Setup and Test of a Procedure for Prediction of late Frost events over complex Terrain

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A simple algorithm based on the model proposed by Reuter (1949) for the prediction of nocturnal cooling is presented along with results form its application to reproduce observed temperature minima at 24 meteorological stations in the Adige Valley and in the Non Valley in Trentino (Northern Italy). The framework in which this study has been developed is a project aimed at understanding physical mechanism which lead to late-frost events and at providing simple and reliable forecasting tools.

The stations considered here cover a height spectrum ranging from 124 to 912 m a.m.s.l., but most of them (12) are located in the subrange 100 - 200 m a.m.s.l., i.e at or close to the valley floor. Data recorded at the meteorological stations during the period March-May 2003, 2004 and 2005 have been used as a testing and calibration base. These information allowed the determination of the optimal value of the decay coefficient to be embedded in the algorithm, which is based on the assumption that the cooling process is proportional to the square root of time starting from sunset. As a matter of fact, the value of this coefficient is obtained through a multiple linear regression which involves meteorological variables such as wind speed, air temperature and relative humidity measured at sunset. By means of this regression, the final values of the decay coefficient for the different sites ranges between 0.7 and 5.2, leading to a minimum temperature prediction in good agreement with observed data (R2 greater than 0.84). Moreover the overall performance of the proposed method has also been satisfactory in reproducing the time evolution of the process, i.e. in catching the time period in which air temperatures fall below 0 °C. Since this is one of the most valuable information for the farmers, the procedure has been applied on a routine basis for the period March-May 2006 giving a good estimate of the temperature decay in the late afternoon, when the algorithm is initialised.

The overall uncertainity in providing the beginning of the below-zero time period as well as the error in predicted minimum temperatures (the verification procedure includes the evaluation of following coefficients: bias, proportion correct, hit rate, false alarm rate and root mean square error) can be considered satisfactory for most of the stations, therefore the method seem to be sufficiently reliable for operational use and for issuing frost alerts to the farmers.