Air pollution

DURING the 20th century air pollution, once a localized problem, became a global one. Nowhere is immune from toxic fallout or changes to the planet's atmospheric chemistry. Even so, the most intense effects on both ecosystems and human health are local.

Approximately half of the world's population now lives in urban areas, and half of all the world's urban residents are exposed to potentially harmful amounts of sulfur dioxide (SO_2), ozone and particulate matter in "smogs"[1]. The chemistry of smogs takes different forms. Winter smogs largely arise from burning coal to warm buildings during cold weather. When the smoke and SO_2 combine with fog in windless weather they create a pollution cap that the sun is not strong enough to clear.

Some 4 000 people died from lung and heart conditions during a London "peasouper" smog in December 1952. Similar smogs now occur regularly in northern Chinese and Indian cities, including Delhi and Beijing. China's smogs cause more than 50 000 premature deaths and 400 000 new cases of chronic bronchitis a year in 11 of its largest cities alone[2].

Summer smogs, first reported in Los Angeles, involve pollutants – mainly from vehicle exhausts – that undergo photochemical changes in bright sunlight, creating substances such as ozone, a gas that can trigger asthma attacks. Conditions are worst in thin air at higher altitudes and if the air is trapped inside a valley. Both situations apply in Mexico City, the world's second largest urban agglomeration, where smog alerts close factories and force cars off city streets several times a year. Globally, some 50 percent of cases of chronic respiratory illness are now thought to be associated with air pollution[3].

A particularly toxic component in some urban air is lead, the heavy metal which has for many years been added to gasoline to raise octane levels and help engines run more smoothly. It is emitted as tiny particles in exhausts, contaminating both air and food. Elevated lead levels are widespread among children in cities where leaded petrol is sold. Lead damages the neurological development of children, lowering IQ and causing attention and behavioral problems. Many nations have reduced or banned lead additives. Elsewhere, urban areas can have high lead contamination even with relatively low vehicle numbers. Lead levels in the air of large African cities such as Cairo, Cape Town and Lagos are up to ten times those typical of European cities[4].

Analysts at the World Bank argue that exposure to lead is due less to urban demographics, vehicle numbers or national wealth and more to direct political choice. The Bank says that removing lead from gasoline is one of the most cost-effective ways of improving both the urban environment and human health[5].

Smogs are generally very acidic. Some of the pollutants they contain travel long distances on the winds, causing acid deposition in surrounding countryside and even in neighboring countries. In the 1980s, "acid rain" was identified as a major international environmental problem, spilling over from densely populated and heavily industrialized areas of both Europe and North America

Atmospheric chemistry

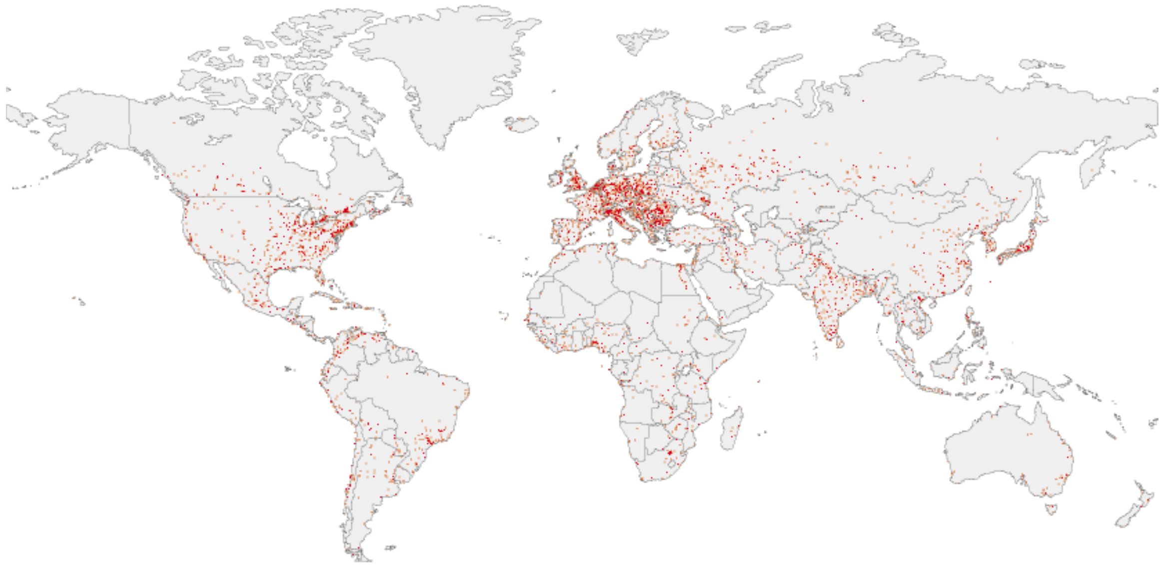
Humankind has been manipulating atmospheric chemistry on a small scale, usually accidentally, for many centuries. Urban areas contain enough heat-absorbing construction material to keep cities warmer than surrounding areas. Sulfate particles in urban smog, on the other hand, reduce solar heating. Deforestation has upset the hydrological cycle, often reducing rainfall downwind. For half a century scientists have attempted, generally unsuccessfully, to "seed" clouds with tiny particles to encourage the formation of raindrops. In recent decades evidence has grown that humans are altering climate on the global scale by adding greenhouse gases to the atmosphere.

TOP VEHICLE-OWNING COUNTRIES, 1998

	Vehicles per thousand people	GNP per capita US$ 1998
USA	767	29 240
Australia	605	20 640
Italy	591	20 090
New Zealand	579	14 600
Canada	560	19 170
Japan	560	32 350
France	530	24 210
Germany	522	26 570
Austria	521	26 830
Switzerland	516	39 980
World	**116**	**4 890**
China	*8*	*750*
India	*7*	*440*

Source: World Bank.

GLOBAL DENSITY OF INDUSTRIAL FACILITIES, 1990s



Source: ESRI.

The maps show the most significant centers of manufacturing, taking into account the size of the labor force and the value of output.

COUNTRIES WITH THE GREATEST INCREASE IN OWNERSHIP OF VEHICLES, 1980-98

	Vehicles per thousand people 1980	Vehicles per thousand people 1998	% increase 1980-98
Korea, Rep.	14	226	1 514
Thailand	13	103	692
Nigeria	4	26	550
China	2	8	300
Pakistan	2	8	300
Uganda	1	4	300
Turkey	23	81	252
India	2	7	250
Poland	86	273	217
Indonesia	8	22	175
Bolivia	19	52	174
Hungary	108	268	148
Greece	134	328	145
Portugal	145	347	139
Israel	123	264	115
Mauritius	44	92	109
Finland	228	448	96
Spain	239	467	95
Chile	61	110	80
Italy	334	591	77

Source: World Bank.

CITIES WITH REPORTED LEVELS OF ATMOSPHERIC POLLUTANTS ABOVE WHO GUIDELINES, 1990-95

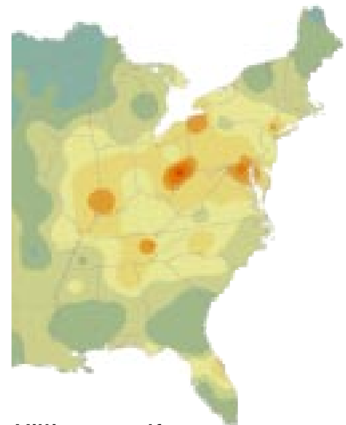
Country	City	TSP	NO_2	SO_2
		Micrograms per cubic meter		
Argentina	Cordoba City	97	97	
Brazil	Rio de Janeiro	139		129
	Sao Paulo		83	
Bulgaria	Sofia	195	122	
Chile	Santiago		81	
China	Anshan	305	88	115
	Beijing	377	122	90
	Changchun	381	64	
	Chengdu	366	74	77
	Chongquing	320	70	340
	Dalian	185	100	61
	Guangzhu	295	136	57
	Guiyang	330	53	424
	Harbin	359		
	Jinan	472		132
	Kunming	253		
	Lanzhou	732	104	102
	Liupanshui	408		102
	Nanchang	279		69
	Pinxiang	276		75
	Quingdao		64	190
	Shanghai	246	73	53
	Shenyang	374	73	99
	Taiyuan	568	55	211
	Tianjin	306	50	82
	Urumqi	515	70	60
	Wuhan	211		
	Zhengzhou	474	95	63
	Zibo	453		198
Colombia	Bogota	120		
Denmark	Copenhagen		54	
Ecuador	Guayaquil	127		
	Quito	175		
Egypt	Cairo			69
France	Paris		57	
Germany	Munich		53	
Ghana	Accra	137		
Greece	Athens	178	64	
Hungary	Budapest		51	
India	Ahmedabad	299		
	Bangalore	123		
	Calcutta	375		
	Chennai	130		
	Delhi	415		

INDUSTRIAL FACILITIES IN EUROPE, 1990s

Source: ESRI.

- Woodworking; printing; textiles; chemical and pharmaceutical; building materials
- Electrical and precision equipment; machinery; metal working; transport
- Oil, gas and petrochemical processing; metallurgy
- Food industry; art and craft

SULFUR DEPOSITION IN THE EASTERN USA, 2000



Milligrams sulfur per square meter

- Less than 200
- 200-300
- 300-400
- 400-500
- 500-600
- 600-700
- 700-800
- 800-900
- More than 900

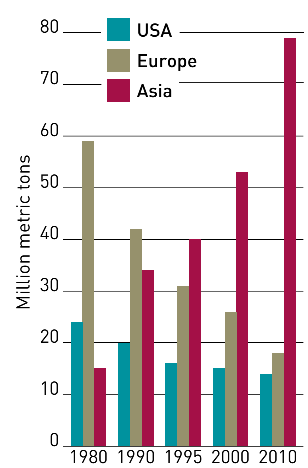
Source: NADP/NTN.

Country	City	TSP	NO_2	SO_2
		Micrograms per cubic meter		
	Hyderabad	152		
	Kanpur	459		
	Lucknow	463		
	Mumbai	240		
	Nagpur	185		
	Pune	208		
Indonesia	Jakarta	271		
Iran	Tehran	248		209
Italy	Milan		248	
	Turin	151		
Japan	Osaka		63	
	Tokyo		68	
	Yokohama			100
Korea, Rep.	Pusan	94	51	60
	Seoul		60	
	Taegu		62	81
Mexico	Mexico City	279	130	74
Netherlands	Amsterdam		58	
Philippines	Manila	200		
Portugal	Lisbon		52	
Romania	Bucharest		71	
Russia	Moscow	100		109
	Omsk	100		
South Africa	Cape Town		72	
Spain	Barcelona	117		
Thailand	Bangkok	223		
Turkey	Ankara			55
	Istanbul			120
UK	London		77	
Ukraine	Kiev	100	51	
USA	Chicago		57	
	Los Angeles		74	
	New York		79	
Venezuela	Caracas		57	

Annual mean guidelines
TSP: Total suspended particulates, 90 micrograms per cubic meter
NO_2: Nitrogen dioxide, 50 micrograms per cubic meter
SO_2: Sulfur dioxide, 50 micrograms per cubic meter
Where no figure is shown for the above, its concentrations are within WHO guidelines or are unavailable

Source: World Bank.

SO_2 EMISSIONS FROM FOSSIL-FUEL BURNING



Source: UNEP.

BIOMASS BURNING AND CO_2 EMISSIONS, 1990s

	Biomass burned*	Carbon released
	Million metric tons per year	
Savannahs	3 690	1 660
Agricultural waste	2 020	910
Tropical forests	1 260	570
Fuelwood	1 430	640
Temperate and boreal forests	280	130
Charcoal	20	30
World	8 700	3 940

* Dry matter

Source: UNEP.

Researchers have only quite recently realized the importance of biomass burning in overall emissions of greenhouse gases. More than half of the carbon released into the atmosphere comes from biomass burning, the remainder being produced by fossil-fuel burning, cement manufacture and gas flaring.

into prime agricultural areas. Mountain regions suffered worst because their higher rainfall increased the volume of acid deposition, and their often thin soils could not neutralize the acid. Lakes and streams in "pristine" parts of Scandinavia and Scotland became acidified, losing fish over large areas. The most intense fallout occurred in the "black triangle" bordering Germany, the Czech Republic and Poland.

Since 1985, international treaties and heavy investment by power station operators in "desulfurization" equipment have cut sulfur pollution in Europe and North America by as much as 80 percent. Meanwhile nitrogen emissions from vehicles have stabilized, with the impact of cleaner cars counterbalanced by increased car use. Critical loads for acidification are still being exceeded in 10 percent of the land area of Western and Central Europe[6]. In some places, acidified soils and surface water are recovering. But in others the large amounts of acid accumulated in soils mean recovery could take decades[7]. The 1998 *Forest Condition Survey of Europe* by the UN Economic Commission for Europe found a quarter of the continent's trees were missing more than a quarter of their leaves. Air pollution was the main cause[8].

As more countries industrialize, acidification of the environment is becoming a global problem. Asian emissions of SO_2 were expected to exceed those of Europe and North America combined in the year 2000. The largest source is China, which emits 18 million tons of SO_2 a year. China's losses to crops and forests from acid deposition stand at US$5 billion a year[9]. Japan, which invested heavily to clean up its own emissions, is now suffering cross-border pollution from its neighbors[10]. Modelling studies suggest that without a clean-up, acid fallout over large areas of China will by 2020 exceed the levels reached in Central Europe in the 1970s[11].

Under certain meteorological conditions, smogs can spread very large distances to remote, unpopulated areas. In winter, weather systems take smog from Russian industrial centres north into the Arctic, where it lingers for many months – a phenomenon known as Arctic haze[12]. Similarly, Asian smogs sometimes travel on westerly winds across the Pacific to North America in spring[13].

The smoke from some forest fires can also be categorized as human-induced pollution, and can spread thousands of kilometers. In late 1997, Indonesian forest fires polluted neighboring countries, causing plane and shipping crashes as well as thousands of hospital admissions for lung and eye complaints. Health costs from the fires were later put at US$940 million[14].