IMPACT OF CLIMATE CHANGE IN AN OBJECTIVE CIRCULATION TYPE CLASSIFICATION

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1.- OBJECTIVE

To analyze how anthropogenic climate change may affect atmospheric circulation inducing changes in frequency and mean lifetime of the Circulation Types (CTs, henceforth) over the Euro-Atlantic region.

2.- DATA

Euro-Atlantic daily gridded winter (DJFM) 500-hPa geopotential height (00UTC) of the following datasets:

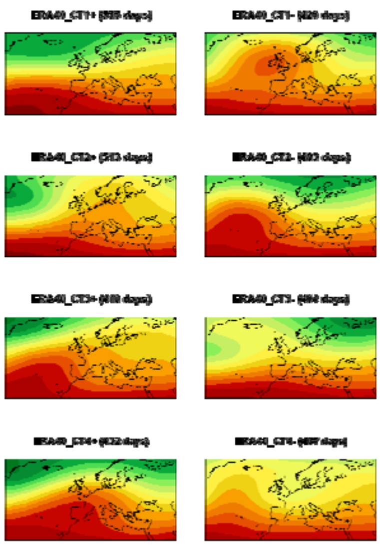
- Reanalysis **ERA40** (Uppala, 2005), 1961-1990.
- Model simulations of **CGCM2** from the CCCma (Flato and Boer, 2000): Control run:1961-1990 and IPCC SRES-A2 forcing scenario 2071-2100.

3.- METHODOLOGY

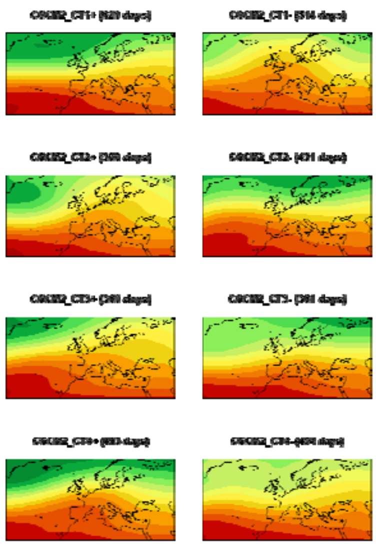
- Principal Component analysis (PCA) in T-mode followed by a varimax rotation, (Richman, 1986) applied to ERA40.
- Four PCs rotated determined by the Log-Eigenvalue diagram.
- Cumulative percentage of variance explained by the four PCs rotated: 65.5%.
- CGCM2 loadings obtained from the four ERA40 PC score patterns projected onto CGCM2 simulations.
- Each day is classified on the PC with the highest loading, the higher the loading the greater the similarity (Huth, 1996).
- As loadings may be either positive or negative, twice as many CTs as PCs rotated are obtained. In this case eight CTs provided by the four PCs rotated.
- CTs are the composites of the maps assigned to each CT.

4.- CIRCULATION TYPES

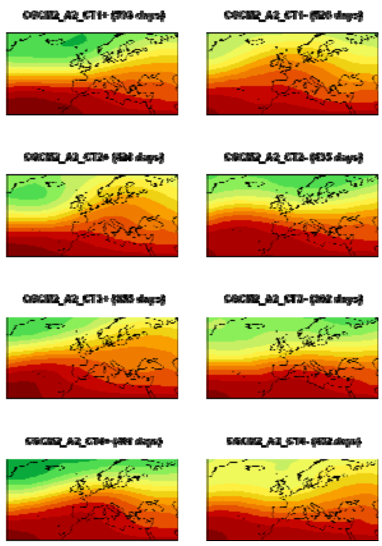
ERA40 1961_1990



CGCM2 1961-1990



CGCM2 2071-2100



4.1.- ERA40 CTs DESCRIPTION

Circulation Types	Description
ERA40_CT1+	Zonal flow
ERA40_CT1-	Euro-Atlantic blocking with centre over the British Isles
ERA40_CT2+	Scandinavian blocking
ERA40_CT2-	Atlantic ridge as an extension of the Azores anticyclone
ERA40_CT3+	Ridge tilted from the Southeast Atlantic to the central
ERA40_CT3-	Ridge over Iceland, zonal flow southern Europe
ERA40_CT4+	Ridge with axis from the Iberian Pen. to Scandinavia
ERA40_CT4-	Atlantic ridge with axis south of Iceland

4.2.- CTs FREQUENCIES (%)

Circulation Types	ERA40 1961_1990	CGCM2 1961_1990	CGCM2 A2 2071_2100
CT1+	15.29	17.33	16.34
CT1-	11.74	14.16	14.55
CT2+	14.14	10.69	11.68
CT2-	13.31	11.88	11.99
CT3+	11.30	9.92	9.78
CT3-	11.13	9.95	9.98
CT4+	11.90	13.59	13.25
CT4-	11.22	12.51	12.46

4.3.- CTs PERSISTENCE (days)

Circulation Types	ERA40 1961_1990	CGCM2 1961_1990	CGCM2 A2 2071_2100
CT1+	3.56	3.64	3.01
CT1-	2.98	3.81	3.43
CT2+	3.47	2.74	2.76
CT2-	2.96	2.68	2.46
CT3+	2.44	2.69	2.54
CT3-	3.88	3.32	2.83
CT4+	3.18	3.34	2.78
CT4-	3.16	3.32	3.59

5.- CONCLUSIONS

- **ERA40** CTs closely resemble the main CTs obtained in previous studies (Michelangeli et al., 1995; Huth 1996). The most frequent CT is the zonal one, followed by the Scandinavian blocking and the Atlantic ridge. CT3- is the less frequent but the most persistent.
- The CTs simulated by **CGCM2** do not properly reproduce the ridges over the Atlantic and western Europe. The CTs are characterized by a weakness of the meridional circulation showing a stronger zonality and a weakness of the ridges and troughs with respect to ERA40. A northwards shift of the jet is found. There is higher frequency and longer persistence for CT1+,- and CT4+,- than found in ERA40.
- The frequency of the CTs for the SRES A2 scenario has the same problems as the control simulation. The major differences between the control and the scenario are found for CT1+, that decreases, and CT2+, that increases. This would make the circulation slightly less zonal. The persistence decreases in most cases with respect to the control. The northward shift of the jet is more pronounced.

6.- REFERENCES

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