၂၀၁၈ ခုနှစ်၊ စက်တင်ဘာလ

တီကျစ်ဒေသ
လေထုအရည်အသွေး ဆန်းစစ်လေ့လာချက်
အစီရင်ခံစာ

Air Pollution Assessment Report

ကန့်သတ်

အခန်း(၁) အစည်နှင့် အဓိပ္ပါယ်ဖော်ပြချက် ၂ (စ)

ပတ်ဝန်းကျင်အပေါ် သက်ရောက်မှုဆိုသည်မှာ အဆိုပြုထားသည့်စီမံကိန်း သို့မဟုတ် စီးပွားရေးလုပ်ငန်း သို့မဟုတ် လုပ်ဆောင်မှု သို့မဟုတ် တာဝန်ယူဆောင်ရွက်မှုများကြောင့် သဘာဝပတ်ဝန်းကျင်၊ တည်ဆောက်ထားသောပတ်ဝန်းကျင်၊ အများပြည်သူနှင့် လူမှုအဖွဲ့အစည်းအပေါ် ဖြစ်ပေါ်နိုင်သည့် အကျိုးသက်ရောက်မှု သို့မဟုတ် အကျိုးဆက်ကို ဆိုသည်။ ယင်းစကားရပ်တွင် လုပ်ငန်းခွင်ဆိုင်ရာ၊ လူမှုအဖွဲ့အစည်း၏ လူမှုရေး၊ စီးပွားရေး၊ ယဉ်ကျေးမှု၊ အများပြည်သူနှင့် လူမှုအဖွဲ့အစည်း၏ ကျန်းမာရေးနှင့် ဘေးအန္တရာယ်ကင်းရှင်းရေးဆိုင်ရာ ကိစ္စရပ်များ အပေါ် တိုက်ရိုက်သော်လည်းကောင်း၊ ကောင်းကျိုးသော်လည်းကောင်း၊ ဆိုးကျိုးသော်လည်းကောင်း၊ နှစ်မျိုးလုံးသော်လည်းကောင်း ဖြစ်ပေါ်နိုင်သည့် သက်ရောက်မှု များအပြင် ဆန္ဒမပါဘဲသောနေရာရွှေ့ပြောင်းမှု သို့မဟုတ် တိုင်းရင်းသားမျိုးနွယ်စုနှင့်သက်ဆိုင်သည့် လူမှုရေးဆိုင်ရာ သက်ရောက်မှုများလည်း ပါဝင်သည်။

ကျေးဇူးတင်လွှာ

ဤအစီရင်ခံလွှာဖြစ်မြောက်ရေးအတွက် အဖက်ဖက်မှ အင်အားစိုက်ထုတ် အကူအညီပေးခဲ့ကြသော **၁။ စိမ်းလန်းအမိမြေ ဖွံ့ဖြိုးတိုးတက်ရေးအသင်း ALARM၊**

၂။ Earth Rights International (ERI)

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၅။ ပေါင်းကူး (Paung Ku)

စသည့် တို့ နှင့် တကွ အခြား ပူးပေါင်းပါဝင်ခဲ့ကြသော အဖွဲ့အစည်းများနှင့် လူပုဂ္ဂိုလ် တစ်ဦးချင်း စီတို့အား လှိုက်လှဲစွာ ကျေးဇူးတင်ရှိပါကြောင်း။

မြန်မာနိုင်ငံ ပွင့်လင်းမြင်သာမှုနှင့် တာဝန်ယူမှု၊ တာဝန်ခံမှုဆိုင်ရာ အရပ်ဖက် မဟာမိတ်အဖွဲ့ MATA

June 26, 2018

Assessment of air quality sampling results around Tigyit coal-fired power plant, Shan State, Myanmar

Lauri Myllyvirta, senior analyst, Greenpeace Global Air Pollution Unit

Introduction

Air samples and meteorological data were collected by ALARM (2018) on three consecutive days in the vicinity of the Tigyit coal-fired power plant. Sampling was carried out in a different location on each day, for 24 hours. Samples were analyzed for several key pollutants of health concern and key air quality markers.

Tigyit power plant

The Tigyit power plant is a 120-megawatt coal-fired power plant in Shan State, Myanmar.[1] It was the first coal-fired power plant to be built in the country, by Myanma Electric Power Enterprise in 2001. Operations began in 2005, under the management of China National Heavy Machinery Corporation, with local companies Eden Group and Shan Yoma Nagar. (CoalSwarm 2018.)

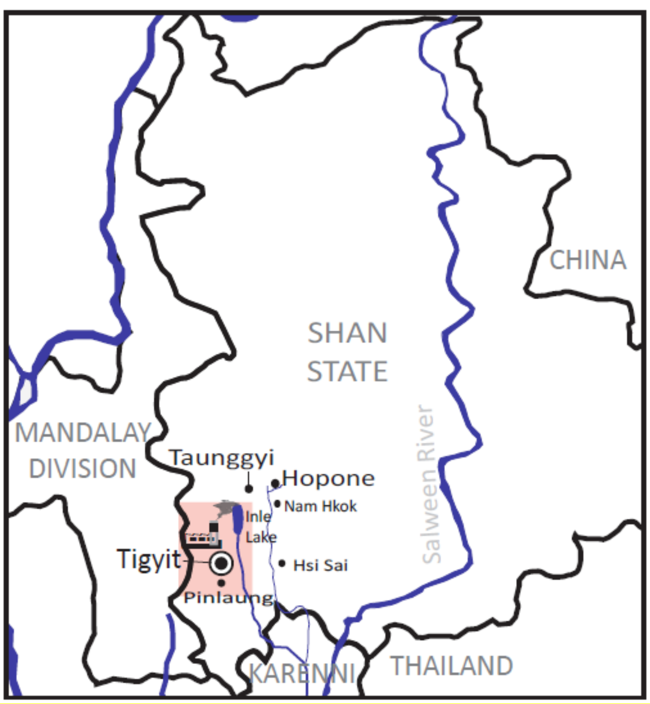

Figure 1. Location of the Tigyit power plant in Shan State.

[1] There are no official public reports on the current operational capacity of the power plant. Some sources indicate that it may have been running well below the full capacity of 120MW during the time of sampling.

The plant has two 60MW generating units and produces 600GWh electricity annually, using 640,000 tons of coal per year from the Tigyit coal mine just a few kilometers away.

The operation of the facility was suspended in 2014 amid local complaints about air pollution (Kyi Kyi Sway 2016). In April 2016, Chinese Wuxi Huagaung Electric Power Engineering said it had upgraded the plant claiming to improve its environmental standards and efficiency, but this is yet to be verified independently.

Sampling locations and conditions

Air samples were collected at three sites around the power plant, labeled EL-R 115 to 117, shown in Figures 2 to 5. These samples were collected on consecutive days, each during a period of 24 hours.

EL-R 115: 550m northeast of power plant; 500-700m north to northwest of coal ash disposal site; surrounded by residential buildings, fields and small roads.

EL-R 116: west of mining area, 500m away; 1.6 km south-southeast of power plant: surrounded by residential buildings and small streets.

EL-R 117: 1900m north of power plant and ash disposal area; residential buildings, small road, and streets.

Figure 2 Overview of the power plant, mining area and sampling locations.

Figure 3 Sampling location EL-R/115.

Figure 4 Sampling location EL-R/116.

Figure 5 Sampling location EL-R/117.

Wind direction was from southwest to south-southwest during the first two sampling periods (EL-R 115 and 116) and from south-southeast during the third sampling period (EL-R 117).

There are small roads, agriculture, and residential areas around the sampling sites. Only known industrial sources are the Pinpet iron ore mine and Nagar cement plant 60km away.

Analysed pollutants

Coal power plants release a range of air pollutants, such as sulphur dioxide (SO2), oxides of nitrogen (NOx), toxic volatile organic compounds (VOCs), heavy metals such as mercury, and particulate matter (PM). These primary pollutants are precursors to the formation of fine particulate matter (PM2.5) and ozone (O3). Coal burning is the dominant source of SO2 emissions in most countries with significant coal use, and an important contributor to NOx emissions. These pollutants can be reduced by using pollution control techniques such as Flue Gas Desulfurization and Selective Catalytic Reduction of nitrogen oxides (SCR), but these techniques are not used in the Tigyit power plant.

Coal mining operations, as well as coal and coal ash handling and storage, generate fugitive dust, which is either unburned coal or combusted coal ash. Both types of particles contain toxic heavy metals and coal dust contains toxic PAHs (Polycyclic Aromatic Hydrocarbons).

These pollutants have serious impacts on the communities that live near the plant: causing and worsening a range of medical conditions such as asthma, respiratory problems, stroke, angina, heart attack, and cancer. They irritate and inflame the lungs leading to chronic lung disease, and restricted lung growth in children. Children and elderly people are particularly affected.

Nitrogen dioxide (NO2)
It irritates and corrodes skin and the respiratory tract. Inhalation of high concentrations of this pollutant for a short period may lead to pulmonary edema. Prolonged exposure can affect the immune system and lungs, weakening resistance to infections and causing irreversible changes in the lung tissue. NO2 can lead to the formation of secondary particulate matter and ozone.

Sulfur dioxide (SO2)
It is irritating and toxic. It mainly affects the mucus and lungs, causing coughing fits. Exposure to high concentrations for short periods of time can irritate the respiratory tract, cause bronchitis, asthmatic reactions, respiratory arrest and congestion in the bronchial tubes of asthmatics. Similar to NO2, SO2 is a precursor to the formation of secondary particulate matter.

PM10
Particles with an aerodynamic diameter of ≤ 10 μm, commonly known as respirable particles. They are made up of inorganic compounds such as silicates, aluminates, and heavy metals, among others, as well as organic material associated with carbon particles. Prolonged or repetitive exposure can cause harmful effects on the respiratory system.

PM2.5
Particles with an aerodynamic diameter of ≤ 2.5 μm, commonly known as fine particles. They are mainly made up of secondary particles formed in the atmosphere from precursor gases – particularly NOX, SO2, VOC, NH3 – through chemical processes or liquid phase reactions. They penetrate the nose and the throat, reaching the lungs and penetrating into the bloodstream. They may cause respiratory morbidity, damage to lung function and lung cancer, and increase the risk of cardiovascular diseases such as stroke and ischemic heart disease. Exposure to PM2.5 is the leading environmental health risk worldwide and the leading environmental cause of cancer deaths.

The sources and atmospheric characteristics of the key pollutants are discussed in

Table 1.

Table 1. Characteristics of the key pollutants analyzed.

Pollutant	Typical emission sources	Characteristics
SO2	Coal burning; heavy oil burning, smelters	Short atmospheric lifetime – SO2 concentrations reflect local emissions within some tens of kilometers at most
NO2	Coal, oil and gas burning, power plants, industry, vehicles, diesel generators	Combustion sources mainly emit nitrogen monoxide (NO) which is oxidized into NO2 in the atmosphere. Generally longer atmospheric lifetime than SO2 but shorter than PM2.5 – concentrations can reflect both local sources and regional sources up to 100km away.
PM2.5	Coal and biomass burning, vehicles, diesel generators	Long atmospheric lifetime. Much of PM2.5 is formed in the atmosphere through chemical reactions from gaseous pollutants such as SO2, NOx and ammonia.
Coarse particles	Road dust and mineral dust, biomass burning, fugitive dust from coal mining and handling, coal storage, coal ash handling and storage, construction dust, solid fuel burning	Short atmospheric lifetime, as coarser particles are deposited more readily than small particles. Mostly emitted as dust and soot particles.

Results and discussion

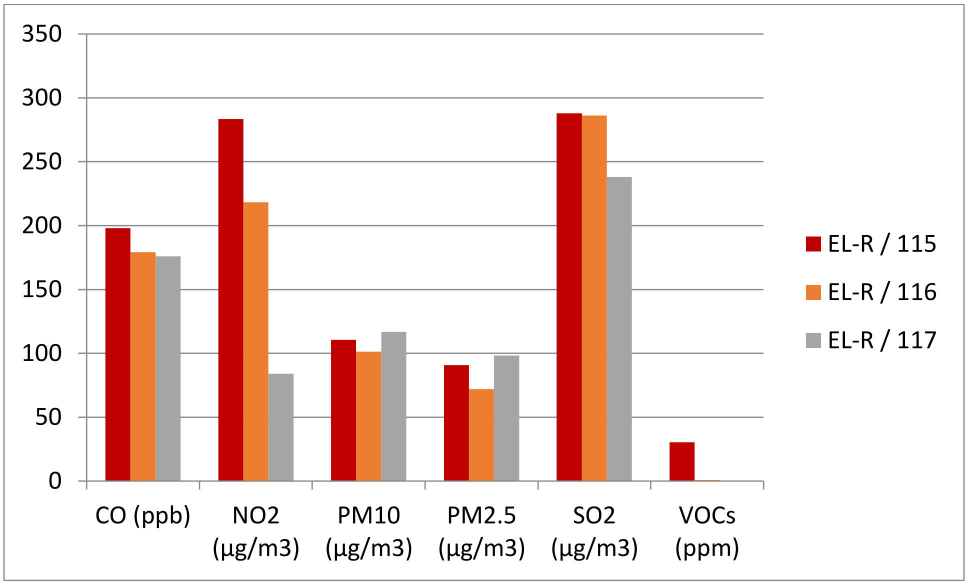

Figure 6. Observed 24-hour average pollutant levels at the three sites.

Observed concentrations were similar in the three samples, except for significantly lower NO2 in the third sample (EL-R 117) and significantly higher VOC level in the first sample (EL-R 115) (Figure 6).

The concentrations on all days are alarmingly high from a public health perspective, especially if the observed pollution levels broadly represent the average conditions during the year or the season. In particular, the 24-hour average PM2.5 concentrations are 3-4 times as high as Myanmar's 24-hour air quality guideline and 7-10 times as high as the guideline for annual average concentration. They are also twice as high as the annual average level of all cities in China[2] and 10 times as high as in the U.S.[3]. SO2 concentration is 15 times higher than average concentrations in China and nearly 90 times higher than in the U.S. NO2 concentration is 6 times higher than China and 11 times higher than the U.S.

There are very few vehicles on the roads in all the satellite imagery from the area, making it likely that local transport on public roads is not a significant source.

The sampling period in mid-March 2018 had a very large amount of agricultural burning in the region (Figure 7) which probably accounts for a lot of the high PM, CO and VOC (Volatile Organic Compounds) readings. However it doesn't account for SO2 and NO2, and PM2.5 to PM10 ratio is much higher than is typical for crop burning, indicating that there was likely a substantial contribution from other sources.

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[2] http://www.mep.gov.cn/hjzl/zghjzkgb/lnzghjzkgb/201805/P020180531534645032372.pdf
[3] https://www.epa.gov/outdoor-air-quality-data/air-quality-statistics-report

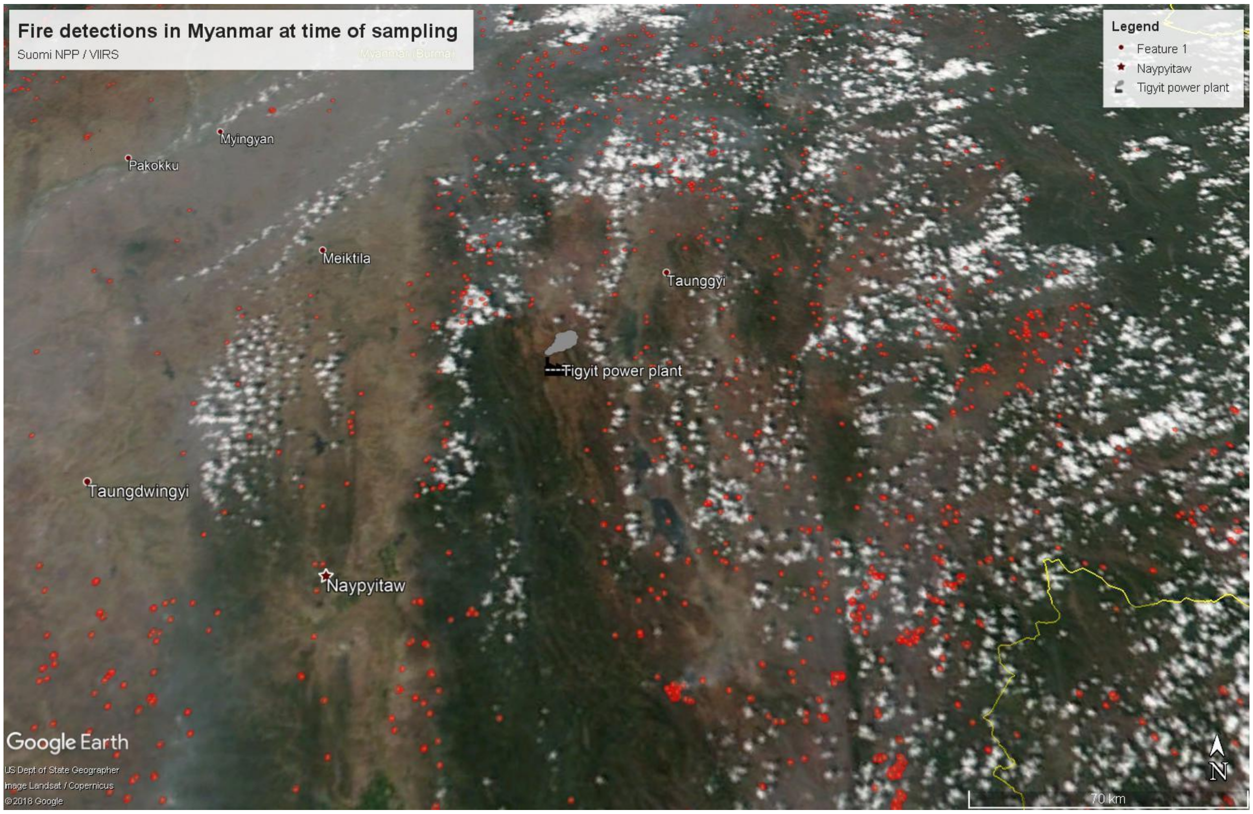


Figure 7. Detected fires during the sampling period, showing prominent agricultural burning.

In order to assess the potential contribution of the Tigyit power plant to the detected pollution levels, dispersion simulations were carried out for each sampling period, using the HYSPLIT model (Stern et al 2015) developed by the U.S. National Oceanic and Atmospheric Administration. The simulation was started 48 hours before the start of the sampling, and a uniform emission rate was assumed over the simulation period. Predicted average ground concentration during each sampling period was output from the model (Figure 8).

Because data on emissions rates from the power plant was not available, a unit emission rate of 1kg per hour was used to assess the ratio of emissions and resulting ground-level concentration contributions.

The modeling results indicate that the power plant was contributing to the measured pollutant concentrations during sampling, in a quantitative sense, during all three sampling periods. The predicted contribution was the highest during the first sampling period (Mar 11-12, EL-R/115), when highest NO2, SO2 and CO levels were observed. On the second and third days, for locations other than the sampling location, the modeling predicted had far higher concentrations, indicating that the impact of the power plant emissions on air quality in these locations around the power plant was likely several times larger.

Coal mining and coal and coal ash handling, transport and storage operations are likely to have contributed to the PM10 and PM2.5 levels as well. Carrying out a more detailed analysis is not possible without having actual emissions data of the power plant or a much longer time series of air quality data.

The health risks associated with the observed pollution levels can be assessed by applying results of existing scientific studies on the increase in the risk of different diseases, health conditions and death from different causes associated with an increase in the levels of air pollution. These studies express the relationship between air pollution levels and health risks in terms of risk ratios (RRs), representing the ratio of the risk of different health conditions when air pollutant levels increase by a certain amount (typically 10µg/m3). These RR values can be applied to the sampling results to give an estimate of the increase in health risks for the population around the sampling sites compared with a hypothetical situation in which the air is clean.

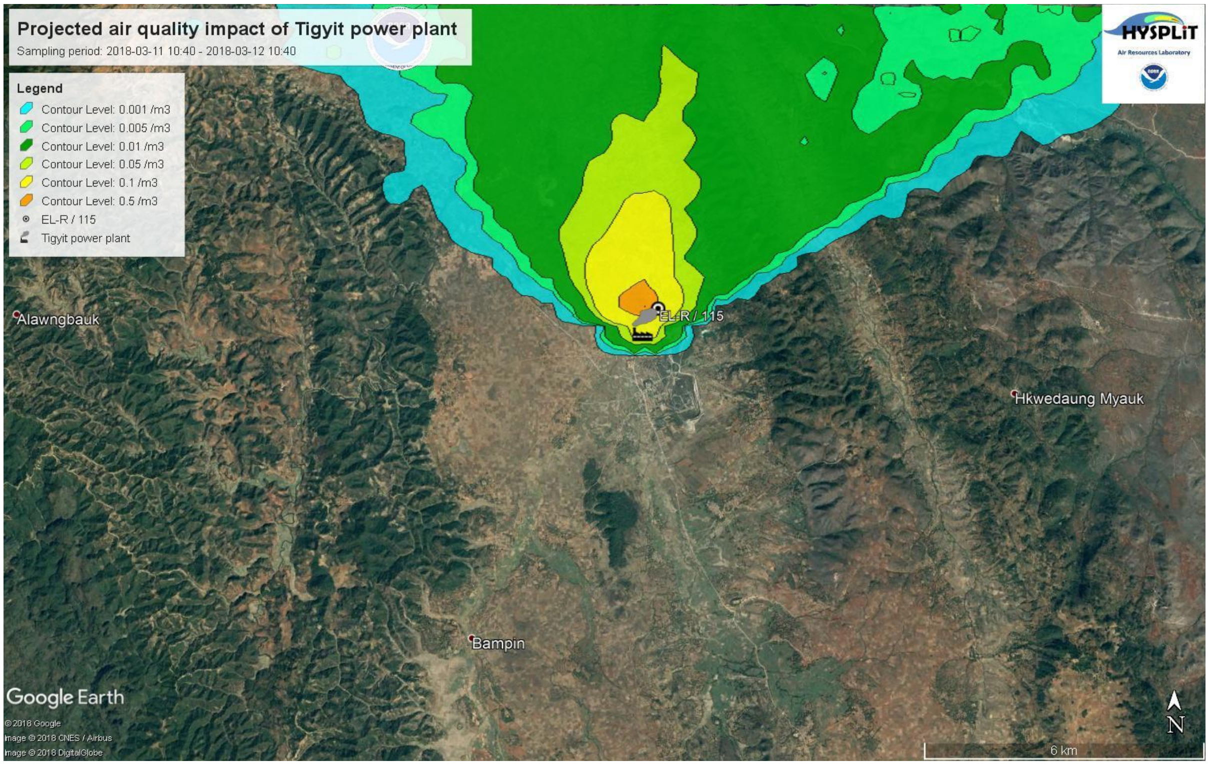
Table 2 shows the resulting estimates of increased health risks.

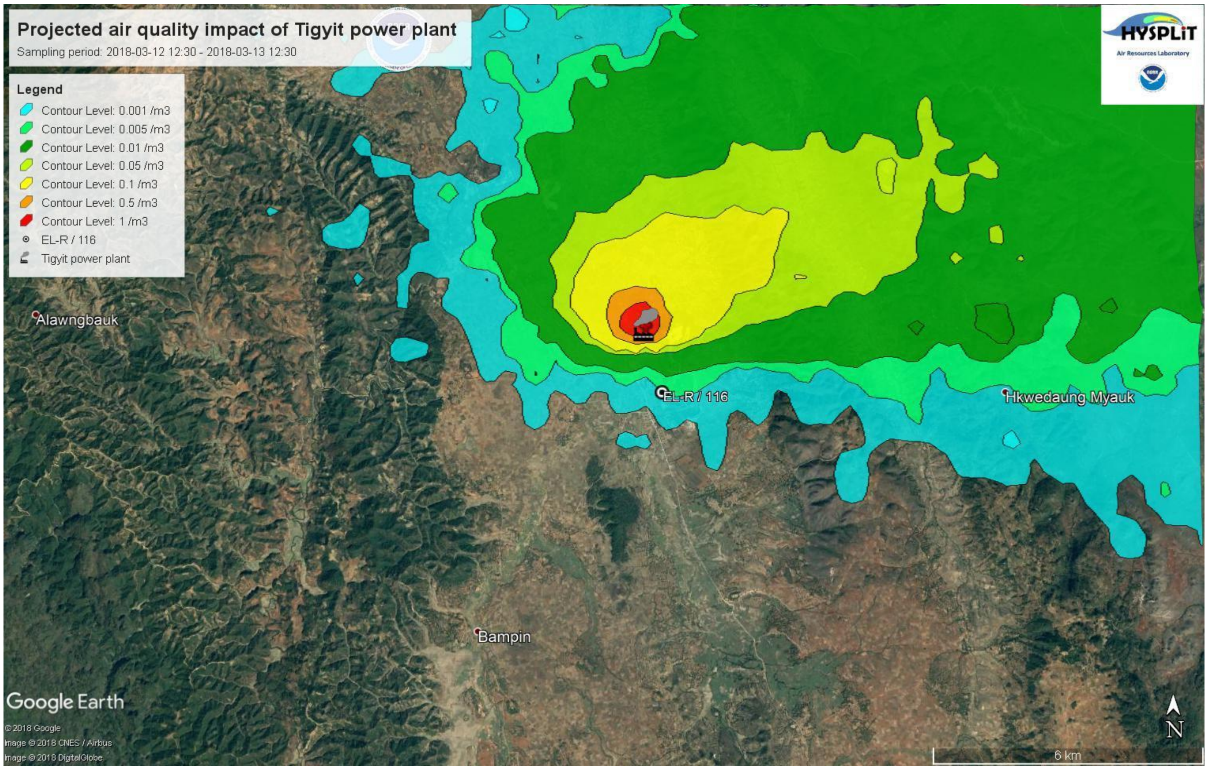
Table 2 Estimated increases in health risks associated with the observed pollution levels.

Effect	Pollutant	Increase in risk	Basis	Source
Risk of premature death due to:				
All causes (newborns under 1 year of age)	PM2.5	40%	Annual average[4]	WHO HRAPIE (2013)
Acute lower respiratory diseases (children)	PM2.5	90%	Annual average[4]	Global Burden of Disease (201X)
Chronic obstructive pulmonary disease (adults)	PM2.5	30%	Annual average[4]	Global Burden of Disease (201X)
Ischaemic heart disease (adults)	PM2.5	100%	Annual average[4]	Global Burden of Disease (201X)
Lung cancer (adults)	PM2.5	50%	Annual average[4]	Global Burden of Disease (201X)
Stroke (adults)	PM2.5	140%	Annual average[4]	Global Burden of Disease (201X)
Incidence of:				
cardiovascular hospital admissions	PM2.5	10%	Daily average	WHO HRAPIE (2013)
respiratory hospital admissions	PM2.5	20%	Daily average	WHO HRAPIE (2013)
asthma symptoms in asthmatic children	PM10	30%	Daily average	WHO HRAPIE (2013)
new cases of chronic bronchitis in adults	PM10	120%	Annual average[4]	WHO HRAPIE (2013)

[4] *increase in risk calculated assuming that the average of the sampling results represents annual average – should be seen as indicative.*

bronchitic symptoms in asthmatic children	NO2	40%	Daily average	WHO HRAPIE (2013)
respiratory hospital admissions	NO2	30%	Daily average	WHO HRAPIE (2013)





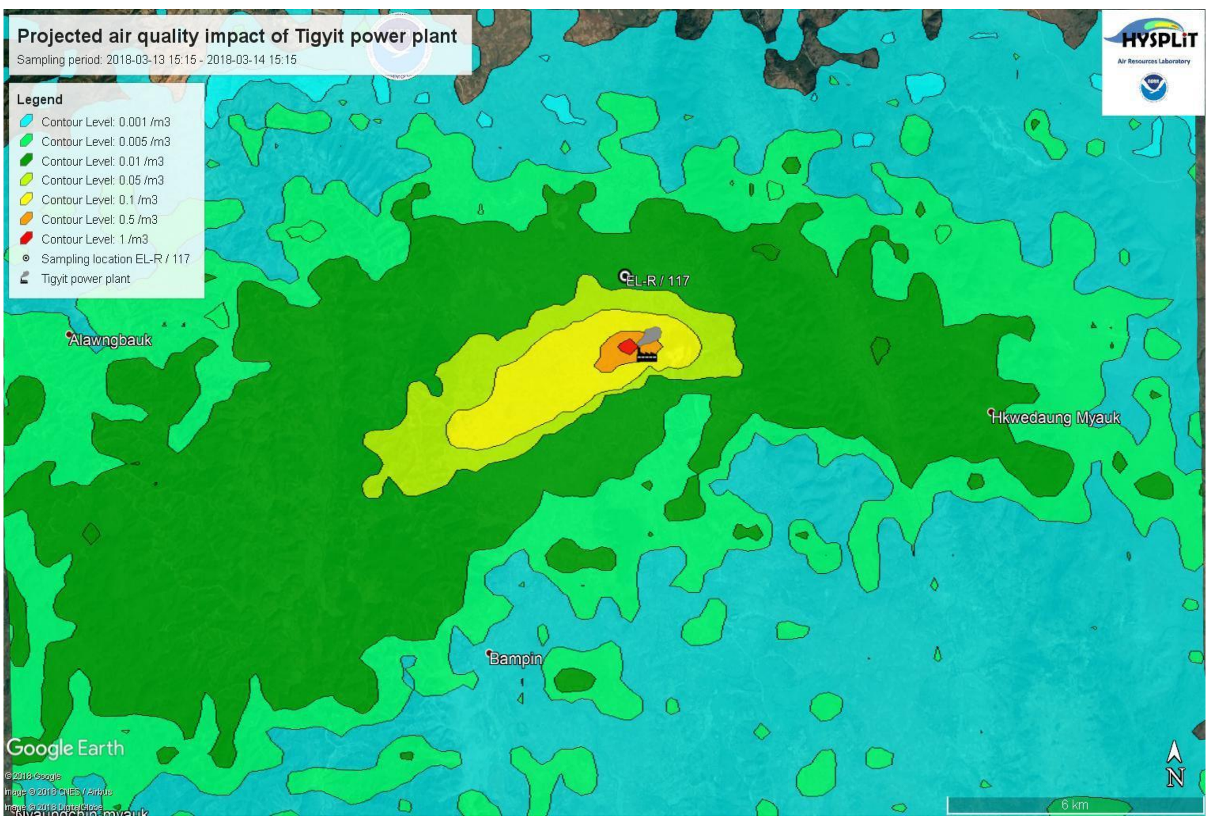


Figure 8. Contributions to ground-level pollution per unit of emissions from the Tigyit plant stack, for the three sampling periods, and locations of each sampling site. Projected using the HYSPLIT atmospheric dispersion model. Unit: ratio of ground concentration in µg/m3 to emission rate in kg/h.

Conclusions

The observed levels of air pollution in the area imply very high health risks to the population, especially as they are likely to be representative of average annual or seasonal conditions.

The levels for all key pollutants far exceed Myanmar's national guidelines:

- PM2.5 levels in all three samples are 3-4 times as high as the guideline value for 24-hour concentration, and 7-10 times as high as the guideline value for annual average.
- PM10 levels in all samples are more than two times as high as the 24-hour guideline, and 5-6 times as high as the annual average guideline.
- SO2 levels are 12-15 times as high as the 24-hour guideline value.
- 24-hour average NO2 levels exceed the 1-hour guideline value, making it likely that highest 1-hour values exceed the guideline very significantly. The annual guideline value is exceeded 7-fold, 5-fold and 2-fold on the three days of sampling.

The guidelines are supposed to be met at least 95% of the time. Since there is no indication that the sampling days were completely exceptional, it is very likely that the national air quality guidelines are being exceeded in the area multiple times.

These high levels of air pollution represent very substantial health risks to the affected populations. For example, the risk of death from lung cancer, stroke and ischemic heart disease is estimated to increase by 50%, 140% and 100% for adults, and risk of death from acute respiratory infections is estimated to increase by 90% for children, if they are continuously exposed to the observed levels of PM2.5. The observed levels of PM10 and NO2 could both increase the incidence of respiratory symptoms in children suffering from asthma by 30-40%. For newborns, risk of death before first birthday is estimated to increase by 40% if PM2.5 remains at the observed levels. (

Table 2.)

While reliable source attribution would require much more detailed data on emission sources in the area and day-to-day or hour-to-hour variations in air quality, the Tigyit power plant emits all of the detected pollutants of highest concern (PM2.5, PM10, SO2 and NOx). Coal mining, handling transport and storage operations as well as coal ash handling and storage operations release PM2.5 and PM10. Qualitatively, analysis of atmospheric conditions during the sampling period strongly indicates that emissions from the power plant were contributing to the observed pollution concentrations, and could account for a substantial part of the pollution levels, depending on emissions rates. In particular, combustion of coal or other high-sulfur fuel in the local area is likely to be the main source of the exceptionally high SO2 levels detected.

June 26, 2018

Disclaimers:

The author of this statement has analysed air quality sampling data as provided by ALARM and is in no position to independently validate the sampling and analytical methods and results. However no indication of any issues regarding the reliability of the data arose during the preparation of this statement.

Maps in this statement are generated using third party platforms and should not be construed as representing the author's position on any issues related to sovereignty, territorial claims, ownership rights or any other issues with respect to any political, legal or business entity or organization.

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