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Project full title: **Copernicus Relays for Digitalisation spanning a Network**

Pilot Projects Description Sheets

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Definition of terms:

- **Copernicus Stakeholders:** Most generic reference to the large Copernicus family of individuals and entities involved in the Copernicus programme
- **Copernicus users:** Refers to individuals, industries, research, public entities, etc. actually using and benefiting from Copernicus data, services and added value services
- **Copernicus potential users:** Refers to the said individuals or communities, knowledgeable of Copernicus, that have not yet begun using it for the implementation of their mandate or obligations.
- **Copernicus Entrusted Entities (EEEs):** Dedicated service providers through "Delegation Agreements" by the European Commission for the implementation and operation of Copernicus [core] services".
- **Copernicus Service Providers:** Dedicated service providers, either institutional or industrial, through Framework Contracts with the EEEs, for the development of core services
- **Copernicus downstream service providers:** Dedicated service providers, either institutional or industrial, that implement the core services with specific added value assets.
- **Copernicus Networks:** Refers to the Copernicus Academy and Copernicus Relays
- **Copernicus Ecosystem:** Refers to the overall Copernicus components and architecture: services, providers, users, EEEs, Relays, RUS, Academy, DIAS platforms, National Representatives, National Fora, Copernicus User Forum
- **Copernicus User Forum (CUF):** EU Member States representatives assisting the Commission in relation to the implementation of existing Union legislation, programmes and policies, in the preparation of delegated acts and providing expertise to the Commission when preparing implementing measures, i.e. before the Commission submits these draft measures to a comitology committee
- **Copernicus data:** Refers to raw data provided by geo-positioning GNSS, Sentinel mission, third party contributing missions and in situ data
- **Copernicus information:** Refers to Copernicus data and Copernicus Services, either core or downstream added value.

COPERNICUS ENTRUSTED ENTITIES		DOMAIN
EEA	European Environment Agency	Land
JRC	Joint Research Centre	Land
JRC	Joint Research Centre	Emergency
ECMWF	The European Centre for Medium-Range Weather Forecasts	Atmosphere
Mercator Ocean	Mercator Ocean	Marine
ECMWF	The European Centre for Medium-Range Weather Forecasts	Climate Change
FRONTEX	Agency for the Management of Operational Cooperation at the External Borders of the Member States of the European Union	Security
EMSA	European Maritime Safety Agency	Security
SatCen	European Union Satellite Centre	Security

Content

CoRdiNet Pilot Projects Description Sheets

CoRdiNet supports the creation of pilot projects to create business links between users and suppliers of Copernicus related services. In more commercial and market oriented words, the objective is to find **needs for the use of Copernicus data and added value services amongst tractor end users**.

"Tractor" end users are certainly found amongst Public Administrations, national or international, regional or local, bound by legal frameworks in which Copernicus may be used as a tool for knowledge and decision making. Other tractor end users worth noting are large industries or industrial sectors.

In the course of CoRdiNet Project, WP4 has hosted or participated in 69 Copernicus uptake events, fostering the match between Copernicus tractor end users' and Copernicus added value developers. Moreover, led by Nereus, two public calls for the development of small demonstration projects have gathered 24 proposals, showcasing concrete Copernicus solutions to specific needs.

CoRdiNet team gathers in this document a synthesis of needs claimed by tractor users which can be supported or boosted with specific Copernicus based products developed by down-stream providers. From the scientific and technical point of view, the quality of the products is backed up by validation processes published in peer reviewed papers or the result of competitive projects.

At times, although the need of EO data for institutional reporting is recognised, its use is limited and satellite data has not disrupted the standard procedures used to date in the classical reporting procedures. These Pilot Projects Description Sheets select specific needs, mostly nature and environmental conservation oriented, and one specific available solution (out of many possible) produced by the EO downstream market.

CoRdiNet Pilot Projects Description Sheets strive to facilitate tractor EO users to consider and dare to use these new means of data information and validation in the mandates and competences they are obliged to attain.

CoRdiNet members have been in contact with tractor end users with specific needs for Copernicus data and added value services: Public Administrations, national or international, regional or local, bound by legal frameworks in which Copernicus products may be used as a tool for knowledge, reporting and decision making.

The Pilot Projects Description Sheets select a specific need, mostly nature and environmental conservation oriented, and one specific available solution (out of many possible) produced by the EO downstream market. The quality of the products is recognised by scientific peer reviewed processes (papers, patents, prototypes).

The relationship between the need and the solution **is not yet established**. The Pilot Project Description Sheet is intended as a working document for exploring how the disrupting technologies and solutions offered by Copernicus data could facilitate the reporting obligations of certain public administration levels and other large corporations. The sheets are open windows to the market.

Thus, these samples seek to facilitate Copernicus Users and service providers to answer key questions such as: What reporting legal frame or procedure obliges to produce thematic data that are not available? Is the traditional reporting process compliant with the digitalisation goals? Are classical reporting procedures economically viable? Could Copernicus data or thematic products disrupt and improve institutional reporting? Could Copernicus minimize institutional data gathering costs?

1 Monitoring phenology in National Parks for Nature Conservation in Spain (GMV)

	Pilot Project Description Sheet
Need	OAPN (Organismo Autónomo de Parques Nacionales, Spain) Needs remote sensing to obtain information on nature conservation of the natural Systems protected under the 15 National Parks and other joint sites. Needs ■ Vegetation greenness indicators related to primary gross biomass production ■ Phenology and seasonality records
Topic. Application area	Nature Conservation
Issued by, Institution, Entity, Country	Organismo Autónomo Parques Nacionales (OAPN), Spain National Parks Authority, Spain (Ministry of Environment. Ministerio para la Transición Ecológica y el Reto Demográfico)
Legal frame of the need. Reporting Obligations scenario	Law 30/2014, of National Parks; Royal Decree 389/2016), Plan for National Parks, which includes the REMOTE system, based on MODIS and Landsat. No direct reporting to EU domains. However, National Parks report to the National Nature Data Bank, which does report to EU level
Year	Monitoring, on going
How was the need covered till present	Modis and Landsat data sets
Copernicus product solution	EEA Forest High Resolution layers EEA, Copernicus Natura 2000, protected sites, Coastal areas and Riparian zones These could serve sa excellent support
Solution Provider	Added value Service provider in Spain: GMV.
Data set	Sentinel 1- Sentinel 2
Methodology	The requirements Vegetation greenness indicators related to primary gross biomass production and Phenology and seasonality records are linked to the forest age and to the continuous monitoring of the Canopy The product is obtained by analysing of multitemporal satellite data derived from Landsat (1984-2015) and Sentinel-2 (from 2016 onwards) missions. Due to the length of data record, the product

	cannot distinguish age ranges beyond 30 years and a unique category is assigned, which is labelled "older than 30 years"
Technical specifications	Update Frequency → Annually updated with the forest disturbances product
	Accuracy → 80-90%
	Format → Classification image in raster format (.tif) and metadata (.txt)
	Optional deivery online
	Input data → Sentinel-2. Landsat 5-8.
	Archive Length → Landsat 5-8, since 1984. Sentinel-2, since 2016.
	Spatial resolution → 10m. Landsat output is downscaled from 30 to 10m to match Sentinel-2 resolution.
	Minimum Mapping Unit → 0.1 ha (equivalent to 10 pixels/10m pixel)
Expected impact	On Sustainable forest managers and public officers bound to reporting in the following aspects • Forest Inventory • Forest and Natural Resources Management • Land Use planning and Land use and Land Cover Dynamics Monitoring • Environmental Assessment • Biomass estimation and carbon offset projects • Biodiversity conservation

2 Satellite crop monitoring needs for national control and paying agencies (TeRN)

	Pilot Project Description Sheet
Need	The agricultural subsidies required by the European farmers to the National Control Paying Agency (NCPA) for implementing the Common Agricultural Policy (CAP) represents about 40% of the EU's yearly budget. NCPA has to manage the following issues: ■ Mapping of areas ■ Recognize crops ■ Trace back to previous crops
Topic. Application area	European funds management, Agriculture
Issued by, Institution, Entity, Country	National Control and Paying Agency (NCPA), Europe https://ec.europa.eu/sfc/en/system/files/ged/Paying%20Agencies%20List.pdf
Legal frame of the need. Reporting Obligations scenario	Common Agricultural Policy (CAP)
Year	Monitoring, on going
How was the need covered till present	By orthophoto
Copernicus product solution	Season crop mapping
Solution Provider	Added value Service provider: Various added value companies
Data set	Sentinel 2A/2B; Landsat 7-8
Methodology	C. Filizzola, R. Corrado, A. Falconieri, M. Faruolo, N. Genzano, M. Lisi, G. Mazzeo, R. Paciello, N. Pergola, V. Tramutoli (2018). On the use of temporal vegetation indices in support of eligibility controls for EU aids in agriculture. *International Journal of Remote Sensing, Special Issue "Advances in Remote Sensing applications in Silvo-Pastoral Systems"* Vol.39, pp. 4572-4598. Published online: 09 Nov 2017. (ISSN: 0143-1161).
Technical specifications	Global coverage, up to 3 days revisit time
Expected impact	Support to the local and national public authorities

3   Protecting biodiversity from Invasive Alien Species (GMV)

	Pilot Project Description Sheet
Need	Invasive alien species (IAS) are an economic problem, these species cause more than 12 billion EUR economic loses every year in Europe, hazards to human health and damage to infrastructure and agricultural losses. IAS are also a biodiversity problem, in Europe, there are over 12,000 alien species, 15% of which are invasive. These species are the third most severe threat to European threatened species. Needs: ■ Vegetation indexes and spectral properties of Invasive alien plants species (IAPS) ■ Mapping of IAS extension ■ Damage Assessment
Topic. Application area	Invasive Alien Species (IAS), Biodiversity
Issued by, Institution, Entity, Country	The Ministry for the Ecological Transition and the Demographic Challenge (MITECO), Spain Regional Administrations, Spain
Legal frame of the need. Reporting Obligations scenario	Regulation (EU) 1143/2014 on invasive alien species (the IAS Regulation), Europe EU 2020 Biodiversity Strategy, Europe Commission Implementing Regulation (EU) 2017/1454 of 10 August 2017 specifying the technical formats for reporting by the Member States pursuant to Regulation (EU) No 1143/2014 of the European Parliament and of the Council, Europe. Spain, as Member State, has reporting obligations every six years about the distribution of the invasive alien species, the action plans undertaken and other obligations established in the Article 24(1) of Regulation (EU) No 1143/2014. Law 42/2007, Of December 13, Of Natural Heritage And Biodiversity, Spain.
Year	Monitoring, on going
How was the need covered till present	Orthophotos, Landsat, MODIS, Sentinel 2A/2B,

Copernicus product solution	Product non-existent as such. Some EEA land products can provide side information on native class species
Solution Provider	Added value Service provider: GMV
Data set	Sentinel 2A/2B, Landsat, EnMAP
Methodology	Vegetation indexes sucha as NDVI, EVI and other derived indixes to detect invasive alien species. Possible use of images from the future hypespectral EnMAP satellite to improve the identification of the invasive alien plants species through their particular spectral properties. Evaluation of the damage caused by Bark Beetle In Remote Sensing Journal https://www.mdpi.com/2072-4292/12/21/3634 By A. Fernandez-Carrillo, at al 2020
Technical specifications	Update Frequency → Customizable. Minimum production update 5-days Accuracy → 85-90% Format → Classification image in raster format (.tif) and metadata (.txt) Optional delivery online Input data → Sentinel-2 imagery Archive Length 2016 - Present Spatial resolution → 10 m Minimum Mapping Unit → 0.1 ha (equivalent to 10 pixels/10m pixel) Temporal coverage → Several images are required to perform a monitoring of subsequent pest outbreak and diseases as of reference date. Spatial coverage → Use global coverage input data. Customizable local/regional set up Requires Field Data→ No Validation → To do any comparison with ground datasets, field spatial data need to be available at the time of event.
Expected impact	Support to the regional, national public authorities on plant heath and pests contrpl

4   Monitoring Natural Habitats Status (GMV)

	Pilot Project Description Sheet
Need	Member States must report every six years about the progress made with the implementation of the Habitats Directive, focusing on capturing the status and trends of the habitat types and species of community interest. Needs: ■ Distribution map ■ Status of habitat area
Topic. Application area	Landscape Ecology, Ecosystem Restoration, Environmental Impact Assessment, Wildlife management
Issued by, Institution, Entity, Country	The Ministry for the Ecological Transition and the Demographic Challenge (MITECO), Spain
Legal frame of the need. Reporting Obligations scenario	Law 42/2007, Of December 13, Of Natural Heritage And Biodiversity Council Directive 92/43/EEC of 21 May 1992 on the conservation of natural habitats and of wild fauna and flora, Europe
Year	Annual
How was the need covered till present	Information registered through National/regional forest inventories. Direct monitoring of habitats
Copernicus product solution	EEA Copernicus High Resolution Layers products for Forests, grasslands, small woody features and water and wetness provide good background. Updated every 3 years.
Solution Provider	Added value Service provider: GMV
Data set	Sentinel 2A/2B
Methodology	Measurement of the habitat fragmentation by classifying spatial patterns and vegetation density. This product has been developed for forest applications but it could be adpated to other types of habitats.
Technical specifications	Input data →Sentinel-2 imagery Archive Length →2016 - Present Spatial resolution →10 m Minimum Mapping Unit →0.1 ha (equivalent to 10 pixels/10m pixel)

	Temporal coverage →Several images are required to include seasonal foliage conditions in the same reference year
	Spatial coverage →Use global coverage input data. Customizable local/regional set up
	Requires Field Data →No
	Validation →Whenever available, the habitat fragmentation product can be validated against information from National Forest Inventory or other national datasets.
Expected impact	Supporting administrations on the reporting in the frame of the Habitats Directive. Monitoring and management of the Natura 2000 network. Areas of application • Landscape Ecology • Ecosystem Restoration • Environmental Impact Assessment • Wildlife management

5 Forest Characterisation and Condition (GMV)

	Pilot Project Description Sheet
Need	Forest ecosystems should be protected and enhanced in order to reach a healthier environment and to support the forestry industry. Several EO services could be of great help for the monitoring and management of forest ecosystems. Needs: ■ Forest characterization (extent and evolution of species) ■ Forest condition (health)
Topic. Application area	Forestry, Forest conservation, Environmental Impact Assessment
Issued by, Institution, Entity, Country	Public sector with management and reporting commitments. Ministry for ecologic transition of Spain
Legal frame of the need. Reporting Obligations scenario	Spanish forest law -Ley 43/2003, of 21 November 2003-. BOE-A-2003-21339,
Year	Every second year for the extent and spatial evolution of species. Once a year for the health forest condition
How was the need covered till present	By the National Forest Inventory
Copernicus product solution	EEA Copernicus High Resolution Layers products for Forests, grasslands, small woody features and water and wetness provide good background. Updated every 3 years.
Solution Provider	Added value Service provider
Data set	Sentinel 1, Sentinel 2A/2B, Landsat 5-8
Methodology	There would be provided the following products: forest mask, main forest type, forest age, burnt scars, clear cuts, timber volume, above-ground biomass and CO_2 stock.
Technical specifications	See technical specifications at https://mysustainableforest.com/services/portfolio/ A Forest Mask classifies forest/non forest land coverages (a binary forest land classification). The forest mask product is the basis for other products such as forest type classification or vegetation stress monitoring. These products can be made in High Resolution, Very High Resolution or with LIDAR.

	Main forest types: A supervised image classification which provides a map of the dominant species spatial distribution and identifies the mix of species present within an area. A preliminary desk study of dominant species or forest communities is required
	The Forest Age product is obtained by analysing of multitemporal satellite data derived from Landsat (1984-2015) and Sentinel-2 (from 2016 onwards) missions. Due to the length of data record, the product cannot distinguish age ranges beyond 30 years and a unique category is assigned, which is labelled "older than 30 years".
	Burnt forest areas are mapped out using change detection techniques between two dates (pre-fire/post-fire). The analysis allows estimating burnt severity to support recovery plans.
	Clear cuts detect areas where forest has been cut. It requires a forest mask for a given initial date. Change detection algorithms are used to detect forest changes due to logging practices.
	The Timber Volume, Biomass and CO_2 Stocks service provides estimations of the living volume of trees in a forest and its CO_2 stock. These products are key for the forest biomass industry and carbon accountings.
Expected impact	Support to the public authorities and to the forest industry

6 Ecological status of inland waters (GMV)

	Pilot Project Description Sheet
Need	EU Water Framework Directive (WFD) commits Member States to achieve good qualitative and quantitative status of all water bodies. Needs: ■ Ecological status of inland waters (Chlorophyll-a as indicator of eutrophication)
Topic. Application area	Water management
Issued by, Institution, Entity, Country	Public sector with management and reporting commitments. River basin districts, Spain
Legal frame of the need. Reporting Obligations scenario	Directive 2000/60/EC of the European Parliament and of the Council establishing a framework for the Community action in the field of water policy. Law 62/2003, Of 30 December, Fiscal Measures, Administrative And Social Order.
Year	On-going monitoring. Information needed weekly, linked to specific weather conditions of heat spells.
How was the need covered till present	In-situ data. Measured by river authorities
Copernicus product solution	EEA Copernicus High Resolution Layers product for water and wetness provides good supportive background. Updated every 3 years.
Solution Provider	Added value Service provider: GMV
Data set	Sentinel 2A/2B
Methodology	Chlorophyll-a as indicator of eutrophication of waters to measure water quality status. Ansper, A.; Alikas, K. Retrieval of Chlorophyll a from Sentinel-2 MSI Data for the European Union Water Framework Directive Reporting Purposes. Remote Sens. 2019, 11, 64.
Technical specifications	Input data →Sentinel-2 imagery

	Archive Length →2016 - Present
	Spatial resolution →10 m
	Minimum Mapping Unit →0.1 ha (equivalent to 10 pixels/10m pixel)
	Temporal coverage →once a week. Ideal, once every 5 days, particularly during hot seasons
	Spatial coverage →Use global coverage input data. Customizable local/regional set up
	Requires Field Data →No
	Validation →Whenever available, the Chlorophyll-a as indicator of eutrophication of waters product can be validated against information from the River Basin Authorities.
Expected impact	Support to the public authorities , Regional, National and transboundary in shared river basins

7   Active Volcano Surveillance (TeRN)

	Pilot Project Description Sheet
Need	Thermal Remote Sensing may support volcanic observatories in the surveillance of active volcanoes. Needs ■ Accurate mapping of areas inundated by lava flows ■ Accurate localization of active vents ■ Identification of subtle thermal anomalies (e.g. possible thermal precursors of volcanic eruptions)
Topic. Application area	Natural Hazards
Issued by, Institution, Entity, Country	Volcano observatories especially those in developing countries where often there is a lack of expertise in processing satellite imagery.
Legal frame of the need. Reporting Obligations scenario	The Italian Department of Civil Protection has the function of addressing, promoting and coordinating the National Service of civil protection, Legge n. 152 del 26 luglio 2005: disposizioni urgenti in materia di protezione civile Decreto-legge n. 59 del 15 maggio 2012 convertito dalla legge n. 100 del 12 luglio 2012: disposizioni urgenti per il riordino della protezione civile Legge n. 225 del 24 febbraio 1992: istituzione del Servizio Nazionale della Protezione Civile
Year	Monitoring, on going
How was the need covered till present	Volcanoes monitoring through systems using high temporal resolution satellite data (e.g. Modis; SEVIRI). Thermal monitoring by means of in-situ techniques (e.g. thermal cameras)
Copernicus product solution	None of the proposed. Some meteo-products on ash flows. Support Information from the European Volcano Observatory Space services and national observatories
Solution Provider	Added value Service provider Industry or Laboratory
Data set	Sentinel 2A/2B

Methodology	Marchese, F., Genzano, N., Neri, M., Falconieri, A., Mazzeo, G., & Pergola, N. (2019). A Multi-Channel Algorithm for Mapping Volcanic Thermal Anomalies by Means of Sentinel-2 MSI and Landsat-8 OLI Data. Remote Sensing, 11(23), 2876.
Technical specifications	Global coverage, up to 3 days revisit time
Expected impact	Support to the surveillance of active volcanoes and risk mitigation

8 Control of agricultural subsidies (Bavairia)

	Pilot Project Description Sheet
Need	The satellite data (VHR/HR) provided by EC are used to check on agricultural subsidies/payments and, in the framework of pilot projects, the use of Sentinel data is tested for the new area/plot monitoring procedures
Topic. Application area	The data are used for control procedures, to check on observance of eligibility criteria, obligations and other terms to be- come or rest eligible for state aids, which are checked via remote sensing
Issued by, Institution, Entity, Country	Bayerisches Staatsministerium für Ernährung, Landwirtschaft und Forsten – Zahlstelle Bayern (Bavarian Ministry for Nutrition, Agriculture and Forestry - Payment Agency)
Legal frame of the need. Reporting Obligations scenario	VO (EU) Nr.1306/2013, VO (EU) Nr.1307/ 2013, VO (EU) Nr.809/2014 EU working documents: DSCG/2014/32 Final, Guidance CTS, 22345_VHR_951_VHR_Specs, 22346_HR_71_HR_Specs
Year, period	Annual checks, exact periods depend on procedure to check on
How was the need covered till present	Checks are almost entirely done via remote sensing. Image data are provided via the contingent of EU-VHR (Worldview, GeoEye, KompSat), HR/HHR (SPOT). In addition, own image data are used, like orthophotos via own surveying flights or purchase of VHR image data (LandSat, Sentinel2, RapidEye) by Bavarian Agency for Digitisation, High-Speed Internet and Surveying or procurement via an external contractor.
Copernicus product solution	
Solution Provider	EO added value companies in collaboration with service agencies
Data set	Sentinel 1 and Sentinel 2, PlanetScope
Methodology	Methods used from machine learning (RandomForest) and neural networks methods - exact methodologies to be development during pilot projects
Technical specifications	To be stated by the Regional/national paying agencies.

	The EU Common Agricultural Policy sets minimum parameters, quite tight to achieve with sentinel data due to limited spatial resolution.. Artificial Intellgenceand multitemporal cloud computing techniques under test.
Expected impact	Transformation of entire checking procedure and restructuring of control process.

9 Soil water forecast (ULEIC)

	Pilot Project Description Sheet
Need	▪ Soil Water Forecast ▪ Water Quality Analysis
Topic. Application area	Agriculture: irrigation, harvest optimisation, stabilisation of the food supply chain
Issued by, Institution, Entity, Country	Central Rift Valley Lakes (CRVL), Ethiopia
Legal frame of the need. Reporting Obligations scenario	Need expressed in the context of UK cooperation Need expressed in the context of GMES for Africa
Year	2020
How was the need covered till present	Copernicus Land services, Sentinel-1 and Sentinel-2 data
Copernicus product solution	None at international level
Solution Provider	Added value Service provider
Data set	Sentinel 1 A/B; Sentinel 2A/2B;
Methodology	
Technical specifications	Initial local coverage, product scalable to global coverage, up to 5 days revisit time
Expected impact	Support to the local farmers' community and to the local and national public authorities