TECHNICAL PROGRESS REPORT ON THE GLOBAL DATA-PROCESSING SYSTEM FOR 1999 MOROCCO

Direction de la Météorologie Nationale (DMN)

1. SUMMRY OF HIGHLIGHTS

- Increase of the resolution to 16.7km for ALADIN-Maroc.
- Quarterly control of Aladin-Maroc.
- Installation of Meteorological Data Base (BDM)
- Execution of ARPEGE-CLIMAT in Morocco to produce seasonal forecasts.
- Installation of SADIS.
- Y2K transition.

2. HARDWARE USED (see figure 1 : Important components of the data processing)

- Information commutators on GTS are the TRANSMET computers (two Motorola, operating with OS Unix and Oracle).
- NWP operational models are running on a CRAY J916 (6 processors and 2 Gbytes memory).
- The management of the forecasting system (control of the data in input of NWP model, preprocessing) is made on CRAY SUPER SERVER 6400 used as file server and running Oracle, the production of charts with the ALADIN-Maroc output is made on a CRAY J916 with Magics and NCAR software. The whole system (human facilities, calculation machine, file sever, workstation for development and ALADIN-Maroc model) is called ALBACHIR.
- Dissemination of forecast and observation products (from GTS included), in particular to the moroccan weather stations, is made through the fac-simile.
- Facilities network assuring the interconnection of the different networks of the DMN is the FDDI ring.
- For getting coupling files from Toulouse and data from GTS a 64 kbytes data link is used to link Casablanca to Toulouse.

3. USE OF DATA PRODUCTS FROM GTS

The following types of observation, extracted from GTS are presently used at the DMN :

SYNOP, SHIP, BUOY, BATHY,
METAR
TEMP, TEMPSHIP, PILOT,
AIREP, AMDAR, ACARS,
SATOB, SATEM

GRID and GRIB products received from Toulouse.

Fac-simile products:
- aeronautical charts from Toulouse (T4 code)
- Cifax charts

4. **DATA INPUT SYSTEM**

Automated.

5. **QUALITY CONTROL SYSTEM**

- The format of all coded reports are checked and if necessary corrected if possible.
- All received messages are checked for internal consistency before storing and exchange.
- Space consistency check.
- Time series consistency check.

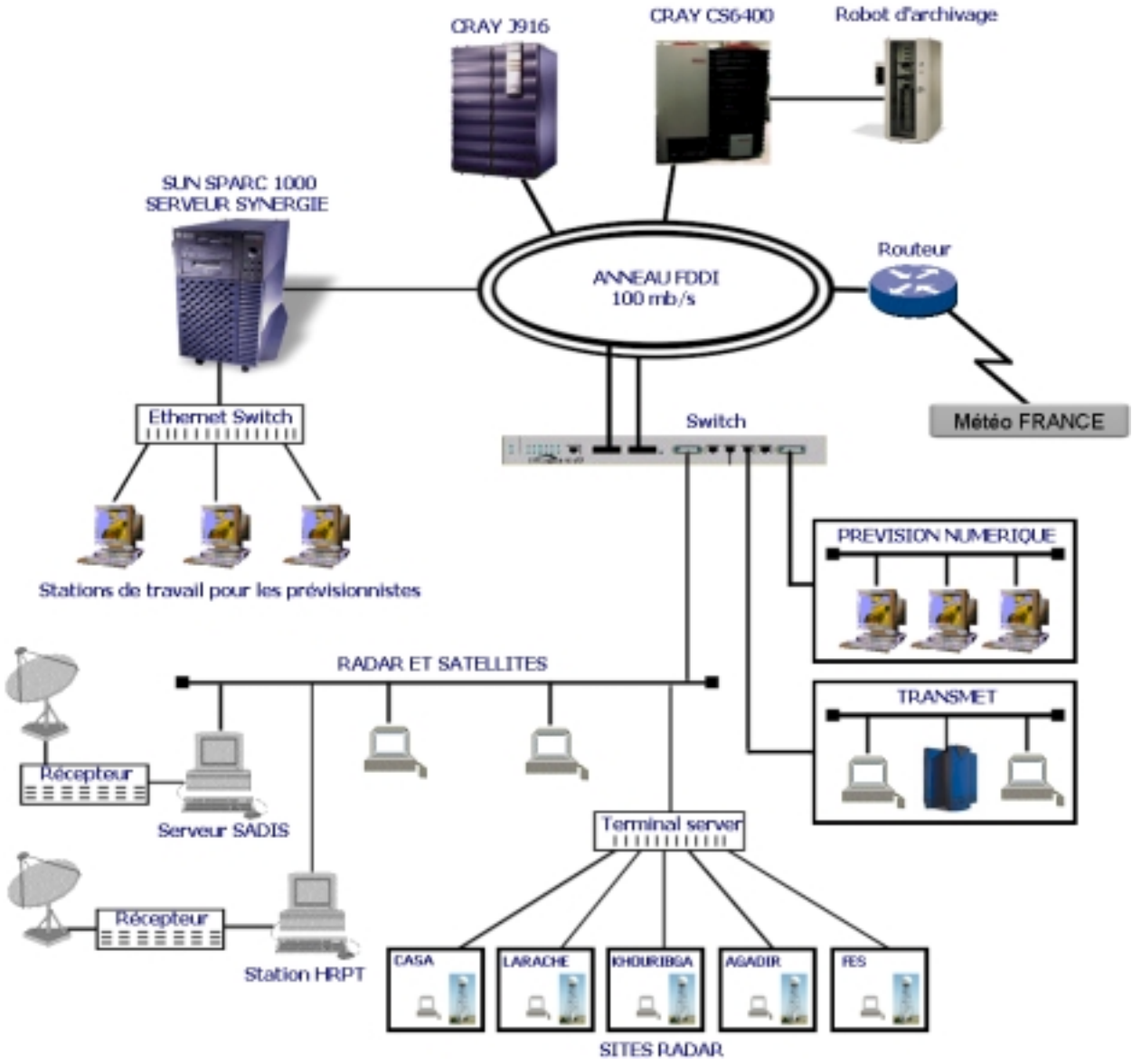


Fig 1 :Important components of the data processing

6. **FORECAST SYSTEM**

The operational forecast system at DMN is based on ALADIN library developed jointly by Météo-France and the national meteorological or hydrometeorological services of the following countries :
Austria, Belgium, Bulgaria, Croatia, Czech, Republic, Hungary, Moldova, Morocco, Poland, Portugal, Romania, Slovakia, Slovenia.

ALADIN (0-48hours)
ALADIN is a limited area version of ARPEGE-IFS. This implies that :

- ALADIN is spectral (like ARPEGE-IFS)
- As spectral-LAM it works on a biperiodic domain and uses bi-Fourier horizontal transforms
- Its physics and ARPEGE one are identical
- It gets initial and boundary conditions from ARPEGE

Up to now ALADIN-Maroc is run in mode with data assimilation.

The ALADIN-Maroc is using a two time level semi lagrangien scheme with a time step value to 675 s and an horizontal resolution about 16 km. The integration is done over the domain centred on Morroco and limited by (18.4 to 43) on latitude and (-19.8 to 9.8) on longitude.

The vertical resolution is 31 levels, with an increased density in the low atmosphere, the first level is at 5 hPa. The digital filter initialization uses a Dolph-Chebishev filter with a stop-band edge period of three hours and a backward-forward scheme.

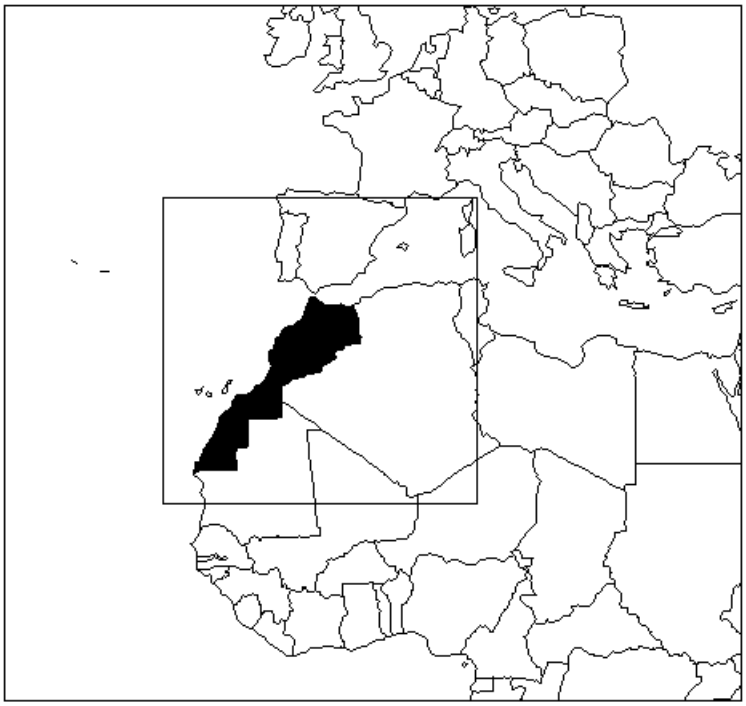
This version of ALADIN-Maroc is running twice a day up to 48 hours range, with initial and lateral boundary conditions given by the corresponding ARPEGE run. It is based on hydrostatic assumption.

The post-processing is performed every three hours then grib files and graphical charts are produced and sanded to forecaster workstation Synergie.

6.1 . Schedule of the Forecast System

The operational forecast system at DMN is based on ALADIN-Maroc runs using the observed data at 00 UTC and at 12 UTC :

00 UTC data : ALADIN-Maroc analysis and forecast up to 48h
12 UTC data : ALADIN-Maroc analysis and forecast up to 48h



Domain of the ALADIN-Maroc model
Mesh size ~ 16.7 km, 180x180 gridpoints

6.2. Assimilation, objective analysis and initialization

The Aladin-Maroc is running operationally with data assimilation cycle and Canari analysis. Now, the Meteorological Data Base (BDM) is installed and the assimilation is using local observations file merged to the observation file received from Toulouse (like the coupling files), at the end of this project the observation files will be performed in Casablanca (only ARPEGE analysis departures are needed from Toulouse).

The assimilation runs with a 6 hour cycle, the analysis works in vorticity, unbalanced divergence/ temperature/surface pressure and specific humidity on model levels.

Assimilation data :	TEMP and TEMPSHIP (part A, B, C and D), PILOT (part A, B, c and D), AIREP, AMDAR, ACARS, SATOB, SATEM with observation time in [H-3h, H+3h] for the analysis at H, SYNOP, SHIP, BUOY BATHY with observation time in [H-30', H+30'].
Assimilation cycle :	6 hour cycle.
Analysed method :	Optimal Interpolation.
Analysed variables	Wind, temperature, surface pressure and specific humidity on model levels.
First guess :	A 6-hour forecast of ALADIN-Maroc. By default a 12, 18 or 24-hour forecast.
Horizontal resolution :	Linear grid (180 x 180 points) equivalent to (2800x2800 km).
Vertical resolution	The analysis is done on the model levels: 31 levels (hybrid vertical co-ordinate) from screen up to 5 hPa.
Initialization :	Incremental digital filter initialization (ie filtering analysis increments fields) using a Dolph-Chebishev filter with a stop-band edge period of 5h and a backward-forward scheme.
Surface :	- analysis of superficial and mean soil temperature from forecast errors on 2m

temperature
- analysis of superficial and mean soil moisture from forecast errors on 2m temperature and 2m relative humidity
- small relaxation towards climatology for snow and mean soil temperature and moisture

6.2 Model

Basis equations :	Primitive equation system
Independent variables :	Both components of the horizontal wind, temperature, specific humidity and surface pressure.
Dependant variables :	Vertical velocity and density.
Numerical technique :	Spectral and semi-lagrangian model, the temporal discretization used is leap-frog semi-implicit scheme.
Integration domain :	the limited area domain centered on Morocco.
Orography, gravity wave drag :	The orography of this model on grid (180x180 points) is obtained from GTOP030 US Geological Survey's EROS data and US NAVY 10' data, that strongly reduces the noise associated to Gibbs waves.
Horizontal diffusion :	Implicit in spectral space and incorporating an orography dependent correction for temperature.
Vertical diffusion :	Scheme linked to PBL.
Planetary boundary layer :	ECMWF method (Louis et al. 1981).
Resolution, time step :	It has 16.7km mesh and 31 vertical levels from screen up to 5hPa, using the hybrid (s,p) co-ordinate from Simmons and Burridge (1981). The time step is 675 seconds.
Earth surface :	Fixed analyzed sea surface temperature and amount of sea-ice. An improved version of the ISBA (Interaction Soil Biosphere Atmosphere) schema is used, including an explicit parameterization of soil freezing. Six prognostic variables are handled by ISBA : surface temperature, mean soil temperature, interception water content (first centimeter), total liquid soil water content, total frozen soil water content and snow cover.
Radiation :	Hypersimplifed scheme at every time step (Ritter and Geleyn 1992).
Convection :	Mass flux scheme (Bougeault 1985) modified by Geleyn and. lvanovici
Humidity :	Specific humidity is the variable: no storage of condensate; evaporation of falling rain; treatment of the ice-phase.
Limits :	(18.4 to 43) on latitude, (-19.8 to 9.8) on longitude.

6.3 NWP Products

The above described numerical model feed a archive robotic with analysis and forecast files, having following characteristics :
horizontal domains and horizontal resolution (18.4N to 43N, -19.8W to 9.8E with a 0.15° mesh)
Vertical levels are the standard pressure levels.

The meteorological fields stored are :
- at all levels : geopotential, temperature, humidity, wind (including vertical velocity)
- at screen level : pressure, temperature, humidity, heat and radiation fluxes, snow and water content
- at sea surface level : reduced pressure
- some data at particular levels : 500hPa absolute voracity, high medium and low cloudness, iso 0° and iso –10°, tropopause etc …

6.4 Operational use of NWP products

On screen (especially SYNERGIE workstation) or on paper …

7.SPECIALIZED FORECASTS

7.1. Local weather elements

We plan to make several kinds of forecasts by statistical adaptation of the NWP products from the above described model, we started with Min-max daily temperature over 40 station in Morocco.

7.2. Marine forecasts

The model run operationally in Morocco determining the sea conditions :
DSA5, computing the waves over the northern hemisphere part of the Atlantic ocean, from the wind outputs of large scale fields derived from ARPEGE.

This model is available between 0430UTC and 0500UTC, on 00UTC run.
The model is running once a day based on 00 UTC, up to 48h.

8. CONTROL OF THE MODEL ALADIN-Maroc

Only the values given by ALADIN-Maroc at moroccan station are controlled by comparison to the observations at this station, statistics are produced every three months and summarised in a quarterly bulletin.

Quarterly scores (October – November – December 1999)of the operational ALADIN-Maroc model :

2m TEMPERATURE (degres celsius)

	Forecast range				
	06H	12H	24H	36H	48H
Bias	-1,42	-0,52	-2,38	-0,59	-2,66
RMS	3,40	2,35	3,73	2,49	4,04
SD	2,07	1,98	2,03	2,09	2,17

MLS PRESSURE (Pascal)

	Forecast range				
	06H	12H	24H	36H	48H
Bias	46,02	-25,88	-55,73	-64,59	-76,14
RMS	167,29	136,88	151,89	169,02	174,16
SD	133,60	111,15	118,99	130,07	136,86

10m WIND (m / s)

	Forecast range				
	06H	12H	24H	36H	48H
Bias	0,05	-0,62	0,07	-0,70	0,01
RMS	1,97	2,31	2,00	2,35	2,04
SD	1,69	1,94	1,73	2,00	1,80

COULD COVER (%)

	Forecast range				
	06H	12H	24H	36H	48H
Bias	-1,17	-5,98	4,40	-5,91	4,65
RMS	33,34	29,46	33,23	30,34	32,97
SD	32,46	28,01	31,87	28,96	31,75

SOIL HUMIDITY (%)

	Forecast range				
	06H	12H	24H	36H	48H
Bias	-4,29	1,03	-0,53	1,11	0,30
RMS	17,64	17,57	16,79	17,92	16,58
SD	15,03	16,36	14,91	16,56	14,48

Bia : Mean error
RMS : Root Mean Square erreur
SD : Standard Déviation

CONTINGENCY TABLE FOR PRECIPITATION ECHE_12

	P<0,1	0,1<P<2	2<P<10	P>=10	Total
P<0,1	76,55%	6,25%	3,77%	1,67%	88,24%
0,1<P<2	2,66%	1,43%	1,33%	0,60%	6,01%
2<P<10	0,55%	0,58%	0,98%	0,33%	2,43%
P>=10	0,00%	0,03%	0,14%	0,35%	0,53%
Total	79,75%	8,29%	6,22%	2,96%	97,22%
Best forecast : 79,31%				Skill score : 0,258	

Recall :

DMN draws up a "quarterly bulletin of control" (in french). These bulletins can be obtained by writing to :

Direction de la Météorologie Nationale
Centre National de Recherches Météorologiques
BP : 8106 Casablanca-Oasis
CASABLANCA
MOROCCO
Email : dmn@mtpnet.gov.ma

9. Y2K TRANSITION

All the operational services related to the three functions : Observation, Reception/Transmission and production passed successfully the Y2K.

No problem had been noticed for these functions which were the strict necessary tasks that must be safe ensured.

The regular users of DMN product received normally all the requested meteorological information during the critical period.

10. FUTUR PLANS

- Acquisition of a preferment computer.
- Use of multivariate three dimensional variational analysis.
- Running a non-hydrostatic version of ALADIN-Maroc.
- Operational seasonal forecast using ARPEGE-Climat.
- Running the regional ALADIN model in the regions on workstation.