

Abstract

Globally, climate change has a significant impact on the aviation sector. The negative aspects that are caused by climate change are a cause for concern. Despite all the negative consequences of climate change, humans have been resilient and creative in their quest to find ways to lessen its impact. Some of the concerns related to climate change include sea level rise, increased storm intensity and capricious temperature disparities. The change in climate has increased air turbulence where passenger safety is a concern and may lead to less demand for passenger travel. The short term impact of climate change in the aviation industry may have a direct correlation to its financial and economic stability. Extreme weather events caused by climate change have caused many flight cancellations, delays, and maintenance costs that affect the revenue of airlines and their operational efficiency. Some of the changes that may be implemented to mitigate these problems include technological innovations such as utilizing propulsion systems that are powered by hydrogen and electricity, which can reduce the carbon footprint. Human behavior plays a crucial role in mitigating the calamities of climate change. Individuals can contribute to supporting sustainable practices to mitigate climate change by reducing demand for products that are harmful to the environment and promoting eco-friendly alternatives. Thus, the research conducted will aim to ascertain what strategies may be adopted to mitigate the impact of climate change, its effects on the aviation industry, and how to encourage a cultural shift toward a more sustainable aviation industry.

Keywords: climate change, aviation, technology, emissions, human behavior

Introduction

Climate change has major impacts in the Aviation industry all over the world, these impacts with all its negative aspects is a cause for concern for the whole industry. However, with all the negative aspects out there, we humans are capable of looking at the bright side and fight these by creating some positive aspects and solutions. If we start to look at the things of concern in the aviation industry due to climate change, we have to take into account the long-term impacts like rise in sea level, increased intensity of storms and change in temperature (ICAO, 2020). These factors affect the aviation industry in a lot of ways resulting to loss of tourist demand, ineffective airport infrastructure due to rise in water level, aircrafts not being able to function efficiently due to humid conditions (ICAO, 2020). If we take into account the short-term effects of this climate change impact, financially and economically it does not look good for our industry. Extreme weather conditions and water level rise have cost airports a lot of losses, also there is always costs arising on construction of new infrastructure to fight these challenges (Lundaev, 2019). With our case study How Does CO2 Emissions Contribute to Global Greenhouse Gas Emissions? We will look into one of the important factors and impacts of climate change which is affecting the aviation industry very much. Although this is a global and a very substantial issue if we all take responsibility on either small or large steps, we can reduce these effects if not for us than maybe for the future generations.

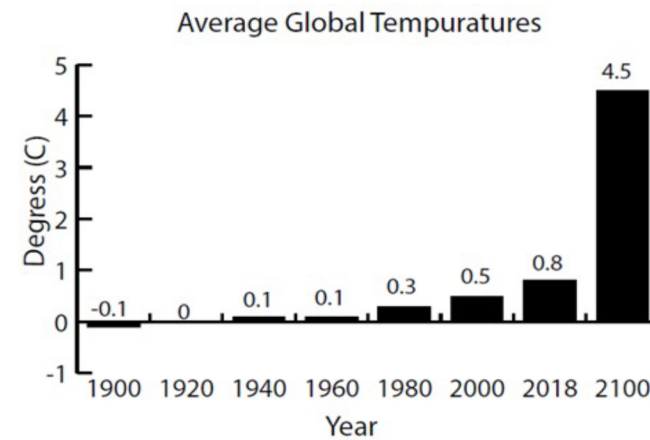


Figure 1. Graph on changes in global temperatures and their projected increase. Adapted from “Climate change and the impact of extreme temperatures on aviation,” by E. D. Coffel and R. M. Horton, 2015, Weather, Climate, and Society, 7(1), p. 94. <https://doi.org/10.1175/WCAS-D-14-00026.1>

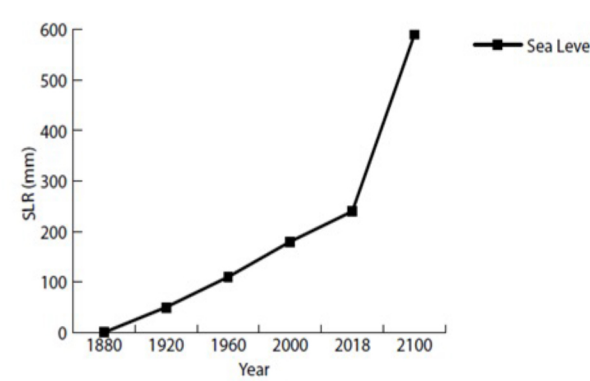
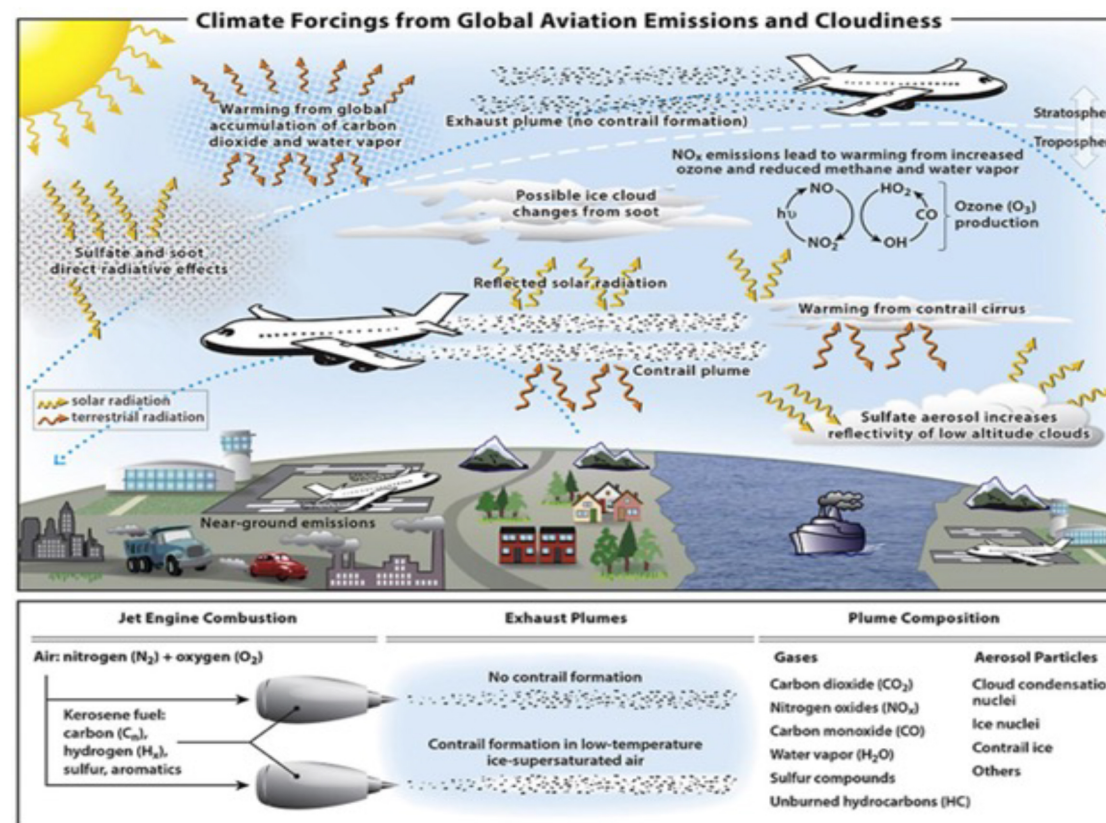
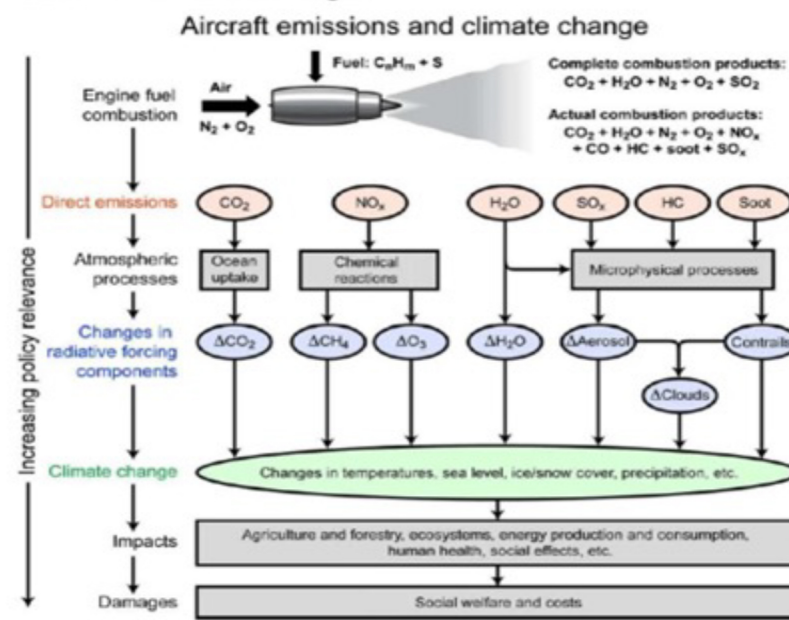


Figure 2. Graph on sea-level rise and its projected increase. Adapted from “Vulnerability assessment of coastal areas to sea-level rise from the physical and socioeconomic parameters: Case of the gulf coast of Bejaia, Algeria” by F. Djouder and M. Bouriba, 2017, Arabian Journal of Geosciences, 10(14), p. 2. doi:10.1007/s12517-017-3062-5

Figure 2 Discusses the impacts on climate change from emissions of an aircraft engine.



Case Study: How Does CO2 Emissions Contribute to Global Greenhouse Gas Emissions?

According to a recent study, which offers the most thorough estimates of aviation's climate impact, 3.5 percent of all human activity-related CO2 emissions of climate change are attributable to air travel and transportation worldwide (Kiest, 2020). A study examined all the ways in which the aviation sector contributes to global warming, such as carbon dioxide (CO2) and nitrogen oxide (NOx) emissions, as well as the effects of contrails and contrail cirrus, which are transient clouds formed in jet engine exhaust plumes at cruise altitudes that reflect sunlight during the day and trap heat that is trying to escape at night (Kiest, 2020).

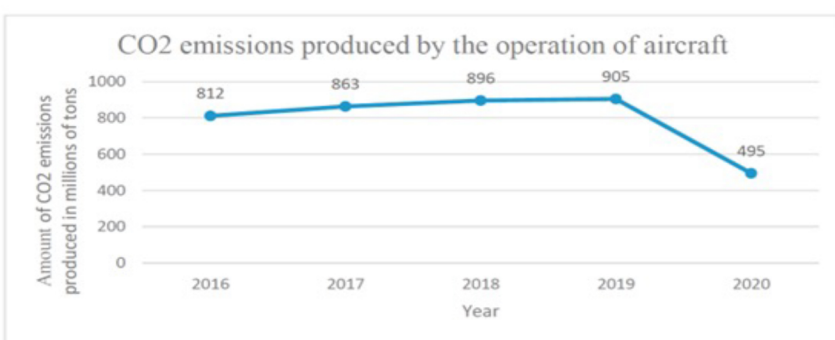


Fig. 1. Aircraft operation CO2 emissions (authors)

The graph indicates carbon emissions between 2016-2020. From 2016 to 2019, carbon emissions showed a steady increase, largely due to continuous economic growth and industrial activities. However, starting in early 2020, there was a significant and sudden decrease in emissions. This dramatic drop is attributed primarily to the onset of the COVID-19 pandemic, which severely impacted the aviation industry, among other sectors (Kiest, 2020).

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Picture indicating "ZERO EMISSIONS" from aircraft



Picture indicating international collaboration for aviation sustainability



Flooded tarmac of Salgado Filho International airport, city of Porto Alegre, Rio Grande do Sul State, Brazil, May 2024. Source : Anselmo Cunha

Mitigation Strategies to Reduce Climate Change in the Aviation Industry Behavioral Change

A few methods that people can alter their behavior to help the aviation sector combat climate change include changing how they consume energy, food, waste, housing, water, and transportation (Baumeister, 2019). To mitigate the effects of human activity on the environment and climate change, a significant portion of consumers may need to modify their lifestyles by adopting new behavioral patterns. Reducing emissions related to local air pollution and climate change was the most popular action (Baumeister, 2019). The installation of winglets improved operating practices, engine washing, weight reductions on existing aircraft, and the adoption of newer, more fuel-efficient aircraft were the primary methods used to achieve these reductions. Although the airlines must initially implement new technology to reduce emissions, this involves pro-environmental measures as well (Baumeister, 2019).

Short-term Measures

A few airlines now provide customers with the option to buy carbon offsets to offset or reduce their carbon footprint (Capocci, et al., 2010). While West jet has joined with Offsetters.ca, Air Canada has teamed with Zero Footprint. Japan Airlines partnered with Recycle One in 2009 to assist its customers in mitigating the carbon footprint of their travel. The overall emissions amount is dependent on various factors, including the type of aircraft, the distance traveled, and the ratios of passengers to cargo (Capocci, et al., 2010). Similar programs are offered by Continental, SAS, Qantas, British Airways, JetStar, Virgin Atlantic, Virgin America, and a few other carriers. While these initiatives are already setting the standard, more force may be needed to significantly lower emissions (Capocci, et al., 2010).

Long-term Measures

Like all other businesses, airlines will need to reconsider their business strategy in order to address the issue of climate change (Capocci, et al., 2010). They will most likely need to consent to become a member of a network that quickly and effectively transports people and things from one location to another. They will need to work together and establish connections with other transportation providers, such as the railroads, in order to accomplish this goal (Capocci, et al., 2010). There is a longstanding history of collaboration between train firms and airlines in the Netherlands. KLM has already ended several short-haul flights on routes where quick train connections were available well before the company merged. A significant portion of KLM's overseas flights to Dutch cities include a final train segment (Capocci, et al., 2010).

The importance of governments working together to address this crisis cannot be overstated, given its immensity. The aviation industry will continue to use band-aid solutions to lessen its environmental impact in the near term until someone takes the initiative to establish regulations that control the green practices of the whole sector (Capocci, et al., 2010).

Conclusion

The impact of climate change on the aviation industry is profound, with rising sea levels, changing temperatures, shifting precipitation patterns, and altered wind dynamics posing significant challenges. Sea level rise threatens airport infrastructure, particularly in coastal regions, potentially leading to costly adaptations or relocations. Increasing temperatures can reduce aircraft performance, requiring longer runways for takeoff and altering flight dynamics. Variability in precipitation affects airport operations, causing delays and disruptions, while changes in wind patterns can affect flight routes and fuel efficiency. Together, these factors compel the aviation industry to adapt both its infrastructure and operational strategies (Jarošová & Pajdlhauser, 2022).

To mitigate these impacts, in the short term, airlines are offering customers the option to purchase carbon offsets, which help counterbalance their emissions by funding projects that reduce or remove CO2 from the atmosphere. This approach allows travelers to mitigate their impact on the environment and supports global efforts to lower emissions (Capocci, et al., 2010). For long-term solutions, policymakers must collaborate to develop comprehensive strategies that address the aviation industry's contributions to climate change. This could include investing in sustainable aviation fuels, improving air traffic management, incentivizing the development of more efficient aircraft, and setting stringent emission reduction targets. Through coordinated efforts, the aviation sector can significantly reduce its environmental impact and contribute to the global fight against climate change (Capocci, et al., 2010).