

Integrated Assessment of Climate Impacts in Europe

(JRC PESETA II project)

*Juan-Carlos Ciscar **
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* The views expressed are purely those of the authors and may not in any circumstances be regarded as stating an official position of the European Commission

Outline

1. Introduction, methodology
2. JRC PESETA II, EU assessment
3. Conclusions

1. Introduction: integrated Methodology

EU Adaptation Strategy

- Following the Green Paper (2007) and White Paper (2009) on adaptation, the EU Strategy on Adaptation to Climate Change was adopted in April 2013 (European Commission Communication)
- The JRC PESETA II project provides background evidence on climate impacts in the Impact Assessment of the Communication.

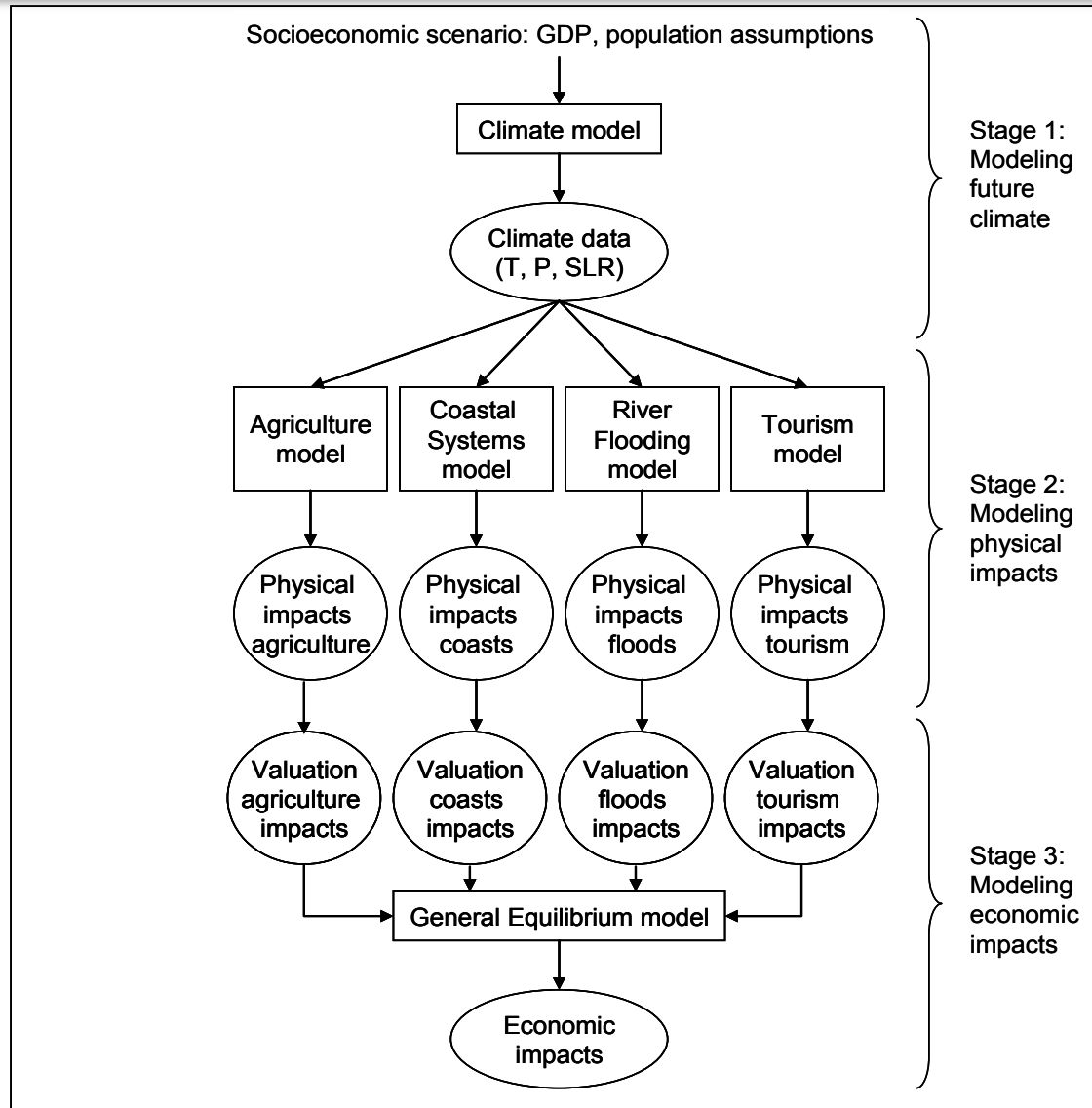
Questions of interest

- What are the climate impacts (reference and 2°C)
- What are the distributional implications of climate impacts? Fairness and equity issues
- How much adaptation can reduce climate impacts?
- Are spatial (cross-country) spillovers significant?

Integrated, granular modelling

- *Multi-disciplinary impact assessment*
- *Soft-link of models*
- *High space-time resolution of climate data (T, P, other), common to all impacts (considers spatial correlation)*
- *Run detailed physical impact models for each impact category*
- *Integration of market impact results under a Computable General Equilibrium (CGE) model: overall economic effects, direct + indirect; trade effects*

3 stages in the integration

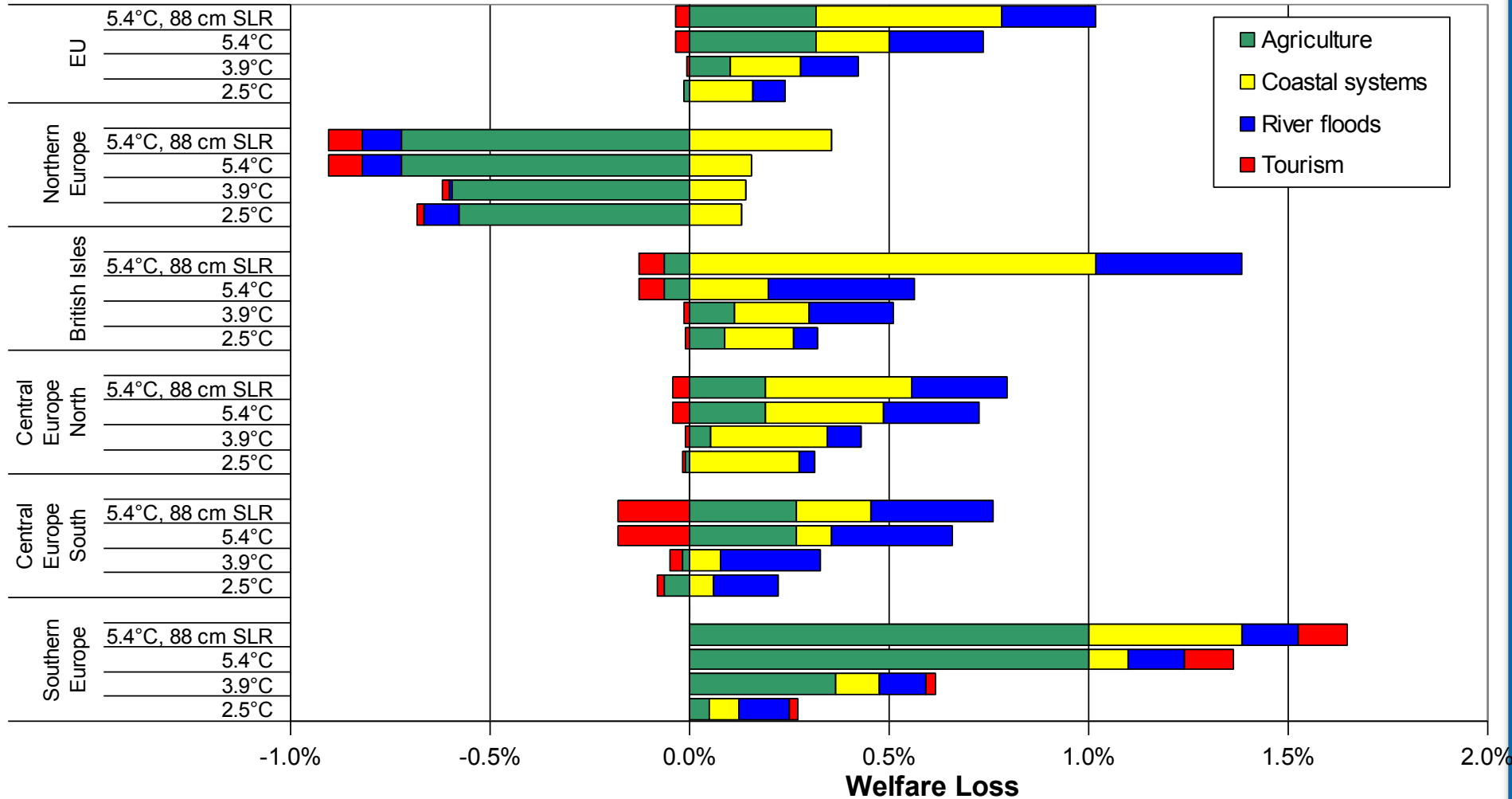


General Equilibrium Model

GEM-E3 European model

- *Large-scale database (Economy, Energy, Environment)*
- *Based on neoclassical economic paradigm*
- *Sectoral resolution: 18 Economic sectors*
- *Country resolution: 24 EU countries*
- *Overall economic effects: direct + indirect effects on the rest of the economy*
- *Trade effects: cross-country effects*
- *Comparative statics*
- *Permits to compare different biophysical impact categories in a consistent way*
- *Provides consistency to the economic assessment*

PESETA project results. Sectoral decomposition of welfare changes (%)



Source: Ciscar et al. (2011), PNAS

2. JRC PESETA II project

PESETA II Project strategy

Building climate impact modeling capabilities at JRC

- Existing data and resources within JRC
- Operational and research models
- Learning-by-doing within JRC

To support the EC services on adaptation policy

- EU adaptation strategy
- DG AGRI, CLIMA, ENER, ENV, MOVE, REGIO, Others

Climate models (A1B)

Acronym	RCM	GCM
C4I-RCA-HadCM3	RCA	HadCM3
CNRM-ALADIN-ARPEGE	ALADIN	ARPEGE
DMI-HIRHAM5-ARPEGE	HIRHAM5	ARPEGE
DMI-HIRHAM5-BCM	HIRHAM5	BCM
DMI-HIRHAM5_ECHAM5	HIRHAM5	ECHAM5
ETHZ-CLM-HadCM3Q0	CLM	HadCM3Q0
KNMI-RACMO2-ECHAM5	RACMO2	ECHAM5
METO-HadRM3Q0-HadCM3Q0	HadRM3Q0	HadCM3Q0
MPI-REMO-ECHAM5	REMO	ECHAM5
SMHI-RCA-BCM	RCA	BCM
SMHI-RCA-ECHAM5	RCA	ECHAM5
SMHI-RCA-HADCM3Q3	RCA	HADCM3Q3

- ensemble of 12 RCM/GCM combinations
- spatial resolution of 25 km

Climate models (E1)

Acronym	RCM	GCM
MPI-REMO-ECHAM5-r1	REMO	ECHAM5 (BC r1)
MPI-REMO-ECHAM5-r2	REMO	ECHAM5 (BC r2)
MPI-REMO-ECHAM5-r3	REMO	ECHAM5 (BC r3)

- spatial resolution of 50 km
- 3 runs with same RCM-GCM combination
- different boundary conditions GCM
- captures much less uncertainty in future climate for E1

Temperature change (°C) in climate runs for 2071-2100, compared to 1961-1990

	Reference	Reference variant 1	Reference variant 2	2°C
Northern Europe	3,8	4,8	3,4	3,2
UK & Ireland	2,1	2,9	1,7	1,4
Central Europe north	2,8	3,7	2,0	2,1
Central Europe south	3,0	3,8	2,0	2,1
Southern Europe	3,2	3,7	2,4	2,3
EU	3,1	3,9	2,4	2,4

PESETA II Impact categories

Sectoral impact categories teams

- *Agriculture physical modelling (IES)*
- *Agriculture economic modelling (IPTS)*
- *Forest fires (IES)*
- *Tree species habitat suitability (IES)*
- *River flood (IES)*
- *Tourism (IPTS)*
- *Energy (IPTS)*
- *Transport (IPTS)*
- *Human health (IPTS)*

- *Climate tipping points (IPTS)*

CGE modeling for the integration

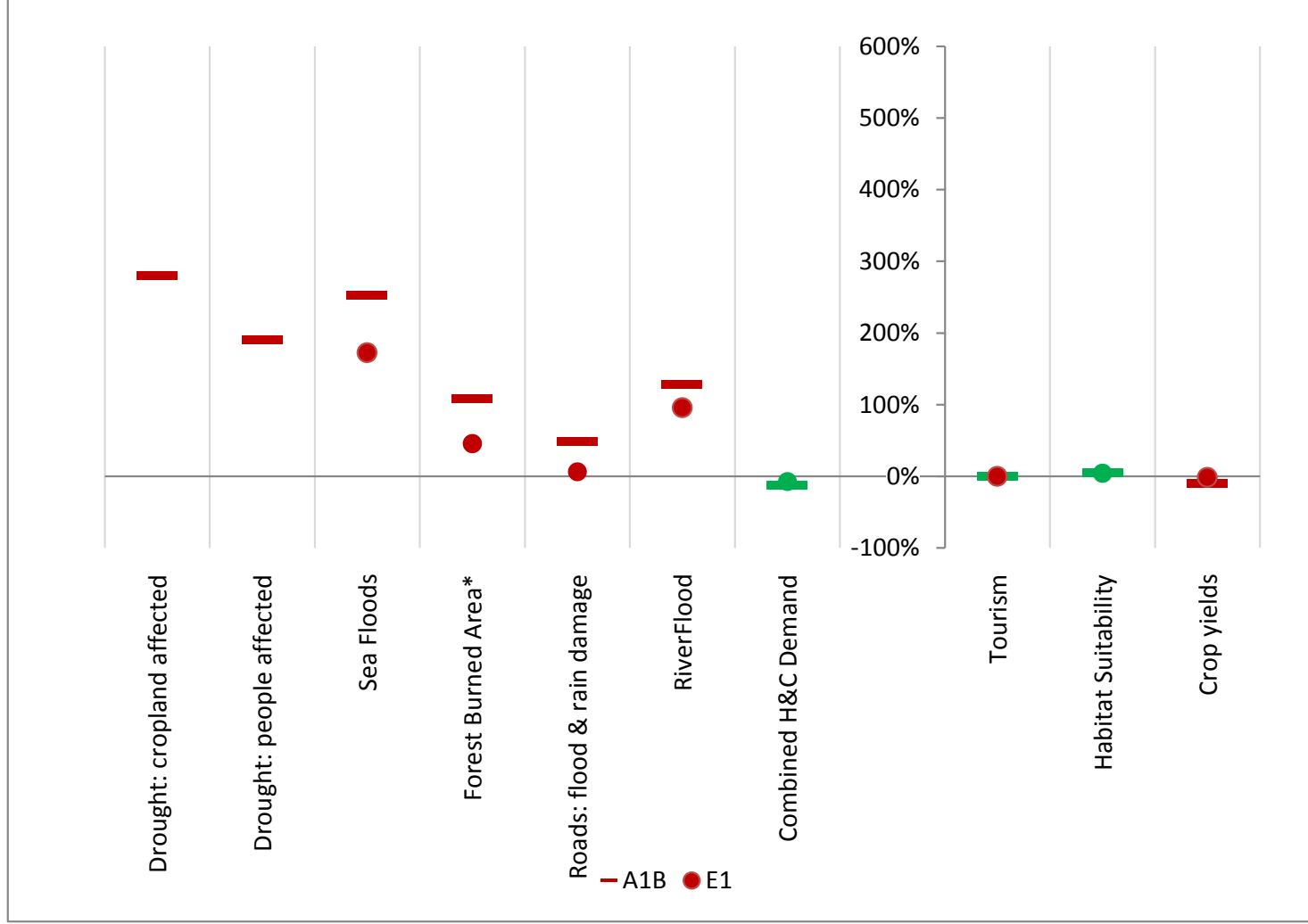
Climate data input per impact category

Sector	Input variables	Time resolution	Spatial Resolution
Transport	Average Temperature	Daily	25x25, 50x50 Km
	Maximum Temperature		
	Average Precipitation		
Human Health	Maximum Temperature (June-September)	Daily	NUTS 2 Regions
	Average Temperature		
Tourism	Average Temperature	Daily	NUTS 2 Regions
Agriculture	Maximum air temperature	Daily	25x25, 50x50 Km
	Minimum air temperature		
	Total Precipitation		
	Global solar radiation		
	Air relative humidity maximum and minimum		
	Wind speed		
	Reference evapotranspiration		
	Vapour pressure deficit		
River Floods	Maximum and Average Temperature	Daily	25x25, 50x50 Km
	Precipitation		
	Humidity		
	Windspeed		
	Solar + thermal radiation		
	Albedo		
	Dewpoint temperature		
Energy	Average Temperature	Daily	Country
	Average Precipitation		
	Wind Speed		
Forest Fires	Average Air Temperature	Annual	25x25, 50x50 Km
	Relative Humidity		
	Wind Speed		
	Average Precipitation		
Forest Species Habitat Suitability	Average Temperature	Annual; Monthly	25x25, 50x50 Km
	Maximum Temperature	Monthly	
	Minimum Temperature	Monthly	
	Average Precipitation	Annual; Monthly	

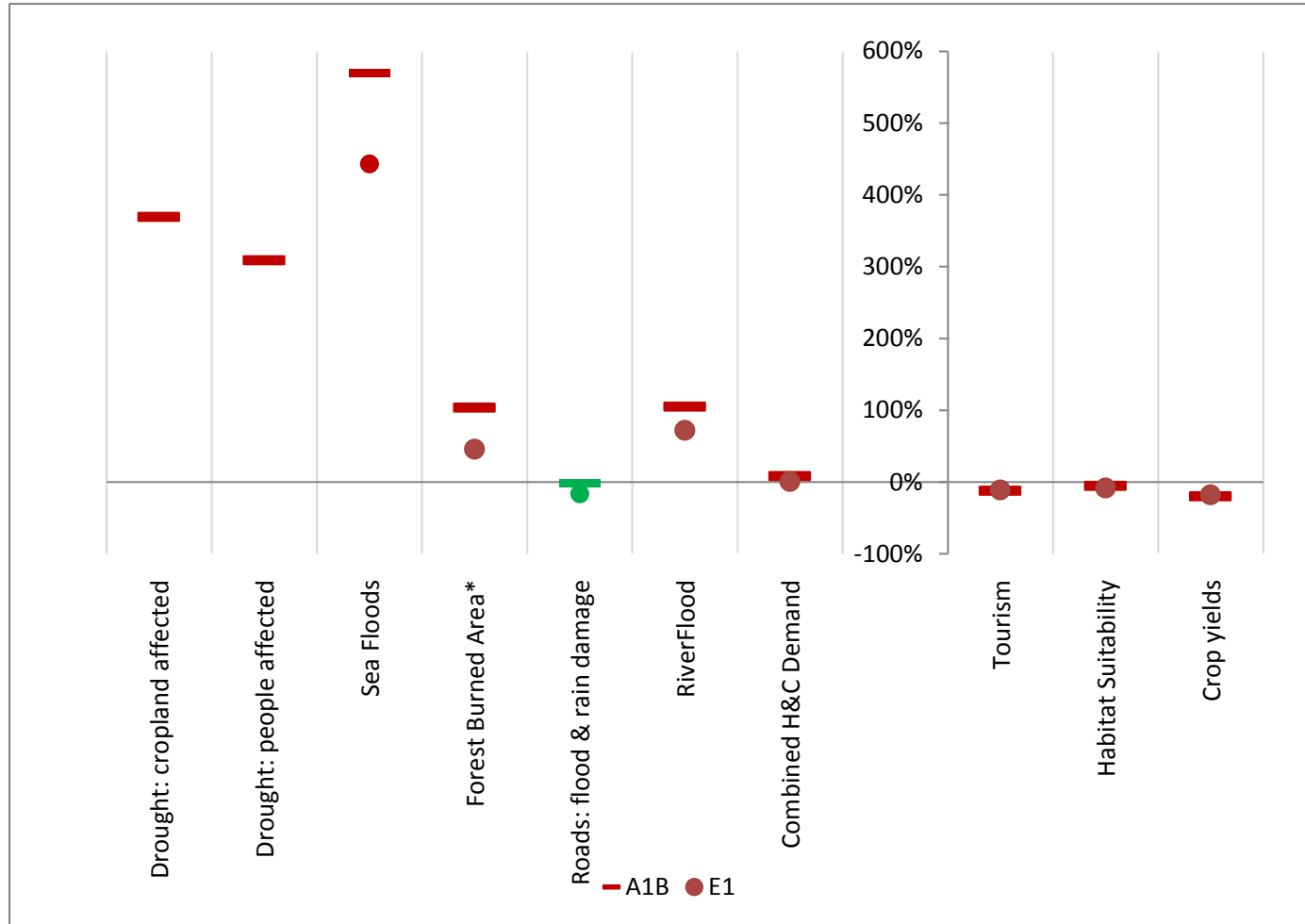
Preliminary biophysical results (change relative to control run)

**“Avoided” impacts
(from A1B to E1 runs)**

EU Biophysical impacts: A1B and E1 (2C)



Southern Europe Biophysical impacts: A1B and E1



Preliminary economic results

(Impact Assessment of 2013 Adaptation Strategy)

(based on JRC PESETA II, and FP7 ClimateCost results for Agriculture and Coasts)

Shock implementation into GEM-E3

Impact		Model implementation
Agriculture	Yield change	Productivity change for crops
Coastal areas	Migration cost	Additional obliged consumption
	Sea floods cost	Capital loss
River floods	Residential buildings damages	Additional obliged consumption
	Production activities losses	Capital loss
Energy	Heating and cooling demand changes	Households: Change in subsistence energy demand Service sector: Change in electricity and fuel (per unit of product)
Transport infrastructure	Changes in cost of road asphalt binder application & bridge scouring	Additional obliged consumption
	Net change in costs related to extreme flooding & - winter conditions	Capital loss
Forest Fires	Burned area damage	Capital loss
	Reconstruction costs	Obliged consumption

Reference run, 2080s (Welfare change, million €)

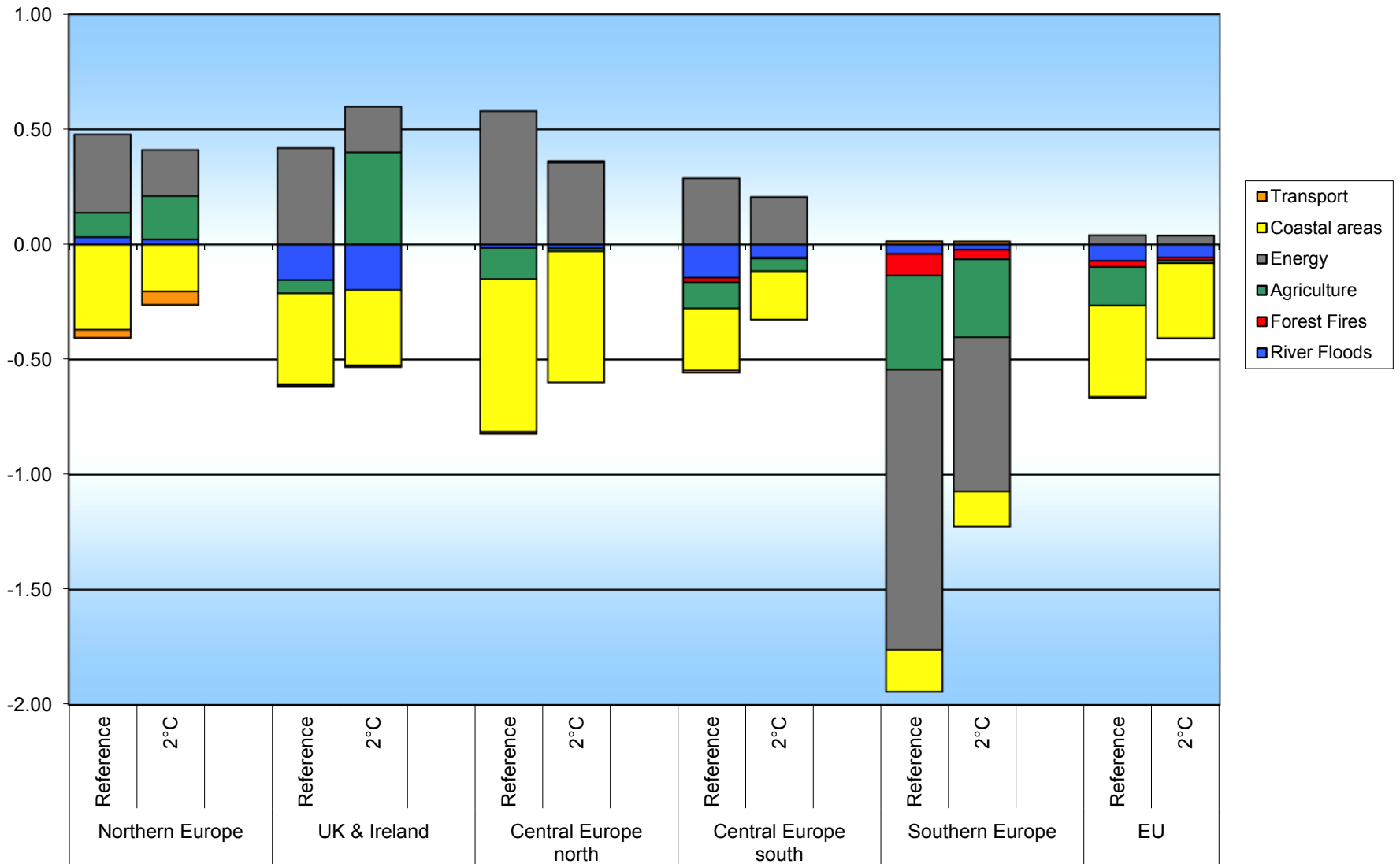
	Impact categories (million €)						Sum of impacts	
	Coastal areas	Energy	Agriculture	Forest Fires	River Floods	Transport	million €	€/person
Northern Europe	-2,485	2,284	712	1	212	-801	-78	-3
UK & Ireland	-7,616	8,050	-1,100	5	-2,965	-434	-4,060	-61
Central Europe north	-21,483	18,762	-4,379	5	-469	-748	-8,310	-56
Central Europe south	-6,011	6,427	-2,541	-435	-3,210	-874	-6,644	-54
Southern Europe	-4,659	-31,258	-10,491	-2,419	-1,037	-194	-50,057	-369
EU	-42,253	4,266	-17,799	-2,844	-7,469	-3,050	-69,149	-138

Source: JRC PESETA II, ClimateCost (agriculture, coasts)

Reference run, 2080s (Welfare change, % of GDP)

	Coastal areas	Energy	Agriculture	Forest Fires	River Floods	Transport	Sum of impacts
Northern Europe	-0.4%	0.3%	0.1%	0.0%	0.0%	-0.1%	0.0%
UK & Ireland	-0.4%	0.4%	-0.1%	0.0%	-0.2%	0.0%	-0.2%
Central Europe north	-0.7%	0.6%	-0.1%	0.0%	0.0%	0.0%	-0.3%
Central Europe south	-0.3%	0.3%	-0.1%	0.0%	-0.1%	0.0%	-0.3%
Southern Europe	-0.2%	-1.2%	-0.4%	-0.1%	0.0%	0.0%	-1.9%
EU	-0.4%	0.0%	-0.2%	0.0%	-0.1%	0.0%	-0.7%

Regional welfare change (%GDP), Reference and 2°C



Coastal impacts, 2080s, adaptation (Welfare change, million €)

	No Adaptation	Adaptation
Northern Europe	-2,485	-43
UK & Ireland	-7,616	-181
Central Europe north	-21,483	-844
Central Europe south	-6,011	-378
Southern Europe	-4,659	-132
EU	-42,253	-1,577

Uncertainty: Range of impacts for River Floods (Welfare change, million €)

	Worst case	Reference	Best case
Northern Europe	-493	212	-26
UK & Ireland	-13,462	-2,965	110
Central Europe north	-3,702	-469	-383
Central Europe south	-9,818	-3,210	-57
Southern Europe	-4,489	-1,037	-2,603
EU	-31,965	-7,469	-2,958

Transboundary effects (Welfare change, million €)

	Coast / Central Europe North	Agriculture / Southern Europe
Northern Europe	-491	-173
UK & Ireland	-1,677	-798
Central Europe north	-20,518	-1,380
Central Europe south	-1,966	-1,209
Southern Europe	-1,530	-14,979
EU	-26,181	-18,540

Conclusions

- JRC PESETA II as a pilot study: soft-linking of JRC models
- Fruitful cooperation within JRC

Contribution to IA of Adaptation Strategy

Next

Water, land use

Non-market impacts, extremes

Dynamic perspective: climate change and growth

Damage function derivation?

Thanks for your attention!

juan-carlos.ciscar@ec.europa.eu

<http://peseta.jrc.ec.europa.eu/>