SEVERE THUNDERSTORM FORECASTING OVER PIEDMONT USING THUNDERSTORM INDICES FORECASTED BY COSMO-LAMI

Paolo Bertolotto[1]

[1]*ARPA Piemonte, Area Previsione e Monitoraggio ambientale, Corso Unione Sovietica 216, Torino, Italy, paolo.bertolotto@arpa.piemonte.it*

I. INTRODUCTION

There are relatively few studies about the behaviour of atmospheric instability indices in forecasting severe thunderstorms (Reap and Foster, 1979; Andersson et al., 1989; Schultz, 1989; Jacovides and Yonetani, 1990; Lee and Passner, 1993; Huntrieser et al., 1996; Haklander and Van Delden, 2003), however the knowledge of the indices value and their ability to discriminate between thundery and non-thundery days may be very useful to forecasters. Here the effectiveness of five predictors forecasted by COSMO LAMI over Piedmont is evaluated by using verification parameters as Pierce Skill Score and probability distributions. In addition, the effectiveness of a combination of these scores is evaluated in order to improve the forecast skill of the single indices.

II. PRESENTATION OF RESEARCH

The behaviour of five parameters during the summer 2004-2005-2006, computed by COSMO LAMI and operatively employed in forecasting thunderstorms over Piedmont is evaluated. The first aim of the work is to detect the critical values of the instability indices in discriminating between thundery and non-thundery days (see fig.1 as an example). Thundery days are identified by identifying 6-hour intervals in which precipitation exceeded a 30 mm threshold and at least one lightning was detected over a specifical Piedmont warning area (Piedmont was divided in 4 main areas to this aim, see fig. 2).

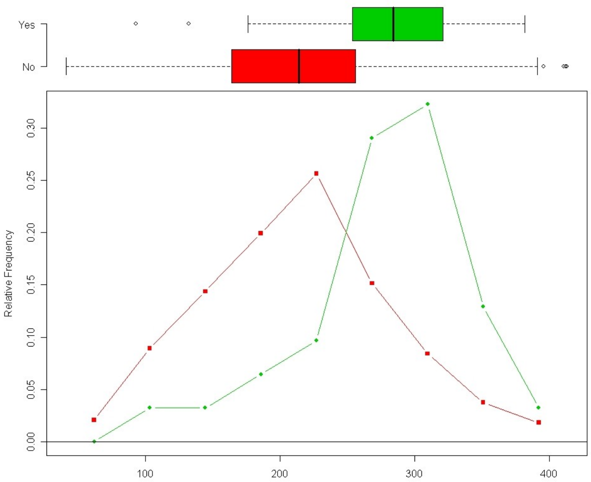

FIG. 1: Relative frequency distribution of SWEAT index forecasted by COSMO LAMI over Piedmont Southern reliefs for thundery (green) and non-thundery days (red).

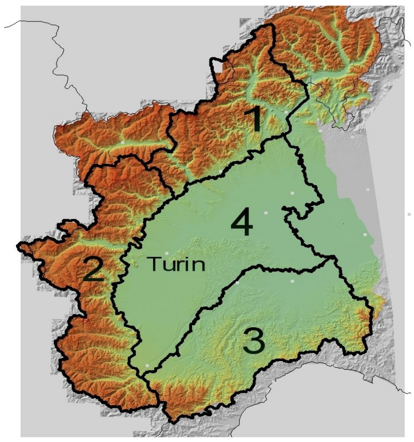

FIG. 2: Piedmont thunderstorm warning areas

Secondly, some verification scores, in particular Pierce Skill Score (TSS), were computed in order to complain which parameters are the best thunderstorm predictors over every area.

Param.	**PSS Area1**	**PSS Area2**	**PSS Area3**	**PSS Area4**
K	**0,40 (35)**	**0,54 (37)**	0,27(29)	**0,42 (33)**
SLI	**0,40 (-3)**	0,45 (-5)	0,36 (-3)	0,29 (0)
SWEAT	0,25 (187)	0,45 (285)	**0,39 (218)**	0,29 (222)
CAPE	0,36 (1610)	0,48 (3410)	0,28 (1490)	0,29 (790)
DThE500 -950 hPA	0,31 (-11)	0,39 (-23)	0,32 (-12)	0,29 (-2)
Piedmont Combin.	0,38	0,48	0,32	0,35

TABLE I: Maximum PSS with correspondent index value of the five parameters forecasted by COSMO-LAMI and the Piedmont combination for the forecast time +24h/+48h (better scores results bolted).

Thirdly, a simple parameter combination (called Piedmont combination in table1), used operatively by ARPA Piemonte (even though on a slightly different form) and based on the critical parameters values found previously, was verified over the same set of data and over an independent one (summer 2007).

III. RESULTS AND CONCLUSIONS

In this work a set of 1104 6h intervals were used as a dataset over 4 Piedmont areas (Northern Alps, Western Alps, Southern reliefs and plains) whereof only about 3-4% were affected by thunderstorms. We deal, therefore, with a problem of rare events verification, so we choose to use PSS (Doswell et al., 1990; Huntrieser et al., 1996) to verify the COSMO-LAMI parameters reliability.

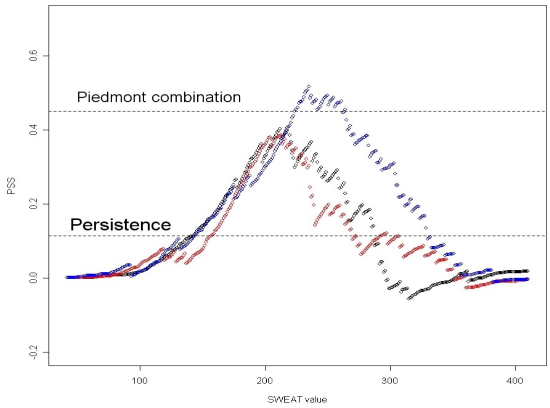

FIG. 3: SWEAT index PSS for day1(black), day2(red) and day3 (blue) compared to persistence and Piedmont combination PSS over Southern reliefs (area3).

We found some critical values that can discriminate between thundery and non-thundery intervals over every area and for every forecast time (00/+24h, +24/+48h, +48/+72h, or alternatively called day1, day2 or day3) but the skill scores values are low and the false alarms dominate the dataset, pointedly ruling out the correct negatives.

Comparing the parameters behaviour, it has found that the best one is mainly K index, and in some exceptions SLI or SWEAT index, but the discriminating values are not always the same for forecast day1, day2 or day3 (see fig.3 as an example).

The Piedmont combination used operatively is developed taking averaged parameters discriminating values for every different area and considering “thundery intervals” the ones wherein three of the five parameters exceed the critical values. It shows a pretty good behaviour compared to the other parameters, even though not exceeding the K index itself. However it has the advantage of considering fixed discriminating values for forecast day1, 2 and 3. At the end of summer 2007 the parameters will be verified over that independent dataset.

IV. ACKNOWLEDGMENTS

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