LACE Working Group for Dynamics & Coupling: Research plan for the year 2004

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Introduction

This paper summarise the planned research for the year 2004 covered by the RC LACE in dynamics & coupling. It follows the structure of the plan for 2003, thus no legend is given in this paper. The proposed areas of research are still the same:

- I. Non-hydrostatic dynamics
- II. Dynamics - other topics
- III. Coupling

This structure is kept mainly to keep some long term consistency even when there are possibly overlaps between the first two groups and no research at all currently planned for the third one. It should be noted that the second area of research can be understand as the dynamics subjects *not specifically linked to* just *NH* which is a bit transformed meaning from the previous research plan for dynamics. It just illustrates the fact that the current research is increasingly focused to the high resolution modelling - the subject of the primary importance for the LACE countries operational exploitation.

Another feature should be commented here. It is the reduced amount of planned work in comparison with the previous year. This fact well corresponds with the end of the ALATNET funding. Other reason for the less research efforts planned for this year is the lack of new people joining the research. Both reasons are potentially danger for the future of any LACE research. Hence please consider this plan as the proposal related to the current LACE manpower. It would be very pleasant to extend it by any new subject related to newcomer interested about research in the field of dynamic or coupling. At least two possible entry points for potential newcomer are already specified in the plan.

1 Non-hydrostatic dynamics

- **Iterative schemes**

  Description and objectives: The 2TL P/C (predictor/corrector) scheme has been developed and implemented in the 2TL model. The work is almost done, just need small finalisation. This would concern mainly the cleaning of the code and extension of the iterative scheme into 3TL Eulerian advection (and possibly semi-Lagrangian as well). Development of the Eulerian P/C scheme is important in order to clean the NH code and to make it consistent with SL schemes. Better stability and robustness of the Eulerian scheme is expected with the P/C scheme. To achieve this the d_4 variable has to be extended to Eulerian scheme as well.

  Planned work:

  1. cleaning and optimisation of PC scheme (resp. NH dynamics)
  2. coding of 3TL Eulerian P/C scheme

  Risk evaluation: 1

  Means: 2 person × months of local work + 1 person × months LACE stay at Vienna

Contributors: Jozef Vivoda

Calendar: spring 2004 (code cleaning), last quarter of 2004 (3TL Eulerian P/C scheme) including the LACE stay at Vienna

- **Choice of the additional NH prognostic variable**

  Description and objectives: During evaluation tests of P/C scheme a pathological behaviour of d variable was observed in the bubble experiment. When w is advected instead of d itself the problem disappear. However since to use w advection is not a preferable option for the future operational exploitation, some effort has to be invested to diagnose and possibly improve the pure d solution. The already started work in this subject offered quite promising result: the Eulerian advection with d solution seems to be not affected by the pathological behaviour. This is supporting the optimistic view that the problem is not linked directly to the d formulation, thus can be in principal cured when keeping the pure d advection only.

  Planned actions:

  1. perform diagnostics tests
  2. analyse the problem

  Risk evaluation: 2

  Means: 1 person × months of local work

  Contributors: Ján Mašek

  Calendar: summer 2004

- **Bottom boundary condition**

  Description and objectives: When solving the so called chimney problem by introducing the diagnostic formulation of BBC for SL scheme another problem linked to the orographic features was detected. Further studies showed that this new problem is related to a missing contribution of horizontal diffusion and physical tendencies in the current BBC formulation. Physical tendencies can be incorporated into BBC quite easily. This is not the case for the contribution of horizontal diffusion which is computed after dynamic, thus after the BBC evaluation. Several proposals exists to deal with this problem, however none of them is really ideal. If all of the proposals would fail, there is still chance to use SLHD diffusion which is computed during the RHS evaluation.

  Planned actions:

  1. implement the correct physical tendencies treatment into BBC
  2. analyse the possible solutions for a more consistent horizontal diffusion treatment in BBC
  3. decide for solution and implement it into the model

  Risk evaluation: 2

  Means: 2 person × months of LACE stays at Prague and possibly Toulouse + 2 person × months of local work

  Contributors: Ján Mašek, Radmila Brožková

  Calendar: June, September-November 2004 for stays + any time during the year for the local work

- **Finalization of NH dynamics**

  Description and objectives: Despite some residual problems listed by the previous topics the ALADIN NH dynamics seems to reach state offering stable and accurate performance to become dynamic core for the future high resolution operational application. Before this would become the reality some cleaning has to be performed after various research activities aiming to filter the valuable part from the rest. Some further real case studies would be also profitable in order to better understand

the potential of the NH dynamics. According experience there may appear some need of additional research during the other NH topic fulfilment process. Hence it is expected that this topic would dynamically cover such potential sources of problems. From this reason the experienced person is proposed to cover this topic. On the other hand the real case studies would be a good starting point for a potential newcomer.

Planned actions:

1. cleaning according proposed material (available from K. Yessad)
2. real case studies
3. on demand provide an ad hoc help to other or newly appearing NH topics

Risk evaluation: 1

Means: 2 person × months of local work, possible entry point for a newcomer

Contributors: Radmila Brožková

Calendar: spring 2004 (code cleaning) + any time during the year

- **Diabatic forcing in fully compressible model**

  Description and objectives: Diabatic terms in the model are currently modified in order to fulfil the so called hydrostatic adjustment parametrization. The idea behind is to avoid direct generation of the acoustic waves. This arrangement creates some inconsistency in the model equation. Thus it can be a source of the potential problems. Logically more consistent would be to implement the diabatic terms in agreement with the theory. In the framework of the 2D academic experiments with no physics (except the introduced source of heating) the performance of the hydrostatic adjustment and the exact implementation of the diabatism was studied. Performed experiments gave an indication that the differences between the two approaches are negligible after a very short period. Hence it seems to be promising starting point for the next efforts which could be put on coding of 3D exact version and to test it during the real case experiment.

  Planned actions:

  1. coding 3D exact diabatic treatment
  2. according the real case studies decide which approach is more profitable to be implemented into the model

  Risk evaluation: 2

  Means: 2 person × months of deported work (1 month ALATNET Prague stay at Toulouse, 1 month LACE stay at Toulouse)

  Contributors: Alena Trojáková

  Calendar: February 2004, autumn 2004

2 Dynamics - other topics

- **Semi-Lagrangian horizontal diffusion**

  Description and objectives: Since the AL28T1/CY28T1 SLHD will be an integral part of the source code allowed by most of the model configurations. However for its potential further operational application numerous validation have to be done. Hence some extended validation is expected with the global model, NH dynamics, P/C scheme, etc during the spring 2004 after the export version of AL28T1/CY28T1 will be available.

  In agreement with the planed separation of SL interpolatores for various GFL fields the SLHD scheme has to be further extended to follow this code feature.

Targeted analysis of the scheme performance confirmed, that some hypothesis anticipated during the academic ideal experiment tests have to be revisited. They are still some open question inside the SLHD which has to be answered.

Finally intensive real case studies should be launched especially linked to the optimal diffusivity of the moisture in the high resolution (whether to use moisture as the gridpoint field only or if there is still need for it be transformed to the spectral space).

Planned actions:

1. various validation of SLHD
2. extension of SLHD to be on demand available to separate GFL fields
3. further diagnostics of SLHD with outcome to improve its performance
4. according diagnostic of vorticity and divergence answer the question whether the end of the model divergence spectra can be fully controlled through the horizontal flow deformation
5. real case studies oriented to the moisture used as GP field only

Risk evaluation: 1-2 according specific action

Means: 6 person × months of local work, possible entry for a newcomer (having to start at Prague)

Contributors: Filip Váňa

Calendar: spring 2004 (validation) + any time during the year

- **Radiative upper boundary condition**

  Description and objectives: An analysis of the recursive filter based on the non-reflecting upper boundary condition (RUBC) for gravity and acoustic waves interaction with the semi-implicit temporal scheme was carried on. The main concern was to influence of the modification of phase speed of the waves caused by a SI scheme on the radiative performance of RUBC. It was suggested that RUBC should be kept in an explicit form in order to properly handle wave radiation. The work on this topic has started. Set of equation has been analysed. Guidelines for the future work has been defined. The research haven't arrived to its experimental part yet.

  Planned actions:

  1. implementation to 2D vertical plane version of ALADIN
  2. merging with P/C scheme to get a stable solution
  3. 2D and 3D experiments (SCANIA case)

  Risk evaluation: 3

  Means: 2-3 person × months of local work, 1 person × months of LACE stay at Toulouse (optional)

  Contributors: Martin Janoušek

  Calendar: 2004

- **Physics / dynamics interface**

  Description and objectives: The physics/dynamics interface currently allows the model to use diabatic tendencies in a stable way for most of the model configuration including NH and iterative schemes. However the accuracy is just of first order. With increasing resolution (and role of the diabatic processes) various proposals to improve an accuracy with at least keeping the model stability exists. They are mainly linked to the SL P/C scheme which seems to be the future solution for the model dynamics in high resolution.

  Planned actions:

  1. allow usage of averaged diabatic tendencies along the SL trajectory
  2. perform various tests with different tendencies considered either at origin or final points

Risk evaluation: 2

Means: 1 person × months of local work, 1 person × months of LACE stay at Prague

Contributors: Martina Tudor

Calendar: March 2004 (stay at Prague), any time afterwards for the continuation

- **Case study in high resolution**

  Description and objectives: A comparison of the performance of 2-km resolution hydrostatic dynamical adaptation with the same based on NH dynamics. The aim is to diagnose whether the NH dynamics would have some positive impact for such severe effects like a bura formation.

  Planned actions:

  1. prepared the NH dynamical adaptation
  2. compare the performances of hydrostatic and NH dynamical adaptations for selected cases

  Risk evaluation: 1

  Means: 1 person × months of local work

  Contributors: Martina Tudor

  Calendar: 2004

3 Coupling

Nothing planned for year 2004