SATCULT Project: Good Practice Documentation Template

The application of satellite data in cultural heritage (CH) protection is still in its early stages, predominantly utilised by archaeologists. However, the SATCULT consortium has begun exploring its potential future uses in the wider CH area.

As part of an upcoming vocational training programme for CH practitioners , the SATCULT initiative gathers examples of Good Practices which show how satellite data can be used for the protection of CH including the benefits of accessing and utilising this data, and required skills for effective use. We are specifically interested in Good Practices from CH beyond archaeology.

The primary focus will be on desk research, collecting examples from European and international contexts with the assistance of Geoinformation and CH protection experts and practitioners. These examples will be analysed to determine the training needs of professionals and practitioners in CH protection and compiled into a compendium.

Please note filling this template requires knowledge to address properly the fields described throughout the survey. Although it is not long, it might take around 15 – 20 minutes to complete it thoroughly and properly.

A selected number of Good Practices, representing the working areas in cultural heritage, will be published in a European brochure and all Good Practices will be published on the SATCULT homepage and presented in the SATCULT LinkedIn group.

SATCULT:
Closing a knowledge gap by vocational training about satellite-based services in cultural heritage preservation

Erasmus+

media k | Consiglio Nazionale delle Ricerche | Istituto di Scienze del Patrimonio Culturale | ERATOSTHENES CENTRE OF EXCELLENCE

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Project number 2024-1-DE02-KA210-VET-000244931

Name/Title of the Good Practice *

Space to Tree: Earth Observation based monitoring of Natural and historical Park

Name of the organisation *

Consiglio Nazionale delle Ricerche - Istituto di Scienze del Patrimonio Culturale

Type of organisation in charge of the Good Practice *

- ○ Cultural Heritage organisation
- ○ Cultural Heritage site
- ○ Cultural Heritage -related public entity (Ministry, Prefecture, Municipality)
- ○ University
- ◉ Research Institute
- ○ Earth Observation -related organisation
- ○ Geo-Informatics (Geomatics) organisation/company
- ○ Private Company
- ○ Άλλο: .....

Domain of organisation's activities/expertise *

- ◉ Cultural Heritage
- ○ Archaeology
- ○ Earth Observation
- ○ Geo-Informatics
- ○ Άλλο: .....

Contact Information and Organisation's Logistics

Respondent's contact details

Full name of the contact person *

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Telephone number *

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Organisation's details

Country *

Italy

City *

Potenza

Address *

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Information about the Good Practice

Please name below the *Country*, *City* and *District* where the Good Practice took place *

Rome, Italy

Please provide below a *Google Maps link* or *GPS coordinates* to the Good Practice's location *

https://www.google.it/maps/place/Parco+archeologico+del+Colosseo/@41.8912436,12.4840787,17z/data=!3m1!4b1!4m6!3m5!1s0x132f61b45a97e325:0x5d48c32292745559!8m2!3d41.8912436!4d12.4866536!16s%2Fg%2F11hd7lkb4b?hl=it&entry=ttu&g_ep=EgoyMDI1MDUyNi4wIKXMDSoASAFQAw%3D%3D

Is this considered a sensitive* area ? *
*(protected, fragile, has restricted access, or located within a conflict zone, etc.).

Please elaborate further.

No

Who owns the cultural asset (ministry, other public body, private institution, none), on which the Good Practice was applied ? *

Ministero della Cultura (MiC)

Date(s) or period the Good Practice took place *

Please insert below the period when the good practice held. (eg. 2019-2020, March 2020 – June 2021, etc.)

2 november 2020 - 30 april 2024

Description of the Good Practice *

Please describe how the satellite data were collected (please mention the repositories or services where you acquired them); how they were used in your project; which were the aims of your study; and why these data were useful towards your research goals. (character limit: 1500)

The Space-to-Tree project stands as a best practice in the monitoring of natural and cultural heritage through the integration of Earth Observation (EO) and IoT technologies. It adopts a multiscale methodological framework leveraging time-series Sentinel-2 L2A data processed via Google Earth Engine (GEE), a cloud-based platform enabling large-scale geospatial analysis. Red (B4) and Near-Infrared (B8) bands are used to compute NDVI indices, producing high-temporal-resolution vegetation health maps. These datasets are subsequently processed using supervised machine learning algorithms to detect phenological variations at the single-pixel level.
This approach enables detailed assessment of tree health in culturally sensitive areas, such as the Colosseum Archaeological Park, supporting evidence-based and preventive conservation strategies. By integrating real-time IoT sensor data and 5G telemetry, the system allows for continuous biodynamic monitoring, including non-invasive diagnostics of tree stability under wind stress. Results are made accessible through an interoperable WebGIS platform, which supports both operational decision-making for site managers and local data download for scientific research. Space-to-Tree demonstrates how EO data and AI-driven analysis can provide an effective, scalable solution for the sustainable and predictive management of historic urban green spaces.

Why is this considered a Good Practice for making satellite data beneficial for Cultural Heritage ? (character limit: 1500) *

The Space-to-Tree project represents a best practice in natural and cultural heritage monitoring, as it integrates satellite technologies, IoT sensors and 5G telecommunications into a multiscale, non-invasive system. Using Sentinel-2 data downloaded from Google Earth Engine, the system processes NDVI time series to detect phenological changes at the single pixel level. This data is analysed using supervised machine learning algorithms, enabling early diagnosis of vegetative stress and preventive risk management.
The approach adopted overcomes the limitations of manual inspections, offering a continuous, secure and high-resolution solution that has been successfully applied in the Colosseum Archaeological Park. The results are accessible through an interoperable and user-friendly WebGIS platform, useful for both operational management by public authorities and scientific analysis. The replicability of the model, makes Space-to-Tree a concrete and transferable example of intelligent management of monumental greenery.
In addition, the system contributes to visitor safety by preventing potential risks from falling trees or branches in areas with high tourist traffic. The ability to monitor the biomechanical stability of trees in real time allows for timely intervention, reducing the risk of accidents and ensuring the safe enjoyment of cultural and natural sites.

Required skills section

Skills required to conduct the Good Practice *

Please reflect here which skills – e.g. technical, technological, social, heritage-related – are/were needed for the successful implementation of this Good Practice.

Remote Sensing & Earth Observation; Google Earth Engine (GEE); Machine Learning for Remote Sensing; WebGIS and Platform Development; IoT & Environmental Sensor Networks; Data Analysis & Data Integration

Are/were there any technical skills required for this Good Practice that were not initially available within your organisation and had to be acquired or outsourced? *

- ○ Yes
- ◉ No

Please list the specific skills acquired or outsourced and describe their purpose (e.g. “I learned Python to automate the downloading and preprocessing of collected satellite data.”) *

Evidence of success *

Please describe the benefits they provide to the cultural heritage asset (e.g. a site can be protected from a hailstorm, looters can be deterred from illegal excavation, damage can be recorded online through international cooperation, etc.). (character limit: 1500)

The Space-to-Tree project has proven its success through various concrete examples in the context of the Colosseum Archaeological Park. The project has proven useful in Decision support for green space management: The platform developed offers effective tools for planning and maintaining the tree heritage, contributing to the conservation and enhancement of the historic landscape. As an application in contexts of high historical value: The application of the project in the Colosseum Park has highlighted its effectiveness in complex environments, where the protection of natural heritage is integrated with that of cultural heritage. In the involvement of research bodies and institutions: The collaboration between CNR-ISPC, Digimat srl and the European Space Agency has ensured a multidisciplinary approach and the adoption of high scientific standards. This evidence confirms Space-to-Tree as a replicable best practice for the monitoring and management of green spaces in historical and archaeological contexts. To date, the tool provided to the Colosseum Archaeological Park is used for green space management and understanding the risks associated with it in cultural and natural contexts.

Available references for the Good Practice *

Please mention below if there are any derived publications, media reports or any other content that refers to the described Good Practice. Please include also a web link if available.

(character limit: 1500)

N. Masini et al., From Space to Tree: multisensor and multiscale remote sensing based approach for monitoring monumental trees. The case of archaeological park of Colosseum in Rome. Preliminary results. In 2023 IMEKO TC4 International Conference on Metrology for Archaeology and Cultural Heritage, 2023. 10.21014/tc4-ARC-2023.035.

Please upload 2-3 images that concern the Good Practice. *
(each image cannot exceed the size limit of the 100 MB)

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Προσθήκη αρχείου

Do you own the copyrights for these images ? *

- (●) Yes
- ( ) No

Should any form of media or outreach material will be created in the future, can we use them to advertise your organization and the CH asset with proper acknowledgement? *

- (●) Yes
- ( ) No

Please provide below the credits for the picture(s): *

The images were produced as part of the Space to Tree Project (ARTES IAP-5G for ART Demonstration Projects – European Space Agency) as part of the project outputs, by Digimat srl (project leader) and CNR - ISPC, CNR - IMAA.

Did you encounter any technical and/or technological challenges or issues associated with the implementation of this Good Practice? E.g. missing knowledge, doubts of colleagues, financial issues. *

There were technical problems related to the resolution of ESA Copernicus satellite data (10 m) for identifying individual pine trees, but these were resolved thanks to the size of the trees and the use of multi-temporal series. Another technical problem was related to the use of proximity sensors for tree monitoring, as these could not be placed in plain view within the park area so as not to interfere visually with visitors. They were therefore camouflaged to blend in with the environment.

Is there any potential for transferring this Good Practice to other cultural heritage organisations ? If so, please share more details. *

The Space to Tree project was conceived with the idea of being reapplied, scaled and modified according to the different needs of other cultural and natural sites. For this reason, it has already been designed as a model to be transferred.

Additional Information. Please include below any other information or experience you wish to share.

The information provided will be used exclusively for the activities of the SATCULT project and within the rules and obligations defined by the GDPR rules. The EU General Data Protection Regulation (GDPR) regulates how personal data of individuals in the EU may be processed and transferred. *

- (●) I have taken note of this information and agree to the use of my responses within the SATCULT project.