CLIMATE CHANGE PROGRAMME

Impacts of climate change on human health in Finland: challenges for risk assessment and adaptation response

Timothy Carter

Finnish Environment Institute (SYKE)

Climate Change Programme

Acknowledgements:

Reija Ruuhela, Finnish Meteorological Institute, Senior Climate Expert
Emma Terämä, SYKE, Policy Centre
Stefan Fronzek, Kirsi Mäkinen, SYKE, Climate Change Programme

SYKE

CLIMATE CHANGE PROGRAMME

Climate change impacts on human health in Finland: three aspects

1. Potential impacts: vulnerability mapping
2. Potential impacts: risk mapping
3. Observed impacts and adaptation

SYKE

1. Mapping outcome vulnerability

Potential impacts of climate change

Vulnerability assessment (AR4)

$$V = f(E, S, AC)$$

where:

E = Exposure

S = Sensitivity

AC = Adaptive Capacity

V = ”End-point” or ”Outcome” Vulnerability

IPCC AR4, Parry et al. (2007)

Current and future indicators of climate change vulnerability of the elderly

Vulnerability is a function of: ***Exposure & sensitivity*** & ***Adaptive capacity***

	Biophysical Determinants		Social Determinants		
Current State	Hot days/spells Cold days/spells Freezing pt days Population	&	Health care Social exclusion Economic support	=>	**Present vulnerability**
Future	Δ Hot days/spells Δ Cold days/spells Δ Freezing pt days Future population	&	Health care Social exclusion Economic support	=>	**Future vulnerability**
			Future State		

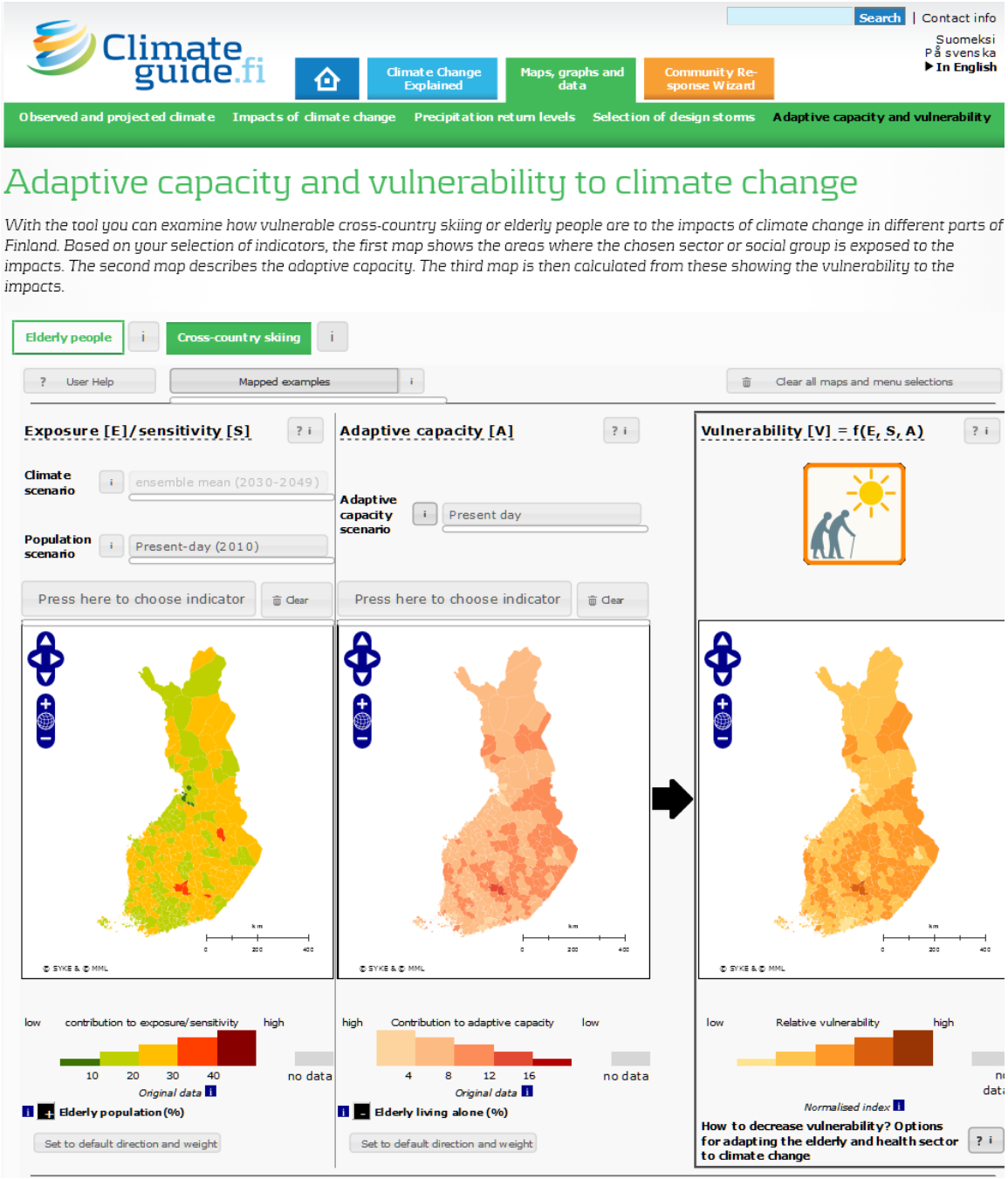
Adapted from Preston and Stafford-Smith (2009)

Current and future indicators of climate change vulnerability of the elderly

Vulnerability is a function of: ***Exposure & sensitivity*** & ***Adaptive capacity***

	Biophysical Determinants		Social Determinants		
Current State	Hot days/spells Cold days/spells Freezing pt days Population	&	Health care Social exclusion Economic support	=>	**Present vulnerability**
Future	Δ Hot days/spells Δ Cold days/spells Δ Freezing pt days Future population	&	Health care Social exclusion Economic support	=>	**Future vulnerability**
			Future State		

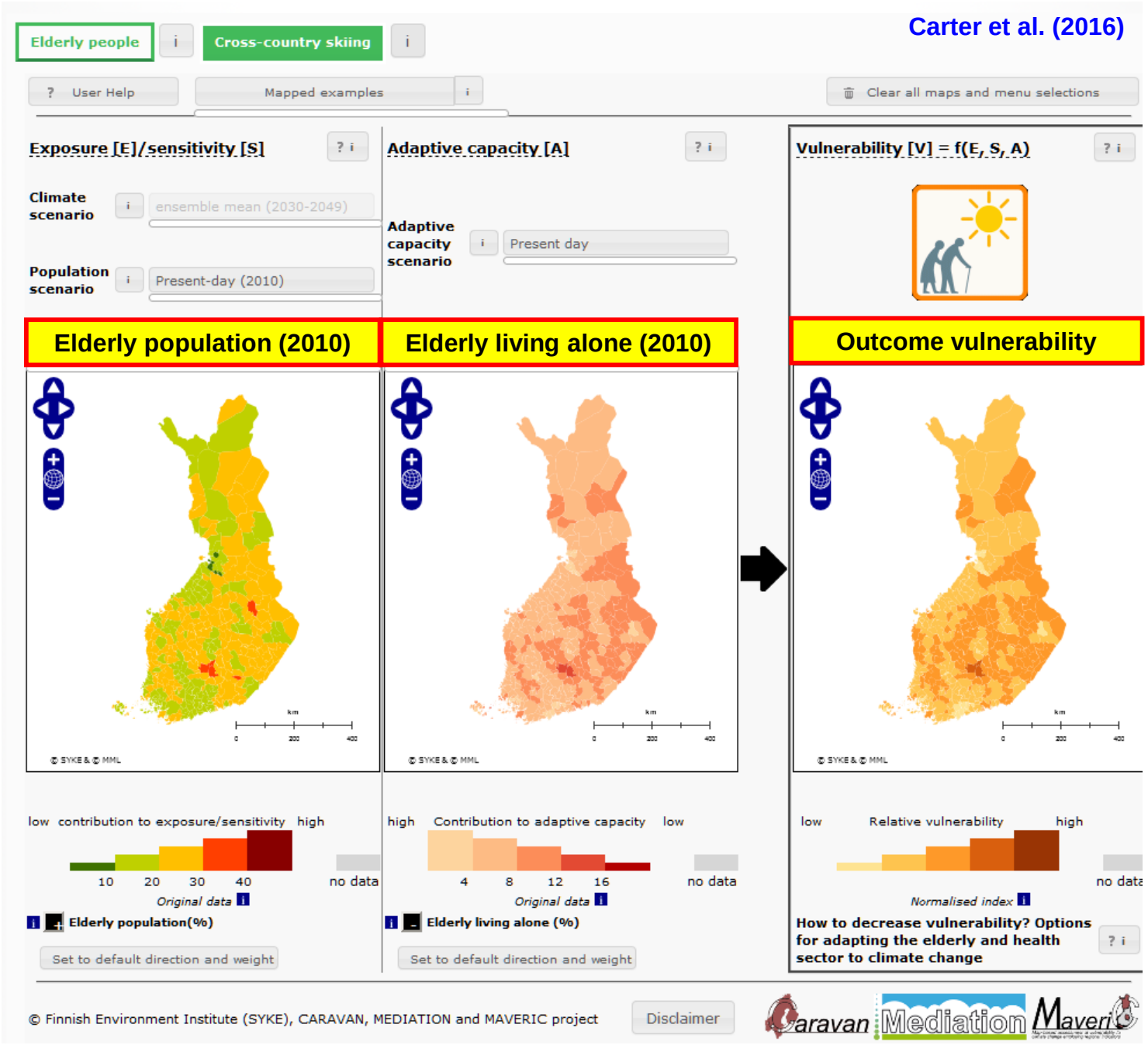
Adapted from Preston and Stafford-Smith (2009)



Carter et al. (2016)

CLIMATE CHANGE PROGRAMME

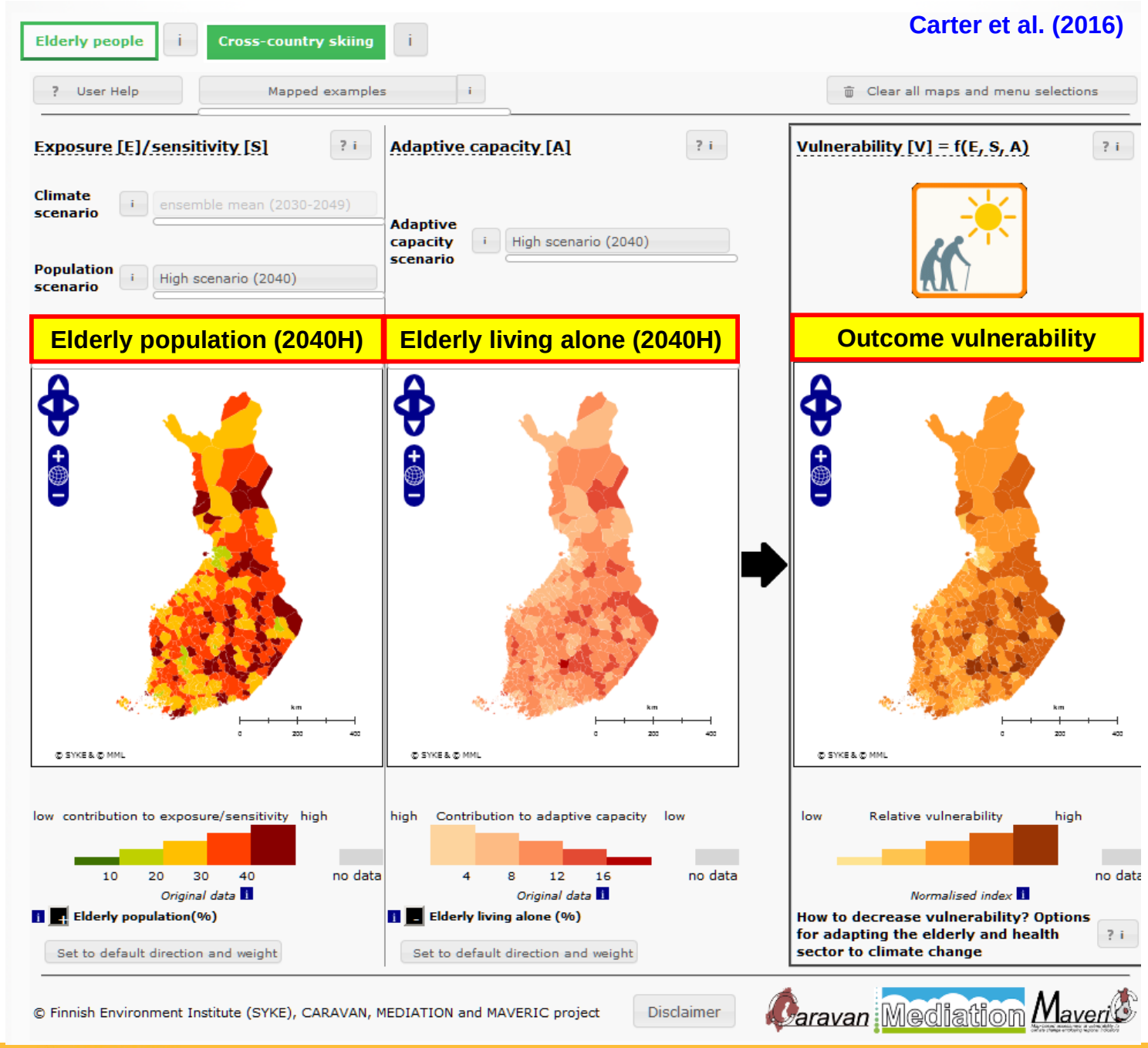
Carter et al. (2016)



Disclaimer

SYKE

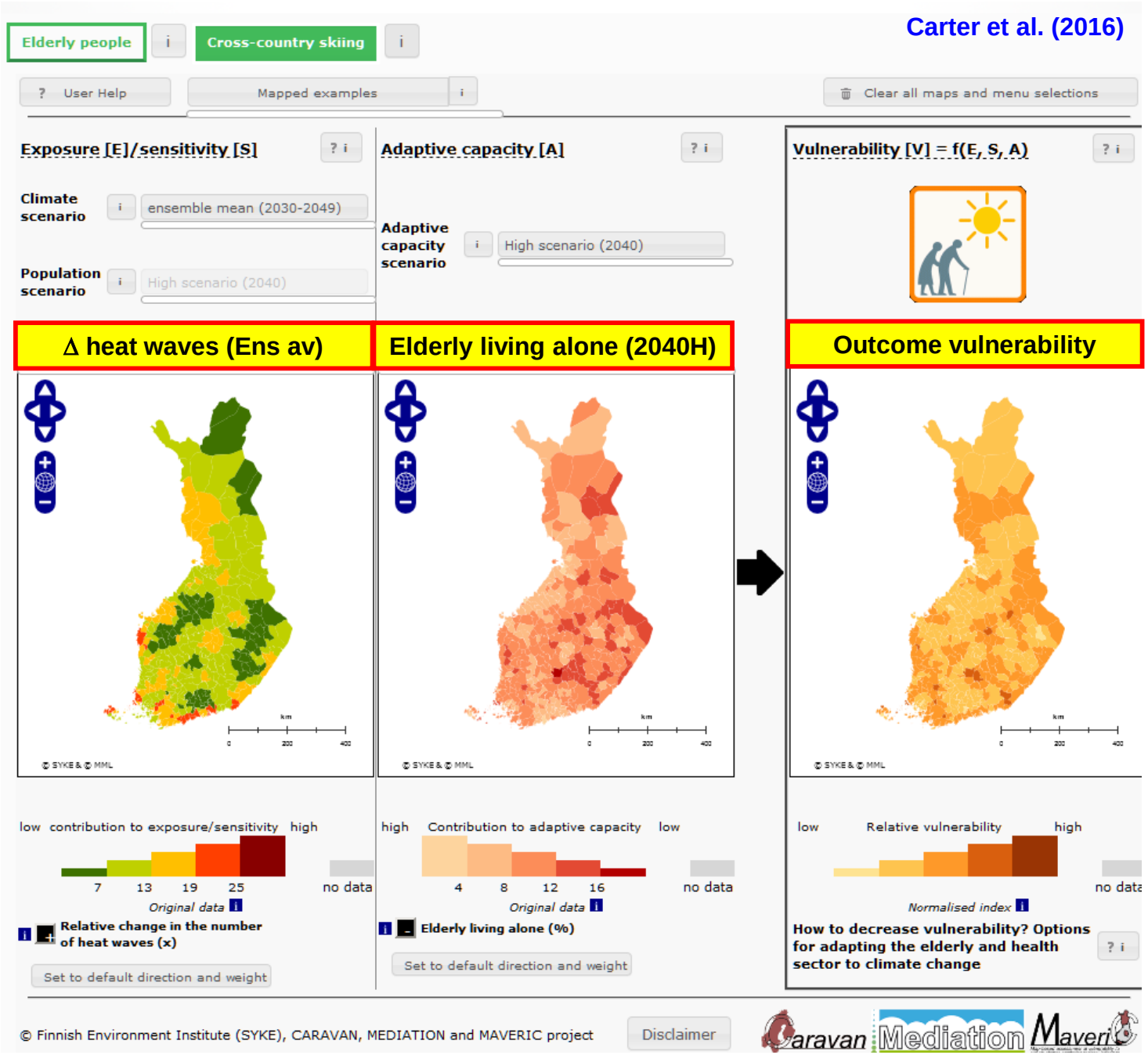
Carter et al. (2016)



SYKE

CLIMATE CHANGE PROGRAMME

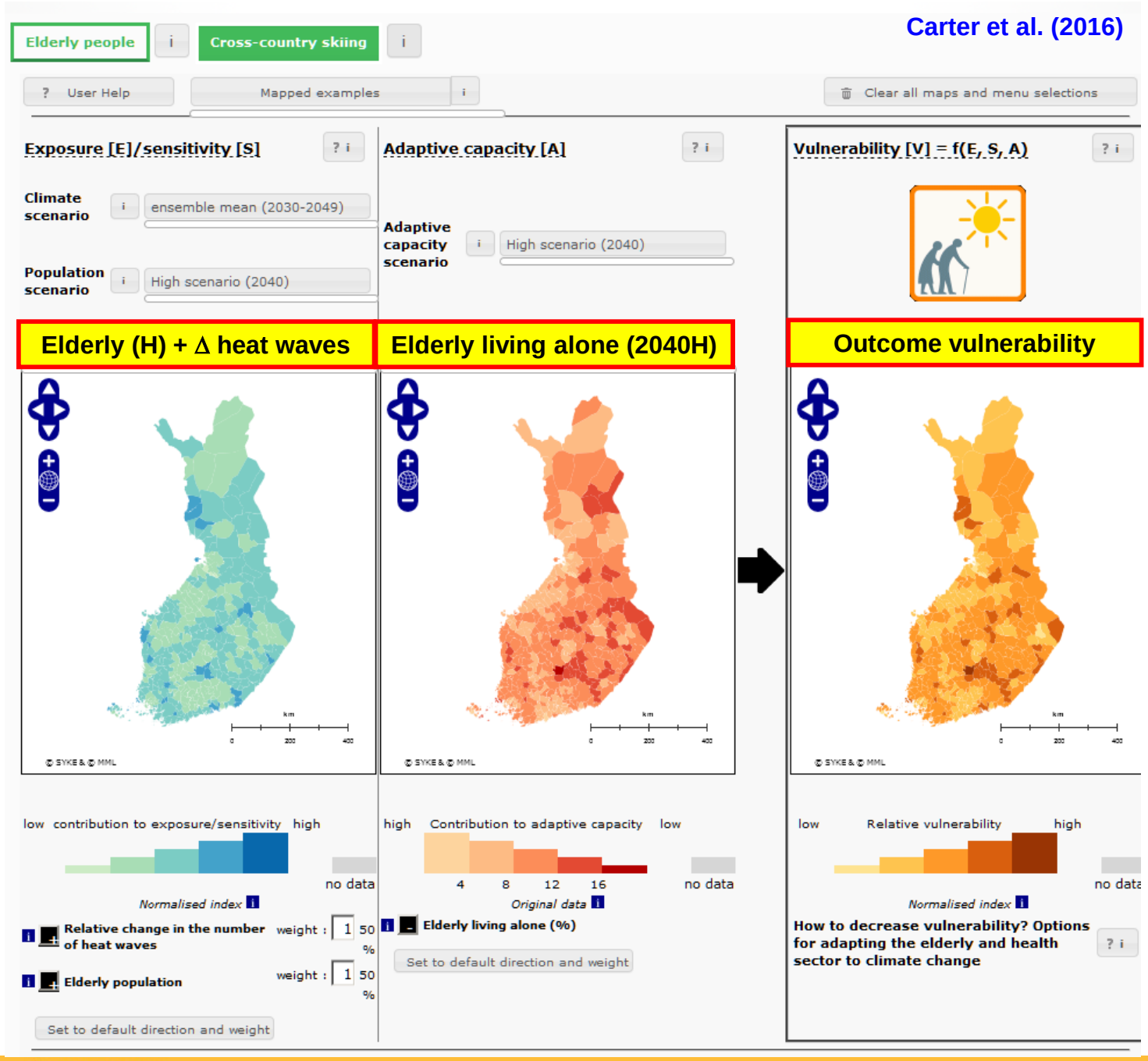
Carter et al. (2016)



SYKE

CLIMATE CHANGE PROGRAMME

Carter et al. (2016)



SYKE

1. Mapping outcome vulnerability

Messages:

- User interface for stakeholder participation
- Considers present-day & future adaptive capacity
- Indicators are presented transparently
- Flexible options for indicator selection and manipulation (weighting and direction of effect)
- Indicators combined by users, rather than researchers
- Framing of vulnerability outdated

2. Towards unbiased mapping of risk

Potential impacts of climate change

Risk assessment (AR5)

R = f (H, E, V)

where:

H = Hazard

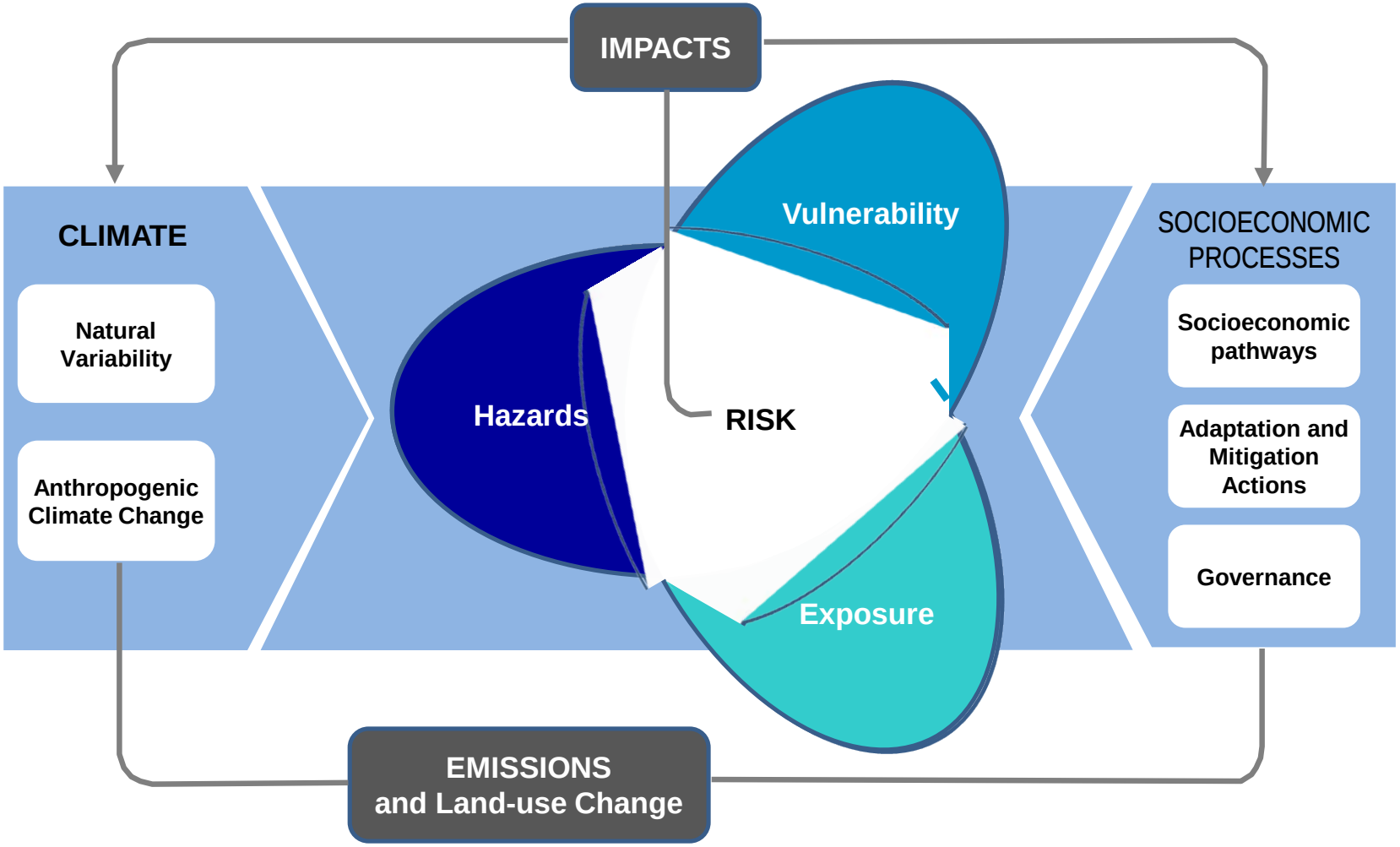
E = Exposure

V = "Starting point" or "contextual" Vulnerability

IPCC AR5, Field et al. (2014)

CLIMATE CHANGE PROGRAMME

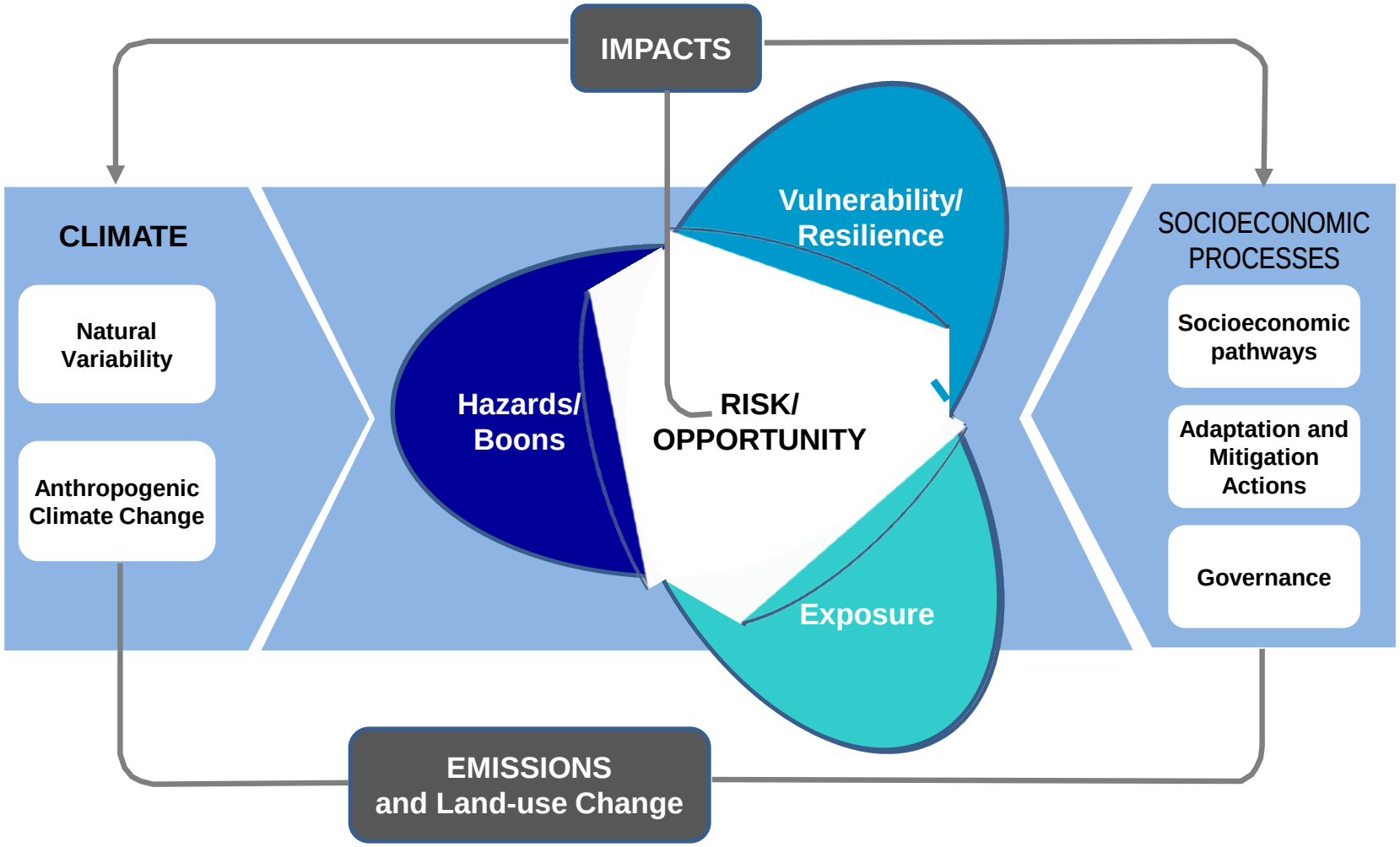
Framing potential impacts (risk - IPCC AR5)



IPCC AR5, Field et al. (2014)

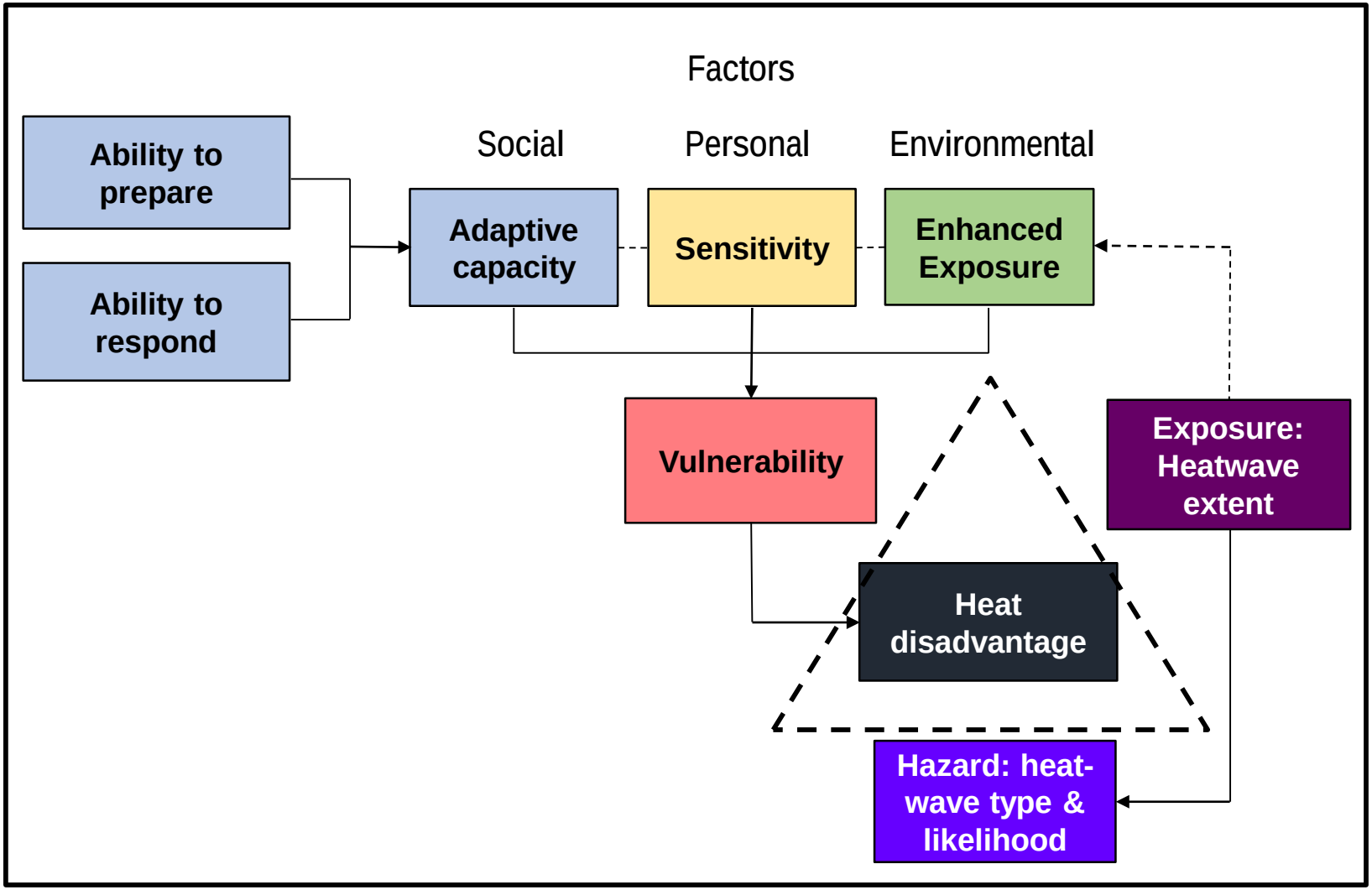
SYKE

Framing potential impacts (unbiased)



Modified from Field et al. (2014)

Framework of social vulnerability to heatwaves and heat disadvantage



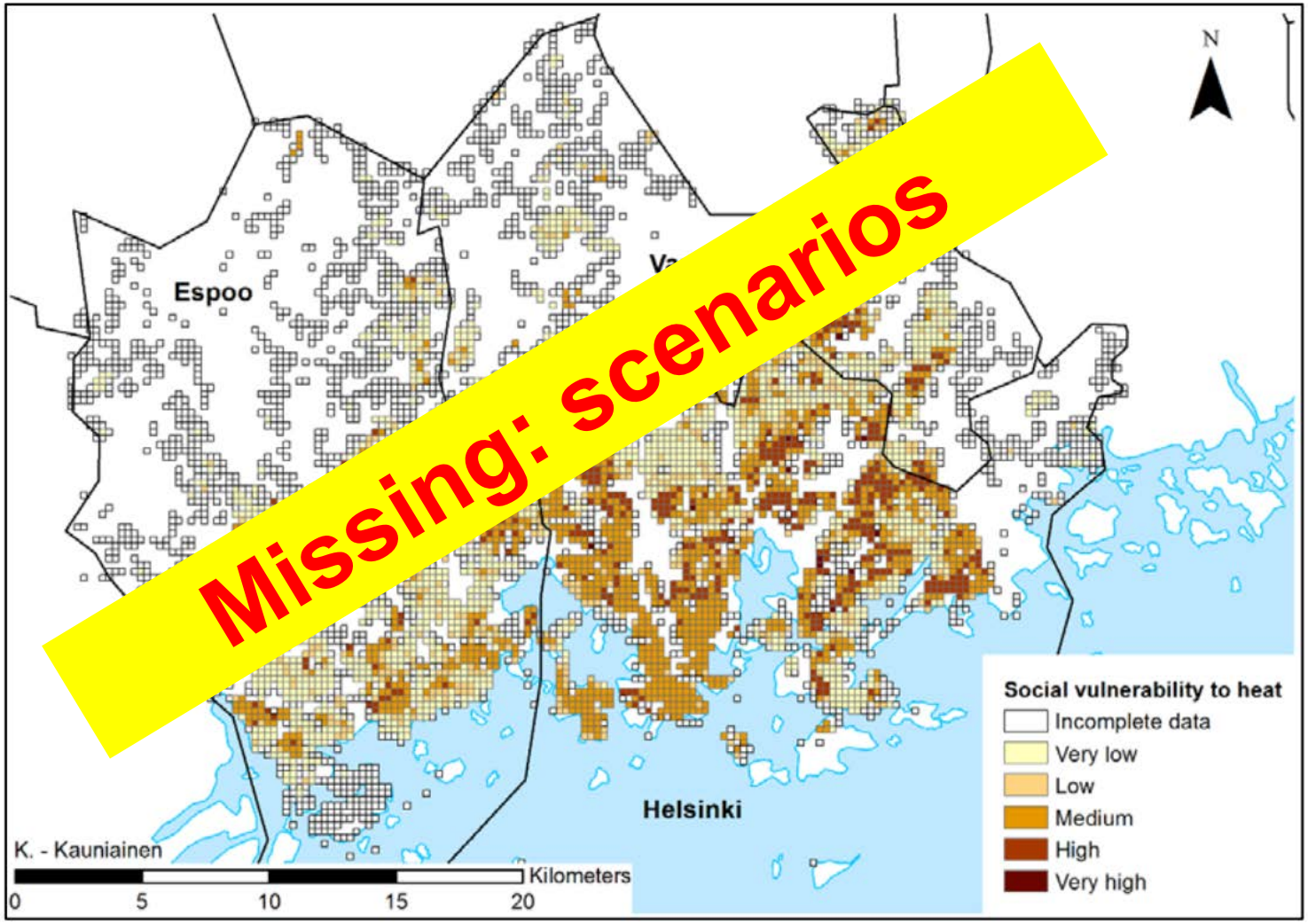
Source: Modified from Kazmierczak et al. (2015)

Indicators of social vulnerability to heat and flooding identified for Helsinki Metropolitan Area

Code[3]	Indicator	Aspect of vulnerability	Weight in vulnerability to flooding	Weight in vulnerability to heat	Sensitivity	Dimensions of social vulnerability to flooding				Dimensions of social vulnerability to heat		
						Ability to prepare	Ability to respond	Ability to recover	Enhanced exposure	Ability to prepare	Ability to respond	Enhanced exposure
i_1	Location within 1km from a railway station	Access	0.25	0			Y					
i_2	Accessibility zone	Access	0.25	0			Y					
i_3	Percentage of households with no car	Access	0.25	0			Y					
i_4	Access in case of emergency	Access	0.25	0			Y					
i_5	Percentage of people with basic studies	Information	1	1		y	y	Y		y	Y	
i_6	Percentage of children 0-6 years old	Age	0.5	0.5	Y							
i_7	Percentage of people over 75 years old	Age	0.5	0.5	Y							
i_8	Percentage of unemployed in labour force	Income	0.25	0.25		y	y	Y		y	Y	
i_9	Percentage of economically inactive people in the population	Income	0.25	0.25		y	y	Y		y	Y	
i_10	Percentage of long-term unemployed in the labour force	Income	0.25	0.25		y	y	Y		y	Y	
i_11	Median household income	Income	0.25	0.25		y	y	Y		y	Y	
i_12	Occupancy rate	Overcrowding	0.5	0			y	Y				
i_13	Percentage of households containing 7 or more people	Overcrowding	0.5	0			y	y				
i_14	Percentage of dwellings in flats	Housing	0	1								Y
i_15	Percentage of water area in the grid cell	Physical environment	0	0.33								Y
i_16	Percentage of total green space area in the land area	Physical environment	1	0					y			
i_17	Percentage of low vegetation area in the land area	Physical environment	0	0.33								Y
i_18	Percentage of area covered by trees in land area	Physical environment	0	0.33								Y
i_19	Percentage of students in the population	Social networks	0.33	0		y	y	Y				
i_20	Percentage of single person households	Social networks	0.33	0.5		y	y	Y		y	Y	
i_21	Percentage of school age children in the population	Social networks	0.33	0.5		y	y	Y		y	Y	
i_22	Percentage of rented households	Tenure	0.5	0.5		y		Y		y		
i_23	Percentage of dwellings rented from ARA	Tenure	0.5	0.5		Y		y		y		
Number of indicators used in calculation of indices		**23**	**19**	**15**	**2**	**10**	**14**	**12**	**1**	**9**	**7**	**4**

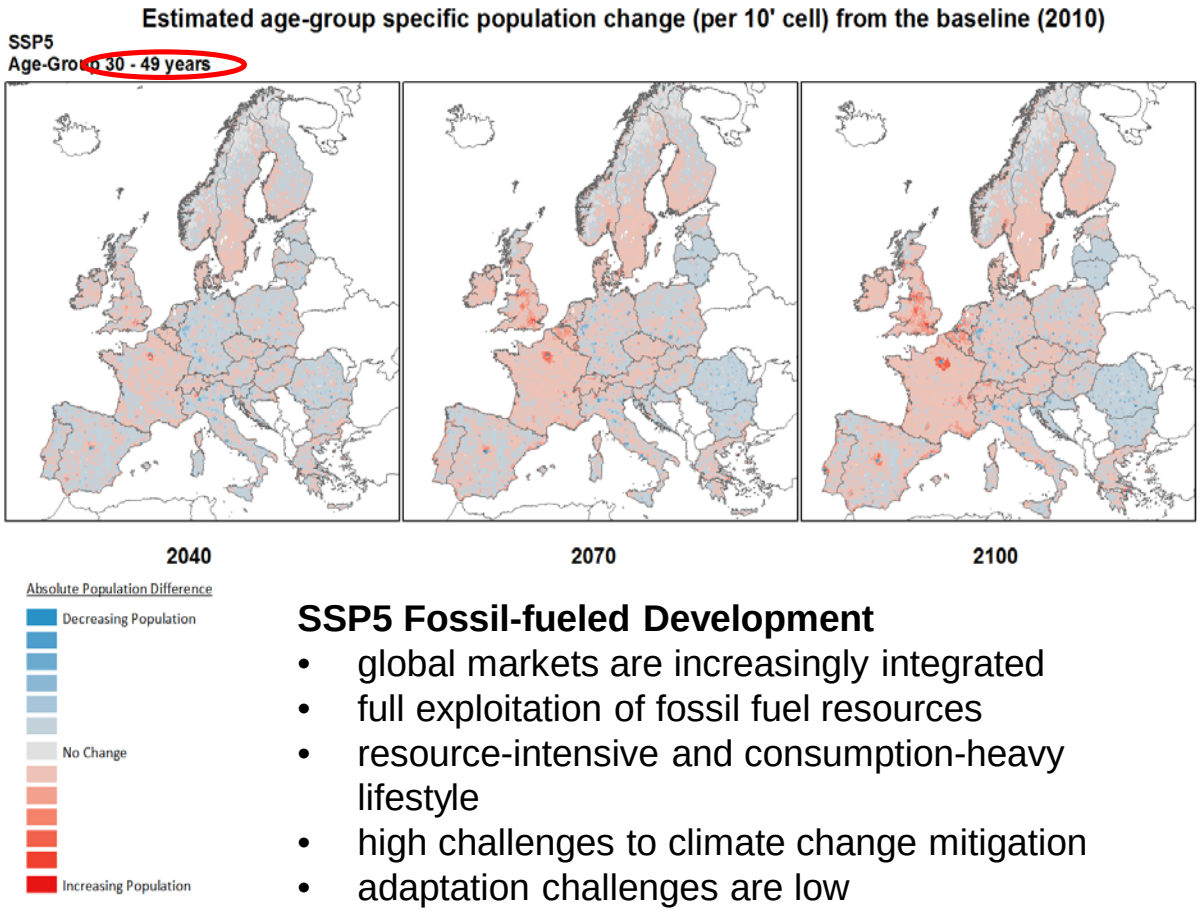
Source: Kazmierczak et al. (2015)

Social vulnerability to high temperatures in the Helsinki Metropolitan Area



Source: Kazmierczak et al. (2015)

Integrating sub-national population projections with an urban growth model for Europe



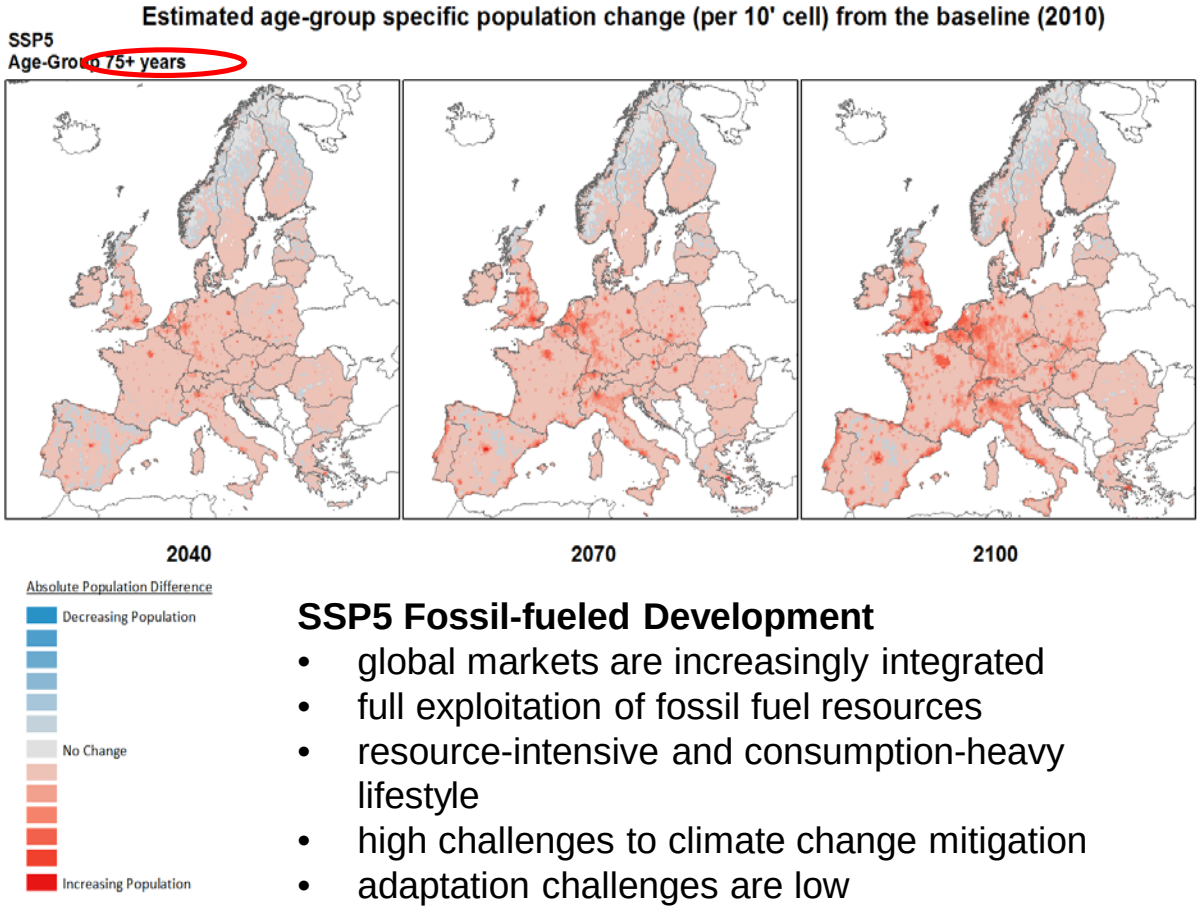
SSP5 Fossil-fueled Development

- global markets are increasingly integrated
- full exploitation of fossil fuel resources
- resource-intensive and consumption-heavy lifestyle
- high challenges to climate change mitigation
- adaptation challenges are low

Source: Terämä et al. (2017)

SYKE

Integrating sub-national population projections with an urban growth model for Europe



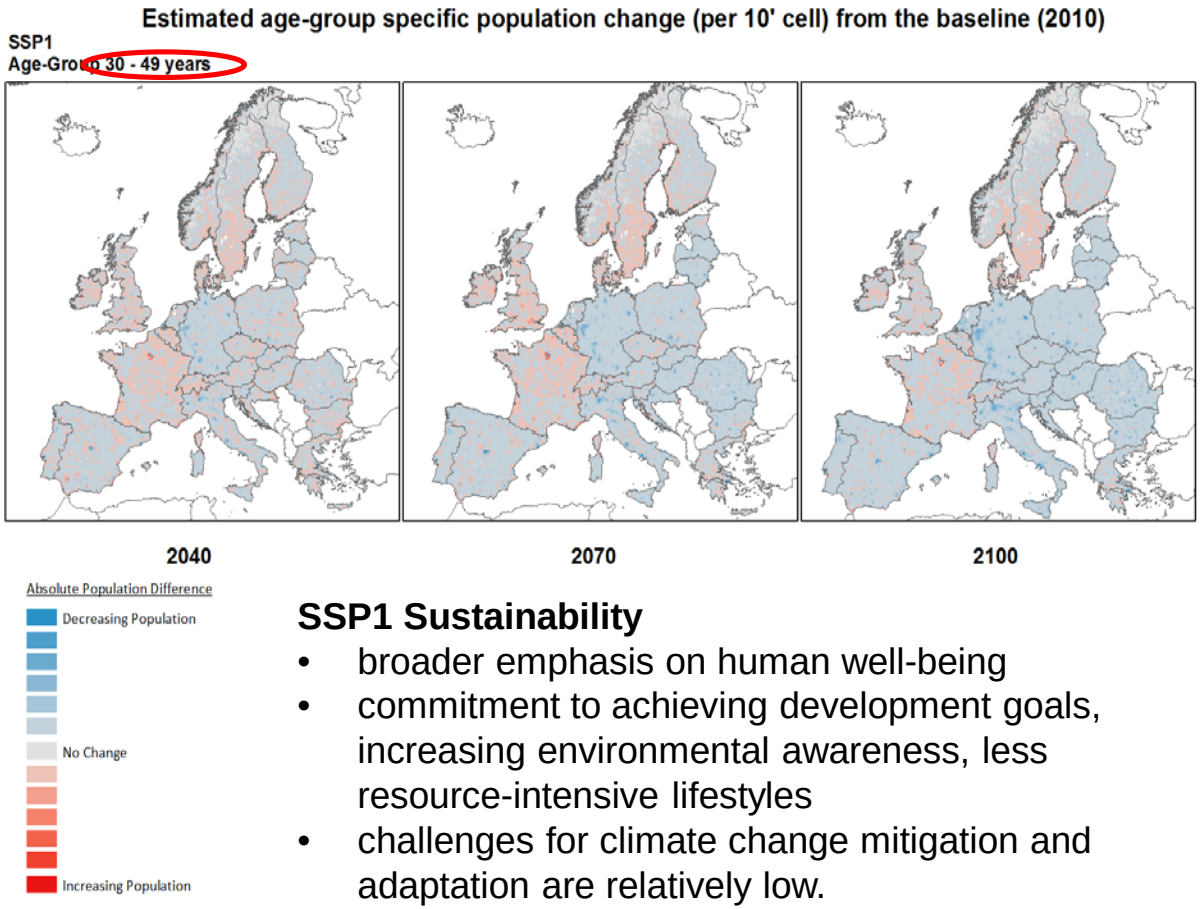
SSP5 Fossil-fueled Development

- global markets are increasingly integrated
- full exploitation of fossil fuel resources
- resource-intensive and consumption-heavy lifestyle
- high challenges to climate change mitigation
- adaptation challenges are low

Source: Terämä et al. (2017)

SYKE

Integrating sub-national population projections with an urban growth model for Europe



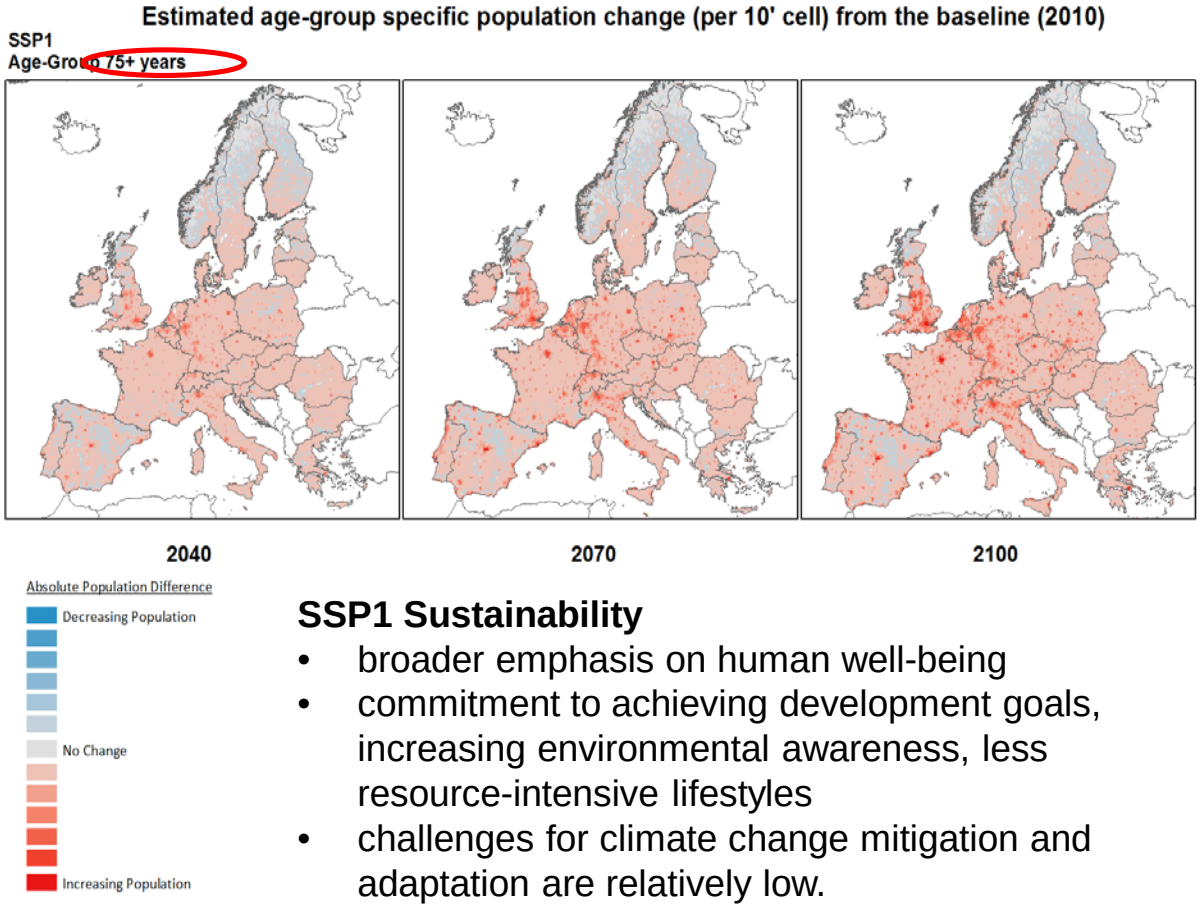
SSP1 Sustainability

- broader emphasis on human well-being
- commitment to achieving development goals, increasing environmental awareness, less resource-intensive lifestyles
- challenges for climate change mitigation and adaptation are relatively low.

Source: Terämä et al. (2017)

SYKE

Integrating sub-national population projections with an urban growth model for Europe



SSP1 Sustainability

- broader emphasis on human well-being
- commitment to achieving development goals, increasing environmental awareness, less resource-intensive lifestyles
- challenges for climate change mitigation and adaptation are relatively low.

Source: Terämä et al. (2017)

SYKE

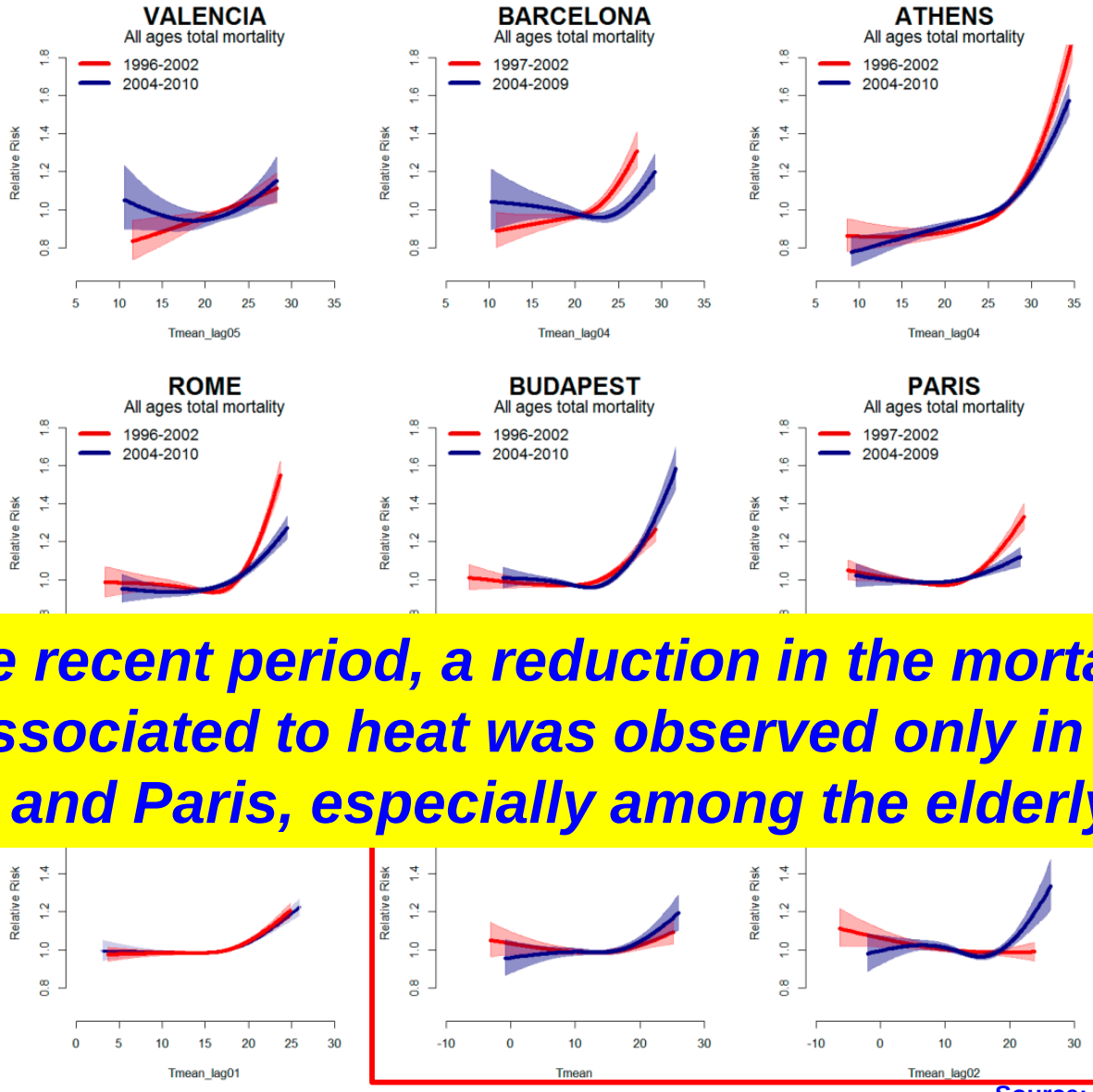
2. Towards unbiased mapping of risk

Messages:

- National mapping inadequate for local response
- Social vulnerability mapping initiated in Helsinki
- Fine resolution hazard information missing
- SSP-based scenario development in progress
- Unbiased approach identifies risks & opportunities

3. Observed impacts and adaptation

Mean temperature–mortality relationship (95% confidence limits) 1996-2002 (red lines) and 2004-2010 (blue lines) in nine European cities

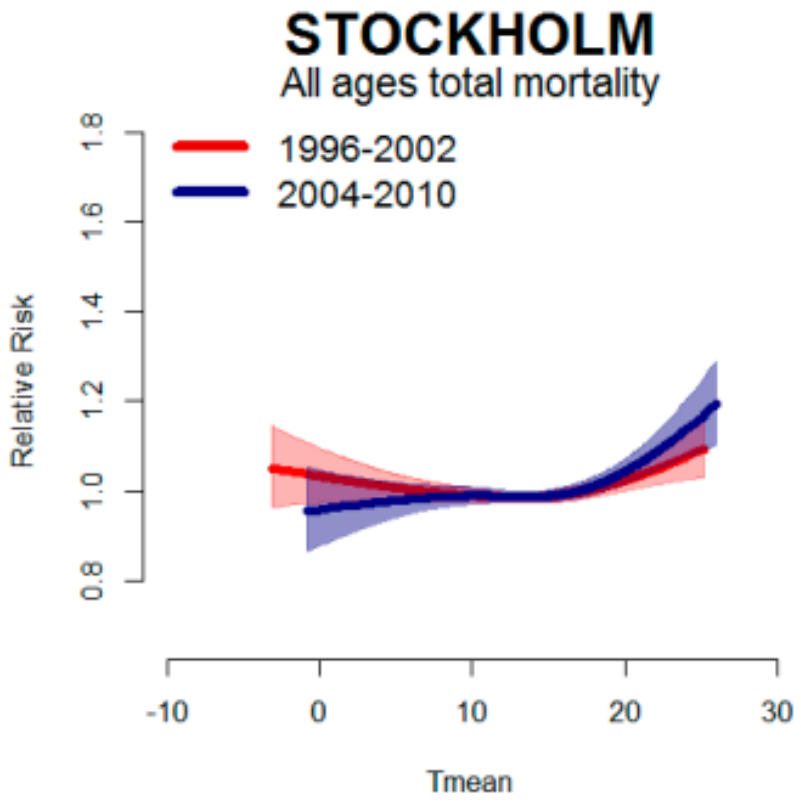


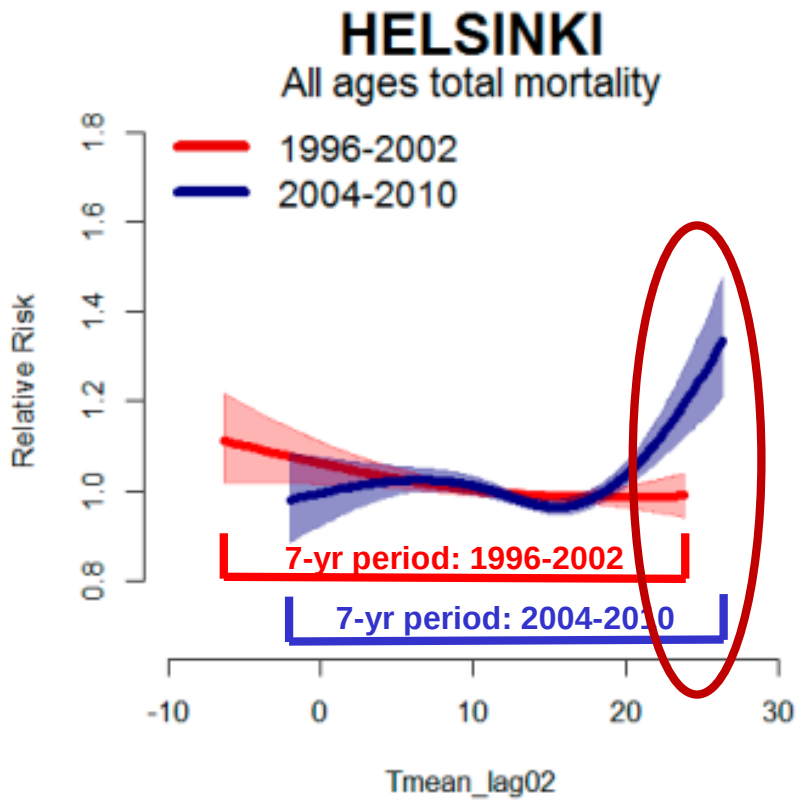
"In the recent period, a reduction in the mortality risk associated to heat was observed only in Athens, Rome and Paris, especially among the elderly."

Source: de' Donato et al. (2015)

Mean temperature–mortality relationship (95% confidence limits) pre-2003 (red lines) and post-2003 (blue lines) in nine European cities

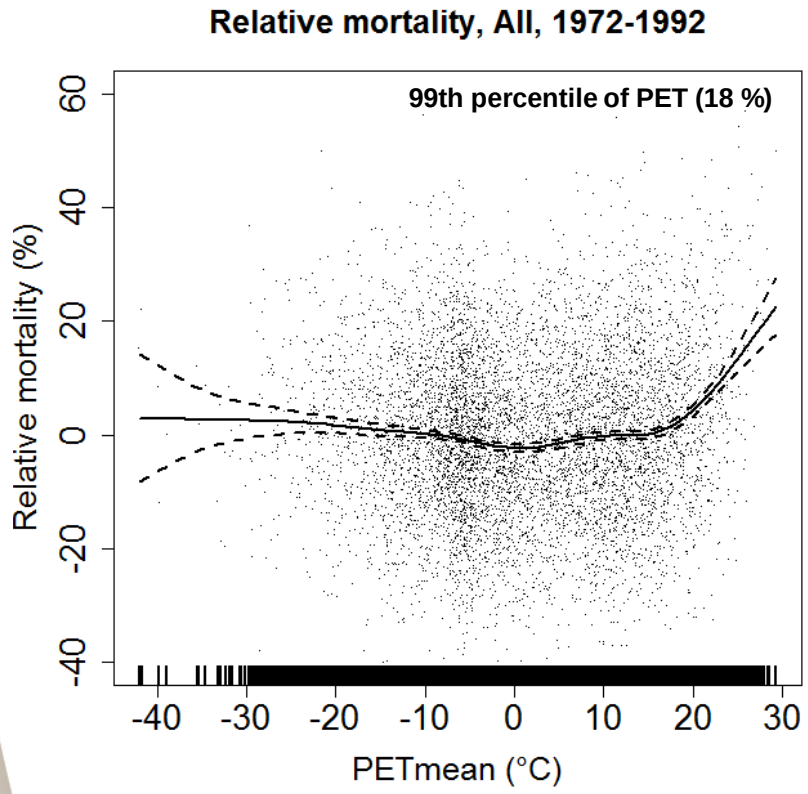
"In Helsinki and Stockholm, there is a suggestion of increased heat effect."

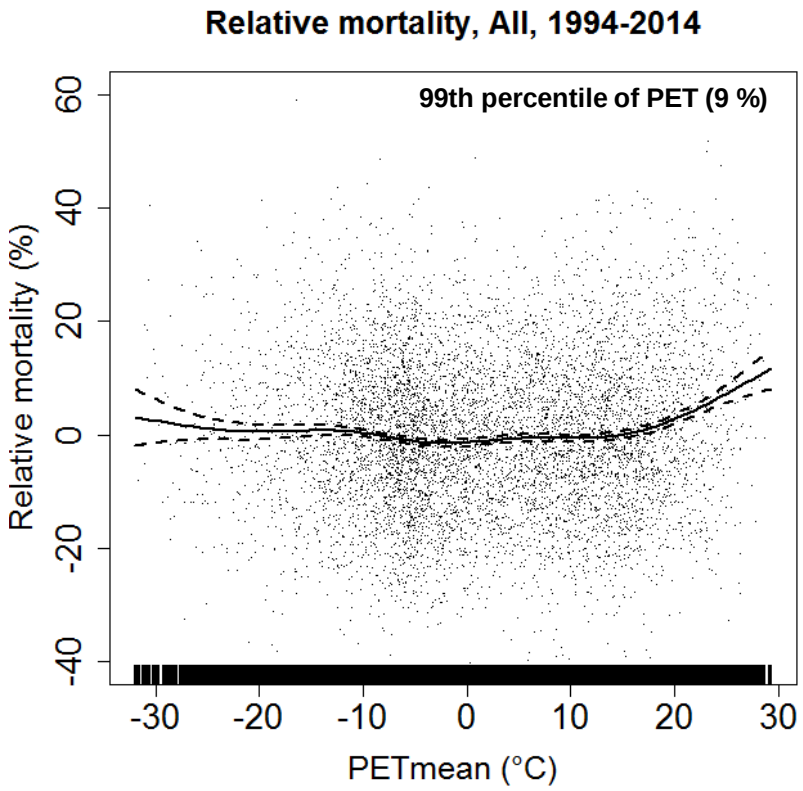




Source: de' Donato et al. (2015)

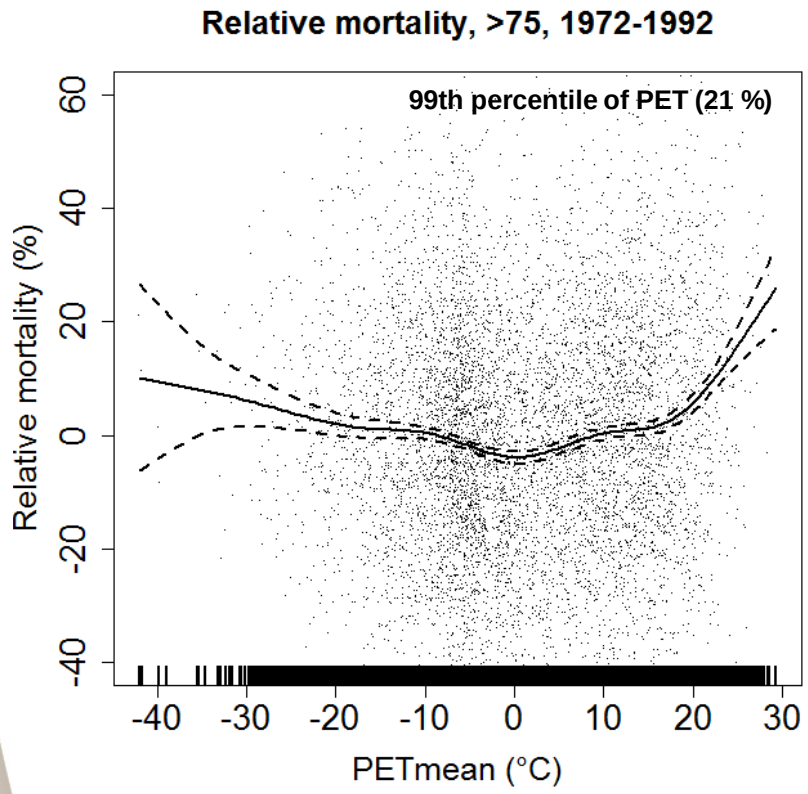
Helsinki: relative mortality (all) 1972-1992 & 1994-2014
Evidence of reduced sensitivity to high temperatures

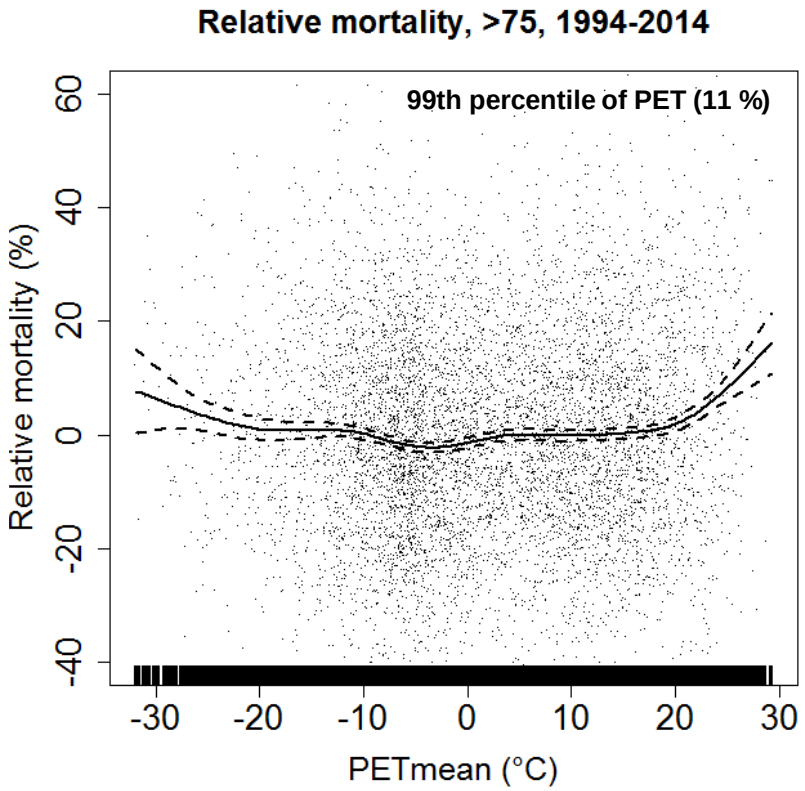




Ruuhela et al. (2017)

Helsinki: relative mortality (>75) 1972-1992 & 1994-2014
Evidence of reduced sensitivity to high temperatures





Ruuhela et al. (2017)

3. Observed impacts and adaptation

Messages:

- **The choice of analytical method may be crucial for determining outcomes**
- **Heatwave sensitivity has declined in Helsinki**
- **Is this adaptation?**

Conclusions

Challenges for research on health impacts in Finland:

- Stakeholders: national vulnerability mapping tool helpful for awareness raising, but need localised information
- Need to reframe vulnerability in terms of risks and opportunities
- Mapping of social vulnerability could be extended
- Fine resolution hazard assessment needed
- Scenario analysis required for projecting all indicators
- Modelling of heatwave mortality requires analytical care
- No targeted research funding for climate change and human health in Finland

Thank you for listening