Thực hành đánh giá tác động môi trường

Lê Việt Phú

Chương trình Giảng dạy Kinh tế Fulbright

5-2015

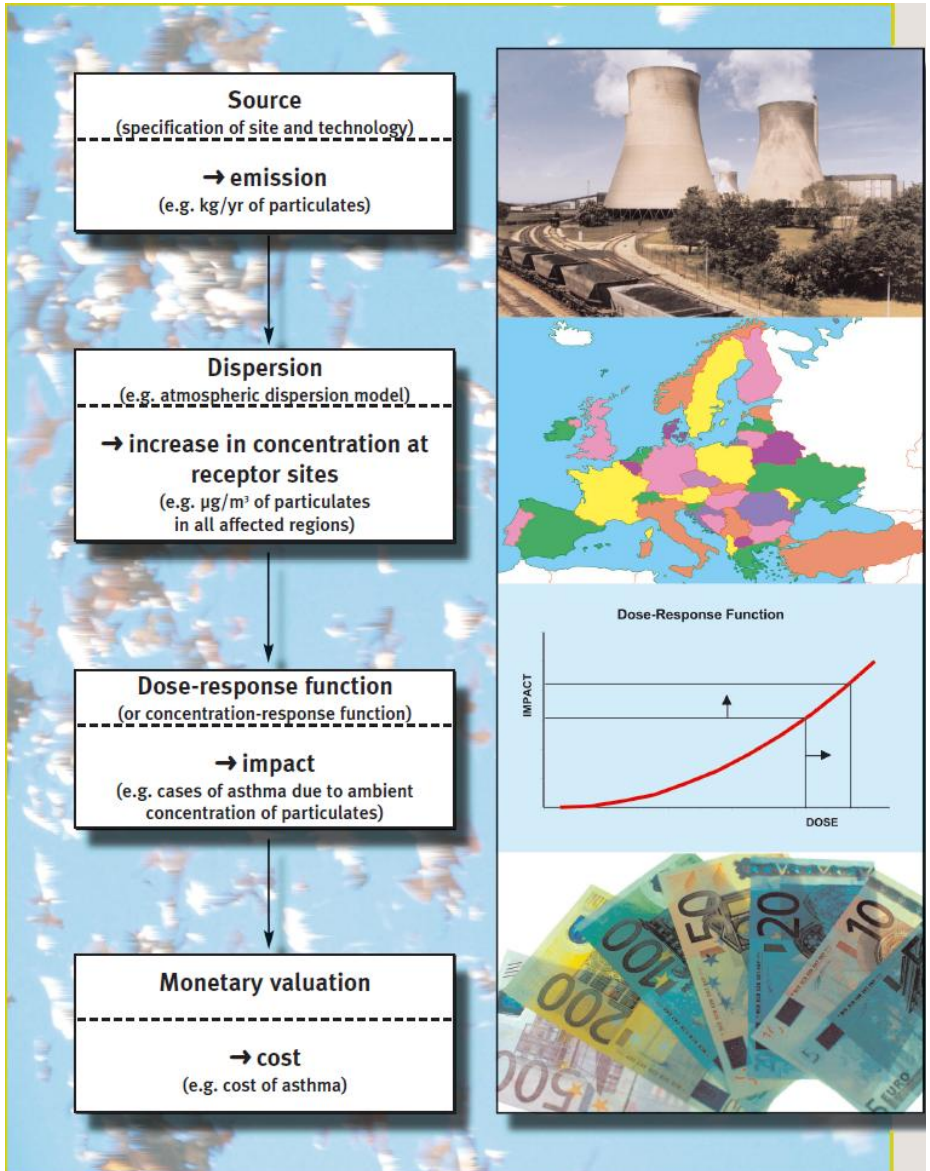
Những tác động lên môi trường có thể xảy ra

- Trong giai đoạn hoạt động
  - Tác động lên nước ngầm
  - Tác động lên hệ sinh thái trên cạn
  - Tác động lên hệ sinh thái dưới nước
  - ***Tác động lên không khí***
  - Tác động đến biến đổi khí hậu toàn cầu
  - Tác động lên cảnh quan
  - Tiếng ồn
  - Rủi ro xã hội và sinh kế
  - Bảo toàn văn hóa
  - Giao thông
  - Sử dụng đất
  - Cơ sở hạ tầng hiện tại
  - Du lịch
  - Nông nghiệp

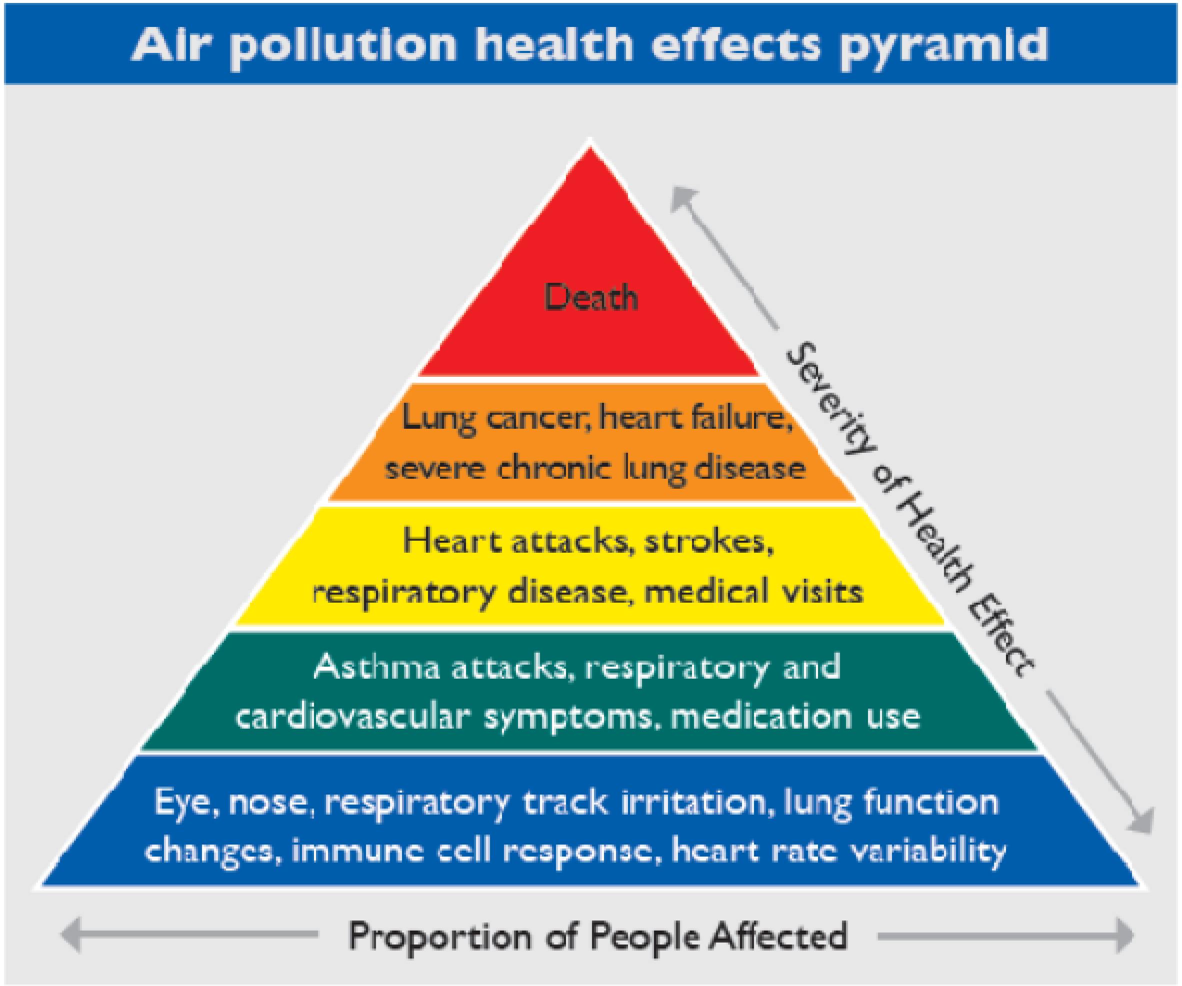
Những nhân tố gây ô nhiễm không khí

- **CO2 and CFCs**
- **Sulphur dioxide (SO2)**
- **Nitrogen dioxide (NO2)**
- **Particulates**
- **Metals**
- **Benzene**
- **Ozone**

Impact Pathway Approach (IPA)



Example: Health effects of air pollution



Health effects of air pollution

Table 1. Toxicological and Environmental Properties of Hazardous Air Pollutants (HAPs) Emitted from Electric Generating Stations Fueled by Coal.

Class of HAP	Notable HAPs	Human Health Hazards	Environmental Hazards
Acid Gases	Hydrogen chloride, Hydrogen fluoride	Irritation to skin, eye, nose, throat, breathing passages.	Acid precipitation, damage to crops and forests.
Dioxins and Furans	2,3,7,8-tetrachlorodioxin (TCDD)	Probable carcinogen: soft-tissue sarcomas, lymphomas, and stomach carcinomas. May cause reproductive and developmental problems, damage to the immune system, and interference with hormones.	Deposits into rivers, lakes and oceans and is taken up by fish and wildlife. Accumulates in the food chain.
Mercury	Methylmercury	Damage to brain, nervous system, kidneys and liver. Causes neurological and developmental birth defects.	Taken up by fish and wildlife. Accumulates in the food chain.
Non-Mercury Metals and Metalloids (excluding radioisotopes)	Arsenic, beryllium, cadmium, chromium nickel, selenium, manganese	Carcinogens: lung, bladder, kidney, skin. May adversely affect nervous, cardiovascular, dermal, respiratory and immune systems.	Accumulates in soil and sediments. Soluble forms may contaminate water systems.
	Lead	Damages the developing nervous system, may adversely affect learning, memory, and behavior. May cause cardiovascular and kidney effects, anemia, and weakness of ankles, wrists and fingers.	Harms plants and wildlife; accumulates in soils and sediments. May adversely affect land and water ecosystems.

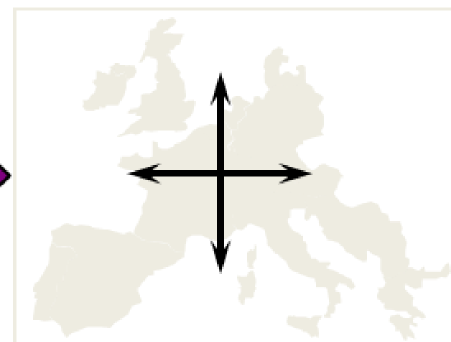
Health effects of air pollution

Polynuclear Aromatic Hydrocarbons (PAH)	Naphthlalene, benzo-a-anthracene, benzo-a-pyrene, benzo-b-fluoranthene, chrysene, dibenzo-a-anthracene	Probable carcinogens. May attach to small particulate matter and deposit in the lungs. May have adverse effects to the liver, kidney, and testes. May damage sperm cells and cause impairment of reproduction.	Exists in the vapor or particulate phase. Accumulates in soil and sediments.
Radioisotopes	Radium	Carcinogen: lung and bone. Bronchopneumonia, anemia, brain abscess.	Deposits into rivers, lakes and oceans and is taken up by fish and wildlife. Accumulates in soils, sediments, and in the food chain.
	Uranium	Carcinogen: lung and lymphatic system. Kidney disease.	
Volatile Organic Compounds	Aromatic hydrocarbons including benzene, toluene, ethylbenzene, xylene	May cause irritation of the skin, eyes, nose, and throat; difficulty in breathing; impaired function of the lungs; delayed response to a visual stimulus; impaired memory; stomach discomfort; and effects to the liver and kidneys. May also cause adverse effects to the nervous system. Benzene is a known carcinogen.	Degrade through chemical reactions in the atmosphere and contribute to carbon-based radicals that contribute to formation of ground-level ozone and its human health effects.
	Aldehydes including formaldehyde	Probable carcinogen: lung and nasopharyngeal cancer. Eye, nose, and throat irritation, respiratory symptoms.	
Hazard information compiled from toxicological profiles and concise chemical assessment documents for specific pollutants published by the Agency for Toxic Substances and Disease Registry and World Health Organization and available on-line (ATSDR, 2011; WHO, 2011).			

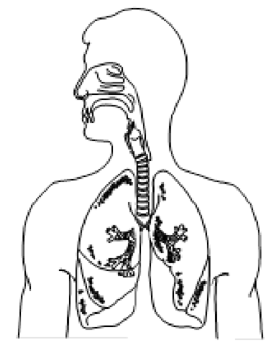
5 steps in IPA of air pollution

Emissions

Transport and Chemical Transformation;

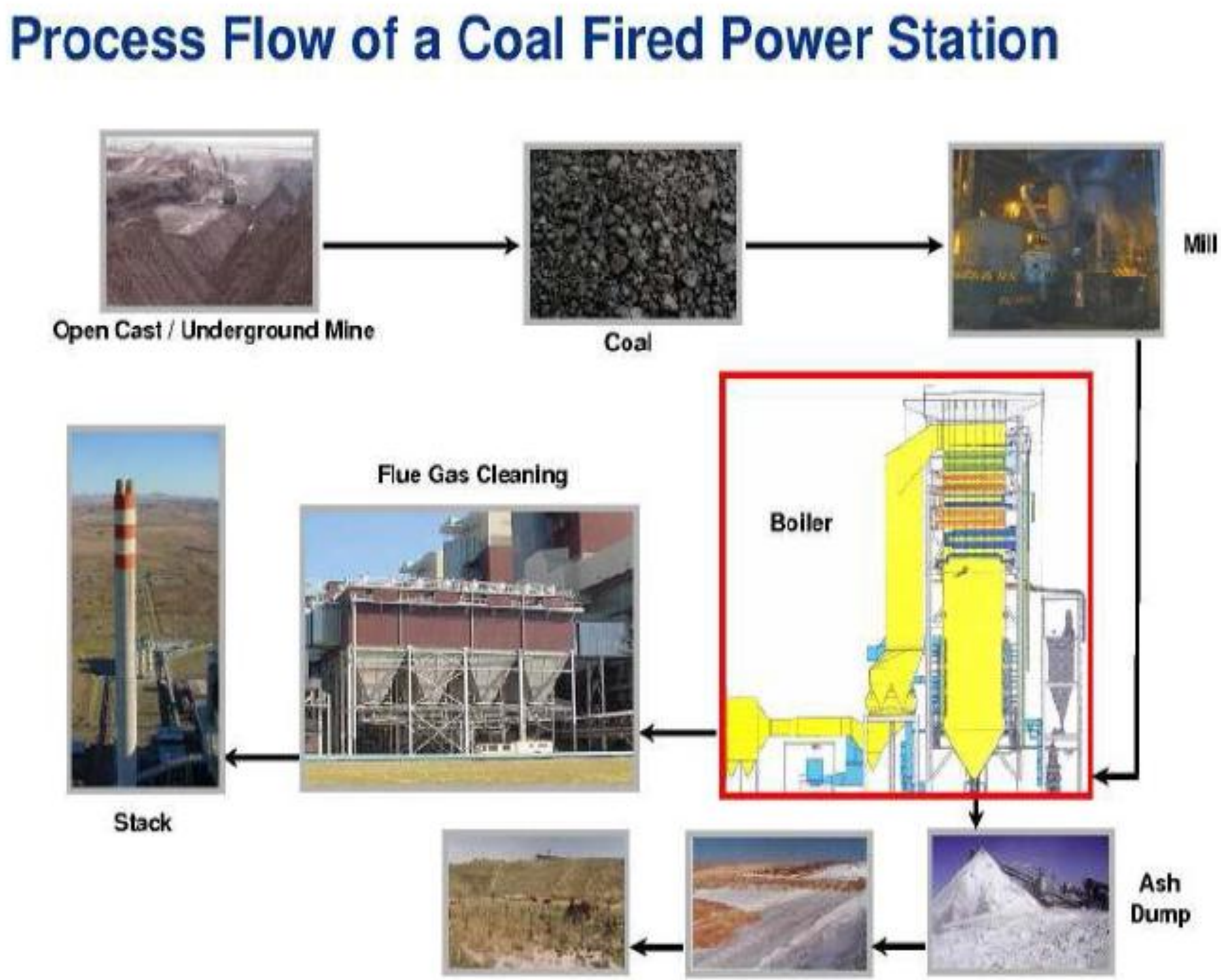


Differences of Health Risks



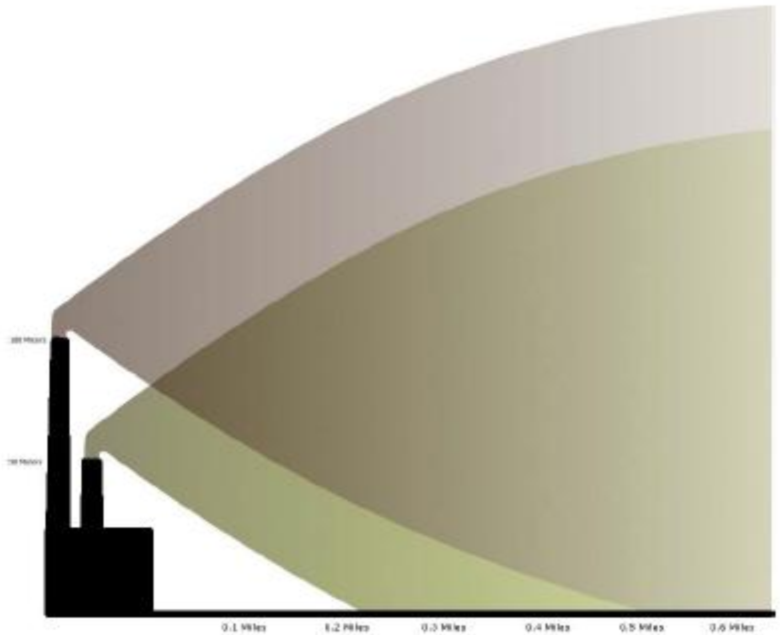
Calculation is made twice: with and without power plant!

1st – Identify emissions from sources

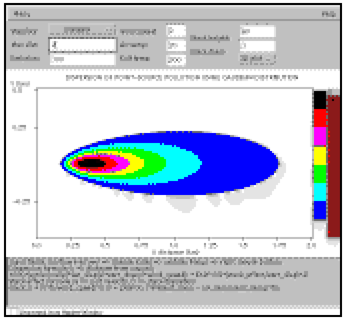


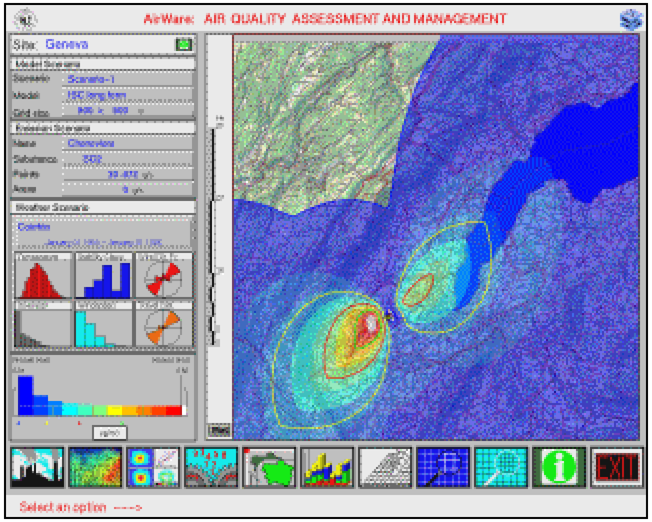
2nd – Dispersion of pollutants

- Gaussian steady-state dispersion model
  - Emission rate (g/s)
  - Wind speed (m/s)
  - Air temperature (degree C)
  - Stability Class (Pasquill)
  - Stack height (m)
  - Stack diameter (m)
  - Exit temperature (degree C)
  - Distance from stack



Schematic of location of initial ground-level impacts in relation to height of hazardous air pollutant release.

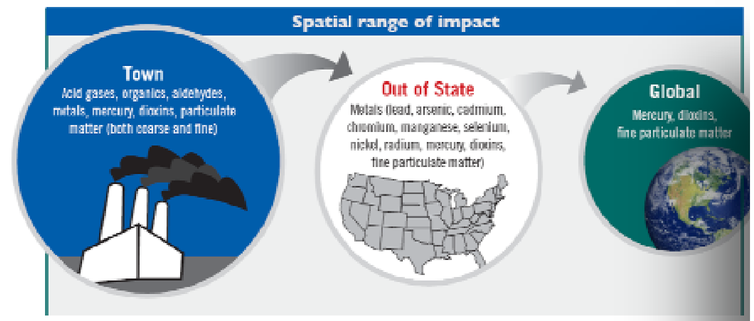


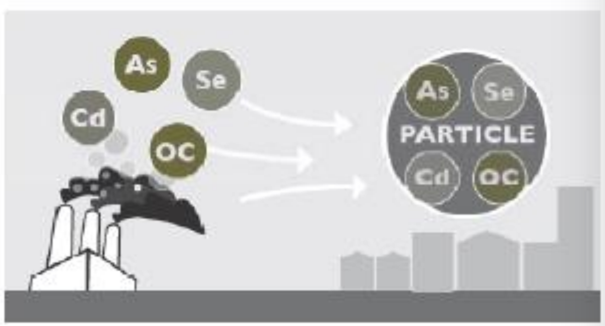


Gaussian dispersion model

$$C(x,y,z,t) = \frac{Q}{2\pi\, u.\sigma_y.\sigma_z}.\exp\left(-\frac{y^2}{2\sigma_y^2}\right)\left[\exp\left(-\frac{(z-H_{eff})^2}{2\sigma_z^2}\right)\right]+\exp\left(-\frac{(z+H_{eff})^2}{2\sigma_z^2}\right)$$

- C(x, y, z) : pollutant concentration at point (x, y, z)
- U : wind speed (in the x "downwind" direction, m/s)
- σ represents the standard deviation of the concentration in the x and y direction, i.e., in the wind direction and cross-wind, in meters;
- Q is the emission strength (g/s)
- Heff is the effective stack height





As–Arsenic Cd–Cadmium Se–Selenium OC–Organic Compounds

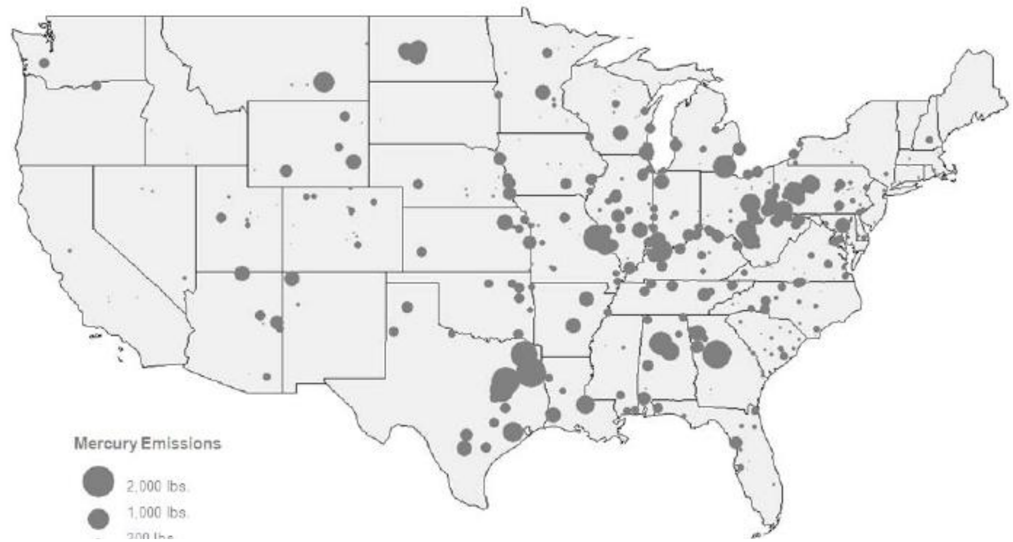
Table 5. Residence Time of Hazardous Air Pollutants in the Atmosphere

HAP Group	Indicator Pollutant(s)	Residence Time*	Likely Range of Transport
Mercury	Methylmercury	7–10 days	Local, regional, global
Metals	Arsenic	7-9 days (lifetime)	Local, regional, global
	Beryllium	10 days (lifetime)	Local, regional, global
	Cadmium	1-10 days (lifetime)	Local, regional, global
	Chromium	Up to 7-10 days	Local, regional, global
	Nickel	Up to 30 days (half-life)	Local, regional, global
	Manganese	Several days (half-life)	Local, regional
	Selenium	1-10 days	Local, regional, global
	Lead	Up to 10 days	Local, some regional
Radioisotopes	Uranium, Radium	Not reported	Local, regional, global**
Dioxins/Furans	Chlorinated dibenzo-p-dioxins	0.5 - 9.6 days (lifetime)	Local, regional, global
	Dibenzofurans	4 days (half-life)	Local, regional
	Chlorodibenzofuran (CDFs)	More than 10 days (half-life)	Local, regional, global
Aldehydes	Formaldehyde	<20 hours (half-life)	Local
Volatile Organic Compounds	Benzene	4–6 hour (half-life in presence of NOx and SO_2)	Local
	Xylene	8–14 hours (half-life)	Local
	Toluene	13 hours (half-life)	Local
	Ethylbenzene	2 days (half-life)	Local
Acid Gases	HCl/HF	1-5 days (half-life)	Local, regional, global
	HCN	530 days (half-life)	Local, regional, global
Polycyclic Aromatic Hydrocarbons (PAHs)	Benzo-a-anthracene, Benzo-a-pyrene, Fluoranthene, Chrysene, Dibenzo-a-Anthracene	Up to several days (lifetime)	Local, regional, global

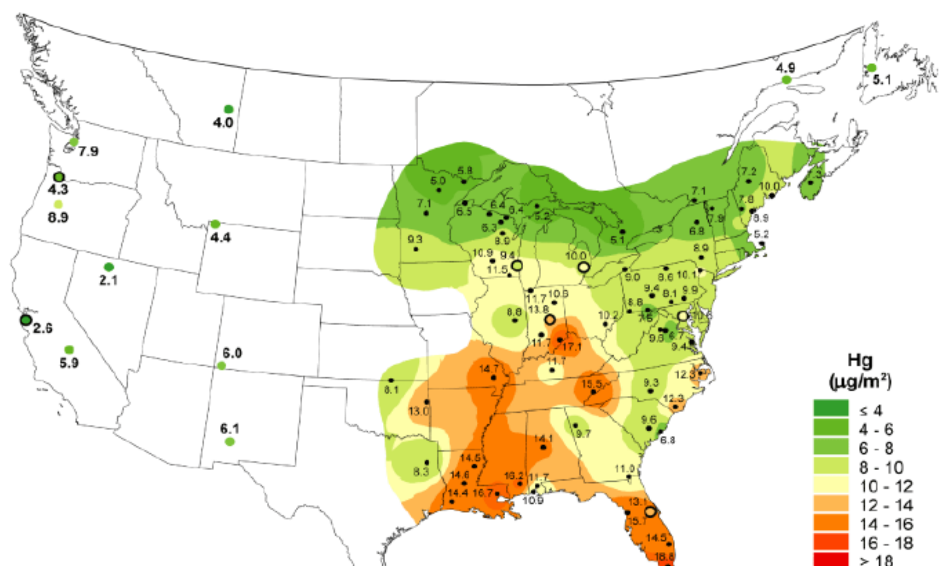
*Atmospheric residence time based upon lifetime or half-life as reported in chemical specific profiles published by the Agency for Toxic Substances and Disease Registry and the World Health Organization; available on-line (ATSDR, 2011; WHO, 2011).
**Assumed to be a component of fine particles

3rd – Measure changes in ambient condition

Panel A: Location and Size of US Power Plants by Mercury Emissions



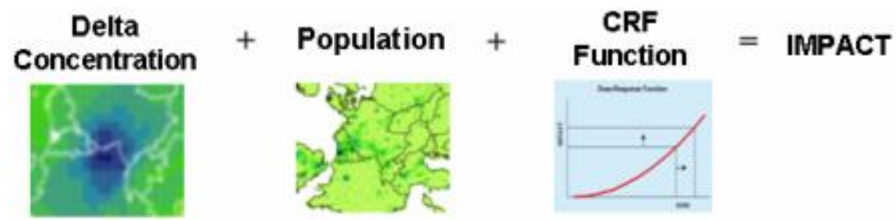
Panel B: Annual Amounts of Mercury Deposition in Rainfall

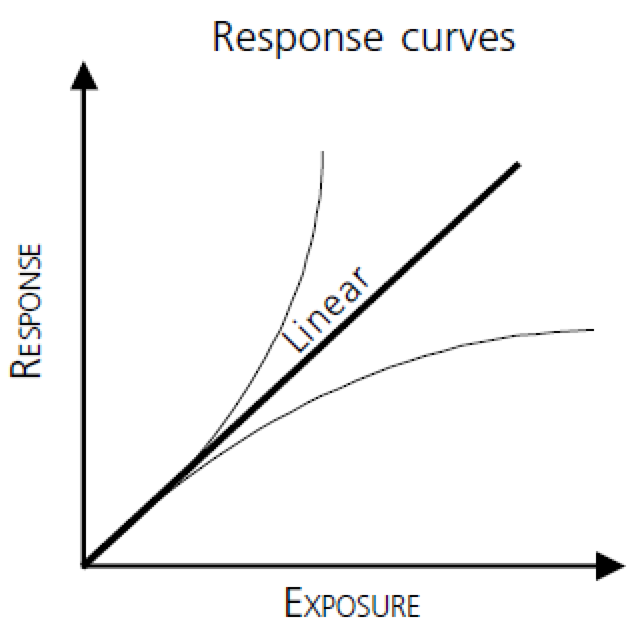


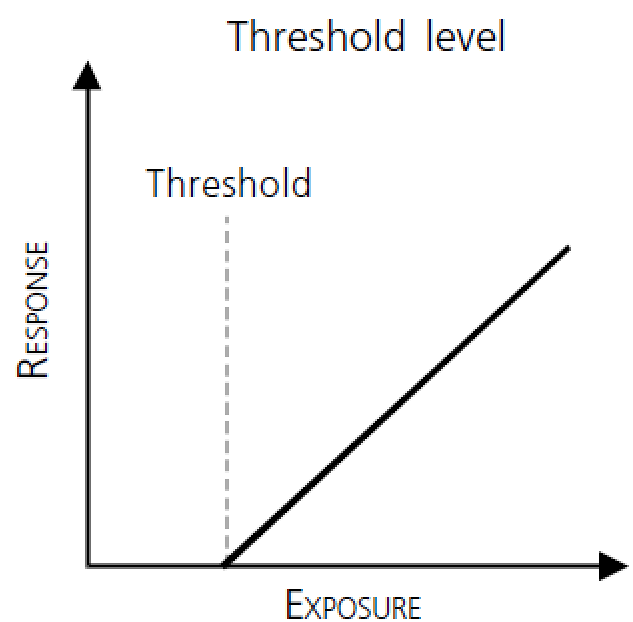
National Atmospheric Deposition Program/Mercury Deposition Network

4^{th} – Dose-response function (DRF)

- Also known as **Concentration Response Functions (CRF)**







Impact of emissions on years of life lost in France

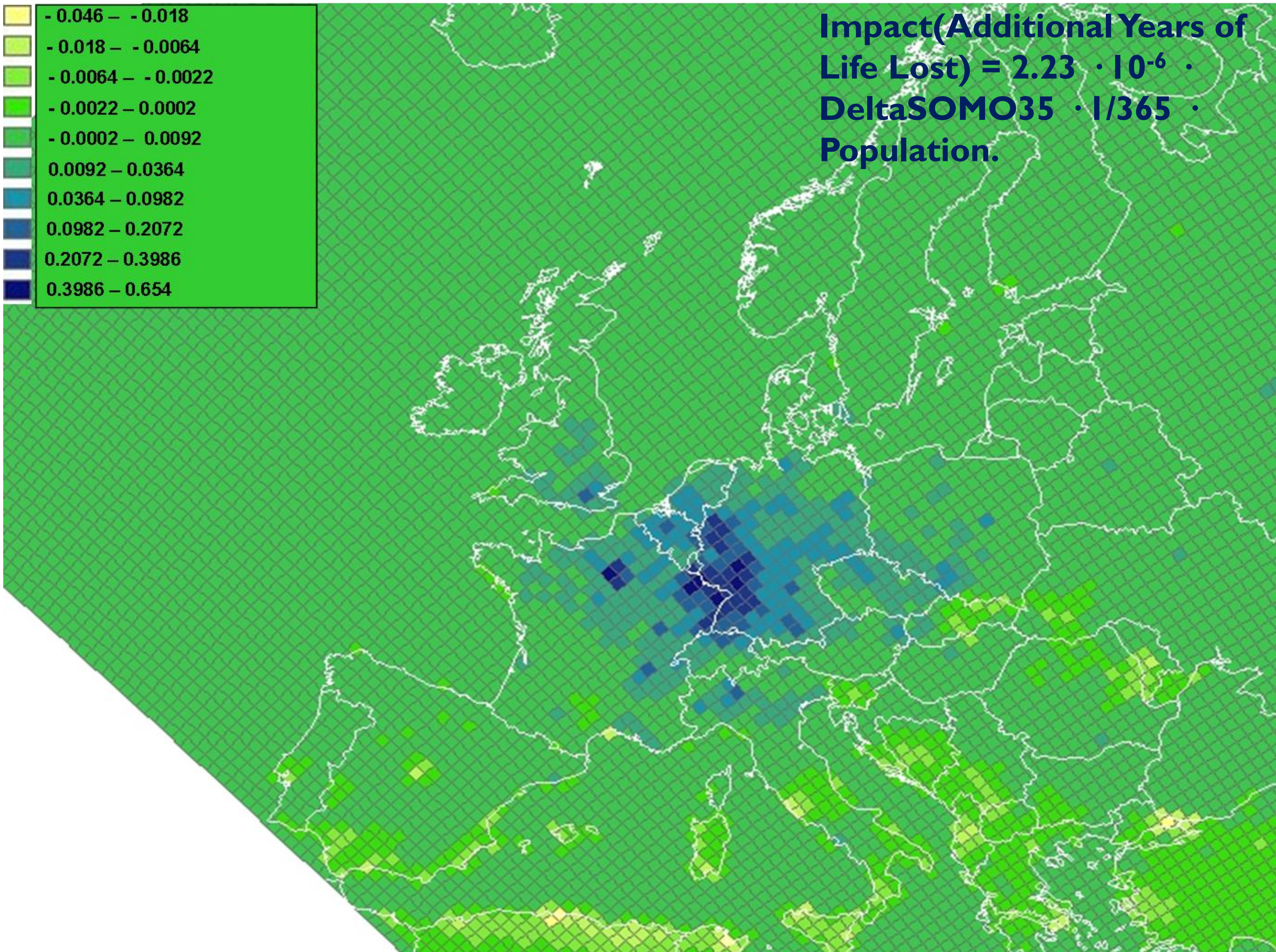


Table 1: Overview of the CRF for particulate matter (PM) and ozone based on (Torfs et al. 2007)

Pollutant and corresponding endpoint	Health risk per person per µg per m³ and year [x/(µg/(m³ *a)]	Unit
Particulate Matter < 2.5µm, i.e. PM2.5		
Life expectancy reduction – years of life lost	$6.51*10^{-04}$	years
net restricted activity days (NetRAD)	$9.59*10^{-03}$	days
Work loss days (WLD)	$1.39*10^{-02}$	days
Minor restricted activity days (MRAD)	$3.69*10^{-02}$	days
Particulate Matter < 10 µm, i.e. PM10		
Increased mortality risk (infants)	$6.84*10^{-08}$	cases
New cases of chronic bronchitis	$1.86*10^{-05}$	cases
Respiratory hospital admissions (RHA)	$7.03*10^{-06}$	cases
Cardiac hospital admissions (CHA)	$4.34*10^{-06}$	cases
Medication use / bronchodilator use (child)	$4.03*10^{-04}$	cases
Medication use / bronchodilator use (adult)	$3.27*10^{-03}$	cases
Lower respiratory symptoms (adult)	$3.24*10^{-02}$	days
Lower respiratory symptoms (child)	$2.08*10^{-02}$	days
Average daily SOMO35: Indicator for ozone		
Life expectancy reduction - years of life lost	$2.23*10^{-06}$	years
Respiratory hospital admissions (RHA)	$1.98*10^{-06}$	cases
Minor restricted activity days (MRAD)	$7.36*10^{-03}$	days
Medication use / bronchodilator use	$2.62*10^{-03}$	cases
Lower resp. symptoms (LRS) excluding cough	$1.79*10^{-03}$	days
Cough days	$1.04*10^{-02}$	days

Terminologies

CRF: concentration-response function

YOLL: years of life lost

RAD: Restricted activity days

NetRAD: To avoid double counting, RAD is corrected according to (Torfs et al. 2007). "Since Work Loss Days (WLD), Minor Restricted Activity Days (MRAD and days in hospital because of cardiac hospital admissions CHA and Respiratory Hospital Admissions (RHA) are also RADs the net RADs are calculated as:

NetRAD (per µg/m³ PM2.5) = RAD – WLD – WRAD – (RHA and CHA due to PM10) x 10 days"

WLD: Work loss days

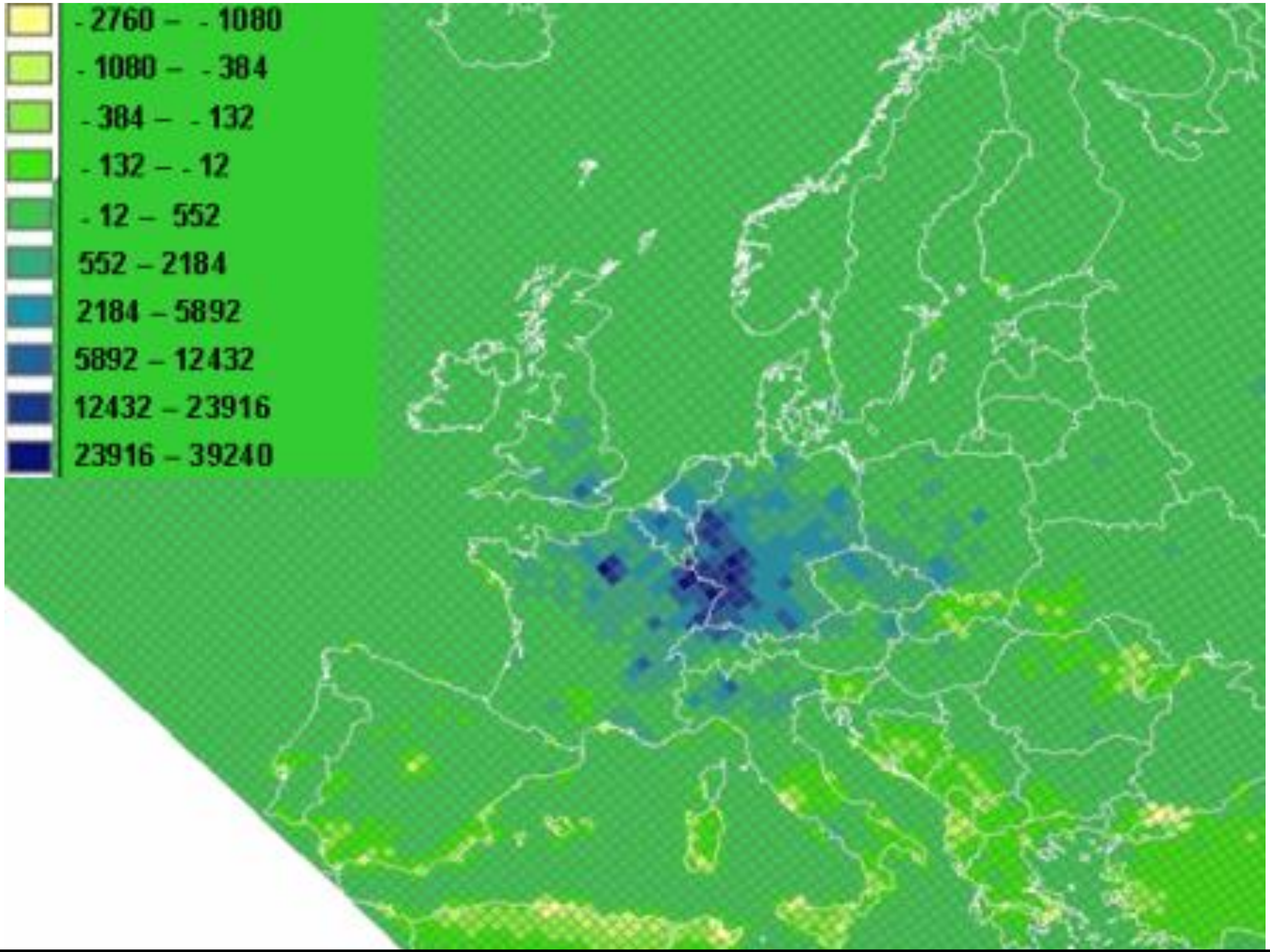
MRAD: Minor restricted activity days

LRS: lower respiratory symptoms

Average daily SOMO35: for each day of the year, the maximum ozone concentration during any 8h-period of the day is determined. If this maximum exceeds 35 ppb (parts per billion), then the difference between the concentration and 35 ppb is determined. For each day with an exceedance these differences are added. The result is the indicator for ozone exposure SOMO35 (sum of means over 35 ppb). Dividing this value by 365 gives the average daily SOMO35 value.

5th – Monetization of impact

- Damages due to changes in the Ozone concentration caused by a facility in France. Damages are expressed in €$_{2000}$ per year.



Tài liệu tham khảo

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- Assessment of Health Impacts of Coal Fired Power Stations in Germany - by Applying EcoSenseWeb 2013. Philipp PREISS, Joachim ROOS, and Rainer FRIEDRICH, Institut für Energiewirtschaft und Rationelle Energieanwendung, Universität Stuttgart.
- Emissions of Hazardous Air Pollutants from Coal-fired Power Plants 2011. Environmental Health and Engineering, Report 17505.