

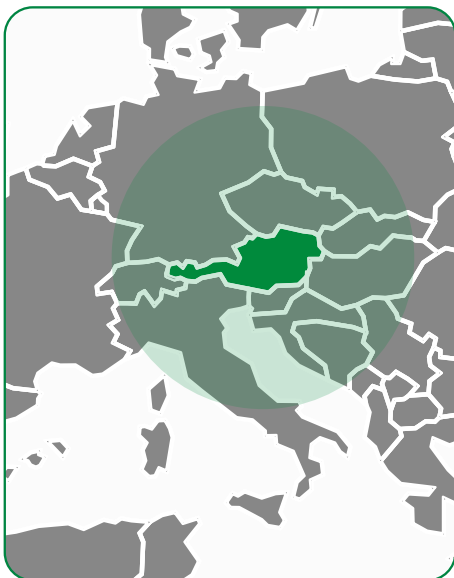
## IRRIGATION DETECTION & MAPPING IN AUSTRIA

Copernicus Sentinel data are used to detect irrigation on agricultural fields in Austria by the Umweltbundesamt – Environment Agency Austria to understand water usage in time and space. This helps to prepare and inform current and future water management policies and measures in the country.



### THE CHALLENGE

Water scarcity is a global risk in terms of its potential impact on the sustainable development of human society. In this context, climate change is expected to increase the frequency and duration of extreme events and hazards such as floods and droughts, with the latter making crops more dependent on water supplies. Irrigated agriculture is the main consumer of freshwater resources. Irrigation plays a key role in increasing crop production and ensuring global food security. Considering the global population growth and the mismatch between crop water demand and actual irrigation applied, better and more effective water management policies are needed to meet the growing demand for food production. In addition, groundwater levels have been declining in many regions in recent years for a variety of reasons, adding to the need to improve overall water management.



Austria has been and is likely to remain a water-rich country overall, although the degree of water supply varies from region to region. For example, the water-poor lowland regions in eastern Austria are expected to suffer more often from severe water shortages in the future. As farmers are currently dependent on irrigation, they will be the first to suffer from increasing scarcity. Against this background, the Environment Agency Austria has been investigating how remote sensing and EO data can help to better identify where and when irrigation takes place, supporting the Federal Ministry of Agriculture, Forestry, Regions and Water Management to prepare future-proof water management policies. This will support better management of permits for water use of farmers, taking into account future climatic changes such as new precipitation patterns and prolonged droughts in Austria.

## HOW SATELLITES CAN HELP

The Austrian water authorities have a fairly good overview of the general water supply and availability throughout the country, both in terms of precipitation, groundwater and the hydrological situation. What is lacking, however, is a comprehensive overview of water abstraction throughout Austria. While permits of all water uses and water abstraction rights are documented in a digital register, so called "Wasserbuch" (water book), information on the abstracted amount of water is not summarised and collected at the federal level.

The lack of an aggregated view of where and when farmers in Austria irrigate their fields makes it difficult to manage a sustainable use of water resources across the country. Field visits would take a lot of time and money. Therefore, the Ministry together with the Environment Agency Austria decided to test the use of satellite imagery from the EU's Copernicus programme, which provides fresh data every few days across the country. Satellite data, in particular Sentinel-1 and -2 data, show up as opportunity in minimizing or complementing reporting obligations at the local / regional level to the federal.

For this purpose, both radar (Sentinel-1) and optical (Sentinel-2) satellite imagery are retrieved. Using Machine Learning techniques and models, insights are derived to provide information about the timing and the areas of crops which are irrigated. For now, the solution includes maize, soya, potatoes and sunflowers and the application of this solution has been limited to Eastern Austria. Currently, more reference data in the form of on-site field mapping of irrigation are needed to train the models further. In the long run, the service will be easy to use and independent from reference data such as agricultural statistical surveys or records. The service could be extended to more recent observations (e.g., near-real time) and new regions. This will allow to monitor and track the expansion (or reduction) of irrigated areas and identify possible unauthorized water extractions.



### The satellite data:



**Sentinel-1** is the Copernicus radar mission, providing an all-weather, day-and-night supply of imagery of Earth's surface. The mission consists of two satellites embarking C-band synthetic aperture radars (SARs) in continuity of the ESA's ERS-2 and Envisat missions. The mission images the entire Earth every six days for the benefit of manifold applications such as monitoring of Arctic sea ice extent, surveillance of the marine environment, monitoring land-surface for motion risks, mapping for forest, water and soil management.

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

Sentinel-1 data can be accessed at <https://dataspace.copernicus.eu>

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

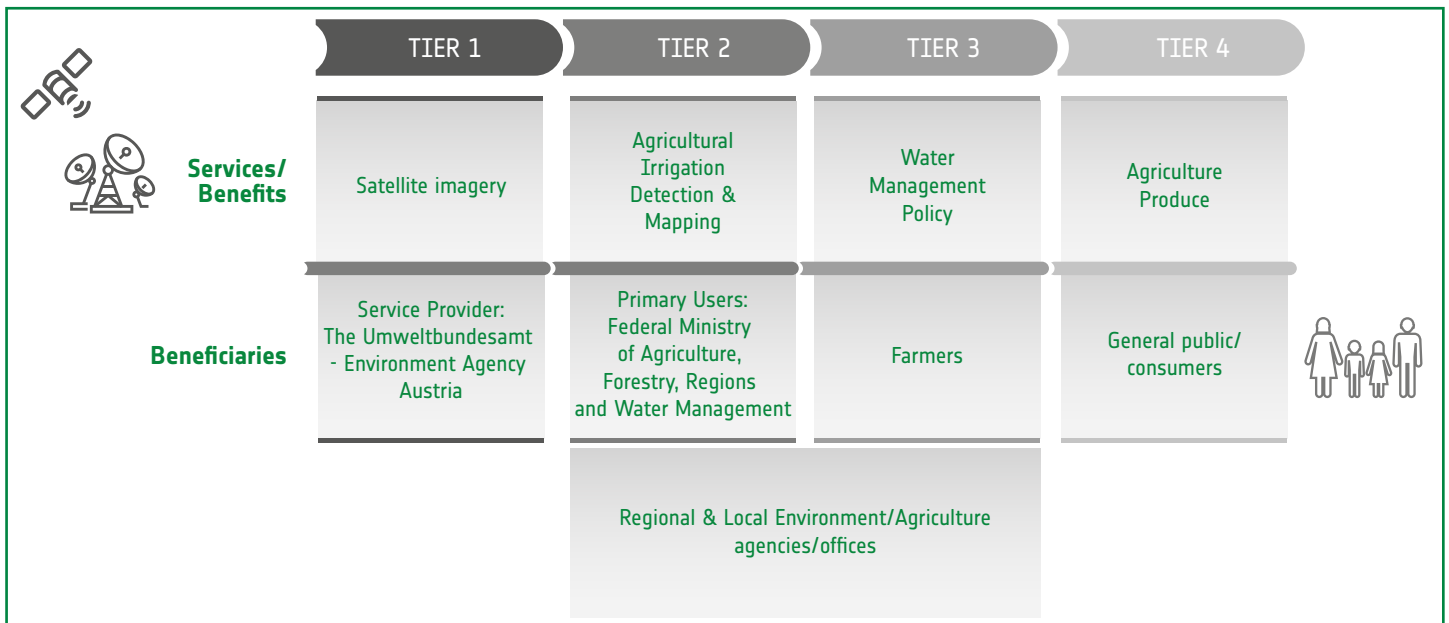


**Sentinel-2** carries an innovative wide swath high-resolution multispectral imager with 13 spectral bands. The combination of high resolution, novel spectral capabilities, a swath width of 290 km and frequent revisit times provides unprecedented views of Earth. Sentinel-2 images can be used to determine various plant indices such as leaf area, chlorophyll and water content, providing information useful for agricultural and forestry practices and for helping manage food security. Sentinel-2 also provides information on pollution in lakes and coastal waters. Images of floods, volcanic eruptions and landslides contribute to disaster mapping and help humanitarian relief efforts.

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Sentinel-2 data can be accessed at <https://dataspace.copernicus.eu>

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



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

## WHO IS CONCERNED?

The insights are provided by the **Environment Agency Austria**, which has a remote sensing team working on the use of Earth observation data, such as those from the Copernicus programme, to support its activities and provide partners and customers with evidence-based information and actionable insights.

The results are used by the Austrian **Federal Ministry of Agriculture, Forestry, Regions and Water Management**. Among other things, the Ministry is responsible for the country's water policy and water management, which covers three main areas: (1) resource protection, (2) regulation of use and (3) flood protection. As part of the regulation of water use, the Ministry sets up management plans for water and water bodies, which are used in many different ways, one of which is agriculture, which needs water for irrigation.

With the information provided by the Environment Agency Austria, i.e. an overview of where and when agricultural fields are irrigated, the Ministry can better plan and regulate water use in a sustainable manner.

This knowledge of the extent and timing of irrigated areas is a prerequisite for estimating future water demand and how much water can be used and extracted from aquifers in the future without depleting them.

In the long term, **regional water management authorities** will also benefit from improved water management policies at the federal level and additional information on water use, as they will be able to grant water abstraction rights and permits to farmers that are consistent with environmental and climate change considerations, minimizing risks of depletion of water bodies and aquifers.

Additionally, improved water management policies will increase

### The Service Provider

The Umweltbundesamt - Environment Agency Austria is the most important expert institution for the environment in Austria. As one of the leading environmental consultants in Europe, the Environment Agency Austria stands for the transformation of the economy and society to ensure sustainable living conditions. The experts develop decision-making bases at local, regional, European and international level, work transparently and in an all-party manner and are in dialogue with politics, administration, business, science and civil society. The Environment Agency's clients and partners include scientific and political institutions in Austria, the EU and beyond as well as companies. The Environment Agency Austria is based in Vienna.

**umweltbundesamt**<sup>1</sup>  
ENVIRONMENT AGENCY AUSTRIA

**farmers'** resilience to climate change, optimise water use, reduce risks, secure crop yields and support sustainable agriculture, promoting long-term viability and environmental stewardship.

In addition, improved water management policies benefit the **public** by supporting water security, environmental protection and climate resilience.

## WHAT ARE THE BENEFITS?

The Ministry responsible for water policy and water management considers that the use of Sentinel data in combination with machine learning techniques provides significant added value in providing a comprehensive overview of irrigation use in Eastern Austria for specific crops. Although still at an early stage, the Ministry emphasised that the main benefit is the efficient use of public sector resources and the minimising of costly imposition of reporting obligations on regional water authorities and the Ministry to derive an overall synthesised picture of the irrigation situation at the federal level.

The information derived will lead to better policy making by understanding water use and irrigation demand, particularly in the light of climate change and the need for adaptation measures in water management. In addition, the use of Sentinel data in the public sector is an innovative way of understanding water use and providing an objective and comprehensive common picture.

The **key benefits** are:



### Economic

- The use of the Sentinel data leads to minimizing costs through potential less reporting needs
- The use of Sentinel data leads to efficiency gains in the reporting processes between the national/federal and local/regional levels as less manual reporting and aggregation of data / information is required.



### Environmental

Better information and water management policies leads to reduced natural resource depletion / consumption of natural resource i.e. water.



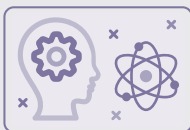
### Regulatory

The use of Sentinel data helps to improve the policy making process and the outcome of water policy through better and more comprehensive information.



### Innovative-Entrepreneurial

The use of Sentinel data is an innovative way of collecting data on irrigation (as opposed to field visits or reporting procedures).



### Scientific-Technological

The observations supported analyses about the impact of changing irrigation patterns in the region, and two academic papers have been published on this topic by UBA.



### Strategic

The use of Sentinel data provides a better common operational picture.

## The Primary Users

The Austrian Federal Ministry of Agriculture, Forestry, Regions and Water Management is engaged at both national and international level in sustainable agriculture, forestry and water management. With information and awareness measures, it communicates these issues to the public.

As part of a sustainable and environment-friendly agricultural and food policy, Federal Ministry of Agriculture, Forestry, Regions and Water Management advocates fair production conditions and sustainable water resource use and seeks to improve food security in Austria and combat hunger throughout the world. In addition, it supports many sustainable projects in developing countries.

 **Federal Ministry  
Republic of Austria**  
Agriculture, Forestry, Regions  
and Water Management

## EXTENDED IMPACT

The use of this type of satellite image analysis can be significantly expanded. Other departments within the same ministry, other ministries such as the Austrian Federal Ministry of Education, Science and Research or the ministry responsible for digital affairs, federal/regional agencies as well as research organisations dealing with water management may have an interest in obtaining information on where and when agricultural land is irrigated and the underlying methodology. Furthermore, the data and analysis techniques used in this use case are potentially applicable nationally and even globally. After all, Sentinel imagery provides global periodic coverage, and the need for irrigation information is nationwide, including all types of crops. Moreover, reduced and/or changing rainfall patterns and increased pressure on supplies is a problem faced by many countries all over the globe, thus a solution such as this may be expanded significantly geographically to countries who may have a need for such knowledge.

Understanding irrigation practices is a first step in the process, but the use of this type of satellite image analysis can be expanded in the future to include also analyses of other, yet related parameters that will be impacted by climate change such as groundwater level, seasonal fluctuations as well as changing crop patterns which will change irrigation needs.

The solution provided by the Environment Agency Austria is a first step towards more effective water management through improving estimates and forecasts of future irrigation needs. In the future, new crops will be included in the observations, and crop models, meteorological data and groundwater levels will be introduced to improve sustainability estimates.

## 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.



We acknowledge that the understanding of the case was supported by discussions with Heike Briemann, Luca Zappa and Gebhard Banko from Environment Agency Austria (Umweltbundesamt) and Ernst Überreiter from the Austrian Ministry of Agriculture, Forestry, Regions and Water Management. 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](mailto:info@earsc.org)

**More Information on Sentinels Benefits Studies:**

[www.earsc.org/sebs](http://www.earsc.org/sebs)



European Union



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.



*View of the Marchfeld region in Eastern, Austria*

*@Stefanie Gruessel/with thanks to the Austrian Ministry of the Interior Aviation Police*

**“Satellite data supplement the information about water use necessary for sustainable water resources management. They thus offer the opportunity to optimise the management of water resources and at the same time minimise the reporting effort on farmers”**

*Ernst Überreiter, expert for water resources, Federal Ministry for Agriculture, Forestry, Regions and Water Management of Austria*