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**Agroscope**

# SwisensPoleno: Real-time assessment of *P. infestans* sporangia in the air

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# Content

- The measuring system SwisensPoleno and goal of the project
- Development of the *P. infestans* specific classifier
- Field trial setup and Lab trials
- Results
- Conclusions, Challenges and Outlook

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# SwisensPoleno

## Automatic Real-time Monitoring of Bioaerosol

Current method for identifying pollen and spores

Sampling

Visualization

- **Manual identification**
- **Several days delay**

New method:

- **Fully automatic**
- **Continuous monitoring**
- **Real time identification**

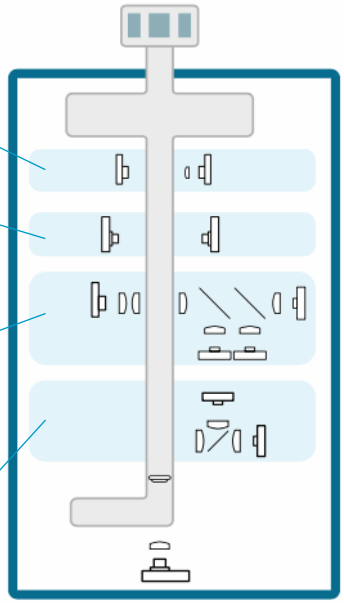
# SwisensPoleno

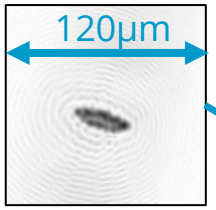
Holographic images provide rich **morphological** data

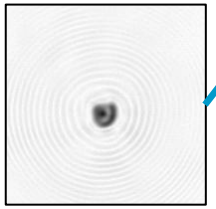
**Classification** in real-time classification using Machine Learning

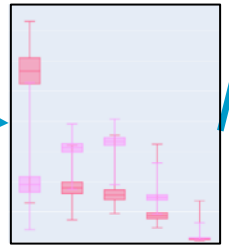
SwisensPoleno Jupiter

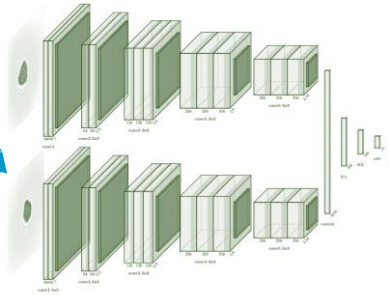
1. Trigger, scattering
2. Holographic imaging
3. Fluorescence spectra and lifetimes
4. Polarized time-resolved scattered light









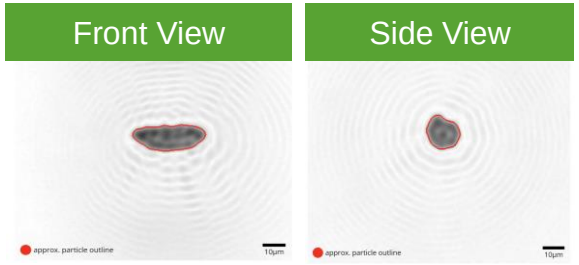
**Prediction result**

| | |
|---|---|
| 0.0 | Water droplets |
| 0.0 | *Alternaria alternata* |
| 0.0 | *Alternaria solani* |
| 0.0 | *Erysipe necator* |
| **0.9** | ***Phytophtora infestans*** |
| 0.1 | *Plasmopara viticola* |
| 0.0 | *Alnus Glutinosa* |
| 0.0 | *Betula Pendula* |
| 0.0 | *Carpineus sp.* |
| 0.0 | *Fraxineus excelsior* |

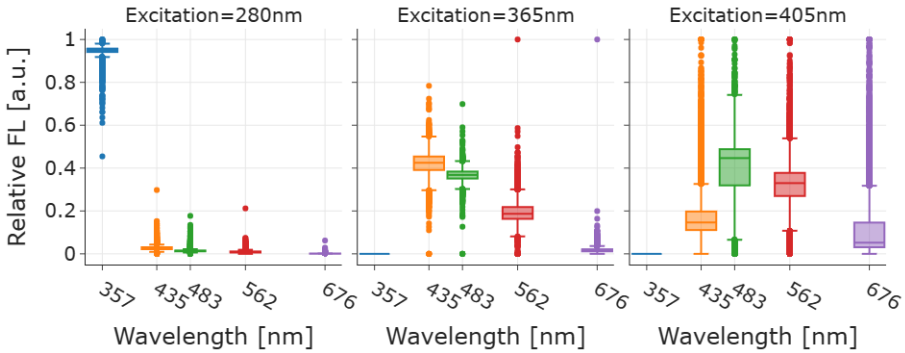
Relative fluorescence spectra provide **fingerprints** on the **chemical composition**

# Development of classifier

- The classifier (Holo-FL 2024) was trained on 443’874 measurement events to distinguish between 58 different classes (21 spore taxa, 35 pollen taxa, 2 others)
- Fluorescence spectra data was included to improve classification of morphologically similar particles
- Empirical thresholds based on collected datasets are applied after classification


Relative Fluorescence Spectra of 11'146 *P. infestans* spores



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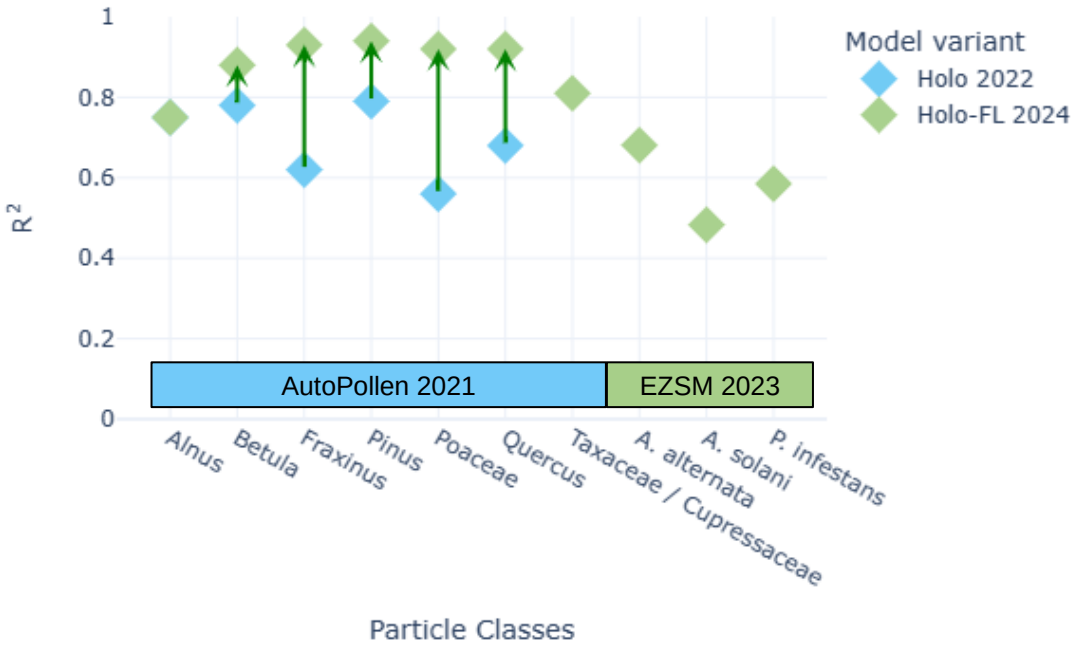
# Classifier improvements
## Holo 2022 <> Holo-FL 2024

- The new classifier using fluorescence data significantly improves the performance of particle classification for pollen (AutoPollen 2021)
- Spores and sporangia relevant for potato farming correlate well with reference Hirst data.
  - P. infestans $R^2$: 0.59
  - A. alternata $R^2$: 0.68
  - A. solani $R^2$: 0.483



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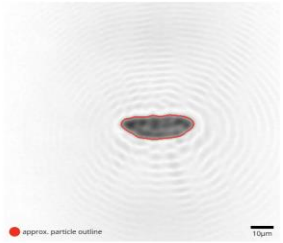
# Field and Lab trails

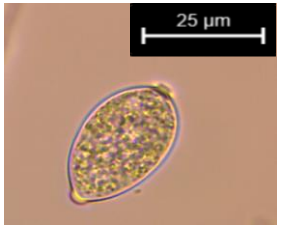
**Field:**

- untreated potato plots in Zurich and Zollikofen (BE)
- SwisensPoleno Jupiter (automatic) and traditional Hirst spore trap (manually)
- Late blight assessment (occurrence, spread) as well as registration of **m**ain **i**nfection and **s**porulation **p**eriods (MISP PhytoPRE)

**Lab:**

- clean datasets for classifier development
- SwisensPoleno system in the lab
- Measurements with artificially and naturally infected leaves/tubers, different Pi isolates





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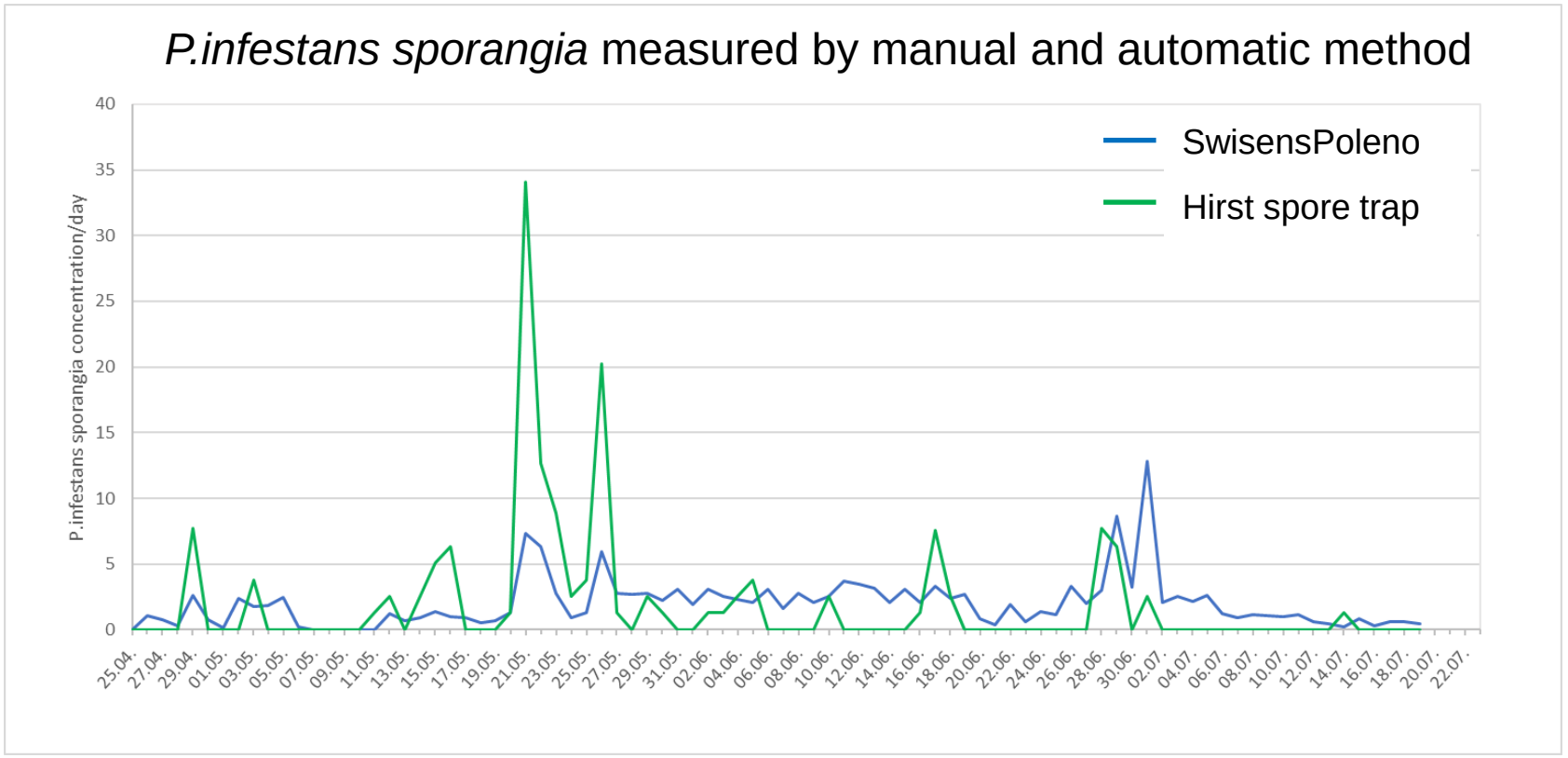
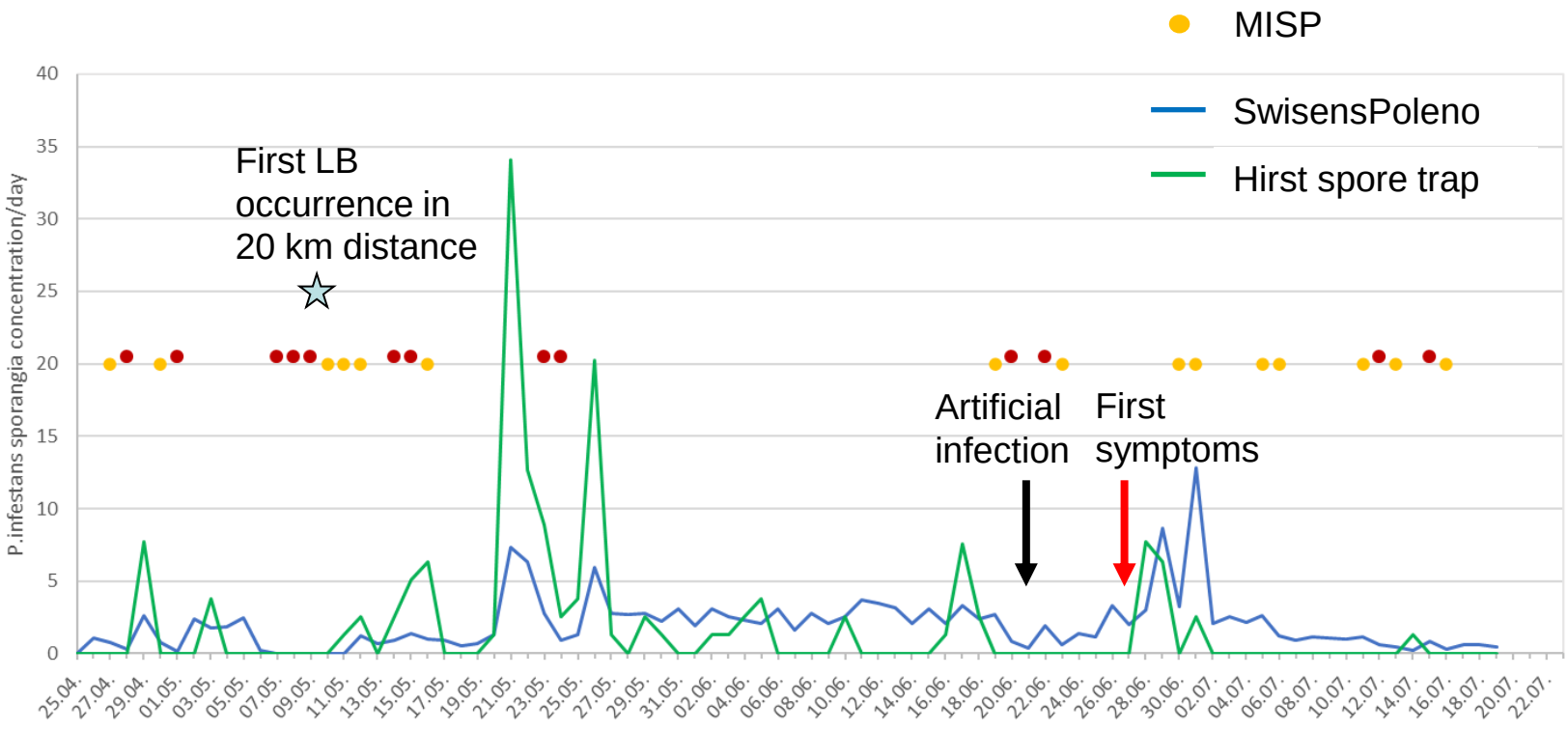
# Relation between measured sporangia concentration by different spore traps

Location: Zurich Reckenholz, 2023



# Relation between assessed DSS-infection risk, LB occurrence and sporangia concentration

Location: Zurich Reckenholz, 2023



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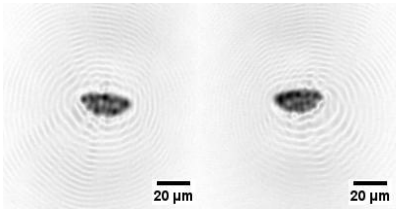
# Conclusions

- Detection and identification of *P. infestans* sporangia successful with SwisensPoleno Jupiter system



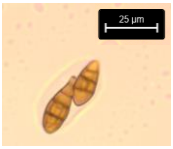

- Correlation between SwisensPoleno Jupiter, Hirst spore trap and occurrence of LB in the field

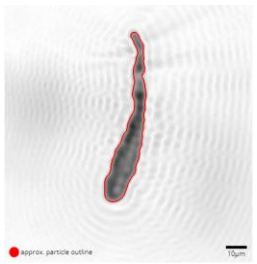
Reliable real-time measurement with SwisensPoleno Jupiter based on the specific developed classifier for *P. infestans* has to be validated with more sites and seasons

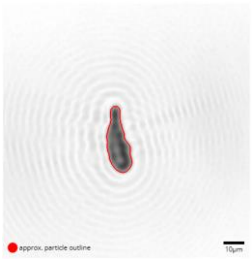
# Challenges and Outlook

- Identification of the minimal spores concentration in the air which leads to a successful *P. infestans* infection in the field
- Analysis of weather data
- Do we find *P.infestans* sporangia also at higher elevations (rooftop) and can these measurements be used for reliable assessments?
- How to integrate into DSS (PhytoPRE) ?

- Further field trials without artificial infection to validate the classifier at several locations
- Expansion of identifiable spores, especially *Alternaria solani* and *A. alternata*



*A. solani* *A. alternata*

# Thank you for your attention

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Sponsered by: BLW-Project and Chips Joint AGRARSENSE

# Question we would like to discuss with you

- Where do you see value of automatic spore monitoring?
- How would you quantify the value of spore detection?
- How dense should the measurement network be?

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