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D4.9 Report on EGIDA Methodology Transfer use-case: Slovenia

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Executive Summary

The Use Case Slovenia was selected as an example of replication of EGIDA Methodology for building a spatial data infrastructure for the purpose of management of a degraded Soča/Isonzo river catchment in Western Slovenia, exposed to a variety of pressures. Environmental issues addressed are releases of contaminants from point and diffused sources, geohazards, climate change and human health issues. In attempting to construct the dedicated SDI, all relevant steps suggested in the EGIDA Methodology were followed and evaluated, thus contributing to the evaluation and assessment of the whole Methodology in its approach and implementation.

At first, the general framework of the Use Case was set, based on general characteristics of the targeted area (upper Soča/Isonzo and Idrijca catchment area). Taking into account the specific environmental issues (release of contaminant into the atmosphere, soil and water, geohazard – mass wasting, flooding, climate change – and human health in terms of source-receptor relationship), the DPSIR framework was for selection of key indicators for specific environmental issues, schematic presentation of interactions and connectivity among them, management of information included in SDI as well as identification of the most important stakeholders involved. Detailed analysis of connectivity and cause-effect relationships between interacting components or issues in the environment provided a basis for selection of specific indicators that shall be included into the dedicated base of spatial data. The use-case specific catalogue of existing spatial data was constructed, driven by data needs for environmental issues that need to be addressed in the catchment and based on the relevant indicators. The catalogue contains more than 100 indicators identified by DPSIR framework, existing in different forms and formats (layer-shaped, ASCII, tabulated or raster data). The data providers relevant for the use case were identified for each SBA within the national stakeholder network. Existing spatial data infrastructure was analysed and most of relevant data is already available at different national data custodians and providers. As most important sources, the Environmental Atlas (web mat viewer), Inspire GEOportal http://www.geoportal.gov.si/ (hosted by the Surveying and Mapping Administration), GEOportal

http://gis.arso.gov.si/geoportal/catalog/main/home.page (hosted by the national Environment Agency), EIONET-SI http://nfp-si.eionet.europa.eu/ (interactive maps, tables, texts or downloadable shape files) and GERK http://rkg.gov.si/GERK/viewer.jsp (land parcel identification system hosted by the Ministry of Agriculture and Environment) were identified. Within the networking activities, meetings and workshops were co-organised with the Slovenian partners of two other EU FP7 project dealing with similar topic – OBSERVE (http://www.observe-fp7.eu/) and BalkanGEOnet (http://www.balkangeo.net/). Great advantage was taken also from the common survey performed by these two projects, which – similarly to EGIDA – aimed at identifying the main drawback of SDI development process in Balkan region (Kosmatin-Fras, 2012). It was expected that the lack of spatial data could be the main obstacle in building the dedicated SDI. However, it was found that a lot of high quality spatial data exists, however, different initiatives are not coordinated, data is sometimes difficult to access and incomplete. Lack of spatial and temporal continuity was outlined as one of crucial problems, which is mainly the consequence of national research funding policies within last two decades. Further, the data quality assurance and control depends upon the internal QA/QC policy of the data provider; data formats are not harmonized and are generally not interoperable. Problematic is also lack of information on new data and application for obtaining information from spatial data.

Due to the complexity of the use case, the public GEOportal at the national Environment Agency domain would be the most suitable in terms of re-engineering and adaptation for the specific needs of the case and could be potentially considered as a possible component of GEOSS. Its main advantages are its environmental character, public availability of datasets already organized into suitable thematic data groups, possibility of exporting data via WFS application, rather detailed and consistent metadata description, and the possibility to straightforward include missing resources into the existing infrastructure. Nevertheless, as a compelling example, the Geopedia.si (www.geopedia.si) portal was identified. Geopedia to the moment represents the most complete collection of spatial data in more than 10 000 layers contributed by more than 18000 contributors. It has an open structure enabling browsing, editing, importing, exporting spatial data, integration of layers into own system. Further, the contacts and

agreements with a great variety of public and private data holders are already established, and datasets are thoroughly described, tagged, cross-referenced and categorized. As a main drawback, Geopedia.si suffers from common flaws of crowd-sourced data portals, in particular questionable quality of some datasets and lack of motivation from portal developer's part.

In conclusion, the advantages and benefits of sharing data are well recognized among the stakeholder network, but most partners don't see themselves as potential contributors to GEO/GEOSS, not even the Environment Agency which initiated participation of Slovenia in GEO/GEOSS and which is the main provider and custodian of spatial environmental data in the country. Further, adequate and affordable education programmes for data users and continuity of education of data users shall be provided. All stakeholders agreed that to bridge the main gaps, a coordinated action organized by a top-down approach would be needed. The leading body shall be either one of the Ministries responsible for spatial and/or environmental data in cooperation with the main national research funding agency – SRA.

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Acronyms and Abbreviations

Abbreviation	Name
ACPDR	Administration for civil protection and disaster relief
CORDIS	Community Research and Development Information Service
EC	European Commission
EU	European Union
FP7	Seventh Framework Programme
GEO	Group on Earth Observations
GEOSS	Global Earth Observation System of Systems
GMES	Global Monitoring for Environment and Security
EARS	Environment Agency of the Republic of Slovenia
INSPIRE	Infrastructure for Spatial Information in Europe
MAE	Ministry of Agriculture and Environment of Republic of Slovenia
MEDT	Ministry of Economic Development and Technology of Republic of Slovenia
MESCS	Ministry of Education, Science, Culture and Sports of Republic of Slovenia
MESP	Ministry of Environment and Spatial Planning of Republic of Slovenia
MD	Ministry of Defence of R Slovenia
MISP	Ministry of Infrastructure and Spatial Planning of Republic of Slovenia
MPA	Ministry of Public Administration of Republic of Slovenia
MS	Member State
NSA	Nuclear Safety Administration
SDI, NSDI	Spatial Data Infrastructure, National Spatial Data Infrastructure
SEIS	Shared Environmental Information System
SMA	Surveying and Mapping Authority of Republic of Slovenia
SRA	Slovenian Research Agency
TIA	Slovenian Technology Agency

1 Introduction

Although Slovenia officially joined the GEO community in 2005, its visibility in GEO and GEOSS has remained low. In parallel with national activities related to the transposition and implementation of the INSPIRE Directive, Slovenian partners participate in several international projects and actions dedicated to technological and non-technological development of SDI and Earth observation systems. In spite of a variety of SDI and Earth observation activities — national research programmes and projects and EU-funded projects, ranging from in-situ EO data collection, development of sensor networks for in-situ and remote sensing, to the development of interactive remote-sensing technologies and microsatellites — Slovenia nevertheless remains among the EU countries with the lowest number of reported datasets in GEOSS.

Environmental monitoring and research, natural hazard assessment and management, the use and management of natural resources are among the topics which more and more build upon spatial data and their application. Considerable developments have been made recently in the framework of national and international development and scientific research projects, as well as due to private initiatives. In spite of many efforts of the key players in NSDI development, the harmonization and interoperability of datasets deriving from different disciplines, different sources and in different formats still remain the main problem. According to the estimation made by the national Survey and Mapping Authority - the body responsible for the transposition and implementation of INSPIRE directive in Slovenia - it will take further 6 to 8 years to achieve full interoperability of data from different providers and custodians, compiled in the national INSPIRE GEOportal (Ažman, 2012).

The NSDI has been built by a top-down approach, where bodies responsible for the NSDI and capacity building and development at national level were appointed by the government of the Republic of Slovenia and responsible Ministry, which was the Ministry of Environment and Spatial Planning, holding its mandate until January 2012. The relatively slow rate of the first phase of NSDI development, in particular applications for visualisation and obtaining information from (environmental) spatial data, lagged behind

the needs of the research community, which independently produced its own spatial datasets and applications (Ažman and Petek, 2009). Lack of standardisation and data quality assurance protocols resulted in extended fragmentation of SD and data management, leading to a situation which is quite confusing for the users. Inconsistent capacity building programmes to contribute and use the EO data further increased the overall costs of data collection, processing, distribution and archiving, limited the visibility of existing datasets for the research community, led to the diversification of observational strategies, poor data coverage and poor continuity of data – a situation which was clearly described by GEO (2007). On the other hand, no incentives or support were offered to the data producers and providers to harmonize their activities. As an example, the Central Evidence of Spatial Metadata was established by the SMA in 1998, providing a list of administrators and distributors of spatial data in Slovenia. In 1999, the CEN/TC287 standard was adopted as the official spatial metadata standard of the Republic of Slovenia by the Office of Standards and Metrology. Data producers, owners and distributors were invited to upload metadata descriptions using an MPedit tool available at the SMA website, but there were no incentives for uploading and registration of data, or providing information, even when the obtained datasets were result of project funding from public sources. As a result, the response of the scientific community was disappointing.

According to the latest report on the SDI in Slovenia – State of Play 2011 (Vandenbroucke et al., 2011), the situation is as follows:

- the basic geodatasets exist which provide a basis for the coverage of the INSPIRE-selected data themes and components,
- the geodetic reference system and projection systems are standardized, documented and interconvertible,
- there exists an independent thematic environmental SDI and
- the key barrier to the sharing of spatial data and services between public authorities appears to be the lack of efficient cooperation infrastructure.

2 Use-case objective

This section describes the use-case objective in the light of the GEOSS sustainable contribution. Starting from the EGIDA Methodology definition...

> *The EGIDA METHODOLOGY is a general methodological approach for implementing a (re-) engineering process of the S&T national infrastructures and systems, which can be adopted by national/regional S&T communities, for a sustainable contribution to the GEOSS and relevant European initiatives based on a SoS approach, through the mobilization of resources made available from the participation in national, European and international initiatives and projects.*

...this use case is selected in the context of grouping of European neighbouring regions for outreach activities to create replication opportunities for the identified good practices. The feasibility of the use case in Slovenia as a small country with several hot-spot and dispersed pollution sources, as well as other environmental problems will be investigated. The main objectives of the Slovenia Use-Case are:

- Demonstration and evaluation of the applicability of the EGIDA methodology on an example of a small country with well-developed spatial data infrastructure and numerous but fragmented projects and initiatives aimed at producing and providing spatial data from different benefit areas as listed in GEO.
- Systematic analysis of national SDI, available datasets, data providers, information sources and relevant national and EU projects.
- Possibilities and limitations of the use of spatial data and in particular environmental data accessible through national GEO portal and other national (meta)data repositories on a complex example of a degraded area in Western Slovenia.
- Analysis of possible establishment/re-engineering of a national/regional SDI infrastructure.

- Recommendations activities at national level to overcome the inconsistencies in spatial data collection, incompatibilities of datasets, and barriers for sharing and re-use of existing spatial data and infrastructures.

The Use Case shall demonstrate the potential for a coherent national contribution to the GEOSS implementation in several steps. The current situation was assessed in a case study – management of a degraded Soča (Isonzo) river Basin downstream the confluence with contaminated Idrijca river, affected (among other environmental issues) by more than 500 years of Hg mining and ore processing, and the Bay of Trieste exposed to the long-term Hg pollution. In the process of collecting data for the case study, based on the DPSIR approach, the national SDI and available spatial data covering all SBAs were assessed, gaps were identified and recommendations for further development were elaborated. In the process we replicated the EGIDA Methodology, so that on a practical example at national level, the strengths and eventual drawbacks of the proposed methodology were experienced.
The Use Case is thematically based upon several on-going R&D activities at national level and international projects, which provided either methodological approach or spatial data relevant for the use case:

International projects:

- COPHES II – European Coordination Action on Human Biomonitoring (CA, Environment), 244237, 2009-2012
- EMRP, JRP12e: Traceable measurements for monitoring critical pollutants under the European Water Framework Directive (WFD-2000/60/EC) 2010-2013
- DEMOCOPHES – Pilot human biomonitoring in EU Life+
- GMOS – Global Mercury Observation System, FP7-ENV-2010, ENV-2010.4.1.3. 2010 – 2015
- PHIME - Public health impact of long-term, low-level mixed element exposure in susceptible population strata, FOOD-CT-2006-016253, 2006-2012

- BIOMERCURY - Worldwide Remediation of Mercury Hazards Through Biotechnology, 6.FP EU
- EMECAP - European Mercury Emission from Chlor-Alkali Plant. 5.FP EU, Quality of life and management of living resources, QLK4-CT-2000-00489
- EUROCAT - European Catchments - Catchments Changes and their Impact on the Coast - IdriCat: Soča Catchments and the Gulf of Trieste. 5FP EU, Environmental and Sustainable Development, EVK1-CT-2000-000444
- Hg-197 MeHg Assess – Evaluation of Methyl- mercury Production and Decomposition by Using Hg-197 Radiotracer produced out of Mercury Enriched in Hg-196 Isotope, FP7-PEOPLE- 221724, 2008-2009
- HYDRONET - Floating Sensorised Networked Robots for Water Monitoring, 212790, FP7-ENV-2007, 2008 – 2012
- Mercury measurements in ambient air and deposition, CEN/TC 264/WG25, Standardisation project funded by the DG ENV
- MERCYMS - An Integrated Approach to Assess the Mercury Cycle Into the Mediterranean Basin, 5.FP EU, EVK3-CT-2002-00070
- UNEP – Global Study on Contaminated Sites, 2008-2009
- Nutritional Status and Exposure to Mercury and its Compounds in Pregnant Women and Women of Childbearing Age in Former Mercury Mining Site using Nuclear and other Techniques; Exposure to Toxic and Potentially Toxic Elements in Women of Childbearing Age in Developing Countries, 13250/R1
- Feasibility Study on Mehylmercury Exposure in the Eastern Aegean, EP-P11793/C5837, Gary Parmenter, Electric Power Research Institute Inc., Palo Alto, CA, USA

National research projects:

- Z1—3675 Vulnerability assessment and identification of suitable remediation measures in degraded ecosystem – a case study of the Idrija mercury mine region 1.5.2010—30.4.2012

- J1—2136 Relation between organic matter and metals, with special emphasis on Hg, in coastal sea (Bay of Trieste) 1.5.2009—30.4.2012
- L1—0367 An integrated methodology for the remediation of an area impacted by the past mining activity 1.2.2008—30.1.2011
- L2 – 9023 Control of mercury and other toxic elements emissions from thermal power plants, cement works and other high temperature industrial processes. 1.1.2007 – 31.12.2009
- L1—7407 Biological methods for monitoring mercury hot spots 1.9.2005—31.8.2008
- J1—7369 The impact of microbial processes on Hg biomagnification in food webs of the Gulf of Trieste (northern Adriatic sea) 1.9.2005—31.8.2008
- L2—6458 Development of tools for management and analysis of the loads and influences on waters in the Sava and Soča catchments 1.2.2004—30.1.2007
- Z1—6536 Bioremediation of mercury on contaminated sites of Idrija 1.7.2004—30.6.2006
- 1—3186 Joint effects of binary mixtures of cadmium, zinc and mercury on selected test animals and plants 1.7.2001—30.6.2004
- J3—3076 Lipid peroxidation and functional damage in target tissues and organs in citizens of Idrija and mercury miners exposed to the elemental mercury 1.7.2001—30.6.2004
- Z2—3502 Modelling of mercury and its compounds transport and transformations in heavy polluted land and river environment: Idrija mercury mine influence area 1.7.2001—30.6.2004
- L3—0304 Hg burden in residents of Idrija (Slovene) 1.7.1998—30.6.2001
- L4—1595 In-situ testing of genotoxicity in fish as a consequence of low doses of chemical agents in Slovenian rivers and in the Bay of Trieste 1.1.1999—30.6.2001
- V1—0233 Experet groundwork for the analysis of contamination with Hg and suggested measures based on 84/156/EEC Directive 1.10.1999—30.6.2000
- J1—8905 Biogeochemistry and modelling of mercury in the Gulf of Trieste 1.1.1997—31.12.1999
- J1—8907 Critical radionuclides, metals and organic contaminants in Slovenian environment 1.1.1997—31.12.1999

3 Use-case description

To explain the context, specifics and constrains of the Use Case, in the following section we describe the use-case specific environmental issues that will be addressed, institutional framework and current activities related to GEO and GMES in Slovenia.

3.1. Use-Case specific environmental issues

Slovenian use-case is dealing with the analysis of a degraded area located in W Slovenia, namely the Soča river catchment (Figure 1). Ecological assessments of catchments are complex because catchments typically overlap multiple jurisdictional boundaries, are subjected to multiple environmental stressors, and have multiple stakeholders with diverse environmental and socioeconomic interests (US EPA, 2007). Catchment degradation is a result of variety of natural and human induced factors that act as environmental stressors. Integrated approach is needed when dealing with these stressors that require multiple solutions, involving multiple stakeholders and multiple targets.

The following environmental issues that go hand in hand and are related to the Soča River catchment are addressed in this use-case:

- Releases of contaminants from point and diffused sources
- Geohazards
- Climate change
- Human health (source-receptor relationships)

Figure 1: *Soča River catchment*

General characteristics of the Soča catchment:

The Soča (in Slovene) or Isonzo (in Italian) river draining the Soča catchment is a 140 km long river that flows through western Slovenia and north-eastern Italy (Figure 1). The whole catchment covers an area of 3300 km^2 (Slovenian and Italian part). An Alpine river in character, its source lies in the Julian Alps in Slovenia, at an elevation of around 1100 metres. In the Soča river drainage basin, carbonate sediments dominate, originating from Mesozoic limestone outcrops. The upstream stretch of the Soča is mountainous, draining tectonically active regions, after crossing the Slovene-Italian border, the river flows over low fertile plains to the Gulf of Trieste in N Adriatic Sea. In general, the study area has a warm humid temperate climate. It is characteristic of such climate that the average temperatures of the coldest month do not drop below -3 °C and that at least

four months have an average temperature above 10 °C. Relative to precipitation, all seasons receive approximately the same amount of rain with no distinctive dry or wet periods (Ogrin, 2004). However, there are significant differences within the catchment. The transit character of this area between the Alps, Dinaric mountains and the Mediterranean influence the climate the most. Northern parts of the catchment have an alpine climate. As the mountains (Julian Alps) block air circulation from the northern Adriatic Sea to the north, annual precipitation here is very high and ranges between 2400 and 3200 mm $year^{-1}$. To the south and southwest of the Alpine-Dinaric barrier, whose relief opens toward the Adriatic Sea, climate becomes sub Mediterranean. The precipitation regime in sub Mediterranean is with high precipitation in the fall and at the end of spring or beginning of the summer and low precipitation in the winter and summer (Ogrin, 2004). At the catchment scale, average air temperature for the months representative of the seasonal meteorological variation in the domain are: 0-2 °C in January, 6-10 °C in April, 16-22 °C in July, and 8-12 °C in October. Due to the steep mountain slopes, strong erosion occurs, especially in the upper stretches of rivers, causing important sediment transport. However, this sediment transport is strongly diminished by three dams used for hydroelectric power production. Before the river reaches the sea, the bed load is practically eliminated in the reservoirs behind the dams, while transport of suspended sediment is still strong, especially at high water flows. There are typically two water-discharge extremes during the year: the longer spring maximum from March to June (due to snowmelt) and the shorter but more intensive autumn maximum in October and November. It is estimated that the mean discharge of the river Soča at its mouth is about 170 m^3/s. In extreme situations, such as in November 1997, the peak discharge at the mouth was 2500 m^3/s.

The Slovenian part of the catchment (Figure 2) covers an area of 2300 km^2 and is one of the six catchments on the first level of the catchment coding system of the Republic of Slovenia. The whole catchment is divided on four sub-catchments on the second level, on 28 on the third level and on 91 sub-catchments on the fourth level (Šraj, 2001). The northern alpine region of the Soča has many smaller tributary streams that drain similar climate zones and lithology. The main tributary streams to the Soča River are the Idrijca

and Vipava Rivers. The Idrijca River is the largest catchment entering the Soča from the Alpine/Karst region. The Idrijca catchment has an area of 598 km^2 and drains mainly carbonates. The Bača River, which has an area of 142 km^2 is included with the Idrijca. The Vipava River drains 593 km^2 and is fed by springs that are sourced from the Karst to the north and drains flysch deposits. The whole area is geomorphologic very heterogeneous, with a wide range of altitudes from 170 to more than 2000 m a. s. l. Forests cover as much as 80 % of the surface. Due to the unfavourable relief, the land was never suitable for agriculture. Therefore, the rest 20 % is mostly natural grassland with some pastures, while urban areas present less than 1 %. Beech is the dominant tree species in the region.

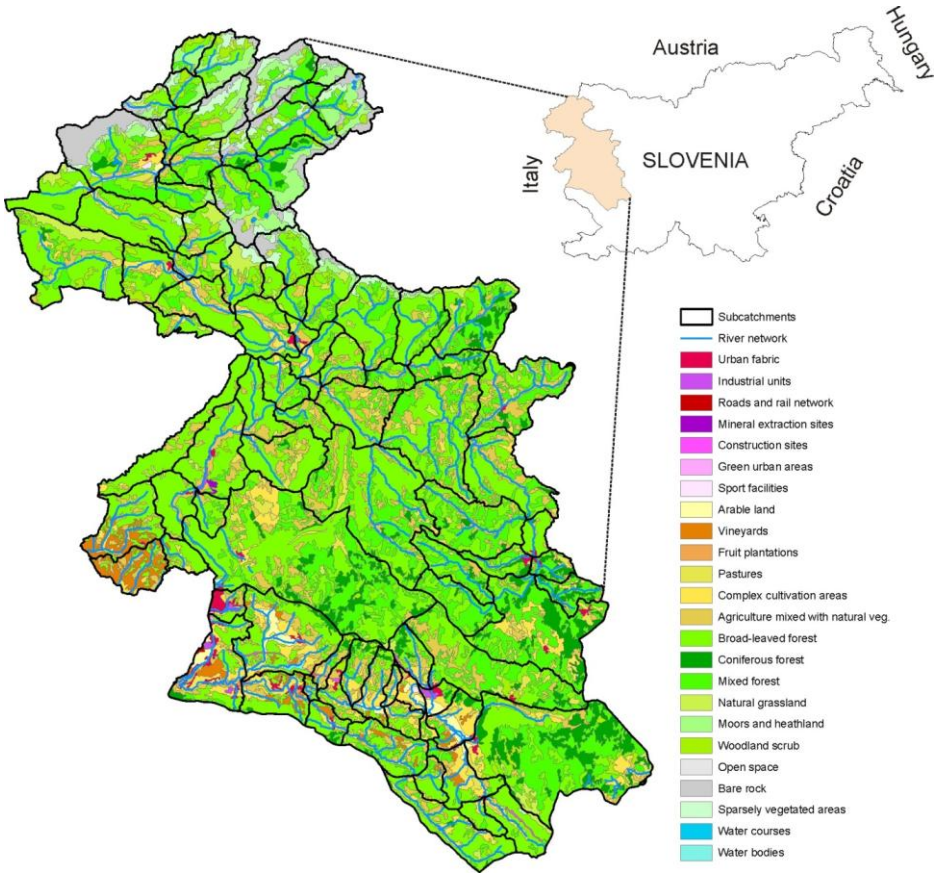

Figure 2: *Slovenian part of the Soča River catchment*

3.1.1. Releases of contaminants from point and diffused sources

Mercury pollution is one of the major environmental concerns in the Soča catchment. Namely, five centuries of mercury (Hg) mining and ore processing operations in the town of Idrija left behind intense pollution, not only in the vicinity of the mine but also in the wider area. Although the production of mercury (Hg) at the Idrija mercury mine stopped in 1994, centuries of mining and ore processing operations left behind intense pollution. Highly elevated levels of mercury compounds in all environmental compartments of the whole impact area of the Idrija mercury mine have a negative impact on human health as well as on the entire ecosystem. According to official data, during the operating period of the mine (since 1490) over 12 million tons of mercury ore had been extracted, which amounts to 107.500 tons of commercial mercury produced. Taking into account the losses during mining and inefficient smelting, the total amount of mercury mined is estimated to be at least 153.000 tons. It has been estimated that the difference of 45.500 tons of mercury was emitted into the environment during the operating period of the mine. There were different ways of transport of mercury away from the production centre in the town of Idrija, causing Hg dispersion on local and regional scale, respectively. During the ore smelting significant quantities of mercury were emitted to the atmosphere (up to 20 kg/day). Since strong temperature inversions are common and strong winds are rare in the Idrija area, a big part of the atmospheric Hg was redeposited within the Idrijca River catchment via dry and wet atmospheric deposition. On the other hand, significantly quantity of mercury bound to smelting remains which were deposited directly in the Idrijca River or along its banks, has been washed away and transported downwards the Idrijca and Soča River system all the way to the marine environment of the Gulf of Trieste in N Adriatic. Therefore, the area impacted by the Idrija mercury mine consists of the terrestrial ecosystems throughout the Idrijca and Soča catchments, freshwater ecosystems of the Idrijca and Soča as well as the coastal environment of the Gulf of Trieste in N Adriatic. Therefore, the problem of mercury contamination in the Idrija Hg-mine region is not only of local but also of regional and global concern. Mercury (Hg) is a potent toxic substance and once released into the environment, mercury is

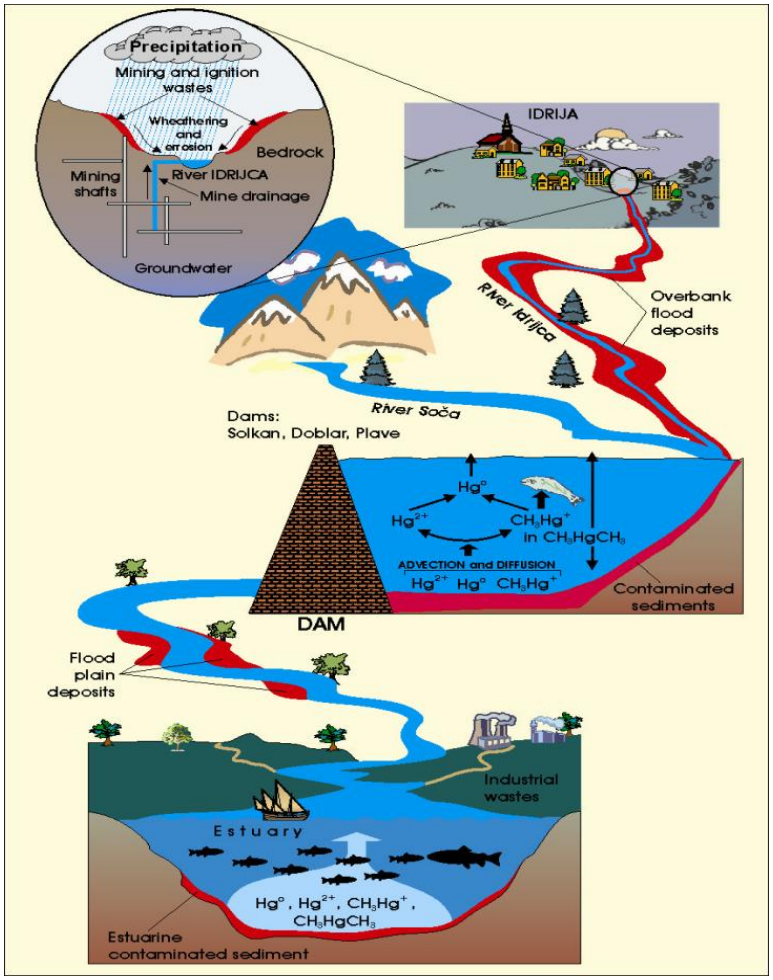

Figure 3: *Schematic representation of mercury distribution and main transformation sites in Idrijca-Soča-Gulf of Trieste system*

redistributed in the atmospheric, terrestrial and aquatic ecosystems through a complex combination of transport and transformation processes. During this cycle, mercury's chemical compounds, mostly organic, can bioaccumulate and biomagnify in living

organisms to levels that can result in a variety of ecological and human health impacts. In Figure 3, a schematic representation of mercury pathways, its main transformation sites in the Idrijca-Soča-Gulf of Trieste system and major environmental concerns are presented.

3.1.2. Geohazards

Landslides are the most common local geohazard problem in Slovenia (Komac, 2012). They can occur on any terrain given the suitable conditions of soil or bedrock, groundwater, and the angle of slope. Landslides commonly occur in conjunction with other natural hazards such as storms, floods and earthquakes (Jelinek et al., 2007). Due to the steep relief, extensive precipitation and underlying geologic structural elements, many areas in the Soča catchment are very susceptible to landslides (Figure 4). The most critical are the upper parts of the catchment, where combination of extreme events such as earthquake-induced large rock falls or rainfall-induced landslides may, during the event itself or in a period after it, also greatly increase the sediment delivery and river sediment transport (Mikoš et al., 2006).

Floods: According to Administration for Civil Protection and Disaster Relief of Republic of Slovenia, floods present a threat to over 300,000 hectares of land in Slovenia. The majority of land prone to flooding (270,000 hectares) lies in narrow valleys carved by torrents. Flood threat depends not only on the height of the flood wave but also its duration. Long periods of high water can permeate dams, which become less solid and can even collapse, opening a pathway for water on to fertile land and settlements. Most rainfall occurs during advances of wet and relatively warm air from the Mediterranean. On hitting the mountains the air rises up and cools down, and that is when excess water is shed. This is why most annual rainfall occurs in the western parts of the Julian Alps and at places along the Dinaric-Alpine divide (source: http://www.sos112.si). In Figure 4, flood risk areas in the Soča river catchment are shown.

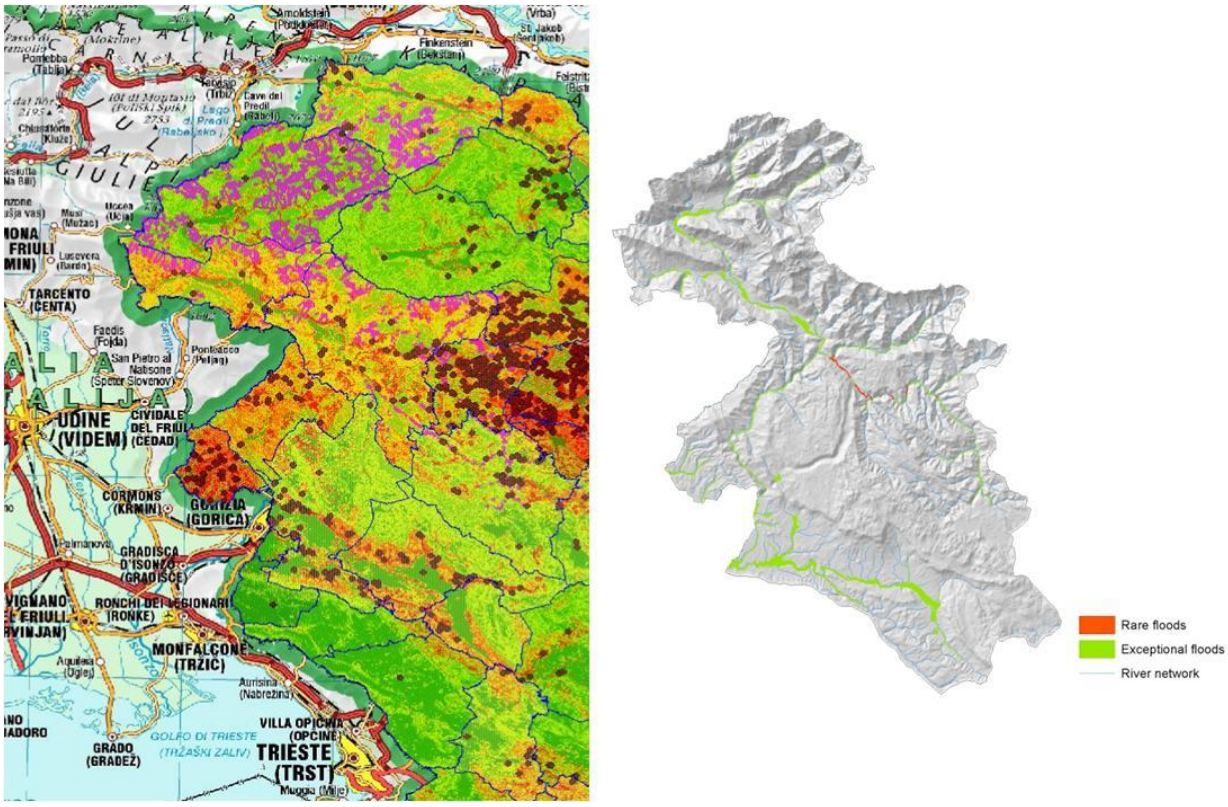

Figure 4: *Locations of registered landslides and landslide susceptibility map (left) (source:www.geopedia.si) and flood risk areas in the Soča catchment (right)*

3.1.3. Climate change

In the last decades temperatures in Slovenia increased significantly. For 2004, Ogrin (2004) reported average annual temperatures in all Slovene regions to be 0.5° to 1 °C higher than the average temperatures between 1961 and 1990, more specifically winters were 1° warmer, and the summers 1° to 1.5° warmer. The forecasts show the increase in temperatures by 1°±0.5° by 2025, and in the long term by 2°±1° by 2075. Negative

already seen influences of climate change are among others more intensive precipitation, and more frequent and more intensive extreme weather events such as droughts, floods, and thunderstorms (Ogrin, 2004). Consequently, climate change is expected to alter also areas contaminated with mercury as it can influence some of the basic conditions in which mercury reactions take place. It is expected to influence both the rates of volatilization and hydrologic fluxes of Hg. It is known from the previous studies that the majority of the Hg in the Idrija Hg-mine region is absorbed and retained relatively firmly in soils. However, future climate change could influence the distribution patterns, mobility and bioavailability of Hg and lead to changes in its uptake and accumulation in aquatic food chains. Higher frequencies of extreme events would increase the releases of Hg through surface runoff, soil erosion and flooding. In addition, in a warmer and drier environment under climate change, Hg emissions from soils will increase. Therefore, in the future environmental management activities in the Idrija mercury mine region (e.g. remediation, forestry, agricultural practices, flood control…) possible effects of the changed climate should be taken into account.

3.1.4. Human health issues (source-receptor relationships)

People are exposed to large numbers of chemicals in the environment, but the exposure is relatively poorly defined, particularly for chronic exposure to low doses. Assessment of exposure is the key to making risk assessments for human health. Many of the pollutants are environmentally persistent, volatile and mobile so that they can be dispersed in large geographical areas. Thus, the total population can be exposed over wide geographic areas. In addition, people are exposed to many chemicals in their living environment. The risk assessments are usually performed in the frame of biomonitoring studies, by measurements and monitoring of changes in organisms, tissues, fluids, cells or biochemical processes resulting from exposure to the organism to various chemicals. In addition, spatial (geographic) differences in exposure of population due to the specifics of local environment must be taken into account (e.g. locations of past and current

industrial activities, spatial distribution of pollutants in different environmental compartments...). Therefore, in addition to the results of biomonitoring (levels of contaminants in body tissues), thematic SDI needs to be build. These data then enable risks assessment to human health as well as development and implementation of risk reduction measures. Such characterization of the source/receptor relationships requires detailed data about the level of environmental exposure (Figure 5).

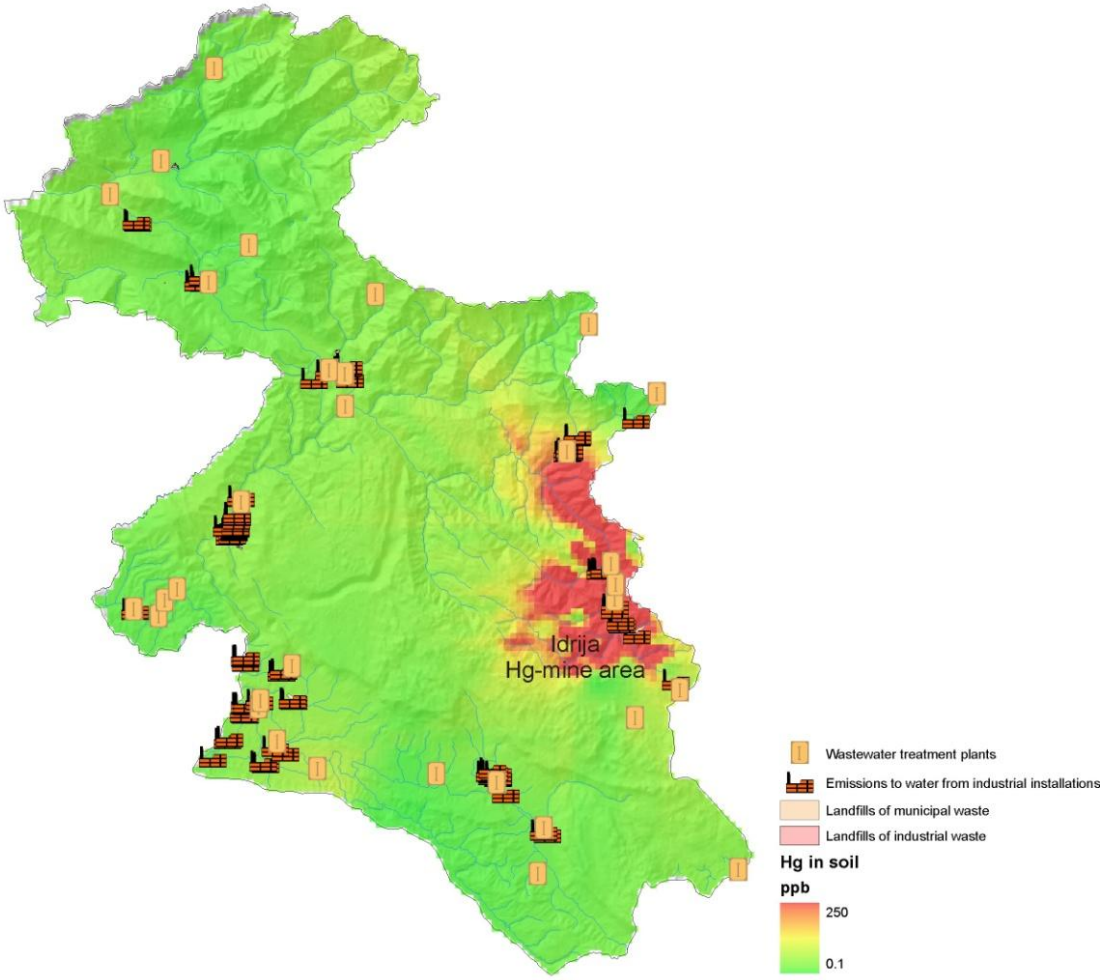

Figure 5: *Major pollution sources in Soča river catchment*

3.2. In search for environmental spatial data in Slovenia: the institutional framework at national level

In the EGIDA project, we focus only on the part of SDI which is related to the establishment of basic geographic data infrastructure, and the institutions responsible for collection, custody and distribution of spatial data relevant for the GEO societal benefit areas - environmental monitoring, environment observation and environmental research, natural resources and natural hazard management, civil protection and disaster relief. As there is no comprehensive and complete central evidence of spatial data for Slovenia, the institutions and research groups which could provide necessary data had to be identified.

In Slovenia, a great part of the development of the national SDI ran parallel to the "e-government" initiatives within the Ministry of Environment and Spatial Planning (MESP) and Ministry of Public Administration (MPA). The necessary reform of the standards and organizational aspects of SDI to adopt and transpose the INSPIRE Directive was the responsibility of the MESP. After the re-organization of the Government in January 2012, the MESP has been dissolved and the activities related to the SDI were dispersed between four restructured Ministries: the Ministry of Infrastructure and Spatial Planning (MISP), the Ministry of Agriculture and Environment (MAE), the Ministry of Economic Development and Technology (MEDT) and the Ministry of Education, Science, Culture and Sports (MESCS). As to the moment (May 2012) the detailed specification of responsibilities of each reformed Ministry is still not elaborated and the allocation of funds in the new national budget is still not clear, we briefly describe the situation before the reconstruction of national Government in 2012.

In 2009, the Surveying and Mapping Authority (SMA) was nominated by the MESP as a responsible body for INSPIRE implementation process with a mission to regulate the geographical information (GI) policy, standardization, legislation, data exchange and distribution, as well as to develop appropriate user services (metadata services,

catalogues, (meta)data distribution), raising awareness of GI infrastructure, management of human resources, research and development, provision of tools, training, data integration etc. The Infrastructure for Spatial Information Act, adopted in 2010, transposes the INSPIRE Directive and determines the entities responsible for establishing, managing and using spatial data and services, the coordination of the NSDI and its usage.

The key institution in Slovenia focusing on environmental data and applications is the Environmental Agency of Republic of Slovenia (EARS), which played an important role as the main provider and custodian of environmental spatial data. However, environmental research providing spatial data is performed at many other public and private organizations and companies, which will be described in more detail in following chapters.

3.2.1. Research funding in Slovenia

3.2.1.1 Research funding organizations

The national funding of the SDI development ran through several parallel programmes. The two governmental agencies – SMA and EARS obtained funding for their core activities related to the NSDI and regular environmental monitoring directly from the national budget, in a form of orders exempted from the public calls and/or public procurement system. All other activities, including scientific research activities providing spatial data on the environment, were funded either within the public funding scheme for scientific research and targeted research projects from governmental funds through the Slovenian Research Agency and responsible ministries and their bodies (offices, agencies), depending on the research area. In general, the Ministries are responsible for creation of policies and legislation in the area of scientific research, technology, environment and spatial planning, whereas the funding of research occurs mainly

through a public agency established by the government, responsible for research funding.

Slovenian Research Agency (SRA) is the implementing organisation of the Ministry of Higher Education, Science and Technology (until January 2012 – now MESC) and is the main funding body for scientific research in Slovenia. It was established in 2004. The government has been fully and closely engaged in determining the mandate and strategy of the SRA and in providing the necessary investments in proportion to the portfolio of the agency. SRA has the status of an independent public funding organisation which performs tasks relating to the National Research and Development Programme and creation of European Research Area.

Slovenian Technology Agency (TIA) is an independent public agency responsible for the enhancement of technology development. Its main activities are grant programs for supporting common R&D projects of (public) research institutions, universities and industry, but so far played a minor role as the funding agent for research supporting environmental SDI.

3.2.1.2. Funding instruments and programmes

Apart from direct assignments of the SMA and EARS, scientific research and partially technological R&D activities are mainly funded from the funds of the SRA through their different funding instruments; the role of other national research funding sources (foundations) in funding environmental research providing spatial data is virtually negligible. Applied research partially obtains co-funding from public sources distributed by the SRA, TIA or other governmental agencies; generally, applied research and developments projects cover between 50 and 75 % of eligible costs.

The funding instruments offered by the SRA are research programmes, infrastructure centres, research projects and targeted research projects.

Research programmes are carried out by "programme groups" in public research institutions, universities, independent education institutions and groups organised by public and private legal entities on the basis of concessions. In fact, research

programmes represent the core funding of scientific groups of most of the public research institutes and universities. The minimum amount of funding for a programme group is defined by 2 FTEs for the duration of the programme period. In the last call for funding, 288 research programmes were funded (in total 886.6 FTE). Currently 24 on-going research programmes are dealing with GIS, SDI technologies, Earth, environmental and infrastructure research which can potentially be related to GEO, funded by a total amount corresponding to 103.4 FTE per year (in average 4.1 FTE/yr per programme). A part of Research Programme instrument is also the funding of Infrastructure Programmes; currently 4 infrastructure programmes related to the NSDI and GIS are funded, in total amount of 17 FTE/yr).

Research projects are carried out by a legal or neutral person registered in the evidence record at the Agency. The selection and funding of a research project is based on the annual public calls and are subject to the public procurement regulations. *Basic research projects* are funded up to 100 % eligible costs. *Applied research projects* are co-funded by users to at least 25 % of eligible costs. Applied research may include industrial research – in this case the user's co-funding must be at least 50 %. *Post-doctoral projects* may be a basic or applied research activity implemented so that a researcher can acquire additional post-doctoral experiences and knowledge and also provides additional training for Slovenians without Slovenian citizenship returning to Slovenia.

Target research projects (CRP) represent a system for inter-sectorial cooperation in planning and implementing networked R&D projects for specific areas of public interest. The CRPs are designed and co-funded by the ARRS, responsible ministries (in the field of NSDI and environmental spatial data, MAE, MEDT, MISP, MD and MPA were the most active) and end-users, depending upon the topic of research.

From the year 2000 on, in total 114 research projects and CRPs were funded, which performed research related to the SDI development, acquisition and management of EO and spatial data from following fields of research:

Agriculture: 59

Biology: 9

Energy: 1

Environmental sciences: 20

Earth sciences: 17

Forestry: 13

Social sciences and humanities: 16

Security: 7

Communication technology: 26

Research Infrastructure: the SRA covers the fixed operating costs of research infrastructure of public research institutions and subsidises (up to 75 %) the purchase of research, information and communications equipment on the basis of public tenders and through the direct allocation of funds to ICT organisations that provide the infrastructural basis for the implementation of the National research and development programme.

International funding with national co-funding: In the area of SDI and GEO, most commonly used funding sources are the EC framework programmes, Structural funds and Cohesion funds (European Regional and Development Fund), funds devoted to support transnational bilateral and multilateral cooperation – such as Alpine, Central Europe, South-East Europe, Mediterranean, ESPON, URBACT, INTERREG, IPA, Life+ – and international initiatives (such as OneGeology, EUMETSAT and similar) which are also financed partly through national sources through memberships.

3.2.2. Research performers - key players in development of NSDI in Slovenia

The most important research performers in Slovenia are the four public universities and public research institutes. In last few years, private research institutes and public-private partnerships are becoming increasingly important players, as well as private companies, in particular in the area of technological and infrastructure development.

The key players were identified from the users' perspective, based upon the best available and most convenient entry points to the NSDI, represented by the two GEOportals (Slovenian INSPIRE GEOportal hosted by the SMA and GEOportal hosted by

the EARS), portal PROSTOR ("Space") hosted by SMA and Geopedia.si developed and hosted by a private company, Sinergise Ltd.

The main groups of stakeholders are:

- governmental agencies and offices, public and private research institutes, private companies involved in SDI development and collection of spatial data
- national S&T subjects and organisations participating in activities that could potentially build a sustainable contribution to the GOESS through resources form on-going initiatives and
- project within European and other international programmes that aim to replicate or put in practice services related to the Earth observation in the broadest sense

3.2.2.1 Relevant governmental bodies and agencies

Ministry of Economic Development and Infrastructure: Surveying and Mapping Authority of R Slovenia (SMA)

The SMA was designated by the MESP to develop the national spatial data infrastructure and is now a legal entity subordinate to the Ministry of Infrastructure and Spatial Planning. The competence comprises the creation, administration and updating of databases pertaining to the basic geodetic system, real estate, state border, spatial units and house numbers, and to the topographic and cartographic system.

The Geodesy office is responsible for basic geoinformation infrastructure, implementation of administrative and technical assignments, coordination, implementation and supervision in the field of the national geodetic system and the data on the actual situation in the physical space. It coordinates the assignments pertaining to the transition to the European coordinate system and is responsible for linking the national coordinate system with the coordinate systems of the neighbouring countries.

The Land Survey Service is responsible for the basic data on physical space and real estate in the finalized databases and provides services pertaining to the registration of changes in physical space and on real estate properties and performs the role of a coordinator in the field of the real estate system and the spatial data infrastructure.

The SMA is the responsible body for the transposition and implementation of the INSPIRE Directive; it established and manages the INSPIRE GEOportal (http://www.geoportal.gov.si/domov/), which contains or is linked to spatial data of 12 national SD custodians:

- Environment Agency (EARS)
- Biotechnical Faculty (University of Ljubljana)
- Surveying and Mapping Authority (SMA)
- Geological Survey
- Local communities
- Ministry of Infrastructure and Space
- Ministry of Education, Science, Culture and Sports
- Ministry of Agriculture and Environment
- Ministry of Interior
- Ministry of Health
- Slovenia forest service
- Fisheries Research Institute

The INSPIRE GEOportal contains 80 data collections classified in Annexes I (32), II (5) and III (43 collections) covering 34 different themes (http://www.geoportal.gov.si/seznam-zbirk/). SMA offers administrative services (ordering data, data samples, some free access databases and information on structure and validity of data) and web applications (Map Viewer, Central Evidence of Spatial Metadata – accessible through INSPIRE GEOportal). As of April 2012, 33 collections from 9 themes were specified and interoperable, while for 25 other themes the data specifications were in preparation. According to the statement of the SMA, 6 to 8 years will be needed to achieve the full interoperability of INSPIRE GEOportal linked data collections.

The SMA established the **Central Evidence of Spatial Metadata (CESM) -** Metadata base containing information on the content, purpose, use and quality of data, information on owners, administrators and distributors, information on the method, procedure, price and conditions for obtaining data as well as all the other information required for the

proper selection and usage of spatial data. The updating preserved the basic structure of the metadata description in CESM (elements in accordance with the current CENT TC/287 specification) but the access to the database changed and is now based on a three-level structure. The overview of the metadata contents is friendlier, clearer and more easily understandable for an individual user. It is divided into three levels: brief overview – it contains only the informative data on the dataset with the clear graphic representation; the content elements presented are those specified by the Dublin Core specification. Altogether, 95 metadata sets are available.

Ministry of Agriculture and Environment

1. Environment Agency of R Slovenia (EARS)

The EARS performs expert, analytical, regulatory and administrative tasks related to the environment at national level. These tasks are performed by the national services for meteorology, hydrology and seismology. The Agency's mission is also to monitor environmental contamination and to provide reliable public environmental data. The EARS provides spatial (meta)data and services through three entry points:

- GEOportal (http://gis.arso.gov.si/geoportal/catalog/main/home.page),
- the GIS based Environment Atlas (http://eionet-en.arso.gov.si/) and the
- "EIONET in Slovenia" portal (http://eionet-en.arso.gov.si/).

The EARS participates in several projects of GEO and GMES (Global Monitoring for Environment and Security), collaborates with other GEO/GMES contributing organisations (such as ECMWF – European Centre for Medium-Range Weather Forecasts; EEA – European Environment Agency; ESA – European Space Agency; ESEAS – European Sea Level Service; EUMETNET/EUCOS – Network of European Meteorological Services / Composite Observing System; EUMETSAT – European Organisation of Meteorological Satellites; EuroGeoSurveys (Association of the Geological Surveys of the European Union).

The EARS was the institution, which took the initiative for Slovenia to join the GEO in late 2005. Since then, the EARS organized 2 events aiming to inform the public about GEO/GMES activities and to bring closer different organisations and companies acting in many dispersed initiatives in this area, one in 2007 and another in 2011, in a form of half-day workshops.

Direct links between INSPIRE and GMES exist at least two points – emergency management – mapping services (service component, Action I) and pan-EU land cover monitoring service (*in situ* component, Action II).

2. *The Slovenian Nuclear Safety Administration:*

The Slovenian Nuclear Safety Administration's competence includes carrying out administrative and professional tasks and regulating, among others, radiological monitoring of the environment and early notification in case of nuclear or radiological accidents. These activities are, at least to a certain extent, related to the environmental observation and the use (and production) of spatial data. The real-time data on radioactivity measurements is publicly accessible at the www.radioaktivnost.si portal in the ROKO database, where measured data from annual reports since 1961 are compiled.

3. *Slovenia Forest Service:*

The Slovenia Forest Service is a public institution funded by the Republic of Slovenia which performs public forestry service in all Slovenian forests, irrespective of ownership. At state level it is organized with its central unit in Ljubljana, at regional level in 14 regional units, and at local level it has 93 local units and 408 forest districts. The Slovenia Forest Service also comprises 10 hunting reserves with a special purpose whose task is sustainable management of wild animals, protection of rare and endangered animal species and they also perform activities of hunting tourism. The Forest Service contributes spatial data on forests, forest composition, forest management system and hunting reserves.

4. ***Other web applications of the MAE:***

The MAE offers several web applications for viewing spatial data, relevant for environmental research; some of them are publicly available (for registered users), while other have restricted access for professionals, such as farming counselling services or similar.

Public applications for retrieving spatial data (http://rkg.gov.si/GERK/):

- eRegister of farms
- public viewer for registers such as GERK (land in agricultural use), GERK-RABA (de-facto land use on land in agricultural use, orthophoto and some other data in SMA's custody, KataKoma (land consolidation), KatMeSina (cadastre of meliorated areas), spatial data on land conversion

Spatial data application – restricted access:

- KMG-web for counselling service
- bathos (grape and wine production)
- VOLOS – register of farming animals
- eAdministration – link to the portal of the Ministry of Justice and Public Administration

Ministry of Defence: Administration of Republic of Slovenia for civil protection and disaster relief **(ACPDR)**

ACPDR performs administrative and professional protection, rescue and relief tasks as well as other tasks regarding protection against natural and other disasters. The Administration has supported several projects related to or using spatial data and data management, but the access to the data and applications is now restricted. However, upon request, it can be granted for research purposes. Some examples of spatial data in custody or possession of the ACPD:

- endangered areas and methods of classifying areas threatened by landslides,
- climate change scenarios in Slovenia as the basis for assessing the threat of natural disasters caused by the weather in the future,
- avalanche database for the municipality of Bovec (ArcView) ,
- GIS prediction model for a fire threat in a natural environment

- mobile environmental information system (MEIS) for monitoring and modelling the spread of radiological, biological and chemical pollutants in the atmosphere,
- the system of radiological air reconnaissance in connection with GIS_UJME - SZRI GIS.

3.2.2.2 Public research institutions

From many research institutions, we provide only a short list of those which could be considered as key-players in research areas relevant for SDI development and research providing spatial data relevant for the Use Case. Due to a great variety of activities, their detailed descriptions are omitted, except for the Geological Survey which is the main provider and custodian of geological spatial data in the country.

Geological Survey of R Slovenia (Geo-ZS, www.geo-zs.si)

The Geological Survey of Slovenia has the status of a public research institute, however, it is also a designated organisation which performs a part of their activities through direct orders from the Ministries. The Geo-ZS collects and stores geological data within a single Geological Information System, which was developed in the framework of the Geological Information Centre, and disseminates data to the users. Data is organized in 11 databases (Database of laboratory investigations (petrological, micropalaeontological etc.), Database of pollution with heavy metals in Slovenia, Geochemical databases, Non-metallic mineral raw materials databases , Database of research boreholes on mineral and non-mineral raw materials, Database of landslides, Database of geological cross-sections, Database of boreholes in the Kranj municipality, Database of water resources in Slovenia, Database of hydrogeological boreholes (wells), Database of hydrochemical investigations). The geological map and thematic charts are available via the web viewer and as thematic GIS layers. (Meta)data from Geological Information Center are accessible through the INSPIRE GEOportal. The activities of the Centre are funded through the SRA Infrastructure Programme funding.

University of Ljubljana:

Faculty of Civil and Geodetic Engineering, Department of Geodetic Engineering (http://www3.fgg.uni-lj.si/en/): The chair is involved in teaching, scientific research and professional work in the fields of cartography, photogrammetry and remote sensing as well as research in map design and map use, cartographic methodology and technology, topographic and non-topographic photogrammetric measurements using terrestrial and aerial systems, GIS technologies and spatial data analysis. The researchers have been involved in many national and international research projects, at the moment in FP7 project Observe and three national projects. The chair members are active representatives in ICA and ISPRS.

Biotehcnical Faculty: research activities of the Biotechnical faculty comprise collection and processing of spatial data in the fields of biodiversity, pedology and forestry. Within the Department of Agronomy (http://www.bf.uni-lj.si/en/agronomy/about/), the Centre for pedology and environment protection collects spatial data on soil characteristics and quality; the centre manages the national soil data base. Active as producer and user of spatial data is also the research group at the Chair of agrometeorology.

Research centre of the Slovenian Academy of Sciences and Arts **–** Anton Melik Geographical Institute (http://giam.zrc-sazu.si/) works on geographic information system (GIS) development and prepares GIS support for various institute projects, application of geographic information system for landform classification of Slovenia, determination of natural landscape types of Slovenia using geographic information system and thematic cartography. The Institute is also one of the founding members of the Space-SI Centre of Excellence (see below).

Slovenian Forestry Institute (http://www.gozdis.si/index.php?id=23) is managing the national Forest information system and hunting information system (OLIS).

National Institute of Biology – Marine Biology Station (http://www.nib.si/eng/index.php/oddelki/morska-bioloka-postaja-piran.html) is involved in scientific research related to GMES, such as projects MyOcean and MyOcean2 - Development and pre-

operational validation of upgraded GMES marine core services and capabilities, SESAME - Southern European seas: assessing and modelling ecosystem changes, SEADATANET - A Pan-European infrastructure for ocean and marine data management.

Jožef Stefan Institute (www.ijs.si)**–** Department of Environmental Sciences (www.environment.si) is active in environmental research and was involved in most of the research projects providing relevant environmental data upon which the Use Case is built (see Chapter 2 Use Case Objective).

3.2.2.3 Private-public and private institutions

There are many private companies registered for activities related to the spatial data management and provision, however, we outline only two which are relevant for the Use Case:

CO Vesolje (Space-SI Centre of Excellence)

The Space-SI Centre of Excellence was established in 2009 by 5 national research institutes and 6 high-tech private companies with financial support of Structural Funds and MHEST. It performs R&D in the fields of remote sensing, micro- and nanosatellite technologies, satellite communications, and development of a multidisciplinary laboratory for testing space technologies. It takes part in international space missions and transfer of space technologies to terrestrial applications. Some applications developed by the CO are the "Natural Disasters" web portal, real-time weather reports, flood monitoring etc.

Sinergise Ltd.

Sinergise Ltd. Company is a private GIS company, building large turn-key information systems in the field of agriculture and real-estate administration. It focuses on advanced applications for distributed GIS editing and GIS applications emerging from the needs of customers and packed as off-the-shelf products. During the development of GIS turn-key systems, some tools that can be used as independent products were created. They support processor intensive procedures such as image processing and topology checking.

Sinergise also offers a completely web-based GIS editing client, which has evolved into a countrywide crowd-sourcing GIS system.

3.2.2.4 Some other national projects & initiatives

BioPortal – data collection created by a private company (Center za kartografijo flore in favne – Centre for flora and fauna cartography); it contains spatial data on occurrence of more than 27000 species with over a 1 million entries from 6000 sources at 46619 localities.

Interactive map of Slovenia with collections of the Slovenian Academy of Sciences and Arts – contains archaeological cadastre, forest communities, Linguistic Atlas, a digital elevation model, passive solar, the Slovenian landscape map etc.

Interactive Geo-information portal Ljubljansko barje Natural Reserve offers viewing of more than 120 different cartographic data layers (Natural reserve borders, zonation, Natura 2000 areas, spatial development plans, agricultural use, water data etc.)

Interactive Atlas of nature conservation is an online service in which the Agency of the Republic of Slovenia, at minimal cost management and maintenance, providing access to spatial content to the widest range of users. The solution is based on the use of online geo-information (GIS) technology and now has over 10,000 users with more than a million requests a month.

Slovenian Environment Agency WEB CDS - The Catalogue of Data Sources on the Environment - CDS (KPV) provides an overview of the data collected and stored by the Slovenian authorities and institutions. The KPV is a way to fulfil the requirements of the Slovenian Environmental Protection Act (National Gazette of R Slovenia, No. 41/04), the Directive 2003/4/EC of the European Parliament and of the Council on Public Access to Environmental Information, and also of the Act on the Access to Information of Public Character (National Gazette of R Slovenia, No. 24/2003). The CDS is to be used by interested citizens, who want to know which data sources are available, who owns the sources, in what form, where and how to access these sources. It is especially suitable

for the administrators, environment-related and environmental researchers. The CDS uses the WinCDS tool developed by the EEA that is currently being adjusted to Slovenian needs and possibilities. Information on the following environmental topics is available: Air, Climate Change, Water, Nature, Noise, Chemicals and Biotechnology, Waste, Energy, Radiations, Industry and the Environment, Environmental Impact Assessment, Soil, Natural and other Disasters, Legislation, etc.

Slovenian National Landslide database is one of the first steps towards an effective strategy of fighting landslides and other slope mass movements, where virtually all known landslide occurrences are reported and described. More than 6600 landslides are registered, of which almost half occurred at a known location and were accompanied with the main characteristic descriptions.

3.2.3. International projects and initiatives contributing to GMES and GEO/GEOSS with participation of Slovenian partners

Until now, Slovenian partners participated in several international projects and initiatives which are based on EO, produced relevant spatial data or provide potential contribution to GEO/GEOSS.

AGRI4CAST - JRC Action, developing and operationally running a Crop Forecasting System since 1992 in order to provide timely crop production forecasts at European level. This system is able to monitor crop vegetation growth (cereal, oil seed crops, protein crops, sugar beet, potatoes, pastures, rice) and include the short-term effects of meteorological events on crop productions and to provide yearly yield forecasts on European crops. The AGRI4CAST system, also known as the MARS Crop Yield Forecasting System, is made by remote sensing and meteorological observations, agro-meteorological modelling (Crop Growth Monitoring System (CGMS), MARS Model Library) and statistical analysis tools. Besides, AGRI4CAST is the depositary of techniques developed using remote sensing and area frame sampling at European level to estimate crop areas. Partner from Slovenia: University of Ljubljana, Biotechnical Faculty

Balkan Trout restoration - the main interest of the group is focused toward the Balkan salmonids, which include several endemic taxa with important unresolved taxonomic problems and only little information on their distribution and conservation status. The main research efforts of the group focus on genetic analysis of the involved taxa in order to study their phyllogeography, population structure and hybridization. The ultimate aim of our research is to diagnose the taxa that exhibit their own evolutionary tendency and are so different from other taxa that they deserve a special attention in terms of their protection and conservation. Partner from Slovenia: University of Ljubljana, Biotechnical Faculty

DIS-ALP - Disaster Information System of Alpine Regions, a project funded by the Structural Funds of the EU. It supports the increase of disaster information availability and access in the field of natural disasters in alpine regions. DIS-ALP will help to harmonise the information basis and make it more easily accessible and better integrated in spatial decision-making processes. Partner from Slovenia: Podjetje za urejanje hudournikov Ltd. (Torrent Management Enterprise Ltd., www.puh.si)

DMCSEE - Drought Management Centre for South-eastern Europe, transnational project co-funded by the EU Structural funds with main objectives to prepare the regional drought monitoring, analysis, early warning products, to set-up Drought Management Centre for South East Europe and exchange knowledge, experience and best practice on drought issues (SEE network). Partner from Slovenia: University of Ljubljana, Biotechnical Faculty

EO-MINERS Earth observation for monitoring and observing environmental and societal impacts of mineral resources exploration and exploitation; EO-MINERS scientific and technical objectives are to: - assess policy requirements at macro (public) and micro (mining companies) levels and define environmental, socio-economic, societal and sustainable development criteria and indicators to be possibly dealt using EO - use existing EO knowledge and carry out new developments on demonstration sites to further demonstrate the capabilities of integrated EO-based methods and tools in monitoring, managing and contributing reducing the environmental and societal footprints of the extractive industry during all phases of a mining project, from the exploration to the exploitation and closure stages. Partner from Slovenia: Geological Survey

EuroGeoSource - EuroGeoSource is a data portal, which allows access to the aggregated geographical information on geo-energy (oil, gas, coal etc.) and mineral resources (metallic and non-metallic minerals, industrial minerals and construction materials: gravel, sand, ornamental stone etc.), coming from a wide range of sources in a significant coverage area of Europe (ten countries). The project is co-funded by the Competitiveness and Innovation Framework Programme (CIP), under the Policy Support Programme (PSP). Partner from Slovenia: Geological Survey

eWater - Multilingual cross-border access to ground water databases**;** The main objective of the project is to increase the cross-border availability, accessibility and re-usability of data on quality, location and use of subsurface waters. Geo-data market research has shown that the groundwater (geo-hydrological) data is of great market demand, occupying the second position in the rating list immediately after the data on rock composition (lithology). This data is currently stored in national databases and available exclusively for a national user in a local language. Therefore the geo-hydrological data across the national borders form separated, uncorrelated, not interoperable data sets. As the result much of the geo-hydrological spatial information is difficult to exploit in both international and national water management context. In order to achieve the main objective the project will develop an Internet system that will provide cross-border multi-lingual access to ground water spatial data sets stored in the national databases of the participating countries. The developed eWater Web portal serves as a common entrance point for all those, who have stakes in cross-border management issues, including EC. Slovenian partner: Geological Survey

I^2GPS - Integrated Interferometry and GNSS for Precision Survey is a project that developed a novel, integrated approach to the use of synthetic aperture radar interferometry (InSAR) and GNSS for use in the monitoring of subsidence, tectonic changes or other environmental hazards, which can only be identified by millimetre-precision surveying techniques. I2GPS was supported by the European Union (FP7-GALILEO-2008-GSA-1). Partner from Slovenia: Geological Survey

GMOS – Global Mercury Observation System, EU FP7 project with the overall goal to develop a coordinated global observation system for mercury, including ground-based stations at high altitude and sea level locations, ad-hoc oceanographic cruises over the Pacific, the Atlantic and the Mediterranean, and free tropospheric mercury measurements. This will then provide high quality data for the validation and application of regional and global scale atmospheric models, to give a firm basis for future policy development and implementation. Partner from Slovenia: J.Stefan Institute

SloWolf - Conservation and surveillance of the conservation status of the wolf (*Canis lupus*) population in Slovenia ; The LIFE+ SloWolf project represents the first large-scale project about wolves in Slovenia. The project is carried out collaboratively by partners from the University of Ljubljana, the Slovenian Forest Service, and the Society for the Conservation, Research and Sustainable Development of the Dinaric Alps – Dinaricum. The applicant and leader of the project is the Animal Ecology Group at the Department of Biology of the Biotechnical Faculty of the University of Ljubljana. The goal of the project is the long-term conservation of the wolf population, its main prey and habitats in Slovenia, and improvement of their coexistence with humans.

SylvaMED: Mediterranean Forests for All SylvaMED (2010-2013) is a European territorial cooperation project, part of the MED transnational program that intends to facilitate innovative integration of forests environmental services into regional policies through to demonstrate that PES and MBI systems are feasible and sustainable both environmentally and economically in our Mediterranean rural communities, providing for both long-term conservation of natural resources and additional income for local populations. Partner from Slovenia: Slovenia Forest Service

Programmes of the International Atomic Energy Agency – The isotope and hydrochemical data, together with relevant hydrogeological information on the studies on water resources conducted with support of the Water Resources Programme, either as Technical Cooperation projects or as part of Coordinated Research Projects, are being

compiled in the Isotope Hydrology Information System (ISOHIS). The system also contains the information from other monitoring programmes, such as the Global Network of Isotopes in Precipitation (GNIP), the Global Network of Isotopes in Rivers (GNIR), and Moisture Isotopes in the Biosphere and Atmosphere (MIBA). The information stored in ISOHIS can be visualized in maps and plots in the GIS-based application Water Isotope System for Data Analysis, Visualization, and Electronic Retrieval (WISER). The Isotope Hydrology Information System (ISOHIS) was developed by the Isotope Hydrology Section of the Department of Nuclear Applications of the International Atomic Energy Agency (IAEA), in co-operation with the Division of Information Technology. The database contains isotope data with related hydrological and meteorological information from several monitoring networks (GNIP, GNIR, MIBA) as well as data from isotope hydrology projects in Member States. The contents of the database include:

- Summary information about isotope hydrology projects and monitoring networks;
- Basic information about the nature and origin of water samples analysed.
- Data on the concentrations of the major and minor ions, trace constituents, isotopes, dissolved gases measured in water, and relevant hydrological/hydrogeological, geographical and analytical information.

Water Isotope System for Data Analysis, Visualization, and Electronic Retrieval (WISER), The WISER has been developed by IAEA in collaboration with the University of Vienna, IfGR. It has been designed to visualize and download isotope and related data collected as part of the IAEA-supported projects and global isotope monitoring programmes. This GIS-based application offers a number of possibilities for presenting and analysing geo-referenced isotope and hydrochemical data around the world. The graphical interface permits the creation of thematic layers as well as the easy selection of data for download in several formats. WISER also contains a direct download module. WISER provides direct access to three primary databases:

GNIP - Global Network of Isotopes in Precipitation. The GNIP module contains more than 115,000 records and is subdivided into three categories: GNIP-monthly (long-term isotope data on monthly basis), GNIP-events (stations collecting event-based samples or samples with irregular frequency) and GNIP-vapour (isotope data on water vapour). Basic summary statistics such as yearly, monthly, and long-term averages for the

stations in GNIP-monthly are provided. Download is possible through several search options.

GNIR - Global Network of Isotopes in Rivers. Tritium and stable isotope records for a number of rivers are also accessible.

IGLASS - Isotopes in Groundwater, Lakes, Springs and Streams - Hydrological, isotope and chemical results obtained as part of various technical cooperation projects and coordinated research activities supported by the Water Resources Programme of the IAEA can now be downloaded. Several search options have been included to facilitate selection of data.

Participating organization from Slovenia: Jožef Stefan Institute.

Apart from above-mentioned projects, Slovenian partners are involved in several GMES-related projects, such as: GSE Land Information Service, GSE/FM (GSE Forest Monitoring 1), GSE/FM (GSE Forest Monitoring 2), GSE/RISK-EOS, MACC - Monitoring atmospheric composition and climate, MARCOAST, MARISS, GMES-DSL – Downstream Service Land Austria – Slovenia - Andalusia, an ERA-STAR Regions project aiming to develop a concept for a cross-border (AU-SLO) land cover/land use (LC/LU) information system and to integrate European-level GMES data, mostly derived employing space borne EO data, with data already existing in the regions (GIS & in-situ data, including aerial photographs). MyOcean, MyOcean2, PANGEO - Enabling access to geological information in support of GMES, enabling free and open access to geo-hazard information. SAFER-Emergency Response Service, SAGE – GMES Service on Environmental Monitoring etc.

3.3. DPSIR

For the analytical presentation of the current status regarding data management, a DPSIR framework (Drivers, Pressure, State, Impact, Response) have been used, which is a general framework for organising information about the state of the environment (OECD, 1993). The Drivers-Pressures-State-Impact-Response (DPSIR) approach was developed by the Organisation for Economic Cooperation and Development (OECD) and is extensively used by the European Environment Agency (EEA) to provide an insight into

environmental processes and the links between human activities and their impact on the environment. The DPSIR framework assumes cause-effect relationships between interacting components of the social, economic and environmental systems, which include:

- DRIVER - Driving forces of environmental change
- PRESSURE - Pressures on the environment
- STATE - State of the environment
- IMPACT - Impacts on population, economy and ecosystems
- RESPONSE - Response of the society

Hence, '*Driving Forces*' are considered normally to be the economic and social policies of governments, and economic and social goals of those involved in industry. '*Pressures*' are the ways that these drivers are actually expressed, and the specific ways that ecosystems and their components are perturbed, i.e. for the ecosystem effects of fishing, the central pressure would be fishing effort. These pressures degrade the 'State' of the environment, which then 'Impacts' upon human health and ecosystems, causing society to 'Respond' with various policy measures, such as regulations, information and taxes (Borja, 2006). Here, DPSIR framework was used for selection of key indicators for specific environmental issues, schematic presentation of interactions and connectivity among them, management of information included in SDI as well as identification of the most important stakeholders involved. General DPSIR framework addressing environmental issues for the Slovenian use-case is shown in Figure 6.

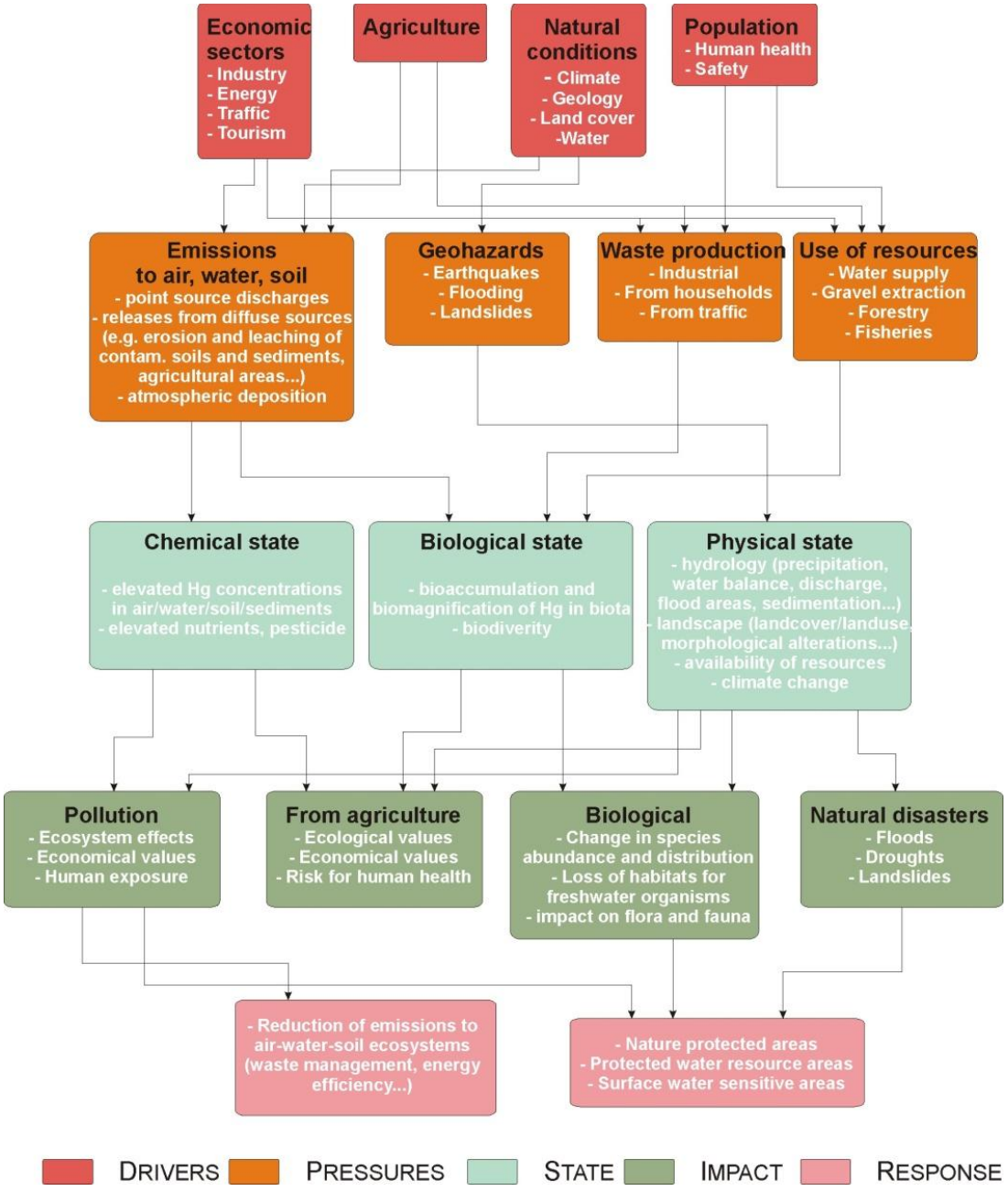

Figure 6. *General DPSIR framework for the Slovenian use-case*

3.3.1. Environmental issues in Soča catchment – interactions and connectivity

Soča catchment is subjected to multiple environmental stressors. In Figure 7, schematic presentation of interactions and connectivity of environmental multi-stressors (cause-effect relationships between interacting components), as selected for the use-case, is shown. In general, in terms of the DPSIR framework, the main *Drivers* are human health, wellbeing and safety. Therefore, the overall goal is reduction of exposure of population to various contaminants and geohazards. *Pressures* are multiple (emissions to various environmental compartments, geohazards, waste production, use of resources). *State* is defines as environmental quality, comprising of chemical, biological and physical state. *Impacts* are health and safety issues related to anthropogenically induced changes of the ecosystem and natural disasters.

Connectivity and cause-effect relationships between interacting components/issues as covered in DPSIR framework illustrated based on the example of mercury pollution:

- In terms of mercury (Hg) pollution, the main pressures on the ecosystem are Hg releases from the abandoned Idrija-Hg mine facilities, discharges from industrial point sources in the catchment and releases from diffuse sources. Due to the specific environmental behaviour and fate of mercury, these releases occur to atmospheric, aquatic and terrestrial ecosystems.
- Due to the abundant precipitation, steep slopes and highly erodible underlying lithology, this region is especially prone to erosion. As a result of erosion of Hg contaminated soils and sediments at the catchment scale, dissolved and particulate Hg phases are being carried by riverine flow downstream all the way to the marine ecosystems in the Gulf of Trieste in N Adriatic. On the other hand, due to its volatile nature, significant amounts of elemental mercury from these areas are emitted to the atmosphere.

- Soil erosion processes responsible for Hg load to aquatic systems are very complex and are affected by various spatial parameters (natural conditions) including surface geology and soils, topographic features, climate, and land use.
- The magnitude of Hg exchange between contaminated surfaces in the catchment and the atmosphere strongly depends on spatial distribution of Hg in soils, vegetation cover, solar radiation, soil moisture and temperature.
- Changed hydro-meteorological conditions as a consequence of climate change in the impacted area might significantly affect mercury's behaviour (i.e. higher frequency of extreme hydrological events leads to increase erosion and riverine transport of mercury while increased temperatures and UV irradiance would increase its surface/air exchange).
- Land and resource management can increase or decrease erosion processes (agricultural land use, other land use susceptible to erosion).
- Mercury contaminated sediments in freshwater and marine environments act as a reservoir for the production of methylmercury (MeHg), the most toxic mercury form.
- Transport of mercury away from local sources can result in the remobilization of Hg that is available for methylation, depending on parameters such as land use patterns, soil characteristics, chemical state of waters (e.g. organic pollution) etc.
- Mercury's chemical compounds, mostly organic, can bioaccumulate and biomagnify in living organisms to levels that can result in a variety of ecological and human health impacts. Human exposure, particularly the most sensitive ones (infant, children and pregnant women) is mainly through contaminated food consumption and inhalation of mercury vapour.

3.3.2. Indicators selection

With the above in mind, the key indicators for specific environmental issues addressed in the use-case and associated spatial data needs, were selected.

3.3.2.1. Hg contamination – load from terrestrial to aquatic ecosystems due to erosion

In Slovenia, due to the specific topographic and meteorological conditions, soil erosion is calculated based on the Erosion Potential Method (EPM) (Gavrilović, 1988). The EPM is a parametric distributed model which has been widely used for the annual prediction of soil erosion rates and sediment yield on the basin scale in Slovenia the western Balkans in the last decades (e.g. Nyberg and Prevodnik, 1999; Globevnik et al., 2003; Mikoš et al., 2006). The EPM has been developed for management practices in erosion protection, mainly in forest management and torrent control. Soil erosion and sediment deposition processes are determined by four main factors: geology and soil type, climate, topography and land use. The overview of the spatial data needs and the generic steps involved in the extraction of environmental indicators for the purpose of soil erosion modelling are shown in the flow-chart (Figure 7).

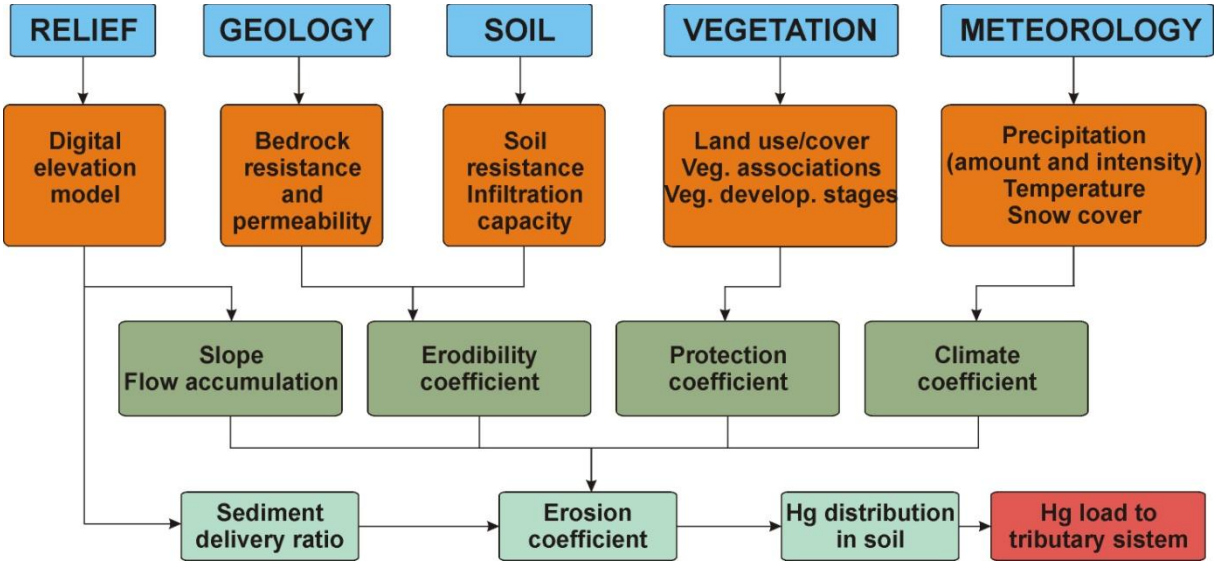

Figure 7: *Flow chart of spatial date needs for the purpose of the erosion modelling.*

3.3.2.2. Hg contamination – emissions to the atmosphere

Exchange of mercury between terrestrial environment and the atmosphere is one of the most important pathways in Hg cycle. A fraction of the Hg in contaminated surfaces in the Soča catchment is reduced and volatilized back to the atmosphere. In order to take this process into account, modelling at the catchment scale is required. The model input data consist of geographical, meteorological, land cover and mercury (Hg in soil and emission) data. Site specific empirical correlations between the Hg emission fluxes measured and the parameters controlling this process have to be established and incorporated in the model. The amount of Hg emitted from the surfaces is strongly controlled by substrate Hg concentration, vegetation cover, light intensity, moisture and temperature. Therefore, thematic spatial layers of these parameters are needed. The final result of the emission model is spatially distributed map revealing the sites which are the most significant contributors to the atmospheric load and need to be managed properly and/or remediated. The overview of the spatial data needs and the generic steps involved in the extraction of environmental indicators for the purpose of Hg emission modelling are shown in the flow-chart (Figure 8).

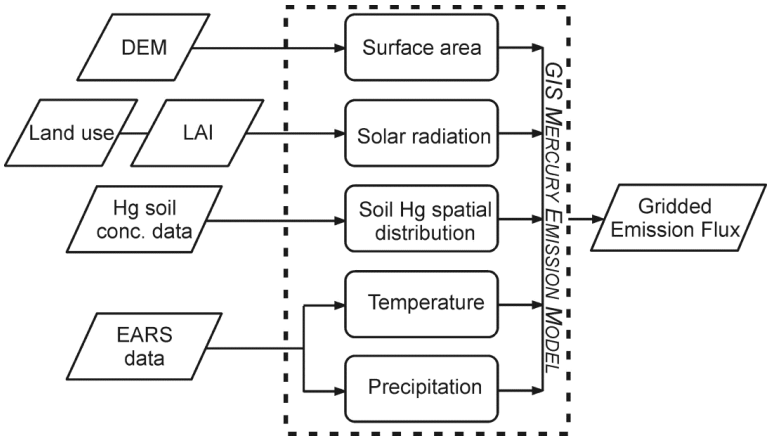

Figure 8: *Flow chart of spatial date needs for the purpose of the Hg emission modelling.*

3.3.2.3. Geohazards

Landslides: To understand natural processes such as landslides, the influencing factors on observed processes have to be defined and their interaction has to be addressed (Komac, 2012). In Slovenia, susceptibility of an area for the occurrence of landslides is studied in relation to the spatio-temporal precondition factors (lithology, slope inclination, slope curvature, slope aspect, distance to geological boundaries, distance to structural elements, distance to surface waters, flow length, and land cover type) and in relation to the triggering factors (maximum 24-h rainfall, average annual rainfall intensity, and peak ground acceleration) (Komac and Ribičič, 2006).

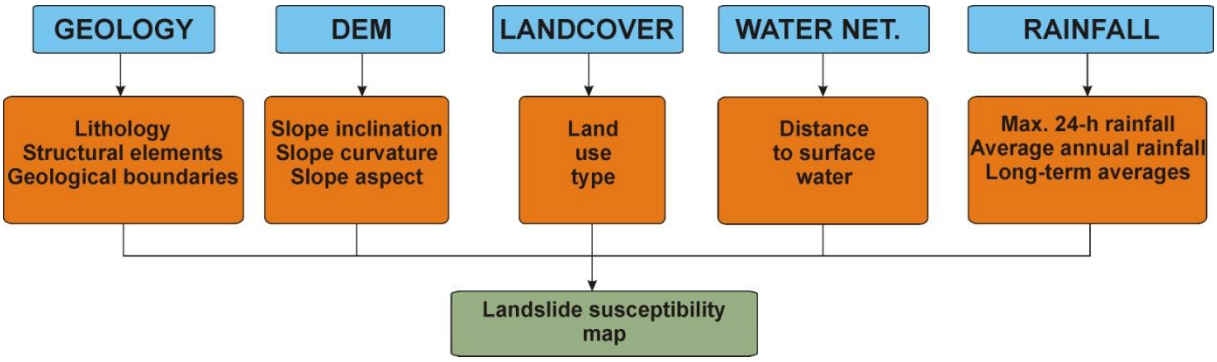

Figure 9: *Flow chart of spatial data needs for the purpose of the landslide susceptibility mapping (adopted from Komac, 2012).*

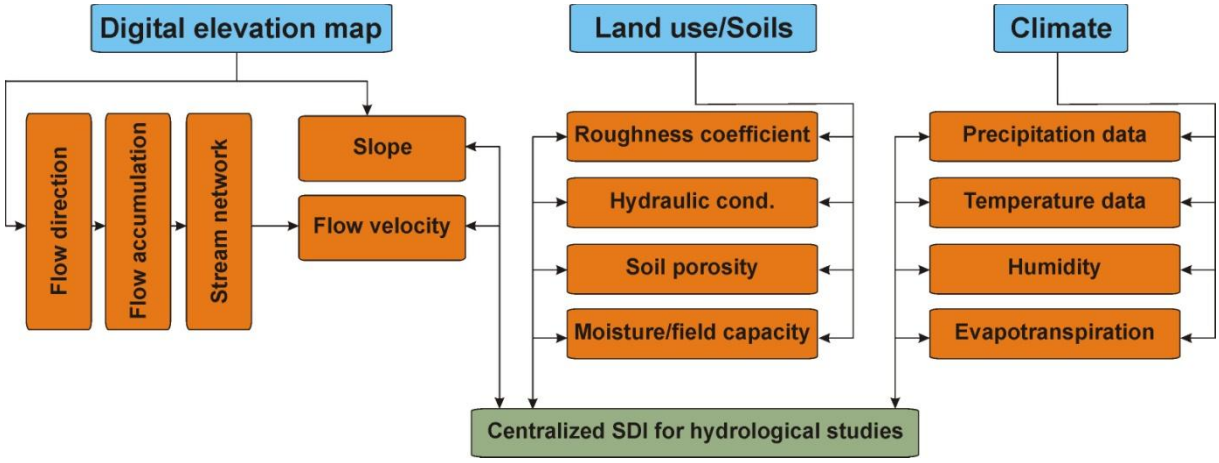

Figure 10: *Flow chart of spatial data needs for the purpose of catchment scale hydrological studies*

Floods: Depending on precipitation, we often have to face the floods, as well as the scarcity of water in the dry periods. These facts and the growth of industrialization and urbanization cause that the problems in water management turn to be ever more complex. Therefore, the solving of water management questions and problems must be ever more integral, with the aim to provide greater efficiency of the sustainable management of waters, which will be in harmony with natural conditions and environmental protection (ARSO). In Figure 10, a conceptual overview of the spatial data needs in hydrological studies dealing with catchments.

3.3.2.4. Human health – biomonitoring

Biomonitoring of the environment can be implemented with a number of methods of monitoring the ecological status of the various ecosystems and their living indicator organisms - organisms use to show the effects of pollutants (bioindication) - methods of active and passive monitoring of pollution, taking into account the analysis of the

presence and diversity of species, chemical, biochemical, genetic and other analyses. In Slovenia, biological monitoring is an essential means of systematic collection of information on exposure to various pollutants in environment. Human biomonitoring program includes investigations of various biomarkers. The results of biological monitoring are therefore indicative cumulative indicator of the living environment in terms of burden of POPs and other pollutants.

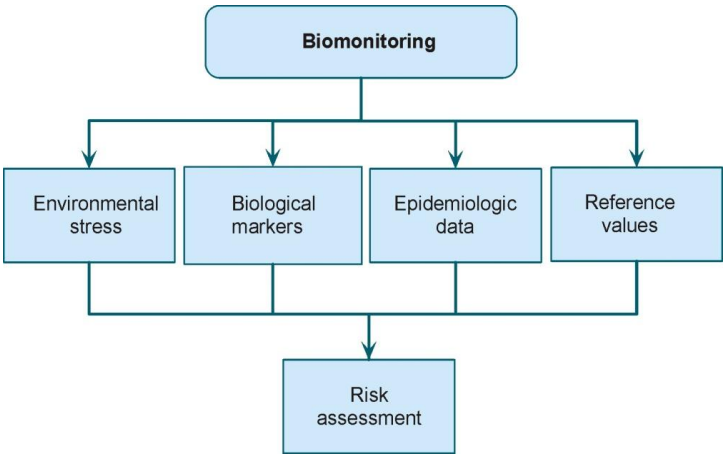

Figure 11: *Conceptual model of data flow for human exposure risk assessment*

3.3.3. Database compilation

A catalogue of spatial data was prepared, driven by data needs for environmental issues that need to be addressed in the Soča catchment and based on the relevant indicators as discussed above. The DPSIR approach was followed.

Table 1: Indicators for Slovenian use-case

Layer	DPSIR[a]	Data type	Media[b]	Source
State maps	A	Raster	T	MESP
The state border of the RS	A	Layer-shape	T	MESP
municipalities	A	Layer-shape	T	MESP
administrative units	A	Layer-shape	T	MESP
Coding system of settlements	A	ASCII	T	MESP
Coding system of streets	A	ASCII	T	MESP
cadastral area	A	Layer-shape	T	MESP
Orthophoto	A	Raster	T	MESP
Digital elevation model	A	Raster	T	MESP
Hydrographic network	A	Layer-shape	W	EARS
Surface water bodies	A	Layer-shape	W	EARS
Surface water bodies	A	Layer-shape	W	EARS
Groundwater bodies	A	Layer-shape	W	EARS
Hydrographic areas	A	Layer-shape	W	EARS
River basins	A	Layer-shape	W	EARS
Ameliorated Areas	D	Layershape		EARS
Corine Land Cover 2000	D	Layer-shape		EARS
Settlements	D	Layer-shape		EARS
Larger emission sources	D	Layer-shape	A	EARS
Air pollutant emissions from industrial sources	D	Table	A	EARS
Stone geology in Slovenia	D	Layer-shape	T	EARS
Nature protected areas	D	Layer-shape		EARS
Sewage Areas	P	Layer-shape	W	EARS
Water Supply Areas	P	Layer-shape	W	EARS
Municipal Waste Water Treatment Plants	P	Layer-shape	W	EARS
Generation of municipal waste	P	Table		EARS

Generation of industrial waste	P	Table		EARS
Generation of hazardous waste	P	Table		EARS
SO2 emissions by administrative units	P	Layer-shape	A	EARS
NO2 emissions by administrative units	P	Layer-shape	A	EARS
Air pollutant emissions by main source categories	P	Table	A	EARS
Greenhouse gas emissions	P	Table	A	EARS
Emissions to water from industrial installations	P	Layer-shape	T	EARS
Landfills of industrial waste	P	Layer-shape	T	EARS
Landfills of municipal waste	P	Layer-shape	T	EARS
Wastewater treatment plants	P	Layer-shape	T	EARS
Protected Water Resources	R	Layer-shape	W	EARS
Nature Protected Areas	R	Layer-shape	W	EARS
Protected Water Resource Areas	R	Layer-shape	W	EARS
Landslide susceptibility map of Slovenia	R	Layer-shape	T	Geological Survey
Approved change of land use	R	Layer-shape	T	MAFF
Valuable natural features	R	Layer-shape		EARS
Ecologically important areas	R	Layer-shape		EARS
Local protected areas	R	Layer-shape		EARS
National protected areas	R	Layer-shape		EARS
Natura 2000 areas	R	Layer-shape		EARS
Water protection areas	R	Layer-shape	W	EARS
Water protection areas	R	Layer-shape	W	EARS
Water management sections	R	Layer-shape	W	EARS
Flood Areas	S	Layer-shape	W	EARS
Annual Precipitations	S	Layer-shape	W	EARS
Industrial waste landfills in Slovenia	S	Table		EARS
Municipal waste landfills in Slovenia	S	Table		EARS
Assessment of air quality for particulate matters (PM10) in Slovenia	S	Layer-shape	A	EARS
Hydrogeological map of	S	Layer-shape	W	Geological

Slovenia 1:250.000 - IAH (2004)				Survey
Map of water infiltration	S	Layer-shape	W	Geological Survey
Major water springs	S	Layer-shape	W	Geological Survey
Engineering geological map of Slovenia	S	Raster	T	Geological Survey
Engineering geological map of Slovenia - erosion	S	Layer-shape	T	Geological Survey
Engineering geological map of Slovenia - rock resistance Layer-shape	S	Layer-shape	T	Geological Survey
Engineering geological map of Slovenia - soil thickness	S	Layer-shape	T	Geological Survey
Engineering geological map of Slovenia - stability	S	Layer-shape	T	Geological Survey
Stability map of Slovenia - landslides	S	Raster	T	Geological Survey
Digital basic geological map of Slovenia	S	Layer-shape	T	Geological Survey
Geochemical map of Slovenia	S	Raster	T	Geological Survey
Map of natural radioactivity in Slovenia	S	Raster	T	Geological Survey
Structural - tectonic map of Slovenia	S	Layer-shape	T	Geological Survey
Graphical units of agricultural land use (GERK)	S	Layer-shape	T	MAFF
De-facto land use	S	Layer-shape	T	MAFF
Land Consolidation	S	Layer-shape	T	MAFF
Meliorated areas	S	Layer-shape	T	MAFF
Pedology map	S	Layer-shape	T	MAFF
Forest Communities of Slovenia	S	Layer-shape	T	ZRC SAZU
Solar Radiation in Slovenia	S	Raster	T	ZRC SAZU
Satellite images - Landsat	S	Raster	T	ZRC SAZU
Satellite images – Land Use	S	Raster	T	ZRC SAZU
Soil textural classes map	S	Raster		Biotechnical faculty
Soil organic matter map	S	Raster		Biotechnical faculty

Soil thickness map	S	Raster		Biotechnical faculty
Soil pH map	S	Raster		Biotechnical faculty
Soil water retention capacity	S	Raster		Biotechnical faculty
Various air temperature maps	S	Layer-shape	A	EARS
Snow cover maps	S	Layer-shape	A	EARS
Precipitation maps	S	Layer-shape	A	EARS
Bright sunshine duration	S	Layer-shape	A	EARS
Wind speed	S	Layer-shape	A	EARS
Air quality evaluation zones	S	Layer-shape	A	EARS
Corine land cover 1995-2006	S	Layer-shape	T	EARS
Soil pollution monitoring map	S	Layer-shape	T	EARS
Fish water segments	S	Layer-shape	W	EARS
Eco type of watercourse	S	Layer-shape	W	EARS
Eco type of coastal waters	S	Layer-shape	W	EARS
Hydrogeological map IAH	S	Layer-shape	T	EARS
Flood waters	S	Layer-shape	W	EARS

[a] *D-river,P-pressure, S-state ,-impact, R-response, A-ancilary data*
[b] *T-terrestrial, W-water, A-air*

4 Description of the EGIDA Methodology Transfer process

The list of networking and technical activities listed in EGIDA Methodology was followed. Performed actions comprise:

- relevant stakeholders from research, industry, policy & decision making and funding bodies were defined
- metadata and spatial data providers at national and international level (GEOportal, INSPIRE GEOportal, CESM, EIONET, EoE, Geopedia.si, national projects) were examined
- relevant national and international (at EU level) initiatives and projects where Slovenian partners are involved were investigated
- national role in GEO was evaluated
- compatibility of data bases and infrastructures was checked
- level of awareness of identified stakeholders about GEO/GEOSS was examined
- network of stakeholders, supporting a common information network potentially contributing to GEOSS was created

4.1. Actions and sub-actions applied

4.1.1. Networking activities (NA)

The networking activities followed the recommended set of activities in EGIDA Methodology, but were matched to the needs of the Use Case and current situation in the Stakeholder Network.

NA1: Identification of stakeholders

In collection of national stakeholders network, two basic documents – Spatial Data Infrastructures in Slovenia: State of play 2010 (Vandenbroucke et al., 2010) and State of Play 2011 (Vandenbroucke et al., 2011) – were used as the entry point of obtaining information. Further, information on institutions, companies, national projects and initiatives funded from public sources for research and development projects in the areas of spatial data infrastructure and environmental research was collected in the *SICRIS* – information system developed and maintained by the Institute of Information Science (IZUM) and the SRA (http://sicris.izum.si/default.aspx?lang=eng). Since private funding of these activities in Slovenia is negligible, we have reason to believe that this was the most appropriate way to identify the key institutions and companies in the country active in these two areas. SICRIS contains information on research organizations (905), research groups (1431), research projects (5714) and research programmes (438), fully or partly financed by the Ministry of Science since 1995. Further, the list of EU FP5-7 and transnational cooperation projects in the ICT and Environment and Climate Change domains (accessible at CORDIS) was checked to find potential partners in on-going or already completed projects.

From those, the potential stakeholders form the research community were identified and invited to participate in the network activities (4 ministries, 2 public agencies, 40 institutions and private companies, 36 infrastructure centres and research programmes, 113 projects and some individual researchers), all of them potential data providers, custodians, distributors, users, or developers of technologies or SD applications.

The stakeholders identified in the networking process include:

- Information providers – research institutions and groups
- Technology providers – key players in the SDI development (EARS, SMA, Space-SI Centre of Excellence, Sinergise Ltd.)
- Intermediate users: public research institutes and companies dealing with data collection, data harvesting and use of environmental spatial data
- Final users: public and governmental bodies, such as Administration for civil protection and disaster relief and Nuclear Safety Administration

- Advisors – mainly technology and information providers experienced in data collection, Earth observation and SDI design (EARS, SMA, public research institutes) described in Section 3.2

NA2 & NA3: Assessment of the awareness of GEO/GEOSS initiative in the proposed network and Dissemination of the GEO/GEOSS initiative in the proposed network

Assessment of the awareness of GEO/GEOSS and dissemination of the GEO/GEOSS initiative ran parallel to the identification and through the initial contacts with potential stakeholders.

Two main networking activities took place within the networking activities to assess the awareness and disseminate the GEO/GEOSS initiative in the network :

- workshop May 2011 organised by the EARS
- workshop "Collecting, processing and application of spatial data: GEO, GMES and national initiatives in Slovenia" on 16 February 2012 in Ljubljana

In May 2011, a GEO/GEOSS promotion workshop was organised by the EARS in Ljubljana, where some international GEO-related projects with Slovenian partners were presented and the GEO/GEOSS activities were promoted by the representative of the EC DG Research. This was the first organized contact with most partners which played a relevant role in the Use Case network.

The main networking event was the workshop in 2012 organized by the J. Stefan Institute (representing EGIDA and BalkanGEOnet projects) and Department of Geodesy of the Faculty of Civil and Geodetic Engineering (representing OBSERVE). A questionnaire on the relation to EO activities, data and their use was prepared by BalkanGEOnet and OBSERVE consortia and the results were presented at the workshop in February 2012 in Ljubljana (Kosmatin-Fras, 2012). 80 % of interviewed stakeholders use spatial data daily or weekly and are aware of GEO initiatives. The promotion of GMES, GEO and GEOSS was one of the main targets of the workshop. Although the information on possibilities for registration of components or services in GEOSS was disseminated,

the response of data producers and custodians was not as positive as expected. Common opinion was that in general, such actions should be perceived as positive, however, no motivation was found to get actively involved in building components as possible contribution to GEO/GEOSS. Because of lacking coordination of EO activities, a top-down action would be preferred, coordinated by one of the responsible ministries (MEDT, MAE) or agencies (EARS, SMA). To the moment, however, none of these institutions was willing to take the initiative since none has mandate to take the lead of such action, or allocated resources to support it.

Information on the Workshop was provided also by the Earthzine (Lojen et al., 2012, http://www.earthzine.org/2012/03/06/a-workshop-in-slovenia-on-collecting-processing-and-the-application-of-environmental-and-spatial-data/).

NA4: Operation of the network

The operation of the network is on one hand facilitated by the three GEO/GEOSS related on-going EU FP7 projects (EGIDA, OBSERVE, BalkanGEOnet) and on the other through the bottom-up initiative of the stakeholders who are interested in exchange of information, data, applications and collaboration in common projects and initiatives. Stakeholders already collaborate in several common R&D projects at national and international level, so that the contacts are easily maintained. Operation of such a network in a small country is usually easy because of a small community, which makes finding contact easier; small number of stakeholders facilitates direct (personal) communication, which is still the most efficient. Therefore, a small country definitely represents an advantage for networking. On the other hand, the size, capacities and the number of research groups dealing with a certain topic can be insufficient to create a critical mass of knowledge and resources to perform large projects. This is in particular evident in some complex projects in the field of environmental research and management. Therefore finding contacts outside the borders of the own country is decisive for their accomplishment.

The stakeholders identified as the first priority the coordination of the activities related to environmental spatial data collection, provision and building of environmental SDI. Currently, the GMES activities are in the focus of the key stakeholders.

NA5: Addressing sustainability of the reengineering process

Although Slovenia has officially joined the GEO community in 2005, it's visibility in GEO and GOESS remained rather low. In fact, no progress has been made within 7 years of the membership, although the national spatial data infrastructure made a considerable development; in this time, the environmental monitoring programmes mostly performed by the EARS were modernised in terms of instrumentation, general approach and deliverables which are now mostly available as time series of spatial data, adequately catalogued and available on-line, to a great extent free of charge. In parallel with national activities related to transposition and implementation of the INSPIRE Directive, Slovenian partners participate in several international projects and actions dedicated to technological and non-technological development of SDI and Earth observation systems. To adequately address the sustainability of the (re)engineering process of a use-case dedicated spatial data infrastructure, a **gap analysis** was performed in collaboration with the stakeholders. Following most relevant issues were identified:

1. Problems in use and exchange of spatial data: data is expensive, incomplete, out-of-date, not easily available or not accessible at all, erroneous, lack of continuity in time and space
2. Lack of quality control of spatial data and data layers: quality control is responsibility of the data producers. Larger public research institutions have their own quality management systems and protocols, which results also in produced datasets, however, the level of control decreases in crowd-sourced applications.
3. Data formats are not harmonized, data bases are not interoperable: the opinion of the SMA- the INSPIRE GEOportal custodian - is that complete interoperability of data on the portal will not be achieved before 2020.

4. Lack of continuity of research funding is reflected in lack of temporal and spatial continuity of data and poor or no maintenance of many of existing databases
5. Lack of national evidence and coordination of activities leads to complete fragmentation of activities and in some cases even replication of data collection
6. Most of stakeholders recognize the advantages and benefits of a global EO system and (meta)data repository (quick and simple access and exchange of data, lower costs for the end-user, central entry point), but most of them don't see themselves as potential contributor to such a system
7. Poor dissemination of information on existing and new data and applications; competition of public research groups for national research funding has sometimes even negative effects on the willingness for collaboration.
8. Lack of appropriate and/or affordable education programmes for data users
9. Lack of continuity of education of data users
10. Inconsistent national research policy results in lack of incentives for researchers to insist on (a) long-term maintenance of spatial data bases and (b) develop a contribution to GEOSS in terms of new components
11. The recent economic crisis led to the reconstruction of government, which reduced the number of ministries. The NSDI, environmental SDI and environmental research which used to be in the domain of MESP with financial support for research activities in the form of ARRS grants, is now coordinated by different governmental bodies split between 5 different ministries, which – considering the traditional lack of inter-sectorial cooperation and coordination of activities – represents a serious drawback for future activities.

4.1.2. Technical activities (TA)

In the light of Slovenian use-case objectives, already existing environmental data and information should be organised in an integrated System-of-Systems based on information/data access, sharing and interoperability principles. Therefore, in the

following sections a systematic analysis of national SDI, available datasets, data providers, information sources and relevant projects is given. In contact with data users and data providers from different SBAs, the results of analysis are discussed.

TA.1 Management structure and process for capacity building

TA.1a Central coordination:

In Slovenia, most of the SDI is organised at national level and build in a centralized top-down approach. The most important actor for developing of the Slovenian SDI is Surveying and Mapping Authority of Slovenia (SMA) which is a body within the Ministry of Environmental and Spatial Planning (MESP). The competence of the SMA comprises the assignments of the national land survey service, which include the creation, administration and updating of databases pertaining to the basic geodetic system, real estate, state border, spatial units and house numbers, and to the topographic and cartographic system. The land survey service is responsible for the basic data on physical space and real estate in the finalized databases and provides services pertaining to the registration of changes in physical space and on real estate properties, performs the role of a coordinator in the field of the real estate system and the spatial data infrastructure. It creates conditions for implementing land surveys and ensures the compliance of the national coordinate system with the European coordinate system. In addition, the Environmental Agency of the Republic of Slovenia (EARS) which is also part of MESP is another important actor in the development of SDI. EARS performs expert, analytical, regulatory and administrative tasks related to the environment at the national level. The agency is responsible for Catalogue of Spatial Data Sources on the Environment and Environmental Atlas of Slovenia (available at http://kpv.arso.gov.si/welcome/welcome?L1=94&L2=302). Moreover, there is a number of governmental agencies, institutes and authorities that are either producers or data holder or both within different SBA (Statistical office, Ministry of Agriculture Forestry and Food, Ministry of Defence, Ministry of Transportation, University of Ljubljana -

Biotechnical Faculty, Geological Survey of Slovenia, Forestry Institute, ZRC SAZU - Research Centre of the Slovenian Academy of Sciences and Arts).

Apart from the SDI developed by governmental agencies, various thematic environmental datasets exist, partly being offered on the internet that was produced within national and European research projects or as a result of crowd-sourcing within private initiatives (e.g. Geopedia - www.geopedia.si). In Table 2, a summary of existing SDIs from various sources (public and private, various projects related…) available for the Use-Case is shown.

Table 2: SDIs and thematic environmental datasets available for the Use-Case.

Name	Description with link
Agrometeorological sensor viewer	Sensor measurements data co-related to GIS. Sensors measure data relevant for agriculture (Temperature, humidity, leaf wetness, rainfall, wind speed and direction http://www.fito-info.si/index1.asp?ID=Prognoze/postaje/mreza1.asp
BalkanGEOnet	This project aims to identify existing EO-data providers and users in the wider Balkan region, to determine their status, potentials and needs, and to coordinate EO players by establishing proper interfaces and networking between them. A broad analysis of gaps and complementarities of EO activities within the region will be performed, with the emphasis on user needs in the specific context of the Balkan region. **http://www.balkangeo.net/**
Catalogue of Data Sources on the Environment	The Catalogue of Data Sources on the Environment - CDS (KPV) provides an overview of the data collected and stored by the Slovenian authorities and institutions. http://kpv.arso.gov.si/index_html/welcome?L1=94&L2=302
CESM - Central Evidence of Spatial Metadata	Metadata contain information on the content, purpose, use and quality of data, information on owners, administrators and distributors, information on the method, procedure, price and conditions for obtaining data as well as all the other information required for the proper selection and usage of spatial data. http://prostor.gov.si/cepp_ang/index.jsp
Current Road traffic	Interactive map of Slovenian roads, showing current situation on them (road work,

	congestions…) http://promet.si/portal/sl/razmere.aspx
Digital bathymetric model	Digital bathymetric model of Slovenian see. http://www.harphasea.com/images/pdf/geod_vestnik_meritve_morja.pdf
Drought Management Centre for South-eastern Europe	The main aim of this project and DMCSEE is to improve drought preparedness (risk assessment and early warning system) and to reduce drought impacts. http://www.dmcsee.org/
EARS GEOportal - including Environmental Atlas	portal for browsing, searching and downloading metadata sets related to GIS layers in the EARS domain, all together 114 publicly accessible datasets related to the status of the environment in Slovenia; data can be transferred using WFS application http://gis.arso.gov.si/geoportal/catalog/main/home.page
EGI-INSPIRE	European Grid Initiative: Integrated Sustainable Pan-European Infrastructure for Researchers in Europe
ENGIS	EnGIS is a web application that provides an overview of renewable energy sources in Slovenia. The purpose of the evaluation of applications throughout the energy potential and energy economy in Slovenia http://www.engis.si/
eWater	Multilingual cross-border access to ground water databases; The main objective of the project is to increase the cross-border availability, accessibility and re-usability of data on quality, location and use of subsurface waters.
Floods in Slovenia	An European Space-based mapping service to support crisis management http://www.emergencyresponse.eu/gmes/en/event/Floods-in-Slovenia_25.html
Forest response to anticipated climate change	Changes in spatial distribution of forests as a result of the impact of projected climate change. http://petelin.gozdis.si/splet/?p=raziskava&id=32
Geology of Slovenia	Lithostratigraphic units, important geologic structures and regional faults in Slovenia. http://kalcedon.geo-zs.si/website/OGK100/viewer.htm
GEOPEDIA	The largest national collection of spatial data, considered as a compelling example for crowd-sourced SDI; see description in highlighted section; www.geopedia.si
GIC (Geological Information Centre)	Digital geological map of Slovenia and related spatial data.

Interactive map of Slovenia with databases of ZRC SAZU	archaeological cadastre, forest communities, Linguistic Atlas, a digital elevation model, passive solar, the Slovenian landscape http://gis.zrc-sazu.si/zrcgis/
Interactive Atlas of nature conservation	Interactive Atlas of nature conservation is an online service in which the Agency of the Republic of Slovenia, at minimal cost management and maintenance, providing access to spatial content to the widest range of users. The solution is based on the use of online geo-information (GIS) technology and now has over 10,000 users with more than a million requests a month. http://kremen.arso.gov.si/NVatlas/
Kaliopa	GIS data at municipality level http://gis.iobcina.si/help/index.html?video_vsebine.htm
Land survey data viewer	Collection of Slovenian GIS related data such as orthophoto, heights, borders, real estates, building information, Land Cadastre, topographic cards… http://prostor.gov.si/iokno/iokno.jsp
Lidar Observatory at Otlica	In cooperation with EARS Otlica is since 2006 a part of the national network for environmental monitoring; standard meteorological and environmental measurements are routinely performed and presented online on the EARS web pages. http://www.ung.si/en/research/atmospheric-research/
LIDAR pictures of Slovenia	High resolution DEM based on LIDAR technology. http://www.poplavljen.si/
MACC	Monitoring atmospheric composition and climate
MACC - Monitoring Atmospheric Composition and Climate	Global Forecasts, European Air Quality Forecasts, UV index forecasts, GEMS Reanalysis http://www.gmes-atmosphere.eu/about/product_portfolio/
MARCOAST	Satellite-based services in the field of marine and coastal applications http://www.gmes-marcoast.info/
Natural landscape types of Slovenia	National Research Project; On the basis of digital data on relief, rock, and vegetation, the most significant elements of the internal structure of Slovene landscapes and at the same time of their external appearance, the geographic information system and verification in the field will be employed to elaborate a natural landscape typification of Slovenia.

OBSERVE	Strengthening and development of Earth Observation activities for the environment in the Balkan area
PANGEO	Enabling access to geological information in support of GMES http://www.pangeoproject.eu/
PISO - prostorski informacijski sistem občin (spatial information system of municipalities)	Municipalities geoinformation systems in Slovenia. http://www.geoprostor.net/PisoPortal/Default.aspx?
Portal GIS Ujme	EGIS_UJME Information System is a Web GIS application that allows users to review spatial information related to the protection and rescue throughout the Republic of Slovenia. http://gis3.sos112.si/portal-gis_ujme/
Space SI	Slovenian Centre of Excellence for Space Sciences and Technologies Space-SI http://www.space.si/r-r-projekti
SAFER-Emergency Response Service	implementation of ERS within GMES http://www.emergencyresponse.eu/site/FO/scripts/myFO_contenu.php?noeu_id=32&lang=EN
SAGE	GMES Service on Environmental Monitoring http://www.gmes-sage.info/ps/index.php
SLOVENIAN COAST SEA FLOODS RISK	The flood risk map in the coastal area of Slovenia has been made http://www.harphasea.com/images/pdf/Ogrozenost%20slovenske%20obale%20zaradi%20poplav.pdf
Slovenian forests	Slovenia forest maps service. http://www.zgs.gov.si/slo/gozdovi-slovenije/o-gozdovih-slovenije/karte/index.html
Slovenian National Landslide database	http://sraka.uni-mb.si/geologija/dokument.aspx?id=510
SPIN	Interactive atlas of current disasters in Slovenia. The disasters that happened in the last 12 hours are noted. They note car accidents, natural disasters, fires, pollutions… http://spin.sos112.si/spin2/Javno/GIS/GraficniPrikaz.aspx

Surveying cadastre	Land survey service is responsible for the basic data on space and real estate in the finalised databases and provides services pertaining to the registration of changes in space and on real estate properties, performs a coordination role in the field of the real estate system and spatial data infrastructure. http://e-prostor.gov.si
TERRAFIRMA	Ground motion hazard information service, distributed throughout Europe via national geological surveys and institutions. http://www.terrafirma.eu.com/products.htm

Due to the variety of SDIs sources and the nature of data holders (public/private), for the Slovenian use-case SDI management structure and capacity building, a combination of bottom-up approach and top-down approach is considered.

Table 3: Data providers relevant for Slovenia use-case and sorted by social benefit areas.

SBA	National	Other
Disasters	ARSO, Nuclear Safety Administration, GeoZS, Administration for Civil Protection and Disaster Relief	projects
Health	Health Protection Institute	GMOS, DEMOCOPHES
Energy	CESM,	Geopedia
Climate	ARSO	
Water	ARSO, Geo-ZS	
Weather	ARSO	
Ecosystems	Forestry Institute, Institute of RS for Nature Conservation, Slovenian Academy of Sciences and Arts	Geopedia
Agriculture	Ministry of Agriculture, Forestry and Food	
Biodiversity	Slovenian Academy of Sciences and Arts, Hunting Association, Biotechnical Faculty, Geopedia	

TA.1b Thematic working groups

Taking into account the multi-disciplinary and multi-thematic nature of the Slovenian use-case as well as its national context, Thematic Working Groups (TWG) are defined as a combination of GEOSS SBAs and environmental indicators of the DPSIR framework, as defined in Section 4. The following TWGs were recognised:

- Soil/water/air quality
- Hydrogeological hazards
- Climate change
- Human health

TA.1c Identification of relevant transversal areas/themes

Eventual relevant transversal areas/themes will be identified in a course of the project through the DPSIR analysis (see section 3.3).

TA.2 Identification and removal of barriers to information sharing

As stated in the Inspire member state report for 2010 (Inspire, 2010), the coordination group responsible for cooperation of all managers of spatial data sets and services and the users thereof has not been yet appointed in Slovenia. Consequently, measures for sharing the spatial data sets and the services related thereto were still not properly addressed. An intersectorial coordination group at national level is foreseen, as a strategic body for directing the measures for sharing the spatial data sets and the services related thereto. Such a coordination group will advise and offer help to individual public authorities in preparing the legal acts in the field of regulating and managing spatial data sets and their usage (Inspire, 2010). However, non-governmental initiatives involved in SDIs are not taken into account in these plans. Here, in the light of SDI

creation needed for the Slovenian Use Case, the following barriers to information sharing were recognised:

1. Existing SDIs are thematic and fragmented between different sectors/public administrations and NGOs. Therefore, often a combined use of several applications and copying data from one to another is needed, representing much of inconvenience for the users. Moreover, for projects where combined data from various sources are needed, the process of spatial data gathering can be unreasonably long and expensive.
2. The Central Evidence of Spatial Metadata (CESM) is existing and is being maintained by EARS. CESM is the most comprehensive directory of digital geospatial data sources and its providers in Republic of Slovenia. The directory is designed to contain information about content, purpose, usage, quality, distribution and all other information necessary to select and use available spatial data. However, contribution of metadata by data holders is voluntary and there are no incentives for the contributors. Also important is the fact that there is extremely low level or no awareness of its existence. Moreover, there is no standardise approach for metadata creation and some spatial data sets are of unsatisfactory or undefined quality.
3. Poor or non-existent communication between data providers and/or institutions participating in different (national or international) projects related to SDI, EO and GEO/GEOSS, no information flow: a platform for discussion is missing.
4. Many data providers still reluctant to share data
5. Lack of information: Which data can I share? How can I share my data? How will my intellectual property be protected? – all issues, in fact, covered by GEO data sharing principles
6. Data policy not defined. E.g., there are no clear criteria and conditions for determining the fee for data and service sharing by public data holders.
7. The problem of licensing for data sharing not addressed

8. A survey among the national stakeholders performed by OBSERVE and BalkanGEOnet projects showed that the main problems users face in search for spatial data are fragmentation of available data, poor coordination of data providers, data discovery services, managers and users, high prices charged by some providers and incompatible data formats. Another burning issue is a lack of a data quality control systems for datasets not compliant with INSPIRE, many data sets are out-of-date, incomplete or hardly accessible.

Actions taken to overcome/remove barriers to data sharing:

On February 16, 2012, a workshop with round table discussion on collection, processing and application of environmental and spatial data in Slovenia was held in Ljubljana, hosted by Slovenian partners of three on-going EU FP7 support actions: OBSERVE (University of Ljubljana, Faculty of Civil and Geodetic Engineering), BalkanGEOnet and EGIDA (Jožef Stefan Institute) and the Slovenian Centre of Excellence for Space Sciences and Technologies Space-SI. The goal was to inform national stakeholders, experts, policy makers and academics on the current status and on-going activities related to the GEO (Group of Earth Observation), GEOSS (Global Earth Observation System of Systems) and GMES (Global Monitoring for Environment and Security).

The workshop was attended by 68 representatives of spatial data providers and users, among others, the key institutions providing and managing spatial data and data collection – Surveying and Mapping Administration, Environment Agency of Slovenia, Geological Survey, Ministry of Defence, Ministry of Agriculture and Environment, Ministry of Economic Development and Technology, Biotechnical Faculty, Academy of Sciences and Arts, Forestry Institute, Statistical Office, and others, who presented the current status and activities in development of national spatial data infrastructure.

As the needs and number of spatial datasets are constantly increasing, private sector became more and more involved and several private web-portals emerged. One of the Fling examples is the Geopedia.si portal, established in 2007 (www.geopedia.si) which until now grew from a crowd-sourcing application to a commonly used research tool. A common view of participants of the vivid round-table discussion was that not the lack of

spatial data, but the lack of coordination of activities in data provision and sharing, and in particular lack of applications for processing and gathering information from spatial data have to be overcome in action coordinated at national level, where the governmental bodies shall play a leading role through better inter-sectorial coordination of their activities.

TA.3 Design of a national/regional resource sharing systems

TA.3a Existing systems/sub-systems

Based on the analysis of the available resources in Slovenia that could be part of wider SoS the following existing services/infrastructures that could be useful for the Slovenian use-case were identified.

- **EARS GEOportal - including Environmental Atlas:** EARS GEOportal is portal for browsing, searching and downloading metadata sets related to GIS layers in the EARS domain. Altogether, 114 publicly accessible datasets related to the status of the environment in Slovenia are available that can be transferred using WFS application (http://gis.arso.gov.si/wfs_web). WFS EARS allow the export of spatial data in Shp or. GML format. Data are organised in seven thematic groups: climate, environment, soil, nature, earthquakes, water, monitoring. WFS application consists of two parts. The first part is for the display of all the spatial data that are publicly accessible, while the second part is for a more detailed description of the selected spatial data and transfer information to the user. In addition to searching summary of metadata is given, the purpose of collection and links to more detailed metadata description. In addition, environmental data atlas is a web portal dedicated to searching and downloading metadata available at environmental Agency of Slovenia. The data includes information on borders (national and local), seismographic measurements, sea monitoring data, lakes and river water monitoring, air quality, meteorological stations data, natural

values (caves, points), bear habitat, wolf habitat, Natura 2000 areas, protected forests, water treatment plants, ... All the data is available for download free of charge.

- **Catalogue of Data Sources on the Environment:** The Catalogue of Data Sources on the Environment - CDS (KPV) provides an overview of the data collected and stored by the Slovenian authorities and institutions. The KPV is a way to fulfil the requirements of the Slovenian Environmental Protection Act (Ur.l. RS, No. 41/04), the Directive 2003/4/EC of the European Parliament and of the Council on Public Access to Environmental Information, and also of the Act on the Access to Information of Public Character (Ur.l. RS, No. 24/2003). The KPV is to be used by interested citizens, who want to know which data sources are available, who owns the sources, in what form, where and how to access these sources. It is especially suitable for the administrators, environment-related and environmental researchers. In other words, the catalogue provides environmental meta-data to their users, helping them to locate and retrieve relevant data sources. The KPV uses the WinCDS tool developed by the European Environment Agency that is currently being adjusted to Slovenian needs and possibilities. Through the WEB site user can find information on the following environmental topics: Air, Climate Change, Water, Nature, Noise, Chemicals and Biotechnology, Waste, Energy, Radiations, Industry and the Environment, Environmental Impact Assessment, Soil, Natural and other Disasters, Legislation, etc. Searching is enabled by the names of the data sources and by data administrators / contacts. Using advanced search capabilities user can also include keywords from GEMET. By pressing the Thesaurus button user is able to browse more than 5000 environmental terms in English and Slovene language (terms in 20 other languages are added) together with English and Slovene definitions (source: http://kpv.arso.gov.si).
- **CESM - Central Evidence of Spatial Metadata:** CESM represents a consolidated database of descriptions of spatial metadata in the territory of the Republic of Slovenia, organised by dataset administrators. Metadata descriptions in the database are compatible with the European standard for spatial metadata CEN/TC

287. The overview of the metadata database is publicly accessible through the Surveying and Mapping Administration of the Republic of Slovenia website at: http://prostor.gov.si/cepp_ang/index.jsp. The website enables searching, browsing and listing of database descriptions. CESM can be regarded as a collection point through which the producers of spatial data provide users with information about its data. Every producer in the CESM database has been allocated space in which metadata descriptions for whose contents the producer is responsible are stored. Therefore, the primary purpose of CESM is the recording of spatial metadata for the entire country in one location and in uniform form. The benefits to the users lie in the fact that they are able to obtain information about available spatial data in one location (what kind of data, where and how they can be obtained, etc.). A considerable benefit to the producers lies in the fact that they do not need to establish own information systems. The Administrator of the CESM database is the Ministry of Environment, Spatial Planning and Energy, the Surveying and Mapping Authority of the Republic of Slovenia. The administrator is responsible for the system administration, uninterrupted online access, suitable software support for users, assignment of user names, addition and control of metadata descriptions, but is not responsible for their content (source: http://prostor.gov.si/cepp_ang/files/oCEPP.html). Metadata contain information on the content, purpose, use and quality of data, information on owners, administrators and distributors, information on the method, procedure, price and conditions for obtaining data as well as all the other information required for the proper selection and usage of spatial data. The updating preserved the basic structure of the metadata description in CESM (elements in accordance with the current CENT TC/287 specification) but the access to the database changed and is now based on a three-level structure. The overview of the metadata contents is friendlier, clearer and more easily understandable for an individual user. It is divided into three levels: brief overview – it contains only the informative data on the dataset with the clear graphic representation; the content elements presented are those specified by the Dublin Core specification.

- **Geological Information Centre (GIC):** The main purpose of the Geological Information Centre is to collect, process and store geological data within the frame of a single information system and disseminate geological information to potential users. Data are stored in 13 databases and are available in printed or digital form: Database of laboratory investigations (petrological, micropalaeontological etc.), Database of pollution with heavy metals in Slovenia, Geochemical databases (radiometric survey, coal), Non-metallic mineral raw materials databases (spatial interference, clays, construction raw materials, natural stone, chemical industry), Database of research boreholes on mineral and non-mineral raw materials, Database of landslides, Database of geological cross-sections, Database of boreholes in the Kranj municipality, Database of water resources in Slovenia, Database of hydrogeological boreholes (wells), Database of hydrochemical investigations. Available maps: Lihtostratigraphic map of Slovenia, Structural - Tectonic map of Slovenia, Hydrogeological map of Slovenia, Engineering geological map of Slovenia, Map of non-metallic mineral raw materials of Slovenia with databases, Geochemical map of Slovenia, Map of natural radioactivity of Slovenia, Map of electric specific resistance of Slovenia, Gravimetric and magnetometric map of Slovenia, Geothermal map of Slovenia. Apart from the above mentioned data, the Geological Information Centre collects, processes and stores data on other themes and in other scales: Geological cross-sections, Maps of geohazard, Thematic geological maps (engineering geological, structural-tectonic, geochemical, hydrogeological, geophysical, etc.) (source: http://www.geo-zs.si/podrocje.aspx?langid=1033). Geological Survey of Slovenia develops and maintains all these databases which are available against payment. All the associated metadata are in format compliant with CENT/TC 287.
- **EIONET-SI:** EIONET-SI is an information and communication network. It supports collection and dissemination of environmental data. It is a part of EIONET network established by European Environment Agency (EEA). Environmental Agency of the Republic of Slovenia at Slovenian Ministry of the Environment and Spatial Planning is the Slovenian National Focal Point to the European Environment Agency (EEA) and the connection point for EIONET

(European Environment Information and Observation Network) in Slovenia. Spatial data are available at http://eionet-si.arso.gov.si/Podatki_in_informacije/F1084793652 and are organised based on the DPSIR framework. Data are presented through interactive maps, tables, text or downloadable shape files. Adobe SVG Viewer is used for viewing of spatial data in a web browser. The user can click on a certain point, line or polygon in order to obtain associated attribute data.

- **GERK- Land Parcel Identification System:** Graphical Units of Agricultural Land (in Slovene: GERK) are established. Application was developed for Slovenian MAFF. Its main principle is to define location and area of unified piece of agricultural land with the same land use, cultivated by one farmer on the basis of aerial digital orthophoto images of Slovenia. GERK is a web application written in Java programming language allowing more users (collaborators from MAFF, Agricultural Advisory Service, Administrative Units and local Geodetic Services) to work on the same database via internet or intranet (source: http://www.sinergise.com/en/references/4/1/land-parcel-identification-system).
  In addition, digital soil map of Slovenia is also available at http://rkg.gov.si/GERK/viewer.jsp.

A compelling example: Geopedia.si

Geopedia (www.geopedia.si) is a web based application for searching, viewing, and editing of geographical data, with service available to many clients at the same time. This private initiative was developed by Sinergise company (www.sinergise.com) based on their experience in making Giselle geographic information system. Giselle is a framework that enables users to manage polygons of the underlying map as well as add other graphical elements such as text, points and lines with an applet from within a browser (http://www.sinergise.com/en/products/general-purpose-GIS/giselle.html). This web-based GIS editing client has evolved into a countrywide crowd-sourcing GIS system. It contains various kinds of geographical and georeferenced information which comes from many

*different sources and is thoroughly described, tagged, cross-referenced and categorized. Searching of data is enabled either through full text search or via hierarchically organized categories. In addition, users can define and publish new layers with custom styling and textual descriptions, aggregate related layers into custom maps and associate them with other sources of information (http://www.sinergise.com/docs/documents/flyer-Geopedia.pdf). **Geopedia.si portal**, established in 2007, now grew from a crowd-sourcing application to a commonly used research tool offering access to more than 10.000 spatial layers; as an example, the portal recorded over 800.000 visitors and 18.000 contributors (individuals and institutional) in 2011. The Geopedia widget can be implemented into other websites (similar to Google Maps). Key advantage is that users can create their own set of layers within Geopedia, group them with other public layers into themes and publish them on their web-site. The integration is simple and supports JavaScript functions for turning on/off specific layers, setting location, filtering layers etc.*

TA.3b Gap analysis of existing infrastructures

A gap analysis of existing infrastructures was undertaken to identify which components and/or resources are missing, how complete they are in the light of use-case needs and possible re-engineering of existing systems. The outcomes of the analysis can be summarised as follows:

1. In Slovenia, spatial data infrastructures dealing with environmental data are relatively well developed. Various public SDIs and services exist that are maintained by individual ministries and other governmental institutions.
2. Due to lack of coordination at national level and efficient cooperation structure, these infrastructures are too fragmented from the use-case point of view.
3. Another general problem is insufficient interoperability due to the technical issues. E.g., some of existing services enable only browsing and data viewing, while within others also spatial analysis and exporting of spatial data in desired format is possible.

4. Due to the multi-thematic nature of the use-case, the GEOportal in the EARS domain would be the most suitable in terms of re-engineering and adaptation for use-case specific needs. The main advantages of this portal are its environmental character, public availability of datasets that are already organised in suitable thematic groups, possibility of data export via WFS application and rather detailed and consistent metadata descriptions. Moreover, it would be relatively straightforward to include at this point missing resources in the existing infrastructure, at least those in the domain of public institutions. However, in this case central coordination of SDIs in public domain is needed (e.g. national contact point that is mission at this point). The lack of efficient national cooperation structure was recognised as the main gap.
5. In addition to public institutions, in the last years public sector in Slovenia is increasingly involved in creation of their own specific SDIs. One of the compelling examples is the Geopedia.si portal, which was recognised as the most suitable SDI in the light of our use-case. The main advantages of this portal are, among others: (i) open structure that enables browsing, editing, importing and exporting of spatial data as well as integration into own systems; (ii) already established contacts and agreements with variety of public and private data holders; (iii) thoroughly described, tagged, cross-referenced and categorized data/metadata. However, the only barrier for the use of this infrastructure for the use-case needs is the lack of motivation from portal developer's part.

TA.4 Implementation of the system

Due to the lack of resources within the EGIDA project and due to the barriers and gaps addressed in previous sections, the implementation of the system (e.g. deployment of a portal, catalogue service and view service) is not feasible at this point.

5 EGIDA Methodology Assessment

5.1. General Assessment

The EGIDA methodology provided a valuable operational action plan and related guidelines that were followed in the use-case. In the light of the use-case specificity, this methodology proved to be a useful general methodological approach, which can easily be adopted or amended regarding the specific needs of a topical use case. Networking activities as listed in the EGIDA Methodology enabled identification of relevant stakeholders, metadata and spatial data providers, relevant national and international initiatives/projects; evaluation of national role in GEO, compatibility of data bases/infrastructures as well as creation of network of stakeholders potentially contributing to GEOSS. Similar, within the technical activities, barriers to information sharing were identified and a gap analysis on existing infrastructures was successfully performed. However, considering the use-case specificities (e.g. multi-thematic nature of the use-case, fragmentation of existing spatial data and infrastructures between the public and private sector...) more detailed and specific guidelines with regards to coordination activities are needed. This would then enable the re-use of existing components and tools at national level and consequently enable implementation of the system by deployment of SDI portal.

The approach we used in replication process was case specific, tailored to the needs of dedicated environmental SDI.

5.2. Recommendations for new actions/sub-actions

Existing EGIDA Methodology proved to be successful up to the final technical activities TA.4, where lack of resources and lack of motivation of key players in the national SDI made the final steps in preparation of GEOSS components impossible. This can be overcome by involvement of responsible Ministries and policy makers to provide

incentives for potential contributors to GEO/GEOSS. Therefore the recommended actions should address in particular the education of

(a) policy makers at the highest national level to build the incentives for data sharing into the national R&D system and

(b) data providers and custodians to increase their willingness to share spatial data at international level.

5.3. Recommendations of new guidelines for existing actions/sub-actions

The Use Case focussed on a specific environment of a small country with moderately developed and organised NSDI. Based on the experience, the recommendations mostly tackle the networking activities since these surprisingly showed to be a more complex problem than anticipated. The following set of recommendations is proposed:

→ Take advantage of a small country for using personal communication: personal communication proved to be the most efficient in the first phases of the networking process, in particular in activities of identification of stakeholders and motivating them to participate in the network.

→ *Study the national legal framework*; national legislation regulating the development, organization and management of spatial data infrastructure, which gives some basic information on the organization and the main key players in SDI development in the country, e.g. who has the mandate to coordinate the elaboration of the SDI.

→ *Study the national research and development funding system*: information on terms and conditions for funding research and development activities in the country can give information on potential stakeholders. In small countries, scientific research and development projects are funded mainly from public sources or through international funding organizations and instruments, where registers of beneficiaries and participating organisations (project partners) exist and are in most cases publicly available.

→ *Mobilize project groups, professional and technical associations* in search for potential stakeholders and partners – potential organizations and networks can be national and European project partnerships, national and European technology platforms and initiatives, centres of excellence etc.

→ Information sources for identification of stakeholders vary from country to country, therefore it is recommended to study the national approach to the building of NSDI. For European countries, the national *EC INSPIRE – State of Play Reports* are a valuable source of information on the status and the key entry points to the NSDI. Nevertheless, these reports can still be incomplete in particular in countries where a thematic spatial data is fragmented and to a great extent produced by private companies and/or physical persons.

→ *Involve decision and policy makers*: As it was generally suggested that the top-down approach is the preferred option for building a consistent (environmental) NSDI, the involvement of national and local decision and policy makers from all relevant domains (environment protection and management, spatial planning, science, infrastructure and economic development, health and security) is of utmost importance.

→ *Encourage and promote inter-sectoral collaboration:* As the lack of incentives for data sharing and development of environmental datasets into GEO/GEOSS components is the main reason for poor interest of national data providers and custodians, the researchers must act as a connection linking the scientific and policy making communities on one side, and a link between different sectors on the other. To achieve this, bottom-up approach is needed, e.g. the numerous initiatives from the public, private non-governmental bodies and organizations will enhance the understanding of the decision and policy makers that the benefits of collaboration go beyond the scientific community to the welfare and well-being of the society at large.

→ As in the Use Case of replication of EGIDA Methodology for the data infrastructure supporting the management of a contaminated area representing a complex environmental problem reaching into all GEO/GEOSS SBAs, *the organisation of thematic working groups*

(TWG)s defined as a GEOSS SBAs and environmental indicators proved to be a recommendable approach.

→ In organization of the network, workshops and thematic discussions proved to be a successful approach for assessment of the awareness and dissemination of the GEO/GEOSS initiative in the network and operation of the network in general

→ A small country also means limited size of the (R&D) community, therefore areas exist where the critical mass of knowledge and infrastructure is not available. International, in particular trans-boundary cooperation must be a vital interest and priority of these communities in small countries.

→ Enhance collaboration with international organizations and agencies, such as WMO or IAEA etc., which often provide special support to small and developing countries.

6 Use Case References

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