

Annual Technical Progress Report on the GDPS 2002

Country: Switzerland

1 Summary of Highlights

In 2002 there was a significant progress in a project to consolidate its various databases, data processing and quality control systems in a unified conceptual architecture.

As to the forecasting system, the main achievements were the successful testing of prognostic precipitation and the consolidation of the operational environment.

2 Equipment in use for the Forecasting System

The Forecasting System is operated externally at the Swiss Centre for Scientific Computing (SCSC).

Main System: NEC SX5 consisting of a single node with 16 CPU's, 8 gigaflops each and 64 Gbytes of shared main memory.

Post Processing: SGI Origin

3 Data and Products from GTS in use

At present nearly all observational data from GTS are used. Further GRIB data from Bracknell, Washington and Offenbach as well as T4-charts from Bracknell and Washington. Additionally, most of the MOTNE and OPMET data are used as well.

Typical figures for 24 hours are:

SYNOP, SYNOP Ship	10'700 reports
TEMP part A + B	1'111 reports
PILOT part A + B	120 reports
METAR	28'500 reports
TAF short/long	8'800 reports
AIREP/AMDAR	2'900 reports
GRIB	25'600 reports
T4-charts	410 reports
BATHY/TESAC	180 reports
DRIFTER	1'400 reports

4 Data input system

A fully automated system is used. A bulletin, which is entering the Message Handling System (MHS), is stored as it is to the database. SYNOP, TEMP and some national station reports are decoded on the MHS for further distribution to related systems or customers. METAR and TAF are reformatted back to old code format (removing keyword METAR/TAF from every station report) for internal use and national customers.

5 Quality control system

Quality control is done format based for ascii coded bulletins on input and can be switched off or on for every bulletin type desired. Bulletins failing this check are routed to operators workplace for correction if possible. Currently SYNOP and TEMP for region VI will be corrected as well as OPMET data for indicators L/// and E///.

6 Monitoring of the observing system

Currently computer aided manual system. For future enhancements see chapter 9.

7 Forecasting System

Generation of *medium* and *extended* range forecasting products at MeteoSwiss is based on external sources (ECMWF, DWD, ...), but MeteoSwiss runs its own *short-range* forecasting system. The core of this latter system is the non-hydrostatic Local Model developed by COSMO, the Consortium for Small-Scale Modelling founded in 1998 and currently composed of the national weather services of Germany, Switzerland, Italy, Greece and Poland (see cosmo-model.cscs.ch).

7.1 System run schedule and forecast ranges

The MeteoSwiss short range forecasting system uses a limited area model, and lateral boundary conditions are currently provided by the global model GME of the German weather service. The scheduling explained below is driven by the one of the GME.

A continuous data assimilation suite and two daily 48 hours forecast are calculated, with initial time of 0 and 12 UTC. Cut off time for the main assimilation suite is 5 hours, and this suite is implemented with 3-hour assimilation runs. Two additional 3-hour assimilation runs with a shorter 2h50 cut off are calculated to provide initial conditions for the forecast. All time critical forecast products are available after 65 minutes.

A sophisticated set of scripts controls the whole operational suite, and allows for a very high reliability of the system, with less than 2% of the forecast requiring manual intervention. This same environment is also used to run parallel suites validating proposed modifications of the system and to facilitate experimentation by the modelling group.

The computing resources and expertise is provided by the Swiss Centre for Scientific Computing (SCSC, see www.cscs.ch). The Swiss version of the Local Model, called *aLMo* for alpine model, is calculated on a single node 16 processors NEC SX-5, and pre- and post- processing needs are covered by a SGI O3000 platform; a large multi-terabytes long term storage is used for archiving purposes, and a 10 Mbit/s link connects the MeteoSwiss main building with the SCSC (on the other side of the Alps!).

It is planned in the near future to reduce the forecast cycle cut off time from 2h50 to 1h30. It is also planned to increase the range of the 0UTC forecast to 72h.

7.2 Medium range forecasting system

MeteoSwiss does not run a medium range forecasting system.

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

7.3.1 Data assimilation, objective analysis and initialisation

Data assimilation with the Local Model is based on the nudging or Newtonian relaxation method. This technique has been implemented using relaxation of model dynamical fields towards direct observations [Schraff, 1997].

Conventional data of types SYNOP, SHIP, DRIBU, PILOT, TEMP and AIRCRAFT are currently used. The variables nudged at all model layers are the horizontal wind, the temperature and the humidity; at the lowest model level the pressure, the 2m-humidity and the 10m-wind are also used. Data assimilation is implemented as a continuous cycle with 3-hour assimilation runs. A typical 24 hour assimilation at MeteoSwiss ingests about 180 vertical soundings, about 7000 upper-air observations and about 25000 surface observations.

The full ECMWF observation pre-processing software has been installed at MeteoSwiss, on a SGI O3000 platform; the associated database is fed with bulletins coming from the GTS. Besides the data quality control included in this ECMWF software, a simple observation increment threshold test is applied during data assimilation.

The Local Model is also able to assimilate GPS derived integrated water vapour, wind profiles from wind profilers and from weather radar; a radar based 2-dimension latent heat nudging scheme is being developed. It is planned to use these additional data in the future, after a comprehensive evaluation of their impact.

Sea surface temperature and soil model analysis being not implemented at MeteoSwiss, two daily update of the corresponding model fields based on the driving model are made. However, a satellite based analysis of snow cover, sea and lake temperature and of some vegetation parameters is currently being developed and will be progressively introduced in production.

7.3.2 Model

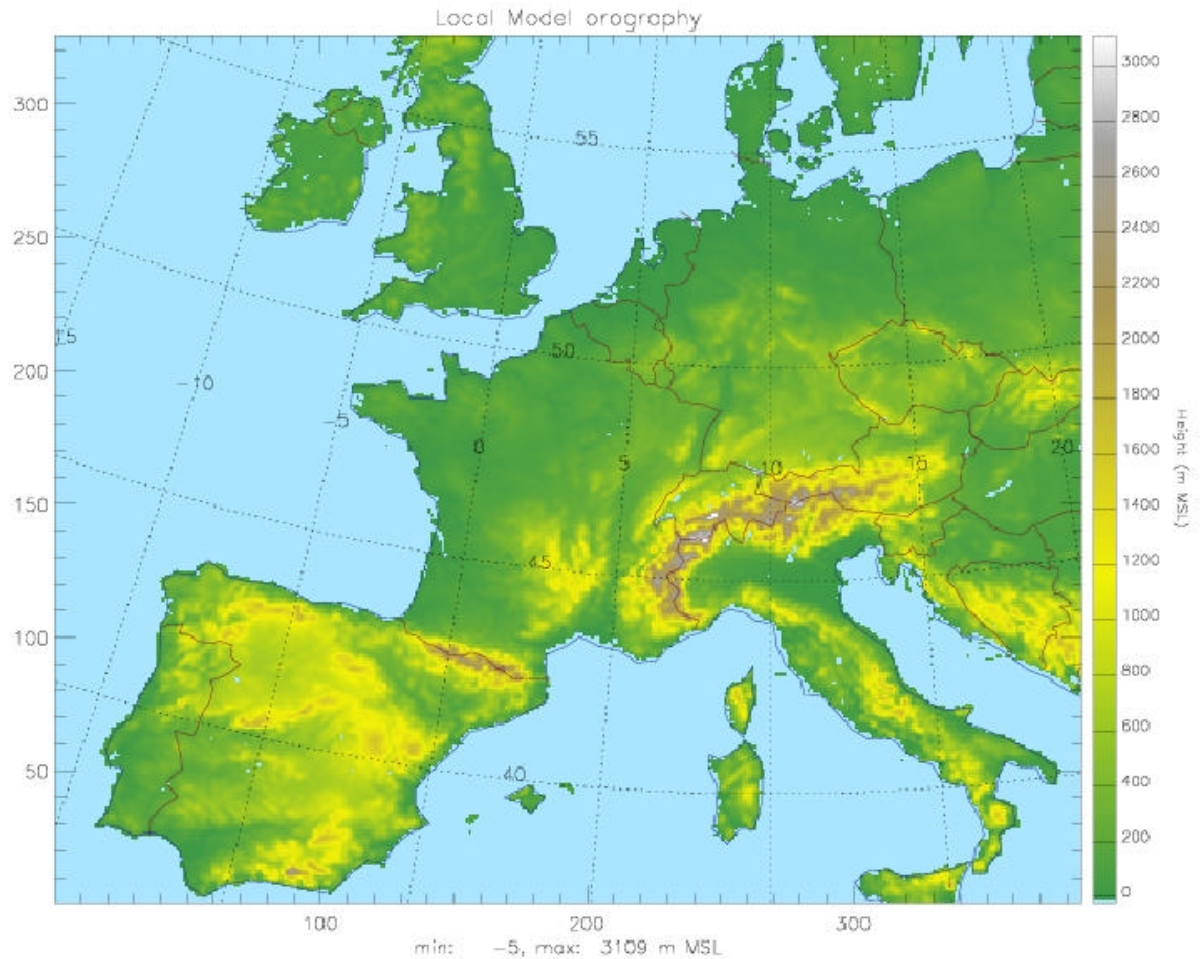


Figure: Local Model domain and orography (min: -5m, 3109m)

A thorough description of the Local Model itself can be found on the COSMO web site at cosmo-model.cscs.ch or in the first COSMO newsletter [Doms, 2001]. It is a non-hydrostatic primitive equation model, with the 3 wind components, the pressure perturbation, the temperature, the specific humidity and the liquid water content as prognostic variables. Additional optional prognostic quantities are the cloud ice and the turbulent kinetic energy.

The model equations are formulated on a rotated lat/lon Arakawa-C grid, with a generalized terrain-following height coordinate. Finite difference second order spatial discretization is applied, and time integration is based on a 3 time level split explicit method.

The Swiss version of the Local Model is called aLMo, for alpine model, and is calculated on a 385×325 mesh, with a 1/16° mesh size (about 7km), on a domain covering most of western Europe (see figure). In the vertical a 45 layers configuration is used; the vertical resolution in the lowest 2km of the atmosphere is about 100m (see figure). The main time step is chosen to be 40 second. Two daily 48h forecasts are calculated.

Hourly lateral boundary conditions are provided by the Global Model of the German Weather Service [Majewski, 1998] and assimilated by a 1-way nesting procedure according to Davies. Rayleigh damping is active in the upper layers. Initial conditions are provided by the assimilation suite.

7.3.3 Numerical weather prediction products

A suite of post processing modules are available:

- Kalman filtering of model output for 2 meter temperature and dew point temperature (will soon be completed by Kalman filtering of 10 meter wind velocity);
- visualization software based on the ECMWF MetView package and on in-house developments at MeteoSwiss and at SCSC; static maps, 2- and 3-dimensional loops with texture based flow visualization are created;
- a trajectory model providing guidance on transport route (hot air balloons, pollutants,...);
- a lagrangian particle dispersion model to calculate dispersion and deposition of radioactive materials.

Based on these modules, a standard set of products is provided to the MeteoSwiss bench forecasters, and are used as guidance for short-range forecasts. In case of necessity the two last modules can be run by the on-duty forecasters at any time (on-demand mode).

Besides that a large quantity of tailor made products, based on direct model output, are disseminated to internal and external clients.

For details of product availability please refer to the ECOMET-Catalogue via www.meteo.be/ECOMET/members/Switzerland.html

7.4 Specialized forecasts

Operational UV prediction model data available

7.5 Extended range forecasts

Not available

7.6 Long-range forecasts (30 day up to two years)

Products:

At MeteoSwiss a prototype product (referred to “Clim-gram”) was developed. It predicts probability distributions of seasonal 2m temperature anomalies on various sub-regions of the globe one to six months ahead. Initially the forecasts were based on the experimental ECMWF seasonal forecast system 1. During 2002 the product has been migrated to the ECWFMF system 2. The forecasts consist

of 40 ensemble members and the model drift is corrected using all ensembles of the hind-cast period 1987 to 2001. Preliminary calculations of the ranked probability skill scores for temperature predictions indicated limited skill over Europe.

8 Verification of prognostic products

For decades MeteoSwiss has assessed the quality of its forecasts. For over 15 years the method OPKO (ObjektivePrognosenKontrolle) has been in use. The verification method of the official forecasts will be described in the following paragraph. The available results will be presented and commented according to different criteria.

Method

Several times a day MeteoSwiss issues forecasts in three languages for the general public through its regional centres. These forecasts are assessed on a regular basis. First of all the texts have to be coded. The verbal contents are transferred into numerical codes according to precise regulations. This is quite easy with temperatures, but becomes a little more difficult with other meteorological data.

To assess cloudiness, the relative sunshine time will be taken in account. This means the measured time in relation to the maximum sunshine duration possible, the later changing daily according to the shape of horizon. The difficulty with this method is the conversion of terms describing sunshine or degrees of cloudiness into a code number. We have determined the corresponding categories on the basis of a public opinion poll and our forecasters are obliged to write their texts according to these binding categories.

Also precipitations are coded according to clear and binding regulations. The same applies to wind in cases where gusts of more than 25 knots are expected. Altogether quite a demanding, time-consuming job, which is still carried out manually for the time being.

The forecasts are assessed taking into account the measurements of our automatic network. 67 stations are used, however the temperatures of mountain-stations are not considered. The measured values are compared with the coded weather data. Fixed scores quotients are used to evaluate the results.

Results

The overall forecast results for the climatological year 2002 show the following scores:

Central and eastern part of Switzerland	84%
Western part of Switzerland and Valais	85%
Southern part of Switzerland and Engadine	84%
The whole of Switzerland	84%

The forecast analysis of more than 15 years with this same method shows in the beginning results around 80% and now around 84%. The results in flat areas are generally better, because forecasting in mountain regions is more difficult. If the difference between forecast and persistence is analysed in



the same period, the performance of our weather service is even better, because the persistence has slightly decreased in the last 15 years.

Outlook

The above described method will continue to be used for the moment. Deficiencies are known, especially because we cannot compare our results with those of other weather services. We are currently analysing other verification methods with a view to introducing an improved method in the future.

9 Future plans

In 2001 MeteoSwiss has started a project to consolidate its various databases, data processing and quality control systems in a unified conceptual architecture. As far as quality control is concerned a new generation of tools was implemented which has been developed over the last few years. The checking logic follows the recommendations of WMO. Additional tests were added to take into account the particularities of Alpine weather (e.g. Foehn, strong cold air pools). Station specific percentiles for each month are used as threshold values for limit checks. The thresholds were recalculated from long time series of high temporal resolved data (usually 10 minute data).

The quality control tools are distributed in several modules in order to check data as close as possible to the data source and to put at the users disposal checked data as quickly as possible. Some of the modules in the chain act without user interaction, flag suspicious data and attempt to correct obvious errors automatically, others allow interactive checking and correction of actual as well as historical data. This concept allows to have different levels of quality according to the customers needs. All modules use a unified flagging procedure consisting of the 'plausibility information' (a bitmap indicating the test violations) a 'treatment information' (indicating the correction if one was applied) and the 'time series state' (indicating the quality level of the data) to guarantee transparency about a value's status.

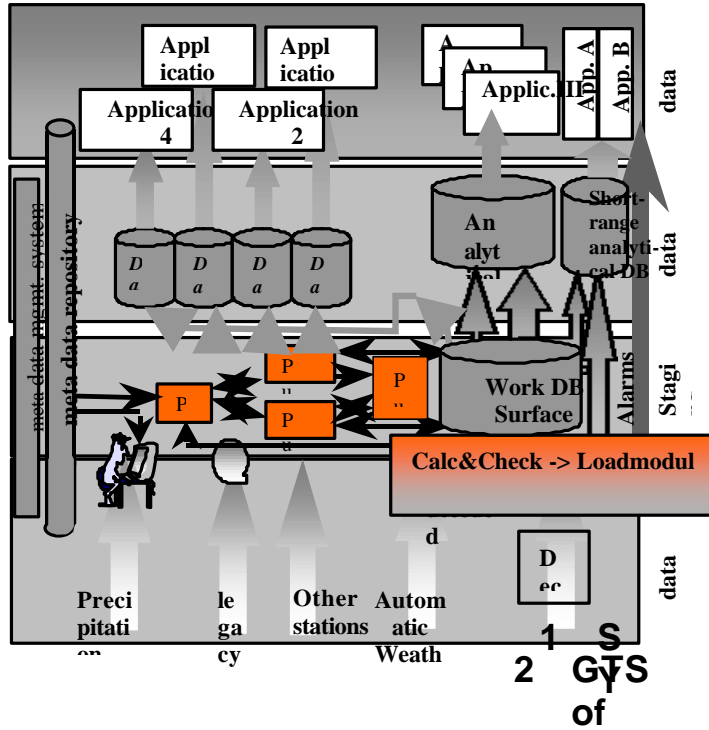


Figure 1: Unified, conceptual architecture at MeteoSwiss