Exploring Extreme Weather Impacts on Transportation System Operations in Europe: Opportunities for Climate Change Adaptation and Mitigation

Aviation and Extreme Weather: Findings from Extreme Weather Impacts on European Networks of Transport Project and Other European Projects

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Selected major airports per climate zone
Visibility during winter month at different European Airports
(METAR-analysis from 1997 to 2010, 05:00-23:00)
Causal diagram

- Low Visibility
- Snow Icing
- Heavy Precipitation
- Hail
- Tornado

- Reduced visual recognition
- Increased aircraft separation
- Operating restrictions for non-equipped aircraft
- Airport / Runway closure
- Ground holding for departing aircraft
- Airborne holding for departing aircraft
- Diversion of flights
- Flight cancellation
Examples from Causal diagram

- **Decreasing Fog**: Reducing of higher separation → Increase in capacity → Delay reduction

- **Increasing Wind / Thunderstorms**: Runway / Airport closure → Decrease in capacity → Delay / Cancellation

- **Higher temperature**: Less de-icing → Faster turnaround → Increase in capacity → Delay reduction
Traffic safety impacts on aviation

- Low weather thresholds to avoid situations resulting in a harmful event

- Significant influence of even slight weather phenomena on operations

- Adverse weather involved as a contributing or circumstantial factor in many accidents

- High safety level in aviation will not decrease in future
Situation

⇒ Aviation is highly weather dependent

⇒ Main area concerned are the approach, departure and ground operations, i.e. airport and TMA operations

⇒ High safety standards result in change of operations procedures even for small weather effects

⇒ The impact of climate changes on aviation is not predictable for the time being

⇒ Nevertheless, weather will have an increased impact on aviation for another reason…
Weather related delay in air transportation

Proportion of ATFM delay in November 2011

- Airport Weather, 55.9%
- Airport Infrastructure, 8.2%
- En route Weather & External Disruptions, 5.7%
- En route Events, 0.1%
- En route ATC Disruptions, 2.3%
- En route ATC Staffing, 5.9%
- Airport ATC Capacity, 6.0%
- En route ATC Capacity, 15.9%

Source: Eurocontrol Network Operation report Nov. 2011
Example comparison
London Heathrow (LHR) vs. Helsinki Vantaa (HEL)

<table>
<thead>
<tr>
<th></th>
<th>LHR:</th>
<th>HEL:</th>
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</thead>
<tbody>
<tr>
<td>Declared capacity:</td>
<td>88 mv/hr</td>
<td>80 mv/hr</td>
</tr>
<tr>
<td>No. of runways:</td>
<td>2</td>
<td>3</td>
</tr>
</tbody>
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- LHR operates closer to the limit, i.e. is more sensitive for disturbance e.g. Cleaning a runway from snow
Prognosis

2010 TRAFFIC 9.5 M (+0.8%)

IFR flights (million)

STATFOR Medium-Term Forecast (Feb. 2011)

(before 1997, estimation based on Euro 88 traffic variation)

source: EUROCONTROL/STATFOR (ESRA2008)
Weather disturbance reports over a wide area and arrival punctuality at a selected airport (Winter 06/07 und 07/08)

- Wind
- Visibility CAT II,III

Arrival punctuality

Number of disturbance reports at Centraleurope major airports outside the selected airport

0: 114 Days, 108 Days
1: 45 Days, 51 Days
2: 22 Days, 34 Days
3: 22 Days, 14 Days
4: 19 Days, 9 Days
5: 9 Days, 4 Days
>=6: 7 Days
Increasing weather sensitivity

- Increasing number of airports will operate near the capacity limit
- Extension of airports very expensive and not accepted among the society due to environmental impact
- Room for measures against negative weather impacts will decrease
- Network effects worsen the situation
- Delay due to weather phenomena will increase
- New technical and operational options must be developed to reduce weather impacts
Conclusion

- Weather has a great impact on aviation

- Each airport has its own characteristic according to weather phenomena

- Network effects can be significant, i.e. analysis of local weather phenomena is not sufficient

- Quantitative analysis requires case-by-case studies

- E.g. for airports typical hour values can be used for quantifying the consequences of airport closure due to bad weather

- More information at http://ewent.vtt.fi/