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IRIDE, the Euro-Italian Earth Observation Program: Overview, Current Progress, Global Expectations, and Recommendations †

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Abstract: Recently, the Italian government has announced IRIDE, a new Earth observation program. IRIDE will likely be completed by 2026 under the management of the European Space Agency (ESA) and with the support of the Italian Space Agency (ASI). IRIDE is an end-to-end system made up of a set of sub-constellations (with radar and optical sensors) and services intended for the Italian Public Administration. The aims of this work are twofold: firstly, to disseminate information within the scientific community regarding the IRIDE program by highlighting key constellation characteristics as outlined in the latest ASI technical communications; secondly, to put forth valuable recommendations for the global applicability of this data, adopting a bottom-up perspective.

Keywords: IRIDE; Italian Space Agency; European Space Agency; Italian government; earth observation data; services; ChatGPT3.5; Google AI Gemini; expectations; suggestions; overview

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1. Introduction

In recent years, the number of both public and private Earth observation space programs has experienced exponential growth, thanks to substantial investments in the space economy [1]. The strategic importance of space extends beyond scientific and research objectives, with many countries and companies recognizing its significance and economic implications through technological transfers across various sectors, including defense, climate, agriculture, forestry, land, marine, and health within a one health perspective [2–10].

Despite the expanding array of missions and services utilizing Earth observation (EO) data, applications in mountainous areas remain challenging due to geomorphology. However, the advent of newer sensors with enhanced temporal-spatial resolution holds the potential to improve applications in these regions [11,12]. For instance, Google's planet missions serve as an example. Nonetheless, limitations such as reduced spectral resolution, unclear scientific descriptions of processing flows, and associated costs significantly hinder their applications in both scientific domains and technology transfer [13–16].

Recently, the Italian government announced the development of an ambitious space program named IRIDE, poised to become one of the most significant European Earth observation satellite programs. IRIDE will be implemented in Italy, initiated by the government and funded through the resources of the National Plan of Recovery and Resilience (PNRR). The program is projected to be completed, likely by 2026, under the management of the European Space Agency (ESA) with support from the Italian Space Agency (ASI).

IRIDE represents an end-to-end system, consisting of sub-constellations of low Earth orbit (LEO) satellites (upstream segment), ground-based operational infrastructure (downstream segment), and services tailored for the Italian Public Administration (service segment). Comprising various sensing instruments and technologies, the IRIDE constellation stands out. It spans from microwave imaging, utilizing synthetic aperture radar (SAR) to optical imaging at various spatial resolutions (from high to medium resolution) and across different frequency ranges, including panchromatic, multispectral, hyperspectral, and infrared bands.

The current agreement for IRIDE has a total value of EUR 68 million for 22 satellites. Notably, the IRIDE constellation aims to deliver both higher temporal and spatial resolution. By the end of 2025, the constellation is set to have its first twin platforms equipped with multi-spectral sensors, aligning with developments in the Copernicus Sentinel-2 missions. This advancement will enable daily monitoring of each location in Italy with a ground sampling distance (GSD) of approximately 2 m.

IRIDE aims to provide analytical data supporting the development of commercial applications by startups, small and medium-sized enterprises, and sector industries. The constellation will offer eight macro services encompassing marine and coastal monitoring, air quality, land movements, land cover, hydro–meteor–climate, monitoring of water resources, emergency management, and safety. Additionally, in collaboration with other national and European space systems, IRIDE will support civil protection and other administrations in addressing hydrogeological instability, fires, coastal protection, monitoring critical infrastructures, air quality, and weather conditions.

Given the promising nature of this mission in terms of potential data offerings to the scientific community, as well as both the public and private sectors, the aims of this work are twofold. Firstly, the aim is to disseminate information within the scientific community regarding the IRIDE program, highlighting key constellation characteristics outlined in the latest ASI technical communications. Secondly, the aim is to propose valuable recommendations for the global applicability of this data, adopting a bottom-up perspective, with the hope that it will contribute to a valuable technological transfer within the geospatial sector and the space economy [17–21].

2. Materials and Methods

Since the IRIDE mission will not be operational until 2025, with this work, careful research was conducted on the official sites of the space agencies and entrepreneurial partners involved in order to collect all the useful information to describe the characteristics of the sensors and this ambitious program space. At the same time, feedback was collected from users who use remote sensing data for research and work activities from communities (hereinafter called RSC) such as EO college (https://eo-college.org/forums/ last accessed on 18 January 2024), STEP forum (https://forum.step.esa.int/ last accessed on 18 January 2024), the Google Earth Engine Developers Community (https://groups.google.com/g/google-earth-engine-developers/about?pli=1 last accessed on 18 January 2024), and other remote sensing communities so as to collect the main strengths and weaknesses of each and propose suggestions for IRIDE in order to have a useful final user platform to use EO data.

2.1. Characteristics of the IRIDE Constellation

One of the most important recent European Earth observation projects is the IRIDE satellite constellation, whose development, which began in 2022, is now entering the new implementation phase, with 47 Italian companies and 20 public entities (like region, in-house enterprises that will be involved in its implementation). The constellation, which will be made up of 69 devices, the first of which will reach orbit in 2025, will exploit multiple observation techniques and will have state-of-the-art satellites at the service of both institutions and national startups and industrial entities. Upon completion, expected by mid-2026, IRIDE will allow a daily revisit of each Italian location, with a ground sampling distance of the order of 2 m. Multispectral and SAR sensors will constitute the payload on-board the satellite.

As regards the installation of hyperspectral and thermal sensors, it is not yet totally clear from the information collected which line will be taken as well as the nature of the SAR band. Therefore, the information reported here refers to the beginning of 2024.

With certainty, the IRIDE will be the first public higher spatio-temporal resolution space program with all its missions, and the data access will be totally free as stated by ASI. Nevertheless, no information is available at the present time about the registration and access of such data. As previously reported, IRIDE will be made of a set of sub-constellations of LEO satellites (upstream segment) and the ground-based operational infrastructure (downstream segment), as well as services intended for the Italian Public Administration (service segment) first and the rest of Europe second.

Concerning the resolution of multispectral, hyperspectral, SARs, and probably thermal sensors, Table 1 reports a general summary.

Table 1. IRIDE program and resolution missions: a general overview.

Resolution	*Description*	*Note*
Spatial	~2 m	~1–3 m according to the bands and device SARs, optical, TIR. None of the information is still available for the hyperspectral. The coverage will be global with a particular focus on Italy, Europe, and the Mediterranean areas.
Temporal	<1 day	from daily to multi-daily (8–12 times a day only for Italy and some EU and Mediterranean areas)
Spectral	depending on sensor typology	Depending on each sensor. Multispectral with panchromatic and hyperspectral will be compatible with Sentinel-2 (https://sentinels.copernicus.eu/web/sentinel/missions/sentinel-2/instrument-payload/resolution-and-swath *) and PRISMA respectively (https://www.asi.it/en/earth-science/prisma/ *). While thermal would be probably close to SatVU missions (https://www.satellitevu.com/ *) within the Platino-2 platform powered by Sitael (https://www.sitael.com/space/references-and-customers/earth-observation/ *) for ASI. The SAR will probably operate in band X as reported by the contractor company MetSensing (https://metasensing.com/it/metasensing-selected-to-provide-the-sar-payload-sensor-for-the-nox-mission-in-italys-iride-constellationn/ *) and for sure will be on Platino-1 platform powered by Sitael and ION platform for ASI within the NOX Project. The SAR mission will acquire data in Stripmap, Spotlight, ScanSAR and TopSAR mode. (* last access 20 January 2024)
Radiometric	>16 bits	16 bits integers or upper

As shown in Table 1, the IRIDE missions involve different sensors and platforms. In particular, the characteristics of those mentioned are given where available and are state of the art.

The PLATiNO-1 missions within IRIDE will incorporate a Micro-SAR X payload developed by MetSensing and Thales Alenia Space Italia. The mission involves these two key phases: the first phase operates at 619 km in passive mode, while the second phase operates at 410 km in active mode. It is worth noting that SAR band X will operate between 8 and 12 GHz with wavelengths around 2.4–3.8 cm. Furthermore, the band characteristic enables urban monitoring, as well as ice and snow and canopy tree height detection due to a little penetration into vegetation cover and fast coherence of decay in vegetation areas.

The PLATiNO-2 missions within IRIDE outlines the development of the second satellite utilizing the PLATiNO platform, featuring an embedded thermal infrared (TIR) payload. This mission serves to validate the multi-applicability feature of the PLATiNO platform. Developed collaboratively by Leonardo and SITAEL, the PLATiNO-2 TIR payload is designed to capture images that will facilitate essential services for territory control and protection. These services include monitoring bodies of water, glaciers, and pollutants, as well as assessing the state of crops, vegetation, and energy consumption in urban areas. Notably, PLATiNO-2 is equipped with the magnetically shielded HT 100, an enhanced version of the SITAEL electric thruster. This feature positions PLATiNO-2 as one of the pioneering missions globally, enabling Earth observation in the thermal infrared from an orbit less than 400 km, thereby significantly enhancing the resolution of the acquired images.

2.2. Data Suggestion and Expectation Collection

In order to achieve this last goal, we use the freely available AI open access platforms (hereinafter AIP) ChatGPT3.5 (https://chat.openai.com/ last access 20 January 2024) and Google's Bard, an AI based on Gemini (https://bard.google.com/ last access 20 January 2024), to perform OSINT and scraping techniques onto RSC. It is worth noting that open-source intelligence (OSINT) refers to the collection and analysis of information from publicly available sources, while scraping in the context of the internet refers to the automated process of extracting data from websites or content according given rules. The content of each RSC has been imported into AIP and extracted according to target questions to count and extract feedback from users in order to perform aggregated statistics and sum up the recurrent issues. In Table 2, the main questions for operation performance to adopt simple scraping and OSINT techniques are listed.

Table 2. Questions to aggregate data and perform scraping into RCS.

N°	Questions
1	Count the number of words that mentioned IRIDE space program;
2	Sum up main issues arisen by users;
3	Detect and count main strengths or perspective underlined by users;
4	Detect and count main problems or weakness underlined by users;
5	Upon the previous questions filter by Earth observation platform, download data, willing perspectives;
6	Count the entire feedback and, with respect to the previous questions, compute the statistical percentage.

In Table 2, the main questions for operation performance to adopt simple scraping and OSINT techniques are listed. The plots generated to sum up the main feedback reported in the results have been generated in R studio vers.2022.02.2.

3. Results

The new IRIDE space program will allow for a technological transfer in the remote sensing services framework. Several areas of application and domains will be involved, thanks to the advanced temporal and spatial resolution of the satellite sensors of the various IRIDE missions. In collaboration with other national and European space systems, this constellation is poised to support public administrations, with an initial focus on civil protection. Distinguished by a diverse array of sensing technologies and tools, the constellation stands out as a unique entity. The data it collects will be accessible at no cost and will be permanently stored in a cutting-edge storage infrastructure. As previously mentioned, IRIDE will be equipped with synthetic aperture radar and optical payloads, offering resolutions of 2–3 m, and in certain cases, even less than 1 m, contingent upon the acquisition mode for specific sensors.

3.1. Areas of Application: An Overview

The range of the IRIDE missions will cover a tremendous application area, from observation of the coasts to monitoring the atmosphere and the land ecosystems, and from the quality of the water and the water system to the movements of the land and large infrastructures. These are all capabilities that can be translated into security, prevention, and emergency management services or into applications to support agriculture, forestry management, and services already available within the Copernicus and Landsat programs, for example, but with a unique temporal and spatial resolution. Table 3, lists the main services according to 8 IRIDE macro-services and relative topics.

Table 3. IRIDE macro-service and topics.

Macro-Service	Topic
Land cover	Land
Monitoring of land movements	Land
Agriculture and Forestry	Land
Marine and coastal monitoring	Water
Monitoring of water resources	Water
Hydro-weather climate	Climate
Air quality	Atmosphere
Emergency management and safety	Security

The constellation will play a pivotal role in assisting the Department of Civil Protection and other administrations in addressing challenges related to hydrogeological instability and fires. Additionally, it will contribute to safeguarding coastlines and overseeing critical infrastructure, air quality, and meteorological conditions. This comprehensive system enables multi-sensor and multi-temporal monitoring, facilitating swift mapping for various emergency scenarios, including droughts, fires, water conservation in agriculture, and the supervision of waste disposal and polluting discharges. Specifically, as summarized in Table 3, IRIDE will offer eight macro services encompassing marine and coastal monitoring, air quality assessment, monitoring of land movements, land cover analysis, agriculture and forestry monitoring, hydro-weather climate observation, assessment of water resources, emergency management, and safety. These services are strategically planned to cover both terrestrial and marine components, demonstrating the versatility of the system in addressing a wide array of environmental and emergency-related concerns.

3.2. Global Expectations and Recommendations

Based on the analysis conducted in the RSC, performing OSINT and scraping using AIP, the main global expectations and recommendations are outlined below:

- Develop an easily accessible data platform offering various processing levels, equipped with APIs compatible with Python, Javascript, and R. The platform should prioritize clarity, simplicity, and quick access, contrasting with the cumbersome ASI PRISMA data interface, which stands as a notable example of inconvenience, particularly for research and development purposes (https://appeears.earthdatacloud.nasa.gov/ last accessed on 20 January 2024);
- Establish process chains and validated services through rigorous scientific analyses and publications, including case studies at different scales to highlight the limitations and potentials of sensors. The Theia portal serves as an exemplary model in this context (https://www.theia-land.fr/en/products/ last accessed on 20 January 2024);
- Implement data on cloud processing platforms like Google Earth Engine (https://earthengine.google.com/ last accessed on 20 January 2024) and Microsoft Planetary. If data transfer implications to foreign multinationals pose challenges, a desirable alternative would be a free-cloud platform, especially for scientific research, respecting national interests and asset protection;
- Develop free GIS plugins and calibration functions, collaborating with research centers, such as Orfeo Toolbox, QGIS, and SAGA GIS;
- Integrate multispectral sensors that are spectrally equivalent or comparable to Sentinel-2;
- Ensure the availability of an always-accessible archive collection, preferably managed at the national and/or European level by public or private bodies but under public body control, addressing past issues seen with Copernicus mission data on Scihub;

- Establish massive open online courses (MOOCs) on data processing and services, following the example set by ESA, DLR, CNES, such as EO college (https://eo-college.org/welcome last accessed on 20 January 2024);
- In the alpine context, the availability of a spatially coeval digital terrain model (DTM) is crucial for bottom of atmosphere-surface reflectance (BOA-SR) products;
- Develop masks for clouds, shadows, and defective pixels at the same native resolution as the highest resolution band, ensuring clear application;
- Explore the possibility of acquiring a very high-resolution P-band synthetic aperture radars (SARs), especially beneficial for forest inventories in alpine areas and beyond;
- Strengthen the network of ground control points in the alpine area, addressing both related and derived products;
- Foster greater involvement of academies and research centers in the planning phase, particularly those working with these data at mountain levels;
- Consider the development of a thermal sensor with a resolution of less than 10 m, facilitating the creation of a one health service and enhancing vegetation monitoring;
- Correct co-registration of images to avoid shifting in the time series.

In the subsequent graph (Figure 1), the most desired or existing aspects in remote sensing portals and implementations, crucial for addressing issues starting from question 6 of Table 2, are depicted as a percentage of all comments received in the RSC.

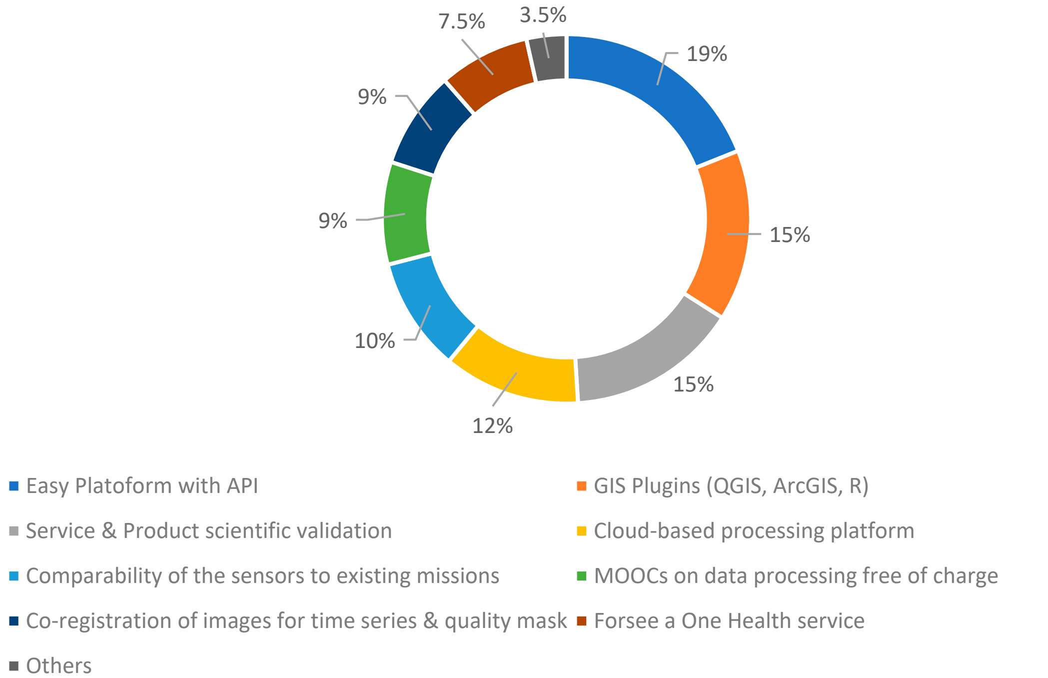

Figure 1. Main topics related to IRIDE and Earth observation platform and services underlined in RSC.

4. Discussion

The uniqueness of IRIDE lies in its constellation that comprises dozens of satellites of smaller dimensions compared to Italy's main developed devices, such as Cosmo-SkyMed. Notably, these satellites will not all be identical but of various sizes to accommodate sensors and instruments of different natures and complexities, resulting in varying weights.

A noteworthy aspect is the active participation of over 47 Italian companies in the project, responsible for constructing the system and providing services to users. Additionally, the involvement of more than 10 administrations, representing approximately 23% of the Italian surface area, 37% of the population, and 33% of the national GDP, is significant. Numerous stakeholders stand to benefit from the data that IRIDE will make available.

Already signed agreements enable IRIDE to establish collaboration within a national team. Out of the 34 commissioned satellites (with an additional 35 as optional), the creation of the initial 22, financed with a total of EUR 68 million, was entrusted to the Turin-based Argotec enterprise (10 devices with an option for another 15) and Ohb Italia (12 satellites plus a potential additional 15). The latter is also assigned the responsibility of managing the flight operation segment, i.e., in-orbit management. Argotec will lead an industrial group consisting of Officina Stellare and Rhea System to deliver the first 10 high-resolution multispectral satellites by November 2024. Ohb Italia, at the helm of a team comprising Optec, Telespazio, and Aresys, will provide similar equipment. Thales Alenia Space, a joint venture between Thales (67%) and Leonardo (33%), will construct six SARs (synthetic aperture radars) satellites and one optical satellite. Two agreements, one valued at EUR 112 million and the other at EUR 30 million, also include an option for an additional four SAR satellites (for EUR 75 million) and an optical one (for EUR 19 million). These satellites will utilize the NIMBUS (new Italian micro bus) modular platform of approximately 170 kg, designed by Thales Alenia Space for high-revisited and high-production-capacity constellations. The supply of the payload data ground segment (PDGS) of the constellation, valued at EUR 25 million, was awarded to the Apulian company Exprivia. Over the next three years, Exprivia, leading a group comprising Telespazio, Planetek Italia, Serco Italia, and Aresys, will manage the platform capable of collecting and processing data from the 34 satellites for studying natural climatic and territorial phenomena. Exprivia's press release emphasizes the provision of useful tools for government agencies in decision-making processes related to monitoring natural phenomena, crisis scenarios, and maritime traffic. The two most recent assignments went to D-Orbit and Sitael. D-Orbit, with a EUR 26 million order, will build a satellite utilizing microwave technology to provide high-resolution images for nighttime or cloudy conditions. The agreement, including Meta-sensing for sensor development, incorporates an option for an additional satellite for EUR 24 million.

5. Conclusions

IRIDE stands out as one of the most significant European space programs for Earth observation in low orbit, constituting a crucial component of the next generation EU initiatives dedicated to advancing space activities in support of ecological and digital transitions. Spearheaded by the Italian government, this program is set to be implemented in Italy, with completion anticipated by 2026, facilitated by the support of the European Space Agency (ESA) and the Italian Space Agency (ASI). The total allocated funding for IRIDE amounts to EUR 1.1 billion, earmarked within the National Plan for Recovery and Resilience (PNRR). IRIDE aims to establish an end-to-end system, encompassing constellations of low Earth orbit (LEO) satellites (upstream segment), operational ground infrastructure (downstream segment), and geospatial services catered to Italian and European public administration (service segment), as well as private customers. Notably, the IRIDE constellation will be unparalleled, featuring an array of instruments and detection technologies, spanning from microwave imaging, utilizing synthetic aperture radars (SARs) to optical imaging with varying spatial resolutions (ranging from high to medium resolution) and across different frequency ranges, from panchromatic to multispectral, hyperspectral, and infrared bands. Diverse services are planned for both terrestrial and marine components, with a crucial emphasis on expanding offerings to include contemporary services, such as those dedicated to one health applications. The imperative to broaden service capabilities is underscored, particularly in the development of an easily accessible platform with APIs and a cloud processing platform, inspired by Google Earth Engine. This strategic approach aims to catalyze tangible technological transfers on a global scale, especially in alpine environments, recognizing the substantial portion of the Italian territory that is situated in hilly and mountainous areas.

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References

1. Highfill, T.C.; MacDonald, A.C. Estimating the United States Space Economy Using Input-Output Frameworks. *Space Policy* **2022**, *60*, 101474. [CrossRef]
2. Orusa, T.; Orusa, R.; Viani, A.; Carella, E.; Borgogno Mondino, E. Geomatics and EO Data to Support Wildlife Diseases Assessment at Landscape Level: A Pilot Experience to Map Infectious Keratoconjunctivitis in Chamois and Phenological Trends in Aosta Valley (NW Italy). *Remote Sens.* **2020**, *12*, 3542. [CrossRef]
3. Viani, A.; Orusa, T.; Borgogno-Mondino, E.; Orusa, R. Snow Metrics as Proxy to Assess Sarcoptic Mange in Wild Boar: Preliminary Results in Aosta Valley (Italy). *Life* **2023**, *13*, 987. [CrossRef]
4. Carella, E.; Orusa, T.; Viani, A.; Meloni, D.; Borgogno-Mondino, E.; Orusa, R. An Integrated, Tentative Remote-Sensing Approach Based on NDVI Entropy to Model Canine Distemper Virus in Wildlife and to Prompt Science-Based Management Policies. *Animals* **2022**, *12*, 1049. [CrossRef] [PubMed]
5. Orusa, T.; Borgogno Mondino, E. Exploring Short-Term Climate Change Effects on Rangelands and Broad-Leaved Forests by Free Satellite Data in Aosta Valley (Northwest Italy). *Climate* **2021**, *9*, 47. [CrossRef]
6. De Marinis, P.; De Petris, S.; Sarvia, F.; Manfron, G.; Momo, E.J.; Orusa, T.; Corvino, G.; Sali, G.; Borgogno, E.M. Supporting Pro-Poor Reforms of Agricultural Systems in Eastern DRC (Africa) with Remotely Sensed Data: A Possible Contribution of Spatial Entropy to Interpret Land Management Practices. *Land* **2021**, *10*, 1368. [CrossRef]
7. Orusa, T.; Viani, A.; Moyo, B.; Cammareri, D.; Borgogno-Mondino, E. Risk Assessment of Rising Temperatures Using Landsat 4–9 LST Time Series and Meta® Population Dataset: An Application in Aosta Valley, NW Italy. *Remote Sens.* **2023**, *15*, 2348. [CrossRef]
8. Latini, G.; Bagliani, M.; Orusa, T. *Lessico e Nuvole: Le Parole Del Cambiamento Climatico*; Youcanprint: Lecce, Italy, 2021.
9. Orusa, T.; Mondino, E.B. Landsat 8 Thermal Data to Support Urban Management and Planning in the Climate Change Era: A Case Study in Torino Area, NW Italy. In Proceedings of the Remote Sensing Technologies and Applications in Urban Environments IV, Strasbourg, France, 9–10 September 2019; International Society for Optics and Photonics: Bellingham, WA, USA, 2019; Volume 11157, p. 111570O.
10. Orusa, T.; Viani, A.; Cammareri, D.; Borgogno Mondino, E. A Google Earth Engine Algorithm to Map Phenological Metrics in Mountain Areas Worldwide with Landsat Collection and Sentinel-2. *Geomatics* **2023**, *3*, 221–238. [CrossRef]
11. Orusa, T.; Cammareri, D.; Borgogno Mondino, E. A Scalable Earth Observation Service to Map Land Cover in Geomorphological Complex Areas beyond the Dynamic World: An Application in Aosta Valley (NW Italy). *Appl. Sci.* **2022**, *13*, 390. [CrossRef]
12. Orusa, T.; Cammareri, D.; Borgogno Mondino, E. A Possible Land Cover EAGLE Approach to Overcome Remote Sensing Limitations in the Alps Based on Sentinel-1 and Sentinel-2: The Case of Aosta Valley (NW Italy). *Remote Sens.* **2022**, *15*, 178. [CrossRef]
13. Samuele, D.P.; Filippo, S.; Orusa, T.; Enrico, B.-M. Mapping SAR Geometric Distortions and Their Stability along Time: A New Tool in Google Earth Engine Based on Sentinel-1 Image Time Series. *Int. J. Remote Sens.* **2021**, *42*, 9126–9145. [CrossRef]
14. Sarvia, F.; Petris, S.D.; Orusa, T.; Borgogno-Mondino, E. MAIA S2 Versus Sentinel 2: Spectral Issues and Their Effects in the Precision Farming Context. In Proceedings of the International Conference on Computational Science and Its Applications, Cagliari, Italy, 13–16 September 2021; Springer: Cham, Switzerland, 2021; pp. 63–77.
15. Viani, A.; Orusa, T.; Mandola, M.L.; Robetto, S.; Belvedere, M.; Renna, G.; Scala, S.; Borgogno-Mondino, E.; Orusa, R. R05. 4 Tick's suitability habitat maps and tick-host relationships in wildlife. A One Health approach based on multitemporal remote sensed data, entropy and Meta® population dataset in Aosta Valley, NW Italy. In Proceedings of the GeoVet 2023 International Conference, Teramo, Italy, 19–21 September 2023.
16. Viani, A.; Orusa, T.; Borgogno-Mondino, E.; Orusa, R. A one health google earth engine web-GIS application to evaluate and monitor water quality worldwide. *Euro-Mediterr. J. Environ. Integr.* **2024**, 1–14. [CrossRef]
17. Caimotto, M.C.; Latini, G.; Orusa, T. Parlare è pensare. In *Lessico e Nuvole: Le parole del Cambiamento Climatico*, 2nd ed.; Università degli Studi di Torino: Turin, Italy, 2020; pp. 281–284.

18. Tartaglino, A.; Orusa, T. *Bilancio Energetico/Energy Balance in Lessico e Nuvole: Le Parole del Cambiamento Climatico II ed. Università Degli Studi Torino*; Bilancio Energetico; Università degli Studi di Torino: Turin, Italy, 2020; pp. 61–63.
19. Orusa, T.; Cammareri, D.; Freppaz, D.; Vuillermoz, P.; Borgogno Mondino, E. Sen4MUN: A Prototypal Service for the Distribution of Contributions to the European Municipalities from Copernicus Satellite Imagery. A Case in Aosta Valley (NW Italy). In Proceedings of the Italian Conference on Geomatics and Geospatial Technologies, Virtual Event, 18–20 December 2023; Springer Nature: Cham, Switzerland, 2023; pp. 109–125.
20. Viani, A.; Orusa, T.; Divari, S.; Lovisolo, S.; Zanet, S.; Borgogno-Mondino, E.; Orusa, R.; Bollo, E. Bartonella spp. distribution assessment in red foxes (*Vulpes vulpes*) coupling geospatially-based techniques. In *Atti SISVet*; SISVet: Brescia, Italy, 2023; p. 69.
21. Orusa, T.; Viani, A.; Borgogno-Mondino, E. Earth Observation Data and Geospatial Deep Learning AI to Assign Contributions to European Municipalities Sen4MUN: An Empirical Application in Aosta Valley (NW Italy). *Land* **2024**, *13*, 80. [CrossRef]