



IPCC-AR4 intra-seasonal variability and more ...

Paolo M Ruti

Thanks to: A Dell'Aquila, S Corti, BM Batoure, PD Reyes



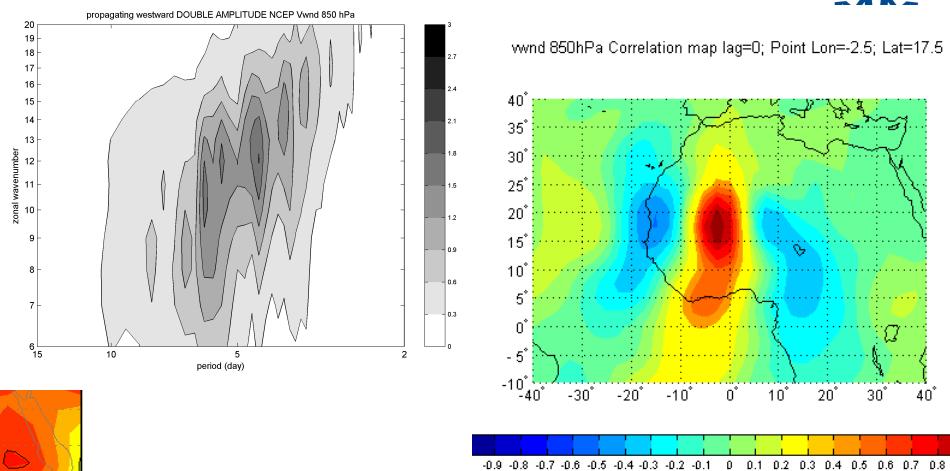
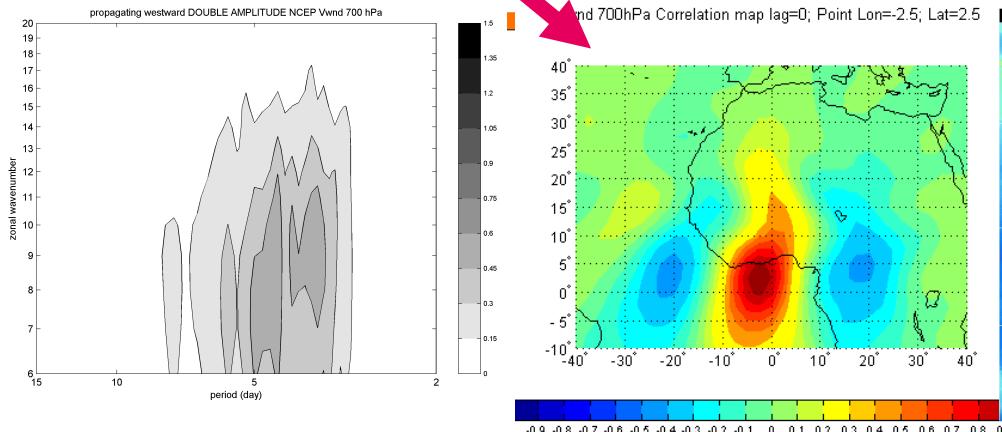
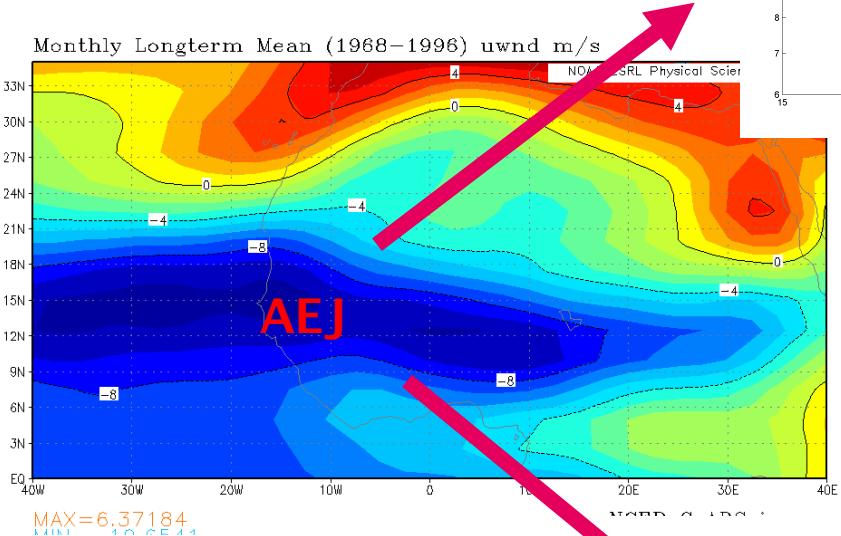


- WA vulnerable region
- Human pressure
- Niamey meeting, AMMA-ENSEMBLES: seasonal forecast & impact studies

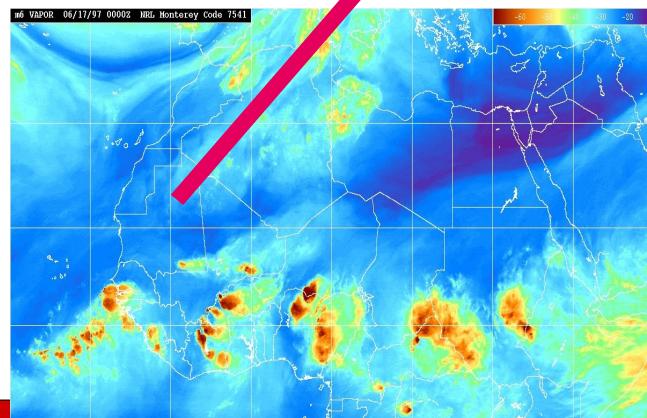
- The intra-seasonal variability in IPCC-AR4
- The land-ocean forcing on WAM

□ The intra-seasonal
variability in IPCC-AR4

AEJ and instabilities



MCS



We compare the Reanalyses and IPCC models in terms of their representation of major features of summer West Africa circulation (AEJ, AEWs)

WHY?

West Africa is one of the most vulnerable regions in the world. Are IPCC models able to correctly reproduce the mean state and the disturbances over this region?

CAST (in alphabetical order)

Model (Reference)	Institution	Atmosphere						Ocean		
		Trunc. (Lon x Lat)	Z	Chemistry and Aerosols	Clouds and Convection	Albedo	Numerics and Adjustments	Lon x Lat. (Equator)	Vertical	
1. BCCR-BCM2.0 Furevik et al. (2003)	Bjerknes Center for Climate Research, <i>Norway</i>	T63	h31	mA _c , dA _c , uA _p , sA _p	S: Ricard and Royer (1993) C: Bougeault (1985)	O _c , I _m , L _m	L,sl	1.5° x 1.5° (1.5° x 0.5°)	35σ	
2. CNRM-CM3 Salàs-Melia et al. (2005)	Météo France, <i>France</i>	T63	h45	O ₃ , mA _c , dA _c , uA _p , sA _p	S: Ricard and Royer (1993) C: Bougeault (1985)	-	L,sl	2° x 2° (2° x 0.5°)	31z	
3. CGCM3-1(T47) CGCM3.1(T63) Kim et al. (2002)	CCCma, <i>Canada</i>	T47(T63)	z31	-	C: Zhang and McFarlane(1995)	-		1.85° x 1.85° (1.4° x 0.94°)	29z	
6. ECHAM5/MPI-OM Jungclaus et al. (2005)	Max Planck Inst., <i>Germany</i>	T63	h31	sA _p	S: Lohmann and Roeckner (1996) C: Nordeng (1994)	I _m , L _m	L,sl/Lp	1.5° x 1.5°	40z	
6. FGOALS-g1.0 Yu et al. (2004)	LASG, <i>China</i>	2.8° x 2.8°	σ26	sA _p	S : Slingo(1987), Kiehl (1998), Rash and Kristjansson(1998) C: Zhang & McFarlane(1995), Hack (1994)	-	O, sl, HWnC	1° x 1°	H	
7. GFDL-CM2.0 GFDL-CM2.1 Delworth et al. (2005)	GFDL, <i>USA</i>	2.5° x 2.0°	h24	mA _p , dA _c , uA _p , sA _p	S: Rotstayn (2000), Tiedke(1993) C: Moorthi and Suarez (1992)	-	C (CM2.0) L (CM2.1)	1° x 1° (1° x 1/3°)	z	
9. GISS-AOM Lucarini and Russel (2002)	NASA-GISS, <i>USA</i>	4° x 3°	h12	sA _p	-	I _m , L _m	U, Lp	4° x 3°	16σ	
10. GISS-EH GISS-ER Schmidt et al. (2005)	NASA-GISS, <i>USA</i>	4° x 5°	σ20	mA _p , dA _p , uA _p , sA _p	-	I _c , L _m	U	2° x 2° (EH) 4° x 5° (ER)	σ (EH) z (ER)	
12. INM-CM3.0 Volodin and Diansky (2004)	Inst. Of Num. Math., <i>Russia</i>	5° x 4°	σ21	sA _p	S: Volodin and Diansky (2004) C: Betts (1986)	I _p , L _m	C, sl, F	2.5° x 2°	33σ	
13. IPSL-CM4 Marti et al. (2005)	IPSL, <i>France</i>	2.4° x 3.75°	h19	-	S: Bony and Emmanuel (2001) C: Grandpeix et al. (2004)	I _m , L _m	C, Lp	2° x 2° (2° x 0.5°)	31z	
14. MIROC3.2(hires) MIROC3.2(medres) K-1 mod. Dev. (2004)	CCSR/NIES/FRCGC, <i>Japan</i>	T106(hires) T42(medres)	σ56(hires) σ20(medres)	mA _m , uA _m , sA _m	S: Le Treut and Li (1991) C: Pan and Randall (1998)	I _m , L _m	L, Lp	1.4° x 1.4° (1.4° x 0.5°)	43h	
16. MRI-CGCM2 Yukimoto and Noda (2002)	Meteorological Research Institute, <i>Japan</i>	T42	h30	sA _p	S: Yukimoto et al. (2001) C: Randall and Pan (1993)	I _m , L _m	S, Lp, F	2.5° x 2.0° (2.5° x 0.5°)	?z	

and..

Global Reanalyses NCEP and ERA40

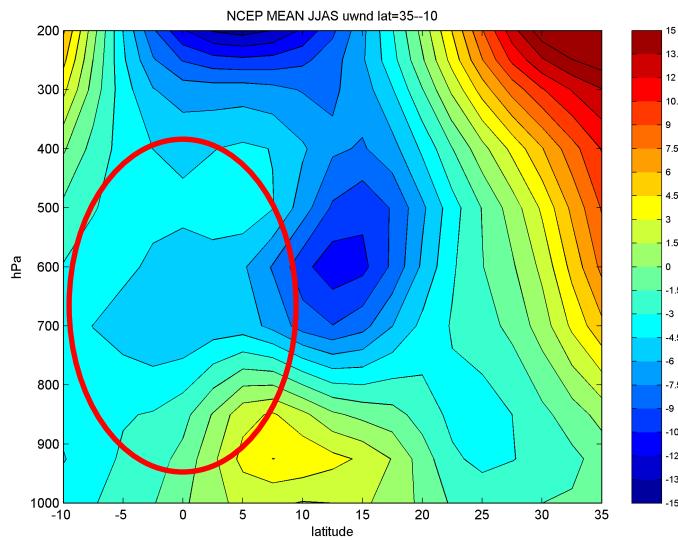


AEJ: the mean state

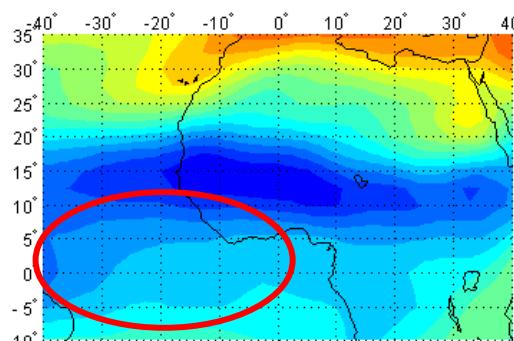
MEAN STATE zonal wind JJAS 1961-2000



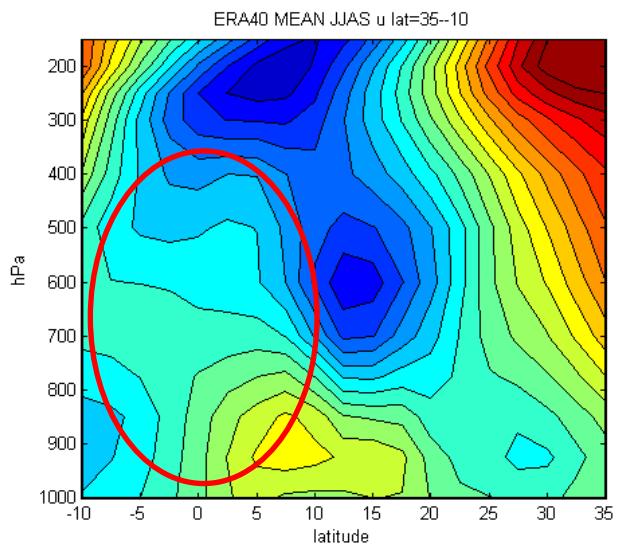
NCEP



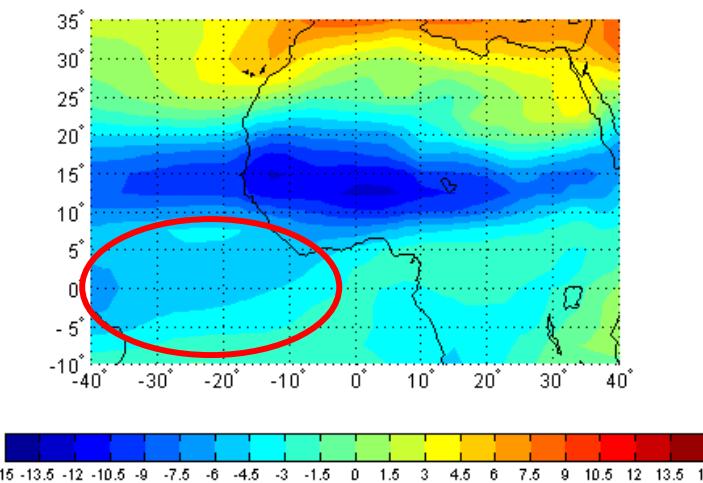
MEAN STATE NCEP JJAS uwnd lev=600hPa



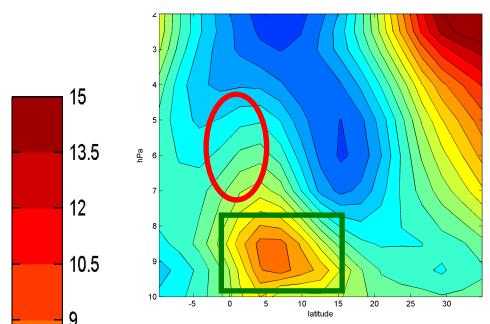
ERA 40



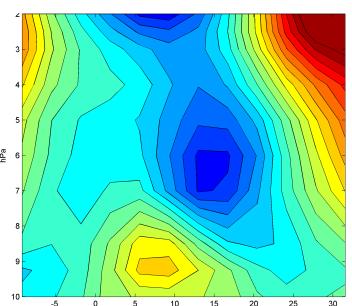
MEAN STATE ERA40 u JJAS lev= 600hPa



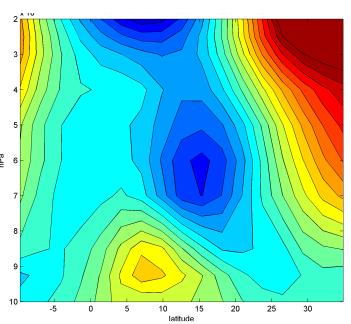
BCCR



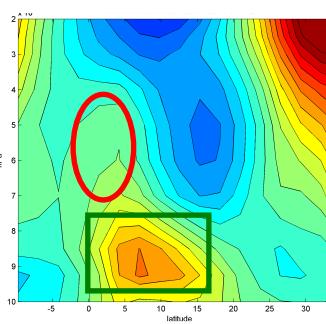
CGCM-T47



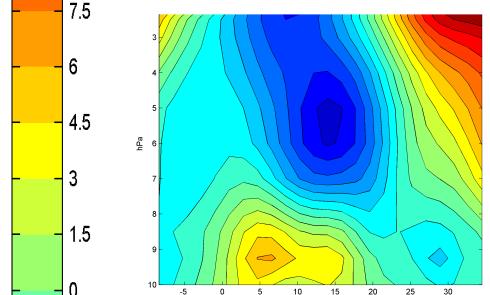
CGCM-T63



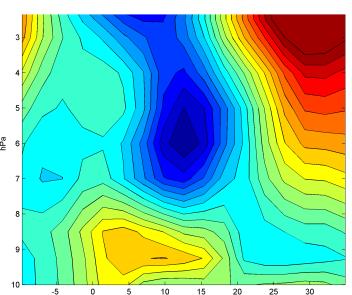
CNRM



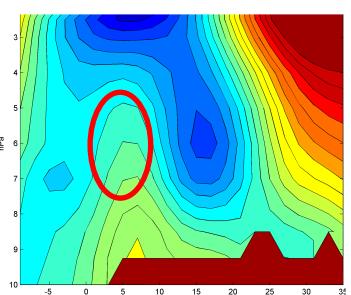
ECHAM5



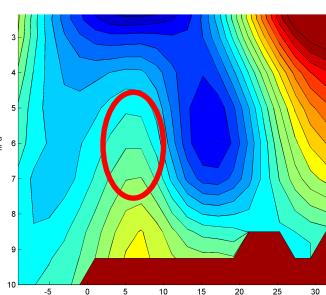
FGOALS



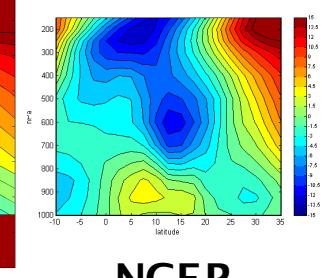
GFDL2.0



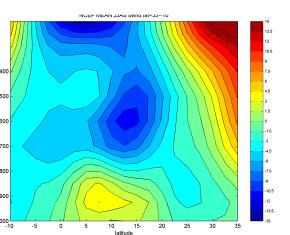
GFDL2.1



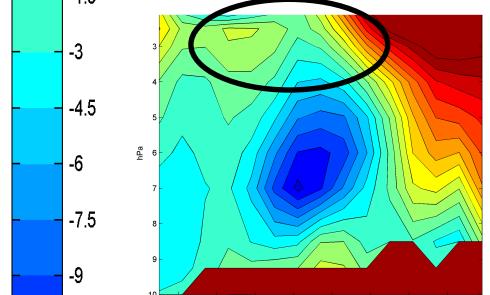
ERA 40



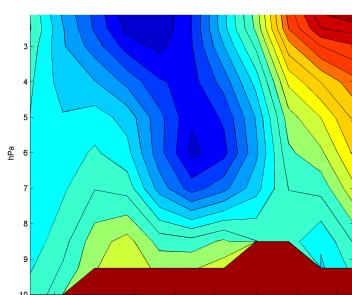
NCEP



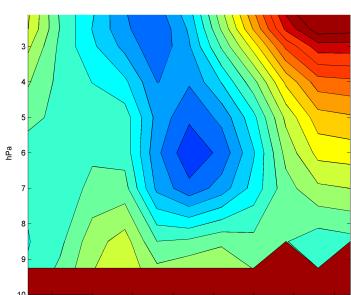
GISS-AOM



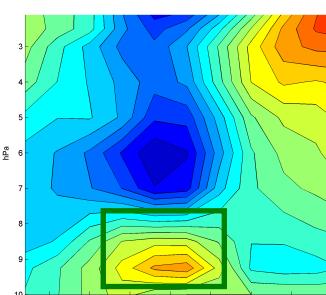
GISS-EH



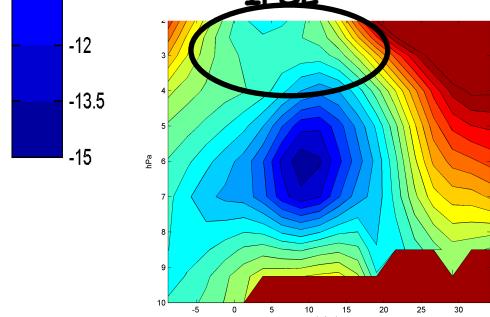
GISS-ER



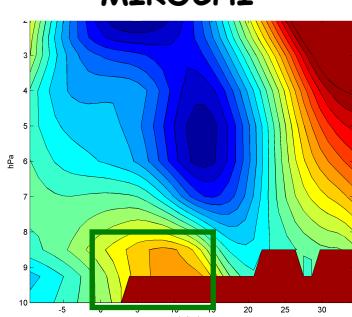
INM



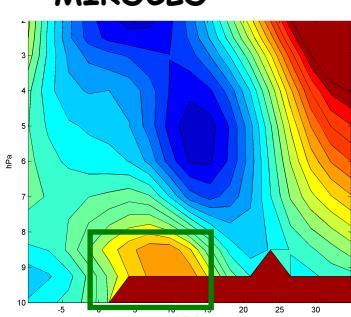
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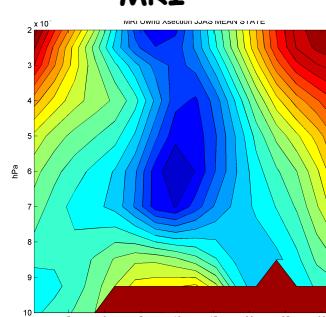
MIROCHI



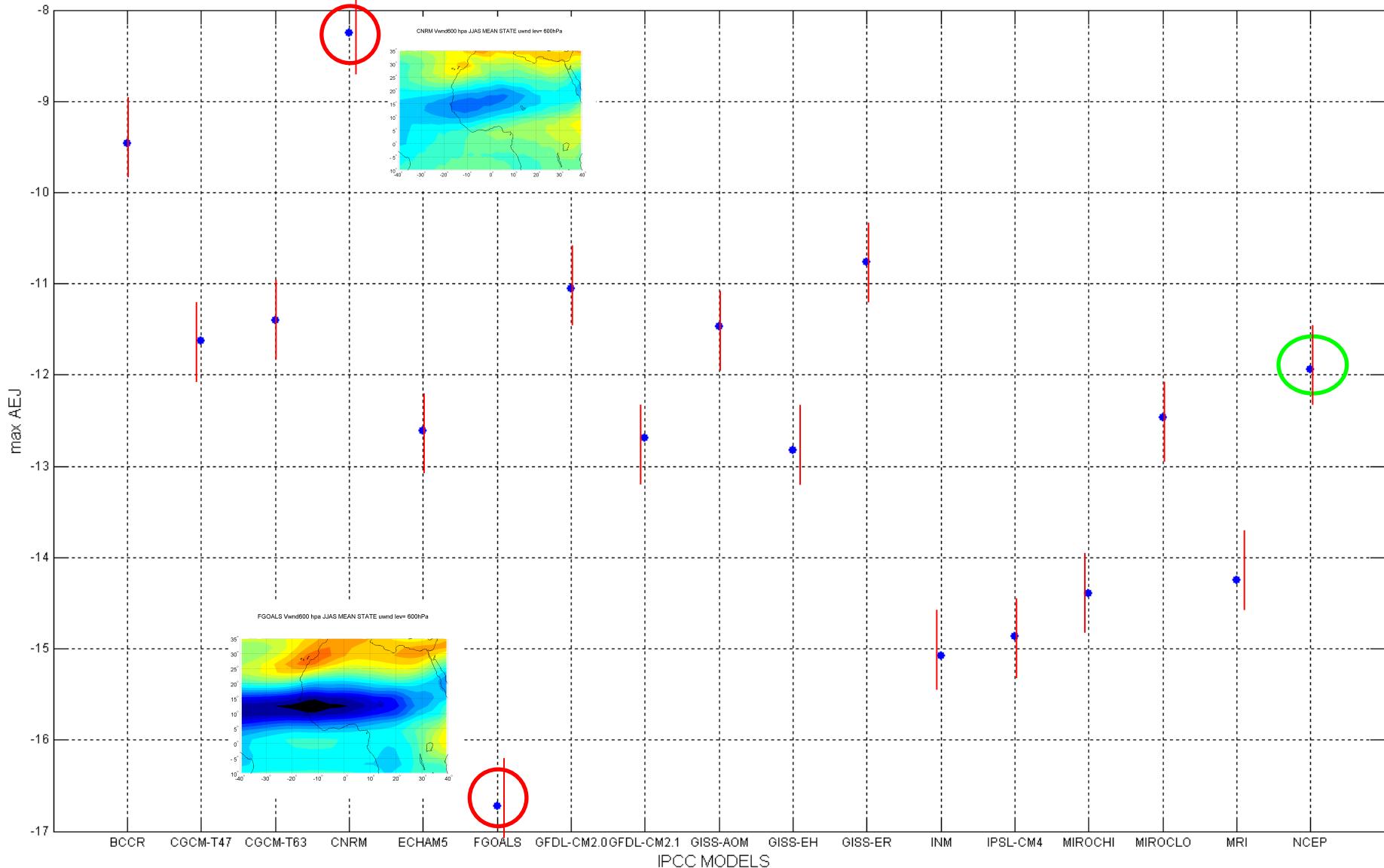
MIROCLO



MRI



JET STRENGTH (m/s)



Briefly, some results on: **MEAN STATE**

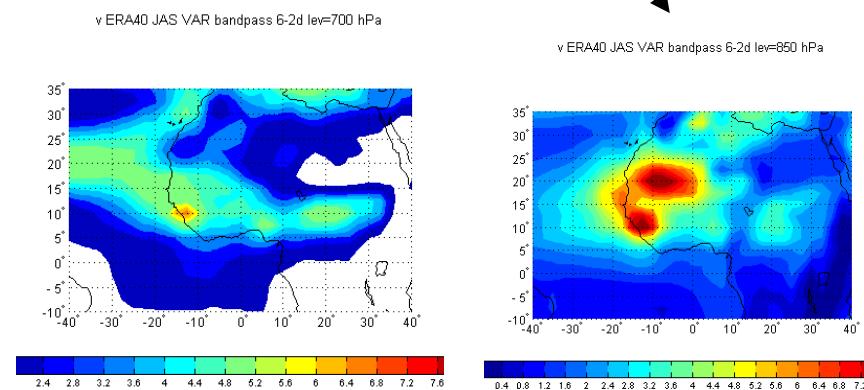
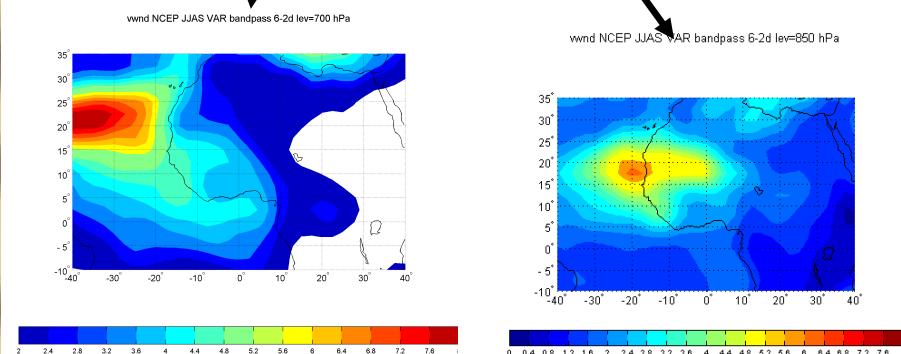
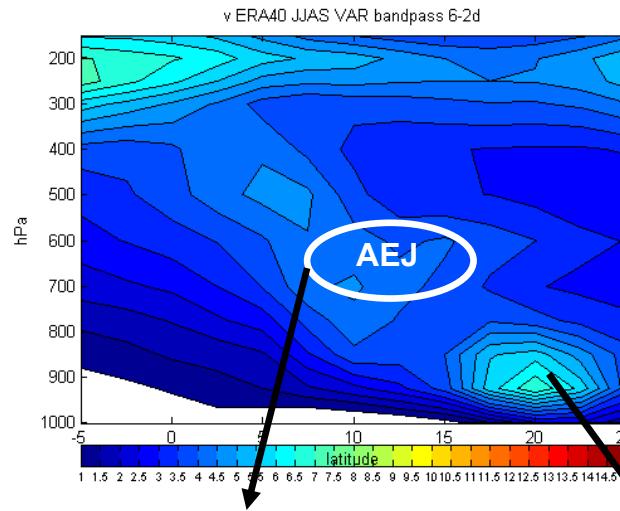
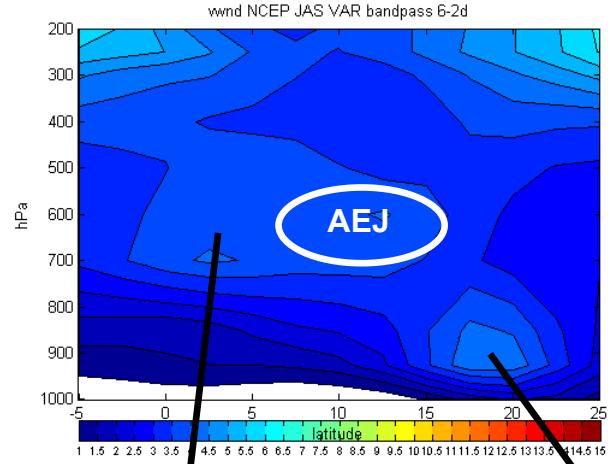
- All the models reproduce the mean tropospheric circulation; in some models no TEJ (vertical resolution !)
- Discrepancies: the southern flank of AEJ in Reanalyses ...
- Location of AEJ
- Strength of Monsoon

AEWs: the variance

NCEP

Daily Meridional wind speed

ERA40

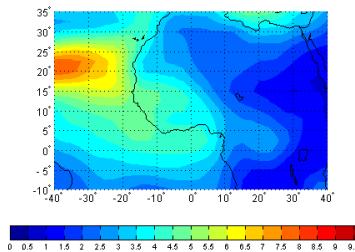


Cross-section 10W-10E

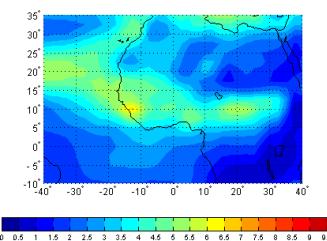
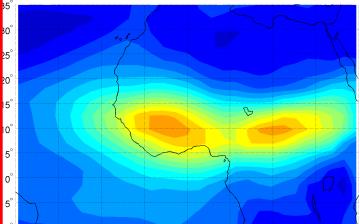
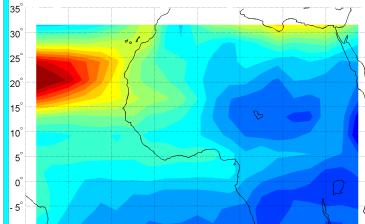
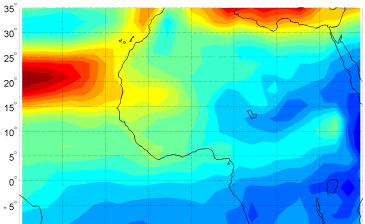
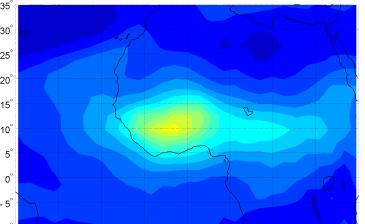
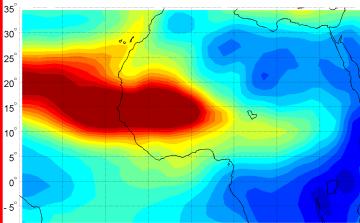
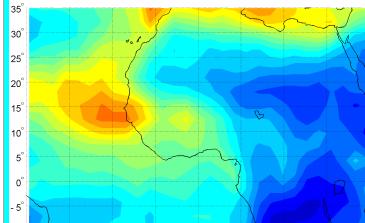
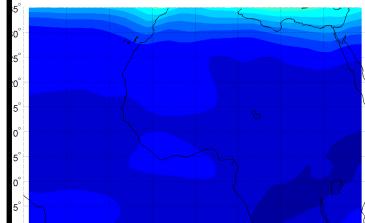
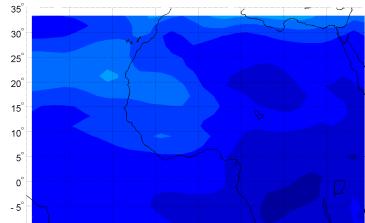
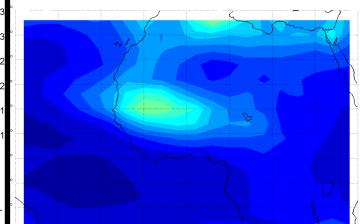
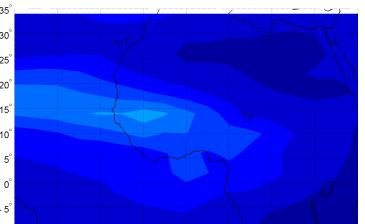
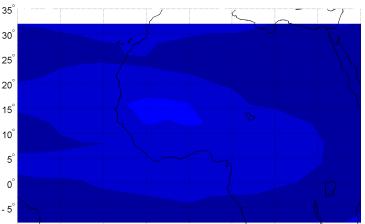
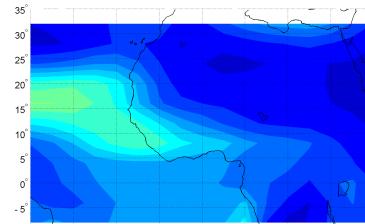
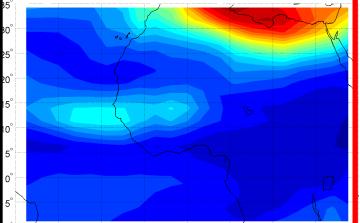
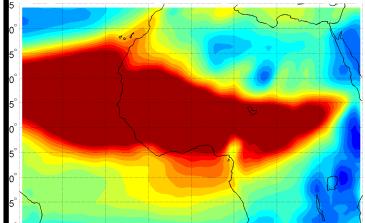
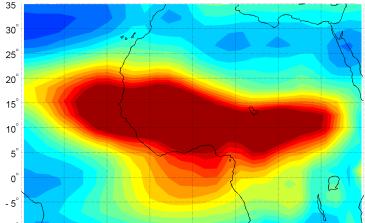
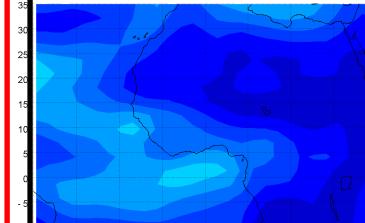
Band pass 2-6 days

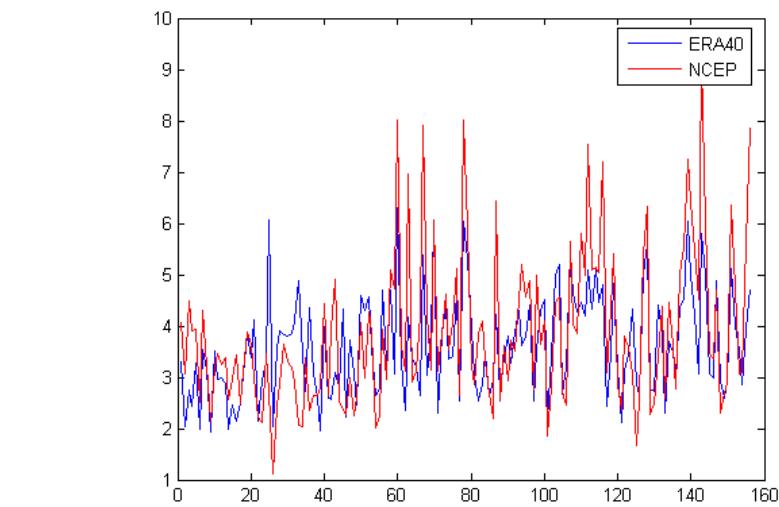
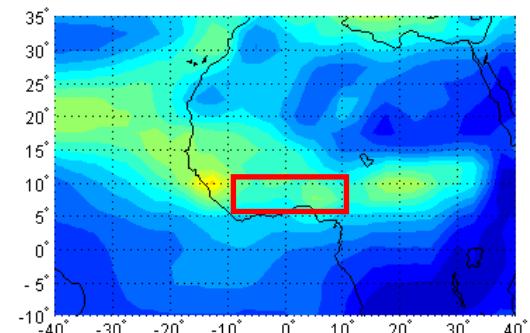
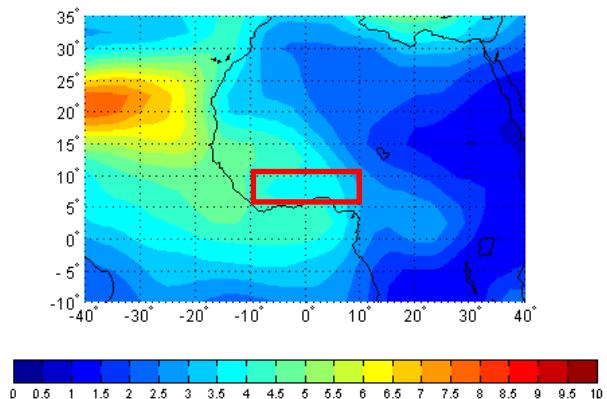
VARIABILITY (AEWs)

wnd NCEP JJAS VAR bandpass 6-2d lev=700 hPa


ERA40

v ERA40 JJAS VAR bandpass 6-2d lev=700 hPa

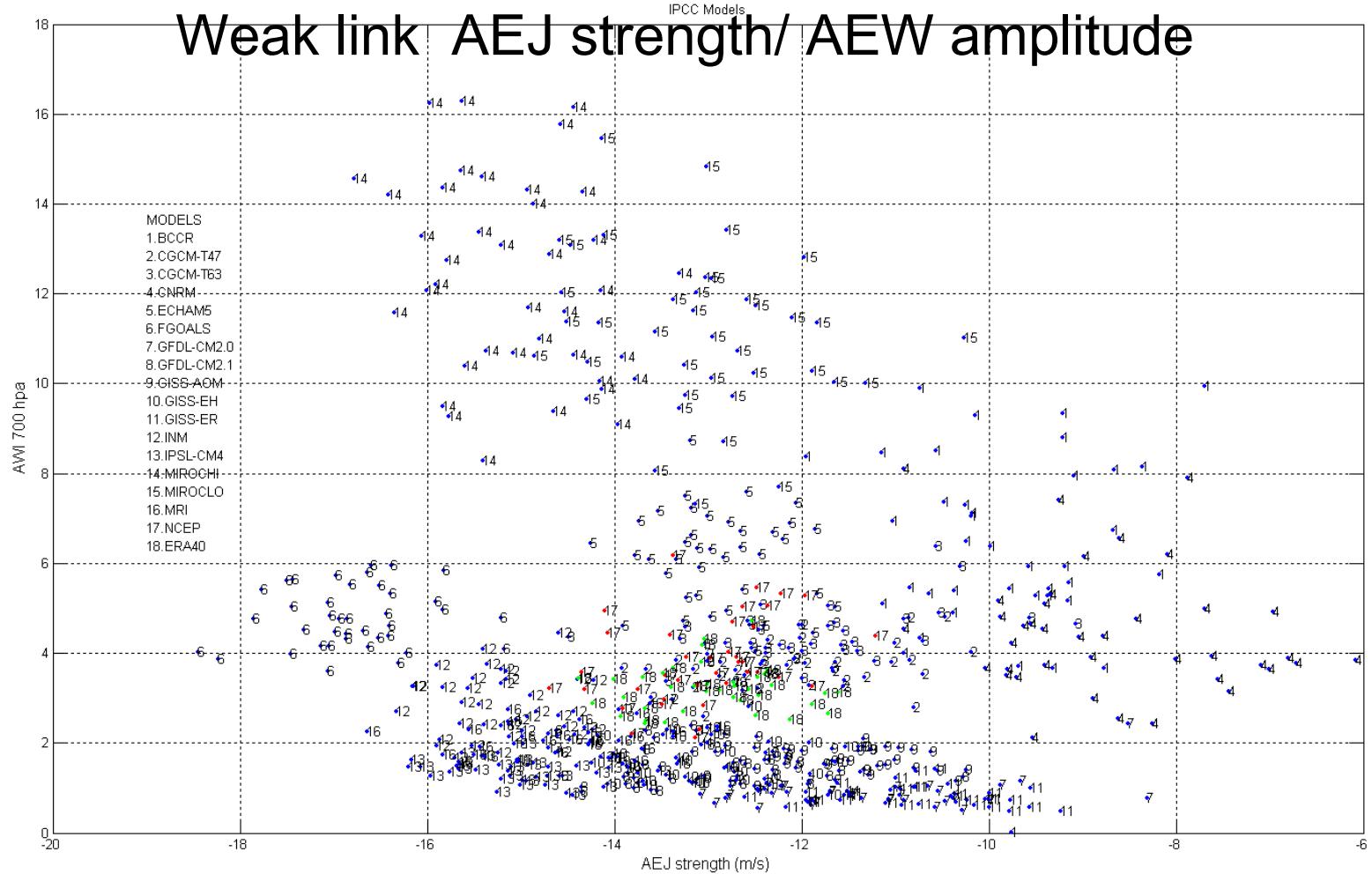

BCCR

CGCM-T47

CGCM-T63

CNRM

ECHAM5

FGOALS

GFDL2.0

GFDL2.1

GISS-AOM

GISS-EH

GISS-ER

INM

IPSL

MIROCHI

MIROCLO

MRI

BAND PASS 2-6 DAYS



Index of wave activity (AWI);

Weak link AEJ strength/ AEW amplitude

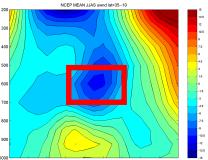
STRONG AEW



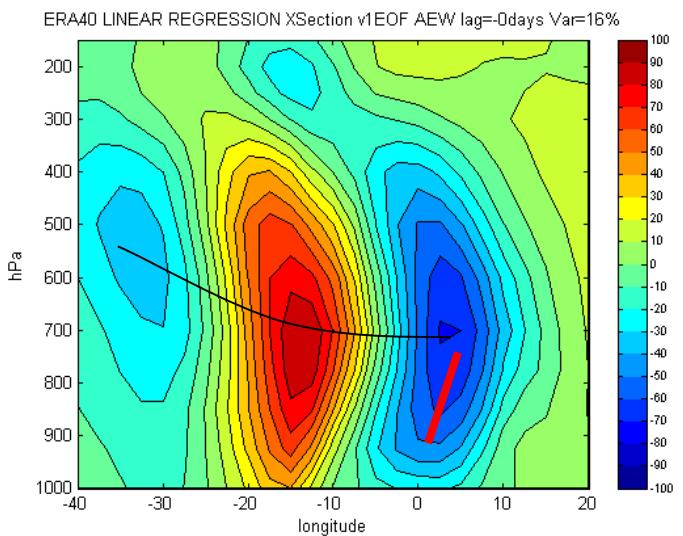
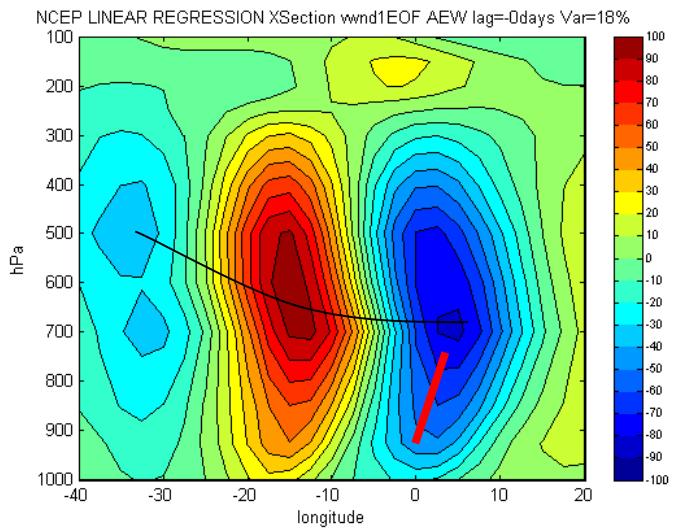
weak AEW

STRONG AEJ

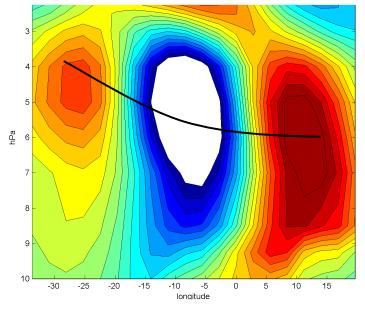
weak AEJ



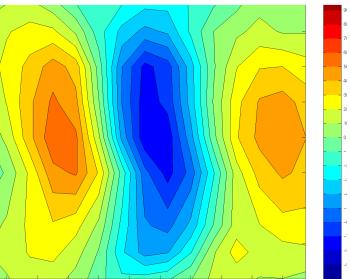
First EOF Cross-section Lon-height for v averaged between 5-10N



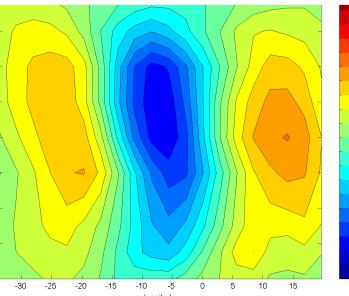
BCCR



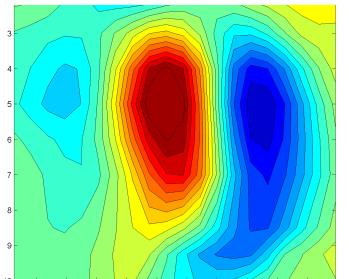
CGCM-T47



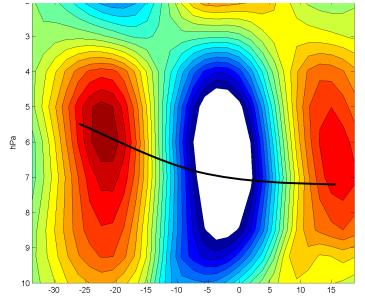
CGCM-T63



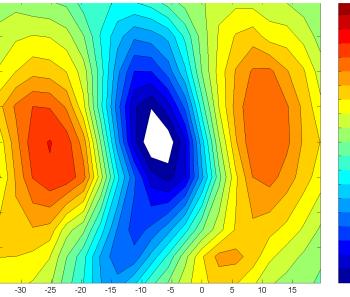
CNRM



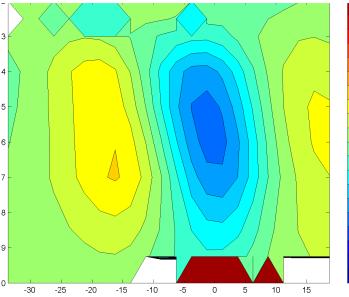
ECHAM5



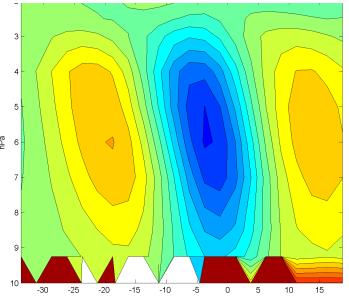
FGOALS



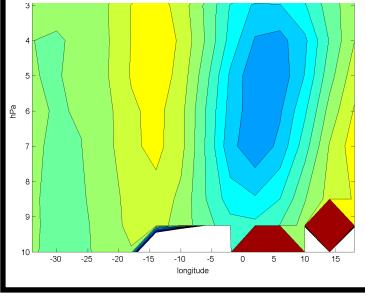
GFDL2.0



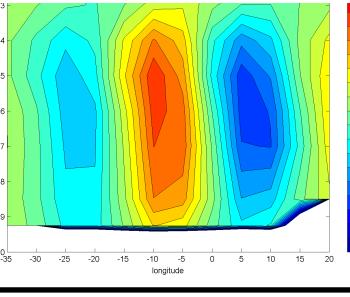
GFDL2.1



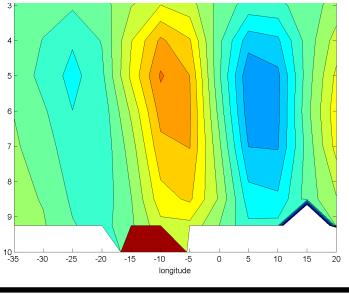
GISS-AOM



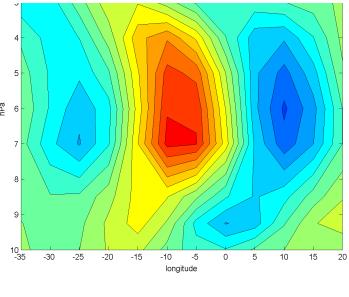
GISS-EH



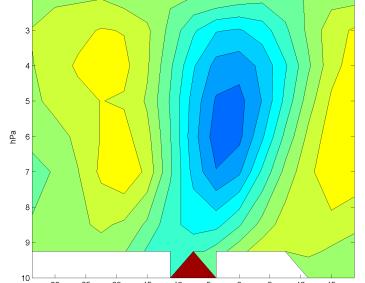
GISS-ER



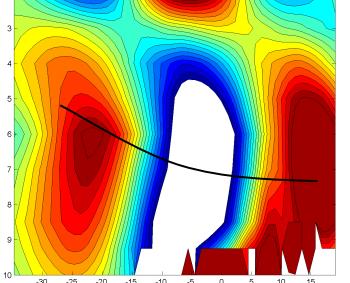
INM



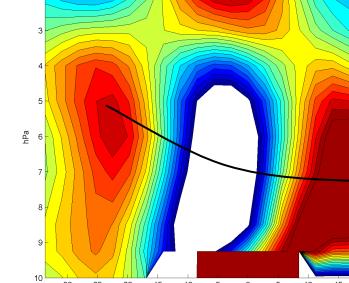
IPSL



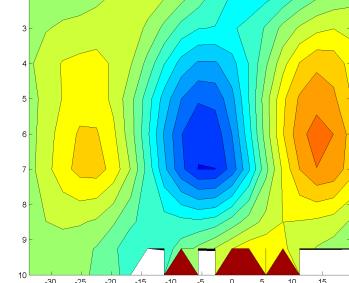
MIROCHI



MIROCLO



MRI

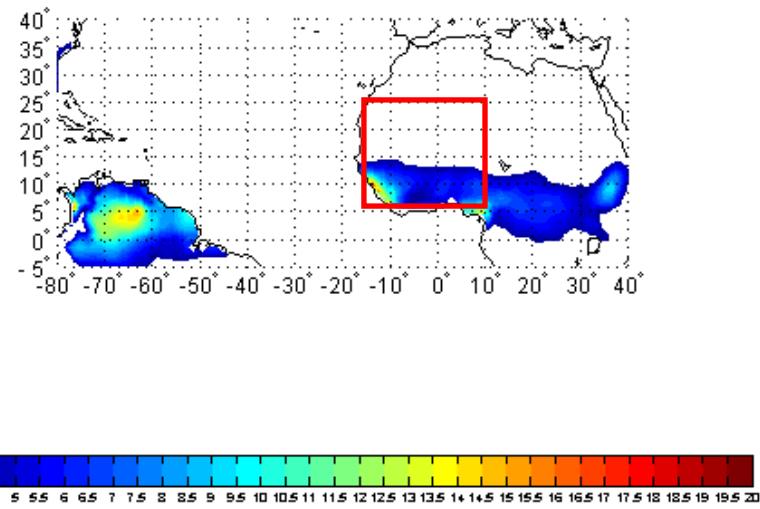


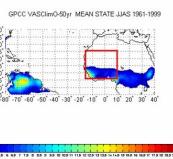
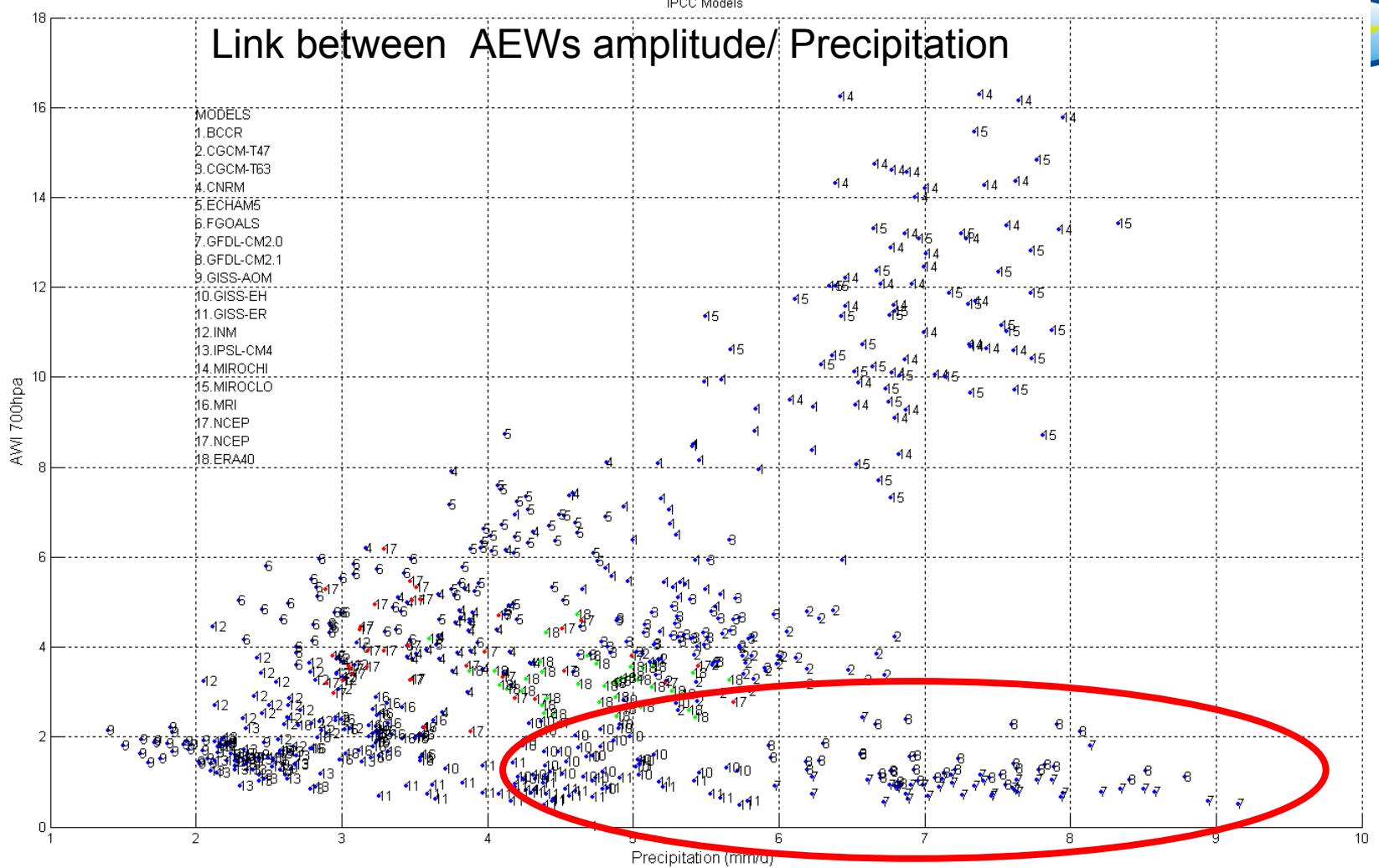
Briefly, some results on: representation of AEWs

- In Reanalyses discrepancies in the spatial pattern of southern AEWs
- Large range of behavior in the models: amplitude of variance, in spite of good agreement in mean state
- Spatial location of the bulk, propagation of the disturbances
- Vertical structure (processes involved) and time window

PRECIPITATION & AEWs

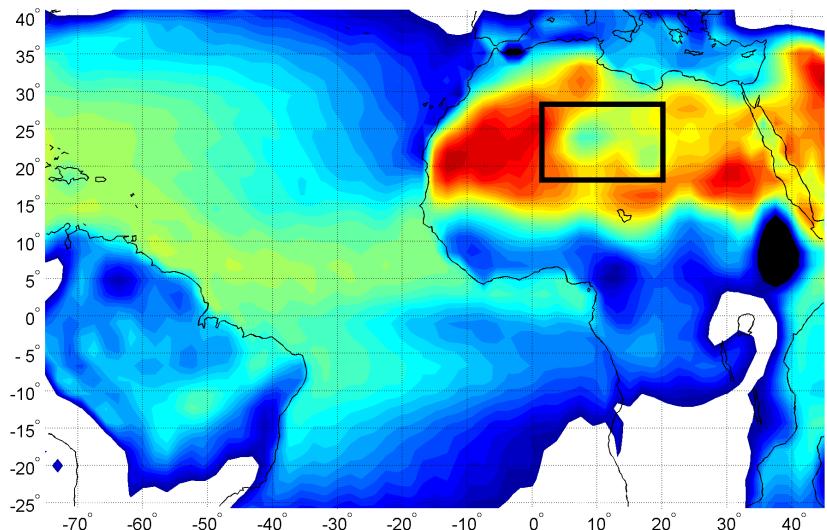
GPCC VAS Clim0-50yr MEAN STATE JJAS 1961-1999





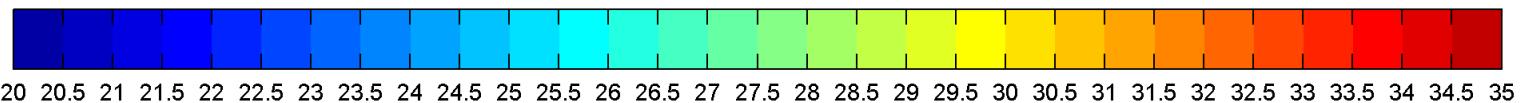
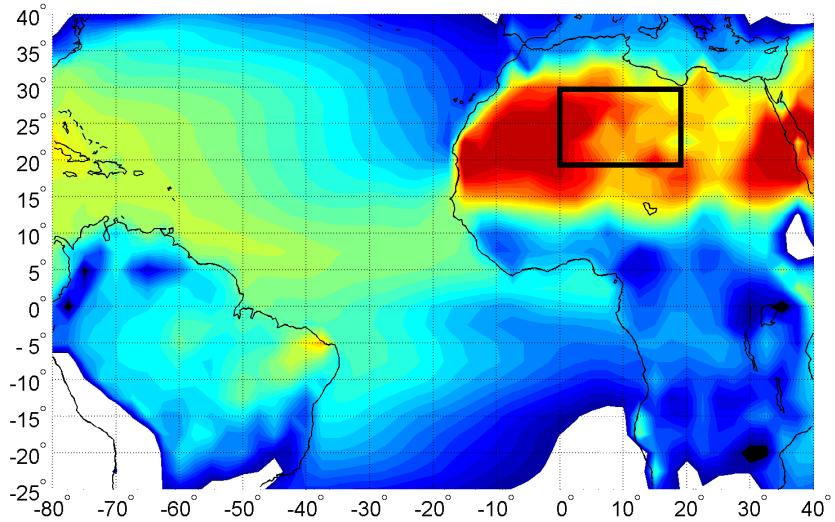
SURFACE FORCING

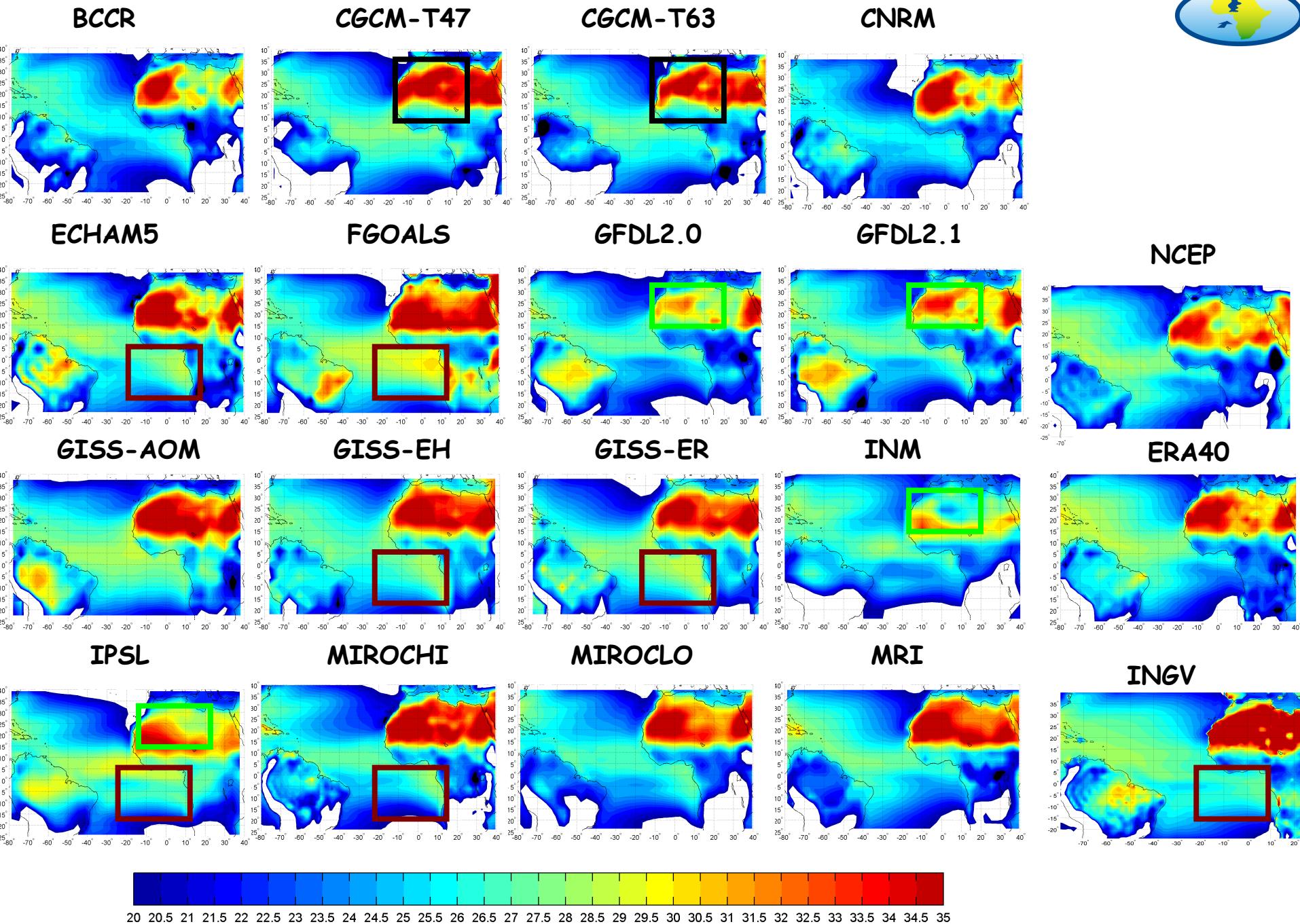
NCEP



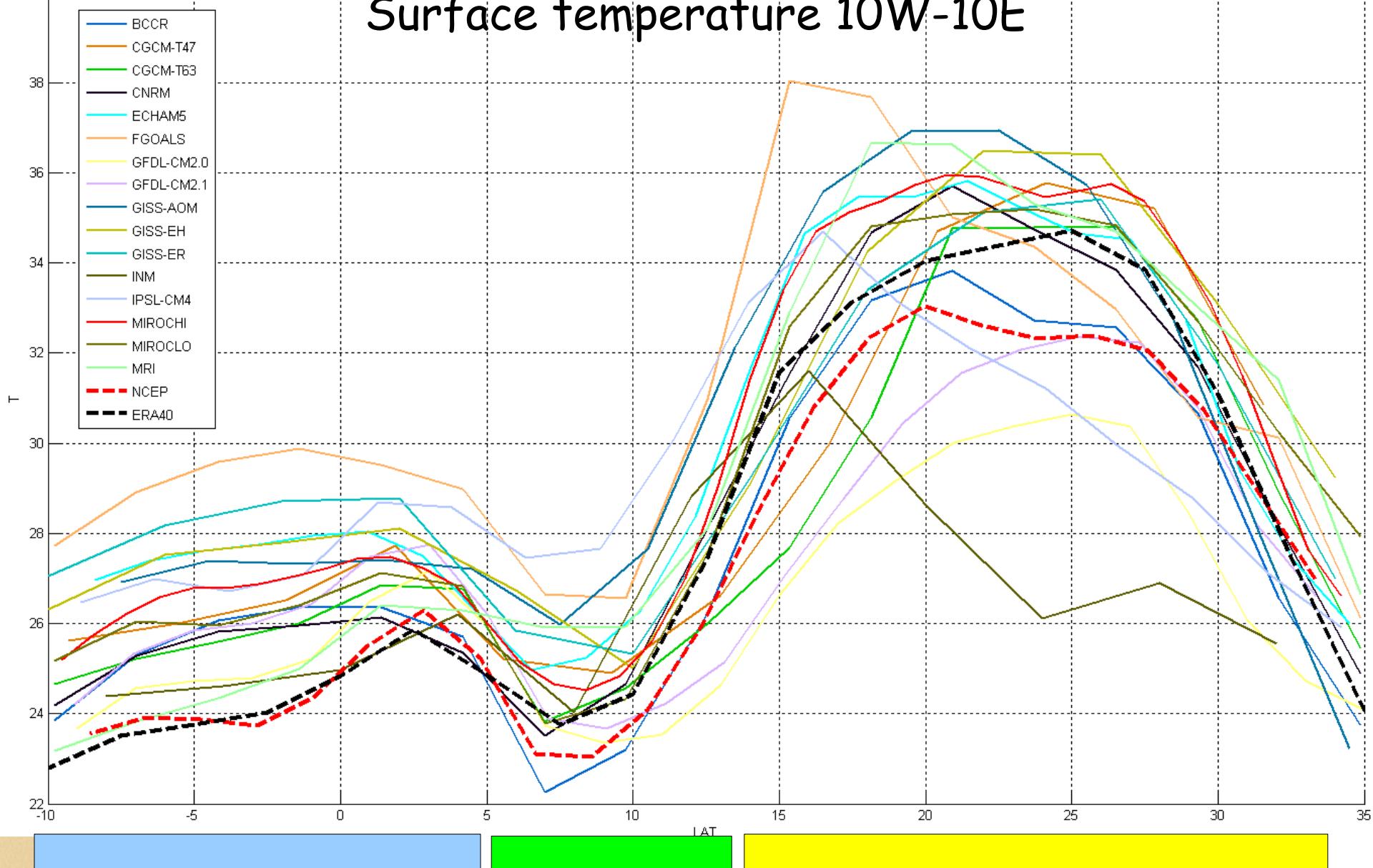
Summer Skin temperature

ERA40



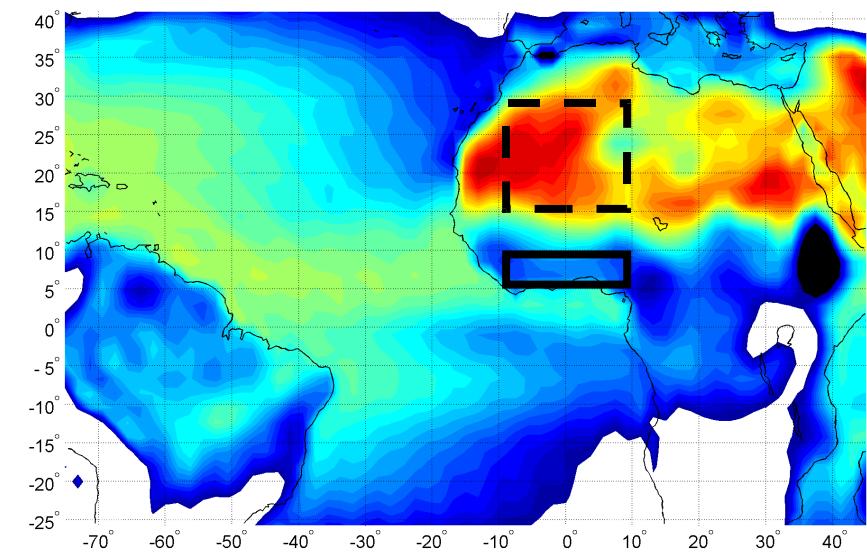


Surface temperature 10W-10E

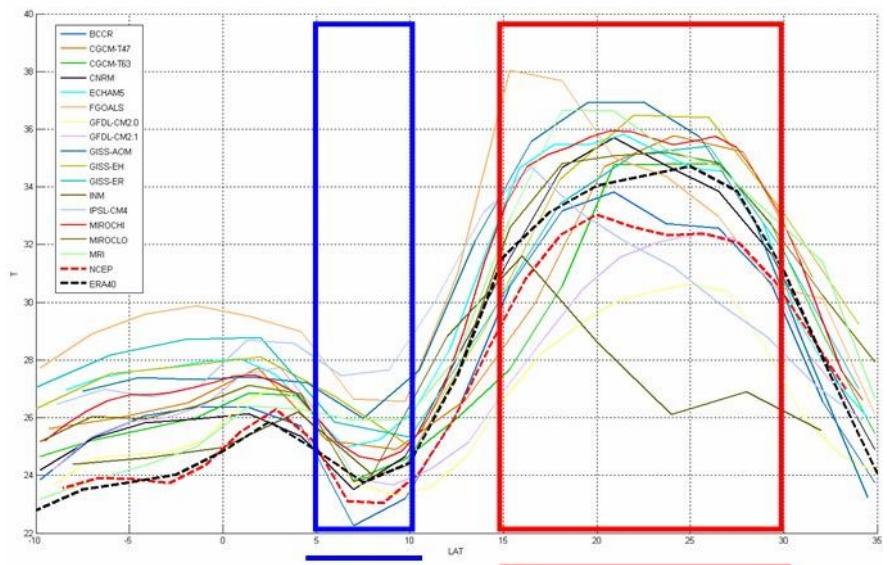


SURFACE FORCING INDEX

MEAN STATE NCEP skt JJAS



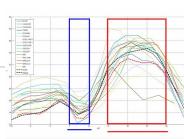
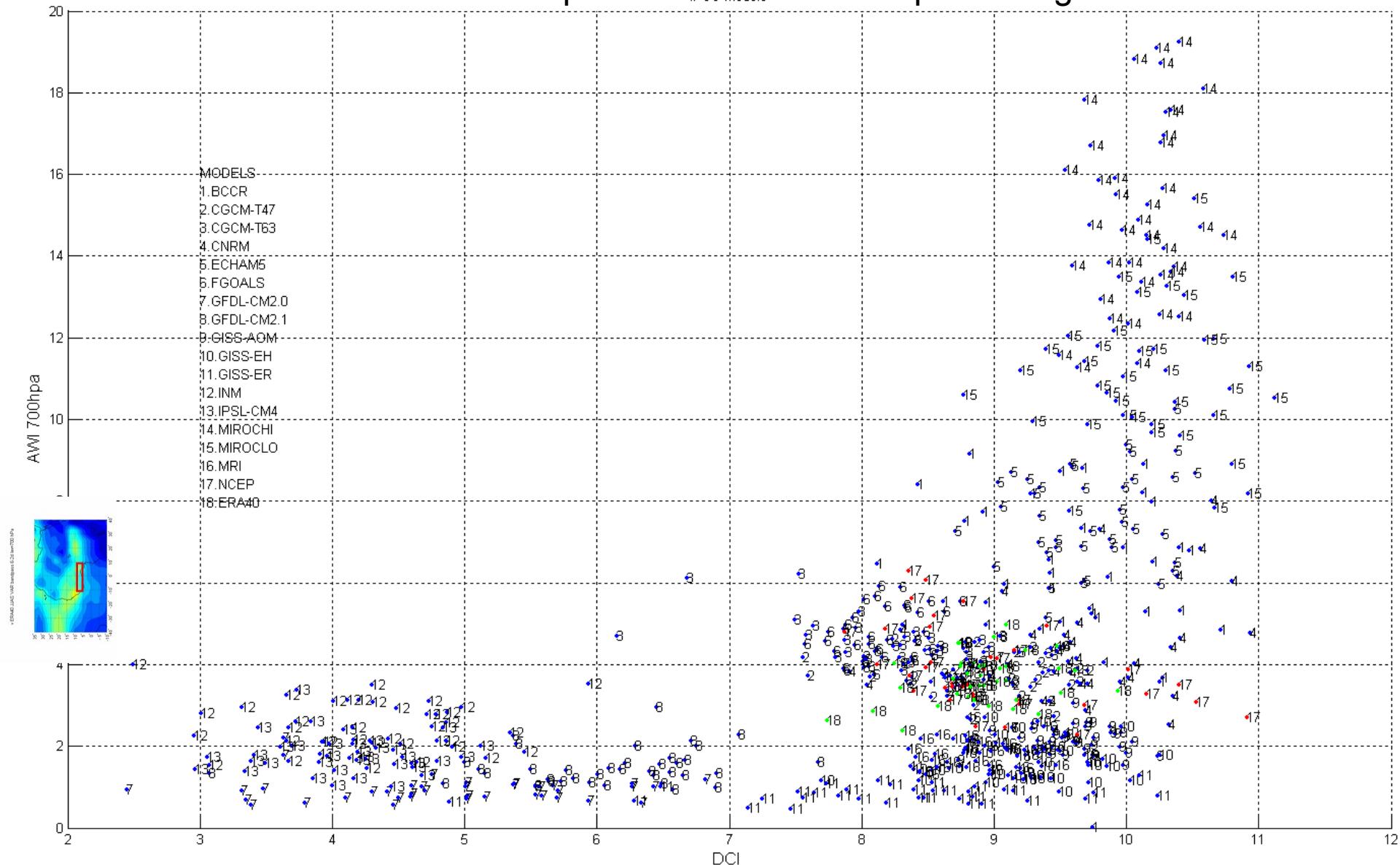
$$DCI = ST|_{15N}^{30N} - ST|_{5N}^{10N}$$



Coast

Desert

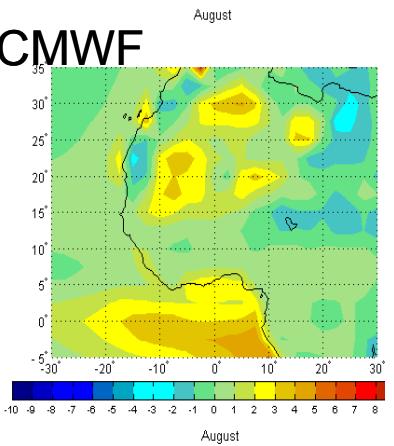
Link between AEW amplitude/ Meridional temperature gradient



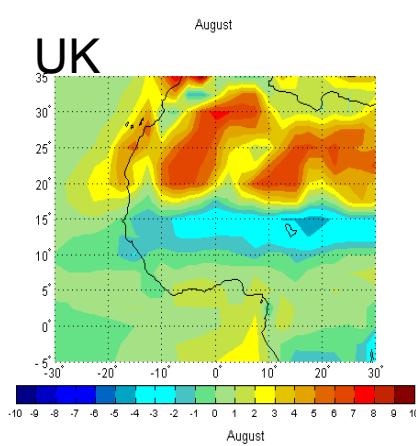
Temp & Prec Aug bias forecast started in May

Surf Temp

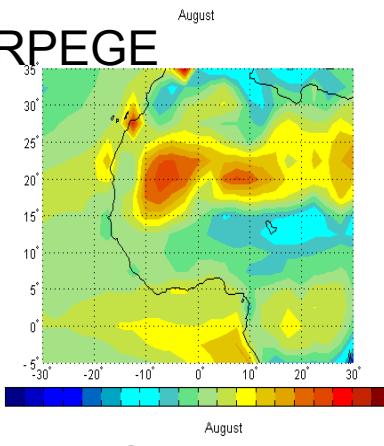
ECMWF



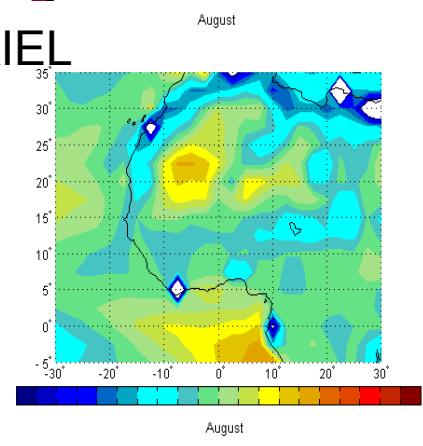
UK



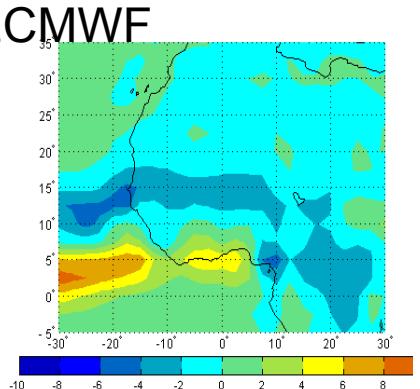
ARPEGE



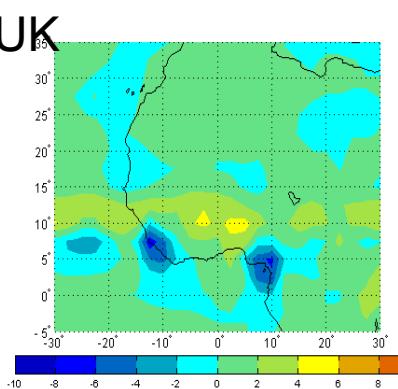
KIEL



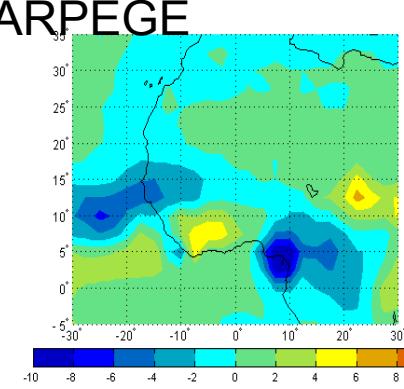
ECMWF



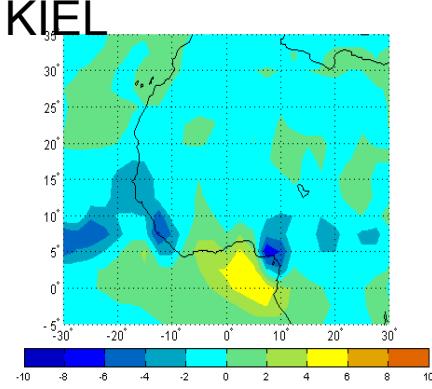
UK



ARPEGE



KIEL



Rainfall

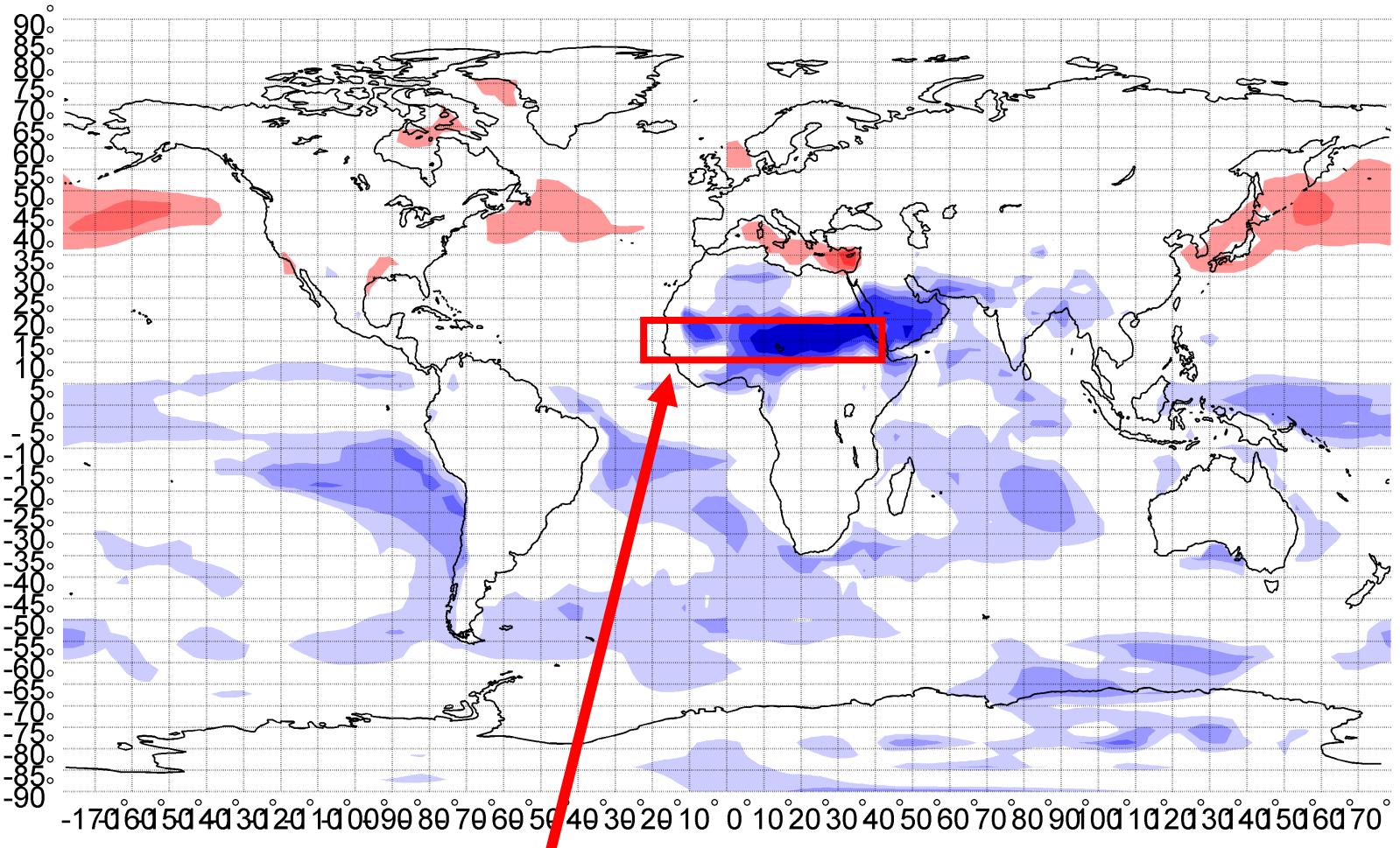
BRIEF final SUMMARY

(key words and some open questions)

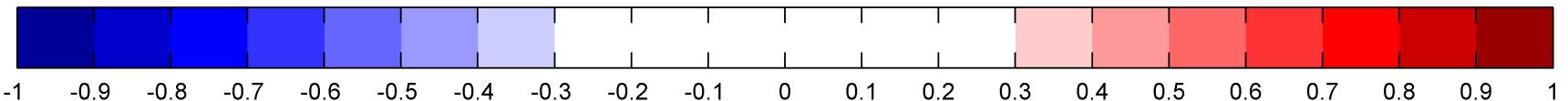
- Weak link mean state/ AEWs (role of dynamics)
- TEJ representation depends on vertical res.
- Processes (Baroclinicity in lower levels), coupling with PBL
- Link to Surface forcing (Available Potential Energy and thermal forcing)
- Description of desert environment of Heat Low (Land surface)

- The intra-seasonal variability in IPCC-AR4
- The land-ocean forcing on WAM

□ The land-ocean forcing on
WAM



Sahel box, 20W-40°, 10N-20N → rainfall index, JAS, 1961-1999, SEASONAL AVERAGE
Temperature index in the same box



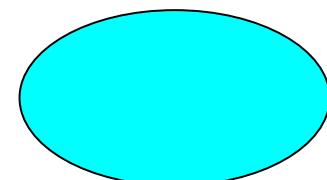
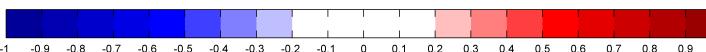
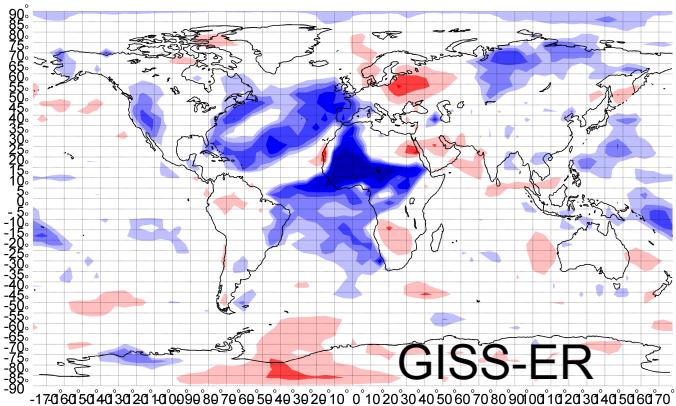
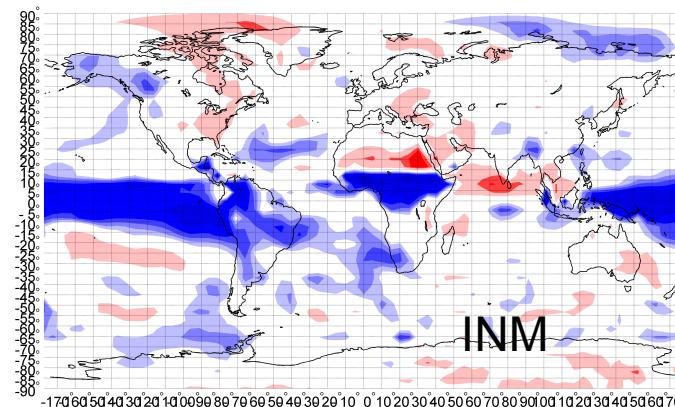
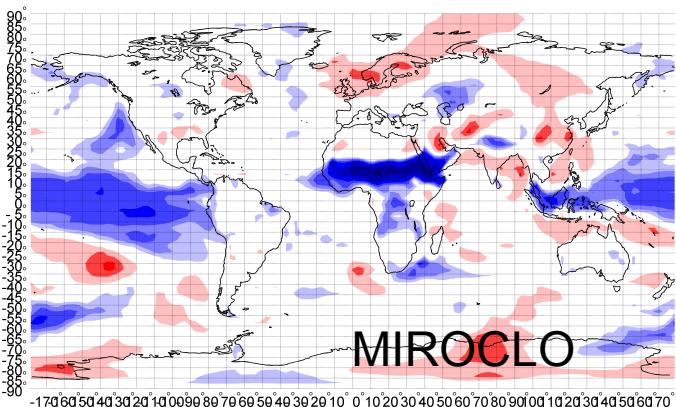
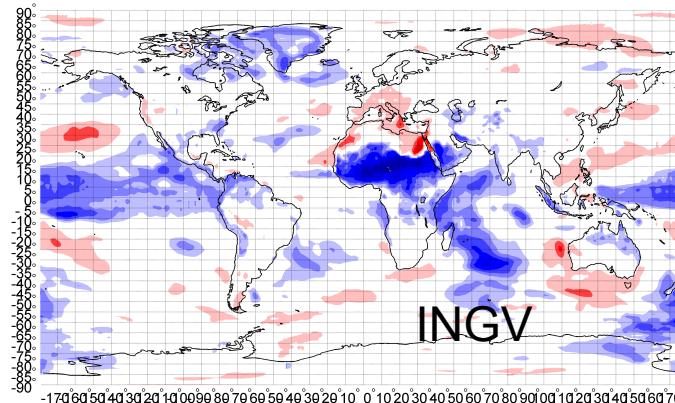
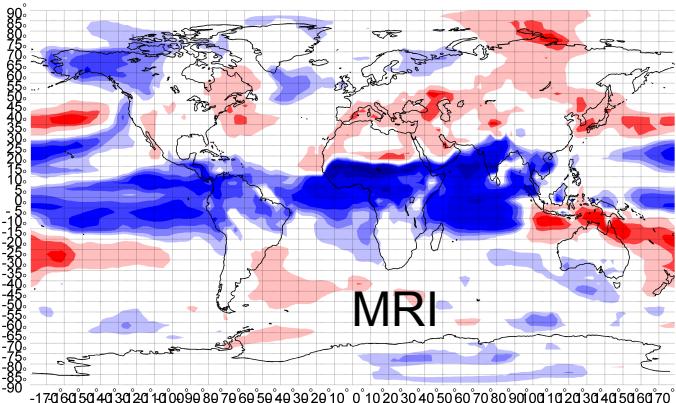
Data & Methods

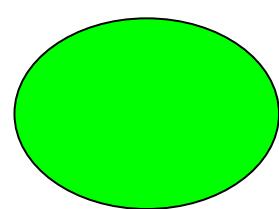
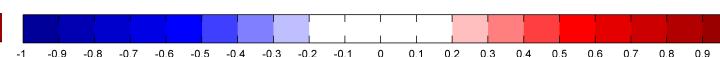
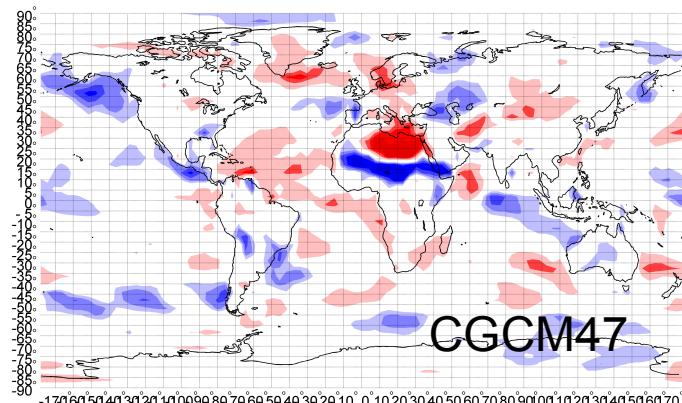
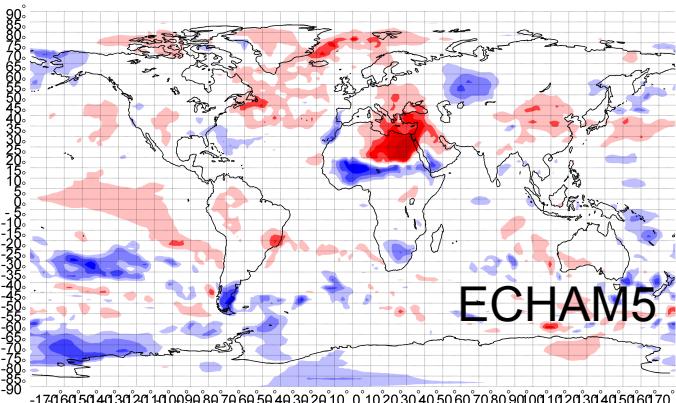
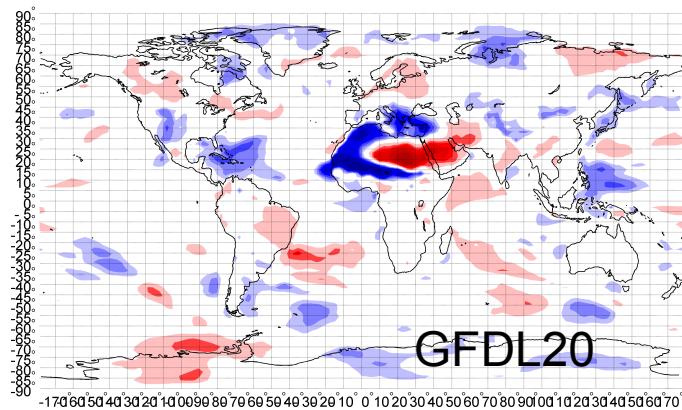
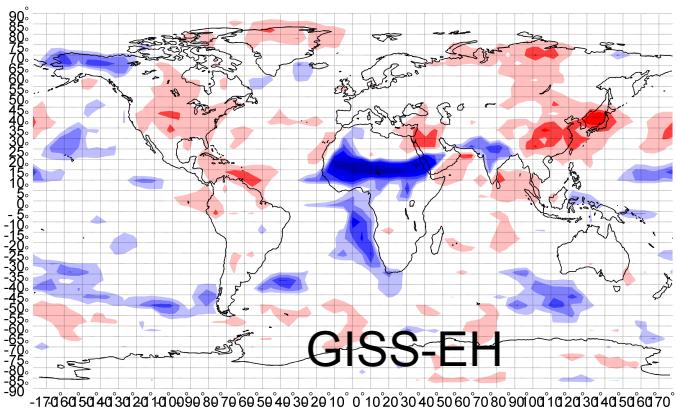
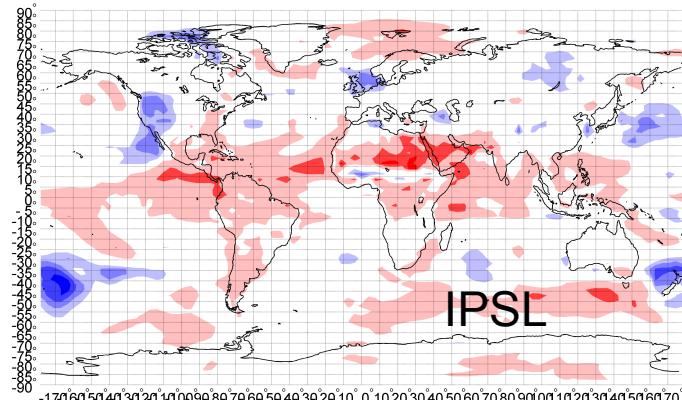
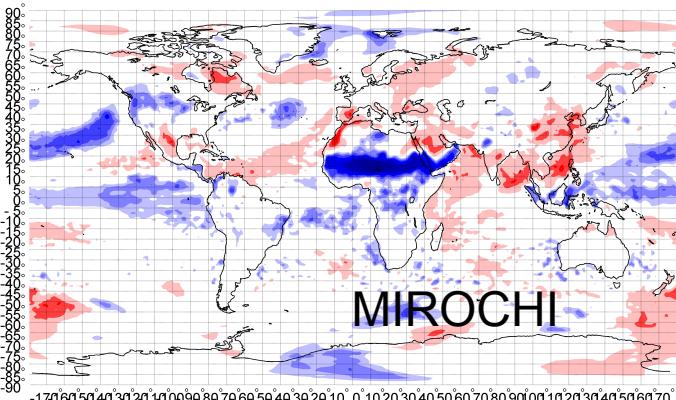
- PCMDI IPCC-AR4 data
- Ts and pr, monthly data
- JAS period
- Linear detrending
- Season average (39 points)

Cluster analysis by visual inspection !!!!

Non-Local-Ocean

Local-Land

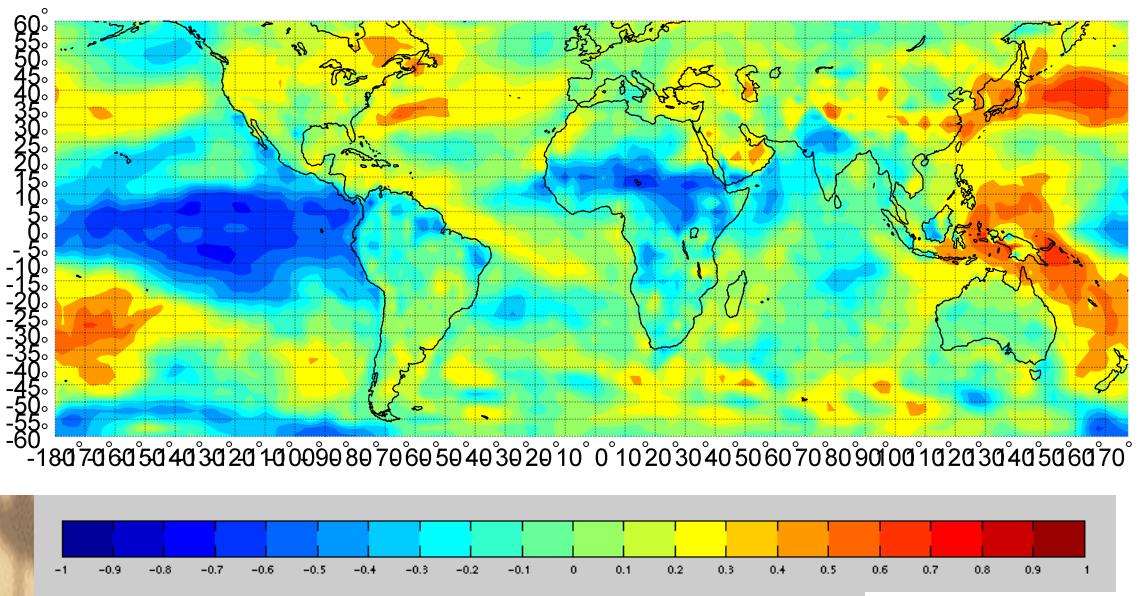




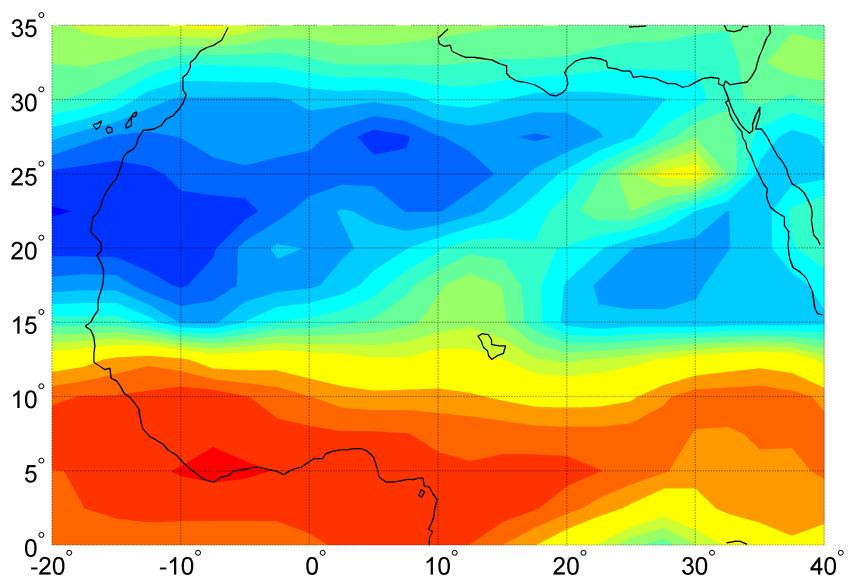


JAS SVD
NCEP data
Uwind, skT

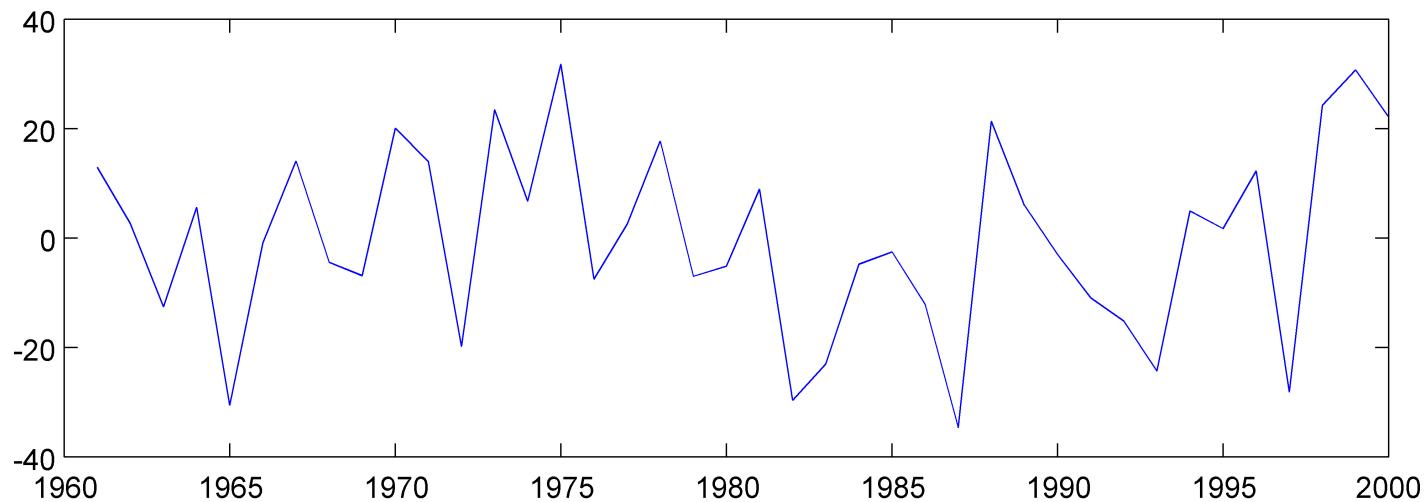
SKT



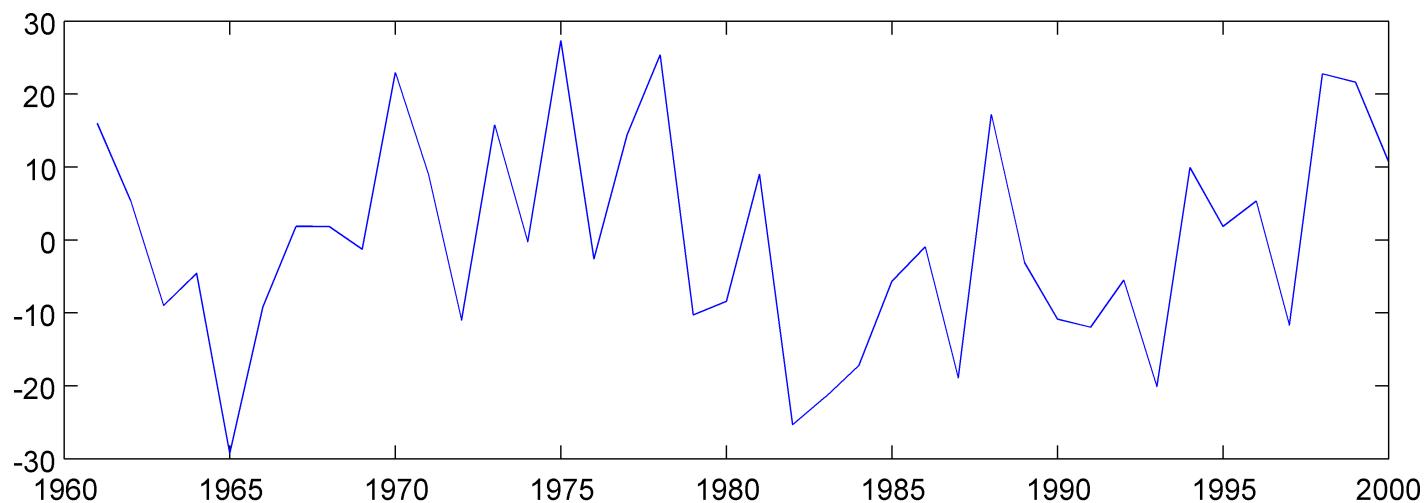
U600 hPa



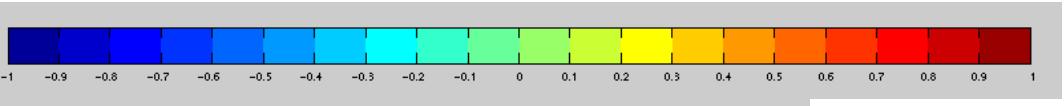
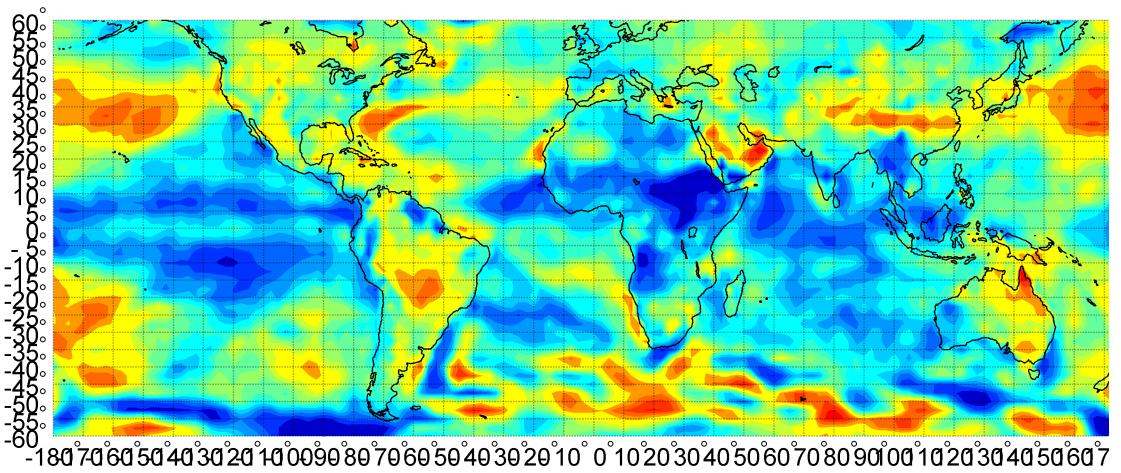
skt1 SCF=44.2%



u1 SCF=44.2%

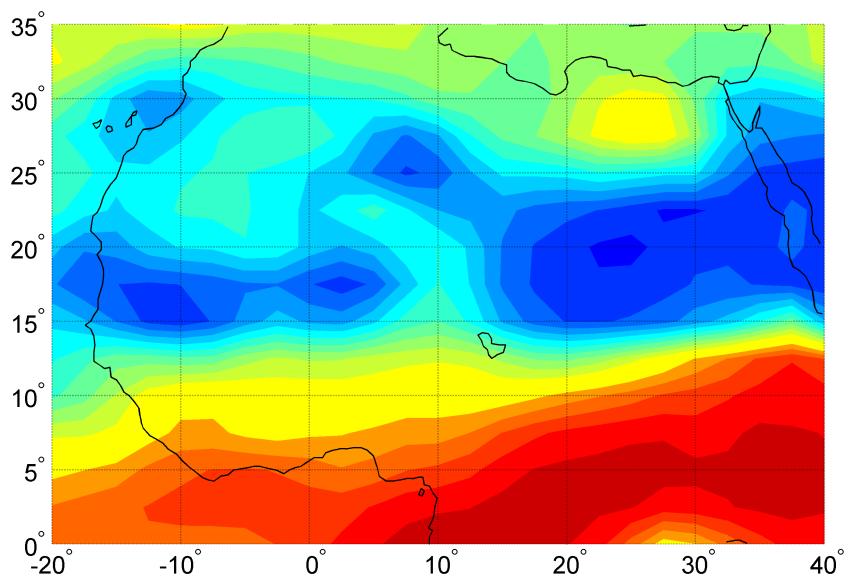


SKT

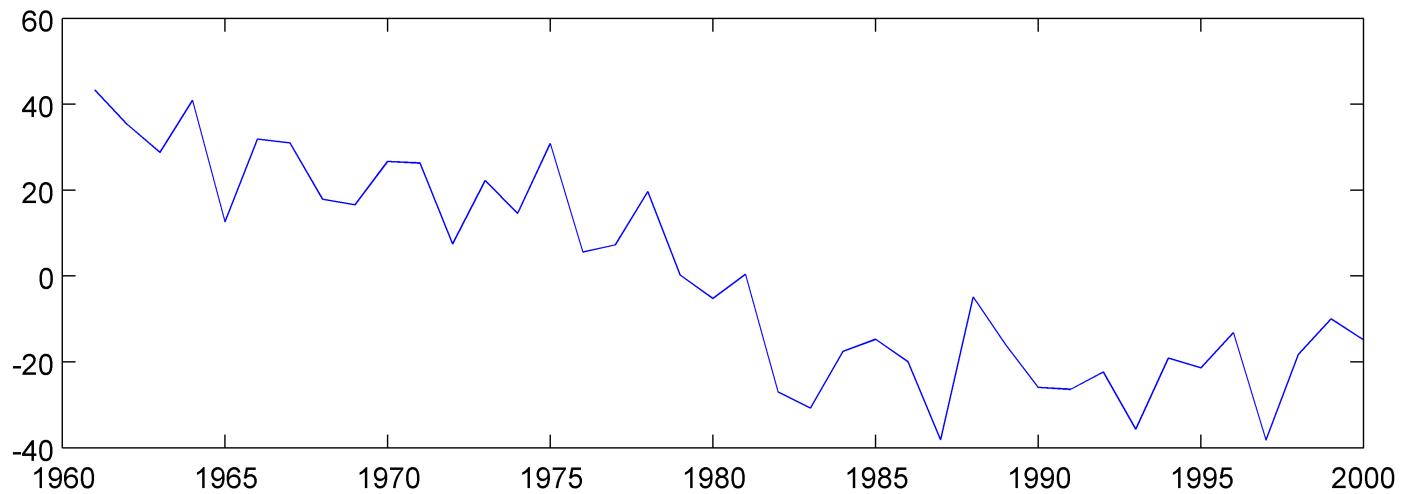


SCF 69.3 %

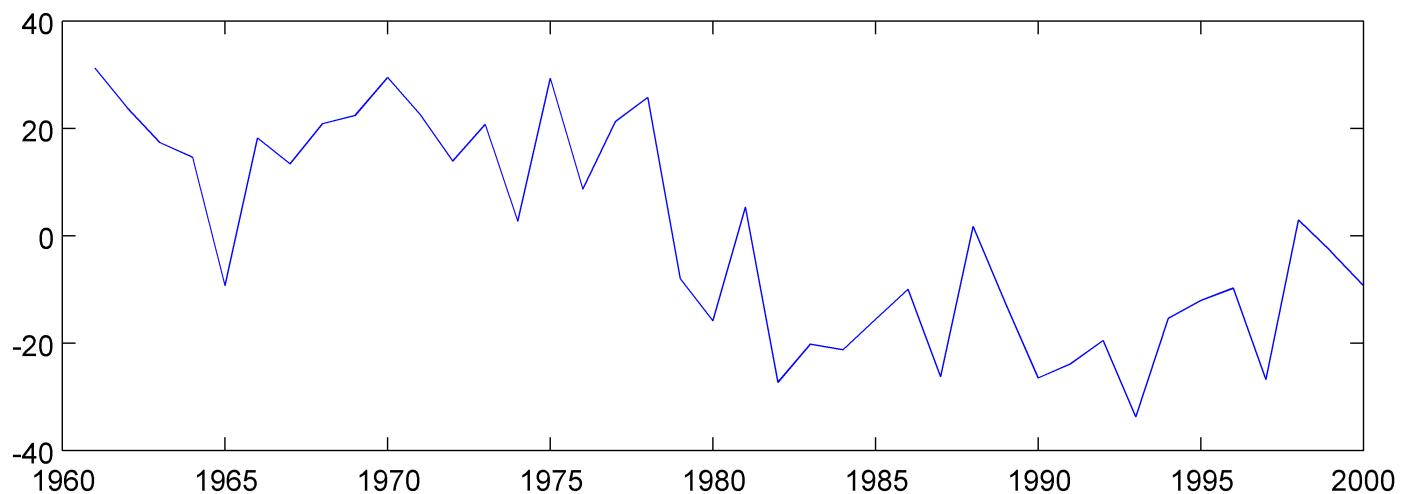
U600 hPa



skt1 SCF=69.3%



u1 SCF=69.3%



U-skt SVD

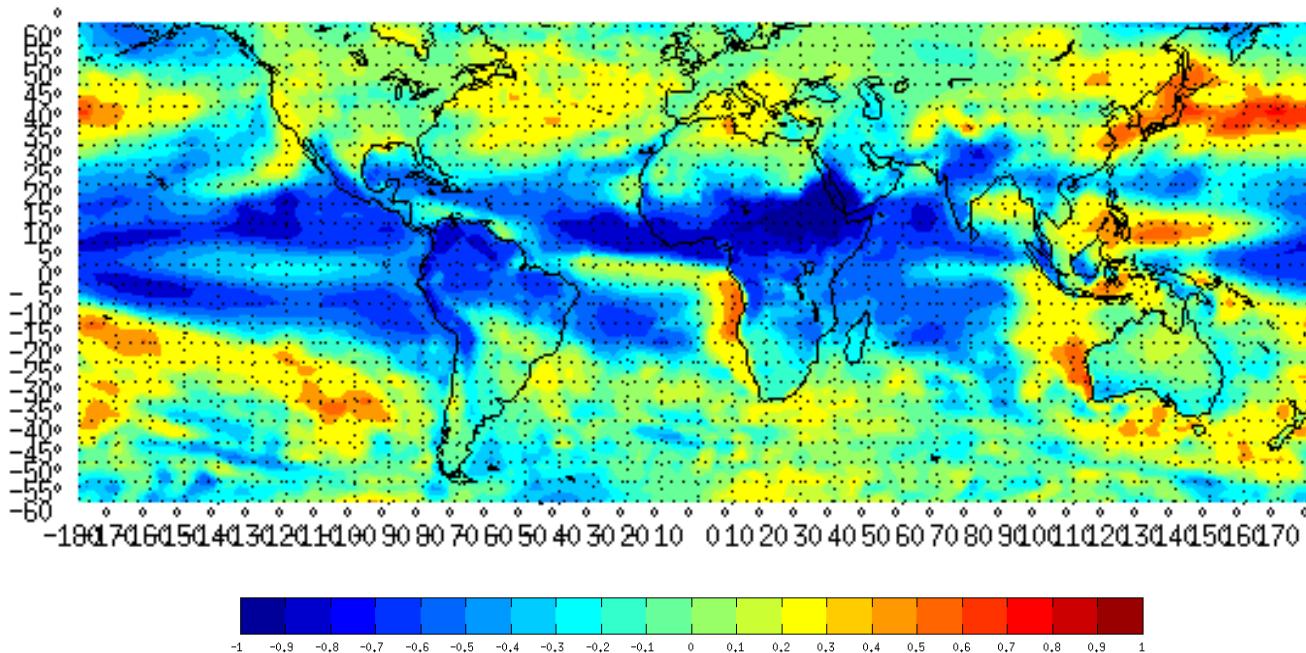
- JAS mean data of IPCC AR4 model
- Detrending applied to all the data

ECHAM5

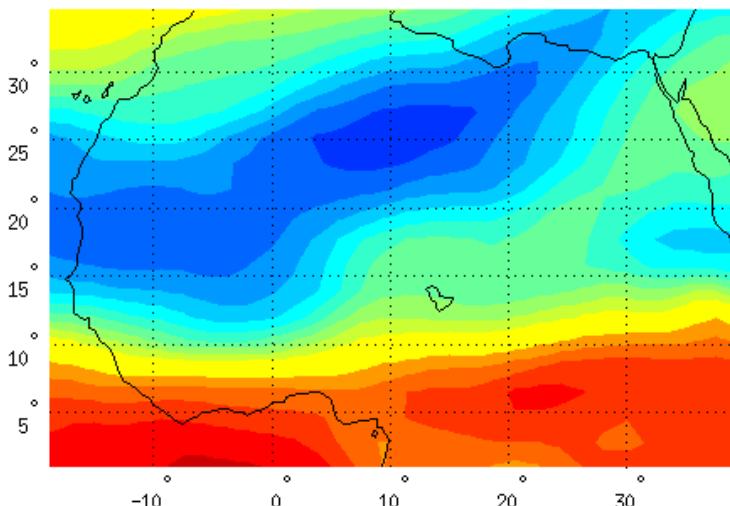


skt vector 1 SCF=61.3%

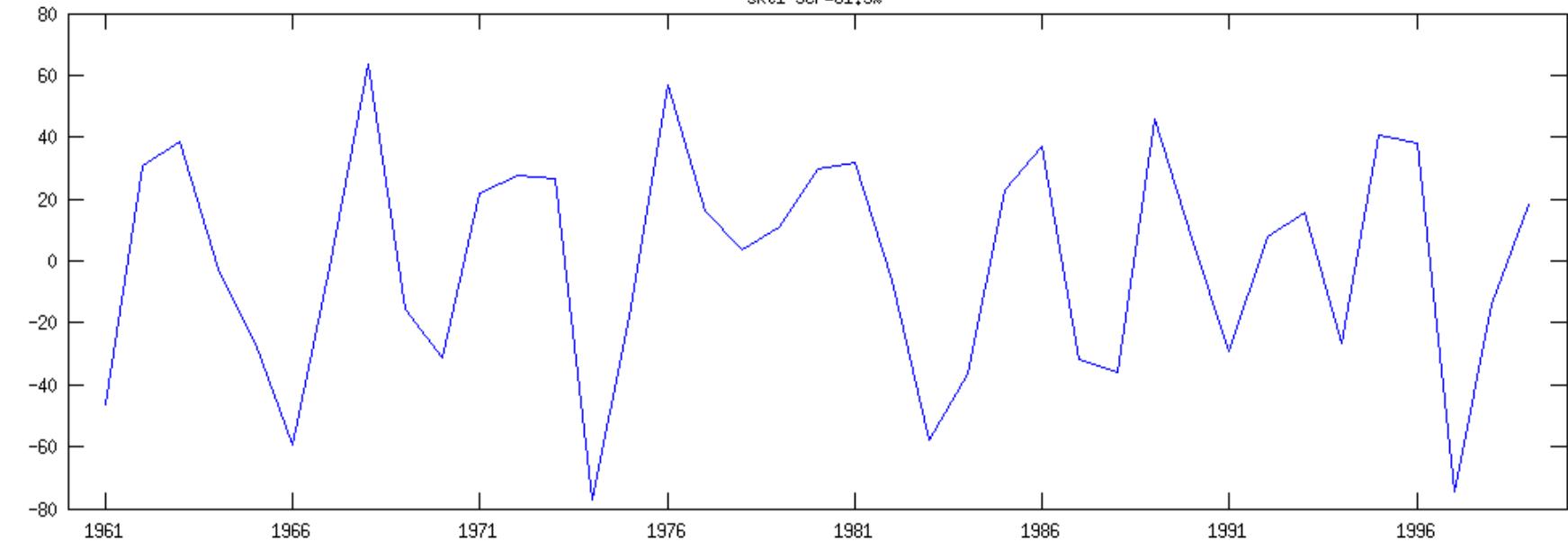
SKT



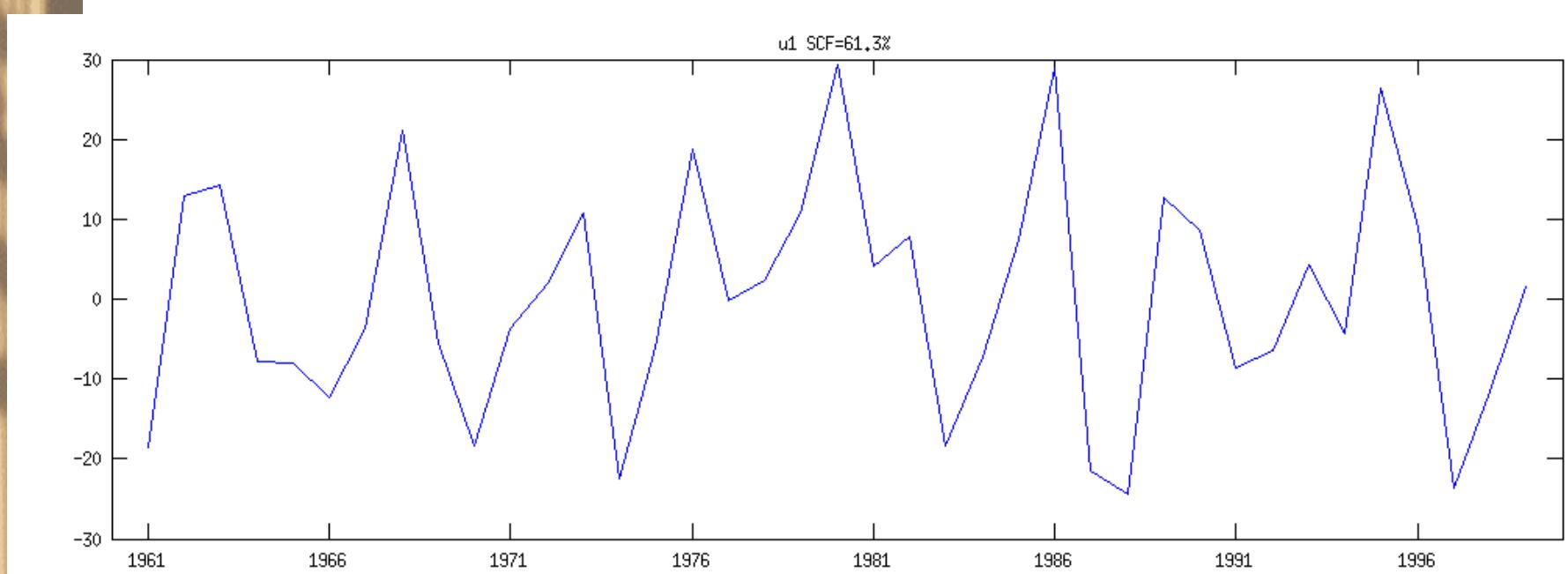
U 600 hPa



skt1 SCF=61.3%



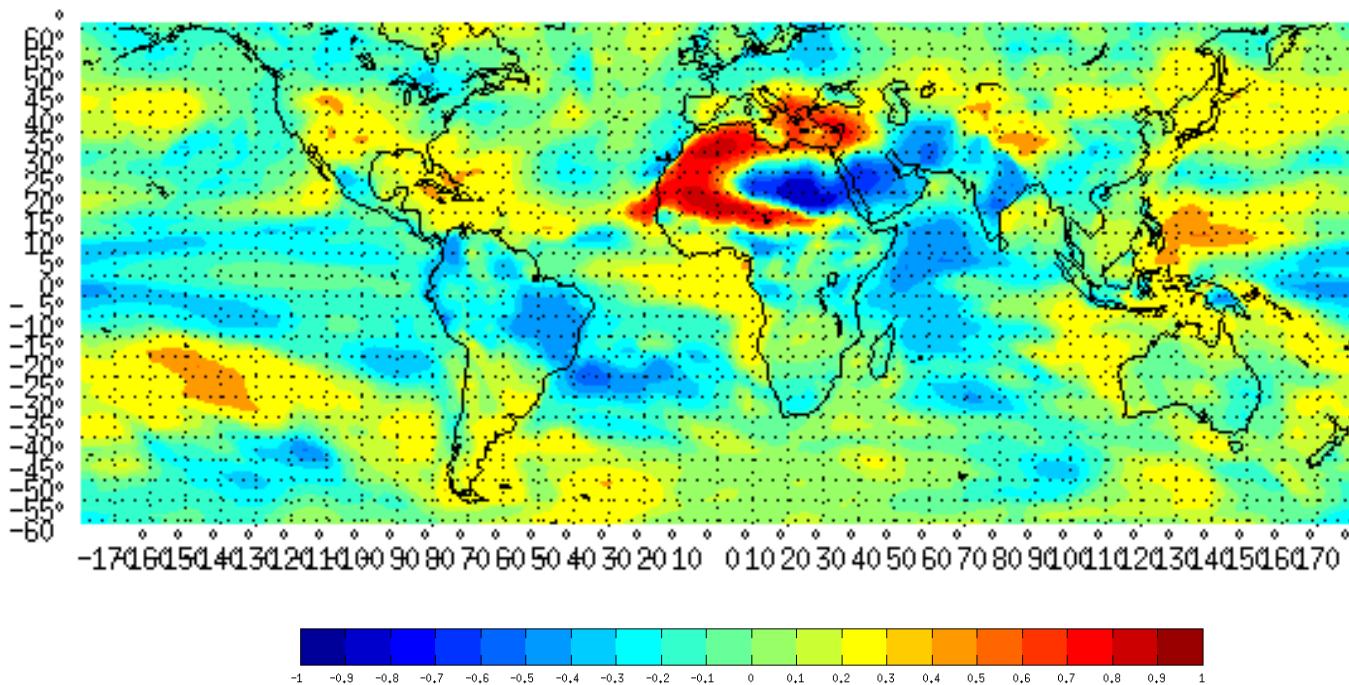
u1 SCF=61.3%



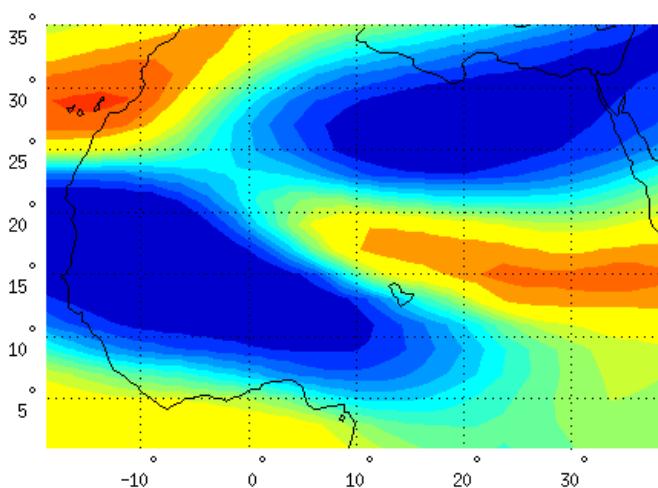
GFDL20

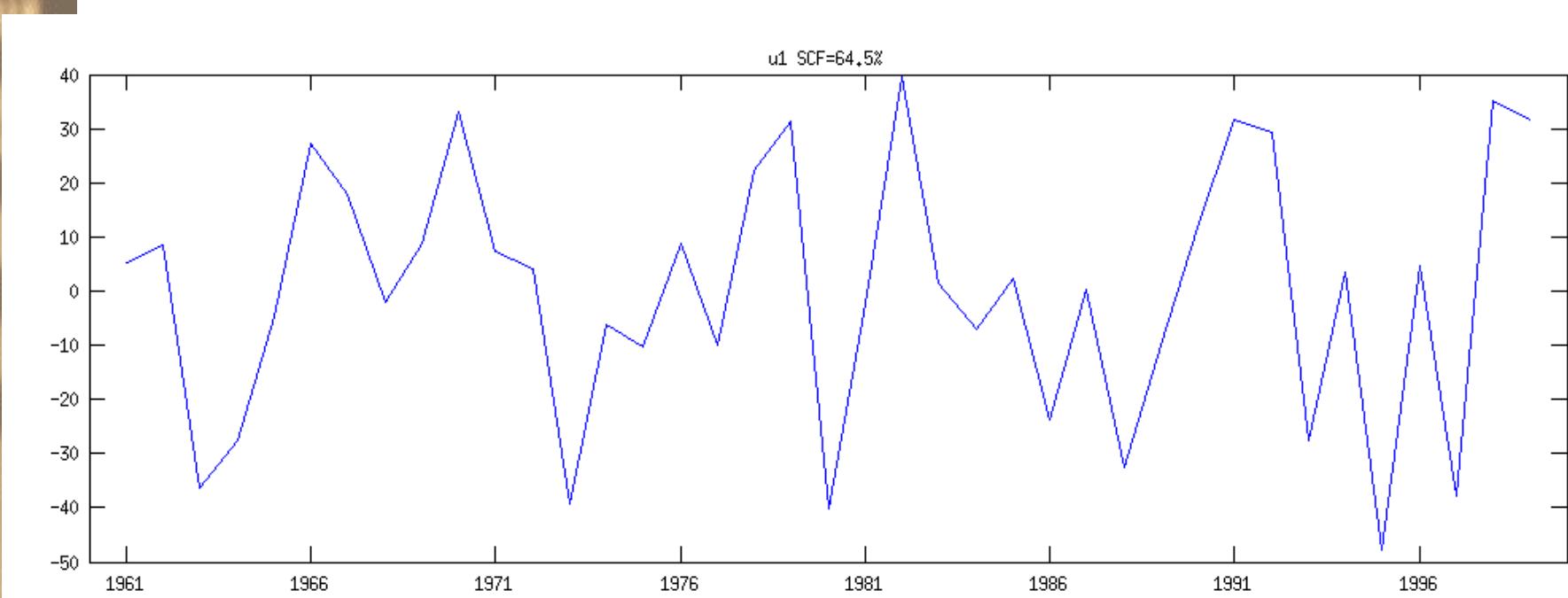
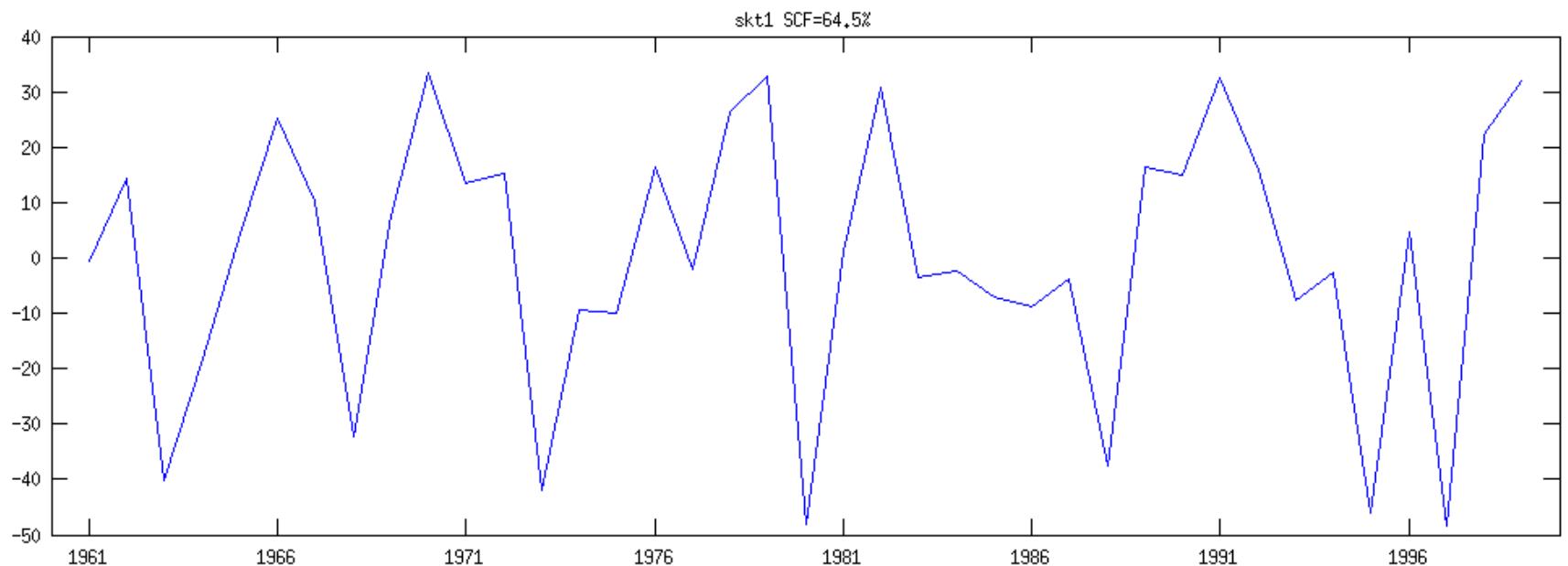


skt vector 1 SCF=64.5%



U 600 hPa



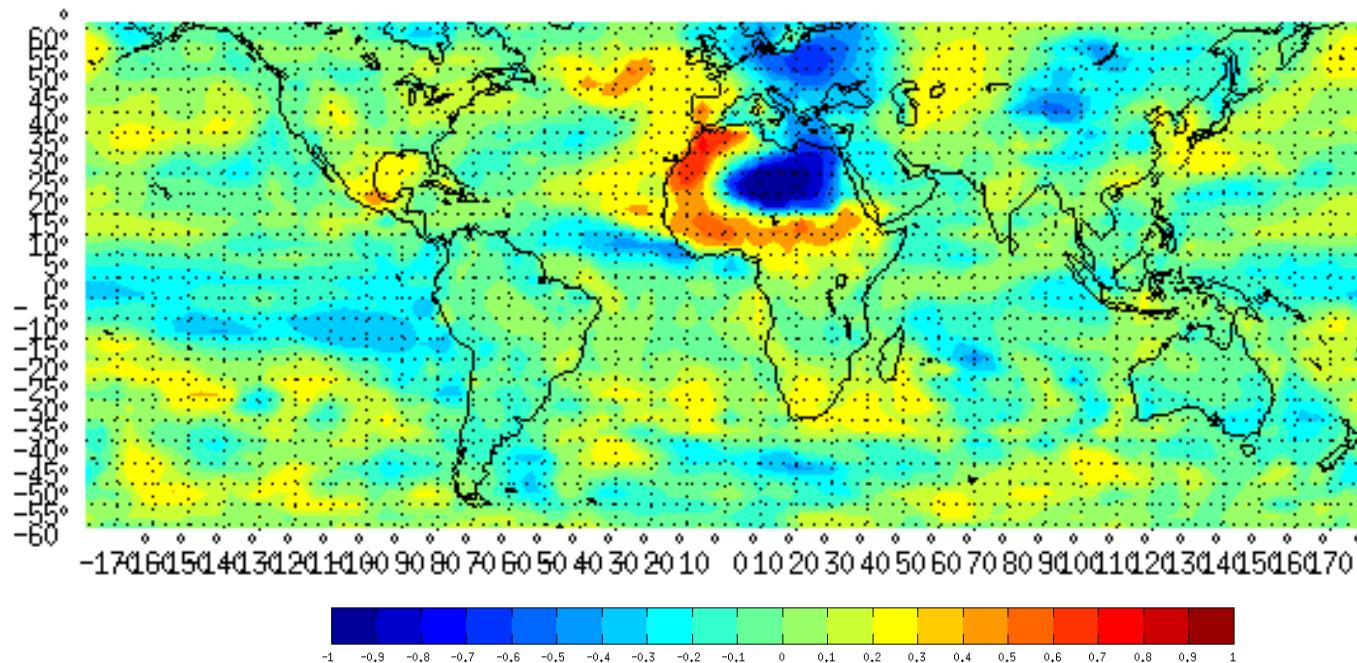


GISS-AOM

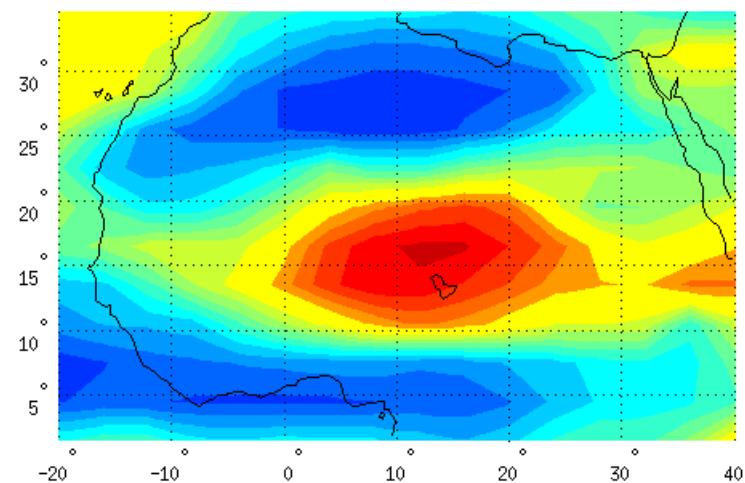


skt vector 1 SCF=31.6%

SKT

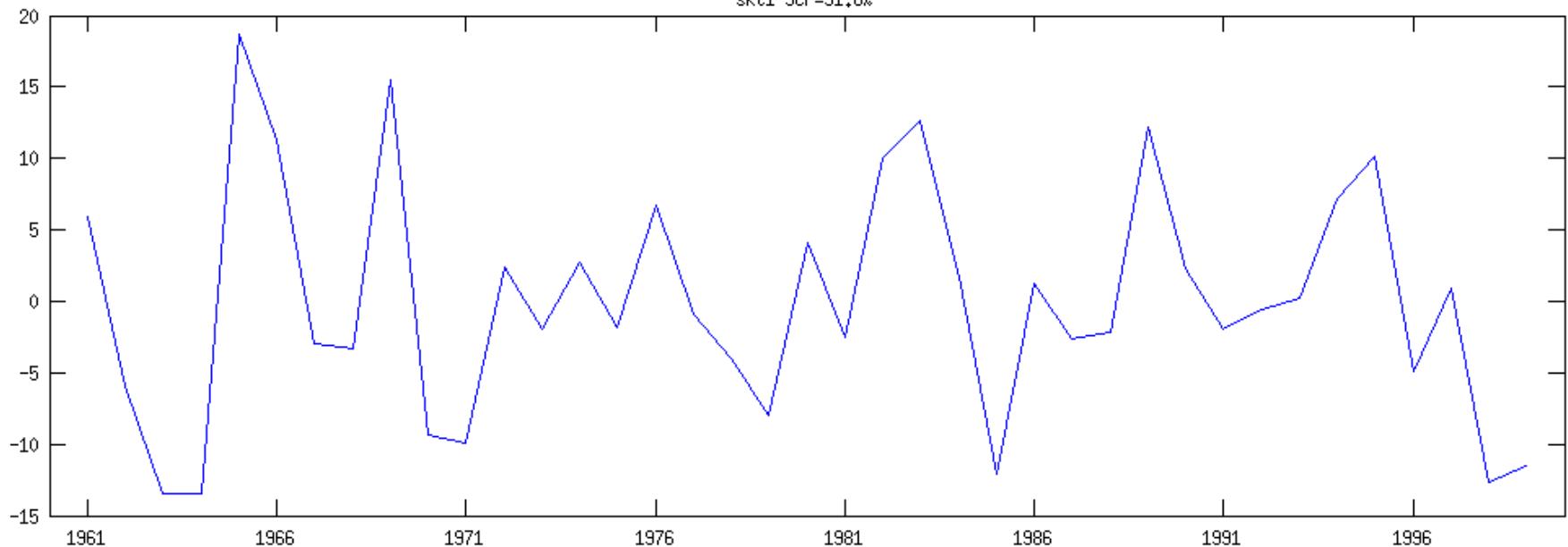


U 600 hPa



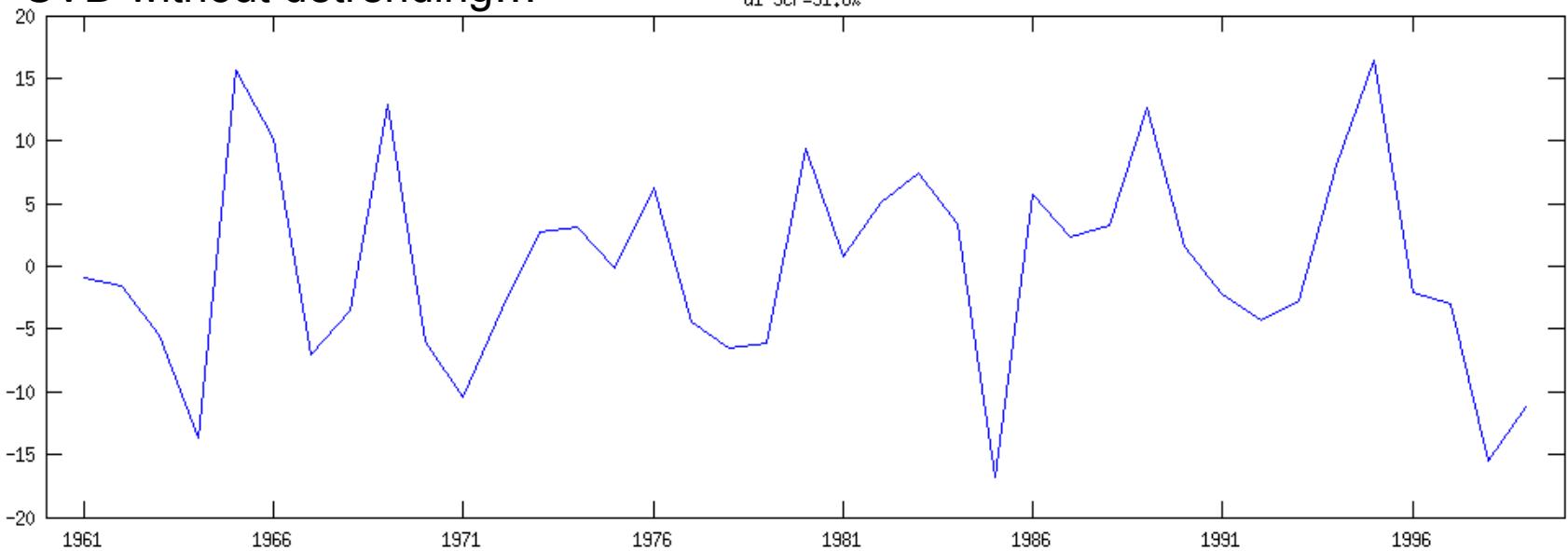


skt1 SCF=31.6%



The GISS-AOM model is the only one showing a significant trend in the SVD without detrending...

u1 SCF=31.6%



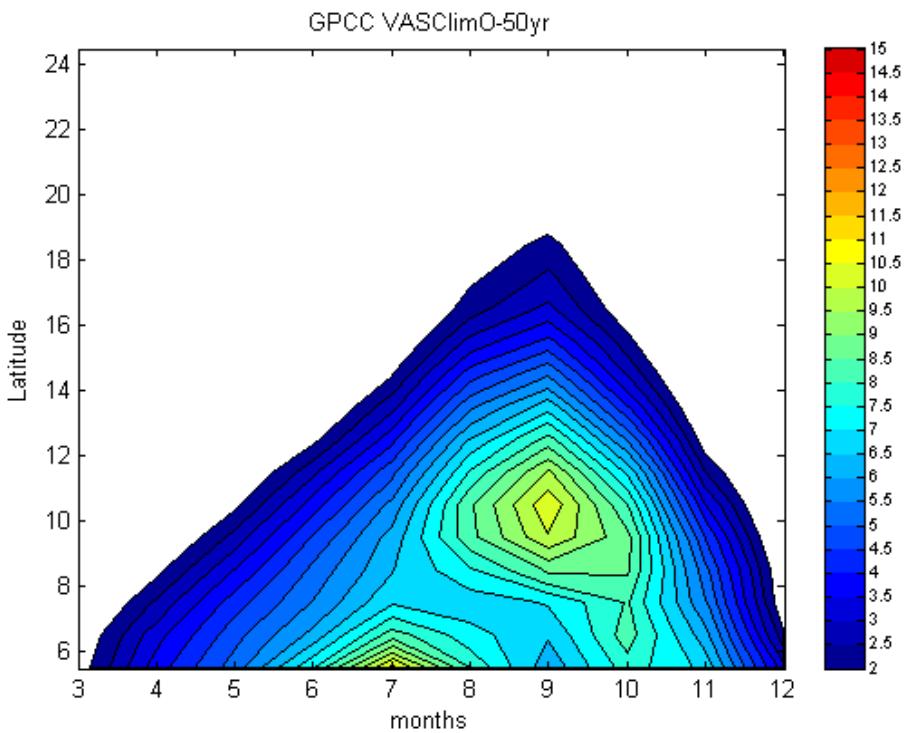
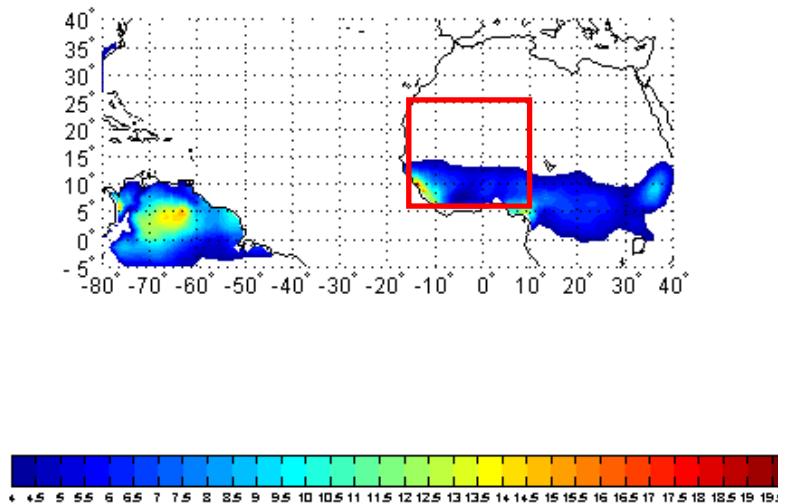
<http://www.amma-eu.org>

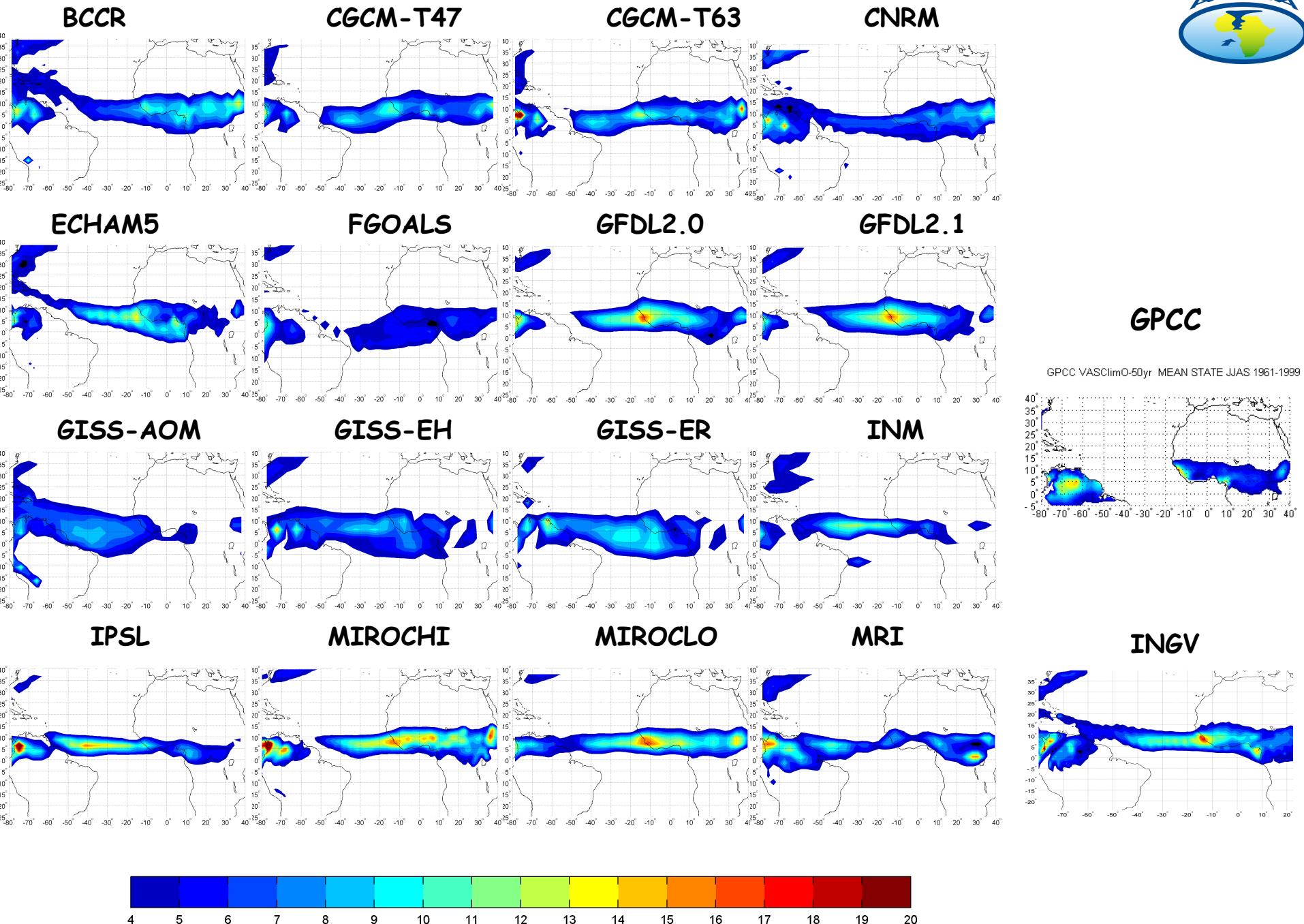
Thanks

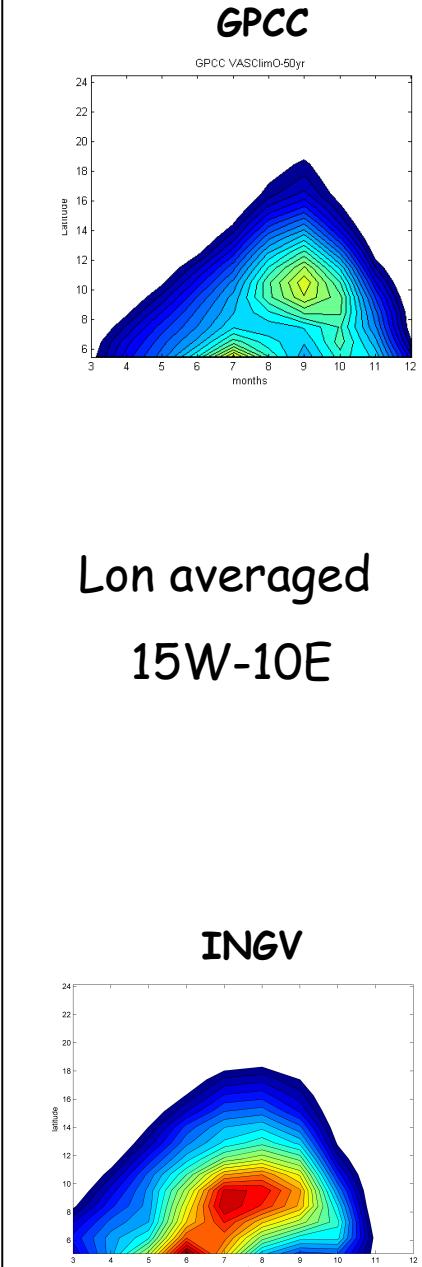
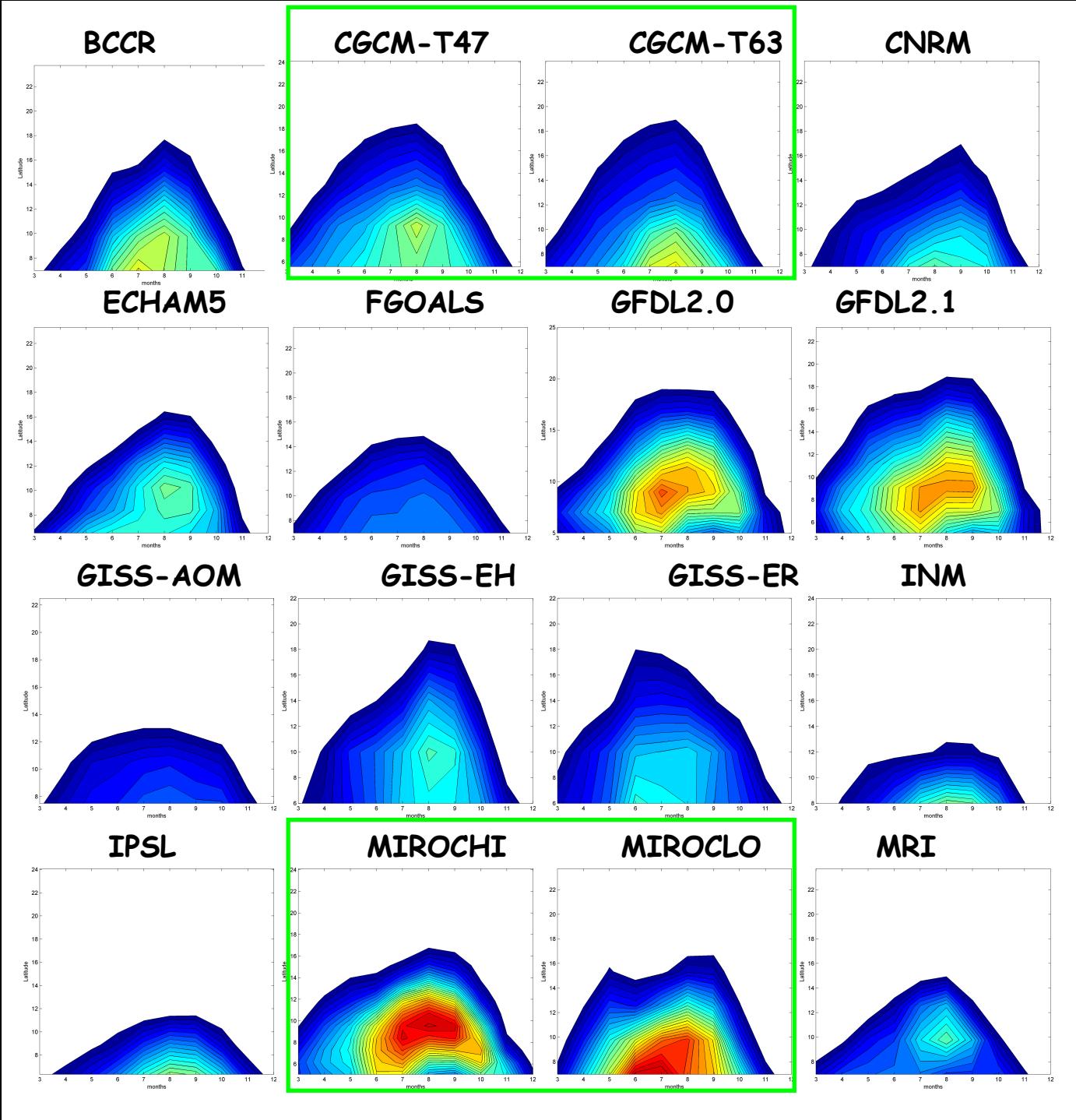
paolo.ruti@casaccia.enea.it

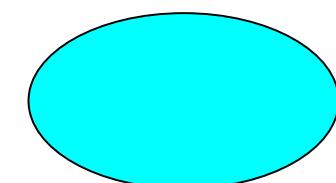
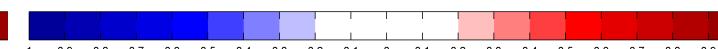
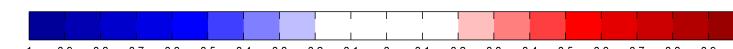
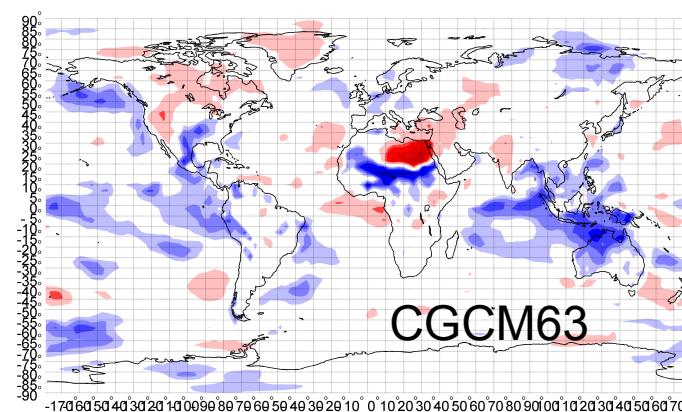
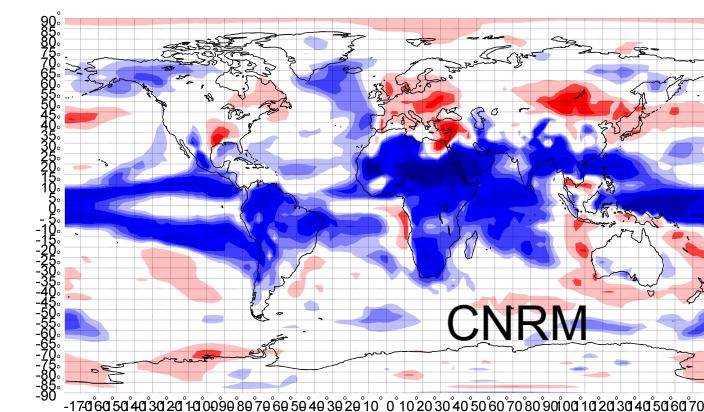
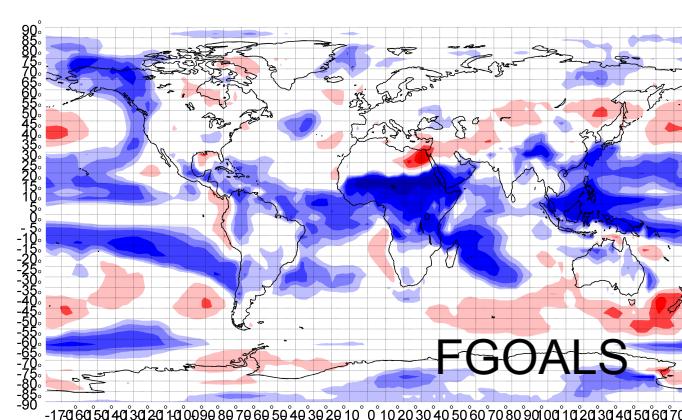
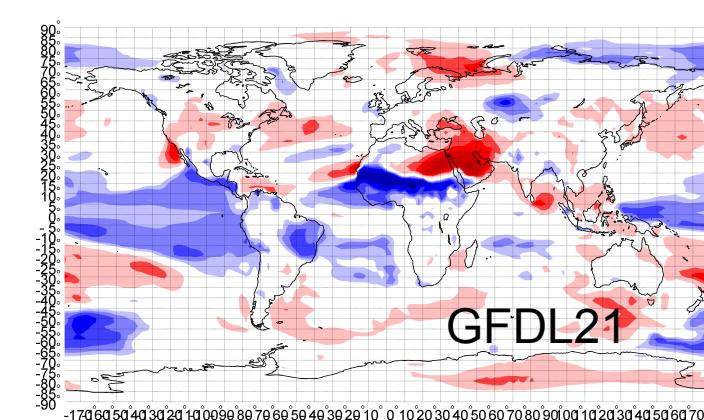
PRECIPITATION

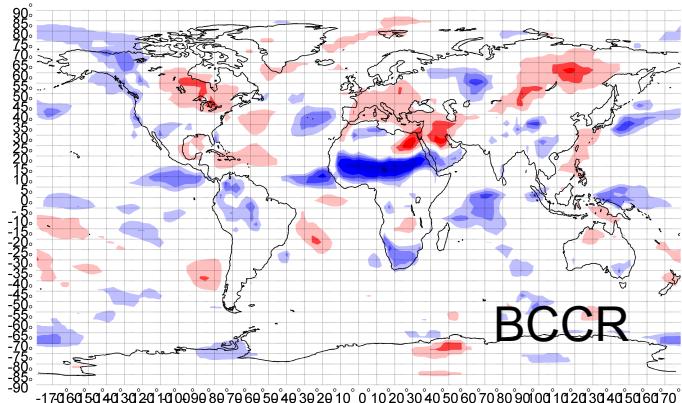
GPCC VASClimo-50yr MEAN STATE JJAS 1961-1999



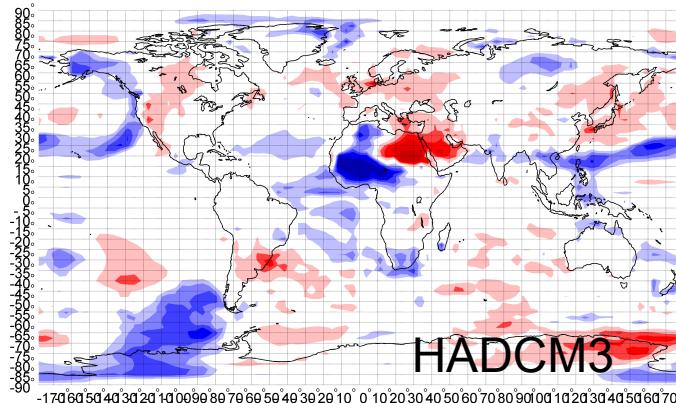




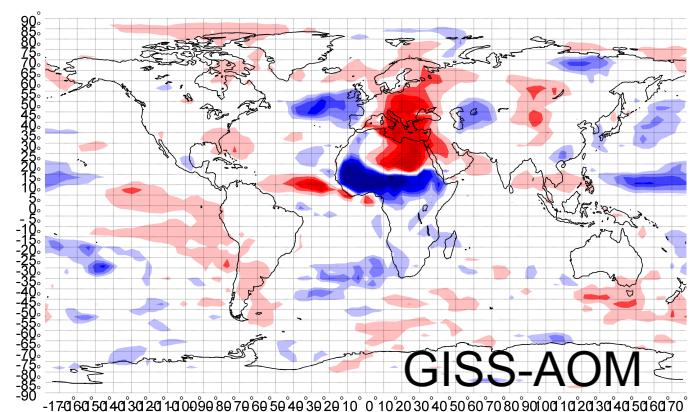
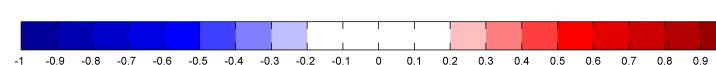




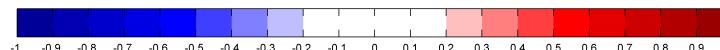
BCCR



HADCM3



GISS-AOM

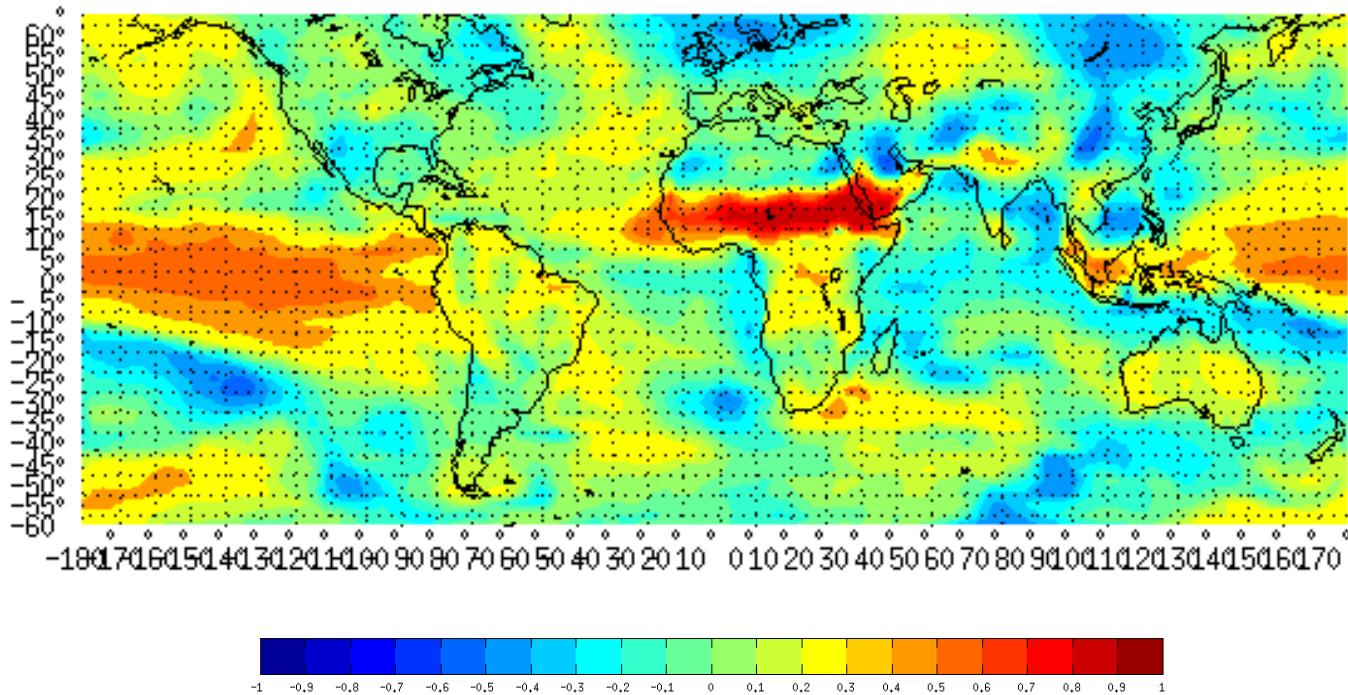


MIROCLO

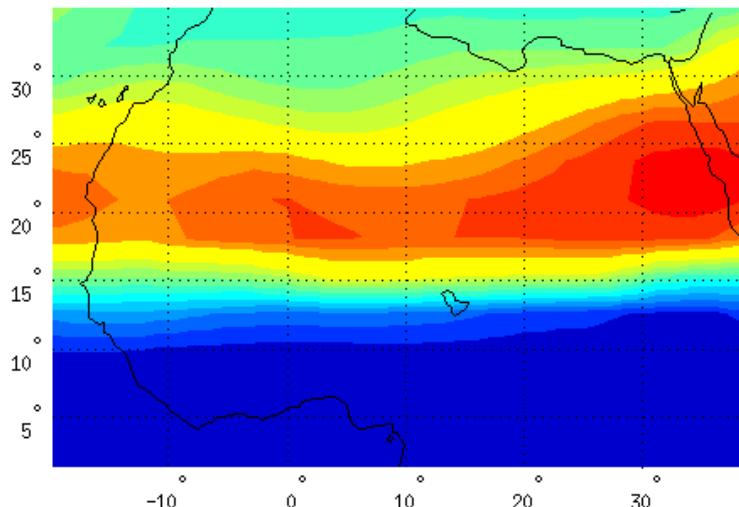
skt vector 1 SCF=74.2%



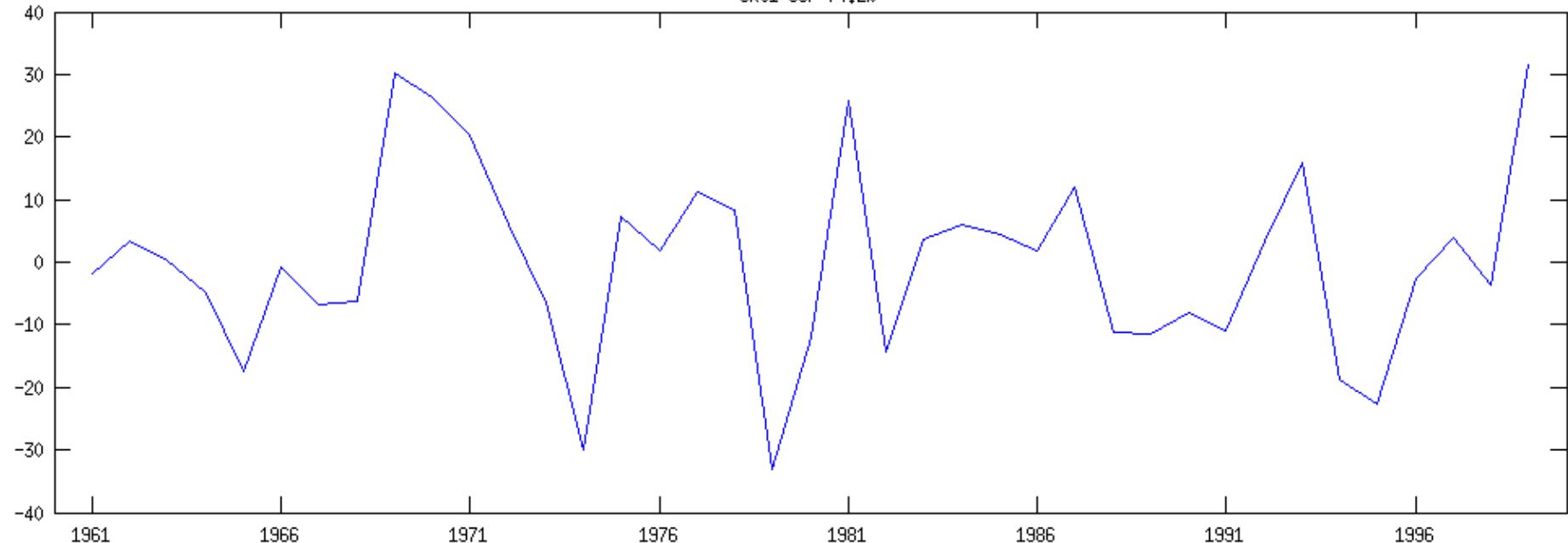
SKT



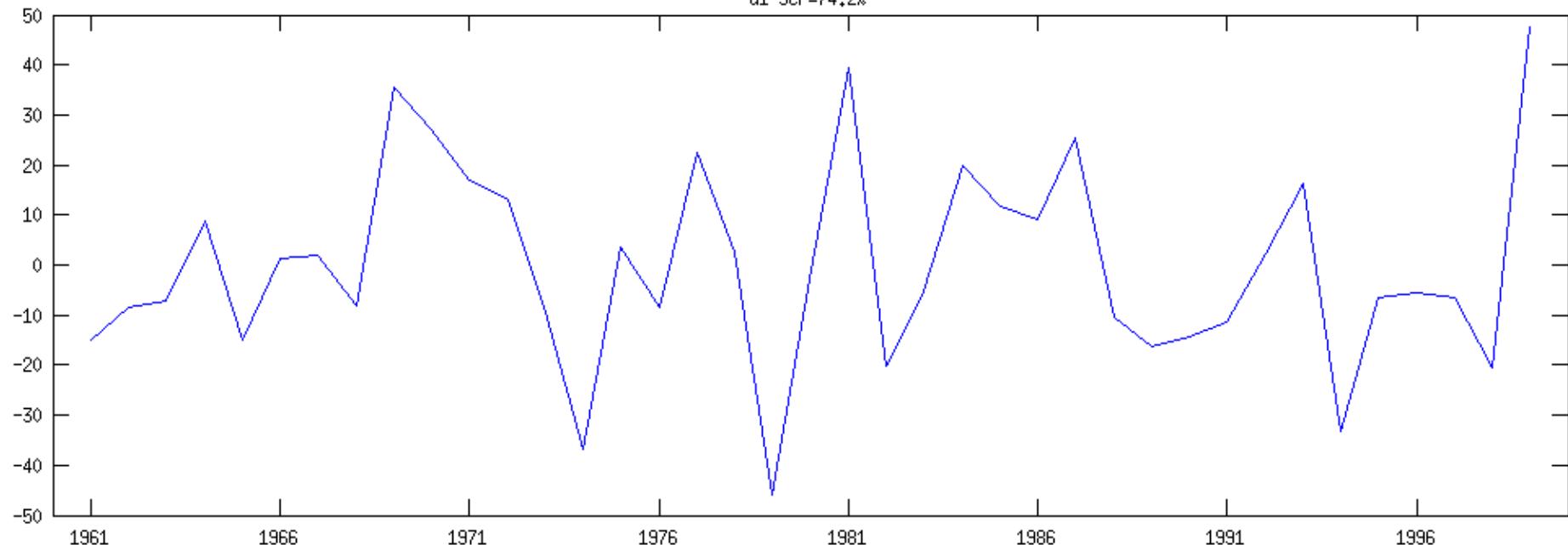
U 600 hPa



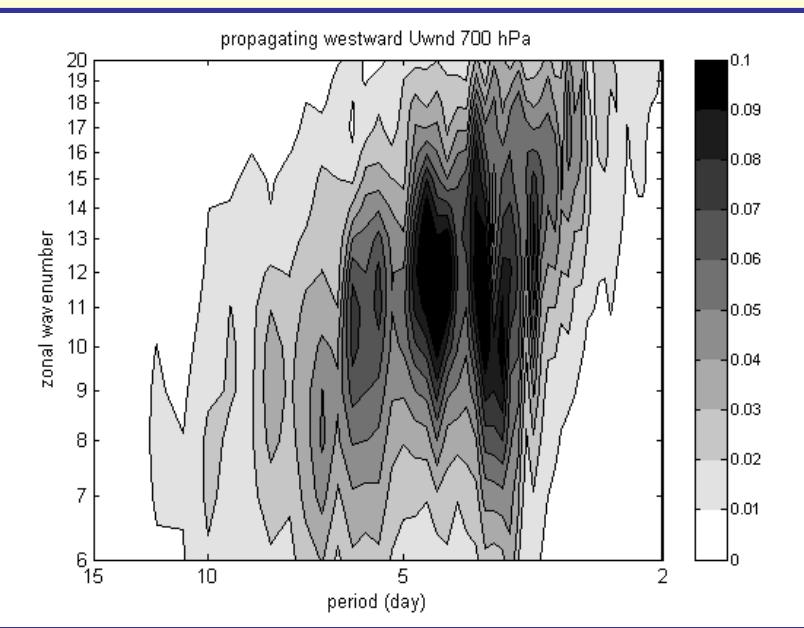
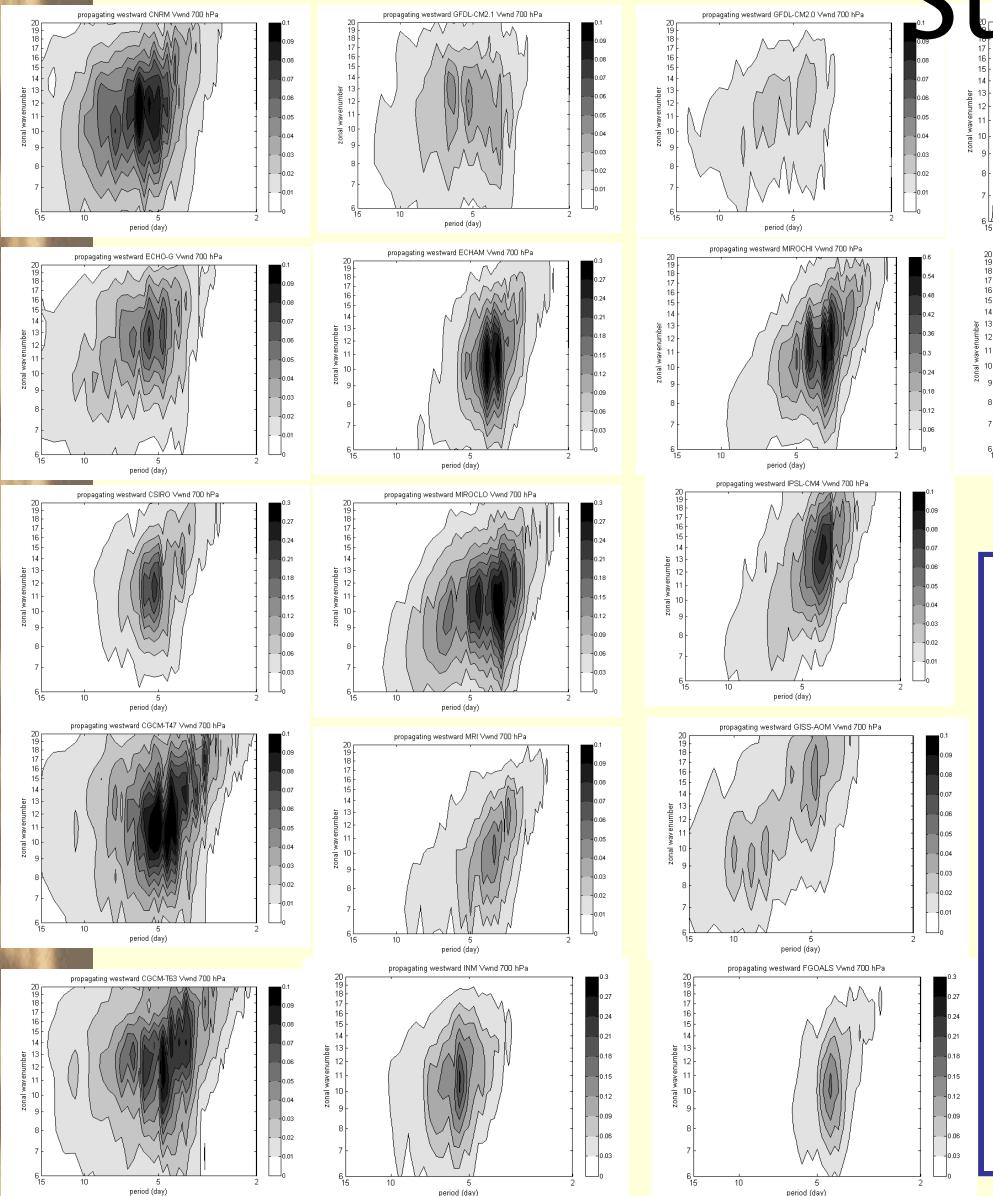
skt1 SCF=74.2%



u1 SCF=74.2%



Stamps collection



Stamps collection

