



Lessons from integrating and aggregating climate change impacts and responses across sectors and regions

Adriaan Perrels (FMI)
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- TOPDAD: integrated toolset for decision support in regional and national adaptation planning in EU Member States, through:
 - 1) assessment of climate change impacts and adaptation options at regional to national level for selected sectors with a suite of sector models
 - 2) assessment of macroeconomic effects of climate change impacts and adaptation options – including sector results from (1) – at national to European level with a general equilibrium model and a dynamic input-output model respectively
 - 3) multi-criteria decision support – among others using results from (1) and (2) – for sectoral or regional adaptation decision making, and
 - 4) an internet tool allowing for tailored comparison of results

<i>examples</i>	Separated / Additional	Integrated
Process / continuous	<ul style="list-style-type: none"> External (mandatory) risk assessment 	<ul style="list-style-type: none"> Risk assessment as part of comprehensive resilience policy Risk assessment as part of asset management
Project / distinct	<ul style="list-style-type: none"> As response to extreme event Some climate services? 	<ul style="list-style-type: none"> Extra road safety measures Urban green development as part of urban plan

Factors affecting interpretation and location in the table:

- Policy cycle
- Decision level

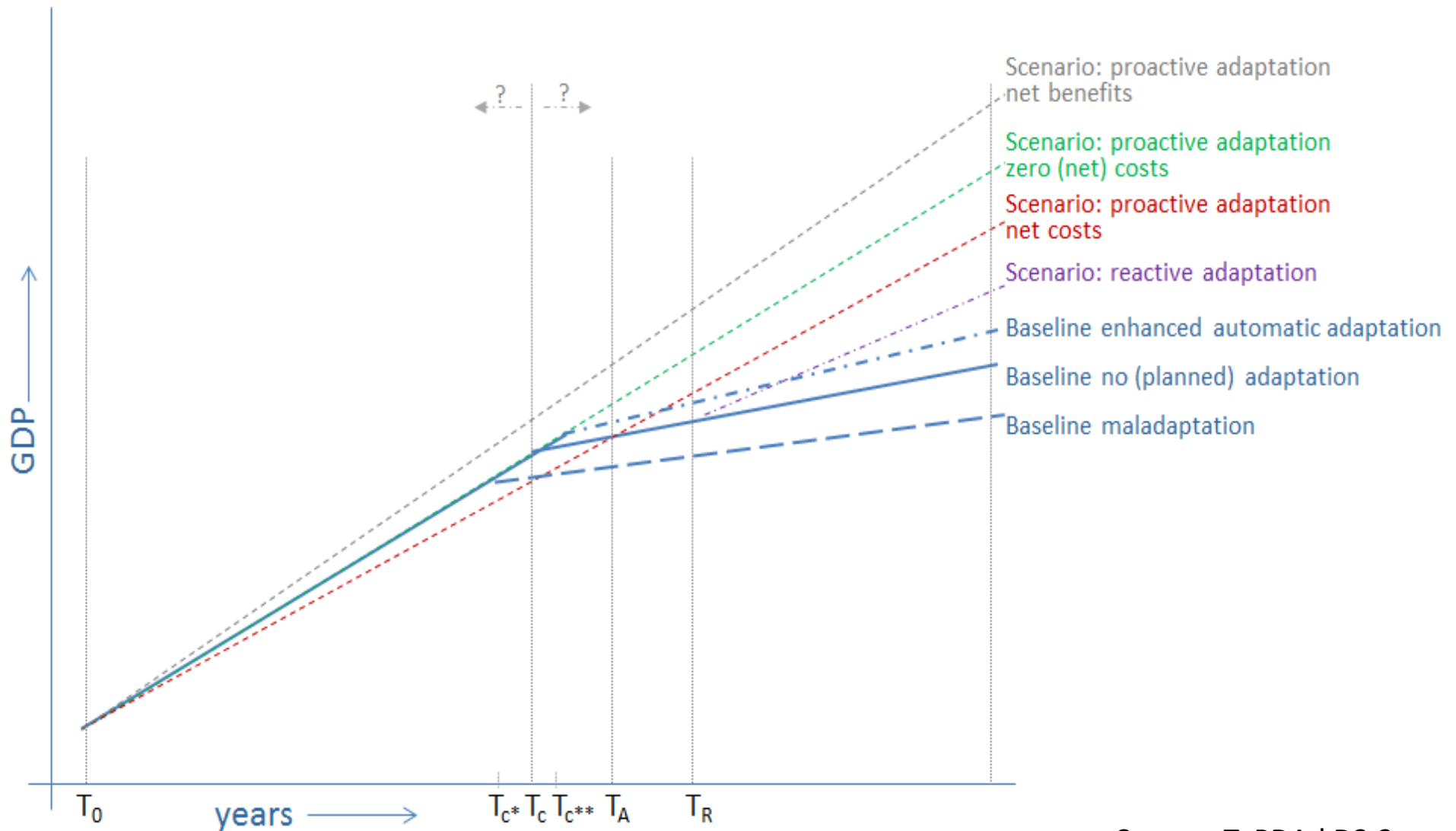
- from IPCC AR3 WGII

- **Autonomous** – (natural) systems respond without human intervention
- **Automatic** – built-in mechanisms cause a practically automatic reaction in the system
- **Planned** – anticipatory or responding to experienced events

- extensions

- ['autonomous' not used]
- **Enhanced Automatic** – automatic adaptation enhanced by organizational and technical improvements
- **Planned & Innovation based** long term action involving dedicated innovations

What is adaptation? What is baseline?

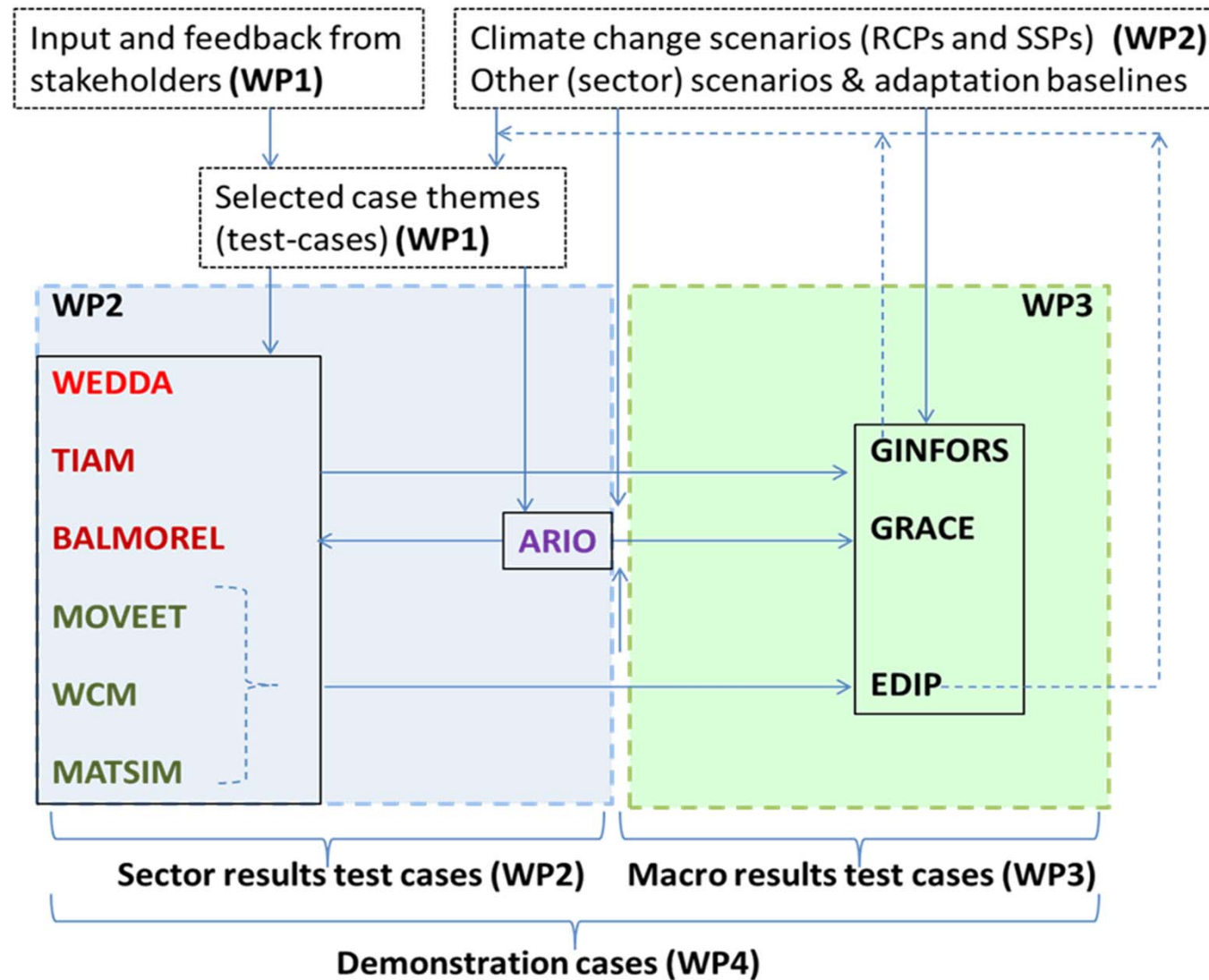


- 1. Ski tourism** – adaptation at the supply and demand side; 2015—2045//2035-2065;
RCP2.6-SSP1//RCP4.5-SSP4//RCP8.5-SSP5
- 2. Beach tourism** – adaptation at the supply and demand side; 2015—2045//2035-2065
RCP2.6-SSP1//RCP4.5-SSP4//RCP8.5-SSP5
- 3. Arctic shipping** – use of NSR - planned adaptation or no response by ~2040;
RCP4.5 , RCP8.5
- 4. Urban transport** – extreme downpours, adaptation through information; 2010/2030
[RCP2.6-SSP1//RCP4.5-SSP4//RCP8.5-SSP5]



5. **Energy (EU) / Electricity (Baltic Rim)** – long term energy capacity and supply mix adaptation
RCP2.6-SSP1//RCP4.5-SSP4//RCP8.5-SSP5
6. **Urban flooding (London)** – exploring enhanced automatic adaptation (recovery) and planned adaptation (protection)
RCP2.6-SSP1//RCP4.5-SSP4//RCP8.5-SSP5
7. **Severe drought + heat wave and French power supply** – enhanced automatic adaptation and planned adaptation
RCP2.6-SSP1//RCP4.5-SSP4//RCP8.5-SSP5





Stepwise assessment - in theory

**Stepwise
scenario
based
assessment**

Case theme	1: Decreasing Snow Reliability	2: Rise of the Average Summer Temperatures	3: The Impact of Arctic Ice Melting	4: Weather Variations, Extremes and Traffic	5: Variations in Energy Production	6: Floods	7: Droughts
Sector	Tourism	Tourism	Transport	Transport	Energy	All	All
RCP2.6 + SSP1							
Step 1: Baseline no climate change impacts	Baseline formation	...	...	...	...	...	...
Step 2: No adaptation	Baseline formation	...	...	...	...	...	...
Step 3: No adaptation + extreme effects	Baseline formation	...	...	...	...	...	...
Step 4: Autonomous / enhanced adaptation	Baseline formation	...	...	...	...	...	...
Step 5: Autonomous / enhanced adaptation + extreme effects	Baseline formation	...	...	...	...	...	...
Step 5: Adaptation policy (SPA)	Evaluation of specific adaptation options	...	...	...	...	...	...
Step 6: SPA + extreme effects	Evaluation of specific adaptation options	...	...	...	...	...	...
Step 7: SPA + innovations	Evaluation of specific adaptation options	...	...	...	...	...	...
RCP4.5 + SSP4							
...
RCP8.5 + SSP5							
...

I. Model the impacts in absence of case-specific adaptation policies and measures

II. Model and evaluate the impacts of case-specific adaptation policies and measures.

Same process throughout the scenarios and case themes.

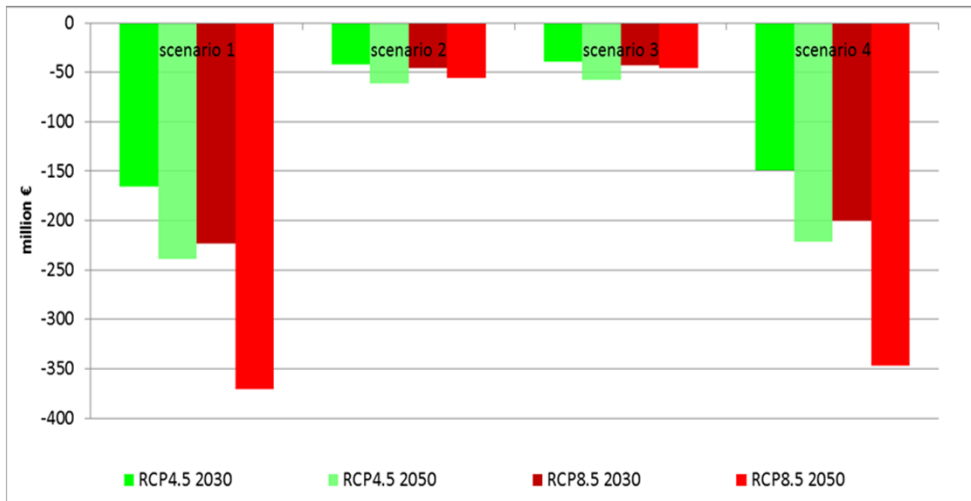
Source:
ToPDAd D2.3

		1.Ski holidays	2.Beach holidays	3.Arctic shipping	4.Urban transport	5. Energy	6.Flood London	7.Drought France
1	Baseline							
2	Baseline + CC							
3	Baseline + CC/XE	n.a.		n.a.		n.a.		
4	Baseline + CC + Aut_Ad			n.a.			n.c.	n.c.
5	Baseline + CC + E_Aut_Ad			n.a.		n.c.		
6	Baseline + CC + Pl_Ad				n.a	n.c.	n.a.	n.a.
7	Baseline + CC/XE + Pl_Ad	n.a.	n.a.	n.a.	n.a	n.a.		
8	Baseline + CC + Inno		n.c.		.	n..c.	n.c	n.c.

Legend; CC – climate change; XE – extreme events (in conjunction with CC); Aut_Ad – automatic adaptation; E_Aut_Ad – enhanced automatic adaptation; Pl_Ad – planned adaptation; Inno – innovations; n.a. – not applicable; n.c. – not considered;

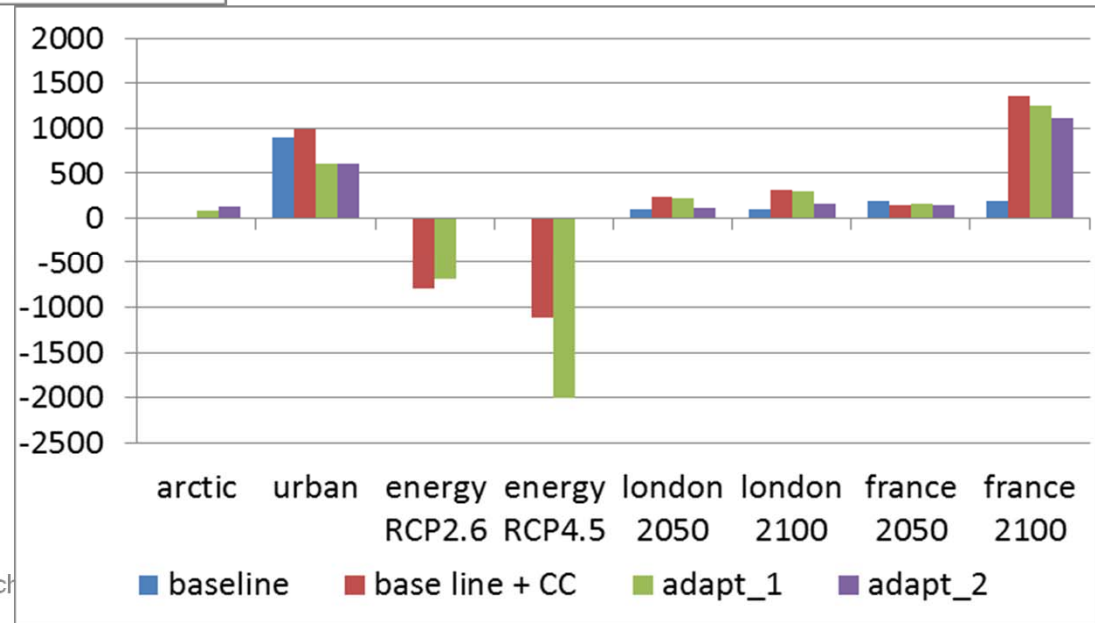
		1.Ski holidays	2.Beach holidays	3.Arctic shipping	4.Urban transport	5. Energy Europe / Baltic	6.Flood London	7.Drought France
		Change in regional tourist revenues		Cost savings (€ 10 ⁶) annual	Disruption cost (€ 10 ⁶) annual	Annual supply cost (€ 10 ⁹)	Lost value added (€ 10 ⁶)	Lost value added (€ 10 ⁶)
		2015-2045 across RCPs	2015-2045 across RCPs	~ 2040	~ 2030	~ 2050 across RCPs	A: 2015- 2050; B: 2065-2100 RCP2.6 – RCP8.5	A: 2015- 2050; B: 2065-2100 RCP2.6 – RCP8.5
1	Baseline	+0.7% ~ +3% annually	+1.3% ~ +2.7% annually	~ 0	MIN: 20# MAX: 94# AVG: 43#	SSP1:79 SSP4:74 SSP5:101	~3400* (period)	~6400* (period)
2	Baseline + CC	-50% ~ 0% (period)	-4% ~ +7% (period)		-	-1.0% ~ -2.0% (SSP1 – SSP5)		
3	Baseline + CC/XE				+5% ~ +20% (see text)		A:5200 ~ 11800 B:6900 ~ 15700	A:6450 ~ 5800 B:6500 ~ 88500
4	Baseline + CC + Aut_Ad	-30% ~ +15%	-5% ~ +5%			(-1.3 % ~ - 2.5%) -0.8% ~ -4.4% (SSP1 – SSP5)		
5	Baseline + CC + E_ Aut_Ad	(part of above range)			MIN: 14# MAX: 63# AVG: 29#		A:4600 ~ 10500 B:6100 ~ 14600	A:5900 ~ 5200 B:5900 ~ -83500
6	Baseline + CC + PI_Ad	-40% ~ +0%		+50 ~ 100				
7	Baseline + CC/XE + PI_Ad						A:2500 ~ 5200** B:3600 ~ 7800**	A:4600 ~ 5100 B:4600 ~ 73200
8	Baseline + CC							

Examples of decomposition



Calculated average monetized impacts on annual winter sport tourist revenues in Tiroler Unterland by RCP-SSP combination and tourist response option

Annualized monetized expected losses (+) or benefits (-) in different cases by degree of adaptation (million €) **NB! Swiss urban traffic results tentatively scaled up to Europe**



Model integration: WEDDA (econometric) ; GRACE (CGE)

Supply side:

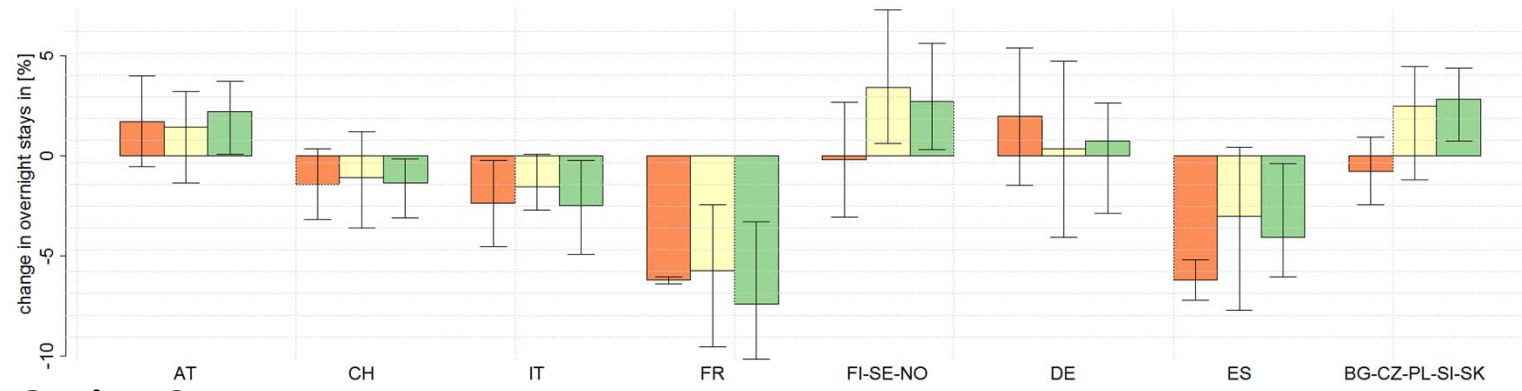
1. Artificial snow making
2. Diversification of attractions (including less snow dependent ones)

Demand side:

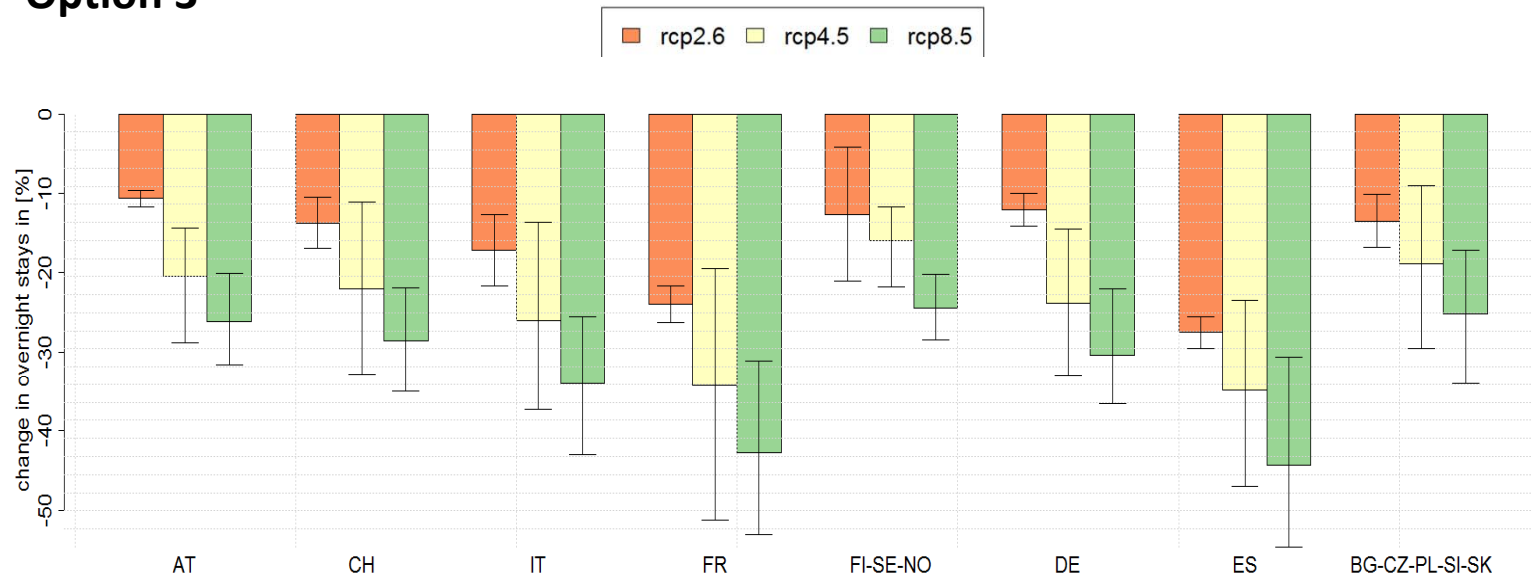
1. Tourists only respond to *absolute* changes in a destination's climate and related attraction and not to relative changes
2. Tourists stick to the holiday type "skiing" and the month of their skiing holidays, but *may change the destination*
3. Tourists stick to the holiday type "skiing" but *may change the month and the destination* of their skiing holidays.
4. Tourists stick to the winter season, but may change holiday type, month and/or destination.

➤ **Supply side's challenge: information and perception**

Demand side adaptation effects winter tourism (WEDDA model) - deviations from baseline



Option 3

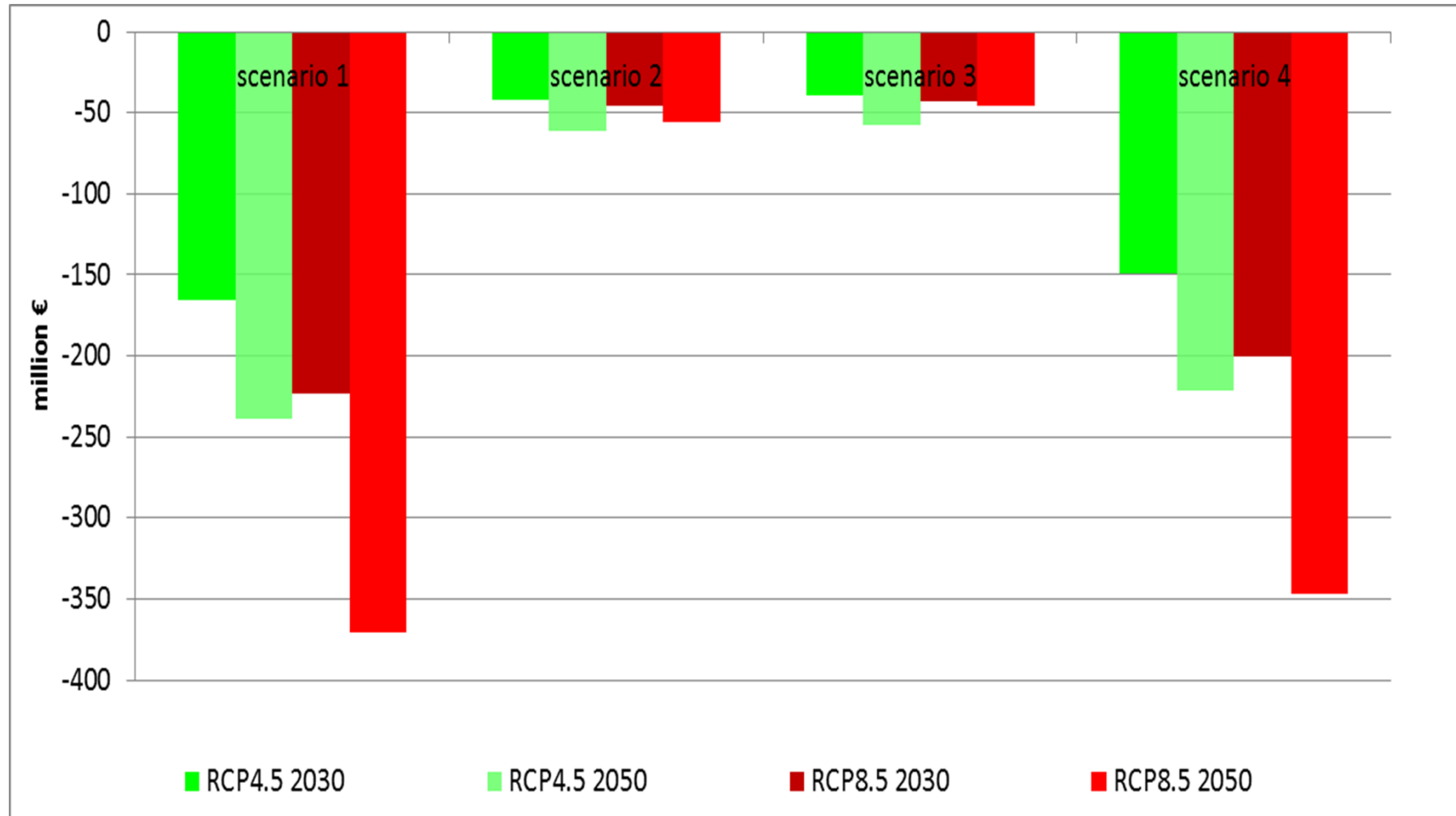


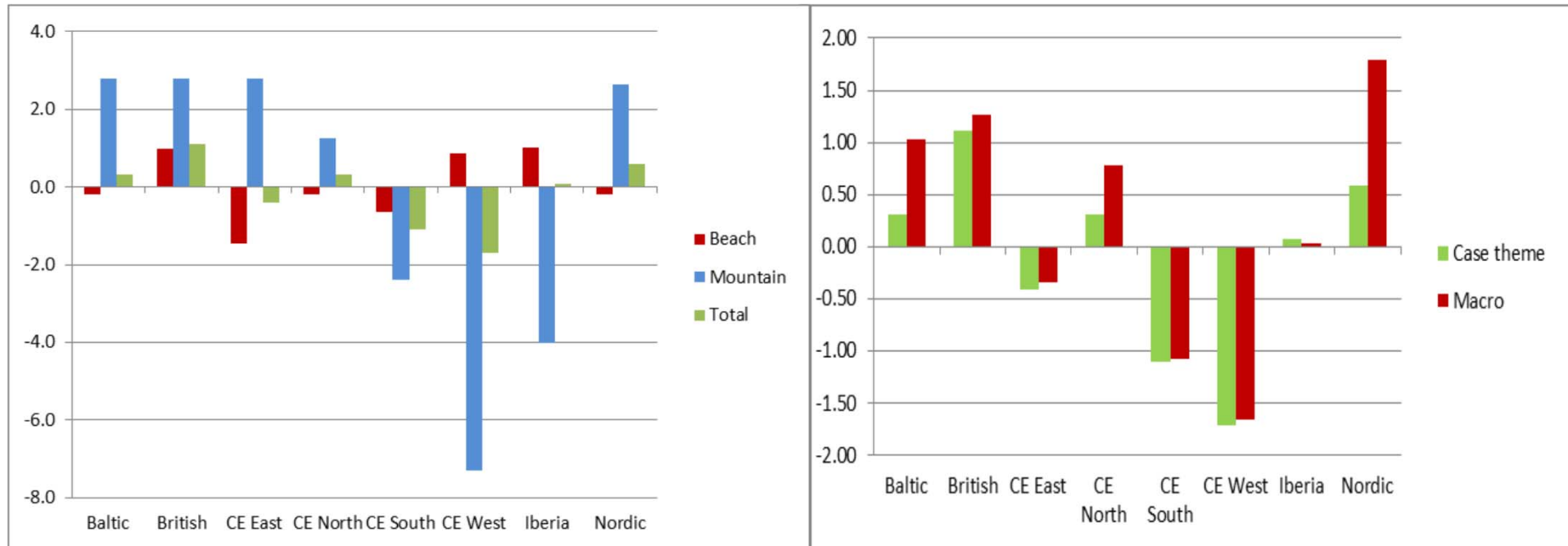
Option 4

Source:
ToPDAd D2.

Overall revenue effects (WEDDA)

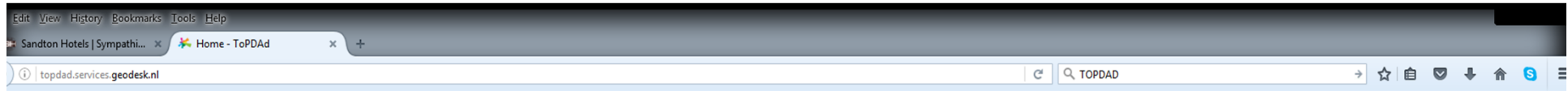
- including demand and supply side adaptation -
 example Tyrol (averages)





GRACE input – for WEDDA response option 3
Δ% overnight stays by 2050 in RCP8.5

GRACE output – given WEDDA based input for response option 3
Δ% in climate sensitive tourism expenditures by 2050 in RCP8.5 and differences between sector and macro analysis



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The Project



The objective of ToPDAd (Tool-supported policy development for regional adaptation) is to support businesses and regional governments in **assessing different strategies to adapt to the expected short term and long term changes in climate.**

The ToPDAd methodology supports decision makers in **selecting adequate and viable adaptation strategies.** The integrated approach, combining sector models and macro-economic models with detailed climate change modelling, allows for detailed regional and localized assessments. At the same time, cross-sectoral and European scale effects of the examined adaptation strategies are taken into account.

[read more >>](#)

[Overview of the ToPDAd Project](#)

[Methodology Overview](#)

ToPDAd Interactive Tool

The Interactive Tool offers information on adaptation strategies to regional policy makers, researchers and others with a professional interest in climate change adaptation in the sectors energy, transport and tourism. The tool presents outcomes of ToPDAd's model calculations for seven European case studies and for three economic impact assessments. The Data Exploration tool allows the user to examine the data sets underlying the case studies and assessments.



Project Results



The ToPDAd project has developed an integrated methodology to assess climate adaptation strategies and then applied it to **seven regional case studies from the energy, transport and tourism sectors.**

The case studies are relevant for wider regions in Europe and provide insight into the economic effects of climate change and adaptation measures on a timescale up to 2050 or 2100. Based on a unique combination of sector models and macro-economic models, the case studies provide both a **sectoral outlook** and information on the **overall (inter)national economic effects.**

With this Interactive site and its Data Exploration Tool you can explore the main conclusions and the detailed outcomes.

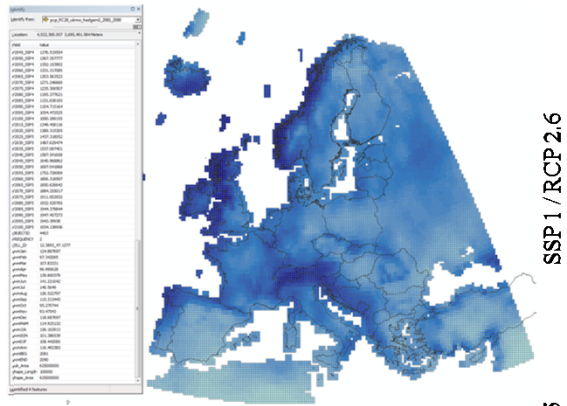
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[Overview of ToPDAd Project Results](#)

[Explore ToPDAd model output](#)



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SSP 1 / RCP 2.6

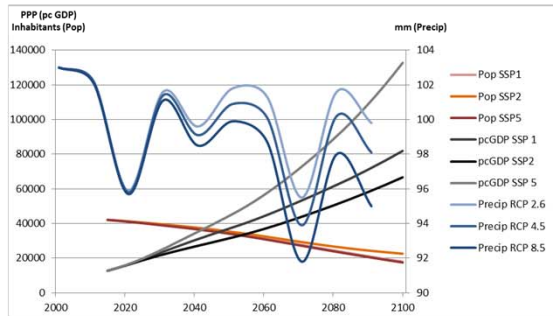
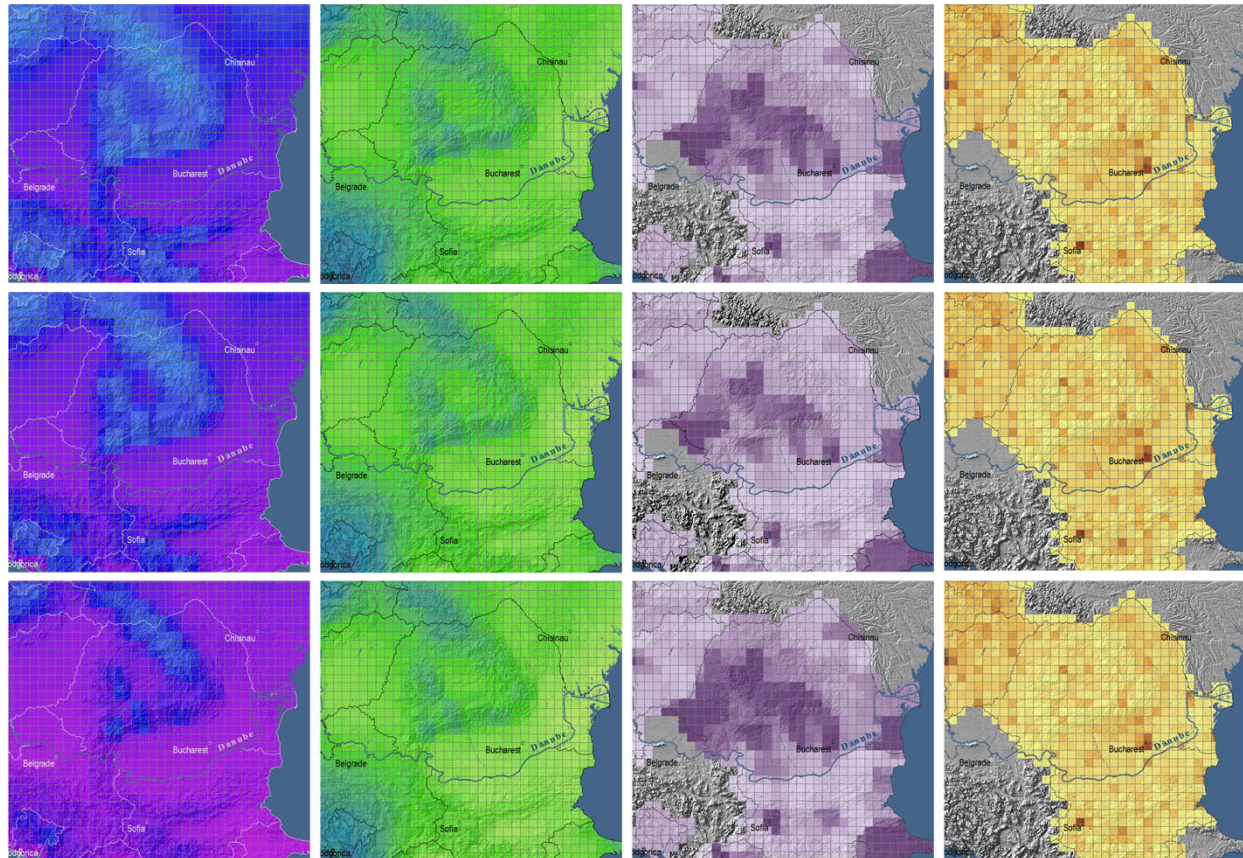
SSP 2 / RCP 4.5

TEMPERATURE

PRECIPITATION

PER CAPITA GDP|PPP

POPULATION



- Climate change affects economic sectors and regions both negatively and positively, creating losing and winning regions
- The stronger the extent and the faster the pace of climate change the more the negative effects will dominate
- Adaptation policy should also address automatic adaptation, and intermediate steps to planned adaptation
- Innovation merits more attention in adaptation policy
- Intelligent tailored weather & climate services are a no regret means to promote adaptation, but the right information dose needs further RD&D
- Evolution of habits is the most uncertain factor for adaptation in tourism, and probably in quite many other sectors
- Favourable effects of climate change on (renewable) energy supply cost may not outweigh the costs of enhanced extreme effects

- Model integration can expand the scope of results, but coherence requirements can limit the applicability or demands very thorough preparation
- The combined use of sector and macro models is only meaningful if
 - (1) indirect effects are relatively large and (2) linking does not simplify the sector results too much
- Sectoral adaptation needs concerted action across spatial scales (firms – regions – countries – trade blocks)
- Stakeholder participation and tool dissemination should more carefully engage with existing trusted / privileged DSS structures

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Thank you

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