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Beijing's hazardous blue sky

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In the first analysis of US embassy "Twitter" data on pollution, Steven Q Andrews finds major failures in Chinese air quality assessments. Tighter standards are on their way, but will continue to fudge the health risks.



In the last two years, Beijing officials have [announced](#) good or even excellent air quality nearly 80% of the time, notwithstanding the [persistent smog](#). But a monitor atop the United States embassy illuminates a different perspective: over 80% of days had unhealthy levels of pollution, and the air quality has been hazardous more often than good. Dozens of countries around the world have public air pollution reporting, but [no other country](#) describes even very low levels of pollution as excellent.

Some of the discrepancy between reported pollution levels is due to omission. The Beijing government monitors but [does not report](#) fine particulate and ozone, both of which are pollutants linked to lung disease and premature death. And some of the discrepancy is due to commission: official reports grossly understate the [severity of pollution](#). [See *Figure 1: Reporting of Equivalent Pollution Levels in Beijing, Hong Kong, Europe, and the US: Air Pollution Index Values, Pollution Levels, and Reported Color*]

Figure 1.

"If Beijing's fine particulate concentration even reached the levels of Los Angeles – America's most polluted city – life expectancy may increase by over five years."

Particulate Concentration PM10 (µg/m3)	Beijing			Hong Kong			Europe			United States			
	Pollution Index	Air Quality	Color	Pollution Index	Air Quality	Color	Pollution Index	Air Quality	Color	Pollution Index ¹	Concentration ² (PM2.5)	Air Quality	Color
50	50	Excellent	Blue	45	Medium	Blue	75	Moderately High	Yellow	102	(<~37)	Unhealthy for Sensitive Groups	Orange
150	100	Good	Green	88	Moderately High	Yellow	Above Index	Very High	Red	178	(<~112)	Unhealthy	Red
250	150	Minor	Yellow	141	High	Red	Above Index	Very High	Red	238	(<~187)	Very Unhealthy	Purple
350	200	Light	Orange	200	High	Red	Above Index	Very High	Red	312	(<~262)	Hazardous	Maroon
352	201	Moderate	Red	201	Severe	Black	Above Index	Very High	Red	313	(<~263)	Hazardous	Maroon

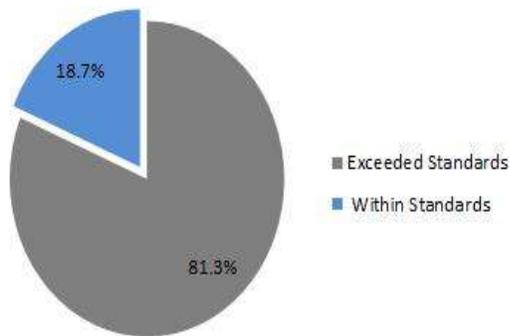
1 US monitors PM2.5 to assess pollution levels. 2 PM2.5 concentrations in Beijing have averaged over 75% (85.3%) of PM10 concentrations in the last two years based on Embassy and BJEPPB city average data.

Due to [public pressure](#) arising from the US embassy assessments, the government recently announced [plans](#) to include fine particulate and ozone in public reporting, but not until 2016. In the last two years, over half the days (around 55%) in Beijing exceeded the new daily fine particulate standard (75 micrograms per cubic metre) and the annual average concentration has been approximately three times higher (around 100 micrograms per cubic metre) than the proposed standard (35 micrograms per cubic metre). [See Figure 2: *Acceptable Air Quality in Beijing? (PM2.5) Percent of days meeting air quality standards based on US embassy monitoring data and US and Beijing Proposed Chinese PM2.5 Standards. Jan 2010 – Oct 2011*]

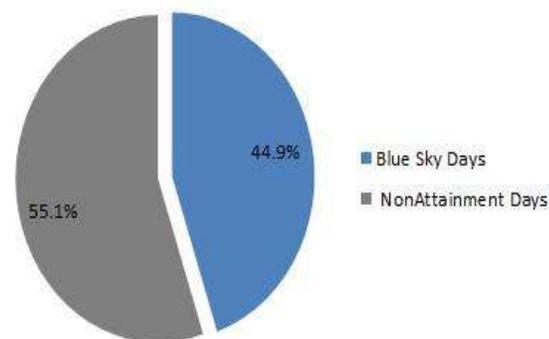
But many of the misleading descriptions [will remain](#) under the new regime and, in some cases, worsen.

Figure 2.

United States Reporting (US PM2.5)



Beijing Proposed PM2.5 Standard (US PM2.5)



The main publicly reported pollutant of concern in Beijing is particulate, tiny particles of solid matter suspended in the air whose impact on human health varies according to their size. Under current guidelines, so-called excellent air quality can have coarse particulate (PM 10 – meaning particulates of 10 microns or less in diameter) levels two-and-a-half times higher than the World Health Organization (WHO) [guidelines](#). Once China begins reporting fine particulate (PM 2.5), levels three-and-a-half times higher than WHO guidelines will still be called “excellent”. PM 2.5 concentrations considered moderate in the United States will also be “excellent”. [See Figure 3: *Proposed Daily PM2.5 Reporting*]

Guidelines in China and Current US Standards]

Figure 3.

Particulate Concentration PM2.5 (µg/m ³)	China (Proposed)			U.S.		
	Pollution Index	Air Quality	Color	Pollution Index	Air Quality	Color
35	50	Excellent	Green	99	Moderate	Yellow
75	100	Good	Yellow	156	Unhealthy	Red

The US embassy monitor has a Twitter feed, [@beijingair](#), which is widely viewed on mobile apps and reposted on Chinese microblogging sites like Sina Weibo. Many media reports have mentioned these hourly reports, which often assess the air to be hazardous, but this article provides the first discussion of *daily* average pollution concentrations measured by the embassy. These measurements are taken over the same time period as those recorded by the Beijing Environmental Protection Bureau (BJEPB).

Methodologies approved by the US Environmental Protection Agency for assessing PM 2.5 concentrations are [based on a 24-hour average](#), so the embassy's hourly tweets may actually overstate the severity of pollution in Beijing. For example, in the first 10 months of this year, 57 days had at least one tweet reporting "hazardous" pollution levels, although only 17 days had a 24-hour average PM 2.5 concentration that was hazardous. These days had air quality that was "very unhealthy" rather than hazardous.

According to Du Shaozhong, vice-president at the BJEPB, it is an "[indisputable fact](#)" that air pollution in Beijing has improved in recent years. In China, days that meet air quality standards are termed "blue sky days" and described as having "good" or "excellent" air quality. Officially, the number of blue sky days increased to 286 days (78%) in 2010, up from 100 days (27%) in 1998.

But, these so-called improvements are due to irregularities in the monitoring and reporting of air quality – and not to less polluted air. Most importantly, the government [changed monitoring station locations](#) twice. In 2006, it shut down the two most polluted stations and then, in 2008, began monitoring outside the city, beyond the sixth ring road, which is 15 to 20 kilometres from Beijing's centre.

These changes continue to reap dividends for the authorities, not only in the increased numbers of blue sky days, but also in [lower reported pollution](#) concentrations. The reported number of blue sky days in 2010 would have been approximately 71 days less if the monitoring station locations had not changed. (Fifty-five days due to the 2006 changes, and 16 days due to the 2008 changes.) [See Figure 4: 16 Blue Sky Days in 2010 would have exceeded standard (Index <= 100) without 2008 additions to monitoring network. Approximately 55 additional days would have been above standard without 2006 changes to monitoring network.] Meanwhile, though the Beijing government used to publicly report daily ozone levels, it [stopped doing so in 2002](#).

Figure 4.

	Monitoring Stations Used in 2006-2007									Monitoring Stations Added in 2008					Without Changes	Index
	Average	Dongsi (Dong cheng)	Tiantan (Dong cheng)	Guan yuan (Xicheng)	Wanshou xigong (Xicheng)	Aoti (Chao yang)	Nong zhanguan (Chao yang)	Wanliu (Haidian)	Gucheng (Shijingshan)	Renhe (Shunyi)	Chang ping	Huairou				
1/9/2010	105	100	106	110	107	106	100	113	114	103	94	97	107	105		
1/25/2010	99	116	106	116	97	112	99	84	110	95	78	77	105	99		
2/17/2010	95	112	103	115	99	104	96	89	100	92	65	62	102	94		
2/19/2010	98	117	116	106	108	105	107	97	99	84	68	74	107	98		
3/12/2010	98	108	99	96	92	95	90	110	114	94	111	73	101	98		
3/29/2010	100	108	99	97	97	91	100	111	120	100	93	85	103	100		
4/1/2010	99	117	97	99	96	114	97	97	98	90	114	69	102	99		
5/3/2010	98	120	98	122	105	94	97	93	108	87	85	64	105	98		
5/21/2010	96	99	99	93	100	98	95	108	122	100	81	61	102	96		
7/28/2010	100	99	95	100	105	100	104	106	107	95	108	82	102	100		
8/4/2010	98	95	98	99	100	91	91	109	131	100	92	72	102	98		
9/7/2010	95	117	110	99	100	89	92	95	114	85	73	72	102	95		
10/6/2010	95	112	98	99	100	92	95	98	117	85	74	73	101	95		
11/23/2010	100	119	120	100		108	117	105	97	97	75	60	109	100		
12/9/2010	98	99	105	105	104	116	98	97	100	116	67	67	103	98		
12/20/2010	100	107	110	93	108	115	121	96	100	110	80	61	106	100		

1 For

discussion of methods, see SQ Andrews, (2008) *Inconsistencies in Air Quality Metrics: Blue Sky Days and PM10 Concentrations in Beijing*, *Environmental Research Letters*. The 2006 changes result in a reported decrease in PM10 concentrations of approximately 12 micograms per cubic metre, (ug/m3) and the 2008 changes result in a reported decrease in PM10 concentrations of approximately 4 ug/m3. Without the changes to the monitoring network the number of Blue Sky days and annual average PM10 concentration in 2010 would have been similar to that reported eight years ago. In 2010, 286 blue sky days were officially reported and the annual average PM10 concentration was measured at 121 ug/m3. Without the changes to the monitoring network in 2010 there would have been approximately 215 blue sky days and an average PM concentration of 137 ug/m3. In 2003, there were 224 blue sky days and an average PM concentration of 141ug/m3.

The Chinese Academy of Sciences, using its own measurements, has found that PM 2.5 concentrations actually [increased by 3% to 4%](#) every year over the past decade. PM 2.5 is believed to pose the largest health risks, because particles of this size can be absorbed into the lungs and blood.

Two weeks ago in Beijing, while very unhealthy levels of pollution were again being officially reported as good air quality, Bie Tao, an official at the Ministry of Environmental Protection (MEP) [announced](#) that public opinion would soon be used to “assess the performance of local governments on environmental protection”. Understanding the true severity of pollution and the extent to which the public and media have been misled is now increasingly important.

Data and methods

The US embassy began publicly reporting pollution concentrations and qualitative descriptions of air quality in 2008 as an unofficial resource for its staff. For this simple analysis, I downloaded [archived Twitter data](#) from January 2010 through to the end of October 2011 and compared it with data reported by BJEPA. Officially reported Air Pollution Index concentrations are converted to [PM 10 concentrations](#) and compared to the qualitative reporting systems used in [Hong Kong](#) and the [European Union](#). Annual PM 2.5 concentrations and the ratio for PM 2.5 to PM 10 are also calculated based on daily US embassy data.

Additionally, the US embassy data is compared to the new Chinese daily and annual fine particulate standards. While there are some gaps in the data, daily concentrations were obtained on 81% of days during this 22-month period, and analysis was only conducted on the days for which there was data both from BJEPC and the US embassy. (The US embassy refused my request for the rest of the data, responding that some gaps in the data are due to maintenance of the monitor.)

Two main concerns have been raised regarding the embassy figures: that they are [not representative](#) of the city overall – an issue mentioned on the embassy’s own website – and that the data is [not accurate](#), a position put forward by Beijing’s environmental authorities. But while the air quality at the US embassy in Chaoyang district may not be representative of all of Beijing, air quality in the area has historically been better, not worse, than the rest of the city. It is also [typical](#) in [most countries](#) to use the worst monitoring station in the entire network to calculate attainment of standards, not a selective subset as is done in Beijing. Beijing actually reported annual average pollutant concentrations for individual monitoring stations, but only in 1998, and not since.

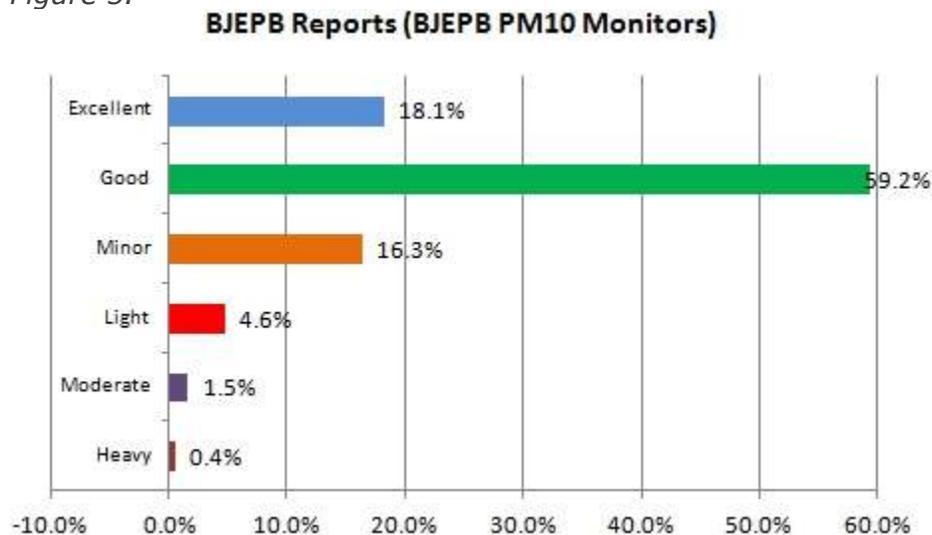
Moreover, the monitor model used at the embassy – the [BAM 2010 PM 2.5 monitor](#) – is the only continuous particulate monitor that the US Environmental Protection Agency [allows](#) for PM 2.5 monitoring in the United States. If the data is good enough for assessing compliance with air quality standards in America, then it should be useful for at least an initial assessment of pollution levels in Beijing.

The BJEPC has argued that air quality should not be judged from data released from foreign embassies and that the measurements are hype, but the fact that PM2.5 concentrations monitored by the BJEPC are not publicly reported makes such analysis necessary. Examining daily rather than hourly concentrations helps avoid the “hype”.

Results

This research indicates that the misleading descriptions of the severity of particulate concentrations play an important role in understating the severity of pollution. The descriptions given for pollutant concentrations have a significant impact on how the severity of pollution is perceived by the public. [See *Figure 5: Daily Pollution Levels and Colors in Beijing (PM10) Based on US Embassy data and Chinese, Hong Kong and European PM10 Standards. Jan 2010 – Oct 2011*]

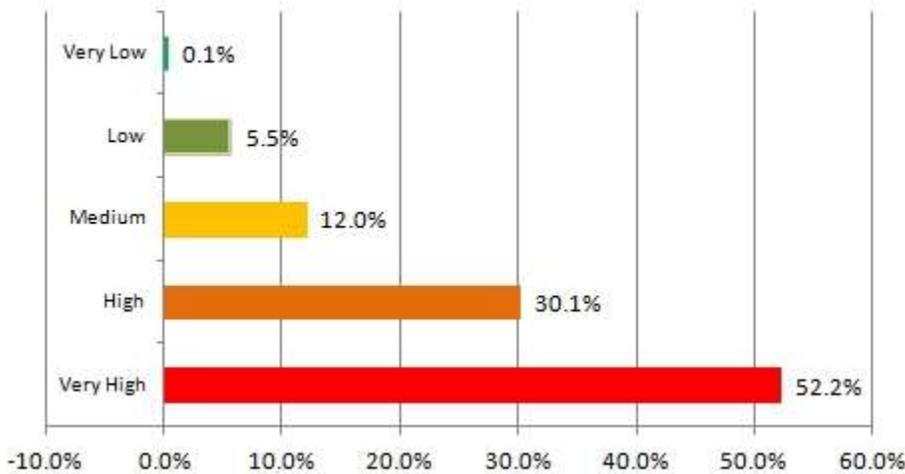
Figure 5.



Hong Kong Reporting (BJEPB PM10 Monitors)

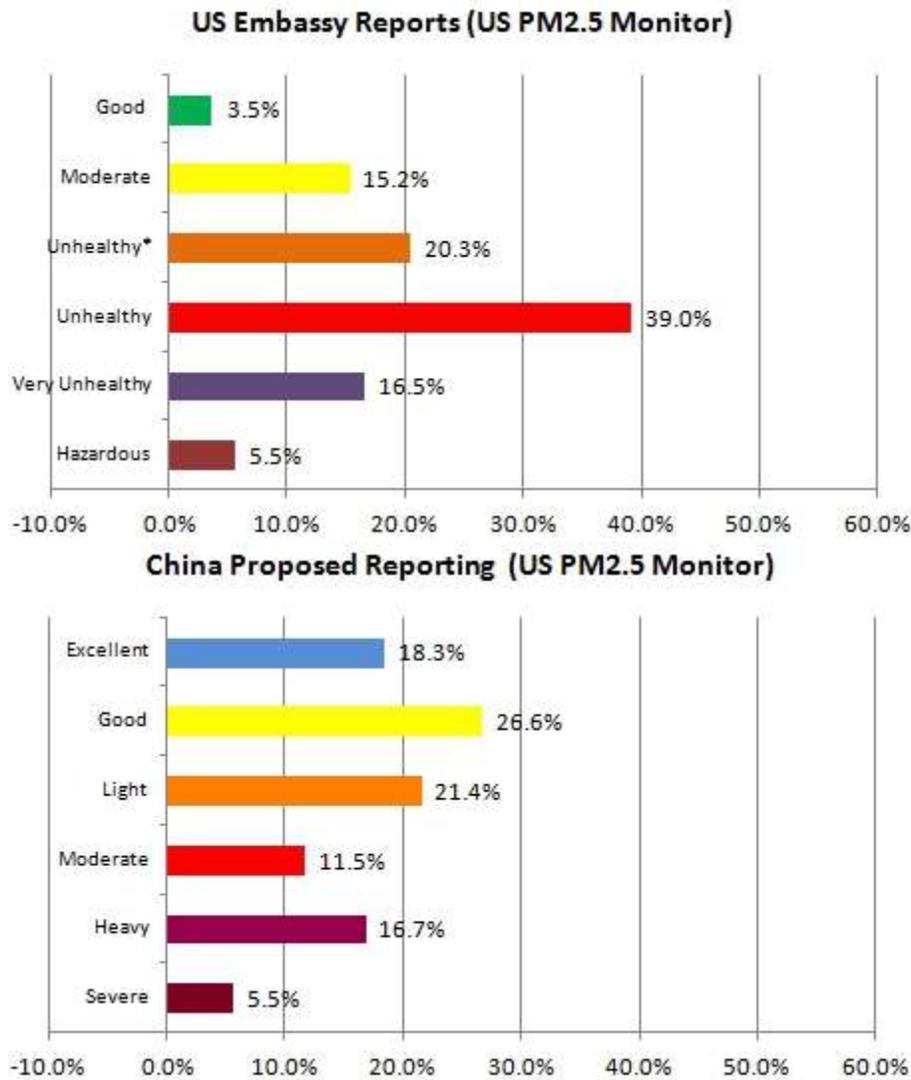


European Union Reporting (BJEPB PM10 Monitors)



Even after the proposed revisions the severity of pollution levels will continue to be understated. According to the US embassy daily reports, there was good air quality on only 3.5% of days during the year, while under the proposed reporting system there was reported good air quality on approximately 45% of days. [See Figure 6: Daily Pollution Levels and Colours in Beijing (PM 2.5) Based on US Embassy data and US and Proposed Chinese Standards. Jan 2010 - Oct 2011]

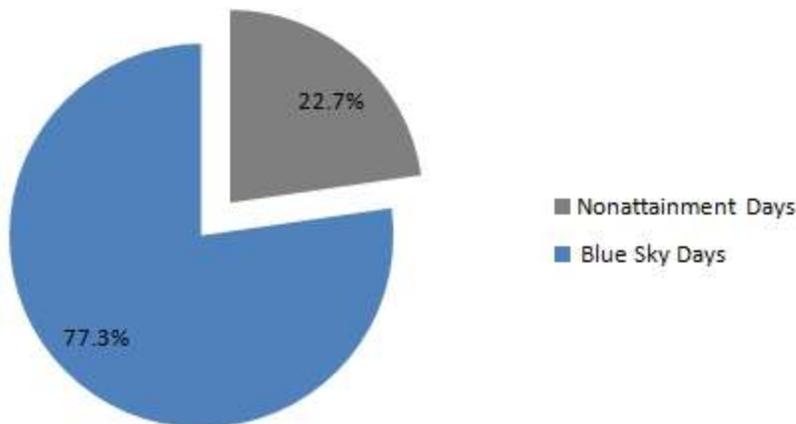
Figure 6.



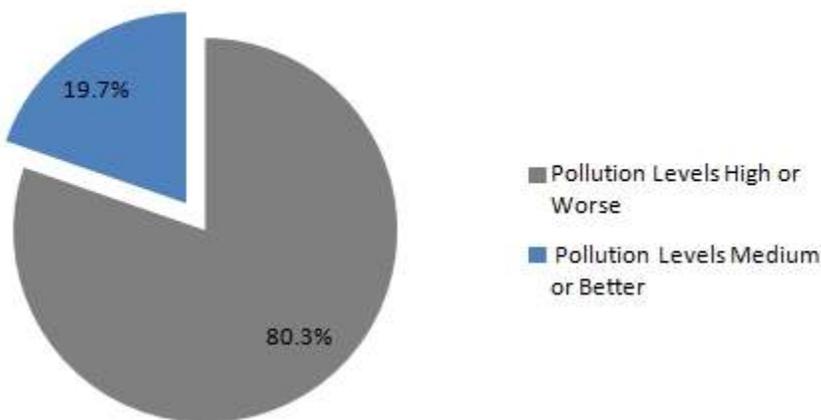
In the last two years, Beijing reported that nearly 80% of days had good or even excellent air quality. These same levels of PM 10 pollution would have been classified as high or worse on over 80% of the days in Hong Kong and the European Union. [See Figure 7: Acceptable Air Quality in Beijing? (PM10) Percentage of days with good (China) and medium (HK and EU) air quality based on Chinese, Hong Kong, and European Union reporting. Jan 2010 - Oct 2011]. These pollution levels are quite similar to the reported air quality based on independent PM 2.5 measurements from the US embassy, where over 80% of days were found to be above American standards for safe levels of air pollution. The US EPA has also recently proposed [plans](#) to significantly tighten its PM 2.5 standard.

Figure 7.

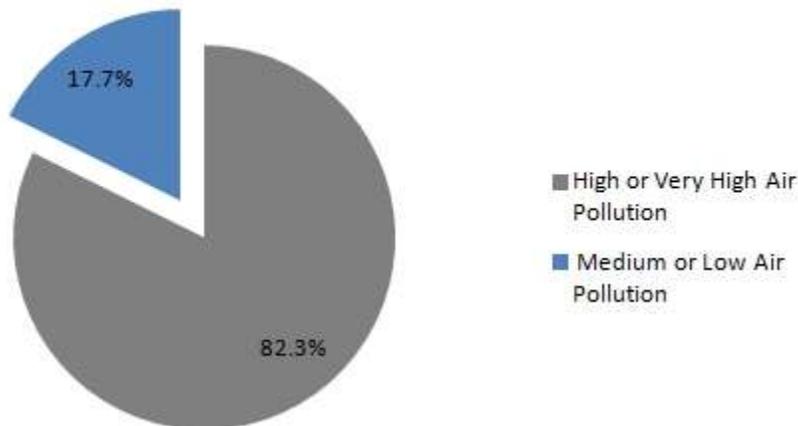
Beijing Official Reporting (BJEPB PM10)



Hong Kong Reporting (BJEPB PM10)



European Union Reporting (BJEPB PM10)



During the past two years, PM 2.5 concentrations measured at the US Embassy were on average approximately 85% of the PM 10 concentrations reported by the BJEPB. Annual average fine particulate concentrations monitored by the US embassy have been at approximately 100 micrograms per cubic metre for the last two years.

What next?

Most people don't really care about governmental constructs like blue sky days and pollution indices. People worry about what really matters – the impacts of pollution on their health. As the *China Daily* recently [wrote](#): "All of the residents in the city are aware of the poor air quality, so it does not make sense to conceal it for fear of criticism." Even with the proposed revisions, the severity of air pollution in China will continue to be understated.

The average annual PM 2.5 concentration of approximately 100 micrograms per cubic metre for the last two years is nearly three times higher than the [proposed annual standard](#) of 35 micrograms per cubic metre. These levels are similar to [published measurements](#) for Beijing in 2000 and 10 times higher than the World Health Organization [guidelines](#) of 10 micrograms per cubic metre. In comparison, [annual average fine particulate concentrations](#) in America's [most polluted city](#), Los Angeles, were at 15 micrograms per cubic metre in 2010. In a recent study of over 500 cities around the world, the WHO found that urban areas in [Mongolia, Madagascar, Kuwait and Mexico](#) had the highest PM 2.5 concentrations, but the pollution levels measured were only about half as severe as Beijing.

One of the most authoritative studies on the health effects of pollution, by C Arden Pope and others, published in 2009, found a decrease of 10 micrograms per cubic metre in a city's fine-particulate concentration was associated with an estimated increase in life expectancy of approximately 0.6 years. This indicates that if Beijing's fine particulate concentration even reached the polluted levels of Los Angeles, life expectancy may increase by over five years. Back in 1999, Chinese premier Zhu Rongji stated his own fears that air pollution in Beijing would shorten his life "[at least five years](#)" – and fine particulate concentrations have not improved since then.

There is no reason for the Beijing government to continue to wait before publicly reporting and accurately describing the hazardous air. As a first step, the government should stop describing dangerous levels of air pollution as excellent air quality. Because fine particulate and ozone levels are already measured, they should be reported to the public. With every additional polluted blue sky day the government reports, it continues its misinformation campaign that has misled the public and helped prevent real improvements in the city's air.

Steven Q Andrews is an environmental consultant based in Beijing. He recently completed a JD at the UCLA School of Law, and previously studied geosciences at Princeton University. His research on Chinese air pollution began while he was a Princeton-in-Asia fellow in Beijing during 2006-2007.

Image and graphs by Steven Q Andrews
Homepage slider image courtesy of [onekell](#)

<http://www.chinadialogue.net/article/show/single/en/4661-Beijing-s-hazardous-blue-sky>



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