Can innovative weather services mitigate extreme events' impact on transport?

A test case study for Zurich, Switzerland.

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1 Introduction

Increased weather variability and a larger number of extreme events are among the expected impacts of climate change. Switzerland has already experienced some occurrences of this trend in recent years.

For the transport sector this means additional challenges as such events are highly unpredictable and potentially disruptive. In the case of rather destructive events, such as major floods, direct costs, typically the cost of rebuilding the infrastructure, are what matters most. The recurrence interval of such events is however still in the order of several decades. For events with shorter recurrence and limited destruction potential, indirect cost can amount for a substantial part of the total costs. Such costs are basically the monetisation of the economic losses due to an impaired transport system. The level of information of travellers plays a role in their behaviour and, ultimately, in the output of the system. Roughly, it is expected that increasing the number of informed travellers, for example through innovative weather services, will lead to a reduced negative impact of weather events.

An agent-based simulation approach was used to estimate the actual impact of this kind of weather services in case of extreme weather events. Using the urban area of Zurich as a test case, several scenarios with various levels of extreme weather and different levels of informedness were tested. It was then looked at the impact on the transportation system in terms of additional travel time (Perrels, 2015).

2 Simulations

Using the agent-based transport micro-simulation software MATSim, the Zurich area was modelled. A baseline scenario without disruption and scenarios where the agents were confronted with occurring disruptions in the network were simulated. In the latter, different levels of informedness were applied. If the agents were informed, they were informed as soon as they entered a 5km radius area around the disruptions. Agents informed about the disruptions could replan their routes but not shuffle or drop activities from their daily schedule.

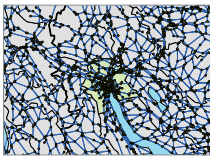
Disruptions [% of original values]

Scenario	*Speed*	*Flow*
Severe	20	20
Medium	100	25
Light	100	50

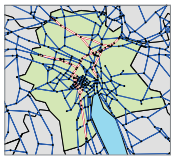
Informedness [% of the total population]

0	25	50	100

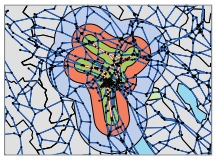
Each disruption scenario was combined with each level of informedness. The disruptions lasted from 07:00 a.m. to 09:00 a.m. Afterwards the original speeds and capacities were restored. The informed agents were able to change routes from 07:00 a.m. to 12:00 a.m. The three additional hours enabled the agents to realize that the disruption is over and to adjust their plans again.



Simulation area



Disrupted links



Informed area (colored)

The simulations (incl. figures) were originally presented in (Dobler et al., 2012).

3 Results

The results of the simulation show that even without rescheduling of activities, a substantial benefit in travel times can be achieved by informing the travellers. A particular property of these results however, is that there are strongly diminishing marginal benefits of travel information. Following Dobler et al. (2012), it is found that informing a minimum of 25% of the population leads to drastically lower travel times. Benefits are still substantial when the level of informed travellers reaches 50%, but the impact becomes comparatively low. This particular impact of information on travellers has been reported before for example in Rietveld (2010), Pilli-Sihvola (2014). Informing the full population can have even a negative effect on the travel times compared to informing a lower share of the people.

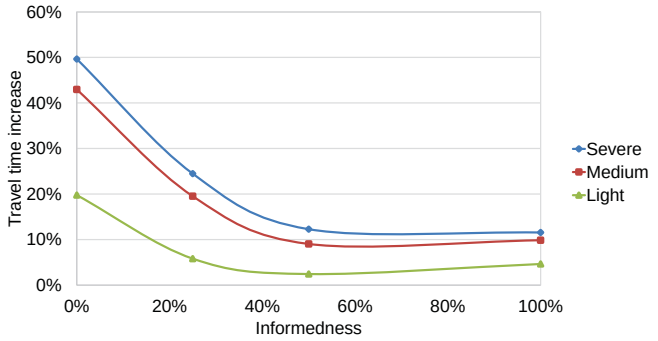


Figure Impact of informedness on travel times.

4 Conclusion

If a severe weather event with disruptive effects on the transport infrastructure occurs, informing the people can lead to substantial minimization of the negative impacts of that event on the transport system.
Informing the majority of the travellers however, paradoxically, does not lead to better results compared to informing only 40% to 50% of the people, as people may overreact to biased information: Informed travellers use bypasses to avoid affected links and areas. If too many travellers change the routes however, these bypasses can get congested.

The presented results suggest that for the overall system it would be beneficial if some individuals take sub-optimal decisions. It means that this kind of services are useful but caution should be exercised in the way they will be introduced. A service which would provide this information to all travellers would cause a sub-optimal systemic response. This evidences a criticality in determining which type of actor (private vs. public) should introduce and manage such a service.

5 References

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