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[redacted]

From: [redacted]
Sent: 21 January 2020 12:14
To: TRANSPORTINFRASTRUCTURE
Subject: Comment on Manston DCO.
Attachments: Aircraft pollution 2.pdf; Aircraft pollution 2020 3.pdf; Airplanes emit particles and gases such as carbon dioxide.docx; pdf on particulants for aircraft 2018.pdf

Dear Sir's I run a group in the town of Ramsgate it is called OAPs against a 24/7 cargo hub and have sent information to you before, I am surprised that this DCO has not been ruled out weeks ago and that the time limit has been extended but am pleased that we have another chance to comment on what to us residents is a life and death matter. I am sending PDFs on the threat to human life that is now being highlighted from many qualified medical experts on the emissions from aircraft exhausts these are particulates 2.5 microns and 10 micros that lodge in the lungs or blood stream and cause death or constant sickness. Mr Freadman who wants to open a 24/7 freight terminal to fly over our lovely town at roof top height insists that the wind will disperse this threat, but experts say these harmful particulates lodge up to eight kmts from the flight path. There is also the added nuisance from noise that will be to many people very debilitating here again Mr Freadman's noise contour map is only half the area off a detailed contour map carried out by the CAA on aircraft noise I do hope that when the time comes to take what should be an easy decision you think about the carbon output from air craft and all the other nasty outputs such as Odours, Ozone, Soot, and the dreaded, Particulates, Ronald Blay

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It's time to wake up to the devastating impact flying has on the environment

Partners

Ready to get over your post-festive comedown by booking an escape to the sun? For many of you, that will involve flying. And while I'm sorry to put a downer on your holiday plans, there are several problems with this from a climate perspective.

The first is that aviation is essentially a fossil fuel industry, one which guzzles an eye-watering 5m barrels of oil every day. Burning that fuel currently contributes around 2.5% to total carbon emissions, a proportion which could rise to 22% by 2050 as other sectors emit less.

The second problem is, as Air Asia puts it, "Now everyone can fly". And in "generation easyJet", those who already fly, fly more than ever. This increasing demand from new and existing travellers means the number of passenger aircraft in our skies is set to double by 2035.

The third problem is that unlike other sectors where there might be a greener alternative (solar not coal, LEDs not lightbulbs etc), there is currently no way to fly 8m people every day without burning lots of dirty kerosene. Aircraft are becoming more fuel-efficient, but not quickly enough to offset the huge demand in growth. Electric planes remain decades away, weighed down by batteries that can't deliver nearly as much power per kilo as jet fuel.

But here's the peculiar thing: although no other human activity pushes individual emission levels as fast and as high as air travel, most of us don't stop to think about its carbon impact.

While in many countries new cars, domestic appliances, and even houses now have mandatory energy efficiency disclosures, air travel's carbon footprint is largely invisible, despite it being relatively much bigger. For instance, a return trip from Europe to Australia creates about 4.5 tonnes of carbon. You could drive a car for 2,000 kilometres and still emit less than that. And the average per capita emissions globally is around 1 tonne.

Several studies have found people to be quite ignorant of how their own flying behaviour contributes to climate change. It's not hard to see why. Research into airline websites shows little mention of environmental impact. Green NGOs are often quiet on the issue, perhaps being reluctant to "preach" to their members to fly less, and concerned over accusations of hypocrisy as their own staff fly around the world to conferences.

Political leaders are also unwilling to point the finger at passenger-voters. Indeed, Tony Blair asked as prime minister in 2005 "how many politicians facing a potential election would vote to end cheap air travel?" His answer: zero. The political strategy seems to be passing the buck to the airline industry, and hoping for the best.

Aviation is a golden goose for politicians. In the UK, where sources of future post-Brexit economic growth are hard to identify, the industry looks set to continue its enviable historic growth-rate of 4-5% annually. The main problem for airlines now is finding enough space to accommodate planes at crowded airports such as Heathrow. Airlines' seductive message to politicians is "If you build it, they will come."

And the primary reason that they will come is because flying is kept artificially cheap, while trains and cars become more expensive. The main reason for this is the so-called "Chicago Convention", agreed in 1944 by a then much smaller air industry, which prohibits countries from imposing jet fuel tax and VAT on international flights. Taxes on other forms of transport have increased dramatically since 1944 but thanks to the convention aviation has remained almost unscathed. Things have actually moved in the other direction since the 1990s, when an influx of low-cost carriers led to big cost savings and even lower ticket prices.

What is to be done? Aviation, along with shipping, was given special status and excluded from the Kyoto and Paris climate change agreements. The industry was tasked to come up with its own solutions instead. After much foot-dragging, the International Civil Aviation Organisation (ICAO), finally addressed aviation emissions in 2016, proposing a market-based mechanism, the Carbon Offsetting and Reduction Scheme for International Aviation (CORSIA).

Under CORSIA, countries' airlines are given allowances to emit carbon, and if they exceed their allowances (which they will) then they must buy offsets from other sectors. Yet the plan is not nearly radical enough. It doesn't even come into power for another decade, and it does nothing to stifle demand – unlike a carbon tax.

As we can see, regulating the environmental impact of flying is a complex business. Ignorance and inaction is an appealing reaction to complexity, but we need to act before aviation gobbles up more of the increasingly small wriggle-room for emission cuts. We can try and reduce the number of flights taken, buy carbon offsets for unavoidable flights, and question the broader logic of allowing the industry to grow ad infinitum. Just using a carbon calculator to learn about the carbon impact of our sunny escapades is a good start.

If citizens remain blissfully unaware of aviation emissions, then airlines and governments are unlikely to do anything about them. Alternatively, if governments ever wish to place a global carbon tax on flights, then they will need to create political "buy-in" from citizens who increasingly see cheap flights as a right.

As the world gets hotter and more crowded, our engines continue to pump out dirty emissions, and half the world has no access to clean fuels or technologies (e.g. stoves, lamps), the very air we breathe is growing dangerously polluted: nine out of ten people now breathe polluted air, which kills 7 million people every year.

The health effects of air pollution are serious – one third of deaths from stroke, lung cancer and heart disease are due to air pollution. This is having an equivalent effect to that of smoking tobacco, and much higher than, say, the effects of eating too much salt.

Air pollution is hard to escape, no matter how rich an area you live in. It is all around us. Microscopic pollutants in the air can slip past our body's defences, penetrating deep into our respiratory and circulatory system, damaging our lungs, heart and brain.

Air pollution is closely linked to climate change - the main driver of climate change is fossil fuel combustion which is also a major contributor to air pollution - and efforts to mitigate one can improve the other. This month, the UN Intergovernmental Panel on Climate Change warned that coal-fired electricity must end by 2050 if we are to limit global warming rises to 1.5C. If not, we may see a major climate crisis in just 20 years.

Meeting the goals of the Paris Agreement to combat climate change could save about a million lives a year worldwide by 2050 through reductions in air pollution alone. The economic benefits from tackling air pollution are significant: in the 15 countries that emit the most greenhouse gas emissions, the health impacts of air pollution are estimated to cost more than 4% of their GDP.

"The true cost of climate change is felt in our hospitals and in our lungs. The health burden of polluting energy sources is now so high, that moving to cleaner and more sustainable choices for energy supply, transport and food systems effectively pays for itself," says Dr Maria Neira, WHO Director of Public Health, Environmental and Social Determinants of Health.

Airplanes emit **particles** and gases such as **carbon dioxide** (**CO_2**), water vapor, **hydrocarbons**, **carbon monoxide**, **nitrogen oxides**, **sulfur oxides**, **lead**, and black **carbon** which interact among themselves and with the atmosphere

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Analysis of the particle size distribution near the civil airport runway

Analysis of the particle size distribution near the civil airport runway

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Abstract. Particles emitted from internal combustion engines are extremely dangerous to human health due to their very small size. Attempts to reduce particles emissions from motor vehicles, result in the installation of additional filters to purify the exhaust gases. In the case of aircraft, any interference in the exhaust system of the jet engine is unacceptable. For this reason, aircraft are an important source of particles emission in the regional aspect, so that airports can be considered as particles emission sources. The article evaluates the impact of aircraft take-off and landing operations on the concentration of particles in the ambient air. The measurements were carried out at the civilian airport area near the runway. Based on the measurements carried out, it was found that airport operations cause relevant changes in the concentration and size distribution of particles in the ambient air.

1. Introduction

Exhaust emission from internal combustion engines is the subject of analyses and scientific research due to its strict connection with deterioration of air quality and negative impact on human health. All over the world, and in particular in Europe, strict emission limits are introduced [1, 2]. In addition, new approval procedures are created to better simulate the actual conditions of vehicle operation [3, 4]. In the case of automotive, it is possible to purify the exhaust gases by aftertreatment systems. Due to the design and principle of turbine engines operation the above solution is impossible to implement in aviation [5].

One of the basic issues in case of assessing air quality is the concentration of particles [6]. Particles is a term generally used for the type of air pollutants, consisting of a complex of different mixtures of suspended particles that differ in size, composition and location. The main sources of this type of pollution include: factories, power plants, incinerators, motor vehicles and many more. The basic division of particles results from their aerodynamic diameter, which allowed to determine two main groups: PM2.5 and PM10 (Particulate Matter) for diameters smaller than 2.5 μm and 10 μm respectively [7]. The dynamic development of the particles issue and changes in their properties depending on their size forced a more detailed division. Ultrafine particles were assumed to be particles with a diameter of less than 1 μm and fine particles or nanoparticles are particles smaller than0.1 μm.

The pollution of the atmosphere with particles emitted by aircraft engines has a negative effect on human health. Particles with a diameter of 10 μm or less can cause diseases of heart and lungs, and related deaths. The intensity of diseases is combined with the long-term effects of particles in the environment. They contribute to the occurrence of diseases such as asthma and bronchitis. They are also one of the causes of cardiac arrhythmia and heart attacks. The most serious problems result from the interaction of fine particles. The lowest resistance to the negative effect of particles is demonstrated by people with heart and lung diseases, the elderly and children [8].

Determining the air quality is done by measuring the mass concentration of particulates (PM10 and PM2.5) in the air. The above method is ineffective due to the lack of determination of the particle number. Particularly dangerous are small particles with very small mass. Measuring only the mass content of particles in the air, without specifying their dimensions and number, it is not possible to determine the air quality effectively [9].

In the case of aircraft, regulations regarding particle emissions are reduced only to determination the Smoke Number parameter, which does not reflect the significance of the problem of particles emission especially theirs number [10]. Due to the lack of the possibility of testing exhaust emissions from aircraft engines in real flight conditions, measurements of air quality in the area of the airport are increasingly being conducted. The latest publications on particle measurements in airport areas are aimed at estimating the actual emission of PN (particle number) and its impact on air quality.

2. Methodology of the research

2.1. Purpose and conditions of the research

The purpose of the research was to determine the impact of take-off and landing operations on the concentration of particles in the air and their dimensional distribution. To achieve the goal, measurements of the particle number concentration in the vicinity of the civilian airport runway were made (Fig. 1).

Fig. 1. Poznan-Lawica airport and measuring area.

The research place was the Poznan-Lawica airport, located in close proximity to the city centre. The measuring apparatus was placed at a distance of 350 m from the threshold of the runway. The research was carried out on January 8th, 2018. Atmospheric conditions were typical for this season in Poland, the ambient temperature was 7°C and the windless conditions prevailed. The landings and take-offs of aircraft are dependent on the direction of the wind. Due to the windless conditions, ton that day the flight tower allowed pilots to choose from which direction they wanted to approach landing or take-off.

The tests consisted in measuring the concentration of the particles number in the air and its changes during the take-off or landing of an aircraft. In addition, the dimensional distribution of particles was measured. On the day of the tests, the aircraft performing the operations were Boeing 737-800 (Fig. 2a) and Bombardier CRJ-900 (Fig. 3a). The Boeing 737 was equipped with two jet engines CFM56-7B (Fig. 2b) while the Bombardier CRJ-900 had two CF34-8C jet engines (Fig. 3b). Technical specification of those two engines can be found in the Table 1.

a) b)

Figure 2. The view of Boeing 737-800 (a) and CFM56-7B jet engine.

a) b)

Figure 3. The view of Bombardier CRJ-900 (a) and CF34-8C jet engine.

Table 1. Technical specification of CFM56-7B and CF34-8C jet engines.

Parameter	CFM56-7B	CF34-8C
Maximum take-off thrust [kN]	108	62
Bypass Ratio [-]	5.1	5.1
Overall pressure ratio [-]	33	28
Thrust/weight ratio [-]	5.2	5.7
Weight [kg]	2370	1089
Length [mm]	2628	3251

2.2. Measuring apparatus

Measurement of particle diameters was performed with an EEPS 3090 (engine exhaust particle sizer™) (Fig. 4). It enabled the measurement of a discrete range of particle diameters (from 5.6 nm to 560 nm) on the basis of their differing speeds. The degree of electric mobility of particulate matter is changed exponentially, and measurement of their size is carried out at a frequency of 10 Hz.

Figure 4. The view and location of measurement equipment.

The sample is routed through a dilution system and to the spectrometer while maintaining at the desired temperature. The initial filter retains particles with a diameter greater than 1 micron, which are outside of the measuring range of the device. After passing through the neutralizer the particles are directed to the charging electrode; after getting electrically charged they can be classed by their size.

The particles deflected by the high-voltage electrode go to an annular slit, which is the space between the two cylinders. The gap is surrounded by a stream of clean air supplied from outside. The exhaust cylinder is built in a stack of sensitive electrodes isolated from one another and arranged in a ring. The electric field present between the cylinders causes the repulsion of particles from the positively charged electrode; then the particles are collected on the outer electrodes. When striking the electrodes, the particles generate an electric current, which is read bya processing circuit.

The measuring apparatus was set up in the approach axis for the landing and take-off of passenger aircraft. The measurements were divided into three phases: pre-landing measurement – to determine the measurement background; measurement during the landing – to determine changes in the concentration of particles during the landing operation; measurement after landing – to determine the maximum concentration of particles.

3. Research results and their analysis

The purpose of the measurements was to determine the change in the particles concentration in the ambient air caused by the aircraft take-off and landing. In addition, the particles size distribution was determined. The measurements were taken during single take-off operation of Bombardier CRJ-900 and its two landings, also the measurements were carried out during landing operation of Boeing 737.

The value of the particles concentration before the Bombardier's take-off operation was $1.8 \cdot 10^4$ cm–3. The aircraft's take-off caused a thirty-fold increase in the concentration of particles to the level of $5.2 \cdot 10^5$ cm^{-3} (Fig. 5a). The presented results of the particles concentration measurements in function of time were divided into four phases: reference level, take-off, dispersion and again reference level. The reference level corresponds to the particle concentration before the take-off or landing operation. The dispersion phase is the period in which the particle concentration stabilizes and equalizes to the level of the measuring background. In the case of Bombardier's take-off the dispersion phase lasted for 250 seconds. The average size distribution of particles during take-off and the phase of dispersion is shown in the Figure 5b. The dominant particles are from 6 to 15 nm. This is a characteristic dimensional distribution of particles for aircraft engines. Particles with these diameters are at the measurement limit. In spite of their very large number, they are invisible to the human eye, therefore they do not pose a threat. The fact is that they are the most dangerous to human health.

a) b)

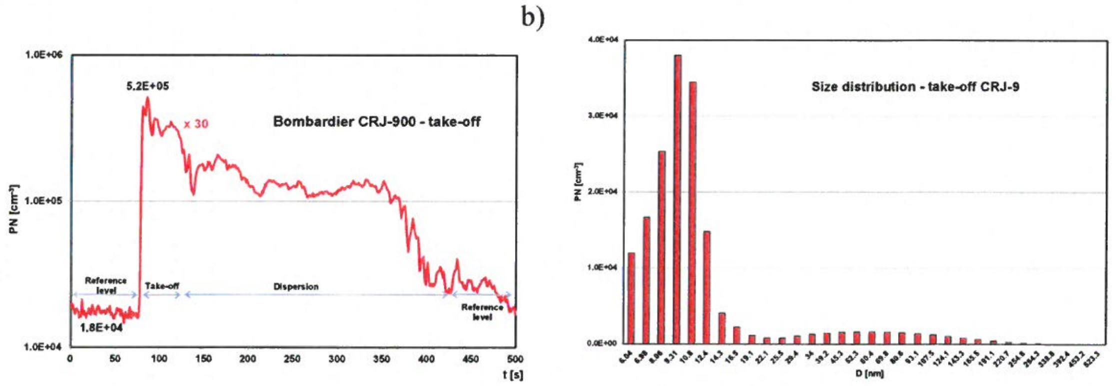

Figure 5. Total concentration of particles (a) and size distribution (b) during CRJ-900 take-off.

The value of the particles concentration before the Bombardier's landing operation was $1.1 \cdot 10^4$ cm^{-3} and was assumed as reference level. The aircraft's landing operation caused a twenty two-fold increase in the concentration of particles to the level of $2.4 \cdot 10^5$ cm^{-3} (Fig. 6a). The dispersion phase lasted for 200 seconds and was characterized by a turbulent course.

The average size distribution of particles during take-off and the phase of dispersion is shown in the Figure 6b. The dominant particles are from 6 to 15 nm, close to log-normal distribution. Particles with the smallest dimensions had the highest concentration. The resulting distribution is significantly different from the dimensional distribution determined during the start of the same aircraft model.

a) b)

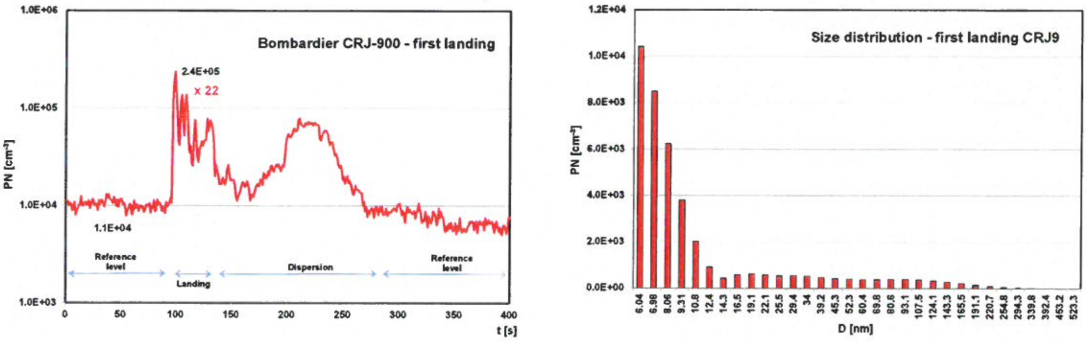

Figure 6. Total concentration of particles (a) and size distribution (b) during CRJ-900 first landing.

The value of the particles concentration before the Bombardier's second landing was 6.9 • 10^3 cm^{-3} and was assumed as reference level. The aircraft's landing operation caused almost twenty-fold increase in the concentration of particles to the level of 1.3 • 10^5 cm^{-3} (Fig. 7a). The dispersion phase lasted for 100 seconds. The dilution of particles emitted by the aircraft was regular. A clear landing and dispersal phase cannot be determined because the measurement results show only the dilution phase.

The average size distribution of particles during landing and the phase of dispersion is shown in the Figure 7b. The dominant particles are from 6 to 15 nm, close to normal distribution. The obtained dimensional distributions during landings differ, but the fact is that the dominant particles are those with diameter 6–15 nm.

a) b)

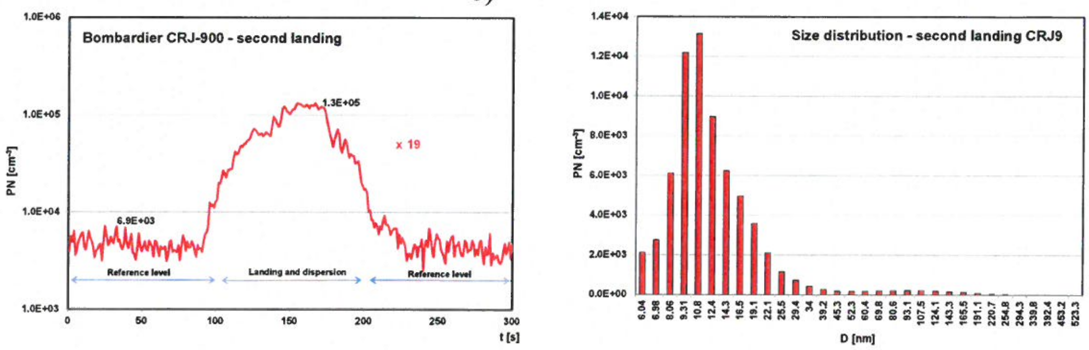

Figure 7. Total concentration of particles (a) and size distribution (b) during CRJ-900 second landing.

The value of the particles concentration before the Boeing landing was 4.7 • 10^3 cm^{-3} and was assumed as reference level. The particles concentration after landing was one thousand bigger and reached 1.3 • 10^5 cm^{-3} (Fig. 8a). The dispersion phase lasted for 200 seconds. The dilution of particles emitted by the aircraft was regular.

The average size distribution of particles during landing and the phase of dispersion is shown in the Figure 8b. The dominant particles are from 6 to 15 nm, close to normal distribution. The larger concentration of particles in the ambient air after Boeing landing is caused by the fact that it is equipped with twice as large engines as the Bombardier. This involves more thrust and a proportionally greater flue gas stream, which results in increased particles emissions.

a) b)

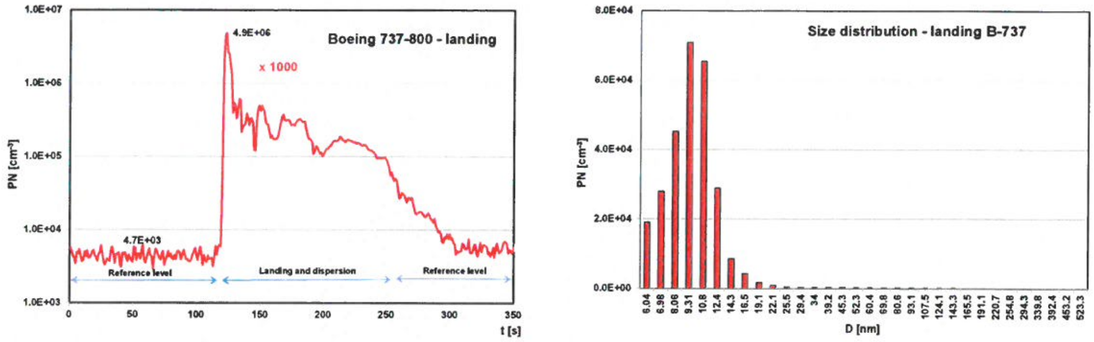

Figure 8. Total concentration of particles (a) and size distribution (b) during B-737 landing.

4. Summary

Based on the results of the tests, it was found that take-off and landing of the same model of aircraft show a different impact on the air in the area of the airport. During the start, the concentration of particles in the ambient air is clearly higher than after landing, while the dimensional distributions obtained in both cases are similar, the dominant particles are in the range of 6–15 nm. It was noted that the dispersion phase, whether the spread of particles and reducing their concentration takes up to twice as long in the case of take-off rather than landing. Landing operation of an aircraft equipped with engines with twice bigger maximum thrust resulted in up to fifty times greater increase in the concentration of particles in the air in comparison to smaller aircraft. The dimensional distribution of solid particles did not differ significantly from the distributions obtained in the case of aircraft equipped with smaller engines.

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