DISTRIBUTION CHARACTERISTICS OF WINTERTIME TELECONNECTIONS IN CLIMATE CHANGE

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1. MOTIVATION

The extratropical intra-seasonal atmospheric variability is characterized in terms of space-stationary and time fluctuating structures known as "teleconnection patterns". These patterns play an important role in the global climate system. In this context we focus on the likely impacts of climate change on the structure and characteristics as skewness and kurtosis of the Probability Density Functions (PDFs, henceforth) of the wintertime teleconnections in the Euro-Atlantic region.

2. DATA

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

- Reanalysis ERA40 (Uppala, 2005), 1961-1990
- Model simulations of a) CGCM2 from the CCCma (Flato and Boer, 2000) and b) ECHAM4 (Roeckner et al., 1996). Control run:1961-1990 and IPCC SRES-A2 forcing scenario: 2071-2100.

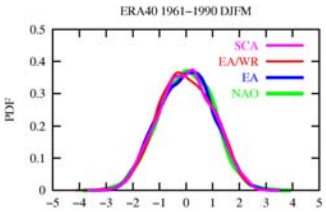
3. METHODOLOGY

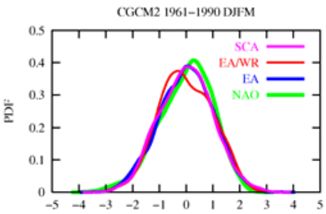
3.1 Principal Component Analysis (PCA) in S-mode, followed by a varimax rotation (Richmann, 1986) have been applied to isolate teleconnection indices. We have obtained the main Euro-Atlantic teleconnection described in the literature: the North Atlantic oscillation (NAO), the East-Atlantic/West Russian (EA/WR), the East-Atlantic (EA) and the Scandinavian (SCA).

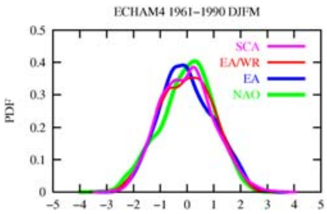
3.2. A non-parametric Gaussian kernel estimator has been applied to the normalised NAO, EA/WR, EA and SCA indices to estimate their PDFs (Silverman, 1986). The smoothing parameter (h) has been chosen equal 0.25 after several tests.

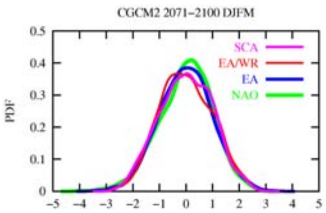
4. RESULTS

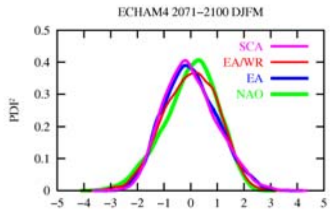
4.1 PDFs











4. 2 SKEWNESS

1961-1990

	NAO	EA	EA/WR	SCA
ERA40	-0.053	-0.024	-0.425	-0.023
CGCM2	-0.413	-0.103	0.011	-0.014
ECHAM4	-0.243	0.189	-0.030	0.181

2071-2100

	NAO	EA	EA/WR	SCA
CGCM2	-0.291	-0.015	0.079	-0.051
ECHAM4	-0.398	0.219	-0.186	0.330

4.3 EXCESS KURTOSIS (B_2-3)

1961-1990

	NAO	EA	EA/WR	SCA
ERA40	-0.277	-0.492	-0.993	-0.485
CGCM2	-0.027	-0.266	-0.416	-0.206
ECHAM4	-0.288	-0.438	-0.545	-0.296

2071-2100

	NAO	EA	EA/WR	SCA
CGCM2	0.120	-0.040	-0.403	-0.458
ECHAM4	-0.144	-0.285	-0.325	-0.144

5. CONCLUDING REMARKS

a) 1961-1990

ERA-40: Some kind of bimodality is observed in the SCA pattern. The teleconnection indices are asymmetric with negative skewness, especially EA/WR. This implies that more extreme values are found when the mode is negative. Kurtosis is also negative, the small values correspond to NAO and the large values are found for EA/WR. This platycurtic behaviour indicates that the tails of the respective distributions present a low probability.
CGCM2: Noticeable increase in the negative asymmetry of NAO while notorious decrease in the negative asymmetry of EA/WR. As regards ERA40, the SCA and the EA asymmetry have a change of sign. Less negative kurtosis compared with ERA40, especially remarkable for NAO.
ECHAM4: Increase in the negative asymmetry of NAO, not so noticeable as in the CGCM2 model. Increase in the asymmetry of EA and SCA (reverse sign with respect ERA40). While NAO and EA kurtosis are similar to ERA40, EA/WR and SCA are similar to CGCM2 values.
Summarizing, more traces of bimodality in the control simulation compared to ERA40 and a notorious increase in the asymmetry of NAO mode, behaviour that may have very important consequences in the correct simulation of extremes.

b) 2071-2100

CGCM2: Notorious decrease in the negative asymmetry of NAO. Change in the sign of the asymmetry for EA and SCA compared with the control simulation. As far as kurtosis is concerned, change in the sign for NAO and increase for SCA and EA.
ECHAM4: There is a noticeable increase in the asymmetry of the indices, compared with its control simulation. The kind of asymmetry (positive or negative) is kept on this model.
Summarizing, when considering climate scenarios, significant changes in the intensity of the asymmetry is detected, especially in the ECHAM4 simulation, although the distributions kept being platykurtic.

6. REFERENCES

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