ASSESSMENT OF MAXIMUM PRECIPITATION RATES IN THE SOUTH-EASTERN ALPS

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Abstract: A method for assessment of maximum precipitation rates in the South-Eastern Alps calculated from observed low-level wind speed, air-mass specific humidity and mountain slope is presented. The results show good potential of method, especially for estimation of possible pre-frontal precipitation rates.

Keywords – *Assessment of maximum precipitation rates*

1. INTRODUCTION

Occasionally even high resolution models fail to capture the extreme precipitation events. The source of errors is mainly due to low resolution of model orography resulting in improper shape of trajectory of incoming air-mass leading to usually underestimated wind speed of low-level jet and too low humidity of the air-mass. The method presented in the following paper could be used for diagnosing such errors.

Usual indicators for diagnosing extreme precipitation events (e.g. CAPE) are not applicable in complex terrain because of their high spatial variability. Using Doswell (1996) 'ingredients-based methodology', where the low-level upward vertical motion may be controlled either by orography (w_{oro}) or the environment (w_{env} - e. g. synoptic system), Lin e al. (2001) evaluated the orographic contribution as:

$$LIN = U(\partial h/\partial x)q \qquad (1)$$

where U is low-level wind speed (low-level jet), $(\partial h/\partial x)$ is mountain slope and q is air-mass specific humidity. In the paper authors studied several extreme precipitation cases all around the world, comparing *LIN* index, CAPE values and 24 hours precipitation accumulation, while our intention is to find the skill of method for assessment of maximum precipitation rates for the nowcasting or very short range forecasting (+12 h) purpose.

2. CASE STUDIES

The method has been applied for the region of South-Eastern Alps, calculating the index from the Udine radiosounding, located 20 km upstream from the main mountain ridge.

The studied cases are MAP IOP 10 and several other extreme precipitation events in years 2003 and 2004 with precipitation rates up to 89 mm/h. The cases with south-westerly winds (200 to 240 degrees) when usually the precipitation rates are the highest are selected. The index is calculated at the level between 960 an 915 mb where Uq product has the maximum. The detailed comparison of maximum precipitation intensities and *LIN* index show that in most cases 6 hours resolution of radio-soundings measurements is necessary, therefore the maximum value is selected from precipitation rates which are measured only up to 6 hours later than the radiosounding observation.

The main focus is given to the correlation between the value of *LIN* index and the maximum hourly precipitation rate which is shown in Fig. 1. This is of the main interest for some purposes (civil protection, discharges of rivers, nowcasting). Where rainfall measurements are not available, the radar derived rainfall accumulations of ARPA FVG (Friuli) radar are used. In Fig. 1 one can see good correspondence of the highest precipitation rates and regression line, but there is still a gap in data between 50 and 89 mm/h which could have impact on the slope of line. The values much above the regression line could be due to influence of synoptic system (cold front approach) which can increase vertical motion or due to lack of data in lower levels of radiosounding which could lead to the

underestimation of low-level wind speed or air-mass specific humidity. The reason for deviation of lower values and the regression line could be underestimation of maximum precipitation rate due to insufficient density of rainfall measurements in time and space.

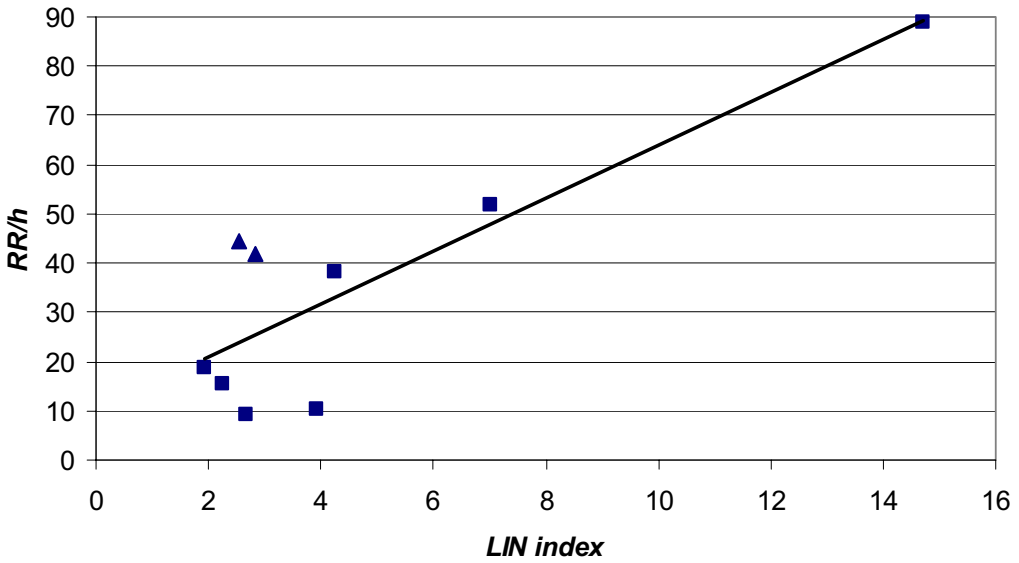

Figure 1. Scatter-plot of maximum hourly precipitation rate *RR/h* [mm/h] against *LIN* index in *gm/kg* with regression line**.** The precipitation rate is calculated either from 5 min accumulations or from radar derived rainfall accumulations of ARPA FVG (Friuli) radar. Square mark denotes pre-frontal accumulations, triangle mark frontal precipitation.

3. CONCLUSION

The correlation between values of maximum observed precipitation rates and *LIN* index values is significant, rendering the method a promising one for this region particularly for the pre-frontal type of precipitation. Before the implementation in the operational use further case-studies with precipitation rates between 50 and 89 mm/h should be added and reasons for deviations should be studied.

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