Influence of sensor calibration on forecasting models for vineyard disease detection

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Abstract. The evolution of vineyard diseases, such as Downy Mildew, are depending by temperature, humidity and rain [1]. The pathologies are controlled with the use of fungicides, which has considerable economic costs, negative effects on environment, human health and wine quality [2; 3]. In order to identify fungicide sprays periods, several forecasting models were proposed [4]. These tools require accurate knowledge of meteorological variables. Nevertheless, these models do not consider the quality of the input data in terms of evaluation of measurement uncertainty and traceability to the reference sensors [5].

Calibration of weather stations installed in agricultural sites is usually performed by comparison, positioning the reference sensors for a short period close to the station under calibration. This procedure was metrologically evaluated and showed relevant weak points [6]. Moreover, Vineyards and other agricultural sites are often positioned on slopes and close to forests where the canopy influences weather conditions in the vicinity. This enforces a non-ideal position for installing weather instruments and the resulting data do not take into account the effect of slope, the proximity of trees or intensity of solar radiation [7]. The contribution of measurement uncertainty arising from these conditions is not generally considered;

There is a need for testing various types of sensors, their calibration, and to evaluate the measurement uncertainty related the meteorological quantities [8] in order to improve vineyard disease predictions and reduce the use of chemicals in agriculture.

Two automatic weather stations were installed in a vineyard located in Monferrato and the outcomes data were analysed both with metrological methods and statistical test, in order to evaluate the uncertainty related to the positioning of the sensors and the influence on meteorological measurements. The data of the weather stations were also used as input values of an epidemiological forecasting model. The forecasts provided by calibrated data are overlapped around the estimate period of infection, confirming that the inclusion of measurement uncertainties produce data closer to the real value of the measurands.

The inclusion of the sensors calibration and weather instrument positioning contributions, affects the disease prediction up to 5 days. Therefore, the choice of instrument position and calibration procedure becomes a matter of importance in agriculture. Measurements should be based on fully documented traceability and forecasting models should include measurement uncertainties in the input values, to improve output data reliability

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