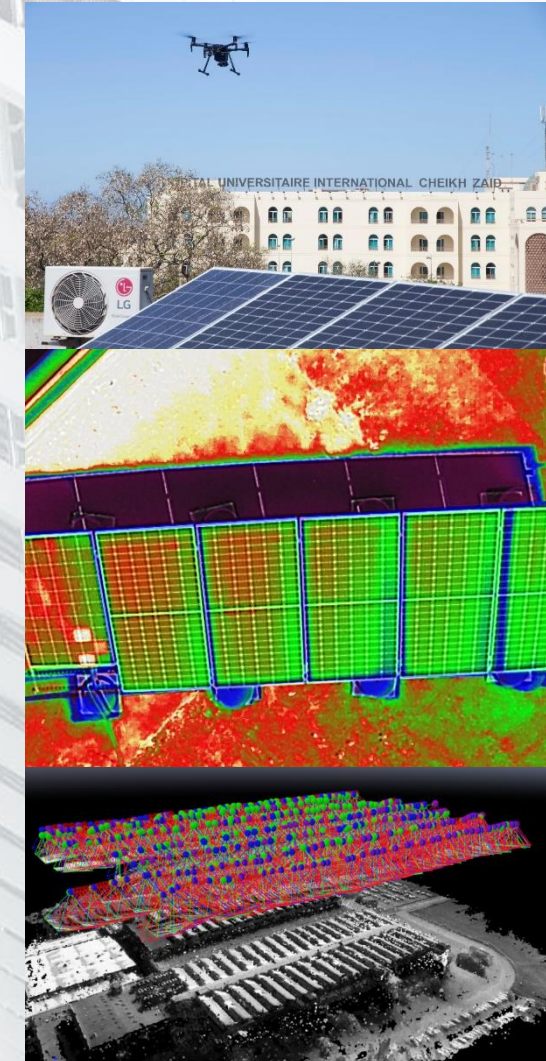# Projet SmartDrone4PV

Prof. Imane Sebari, Ing. PhD
Département de Photogrammétrie-Cartographie
Ecole des Sciences Géomatiques et Ingénierie Topographique
IAV Hassan II, Rabat
Maroc

SMARTDRONE4PV PROJECT

Photogrammetry-Cartography Department, IAV Hassan II Institute, Morocco
Electrical Engineering Department, EMI, Morocco
ETAFAT Company, Morocco
IRESEN, Research Institute for Solar Energy and New Energies, Rabat, Morocco

End-to-end solution for defect detection on large-scale PV installations

1. ADVANCED UAV PHOTOGRAMMETRY

for RGB, long-wave and short-wave thermal infrared image acquisition

2. DEEP LEARNING SOLUTIONS

for defect detection and classification on the used imagery types

3. BIG DATA ANALYTICS

to handle the huge datasets that are generated by large-scale PV plants

www.smartdrone4pv.com

SMARTDRONE4PV PROJECT

www.smartdrone4pv.com

3éme édition du Forum Innovation & Climat – Montreux, 10 novembre 2023

2023 International Conference on Power and Renewable Energy Engineering
SMARTDRONE4PV: AN END-TO-END SOLUTION FOR THE INSPECTION OF UTILITY-SCALE PHOTOVOLTAIC
INSTALLATIONS THROUGH BI-SPECTRAL MULTIVIEW UAV PHOTOGRAMMETRY, ARTIFICIAL INTELLIGENCE AND BIG DATA

CONTEXTE

Humidity Intrusion

Fierce Winds

Rain/Snow/Hail

Contrasted Temperatures

Handling & Installation

Solar Photovoltaic Modules

Multiple Defects that **develop over time** and **penalize the electricity production**

Remotely Sensed Imagery by UAVs

FIGURE 1.
Thermal + RGB images of a PV strings acquired by a UAV.

- **Enables contactless, fast, reliable characterization of PV Plant**
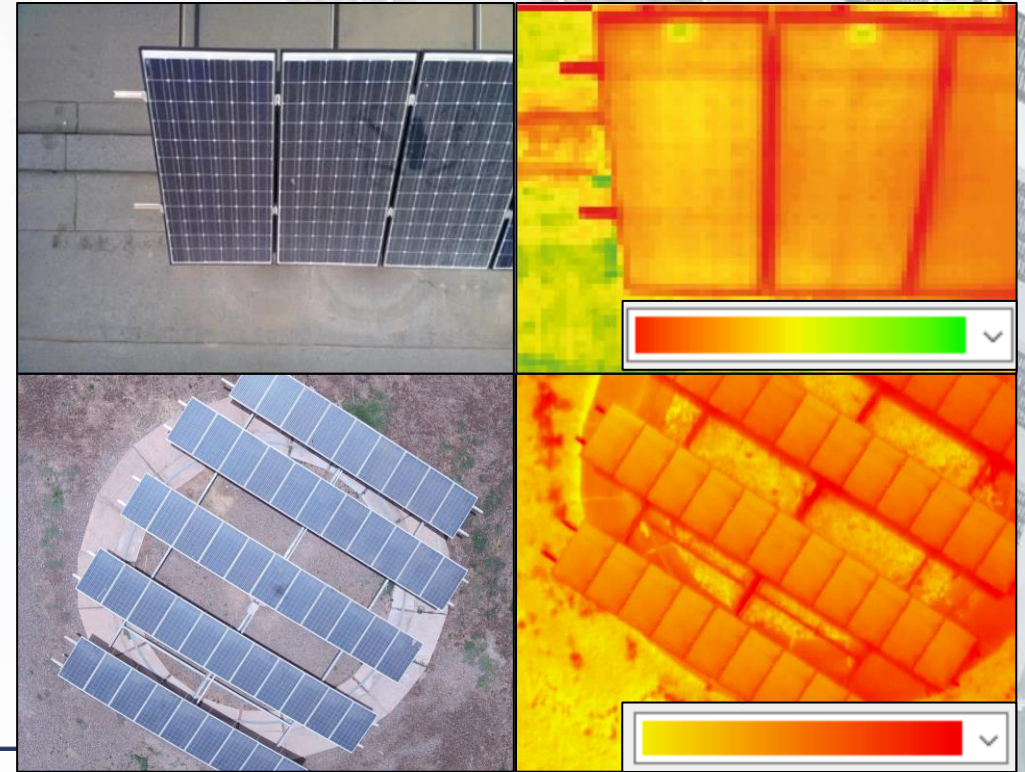- **with proven efficiency and cost-effectiveness**

ARCHITECTURE DE LA SOLUTION

I.1. UAV image acquisition
- RGB + Thermal infrared simultaneous imagery of the PV plant to inspect ;
- UAV equipped with a dual-sensor camera.

▶ **Raw RGB + thermal images**

I.2. Photogrammetric SfM-MVS postflight processing workflow
- (a) Initial calibration; (b) 3D dense point cloud generation;
- (c) DSM and orthomosaic generation.

▶ **RGB + Thermal orthomosaics**

I.3. Automatic generation of image base detection units
- PV modules extracted using a deep learning model ;
- Tiles extracted using a regular grid.

▶ **Orthorectified module images + Tiles**

I.4. Defect detection
- DL-based image classification, segmentation and object detection
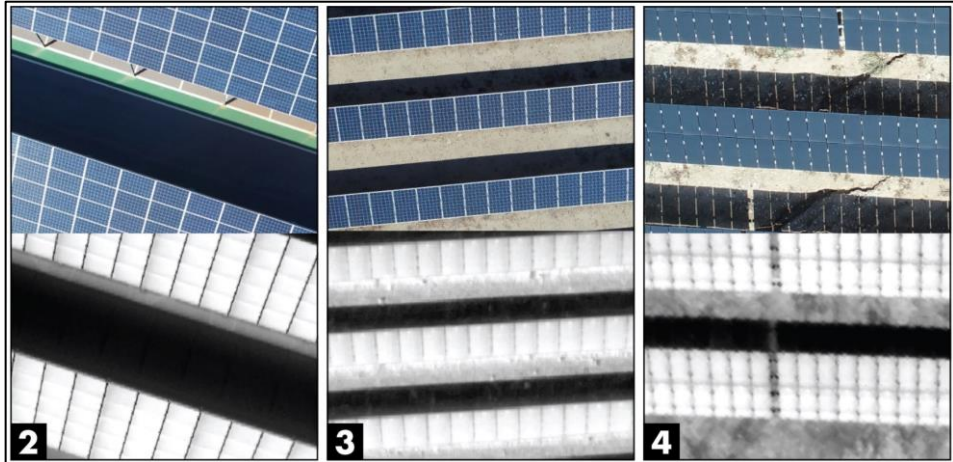
▶ **Defect identification + localization**
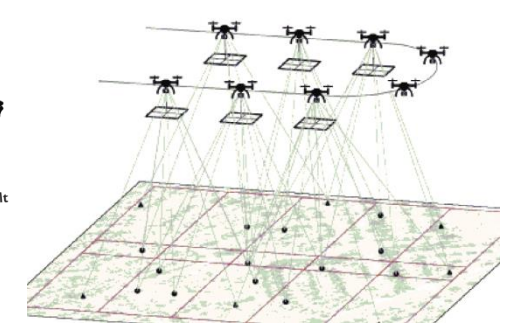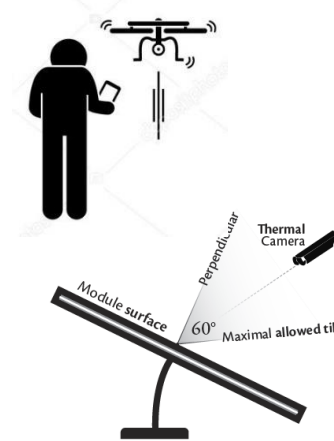
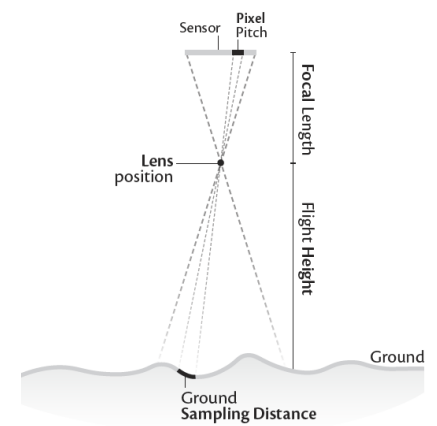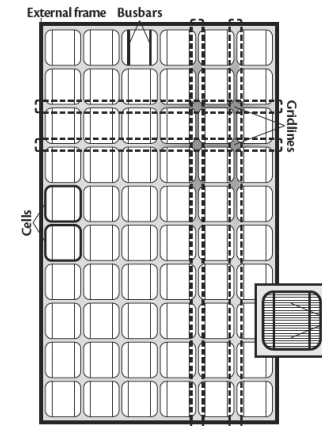**I.5. Result visualization, reporting and exploitation**
- Use of GIS tools within a geoportal ;
- Automatic report generation

▶ **Comprehensive and Intelligent PV inspection**

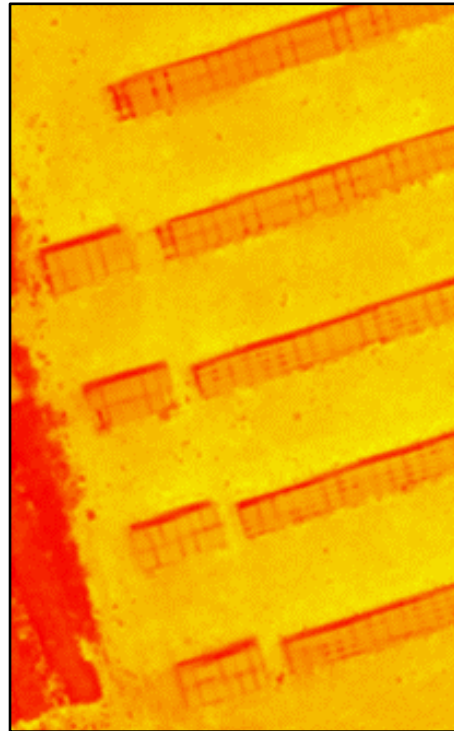## SOLUTION   I.1. UAV image acquisition protocol

Sample RGB + thermal images taken using a UAV from different PV plants, showcasing PV arrays of different types and under various layouts and backgrounds.

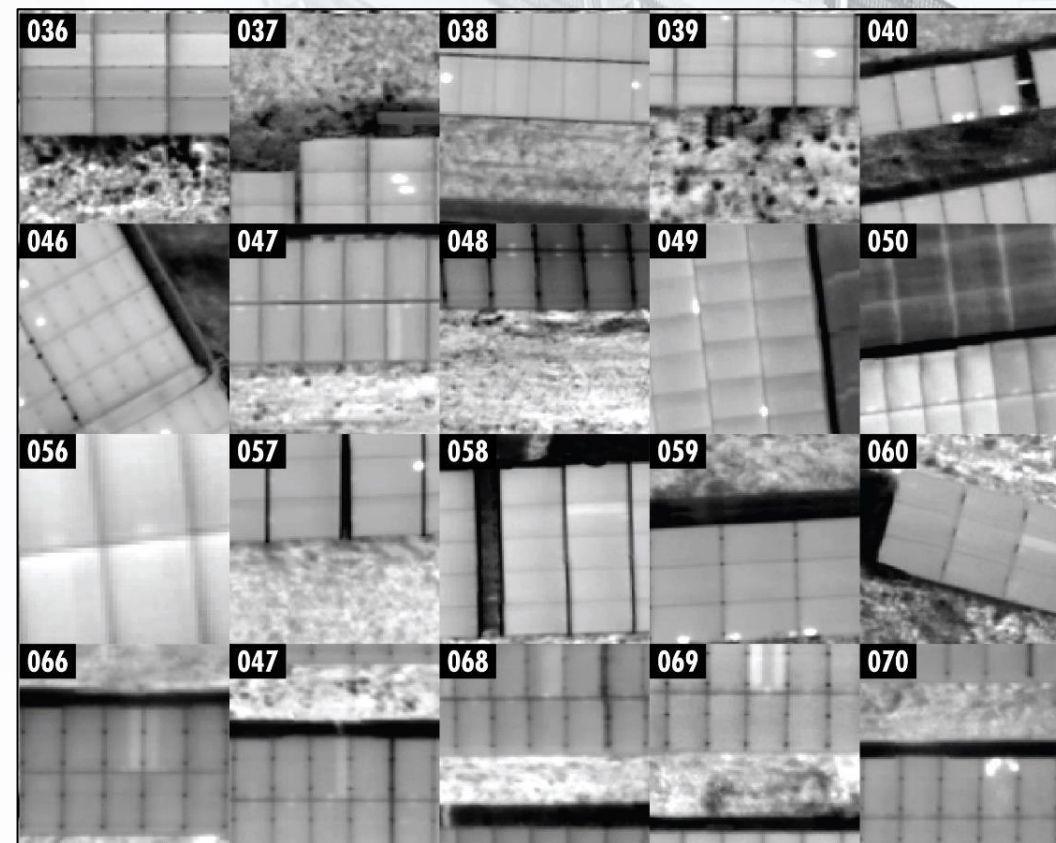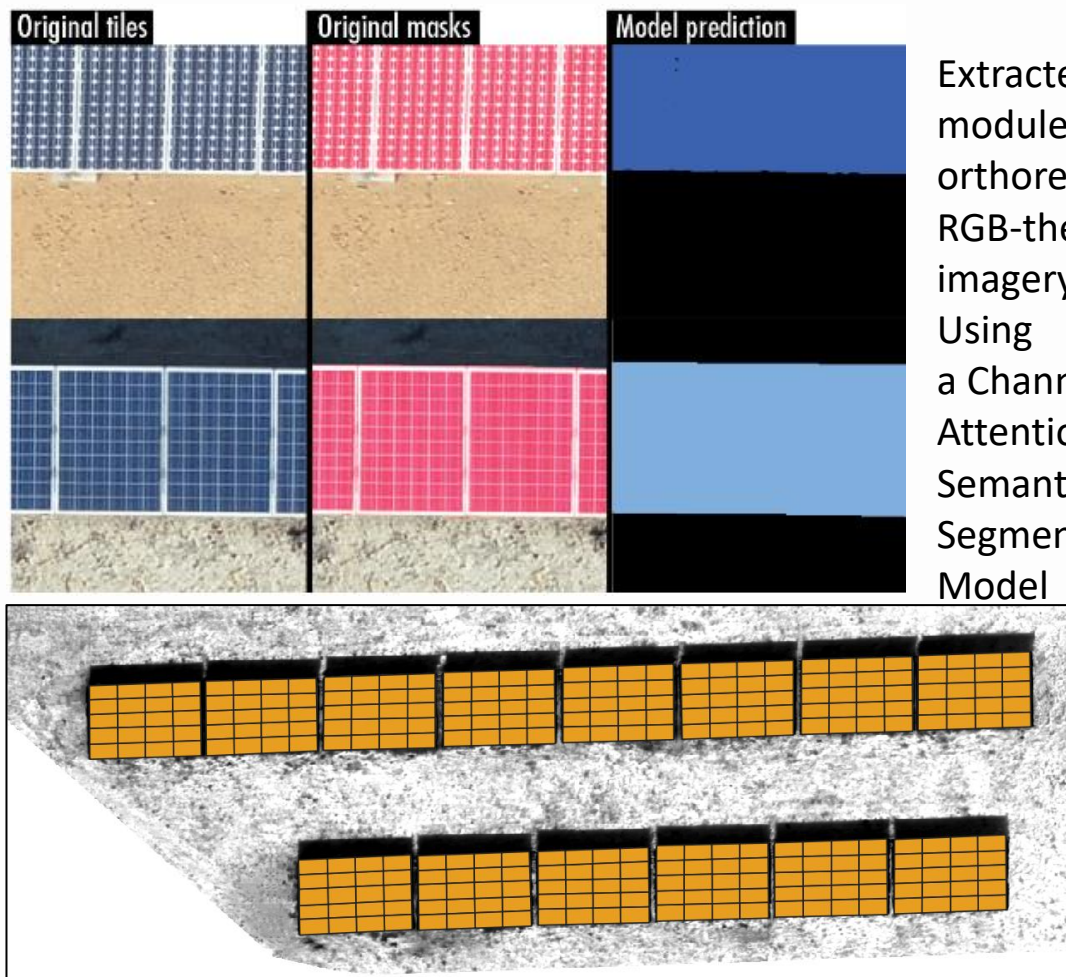**SOLUTION**   **I.2. Workflow Photogrammétrique SfM-MVS postflight**

RGB + thermal
orthomosaics of a PV site
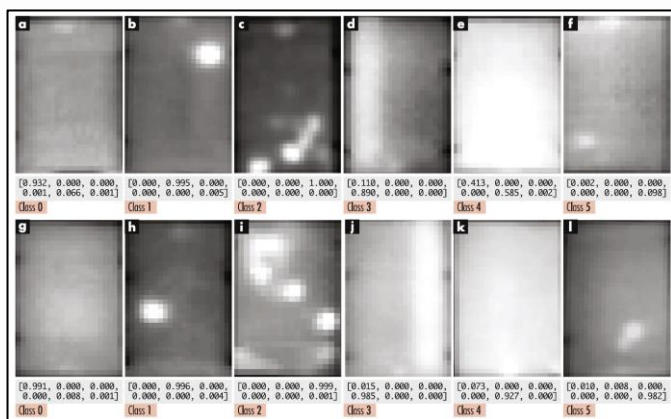
Photogrammetric
image processing

SOLUTION   **I.3.** **Détection automatique des panneaux PV**

Extracted PV modules from orthorectified RGB-thermal imagery
Using a Channel-Based Attention Deep Semantic Segmentation Model
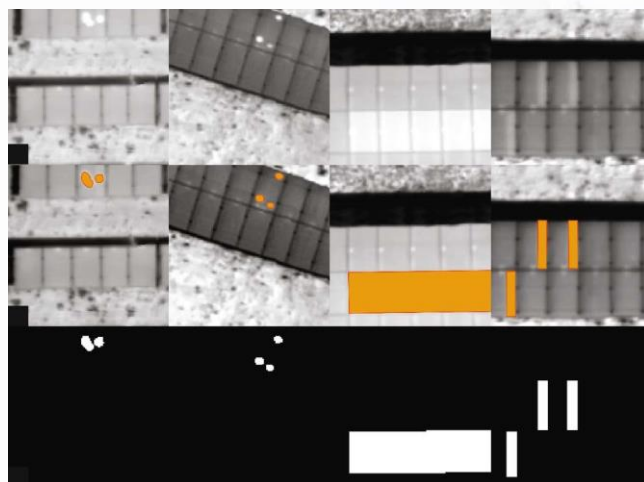

Extracted tiles from orthorectified thermal imagery

SOLUTION **I.4. Détection intelligente des défauts des panneaux PV**

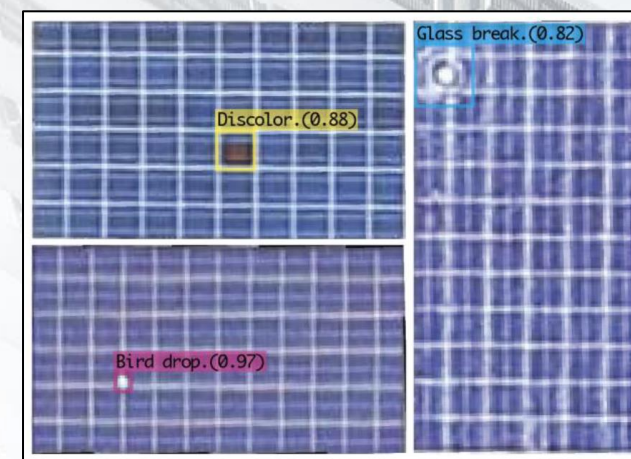Defect detection using image classification on thermal imagery.

Defect detection using image semantic segmentation on thermal imagery.

103 **PV installations**

93.44%

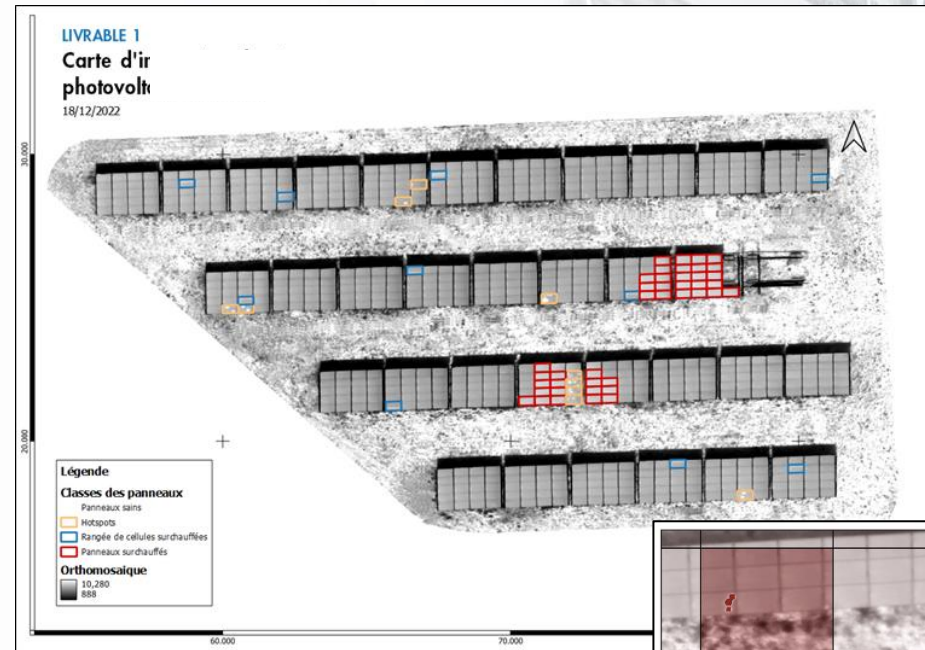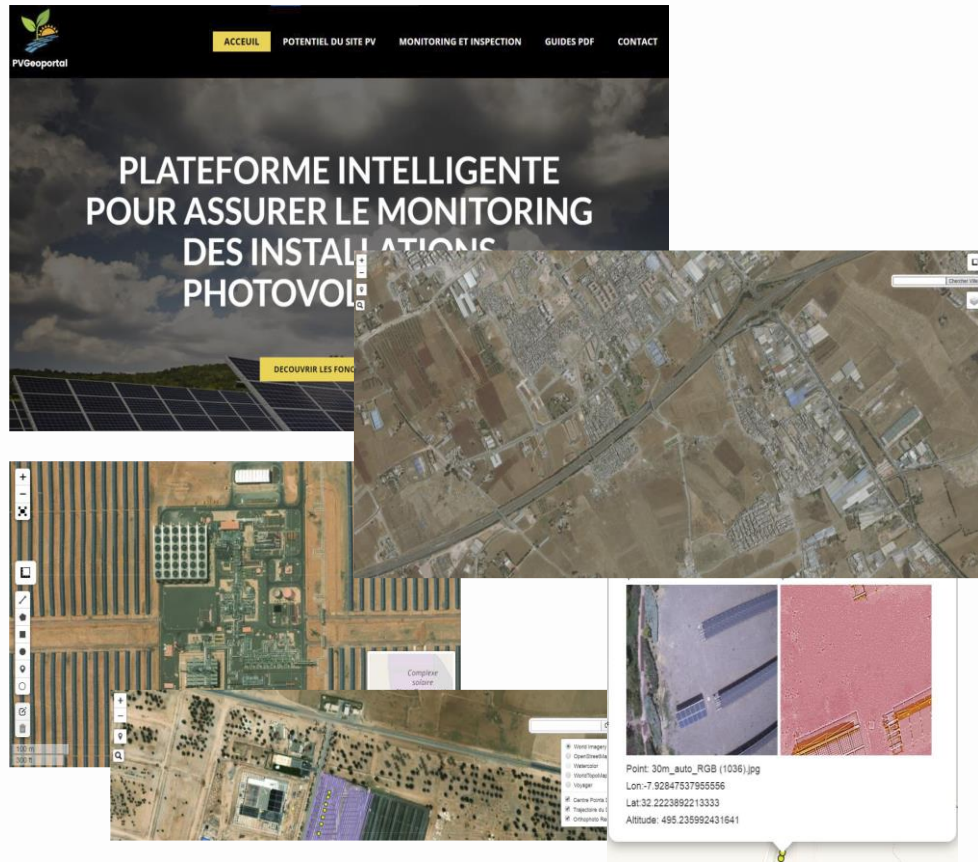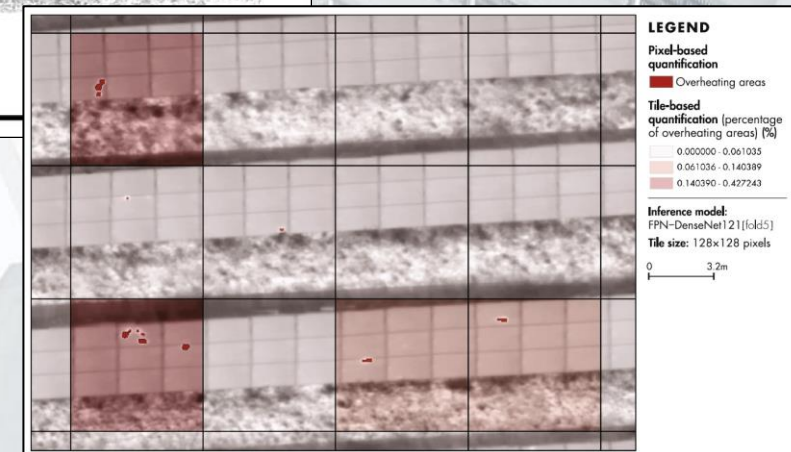**28** **PV installations**

94.52%

Defect detection using object detection on RGB imagery.

SOLUTION | **I.5. Plateforme intelligente de monitoring PV**

Rapports d'inspection

DISSEMINATION

1   **Brevet déposé**

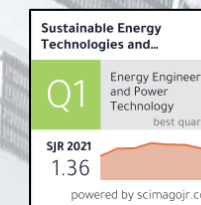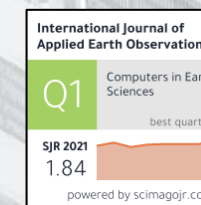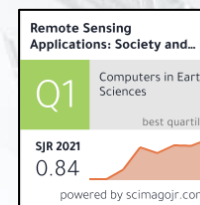**1**   **Thèse de doctorat soutenue**

4   **PFEs**

4   **Articles journaux Q1**

5   **Articles conférences (scopus/IEEE)**

6   **Présentations orales**

www.smartdrone4pv.com

PERSPECTIVES

Edge-IA
for
Real-time processing

Intégration du edge computing et des models de l'intelligence artificielle pour la detection et l'analyse en temps reel

Integration de **nouveaux capteurs Imageurs**

Intégration de la camera SWIR pour l'acquisition des images d'Electroluminescence Outdoor

Federate Learning

Données drone, électriques, capteurs IoT et autres sont fédérés pour des décisions plus efficientes dans un objectif de Solar Digital Twin

MERCI

MERCI.

Prof. SEBARI Imane
i.sebari@iav.ac.ma

www.smartdrone4pv.com