

Status of ALADIN operational activities at SHMU (X/2017 - II/2018)

SUMMARY

The operational version is based on CY40t1_bf07_export, 4.5km/63levels, ALARO-1vB physics. Old 9km/37l CY36T1 is still running for few applications on old HPC (see Table 1.). No upgrade of the operational version since the last report. The public IP address was transferred from old HPC to the new HPC, so the new one is now visible for external world. There are two experimental version of the convection permitting model running over identical domain (2 km/L73), mostly for subjective evaluation and case studies: AROME and ALARO-1vB.

Table 1: The current and former ALADIN/SHMU system setup.

	new operational	former operational
HPC	new HPC	old HPC
model	CY40T1_bf07_export	CY36T1_bf10
horizontal resolution	4.5km	9km
number of grid points	625 x 576	320 x 288
spectral resolution	312x287 (linear)	106 x 95 (quadratic)
orography	mean orography (old Z0)	envelope orography
number of levels	63	37
time-step	180s	400s
coupling model	ARPEGE (long- & short cut off), 3h	
assimilation initialization	Upper air spectral blending with CANARI surface assimilation no initialization	
forecast ranges	78/72/72/60 (a' 1h)	72/72/72/60 (a' 1h)
physics	ALARO-1vB	ALARO 3MT, SLHD

HARDWARE

NWP system ALADIN is exploited on SHMU supercomputers. Currently there are 2 IBM clusters available:

- NEW HPC: 12 nodes of IBM Flex System p460, each node contains 4 processors Power7+ 8 core CPUs (3.6 GHz), 256 GB RAM, operational system is Red Hat Enterprise linux
- OLD HPC: 10 nodes of IBM p755, each node contains 4 processors POWER7 8 core CPU 3.55 GHz and 256 GB RAM, connected via 2x InfiniBand switch IBM 7874-024, and 2 management servers IBM POWER 750 with processor POWER7 6 core, 64 GB RAM, operational system is AIX 6 SE OS

Each cluster has its own disk array

- For IBM p755 disk storage IBM System Storage DS5100 with
 - o 32x 300GB 15k rpm FC Disk
 - o 32x 2TB 7.2k rpm SATA Disk
- For IBM p460
 - o 5TB fibre channel discs
 - o 177 TB sas disks

Archiving is ensured by tape library based on IBM System Storage - Tivoli S3310 (120 date tapes LTO5 1.5TB). Two UPS 60kVA are installed.

ACTIVITIES:

Technical and operational activities:

- Ongoing porting of operational and user applications to new hpc.
- Neverending upgrade/new products for customers.
- On the fly tuning of HW/SW operational/user environment on new HPC.

Research and development activities:

- SURFEX (Viktor Tarjani): New offline SURFEX suite was written (python scripts) and it was tested in SHMU operational environment (run_app). Technically it works fine, the only limitation for now is that SURFEX executable can be run only on single processor. This executable is part of operational pack (both cy40t1 and 43t1 were tested). We assume this to be solved after planned upgrade to newest official SURFEX version 8.1. Up to now no surface assimilation is done. SURFEX prod suite is executed simultaneously with operational ALARO and with same frequency (each 6 hours) and prepares 72h long surfcast (SURFEX forecast). Horizontal domain is identical with operational model. Forcing is taken from lowest model level. Assimilation cycling will be treated later. It is planned to replace precipitation forcing by INCA. In assimilation cycle CANARI gridded observations of screen level temperature and humidity can be used for SURFEX forcing. Validation of snow schemes (D95, 3-L, CRO) has started.
- Validation of EKF surface assimilation scheme (Viktor Tarjani): Sensitivity analysis of 2-L and 3-L ISBA force restore scheme for soil volumetric water content has been started using the offline SURFEX and 1-column setup. A new method was proposed which allows for efficient computation of EKF Jacobian matrices H and M in 1-column runs. It may be especially useful for higher dimensional control space like in diffusion scheme. It was used to investigate the nonlinear behaviour of coupled ISBA-CANOPY (ISBA-DIAG) scheme acting effectively as observation operator in EKF analysis of soil moisture. Nonlinear behaviour was expected in the

vicinity of extreme soil states as saturation, field capacity and wilting point, when linear approximation of extended Kalman filter may be violated resulting in wrong analysis increments. Such analysis can help determine the domain of validity of linear approximation and also the size of perturbation used in calculation of Jacobian matrices H or M.

- Coupling ALARO with SURFEX (Martin Dian): continuation of the RCA LACE stay in Prague - checking the usage of roughness and screen level interpolation on SURFEX side, in order to enable scientifically consistent transition from ISBA to SURFEX. Code checks on ISBA side were performed as well, revealing several bugs and inconsistencies to be corrected.
- NH dynamics (Jozef Vivoda): Latest development of NH dynamics/VFE scheme was cleaned and phased to CY45T1. For the dynamic definition of the iterative time scheme, simplified approach was applied to define a complete set of semi-Lagrangian advection schemes that are second order in time accurate and that use the information from the three consecutive time levels and the spatial location of departure and arrival point and that includes the currently implemented SETTLS scheme. A combined scheme was proposed writing the so called NESC scheme as a departure from SETTLS scheme and enabling different combinations of these two schemes depending on a chosen parameter. This was implemented in the code on the base of CY43 and tested in a simplified context.
- LAEF (Martin Bellus): The problem of land-surface and sea-surface temperature fields in the initial conditions was successfully solved with the help of the GL experts from HIRLAM community. The boundary conditions for 2-weeks period were recreated using corrected tools and downscaling of ECMWF-EPS was rerun for a clean reference to our LAEF experiments. Finally, new ALADIN-LAEF phase I configuration was put together, tested and verified against the mentioned reference. The added value of new ALADIN-LAEF over the downscaled ECMWF-EPS is obvious for the surface parameters, while it is rather neutral in the upper-air. The operational implementation of the ALADIN-LAEF phase I is going to be postponed to the next year.
- Preprocessing of EPS data (Ivan Prcuch): preparation for visualization and further processing.
- Tests of LBC from Arpege SURFEX (Maria Derkova): Final tests before operational implementation.
- Bmatrix for AROME/SHMU (Maria Derkova): ensemble B-matrix for AROME/SHMU domain was computed and single obs experiments performed to validate it.
- Surface assimilation of Non-GTS data (Michal Nestiak): Test with CANARI + MESCO using non-GTS stations. Among others home-built urban stations based on Raspberry Pi were tested.
- Assimilation of ZTD GNSS data (Martin Imrisek): further tests with ZTD GNSS data assimilation over AROME/SHMU, extended with HR and GEO WIND data utilization. Technical preparation of slant total delays for GNSS tomography and assimilation in AROME.
- High resolution experiments (Martin Dian): Two possible configurations of the convection-permitting non-hydrostatic model are being tested: the ALARO and the AROME CMCs applied over identical domains with 2 km horizontal grid and 73 vertical levels. The model domains are covering Slovakia and close neighborhood, having size of 768 km x 1024 km (see Table 2). Both systems are tested in the downscaling mode only, i.e. no data assimilation procedures have been applied. The convection-permitting models are coupled to the

ALADIN/SHMU system (4.5 km/L63) with hourly coupling frequency. Longer periods of runs are performed as well as individual case studies for testing.

Table 2: The experimental setup of two possible convection-permitting systems currently tested at SHMU.

	AROME CMC	ALARO CMC
HPC	IBM Flex System p460 (HPC2)	IBM p755 (HPC1)
model/code version	CY40T1_bf07	
physics	AROME-France CMC	ALARO-1vB CMC
horizontal resolution, no. of grid points	2.0 km, 512x384pts	
number of vertical levels	73	
time-step	144s	100s
coupling model	ALARO-1vB (4.5km), 1h coupling frequency	
assimilation, initialization	downscaling, no initialization	
forecast ranges (model output frequency)	+78h at 00 UTC/+72h at 12 UTC (a' 1h)	

2018 PLANS

1. Procurement of new HPC
2. Porting to new HPC (if available)
3. Development of 3h RUC with 3DVAR - AROME
4. Offline SURFEX operational
5. Development of SURFEX data assimilation
6. Case studies of extreme weather events