D13.3
ETHICAL GUIDELINES FOR RIs

WORK PACKAGE 13 – DEVELOPING AN ETHICAL FRAMEWORK FOR RIs

LEADING BENEFICIARY: ISTITUTO NAZIONALE DI GEOFISICA E VULCANOLOGIA

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ABSTRACT

This deliverable refers to the "Ethical Guidelines" (EGs) for Research Infrastructures (RIs) developed and implemented by WP13. The EGs present a general framework of ethical values, to be used by each research infrastructure of the ENVRI community. They are a basis to design or to shape individual ethical guidelines taking into account RIs' peculiarities with respect to their status, duties, activities, and goals.

The EGs are structured in a main section, explaining general ethical values, and a subordinate section, where some delicate matters of interest for RIs are discussed from an ethical perspective. Ethical values included in the EGs refer to four ethical domains, affecting RI's as a whole as well as individual scientists working at RIs. The domains mirror the ethical profile of each scientist/technician/administrator, his/her relationships with colleagues and their working environment, the interaction with society, and their obligations towards the Earth system. In addition to these four domains, the EGs discuss several issues which are considered to have a particular importance for the RIs: working environment, data life cycle, conflicts of interest, and relationship with decision-makers. Their balance is indispensable for a respectful and caring work environment and are needed to ensure a fair reflection of the institutional activities and results towards society.

The EGs are the result of an extensive survey of relevant literature produced by scientific and professional organizations, institutions, and bodies focusing on applied ethics for research and other professional activities conducted at RIs.

Project internal reviewer(s):

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PROJECT SUMMARY

ENVRIplus is a Horizon 2020 project bringing together Environmental and Earth System Research Infrastructures, projects and networks with technical specialist partners to create a more coherent, interdisciplinary and interoperable cluster of Environmental Research Infrastructures across Europe. It is driven by three overarching goals: 1) promoting cross-fertilization between infrastructures, 2) implementing innovative concepts and devices across RIs, and 3) facilitating research and innovation in the field of environment for an increasing number of users outside the RIs.

ENVRIplus aligns its activities to a core strategic plan where sharing multi-disciplinary expertise will be most effective. The project aims to improve Earth observation monitoring systems and strategies, including actions to improve harmonization and innovation, and generate common solutions to many shared information technology and data related challenges. It also seeks to harmonize policies for access and provide strategies for knowledge transfer amongst RIs.

ENVRIplus develops guidelines to enhance transdisciplinary use of data and data-products supported by applied use-cases involving RIs from different domains. The project coordinates actions to improve communication and cooperation, addressing Environmental RIs at all levels, from management to end-users, implementing RI-staff exchange programs, generating material for RI personnel, and proposing common strategic developments and actions for enhancing services to users and evaluating the socio-economic impacts.

ENVRIplus is expected to facilitate structuration and improve quality of services offered both within single RIs and at the pan-RI level. It promotes efficient and multi-disciplinary research offering new opportunities to users, new tools to RI managers and new communication strategies for environmental RI communities. The resulting solutions, services and other project outcomes are made available to all environmental RI initiatives, thus contributing to the development of a coherent European RI ecosystem.

TABLE OF CONTENTS

ETHICAL GUIDELINES FOR RIS

REPORT TEXT

1. INTRODUCTION

Establishing an ethical reference framework for RIs is one of the goals of ENVRIplus.

This goal has been achieved through the activities carried out in Work Package 13, which were aimed at:

- increasing the awareness of both the scientists and the public of the importance of ethical aspects in Earth sciences;
- establishing a shared ethical reference framework, to be adopted by the RIs governing bodies, including management guidelines for Ethical Boards in RIs;
- increasing the awareness of RIs management, operators and individual scientists of their social role in conducting research activities;
- assessing the ethical and social aspects related to the results achieved and deliverables released within the project.

Activities planned in the three WP tasks have gradually led to theoretical insights into ethical issues (as the results of a survey presented in D 13.1), as well as to concrete products (as the Ethical Label Template presented in the D 13.2). The Ethical Guidelines presented in this D 13.3 are the conclusive result of this path of activities.

The ENVRI community is formed by RIs dealing with topics ranging from biological processes/life to solid Earth dynamics and technological advances.

Due to the huge amount of ethical and social implications related to the different activities these RIs conduct, it becomes very challenging to develop standardized ethical guidelines. We therefore developed a framework containing ethical aspects relevant for the ENVRI community.

Despite not being exhaustive, the EGs offer a point of reference for RIs on which to base their individual ethical guidelines or codes of conduct, which shall guide their activities and address specific problems.

2. PRELIMINARY WORK

The Ethical Guidelines for RIs has been developed starting from the results of some preliminary works.

In particular an **online survey** was released to investigate the importance of ethical and social issues related to scientific and technical activities within RIs. Its title is “what do you know about ethics in geosciences?” (see the Deliverable 13.1: http://www.envriplus.eu/wp-content/uploads/2015/08/D13.1.pdf). Questioned were all members of the ENVRIplus project.

The results of the survey have clearly shown that the interviewees (ENVRIplus participants) recognize the involvement of ethical and social aspects involved in their research and technical activities. However, at the same time, they are unaware what this actually means, especially when it comes to their own work and potential implications for society.

Moreover, the **ethical label template** was developed (see the Deliverable 13.2: http://www.envriplus.eu/wp-content/uploads/2015/08/D13.2-Ethical-label-template.pdf). It is a tool allowing researchers to provide information about the ethical, social, and environmental implications of their deliverable or project. The ethical template is an added value to common technical-scientific focused descriptions of project outcomes. The ethical label template supports the development of critical thinking with respect to ethics in science and to its interactions with society. In fact, when project participants need to fill in the ethical label to tag a project outcome, they have to re-think the development process. Based on the predefined fields they have to disclose ethical and societal aspects associated with that outcome. The ethical label template has been developed to support researchers, technicians, and administrators to clarify the potential ethical, societal, and scientific impact of their activities.

Finally, an in depth collection and **analysis of documents already existing** on the ethical issues in research and professional activities in sciences was conducted (see section 4).

3. FUNCTION OF THE ETHICAL GUIDELINES FOR RIS

The EGs provides a general framework of values to be considered for research and technical activities (see Appendix A).

The EGs aim at supporting RIs in developing their own ethical guidelines and/or codes of conduct by suggesting values to base on virtuous behaviours and best practices for the benefit of the scientific community and society as a whole

This document, despite of not having addressed all issues relevant for the different RIs, highlights essential ethical values that should be considered in codes of ethics and conduct by each RI. In addition, it aims to raise awareness of ethical and societal obligations in the ENVRIplus community including scientists, technicians, and administrators.

The EGs are intended as first steps in motivating RIs to establish a common ethical background, which takes into account ethical and societal expectations expressed by members of the ENVRIplus community.

In order to establish these EGs, the expectations expressed by the ENVIRplus community have been compared to and combined with a variety of existing ethical guidelines. Those documents were presented and discussed during past ENVRI weeks (2015, 2016, and 2017). In those occasions, the participants contributed their suggestions, needs, and objections, which were considered in the final document.

In addition, the results of the survey were incorporated (see the Deliverable D13.1). They provided information about views and expectations on the ethical matters by the RIs members, but also clear indications of deficiency of knowledge, needs, gaps.

The EGs begins to fill gaps in ethics and has the aim of giving a first orientation to the ENVRI community, with a goal open to future developments and integrations.

4. SELECTED DOCUMENTS OF REFERENCE

The collection and analysis of materials (documents, declarations, and statements) concerning research ethics within scientific and professional organizations, institutions, and corporate bodies has been useful to create the framework of ethical values proposed in the EGs.

The collected documents cover different aspects of ethics, both theoretical and practical:

a) Principles of research integrity.

b) Principles of professional ethics.

c) Guidelines concerning the impact of research or technical activities on the environment.

d) Guidelines related to influence of research activities on different components of society (such as citizens, decision makers, politicians, local authorities, etc.). They are the end-users interested in the research outcomes, which they will use in different ways and for varying purposes.

Among the examined literature on ethical aspects in scientific research, the following documents have been considered of particular relevance for the development of the EGs:

- **ICOS ethical rules (draft).** These describe principles of ethics in the research activities focusing on some key concepts and aspects including conflicts of interest, scientific freedom, data quality, acquisition and processing, principles to follow in publishing, etc. Interesting references are also indicated. (Source: Werner Kutsch - ICOS).

- **EPOS Ethics issues (draft)**. These focus on similar key concepts, such as security, safety, sharing, intellectual property rights, preservation; and consider aspects such as:
  a) data integration, sharing and access policies to be adopted;
  b) services for diverse stakeholders ;
  c) actions to prevent misuse associated with access to solid Earth data and services;
  d) proper cyber-infrastructure security;
  e) procedures of registration, authentication and authorization;
  f) solutions for data curation and preservation;
  g) the possibility to establish an external board dedicated to monitor and manage ethics issues.

  (Source: Massimo Cocco - EPOS)

- **Singapore Statement on Research Integrity**. This was developed as part of the 2nd World Conference on Research Integrity (21-24 July 2010), in Singapore, as a global guide to the responsible conduct of research. It is not a regulatory document and does not represent the official policies of the countries and organizations that funded and/or participated in the Conference. It focuses on principles that should guide the research activities such as honesty, accountability, professional courtesy and fairness in working with others, good stewardship

of research on behalf of others. Moreover, it emphasizes the importance of adhering to regulations and to scientific methods, to assure the repeatability of the studies by colleagues, to share the results, to respect the rules on authorship and the peer review process, to avoid conflicts of interest, etc. (Source: https://wcrif.org/guidance/singapore-statement).

- **Montreal Statement on Research Integrity in Cross-Boundary Research Collaborations.** This was released in 2013 after the 3rd World Conference on Research Integrity. It deals with topics similar to the previous statement but focuses on the cross-boundary research collaborations that present special challenges for the responsible conduct of research, because they may involve substantial differences in regulatory and legal systems, organizational and funding structures, research cultures, and approaches to training. It is critically important, therefore, that researchers be aware of and able to address such differences. Similar to the Singapore statement, the principles that inspire this document are integrity, trust, transparency, communication, and compliance with laws, policies and regulations, rules in publishing. (Source: https://wcrif.org/guidance/montreal-statement)**.**

- **The Geoethical Promise**. This was proposed by the Committee on Geoethics of the FIST – Italian Federation of Earth Sciences in 2014. It focuses on aspects such as :
  a) awareness of the social implications of the scientific activity;
  b) necessity to protect the geosphere for the benefit of mankind;
  c) responsibilities towards society, future generations and the Earth;
  d) availability to put expertise at the disposal of the decision makers;
  e) duty to improve one's own scientific knowledge lifelong;
  f) duty to respect colleagues;
  g) commitment to foster progress in science, dissemination of scientific knowledge and ethical approaches in managing land and resources.

  (Source: http://www.geoethics.org/promise.html).

- **The Cape Town Statement on Geoethics.** The statement has been released by the International Association for Promoting Geoethics (IAPG) in October 2016. It summarizes values, concepts, and contents on ethics in geosciences. (Source: http://www.geoethics.org/ctsg).

- **The European Code of Conduct for Research Integrity – Revised Edition.** All European Academies (ALLEA), 2017. This is a document listing principles, good research practices, and violations of research integrity.

  (Source: https://ec.europa.eu/research/participants/data/ref/h2020/other/hi/h2020-ethics_code-of-conduct_en.pdf).

- **The European Charter for Researchers.** This is a set of general principles and requirements which specify the roles, responsibilities and entitlements of researchers as well as of employers and/or funders of researchers, 2005. (Source: https://euraxess.ec.europa.eu/jobs/charter/european-charter).

- **Declaration on Science and the use of Scientific Knowledge.** Text adopted by the World Conference on Science, 1 July 1999, under the aegis of the United Nations Educational, Scientific

and Cultural Organization (UNESCO) and the International Council for Science (ICSU). This declaration comprises a set of principles dealing with topics such as science for knowledge and knowledge for progress, science for peace, science for development, science in society and science for society. (Source: http://www.unesco.org/science/wcs/eng/declaration_e.htm).

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- **Freedom, Responsibility and Universality of Science.** International Council for Science (ICSU), August 2014. (Source: https://council.science/cms/2017/04/CFRS-brochure-2014.pdf).

- **Statement on the formulation of a code of conduct for research integrity for projects funded by the European Commission.** European Group on Ethics in Science and New Technologies (EGE). (Source: https://ec.europa.eu/research/ege/pdf/research_integrity_ege_statement.pdf).

- **Codes of ethics and codes of conduct**. Developed by scientific associations, organizations and societies, focused on different disciplines (mining, petroleum, engineering geology, etc.) and in different countries. Among the different associations, the Geological Society of London and the American Geosciences Institute. These codes touch a wide range of aspects, not only related to the research activities but also to professional practice, so that they often propose rules for behaving in an ethical manner when one works in the private field, with industry, private clients, etc. Moreover, often they refer to practical situations and real cases. (Source: http://www.geoethics.org/codes.html).

5. STRUCTURE OF THE ETHICAL GUIDELINES

The EGs are designed and developed as a set of ethical values in an agile framework. They provide a first orientation to researchers, technicians, and administrators including values supporting responsible scientific and technical activities.

The EGs are based on two fundamental concepts: responsibility and intellectual freedom.

Responsibility is a prerequisite to establish ethical best practices, activities, and functional capacity building.

Intellectual freedom is a prerequisite for being able to act responsibly and to take ethical decisions.

The EGs are structured in a main section containing fundamental ethical values and a subordinate section discussing some delicate matters of interest for RIs from an ethical perspective.

Ethical values included in the EGs refer to four ethical domains affecting RIs and their employees. The domains mirror the ethical profile of each scientist/technician/administrator, his/her relationships with colleagues and their working environment, the interaction with society, and their obligations towards the Earth system

In addition, numerous matters of RIs have social and ethical implications. They cover a wide variety of distinctive activities.

This version of the EGs considers “working environment”, “data life cycle”, “conflicts of interest”, and “relationship with decision-makers” among the most important matters to be tackled from an ethical perspective. They are fundamental for a respectful and serene work atmosphere that is at the base of sound and fruitful scientific and technological activity, and beneficial for the science-society interface.

6. DEFINITIONS

This section provides definitions of terms that RIs might use to prepare their ethical documents, realizing that a common and defined terminology is important to establish a common understanding within and between RIs.

Ethics

Ethics reflect the conduct of humans and sets the criteria to evaluate behaviors and choices in order to identify “good intentions” as well as the means to achieve them. It also addresses the moral duties of humans towards themselves and others, and what is the right thing to do when facing a decision. Regarding the practice of a profession, ethics is the identification of duties and rights that regulate the professional activity (deontology) by members of a social group, who are characterized by the possession of specific technical-scientific knowledge, methods, and tools for its application.

Research integrity

Research integrity is a set of ethical values, deontological duties and professional standards on which a responsible and correct conduct is founded by those who perform, finance or evaluate scientific research as well as by institutions that promote and realize it. The application of the values and the respect of deontology and professional standards guarantee the quality of research and contribute to an increase of reputation and public perception of science, with important repercussions to the scientific community and society.

Professional ethics

Professional ethics encompass the personal and corporate standards of behavior expected by professionals belonging to a professional community.

Earth system

The Earth system refers to physical, chemical, and biological Earth's constituents and their interacting processes and cycles both on the Earth's surface and its interior, capable to transform and/or transfer matter and energy throughout the whole system in ways that are governed by the laws of conservation of matter and energy. The Earth system consists of geosphere (the solid Earth), atmosphere, hydrosphere, cryosphere and biosphere.

Geosciences

Geosciences (or Earth sciences) are a wide set of scientific, basic and applied, disciplines whose aims, methods, tools are used by geoscientists to investigate the Earth system in order to understand its composition, structure, forces, processes, dynamics, cycles, resources, and evolution, at different spatial and temporal scales and intervals. Geosciences analyse the interaction between Earth constituents, the relationships between planet Earth and other celestial bodies, the influence of human activities on geological deposits, processes, dynamics, and the ecosystem. Geosciences investigate both abiotic and biotic phenomena, the active and passive interaction between biological and a-biological processes and dynamics (for example corals and coral reefs, or biological matter and oil formation), how animal and vegetal life, and humans, can determine or influence rock and geologic deposit formation and modification.

Geoscience studies use direct and indirect methods to make observations and get data, and through models geoscientists provide deterministic or probabilistic scenarios to forecast the spatial and temporal occurrence and evolution of physical, chemical, and biological phenomena.

7. TIMING OF DELIVERABLES AND REVIEW

As these reports are important for the stakeholders (RIs) and to the overall project review, we have conducted internal reviews of the documents. Each document thus has additional persons besides the team, which have written the deliverable and revised it before it has been submitted to the Commission by the project office (see Table 1).

TABLE 1 ROLES OF THE DELIVERABLE REVIEW

Role	Task	Appointed by
Mairi Best **(Technical expert)**	Technical, editorial and scientific review of the document – done by internal expert.	Theme leader
Laura Beranzoli **(RI expert)** *Consultation* in Activecollab	User community (RI) representative who mainly analyzes the usability of the deliverable for Stakeholders.	RI's leader
Silvia Peppoloni **(usually WP leader)**	Decision that the reviewer comments are sufficiently well taken care and the deliverable quality is acceptable	WP leader

8. CONCLUSIONS

The EGs for RIs have been developed as a tool to support the creation of a common ethical space despite the differences in services and data provided as a consequence of the peculiarities of each RI.

The mid-term review of ENVRIplus project had highlighted the importance and meaningful contribution of the WP13 deliverable D13.1 (online ethical questionnaire and results of the survey) to the ENVRIplus project, since the work done "*has already substantially increased sensitivity to and engagement with relevant ethical issues*".

The questionnaire had pointed out that most of the interviewees recognized the importance of ethical and social aspects in scientific and technological activities. They were also aware that neglecting those aspects could be problematic, especially if activities have societal implications.

The deliverable D13.2 (ethical label template) was the first practical tool to help the ENVRI community to address ethical and societal issues, providing a template for characterizing easily a project product to be released both to specialist and not-specialist, highlighting through a standard format those ethical and social aspects.

Now the EGs is an additional, fundamental step to provide the ENVRI community with a tool that has a twofold goal: One is to give a point of reference to those working at an RI, supporting them to declare personal obligations and to assure the integrity of their activities. Second, to fix a starting point in tracing the RIs path in developing specific ethical guidelines and codes of conduct for each RI, so that better working conditions can be assured and society can be served in a fully trustfulness atmosphere.

Finally, the EGs should be branded as an ENVRI product.

9. IMPACT ON PROJECT

The EGs are a practical tool that each RI of the ENVRI community might consider to shape own ethical guidelines and codes of conduct.

The EGs provide an ethical framework to configure problems and development prospects of RIs while dealing with internal organization and external relationships.

In any case, the EGs are an ethical compass for individual scientists, technicians, and administrators working at RIs' helping to create a common ethical background among different scientific and technological communities.

10. IMPACT ON STAKEHOLDERS

Scientific and technological communities more aware of their ethical and societal obligations towards their members and society as a whole can be capable of achieving their institutional goals in a more responsible way.

Since one of the main goals of RIs is to provide excellent services and data for the benefit of society, RIs cannot neglect ethical and social implications affecting those services and data, at the risk of losing credibility and the trust of society.

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APPENDICES

- Appendix A: Ethical Guidelines for RIs

D13.3

Appendix A

Ethical Guidelines for RIs

WORK PACKAGE 13 – DEVELOPING AN ETHICAL FRAMEWORK FOR RIs

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TABLE OF CONTENT

1. PREAMBLE

As indicated by the European Group on Ethics in Science and New Technologies: "*Scientific misconduct is a matter of concern for all the actors involved in research. A procedure devoted to the analysis of any indication of misconduct and to the identification of the participants responsible for irregular behaviours should be put into practice. That system should include specific protection of whistle-blowers. The institutions that are the contractors with the European Commission have a responsibility to act to ensure integrity.*"

Ethical guidelines and codes of conduct are means fundamental to eliminate or, at least, to reduce unethical behaviours and unprofessional and/or unacceptable practices in research and technological activities.

In order to improve the working conditions of scientific communities and the observance of ethical conduct, the mere adoption of guidelines or codes may not be sufficient. In fact, the observance of values and practices deemed ethical (contained in guidelines or codes) should not be confused with the essential ethical training that each geoscientist should receive in order to reach a higher level of integrity, respectability, and credibility within the community of reference. Ethical behaviours and decisions can only come from a responsible choice, made freely, and ethics of responsibility must not be confused with ethics embodied by guidelines and code itself. The deep meaning of ethics for a professional is to be honest with respect to their own work and in relationships with colleagues and end users, and to assure societal and environmental stewardship.

2. INTRODUCTION

The Ethical Guidelines (EGs) for Research Infrastructures (RIs) are meant to help scientists and RIs retain professional integrity as they fulfil their personal, interpersonal and institutional activities and interact with society and the environment.

As stated by the ALLEA - All European Academies in its Code of Conduct for Research Integrity "*A basic responsibility of the research community is to formulate the principles of research, to define the criteria for proper research behaviour, to maximize the quality and robustness of research, and to respond adequately to threats to, or violations of, research integrity… The primary purpose… is to help realise this responsibility and to serve the research community as a framework for self-regulation.*"

The EGs have been prepared in line with the ALLEA indications and consider responsibility as the ethical criterion on which to base appropriate behaviours and practices to make excellent science and to serve the science community and society. A constellation of values considered as the fundamental behavioral system to take decisions and to measure the level of integrity of individuals and institutions are provided.

Ethical values included in the EGs refer to four domains affecting RIs as well as individual scientists. The domains refer to the ethical profile of each geoscientist, his/her relationships with colleagues, the interaction with society and the Earth system.

3. PURPOSE OF THE ETHICAL GUIDELINES

The EGs provide a general framework of values to be considered in research and for technological implementation. In order to promote responsibility, intellectual freedom and integrity among RIs operators, a greater professionalism in the conduct of research and a more respectful, fair and cooperative working environment has to be established to assure high-quality services and to facilitate excellent science. Moreover, the EGs focus on important aspects with respect to the relationship between scientists and society, intended in all its diverse component parts (such as decision-makers, local authorities, government agencies, industry, and citizens), which represent the final users of the scientific results and services.

The EGs aim at supporting RIs in developing their own ethical guidelines and/or codes of conduct by suggesting values on which to base correct behaviour and best practices for the benefit of the scientific community and society as a whole.

The EGs have the goal to push governing bodies of RIs to create their own ethical guidelines, codes of conduct and self-regulation documents, and to make ENVRI communities including scientist, technicians and administrators more aware of ethical and social obligations related to individual and team activities.

Institutional duties of RIs should not create a conflict with values suggested in these EGs.

4. RESPONSIBILITY AND INTELLECTUAL FREEDOM

The responsibility expresses the commitment to answer to someone (individuals, institutions, organizations, society in general) for one's own actions and their potential consequences. Responsibility implies the obligation to satisfactorily perform or complete a mandatory task that has a consequent "penalty for failure". With reference to the scientific community, a potential failure should not only be intended from a legal point of view, but also in terms of loss of credibility, trust or reliability, or an impairment of the relationship with colleagues and stakeholders.

Taking responsibility means to act rationally and coherently with respect to the purpose attempted, but also to consider the impact one's choices have on one's own credibility, and/or colleagues, and/or society, and/or the natural environment.

Responsibility means to answer for one's own actions and being competent to execute the actions requested and/or to solve a specific problem.

To ensure responsible conduct, every duty of an RI needs to be executed with best efforts respecting high standards in application of scientific methods and technologies, organizing effective and respectful working environment, and developing beneficial activities.

Responsibility is a prerequisite to establish ethical best practices, activities, and working capacity building.

Intellectual freedom, that encompasses the freedom to hold, receive, and disseminate ideas without restriction (even if controversial or unpopular), is a fundamental prerequisite for assuring responsibility. The absence of intellectual freedom prejudices the possibility of conducting activities in a responsible way and taking ethical decisions.

Harassment, discrimination, bullying, conflicts of interest, and pressure at work can result in a lack of intellectual freedom. These kinds of behaviour offend the dignity of the person, threaten the serene work atmosphere and more generally limit freedom in acting responsibly and making ethical choices. As a consequence, they seriously undermine not only the integrity and credibility of the science community, but also in turn the quality of scientific work. The need for the science community to ensure that working and educational environments are respectful and inclusive and that unacceptable behaviours are identified and effectively policed, is increasingly being recognised in the policies and ethical codes of professional geoscience organisations.

RIs have to guarantee to their operators the intellectual freedom to develop new ideas and projects without putting their staff in jeopardy of losing their jobs or their position in the organization. This is the case especially when RIs operate in association with industry or any other group with legitimate partisan interests. It is crucial that the freedom to conduct research, to speak, and to publish without interference or penalty is respected and maintained. Intellectual freedom must not be used by RIs operators to undermine RIs' credibility and respectability.

5. ETHICAL DOMAINS AND FUNDAMENTAL VALUES

Ethical domains are the areas of application of the EGs. They take into account that RIs' operators can act at various scales, and therefore they have to deal with diverse ethical levels of interactions: starting from the correctness and the benignity of individual behaviours, which necessarily influences the working experience as well as the interaction with colleagues, society and the environment.

The goodness of a behaviour is best measured based on values. These values refer to the four ethical domains discussed in the following: individual, inter-personal, societal, and environmental.

5.1 Individual domain

The individuals working for a RI ensure its functionality. The value and benefits of research and technological implementations vitally depend on the honesty and integrity of their developers.

The individual domain follows the guiding principle: "doing the best at work". It is based on personal skills and abilities, which have to be developed, strengthened, and maintained at a high level of competence and professionalism. But only the convinced adhesion to a set of ethical values can guarantee that RIs' operators take full responsibility for the trustworthiness of their activity and for the integrity of their actions.

Responsible scientists, technicians, and administrators of RIs should respect the following values:

- Honesty
- Awareness
- Integrity
- Transparency
- Reliability
- Competence

These values imply:

- Respect for oneself and others.
- Regular training and life-long learning.
- Strict application of scientific methods; reliability of technical practice; conclusions based on critical analysis of the evidence; findings and interpretations fully and objectively developed.
- Professionalism in planning, organizing, conducting or participating in activities and projects.
- Sharing knowledge at all levels as a valuable activity, including communicating science and results, taking into account intrinsic limitations such as probabilities and uncertainties.
- Verifying the sources of information and data; keeping accurate records in the data life cycle; applying objective, unbiased peer-review processes to technical and scientific publication; guaranteeing the recognition of authorship and merits.
- Convinced adherence to laws, regulations and policies related to research and technological activities.
- Disclosing and solving conflicts of interest.
- Consciousness of the existence of ethical implications in one's own activities, and of the responsibility of being a social actor.

5.2 Interpersonal domain (relationships among colleagues and working environment)

The interpersonal domain refers to the relationships between colleagues, to the management of multidisciplinary research and to the internal relationships between individuals and hosting research institutions and bodies.

The values proposed can contribute to establishing a responsible and respectful working environment in which cooperation, merit and multidisciplinarity are essential requisites to achieve common goals, to find the most suitable solution for complex geoscientific challenges, and to assure adequate competences for managing projects.

RIs of the ENVRI community have the duty to plan, establish, manage, and coordinate services for the benefit of the scientific community and society. At the same time, RIs have an ethical responsibility to establish a working environment in which professional competition, that is a stimulus to raising the quality of activities and outcomes, is balanced by shared ethical values that prevent abuses and unfair behaviour among their staff and promote trustworthiness of research activity and technical practice .

The following values are proposed as essential ideal elements for a respectful and fertile working environment:

- Respect
- Reciprocity
- Courtesy
- Responsible Leadership
- Sharing
- Cooperation
- Inclusivity
- Multidisciplinarity
- Safety

These values imply:

- Respecting different approaches, ideas, perspectives, expertise and methods of colleagues and stakeholders, fostering mutual understanding.
- Accepting a fair debate with hypotheses and theories that disagree, sharing information and data, being respectful of authorship and the intellectual property.
- Professional courtesy and fairness in team working.
- Zero tolerance against research misconduct, irresponsible practices, harassment, discrimination, and bullying.
- Developing policies and offices to foster ethics, inclusivity, accessibility and participation, and to denounce retaliations.
- Guaranteeing trustworthiness of research activity and technical practice.
- Creating and sustaining working environments that encourage integrity through education, clear policies, and reasonable standards for advancement.
- Defining roles and responsibilities in a working team, taking into account as much as possible personal expectations, competences, and needs.
- Responsible leadership in team management capable to support the group, to promote responsibility among colleagues, and to guarantee high professional competence and top level ethical requirements.
- Defining clear institutional regulations and policies related to research and technological activities that favour human and professional respect within teams.
- Taking responsibility, recognizing merits, developing multidisciplinary approaches.
- Respecting intellectual property and rules on authorship, fighting plagiarism or data manipulation, assuring safety and protection of shared data.

5.3 Societal domain (relationships with society)

This domain describes the relationship between RIs and society. The activities carried out by the RIs aim at gaining and providing scientific knowledge, which may impact society as a whole or parts of it. Those impacts imply ethical implications.

RIs task in society is to provide different stakeholders with data, studies, results, and expertise whose access is regulated by “ad hoc” rules, on the basis of their final use.

The societal domain comprises responsibilities for the communication and dissemination of data and findings, education of citizens and their direct involvement in scientific and technological

activities (citizen science), duties towards general public, decision-makers, industry and businesses.

The following values should be respected to ensure a fair and responsible engagement with society.

- Role Awareness
- Trust
- Wise Stewardship
- Service
- Accuracy
- Carefulness
- Clearness
- Authoritativeness

These values imply:

- Working for the benefit of society and the sustainable development of human communities by contributing to shared knowledge, data, and results to protect citizens from natural and anthropogenic hazards, and to mitigate risks.
- Making expertise and data available to decision makers, including errors, probabilities, and uncertainties.
- Being fully aware of ethical and societal implications of research and technological activities, providing service and assistance to society at the best of scientific, technical, and operative capabilities.
- Disseminating results and expertise among citizens, policy- and decision-makers, industry and commercial undertakings, safeguarding the public utility and the open, transparent, and correct use of information, data, interpretations, regulated by use and access policies.
- Communicating activities, data, and results, while taking into proper account cultural and educational differences among stakeholders.
- Limiting comments by RI's operators to their recognized expertise when engaged in public discussions about the application and importance of research data and findings, clearly distinguishing professional comments from personal opinions.
- Taking care of being responsible and clear when sharing, disseminating and communicating insights or findings to avoid misunderstandings and misuse.
- Never misusing instruments and data for commercial use, and putting the interest of society foremost in research and technological activities.
- Avoiding conflicts of interest to maintain integrity and assuring trust by society, so that societal assistance is based on and driven by scientific authoritativeness and competence and not oriented by partisan or commercial interests.
- Where possible, involving citizens in RIs' activities, as a way of contributing to the technical-scientific enterprise, improving their knowledge of natural forms and technological processes, taking care of the quality of the training activities and instruments, assuring accuracy in monitoring and practicing to avoid introducing background and random noise in datasets.
- Compliance with the law.

5.4 Environmental domain (relationships with the Earth system)

The environmental domain refers to the interaction between scientific and technological activities and the natural environment, both in its biotic and abiotic elements, in the awareness that RIs have to approach the Earth system by protecting as much as possible its geodiversity and biodiversity, and by adopting innovative strategies and technologies in order to avoid contributing to the irresponsible depletion of its resources.

The following values are proposed as the essential ideal elements for managing the interaction with the Earth system in a sustainable way:

- Conservation
- Minimization
- Prudence

These values imply:

- Preserving life in all its forms and geomorphological features.
- Conserving transient equilibrium of biotic and abiotic dynamics.
- Minimizing the impact of activities on geosystems and ecosystems by assessing effects on diverse temporal and spatial scales.
- Fostering the adoption of environmentally-friendly and low-energy and water consumption technologies.

6. INTER-DOMAINS MATTERS

Putting in practice the values described in the four domains implies dealing with matters that are cross-cutting those domains. The following matters are considered of extreme importance to guarantee that RIs operate in an ethical perspective: Working Environment, Data Life Cycle, Conflicts of Interest, Decision-Makers.

6.1 Working Environment

Scientist, technicians, or administrators, as individuals, are mainly responsible for establishing a responsible working environment. Responsible RIs need responsible individuals that can assure excellent science, but who are also aware of the ethical and social implications of their activities. RI members, in groups or individually, often require the support of RI management to serve the community at the best of their possibilities. This implies RIs should establish ethical boards not only to guide RIs in addressing ethical and social issues related to institutional activities, but also to assist RIs scientists, technicians and administrators in their ethical obligations deriving from the application of the values of the individual domain, and RIs in the concrete observance of the values of the interpersonal domain.

In a responsible working environment, the RIs ensure the coordination and sharing of intent and instruments among the participating organizations, not only with the institutional commitment

to create a common space for the production of data and services, but also to instill a genuine culture of cooperation between organizations and individuals for the benefit of society.

A respectful working environment allows all members of an organization to professionally grow, assuring that all are treated equally no matter of their age, gender, economic status, religion, or cultural and personal beliefs; individuals are therefore called upon to treat their co-workers accordingly.

A responsible working environment doesn't tolerate harassment (psychological and sexual), discrimination, bullying, abuse, threats, and retaliations. It fosters high level of professionalism, favouring cooperation at all levels and mutual respect.

It provides regulated, planned, and safe accessibility to laboratories and instrumentations and ensures a respectful conduct despite any disabilities. Moreover, supportive capability building, training and education are promoted, being sure that regulations with respect to working hours and personal health are met, as well as to workplace safety issues.

In a responsible working environment scientific articles, data and results produced by colleagues are shared and used being respectful of the intellectual property, always assuring safety, protection and proper usability of data, and severely condemning possible plagiarism or data manipulation.

6.2 Data life cycle

Data are quantitative or qualitative attributes of variables or sets of variables that have been gathered manually or automatically, following encoded procedures and methods, or by using RI recommended sensors, possibly at validated RI stations.

RIs' data provision is aimed at improving the understanding of the physical, chemical, and biological processes responsible for natural and anthropogenic phenomena. This understanding is essential to achieve new discoveries leading to innovation, development, and education.

Open and free delivering of scientific data serves as a tool for leveraging research leading to solutions for the responsible management of the Earth system and its resources, and the mitigation of natural hazards. RIs should be aware that the research promoted by using data delivered through RIs' platforms can have a profound influence on the environment, human health and wellbeing, economic development, and other facets of societies. Malevolent use and/or misuse of data with implications on national and international security, environmental protection and risk communication are possible and cannot be underestimated. In addition, data property rights need to be respected, according to applicable copyright laws and regulations. If not available, scientists should also engage in the formulation of these regulations.

The data life cycle involves different stages, which have different requirements and need to be managed accordingly. They usually comprise the following aspects:

- Planning: developing and maintaining a data management plan, specifying the aims, materials, methods, time schedules and analytical approaches, including roles and

responsibilities of data stewards, data sharing agreements, data access controls and copyrights.

- Acquisition: acquisition by hand or with sensors or other instruments, including generation of new data or obtention of existing data. This includes technical requirements for the acquisition, data standards, and file types.
- Checking: definition of data quality control protocols and scrubbing during the whole data life cycle.
- Archiving: data storage in digital form into an appropriate long-term data centre, capable to assure also safety from intrusions and/or manipulation.
- Describing: data labelling, using also appropriate metadata standards.
- Integrating: creation of homogenous datasets with data from different sources.
- Processing: data elaboration, including activities (visualization, spatial or image analysis, modelling, interpretation) associated with exploring and interpreting processed data.
- Backup and safety: file duplication procedures for protecting data from accidental data loss, corruption, manipulation, anti-intrusion systems against unauthorized access, sensitive data protection proxies.
- Publication: data services for different end-users, including data sharing through journals and websites (data catalogues and portals), to be addressed also in terms of data citation in order to guarantee intellectual property rights.
- Deletion: data destruction according to data management rules, if required.

Data access must be open for end-users and be secure for RIs, in accordance to national laws on accessibility, usability and copyrights.

Data accessibility and restrictions should be managed by considering:

- Different types of user accessibility, ranging from “anonymous” (access without any identification or accreditation), to “registered” (identified access requiring prior registration), to “authorized” (registered and authorized to specific operations).
- Different types of datasets usability, ranging from “open” (freely available/accessible to users either for download or for direct use within an RI service) to “restricted” (available under RI special conditions with restrictions that could be related to specific user categories or types of datasets). Other usability categories should consider specific rights of property of data providers, temporal release of raw data and derived elaborations, and potential misuse of particular sensitive data.

RIs have the duty to acknowledge the persons and organizations that have originally generated data or processed the different levels of data.

RIs should provide only certified data, generated, collected and processed by RI-adopted codes, algorithms and software, shared through license certificates.

Data have to be accompanied by metadata, that include information about data provenance, description, quality, processing, maturity level (raw data streams, automated quality control, processed, derivative products), and collection context. Interoperability with other observatories, archives, and databases should be guaranteed.

Even if data provided by industrial or commercial undertakings cannot be shared by RIs in an open access environment, metadata associated to those data should be freely put at disposal for users to guarantee a minimum level of public transparency and the right to know about the existence of this information.

If data is accessible to non-expert users, explanatory notes should assure clearness in description of potential use and limits of the information, highlighting also possible misunderstandings, which could evolve by inappropriate use.

Unfortunately, data, even in their raw version, could be manipulated for personal, media, industrial or commercial purposes. Appropriate security procedures have to be put in place to prevent fraudulent activities. Moreover, misuse and/or misinterpretation of data must be avoided through access and security polices also for possible legal implications. Those polices must be capable of assuring wide diffusion and sharing of data, but at the same time must assure credibility and reliability of RIs through adequate restrictions or user licenses, with particular reference to sensitive data.

An ethical data management must consider the legitimate rights of all societal actors to access freely information produced with public funds and at the same time it is the duty of RIs to avoid data are used in an improper, incorrect and inaccurate way, threatening the public safety, economic assets and social structures.

6.3 Conflicts of interest

RIs provide services and data that have not only scientific value, but may also be relevant for a number of stakeholders, including decision-makers, and industrial and commercial undertakings. The range of different interests revolving around the RIs' activities lead inevitably RIs, their members and their individuals to be exposed to conflict of interests.

Conflict of interests in a working environment occurs when a subject (or a RI) has, consciously or unconsciously, personal, professional or institutional interests which are in conflict with their professional and institutional responsibilities and with the roles covered. These situations compromise the impartiality of the subject or organization in decisions between competing interests and freedom in actions.

Conflicts of interest may arise as a project or activity evolves, namely after a subject or an organization has assumed a new role or responsibility. In any case, conflicts of interest must be solved to maintain integrity and independence for all kind of activities and decisions a subject or an organization undertakes. If it is not possible to completely solve conflicts of interest for "technical" reasons, they must be clearly declared and minimized to such levels that can be considered acceptable for maintaining equal opportunities between competing interests.

There may also be cases in which individuals or organizations want to avoid situations and / or responsibilities that other people, from the outside, might judge as conflicting. To prevent others from raising accusations or even glimpsing conflicts of interest (which in fact are objectively only potential or completely absent), for purely preventive purposes, subjects or organizations can change their behavior and decisions in a way that damages professional and institutional interests . Even these cases must be considered unethical and sanctioned in the ways and in the forms established by each RI.

Finally, it should be noticed that if the impartiality of a subject, a team or a RI is compromised for any other special reason, the possibility to maintain high ethical standards is compromised.

RIs should carefully analyse financial, scientific, and political situations that could expose their managing bodies, members and individuals to conflicts of interests on the basis of their institutional duties. They need to define how to solve or minimize potential conflicts of interest and even disqualify people who tried to hide them or took advantage of unethical situations.

6.4 Relationship with decision makers

Decision makers are involved in a wide variety of fields ranging from engineering, to management, public policy, social services, and economics. RIs, their members and individuals can do their jobs better if the decision makers are supportive and acknowledge their contributions. RIs' role should be limited to provide services and data in a broad sense (along with errors and uncertainties associated), always avoiding entering the decision-making process itself in order to retain own credibility and societal trust.

If scientists managing RIs have a mandate to provide expertise and or alerts, they need to act independently of economic interests, political pressures, and popular feelings; being as much as possible impartial and careful of the environment and public interest.

Scientists providing expert opinions to decision-makers have a delicate task. They need to consider the societal impact of their communication, in particular on risk perception, scenario definition, and thresholds on which acceptable decisions are based on.

7. CONCLUSIONS

The wide spectrum of activities, services and data provided by the ENVRI community related to environmental and solid Earth processes makes it extremely difficult to compile ethical guidelines that can be useful for all types of RIs.

This document, while not comprehensively addressing all issues relevant for the different RIs, highlights essential ethical values, which should be considered in codes of ethics and conduct by each RI. They shall assure minimum levels of integrity in the working environment and in the relationships between RIs and society, while taking care to minimize negative impacts of RIs' activities on the Earth system.

In addition, these EGs focus on four delicate matters (working environment, data life cycle, conflicts of interest, relationships with decision-makers), which need to be carefully addressed by each RI in the near future if this has not yet been done.

RIs should consider that defining ethical and social aspects related to their institutional role and activity is fundamental to provide more reliable services and to enhance credibility, respect, and

trust by citizens, industry, decision-makers and politicians, assuring their best scientific and technological assistance for serving society in facing global environmental challenges.

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