Project proposal of the LACE Working Group for Data Assimilation for the year 2003

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1 General description

1.1 The aim of the project

The LACE Working Group for Data Assimilation was proposed to frame with the aim to coordinate the work in this field in the LACE member states. The study field of data assimilation is dealing with the task to estimate convenient initial conditions for numerical models using all possible information available. This is an important task considering the fact that the atmosphere and atmospheric numerical models show an important sensitivity to the initial conditions. The first operational applications of the ALADIN model were using entirely the initial conditions of the ARPEGE global model after a simple interpolation to the target geometry. This solution is very cheap, however not convenient to capture meso scale features which would be very important running a fine scale limited area model (LAM). Consequently, a research on LAM data assimilation was initiated within the ALADIN project in order to develop a data assimilation system providing more suitable initial conditions. After many earlier efforts the presently proposed system is based on a 3 dimensional variational assimilation scheme (3d-VAR). In addition, several other tools are available as potential complementary elements of the whole system. In recent years many experiments were done to explore the system's potential benefit and the results were promising. The basic aim of the present research is to make the system efficient on finer scales. This aim will hold an extra importance considering the fact that the AROME project plans to build on the data assimilation system of the ALADIN model. To achieve an improvement on fine scales, at least, two main directions must be followed in parallel during the future work. One is to establish the best methodology to run the data assimilation system, which means more precisely the improvement and an optimal choice of the ensemble of available tools to be used. The other direction is the one to work out the possibility of assimilating new observation types, such as satellite, radar and aircraft data. The planned research topics for the year 2003 are detailed in the 2nd section of this paper.

1.2 Interaction with other projects

As different parts of the model (dynamics, physics, data assimilation) highly depend on each other, it is expected in general that an interaction will occur in their researches as well. Indeed a cooperation was recently initiated between the WGs for Physics and Data Assimilation to work on stratus cases. This is explicitly presented in the Research Plan of the Data Assimilation WG (2nd section). In the further future some interactions are likely with the WG for

Dynamics as well, as coupling turned out to be an important point setting up the data assimilation system. Thinking more generally the interaction with the AROME project has to be mentioned here again. The applicability of a research or development in the future AROME project has to be an important viewpoint preparing the Research Plan of the WG in the future.

1.3   Link to the ALADIN Research Plan

The Research Plan of the LACE WG for Data Assimilation shows a close interaction with the ALADIN Medium Term Research Plan. More precisely, the WG will give a contribution to the realization of certain items listed in the ALADIN plan. The contribution will mean in some cases a full realization as it is foreseen (see the details in the next section).

2   Detailed Research Plan for the year 2003

The following list of research topics aims to precise the planned research for the year 2003. First a brief explanation is given to each item, than the proposed realization is detailed. This latter means the precision of the probable outputs, the estimation of needed manpower and support. The schedule of the work and proposed contributors to the realization of each topic are also presented. If necessary, some still open questions are attached. "Risk evaluation" reflects the probable benefit of the given work (1 - no risk, 2 - at least partly usable results are expected, 3 - risky). The topics are structured following the ALADIN Medium Term Research Plan holding the same priority as it is presented there.

2.1   Methods: algorithmic aspects

- **Biperiodic 3d-VAR analysis increments**
  Description: The ALADIN 3d-VAR system provides biperiodic analysis increments which is a spurious feature. The cure of this problem has a high priority.
  Objectives: The exact reason of the problem must be described and the unrealistic biperiodicity must be eliminated or its magnitude has to be reduced.
  Priority: high
  Realization: Local work coordinated by e-mail exchange. Discussion of the results in the frame of a meeting.
  Risk evaluation: 3

Open questions: The exact date and place of the meeting must be precised. HMS is willing to organize it, perhaps the LACE DA workshop (see the last item of this list) would be a good occasion.
Estimated effort: 3 person x months
Proposed contributors: Radmila Brožková, Gergely Bölöni + supervision by Claude Fischer or/and Loïk Berre
Schedule: Continuous work and discussion at the beginning of June

- **Moving to 3d-FGAT**
  Description: 3d-FGAT (FGAT stands for First Guess at Appropriate Time) is a tool based on 3d-VAR which can take into account observations in a more realistic way (treating them rather at observation times). In theory moving to this tool would ameliorate the quality of the analysis, moreover it would be a step towards 4d-VAR.
  Objectives: First this configuration has to be made run. As a next step it has to be deported to the LACE countries allowing further research.
  Priority: medium
  Realization: local work + phasing
  Risk evaluation: 1
  Estimated effort: 3 person x months
  Proposed contributors: Radmila Brožková, Gergely Bölöni
  Schedule: September or October

- **Study of vertical structure of 3d-VAR analysis increments**
  Description: The vertical structure of analysis increments is determined by the vertical structure functions of background error statistics. Earlier experiments showed erroneously large vertical spread of analysis increments using surface humidity observations.
  Objectives: The vertical spread of multivariate increments should be studied further running single-observation experiments using both standard and lagged background error statistics.
  Priority: high
  Realization: stay in Budapest
  Risk evaluation: 3
  Estimated effort: 1 person x months
  Proposed contributors: Croatian colleague + supervision
  Schedule: to be precised

- **Design of an explicit blending**

  Description: Explicit blending would be a cheap and simple tool to blend ARPEGE/ALADIN files. Its idea is based on an already existing simple program.

  Objectives: Experiments should be done to tune the essential parameters of the basic program and an easy to use script environment should be written around.

  Priority: medium

  Realization: Local work. HMS is ready to investigate on this topic. Uncertain points could be discussed via e-mail correspondence with other colleagues.

  Risk evaluation: 2

  Estimated effort: 2 person x month

  Proposed contributors: Steluta Alexandru, Helga Tóth, Gábor Radnóti

  Schedule: February, March

2.2   Methods: cycling

- **Comparison of "dfi" and "explicit" blending**

  Description: Dfi-blending is a sophisticated tool to blend ARPEGE/ALADIN files. It is efficient but its implementation is complicated. The aim of this experiment would be to explore the applicability of the cheaper explicit-blending comparing to the already well working dfi-blending.

  Objectives: The two blending methods should be implemented at the same time in one of the institutes of the LACE countries and cycling experiments should be run for comparison.

  Priority: medium

  Open questions: The place of the experiments must be precised. CHMI would convenient as dfi-blending is given there which could facilitate the work very much. (The implementation of the explicit-blending is expected to be less complicated task.)

  Realization: 1 stay in Prague

  Risk evaluation: 3

  Proposed contributors: Helga Tóth

  Estimated effort: 2 person x months

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Schedule: July

- **Blendvar cycling experiments**
  Description: Blendvar means the combination of dfi-blending and 3d-VAR. It turned out to be a promising tool for meso scale data assimilation purposes.
  Objectives: Further investigations are required to tune the system and to explore its characteristics. The proposed topic is to compare the weights of blending and 3dvar in the default setting and possibly to tune these weights.
  Priority: high
  Realization: 1 stay in Prague
  Risk evaluation: 2
  Estimated effort: 2 person x months
  Proposed contributors: Helga Tóth + supervision by Radmila Brožková
  Schedule: August

- **3d-VAR cycling experiments to elaborate cold air-pad-cases**
  Description: This topic was initiated recently by Austrian colleagues. The motivation was given by the quite regular miss-forecast of low level inversions during the winter season in the Carpatian-basin. This can partly come from the fact that in most of the cases even the initial field (in fact the ARPEGE analysis) does not recover the low level inversion.
  Objectives: The idea of the experiments is to try to reproduce the real temperature profile in the analysis running 3d-VAR assimilation cycle with two aims. One is to produce convenient fields for colleagues working on physics (low level inversion) and of course the other is to improve the forecast of such cases.
  Priority: high
  Realization: Local work, e-mail exchange, discussion of the results
  Risk evaluation: 3
  Estimated effort: 2 person x months
  Proposed contributors: Gergely Bölöni, Helga Tóth, Thomas Haiden
  Schedule: continuous work (it has already been started)

2.3 Observations

- **Implementation of ODB**

  Description: ODB is the observational data base used in the model. It's new and the implementation of softwares dealing with it is complicated. Moreover as it is foreseen the implementation of new model cycles (concerning configurations using observations) will require the implementation of new ODB versions as well.

  Objectives: The newest version of ODB must be implemented together with the new model cycle (CY25T1) in Budapest. After the successful implementation HMS is willing to organize a training course with the coordination of Sándor Kertész. Interested people should become more familiar with the ODB software concerning both implementation and usage (viewer, screening, 3d-VAR, CANARI).

  Priority: high

  Realization: stay in Budapest

  Risk evaluation: 1

  Estimated effort: 1 person x months + 5 person x weeks for the participants of the training course

  Proposed contributors: Sándor Kertész, Neva Pristov, Stjepan Ivatek-Šahdan, Olda Spaniel, Yong Wang, Frantisek Meszaros

  Schedule: April (Sándor will contact the participants after he succesfully implemented the software.)

- **Assimilation of new observation types**

  1. **ATOVS data**

     Description: Assimilation of ATOVS data has been developed recently in ALADIN/Hungary and ALADIN/France. So far it is basically the copy of the procedure applied in ARPEGE.

     Objectives: The ATOVS assimilation must be validated via assimilation cycle experiments and must be tuned to be efficient as a meso scale LAM application.

     Priority: medium

     Realization: local work

     Risk evaluation: 3

     Estimated effort: 3 person x months

     Proposed contributors: Roger Randriamampianina, Regina Szóták

     Schedule: April

2. **Radar data**

   Description: Assimilation of Radar data is a new topic not only within the LACE project but even in ALADIN.

   Objectives: Météo-France will start soon the adaptation of an observation operator from the HIRLAM model for the assimilation of radar wind data. A contact person from LACE should follow and possibly contribute to this research.

   Priority: medium

   Realization: Contact with Météo-France, bibliographical overview

   Risk evaluation: 3

   Estimated effort: 2 person x months

   Proposed contributors: Marian Jurasek

   Schedule: following the schedule of Météo-France

3. **AMDAR data**

   Description: AMDAR is a type of aircraft data. These data are available in the GTS database. The model part is ready to use them as well however it has never been tried.

   Objectives: Data conversion to ODB must be developed.

   Priority: medium

   Realization: Local work in Budapest.

   Risk evaluation: 2

   Estimated effort: 3 person x months

   Proposed contributors: Gabriella Csima, Roger Randriamampianina

   Schedule: until the end of April

2.4   Surface

- **Implementation of CANARI/Diag-pack**

  Description: CANARI/Diag-pack is a tool to perform hourly surface analysis. The experience shows that forecasters are willing to use it and that it can serve as a basis of nowcasting systems. Diag-pack is already implemented in Austria and Hungary and other LACE countries are planning to implement it too.

  Objectives: Implementation of the tool in interested institutes.

  Priority: medium

  Realization: local work, e-mail exchange with experienced colleagues

(Austrians, Hungarians)

Risk evaluation: 1

Estimated effort: 2 person x months

Schedule: continuous work

- **Smoothing of Soil Wetness Index**

  Description: Soil Wetness Index is a parameter used in the ISBA scheme (surface scheme of ARPEGE/ALADIN) which is used performing surface CANARI analysis. Its smoothing turned out to be necessary in order to avoid some spurious features in the analysis. Experiments were already performed in ARPEGE in this field.

  Objectives: Experiments done with ARPEGE will be repeated with ALADIN/LACE and ALADIN/Croatia.

  Priority: medium

  Risk evaluation: 2

  Realization: local work in Zagreb

  Estimated effort: 1 person x months

  Proposed contributors: Stjepan Ivatek-Šahdan

  Schedule: September or October

- **Assimilation of 10m wind data**

  Description: Investigations will be done in order to assimilate 10 m wind data from SYNOP reports.

  Priority: medium

  Risk evaluation: 3

  Realization: Stay in Toulouse

  Estimated effort: 1 person x months

  Proposed contributors: Marian Jurasek

  Schedule: May, June

2.5 Further Actions

- **LACE Data Assimilation Training and Workshop**

  Description: During the year many work will be done on different topics and in different places. We think it is important to discuss them at some stage and make conclusions together in order to be able to go on in the right direction. We also think it would be useful to improve the knowledge of the WG members. As data assimilation is not a main and frequent

application of the ALADIN model in most of the LACE member states, a training course on data assimilation seems to be reasonable to organize in the near future. Perhaps it would also motivate more people to contribute to work on this task. We propose thus to hold a meeting with the aim of both discussing the already existing results and organizing lectures within the subject of data assimilation.

Objectives: Participants should present their results and should participate on the lectures. They should also become familiar with practical things (i.e. to run data assimilation related configurations of the model).

Open questions: The exact program (lectures and practical exercises) must be precised. Teachers must be also chosen and invited.

Realization: Stay in Budapest

Estimated effort: 7-8 person x weeks

Proposed contributors: Any participants are welcome from the ALADIN member states

Schedule: beginning of June

3 Summary of means

The following table is a short abstract of the Research Plan proposed above concentrating on the needed manpower for each research topic. The desired LACE support is attached to each item as well.

Topic	Estimated efforts	Desired LACE support
Biperiodic 3dvar increments	3 person x months	none
Moving to 3d-FGAT	3 person x months	none
Study of vertical structure of 3d-VAR analysis increments	1 person x months	1 person x months
Design of an explicit blending	2 person x months	none
Comparison of "dfi" and "explicit" blending	2 person x months	1 person x months
Blendvar cycling experiments	2 person x months	1 person x months
3d-VAR cycling experiments to elaborate cold air-pad-cases	2 person x months	none
Implementation of ODB	2 person x months	5 person x weeks
Assimilation of new observation types: ATOVS data	3 person x months	none
Radar data	2 person x months	none
AMDAR data	3 person x months	none
Implementation of CANARI/Diag-pack	2 person x months	none
Smoothing of Soil Wetness Index	1 person x months	none
Assimilation of 10m wind data	1 person x months	none
LACE Data Assimilation Training and Workshop	7-8 person x weeks	7-8 person x weeks ?
Total	**31 person x months**	**3 person x months** + ODB training and DA workshop

Table 1: Means of the project.