Forecast of Frost Days Based on Monthly Temperatures

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Although frost can cause considerable crop damage and mitigation practices against forecasted frost exist, frost forecasting technologies have not changed for many years. The paper reports a new method to forecast the monthly number of frost days (FD) for several meteorological stations at Community of Madrid (Spain) based on successive application of two models. The first one is a stochastic model, autoregressive integrated moving average (ARIMA), that forecasts monthly minimum absolute temperature (tmin) and monthly average of minimum temperature (tminav) following Box-Jenkins methodology. The second model relates these monthly temperatures to minimum daily temperature distribution during one month.

Three ARIMA models were identified for the time series analyzed with a stational period correspondent to one year. They present the same stational behavior (moving average differenced model) and different non-stational part: autoregressive model (Model 1), moving average differenced model (Model 2) and autoregressive and moving average model (Model 3). At the same time, the results point out that minimum daily temperature (tdmin), for the meteorological stations studied, followed a normal distribution each month with a very similar standard deviation through years. This standard deviation obtained for each station and each month could be used as a risk index for cold months.

The application of Model 1 to predict minimum monthly temperatures showed the best FD forecast. This procedure provides a tool for crop managers and crop insurance companies to asses the risk of frost frequency and intensity, so that they can take steps to mitigate against frost damage and estimated the damage that frost would cost.