International Comparative Jurisprudence 1 (2015) 133–142

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International Comparative Jurisprudence

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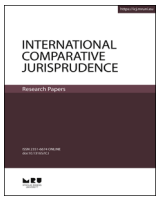

The need for legal regulation of global emissions from the aviation industry in the context of emerging aerospace vehicles

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ARTICLE INFO

Available online 11 December 2015

Keywords:
Greenhouse gases
Black carbon
Aerospace vehicles
Suborbital flights
International emissions regulations
Soft law

ABSTRACT

Emissions of black carbon from aerospace vehicles pose a challenge to international regulators. This mode of transport is still in its infancy, but is predicted to develop rapidly. Despite the lack of comprehensive scientific research, it has been argued that black carbon is the main contributor to climate change after greenhouse gases.

These emissions, which cause transboundary pollution, cannot be effectively reduced by national laws because of differences in emissions standards. The main challenge is how to regulate them – through binding or non-binding laws – and in which form – harmonisation or unification of laws. International air and space regulations are subject to the trends of politicisation and economisation. The lack of a binding international law that regulates greenhouse gas emissions from the aviation industry is primarily caused by a lack of political will and economic calculations of certain states with respect to limits on their national interests. This article proposes soft law as a solution to stagnation in creating binding international regulations for emissions in the aviation and aerospace industry.

1. Introduction

In the 21st century, vehicles of a new kind are emerging – aerospace vehicles, which can be defined as "flight instrumentalities that have all the attributes of aircraft in addition to the capability to operate in outer space" (Pelton & Jakhu, 2010, p. 231). The focus of this article is on aerospace vehicles for suborbital flights, during which they will emit black carbon. The concept of suborbital flight, which is not defined under international law, is however defined in the US Commercial Space Launch Amendments Act (2004) as "the international flight path of a launch vehicle, reentry vehicle, or any portion thereof, whose vacuum instantaneous impact point does not leave the surface of the Earth" (Committee on the Peaceful Uses of Outer Space, 2010). An aerospace vehicle takes off from a spaceport exactly like an aircraft would, goes into

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The article is based on a paper presented at the International Academic Conference on Law, Politics and Management (IACLPM 2015) that was held in Vilnius, Lithuania, on 28–29 May 2015.

Peer review under responsibility of Mykolas Romeris University.

http://dx.doi.org/10.1016/j.icj.2015.12.004

outer space like a spaceship, stays in suborbit for a couple of minutes (with the effect that passengers feel a lack of gravity) and comes back to the spaceport again in the fashion of an aeroplane. An ongoing problem is the distinction between the air zone and outer space, but this dispute is less important for the purpose of emissions – particularly because on 29 May 2014, Virgin Galactic signed an agreement with Spaceport America as that company is prepared to clear off its suborbital flights (Forbes, 2014).

These vehicles emit, among other things, black carbon, which is "a light-absorbing solid particle emitted as a result of the incomplete combustion of carbon-based fuels (i.e., fossil fuels, biofuels, wood)" (Environment Canada, 2015). As such, it is claimed to be the second-biggest contributor to climate change after greenhouse gases (UN Reg Inf Cent West Eur UNRIC, 2013). An IPCC report from 2014 indicates that black carbon emitted from suborbital vehicles is characterised as having "indirect radiative forcing effects and large regional impacts" (Climate Change, 2014), and despite its short duration (Ramanathan & Carmichael, 2008, p. 221–222), may contribute to climate change (Climate Change, 2014). The main consequence of emissions left unattended is their fast growth, which contributes to climate change.

Climate change is defined as a long-term, irreversible process of physical and chemical changes in atmospheric structure that causes an increase in the Earth's temperature and radical weather anomalies (NASA, 2008). According to the Global Warming Policy Foundation, climate change is characterised by "changes in the mean and/or the variability of its properties, and that persists for an extended period, typically decades or longer" (IPCC Introduces New 'Climate Change' Definition, 2011). The most visible results are rising global temperatures, intensive rain, long droughts, floods and hurricanes (US EPA, 2015). Greenland and West Antarctica are losing their ice, which also leads to higher sea levels (National Geographic Society, 2015).

Climate change is to large degree a result of emissions of carbon dioxide (CO_2), as well as carbon monoxide (CO), oxides of nitrogen (NO_x), methane (CH_4), sulphur dioxide (SO_2), nitrous oxide (N_2O) and non-methane volatile organic compounds (NMVOCs) (Treanton, 2001, p. 96). Although aviation contributes "only" up to 3% of global emissions (Reducing emissions from aviation, 2014), this number is likely to increase by up to 15% by 2050 (Dubois & Ceron, 2006, p. 181) if no preventive measures are implemented at an international level. In other words, the aviation industry will make an increasing contribution to climate change in the future if no new laws are imposed to mitigate these emissions, especially in light of the likely doubling of air traffic from 1998 to 2020 (Anderson et al., 2006, p. 1).

The fuel of suborbital vehicles, which has similar properties to that currently used for rockets, adversely affects the ozone layer and thus contributes to the depletion of ozone (Friedberg, 2013, p. 207). There is therefore much to worry about, despite the statement of Sir Richard Branson, the founder of Virgin Galactic, who said that space tourism would have only a minor impact on climate change (Branson, 2013). Researchers from the National Center for Atmospheric Research in Boulder, Colorado, are currently measuring emissions of black carbon from the spaceport in New Mexico (Shiga, 2010), and the simple answer at this stage of research is that the space tourism will adversely affect climate change. Emissions of black carbon from suborbital vehicles should therefore be included to create a complete picture of the harmonisation problem.

In spite of many international soft and hard laws, including the Stockholm Declaration (1972), the Geneva Convention (1979), the Vienna Convention (1985) and Montreal Protocol (1987), the UN Framework Convention on Climate Change (1992) and its Kyoto Protocol (1997), and the resolutions of the International Civil Aviation Organization (ICAO), there is no international legal framework that deals with emissions from aerospace vehicles. The lack of movement on the issue of emissions from aviation industry was interrupted by Directive 2008/101/EC (Directive 2008/101/EC, 2008) and its entry into force in 2012 (hereinafter the EU Directive). This constitutes the first binding, although European, piece of legislation that includes emissions from the aviation industry. However, the EU Directive includes international airlines in its scope, thus causing a global disagreement and accusation by some states (including USA, China, and Russia) of the ICAO's role in regulating international civil aviation being usurped. The ICAO had no choice but to deal with this issue at its session in 2013, and decided to start working on global market measures with a view to achieving a framework for the regulation of emissions by 2020 (ICAO, 2013).

This article provides reasons for the failure of international air and space law in effectively regulating emissions of greenhouse gases (GHG) and black carbon. Moreover, the advantages and disadvantages of binding laws (hard laws), which encompass treaties, conventions and directives, and non-binding laws (soft laws), which include declarations, guidelines, codes of conduct and best practices, as well as the appropriateness of harmonisation or unification in selecting the most effective regulatory path, will be discussed in the context of emissions from the aerospace industry. The objectives of this research are to demonstrate the seriousness of rising emissions of greenhouse gases and black carbon from the aerospace industry and their impact on climate change, and highlight the need to create a more effective legal instrument aimed at reducing these emissions. The failure of international binding air and space law to regulate emissions is caused by international disagreements on the form of legal instrument deemed applicable to emissions, widely varying regimes for air and space law, and the politicisation and economisation of law. Legal instruments are divided into two groups: hard law and soft law. For legal instruments to be effective, their harmonisation or unification is required. Two legal research methodologies will be applied. The first of these, doctrinal methodology (van Gestel & Micklitz, 2011; Hutchinson & Duncan, 2012), helps to describe the most efficient and realistic legal framework for regulating emissions from the aerospace industry. The second, interdisciplinary methodology (Heberlein, 1988), is needed to understand the impact of politics and economics on the international lawmaking process.

In Section 2, the author aims to demonstrate the seriousness of the problem of rising emissions of black carbon from the aerospace industry, provide reasons for creating a legal instrument to help reduce emissions, and describe the use of

aerospace vehicles for point-to-point travel. In Section 3, the binding and non-binding international regime and model law will be outlined, and the harmonisation and unification of international law will be explained. Moreover, international legal instruments, which do not include greenhouse gases emitted by the aviation industry, will be explored in addition to certain aspects of the EU Directive. These examples are given to prove that the establishment of a hard international law that includes emissions from aerospace vehicles is not likely in the near future. The article concludes that, under current circumstances, soft law is the best legal regime for regulating greenhouse gases emissions from the aviation industry and black carbon emissions from aerospace vehicles.

2. Black carbon emissions from aerospace vehicles, climate change, and point-to-point flights

According to the Center for Climate and Energy Solutions, black carbon can be either naturally produced or a result of human activity (What is Black Carbon?, 2010), and is the main component of soot. The principal sources of human-induced black carbon encompass "emissions from diesel engines, cook stoves, wood burning and forest fires" (What is Black Carbon?, 2010). According to Boucher and Reddy, although black carbon is "short-lived" compared to carbon dioxide (Boucher & Reddy, 2008, p. 198), its "destructive effect" on climate change is much greater than has been in the case of carbon dioxide (Boucher & Reddy, 2008, p. 196). "A free chlorine in the exhaust" damages the ozone layer more, even if current rocket emissions constitute just 1% of damage (Great expectations: An Assessment of the Potential for Suborbital Transportation, 2008, p. 73). This is mostly because particles of black carbon in the exhaust fumes of spacecraft do not return to Earth's surface, but stay approximately 40 km above the ground and create a dangerous soot layer. Michael Mills of the National Center for Atmospheric Research (NCAR) analysed the impact of that layer on climate change by using a computer model of Earth (LiveScience Staff, 2010). The results indicate that Earth's surface temperature would decrease on average by 0.7 °C, but the surface of Antarctica would rise by 0.8 °C (LiveScience Staff, 2010).

There is a need for the ICAO to regulate greenhouse gas and black carbon emissions. This is within the ICAO's area of competence because an aerospace vehicle operates in the air zone rather than outer space for most of its flight. Furthermore, emissions from aerospace vehicles cannot be governed by space law, primarily because of Article IX of the Outer Space Treaty of 1967. Although Article IX imposed an obligation on states to prevent any harmful contamination from extra-terrestrial matter, emissions from aerospace vehicles were not subject to this stipulation. It may be more effective to include emissions from suborbital flights in the annex to the Chicago Convention of 1944, or amend the current Annex 16 to that convention with environmental-protection measures[2]. Air law is better established than less-developed space law. This is why any ideas to create new, or amend current, space law legislation in the field of black carbon emissions should be treated in comparison as unrealistic and unlikely to be achieved in the current global situation. There is thus reluctance in agreeing with Krois's (2011, p. 45). This is an ambitious proposal, but as mentioned earlier is unlikely to be successful in the near, or even remote, future. Drafting a convention takes a couple of years on average. Bearing in mind the conflicting interests of different states with regard to outer space, the possibility of a consensus is hardly visible.

Regrettably, most sources disregard the potential challenge posed by black carbon emissions in the discussion of suborbital flights. Instead, they focus on liability and responsibility issues on the part of space operators and governments, the safety of participants in space flights, and the technical safety of aerospace vehicles such as Virgin Galactic's SpaceShipTwo and Blue Origin's New Shepard. Without a doubt, these issues are crucial for the smooth running of an industry that will be severely impacted in the event of any fatal accidents. According to estimates with regard to Virgin Galactic, 600 registered "passengers" have already paid for a suborbital trip in the near future (Virgin Galactic'on track' for 2014 passenger flights, 2013). Soon hundreds – and then thousands – of people will be taking suborbital flights for pleasure (to "feel like an astronaut") or, perhaps more importantly, to travel more quickly. Suborbital flights reach much higher speeds than conventional aeroplanes, even supersonic ones. Regular suborbital flights will be widely available in the not-too-distant future and there is therefore an urgent need to discuss this matter before it happens.

Opponents might say that results derived from computer simulations are neither an accurate nor reliable source of information. This is true, because there is a need for up-to-date research performed in a real environment. This means that climate-change researchers must cooperate both with space operators, such as Virgin Galactic and Blue Origin, and environmental government agencies, such as the US Environmental Protection Agency (EPA). These agencies can play a supervisory and monitoring role with respect to these experiments. The longer-term and more precise the research, the more optimal the results that would be achieved. These results may help space operators to improve technological functions in aerospace vehicles in a way that limits the level of emissions. This can be achieved by using better engine technologies and more environmentally friendly fuels such as biobutanol (Doggett, 2009), a non-toxic "hybrid propulsion system that uses nitrous oxide as an oxidizer and Hydroxyl-terminated polybutadiene (HTPB)" (Knapp, 2013; DeLuca, et al., 2013). However, non-toxic does not equal completely free of black carbon. At the moment, there are no statistics proving that either the type of engine or eco-fuels can realistically decrease the amount of black carbon. What is currently known is that a rocket launched into space 1000 times per year would contribute the same amount to climate change as total emissions from all subsonic aircraft worldwide (Krois, 2011, p. 41).

[2] ICAO Annex 16 "International standards and recommended practices, Environmental protection", Volume II "Aircraft engine emissions" (2008) at 16.

Studies conducted in developed countries such as the UK, Germany, Canada and the US have shown that between 40% and 80% of respondents are interested in going into space (Krois, 2011, p. 41). The research does not, however, reveal whether these people can afford to be astronauts. Companies that offer suborbital flights will therefore try to make them as cost-effective as possible. In the event of expanding such travel to include point-to-point (P2P) flights and then mass space transportation, flights could become cheaper the more people that fly.

International point-to-point suborbital flight (hereinafter P2P flight) is "a special category of flights above the surface of the Earth (an altitude between 100 and 200 km), performed by the suborbital vehicle below the orbital velocity where the place of departure (point one) and the place of destination (point two) are situated in at least two jurisdictions" (Sikorska, 2014, p. 1056–1057). P2P flights are the subject of international political and economic discussions. US law regulating suborbital flights, which to date has been very business-oriented, has omitted what is the prime role of the state regulator – namely to protect the weaker party in their capacity as a consumer. The suborbital-flight business, in the absence of international or European regulation, has been given a "green light" in the US as a source for boosting the national economy and perhaps to strengthen the country's position as a space power and leader in space technology.

The National Aeronautics and Space Administration (NASA), which will be involved in the regulation of point-to-point suborbital flights, has been affected by politics from the beginning of the space era in the US in 1961 because its budget has been agreed upon by US Congress. Logsdon (1989, p. 3) claimed that the Apollo era, which has more to do with politics than with science, because there are no confirmed data about the income that can be made from space exploration and the exploitation of the Moon or Mars (Logsdon, 1989, p. 4). As a solution, Handberg proposes that budget reform should take place in the near future because it is too politically profitable for members of Congress, as well as the President (Handberg, 2003, p. 26). The author claims that reforms, which could work, would make NASA more like the ESA, which has a "multi-year funding cycle" and receives automatic increases to ensure the predictability of space programmes (Handberg, 2003, p. 26). It is also important to note that every space programme aims big, and the plans are often risky and the outcomes hard to predict, which is the opposite of steady "routine politics" and politicians' way of thinking (Handberg, 2003, p. 30).

The challenge with every new market – and P2P flights are no exception – is that, in accordance with Schumpchaper's theory of economics, it is hard to predict how customers will react (Crouch et al., 2009, p. 441). Fulton Corporation estimated in 2002 that there could be as many as 15,000 customers per annum for suborbital flights (Crouch et al., 2009, p. 442), but it must be borne in mind that P2P travel could involve yet more passengers because such flights aim to act as a substitute for the aviation industry rather than simply offering a fun adventure. Studies conducted in developed countries such as the UK, Germany, Canada and the US have shown that 40–80% of respondents are interested in going into space (Crouch et al., 2009, p. 442). However, such studies do not reveal whether these people can afford to buy their dream, or whether this is simply an attitude that can be described as "I have a dream to go into space". Companies that offer suborbital flights will therefore try to make the activity as cost-effective for the money charged as possible. In the case of mass space transportation, the more people who fly, the cheaper flights could be. The international community will perhaps take a closer look at the Japanese approach to achieving the best results for the most competitive price. Professor Suzuki indicates that cost-effectiveness is prioritised in the Japanese space project at the International Space Station. In particular, he mentions key characteristics of these cost-effective projects: firstly, they were created as a result of the private initiative of two small companies; secondly, those companies have clear marketing targets (Suzuki, 2006, p. 433). It is therefore clear that despite repeated statements that "exploration of space is mainly for scientific purposes", this is not true.

Because point-to-point suborbital flights are likely to become part of mass space transportation, Goehlich (2005, p. 293) specifies three steps that need to be taken for this to become a reality: firstly, he notes that there is a need to increase space awareness among the general public; secondly, he suggests "developing and operating a suborbital vehicle for semi-regular flights"; and thirdly, "developing and operating an orbital vehicle for regular flights". He also refers to factors that are indispensable in analysing the price for a ticket or price optimisation, namely "development and production costs, launch rate, a fully operational fleet, fleet life-cycle costs and receipts, enterprise receipts and cost per launch, ticket price and enterprise ticket cost, year of initial operational capability, cash flow, and return on investment" (Goehlich, 2005, p. 296). International point-to-point travel will become another incentive for space powers to compete, and legislation at any level will be affected by long political deliberations together with economic estimations.

3. International and EU greenhouse gas emissions from aeroplanes and climate change: to harmonise or to unify

International laws created by states and international organisations can be divided into binding (hard) and non-binding (soft) laws. Forms of hard law such as treaties, conventions, international customs and general principles of international law are included in Article 38, Chapter II, Statute of the International Court of Justice. Examples of soft law include declarations, guidelines, statements, action plans, codes of practice and model laws, and this list is not exclusive. Binding law describes the rights and obligations of states that have ratified, signed or acceded to a hard-law document. The provisions of a binding instrument are rigid (Faria, 2009, p. 9), leading to disagreements between negotiating parties and long periods of time spent drafting conventions. A good example is the United Nations Convention on Contracts for the International Sale of Goods (CISG), the process of "drafting and refining the convention lasted 30 years" (Zeller, 2002). It can therefore be

presumed that any hard law on emissions from the aerospace industry would take even longer than was the case with the CISG, for which it was in the common interest of all parties to create a document that unified international sales. In the case of emissions, it is more problematic because there are conflicting views about whether and how to regulate. States are therefore often unwilling to be subjected to binding laws. An alternative is usually seen in soft laws, which leave space for states to manoeuvre in implementing and obeying the provisions of such instruments; soft laws also do not impose penalties for breaches of their provisions. The tension between the selection of different forms of law, in terms of considering whether one method might be more effective than another, is especially visible in international air and space law that regulates emissions.

If the creation of international legal instruments is difficult, the international coordination of existing national laws is hardly easier. The international lawmaking process is under pressure from political and economic influences, which automatically leads to the politicisation and economisation of law – of which greenhouse gas emissions from the aviation industry can be seen as a vivid example. In the view of the author, politicisation results from a destructive use of politics in the lawmaking process that weakens the efficiency of legal documents created by particular states. On the other hand, economisation can be described as the use of economic tools and calculations to convince regulators and regulated entities about the effectiveness and efficiency of new regulations. Rather than characterising these phenomena as two negative trends, a distinction should be made between the destructive force of the politicisation of law and the useful tool of economic calculation. An inability to create binding international law is common in the air and space arena, especially in areas that governments care about most, such as security. Politics and economics can also have a massive influence on international lawmaking processes to the extent that they can become ineffective. Furthermore, there are social differences between developed and developing countries with regard to the most effective and equitable approach to the regulation of emissions. The former group of nations attempts to create a single uniform framework, whereas the latter group opposes this by contending that they did not contribute to the status quo of emissions and asserting that they have the right to the same opportunity for economic growth as developed countries had. Developing nations therefore insist that they should not be obliged to pay for the consequences of climate change by adhering to regulations that require reductions in emissions. This is why it has been so hard to either harmonise or unify international emissions from the aviation industry, and it will be difficult to do the same with black carbon emissions from aerospace vehicles at a global level.

Harmonization is a process of establishing a level of equilibrium between laws of different legal systems in order to avoid conflicts of law. This can be achieved by changing rules, standards or processes. “Harmonization does not lead to the one set of agreed rules and it can be achieved by international agreement between states or by mandate of a regional supranational institution” (Zaphiriou, 1993, p. 407). Harmonization also embraces “a wide spectrum of ways to combat differences in legal concepts in different jurisdictions.” (Gopalan, 2004, p. 275). An example of harmonization in the field of emissions within the aviation industry is the EU Directive, which harmonized the laws of member states that regulate emissions from this specific industry by requiring that they all meet a basic standard. Harmonization is often confused with unification which means the “adoption of an agreed set of rules, standards or guidelines” (Zaphiriou, 1993, p. 407) in one legal document. In the case of emissions, unification of law would be an international treaty agreed upon by the states or the international legal framework created by the organization having a mandate to regulate international civil aviation, namely the ICAO. In effect, the creation of the ICAO unified all the matters related to international civil aviation in one agency, however it has not yet unified the law on emissions by facilitating the creation of one internationally binding body of law on the subject. On the other hand, the ICAO is capable of creating laws which aim to achieve harmonization in the international civil aviation. However, it is currently impossible for the ICAO to regulate emissions from aerospace vehicles because it has no legal mandate to do so. Accordingly, the ICAO cannot at present create any hard or soft law regulations aiming to harmonize this sector. In addition, there is no other international organization which is capable of regulating the sector of aerospace vehicles. To date, this sector is devoid of international binding regulations to limit the emission of greenhouse gases and black carbon, despite the fact that both of these forms of pollution have the most deteriorating impact on climate change. Therefore, there is an urgent need for increasing the efficiency of the laws regulating emissions of greenhouse gasses and black carbon in international air and space law.

Rosett (1992, p. 683) claims that a significant advantage of harmonisation is achieving “general consistence in law”. However, this is doubtful because several sets of different rules can bring about more confusion than solutions. On the other hand, unification in the area of international legal instruments would set out a number of rules that were uniform for each contracting party, without distinction between developed and less-developed countries. Such an instrument would undoubtedly be the most effective type of measure, but has no realistic chance of being created – in large part because of the claims of less-developed countries that developed countries hold prime responsibility for climate change. This is, however, doubtful, because several sets of different rules can bring more confusion that solutions. In the context of aviation emissions, developed countries can use environmentally friendly engines and better fuels. The airlines of less-developed countries, on the other hand, use less advanced technology, failed to meet the conditions for minimal emissions set out by the EU, and as a result are banned from the region's air zone (Commission implementing regulation (EU), 2014). The less-developed countries are now in the process of their own industrialisation, and this acts as a serious obstacle to the creation of a binding – or even non-binding – single unified set of international rules for emissions from aerospace vehicles. If such a uniform document could be created, the developed countries would be doubly rewarded because they have already benefited from economic and technological growth, and would now benefit from low emissions. For less-developed states, on the other

hand, lower emissions to reduce the side effects of climate change are of secondary concern compared with failed hopes of economic growth.

Differences in opinion on standardisation of emissions between developed and less-developed countries undermine the potential effectiveness of a uniform binding law between countries. The international community decides on one standard for emissions, or considers using a soft-law instrument because of an inability to create hard law. This is the never-ending challenge of international law: taking into consideration the interests of both developed and developing countries in establishing a single emissions standard. Professor Ancel (1976, p. 115) wrote that in the process of the harmonisation of law, developed and developing states ought to be treated differently. In light of this statement, unification between states would be impossible and harmonisation through having a different set of rules applicable to emissions from aerospace vehicles would not bring the intended consistency.

Another argument, by Stephan (1998, p. 746), is that the harmonisation of international commercial law would decrease legal risk, making transactions more certain and predictable. If an international convention is established, all business parties will be aware of its provisions. The outcome of a single law would therefore be greater reliability and predictability than would be the case with numerous national laws. In particular, some African states rely heavily on customary law, and their systems are constructed in the fashion of legal pluralism. International insolvency law can be used as an analogy for international air and space law regulating emissions. If a multilateral treaty has been chosen as an instrument to harmonise or unify emissions, it must be remembered that such a document is created through a lengthy formal process that comprises several consultations and diplomatic meetings. If countries therefore consciously decide to include emissions in a treaty, this implies firstly that a sufficient number of nations must be party to that treaty for it to enter in force; secondly, upon ratification, accession or signature, a party would be accorded certain rights and obligations; and finally, breaching any of the rights or obligations would amount to a breach of international law. In other words, states cannot be forced to be a party to a treaty, although they can be put under political or economic pressure to do so. If a hypothetical multilateral treaty called the International Convention Regulating Emissions from the Aerospace Industry was proposed, the possible outcomes might be as follows:

the most interested states might not be willing to become parties, and would thus be excluded from the “rights and obligations” of the convention;

the most interested states might become parties but have reservations, excluding the application of certain provisions of the convention and thus undermining its whole purpose;

the most unrealistic scenario is that all interested parties would unreservedly sign the convention, thus achieving full harmonisation.

Professor Mohan (2012, p. 200) describes cross-border insolvency proceedings as “inefficient, prolonged and costly”. In the case of emissions, stagnation caused by a lack of effective international regulations and over-reliance on voluntary instruments (VETS Report, 2007) created by the International Civil Aviation Organization have made regulation inefficient. Even minimal compliance falters if not every ICAO member state even supplies annual reports on emissions. Attempted harmonisation through a soft-law document created by the ICAO would thus fail in its purpose. The process is also prolonged because procedures for oversight by the ICAO are lengthy and costly because of the need for legal and technical verification. Professor Burman indicates that different rules for insolvency proceedings operate in different countries (Burman, 1995, p. 2543), and furthermore, different technical standards are applied to measure emissions in each nation. The provisions of the Chicago Convention do not oblige contracting states to achieve minimum standards of emissions. Article 33 of the Convention only specifies minimum standards relating to “certificates of airworthiness, certificates of competency and licenses”. It is therefore apparent that safety and security take priority over emissions concerns. This is justifiable, but the subject of emissions should not be totally neglected as they currently are. The model example for a convention, subject to an adequate number of signatures, ratifications or accessions, would bring not only a clear set of internationally recognised rules and impose global measures and limits on emissions, but would also expand international cooperation among lawyers (Stephan, 1998, p. 750).

From another perspective, Professor Zamora explains that harmonisation is not inherently linked with one uniform document, but instead attempts to reconcile different legal rules (Zamora, 1995, p. 403). This can be achieved through so-called model laws created by non-state organisations. Some of these laws have proven very successful, such as the UNIDROIT Principles of International Commercial Contracts (2004) and the UNCITRAL Model Law on Cross-Border Insolvency (1997). The advantage of a model law is that it can be implemented either as a whole or as particular provisions in the domestic legal systems of interested states (Studies in trade and investment, 2004, p. 20). The hypothetical Model Law on Global Emissions from the Aerospace Industry created by the ICAO can add some flexibility because it does not have to be rigid. Furthermore, there is less political pressure when model laws are used and the lawmakers are more independent, because scholars from many jurisdictions take an active role in the drafting process – although this can also be seen as a disadvantage because of a lack of representative capacity and the fact that lobby and interest groups can influence the wording of a model law (Goehlich, 2005, p. 293). In addition, the neutrality of provisions in such laws minimises potential objections (Gopalan, 2004, p. 289). Despite all these efforts, the outcome could be that the model law is ultimately another soft law created by the ICAO that adds no value to the effective regulation of emissions.

Aviation is judged by many scholars to be “the biggest contributor to climate change” after road transport (Chapman, 2007, p. 356). Gossling and Upham have warned that the contribution of 3 per cent from aviation to climate change will not last long, because the aviation sector is still expanding (Gossling & Upham, 2009, p. 4). One of the main challenges in

regulating emissions from aeroplanes is that airlines are bound by domestic regulations, which might be rigid in developed and eco-aware countries but very liberal in developing ones. As a result, attempts to regulate emissions at an international level can bring more problems than solutions (Hoof, 1983, p. 189; Fahey & Curtin, 2014, p. 14). Rothengatter points out that the ICAO, which is in sole charge of imposing taxation and charges in international civil aviation by virtue of the Chicago Convention, is unable to do so because of conflicting interests among member states (Rothengatter, 2010, p. 11). Any convention that seeks to impose such charges, and practically every convention that aims to regulate emissions at an international level, therefore has to include them, and must cooperate closely with the ICAO. It is an open secret that the ICAO becomes a forum for political, and not legal, discussion.

In addition to strictly legal obstacles to the regulation of emissions, growing social awareness on the impact of the aviation industry on climate change is still too small to persuade legislators to start requiring mitigation actions. Cohen and Higham found in their research that "participants were unlikely to forgo potential travel decisions to New Zealand because of concern over air travel emissions" (Cohen & Higham, 2011, p. 329).

There are several models of soft and hard international and EU laws that aim to reduce air pollution, but none of them regulate emissions from the international civil aviation industry. The first soft-law document that began the debate on the condition of the environment in the context of air pollution was the Stockholm Declaration of 1972. The Geneva Convention of 1979 was the first internationally binding law to include the need for limitation and reduction of transboundary air pollution by contracting parties. Despite the goodwill of drafters, the wording of the articles is too vague and imprecise, such as "shall endeavour to limit" and "as far as possible, gradually reduce and prevent" (Article 2, Geneva Convention, 1979). In addition, the ICAO decided in 1980 to create a binding Annex No. 16 to the Chicago Convention that addressed environmental issues relating to the aviation industry. While widespread recognition of the impact of aviation on climate change occurred later in the 1990s, close research on the issue was conducted in 1996 and the first preventive measures were introduced in 1998 (Oberthür, 2003, p. 196). Another proposition made by the ICAO was the establishment of a Group on International Aviation and Climate Change in 2007. Despite these efforts, neither the ICAO nor binding international laws created to date have effectively regulated emissions from the aviation industry. The United Nations Framework Convention on Climate Change (UNFCCC) of 1992 achieved a lot by differentiating between developed and developing countries. The supplement to the Convention was the Kyoto Protocol, which urged countries included in Annex I to "pursue limitation or reduction of emissions of greenhouse gases not controlled by the Montreal Protocol from aviation… working through the International Civil Aviation Organization" (Article 2(2)) by introducing concrete reduction levels. Professor Dempsey claims that the Protocol does not refer to international aviation because, firstly, it would be difficult to "attribute international emissions to a single state" (Dempsey, p. 450) and, secondly, such a hypothetical attribution would be "*ultra vires* as the only competent organization in the field of international aviation is [the ICAO]" (Dempsey, p. 450).

The situation changed rapidly after the EU Directive came into force in 2012. This was the first binding document to specifically regulate greenhouse gas emissions from the civil aviation industry. It covered all commercial aeroplanes that carried passengers and cargo and departed from or landed at an EU airport (Budd et al., 2013, p. 118). The rationale of the EU was to encompass all states with airlines that flew in the European air zone and thus more effectively tackle transboundary air pollution.

The most legally questionable article in the EU Directive dealt with the inclusion of a cap-and-trade scheme for non-EU countries (third states), thus raising the important issue of jurisdiction and state sovereignty in international law. Professor Brownlie stated that "the sovereignty and equality of states represent the basic constitutional doctrine of the law of nations, which governs a community consisting primarily of states having a uniform legal personality" (Brownlie, 2008, p. 289). As a result of these principles, a sovereign state can have exclusive jurisdiction over its territory and a duty of non-intervention in areas of exclusive jurisdiction of other states. This principle became an apple of discord between the European Commission, enforcing the EU Directive, and some non-European states with their national airlines. They claimed that the EU usurped the right to act as the ICAO and *de facto* placed EU law on the same footing as international law, even though EU law is binding only on member states of the European Union. They argued therefore that from a legal point of view, third states ought to be excluded from the provisions of the Directive. As a response, in 2011 several US airlines brought cases (Case C-366/10) before the European Court of Justice, the only court that can assess the EU jurisprudence, questioning the EU Directive on several grounds. The Court's opinion involved an ongoing discussion about the relationship between EU and international law. The ruling held that the Directive was a valid piece of law that was complementary to international law. In response, the US House of Representatives called the EU Directive "ill-based and illegal" (CAPA, 2011), and passed a bill forcing US airlines not to obey it. China, India and Russia also openly contested the Directive and at a meeting in Moscow in February 2012, agreed on an action plan against it. The action plan would include "barring airlines from participating in the Brussels plan; filing a formal complaint at the UN's civil aviation body – the ICAO; imposing levies or charges on EU airlines as a countermeasure; and stopping talks with EU carriers on new routes" (ICTSD, 2012). The pressure imposed by the EU Directive on the international community resulted in the decision by the ICAO at the 38th Assembly meeting in October 2013 to adopt more concrete measures aimed at regulating greenhouse gas emissions in a binding legal form. The Assembly agreed to begin working on global market-based measures for aviation emissions at the next session in 2016, and to create an international framework on the basis of those measures by 2020. However, it can be predicted that the international framework will not be created by 2020, despite good intentions. Firstly, the ICAO has not created any binding document concerning global emissions from the aviation sector. And secondly, ICAO member states have not been able to reach a

consensus about suborbital vehicles since 2005, and therefore such emissions will be outside the scope of a potential global framework. The next initiative of the ICAO therefore seems doubtful from the perspective of aerospace vehicles.

4. Conclusion

Bearing in mind the reluctance to regulate greenhouse gases in any binding manner at an international level, a conclusion can be reached that there is no feasible solution to the problem. To date, there is no internationally binding law that regulates greenhouse gases emissions from the aviation industry or black carbon emissions from the emerging sector of aerospace vehicles, despite growing evidence of the adverse impact of such emissions on climate change. The politicisation and economisation of law, which prevent hard-law regulations, are likely to put political interests and preferences before law. In a similar way, economic calculations with regard to emissions limits are likely to impede the lawmaking process. The idea of amending or creating any current space-law legislation in the field of black carbon emissions should be treated as unrealistic and impossible to achieve in the current global situation. The creation of a hard law does not guarantee that a state will become a party to it. Even if a comprehensive convention is created (for example, under the auspices of the United Nations Office for Outer Space Affairs), it might never be ratified by a sufficient number of states to come into force. As a result, it might turn the best intentions into failure, as in the case of the Moon Treaty (1979).

If, therefore, the creation of any international binding laws seems nearly impossible, soft laws could be considered as options. Paradoxically, the lack of sanctions for breaching soft laws increases their effectiveness because it increases the likelihood of them being accepted in the first place. States have proved over the last 50 years that they have had little interest in environmental matters that were lingering at the bottom of the hierarchy of important issues and always fell behind international politics and economy, but soft law is not as "harmful" because of its apparent lack of sanctions. Once a soft law is created, the informal pressure of public opinion emerges to help enforce it. All corporations that operate in the aerospace sector – from established companies such as Boeing and Airbus to newer ones such as Virgin Galactic and Blue Origin – can prove that they care about the environment and, as a result, create self-imposed limitations. This positive public opinion could increase the companies' profits, thus placing profit maximisation on the same side as the good of the environment. Only in the future, when emissions reach a critical point and may be unpleasant to humans, will both the ICAO and state governments meet to create an international framework regulating emissions from the aerospace industry.

The next issue is whether to harmonise or unify emissions from the aviation industry. It appears that harmonisation cannot be achieved at an international level because, up to this point, only one relevant *soft law* document has been created by the ICAO. The harmonisation of emissions standards in the aerospace sector also cannot be achieved because there is no international law regulating emissions. Unification in the form of one binding document is not possible because of the politicisation and economisation of law, and soft-law instruments are unlikely to succeed in the process of unification because of their non-binding nature. Soft law will never be a replacement for binding law – it is simply a bridge to restore international cooperation and draw the attention of the international community to the seriousness of the problem of greenhouse gases and black carbon emissions, initiating some action to help alleviate problems while a longer-term solution is sought.

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