LOCAL FORECAST VERIFICATION IN THE REGIONAL BULLETTIN "DOLOMITI METEO"

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Abstract: The Avalanche Centre of Arabba since the last 25 years is issuing weather forecast, in a regional scale, for the venetian Dolomites and Prealps, a mountainous area about 5000 km^2 large on the southern slope of the eastern Alps. Since 2005 the regional bullettin contains also an experimental section, in which a specific forecast 24h valid is made, for 8 places which are particularly representative of the venetian mountain, both for climatic and social-economical manner. Data, forecasted for the day after the issue's day, concern the Low and the High temperatures, the cloud cover, the chance (%) of precipitation and the cumulated value separated in rain and/or snow. A verification of the accuracy of the local forecast has been made ex-post for the years 2005 and 2006, comparing the temperatures and precipitation forecasted values with the data measured by the automatic stations' network. The results of this first verification were altogether encouraging and remarked the necessity to investigate deeperly, by a forecasting point of view, the synoptic situations which brought the biggest deviations, as the nocturnal irradiation, the daily range of temperatures with low relative humidity values, the thermoconvective precipitations and the heavy rainfalls.
The analisys of the forecasted data errors considered the absolute and the standard deviation, and the percentage destribution of the different kind of error, negative and positve, only about the temperatures data.

Keywords: *Forecast Temperatures Precipitation verification, venetian Dolomites Prealps*

1. INTRODUCTION

Weather forecast are nowadays assuming a "social" significance: every day thousands of users consult the bullettins that different Agencies, internet websites or other private services too, issue.

The demand of detailed weather forecasts is growing up, and limited area weather forecasts are looked for, with high precision data requested.

Since long time the weather forecast bullettin "Dolomiti Meteo", daily issued by ARPAV, Avalanche Centre of Arabba, pursues the way of the detailed forecast. Since 2005 new forecast elements have been introduced in the bullettin, in order to improve the level of information.

The most innovating aspect of the bullettin concerns the creation of a schedule, named "Local Forecast", in which, for the day after the issue's day, some significative parameters are forecasted for 8 places of the venetian Alps, both of them representative of an omogeneus area. The places are:

Bosco Chiesanuova (VR) (1050 m asl), for Verona Prealps;
Asiago (VI) (1010 m asl), for Vicenza Prealps;
Belluno (396 m asl), for Belluno Valley and Belluno Prealps;
Agordo (BL) (578 m asl), for the southern Dolomites;
Arabba (BL) (1645 m asl), for the central Dolomites;
Cortina d'Ampezzo (BL) (1180 m asl), for Ampezzano, central-northern Dolomites;
Pieve di Cadore (BL) (841 m asl), for Low Cadore, eastern Dolomites;
Sappada (BL) (1264 m asl), for Comelico-Sappada, northern Dolomites.

The forecasted data in the schedule concern the following parameters:

- Low and High temperatures 24/h;
- cloud cover situation during the periods 00-06 (night), 06-12 (morning), 12-18 (afternoon) and 18-24 (evening);
- chance (%) of precipitation during the periods 00-06 (night), 06-12 (morning), 12-18 (afternoon) and 18-24 (evening);
- forecasted precipitation accumulation 24/h, separated between rain (mm) and/or fresh snow (cm).

A first verification has been made comparing the measured data with the forecasted ones. The comparison concerns temperatures and precipitation data, and is referred to the years 2005 and 2006. For every place the daily Low temperature, the daily High one, and the daily cumulated precipitation amount have been analized.

The comparison between real and forecasted data is really important to determine the confidence of the local forecast.

2. DATA AND METHODS

A double comparison has been considered:

1. absolute and standard deviation between forecasted and measured data; in this case no evaluation has been made about the sign of the error (positive or negative). The comparison concerns temperatures and precipitation data too;
2. real deviation between forecasted and measured data; in this second case the evaluation concerns only temperatures data, analizing the percentage of the different kind of deviation (underestimation or overestimation).

Temperatures:

The daily Low and High temperatures (special daily values) are considered as recorded by the automatic stations, and they have been compared to the forecasted values foreseen on the daily bullettins for each places. In case of lack of data for some station, the day has not be considered for the single place.

A first analisys concerns the absolute deviation, as the evaluation of the size of the error, without considering if this error determines an underestimation or an overestimation compared to the real value. For the two years under examination (2005/2006) the arithmetical average, and the standard deviation too, have been calculated for any single place. Then the general average, between the average value for any place, has been calculated. A deeper analisys, made for the two places in which the highest errors results, concerns the comparison between the daily deviations in the two years.

In order to determine if the error causes an underestimation or an overestimation of the forecasted values, a second analisys about the real deviation (positive, negative or 0), and the percentage distribution of the kind of error has been determined for the two years.

Precipitation:

The confidence of the forecast daily precipitation amount has been made according to the following standard: due to the difficulty of the rain (or snow) amounts forecast, the forecast of this parameter gives an indication of a range of minimum/maximum (e.g. 5/10 mm); the forecast, in the example, must be considered correct in case of measured precipitation daily amount between 5 and 10 mm. The deviation is calculated considering the value (min or max) nearest to the measured data. For example, in the case overseen, a real precipitation amount of 4 or 11 mm determines an absolute deviation of 1 mm.

The fresh snow amounts has been compared with the rain amounts; due to the lack of a measured snow density value (and then of a water equivalent value) the mean value of 100/kg m^3 has been taken, considering a settled ratio of 1 mm = 1 cm. So the instrumental rain data measured by the automatic stations' network have been compared to the forecasted precipitation data apart the kind of precipitation (rain or snow).

In case on a station in the same day rain and snow are both forecasted, the considered value is the sum of the two values forecasted. So, for example, a daily forecast of 5/10 mm of rain + 5/10 cm of fresh snow gives a cumulated precipitation forecast of 10/20 mm; this is the value used to compare the forecast data with the instrumental measured data.

The error evaluation in precipitation forecast concerns only the days in which a precipitation has been really measured (also if not forecasted) and in which the precipitation has been fortecasted but did not really happen. The days in which the lack of precipitation has been correctly forecasted have not been considered.

3. RESULTS

Temperatures:

The results of the analisys of the temperatures' values deviation show a stable situation in the two years under examination. The most significant aspect seems to be the constancy of the single deviation for each place. For each year the biggest errors concern the same stations for the Low temperatures and for the High ones too. Particularly the station of Asiago (Vi) shows for the two years the biggest absolute and standard deviations in the forecast of the Low daily temperature, and the station of Pieve di Cadore (Bl) shows the biggest absolute and standard deviations for the High ones. In these two cases the mean absolute deviation is bigger than 2°C in 2005 and in 2006 too. For all the other stations, for the Low and the High daily temperatures too, the yearly average absolute deviation is very close or lower than 2°C in the two years, with

the lowest value for the station of Arabba, where the average yearly absolute deviation for the Low daily temperature is 1.32°C in the year 2006.

Considering the standard deviation, except for the station of Asiago in the year 2005 (2.02), all the values are lower than 2°C, with some values really near to 1°C. All the values, for any single place, are lower than the absolute deviation.

Analizing the sign of the deviation the results show a significant different distribution between the Low temperatures and the High ones. Also in this case the trend doesn't change in the two years: concerning the Low temperatures the bigger part (around 45%) of the deviations consists in an overestimation of the forecasted temperatures; the residual distribution consists in around 35% underestimation and around 20% right forecast (deviation +/- 0.5°C). About the High temperatures the distribution is inverse: around 51% consists in an underestimation, around 32% overestimation and around 17% right forecast (deviation +/- 0.5°C).

Precipitation:

The absolute and standard deviation analisys for the precipitation forecast looks quite more uncertain respect to the temperatures. The absolute deviation shows very low values, but this is only an arithmetical analisys, made comparing the measured daily precipitation amounts with the forecast, considering the value nearest to the max or min forecasted data. More information comes from the standard deviation, which results bigger than the absolute deviation for every single place in the two years.

The average absolute deviation values are 2.5 and 1.8 mm in 2005 and 2006, but these values consider any event at the same manner, not considering the size of the amounts (which cuold be very changeable), for all the rain (or snow) events. So it is clear that in case of forecast of light precipitation, the possibility to have really close measured data are relatively high.

The standard deviation results in every case higher than the absolute deviation, respectively 5.2 and 4.4 mm in 2005 and 2006.

4. CONCLUSION

The deviations between the forecasted temperatures and precipitation data and the measured data result acceptable, also if for some stations, characterized by particular microclimatic conditions, the deviation are significatively stronger than the average.

Temperatures:

Particularly the stations placed in the valley bottoms or in depressions (Asiago, Agordo, Belluno) usually present stronger deviation concerning the Low temperatures values, especially during the winter season. Especially in case of strong thermal nocturnal dispersion the deviation could result singificatively high. The station placed aloft, or on a slope (Bosco Chiesanuova, Arabba) depend more on the free atmosphere thermal conditions. In any case the most important parameter to correctely forecast the Low temperatures seems to be the cloud cover situation above any single place.

Concerning the High temperatures forecast, no particular synoptic or local parametr seem to condition directly the deviation. Especially during the summer time a strong deviation between the measured temperatures and the temperatures indicated by models for the different altitude range can often be observed, also if usually the temperature's peaks appear for very short times during the day. Other strong deviations can be observed in case of low relative humidity values during the day, especially on the slopes and aloft, where the forecasted High temperatures result lower than the measured ones; in the valley bottoms, usually interested by higher relative humidity values, the deviation are usually lower.

In any case, absolute deviation lower than 2°C can be considered encouraging.

Concerning the standard deviation it is possible to notice that the values are always lower than the arithmetical averages. This means that most of the deviations are concentrated in a range really close to the measured values, and this is encouraging too.

The causes of the different distribution between the kind of error (under or overestimation), must be deeper analized, considering separtely the Low and the High temperatures forecast.

Precipitations:

Analizing the precipitation deviation data it is possible to consider the precipitation forecast reliable. It's clear that the chance to purpose a range of min/max makes the forecast easier. Nevertheless in some single cases the deviations were very high, also some tens of mm; usually this size of errors happens in case of thunderstorm during the spring or summer time; in fact the predictability of a thunderstorm event on a single

and well located place is really very low. During autumn/winter time the error is usually lower, due to the help that the models' indications gives to the forecaster about the rain amounts.

Concerning the standard deviation it is possible to notice that the values are, contrary to the case of temperatures, always higher than the arithmetical averages. This confirms that the forecast of precipitation remains more difficult, and the changeability of the precipitation events is ususally strong.

5. TABLES AND FIGURES

Table 1: Absolute deviation – Low and High temperatures 2005/2006.

2005				2006		
Absolute deviation (°C)				**Absolute deviation (°C)**		
	T min	**T max**			**T min**	**T max**
Bosco C.N.	1.41	1.80		Bosco C.N.	1.46	1.67
Asiago	2.44	1.88		Asiago	2.20	1.82
Belluno	1.85	2.02		Belluno	1.68	1.86
Agordo	1.70	2.03		Agordo	1.65	1.98
Arabba	1.48	1.69		Arabba	1.32	1.88
Cortina	1.58	1.93		Cortina	1.64	1.90
Pieve di Cadore	1.62	2.29		Pieve di Cadore	1.44	2.20
Sappada	1.66	1.82		Sappada	1.71	1.81
average	**1.72**	**1.93**		**average**	**1.64**	**1.89**

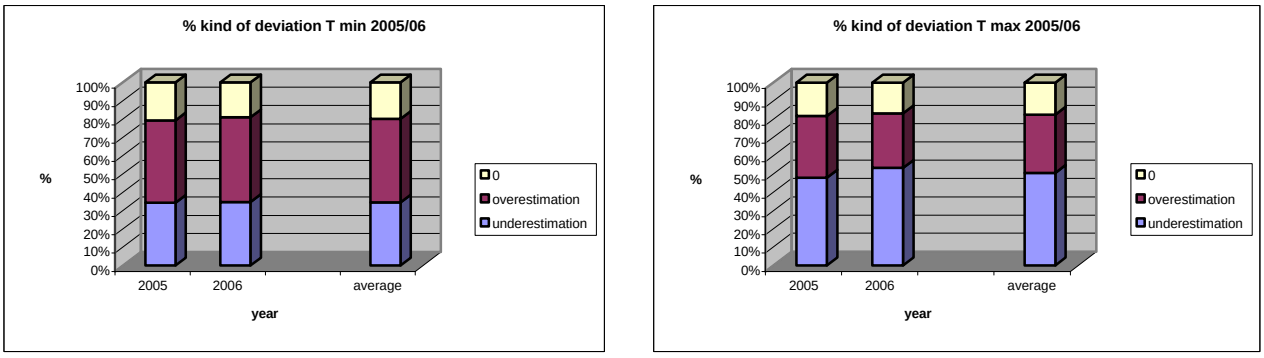

Figure 1: Percentage distribution of kind of error (underestimation or overestimation) 2005/2006– left: Low temperatures; right: High temperatures.

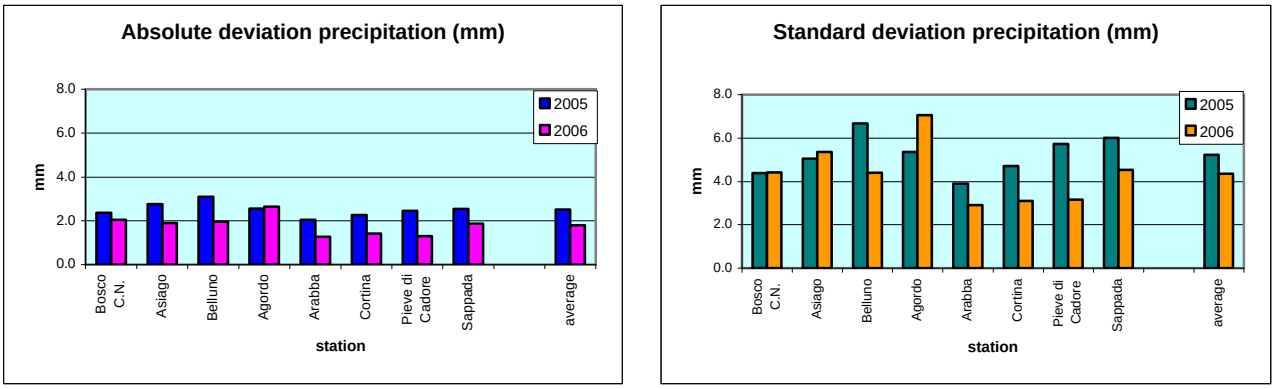

Figure 2: left: absolute deviation - precipitation 2005/2006; right: standard deviation - precipitation 2005/2006

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