THE EFFECTS OF EXTREME WEATHER ON THE EUROPEAN TRANSPORT SYSTEM: AN ANALYSIS BASED ON MEDIA REPORTS

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I. INTRODUCTION

The aim of this study was to find links between extreme weather events and the regional vulnerability of transportation in Europe. The same meteorological phenomenon has different impacts on societies due to their geographic or climatic locations, topography, geological environment as well as social and technological vulnerability. This fact directed us to approach the question of 'extreme weather event' by using local and nationwide media reports as empirical material. Implicitly, media reports also reflect weather events that are relevant from the society's viewpoint.

There are several definitions of the concept 'extreme weather event', mainly determined on contextual grounds and mostly through a meteorological or societal frame. In our study, we use the term 'extreme event' to describe the severe weather event that cause extensive impacts on transportation network in European countries. We focused on atmospheric-originated phenomena and their impacts and excluded from our definition the severe events which can be regarded climatologic, such as global warming, as well as natural disasters (volcano eruptions, tsunamis etc).

According to the data of Swiss Re (Swiss Re, 2001-2010), it appears that extreme weather events such as storms are typically associated with enormous insurance cost claims. It also seems that in some cases, the same kind of weather affects different areas in different ways. Although the occurrence of hazardous weather is related to the general weather situation, the impact of certain weather phenomena on society is also affected by local factors such as topography, vegetation, as well as building codes and even local human behaviour. Moreover, it is not only the intensity of weather events that matters, but also important is the degree that the society is prepared. This depends on the frequency (return period) of a certain high-impact event, or, whether the event has ever previously occurred in a certain region.

It is notable that high-impact weather does not always need to be very extreme; good examples of this are the massive car pile-ups that occurred in southern Finland in March 2005. In this case, only 5cm of snowfall during the rush hours was enough to cause severe multi-vehicle accidents where almost 300 cars crashed, three people were killed and more than 60 persons injured – all as the result of a rapid change in weather conditions (Juga et al., 2010).

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II. EXTREME WEATHER EVENTS AND SOCIETY

At least the following dimensions can be identified as factors associated with extreme weather and its impacts:

- Climatic zones
- Geographical location
- Frequencies of weather events and their impacts
- Intensity of impacts and consequences
- Technical and institutional preparedness
- Economic distribution levels.

Extreme weather events essentially depend on the climatic zone of the area. The same amount of snow during one day can be either extremely exceptional or common news. For this reason, the area of analysis needs to be zoned in order to take climatologic differences into account.

Geographical location and the topography of the area can enhance or diminish the harmful impacts of forceful weather events. For example, dense forests and vegetated areas bind rain water effectively and can "even out" flood. On the other hand, forest areas can enhance the impacts of wind storms due to trees falling across main roads and railway lines. Uncovered land is prone to erosion and increases flood impacts; further, steep topography fortifies flooding rivers and is one reason for avalanches.

Although the frequency of an extreme weather event is rare, it still may occur in consecutive years. The frequencies of their impacts are thus especially important as societies improve their preparedness against recurrent impacts. Due to the preparedness of the society and climatology characteristics, both events and their impacts vary in frequency in different locations, countries and regions.

Extreme weather can be characterised as being a brief, high intensity event that causes immediate impacts. In such cases it is typical that almost all the immediate consequences can be witnessed, e.g. in the form of damaged infrastructure and disruptions in transport flows. However, also slowly evolving weather events, that have an immense aggregate impact over the course of time, exist; for example, long cold periods or heat waves can have a delayed effect on a transportation system.

Warnings for the general public are also very important with regard to preparedness, and to this end, much progress has been made recently in forecasting methods and warning practices. In many European countries, the warning thresholds are defined based on the severity of impacts. Moreover, the Meteoalarm website (http://www.meteoalarm.eu/) was launched in 2007 to disseminate warnings issued by most European National Hydro-Meteorological Services (NHMSs). Preparedness for future storms requires new measures to prevent severe impacts, such as: general guidance for authorities and the public; call to action statements; site-specific action plans for people, public and private properties, and outdoor venues

(Rauhala and Juga, 2010).

Extreme weather events negatively impact on the whole of society. Even then, in some cases the aftermath need for better maintenance and other services will increase the revenue and profits of the service providers and thus enhance the welfare. The economic distribution effect of the consequences can thus be significant in the long run (Perrels et al., 2010).

The report of the United Nations International Strategy for Disaster Reduction (UNISDR) defines society's vulnerability as the characteristics and circumstances that make it susceptible to the damaging effects of a hazard (UNISDR, 2013). Vulnerability comprises various physical, social, economic and environmental factors; these, in turn, include the poor design and construction of buildings, inadequate protection of assets, lack of public information and awareness, a disregard for wise environmental management and limited official recognition of risks and preparedness measures. The vulnerability of the society varies significantly within a community and over time. It can also be defined as its ability to be restored after a shocking event and its susceptibility to the risks. Also resilience and protection issues are included, as well as the response to, and recovery from, risks and hazards.

Schmidt-Thomé (2006) argues that "the most natural hazards cannot fully be mitigated, and besides, the evidence-based definitions of potentially hazardous areas are still impossible to predict, at least on a long- to mid-term perspective". He has identified the spatial risk as a function of the hazard (probability) and the vulnerability. The latter is assessed in terms of population density and GDP per capita of the vulnerable area (Schmidt-Thomé and Kallio, 2006). The notion that 'the greater the GDP, the better the society can cope with the hazards' justifies the use of GDP as a vulnerability indicator. Some countries, such as Canada or Finland, have high GDPs per capita but their population density is very low. Hence, extreme weather might have an even lower than expected impact in such countries; their perceived resilience is enhanced because fewer people and infrastructures exposed to extreme events. Population density itself can be correlated to the overall consequences: high population densities with low income levels are typically exposed to significantly worse impacts. It goes without saying that vulnerability is increased unless the society has both the know-how and technological tradition of how to deal with certain extremes. An additional vulnerability parameter arises from organisational and administrative issues; unless there are clear responsibility mandates regarding who should tackle the extreme weather impacts, there is a risk that "hot bricks" are being tossed around.

The European Severe Storms Laboratory (ESSL) has collected and analysed European storm data since 2006 (Dotzek et al., 2009). ESSL gathers information about wind gusts (v >25ms^{-1}); tornadoes; hail (diameter >2cm); heavy precipitation; funnel clouds; gustnadoes and lesser whirlwinds. The collected data are stored into the European Severe Weather Database (ESWD). The zoning in Fig. 1, created by ESSL, suggests that there exist areas that are somewhat climatologically similar; further, extreme weather also exists equally within each climatologic area. While the classification of these areas is based on severe weather events, it does not take into account other affecting issues such as the topography or technical preparedness of the area. However, this classification was used as a ground for this study.

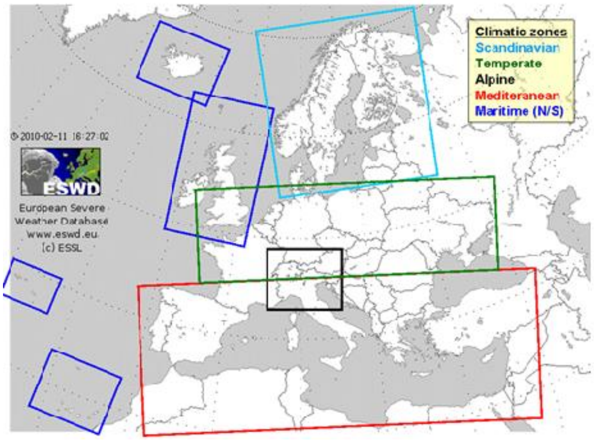


FIG. 1: Used classification of the climatologically similar European regions.

In Europe, strong winds, heavy snow and rainfall are often caused by large-scale low pressure systems; after the passage of the storm centre, the related cold air advection can occasionally bring winter temperatures, even down to the Mediterranean countries. During the summer, mesoscale convective systems (MCS) are important factors that cause heavy rain and hail, frequent lightning and damaging wind gusts in many parts of Europe. MCSs typically occur within the warm continental air mass or at the frontline between the warm air and cooler maritime or polar air masses. They can be very violent and are challenging to predict in advance.

Stormy weather even by itself can have substantial consequences. On the Baltic Sea, for example, one of the most traumatic events in recent times was the sinking of the ship Estonia at the end of September 1994. Although the prevailing weather was probably not the main cause for the accident, the strong wind and associated large waves strongly affected the ship's movement prior to the accident and hampered the rescue operation. The overall situation were very challenging - the 10-minute mean wind was up to 23ms^{-1} and wind gusts up to 29ms^{-1} (Komulainen, 1994).

The preparedness or capacity building of a society can be divided into two task domains: those which must be done before the adverse weather, and those that must be performed as it arrives. The first domain consists of tasks such as road salting and constructing embankments against floods, while the second includes operative work such as changing the route plan to direct the road transportation to a safer area. Most of the work must be done in advance since violent storms typically move quite fast. For example, in Finland in July 2002, a storm caused significant damage by felling some 1 million cubic metres of trees in its wake in a series of intense downbursts (Punkka et al., 2006). The most violent part of the storm moved northwards very rapidly; much faster than the mean deep-layer wind speed (15-20ms^{-1}). When these kinds of storms occur, there is only limited time for pre-warnings and preparation in order to mitigate the expected damage in the area ahead of the storm.

III. CONTENT ANALYSIS OF MEDIA DATA

To determine the kinds of extreme weather events that have occurred in different parts of Europe and how they have affected transportation, a content analysis approach of extreme weather events was implemented. The focus was on determining what kind of weather is regarded as being extreme or adverse in different countries. As the databanks from Meteorological Offices typically don't include any information about the consequences of the events, it was decided to generate a database of media news. The use of media reports allowed a deeper insight into the disaster and its consequences from the injured society point of view, which was not possible by using only meteorological statistics.

The terms 'news item' or 'news report' in the media can be defined as a text in which new information is given about recent events (van Dijk, 1988). Although the news media typically report only a few of the daily events, they don't select those issues randomly (Schrodt and Gerner, 2000). One important criterion for the validation of news is their significance from the society's point of view. The impact of the news is often complex and dramatic, and effects the way people think about themselves and the world they live in (Hannabuss, 1995). Reese (2001) noticed that the media news have the ability to "frame issues and public deliberation in a particular way". Hatley (2006) stated that the media is in the unique position to stimulate individuals and societies to discuss specific issues, while keeping other issues away from public view, and it has the role of political actor in public discourse. Earlier, Singer and Endreny (1987) stated that the media tend to follow the rule "good news is no news". For these points of views we assume that the media has been interested in all significant weather events if they have had major consequences on society. Thus, these particular phenomena could be regarded as being "extreme weather" no matter what their climatologic parameters are.

Using news as a research source was favoured for two reasons: Firstly, the Europe-wide viewpoint made it necessary to compare the consequences of the specific weather events in different parts of Europe. Secondly, weather events that passed the news threshold were often exceptional by their nature and typically therefore impacted adversely on society.

The study was mainly carried out by searching different data sources on the Internet, i.e. internet search services (mainly Google), online news databases and newspapers as well as other service providers (e.g. meteorological institutes, tourist information services) and electronic archives.

Some attention was also paid to scientific articles that discussed negative weather-related impacts on transportation in Europe; however, the main focus was on the news data. The following key phrases were used to search for targeted data:

- Weather-related consequences
- Extreme weather, Freak weather
- Motorist, Railways, Aviation
- Forest fires, Wildfires, Heat wave
- Fog, Black ice, Hail, Sandstorm
- Heavy Rain, Landslide, Flood
- Sea accidents
- Cold wave, Heavy snow

The English versions of the keywords were mainly utilised in the study with some searches performed by using the corresponding terms in German, French, Spanish, Greek, Hungarian, Romanian and the Nordic languages (i.e. Finnish, Swedish and Norwegian).

The extreme weather events identified from the Internet search were documented within an MS-Excel worksheet as a summary table and media database. Details of the documented events included: event date, description of extreme weather phenomenon, more detailed weather parameters (if available), country of occurrence, description of affected transportation systems, and consequences to the transportation systems, inhabitants and society.

In order to validate the collected data, the database was analysed according to the chronology of the events. In this way it was possible to identify the over-riding phenomena and to ensure that same events were not duplicated. It was then possible to identify the most significant weather events which were observed in several countries.

The media database was studied country by country in order to identify which types of events dominated. The aim was to examine if there are region-typical weather events, which seem to occur more often in certain countries or in a certain part of Europe. The media database was also analysed to document the event's time and extent in order to detect any seasonal variations.

The collected media database (at 10 September 2010) includes 191 different weather events and their impacts on society since 1 January 2000.The identified events were distributed evenly across Europe. Hence, this paper describes the situation during the first decade of 2000's. While the reported events were mainly country specific, there were 29 large autumn or winter storms which affected the whole, or a major part, of Europe. These so-called Europe-wide storms had the most significant influences on European transport network, affecting road traffic, railways, aviation, inland shipping and sea transportation.

IV. IMPACTS OF EXTREME WEATHER EVENTS IN EUROPE

Extreme weather consequences specifically related to traffic accidents are generally difficult to find. Our database showed that the most harmful weather events to transportation and humans are strong winds, heavy rain and wintry conditions with heavy snow. According to the collected data, 80% of all accidents occur under rainy, snowy or windy circumstances. Most of the lethal accidents occur on snowy or icy roads and stormy seas. There were no reported fatalities associated with railway transportation due to bad weather during the past ten years; storms mainly resulted in delays and expenses. In aviation, two weather related accidents due to fog were reported on our focus area; the first in Italy with 110 fatalities and the second in western Russia with 96 fatalities.

A significant difference was observed in the number of victims from regional extreme weather events and Europe-wide events; one in every five reported events, to one in every two respectively. The fatalities were not only transport related and also due to other reasons such as falling trees, floods and electricity blackouts.

The most affected transportation mode was road transportation. According to the media database, 80% of reported weather events impacted on road transportation (Fig. 2). Some 41% of all the weather events had an influence also on railway transportation and 23% on sea traffic. Aviation was affected by 15% of the weather events. These events were most often European-wide storms that typically also impacted on inland shipping (8% of all events) and sea traffic. Most of these extreme events occurred during the winter; only 25% occurred during the summer months.

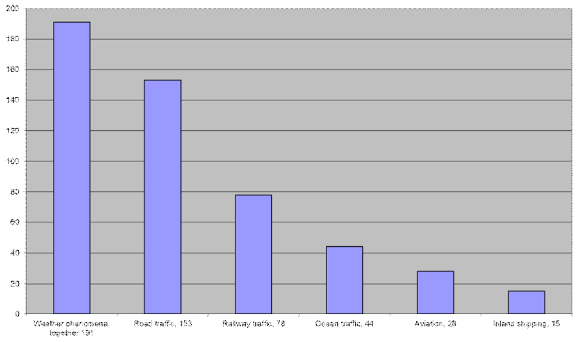
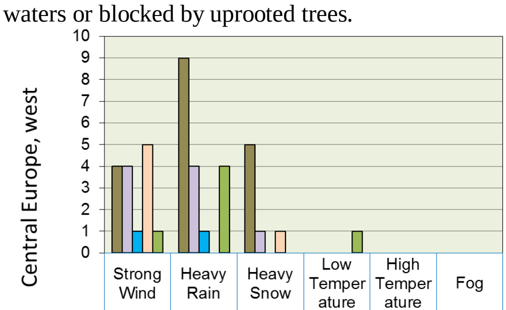


FIG. 2: The number of reported weather events and the affected transport modes.

More than half of all the listed events involved Heavy rain (59), Heavy snow (48) or Strong wind (45). These three represented 80 % of all the reported events. Low temperatures were associated with 10 of the listed events, while 11 events were related to High temperatures. Hail was involved in 8; Fog in 10 and Low visibility in 8 situations.

From the western part of Central Europe 29 weather events were analysed and the results indicate that heavy rain seems to be the most harmful weather event in this area; causing transport disruptions, such as roads and railroads being closed due to flooding (Fig. 3). In this area also, snowfalls, particularly when complemented by strong wind and temperatures below 0°C, make the roads slippery and thus increase the risk of accidents. Also strong wind has an impact on all modes of transportation and especially on sea transport. The most vulnerable targets are typically road transportation and railways. Most of the documented extreme weather events occurred either during the winter (December to February) or summer (June to August). Cold temperatures (around –10°C during the winter 2009-2010) and heavy snowfalls, strong winds and heavy rain or hailstorms have been the main causes for delayed or cancelled rail services; in which rail tracks were covered by flood waters or blocked by uprooted trees.



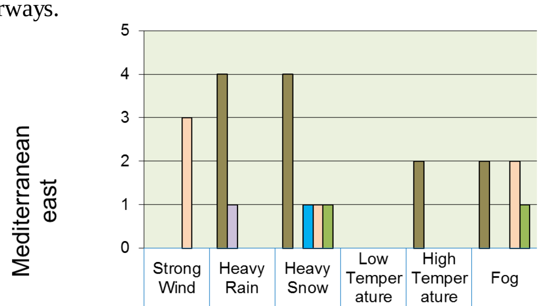
	Strong Wind	Heavy Rain	Heavy Snow	Low Temperature	High Temperature	Fog
Road transport	4	9	5	0	0	0
Railways	4	4	1	0	0	0
Aviation	1	1	0	0	0	0
Ocean Transport	5	0	1	0	0	0
Inland Shipping	1	4	0	1	0	0

FIG. 3: The impacts of extreme weather on transport modes in western-central Europe.

From the eastern part of Central Europe, 19 weather events were analysed. As in general in Europe, most of the transportation disturbances were the result of heavy rain, strong winds and heavy snow. However, due to the continental climate, especially heavy snow and low temperatures, but also high temperatures affected road and rail transportation in this area. Heavy snow was not regular, but when it occurred it had an impact on all transport modes. Temperature and high precipitation effects are significant factors for inland water transportation. High temperatures bring about long periods of drought, which may lead to reduced discharge and low water levels, thereby limiting the cargo carrying capacity of vessels and increasing their sailing times, particularly when progressing downstream. Also, when temperatures are below 0°C for long periods, ice can form on the waterways leading to the suspension of navigation and possible damage to the infrastructure, e.g. buoys, and, in the worst case, result in closure to freight traffic. Heavy rainfall, in particular in association with snow melt, often leads to floods – also resulting in the suspension of navigation. Furthermore, it also causes damage to the waterway's infrastructure as well as the property and health of the inhabitants who live in areas exposed to the flooding.

From the western Mediterranean area, 32 weather events were analysed. Most transportation disturbances in this region were due to heavy rain and snow; mainly affecting road transportation. Heavy winter rainfalls have resulted in flooding and mudslides, which have seriously disrupted road transport, e.g. by closing down road sections for periods of up to a month. The heavy rainfalls themselves as well as the consequent mudslides have also, but less severely, disrupted rail transport. Low temperatures, icy roads and heavy snowfalls have closed roads and caused travel chaos; heavy transport, in particular, has come to a complete standstill locally. High temperatures increase the risk of forest fires and bushfires, which affect and delay both road and rail transport.

From the eastern part of Mediterranean area, 17 weather related events were analysed. They showed that most transportation disturbances were affected by strong winds (sea transportation) and heavy rain and snow (mainly road transportation) (Fig. 4). In this area, also the high temperature and fog played a significant role. Bushfires, due to high temperatures, impact transportation and cause delays. Fog disturbs transportation both on roads and on waterways.



	Strong Wind	Heavy Rain	Heavy Snow	Low Temperature	High Temperature	Fog
Road Transportation	0	4	4	0	2	2
Railways	0	1	0	0	0	0
Aviation	0	0	1	0	0	0
Ocean Transportation	3	0	1	0	0	2
Inland Shipping	0	0	1	0	0	1

FIG. 4: The impacts of extreme weather on transport modes in the eastern Mediterranean area.

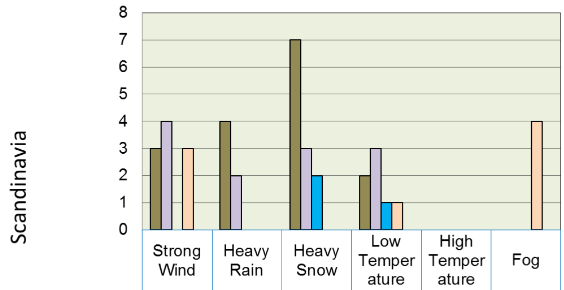
About once in every two years within the Mediterranean Maritime area, there are weather circumstances that can disturb sea transportation. The most common event involves strong winds, which typically result in delays, engine failures, vessels running aground and even shipwrecks. During the past ten years, there have been three fatal incidents and also one that involved a major environmental incident (oil spill).

In accordance with the climatological classification from ESSL, the Alpine area was analysed separately. There were only 10 weather related events reported from that area. Heavy rain was the most often noticed event and it impacted mostly on road and railway transportation. However, also hail was mentioned to be a reason for four road transportation disturbances. The most fatalities arose from one single air accident in Milan airport due to fog in 2001 with 110 deaths.

A total of 28 different weather events were identified in the British Isles: involving heavy rain and wind, landslides due to heavy rain, heavy snow and icy roads, fog and also hail. Most of the identified events were related to heavy rain – sometimes complemented with low temperatures and heavy snow. The events were associated with flooding on the roads and landslides, which resulted in roads being closed, traffic jams and accidents. Also, accidents and road closures were linked to heavy snowfalls and low temperatures. In addition, hail and fog resulted in additional transportation problems. The most vulnerable aspect was road and rail transportation, with sea transportation also being impacted by strong winds. Low temperatures, ice and heavy snowfalls resulted in the cancellation of the rail services in the UK. Heavy rain and consequent flooding has also disrupted rail services.

From the Scandinavian region, 27 weather events were analysed (Fig.5). Most of the disturbances were associated with strong winds, heavy rain, heavy snow and low temperatures. Almost all the road and rail events identified from the Scandinavian media were related to wintry conditions; only a few occurred during the summer. The consequences on road transportation typically involved lower traffic speeds and interruptions due to accidents.

The vulnerable targets were most often road and rail transportation, although aviation also suffered from heavy snow. In Scandinavia, heavy snow (15cm or more in 24 hours) and rainfall (>50mm in 24 hours) significantly slow the traffic or even require that parts of the road and railway network are closed down, resulting in delays and accidents on the roads. Black ice is a relatively normal phenomenon at the end of winter in northern countries causing road accidents. In forested areas, strong winds (gusts >15ms^{-1} (Rauhala and Juga, 2010)) knock down trees, which then cause delays and disruptions when they fall onto the road and railway networks. Trains are especially vulnerable to extremely low temperatures (< –25°C); typically resulting in breakdowns.

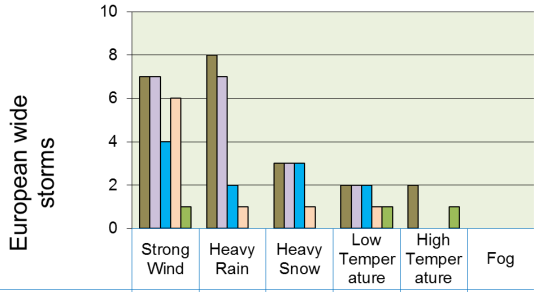


	Strong Wind	Heavy Rain	Heavy Snow	Low Temperature	High Temperature	Fog
Road transport	3	4	7	2	0	0
Railways	4	2	3	3	0	0
Aviation	0	0	2	1	0	0
Ocean Transport	3	0	0	1	0	4
Inland Shipping	0	0	0	0	0	0

FIG. 5: The impacts of extreme weather events on transport modes in Scandinavian area.

Dense snowfall also disrupted aviation by delaying flights or even closing entire airports. Storm winds have also caused severe disruptions to sea transportation. Dangerously high winds have ensured passenger ships need to stay in port or resulted in collisions between vessels and heavy fog prevents transportation. A lack of ice-breaker capacity during strong ice winters disrupts winter sea transportation.

In addition to the regional weather events, 29 Europe-wide events, which had a substantial impact on all transportation modes due to strong winds, heavy rain and snow (Fig. 6), were studied. Europe-wide storms and outbreaks of wintry weather have very widespread effects, as indicated from the events of the winter 2009-2010, where both local and nation-wide transportation was paralysed by severe conditions.



	Strong Wind	Heavy Rain	Heavy Snow	Low Temperature	High Temperature	Fog
Road Transportation	7	8	3	2	2	0
Railways	7	7	3	2	0	0
Aviation	4	2	3	2	0	0
Ocean Transport	6	1	1	1	0	0
Inland Shipping	1	0	0	1	1	0

FIG. 6: The impacts of Europe-wide extreme weather events on transport modes.

Heavy winds coupled with heavy rain typically cause problems throughout Europe. Usually, this phenomenon occurs in summer and can also include thunderstorms. Windstorms affect critical infrastructure due to floods and fallen trees, which also affect transportation. Flooding was also typically associated with other infrastructural disruptions.

V. DISCUSSION

The results of media analysis show that extreme weather effects, conditions and consequences differ according to the location, geography, population distribution, infrastructure, and preparedness for different extreme weather conditions.

"Extreme events" are not the same in different parts of Europe. For example, in Scandinavia the term "heavy snow" signifies usually snow fall more than 100 mm/d when in Mediterranean area as slight as 50 mm/d is often regarded as "heavy snow". By the same token, Mediterranean "cold wave" is not regarded very cold in Scandinavia and Scandinavian "heat wave" is not regarded very hot in Mediterranean area.

The overall pattern based on media reports is surprisingly clear: the most harmful phenomenon is heavy rain, and road transportation system is most affected by it, almost regardless of the region. A good suspect number two is heavy snow, which is number one headache in Scandinavia but surprisingly harmful also in Central parts of

Europe and British isles. Extreme low temperatures may be harmful in Scandinavia and extreme highs in Mediterranean, which is no surprise. Only in the north do cold spells affect any other than land transport modes, because of the ice conditions in the Baltic Sea. Strong winds are affecting road and rail transportation systems more than one would expect. Impacts on road and rail systems seem to be more common – or at least more often noted – than on aviation, which one would expect to be more affected. Aviation seems to be more resilient mode of transportation that the usual media image leads us to believe.

There was one exceptional result from our study. Although we know that heat waves must have been affected to the transportation during the last ten years there were no sign of it in our media data base. Even from the heat wave 2003 in Central Europe there were no single piece of media news dealing with the disturbances in transportation. It is presumable that at that time there was no media interest on transportation while at the same time there were more serious concerns; lack of water, lack of electricity and finally thousands of death people.

One significant result was that Europe-wide storms cause the most serious and long-lasting damage to several countries. They are typically violent and include high wind speeds coupled with heavy rain or snow falls. Societies incur significant costs associated with rebuilding roads, railways, bridges and tunnels, for example; lost income for aviation companies; and delays in logistics systems. These impacts are in fact not only restricted to areas where storms hit but also affect the surrounding economic areas. If larger economic areas are impacted, the recovery could be slow. For example, repairing the damage could be quite time-consuming because of the lack of a skilled workforce. The overall economic consequence of traffic jams or paralysed train timetables are deemed to be difficult to judge – no specific information shedding light on this issue was found from the database.

To summarise, Europe-wide violent phenomena call for Europe-wide responses, which could include:

• Enhanced information exchange between authorities and critical functions (such public transport operators) when high impacts are first observed.

• Enhanced rerouting processes and agreements enabling, or even compelling, airports and harbours to prepare for extra traffic, for example. While EUROCONTROL has this function for aviation, there is no similar function for railways, although in exceptional situations this might be called for.

In this study, the media reports (i.e. the news) were used as research material to assess the distribution of extreme weather events that impact transport systems. One of the considered strengths of the method is the fact that the news per se is material that would not be there without an impact. Furthermore, 'what's in the news is on the lips'; media reported cases are of obvious interest to decision makers, perhaps even too much so. The reliability of the used empirical material in the sense that it represents events that have been severe enough to a have high impact can be thus considered quite high. The reliability of the material in other respects can be debated. Tänzler et al. (2008) emphasise that the use of media analysis always needs to be accompanied with caution because of the special mechanism of news selection, reporting and bias. The strength of news is its capability to describe individual cases; however, this might also be seen as a weakness. The news tells us about events, their background and consequences. The problem, however, might lie in the fact that there is so much diversity in the news – ranging from the local review level compared up to the international level.

As this study was carried out mainly by examining online news articles, the majority of the reported events tend to be more recent. Depending on the provider, the concrete event descriptions might only remain 'in the news' for a couple of months (after which they may not allow open access to it), while others may continue to allow access to the complete range of their articles. Many other news providers do not even maintain any working archive. This 'availability aspect' also influenced the identified events – the authors aimed not to subscribe to any such news systems, relying merely on publicly available material. Additionally, these archiving policies also affected the results, especially for local events, where only the local news provider was able to extensively report on the issue. However, we believe that the reliability is satisfactory since the situation is probably similar in most countries – information on regional storms was mainly from the last two years and Europe-wide storms from the past ten years.

VI. ACKNOWLEDGMENTS

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