



# INSTITUTE OF AGRICULTURAL ENGINEERING Tropics and Subtropics Group (440e)

# **Investigation of the Spatial and Temporal Variations of Weather Conditions in a Mesoscale Vineyard**

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### Introduction

#### **Results**

- Climatological conditions and weather variability have a strong impact in viticulture and vineyard management.
- Humid weather conditions, especially leave wetness, contribute to the spread of fungal pathogens and diseases and quality degradation of grapevine.
- This study aimed to develop a low-cost wireless networked system that guarantees low maintenance, fast and reliable data acquisition for monitoring in real-time conditions in vineyards.

# **Material and Methods**

- A sensor system was developed for fine-meshed, real-time and wireless data acquisition with flexible sensor settings (Fig. 1).
- Precise temperature, air humidity, dew point temperature measurements with capacitive sensor SHT31.





Significant temporal differences (p<0.05) were observed for temperature and relative humidity accredited to the diurnal solar orientation, shaded conditions and wind direction (Fig. 3).



**Fig. 3.** The mean temperature and relative humidity distribution in (a, c) summer and (b, d) winter during daytime and nighttime.

Due to the steeply sloping terrain of the vineyard, substantial differences in spatial distribution of temperature and humidity

**Fig. 1.** (a) CAD Schematic design of measuring unit and (b) in-field installation of sensor system comprised of (1) PETG housing rings, (2) SHT31 sensor, (3) basement, (4) leave wetness sensor, (5) LoRa unit with microcontroller.

- Data transmittance empowered via a functional radio network by Semtech "LoRa" and a STM32L0 microcontroller (Fig. 2).
- Sensor calibrated by a climatic test chamber CTS-20/1000 under a wide-ranging set of temperatures and relative humidities.



gradients were observed during summer and winter (Fig. 4 and 5).



**Fig. 4.** GIS interpolations of (a) temperature and (b) relative humidity differences for a typical hot summer day at 2 p.m. in Hessigheim vineyard.



**Fig. 2.** Schematic representation of wireless data acquisition, transmission and processing network.

- 30-ha mesoscale vineyard located in Hessigheim (Germany) was used as a experimental basis to test the monitoring system.
- 30 sensor prototypes were equidistantly distributed within the vineyard, mounted in the canopy of the grapes.

Fig. 5. GIS interpolations of (a) temperature and (b) relative humidity differences for a typical cold winter night at 2 a.m. in Hessigheim vineyard.

## Conclusions

- The developed sensor system demonstrated a high capability to track the dynamic variability of weather conditions in real-time.
- The reliability of the system is excellent and a battery life of several years is expected.
- High potential for the future integration of the results in a disease prediction modelling framework.

