Working Group for
Dynamics & Coupling:

fulfilment of 2006 plan

February 9, 2007

NOTE: This document is the supplement of the Research plan for the year 2006. 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 certain work was planned or unexpecting progress was achieved.

NH dynamics

Further improvement of the NH dynamics (improve performance of the d variables)
Planned 1.5 of local work for RB. Nothing done, since RB is involved to the ALARO-0 action.

Bottom boundary condition (fine tuning of defaults)
During regular daily tests of AROME in Toulouse a spurious behavior of the T2m was observed. Further diagnosis identified the problem related to the noise in d field (vertical divergence) near the surface. For this prognostic variable the spectral diffusion (so called supporting diffusion) was deactivated in order to obtain the best possible performance with respect to the diffusive chimney. The simulations with the real orography however suffered from such settings. To get rid of the problem a new value for the supporting horizontal diffusion of d has been derived. As it has been also proven the new default keeps the chimney effect at the still sufficiently low level.
Means: 2 weeks
People involved: FV with the help of Yann Seity
Code implications: New default entered the code at level of CY31T1
References: CZ poster in Sophia, presentation of LACE+ALADIN dynamics & coupling on EWGLAM, updated SLHD documentation

VFE (coding, testing, validating)
During his 1 month stay at ZAMG JV coded the prototype of the VFE into the ALADIN-NH. The code is stable, comparable with the stability of the current finite difference treatment. (The related analysis were presented in Sophia.) The VFE scheme causes extra 2-3% of additional cost. Hence it can be considered as very efficient. The only remaining problem is the scheme accuracy - with the activated VFE the model results are subject of noise. The forthcoming research is then logically focused to detection and removal of the source of such noise (whenever it is bug or problem of the scheme formulation). The BBC has been already tested as properly implemented to the code.
During July 16-20 JV visited Copenhagen to start a cooperation with the HIRLAM scientists.
In autumn the working team in LACE was extended by EM, the newcomer joining the SHMU NWP team. The current goal is to have VFE scheme entirely following the well proven ALADIN-NH development.
Means: 5 months (1 month of LACE support)
People involved: JV, EM with people from MF and HIRLAM
Code implications: The existing development exists as a branch based on CY30T1.
References: Presentations in Sophia (ALADIN WS) and Zagreb (SRNWP WS on Numerical Techniques), report from Copenhagen, report from ZAMG.

Other (not only NH) dynamics

Horizontal pressure gradient term Work of U. Andrae from HIRLAM slowly progressing casually being consulted with RB.

Means: 2 weeks
People involved: RB

SLHD (extension to stretched geometry & introducing the map factor for the uniform mesh)

As a potential cure to damp fictive cyclogenesis the SLHD had been tested with very promising results in Arpege. Consequently the adaptation to the stretched geometry was introduced to the code with the provisional tuning for horizontal resolution coarser than guaranteed 40-50 km. During this work the proper dependency to the map factor has been also introduced to the uniform grid.

Currently the paper about SLHD is almost ready for submition. During its preparation a set of interesting cases demonstrating skills of the SLHD were studied with ALADIN and AROME.
Means: 1 month
People involved: FV with François Bouyssel, Karim Yessad and the co-authors of the paper PB, JFG, AS, YS
Code implications: New changes phased to CY31T2
References: CY31T2 description

Numerical coupling of physics to dynamic (investigate alternatives providing higher accuracy and preserving the current stability)

During her stay at CHMI MT started to search for other options to couple the ALADIN/ALARO physics with the dynamics. There are various options to influence this coupling. Out from all 9 various configurations were coded (or activated in the existing code). The three of them are unstable at the moment. The remaining six were investigated. The options averaging physics along the semi-Lagrangian trajectory seems to be superior to the operational scheme (currently all physics is coupled in the origin point). If this is confirmed by a parallel test, it is going to be committed soon to the public source code and replace the operational configuration. The further work on the other options is expected for the future.
Means: 1.5 month (1 month of LACE support)
People involved: MT
Code implications: The working version exists for CY29T2 with ALARO modset
References: Alternative ways of coupling of physics to the dynamics in ALADIN

Study of the spline interpolation for the SL advection (check the code implementation of splines & explain its "strange" behavior)

During his stay at CHMI JM verified the splines implementation to the model. He found them as implemented without bugs. The further test showed that the possible explanation of the worse spline performance when used for the SL scheme is due to their "too accurate" behavior. In case the interpolation is not producing a certain amount of inherent diffusion it needs to be compensated by additional extra diffusion. Moreover the local splines were found as slightly distorsive for the long waves in the model. As a viable alternative to cure the known conservative weakness of the SLHD a general family of two-parametric cubic interpolators was derived. The diffusivity, accuracy and selectivity of such interpolators were then studied. As an outcome a new class of 2nd order of accuracy of interpolators can be obtained providing sufficient diffusion to be used by the SLHD while maintaining the high interpolation accuracy.
Means: 1.75 month (1 month supported by LACE)
People involved: JM, FV (one week supervision)
Code implications: So far none
References: Study of semi-Lagrangian interpolators in idealized framework

TL/AD of the SL scheme (derive, code and test)

During April - mid May 2006 FV started to learn the TL/AD style of coding. As a sort of his training he was also participating to the HIRLAM 4DVAR training. During his 1.5 months stay in Toulouse the TL code was derived for the ALADIN SL scheme. The code was fully validated by the end of August. In September the TL code was further optimized for the vector platforms, committed to ClearCase and finally phased during the CY31T2 phasing. The AD code was derived during October-November. Finally the optimization issues (parallelism issues, support to vector platform) of the code were considered for this code leading to nearly one and half month of additional development.
Means: 6 months (1.5 month supported by MF)

People involved: FV and GB with the help of K. Yessad, M. Janiskova and R. El Khatib
Code implications: The TL part entered CY31T2, AD should enter the CY32T2
References: Description of CY31T2

Coupling

3D diagnostic tool for coupling (development of the 3D tool for testing of LBC coupling)
The tool based on perfect model approach was developed and it is available at CHMI. (It can be however quite easily moved to other center.) It uses mainly perl scripts and standard ALADIN configurations (e001, fullpos). The documentation is also available.

Moreover several tests were performed to justify the current LBC treatment in terms coupling frequency, quadratic versus linear interpolation,. . .
Means: 1.5 month (1 month supported by LACE)
People involved: JM
Code implications: The existing tool is based on CY29t2mxl release at CHMI.
References: Diagnostic tool for lateral coupling