The European Space Agency WORLDSOILS Monitoring System

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SOILS: WHERE FOOD BEGINS

Global Symposium on Soils for Nutrition | 26-29 July 2022

GLOBAL SOIL PARTNERSHIP

Project Objectives

- Develop a **pre-operational** monitoring system
  - estimations of **top Soil Organic Carbon**
  - exploiting space-based **EO data**
  - leveraging large **soil data archives and modelling techniques**
  - **cloud environment**

- Engaging and bringing together **end users and EO experts** for developing soil indices relevant for monitoring the global top soils.

Project Ambition

- Monitoring system prototype characteristics:
  - **Yearly estimations** of top soil organic carbon.
  - **Modular**; allowing its future extension to additional soil indices.
  - **Spatial resolution** 100m x 100m over continental areas and 50m x 50m over three regional test sites.
  - **Large time series (3 years)**
  - **Confidence metrics** provision.
  - **Validation** over three European regions.

On behalf of the Project Consortium

- GMV Aerospace and Defence (**GMV**) - **Prime -** Julia Yagüe, Adrián Sanz
- Catholic University of Louvain (**UCL**) – Bas van Wesemael
- German Aerospace Center (**DLR**) - Uta Heiden
- German Research Center for Geosciences (**GFZ**) - Sabine Chabrillat
- Aristotle University of Thessaloniki (**AUTh**) - Nikolaos Tziolas
- International Soil Reference and Information Centre (**ISRIC**) - Laura Poggio
- Czech University of Life Sciences (**CZU**) - Asa Gholizadeh
- Tel Aviv University (**TAU**) - External service provider **-** Eyal Ben-Do

NCR and Steering Committee

- **National Reference Centres Soil**
  - Service Public de Wallonie – SPW (Belgium)
  - Soil And Water Resources Institute, HAO - Dimitra (Greece)
  - Research Institute for Soil and Water Conservation - VUMOP (Czech Republic)

- **Steering Committee** *(policy and programmatic guidance)*
  - EC DG JRC & DG DEFIS
  - EEA
  - GSP FAO
  - EJP Soil (STEROPES - AgroParisTech)

Project Phases

Phase 1

Feasibility analysis and system requirement baseline definition.

- **Feasibility and Impact Assessment**
- **Requirement Specification**
- **Requirements baseline**

Phase 2

Design implementation, verification and testing.

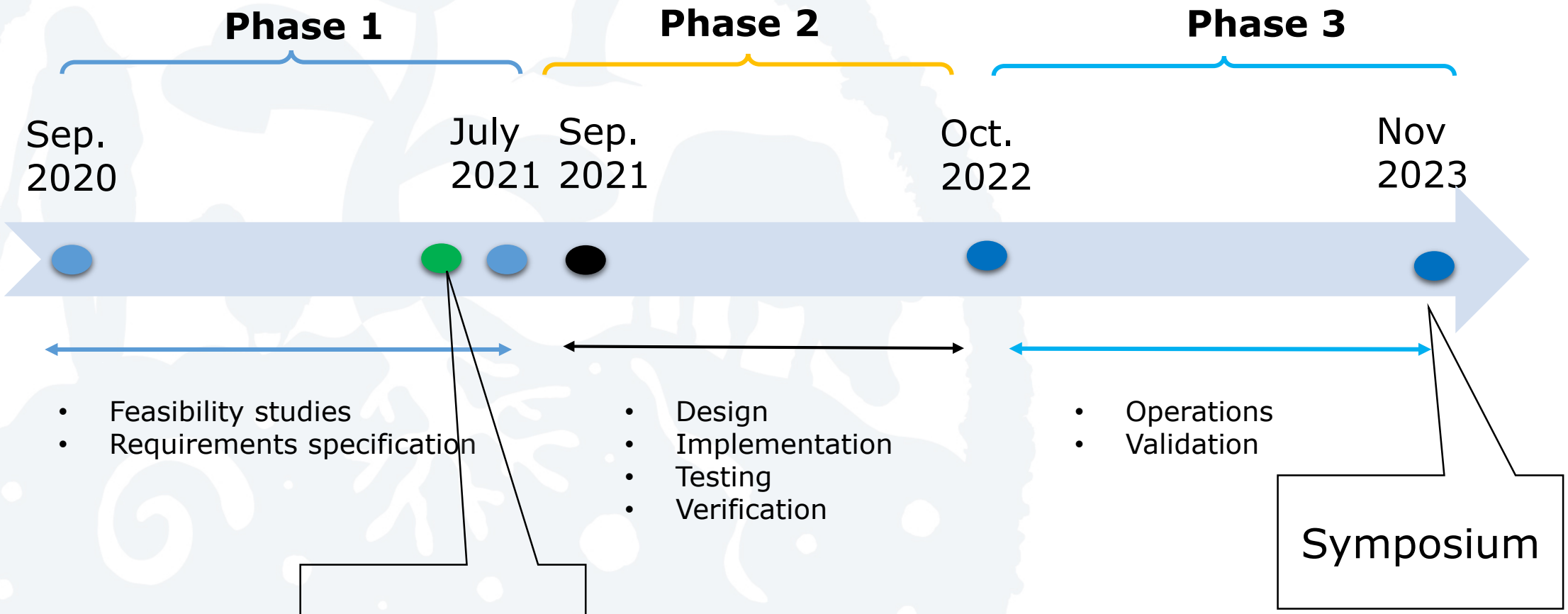
- **Detailed Design**
- **Development & testing**

Phase 3

Operation, validation and analysis.

- **Operated 1 year (SOC monitoring)**
  - Wallonie (Belgium), Czech Republic, Central Macedonia (Greece)
- **Validation and analysis**
- **Final Symposium**

Timeline


Phase 1
Phase 2
Phase 3
Sep. 2020
July 2021
Sep. 2021
Oct. 2022
Nov 2023
• Feasibility studies
• Requirements specification
• Design
• Implementation
• Testing
• Verification
• Operations
• Validation
URs Workshop
Symposium

Work Progress (1/2)

- **Feasibility studies**
  - Development of **SOC prediction models** for bare/vegetated soils
  - Effects of applying **laboratory spectral** models to the remote sensing signal
  - Combining **prediction** and Digital Soil **Mapping**
  - Best use of **Sentinel-2** data and other Copernicus data series

  - **Scientific outcomes**→ workshop report available at https://world-soils.com/

- **User requirements** specification / consolidation /Review/ Workshop
- System **requirements** and implementation options
- **Implementation option agreed** → combination of a **regional approach** for Europe (SOC predictions at the highest accuracy with confidence limits) with a **continental proof of concept** (system allowing integration of upcoming data for the rest of the world, since to-date, reference soil data is limited to Europe).

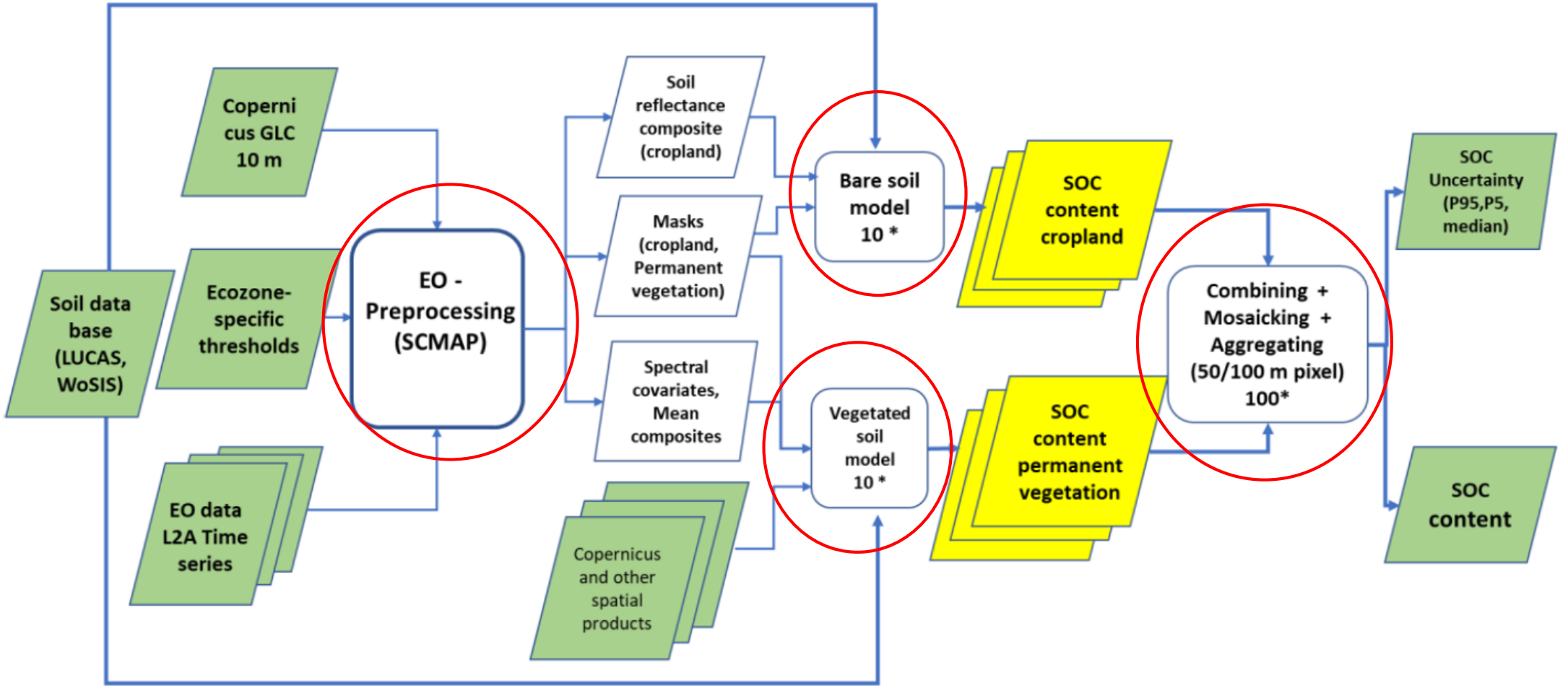
Work Progress (2/2)

- System **design**:
  - **Algorithm** Theoretical Basis,
  - **Data** Procurement,
  - Technical Specifications,
  - Implementation Plan.

- System **Implementation**:
  - Implementation of the **models** and **pre-processor**
    - Bare soil
    - Vegetated soil
    - SCMaP
    - Mosaicking
  - **GUI** –front and back end-
  - Set up of **platform** for modules deployment (DIAS MUNDI)

- **Data preparation**
  - Soil Reflectance composites (*5 years, 2018-2022) & thresholds

SOC Prediction Module



WORLDSOILS block system components. Flowchart of the SOC content prediction module. Input and output are shown in green

Way Forward

- System **deployment**: June-October 2022
- 2023: one year of **operations** and **validation** with the National Reference Centres for Soil Reporting

	100x100m		50x50m	
	SOC Prediction	Validation	SOC Prediction	Validation
Greece	Yes	Yes	Yes	Yes
CZ	Yes	Yes	Yes	Yes
Wallonia	Yes	Yes	Yes	Yes
Europe	No	No	Yes	No
Region in BRAZIL (tbd). Proof of Concept.	Yes	No	No	No

- **Pre-announcement** of WORLDSOILS - Soil Monitoring Symposium. October 2023 in Frascati.
- https://www.world-soils.com/

Stakeholders

- **54 Organisations, 19 Countries**

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Special Issue: Remote Sensing for Soil Organic Carbon Mapping and Monitoring

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This Special Issue welcomes manuscripts addressing: the use of optical and thermal multi- or hyperspectral imagery for SOC mapping, as well as on the challenges involved in producing coherent SOC maps. Such challenges are the compositing of the images in order to increase the coverage of satellite imagery; the transfer of spectral models from spectral libraries to the remote sensing signal; dealing with mixed pixels and improved covariates for mapping soil properties in permanently vegetated areas.

Submission Deadline: 31 July 2022

Submission link: https://www.mdpi.com/journal/remotesensing/special_issues/RS_SOC_Mapping

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Special Issue

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Aims and Scope

Remote Sensing (ISSN 2072-4292) is a peer-reviewed, **open access** journal about the science and application of remote sensing technology, and is published semimonthly online by MDPI. The Remote Sensing Society of Japan (RSSJ) and the Japan Society of Photogrammetry and Remote Sensing (JSPRS) are affiliated with Remote Sensing, and their members receive a discount on the article processing charge.

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16.1 days
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(median values for papers published in this journal in the first half of 2021)

3.4 days
Acceptance to publication
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Special Issue


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