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Rationalize and reduce air transport to counteract climate change, environmental pollution and to protect the health of all species starting with the human one, for ethical and scientific reasons

**Abstract**

During the last decades, air traffic has shown an almost continuous growth mostly in

respect to the freight sector and the low cost flights, usually related to so-called “hit-and-run” tourism, thus leading to an increasingly negative impact on the environment, particularly in terms of atmospheric and acoustic pollution, and to a major contribution to climate change.

According to the European Aviation Environmental report 2016, the number of flights has increased by 80% between 1990 and 2014, and is forecast to grow by a further 45% between 2014 and 2035.

Eurocontrol (www.eurocontrol.int), an organization currently composed of 41 European Member States, estimates that in 2025, the aviation sector will produce between 1,2 and 1,4 billion tonnes of CO2 on a worldwide level (each ton of fuel burnt produces about 3,16 tons of CO2).

Only a small portion of the worldwide population travels by plane, while the dramatic consequences of global warming, which partly arise from air traffic, falls upon all of humankind in terms of desertification, floods, cyclones, climate upheavals, in such a serious way as to cause destruction and famines in ever larger parts of the planet, and increase the phenomenon of forced migration flows, in particular from Africa and Asia.

Scientific literature and studies on environmental, health and climate impact of air transport have been available since many decades and are becoming more and more numerous.

Therefore if we want to counteract climate change we need to undertake national and international programs of reduction and rationalization even of this highly polluting form of mobility.

**Key words**: air transport and climate, environment and health, atmospheric pollution, aircraft noise, noise and children’s cognition and health.

**Introduction**

Air transport is the form of mobility which mostly affects climate change and has a negative impact on the environment, on the ecosystems and human health.

Every day more than one hundred thousand aircraft take off polluting the sky.

During the last decades, air traffic has demonstrated almost continuous growth mostly in

respect to the freight sector and low cost flights, usually related to the so-called “hit-and-run” tourism, thus leading to an increasingly important negative impact on the environment, particularly in terms of atmospheric and acoustic pollution, and to a major contribution to climate change.

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Eurocontrol (www.eurocontrol.int), an organization currently including 41 European Member States, estimates that in 2025 the aviation sector will produce on a worldwide level between 1,2 and 1,4 billion tonnes of CO2 (each ton of fuel burnt produces about 3,16 tons of CO2).

Only a small portion of the worldwide population travels by plane, while the dramatic consequences of global warming, which partly arise from air traffic, fall upon the whole humankind in terms of desertification, floods, cyclones, climate upheavals, in such a serious way as to cause destruction and famine in ever larger parts of the planet, and increase the phenomenon of forced migration flows, in particular from Africa and Asia.

Guiltily airtransport is rarely considered a sector where to intervene in order to reduce atmospheric pollution and to counteract climate change, as regrettably happens at various international climate conferences.

Therefore it would be right and necessary to include in air quality improvement plans such actions and measures aiming to reduce and rationalize air transport, particularly in the big cities where the only measure is to stop the road traffic, every now and then , according to the PM (Particulate Matter) levels detected in the air.

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**The issue in figures**

Already in 1999, the IPCC (Intergovernmental Panel on Climate Change) scientists recommended: «To discourage the nonchalant use of air transport through environmental levies (charges and taxes) and emissions trading.» (https://ipcc.ch/pdf/special-reports/spm/av-en.pdf)

The European Aviation Environmental report 2016 states that the number of European flights has increased by 80% between 1990 and 2014, and is forecast to grow by a further 45% between 2014 and 2035 only in Europe.

At a global level, the International Air Transport Association-IATA forecasts passenger numbers to double in 2035 (http://www.iata.org/pressroom/pr/Pages/2016-10-18-02.aspx).

In this respect we can reasonably expect that the quantity of CO2 and NOX emissions will also double on a global level in 2035 over 2014, whereas they are proportional to the fuel burnt and consequently to the air traffic growth.

Eurocontrol (www.eurocontrol.int), an organization currently composed of 41 European Member States, estimates that in 2025 the aviation sector will produce on a worldwide level between 1,2 and 1,4 billion tonnes of CO2 (each ton of fuel burnt produces about 3,16 tons of CO2).

All of this while a research of the British Warwick Business School University showed that between 2007 and 2014 none of the best known world airline companies, except for some rare cases, has put in action any interventions or strategies aiming to reduce their own emissions.

**High and low-altitude emissions**

Pollutant emissions due toair transport depend on the number of daily aircraft movements, on type of engine, on aircraft weight and kind of journey, and their dispersion depends on a challenging set of meteorological variables such as wind, its strength and direction.

These emissions, formed by gas and particulate matter-PM, alter the concentration of the natural greenhouse gases, starting with carbon dioxide (CO2), ozone (O3) and methane (CH4).

Emissions originating from aircraft engines using kerosene (a mixture composed by different types of hydrocarbons) are generally similar, as to composition, to those generated by combustion of other fossil fuels (production of gas and PM), but they strongly increase the greenhouse effect for they are released directly into the atmosphere: in the higher part of the troposphere and in the lower part of the stratosphere; for these reasons they result even more harmful for the climate.

At a high-altitude, even though combustion occurs more efficiently, we have to highlight that there is an emission of water vapour, UHC (Unburned HydroCarbons) and PM in those areas where the land-base pollution does not reach them.

Moreover, the presence of particulate matter under some atmospheric conditions favours the formation of contrails and increases the build-up of clouds, thus contributing to global warming.

This PM, given its size of the order of micron and submicron (fine and ultrafine dust particulates), remain at high altitude for extended periods joined to the aerosol composed of unburned hydrocarbons.

Contrary to what happens with liquid and solid pollution (PM and UHC) produced at low-altitude, which is periodically washed out by rain, the one at high-altitude is exclusively subject to the force of gravity; as a result there is a build-up of particulate, mainly composed by carbonaceous particles, which not only promotes the creation of cirrus clouds but strongly affects the climate and favours global warming.

At a low-altitude, combustion generally occurs with a lower efficiency and the percentage of CO2 and UHC emissions is higher.

**Damage to vegetation and ecosystems**

The PM released by aircraft emissions also has a climate-change action and contributes therefore to global warming, causing damage to ecosystems.

The PM is not an individual pollutant but a mixture of heterogeneous pollutants different as to origin, measure and chemical composition.

The effects of the PM deposited on vegetation and fields depend on its chemical composition and can produce both direct and indirect effects on the ecosystem involved. The reaction of the ecosystem to pollutants is directly linked to its degree of sensitivity and to its capability to make the most out of the change produced by the presence of PM. The PM with the greatest impact on the environment is the one that contains mainly nitrates and sulphates, because once they are deposited on the soil they alter its potential supply and therefore the intake of nutrients, causing an environmental imbalance on the ecosystem and its biodiversity, with repercussions on the food chain (eutrophication).

Damage to plant growth is caused by the acidification due to sulphur dioxide (SO2), also called sulphuric anhydride, which reacts with water and transforms itself into sulphuric acid (H2SO4) causing the phenomenon of acid rain (plant growth inhibition and defoliation); the same thing happens with nitrogen oxide (NO) which transforms itself into nitric acid (HNO3) becoming co-responsible of acid rain.

Other damage are due to the direct deposit of the PM on leaves, small branches, trunks of plants and vegetation, which forms a barrier to light transmission and reduces thereby the photosynthesis of the plant life system with the consequence of increasing its sensitivity to pathogenic agents.

As an example of damage produced on flora and fauna by polluting emissions of aircrafts we can mention the case of the environmental devastation caused by the take-off of aircrafts within an area of 400 square meters called “Brughiera del Dosso”, close to the airport’s boundary of Milano-Malpensa and on the take-off route of the aircrafts from both the runways (35R and 35L). In 2014, the Ministry of Infrastructure, 15 years later and at the third-instance of the Supreme Court of Cassation, was ordered to pay 8 million euro as compensation (http://milano.

repubblica.it/cronaca/2014/07/08/news/malpensa\_il\_decollo\_degli\_aerei\_inquina\_il\_parco\_il\_ministero\_pagher\_8\_milioni\_di\_euro-91041272/).

**The scientific literature on human health**

The scientific literature and the studies on climate change, on the environmental impact and health damage due to air transport have been available for many decades, and they highlight to a large extent a close synergy between the effects produced by air and acoustic pollution on human health.

These effects, originated from air transport and other sources of pollution, resulted in an increase of cardiovascular, respiratory, chronic-degenerative, immunological, metabolic, neuroendocrine and neoplastic diseases, plus neurobehavioral disorders.

Furthermore, we must consider that pollution due to air traffic adds up to other sources of pollution, exposing particularly children, teenagers, pregnant women and above all the embryo and the fetus to the so-called “cocktail effect” which consists of the amplification and the synergy of the pathogenic action of each pollutant.

These elements, due also to their microscopic size, easily pass all the biological barriers of the human organism and interact negatively with the epigenome (the software of DNA), opening the way to all the chronic diseases that are increasing all over the world both in children and in adults and that could be even transmitted to future generations, through epigenetic changes in gametes.

Therefore it is clear that it is absolutely necessary to reduce exposure to all pollutants and consequently to those pollutants produced by air transport.

**Silence and air transport noise**

Air transport is an important factor of acoustic pollution. This particular form of pollution, in synergy with air pollution, is associated with growing evidence especially of cardiovascular and respiratory diseases, as well as of psychic and cognition disorders.

As to communities living near airports, the scientific studies highlight learning disabilities and attention deficit in children, as well as a clear reduction of the quality of life due to a compromised night’s rest as a consequence also of the overnight airport operations.

The experience of inner silence and silent places is extremely important for the cultural and spiritual education of every single person, and is also the bedrock for the psychological and physical well-being of everyone.

As to the believers of many spiritual traditions, silence is also the *place* where God speaks

( “*Silence is so important! … we are going to the encounter with the Lord, and silence prepares us and accompanies us. Pausing in silence with Jesus.* *From this mysterious silence of God springs his Word which resonates in our heart.*”, Pope Francis in the General audience of Wednesday, November 15th 2017).

Instead, our cities, our environments, our lifestyles have become more and more noisy and are a permanent source of distraction.

Our life is permanently bathed in noise, even before birth, particularly in large cities and towns close to highways and airports.

 In 2015 the review *Health Effects of Noise Exposure in Children* ([Curr Environ Health Rep.](http://www.ncbi.nlm.nih.gov/pubmed/26231366) 2015 Jun;2(2):171-8) confirmed what has already been related earlier and in line with the results of the international literature, namely that there is a relationship between noise exposure and hyperactivity symptoms in children and a correlation, in other groups, between maternal-fetal noise exposure and low birth weight and prematurity.

Children and young people who live around airports have learning disabilities and impaired concentration, which represents for their school education a disadvantage unlikely to be recovered in the future.

The RANCH (Road Traffic & Aircraft Noise & Children's Cognition & Health) Study, *Exposure-Effect Relations between Aircraft and Road Traffic Noise Exposure at School and Reading Comprehension*, published in 2006 on the American Journal of Epidemiology, carried out an analysis of the effects of road traffic and aircraft noise on children’s cognitive development.

More than 2.800 children aged 9-10 years attending 89 schools around major airports in three European countries (Schiphol in Amsterdam, the Nederlands; Barajas, in Madrid, Spain; and Heathrow in London, United Kingdom) were involved in this study.

The researchers measured the levels of acoustic pollution and connected them with the results of a series of cognitive tests conducted on children. Analysis of data pointed out that the exposure to aircraft noise impairs the reading comprehension performance.

The exposure to road traffic noise didn’t seem to have the same significant effect on reading ability, but it was harmful on memory. An exposure to high levels of both types of acoustic pollution was associated with a worse quality of life in children and to a drastic increase of stress.

The authors conclude their study by saying that the schools around airports are not healthy environments nor suitable to childrens’ education and growth.

Further and later studies on this particular population age group confirm the results of the Ranch Study.

We must also point out that the World Health Organization itself exhorts that schools and pre-schools should be built far from airports.

The European Parliament continually emphasizes to the Member States the need to reduce acoustic pollution and to fix the same limits to noise exposure for the entire European Community.

In 2014, 140 European organizations of citizens have signed and supported the petition “Taming Aviation” to the European Parliament in order to impose a ban on night flights as a minimum standard of protection for human health. (http://www.tamingaviation.eu/index.php?id=1&L=4)

**CONCLUSIONS**

According to the World Health Organization every year there are about 12,6 million deaths attributable to air, water and soil pollution, to chemical exposure, climate change and ultraviolet radiation. (http://www.who.int/mediacentre/news/releases/2016/deaths-attributable-to-unhealthy-environments/en/)

Again according to the World Health Organization, 92% of the world’s population breathes polluted air. (http://www.who.int/mediacentre/news/releases/2016/air-pollution-estimates/en/)

Air traffic is the fastest growing source of air pollution and therefore of climate change, and it is one of the biggest sources of environmental pollution and health damage.

Being aware that air traffic is an irrefutable risk factor and a damage to health and the environment, must make us assume the responsibility to constantly study and monitor its effects.

If we really wish to counteract climate change we must deal strongly and clearly with the authorities involved so as to adopt as quickly as possible programs, control and reduction policies of this highly polluting mode of mobility.

Ethical and scientific reasons for air traffic reduction and rationalization

References

Adamkiewicz, G., Hsu, H. H., Vallarino, J., Melly, S. J., Spengler, J. D., & Levy, J. I. (2010). *Nitrogen dioxide*

 *concentrations in neighborhoods adjacent to a commercial airport: a land use regression modeling study*. Environmental Health, 9:73

American Heart Association. (2010). *Particulate matter air pollution and cardiovascular disease: An update to the scientific statement.* Circulation. 121:2331-2378

Ancona, C., & Forastiere, F. (2014). *Rumore e inquinamento: l’effetto degli aeroporti sulla salute dei residenti. (Noise and air pollution: The effect of airports on the health of residents)*. Epidemiol Prev; 38 (3-4):164-166

Babisch, W., Houthuijs, D., Pershagen, G., Cadum, E., Katsouyanni, K.,Velonakis, M., Dudley, M. L., Marohn, H. D., Swart, W., Breugelmans, O., Bluhm, G., Selander, J., Vigna-Taglianti, F., Pisani, S., Haralabidis, A., Dimakopoulou, K., Zachos, I., & Järup, L.; HYENA Consortium.(2009, November). *Annoyance due to aircraft noise has increased over the years–results of the HYENA study*. Environ Int. 35(8), 1169-76

Bowles, D.C, Butler, C.D., & Morisetti N. (2005, October). *Climate change, conflict and health*. J R Soc Med.108(10), 390-5

Calderón-Garcidueñas, L., Torres-Jardón, R., Kulesza, R. J., Su-BinPark, S. B., & D’Angiulli, A. (2014). *Air pollution and detrimental effects on children’s brain. The need for a multidisciplinary approach to the issue complexity and challenges*. Front Hum Neurosci. 8:613. Published online 2014, August 12. doi: 10.3389/fnhum.2014.00613PMCID: PMC4129915

[Clark, C](http://www.ncbi.nlm.nih.gov/pubmed/?term=Clark%20C%5BAuthor%5D&cauthor=true&cauthor_uid=16306314)., [Martin, R](http://www.ncbi.nlm.nih.gov/pubmed/?term=Martin%20R%5BAuthor%5D&cauthor=true&cauthor_uid=16306314)., [Van Kempen, E](http://www.ncbi.nlm.nih.gov/pubmed/?term=van%20Kempen%20E%5BAuthor%5D&cauthor=true&cauthor_uid=16306314)., [Alfred, T](http://www.ncbi.nlm.nih.gov/pubmed/?term=Alfred%20T%5BAuthor%5D&cauthor=true&cauthor_uid=16306314)., [Head, J](http://www.ncbi.nlm.nih.gov/pubmed/?term=Head%20J%5BAuthor%5D&cauthor=true&cauthor_uid=16306314)., [Davies, H. W](http://www.ncbi.nlm.nih.gov/pubmed/?term=Davies%20HW%5BAuthor%5D&cauthor=true&cauthor_uid=16306314)., [Haines, M. M](http://www.ncbi.nlm.nih.gov/pubmed/?term=Haines%20MM%5BAuthor%5D&cauthor=true&cauthor_uid=16306314)., [Lopez Barrio, I](http://www.ncbi.nlm.nih.gov/pubmed/?term=Lopez%20Barrio%20I%5BAuthor%5D&cauthor=true&cauthor_uid=16306314)., [Matheson, M](http://www.ncbi.nlm.nih.gov/pubmed/?term=Matheson%20M%5BAuthor%5D&cauthor=true&cauthor_uid=16306314)., & [Stansfeld, S. A](http://www.ncbi.nlm.nih.gov/pubmed/?term=Stansfeld%20SA%5BAuthor%5D&cauthor=true&cauthor_uid=16306314). (2006, January 1). *Exposure-effect relations between aircraft and road traffic noise exposure at school and reading comprehension: The RANCH project*. [Am J Epidemiol.](http://www.ncbi.nlm.nih.gov/pubmed/16306314) 163(1):27-37. Epub 2005, November 23.

Clark, C., Crombie, R., Head, J., Van Kamp, I., Van Kempen, E., & Stansfeld, S. A. (2012, July 25). *Does Traffic- related Air Pollution Explain Associations of Aircraft and Road Traffic Noise Exposure on Children's Health and Cognition? A Secondary Analysis of the United Kingdom Sample From the**RANCH Project.* Am J Epidemiol.

Diez, D. M., Dominici, F., Zarubiak, D., & Levy, J. I. (2012, August 7). *Statistical approaches for identifying air pollutant mixtures associated with aircraft departures at Los Angeles international airport.* Environ Sci Technol. 46(15):8229-35

Ergasti, G., Pippia, V., Murzilli, G., & De Luca D’Alessandro, E. (2009, May-Jun). *Climate change and Kyoto protocol*. Ann Ig. 21(3):271-81

Evrard, A. S., Bouaoun, L., Champelovier, P., Lambert, J., & Laumon B. (2015 September-October). *Does exposure to aircraft noise increase the mortality from cardiovascular disease in the population living in the vicinity of airports? Results of an ecological study in France.* Noise Health. 17(78):328-36. doi: 10.4103/1463- 1741.165058

Floud, S., Blangiardo, M., Clark, C., De Hoogh, K., Babisch, W., Houthuijs, D., Swart, W., Pershagen, G., Katsouyanni, K., Velonakis, M., Vigna-Taglianti, F., Cadum, E., & Hansell, A. L. (2013 October 16). *Exposure to aircraft and road traffic noise and associations with heart disease and stroke in six European countries: A cross-sectional study.* Environ Health. 12:89. doi: 10.1186/1476-069X-12-89

Greiser, E., & Glaeske, G. (2013, March). *Social and economic consequences of night-time aircraft noise in the vicinity of Frankfurt/Main airport.* Gesundheitswesen. 127-33. doi: 10.1055/s-0033-1333785. Epub 2013, March 1.

Guoqing, D., Xiaoyi, L., Xiang, S., Zhengguang, L., & Qili L. (2012 March-April). *Investigation of the relationship between aircraft noise and community annoyance in China.* Noise Health. 14(57):52-7

Hohmann, C., Grabenhenrich, L., De Kluizenaar, Y. & et al. (2013). *Health effects of chronic noise exposure in pregnancy and childhood: A systematic review initiated by ENRIECO*. Int J Hyg Environ Health. 216:217– 29

ISPRA. (2012 edition, VIII Report). *Qualità dell’ambiente urbano (Quality of the urban environment)*. Focus su Porti, Aeroporti e Interporti (*Focus on harbours, airports and tween-decks*).

Katsouyanni, K., Velonakis, M., Vigna-Taglianti, F., Cadum, E., & Hansell A. L. (2013, October 16). *Exposure to aircraft and road traffic noise and associations with heart disease and stroke in six European countries: A cross-sectional study.* Environ Health. 12:89. doi: 10.1186/1476-069X-12-89

Kugele, K. A., Jelinek, F., & Gaffal, R. (2005). *Aircraft Particulate Matter Emission Estimation through all Phases of Flight*. Eurocontrol Experimental Centre.

Lee, D. S., & et al. (2009). *Aviation and global climate change in the 21st century*, Atmospheric Environment.

Litta, A. (2010, year 9, No.24, pp. 44-48). *Il trasporto aereo come fattore d’inquinamento ambientale e danno alla salute:Il caso di studio della città di Ciampino e delle scuole di Santa Maria delle Mole. (Air transport as a factor of environmental pollution and health damage. The case study of the town of Ciampino and the schools of Santa Maria delle Mole).* Il Cesalpino, a medical-scientific magazine of the Medical Board of Arezzo.

Litta, A. (2017, year 16, No.43, pp. 54-56). *Trasporto aereo e clima*. (*Air transport and climate*) Il Cesalpino, a medical-scientific magazine of the Medical Board of Arezzo. Available on http://www.omceoar. it/default.asp?p=cesalpino

Liu, C., Fuertes, E., Tiesler, C. M., & et al. (2014). *The associations between traffic-related air pollution and noise with blood pressure in children: Results from the GINIplus and LISAplus studies*. Int J Hyg Environ Health. 217:499–505

Morgan, B. ( 2010, September 28). *Study suggests pollution from airplanes flying at ‘cruise’ altitudes contributes to 8,000 deaths per year globally.* MIT News Office. (http://newsoffice.mit.edu/2010/airplane-emissions-0928)

Pisani, S., Bonarrigo, D., Gambino, M., Macchi, L., Banfi, F., Verri, A. M., Degli Stefani, C., Cislaghi, C., Bossi, A., & Cortinovis, I. (2003 July-August). *Epidemiologic study Salus domestica: Evaluation of health damage in a sample of women living near the Malpensa 2000 airport*. Epidemiol Prev. 27(4): 234-41

Stansfeld, S., Berglund, B., Clark, C., Lopez-Barrio, I., Fischer, P., Ohrström, E., Haines, M. M., Head, J., Hygge, S., Van Kamp, I., & Berry, B. F. (2005, June). *Aircraft and road traffic noise and children’s cognition and health: A cross-national study.* Lancet. 4-10; 365(9475):1942-9

Stansfeld, S., Hygge, S., Clark, C., & Alfred, T. (2010, October-December). *Night time aircraft noise exposure and children’s cognitive performance.* Noise Health. 12(49):255-62

Stansfeld, S. *Airport noise and cardiovascular disease*. BMJ 2013;347:f5752

[Stansfeld, S](http://www.ncbi.nlm.nih.gov/pubmed/?term=Stansfeld%20S%5BAuthor%5D&cauthor=true&cauthor_uid=26231366)., & [Clark, C](http://www.ncbi.nlm.nih.gov/pubmed/?term=Clark%20C%5BAuthor%5D&cauthor=true&cauthor_uid=26231366). (2015, June). *Health Effects of Noise Exposure in Children*. [Curr Environ Health Rep.](http://www.ncbi.nlm.nih.gov/pubmed/26231366) 2(2):171-8

Stuber, N., Forster, P., Rädel, G., & Shine, K. (2006, June 15). *The importance of the diurnal and annual cycle of air traffic for contrail radiative forcing*. Nature. 15; 441(7095): 864-7

Westerdahl, D., Fruin, S. A., Fine, P. L., & Sioutas, C. (2008, April). *The Los Angeles International Airport as a source of ultrafine particles and other pollutants to nearby communities*. Atmospheric Environment. *42*(13), pp. 3143-3155.

Zhou ,Y., & Levy, J. I. (2009, May 8). *Between-airport heterogeneity in air toxics emissions associated with individual cancer risk thresholds and population risks.* Environ Health. 8:22

Zuurbier, M., Lundqvist, C., Salines, G., Stansfeld, S., Hanke, W., Babisch, W., Bistrup, M.L., Van Den Hazel, P., & Moshammer H. (2007).*The environmental health of children: priorities in Europe***.** Int J Occup Med Environ Health. 20(3):291-307

Webliography

Aircraft-Noise-and-Public-Health-the-evidence-is-loud-and-clear-final (reportONLINE.pdf) available on www.aef.org.uk/

http://www.dmi.unipg.it/mamone/sci-dem/nuocontri\_1/burgio\_pandemia.pdf

http://www.deplazio.net/attivita/137-sera-italia-ccm-2010-studiosugli-effetti-del-rumore-aeroportuale

http://www.deplazio.net/it/rapporti/cat\_view/36-rapporti-2012

www.eurocontrol.int

www.easa.europa.eu/eaer/system/files/usr\_uploaded/European%20

http://www.eea.europa.eu/it/segnali/segnali-2016/articoli/i-trasporti-aerei-e-marittimi

Aviation%20Environmental%20Report%202016%20-72dpi.pdf

https://www.ipcc.ch/pdf/special-reports/spm/av-en.pdf

www.isde.it

Litta, A. (2017, year 16, No.43, pp. 54-56). *Trasporto aereo e clima (Air transport and climate)*. Il Cesalpino, a medical-scientific magazine of the Medical Board of Arezzo. Available on http://www.omceoar.it/default. asp?p=cesalpino

<https://giuseppinaranalli.blogspot.it/search/label/inquinamento%20aereo>

http://www.tamingaviation.eu/index.php?id=1&L=4

https://www.transportenvironment.org/transport-biggest-climate-problem/campaigns/aviation

www.wbs.ac.uk/news/finnair-found-to-be-cleanest-airline-in-newstudy1/

http://www.who.int/ceh/capacity/noise.pdf

http://www.who.int/globalchange/mediacentre/events/COP21\_climateagreement\_\_health/en/

http://www.who.int/globalchange/mediacentre/events/sign-form/en/

http://www.who.int/mediacentre/news/releases/2016/deaths-attributable-to-unhealthy-environments/en/

http://www.who.int/mediacentre/news/releases/2016/air-pollutionestimates/en/