13 years of experience with IoT for plant protection in viticulture
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Grape: a World-wide Production

- Global presence of grape for table and wine production
- Same crop protection needs worldwide (major diseases: Downy and Powdery Mildew, Grey Mould)
- Sustainability is one of key drivers (plant protection and water management)

Grape: Phytopatology

• Complex polycyclic pathogens
• Environmental data drive fungal pathogenicity
• Monitoring and modelling support sustainable crop protection
Grape: Water Requirements

- Season long water requirements
- Production directly linked to response to requirements (quantitative/qualitative)
- Monitoring supports correct water management and supports specific cropping strategies (controlled stress)

Example of season-long grapevine Evapotranspiration chart
Since the publications of A. De Bary (1863) and H. Müller-Thurgau (1911) vine growers are aware about the interaction of weather, susceptibility of the vines and the occurrence of grape vine downy mildew in their vineyards.

K. Müller and H. Sleumer (1934) published the first models used to improve plant protection based on simple climatic parameters.

This models where improved based on the work of G. Goidanich and B. Casarini (1961) and M. Blaeser (1978).
Grape: From Understanding to Modelling Diseases

Progress of microelectronic allowed the possibility to produce the first Plasmopara viticula predictors in the years 1985 to 1988 (Berghof BioMat 100, Lufft HP100, Anton Paar, Pessl Instruments Metos).

The following step was the introduction of autonomous working devices with build in printers and then PC based disease prediction software using sensor systems connected with circuit switched data dial in modem.
Grape: From Understanding to Modelling Diseases

Grape Downy Mildew

During the first decade of this century the applications moved to the internet and data transfer from field to web server was handled by CDMA, GPRS, EDGE or UMTS
Grape: Modelling, DSS and technical recommendation

Most used Decision Support Systems for grape are Vitimeteo, FieldClimate and Vite.net. All three services are using a close to identical basic model for Plasmopara viticola and similar models for Uncinula necator. They are varying in the models for Botrytis cinerea and Grapevine Berry Moth.

All three are define themselves to be DSS (Decision Support Systems), meaning they supply information to the vine grower helping him to time applications better and to do effective plant protection with the lowest possible impact to the environment.

But all systems refuse to tell the user when and what he has to spray in a "go to spray" sentence. In all three systems disease models are calculated based on measured data from the vineyard and based on a numeric weather forecast.
From Farm Data to Data Management Platform

FieldClimate

IoT APPLICATION ENABLEMENT

Big Data Storage
IoaaS
- (Infrastructure as a Service)
  BUILD
  API
PaaS
- (Platform as a Service)
  DEPLOY
  FieldClimate Platform
SaaS
- (Software as a Service)
  BUY
  IMETEO weather forecast, disease models, picture recognition etc.

CONNECTIVITY

WIRED
- (Interface needed: WiFi, LoRa, Bluetooth, ...)
  Optical Wire
  Copper
  Ethernet
  Cable

WIRELESS Long Range
- (Licensed/Public)
  GSM, 2G, 3G
  LTE
  LTE Cat 0/Cat 1
  5G
  Satellite

WIRELESS Short Range
- (Unlicensed/Public)
  WiFi
  Bluetooth
  Radio

WIRELESS LPWAN
- LoRa (Unlicensed Private/Hybrid/Public)
- SigFox (Unlicensed Private)
- NB IoT (Unlicensed/Public)

MONITORING & LOGGING

iMETOS® 33
iMETOS® 33 WIFI
iMETOS® ECO-DG
iMETOS® Blue
iMETOS® LoRa
iMETOS® NB IoT
iMETOS® PRO
iMETOS® CropView®
iMETOS® iScount®
iMETOS® MobilLab
iMETOS® Object Tracker
iMETOS® Active Tracker
iMETOS® ASOS
iMETOS® Topsoil Mapper
iMETOS® WAN
Growing connectivity possibilities allow for an increased set of monitoring. **Meteo data** (to support disease models for plant protection and frost protection), **soil data** (to support irrigation/fertigation and nutrition) **remote crop and pest monitoring**, object **tracking**.

One single platform gives a complete overview of crop needs to farmers.
Increased Expertise Through Geographic Coverage
Web Services: Answering To Farmer’s Needs

Web services offered to farmer’s cover three areas:

1) Warnings and information about climatic hazards

2) Plant disease related information

3) Soil moisture and climatic information relevant for grape quality
FieldClimate and the connected measurement devices are alerting with SMS the vine grower in case of extreme events.

In the case of late frost events, appropriate protection actions are triggered by the warnings.
Web Services: Grape Plant Disease Management

Temperatures are affecting the duration of the different development stages in fruit development.

Soil moisture deficit can reduce the photosynthesis rate and the nutrient uptake.

All this is affecting vine quality and the specific composition of vine aromatics of a vintage.

The knowledge about this situation helps to act and react in viticulture and later in oenology.
Future Offer

New communication possibilities allow for a greater extent of data sent.

This increase the possibility of field monitoring to new and interesting areas.
The iMETOS iSCOUT® is an insect trap with integrated electronics. Images are sent via UMTS to the FieldClimate.com platform where they are analysed with automatic detection of pest. The results are then visible on web or mobile devices. Control is real-time and the collected data can be used for further analysis.
iMETOS CropVIEW® is an agricultural information system, which periodically receives high resolution photos of farmland, research plots, crop canopies etc. Photos are automatically uploaded to FieldClimate platform, thus allowing a constant crop quality and yield control.
iMETOS® Topsoil Mapper

iMETOS® Topsoil Mapper enables real-time, non-invasive analysis of soil structures for applications in site-specific agriculture without soil contact. The sensor is easy to install and integrates smoothly with all farming operations. Extensive installation work or calibration is not required and the system is immediately ready for use.

**MAIN FEATURES:**

- Autonomous soil conductivity mapping
- Creation of soil maps with different parameters
- Real time variable implement control
- Independent of weather conditions and vegetation
- Maps compaction, texture (soil type), soil moisture (relative water content)
- Topsoil data analysis up to 120 cm depth