MEDIUM-TERM RESEARCH PLAN FOR ALADIN

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J.-F. Geleyn, Météo-France

FOREWORD

Since its launching in 1990/91, the ALADIN project has been characterised by its total reliance on international collaboration. This was a necessity, since none of the partners (including Météo-France) could afford the required manpower investment to carry it alone towards the ambitious goals it has now just reached in such a short time. In fact this international character rapidly became the strong point of the project, the blending of different backgrounds and past experiences giving birth to an odd-looking but very efficient team. Of course, it also brought additional difficulties in communication and organisation, but, retrospectively, advantages clearly superseded disadvantages. There is every reason to believe that this should also be the case in the further phases of the project, in particular its full insertion in the LACE concept. If all partners are convinced of its benefits and act accordingly, the scientific collaboration is profitable to everyone and it remains the best justification of all efforts associated with the project.

I) INTRODUCTION

Accordingly, this plan has been constructed starting from the three following assumptions:

- Sufficient means will be allocated, especially inside the LACE community, to cover the increased burden of code maintenance resulting, for the IFS/ARPEGE/ALADIN software, from a jump from two to four levels (Reading/Toulouse => Reading/Toulouse/Vienna/"Decentralised units"); let everyone remember that the resulting "phasing cascades" have to be accomplished in less than six months;
- The different operational applications of ALADIN (Vienna, Toulouse, Casablanca, ...) will not generate any unnecessary diverging tendencies inside the overall ALADIN community, that also encompasses at least Romania and Bulgaria;
- The LACE Members, despite the additional burden of operational constraints, shall wish to maintain the high level of scientific achievement that has been the trademark of the ALADIN team up to now (and that was particularly obvious during the recently held common workshop with the spectral HIRLAM community, in Copenhagen, 2-3/6/94).

Should any of these three assumptions be rejected as unrealistic, then the plan should be redrafted with less ambitious features.

Consequently we shall take into account the necessity to maintain a strong compatibility with ARPEGE/IFS, the streamlining of research activities towards achievable operational goals (if possible of general interest) as well as the choice of "windows of opportunity for excellence" created by the already achieved research/development steps.

For convenience of presentation the plan shall be divided into seven items of unequal importance: Lateral Boundary Conditions, Dynamics, Physics, Data assimilation, Data monitoring, Verification and Predictability. All those items are of course somehow interconnected and of more general scope than simply to be used for short range forecasting at fine scale, but we assume that these two characteristics are implicit through the work in the IFS/ARPEGE/ALADIN framework.

II) LBCs

From the point of view of operational quality, everything that is good for ARPEGE is good for ALADIN, since improvement in the quality of the LBCs has a direct impact on the quality of the LAM's results. This statement should however be taken here as more than a self evidence. Short term goals and the difficulty to generalise things as much as necessary are sometimes leading to believe too easily that an ALADIN development is "too specific to be useful at larger scale". Independently of the fact that the fine scales of today are the intermediate scales of tomorrow, the usefulness of a given idea in another context is often a matter of surprise and all care should therefore be taken to make every development that is not specific to the ALADIN geometrysufficiently general to beused in ARPEGE.

From the strict point of view of the bi-periodicisation and coupling techniques, no big change of strategy appears necessary now. Some additional tuning will be necessary from time to time, but should not be given too high priority. If the non-hydrostatic ALADIN solution however becomes a standard option, the induced well-posedness of the LBC mathematical problem will require at least a revisit of the Davies-Kallberg problematic.

III) DYNAMICS

This is the part where the most drastic choices have to be made and kept. In the two very important issues of "tangent linear + adjoint" versions and of semi-Lagrangian options, one should keep as close as possible to the IFS/ARPEGE constraints, even if one may, like for the recent semi-Lagrangian operational implementation of ALADIN (earlier than in ARPEGE!), make best use of the remaining limited freedom. In fact the implications for variational and massively parallel issues are here so strong that any big deviation from the Reading and Toulouse versions would automatically mean sooner or later the end of any common work.

Some original work can still be performed in ALADIN on dynamical issues (that are anyhow sometimes more important for theoretical quarrels than for the actual results of the model!) like it is currently the case for the promising and probably crucial non-hydrostatic version. Indeed this could become the backbone of the effort in this chapter. And keeping alive the essential possibility to switch, all things otherwise identical, from hydrostatic to non-hydrostatic will already be a strong enough challenge for the team, if one considers all the options that the above-mentioned other subjects will continuously create inside the basic code.

IV) PHYSICS

The situation is here far more favourable for endeavours of smaller scope. The ARPEGE/ALADIN dynamics-physics interface is sufficiently flexible to allow creativity in a controlled framework. Since ALADIN is likely to be used at higher resolutions than IFS or ARPEGE, it should become the vehicle for advanced tests of the "finest scale physics" inside the software package. Furthermore the issue has been long neglected (the current ARPEGE/ALADIN parameterisation package is closely related to that of EMERAUDE-PERIDOT in 1988!); hence many subjects of interest, and such that an immediate benefit can be expected from any progress, could be chosen, especially in the domain of cloud- and precipitations' representation.

The problem will thus be to strongly increase the effort in that area but also to somehow rationalise the choice of research subjects. This can be helped by starting from two opposite points of view: (i) from operational diagnostics helping to identify the most damaging sources of systematic errors; (ii) from theoretical considerations and upstream research results pointing out at the crucial parameterisation issues at scales not yet reached operationally, even by ALADIN.

However, there is a strong possibility that these two rather classical lines of thoughts will be superseded by an emerging constraint: the need to better study for themselves the interactions between

physics and dynamics on one hand, physics and data assimilation on the other hand. While the latter point (mainly the search for a representative but differentiable physics package for incremental data assimilation) will have to be treated in close connection with ARPEGE, the situation is different for the former one. There is now strong evidence that the semi-Lagrangian time stepping and/or the non-hydrostatic option have a strong influence of the physical fluxes' computation. One may, like currently, simply try to tune again the schemes to adapt to these constraints, but a streamlined, ab-initio and ambitious effort in that area could equally well become a good federating item for the decentralised research units of LACE, even if they would surely not be alone to be interested in such a subject.

V) DATA ASSIMILATION

The situation for this issue is at the same time apparently clear but difficult to correctly assess, because many factors, most of them partly out of reach of the ALADIN problematic, should, in an ideal world, positively influence decisions that have to be taken long before their consequences are felt. The situation is as follows: (i) the handicap of having no data assimilation possibility at all in ALADIN is about to disappear thanks to the merging with the CANARI O/I scheme realised by the Moroccan Service; this can be used as a learning tool for data assimilation strategies and data impact studies; (ii) for the longer term this avenue is not sufficient: O/I at fine mesh will surely not beat 3D- or 4D variational data assimilation global results interpolated to finer meshes; (iii) the spectral character of ALADIN may well open a "window of opportunity" for performing "de/incremental" LAM variational data assimilation (i.e. only on an intermediate wave number range); (iv) there is no guarantee that the information measured at the finest scales (with today's instruments and networks and even perhaps with tomorrow's ones) will be meaningful even for this advanced type of data assimilation (despite the fact that the non-hydrostatic option might have a positive influence there); (v) even if it would be the case, the life-time of that additional information will have to be sufficient to justify the associated man-power investment and computer resources consumption.

It is thus easy to understand that the (not easy at all) choice for deciders is between three avenues:

- to take all risks, hoping that there shall in any case be some induced indirect benefits; in that case the costs (and their indirect negative consequences elsewhere) have to be exactly assessed;
- to start a cautious program of preliminary studies aiming at clarifying the above-mentioned issues (iii) and (v) (perhaps (iv) also) before deciding; the difficulty is here to set up some objective rules beforehand, in order to avoid a syndrome of self-induced "forced" choices;
- to simply pass; the problem is then to resist the strong external pressures to "do at least something" to justify the instrumentation research/implementation programs!

VI) DATA MONITORING

This item is mentioned "for the record". If, and only if, there is a specific data assimilation action in ALADIN and if it is concerned with special data that are not used in global data assimilation systems, then resources should obviously be found to do the "monitoring + black-listing + return of experiment" job on those data.

VII) VERIFICATION

As much as the previous item is depending on other decisions, as much this one does not allow any hesitation. To objectively assess the model's bulk results, their potential downstream applications and the "final product" use that is made of them is an absolute prerequisite for any successful NWP operational application. There was a time when such tasks were sometimes neglected because of little scientific interest. This is fortunately less and less the case and one may even foresee some revolution linked with the above-mentioned data assimilation problematic.

Indeed, as fine scale verifying data will be less and less representative of the (broader) scales of analysed motions, the emphasis will continue to shift from verification against analysis towards verification against data (this has already started in ALADIN); hence the problem of representativeness of the diagnosed "errors" will be posed in exactly the same terms than that of representativeness of the deviations from the "model's guess" for data assimilation (another way to look at monitoring). This should lead either to the integration of most verification tools inside the continuous data assimilation systems (probably too utopian a view) or to a transfer of algorithms from data assimilation towards verification. In any case some increased research effort will be necessary here.

VIII) PREDICTABILITY

This item is also here "for the record". The issue of stochastic forecasting at the shorter ranges and/or finer scales does not yet seem to be ripe (one may ask: "will it anyhow ever be?"). In any case, if it was decided to explore somehow the issue, it is sufficient to notice here that the tools are very close to that of variational data assimilation (once again!) and that the problem is therefore more one of maintenance than of independent research.

IX) CONCLUSION

Many decisions will have to be taken in the coming months concerning most of the questions implicitly or explicitly raised by this plan. These decisions are difficult because:

- the imbrication of the IFS, ARPEGE and ALADIN(s) programs has strong implication on them;
- there are far more subjects of interest than manpower and technical possibilities to treat them in depth;
- in general, scientific advice is never definite (otherwise it even becomes suspicious!), but surely insufficiently concerned with operational goals;
- on the contrary, short term operationally driven research actions are often ignoring the basic rules of scientific investment and even of modelling logic.

The specificity of ALADIN (its fully international character combined with its strong software "anchor") makes it impossible to delay the transition from the current validation/consolidation phase to a new "research" one much beyond February 95 (the project nearly died from its "dry" period of mid 1993). Hence it is urgent to start the necessary debate that this text is simply supposed to initiate. I believe that there should be only two rules, but two strictly obeyed ones, governing that debate:

- the current ALADIN team is sole responsible for clarifying, helping to interpret and (if necessary) quantifying the above-mentioned technical information, that was kept by necessity to an uncomfortable intermediate level in this note;
- the final decisions have to be political ones.

Finally let us hope that this debate will be as large as possible, as an indication that its quasi-operational character has made ALADIN a real "community" tool!?