



Session 1

Regional climate change over Europe
(Iberian Peninsula).

Experiences of application to impact studies
related to biodiversity

Enrique Sánchez Sánchez

Manuel de Castro

Miguel Angel Gaertner

Clemente Gallardo



Grupo MOMAC (Modelización del Medio Ambiente y el Clima)
Facultad de Ciencias del Medio Ambiente y Bioquímica
Universidad de Castilla-La Mancha, Toledo, Spain





Part 1: Regional climate modelling over Europe: PRUDENCE, ENSEMBLES, ESCENA, EUROCORDEX.

- State of the art of the main intercomparison projects.
- Basic evaluation and projection features and uncertainties.
- RCMs as data providers for impact studies. What kind and detail of results can give? (spatial and temporal resolution), variables availability



Part 2: Application results to impacts in biodiversity areas: agriculture, forests, ecology....

- Examples of application over the Iberian Peninsula
- What do impact groups want from RCMs in terms of variables, and time and spatial resolution?
- Known limitations of RCM data. Combination of model and observational information. Bias corrections methods
- Need of good communication between impact and modelling groups



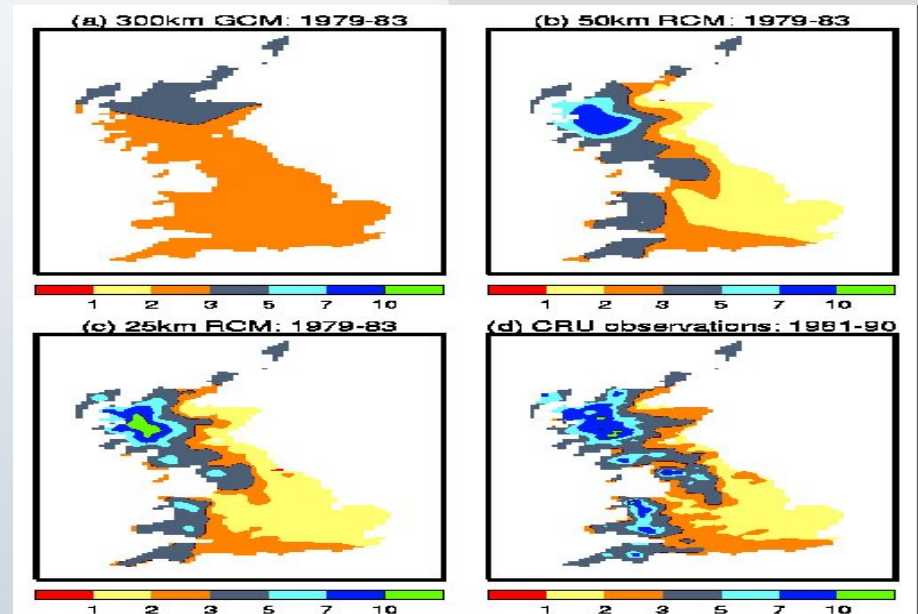
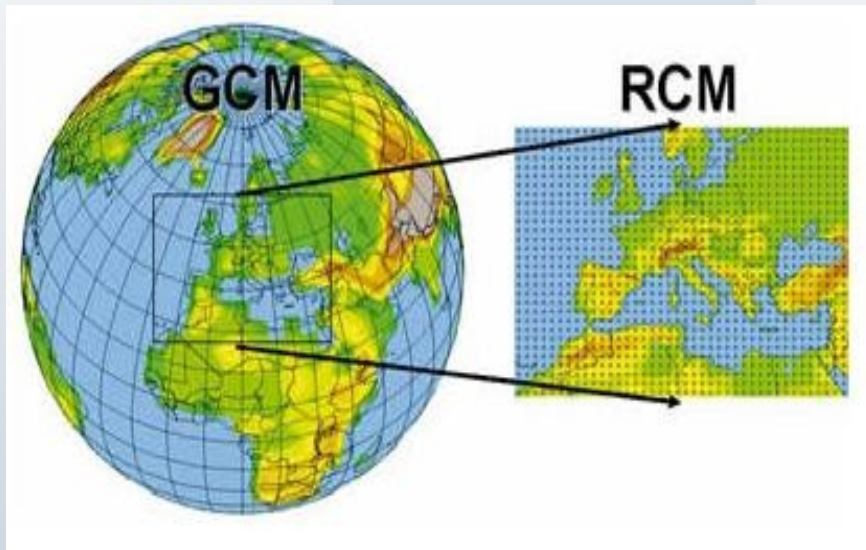
Scientific dialogue between biodiversity and climate change communities

Regional climate modelling exercises over Europe:

<u>Project</u>		<u>Domain</u>	<u>RCMs</u>	<u>GCMs</u>	<u>emis</u>	<u>Res</u>	<u>Periods</u>
PRUDENCE	2002-2004	Europe	9	1	A2-B2	50 km	1961-1990 2071-2100
ENSEMBLES	2004-2009	Europe	16	5	A1B	25km	1951-2100
ESCENA	2008-2012	IP	4	3	A1B,A2, B1	25km	1990-2007 1950-2050
EUROCORDEX	2012-	Europe	17	12	RCP	12.5km	1989-2009 1950-2100

Part 1

Regional climate modelling: dynamical downscaling



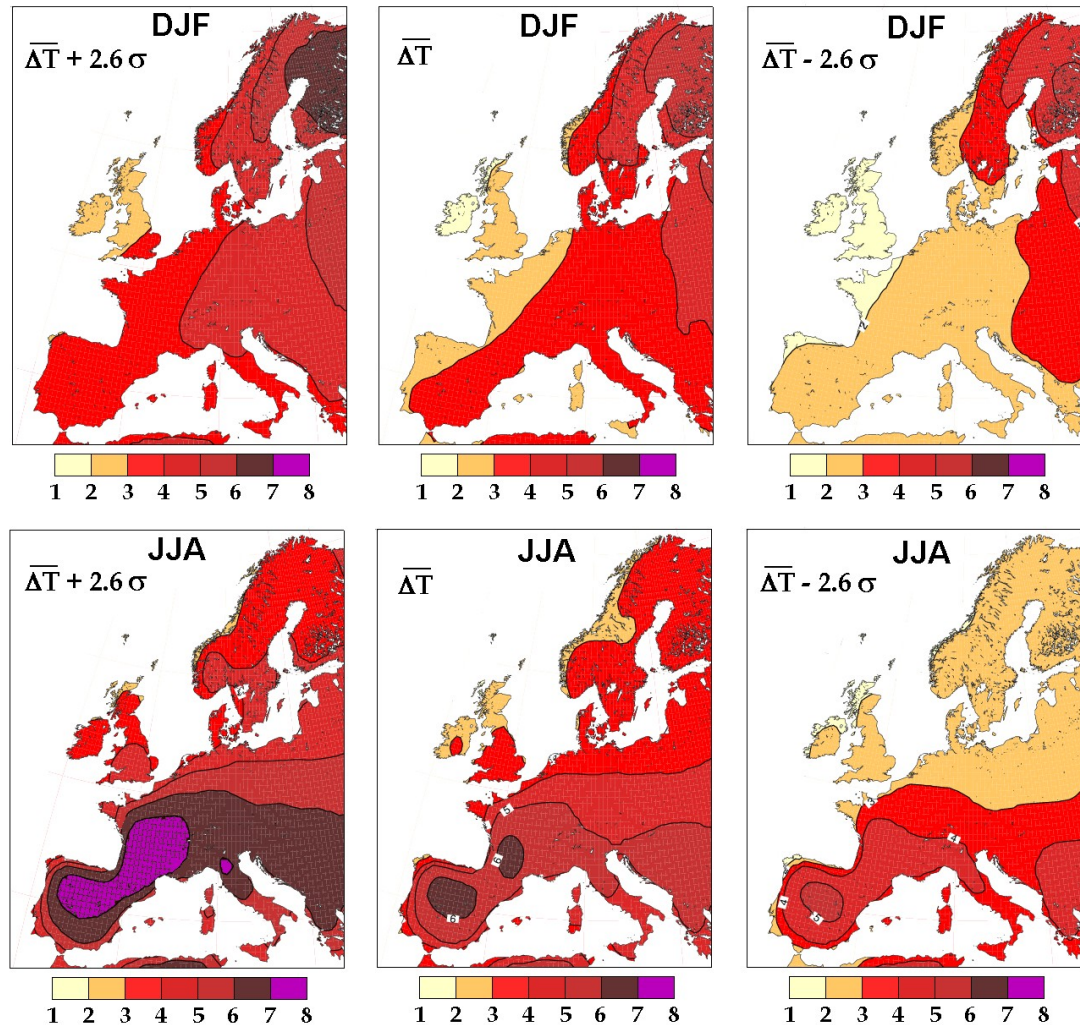
Scientific dialogue between biodiversity and climate change communities

Part 1



Changes in seasonal temperature (99% confidence threshold) from (3 GCMs and 9 RCMs)

SRES-A2 Seasonal temperature change in °C (2071-2100)



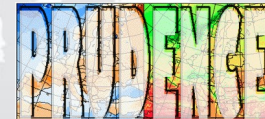
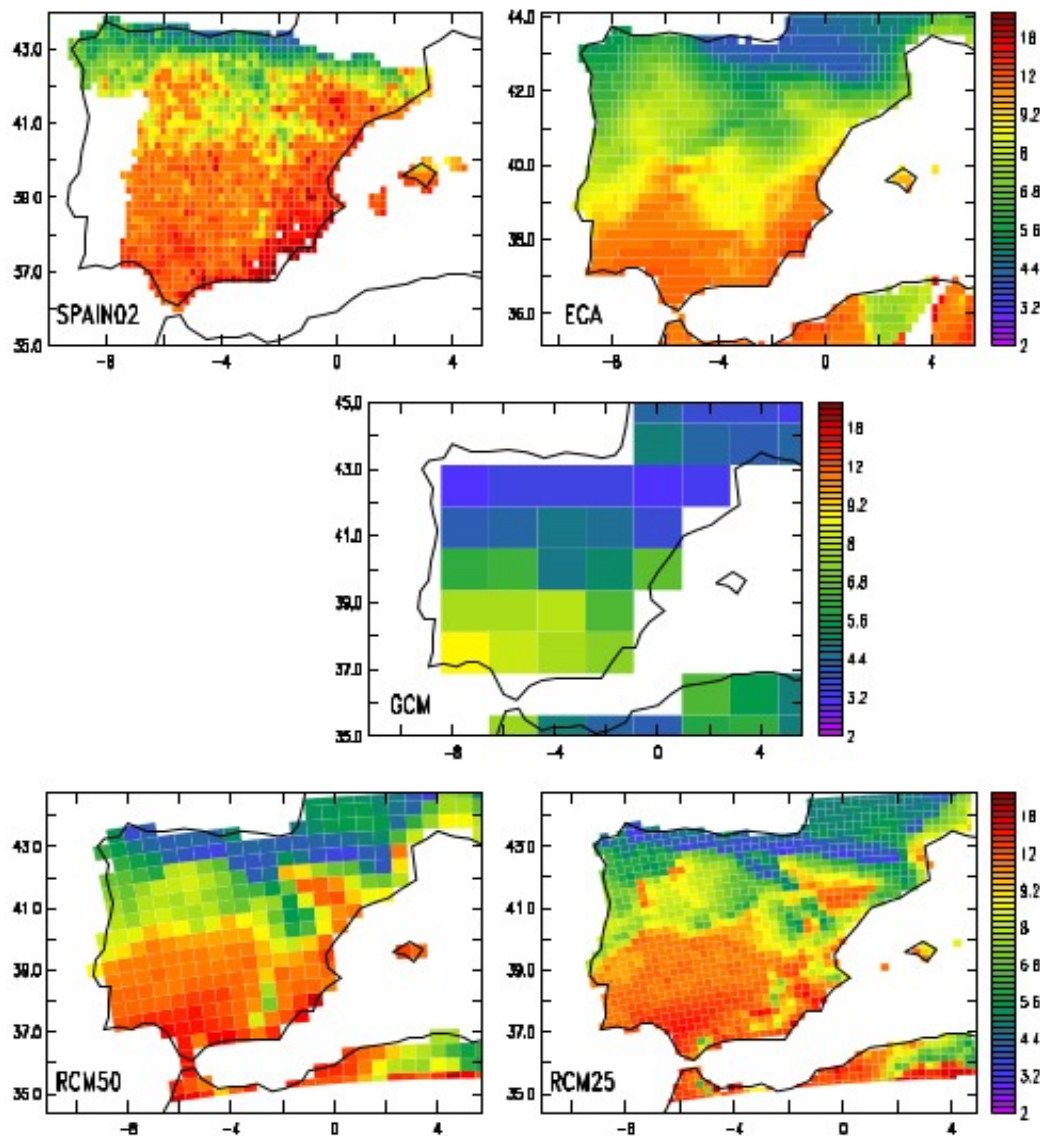
Dequé et al., *Climatic Change* 2007



Scientific dialogue between biodiversity and climate change communities

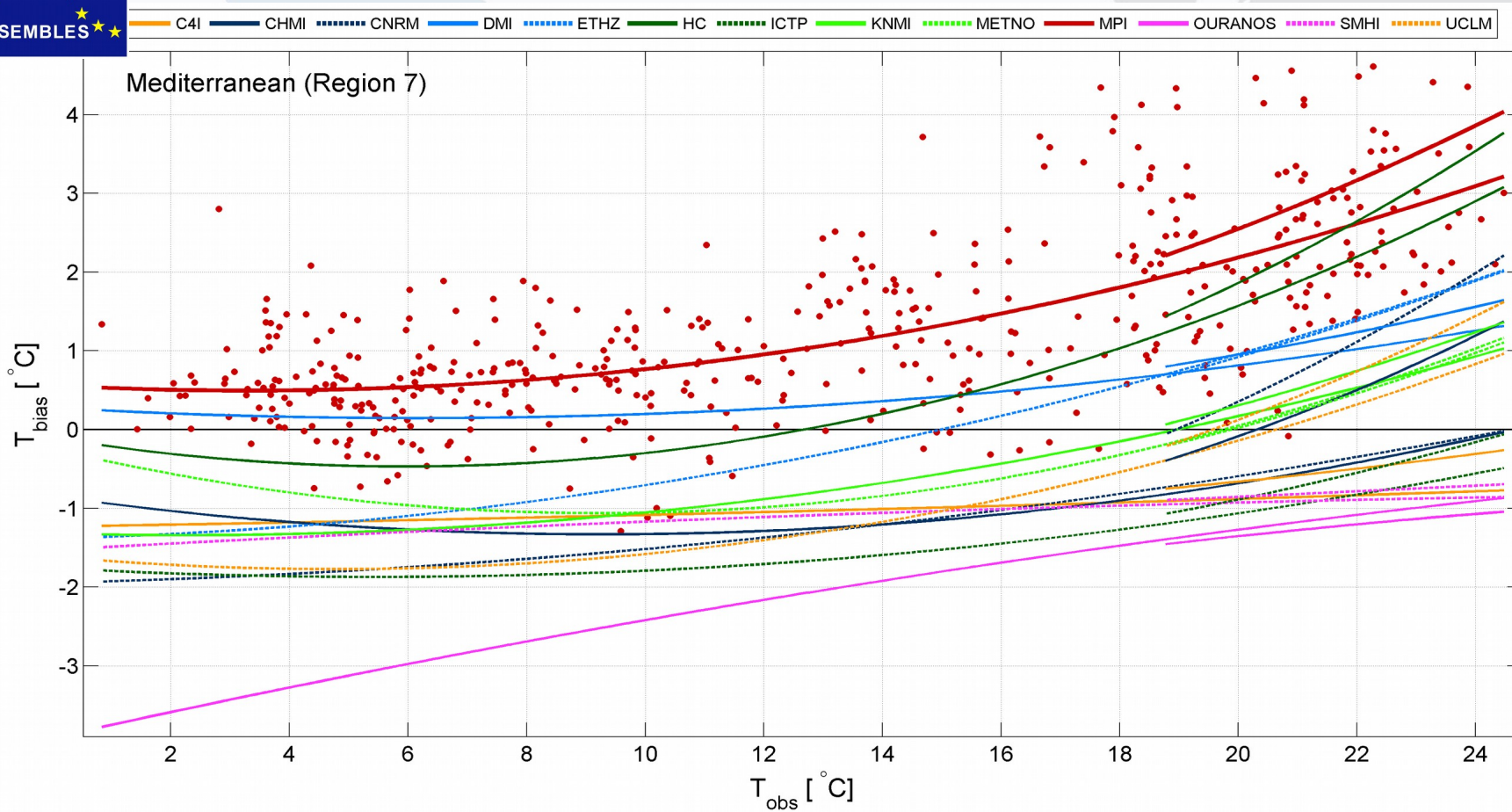
ALCUE NET
Latin America, Caribbean and European Union Network on Research and Innovation

Part 1



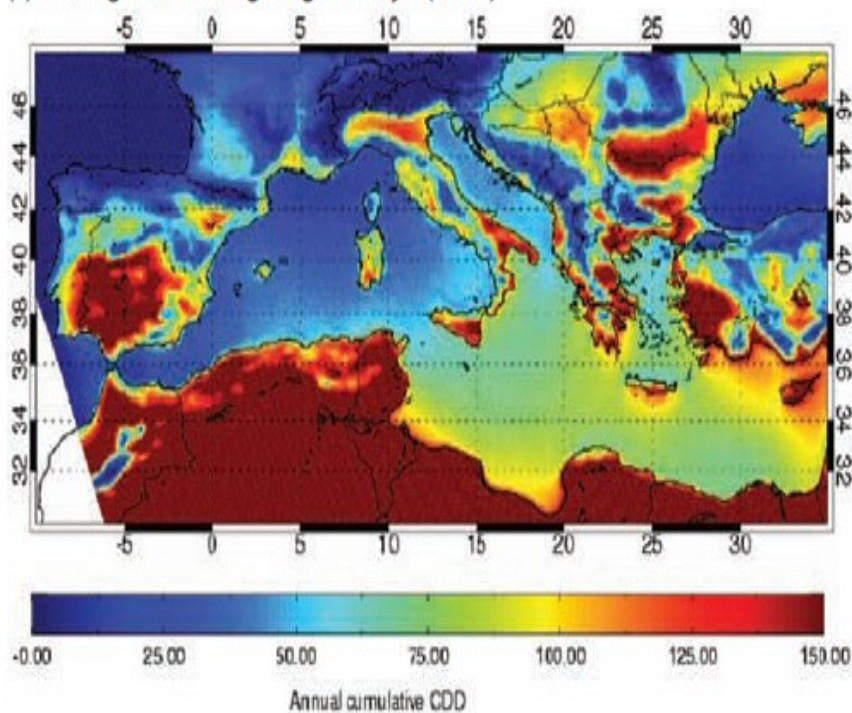
Mean dry spell length for present conditions, as seen by observations, GCM, and RCM at two resolutions (1961-1990)

Sánchez et al. (2011),
Climatic Change

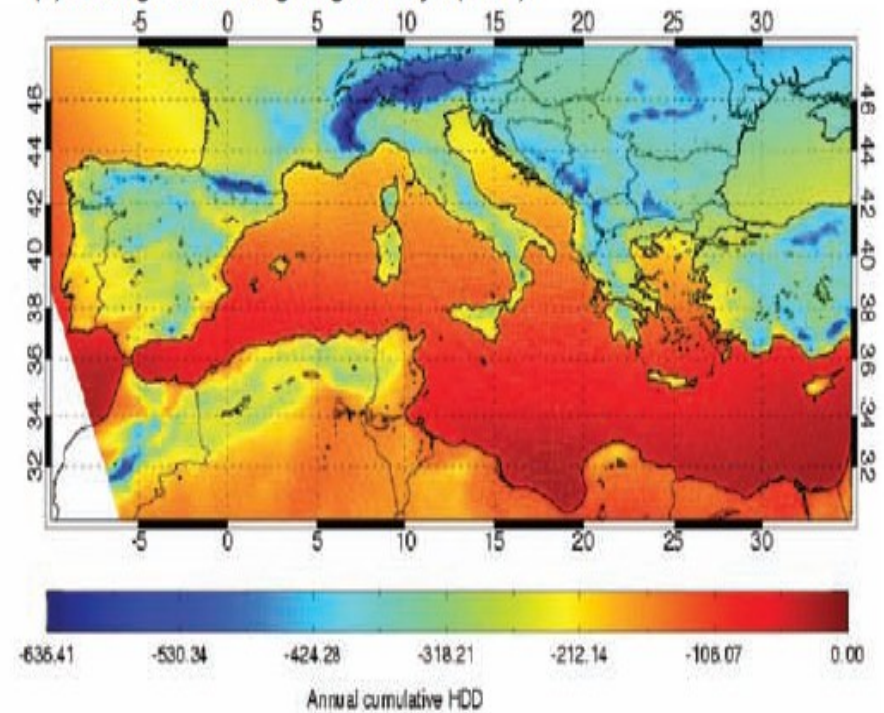


Christensen et al. (GRL, 2008)

(a) Change in cooling degree days (CDD)



(b) Change in heating degree days (HDD)



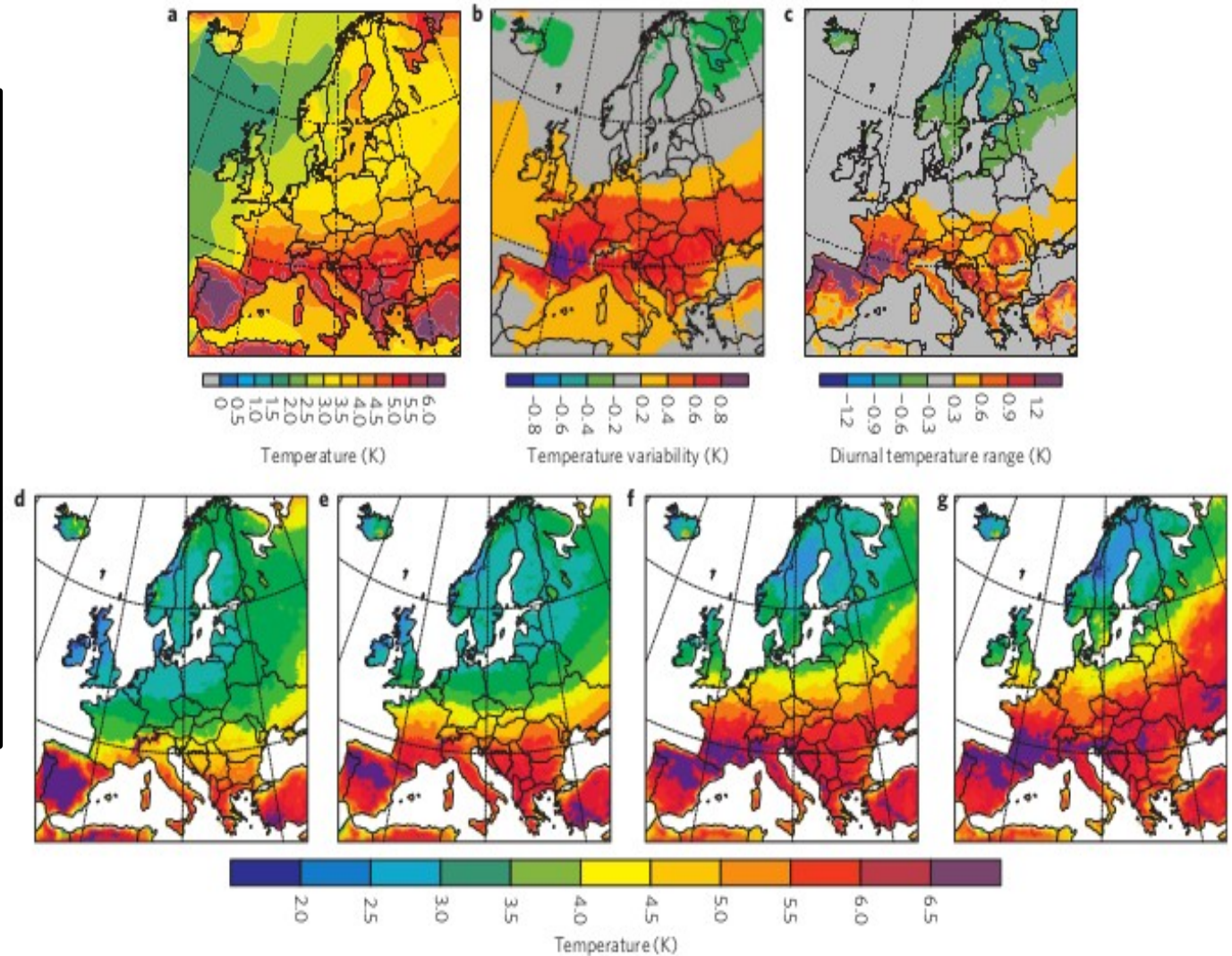
Projected change in potential energy demand (2021-2050 vs 1960-1989) based on accumulated temperature (Fig. 9.14, Ensembles Final Report)

Part 1



Mean of 6 RCMs
temp JJA changes:
(2071-2100)-
(1961-1990).

- a) mean
- b) variability
- c) diurnal range
- d) p10,
- e) p50,
- f) p95,
- g) p99
- (d-g): tmax

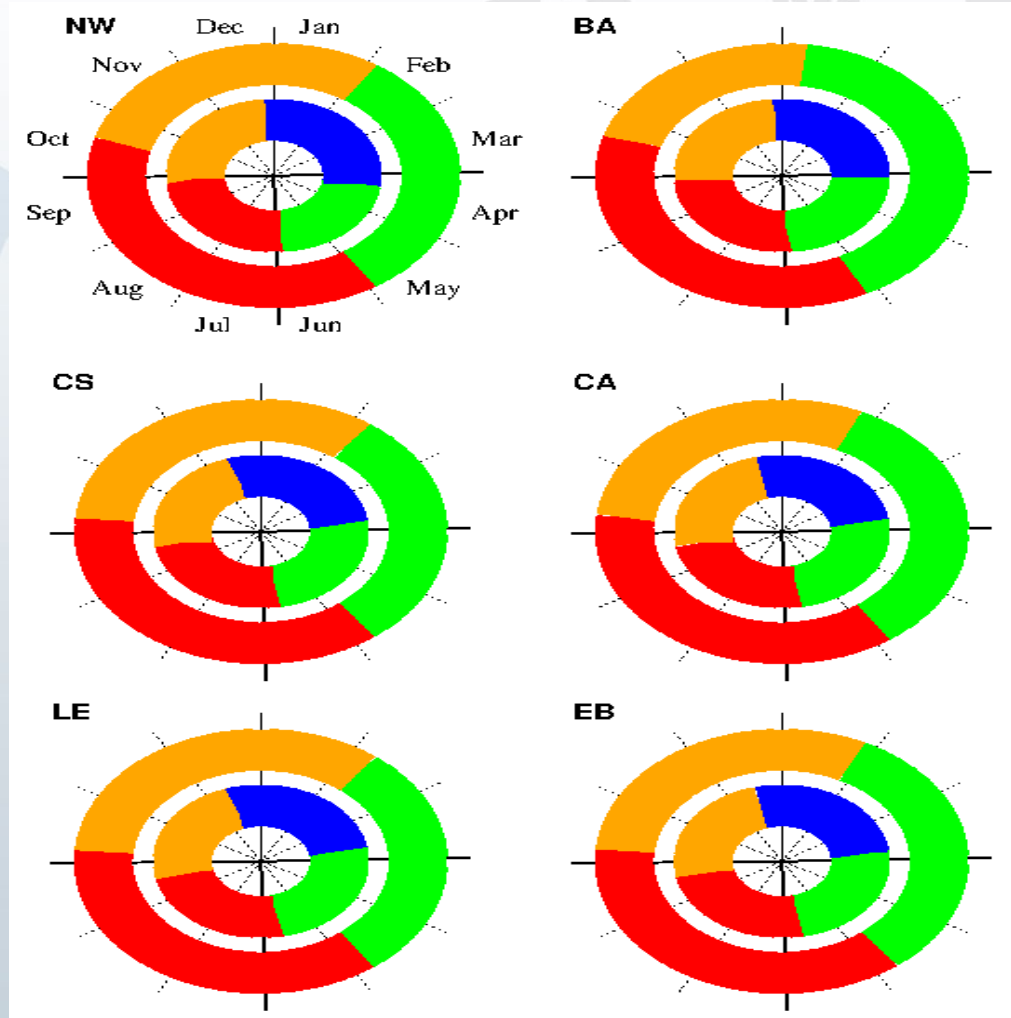


Part 1



Changes in season length over 6 subregions of the Iberian Peninsula for the RCM ensemble: (1961-1990) vs (2071-2100)

López de la Franca et al.,
2013, *Theor. Appl. Climatol.*





Scientific dialogue between biodiversity and climate change communities

ALCUE NET
Latin America, Caribbean and European Union Network on Research and Innovation

Part 1

Spain02,
tasmax (°C)



Daily Tmax
deviation
(1990-2007)
(°C)

Jiménez-Guerrero
et al. (Clim. Res.,
2013)

PROMES

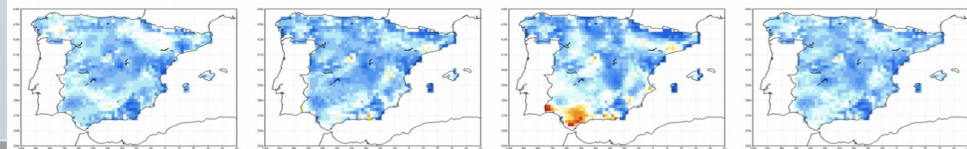
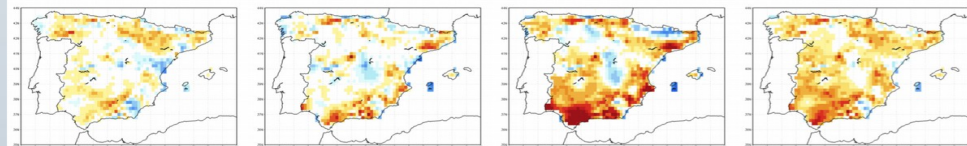
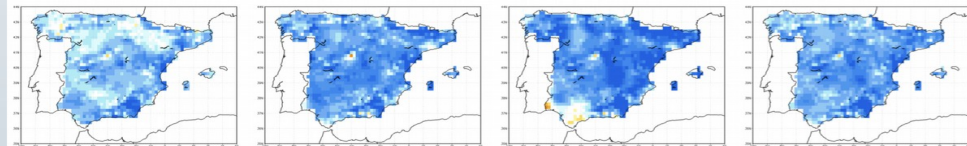
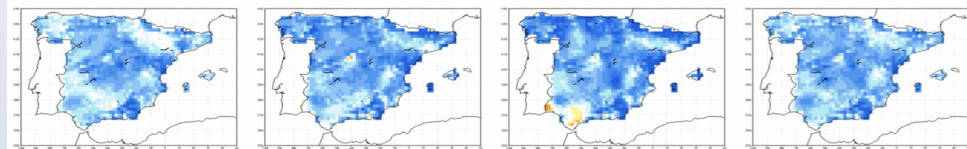
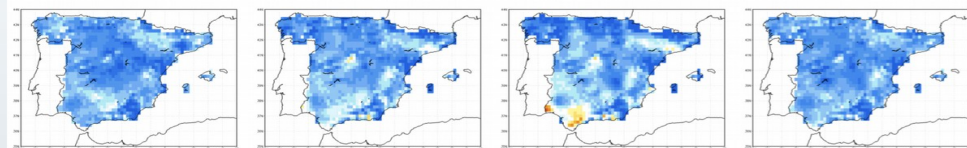
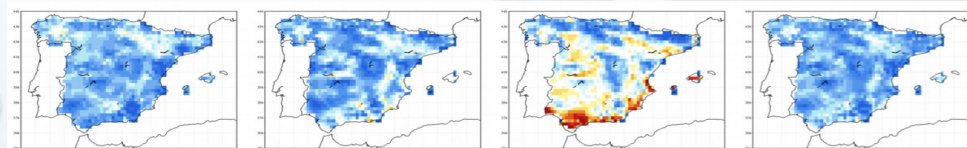
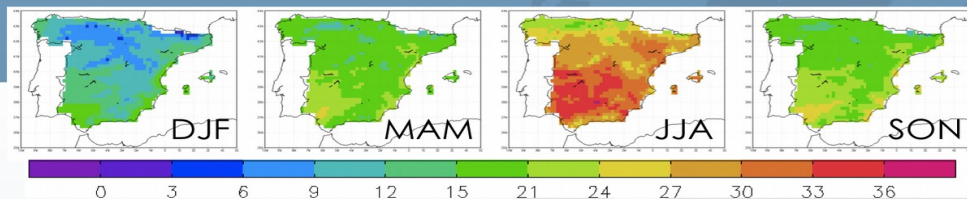
WRF-A

WRF-B

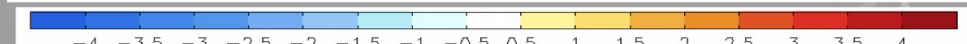
MM5-RCM

REMO

ENSEMBLE



Bias (K)





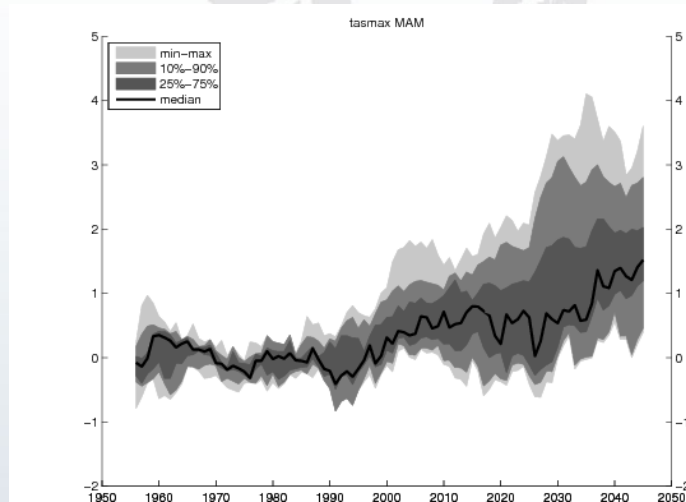
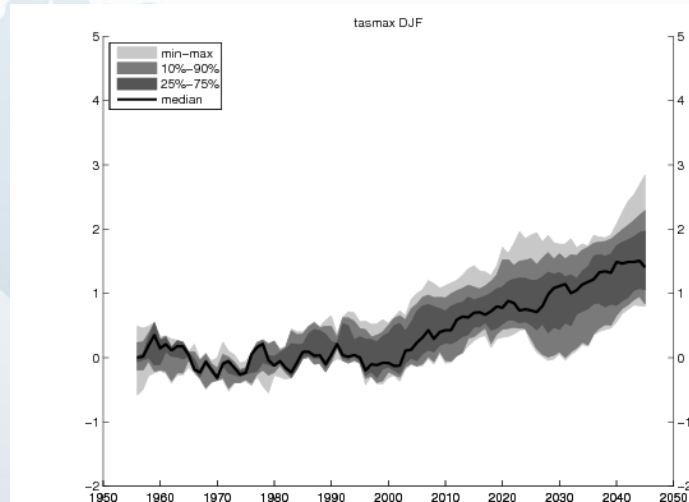
ALCUE NET
Latin America, Caribbean and European Union Network on Research and Innovation

Scientific dialogue between biodiversity and climate change communities

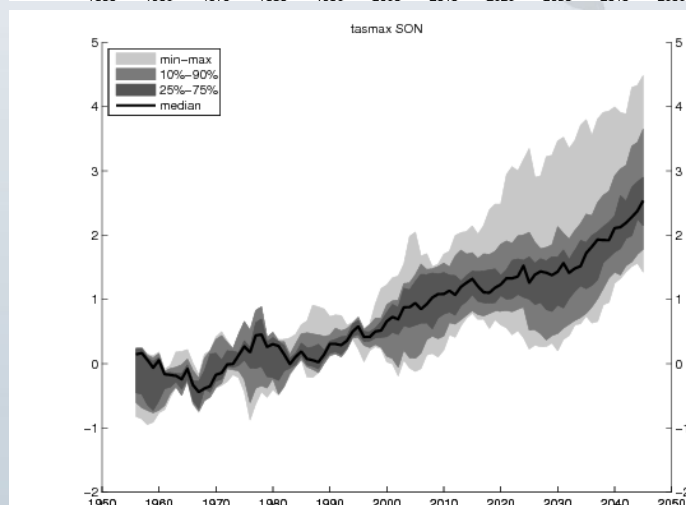
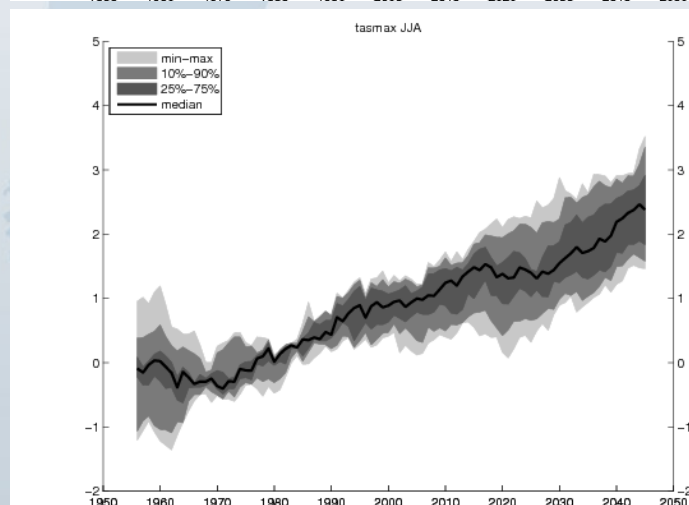
Part 1



DJF



JJA

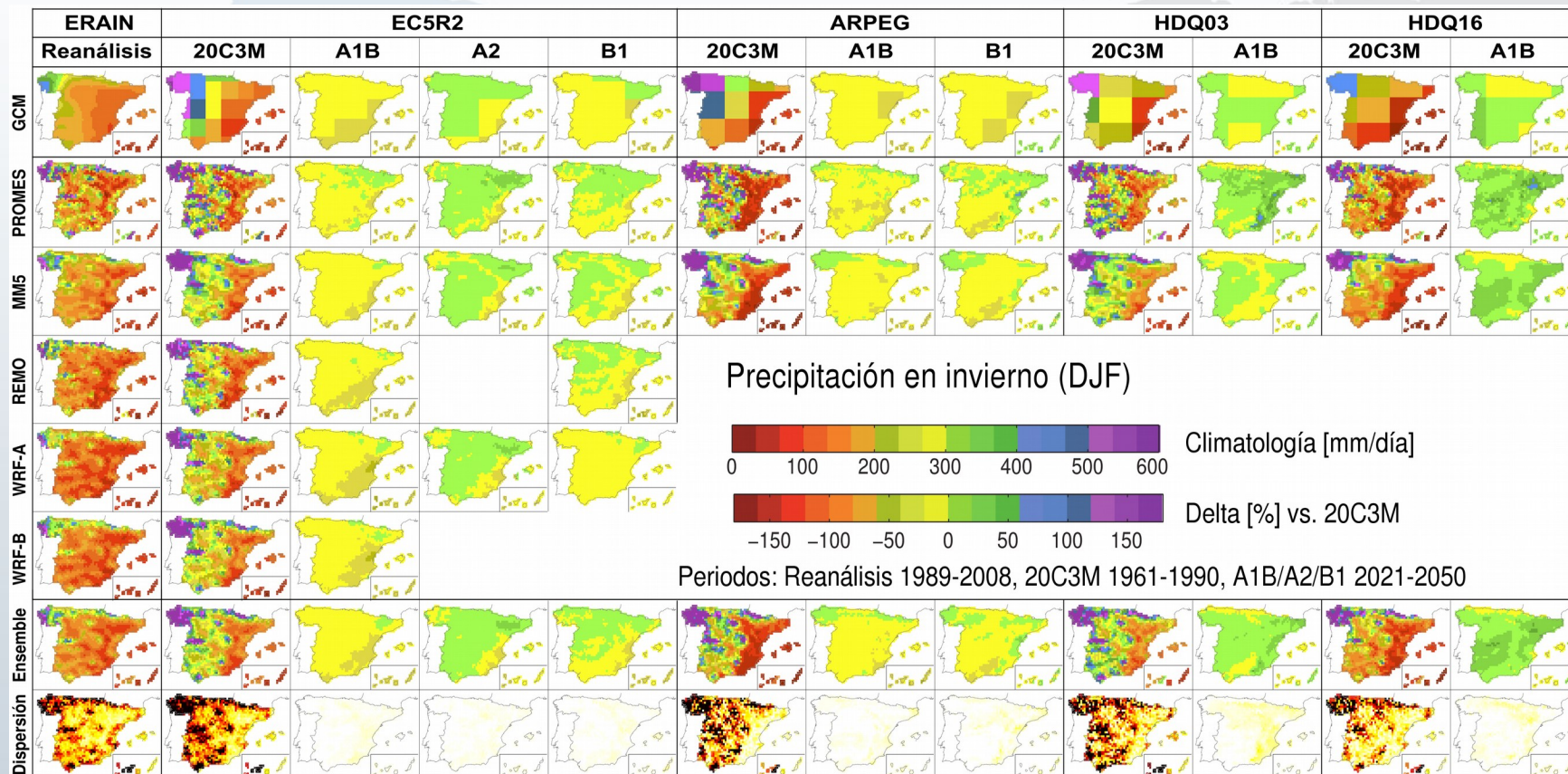


Tmax timeseries for the whole Iberian Peninsula



Scientific dialogue between biodiversity and climate change communities

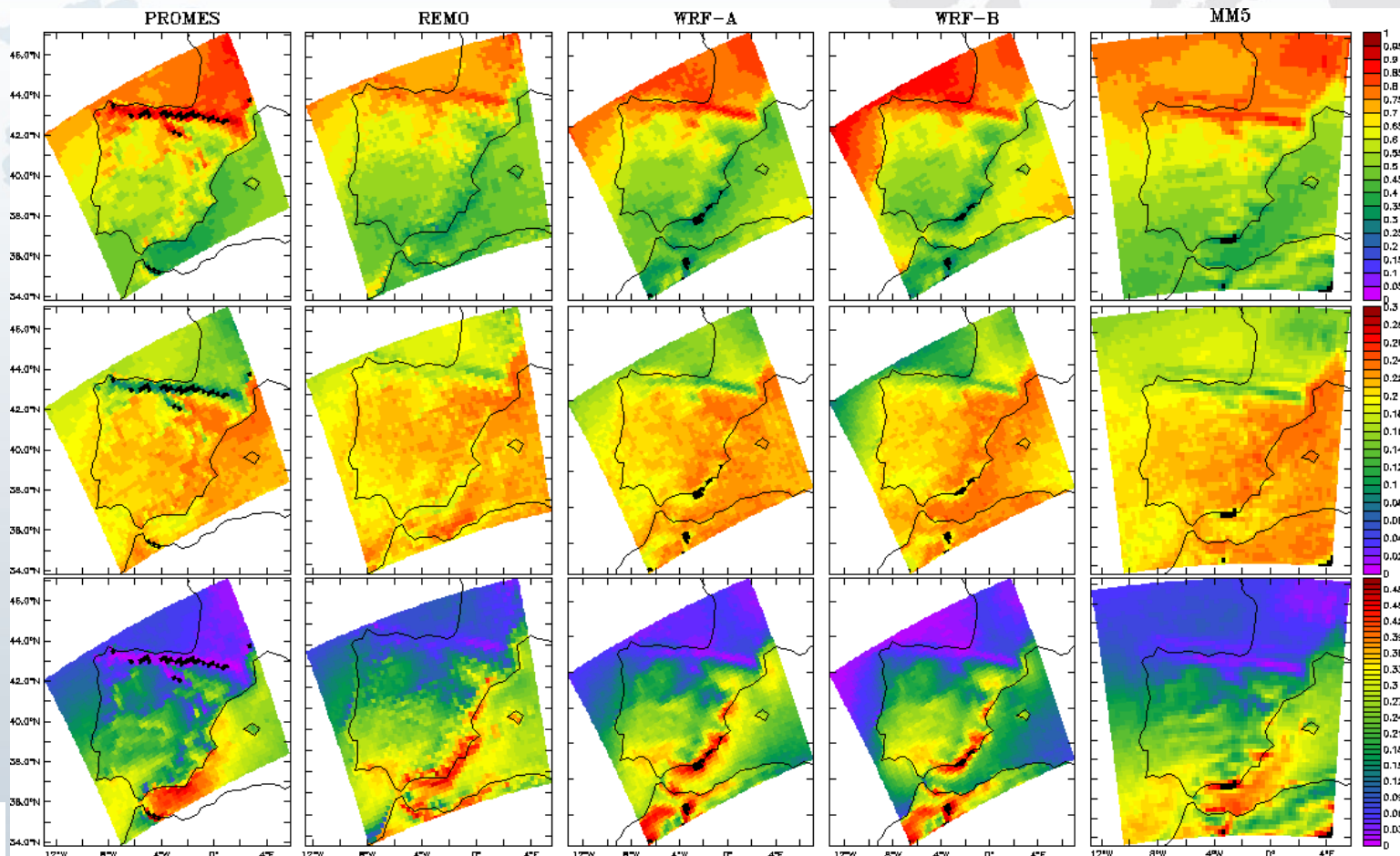
Part 1



Winter precipitation features

Part 1

López de la Franca et al., 2015, *Clim. Dyn.*



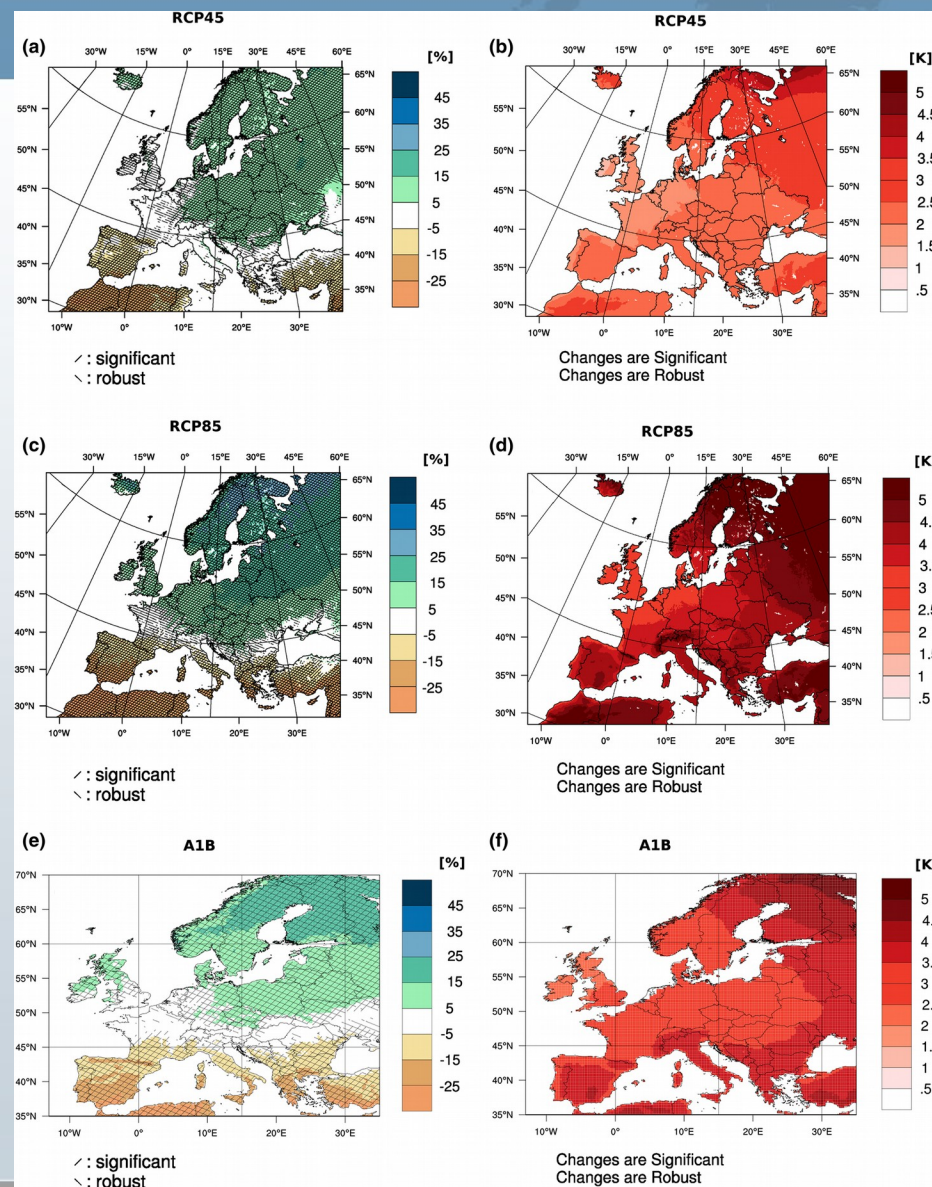
Short, medium, long dry spells classes probability for present climate

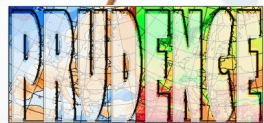
Scientific dialogue between biodiversity and climate change communities



Results of annual temperature and precipitation changes.

From Jacob et al. (2014).
“EURO-CORDEX: new high-resolution climate change projections for European impact research”

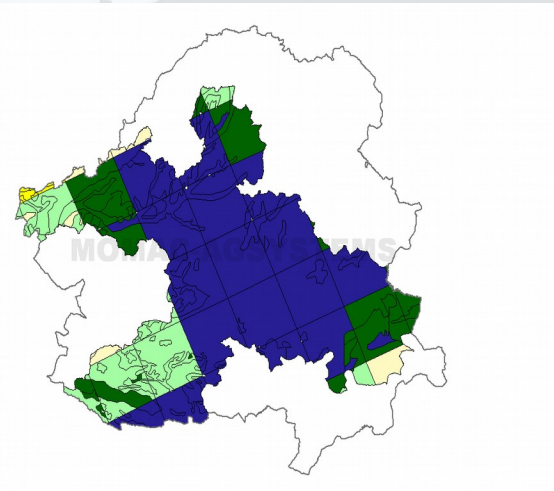
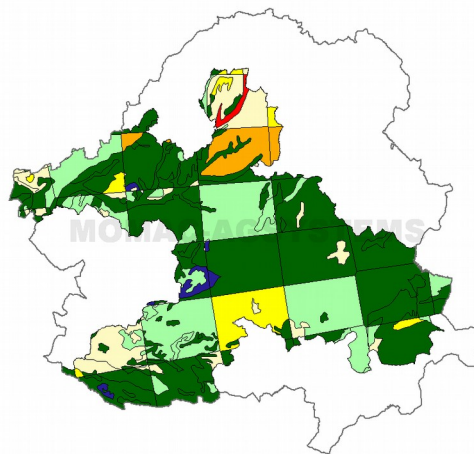
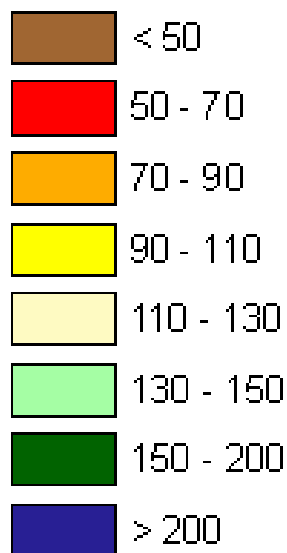




Part 2. Impacts on agriculture

Changes in yield A2/control (%)

Variación del
rendimiento (%)



RACMO

Spring wheat
(non-irrigated)

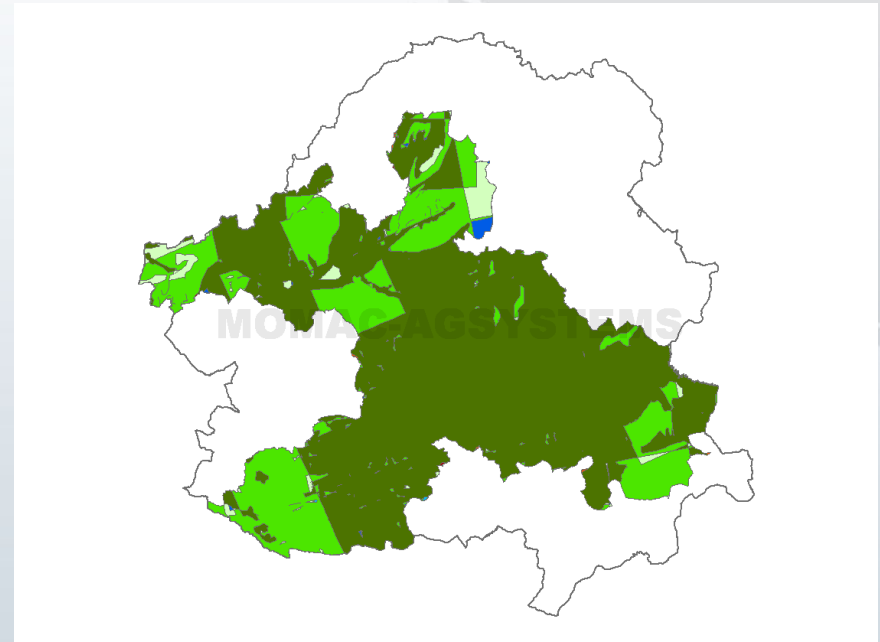
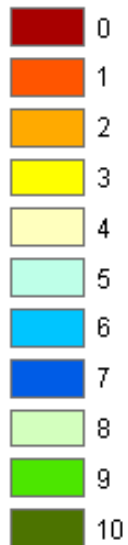
Ruiz-Ramos M y Mínguez MI, AGROCLIMA-SSP v.1.0. Herramienta de Ayuda a la Toma de Decisiones Políticas (Scientific Support to Policies) sobre los Impactos y Adaptaciones al Cambio Climático en los Sistemas Agrícolas de la Zona Centro. UCLM-UPM, España.



Part 2. Impacts on agriculture

Uncertainty in the sign of the impact

Número de proyecciones de aumento - No variación del rendimiento



Spring wheat
(non-irrigated)

Ruiz-Ramos M y Mínguez MI, AGROCLIMA-SSP v.1.0. Herramienta de Ayuda a la Toma de Decisiones Políticas (Scientific Support to Policies) sobre los Impactos y Adaptaciones al Cambio Climático en los Sistemas Agrícolas de la Zona Centro. UCLM-UPM, España.

Part 2. Impacts on agriculture

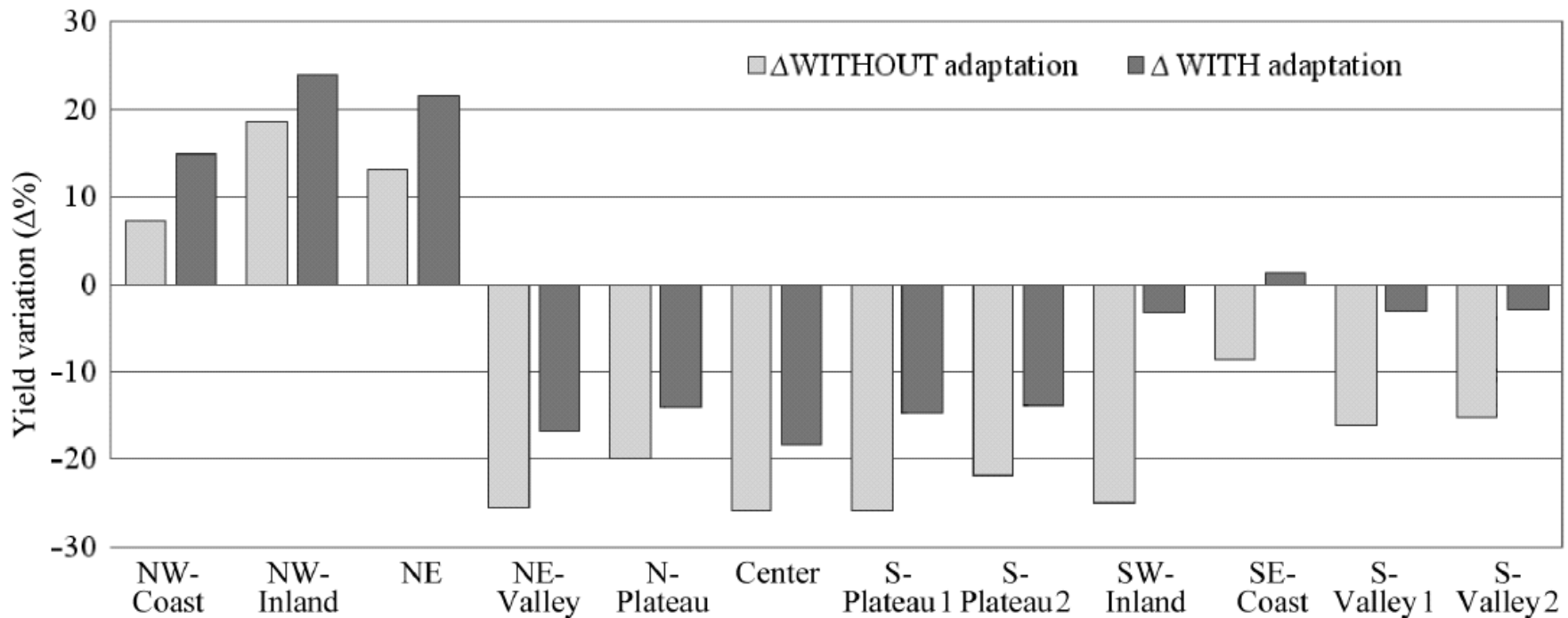
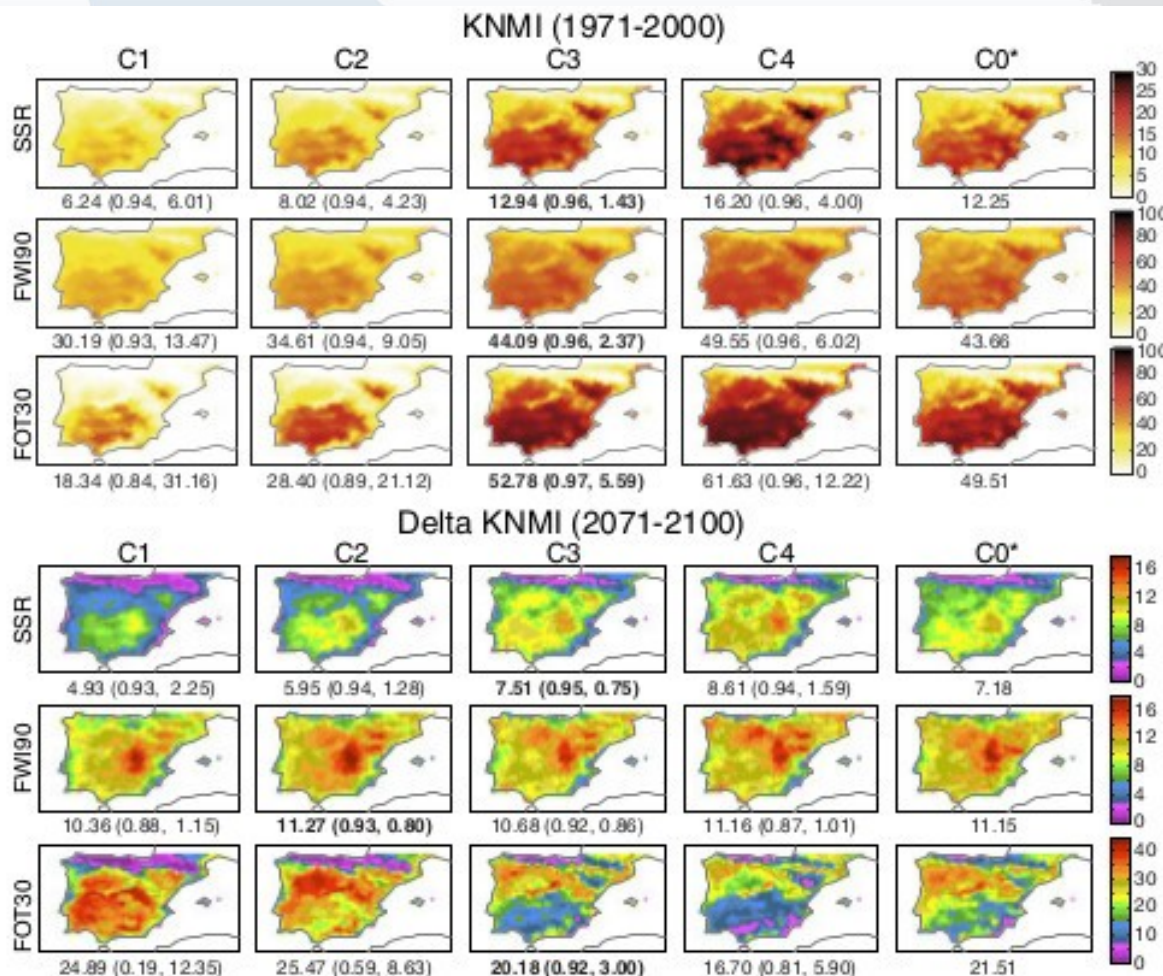


Fig. 3. Yield variation (Δ in %) in maize between the current and future climate: analysis of climate change impacts without and with adaptation

Variety	ECO no.	P1	P2	P5	G2	G3	PHINT
PRU001 CYCLE 700	PRU001	220	0.52	910	700	7	38.9
PRUAD1 LONG SEASON AD	IB0001	320	0.3	940	700	7	45

(Garrido et al., 2011)

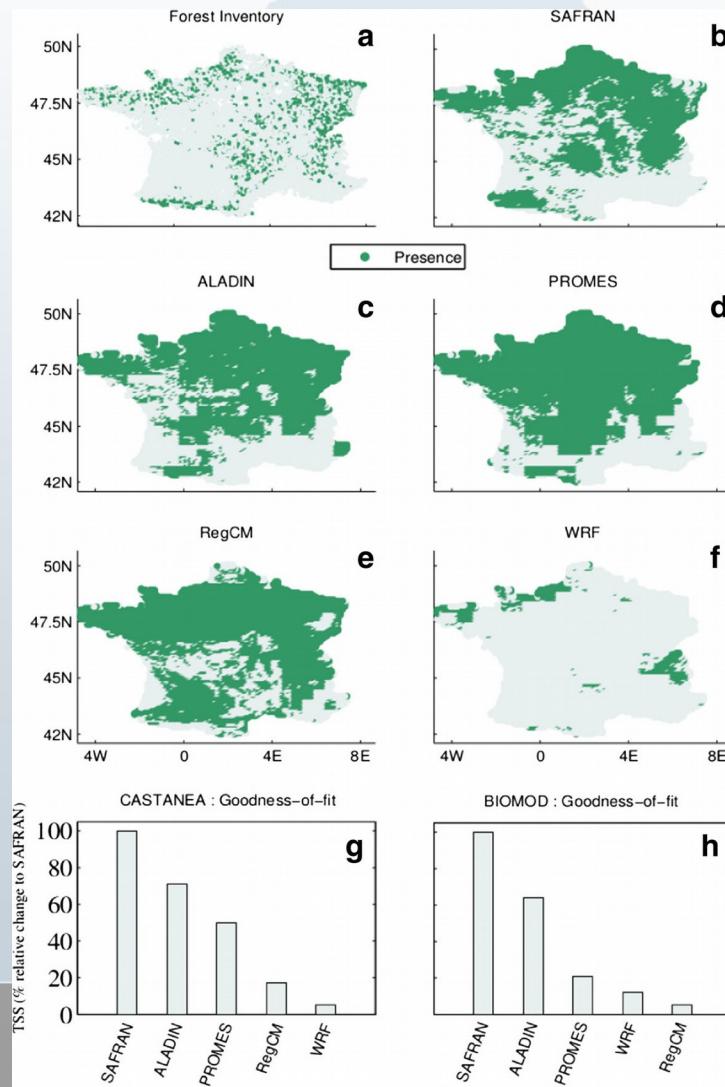
Part 2. Impacts on forest fires



(Bedia et al., 2013)



Part 2. Impacts on forests description (beech)



Input variables: temperature, rainfall, solar downward radiation, wind speed 10m, rh.

They are used for CASTANEA model forest-tree growth model

(Stevens et al., 2015)



Part 2: Bias correction for RCMs

- Delta methods: just from mean seasonal or annual values
- Based on transfer functions obtained from cumulative distribution functions: not only the first-order, but the tails of distributions are taken into account
- Weather generators
- Limitations and applicability: variables, observational information quality. Capacity to perform such modifications to model results in a systematic way.



Part 2. Impacts on agriculture+bias correction

Consecuencias en la simulación del rendimiento

MAIZE		1971-2000	2021-2050		2071-2100		
Location	Ensemble/ Method	Control Mean Yield (kg ha ⁻¹)	Mean A1B Yield (kg ha ⁻¹)	Mean change % from Control	Mean A1B Yield (kg ha ⁻¹)	Mean change % from Control	Difference regarding AEMET simulation Yield (kg ha ⁻¹)
							1971-2000
Albacete	AEMET	11155	n/a	n/a	n/a	n/a	
17 RCMs	ENS	10148	8562	-14	6500	-32	-1007
12 RCMs	ENS-EOBS	10735	9679	-10	7882	-26	-420
12 RCMs	ENS-SPAIN02	10776	9743	-9	8227	-24	-378
12 RCMs	ENS-WG	11238	9321	-17	7996	-29	84
12 RCMs	ENS-EOBS-WG	11238	9419	-16	8288	-26	84
12 RCMs	ENS-SPAIN02-WG	11238	9300	-17	7997	-29	84

(Ruiz-Ramos et al., 2015)



Part 2: Guidelines when using RCMs

- Need of good information and support from modeling groups. Role of meteorological and climate change national and regional agencies
- Different levels of users: experienced and non-experienced.
- Several FAQ from users to be answered, such as: how many models? How many scenarios? From which project? Results “good” or “bad” enough?
- Usage recommendations list
- Probabilistic information. Strong and weak information/results from models. Uncertainties
- Experiencies in Spain: **Workshop in Valsain in 2011**: joining modelling and impact groups. Regional project at UCLM (2010-2013)



Part 2: Data availability from RCMs

- Main variables of interest: surface magnitudes (+soil, atmosphere)
- Time scales: daily, subdaily?, monthly, annual
- Spatial scales: does resolution matter?. Point or areal information and representativity?.
- Usage of ensembles of simulations
- Present climate: usage of direct observations vs regional simulations
- Future climate projections. Emissions scenarios, forcing GCMs
- Example over Spain (AEMET/OECC): [SpainResultsPortal](#)