ILMATIETEEN LAITOS
METEOROLOGISKA INSTITUTET
FINNISH METEOROLOGICAL INSTITUTE

Synthesis of adaptation research in different sectors in Finland

- How to adapt to inevitable climate change?

Second Nordic International Conference on Climate Change Adaptation
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Needs and aims of the Synthesis

- **Review of Climate Change Adaptation Research Programme, ISTO, 2006-2010**
- **Revision of Finland's NAS**
- **EU Adaptation Strategy under preparation**
- **Basis for plans for further adaptation research (programmes)**

=> A need for wider coverage and review of adaptation research in Finland

=> Tens of researchers from several research institutions and universities, and private consulting agencies participated the work

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How to adapt to inevitable climate change?
- A synthesis of Finnish research on adaptation in different sectors

Content of the report:

- Summary of the results of adaptation research in various sectors in Finland
    - climate change in Finland
    - use of natural resources, business, biodiversity, built environment, health
- International aspects
- Cross-cutting issues
    - climate risk assessment and management
    - regional vulnerability
    - economic impacts
    - social impacts
- Needs for further research
- The self-evaluation of the level of adaptation research by the researchers' community

Process – a survey, workshops… writing

3. Ilmastonmuutoksen sopeutumistutkimus on tuottanut toimialalla tietoa, jota voidaan soveltaa käytännön sopeutumistoimissa

Kysymykseen vastanneet: 26

	-5	-4	-3	-2	-1	0	1	2	3	4	5
Maatalous (ka: 2.75; yht: 24)	0% 0	0% 0	0% 0	4.2% 1	0% 0	8.3% 2	4.2% 1	20.8% 5	20.8% 5	33.3% 8	8.3% 2
Metsätalous (ka: 3.042; yht: 24)	0% 0	0% 0	0% 0	4.2% 1	0% 0	8.3% 2	4.2% 1	16.7% 4	12.5% 3	33.3% 8	20.8% 5
Kalatalous (ka: 0.952; yht: 21)	0% 0	4.8% 1	0% 0	4.8% 1	0% 0	33.3% 7	14.3% 3	23.8% 5	14.3% 3	4.8% 1	0% 0
Porotalous (ka: 0.6; yht: 20)	0% 0	5% 1	0% 0	5% 1	5% 1	40% 8	20% 4	10% 2	5% 1	10% 2	0% 0
Riistatalous (ka: 0; yht: 20)	0% 0	5% 1	15% 3	5% 1	0% 0	45% 9	5% 1	10% 2	10% 2	5% 1	0% 0
Vesivarat (ka: 2.5; yht: 22)	0% 0	0% 0	4.5% 1	4.5% 1	0% 0	18.2% 4	0% 0	4.5% 1	22.7% 5	31.8% 7	13.6% 3
Luonnon monimuotoisuus (ka: 1.273; yht: 22)	0% 0	0% 0	4.5% 1	9.1% 2	4.5% 1	13.6% 3	13.6% 3	31.8% 7	4.5% 1	18.2% 4	0% 0
Teollisuus (ka: 0.348; yht: 23)	4.3% 1	8.7% 2	4.3% 1	8.7% 2	4.3% 1	21.7% 5	4.3% 1	21.7% 5	13% 3	4.3% 1	4.3% 1
Energia (ka: 1.773; yht: 22)	0% 0	0% 0	4.5% 1	0% 0	4.5% 1	22.7% 5	9.1% 2	9.1% 2	31.8% 7	18.2% 4	0% 0
Liikenne- ja tietoliikenne (ka: 1.682; yht: 22)	0% 0	4.5% 1	0% 0	0% 0	0% 0	22.7% 5	9.1% 2	27.3% 6	22.7% 5	13.6% 3	0% 0
Alueiden käyttö ja yhdyskunnat (ka: 1.652; yht: 23)	0% 0	4.3% 1	0% 0	0% 0	0% 0	21.7% 5	8.7% 2	34.8% 8	21.7% 5	4.3% 1	4.3% 1
Rakentaminen ja rakennukset (ka: 1.565; yht: 23)	4.3% 1	0% 0	0% 0	4.3% 1	4.3% 1	13% 3	8.7% 2	30.4% 7	17.4% 4	17.4% 4	0% 0
Terveys (ka: 0.364; yht: 22)	4.5% 1	4.5% 1	4.5% 1	0% 0	9.1% 2	27.3% 6	18.2% 4	18.2% 4	9.1% 2	4.5% 1	0% 0
Matkailu ja luonnon virkistyskäyttö (ka: 1.545; yht: 22)	0% 0	0% 0	0% 0	0% 0	13.6% 3	13.6% 3	13.6% 3	31.8% 7	18.2% 4	9.1% 2	0% 0
Vakuutustoiminta (ka: 0.667; yht: 21)	4.8% 1	0% 0	0% 0	4.8% 1	19% 4	14.3% 3	9.5% 2	33.3% 7	14.3% 3	0% 0	0% 0
Sisäinen ja ulkoinen turvallisuus (ka: 0; yht: 21)	14.3% 3	0% 0	4.8% 1	4.8% 1	14.3% 3	19% 4	9.5% 2	9.5% 2	14.3% 3	9.5% 2	0% 0
ka: 1.33; yht: 352	2% 7	2.3% 8	2.6% 9	3.7% 13	4.8% 17	21% 74	9.4% 33	21% 74	15.9% 56	13.9% 49	3.4% 12

Where are we in 2012? - researchers' point of view

- Research is on very different level on different sectors
  - Most advanced: agriculture, forestry, water resources
  - In many important sectors
    - the weather and climate dependencies are not known well enough
    - only qualitative assessments based on experts' judgment on impacts of climate change could be done
- Adaptation measures are sensible regardless of the uncertainty related to the climate change scenarios
  - They may support also other aims in the sector - sustainable development
- Economic impacts and costs and benefits of adaptation are not known well enough
- The future adaptation research programmes hopefully facilitate
  - Multi-disciplinary research
  - Research on impacts and adaptation within systems
  - Economic assessments
  - Monitoring the changes
- Researchers are willing to communicate their results for stakeholders and hope that the results are utilized in decision-making and practical adaptation measures

In Finland temperature will increase more than the global average

- Aim of climate negotiations: to limit **global** temperature increase **max 2 °C**

=> In Finland temp increase **in winter about 5 °C** and **in summer > 2 °C**

=> the speed of the change is a challenge for nature and society in Finland

Changes globally and in Finland in some SRES-scenarios, ref. 1971-2000

	2010-2039			2040-2069			2070-2099		
	B1	A1B	A2	B1	A1B	A2	B1	A1B	A2
Concentration (ppm)	421	434	431	491	542	547	532	655	721
Change in global annual mean temperature (°C)	0,8	0,9	0,8	1,4	1,8	1,8	1,8	2,6	3,0
Change in annual mean temperature in Finland (°C)	1,5	1,6	1,5	2,5	3,2	3,2	3,2	4,4	5,0
Change in annual mean precipitation in Finland (%)	6	5	5	9	12	11	12	17	19

Variable	Area	XII-II	III-V	VI-VIII	IX-XI	Year	Remarks
Mean temperature	North	+	+	+	+	+	Temperature rise
	South	+	+	+	+	+	smallest in summer.
Mean precipitation	North	+	+	+	+	+	
	South	+	+	/	+	+	
Thermal season length	North	-	/	+	/		
	South	-	+	+	+		
Daily maximum temperature	North	+	+	+	+	+	Temperature rise
	South	+	+	+	+	+	smallest in summer.
Daily minimum temperature	North	+	+	+	+	+	Temperature rise
	South	+	+	+	+	+	smallest in summer.
Number of frost days	North	-	-	-	-	-	
	South	-	-	-	-	-	
Number of freezing point days	North	+	-	-	-	/	First freezing point days in winter
	South	/	-	-	-	-	more frequent in south
Snow water equivalent	North	-	-		-	-	Decrease starts from south and
	South	-	-		-	-	from autumn and spring
Number of snow cover days	North	-	-		-	-	Decrease starts from south and
	South	-	-		-	-	from autumn and spring
Number of days with precipitation	North	+	+	( )	+	+	
	South	+	( )	-	( )	+	
Intensity of heavy precipitation	North	+	+	+	+	+	
	South	+	+	+	+	+	
Number of consecutive dry days	North	/	-	( )	-	-	
	South	-	( )	( )	( )	( )	
Cloudiness	North	+	/	(-)	/	+	
	South	+	/	(-)	/	+	
Soil frost	North	-	-		-	-	Calculations made for non-snow-
	South	-	-			-	covered areas (roads, airports, etc.)

Agriculture

Time frame for implementation of adaptation options for the future anticipated changes

Time frame	Anticipated change
2015→	Increased need for crop protection and more diverse control options: anticipation and control increasingly important to avoid production risks and volatility in yields
2015-2025	Current cultivars give way: new range of cultivars move gradually from southernmost towards northern regions of Boreal Zone. Yield potentials increase as do also realised yields in case of successful adaptation measures.
2015-2025	Cropping systems are diversified: for example, oilseed rape has replaced turnip rape also in the Northern European cropping systems and grain legumes are cultivated more commonly to improve crop-based protein self-sufficiency and benefit from many of the ecosystem services (including nitrogen) that diversified cropping systems provide.
2020-2040	Crop production is sustainably intensified and thereby concentrated to the most favourable production regions in Boreal countries: excess arable land is used e.g. for production of commodity exports, bioenergy production, strongly specialized production and/or as nature managed fields.
2020-2040	Water management systems for northern agro-ecosystems have been developed and implemented especially into sustainably intensified production regions of Boreal Zone. Thereby, nutrient cycles are more "closed".
2055	→ Spring sown crops are largely replaced by winter types and cultivars. This concern many cereals and rapeseed in particular.
21st century	Extreme weather events cause great deal of uncertainty for the production: spatial and temporal success in production is accompanied with failures elsewhere. Adaptation needs to become more and more appreciated as a mean to improve resilience of northern agro-ecosystems.

Forestry

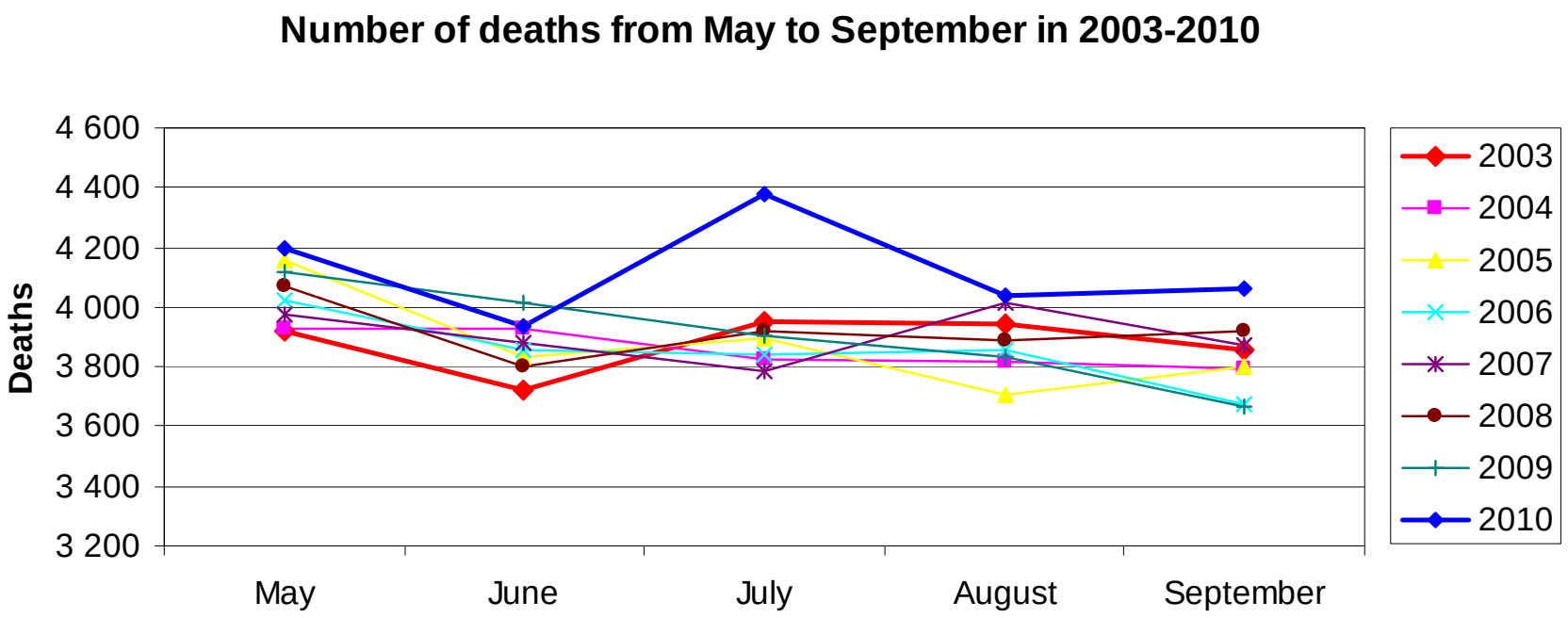
Expected effects of climate change and adaptation measures needed on different time scales	**2010-2039**	**2040-2069**	**2070-2099**
Positive effects:			
Forest growth	↑	↑↑	↑↑↑
Carbon sequestration (stocks)	↑	↑↑	↑↑
Harvesting potential	↑	↑↑	↑↑
Negative effects:			
Growth of Norway spruce	↓	↓↓	↓↓↓
Unfrozen soil period	↑	↑↑	↑↑↑
Risk to forests from wind	↑	↑↑	↑↑↑
Risk to forests from snow	↑↓	↓↓	↓↓↓
Risk of forest fires	↑	↑	↑↑
Drought risk to Norway spruce (in south)	↑	↑↑	↑↑↑
Risk of insect damages	↑	↑↑	↑↑↑
Risk of forest pathogens	↑	↑↑	↑↑↑
New pests and invading species	↑	↑↑	↑↑↑
Forest diversity	↓	↓↓	↓↓↓
Suitable period for harvesting operations	↓	↓↓	↓↓↓
Adaptation measures:			
Site (fertility and soil texture) specific selection of species /genetic entry	↑	↑↑	↑↑↑
Increase of carbon sequestration (stocks)	↑	↑↑	↑↑↑
Consideration of risks in forest management	↑	↑↑	↑↑↑
Consideration of forest hygiene (and health)	↑	↑↑	↑↑↑
Consideration of diversity in forests	↑	↑↑	↑↑↑
Increase of utilization of forest biomass in energy production and wood based products	↑	↑↑	↑↑↑
Development of forest harvesting operations	↑	↑↑	↑↑↑

Water resources

Table 1. The most significant negative and positive impacts of climate change on water resources and adaptation possibilities.

Impact	Area or watershed	Adaptation measures
Risk of frazil ice floods in rivers increases	• Kokemäenjoki • Oulujoki • Kymijoki • Eurajoki • Ähtävänjoki	• Coordinated short-term lake regulation • Long-term lake regulation, lower autumn water levels
Increase in winter floods, probable increase in total flood risk	• Saimaa and Vuoksi • Oulujärvi and Oulujoki • Kokemäenjoki • Päijänne and Kymijoki • Karjaanjoki • Eurajoki • Karvianjoki	• Long-term lake regulation, changes in regulation permits and practices • Forecasts, warnings • Land use planning, flood maps • Flood risk management plans • Levees and other permanent structures • Temporary flood protection measures • Retention of flood waters in runoff areas • Flood insurance
Decrease of spring floods and flood damages caused by them	• Upstream lakes in watershed Vuoksi, Kymijoki, Kokemäenjoki and Oulujoki • Rivers in Ostrobothnia from the middle of the century onwards • Rivers in Southern Finland	• Long-term lake regulation, changes in regulation permits and practices
Increase in summer floods caused by extreme precipitation	• Small rivers on the coastal area • Urban areas	• Retention of flood waters in runoff areas • Environmental urban planning, less impermeable surfaces • Flood routes in urban areas • Design of storm water sewers • Improvements in the security of water supply systems • Flood insurance
Increase of summer dryness and low water levels	• Lake district • Rivers and lakes in southern coastal area and Ostrobothnia	• Long-term lake regulation • Starting lake regulation on unregulated lakes • Construction of submerged weirs • Adjustment of turbines in water power

Heat wave in July 2010: about 400 extra deaths in Finland

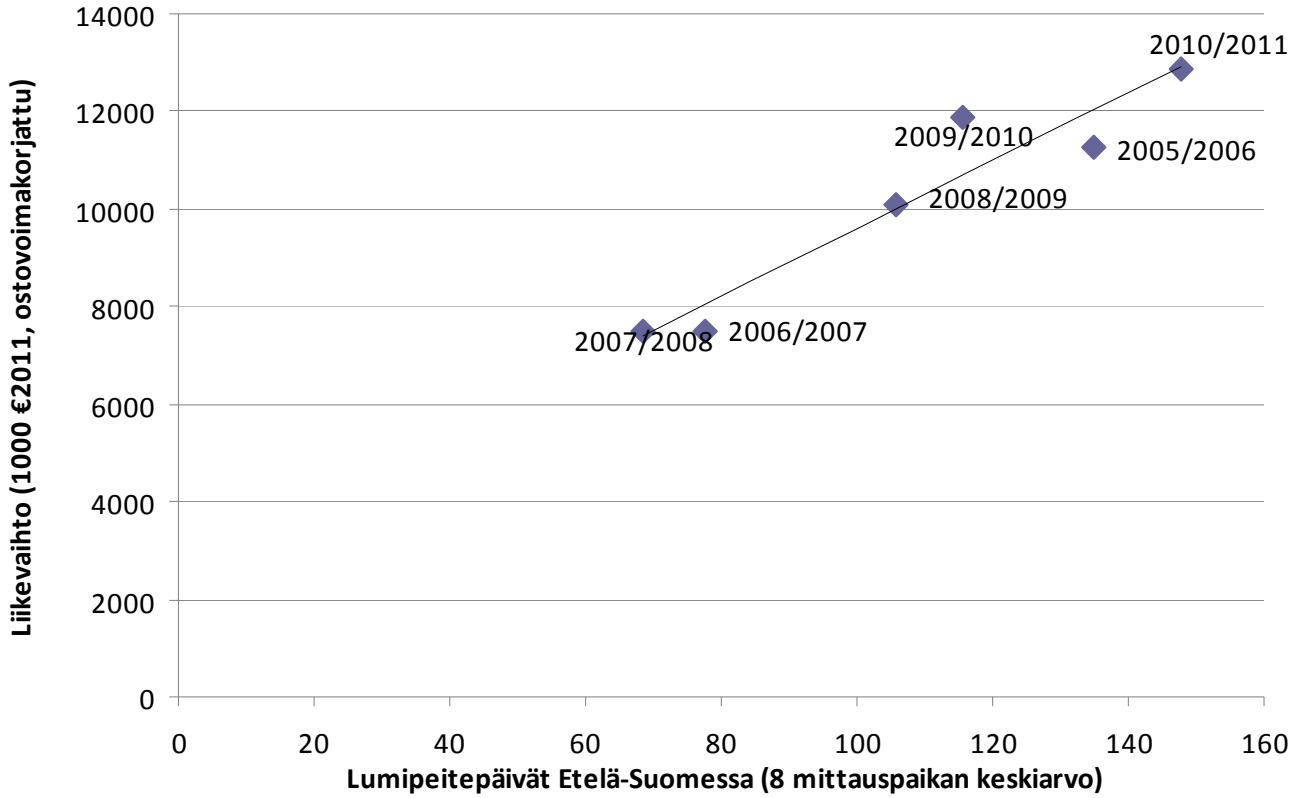


Saimaa ringed seal – Finnish “polar bear”

- About 300 Saimaa ringed seals living currently in Lake Saimaa
- Needs ice cover on lake and enough snow for nesting

Winter tourism depends on snow

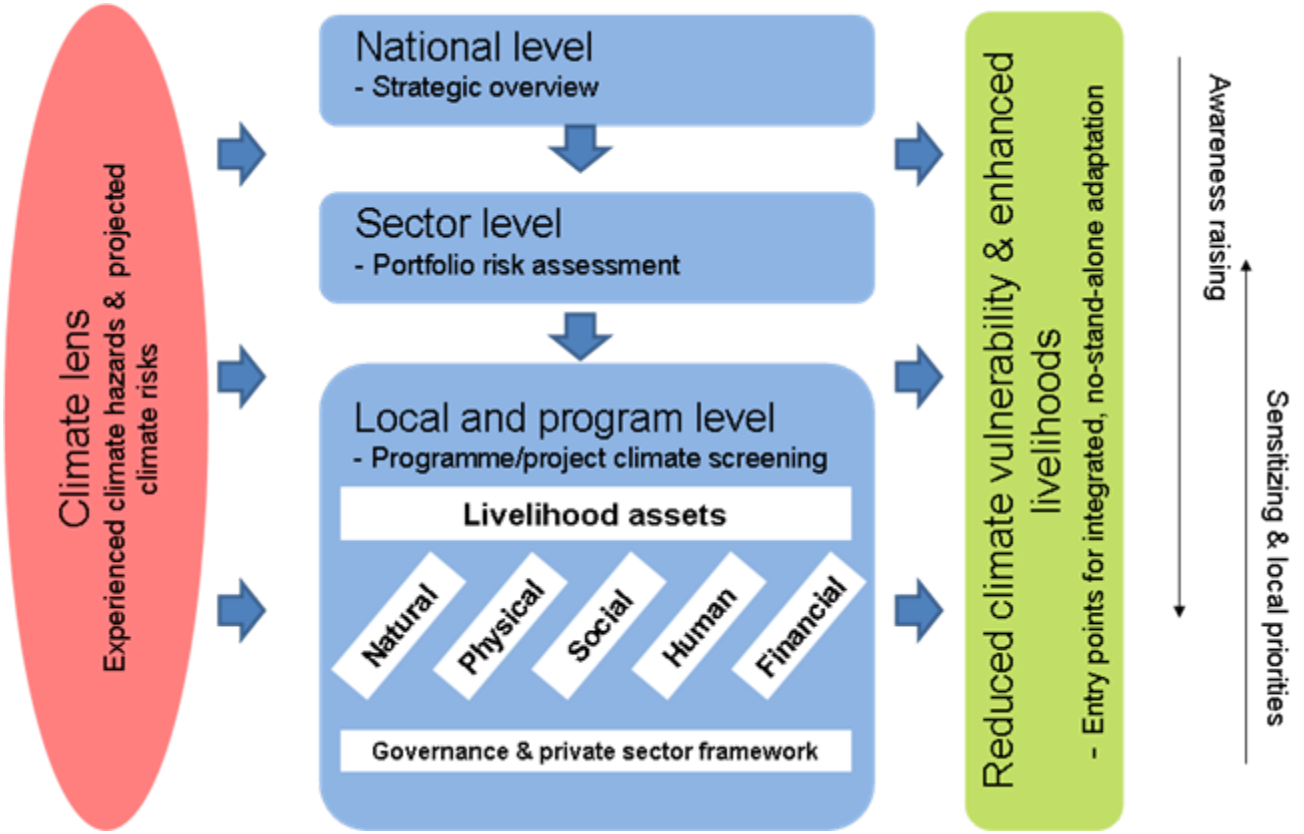
Revenues vs. number of days with snow cover in ski resorts in Southern Finland



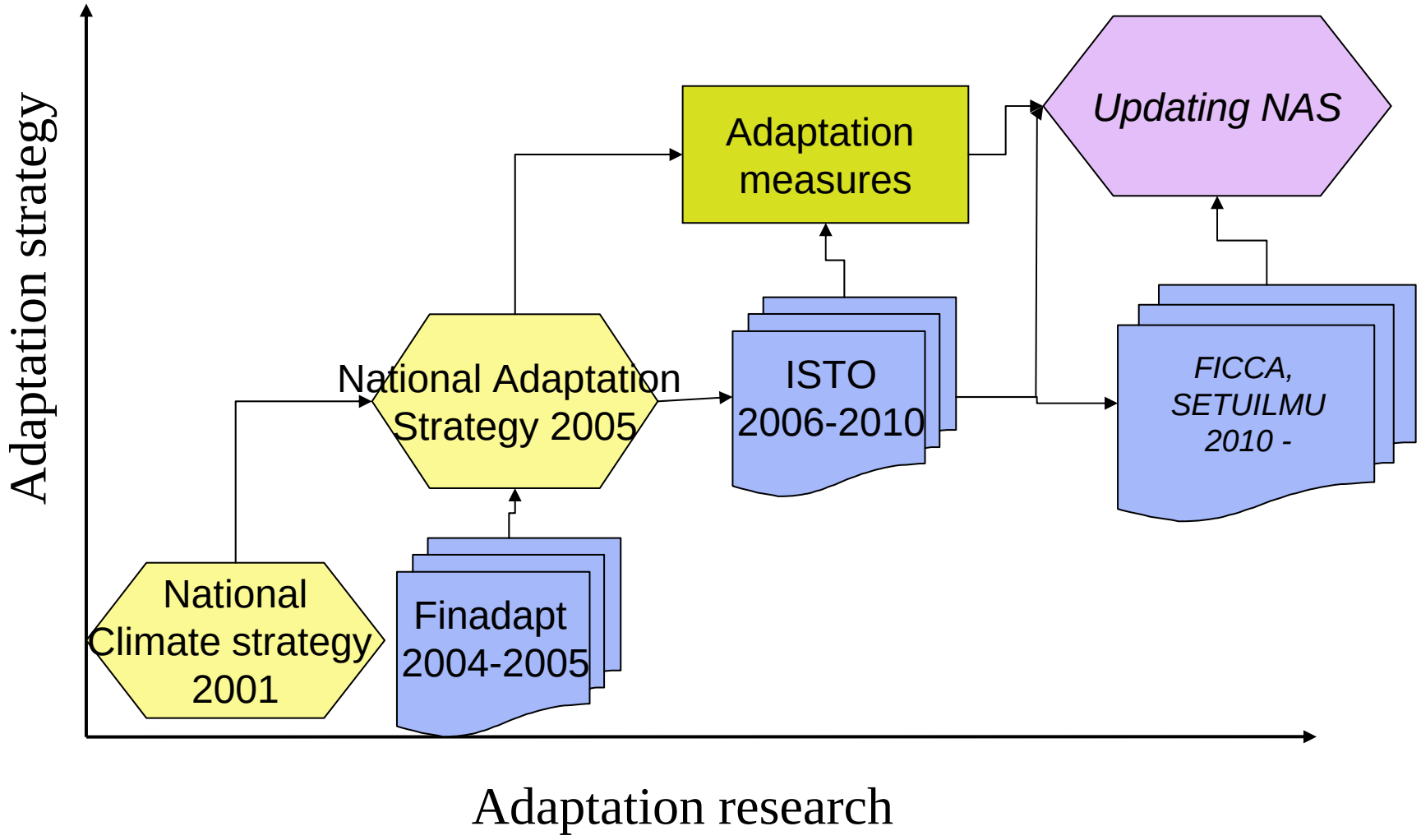
…other sectors and themes

- Baltic Sea
- Fishery, game, reindeer
- Biodiversity
- Industry and energy
- Insurance
- Traffic
- Land use, urban planning, building
- Climate Risk Assessments
- Regional vulnerability
- Economic Assessments
- EWS
- Communication

Climate Risk Management in Finnish Development Cooperation



Science – policy interaction in adaptation in Finland



Report

- In English:

How to adapt to inevitable climate change?

– A synthesis of Finnish research on adaptation in different sectors

- Will be available online on web-pages of Ministry of Agriculture and Forestry

- www.mmm.fi/en

- In Finnish:

Miten väistämättömään ilmastonmuutokseen voidaan varautua?

– Yhteenveto suomalaisesta sopeutumistutkimuksesta eri toimialoilla

- www.mmm.fi

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Thank you
for your interest!

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