



The use of partial thickness method and zero wet bulb temperature for discriminating precipitation type during winter months at the Ebro basin in Spain

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The forecast office of the State Meteorological Agency of Spain (AEMET) which is located in the city of Zaragoza provides weather forecast, warnings and aviation forecast products for Aragón, Navarra and La Rioja regions. This area of Spain lies mainly on the Ebro river basin. Although the likelihood of snowfall in this territory is low, a forecasting of snow-depth higher than 5cm for low elevations activates the orange warning which must be issued to local emergency management and civil protection authorities.

Zero wet bulb temperature has been historically the main tool for forecasting the altitude of snow-rain boundary at the forecast office; it shows the freezing level limit due to evaporational cooling when lower troposphere is saturated from aloft. This work adds two new parameters, the 1000-850 mb and the 850-700 mb thickness in order to characterize the thermal structure of surface based cold air and atmospheric mid-levels.

The three main airports in this area Zaragoza-Aragón, Logroño-La Rioja and Pamplona-Navarra are located at altitudes below 500 m. They are thus suitable for this study. In addition, more than 16 years of meteorological observations every hour, known as METAR (Meteorological Aerodrome Report), are available at these locations. These observations were analysed and the predominant precipitation type during a six-hour period was characterized. The 00h, 06h, 12h and 18h analysis time of the ECMWF Forecast model were employed in order to get the parameters at the day and time when the precipitation took place. The most representative grid point of the model for each airport was chosen in order to illustrate the atmospheric conditions. A correlation between precipitation type and zero wet bulb temperature, 1000-850 mb and the 850-700 mb thickness was done for more than 230 different situations during a 16 year period. As a result, we plotted a series of site specific charts for each airport based on these parameters, in order to describe the environment favouring each precipitation type.

This method is a simple technique for discriminating the different precipitation types. It also provides climatology of snowfall events for each airport, showing the differences due to their geographical location and how different synoptic conditions affect each place.. In the middle of Ebro basin, where Zaragoza airport is placed, the critical parameter to determine the precipitation type is the 1000 – 850 mb thickness. It is possible to find many episodes of snowfall with a very thin 1000-850 mb layer within a wide range of zero wet bulb temperature values. This shows the pool of cold air in the valley over which warm and moist air is advected from the Mediterranean Sea. Located close to the Cantabric sea, Pamplona is about 150 km north of Zaragoza. The snow episodes in this location are more related with cold air in all levels together with a narrow range of zero wet bulb temperature values. The results show that the Logroño area, 150 km northwest of Zaragoza, is influenced by both conditions.

This method became operational during 2009-2010 winter season showing a high degree of accuracy in discriminating precipitation type.