Understanding Aggregate Economic Impacts
The JRC PESETA II project

Juan-Carlos Ciscar, European Commission
Snowmass, 24 July 2014

Outline

1. PESETA II, process model approach

   Communities

   Information flow process

2. River floods economic analysis
3. Abrupt climate change
4. Future research

European Commission

1. PESETA approach: Integration with process models (deriving point estimates, rather than via damage functions)

PESETA II Project strategy

Benefit from process models' knowledge

Building climate impact modeling capabilities within JRC

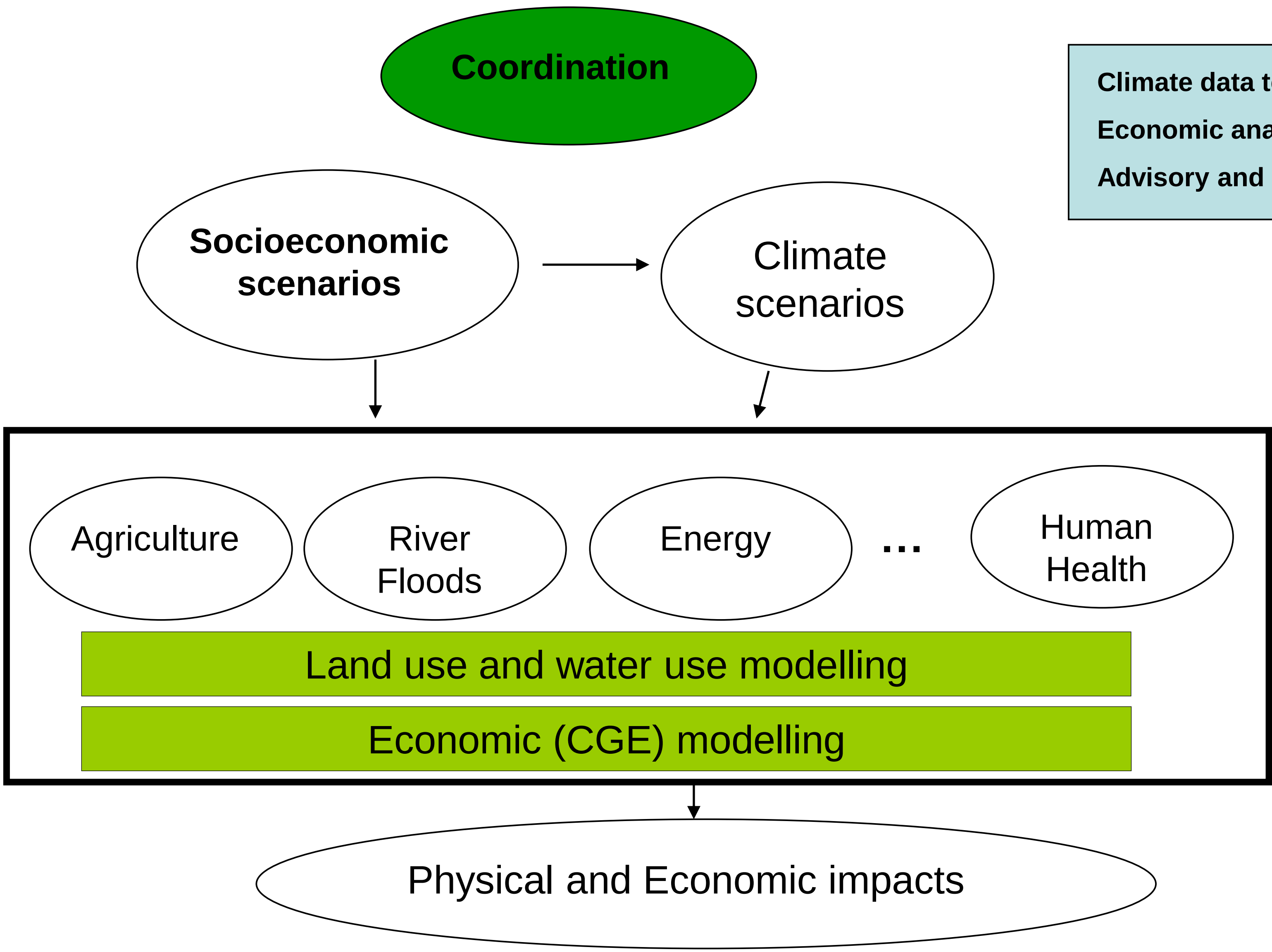
- Existing data and resources within JRC: process models
- Operational and research models
- Learning-by-doing within JRC

To support the EC services on adaptation policy

- EU adaptation strategy (2013
- DG AGRI, CLIMA, ENER, ENV, MOVE, REGIO, Others

European Commission

Project overview



Climate data team

Economic analysis team

Advisory and Review Board

Integrative, granular modelling

3 steps

1. Start with high space-time resolution of climate data, common to all impacts (considers spatial correlation)

   Climate modelling community

2. Use of bottom-up biophysical impact models

   Biophysical impact community

3. Integration of market impact results under an economic model

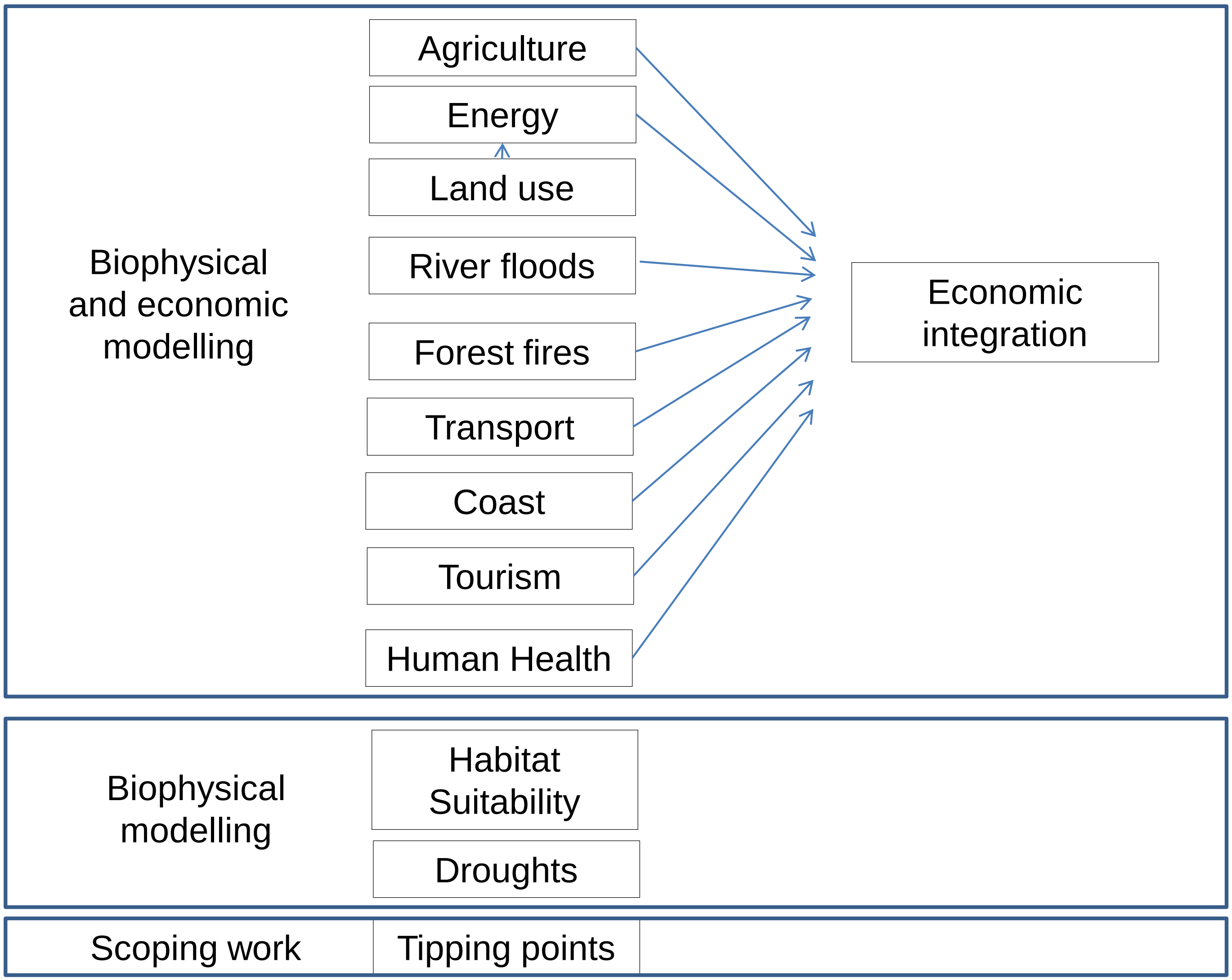
   Economics

Stage 1. Climate data input per impact category

European Commission

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

Stage 2. Biophysical Modelling



Stage 3. Economic modelling

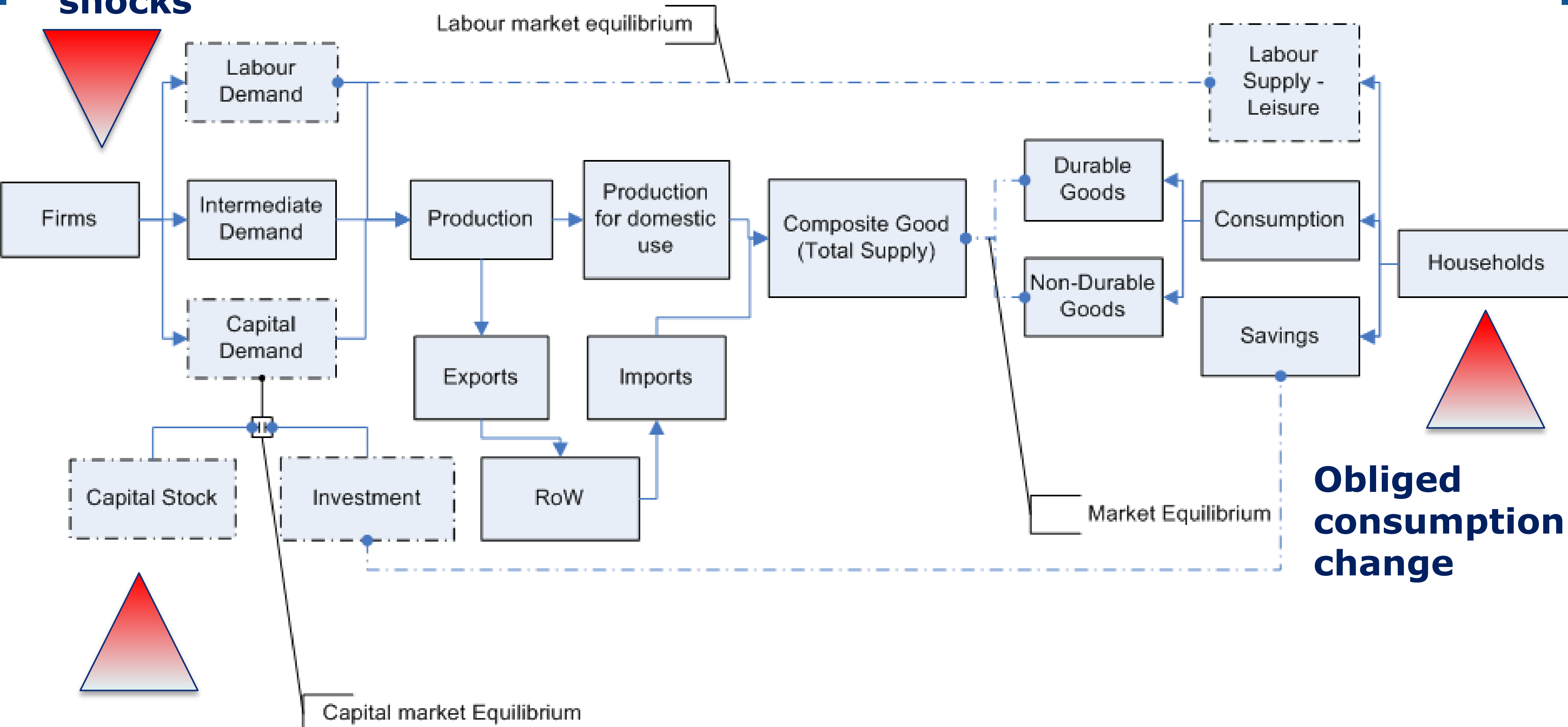
- Multi-sector, multi-country Computable General Equilibrium (CGE) model (GEM-E3 model)
  - Idealised setup without market imperfections or rigidities
  - Market equilibria in long term
  - Ignores short-term adjustment costs

- CGE as an accounting framework: direct and indirect effects; includes cross-sectoral and cross-country effects

- Comparative static framework: impact of future climate change (2080s) on today's economy
- Assuming only private adaptation

First-order climate impacts

Productivity shocks



Capital losses

Communities

Modelling teams

- Climate modellers (physicists)
- Biophysical impact modellers (agriculture engineers, industrial engineers, coast engineers, physical geographers, biologists, physicists, forest engineers)
- Economic modelling (economists, engineers)
- Horizontal support (software engineer)

Advisory and review board

- Physicists
- Economists
- Engineers

Authors

Coordination	JC Ciscar (ed.), L Feyen, C Lavalle, A Soria, F Raes
Climate data pre-processing	M Rozsai
Climate bias corrected data	A Dosio
Agriculture biophysical	M Donatelli, A Srivastava, D Fumagalli, S Niemeyer
Agriculture CAPRI	S Shrestha, P Ciaian, M Himics, B Van Doorslaer
River floods	R Rojas, L Feyen, A Bianchi
Droughts	G Forzieri, L Feyen, R Rojas, A Bianchi
Energy	P Dowling
Transport	F Nemry, H Demirel
Forest Fires	A Camia, G Libertà, J San Miguel
Habitat Suitability	D de Rigo, G Caudullo, J San Miguel, JI Barredo
Tourism	S Barrios, N Ibañez
Human Health	D Paci
Economic, CGE analysis	JC Ciscar, M Perry, D van Regemorter, J Pycroft, T Revesz, B Saveyn, T Vandyck, Z Vrontisi
Tipping points	D Ibarreta, F Nemry
Land use modelling	C Lavalle, C. Baranzelli, I Vandecasteele, F Batista e Silva

Information flow process (1/2)

(1) Selection of climate and socio-economic projections:

Proposed by climate team, according to the needs and available data

Decided by coordination team, in consultation with all sectoral teams

(2) Data preparation/transformation

Climate data (central web site): from cell to country-level or aggregated cell

Economic data: from country to sub-country-level

Information flow process (2/2)

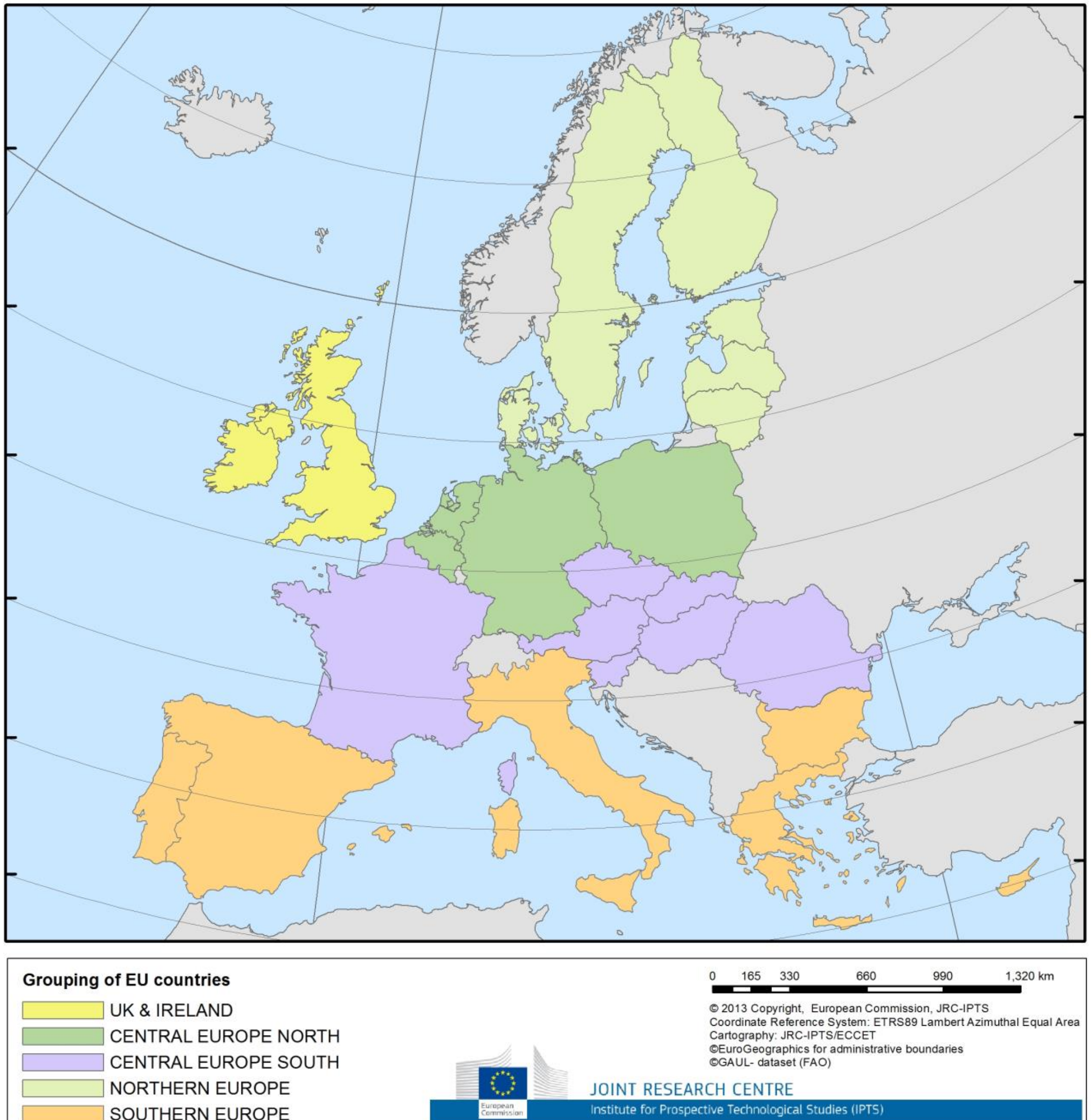
(3) Information lacking

- Downscaling of socioeconomic data to subnational level
- Dynamic evolution of population and GDP
- Agriculture 2080s and Coastal impacts results not @ JRC
  (decision to use results from FP7 ClimateCost)

(4) Challenges

- Dynamic assessment: decision to go static
- Adaptation: heterogeneous across sectors
- Communication, Press Note:
  - Aggregation & economic message
  - "What if global temperature?"
  - Benefits of mitigation (underestimation of benefits)
  - Uncertainty

EU Regions


60°0'0'
55°0'0'
50°0'0'
45°0'0'
40°0'0'
35°0'0'
Grouping of EU countries
UK & IRELAND
CENTRAL EUROPE NORTH
CENTRAL EUROPE SOUTH
NORTHERN EUROPE
SOUTHERN EUROPE
0 165 330 660 990 1,320 km
© 2013 Copyright, European Commission, JRC-IPTS
Coordinate Reference System: ETRS89 Lambert Azimuthal Equal Area
Cartography: JRC-IPTS/ECCET
©EuroGeographics for administrative boundaries
©GAUL- dataset (FAO)
JOINT RESEARCH CENTRE
Institute for Prospective Technological Studies (IPTS)

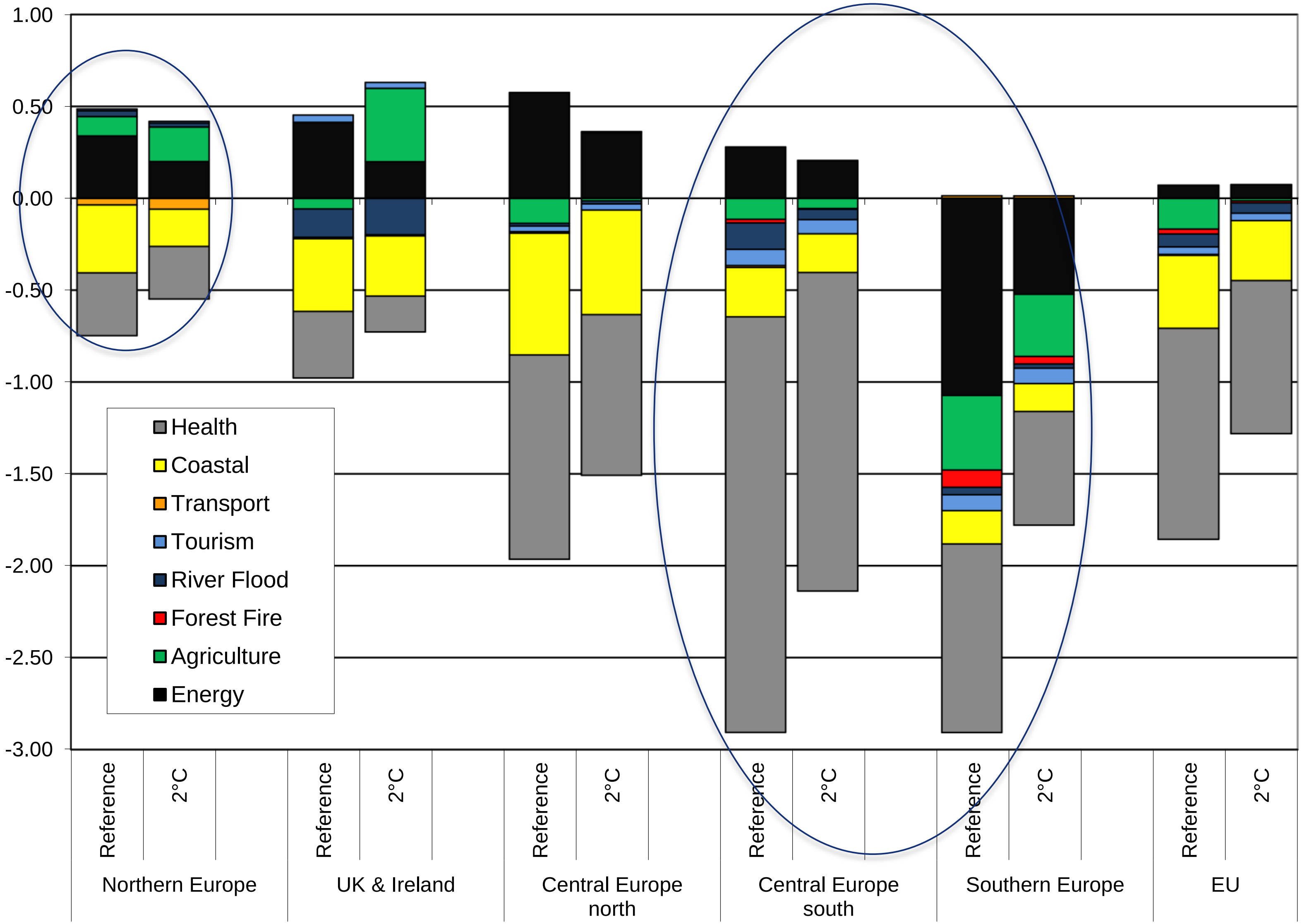
Reference run: headlines

- Agriculture: EU agriculture productivity could be reduced by 10% in the 2080s; by 20% in the Southern Europe region
- Energy: EU Energy demand could fall by 13% (with an increase in Southern Europe)
- River floods: Flood damages could more than triple and people affected almost double
- Droughts: EU cropland affected by droughts could multiply by seven (reaching 700,000 km2/year). People affected by droughts could also multiply by seven (reaching 144 million/year)

Reference run: headlines (cont.)

- Forest fires: Forest fires could more than double in Southern Europe (reaching 800,000 Ha)
- Transport infrastructure: Damages due to climate change could increase by 50%
- Coasts: Sea floods could more than triple
- Tourism: tourism expenditure could drop by €15 billion/year, with Southern Europe half of that
- Tree species habitat suitability of Albies alba: shift towards Northern and higher elevation areas
- Human health: Mortality could double (reaching 100,000 deaths/year)

Welfare change (%GDP), Reference and 2ºC EU and regional breakdown



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**

2. River floods

River floods impact assessment

1. Daily and 25 km climate data

2. Hydrological model (LISFLOOD)

3. Damages as capital losses and obliged consumption, lead to welfare losses

Results for 2080s

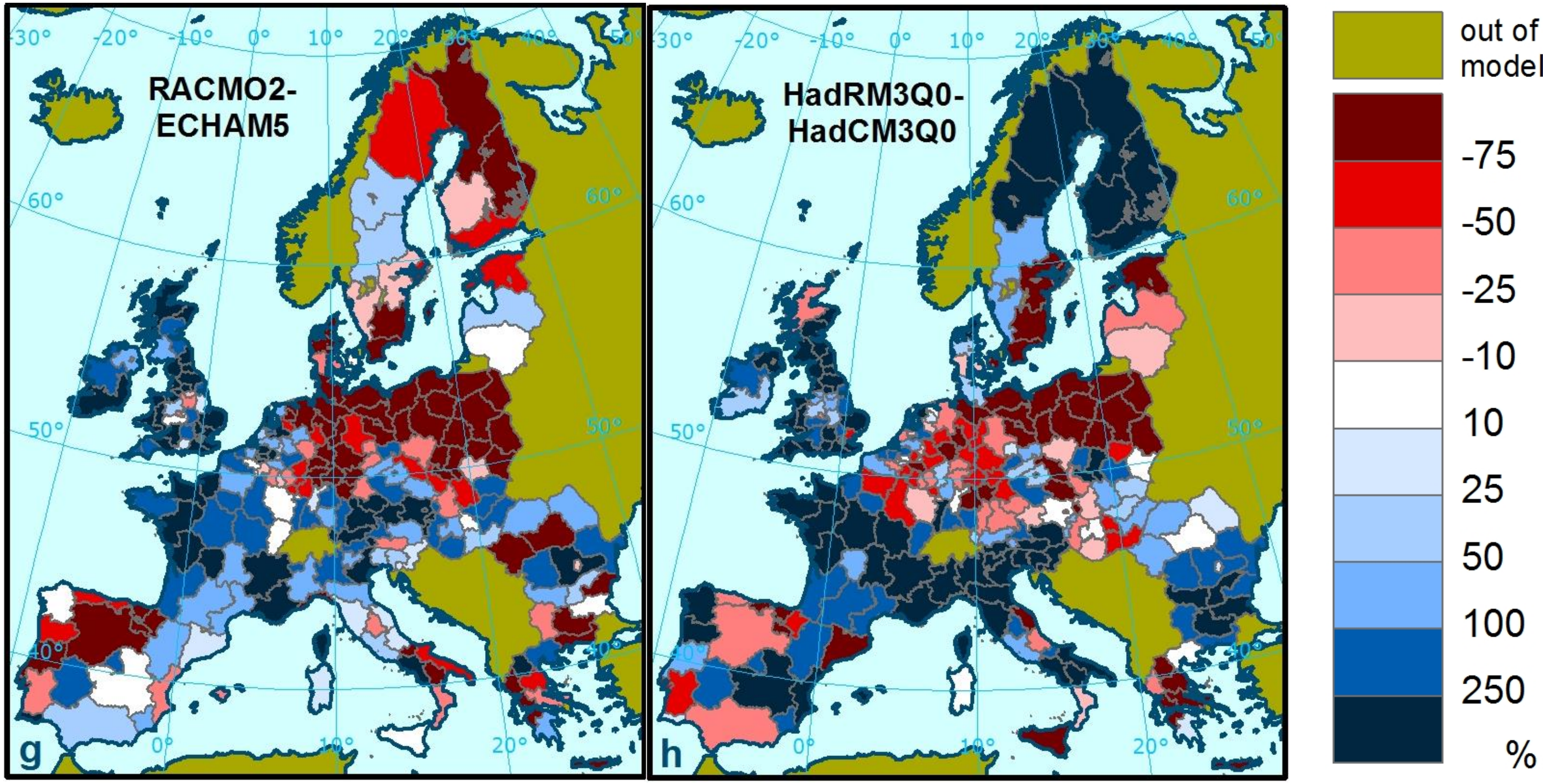
- Annual people affected and direct economic damages could double, compared to past control (static economy)
- Economic damage could be much higher with economic growth (more assets exposed).

European Commission

Welfare impacts of river floods in worst, reference and best cases (€ 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**

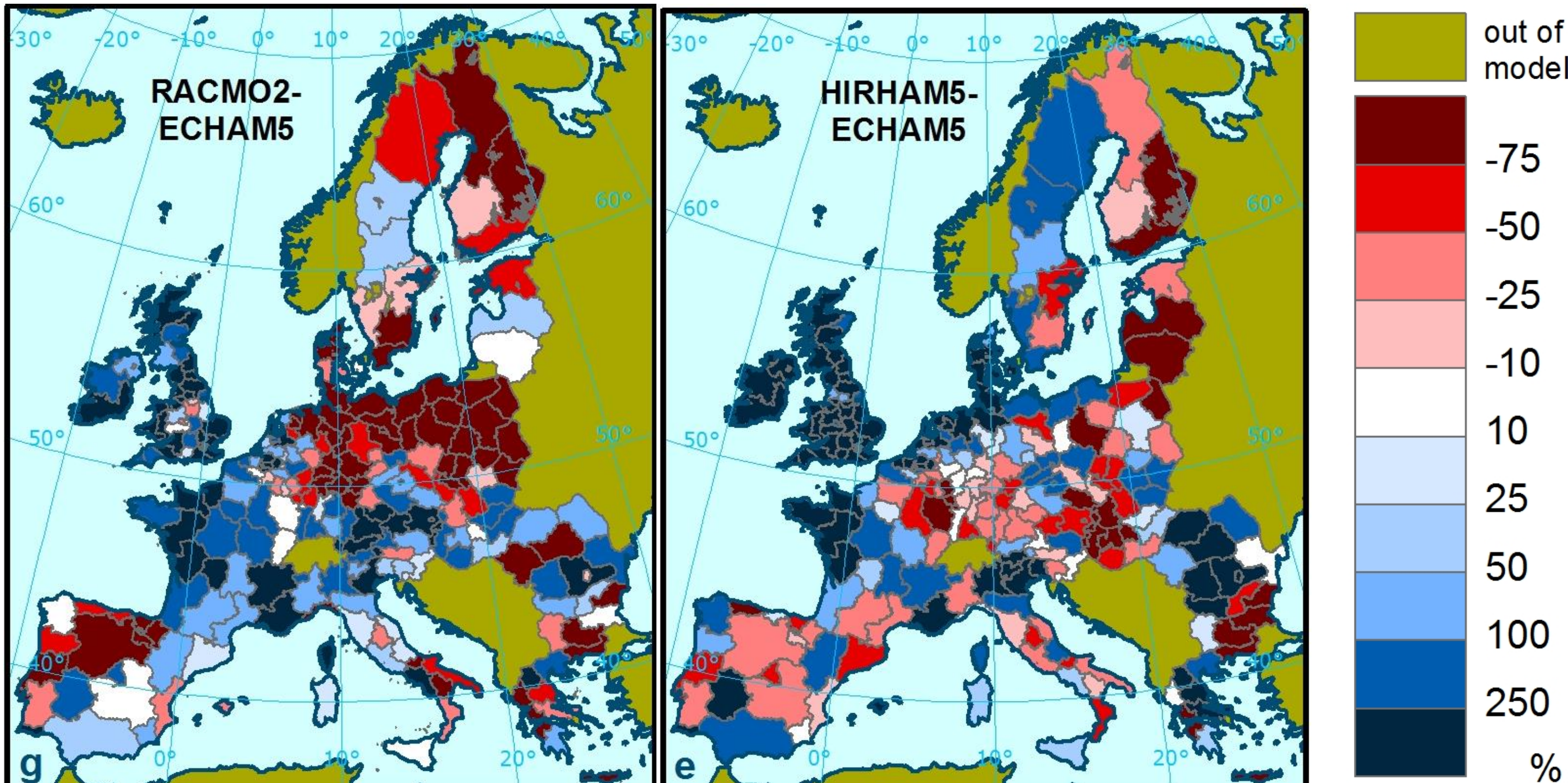
River Floods
Relative change in Expected annual damage



Reference Run **Reference Variant 1**

European Commission

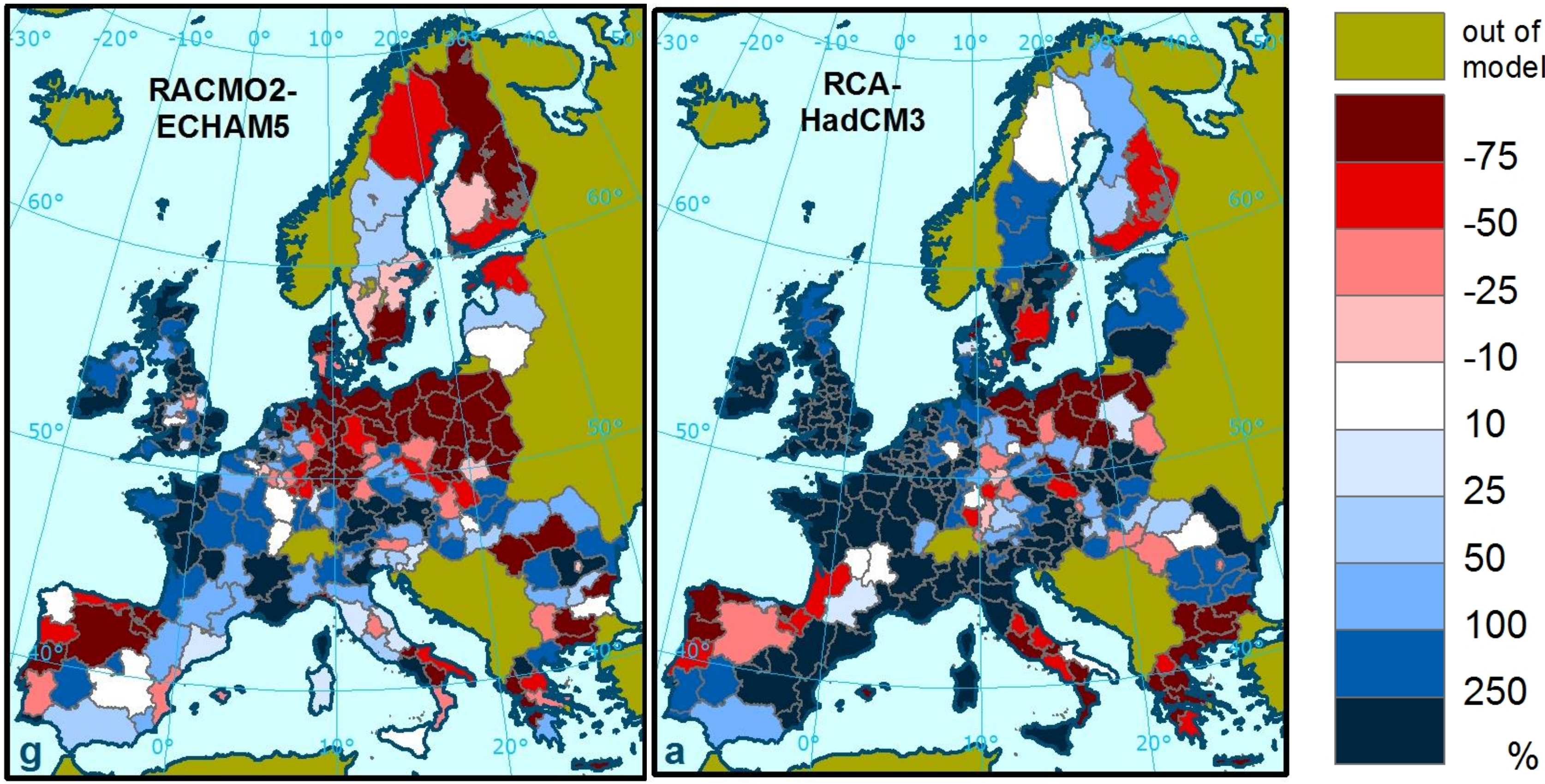
River Floods
Relative change in Expected annual damage



Reference Run **Reference Variant 2**

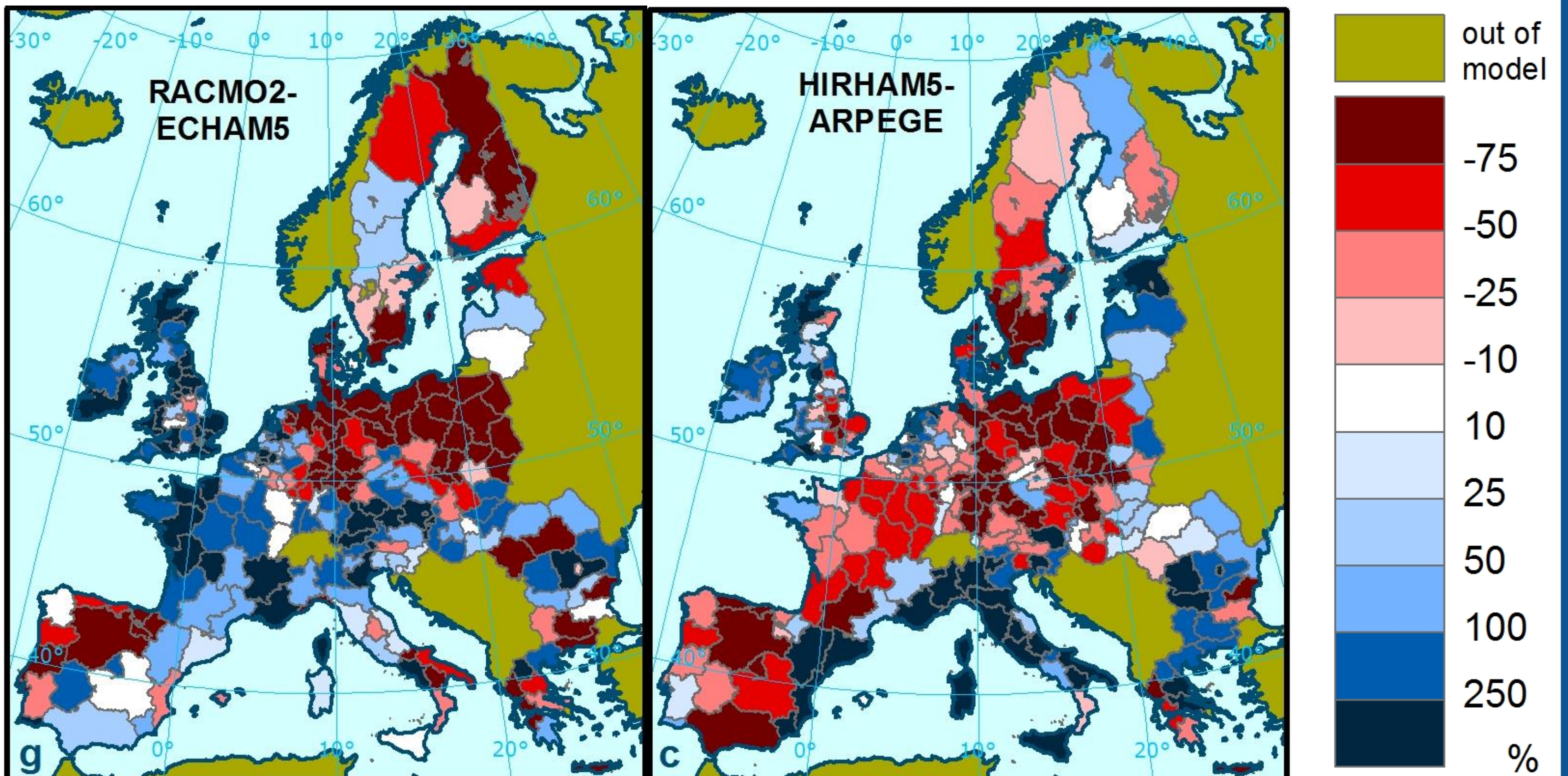
European Commission

River Floods
Relative change in Expected annual damage



Reference Run **Another Variant**

River Floods
Relative change in Expected annual damage



Reference Run **Another Variant**

3. Abrupt Climate Change, integrated modelling

Approach in PESETA II project

Selection of climate tipping points relevant for Europe

- Arctic Sea-Ice melting
- Melting of Alpine glaciers
- Greenland Ice sheet meltdown
- West Antarctic ice sheet collapse
- Collapse of the Atlantic Thermohaline Circulation
- Persistent blocking events of the jet stream

Approach in PESETA II project

"Reverse engineering" (Lenton and Ciscar, 2013):

3. Biophysical impacts to economic impacts

2. Climate change to biophysical impacts

1. Abrupt climate change to (regional) climate change. 2012 Workshop

Scoping work

4. Future research

Towards PESETA III

European Commission

Some lessons from PESETA I, II

- Need of strong horizontal coordination
- Value-added from Interdisciplinary work
- Involve communication team from the beginning
- Advisory and review board
- ***Biophysical and disaggregated*** focus

Possible plan for PESETA III (2015-2016). Focus on

- Extreme events
- 2020-2030 time horizon
- Adaptation measures
- Economics of adaptation (FP7 ECONADAPT)

Other research

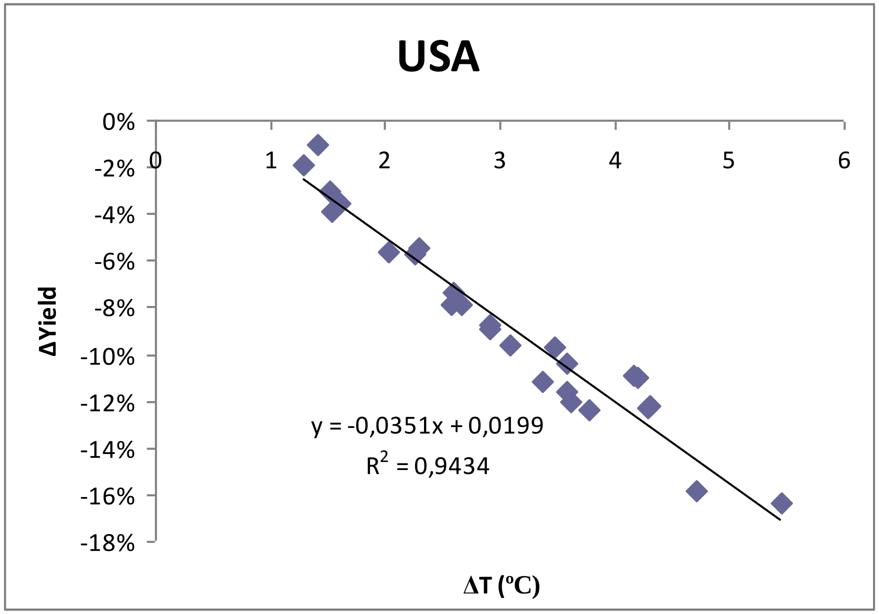
- Impacts in the Rest of the World (beyond Europe) GAP Project, FP7 HELIX project
- Focus on non-market effects (e.g. ecosystem services), Catastrophic impacts
- Macroeconomic growth model (MaGE, CEPII)
- CGE dynamic assessment (maximum entropy)
- Stochastic analysis

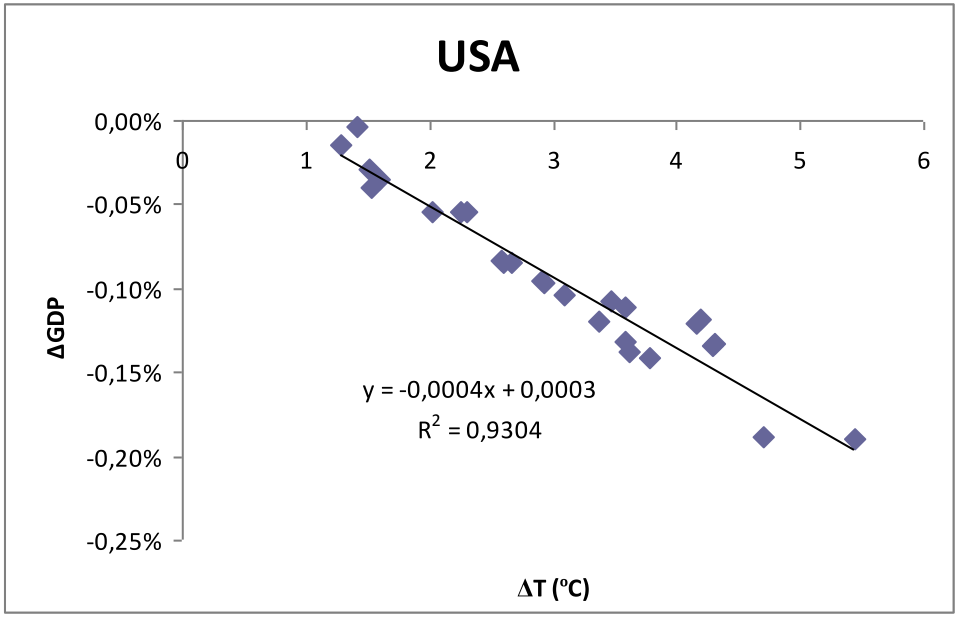
Damage functions?

A tool to integrate knowledge from different disciplines

- Based on literature review, but inconsistency problems
- From historical observations (statistical analysis), but extrapolation beyond sample, instability of the function
- From process model simulations, but can be complex functions

USA damage functions

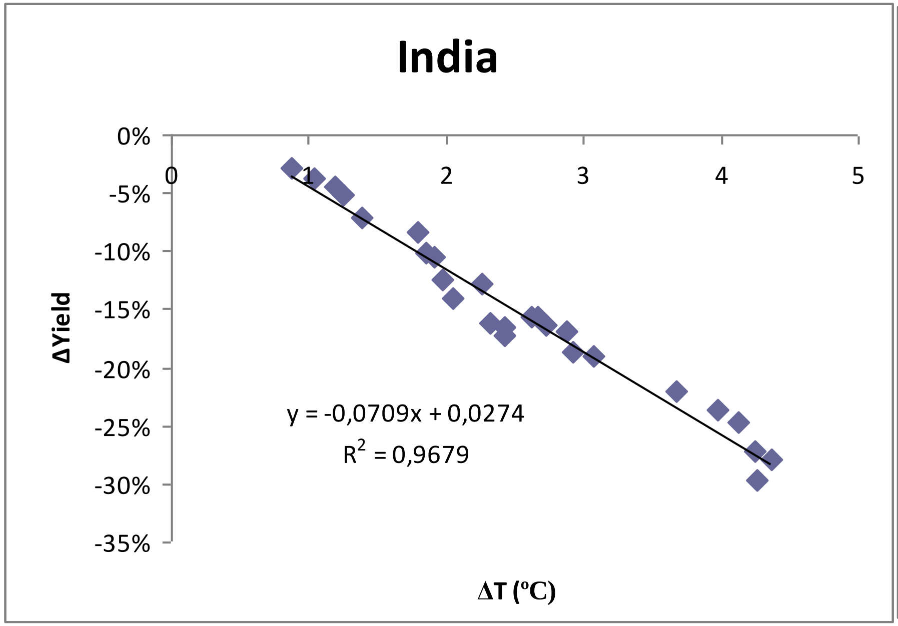


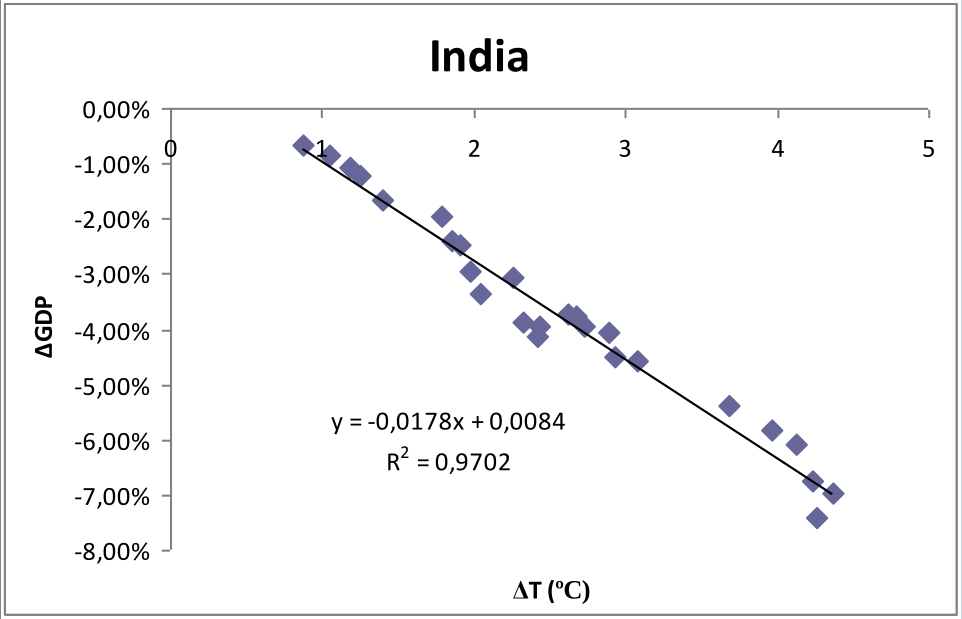


Yield changes

GDP changes

India damage functions

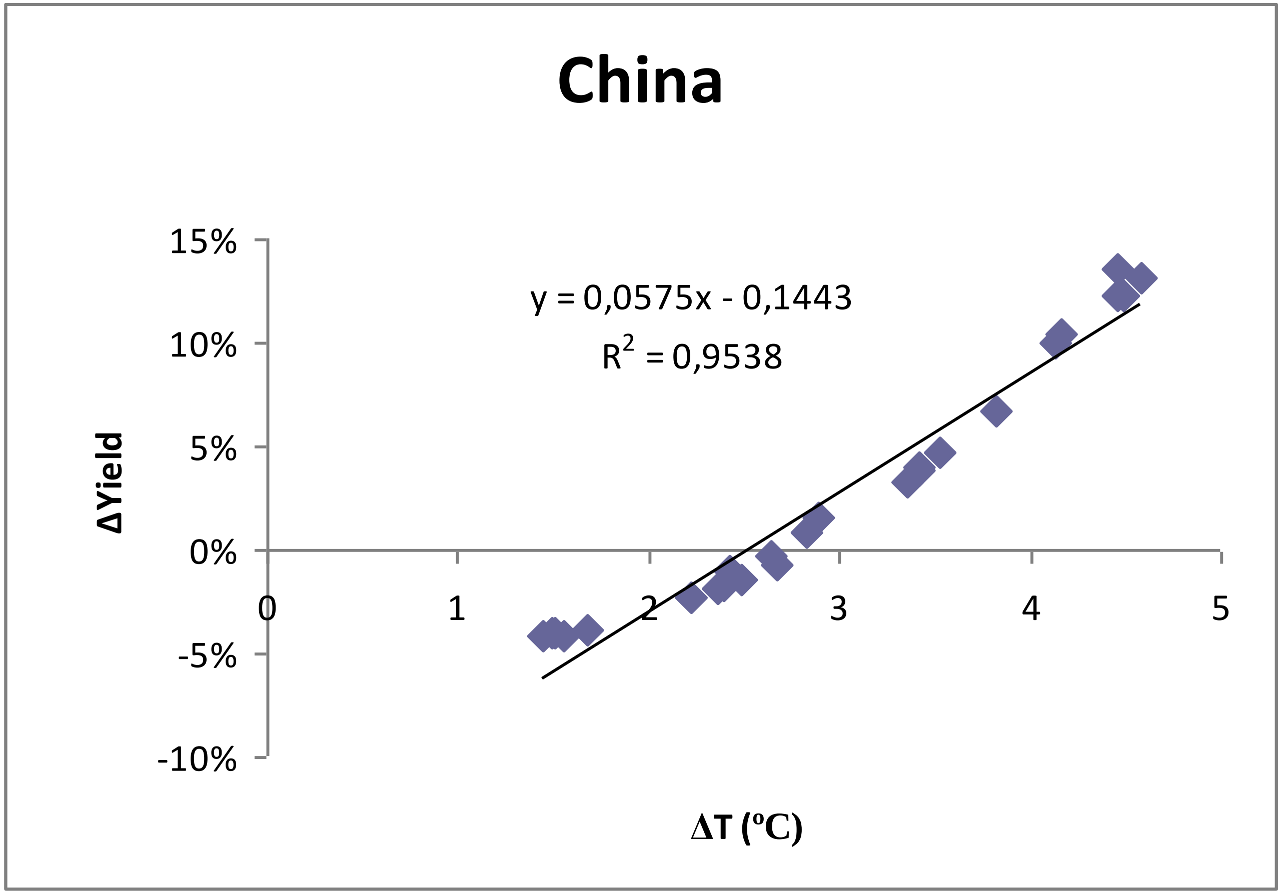




Yield changes

GDP changes

China ΔYield-ΔT function



Thanks for your attention!

juan-carlos.ciscar@ec.europa.eu

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