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D4.6 Policy briefings

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List of Acronyms

Acronym	Meaning
CDTI	Centro para el Desarrollo Tecnológico Industrial
CSC	Copernicus Space Component
CUF	Copernicus User forum
DIAS	Copernicus Data and Information Access Services.
EARSC	European Association of Remote Sensing Companies
ECMWF	European Centre for Medium-Range Weather Forecasts
EEA	European Environmental Agency
EEEs	Copernicus Entrusted Entities
EGNOS	European Geostationary Navigation Overlay Service
EMSA	European Maritime Safety Agency
EO	Earth Observation
ESA	European Space Agency
EU	European Union
FRONTEX	The European Border and Coast Guard Agency
FWC	Framework Contract
JRC	EU Joint Research Centre
PWC	Price Waterhouse Copper
RUS	Copernicus Research and User Support
SME	Small and Medium-sized Enterprise
TBD	To be determined
WP	Work Package
LULUCF	Land Use, Land Use Change and Forestry
CAP	Common Agricultural Policy
HAPS	High Altitude Pseudo-Satellites
UAS	Unmanned Aerial System
LRA	Local and Regional Authority

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

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Abstract

The D4.6 Policy Briefings present recommendations for Copernicus stakeholders to increase the level of interest, maturity of service offers and satisfy user needs in the Copernicus program's services. Based on Copernicus info events and workshops to foster the creation of pilot projects, first, sector-independent policy recommendations are presented. They comprise three areas: Easy data accessibility and usage, increase awareness and use and support for innovations. To set the context, some of the EU's regulative framework linked to the Copernicus services on land, water and air / climate has been put together and discussed.

This deliverable has been updated by feedback received and policy recommendations extracted from targeted events and interviews with (potential) Copernicus users organised during CoRdiNet's second reporting period from October 2019 to December 2020. There is some overlap with the CoRdiNet Deliverable 7.2 Publication of guidelines combined with policy recommendations as well as with Deliverable D4.7 User Uptake. Please consult the three deliverables for a more complete picture. All three documents are downloadable from the project website under https://CoRdiNet.net.

1 Introduction

This document, which has been updated at the end of CoRdiNet's project runtime in December 2020 corresponds to deliverable D4.6 Policy Briefings. It is based on CoRdiNet's D4.3 Policy Briefings published in October 2019. These policy recommendations are targeted at policy makers in order to make them consider practitioners´ experiences evidenced by pilot initiatives, activity groups of stakeholders and targeted events in the context of CoRdiNet's activities and work on WP4. The recommendations aim at influencing future European, national, regional and local policies for making EO services in Europe stronger and wider accepted and employed, removing actual barriers of usage, markets and knowledge.

The objective of D4.6 has been framed within the general goal of CoRdiNet's Working Package WP4: Offer support in the preparation of pilot projects, to create business links between users and suppliers of Copernicus related innovative services. In fact, the scenario of Copernicus challenges and opportunities needs to be acknowledged within:

- The scenario of the EU Space Policy and its flagship programmes of Copernicus and Galileo & GNSS.
- The Copernicus services evolution
- The Copernicus Data Policy Post-2020.

2 Methodologies for deriving policy recommendations

This section describes the methodologies used to identify and formulate recommendations for a wider use of EO Copernicus data and services in the context of EU policies. Some assumptions for a coherent formulation of the recommendations are made:

- WP4 has planned and implemented a series of activities with stakeholders involved in or close to the implementation of EU policies in national or regional , which facilitate the formulation of recommendations
- Other CoRdiNet Working Packages, like WP 2 on Stakeholder Analysis, WP 3 on Info Events and WP7 on the Copernicus European Regional Strategy Panel, are also close to users and service providers, who are ready to give advice, suggestions and recommendations from different standpoints of EO technologies and varied policy frames
- More focus for recommendations is placed around environmental policies. Not all policies can be tackled in the context of the project. Environmental matters are favoured because some environmental authorities have shown great interest since the beginning of the project and offered open collaboration. In addition, the EU put a lot of directives and regulations around environmental protection, offering big opportunities for Copernicus, which has been called GMES before, with an emphasis on environment
- Key policies for which recommendations are elaborated, include land (land use, land-use change and forestry, agriculture), atmosphere as well as continental & shore waters.

CoRdiNet has carried out consultations and interviews, workshops, hackathons, info events including Copernicus presentations to various communities, gathered requirements, listing stakeholders and their priorities in order to enlarge the Copernicus network. All that knowledge serves as base knowledge to support the recommendations included in this deliverable D4.6, see Figure 1, which traces the backbone components of this deliverable:

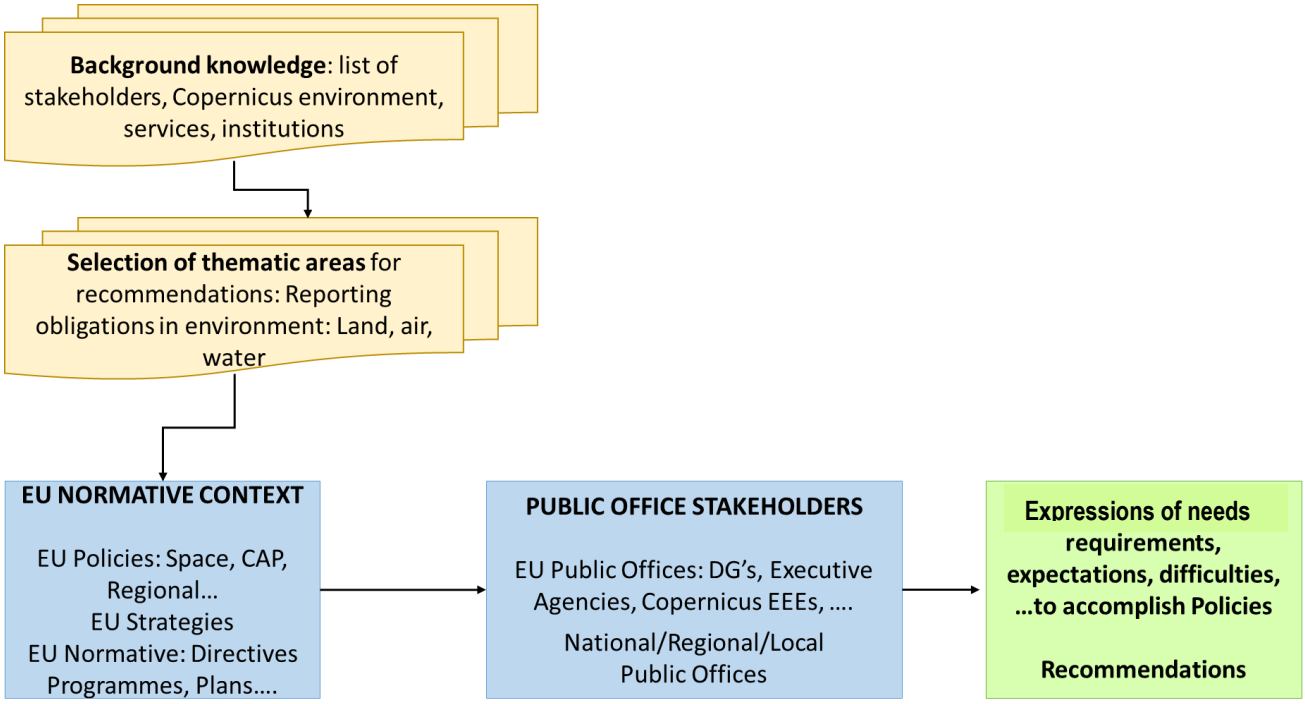

Figure 1: Methodology logic flow

There is a group of stakeholders particularly relevant when it comes to policy matters and that is the personnel in public administrations, including all possible rank categories and administration levels: EU, national, regional and local at town hall level. Public servants and the public administration abide and directs the daily work within the limits of legal frameworks, policies, executive plans, transposition of directives, programmes, etc. In doing so, they often encounter handicaps to keep up with all the novelties and the natural resistance to change and ingest new procedures and technologies.

This is very much the case when referring to the assimilation and adoption of a European programme like Copernicus by public administrators: They are at the forefront of bringing the benefits of such a programme into society, e.g.: technical such as the use of the clean air index in town halls, or legal, as for the obligation of using Copernicus satellite imagery in following the subsidies planned by the Common Agriculture Policy (CAP).

The view of public offices on Copernicus is key to the recommendations made in D4.6. They express concerns, suspects and issues while acknowledging the tremendous potential of Copernicus:

- Public offices follow a set of standard procedures: Question: why change?
- Just few public offices have the technical knowledge surrounding Earth observation via satellites
- Many public offices would need training for specific technical literacy and processes needed for using Earth observation-based services
- Validation of satellite data and products is opaque to many public offices, so trust is limited
- The cost and value for money of the new data sets is not contrasted and clearly shown

- More often than not, there is no explicit reference to the use of Copernicus in most policies, but just mere reference to the convenience of seeking synergies.

3 EU normative context

This section provides some insights into the European directives and reporting obligations. The key question is: What are EU regulatory frames, which already encourage improving monitoring and reporting with the help of EO?

The 2016 Space Strategy for Europe (COM(2016)705, 26 Oct 2016) fosters to maximise the role of space for society and the EU economy and recommends the Commission to promote the uptake of Copernicus data and information, in particular in support of EU policies.

Addressing the needs of the European Union policy should remain the main driver in identifying requirements for the evolution of any programme on Earth Observation, from Copernicus to any other.

The analysis of user requirements carried out in preparation of the future Copernicus generation (NEXTSPACE) shows, from the voice and point of view of end users that the European Parliament and the European Commission are doing a steady work to consolidate the use of remote space observations through the directorates (DGs) as policy units. For instance, DG AGRI, DG REGIO, DG CLIMA, DG DEVCO and DG ENV for monitoring land cover, and the new Common Agricultural Policy (CAP). In relation to the information on climate change, space observations are to provide policy makers with new adaptation measures. Other policy units, although not so involved in remote observations, have manifested an interest in the potential future use of remotely sensed data on air quality, such as DG ENER, DG MOVE, DG REGIO. Lastly, other DGs have a more global outreach, such as DG DEVCO, DG ECHO, DG MARE.

The following sections review the EU policy and legal context for the chosen topics, i.e.: the European Commission's Policy Offices ruling those policies and therefore bounding national officers to compliance and reporting.

3.1 Land use and change

DG ENVIRON: Policies and legal context relative to land:

Agriculture has a direct impact on the environment: Europe's Common Agricultural Policy (CAP) identifies three priority areas for action to protect and enhance the EU's rural heritage; out of the three, the first has the most impact on land use and change:

- Biodiversity and the preservation and development of 'natural' farming, forestry systems and traditional agricultural landscapes.

The CAP ensures that its rules are compatible with environmental requirements and that CAP measures promote the development of agricultural practices preserving the environment and safeguarding the countryside. Farmers are encouraged to continue playing a positive role in the maintenance of the countryside and the environment.

This is achieved by:

- Targeting aid at rural development measures promoting environmentally sustainable farming practices, like agri-environment schemes
- Enhancing compliance with environmental laws by sanctioning the non-respect for these laws by farmers through a reduction in support payments from the CAP.

This calls for monitoring of the status-quo and its temporal developments in the use of land.

- Europe is one of the most intensively used continents on the globe. It has the highest proportion of land - up to 80 % - used for settlement, production systems, in particular agriculture and forestry, and infrastructure. However, conflicting land-use demands often arise, requiring decisions that involve hard trade-offs.
- In addition, the link between economic activity, increased mobility and growth of transport infrastructure usually results in land take. Land is a finite resource: how it is used constitutes one of the principal drivers for environmental change, with significant impacts on ecosystems and quality of life, as well as on the management of green infrastructure.

Source: https://ec.europa.eu/agriculture/envir_en

DG ENV: Policies and legal context relative to land: Activities of EEA

The European Environmental Agency reports to DG ENV. Land-use planning and management are essential in order to better reconcile land use with environmental concerns. Monitoring and mediating the environmental consequences of land use while sustaining the production of essential resources and at the same time protecting the environment is a major priority for policy-makers around the world. Land-use planning and management decisions are usually taken at local or regional level, e.g. as part of urban planning or agricultural and forestry practices. However, the European Commission has a role to play in ensuring that Member States consider environmental concerns in their land-use development plans and practice integrated land management. The 7th Environmental Action program presents the issue of land use and land resource management as an element of natural capital that is crucial to maintaining ecosystems and the services they provide.

- European Union policies on climate change adaptation are directly relevant to current and future land-use practices and the economic sectors that depend on them. Land use is also an important consideration for many other policy areas such as territorial cohesion, transport, the climate and energy framework and the protection of nature and biodiversity.

EEA activities focus on monitoring, documenting and assessing the spatial pattern, extent and dynamics of land use and land cover in Europe. This is based on data from remote sensing and in situ information, facilitated through Geographic Information Systems (GIS) analysis and documented in the framework of land and ecosystem accounting tools. The EEA has also been tasked with the development of a knowledge base, integrated assessments and indicators for land systems by combining land data with urban, rural and soil information, as a contribution to the environmental knowledge community in Europe.

- The main EEA data source is the Copernicus land monitoring service, which includes the Corine Land Cover data set that was produced for 1990, 2000, 2006, 2012 and 2018 and is based on cooperation with EEA member and collaborating countries and the Copernicus programme. It is the basis for the Land take indicator, for example. Additional Copernicus data sets, such as Imperviousness and other high-resolution thematic layers, and the Urban Atlas have been developed to complement Corine Land Cover time series data and are used for further assessments such as land recycling and landscape fragmentation. The EEA is receiving technical support from the European Topic Centre on Urban, Land and Soil Systems (ETC/ULS).

References:

- EU Forest Strategy
- EU Biodiversity Strategy to 2020
- European Commission's Thematic Strategy for Soil protection
- 2030 Agenda for Sustainable Development

Source: https://www.eea.europa.eu/themes/landuse/intro

DG ENV: Policies and legal context relative to coastal zones:

Coastal regions are tremendously important for Europe's economy. Approximately 40% of the EU's population lives within 50 km of the sea. Almost 40% of the EU's GDP is generated in these maritime regions, and a staggering 75% of the volume of the EU's foreign trade is conducted by sea.

The European Commission in 2013 issued a proposal for a new directive. This directive would establish a framework for integrated coastal management and for 'maritime spatial planning' (public policy that deals exclusively with managing maritime space but not land space). Following the debates in the EU institutions, the proposal was modified and adopted as Directive 2014/89/EU of the European Parliament and of the Council of 23 July 2014 establishing a framework for maritime spatial planning. The directive highlighted the need to integrate in a coherent way all of the EU policies that touch on maritime and coastal issues (such as the Habitats Directive, the Water Framework Directive, and the Marine Strategy Framework Directive etc.). It sets up the legal framework providing guidance for how to better manage the competing claims of economic sectors on space and resources in marine areas.

- In close cooperation with Copernicus Marine Environment Monitoring Service (CMEMS), CLMS is now working on a comprehensive coastal zone monitoring solution that is capable of addressing the complex and dynamic situations found in coastal environments. The European Environment Agency (EEA) plays a key role in the development of the Copernicus services, in particular in the technical coordination of the Copernicus Land Monitoring Service (CLMS) and the In Situ Component.

A roadmap addressing the short and the long-term evolution of Copernicus activities for Coastal zones was prepared by CLMS and CMEMS and submitted to DG GROW at the end of 2018 (see Library).

- In 2019 the EEA launched the implementation of a new thematic hotspot product to monitor landscape dynamics in coastal zones. The new products will cover all European coastal territory to an inland depth of 10 km with a total area of approximately 730,000 km². The products will have a minimum mapping unit of 0.5 ha and record around 60 LC/LU classes. Thematic hotspot mapping activities within the CLMS aim, complementary to generic wall-to-wall mapping, to provide specific and detailed land cover / land use (LC/LU) information to address environmental challenges and issues.

The initial production of the Coastal Zone hotspot thematic mapping will consist of:

- a LC/LU status layer for 2012
- a LC/LU change layer between 2012 and 2018
- LC/LU status layer for 2018.

As with the other thematic hotspot products, the Coastal Zones product will provide change/status every 6 years. The release of the Coastal Zones products is expected to begin by the end of 2020

Source: https://land.copernicus.eu/user-corner/technical-library/coastal-zone-monitoring

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References

- With the adoption of the LULUCF regulation in 2018 (Regulation (EU) 2018/841), greenhouse gas emissions and carbon dioxide removals from land use, land use change and forestry (LULUCF) have become part of the 2030 Climate and Energy targets. The LULUCF regulation requires that greenhouse emissions do not exceed removals in all of the land accounting categories in the period 2021 to 2030. This “no net debit” obligation will be assessed for the period 2021-2025 and 2026-2030 and a land-based accounting framework has been established.
- The basis for the reporting on LULUCF emissions and removals are the annually reported greenhouse gas emission inventories that are at present reported by the EU Member States as part of the reporting requirements of the UNFCCC and the EU mechanism for monitoring and reporting of greenhouse gas emissions (Regulation (EU) No 525/2013). Monitoring and reporting on the LULUCF sector is complicated by the fact that emissions and removals are affected both by natural events and anthropogenic activities and it is not always easy to distinguish between the two factors.
- In addition, carbon stock changes have to be calculated for different carbon pools and the uncertainty in these calculations is rather large (32 % in the 2019 EU inventory, with large variations between the different LULUCF reporting categories).
- In order to improve the quality of emissions data, the LULUCF regulation introduced reporting requirements so that significant sources of emissions and removals are calculated using at least Tier 2 methodologies in accordance with the 2006 IPCC guidelines, with the encouragement to use TIER 3 methodologies. With the move to higher tier

methodologies, the LULUCF regulation calls for the use geographically explicit land-use conversion data (Approach 3), and that best use should be made of available Union and MS land use/land cover data including data from the Copernicus land monitoring program and other services/surveys such as LUCAS (Land Use and Coverage Area frame Survey).

Sources: https://land.copernicus.eu/user-corner/events/using-copernicus-land-monitoring-services-clms-to-support-the-land-use-land-use-change-and-forestry-lulucf-regulation and https://land.copernicus.eu/user-corner/land-use-cases

3.2 Water quality

The main overall objective of EU water policy is to ensure access to good quality water in sufficient quantity for all Europeans, and to ensure the good status of all water bodies across Europe. Therefore, policies and actions are set up in order to prevent and to mitigate water scarcity and drought situations, with the priority to move towards a water-efficient and water-saving economy.

DG ENV: Policies and legal context relative to water:

Right now, the EU Water Legislations undergoes a fitness check, a comprehensive policy assessment as per the Better Regulation Guidelines. This also includes the Better Regulation Guidelines-Monitoring. The former enable Earth Observation technologies to gain further access to monitoring tasks.

References

- Water Framework Directive (WFD, 2000/60/EC), its main objective being to protect and enhance freshwater resources with the aim of achieving good status of EU waters, and its 'daughter directives':
- Groundwater Directive (GWD, 2006/118/EC) and
- Environmental Quality Standards Directive (EQSD, 2008/105/EC) and the
- Floods Directive (FD, 2007/60/EC).
- Other linked directives are Evaluation of the Urban Waste Water Treatment Directive (UWWTD, 91/271/EEC), as the measures under the UWWTD are essential for the achievement of the Water Framework Directive objectives.
- The European Commission adopted in February 2018 a proposal for a revised **Drinking Water Directive** (Council Directive 98/83/EC of 3 November 1998 on the quality of water intended for human consumption) to improve the quality of drinking water and provide greater access and information to citizens. The proposal for modernizing the 20-year-old Drinking Water Directive comes as a result of the REFIT evaluation, the implementation of the Commission's response to the European Citizens' Initiative 'Right2Water' and as a contribution to meeting the UN Sustainable Development Goals.

Source: https://ec.europa.eu/environment/water/fitness_check_of_the_eu_water_legislation/index_en.htm

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DG AGRI: Policies and legal context relative to water:

The Common Agricultural Policy supports investments to conserve water, improve irrigation infrastructures and enable farmers to improve irrigation techniques. It also helps to protect water quality. Agriculture affects in different ways the good chemical and good quantitative status of groundwater and surface waters. Water quality may be negatively affected by the presence of pesticide residues, nutrients from fertilizers, or sediments from soil erosion. In terms of quantity, on average, 44 % of total water abstraction in Europe is used for agriculture. Southern European countries use the largest percentages of abstracted water for agriculture. This generally accounts for more than two-thirds of total abstraction. In northern Member States, levels of water use in agriculture are much lower, with irrigation being less important, but still accounting for more than 30 % in some areas. Protecting water quality is a key issue of the Common Agricultural Policy. The central aim is to avoid water pollution through agricultural activity, mainly through a sustainable use of pesticides and fertilizers for avoiding, in particular, nitrate pollution. The main CAP instruments promoting sustainable water management are the following:

- Certain rural development measures support investments for improving the state of irrigation infrastructures or irrigation techniques that require the abstraction of lower volumes of water, as well as actions to improve water quality.
- The cross-compliance framework includes statutory requirements related to water protection and management arising from the implementation of the groundwater directive and nitrates directive, as well as GAEC standards.
- At EU level, the Water Framework Directive, see above, plays a vital role in protecting water quality and quantity. This Directive requires Member States to establish river basin management plans (at the latest by end 2009), and to ensure that water pricing policies provide adequate incentives for users to use water resources efficiently (at the latest by end 2010).
- Payments under Art. 38 of Rural Development Reg. contribute to implementation of Water Framework Directive.

The EU also regulates to protect water quality with respect to nitrates and pesticides. In addition, there is a range of initiatives of EU environmental policy contributing to promote the protection of waters see some additional references right below below:

References

- Thematic Strategy on Soil Protection,
- EU action against climate change
- White Paper on adaptation to climate change and the
- Communication on water scarcity and droughts
- Compulsory Cross-Compliance Regulation: Council Regulation 73/2009 & Commission Regulation 1122/2009.
- EU-Nitrate Directive: Council Directive 91/676/EEC of 12 December 1991
- EU-Pesticide Regulation: Regulation EC No 1107/2009

Source: https://ec.europa.eu/agriculture/envir/water_en

3.3 Air quality / climate change

This review focusses on EU policy aspects relative to air quality, following the legal frames and topics that trace the work of the DG's somehow linked to air quality and remotely sensed AQ properties, namely DG CLIMA, DG ENV and DG ENER.

DG CLIMA: Policies and legal context relative to air quality

Regulation concerning substances depleting the Ozone layer (ODS Regulation), as per the Vienna Convention for the Protection of the Ozone Layer and the Montreal Protocol on Substances that Deplete the Ozone Layer. DG CLIMA has a role in monitoring the effects of current legislation, including fluorinated greenhouse gases (F-gases) and in updating the regulation in order to limit greenhouse effects as per international agreements (e.g: negotiating on behalf of the EU on policy matters related to the Montreal Protocol on substances that deplete the ozone layer). The Commission launched in 2017 an evaluation of the ODS Regulation to examine the actual implementation and performance of the regulation. The evaluation is meant to be completed in 2019.

Concerning F-gases, the baseline regulation adopted in 2006 was replaced in 2014 and entered into force in 2015 (Regulation 517/2014 on fluorinated greenhouse gases and repealing Regulation (EC) No 842/2006 Text with EEA relevance). This regulation bans F-gases in new types of equipment, and tries to prevent emissions of F-gases from old equipment's through regular checks, proper servicing and recovery of the gases at the end of the equipment's life.

Climate change policies and assessment of economic, social and environmental impacts. Results are the 2050 Low Carbon Economy Roadmap (COM(2018) 773 final) and the 2030 climate and energy policy framework. Thematic data interests include: better Greenhouse Gas emissions data, in particularly of non-CO2 Greenhouse Gases, to improve modelling tools used to develop strategic options for the EU's in line with the Paris Agreement.

Legislation on **effort sharing** (i.e. emissions reductions in sectors outside of the scope of the EU Emissions Trading System).To track the progress of climate objectives DG CLIMA leads the monitoring, reporting and verification systems of greenhouse gas emissions in the EU and globally.

Policies that frame the EU actions on **climate change and emissions reduction** are:

- The United Nations Framework Convention on Climate Change (UNFCCC) (1994)
- The Paris agreement (2015), which requires greenhouse gas emission inventories from each signatory country, that can be complemented with in-situ and space-borne greenhouse gas measurements to support an independent and scientific verification of the reported inventories

Global anthropogenic CO2 emissions from Agriculture Forestry and Other Land Use (AFOLU)[1]: 1) **Agriculture** for all non-CO2 gases from agricultural activities such as nitrogen from fertilizer application and manure management or methane from rice fields, and 2) Land Use, Land Use Change and Forestry (**LULUCF**) for all other land categories and gases. 3) **REDD+.** Reducing Emissions from Deforestation, forest Degradation, conservation and sustainable management of forests plus the enhancement of forest carbon stocks[2].

The key policy instrument to be addressed in this chapter is the recent EU LULUCF regulation, including for the first time the LULUCF sector in the EU 2030 climate targets.

References:

- [UN Framework Convention on Climate Change (UNFCCC): *UNFCCC Decision 1/CP.16 (REDD+)]*
- [UN Framework Convention on Climate Change (UNFCCC): Paris Agreement, 2015]
- REGULATION (EC) No 1005/2009 OF THE EUROPEAN PARLIAMENT AND OF THE COUNCIL of 16 September 2009 on substances that deplete the ozone layer
- REGULATION (EU) No 517/2014 OF THE EUROPEAN PARLIAMENT AND OF THE COUNCIL of 16 April 2014 on fluorinated greenhouse gases and repealing Regulation (EC) No 842/2006
- REGULATION (EU) 2018/841 OF THE EUROPEAN PARLIAMENT AND OF THE COUNCIL of 30 May 2018 on the inclusion of greenhouse gas emissions and removals from land use, land use change and forestry in the 2030 climate and energy ... Regulation (EU) No 525/2013 and Decision No 529/2013/EU
- DIRECTIVE 2003/87/EC OF THE EUROPEAN PARLIAMENT AND OF THE COUNCIL (13.10.2003), establishing a scheme for greenhouse gas emission allowance trading within the Community and amending Council Directive 96/61/EC
- DECISION NO 529/2013/EU OF THE EUROPEAN PARLIAMENT AND OF THE COUNCIL OF 21 May 2013 on accounting rules on greenhouse gas emissions and removals resulting from activities relating to land use, land-use change and forestry and on information concerning actions relating to those activities.
- Commission Communication COM(2013) 659 of 20.9.2013 on A new EU Forest Strategy: for forests and the forest-based sector.
- Commission Communication COM(2011) 363 of 20.6.2011 on Rio+20: towards the green economy and better governance.
- 2050 low carbon road map with EU energy, transport and GHG emissions trends to 2050 – Reference scenario 2013 of 18 December 2013 and with COM (2011) 112: A Roadmap for moving to a competitive low carbon economy in 2050 of 8 March 2011
- 2030 Climate and energy framework with Conclusions of European Council 23/24 of 28 October 2014, European Council 26/27 of 27 June 2014, European Council 20/21 of 21 March 2014, COM(2014) 15 - Communication: A policy framework for climate and energy in the period from 2020 to 2030 and SWD(2014) 15 - Impact assessment
- https://ec.europa.eu/clima/policies/ets_en#Main_legislation

[1] IPCC 2006
[2] http://unfccc.int/land_use_and_climate_change/redd/items/7377.php

- https://ec.europa.eu/clima/policies/ets/revision_en
- http://ozone.unep.org/sites/ozone/files/Meeting_Documents/research-mgrs/5orm/index.html

DG ENV: Policies and legal context relative to air quality:

The specific mandate for AQ falls under the EU **Clean Air policy**, which seeks actions in three areas:

- **The ambient air quality directives** (Directives 2008/50/EC and 2004/107/EC, which set common methods and criteria to assess air quality in a comparable and reliable manner in all Member States, and establishes ambient air quality standards for twelve key air pollutants[3] deemed to be most relevant;
- Control on national emissions under **the new National Emissions Ceiling Directive (NECD)** 2016/2284/EU, which sets the total national emissions of the main air pollutants and requires monitoring of the ecosystem impacts of that pollution. The Commission has identified potential new policy initiatives, such as the EU's role in the hemispheric background concentration of ozone;
- **Control on the sources of air pollution**, like transport, industry, shipping, domestic combustion, etc; accordingly emission standards for key pollution sources are established e.g. via legislation on fuel quality, vehicle emissions, industrial emissions, etc.[4]

References

- Directive 2008/50/EC of the European Parliament and of the Council of 21 May 2008 on ambient air quality and cleaner air for Europe
- Directive 2004/107/EC of the European Parliament and of the Council of 15 December 2004 relating to arsenic, cadmium, mercury, nickel and polycyclic aromatic hydrocarbons in ambient air
- Directive (EU) 2016/2284 of the European Parliament and of the Council of 14 December 2016 on the reduction of national emissions of certain atmospheric pollutants, amending Directive 2003/35/EC and repealing Directive 2001/81/EC (Text with EEA relevance)

DG ENERGY: Policies and legal context relative to air quality

DG-ENER develops and implements innovative policies aimed at:

- setting up a market with affordable energy, competitive prices and technologically advanced services
- promoting sustainable energy production, transport and consumption in line with the EU 2020 targets and with a view to the 2050 decarbonisation objective
- enhancing the conditions for safe and secure energy supply in a spirit of solidarity between EU countries

[3] These are sulphur dioxide, nitrogen dioxide and nitrogen oxides, particulate matter (PM10 and PM2.5), ozone, benzene, lead, carbon monoxide, arsenic, cadmium, nickel, and benzo(a)pyrene
[4] The relevant source controls are of the sulphur content of fuels, in particular their use in shipping.

The relation of DG ENER to air quality lies in the need to gather specific AQ information determined by the policy documents:

- To monitor natural gas leakages
- To differentiate biogenic methane and anthropological methane
- To determine the source of trace gases (e.g. ethane, propane for oil/gas related emissions, stable isotopes (13CH4, dD), and 14CH4)
- To detect atmospheric particulate matter (aerosols)
- To measurements of atmospheric CO2 and CH4 (hot spot emissions)
- To assess emission changes against local reduction targets.
- To assess national emissions and changes every 5 years to estimate the global stock take

References

- Common Rules for the Internal Market in Electricity Directive (2009/72/EC)
- Common Rules for the Internal Market in Natural Gas Directive (2009/73/EC)
- Regulation Establishing an Agency for the Cooperation of Energy Regulators (713/2009/EC)
- Regulation on Conditions for Access to the Network for Cross-Border Exchanges in Electricity (714/2009/EC)
- Regulation on Conditions for Access to the Natural Gas Transmission Networks (715/2009/EC)
- European Energy Security Strategy (COM(2014)330)
- Proposal for a regulation on risk-preparedness in the electricity sector and repealing Directive 2005/89/EC (COM(2016) 862)
- The Clean Energy For All Europeans Communication package (COM(2016) 860).

4 Framing the early policy recommendations

This task seeks the preparation of policy briefings with recommendations from the experiences derived from the actions taken as described here in chapter 4 and in the Tasks 4.1 and 4.2 of CoRdiNet's WP4 to promote and encourage end-user uptake at European, national, regional and local levels.

Procedure:

- Analyse the stakeholders and their needs for Copernicus program in specific sectors and application areas
- Elaborate on their needs for Copernicus information for the very specific challenges, relevant subdomains and/or target user communities linked to the CoRdiNet project.

The objective for the formulation of the policy recommendations is the following:

- Increase level of interest in Copernicus services for small and large commercial organizations (companies. Enlarge level of Copernicus products proficiency in clusters and ministries in order to get the higher level of project promotion at the market
- To increase level of interest in wide the areas of applications, especially those linked to European policies for more effective application of Sentinel-family satellites data
- To increase the maturity on Copernicus services adoption.

The policy briefings have the following strategy for action:

- To support program actions, launched in Europe at national and regional level ensuring a broad, coordinated, sustainable coverage for the Copernicus program members.
- To help selected stakeholders to leverage existing tools and resources in order to strengthen the impact of user uptake initiatives:
- To ensure a communication and a feedback loop:
  - Via networking of stakeholders
  - Via workshops for education and training
  - Via working groups to bring together user organizations, e. g. LRAs
  - Via research institutes and service providing companies.

4.1 Formulation of early policy recommendations

In order to ensure the enlargement of interest in Copernicus services at commercial market, three criteria are to be fulfilled:

- Easy data accessibility
- Increase in awareness & use
- Support for innovations.

Thus, the policy briefings and recommendations for stakeholders of the commercial sector are formulated in the following way, taking into account the above-mentioned criteria:

4.1.1 Easy data accessibility and usage

- Copernicus should be made easy to use
- Address the non EO-literate users through dedicated tutorials: still, it is the scientific community, which is mainly using EO data, as it is not so easy to manipulate. The EC should provide basic tutorials to facilitate the usage and processing of EO data by non EO-experts
- Simplify and harmonize the data access infrastructure: Accessing Copernicus data is a significant issue. The multiplicity of access points does not ease the work of non-data specialists, although private intermediate users express that it is positive to have such a large choice. Data access infrastructures should be simplified and harmonized in order to facilitate data access by end users

- Enhance the distribution of Copernicus data sets: Small companies encounter difficulties when downloading Sentinel data sets compared to commercial data. The distribution method, such as downloading specific pictures and not a whole data set, and the delivery channels should be made more user friendly. The creation of an own standard data format could be considered
- Federate newcomers to the Copernicus community: End users report a lack of understanding between their specific job issues and the EO experts. The EC could offer workshops between the Copernicus community and potential end users. An exchange platform could be established, where end users post their needs and value-adding statement stakeholders offer their expertise
- The images provided by Copernicus should all be georeferenced as well as always error margins given
- DIAS: Difficult to download and process data, not sufficiently developed, yet.

4.1.2 Increase awareness and use

- There is a lack of awareness from the side of the local authorities: There should be more info events and awareness raising on the unique selling propositions and the use cases of Copernicus. The EO applications could have a huge impact at local scale. It could be relevant to classify the Copernicus data by territory and to gather feedback from such potential local users. The EC could also present best practice and examples to tackle local situations
- Facilitate to introduce Copernicus in public administrations, tell how to use it, what products it can deliver and what the limits in resolution and errors are. Budget is needed for subcontracting such services, but basic expertise has to be in the administrations for e.g. managing procurement procedures. Support to build multidisciplinary group over various ministries who are experts in handling Copernicus data. Bring them together with industry representatives and with researchers from university, e.g. in workshops, to show what is currently technically possible
- A common base for Copernicus is missing and its incorporation in public offices' workflows, procedures and methodologies. For this training is needed on use and interpretation of data
- Important is the fusion of data, since not all information needed at public offices can be found in Copernicus data; they should be seen as suitable supplementary technology, not as a substitute, e.g. needed to increase resolution. This could be done in combination with e.g. UAS or HAPS.
- Copernicus is useful for building timelines (5-day recurrence time), detecting change and trends. Therefore, data should be more used in combination with forecast models and for continuously improving forecasts. Synergies between industry and public offices has to be increased and consolidated in order to be closer to service providers needed. Open own lab or group within some public offices, e.g. at EEA, which helps public offices how to extract certain indicators from Copernicus satellite data. Access or subcontracting to companies is not sufficient
- Copernicus is not mentioned very often in European policy papers like directives or regulations, only in LULUCF and CAP, it is explicitly mentioned, this could be improved

- Appeal potential end users: Most end users are not aware of the EO data potential. A marketing campaign underlining the savings induced by Copernicus applications based on concrete case studies would be relevant.
- Propose capacity-building solutions: End users are not EO experts and they are asking for capacity building initiatives. The EC could propose basic EO training based on massive open online courses or FAQs with user-friendly interfaces where questions could be asked
- Use Copernicus to gain data on remote areas of your region, when territory is difficult to access.
- Copernicus should be more used for monitoring purposes over as many as possible public administrative processes, especially in order to homogenise and harmonise data and measurements over regions, nations and all over the European Union.

4.1.3 Support for innovations

- Prompt innovation through hackathons and demonstrators: Today, the app to revolutionize the market has not been found, yet. Hackathons and demonstrators still have to be organized to lead to viable applications
- Balance the open data communication: The open data policy is key and enables to build disruptive products in viable business models, but it can also threaten some commercial services. In the current digital trend, end users are now expecting applications and services free. The wording of the institutional communication should take care on not creating confusion between open data and free enabled services
- Clarify and ease the administrative burden on H2020 calls: SMEs are losing time on the administrative part of the H2020 calls at the cost of the technical side. SMEs are confused by the large topics proposed. The EC should design calls that are more precise
- Convince investors of Copernicus-based products: Some SMEs in the EO market are only viable due to subsidies and public funds. Campaigns should be conducted to encourage business angels to jump in
- Coordinate innovative initiatives among European stakeholders: Cooperation between European stakeholders on innovative initiatives should be improved to remain competitive and to be able to face global IT firms
- Change the EO paradigm. End users are not interested in the origin of the information; they just consider EO data as part of a larger ensemble. In the current Big Data context, EC should consider the EO market through the information and communications technology prism.

5 Stakeholder contributions

The CoRdiNet partners are organising info events in the framework of WP3 as well as events to initiate pilot actions in the context of WP4. Shortly after period 1, the number of events organised for the various thematic areas around land, water/maritime and air/climate were too small to give sector-specific, targeted policy recommendations, which would have been verified and discussed in relevant stakeholder groups. Therefore, the CoRdiNet consortium improved and updated Deliverable 4.3 after the end of period 2, when more and more sector-specific events in national and local regional agencies within the CoRdiNet regions were successfully organised, properly reworked, and evaluated. The results can now be found in this chapter 5.

5.1 Policy briefs extracted from interviews and events organised in the frame of CoRdiNet's WP3, WP4 & WP7

From Feb. 2020 on the situation in Europe has been dominated by the COVID-19 pandemic and its consequences on social interactions, especially its effect on physical meetings and gatherings like workshops, working groups, exhibitions or conferences. Especially the former, formed an essential part of the activities, WP4 liked to implement in the second period of the CoRdiNet project. It took about half a year until the end of the summer break 2020, until most of the institutions, companies, service providers and also the policy level in Europe adapted to the situation: Trying and succeeding to transform above-mentioned physical types of social interactions into virtual meeting forms, e.g., some kind of video conference with our without break-out rooms. All of this had to be squeezed into the short time left remaining from September to December 2020.

All CoRdiNet beneficiaries and their local collaboration partners had to go through this learning process. The following sub-chapters list some of the online events and interactions, which were organised in the frame of the WP4's pilot actions, but also in the context of WP3, regional / sub-national info events, targeted at public authorities in order to acquire knowledge on EO data user uptake and its barriers in the regions in Europe. Goal was always to extract policy recommendations from the plans of using and the ongoing actual usage of EO data and services by public authorities. CoRdiNet's WP7 set-up an on special interest group focusing, among others, on policy recommendations. For completeness, this is also mentioned here, but should be traced back to the original publications mentioned in 5.1.1 below.

5.1.1 Contribution to the Policy Briefs from the side of special interest groups, here CERSP (WP7)

Policy recommendations from a special interest group established within the CoRdiNet project itself, the Copernicus European Regional Strategy Panel (CERSP), have already been published. They were part of the CERSP activities within the CoRdiNet Deliverable D7.2, but were partly made public in the form of a joint booklet of the two H2020 Copernicus Relay and Academy projects CopHub.AC and CoRdiNet. The booklet has been published at the occasion of the Joint Final Event of the two networks on Thu, 5 Nov. 2020, hosted by the University of Salzburg as CopHub.AC coordinator. It is available here on the project website of CoRdiNet; the policy recommendations included in Deliverable D7.2 can be downloaded within the CERSP section of the CoRdiNet site at this link.

CERSP comprises eighteen European EO experts with an emphasis on the regional/sub-national expertise within the European Union, although some of the members, who are observers, are linked to European institutions like ESA, DG GROW/DEFIS or business associations like EARSC, Brussels. This subgroup is supposed to be closer to the Copernicus end-user and therefore ought to know the more practical ways about both, around barriers to user uptake as well as about success stories.

Since bavAIRia led Work Package WP7, many of the experiences and insights gained during the regular Bavarian Copernicus Strategy Panel meetings (about 3-4 times a year, starting in 2006 and continuing within the CoRdiNet project runtime until the latest online meeting in October 2020) were incorporated in the policy recommendations mentioned here.

5.1.2 Interactions and events with governmental institutions and LRAs

Since the Copernicus main target users are public administrations, many of the events planned to be implemented in 2020 within WP4 relied on a close cooperation with governments and local & regional authorities. Due to the COVID-19 pandemic, some events could not be implemented as planned, some could be transformed into virtual events or in some cases new ways of communication could be found. In the beginning, events were just cancelled, some LRAs refused to do any events, neither online nor physical or other institutions just decided to postpone any meetings. Once the agreement on a virtual event was settled, the software to be used was restricted or sometimes even the initiation of the communication software within the public authority not allowed. All this took-up time and work efforts to find out, like agreeing on authorized systems, who provides what or how to have more participants of the same institution included in one virtual event. Often, it turned out that a one-to-one interview with a specific (potential) user proved to be faster and more efficient than organising an event.

5.1.2.1 Bavaria

Bavaria is one of the few regions in Europe, which established an own GMES Office (now Copernicus Office Bavaria) already back in 2006. Led by contractor bavAIRia e.V. and with the mandate and financial support of the Bavarian Ministry for Economic Affairs this involves coordination of the EO community of researchers, service providers and public administrations. Some of the ministries and LRAs in Bavaria are therefore dealing with EO data and the information extracted from them already for some time. Often, this is an internal process within the local authority or institution, many times it means participating in pilot projects; external contractors often contribute to such joint pilot action, but not very often on a regular basis as part of the regular public duties. Before the launch of the Copernicus Programme and its Sentinels, Landsat and MODIS satellite data were used (and are still used in order to supplement and compare with the new data sources). Still, most of the time, data needed for reports on environmental monitoring or protection are not gained from EO satellites, but come from ground-based information resources or from aerial surveys, be it for water levels, snow levels, water quality, air quality or ground coverage. Nevertheless, more and more the attitude seems to win, one should combine both types of data, satellite data and data acquired on the ground (or from image flights).

Currently, satellite data are better “advertised” as additional data sources for better services; this takes away the fear popping-up in some LRAs that the use of satellite services threatens to make jobs related to ground-based data acquisition redundant.

In period 2 of CoRdiNet, contractor bavAIRia engaged in close interaction with the major local and regional authorities in Bavaria active in the field: Here is the list of the Bavarian public administrations and governmental institutions contacted, which in some form or the other plan or already deal with satellite data, mostly in joint pilot projects:

- Bayerisches Landesamt für Landwirtschaft (LfL - Bavarian State Office for Agriculture)
- Bayerisches Staatsministerium für Ernährung, Landwirtschaft und Forsten (StMELF - Bavarian State Ministry for Food, Agriculture and Forests)
- Bayerisches Staatsministerium der Finanzen und für Heimat (StMFH - Bavarian Ministry for Finance and Homeland)

- Bayerisches Landesamt für Digitalisierung, Breitband und Vermessung (LDBV - Bavarian Agency for Digitisation, High-Speed Internet and Surveying)
- Bayerische Landesanstalt für Wald und Forstwirtschaft (LwF - Bavarian State Institute for Forestry)
- Landesamt für Umwelt (LfU - Bavarian Environment Agency)
- Bayerisches Staatsministerium für Umwelt und Verbraucherschutz (StMUV - Bavarian Ministry of the Environment and Consumer Protection).
- Bayerische Umweltforschungstation Schneefernerhaus (UFS-Bavarian Environmental Research Station)

Many of the above-mentioned institutions take part in the regular Bavarian Copernicus Strategy Panel, meeting about three times a year.

Types of interactions and joint activities like e.g. events, presentations, video conferences:

- StMELF, LwF: Means of interaction: Phone calls, interviews, email exchanges, pilot description sheet:
  Mediation of contacts, especially in agriculture, provision of pilot action sheet on Copernicus data use by local payment agencies; mediation of contacts to LwF: Example of use of satellite data: Fast estimates on forest damages to set-up first aid support programmes for forest owners after heavy storm damages (Satellite data with about 2,5 m optical resolution from Planet Labs). Also the 2005 outsourced forest administration agency, Bayerisches Staatsforsten, uses GNSS and EO data (see e.g., www.euromap.de) for its monitoring and tasks, also together with external service providers and in joint projects with LwF (“Forest inventory”)
- LfL: Means of interaction: Phone calls & interview:
  Smart farming unit, contact to agricultural machinery providers and software platforms (e.g. Fendt and BayWa), who push smart farming using both, GNSS as well as Earth Observation technologies to support services for farmers, evaluation activities of products and services provided for farmers in Bavaria. Projects on green fodder forecasts (GeoSat, SatGrünSchnitt, MasterGras) with external contractors, also including new Sentinel 1 data, as part of digitisation strategy of Bavarian Government, here StMELF, Bayern Digital II.
- StMFH & LDBV: Means of interaction: Visit and meetings, agreement on a one-day joint info event in 2020, replaced by info TelCo event on 26 Nov. 2020 (Nine participants):
  Meeting and visits with unit head for geodata at StMFH and president of LDBV, agreement on joint event on disaster management in Bavaria, especially related to natural dangers and catastrophes in the Alps, like e.g., snow avalanches, flooding, and landslides. The planned physical event had to be postponed several times and was then fixed to mid-May 2020, when it was finally decided to be cancelled due to the COVID-19 pandemic - despite already started preparations. As a replacement, it was agreed to have the coordination of CoRdiNet participate in the “Koordinationsgremium Geodateninfrastruktur Bayern” (KG GDI BY, Coordination Committee on GeoData Infrastructure Bavaria), which usually meets physically several times a year. This offered a chance to give an update on the Copernicus programme and present specific applications within a half hour presentation and a follow-up discussion round in this inter-ministerial group uniting various Bavarian ministries and application sectors under the subject of geo data. Regular contacts and mutual updates were agreed upon.

- StMUV, LfU, UFS: Means of interaction: Phone calls, interviews, invitation of UFS to presentation in Copernicus Strategy Panel (Application for pilot project on drone-based sensors, combines with EO data and ground truth), joint online event with LfU on 9 Dec. 2020 with nine participants joining:
  Mediation of contacts to LfU, the ministry hired an EO expert from the local German Remote Sensing Data Centre DFD) run by DLR. LfU appointed a coordinator for EO related activities in Bavaria, an agency dealing with a variety of environmental aspects like water, soil and air monitoring and protection. Again a joint physical event, had been agreed on, but could not be implemented due to the COVID-19 pandemic, after several postponements the event was replaced by an online event serving as a pilot for future co-operations: Agreement has been found on two remote sensing applications: Flooding and nature preservation. For this purpose, the members of the Copernicus Arbeitskreis (Copernicus AK-Bavarian Copernicus Strategy Group coordinated bavAIRia e.V.) were contacted in order to search for companies able to offer readymade software and/or cloud-based solutions related to the two subjects above. Out of the four candidates offering suitable products and solutions, one has been selected by the LfU to present during a one-hour online event. This format allowed for deeper questions than a format of three or four companies presenting in one event. The participants from various units of the LfU extensively used the possibility of discussions and Q&As. A feedback session will be organised beginning of 2021 in order to discuss, if and how to proceed together. The chosen format allows both sides, the agency as well as companies, to get to known and to learn from each other. In addition, the agency is able to advertise these online sessions as training courses on remote sensing for its employees, while the format gives an opportunity to gather information for future procurement procedures.

For completeness: Mid-2020, TU Munich's new faculty on Aerospace and Geodesy won one of the three future lab projects of the German Federal Ministry of Education and Research (BMBF, Berlin) called "AI4EO" (Artificial Intelligence for Earth Observation) with an up to 5 Mio. € financial support. Several LRAs will probably join one way or the other during the project runtime via pilot actions.

Recommendations Bavaria

- Do a study on the applications and needs of public administrations in the context of EO, how can EO support the work of public administrations, be it monitoring, be it reporting obligations
- Bring the EO stakeholders in your region together on a regular basis to exchange and to inform about funding opportunities for pilot projects
- Support to involve LRAs in joint pilot projects, best financed by local programmes and resources, e.g., for support of digitisation, bring both sides in, users and providers, best mediated by a local Copernicus Relays
- Try to bring users and suppliers for specific challenges at the LRA in direct contact, e.g. via a series of (online) events, best focussing only on one specific service needed. A series guarantees balanced presentations and awareness for different service providers. LRA appreciate being updated on state-of the art services related to their field. Best, allow for presentations of ready products (those coming with a price tag attached) – LRAs do not want project presentations at research level - unless explicitly asked for
- Currently, the application fields most easily related to remote sensing in Bavaria are either environmental subjects (monitoring and protection) or the EU's Common Agricultural Policy, CAP: Regular reporting obligations on a

European level related to e.g. water or air quality, or audits of payment agencies pose incentives or obligations to deal with and use Earth Observation/Copernicus data. Green fodder and forestry monitoring along with monitoring of old mining sites are important applications in Bavaria. In the future, snow coverage as well as forecasts related to water level management might become relevant to EO applications.

- For air quality measurements in large cities (there, the pollution induced by dense traffic often exceeds EU-imposed limiting values of e.g. NO_2) current spatial resolution of EO satellites and do not allow for continuous monitoring; only background effects can be properly taken into account. Some pilot projects on this subject were done with the municipality of Augsburg (obsAIRve and its follow-up EU-project obsAIRveYourBusiness - FP6 project)
- A LRA should have a contact person within the LRA dealing with and coordinating efforts related to the use and uptake of EO data, best linked to the IT department
- Find out about regular online meetings, you could get involved in in order to address potential target groups within your LRAs
- Is there already an agreed schedule of regular online meetings, best related to public tasks, where the use of Earth Observation data could presented or sustainably attached to, best going beyond one application sector or one LRA, eventually targeting inter-ministerial subjects of interest? One of these joint application themes could be related to geo-data infrastructure issues in general and/or INSPIRE, which is relevant at a European level and needs coordination of activities, anyway.
- Another target area is the provision and regular update of official maps: This is related to the European Copernicus LULUCF services: National institutions responsible for the implementation of Copernicus services and its partners (e.g., German Federal Ministry of Transport and Infrastructure - BMVI, Berlin; Federal Ministry of Interior, BMI, Berlin) and their linked agencies and working groups, e.g., German BKG - Bundesamt für Kartographie and Geodäsie (BMI), Arbeitsgemeinschaft der Vermessungsverwaltungen - AdV), related to surveying and maps. They link to regional working groups like e.g., the above-mentioned KG GeoDatenInfrastruktur Bayern.

5.1.2.2 CoRdiNet events and policy recommendations extracted:

In the context of CoRdiNet's WP4 more than 55 user uptake events were organised, about one third directly organised by CoRdiNet partners and the rest organised by other institutions; still CoRdiNet partners having had a major role, usually as speaker or sometimes as co-organiser. Details on the events can be found in CoRdiNet's Deliverable D 4.7. The short event profiles and the derived policy recommendations from that document are taken over and copied from there in a shortened and more concise form into this deliverable D4.6. Reason is mostly for completeness and in order to have the important policy recommendations here together in this Policy Briefings.

The majority of the events organised illustrates the relevance of the public sector and public administrations as propellers of Copernicus, at all levels and for all applications. Copernicus boosts the competitiveness and innovation capacity of European industry, in addition to promoting scientific and technical progress. An essential aspect for the public administration is that Copernicus will support the Member States not only in the monitoring of the environment and climate change but also in achieving compliance with the environmental, climate and agricultural legislation through the conversion of satellite data into data and indicators with which to monitor our reporting obligations and required by the EU.

Here we list, without completeness, some relevant events and workshops organised in the Period 2 of CoRdiNet, where policy recommendations were planned to be extracted. The list below is a summary of some essential parts taken from CoRdiNet's Deliverable D4.7, in order to unite most of the policy recommendations from CoRdiNet here in this report:

- **Multi-Country Workshop on "Space Applications for Central America & the Caribbean (EC TAIEX-Partnership Instrument, Panama City, 26-27/11/2019) highlights the tractor role of international institutions**:

Recommendations:

- Leveraging internationalisation instruments and economic diplomacy initiatives will help to facilitate access to international markets for European EO companies to translate Copernicus cooperation agreements with third countries into concrete business opportunities.

- **Workshop with the Spanish Ministry for Ecologic Transition (Madrid, 26/06/2019)**
  It highlighted the steering role of the EC towards Member States in the use of Copernicus for environmental reporting.

Recommendation emanating from this event:

- Training of public employees in EO using Copernicus: A big obstacle is the limited knowledge of the Programme across the public administrations, how Copernicus data, products and services can be best adapted to reporting needs.

- **Atlantic from Space workshop 2019 (ESA, 23-25 January 2019, National Oceanography Centre, Southampton, UK).** It assessed opportunities for EO research and development, downstream activities and ICT evolution, with a specific focus on the Atlantic region.

Recommendation:

- Common applications across the Atlantic economic region include seabed mining, renewable ocean energy from waves and tides and marine aquaculture, navigation enhancing the safety of ships, multi-use platforms as joint location of offshore industries, conservation of ecosystems, etc.

- **Webinar "Generating Maps for Forest Management Based on Remote Sensing Data" (CoRdiNet Associate Partner Föra Forest Technologies. How Copernicus can help State Public Administrations in the forest sector, Barcelona, 17/09/2020):**
  Participants: Spanish National Geographical Institute (representative to the Copernicus User Forum). Data managed at national level also serve the needs at regional level and are further complemented with Sentinel data. The tractor role of National Institutions in Copernicus was evidenced in this event:

Recommendations:

- Extend free and open access across all European countries
- Increase the spatio-temporal resolution of those data
- Tackle the challenge of processing and deriving all the thematic data embedded in the petabytes of remote data registered daily

- Support standardisation by National Authorities, so that partial data from various regions can be downloaded in a standard manner
- Pay attention that multiple in-situ measurements via traditional ground-based methodologies could be a handicap for new technologies to break through as technical teams react very cautiously towards the quality standards of the new technologies, while fearing that the high quality in-situ data may be set aside because of the high cost.

- **Webinar "Remote Sensing and Open Data for Sustainable Forest Management: How Copernicus can help" (CoRdiNet Associated Partner Föra Forest Technologies. How Copernicus can help Regional Public Administrations in the forest sector, Barcelona, 29/06/2020**:

  Participants and speakers: Regional governments of Castilla and León, Catalonia, La Rioja and Aragón, and the association CESEFOR of the provincial government of Soria, the University of Valladolid and the Federation of Forest Association in Castilla and León. It was remarkable to verify how regional-local Administrations get involved into the very concrete day-in day-out actions for immediate economic exploitation. Discussions were about the degree of digitalisation reached in each of the four regional administrations, adaptation to digital technologies and data is happening fast, even though the public institutions tend to react quite reluctantly towards changes. A positive side effect of the terrible COVID-19 pandemic has been the push towards digitalisation of the forest sector. The tractor role of regional institutions in Copernicus was evidenced:

Recommendations derived from this event:

- Digitalisation has to happen on both ends: on the side of the public administration and on the side of forest managers and stakeholders. The degree of digitalisation for regional planning in themes such as diagnosis, changes in forest-non forest areas or densification of mases is good and coherent; however, digitalisation drops down when working at site level, which is essential for decision-making and for prioritising the silvic-cultural actions for maintenance or restoration
- There is a need to build-up common processes in the public administration, i.e.: the digitalisation process has to stop being the personal challenge of few technology gifted individuals who work locally, de-centralised, storing important amounts of thematic information. Working in a different way has become a "must: Individual knowledge has to shift into public institutional knowledge. Technicians and departments must share the information and data and organise it in a standard structure, must work in common which will prove cost efficient and quality efficient.
- There is a need to change public working structures into enterprise working groups, even within the public sector.
- There is a need to permeate the new remote sensing and information technologies across the various public institutions.

- **"Two-day-consultation to experts", online event on 16-17 Nov. 2020 organised by GMV.**

  Participants: About 50 experts from research industry, NGOs, ESA and EU institutions on the use of EO data: Objective was to review the status of innovative technologies and their technology-readiness to operate jointly and disruptively with EO missions: Focus was on artificial intelligence, geostatistics and cloud computing. Goal was to extract policy recommendations, which are in this case more technology oriented:

  Here **some criticism on the current disruptive usage of Copernicus** for reporting and result-based payments originating from the consultation event:

  Currently, the use of satellite data for the applications on focus is:

- Slow: It needs monitoring or gathering of field data, which often lack standardisation across the national/regional institutions, and counts with limited resources.
- Costly: Because of the field campaigns for national and subnational surveys, which are very costly and repeat measurements, which not always are well controlled.
- Uncertainties: Classical approaches for measuring and validating oversimplify the reality, spread data processing errors, lack of common definitions for the same items (e.g. elements of National Forest Inventories in different countries. There is no universal method to estimate uncertainties
- Local: Specific methodologies defined or implemented for local projects, not always scale-up to regional, national and pan-European scales
- Untacked changes: Change detection requires longer periods of observation, greater finance and a well-defined methodology to validate changes.

Recommendations on **disruptive actions to speed-up uptake of EO data** across public administrations:

- Educate on the timeframes needed to complete full reporting cycles
- Understand key moments in traditional reporting cycles, in which Copernicus data could complement, ease or lower costs
- Understand (for specific applications), if there could be intermediate reporting cycles totally based on satellite data, validated
- Promote free & open access to data and methods through existing research networks amongst public administration technicians
- Adopt international standards for improving transparency
- Share local data via centralised/standardised systems to create more accurate estimates
- Foster public & private partnerships as well as cross-sectoral coordination
- Adopt international AI and cloud computing guidelines
- Use enhanced uncertainty modelling and error propagation estimation.

Recommendations for implementing **remote sensing** data and services in order to improve reporting obligations and validation with ground data measurements

- Seek agreements with existing ground/in-situ data networks (e.g. ForestPlots.net, SEOSAW) to make some of their data publicly available, particularly from sites, where repeat measurements have been conducted in the period from 2005 to 2010, and from 2015 on, in order to ensure overlap with key space borne missions, now accessible through the Copernicus Archive
- Support re-measuring locations and objectives, where in-situ data are out of date (e.g. in-land water bodies, or forest biomass)
- Extend the portfolio of EO applications beyond Sentinel missions through data included in the Copernicus catalogue from other space agencies (e.g. DLR, JAXA). Agreements have been reached with the EC and are now handled by ESA DWH. Another example of such an agreement is the collaboration between Kongsberg Satellite Services (KSAT), Planet and Airbus with Norway's Ministry of Climate and Environment to provide universal access to high-resolution imagery to monitor the tropics in order to curb deforestation. The contract awarded was ~37 M €, which is comparable to the sum estimate to for the Global Forest Biomass Reference System).

- Explore opportunities and support plans for future missions like GEDI and BIOMASS, and plan their continuity. Invest effort in developing algorithms suitable for these 'explorer' missions in view of the operational mission's data.

Artificial intelligence is a mature approach usable at different stages of eco-variable estimations. The algorithms for dynamic estimation (timelines), data filtering/processing/curation, classification and gaining insight in data, variable and system behaviour needs tuning to specific applications. Thus different machine learning approaches would help to reduce the burden of information dimensionality and facilitate handling e.g. cloud computing processing. There exist various AI applications included in several platforms bringing different communities and tools together, e.g.

- Google Earth Engine (Processing and analysis of satellite imagery & other EO data),
- EO-learn (Python package linking AI ecosystem to the remote sensing/earth observation community),
- Radiant MLHub (ready to use and open-source EO training datasets),
- Open Data Cube (open-source geospatial data management tool),
- ENVI in the Cloud (functionality of the industry-leading remote sensing software packages)

Recommendations for the inclusion of **Artificial Intelligence methods** into Copernicus remote sensing products development cover three spheres: policies and ethics, data quality and quantity and the training of algorithms.

- The use of guidelines in AI ethics should be incorporated in early stages of the development of any AI tool to be trustworthy before stakeholders.
- Stakeholders should be incorporated in the stages of development and deployment of AI tools for understanding limitations/constraints if the system.
- For AI components to reach out to stakeholders, data sharing, training, and experts interaction should be fostered.
- Local and regional regulations should be considered at the moment of developing and deploying any AI component.
- In addition to the requirements established by EO and geostatistics, data gathering should match the requirements settled for the AI systems depending on its application and expected performance (i.e. image processing, regressions, time series analyses, etc.).
- Promote and incorporate hot topics in current AI trends to foster the development of existing methodologies but with better performance (e.g. auto, self-evolving/automatic configuring AI component).
- Consider realistic time-frames requirements for developing tools depending on the reach/scale/performance of the expected tool.

Geostatistical methods are a mature technology mostly known in the nature conservation domain, offering a multitude of methods and algorithms for integrating data of multiple variables in spatial prediction/mapping, including:

- Spatial regression models accounting for spatial correlations, differences in data resolution, measurement error, non-Gaussian distributions, and heteroskedastic errors
- Regression models combined with spatial interpolation, e.g. Kriging
- Spatiotemporal geostatistical models accounting for the temporal dimension of the data
- Computational procedures for handling large data sets
- Bayesian extensions of above.

Recommendations for the inclusion of **geostatistical methods** and algorithms into Copernicus remote sensing product development are:

- Facilitate access to and sharing of representative reference data (including relevant metadata); this is of central importance for model development, testing and validation purposes
- Employ geostatistical methods to link ground-based and remotely-sensed data, accounting for: (a) spatial correlation, (b) differences in spatial resolutions (and possible misalignments) between ground and remotely-

sensed data, (c) errors in reference and other data, (d) non-Gaussian distributions, (e) heteroskedasticity in regression errors, (f) spatial heterogeneity in attribute values when scaling to large regions due to different biomes
- Select state-of-the-art, best public-domain, geostatistical software that should be enhanced in terms of computational efficiency, parallelized for speed, and ported on the system to address large-scale applications.
- Employ geostatistical simulation algorithms to propagate spatial uncertainty stemming from various sources to the final estimates reported
- Quantifying the (possibly monetary) impact of over-estimating versus underestimating the amount of items reported (e.g. LULC changes, forest area, etc.); this will set the stage for enhanced decisions employing formal decision-making-under-uncertainty concepts beyond the current uncertainty buffer approach, and will enable assessing the value of information attached to different data sources
- Develop a set of prototype case studies involving geostatistical models (or AI for that matter) to display the benefit of investing time and effort towards the inclusion of geostatistics in the EO processing systems.

Cloud computing is a mature technology based on the concept of dynamic provisioning, which is applied not only to services but also to compute capability, storage, networking, and information technology infrastructure. Resources are made available through the Internet and offered on a pay-per-use basis from cloud computing vendors. It allows enterprises to host data and run all of their applications in the cloud.

It can be broken up into three models:

- Infrastructure-as-a-Service (IaaS) can be rented: physical or virtual servers, storage and networking
- Platform-as-a-Service (PaaS) includes also tools & software that developers need to build applications on top
- Software-as-a-Service (SaaS) is the delivery of applications-as-a-service, which is the most sought service underlying hardware and operating systems are irrelevant, often bought per-seat or per-user.

Recommendations for the use of **cloud computing** into Copernicus remote sensing products development are:

- Cloud computing options provide the ideal infrastructure for public administrations to handle, homogenise and report the parameters they are bound to by mandate
- With already existing earth observation based cloud platforms, centralised cloud platforms (PaaS) can host relevant satellite data with the condition that such data will be open-access.
- Transfer and store standardised ground-based data to the cloud where such data can be shared provided it is permitted by policy and agreement regulations. Here provision should be created such that the ground-based data could be updated on a regular basis
- Create a SaaS on top of PaaS to provide users with web-based applications.

- **European Big Data Value Forum, Berlín, Virtual, 04/11/2020, Parallel session on "The case for Europe's leadership in AI for Earth Observation".**

  GMV presented the experience on the use of Copernicus data and added-value products for the international financial institutions and NGOs challenging efficient EO and AI operations

  Challenges in relation to satellite data access and other terrain thematic data sets: Access to satellite global data sets and EO products is reasonably easy nowadays; the trouble arises having to develop the analysis and the thematic products at the operational scale required by those institutions. International institutions have international/worldwide mandates, yet, they operate locally. Consequently, the requirements and the global data sets or EO products are often no fit for purpose.

Recommendations:

- Starting from international competences, start procuring national-regional implementations
- Replicate solutions at national/regional scale to ensure fast adaptation. Use AI trained models (issue of spatio-temporal scale)
- Boost innovative technologies in order to operate ready-to-use solutions on broad scale.

This concludes the assortment of recommendations derived from events organized during Period 2 of CoRdiNet.

5.2 Summary of recommendations and criticism derived from above events of CoRdiNet

For completeness and reference purposes, here a copy of the above listed recommendations and criticisms of Chapter 5:

Criticism:

Currently, the use of satellite data for (reporting and monitoring applications) on focus is:

- Slow: It needs monitoring or gathering of field data, which often lack standardisation across the national/regional institutions, and counts with limited resources.
- Costly: Because of the field campaigns for national and subnational surveys, which are very costly and repeat measurements, which not always are well controlled.
- Uncertainties: Classical approaches for measuring and validating oversimplify the reality, spread data processing errors, lack of common definitions for the same items (e.g. elements of National Forest Inventories in different countries. There is no universal method to estimate uncertainties
- Local: Specific methodologies defined or implemented for local projects, not always scale-up to regional, national and pan-European scales
- Untacked changes: Change detection requires longer periods of observation, greater finance and a well-defined methodology to validate changes.

Regional context:

- Do a study on the applications and needs of public administrations in the context of EO, how can EO support the work of public administrations, be it monitoring, be it reporting obligations
- Bring the EO stakeholders in your region together on a regular basis to exchange and to inform about funding opportunities for pilot projects
- Support to involve LRAs in joint pilot projects, best financed by local programmes and resources, e.g., for support of digitisation, bring both sides in, users and providers, best mediated by a local Copernicus Relays
- Try to bring users and suppliers for specific challenges at the LRA in direct contact, e.g. via a series of (online) events, best focussing only on one specific service needed. A series guarantees balanced presentations and awareness for different service providers. LRA appreciate being updated on state-of the art services related to their field. Best, allow for presentations of ready products (those coming with a price tag attached) – LRAs do not want project presentations at research level - unless explicitly asked for
- Currently, the application fields most easily related to remote sensing in Bavaria are either environmental subjects (monitoring and protection) or the EU's Common Agricultural Policy, CAP: Regular reporting obligations on a European level related to e.g. water or air quality, or audits of payment agencies pose incentives or obligations to deal with and use Earth Observation/Copernicus data. Green fodder and forestry monitoring along with monitoring of old mining sites are important applications in Bavaria. In the future, snow coverage as well as forecasts related to water level management might become relevant to EO applications.

- For air quality measurements in large cities (there, the pollution induced by dense traffic often exceeds EU-imposed limiting values of e.g. NO2) current spatial resolution of EO satellites do not allow for continuous monitoring, only background effects can be properly taken into account. Some pilot projects on this subject were done with the municipality of Augsburg (obsAIRve and its follow-up EU-project obsAIRveYourBusiness - FP6 project)
- A LRA should have a contact person within the LRA dealing with and coordinating efforts related to the use and uptake of EO data, best linked to the IT department
- Find out about regular online meetings, you could get involved in in order to address potential target groups within your LRAs
- Is there already an agreed schedule of regular online meetings, best related to public tasks, where the use of Earth Observation data could presented or sustainably attached to, best going beyond one application sector or one LRA, eventually targeting inter-ministerial subjects of interest? One of these joint application themes could be related to geo-data infrastructure issues in general and/or INSPIRE, which is relevant at a European level and needs coordination of activities, anyway.
- Another target area is the provision and regular update of official maps: This is related to the European Copernicus LULUCF services: National institutions responsible for the implementation of Copernicus services and its partners (e.g. German Federal Ministry of Transport and Infrastructure - BMVI, Berlin; Federal Ministry of Interior, BMI, Berlin) and their linked agencies and working groups (e.g. German BKG - Bundesamt für Kartographie and Geodäsie (BMI), Arbeitsgemeinschaft der Vermessungsverwaltungen-AdV), related to surveying and maps. They then link to regional working groups like e.g. the above mentioned KG GeoDatenInfrastruktur Bayern.
- Digitalisation has to happen on both ends: on the side of the public administration and on the side of forest managers and stakeholders. The degree of digitalisation for regional planning in themes such as diagnosis, changes in forest-non forest areas or densification of mases is good and coherent; however, digitalisation drops down when working at site level, which is essential for decision-making and for prioritising the silvic-cultural actions for maintenance or restoration
- There is a need to build-up common processes in the public administration, i.e.: the digitalisation process has to stop being the personal challenge of few technology gifted individuals who work locally, de-centralised, storing important amounts of thematic information. Working in a different way has become a “must: Individual knowledge has to shift into public institutional knowledge. Technicians and departments must share the information and data and organise it in a standard structure, must work in common which will prove cost efficient and quality efficient.
- There is a need to change public working structures into enterprise working groups, even within the public sector.
- There is a need to permeate the new remote sensing and information technologies across the various public institutions.

International context:

- Leveraging internationalisation instruments and economic diplomacy initiatives will help to facilitate access to international markets for European EO companies to translate Copernicus cooperation agreements with third countries into concrete business opportunities.
- Common applications across the Atlantic economic region include seabed mining, renewable ocean energy from waves and tides and marine aquaculture, navigation enhancing the safety of ships, multi-use platforms as joint location of offshore industries, conservation of ecosystems, etc.
- Starting from international competences, start procuring national-regional implementations
- Replicate solutions at national/regional scale to ensure fast adaptation. Use AI trained models (issue of spatio-temporal scale)
- Boost innovative technologies in order to operate ready-to-use solutions on broad scale.

National context:

- Training of public employees in EO using Copernicus: A big obstacle is the limited knowledge of the Programme across the public administrations, how Copernicus data, products and services can be best adapted to reporting needs.
- Extend free and open access across all European countries
- Increase the spatio-temporal resolution of those data,
- Tackle the challenge of processing and deriving all the thematic data embedded in the petabytes of remote data registered daily.
- Support standardisation by National Authorities, so that partial data from various regions can be downloaded in a standard manner.
- Pay attention that multiple in-situ measurements via traditional ground-based methodologies could be a handicap for new technologies to break through as technical teams react very cautiously towards the quality standards of the new technologies, while fearing that the high quality in-situ data may be set aside because of the high cost.

Recommendations on disruptive actions to speed-up uptake of EO data across public administrations:

- Educate on the timeframes needed to complete full reporting cycles
- Understand key moments in traditional reporting cycles, in which Copernicus data could complement, ease or lower costs
- Understand (for specific applications), if there could be intermediate reporting cycles totally based on satellite data, validated
- Promote free & open access to data and methods through existing research networks amongst public administration technicians
- Adopt international standards for improving transparency
- Share local data via centralised/standardised systems to create more accurate estimates

- Foster public & private partnerships as well as cross-sectoral coordination
- Adopt international AI and cloud computing guidelines
- Use enhanced uncertainty modelling and error propagation estimation.

Implementing remote sensing data and services in order to improve reporting obligations and validation with ground data measurements

- Seek agreements with existing ground/in-situ data networks (e.g. ForestPlots.net, SEOSAW) to make some of their data publicly available, particularly from sites, where repeat measurements have been conducted in the period from 2005 to 2010, and from 2015 on, in order to ensure overlap with key space borne missions, now accessible through the Copernicus Archive
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Technical context: Artificial Intelligence methods:

- The use of guidelines in AI ethics should be incorporated in early stages of the development of any AI tool to be trustworthy before stakeholders.
- Stakeholders should be incorporated in the stages of development and deployment of AI tools for understanding limitations/constraints if the system.
- For AI components to reach out to stakeholders, data sharing, training, and experts interaction should be fostered.
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- Develop a set of prototype case studies involving geostatistical models (or AI for that matter) to display the benefit of investing time and effort towards the inclusion of geostatistics in the EO processing systems.

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