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Road transport operation and infrastructure planning – case Finland

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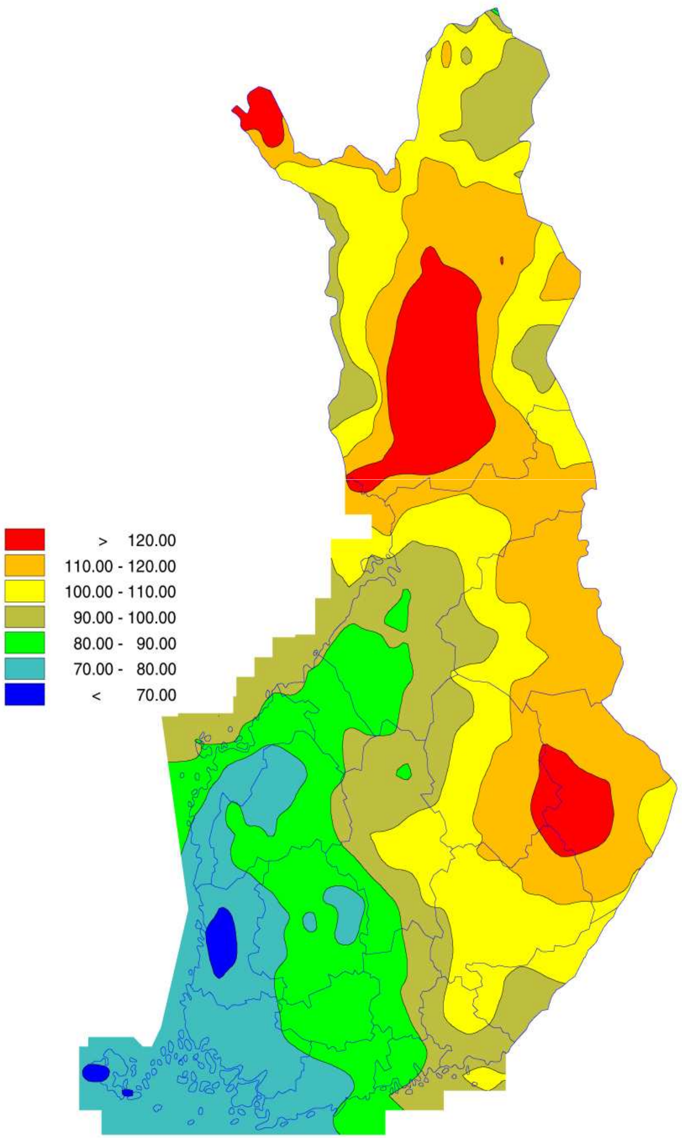
Climate Change Research Unit

Socie-economic impacts of climate and weather

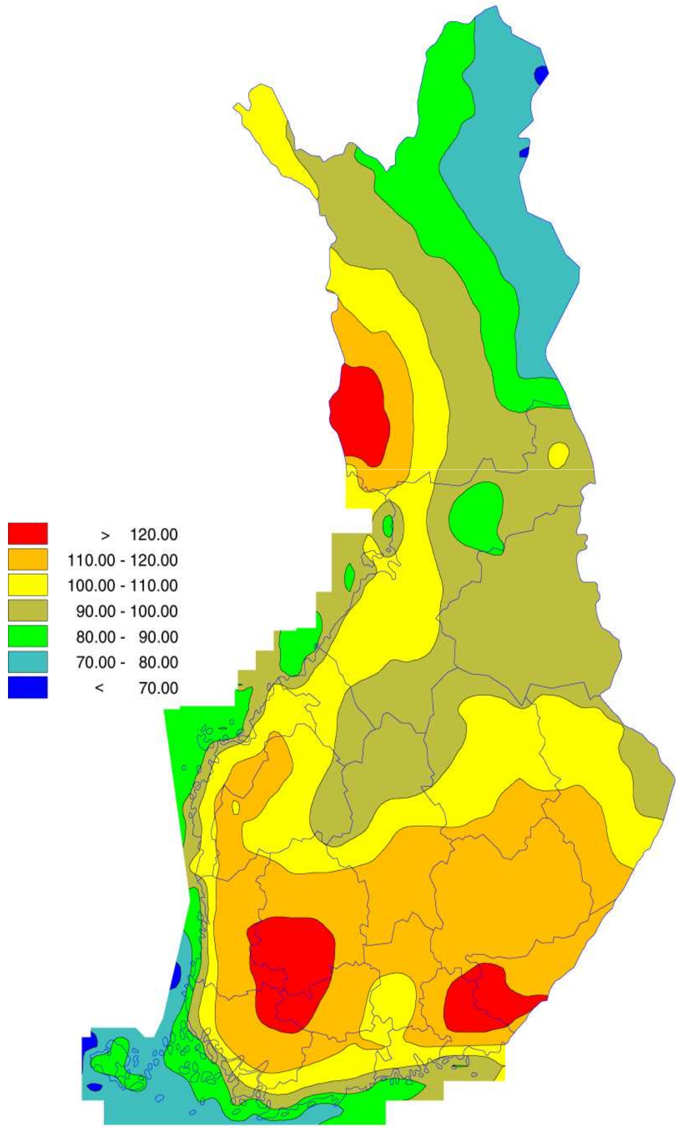
Table 3.16. Lengths of traffic networks in Finland. Sources: [1]Public Roads of Finland 1.1.2004. Finnra Statistics 2/2004. [2]Publications of the Ministry of Transport and Communications 8/2004 (in Finnish): Strategy for the development and maintenance of Finland's transport infrastructure in 2004–2013. Background study. [3]Finland's third report under the framework convention on climate change. 2001.

Traffic routes	Length (or number)
Public roads[1]	78,137
Highways	8,574
Principal roads	4,686
Other main roads	28,437
Local roads	36,441
Bridges	13,979 (number) **+ ca. 5000 (streets, private, etc)**
Private roads[2]	350,000
Bicycle routes[3]	11,000 (in connection with public roads 4,508)
Streets	26,000
Railways[3]	5,836
Waterways[3]	16,000 (fairways maintained by the Finnish Maritime Administration)
Number of airports[3]	27

Snow removal



Slippery conditions

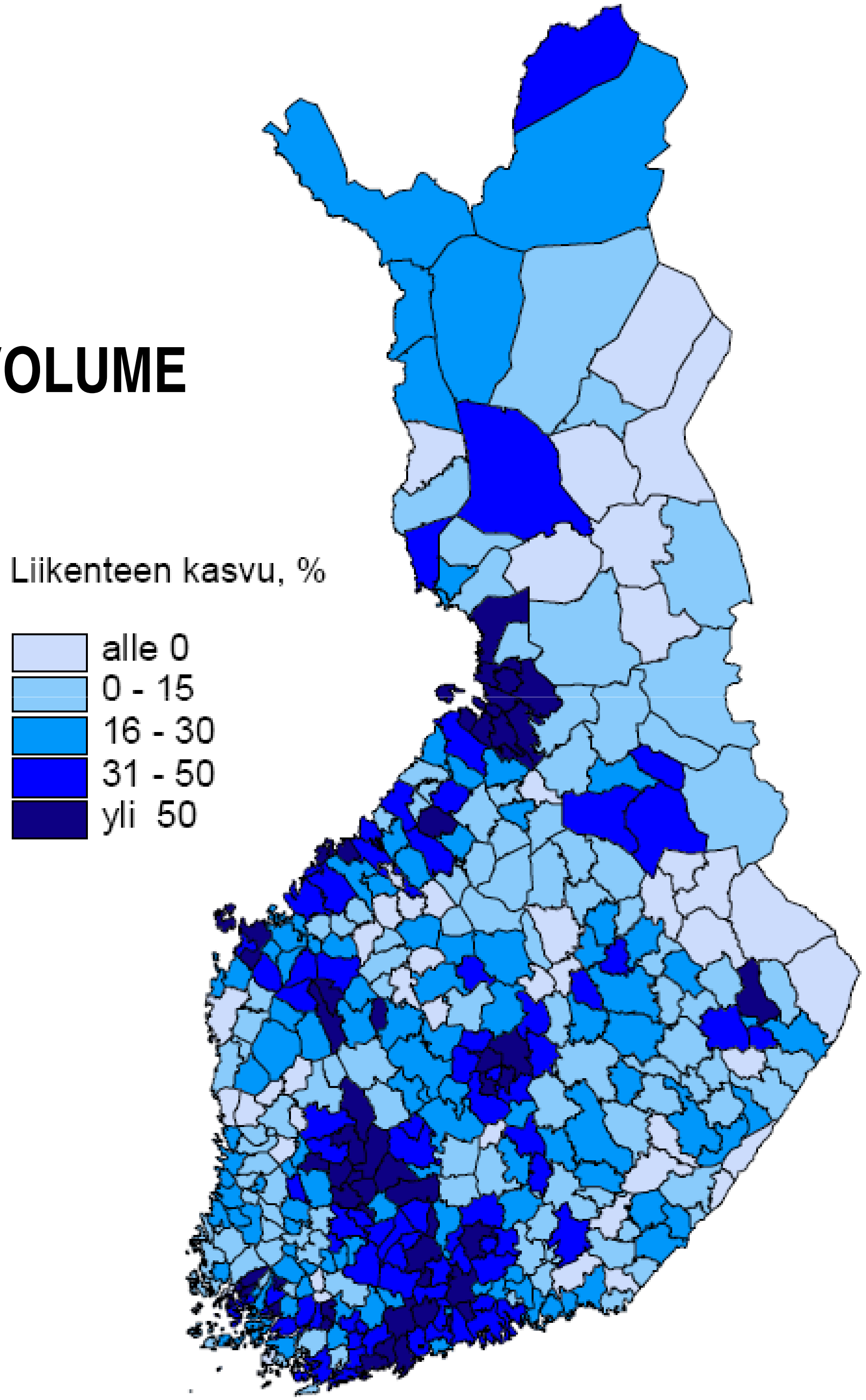


VENÄLÄINEN, A. and KANGAS, M., 2003. Estimation of winter road maintenance costs using climate data. Meteorol. Appl. 10, 69-73.

INCREASE OF TRAFFIC VOLUME 2006 -> 2030 (in percent)

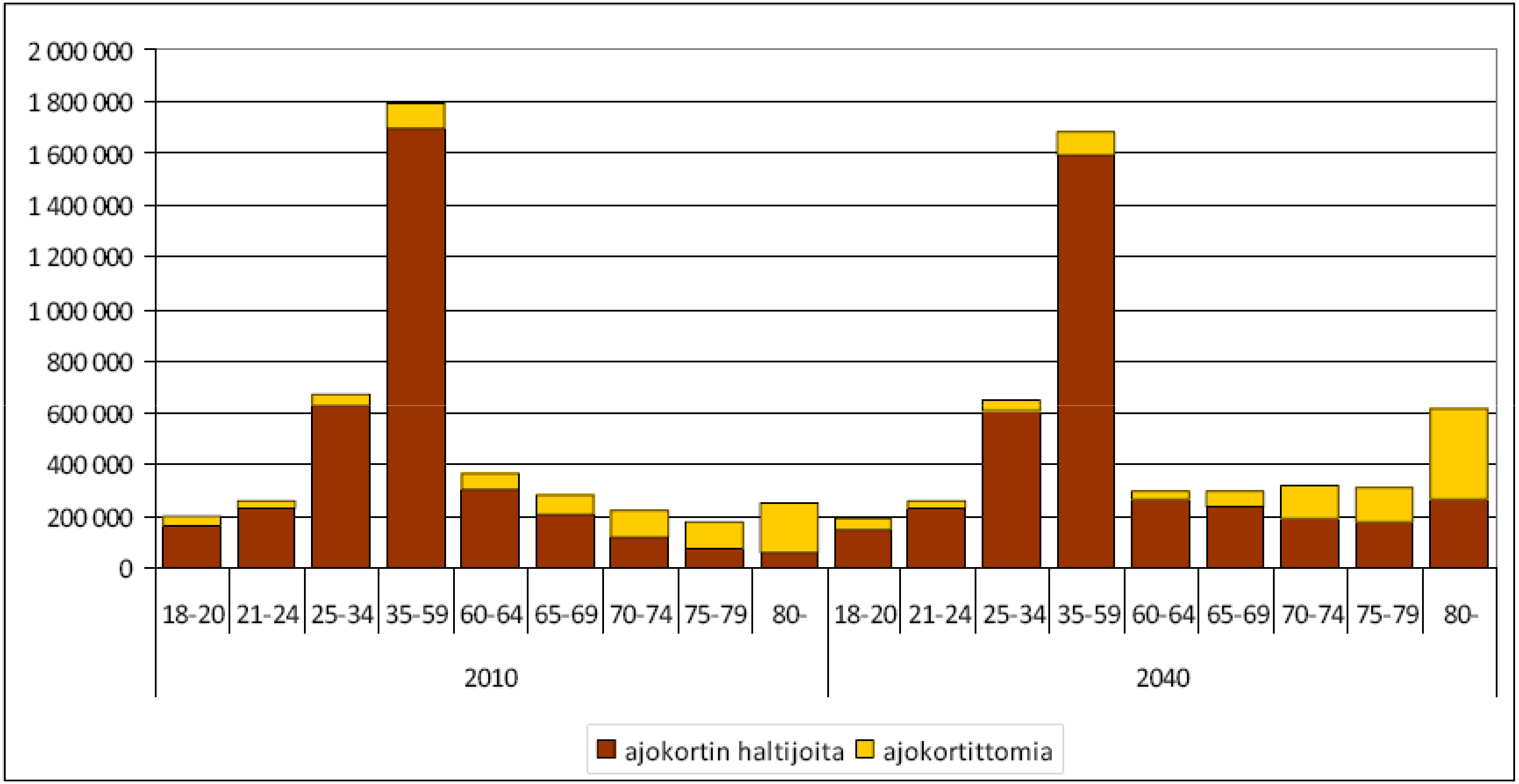
Region	Highway	Main	Regional	Connecting	Total
Uusimaa	1,45	1,40	1,34	1,13	1,37
Itä-Uusimaa	1,44	1,40	1,33	1,12	1,35
Varsinais-Suomi	1,39	1,35	1,28	1,08	1,28
Satakunta	1,25	1,21	1,15	0,97	1,16
Kanta-Häme	1,40	1,36	1,29	1,09	1,33
Pirkanmaa	1,42	1,38	1,31	1,11	1,35
Päijät-Häme	1,40	1,36	1,29	1,09	1,34
Kymenlaakso	1,22	1,19	1,13	0,96	1,17
Etelä-Karjala	1,20	1,17	1,10	0,93	1,14
Etelä-Savo	1,16	1,13	1,07	0,91	1,10
Pohjois-Savo	1,20	1,17	1,10	0,93	1,13
Pohjois- Karjala	1,18	1,15	1,09	0,92	1,10
Keski-Suomi	1,38	1,34	1,27	1,08	1,30
Etelä-Pohjanmaa	1,30	1,27	1,20	1,02	1,21
Pohjanmaa	1,29	1,26	1,19	1,01	1,20
Keski-Pohjanmaa	1,24	1,21	1,14	0,97	1,17
Pohjois-Pohjanmaa	1,38	1,37	1,27	1,08	1,30
Kainuu	1,16	1,13	1,07	0,90	1,09
Lappi	1,12	1,09	1,03	0,87	1,06
All Finland	**1,33**	**1,31**	**1,23**	**1,04**	**1,25**

INCREASE OF TRAFFIC VOLUME 2006 -> 2040 (in percent)



Source:
(Road Administration 2007)

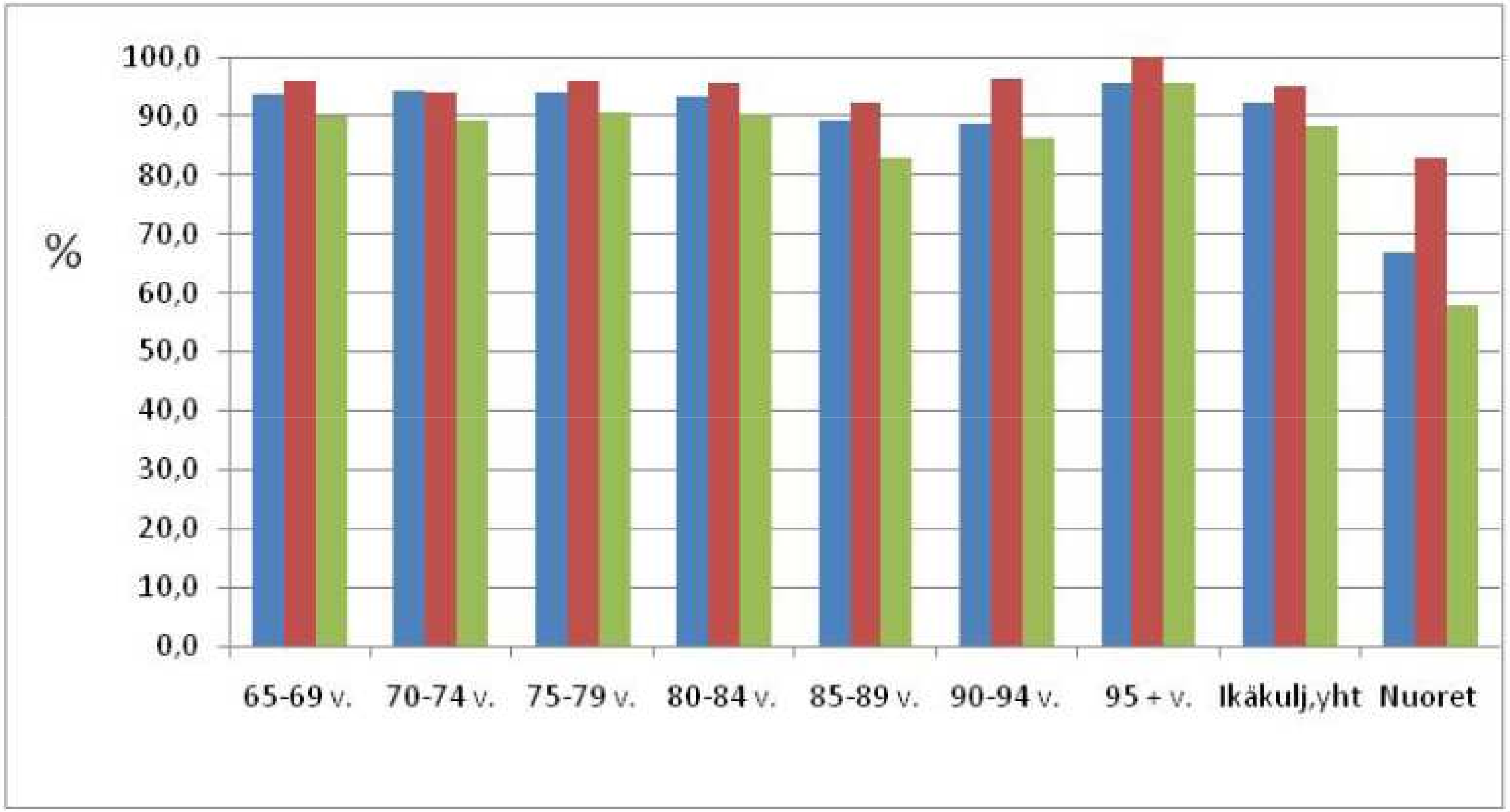
Holdership of driving licenses by age category in 2010 and 2040 (modelled)



Kuva 4.24 Ajokortin haltijoiden ja ajokortittomien määrä vuosina 2010 ja 2040.

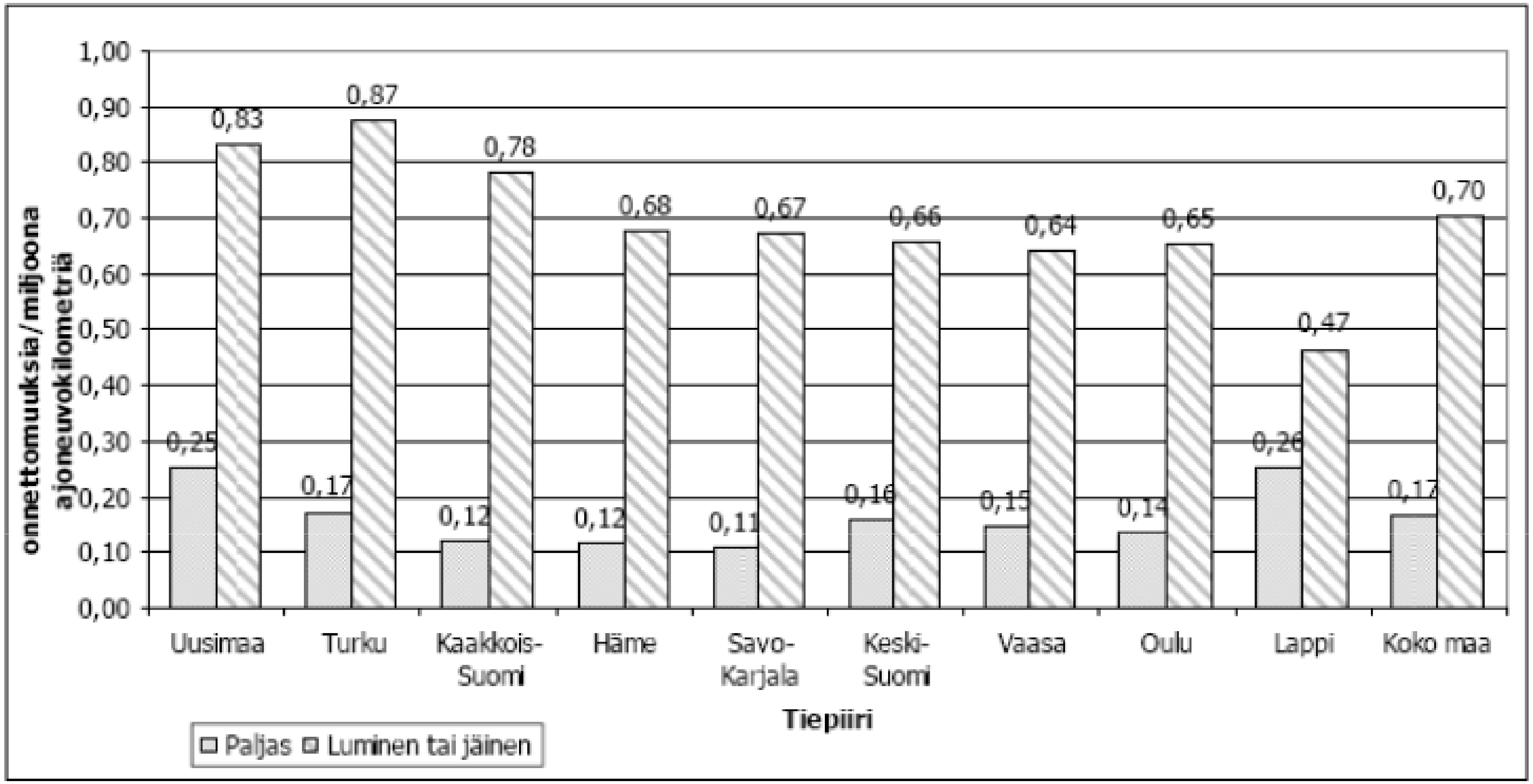
Source: Tiikkaja H. & Kalenoja H. (2010), Henkilöauton ajokortin haltijaryhmät Ennuste ajokortin haltijoista vuosille 2010–2040; Trafi 3/2010

Shares of elderly drivers without accidents and/or fines (in the previous year) by age category, and comparison with very young drivers



Kuva 2. Vahingoitta (sininen), rangaistuksitta (punainen) ja ilman kumpaakaan selvinneiden osuus prosentteina eri ikäryhmissä ja koko aineistossa.

Source: Mikkonen, V. (2010), Seniorikuljettajien seurantaindeksi, Trafi 5/2010



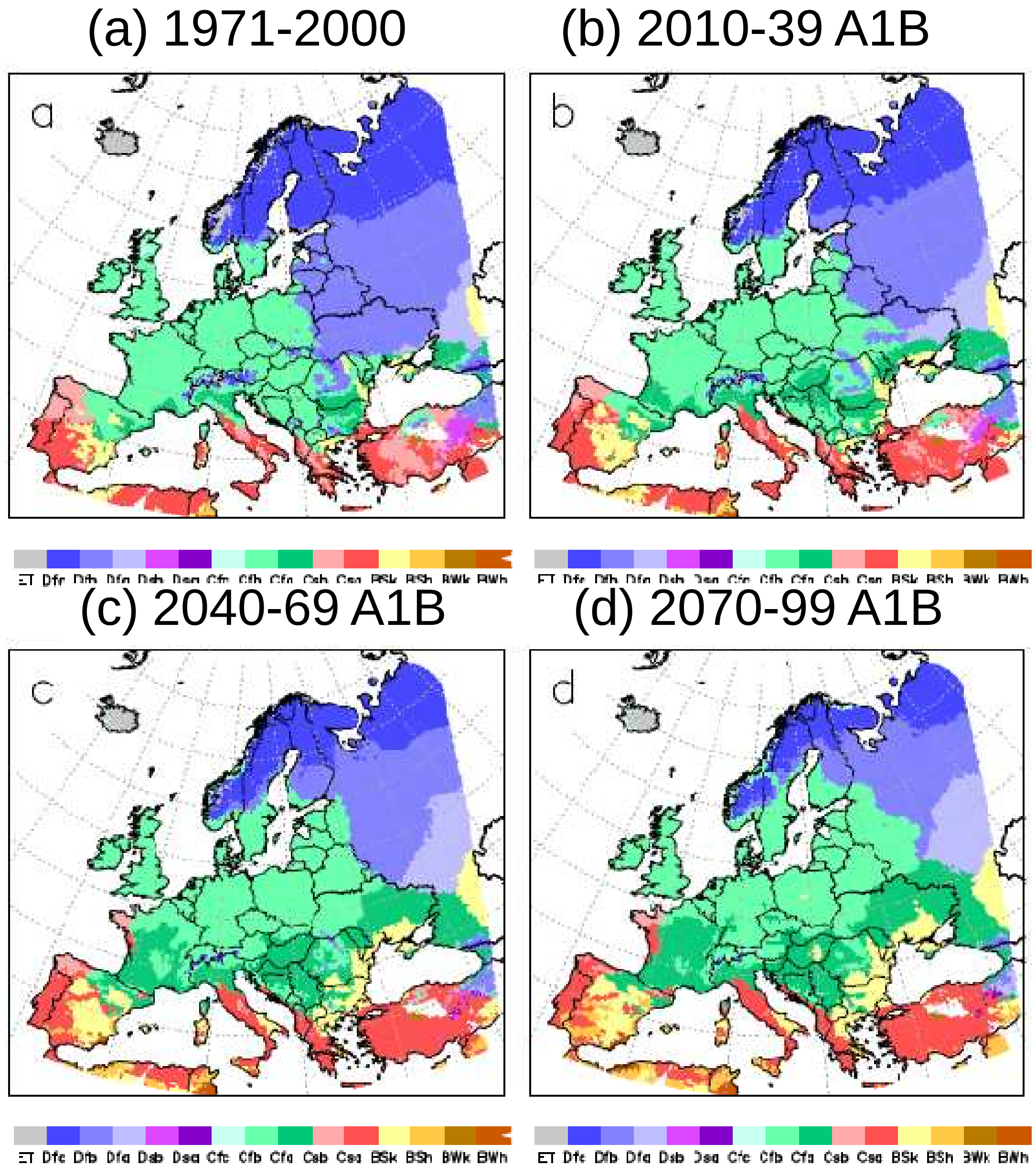
Kuva 11. Liikennevahinkoon johtavien onnettomuuksien riski tienpinnan tilan mukaan tiepiireittäin. Aineistona liikennevahinkoon johtaneet korvatut vahingot talvikausina 2003 - 2006. (Salli et al. 2008).

Aggregate risk of motor vehicle collision (per million vehicle km) in Finland ("dry" road vs. icy/snowy road surface) (2003-2006).

Shifts of climatic zones from cooler or wetter to warmer or drier

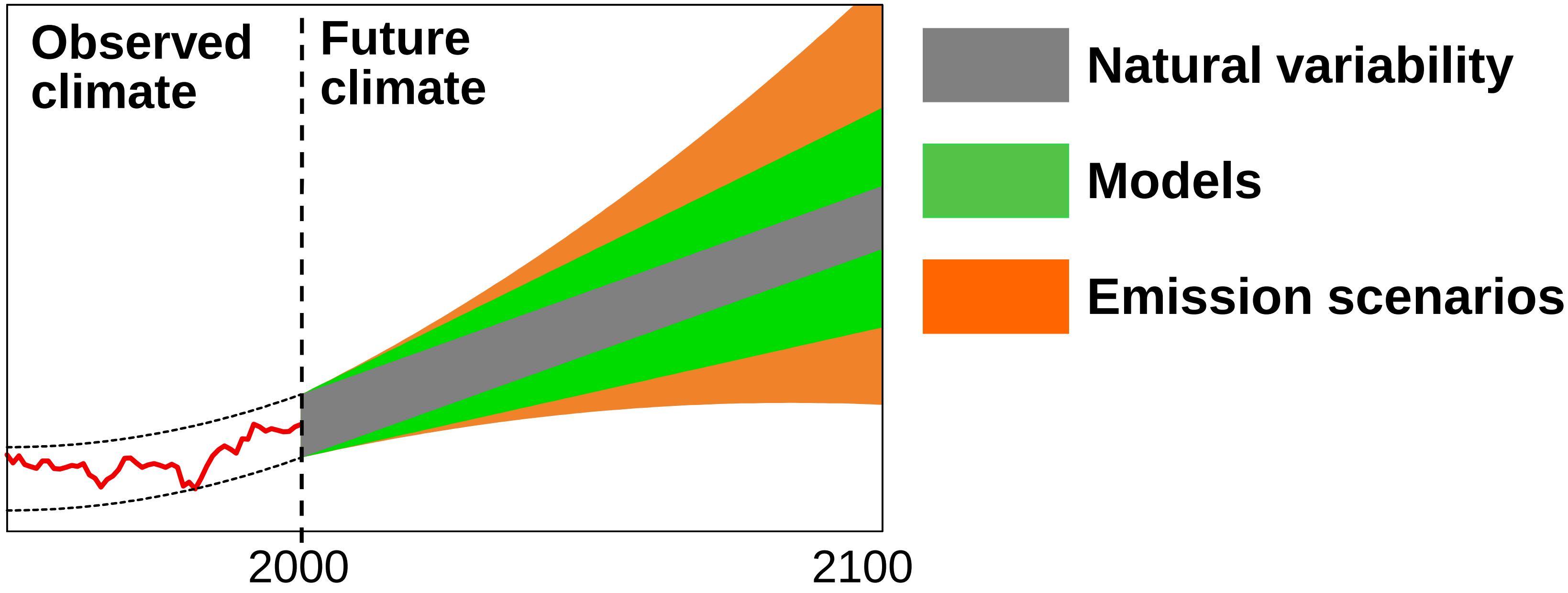
(a) Based on the observational data set (0.25º grid) from Haylock et al. (2008)

(b-d) Based on CMIP3 GCM runs for A1B & the delta-change method



Jylhä et al. (2010)

Uncertainties in climate change schematically



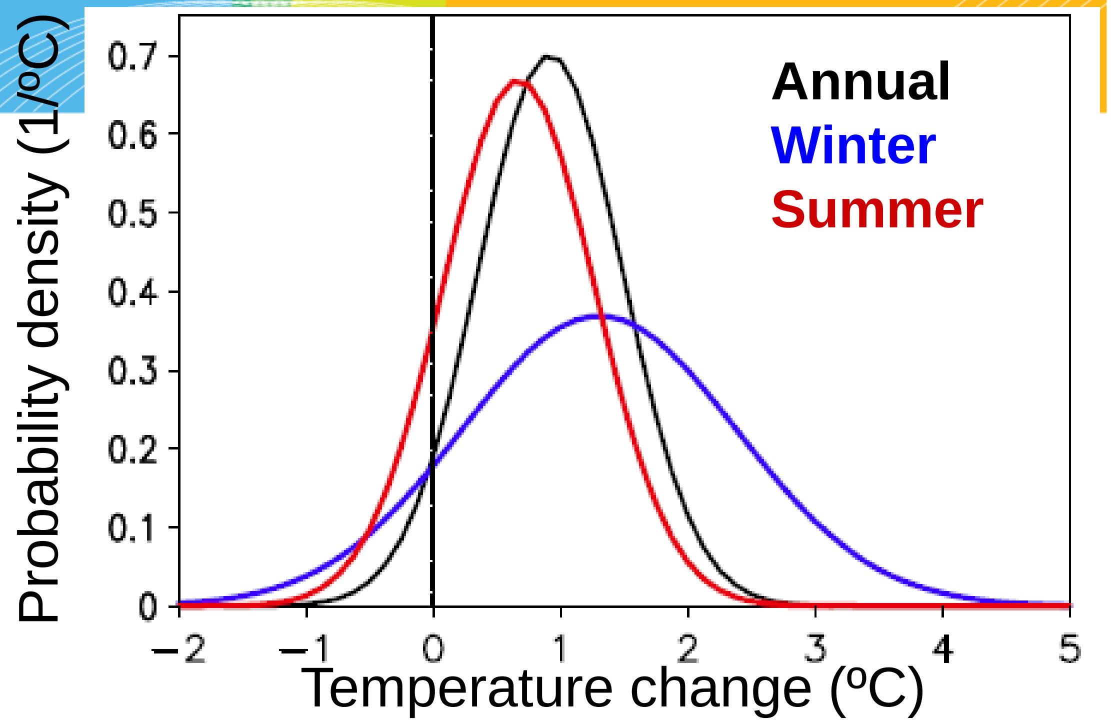
LEVEL OF UNCERTAINTY	Near future	End of the century
Natural climate variability	+	+
Climate model sensitivity	(+)	++
Emission scenarios		++

Source: J. Räisänen (Univ. of Helsinki)

Probabilistic forecasts of temperature change in southern Finland

(1971-2000 → 2011-2020)

- Accounts for natural variability and differences between climate models



	Winter	Summer	Annual
Best estimate (ºC)	1.3	0.7	1.0
5-95% uncertainty range (ºC)	-0.5…+3.1	-0.2…+1.6	0.0…+1.8
Probability of warming (%)	90%	90%	96%

Width of the distribution primarily determined by natural temperature variability: larger in winter than in summer.

Ref: Räisänen and Ruokolainen (2007)

Finland's National Strategy for Adaptation to Climate Change (2005)

Disadvantage	Direction of the impact unclear or a simultaneous disadvantage and advantage	Advantage
– The risk of collapse of railway beds and roads will increase – Floods and heavy rains will damage the structures of road and rail networks, maintenance problems could be expected particularly on gravel roads – The functionality of drainage arrangements based on today's design will be endangered – Bridge and culvert structures are designed to convey present waterflows –	• The impacts may change the attractiveness of different forms of traffic • The need for de-icing salt will increase in some places and decrease in others, so the total cost is unclear • Ice and snow conditions may vary significantly between years	+ + Thinning of the snow cover and shortening of the snow period will bring savings in winter maintenance to the road and rail network and at airports
– The sensitivity of traffic to disturbances will increase – The rectification of and preparation for functional disturbances will impose additional costs – Increased need for antiskid treatment all over the country; for example, the need to apply de-icing salt to roads will extend to the north – – Windiness, storms and heavy rain will cause damage to overhead cable networks and breaks in underground cables		

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Finland's National Strategy for Adaptation to Climate Change (2005)

		Anticipatory	Reactive
Public	Administration and planning	• Inclusion of climate change in the transport sector's long-term planning* • Securing the functionality of telecommunications networks (wired networks) **	
	Research and information	• Surveying of flood sensitive areas* • Anticipatory systems and warning systems for extreme events** • Assessment of the ice situation in the Baltic Sea*	
	Economic-technical measures	• Maintenance of the structures (road body, ditches, bridges and culverts) and condition of road network, particularly on smaller roads and gravel roads as floods and rains increase and ground frost diminishes** • Maintenance of the structures (railway beds) and condition of railways while floods and rains increase and ground frost diminishes** • Minimising the environmental hazards caused by antiskid treatments (alternatives to salt, planning of groundwater protection)**	• Taking more difficult traffic conditions into account in planning and schedules • Repair of storm damage to overhead cables • Increase of winter traffic in the Baltic Sea • Antiskid treatment of roads and airports • Repair of storm damage to the road and rail networks
	Normative framework	• New planning norms and guidelines for road and railway construction**/***	• Guidelines and definition of tolerances for the duration of disturbances

PRIVATE ROADS

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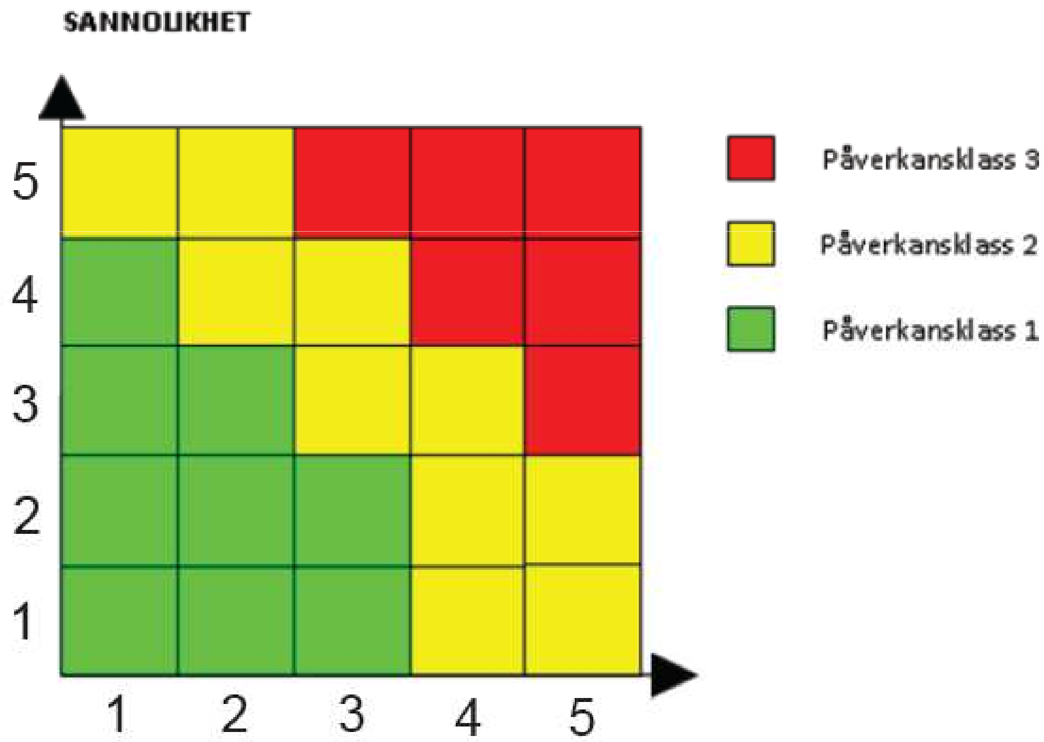
Riskanalys

Sannolikhet	Ord	1 gång på
1	Extremt liten	100 år
2	Mycket liten	25 år -100 år
3	Liten	10 – 25 år
4	Viss	1 – 10 år
5	Påtalig	årligen
Konsekvens	**Ord**	**Siffror**
1	Mycket liten	< 10 Mkr
2	Liten	10- 50 Mkr
3	Stor	50- 100 Mkr
4	Mycket stor	100- 500 Mkr
5	Katastrofal	>500 Mkr



2008-12-29 Vägverket

Riskanalys för klimatförändringars påverkan på väghållningen

Påverkan av klimatförändringar och extrema väderhändelser	Sverige	Norge	Finland	Danmark	Island	Färöarna
Förändring av nederbörd och flöden						
Större skred och ras						
Bortspolad väg och bro						
Översvämningar						
Förändringar av temperatur						
Slitage på beläggningar						
Nedbrytning av vägöverbyggnad						
Vintertransporter på tjälad väg						
Nedbrytning av betongkonstruktionener						
Nedisning av broar						
Temperaturpåverkan på broar						
Vinterväghållning						
Stensprängning						
Förändring av vindhastigheter						
Stora broar och andra utsatta ställen						
Stora mängder träd över vägar (typ Gudrun)						
Stängning av högfjällsvägar						
Förändring av havsvattennivåer						
Tunnlar						
Vägar						
Färjelägen						

Uppskattade kostnadsökningar för skador på grund av erosion, översvämning och skred/ras samt kostnader för förebyggande åtgärder.

I beloppen ingår inte kostnader för mindre erosions- och översvämningsskador eller mindre skred och ras som åtgärdas genom normalt underhåll.

Skadetyp	Förebyggande åtgärder på kort sikt	Förebyggande åtgärder på lång sikt	Kostnadsökning för skador på lång sikt (utan åtgärder)
Större erosions- och översvämningsskador (nuvarande skadekostn ca 65 Msek/år)	150-500 Msek	Totalt 1000-2000 Msek, förebyggande åtgärder mot större erosions- och över-svämningsskador samt skred och ras	50-150 Msek/år
Skred och ras (nuvarande skadekostnad ca 15 Msek/år)	>200 Msek (LAND)SLIDE, COLLAPSE		20-50 Mkr/år
Stora skred (är för närvarande sällsynta)			Ökat antal stora skred
Förtida utbyte av broar		Ca 720 Mkr under perioden[3]	

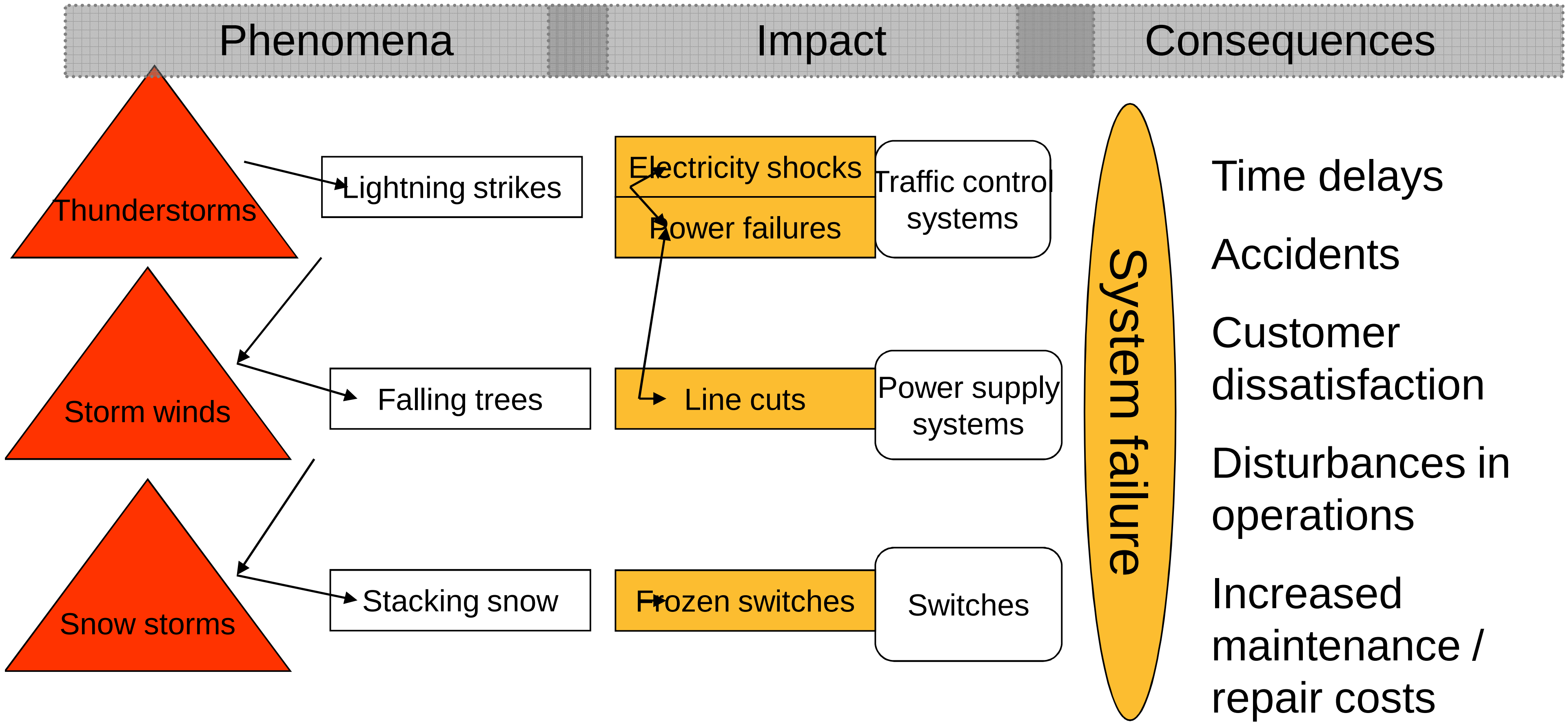
Norlander (2008)

Extreme Weather Impacts on European Networks of Transport - EWENT

Coordinator: Dr. Pekka Leviäkangas, VTT Transport & Logistics

EU FP7 project: 2010-2012

Impact analysis – example railways



Goal and research strategy

The goal of EWENT project is to assess the impacts of extreme weather events on EU transport system**. These impacts are monetised. EWENT will also evaluate the efficiency, applicability and finance needs for adoption and mitigation measures which will dampen and reduce the costs of weather impacts. The methodological approach is based on generic risk management framework that follows a standardised process from identification of hazardous phenomena (extreme weather), followed by impact assessment and closed by mitigation and risk control measures.**

EWENT will start this by identifying the hazardous phenomena, their probability and consequences and proceed to assessing the expected economic losses caused by extreme weather when it impacts the European transport system, taking also into account the present and expected future quality of weather forecasting and warning services within Europe.

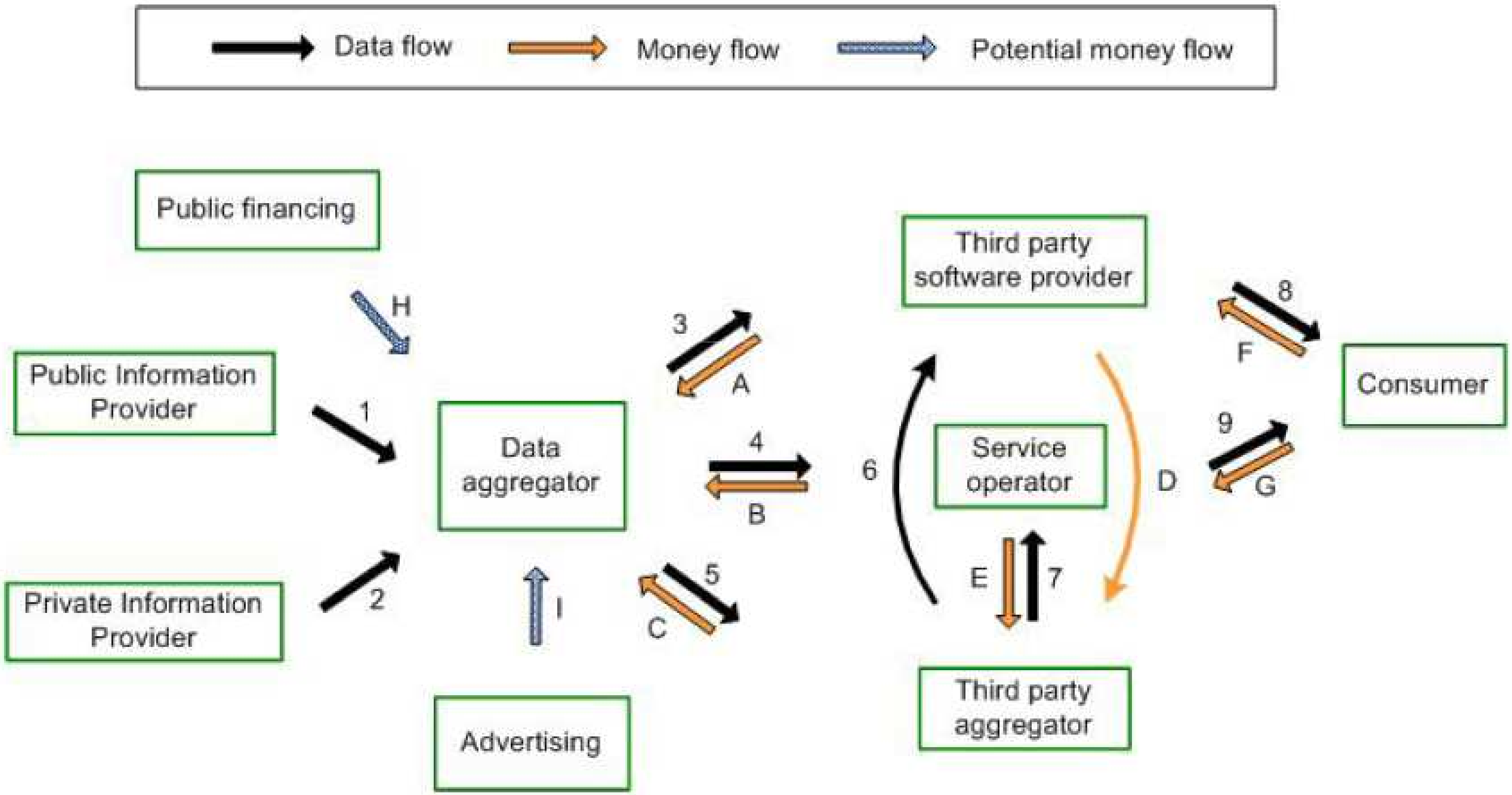


Fig. 3.2. Business model of Gothenburg traffic and weather information service (ROADIDEA pilot

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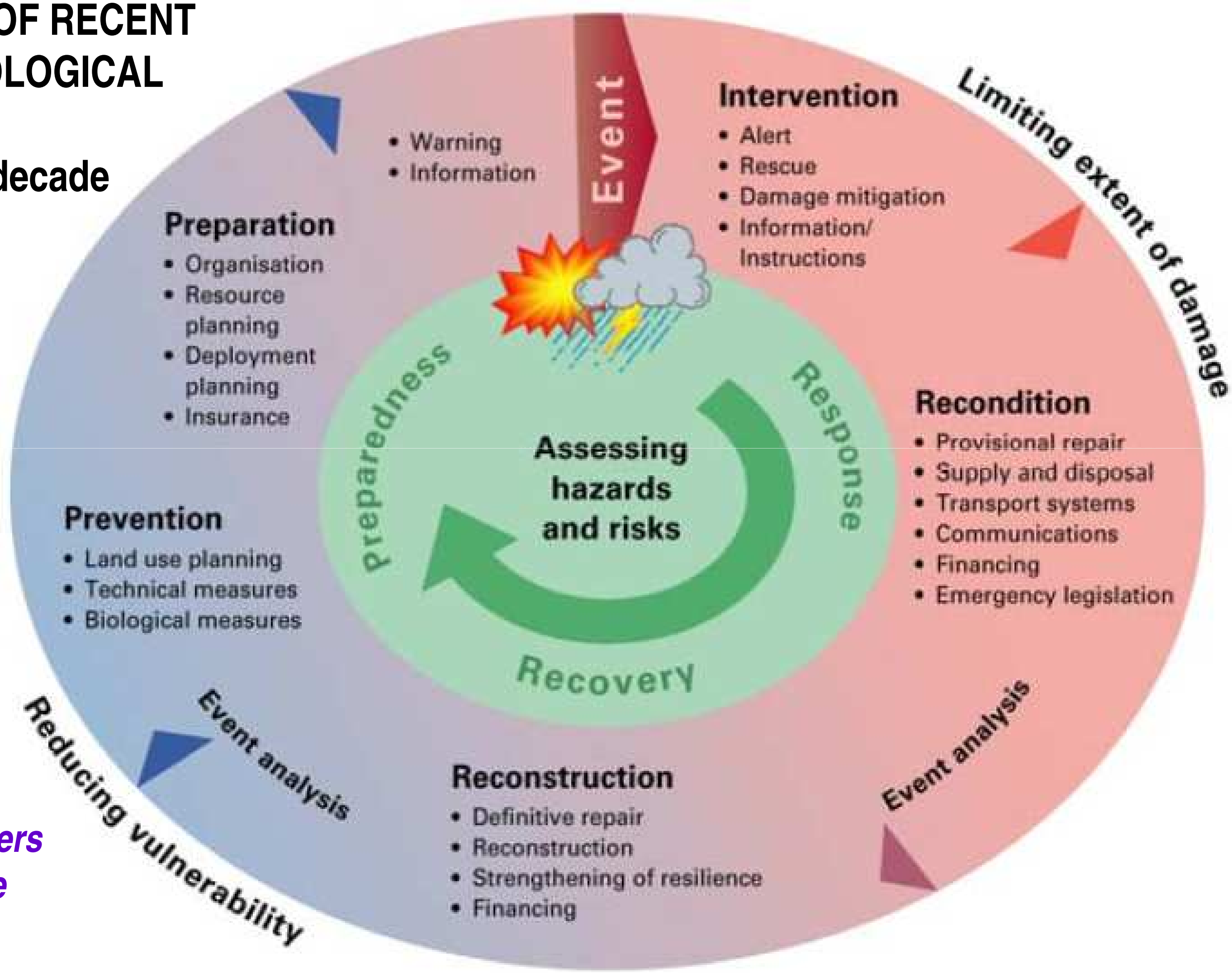
Adaptation of road transport system to climate change – Primary methods

Design → Construction → Maintenance → Operation

Design	Construction	Maintenance	Operation
Location	*Dimensioning*	*Techniques, Level of service*	*Information services, pricing*

MAPPING THE IMPACT OF RECENT NATURAL AND TECHNOLOGICAL DISASTERS IN EUROPE
An overview of the last decade by EEA



IPCC Special Report on Managing the Risks of Extreme Events and Disasters to Advance Climate Change Adaptation (SREX)

Source: Federal Office for Civil Protection FOCP[19].

Dimensions and considerations

LOCAL	→	INTERNATIONAL
DAILY	→	SEVERAL DECADES
OPERATIONAL	→	”ONCE IN A LIFETIME”
PUBLIC	→	PRIVATE
INCREASE	→	DECREASE

CHANGEING NEEDS AND PREFERENCES

TECHNOLOGICAL DEVELOPMENT

STAKEHOLDERS HAVE DIFFERENT AGENDAS