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GOLF COURSE MONITORING IN ITALY

Copernicus Sentinel data is being used by Centrale Valutativa to monitor the health and status of the grass of the golf course as well as to give recommendations on the most efficient way to irrigate the grass helping to save water and energy.

THE CHALLENGE

Water is a precious and valuable, however increasingly limited resource. Considering regional variations of water stress in Europe, several factors such as climate change, human interventions as well as close-to over-consumption are putting at risk the water availability for greater parts of the world population. In Italy, water scarcity is an important issue since most of the country is under extremely high water-stress according to data from the World Resources Institute. Both companies and consumers are affected by these developments and are paying more and more attention to environmental sustainability. As a result, environmental protection and the efficient use and management of water resources has become a pressing topic among sports clubs and associations. A sector that is very reliant on the supply of water and recognises its responsibility for its efficient use is the sport of Golf.

According to the European Golf Association, "the management of water resources is of vital importance, for the economic cost, environmental cost and associated public image". However, water distribution consumes energy and Italy has one of the highest industrial energy prices according to data from the European Commission. To help keep costs down and ensure environmental sustainability, Centrale Valutativa, an Italian service provider for precision-agriculture, has developed a decision-support application using data from Sentinel-2 to monitor the health and status of grassland and to provide irrigation recommendations to greenkeepers of golf courses. Taking into account variability within the golf course regarding vegetation and water requirements and considering all the associated aspects of maintenance on the putting greens, the fairways and the rough, the aim is to improve resource efficiency and to reduce the environmental footprint. Using satellite imagery, TETHYS collects and processes, in real time, data from different sources, allowing the greenkeeper to have information about all aspects related to the modern and efficient maintenance of the course.

More information on **www.earsc.org/sebs**

HOW SATELLITES CAN HELP

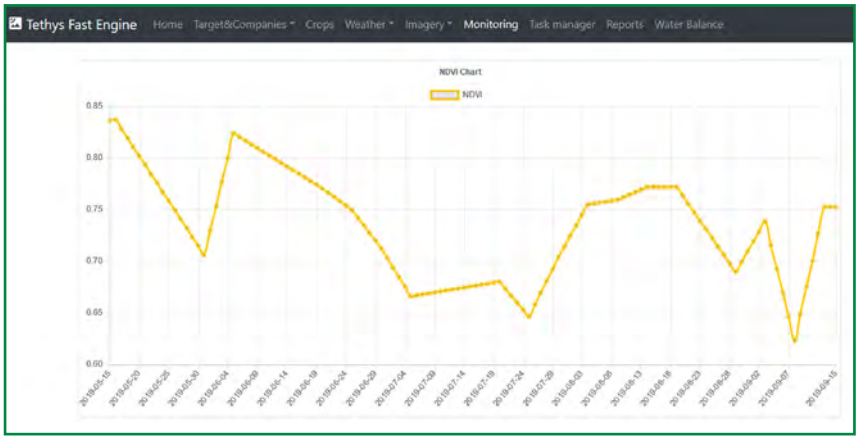
Optical imagery, acquired from satellites such as Sentinel-2, provide extremely useful information on the health status of vegetation and consequently of the turf. Centrale Valutativa, an EO company in Italy, makes use of these data along with other measurements, to derive the following products:

· **TETHYS Green Monitor** which provides a holistic overview of the golf course and a map that shows the health of the vegetation i.e. turf; and

· **TETHYS Water Saver** which analyses the specific water requirements, i.e. need for irrigation on a specific area of the golf course and provides recommendations as to where what amount is needed.

The key advantages of using satellite data are that extensive and wide areas such as golf courses can be accessed efficiently from a synoptic view, that both historical and up-to-date environmental information can be provided thanks to satellite data archives, that it is non-intrusive – no in-situ data is permanently necessary – and that seasonal and long-term trends can be monitored. To sum up: actionable insights that facilitate and improve the greenkeeper`s decision-making.

On top of that, a key advantage of satellite data is that the Sentinel-2 data can provide information on the state and health of the turf days before the greenkeeper`s naked eye would have observed any stress – even if he is out on the course every day. This is because the Sentinel-2 sensors cover a wider electromagnetic spectrum than the human eye and can thus provide more comprehensive insights into the health of the grass. As a result, the greenkeeper is able to focus and direct his attention to those areas of the golf course where his care is most needed. The temporal resolution, i.e. frequency of fresh imagery every 5 days, is sufficient to monitor changes in the turf and then put in place appropriate measures so that he can act in time.



NDVI Index development processed by TETHYS Green Monitor
© Centrale Valutativa

The satellite data:

Sentinel-2 carries an innovative wide swath (290km) high-resolution (10m) multi-spectral imager with 13 spectral bands, providing unprecedented views of the Earth with frequent revisit times.

The mission is mainly intended to support land monitoring: its images can be used to determine various indices related to the status of vegetation that are useful for e.g. agriculture and forestry. When imaging over crisis areas, Sentinel-2 contributes to disaster mapping, helping humanitarian relief efforts. Sentinel-2 imagery is also useful to monitor glaciers, lakes and coastal waters.

Copernicus Sentinels data are available under an open and free data policy.

Sentinel-2 data can be accessed at https://scihub.copernicus.eu

More info: https://sentinels.copernicus.eu

The Service Provider

The Centrale Valutativa is an innovative young company founded in January 2016 by a multidisciplinary team of professionals. Centrale operates in the field of public policy evaluation with a focus on sustainability and offer their services to public authorities, businesses and non-profit organisations.

Thanks to their expertise in the analysis of the relationship between the environment and agriculture, Centrale diversified its portfolio and developed applications for precision farming, circular economy and impact evaluation of farming on the environment.

centrale valutativa

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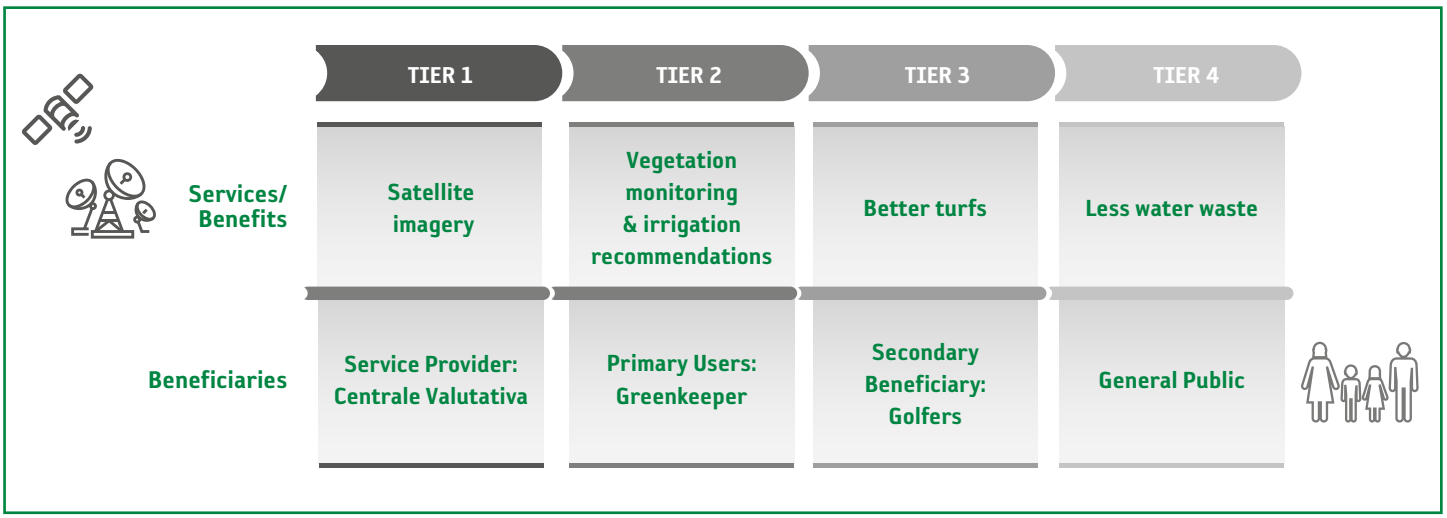


Schematic representation of the main beneficiaries along the value chain, including the corresponding services and benefits provided.

WHO IS CONCERNED?

The maps produced by Centrale Valutativa, a young company based in Italy, are used by the greenkeeper of the Olgiata Golf Club north of Rome. The golf club has hosted some particularly important events including the 2019 Italian national open golf championship - which is part of the PGA European Tour and will host the 2020 Italian Open. This is to say that the highest class of golfers play and compete on the course and thus the highest quality and best playing conditions are mandatory. By definition, it is the greenkeeper`s main responsibility to provide the optimum course conditions for the golfers throughout the year.

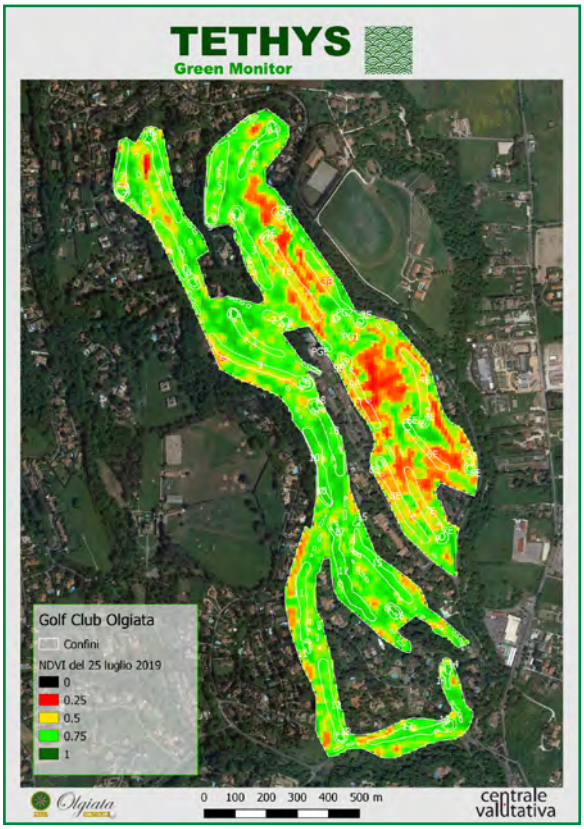
Consequently, the greenkeeper spends most of his time out on the golf course itself to inspect the health of vegetation, repair any damage and manage the irrigation system. Given the Mediterranean climate with high average temperatures especially in the summer and the low amount of precipitation throughout the year, the greenkeeper is increasingly facing a huge challenge. Overall, the Olgiata Golf Club extends over 40,000 hectares with about 40 sprinkler systems to irrigate the course. It is clear that such a vast area cannot be inspected every day which increases the likelihood that issues on the turf can stay undetected for some days. Thus, TETHYS functions as a **decision-support application** that assists the greenkeeper to identify when issues are emerging and to inform about their exact location. This way, the greenkeeper can **coordinate his actions and give priority** to certain "emergency" areas of the golf course.

By processing imagery from Sentinel-2 and calculating vegetation indices, the application provides the greenkeeper with information on the vegetation, the state and health of the turf as well as the degree of humidity in a cost-effective manner. By calculating the Normalised Difference Vegetation Index that shows the photosynthetic activity of the plant, the greenkeeper can monitor in an easy manner the status of the grass. On the basis of the index that is visualized on a map (see Figure on page 4) and sent to the greenkeeper every five days, the greenkeeper can monitor the health in absolute values and visualize long-term trends. This enables the greenkeeper to detect e.g. outbreaks of phyto-parassitary attacks and nutritional deficiencies at an early stage. If critical, the application alerts the greenkeeper to initiate possible interventions.

The Primary Users

Olgiata Golf Club is located north of Rome, Italy, and one of the most prestigious golf courses in Italy. It has been host to several important golf championships in Italy. Recently, in 2019, the Club organised the 76º Italian Open, the third time after 1973 and 2002, an indication of its excellent and high-quality golf course. In 2012, it was almost completely redesigned to fulfil new, more demanding needs of the modern game, and comply with International Tournaments standards. Its popularity is demonstrated by the addition of a second 18-hole course very recently.

The use of TETHYS not only benefits the greenkeeper in managing the golf course and the players through optimum playing conditions but benefits also the general public and natural environment by supporting a more efficient use of water resources and energy. Since high water stress is a common problem in most of Italy, using digital technologies such as Earth observation to consume less water for irrigation is in line with Italian government policy as well as the European Golf Association that is actively promoting best practices for responsible water use on golf courses.



View on Olgiata golf course with highlighting NDVI differences.
© Centrale Valutativa

WHAT ARE THE BENEFITS?

The use of Sentinel data brings several benefits to the greenkeeper and to the Golf Club as a whole, its members, the golfers and the general public. Financially, water use – in the case of Olgiata the water bill is around € 5,000 pa – has been reduced by around 25% depending on the specific efficiency of the sprinkler system. Due to more efficient irrigation, energy consumption – one of the main costs of golf courses – has also been reduced significantly since irrigation is done only when and where it is needed. These efficiency gains also translate into environmental benefits taking away pressure from an already water-stressed environment. Ultimately, players can enjoy excellent golfing conditions whilst societal expectations in the wake of increasing environmental awareness and sustainable water use are met.

The key benefits are:

- **Financial:** Reduced use of water and energy drives down costs.
- **Efficiency:** Efficient use of resources reduces energy and water consumption (c. 20%) within an already water-stressed environment.
- **Timesaving:** Instead of inspecting the whole golf course, the Greenkeeper gives his attention to areas that need it most.
- **Environmental:** Reduced use of water benefits the environment that already suffers from water stress.
- **Sportive:** Overall better management of the turf and irrigation system provides optimal conditions for sporting performance and enjoyment.
- **Societal:** Meeting societal expectations in using responsibly increasingly limited water resources.

EXTENDED IMPACT

This type of satellite image analysis is not limited to golf course monitoring only. It can also be applied to a multitude of other cases involving large areas of grassland where the maintenance and long-term monitoring as well as the reduction of water use and energy consumption is important such as big sports complexes, parks and gardens and even private properties.

The data and techniques used in this case are applicable worldwide. Sentinel images provide global, periodic coverage and the need for monitoring, detection of health issues of the grass and recommendations for water use are common in any part of the world where golf courses and other facilities are maintained. Parts of the world prone to more extreme weather events such as droughts and above all water-stressed regions could benefit greatly from this type of analysis as responsible and sustainable water use is increasingly important given the intensification of climate change.

View on the Olgiata Golf Club course.
© Olgiata Golf Club

ABOUT THE PROJECT

The Sentinel Benefits Study (SeBS) is conducted by EARSC (European Association of Remote Sensing Companies) with partners The Greenland, IIASA (International Institute for Applied Systems Analysis) and Evenflow on behalf of the European Space Agency (ESA). It has the goal to study 20+ full cases by analysing the impact of the use of Sentinel data along a value-chain. This short-case has been prepared where there has been an interesting use made of Sentinel data, but it has not (yet) been possible to conduct a full case. It tells the story of the use of Sentinel data without going deeply into the economic or environmental benefits.

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We acknowledge that the understanding of the case was supported by discussions with Matteo De Sanctis from Centrale Valutativa and Francesco Saverio Modestini from Olgiata Golf Club. We thank them for their valuable insights and availability.

Do you know an interesting case demonstrating the benefits derived from the use of Sentinels data?

Email info@earsc.org

More Information on Sentinels Benefits Studies:

www.earsc.org/sebs

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The Sentinels Benefits Study is funded by the EU and ESA.
The views expressed in this study cannot be taken to reflect the official position of the EU or of ESA.

The use of TETHYS and satellite imagery is a very promising way for us at Olgiata Golf Club to identify problems on the turf in advance and take appropriate measures in time. In addition, it helps us to minimise water and energy use in a cost-effective way.

Francesco, Saverio Modestini, Superintendent, Oligata Golf Club