

Working Group for Dynamics & Coupling:

fulfilment of 2007 plan

October 4, 2007

NOTIFICATION: This document is the supplement of the Research plan for the year 2007. The topic descriptions and objectives are not explained once again here. In case of need they can be referred directly from the Research plan. Moreover the listed topics are restricted to just those for which a progress was achieved.

NH dynamics

Vertical finite element discretization scheme : At this stage there are nothing really new since end of 2006. Before her SHMI departure Emelyn performed real atmospheric studies with the VFE code. The results again confirm there is still a residual problem in the scheme implementation generating a spurious non meteorological signal. Otherwise the scheme offers stable performance with results highly comparable to the original finite difference method. Jozef is supposed to continue in November by further stability tests (in cooperation with KY), work on iterative algorithm of SI solver when C1 condition differs from zero. Finally the major part of the scheme should be also phased to the common code.

Means: 3 months of local work

People involved: ELR, JV

Code implications: Part of the research branch (based on CY30T1) reported to Toulouse (KY). It is not clear how this has influenced the common code.

References: E. Larrieu Rosina: First results on NH SI VFE 3D testing

Other (not only NH) dynamics

New interpolators for semi-Lagrangian advection : Work is well progressing. After first stay of Jan at CHMI the preliminary version (ready for real tests) of the new data-flow is coded. The first experiments confirm the expectation that it should bring more freedom and accuracy to the SL and SLHD schemes. There is also a good chance to reduce the computational cost for both schemes. The work should continue by second stay of Jan at CHMI. It is hoped to finish the new design of interpolators including its implementation into the common code. This requires to keep an option to reproduce the current data-flow and also to derive TL/AD counterparts of the new data-flow.

As side effect of this study it has been clearly demonstrated that the 4-points splines are detrimental to the model results. As it was shown only interpolators exactly reproducing or damping the amplitudes for the interpolated waves are suitable for SL advection schemes. Although the 4-points splines offer higher accuracy to the small scale information it is known they are amplifying the long waves.

Means: 2 months (1 month supported by LACE)

People involved: JM, FV

Code implications: The 4-p splines were removed from the common code at the level of CY32T3.

References: J. Mašek: Test implementation of new semi-Lagrangian interpolators in ARPEGE/ALADIN cycle 32t1a1r01

Physics / dynamics coupling : The work is slowly progressing.

Means: 1 month of local work

People involved: MT

Code implications: research branch based on CY29T2

References: nothing new

TL/AD of the semi-Lagrangian scheme : The AD code has been successfully phased into CY32T2. Since that another increase of performance was achieved (around 13% of performance gain for the most expensive AD routine) for mainly vector platforms and the code was further rationalized to be as close to the global one as possible. Moreover on request from the EPS people the new code has been successfully activated for configuration e601 (SV generation) allowing higher computational efficiency and hopefully also increased accuracy.

Means: 3 months of local work

People involved: FV, RM

Code implications: complete code available since CY32T2, it is further optimized from CY32T3

References: documentation to CY32T2 and CY32T3

Thermodynamics consistency in the model equations : The code has been checked and found consistent with the new multi-phasic system. In addition the flux-conservative thermodynamic equations for the multi-phase system are extended for the fully compressible atmosphere (NH dynamics). This extension encounters the set of prognostic equations in the following points: 1. the impact of the vertical moving water species in the thermodynamic equation, with the kinetic energy contribution extended to the vertical component, 2. the projection of the addition or removal of heat on pressure tendency, 3. the projection on vertical velocity (pressure departure respectively) tendency. The given concept was elaborated in more details with regard to the ARPEGE/ALADIN/ALARO system and technical aspects of the implementation to this system were considered and widely discussed. The consequences of making the hypothesis that any mass flux due to the motion of moisture is compensated by a counter-flux of dry air ($\delta m = 0$) were also considered. The implementation was not yet finished, neither tested on real situations.

Means: 1.5 month of local work

People involved: PS, RB

Code implications: private branch based on CY32T1

References: nothing so far

Optimization of SL advection buffers : In order to reduce the memory conflicts (which is especially important for vector machines) the size of SL buffers used for parallel computation is slightly extended. The procedure doing this is related to the size of memory banks register of a given platform and an empirically found offset. The aim of this work was to re-checked and further optimize this empirical procedure with respect to NEC SX computers (exclusively used as the only vector platform within the ALADIN/ARPEGE community) knowing that the last tuning was done with respect to VPP machines. It was found that the old tuning offers quite good performance also for the NEC computers. The further retuning improves this situation by just slightly more than 0.5%. (To give some estimate the worst tuning for this procedure slows down the whole model performance by 51%.)

Means: 2 weeks of local work

People involved: FV

Code implications: new tuning available since CY32T3

References: documentation to CY32T3

Coupling

Boyd's method in SL space : This study was oriented toward testing fresh approaches (or their combinations) for LB coupling with the diagnostic environment developed by Jan in 2006. One of the tested approaches was an implementation of Boyd ideas (MWR paper from 2005) in the SL space. It seems to offer some skills but not convincingly outperforming the reference Davies' technique. Especially for the out flow areas the Davies scheme is significantly more efficient. Perhaps some further tuning or combination of this technique with the relaxation for the outflow areas could still be beneficial. The tuning of the SLHD seems to offer more potential to improve quality of the LB coupling. When SLHD is increased near the lateral boundaries the observed error caused by LBC techniques is noticeably reduced with respect to the reference one. There were however still some periods for which the reference scheme offered better results. It seems that there are kind of weather for which the increased SLHD gives better forecast. A more detailed analysis would be then profitable in order to activate this technique just for the cases where it is beneficial to the model results.

As there is another project focused on coupling within the ALADIN community this kind of quick win oriented study has been frozen.

Means: 1 month of local work

People involved: FV

Code implications: none for the moment

References: none