration, which is one of toxic substances, in environmental media at Hyogo prefecture.**

Dioxins

Dioxin

Poly-Chlorinated Dibenzo-*p*-Dioxines (PCDDs)

Poly-Chlorinated Dibenzo Furans (PCDFs)

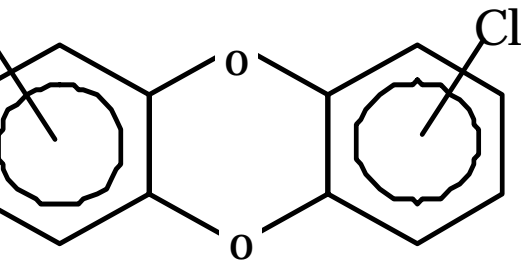
Coplanar-PCB

Toxicity Equivalency Factor (TEF)

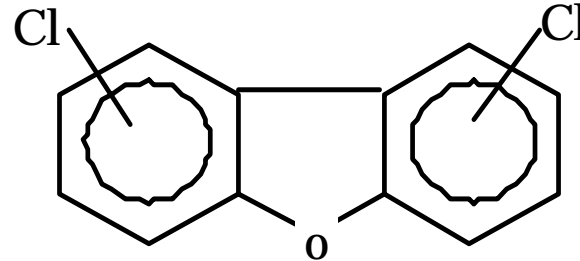
	TEF		TEF
T4CDDs	1	T4CDFs	0.1
P5CDDs	1	P5CDFs	0.05
H6CDDs	0.1	H6CDFs	0.1
H7CDDs	0.01	H7CDFs	0.01
O8CDDs	0.0001	O8CDFs	0.0001

Dioxins

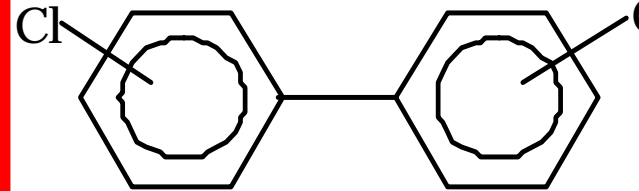
Chemical structure



PCDDs



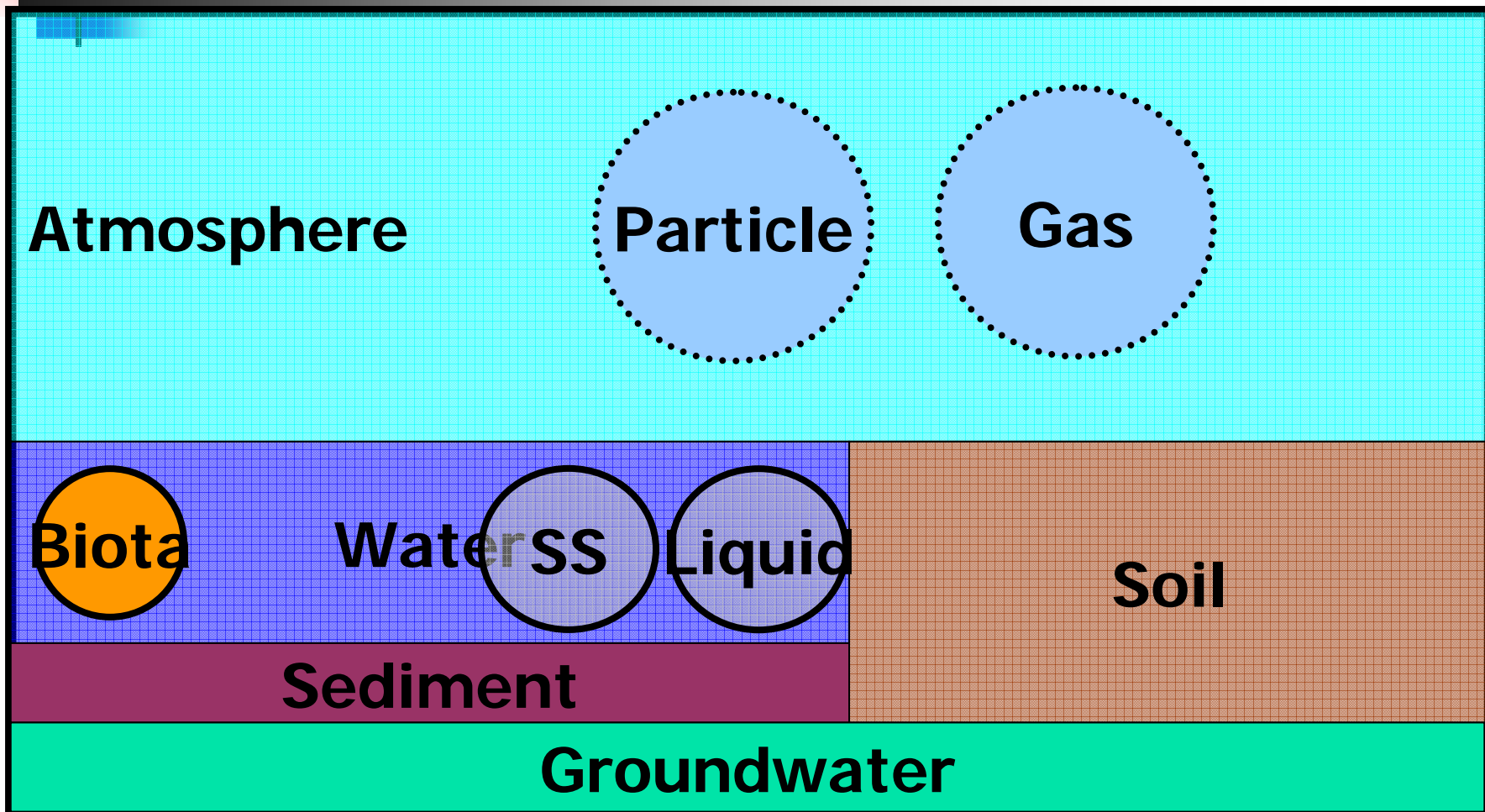
PCDFs



PCBs

Target substances

Concept of Multimedia Model





Basic Equation

$$\Delta C_i V_i / \Delta t = (Q_{i(in)} C_{i(in)} - Q_{i(out)} C_i) + \sum K_{ij} (C_i - H_{ij} C_j) + E_i S_i + C_i V - K_i C_i$$

V_i : media volume (m³)

C_i, C_j : chemical concentration in media i, j (gmol/m³)

$C_{i(in)}$: chemical concentration in the advective input stream

$Q_{i(in)}, Q_{i(out)}$: convective mass exchange (m³/s)

K_{ij} : resistances to mass transfer (m/s)

H_{ij} : equilibrium partition coefficient (-)

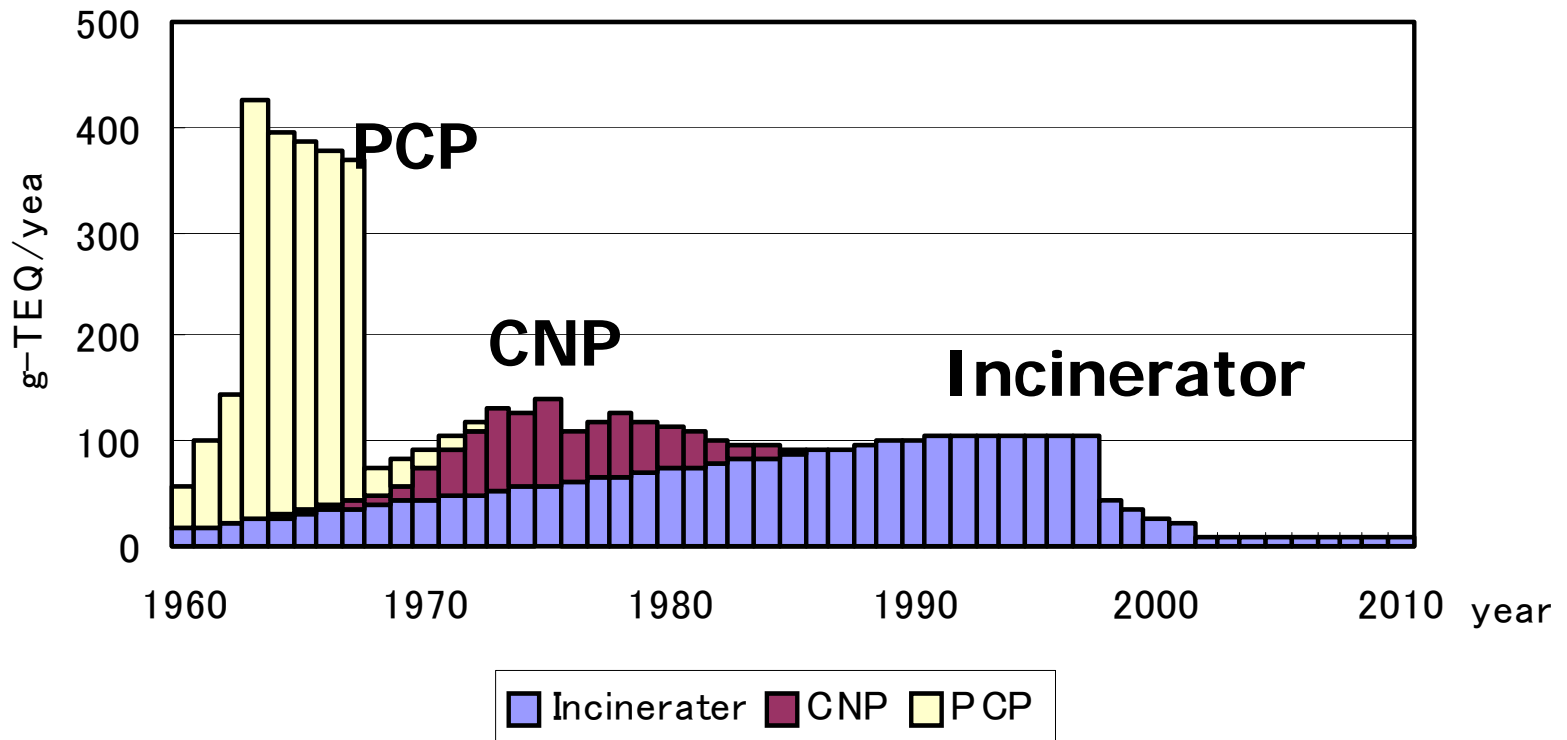
E_i : source emission rate in media i (gmol/m³/s)

S_i : media area (m²)

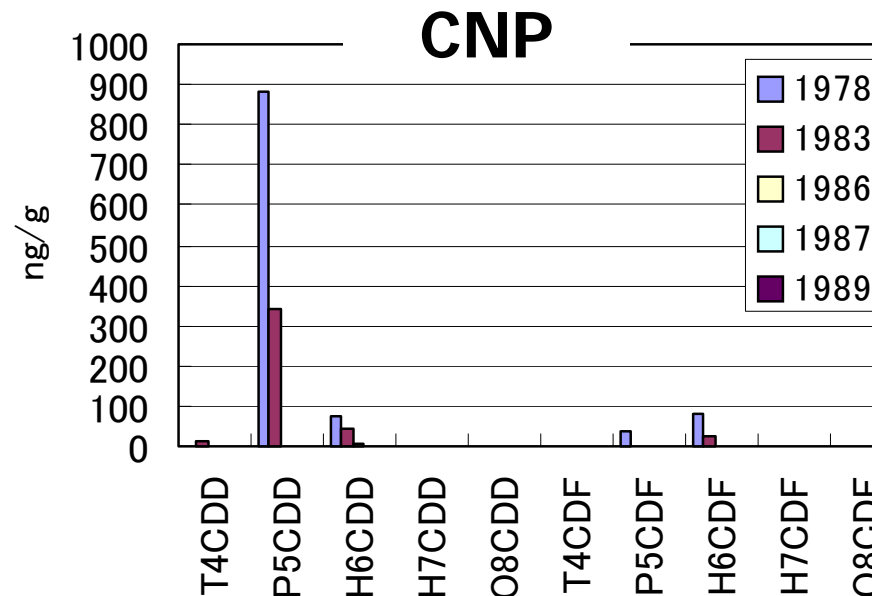
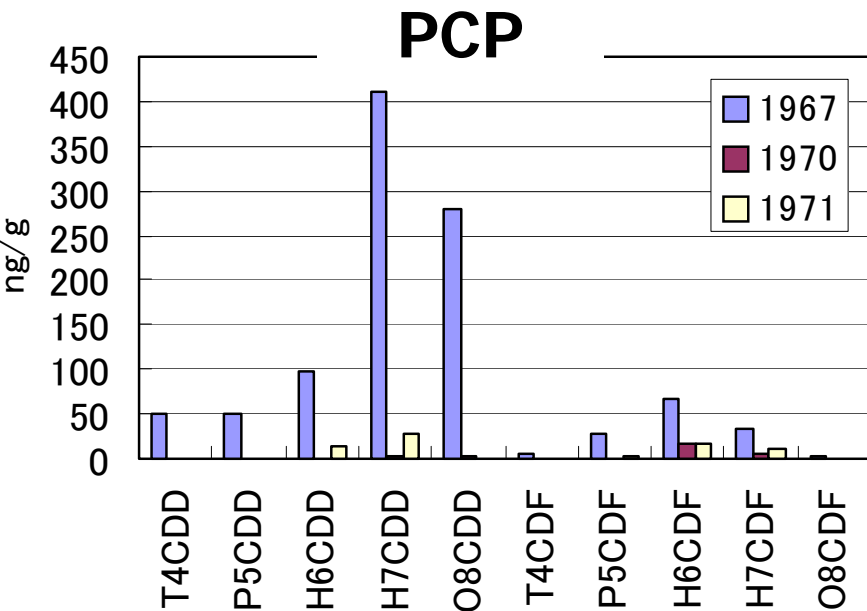
V : deposition velocity (m/s)

K_i : decomposition rate (1/s)

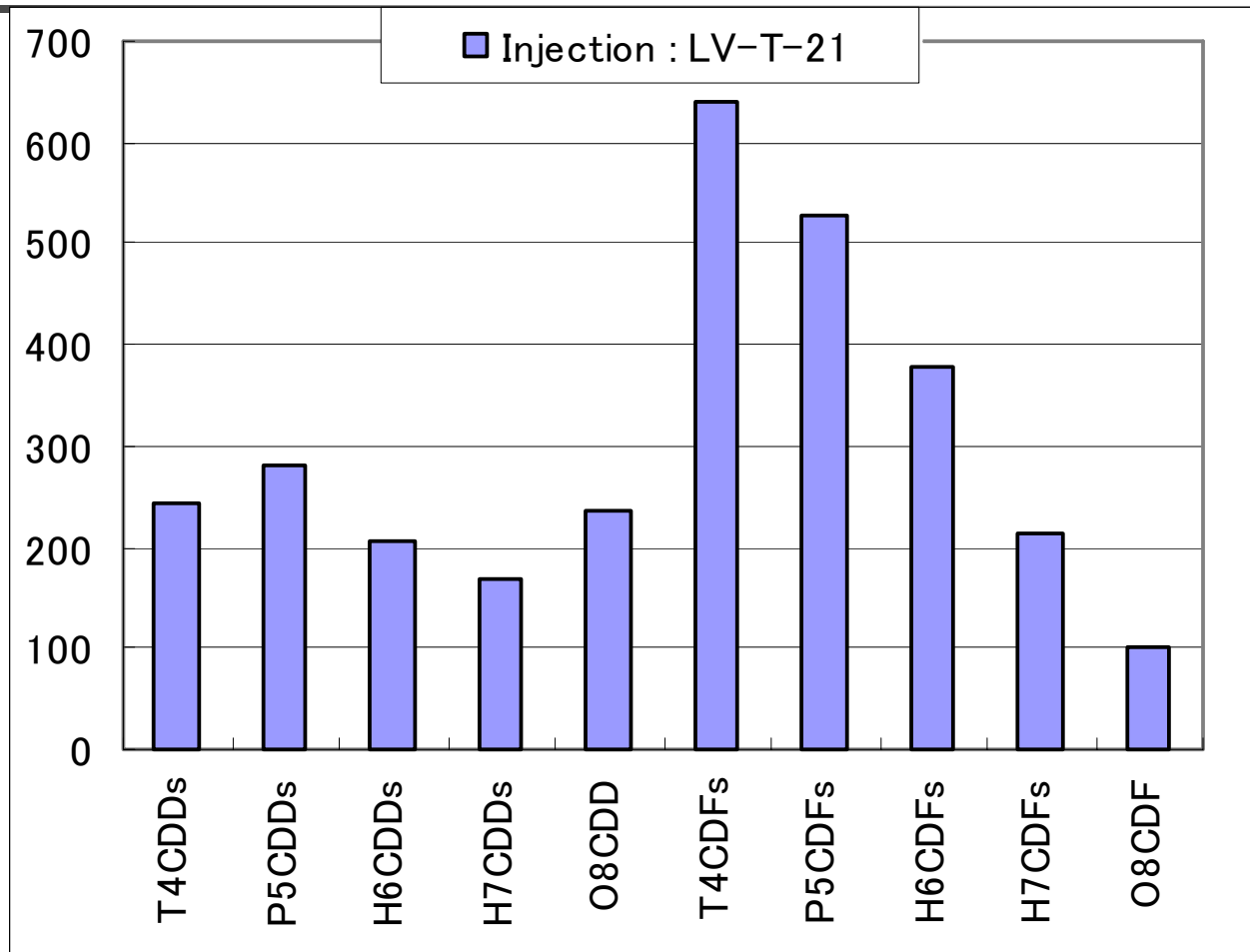
Annual Emission



Content of dioxin in agricultural chemical



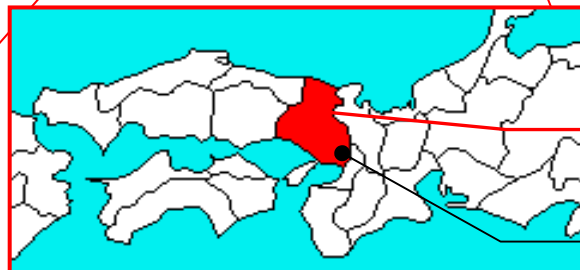
Concentration in Atmosphere in Hyogo Prefecture



Target area



Area	8,392km ³
Depth of air	1,000m
Soil area	8,076km ³
Depth of soil	0.05m
Water area	316 km ³
Depth of water	1m

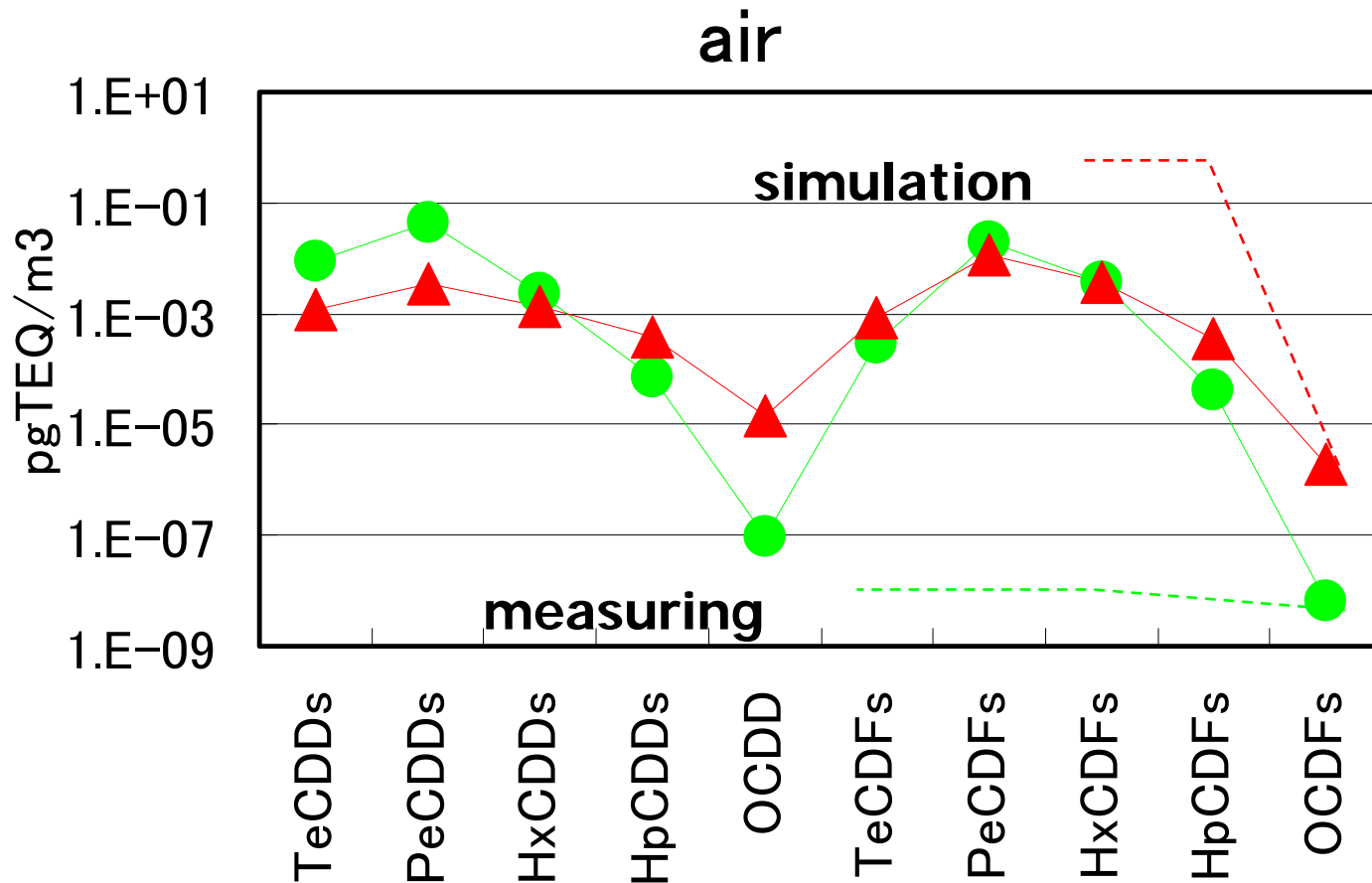


Hyogo

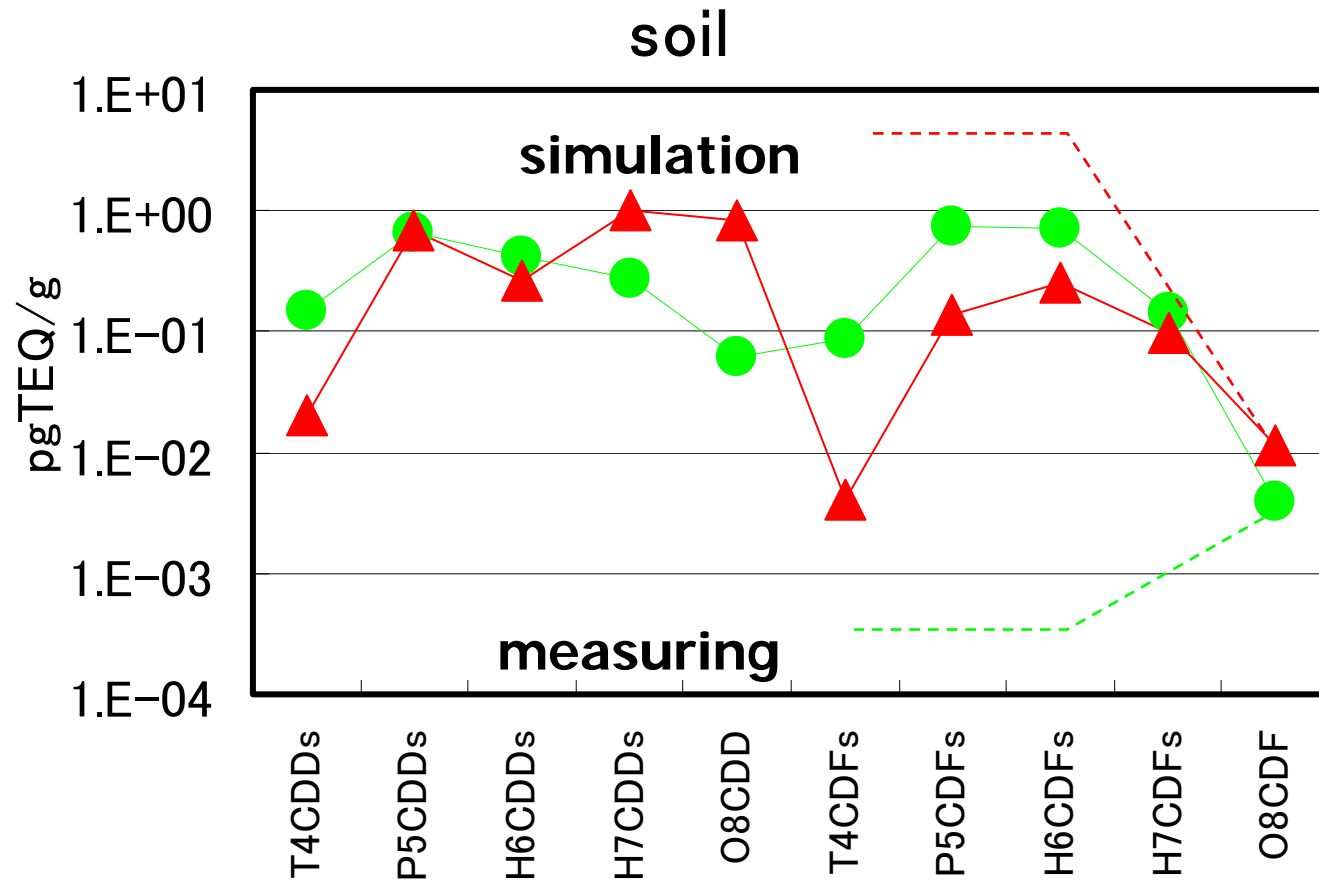
Osaka

Calculated period
1960-2010

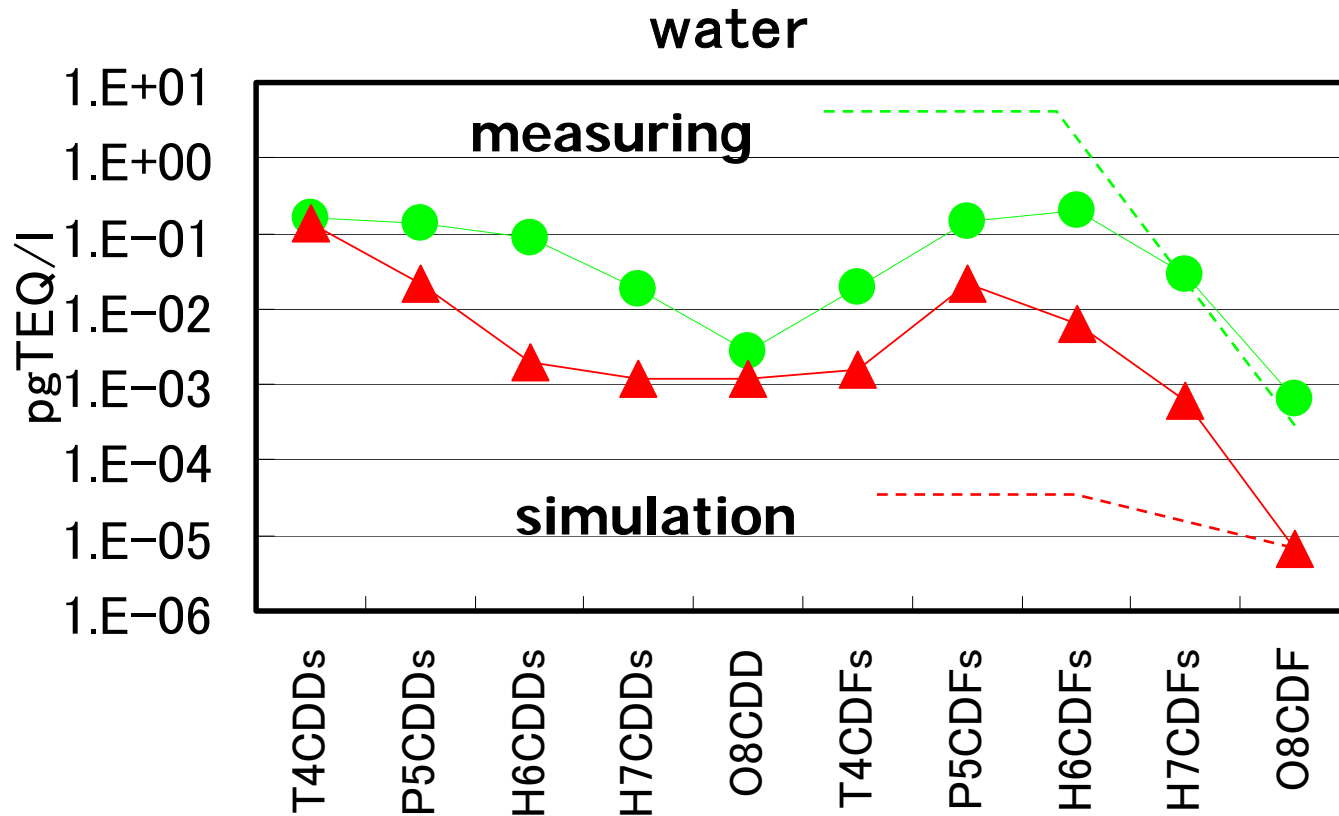
Comparison of concentration for congener (2000)



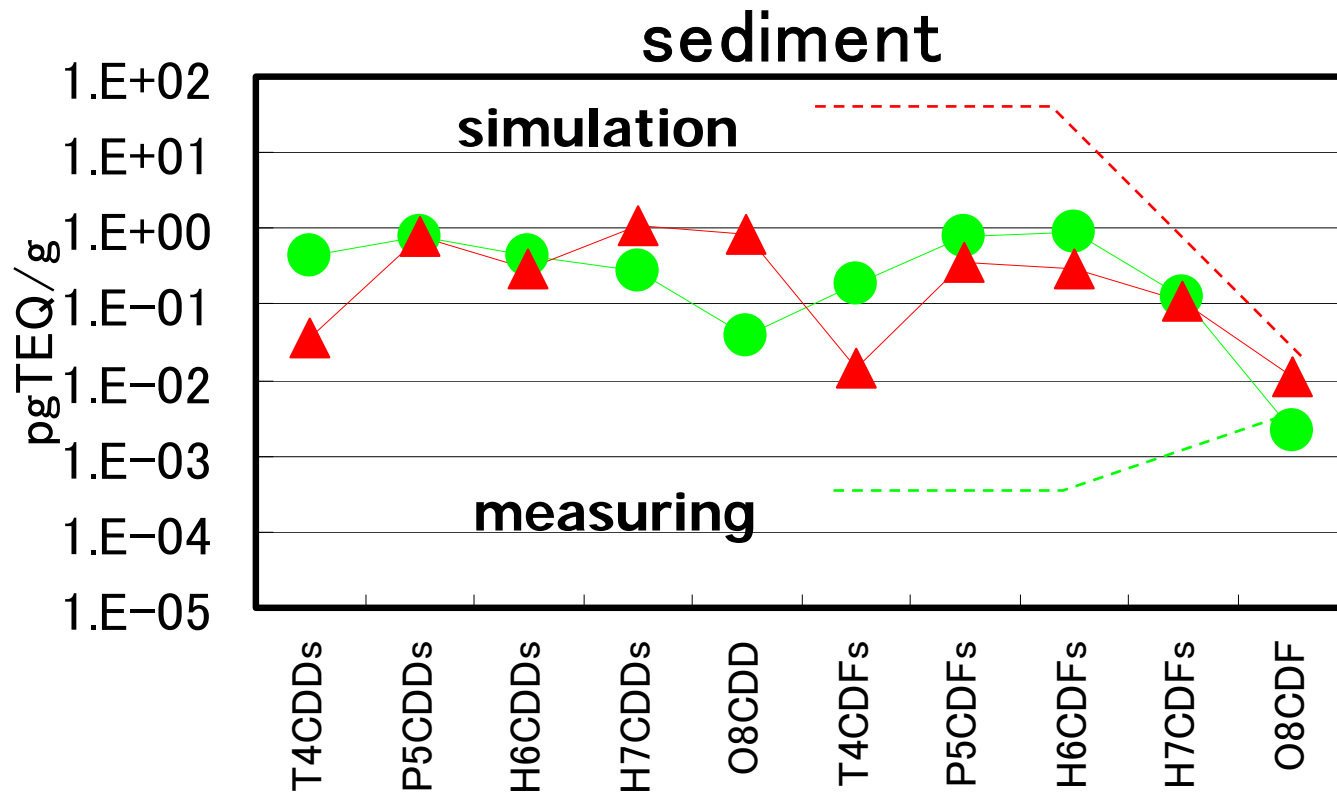
Comparison of concentration for Congener (2000)



Comparison of concentration for congener (2000)



Comparison of concentration for congener (2000)



Comparison of TEQ (2000)

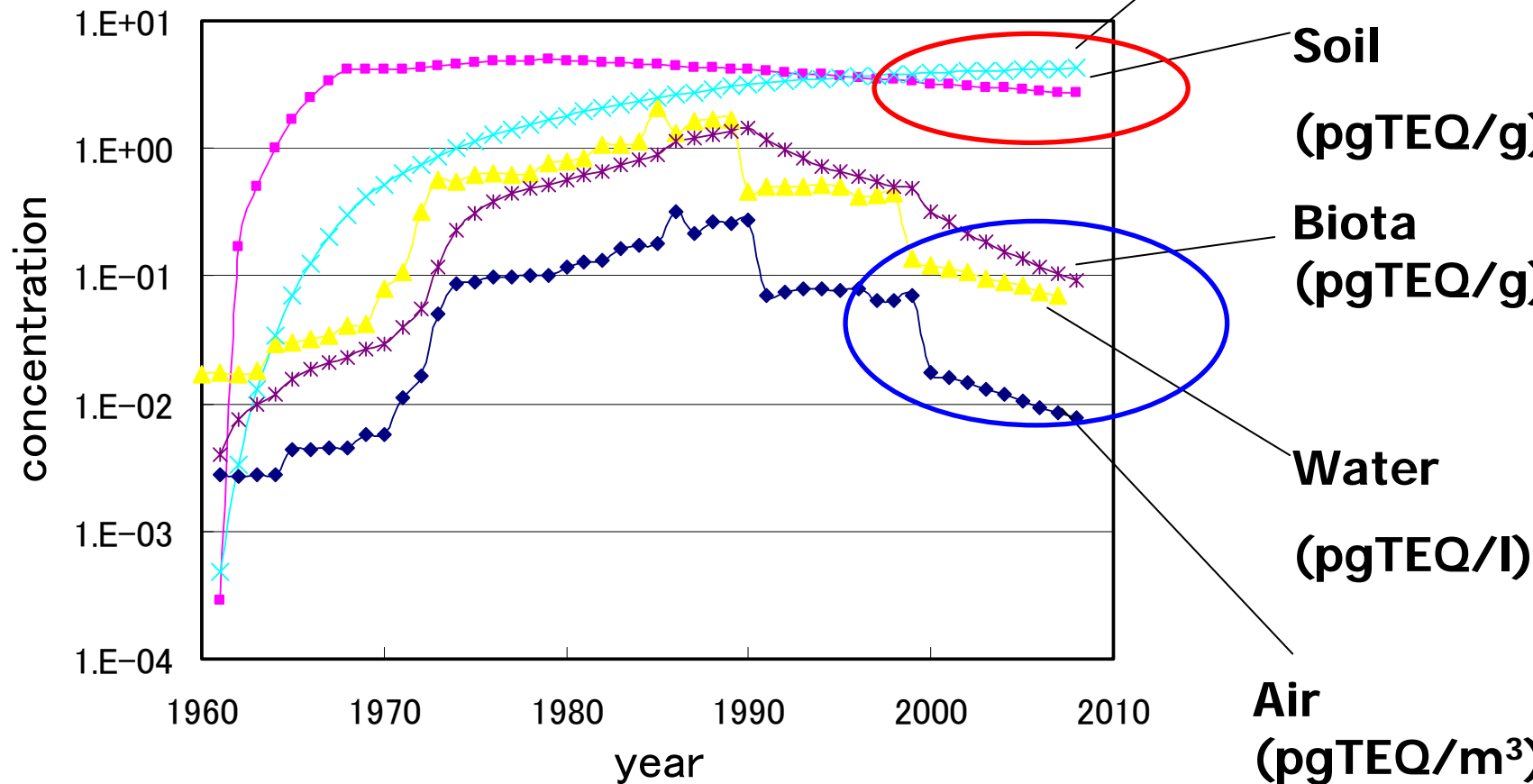
Media	Simulation	Measurement (Number of sample)
Air (pgTEQ/m³)	0.023	0.078(28)
Soil (pgTEQ/g)	3.21	3.25(28)
Water (pgTEQ/l)	0.14	0.81(33)
Sediment (pgTEQ/g)	3.93	3.67(21)
Biota (pgTEQ/g)	0.32	0.7(340)



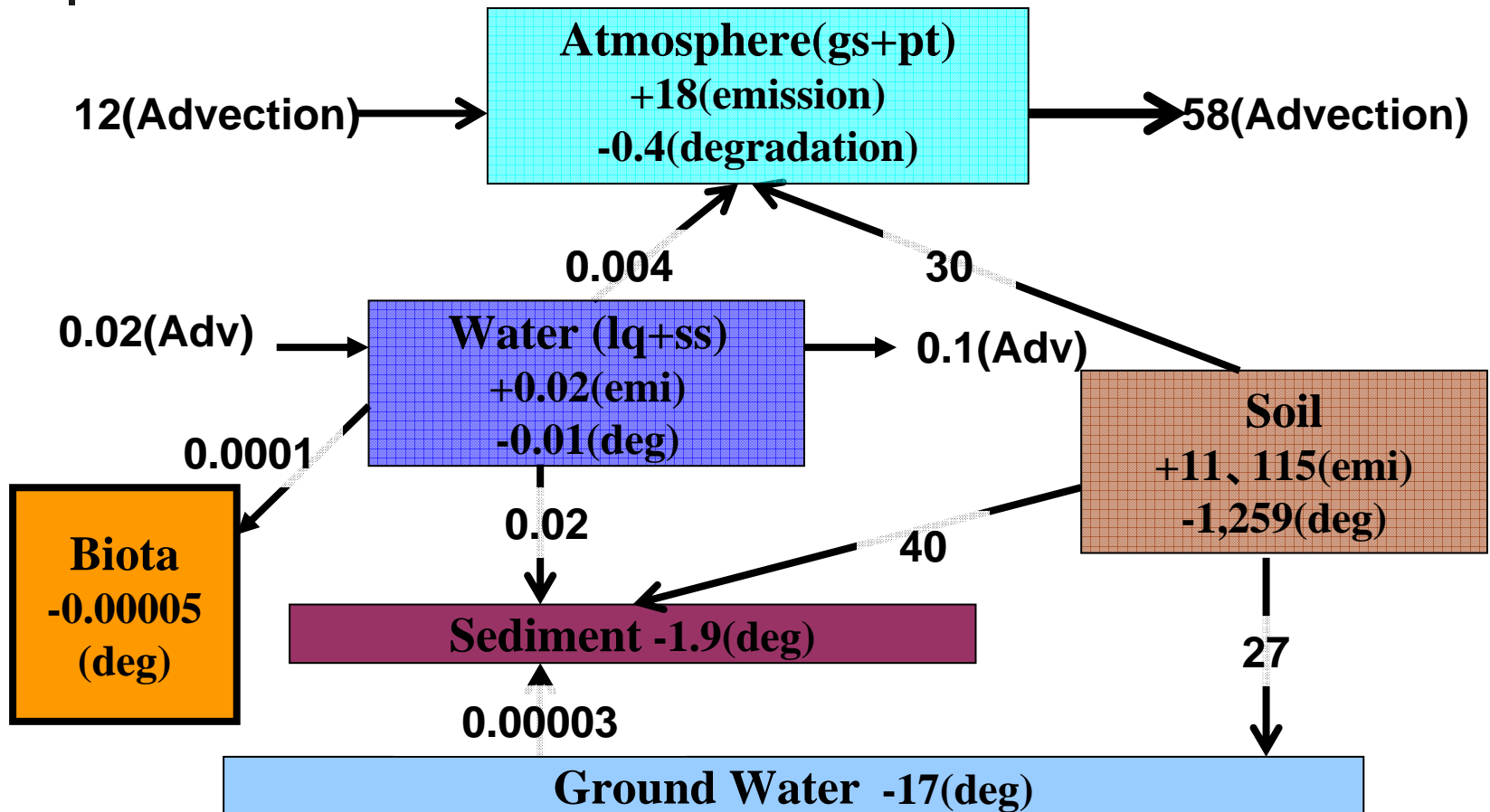
Conclusion

- **The measured concentration and the simulated concentration was good agreement.**
- **The simulated concentrations in atmosphere and water became low compared with the measured concentrations. This result suggests that emission sources were not enough because only the investigated (big) incinerators were assumed to be emission sources. Considering emissions from small incinerator was required.**

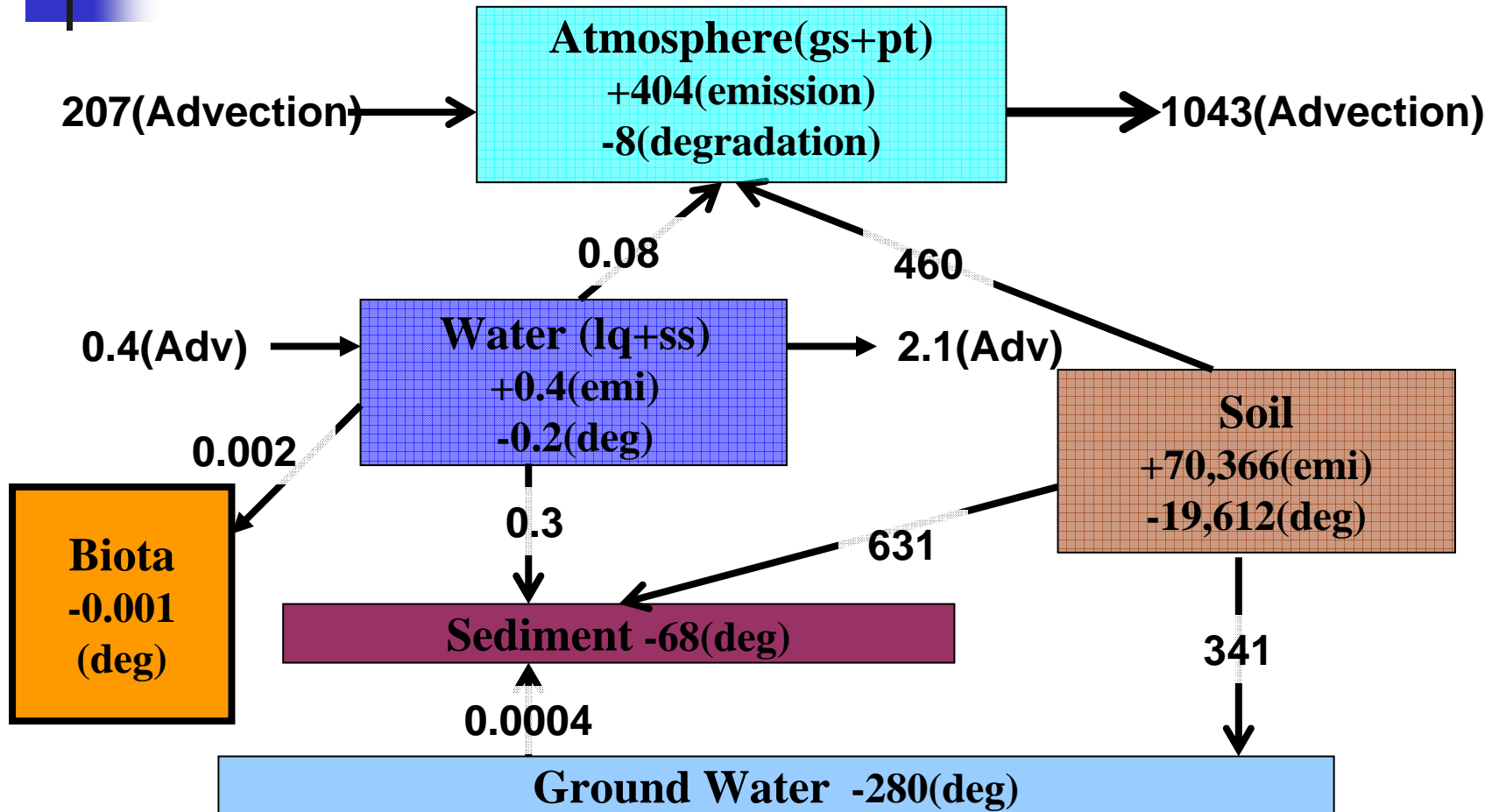
Annual variation



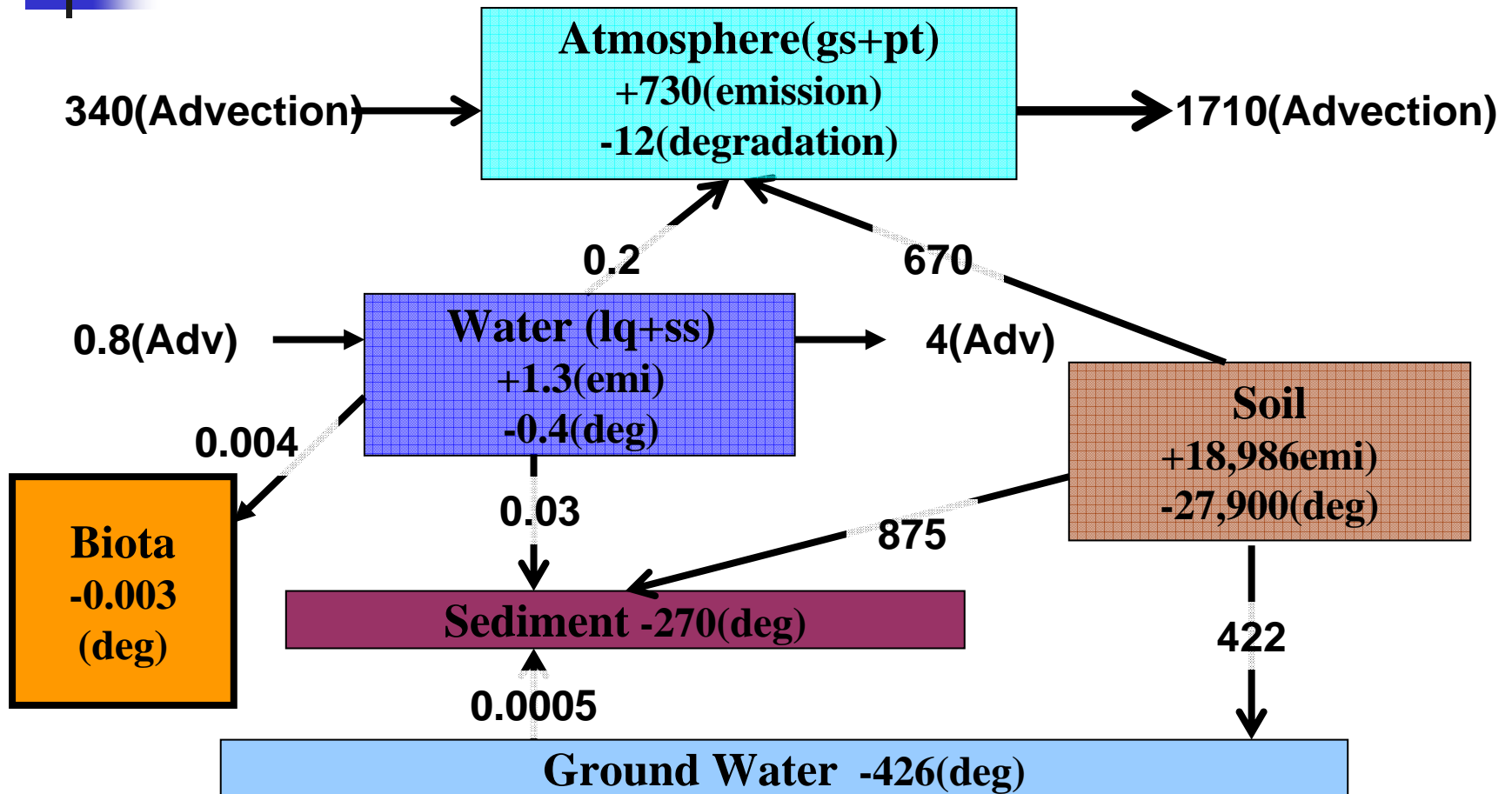
Mass flow(1965) mgTEQ/year



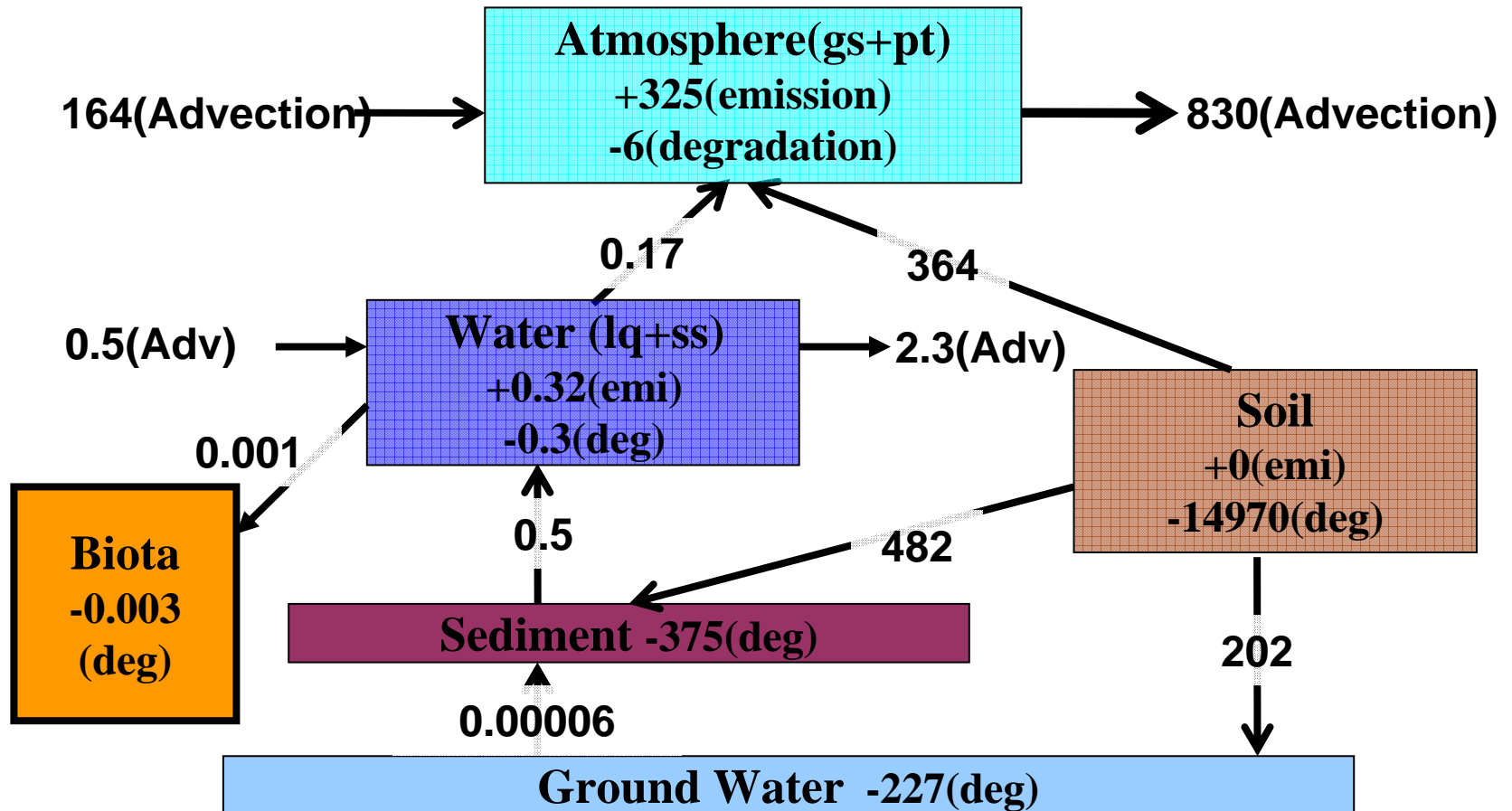
Mass flow(1975) mgTEQ/year



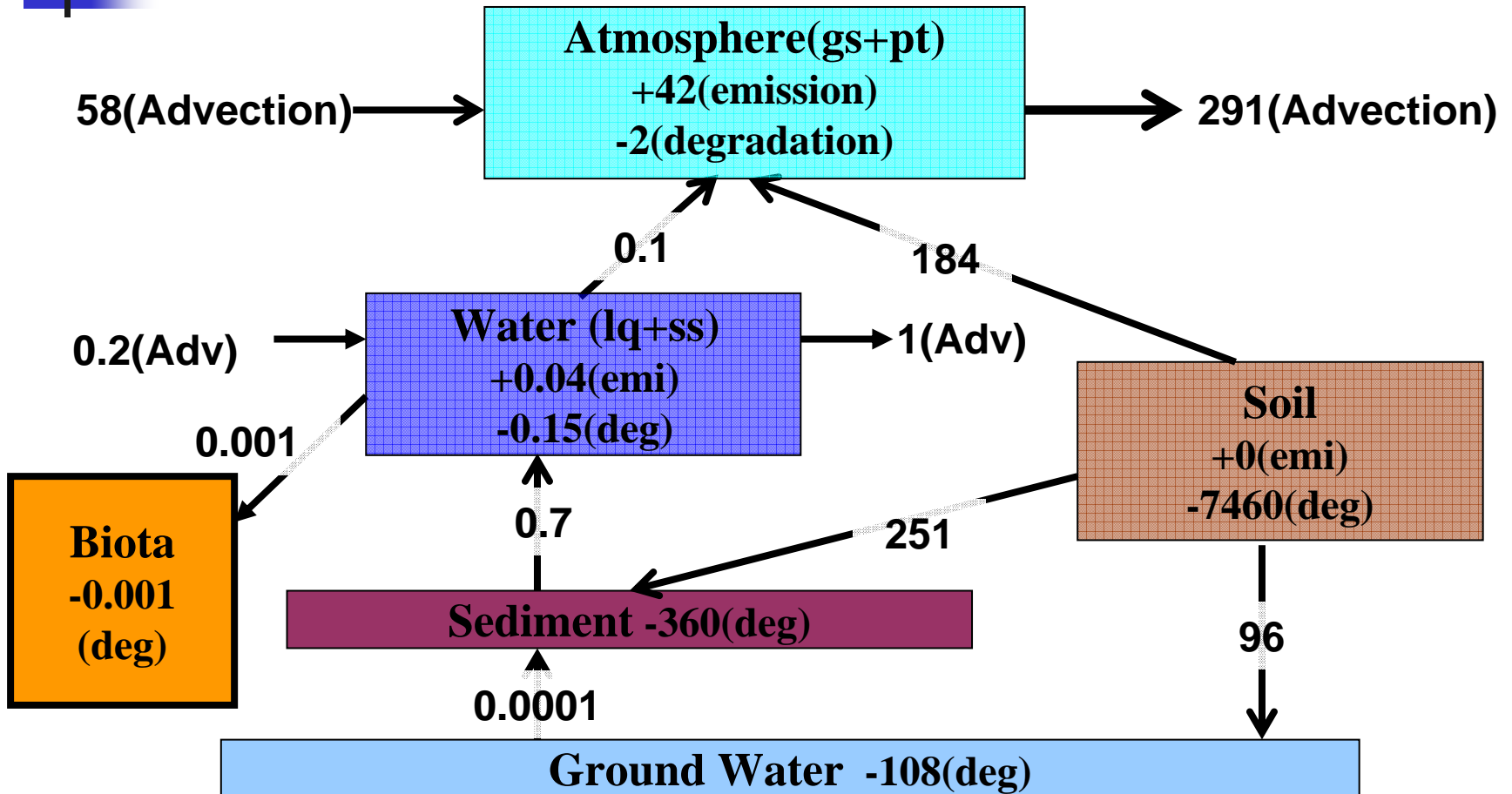
Mass flow(1985) mgTEQ/year



Mass flow(1995) mgTEQ/year



Mass flow(2005) mgTEQ/year





Conclusion

Dioxin concentrations in environmental media were simulated until 2010. Due to decrease of emissions, dioxin concentrations in atmosphere water, and biota decreased but dioxin concentrations in soil and sediment kept high level.



Mass flows suggested that the dioxins emitted in environment were accumulated in soil and sediment due to strong persistence.

Thank you for your attention.

