



*Direction de la Météorologie
Nationale, Maroc*

Seasonal Forecast in Morocco and NA-RCC

Fatima Driouech

With thanks to Atika Kasmi

MedCof meeting, Belgrade 13-19 Novembre 2013

History of operational seasonal forecast in Morocco

- Since 1998, Maroc-Météo has produced the dynamic seasonal forecasts using the GCM **ARPEGE-Climat** (run on its super-computer thanks to the cooperation with Meteo-France .
- Different versions succeeded
- 2010-2012 : Installation of the coupled version thanks to the cooperation with Mercator : ARPEGE-ORCA2 → ensemble forecast (9members)
- March 2012 : Morocco was chosen for leading seasonal forecast for the Proposed North Africa **RCC (PRESANORD)** → Seasonal forecast products (cards and outlooks) for precipitation and temperature are updated each month.
- May 2012 - February 2013 : the coupled version is run with **27 members** (9 atmospheric initial conditions from ECMWF and 3 ocean initial conditions from Mercator)
- Since March 2013 : Production of the **probabilistic forecasts** : three categories
- September 2013 : Installation of a **High Resolution** version of ARPEGE-Climat (~ 54Km over Morocco)



Analyses océanographiques



OPA/NEMO(3.2) : Ocean global circulation model



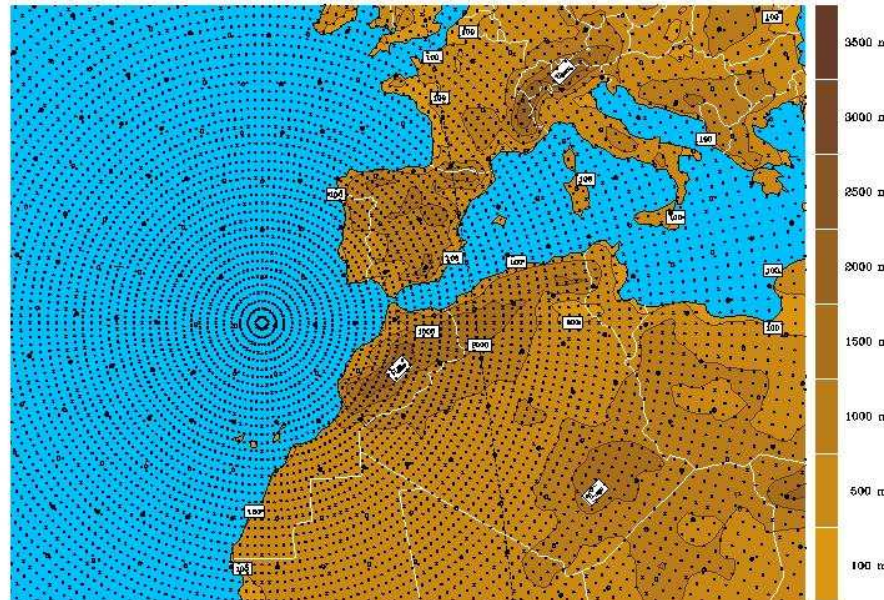
Analyses atmosphériques



ARPEGE-Climat V5: Atmospheric global circulation model

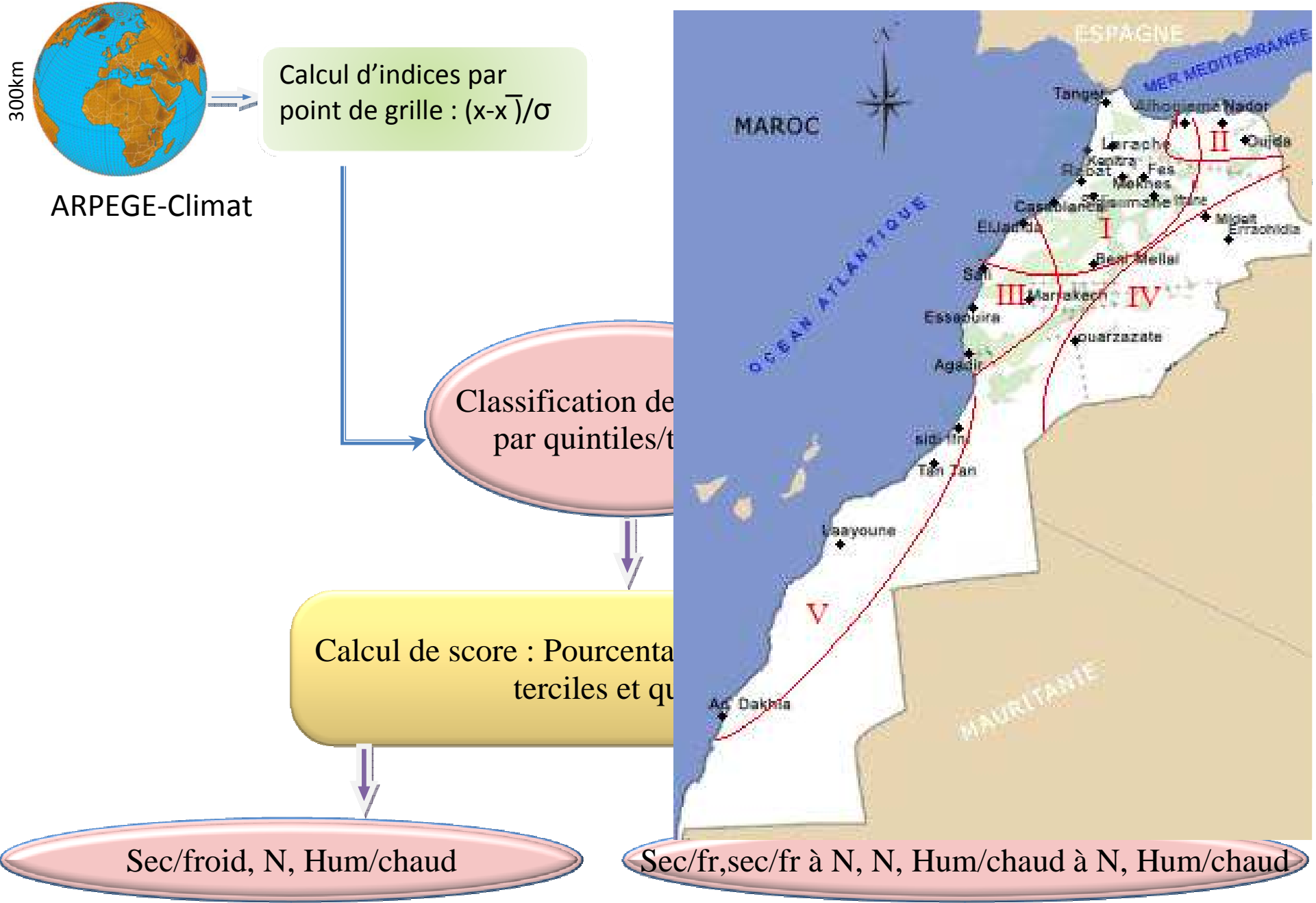
Coupler OASIS

ARPEGE climat V5 marochr, 128 latitudes, étirement 3 au pôle 35N-15W

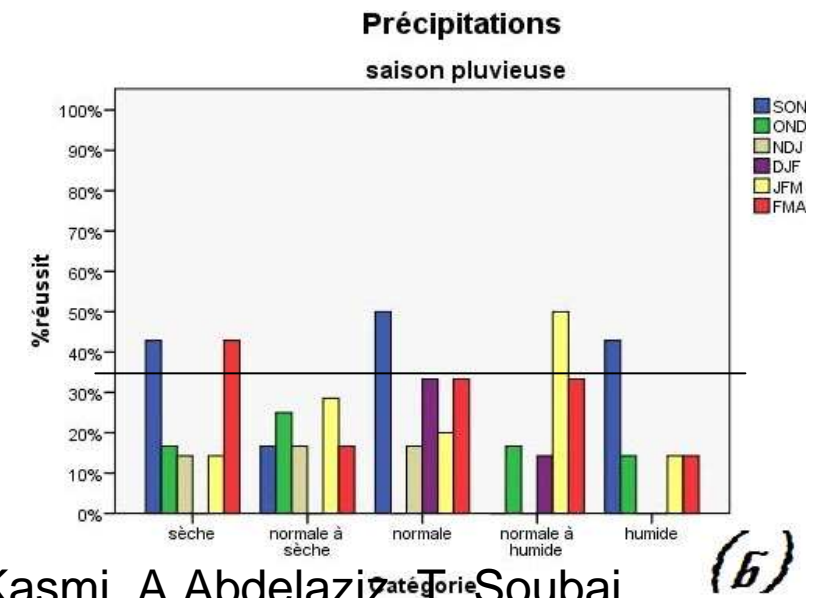
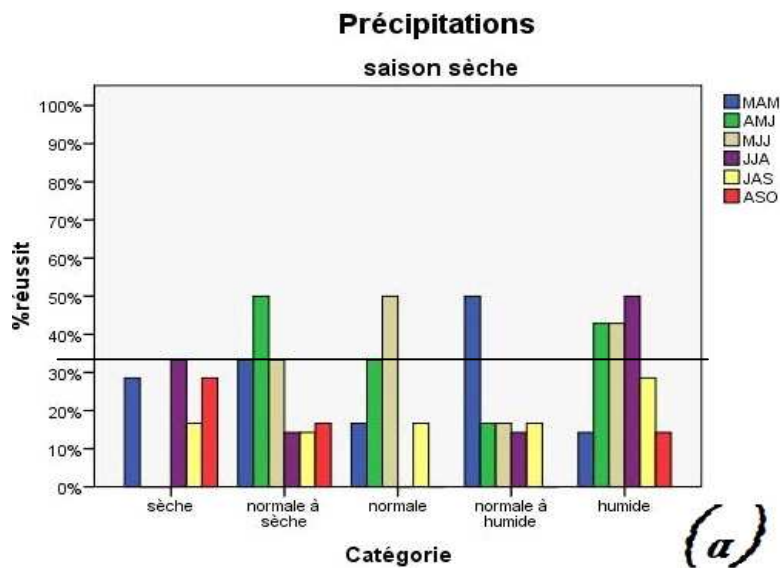
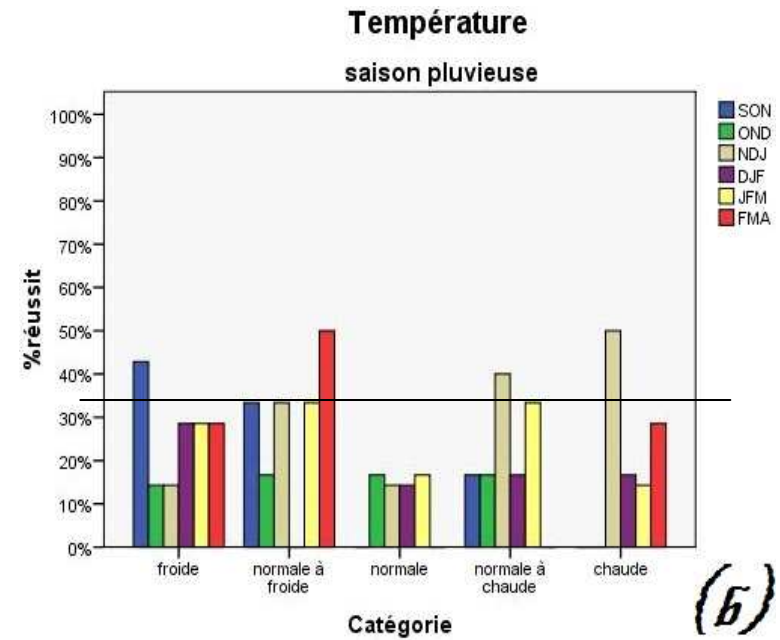
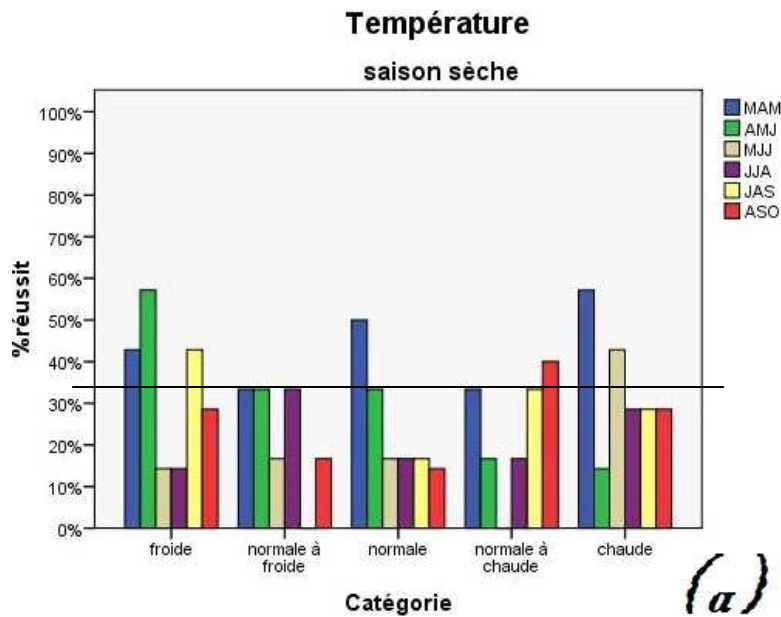


ARPEGE-Climat HR

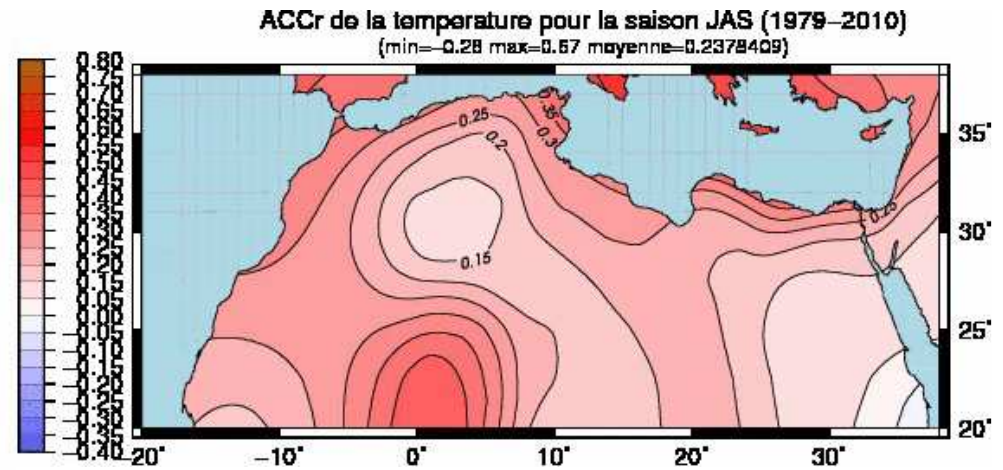
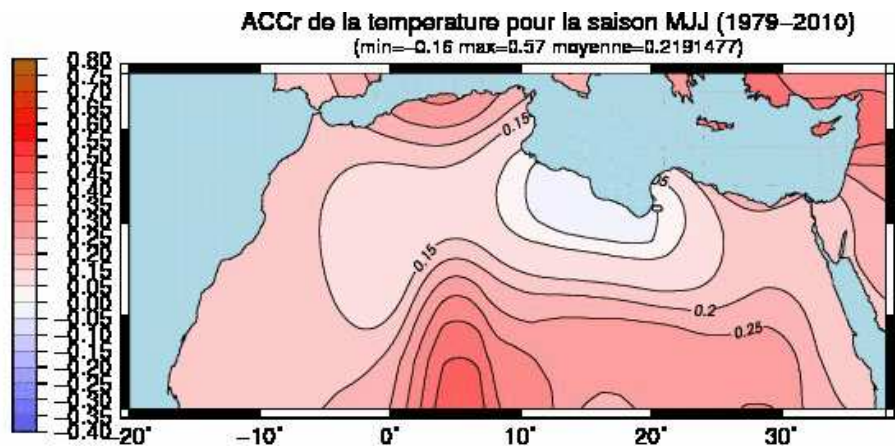
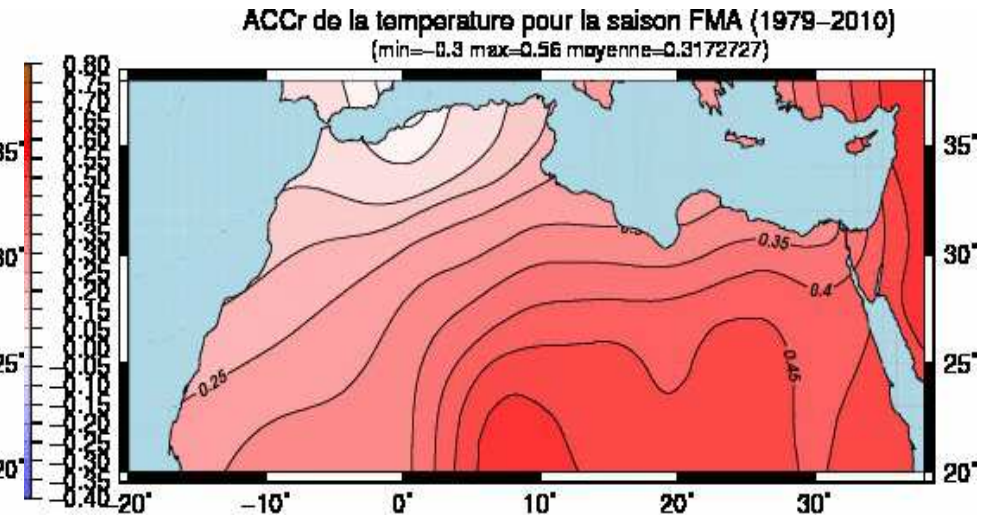
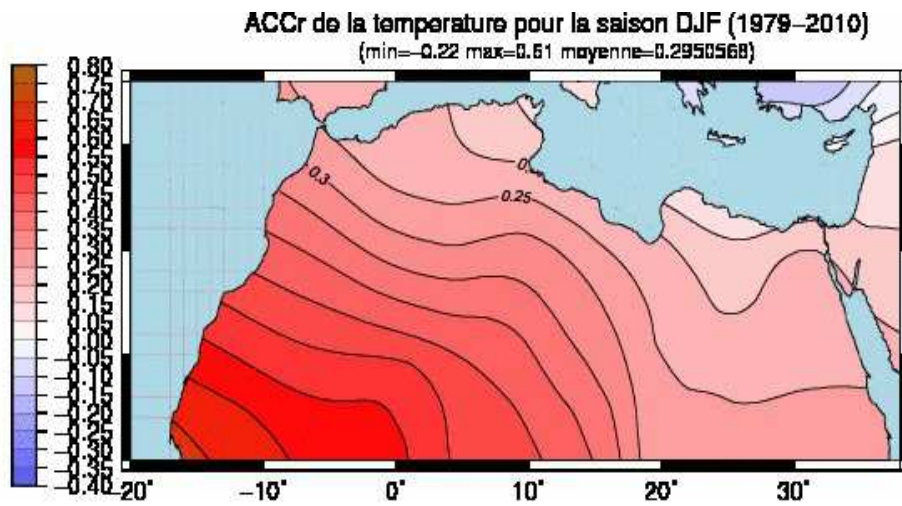
Evaluation of seasonal forecast in Morocco



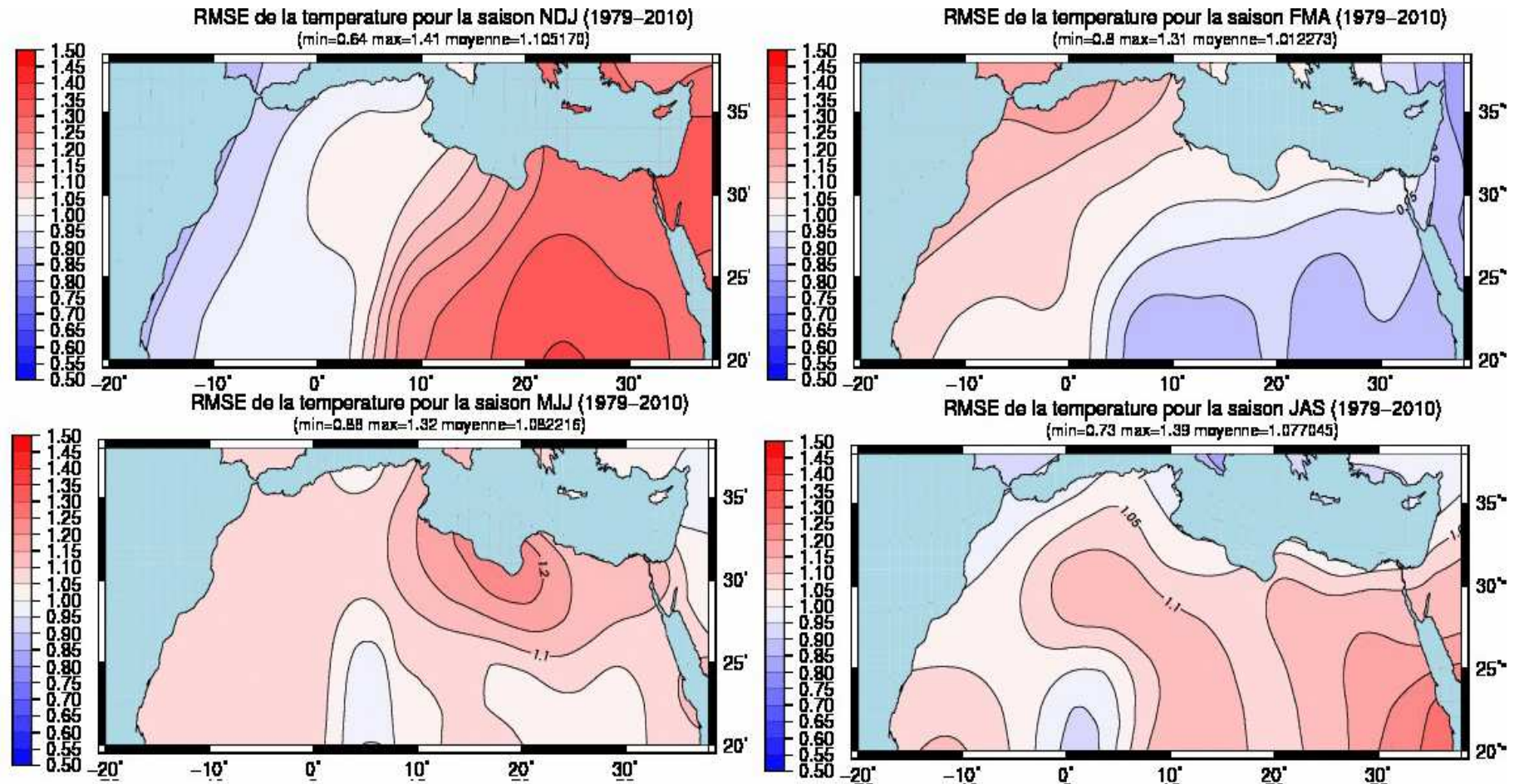
Evaluation of T2m/Precip issued from ARPEGE-Climat vs observations over northern half of Morocco



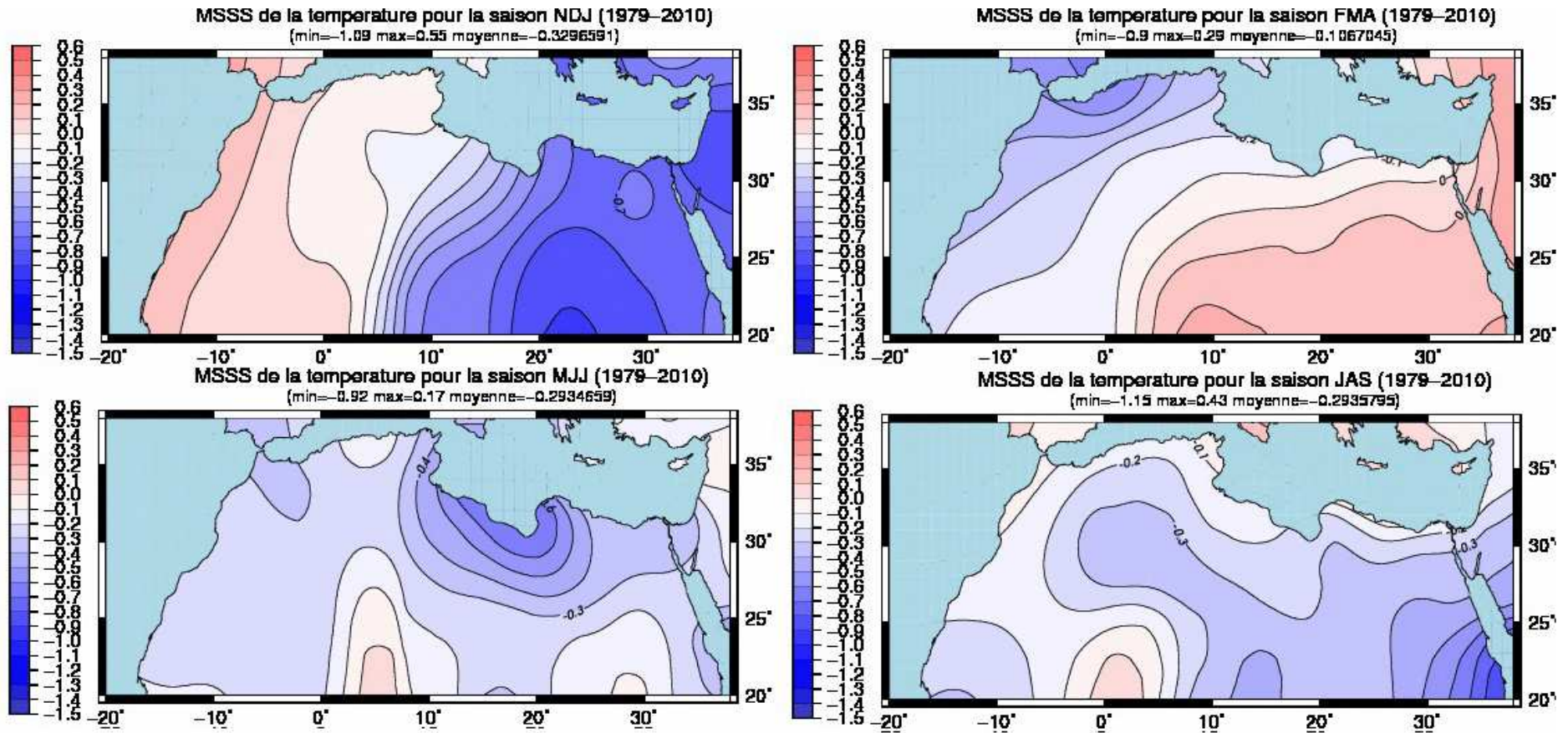
Anomaly Correlation Coefficient of temperature



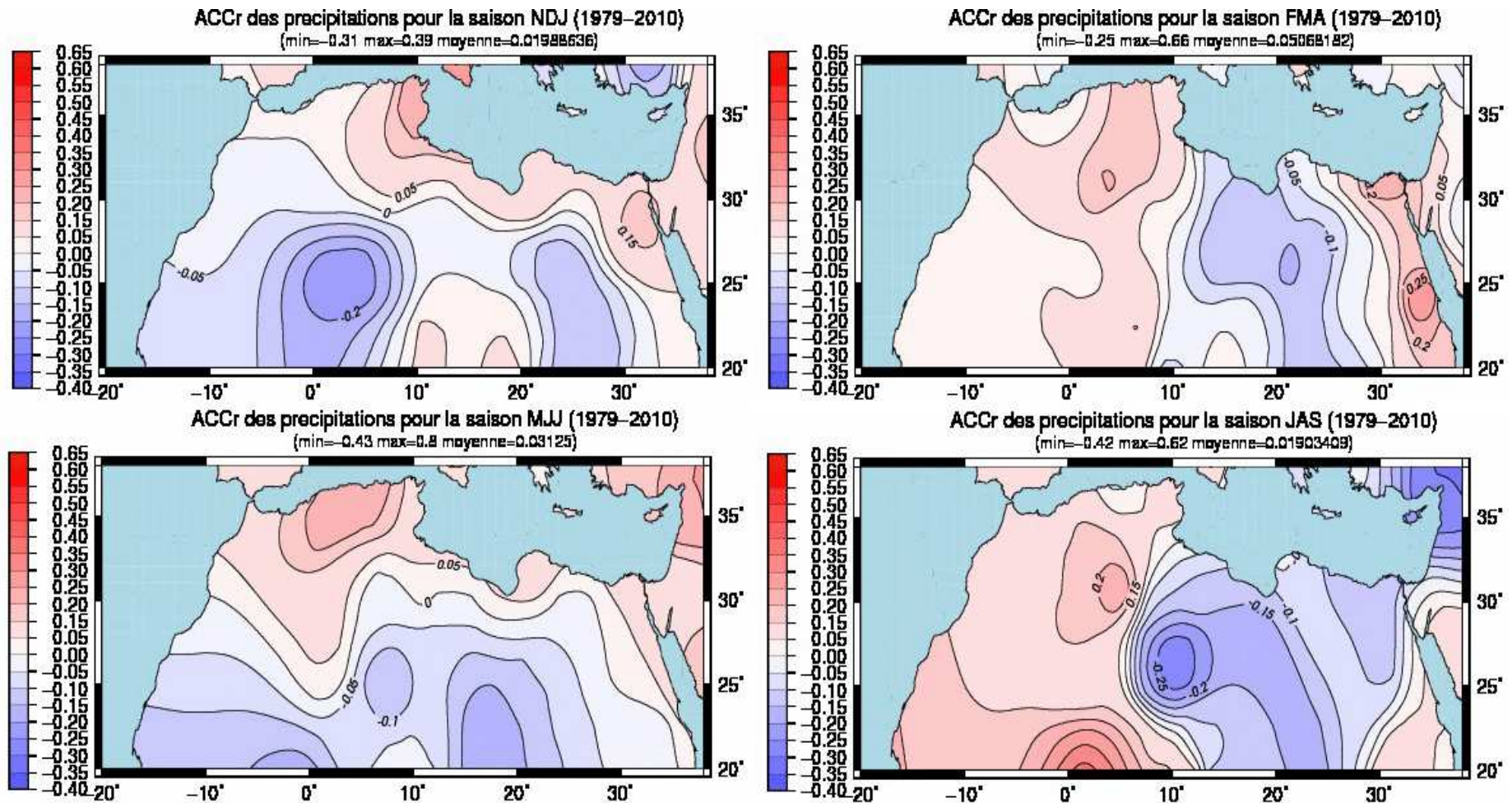
RMSE T2m



MSSS T2m

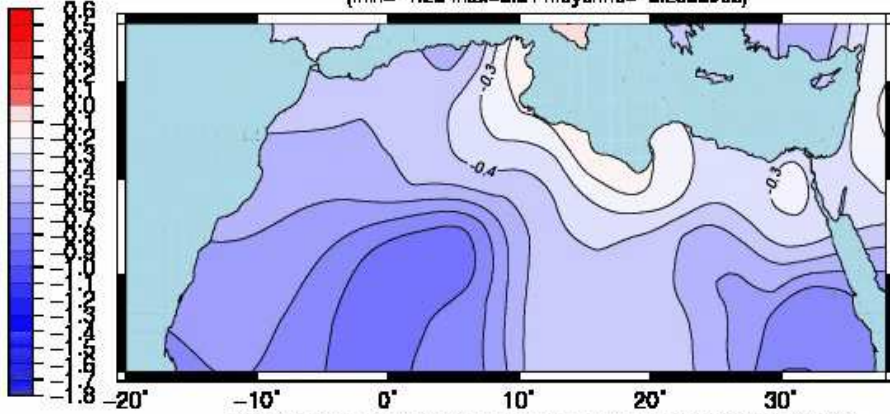


Anomaly Correlation Coefficient of Precipitations Comparison with reanalysis:

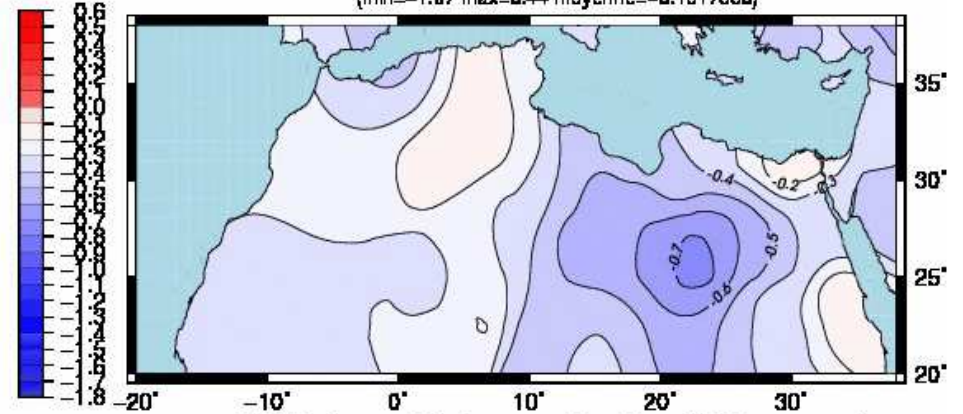


MSSS Précipitation

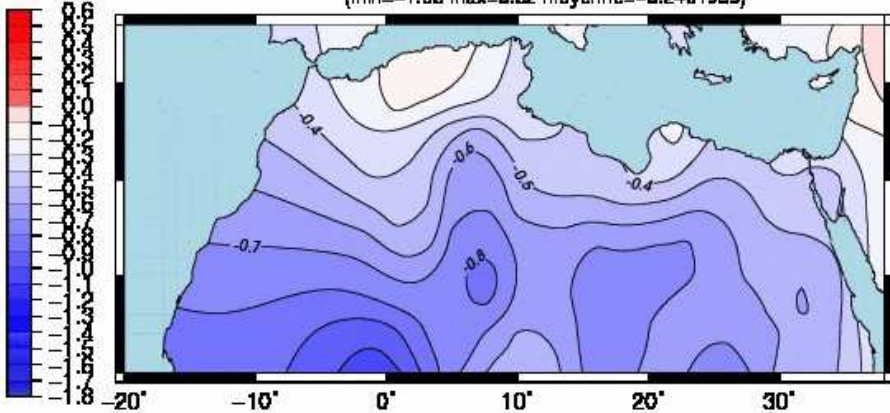
MSSS des précipitations pour la saison NDJ (1979–2010)
(min=-1.25 max=0.04 moyenne=-0.2380966)



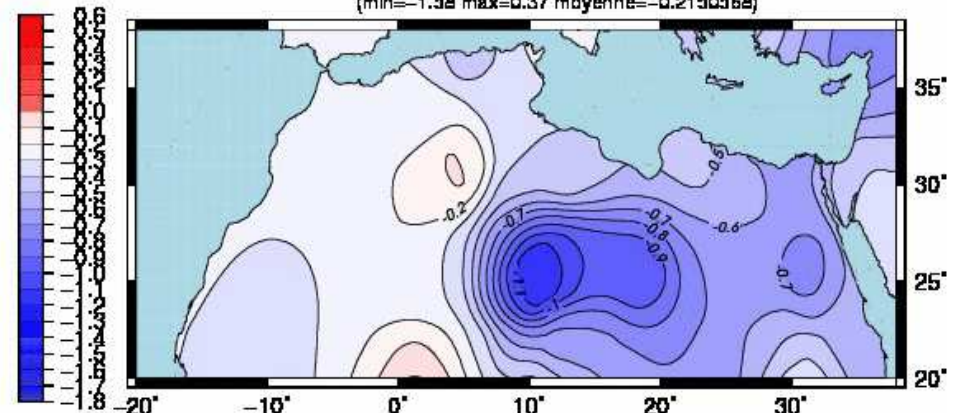
MSSS des précipitations pour la saison FMA (1979–2010)
(min=-1.07 max=0.44 moyenne=-0.1817330)



MSSS des précipitations pour la saison MJJ (1979–2010)
(min=-1.63 max=0.62 moyenne=-0.2401989)



MSSS des précipitations pour la saison JAS (1979–2010)
(min=-1.58 max=0.37 moyenne=-0.2150558)



North African Regional Climate Centre



NA RCC structure and responsibilities

Distribution of functions for the North African RCC-
Network

	Mandatory functions				Highly recommended functions
	LRF	Climate Monitoring	Data Services	Training	
Lead	Morocco	Algeria	Libya	Egypt and Tunisia	Morocco
Co- Lead	Egypt	Tunisia	Morocco	Algeria	Algeria, Egypt, Libya, Tunisia

NA RCC Home page : Presentation

<http://rccnara1.marocmeteo.ma>


The screenshot shows a web browser window with the address bar containing 'Regional Climate Center in WMO RAI' and 'narocmeteo.ma'. The page title is 'Welcome To North African Regional Climate Center Network Homepage'. The page features a central map of North Africa with country names and their respective meteorological services listed below it. The page is organized into several sections: 'Main Climate products' (Long Range Forecast, Climate Monitoring, Data Service, Training, Research & Development), 'Complementary products' (Long Range Forecast, Climate Monitoring, Data Service, Training, Research & Development), and 'NEWS & EVENTS'.

Regional Climate Center in WMO RAI +

narocmeteo.ma

Google

uter avec Firefox À la une

 **Welcome To North African Regional Climate Center Network Homepage**

[Home](#) [Add Favorites](#)

Main Climate products

Long Range Forecast

Description
Seasonal Forecast

Climate Monitoring

link1
link2

Data Service


link1
link2

Training

Training in Tunisia
Training in Egypt

Research & Development

Climate scenarios



Algeria : National Office of Meteorology
Egypt : The Egyptian Meteorological Authority
Libya : National Meteorological Centre
Morocco : Moroccan Meteorological Service
Tunisia : National Institute of Meteorology

Complementary products

Long Range Forecast

Seasonal Forecast

Climate Monitoring

Climate Diagnostics

Data Service

link1

Training

link1

Research & Development

link1

NEWS & EVENTS

- FORUM REGIONAL DE PREVISION CLIMATIQUE SAISONNIERES : PRESANORD-03 from 27 to 28 Septembre 2012; Tunis - Tunisia

MORE

[WMO Regional Association 1 North Africa RCC Network](#)

Algerian Node

The screenshot displays the website www.meteo.dz for the Office National de la Météorologie (ONM) of Algeria. The page is titled "Météo Algerie" and includes a navigation menu with links for "Accueil", "Présentation", "Contact", and "Plan du site".

METEOROLOGIE

- ▶ Accueil
- ▶ Climat en Algerie
- ▶ Station VAG
- ▶ APPEL D'OFFRES (New)
- ▶ Informations

Espace Pro

- ▶ Produits et Services
- ▶ Agriculture
- ▶ Batiment & Travaux Public
- ▶ Entreprises Cotières
- ▶ Industrie & Energie

Nos sites

- ▶ MODEL ETA-ONM
- ▶ RCC-NETWORK

Espace Educatif

- ▶ INSTAT+
- ▶ COIN DES JEUNES

BIENVENUE A METEO.DZ

SALON NATIONAL DES TRANSPORTS

Dans le cadre de la tenue au niveau de la SAFEX du Salon National du Cinquantenaire de la fête de l'indépendance « Mémoire et Réalisation » du 05 au 19 septembre, l'Office National de la

Météorologie (ONM) participe à cet important évènement par une Exposition et la présentation de communications la journée du mardi 11 septembre 2012 au niveau de la salle de Conférence « Ali Maâchii » de la SAFEX à partir de 14H30. Le

Salon National des Transports

Qui est en ligne ?
Nous avons 61 invités en ligne

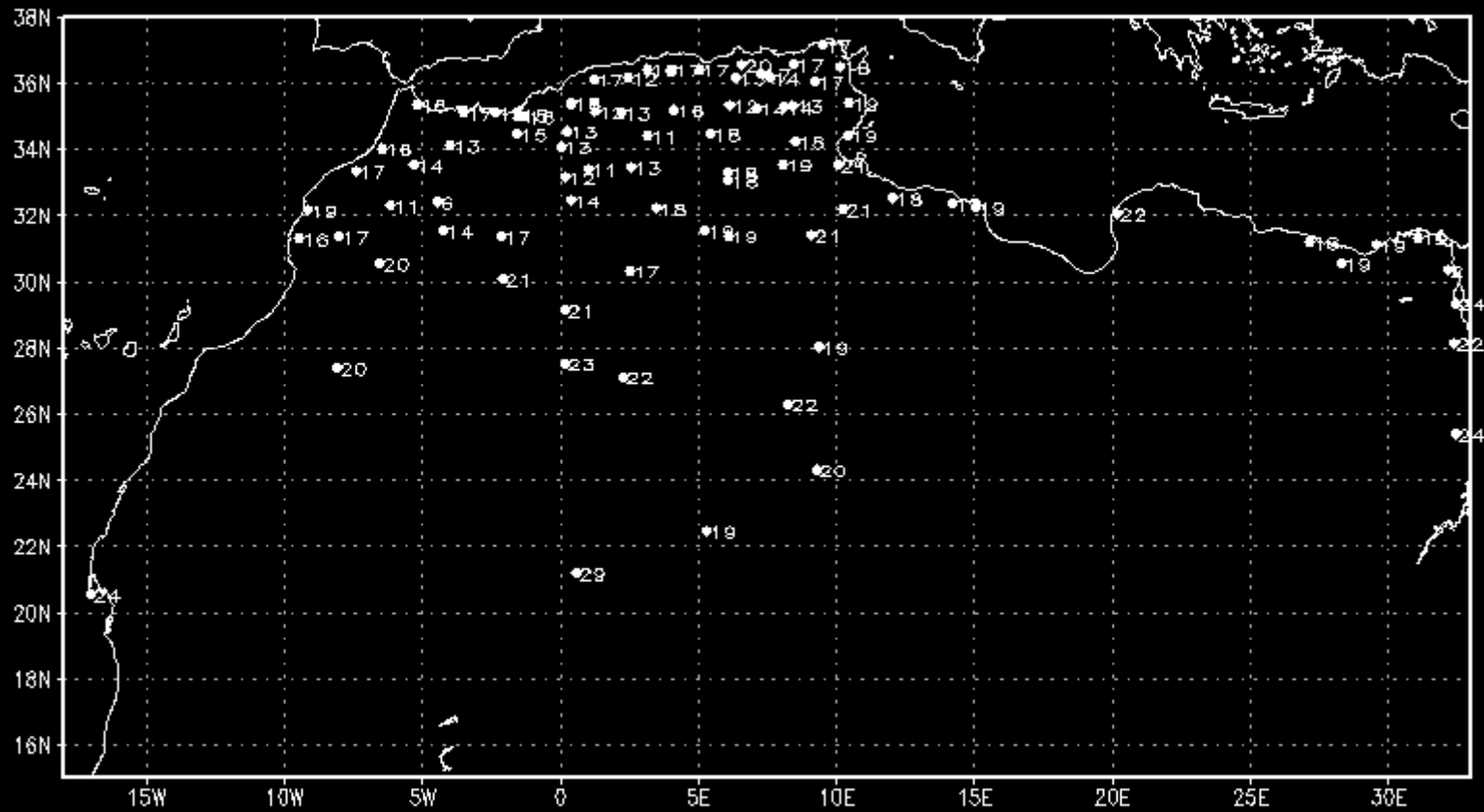
RCC_Network

Le Temps, Le Climat Et l'Eau, Moteur de notre avenir

24 au 26 Janvier 2012

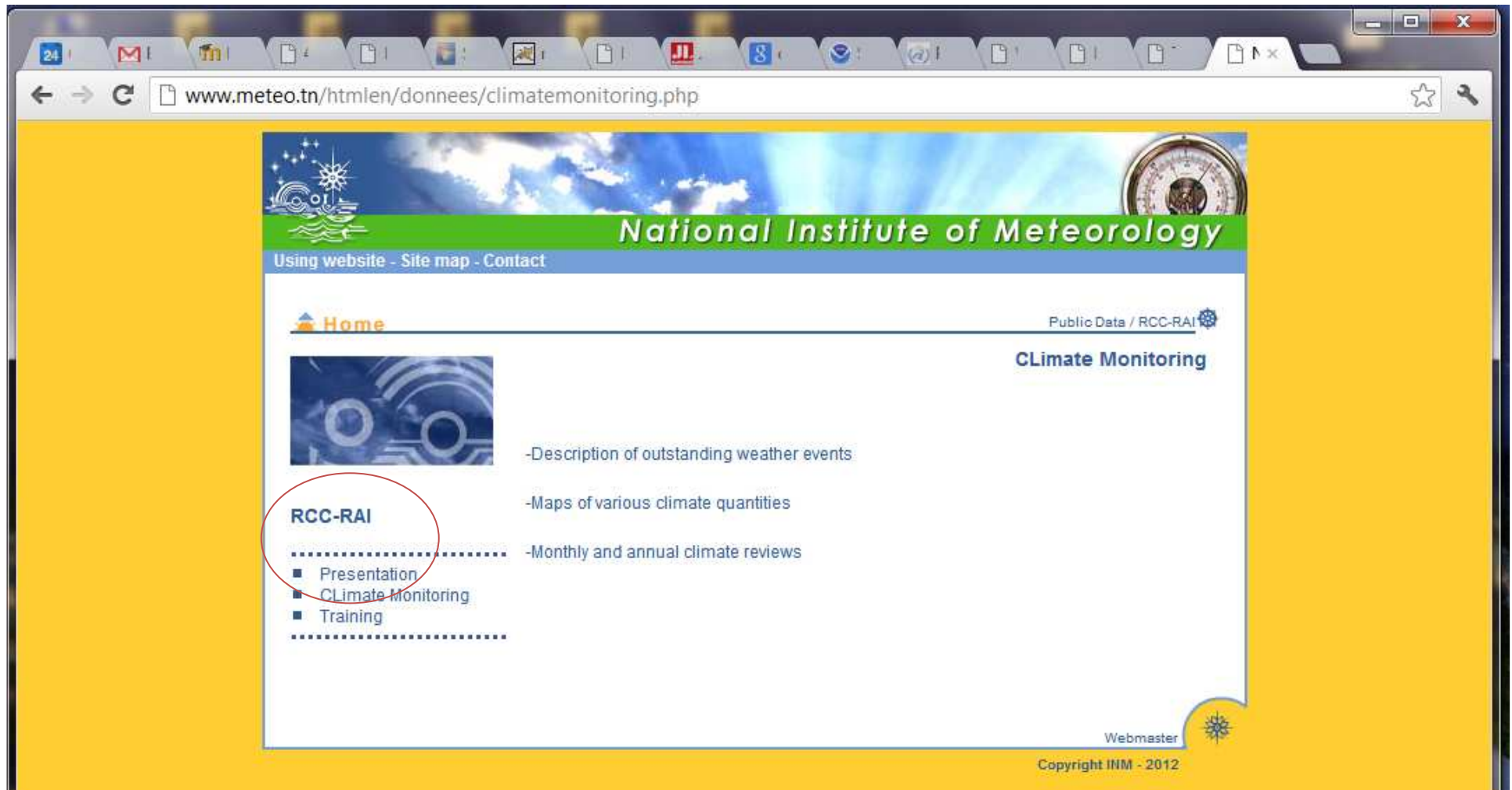
monthly mean
temperature (deg_c)

valid: november 2012



NA RCC Home page

Tunisian Node



The screenshot shows a web browser window displaying the website of the National Institute of Meteorology (INM) in Tunisia. The browser's address bar shows the URL `www.meteo.tn/htmlen/donnees/climatemonitoring.php`. The website has a yellow background and a blue header with the text "National Institute of Meteorology". Below the header, there is a navigation menu with "Home" and "Public Data / RCC-RAI". The main content area is titled "Climate Monitoring" and features a blue image of a globe. The "RCC-RAI" section is highlighted with a red circle and contains a list of items: "Presentation", "Climate Monitoring", and "Training".


www.meteo.tn/htmlen/donnees/climatemonitoring.php

National Institute of Meteorology

Using website - Site map - Contact

[Home](#) Public Data / RCC-RAI

Climate Monitoring


 -Description of outstanding weather events

RCC-RAI -Maps of various climate quantities

..... -Monthly and annual climate reviews

- Presentation
- **Climate Monitoring**
- Training

.....

Webmaster 

Copyright INM - 2012

Egyptian Node

The screenshot displays the website of the Egyptian Meteorological Authority (EMA) in Arabic. The browser address bar shows the URL: www.ema.gov.eg/articles?menu=61&lang=eg. The page features a navigation menu with the following items: **عن الهيئة** (About the Authority), **تعاون وخدمات** (Cooperation and Services), **الأخبار** (News), **بحوث ودراسات** (Research and Studies), **الارصاد البحرية** (Marine Meteorology), **المناخ** (Climate), and **الطقس** (Weather). The main content area is titled **NA-RCC/Cairo** and contains a list of PDF reports:

- Long Range Forecast_ASO_201206.pdf
- LRF_201202.pdf
- Seasonal_Forecast_Report_aug_2012.pdf
- Sesonal forecast and practical giude.pdf
- Sesonal Forecast Aug, Seb, Oct. 2012.pdf
- Sesonal Forecast j, j, Aug 2012 .pdf
- Sesonal forecast -USER.pdf

On the right side, there are several menu sections:

- المناخ** (Climate): **تقارير شهرية وستوية** (Monthly and Seasonal Reports)
- أرصاد زراعية** (Agricultural Meteorology): **Chilling**, **Chilling Monthly**, **Chilling Monthly 3**, **GDD Contribution**, **PET**, **Ten days Agrometeorological weather report**
- المراكز الاقليمية** (Regional Centers): **المركز الاقليمي للتدريب** (Regional Training Center)
- روابط** (Links)

NA RCC Home page

Egyptian Node





Maroc Météo votre partenaire pour un développement durable

Maghreb Tripoli 14 | 26

RECHERCHE...

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Mercredi, 13 Nov. 2013

Espace client

Two empty input fields for user identification.

ACCÈS PERDU?

Maroc Météo

- Mieux nous connaître
- Missions
- Organigramme
- Coopération Internationale
- Temps prévu
- Climat
- Produits et Services
- Nos métiers
- Recherche-Développement
- Qualité d'air
- Démarche Qualité
- Charte d'audit interne
- Météo de A à Z



North Africa RCC products Seasonal forecast

- Verification
- Climate scenarios
- Seasonal outlook

Accueil » Prévision saisonnière

Seasonal regional products

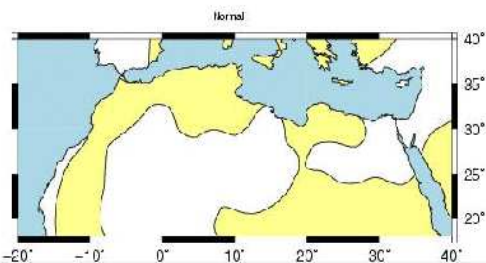
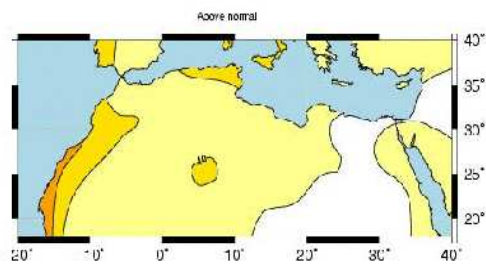
Description

ARPEGE-CLIMAT Seasonal forecasts

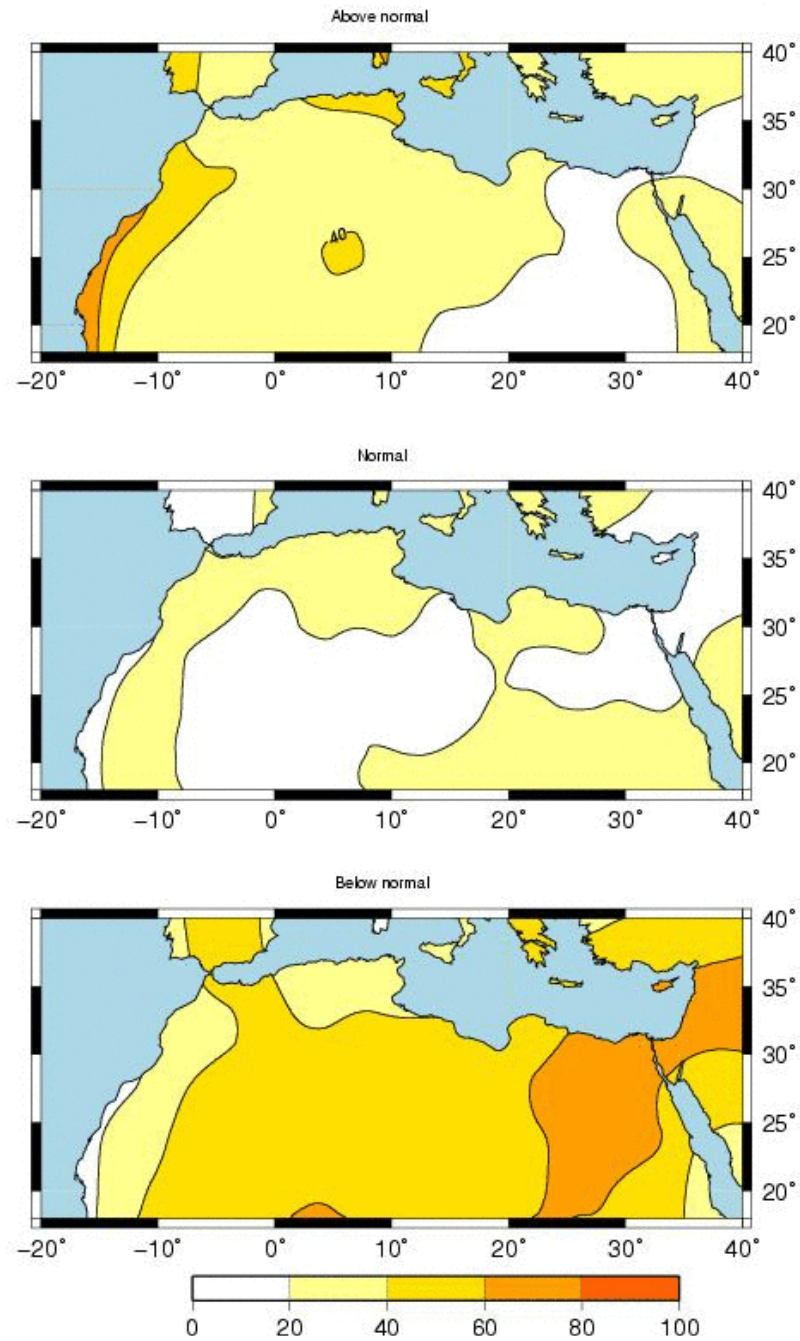
Precipitation forecasts are given for September to May. Temperature forecasts are given for January to December

Season: -- Season DJF --
 Region: -- NORTH AFRICA --
 Element: -- 2m Temperature --
 Zoom ++ Zoom -- Show product

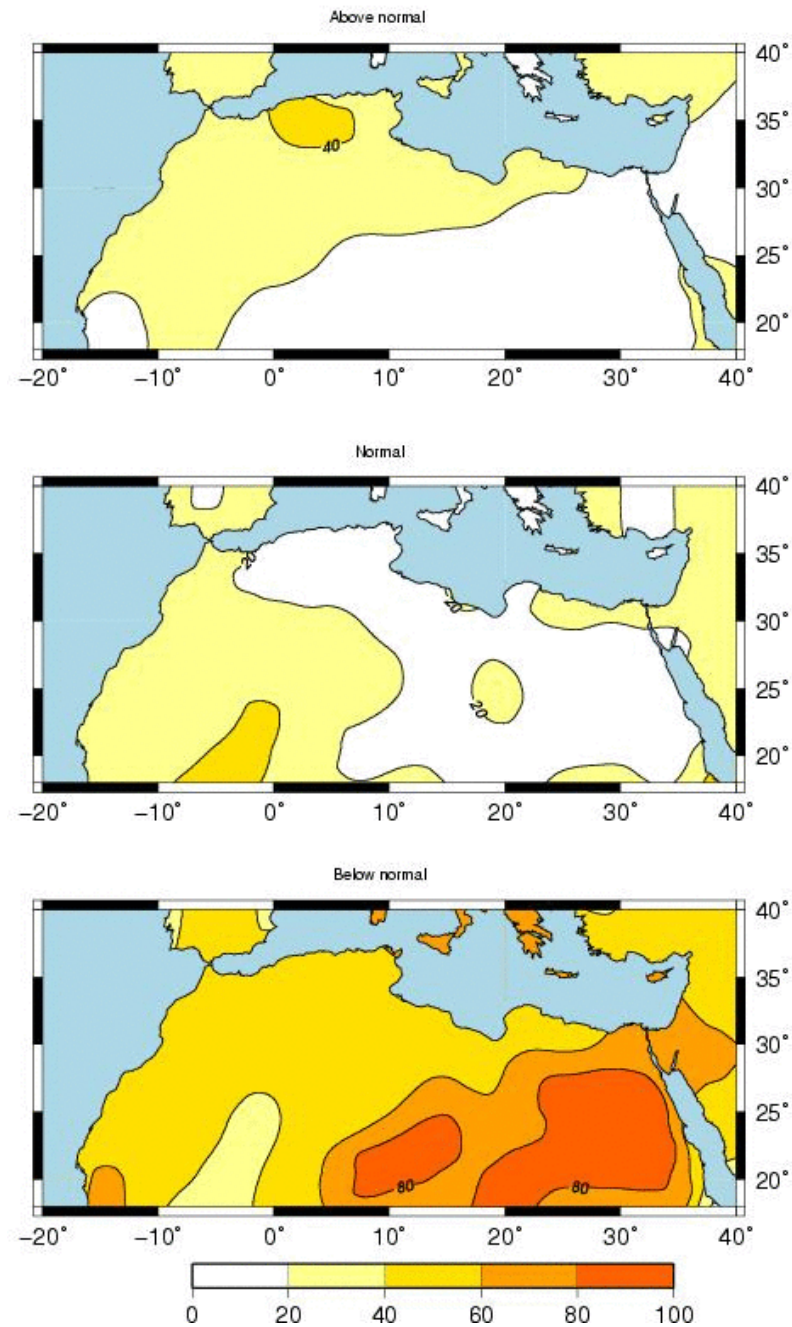
Probability of failure category of 2m temperature for DJF 2013 (ARPEGE-Climate coupled model, issued NOVEMBER 2013)



Probability of tercile category of 2m temperature for DJF 2013
(ARPEGE-Climat coupled model, issued NOVEMBER 2013)



Probability of tercile category of precipitation for DJF 2013
(ARPEGE-Climat coupled model, issued NOVEMBER 2013)



- Organigramme
- Coopération Internationale
- Temps prévu
- Climat
- Produits et Services
- Nos métiers
- Recherche-Développement
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- Météo de A à Z



North Africa RCC products
Seasonal forecast

- Verification
- Climate scenarios
- Seasonal outlook























Outlook for November-December-January 2013/2014 over North Africa

The overall analysis of temperatures forecasts issued from different models for NDJ 2013/2014 shows probably normal to above normal conditions over Morocco, Libya and Egypt. No special scenario is found over Algeria and Tunisia. For precipitation, normal to below normal conditions are likely over North African countries except Egypt where normal to above normal conditions are more likely.

P.S: We note that seasonal forecasts issued from ARPEGE-Climat are given in probabilistic form from March 2013

Tables summarizing seasonal forecast for November-December-January 2013
in North Africa

1- Seasonal temperatures forecast

Model	Morocco	Algeria	Tunisia	Libya	Egypt
<i>ARPEGE-Climat</i>	 N  S			 to 	
<i>ECMWF</i>		 N  S		 to 	 to 
<i>UK Met-Office</i>				 to 	 to 
Synthesis	Probably normal to above normal	No special scenario	No special scenario	Probably normal to above normal	Probably normal to above normal

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Maroc Météo

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Accueil

Verification

Season

-- JAS --

Element

-- TEMPERATURE--

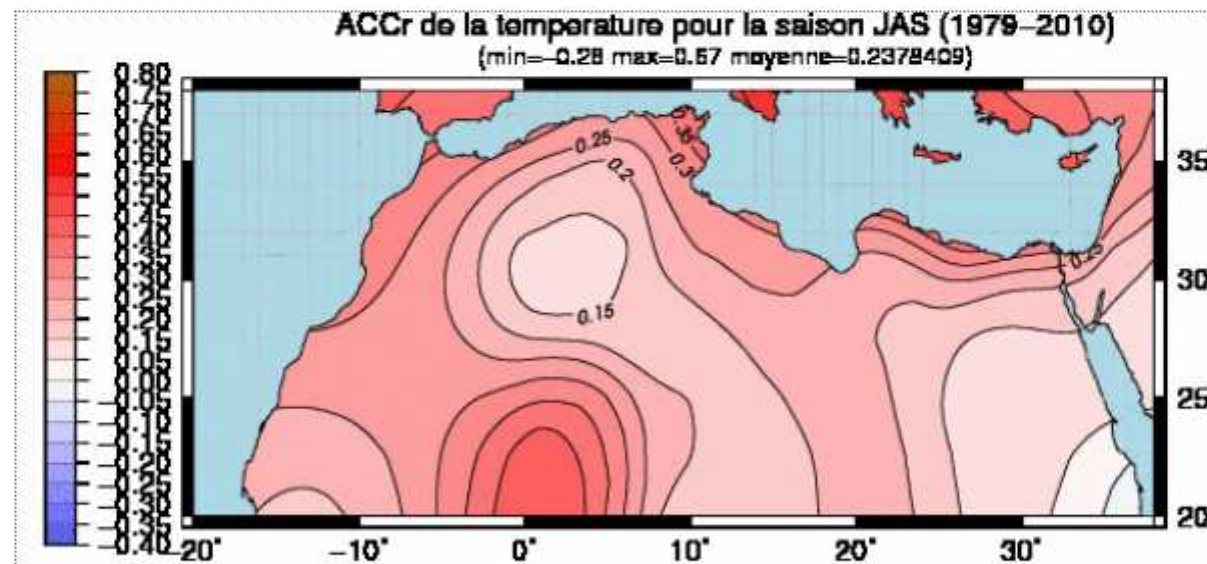
Verification skill

-- ACC --

Show

Zoom ++

Zoom --



Espace client

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[Organigramme](#)

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[Charte d'audit interne](#)

[Météo de A à Z](#)



Accueil

Verification

Season

-- OND --

Element

--PRECIPITATION--

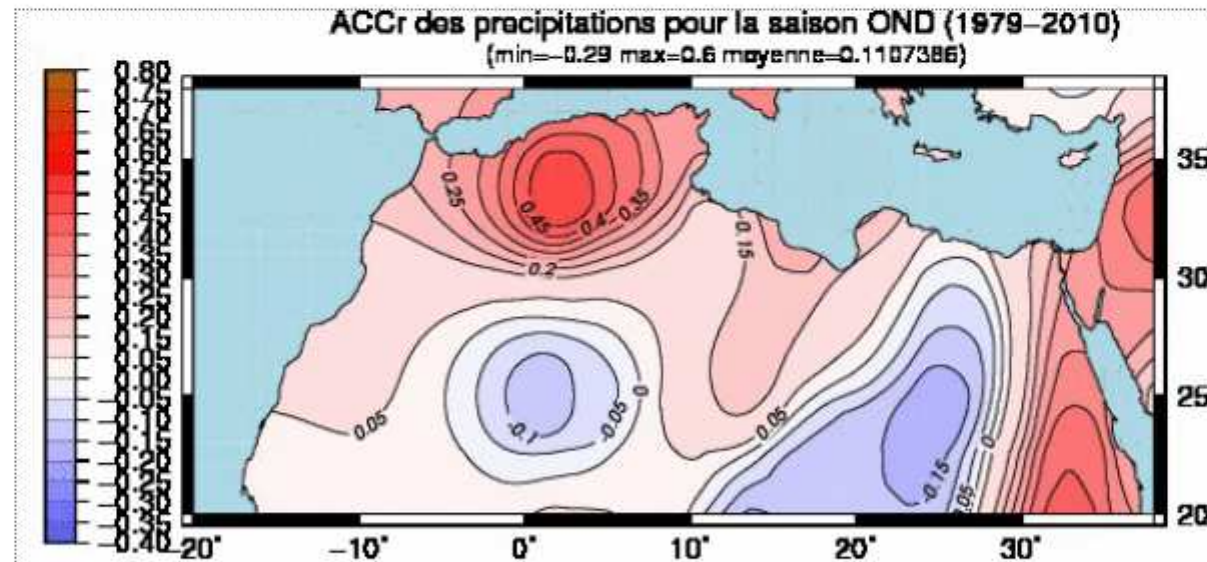
Verification skill

-- ACC --

Show

Zoom ++

Zoom --



North African Regional Climate Center



THANK YOU

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Maroc Météo

Mieux nous connaître

Missions

Organigramme

Coopération Internationale

Temps prévu

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Démarche Qualité

Charte d'audit interne

Météo de A à Z



North Africa RCC products

Seasonal forecast

Verification

Climate scenarios

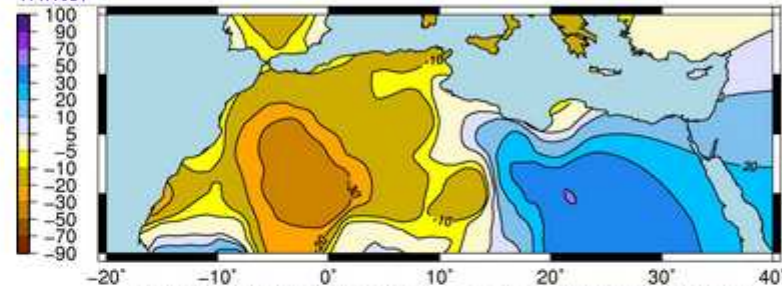
Seasonal outlook

Future changes

Description

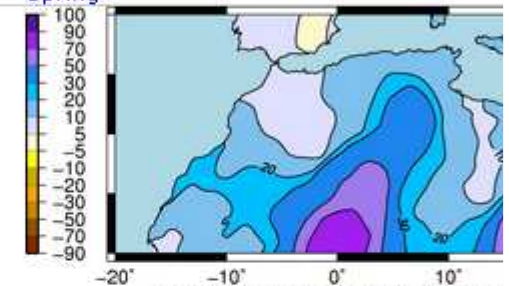
Future changes for mean precipitation average (pav)

Winter



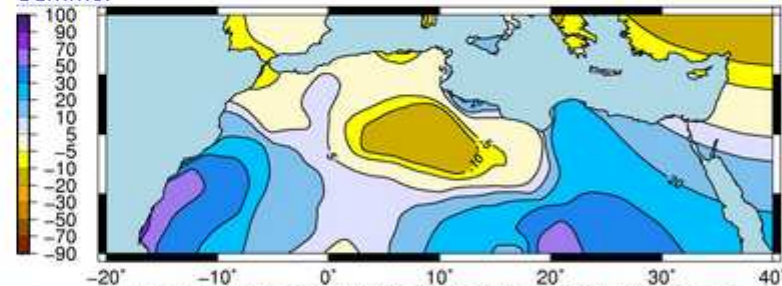
Future changes of DJF mean precipitation as projected by ARPEGE-Climat model under the scenario IPCC-A1B
Future period 2021-2050 compared to the reference period 1971-2000. Authors: Driouch Fatima, El haz Khalid
Note: Raw outputs of daily precipitation have been masked available by Michel Dégué (Météo France)

Spring



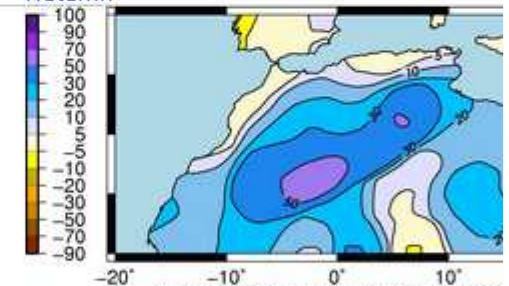
Future changes of MAM mean precipitation as projected by ARPEGE-Climat model under the scenario IPCC-A1B
Future period 2021-2050 compared to the reference period 1971-2000. Authors: Driouch Fatima, El haz Khalid
Note: Raw outputs of daily precipitation have been masked available by Michel Dégué (Météo France)

Summer



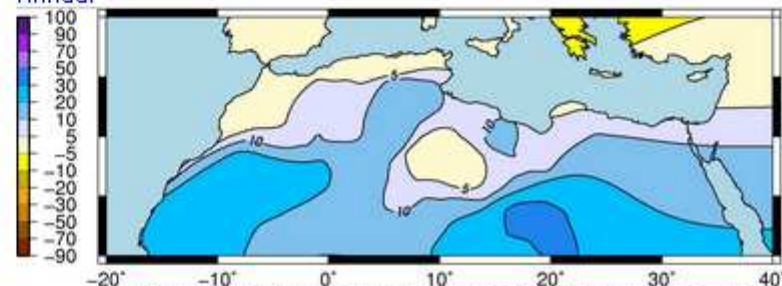
Future changes of JJA mean precipitation as projected by ARPEGE-Climat model under the scenario IPCC-A1B
Future period 2021-2050 compared to the reference period 1971-2000. Authors: Driouch Fatima, El haz Khalid
Note: Raw outputs of daily precipitation have been masked available by Michel Dégué (Météo France)

Autumn



Future changes of SON mean precipitation as projected by ARPEGE-Climat model under the scenario IPCC-A1B
Future period 2021-2050 compared to the reference period 1971-2000. Authors: Driouch Fatima, El haz Khalid
Note: Raw outputs of daily precipitation have been masked available by Michel Dégué (Météo France)

Annual



Future changes of YEAR mean precipitation as projected by ARPEGE-Climat model under the scenario IPCC-A1B
Future period 2021-2050 compared to the reference period 1971-2000. Authors: Driouch Fatima, El haz Khalid
Note: Raw outputs of daily precipitation have been masked available by Michel Dégué (Météo France)

Evaluation of seasonal forecast over North Africa compared with reanalyses

	Modèle		Réanalyses	
Type	ARPEGE-ClimatCouplé		Précipitations	Température
	Modèle atmosphérique	Modèle océanique	GPCP NOAA	ERA-intérim ECMWF
	ARPEGE 4.6	OPA8.2		
Résolution	2.8°x2.8°		2.5°x2.5°	0.562°x0.562°
Période d'évaluation	1979 - 2010			
Domaine d'étude	Afrique du Nord			

Skill scores used

- Coefficient de Corrélation des Anomalies (ACCr) :

$$ACCr = \frac{\sum_{i=1}^N w_i (p_i - \bar{p})(o_i - \bar{o})}{\sqrt{\sum_{i=1}^N w_i (p_i - \bar{p})^2 \sum_{i=1}^N w_i (o_i - \bar{o})^2}}$$

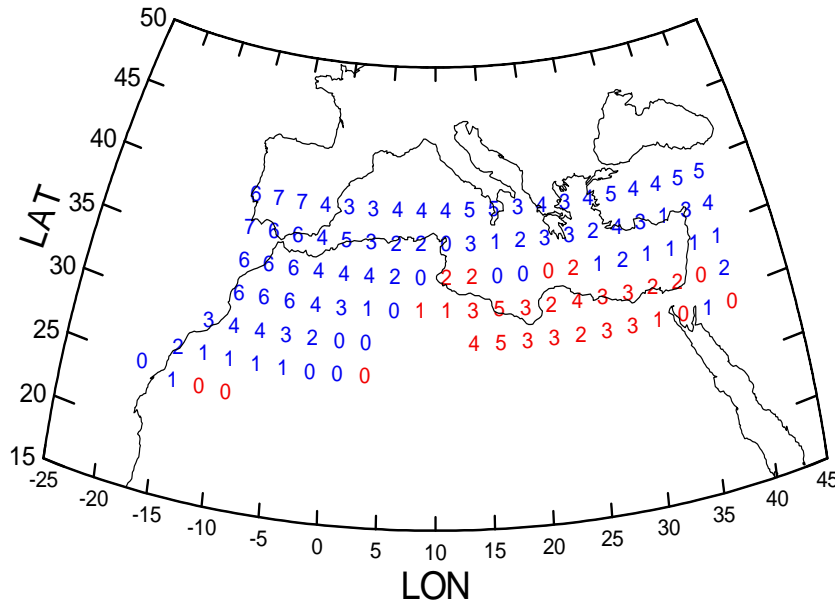
- Erreur Quadratique Moyenne (RMSE) :

$$RMSE = \sqrt{\frac{1}{W} \sum_{i=1}^N w_i (p_i - o_i)^2}$$

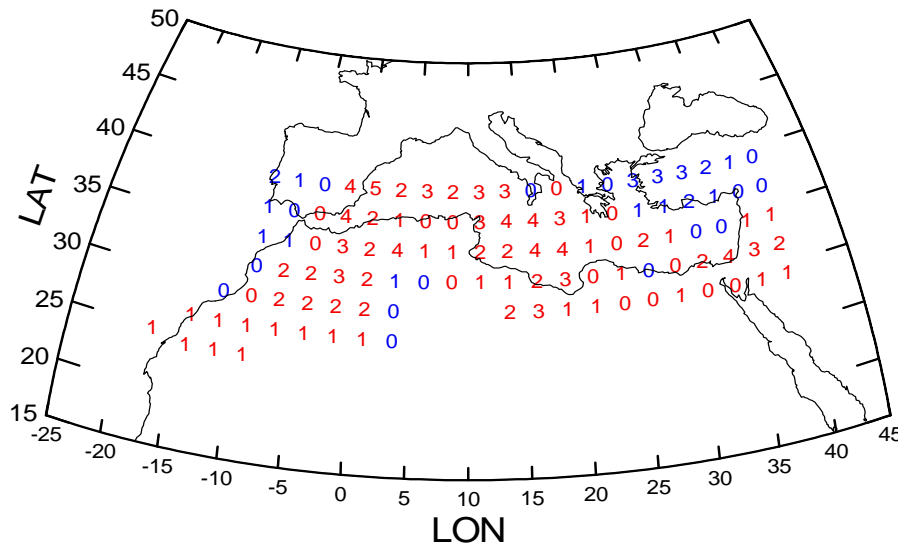
- Mean Square Skill Score (MSSS) :

$$MSSS = 1 - \frac{MSE_{prév}}{MSE_{réf}}$$

Correlation (*10), Red = positive, Blue = negative



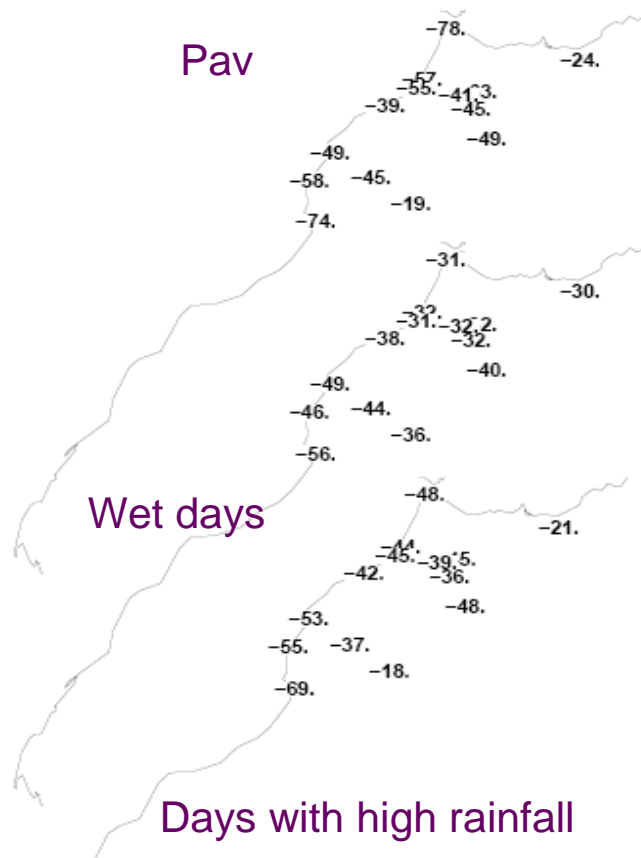
Jan-Feb NAO
Versus
Jan-Feb precipitation



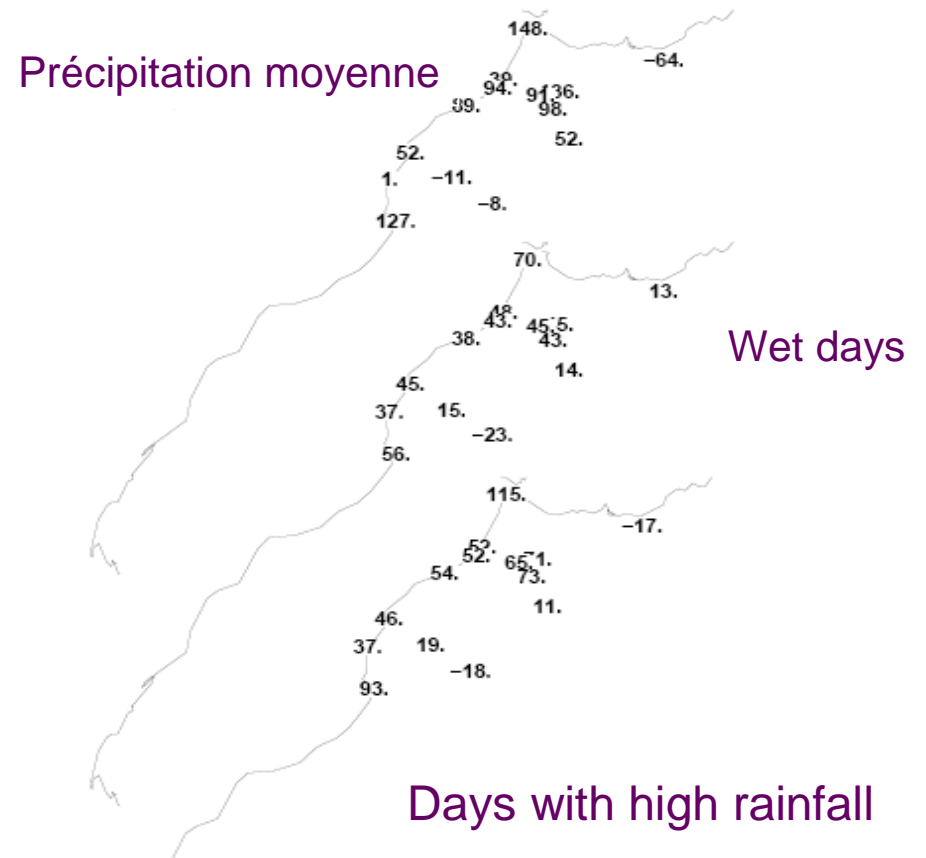
Oct-Nov NAO
Versus
Oct-Nov precipitation

Taken from Neil Ward presentation done in Rabat, Morocco - November 15th, 2012

Régime zonal (NAO+)



Anticyclone groenlandais (NAO-)



Observed relative changes (%) in mean precipitation , the frequency of wet days and the frequency of intense precipitation days for NAO+ and NAO- (Z500 weather regimes).

NAO seems to have an influence on temperature extremes that relationships tend to be stronger with warm extremes than cool extremes.

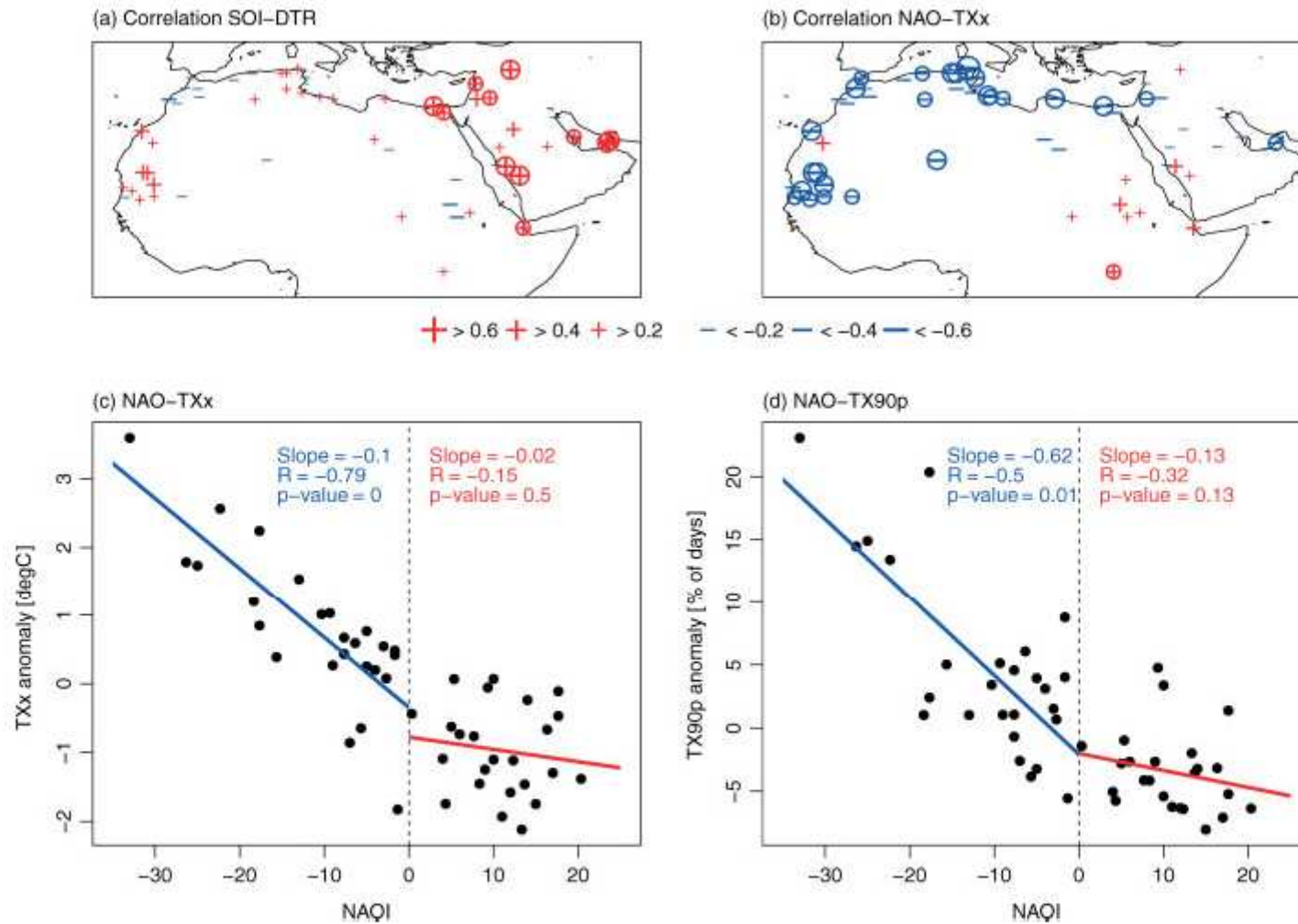
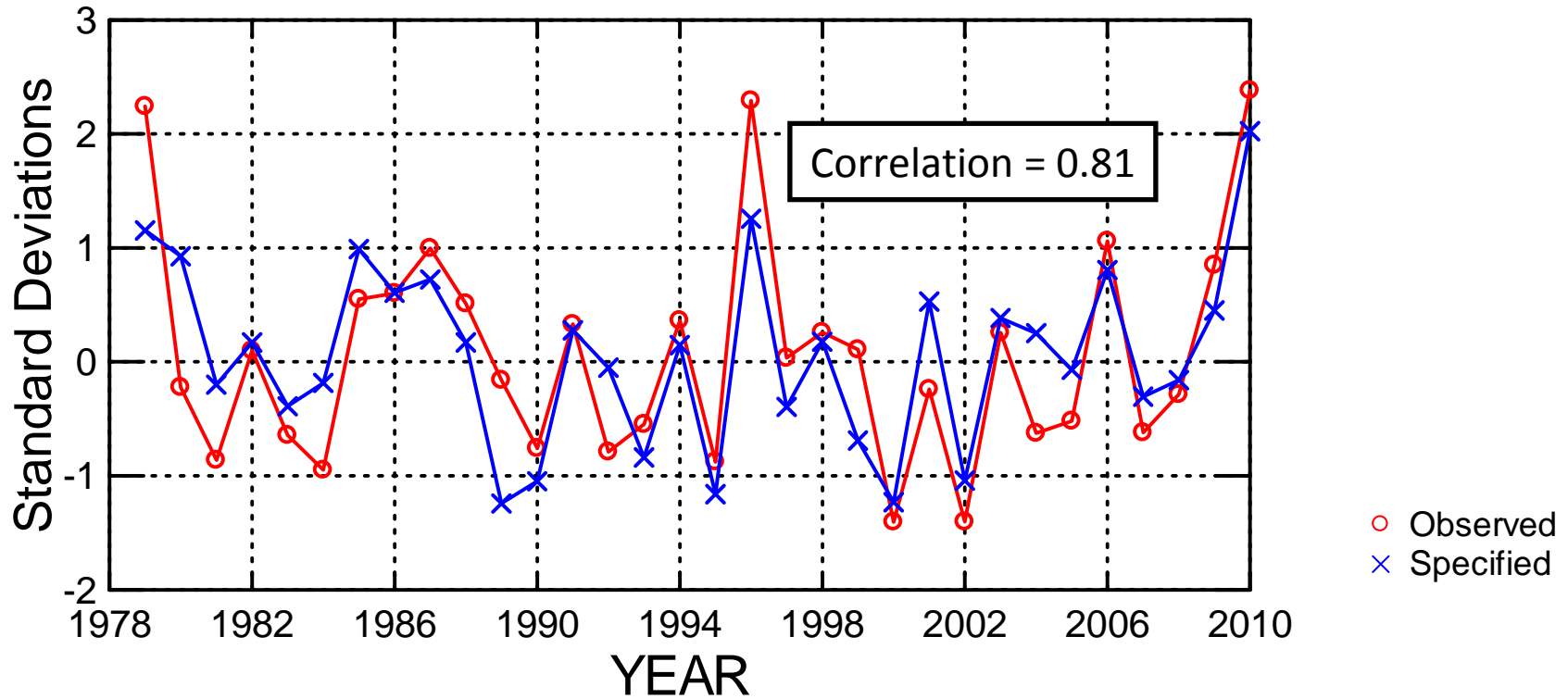


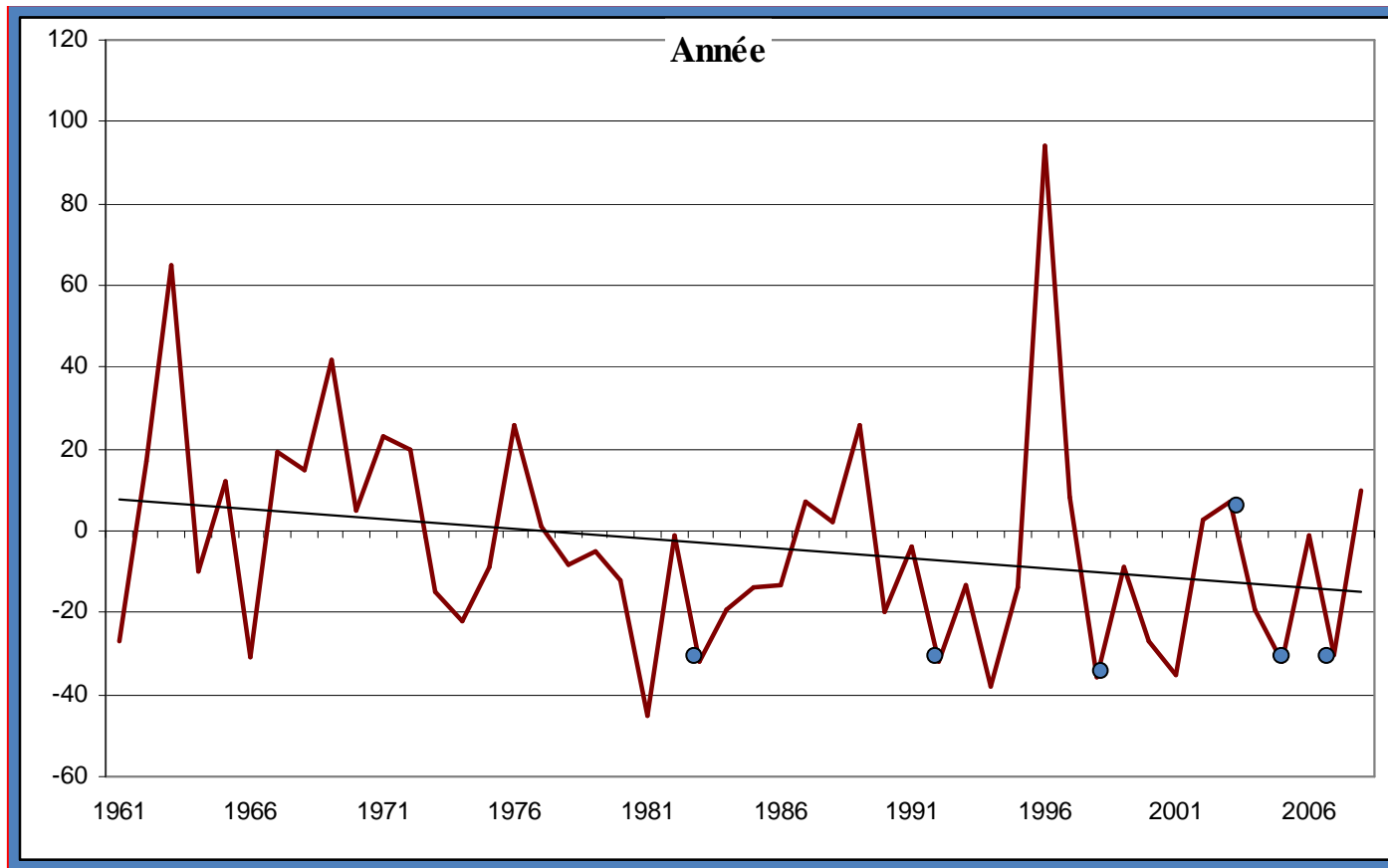
Figure 6. Relationship between chosen extreme indices and ENSO or NAO during boreal winter (DJF). (a) Spearman rank correlation between DTR and the SOI index, (b) correlation between TXx and NAO, + (–) indicate positive (negative) correlations. Significant correlations ($p \leq 0.05$) are marked with a circle. Correlations are calculated for as long as each station provides homogeneous data. (c) Scatter plot for de-trended area-average TXx anomalies during 1961–2010 in the western part of the investigation area (Mauritania, Morocco, Algeria, Tunisia, Libya) and NAO, (d) as (c) but for TX90p.

Regression Prediction of Jan-Feb Region 1 rainfall from Jan-Feb values of NAO index and Scandinavian index



Rainfall region as given in previous slide
NAO and Scandinavian atmospheric mode indices from NOAA/CPC

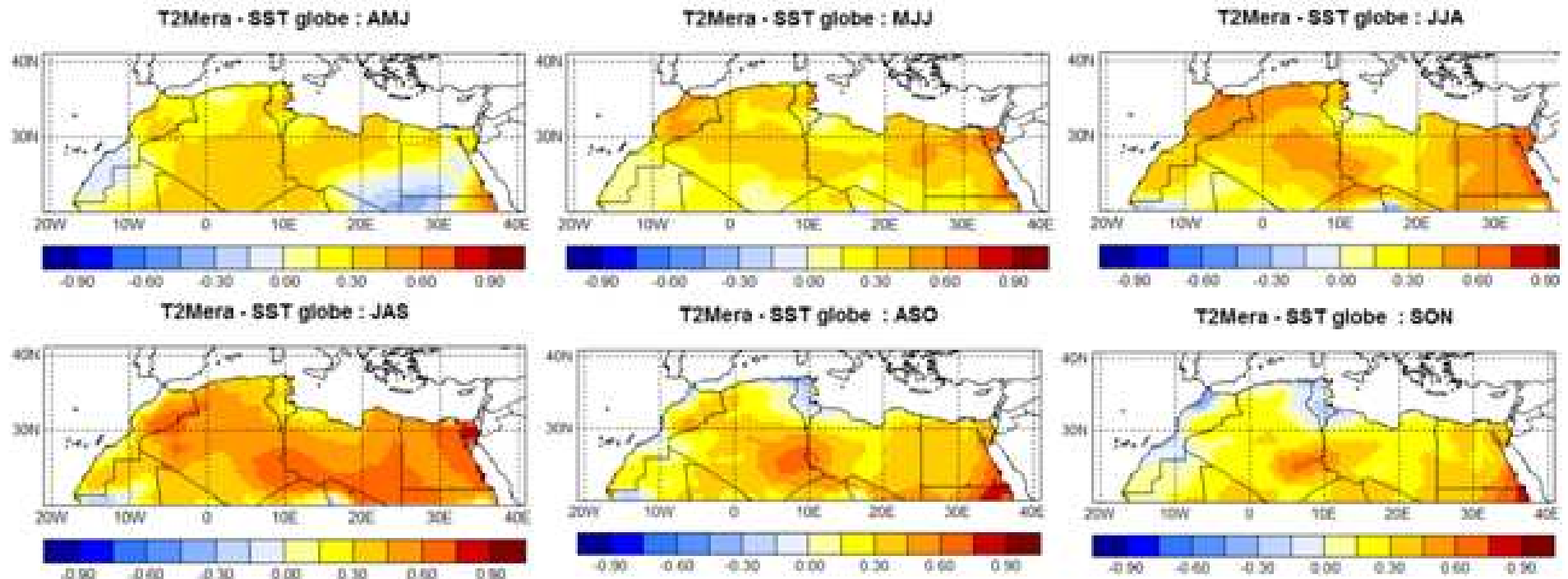
Taken from Neil Ward presentation done in Rabat, Morocco - November 15th, 2012



Nicholson and Kim (1997) and Ward et al. (1999) shows some influence of ENSO on north-west African rainfall: the positive phase leads to fewer precipitation in spring. Knippertz et al. (2003) for 1982-1983 and 1991-1992

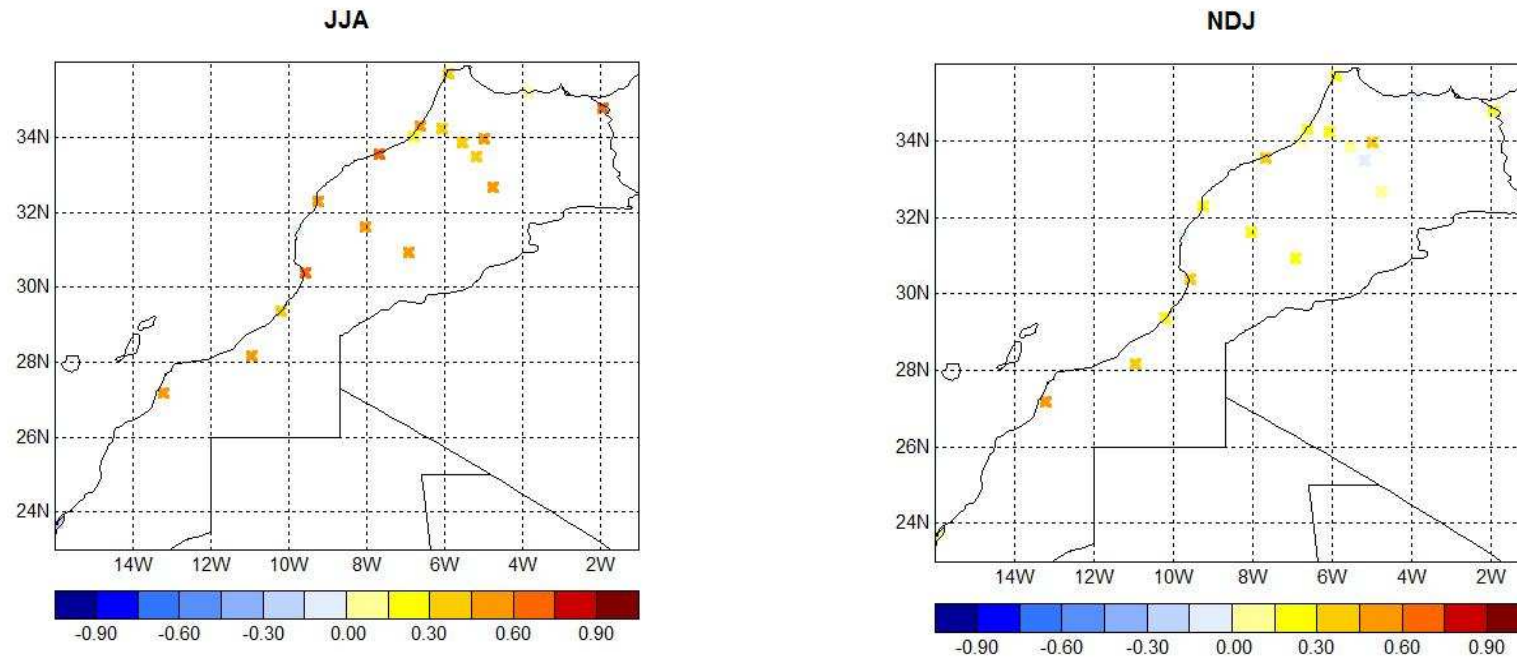
The spring of the second year was dry in many Moroccan stations: 1983, 1992, 1998, 2003, 2005 et 2007 (driouech (2010))

Correlation between observed and predicted air temperature based on SST



Corrélation entre les températures ERA-intérim et celles prévues par la méthode ACC appliquée sur la SST du globe et testée par la cross-validation. Les corrélations supérieures à 0.3 sont significatives à 90% par un t-test.

Impact SST du globe sur les températures à 2m issues de 20 stations synoptiques du MAROC

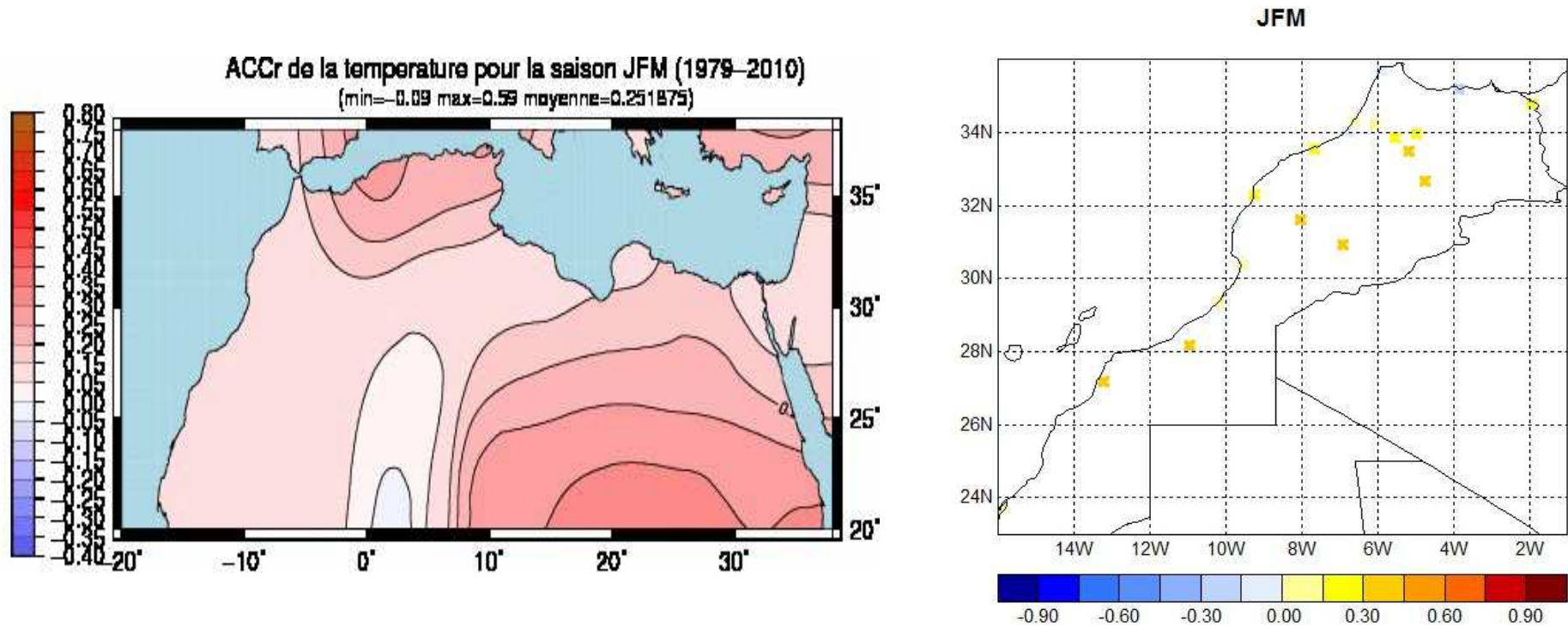


Champ de corrélation entre les températures synoptiques et celles prévues par la méthode RCP appliquée sur la SST du globe

C/C :-La majorité des stations synoptiques ont manifesté une prévisibilité depuis le début MAM jusqu'à la fin de la période chaude (ASO)

-Alors que, pendant la période froide (de SON à FMA) la prévisibilité est généralement faible dans la plupart des stations.

Apport de l'adaptation statistique utilisant Z500 issue d'ARPEGE-Climat pour la T2m sur le Maroc



C/C : L'utilisation de l'adaptation statistique a permis d'améliorer la performance de la prévisibilité des températures à2m sur le Maroc pour les saisons JFM, FMA et MAM (fin d'hiver et printemps)

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