GEO-CRADLE
Regional Workshop
TUNIS | 7-12-2017

GEO-CRADLE in support to SDGs implementation in the areas of Adaptation to Climate Change, Improved Food Security & Water Extremes Management, Access to Raw Materials and Access to Energy

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The **GEO-CRADLE** project has received funding from the European Union's **Horizon 2020** research and innovation programme under grant agreement No 690133

Pilots towards regional challenges - Overview

GEO-CRADLE Thematic Areas vs United Nations SDGs (12/17)




Adaptation to Climate Change (ACC)

Partners:
NOA (Leader), CEDARE, CUT, INOE, IPB, AOA

Improved Food Security – Water Extremes Management (IFS-WEM)

Partners:
IBEC (Leader), NOA, CEDARE, TAU, CUT, UZAY, SRTI, USCM, INCA, IPB, CIMA

Access to Raw Materials (ARM)

Partners:
EGS (Leader), NOA, TAU, UZAY, EGS members PGI (Poland), IGME-GR (Greece), IGME-ES (Spain)

Access to Solar Energy (SENSE)

Partners:
PMOD/WRC (Leader), NOA, EGS

Pilot 1: Adaptation to Climate Change

Objectives

- Collect, homogenize and integrate **ground-, air-, and space-based EO data** with regards to atmosphere, weather and climate.
- Utilize the data to provide accurate services for **atmospheric hazard forecasting** and **climate projections**.
- Assess the **regional climate change impacts** based on region-optimized projections and establish a **climate data hub** supporting decision makers on mitigation and adaptation policies.

Inter-dependencies

- Access to **Solar Energy (SENSE) pilot** on dust / radiation interactions.

State-of-the art, progress, achievements, impact

Overall, the analysis of the interviews regarding the **end-user needs**, the **maturity status** of the countries and partners in the RoI and the potential **stakeholders' synergies**, resulted in **three ACC services,** namely:

i) desert dust services

ii) air quality services

iii) regional climate change projection services.

- For optimal response to the end user requirements, corresponding data have been provided to **potential users** in order to receive **feedback** for the further development of the ACC services. E.g. the "Climate Projection" web application was refined, to be more user-friendly and accurately provide past-present-future climate information using Essential Climate Variables (ECVs) and Climate Indices (CI).

Pilot 1: Adaptation to Climate Change

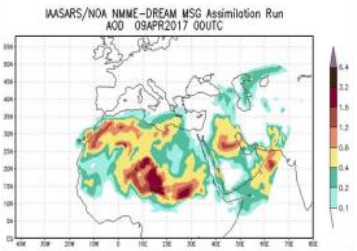
i) desert dust services, and ii) air quality services

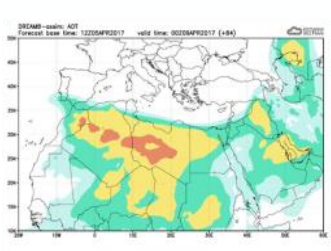
EUFAR awards DoGMA and CIIMA research projects to perform 16 hour flights during PRE-TECT

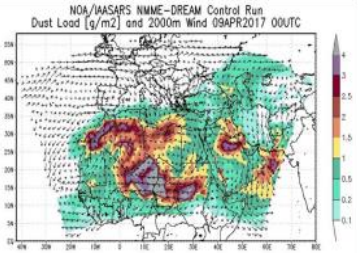
March 9, 2017, 11:42 a.m.

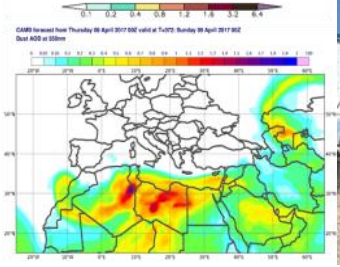
Cloud Radar installation completed

March 30, 2017, 1:07 p.m.







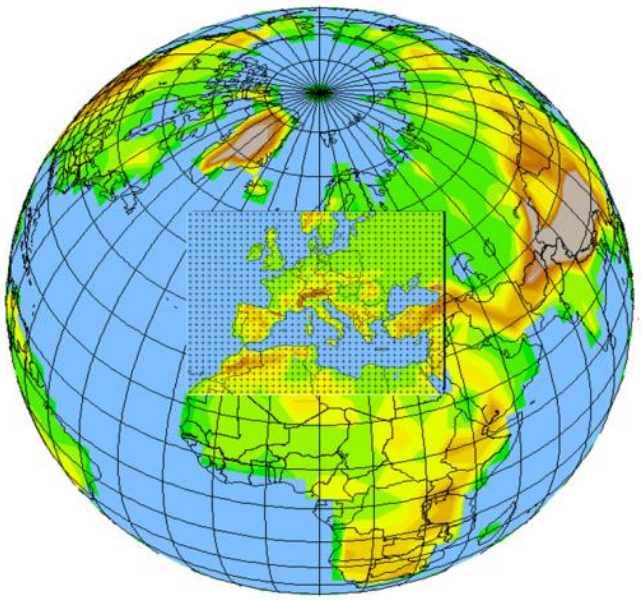


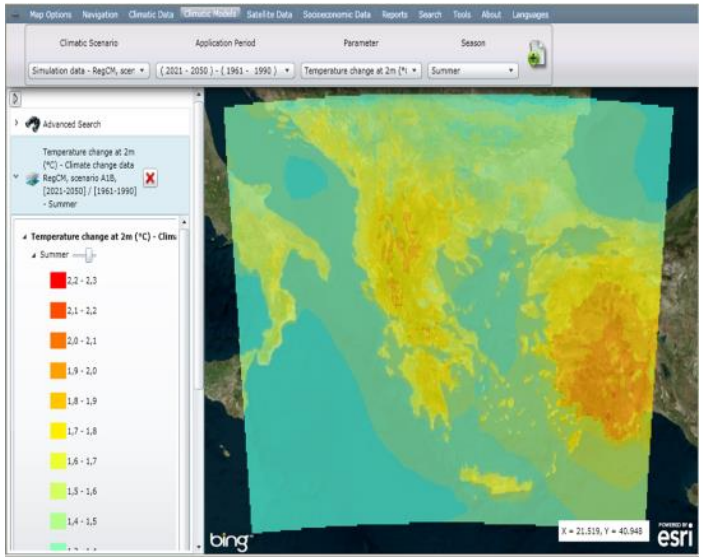
PRE-TECT Campaign (desert dust and air quality services)

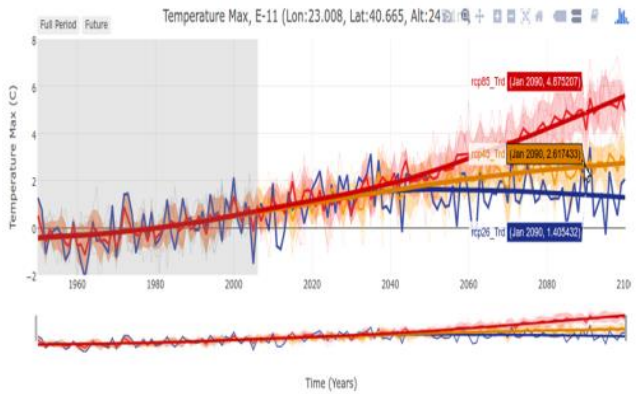
* These services are provided by using **ground and air measurements of dust properties** in conjunction with **atmospheric forecasting models** over **Greece & Cyprus**.

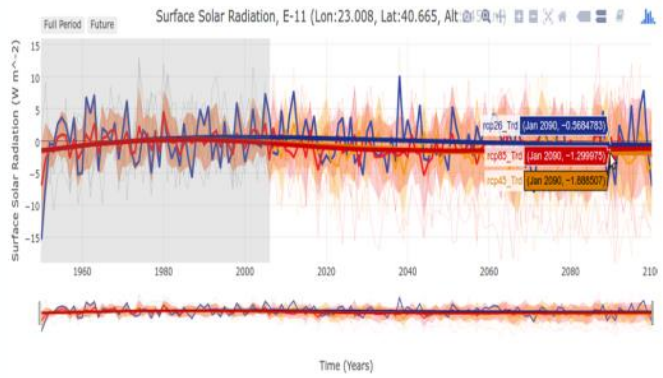
* An **atmospheric experimental campaign** dubbed PRE-TECT was conducted between 1st and 30th of April 2017, in Finokalia, in the island of Crete, Greece. A **multitude of remote sensing instrumentations** are operated at Finokalia station, including sunphotometers, Doppler wind lidars, microwave radiometer, magnetometers and many more.

iii) regional climate change projection services









GEOCLIMA and Climate Projection web tools

* Development of a **climate projection web application** which plots timeseries of **Essential Climate Variables** (ECVs) and **Climate Indices** (CI), **30 climate simulations for 1950-2100**, mean timeseries of historical and future representative concentration pathway scenarios, depicting various moments, etc.

Pilot 1: Adaptation to Climate Change

- These open-access information are especially important for the following sectors:

Energy
Potential solar and power production, as well as estimated energy requirements of households.

Tourism
Favorable summer and winter conditions for tourists by combining various Essential Climate Variables.

Agriculture
Droughts, intense rainfall, frost, evaporation or even growing season periods for plants.

Natural Hazards
Extreme rainfall, intense wind velocity and fires.

Pilot 1: Adaptation to Climate Change

So far collaboration has been established with the following end-users:

- The Ministry of Agriculture, Rural Development and Environment of Cyprus.
- The University of Belgrade Institute of Meteorology in Serbia.
- Balloonera, a private company in Belgrade, Serbia, developing a radiosounding platform.
- The regional hydrology and water resources Sebou Basin Agency (ABHS) of Morocco.
- The Department of Infrastructure and Rural Development of the School of Rural and Surveying Engineering of the National Technical University of Athens (NTUA), Greece.
- The Centre for the Assessment of Natural Hazards and Proactive Planning (CANaH) of the National Technical University of Athens (NTUA), Greece.
- TEMES S.A., a premier destination developer & operator in the high end tourism and real estate sector in Greece.

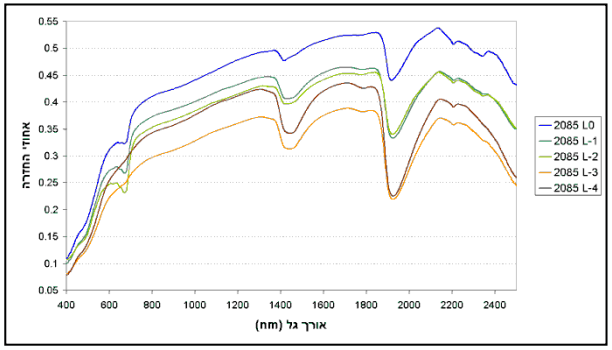
Experimental campaigns from which data will be integrated	**3**
Spin-off and R&D projects built on this GEO-CRADLE pilot	**2 (CLAIRE, Invictus)**

Objectives

- **Establish a common, integrated observational and modelling service capacity** for the benefit of the food security sector (with regards to the needs of farmers, agronomists and relevant stakeholders).
- **Map representative agricultural attributes** using Copernicus data.
- **Establish a Flood and Drought Observatory** using the aforementioned maps.

Pilot 2: Improved Food Security - Water Extremes Management

Generation of a Regional **Soil Spectral Library** (IFS pilot)

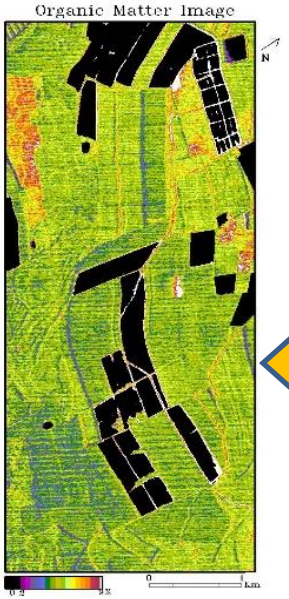


Prediction of **soil moisture and clay content** using spectral based models

Property	SEC, SEP, SEL	R^2_m	Prediction equation	Assignments
Soil Field Moisture (SFM)	0.045, 0.14, 0.016 0.027@	0.645 0.847@	wl_0.739*0.378179 + wl_1.65*0.389602- wl_0.689*0.184370 + 0.062336	1.65 μm-reflectance slope 0.688 μm-reflectance slope 0.739 μm-reflectance slope/chlorophyll
Organic Matter	0.003. 0.015. 0.002	0.827	wl 0.722*0.135211 + wl 2.328*0.034358-	0.722 μm-chlorophyll remaining

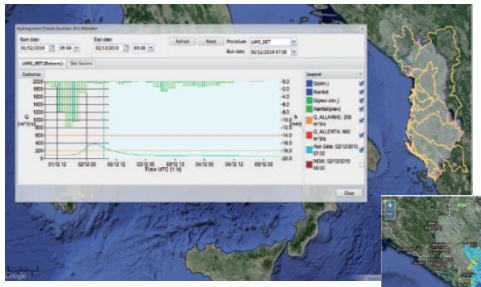
Property	SEC, SEP, SEL	R^2_m	Prediction equation	Assignments
Soil Field Moisture (SFM)	0.045, 0.14, 0.016 0.027@	0.645 0.847@	wl_0.739*0.378179 + wl_1.65*0.389602- wl_0.689*0.184370 + 0.062336	1.65 μm-reflectance slope 0.688 μm-reflectance slope 0.739 μm-reflectance slope/chlorophyll
Organic Matter	0.003. 0.015. 0.002	0.827	wl 0.722*0.135211 + wl 2.328*0.034358-	0.722 μm-chlorophyll remaining

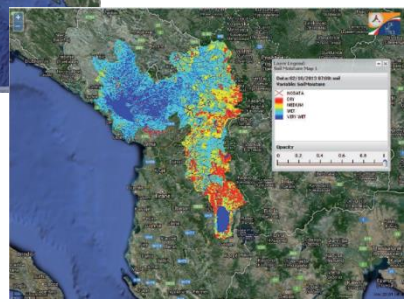
Creation of the **soil moisture and clay content maps** applying the models on a pixel by pixel basis on Sentinel -2 reflectance data



Resampling of the models into **Sentinel-2 spectral configuration**

Application of the thematic maps into the **Flood Forecast Model** (WEM pilot)





Continuum hydrological model

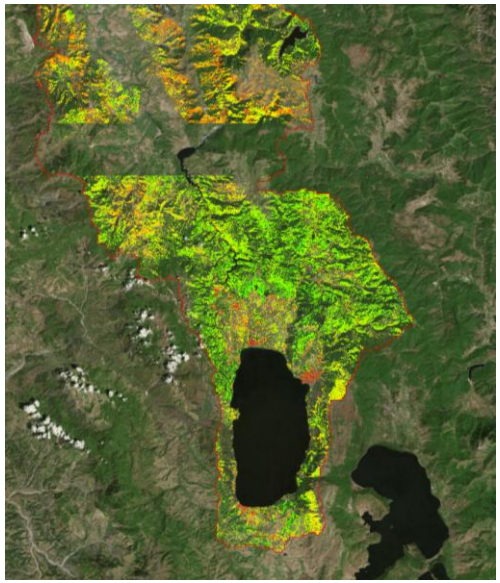
deltares

Pilot 2: Improved Food Security - Water Extremes Management

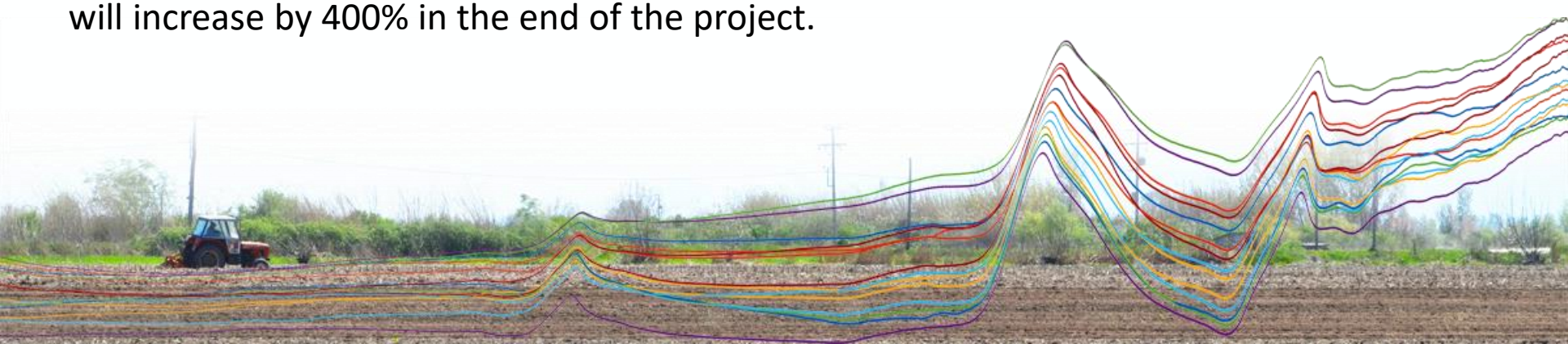
State-of-the art, progress, achievements, impact

- ✓ More than 2,000 soil samples collected.
- ✓ Regional Soil Samples Libraries built for Greece, FYROM, Israel, Serbia, Cyprus, Turkey, Bulgaria and Albania.
- ✓ 2 training days and 2 webinars hosted.
- ✓ Initial maps for the Drin river basin in Albania.
- ✓ Base of the myDEWETRA platform completed.

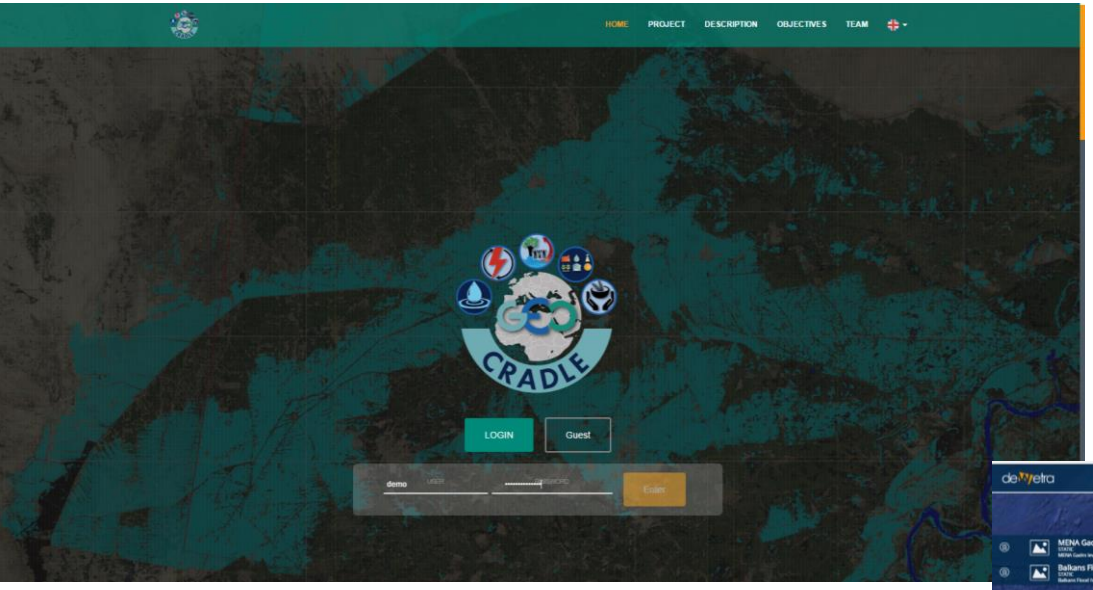
soil clay content map



The publicly available soil spectral data of the RoI will increase by 400% in the end of the project.



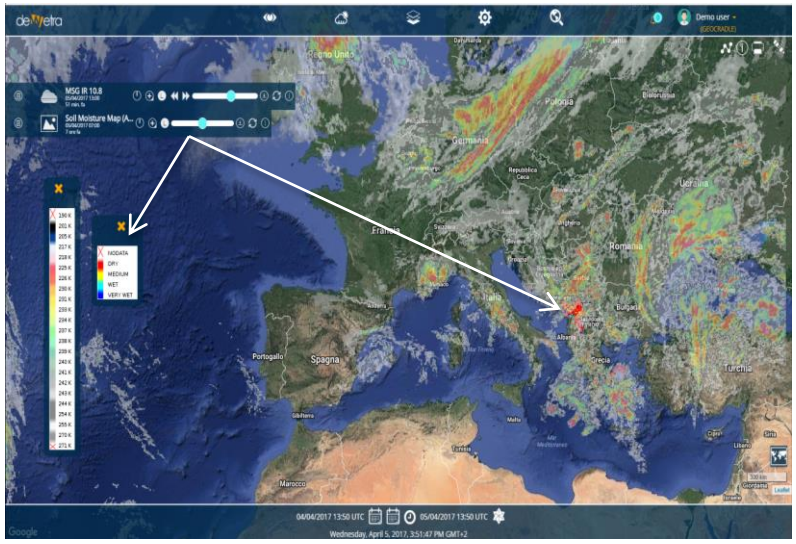
myDewetra implementation at Regional scale

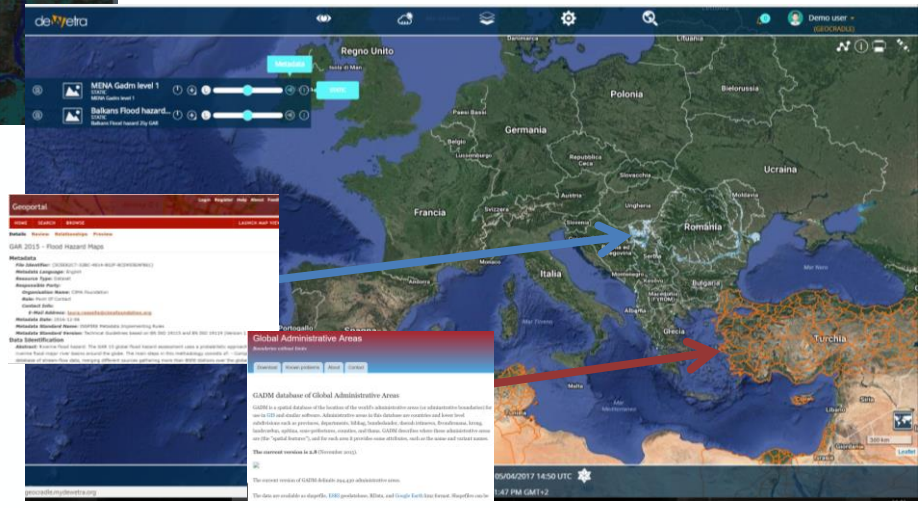


http://geocradle.mydewetra.org

User: demo

Pass: demo4geocradle





Pilot 2: Improved Food Security - Water Extremes Management

End-users and key stakeholders engaged so far:

- Ministry of Economic Development, Tourism, Trade & Entrepreneurship of Albania.
- Ministry of Environment of Albania regarding the development of the hydrological model using EO data.
- GEO's Secretariat regarding the task's activities - particular interest in the countries Albania, FYROM, and Cyprus which are not represented in GEO.
- The agriculture cooperative of Nestos in Greece.
- The Golan Heights Winery in Israel.

Experimental campaigns from which data will be integrated	**9**
Spin-off and R&D projects built on this GEO-CRADLE pilot	**3 (Invictus , InnoSup, EOPEN)**

Objectives

- Establishing a **roadmap** for **long-term monitoring, mapping, and management of mineral deposits** in a severely under-explored ROI.

Use of existing regional capacities and skills

Development of protocol for evaluating the level of impact

Mapping of waste materials in abandoned mines

Monitoring of ground deformation during/after mining

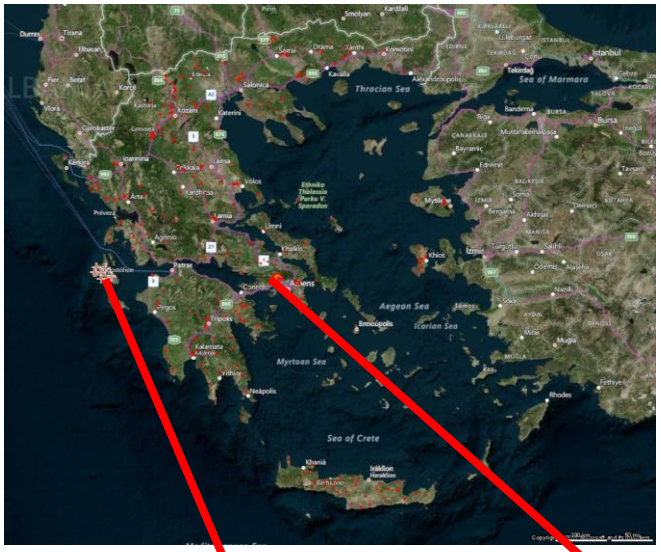
Identification, collection, assessment and use of EO-based and in-situ data

State-of-the art, progress, achievements, impact

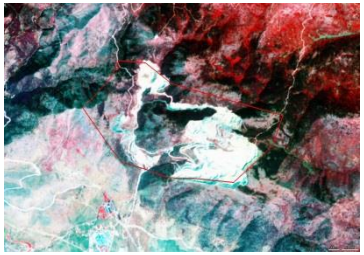
Mining or post-mining test sites were selected in **Greece**, **Cyprus** and **Turkey**.

Pilot 3: Access to Raw Materials

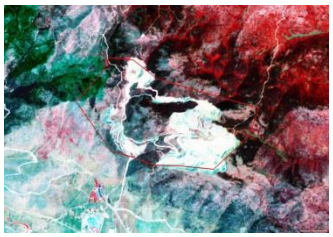
Greece:
Monitoring of illegal quarrying



2015



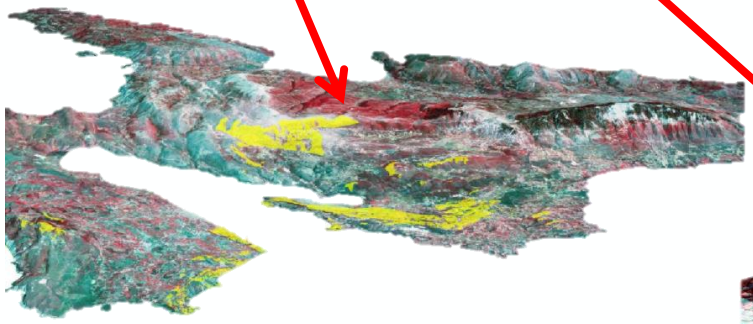
2016



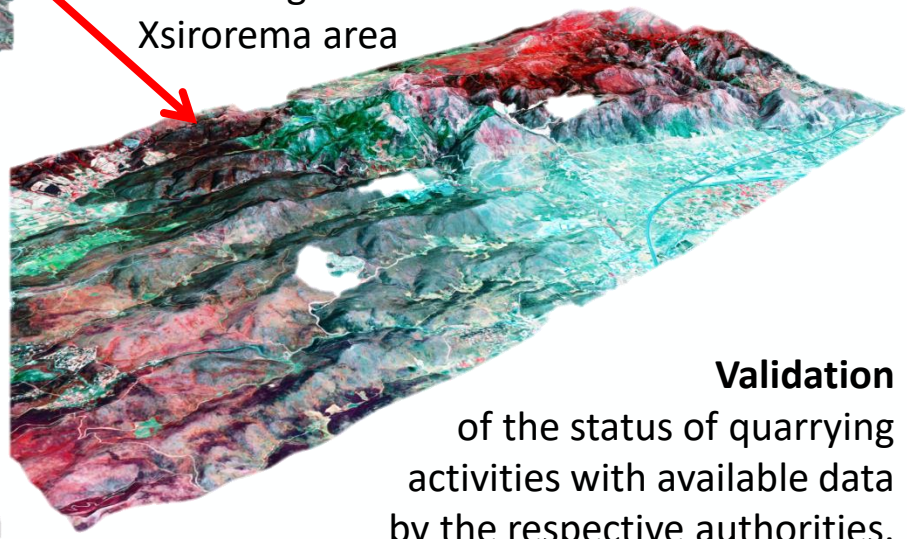
2017

Change analysis monitoring (Sentinel-2) was implemented from 2015 to 2017 for all quarries of **Attica region and Kefalonia island**.

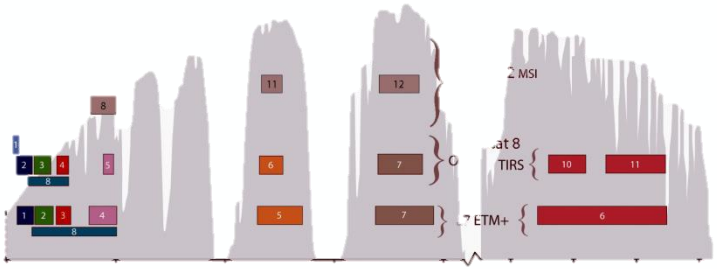
Mitigation of illegal quarrying activities by developing a Monitoring System with the use of EO data to track any detectable potential changes of surface morphology, land use, etc.



Attica region - Xsirorema area

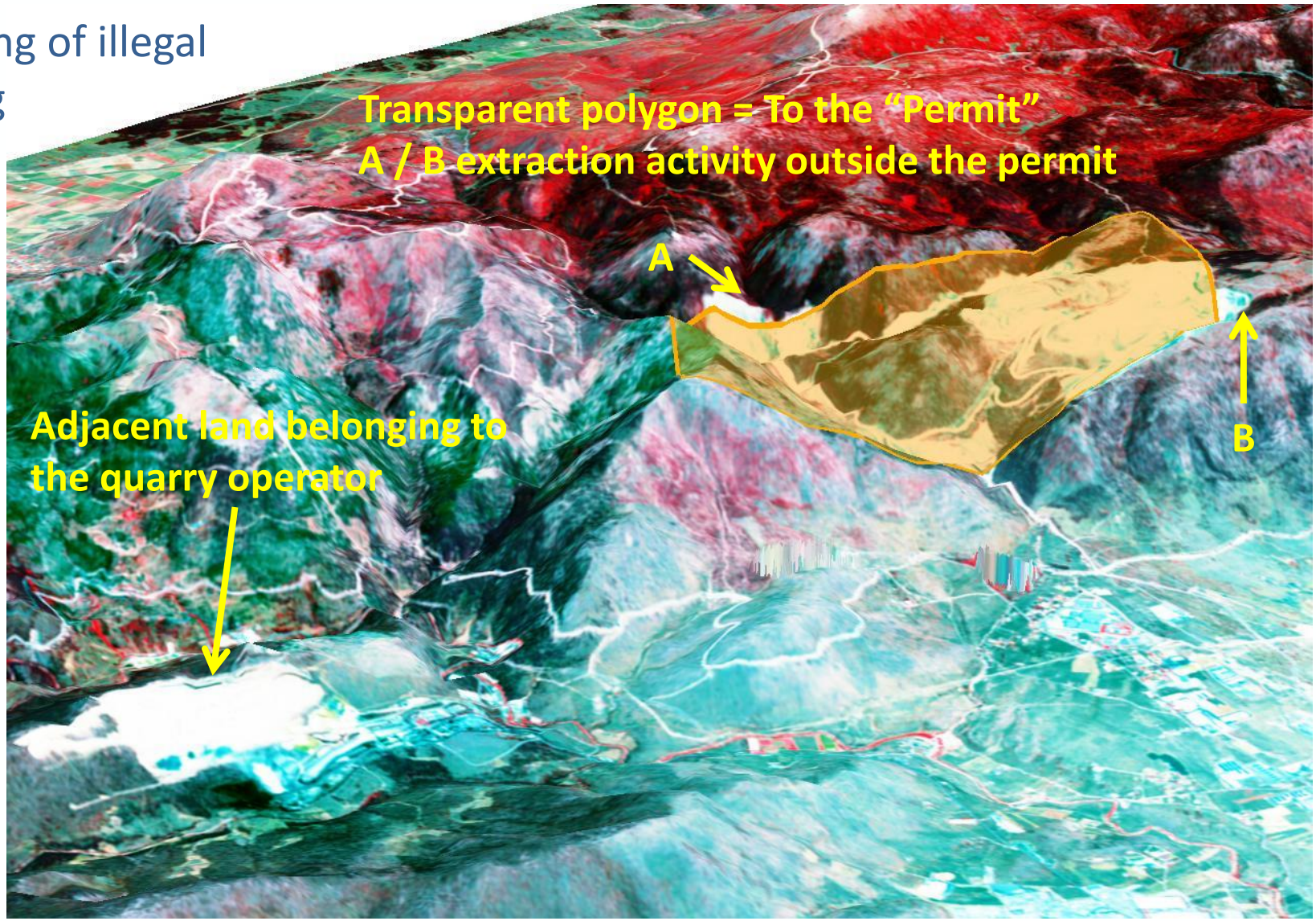


Kefalonia island - all quarries



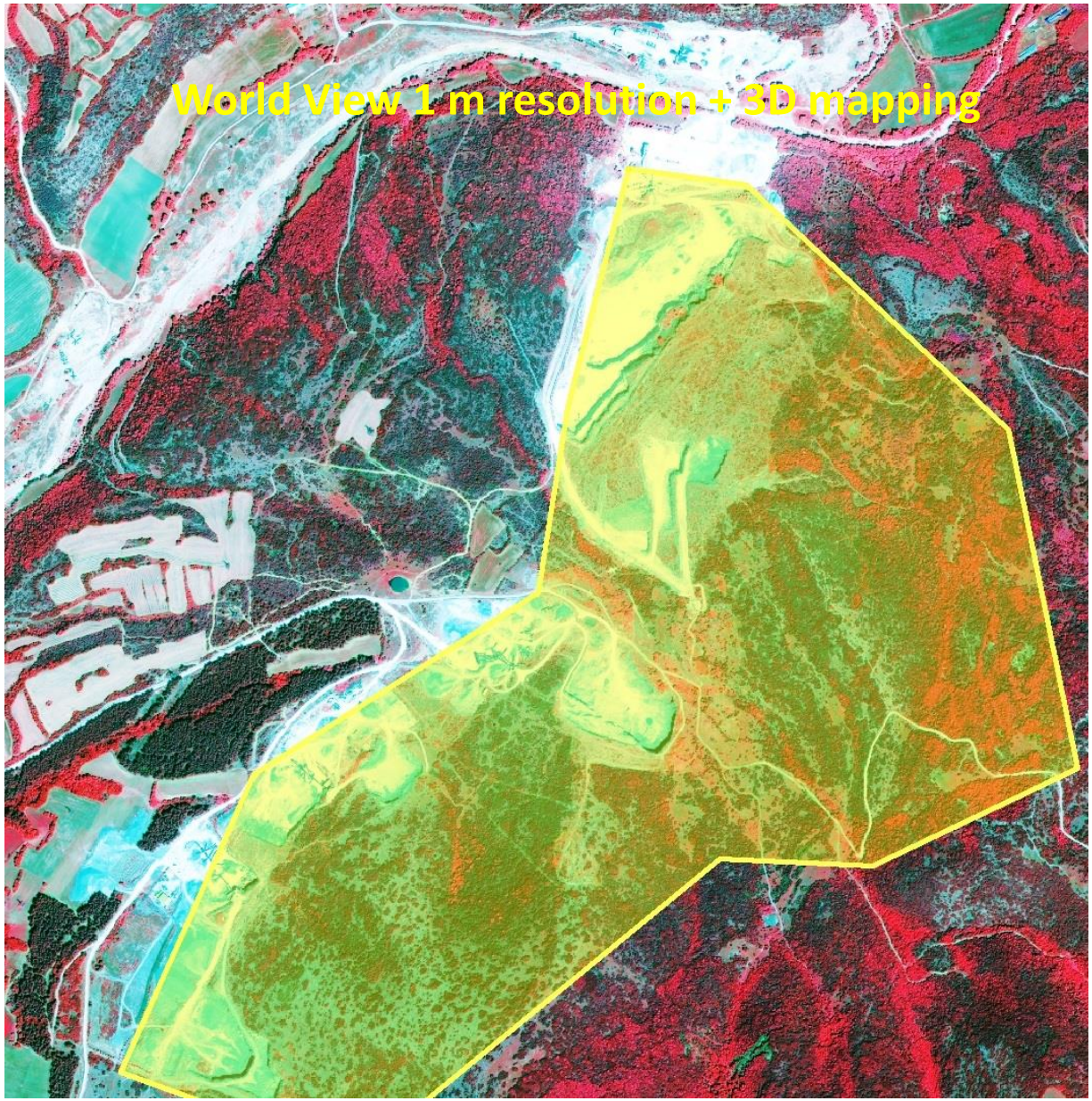
Validation of the status of quarrying activities with available data by the respective authorities.

Greece:
Monitoring of illegal quarrying



Change analysis (Sentinel-2)

Greece:
Monitoring of illegal quarrying

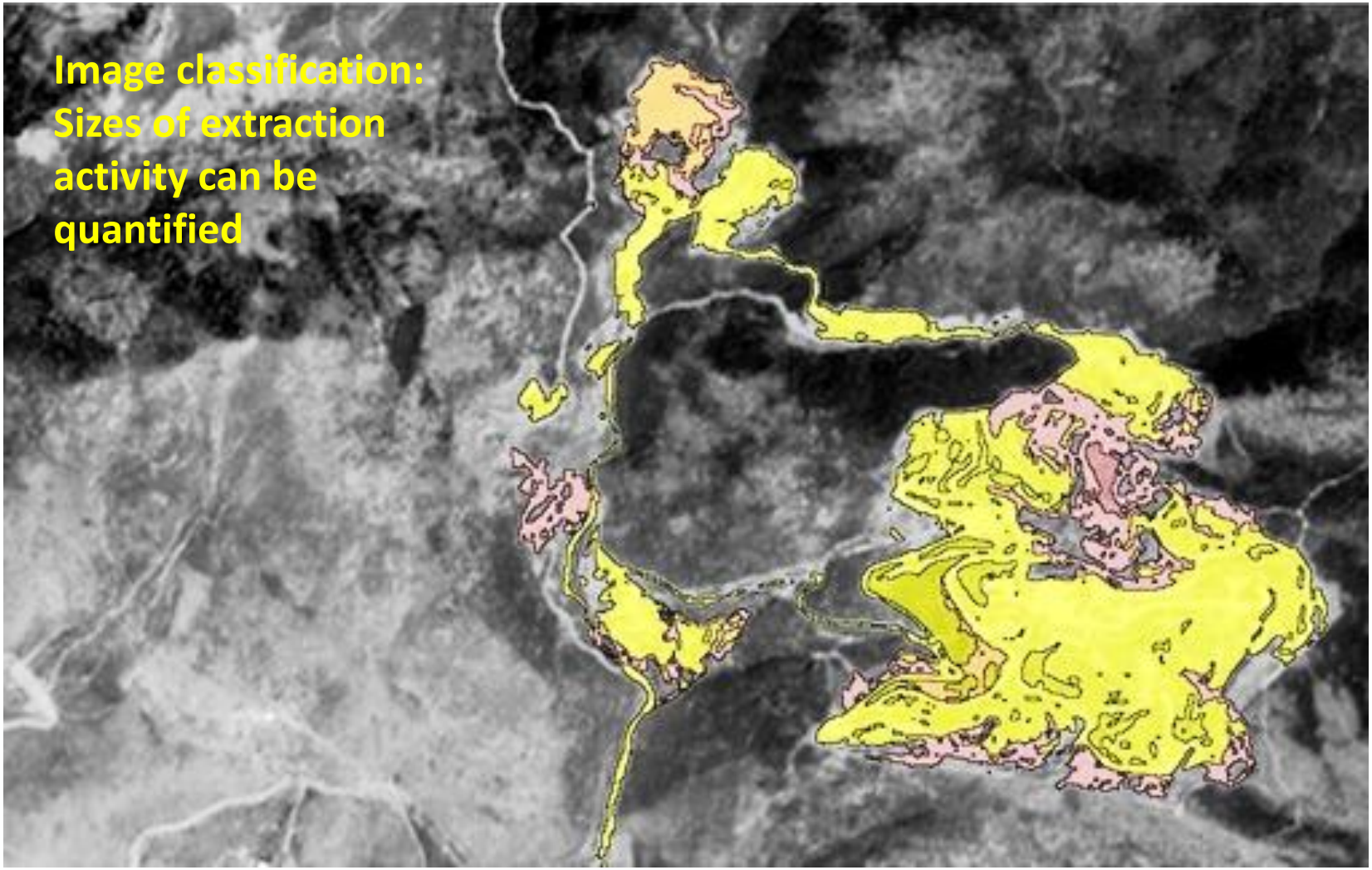


Aspects of certain “quarry inspection cases” have to be based on **high resolution data**: **Satellite** or **UAV**.

Acquisition of **3D data** may also be required using satellite or UAV airborne photogrammetry.

Greece:

Monitoring of illegal quarrying



EO tools assist in mapping & monitoring surface quarrying activity.

Pilot 3: Access to Raw Materials

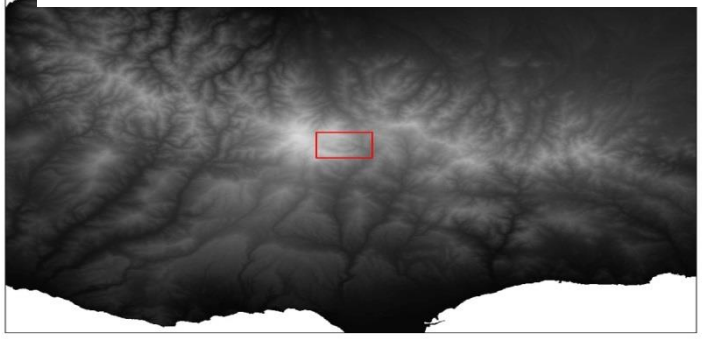
Cyprus:
Abandoned Asbestos mine under restoration

* PSInSAR Seninel-1 processing for determination of **ground stability**.

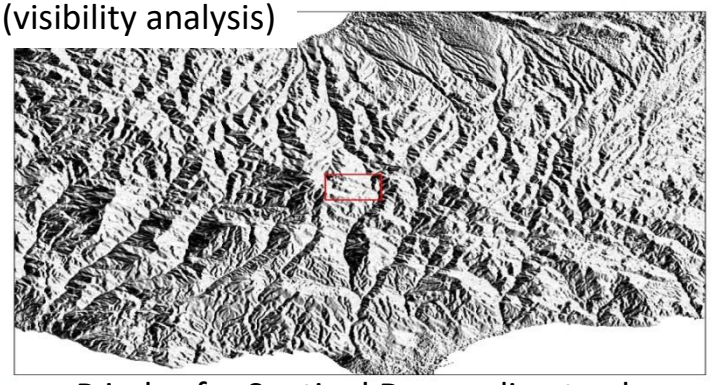
* Sentinel-2 analysis for determination of the **land use changes** and monitoring progress of restoration works.

* Multispectral satellite images analysis for **identification of the local pollution**.

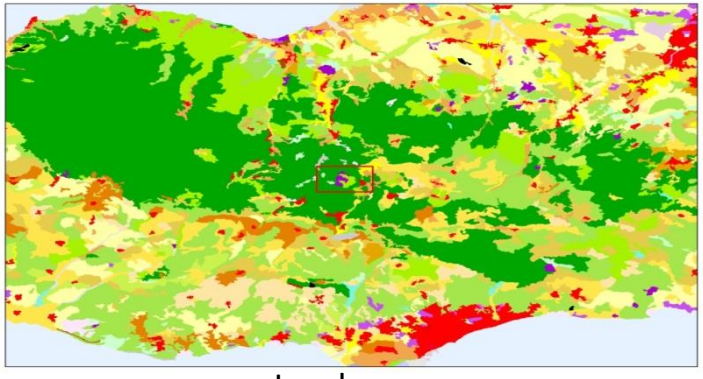
PSInSAR Sentinel-1 processing preparation (visibility analysis)



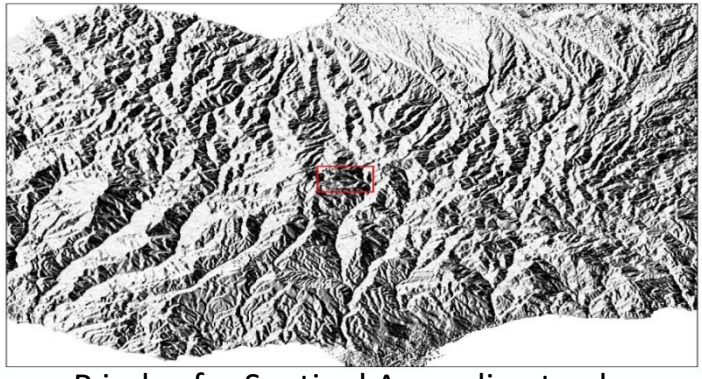
Digital elevation model



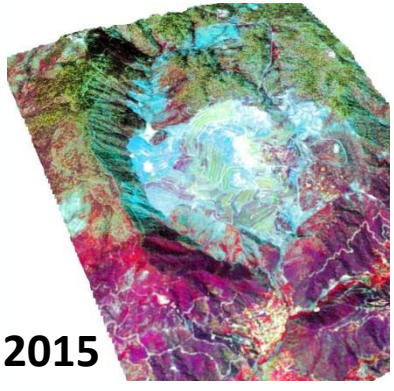
R index for Sentinel Descending track



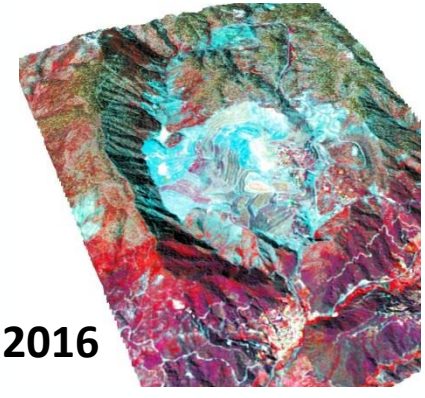
Land cover



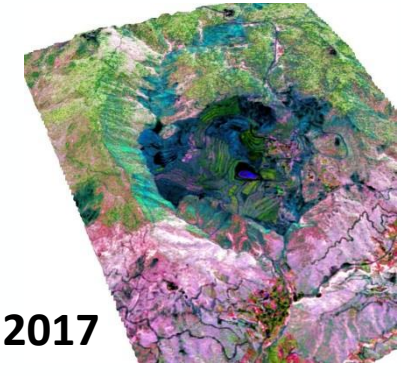
R index for Sentinel Ascending track



2015



2016



2017

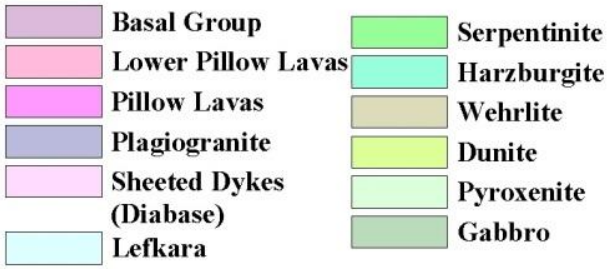
Cyprus:

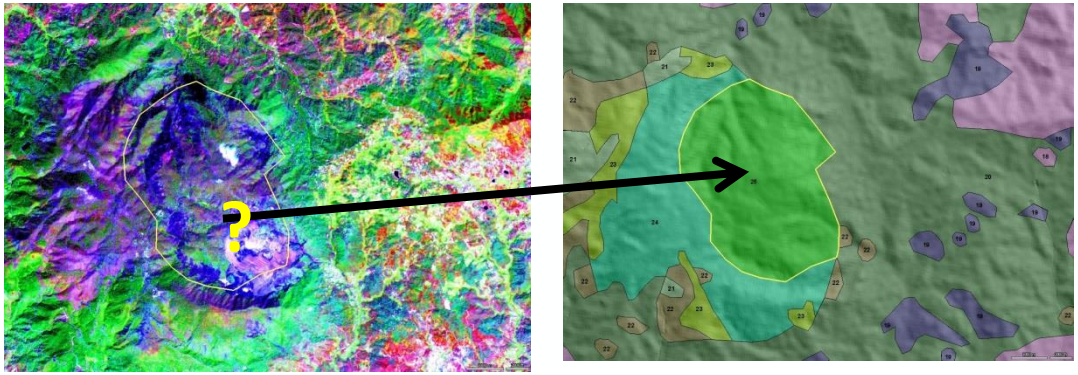
Abandoned Asbestos mine under restoration

Sentinel-2 analysis for Asbestos mine **rehabilitation**: Selected biophysical parameters can be mapped and monitored at regional scales up to 1:25000.

Aspects of mapping & monitoring should be based on high resolution data - Airborne Photogrammetry - UAV - Drones.

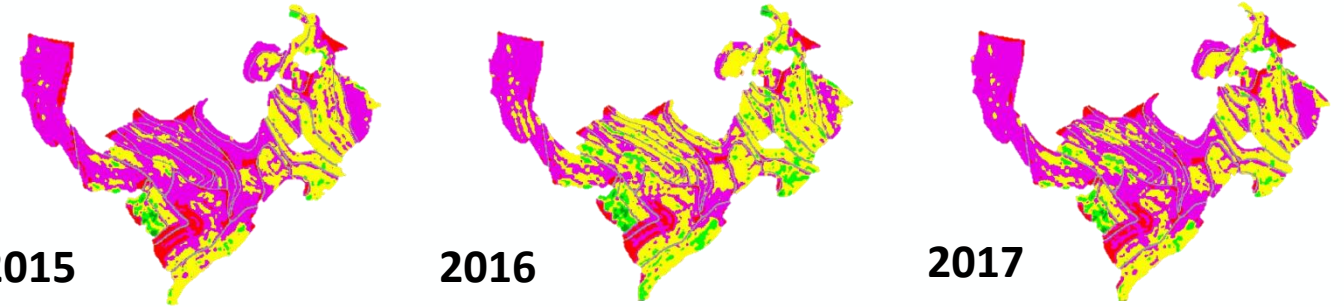
Mineral / lithology mapping





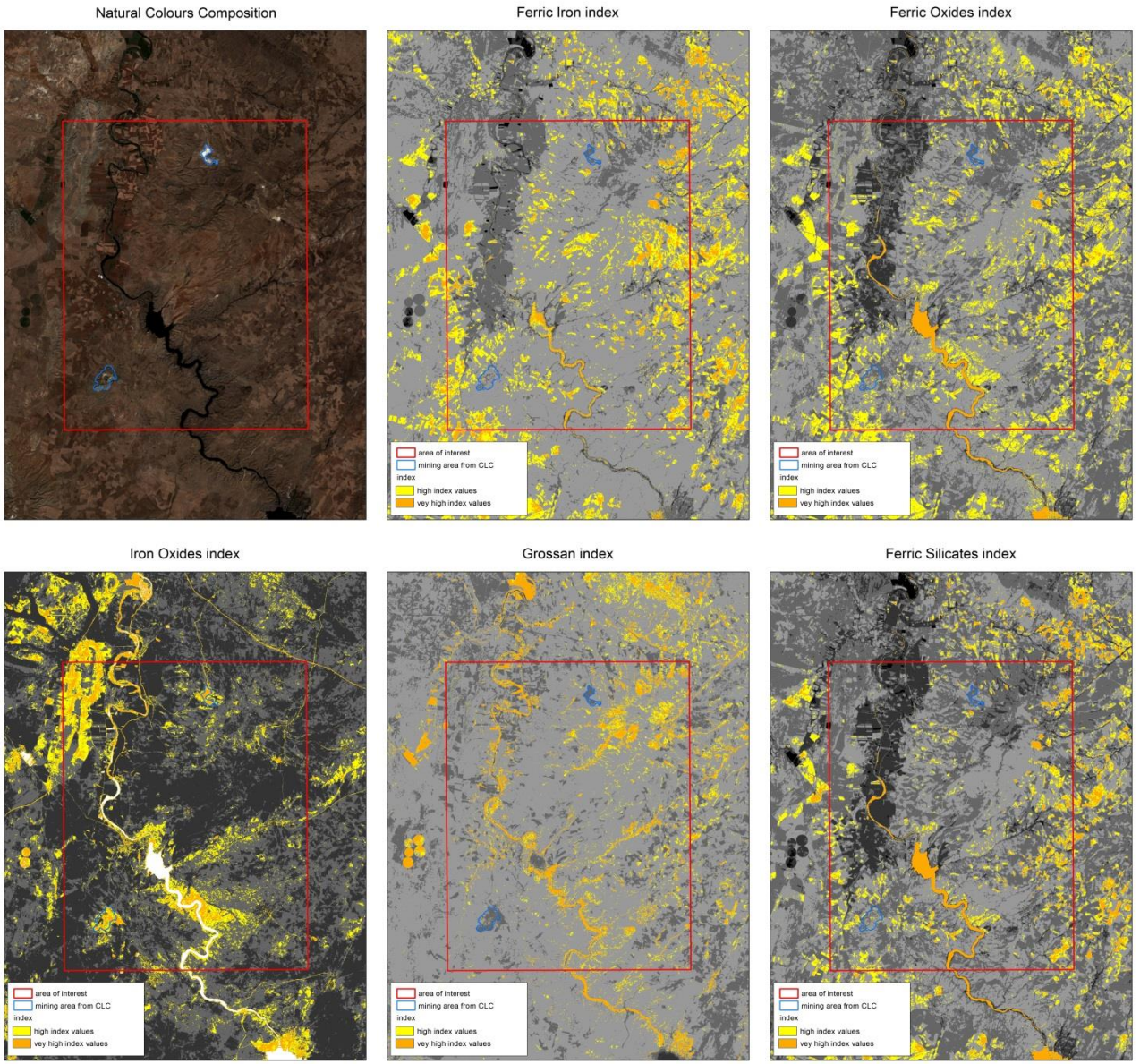
Monitoring land cover changes / reforestation

Normalized Difference Vegetation Index



Turkey 1:
Iron-oxide mineralization

For iron-oxide mineralization district **multispectral satellite images** are used (Landsat 7 ETM+, Landsat 8 OLI, Sentinel 2) to differentiate and identify the presence of OH-FeOx anomalies and potential iron zones and other polymetallic mineralization, specific alteration minerals, often indicators of mineralization in subsurface, which in turn **helps mining companies to focus on areas for further exploration** (prior to expensive conventional methods such as trenching and drilling), thereby **reducing fieldwork and minimizing environmental impact**.

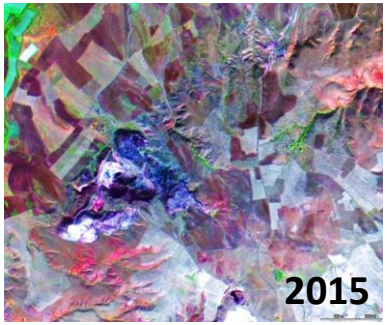


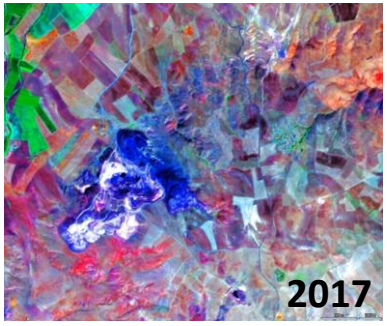
Turkey 1:
Iron-oxide mineralization

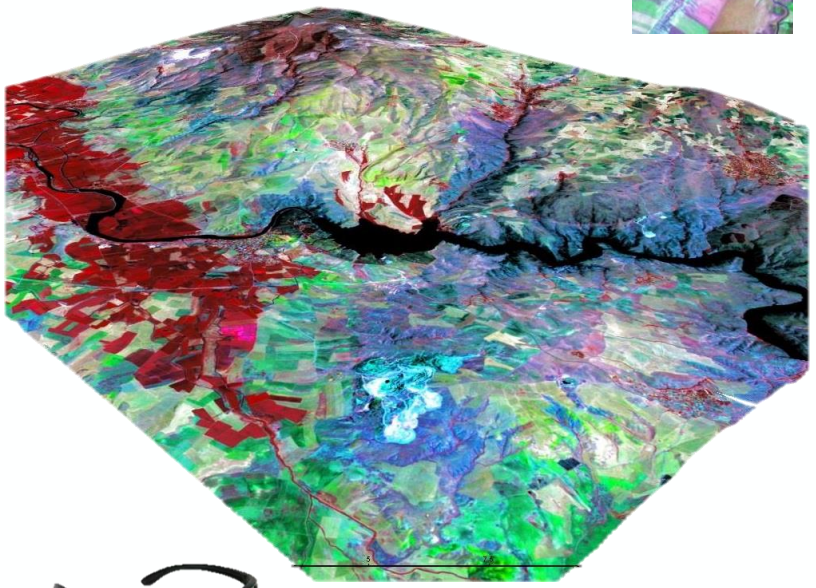
Different image products are evaluated in terms of:

1. Contribution to **geologic mapping**
2. **Mapping** of the various **mining sites**
3. **Monitoring** the **mining areas**

Multi-temporal mapping of changes in the Kirikkale mining area







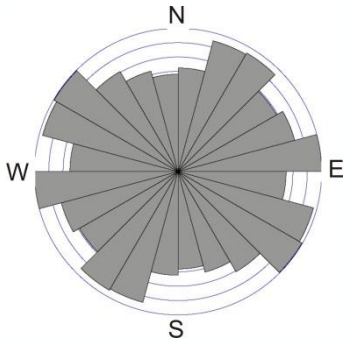
Enhanced images can be viewed as stereo using Anaglyph 3D Glasses

Turkey 2:
Coal deposit potential - lineament extraction

Feasibility study for designation of layers:
* **Tectonic** (lineament) map
* **Geological** layers (based on satellite classification)
* **Tuff outcrops** only (as above)
* **Hydrological** map
* **GIS map of potential coal bearing basin** (based on spread of tuff outcrops and possible propagation)

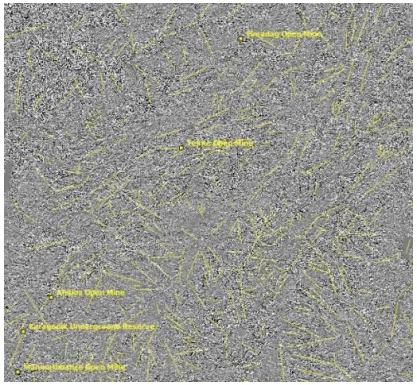
For Tukey lignite 2 test site lineaments were extracted from **Sentinel 2**, **Landsat 8** and **Landsat 7 ETM+**.

Final products

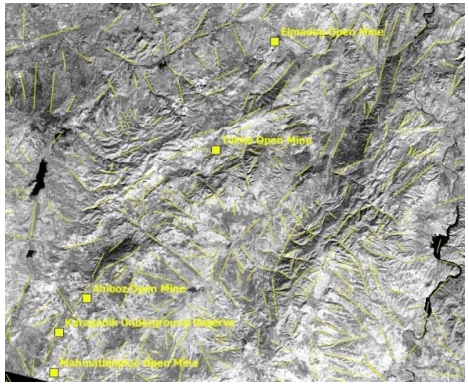


Rose diagram from extracted lineaments

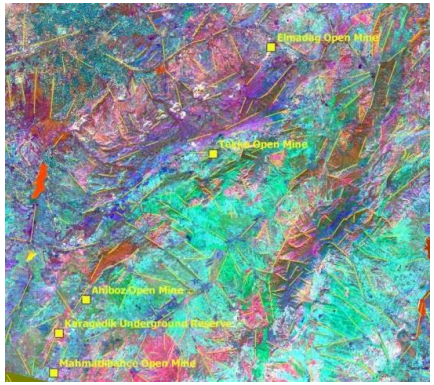
Different processing techniques to extract lineaments



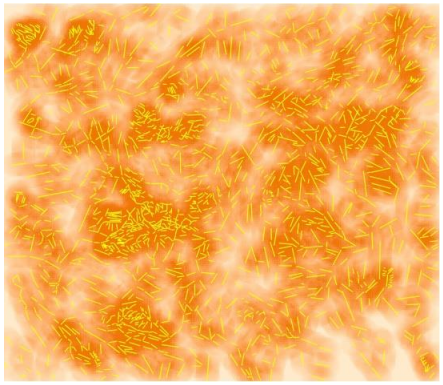
Filtering operations (Sobel filter)



Principal Component Analysis (PCA)



False Color Composite FCC752 Landsat 8



Lineaments density map

Pilot 3: Access to Raw Materials

Closer collaboration was established with the following end-users so far:

- Ministry of Environment and Energy of Greece: a close collaboration has started in order to implement the pilot project on mitigation of illegal quarrying.

- GSD-FD-Ministry of Agriculture, Rural Development and Environment of Cyprus: the scope of the feasibility study for monitoring of ground deformation and stability in the Asbestos Mine under restoration was established.

- Hellenic Copper Mines Ltd and Ministry of Agriculture, Rural Development and Environment of Cyprus: the exchange of information on environmental monitoring before the closure of the mine and the possible use of EO data for Skourriotissa Village area can lead to future collaboration with the Geological Survey of Cyprus.

Experimental campaigns from which data will be integrated	**2**

Objectives

- Coordination of regional EO capacities & research activities (including Copernicus Space & Service Segment initiatives) for an **operational, satellite-driven, real-time system for solar energy now-cast**.
- **Long term solar energy atlases** for various areas with high temporal and spatial detail.
- **Solar radiation related products** (real time and forecasts) related with: **health** (UV Index - melanoma, DNA damage, cataract, Vitamin D efficiency), **agriculture** (photosynthesis), **scientific**…

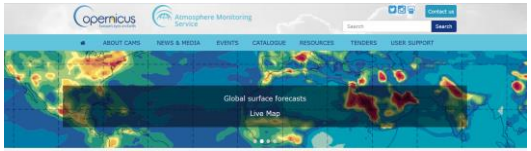
Pilot 4: Access to Solar Energy

SENSE: a Solar Energy Nowcasting and forecasting SystEm + solar energy long-term analysis

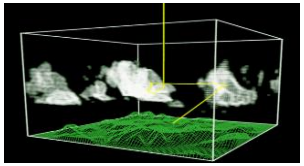
SENSE inputs

Satellite Data

Copernicus Atmospheric Monitoring Service



Radiative Transfer models



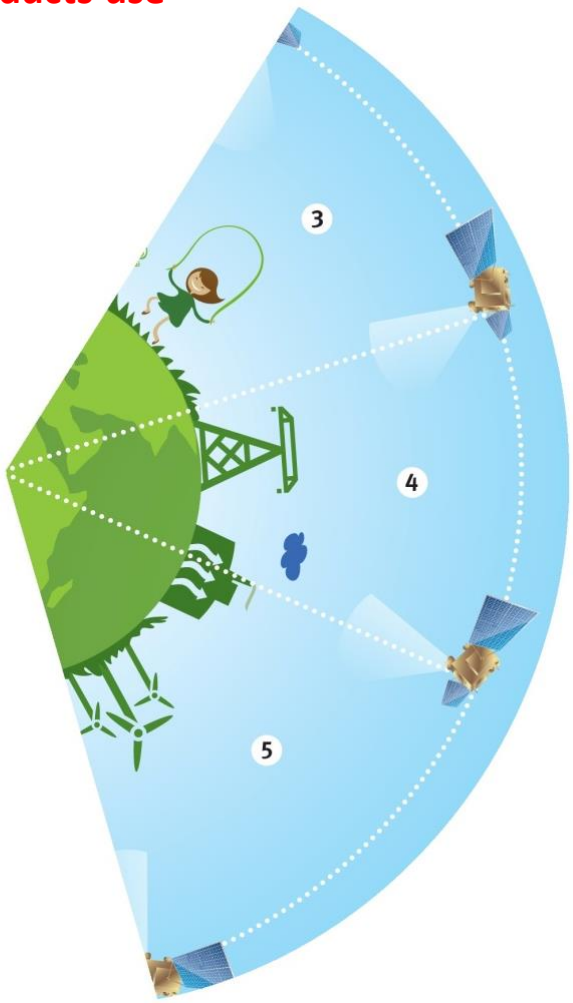
Neural networks, Multilinear functions, machine learning

SENSE products use

3 PUBLIC HEALTH

4 ENERGY MANAGEMENT

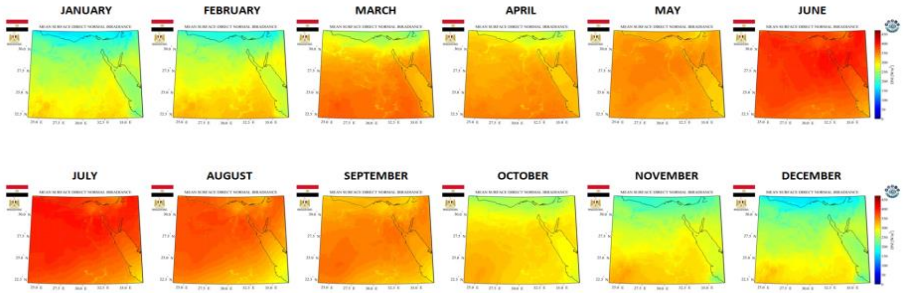
5 CARBON MANAGEMENT

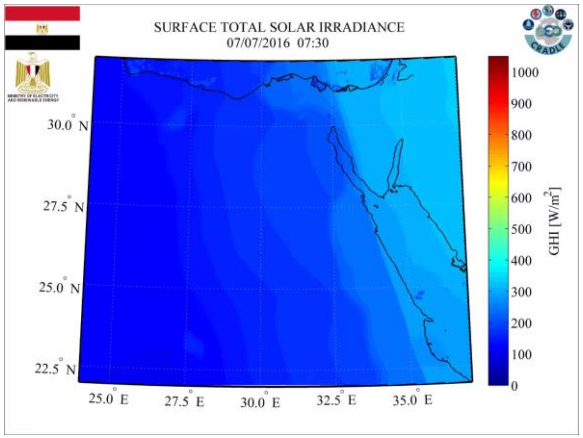


State-of-the art, progress, achievements, impact

- Egyptian Ministry of Electricity and Renewable Energy: a **common website** was developed in which the **real-time and climatological solar energy products** of SENSE are disseminated. An **analytical Egyptian solar atlas** was presented in the regional workshop in Cairo (May 2017).

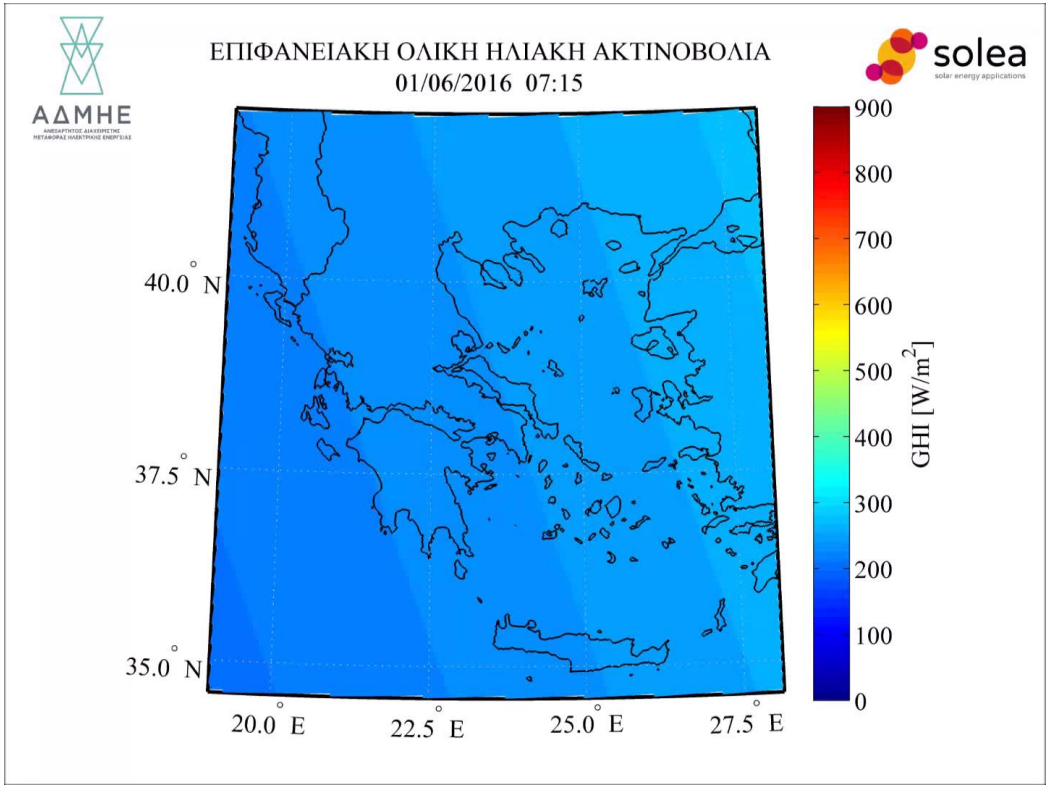
MINISTRY OF ELECTRICITY AND RENEWABLE ENERGY





Pilot 4: Access to Solar Energy

- Greek Independent Power Transmission Operator: a close collaboration in order to **update their nowcasting and forecasting power systems** with the SENSE's state-of-the-art methods. They exploit the **real-time solar energy maps and data** (60K pixels/integrated energy values every 15-minutes) by comparing them with real solar farms and controlling the local energy demands.



Pilot 4: Access to Solar Energy

- Pre-tect international campaign: the **solar energy maps of Crete** were provided **in real-time** for the purposes of the campaign (April 2017) and **spectral comparisons with a high precision solar spectroradiometer (PSR)** are made to further validate the SENSE under high-aerosol loads.

PRETECT

PRETECT About School Data Latest forecasts News

Data

HOME / DATA / SENSE

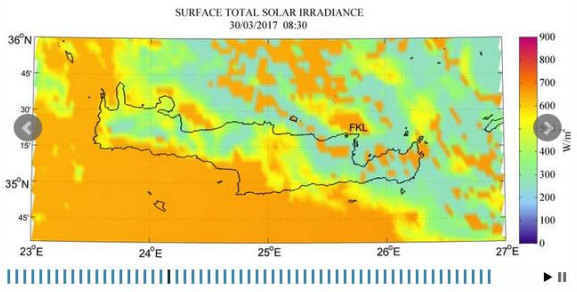
SENSE

Uploaded on 2017-03-30 18:27:00

Start time	March 30, 2017, midnight	**Duration**	1 day
Stop time	March 31, 2017, midnight	**Model**	Solar Energy Nowcasting System (SENSE)

Previous

Related graphs



Graph 1.21: Surface total solar irradiance - 2017-03-30 08:30

Quick links

Parallel measurements

- WRF WIND (Mar 30th, 2017)
- WRF WIND (Mar 30th, 2017)
- WRF WIND (Mar 30th, 2017)
- WRF WIND (Mar 30th, 2017)
- WRF WIND (Mar 30th, 2017)
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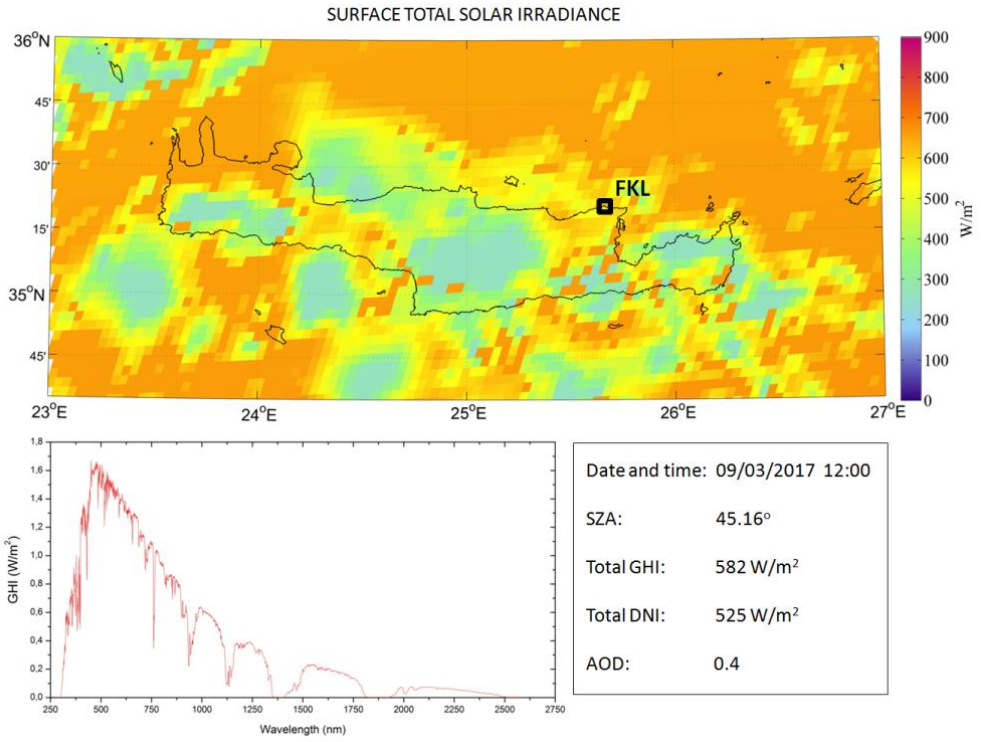
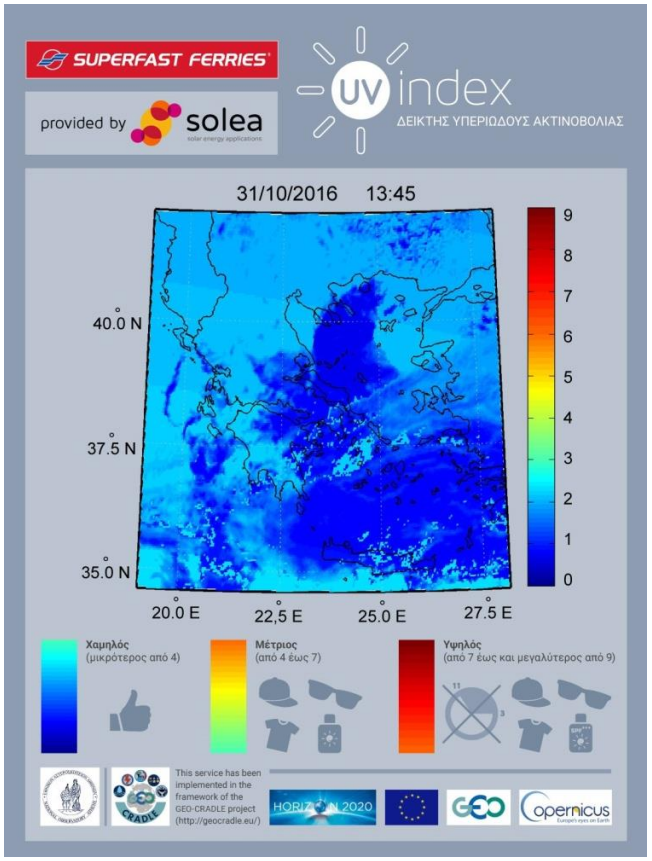
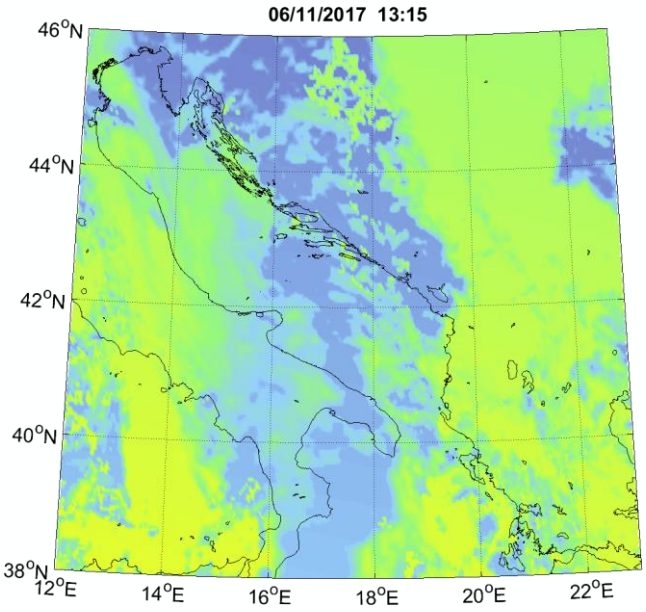


Pilot 4: Access to Solar Energy

- Attica group with Bluestar and superfast ferries, Greece: for the pilot period they attract relevant ads in order to efficiently advertise the **real-time UV-index service** from SENSE through the monitors of their ships with routes to the Aegean and the Adriatic seas.



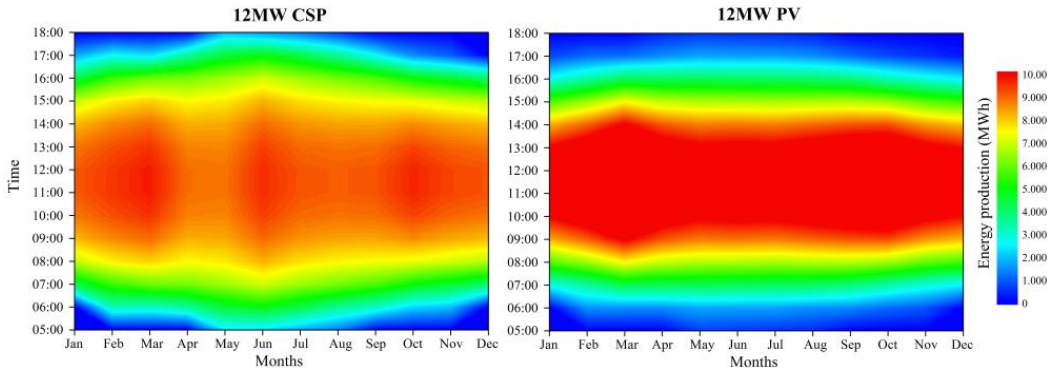


Pilot 4: Access to Solar Energy

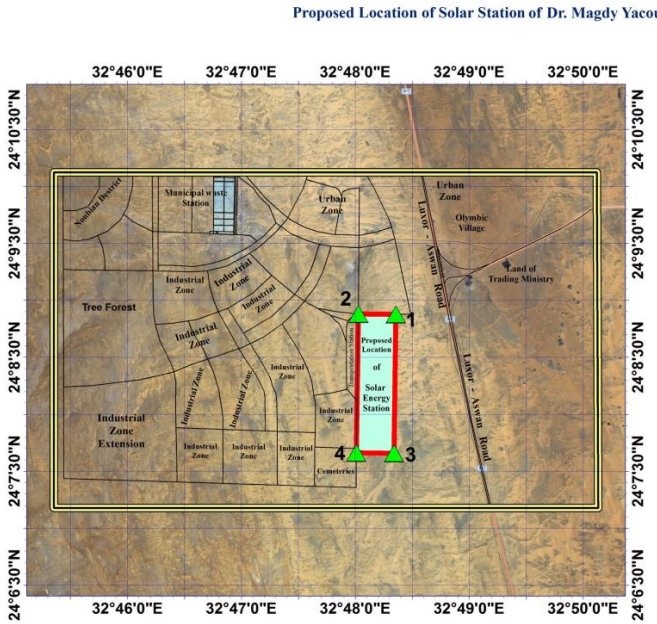
- Magdy Yacoub Medical center in Aswan, Egypt: **Solar energy model and plan**

MAGDI YACOUB HEART FOUNDATION
ASWAN HEART CENTRE

Aswan yearly solar variability



Medical center proposed location

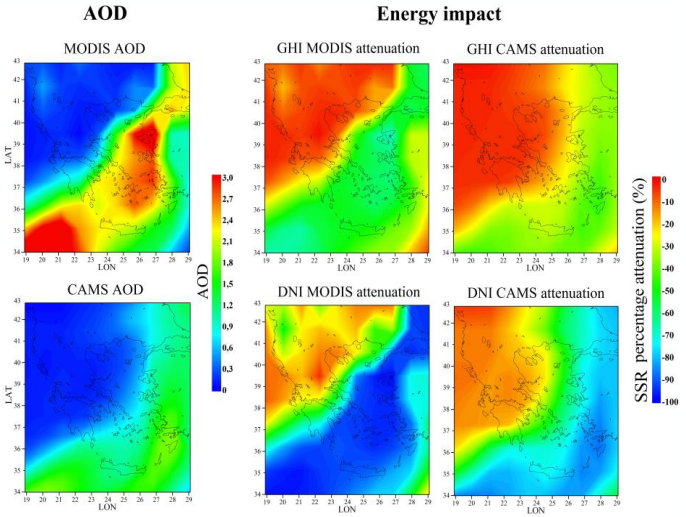


Area = 1260000 m2 (300 Feddan)

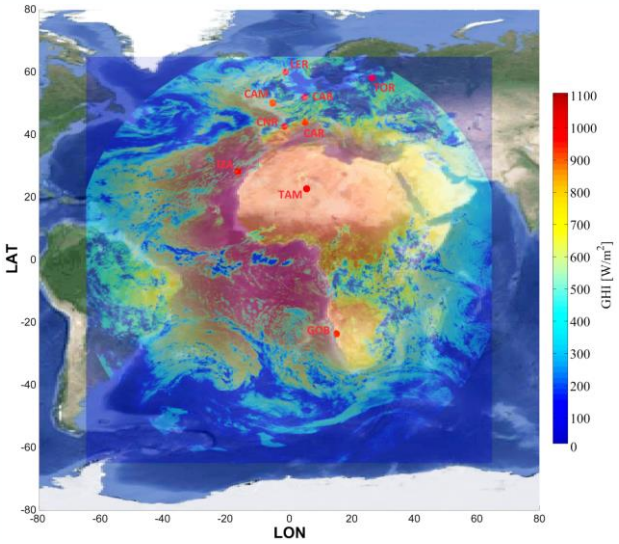
CORNERS	NORTH	EAST
1	N 24° 48' 05.54"	E 32° 48' 21.94"
2	N 24° 05' 52.27"	E 32° 48' 01.55"
3	N 24° 07' 59.07"	E 32° 48' 20.70"
4	N 24° 07' 39.18"	E 32° 48' 00.97"

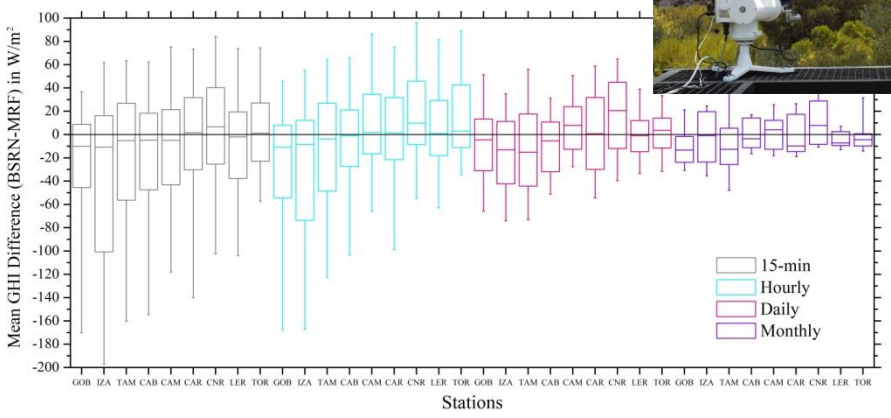
Validation

Dust events
Aerosol and solar energy validation



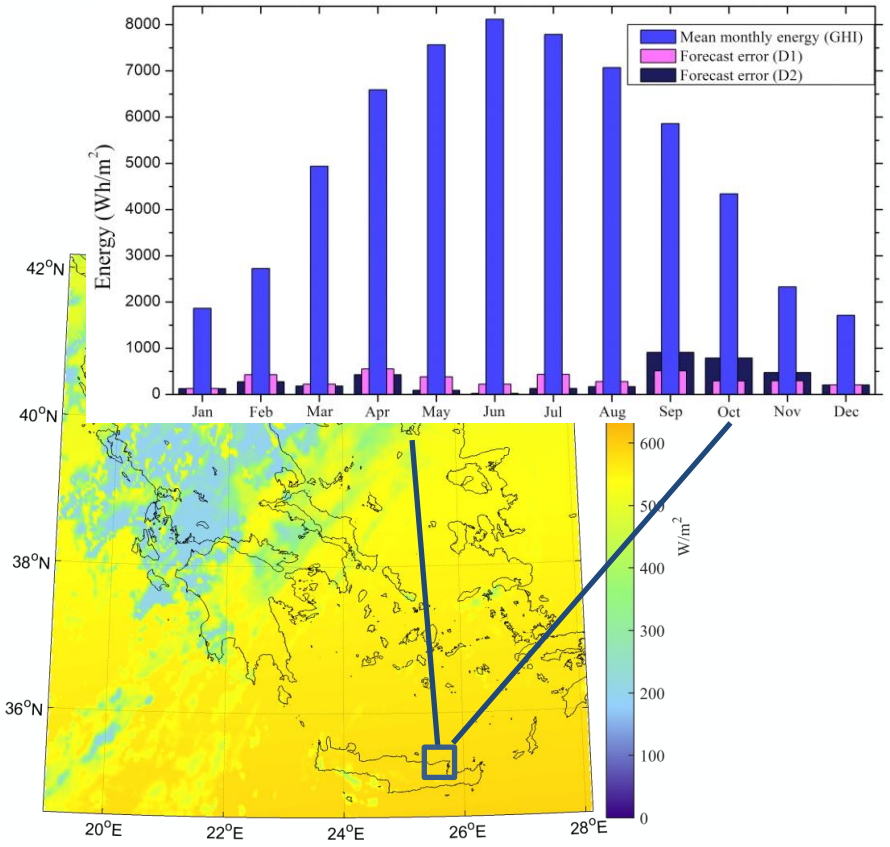
Long term validation using surface solar radiation measurements





Capabilities

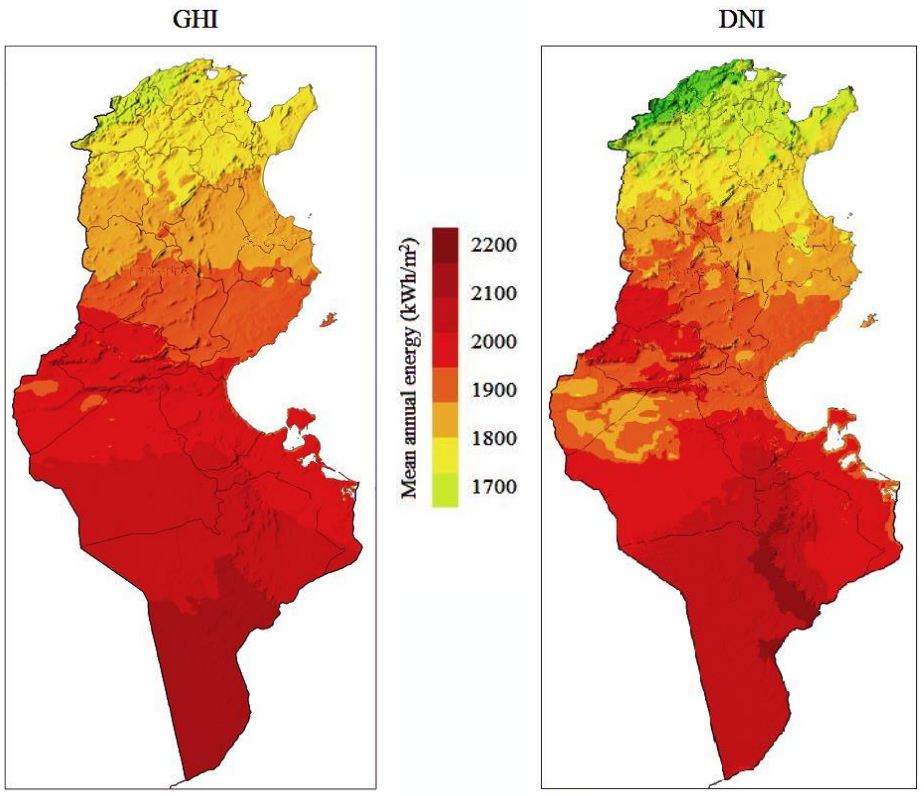
Solar energy planning for high spatial and temporal resolution



Greece, Crete: Mean monthly Solar Energy

PV systems

CSP Systems



Tunisia 1999-2013 mean annual Solar Energy

Capabilities

Solar energy planning for high spatial and temporal resolution

SENSE can be implemented anywhere - tailored products

- **Identify common calls for projects (e.g. GMES in Africa, AfriGEOSS, and future EuroGEOSS)**
- **Capacity building**
- **Continuation of the collaboration with Mediterranean countries**

Forecasting solar variability
Energy storage
Production distribution
Demand management

Pilot 4: Access to Solar Energy

Collaboration and extensive cooperation with the following end-users so far:

- Egyptian Ministry of Electricity and Renewable Energy.
- Greek Independent Power Transmission Operator.
- Pre-tect international campaign.
- Attica group with Bluestar and superfast ferries, Greece.
- Magdy Yacoub Medical center in Aswan, Egypt.

Experimental campaigns from which data will be integrated	**2**
Spin-off and R&D projects built on this GEO-CRADLE pilot	**2 (EOENABLER, Solea)**

thank you!

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