



Regional climate modelling description of drought characteristics over the mediterranean region for present climate and future conditions

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Structure



- 1) Introduction: modelling dry spells from regional climate modelling perspective
- 2) Methodology: RCM ensembles and gridded observational databases. Used Indices
- 3) Results over several domains: present climate validation. Future climate projections
- 4) Conclusions. Lines of work



1) Introduction



Capability of regional climate models to describe drought characteristics over the Mediterranean area

- Availability of RCM ensembles over Europe and subregions to study uncertainties due to RCMs, GCMs, emissions scenarios...
- Comparison with gridded daily precipitation observational databases (E-OBS, Spain02) to evaluate present climate ERAinterim/ERA40 forced simulations
- Indices used to describe dry spells: mean length, number of episodes, extremes, Markov chains...
- Present climate and future climate regional projections: comparison against forcing GCMs and XXIst century projections and uncertainties



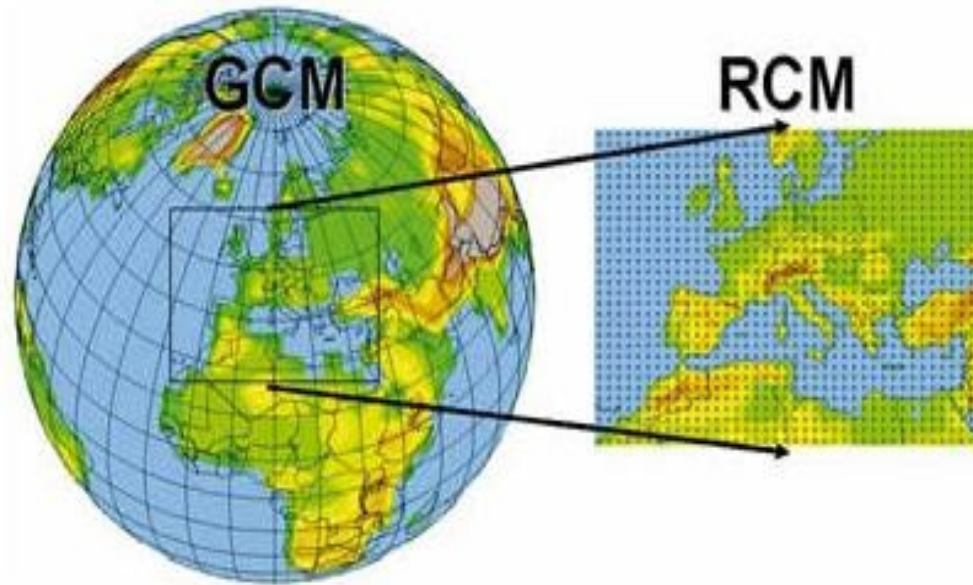
2) Methodology: RCM databases



<u>Project</u>	<u>Duration</u>	<u>Domain</u>	<u>RCMs</u>	<u>GCMs</u>	<u>emiss</u>	<u>Resolution</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
AMMA	2005-2009	Sahel Africa	10	5	A1B	50km	1990-2007 2000-2050
ESCENA	2008-2012	IP	4	3	A1B,A2,B1	25km	1990-2007 1950-2050
EUROCORDEX /MedCORDEX	2012-	17	xxx	xxx	RCP	50/25/12.5 km	1990-2010 1950-2100



2) Methodology: RCM modelling basics



- GCM or Reanalysis boundary forcings. Large scale surface oceanic and greenhouse gases forcings
- Current RCM spatial resolution and time periods covered
- Main relevant parameterizations for droughts: convection/orography, Land/surface interchanges.
- Atmosphere/ocean coupled regional modelling availability
- RCM capability to describe extreme events (droughts?)



2) Methodology: observational databases



Main features

- Daily data needed (CRU not usable)
- Time period covered
- Interpolation procedures for RCM outputs comparison
- Availability of high density station data

Databases

- E-OBS: Over the whole Europe and North-Africa (25km resolution)
- Spain02: Over the Iberian Peninsula (high density of rain gauge stations)
- CPC, GPCP: Satellite-based databases (from 1979)



2) Methodology: indices and magnitudes



- Mean dry spell length (dry day definition, CDD)
- Number of dry spells
- Return periods (after adjustment)
- Longest dry spells (ETCCDI recommendations): extremes
- Markov characteristics of dry spells
- CDF Biases for REA method (Olmos, Garcia-Galiano, Giraldo-Osorio, 2016 work)



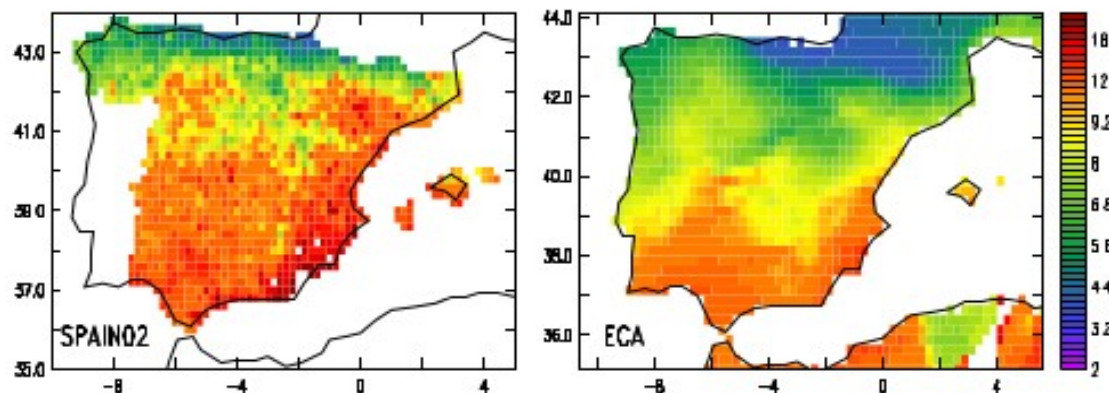
3) Results: related publications



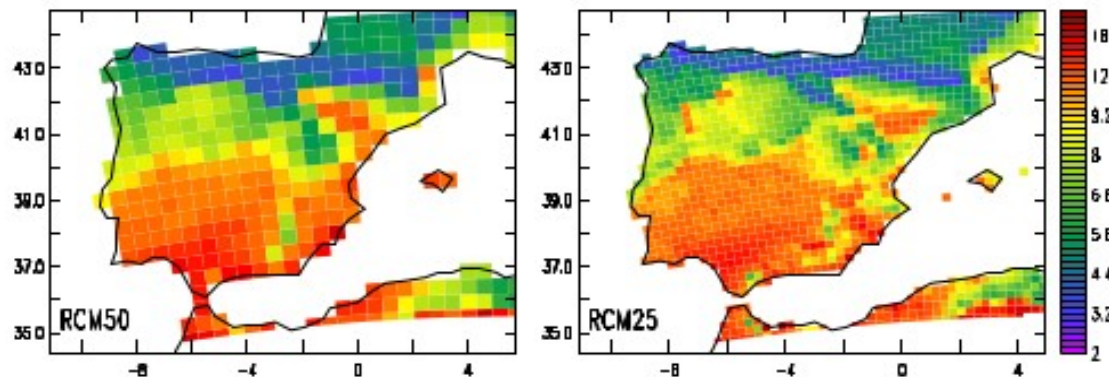
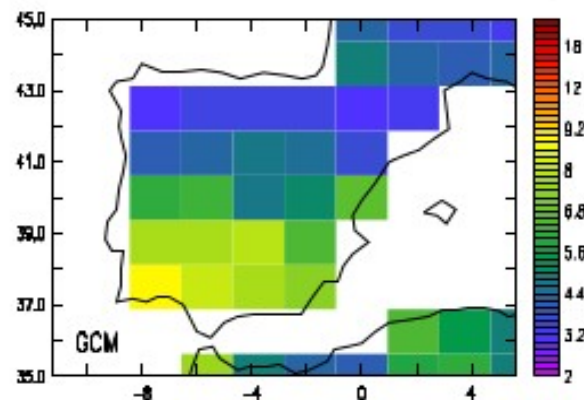
- 1) E. Sanchez, M. Dominguez, R. Romera, N. Lopez de la Franca, M. A. Gaertner, C. Gallardo, M. Castro (2011). "Regional modeling of dry spells over the Iberian Peninsula for present climate and climate change conditions", *Climatic Change*, **107**, 625-634
- 2) M. Dominguez, R. Romera, E. Sanchez, L. Fita, J. Fernandez, P. Jimenez-Guerrero, J. P. Montavez, W. D. Cabos, G. Liguori, M. A. Gaertner (2013). "Present climate precipitation and temperature extremes over Spain from a set of high resolution RCMs", *Climate Research*, **58**, 149-164
- 3) N. Lopez de la Franca, E. Sanchez, R. Romera, M. Dominguez (2013). "Dry spells analysis over the Mediterranean basin for present climate and climate change conditions using ENSEMBLES regional climate models", *Revista de Fisica de la Tierra*, **25**, 123-136, 2013, Dept. Geofis. Meteo., UCM
- 4) N. Lopez-Franca, E. Sanchez, T. Losada, M. Dominguez, R. Romera, M. A. Gaertner (2015). "Markovian characteristics of dry spells over the Iberian Peninsula under present and future conditions using regional climate models", *Clim. Dyn.*, **45**, 661-677
- 5) R. Romera, E. Sanchez, M. Dominguez, M. A. Gaertner, C. Gallardo (2015). "Evaluation of present-climate precipitation in 25 km resolution regional climate model simulations over Northwest Africa", *Climate Research*, **66**, 125-139
- 6) A. Fantini, F. Rafaele, C. Torma, S. Bacer, E. Coppola, F. Giorgi, B. Ahrens, C. Dubois, E. Sanchez (2016). "Assessment of multiple daily precipitation statistics in ERA-Interim driven Med-CORDEX and EURO-CORDEX experiments against high resolution observations", *Climate Dynamics* (special issue), under review (March)



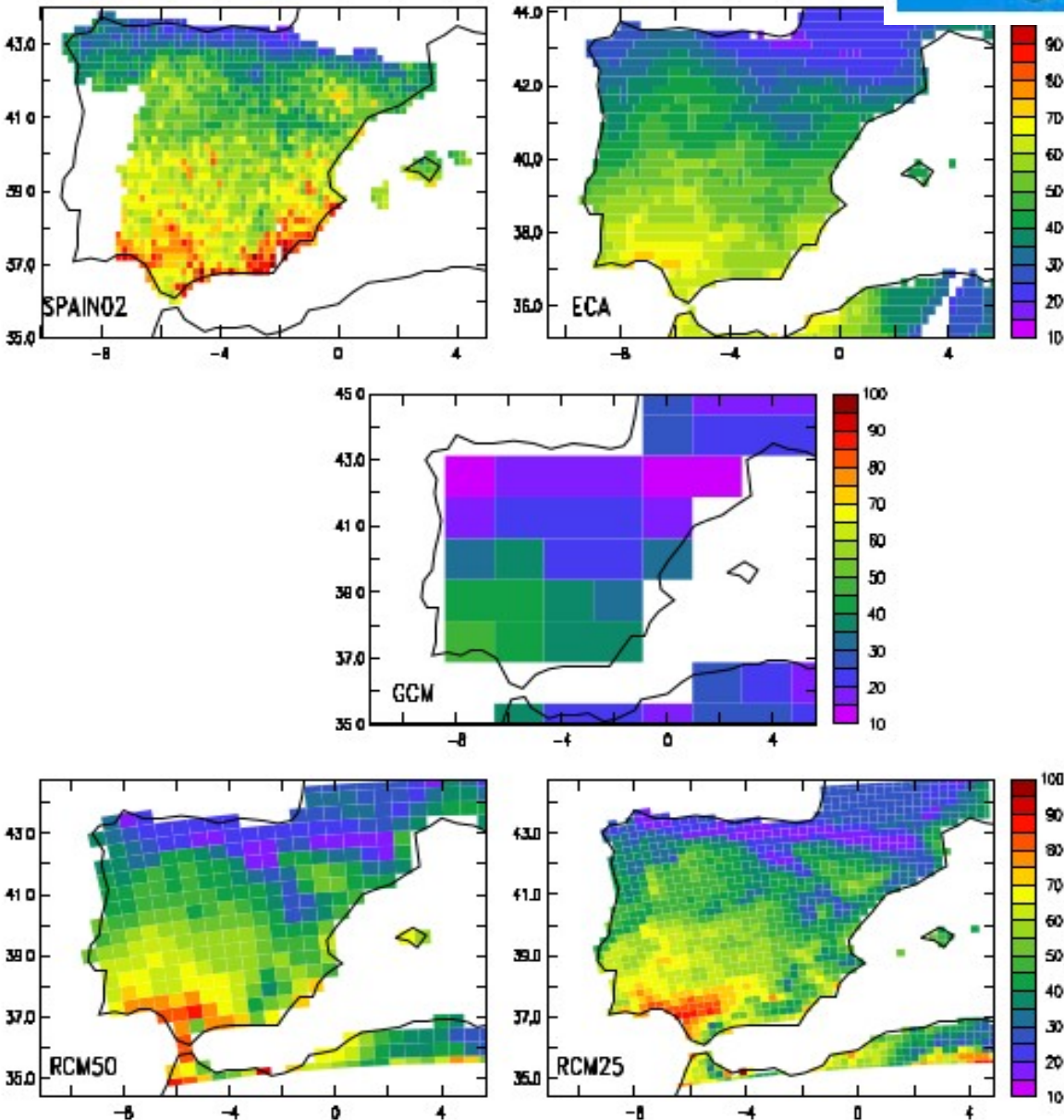
3.1) Dry spells over IP



Mean dry spell length
(1961-1990): obs, GCM
and RCMs



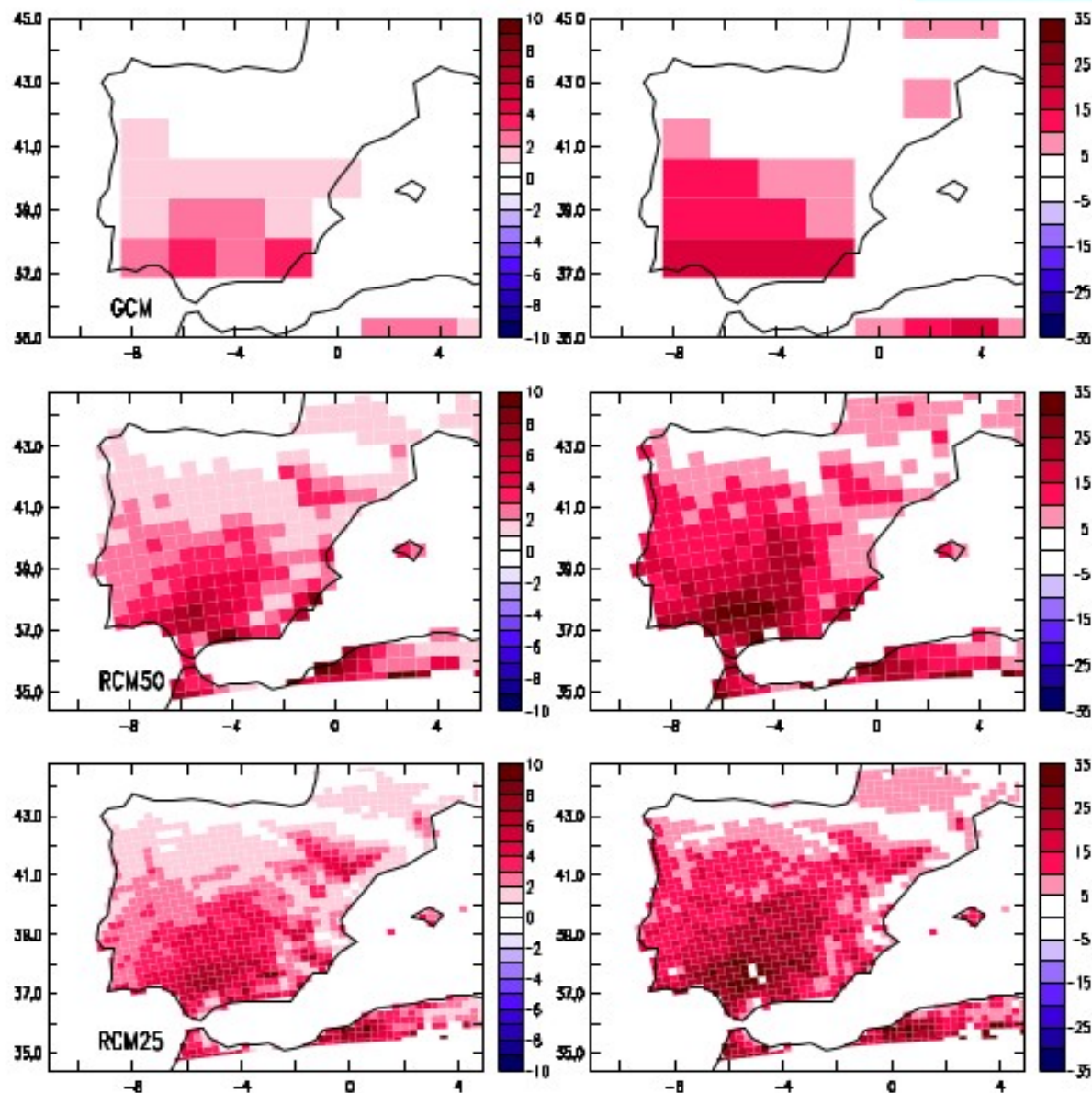
3.1) Dry spells over IP



2 year return period
dry spell length
(1961-1990): obs,
GCM and RCMs

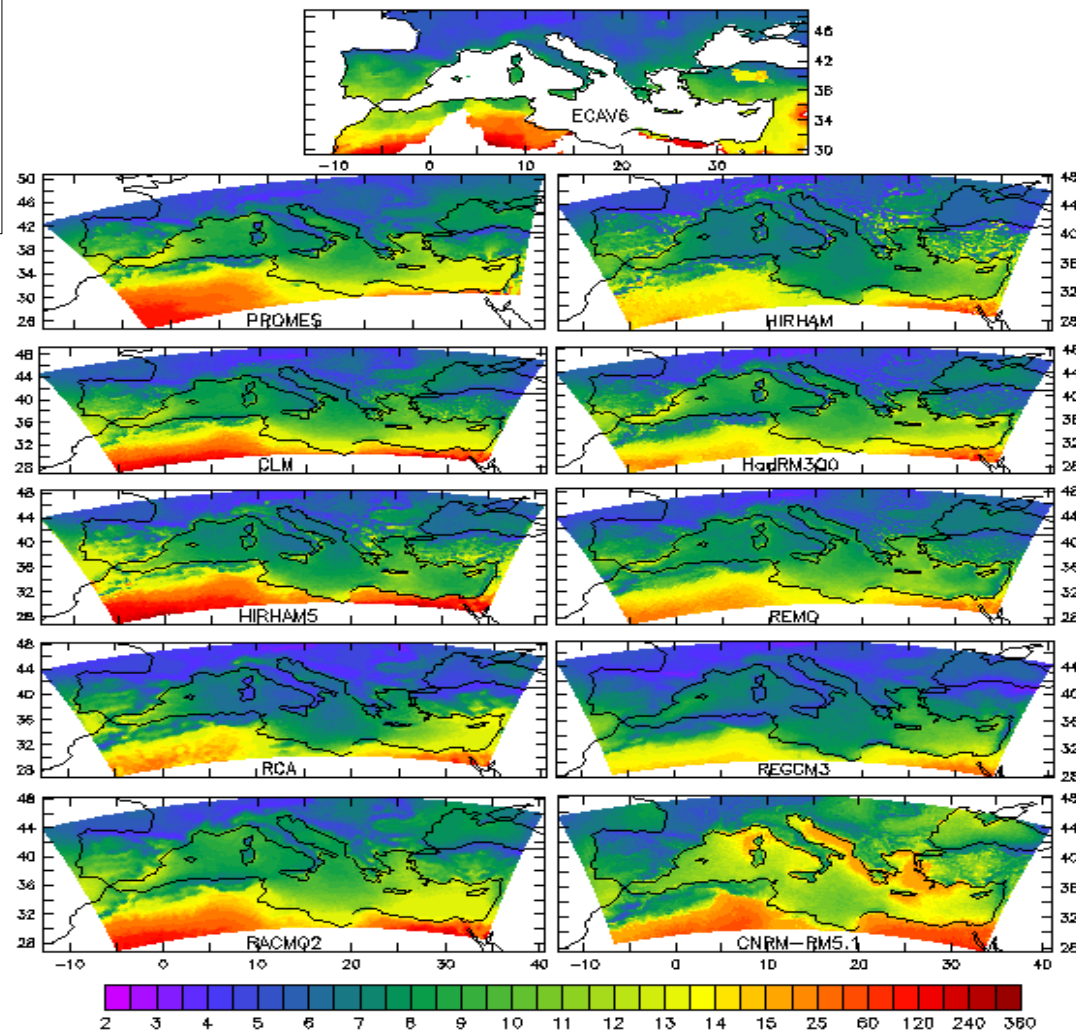
3.1) Dry spells over IP

Future projections changes: mean dry spell length and 2y return period: (2071-2100)-(1961-1990)



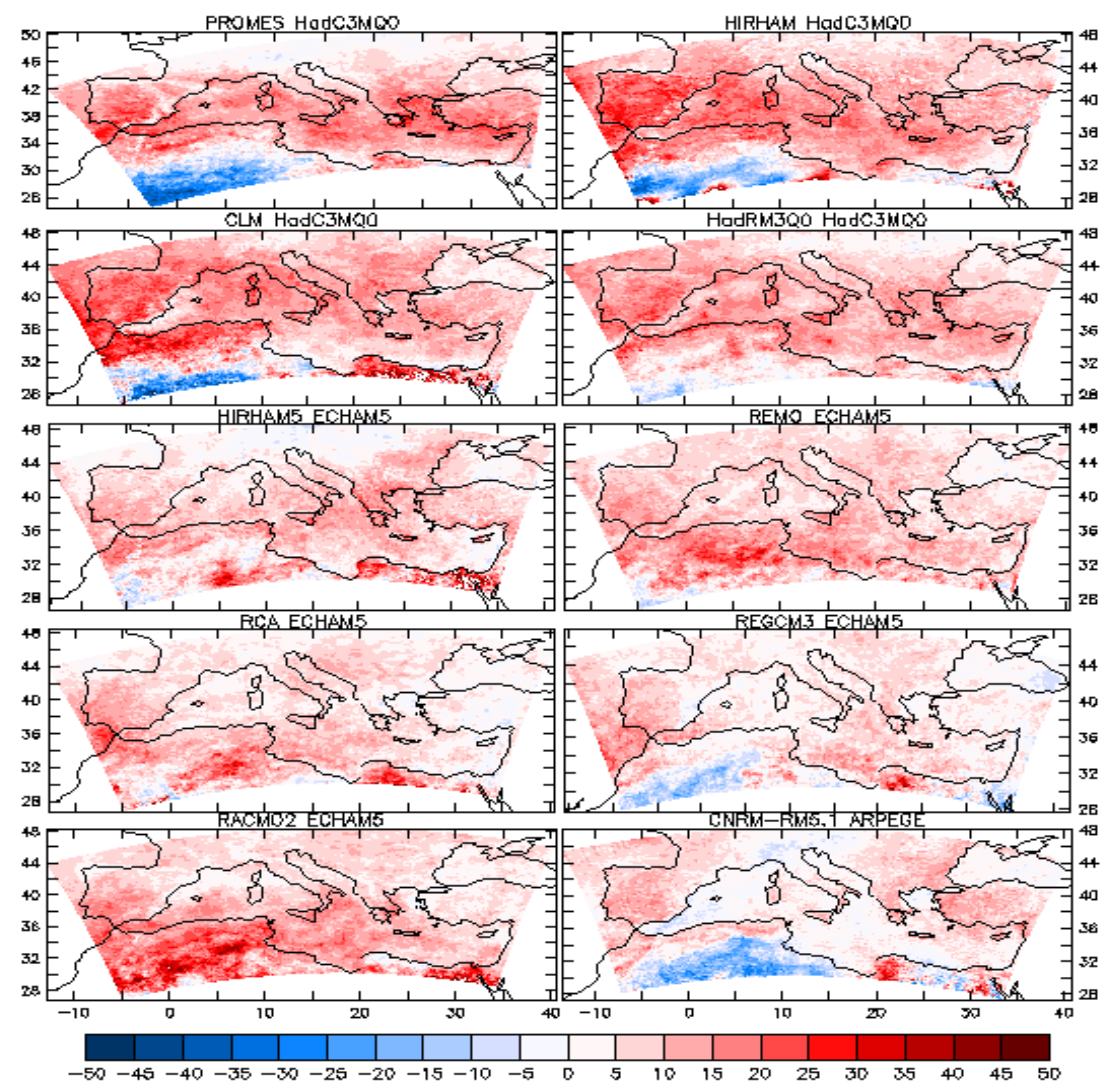
3.2) Dry spells over the Mediterranean

Annual dry spell length for ERA40 forced simulations (1961-2000)

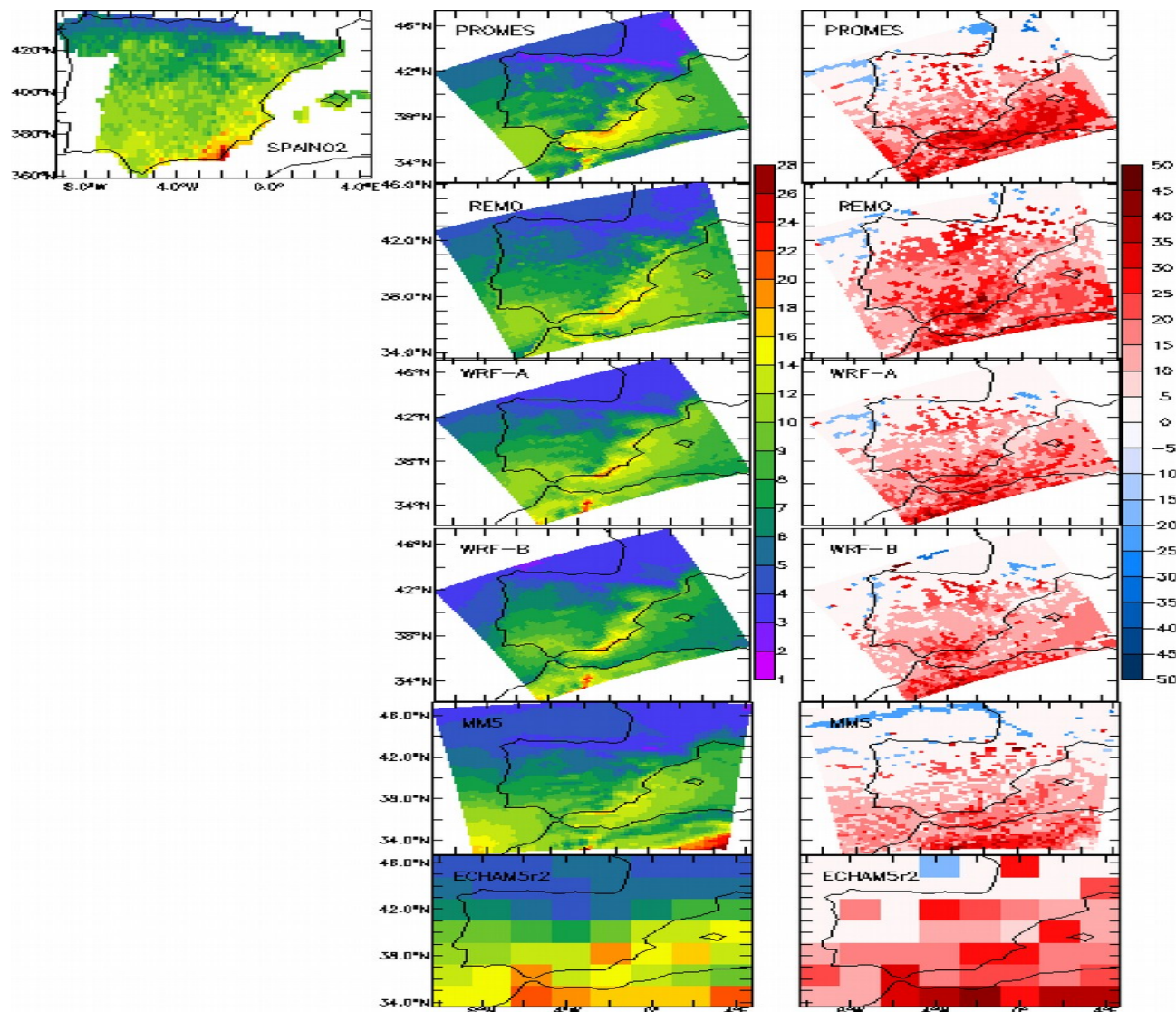


3.2) Dry spells over the Mediterranean

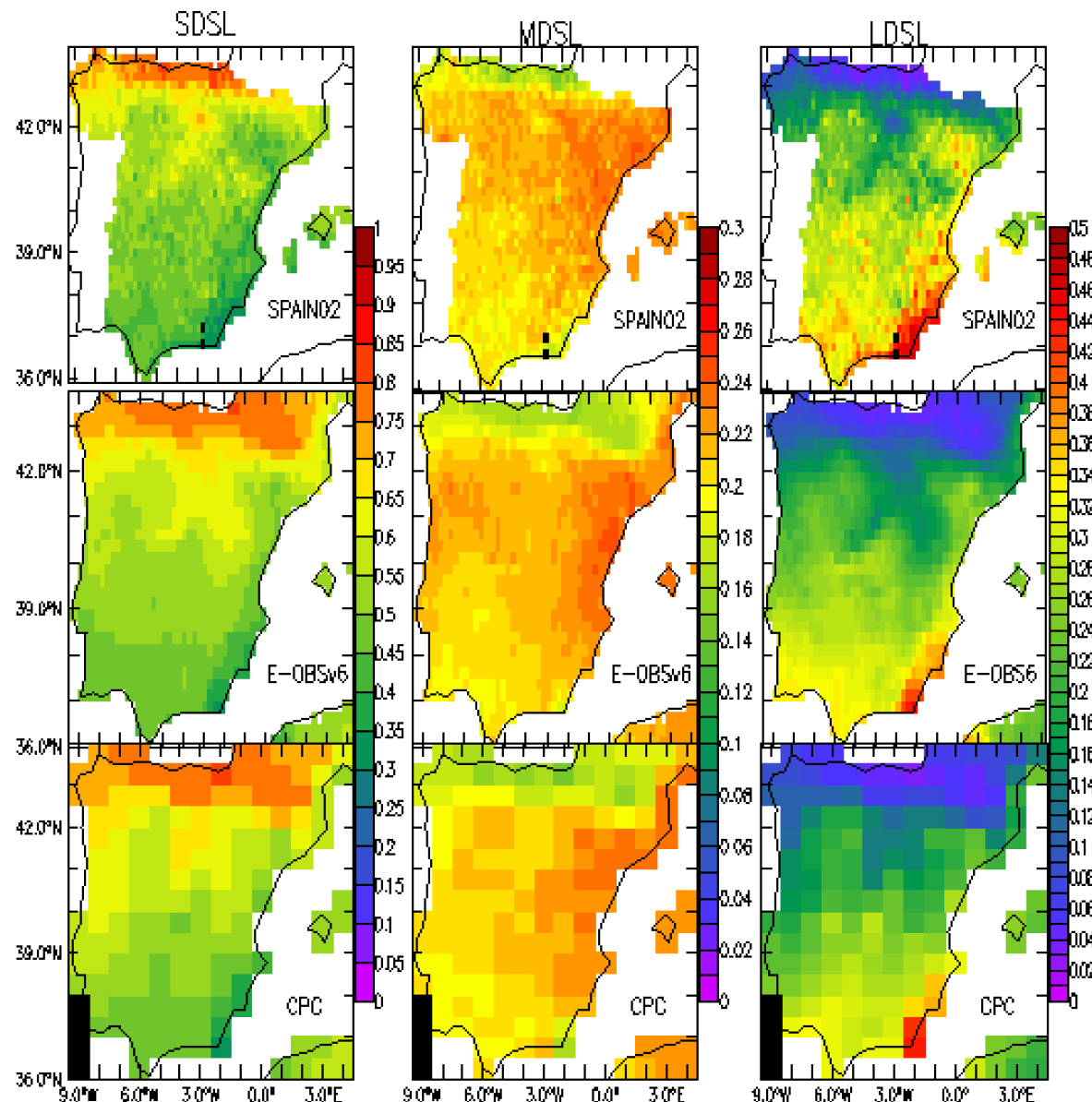
Percentage change of annual dry spell length for GCM-forced simulations (2021-2050)-(1951-1980)



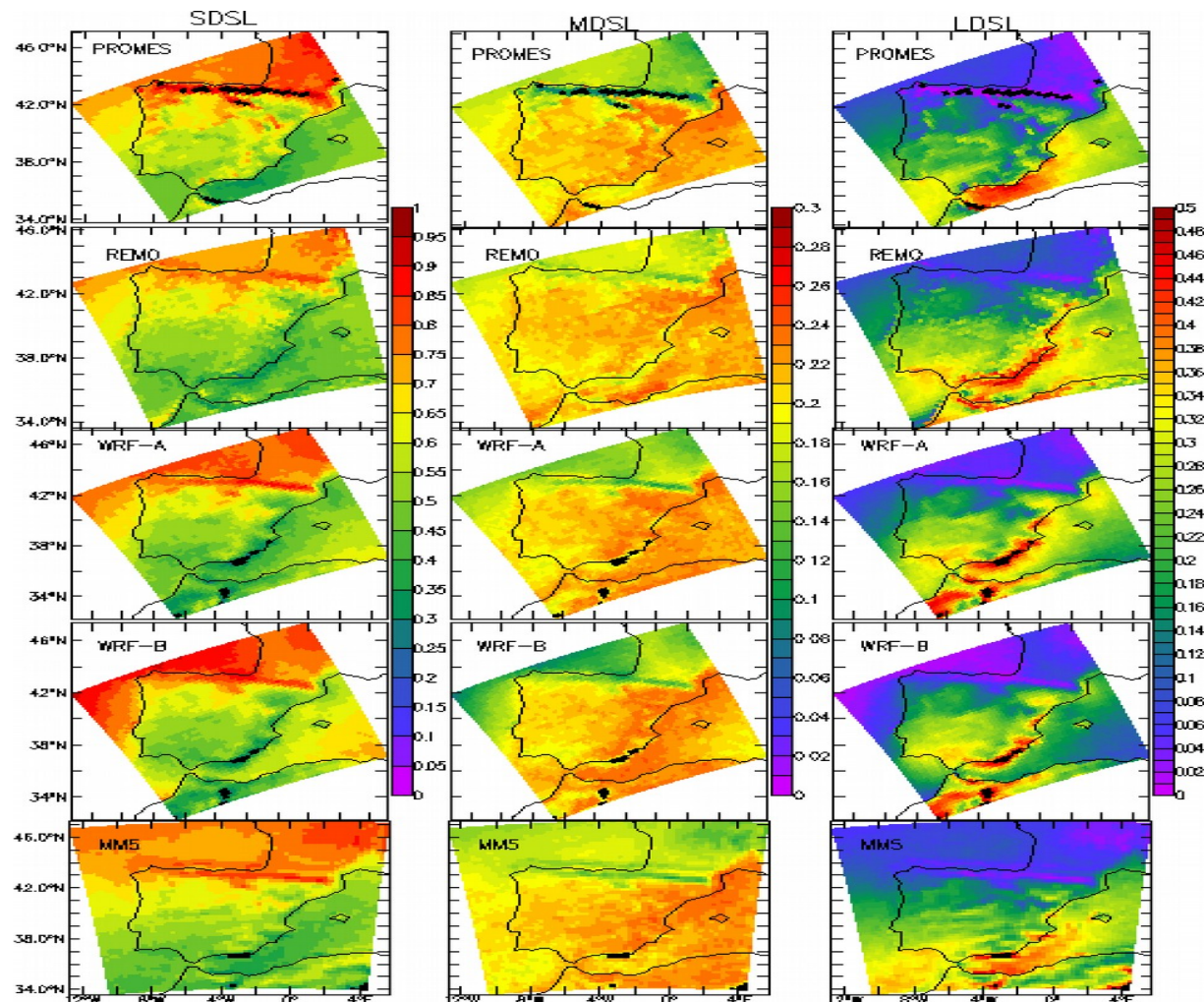
Annual dry spell length for ECHAM5-forced simulations and changes (2021-2050)-(1971-2000)



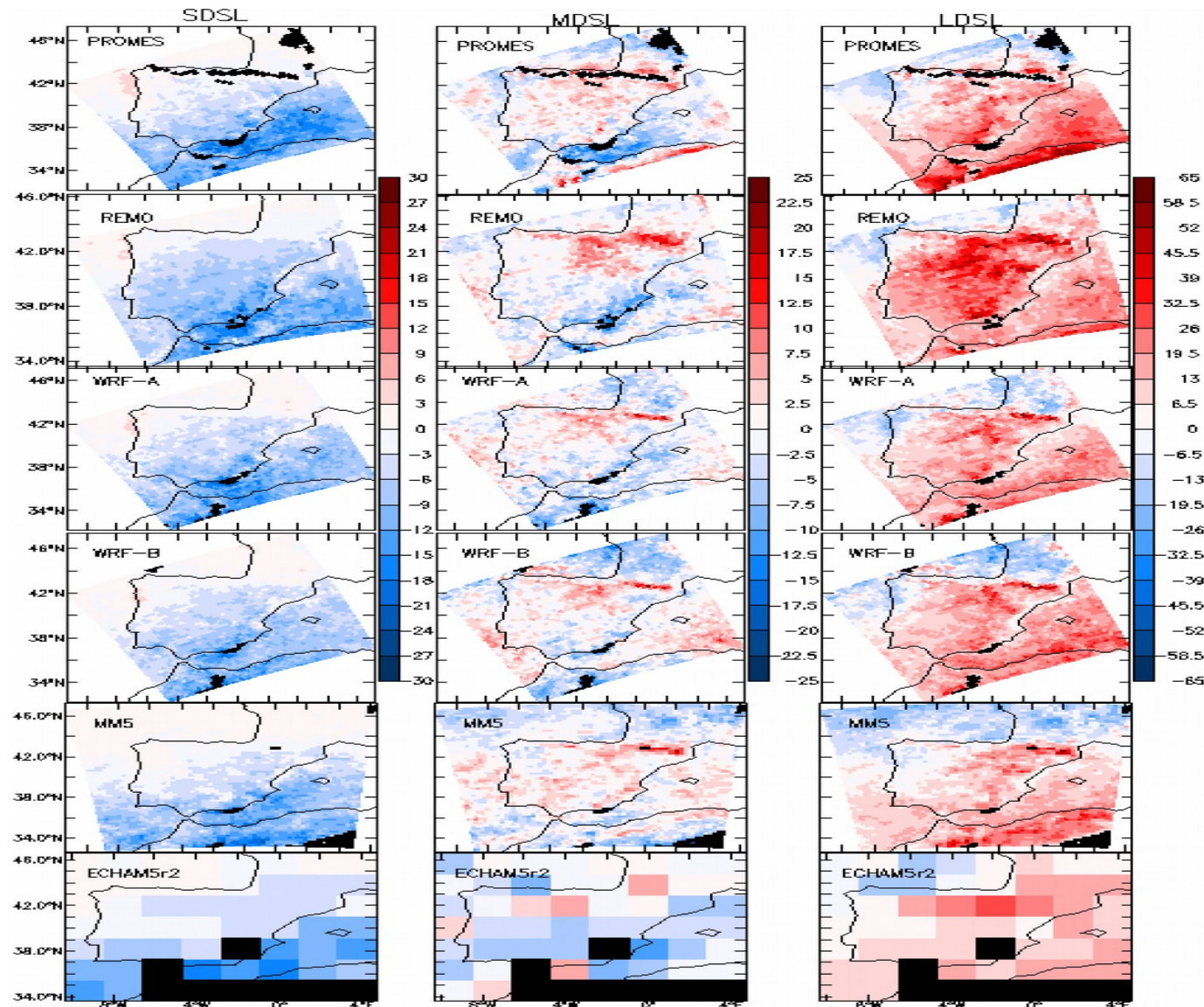
Probability of occurrence of dry spell length classes (1989-2007): short, medium, long MC2 process

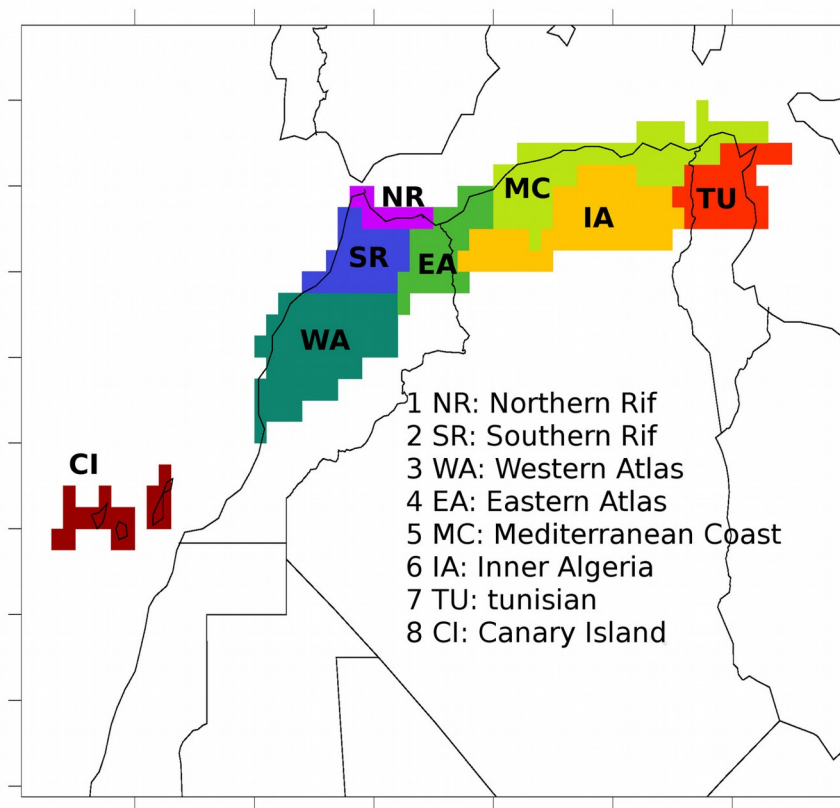
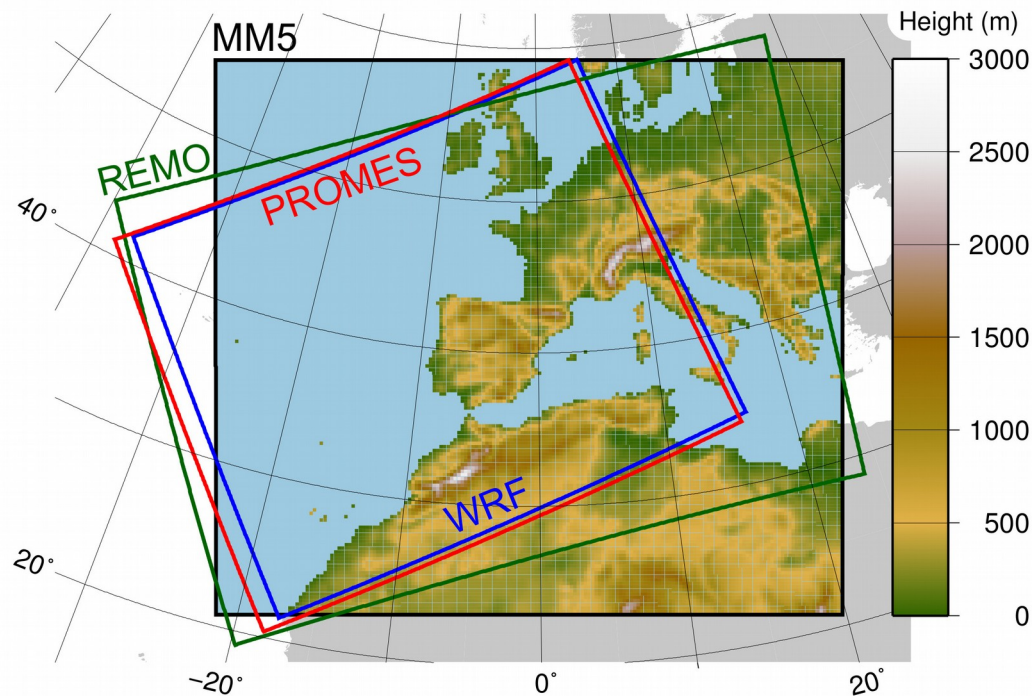


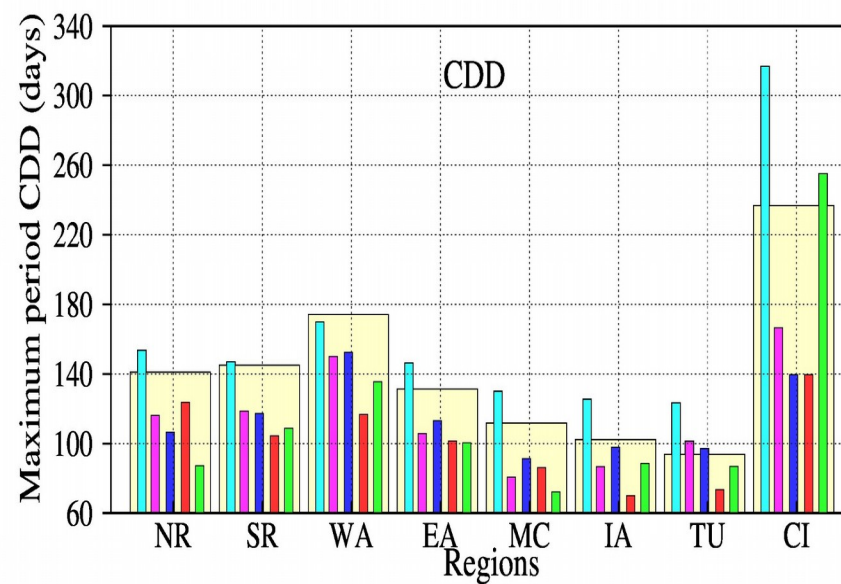
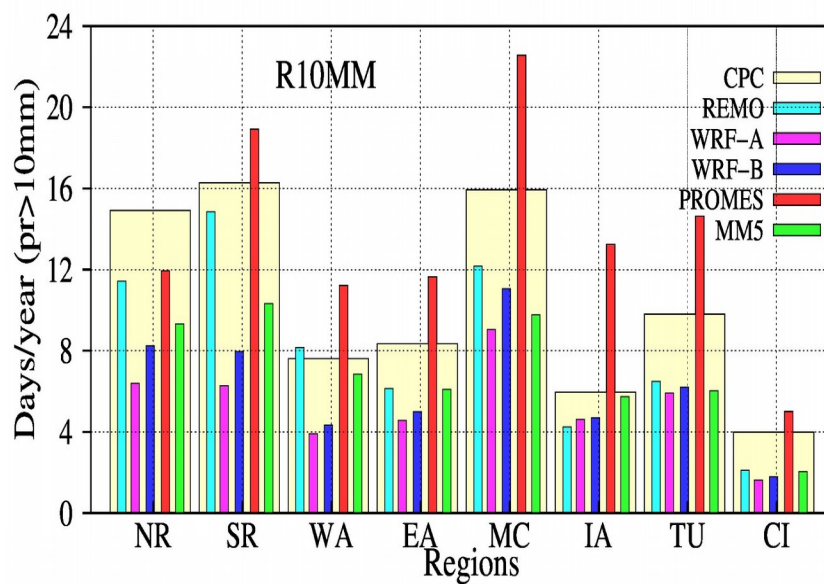
Probability of occurrence of dry spell length classes (1989-2007): short, medium, long MC2 process



Probability of occurrence of dry spell length classes changes for future conditions





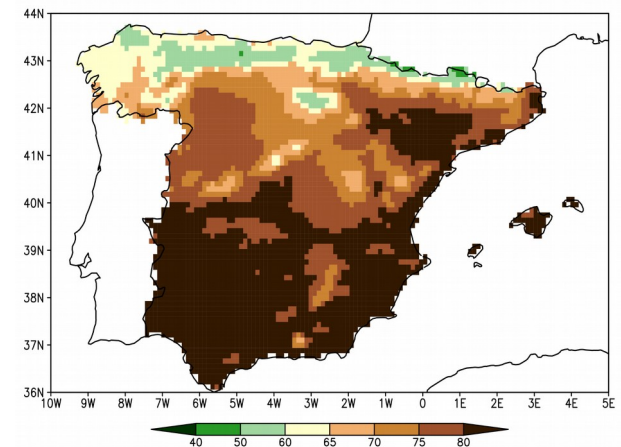
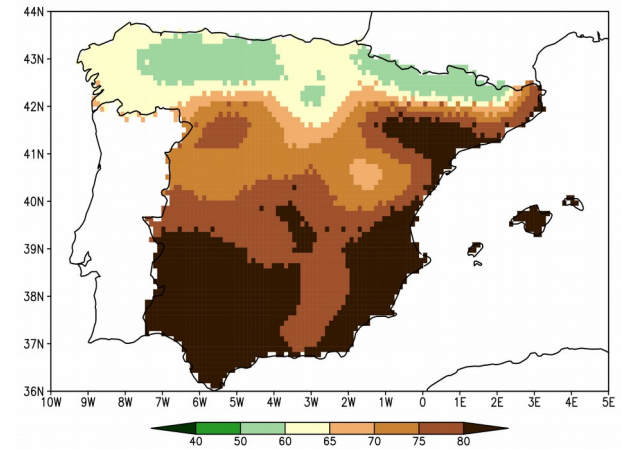
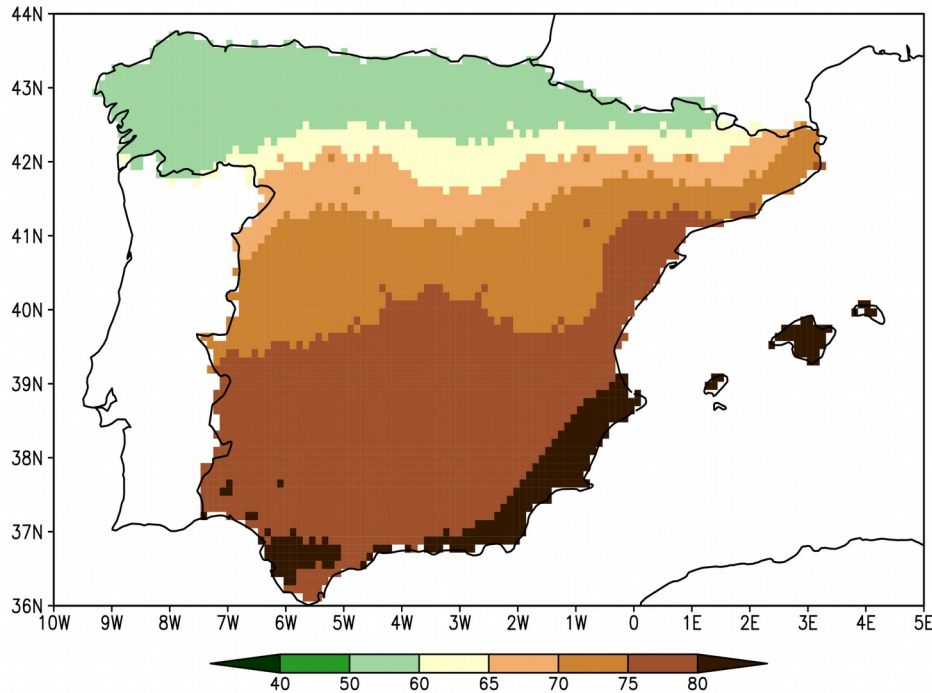


Evaluation of consecutive dry days for ERAinterim forced simulations (1990-2008)

3.5) Dry spells for MedCORDEX



3.5) Dry spells for MedCORDEX



Evaluation of CDD95 for ERAinterim forced simulations (1990-2008)



4) Conclusions. Lines of work



- 1) Acceptable dry spells reproduction by RCMs
- 2) Increase of longer dry spells for future conditions over the Mediterranean basin
- 3) Capability of RCMs to study water and heat budgets, and therefore, drought characteristics, sensitivities. Land-atmosphere parameterizations. Resolution. Local features to be accurately described by regional models