4 Operational Applications

The LM is operated in five centres of the COSMO members (ARPA-SIM, DWD, HNMS, IMGW, MeteoSwiss) and since early 2005 also at the associated member in Romania (NMA). Figure 1 shows the integration domains of the different implementations. This chapter informs about the basic set-up of the LM configurations and about some specific details for every partner.

ARPA-SIM, HNMS, IMGW and NMA use interpolated boundary conditions from forecasts of the global model GME of DWD. Only a subset of GME data covering the respective LM-domain of a centre are transmitted from DWD via the Internet. HNMS, IMGW and NMA start the LM from interpolated GME analyses. In this case it is possible to smooth the initial fields using the digital filtering scheme of Lynch et al. (1997). At DWD, a comprehensive data assimilation system for LM has been installed, comprising the LM nudging analysis for atmospheric fields, a sea surface temperature (SST) analysis, a snow analysis and the soil moisture analysis according to Hess (2001). A data assimilation system based on the LM nudging scheme is also used at MeteoSwiss (since November 2001) and at ARPA-SIM (since October 2003). Since September 2003, MeteoSwiss uses lateral boundaries from interpolated IFS-forecasts.

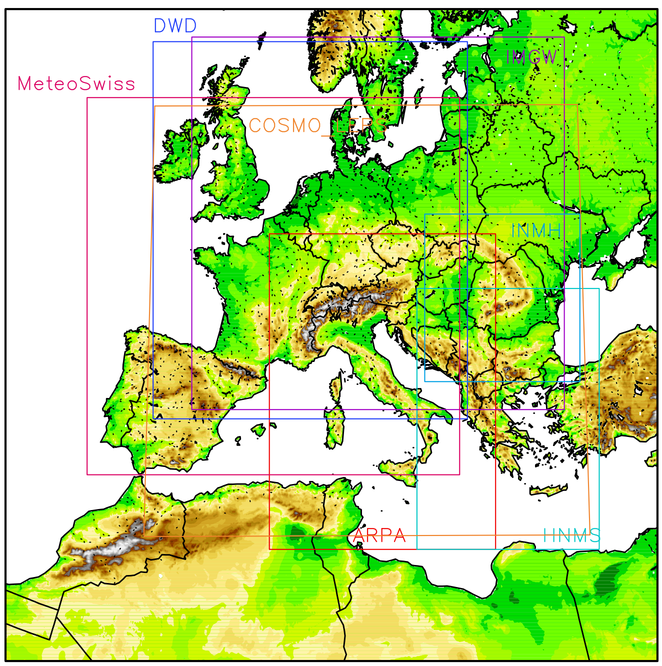

Figure 1: LM integration domains used at the partners and for the COSMO-LEPS

ARPA-SIM installed the COSMO-LEPS (Limited Area Ensemble Prediction System) based on LM and ECMWF ensemble forecasts at the ECMWF computing centre. Several operational LM runs are performed (10 km grid spacing, 32 levels) starting at 12 UTC on initial and boundary conditions for selected representative members of an ECMWF-EPS superensemble.

In addition, the national weather service of Italy, UGM in Rome, runs the LM at the ECMWF computing centre for a domain comparable to the COSMO-LEPS domain. The lateral boundaries for these runs are taken from the IFS.

The following sections give a brief overview on the configurations of the operational LM systems in the COSMO meteorological centres. MeteoSwiss, ARPA-SIM and UGM have renamed the model within their services: the LM application in Switzerland is called ***aLMo*** (Alpine Model), the LM application in Italy is called ***LAMI*** (Limited Area Model Italy) and the LM run by UGM at ECMWF is called ***Euro-LM***.

4.1 ARPA-SIM (Bologna)

Basic Set-Up of LM

The regional meteorological service ARPA-SIM in Bologna operates the LM (as LAMI) at 7 km grid spacing. The rotated lat-lon coordinates of the lower left and the upper right corner of the integration domain are ($\lambda = -5°, \varphi = -24.0°$) and ($\lambda = 9.5625°, \varphi = -7.0625°$), respectively. See Figure 1 for this model domain. The main features of the model set-up are summarized in Table 1.

Table 1: **Configuration of the LAMI at ARPA-SIM**

Domain Size	234 x 272 gridpoints
Horizontal Grid Spacing	0.0625° (∼ 7 km)
Number of Layers	35, base-state pressure based hybrid
Time Step and Integration Scheme	40 sec, 3 time-level split-explicit
Forecast Range	72 h
Initial Time of Model Runs	00 and 12 UTC
Lateral Boundary Conditions	Interpolated from GME at 1-h intervals
Initial State	Nudging data assimilation cycle, no initialization
External Analyses	None
Special Features	Use of filtered topography, new TKE scheme, new surface-layer scheme, cloud-ice scheme
Model Version Running	lm_f90 3.9
Hardware	IBM SP pwr4 (using 64 of 512 processors)

Changes in the last year

In June 2004 all the LAMI operational suites have been upgraded to use LM version 3.9 and GME2LM version 1.19. Some output fields, since that date, are produced every hour rather than every 3 hours. Starting from July 2004, the LM backup suite running on ARPA-SIM Linux cluster makes use of the prognostic precipitation scheme; since October the run with prognostic precipitation has been activated also at CINECA on IBM-SP as an experimental suite, while the main operational run remains without prognostic precipitation. LAMI usually runs on 64 processors at CINECA (IBM) and on 42 at ARPA-SIM (Linux cluster).

Data assimilation

Since October 2003 an operational assimilation suite based on the LM nudging is running to produce the initial state for the atmospheric variables. The assimilation suite includes two 12-h cycles with AOF-file provided by UGM Rome with SYNOPs, AIREPs, TEMPs and PILOTs. Two forecasts up to 72 hours, at 00 and 12 UTC, are performed daily starting from the analyses provided by the assimilation cycles. Figure 2 illustrates the scheme of the assimilation suite.

Computer system

For the operational runs at CINECA, an IBM SP with pwr4 processors is used. The backup

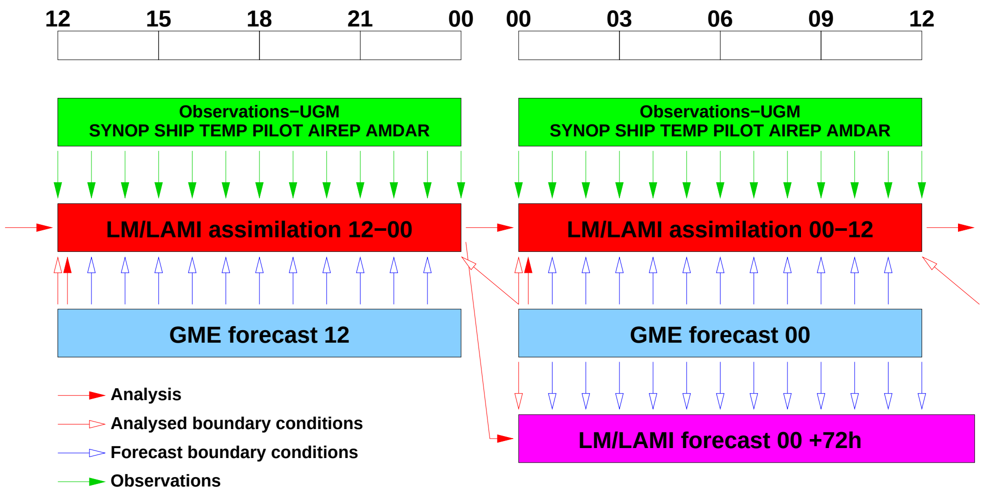

Figure 2: The assimilation suite at ARPA-SIM

suite is being set up at ARPA on a cluster of i386 computers using 42 processors INTEL Xeon 2.4Ghz (out of 44), connected by Gigabit ethernet network and running the Linux/GNU operating system. The setup is similar as the one at Cineca (with additional prognostic precipitation) and the suite is controlled by ECMWF SMS software.

4.2 DWD (Offenbach)

Basic Set-Up of LM

The LM runs operationally at DWD using a 7 km grid spacing and 35 vertical levels. The rotated lat-lon coordinates of the lower left and the upper right corner of the integration domain are $(\lambda = -12.5°, \varphi = -17.0°)$ and $(\lambda = 7.75°, \varphi = 3.25°)$, respectively. See Figure 1 for this model domain. The main features of the model set-up are summarized in Table 2.

Table 2: **Configuration of the LM at DWD**

Domain Size	325 x 325 gridpoints
Horizontal Grid Spacing	0.0625° ($\sim$ 7 km)
Number of Layers	35, base-state pressure based hybrid
Time Step and Integration Scheme	40 sec, 3 time-level split-explicit
Forecast Range	48 h
Initial Time of Model Runs	00, 12 and 18 UTC
Lateral Boundary Conditions	Interpolated from GME at 1-h intervals
Initial State	Nudging data assimilation cycle, no initialization
External Analyses	Sea surface temperature (00 UTC) Snow depth (00, 06, 12, 18 UTC) Variational soil moisture analysis (00 UTC)
Special Features	Use of filtered topography, new TKE-scheme new surface-layer scheme, cloud-ice scheme prognostic precipitation
Model Version Running	lm_f90 3.15
Hardware	IBM SP (NighthawkII; using 185 of 1920 pwr3-processors)

Changes in the last year

These are the main changes in the operational setup in the last year:

- Introduction of *prognostic precipitation*: The prognostic treatment of grid-scale rain and snow is handled by semi-Lagrange advection.
- Reduction of turbulent fluxes over sea by changing the ratio of the laminar scaling factor for heat.
- Computation of synthetic satellite images using the RTTOV-library.
- Use of data from European windprofiler in the assimilation suite.
- Introduction of rain and snow as initial fields for LM (necessary because of their prognostic treatment.

Data Assimilation

At DWD, a comprehensive data assimilation system for LM has been installed. Besides the analysis by observational nudging, three external analyses are run: a sea surface temperature (SST) analysis (00 UTC), a snow depth analysis (00, 06, 12 and 18 UTC) and a variational soil moisture analysis (00 UTC).

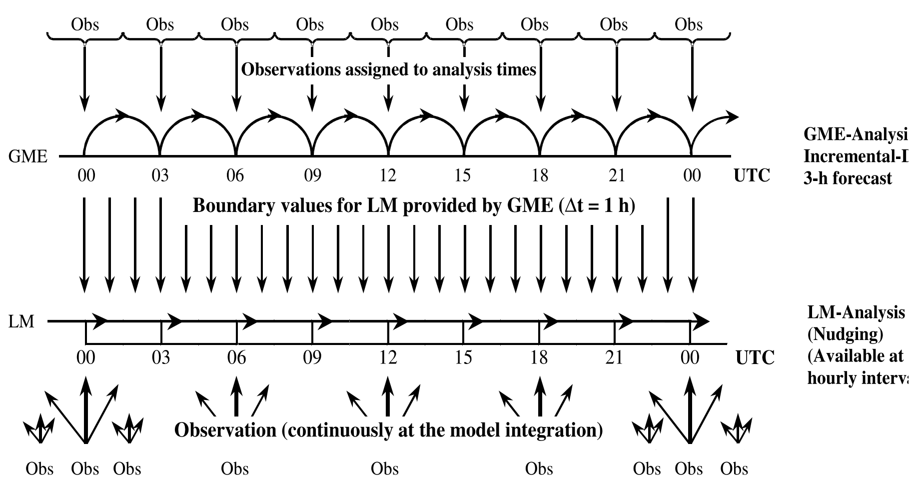

Figure 3: 4-D data assimilation for GME and LM

The data assimilations for the models GME and LM proceed as parallel streams which are coupled only via the boundary data. (see Fig. 3). The GME analysis is based on a 3-D multivariate optimum interpolation (OI) of deviations of observations from 3-h forecasts (first guess), generating an intermittent assimilation cycle with 3-h analysis frequency. All observations within a time window of $\pm$ 1.5 hours are considered as instantaneous, i.e. to be valid at analysis time.

The 3-h GME forecasts to produce the first guess are used to generate boundary data at 1-h intervals for the LM assimilation cycle. The nudging scheme produces a continuous analysis stream, where data are assimilated at the time they are observed - but using a time-weighting function to spread the information in time. For practical reasons, 3-hour LM assimilation runs are done. LM analysis files are written every hour.

Operational Schedule

The operational schedule is structured by data assimilation for GME and LM every three hours, i.e. for 00, 03, 06, 09, 12, 15, 18 and 21 UTC. The data cut-off time for the 00 UTC and 12 UTC model runs of both GME and LM is 2 h 14 min. Based on this analyses, GME performs a 174-h forecast, and LM performs a 48-h forecast. Another 48-h prediction of both models is performed starting at 18 UTC with a data cut-off time of 4 hours. Besides the forecast models, a wave prediction suite comprising a global and a local sea state model (GSM and LSM) is run operationally.

4.3 HNMS (Athens)

Basic Set-Up of LM

The national meteorological service of Greece, HNMS in Athens, operates the LM in a pre-operational mode at 7 km grid spacing. The rotated lat-lon coordinates of the lower left and of the upper right corner of the integration domain are ($\lambda = 4.5°, \varphi = -24.0°$) and ($\lambda = 16.25°, \varphi = -10.0°$), respectively. See Figure 1 for this model domain.

In Athens, the LM (Version 3.1) is run 4 times a day (00, 06, 12, 18 UTC) on a HP-cluster and 2 times also at ECMWF (Version 3.9; 00, 12 UTC) The forecasts starting at 06 and 18 UTC are based on an experimental nudging suite.

Table 3 shows the main features of both model set-ups for the greek runs.

Table 3: **Configuration of the LM at HNMS and at ECMWF**

Domain Size	189 x 225 gridpoints	
Horizontal Grid Spacing	0.0625° (~ 7 km)	
Number of Layers	35, base-state pressure based hybrid	
Time Step	30 sec	
Integration Scheme	3 time-level split-explicit	
Forecast Range	48 h	
Initial Time of Model Runs	00, 06, 12, 18 UTC	00, 12 UTC
Lateral Boundary Conditions	GME, 1-h intervals	IFS, 3-h intervals
Initial State	from GME	from IFS
External Analyses	None	
Special Features	Use of filtered topography; new TKE-scheme new surface layer scheme; cloud-ice scheme	
Model Version Running	lm_f90 3.1	lm_f90 3.9
Hardware	HP	IBM SP

Implementation of LM during the 2004 Athens Olympics

Due to the need of improved accuracy regarding forecasting using the Non-Hydrostatic Local Model (LM), HNMS considered that hourly boundary conditions from both the ECMWF and DWD Global Models would help towards this goal.

Within this framework, ECMWF and DWD consistently provided hourly boundary conditions (full fields for 00 and 12 UTC analysis) covering the period starting from the end of July until the end of September 2004 where Athens Olympics and Paralympics took place.

HNMS was able to successfully implement these boundary conditions in order to initialize LM model by using software developed within the COSMO consortium. LM model run at the IBM supercomputer of ECMWF through the available computational units of HNMS. The Centre generously gave the adequate priority to the submitted jobs for the prompt delivery of the output towards its operational use.

In particular, LM run at ECMWF in the following modes regarding grid size and hourly boundary conditions with analysis from 00 and 12 UTC (i.e. two runs a day per mode):

a) 7.0 km grid initialized from the Global Model of ECMWF.

b) 7.0 km grid initialized from the Global Model of DWD.

c) 5.0 km grid initialized from the Global Model of ECMWF.

d) 2.3 km grid over the wider area of the Olympics initialized from the LM output of (a) and through the Nesting Version of LM (1-way option).

From a first investigation, we may conclude that by using hourly boundary conditions, the incoming and outcoming flow, being to some extent more free from artificial boundary problems, gave the possibility to the model equations to resolve better the whole range of weather disturbances.

The Meteorological support of the 2004 Olympics has been officially considered a most successful one. HNMS would like to deeply acknowledge the invaluable help from all COSMO Members and ECMWF towards this achievement.

4.4 IMGW (Warsaw)

Basic Set-Up of LM

The national meteorological service of Poland, IMGW in Warsaw, operates the LM in an operational mode at 14 km grid spacing twice a day (00 and 12 UTC). The rotated lat-lon coordinates of the lower left and of the upper right corner of the integration domain are ($\lambda = -10.0°, \varphi = -16.5°$) and ($\lambda = 14.0°, \varphi = 3.5°$), respectively. See Figure 1 for this model domain. The main features of the model set-up are summarized in Table 4.

Table 4: **Configuration of the LM at IMGW**

Domain Size	193 x 161 gridpoints
Horizontal Grid Spacing	0.125° (~ 14 km)
Number of Layers	35, base-state pressure based hybrid
Time Step and Integration Scheme	80 sec, 3 time-level split-explicit
Forecast Range	72 h
Initial Time of Model Runs	00 and 12 UTC
Lateral Boundary Conditions	Interpolated from GME at 1-h intervals
Initial State	Interpolated from GME
External Analyses	None
Special Features	Use of filtered topography, new TKE-scheme new surface-layer scheme, cloud-ice scheme
Model Version Running	lm_f90 3.5
Hardware	SGI 3800 (using 88 of 100 processors)

The results of the LM forecasts are provided to the Weather Offices and to the RADAR and HYDRO units of IMGW (also for verification). Figure 4 shows some of these forecast products.

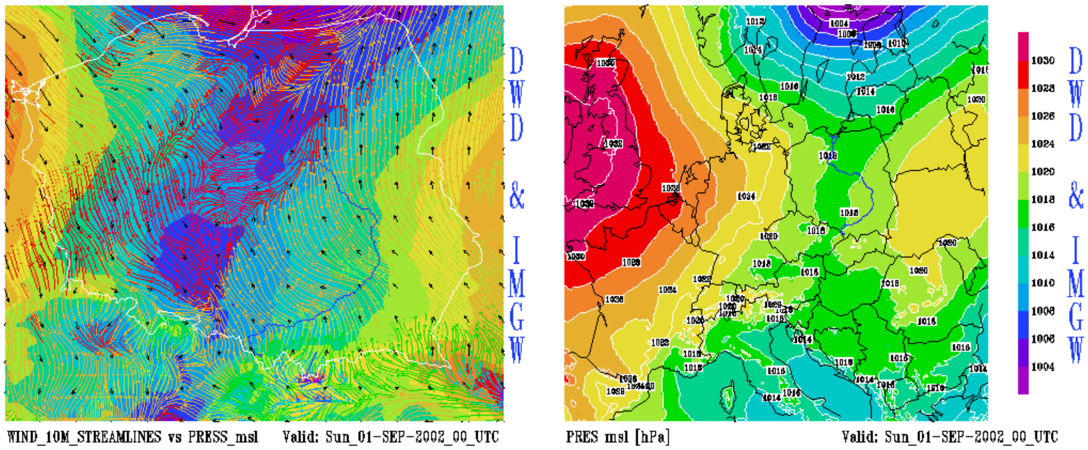

Figure 4: Forecast products used at IMGW, Warsaw

In addition to the operational runs with dx=14 km the LM also runs with a resolution of 7 km, but only for a forecast range of 30 hours.

4.5 MeteoSwiss (Zürich)

Introduction

The Alpine Model (aLMo) is the operational 7km version of the LM at MeteoSwiss. The model is computed on a NEC SX5 operated by the Swiss Centre for Scientific Computing (CSCS) in Manno. During the operational forecasting slots the SX5 enters near-dedicated mode: 14 CPUs are then reserved for the model integration, 1 for the interpolation of the initial and lateral boundary fields provided by the driving global model. From the global model (Integrated Forecast System, IFS, from ECMWF) only frames are used. The operational suite is controlled by the LM Package. This is a set of scripts running on SUN/SGI machines.

Basic Set-Up of aLMo

The aLMo domain extends from 35.11 N, 9.33 W (lower left) to 57.03 N, 23.41 E (upper right). This domain is covered by a grid of 385 × 325 points with a horizontal resolution of 7 km (see Figure 1). The borders are placed prevalently over sea in order to reduce negative interferences generated in the transition zone of the orographies of the driving model (IFS) and aLMo. The main features of the model set-up are summarized in Table 5.

Vertical Coordinates

In operational mode the model runs with 45 levels vertically distributed as shown in Fig. 5.

Hardware and Communications

The computational work of the aLMo suite is managed by 3 systems:

- SUN Enterprise 3000	at MeteoSwiss	(dissemination)
- SGI Origin 3000	at CSCS	(control, pre- and postprocessing, trajectories)
- NEC SX5	at CSCS	(IFS2LM, aLMo, LPDM)

Table 5: **Configuration of the aLMo at MeteoSwiss**

Domain Size	385 x 325 gridpoints
Horizontal Grid Spacing	0.0625° (~ 7 km)
Number of Layers	45, base-state pressure based hybrid
Time Step and Integration Scheme	40 sec, 3 time-level split-explicit
Forecast Range	72 h
Initial Time of Model Runs	00 UTC and 12 UTC
Lateral Boundary Conditions	Interpolated from IFS at 3-h intervals
Initial State	Nudging data assimilation cycle, no initialization
External Analyses	Merging of LM-DWD snow analysis
Special Features	Use of filtered topography
Model Version Running	lm_f90 3.12
Hardware	NEC SX5 (using 14 of 16 processors)

Figure 6 shows the present configuration of hardware and communication used for the operational application of aLMo.

Data Flow
All operational processes are illustrated in the flow diagram of Figure 7. The format of the different products is shown by the different colours of the connections.

LM Package
The operational suite is driven by "LM Package", a software developed at Meteo Swiss. It has a modular structure and is composed by 50 shell scripts. It can be executed in three different modes: operational, test and personal mode. In operational mode preprocessing, aLMo and postprocessing are running concurrently; warnings and exits are transmitted to the permanently on-duty operators, who have the possibility to do manual interventions.

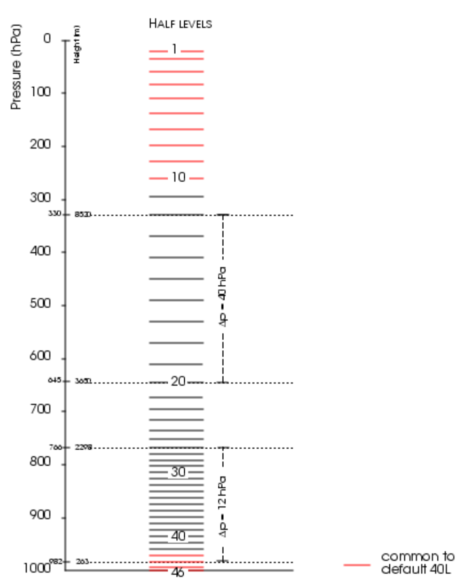

Figure 5: Vertical distribution of levels used at MeteoSwiss

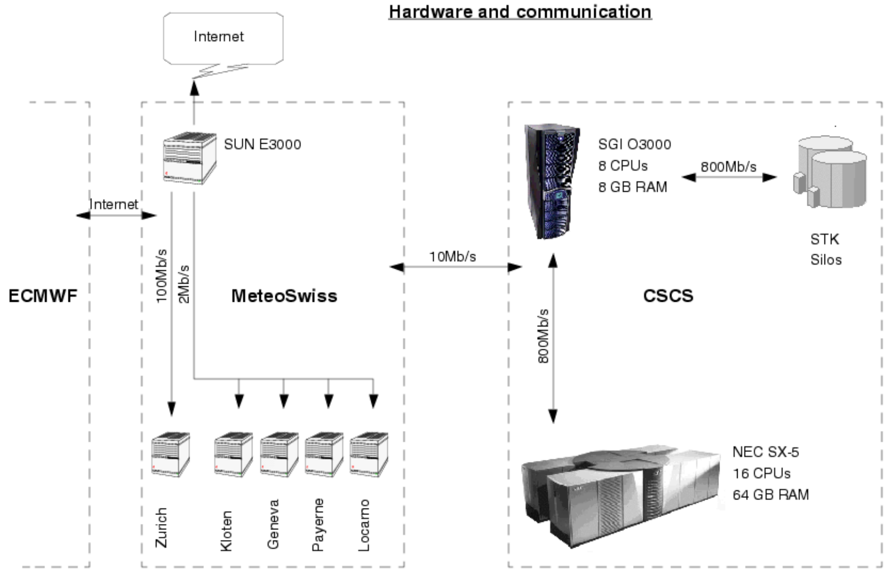

Figure 6: Present configuration of hardware and communications at MeteoSwiss

Products
- 2-D plots: produced by MetView every 3 or 6 hours
- Animations: Hourly loops produced with IDL and AVS
- Tables and extracts of the model output in different formats
- Trajectories
- Concentrations calculated by the LPDM module

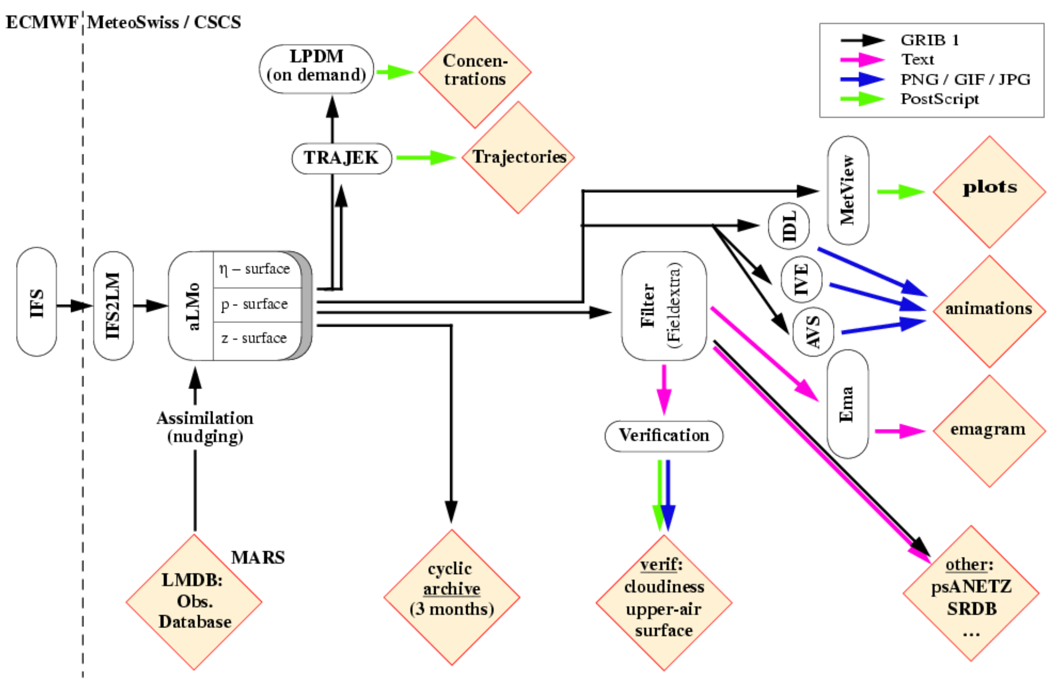

Figure 7: Dataflow of the current operational system at MeteoSwiss

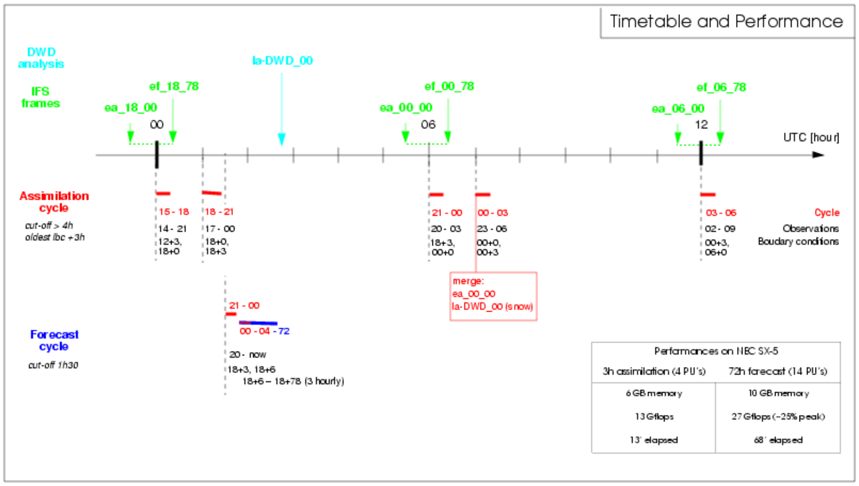

Figure 8: Time table of the aLMo assimilation cycle at MeteoSwiss

Assimilation Cycle

The data assimilation at MeteoSwiss is implemented with 3-hour assimilation runs. aLMo files are written every hour. The cut off time is at least 4 hours. The observations are taken from the aLMo data base, basically a copy of the ECMWF message/report data base. At the beginning of the 00-03 UTC and 12-15 UTC assimilation runs the ozone, vegetation and soil parameters are updated from the IFS analysis. In a similar way the LM snow analysis from DWD is merged into aLMo initial conditions. The schedule for half a day is displayed in Fig. 8.

Time Table

The analysis used by the main 72h forecasts is produced just ahead of the main runs (aLMo forecast) with a 3h run of aLMo in assimilation mode with the IFS frames from 6h earlier (18 or 06 UTC). The boundary conditions in the frames are updated every 3 hours. During the main forecast runs assimilation continues during the first 4 hours. The postprocessing is divided into a time critical and a non time critical part. During the first part the crucial products for Meteo Swiss internal clients (mainly forecasters) are generated and disseminated. During the second part the remaining products for internal and external clients are created. Archiving and statistics take place at the very end of the task. The concurrent processes of the operational production are illustrated in Fig. 9.

Verification

The output of the Model undergoes four different types of verification:

- Surface verification: The surface parameters are compared to measurements taken by synoptical and automatic stations.
- Upper air verification: verification of the model against measured radiosonde ascents;
- Cloud verification: verification of the model cloudiness based on METEOSAT visible images.
- Radar verification: verification of the precipitation against swiss radar network measurements.

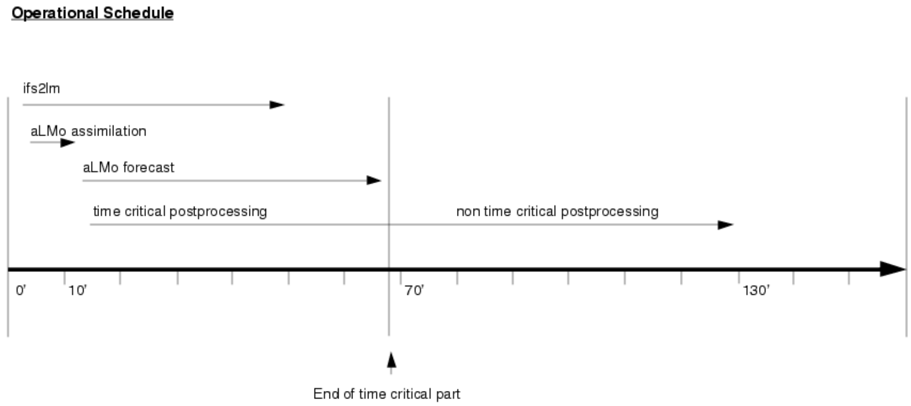

Figure 9: Time table of the operational suite at MeteoSwiss

4.6 UGM/CNMCA (Rome)

Basic Set-Up of LM

The EuroLM is the operational LM version of UGM using a 7 km grid spacing and 35 vertical levels. The rotated lat-lon coordinates of the lower left and of the upper right corner of the integration domain are ($\lambda = -14.0°, \varphi = -27.0°$) and ($\lambda = 15.0°, \varphi = -3.0°$), respectively. See Figure 1 for the model domain. EuroLM is driven by IFS boundary conditions (frames) and initialized by interpolated analysis from the EuroHRM variational data assimilation system (UGM hydrostatic NWP system). The new option of the Rayleigh damping, using filtered LM forecast fields instead of external boundary condition fields, is switched on to reduce the spurious reflection from the top boundary of the model domain. The main features of the model set-up are summarized in Table 6. UGM has started to run EuroLM at ECMWF from February 2004.

Table 6: **Configuration of EuroLM**

Domain Size	465 x 385 gridpoints
Horizontal Grid Spacing	0.0625° (~ 7 km)
Number of Layers	35, base-state pressure based hybrid
Time Step and Integration Scheme	40 sec, 3 time-level split-explicit
Forecast Range	60 h
Initial Time of Model Runs	00 UTC
Lateral Boundary Conditions	Interpolated from IFS frames at 3-h intervals
Initial State	Interpolated from EuroHRM 3D-Var analysis
External Analyses	None
Special Features	Use of filtered topography, new TKE scheme, new surface-layer scheme, cloud-ice scheme new option for Rayleigh damping
Model Version Running	lm_f90 3.15
Hardware	IBM P690 (at ECMWF; using 120 processors)

Data assimilation

EuroLM initial fields are interpolated from the EuroHRM analysis. The EuroHRM intermittent, 3-hourly, data assimilation system is based on the UGM 3D-Var PSAS analysis scheme and the hydrostatic model HRM. Temperature, wind and pseudo relative humidity on 30 pressure levels plus surface pressure are currently analysed. The observations assimilated in a 3 hours time window are: SYNOPs, SHIPs, BUOYs, WIND PROFILERs, TEMPs, PILOTs, QSCAT winds, ERS2 winds, AIREPs, AMDARs, AMVs and AMSU-A radiances. The EuroHRM model domain has a 0.25 grid spacing and 40 vertical levels.

Operational Schedule
The operational schedule is dependent on the data assimilation of EuroHRM. The data cut-off time is 3 hours. As the 00 UTC EuroHRM analysis is produced, the EuroLM model integration is performed up to 72 hours. 3-hourly IFS frames from 18 UTC run are used, as boundary conditions.

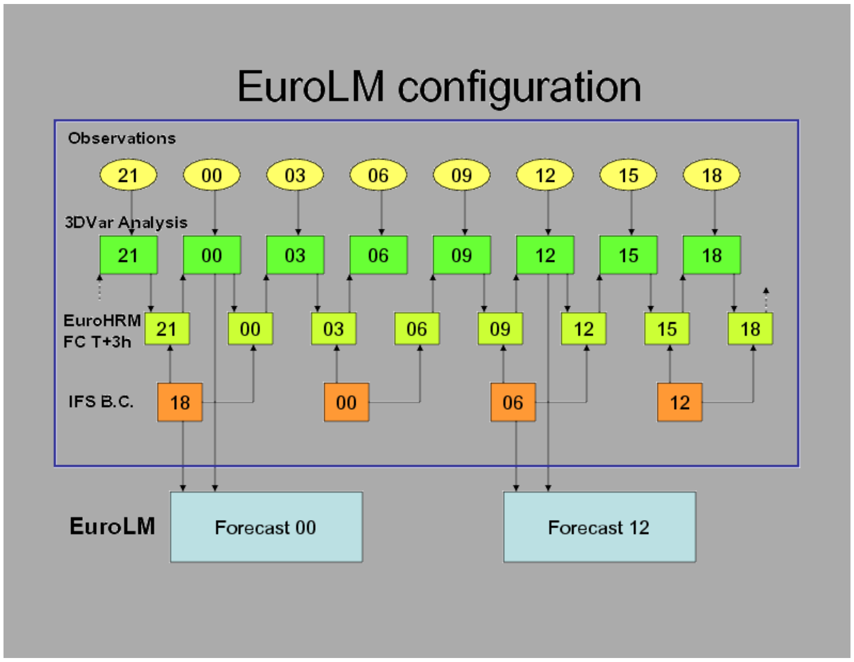

Figure 10: The assimilation suite of UGM/CNMCA

4.7 NMA (Bucharest)

Basic Set-Up of LM
The national meteorological administration of Romania, NMA in Bucharest, operates the LM in an operational mode at 14 km grid spacing twice a day (00 and 12 UTC). The rotated lat-lon coordinates of the lower left and of the upper right corner of the integration domain are ($\lambda = 5.0°, \varphi = -15.0°$) and ($\lambda = 15.0°, \varphi = -6.0°$), respectively. See Figure 1 for this model domain. The main features of the model set-up are summarized in Table 7.

In addition to the operational runs with dx=14 km the LM also runs with a resolution of 7 km on the same domain.

Table 7: **Configuration of the LM at NMA**

Domain Size	81 x 73 gridpoints
Horizontal Grid Spacing	0.125° ($\sim$ 14 km)
Number of Layers	35, base-state pressure based hybrid
Time Step and Integration Scheme	80 sec, 3 time-level split-explicit
Forecast Range	48 h
Initial Time of Model Runs	00 and 12 UTC
Lateral Boundary Conditions	Interpolated from GME at 3-h intervals
Initial State	Interpolated from GME
External Analyses	None
Special Features	Use of filtered topography, new TKE-scheme new surface-layer scheme, cloud-ice scheme prognostic precipitation
Model Version Running	lm_f90 3.9
Hardware	Linux cluster (26 processors)

4.8 COSMO Limited-Area Ensemble Prediction System

The COSMO limited area ensemble prediction system (COSMO-LEPS) based on LM and ECMWF ensemble forecasts has been installed at ECMWF by our colleagues at ARPA-SIM in Bologna (Montani et al., 2003) The system is ready for a quasi-operational trial since November 2002, using 120-h forecasts of 10 LM runs starting at 12 UTC on initial and boundary conditions for 10 representative members of an ECMWF-EPS superensemble. Supervision and scheduling of the suite is done by ARPA-SIM. COSMO-LEPS probability products (derived and processed by the group in Bologna) are ready at about 23.00 GMT. The dissemination to COSMO centres is by GRIB-files.

Basic Set–Up of COSMO–LEPS

Within COSMO–LEPS framework, LM runs operationally at ECMWF using a 10 km grid spacing and 32 vertical layers. In contrast to all other applications, COSMO–LEPS uses a rotated pole with `pollat=40.0` and `pollon=-170.0`. The rotated lat-lon coordinates of the lower left and upper right corner of the integration domain (with this rotated pole) are ($\lambda = -12.5^o$, $\varphi = -16.0^o$) and ($\lambda = 14.95^o$, $\varphi = 7.13^o$), respectively. The main features of the model set–up are summarized in Table 8.

Changes in the last year

Since June 2004, the 10–member suite is operational using the two most recent EPSs to select the representative members. In March 2005, another LM run based on the high-resolution deterministic ECMWF forecast was added to the COSMO-LEPS suite. Products are archived at ECMWF from fc+0h to fc+120h every 3 hours.

COSMO-LEPS Products

At present, the following products are available.

- Probability of 24-h precipitation amount exceeding 1, 20, 50, 100 and 150 mm thresholds.
- Probability of 72-h precipitation amount exceeding 50, 100, 150 and 250 mm thresholds.
- Probability of maximum 2m-temperature above 20, 30, 35 and 40 Celsius thresholds.

Table 8: **Configuration of COSMO–LEPS, run at ECMWF by ARPA-SIM**

Domain size	306 × 258 gridpoints
Horizontal grid spacing	0.09^o (∼ 10 km)
Number of layers	32, basic-state presure based hybrid
Time Step and Integration Scheme	60 sec, 3 time–level split–explicit
Forecast Range	120 h
Initial Time of Model Runs	12 UTC
Lateral Boundary Conditions	Interpolated from EPS members at 6-h intervals
Initial State	Interpolated from EPS members' analyses
Special Features	Use of filtered topography
Model version running	lm_f90 3.9
Hardware	IBM p690 clusters (using 84 processors)

- Probability of minimum 2m-temperature below 5, 0, -5 and -10 Celsius thresholds.
- Probability of maximum 10m wind speed above 10, 15, 20 and 25 m/s thresholds.
- Probability of maximum CAPE (in 24 hours) exceeding 750., 1000., 1500., 2000., 2500., 3000. and 3500. J/kg thresholds.
- Probability of minimum SHOWALTER INDEX (in 24 hours) below 0, -2, -4 and -6 thresholds.
- Probability of minimum 'height of 0 °C isotherm' (HZEROCL) over 24 hours below 1500, 1000, 700 and 300 m thresholds.
- Mean sea level pressure and accumulated precipitation from 10 deterministic LM runs (every 6 hours).
- Geopotential at 700 hPa and temperature at 850 hPa from 10 deterministic LM runs (every 6 hours).