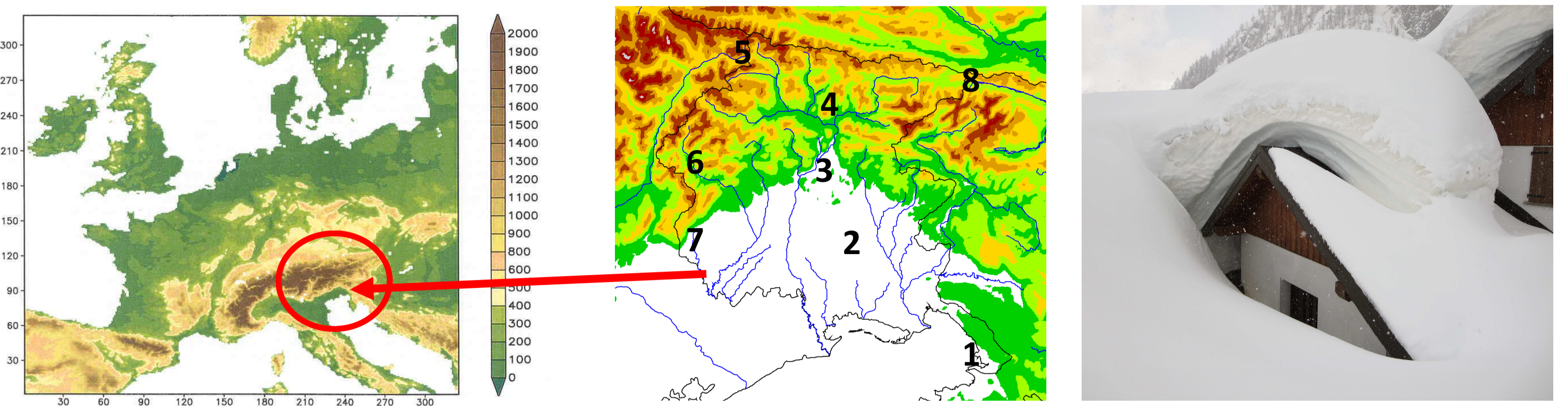


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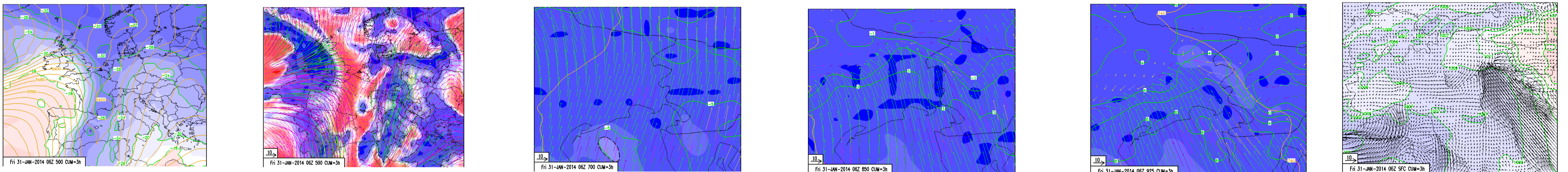
Abstract

This work aims to provide an interpretation of ECMWF deterministic simulations over the Friuli Venezia Giulia region, Italy—hereafter FVG—area in the light of the zero degree level derived from the Udine Campofornido 16044 radio-sounding (that is 50 km far to the south-east, over the friulian plain) during the strongest winter storm of the 2013-2014 season. An estimate of the costs and benefits of a forecast for technological infrastructure, roads, winter resorts, etc., and the comparison with the ECMWF performance in this event and in a well-known event in the 2008-2009 winter season have been provided.



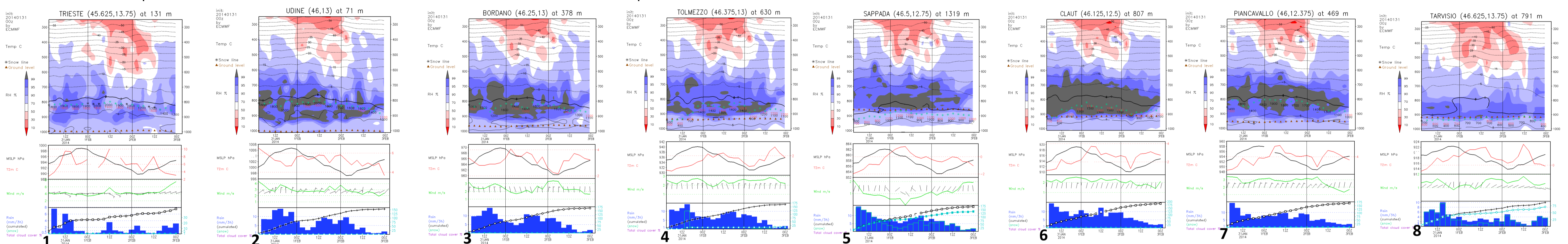
ECMWF Forecast 31/01/2014 run 00

From 31st January to 2nd February a strong cyclonic area extended from North-Atlantic towards the Alps, while a strong anticyclone was over Russia and East-Europe, with cold temperature in the low levels. FVG area received moist advection on the entire column of troposphere, with strong and wet wind from South-West aloft, whereas in the low level there was a blocking with very cold air mass over Slovenia and East-North-Eastern wind; lastly there was an advection of warm and wet flow from Adriatic Sea and wet flow from South-East to the Carnic Alps.



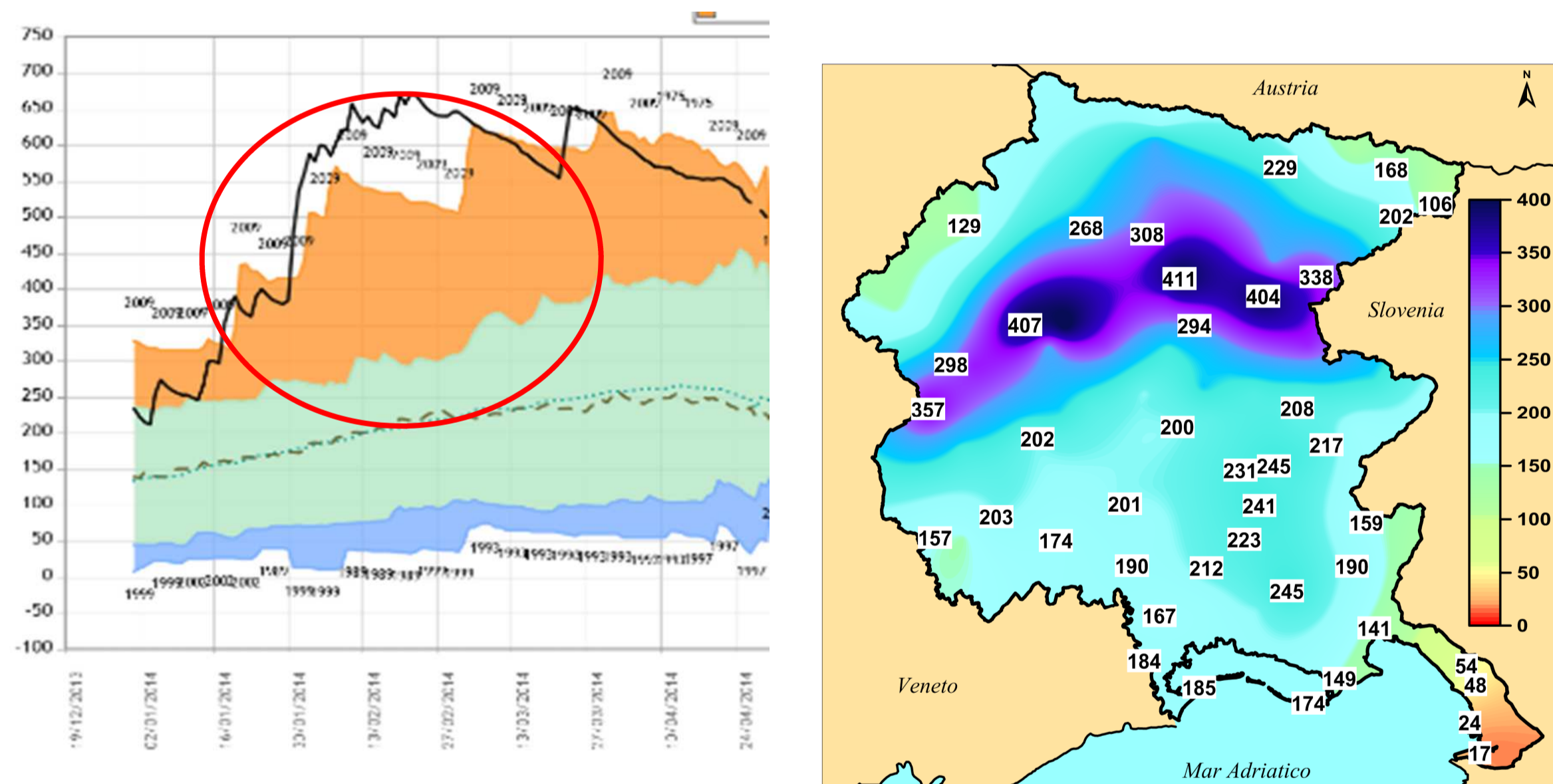
Meteograms based on ECMWF forecast (31012014 Run 00)

It is possible to analyze the great difference in the 0°C level between the coast (Trieste), the plane (Udine) and the mountain area. Inside the mountain area there is too a strong difference between the pre-alpine zone and the innerside alpine zone. Very good forecast have been performed for Tarvisio (alpine danubian zone) and Sappada (Dolomiti, inside valley), while not so good performances have been registered in other alpine zones because we observed a lot of snow lower altitude with respect to the forecast.

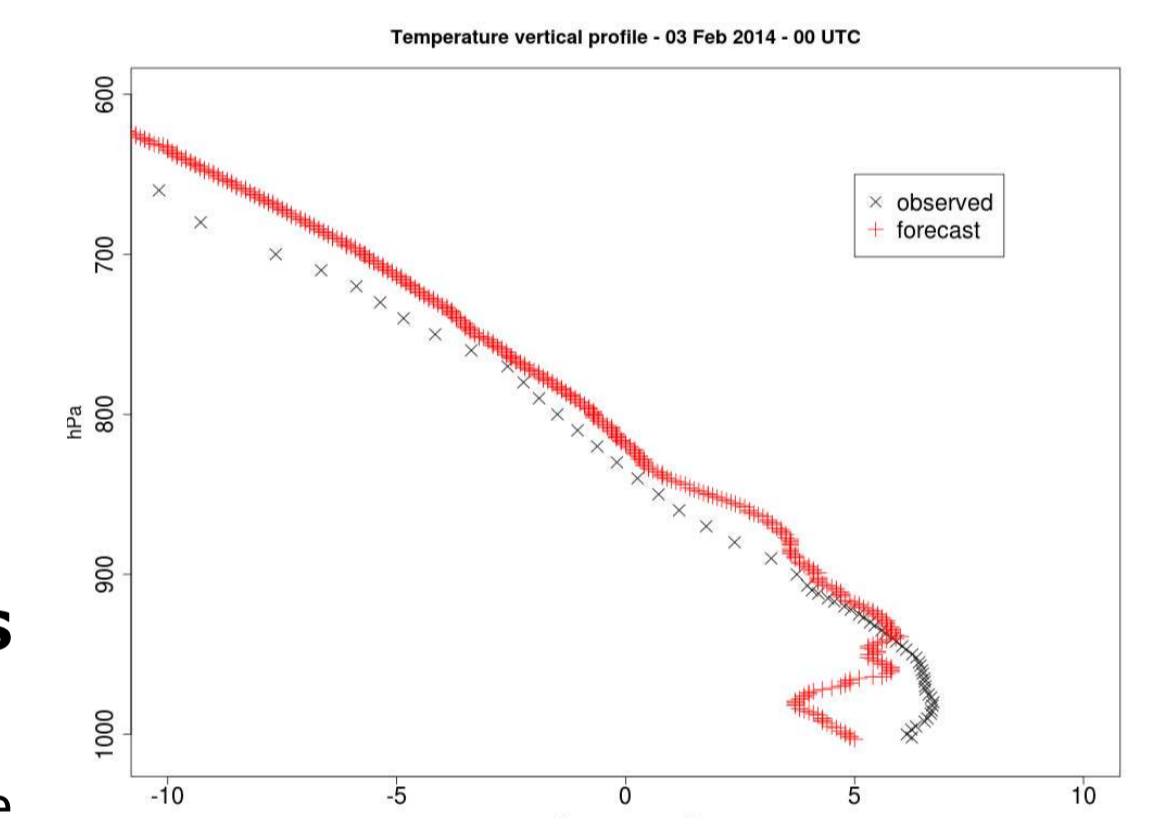


Description of situation

In these days we registered the maximum values of snow height on the ground for the period considered, picture of Rif. Gilberti (m. Canin, Julian Alps, 1850 m ASL). The amount of snow of this year is the black line; the orange one is the previous maximum values, gray is the average, blue is the minimum values. The orange zone is over 90 percentile, blue under 10 percentile (period of observation 1970-2014).

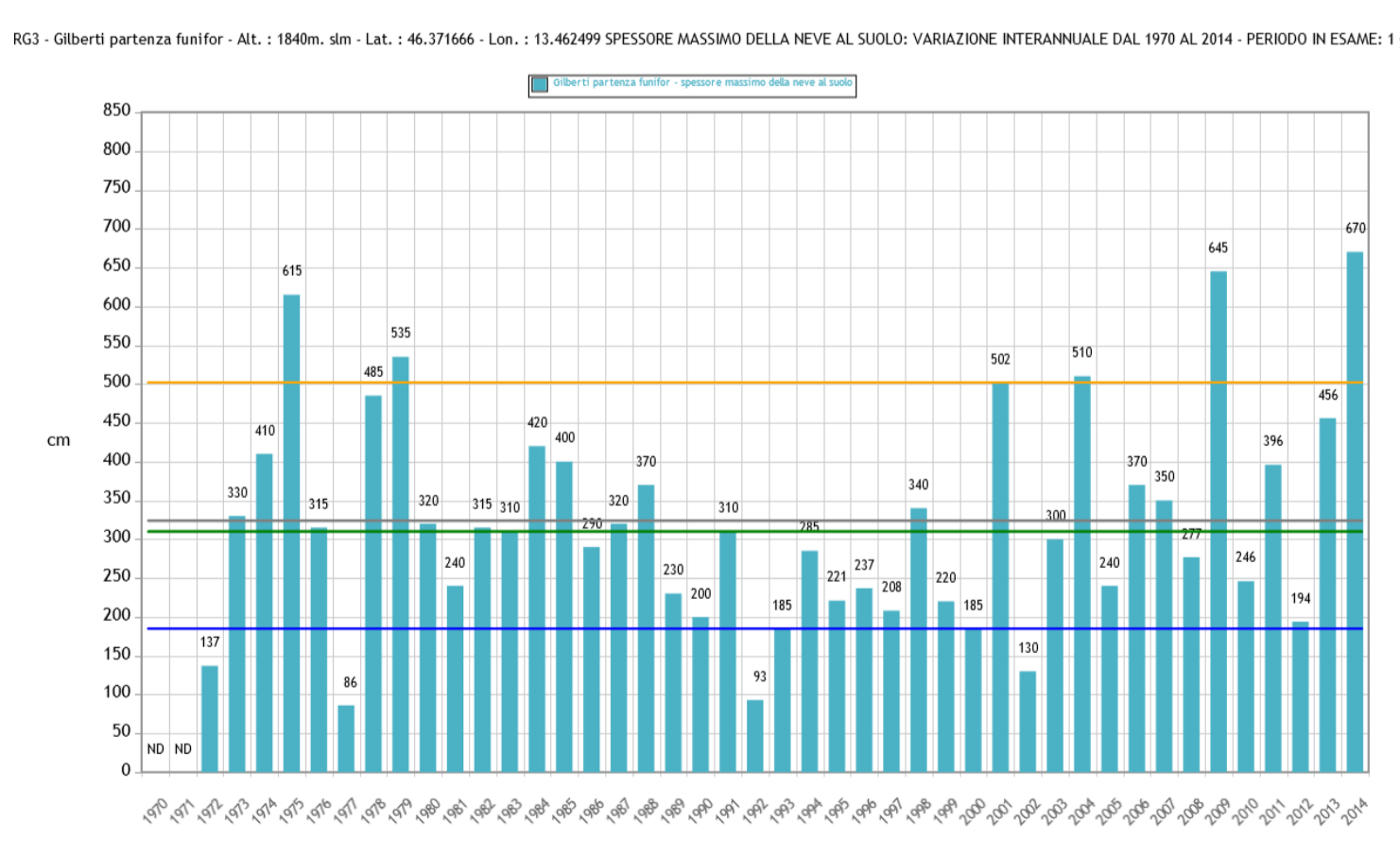
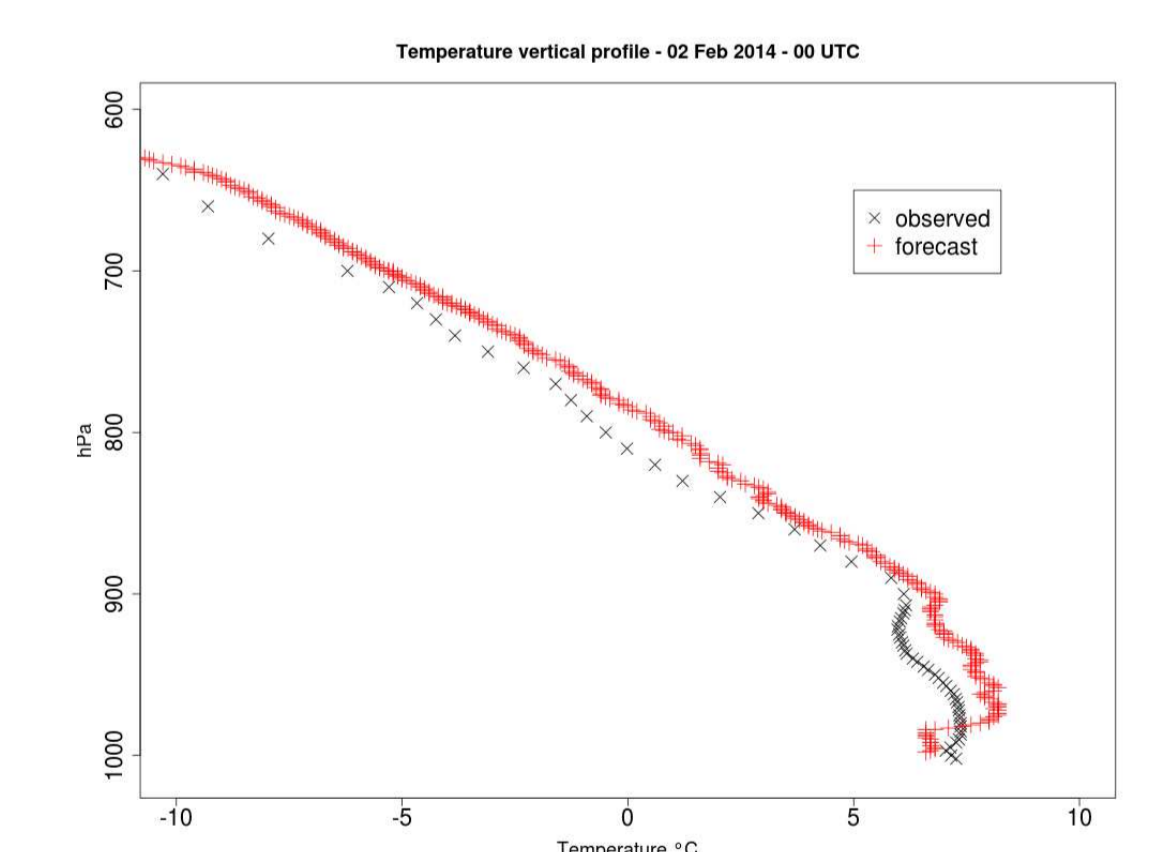
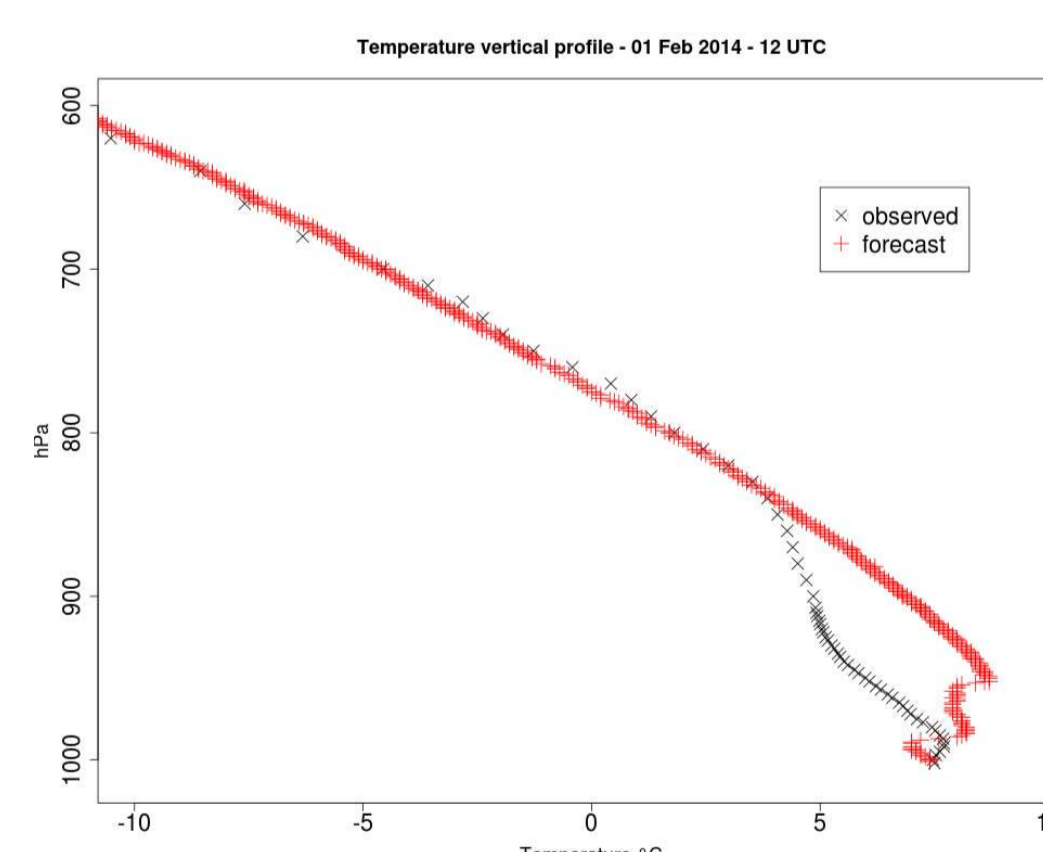
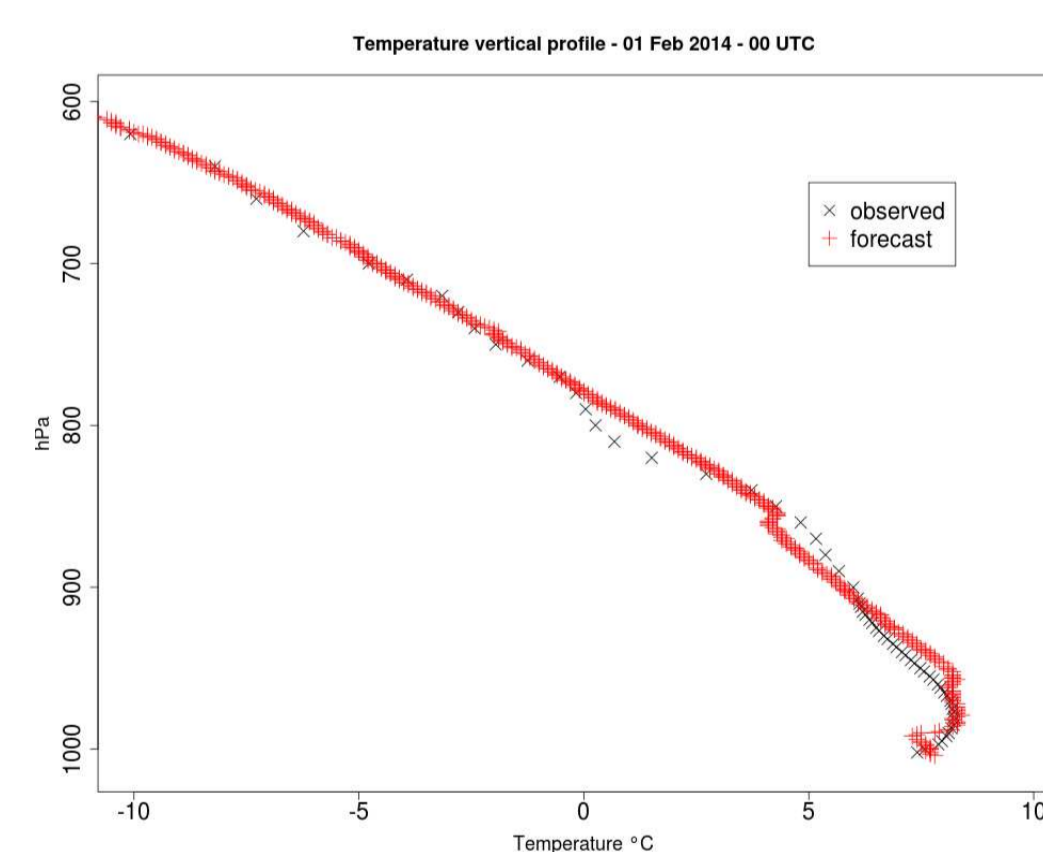
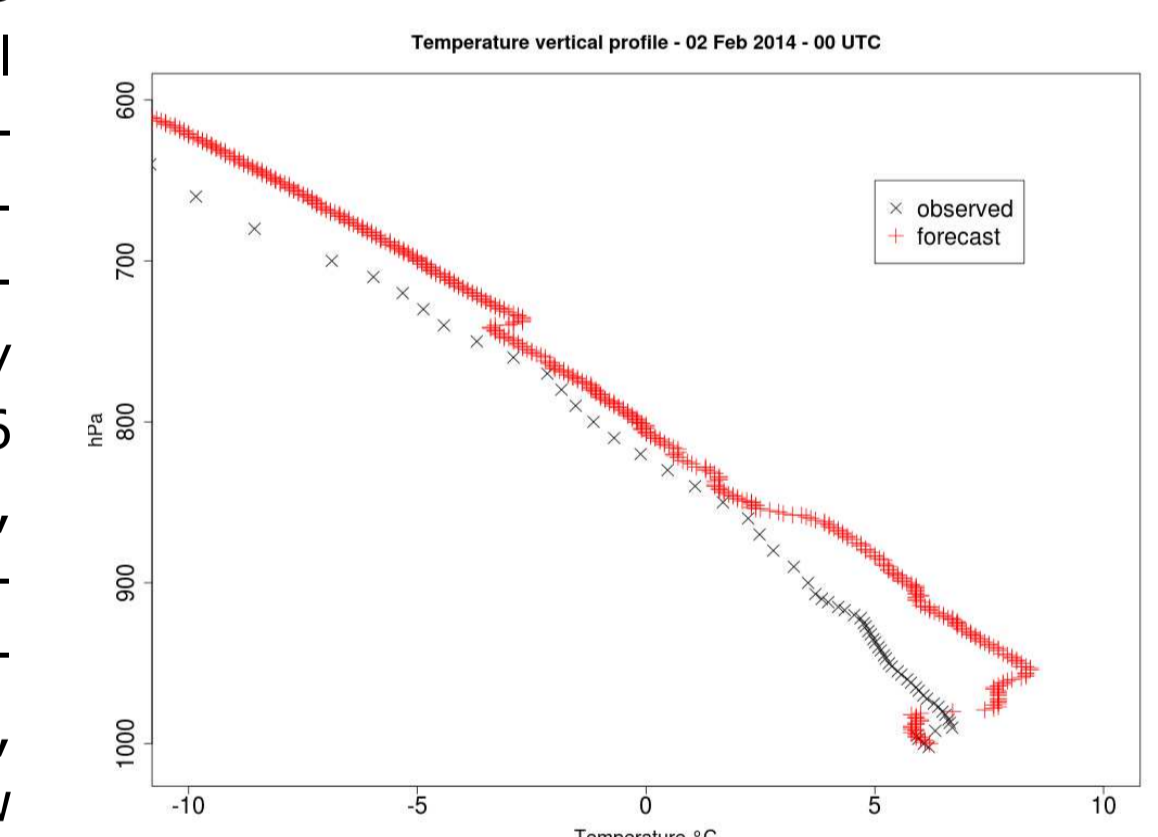
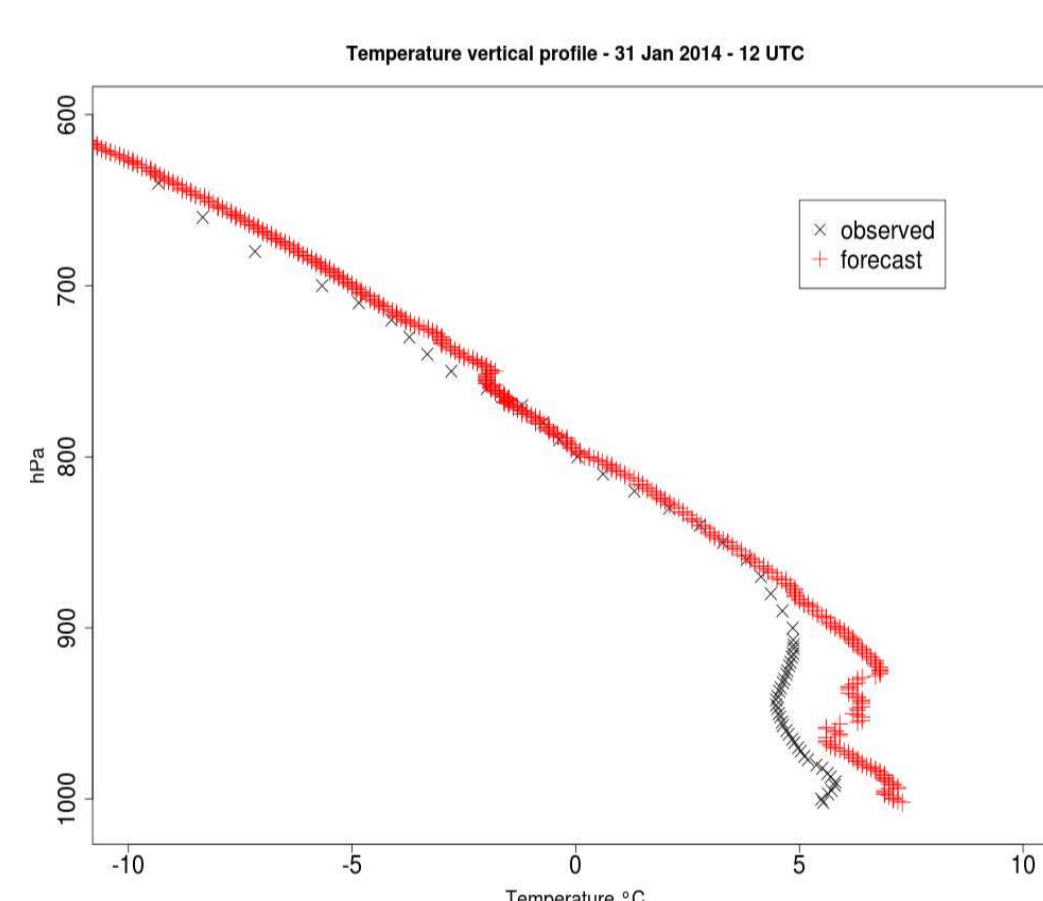


Maps of precipitation of 31/01-02/02 2014 (spazialization with 93 meteorological station)



Analysis 31/01-02/02 2014 RDS Udine Campofornido 16044

In the panels around here (counterclockwise from the left) there is the comparison between the vertical profiles of temperature, since 31 January till 3 February, in black cross as observed by 16044 radiosonde over Campofornido, in red signs as forecast by ECMWF deterministic model over the 46 N - 13 E grid point. As it can be seen, there is always a warm BIAS of the model in the first 150 hPa. It has consequences on the snowfall height forecast, other than on the behavior of the snow flake in the lowest layers, just before reaching the ground.



Maximum thickness of snow on the ground (1972-2014 (cm))

Pressure level and average measurements of temperature, relative humidity, wind speed and directions in winter-season 2008-2009

Average values derived from the Udine Campofornido 16044 radio-sounding (that is 50 km from of mountains area, over the friulian plain) during the most important strong snowfall events of previous strongest snow winter season (2008-2009). It is possible to observe that the relevant snowfall until to the bottom of the valley (350 m ASL) has occurred with "warm" situation at 850 hPa over the plain.

	T (°C)	UR (%)	DD (°Nord)	VV (m/s)
925	6	87	115	10
850	2,5	94	157	13
700	-6,5	92	178	13

Conclusions

Every cold front that has a great impact over this particular zone of Italy in winter season represents a challenge for a correct evaluation of 0°C level and for a discrimination between rainfall or snowfall occurrences. In this case, the study underlines a tendency of ECMWF to overestimate the advection of warm air mass inside the Alps that sometimes remains blocked over the first chain of pre-alps. Model forecast performs better in the inner alpine zone. A strong snowfall, not well forecast as duration and intensity in the pre-alpine zone, may cause a lot of problems for road safety, houses and economic activity. In these 3 days (31/01-02/02) we have registered, only in this small land (7858 km square with 1.230.900 people living) an approximate damage for 3.000.000 euro (black-out, collapsed roofs, fallen trees, no work days in touristic ski-resources, roads closed, railways interrupted,...). Thereafter more efforts must be done in order to improve the snowfall forecasts.



9 mt of snow cover 20 april 2009 at 1800 m msl (Rif. Gilberti Canin)