TERASENS

PFE BOOK

Space Tech for precision agriculture
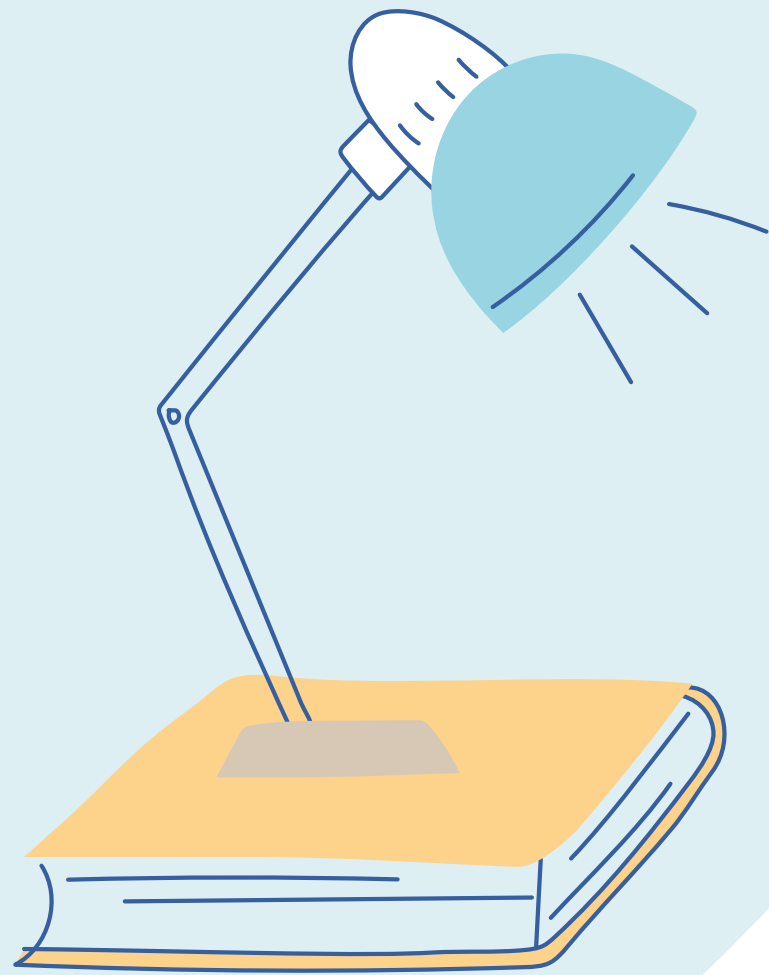
Outline

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01. General Information

- **Host Organization**: TerraSens
- **Project Type**: End-of-Studies Project (PFE)
- **Duration**: *4 to 6 months*
- **Location**: Remote / On-site (Technopole El Ghazala)
- **Fields**:

1. Remote Sensing
2. Data Science & Artificial Intelligence
3. Hydrology & Climate Science
4. IoT & Embedded Systems
5. Web & Mobile Development
6. Business & Innovation

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Who We Are?

We work at the intersection of

🌱 Agriculture | 🌍 Climate | 💧 Water | 💻 Digital Systems

TerraSens develops applied, data-driven solutions using:

- Earth Observation
- IoT sensing systems
- Data analysis & modeling
- Software and AI tools

Our PFE projects aim to connect academic knowledge with real technical challenges, using real datasets and operational problems.

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Topics Overview

1. Climate, Water & Agriculture

- Climate Change Downscaling & Bias Correction
- Water Footprint Modelling & Mapping (Green / Blue Water)
- Smart Irrigation System with AI & Soil Moisture Modeling
- Soil Moisture & Soil Temperature Monitoring using EO & AI
- Crop Monitoring & Yield Prediction (EO + AI)

2. Data Engineering & Application Development

- Weather Data: EO Download, Visualization, Correction & Web Integration
- Data Engineering & Database Design for Climate and Agricultural Data
- Agroclimatic Web Application Development (Back-end & Front-end)

Topics Overview

3. IoT & Mobile Systems

- IoT Weather Station Design (Electronics & Embedded Systems)
- Mobile Application Development for Smart Agriculture

4. Business, Strategy & Design

- Business Development & Market Strategy (AgriTech & Climate Services)
- UX/UI Design System for the TerraSens Platform

PFE 01 – Climate Change Downscaling & Bias Correction

Context

Climate datasets such as ERA5 and CHIRPS often show biases compared to local station data, limiting their direct use at local scale.
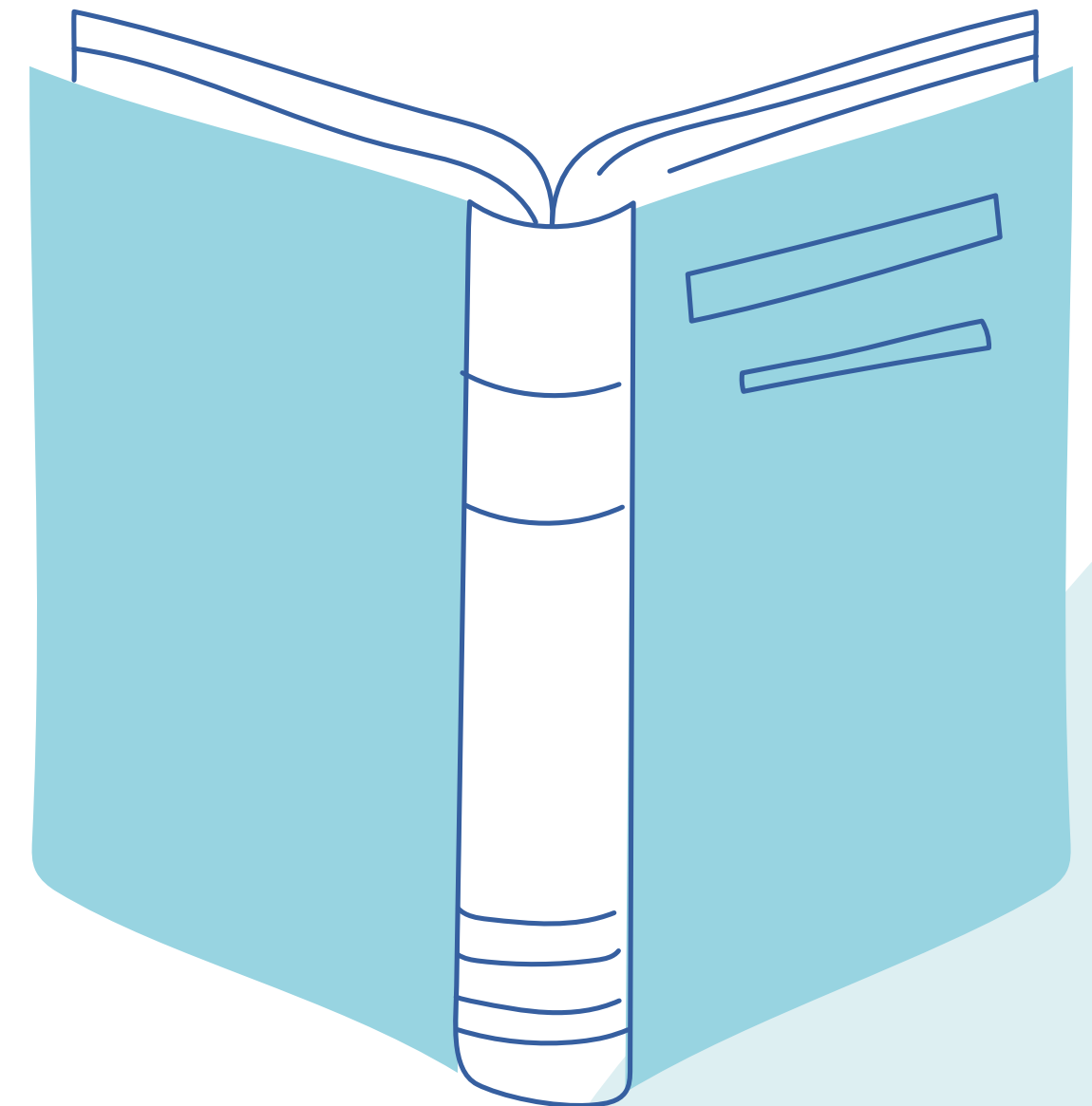
Objectives

- Analyze biases between EO/reanalysis data and station observations
- Apply statistical and ML-based bias correction methods
- Produce corrected historical and future climate series

Main Tasks

- Collect and preprocess climate and station data
- Perform bias analysis and correction
- Validate corrected datasets

Required Skills

- Climate data analysis, statistics, Python, time series processing

PFE 02 – Water Footprint Modelling & Mapping

Context

Water footprint indicators are widely used to assess water consumption in agriculture and support sustainable water management decisions.
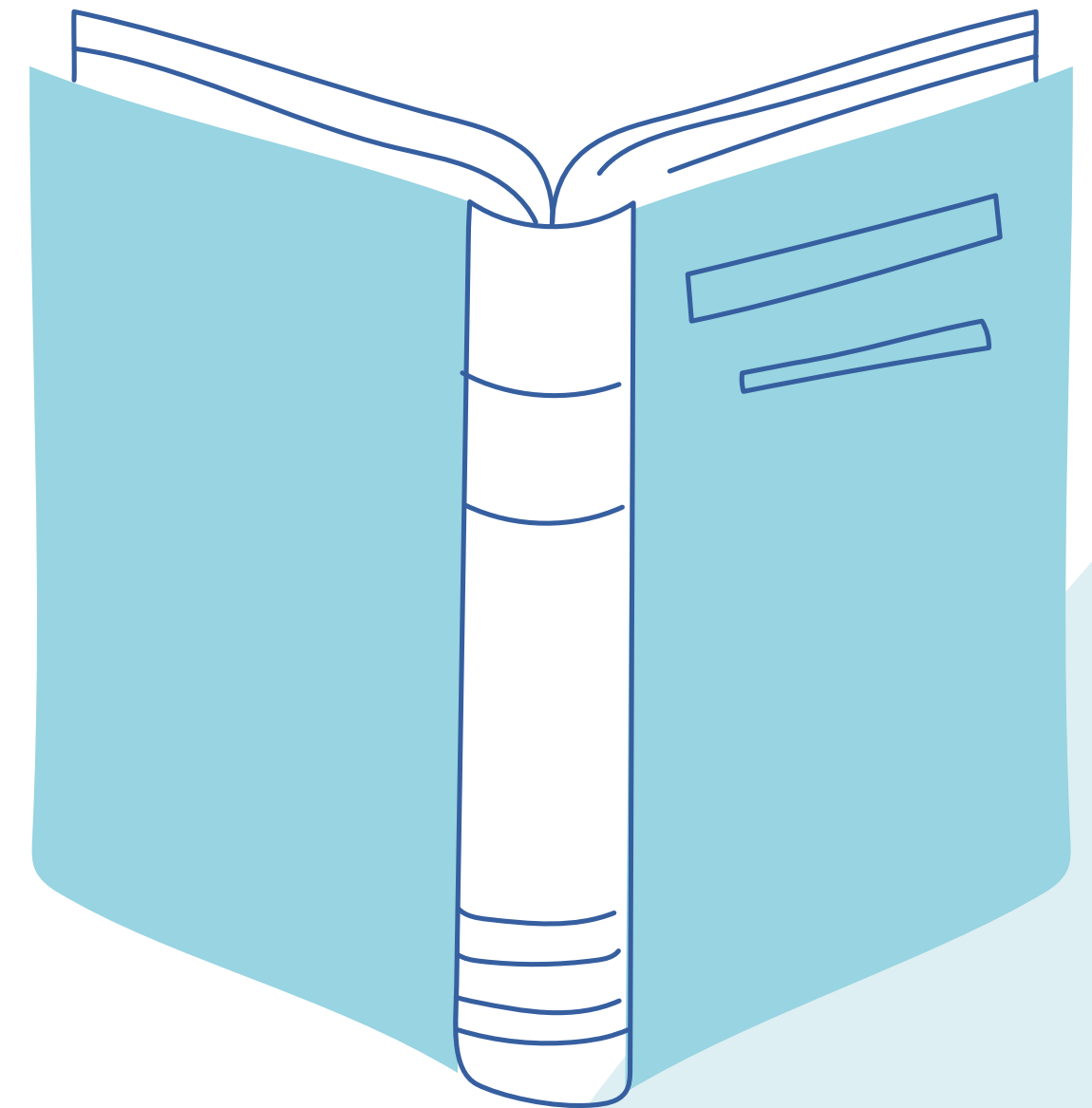
Objectives

- Estimate green and blue water components for crops
- Integrate climate, soil, and crop parameters
- Analyze spatial and temporal variability of water use

Main Tasks

- Build a soil–climate–crop database
- Implement water footprint calculation methods
- Produce maps and indicators by crop and region

Required Skills

Hydrology, agronomy, GIS, Python

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PFE 03 – Smart Irrigation System with AI & Soil Moisture Modeling

Context

- Efficient irrigation management requires accurate estimation of crop water needs and real-time monitoring of soil moisture under variable climate conditions.

Objectives

- Estimate crop water requirements using ET_o and crop coefficients
- Integrate soil moisture sensor data
- Develop AI-based irrigation recommendation models

Main Tasks

- Compute ET_o and dynamic crop coefficients
- Process soil moisture measurements
- Train and test irrigation decision models

Required Skills

Hydrology, data analysis, Python, machine learning

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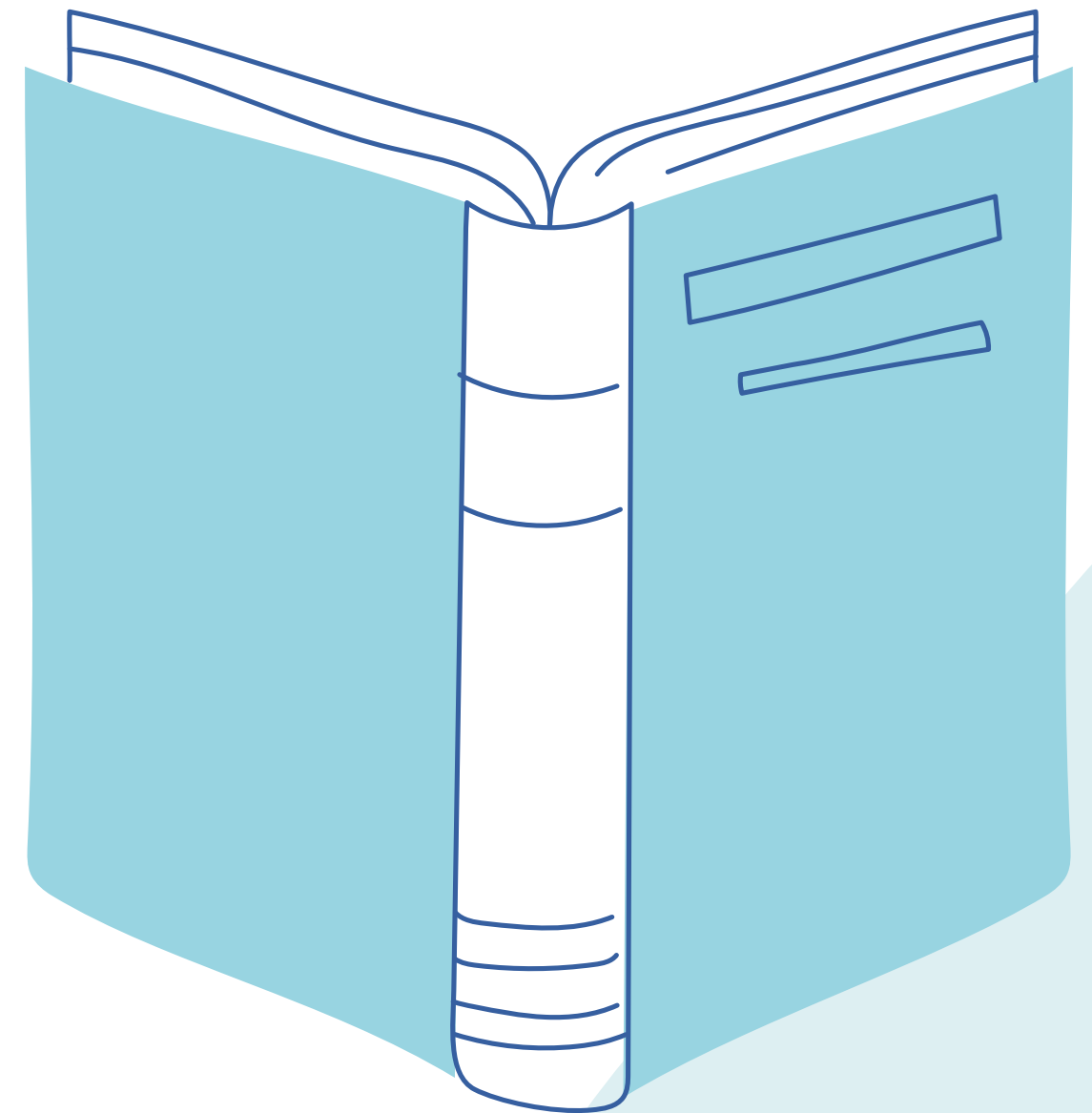
PFE 04 – Soil Moisture & Soil Temperature Monitoring using EO & AI

Context

Soil moisture and temperature are key variables for irrigation management, crop monitoring, and environmental analysis, but are difficult to monitor continuously at large spatial scales.
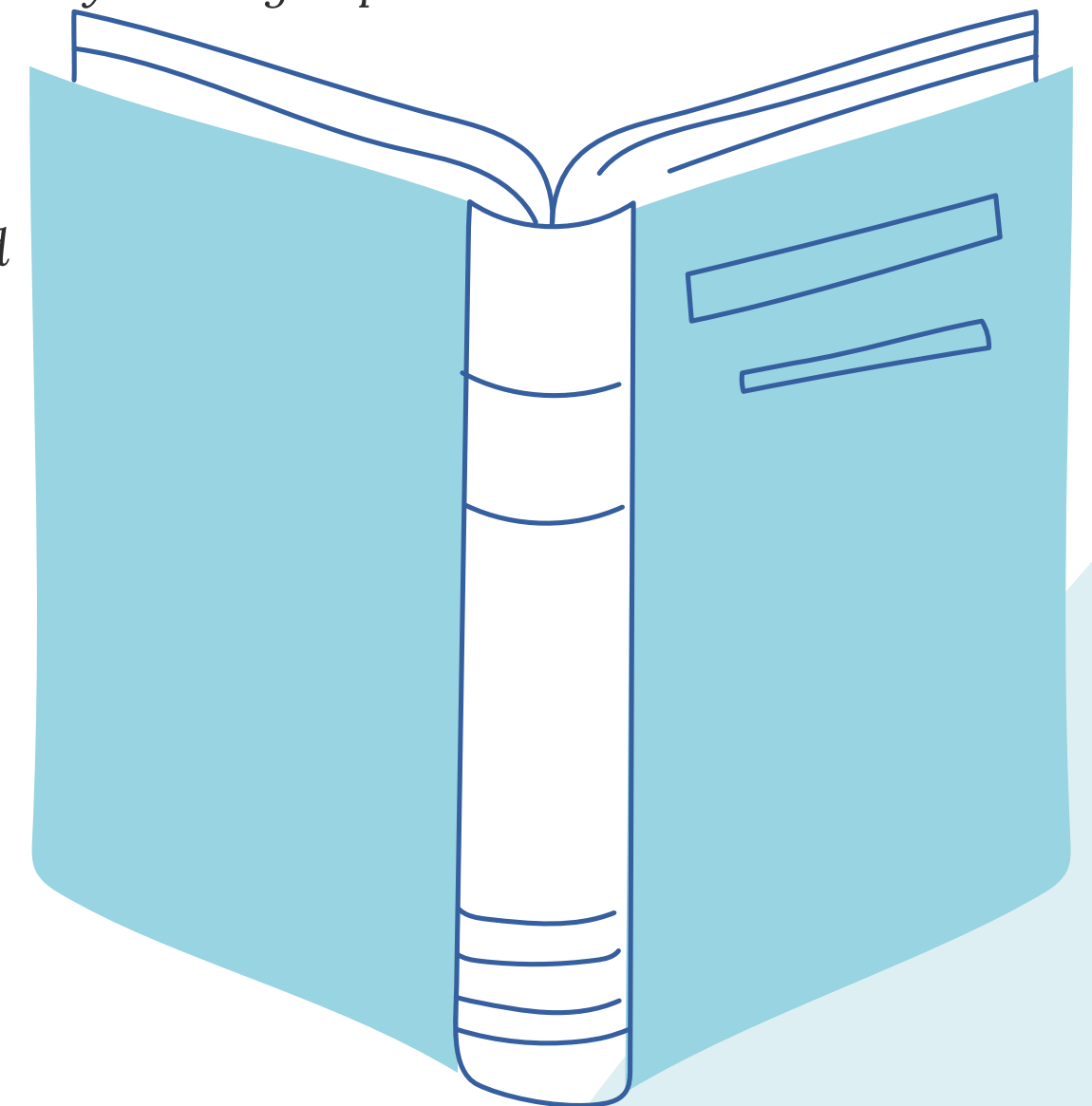
Objectives

- Estimate soil moisture and temperature using Earth Observation and climate data
- Analyze spatial and temporal variability of soil conditions
- Apply AI models for improved estimation accuracy

Main Tasks

- Process Sentinel-1, Sentinel-2 and climate datasets
- Develop EO- and AI-based estimation models
- Evaluate model performance using reference datasets

Required Skills

Remote sensing, machine learning, Python, data analysis

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PFE 05 – Crop Monitoring & Yield Prediction (EO + AI)

Context

Satellite imagery provides continuous information on crop development and condition, enabling large-scale agricultural monitoring.
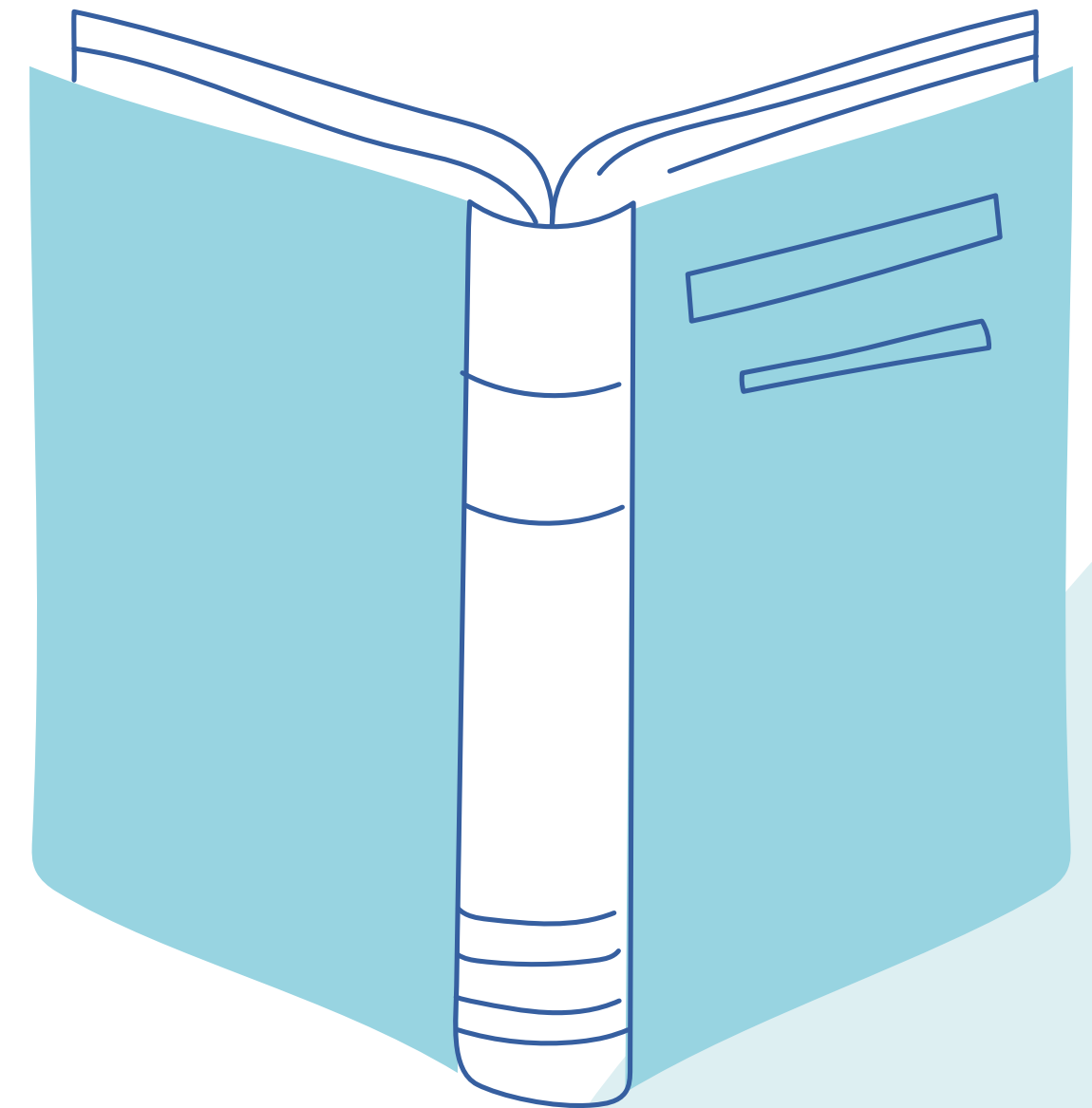
Objectives

- Monitor crop growth using vegetation indices
- Detect crop stress and anomalies
- Predict crop yield using AI models

Main Tasks

- Process Sentinel-2 time series
- Extract vegetation indices and phenological metrics
- Train and evaluate yield prediction models

Required Skills

Remote sensing, machine learning, Python

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PFE 06 – Weather Data: EO Download, Visualization, Correction & Web Integration

Context

Climate and weather data from EO sources require preprocessing, correction, and integration before operational use.
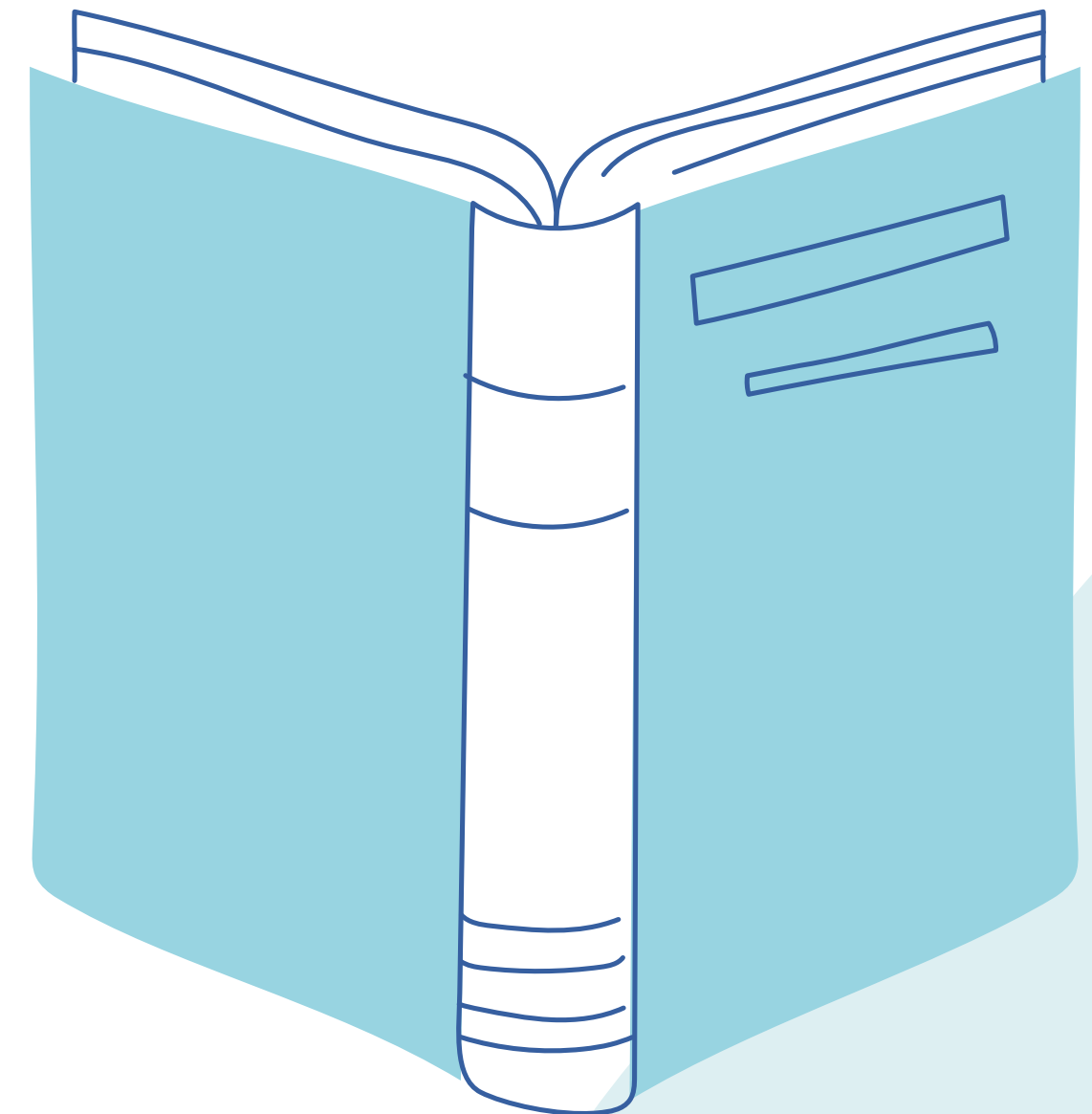
Objectives

- Automate EO weather data acquisition
- Visualize and analyze climate variables
- Integrate processed data into a web platform

Main Tasks

- Download and preprocess ERA5 / CHIRPS data
- Perform data aggregation and correction
- Develop web-ready data services

Required Skills

Python, data engineering, climate data formats

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PFE 07 – Data Engineering & Database Design for Climate and Agricultural Data

Context

Efficient data storage and organization are essential for managing large climate and agricultural datasets.
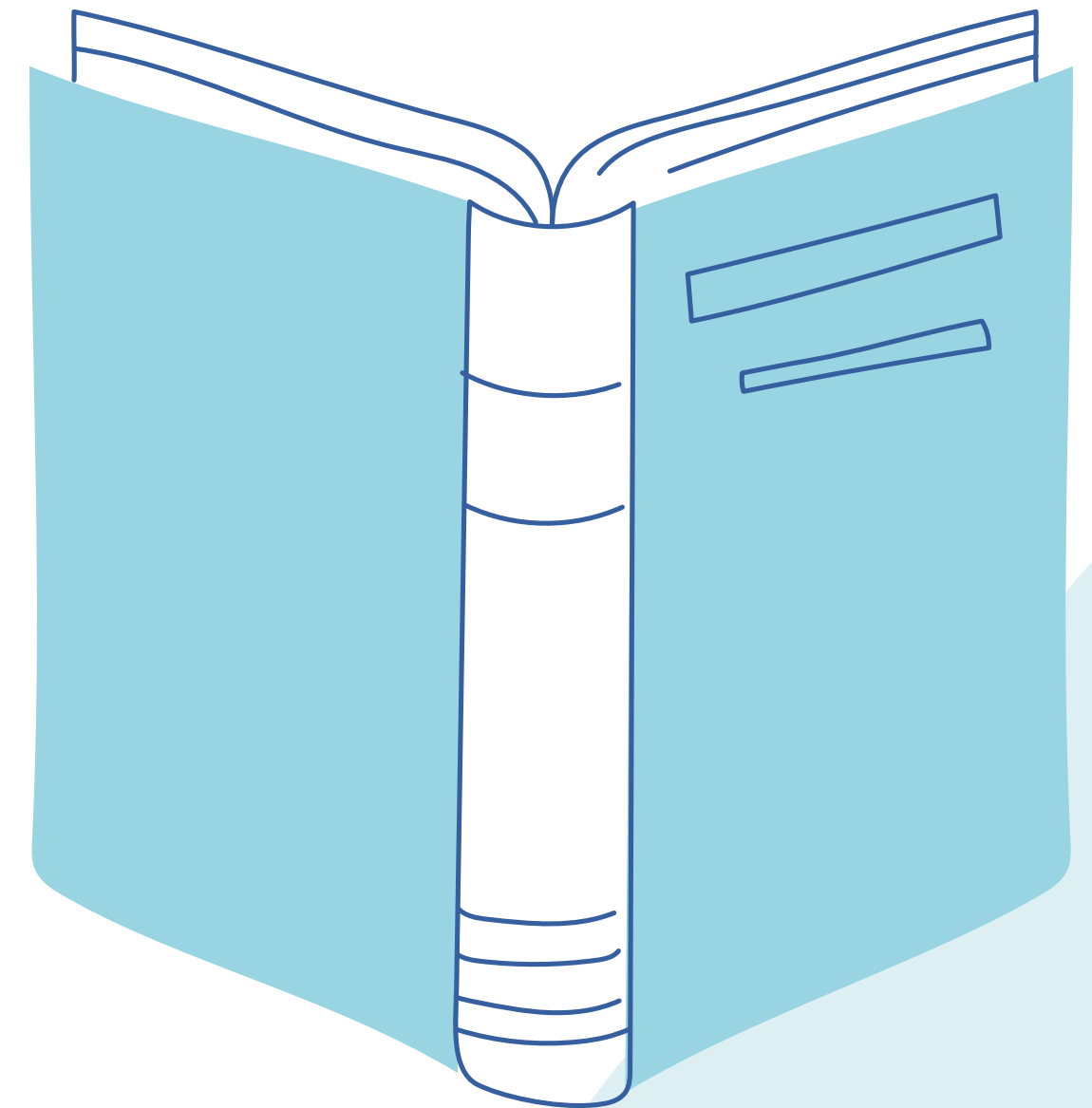
Objectives

- Design structured databases for climate and EO data
- Ensure data consistency and scalability
- Support analytics and application layers

Main Tasks

- Design database schema
- Implement data ingestion pipelines
- Optimize data storage and access

Required Skills

Data engineering, databases, Python, SQL

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PFE 08 – Agroclimatic Web Application Development (Back-end & Front-end)

Context

Web applications are essential for visualizing and interacting with agroclimatic data and indicators.
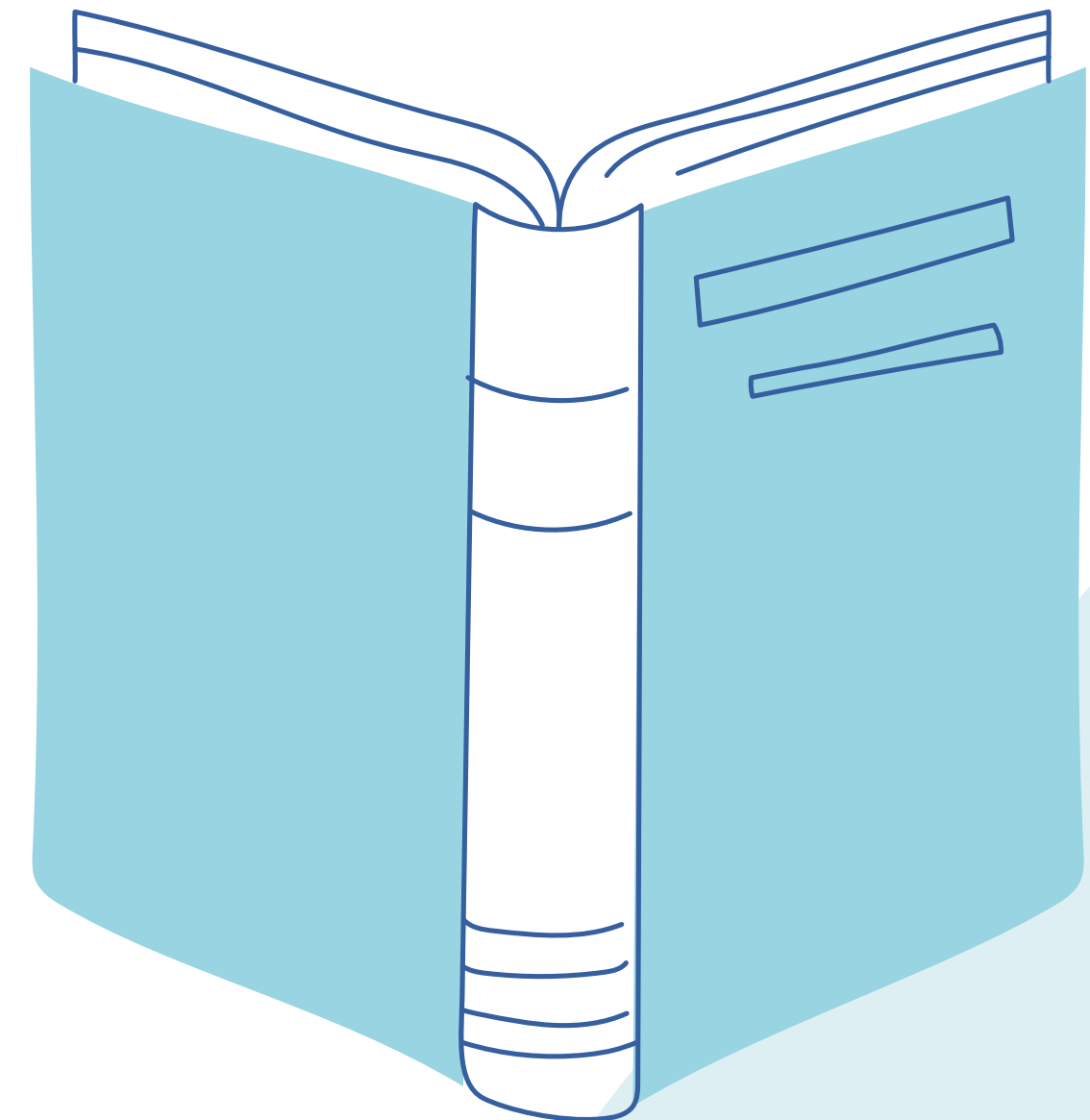
Objectives

- Develop a full-stack agroclimatic web application
- Integrate EO and climate datasets
- Create interactive dashboards and maps

Main Tasks

- Develop backend APIs
- Build frontend interfaces
- Integrate maps and visualizations

Required Skills

Web development, APIs, GIS web technologies

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PFE 09 – Power BI Dashboards for Advanced Climate Data Visualization

Context

Decision-makers require clear and interactive dashboards to interpret complex climate and water data.
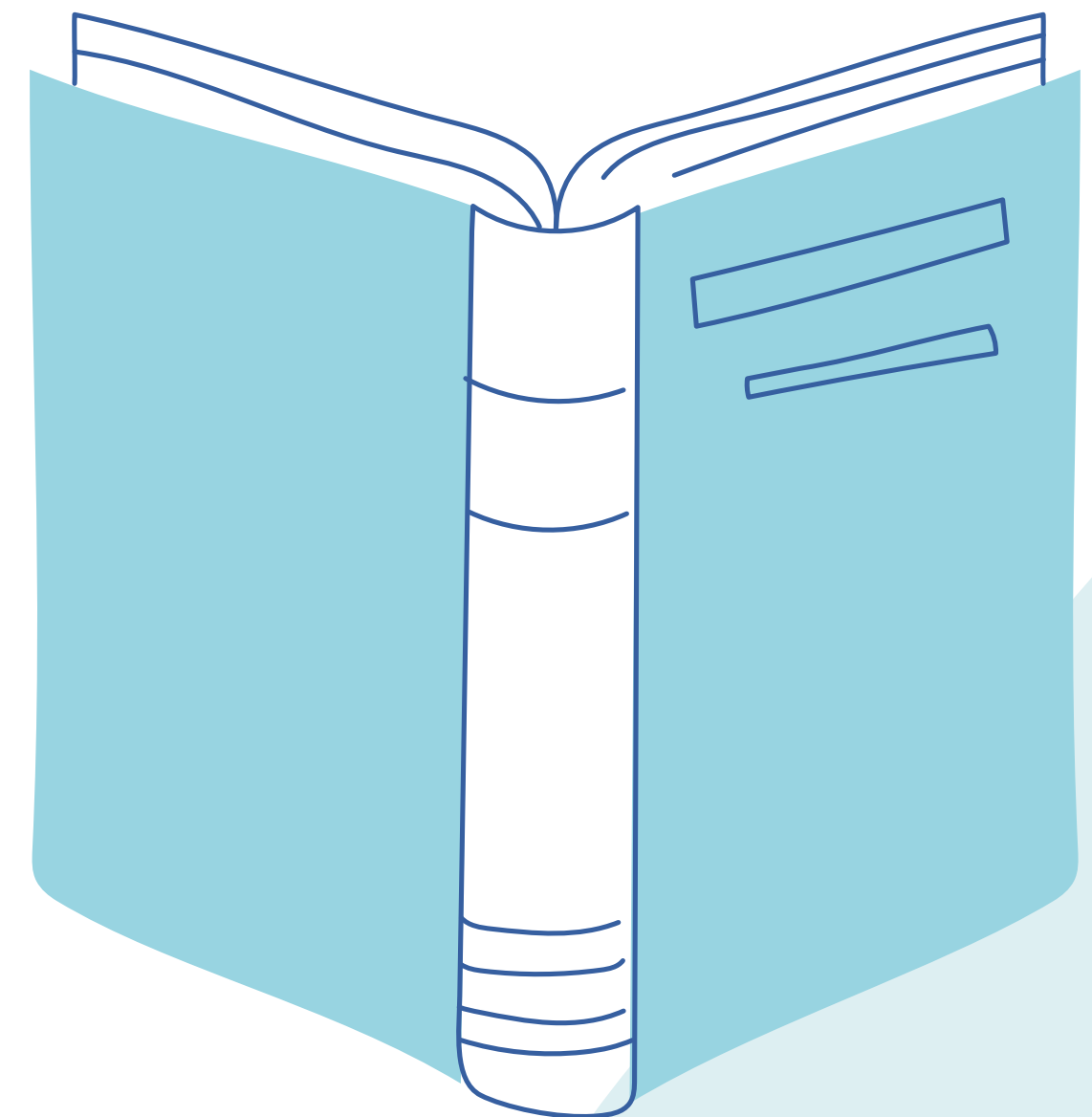
Objectives

- Prepare climate and agricultural datasets
- Develop interactive Power BI dashboards
- Define key indicators and metrics

Main Tasks

- Data preparation and modeling
- Dashboard design and visualization
- KPI definition and automation

Required Skills

Power BI, data analytics, Python

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PFE 10– Mobile Application Development for Smart Agriculture

Context

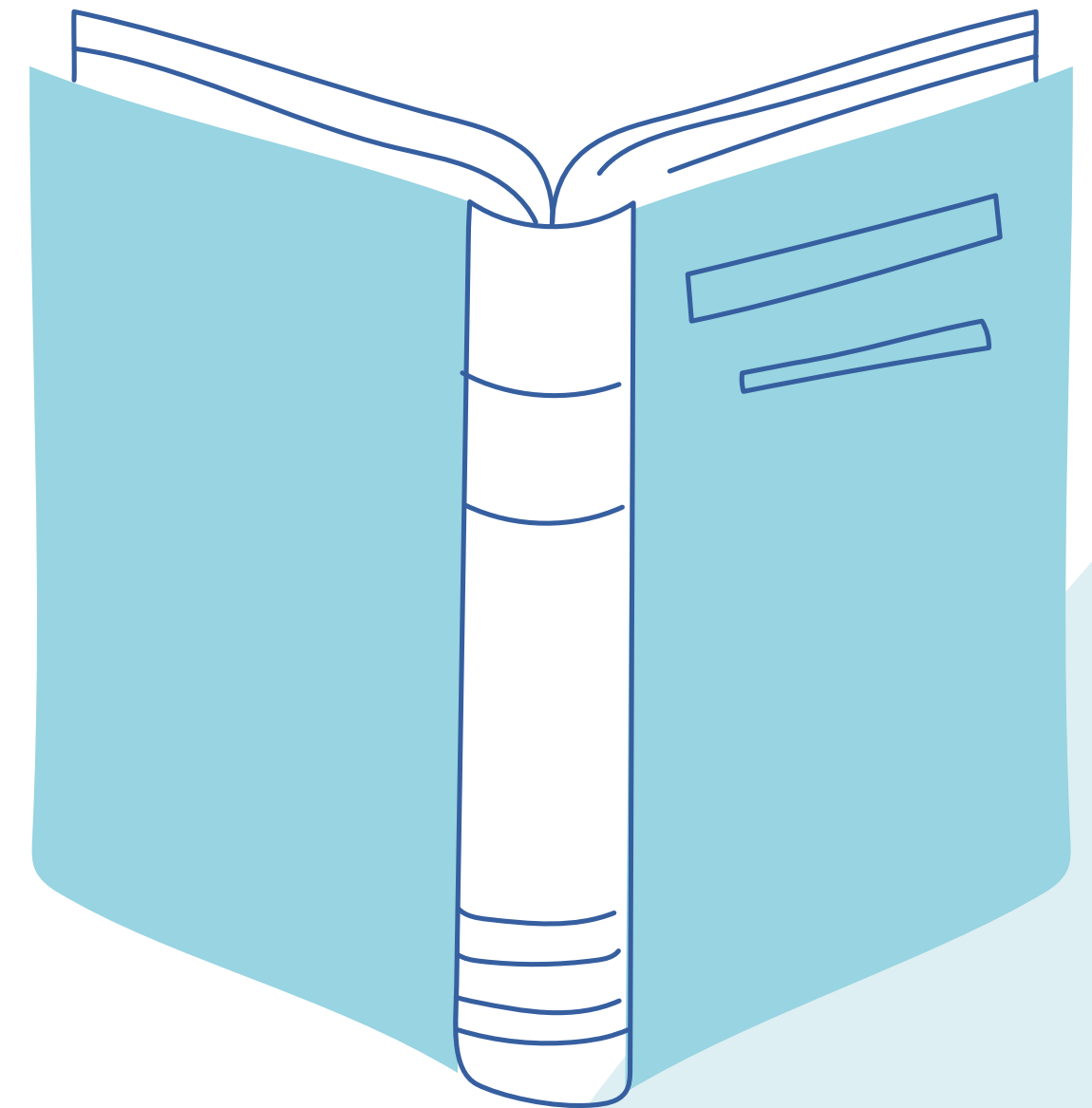Mobile applications enable direct access to agricultural information for users in the field.

Objectives

- Develop a mobile application for agricultural monitoring
- Display climate, irrigation, and alert information
- Ensure usability and offline access

Main Tasks

- Mobile app development
- API integration
- User interface implementation

Required Skills

Mobile development, REST APIs

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PFE 11- IoT Weather Station Design (Electronics & Embedded Systems)

Context

Local weather stations are essential for monitoring microclimatic conditions in agricultural areas.
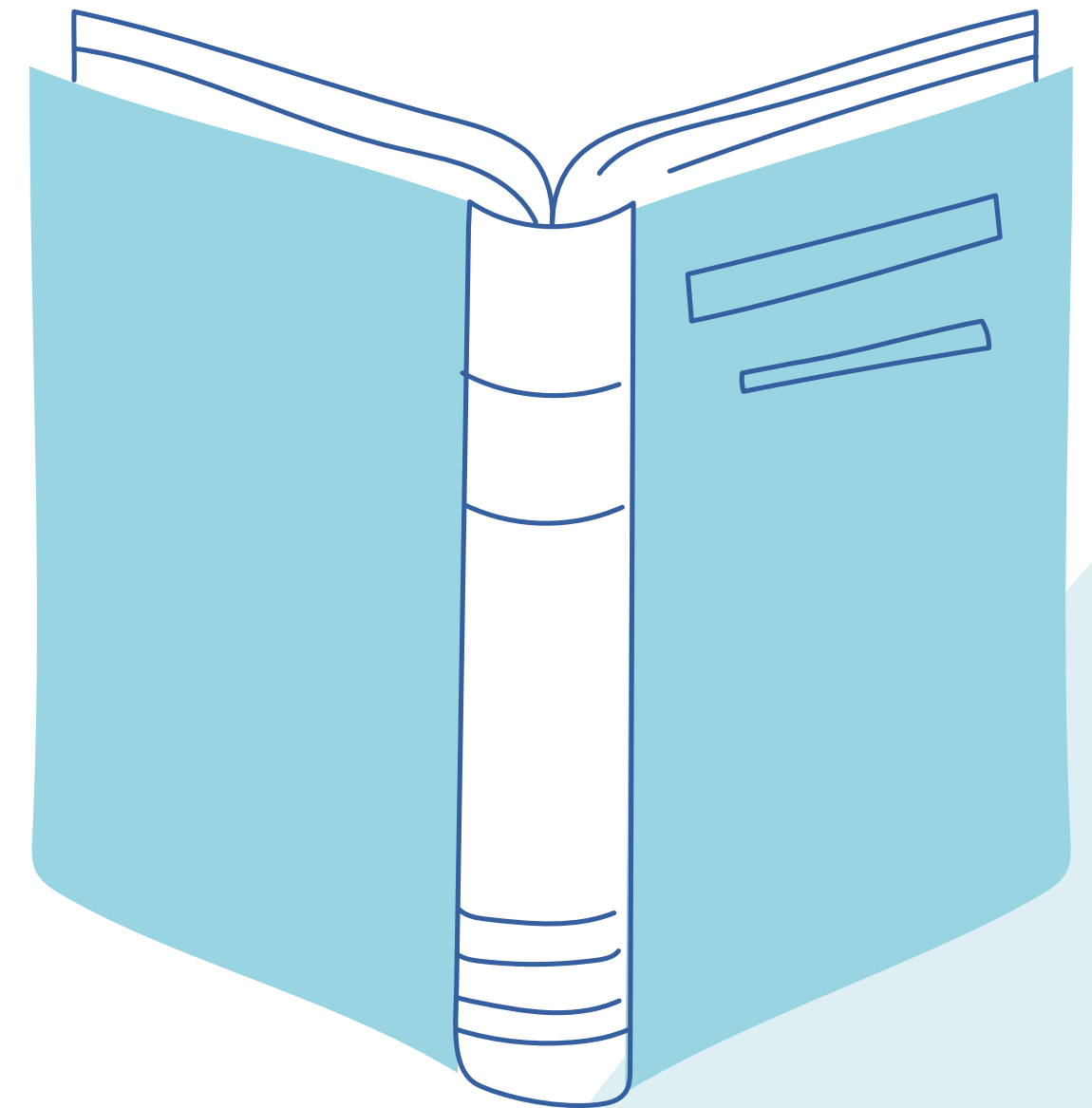
Objectives

- Design an IoT-based weather station
- Develop embedded firmware
- Optimize power consumption

Main Tasks

- Electronic schematic and PCB design
- Firmware development
- System testing and validation

Required Skills

Electronics, embedded systems, IoT

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PFE 12– UX/UI Design System for the TerraSens Platform

Context

User experience plays a key role in the adoption of digital agricultural platforms.

Objectives

- Analyze user needs and workflows
- Design consistent web and mobile interfaces
- Develop a reusable design system

Main Tasks

- UX research and wireframing
- UI design and prototyping
- Design documentation

Required Skills

UX/UI design, Figma, user-centered design

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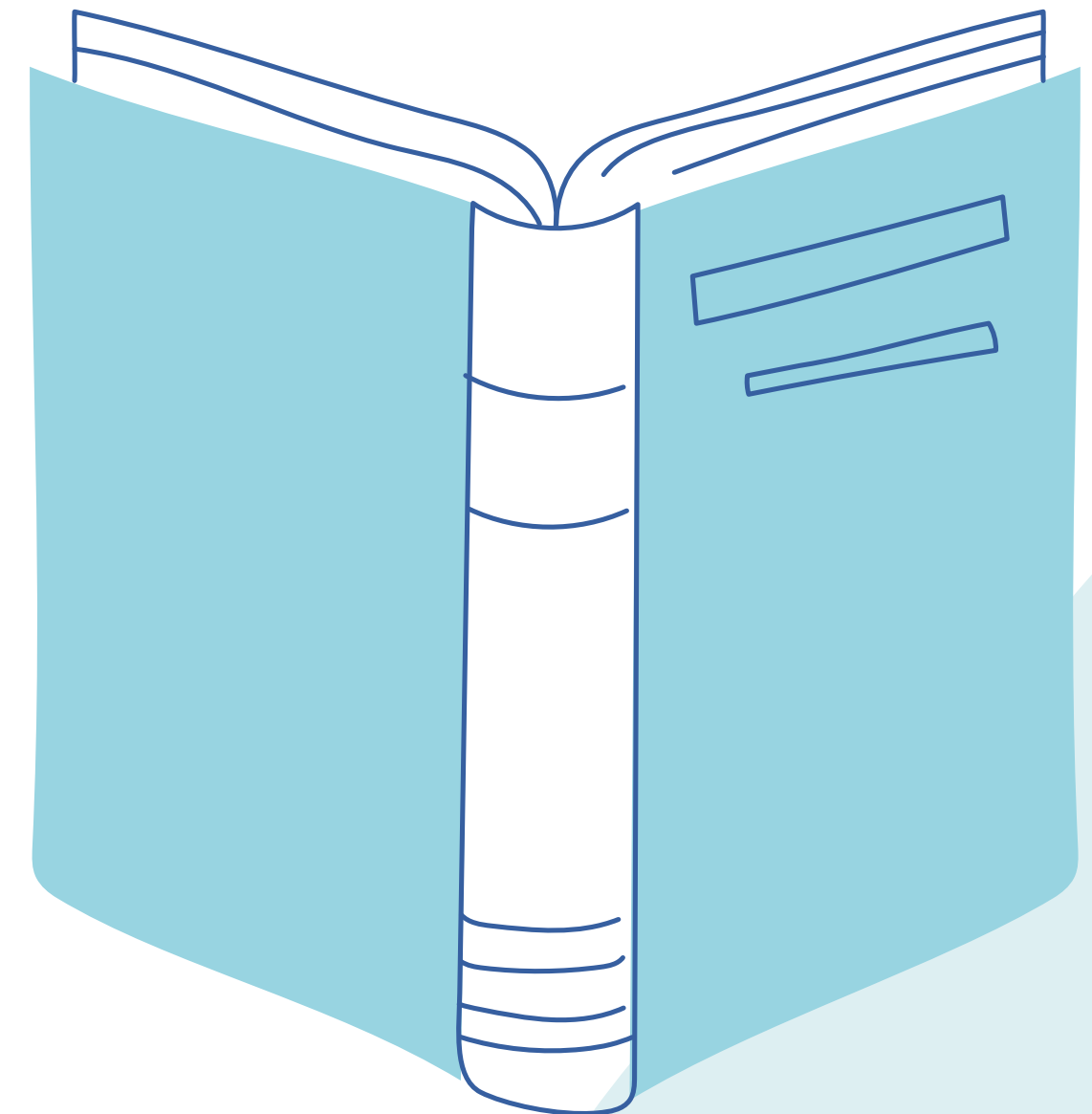
PFE 13- Business Development & Market Strategy (AgriTech & Climate Services)

Context

AgriTech solutions require clear market positioning and sustainable business models.

Objectives

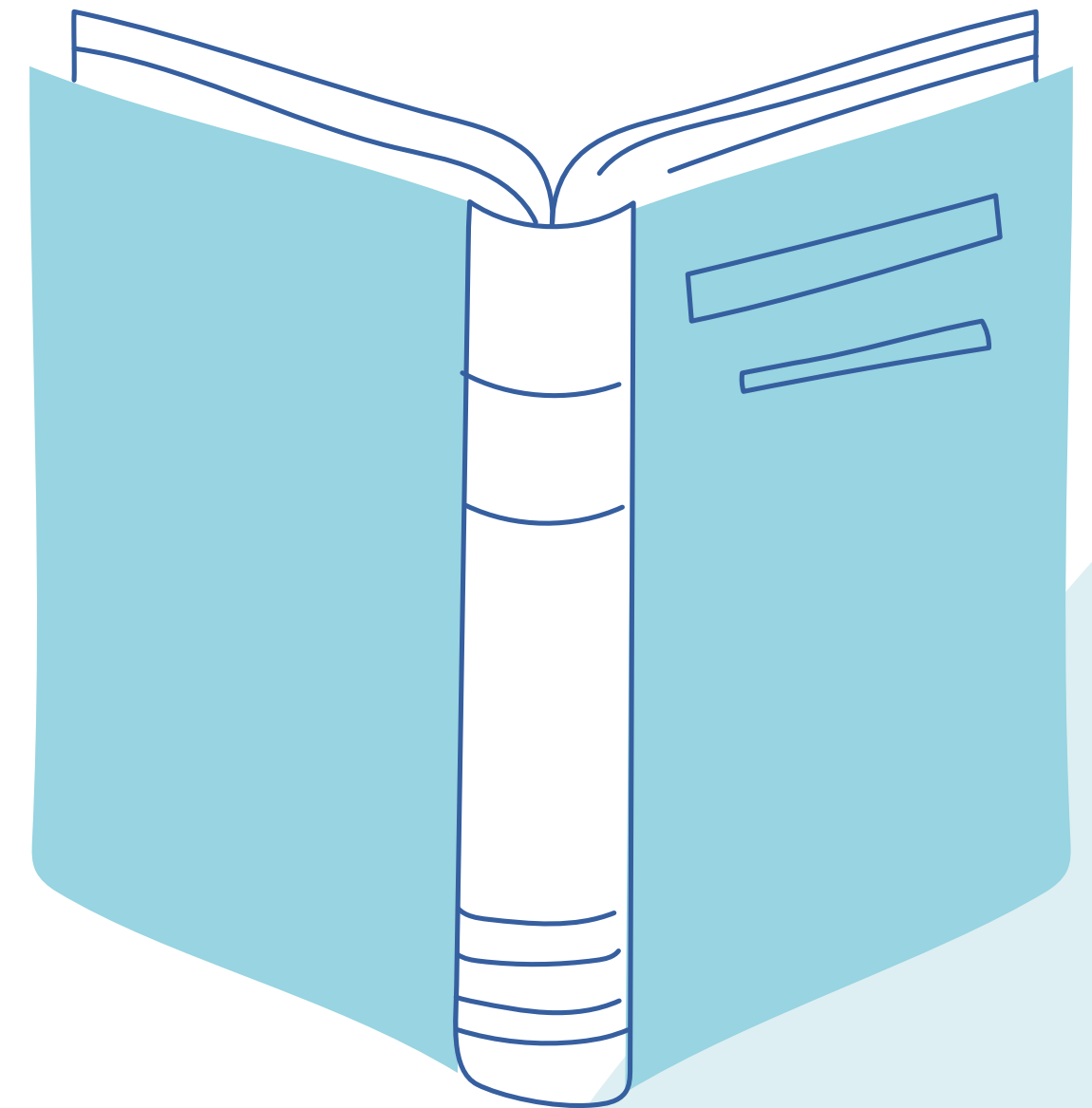- Analyze AgriTech and climate services markets
- Define business and pricing strategies
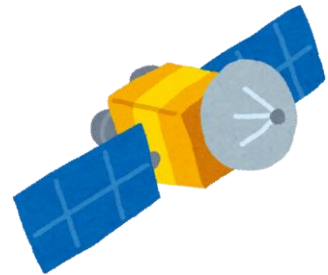- Support commercialization planning

Main Tasks

- Market and stakeholder analysis
- Business model development
- Strategy and roadmap definition

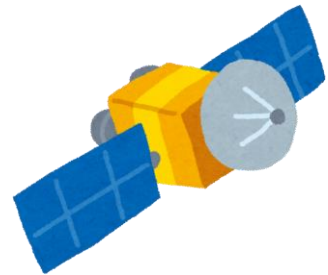## Required Skills

Business analysis, market research, strategy

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How to Apply

Choose one or more topics · Send CV + motivation letter

✉ contact@terrasens.tn

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Thank you

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