Annual WWW Technical Progress Report on GDPS - 2002

ITALY

Country: Italy **Centre:** CNMCA **January 2003**

CNMCA: National Centre for Aeronautical Meteorology and Climatology
Aeroporto De Bernardi, Via di Pratica di Mare Km 7, I-00040 Pomezia (Roma)
(web: http:://www.meteoam.it)

1. SUMMARY OF HIGHLIGHTS

CNMCA, the National Weather Centre of the Italian Meteorological Service (UGM: Ufficio Generale per la Meteorologia – Aeroporto F. Baracca, Via di Centocelle 301, I-00175 Roma), is undergoing wide re-arrangement of operational equipment and procedures. The most important ones are:

- Implementation of a new integrated computing system (NSED) with revised operational procedures and DBs;
- Installation of Meteosat Second Generation (MSG) primary receiver;
- Implementation of a satellite based video data broadcast (VDB) system (NUBIS);
- Operational dissemination of LAMI (non-hydrostatic model) outputs
- Upgrade of central and peripheral radar systems
- Implementation of a national lighting detection and location system (LAMPINET)
- Renewal of the Internet Web Server

All the above mentioned improvements started in 2002 and will be complete in 2003. Since 2002, CNMCA is also routinely contributing to the WMO World Weather Information System.

2. EQUIPMENT IN USE AT THE CENTRE

2.1. Main computers

2.1.1. Main Computing Area for model runs and operational procedures

2.1.1.1 Computers:

HP ES45 (4 PEs) – 4 GB RAM
HP GS60 (4 PEs) – 4 GB RAM
HP GS60E (4 PEs) – 4 GB RAM
2 HP Alpha Server 4100 (2 PEs) – 0.5 GB RAM
1 HP Alpha Server DS20E (2 PEs) – 4 GB RAM
1 HP Alpha Server DS20E (2 PEs) – 2 GB RAM
LAN attached HP Workstations (HP XP1000 – HP AU600 – HP AU500)
LAN attached PCs and printers

2.1.1.2 External input/output devices:

1 RAID unit HP RA3000 tailored in RAID 0+1 Configuration providing 360 GB
1 RAID unit HP RA7000 tailored in RAID 0+1 Configuration providing 254 GB
Online climatological archive providing 130 GB
2 line printer/plotter devices XEROX 8825
2 A0 scanners XEROX
4 line plotters OCE G9055-S

2.1.1.3 Operating System:

HP Tru64 UNIX 5.1.a

2.1.2. Telecommunication area

GTS meteorological communication is based on the Unified Message Switching system (UMS) by Global Weather. Further, dissemination is in many cases assured through the Web. Main equipment for the different funcions is:

- 2 Alpha Servers 2100 for UMS
- 2 Alpha Servers 800 for Web ftp
- 1 Alpha Server DS20 as Web Server
- 1 Alpha Server 1000 as public ftp server
- 1 Apha Serve r 4100 for the Web server DB

Operating system is in all cases Unix.

2.1.3. Desktop systems for Forecasters

Two main visualization systems are currently used at the Italian Air Force Met Service: an INTRANET based non-interactive distribution system delivering meteorological products on a WAN scale, and the JAVA based semi-interactive 'VISIMET' system serving only forecaster positions at CNMCA. All the remote sites connected on the INTRANET are provided through the WAN with plenty of satellite images, NWP text and pictorial products, which can be surfed through a conventional browser. The VISIMET system offers the capability of manipulating NWPs allowing elementary mathematics on FM 92 GRIB meteorological fields. Such a graphical system has served as an experimental tool to set up "IOVIS", the new NSED Visualization and production tool, which will be fully operational in the 2nd quarter of 2003. It will be used at CNMCA and at other major operational locations in Italy. At each site an HP DS10 Workstation will be running the graphics engine, responding to the various visualization tasks submitted by client PCs. IOVIS is able to display any combination of meteorological fields, and different information sources can be overlaid to represent on-fly composite imagery. Picture creation procedures can be stored in macros, and reused for daily mass production of meteorological maps.

2.1.4. Distribution of NWPs in GRIB code

The NWPs in FM92 GRIB code are disseminated at CNMCA through a fully automated distribution system (Districo), set up on a cluster machine consisting of 2 HP DS20E. Both NWPs incoming from other Centers, as well as NWPs produced at CNMCA, are loaded into a Database, where they are retrieved from and processed by a PHP procedure. This fits user's requirements in terms of interpolation to specific user defined grids, which involve rotation and stretching from native grids. The transformed products are re-loaded into the Database, ready for delivery via ftp. Every day more than 2 GB of GRIB coded products are made available both for internal and external use.

2.2. Network

The LAN is a Ethernet with more than 100 PCs, and about 30 Servers (Web, DNS, Proxy, Mail, etc.) or Workstations. Peripheral equipment includes scanners, plotters, printers and fax. The WAN connects 34 local or regional meteorological offices and about 40 major external users over the whole national territory.

2.3. Special systems

CNMCA is equipped with a PDUS Meteosat receiving station, and an automated NOAA station. Implementation of a new MSG station is under course. GTS data are received and sent by a GW UMS System. The data storage is organized partly in a file system, and partly in a Informix DB.

3. DATA AND PRODUCTS FROM GTS IN USE

GTS is received via Offenbach and Toulouse through a pop to RMDCN (operating since March 2002). Special use is made of synoptic data (Synop, Ship, Temp, Satob), and aeronautical messages (Metar, Taf, Sigmet, etc) from the Euromediterranean area. Dayly operations involve more than 40.000 messages, half of which are of aeronautical interest.

4. DATA INPUT SYSTEM

Fully automated, partly using an operational Informix DB.

5. QUALITY CONTROL SYSTEM

A first QC is performed at the observing stations, where data are introduced partly automatically and partly by hand by a PC based graphical inteface (gross error check and internal consistency). A further QC is performed, following WMO specification, on individual stations and offline, before data archiving for climatological purposes. Quasi-real time correction is done on a operational basis only if possible and necessary.

6. MONITORING OF THE OBSERVING SYSTEM

Surface and upper air observations at the national level. Ships are routinely monitored over the whole Mediterranean area.

7. FORECASTING SYSTEM

7.1. System run schedule and forecast ranges

The forecast system is based on the ECMWF 12 utc run, which is used for initializing the national LAM (HRM), the nested EuroHRM (both runned at 00 and 12 utc, and the non-hydrostatic LAMI (all described in 7.3). Some details are shown in fig. 1 and 2 for HRM and Euro-HRM.

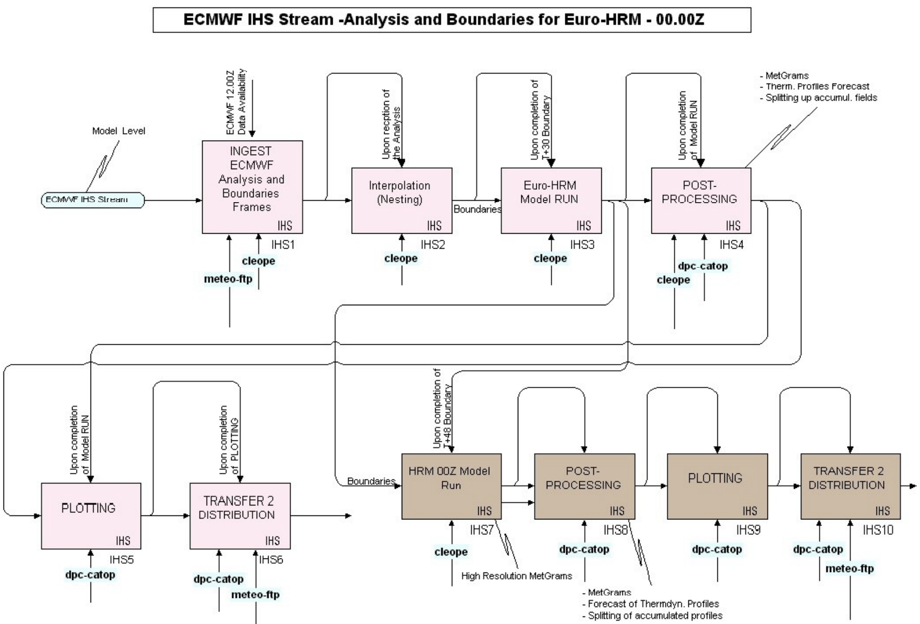

Fig. 1: Example of data flow and processing (Euro-HRM).

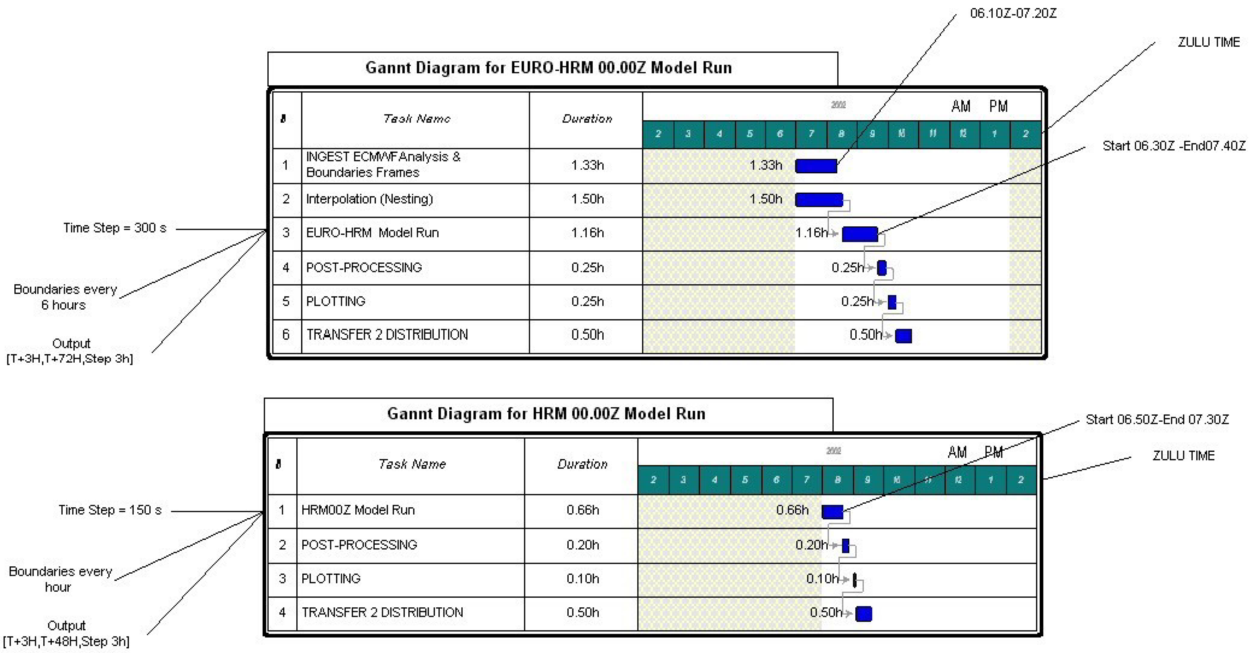

Fig. 2: Timing of processing for HRM and Euro-HRM.

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

Medium range forecast for Italy and Europe in plain text are based on ECMWF products (deterministic and EPS).

7.2.1. Data assimilation, objective analysis and initialization

None

7.2.2. Model

For the medium range both the deterministic ECMWF T511 and the EPS are corrently used to produce general plain text forecast and Public Safety Warnings.

7.2.3. Numerical weather prediction products

Model direct outputs, received in GRIB code, are used for postprocessing, and to produce a number of combined fields for graphical presentation. The most frequently used field combinations are:

- 500 hPa geopotential heights and potential vorticity
- 850 hPa Wet bulb temperature
- 500 hPa geopotential heights and 700 hPa vertical velocities
- vertical profiles of temperature, dew point and wind for selected locations (sounding stations)

Meteograms (graphical and ASCII form) are also produced for a number of selected locations in Italy and abroad.

7.2.4. Operational techniques for application of NWP products

A dynamical-statistic postprocessing is performed to produce a forecast of the main weather parameters for 150 sites over Italy (ARGO).

7.2.5. Ensemble prediction system

The ECMWF Ensemble Prediction System (EPS) is used for far and (combined with the deterministic T511 Model), near medium-range forecasting. In order to provide forecasters with sufficient basic information, a number of GRIB and BUFR files are processed. Two kinds of EPS representations are currently shown:

a) areal maps: Stamps (esplicit maps), Clusters, Tubes, Ensemble Mean with r.m.s error for 500hPa geopotential; Probability Maps for 850hPa temperature anomaly, 24 h cumulated precipitations and 10m wind speed;
b) local maps: Plumes, EPS-grams and Prob-Plumes, for 17 sites (surface observation stations) and 4 parameters (2m temperature, 10m wind speed, 12 h cumulated precipitations, total cloudiness); Fax-Maps for 6 localities (mainly radio-soundig stations) and 3 parameters (850 hPa temperature, 12 h cumulated precipitations, 500 hpa geopotential).

The EPS is mainly used to estimate the low current predictability on european area: only in the case of very low spread of EPS it is suggested to relay upon the deterministic model (only for significant spread, the Tube 0 scenario giudence is preferred.
The EPS is also daily checked for probabilities of severe weather.

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

7.3.1. Data Assimilation

The main focus of the activities over the past year has been the operational implementation of an intermittent 6-hourly data assimilation cycle for the HRM model using optimal interpolation methods over the EURO domain of integration. The main characteristics of the **HRM hydrostatic model** are summarized in 7.3.2. Fig. 3 shows the EURO and the nested MED HRM integration domain. The same is shown in Fig. 5 for the **non hydrostatic LAMI**.

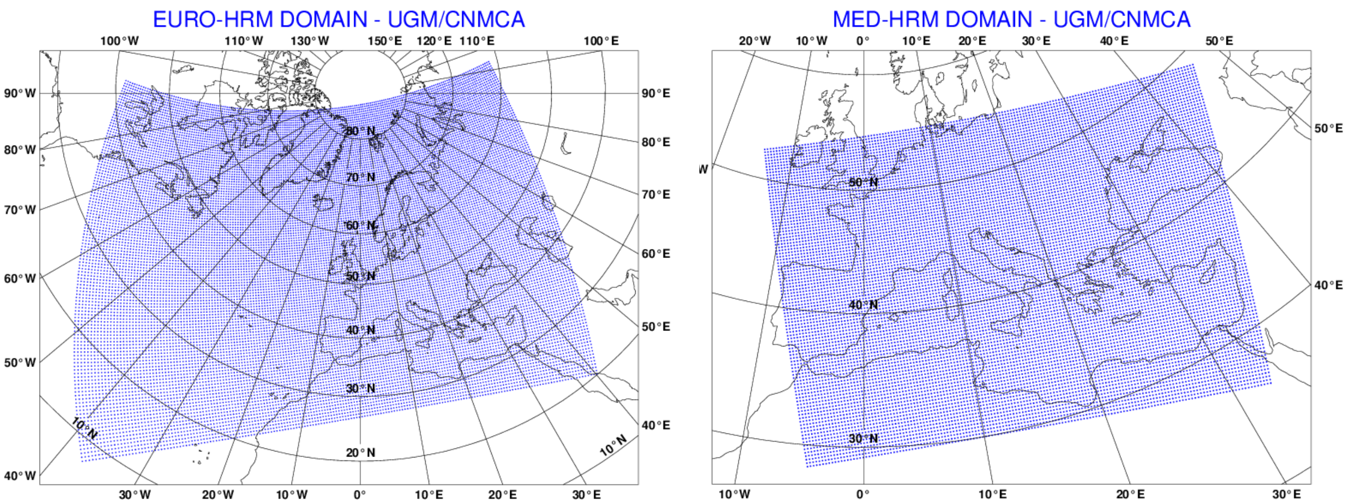

Fig. 3: Integration domains for the HRM hydrostatic model.

The main features of the objective analysis scheme employed in the data assimilation cycle are:

- Global solution of analysis equations by direct solver;
- Analyzed variables: Z,u,v,RH;
- Geostrophic, quasi non-divergent constraint;
- Interpolation Statistics from statistical analysis of observation increments.
- Type of Observations: TEMP, PILOT, SYNOP, SHIP

A flow diagram of the data assimilation cycle is given in Fig. 4

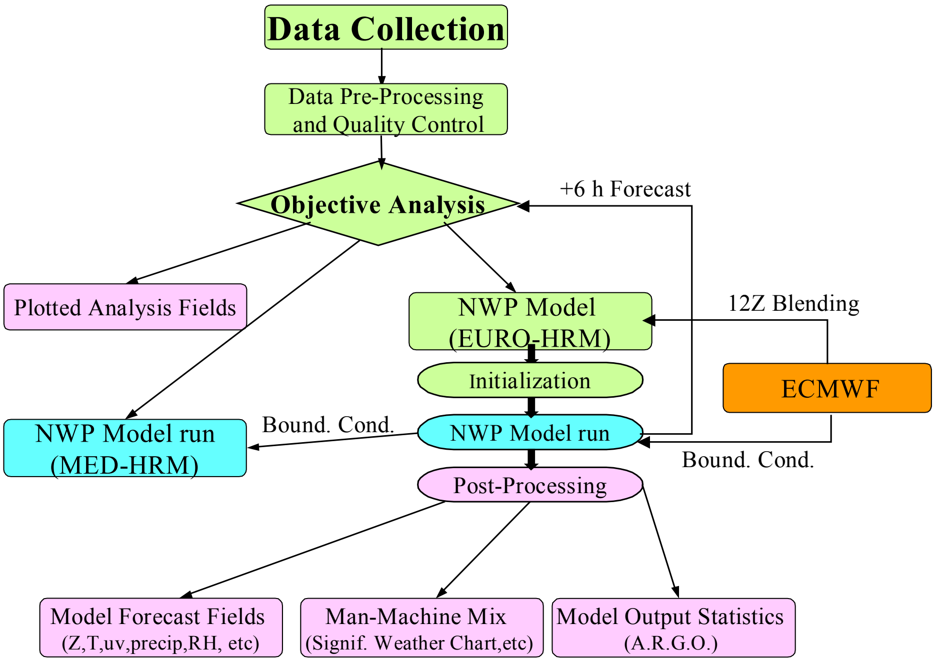

Fig. 4: Flow diagram of the data assimilation cycle

Non-Hydrostatic Modelling: The main features of the operational implementation of the Lokal Model over the Italian domain of integration (**LAMI,** in cooperation with the Emilia-Romagna regional service) are summarized below and in Fig. 3.

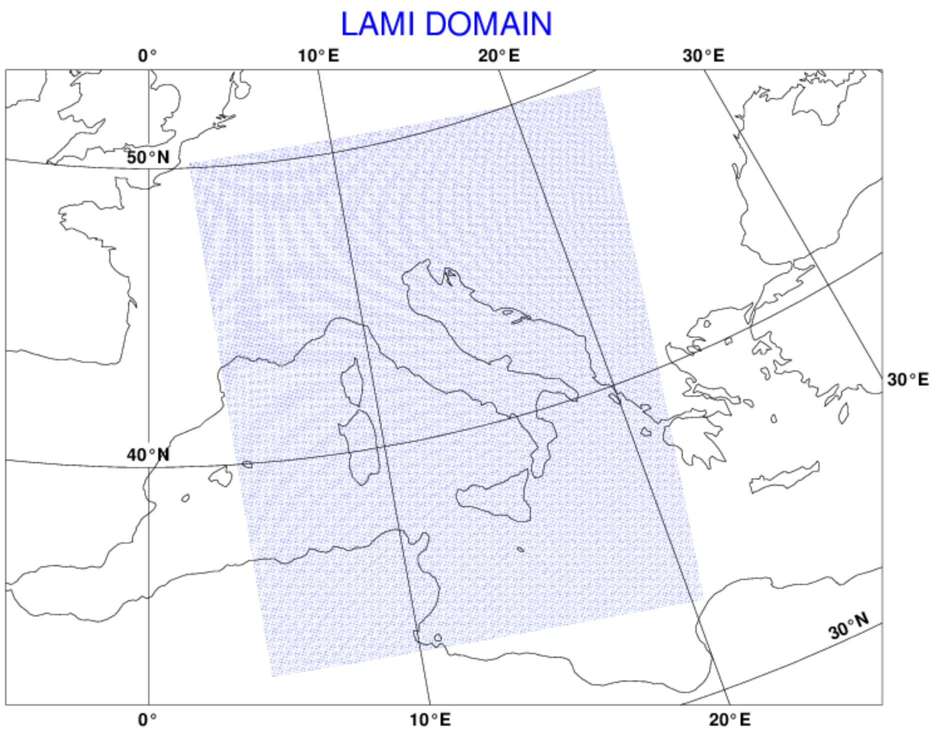

Fig. 5: Integration domain for the LM non hydrostatic model.

7.3.2. Models

Sintetic description of the main model features is shown in the following.

Characteristics of EURO-HRM operational implementation:

Domain size:	181 x 121
Grid spacing:	0.5 (56 km)
Number of layers:	31
Time step and integration scheme:	300 sec , split semi-implicit
Forecast range:	72 hrs
Initial time of model run:	00/12 UTC
Lateral boundary conditions:	IFS (ECMWF)
L.B.C. update frequency:	3 hrs
Initial state:	Statistical Analysis(Z,u,v,RH,Surf .Press.)
Initialization:	Normal Mode Initialization
External analysis:	External analysis
Status:	Operational
Hardware:	Compaq DS20E
N° of processors used:	2

Characteristics of MED-HRM (or, shortly: HRM) operational implementation:

Domain size:	151 x 101
Grid spacing:	0.25 (28 km)
Number of layers:	31
Time step and integration scheme:	150 sec , split semi-implicit
Forecast range:	48 hrs
Initial time of model run:	00/12 UTC
Lateral boundary conditions:	IFS (ECMWF)
L.B.C. update frequency:	1 hrs
Initial state:	EURO-HRM
Initialization:	N.M.I.
External analysis:	None
Status:	Operational
Hardware:	Compaq DS20E
N° of processors used:	2

Characteristics of LAMI operational implementation

Domain size:	234 x 272
Grid spacing:	0.0625 (7 km)
Number of layers:	35
Time step and integration scheme:	40 sec, 3 time level split-explicit
Forecast range:	48 hrs
Initial time of model run:	00/12 UTC
Lateral boundary conditions:	GME (DWD)
L.B.C. update frequency:	1 hrs
Initial state:	GME (DWD)
Initialization:	None
External analysis:	None
Special features:	Use of filtered topography
Status:	Operational
Hardware:	IBM SP4 (CINECA - Bologna)
N° of processors used:	32

7.3.3. Products
HRM and **EuroHRM** standard outputs are:

- Geopotential height at 300, 500, 700, 850 hPa
- Vertical velocity at 700 hPa
- Potential Wet Bulb Temperature 850 hPa
- Surface Pressure
- 10 m Wind and Wind Max in 6 h
- 2 m Temperature, Dew Point and dew point depression
- Temperature extremes in 6 h
- Low and total cloudiness
- Freezing Level
- Cumulated precipitation in 6 and 12 h

Main and most used products of **LAMI** are:

- 10 m Winds
- Precipitations
- 2 m Temperature (Minimum, Maximum, Dew Point)
- Total Cloudness
- Cumulated precipitation in 6 and 12 hours.

7.3.4. Operational techniques for application of NWP products
In the Forecasting Section diagnosis and prognosis are performed on derived fields from the following numerical models: ECMWF T511 and EPS, HRM, EuroHRM, LAMI.
Synoptic interpretation is based on conceptual models (front, pseudo-front, comma, trough, convergence line), using satellite report as reference**,** and video overlapping of satellite images on analysis maps.

7.4. Specialized forecasts

7.4.1. Data Assimilation
(not applicable)

7.4.2. Models
3D trajectories are computed from ECMWF outputs for special purposes (dispertion of pollutants, volcanic ash).

7.4.3. Products
Trajectory maps at different levels, Pasquill categories in tables and a forest fire index are operational products based on ECMWF model outputs.

7.4.4. Operational techniques for applications of NWP results
ECMWF Wave Model is used to produce graphics and tables for marine forecasts, covering the Mediterranean basin and concerning: sea state, wind and swell, inshore and offshore, every 12 hours.

7.5. Extended range forecasts (10 days to 30 days)
None

7.6. Long range forecasts (30 days up to 2 years)
None

8. VERIFICATION OF PROGNOSTIC PRODUCTS

Quality Control of main forecast products has been totally revised at CNMCA. A totally automatized system named APOLLO (Autom. Procedures Of quaLity controL(O)), made up of temporary and permanent archives and of retrieve, elaboration and visualization software, is operational since the beginning of 2001, and now regularly producing an updated performance verification of the (interpolated) direct model outputs normally used in the forecasting section (weather parameters).
Objective verifications of weather parameters (2m Temperature, 10m wind-Speed, 6h Cumulated Precipitations) forecasts are performed, for every principal synoptics hours and for 4 model meteograms interpolated on 90 localities. Observing and Forecasting data-set is temporally collected on montly, quarterly and annual periods and, besides local, spatially collected in 9 sub-areas (3 Tyrrhenian, 3 Adriatic, 1 Continental North-West, 1 Sicilia, 1 Sardegna), 3 sub-areas (North, Center and South Italy), and 1 large area (Italy).
Quality aspects considered are Absolute and Relative Accuracy and Bias, that are usually measured respectively by:

a) Mean Absolute Error (MAE), Skill Skores (SS) and Mean Error (ME), for continuous variable;

b) Hit Rate (HR) (together with Threat Score (TS), Probability of detection (POD) and False Alarm Rate (FAR)), True Skill Statistics (TSS) and Frequency Bias Index (FBI), for events.

Comparisons are performed with the built-in dynamical-statistic model named ARGO and with Climatology and Persistence, and ultimate tables with short comments are shown on CNMCA Intranet web-page. Because of the great amount of information contained in these tables, any judgement is draft up in agreement with the most intensive users, i.e. forecasters and modelists, that are usually interested in different aspects of quality.
In the following table, a verification example (for 2002: a relatively dry year) is shown.

9. PLAN FOR THE FUTURE

In 2003 the new computer environment (NSED), the MSG products release towards external users via a staellite dissemination facility (NUBIS), and the acquisition from a new lightning detection system (LAMPINET) shall be operational. New radar equipment and computing system is also planned to start operations before the end of 2003, as well as the new web server.
Finally, purchase of a supercomputer is planned for 2004-5.

10. REFERENCES

De Simone, Costante; M. Ferri: “ARGO, local weather predictions system of the Italian Air Force Meteorological Service”, Rivista di Meteorologia Aeronautica, n.1-2, 1987.

Veccia, Ermanno; R. Tajani, U. Guarnera, P. Emiliani: “La verifica delle previsioni al CNMCA: il sistema APOLLO”, Rivista di Meteorologia Aeronautica, n.3, 2001.

Maresca Giovanni, “Recent development at Itl. A.F. Met. Sercvice”, Proceedings of 12th EGOWS Meeting, Zurich 2001

Torrisi Lucio, M. Ferri: “Numerical Weather Prediction at the Italian Meteorological Service”, 23rd EWG LAM / 8th SRNWP Meeting, Cracow, 2001

Euro-HRM 00 utc run Forecast Verifications - Year 2002
24 h Cumulated Precipitation over Italy - 3 Ranges and 22 Tresholds

		0,0	0,1	0,2	0,3	0,5	0,7	1,0	2,0	3,0	4,0	6,0	(mm)
FAR	d+1	0,49	0,44	0,44	0,43	0,42	0,42	0,44	0,43	0,43	0,44	0,45	
	d+2	0,46	0,41	0,43	0,41	0,40	0,41	0,44	0,44	0,46	0,48	0,50	
	d+3	0,47	0,44	0,45	0,44	0,44	0,45	0,47	0,48	0,49	0,50	0,54	
TS	d+1	0,48	0,51	0,51	0,52	0,52	0,52	0,50	0,48	0,46	0,45	0,42	
	d+2	0,48	0,52	0,50	0,51	0,51	0,50	0,47	0,44	0,42	0,39	0,37	
	d+3	0,47	0,48	0,46	0,46	0,45	0,43	0,41	0,38	0,37	0,35	0,32	
FBI	d+1	1,74	1,53	1,55	1,48	1,44	1,43	1,43	1,31	1,26	1,23	1,17	
	d+2	1,55	1,38	1,40	1,33	1,29	1,28	1,31	1,23	1,19	1,18	1,17	
	d+3	1,53	1,35	1,36	1,28	1,23	1,20	1,23	1,14	1,10	1,08	1,09	
POD	d+1	0,89	0,86	0,86	0,85	0,83	0,83	0,81	0,75	0,72	0,69	0,64	
	d+2	0,83	0,81	0,80	0,79	0,77	0,76	0,74	0,69	0,65	0,62	0,59	
	d+3	0,80	0,76	0,75	0,72	0,69	0,66	0,65	0,59	0,57	0,54	0,51	
KSS	d+1	0,44	0,50	0,55	0,56	0,58	0,58	0,59	0,59	0,59	0,58	0,55	
	d+2	0,45	0,51	0,53	0,54	0,56	0,55	0,54	0,54	0,52	0,50	0,49	
	d+3	0,44	0,46	0,48	0,48	0,47	0,46	0,46	0,44	0,44	0,43	0,41	

		8,0	10,0	12,0	14,0	16,0	18,0	20,0	25,0	30,0	35,0	40,0	(mm)
FAR	d+1	0,49	0,53	0,55	0,57	0,60	0,60	0,63	0,70	0,76	0,80	0,80	
	d+2	0,53	0,55	0,59	0,62	0,66	0,68	0,70	0,77	0,81	0,83	0,81	
	d+3	0,58	0,60	0,61	0,64	0,65	0,66	0,69	0,74	0,81	0,82	0,81	
TS	d+1	0,38	0,33	0,32	0,31	0,28	0,28	0,26	0,22	0,18	0,14	0,14	
	d+2	0,33	0,31	0,29	0,26	0,24	0,23	0,21	0,16	0,14	0,12	0,13	
	d+3	0,28	0,26	0,25	0,23	0,23	0,22	0,20	0,17	0,13	0,11	0,12	
FBI	d+1	1,20	1,17	1,16	1,19	1,22	1,22	1,27	1,49	1,66	1,59	1,46	
	d+2	1,14	1,12	1,18	1,20	1,35	1,36	1,40	1,56	1,68	1,78	1,66	
	d+3	1,10	1,09	1,08	1,09	1,16	1,16	1,17	1,34	1,41	1,28	1,22	
POD	d+1	0,61	0,54	0,53	0,51	0,49	0,49	0,48	0,45	0,40	0,33	0,30	
	d+2	0,54	0,50	0,49	0,46	0,46	0,44	0,42	0,36	0,32	0,30	0,31	
	d+3	0,46	0,44	0,42	0,40	0,40	0,40	0,37	0,34	0,27	0,23	0,23	
KSS	d+1	0,53	0,47	0,46	0,46	0,44	0,44	0,44	0,41	0,37	0,30	0,28	
	d+2	0,45	0,43	0,42	0,40	0,40	0,38	0,37	0,32	0,29	0,27	0,29	
	d+3	0,38	0,36	0,35	0,34	0,35	0,35	0,33	0,31	0,24	0,21	0,22	