LACE Physics

Progress in research, year 2008
draft report

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Content:

1 Short overview of the of the project (status at the end of the 2008)

Project name: Operational ALARO configuration at scales around 5km mesh-size
Responsible person: Areal leader for Physics
Responsible Center: CHMI

Task: 1.1 Turbulent scheme
Description: Further sophistication of the current turbulent scheme (pTKE).
Realization:
There are two main tasks linked to improvements of the scheme:
- to find the best mixing length formulation
    - BL89 is successfully implemented
    - some alternatives have been coded

    1D experiments on GABLS case show that the improvement coming from the TKE-based mixing length is significant.
- to code consistently the full TKE scheme into the framework of the existing scheme
    - eTKE emulating CBR and QNSE is coded and verified (two stability dependency function are lately introduced (instead of one) to take into account anisotropic turbulent aspects)
    - fTKE extension of pTKE to full TKE scheme is coded and verified. The aim is to have a reference for the eTKE scheme.
    - during the testing and comparing of some variants of code emulating full TKE scheme using 1D model some bugs and new ideas for the scheme formulation were found .

    The results computed with eTKE and fTKE are equivalent so it has been proven that eTKE emulates the full TKE, although they are computed in completely different way.

Code for pTKE related part of developments is prepared to enter into cycle CY35T2 (mid January

2009). These include rationalization of the pTKE code, two bugfixes (wrong bottom boundary of the solver, a conceptual problem of the stabilization), introduction of the family of TKE-type (e-type) mixing lengths for pTKE and some preparations for the eTKE scheme.
Efforts: 7 pm
Contributors: F. Váňa (Cz), I. Bašták (Sk), J.-F. Geleyn
Documentation: not available yet (permanent update)

Task: 1.2 Radiation scheme
Description: Implementation of new transmission functions and improvement in aerosol's optical properties.
Realization:
– Fits of gaseous broad band transmission functions in ACRANEB scheme (for thermal band) were redone on the basis of transmission data extracted from RRTM-ECMWF.
– New correction was added to the computation of optical depths for composite of gases. This correction accounts for the fact that summing individual contributions of single gases to the total optical depth is not precisely equivalent to the opt. depth of their composite. Impact of the correction on the evaluation of total gaseous optical depth have been validated via inter-comparison of ACRANEB and RRTM schemes using single column model.
– The fit of the NER 'statistical weights' with an input produced on the basis of the above-improved basic gaseous transmission functions has been redone. Impact of the slightly different values of new weights on the radiative heating/cooling rates is negligible.
– Inter-comparison with RRTM was done also via DDH diagnostics with full model integration and verification via scores with positive impact on temperatures bias in the lower troposphere.
Efforts: 3.5 pm
Contributors: T. Kral (Cz)
Documentation: not available yet

Task: 1.3 Cloudiness scheme
Description: The prognostic water species are now available in the model and the description of cloudiness should take this into account. Method should be revised, also link between clouds and radiation. Maybe unified cloud scheme can be proposed, find out if same clouds can used in the radiation scheme or not.
Realization:
– Effort started to revise the work done earlier (J. Rio May 2007) under the constrains which appeared after the modification of 3MT.
Efforts: 1 pm
Contributors: J. Rio (Pt)
Documentation: not available yet

Task: 2.1 Code stabilization
Description: Stabilization of the 3MT code, solving some already know weaknesses, code cleaning.
Realization:
– an impact of condensed water and precipitating water on the computation of pressure gradient term due to the gradient of RT .
– the computation of CAPE for diagnostic purposes in the 3MT convective updraft routine is activated (was forgotten).

Efforts: 0.5 pm
Contributors: R. Brožková (Cz)
Documentation: soon available on LACE forum

Task: 2.2 Evaluation (5 km mesh-size)
Description: Examine the performance at scale around 5km mesh-size, recognize good/weak/bad behavior while studying position and the amount of (convective) precipitation, life cycle of convection (diurnal cycle), triggering of the convection.
Realization:

Environment is set in 4 services:
– at: domain with resolution 4.9 km, case studies with stratus situation in stable winter anticyclone, daily test runs (00run, 59 levels, up to +48h)
– cz: domain with resolution 4.5 km and 2.3 km (smaller), case studies
– si: domain with resolution 4.4 km,
  – regular daily runs for subjective evaluation, verification scores are inserted into AVP,
  – case studies on strong convection cases where sensitivity to time-step length was studied. Convective areas are more sensitive to time-step length, shortening the time-step to 0.5 or 0.25 of usual value can considerably modify the structure of convective precipitation. Further investigation with DDH diagnostic is ongoing.
  – daily precipitation (24h) data of forecasts for the year 2007 and observations from 38 climatological station over Slovenia were used as the dataset for the computation of the verification scores.
– ro: domain with resolution 5 km, case studies

Efforts: 4 pm
Contributors: C. Wittman (At), H. Seidl (At), R. Brožková (Cz), M. Žagar (Si), N. Pristov (Si), D. Banciu (Ro), N. Lopez (Pt)
Documentation: LACE forum; Nuno Lopez, 2008: Verification of ALARO 3MT on 4.4km resolution , report from stay;

Task: 2.3 Entrainment
Description: Validation of the historic entrainment. Study of the prognostic entrainment, which is foreseen/anticipated to be needed at higher resolutions.
Realization:

The study and the tuning of the historical entrainment rate formulation:
– a diagnosis of the entrainment rate vertical distribution for current setup and whit the historical entrainment
– to obtain similar histograms some modifications were done:
  – the 'historic' variable had to be made 'prognostic', accordingly, without resetting to zero (corresponding to a maximum entrainment rate) when no-convection takes place
  – a separation of the (anti-hysteresis 'Mironov') term representing the more organized entrainment from the historical part, that allows to treat it as an independent addition
  – the minimum and maximum entrainment values are rescaled to dimensionless numbers and are now dependent on height. This dependency is made on the basis of the analysis of cloud resolving models data.
  – retuning the three major coefficients of the scheme which are: the characteristic time of

downdraft dissipation (tau), the coefficient of the downdraft fractional area term (kappa) and the coefficient of the term representing the more organized part of the entrainment(beta).

– the modification of the equation governing the evolution of the historical variable evolution by modulating the two antagonist terms (the downdraft dissipation term and the downdraft fractional area term); the two additional free parameters controlling the modulation were tuned together with the retuning of the one controlling the ensemble simulation effect.

The clean code containing all the above listed developments (including the ascending compatibility with the non-modulating historical variable evolution) was prepared and phased into cy35t1 and will enter in the cy35t2. The default set-up of the prognostic entrainment specific parameters is still provisional since it leads to not enough convection.

Efforts: 3 pm
Contributors: D. Banciu (Ro), R. Brožková (Cz)
Documentation: in preparation

Name, topic, location	planed stays in 2008 (months)	LACE stays (executed)	ALADIN flat rate stays
Ivan Baštak Topic 1.1 Stay at CHMI	2	2	
Doina Banciu Topic 1.3 Stay at CHMI	1.5	1.5	
Joa Rio Topic 1.4 Stay at CHMI	1.5		1
Nuno Lopez Topic 2.2 Stay at EARS			1
Total	5	3.5	2

Table 1: Research stays in 2008.

2 Developments not linked to the project

Diagnostic tool DDH

DDH (Diagnostic par Domaines Horizontaux) diagnostic package is relevant for all models ARPEGE, ALADIN, ALARO and AROME.

Debugging and verification of DDH for AROME has been completed. Few bugs were solved, for example some changes were needed in MNH routine rain_ice.

Efforts: 1.5 person x month

Contributor: T. Kovačić (Hr)
Status: completed
Documentation: -

INCA

The INCA INTERREG project was narrowly rejected. Based on the rather constructive criticism of the reviewers there are good chances for a second try later this year.

The development work on INCA concentrated on the temperature, humidity, and precipitation analysis, and on the wind forecast:

– Optimization of all parameters in the temperature analysis. MAE averaged over all stations is now <1 K in well-mixed situations and ~1.5 K in stable situations. The INCA temperature analysis has definitely a very good quality now.

– Application of the bias correction in the INCA humidity forecast (before, it was only used for temperature). This has reduced the error of the INCA forecast relative to ALADIN. However, in the nowcasting range INCA is still slightly worse than persistence. It appears that the temporal tendency of specific humidity in ALADIN on an hour-to-hour timescale does not have a significant skill. So there is more work needed here to clarify the problem.

– A comparison of GPS column water vapor content (precipitable water) with ALADIN and INCA.

– Improvement of the INCA wind downscaling (reduction of a strong negative bias that was caused by the large difference between ALADIN envelope topography and INCA topography).

– Comprehensive re-investigation of the elevation dependence of precipitation at short time intervals

Contributor: At team
Status: permanent

Lake modeling in SURFEX

The local environment for the use of Flake model in the off-line mode (outside SURFEX) was prepared. Cooperation was initiated to collect observation data for the lake Balaton in order to learn more about lake behaviour and to use them as experimental forcing. Off-line simulations driven by observed or forecasted atmospheric forcing from the ALADIN model were done. Preliminary results show promising performance of Flake model to simulate surface temperature of the lake Balaton.

Efforts: 5 person x month
Contributor: M. Vörös (Hu)
Status: ongoing
Documentation: http://netfam.fmi.fi/Lake08/Lake08_programme.html

ALARO-0 evaluation

Short overview of present status:
ALARO-0without3MT, cy32t1:
        operational: Hr, At, initialization with 0

ALARO-0with3MT, cy32t1, cy32t3:
    operational:
        Cz (since 4 June), assimilation cycle
        Si(since 16 June), initialization with 0
        Sk (since 19 August),   'pseudo' assimilation cycle
    parallel: At for some period
    case studies: Ro

Comparison between ALARO-0without3MT and ALARO-0with3MT has been done in at, cz and sk. It can be noticed that unrealistic areas of weak precipitation are removed, convection is better structured. Verification scores has to be collected and evaluated.

Efforts: 0.5 per country
Contributor: At, Cz, Hr, Ro, Si, Sk
Status: ongoing
Documentation:

3 Summary

A short overview of the status, realization and LACE support for the year 2008 is in the table below:

Topic	Status	Estimated effort (person x month) realized	LACE support (person x month) planned/realized
Project			
WP1 – development of the schemes			
1.1 Turbulent scheme	ongoing	7	2/2
1.2 Radiation scheme	ongoing	3.5	-
1.3 Cloudiness	ongoing	1	*1.5/1*
WP2 -Scientific maintenance of the code			
2.1 Code optimization	ongoing	0.5	-
2.2 Evaluation, performance	ongoing	4	-/1
2.3 Entrainment	ongoing	3	1.5/1.5
Other developments			
Validation, evaluation of ALARO-0	ongoing	3	
DDH	completed	1.5	
FLake	ongoing	5	
INCA	permanent		

List of stays:

  Ivan Bašták – Prague – 17 March – 18 April (4 weeks) – turbulent scheme
  Doina Banciu – Prague – 18. August – 27 September (6 weeks) – entrainment in 3MT
  Ivan Bašták – Prague – 3 November - 28 November (4 weeks) – turbulent scheme

  from ALADIN Flat-rate: topics linked with ALARO-0
      Prague: Joao Rio, 4 week (October, November)
      Ljubljana: Nuno Lopez, 13 October – 8 November

List of short visits:

  Chistoph Wittman – Prague – 4-6 Februar 2008 – 3MT
  Neva Pristov – Prague – 4-6 Februar 2008 – 3MT
  Neva Pristov – Prague – 15-17 September 2008 – DDH issue for "Convergence" days, radiation

Financial support:

  Neva Pristov, Chistoph Wittman - ECMWF Seminar
  Miklós Vörös – Workshop on "Parameterization of Lakes in Numerical Weather Prediction and Climate Modelling"
  Radmila Brožková, Neva Pristov, Chistoph Wittman - "Convergence" days
  Neva Pristov - Meeting on the deep convection around AROME

List of events:

- 2nd AROME Training Course, 4-7 March 2008, Lisbon, Portugal
- ALADIN – HIRLAM Workshop, 7-10 April 2008, Brussels, Belgium
- Workshop on "Parameterization of Lakes in Numerical Weather Prediction and Climate Modelling" 18-20 September 2008, Zelenogorsk
- *PAN-GCSS meeting on "ADVANCES IN MODELING AND OBSERVING CLOUDS AND CONVECTION", Toulouse*
- Seminar on Physical parametrization processes and their dynamical interactions, 1-4 September 2008, ECMWF
- Convergence days (CNRM, ALADIN partners), 24-25 September 2008, Toulouse, France
- EWGLAM and SRNWP Annual Meeting 2008, Spain
- Meeting on the deep convection around AROME (AROME team, HIRLAM developers), 24-25 November, Toulouse

Reports and documents:

- Nuno Lopez, 2008: Verification of ALARO 3MT on 4.4km resolution, report from stay 13 October - 7 November 2008 in Ljubljana
- Neva Pristov, 2008: DDH, report from stay 15-17 September in Prague
- Doina Banciu, 2008: Study and the tuning of the ALARO historical entrainment rate formulation, report from stay 18 August - 27 September 2008 in Prague, in preparation
- Ivan Bastak, 2008: "New" ACCOEFK subroutine in pTKE parametrisation scheme, upgrade, report from stays 17 March - 18 April, 3-28 November in Prague, permanent
- Neva Pristov, Christoph Wittmann, 2008: An overview of the namelist settings in ALARO, report from stay 4-6 February in Prague
- Jure Cedilnik, 2008: Investigating the impact of advection on TKE, ALADIN Newsletter 34 , 43-49
- Jan Mašek, 2008: Note on case with over predicted convective activity (23-27 May 2007), ALADIN Newsletter 34 , 39-42

- R. Brožková, J.-F. Geleyn, 2008: List of 3MT-related upgrades to the ALARO-0 code since early March 2007 (18 March)

Presentations:
- Radmila Brožková: ALARO physisc; development of 3MT, 30th EWGLAM and 15th SRNWP Meetings , 6-9 October 2008, Madrid
- Radmila Brožková: Time-steps consistency aspects of 3MT, The 18th ALADIN and HIRLAM Workshop , Bruxelles, 7-10 April 2008
- Neva Pristov: ALARO physics in (pre-)operational use, Workshop on deep convection around Arome , Toulouse, 24-25 November 2008
- Miklós Vörös: Application of FLake on theLake Balaton, Workshop on "Parameterization of Lakes in Numerical Weather Prediction and Climate Modelling" 18-20 September 2008
- Radmila Brožková, Neva Pristov, Christoph Wittmann, Convergence days meeting, Toulouse 24-25 September 2008