Operational and other ALADIN activities in Meteorological and Hydrological Service of Croatia in 2011

Antonio Stanešić, Stjepan Ivatek-Šahdan, Alica Bajić,

Tomislav Kovačić and Martina Tudor

1. Summary

The computer has been upgraded to 56 processors. A new, 24 hour high-resolution forecast is established using NH ALADIN dynamics and ALARO setup with 3MT.

Model version	resolution	points	levels	Start range	Assimilation	Driving model	Coup. fr.
ALADIN	8km	229x205	37	00/12 +72h	3DVar+OI	ARPEGE	3h
ALADIN/NH	2km	439x439	37	00from+06 fcst +24h	none	ALADIN 8km	1h

A switch to initialization of the 8 km resolution operational forecast from asimilation cycle (3DVar analysis for upper air fields and CANARI land surface analysis) is done in November.

2. Operational suite

2.1. Porting

AL36T1 is ported and used in the high-resolution NH run.

2.2 Computer upgrade

SGI Altix LSB-3700 BX2 Server with 56 Intel Itanium2 1.6GHz/6MB
112 GB standard system memory
2x146 GB/10Krpm SCSI disk drive, 1.6 Tb scratch disk

Storage: 32Tb online data + tapes
OS SUSE Linux Enterprise Server 9 for IPF with SGI Package

Compilers: Intel Fortran version 9.0.031 & C++ version 9.1.053
Queuing system (PBS Pro version PBSPro_11.1.0.111761)

Main users: NWP, Air-quality modelling & Climate modelling

Figure 1. Computers at CMHS.

3. Data assimilation

From mid February 2010, assimilation suite is run as parallel suite in Croatian Meteorological and Hydrological Service. The B-matrix was computed by standard NMC method by taking 100 forecast differences for period 15. February 2008 until 25. May 2008. Model runs were initialized with a 24 hours time difference and forecasts were valid at the same time (36h and 12h forecasts). Testing of the longer 1-yr period (Feb 2008 - Feb 2009) for standard NMC and ensemble computation of the B-matrix is in progress.

Verification results for seasons from March 2010 till mid August 2011 for 2m temperature and 2m relative humidity and surface pressure are presented. The best improvement is achieved for winter period when BIAS, RMS and SD are much better for forecast that use initial condition provided by assimilation cycle. There is still some problem during the summer connected with unrealistic to dry soil during the day or to wet soil during the night resulting with wrong 2m temperature and 2m relative humidity forecast. We intend to make the assimilation suite operational this autumn.

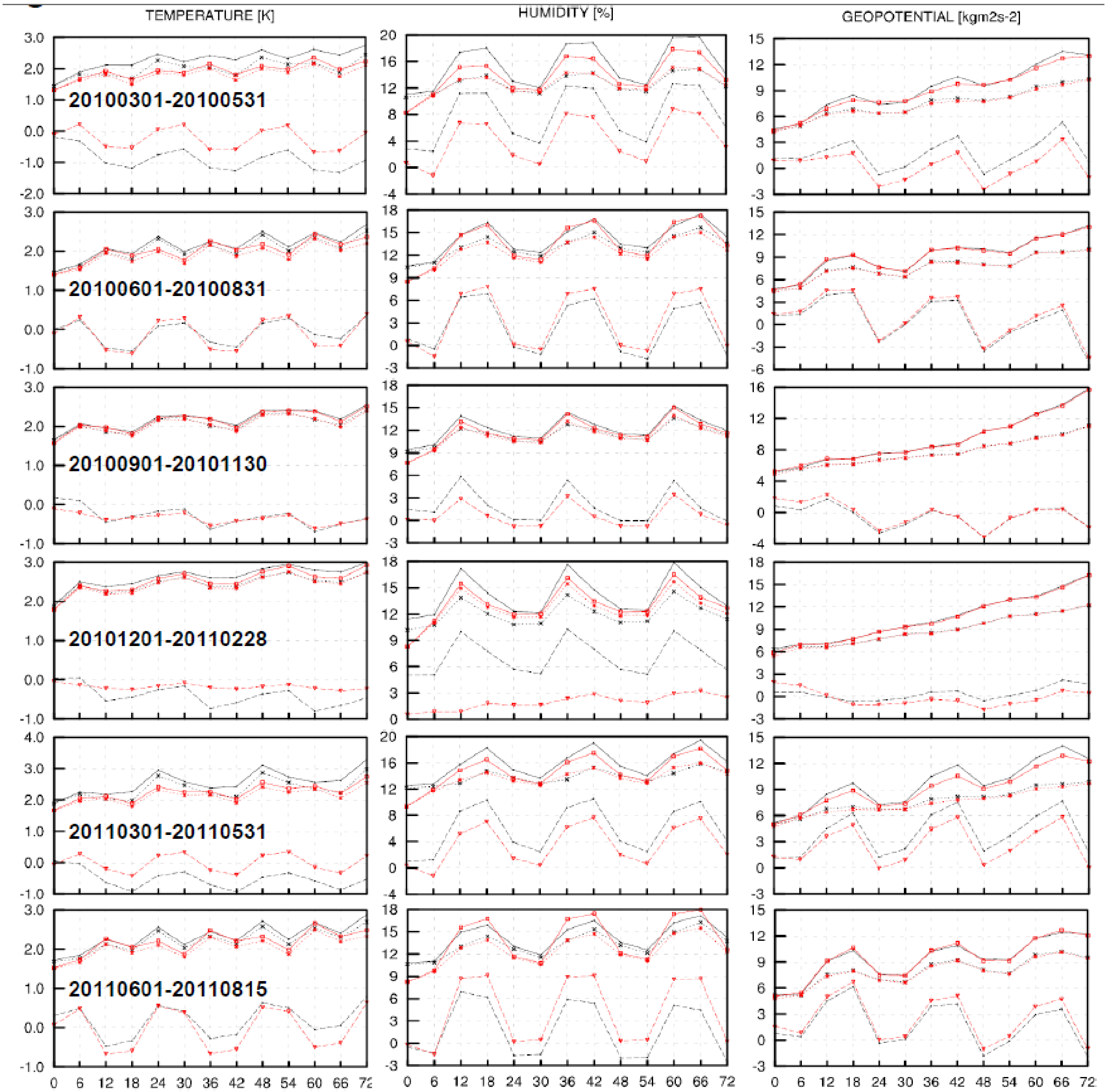
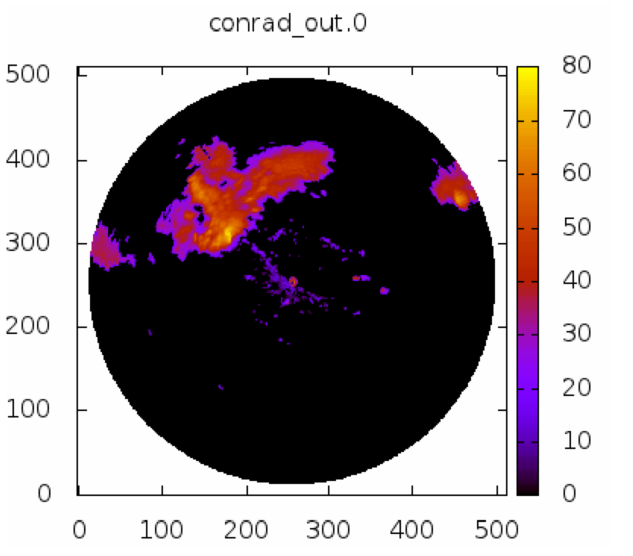


Figure 2. Verification scores for data assimilation and operational runs.

4. Assimilation of radar data in ALARO

RC LACE countries use ALARO aimed for resolutions of 4 km or less. At this resolution, radar data are an essential source of information. To make implementation of different data formats used in national services a tool that prepares environment for new data format was developed. The core of the software is C++ classes called Radar Classes. These are general classes for handling radar data. This year LACE joint HIRLAM in development of CONRAD and Radar Classes are built in CONRAD. Further development in assimilation of radar data is implementation of AROME reflectivity operator.



5. New high resolution NH run

From the beginning of July 2 km NH runs starts. Operational 8 km model forecast are used as initial and boundary condition. The initial file is 6 hrs forecast from the 8 km run started at 00 UTC, LBC frequency is 1 hour. Comparison of measurements with, 8 km and 2 km results for 24 hrs precipitation are shown bellow for few examples. In general results are reasonably good. However, a lot of tuning is still needed. For sure there is a problem with heavy precipitation nearby steep orography.

The 2km resolution precipitation forecast could benefit from several improvements and tunings, but there is little measured data available to validate such improvements. Radars cover only inland part of Croatia. Slovenian radar covers Istria, but on the edge of the range. The rain-gauge measurements available operationally in reasonably short time arrive from less dense network consisting mostly of SYNOP stations. Rain gauge measurements are collected from a more dense network, but these are available several months after the event. The high-density network reveals the high spatial variability of the precipitation intensity, while the operationally available measurements yield smooth precipitation.

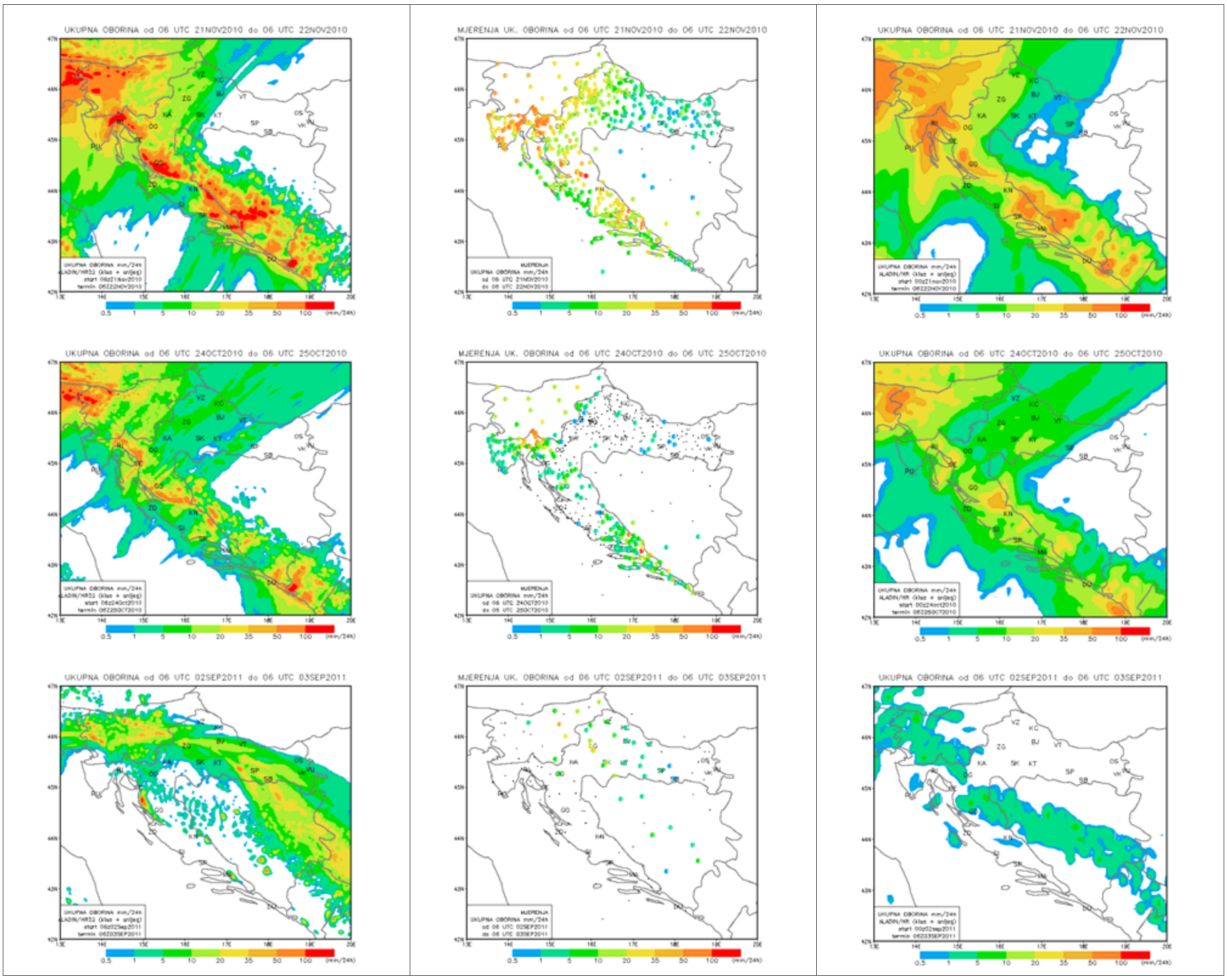


Figure 4. Forecast of the 24 hourly accumulated precipitation in 2 km resolution (left column), available rain gauge measurements (middle column) and 8 km forecast (right column) are shown for 3 days with precipitation.

Initialization of the 8 km operational suite from dynamical adaptation with DFI was replaced in November with initialization from assimilation cycle where 3Dvar analysis for upper air fields and CANARI analysis for land surface variables are used. The high-resolution NH run will use the 6 hour forecast of the 00 UTC run as the initial file.

6. Flash flood – Pula Case study

On 25th September 2010, just after midnight, intensive rain hit Pula city on the southern part of Istria Peninsula. The rain was intensive for several hours and the maximum measured rainfall rate at reached 43.9 mm per hour.

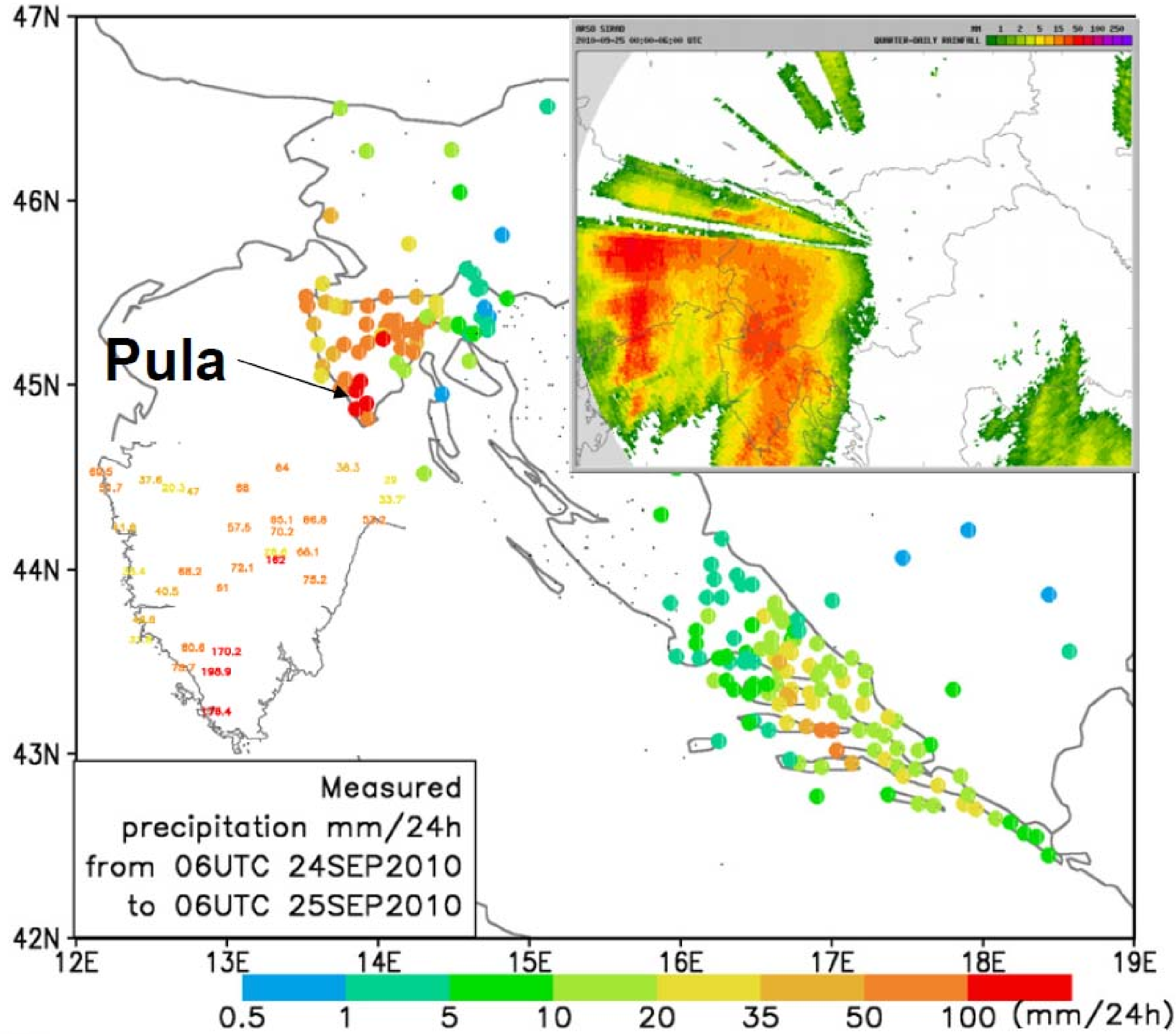


Figure 5. Rain-gauge measurements of the 24 hourly accumulated precipitation and from radar at Lisca (Slovenia).

Maximum 24 hours precipitation amount measured at rain-gauge network in Istria were higher than 100 mm on several stations. The 6 hours accumulated precipitation pattern from ARSO RADAR measurements (Thanks to Slovenian colleagues) shows one precipitation maximum over north-western Italy and second over Istria Peninsula.

The operational forecast without assimilation (coupled to ARPEGE) underestimated the precipitation intensity and put the rainfall maximum above north-western Italy. Similar results are achieved when ALADIN model was coupled with IFS with maximum precipitation little-bit closer to affected area on Istria Peninsula.

Improvement, spatially in structure of the precipitation was achieved if upper air assimilation (3D-Var) were used to produce initial conditions. Intensity was still too low, but the divergence from measured data is much smaller than without assimilation.

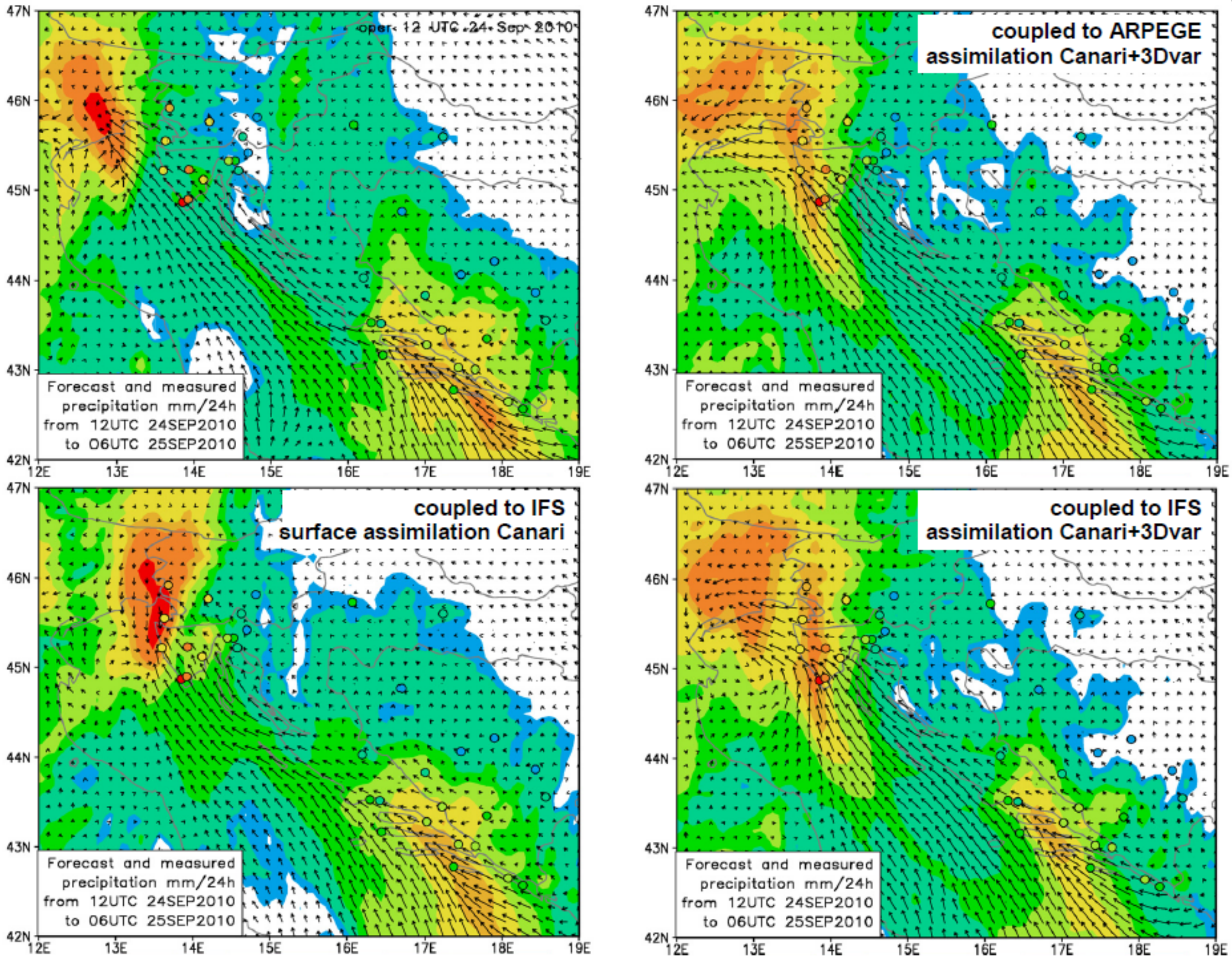


Figure 6. Forecasts of 18 hourly accumulated precipitation in 8 km resolution using different initial and boundary conditions. The operational one is coupled to ARPEGE using DFI (top left).

7. Published papers

Horvath, Kristian; Bajić, Alica; Ivatek-Šahdan, Stjepan: Dynamical Downscaling of Wind Speed in Complex Terrain Prone To Bora-Type Flows. Journal of applied meteorology and climatology. 50 (2011), 8; 1676-1691.

Stanešić, Antonio: Assimilation system at DHMZ - Development and first verification results. Croatian Meteorological Journal. 44/45 (2011); 3-17.

Tudor, M. The meteorological aspects of the DART field experiment and preliminary results. Croatian Meteorological Journal. 44/45 (2011); 31-46

Wang, Yong; Bellus, Martin; Wittmann, Cristoph; Steinheimer, Martin; Weidle, Florian; Kann, Alexander; Ivatek-Šahdan, Stjepan; Tian, Weihong; Ma, Xulin; Tascu, Simona; Bazile, Eric: The Central European limited-area ensemble forecasting system: ALADIN-LAEF. Quarterly Journal of the Royal Meteorological Society. 137, (2011), 655; 483-502.