PhytoOracle: Scalable, modular phenomic data processing pipelines

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Emerging technologies are part of the solution

Robots

(Wall Street Journal, LemnaTec)

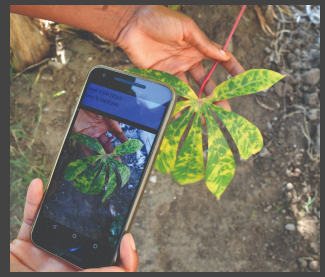
Carts

(USDA)

Drones

(DJI)

Phones



(IITA)

Increasing data volumes necessitate scalable frameworks

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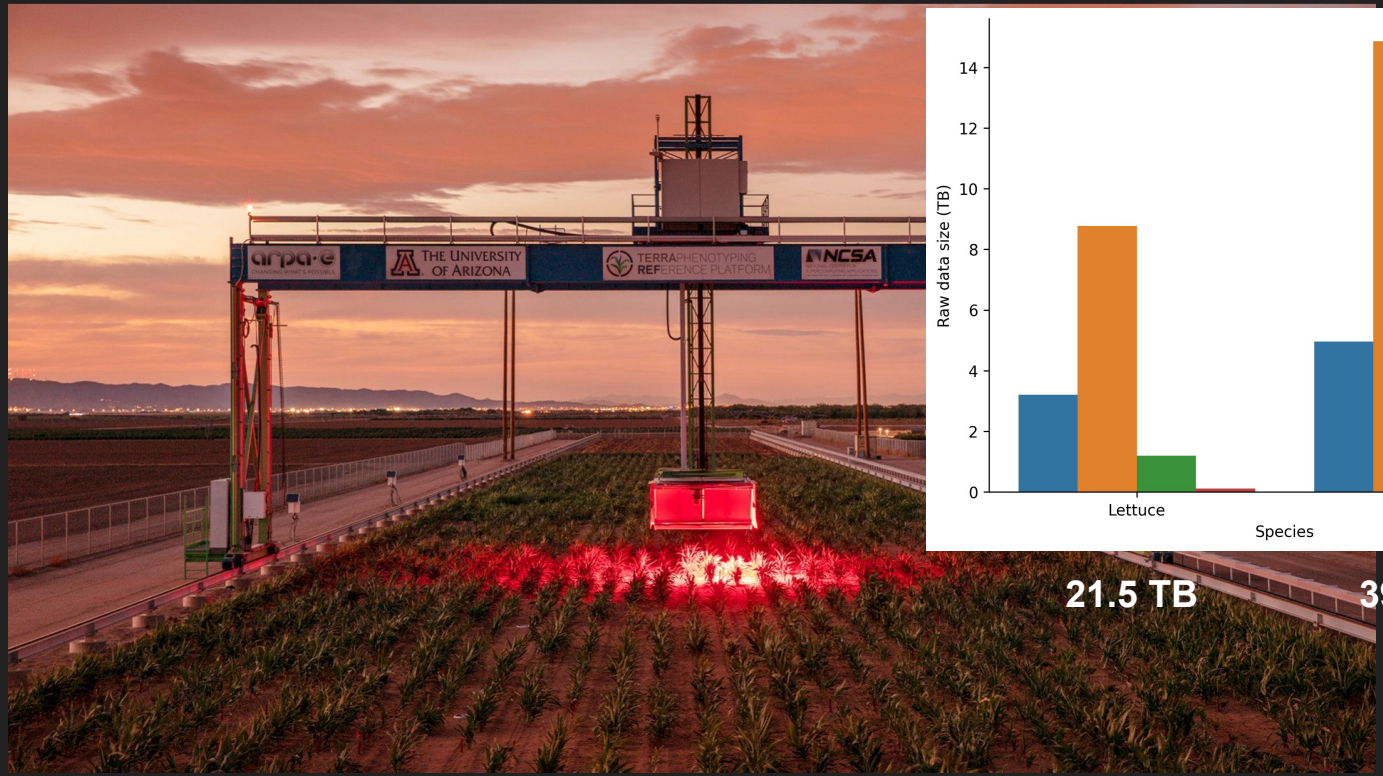
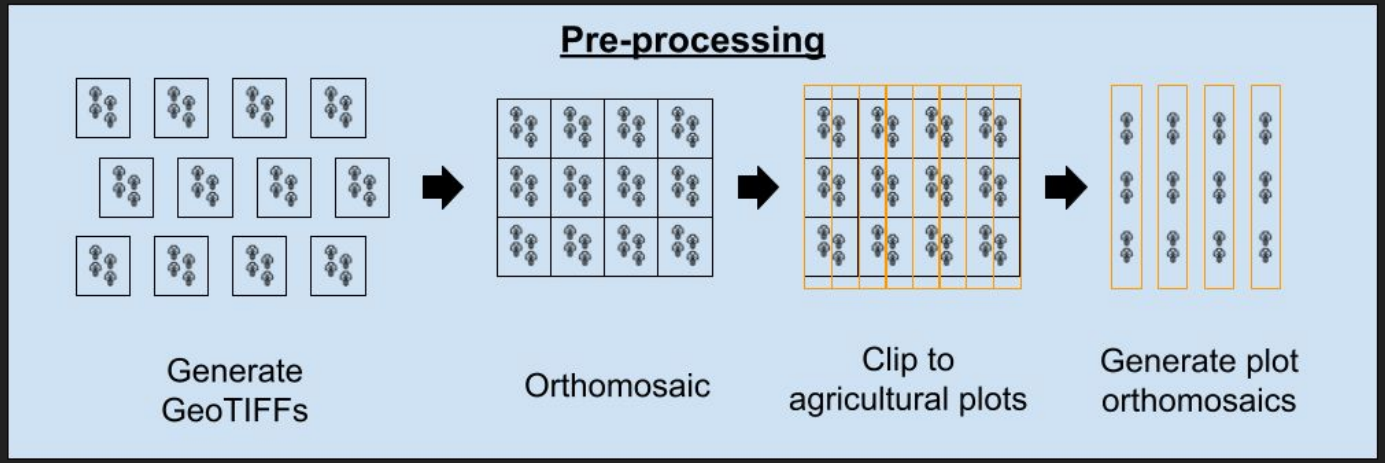


PhytoOracle data processing overview



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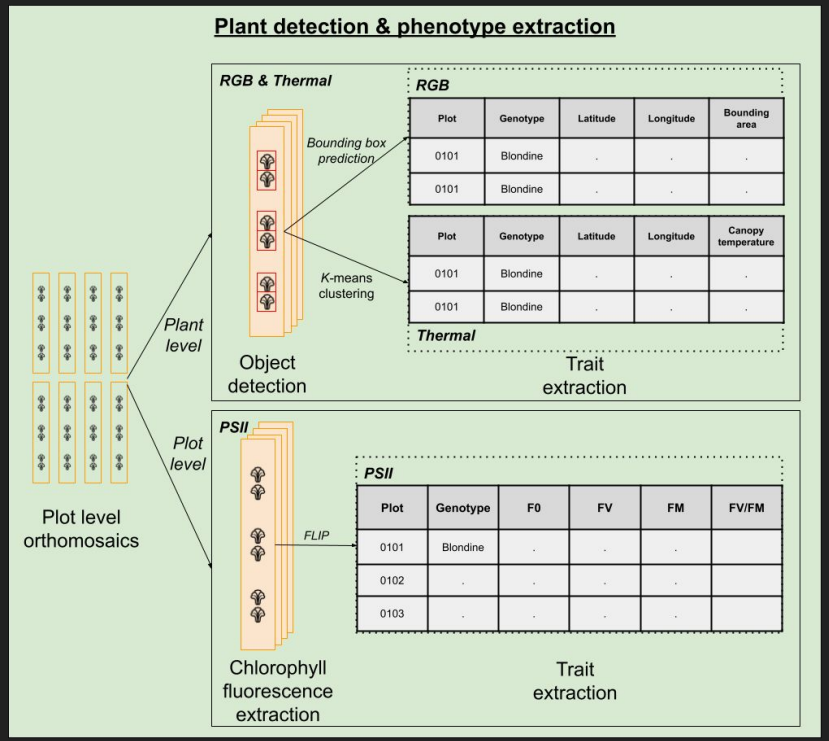
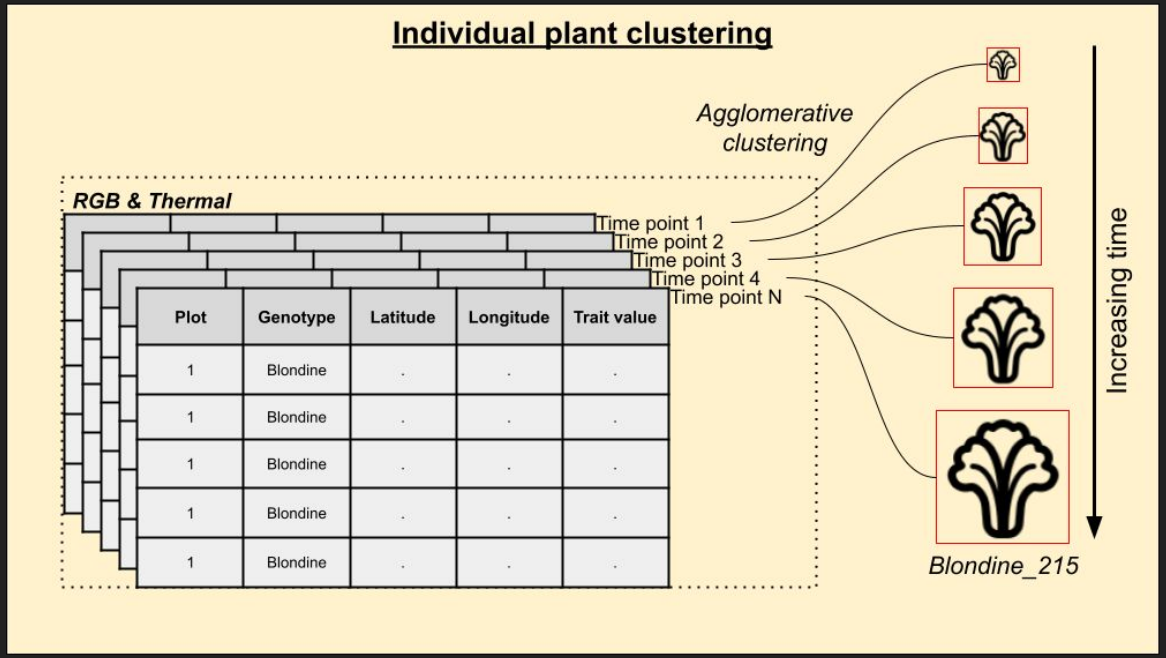
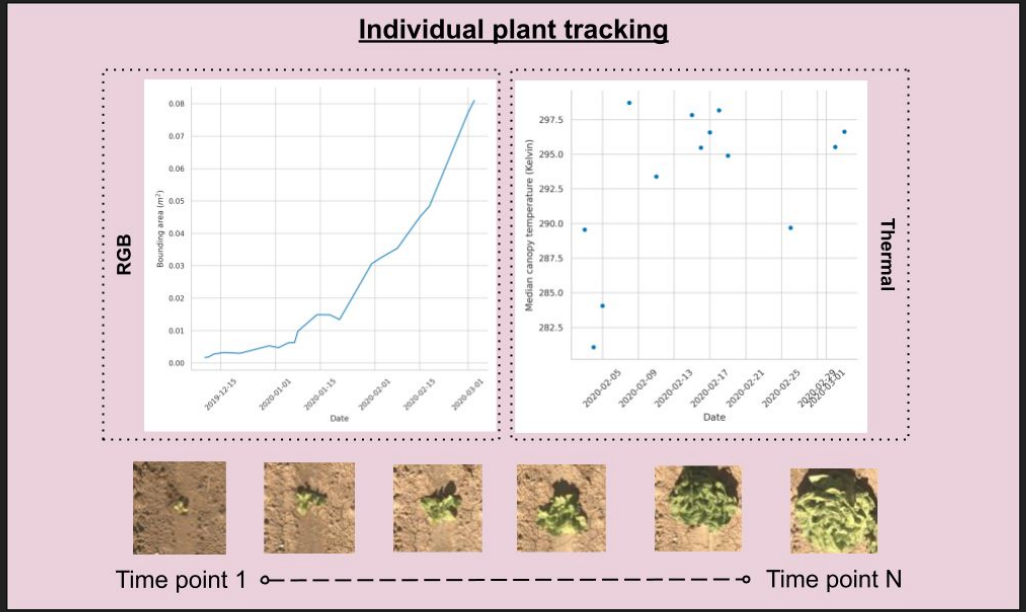


PhytoOracle data processing overview



PhytoOracle data processing overview



PhytoOracle provides a general-use framework

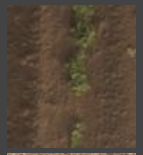
GeoTIFF image/s + GeoJSON/Shapefile + PyTorch Faster RCNN model

Input

Output

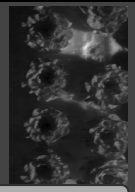
RGB

Faster R-CNN



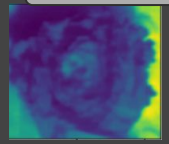
Bounding area

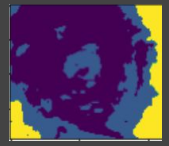
Thermal



Faster R-CNN

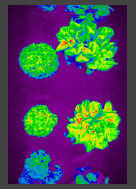
K-means



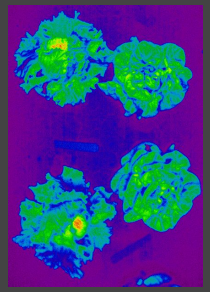


Canopy temperature

PSII

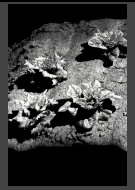


FLIP

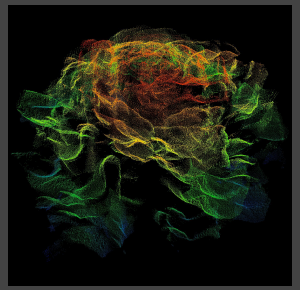


F_v/F_m

3D Laser

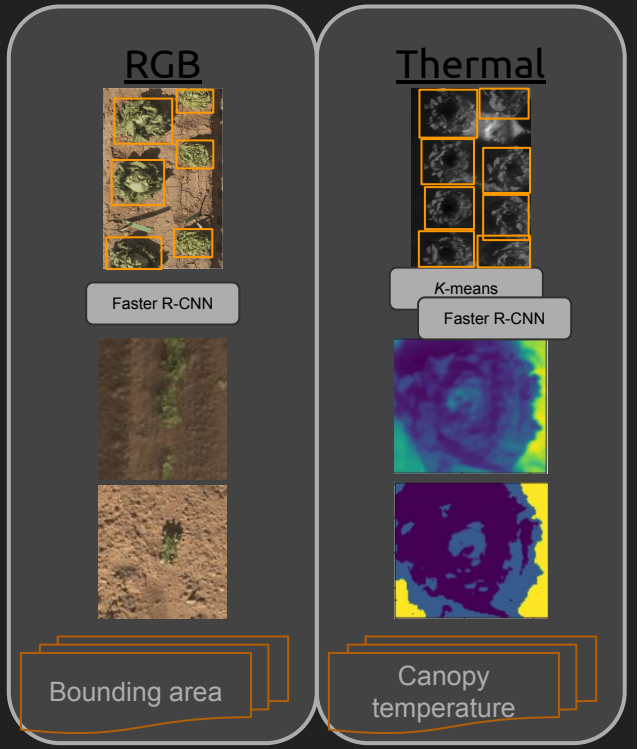


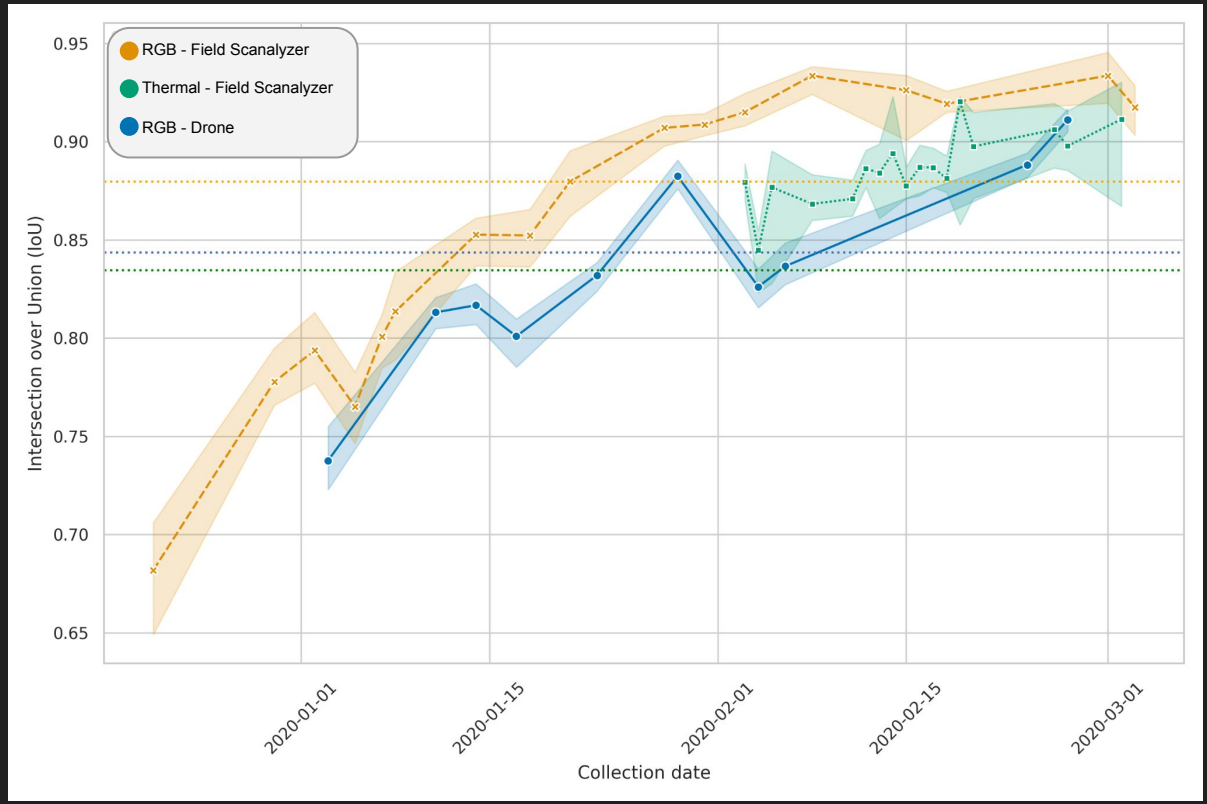
Semantic segmentation



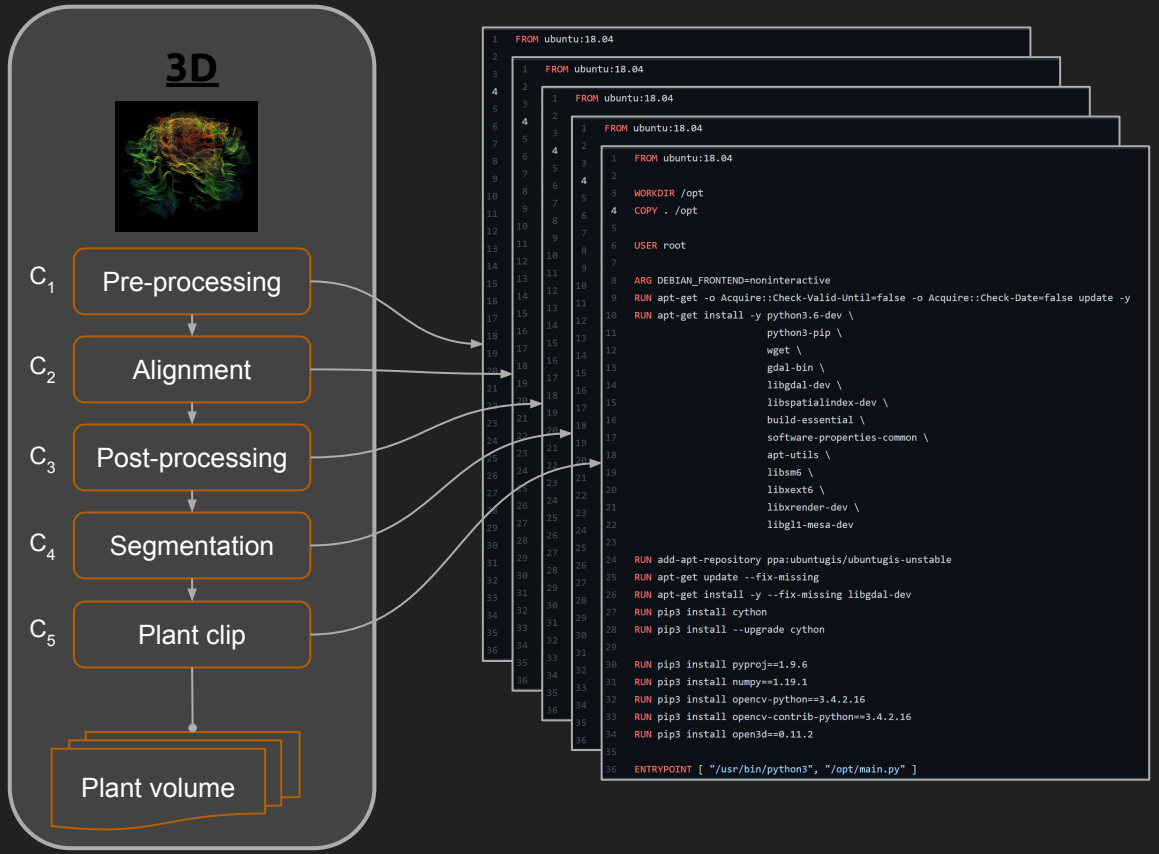
Plant volume

PhytoOracle provides a general-use framework





PhytoOracle enables reproducible science



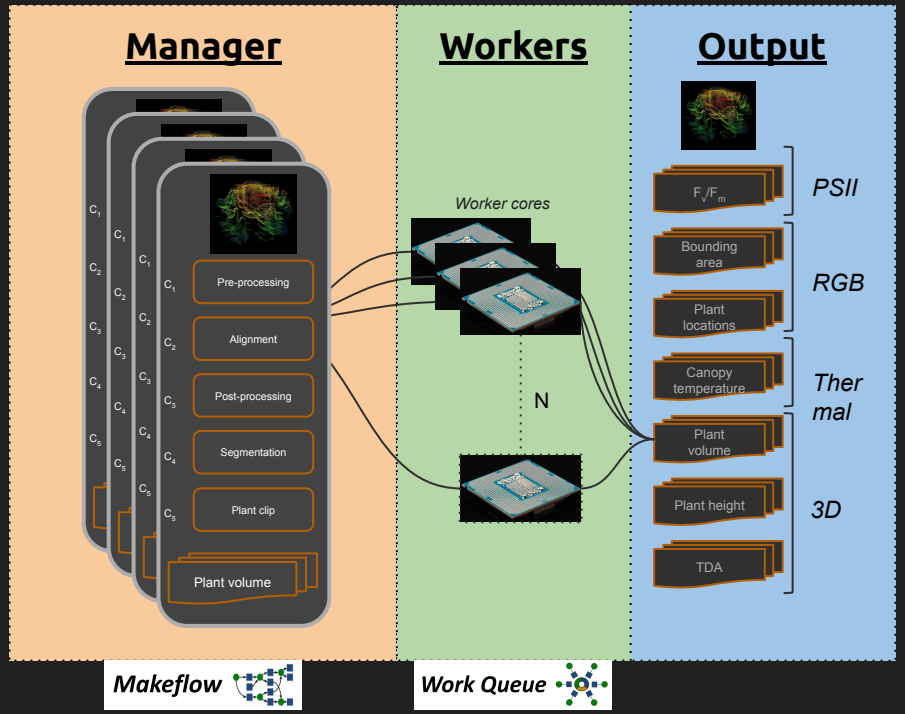

```
FROM ubuntu:18.04

WORKDIR /opt
COPY . /opt

USER root

ARG DEBIAN_FRONTEND=noninteractive
RUN apt-get -o Acquire::Check-Valid-Until=false -o Acquire::Check-Date=false update -y
RUN apt-get install -y python3.6-dev \
                       python3-pip \
                       wget \
                       gdal-bin \
                       libgdal-dev \
                       libspatialindex-dev \
                       build-essential \
                       software-properties-common \
                       apt-utils \
                       libsm6 \
                       libxext6 \
                       libxrender-dev \
                       libgl1-mesa-dev

RUN add-apt-repository ppa:ubuntugis/ubuntugis-unstable
RUN apt-get update --fix-missing
RUN apt-get install -y --fix-missing libgdal-dev
RUN pip3 install cython
RUN pip3 install --upgrade cython

RUN pip3 install pyproj==1.9.6
RUN pip3 install numpy==1.19.1
RUN pip3 install opencv-python==3.4.2.16
RUN pip3 install opencv-contrib-python==3.4.2.16
RUN pip3 install open3d==0.11.2

ENTRYPOINT [ "/usr/bin/python3", "/opt/main.py" ]
```

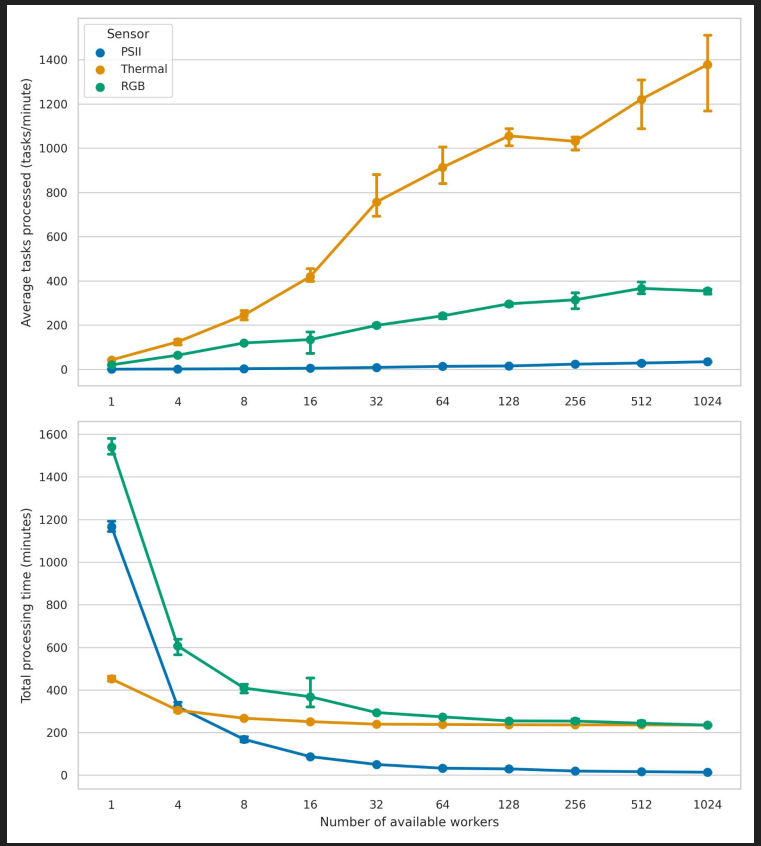
Computational tools

Docker containers provide **extensibility** and **reproducibility**

Singularity enables **distributed** processing on high performance computer (**HPC**) clusters

PhytoOracle leverages distributed processing



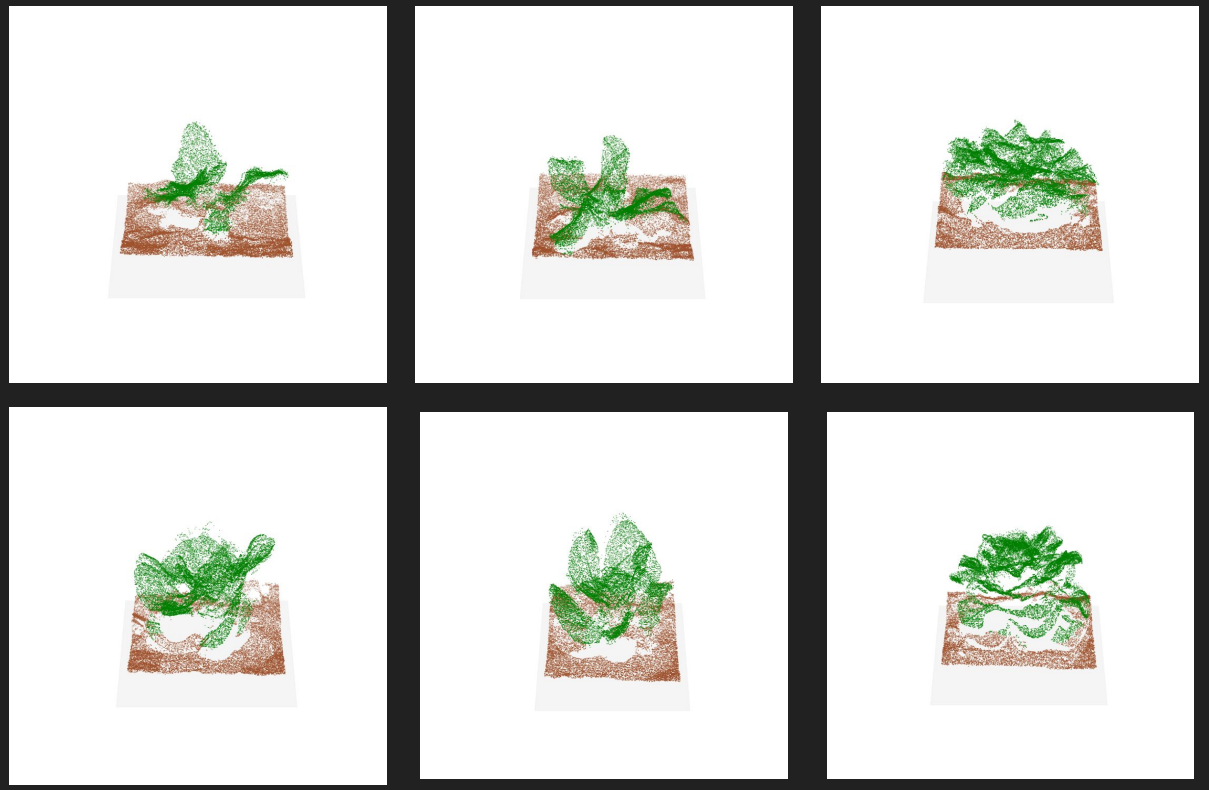


PhytoOracle-enabled time series

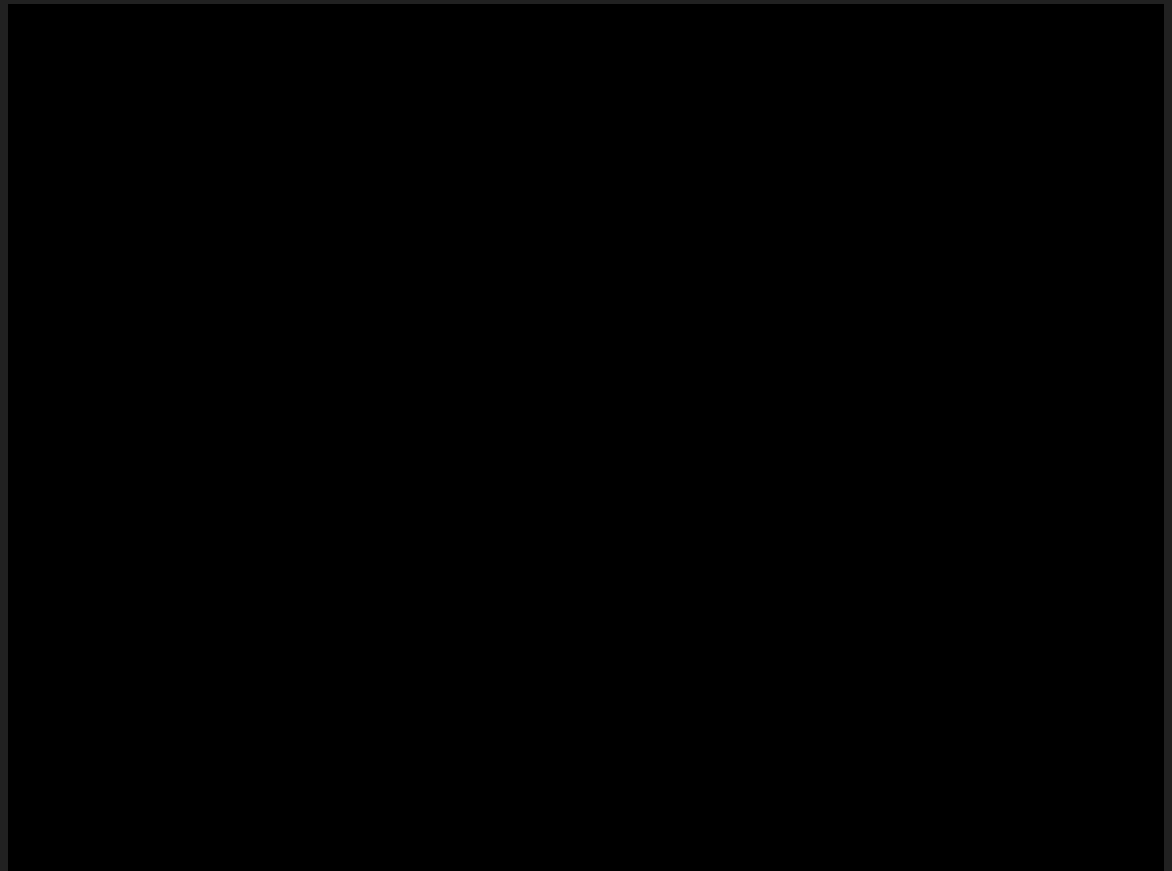
Early

Mid

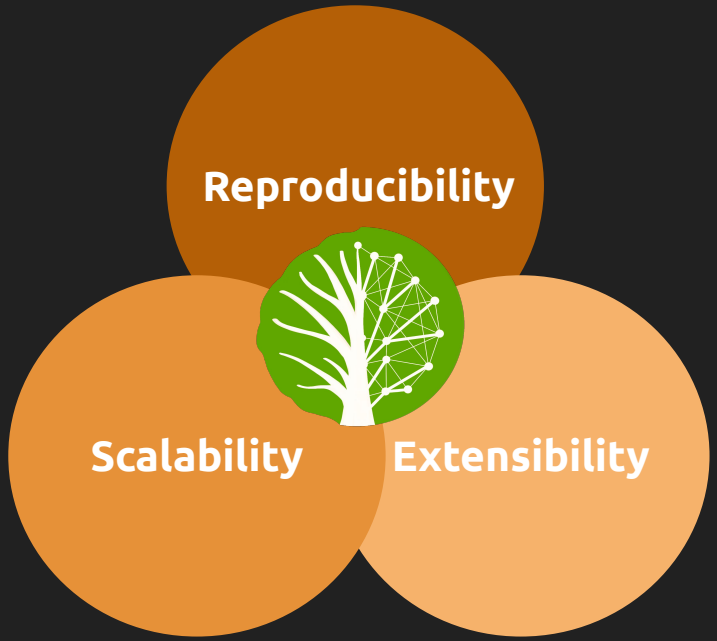
Late



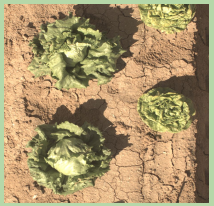
Moving phenomics to VR



PhytoOracle addresses three major concerns

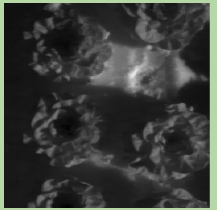


RGB



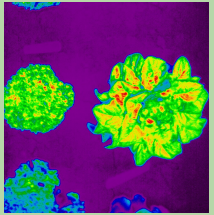
Disease detection
Canopy area

Thermal



Water use efficiency
Stomatal conductance

Fluorescence



Photosynthetic efficiency
Stress assessment

3D / Lidar

Architecture
Biomass
Leaf angle

Acknowledgements

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arpa·e

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The University of Arizona — High Performance Computing

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