Table 1. List of Beneficiaries

No	Participant organisation name/Corresponding contact	Country
1	Helmholtz-Zentrum Geesthacht Zentrum für Material- und Küstenforschung GmbH, Climate Service Center/**HZG** – **Coordinator/ Daniela Jacob**	Germany
2	Potsdam Institut fuer Klimafolgenforschung/ **PIK / Fred Hattermann**	Germany
3	UniResearch, Bjerknes Centre for Climate Research/ **UniRes /Stefan Sobolowski**	Norway
4	Meteorologisk Institutt/**MET.NO/ Jan Erik Haugen**	Norway
5	Sveriges Meteorologiska och Hydrologiska Institut, Rossby Centre /**SMHI/ Erik Kjellström**	Sweden
6	JRC -Joint Research Centre- European Commission/ **JRC/ Alessandro Dosio**	Belgium
7	Agenzia Nazionale per le Nuove Tecnologie,L'energia e lo Sviluppo Economico Sostenibile / **ENEA/ Sandro Calmanti**	Italy
8	Centre National de la Recherche Scientifique Institut Pierre Simon Laplace/ **CNRS-IPSL/ Robert Vautard**	France
9	Centre National de Recherches Meteorologiques METEO-FRANCE/**MeteoF/ Michel Déqué**	France
10	Universität Graz, Wegener Zentrum für Klima und Globalen Wandel/ **UNIGRAZ/ Heimo Truhetz**	Austria
11	Joanneum Research Forschungsgesellschaft MbH / **JR / Franz Prettenthaler**	Austria
12	Internationales Institut fuer Angewandte Systemanalyse **/ IIASA / Michael Obersteiner**	Austria
13	Danmarks Meteorologiske Institut / **DMI / Ole Bøssing Christensen**	Denmark
14	Koninklijk Nederlands Meteorologisch Instituut / **KNMI / Geert Lenderink**	Netherlands
15	Wageningen Universiteit / **WU /Fulco Ludwig**	Netherlands
16	Technical University of Crete / **TUC / Ioannis Tsanis**	Greece
17	Paul Watkiss Associates Ltd/ **PWA / Paul Watkiss**	UK
18	Universite de Lausanne / **UNIL / Hans-Jörg Albrecher**	Switzerland
19	University of Southampton/ **SOTON / Robert J. Nicholls**	UK
20	Stockholm Environment Institute Ltd /**SEI-OXFORD / Ruth Butterfield**	Sweden
21	**MET OFFICE / Jason Lowe**	UK
22	Ministry of Housing and Environment /**MHE / Ali Shareef**	Maldives
23	Bangladesh Center for Advanced Studies / **BCAS / Md. Abu Syed**	Bangladesh
24	International Water Management Institute /**IWMI / Simon Langan**	Sri Lanka
25	Stichting Wetlands International / **WI / Pieter van Eijk**	Netherlands
26	World Health Organization, Regional Office for Europe, Kopenhagen-Rome/**WHO / Bettina Menne**	Switzerland
27	Institute of Water Modelling / I**WM / Asif Zaman**	Bangladesh
28	African Centre of Meteorological Application for Development / **ACMAD / Andre Kamga Foamouhoue**	Niger
29	Global Climate Forum E.V./ **GCF/ Jochen Hinkel**	Germany

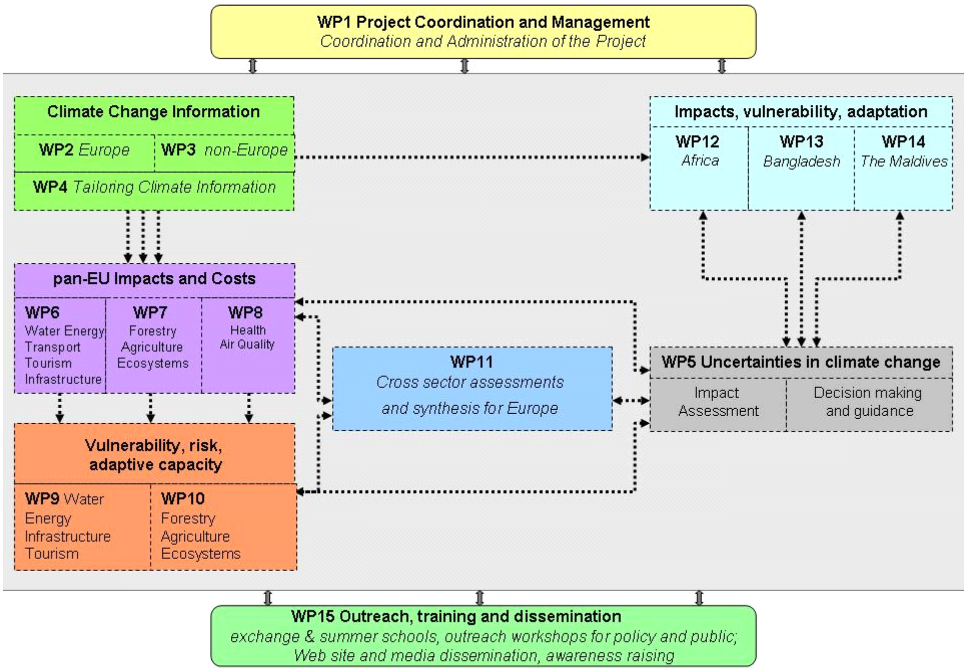


Figure 1 *Workpackages and their interactions.*

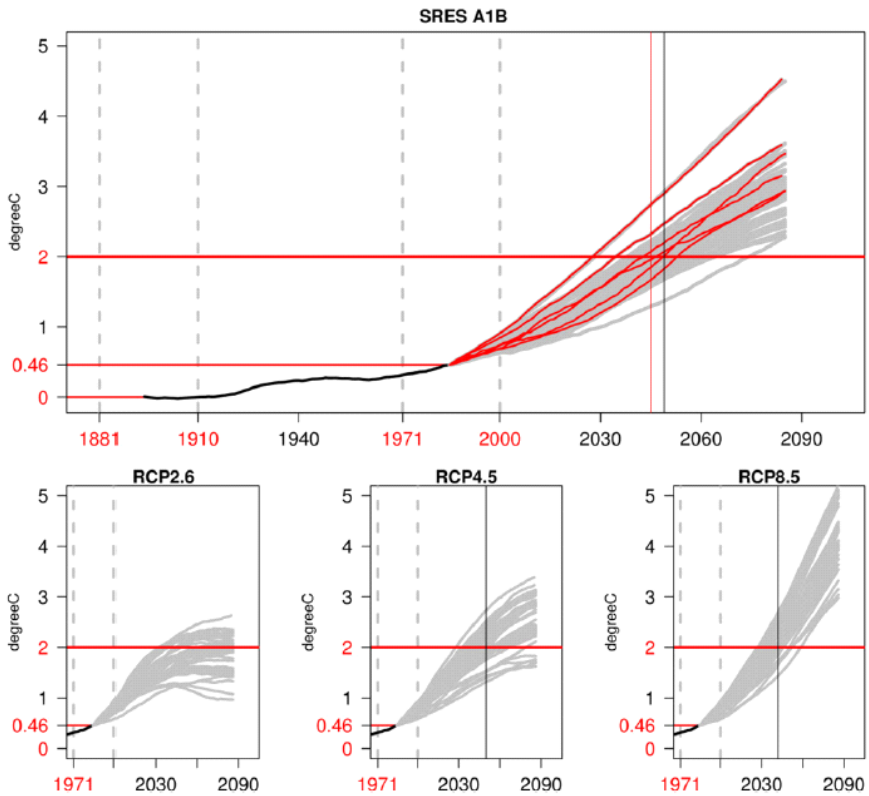


Figure 1. ***Global mean temperature (30-year running mean; grey lines) for the SRES A1B ensemble (top panel) and for the RCP2.6, RCP4.5 and RCP8.5 CMIP5 simulations (bottom panels) exceeding the +2ºC threshold (bold red horizontal line). The average observed temperature compared to preindustrial (1881–1910) is depicted in the upper panel (black line). The CMIP3 and CMIP5 ensemble median years for reaching the 2ºC target for each emission scenario are shown as black vertical lines, whereas the red vertical line represents the median year of the six driving GCMs of this study, which are highlighted in red. Since most RCP2.6 simulations stabilise below +2ºC, no median year that exceeds the +2ºC threshold is shown. From Vautard et al. (2014).***

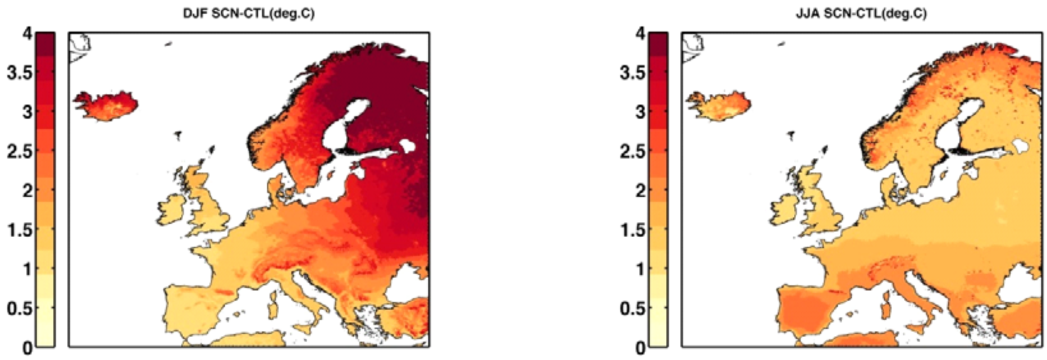


Figure 2 ***Changes between the 1971–2000 and the +2ºC period, in seasonal mean Tmin in winter (left) and Tmax in summer (right). From Sobolowski et al. (2015).***

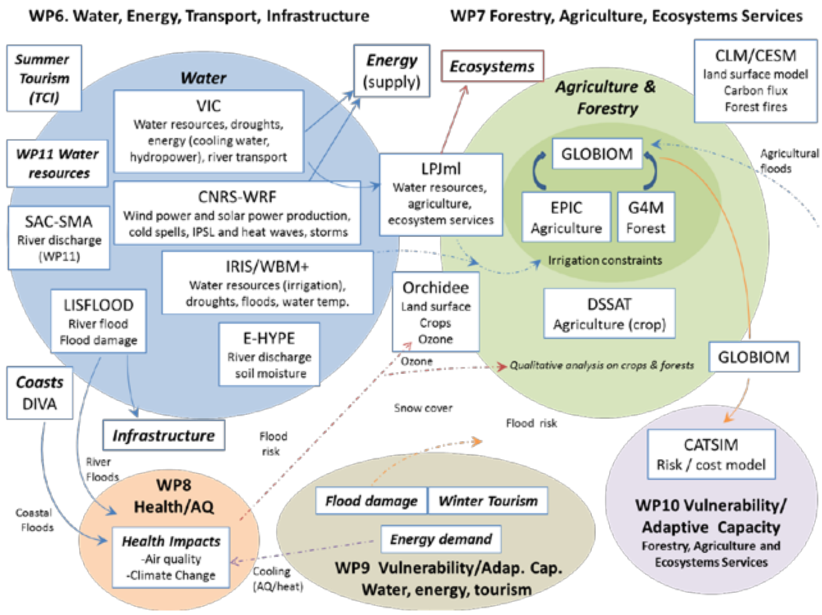


Figure 3. The **linkages of models across different sectors**

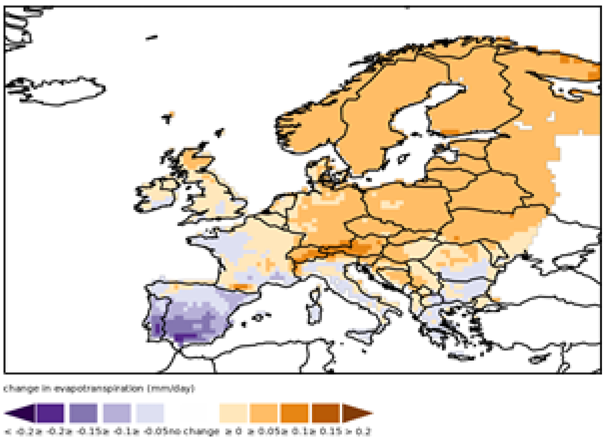


Figure 4. Changes in the water cycle (run off) in Europe under 2°C global warming. Figure shows changes relative to the 1971-2000 in run-off [mm/day] (for RCP4.5 only)

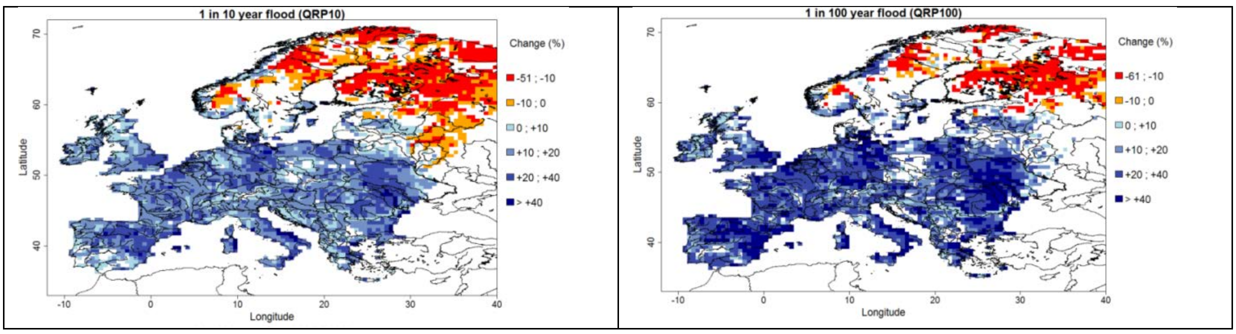


Figure 5 Median of Relative Future Changes in high flows under +2°C global warming for QRP10 (left panel)and QRP100 (right panel). The median is computed over 33 members (11 mandatory simulations x 3 Hydrological models). Only significant changes are shown here.

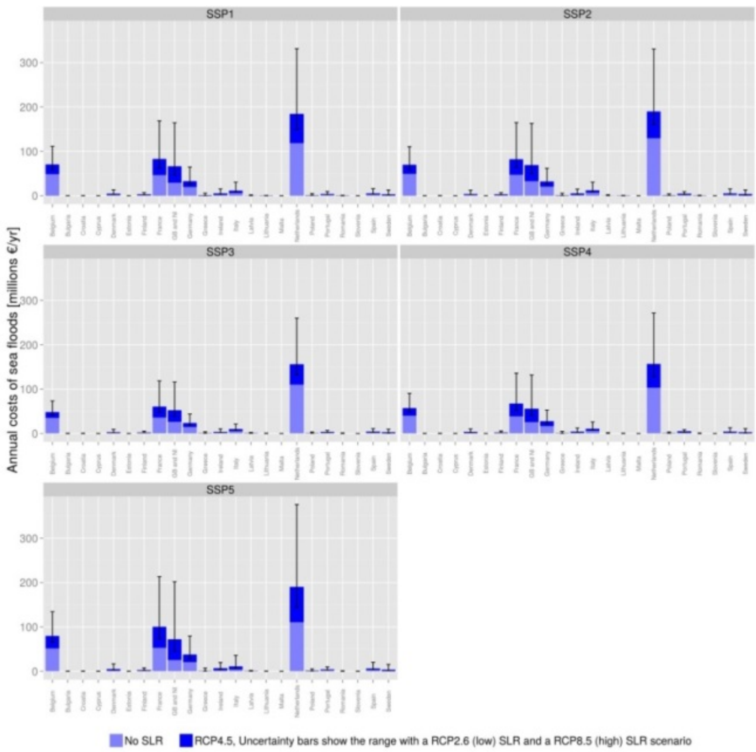


Figure 6. Annual costs of sea floods per EU country for each SSP scenario in the 2080s. The dark blue bar indicates a RCP4.5 mid scenario, with uncertainty bars showing the range of impacts with low (RCP2.6 low) and high (RCP8.5) scenario. A scenario of no sea-level rise is indicated for each country by the lighter blue bar.

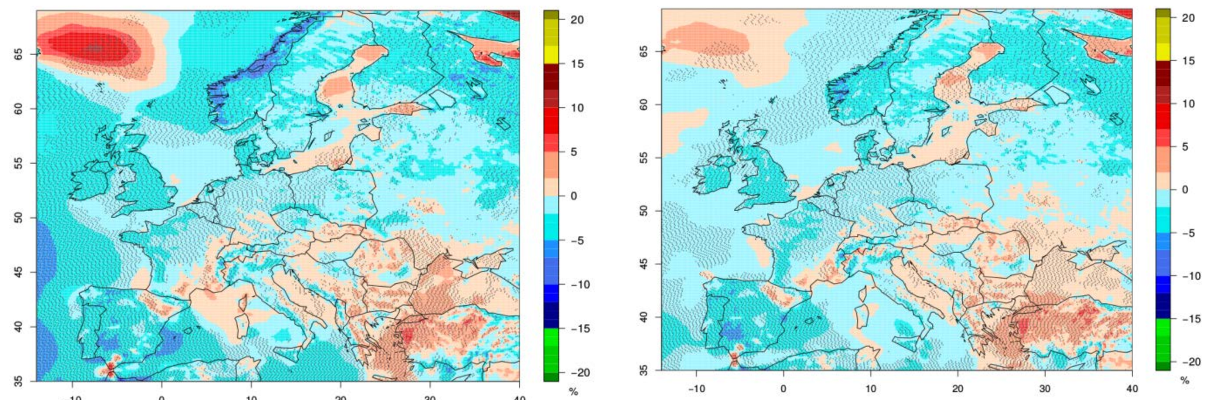


Figure 7 (left) Ensemble mean changes in annual wind energy density at 90m (W.m^{-2}) under +2°C global warming with respect to the recent period (in %), were assessed from the 5 RCP4.5 simulations set (left). The figure on right was assessed using the 9 RCP4.5-RCP8.5 simulations set.

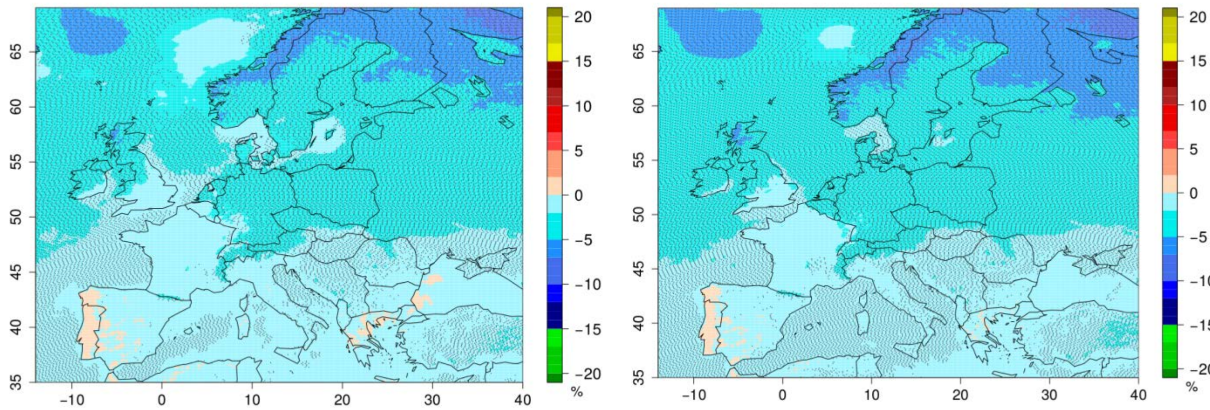


Figure 8 (left) Ensemble mean solar PV potential (kWh.yr-1.m-2) under a 2°C global warming with respect to the recent period (in %), assessed from the 5 RCP4.5 simulations set (left). The figure on right was assessed using the 9 RCP4.5 and RCP8.5 simulations set. Grid points where changes are robust are marked with black dots.

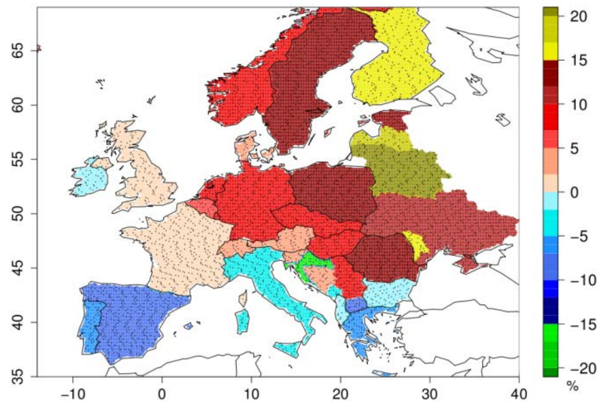


Figure 9 Ensemble mean national gross hydropower potential (MW) under +2°C global warming with respect to the recent period (in %), assessed from the 5 RCP4.5 simulations.

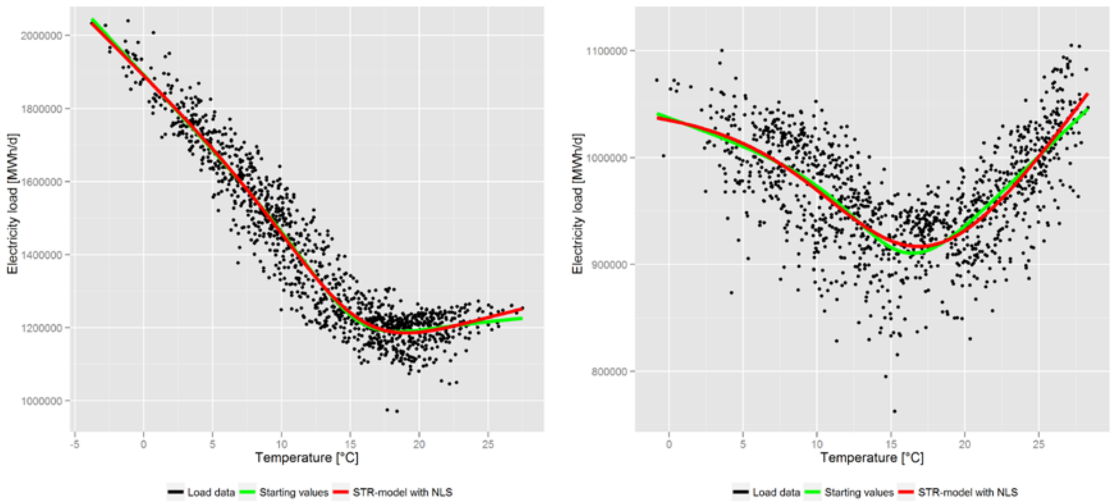


Figure 10: Temperature impacts on electricity load in France (left) and Italy (right) on working days.

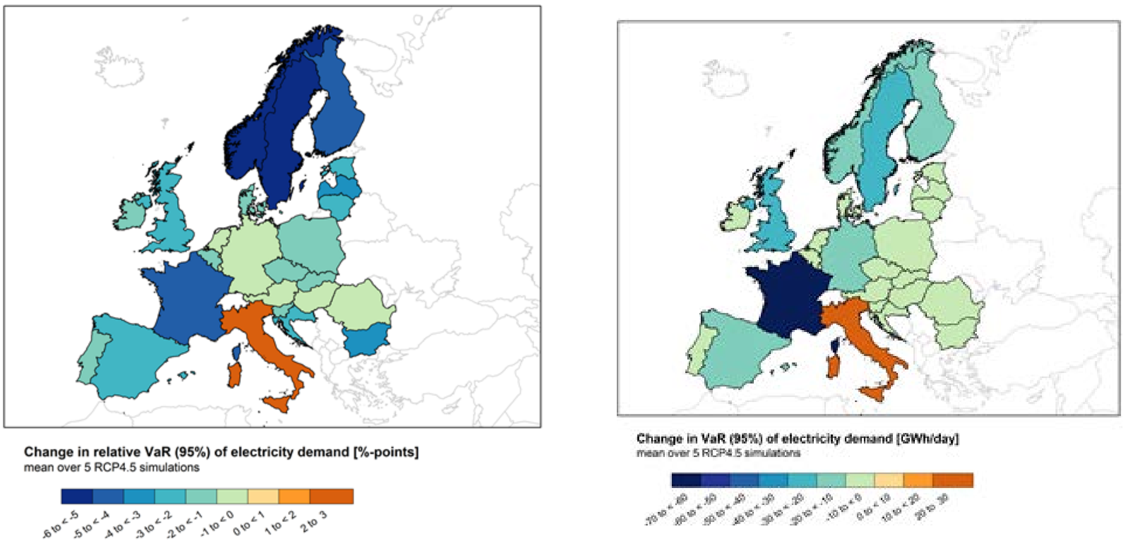


Figure 11 Change in VaR (95%) of electricity demand on working days between 2036-2065 and 1971-2000 (mean over 5 RCP4.5 simulations), in relative terms (%-points, left plot) and absolute terms (GWh/day, right plot).

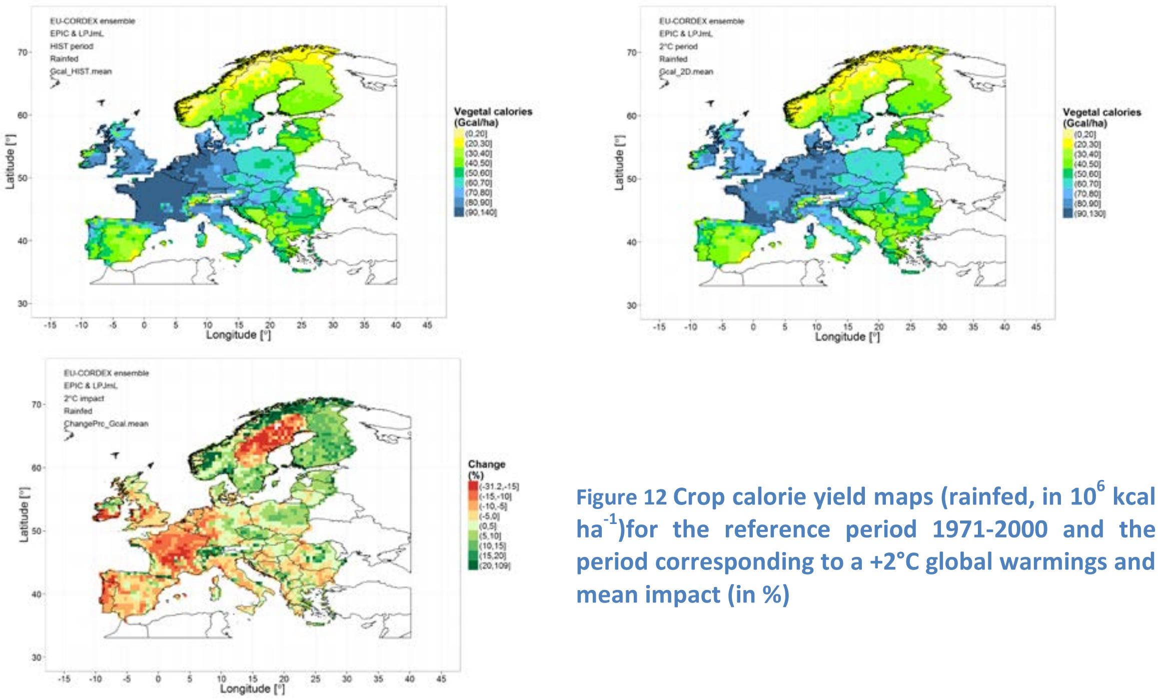
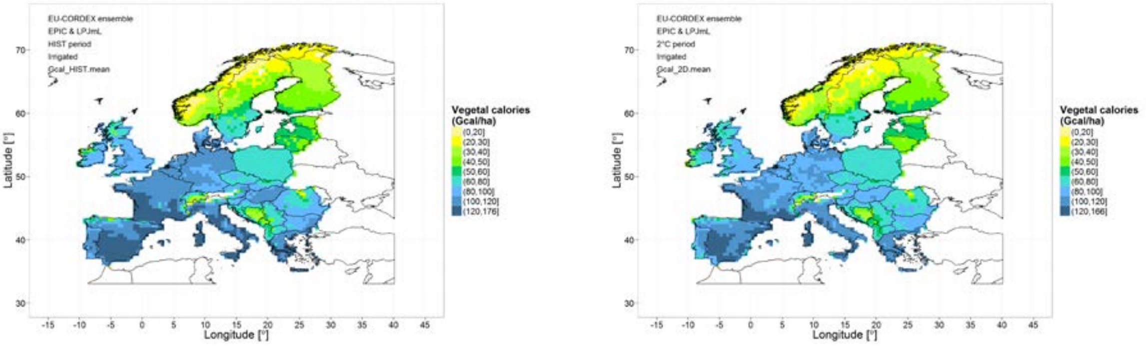


Figure 12 Crop calorie yield maps (rainfed, in 10^6 kcal ha^{-1})for the reference period 1971-2000 and the period corresponding to a +2°C global warmings and mean impact (in %)



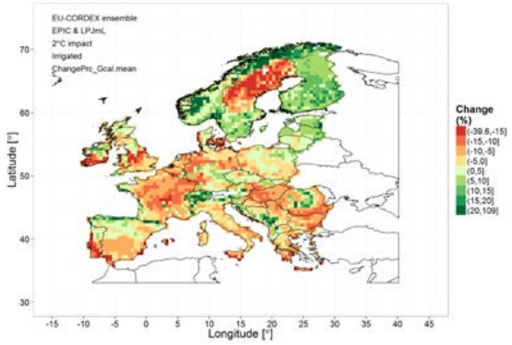
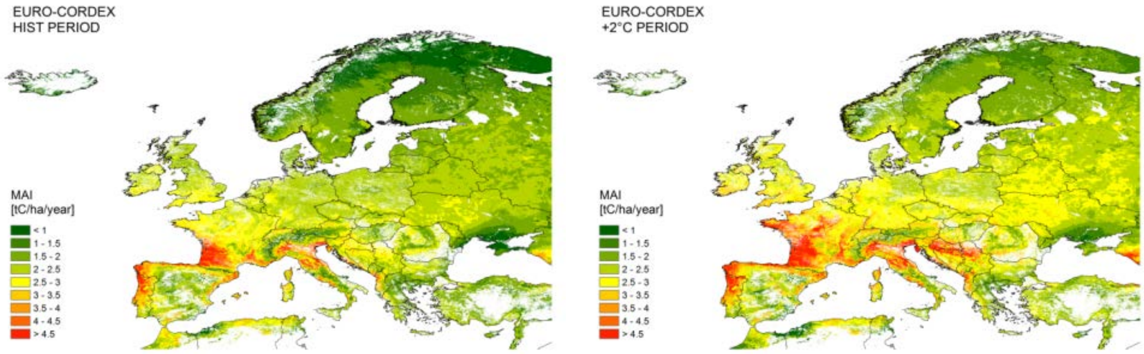


Figure 13 Crop calorie yield maps (irrigated, in 10^6 kcal ha^{-1})for the reference period 1971-2000 and the period corresponding to a +2°C global warming and the mean impact (in %).



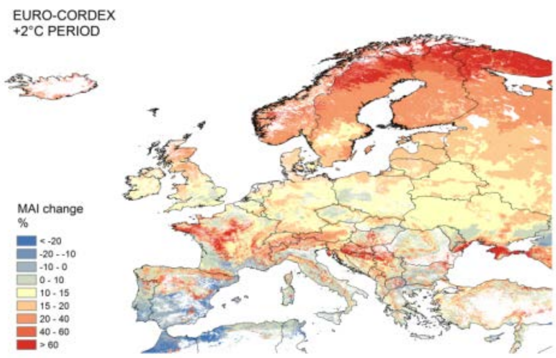


Figure 14 EURO-CORDEX mean potential tree increments (in tC ha-1 year-1) simulated for the reference historical period 1971-2000 and the period of a +2°C global warming, and mean impact (in %) simulated by G4M.

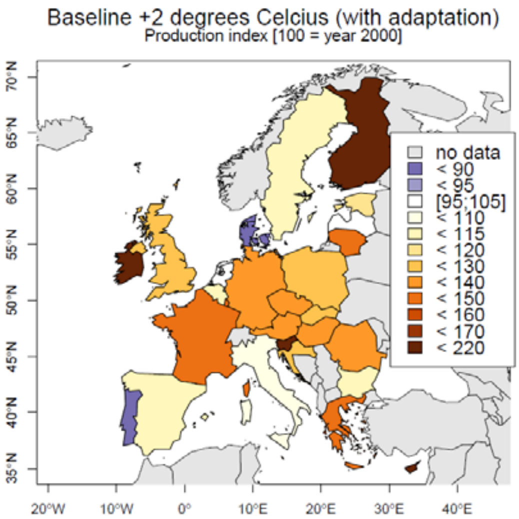


Figure 15 Value of the index of calories produced from cropland (base 100 in year 2000) in a +2 °C world, accounting for all drivers including socio-economic developments, climate change, and adaptation.

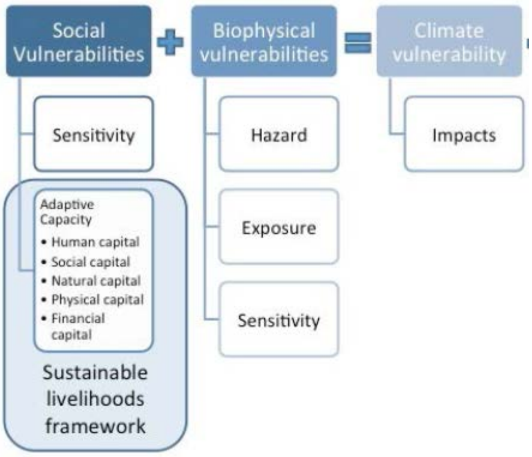


Figure 16 Outline of the IMPACT2C approach.

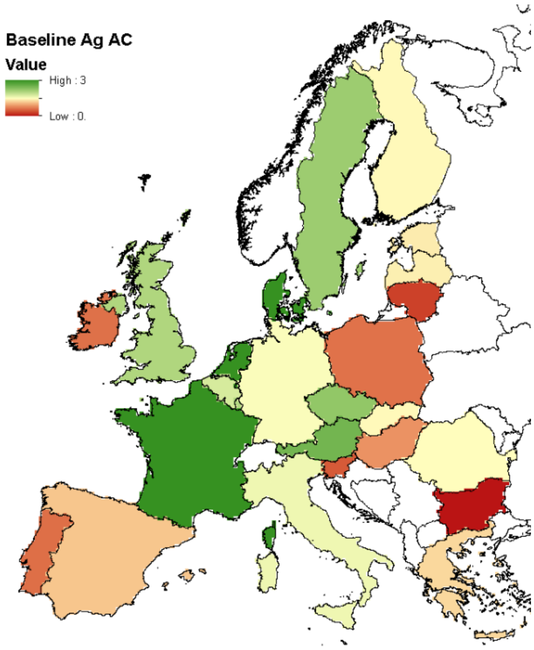


Figure 17 Baseline adaptive capacity for the agricultural sector

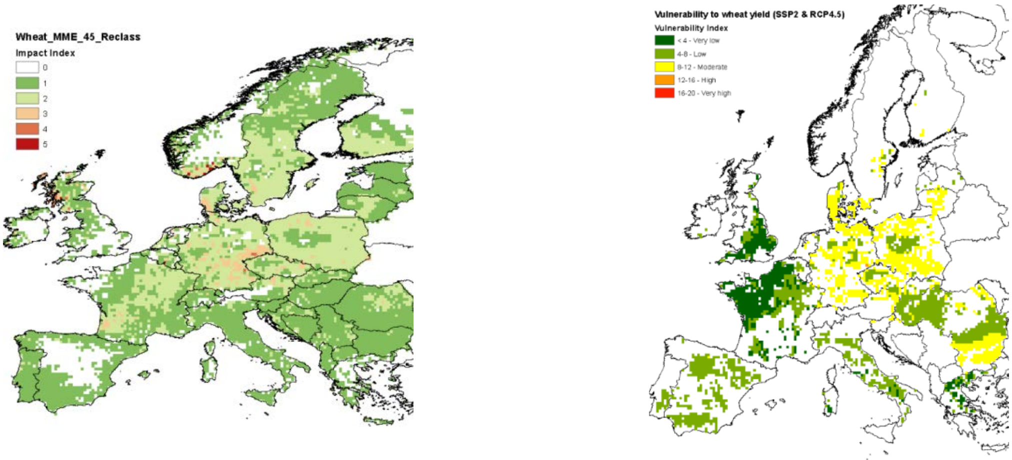


Figure 18 Assessing vulnerability to drought affecting wheat yields under +2°C degrees of global change. The map on the left shows the calculated impact indicator depicting the severity of decreasing yields, from 0 to 5, with 0 being any increase in yield. The map on the right combines impacts with an inverse AC index, and excludes areas which do not have < 5% harvested crop area. Scenario: RCP4.5 / SSP2

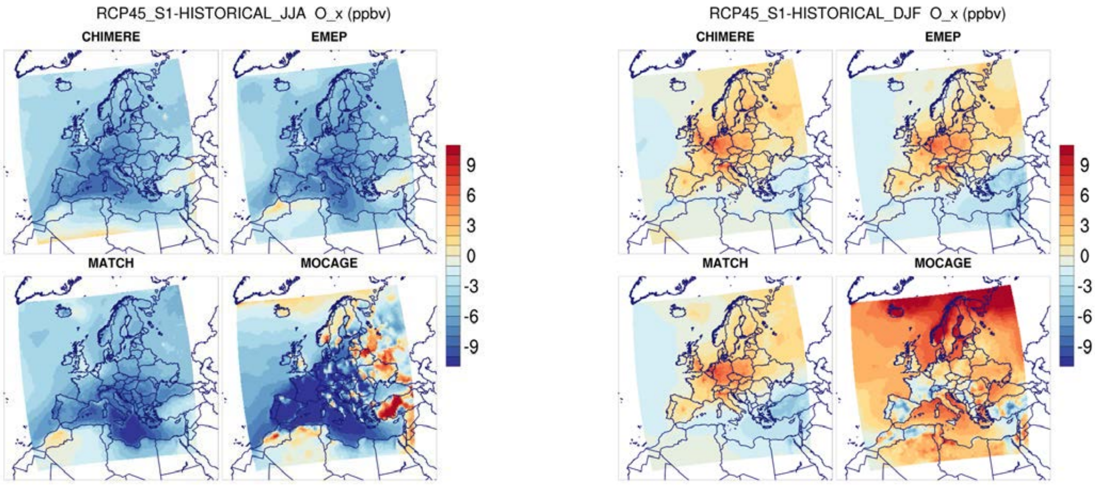


Figure 19 Differences in average O3 concentrations (in ppb(v)) between S1 and 1971-2000 simulated by CHIMERE, EMEP, MATCH and MOCAGE for summer (left) and winter (right).

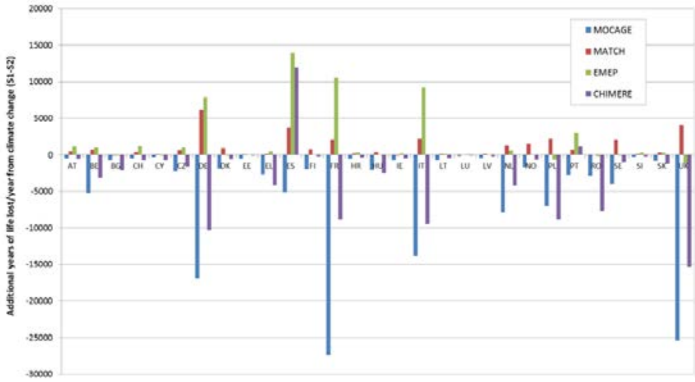


Figure 20 Change in life years lost/year in 2050 from the additional impact of climate change (S1-S2) on PM2.5 concentrations

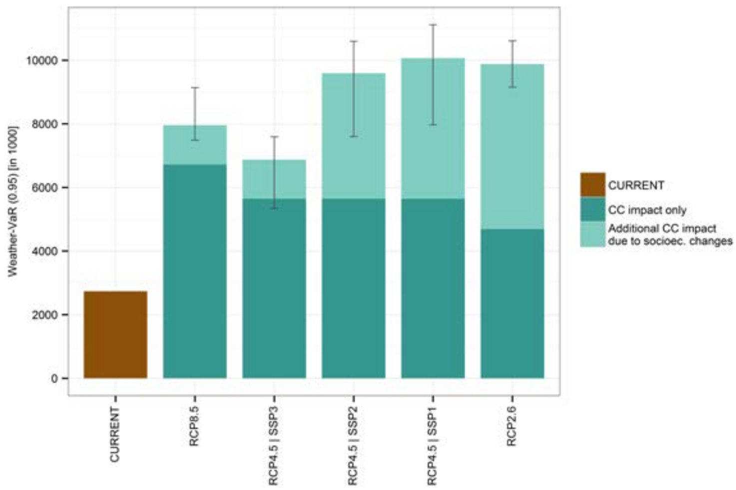


Figure 21 Weather-Value at Risk (0.95)* of winter overnight stays in the +2°C periods in comparison to the reference period, in absolute (left) and relative terms (right) and aggregated at country level

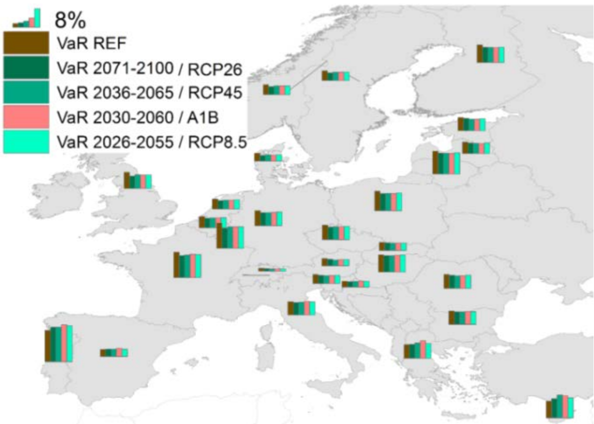


Figure 22 Value at Risk (95%) of summer (May to October) overnight stays – aggregated at country level.

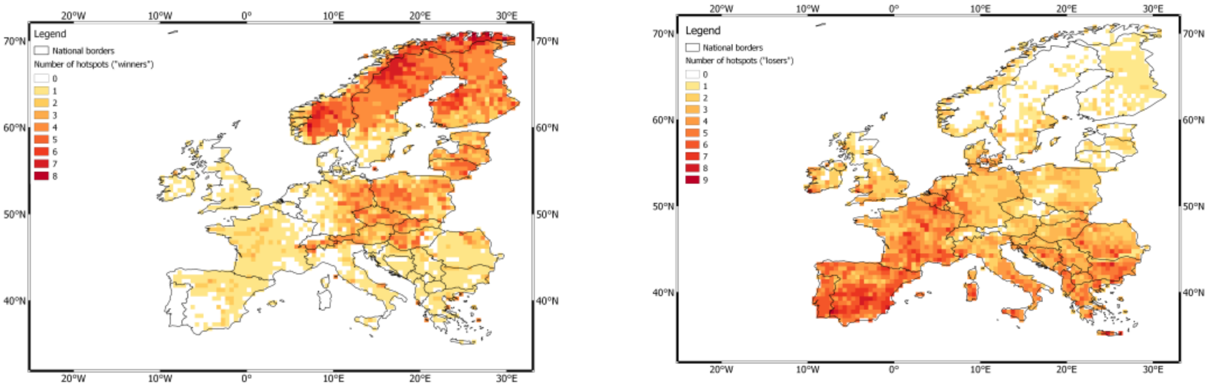


Figure 23 Robust multi-sectoral hotspots 'winner' (left panel) and 'losers' (right panel)

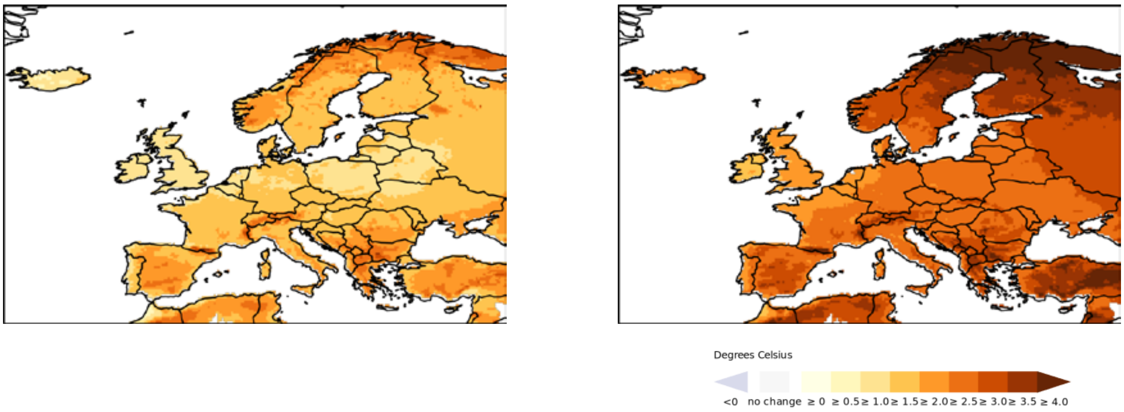


Figure 24 Climate change signal over Europe for the +2°C (left panel) and +3°C (right panel) for mean air surface

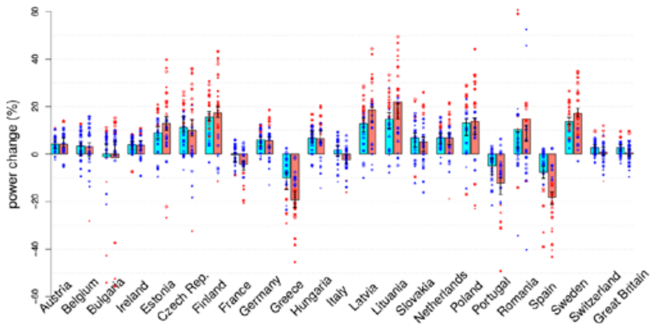


Figure 25 Changes in national mean annual gross hydropower potential under a 2°C (cyan) and 3°C (salmon) global warming. Model individual changes are represented by differing symbols: symbols are red when changes are significant at 95%.

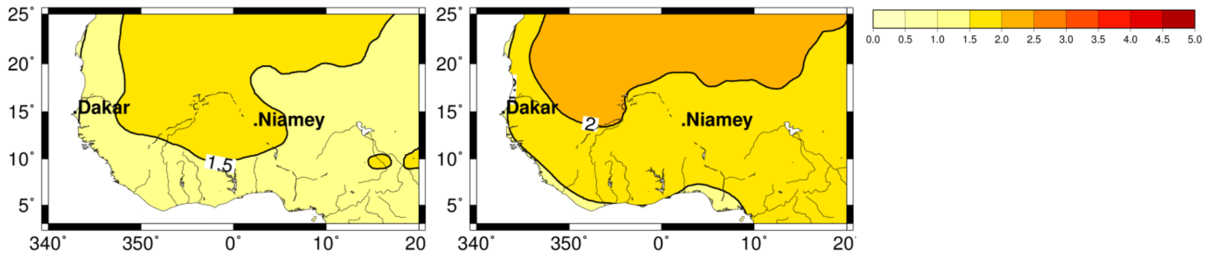
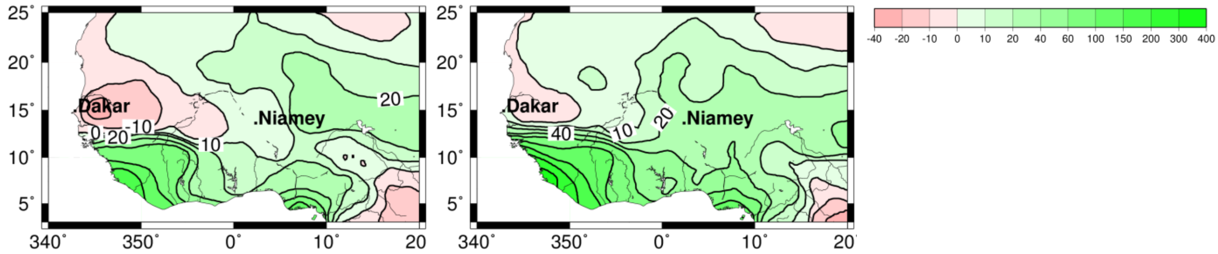


Figure 26 Climate change patterns over Western Africa for temperature [oC]



and precipitation [mm/year] (right) for 1.5°C (right) +2°C (ledt) global warming relative to 1971-2000

Figure 27 Summary of the projective relative (percentage) changes in drought affected people in the Nile and Niger basins. Thick lines represent the ensemble average among the considered RCM-GCM combinations. The shaded areas represent the middle tercile of the distribution of all models.

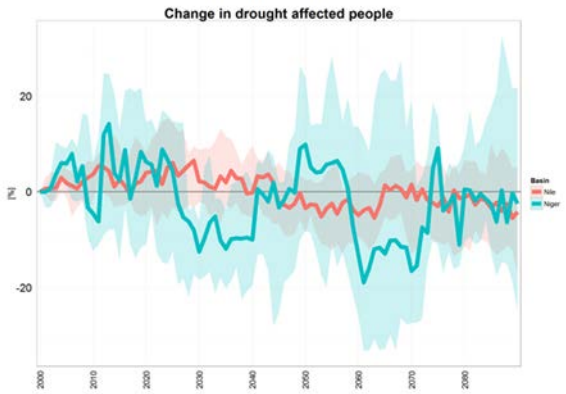
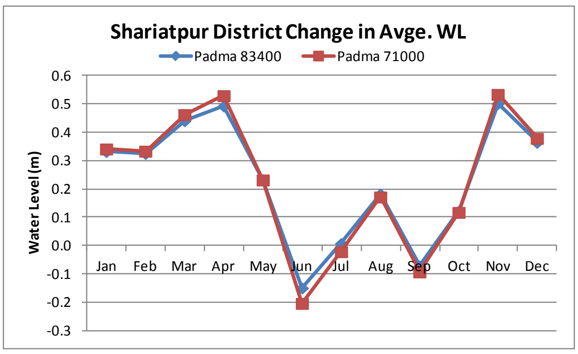
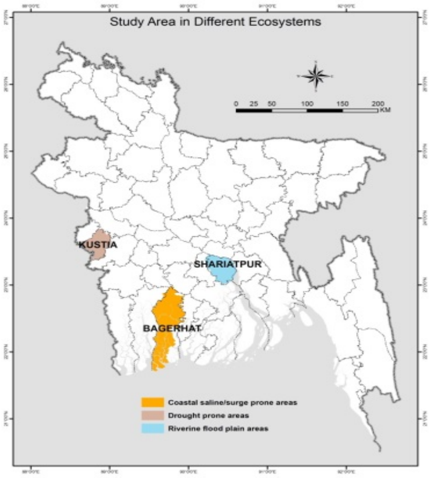


Figure 28 Simulated water levels for +2°C global warming at grid points on Padma River in the Shariatpur District.



Adaptation options for Bangladesh

1. Saline resistance rice variety
2. Rice prawn farming
3. Rising the height of the mud wall of fish and shrimp farms during flood
4. Replantation of crops after hazards/or other management approaches
5. Short rotation rice varieties
6. Using more chemical fertilizers and pesticides
7. Alternative cropping
8. River dredging



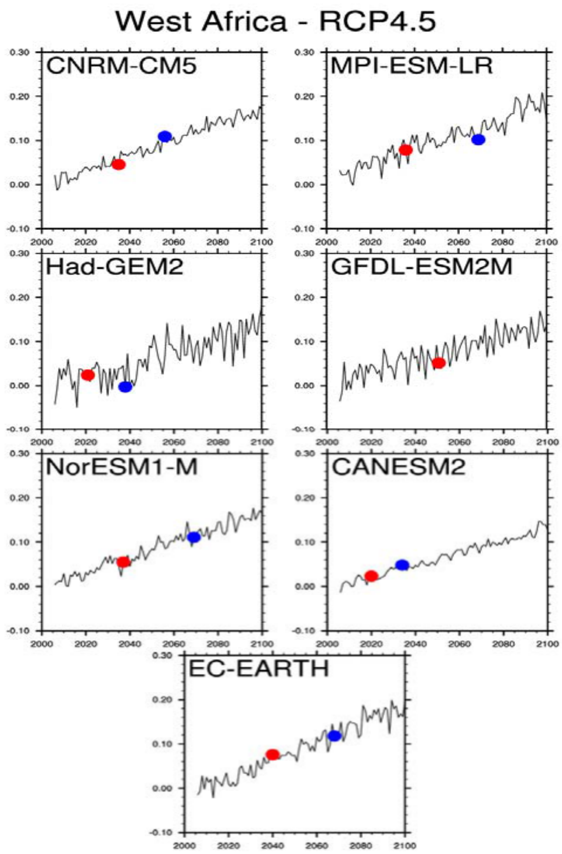


Figure 29 Projected sea level change (m) averaged over West Africa for the RCP4.5 scenario.

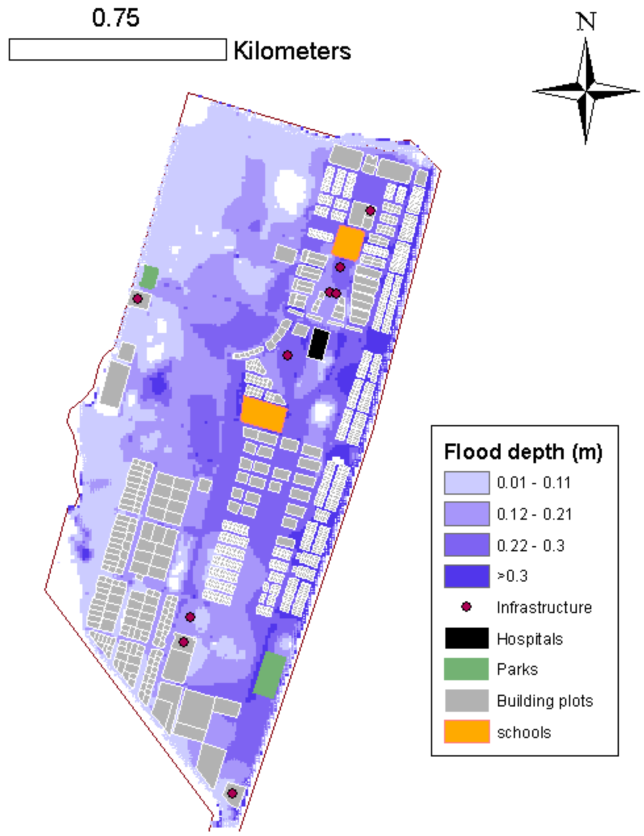


Figure 30 Example of peak water depth distribution on Hulhumalé, from a simulation of the waves from the May 2007 design storm superimposed upon a larger sea-level of 1.4 m AMSL (equivalent to approx. 0.8m of MSLR).

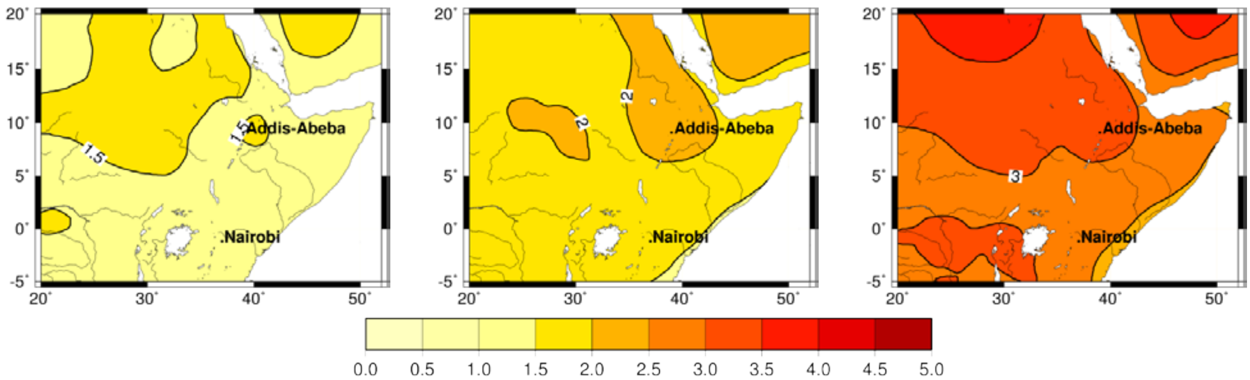


Figure 31 Temperature response over East Africa (°C) ; from left to right for +1.5°C, +2°C and +3°C. Temperature differences with respect to 1971-2000, which is about 0.5°C above the pre-industrial climate

Appendix

Ensemble of climate mandatory simulations for Europe

Institute-RCM	***Driving-GCM***	***Global warming***		
		+1.5°C	***+2°C***	***+3°C***
Fast-track mandatory simulations from ENSEMBLES (A1B scenario)				
DMI-HIRHAM	BCM	2025-2054	2038–2067	Inf**)
SMHI-RCA	HadCM3Q3	2014-2043	2033–2062	Inf**)
METO-HadRMQ0	HadCM3Q0	2008-2037	2021–2050	2052-2081
CNTM-RM5.1	ARPEGE	2014-2043	2029–2058	2064-2093
MPI-REMO	ECHAM5	2021-2050	2034–2063	2058-2087
Slow-track mandatory simulations from CORDEX (RCP 2.6)				
CSC-REMO2009	MPI-ESM-LR	2035-2064	Inf*)	Inf**)
SMHI-RCA4	EC-EARTH	2028-2057	Inf*)	Inf**)
Slow-track mandatory simulations from CORDEX (RCP 4.5)				
CSC-REMO2009	MPI-ESM-LR	2020-2049	2050-2079	Inf**)
IPSL-WRF331F	IPSL-CM5A-MR	2009-2038	2028-2057	Inf**)
KNMI-RACMO22E	EC-EARTH	2018-2047	2042-2071	Inf**)
SMHI-RCA4	EC-EARTH	2019-2048	2042-2071	Inf**)
SMHI-RCA4	HadGEM2-ES	2007-2036	2023-2052	2055-2084
Slow-track mandatory simulations from CORDEX (RCP 8.5)				
CSC-REMO2009	MPI-ESM-LR	2014-2043	2030-2059	2053-2082
KNMI-RACMO22E	EC-EARTH	2012-2041	2028-2057	2052-2081
SMHI-RCA4	EC-EARTH	2012-2041	2027-2056	2052-2081
SMHI-RCA4	HadGEM2-ES	2004-2033	2016-2045	2037-2066

*) ... not reaching +2°C global warming until 2100. Take 2071-2100 as 2C period (decided on Uncertainty WS - Hamburg 2014).;**) ... not reaching +3°C global warming until 2100.

Ensemble of simulations with the impact models (msism – mandatory simulations) for Europe

Sector	*Impact Models and variables*	*WP(s)*	*RCP2.6*	*RCP4.5*	*RCP8.5*
Water	**E-Hype**; **LisFlood**; **LPJm; VIC WBM**	6, 9	2 Msims x 10 hydro model Total 20	5 Msims x 5 hydro model Total:25	4 Msims x 5 hydro model Total:20
Agriculure	**EPIC**:	7,10	Rain fed: 2Msims x EPIC Irrigation: 2Msims x EPIC Total:4	Rain fed: 2Msims x EPIC Irrigation: 2Msims x EPIC Total:4	None
	LPJmL	7	2Msims x EPIC Total:2	5Msims x EPIC Total:5	None
Forestry/Ecosystem services	**CLM4.0-CN**:	7			
	G4M: changes in the output is mainly the potential increment per forest hectare per year and t	7	2Msims x G4M Total:2	5Msims x G4M Total:5	None
	LPJmL:	7	2Msims x LPJmL Total:2	5Msims x LPJmL Total:5	None
Tourism	**TCI**: summer tourism (beach) effects, and value at risk	6, 9	1 EC-Earth SMHI Total:1	5Msims Tota:l 5	4Msims Total:4

Sector	*Impact Models and variables*	*WP(s)*	*RCP2.6*	*RCP4.5*	*RCP8.5*
	Summer tourism value at risk	6, 9	1 EC-Earth SMHI Total:1	5Msims Tota:l 5	4Msims Total:4
	Winter tourism value at risk	6,9	2msims Total:2	5Msims Tota:l 5	4Msims Total:4
Coastal	**DIVA**:	6	2msims Total:2	5Msims Tota:l 5	4Msims Total:4
Energy					
Wind energy	wind power potential & production	6	-	5Msims Tota:l 5	4Msims Total:4
Solar photovoltaic (PV)	PV power potential and production	6	-	5Msims Tota:l 5	4Msims Total:4
Gross hydropower potential	*E-Hype;* LisFlood; LPJm; *VIC WBM*	6	-	5 Msims x 5 hydro model Total:25	4 Msims x 5 hydro model Total:20

Design of experiment for air pollution for Europe

Model chain:

Institute	CTM	Driving GCM	RCM used for downscaling	Chemical boundary conditions
CNRS-IPSL	CHIMERE	IPSL-CM5A-MR	WRF	LMDz-INCA*
Météo-France	MOCAGE	ARPEGE	ARPEGE	MOCAGE
MET. NO	EMEP	NorESM	WRF	LMDz-INCA
SMHI	MATCH	EC-EARTH	RCA4	LMDz-INCA

Emissions used:

Name	Climate	Boundary conditions	Emissions
HINDCAST	1989-2008	2005	ECLIPSE v4a 2005
HISTORICAL	1971-2000	2005	ECLIPSE v4a 2005
S1	+2°C period for RCP4.5	2050	ECLIPSE v4a 2050 CLE
S2	1971-2000	2050	ECLIPSE v4a 2050 CLE
S3	+2°C period for RCP4.5	2050	ECLIPSE v4a 2050 MFR

Socio-economic pathways used in the project

Shared Socioeconomic Pathway (SSP) 2 'middle of the road' scenario (O'Neill et al 2014) was used to estimate the impact of +2°C global warming and associated costs on river flood, sea-level rise, heat mortality. For agriculture and tourism, the analysis was further extended to SSP1 and SSP3, differing from SSP2 in terms of trajectories of population, food preferences, technological progress and trade regimes.

O'Neill B C, Kriegler E, Riahi K, Ebi K L, Hallegatte S, Carter T R, Mathur R and Vuuren D P 2014 A new scenario framework for climate change research: the concept of shared socioeconomic pathways Clim. Change 122 387–400

Ensemble of climate simulations for non-European regions

Institute-RCM	***Driving-GCM***	***Region***	***Emission Scenarios***
CNRM-ARPEGE52	CNRM	Bangladesh, Africa, Maldives	RCP2.6, 4.5, 8.5
SMHI-RCA4	EC-EARTH	Bangladesh ,Africa ,Maldives	RCP2.6, 4.5, 8.5
BCCR-WRF331	NORESM	Bangladesh	RCP2.6, 4.5, 8.5
BCCR-WRF331	NORESM	Maldives	RCP2.6, 4.5, 8.5
DMI-HIRHAM	EC-EARTH	Africa	RCP2.6, 4.5, 8.5
ENEA-REGCM	CNRM	Africa	RCP2.6, 4.5, 8.5
CSC-REMO2009	EC-EARTH	Africa	RCP2.6, 4.5, 8.5
CSC-REMO2009	MPI-ESM-LR	Africa	H RCP2.6, 4.5, 8.5

Ensemble of simulations with the impact models for non-European regions

Africa: *Climate simulations adopted as input for the impact models. "Group" refers to projection group where "M" is MENA-CORDEX, "A" is Africa-CORDEX, "I" is ISI-MIP, "R" is raw RCM, "B" is bias-corrected, "4" is RCP4.5 and "8" is RCP8.5."Models" refers to impact models where "Sm" is SWIM, "H" is Hype and "A" is Africa RiskView"*

Scenario	GCM	RCM	Group	+1.5°C	+2.0°C	Models
RCP4.5	EC-EARTH	RCA4	MR4	2019-2048	2042-2071	Sm,H
RCP4.5	CNRM	RCA4	MR4	2021-2050	2043-2072	Sm,H
RCP4.5	GFDL	RCA4	MR4	2034-2063		Sm,H
RCP4.5	EC-EARTH	RCA4	MB4	2019-2048	2042-2071	Sm,H
RCP4.5	CNRM	RCA4	MB4	2021-2050	2043-2072	Sm,H
RCP4.5	GFDL	RCA4	MB4	2034-2063		Sm,H
RCP4.5	HadGEM2-ES	None	I4	2007-2036	2023-2052	Sm,H
RCP4.5	IPSL-CM5A-LR	None	I4	2010-2039	2026-2055	Sm,H
RCP4.5	MIROC-ESM-CHEM	None	I4	2010-2039	2024-2053	Sm,H
RCP4.5	GFDL-ESM2M	None	I4			Sm,H
RCP4.5	NorESM1-M	None	I4	2022-2051	2053-2082	Sm,H
RCP4.5	EC-EARTH	RCA4	AR4	2019-2048	2042-2071	Sm,H,A
RCP4.5	CNRM	RCA4	AR4	2021-2050	2043-2072	Sm,H,A
RCP4.5	GFDL	RCA4	AR4	2034-2063		Sm,H,A
RCP4.5	CCCma	RCA4	AR4			Sm,A
RCP4.5	MIROC-ESM-CHEM	RCA4	AR4	2010-2039	2024-2053	Sm,A
RCP4.5	MPI-M	RCA4	AR4			Sm,A
RCP4.5	NorESM1-M	RCA4	AR4	2022-2051	2053-2082	Sm,A
RCP8.5	EC-EARTH	RCA4	MR8	2012-2041	2027-2056	Sm,H
RCP8.5	CNRM	RCA4	MR8	2015-2044	2030-2059	Sm,H
RCP8.5	GFDL	RCA4	MR8	2022-2051	2039-2068	Sm,H
RCP8.5	EC-EARTH	RCA4	MB8	2012-2041	2027-2056	Sm,H
RCP8.5	CNRM	RCA4	MB8	2015-2044	2030-2059	Sm,H
RCP8.5	GFDL	RCA4	MB8	2022-2051	2039-2068	Sm,H
RCP8.5	HadGEM2-ES	None	I8	2004-2033	2016-2045	Sm,H
RCP8.5	IPSL-CM5A-LR	None	I8	2006-2035	2020-2049	Sm,H
RCP8.5	MIROC-ESM-CHEM	None	I8	2007-2036	2018-2047	Sm,H
RCP8.5	GFDL-ESM2M	None	I8	2022-2051	2039-2068	Sm,H
RCP8.5	NorESM1-M	None	I8	2017-2046	2032-2061	Sm,H
RCP8.5	EC-EARTH	RCA4	AR8	2012-2041	2027-2056	Sm,H
RCP8.5	CNRM	RCA4	AR8	2015-2044	2030-2059	Sm,H
RCP8.5	GFDL	RCA4	AR8	2022-2051	2039-2068	Sm,H
RCP8.5	CCCma	RCA4	AR8			Sm
RCP8.5	MIROC-ESM-CHEM	RCA4	AR8	2007-2036	2018-2047	Sm
RCP8.5	MPI-M	RCA4	AR8			Sm
RCP8.5	NorESM1-M	RCA4	AR8	2017-2046	2032-2061	Sm

***The Maldives:** Methodology to determine is overtopping could occur with sea-level rise, and if so what infrastructure of the could be affected.*

	1) Determine height of island using data collected from differential Geographical Positioning Survey and link to bathymetric data.
	2) Determine from tide gauge and hindcast data how frequently extreme events have happened in the past, and under what conditions.
	3) Use an overtopping model to determine under what oceanographic conditions inundation could occur using data from 1) and 2) under different scenarios of sea-level rise.
	4) Determine the flood extent and flood depth.
	5) Determine infrastructure affected.

***Bangladesh:** The framework to asses the impacts on the hydro-meteorological systems and water resources of Bangladesh*