DIAGNOSTIC MAPS OF CAPE FROM LAM AND DATA FROM NETWORK OF SYNOPTIC STATIONS

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Abstract: The convective available potential energy (CAPE) can be calculated from radio sounding data or from outputs of numerical weather prediction model. Comparison of values of CAPE obtained in these two wais reveled that there are errors in model's CAPE. By replacing data at lowest level of the model by measured data CAPE was calculated that has excellent agreement with measured CAPE. This gives us opportunity do make accurate and detailed maps of CAPE combining model outputs with data from synoptic station. The accuracy of such maps is confirmed by radar images of 30 May 2001 thunderstorms.

Keywords *– CAPE, thunderstorm, NWP, nowcasting*

1. INTRODUCTION

The convective available potential energy (CAPE) is used as index of convective instability and in parameterization of convection in numerical weather prediction models. It can be calculated from radio sounding data or from model outputs. Radio soundings are very sparse in time and space while model data can have errors. Ducroqu et al, 1998, examined ability of CAPE derived from model data for early warning of convection. They used data from limited area model ALADIN and found a combination of CAPE and low-level moisture to be a good diagnostic tool for all analyzed situations. Brzovic, 1995 has shown that severe storms with hail in Croatia were connected with extreme values of CAPE derived from atmospheric soundings in Zagreb. A simple method to calculate CAPE that combines measured data and data from numerical weather prediction model is demonstrated here.

2. DESCRIPTION OF THE METHOD

Comparisons of convective available potential energy (CAPE) calculated from radio sounding data from Zagreb-Maksimir with CAPE calculated from initial and prognostic pseudotemps (artificial soundings derived from ALADIN's initial and prognostic fields) for Zagreb gave correlation coefficients within 0.48 and 0.57. Explained variance, R^2, by linear regression equation with CAPE from soundings as dependent variable and CAPE from pseudotemps as independent variable is less or equal to 34%. As it was expected that error was coming form model's surface data. To achieve better results surface values of pressure, temperature and specific humidity in pseudotemps were replaced with measured values. With this correction in pseudotemps a very good agreement between CAPEs calculated from pseudotemps and those from radio soundings was achieved. Explained variance by regression equation is between 95%, at the initial moment of the model's run, and 80%, for 48 hour forecast. CAPE calculated combining measured surface data and upper level data from model we call corrected CAPE (cCAPE). It can be calculated in every point with surface measurements provided data from model at this point for the same instant of time. As the network of surface measurements is much denser than radio sounding network and measurements are more frequent we can draw a map of cCAPE with more details in it then when only radio soundings are used and more accurate than when only model outputs are used. Such maps can be used as a diagnostic tool in nowcasting, in model verification and in research of thunderstorms.

3. RESULTS

A thunderstorm on 30 May 2001 was chosen to compare cCAPE maps to radar images. Thunderstorms started to develop in Slovenia about 12 UTC. They were moving eastward into Croatia. Such state persisted the whole afternoon and night, until early morning next day. Some storms developed in Croatia and some in Bosnia and Herzegovina, too. The beginning of the storms can be seen on the radar image at 12:50, Fig. 1. The main storm at that time was in southeastern Slovenia. This corresponds well with cCAPE at 12:00 (Fig. 2b) and not so well, but still good with CAPE (Fig. 2a) from limited area model ALADIN. On both maps CAPE was calculated at the same points. There was some stormy weather in Austria and Bosnia and Herzegovina but no data from there were used and cCAPE there is interpolated or extrapolated from regions with data. The same holds for CAPE over Adriatic see. Storms in Bosnia and Herzegovina can be linked to two maximums in cCAPE, one in central part of northern and the other of southern Croatia. The orography of this study's region is very complex, islands, coast line, mountains, plateaus, valleys ad flat land can be found. One would expect that position of synoptic

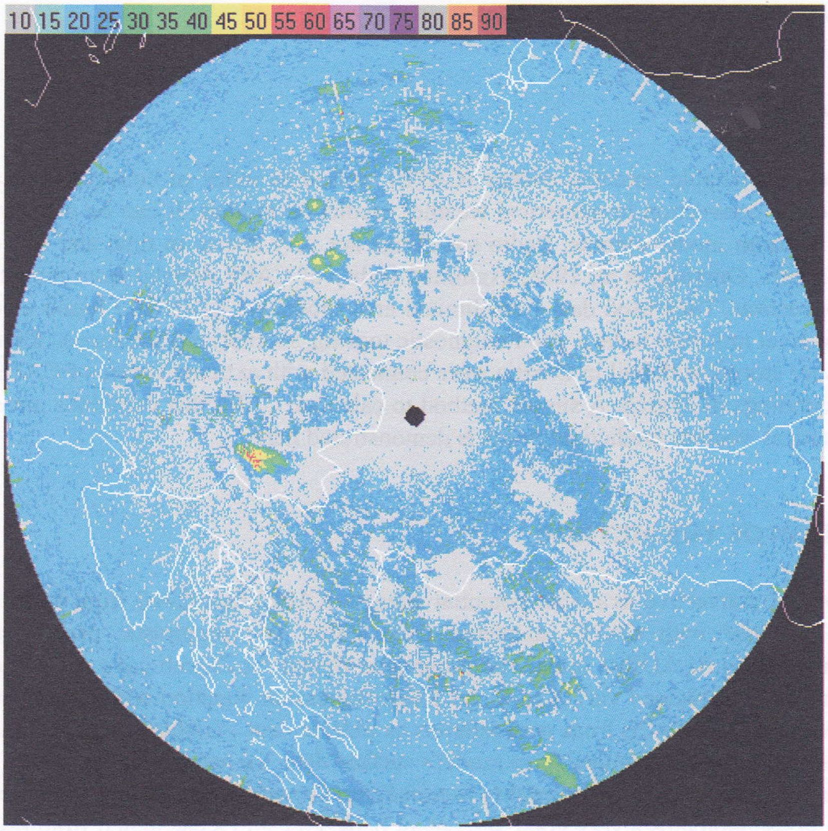

Figure 1. Radar image at 12: 50 UTC on 30 May 2001. Scale on the top of the images in dBZ.

stations on different kinds of terrain has influence the values of cCAPE and that terrain features would be visible in cCAPE field. According to the shown map of cCAPE it seems that just the most elevated station Kredarica (2514 m) in the northwestern corner of Slovenia gives lower values than at surrounding station with exception of station Bovec placed to the northwest form Kredaric. At the same time at station Zavizan (1594 m) on mountain Velebit, cCAPE is just slightly lower than on neighboring stations. Third of the most elevated stations is Puntijarka (988 m) on mountain Medvednica, to the north from Zagreb. It has cCAPE much bigger than on stations in the flat land around it. There are two more mountain stations Lisca (943 m) in Slovenia and Parg (863 m) in Croatia. The cCAPE values at these stations doesn't differ from those on surrounding stations. At the island stations and those on the Adriatic cost higher values of cCAPE often can be seen but no thunderstorm occurs. The reason could be a high value of convective inhibition (CIN). A deficiency of this method when used as nowcasting tool is that corrected CIN cannot be calculated in the same manner as CAPE. If model gives wrong CIN it means that all variables in PBL are wrong and they must be recalculated.

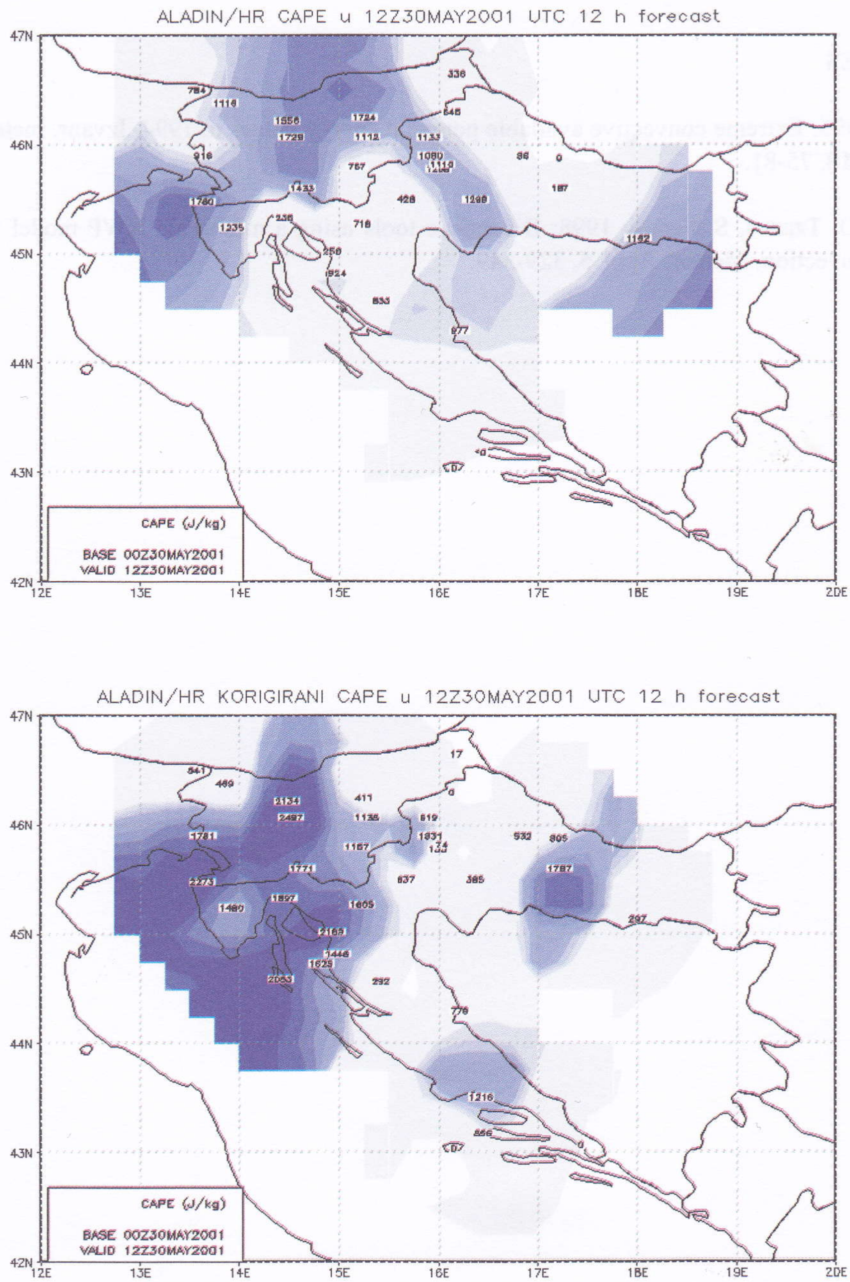

Figure 2. CAPE from a) limited area model ALADIN and b) cCAPE, from ALADIN data with surface data replaced with measured data. The maps are for 30 May 2001 at 12:00.

4. CONCLUSION

Combining data from synoptic stations with upper level data from model we can draw accurate and detailed maps of CAPE. Positions of maximums in CAPE field are in good agreement with positions of thunderstorms. This is valid even over complex terrain. Only at very elevated station (Kredarica, 2514 m) lower value of CAPE was found than on surrounding stations. The method can be used in nowcasting to predict convective instabilities, in validation of model's and in research of thunderstorms. The drawback is that we cannot calculate CIN in the same way.

REFERENCES

Brzovic, N, 1995: Extreme convective available potential energy values in 1994. Izvanr. meteorol. hidrol. prilike Hrvat, **18**, 75-81.

Ducroqu V., D. Tzanos, S. Senesi, 1998: Diagnostic tools using a mesoscale NWP model for the eatly warning of convection. Meteor. Appl. **5**, 329-349.