6 Working Groups

COSMO's scientific and technical activities are organized in *Working Groups* (WG) which cover the main research areas related to a NWP-system. Each Working Group is headed by a *Work Package Coordinator* (WPC), who is responsible for the consistency of the execution of the work packages and for the coordination, planning, and supervision of the scientific and technical activities related to the work packages in his group.

This section gives an overview on the current personnel composition of the WGs. All scientists contributing actively to the work packages are included in the lists, also those from outside COSMO member institutions. For each WG, the main research activities from the recent COSMO period (Oct 2001 - Oct 2002) are briefly summarized and a short note on the planned activities for the present period (Oct 2002 - Oct 2003) is given. The work plan lists as well as a detailed description of each work package within a WG, are available at the member area of our web-site.

6.1 Working Group 1: Data Assimilation

This working group considers various aspects of 4-dimensional assimilation of observation data using the nudging analysis technique. For soil moisture and some surface fields, a set of 2-dimensional intermittent analysis schemes is applied in addition. The group is headed by Christoph Schraff (DWD) as WPC. The following scientists are members of this group.

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The main research activities of WG 1 for the period Oct 2001 - Sept 2002 covered the following points.

- The development work on the assimilation of GPS-derived precipitable water (PW) has included the conduction of parallel assimilation cycle and forecast experiments both at DWD and at MeteoSwiss. The use of the GPS data has improved PW and upper-air temperature and humidity in forecasts up to about +15 h , but has resulted in a mixed impact on precipitation and a negative impact in wintertime low-stratus cases. Further efforts will be required to tackle problems related to the vertical distribution

of the PW information and to a summerly diurnal wet bias of the GPS data relative to the model forecasts. For the most recent results on the use of the GPS PW data, see the contributions *Assessment of the Impact of the GPS Data Assimilation on the Performance of the NWP Model of MeteoSwiss: Case Studies* and *Assimilation of GPS Data in August 2002* in Section 9.

- The work on the assimilation of radar-derived precipitation by means of latent heat nudging (LHN) has been resumed (see *Assimilation of Radar Data in aLMo* in section 9). The old LHN version of Koepken based on a scheme of UKMO has been ported to the new LM version. A first case study indicates that much further effort will be required, in particular in order to prevent convective systems incorporated successfully into the analysis from disappearing very quickly and erroneously during the forecast.

- A 3-week parallel assimilation cycle and forecast experiment has been performed to test the use of wind profiler data. Monitoring in March / April 2002 revealed that due to insufficient data quality, 4 out of the 14 European stations had to blacklisted completely and another 5 partly. Also, the 2 RASS temperature profilers had to blacklisted. Due to the limited and altogether neutral impact of the remaining data, further tests and operational use of these data are not planned at present.

- The work on the tuning of the surface pressure nudging has been completed and is summarized in the contribution *Tuning of Nudging of Surface Pressure Observations* in Section 9. As a result, a doubling of the nudging coefficient for surface pressure and a small modification to the geostrophic wind correction will be applied operationally in early 2003.

- A follow-up 27-day observation system experiment was conducted for EUCOS to assess the impact of the SYNOP data. While thinning these data by 50 % had little impact, omitting them degraded the pressure forecasts up to +24 h and humidity and low-tropospheric wind up to +6 h (although surface pressure data derived from radiosonde geopotential were still assimilated).

- At ARPA-SMR, a comparison was conducted between nudging runs and LM runs started from interpolated ECMWF analyses for two MAP IOP cases. The nudging greatly reduced the spin-up problem and improved e.g. precipitation forecasts up to +12 h .

- The work for an enhanced use of surface-level humidity and wind has been continued.

In general, there is a shift of the focus from the consolidation of the nudging scheme towards the use of additional data including satellite data. In particular, there are work packages (most of them starting only in 2003) on the use of Meteosat and MSG data, of SATOB data, of 1DVAR TOVS retrievals, and of cloud analyses which also incorporate satellite data. The work on the assimilation of GPS PW continues with some restrictions, while the efforts on the use of radar data can be intensified. With respect to the consolidation, the tuning of the temporal weights and the determination of statistical vertical correlation functions will be done, and the work on refining the use of surface-level data and on extending the variational soil moisture analysis scheme will continue.

6.2 Working Group 2: Numerical Aspects

The WG on numerical methods and basic model dynamics is headed by Jürgen Steppeler (DWD) as WPC. Currently, the following scientists are members of this group.

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The main research activities of WG 2 for the period Oct 2001 - Sep 2002 covered the following points.

- The present terrain-following coordinate system will result in large and presumably not acceptable numerical errors in case of steep topography. Thus, work on a z-coordinate system version of LM for high-resolution applications has been continued. The following progress was achieved:
  - use of the realistic orography of Scandinavia,
  - inclusion of dry physics for idealized tests,
  - creation of a LM_Z source-code library,
  - introduction and test of the switch between LM and LM_Z.
- The evaluation of the 2-time-level RK split-explicit integration scheme has been continued. A library version of the scheme was created and tests in a parallel suite were started.
- For applications on the meso-γ scale the full 3-D transport of rain and snow has to be considered instead of the present column-equilibrium approximation. The scheme was changed to include implicit vertical advection and a preliminary version is tested in a parallel suite (see contribution by Almut Gassmann in Section 9).
- A LM-User Seminar was organized from 27 – 29 May 2002 in Langen near Frankfurt (Germany).
- Options for the use of IFS boundary data defined on frames and for the use of the SLEVE vertical coordinate have been implemented.

The major work packages for 2002 include further development work for the new z-coordinate, which is considered to be essential for NWP on the meso-γ scale. Another point of interest is the operational application of the 2-time-level integration scheme.

6.3 Working Group 3: Physical Aspects

The main effort of this working group is to develop new physics packages for future operational applications and to improve existing parameterizations. The WG on physical processes is coordinated by Marco Arpagaus (MeteoSwiss). The following scientists are members of the group:

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During the last COSMO period, the following topics were of major importance:

- Work continued on the new turbulence scheme (level 2.5) based on a prognostic treatment of turbulent kinetic energy (TKE) as well as on the new surface layer scheme based on the TKE approach. Both schemes are operational at DWD and ARPA-SMR since April 2001 and May 2002, respectively, and are expected to be operational at MeteoSwiss soon. A technical report on parts of this work package("Evaluation of Empirical Parameters of the New LM Surface-Layer Parameterization Scheme") can be obtained on the COSMO website at http://www.cosmo-model.org/cosmoPublic/technicalReports.htm.

- The new multi-layer version of the soil model TERRA, which includes freezing and melting of soil layers and a revised formulation of the snow model, has been thoroughly tested and is currently undergoing final pre-operational testing. A technical report describing the changes to TERRA ("The Multi-Layer Version of the DWD Soil Model TERRA_LM") is available on the COSMO website at http://www.cosmo-model.org/cosmoPublic/technicalReports.htm.

- Implementation work on the Kain-Fritsch convection scheme continued. Tests show promising results, but rigorous validation is still pending and the code eventually needs substantial re-writing to improve the performance on vector machines.

- A cloud-ice scheme has been developed and implemented into both LM and GME. Final tests are currently under way. Operational implementation is planned for early 2003, but needs an organizational effort since all local area models depending on GME boundary data should switch simultaneously to prevent systematic errors.

- An effort to understand the cause of the large forecasted precipitation differences over Switzerland seen between the operational LM implementations at MeteoSwiss and DWD was undertaken. The results of this study are documented in Section 9 of this newsletter.

In addition, a joint workshop with WG5 on interpretation, verification and tuning issues related to the new boundary layer schemes (turbulence, surface-layer) was organized in February 2002 in Turin. The minutes of this workshop can be found at http://www.cosmo-model.org/cosmoPrivate/various/minutes/interpretation/interpretation2002/discussion.htm (COSMO members only).

The plan for 2003 includes further work on all but the last package mentioned above. For the new turbulence scheme, this consists of parameter tuning, further extension of the scheme as well as writing up a documentation. The soil model and the cloud-ice scheme mainly await operational implementation, and the implementation of the Kain-Fritsch convection scheme is "work in progress".

New packages for the work plan of 2003 include the parameterization of boundary layer clouds & sub-grid scale cloudiness (either within the new turbulence scheme or an entirely new package), the development of an extended snow model and a lake model as well as the implementation of a 3D turbulence formulation and the test of penetrative (explicit) convection for LM runs at 2.8 km or even smaller grid-spacing.

6.4 Working Group 4: Interpretation and Applications

The main effort of this working group is to develop methodologies and tools for the interpretation of high-resolution direct model output, including model applications to limited area ensemble prediction and various postprocessing methods. The WG on interpretation and applications is coordinated by Pierre Eckert (MeteoSwiss). The following scientists are members of the group:

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The main effort in 2002 has been devoted to operational implementation of the COSMO LEPS (five 10 km LMs driven by the ECMWF global EPS). The technicalities connected to the use of member state units at ECMWF and the providing of the EPS initial and boundary conditions being solved, the real time operations could start in November 2002. The dissemination of LEPS members and probability products to the COSMO community in GRIB format started thereafter. The probabilistic scores have been defined and will be applied on the real time runs in 2003. The COSMO LEPS will be benchmarked against two other ways to detect severe impact weather. One of them is the ECMWF EFI (Extreme Forecast Index). The other is the statistical recognition of such events by the means of

supervised neural network training. The work done in Geneva nicely progressed and gives de possibility to significantly increase the hit rates and decrease the false alarm rates of strong rainfall events. In Switzerland, a project for developing a shorter time range LEPS based on moist singular vectors also started.

Preliminary work has been devoted to the inventory and exchange of internal and external postprocessings of the various LMs, including MOS, Kalman filters, instability indices. This work will be extended in 2003 to include Poland. Finally, it has been decided that the verification results produced by WG5 should be condensed in a practical user guide for the bench forecasters.

6.5 Working Group 5: Verification and Case Studies

This Working Group takes care for the verification of operational model forecasts, for the development of new verification methods and diagnostical tools as well as for case studies with the LM. The WG is coordinated by Carlo Cacciamani (ARPA-SMR) as WPC. The following scientists are members of this group.

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The main activities of WG 5 for the period Oct 2001 - Sep 2002 covered the following points.

- Operational verification of surface parameters, using SYNOP stations and also regional high resolution networks. Results are summarised in verification reports which are distributed on a quarterly basis on the COSMO web-site.
- Operational verification of upper-air parameters, using TEMP stations. As in the case

of surface verification, results are summarised in reports distributed on a quarterly basis on the COSMO web-site.

- High resolution verification of precipitation, using available high resolution dense non-GTS surface data.
- Weather regime verification of surface and upper-air data. This activity is operational at MeteoSwiss for verification of vertical profiles and precipitation using radar composites.
- Verification of model cloudiness with Meteosat VIS channel at 12 UTC.
- Verification of precipitation using radar composites.
- Since May 2002 it is available a daily verification, at Payerne, of shortwave and longwave radiation, sensible heat and albedo.
- Verification of integrated water vapour content using GPS data and also with TEMPs (at Payerne, MeteoSwiss).
- Verification of LM with the new prognostic cloud ice scheme (results presented at Seminar of the LM-User Group 28.05.02).
- Verification of longwave radiation with ASRB (Alpine Surface Radiation Budget) measurements.

An internal meeting on the verification of LM was held on 6-8 February 2002 in Turin (Italy), together with the the Worging Group 3 on Physical Aspects. The participants addressed different open problems:

- Comparison of model output with near surface observations and selection of representative (SYNOP) stations;
- Verification with feedback on the physics parameterizations and determination of the parameters of the new PBL scheme(s);
- Statistical significance of the verification "scores";
- High resolution verification of precipitation and investigation of the "realism" of the LM forecast;
- Exchange of non-GTS data between COSMO partners;
- Selection of periods for the "test" cases to be runned at ECMWF:
- Setup of a common verification package at ECMWF.

The major workpackages for 2003 include a continuation of the current operational verification of surface and upper air using SYNOP and Temp stations and also some special and dense observational networks for the verification of QPF. LM cloudiness will be checked using Meteosat VIS data. During 2003, many verification activities will be achieved also at IMGW in Poland, the new Institution within COSMO. In particular IMGW will perform a new activity concerning the verification of runoff over river basins in Poland using LM QPF.

6.6 Working Group 6: Reference Version and Implementation

The WG on code maintenance, reference version, documentation and implementation is headed by Ulrich Schättler (DWD) as WPC. The following scientists contribute to the work of this group:

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In the period Oct. 2001 - Oct. 2002 the following work was done by WG 6:

- Updates of the GME2LM and LM have been programmed, tested and implemented at all sites.
- The web site has been maintained and updated and is now an excellent point of communication and documentation of the work done in COSMO. To prevent possible bottlenecks in accessing the web site, it is now also mirrored at the computing center in Manno.
- The different versions of the interpolation programs (GME2LM, IFS2LM, LM2LM) have been further developed and tested. The combination of all these parts and implementation in a unified interpolation program INT2LM will be started in the next period.
- The 2-way interactive nesting version has been tested more intensively and more problems could be detected and solved.
- Work has been started to restructure and update the Scientific Documentation. It is now splitted into the parts Numerics/Dynamics, Physics, Assimilation, Pre- and Postprocessing and others.

Ongoing activities of WG 6 are the update of the programs and of the web site. New versions of the programs will be installed and tested at all sites. The first COSMO Reference Version will be defined and tested using special single cases. Future versions will be compared to the Reference Version using these tests. On the web site the operational applications of all partners will be described using a common template. Work on restructuring the documentation has to be carried on (Physics, Assimilation, User Guide). The operational coding of the unified interpolation program and the nesting version has to be tackled. Finally, some changes regarding the diagnostic output of LM and the Grib Code have to be implemented.