The 6th ASIA- PACIFIC MERCURY MONITORING NETWORK MEETING IN TAIWAN

Air quality in Mongolia

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Contents

- Background
- Role of organization NAMEM/IRIMHE in air quality
- Air pollution sources and monitoring
- Air quality management legislation and standard
- Current situation in Mongolia
- In the future – MERCURY MONITOR

Brief introduction of Mongolia

- Capital: Ulaanbaatar
- Area: 1.564 million km2
- Population:3.09 million (June, 2016, NSO)
- GDP Growth: 3.1% (I quarter, 2016)
- Inflation rate: 1.8 % (NSO, May 2016)

North Mongolia

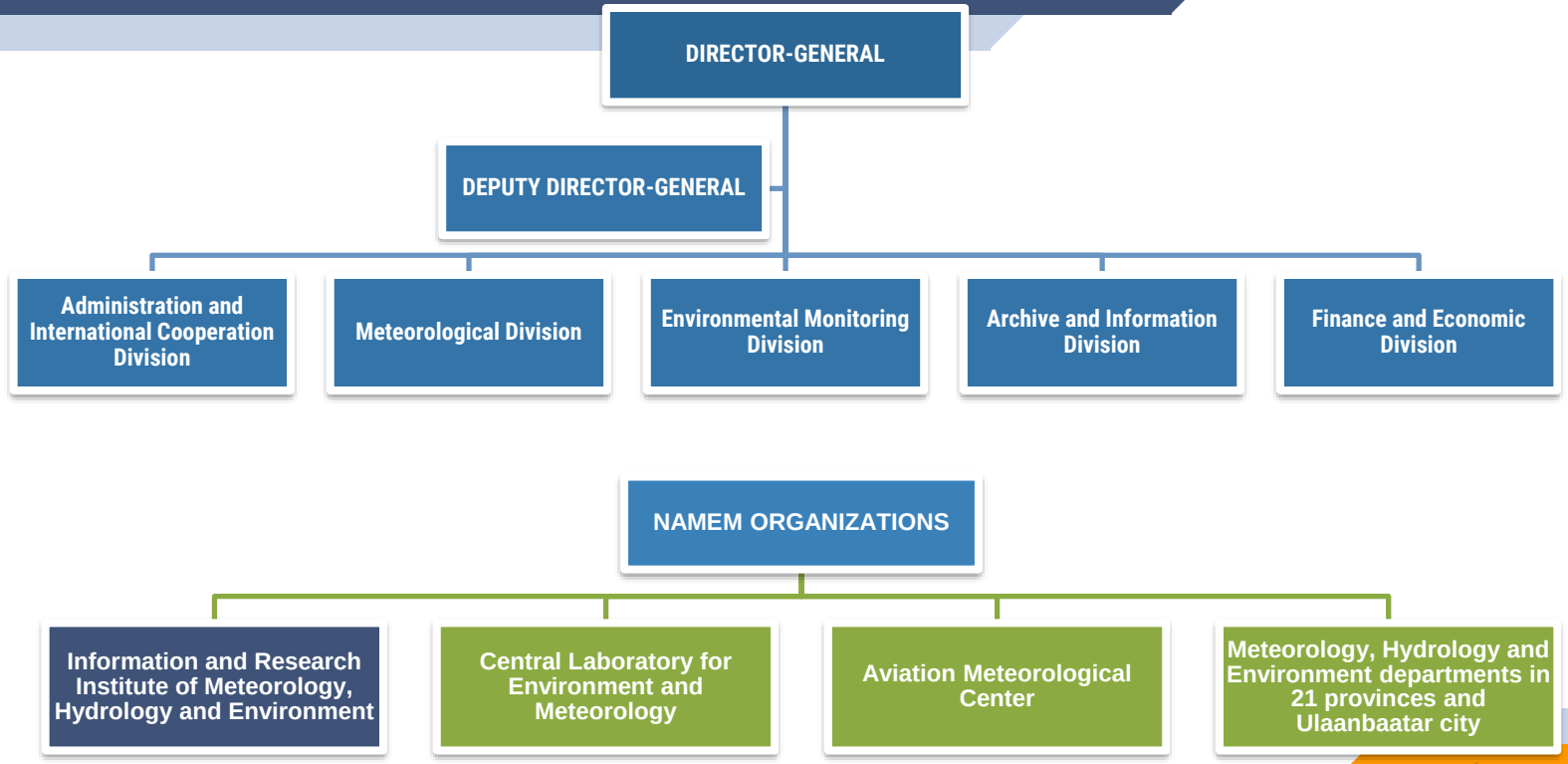
South Mongolia

	North Mongolian forest -steppe area	South Mongolian Gobi area
Number of days with temperature above zero on the ground surface	170-190 days	230-250 days (surface soil is heated up to 600-650C or more)
Average wind speed per month	2, 2 meter per sec	3, 7 – 4, 0 meter per sec
Average Humidity	50-60%	14-18%
Average monthly precipitation	30-40 mm	3,0-3,9 mm
Yellow dust transportation	Not known	by wind (sometime up to 30-40 m/sec)

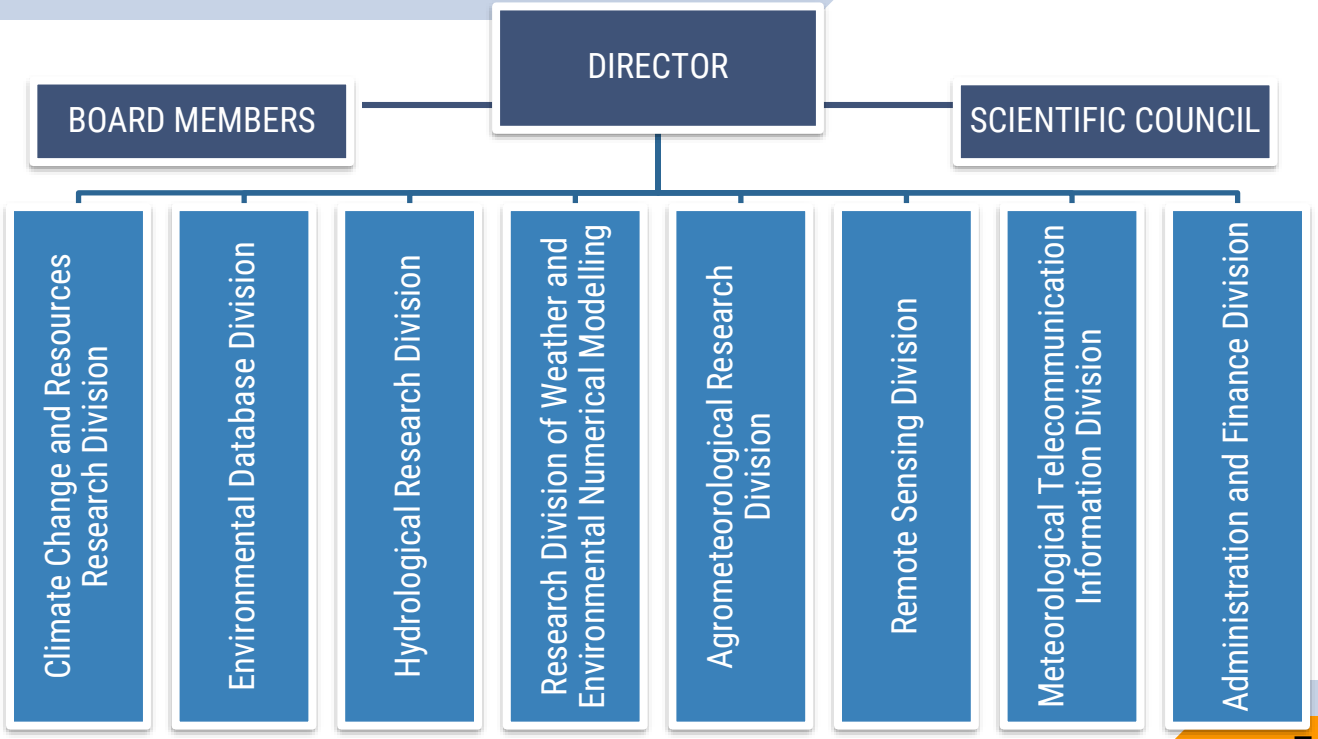
Short introduction Mongolia

Economic activity in Mongolia has traditionally been based on herding and agriculture, although development of extensive mineral deposits of copper, coal, molybdenum, tin, tungsten, and gold have emerged as a driver of industrial production.

Organizational Structure



Information and Research Institute of Meteorology, Hydrology and Environment



Mongolian Air quality monitoring network

- There are 38 stations in air quality monitoring network
- In Ulaanbaatar 14 stations

Main sources of air pollution in Mongolia (2015)

Air pollution various sources	Stoves and boilers					Vehicles
	Common stoves that capacity less than 10kw	Yearly consumption of coal ton	Stationary sources that more than 100 KW capacity			
			10-100KW	More than 100KW	Yearly consumption ton	
In Mongolia	608698	876021	6291	409	8004954	**720278**
In UB	171731	588769	2866	337	5801326	**439129**
In Provinces	436967	287252	3425	72	2878512	**281149**
Province centers	114257	357672	871	49	2071199	

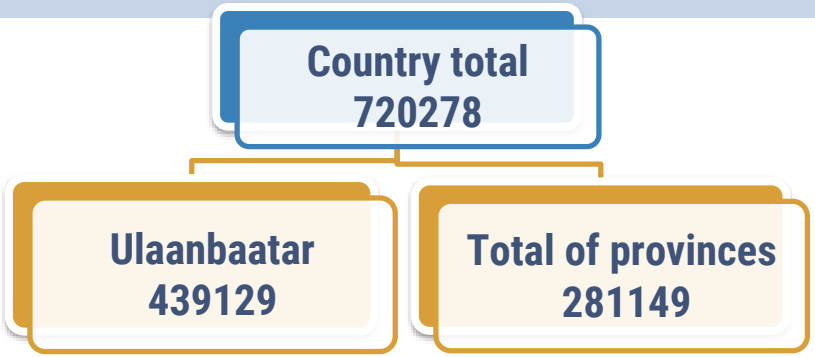
Main sources of air pollution in Ulaanbaatar

TERMO POWER PLANTS(TPP)
HEAT ONLY BOULERS (HOBs)

GER AREA

VEHICLES

Mobile sources in Mongolia



In 2015 vehicle quantity increased by 4.95% than 2014. It is 79% are used cars older than 10 years, 10% is 7-9 years old vehicles.

Types, aim	Vehicles		Difference
	At 2014	At 2015	
Passenger car	481151	509287	**28136** ↑
Trucks	163241	169006	**5765** ↑
Bus	6228	6474	**246** ↓
Special aim	15238	15091	**147** ↓

Air quality monitoring station types and measuring parameters

	Sites (types)	Measuring techniques	Which parameters
1	UB01(industrial) (UB02 (roadsite) UB04 (urban) UB05 (urban) UB08 (background) Ulaanbaatar, Mongolia	 Automatic analyzers	SO2 O3, NO2, NO, NOx, CO, PM10, PM2,5, T,WD,WS,P, temperature, wind direction, wind speed, pressure –(15 min)
2	22 stations in provinces	Air sampling aspirators	NO2, SO2

International sites

EANET SITES (http://www.eanet.asia/site/)

Ulaanbaatar

Characteristics of sites : Urban
Sampling interval(Precipitation) : Daily
Sampling interval(Filter pack) : Biweekly
Starting Month : August '98
Monitoring Items
Precipitation : Precipitation amount, EC, pH、
Ionic substances (SO4 2-,NO3 -,Cl-,NH4+,Na+,Ca2+,Mg2+)
Air concentration
Automatic monitors： None
Filter pack
Meteorological Measurements : Precipitation amount, Wind , Temperature, Humidity

Terelj

Characteristics of sites : Remote
Sampling interval(Precipitation) : Daily
Sampling interval(Filter pack) : Biweekly Starting Month : Sept. '98
Monitoring Items
Precipitation : Precipitation amount, EC, pH、
Ionic substances (SO42-,NO3-,Cl-,NH4+,Na+,Ca2+,Mg2+)
Air concentration Automatic monitors： None
Filter pack
Meteorological Measurements :
Precipitation amount, Temperature, Humidity,

GHG SAMPLING SITE FROM GMD NOAA, USA

Location: semi desert region of Mongolia (Erdene soum, Dorongovi province
Sampling method: passive sampling
Gases: CO_2, CH_4, N_2O, SF_6

Dust and PM observation network

RUSSIA

90° E 95° E 100° E 105° E 110° E 115° E 120° E

50° N 45° N 40° N

Legend

Cour

Aima

Elevation

High

Low : 526.172

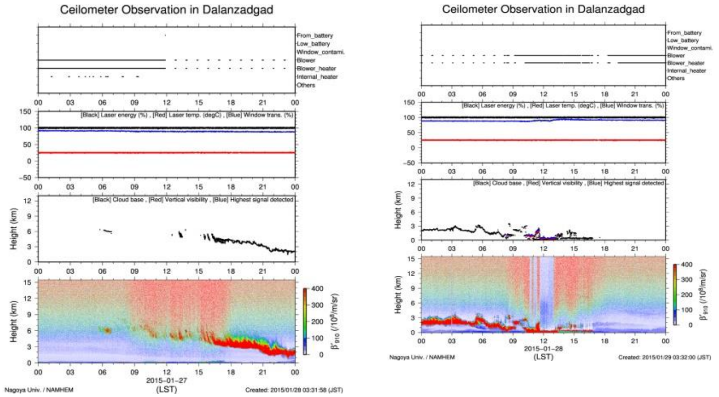
- Dust monitoring site, KMA
- Tottori site
- Ceilometer (Nagoya University), KOSA monitoring (NIES)
- LIDAR (NIES), KOSA monitoring site
- Meteorological station

Instruments (Ceilometer, CL51)
Nagoya University

Cloud, rain, snow,
dust, aerosol

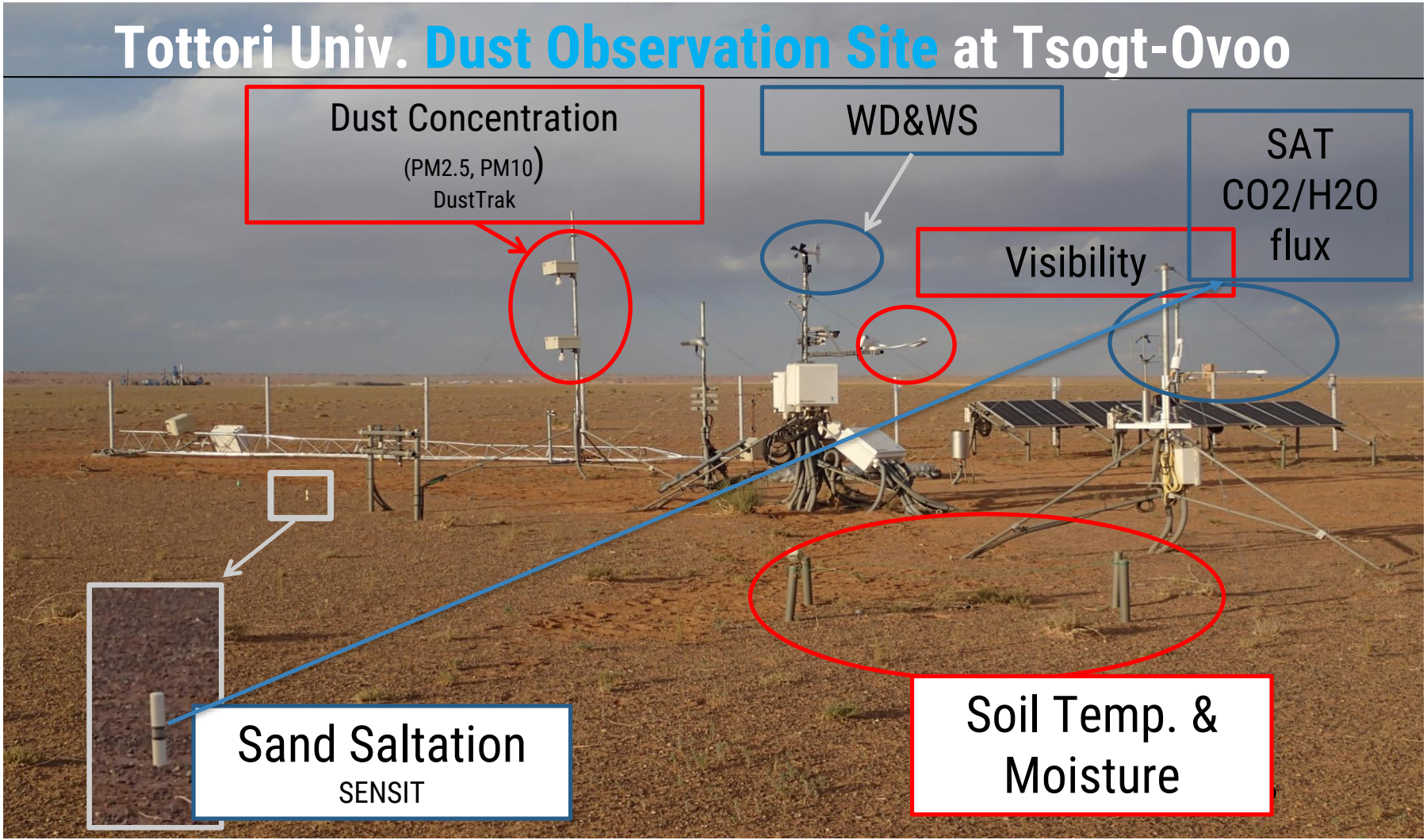
910 nm
6.5 kHz

Range: 0 - 15 km
Resol.: 6 s, 10 m

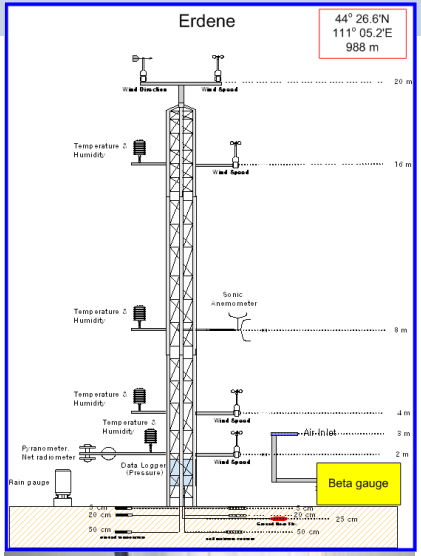


Quasi real time
monitoring
on our web site

Collaborations between Nagoya University and IRIMHE, ceilometer was set up: At Dalanzadgad in 28-29 April 2013


Tottori Univ. Dust Observation Site at Tsogt-Ovoo
Dust Concentration
(PM2.5, PM10)
DustTrak
WD&WS
SAT
CO2/H2O
flux
Visibility
Sand Saltation
SENSIT
Soil Temp. &
Moisture

Collaboration between NAMEM and KMA / NIMR



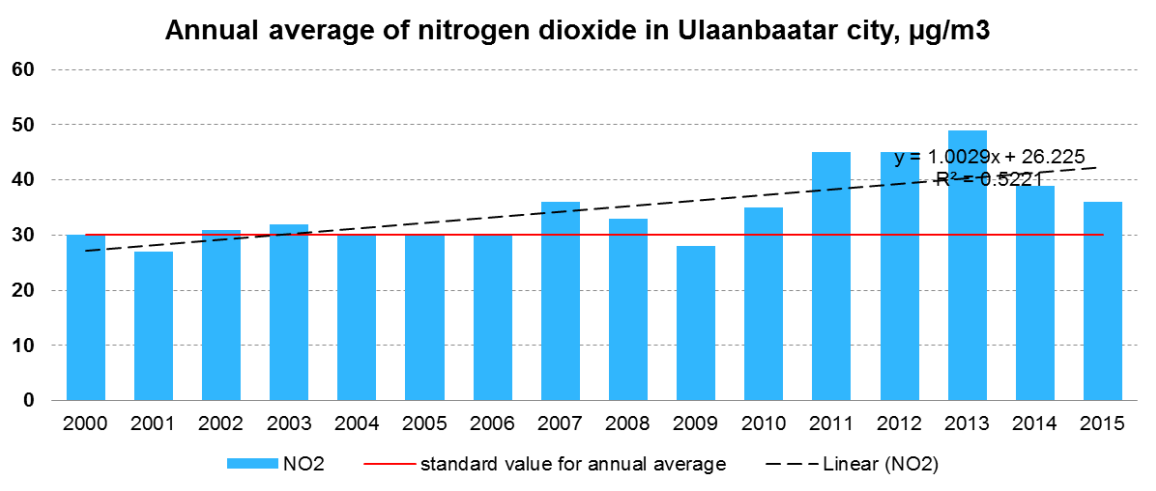
Collaborations between KMA and NAMEM, 2 sites for meteorological and dust monitoring towers were set up:

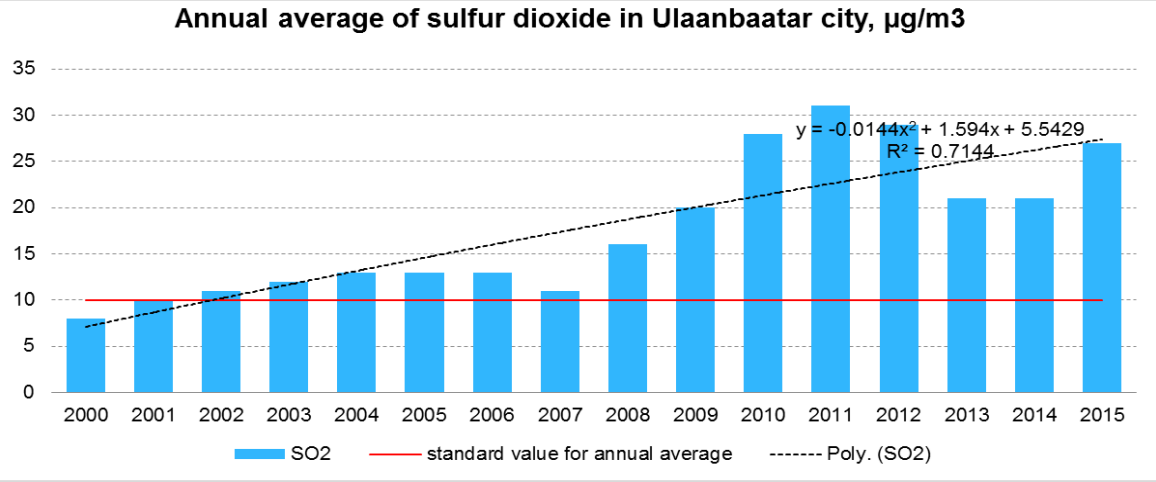
- At Erdene in 26-29 October 2007
- At Nomgon in 15-17 October 2010.

Instruments:

- Met. parameters by Vaisala instruments
- Dust PM10 concentration by instruments from Thermo Electron Corporation.

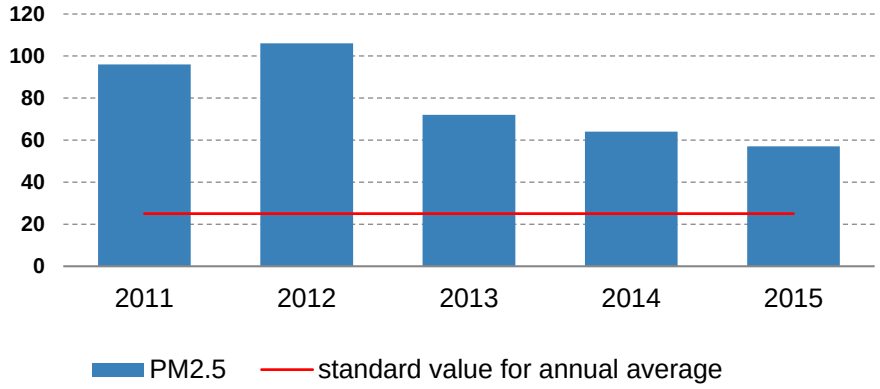
The beta-attenuation chamber measures alpha emissions from the accumulated aerosol.



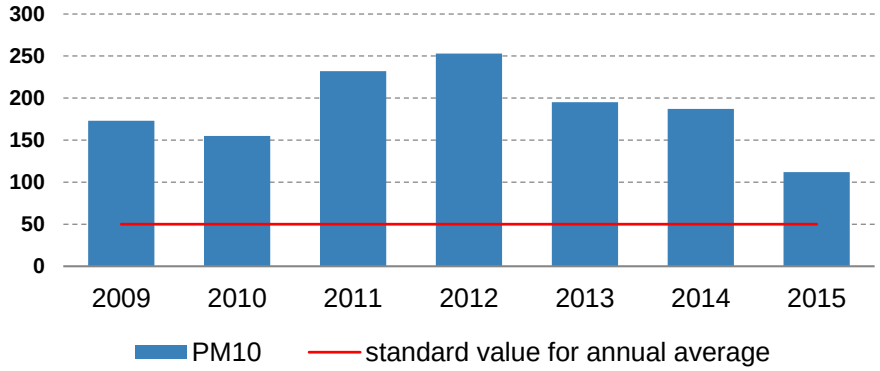


Annual average concentration of sulfur dioxide (SO2) and nitrogen dioxide (NO2) are increased very rapidly in last years.

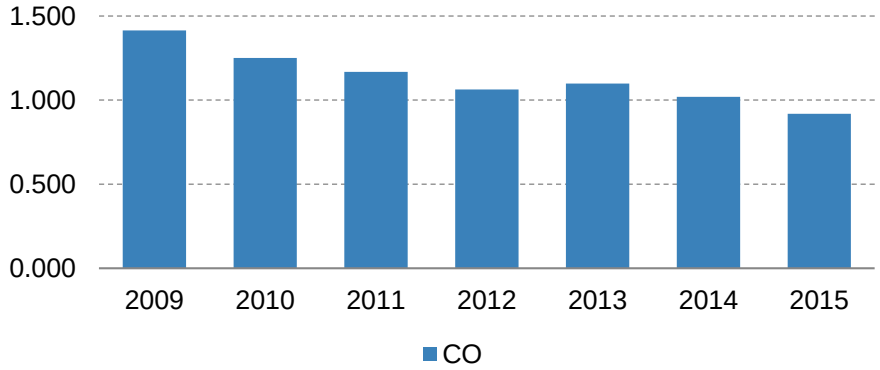
Annual average concentration of PM2.5 in Ulaanbaatar city, µg/m3



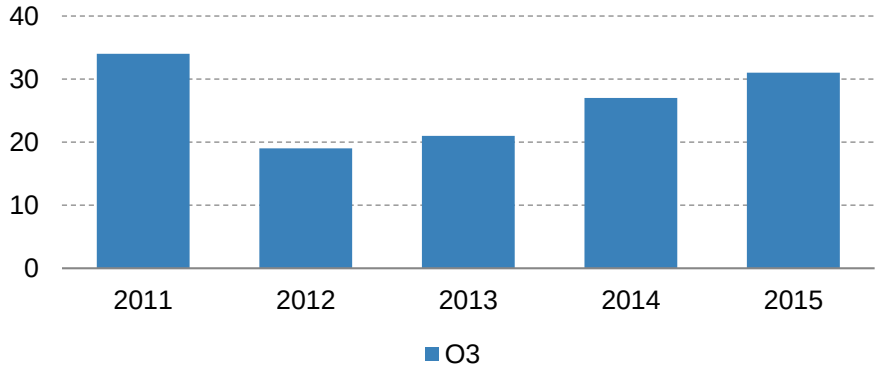
Annual average concentration of PM10 in Ulaanbaatar city, µg/m3

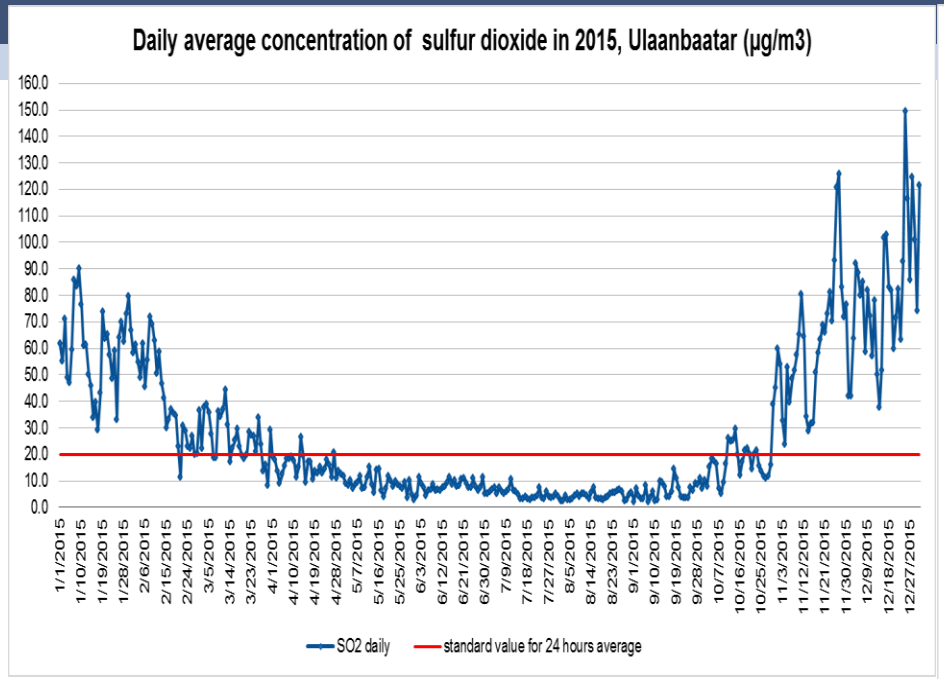


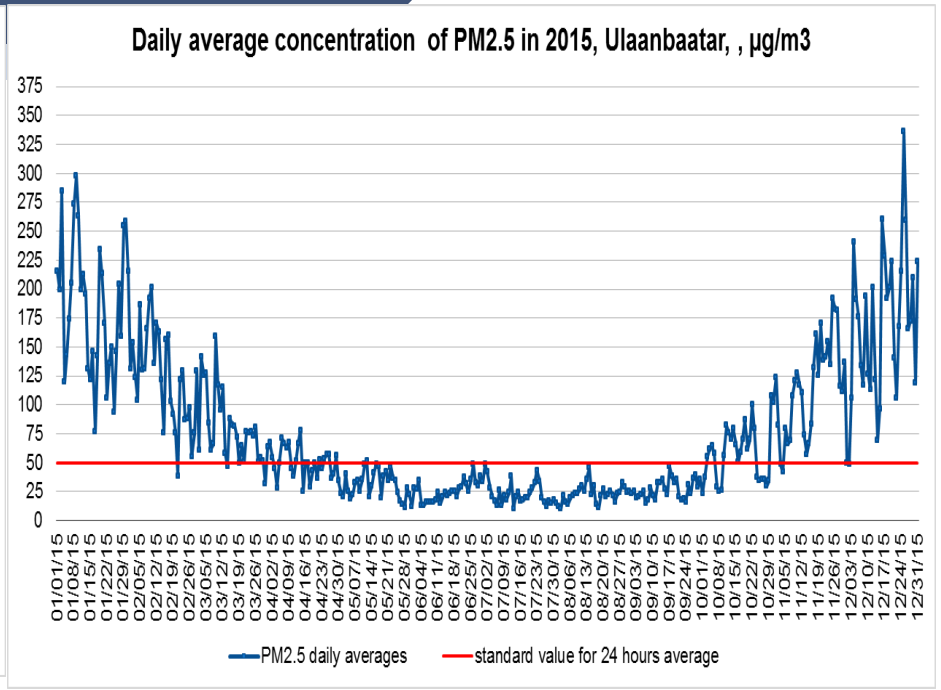
Annual average of carbon monoxide (CO) in Ulaanbaatar city, mg/m3



Annual average of ozone (O3) in Ulaanbaatar city, µg/m3

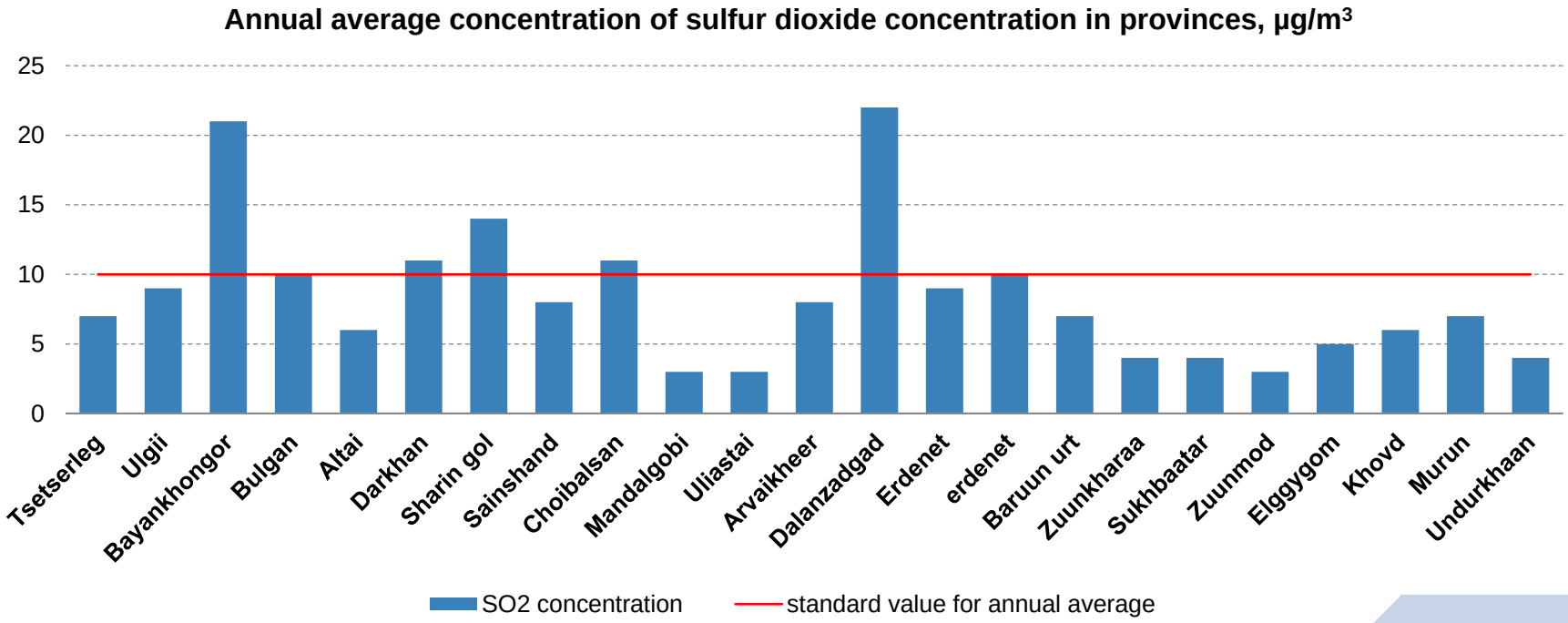




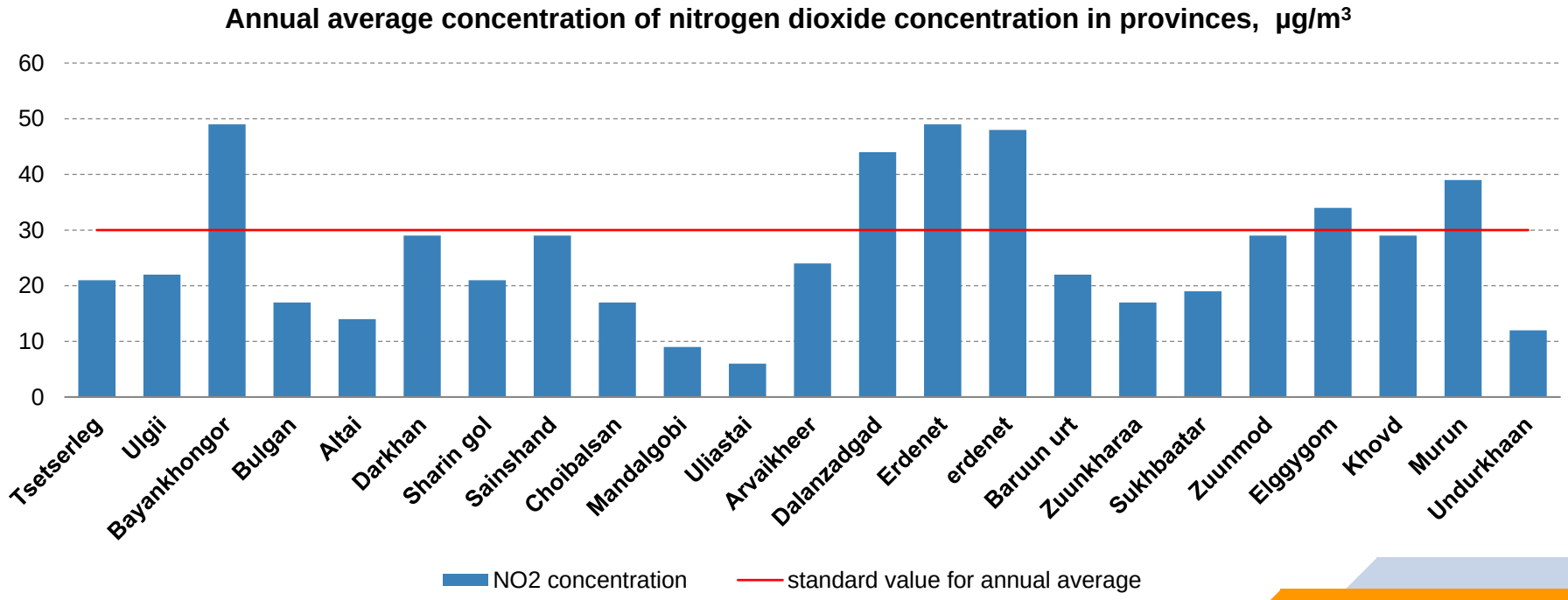


In the cold season, PM and SO2 higher than AQS (example 2015)

Air quality in provinces



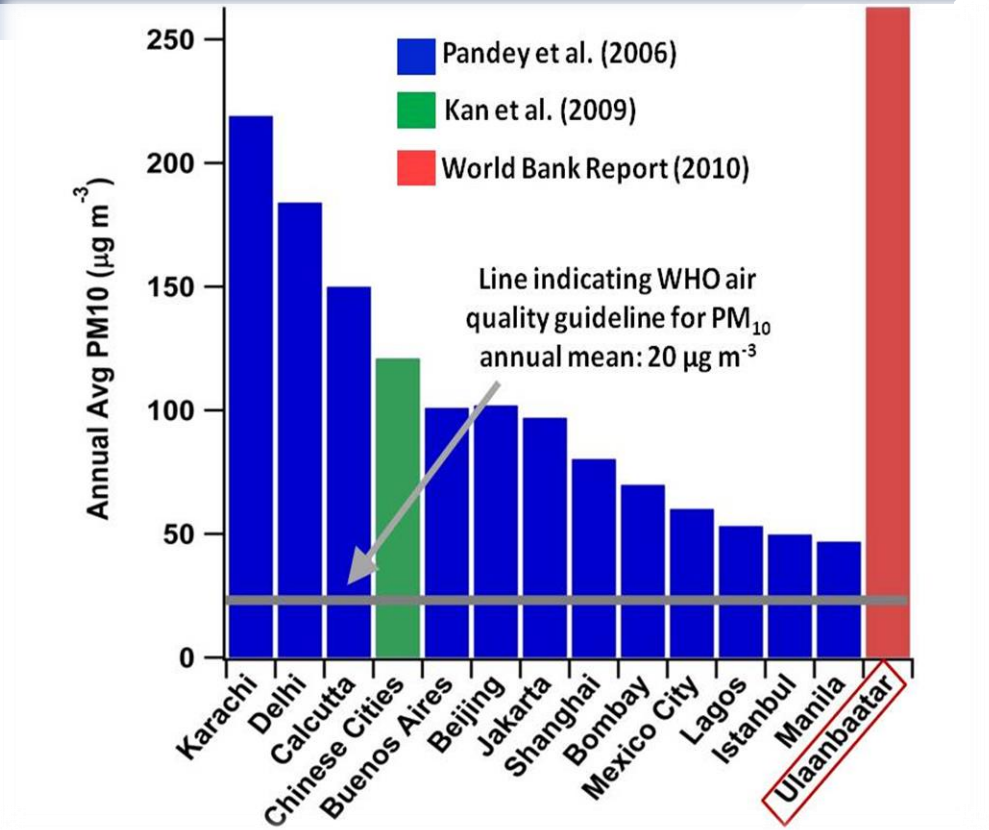
Air quality in provinces



Monitoring results

Air pollution has been increasing intensively during last decade in the big cities of Mongolia especially in Ulaanbaatar due to urbanization, poor urban plan, migration from rural areas to urban areas, poverty, unemployment, economic crises, exercise with unclean technology mainly coal for heating and cooking, raise of number of motor vehicle and other air pollution sources; as result of this phenomena population health has been worsening.

http://cires.colorado.edu/



Air quality management legislation and role of central and local government in air quality management

Main legal documents for air quality management

- Law on “Air” (1995) updated (2012, 2015)
- “Air pollution payment” law (2010)

Ambient air quality standards

MNS4585:2007 Air quality standard for Common air pollutants

MNS5885:2008 Air quality standard for Hazardous air pollutants

Emission standards

MNS 5013:2009 Permitted limit and methodology of measurement of petrol engine automobile in emission.

MNS 5014:2009 Permitted limit and methodology of measurement of diesel engine automobile in emission.

Year: 2015 country: Mongolia area: Ulaanbaatar

	Unit (ppm or mg/m³)	Standard Value		Current Annual Average	Existing Problems
		1 hour	1 day		
Sulfur dioxide	mg/m³	-	0.020	0.025	Concentration in heating season is very high because of raw coal burning.
Nitrogen dioxide	mg/m³	-	0.040	0.036	Concentration in roadside is higher than daily standard
Photochemical Oxidant	mg/m³	-	Ozone 8 hour 0.100	0.031	-
Carbon monoxide	mg/m³	30	8 hour 10	0.918	Concentration is growing during heating season. Higher than standard few time a year.
Suspended Particle Matter such as TSP, PM10, PM2.5	mg/m³	-	TSP 150 PM10 100 PM2.5 50	PM10 0.126 PM2.5 0.057	PM10 - Concentration in winter time is very high because of raw coal burning. PM2.5 - Concentration in heating season is very high because of raw coal burning.
Others		-	-		-

MNS4585:2007 Air quality standard for Common air pollutants

Minamata convention on Mercury

Since 2013, Mongolia joins Minamata Convention on Mercury

- Minamata Convention aims to curb health and environmental damages caused by mercury. As a result of the convention, discharge of mercury into environment, sub-standard storage and disposal of mercury, and the use of mercury in gold mining are expected to decrease.
- All member nations were given the duty to ban the manufacture, import and export of batteries, switches, fluorescent glass lamps, cosmetics products, pesticides, metric equipment and tools with containing mercury and replace them with products free of mercury.
- Mongolia has been using mercury since 1990 for gold mining and usage increased after 2000, as independent gold miners began using mercury, even in households, without consideration for environmental issues. Though joining the effort quite late, the Mongolian government has now taken a significant step to combat mercury usage nationwide. The government banned mercury import and usage in 2007 and confiscated 247 mills using mercury. The first inspection by experts showed that mercury usage had spread, and the impact on human and environmental health had reached hazardous levels in Mongolia.

Sources of Mercury in Mongolia

MERCURY SOURCES

- Illegal import of metallic Mercury (for Small Scale Gold mining activity, amalgamation)
- Coal burning, used car (coal combustion of large power plants and gers)
- Waste (batteries, lamps, thermometers etc.)
- Placer Mercury mine (from the Bottom of River)
- Others (cement, Metal factory etc.)

Animals were watered from the mercury polluted Boroo river and small-scale mining activity.

MERCURY AWARENESS

Mercury being driven off as invisible toxic Hg vapour by heating the Au Hg amalgam.

Metallic mercury in direct contact with unprotected bare skin of hands.

South Mongolia. Common view of Mercury Waste in South Gobi (GPS #672).

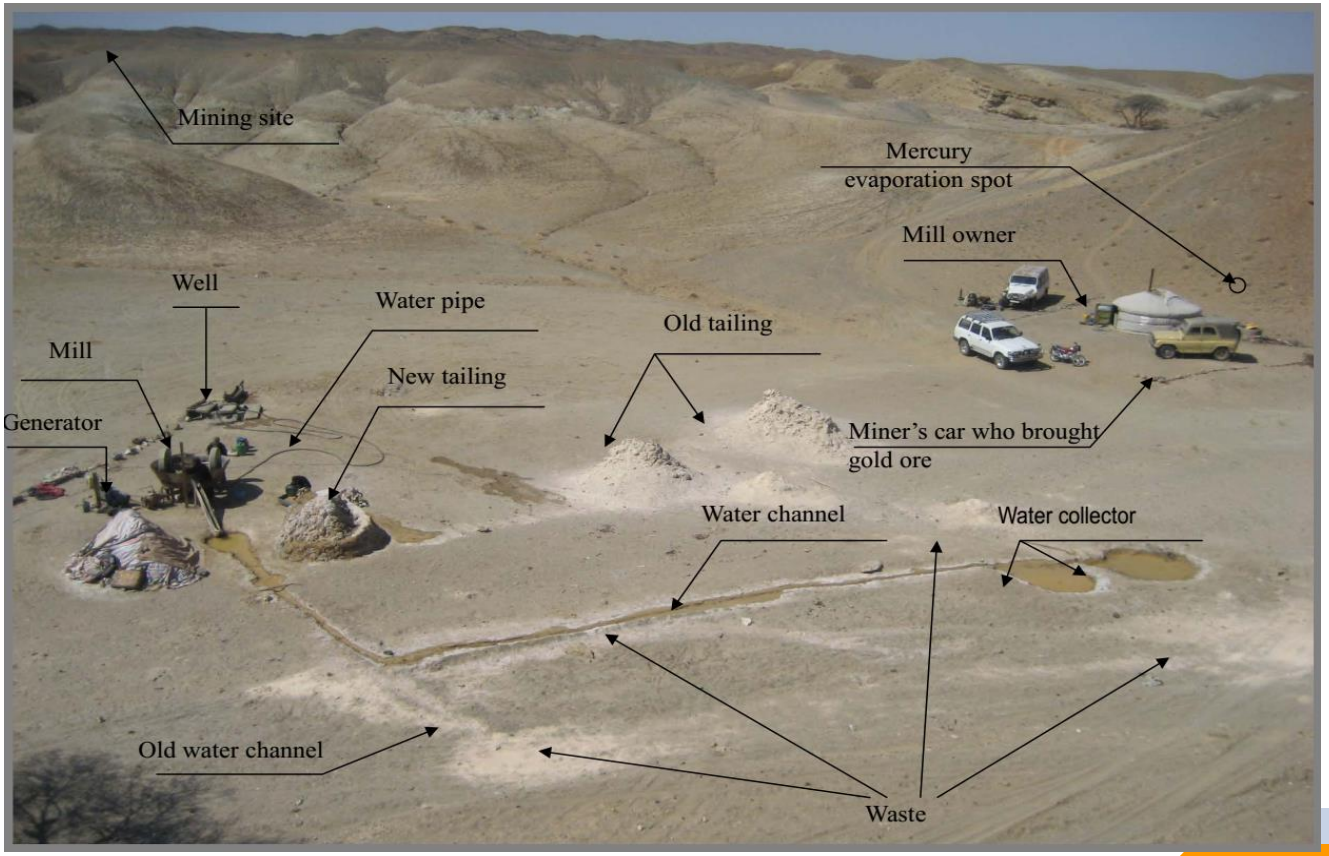


Photo taken in 2006

Mercury content in Coal

Coal Deposits	Mercury content in coal	Burned coal and mercury
Tavantolgoi	0.1 ppm	3,3 mln. ton in Ulaanbaatar (759kg Hg/year)
Baganuur	0.23 ppm	
Nalaikh	0.16 ppm	

Source of Mercury in Mongolia

Source: Dr. Jargalsaikhan and other (2011) MNE. Inventory of Hg releases in Mongolia

Source categories	Estimated input, Kg Hg/y
Energy consumption (Coal uses, biomass etc.)	1786
Primary metal production (gold extraction, production of Cu from concentrate)	542197
Use and disposal of products with mercury content (Dental,Thermometer etc.	1237
Waste disposal /land filling and waste water treatment	4559
TOTAL of quantified inputs about ….	548,410

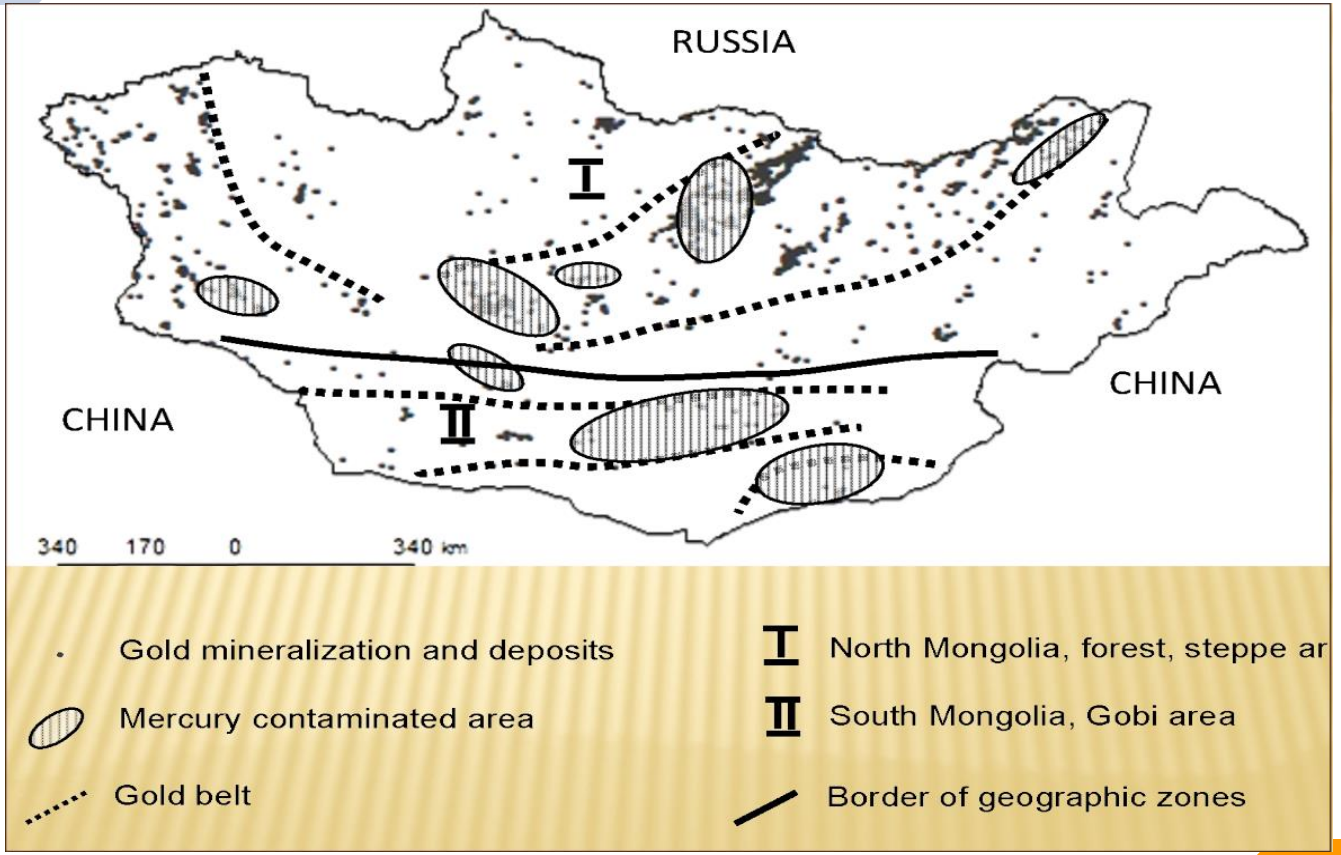
Mercury control needs

MNS5885:2008 Air quality standard for Hazardous air pollutants

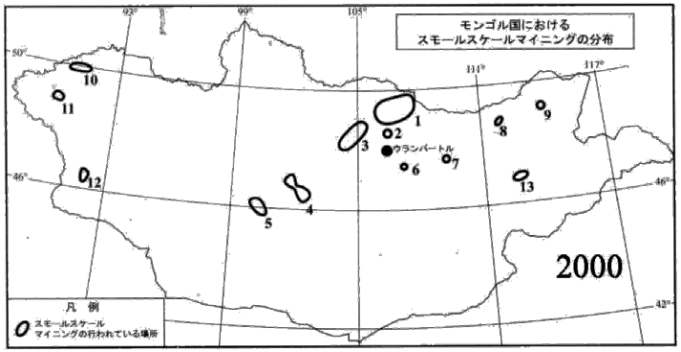
	average 30min	24 hours	annual
Hg	5μg/m3	2μg/m3	1μg/m3

There is air quality standard for Mercury in Mongolia. But we do not have continuously control. In the future mercury control and monitoring needs

Mercury Contaminated Sites and Gold Distribution

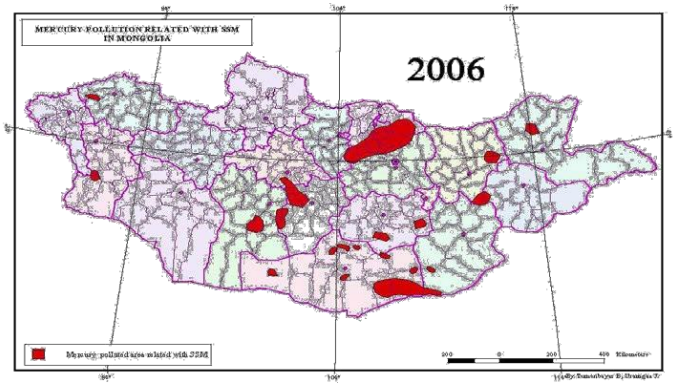


Mercury polluted locations



In 1996 Mercury polluted area was 1 spot in the North Mongolia

In 2000 It is increased up up to 13 spots



In 2006 Mercury polluted area about 128 spots.

Source: Dr. Jargalsaikhan and other (2013) MNE. Inventory of Hg releases in Mongolia

IN THE FUTURE ….

- To determine baseline and hot spots of Mercury
- To establish long-term observation sites
- To develop of monitoring methodologies and technologies.
- To report mercy level to public
- To assess transboundry pollution
- To control and prevention and its reduction.
- To contribute to international effort in atmospheric mercury monitoring.
- To support further implementation of Minamata convention

THANK YOU FOR YOUR ATTENTION