ERATOSTHENES Centre of Excellence (ECoE)

EXCELSIOR

ERATOSTHENES:
Excellence Research Centre for Earth Surveillance & Space-Based Monitoring of the Environment

1st virtual EXCELSIOR International Technical Workshop

15 July 2020

Carbon reduced Agriculture using EO data and services

@excelsior2020eu

Professor Dr. George Zalidis

Interbalkan Environment Center

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CONSORTIUM

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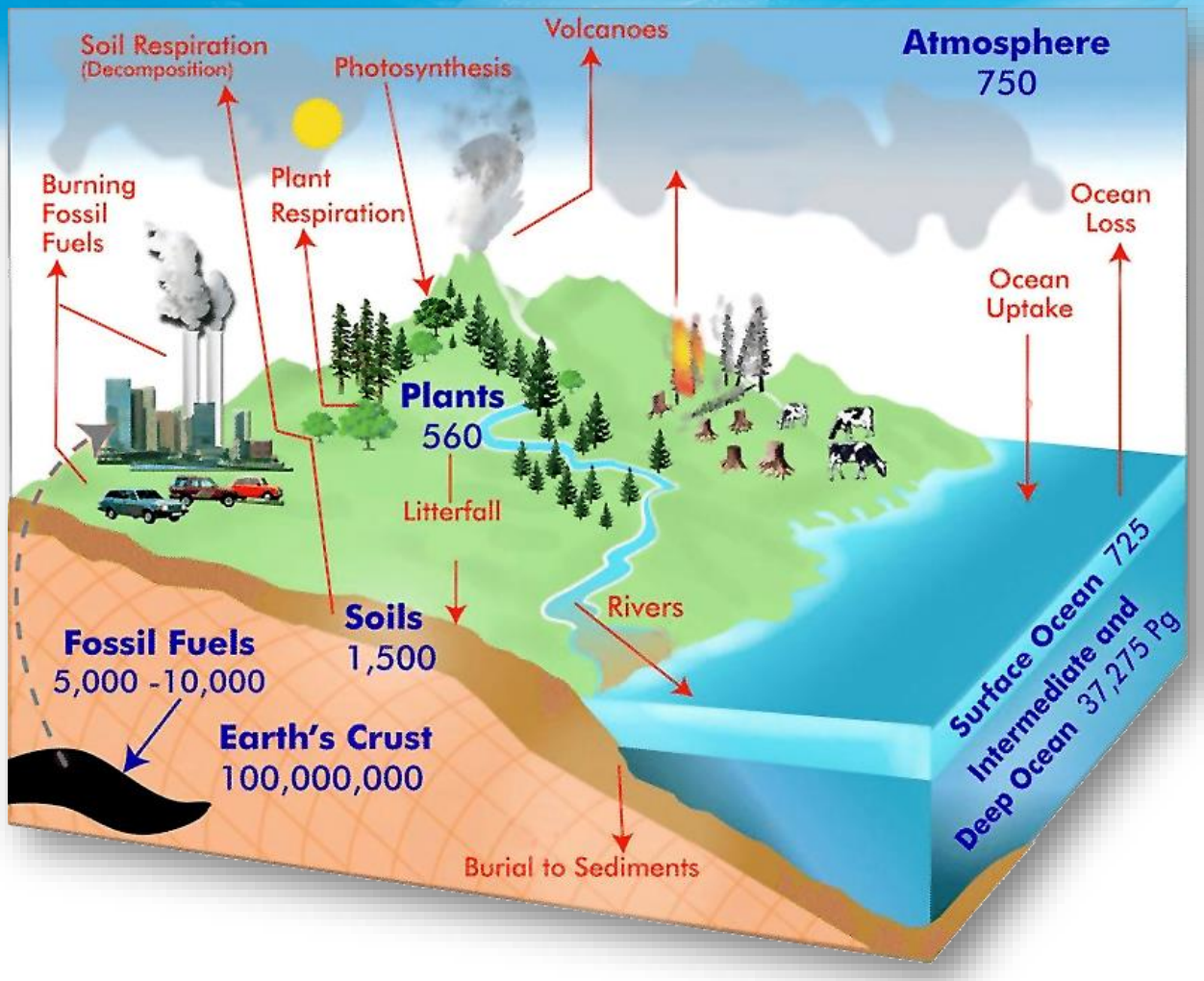
IMPORTANCE & CHALLENGES OF SOIL ORGANIC CARBON [SOC]

The Carbon Cycle



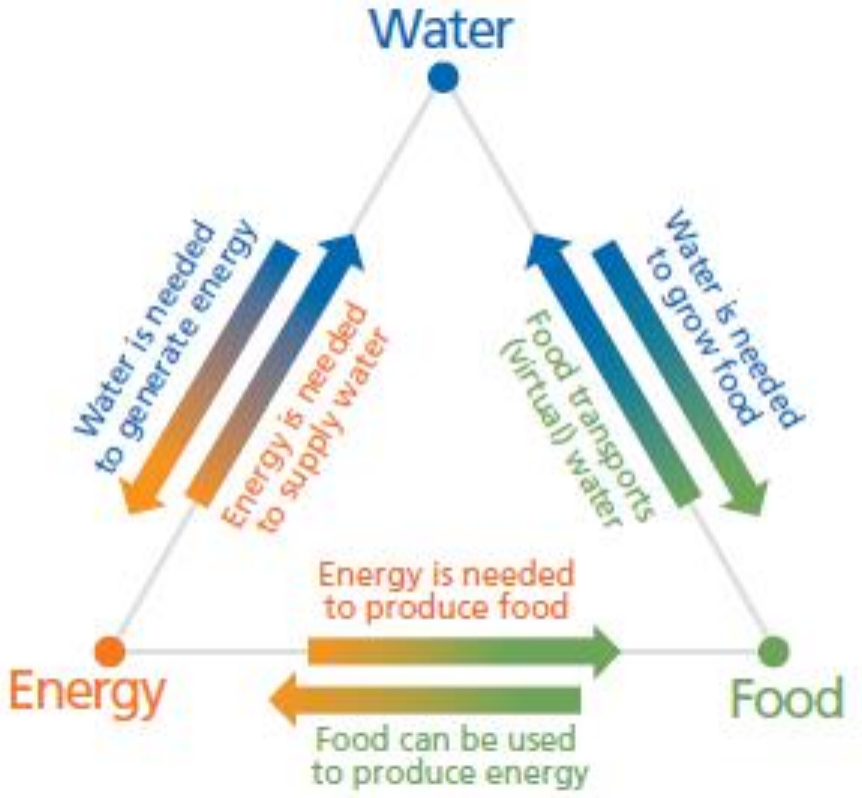
Why Carbon Farming?

Carbon Farming involves implementing practices that are known to improve the rate at which CO_2 is removed from the atmosphere and converted to plant material and/or Soil Organic Matter

The Nexus Approach

The Nexus Approach to environmental resources' management:

- Examines their inter-relatedness and interdependencies;
- Examines resources transitions across spatial scales;
- Strengthen capacity for adaptation to climate change.
- Relates resources, their integrated management and reseliance to public health

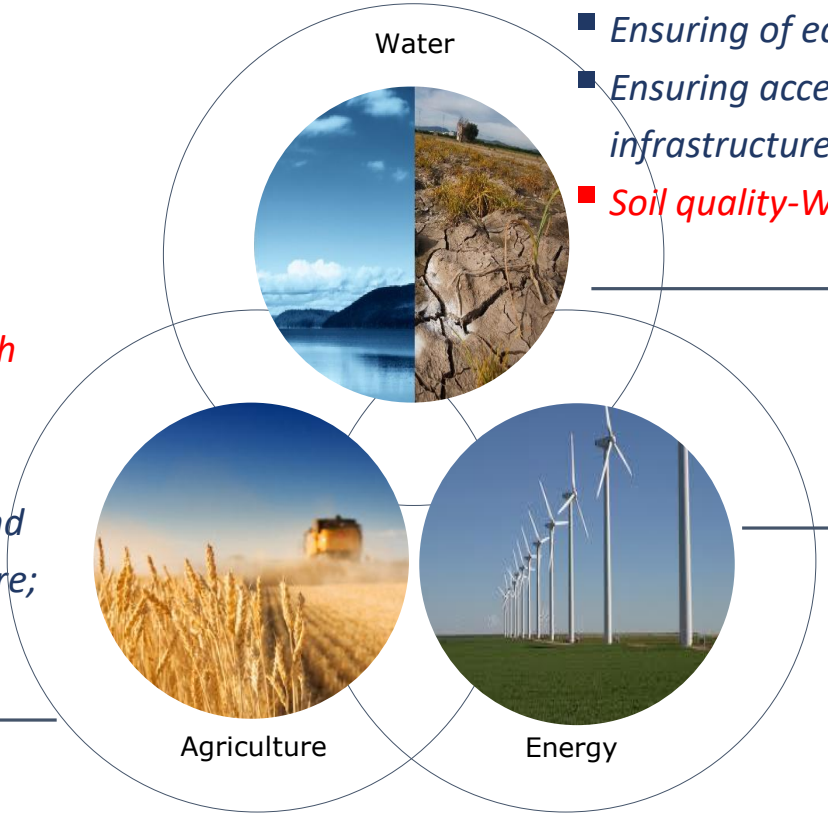


A Nexus Approach in the Sustainable Development Goals

Food water Soil quality/health contribute to public health

- *Ending hunger and ensuring good nutrition;*
- *Making food and agricultural systems sustainable;*
- *Sustainably improving agricultural yields;*
- *Food security and public health*
- *Agri- food chain supply and public health*
- *Addressing land conversion and climate impact for/of agriculture;*

LDIN

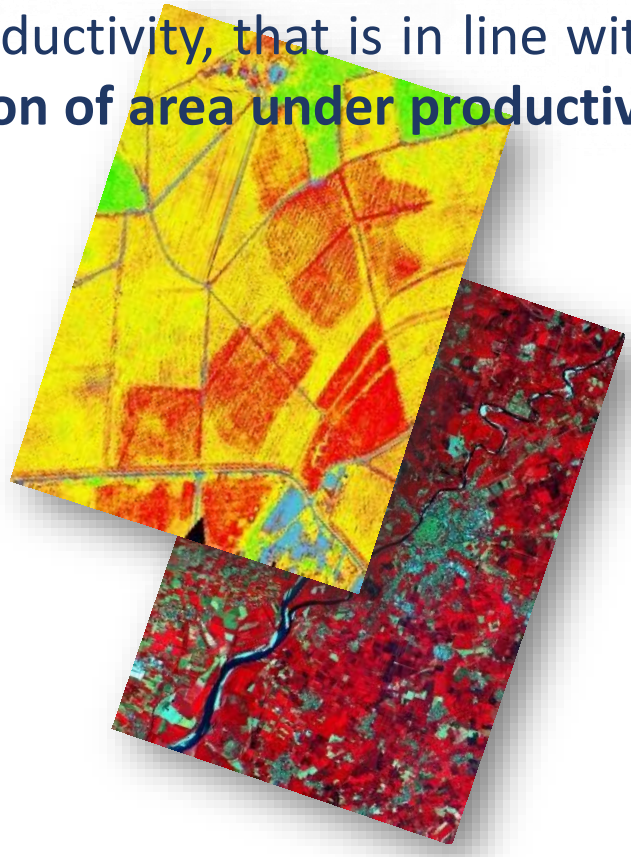


- *Improving water use efficiency;*
- *Improving the balance of water withdrawals and supply;*
- *Ensuring good management of water/soil resources;*
- *Ensuring of ecosystems to sustain biodiversity*
- *Ensuring access to water (drinking-water, services and infrastructure)*
- *Soil quality-Water quality and public health*

- *Improving energy efficiency;*
- *Increasing the share of energy that comes from renewable sources*
- *Clean Energy and climate adaptation*

Monitoring and Reporting on SDG targets and indicators

Provide a new classification scheme for land, based on productivity, that is in line wit **GI-18 Initiative** and specifically **SDG Target 2.4.1 "Proportion of area under productiv and sustainable agriculture"**.



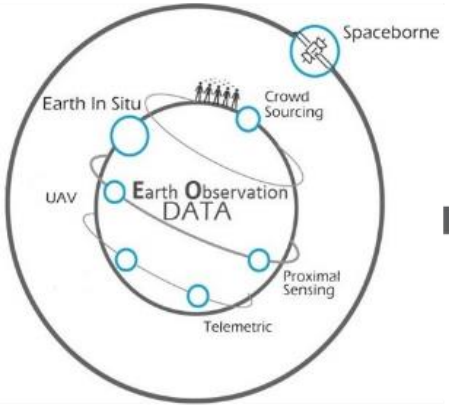
- Collection and interpretation of different spatial-temporal resolution data;
- Production of quantitative estimates and mapping products.

Monitoring and Reporting on SDG targets and indicators

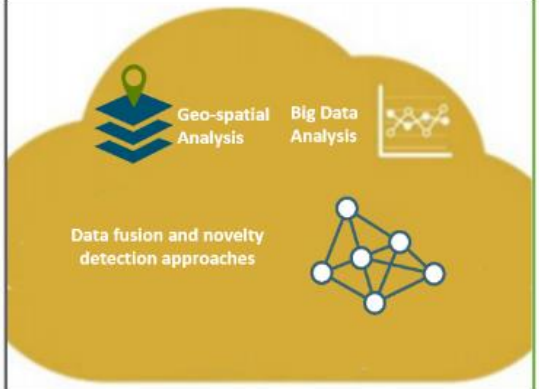
Use of multiple sources of data for a **transparent, national and/or regional-driven process**

National Official Statistics

- Step 1: Earth observation, geospatial information (e.g. assessments and ground measurements) and modelling
- Step 2: Statistics based on estimated data for administrative or natural boundaries



Connectivity adapters (App, Telemetry)



Hub and Communication Channel

SDG GOAL BASED APPROACH

Soil Organic Carbon

Carbon stocks below ground

Sub - Indicators

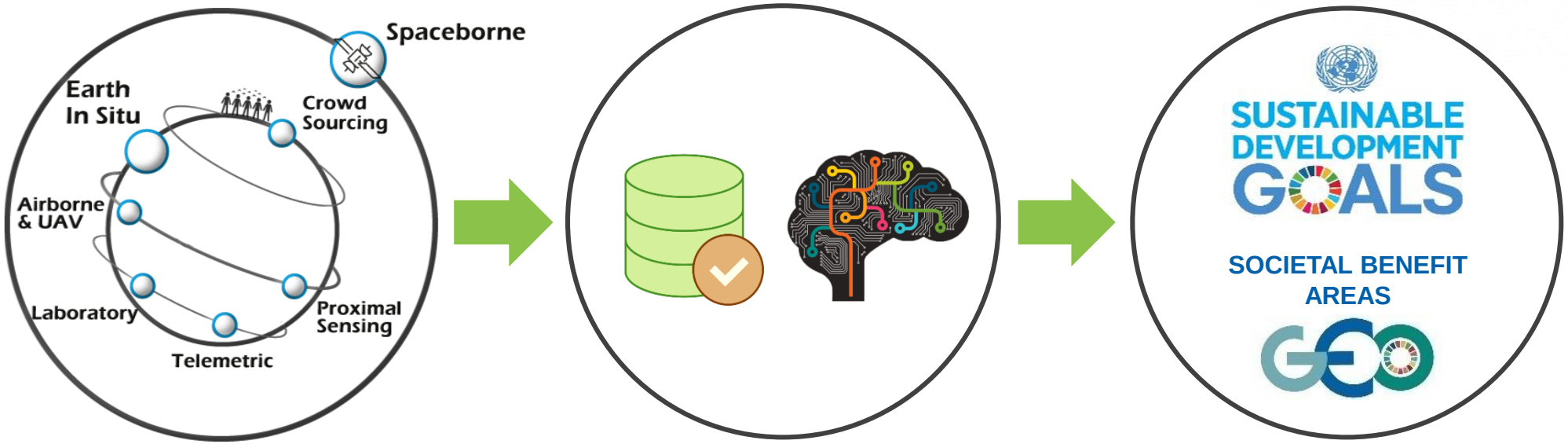
2.4.1
Proportion of agricultural area under sustainable and productive agriculture

SUSTAINABLE DEVELOPMENT GOALS

15.3.1
Trends in land degradation

SDG Indicators Targets and relevant Goals

OVERALL METHODOLOGY



Data Tier

Platform Tier

Knowledge Tier

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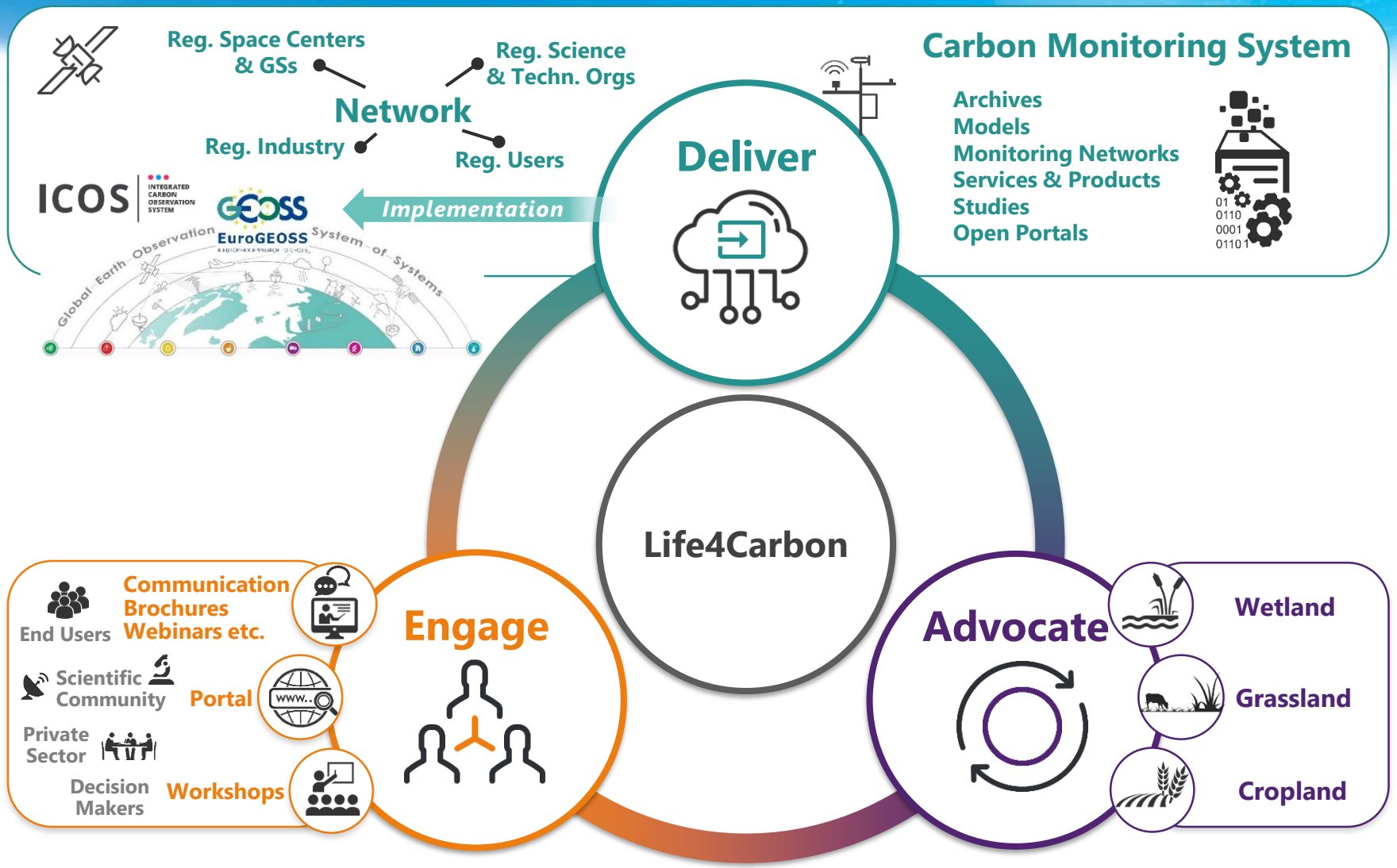

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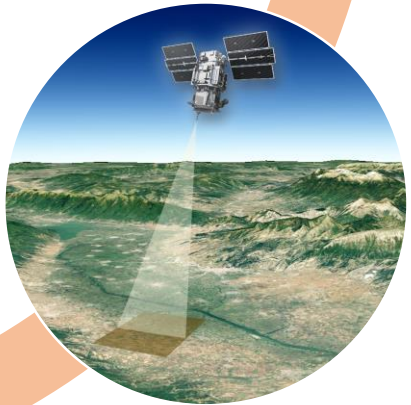
Mobile Soil Sensor System [vis-NIR Spectrometer]

Develop
Innovative Solutions
for & with end-users

Field Diagnostic Toolbox
Complete Set of Measurements in the field
Precise – Instant – Low cost



Working Together with selected GEO initiatives and H2020 projects

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Expected impacts

- Improve space-borne and in-situ component of essential variables monitoring with direct links to **GEO initiatives;**
- **Improved in-situ EO data and services** related to specific Copernicus products;
- Create a **validation and calibration resource** for air- and space-borne sensors.

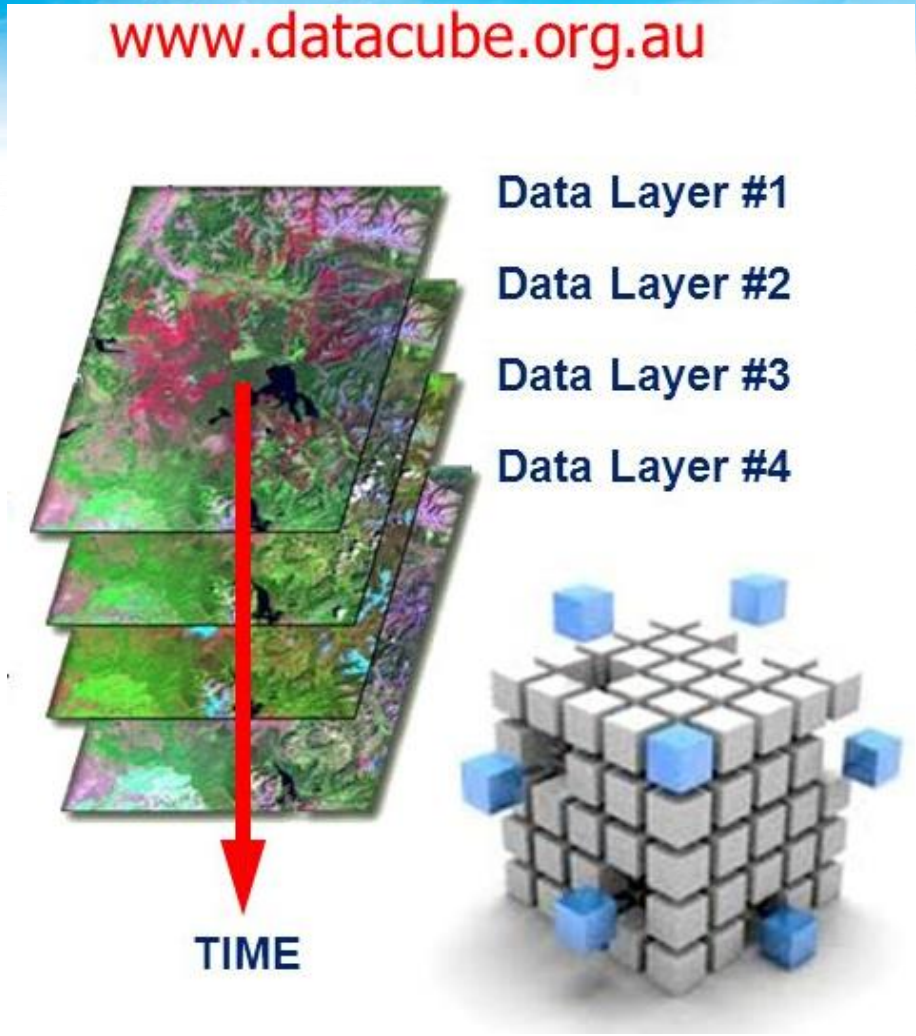
REMOTE SENSING

Satellites

- **Gomez et al. [2008]** In situ Vis-NIR; R2=0.66
- Hyperion data R2= 0.51
- **Mirzaee et al. [2016]** Landsat 7 ETM+; CV = 63.3%
- **Mondal et al. [2017]**
- LISS-II, ASTER and Landsat TM data
- **Wang et al. [2018]**
- **Castaldi et al. [2016]** compared EO-1 ALI and Hyperion, Landsat 8 OLI, Sentinel-2 MSI to EnMAP, PRISMA and HyspIR [EnMAP R^2= 0.67 and Landsat 8 R^2= 0.50]

Data Cube

- A **multi dimensional** (space, time, data layers) data Cube in an efficient and effective solution
- Analysis Ready Data Product vs Raw Data
- Data Cube approach **supports an infinite number of application**
- **Open source software** approach expands capabilities, data use and capacity.



PROXIMAL SENSING

Laboratory

- MARS + Continuum Removal ➡ **R^2=0.81** [Nawar et. al, 2016]
- SVR + Successive Projection Algorithm

  SVMR + SPA ➡ **R^2=0.73**

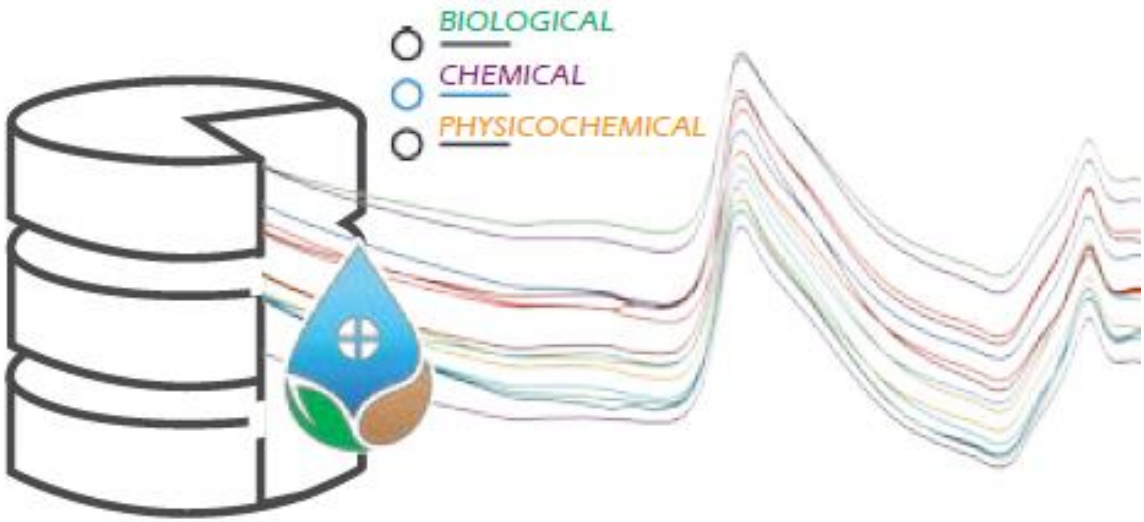
  PLSR + SPA ➡ **R^2=0.62** [Peng et al, 2014]

- **Dry calibration models** were used to predict wet samples, low predictions were given [**RMSE = 30.21 g C kg^{-1}**]
- To use national and global Soil Spectral Libraries [SSLs] there is a need to **remove the effect of Soil Moisture**

Spectral Libraries (SLs)

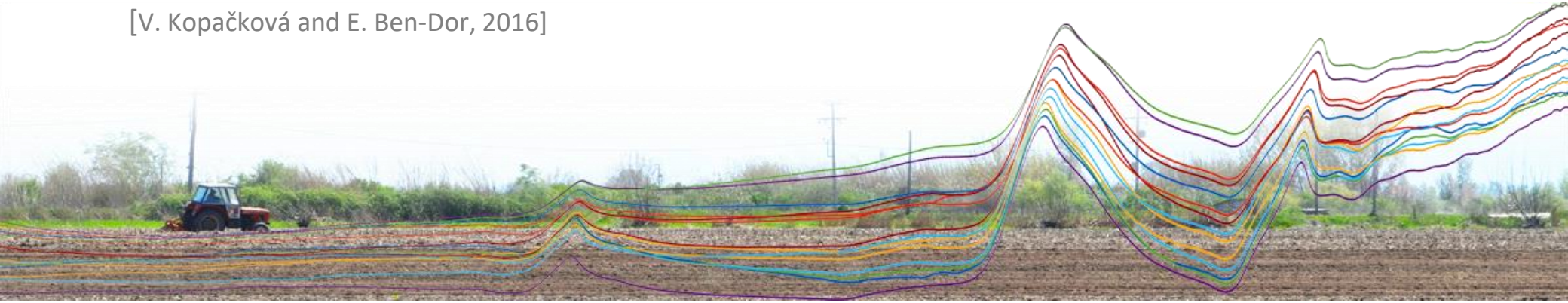
Spectral libraries contain meticulous recordings of reference spectra from samples coupled with precise chemical observations

Precise standards and protocols to ensure the integrity of the results



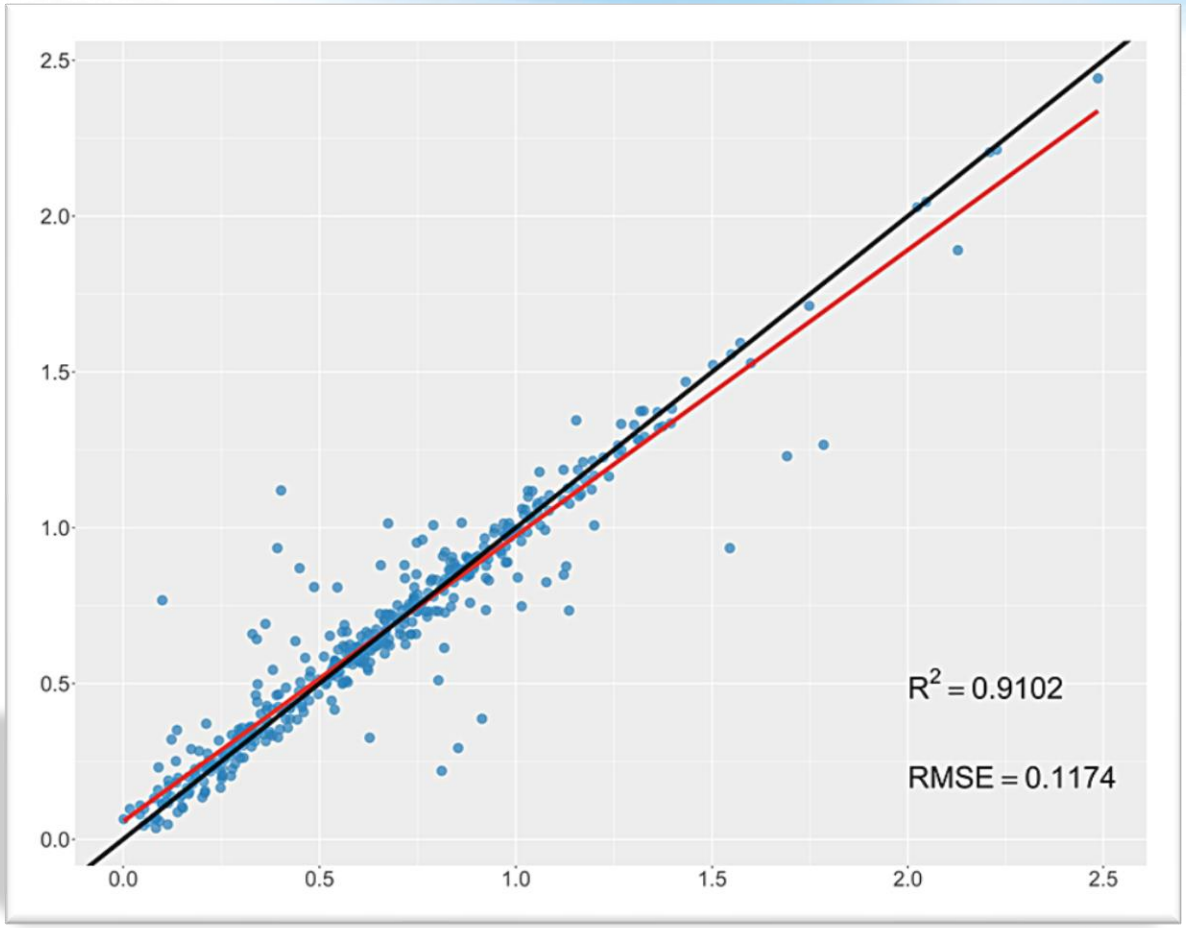
BUILDING THE GREEK SSL

- 474 Soil Samples
- Chemical Analysis of SOC
- 350 - 2500 nm - Sampling Output of 1nm
- Standard Protocol
  [V. Kopačková and E. Ben-Dor, 2016]



MACHINE LEARNING

Scatter Plot of the Best Model



5-FOLD CROSS-VALIDATION

BOOSTED REGRESSION TREES

SIGNIFICANT & ROBUST RESULTS

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BUILDING A REGIONAL LIBRARY IN SOUTH-EASTERN EUROPE, MIDDLE EAST AND NORTH AFRICA

Member of the Advisory Board

Food and Agriculture Organization of the United Nations

GEO CRADLE

- Building of a Regional Standardized SSL [Task 4.2]
- Part of the Data Hub of GEO-CRADLE
- Open To All

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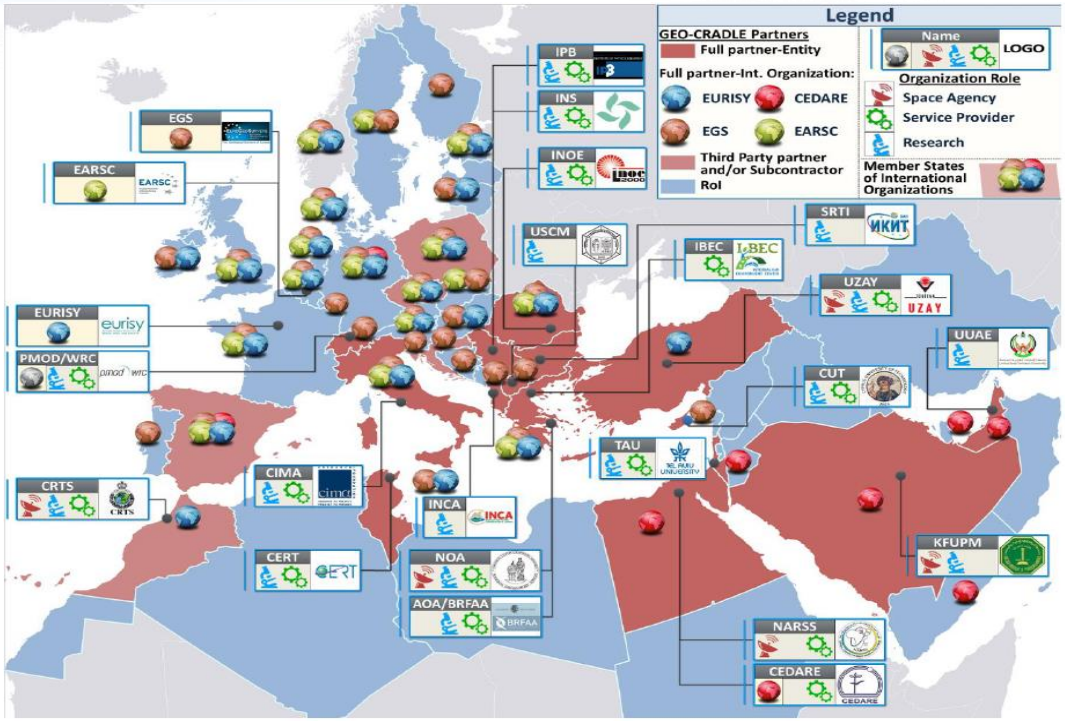
Examples of Relevant Activities

Coordinating and integrating state-of-the-art Earth Observation activities and developing links with GEO related initiatives towards GEOSS IN THE CONTEXT OF EXCELSIOR



- *EO data for **low Carbon footprint sustainable agriculture** and **improved soil quality, LDN***
- *Offering **reliable EO data**, adhering to OGC standards*

Engagement Implementation Plan Via EXCELSIOR

- ***Promote science*** *to address knowledge gaps*
- *Establish regional offices following a bottom up approach to* ***enhance policy support and capacity building***

- ***Develop and promote a toolbox*** *able to transform data into meaningful knowledge and services to achieve* ***SDGs in terms of SBAs***

GEO GROUP ON EARTH OBSERVATIONS
GEOGLAM Global Agricultural Monitoring
SUSTAINABLE DEVELOPMENT GOALS

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Engagement Implementation Plan

Activities that should be at core:

- Support GEO in defining the indicators for the SDGs 2 (Food security) and LDN

- Provide support to **through EXCELSIOR in the Region** in achieving the Carbon reduced Agriculture

- Working together with selected **GEO initiatives** (e.g. GEOGLAM and capitalize on other GEO capacity building mechanisms- e-shape, GEO-gradle)

- Develop **flagship projects in the region** focusing on integration of EO information with **national statistical** accounts related to Carbon footprint

- Establish the “SDG institutional organization”

THANK YOU FOR YOUR ATTENTION

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Coordination and support action
Grant agreement No. 857510
Proposal acronym: EXCELSIOR

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