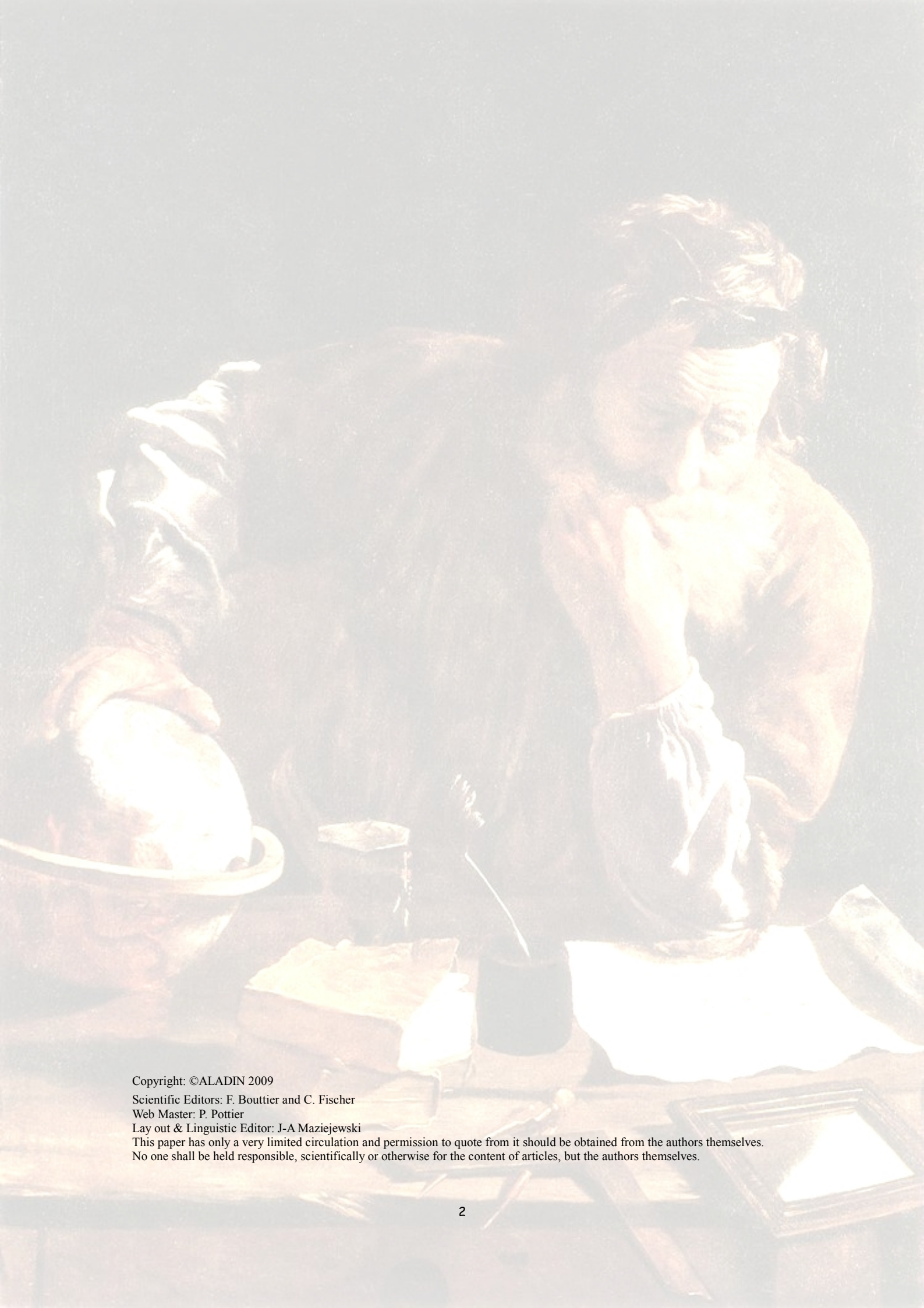


A low-angle photograph of a field of red poppies. The flowers are in various stages of bloom, with some fully open and others as buds. The stems are thin and green. The background is a bright, slightly hazy sky with a prominent sun flare in the center, creating a warm, golden light across the scene.

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1. EDITORIAL

1.1. Foreword

A newsletter is an informal publication, often simple in format and crisp in style, that provides special information, advice, opinions, and forecasts for a defined audience. Newsletters are ordinarily but not always issued regularly. Common topics covered in newsletters include business and the professions, energy, health, safety, and travel. Forerunners of modern newsletters were the “[corantos](#)”—single-page collections of news items from foreign journals. They were circulated by the Dutch early in the 17th century, and English and French translations were published in Amsterdam.

A **newsletter** is a regularly distributed [publication](#) generally about one main topic that is of [interest](#) to its [subscribers](#). [Newspapers](#) and [leaflets](#) are types of newsletters.^[1] Additionally, newsletters delivered electronically via email (e-Newsletters) have gained rapid acceptance for the same reasons email in general is gaining popularity over printed correspondence.

Many newsletters are published by [clubs](#), [churches](#), societies, associations, and businesses, especially [companies](#), to provide information of interest to their members, customers or employees. Some newsletters are created as money-making ventures and sold directly to subscribers. Sending newsletters to customers and prospects is a common marketing strategy, which can have benefits and drawbacks.

General attributes of newsletters include news and upcoming events of the related organization, as well as contact information for general inquiries.

The newsletter had been accepted as a conventional form of correspondence between officials or friends in Roman times, and in the late Middle Ages newsletters between the important trading families began to cross frontiers regularly. One family, the [Fuggers](#), were owners of an important financial house in the German city of Augsburg; their regular newsletters were well-known even to outsiders. Traders’ newsletters contained commercial information on the availability and prices of various goods and services, but they also could include political news.

In Europe, the impetus for regular publication of news was lacking for several centuries after the breakup of the Roman Empire. The increased output of books and [pamphlets](#) made possible by the invention and further development of [typographic printing](#) (see [the invention of typography](#)) in the 15th and 16th centuries did not include any newspapers, properly defined. The nearest form was the news sheet, which was not printed but handwritten by official scribes and read aloud by town criers. News was also contained in the news book, or news pamphlet, which flourished in the 16th century as a means of disseminating information on particular topics.

jam

1.2. EVENTS

Congratulations to Edit HÁGEL who, on the 29th January 2010, successfully defended her PhD thesis "Development and operational application of a short-range ensemble prediction system based on the ALADIN limited area model" at Eötvös Loránd University, Budapest, Hungary.

1.3. ANNOUNCEMENTS

◆ Joint HIRLAM All Staff Meeting (ASM)/20th ALADIN Workshop 2010, will take place on 13-16 April in Krakow, Poland.

In addition, a meeting of the HIRLAM Management Group and the ALADIN CSSI will take place to discuss common plans and activities, on Monday 12 April and on Friday afternoon 16 April to wrap up any remaining matters.

See the dedicated page on ALADIN website (<http://www.cnrm.meteo.fr/aladin/spip.php?article162>)

◆ The 6th Policy Advisory Committee Meeting will take place in Bucarest in June 3-4, 2010.

2. OPERATIONS

2.1. CYCLES

Cycles installed at Météo-France:

CY36: Start of phasing on May 5th 2009 (common with ECMWF/IFS)

- MF and partners contributions on top of CY35T2:
 - AROME: MASDEV4.8 (mostly new EDKF scheme for shallow convection) – S. Malardel and Y. Seity –
 - HIRLAM: shallow convection code from KNMI (W. De Rooy) via Sylvie+Yann's contribution (routines moved to “arp/phys_dmn” and renamed)
 - cleanings in the SL code, especially some reorganization of the SL/AD code (K. Yessad)
 - updated code in the dynamics for rotated/tilted Mercator, including both direct, TL and AD versions (P. Bénard, J.-D. Gril, G. Kerdraon, F. Vaña)
 - some small rearrangement of the code for spectral orography filtering under key LSPSMORO in e923 (M. Dahlbom, F. Taillefer)
 - minor bugfixes: SPECTRAL_FIELDS, SUEJBBAL (O. Vignes)
 - introduction in MF’s “bator” of the facility to read the BUFR format version from an external file (rather than an “IF” statement in the code). This facility will be first tested for IASI data in ECMWF’s BUFR version by Hirlam (D. Puech, F. Guillaume, R. Randriamampianina)
 - assess surface emissivity over sea and land ice (F. Karbou)

CY36 has been declared in July 2009.

CY36T1: prepared over November/December; initial declaration on December 21st (but still with bugs present in the assimilation – only forecast models were completely validated with CY36T1_main)

- Assimilation:
 - Microwave radiances:
 - add the term emissivity*Tsurf ($\epsilon.T_s$) to the control vector as a new sink variable for VarBC (E. Gérard & F. Karbou),
 - infrared radiances:
 - *postponed to CY36T2*
 - preparation for the pre-treatment of ADM/Aeolus data at MF, mostly in the “bator” pre-processing tool (C. Payan, C. Desportes)
 - bugfix for the correct check of observation positions for big LAM domains in rotated geometry (OBATABS) (J.-D. Gril)
- Model dynamics:
 - Miscellaneous cleanings following the agreements between MF+partners and ECMWF, based on Karim’s document
- Arpège/Aladin-France physics:
 - Finalize the code for using the external surface scheme SURFEX
 - Plug-in for using EDKF; tunings for vertical turbulence (TKE-CBR) and shallow

- convection KFB
 - Add tendencies from the dynamics to the DDH diagnostic package (F. Voitus)
 - Modified version of gravity wave drag for TL/AD models (O. Rivière)
- Arome:
 - Protection against negative values in the turbulence scheme
 - New diagnostic fields for wind gust (max value over the last 10 mns)
 - Introduction of SURFEX Version 5
 - Proper patch to take into account gridpoint Ql and Qi when converting T back to Tv in the minimization (case LSPRT=.T.); various other corrections for Arome/FGAT
- Alaro physics: (first three items by F. Vana; others by R. Brozkova)
 - turbulence (mixing length, solver);
 - some optimisation of ESPCHOR, ESPCHORAD (consulted with Ryad);
 - split of SL buffers to allow for computation of dynamical tendencies in DDH and for 3D turbulence (agreed with Fabrice and Karim).
 - historic entrainment; (Doina)
 - aerosols (in ACRANEB); (Tomas Kral)
 - Rash-Kristjansson condensation scheme under 3MT (Lisa Bengtsson, Doina)
 - cleaning and completing the 3MT cascade (Doina, Radmila)
 - cloudiness diagnostics (ACNPART routine only; Christoph Wittmann)
- Hirlam/Harmonie:
 - Minor code adaptations (Ole Vignes)
- Miscellaneous and system:
 - Improvements in configuration 901 (CPREP1) for surface field conversion TESSEL => ISBA/SURFEX (J. Ferreira, F. Bouyssel, P. Saez)
 - Code reorganization under POS (K. Yessad)
 - Plug-in the missing model code for running the 1D vertical model version in Arpège/Aladin, “Single Column Unified Model” (E. Bazile, O. Rivière): only the code for running unforced 1D columns will become available in the common official releases (i.e. forcing versions require extra code changes)
 - Debugging for Fullpos and the RTTOV9 interface
 - Optimisation in LAM 3Dvar code

CY36T2: the proposed deadline for contributions is by end of March – or a bit later - 2010. Due to the shutdown of the SX9 clusters over parts of February and March, followed by the Eastern holidays in France, this cycle should be prepared end of April and in May. Provisional content:

- Assimilation:
 - Cleaning of Neural Network routines for AIRS (V. Guidard)
 - Adaptation of code to use the ECMWF bias correction for radiosonde and SYNOP at Météo-France (P. Moll)
 - Microwave radiances:
 - Addition of emissivity parameterization using a Lambertian approximation for refractivity (F. Karbou) and compare with the specular hypothesis,
 - Infrared radiances:

- Computation of cloud top pressures for cloudy IASI radiances (performed once during screening with a different formulation than in the IFS, V. Guidard and N. Fourrié). Same development already is operational for AIRS.
- Introduction of an alternative cloud detection method for AIRS and IASI (MMR code from Thomas Auligné), unless similar work planned at ECMWF (V. Guidard or N. Fourrié) – to be confirmed
 - Snow analysis updated code in CANARI (F. Taillefer, M. Homleid, L. Taseva)
- Arpège/Aladin physics:
 - Adaptations for using 3MT (modular multi-scale microphysics/turbulence) – J.-M. Piriou
- Arpège simplified physics schemes (O. Rivière):
 - Modified gravity wave drag scheme (by ignoring the perturbations of some terms)
 - New large scale precipitation scheme: adjustment Smith scheme ($Q_v \Rightarrow Q_v^*$, Q_l^* , Q_i^* , cloud fraction) followed by auto-conversion and precipitation of all condensed excess (Q_r^*)
 - Convection scheme based on a simplified Betts-Miller scheme

Further code contributions until CY37 may concern (to be confirmed):

- A thorough overhaul of the SURFEX to atmospheric models interface, in order to improve its robustness and prepare for further optimizations (make it Open-MP proof)
- An overhaul of the physics/dynamics interface (CPTEND, CPUTQY) in collaboration with the Aladin/ALARO partners
- Extension of the MSG/SEVIRI raw radiance assimilation in the LAMs (Aladin and Arome) to cloudy radiances (S. Guedj)
- Cleaning of the MF_PHYS interface (reduce substantially the number of dummy arguments) – Y. Bouteloup

CY37: so far, the proposal is for June or July 2010. The final dates for this common cycle shall be re-discussed with ECMWF early 2010.

2.2. FRANCE

Progress in 2009 and first semester of 2010:

- ◆ Complete Acceptance Test ("VSR" in French acronym) of NEC Phase 2 upgrade: completed on week 25 (June 2009).
- ◆ The operational suite has been moved to the new system on September 22nd, 2009. It has been followed by a shut down of the old SX8 clusters, in order to re-assemble them into one single cluster. This operation has been performed between 29/09/09 and 19/10/09. A specific Acceptance Test period followed this work, after which MF's upgraded computing facilities would consist of: a R&D dedicated SX8R cluster ("TORI") with 32 nodes, a R&D SX9 cluster ("YUKI") with 7 nodes (that will receive 3 more nodes on the first quarter of 2010), an Operations-devoted SX9 cluster ("KUMO") with 6 nodes (that will receive 4 more nodes on the first quarter of 2010)
- ◆ PEARP Version 2: increase of PEARP members from 11 to 35 + second production network (6 UTC in addition to 18 UTC) + coupling with the ensemble assimilation + some physics perturbations + L65. Forecast set-up upgraded to the latest standard of the deterministic ARPEGE physical parameterization except those schemes contributing to the "modelling error" representation approach. This version has been installed in operations on December 8th 2009.
- ◆ ARPEGE and ALADIN-France E-suite (autumn/winter 2009/2010):
 - CY35T2
 - new change of resolution of ARPEGE: T798C2.4L70
 - new resolution for the 4D-VAR analysis increment: T107C1.0L70 (25 iterations) and T323C1.0L70 (30 iterations) with $\delta t=1350$ s; the benefit of moving to 3 outer loops and minimizations has eventually not been clearly seen, thus the multi-incremental 4D-VAR will stay with 2 outer loops
 - changes in the assimilation ensemble: L70
 - Double the density of about all radiance types (change the scale of data use from one spot every 250 km to one every 125 km)
 - assimilation of NOAA-19 channels; reactivate VarBC for channel 13 of AMSU-A
 - extend the number of assimilated IASI channels (surface channels and WV channels),
 - introduce a bias correction for MSLP and T observations (based on ECMWF practice)
 - retuned error standard deviations: REDNMC from 2.0 to 1.6; σ_0 multiplied by 0.9 globally
 - Physics: new moist simplified physics version for TL/AD (based on Smith) including some microphysics;
 - ALADIN-France: L70, slight increase of resolution to about 7.5 km
- ◆ AROME-France E-suite (over the same period):
 - AROME will inherit some of the ARPEGE/ALADIN changes (doubled radiance density, NOAA-19), and gain new features (AIRS, IASI, SSMI assimilation, activate VarBC for SEVIRI)
 - Assimilation of radar reflectivity
 - Increased vertical resolution (60 levels)
 - Activation of an upper level sponge towards the coupling model (in the forecast), based on the spectral coupling formulation

- Assess the direct lateral boundary coupling between ARPEGE and AROME
- test new choice for B-level parallelization (made possible after correcting an old, sleeping bug in the B-level decomposition of LAM Semi-Lagrangian advection scheme)
- new version of shallow convection (to increase the persistence of Sc clouds)
- new version of CANOPY, including a fix to allow proper initialization of CANOPY fields at timestep 0
- one fix to prevent negative values on some water species contents
- ◆ Introduce the ARPEGE ensemble-based flow-dependent σ_b information in regional assimilations such as ALADIN-France, ALADIN-Réunion and possibly AROME, and prepare the installation of the ensemble assimilation for the ALADIN-Réunion system (*to be confirmed*)

The above described E-suites are being progressively installed on the SX9 over December and January. They most likely will be switched to operations after the upgrade period of the two SX9 clusters (see below).

One important change will occur in the Computer Centre over February/March 2010, with the successive upgrades of the two NEC/SX9 clusters (add more CPU on each of them). This upgrade will require to shut down successively each cluster for about two weeks, and new Acceptance Tests will be done. This work should take place over February/March with the major slowdown for R&D activities taking place in the 10/02/10-14/03/10 period.

In 2010, significant efforts will also be dedicated to the following subjects. Those may influence the ALADIN activities:

1. works to upgrade the organization and maintenance of the operational suite, with a view to improve productivity to switch a suite from OLIVE to operations
2. revise, possibly in-depth, the schedule of the operational suite, with the primary objective of simplifying the 00 UTC production
3. decide of a future for ALADIN-France: it may well be that ALADIN-Réunion becomes the reference ALADIN, supplemented by 2 or 3 overseas ALADIN. However, the firm decision to stop, and when, ALADIN-France remains presently an open issue since a number of downstream applications depend on its data.

Plans for 2nd semester of 2010:

Possible contents of the 2010/2 E-suites:

- ◆ Assimilation (global 4D-VAR as reference):
 - monitoring of SSMI/S
- ◆ Arpège/Aladin-France upper-air physics
 - New convection scheme (possibly based on 3MT)
 - Other potential candidates: replace KFB by the EDKF scheme for shallow convection, test IFS' solar radiation scheme
- ◆ Implementation of SURFEX in some of MF's Aladin model applications (France, Overseas, ...)
- ◆ Arome-France:
 - ICE4 microphysics (including hail)

- Extension of the size of the horizontal domain
- Other potential candidates: move to the new physics/dynamics interface CPTEND_NEW, orographic drag formulation based on the proposal by A. Beljaars (Surfex) , test IFS' solar radiation scheme
- ◆ PEARP: increase horizontal resolution

2.3. HUNGARY

(kullmann.l@met.hu)

There were 4 important changes in the operational version of the ALADIN/HU model during the year 2009:

- ❑ We changed to cycle cy33t1
- ❑ New observations (SEVIRI, SYNOP RH and T) are used in 3dVAR.
- ❑ We use variational bias correction of satellite data (VARBC) in 3dVar.
- ❑ Observation preprocessing is done operationally by the OPLACE system

The main characteristics of the recent deterministic operational suite:

- ❑ ALADIN cycle: cy33t1
- ❑ Horizontal resolution: 8 km
- ❑ Vertical levels: 49
- ❑ Grid: linear
- ❑ Lateral boundary conditions: ECMWF
- ❑ Data assimilation: 3d-var with 6h cycling, Canari (OI) at the surface
- ❑ Observations: SYNOP (geopotential, humidity, temperature), TEMP (temperature, wind components, humidity, geopotential), AMDAR (temperature, wind components), ATOVS:AMSU-A and AMSU-B radiances, MSG/GEOWIND (AMV), SYNOP SHIP, WINDPROFILER, SEVIRI.
- ❑ Observations for OI: SYNOP (T2m, RH2m)
- ❑ Production is performed 4 times per day: 0 UTC (+54h), 6 UTC (+48h), 12 UTC (+48h), 18 UTC (+36h).

The main characteristics of ALADIN EPS model version are as follows:

- ❑ Downscaling of the first 11 members of PEARP
- ❑ Horizontal resolution: 12 km
- ❑ Domain covering continental Europe (LACE domain)
- ❑ Vertical resolution: 46 levels
- ❑ Integration once per day to 60h starting from the 18 UTC data
- ❑ Boundary conditions updated every six hours by the ARPEGE EPS (PEARP) system.

Parallel suites during the period:

- ❑ cy33t1 with SEVIRI and SYNOP (T2m, RH2m) observations.
- ❑ Test the impact of VARBC vs. the static satellite bias correction method
- ❑ Dynamical adaptation as a reference to 3d-var system at same vertical and horizontal resolution (using also ECMWF LBC data).
- ❑ AROME (cy33t1) dynamical adaptation. The horizontal resolution is 2.5km with 300x192 gridpoints. 60 vertical levels are used. LBCs are taken from the operational ALADIN model with 1h frequency. Production is performed 4 times per day: 0 UTC (+36h), 6 UTC (+6h), 12 UTC (+18h), 18 UTC (+6h).

2.4. PORTUGAL first half of 2009

(nuno.lopes@meteo.pt)

In the first half of 2009 the operational development was focused on three premises: products available from the model (1), starting CANARI operationally (2) and verification (3).

1. Products available from the model

The area of forecasting interest for us is quite large because of Azores and Madeira islands; hence, making plots available for each area is essential. On the other hand, additional variables have been made either available or completely reshaped, as for example cloud cover and gusts at 10m. Figures 1 to 7 are examples of the work developed.

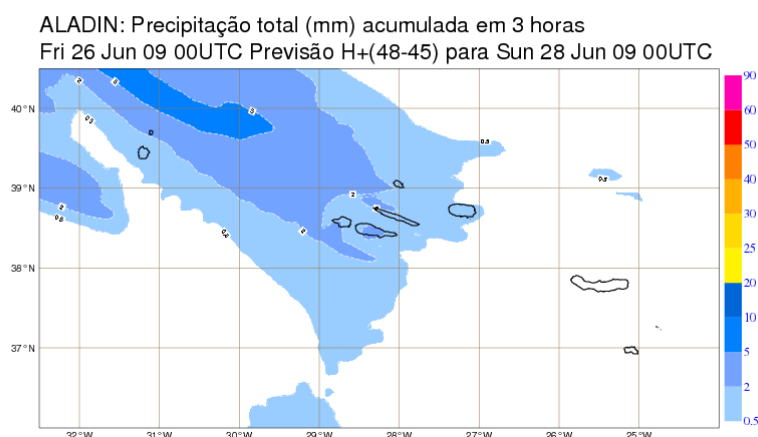


Fig. 1 – Three hour total precipitation in Azores.

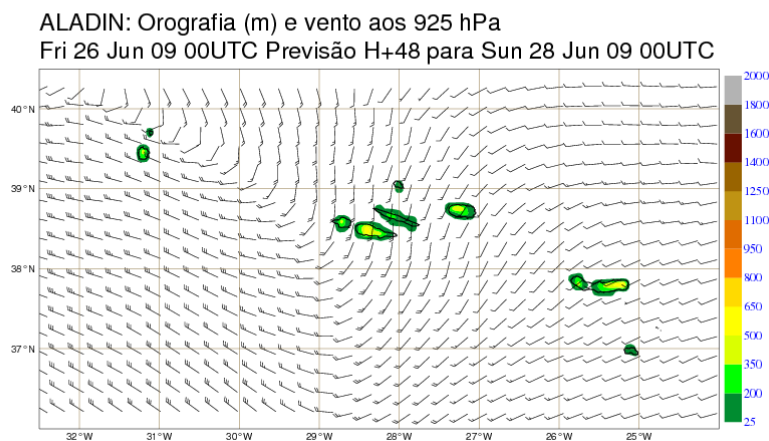


Fig. 2 – Orography and wind speed at 925 hPa level in Azores.

ALADIN: Nuvens Baixas B+M Medias M+A Altas A+B A+M+B
 26-06-09 00 UTC Previsao H+48 para 28-06-09 00 UTC

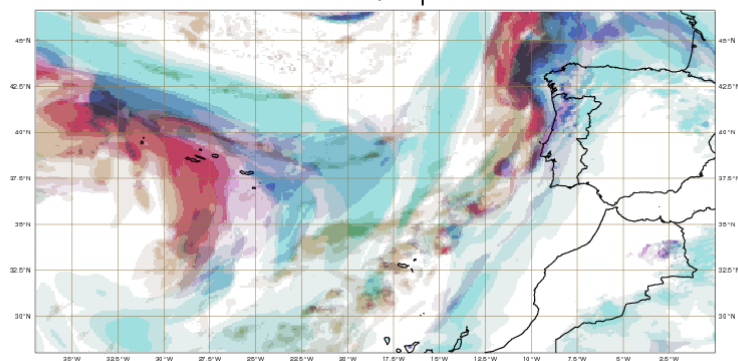


Fig. 3 – Total cloud cover (by type) in the whole domain.

ALADIN: Nuvens Baixas
 17-06-09 00 UTC Previsao H+09 para 17-06-09 09 UTC

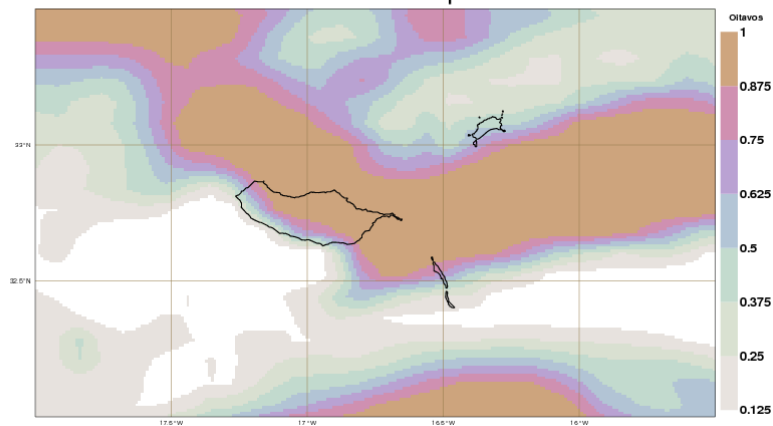


Fig 4 – Low cloud cover in Madeira.

ALADIN: Pressão ao n.m.m (hPa) e vento (kt) a 10 m
 Wed 17 Jun 09 00UTC Previsão H+00 para Wed 17 Jun 09 00UTC

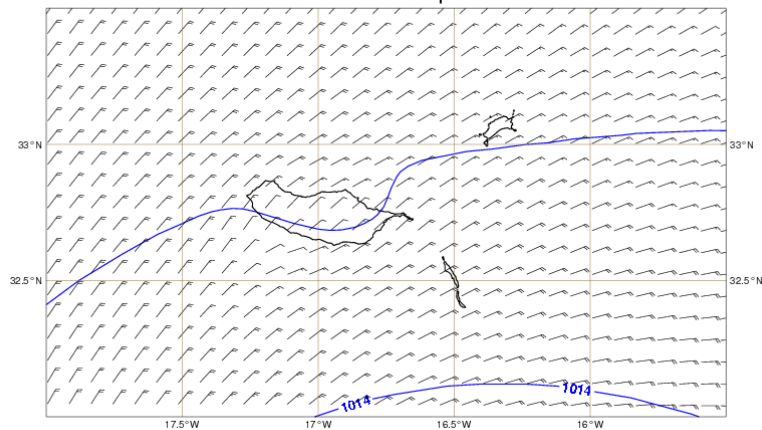


Fig. 5 – 10m wind speed and mean sea level pressure in Madeira.

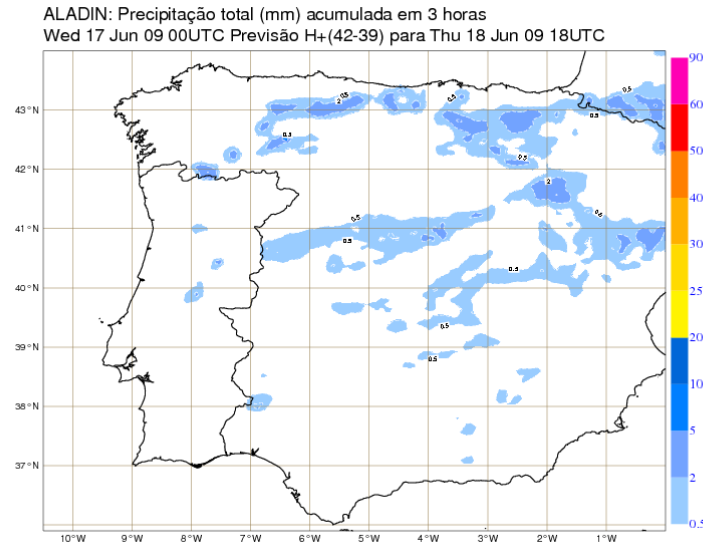


Fig. 6 – Total precipitation in Iberia (this case was mostly convective).

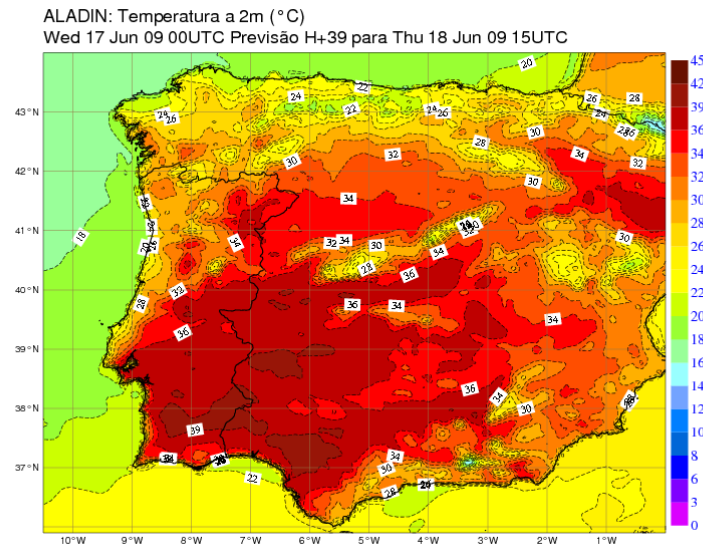


Fig. 7 – 2m temperature in a very warm Iberia (same day as in fig. 6)

2. CANARI in operation

It started running operationally in early January, based on cy32t1. Figures 8 and 9 are examples of the two variables under interest: 2m temperature and relative humidity. On the left panel is the ALADIN forecast, in the middle is the CANARI analysis at same the time and in the right one are some of the available observations.

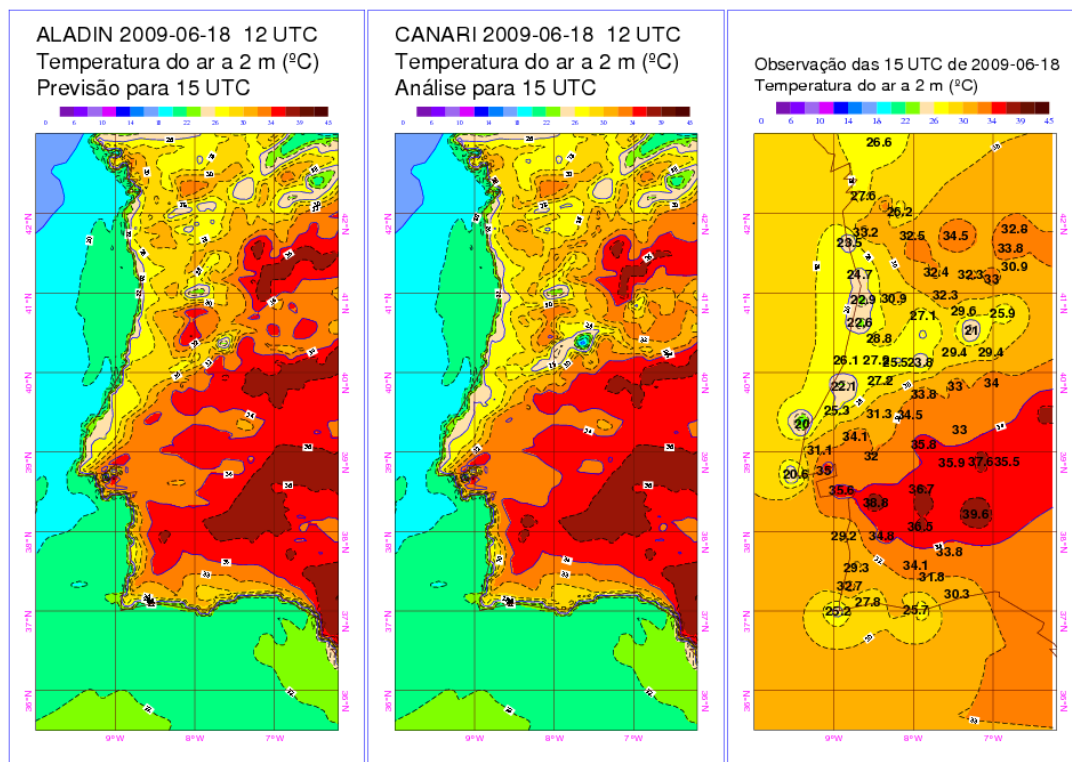


Fig. 8 – 2m temperature: ALADIN, left; Canari, middle; observations, right.

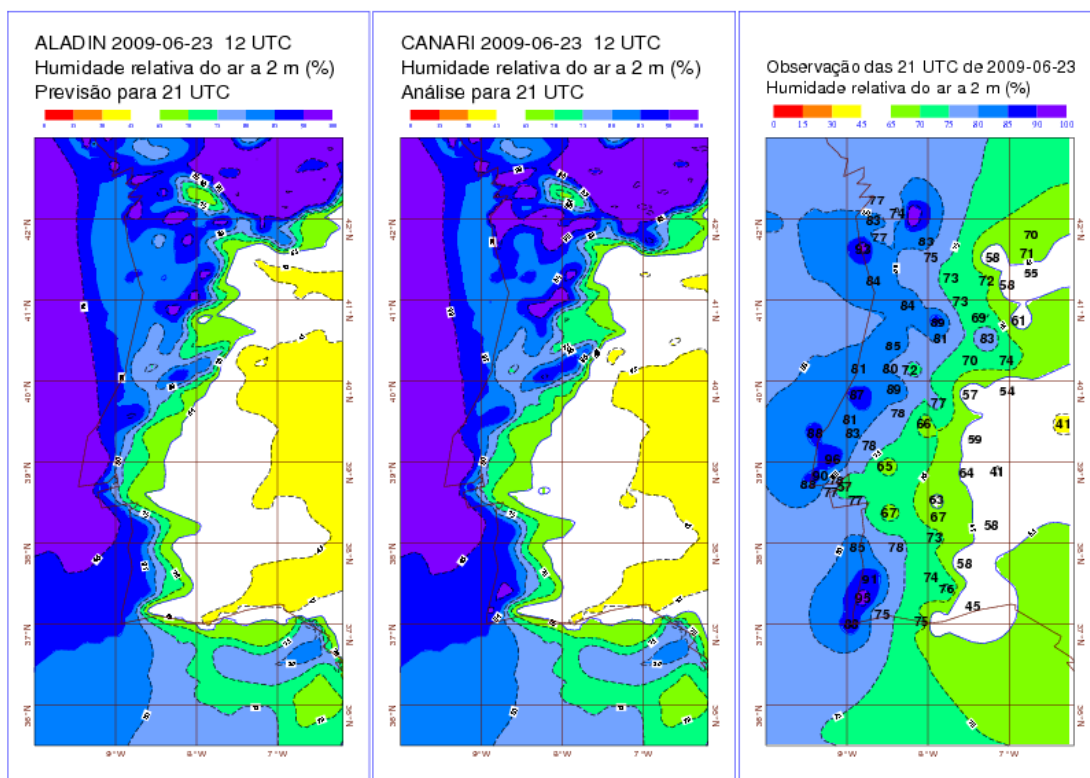


Fig. 9 – 2m relative humidity: ALADIN, left; Canari, middle; observations, right.

3. Verification

A verification package, optimized facing the database structure and hardware used, has been under development. At the present stage of development is it producing plots on both daily and monthly basis. The basic score is the root mean squared error for a group of selected sites and lead times. On a seasonal basis, a report is being done to assess the skill of ALADIN and ECMWF forecasts for the three Portuguese geographical areas: mainland, Azores and Madeira.

Figures 10 and 11 present the monthly values of RMSE for the 2m temperature, at four lead times (H+6, H+15, H+30 and H+39), respectively, for ALADIN and ECMWF. The score is computed for 48 weather stations in the mainland and all forecasts started in a given month are used to compute the respective monthly score. Please note that the results have been computed only for the 00 UTC and that the cycle cy32t1 came into operations in December 2008.

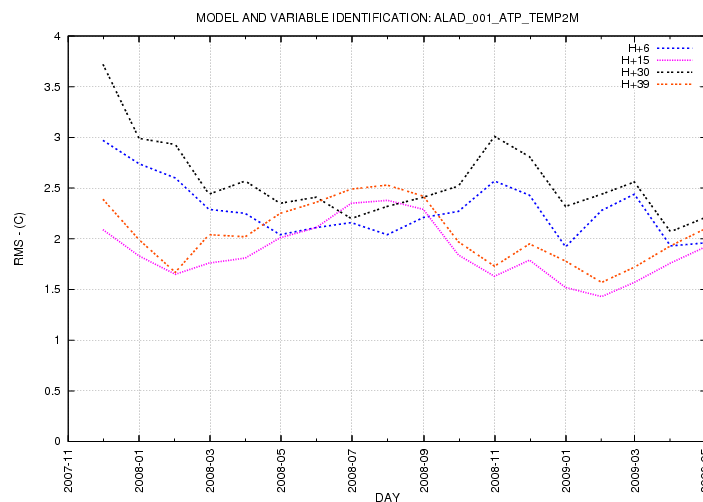


Fig. 10 – Historical monthly RMSE of 2m temperature for ALADIN.

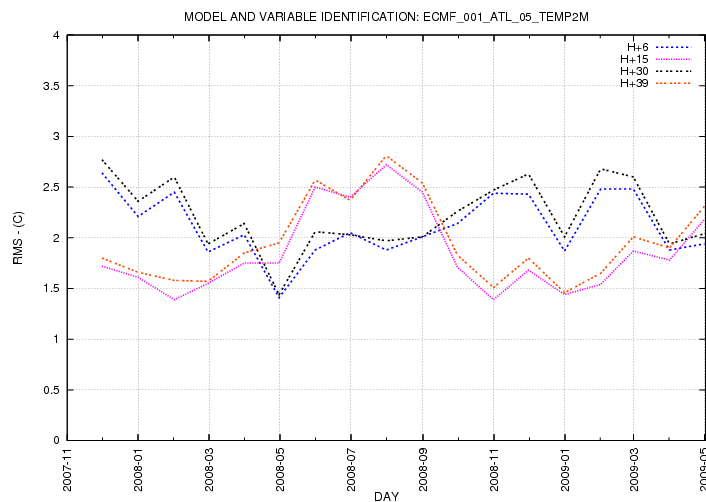


Fig. 11 – Historical monthly RMSE of 2m temperature for ECMWF.

The RMSE becoming larger during the afternoon in the summer months and in the evening in the winter ones is a clear sign of lower variability of the forecasts produced by ECMWF, caused by the lower resolution. This feature is not so visible in ALADIN. In the case of ALADIN, the monthly RMSE from December 2008 seems to be smaller when compared to the previous year, as a sign of the benefits of the new cycle, which came into operations on December, 9, 2009, in the 12 UTC run.

As an example of the verification made in the islands, figures 12 to 14 show the bias,

Equitable Threat Score (ETS) and the Heidke Skill Score (HSS) of ALADIN and ECMWF forecasts of 24 hour total precipitation (H+6 to H+30), in 10 stations in Azores, for the winter 2008/9.

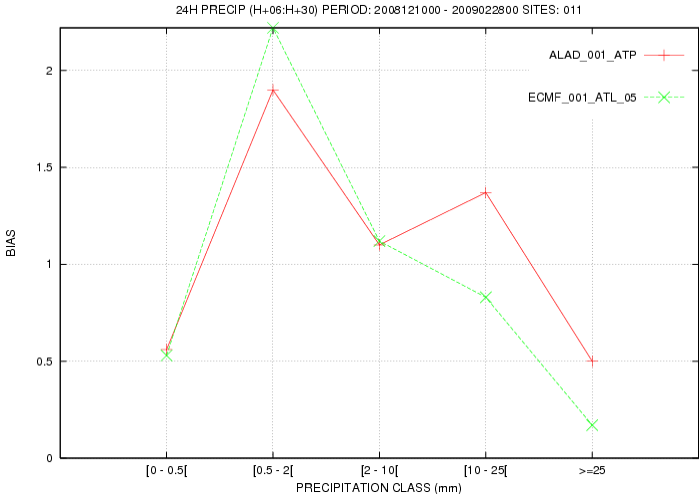


Fig. 12 – Bias of 24h precipitation, for the winter 2008/9 period.

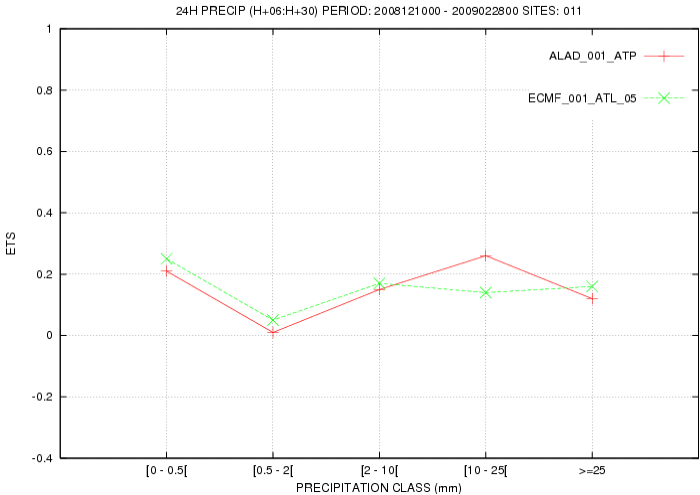


Fig. 13 – ETS of 24h precipitation, for the winter 2008/9 period.

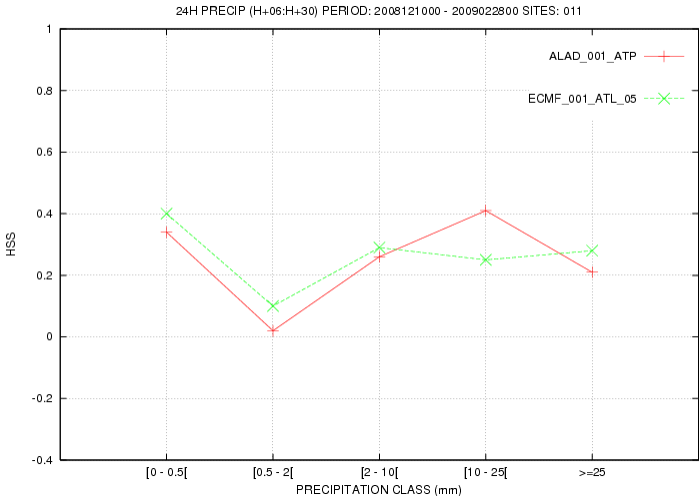


Fig. 14 – HSS of 24h precipitation, for the winter 2008/9 period.

In the period shown both models clearly over-estimated small amounts of precipitation, but had some difficulty in forecasting more than 25 mm (ALADIN behaves better than ECMWF in the categories above 10 mm). The comparison of ETS with HSS show that both models have very similar results, which reflect that traditional methods are not able to capture the true benefits of the higher resolution of mesoscale models.

Figure 15 presents the scatter-plot of the 10m wind speed in Lajes, Azores, in the winter 2008/9 period, which shows a classic feature: clear over-estimation of the wind speed at low values, but underestimates at higher speeds. The bias of the wind speed in Madeira and Azores is about 1 m/s higher when compared to the mainland (not shown).

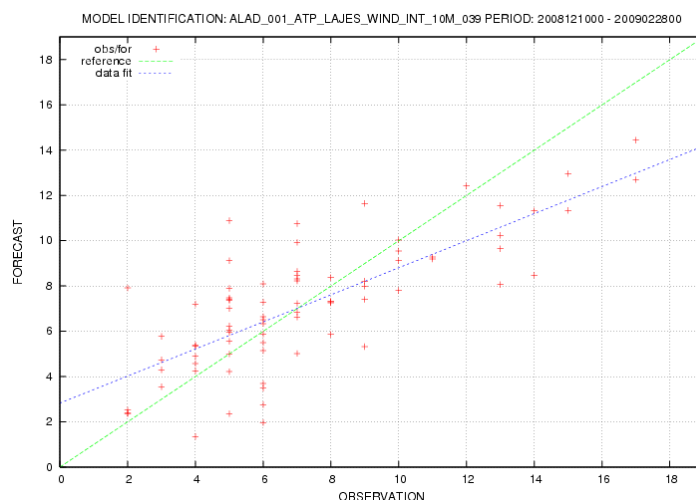


Fig. 15 – Scatter-plot of 10m wind speed for winter 2008/9, in Lajes, Azores.

Figure 16 show the observations and forecasting time series (one model, several runs) for the 10m wind speed at Flores, Azores. These plots are produced hourly at selected stations for ALADIN and are very useful to assess how the model is performing and the forecasts' consistency.

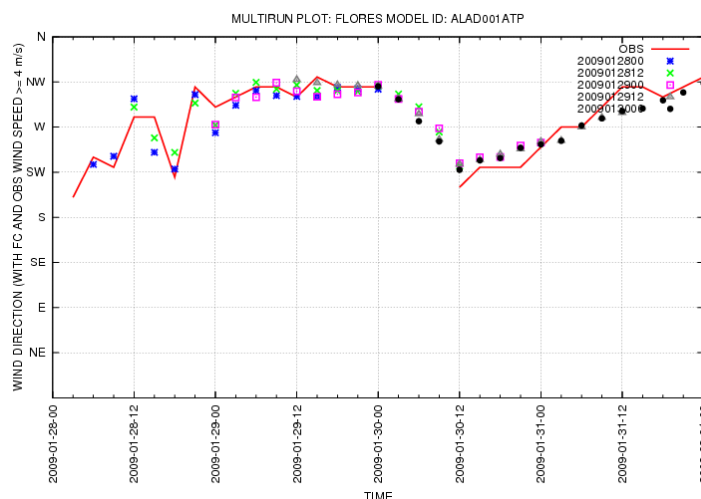


Fig. 16 – Time-series of observations and forecasts from 5 ALADIN forecasts, for 10m wind direction in Flores, Azores.

Figure 17 is similar to 16, but for 3h total precipitation at Calheta, Madeira, when the area was under the influence of a low. In this particular event, even though the several runs forecasted precipitation, none was able to forecast such a high value as 60 mm in 3 hours. ECMWF did not provide any guidance as well (not shown).

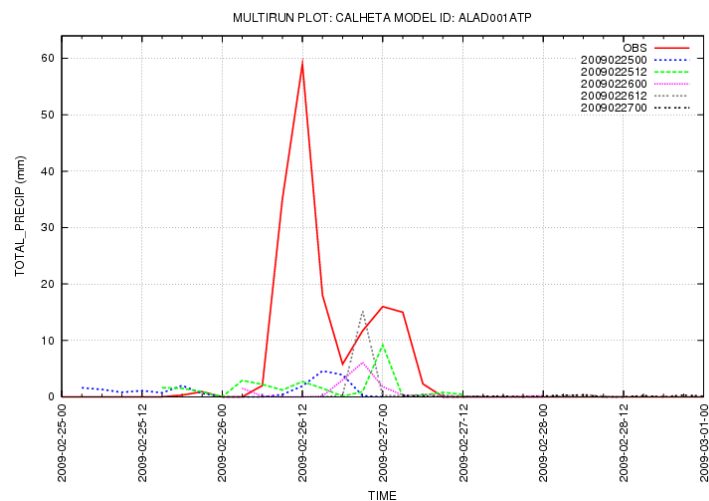


Fig. 17 – Time-series of observations and forecasts from 5 ALADIN forecasts, for 3h total precipitation in Calheta, Madeira.

2.5. PORTUGAL second half of 2009

(manuel.lopes@meteo.pt)

The main events in the second half of 2009 were:

1. ALADIN cy35t1 became operational on the 12 UTC run of 27 October.
2. ALARO tests from cy35t1 started on two domains: the operational one (9 km resolution) and Madeira islands (5 km resolution);
3. AROME tests from cy35t1 started on two domains, Portugal mainland and Madeira islands (both with 2.5 km resolution).

1. ALADIN

Although the cycle of the operational model has changed to cy35t1, the characteristics of the current domain and the configuration used on IBM p5-575 machine to run the model remained identical to the ones of the previous implemented version (cy32t3), which were mentioned on the Newsletter no. 35.

A validation based on the direct model output was made by comparing the results of ALADIN cy35t1 against the results of ALADIN cy32t3. For this validation 48 weather stations in the Portugal mainland were used in the period January-September of 2009. In the following plots, the blue line refers to ALADIN cy32t3 (ALAD_001_ATP) and the green line to ALADIN cy35t1 (ALAD_002_ATP).

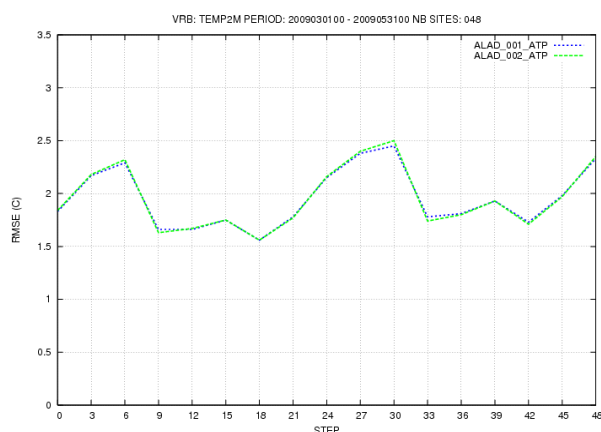


Figure 1 - RMSE of 2m temperature for the Spring period of 2009.

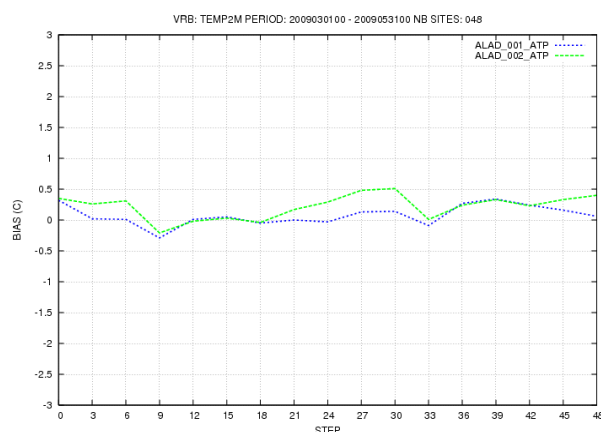


Figure 2 - Bias of 2m temperature for the Spring period of 2009

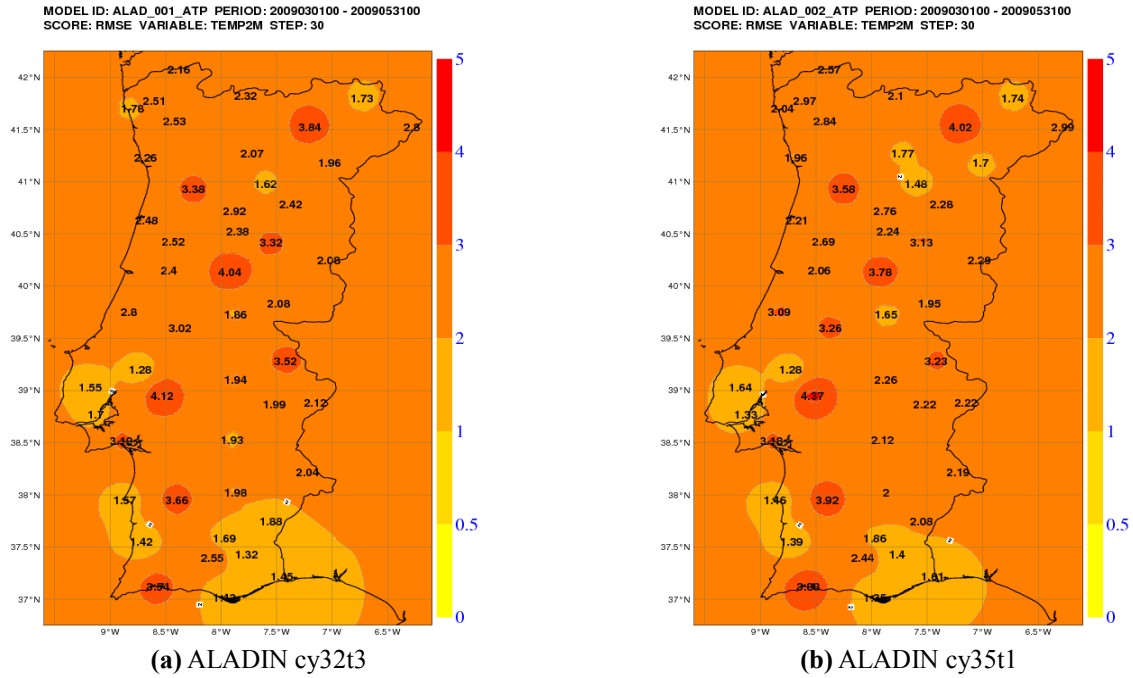


Figure 3 – Spatial distribution of RMSE for 2m temperature (H+30): Spring period of 2009.

From the analysis of the Root Mean Squared Error (RMSE) of 2m temperature for the Spring period of 2009 (Figure 1) one concludes that it has an identical evolution in both versions of ALADIN, which is independent from the forecast time range. Also the spatial distribution of the error is similar in both versions (Figures 3(a), 3(b)), being the magnitude of the error larger on the step H+30 (6 UTC) than on the other steps (not shown).

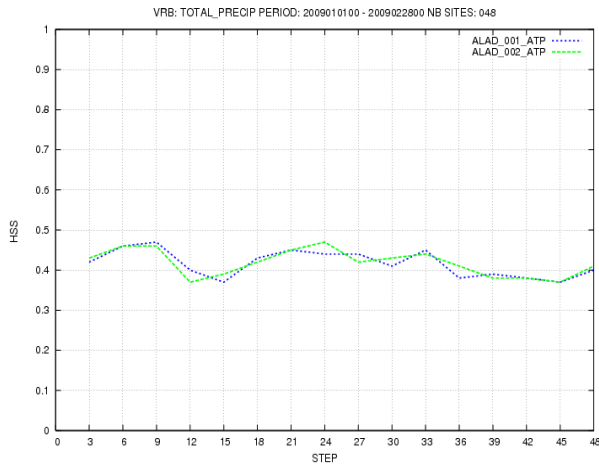


Figure 4 - HSS of the accumulated precipitation in 3h for the Winter period of 2009.

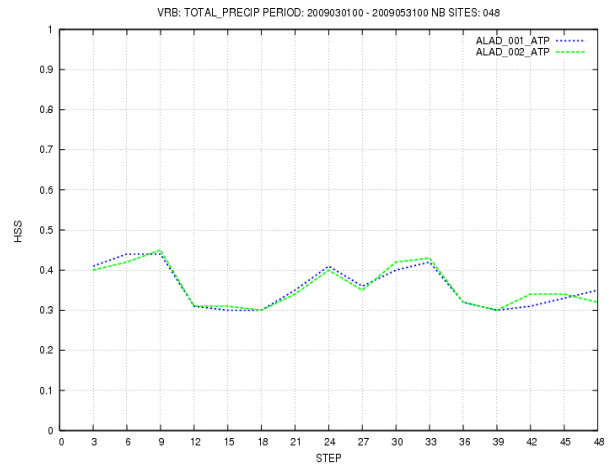


Figure 5 - HSS of the accumulated precipitation in 3h for the Spring period of 2009.

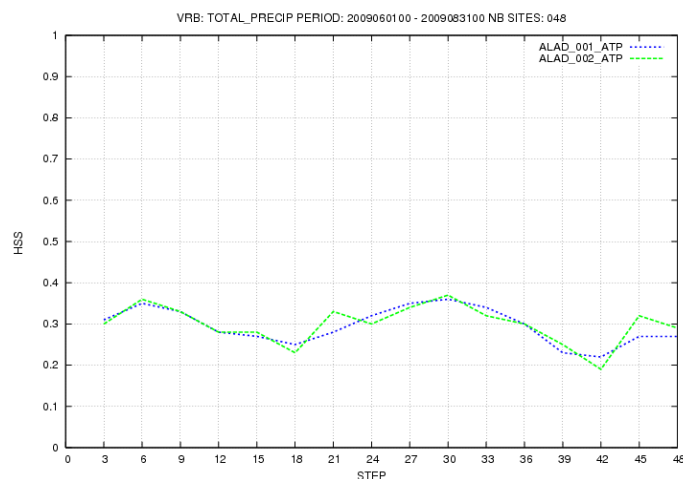


Figure 6 - HSS of the accumulated precipitation in 3h for the Summer period of 2009.

The Heidke Skill Score (HSS) of the accumulated precipitation in 3h *versus* the forecasted time range for the Winter, Spring and Summer periods of 2009 (Figures 4-6) shows that the differences between the quality of the forecasts of both versions of ALADIN are not relevant. As expected the scores in Winter are better than those computed for Summer, since precipitation is mostly synoptic in the Winter period and convective in the Summer period.

2. ALARO

ALARO cy35t1 is running experimentally on two domains with different resolutions: one that is identical to the operational ALADIN domain (see the characteristics on the Newsletter no. 35) with the resolution of 9 km; another one, smaller, that includes Madeira islands (domain (C+I) of 97 x 109 points) with the resolution of 5km.

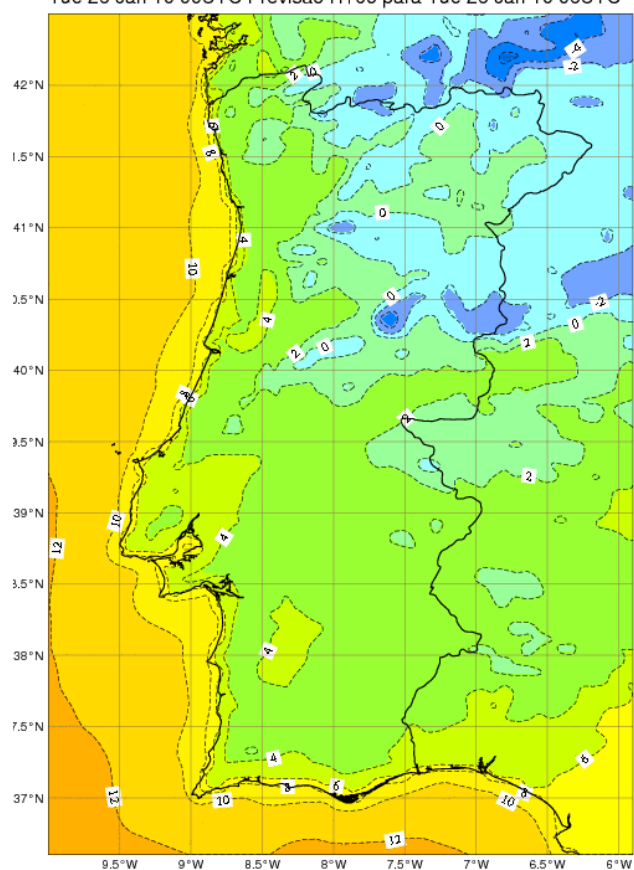
A validation of this model was made by the comparison of its results from 00 UTC run against the results of the current ALADIN. This validation has signaled some difficulties of ALARO in forecasting the 2 m temperature in Winter nights with strong radiational cooling. In summary, ALARO scores are similar or better to those computed for ALADIN.

3. AROME

AROME cy35t1 is running experimentally with the resolution of 2.5km also on two distinct domains: one that includes Portugal mainland, (domain (C+I) of 239 x 349 points); another one that includes Madeira islands (domain (C+I) of 181 x 189 points). On both cases, the model uses 46 levels, 60s time step, 2 runs (00 and 12 UTC) with 30 hours of integration range and 3 hours coupling. Verification of the forecasts is expected for early 2010.

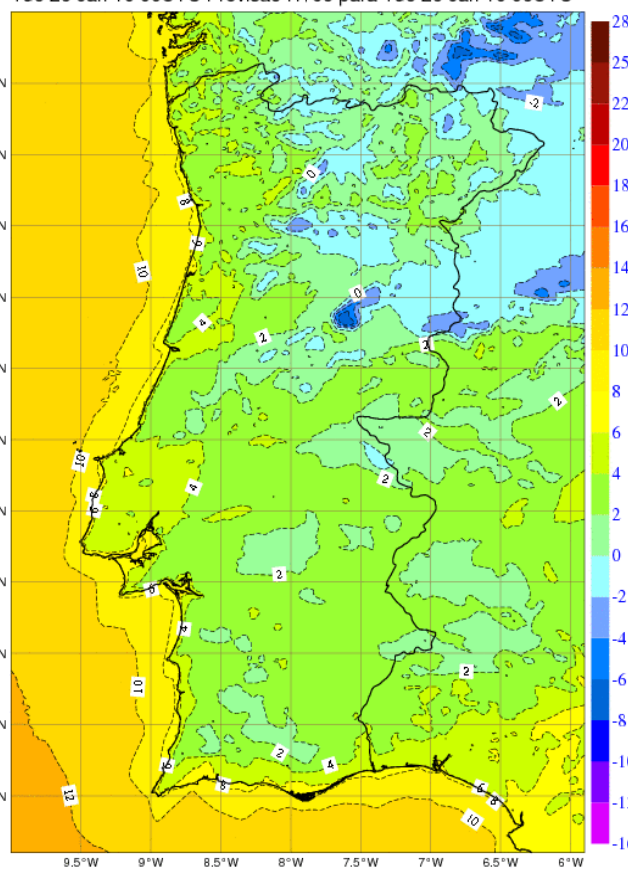
Some examples of post-processed fields are shown below.

ALADIN: Temperatura a 2m (°C)
Tue 26 Jan 10 00UTC Previsão H+06 para Tue 26 Jan 10 06UTC



(a) ALADIN operational cy35t1 (9 km resolution)

AROME: Temperatura a 2m (°C)
Tue 26 Jan 10 00UTC Previsão H+06 para Tue 26 Jan 10 06UTC

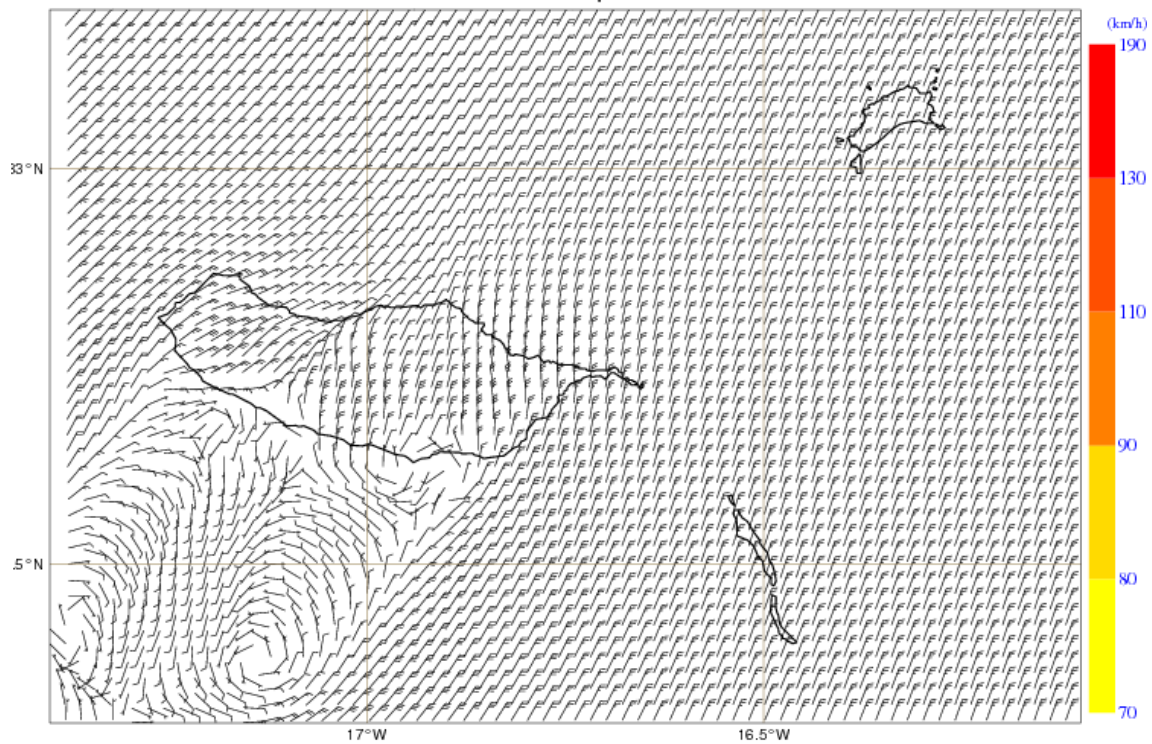


(b) AROME cy35t1 (2.5 km resolution)

Figure 7 - 2 metres temperature (°C): forecast H+06 from the run 00 UTC of 26th January 2010.

AROME: Rajadas a 10 m

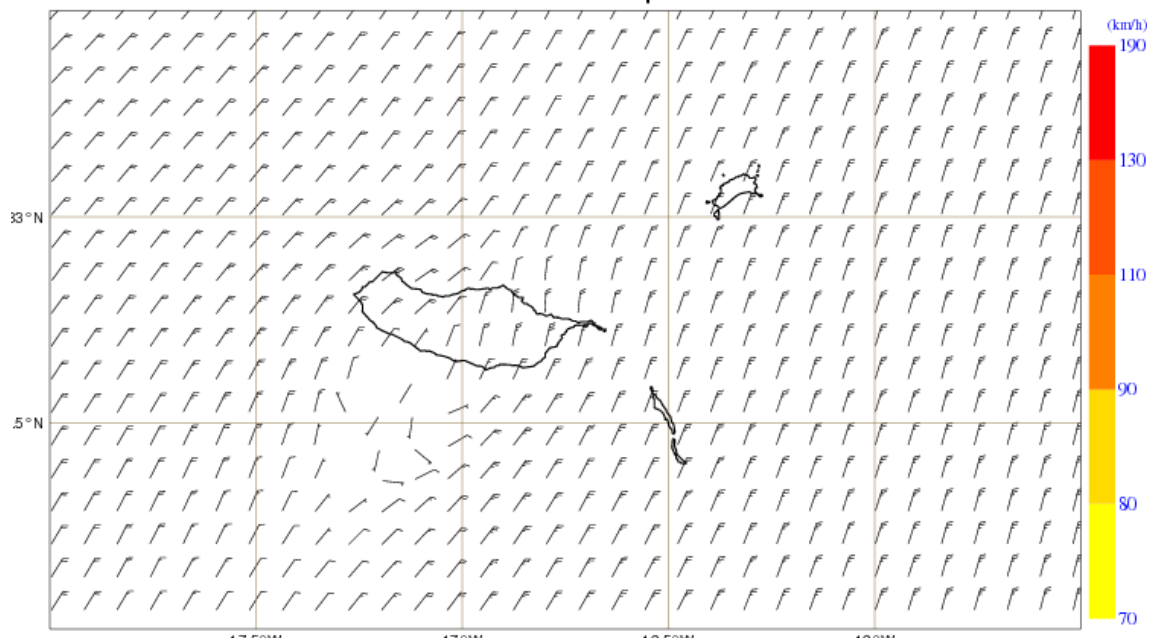
Tue 26 Jan 10 00UTC Previsão H+03 para Tue 26 Jan 10 03UTC



(a) AROME cy35t1(2.5 km resolution)

ALARO: Rajadas a 10 m

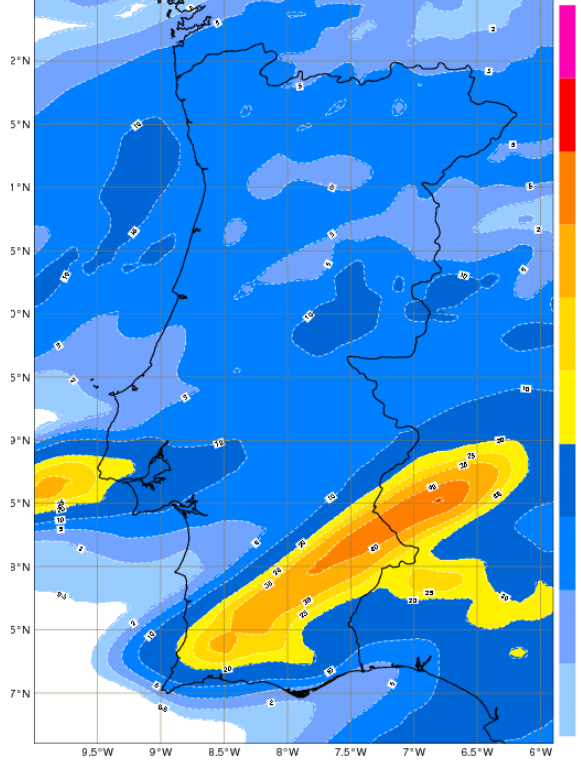
Tue 26 Jan 10 00UTC Previsão H+03 para Tue 26 Jan 10 03UTC



(b) ALARO cy35t1(5 km resolution)

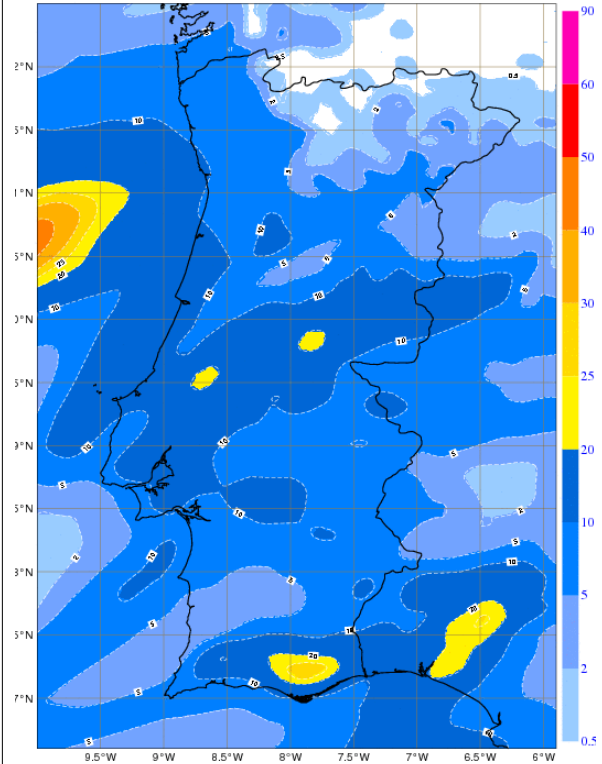
Figure 8 Wind gusts at 10 m (kt): forecast H+03 from the run 00 UTC of 26th January 2010.

ALADIN: Precipitação total (mm) acumulada em 3 horas
Tue 22 Dec 09 00UTC Previsão H+(30-27) para Wed 23 Dec 09 06UTC



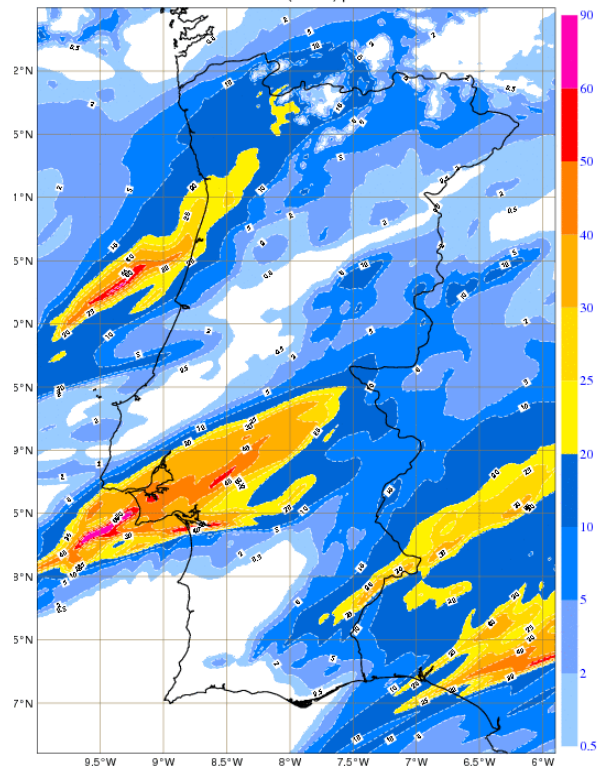
(a) ALADIN operational cy35t1 (9km resolution)

ALARO: Precipitação total (mm) acumulada em 3 horas
Tue 22 Dec 09 00UTC Previsão H+(30-27) para Wed 23 Dec 09 06UTC



(b) ALARO cy35t1 (9 km resolution)

AROME: Precipitação total (mm) acumulada em 3 horas
Tue 22 Dec 09 00UTC Previsão H+(30-27) para Wed 23 Dec 09 06UTC



(c) AROME cy35t1(2.5 km resolution)

Figure 9 – Accumulated precipitation in 3h (mm): forecast H+(30-27) from the run 00 UTC of 22th December 2009.

2.6. SLOVAKIA

(oldrich.spaniel@shmu.sk)

SUMMARY

Operational suite at SHMÚ is frozen, last update of core applications (switch to 3MT) was done on 19-08-2008. **Technical parsuite and operational switch to cycle 35t1 was postponed. Local implementation of CANARI on cy35t1 has just started.**

Increased number of vertical levels would be desirable, but with current domain and resolution IBM machine is on the edge of CPU limits (it has not been upgraded since February 2004). **There is also critical lack of disk space. Archiving strategy was revisited and the new tapes for storage were bought, but without license for additional tape slots (i.e. tapes not fitting available slots must be interchanged manually).**

HARDWARE

- Computer [no change]:
 - ➔ IBM Regatta
 - ➔ 32 CPUs of 1.7 GHz
 - ➔ 32 GB RAM
 - ➔ 1.5 TB disk array
- Archiving facility [no change]:
 - ➔ IBM Total Storage 3584 Tape Library with IBM Tivoli Storage Manager
 - ➔ current capacity of tapes around 30 TB **(plus 10 TB of external tapes)**
 - ➔ used for automatic storage of ICMSH files, GRIBs and selected products

OPERATIONAL SUITE

- Domain and geometry [no change]:
 - ➔ 309 x 277 points (C + I zone)
 - ➔ $dx = 9.0$ km
 - ➔ quadratic truncation
 - ➔ 37 vertical levels
- Operational model version [no change]:
 - ➔ cy32t1 - ALARO with 3MT
 - ➔ SLHD scheme
- Integrations [no change]:
 - ➔ 4 runs per day (00, 06 and 12 UTC up to 72 hours; 18 UTC up to 60 hours)

- Pseudo assimilation cycle (upper air spectral blending):
 - ➔ 4 runs per day (00, 06, 12 and 18 UTC up to 6 hours with long cut-off ARPEGE LBC)
 - ➔ assimilation guess is used to copy hydrometeors, TKE and 3MT prognostic fields; remaining 3D prognostic fields (temperature, wind, humidity) are blended with ARPEGE analysis
 - ➔ surface analysis is interpolated from ARPEGE

ARPEGE LBC DOWNLOAD

Both assimilation and production LBC are downloaded 4 times per day. Primary channel is internet connection to BDPE. Backup channel is routed via ECMWF and ZAMG (sequence of RMDCN and internet). **Capacity of internet lines is sufficient.**

2.7. SLOVENIA

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Computer system SGI ALTIX ICE 8200

1 *Technical characteristics:*

- ❑ 36 compute nodes installed in a single rack, every compute node has a 16 GB of memory and 2 Quad core Intel Xeon 5355 processors (288 cores)
- ❑ two Infiniband DDR networks, one for IO and the other for MPI communication
- ❑ additional 7 service nodes are used for login, management, control and IO operations (308 cores all together)
- ❑ a dedicated NAS IO node is installed with 30 TB FC disk array

2 *Programs:*

- ❑ OS: SGI ProPack on top of SLES 10
- ❑ MPI: OpenMPI, *SGI MPI*
- ❑ queuing system: Altair PBS Pro 9.2
- ❑ Tempo 1.3 cluster management system
- ❑ Intel 10.1. and 11.0 Fortran compiler

OPERATIONAL SUITE

1 *Domain and geometry:*

- ❑ 258*244 points, (with extension zone 270*256), E134x127
- ❑ 9.5 km horizontal grid spacing
- ❑ 43 vertical model levels
- ❑ linear spectral elliptic truncation
- ❑ Lambert projection

2 *Integration:*

- ❑ four runs per day: 00 UTC (72h), 06 UTC (72h), 12 UTC (72h), 18 UTC (48h)
- ❑ initial and lateral boundary conditions from ARPEGE
- ❑ digital filter initialization
- ❑ coupling at every 3 hours
- ❑ 400 s time-step

3 *Operational model version:*

- ❑ AL35T1 using ALARO-0 physics (3MT)

The model integration is using now 64 processors on 8 nodes, 72 hour forecast is finished in a half of an hour, optimal with the coupling files availability. Whole production suite is completed in an hour.

Operational suite is running in Supervisor Monitor Scheduler, ECMWF product. The computer system and operational suite is controlled by NAGIOS supervision system.

1 *LBC download:*

- ❑ Production LBC from ARPEGE are downloaded 4 times per day.
- ❑ Primary channel is internet/BDPE, backup is done via ECMWF.

2 Archiving:

- ❑ production LBC files for runs 00 and 12 are stored on DVD

OTHER OPERATIONAL ACTIVITIES

1 *parallel suite, differences to operational suite are:*

- 4.4 km
- 439*421 points, (with extension zone 450*432), E224x215
- domain is smaller
- two runs per day: 00 UTC (54 h), 12 UTC (54 h),
- 180 s time step
- The model integration is using 128 processors on 16 nodes, 54 hour forecast is finished in 60 minutes,

2 *INCA analysis and nowcasting system is routinely running in pre-operational mode under SMS*

- temperature, humidity, wind and several convective indices are updated hourly
- precipitation type, rain and snow rate products are updated every half an hour

3 *experimental assimilation cycle*

- same setup as in parallel suite (4.4 km)
- 6-h forecasts as first guess (long cut-off LBC's from ARPEGE)
- SST analysis from ARPEGE (with BLENDSUR)
- CANARI surface analysis using surface observations (T and RH at 2 m),
- 3DVar upper air analysis using OPLACE data and local observations (SYNOP)

4 *LACE observational monitoring system installed from the first export package*

5 *operational model can be run with the initial and coupling files from ECMWF model on demand*

SHORT HISTORY OF CHANGES in the operational suite in the last year

04.05.2009

Minor computer upgrade (additional node, additional disk array).

26.06.2009

Modification of climatological files for parallel suite (4.4 km).

08.07.2009

Additional fields and levels in post-processing needed for convection forecasting.

16.07.2009

ALADIN cy35t1 with open MPI has become operational.

03.09.2009

ALADIN products are available on web mobile portal.

22.09.2009

Update of the production for www.rclace.eu.

23.12.2010

Forecasting range of 06 run is prolonged to 72 hours.

07.01.2010

Memory upgrade from 8GB to 16GB per each compute node.

18.01.2010

Change of the time step in parallel suite (180s instead of 200 s).

3. RESEARCH & DEVELOPMENTS

3.1. HUNGARY

(kullmann.l@met.hu)

The main scientific orientation of the Hungarian Meteorological Service for the ALADIN project is unchanged: data assimilation, short range ensemble prediction and high resolution meso-gamma scale modelling (AROME model).

The main scientific developments for the second half of 2009 can be summarized as follows:

□ DATA ASSIMILATION:

1 A 4dvar prototype has been set up at HMS (and also in ARSO in a co-work with the Slovenian colleagues) based on cy35t1. Three outer-loops are implemented in a multi-incremental manner. The inner-loops are performed on a half resolution. The prototype is implemented under SMS and was based on the Slovenian pre-operational 3dvar suite adding the 4dvar related components from the HARMONIE 4dvar prototype at ECMWF (which is based on the prototype of Meteo-France). Technical validations of the 4d minimization were performed in single and full observation experiments. Multi incremental results were compared with those done at full resolution in a very simplified framework (single outer-loop and single observation). So far very simplified dry MF physics were used in the TL/AD runs. The CPU and memory consumptions were measured.

2 A 3dvar parallel suite with 3h analysis frequency was run by the end of the year. After positive results on earlier test periods this suite is considered to be a last step before an operational implementation in case of supporting our previous conclusions. The used quantity of most observation types is doubled with the higher frequency. Production runs are kept 6-hourly (4/day). The forecast quality and scores from this suite are under evaluation.

□ LAMEPS:

The operational LAMEPS/Hu system is running on the SGI Altix supercomputer with ALADIN cycle 30t1. A long-term verification of the LAMEPS system was performed and the results have shown poor skill at the lower levels, especially at the surface, hence generation of the local perturbation is developed. The experiment of the ALADIN singular vector computations has been going on, different norms have been examined to determine the best settings of the efficient local perturbation. Perturbation of the surface observations is also examined to improve the ALADIN LAMEPS surface fields by a CANARI assimilation cycle.

The cooperation with TIGGE-LAM was started to provide our LAMEPS products towards the TIGGE-LAM. This cooperation means another set of post-processed LAMEPS/Hu forecasts, which will be collected by the ECMWF center. Visualisation of the LAMEPS/Hu was developed with the ECMWF Magics ++ package.

□ AROME:

Since September 2009 we run AROME on daily basis and we compare the performance with the observations and other NWP models (ALADIN, MM5, ECMWF). As a general view AROME gives better T2m and wind forecast but the low level cloudiness is usually underestimated.

3.2. SLOVENIA

Slovenian team (Neva Pristov, Jure Cedilnik, Benedikt Strajnar)

◆ Data assimilation

3DVAR and CANARI assimilation suite is now running in pre-operational mode at EARS. The aim of this local assimilation application is to provide a higher-resolution (4.4 km) initial fields for model integration.

The assimilation cycle using ALADIN/ALARO consists of those basic steps:

1. 3DVAR upper air assimilation using all OPLACE data available via ftp and local non-GTS and other data at surface level. The observation set contains SYNOP, TEMP, AMDAR, GEOWIND, PRIOFILER, NOAA ATOVS and METEOSAT SEVIRI observation types
2. CANARI surface analysis using T-2m and RH-2m received via OPLACE and local non-GTS and other data on surface level
3. surface blending step, which writes CANARI surface analysis over land and ARPEGE sea-surface analysis into analysis file, which is output from 3DVAR
4. optional initialization (pure cycling) of microphysics (currently switched off)
5. first guess step using long cut-off ARPEGE lateral boundary conditions, DFI included

Further details include bias correction, which is at the moment still old fashioned (the static one). Variational bias correction has been tested, but not properly validated to be included in the pre-operational setup. The background error statistics is computed using ensemble technique (ARPEGE assimilation ensemble) and dataset of 60 downscaled forecast differences. From the beginning of 2010, new statistics on 450 difference sample will be used.

The performance of the assimilation cycle is considered good, although there are minor improvements over the dynamical adaptation mode in the verification scores. There is also a minimal, but consistent degradation for humidity forecast. The main issue before switching to operational mode is still unresolved big with wrong (negative) surface temperature, which can sometimes, after a couple of assimilation steps, cause a crash in model integration. The same crash occurred also with 3 hour RUC cycling, which was set up and tested by Edit Adamcsek (during her short stay in Ljubljana). An investigation of this problem is still going on. With the help of Czech colleagues a problem of reading the guess file has been identified, the quick and easy solution (but unsatisfactory) is to switch off packing of output fields.

As part of LACE research activities, a preliminary test of 4DVAR configuration was done with help of Hungarian visitor Gergely Boloni. All relevant configurations were installed and are technically working. The sample suite was implemented under SMS, inspired by the solutions of HARMONIE 4DVAR (outer loops design etc.). As a validation, mostly single observation experiments were carried out. It is also possible to run it with the complete observation set, but it is very costly. This preliminary 4DVAR suite has been installed in Ljubljana and Budapest and is prepared for further experimentation and validation.

◆ Other miscellaneous topics

During the stay of Lora Taseva the CANARI snow analysis scheme has been implemented in the local ALADIN model (see separate contribution). Other subject of her stay was the validation of ALARO where the impact of different computation of the inter-layers ETA(L) (LREGETA switch)

and initialization of the hydrometeors were studied. Case studies and one month cycling were performed, for visualisation and some statistics computation R (a language and environment for statistical computing and graphics) packet was used. With the support of Belgium colleagues also SAL method verification for precipitation was installed into local R software.

The switch `LREGETA=.F` keeps the structure of the total precipitation fields almost unchanged, total precipitation amounts are slightly lower. For all situations is definitely seen that non-zero initial values of the hydrometeors leads to increasing of the total precipitation in the first hours, while differences are not so significant for longer forecast ranges.

The Agency has started two projects started where our group is taking part.

The first one is regional climate modeling (ALADIN climate) where ARPEGE climate simulations will be downscaled for south central Europe region. The idea is to downscale two periods of global simulations: from 2000 to 2010 and from 2090 until 2100, both at 15 and 4.5 km. So far, the project is in its initial phase and only boundary conditions have been produced (in Toulouse). The model physics set-up for this downscaling is yet to be defined.

The second one is linked to air quality modeling. Namely the air quality department has launched a project with a goal to establish an operational air quality modeling process. Most of the work on this issue will be carried out by the meteorology group at the University of Ljubljana. During the initial phase of the project, AROME-chemistry was also considered as a possibility, so some basic test were performed by Jure Cedilnik. After some debugging and work with preparation of initial files with single emission species, it turned out that AROME-chemistry is far from suitable for operational running with our present computer infrastructure. So finally, a cheaper solution was chosen: ALADIN coupled with CAMx, similarly to how this is implemented in Austria. Currently, work is in progress, no results are yet available.

4. PAPERS and ARTICLES

4.1. Implementation and Testing of CANARI Snow Analysis Scheme in ALADIN SLOVENIA

Lora Taseva (1), Jure Cedilnik (2)

(1) National Institute of Meteorology and Hydrology, Bulgarian Academy of Sciences

(2) Slovenian Meteorological Service, Environmental Agency of the Republic of Slovenia

4.1.1. Introduction

The option for snow cover analysis has existed already since 2000 in CANARI OI package for surface analysis (Taillefer, 2002). It has been tested for some case studies over ALADIN-FR and ALADIN-BG domains but never in assimilation mode (Gaytandjieva et al, 2000a; Gaytandjieva et al, 2000b).

Lately, the snow analysis scheme in ALADIN has again drawn some attention. The main reason for this revival is that now most of the services run their operational models at resolution below 10 km (from 2.5 to 10 km) and that ARPEGE downscaling alone is not good enough in the aspect of snow analysis. Furthermore, the values of snow cover from ARPEGE are not really the best, since it uses no analysis itself. Model snow in ARPEGE is calculated and cycled from run to run with some relaxation to climatology. Such relaxation is probably appropriate for the areas where there is at least some snow every year (Scandinavia, NE Europe), but is not very suitable for Central or, even less, for Southern Europe, where on average there is much less snow.

Another likely reason for putting more attention to the snow analysis is the necessity of studying the impact of snow cover on the forecast of 2m temperature, and possibly through moisture, on the trigger causing fog and low cloudiness. When certain winter stable conditions occur over the continental Europe, the 2m temperature model warm bias can reach very high values and introducing snow cover in such a case (provided that there is snow on the ground and none in the model) is believed to improve this significantly (Toth, 2004).

The aim of the work presented in this article is to:

- test for a given synoptic case the different options of the existing CANARI/ALADIN snow analysis scheme for ALADIN-SI;
- validate its performance in assimilation mode over a longer period.

The tests have been done for January 10. – 30. 2009. The period has been recommended by Fr. Taillefer (personal communication) as a period with significant snow amount over the area of interest.

4.1.2. CANARI snow analysis

To enable the CANARI snow analysis it is necessary to make a minimal modification in hop.F90 (see Appendix), recompile the code and set LAESNM=.TRUE. in NACTEX

CANARI/ALADIN snow scheme is an univariate OI analysis scheme for the variable snow reservoir (quantity) [kg/m**2] with statistical structure defined by the rms model error σ_b , rms observation error σ_o and the correlation function $\mu(r, p)$, represented by the horizontal $\mu_h(r)$ and vertical $\mu_v(p)$ components:

$$\mu(r, p) = \mu_h(r) * \mu_v(p)$$

$$\text{where } \mu_h(r) = \exp(-1/2 * (r/d)^2); \mu_v(p) = \exp(-1/2 * (dp_{ij}/P))$$

(for the notations, see (Taseva, 2009))

The values of the horizontal characteristic length d , the vertical characteristic parameter P and the rms model error σ_b are tunable, while the rms observation error σ_o is hard coded in CANARI software. The default values of those parameters are: $\sigma_b = \sigma_o = 5$ [kg/m**2]; $d = 60\,000$ [m]; $P = 0.05$. There is no spatial quality control of the snow observations inside the snow analysis, but only check against the first guess field. The threshold value above which the snow observations are not used in the analysis is $RCSNSY * \sigma_o$, where $RCSNSY = 2.5$ [kg/m**2], set in canali.F90.

There are three other parameters, which are crucial for the snow analysis. They are:

- ORODIF - controls the difference between the model orography at the obs point and the altitude of the obs station;
- OROLIM - controls the altitude of the obs station above which the observation is not taken into account,
- the default values of those parameters are $ORODIF = 10000$ and $OROLIM = 10000$, defined in NACOBS;
- RCLIMCA - relaxation coefficient towards the snow climatology after CANARI analysis of the surface fields. The default value of that coefficient is $RCLIMCA = 0.045$ defined in NACTEX.

The default settings for the parameters of the statistical structure, ORODIF, OROLIM and RCLIMCA, described above, have been used for the so-called reference run with ALADIN-SI.

Experiments with CANARI snow analysis scheme for ALADIN-SI have been performed with the default correlation function $\mu(r,p) = \mu_h(r) * \mu_v(p)$ but with the following changes of the parameters ORODIF, OROLIM and RCLIMCA:

- $RCLIMCA = 0.0$ (not to use relaxation to snow climatology after the CANARI analysis of the surface fields);
- $ORODIF = 500$. (not to take into account stations where the difference between model and real orography is greater than 500m);
- $OROLIM = 2000$. (not to take into account measurements of stations that are located higher than 2000 m above sea level).

The first guess is the 6-hour ALADIN-SI forecast, post-processed at the observation point by the so-called observation operator. In the recent version of CANARI software the default obs operator is based on the formula derived in (Urban, 1996). Here it should be mentioned that in this article the formula has been tested for ARPEGE with resolution of approx. 150 km. We could expect this snow obs operator not to be suitable for the current versions of the ALADIN model due to the fact that the resolution of the recent models has increased considerably since 1996. The preliminary results obtained in (Gaytandjieva et al, 2000b) have shown some problems in snow analysis caused by that obs operator. In CANARI software there is another option for the snow obs operator (simple horizontal semilagrangian interpolation). By now the switch from the default obs operator to the other one can not be done through a namelist but only by recompilation of the code.

The input for CANARI snow analysis are SYNOP observations. As it is seen from Figure 1, the number of these observations varies with observation time. At the standard times (06, 18 UTC) the amount of SYNOP snow observations is significant, at (00, 12 UTC) however, only some stations in mountainous regions and in Germany report snow depth. Here could rise the question about the observation error of the snow measurements in dependence of whether the stations are

manned or AWS (automatic weather stations). It is also surprising that there are very few observations over Austria and Hungary even at 06 UTC (see again Figure 1). The SYNOP data were obtained from obsoul files processed in Toulouse.

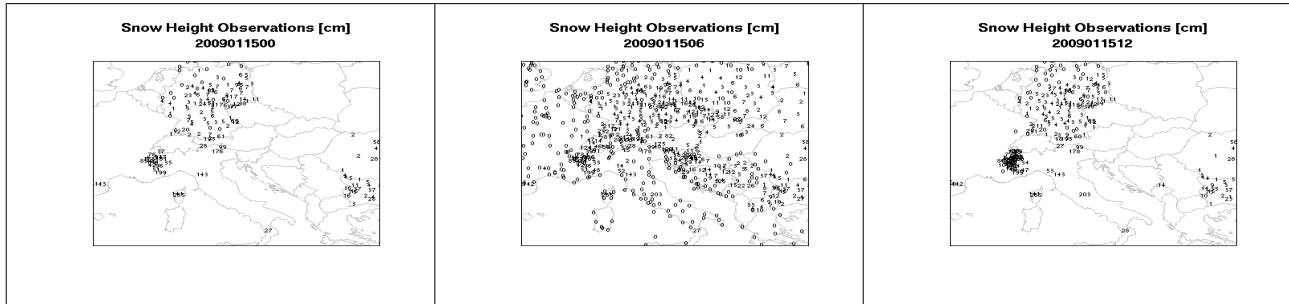


Figure 1: Distribution of the SYNOP stations with snow observations for different times: left 00 UTC, center 06 UTC and right 12 UTC. All valid for Jan 15th 2009.

4.1.3. Case study: 15. 1. 2009, 06 UTC

The first test with CANARI snow analysis for ALADIN-SI has been performed for the same date and in a similar manner as in (Taseva et al, 2009), where the snow scheme has been tested for ALADIN-FR domain. The main differences between the two runs are in:

- the domain size and the resolution of ALADIN-FR and ALADIN-SI (resolution: 8 km in ALADIN-FR vs. 4.4 km in ALADIN-SI),
- different physics in the two models (ALARO-0 in ALADIN-SI),
- the definition of the snow obs operator (horizontal semilagrangian interpolation in (Taseva et al, 2009) vs. the default version of the obs operator based on the formula (Urban, 1996)).

Later in this paper, we will show the impact of both obs operators on the results of the snow analysis. Hereafter the default snow obs. operator based on the formula (Urban, 1996) will be referred as “formula” or “default obs operator”

For this single date, the performance of the snow analysis has been first evaluated by comparison of the obs-analysis statistics. The tests have been performed with the default CANARI snow settings (reference run) and with the modifications of the parameters OROLIM, ORODIF and RCLIMCA as described in the previous paragraph. The results of the statistics are summarized in Table 1. It is seen that the analysis scores have been slightly improved after excluding the relaxation towards snow climatology (RCLIMCA=0.) and significantly improved after introducing the limits for the parameters OROLIM and ORODIF both for the guess and analysis (rejected observations due to those limits are approx. 50).

	OBS-MOD average/sigma (number of obs)	
CASE	GUESS	ANALYSIS
Default RCLIMCA, OROLIM, ORODIF	11.713/31.967(554)	8.647/31.135
RCLIMCA=0, default OROLIM, ORODIF	11.713/31.967(554)	8.646/31.107
RCLIMCA=0, OROLIM=2000, ORODIF=500	5.934/17.284(502)	3.265/16.947

Table 1: Obs-analysis statistics (averaged over all observation points) from NODE files (for the: - reference run with the default settings; - no relaxation towards snow climate; - the improved settings for RCLIMCA, OROLIM and ORODIF). Obs operator for all experiments is the default one. GUESS stands for the statistics before analysis, ANALYSIS – same after performing snow analysis

The snow analysis fields of this single case are shown in Figure 2. The benefit of the CANARI snow analysis in comparison to the ARPEGE downscaled field is evident in regions like Germany or northern Italy, where there is clearly a great improvement of the snow cover.

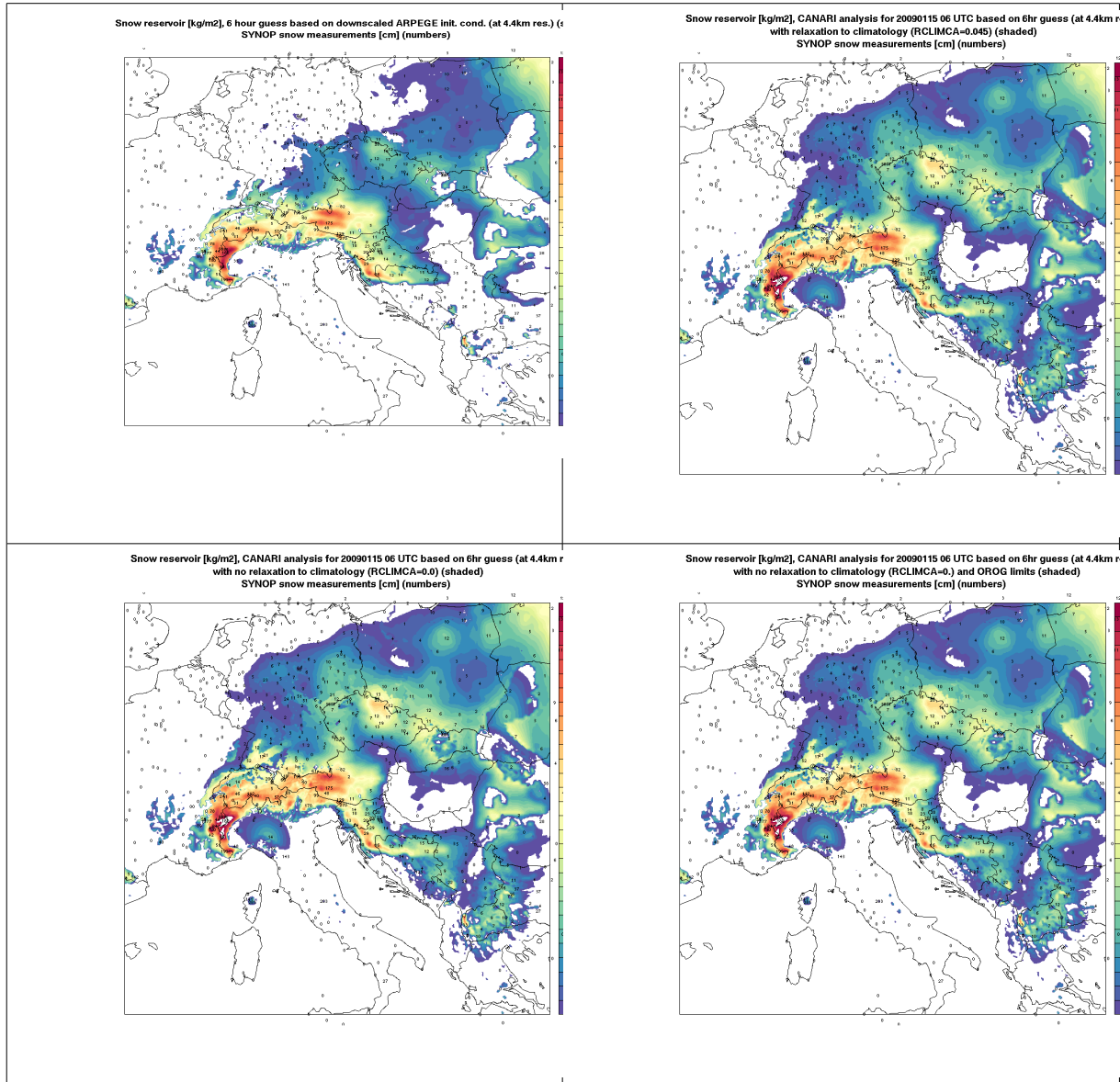


Figure 2: Snow reservoir for Jan 15, 2009 at 6 UTC: top left - first guess (6 hour forecasts starting from downscaled ARPEGE after ee927); top right - analysis with the default settings; bottom left - analysis with no relaxation to snow climatology & default values for ORODIF and OROLIM; bottom right - analysis with improved settings (no relaxation to snow climate and for ORODIF&OROLIM – see text). Numbers on all images depict snow measurements (but these include also rejected data).

In Figure 3 we have presented the downscaled ARPEGE and ECMWF snow analysis fields (after interpolation to 4.4km – ee927), the 6-hour ALADIN-SI first guess after 00 UTC cold start and the ALADIN-SI snow analysis based on the 6-hour ALADIN-SI first guess. It is seen that the CANARI/ALADIN-SI snow analysis field fits the observations better than the other snow fields over the Central and Easter part of the domain.

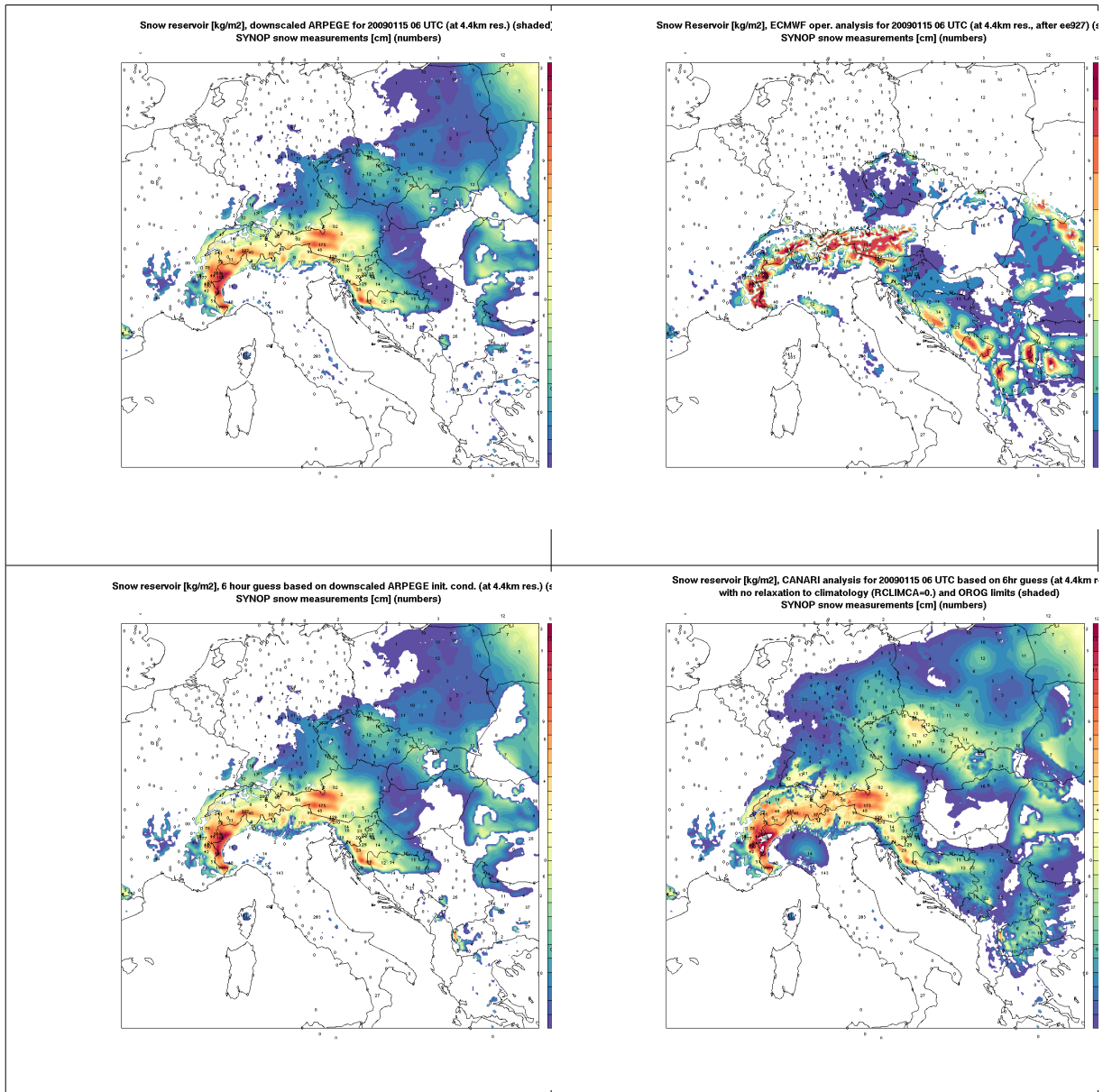


Figure 3: Snow reservoir for Jan 15, 2009 at 6 UTC: top left - downscaled ARPEGE (after ee927); top right - ECMWF analysis (after ee927); bottom left - ALADIN-SI first guess after cold start at 00 UTC; bottom right - CANARI SNOW analysis, based on first guess from bottom left. NOTE: The scale is different for ECMWF.

4.1.4. Experiments with snow analysis in assimilation mode

Encouraged by the results of the snow analysis obtained in the previous paragraph, we accepted the next challenge - to study it in assimilation mode. For that an assimilation cycle for the snow analysis has been prepared and launched.

The first assimilation test has been done with the “best” values for RCLIMCA, ORODIF and OROLIM (as described above – bottom row of Table 1) and the default snow obs operator. The assimilation cycle started on January 10 at 6 UTC and ended on January 30, 2009. The cycle has been constructed in such a way that only snow has been analysed, all other analysis options (usual CANARI, 3DVAR) have been switched off. The snow analysis has been performed every six hours with all available data.

The results are very surprising - the analysis increments clearly show large oscillations from one analysis to the analysis at the next 6-hour step (Figure 4). This happens even when the snow observations are almost the same (see for example the area of Germany or north east Hungary in Figure 4).

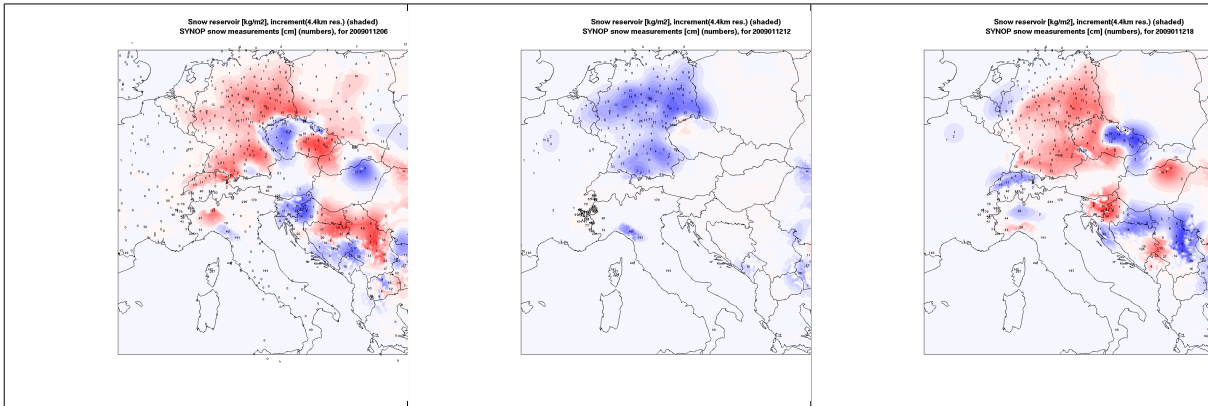


Figure 4: Snow increments for three consecutive analyses: left is 12/1/2009 at 6 UTC, middle at 12 UTC and right at 18 UTC

The fluctuations have been further analysed by plotting the time series for a few stations (Figure 5). It is seen that all four evolutions show significant fluctuations of the values of the analysed quantity (snow reservoir) from one analysis to the next one, while nothing similar happens with snow reservoir based on downscaling of ARPEGE or full cycling of snow.

A lot of effort has been put to understand why this flip-flopping occurs, main investigated issues were:

- The impact of the values of the rms observation and model errors (changes have been made of some sigma o and sigma b settings, setting ratio to 1:5);
- The impact of the cycle length (a test has been performed with 24-hour cycle length due to different data availability over the model domain)
- To eliminate the influence of the other measurements on the obs value at the obs point , a single obs experiment has been done to test whether the analysis is between the first guess and the observation.

Finally, it has been found realized that the fluctuations are a consequence of the usage of the default obs operator based on the formula (Urban, 1996) or perhaps because of its inefficient tuning. By simply switching it off and replacing it by horizontal semi lagrangian interpolation we have obtained far much better results for the assimilation cycle. The comparison of the time evolution of snow reservoir in the assimilation cycle with the default snow obs operator and with the horizontal semi lagrangian interpolation is shown in Figure 6.

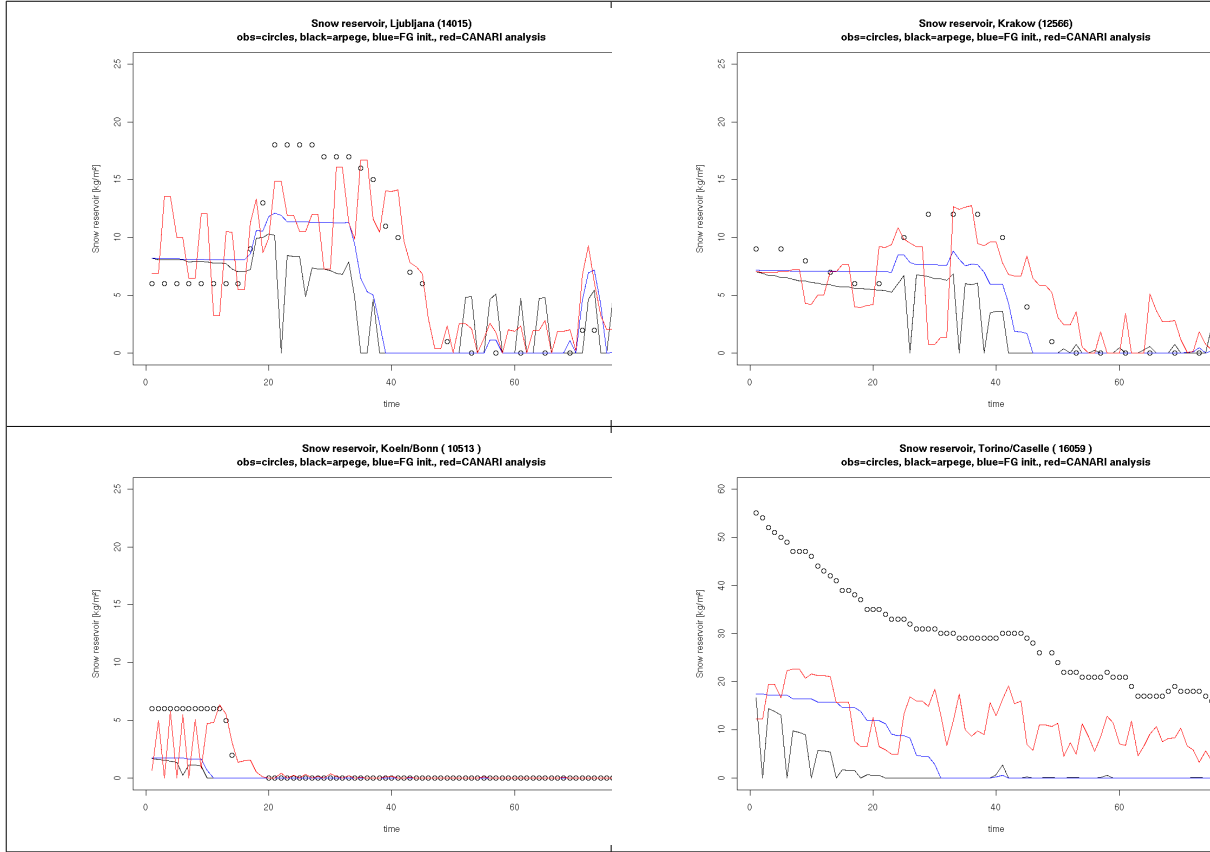


Figure 5: Time series of snow reservoir for four chosen stations: top left - Ljubljana (14015), top right - Krakow (12566), bottom left - Koeln/Bonn (10513) and bottom right - Torino/Caselle (16059). Red line is CANARI snow analysis, black circles are observations, black line is downscaled ARPEGE snow reservoir and in blue is first guess initialization (cycling of snow).

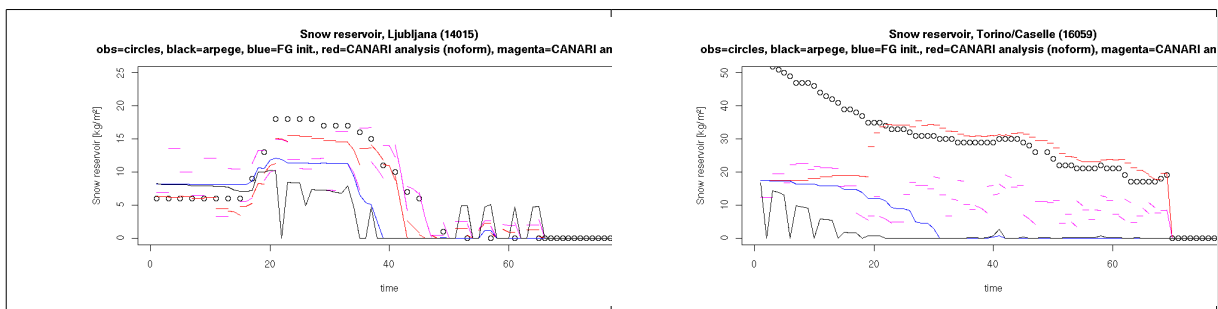


Figure 6: Same as Figure 5, only that the CANARI analysis with the default obs operator is now in magenta and without it is in red. Left is for Ljubljana (14015) and right is for Torino/Caselle (16059). The analysis in the right image is delayed with its start until the difference between observation and first guess becomes low enough not to be excluded by the quality control (within the analysis procedure itself).

Figure 6 is very clear evidence that at resolution of the model of around 5 km, the default snow obs operator should not be used. Instead of it, one should use the other option in CANARI software for snow analysis where the obs operator is based on horizontal semi lagrangian interpolation.

4.1.5. Case study: 15. 1. 2009, 06 UTC, part II

After the results obtained in the previous paragraph, there was a clear need to change the default obs operator and to rerun the snow analysis for the case 15.01.2009/06 UTC. Table 2 summarizes the results of all experiments (including those from Table 1).

It is seen that:

- ◆ With the default obs operator the bias and the rms for the guess are bigger in comparison with those when the obs operator is horizontal semi lagrangian interpolation (referred as HSLI). There is no explanation of the smaller values of bias and rms for the analysis with the default obs operator in comparison with the HSLI for the analysis;
- ◆ The tendency for significant decrease of the bias and the rms for the guess and analysis with the “best” values for RCLIMCA, ORODIF and OROLIM is kept for both obs operators.

Since that is a single case study one can not judge for the expected values of the bias and rms errors of the snow analysis against the observations, but it is obvious that:

- ◆ the default snow obs operator should be replaced;
- ◆ the relaxation towards snow climatology should be excluded;
- ◆ and that the values of the parameters ORODIF and OROLIM should be tuned.

	OBS-MOD average/sigma (number of obs)	
	GUESS	ANALYSIS
Case 15th of January with the default obs operator		
Default RCLIMCA, OROLIM, ORODIF	11.713/31.967(554)	8.647/31.135
RCLIMCA=0, default OROLIM, ORODIF	11.713/31.967(554)	8.646/31.107
RCLIMCA=0, OROLIM=2000, ORODIF=500	5.934/17.284(502)	3.265/16.947
Case 15th of January with horizontal semi lagrangian interpolation		
Default RCLIMCA, OROLIM, ORODIF	10.665/31.624(554)	9.107/31.653
RCLIMCA=0, default OROLIM, ORODIF	10.665/31.624(554)	9.028/31.652
RCLIMCA=0, OROLIM=2000, ORODIF=500	5.618/16.391(502)	3.807/16.153

Table 2: Obs-analysis statistics from NODE files (for the: - default settings; - no relaxation towards snow climate; - the improved settings for RCLIMCA, OROLIM and ORODIF), the first half is with the usage of the default snow obs operator, the second one is with usage of the horizontal semi lagrangian interpolation

Figure 7 shows the snow analysis fields which correspond to the three different settings for each of the obs operators (the default one and the horizontal semi lagrangian interpolation).

A subjective comparison of the fields on Figure 7 (bottom row) shows that there is a different distribution of snow cover with the two obs operators. While more snow is present in some places with the default obs operator, other places receive more snow in case of semi lagrangian obs operator (see for example western Poland, main valleys in Switzerland or central Balkans). The impression is that the snow analysis field, obtained with the improved settings for RCLIMCA, ORODIF, OROLIM and with the obs operator based on horizontal semi lagrangian interpolation fits much better to the observations especially over the areas with high amount of snow. A little bit annoying is the overestimation of the snow over Hungary.

The results obtained in this study with ALADIN-SI have shown the potential of the CANARI/ALADIN snow analysis scheme to perform reasonable fields, but the scheme and the parameters should be tested and tuned very carefully.

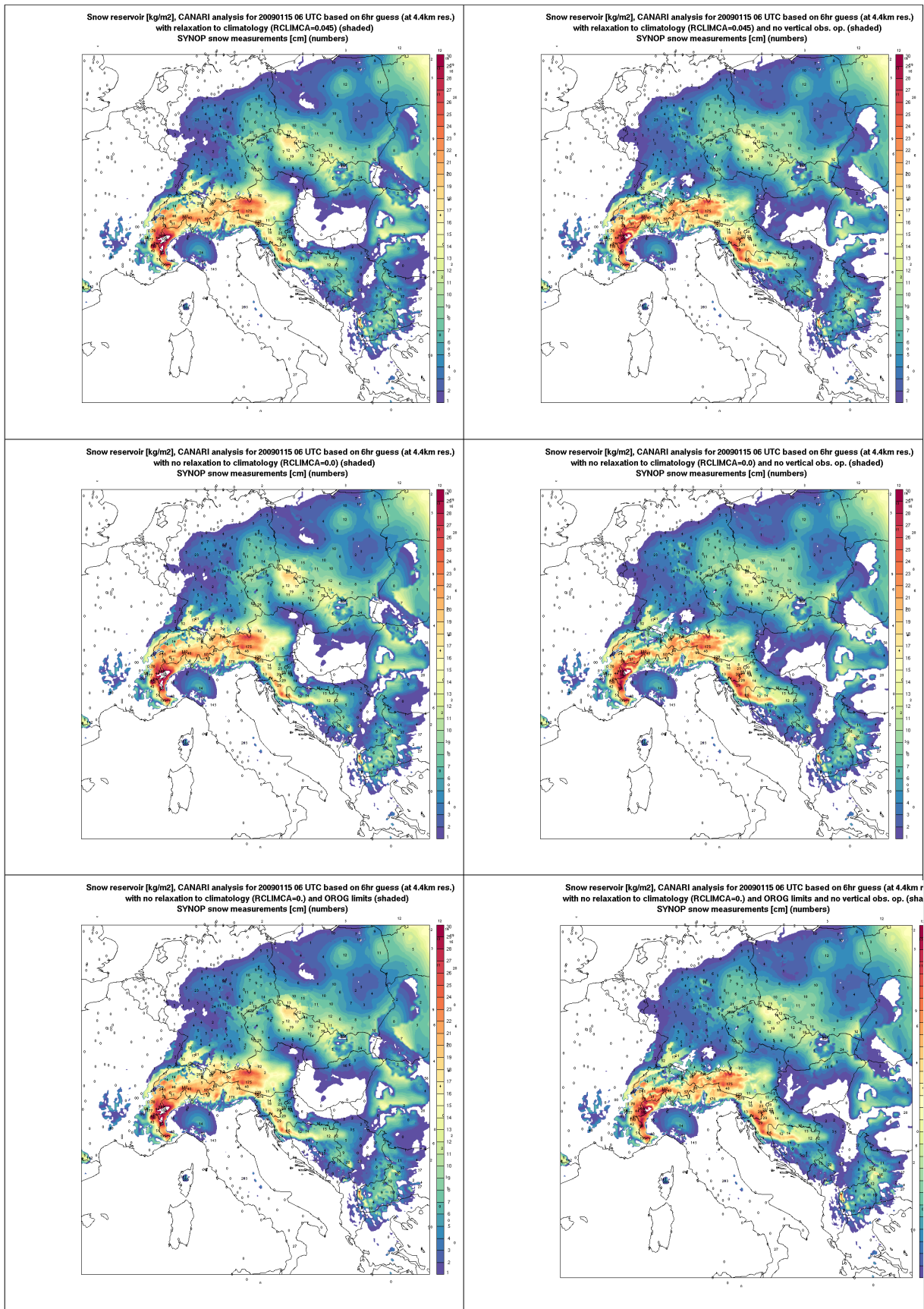


Figure 7: CANARI snow analysis: left column is for the default obs operator and right for obs operator based only on horizontal semilagrangian interpolation. First row is relaxation towards climatology, in the middle there is no relaxation to climatology and in the bottom row the input obs are limited to maximum height of 2000m and maximum difference in height of the model point and the obs point to 500m.

4.1.6. Conclusions

The performance of CANARI/ALADIN snow analysis scheme has been evaluated for ALADIN-SI in a single case study and in an assimilation cycle. According to our knowledge, this is the first time that the snow analysis scheme has been tested in an assimilation cycle.

The single case study with both obs operators (the default one based on the formula (Urban, 1996) and the obs operator based on horizontal semi lagrangian interpolation) doesn't clearly show which one gives better results. The obs-mod statistics for the analysis (see Table 2) favors slightly the option with the default obs operator, but the tests of the snow analysis in assimilation mode have shown very clearly that the default obs operator causes severe problem. When using it, a very disturbing and unusual flip-flopping occurs in the time evolution of the snow reservoir in several given observation points. We have great difficulties explaining this unusual pattern.

It is also evident from Figure 6, that neither direct ARPEGE downscaled snow cover nor first guess initialization run can produce and keep as much snow as the CANARI snow analysis. Clearly, snow assimilation (in one way or another) is needed, but the CANARI scheme and the parameters should be tested and tuned very carefully.

What remains to be done is to check the production scores based on this analysis for the whole period and to compare them to simple downscaling.

APPENDIX: Some technical details

- Obsoul files need to be generated in such a way to contain information about snow.

An example of an obsoul file containing snow is listed below. This example is for Ljubljana station for Jan 15 2009 at 6UTC. The snow relevant part (parameter no. 92) is underlined – there was 18 cm of snow measured on this date.

```
52 1 1011 46.06667 14.51667 '14015 ' 20090115 60000 2.98000E+02 8 1111 100000
1 -1.02140E+05 1.70000E+38 0.00000E+00 2064
39 9.83900E+04 1.70000E+38 2.70350E+02 2048
58 9.83900E+04 1.70000E+38 9.30000E+01 2048
7 9.83900E+04 3.06387E-04 2.84903E-03 2048
41 9.83900E+04 0.00000E+00 0.00000E+00 2048
91 9.83900E+04 1.70000E+38 1.00000E+02 2048
92 9.83900E+04 1.70000E+38 1.80000E-01 2060
80 9.83900E+04 4.32000E+04 5.00000E+00 2060
```

- The source code for CANARI has to be recompiled due to a very minor change: line 672 in hop.F90 needs to be uncommented in order to enable snow analysis:

```
671 IF(IVNMRQ(JOBS,JBODY) == NVNUMB(25) .OR.&
672! & IVNMRQ(JOBS,JBODY) == NVNUMB(46) .OR.&
673 & IVNMRQ(JOBS,JBODY) == NVNUMB(34) .OR.&
674 & IVNMRQ(JOBS,JBODY) == NVNUMB(89) ) THEN
675 IVNMRQ(JOBS,JBODY)=0
676 ENDIF
```

- In addition another modification of the code should be done due to the necessity for modifying the snow obs operator in the subroutine ppobsn.F90. In that subroutine the hard coded default obs operator for calculation the model equivalent of the snow at the observation point is based on the formula derived in (Urban, 1996) for ARPEGE with approx. resolution of 150 km. It has been shown that this formula leads to wrong results for the snow analysis and it has been recommended to replace it only by semi lagrangian horizontal interpolation. To switch the formula off it is necessary to modify ppobsn.F90 and to recompile the code. The modification consists in putting the additional line

```
168 PXPP(JROF,1,1) = ZSNS(JROF)
```

thus having in PXPP(JROF,1,1) the value of horizontally interpolated snow model equivalent at obs point.

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4.2. Global dataset for the parametrisation of lakes in Numerical Weather Prediction and climate modelling.

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Introduction

The structure of the atmospheric boundary layer depends on physical state of different types of the underlying surface, including lakes. In regions with high percentage of lake area, lakes affect local weather conditions and a regional climate. The problem becomes particularly pressing as the horizontal resolution of atmospheric models increases. Lakes should be parametrized in Numerical Weather Prediction (NWP) and climate models, and for this we need fields of external lake parameters. Fields should be global and, in principle, should contain information about properties of all existing lakes. Any atmospheric model with a lake parametrization scheme included needs at least information about lake depth, the mean lake depth or even the bathymetry. Great fidelity of the depth data is not critical, but global coverage is important. The lake fraction (the percentage of the atmospheric model grid box covered by lake water) is another external parameter needed by an atmospheric model.

Different lake databases are developed for different purposes. Regional databases are concentrated on individual characteristics of lakes but they do not represent all information on one map. Global databases pay much attention to the detailed information about geographical location of lakes, their extent and distribution but without providing individual physical characteristics (except from very large lakes or lakes significant from socio-economic point of view). See, for example, the Global Lakes and Wetlands Database (GLWD) (Lehner and Döll, 2004), the Global Land Cover Characteristics dataset (GLCC) (Loveland et al., 2000), the ECOCLIMAP dataset (Masson et al., 2003). Being represented in the raster form with pixels classified as “inland water”/“no inland water”, these databases can be used as a map. The lake fraction can be calculated from such a map in a standard way.

The dataset presented in this paper provides the external parameters fields for the parametrisation of lakes in atmospheric modelling. It combines depth information for the individual lakes from different sources with a map. As a result, lake depth is represented on the global grid with the resolution of 30 sec. of arc (approx. 1 km). For some large lakes the bathymetry is included. Additionally, the software to project the lake-related information accurately onto an atmospheric model grid is provided. The prototype for this dataset was developed for Europe and is described in details in (Kourzeneva, 2010).

4.2.1. Data sources

□ Mean depth information for individual lakes

Data for individual lakes were collected from different regional databases and water cadastres. For Europe, different organizations kindly provided data, mainly through personal communication, see (Kourzeneva, 2010) for details. For the rest of the world data were extracted from different sources in internet. Often we relied on data from Wikipedia, mainly from its national pages, which for some countries are very rich. Although Wikipedia is the “semi-scientific” source of information and provides no legal warranty, we did not reject this data. The reason is that for Wikipedia people use information from many scientific and governmental institutions around the world and most of pages contain references to the appropriate publications, but it is difficult to contact these organizations directly.

Both natural and man-made lakes are considered. Special attention is paid to saline lakes and endorheic basins. Freshwater lake models can't describe their behaviour. They can change size and

shape over time. Some of them are intermittent or ephemeral. Saline lakes are separated from freshwater ones and form the additional dataset. Lakes with low salinity (less than 10 ‰) and with stable size and shape are considered as freshwater. By now, the main dataset comprises about 13 000 freshwater lakes, the additional dataset comprises about 220 saline lakes and endorheic basins. The list of data sources includes ca. 295 references, and they are located together with data.

For each individual lake we used the following information: geographical coordinates of a point on the water surface, the mean depth of the lake, its maximum depth, its surface area, the lake name and the name of the country where the lake is located. Where the data about the mean lake depth were missing, the default value of 10m was used.

❑ **Map for lake depth information**

At present, in geophysical sciences much attention is paid to the development of global and regional ecosystem datasets - GLCC, ECOCLIMAP, GLC2000 (Bertholomé and Belward, 2005), CORINE (CEC, 1993), GLOBCOVER (Bicheron, 2006). They are used by atmospheric models to specify fields of external parameters. They have different resolution (25 m – 1 km) and some of them distinguish between different types of water bodies – seas, lakes, rivers. However, as it was discussed in literature (Lehner and Döll, 2004; Merchant and MacCallum, 2009; Kourzeneva, 2010), most of them have inaccuracies in the shoreline. These inaccuracies are inherited from the initial data sources, as most of them use the Digital Chart of the World (DCW), (ESRI, 1993) and the ArcWorld 1:3M dataset (ESRI, 1992) to specify the shoreline. To get rid of these inaccuracies, the high resolution remote sensing could be helpful, but the correct automatic classification based on space-born data only is difficult. In order to choose the ecosystem dataset for a basic map, we made the express-comparison of 4 global products with 1 km resolution. These are GLCC, GLWD, ECOCLIMAP and ECOCLIMAP2 (Faroux et al., 2009; Champeaux et al., 2004). The comparison was based on visual estimates. The remote sensing data were used as a gauge. We examined several test regions on the globe with the main attention given to Europe. Artefacts (e.g. a big lake does not exist on the map but do exist in reality, or there is a false big lake or a false island on the map) and the bias (too much water/too few water) were estimated. After removing some artefacts from ECOCLIMAP2, it was chosen for mapping of lake depth information. ECOCLIMAP2 distinguishes between rivers and lakes, but many rivers are erroneously referred as chains of lakes.

❑ **Bathymetry data for large lakes**

At present, there are two global datasets containing the bathymetry information for large lakes. The dataset ETOPO1 (Amante and Eakins, 2009) has the resolution of 1min of arc and contains the detailed information about the bathymetry of Great Lakes. This information was used. The dataset ETOPO5 (ETOPO5, 1988) has the resolution of 5min of arc and contains the bathymetry information also for some other large lakes apart from Great Lakes. But the quality of data is quite poor, so we refrained from using this dataset. The bathymetry for 30 other large lakes (apart from Great Lakes) was obtained from topographic and navigation maps in a graphic form by digitizing with kriging interpolation method used for gridding. Topographic and navigation maps were obtained from different sources, many sketch-maps were taken from the International Lake Environmental Committee database (ILEC, 1988-1993). Note that the model variable which communicates information between the lake and the atmosphere is the lake surface temperature. Its sensitivity to the lake depth is quite low for very deep lakes. In the lake model FLake (Mironov, 2008) which is used in many NWP and climate models to parametrise lakes, there is a limit to the lake depth of 50m. So, the bathymetry was included for large lakes which are not too deep (the mean depth is less than 70m), not too shallow (the maximum depth is more than 10m), and have the

difference between the mean depth and the maximum depth of more than 6m. In other words, the bathymetry is not included for the lakes which can be in practice characterized by their mean depth. So, the bathymetry for such big lakes as Lake Baikal, Lake Tanganyika, Lake Chad, Lake Balaton, and Lake Manitoba is not included.

4.2.2. Methodology

The methodology to combine automatically mean depth data for individual lakes with a raster map described in (Kourzeneva, 2010) was further developed and used. Its basic ideas are:

- A lake on a raster map (a “spot-lake”) is a set of conterminal pixels with the “lake” ecosystem type. Our task is to find correspondences between “spot-lakes” and lakes in the dataset for individual lakes.
- The dataset for individual lakes may have random errors in coordinates of a point on the lake water surface; the shoreline on a map is also defined with random errors. So, the probabilistic approach was used.

The new algorithm is described here briefly.

- For the lake H from the dataset for individual lakes we considered the coordinate vector X of a point on its surface as a continuous random value with the normal distribution. We assume that in the dataset for individual lakes its mean value X_0 is given. We prescribe the value of variance and calculate the field of probability P_h of the hit of this point into every pixel of the raster map within some influence radius around X_0 .
- We assume that the “spot-lake” L on the raster map corresponds to a lake L in reality. In the pixels of the raster map we appoint the field of probability P_b of the event that the pixel in question belongs to the lake L in reality. The field is constructed so that P_b decreases according to the square-law in the vicinities of the shoreline of the “spot-lake” L .
- For every lake H from the dataset for individual lakes we find the pixel on the raster map corresponding to X_0 . In the area around this pixel we calculate the probability field P_h . For every “spot-lake” L on the raster map within this area we calculate also the probability field P_b . The total probability P that the lake H is the same lake with the “spot-lake” L is $P = P_h \cdot P_b$. We find the maximum field value of P and set the correspondence between the lake H and the “spot-lake” L having the probability P .
- As a result of the previous step, every “spot-lake” L on the global raster map receives more than one correspondence with a lake H or it does not receive any correspondence. In the case of zero correspondence (the “spot-lake” L was not recognized), every pixel of the “spot-lake” L receives the default depth value. In the case of more than one correspondence we choose that with the maximum probability P value, and every pixel of the “spot-lake” L receives the depth value from the appropriate lake H .

We used the 15 km value for the influence radius and the 10m value for the default lake depth. The same default depth value of 10m was used for the lakes with missing lake depth information in

the dataset for individual lakes. All pixels of the raster map with the “river” ecosystem type received the default depth value of 3m. At the moment, only information from the dataset for freshwater lakes was used, the saline lakes were not included.

We applied the mapping method twice. First, preliminary run made possible to find and to fix the rough errors in the coordinates of large lakes in the dataset for individual lakes. The final product was obtained after the second run.

The bathymetry for large lakes was first interpolated into the grid of our raster map with the 30 sec. of arc resolution. The simple linear interpolation was used. Then the shoreline for every large lake was put into accordance with our raster map ECOCLIMAP2. The nearest-neighbour method was used for extrapolation if necessary. Finally, for the large lakes we replaced the mean depth lake values in every pixel by the bathymetry.

4.2.3. Products

1. The global gridded dataset containing lake depth information, namely the mean lake depth values or the bathymetry, with the resolution of 30 sec. of arc (approx. 1 km).
2. The additional dataset containing the variable S to estimate reliability of the lake depth information in every pixel of the grid. This variable is determined as follows. $S=0$ if there is no inland water, $S=1$ if the “spot-lake” was not recognized, $S=2$ if the “spot-lake” was recognized but with missing lake depth information in the dataset for individual lakes, $S=3$ if the real depth value was used, $S=4$ if there is a river and the default depth value for rivers was used. This dataset can be useful if we want to estimate the quality of our data.

These products are possible to download freely from the lake model FLake web page (<http://nwpi.krc.karelia.ru/flake/>). The datasets for individual lakes, freshwater and saline, as well as the list of lakes with the included bathymetry, all provided with references to the data sources, can be also downloaded from this web page. Illustrations for the gridded lake depth dataset are presented in Figs. 1-2 with the visualized lake depth data for the areas near Great Lakes and in Sweden.

4.2.4. Projection onto an atmospheric model grid

The lake depth field is discontinuous hence averaging of the lake depth values is incorrect. The method to aggregate the lake depth information onto an atmospheric model grid, which is in principle coarser than the grid for lake depth, was described in (Kourzeneva, 2010). The method is based on the empirical probability density functions for every grid box and uses the mode statistics (the most probable lake depth value for the grid box in question). This method is recommended also to apply for the presented gridded lake depth field with the fine resolution of 30 sec. of arc to project it onto the atmospheric model grid.

The appropriate software was developed and also can be downloaded from (<http://nwpi.krc.karelia.ru/flake/>). Different atmospheric models use very different coordinate systems, map projections and have very different grids. Hence, it is very difficult (if possible at all) to have the universal software, which does not need any additional efforts in programming from a user. So, the FORTRAN90 routine is provided to aggregate the lake depth data for one grid box of the atmospheric model (target) grid approximated by the polygon in geographical (longitude and latitude) coordinates. The output from this routine is the lake fraction for the grid box in question, the most probable depth of lakes in the grid box in question, and the most probable value of the

variable S (see above) for the grid box in question. If somebody prefers to use the average value instead of the most probable, this option is also possible. The examples of the output from this software, namely the fields of lake fraction and lake depth are shown in Figs. 3-4. For the target grid the rotated spherical coordinates are used with the new South Pole location in the point with geographical coordinates of 30° in longitude and of -30° in latitude, the resolution is 0.1° . The domain covers the area around Baltic Sea. It includes large lakes Lake Ladoga, Lake Onega, Lake Vanern, Lake Vattern, Rybinskoe Reservoir, and Lake Peipsi (Chudskoe).

4.2.5. Discussion

The automatic mapping method makes it very easy to include new lake data and to update the product. The quality of the final product is strongly dependent on presence of data in the dataset for individual lakes. It is very important to maintain it in future, adding new lakes and correcting the data.

Saline lakes should be also taken into account, bearing in mind their specific features. Rivers are defined in ecosystem datasets very poorly (except from GLWD, the situation is better there). Sometimes it is very difficult to distinguish automatically on the map the boundary between the river and the lake or between the river and the sea. Coastal lagoons, even freshwater, are treated by ecosystem datasets as “sea water” very often. In many cases distinguishing between different types of water bodies is difficult, as the definition of lake in reality is rather questionable (Lehner and Döll, 2004; Merchant and MacCallum, 2009).

Only express-comparison of the different raster maps was made. Better comparison would be useful. New raster maps will appear in future with the shoreline described more precisely (Bicheron et al., 2006; Merchant and MacCallum, 2009). They also could be used for mapping. The automatic method of mapping makes it possible to change easily the ecosystem dataset used for a raster map.

Note that the accuracy of the bathymetry data in the presented product is low and suitable only for atmospheric modelling, hydrological or environmental applications, but not for navigation. New bathymetry information for large lakes can be easily included, if we have the appropriate data. Bathymetry maps for large lakes in digital or graphic form do exist, although many of them are not free. This information should be included also.

Even if we could collect all the measured data on lake depth, this is not enough. In some regions (e.g. Northern Canada, Siberia) the depth was not measured at all for many lakes. So, indirect estimates, e.g. from the orography variation or from the surface temperature annual cycle, are very welcome. As least, the default lake depth value may depend on a region.

4.2.6. Conclusion

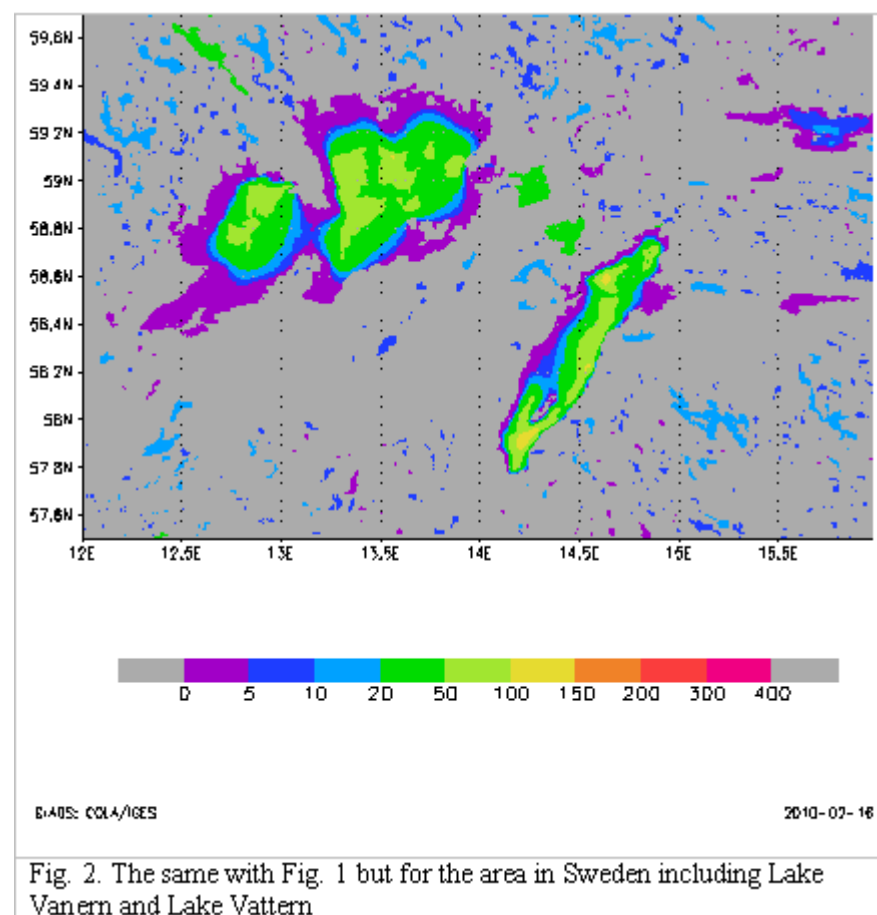
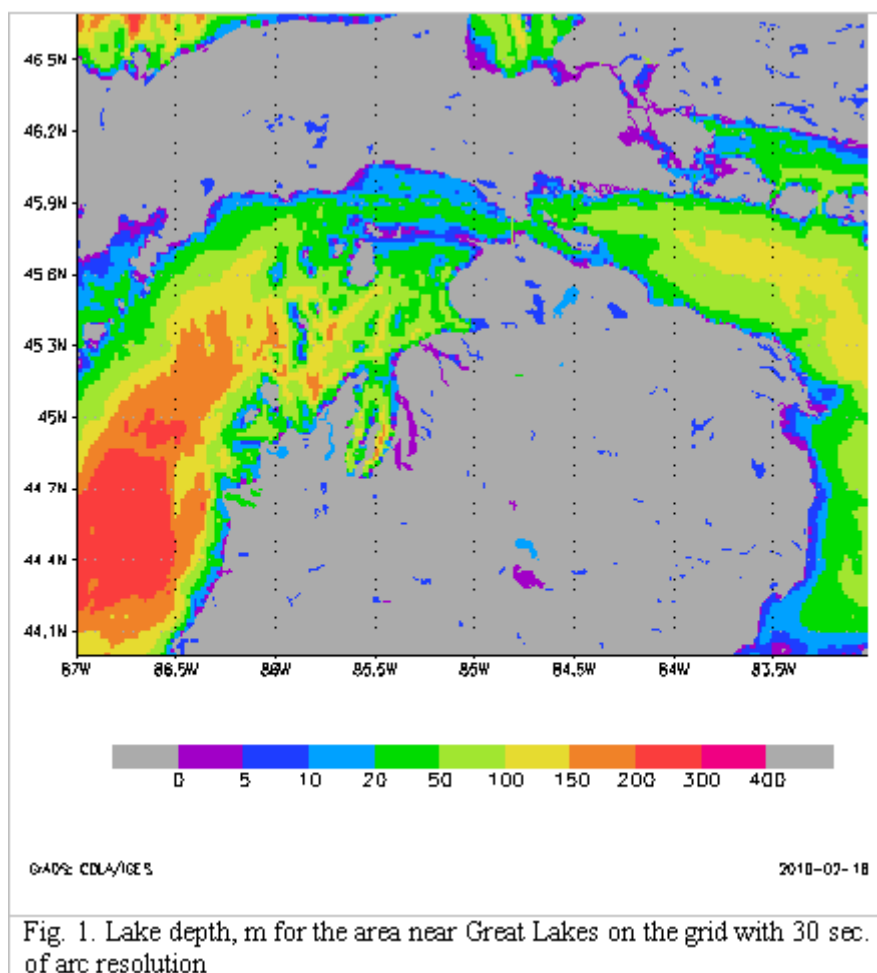
The new Global dataset for the parametrisation of lakes in Numerical Weather Prediction and climate modelling is presented. It contains global gridded data for lake depth, the mean values or the bathymetry, with the resolution of 30 sec. of arc and the additional dataset about the reliability of the depth data. They were obtained by mapping the information from the dataset for individual lakes comprising ca. 13 000 lakes, to the map of dataset for ecosystems ECOCLIMAP2 (Faroux et al., 2009; Champeaux et al., 2004). For mapping, the new method of appointed probabilities was used. The method is automatic, it allows easy maintenance of the product and provides good tools for further developments. The new lake depth data are highly desirable. To project the presented gridded lake depth data onto an atmospheric model grid, the method of empirical probability density functions is recommended. The appropriate software (FORTRAN90 routine) is provided.

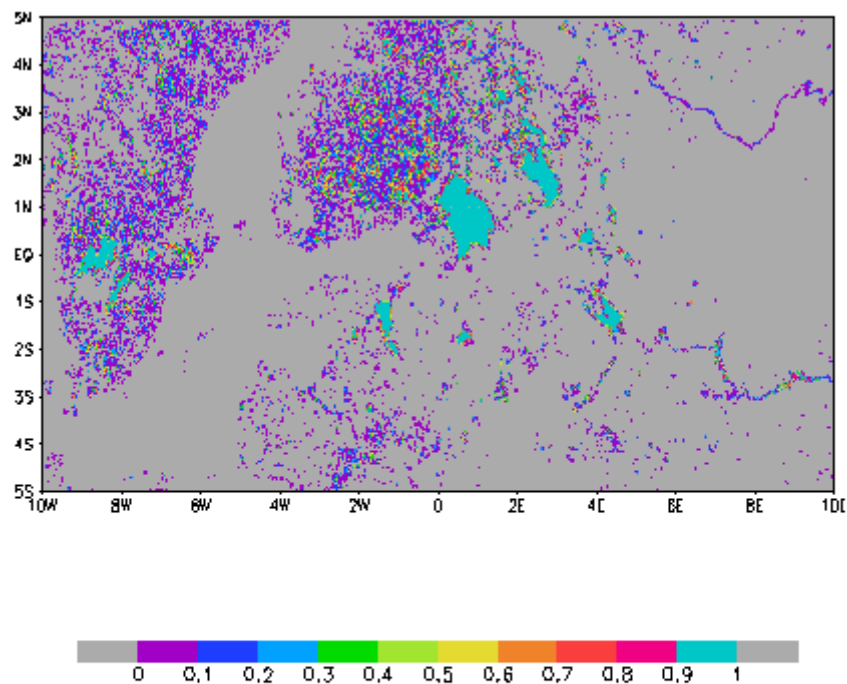
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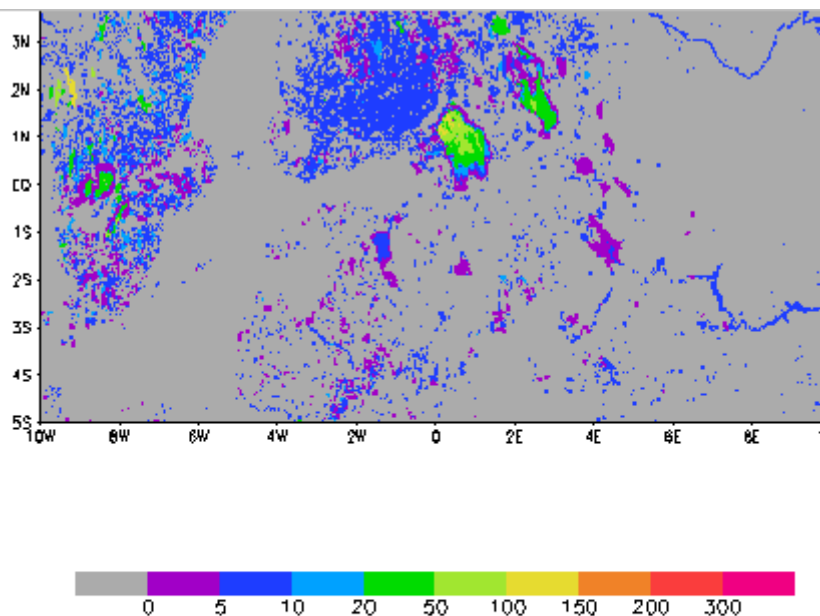




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Fig. 3. Lake fraction (0-1) for the atmospheric model grid with the resolution of 0.1° (see text for details), the domain covers the area around Baltic Sea



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Fig. 4. Mean lake depth in meters for the atmospheric model grid with the resolution of 0.1° (see text for details), the domain covers the area around Baltic Sea

5. PhD Studies

See: <http://www.cnrm.meteo.fr/aladin/spip.php?article88>

6. PUBLICATIONS

See: <http://www.cnrm.meteo.fr/aladin/spip.php?article18>