LACE Working Group for Dynamics & Coupling: Research plan for the year 2009

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Introduction

This plan gives an overview of the areas on the fields of dynamics and coupling which seem to be both of interest and possibility to be studied during 2009 within the organized RC LACE research. The main focus for dynamics is indeed the NH dynamics launched as the LACE project. This document then should be considered as the complementary information to the definition of the project: "Toward an operational implementation of the NH dynamics" updating the original project with respect to the current situation. Additionally the other research subjects being outside the NH project but still of interest for RC LACE are also listed here.

1 LACE Project: Toward an operational implementation of the NH dynamics

The original harmonogram for the project has to be adapted. There are several issues appeared not known at the time of the Project definitions with strong impact to it. Among the others it is mainly the delayed delivery of the new high performing computer at CHMI, the one supposed to serve for the first (pre)operational NH tests at the targeted resolution 4-5 km. The expected delay will be at least 10 months. The schedule for the second half of 2008 was also influenced by the delayed release of the CY35T1 model cycle, the one expected to be used for the operational comparison.

Finally a new issue has been detected in the model affecting significantly the vorticity (and divergence) fields in the vicinity of orographic obstacles by spurious noise. The origin of the noise has to be explained. It can be related to the way horizontal pressure gradient is computed. Another source of problem is seen through the aliasing. It is also evident that orography is participating to the problem, so a better treatment of model orography might be also beneficial with respect to the described problem. It is evident that this spurious effect significantly influences model derivatives of momentum fields. Moreover it has been found to be further amplified with increased vertical and/or horizontal resolution. Knowing that the NH dynamics is much more sensitive to the derivatives of momentum fields, it is clear that this issue has to be explained and solved before the NH dynamics is used in parallel test to the hydrostatic one.

The strategic work on VFE is stagnating. It has been decided to put maximum available workforce to deal with it for period of three months (two people times two months). If even this enhanced activity won't lead to any progress this subject will be abandoned or leaved for better time.

Recently another issue has been detected related to the `LSPRT` option (use of virtual temperature in spectral space representing the temperature). It has been found that the results are sensitive to this options even for settings where it should play no impact. This founding perhaps indicates another problem. No doubt it is worth to trace it before moving to high resolutions real atmosphere studies.

The re-scheduled deliverables of the Project then will be:

task 1.1: Redo academic tests with the recent version of the NH dynamics
first half of 2009 (Masek, Vana)

task 1.2: Check the way the physics is coupled to dynamics in ICI scheme
first half of 2009 (Vana, Bastak, Tudor?)

task 2.1: Time step organization - improved coupling of physics to dynamics
continuous (Bastak, Tudor?) - low priority

task 2.2: Vertical finite element discretization for NH dynamics
continuous (Vivoda, Masek)

task 2.3: Consistent coupling of physics to fully elastic dynamics
tackled outside LACE (B. Catry) - low priority

task 2.4: Balanced LBC treatment for NH dynamics
second half of 2009 (LACE stay)

task 2.5: Optimal cycling strategy
second half of 2009 or beginning of 2010

task 2.6: Introducing physicsl tendency to w
difficult and low priority at the moment

task 2.7: Dealing with unexpected problems
as soon as possible (Vana, Brozkova, Masek)

task 3.1: Implementeation of (hydrostatic) operational model to the targeted resolution
second half of 2009

task 3.2: Extensive comparison of the hydrostatic and NH model results
second half of 2009 or beginning of 2010

tasks 4.? and 5.?: Code optimization of the NH dynamics and **Operational implementation**
2010

2 Other topics outside the NH project

2.1 Dynamics

- **3D turbulence scheme**

  Description and objectives: Considering the increased interest to simulate meso-scale processes by the operational application a turbulence processes taking into account also the horizontal mixing shouldn't be neglected any longer. Due to efficiency reasons model is written in a way that consideration of local non-linear processes along horizontal dimensions is not straight forward. A solution however exists in applying parameterization of those processes during the 3D interpolation of semi-Lagrangian stencil. The proposed work should extend the existing model data-flow by allowing diabatic tendencies to be treated correctly with the 3D turbulence. Moreover the triggering mechanism and decoupling turbulence between vertical and horizontal directions has to be available by the model code. In case previous is going well, first academic test (in LES mode for cases like GABLS) can be performed to further study the behavior of this new feature of the model.

  Priority: 2

  Contributors: FV

  Means: 2 months

2.2 Coupling

- **Better LBC treatment**

  Description and objectives: With the available manpower LACE is not able to drive any research in the area of LBC coupling. However, as the LBC is one of the crucial factors of importance for LAM modelling, it is desirable to achieve some progress in this area. The promising but still long term oriented work of P. Termonia and F. Voitus on externalized LBC treatment allowing its adaptations to the work of A. McDonald on transparent boundary condition seems to be sleeping for the moment.

LACE would like to re-initialize this important work by organizing working months during summer on LBC. Here we intend to play role of catalyzator rather main engine, but at least demonstrating the importance of this subject for LACE. Among the externalization of the LBC, the adaptation of Boyd's solution at the code level is planned (continuation of work of P. Termonia and B. Strajnar). Finally also the problem of well-posedness of LBCs for the Euler system should be accessed.

Priority: 2

Contributors: P. Termonia, F. Voitus, FV, JM(?)

Means: 1 month per each participant