"Challenges of growth" environmental update study

Climate Adaptation Case-Studies: EUROCONTROL Commentary

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EUROCONTROL

BACKGROUND

In 2008 EUROCONTROL commissioned a specific Environment Technical Report to accompany its 2008 Challenges of Growth Report (CG08), a periodic assessment of the potential constraints to growth facing the European air traffic management (ATM) system. The research for the CG08 Environment Report was carried out by the OMEGA Consortium, a partnership of UK Universities, and the UK Met Office. It identified for the first time at European level the potential of climate change-related effects, such as global sea-level rise and an increase in extreme weather events (storminess), to impact the European ATM system.

Consequently, EUROCONTROL commissioned OMEGA and the Met Office to carry out a set of further, more detailed, case-studies in the areas identified as potentially most significant for European ATM. The research team carried out modelling and analysis of potential impacts over a 2020-2090 timescale in the following three areas:

- **Case-study 1:** Potential shifting traffic demand due to climate-related changes in tourist destination preferences and resource availability in the Mediterranean basin (e.g. potable water);
- **Case-study 2:** A qualitative assessment of potential sea-level rise and flooding at three coastal and low-lying airports – including ground transport access and infrastructure; and,
- **Case-study 3:** The potential impact of increased extreme weather (convection) events on en-route air traffic in the Maastricht Upper Airspace, one of the most congested in Europe.

The objective of exploring these issues further through case-studies was to make the general findings of the initial report more 'tangible', to explore possible outcomes in more detail and to examine gaps and weaknesses in our understanding of these risks. The work was carried out in the first Quarter of 2010 and thus represents a snapshot of the understanding at that point in time.

The completed case-study reports can be accessed from the EUROCONTROL website: http://www.eurocontrol.int/environment/public/subsite_homepage/homepage.html

This additional commentary is intended to accompany the case-study reports and provides EUROCONTROL's analysis of their findings in relation to the planned future development of the European ATM system. However, whilst this risk is felt directly by the ATM system and the wider aviation industry, EUROCONTROL also believes it to be a matter for governments and society as a whole, since it could have significant implications for both mobility and the global economy. It is also worth noting that this topic will be picked up on in the Single European Sky ATM Research programme (SESAR) under the project covering long-term environmental risk, which EUROCONTROL leads, and to which this set of case-studies will be provided as a contribution.

CASE-STUDY 1

Case-study 1 focuses on a Mediterranean country with a significant percentage of its GDP sourced from tourism and where, due to geographic location, aviation is also the key means of tourist arrivals. The study considers how a rise in temperatures and changes in humidity might affect tourists' thermal comfort levels (an indicator of the range of pleasantly acceptable temperatures). As a consequence some tourists may thus find their chosen destination uncomfortably hot during the traditional peak holiday (summer) months, leading to some displacement of high season tourism traffic either to other destinations or to the spring and autumn shoulder months (Dimitriou & Drew, 2010).

According to the analysis, carried out using a Met Office climate model and EUROCONTROL traffic forecasts, predicted temperature and humidity trajectories suggest that significant effects of climate change are unlikely to be felt in the case-study State, and by proxy similar areas in the same region, before 2030 but that by 2050 the reduction in summer demand could be as high as around 40% (Dimitriou & Drew, 2010).

If these changes in traffic demand do occur, it is likely that aircraft operators, whose assets are by definition mobile, would adapt quickly to the new situation. Air Navigation Service Providers and Airport Operators however, with their fixed facilities of airports, control centres and towers, and their airspace improvement packages, may discover that their investment planning delivers capacity for the summer peaks that may no longer be necessary, particularly as present planning horizons are focused on meeting annual demand growth of 1.6-3.9% between now and 2030 (EUROCONTROL 2010a). A further uncertainty from a demand planning perspective arises because it is not known to what extent society would adapt its holiday period selection, which is largely determined by fixed school holidays, in order to map to a change in the attractiveness of the seasons of a particular destination or region.

EUROCONTROL's analysis therefore concludes that, as in the short-to-medium term, traffic is still predicted to grow substantially, current planning horizons should necessarily focus on meeting demand before 2030; in other words, present capacity and infrastructure plans will still be required if that demand is to be accommodated. (EUROCONTROL, 2010a, figure 1). However, analysis also concludes that long term planning should seek to better understand this issue and, where possible, take the findings of the study into account. In particular, it seems prudent that the business case for ATM infrastructure proposals with a life expectancy of more that 20 years (i.e. post 2030) should take possible climate-change induced demand changes into account where possible – and that these factors will become more important to decision-making over time as the anticipated climate impacts approach and become more certain.

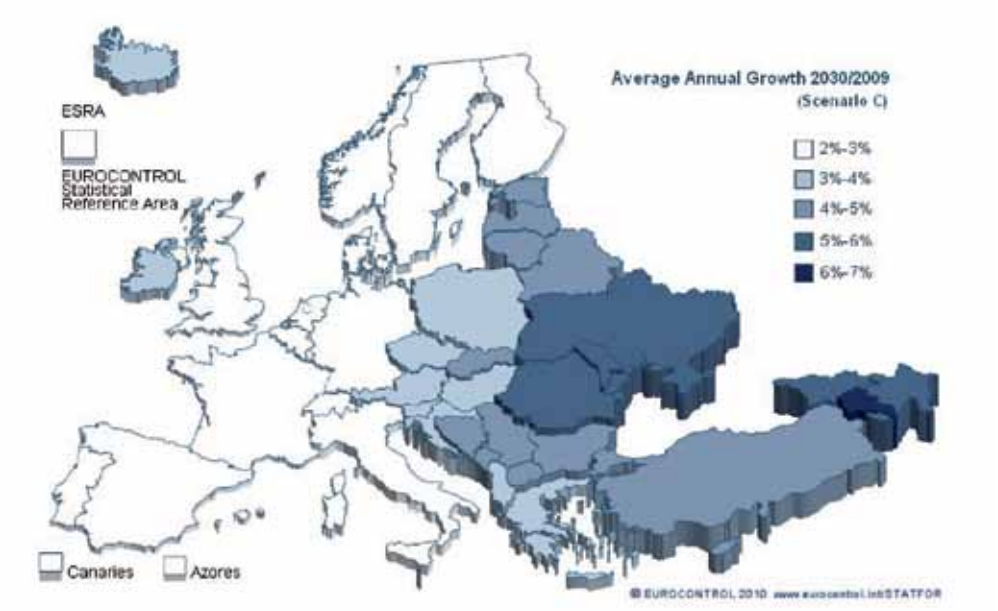

Figure 1: Average annual growth 2009-2030 by State for a scenario incorporating both regulation and growth (STATFOR Scenario C: regulated growth) (EUROCONTROL, 2010a)

Notwithstanding the perspective that present ATM planning is mainly aimed at performance improvements needed over the next 20 years when no significant climate induced demand changes are expected, EUROCONTROL considers that this initial case-study has relevance for the entire Global and European ATM system in the longer-term (2030+). Further studies into this topic and closer links between the ATM/Aviation Sector, the Tourism Sector and possibly other interested parties such as Governments, will be needed if this risk is to be managed appropriately and if unnecessary, inappropriate or mistimed infrastructure investment is to be avoided. EUROCONTROL can see four potentially significant issues arising from this initial case-study:

- Where forecast demand is not realised due to changing tourist preferences then pressure to accommodate increasing throughput may be eased and a lesser investment in infrastructure capacity development may be warranted.
- Where demand is displaced to the shoulder seasons of Spring and Autumn this may reduce the annual peak in demand by spreading it over a greater proportion of the year. This may allow more optimum use of parts of the ATM system. There are however other major influences on the timing of 'family' holiday-related demand including the scheduling of school holidays, which presently tend to be centred on the summer period. If such influences do not change in-line with changes in tourism preferences – then it is not unreasonable to conclude that a significant element of demand will be shifted geographically rather than temporally.
- Where tourism preferences are displaced geographically, this will stimulate changing demand patterns. Although this will almost certainly lead to a reduction in demand to some destinations it also implies that there may be increases in demand to alternative destinations. This means that present forecasts for such increasingly popular destinations may be –significantly- exceeded given that such climate-change driven demand increases are not accounted for in current planning. Therefore, unless capacity planning is sensitive to the risks from such potential displacement of tourism demand, ATM capacity and infrastructure planning could be inappropriate in scale, timing or location. Of course, it should not be overlooked that if tourists from Northern Europe are choosing to holiday in destinations closer to home, this may stimulate a modal shift from air travel to the train, boat or car (Dimitriou & Drew, 2010).
- Some degree of mitigation of these effects could be achieved by diversification in tourism markets in those areas affected, although this is not yet fully understood (Dimitriou & Drew, 2010).

The study predicts that these climate change and tourism related risks generally become more significant in the longer term (post 2030). It also concludes however that some effects such as the policy response to climate change will be felt before 2030 (e.g. charges and taxes) and therefore needs to be considered in present planning activities. For the latter, the EUROCONTROL traffic forecast scenarios already include an element to cover environmental costs and the implications for economies etc.

The study also concludes that robust and commonly agreed information on this topic is not readily available at present and that consequently, further detailed studies are required if this risk is to be adequately understood. This lack of good information on what has the potential to be a very significant business risk, signals the need for joint public-private research into this topic, within an overarching coordination strategy. There is some recent evidence of the elevation of Climate Adaptation as a key aviation agenda item: for example, the inclusion of this topic in the ICAO 2010 Colloquium on Aviation and Climate Change.

EUROCONTROL's analysis therefore concludes that although present capacity and infrastructure plans will still be required if near-term forecast capacity demands are to be met, it is nevertheless prudent to take possible climate-change induced demand changes into account in longer-term planning, particularly when the business case for ATM infrastructure proposals with a life expectancy of more that 20 years is being considered. Therefore, although it is not expected that significant changes would be seen before 2030 this topic should be taken account of particularly in the planning of new infrastructure in both current and potential future destinations. However, further detailed studies are required if this risk is to be adequately understood. Additionally, although the study focused on one Mediterranean country the results are potentially applicable to States across this region due to the similarities in tourism patterns and current climate as well as to other areas around the globe which might be susceptible to similar impacts of climate change.

As noted above, this topic will be picked up on in SESAR under the project covering long-term environmental risk, which EUROCONTROL leads, and to which this case-study will be provided as an input.

CASE-STUDY 2

The initial Challenges of Growth 2008 Environment Technical Report (Thomas et al, 2009) identified 34 European Airports potentially at risk of sea level rise by the end of the century. This study focuses in greater detail on three of these airports. The study uses a 4°C Global Mean Surface Temperature increase scenario to model the projected sea-level rise expected for each airport location for this amount of warming by 2099. 4°C is at the upper end of predicted climate scenarios but is now accepted by many in the scientific community as being the most likely scenario given the lack of progress in achieving significant global cuts in emissions (Met Office 2009). Inertia in the climate system means that the full effects of today's greenhouse gas emissions (or of any emission reductions induced by regulation) may not be seen for several years to come. Thus the use of a 4°C scenario in the study can be seen as illustrating both the potential worst-case situation, but also one which, given current emissions projections, remains highly possible.

The study indicates significant flooding risk for several airports will be experienced by around 2099 but that some increased flooding could already be experienced by mid-century. The study also points out that in some cases the actual airport itself may not be the main infrastructure risk but that there might be ground transport infrastructure which could pose a much larger-scale engineering and economic problem for mitigation strategies (de Gusmão, 2010).

EUROCONTROL analysis considers this specific climate-related risk, with over 30 airports potentially impacted, to be very significant for the European ATM system albeit with a (potentially) long lead-in time. The potential unplanned loss of one or more ECAC runways is a significant risk for the efficiency and delay performance of the entire European ATM system. This can be evidenced by the closure of one runway in 2001 which led to an increase in average European delay from around 1-2 minutes up to 40 minutes within a few hours (EUROCONTROL 2000), or as was witnessed in Winter 2010 or the 2010 volcanic ash event, when the unforeseen closure of key European Airports or airspace led to delays across the continent and cancellations of flights on a global scale. Therefore analysis also envisages that this is not just a European risk but a global one, where even temporary loss of any major airport assets could have knock-on effects around the globe.

As noted above, whilst this risk is felt directly by the ATM system and the wider aviation industry, EUROCONTROL also believes it to be a matter for governments and society as a whole, since it could have significant implications for both mobility and the global economy. Flood defences are very expensive, especially where these are required for wide-spread infrastructure such as ground-transport networks. It is pointless for one part of the global integrated transport system to become fully protected against this risk, if another vital part does not. However, planned ATM efficiency improvements together with operational improvements aimed at improving system resilience and flexibility could (if correctly aligned), go some way towards mitigating this risk and its adverse effects.

Notably, although the study looks at the long-term consequences of sea-level rise for coastal airports, it also suggests that it is possible that some impacts will be seen at some locations before this; for example there is likely to be an increase in number and severity of storm surges much earlier than this. This dictates that a combined and coordinated suite of adaptation measures such as installing flood defences as well as contingency plans for weather-inhibited operations, and the resulting delays and diversions, may need to be considered within current planning horizons for those airports considered to be most at risk.

EUROCONTROL notes that the uncertainties in the study (due to its limited brief and commonly agreed information) and the present shortage of available data on this topic strongly suggest that more research is required, particularly at those locations potentially most at risk. However it is to be noted that some studies that may help to understand this risk from a European perspective are underway both within individual States and organisations and under European auspices (e.g. the European Commission). This is also a matter to be covered in SESAR work-package 16.3.7, led by EUROCONTROL, which covers long-term environmental risk.

EUROCONTROL analysis concludes that changes to present plans for implementing ATM Operational Improvements (e.g. SESAR) in relation to this specific risk are not necessary in the short- and medium-term at most locations. However, as the impacts of sea-level rise may be experienced from around mid-century, there should be sufficient time to put adaptation strategies in place, keeping in mind that with over 30 European airports potentially at risk of loss of runway capacity through such impacts as sea-level rise and storm surges, the future impact on runway operations could be very significant for the European ATM system. Of particular significance is the number of secondary or diversionary airports which may also be closed if the main airport were closed. It can therefore be concluded that it would be prudent to begin considering such issues in medium to long-term planning. In order to do so, a greater understanding of the risk, its mitigation and the delegation of roles and responsibilities needs to be developed soon. Ultimately, however, responding effectively to this risk will not lie solely within aviation but will require the coordinated effort of many interested public and commercial parties.

CASE-STUDY 3

The purpose of Case-Study 3 was to investigate the likelihood of an increase in severe weather events, specifically increased convective activity which induces storminess, and how this may impact European ATM. The study concentrated on the airspace controlled by the Maastricht Upper Air Control Centre (MUAC) which covers the upper airspace of four European States and is managed by EUROCONTROL on their behalf. Maastricht Upper Airspace (MUA) is one of the busiest areas of airspace in Europe and has a high proportion of climbing and descending traffic. It therefore presents a valid case-study to represent European Upper Airspace. The study does not cover the additional risks from increased storminess at and around airports and terminal areas, although this even today is significant, for example 28% of flow-management delays at airports in June 2010 was due to weather (EUROCONTROL 2010b).

The study results indicated both a predicted increase in individual occurrences of storminess, as well as an extended period of potential storminess for a greater proportion of the year rather than during the 'traditional' summer months. Impacts are expected from as early as 2020. The implications for this in terms of reduced annual ATM performance are not yet known (McCarthy and Budd, 2010).

The study also identified a potential decrease in route efficiency when analysing operations for a specific day experiencing storminess when compared with a 'normal' weather day, suggesting that the weather system may have had a negative impact on the functioning of the airspace (please see the study for further details of both analyses) (McCarthy and Budd, 2010). EUROCONTROL analysis therefore concludes that although this cannot be interpreted as statistically significant it can be taken to indicate a potential association between an increase in severe weather and a decrease in route efficiency which warrants further research.

Moreover, although it is early to be considering mitigation, this is something which needs to be taken account of in the planning of operational improvements to a number of ATM Key performance areas including: safety, capacity, efficiency, flexibility, predictability and environment. However, it should be noted that SESAR is already addressing requirements for improving ATM performance in each of these areas. SESAR will also develop much more integrated information and communications in its System Wide Information Management (SWIM)-related work-packages, which will cover MET data and forecasting.

These kinds of operational improvements are inherently aligned with the challenges that may arise from increased storminess, and climate change-related operational impacts in general. So some mitigation of these effects is already being addressed. However, although the study does not cover the additional risks from increased storminess in terminal airspace (TMAs) and at airports, for example risk of delay arising from capacity reduction (e.g. temporary airport closures), this is also an area which needs to be considered for further research as it is already a current issue of significance: as mentioned above 28% of flow-management delays at airports in June 2010 were due to weather (EUROCONTROL, 2010). On a global scale, several other regions are already susceptible to regular occurrences of extreme weather. Although the EUROCONTROL study focused on a particular area and thus cannot be directly extrapolated to areas with differing climatic conditions, the implication is that changes in extreme weather patterns, and the associated impacts for ATM may be experienced in other regions.

THE BIGGER PICTURE

The CG08 case-studies considered three potential impacts of climate change on aviation in isolation. However, in addition to considering the individual implications of each we should also consider the combined scenario where these or other combinations of climate change-driven impacts coincide. Given the interconnectedness of the ATM system, as evidenced by the knock-on effect of the closure of the runways at one European airport (see above), or the temporary disruption in 2010 caused by the volcanic ash cloud and extreme winter weather, it is essential to consider system-wide effects in conjunction with localised impacts. Further, given the linkages between the air transport industry and other parts of the economy, such as tourism, there is a need to consider greater integration of strategic planning between aviation and other critical sectors.

CONCLUSIONS

Both the original 2008 work done by the OMEGA Consortium, and the follow up scoping case-studies carried out in 2010 which expand thereon, highlight a significant risk for climate change-related impacts to affect the European ATM system. This risk increases over time. Three potential impacts have been covered in the case-studies including climate-induced changes in demand patterns which affect both the timing and location of traffic peaks and flows, flooding risk to airports' operations with potential for a system wide effect, and increased extreme weather events affecting en-route capacity, and causing an increase in track miles and delay. Risks requiring further research have been identified in each area. Moreover, a key area for further consideration is a combined scenario where these or other combinations of climate change driven impacts coincide in order to identify the possible system-wide impacts this may induce. Thus although the timescales over which these impacts may begin to be experienced varies from 2020 to 2090, analysis suggests that it would be prudent to begin considering such likelihoods in current medium to long-term planning, as well as to carry out further research into the likely magnitude and timing of such events within current projects such as SESAR. This will enable informed adaptation planning across the sector.

It is evident that in recent years many millions of Euro have been and continue to be correctly invested in understanding and mitigating the impact of aviation on the climate – but it also seems that to-date, society's investment in understanding the potential risk from inevitable climate change on mobility networks is lagging behind. It is encouraging however that this topic is presently starting to attract interest and investment. ATM needs to be playing an active role in supporting this endeavour.

However, climate change adaptation planning is not an issue for ATM, or even the aviation industry, alone but is a collective challenge which, given the linkages between the air transport industry and other parts of the economy, such as tourism, needs to be addressed by all stakeholders in a region. This indicates a need for greater integration of strategic planning between aviation and other critical sectors. Moreover, as ATM is a transnational industry, adaptation action in one region or nation can be negated by a lack of adaptation action elsewhere. Given the interconnectedness of the ATM system, it is essential to consider system-wide effects in conjunction with localised impacts. This necessitates tackling the problem at local, national and international levels. Indeed, given the global nature of the issue being faced, an integrated international approach would seem logical. It is, of course, essential that aviation continues the substantial progress it has made towards mitigating its environmental impact in general and reducing its release of greenhouse gas emissions in particular. However, with the impacts of climate change now a clearly-identified, if not fully understood, risk for the sector, adapting to that emerging reality should now become an essential part of medium to longer term planning.

NEXT STEPS

Since the original CG08 report was completed several other aviation organisations have included this issue in their work programmes. These include ICAO, ACI-World and CANSO. There are also now two EU-funded research projects 'EWENT' and 'WEATHER' looking into this area as well as a number of ECAC States and individual organisations, such as the ANSPs NATS and Avinor, who have now initiated studies with a view to planning local mitigation strategies which will cover aviation. The EUROCONTROL Agency will continue this work through SESAR Work Package 16, which it is leading, specifically through project 16.3.7 which focuses on Future Regulatory Scenarios and Environmental Risk. The project will address the risk and potential implications of climate change adaptation for the European ATM system, as well as the future regulatory responses which may entail as a result. As work package leader, EUROCONTROL will therefore continue to be actively engaged in this area.

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