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Probabilistic risk assessment to climate and socio-economic changes across sectors and European regions using impact response surfaces

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Background and objectives

- Climate change impact models used in case studies in IMPRESSIONS EU project
- Overview of sensitivity across sectors and European regions
- at the same time to test models
- Impact response surface (IRS) approach
  - ”scenario-neutral”
  - used for single sectors/regions to test climate change sensitivity, not yet the sensitivity to socio-economic changes

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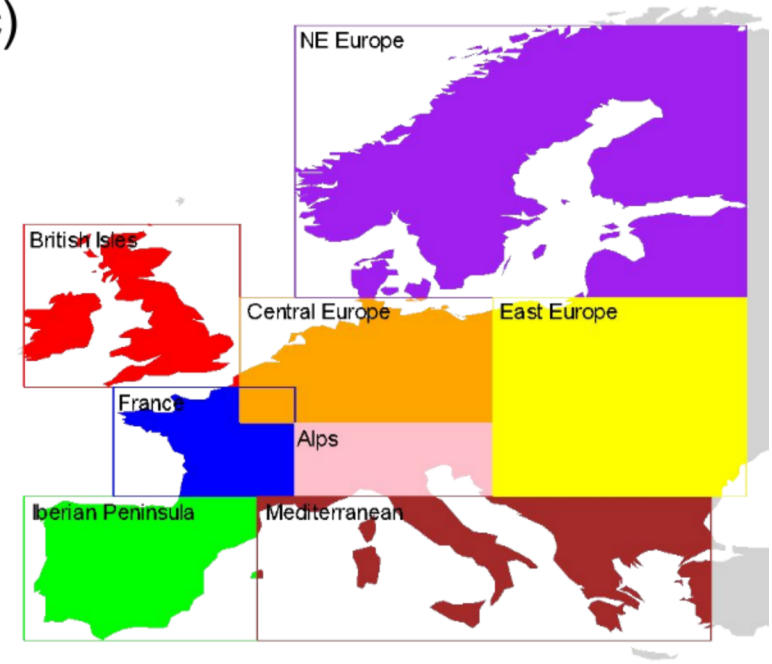
Protocol for sensitivity analysis

- Sensitivity analysis to perturbations in two variables (climate or socio-economic)
- Regional aggregates of results to 8 European sub-regions
- Results plotted as impact response surfaces (IRSs)
- Combining IRSs with probabilistic projections for risk assessment



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Impact indicators and models

Impact indicator	Model	Sensitivity variables
Agriculture		
Yield of 3 major crops	M-GAEZ	Temperature (T) x Precipitation (P)
NPP	VISIT	T x P
Low river flows (Q95)	WaterGAP3	T x P
Intensive agricultural land use	SFARMMOD	T x P x population x tech. development x CO2
Required irrigation change to avoid severe water stress	SWAT	T x P
Forestry		
Basal area of 5 tree species	ForClim v3.3	T x P
Tree biomass for 3 species	LandClim v1.4	T x P
Forest land use	SFARMMOD	T x P x population x tech. development x CO2
Biodiversity		
Mean species abundance index	GLOBIO	T x agricultural land use
Human health		
Heat excess mortality	AIM/Impact[health]	T x population
Flooding		
People affected by coastal floods	CFFlood	Sea-level rise (SLR) x population (SLR x GDP)
High river flows (Q5)	WaterGAP3	T x P

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Range and intervals of perturbations

Driver	Min	Max	Interval	n
Temperature	-1°C	+11°C	1°C (-1 – 5) or 2°C (5 – 11)	10
Precipitation	-60%	40%	10%	11
Regional sea-level rise	0 m	2.5 m	0.25 m	11
CO2 level	350 ppm	950 ppm	100 ppm	7
Population[1]	-90%	+210%	30%	11
GDP[1]	0%	+700%	25% (0 – 100), 100% (100 – 300) or 200% (300 – 700)	10
Agricultural land use	-10%	30%	5%	9
Yield changes due to techn. dev.	-50%	100%	50%	4

[1]) Ranges approx. covering the SSP ranges across all European countries in the IIASA SSP database.

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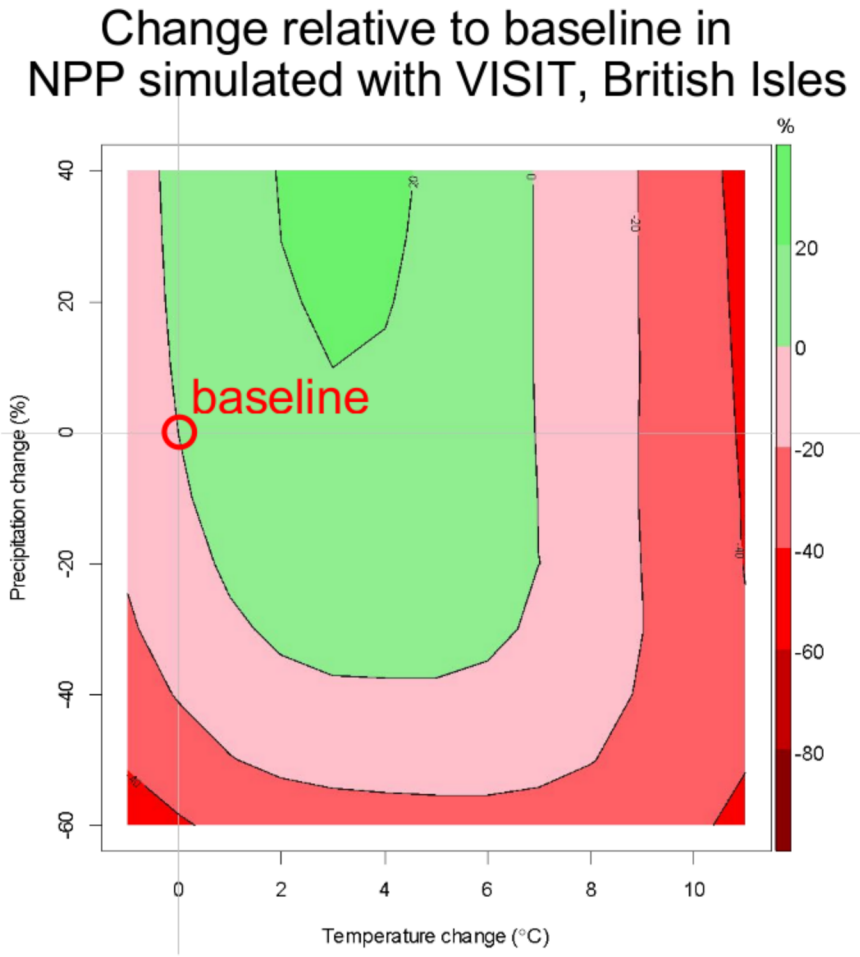
Example of an impact response surface (IRS)

- Sensitivity analysis to fixed perturbations to:
  - mean annual temperature (between -1 and +11 °C; 1 °C increments), and
  - precipitation (-60 to +40 %; 10 % increments)
- Aggregation to regions: average of grid cells in a region



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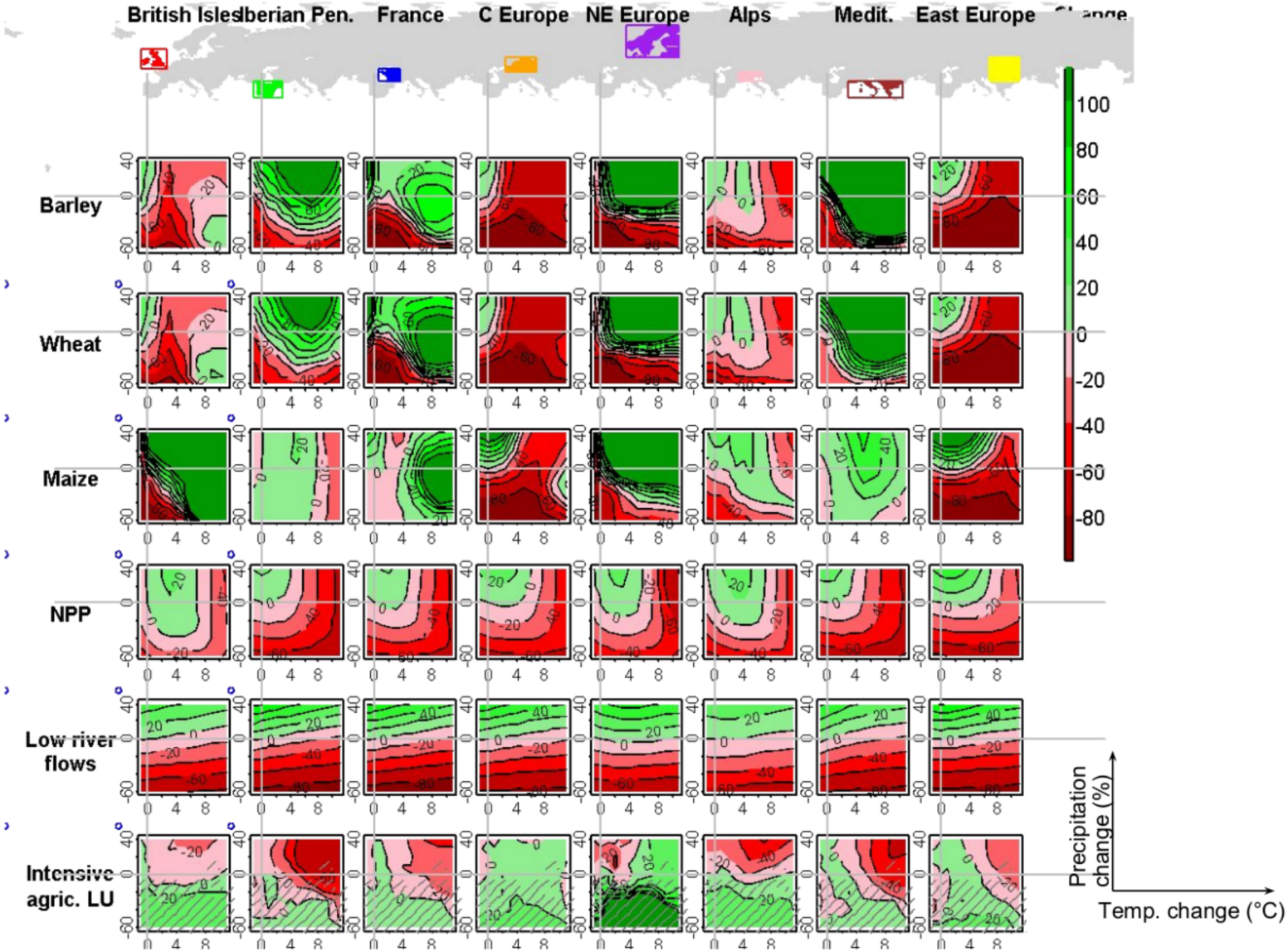
Impact response surfaces: agriculture



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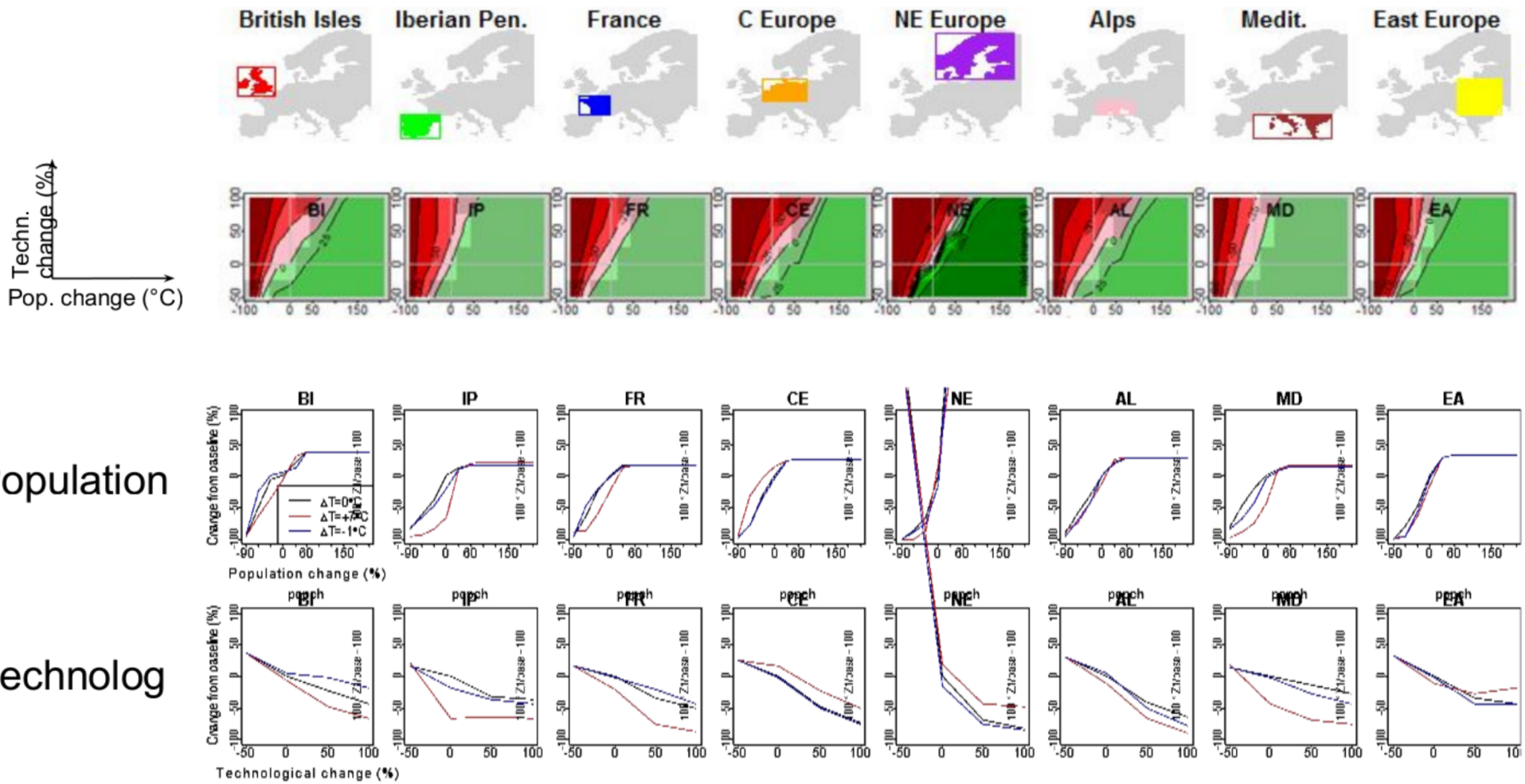
IRS with socio-ec variables, e.g. Sfarmod or coastal flooding or both



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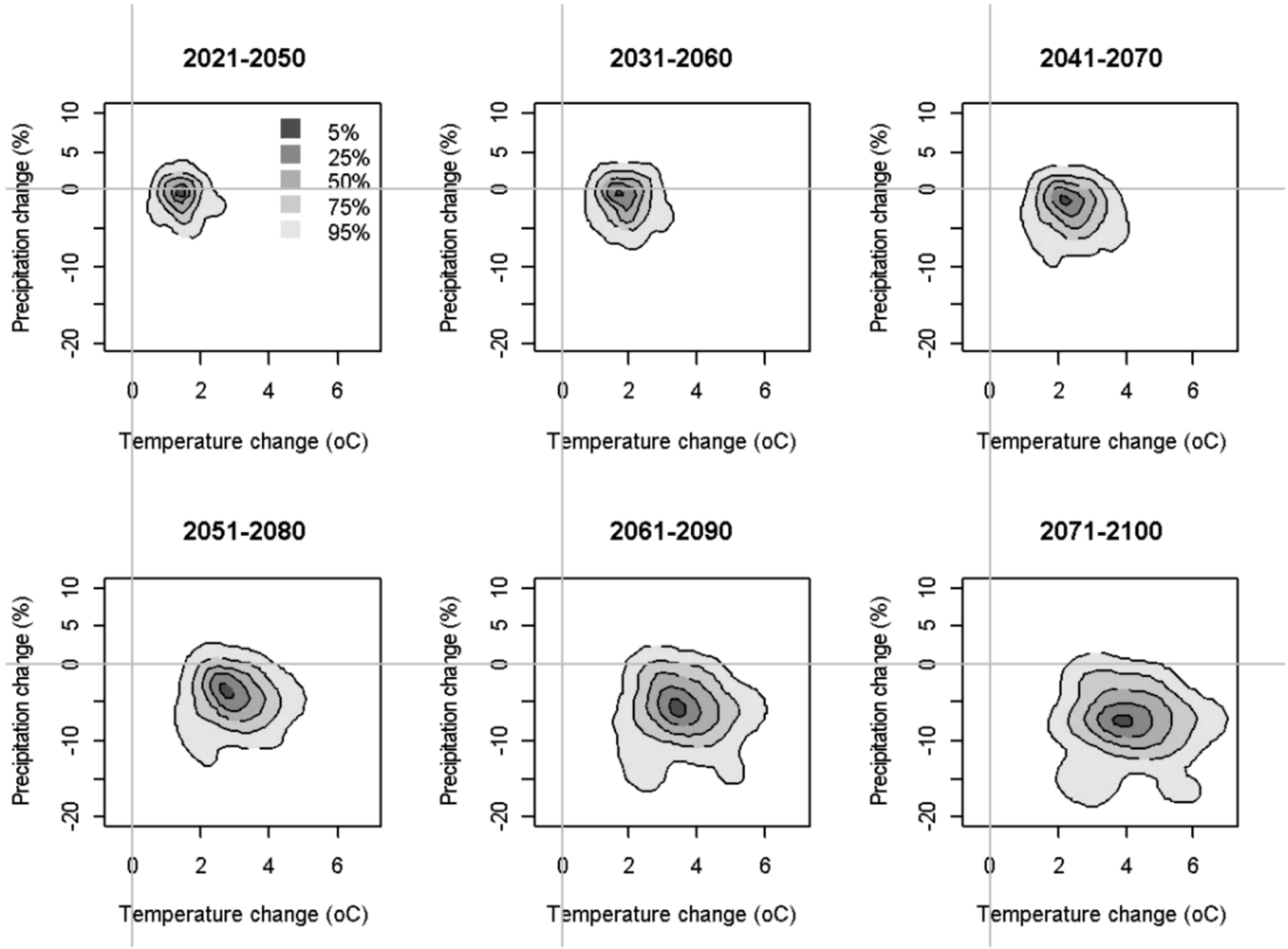
Probabilistic projections of climate change relative to 1981-2010 for Iberian Peninsula, RCP8.5

Source: Jouni Räisänen, pers. comm.; Räisänen & Ruokalainen (2006)



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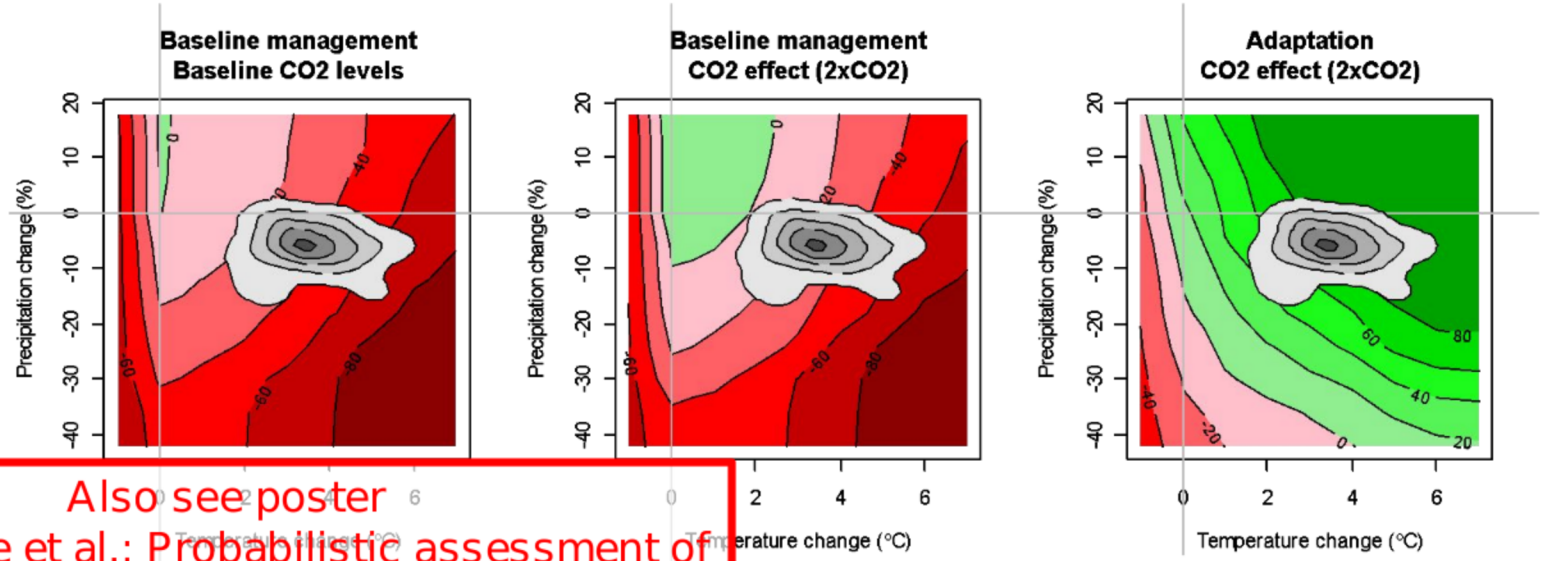
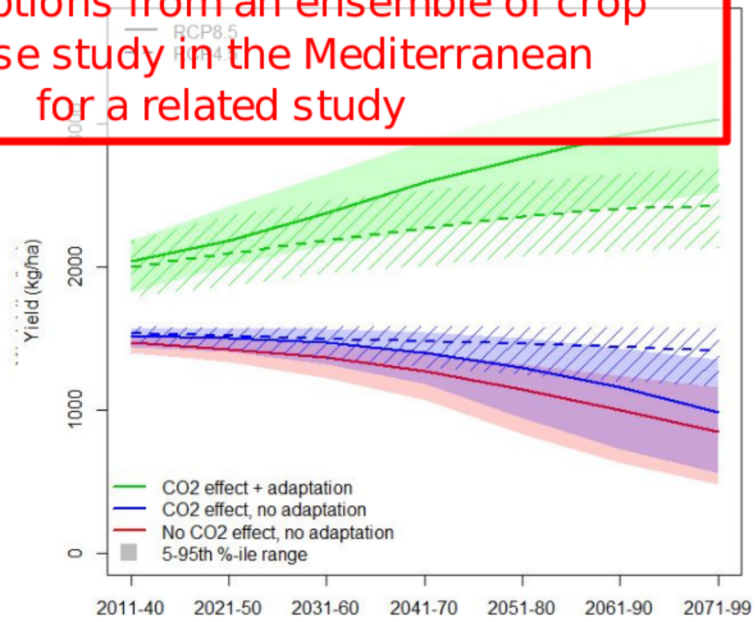
Probabilistic projection of wheat yields, Iberian Peninsula



Also see poster

P.C10 Ferrise et al.: Probabilistic assessment of adaptation options from an ensemble of crop models: a case study in the Mediterranean

for a related study



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Conclusions and outlook

- Examples of impact indicators from different sectors; not comprehensive
- Demonstration of the Impact Resonse Surface (IRS) approach
- Some lessons learnt by the individual modelling groups
- Some uncertainties hidden by aggregation to large regions
- Summarize sensitivities distinguishing sectors and regions
  - Agriculture: Large regional differences in crop yield changes
  - Forestry: Distinct differences between tree species with regional specific thresholds for T and P changes; large increases for more optimal climate conditions possible
  - River discharge: small regional differences for relative changes; some snow effect
  - Heat-related mortaliy: British Isles and Mediterranean largest relative increase with warming
  - Coastal flood protection effective up to 50 cm SLR in many areas
- Probabilistic projections of drivers can be directly used with IRSs
- Future work: use probabilistic population projections

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