Progress in research for ALADIN along the first 10 months of 2002 (contributions from thematic coordinators)

Coupling

- Spectral coupling :

Coding is achieved and basic tests with spectral coupling have been done. Technically it works, but meaningful case studies are still missing for tuning an optimal combination of Davies and spectral coupling. Now experiments with a 1d shallow-water model are being performed.

- Surface pressure tendency coupling :

Situation did not change much. The code has been ported to the last library, AL25T2, but further experimentation is required.

- Time interpolation :

Intensive work has been done on this subject. No satisfactory solution has been found that would be competetive with increasing time frequency of coupling files. Spectral analysis of the time evolution at the Christmas' storm case indicated a good potential in finding diagnostics that can be computed in the coupling model to determine the time-dependent coupling frequency required by the situation.

- The work on two-way-nesting was delayed. Instead an investigation of the problem of coupling in ALADIN following a similar approach as Aidan Mc Donald used for HIRLAM was launched.

Dynamics

- Stabilization of NH dynamics

A new prognostic variable for pseudo-divergence (*d4*) has been implemented in the main code of ALADIN. Stability analyses and 2d experiments showed it could improve stability in the presence of orography. Besides a new time-discretisation called "predictor/corrector" was also coded, to allow the use of a two-time-level semi-Lagrangian scheme, but only for the old prognostic variables as a first step. The merging of the two ingredients will be completed in the next weeks. These two ingredients are expected to offer a robust enough scheme to be used with 2 time-levels discretisations. Preliminary 2D tests are very encouraging.
Besides an analysis of the anelastic approach in ALADIN was done. It was found that the anelastic approximation is not practically applicable using the Laprise coordinate in a spectral semi-implicit model.

- Evaluation of dynamics at high resolution

The properties of ALADIN dynamics (accuracy, stability, efficiency, consistency) were evaluated for increasing horizontal and vertical resolutions, using the "quasi-academic" ALPIA framework. It consists in 4 embedded models covering the French Alps, with mesh-sizes decreasing from 10 km to 1.25 km and the number of vertical levels increasing simultaneously from 30 to 85.
The first part, dedicated to the comparison between Eulerian and semi-Lagrangian stability criteria, was completed. The experiments were done with three-time-level Eulerian and semi-Lagrangian non-hydrostatic schemes. As outcome, there is now a robust result that the three-time-level semi-Lagrangian scheme can be used still with at least double of the Eulerian time-step without meeting Lipschitz criterion.
Then the experiments were resumed to investigate in details the properties of ALADIN dynamics at very high resolution : hydrostatic versus non-hydrostatic, explicit versus semi-implicit, Eulerian versus semi-Lagrangian, ...

- Lower boundary condition for NH

An alternative, more consistent, implementation of the lower boundary condition has been introduced in the main code of ALADIN. The principle is to use vertical velocity (*w*) as a gridpoint prognostic variable instead of the vertical divergence (e.g. *d4*), in the advection process. This ingredient improves the response over mountains for the semi-Lagrangian scheme in non-hydrostatic dynamics. Merging with the two other main modifications is in progress.

- Radiative upper boundary condition

The work is slowly restarting, following a new approach based on recursive filtering.

- Gridpoint semi-Lagrangian diffusion

The work was resumed at the beginning of August, by a new student, and has to start with an update of the corresponding code. No significant progress is expected within the end of the year.

- Improved filtering of orography

A new method was proposed to smooth orography at high resolution, which was proved necessary (to avoid spurious small-scale noise, especially when using "linear" spectral truncations). An additional spectral term is added to the cost function used to compute and optimize the spectral orography, which acts at damping the smallest scales. This should provide smoother spectra than the present method (importing the "quadratic" spectral orography when using a "linear" truncation), which abruptly sets to zero the contribution from the smallest scales (the last third of the spectrum), and will be far more flexible. However the first tests interfered with problems in the minimization library, and the present formulation is to be reconsidered.

- Relaxation of "thin layer" hypothesis

The corresponding modifications are now implemented both in ARPEGE and ALADIN. Experimentation is in progress, to evaluate the practical impact in terms of scores or forecast accuracy, mainly in tropical regions. An extension to non-hydrostatic dynamics with the Laprise coordinate is under study.

Physics : precipitations (convection, microphysics, ...)

A development work plan on moist processes was adopted at the meeting in Medulin.

Two main approaches of the cloud-precipitation scheme are investigated, namely the Functional Boxes approach focusing on "resolved" cloud and precipitation (and using the operational diagnostic convective scheme as another box), and a more integrated approach focusing on convection and using a microphysical scheme derived from the one developed by Philippe Lopez.

- Integrated approach (L. Gerard)

  A version of the physical package under AL15 with a microphysical scheme derived from Ph. Lopez's, but separating ice and liquid cloud condensate and considering a pseudo-historical precipitation content, is now available.

  The prognostic convection scheme developed last year by L. Gerard is now running under AL15. At this occasion, we observed an undesirable stiffness of the tunings with the re-introduction of the modulation of moisture convergence by the mesh size (GCOMOD=1). \\ Validation tests of the scheme are going on in Vienna(S. Greilberger).

  A version of the code with both modifications mentioned above is also ready.

  Work is going on on the new integrated scheme, implying a separation of the downdraught and the updraught; the updraught routine under test implies an explicit treatment of the suspended cloud condensate, full 3D prognostic variables for the updraught velocity \SE{and} the updraught mesh fraction, the production of detrained condensate instead of precipitation.

- Functional boxes approach

  A communication of E. Bazile in HIRLAM Newsletter 41 (2002), pp79-83, synthesizes the current status.

  The problems of the ice phase seem now solved -- except maybe a small difficulty around the triple point.

  The functional boxes seem very sensitive to time and vertical instabilities of the parameterisations, and can often reveal hidden weaknesses in them.

- Entrainment in clouds

  The sensitivity of the deep convection scheme to the humidity of the middle atmosphere has been tested within the EUROCS project frame. The present entrainment formulations confer a pretty good sensitivity to the scheme as compared to Cloud Resolving Models.

- Stratocumulus clouds

  The underestimation of stratocumulus clouds has been investigated on the FIRE I case. A diagnostic approach using a new cloud contents and cloudiness has been proposed. A prognostic approach, base on the same "Philippe Lopez" as mentioned above, is also under tests and progress.

- Other aspects

  It was decided in June to start the development of a shallow-convection scheme, based on a mass flux approach (Th. Haiden, J.M. Piriou).

  Extended collaborations participations were planned in Medulin, but the communication about this stays weak.

Physics : turbulent processes, boundary layer

- Andre Simon : Study of the relationship between turbulent fluxes in stable PBL and cyclogenesis (ALATNET PhD).

  Main goals are :

- explain the sensitivity of the forecast of rapid cyclogenesis on parameterization of turbulent heat exchange (tuned above all by parameter USURID).

- find new methods to adjust the current parameterization of critical Richardson number while avoiding the erosion of inversion

Results :

- The heat flux parameterization used in cycle 24 was tested on case study of explosive cyclogenesis on 20 December 1998. Main sensitivity was found in area eastward from Newfoundland. The role of increased heat exchange seems to be in a decrease of static stability in the mentioned area, that allows bigger vertical velocities and slower drop of pressure during the decaying period of the cyclone. Thus the influence is indirect, because it acts before the rapid reinforcement of the storm (42 hours later).

- The used value of USURID parameter (0.042 - operational in the beginning of 2002) gives unrealistic forecasts of static stability in the PBL in areas crucial for development of the cyclone. Even very high values of USURID (0.14) give less static stability in comparison to model analysis.

- The Richardson number limitation is more important by values between 1 and 100 as by very high values (relative differences in K-profiles for current parameterization reach their maximum by Ri=4.5 for various USURID and by constant wind shear).

Suggestions :

- make the parameterization of heat exchange in the PBL dependent on surface stability. This is not a final solution for the cyclogenesis problem but keep more stability over cold surfaces (land) and allow instability over warm lowest layers (sea). Similarly, differentiation should be made for momentum exchange as well.

- make the height of K- decrease situation dependent (decrease or increase the parameter UHDIFV for instable/stable PBL layers)

- vertical discretization of Rid gives very small differences, while tuning it via parameter USURIDE. Thus new kind of vertical discretization of ZUSURID should be used to allow "more freedom" for tuning.

• Janko Merse is finishing an article for *Meteorology and Atmospheric Physics* (79, 195-213, 2002) with the title: "Turbulent dissipation of the cold-air pool in a basin: comparison of observed and simulated development", where the MM5 model has been used to simulate the process and it's been shown that MY 2.5 parameterization of the PBL (taken from the ETA model) seems to describe the process quite well.

• Martin Gera : Improved representation of boundary layer, main goals for year 2002 :

- Analysis of anisotropy and inhomogeneity of turbulent processes. Influence of stratification and surface to the behaviour of turbulence.

- Creation of new integral stratification dependence functions for friction velocity and friction potential temperature, which express their variability nearest the surface. The bases for the derivation are Businger's empirical functions and the static equation for TKE.

- Anomalous dissipation of energy close to the surface is expressed by blocked kinetic energy. Some comparisons are done with classical Prandtl mixing length expression near the surface. This approach modifies current ALADIN mixing length expression and looks better when using the prognostic TKE equation (it's in progress now).

- Implementation of TKE computation for stationary regime, it was the first step for solving prognostic equation. We have concentrated on the behaviour near the surface.

- Implementation of prognostic TKE equation and consecutive computation of exchange coefficients. They have a direct dependency on TKE.

- The scheme is still unstable, we are assessing methods for solving the nonlinear TKE equation.

• Alexander Kann and Harald Seidl :
Strange oscillations of humidity and consequently cloudiness at certain levels were encountered within the 1d version of ALADIN (cy22t1op8) which did not appear in the 3D runs (al12 +cycora-bis). Concerning our stratus diagnosis it seems that we have to lower the threshold values within the code in order to gain more realistic Lifted Fog Forecasts. This seems to be necessary as the initial state of vertical profiles already deviates from observed soundings.

• Martina Tudor performed a few case studies connected with Bura wind on the Adriatic for the Croatian ministry for traffic (because the road is being built there). She has used the dynamical adaptation of wind field to 2km resolution for that.

Physics : radiation

• Introduction of ozone climatologic profiles varying with the month and the location, instead of a unique profile. The impact has not yet been tested.

• Comparison of the physics from the Climate model to the one from the NWP model. This test lead to a closer assessment of the operational radiation scheme, and to testing more other schemes in single column model (Morcrette, Graals and modified versions of the current operational scheme).

• It appears that the radiation has a strong impact on dynamics much sooner than was thought up to now.

Physics : surface

• The use of new databases is presently in standby. Some tests of O. Latinne showed a slight deterioration of the scores during the summer, and also dubious values of the Leaf Area Index over boreal forests. This lead to light modifications of the databases, and we are awaiting some feedback from the Climate Group which had to test it. The main problem is the want for a person who would redo a whole set of tests over one summer in assimilation mode.

• Phasing is on the way for the improved snow parameterisation, on cycle CY25 which should be running in double chain before the winter. This scheme and its tunings are described in the proceedings of SRNWP/HIRLAM meeting of 22-22 October 2001.

Physics : orography

• From the side of orographic forcing, the main event was the specialised mini workshop in Toulouse that identified and prioritised three needs:

– the one of finding a new way to use data bases, in particular regarding the current "quadratic cut-off" for linear grid applications that should be replaced by a smoother transition, this action being possibly twined with a revival of the concept of "envelope at constant volume";

– the one to have again available the kind of momentum budget diagnostic tools once developed by G. Gregorcic, in order to better understand how the several components of our orographic forcing (resolved mean, resolved envelope, gravity wave drag, form drag, lift -if activated-) do interact at fine scale to deliver an as consistent as possible large scale balance of angular momentum;

– that of a rather independent search for the causes of the vexing problem of ill-placed (slopes rather than summit) orographically induced precipitation.

• In addition, discussions taking place at the recent informal RC-LACE training course, raised the following hypothesis: are not we unable to modify the current unsatisfactory situation where we need envelope despite form-drag, where lift cannot be incorporated without deterioration of the results and where our form-drag-coefficient is much too large, simply because we try to evolve incrementally (while a simultaneous jump to more logical choices might be successful at once) ?

• Concerning the optimization of the orography for operational models, nothing was done.

Physics : simplified physics

• Cornel Soci proposed and tested successfully modifications of the parametrization of large-scale precipitations, for use at a resolution of 10 km.His coming stay (early 2003) in Toulouse will be the occasion to transfer his knowledge about specific LAM constraints to C. Loo.

• In ARPEGE, some modifications and tunings in vertical diffusion have been done in order that the simplified version would be in better agreement with the complete one and in order to avoid some instabilities appeared in linear models from increase of resolution. A validation of the simplified direct physical package was also done.

Physics : validation

• Methods

Debugging of the Horizontal Domains Diagnostic package in the LAM is on the way.
Discussion in June in Medulin also planned :

- to set up a ‘‘Gaussian’’ control of the tendencies,
- to enter the code for extracting profiles from the 3D model for the Single Column Model, into the main cycle,

but this is not yet realized.

• Experimentation

One is referred to J.F. Geleyn's document of "25 items".

It must be recognised that ALADIN physics is just emerging from an incredible "black series" (not completely finished though) as if the past five years of extreme stability and of concerted evolution via big CYCORA-type packages had to be "paid" (probably because of insufficient consolidation work at the time). The itemisation of the causes (repeated below) is also very revealing of the diversity of sources for the different problems that makes any strategical effort to prevent a future repeat difficult - but for a strong increase in post-coding non-numerical validation (something everyone hates to do!).

Statistically the 25 items are distributed as follows :

- Severe bugs : 2
- Small bugs : 2
- Design errors prior to or at the CYCORA-bis level : 4
- Design errors following CYCORA-bis : 2
- Forced scientific changes : 6
- Preventive actions : 1
- Scientific innovations : 5
- Tuning : 3

Last, a "nutshell" description of the physics operational in ALADIN-France was produced.

• The planned "validation chart" is not ready.

Physics : interface to dynamics

• Study of the interactions between non-hydrostatic features and physical parameterisations

The problem of the introduction of diabatic forcing within the predictor-corrector approach was addressed during the dedicated mini-workshop. Safety locks to preserve the presently used alternatives will be introduced. A more thorough investigation is delayed, waiting for a stable dynamical core and more impact studies.

Besides a number of empirically derived approximations to the treatment of the diabatic heating are being tested. There are labelled quasi-anelastic and quasi-hydrostatic approximations to the diabatic heating because they produce results analogous to those obtained with the correspondingly approximated dynamical models, when using short time-steps.

• Use of new prognostic variables for physics

The interface for introducing new prognostic variables in convection has been developed and should enter the next library (end 2002), together with the parallel changes for using a TKE-based turbulence parameterization.

• Sensitivity of physics to the length of time-step and the vertical discretization, fibrillations

The large vertical oscillations exhibited by Martina Tudor last autumn while trying to diagnose the PBL height, and problems noticed when increasing the operational vertical resolution, led to reconsider the anti-fibrillation scheme. First, it is now obvious that a retuning is required for each change in resolution. Second, the vertical variations of the coefficient controlling the anti-fibrillation scheme are limited, with a maximum equal to the value at the lowest level, in order to avoid the vertical slicing. This prevented problems in operations, waiting for a more thorough investigation of the behaviour of physical parameterizations as longer time-steps are used.

Eric Bazile started, using the single-column model and addressing the parameterizations of vertical diffusion and convection. The response of the vertical diffusion scheme iss very regular, but for convection very steep jumps are observed. This is due to the fact that the triggering of convection depends on the tendencies issued from vertical diffusion at two adjacent vertical levels, and the scheme is very noisy on the vertical. A correction was proposed and the first 1d tests performed.

Martina Tudor afterwards undertook a thorough study of the ARPEGE/ALADIN-physics' susceptibility to stiffness and nonlinear instability. This was done by halving the time-step used to compute fluxes (and not the one to apply their effect) for detecting stiffness and by applying the mirror trick of the previous one in space (thicker levels only at the time of the flux computation) for tracking nonlinear instability.

In the first case, the vertical diffusion problem was identified again and the new anti-fibrillation cure positively reassessed. More surprisingly a potential source of stiffness was detected in the condensation/rain-reevaporation cycle but the maintaining mechanism is "dry" (either in vertical advection and/or in vertical diffusion) which forbids any practical action in the current state of the physics.

In the second case the test allowed to find a small bug in the protection against nonlinear instability for the pseudo-advection by the convective mass-flux. This discovery indirectly proves the power of the method since no other problem was spotted once the bug being corrected. Interestingly, the remaining open question corresponds to one known problem in the TL/AD regularised physics (together with the one of fibrillations). Hence the whole picture in this area of research is now more consistent, pending further study of the huge amount of accumulated results.

• Smoothing of the shallow-convection parameterization

The smoothing proposed last year by Martin Bellus on a suggestion of Eric Bazile was cleanly introduced into the code and revalidated in order to prepare a possible operational implementation. Its main aim is to suppress a coupled time/space oscillation (the second aspect being mainly but not only in the vertical) created by the on/off character of the shallow-convection parameterisation, which cannot be handled by the anti-fibrillation scheme.

Most problems are damped, but some oscillations still resist. The ad-hoc character of the time-smoothing scheme underlines the need to code a new scheme.

• Impact of time-stepping

Ilian Gospodinov started to analyse various techniques for introducing physical tendencies within the semi-implicit approach, with hydrostatic dynamics.

Data assimilation : methods

• Local pre-operational 3D-Var assimilation suites using raw ATOVS or aircraft data (including local tunings of statistics, observation use, cycling and initialization) :

This work is still under progress, with significative advances in every center involved :

- Budapest :

  Several solutions for a local assimilation cycle based on 3D-Var are under evaluation, with emphasis on coupling issues (choice of coupling data, simple versus double nesting) and injection of local raw radiance data. In parallel, experience on the objective evaluation of assimilation cycles is gained. A pre-operational, stabilized 3D-Var assimilation cycle is planned for completion for ???

- Casablanca :

  Preliminary assimilation suites, based on the principle of a combined use of DFI-blending and 3D-Var analysis, have been installed in research mode for the ALADIN/MOROCCO model. A new assimilation cycle, again blending+ 3D-Var, is under construction for the ALADIN/NORTH-AFRICA domain. This "blendvar" cycle should be run using ATOVS raw radiances for pre-operational, then operational, use early 2003.

- Prague :

  The evaluation of the "blendvar" type of assimilation cycles has been continued, in research mode only, in order to study both individual cases (where pathological behaviours such as when very localized storms can appear) and perform objective verification (scores). The future plans for operations will be finalized after migration to the new computer in 2003, with probably tests of DFI-blending+SurfCANARI followed by DFI-blending+ 3D-Var+SurfCANARI.

- Toulouse :

  An important work has been devoted to the stabilization and validation of the main algorithms under the new technical environment (ODB, raw radiances, CY25). A renovated version of the assimilation scripts is in progress, which should eventually lead to a stable, user-friendly tool for "switch-on/switch-off" ALADIN assimilation cycles.

• Local implementation and tuning of blending :

3 centers have implemented blending cycles :

- Casablanca :

  in research mode for ALADIN/MORROCCO and under preparation for ALADIN/NORTH-AFRICA; more evaluation to be done in late 2002 and 2003

- Prague :

  maintenance of the LACE operational blending suite

- Toulouse :

  A renovated blending suite is in preparation, for the ALADIN/FRANCE linear grid (41 vertical levels). This suite will be evaluated in the 4th quarter of 2002, for operational purpose.

• Prototype version of 3d-FGAT :

This work has started in September 2002, mainly as part of Vincent Guidard's PhD developments. The technical work has progressed (4D-screening is ok), and a first scientific evaluation will be performed using the well-known MAP IOP14 case. This work will be continued by a more in-depth re-evaluation of the problem of coupling between LAM and global data assimilation suites : evaluation of LAM versus LBC error growth, evaluation of different strategies for the injection of the global model solution into the LAM (2003-2004).

• Investigation of the problems related to double-nesting :

This work has started under the frame of Steluta Alexandru's ALATNET PhD. Several strategies for the nesting have been defined, with coupling data chosen either from ARPEGE or from ALADIN/LACE (simple versus double nesting)

and either space- or time-consistent lateral boundary data. Comparisons with the operational ALADIN/HUNGARY dynamical adaptation are also performed. So far, the results show a significative fit towards the observations with 3D-Var, but 6 hour forecast scores only marginally benefit from the analyses. The potential imbalances of the 3D-Var increments have also been checked, and it has been shown that dynamical imbalances are not generated significantly by the 3D-Var analyses.

- A posteriori validation tools and tuning of Jb / Jo; completion of the PhD work of Wafaa Sadiki :

This work has been re-started this summer in Toulouse, keeping a quite simple formulation of the a-posteriori functions. For a reminder, the main diagnostics are : the ratio Jmin/P, the estimated global background error variance rescaling "Sb" (=Jbmin/Tr(KH)) and the estimated global observation error variance rescaling "So" (=Jomin/Tr(Ip-HK)).

The main results so far:

- There is a clear need to compare the a-posteriori results with independent diagnostics (such as explicit statistics on the innovation vector), in order to have a more in-depth understanding of the possible misfits between modelled and real error statistics. Indeed, it appears that too many ingredients (possible misfits) enter these diagnostics so that extra knowledge is needed for the understanding. For example, Wafaa is now comparing her results with the output of a Lönnberg-Hollingsworth method for auto-covariances, for comparison of both variances and correlation length-scales.
- There remains a fundamental difficulty in assessing the amount of scale-selective error variances, since the innovation vector which is involved in the a-posteriori validation contains all the scales. A scale-selective approach could be a possible future direction of research, for a potential candidate.
- The diagnostics exhibit clearly case-dependent behaviours, which indicates that the error statistics in the LAM are sensitive to weather systems (eg. synoptic storm inside the ALADIN domain, anticyclonic state, ...)
- A posteriori validation apparently can be used for re-tuning of statistical parameters, although the work with real data obliges one to depart from the strict theoretical framework and imagine tractable, pragmatical applications. For example, the perturbation method to compute the "Trace" operators demands to aggregate daily datasets together, and to verify afterwards that the (neglected) time-correlations do not spoil the results too much. Also, one needs to assess the stationnarity of the diagnostics over the period of aggregation, which in practice means that the diagnostics are more like monthly climatology.

Wafaa Sadiki will write her PhD manuscript in 2002/03, for a scheduled PhD defense in early summer 2003. The work on a posteriori validation will be one major contribution to her PhD. A continuation of this work is planned in 2003 in Budapest.

- Improved Jb (new methods, geographical modulation, part of humidity, ...) :

The work on the geographical dependency of the background error statistics has been continued. One-dimensional variations of the standard-deviations and of the length-scales with respect to latitude were calculated from the bi-Fourier coefficients, and they were successfully validated by comparison with the results of Mohamed Raouindi based on mono-Fourier coefficients. This diagnostic work will be continued by investigating the two-dimensional variations.

A formalization of the different variants of the NMC method was proposed. This gives some indications on the formal contributions to forecast differences, which can come from differences in the initial conditions, in the lateral boundary conditions, and in the models (ARPEGE versus ALADIN). For instance the emphasis on meso-scale features that is provided by the so-called "lagged NMC method" is consistent with the use of initial differences related to ARPEGE and ALADIN model differences, and with the absence of lateral boundary differences.

An innovative work on the use of wavelet functions for the B matrix representation has also started. Standard-deviations and correlation functions implied by a diagonal wavelet covariance matrix were examined in particular. The results appeared to be intermediate between those implied by a diagonal approach in spectral and gridpoint spaces respectively.

Background error standard deviations have also been evaluated for the pre-processing of IASI sounding data (Malgorzata Szczech in Toulouse, ALATNET PhD).

In the frame of ARPEGE data, the use of ensemble analyses for the computation of the background errror statistics is under test (Margarida Belo Pereira, in her ALATNET PhD). The production of such ensembles has been performed, and the evaluation of the physical properties of the derived statistics, with a comparison with the NMC-derived data, is under way.

- Sensitivity studies; completion of the PhD work of Cornel Soci :

The ALATNET PhD work has been completed in the first quarter of 2002. The overall conclusions concerning the evaluation of the adjoint model solutions in ALADIN, and the sensitivity of precipitation forecasts to changes in the initial conditions, are as followin g:

- The perturbation of the lateral boundary conditions by projected elements from the adjoint model is probably leading to a dead-end issue, in the frame of the classical Davies' relaxation.
- The use of the ARPEGE simplified physics exhibits the development of sometimes very strong instabilities, but that are the high-resolution equivalents of the already known flaws of the large-scale linearized physics. At this stage, it remains an open question whether one should devote a significative amount of work to the linear physics for high resolution 4D-Var or rely on very simple formulations, as was done a few years ago in the global models. Especially, a

very selective application of the linear physics, and possibly more in-depth reformulation of the simplified parametrizations, cannot be excluded. It is believed that this issue will re-appear in a few years, for high-resolution adjoint computations.

- Cornel's test cases have shown a wide range of behaviours, with respect to the sensitivity to initial conditions, for cases of misforecast precipitations : no impact because the adjoint solution moves outside the limited area of the model, no impact because model shortcomings (in the parametrizations) are at stake, existing impact either due to wrong vertical wind profiles or wrong low-level conditions (controlling the onset of convection).

Cornel Soci is now writing his PhD manuscript for the University of Bucarest, and plans his defense for early 2003.

Data assimilation : observations

- ODB : training, design of new tools for ALADIN + local implementations

- training in Toulouse for ALADINers.
- design of new tools for ALADIN : geographical selection of observations for C+I zone.
- ODB is running with cycle 24T1 in Budapest, Prague and Casablanca, in research mode.
- Morocco has established a stable, local observational database and can now handle a local, autonomous database collection (the next step will be to add local radiance data in it).

- Screening : problem of observations close to lateral boundaries, local tunings

No significant development was performed for screening, except on the thinning of AIREP data. It is planned to look in more details at the ATOVS raw radiance data sampling.

- Using aircraft data in local ALADIN 3D-Var suites

No major progress.

- Using observations of Hu2m for upperair assimilation

The purpose was to study the possible use of screen-level humidity observations in 3D-Var analysis within ALADIN-LACE. The results with lagged statistics compared to standard ones lead to decrease the values of the increments for specific humidity and temperature both in vertical and horizontal directions.

- Impact of the drift of radiosondes

This work has been accomplished in the frame of LACE Center activities. It was based on the monitoring of the raw sounding data from 2 stations, with explicit recovering of the (X,Y) positions from each individual measurement. The study has revealed a weak positive impact.

- Use of raw ATOVS data in ALADIN 3D-Var

Promissing progresses are reported from Budapest but there are still problems in the reference library (CY24T1) in Toulouse for assimilating the ATOVS raw radiances in ALADIN 3D-Var. An adaptation on ALADIN of bias correction procedure, originally designed for ARPEGE, is under development, but already well advanced in Budapest and Toulouse.

Sensitivity studies on sampling (when extracting the data from the database) and thinning (when assimilating the data) with respect to Jb structure functions (standard Jb / lagged Jb) need to be performed (in 2003). This topic will receive again much attention in 2003, as it is interesting several Centers ready to participate actively (Budapest, Casablanca, Toulouse).

- Use of pseudo-observations (from MAP) in 3D-Var

One case study of using humidity pseudo-observations from the MAP POI-14 provided by GMME (Météo-France) has shown slightly positive impact on precipitation forecast in ALADIN-FRANCE.

More case studies should be performed in 2003 with improved pseudo-profiles on the North Africa domain within a coordination/collaboration with GMME

- Use of AIRS/IASI data over land : continuation

Normal progress in the framework of an Alatnet PhD (Malgorzata Szczech) :

- Specification of the background error covariance matrix is done for surface temperature and will be done for emissivity.
- Homogeneous bands have been selected in the infrared domain, based on mean transmittances on a profile database. For each of these 18 infrared spectral bands, emissivity maps will be produced from a database used by the MODIS team for 18 types of surfaces in the model. Validation will be performed with MODIS emissivities.
- Channel selection and retrieval of surface parameters is planned for 2003.

Data assimilation : surface

- New background error statistics for 2m analyses

The Lönnberg-Hollingsworth's method has been used to compute the background error statistics for 2m temperature and relative humidity. The obtained 2m background error correlations decrease more rapidly with distance than the operational ones, in agreement with the statistics used in CANARI-Diagpack for mesoscale screen-level analyses. A new function representing the background error correlations and rescalings have been proposed.

- Spatial smoothing of soil moisture

Because of the small scales described by the model (precipitation, cloudiness, surface characteristics), the threshold conditions used in the surface assimilation, and the long time-scale of the evolution of the soil moisture, the soil water content in ARPEGE and ALADIN models present some unrealistic high spatial heterogeneities. This feature is not controlled by the surface analysis since its length-scale is much smaller than the surface observation network density, and is responsible for spatially noisy 2m forecasts in case on strong solar radiation.

A spatial smoothing has been developed for ARPEGE and ALADIN within CANARI analysis, controlled by two tuning parameters : the spatial characteristic length of the smoothing and the number of iterations of the process. The optimal values have been studied for ARPEGE and ALADIN. The impact of this smoothing has been evaluated on a 2 months summer period with a small positive impact on 2m forecasts and without any long term drift.

- Combination of upperair and surface assimilations

The potential combinations between O.I. surface analysis and upperair assimilation were examined in two frameworks : in ARPEGE with 4D-Var and in ALADIN-LACE with spectral dfi-blending.

The upperair fields analysed with 4D-Var are currently used as input for CANARI surface analysis. This choice aimed at reducing the 2m errors related to the lowest model errors, but this is not fully in agreement with the optimal interpolation theory which considers two uncorrelated sources of informations : the observations and a first guess. Moreover since the replacement of 3D-Var by 4D-Var the upperair analysed fields are in equilibrium with surface fields at initial time, which differ from the background surface fields (via a 3h forecast with different atmospheric fields). This inconsistency may have locally some negative impacts. There is also one technical argument in favour of using upperair guess as input to surface assimilation : it allows more flexibility on the operational suite because the upperair and surface analyses could be run in parallel. For these reasons the impact of using the upperair guess has been evaluated. The differences between the two methods on 2m analysed fields are generally small. It appears very difficult to prove the superiority of one choice compared to the other.

The objective was to replace the surface blending by the CANARI surface analysis in ALADIN. The experiments have shown that the use of CANARI surface analysis in the blending cycle improves the low level forecasts on temperature and humidity. The experiment where the surface analysis is done first before the upperair blending is the most balanced one.

- Variational surface analysis

A variational surface analysis is being developed in the framework of the European ALATNET project. The validity of the linear hypothesis for the evaluation of the observation operator and the decoupling hypothesis between gridpoints have been verified. Different strategies for the evaluation of the observation operator were studied. The configuration with two chess-type perturbations was found to be the best compromise between an accurate evaluation and a reasonable computational cost. No empirical condition is necessary to control the soil moisture corrections, which is an improvement compared to the current operational optimal interpolation surface analysis. An article is submitted to QJRMS and G. Balsamo is writing his PhD manuscript. This work will continue in 2003 in the framework of the ELDAS (European Land Data Assimilation System) project.

- Snow cover analysis

No progress.

- SST analysis

Some work was done in 2002 to improve the use of a land/sea mask in the guess estimation at the observation point for the SST measurements. We noticed during the first months of 2002 some spots in the SST analysis, especially near the coasts, in the North Sea and in the Baltic Sea. Investigations have shown that these spots were due to a wrong use of SST measurements from oil platforms and coastal stations. So, some modifications have been made in the code in order to consider platforms as SHIPs on one hand and to produce two first-guess values for surface temperature on the other hand : one valid for land measurements (T2m and Hu2m observations) and the other one for sea measurements (SST), for the use of coastal observations. A procedure to avoid using observations at isolated land or water points has been designed too.

The first steps in the use of satellite data to better describe sea-ice limits are ready (interface to observations).

- Diagpack

An interface to ODB and new tools were developed. The work on the use of aircraft data is progressing, but no significant impact was noticed despite of retunings.

The CANARI documentation has been updated.

Predictability

In the medium-term research plan it was the first time that the predictability topic appeared. However for the time being effective work was carried out only at Météo-France, where ensembles were computed taking into account 10 predictions (and generating own perturbations). Meanwhile the interest is growing at the Member States and on top of that the first LAM-EPS workshop was organised in the SRNWP framework in Madrid at the beginning of October. Based on the discussions and recommendations of this workshop and internal ALADIN discussions a working plan is planned to be compiled within the end of this year, where the main objectives, steps, milestones will be identified, and the effective work can start at the beginning of 2003. For the time being there is a clear interest for the topic in Hungary and Morocco, however all the Partners will be asked to identify their interest and their level of contribution to this very new and important project of ALADIN.

More details are available in the ALADIN/ALATNET Newsletters !