Ref. Ares(2021)6753567 - 03/11/2021

WP1 - Policy, Stakeholder and Service Analysis

D1.2 Public domain and business sector identification

Project Identification	
Project Full Title	Water scenarios for Copernicus Exploitation
Project Acronym	Water-ForCE
Grant Agreement	101004186
Starting date	01.01.2021
Duration	36 months

Document Identification	
Deliverable number	D1.2
Deliverable title	Public domain and business sector identification
Type of deliverable	Report
Dissemination level	Public (PU)
Work package	WP1
Leading partner	dotSPACE

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History of Changes

Date	Version	Comments
12/10/2021	V0	Draft outline of the deliverable report (Linda van Duivenbode, dotSPACE)
28/10/2021	V1	Draft submitted for revision (Andrei Bocin-Dumitriu & Miraslava Kazlouskaya, dotSPACE)
02/11/2021	V2	Draft revised by Water-ForCE project internal reviewers: Tiit Kutser(UT), Alo Laas (EMU), Andrew Tyler & Evangelos Spyrakos (Stirling University), and Carmen Cillero (3edata).

List of Acronyms

AGRI	Directorate-General Agriculture and Rural Development
C3S	Copernicus Climate Change Service
CAP	Common Agricultural Policy
CLMS	Copernicus Land Monitoring Service
(DEFIS	Directorate-General Defence Industry and Space
EARSC	European Association of Remote Sensing Companies
EEA	European Environment Agency
EMSA	European Maritime Safety Agency
ENVI	Directorate-General Environment
EO	Earth Observation
ESA	European Space Agency

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EU	European Union
JRC	Joint Research Centre
MARE	Directorate-General Maritime Affairs and Fisheries
OECD	Organisation for Economic Co-operation and Development
SDG	Sustainable Development Goal
PwC	PricewaterhouseCooper
RTD	Directorate-General Research and Innovation
TEU	Treaty on the European Union
TFEU	Treaty on the Functioning of the European Union
UN	United Nations
Water-ForCE	Water scenarios for Copernicus Exploitation
WP	Work Package

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1. Introduction

1.1 Project & work package introduction

The **Horizon 2020** project **Water-ForCE** (Water scenarios for Copernicus Exploitation) is developing a Roadmap to better integrate the entire water cycle within the **Copernicus services**, thereby addressing current disconnects between remote sensing / in-situ observation, modelling and the user community. The clarity in terms of the needs and expectations of both public and private sectors from the core Copernicus Program and the wider research and business innovation opportunities will be delivered. The Roadmap will then also advise on a strategy to ensure effective uptake of water-related services by end-users and further support the implementation of relevant directives and policies.

The Water-ForCE consortium is led by the University of Tartu (Estonia) and consists of 20 organizations from all over Europe. It will bring together experts on water quality and quantity, in policy, research, engineering, and service sectors. Through close collaborations with these communities, Water-ForCE will among others:

- **Analyse EU and international policies** to identify where the Copernicus services can improve monitoring programs and how the Copernicus data can be more effectively used in developing and delivering the next versions of the directives.

- **Specify the requirements** for future Copernicus missions (e.g. optical configuration of Sentinel-2E and onward, hyperspectral sensors).

- **Optimise future exploitation** for inland water monitoring & research and, consequently, (a) enlarge the service portfolio and (b) improve the performance of current services.

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The project is divided into eight work packages (WP), each of them focusing on a specific problem and/or target of the Copernicus service (see Figure 1). The project started 1 January 2021 with a duration of three years.

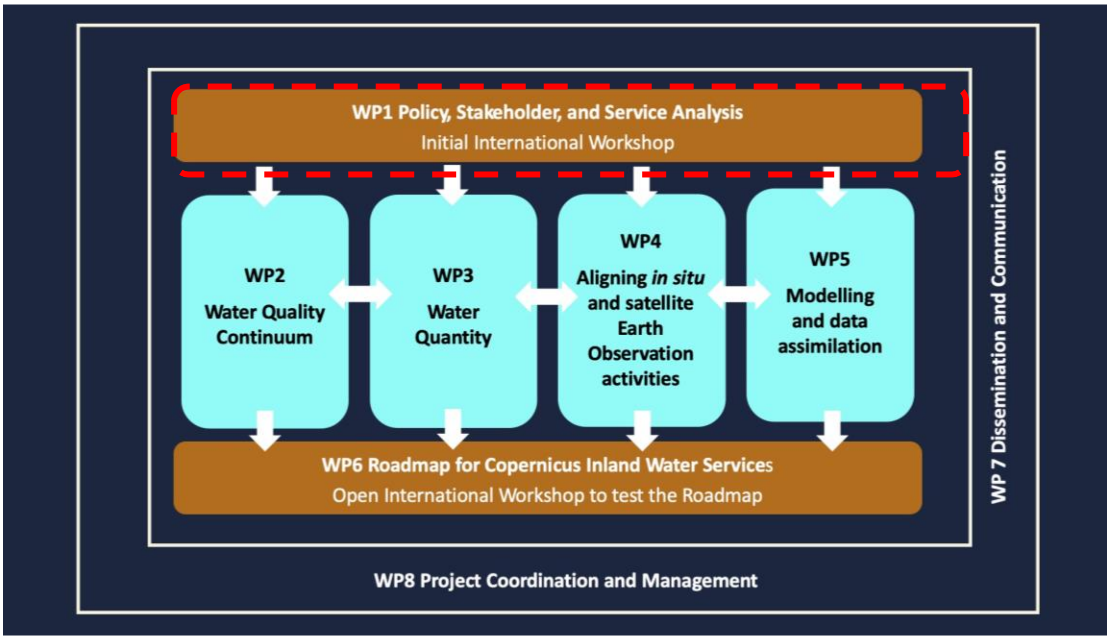

Figure 1 : Organizational structure of the different work packages in the Water-ForCE project.

This report delivers the result of Task 1.2 (T1.2): Public domain and business sector identification (Deliverable 1.2 - **D1.2**).

1.2 WP1 overall aim and expected impact

The overall aim of WP1 is to identify key users within the different public domains and business sectors and evaluate whether operational services can meet policy goals. The expected impact is increased coverage of EU policies clearly identifying which and how the project would like to address them.

1.3 Objectives T1.2

Having mapped the value chain and identified key stakeholders in T1.1 (reported in D1.1 and graphically represented in the figure below), the objective of T1.2 is to identify policies and strategies affecting public domains and business sectors relevant to the inland water cycle.

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The aim is to create a comprehensive overview as the basis for an analysis of overlaps and gaps, as well as bottlenecks and opportunities for future development (feeding into T1.3).

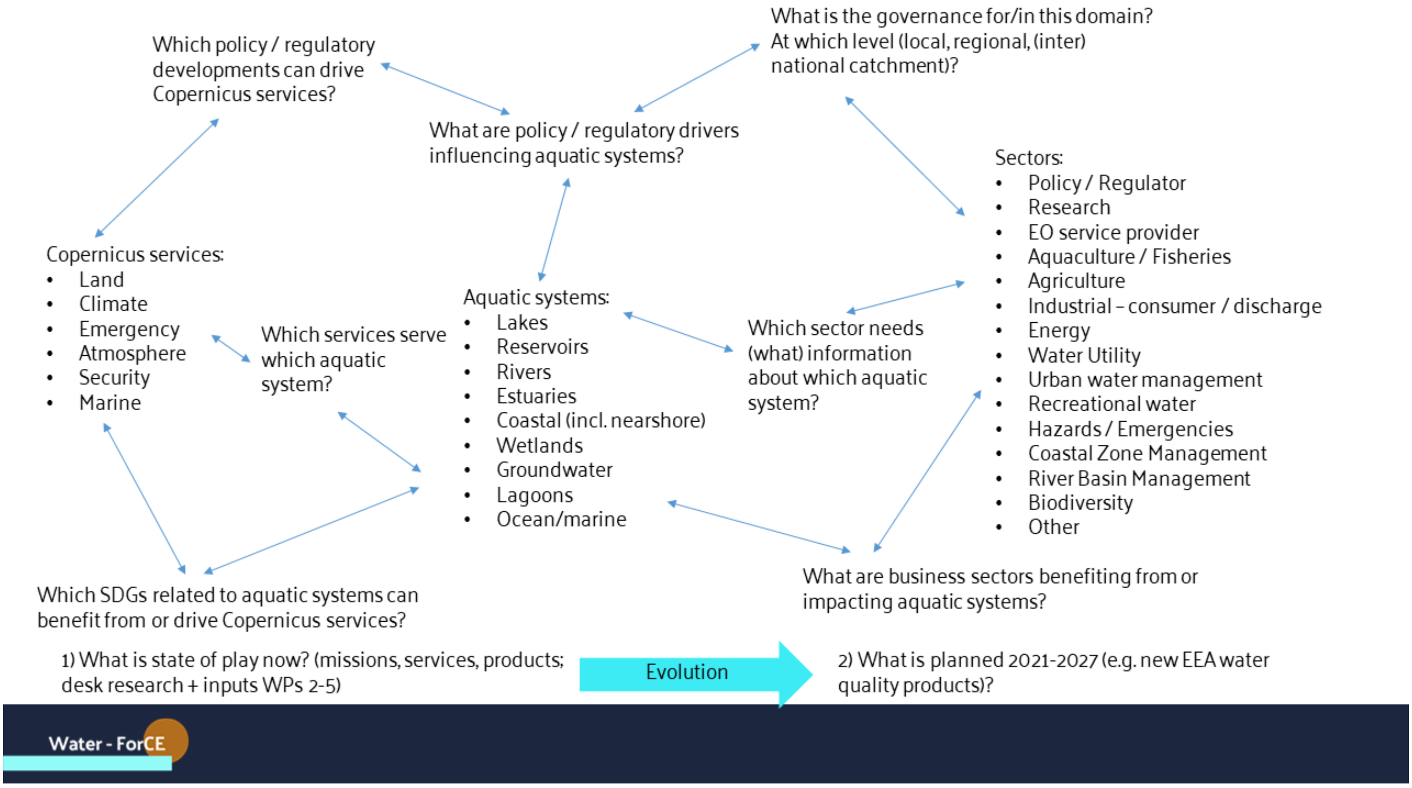

Figure 2: Value chain with relationships and questions to be addressed

In this document, we identify the role of inland waters for public and private services for human health and well-being: source of drinking water and food (irrigation, fisheries, aquaculture), recreation and tourism, creation and support of habitats to support biodiversity and vital ecosystem services as well as their role in the global carbon and various nutrient cycles; how this role has been translated into policies and instruments; and how Copernicus can play a role.

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1.4 Approach

Through desk research, we carried out an extensive review of sources on the policy and regulatory regime and business sectors relevant to the inland water cycle. The steps we took to come to this were to:

1. establish a long list of policies & legislative domains and markets & business domains with a potential link to water management.
2. carry out a quick review of the documents to determine key search words with which to identify which of the policies, legislation, markets, and business domains are of most relevance to Copernicus.

The result of the T1.2 is presented in this deliverable document (D1.2). We will use the results from the keyword search to prioritize the policies and business sectors in terms of relevance for further detailed analysis - as input to T1.3 - T1.6. The activities and findings are described in sections 2 and 3 of this report, with the long list of inventories included in the Annex.

This deliverable also used information and data gathered:

- through the workshop organised on 20 April 2021 (reported on in D1.1)
- a survey conducted through a virtual "booth" on the Water Europe exhibitorweb page
- a second workshop (20-21 October 2021). This hybrid workshop was organised near the premises of the European Environment Agency (EEA) as one of the major users of water data as well as one of two implementing agencies of the Copernicus Land Monitoring Service (CLMS). Participants in the blended workshop were the EU public institutions with responsibility for one of the Copernicus services and/or EU policy domains relevant to inland water such as Joint Research Centre (JRC), European Space Agency (ESA), European Maritime Safety Agency (EMSA), European Commission directorate-general for Defence Industry and Space (DEFIS), Agriculture and Rural Development (AGRI), Maritime Affairs and Fisheries (MARE), Environment (ENVI), Research and Innovation (RTD).

In the next chapters, we present our findings from:

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- the regulatory domain (policies, strategies, legislation) - section 2.
- the market and business domain (users and provider perspective on Earth Observation (EO) applications) - section 3.

This informs the next steps and methodology for the identification and analysis of regulatory and business drivers for Copernicus service for inland water (section 4)

2. Regulatory domain

The quality of the EU's public administration is a key factor in its economic performance and the well-being of its citizens. Government administrations are responsible for the governance of public services, through setting policy objectives and an appropriate regulatory regime. Policy and legislative changes (such as the Green Deal or the European Climate Law) can drive new Copernicus (based) applications or services and vice versa. The data from Copernicus can inform and improve policy and legislative development, implementation, monitoring, and evaluation. At the same time, the regulatory framework can hinder the uptake of Copernicus, for example, because specific mechanisms for spatio-temporal monitoring are mentioned that do not include satellite-based (EO) or those implementing and monitoring simply are not aware of the possibilities. To assess the regulatory domain, we divide this section into:

1. the EU space policy and its legislative framework and programme for Copernicus
2. thematic / sectoral policies and legislation. For this category we look at the institutional and EU governance of the regulatory domain, determining which level is the competent authority.

2.1 EU space policy: Copernicus

The first assessment of the relevant public domain for inland water starts with the EU space policy, legislation and of course specifically the Copernicus programme. In April 2021, the Council and European Parliament adopted a regulation establishing the new EU space programme for the years 2021 to 2027. The programme entered into force retroactively on 1 January 2021 and forms the basis of the evolution of the Copernicus Programme and its six services. A major objective of Water-ForCE is to identify how water management is

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embedded in Copernicus, and for this we will carry out an in-depth review of the six services (T1.3 Links between mission-service-application) with input from the Policy expert workshop organised 20-21 October 2021.

The EU legislative process provides several types of acts differing on their force. As a matter of prioritizing such legislation for the purposes of this report, the EU Regulation 2021/696 establishing the Union Space Programme and the EU Agency for the Space Programme is seen as the major source for policymakers. According to the Regulation, actions under Copernicus shall cover, inter alia, innovative environmental applications in water management and providing information on inland water quantity and quality.

2..2 Policies and legislation: thematic and sectoral

A second driver for the development of water-related products and services can come from thematic/sectoral policies. At the proposal stage we identified the following policies, international treaties and EU policies and legislation relevant for assessment and, analysis of the links between Copernicus and the policy/strategy cycle:

- International: UN Water coordination mechanism and the World Bank Water Partnerships; Global Climate Observing System (GCOS) Essential Climate Variables, the Sustainable Development Goals (SDG) no.6 (Clean Water and Sanitation) and other relevant SDGs of the UN 2030 Agenda for Sustainable Development.
- Water Policies: EU Water Policy - Water Framework Directive (2000/60/EC), Bathing Water Directive (2006/7/EC), Floods Directive (2007/60/EC), Marine Strategy Framework Directive (2008/56/EC)
- Other sectoral policies related to water: agriculture, inland transport, urban planning (wastewater), food security, energy, climate and hydropower. Habitats Directive 92/43/EEC and Birds Directive 2009/147/EC.
- New strategies and policies such as Biodiversity strategy (March 2020) or EU Green Deal, Fit for 55 & Blue Growth.

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As a first step, we look at the different forms of legislation at global and EU level, to determine who is the competent authority (and therefore at what level policy development, implementation and monitoring & evaluation take place.

2.2.1 International / global

International Law Treaties

Treaties are the most binding instrument at international and global level. They come into force once a certain number of countries, depending on the treaty provisions, has signed. Examples relevant to this deliverable are the Ramsar Convention on Wetlands of 1971, the Convention on Biological Diversity of 1992, the Convention on the Protection and Use of Transboundary Watercourses and International Lakes (Water Convention) of 1992 with its Protocol on Water and Health of 1999. Among these treaties, only the oldest one, the Ramsar Convention, does not refer to any monitoring measures. Other instruments in this line tend to oblige States Parties to undertake monitoring or observation measures, including technical programs, for the waters control. Interestingly, the UN Framework Convention on Climate Change (Paris Agreement) of 2015, even though it provides for the observation measures, does not mention water. It can be seen as a gap since many inland water bodies are subject to severe anthropogenic pressures, including climate change. Within the Copernicus framework, water monitoring issues are also included in the Climate Change Service.

UN Resolutions

In 2015, the 2030 Agenda for Sustainable Development was approved, introducing 17 SDGs. Neither the Agenda nor the SDGs are legally binding and cannot be enforced. However, they represent the global target of the international community to overcome environmental and societal challenges, and were negotiated by a consensus of the UN Member States. Thus, governments are expected to fulfill the agenda, collaborating with different sectors, while

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also having freedom in choosing their methods. The most relevant SDG for this project is SDG 6 - Clean Water and Sanitation. Others include SDG 7 (Affordable and Clean Energy), SDG 13 (Climate Action), SDG 17 (Partnerships for the Goals). Elaborated analysis on SDGs for water management will be provided in D1.6.

Next document concerns disaster risk reduction as stipulated in the Sendai Framework on the disaster risk reduction adopted by the UN General Assembly Resolution in 2015, which also addresses water disasters. To achieve the goals of the Resolution, among other measures, it is recommended to maintain and strengthen remote EO.
Another resolution was developed in 2017 by the UN Environment Programme for addressing water pollution to protect and restore water-related ecosystems (Resolution 3/10). It requests to use EO techniques for data collection, analysis and sharing in order to implement water-related SDGs.

World Health Organization Instruments

WHO instruments described below (resolutions, strategies, and guidelines) are not legally binding, however on the national level they can be incorporated into domestic legislation. Development of monitoring systems is recommended but the technology is not specified in the following related instruments: Water, Sanitation and Hygiene strategy 2018-2025; Guidelines for drinking-water quality (2017); Guidelines for safe recreational water environments (2003); Guidelines for the safe use of wastewater, excreta and greywater (2006); Drinking-Water, Sanitation and Health resolution of 2011.

Other International Initiatives

Moreover, clarification and formulation of certain principles and recommendations within integrated water resources management are provided in the Integrated Water Resources Management by Global Water Partnership, 2000. Monitoring requirements are stated there

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as well. Among other international initiatives it is worth starting with the World Bank which influences water policies by developing advisory strategies concerning various aspects of water management. Its Water Resources Sector Strategy of 2003 provides for monitoring and disseminating data but does not explicitly mention the technology. Another document was developed by UNESCO - “International Hydrological Programme (IHP) eighth phase: Water security: responses to local, regional and global challenges (IHP-VIII for 2014-2021)”, which included recommendations related to water governance at the national and transboundary scales, including implementation of monitoring systems.

2.2.2 EU

The European Union is governed by the Treaty on the European Union (TEU) and the Treaty on the Functioning of the European Union (TFEU), forming the basis of EU law. EU procedure distinguishes between Regulations, Directives, Decisions, Recommendations and Opinions, depending on the competence the EU has in the domain and the way the procedure is being shared with the Member States.

Regulations

Specific to this domain, the EU Regulation (EU) 2020/741 on minimum requirements for water reuse sets the goal for monitoring of water quality and risk management in relation to reclaimed water in the context of integrated water management. Notably, the EU regulations have a binding legal force throughout every Member State, thus national authorities should make sure it is applied correctly on the domestic level.

Directives

On the next level, the EU has introduced a number of directives (hard law) on water management and related sectors. Regarding water management, Water Framework Directive 2000/60/EC, first of all, provides for the establishment of programmes for the monitoring in order to establish a coherent and comprehensive overview of the water status

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including ecological and chemical aspects. Accordingly, Marine Strategy Framework Directive 2008/56/EC, Groundwater Directive 2006/118/EC, Urban Waste Water Treatment Directive 91/271/EEC, Nitrates Directive 91/676/EEC, Bathing Water Directive 2006/7/EC, Drinking Water Directive 2020/2184 establish relevant monitoring programmes specific to the regulated subject.

Water management issues are also addressed in other related directives. Thus, Environmental Quality Standards Directive 2008/105/EC refers to the monitoring of water status; Industrial Emission Directive 2010/75/EU urges the Member States to control the emissions of pollutants into the water; Birds Directives 2009/147/EC and Habitats Directive 92/43/EEC prescribe prevention mechanisms for serious damage to water for the aim of species protection.

According to Article 288 of TFEU, Member States must incorporate directives in their domestic legislation. As seen from the above, the described mechanisms do not allude to a specific technology, thus providing a certain level of flexibility when implementing prescribed measures on the national level. Therefore, it could include the use of EO services. Still, the fact that remote sensing technologies are not explicitly mentioned in EU regulations is a barrier to their implementation especially for national commercial activities. Additional investment will be needed to implement a remote sensing approach for monitoring, and therefore explicit requirements would greatly assist. Moreover, many of the indicators that are monitored according to the directives can or are provided as remote sensing based products by Copernicus Services or other service providers. This is also a conclusion that was derived from the discussions with experts from EEA, DGs and other participants during the international conference organised by Water-ForCE project in Copenhagen (20-21 October, 2021). In this manner, the EU legislation has the potential to facilitate the usage of space applications, namely Copernicus, for the question at hand. Copernicus' application for monitoring, as prescribed in regulations and directives, will further assist in preventing environmental and health hazards including water chemical pollution, drinking water leakage, and wildlife conservation in water habitats.

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EC Communications

Alongside the 'hard law' instruments, the European Commission (EC) issues non-binding legal documents. For the purposes of this topic, noteworthy of them are '*communications*', which serve for the comments, *explanations or proposals* for future policy actions. Among the most compelling is A Blueprint to Safeguard Europe's Water Resources of 2012, which accumulates analysis of the EEA State of Water report, the Commission assessment of the Member States River Basin Management Plans and Review of the Policy on Water Scarcity and Droughts, and the Fitness Check of EU Freshwater Policy. Specifically, the 2012 Blueprint policy counts on the reliance on satellite imagery and derived information for identifying areas that are irrigated significantly in excess of what is allowed by national permits. The Water Scarcity and Drought Communication of 2007 provides that full exploitation of space data and monitoring tools is a way forward for the impact analyses with regard to water scarcity, thus alleviating decision making through supporting water policies, land use and irrigation planning.

Agricultural policies are directly related to inland water management. The EC Communication of 2014 on the proposal for the Regulation establishing rules on support for strategic plans under the Common Agricultural Policy (CAP) sets a goal for fostering sustainable development and efficient management of natural resources, including water. Sustainable management of water in agriculture is emerging as a core issue in the context of climate change, and this is something that will be taken into consideration in the new CAP. The different elements of the CAP work on the basis of other EU Regulations (1307/2013, 1306/2013, 1305/2013, 1308/2013, 2020/2022). Among all, regulations include mechanisms that tie direct payments to farmers to conform with different rules relating to the environment and biodiversity preservation and to maintaining agricultural land to good conditions (i.e. protection of water and groundwater against pollution, protection of wetlands and peatlands, etc). Further to above, Member States have to report on the performance of CAP implementation through a set of indicators. The latter include

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monitoring of water quality that aims to assess the impact of agriculture on nitrates and phosphates pollution in groundwater and surface water, as well as monitoring the volume of water which is applied to soils for irrigation purposes.
The 2017 EC Communication "Future of Food and Farming", states that modern technologies and innovative climate-smart farming should be implemented for CAP monitoring to maximise the contribution of agriculture to the EU and global objectives. Currently, the different actors across Europe are encouraged to substitute conventional methods with area-based monitoring approaches relying on Copernicus data and other innovative tools such drones, mobile applications and sensing devices towards ensuring efficient CAP monitoring and evaluation.

Moving forward, the Communication of 2019 on the Strategic Approach to Pharmaceuticals recognizes that monitoring of pharmaceuticals in the environment is very limited, even though particular substances are monitored in surface and ground waters. The Commission acknowledges that this should be changed to improve environmental risk assessments. At the same time, no specific means of monitoring are mentioned.

The Green Deal Policy of 2019 also does not mention tools for monitoring, but promotes digitalisation in this field to prevent and remedy water pollution. In the same manner, the Sustainable and Smart Mobility Strategy of 2020 promotes zero pollution for inland waterways. Furthermore, according to the Biodiversity Strategy for 2030 with its Zero Pollution Action Plan for Air, Water and Soil adopted in May 2021, one of the key commitments by 2030 is to appropriately monitor protected areas. Another Communication of 2021 on the Proposal for a new directive on energy efficiency mentions that effective management of water can make a significant contribution to energy savings, however does not identify necessary instruments.

Finally, the Circular Economy Action Plan of 2020 clearly states that projects under Horizon Europe and Copernicus data will improve circularity metrics at various levels.

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In summary, EC Communications either state the general strategy regarding specific issues or make a proposal for the new directives or regulations. However, only few directives directly mention satellite data application, while others maintain generalities in relation to monitoring activities. Without specific recommendations, it is unlikely that there will be sufficient motivation to adopt Copernicus based approaches systematically across Europe. Since there is always a cost-benefit assessment of new methods and techniques, our Roadmap needs to indicate whether and where Copernicus water products replace existing methods (efficiency, cost saving), accelerate the accumulation of knowledge, complement or add value to existing methods (effectiveness).

It should be noted that in environment and space areas both the EU and Member States are able to pass laws. However, Member States can do so only if the EU has not already proposed a law or has decided not to regulate this issue. Based on such shared competencies and the analysis above, it is advisable to Member States to take action in the areas where there is a gap in monitoring activities - particularly Sustainable and Smart Mobility, Food and Farming, Nitrates, and Flood Risk. Other policies allow for a wide variety of monitoring options, which can also apply use of Copernicus.

3. Market and business domain

The aim of this section is to identify which business sectors have a strong relationship with or dependence on water (quality and/or quantity) as a first step towards assessing gaps, barriers and opportunities for Copernicus services. Starting point for the identification and classification of business sectors and markets is the taxonomy developed by the European Association of Remote Sensing Companies (EARSC taxonomy):

> "EARSC's extensive engagement with EOn user communities has highlighted the need for a common language to help service providers and users arrive at a mutual understanding of the types of services that can be offered and the benefits that can be delivered. We have developed an EO taxonomy that is not only a process of naming and classifying EO services but additionally a tool to improve the understanding between these communities."

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The taxonomy looks at EO services from two perspectives; 1) market (customers and users) and 2) thematic (provider, technical and expert). Two tables showing these two perspectives are provided in the Annex.

The EARSC taxonomy was used by PricewaterhouseCooper (PwC) in its assessment of the market for Copernicus services and cost-benefit analysis. The table below is a combination of EARSC taxonomy of thematic areas with applications and end-user benefits developed by PwC in the Copernicus ex-ante benefits assessment of December 2017, showing those with a relationship with inland water.

Markets	**Applications and benefits for end users**
Atmosphere and climate	**Climate modelling** The Copernicus Climate Change Service (C3S) provides comprehensive climate information on key climate variables, such as surface air temperature, sea-ice changes as well as on a variety of other hydro-climatic variables. C3S also conducts global and regional analysis to provide detailed information on historical changes in the climate.
	Benefits: • Reduced economic loss from climate related extreme weather events • Improved response to new diseases or diseases spreading to new areas as result of climatic conditions • Reduced agricultural loss from drought • Improved sectoral adaptation to climate change

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Land	**Crop monitoring - support to agriculture** The agriculture sector today faces unprecedented challenges and its capability to overcome them will be crucial for our future. Indeed, in Europe farmers are confronted with a double issue: keep producing to ensure food security whilst reducing their impact on the environment and the climate and protecting biodiversity. At a global level, the Food and Agricultural Organization projects that food production will have to increase by 70% by 2050 to feed more than 9 billion people 72 globally (mainly in developing countries). To increase global food production while ensuring a preserved environment, agriculture will need to increase its productivity by using new technologies such as remote data sensors.
	Applications: Contribution to food security (early warning), and to precision farming and its impact on agriculture profitability and sustainability. Support the monitoring of agricultural land use and their compliance to EU Agriculture directives, leading to the advent of a more sustainable farming sector (mainly related to CAP - see below). Helping assess crop conditions and yield forecast, for precision farming and food security applications Benefits: • Improve agriculture profitability and cost efficiency • Ensure food security • Reduce the negative impacts on the environment

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	Water resources management 20% of all surface water in the EU is seriously threatened by pollution and the number of people and areas affected by water scarcity and drought has increased by 20% in the past 30 years. The depletion of current water resources is compounded by a growing urban population expecting better living standards and by the effects of climate change. These social and environmental factors lead to an increasing competition between farmers, industry sectors and citizen access for water. In addition to the farming sector (first water consumer), several other economic sectors rely on water availability like hydropower and the inland waterway transport sector. Therefore, sustainable water resources management is one of the main challenges for the future and requires the development of new technological and scientific tools.

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	Applications: Provision of regular and comprehensive data to monitor water cycle parameters (e.g., soil moisture, meteorological data). Soil moisture data combined with evapotranspiration and rainfall data, are crucial to assess the water requirement of crops and to forecast drought and water stress situations Availability and quality of surface water bodies (e.g., fresh water reservoirs) such as the state of water bodies and river run-off (quality, extent and depth). When combining these data with spatial planning information, it is possible to assess the balance between the supply and the demand of water (irrigation, energy production etc.) in a given area. With Copernicus data, decision-makers have an effective tool to monitor water resources. Benefits: ● Improve profitability in the hydropower sector ● Improve inland waterway transport optimization ● Improve agriculture cost efficiency by saving irrigation costs and reducing water usage ● Save environmental resources (reduction in groundwater depletion

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	Wetland monitoring Wetlands, including mires, bogs and fens, are among the most threatened ecosystems in Europe, having been subject to major losses in recent decades. However, wetlands are some of the planet's most productive ecosystems. They hold an important part of Europe's biodiversity. A significant number of birds and mammals depend on freshwater wetlands for breeding or feeding. Wetlands provide spawning grounds for fish and ideal conditions for other species groups such as insects and amphibians. Moreover, wetlands are particularly important for carbon sequestration. They also provide a wide range of other services such as water provisioning, management and purification and flood defence and offer recreational and tourism opportunities. Relevant legislation: Ramsar Convention (international), Habitats directive, Birds directive, Water Framework Directive (EU) Implementation: Natura 2000 sites; river basin management planning
	Applications: Support the monitoring of the Natura 2000 network and meet requirements of Habitats Directive Article 17. Provides knowledge to support implementation of the directives (status of and trends for habitats and species). Benefits: Provide environmental authorities accurate wetlands mapping, to identify and register wetland areas and their surroundings, assess their status (soil moisture index) and measure their extent. Improve restoration of wetland ecosystems' services

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	Common Agricultural Policy (CAP) monitoring At the time of PwC producing their benefits assessment in 2017, a CAP regulation reform was underway regarding the controlling approach (Integrated Agricultural Control System) for the management and control of payments to farmers made by the member states in application of the CAP. Benefits: ● A more efficient, effective and traceable monitoring system of the CAP ● A better implementation of the greening measures, where Copernicus Land/land Cover capabilities are significantly useful ● A cost reduction overall, as an important part of the high-resolution commercial images can be replaced by free Sentinel data.
Marine & Ocean	**Coastal area monitoring** Coastal area monitoring includes a broad range of interlinked challenges between urban and land areas and offshore maritime areas. Indeed, natural marine and environmental factors such as waves, winds, tides, storms, currents, etc. have an impact on coastal land areas. In addition, human factors such as coastal urbanisation and economic activities are also included in the list of drivers contributing to coastal degradation.

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	Applications: Support coastal area monitoring activities in the different EU sea basins as well as Pacific, Atlantic, Indian, Arctic and Antarctic Oceans where Copernicus data enabled replacement and update of Envisat. Envisat was a one-off science mission and despite being very useful for demonstrating the possibilities of developing different water quality remote sensing products it is obsolete. Sentinel-3 carries onboard the OLCI instrument (continuity of the Envisat MERIS instrument capability) and it has monitoring capability while the continuity of the service is foreseen for decades.. Support Integrated Coastal Zone Management initiative for risk prevention, better informed decision making, coastal environment protection and sustainable planning. Detection of coastal erosion and corrosion, habitat mapping and monitoring and the detection of salt intrusion into underground water sources. Benefits: ● Improve land planning (civil works at coasts, port infrastructure); ● Prevent loss of land; ● Protected coastal population against natural disasters; ● Protection of agriculture (with 41% of water used for irrigation comes from groundwater sources).
	Water quality monitoring (maritime)

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	Applications Water quality monitoring provides information to support public policy and regulatory decisions on health and environmental issues, which can assess and prevent damages to ecosystems and coastal communities and economies. Monitoring of ocean conditions can, for example, detect potential hazards to fish stocks such as harmful algal blooms. Once detected, increased testing of aquaculture stocks can reduce the levels of toxins in food destined for human consumption. Jellyfish blooms can also be monitored through ocean analysis, which can affect tourism in coastal environments, and have implications for healthcare provision. The data provides key inputs into monitoring, modelling and forecasting these hazards, which can be used to develop guidance on bathing in coastal environments, and inform fish farmers' decisions on their fish stocks. Also, aquaculture (e.g. fish, oysters, seaweed) has a direct effect on the water environment where they exist and remote sensing is used for planning where to place them in order to minimise their impact and monitor how much they pollute. Additionally, ocean current analysis is a key input into the monitoring of plastic waste in the oceans, particularly the North Pacific Gyre. Therefore, the use of satellite imagery is key to monitor conditions and support the modelling of key water quality hazards. Benefits: ● Environmental monitoring (e.g., for Water Framework Directive and Marine Strategy Framework Directive) ● Maritime spatial planning (planning marine protected areas, monitoring protected areas, bathymetry and habitat mapping, etc.)

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	• Research, carbon and other matter cycle studies, exchange of matter between land and ocean, impact of spatial planning decisions on coastal water quality, biodiversity, etc. • Reduced plastic waste in oceans • Increase productivity in the fishing industry • Improved public health (e.g., harmful algal bloom warning) • Increased tourism
Disasters and geo-hazards	**Flood monitoring and forecasting** Floods are the most recurring disasters in Europe, and claim the highest number of victims and economic damages on yearly averages than any other disaster. Flood damages do not only consist of destroying property or land, but have long term effects as well as they leave people homeless and injured or lead to fatalities, cause disruptions in daily utilities such as electricity and water connections/networks. Destruction of schools could interrupt access to education for weeks. Access to proper and necessary medical care post floods could be compromised due to destruction of hospitals. On another level, floods could lead to the contamination and chemical poisoning of crops and vegetation, or of the drinkable water and cause more serious long term health problems that would not be detected immediately after the flood.
	Applications European Flood Awareness System (EFAS) EFAS was set up to warn entities of flood risks before they occur, providing the chance to prepare for the flood, evacuate the areas and take necessary mitigation measures. EFAS historical and continuous flood information increases awareness about areas of high risks and vulnerability, and therefore allows authorities to make better informed decisions on socioeconomic growth favourable to flood risk reduction,

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	which on a long run, will reduce the economic damages due to floods. By providing on-demand Rapid Mapping services, Copernicus can deliver support to on ground response within the first hours or days of the flood occurrence be a key component of emergency response and operations strategy. Risk and Recovery Mapping provides geospatial information supporting related entities in preparing for flood risks or in planning recovery. These mappings will lead to more efficient response plans, and mitigation measures. Recent flood events in 2021 (Germany, Belgium, the Netherlands and currently Sicily) show that constant improvement and updating of the system is needed to cope with "extreme" events becoming the new normal. Benefits: ● Avoid fatalities and injuries in the population (Societal benefit) ● Reduced economic losses (Economic benefit)

The above list is not exhaustive and will be tested, updated and elaborated in T1.5, paying attention to the innovation and business opportunities and the division between Copernicus missions and services (T1.3) and the market. Sources to be used for example are the NEREUS Space4Regions publication and Eurisy use cases.

4. Identify regulatory and business drivers for Copernicus service for inland water

4.1. Methodology

The previous sections (2 and 3, and the Annexes) identified a set of documents that define or contain references to policies, legislation and business sectors that focus on inland waters and water management. We propose a hybrid methodology with the scope to determine within the identified list of relevant documents if and where there are indicated

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textually the possible connections (drivers) and needs (gaps, bottleneck or uptake potential) for Copernicus services.

The hybrid methodology is not replacing or offsetting the expert desktop research but it helps to examine large collections of documents, perform multiple processes/searches at the same time, or decrease the amount of time necessary to conduct the research. But, most importantly, it may lead to discovering new information to our specific research questions using an unbiased process because text mining has the capacity to identify facts, relationships and assertions that would otherwise remain buried in the mass of textual big data.

We use the hybrid methodology for finding within the body text of the analysed documents references to direct and indirect measurements of environmental or other parameters related to inland water and indicate where there is (unmet) potential to improve, measure or monitor using new services. These new services need to include either Copernicus core and downstream products or derived products developed by R&D and remote sensing service providers community which have the potential to strengthen or integrate the existing in-situ data.
The methodology we use involves a step-like iterative approach. We apply in the first instance automated techniques for text mining (preprocessing: filtering, tokenization, tagging) in order to transform free (unstructured) text from the selected documents into normalized structured data suitable for analysis. Afterwards we perform the search process using predefined lists of relevant keywords. The expert review is used iteratively for fine tuning the way we perform the keywords search, for running combined terms searches or selecting subsets of documents to run the search or further analysis.

We compile different lists with sets of keywords in order to search for context rather than just obtaining a raw number of search results ("hits") which help us further in our task for identifying the most relevant documents which refers to policies, legislation, markets, and

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business domains where Copernicus services for inland water can be deployed. The results also deliver qualitative and quantitative indicators about the keywords which will help us in prioritising the analysis of the WP (T1.3-T1.6). The methodology aligns with FAIR principles and it allows at various stages of the project to update and refine continuously the keywords and searching workflows for relevant "hits". The methodology uses open source applications and it does not require coding skills to run which makes it accessible to larger communities. The domain experts are allowed to provide their input using predefined templates and they have access to a transparent and accessible system for analysis. The results are delivered in a format that can be used as input or linked with other outputs of the projects such as EO product inventory (Copernicus, ESA, NOAA, JAXA) which are currently under development by other WPs of the project (WP2 to WP6).

4.2 Text mining, documents and keywords

For text and data mining we are using a series of techniques and applications integrated in an open source software Orange (Canvas). This is a component-based data mining software. It includes a range of data visualization, exploration, preprocessing and modeling techniques. It can be used through an easy to use and intuitive user interface or, for more advanced users, as a module for the Python programming language.

A collection of 44 relevant documents (22 international water policy, 13 EU water policy and 9 EU and international space policy) have been put together which represent the base of our preliminary assessment. The collection has been compiled using a list of reviewed policies focusing on inland water (Annex 1, List of relevant policies with links) and the analysis carried out by previous deliverables (D1.1) or the current deliverable (sections 2 and 3 of D1.2).

The documents collection was split into two main categories, in documents focusing on space policies and documents focusing on (water) thematic/sectoral policies. This was done in order to run the keyword searches on two different lexicons, water and space, with terms

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which helped us to find gaps or barriers as well as needs. Therefore, the search was performed:

- for space keywords within documents which concentrate on (inland) water European laws (Directives), regulations (recommendations), and communications, and
- for water related (terminology) keywords within the collection of European or international space documents collection.

This was done also in order to minimise the risk of skewing the findings towards redundant or already known results which might overprint new meaningful information.

In practice, for example, we conducted a search through the documents from the space policy/legal and business perspective for terms like "water", "aquatic", "drought", "flood", and, the documents from thematic/sectoral policies/legislation perspective for terms like "monitoring", "observation", "spatial", "temporal", "resolution" , "ground-based", "in-situ", "latency". Consequently, we clustered the keywords in lists of keywords which also are further bundled in subsets of keywords based on which source was used in order to compile the terminology (e.g., stakeholders' input, service provider community, environmental or other terminologies, remote sensing). The key, as mentioned above, is to determine which keywords can deliver a manageable list of sources with meaningful information for further analysis of the documents for the subsequent tasks of the current WP. By doing so and using the hybrid methodology to cluster and refine the keywords, we are able to deliver results using a transparent, efficient and data science oriented digital process.

As mentioned above, in order to carry out the first batch of searches we put together the following lists of keywords:

(i) Stakeholder Analysis

(ii) Space Community

(iii) EARSC taxonomy

(iv) PwC Copernicus

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The first list is based on the Stakeholders Analysis carried out in the previous task (T1.1 and D1.1), and it contains keywords selected from the stakeholder characterisation of aquatic systems, indicated relevant inland water sectors, mentions about Copernicus core services, in-situ and environmental observations. The second list is compiled based on space experts input, on-line glossaries or from information collected from the international conference Water-ForCE organised in October 2021 in Copenhagen (Copernicus water component evolution – policy expert). The third list is based on the analysis of the EARSC taxonomy representation of "User" Market and "Supplier" Thematic views of the use of EO services (see Annex for EARSC market and thematic taxonomy). As mentioned in the description document of the EARSC thematic taxonomy, keywords are used to define the products which make up a service, or furthermore keywords are also considered within the taxonomy to represent products, parameters or essential variables. The fourth list, the PwC Copernicus list, is created by identifying keywords within the two PwC Copernicus market reports published in 2017 and 2019 and focusing on ex ante societal and economic impact of the Copernicus programme.

In the following paragraphs we present in detail the compiled lists of keywords.

i. Stakeholder analysis list

1. Aquatic systems: "(inland)+[1]water", "aquatic", "lake", "reservoir", "river", "coastal", "wetland", "groundwater", "lagoon", "ocean", "marine"
2. Active sectors: "policy+regulator", "aquaculture+fishery", "industrial+consumer+discharge", "energy", "water+utility", "(urban)+water+management", "recreational+water", "hazard+emergency",

[1] where the symbol "+" is present it indicates that the search should be performed using both words together as a single "keyword" (e.g., "inland" AND "water")

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river+basin+management","coastal+zone+management","biodiversity","research", "(earth+observation/EO)[2]+service+provider"

3. Copernicus services: "Copernicus+service", "Atmosphere", "Marine", "Land", "Climate Change", "Security", "Emergency"

ii. Space community list

1. Remote Sensing terminology: "analyse", "assessment", "Copernicus", "detection", "earth+observation", "evaluation", "extent", "ground+based", "hazard", "in+situ", "indicator", "map", "measure", "monitoring", "parameter", "pollution", "remote+sensing", "resolution", "satellite", 'spatial", "temporal", "time+series", "track"

iii. EARSC taxonomy list

1. EARSC thematic taxonomy: "drought", "turbidity", "run-off", "irrigation", "soil+water+index", "surface+soil+moisture", "map+vegetation+index"
2. EARSC market taxonomy: "water+use", "map+water+depth", "bathymetry", "dredging", "groundwater", "water+plant"

iv. PwC Copernicus list

1. Market oriented terminology: "climate+modelling", "crop+monitoring", "water+resource+management", "water+cycle", "soil", "moisture", "water+stress", "rainfall", "wetland+monitoring", "common+agricultural+policy", "coastal+area+monitoring", "integrated+coastal+zone+management", "land+planning", "water+quality+monitoring", "bloom", "carbon+cycle", "plastic+waste", "flood+monitoring", "flood+forecasting".

[2] where keywords are between parentheses "()" using an additional keyword for setting further the thematic/sectoral context is suggested

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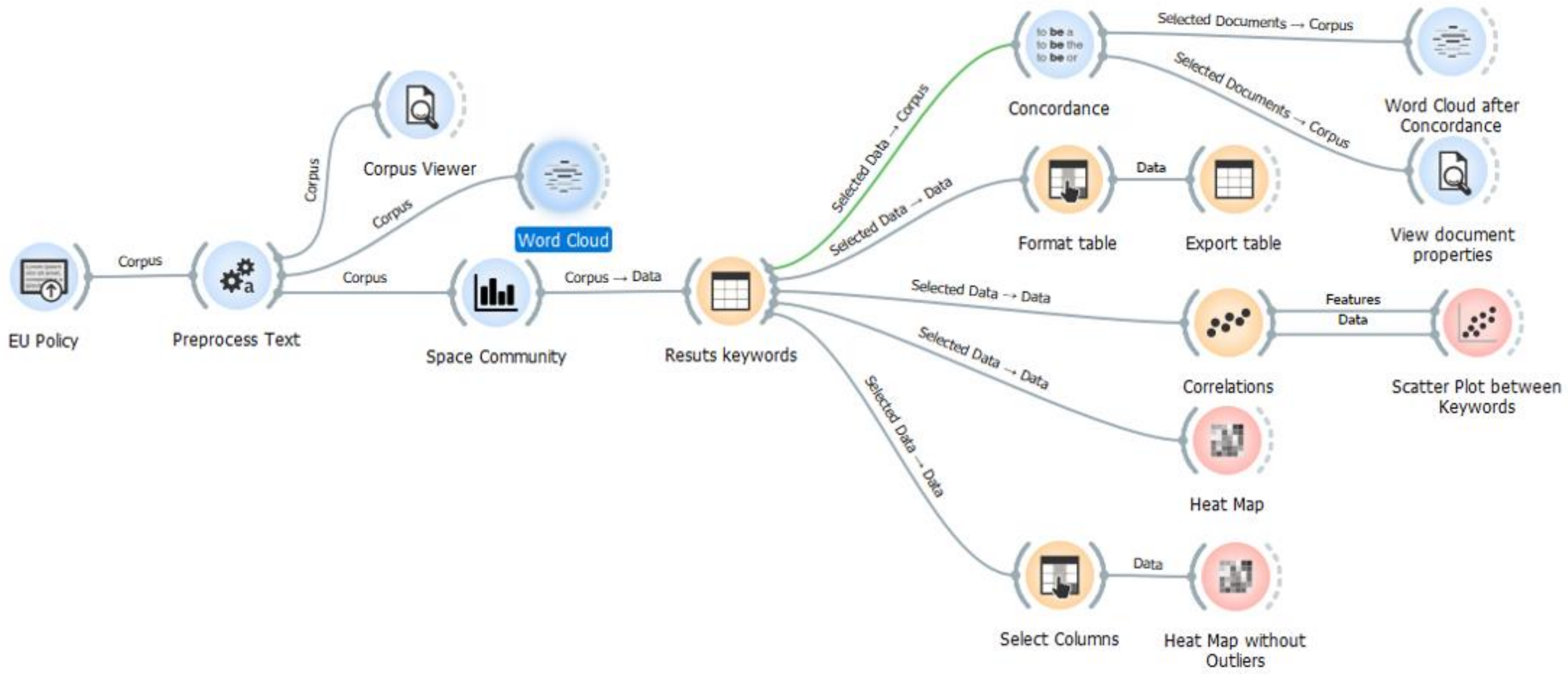
4.3 Description of workflow and preliminary results

For running the search for keywords, we developed the following Orange workflow:



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The workflow has the following steps:

1. Import documents
    - E.g., Import EU Policy documents as *.pdf files.
2. Preprocess text

   We used for preprocess text steps several modules for filtering text elements that are not important for the analysis, such as stop words, punctuation, numerals, etc. The following modules were used in order to perform the second step of the workflow:

    - Transformation where all words are converted into lowercase
    - Tokenization which is a method of breaking the text into smaller components (words, sentences, bigrams). We used "Whitespace" which splits the text by whitespace only. E.g., "European Policy" → ("European"), ("policy")
    - First Filter(ing) which removes a selection of words as specified within input text files or using "regular expression" (Regexp) for filtering out unwanted words and characters. In this case we used two input files for removing all conjunctions (FilterConj.txt) and stop words (stop_words_english.txt) from the text (English) and a Regexp for removing punctuation. The conjunctions and stop words files were compiled using online sources.
    - Part of Speech (POS) tagger which labels words in a sentence as nouns, adjectives, verbs, etc.
    - Second Filter(ing) which is set to remove all numerals from 1 to 2100 and all POS tags mentioned in the list (adverbs, pronouns - Link1, Link2).
3. Run statistics on text focusing on a predefined list of words (i.e., the lists of keywords from above) in order to understand how often these words, occur in the collection of documents we imported in the first step. For example, in the Annex 2 (Fig. 1) we present a snapshot of the Space community list as input for Orange Canvas using a combination of searching techniques:
    - words which contain the keywords from the list, e.g., contains "indicator", or
    - group of words by using regular expressions rules to identify combinations of words from the list, e.g., "earth+observation".

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4. Save search hits results, i.e., how many times the keywords appear in the collection of documents, to data tables for further analysis (see tables 1 to 3).

The following steps represent some preliminary analysis that were run in order to understand better how the keywords were used (context) and quantify their importance within the documents by compiling heat maps or calculate what is the concordance between different keywords. Specifically, the concordance and correlation are very interesting because it shows where in the phrase the keyword was used and how much a keyword correlates with other keywords. More details are presented in the description of steps 5 to 8 below:

5. Concordance displays the context of the word in the phrase. The results are summarised in a list of concordances where the chosen keyword needs to be input before retrieving their occurrence in the documents collection. In Annex 2 (Fig. 2), for example the keyword “indicator” is used and a list of results are summarised in a table where 10 words are quoted from the document text to the left and right of the keyword. In this way the context in which the keyword is being used can be retrieved. After the concordances are retrieved, they can be displayed either in Word Cloud or Document properties (see also Annex 2, Fig. 3 and 4).
6. Format and export table(s) to Excel file(s). Only the columns which are relevant, for example the names of the documents, columns with keywords occurrence for each document, are selected and then exported to a table which can be saved as mentioned before in a regular spreadsheet dataset format (*.csv).
7. Correlations compute all pairwise keywords correlations. Since we quantify (numerical attribute) the occurrences of keywords within a collection of documents we can compute how many positively correlated feature pairs (e.g., “indicator” AND “temporal”) are present in the text. The correlations are listed in a summary table from the largest value at the top to the lowest one to the bottom as seen in Annex 2, Fig. 5. We also made a scatter plot between keywords, in this case between the “indicator” and “temporal” keywords, which in our case had the highest value of correlation (Annex 2, Fig. 6). The scatter plot shows the numerical value of the correlation but also within which documents the correlation has the highest value.

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8. Finally, we are able to compile a heat map of the keywords search results which displays the number of occurrences for each of the keywords within each document of the collection. The heat map displays the results by clustering data by similarity (see Annex 2, Fig. 7). A certain attribute (i.e. keyword) can skew the heat map results by having a value with at least one order of magnitude higher. In order to display the results excluding the "outlier" we can leave out from the assessment the high value and re-plot the results. In this way we can see better the distribution of the rest of the keywords (see Annex 2, Fig. 8).

Based on the workflow described above we obtained the following results summarised as tables below:

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Table 1. List of keywords used for searching within EU thematic/sectoral policies documents and the number of search hits/document

Document title	EU-A Blueprint to Safeguard Europe's Water Resources (Communication)	EU-Bathing Water Directive	EU-Drinking Water Directive	EU-Environmental Quality Standards Directive	EU-Floods directive	EU-Integrated Coastal Zone Management (Recommendation)	EU-Marine Strategy Framework Directive	EU-Nitrates directive	EU-Regulation on minimum requirements for water reuse	EU-The Groundwater Directive	EU-Urban Waste Water Treatment Directive	EU-Water Framework Directive	EU-Water scarcity and drought (Communication)
analyse	2	4	3	3	0	2	4	0	1	1	1	4	2
assessment	21	37	43	6	23	1	42	0	0	16	0	35	11
copernicus	0	0	0	0	0	0	0	0	0	0	0	0	0
earth observation	0	3	0	0	0	0	0	0	0	0	0	1	0
detection	0	1	1	0	0	0	0	0	0	1	0	6	1
evaluation	2	5	5	2	1	3	2	0	1	3	1	2	0
extent	3	0	3	7	4	0	6	1	0	5	0	6	5
ground based	9	8	24	4	3	6	10	9	8	167	3	221	16
hazard	2	1	13	5	17	0	3	1	1	11	0	15	0
in-situ	737	533	735	528	332	172	922	203	255	453	249	1576	367
temporal	0	0	0	0	0	0	4	0	0	1	0	0	0
indicator	2	1	5	0	0	0	9	0	9	18	0	1	2
map	3	1	4	3	35	0	1	1	0	2	0	33	2
measure	39	36	55	39	24	5	82	29	10	38	14	131	13
monitor	10	33	71	57	1	1	24	9	21	38	8	119	6
remote sensing	0	0	0	0	0	1	0	0	0	0	0	0	0
parameter	0	16	83	5	0	0	0	0	1	1	12	23	0
pollution	13	44	4	24	4	0	12	23	1	23	4	62	0
resolution	1	1	0	0	0	3	0	1	1	1	1	3	0

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satellite	1	0	0	0	0	0	0	0	0	0	0	0	0
spatial	2	0	1	0	1	0	7	0	0	1	0	4	1
time series	6	12	7	6	0	1	11	2	2	10	6	28	1
track	1	0	0	0	0	0	0	0	0	0	0	0	0

Table 2. List of keywords used for searching within international thematic/sectoral policies documents and the number of search hits/document

Document title	GWP-Integrated Urban Water Management	GWP-Integrated Water Resources Management	OECD-Agriculture and water policy changes	RAMSAR - 4th Strategic Plan	RAMSAR-Convention	UN-Paris agreement	UN-Sendai Framework	UN-Strategic Plan for IPHP-	UN-Towards a Water and Food Secure Future	UN-World Water	WHO-Guideline-for-drinking-water-quality	WHO-Guidelines for safe recreational water environments.	WHO-Guidelines for the safe use of wastewater, excreta and greywater - Volume 1	WHO-Guidelines for the safe use of wastewater, excreta and greywater - Volume 2	WHO-Guidelines for the safe use of wastewater, excreta and greywater - Volume 3	WHO-Guidelines for the safe use of wastewater, excreta and greywater - Volume 4	WHO-Guidelines on recreational water quality-volume 1-coastal and fresh	WHO-Guidelines-for-safe-recreational-water-environments-vol1	WHO-WASH strategy 2018-2025	WorldBank-Water Resources Sector Strategy	WorldBank-Water Supply and Sanitation Sector Business Strategy	WorldBank-Working-Together-for-a-Water-Secure-World
analyse	3	2	3	0	0	0	0	2	0	21	17	3	2	0	0	1	34	18	5	0	0	0
assessment	14	26	49	17	0	3	16	18	10	138	445	52	113	18	19	12	216	178	24	0	21	1
copernicus	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
earth observation	0	0	0	0	0	0	0	0	2	3	210	13	0	0	0	0	17	25	1	0	0	0
detection	7	0	0	0	0	1	2	15	12	52	26	6	5	0	0	0	25	23	0	0	0	0
evaluation	2	6	19	1	0	0	0	7	2	7	120	5	16	1	0	0	9	20	1	0	24	0
extent	1	3	9	1	0	3	2	3	5	17	24	10	3	0	0	0	11	19	1	0	6	0
ground based	48	44	85	24	0	3	16	180	87	290	1041	61	186	14	10	10	143	81	43	0	40	16
hazard	5	2	2	0	0	0	40	16	0	38	254	165	99	4	6	1	139	263	2	0	1	2
in-situ	1617	1627	1597	805	207	565	1009	1924	2305	9041	20528	5524	3200	250	367	194	6247	8544	1612	0	2889	600
indicator	0	2	23	52	0	0	8	0	6	24	191	31	38	0	0	0	87	26	39	0	31	1
map	7	0	5	0	1	0	4	18	2	27	2	1	4	1	0	1	7	8	8	0	6	1

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measure	30	11	60	15	0	6	26	17	9	157	344	52	216	9	11	8	144	162	4	0	37	0
monitor	12	16	27	5	0	0	10	30	6	85	284	78	127	12	11	10	273	175	113	0	36	7
remote sensing	0	0	1	0	0	0	0	2	0	8	81	16	21	0	0	0	26	23	0	0	0	0
parameter	13	23	43	3	1	0	0	35	7	38	57	14	13	0	0	0	108	177	2	0	13	3
pollution	3	0	3	4	0	0	1	20	6	31	1	1	0	0	0	0	9	6	0	0	0	0
resolution	0	17	0	6	2	0	6	5	1	10	5	0	1	0	0	0	0	2	5	0	0	0
satellite	0	0	1	0	0	0	0	4	4	13	0	0	0	0	0	0	3	1	0	0	0	0
spatial	1	8	9	0	0	0	4	8	1	21	2	0	0	0	0	0	13	14	0	0	0	0
time series	21	26	19	2	6	0	13	22	37	134	282	52	65	0	0	0	99	144	14	0	29	7
track	1	0	10	0	0	0	0	1	0	7	3	0	0	0	0	0	19	0	25	0	12	0
temporal	1	3	1	0	0	0	0	6	1	8	2	0	0	0	0	0	5	10	0	0	0	0

Table 3. List of keywords used for searching within space policies documents and the number of hits/document

Document title	ESA-EO4SD Catalogue	EU-JRC Proceedings of the BiDS'19	EU-Union Space Program	GEO-Canberra Declaration	GEO-Strategic Plan 2016-2025 Implementing GEOSS	PwC-Copernicus Market Report 2016	PwC-Copernicus Market Report 2019	UN-UNOOSA Status and outlook of the Space4Water Project	UN-Use of Space Technology for Water Management
inland water	135	0	1	2	9	26	120	113	144
aquatic	1	0	0	0	0	2	1	2	0
lake	7	0	0	0	0	2	6	1	3
reservoir	2	0	0	0	0	2	3	0	1
river	14	2	0	0	0	29	71	2	3
coastal	1	0	0	0	0	15	54	1	1

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wetland	8	0	0	0	0	0	0	1	0
groundwater	0	0	0	0	0	1	0	3	10
lagoon	0	0	0	0	0	0	0	0	0
ocean	0	0	0	0	4	81	70	2	0
marine	0	0	1	0	1	40	96	0	0

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4.4 Interpretation, discussion and conclusion

We focus our interpretation at this stage of the project on two "test run" set of results:

I. searching for the keywords from "Space community list" within the collection of European laws (Directives), regulations (recommendations), and communications which we shortlisted and assessed in the previous sections of this deliverable

II. searching for (one) of the subsets of "Stakeholders analysis list" within the collection of European or international space documents collection.

Therefore, using the workflow described above we obtained the following conclusions for each of the searching "test run" results, as follows:

I. EU policy documents test run

- "in-situ" has the largest number of "hits" with at least one order of magnitude higher than the rest of the other keywords from the list (see Table 1 above). We mentioned above that the in-situ measurements can be a barrier but also an opportunity meaning that where in-situ term is suggested in the text it means that at the time when the text was written in-situ was considered the best option for conducting various measurements or assessment. However, based on the presentations of EEA during the "Policy Experts" international conference focusing on inland water held by Water-ForCE project in Copenhagen (October 2021), the Copernicus in-situ component of the Land Core Service, EEA considers that:
  - in-situ component provides access to in-situ data, serving primarily the Copernicus services;
  - The Space component includes provision of in-situ data for calibration and validation of dedicated mission observations;
  - Copernicus relies predominantly on existing 'in-situ data' capacities;
  - Member states', organisations' and many others in-situ infrastructures and data are essential contributions to Copernicus.

  As such, taking into account these statements although foreseen for a long time as a barrier the in-situ should be considered actually as an opportunity for integrating ground-based measurements with Copernicus products. Moreover, it has been also

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mentioned that the future is to develop new indicators based on the integration between in-situ and Copernicus products data than developing a new service for inland water. By simply running the text mining workflow we already identified an important feature of the document collection which is the use of "in-situ" is very important for the inland water policies and further analysis will probably demonstrate with more details and accuracy if indeed there is an uptake potential of Copernicus products for inland water which can be tapped.

- "indicator" keyword was also found as relevant for the current searching algorithms as it is a word that seems to be used regularly by policy makers, regulators, water experts, service providers or space experts. This specific keyword in correlation with other keywords provide a good basis for further analysis. As such, when present in the documents collection it might demonstrate a possible uptake for Copernicus. In Annex 2, figures 2/5/6 and 8 the keyword is analysed in which context is being used, what are the strongest correlations between it and the other keywords and how often and where it is being used. Figure 5 shows a strong correlation between the "indicator" and "temporal" keywords which might mean or call for conducting assessments with a certain regularity, in other words monitoring. The EARSC taxonomy of markets and services, the PwC reports shows a clear potential of Copernicus for (inland) water monitoring, which is in fact nothing new as it has been used largely to study oceans or large bodies of water. With specification of using Copernicus (existing core) products, which is going to be largely discussed in the other WPs of the project, and applications developed by space sector service providers the need of finding and developing new "indicators" can be met also for inland waters.
- "monitor" keyword if often found after excluding the outlier ("in-situ" keyword) as well as other keywords like "measure", "ground-based", "pollution" or "assessment". All these keywords are related or indicate a form of analysis or quantitative assessment. Studying the context in which these were used in the latter tasks of the WP leads to further understanding of gaps, barriers or needs.

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- "Copernicus" keyword which is central to the EU space program surprisingly returned zero (0) "hits" in the search within the EU water thematic or sectoral policies documents. The fact that Copernicus (i.e. remote sensing) is not explicitly mentioned in directives is a barrier to its implementation by public authorities from member states. But there are some possible explanations such as the timeline of these directives publications which pre-dates the Sentinel missions or limited knowledge/skills about space programs in general. Also, the writing policy style is different as it is picked up by some preliminary text mining analysis whereas older policy documents seem to be disconnected as style and structure from the newer ones; an obvious conclusion which underlines the overall evolution of policy writing with years but the large differences indicate a shift which needs to be transformed and implemented at all policy levels.

II. EU and international space documents test run

- There is a clear separation in terms of keywords findings between policy documents and treaties, strategies, market reports documents. The latter have much more keywords "hits" for almost all the keywords.
- "security" keyword outweighs by far the rest of the core services keywords in the Union Space Program document. The word security has been used 67 times in the document compared with less than 10 hits for each of the other keywords that define the Copernicus core services. On the other hand, "Copernicus service" has been used 198 times in the same document. It shows that Copernicus services are central to the Union program but the text seems to avoid specificity in terms of connecting different services with the strategy and the services are treated in general as a whole and not intended to address sectoral issues, excepting as mentioned before, maybe, security.
- "urban water management" keyword is mentioned 22 times in the Union Space Program document as well as in the rest of the other document which suggest a focus in general for this topic

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- The high correlation between the "EO service provider" keyword and the other keywords in general demonstrate an interesting trend where the service providers have an active role in the general uptake of the space policies and maybe the Copernicus program in general.

All the above shows that there is a confirmed potential of text mining, like the methodology we are using in the current deliverable, to investigate in a rapid and efficient way large collections of documents. The encouraging results shows besides expected results also surprising information, from the limited to zero adoption of Copernicus into policy documents to unexpected trends and correlations between different keywords which hints to possible gaps, barriers or needs. There are multiple possibilities to refine the results or apply more in-depth techniques for text mining but this will be performed within the remaining tasks of the current work package as well as in coordination with other work packages and tasks.

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Annex 1: Long list of policies and legislation

Table 1: Summary of the policies and legislation documents considered for the initial stage of research

Intergovernmental treaties	Paris Agreement 2015
	Ramsar Convention on Wetlands 1971
	Convention on Biological Diversity 1992
	Convention on the Protection and Use of Transboundary Watercourses and International Lakes (Water Convention) 1992
UN Resolutions	Protocol on Water and Health 1999
	Sendai Framework for Disaster Risk Reduction 2015
	The 2030 Agenda for Sustainable Development 2015
	UN Water Quality Resolution 3/10 2018
WHO	Water, Sanitation and Hygiene strategy (WASH) 2017
	Guidelines for drinking-water quality 2017
	Guidelines for safe recreational water environments 2003
	Guidelines for the safe use of wastewater, excreta and greywater 2006
	Guidelines for sanitation and health 2018
	Drinking-Water, Sanitation and Health Resolution 2011
	Water, sanitation and hygiene in health care facilities resolution 2019
World Bank	Water Resources Sector Strategy 2003
	Strategic action plan on Water 2019
GWP	Integrated Water Resources Management 2000
UNESCO	Strategic Plan for IHP-VIII 2014
EU Regulations	Regulation (EU) 2019/166 amending Directive (EU) 2016/1629 of the European Parliament and of the Council laying down technical requirements for inland waterway vessels
	Regulation (EU) 2019/838 on technical specifications for vessel tracking and tracing systems and repealing Regulation (EC) No 415/2007
	Regulation (EC) No 414/2007 concerning the technical guidelines for the planning, implementation and operational use of river information services (RIS) referred to in Article 5 of Directive 2005/44/EC of the European Parliament and of the Council on harmonised river information services (RIS) on inland waterways in the Community

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	Regulation (EU) 2020/741 on minimum requirements for water reuse (Text with EEA relevance)
	Regulation (EU) No 1307/2013 establishing rules for direct payments to farmers under support schemes within the framework of the common agricultural policy and repealing Council Regulation (EC) No 637/2008 and Council Regulation (EC) No 73/2009
	Regulation (EU) No 1306/2013 on the financing, management and monitoring of the common agricultural policy and repealing Council Regulations (EEC) No 352/78, (EC) No 165/94, (EC) No 2799/98, (EC) No 814/2000, (EC) No 1290/2005 and (EC) No 485/2008
	Regulation (EU) No 1305/2013 on support for rural development by the European Agricultural Fund for Rural Development (EAFRD) and repealing Council Regulation (EC) No 1698/2005
	Regulation (EU) No 1308/2013 establishing a common organisation of the markets in agricultural products and repealing Council Regulations (EEC) No 922/72, (EEC) No 234/79, (EC) No 1037/2001 and (EC) No 1234/2007
	Regulation (EU) 2020/2220 laying down certain transitional provisions for support from the European Agricultural Fund for Rural Development (EAFRD) and from the European Agricultural Guarantee Fund (EAGF) in the years 2021 and 2022 and amending Regulations (EU) No 1305/2013, (EU) No 1306/2013 and (EU) No 1307/2013 as regards resources and application in the years 2021 and 2022 and Regulation (EU) No 1308/2013 as regards resources and the distribution of such support in respect of the years 2021 and 2022
	Regulation (EU) 2021/696 establishing the Union Space Programme and the European Union Agency for the Space Programme and repealing Regulations (EU) No 912/2010, (EU) No 1285/2013 and (EU) No 377/2014 and Decision No 541/2014/EU
EU Directives	Directive 2008/56/EC establishing a framework for community action in the field of marine environmental policy (Marine Strategy Framework Directive)
	Directive 92/43/EEC on the conservation of natural habitats and of wild fauna and flora (Habitats Directive)
	Directive 2009/147/EC on the conservation of wild birds (Birds Directive)
	Directive 98/83/EC on the quality of water intended for human consumption (Drinking Water Directive)
	Directive 2006/7/EC concerning the management of bathing water quality and repealing Directive 76/160/EEC (Bathing Water Directive)
	Directive 91/271/EEC concerning urban waste-water treatment (Urban Waste Water Treatment Directive)
	Directive 2008/105/EC setting environmental quality standards in the field of water policy (Environmental Quality Standards Directive)

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	Directive 91 /676/EEC concerning the protection of waters against pollution caused by nitrates from agricultural sources (Nitrates Directive)
	Directive 2010/75/EU on industrial emissions (integrated pollution prevention and control) Text with EEA relevance (Industrial Emissions Directive)
	Directive 2012/27/EU on energy efficiency, amending Directives 2009/125/EC and 2010/30/EU and repealing Directives 2004/8/EC and 2006/32/EC (Energy Efficiency Directive)
	Directive 2005/44/EC on harmonised river information services (RIS) on inland waterways in the Community
	Directive (EU) 2016/1629 laying down technical requirements for inland waterway vessels
EU Communications	COM/2019/640, The European Green Deal
	COM(2016)705, The Space Strategy Europe
	COM/2021/558, Proposal for a Directive on energy efficiency
	COM/2020/789, Sustainable and Smart Mobility Strategy – putting European transport on track for the future
	COM/2019/128, Strategic Approach Pharmaceuticals
	COM/2017/0713, The Future of Food and Farming

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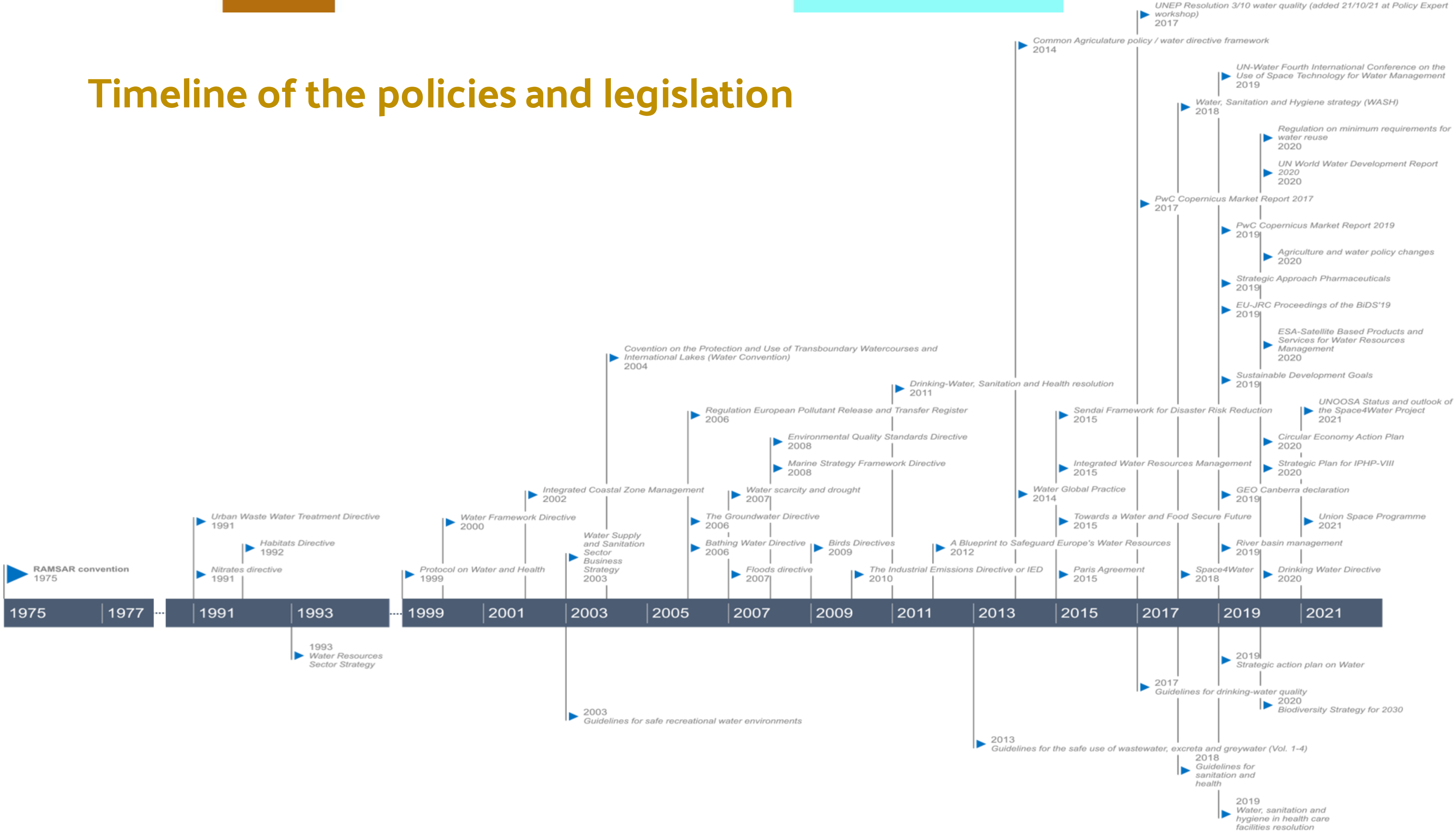
Timeline of the policies and legislation



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Annex 2: EARSC taxonomy

Table 1: Market for EO services

Market for EO services: 8 markets and 26 sectors	
Energy & mineral resource	Raw materials Renewable energy Oil & gas
Citizens & society	Consumer solutions Education, training & research Leisure
Defence & security	Emergency & social protection Security, defence & military Humanitarian operations
Environment, climate & health	Meteo & climate Environmental, biodiversity, pollution Healthcare
Financial & digital services	News & media Insurance & real estate Retail & geo-marketing ICT, digital interfaces
Infrastructure & transport	Travel & tourism Utilities & supplies Construction Communications & connectivity Marine Transport & logistics
Urban development	Smart cities Local & regional planning
Managed living resources	Fisheries Agriculture Forestry

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Table2: Provision of EO services

Thematic provision of EO services: 6 domains (classes) and 32 segments (areas)	
Atmosphere & climate	Meteorology Atmosphere Climate change
Disasters and geohazards	Floods Landslides Earthquakes Fires Volcanoes
Land	Biodiversity & land ecosystems Inland water Snow & ice Topography & motion Geology Land use / land cover Forests Agriculture
Built environment	Waste Urban areas Infrastructure Transport networks
Marine & maritime	Shipping Sea-ice & icebergs Marine pollution Fisheries Biodiversity & marine ecosystems Coastal Metocean
Security & safety	Customs & borders Health (epidemics & disease) Food security & production

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Annex 3: Text mining steps

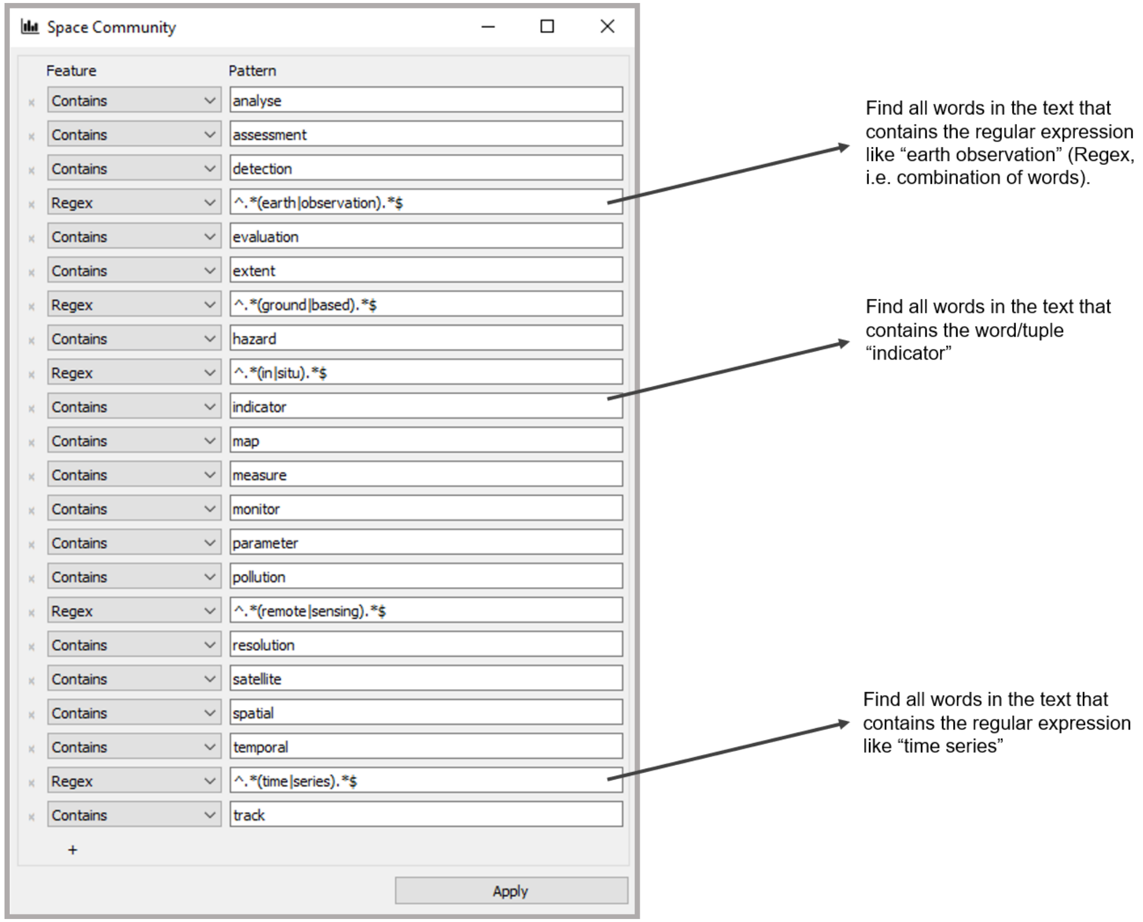

Figure 1: Space community list of keywords as input for Orange Canvas

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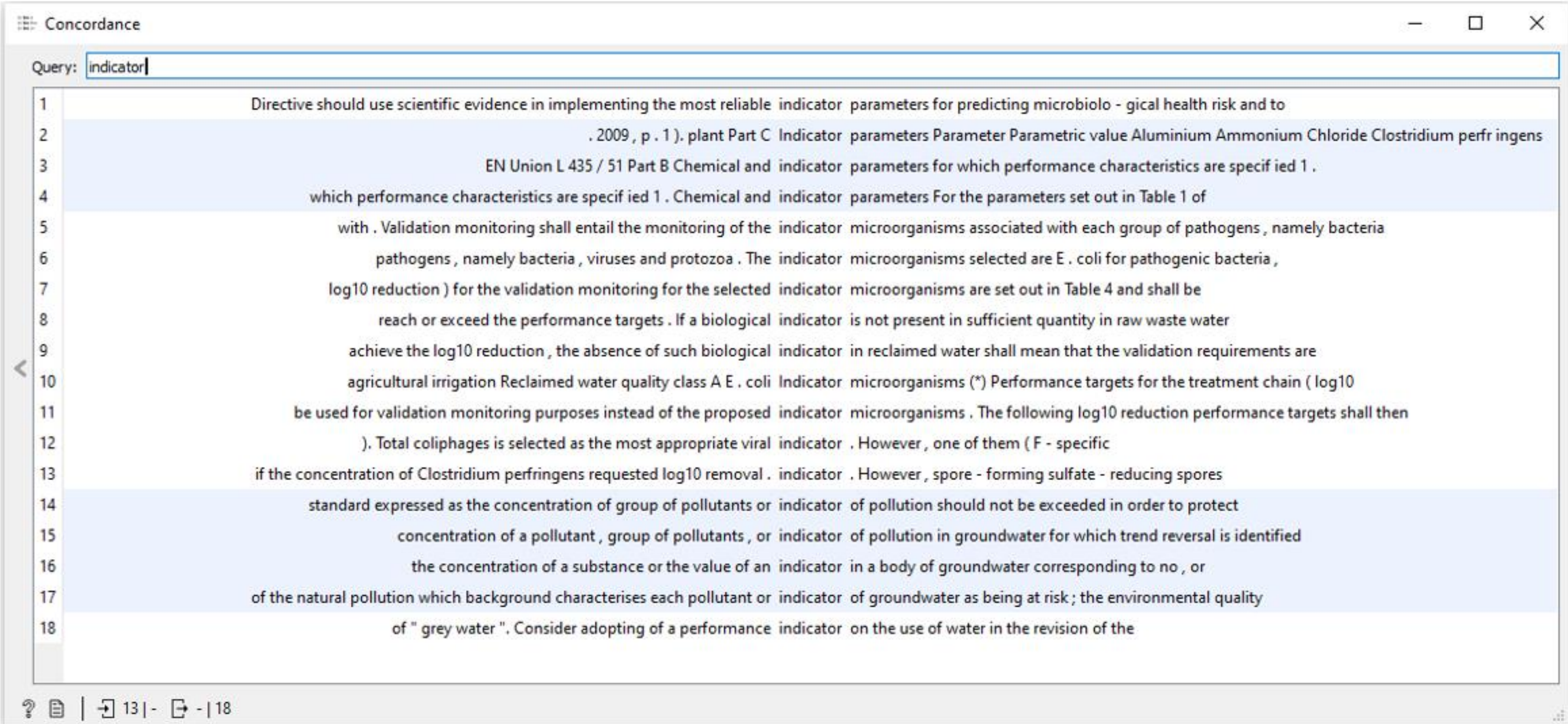

Figure 2: Concordances summary for keywords (here for “indicator”)

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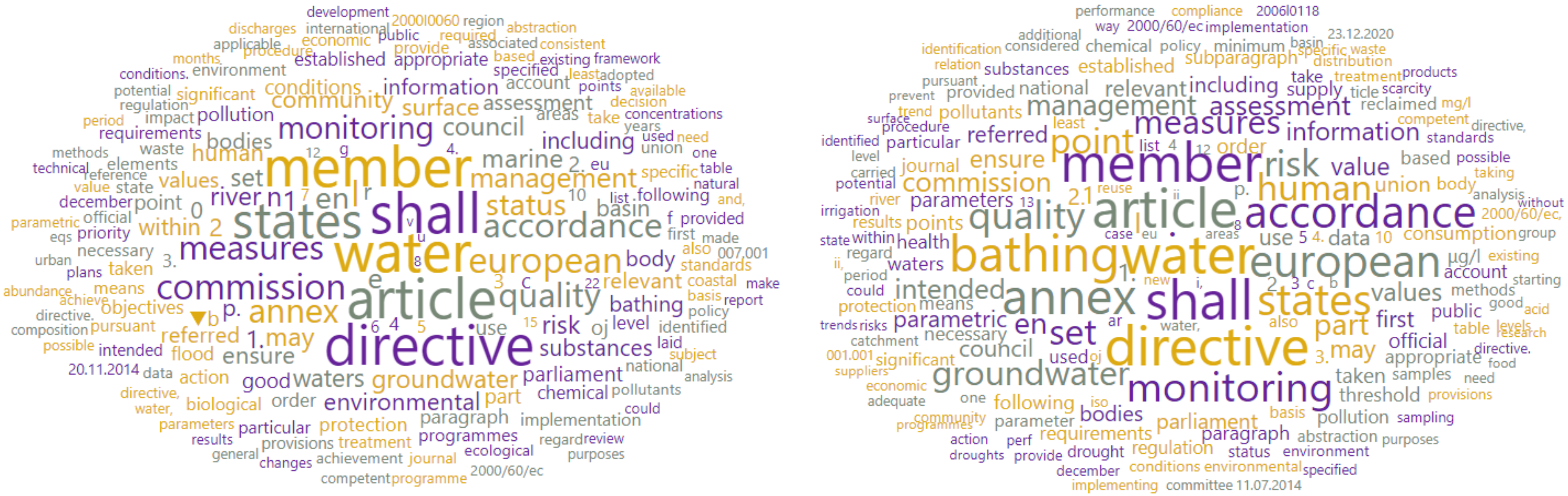

Figure 3: Word Cloud compiled before (left) and after (right) the concordance step which displays the most common words used in the thematic/sectoral documents. After the concordance step in this case only documents which contain the keyword indicator were used for creating the Word Cloud. The words' size is directly proportional with weight (i.e., occurrence). Words like monitoring, parameters, risk, assessment are to be noticed after the concordance step.

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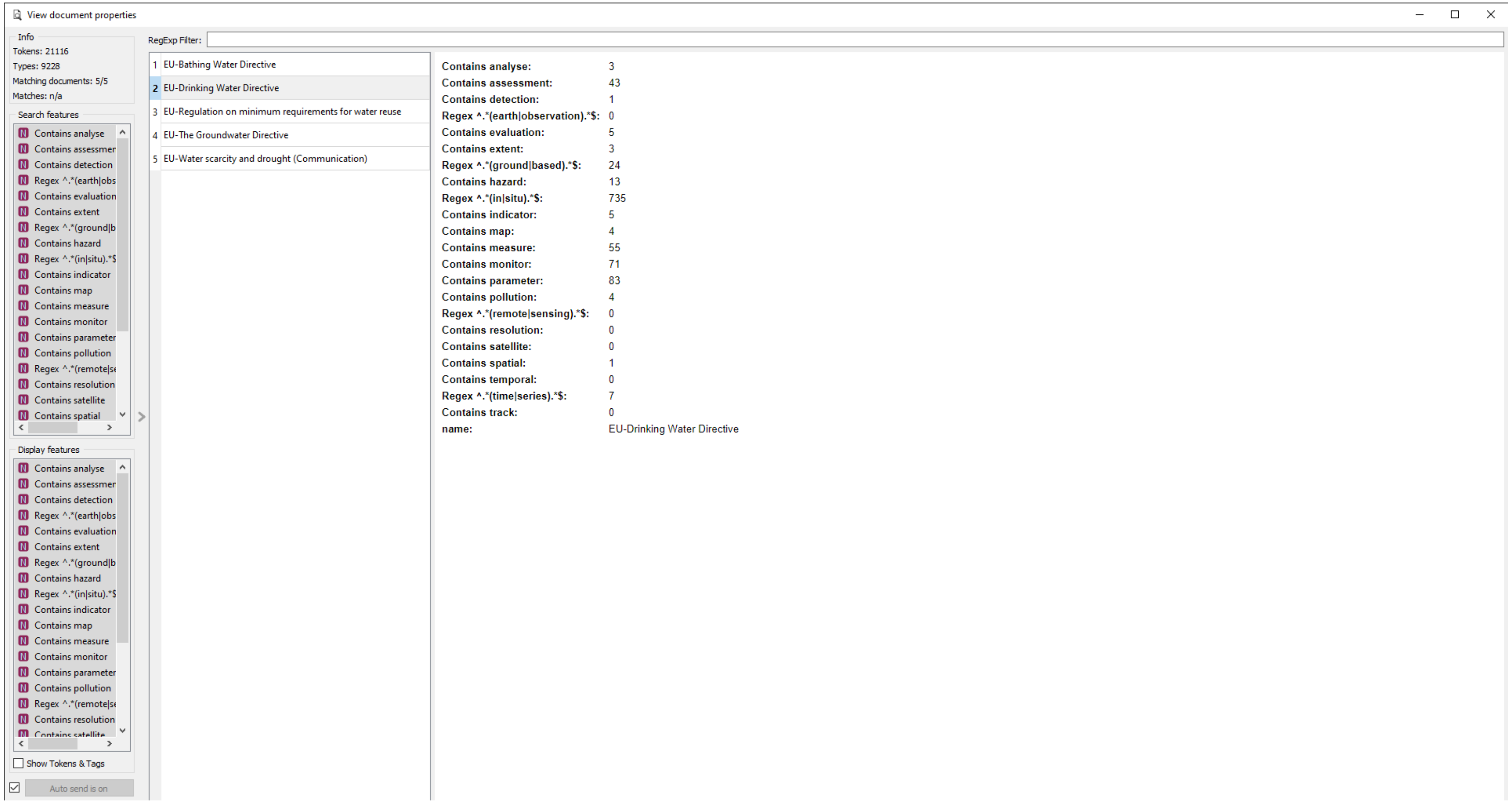

Figure 4. Document properties

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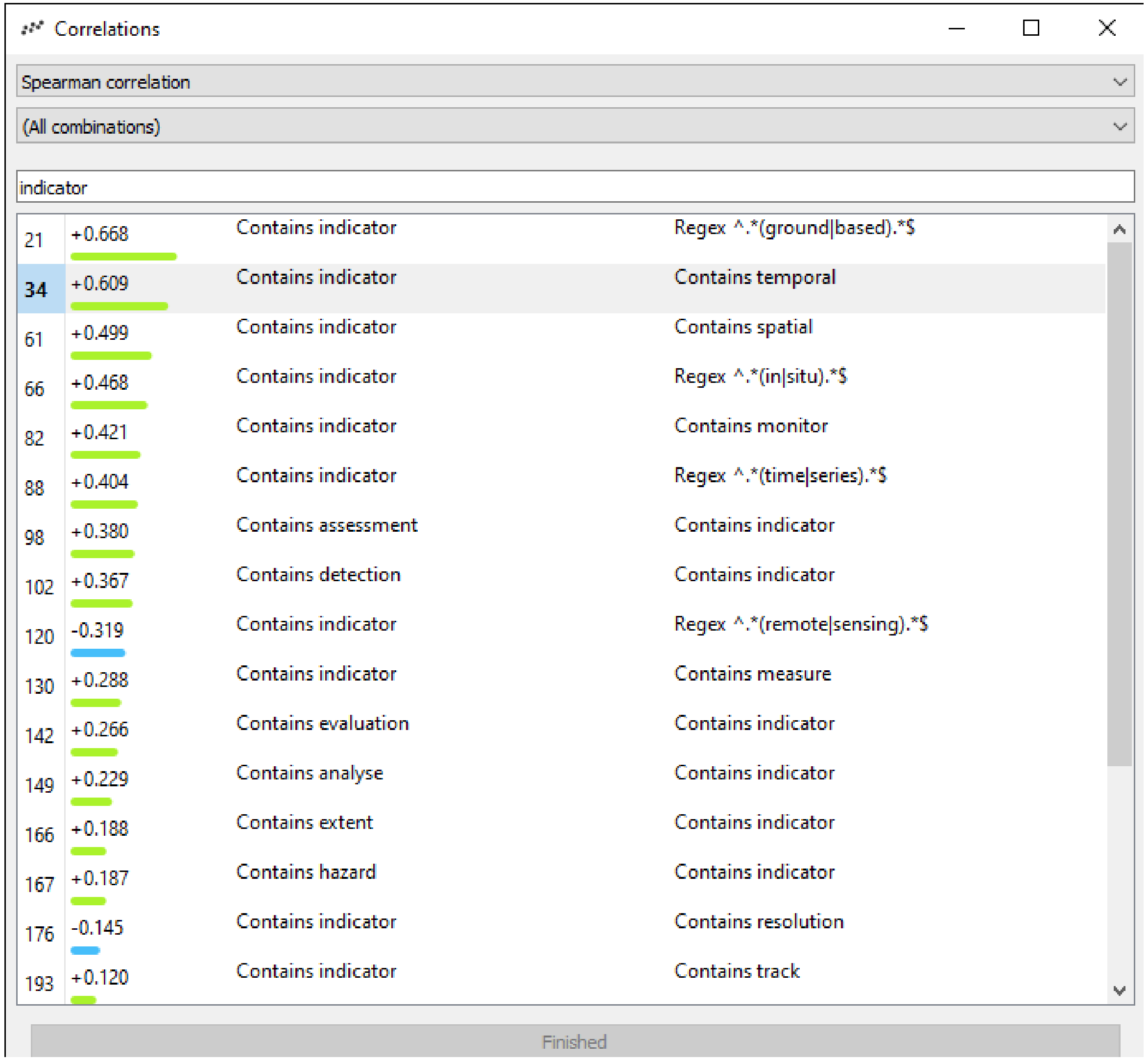

Figure 5. Correlation between attributes (i.e., keywords). Here is an example of the keyword “indicator” correlation with all the other indicators from the Space community list. The correlations which are constant (=0) are left out of the summary.

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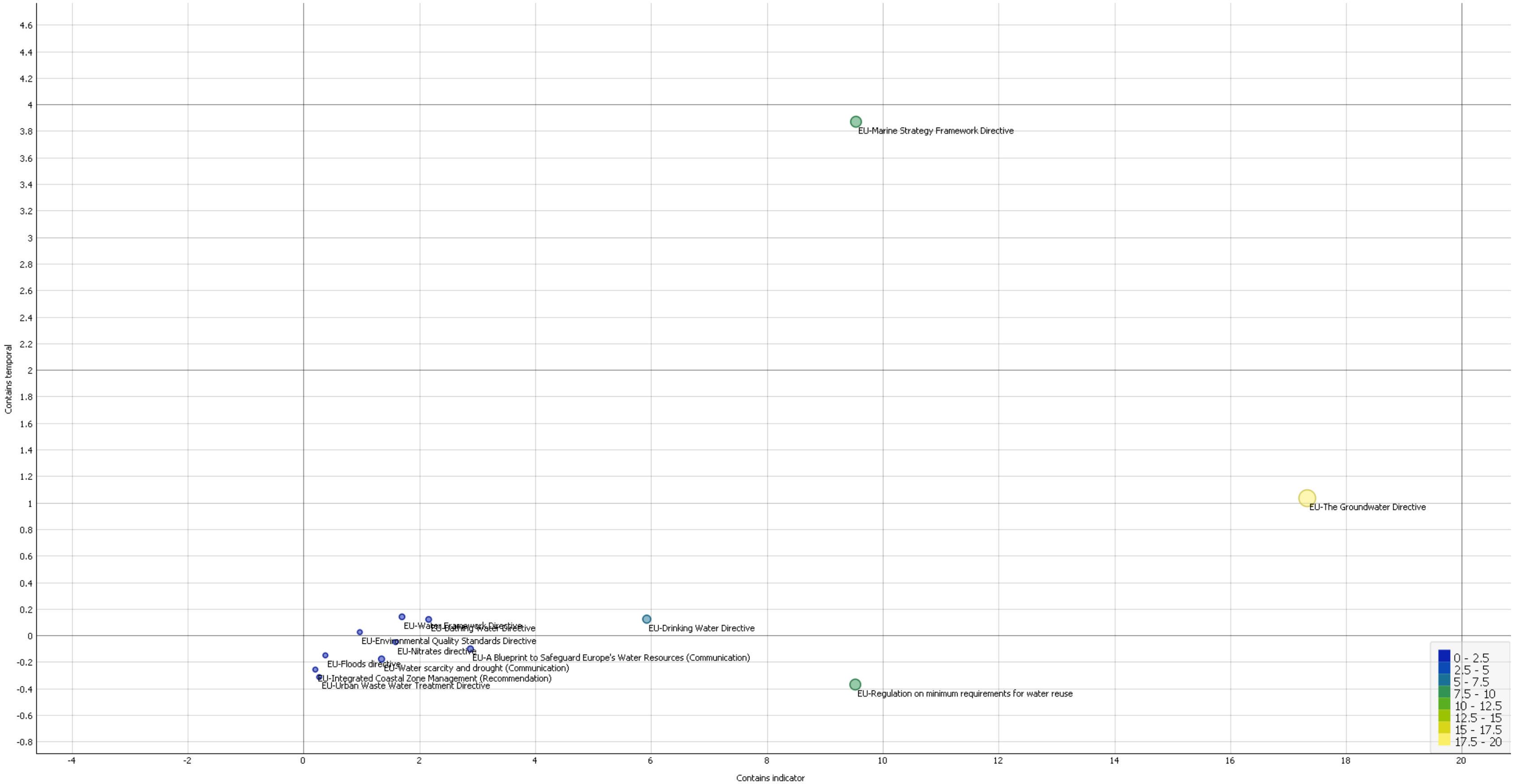

Figure 6. Scatter plot which shows how the keywords pair within the collection of documents. In this example the “indicator” and “temporal” keywords were used for display.

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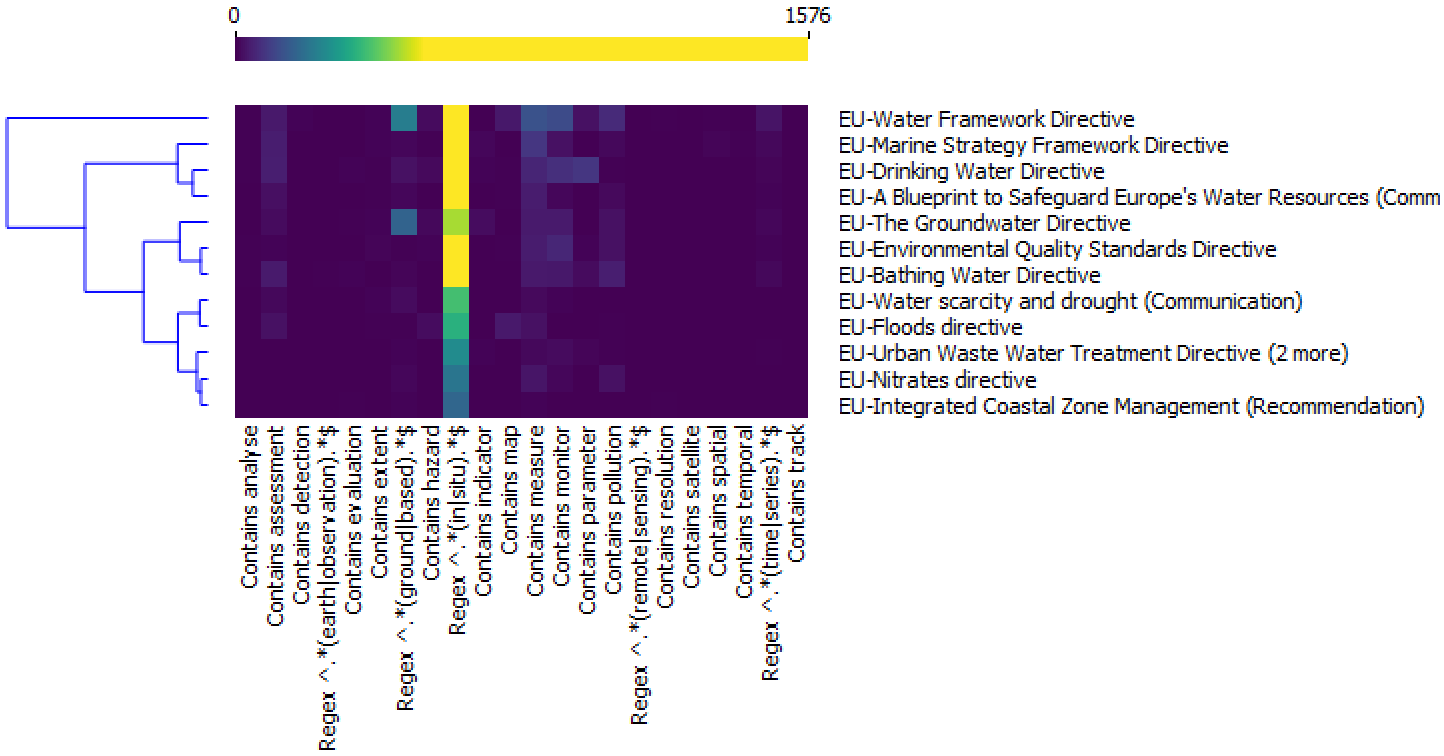

Figure 7. Heat Map with keywords occurrences within the documents collection

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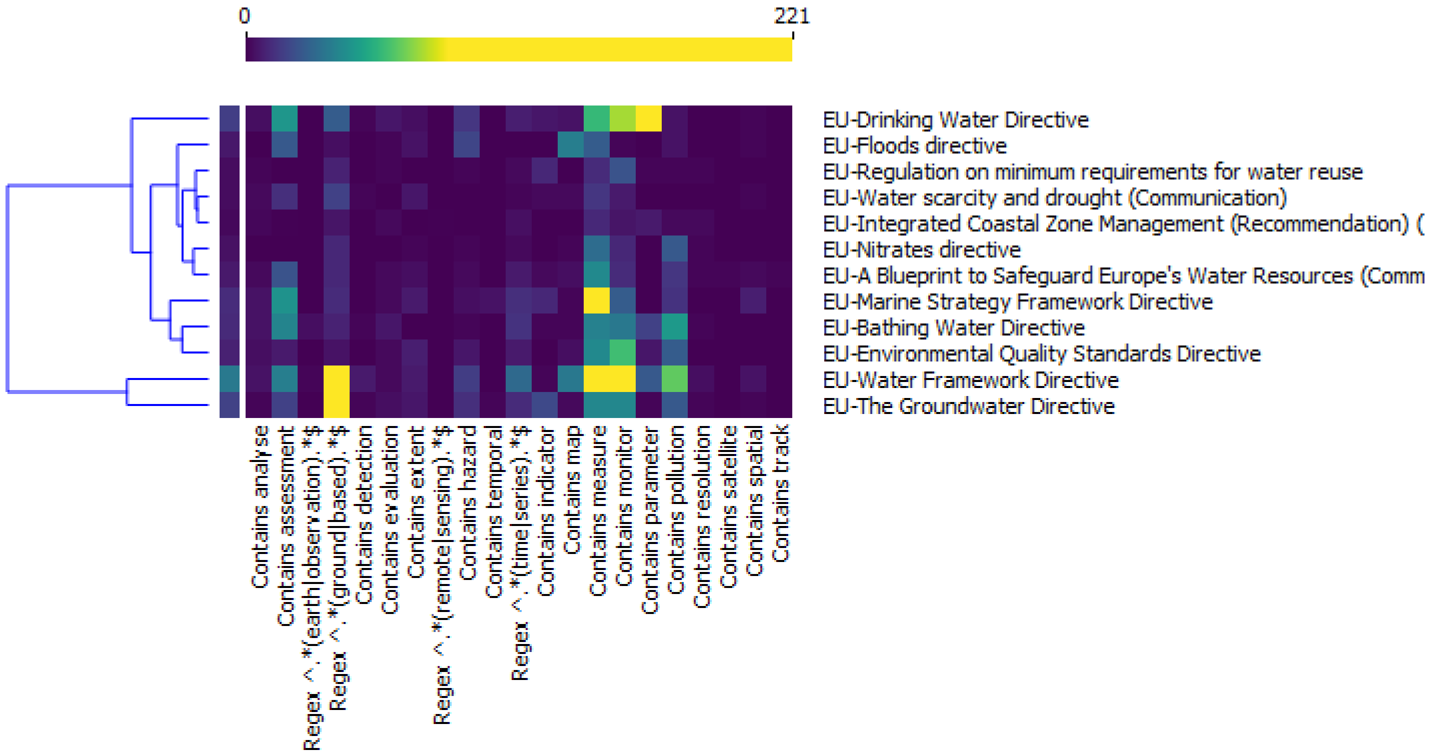

Figure 8. Heat Map with keywords occurrences within the documents collection excluding "outlier" (i.e. exaggerated value, here **'in-situ")**

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