ANNUAL JOINT WMO TECHNICAL PROGRESS REPORT

ON THE GLOBAL DATA-PROCESSING AND FORECASTING SYSTEM (GDPFS)

INCLUDING NUMERICAL WEATHER PREDICTION (NWP) RESEARCH ACTIVITIES FOR 2017

MOROCCO

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1. Summary of highlights

Being a member of ALADIN-HIRLAM consortia, and a cooperating member of European Center for medium-range weather forecast, Morocco NWP team continues to develop and adjust the local operational and no-operational suites in order to have more accurate weather forecast and help in decision making.
Thus the last NWP activities focused especially on two aspects: the introduction of more local observations in the data assimilation system, and the increasing of the mesh size of the operational configurations reaching kilometric scales.

The focus of DMN on marine prediction is essentially on installing and adjusting the latest version of the WaveWatch III numerical model.

The Moroccan Meteorological Service (referred in the document as DMN) has been designated officially in 2015 as a Global Information System Center of the WMO information system (WIS) and as a consequence the DMN is responding to the technical specifications required for such centers as described in the WMO manual on WIS N°1060.
DMN is also linked to the RMDCN since 2010. This link has been upgraded in 2016 to reach a speed rate of 2Mbps with an RNIS backup.
DMN is also using high speed internet connections for distant access. This kind of links is used, for example, as a backup for the upload from Météo France of nesting files for NWP purposes.

2. Equipment in use at the Centre

- ***Computing and data-processing Systems (IBM HPC) :***
  - 9 Physical Blade Center H :
    114 shared memory nodes : 4 cores each, 16GB memory
    2 shared memory nodes : 8 cores each, 32GB memory
    CPU : RISC/UNIX IBM Power6+ @4.2 GHz
  - 6 P520 network and I/O nodes, 8 cores, 16GB memory
  - 2 Switch InfiniBand for I/O and MPI

    ~475 core in total
    ~ 1.95 TB memory,
    ~ 8.3 Tflops theoretical peak performance for application
    ~ 250 + 52 TB disk space

- ***Archiving System :***
  IBM TS 3310, 4 drives, LTO4 cartridges, capacity: 170 To.

IBM TS4500, 12 drives, LTO6 cartridges, capacity 2.2 Po.

- ***Storage Systems :***
  - IBM DS4700. SATA disks. Capacity: 16 To.
  - IBM DS5100. SATA &FC disks. Capacity: 52 To.
  - IBM V5000. LFF & SFF disks. Capacity 250 To.

- ***GTS management :***
  A dedicated solution for **GISC,** an Automatic Message Switching System Cluster (**TRANSMET**) and a dedicated solution for the dissemination of products (**DIFMET**) that includes:
  - Computer Server types: Cluster **of 11** servers HP PROLIANT DL 360 G8.
  - OS: Linux centos 5.4.
  - RDBMS: Postgres & SQLite.
  - Open WIS solution for the GISC

  The reception of products from abroad (Météo-France in particular) is done through a **RMDCN connection** (2Mbps with a back up based on RNIS connection).

  The dissemination of products (from GTS included) to local and regional services within the country is made through WAN communication based on VPN MPLS connections.

- ***Data processing and visualization system :***
  - Tool for gathering information, visualizing, forecasting and warnings (**SYNERGIE**).
  - Computer Server type: Cluster of 2 HP Proliant ML370 .
  - OS: Linux whitebox 3,0.
  - RDBMS: ORACLE 8i.
  - RAID 5 configuration.

- ***Dedicated solution for the management of Met-aeronautical products (Sadis)***
  - Tool for gathering and visualizing met aeronautical information (**SADIS**).
  -Computer Server type: Cluster of 2 HP Proliant ML370 G4.
  - OS: Linux Centos 3.8.
  - RDBMS: ORACLE 8i.
  - RAID 5 configuration.
- ***Central solution for the concentration of the data received from the Moroccan automatic weather observing stations network (156 AW0S)***
  - Computer servers type: a cluster of 12 servers HP DL380 G7
  - Dedicated software (CIMNET, UDCS, CLDB)

3. Data and Products from GTS in use

DMN is using not only all kind of products that are exchanged in the GTS but also those disseminated through EUMETCAST. The SADIS system is used as a primary access to met-aeronautical data and products even those that are already available in the GTS.

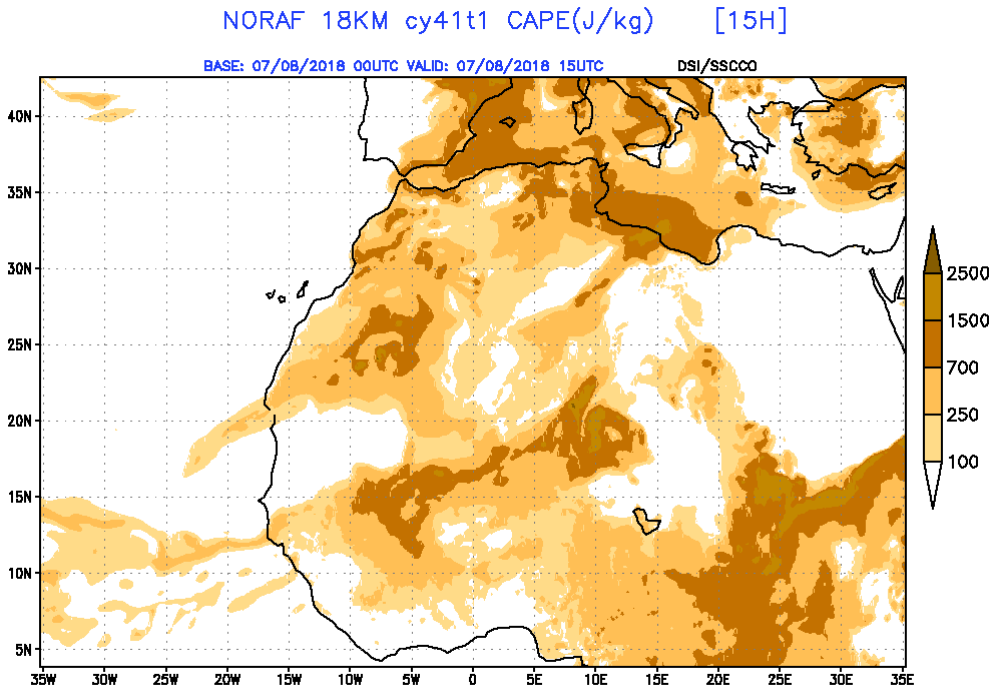
4. Forecasting system

4.1. System run schedule and forecast ranges

The operational forecast system at DMN is based on five configurations of the ALADIN/AROME code :

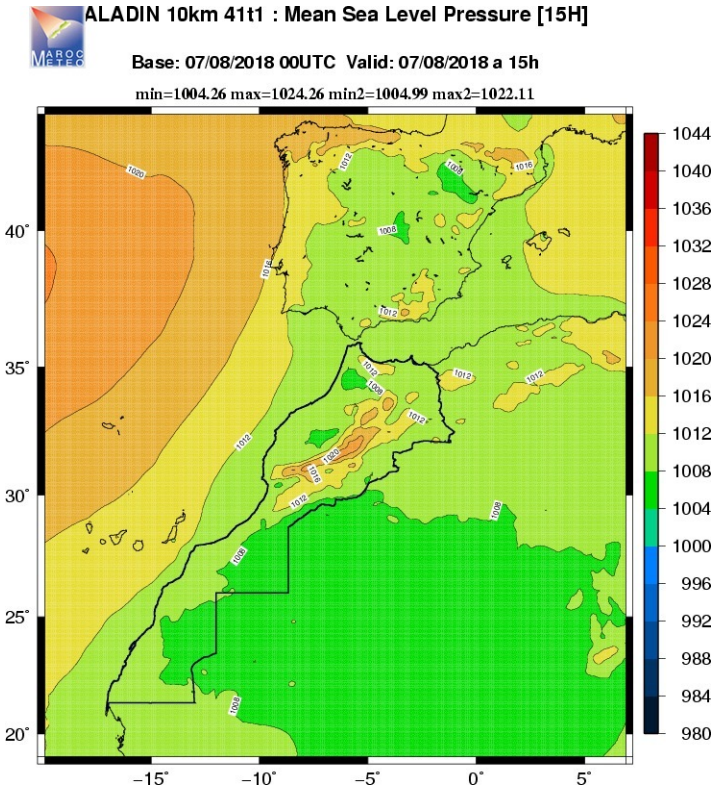
(a) NORAF configuration :

- 0000 UTC and 1200 UTC (Range 72H).
- Covers the North of Africa, 18 Km of horizontal resolution, 70 vertical levels
- Code cycle : cy41t1



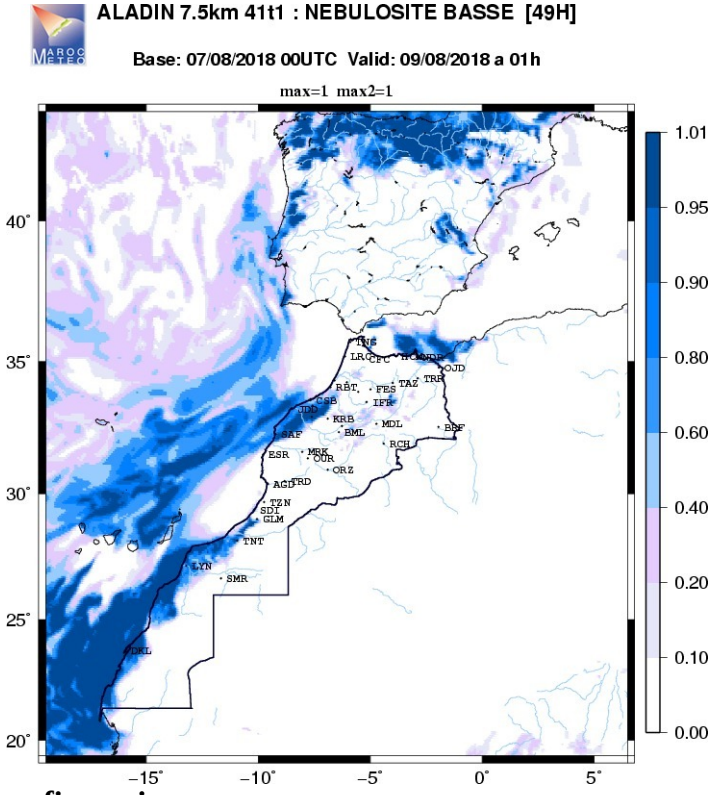
(b) ALBACHIR configuration :

- 0000 UTC and 1200 UTC (Range 72H).
- Covers the Moroccan area, 10 Km of horizontal resolution, 70 vertical levels.
- Code cycle : 41t1



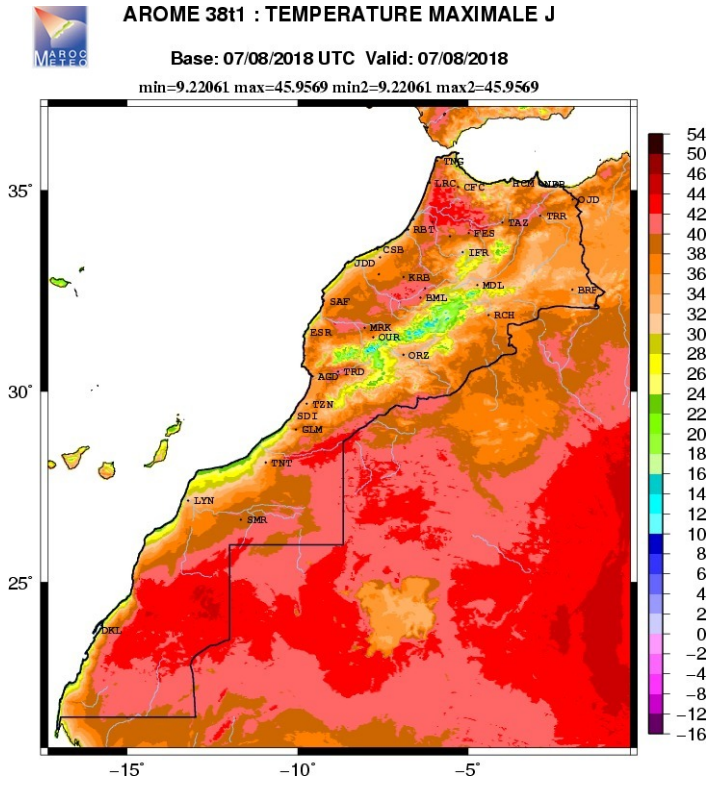
(c) ALADIN-MAROC configuration :

- 0000 UTC and 1200 UTC (Range 72H).
- Covers the Moroccan area, 7.5 Km of horizontal resolution, 70 vertical levels.
- Code cycle : 41t1 with SURFEX activation



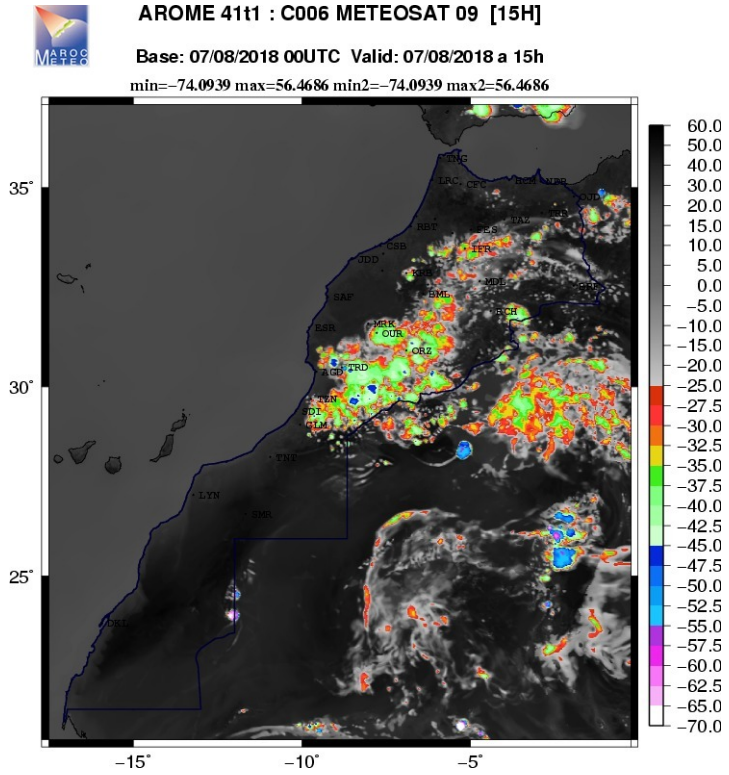
(d) AROME-38t1 configuration :

- 0000 UTC and 1200 UTC (Range 48H).
- Covers MOROCCO area; 2.5 Km of horizontal resolution, 60 vertical levels.
- Code cycle : 38t1



(e) AROME-MAROC configuration :

- 0000 UTC and 1200 UTC (Range 48H).
- Covers MOROCCO area; 2.5 Km of horizontal resolution, 90 vertical levels.
- Code cycle : 41t1



4.2. Medium range forecasting system (4-10 days)

4.2.1 Data assimilation, objective analysis and initialization

4.2.1.1 In operation

4.2.1.2 Research performed in this field

4.2.2 Model

4.2.2.1 In operation

4.2.2.2 Research performed in this field

4.2.3 Operationally available Numerical Weather Prediction (NWP) Products

4.2.4 Operational techniques for application of NWP products (MOS, PPM, KF, Expert Systems, etc.)

4.2.4.1 In operation

Prediction of daily extreme temperatures over synoptic stations by using model output statistics.

4.2.4.2 Research performed in this field

4.2.5 Ensemble Prediction System (EPS) (Number of members, initial state, perturbation method, model(s) and number of models used, number of levels, main physics used, perturbation of physics, post-processing: calculation of indices, clustering)

4.2.5.1 In operation

4.2.5.2 Research performed in this field

4.2.5.3 Operationally available EPS Products

4.3. Short-range forecasting system (0-72 hrs)

4.3.1 Data assimilation, objective analysis and initialization

One of the forecasting systems is based on AROME initialized by a 3DVAR technique. The cycling period is each 3 hours assimilating conventional, GPS and ATOVS data. The B-matrix used is ensemble one, the horizontal resolution of 2.5Km and 90 vertical levels are used.

The data in use in the 3DVAR assimilation system are coming from both the GTS and other local observing systems. Local processing is done for each type of data. The following data are assimilated: SYNOP, TEMP, AIREP, DRIBU, ATOVS and GPS.

Local observing systems are mainly automatic synoptic stations and GPS. In fact, more than 150 synoptic automatic stations are locally processed and monitored and then added to the local database as input to the data assimilation system.

Also, the processing of 10 local GPS stations in addition to other GPS in the region, is locally done using Bernese, in near real time. The Zenithal total delay is then produced and introduced to the 3DVAR assimilation System.

4.3.1.1 In operation

4.3.1.2 Research performed in this field

The assimilation in a 3DVAR framework of the Moroccan Radar QPE adjusted by rain gauges using 1DVAR +3DVAR approach is under tests within the NWP team.

Also, the 3DVAR assimilation of gradients from GPS observations is a field of research in Morocco.

4.3.2 Model

4.3.2.1 In operation

NORAF :

Domain size	324x540
Horizontal resolution	18 Km
Number of layers	70
Time step	600 sec

Forecast range	72hrs
Initial time of model run	00/12 UTC
Lateral boundary conditions	ARPEGE
L.B.C. update frequency	6 hours
Initial state	ARPEGE analysis in dynamical adaptation mode
Initialisation	Incremental DFI
Status	Operational
Code cycle	41t1
Hardware	IBM HPC
N° of processors used	128 + 8

ALBACHIR :

Domain size	320x320
Horizontal resolution	10 Km
Number of layers	70
Time step	300 sec
Forecast range	72hrs
Initial time of model run	00/12 UTC
Lateral boundary conditions	ARPEGE
L.B.C. update frequency	3 hours
Initial state	ARPEGE analysis in dynamical adaptation mode
Initialisation	Incremental DFI
Status	Operational
Code cycle	41t1
Hardware	IBM HPC
N° of processors used	128 + 8

ALADIN MAROC :

Domain size	400x400
Horizontal resolution	7.5 Km
Number of layers	70
Time step	300 sec
Forecast range	72hrs
Initial time of model run	00/12 UTC
Lateral boundary conditions	ARPEGE
L.B.C. update frequency	3 hours
Initial state	ARPEGE analysis in dynamical adaptation mode
Initialisation	Incremental DFI
Status	Operational
Code cycle	41t1 with SURFEX activated
Hardware	IBM HPC
N° of processors used	128 + 8

AROME 38t1 :

Domain size	800x800
Horizontal resolution	2.5 Km
Number of layers	60
Time step	60 sec
Forecast range	48hrs
Initial time of model run	00/12 UTC
Lateral boundary conditions	ALBACHIR

L.B.C. update frequency	1 hours
Initial state	ALBACHIR in dynamical adaptation mode
Status	Operational
Code cycle	38t1
Hardware	IBM HPC
N° of processors used	320 + 80

AROME MAROC :

Domain size	800x800
Horizontal resolution	2.5 Km
Number of layers	90
Time step	60 sec
Forecast range	48hrs
Initial time of model run	00/12 UTC
Lateral boundary conditions	ALBACHIR
L.B.C. update frequency	1 hours
Initial state	ALBACHIR in dynamical adaptation mode
Status	Operational
Code cycle	38t1
Hardware	IBM HPC
N° of processors used	352 + 80

4.3.2.2 Research performed in this field

4.3.3 Operationally available NWP products

4.3.4 Operational techniques for application of NWP products (MOS, PPM, KF, Expert Systems, etc..)

4.3.4.1 In operation

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4.3.4.2 Research performed in this field

Study of the vertical wind shear forecasted by AROME-MAROC model for aeronautic use : The vertical wind shear is computed from AROME-MAROC output for every 30 meters between the surface and 500 meters and every 3 hours in order to help the aeronautic forecasters lo localise the zones where there is a risk of strong wind shear.

4.3.5 Ensemble Prediction System (Number of members, initial state, perturbation

method, model(s) and number of models used, perturbation of physics, post-processing: calculation of indices, clustering)

4.3.5.1 In operation

4.3.5.2 Research performed in this field

4.3.5.3 Operationally available EPS products

4.4 Nowcasting and Very Short-range Forecasting Systems (0-12 hrs)

4.4.1 Nowcasting system

4.4.1.1 In operation

A fog nowcasting system is operated for Mohamed V (GMMN) international airport. It makes use of the single column detailed physics COBEL-ISBA model and conventional and mast measurements.

4.4.1.2 Research performed in this field

A first version of the meteorological high-resolution prediction system based on AROME mesoscale model has been developed with a 1.3km resolution and 90 vertical levels over limited area containing the main national airports. This prototype has been assessed over a winter period for its ability to well predict the onset and dissipation of fog based on liquid water content at the lowest level in the atmospheric boundary layer.

A variety of machine learning techniques are currently being tested for fog and low cloud detection and estimation of visibility and cloud ceiling height from conventional meteorological parameters and satellite data.

Note: please also complete the CBS/PWS questionnaire on Nowcasting Systems and Services,

(2014)

4.4.2 Models for Very Short-range Forecasting Systems

4.4.2.1 In operation

4.4.2.2 Research performed in this field

4.5 Specialized numerical predictions (on sea waves, storm surge, sea ice, marine pollution transport and weathering, tropical cyclones, air pollution transport and dispersion, solar ultraviolet (UV) radiation, air quality forecasting, smoke, sand and dust, etc.)

4.5.1 Assimilation of specific data, analysis and initialization (where applicable)

4.5.1.1 In operation

4.5.1.2 Research performed in this field

4.5.2 Specific models (as appropriate related to 4.5)

DMN has made IT facilities available for air quality modelling projects. The models ADMS, AERMOD, MOCAGE and CAMS are used for air quality modelling purposes.

4.5.2.1 In operation

Air quality forecast models:

ADMS Urban: In 2012, DMN implemented the Casablanca-Air project whose main purpose was the implementation of a high-resolution monitoring and forecasting platform of air quality in the Casablanca metropolitan area. The Casablanca-Air system is based on the

street scale model ADMS Urban which is the most comprehensive version of the Atmospheric Dispersion Modelling System (ADMS) (Carruthers et al., 1997; McHugh et al., 1997) and is allowing 48 hours forecasting of air quality on daily basis (including NO2, SO2, O3 and PM10) at the scale of the Casablanca agglomeration (Fig.1). It uses the topographic data of the city, weather conditions, local emissions (emissions inventory on the city) and observations from 13 measuring stations implemented in the area. The main features of ADMS-Urban system are:

- An advanced dispersion model in which the boundary layer structure is characterized by the height of the boundary layer and the Monin-Obukhov length, a length scale dependent on the friction velocity and the heat flux at the surface;
- A non-Gaussian vertical profile of concentration in convective conditions which allows for the skewed nature of turbulence within the atmospheric boundary layer that can lead to high concentrations near the source;
- A meteorological pre-processor which calculates boundary layer parameters from a variety of input data, meteorological input data are issued from the ALADIN Moroccan forecasting model;
- An integrated street canyon model;
- The calculation of flow and dispersion over complex terrain.

Fig. 1 The Grand Casablanca Area: the Domain map for Urban Air.

MOCAGE: In the framework of the cooperation between DMN and Météo-France, the forecasting chain of the French air quality model, MOCAGE, on the domain of Morocco resumed in early 2018 in operational daily basis.

The MOCAGE (MOdèle de Chimie Atmosphérique à Grande Echelle) is a three-dimensional chemistry-transport model that simulates the interactions between dynamic, physical and chemical phenomena from the regional to the global scales. It allows air quality forecasting and may be part of the public alert system.

MOCAGE takes into account both gaseous species and aerosols. It considers chemical reactions of 112 gaseous species and 7 aerosol species. The scheme used covers both the troposphere (RACM scheme) and the stratosphere (REPROBUS scheme) and details the chemistry of tropospheric ozone and its precursors (nitrogen oxides and volatile organic

compounds) and that of stratospheric ozone including catalytic processes related to chlorofluorocarbons and other brominated species.

The primary aerosols considered are desert dust, marine salts, carbon-soot, and organic carbon. Inorganic secondary aerosols (module ISORROPIA) are also taken into account such as Sulfate, Nitrate, Ammonium, etc

Currently, MOCAGE-Maroc runs daily for one day and produces NO2, SO2, O3, PM10, PM2.5 and CO forecasts. Its simulations are carried out on two nested domains: the globe at 1 ° of horizontal resolution and Morocco at 0.2 ° (Fig.2). 47 levels are used on the vertical, the top level is at 5 hPa. There are about 7 levels in the planetary boundary layer.

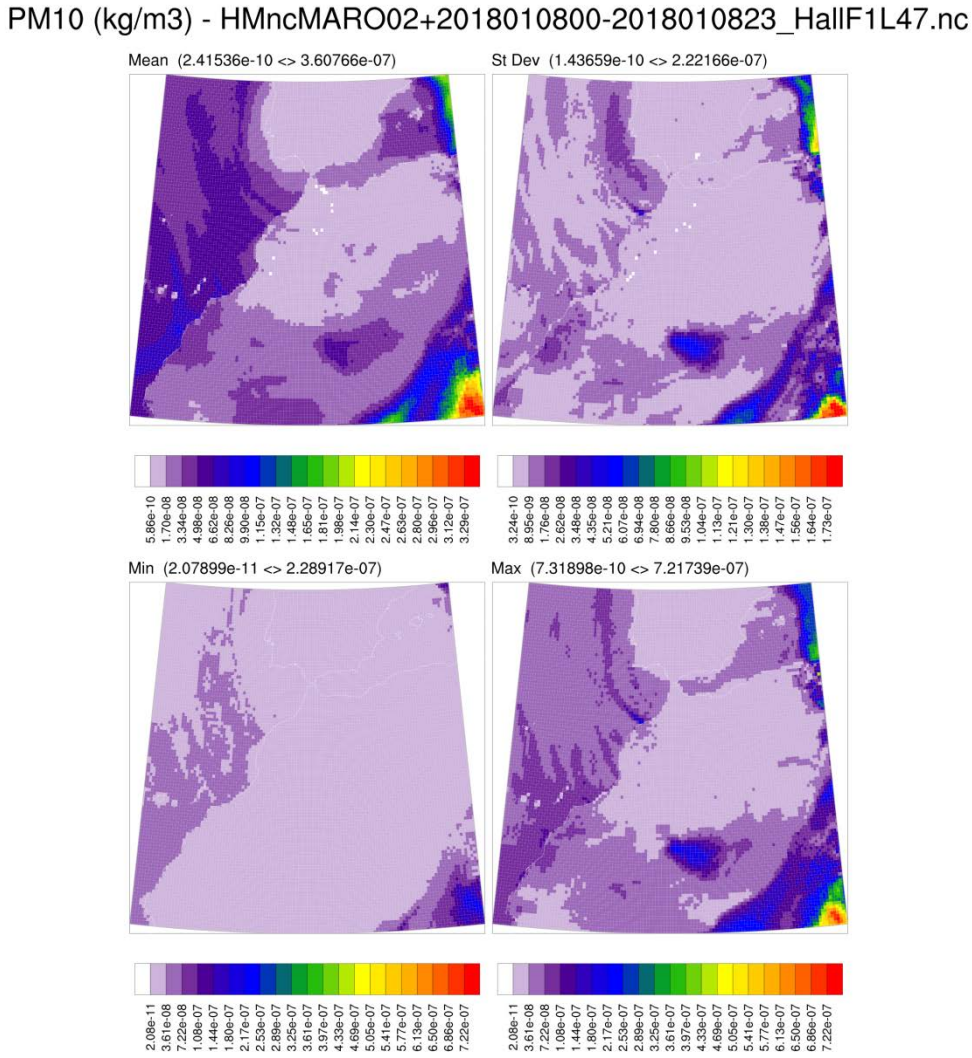

Fig. 2 Example of PM10 forecasting products from Mocage-Maroc

CAMS: Currently, DMN uses the products of the Copernicus Atmosphere Monitoring Service (CAMS) to follow air quality (NO2, SO2, O3, PM10, PM2.5 and CO) at the global and the country levels. Daily production of near-real-time analyses and 4 days' forecasts of global

atmospheric composition are regularly retrieved using password protected FTP account made available to DMN by ECMWF.

The CAMS uses a comprehensive global monitoring and forecasting system that estimates the state of the atmosphere on a daily basis, combining information from models and observations. The global modelling system is also used to provide the boundary conditions for an ensemble of more detailed regional air quality models that are used to zoom in on the north of Morocco and produce 4-day forecasts of air quality.

GLO (WaveWatch III):

Domain size	141x81
Horizontal resolution	1°
Coverage area	0N-80N ; 80W-60E
Time step	3600 sec
Forecast range	72hrs
Initial time of model run	00/12 UTC
Lateral boundary conditions	No data input
Wind input	IFS
Status	Operational
Code cycle	41t1
Hardware	IBM HPC
N° of processors used	8

IMB (WaveWatch III):

Domain size	28x139
Horizontal resolution	0.25°
Coverage area	10N-44.5N ; 35W-35E
Time step	3600 sec
Forecast range	72hrs
Initial time of model run	00/12 UTC
Lateral boundary conditions	No data input
Wind input	IFS
Lateral boundary conditions	GLO
L.B.C. update frequency	3 hours
Initial state	GLO
Status	Operational
Code cycle	41t1
Hardware	IBM HPC
N° of processors used	8

GLN (WaveWatch III):

Domain size	91x81
Horizontal resolution	1°
Coverage area	0N-80N ; 80W-10E
Time step	3600 sec
Forecast range	72hrs
Initial time of model run	00/12 UTC
Lateral boundary conditions	No data input
Wind input	BRACKNELL

Status	Operational
Code cycle	41t1
Hardware	IBM HPC
N° of processors used	8

IMN (WaveWatch III):

Domain size	237x217
Horizontal resolution	0.25°
Coverage area	10.15N-42.55N ; 25.5W-9.9E
Time step	3600 sec
Forecast range	72hrs
Initial time of model run	00/12 UTC
Lateral boundary conditions	No data input
Wind input	IFS
Lateral boundary conditions	GLN
L.B.C. update frequency	3 hours
Initial state	GLO
Status	Operational
Code cycle	41t1
Hardware	IBM HPC
N° of processors used	8

4.5.2.2 Research performed in this field

Pollutant transport and dispersion forecasts

Aermod: A gaussian model developed by the American Meteorological Society (AMS), it includes the PRIME (Plume Rise Model Enhancements) algorithm for modelling the effect of the downwash created by the pollution plume nearby buildings. It is an integrated atmospheric dispersion modelling system that includes three modules:

- Steady state dispersion model: short-term dispersion of air pollutant emissions from stationary industrial sources
- Meteorological Data Pre-processor (AERMET) that accepts surface weather data, elevation soundings and instrument tower data on site. It then calculates the atmospheric parameters necessary for the dispersion model
- A field pre-processor (AERMAP) whose main purpose is to provide the physical relationship between terrain characteristics and the air pollution plumes behaviour. It provides information that allows the dispersion model to simulate the effects of air flowing over hills or dividing to circulate around hills.

Aermod is used at DMN since 2012 for research purposes related to pollutants transport and dispersion modelling with the main objective of forecasting continuous or accidental dispersion of emitted pollutants

4.5.3 Specific products operationally available

Marine model

- Significant height of waves
- Mean direction of waves
- Mean period of waves
- Wind speed
- Wind direction

4.5.4 Operational techniques for application of specialized numerical prediction products (MOS, PPM, KF, Expert Systems, etc.) (as appropriate related to 4.5)

4.5.4.1 In operation

4.5.4.2 Research performed in this field

4.5.5 Probabilistic predictions (where applicable)

4.5.5.1 In operation

4.5.5.2 Research performed in this field

4.5.5.3 Operationally available probabilistic prediction products

4.6 Extended range forecasts (10 days to 30 days) (Models, Ensemble, Methodology)

4.6.1 In operation

4.6.2 Research performed in this field

4.6.3 Operationally available EPS products

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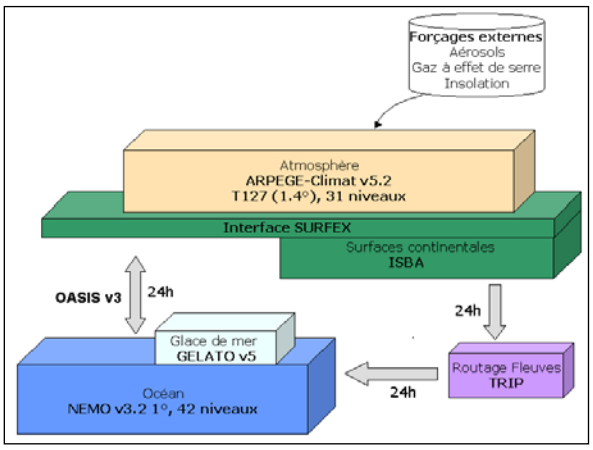
4.7 Long range forecasts (30 days up to two years) (Models, Ensemble, Methodology)

- Seasonal Forecast Process (3 months)

The elaboration of seasonal forecast is based on dynamical and statistical prediction and on information from different source of predictability. Regarding dynamical prediction, the version 5.2 is of ARPEGE-Climate, which is operationally running (monthly basis) on DMN super-computer is used. (http://www.cnrm.meteo.fr/gmgec/arpege-climat/ARPCLI-V5.2/index.html). A set of 27 forecasts combining 9 atmospheric analyses, from ECMWF database, and 3 ocean analysis (PSY2G3R4) from MERCATOR are used to initialise the ARPEGE-Climate model. Different products issued from ECMW, EUROSIP, WMO LRF-MME, UK Met-Office and IRI are also used for the forecast. In addition, several sources of predictability from sea surface temperature (SST) and large-scale drivers are explored using statistical methods when there is significant signal. It is noteworthy that this influence varies from one region to another within Morocco and throughout the year

4.7.1 In operation

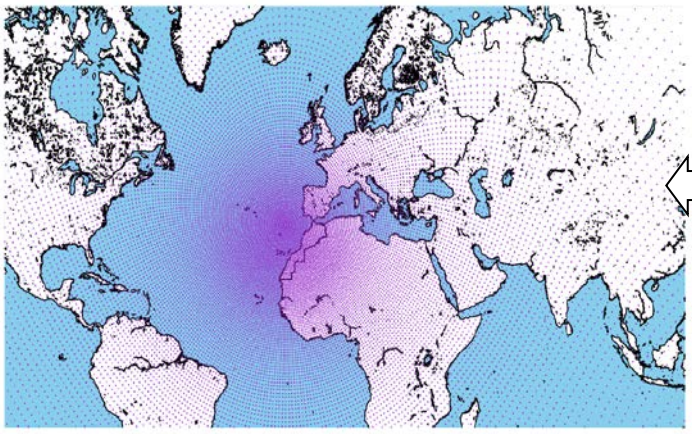
Dynamical seasonal forecasts are performed using ,among others, version 5.2 of the atmospheric French model ARPEGE-Climat coupled with the oceanic model OPA developed at LOCEAN (Oceanography and climate laboratory) and implemented in NEMO3.2 version at MERCATOR center (Ocean analysis and forecasting center). OASIS3 coupler developed at CERFACS (European Centre for Research and Advanced Training in Scientific Computation) is used to synchronize, interpolate and exchange fields between atmospheric and oceanic models.



Operational Seasonal Forecast System ARPEGE-Climat at Maroc-Meteo;

- T127 instead of T106 for v4
- Pole of stretching centered on Moroccan Atlantic

Illustrative scheme of Seasonal forecasting system :ARPEGE-Climat V5.2



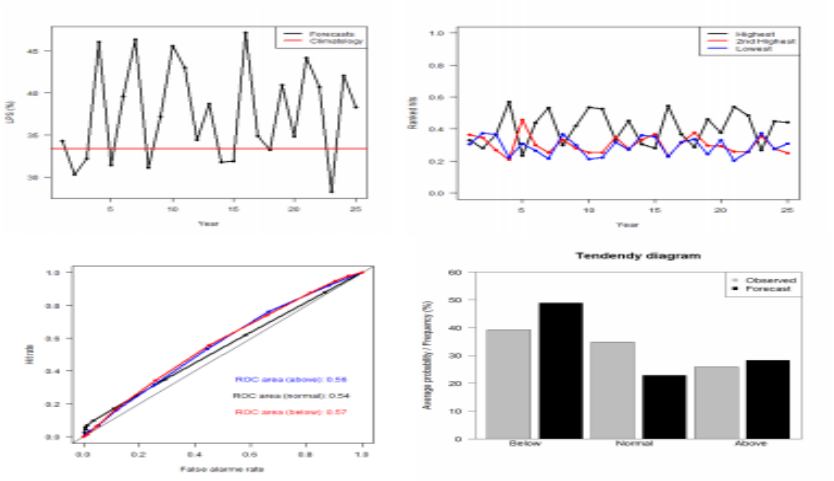
Resolution over Morocco~ 50 to 60 Km

Spatial resolution of ARPEGE-Climat V5

4.7.2 Research performed in this field

- *Verification of seasonal forecast from "ARPEGE-Climat"*

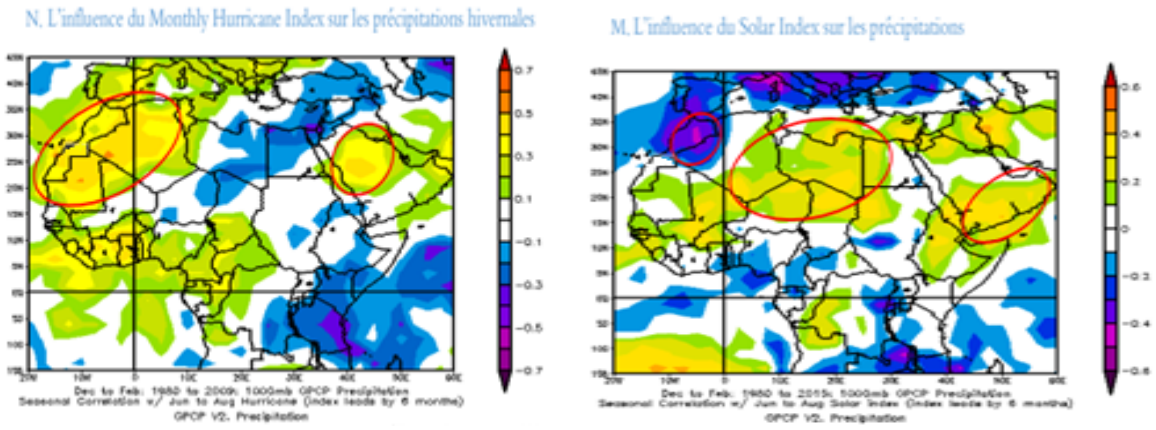
A number of probabilistic scores are computed in order to assess the quality of the probabilistic seasonal forecast products of ARPEGE-Climat. Among these scores we use mean Bias, the ROC score, the LEPS score and the Hit score. An example of these scores for winter precipitation prediction over North Africa is shown hereafter.



Scores probabilistes du modèle Arpège Climat sur la région NORAF pour la saison DJF

- *Prospections of new sources of predictability*

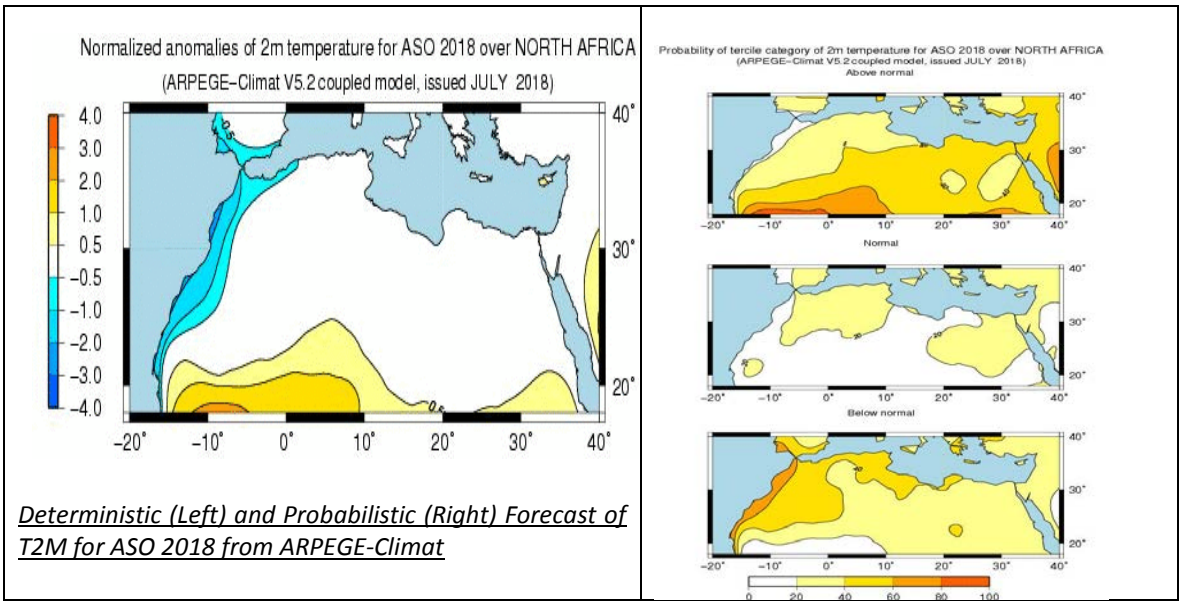
The aim of this project is to identify new drivers that affect the climate of Morocco, North Africa and Arab region especially rainfall and temperature. Maps below show an example of the impact of the hurricane occurrences and solar flux on winter precipitation over the Arab region.



Linear correlation between winter precipitation and hurricane index (left) and solar flux index (right) over the Arab region

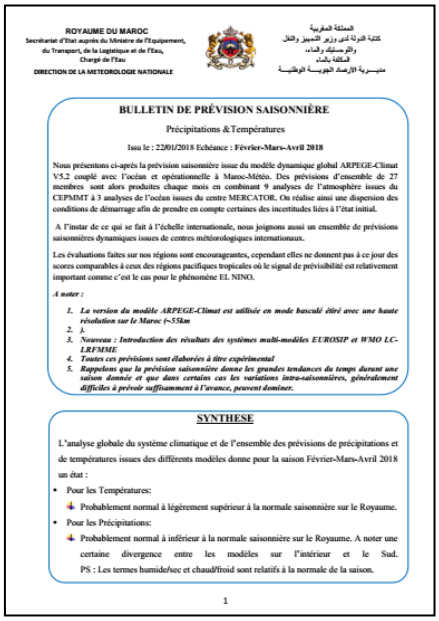
4.7.3 Operationally available products

- *Dynamical and statistical forecast product for precipitation and temperature* (Deterministic and Probabilistic)



Deterministic (Left) and Probabilistic (Right) Forecast of T2M for ASO 2018 from ARPEGE-Climat

- *Seasonal Forecast Products for agriculture purpose:* Daily precipitation, temperature, relative and specific humidity and wind data (issued from ARPEGE-Climat) are monthly transmitted to Agricultural service to feed their agro-meteorological model.
- *Bulletin of seasonal forecast over Morocco:* The Seasonal Forecast Bulletin is monthly elaborated and sent to 15 governmental departments and ministries.



ROYAUME DU MAROC
Secrétariat d'Etat auprès du Ministre de l'Equipement, du Transport, de la Logistique et de l'Eau, Chargé de l'Eau
DIRECTION DE LA METEOROLOGIE NATIONALE

المملكة المغربية
كتابة الدولة لدى وزير التجهيز والنقل والتوجستيك والماء، المكلفة بالماء
مديـــرية الأرصاد الجويـــة الوطنيـــة

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Précipitations & Températures

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Nous présentons ci-après la prévision saisonnière issue du modèle dynamique global ARPEGE-Climat V5.2 couplé avec l'océan et opérationnelle à Maroc-Météo. Des prévisions d'ensemble de 27 membres sont alors produites chaque mois en combinant 9 analyses de l'atmosphère issues du CEPMMT à 3 analyses de l'océan issues du centre MERCATOR. On réalise ainsi une dispersion des conditions de démarrage afin de prendre en compte certaines des incertitudes liées à l'état initial.

A l'instar de ce qui se fait à l'échelle internationale, nous joignons aussi un ensemble de prévisions saisonnières dynamiques issues de centres météorologiques internationaux.

Les évaluations faites sur nos régions sont encourageantes, cependant elles ne donnent pas à ce jour des scores comparables à ceux des régions pacifiques tropicales où le signal de prévisibilité est relativement important comme c'est le cas pour le phénomène EL NINO.

A noter :

1. *La version du modèle ARPEGE-Climat est utilisée en mode basculé étiré avec une haute résolution sur le Maroc (~55km*
2. *).*
3. *Nouveau : Introduction des résultats des systèmes multi-modèles EUROSIP et WMO LC-LRFMME*
4. *Toutes ces prévisions sont élaborées à titre expérimental*
5. *Rappelons que la prévision saisonnière donne les grandes tendances du temps durant une saison donnée et que dans certains cas les variations intra-saisonnières, généralement difficiles à prévoir suffisamment à l'avance, peuvent dominer.*

SYNTHESE

L'analyse globale du système climatique et de l'ensemble des prévisions de précipitations et de températures issues des différents modèles donne pour la saison Février-Mars-Avril 2018 un état :

- Pour les Températures:
  - Probablement normal à légèrement supérieur à la normale saisonnière sur le Royaume.
- Pour les Précipitations:
  - Probablement normal à inférieur à la normale saisonnière sur le Royaume. A noter une certaine divergence entre les modèles sur l'intérieur et le Sud.

PS : Les termes humide/sec et chaud/froid sont relatifs à la normale de la saison.

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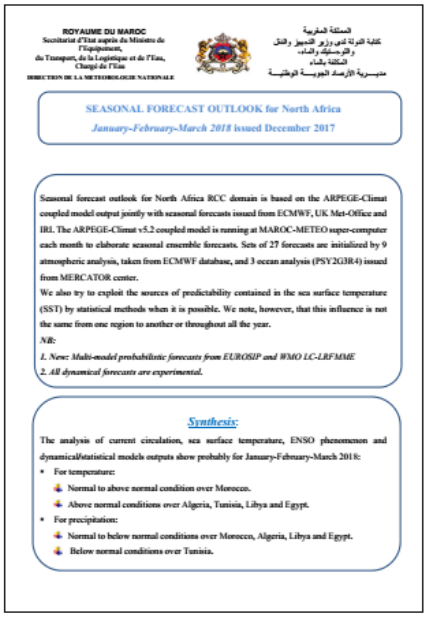
Example of Moroccan SF Bulletin

- *Bulletin of seasonal forecast over North Africa:* As lead of Regional Climate Center (RCC), DMN is responsible of seasonal forecast production over North Africa. For this purpose, the RCC website is monthly updated with the North Africa Seasonal Forecast Bulletin and also with seasonal forecast maps.



ROYAUME DU MAROC
Secrétariat d'Etat auprès du Ministre de l'Equipement, du Transport, de la Logistique et de l'Eau, Chargé de l'Eau
DIRECTION DE LA METEOROLOGIE NATIONALE

المملكة المغربية
كتابة الدولة لدى وزير التجهيز والنقل والتوجستيك والماء، المكلفة بالماء
مديـــرية الأرصاد الجويـــة الوطنيـــة

SEASONAL FORECAST OUTLOOK for North Africa
***January-February-March 2018* issued December 2017**

Seasonal forecast outlook for North Africa RCC domain is based on the ARPEGE-Climat coupled model output jointly with seasonal forecasts issued from ECMWF, UK Met-Office and IRI. The ARPEGE-Climat v5.2 coupled model is running at MAROC-METEO super-computer each month to elaborate seasonal ensemble forecasts. Sets of 27 forecasts are initialized by 9 atmospheric analysis, taken from ECMWF database, and 3 ocean analysis (PSY2G3R4) issued from MERCATOR center.

We also try to exploit the sources of predictability contained in the sea surface temperature (SST) by statistical methods when it is possible. We note, however, that this influence is not the same from one region to another or throughout all the year.

NB:

1. New: Multi-model probabilistic forecasts from EUROSIP and WMO LC-LRFMME
2. All dynamical forecasts are experimental.

Synthesis:

The analysis of current circulation, sea surface temperature, ENSO phenomenon and dynamical/statistical models outputs show probably for January-February-March 2018:

- For temperature:
  - Normal to above normal condition over Morocco.
  - Above normal conditions over Algeria, Tunisia, Libya and Egypt.
- For precipitation:
  - Normal to below normal conditions over Morocco, Algeria, Libya and Egypt.
  - Below normal conditions over Tunisia.

Example of North Africa SF Bulletin

5. Verification of prognostic products

5.1 Annual verification summary

5.2 Research performed in this field

6. Plans for the future (next 4 years)

6.1 Development of the GDPFS

6.1.1 Major changes in the operational DPFS which are expected in the next year

- Acquisition of a new more powerful HPC system.
- Implementation of AROME 1.3km suite
- Implementation of ALARO 5km suite
- Installing and testing the latest version of WaveWatch III (v. 5.16)

6.1.2 Major changes in the operational DPFS which are envisaged within the next 4 years

6.2 Planned Research Activities in NWP, Nowcasting, Long-range Forecasting and Specialized Numerical Predictions

6.2.1 Planned Research Activities in NWP

6.2.2 Planned Research Activities in Nowcasting

6.2.3 Planned Research Activities in Long-range Forecasting

- Prospecting different sources of predictability over Morocco, North Africa and Middle East.
- Qualitative and quantitative evaluation of seasonal forecast products from different GPCs.
- Weighted Multi-Model Mean Ensemble.

6.2.4 Planned Research Activities in Specialized Numerical Predictions

7. Consortium (if appropriate)

7.1 System and/or Model

7.1.1 In operation

7.1.2 Research performed in this field

7.2 System run schedule and forecast ranges

7.3 List of countries participating in the Consortium

7.4 Data assimilation, objective analysis and initialization

7.4.1 In operation

7.4.2 Research performed in this field

7.5 Operationally available Numerical Weather Prediction (NWP) Products

7.6 Verification of prognostic products

7.7 Plans for the future (next 4 years)

7.7.1 Major changes in operations

7.7.2 Planned Research Activities

8. References

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