

# MULTIFUNCTIONAL AGRIVOLTAICS

## SPATIO-TEMPORAL MODELLING OF ENVIRONMENTAL AND AGROECOLOGICAL DYNAMICS

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### THE CHALLENGE

Rapid expansion of solar infrastructure causes land use conflicts with traditional agriculture



### THE OPPORTUNITY

Optimized configurations balance food security, water protection, and nature conservation



### THE APPROACH

Balancing food production and agro-environmental issues using high-resolution data

### UAV MONITORING

High-frequency aerial surveys capturing spatio-temporal dynamics of the Agri-PV ecosystem at sub-centimeter resolution.



#### SURVEY SYSTEM SPECIFICATIONS

Platform	DJI Mavic 3M
Primary Sensor	20MP RGB + 4-Band Multispectral
Ground Sampling	0.8 cm/px (GSD)
Survey Frequency	Multi-Temporal/Monthly

#### SENSOR ARRAY & MONITORING FOCUS

Omni-directional Vision Sensors  
RTK-Module  
Multispectral (Red, Green, NIR, RedEdge)  
RGB | Visible

**Vegetation Analysis**  
Development, Diversity, Crop Health, Distribution Patterns, Indices (NDVI, GNDVI, NDRE, LCI, OSAVI)

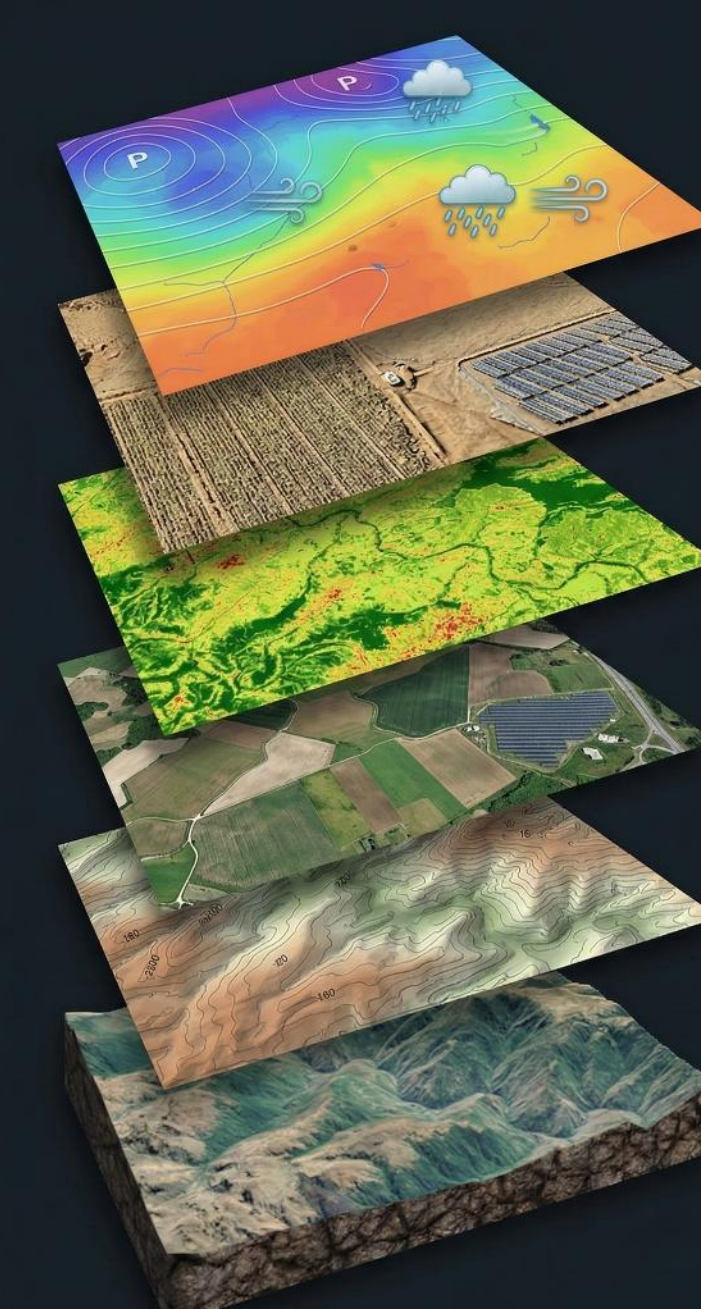
**Structural Mapping**  
3D Photogrammetry, Orthomosaics, Digital Surface/Elevation Models (DSM/DEM), Point Clouds

#### FIELD RECORDS & PHENOTYPING



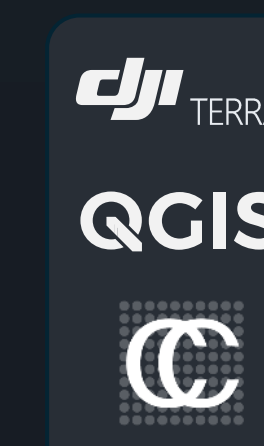
### PROCESSING & SPATIAL ALIGNMENT

Implementing a structured multi-sensor workflow to transform massive environmental datasets into a synchronized, high-precision spatial framework for long-term monitoring.



- Meteorology: Air-Temp., Rain, Radiation ...
  - Surface Roughness Model
  - Vegetation Indices
  - Orthomosaic (RGB)
  - High-Res Spatial Analysis: DTM/DEM/Contours
- DATA LAYERS
- REAL WORLD

- **Generation:** Reconstruction of Orthomosaics & 3D Point Clouds (DJI Terra).
- **Refinement:** Cleaning and sub-sampling of large-scale data (CloudCompare).
- **Alignment:** Precision transformation and seamless layer reprojection (QGIS).
- **Validation:** Positional correction and absolute accuracy assessment via GCPs.



#### VEGETATION INDICES (SELECTION)

RGB Mosaic	NDVI/GNDVI	NDRE	OSAVI	DSM

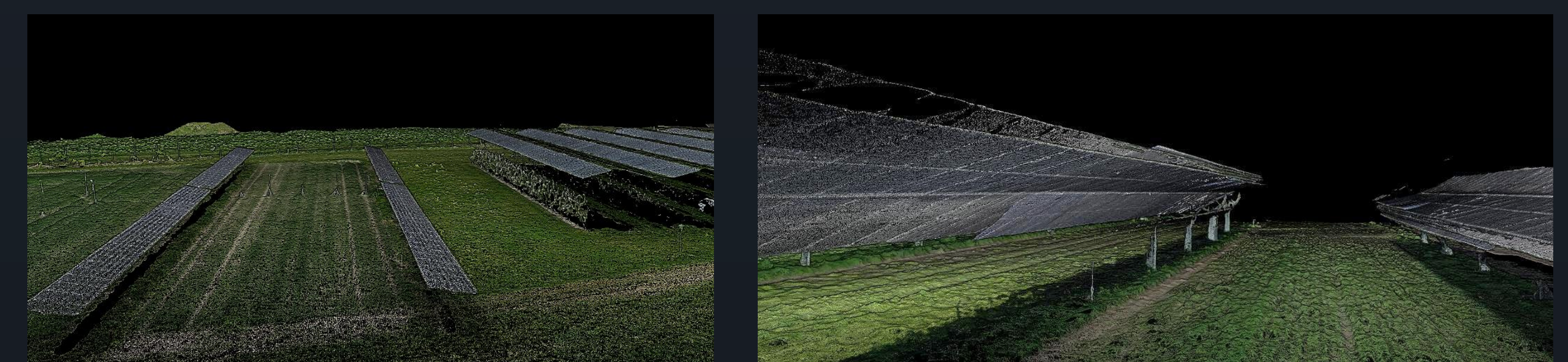
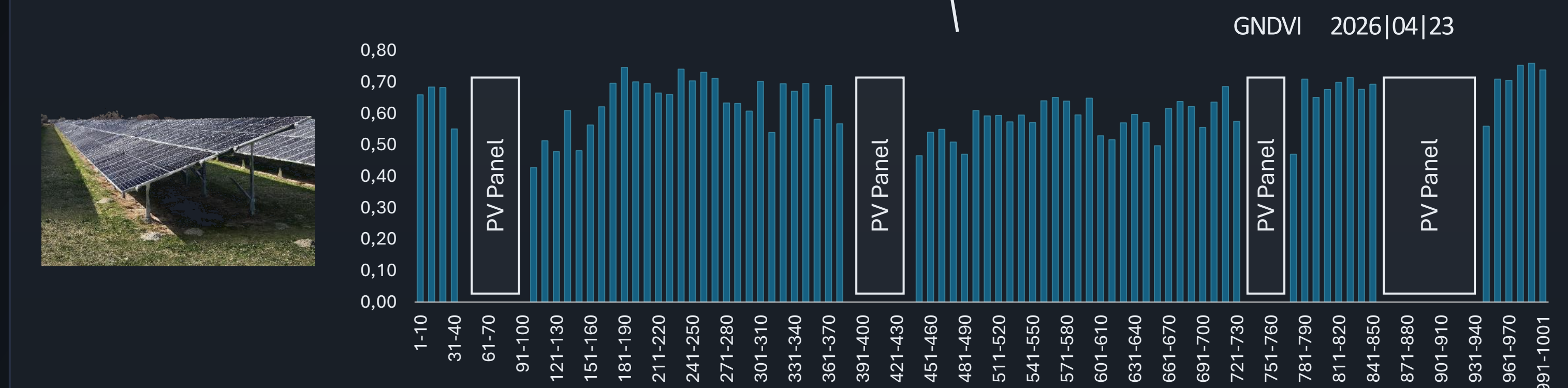
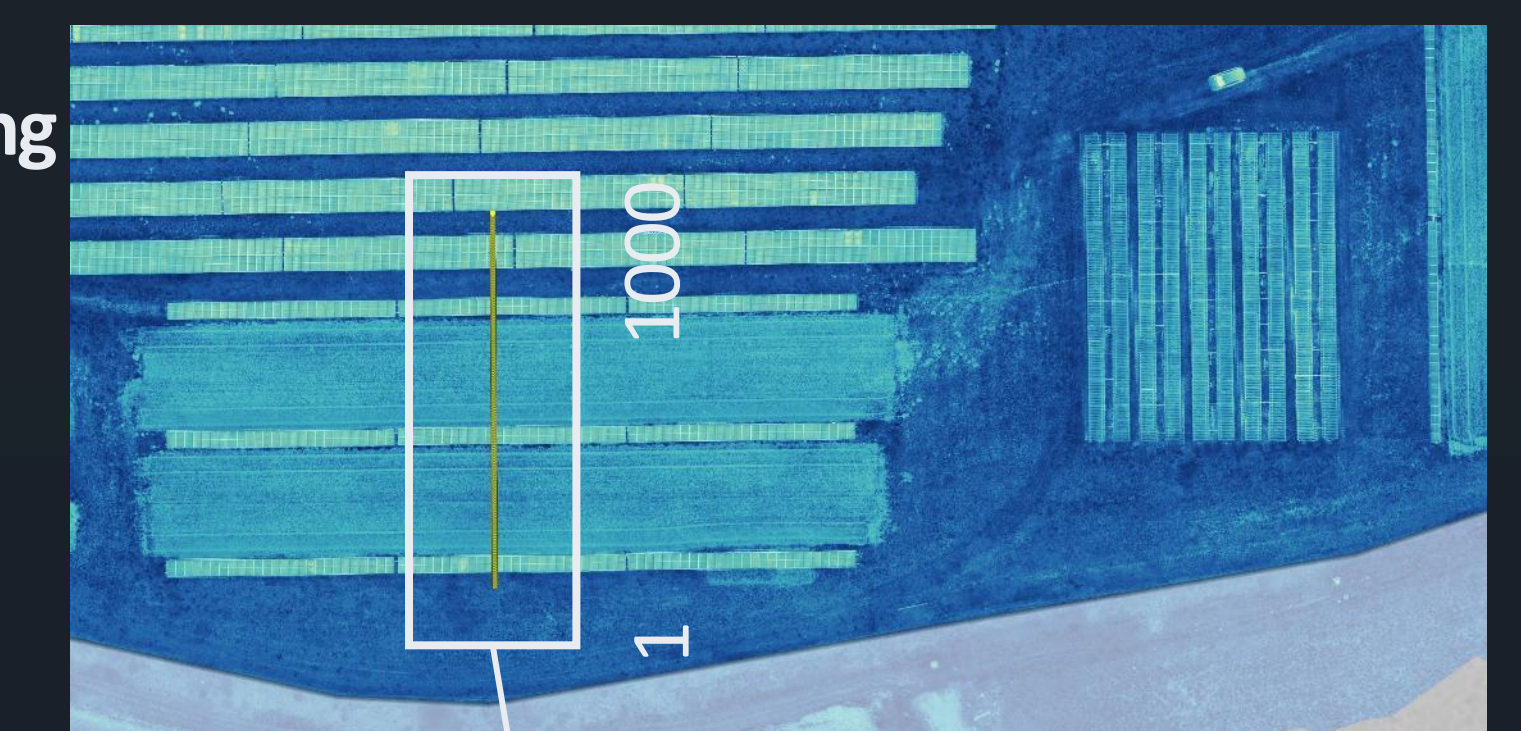
### HIGH-RESOLUTION MODELLING



Environmental dynamics, vegetation development, diversity, yield assessment and prediction, semantic segmentation, visualization

#### Spatiotemporal Ecosystem Modelling

- Digital Twin Construction
- Microclimate Simulation
- Vegetation Dynamics



### IMPACT

- **Food Security & Climate Adaptation:** Systems buffer microclimatic extremes to stabilize output through simulation of complex crop-energy interactions.
- **Modular & Automated Analytics:** Implementation of end-to-end interpretation pipelines for scalable environmental monitoring.
- **Operational Vision:** Transitioning toward automated, office-based UAV surveys (subject to evolving legal frameworks).

**FINAL CONCLUSION** | Our structured workflow transforms massive raw datasets into actionable insights, proving that **Agrioltaics** can effectively **mitigate climate risks** while securing **decentralized energy production**.

