In particular, new methods for automated, flexible digital rights management and common-use licensing (such as Creative Commons licenses) for otherwise copyrighted data products provide the capability to manage a reasonable range of data restrictions in a rapid and seamless manner online. These methods can also help educate users about their rights, responsibilities, and restrictions regarding the data or information they obtain from GEOSS. Such approaches offer greater flexibility and the potential to promote both planned and unforeseen societal benefits than more traditional approaches that rely on technical controls, while reducing transaction costs.

Moreover, as the diversity and volume of resources and services offered by GEOSS increase, users will have more choices of data and information types and sources to address their needs. For example, they may need to choose between access to free data, which they may need to process themselves, or to value-added information or services, for which charges will most likely apply, but which can save them time or effort. They may face tradeoffs between the higher costs of high resolution data vs. free or low-cost low resolution data, between more processed quality-controlled data vs. raw data, or between real-time vs. near real-time or historic data. Some users may need to obtain data without re-dissemination or reuse restrictions, whereas others may be willing to live with restrictions in return for lower costs. To facilitate these decisions, it is important for GEO to explore implementation of online cost recovery mechanisms similar to those now common on the Internet in industry. Such systems should greatly reduce the transaction costs for cost recovery and provide users with much more detailed and accurate information on the costs of accessing alternative data and information available through GEOSS, while encouraging participation of potential GEOSS data providers, particularly from the private sector.

4. Metrics and indicators for cost/benefit analyses and evaluation of performance

As noted elsewhere in this report, a vital issue for GEOSS is its economic sustainability over the long term. This encom-

passes not only the ways in which specific costs for supporting the dissemination and use of GEOSS data can be shared equitably and efficiently between producers and users in developed and developing countries, but also the development of qualitative and quantitative metrics that can clearly justify continued public investment in GEOSS components and the system as a whole. Harmonization of data sharing policies regarding cost recovery, data attribution, and usage metrics could be of great value in ensuring that GEOSS will continue to receive the support it needs to function well.

There are at least two ways in which metrics can be used to promote participation in and improve the performance of GEOSS. One is through an empirical analysis of the benefits of data sharing and unrestricted reuse of data. Fact-based assessments can make a strong case in support of the GEOSS Data Sharing Principles by developing objective metrics and more subjective indicators that measure the positive economic and social effects of making data openly available and usable, especially online.

Metrics and indicators also can be valuable in encouraging GEOSS stakeholders to continue to participate and abide by the principles. Monitoring and evaluation tools can even be used to promote compliance with the policies as an enforcement tool, as discussed below, and as a means of positive attribution. The use of evaluation methods can be both expensive and onerous, however, so the costs of doing such evaluations and their actual benefits need to be carefully considered prior to implementation.

Finally, because a key objective of GEOSS is to provide integrated GEOSS data and information from multiple sources to users as quickly and seamlessly as possible, it is vital that GEOSS develop straightforward methods for assessing usage and the results of that use. This will enable GEOSS to report on usage and impact to GEOSS components, which in turn can use these metrics to justify continued operations, system improvements, and/or specific subsidies for research, education, and developing country applications.

Toward this end, GEO Members and other sponsors and participants in GEOSS will need statistical information on the volume and diversity of data and information delivered by

GEOSS, on the services rendered for users, and on the user community itself. But equally important will be metrics and indicators, both quantitative and qualitative, which characterize the impact of GEOSS across, at a minimum, the nine societal benefit areas. Planning for such assessments in a systematic manner at an early stage, while difficult, will help GEOSS evolve more quickly and effectively.

5. Peer pressure

In general, the potential embarrassment of being caught violating rules, not complying with guidelines, or simply not contributing a "fair share" is a strong motivation for compliance, particularly in small communities of practice where many of the stakeholders are known to each other. When Member States, Participating Organizations or public agencies see that their peers are complying with the data sharing principles and are achieving the desired results, they will be inclined to follow these examples. This will especially be the case if the general public is aware of these good examples and is demanding that their Member State, a Participating Organization, or public agencies do the same. No Member State or Participating Organization wants to be considered as the "weakest link in the data chain," or to be labeled as being less interested or unwilling to share its data with other stakeholders in the GEOSS partnership. This also is true for helping to promote sharing norms among data users, or conversely assisting in compliance with various applicable restrictions on uses. Nevertheless, peer pressure by itself is insufficient in most cases as a mechanism for ensuring that the stakeholders are adhering to the GEOSS norms, values, and legal rules on data sharing.

6. Developing other means for encouraging compliance by both data providers and users with the GEOSS Data Sharing Principles

Although peer pressure is important for helping to promote compliance with the GEOSS Data Sharing Principles, it is unlikely to be sufficient. Users—and the GEO purpose—will become frustrated if the exceptions start to become more preva-

lent than the rule. Because the GEOSS Data Sharing Principles set a high standard for data access, it is important for GEO to develop effective mechanisms and procedures to encourage GEOSS data providers to comply with the Data Sharing Principles and that any disputes about their implementation are handled as quickly and transparently as possible. GEO needs to have a way to make sure that the data providers continue to meet the established criteria for participation; otherwise, the overall "system of systems" is unlikely to attain its full potential.

Since the success of GEOSS depends to a large extent on establishing and maintaining data dissemination processes and activities founded on the agreed Data Sharing Principles, the Member States, and Participating Organizations, supported by the GEO Secretariat, therefore need to develop a comprehensive implementation plan that is consistent with the Principles and related Implementation Guidelines. This will require consultation with all major GEOSS stakeholder groups and continuing outreach efforts.

Similarly, users need to abide by the agreed terms and conditions on use of the GEOSS data providers, consistent with the Data Sharing Principles. Appropriate sanctions on users who do not respect the data providers' terms and conditions need to be developed by the GEOSS Members and Participating Organizations, and may include a variety of sanctions.

APPENDICES

APPENDIX A

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APPENDIX B

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APPENDIX C

Regional European Data Sharing Policies

European Community – directive on re-use of public sector information	Members: European Union (27 Member States) + EEA Countries (Iceland, Norway and Liechtenstein)	Directive 2003/98 of the European Parliament and of the Council of 17 November 2003 on the re-use of public sector information (http://eur-lex.europa.eu/LexUriServ/LexUriServ.do?uri=OJ:L:2003:345:0090:0096:EN:PDF	The PSI directive lays down a minimum set of rules for public sector bodies to make their documents available to the private sector for re-use. Re-use is defined as "the use by persons or legal entities of documents held by public sector bodies, for commercial or non-commercial purposes other than the initial purpose within the public task for which the documents were produced. Exchange of documents between public sector bodies purely in pursuit of their public tasks does not constitute re-use." Member states are not under any obligation to make their documents available for re-use, but are encouraged to do so under specified conditions. These conditions include time limits, available formats, fees and transparency. The directive also makes sure the public sector bodies comply with the rules of fair competition. If a public sector body creates value-added products or services on the basis of its own documents for commercial activities outside of the scope of its public tasks, the same charges and conditions should apply to the supply of the documents as those for other users. Exclusive agreements are prohibited, unless such an exclusive right is necessary for the provision of a service in the public interest.

European Community – directive on public access to environmental information	European Union (27 Member States) and EEA (Liechtenstein, Norway and Iceland)	Directive 2003/4 of the European Parliament and of the Council of 28 January 2003 on public access to environmental information and repealing Council Directive 90/313/EC (http://eur-lex.europa.eu/LexUriServ/LexUriServ.do?uri=OJ:L:2003:041:0026:0032:EN:PDF)	The directive on access to environmental information aims to guarantee the right of access to environmental information held by or for public authorities and to ensure that environmental information is progressively made available to the public. It introduces the dispositions of the Aarhus Convention in Community law. The directive ensures free-of-charge on-site viewing of environmental information while allowing the public authorities to charge a reasonable fee for supplying the information. As a general rule, the charges may not exceed the costs of production. However, when a public authority makes its environmental information available commercially in order to guarantee continued collection and publication of such information, market rate charges are allowed. The directive also contains obligations for the Member States regarding the dissemination of environmental information. The Member States have to ensure that environmental information progressively becomes available in electronic databases which are easily accessible to the public through telecommunication networks. The Member States have to take the necessary measures to ensure that, in the event of an imminent threat tc human health or the environment, whether caused by human activities or due to natural causes, all information held by or for public authorities which could enable the public likely to be affected tc take measures to prevent or mitigate harm arising from the threat is disseminated, immediately and without delay.

Europe – EUMETSAT www.eumetsat.int	Members: Austria, Belgium, Croatia, Denmark, Finland, France, Germany, Greece, Ireland, Italy, Luxembourg, the Netherlands, Norway, Portugal, Slovak Republic, Spain, Sweden, Switzerland, Turkey, United Kingdom Cooperating States: Czech Republic, Poland, Slovenia, Hungary, Romania, Latvia, Lithuania, Bulgaria, Iceland, Estonia	Convention for the establishment of a European Organisation for the exploitation of meteorological satellites as amended by the EUMETSAT Council in Resolution EUM/C/Res. XXXVI of 5 June 1991, and subsequently accepted by all EUMETSAT Member States EUMETSAT Data Policy document (Council Resolution EUM/C/98/Res.IV)	**Availability of data for the Member States** The National Meteorological Services (NMSs) of the Member States receive all EUMETSAT data, products and services for their official duty at no cost, except for the cost of decryption key units. Official Duty is defined as all activities which take place within the organisation of a NMS and external activities of a NMS resulting from legal, governmental or intergovernmental requirements relating to defence, civil aviation and the safety of life and property. Insofar as required for Official Duty use, the NMSs may grant access to other Departments within their respective National Administrations, subject to arrangements in accordance with national legislation, but all conditions defined in the data policy remain attached to the use of the data. **Availability of data for others** Essential data • The EUMETSAT Council has defined a set of data, products and services that is available on a free and unrestricted basis as "essential" data and products in accordance with WMO Resolution 40 (Cg-XII). • Non-essential data NMSs of non-Member States have access without charge to Three-hourly Meteosat Data for Official Duty use. They have access to Hourly, Half-hourly and Quarter-hourly Meteosat Data for Official Duty use in accordance with the conditions specified in the data policy. The annual fees are determined	

			based on the GNI per capita derived from World Bank Statistics. For limited periods, to support the monitoring of disasters or emergencies and in accordance with relevant UN resolutions, the full set of Meteosat Data will be made available without charge. For Official Duty use by NMSs of non-Member States subject to tropical cyclones, the full set of Meteosat Data will be made available without charge.
European Space Agency www.esa.int – ENVISAT, Earth Explorer	Members: Austria, Belgium, Denmark, Finland, France, Germany, Greece, Ireland, Italy, Luxembourg, the Netherlands, Norway, Portugal, Spain, Sweden, Switzerland and the United Kingdom. Canada, Hungary and the Czech Republic also participate in some projects under cooperation agreements.	Convention for the establishment of a European Space Agency of 30 May 1975 ENVISAT Data Policy of 19 February 1998	The conditions attached to the distribution of Envisat or Earth Explorer data depend on the use of the data. The following two categories of use are defined. *Category 1 use*. Research and *applications development* use in support of the mission objectives, including research on long term issues of Earth system science, research and development in *preparation for future operational use*, certification of receiving stations as part of the ESA functions, and ESA internal use. *Category 2 use*. All other uses which do not fall into category 1 use, including operational and commercial use. Envisat data is available in an *open and non discriminatory way*, in accordance with the United Nations Principles on Remote Sensing of the Earth from Space (United Nations Resolution 41/65, 3 December 1986). The Envisat distributing entities have to provide services to users in a fair and non-discriminatory way.

			ESA determines the price for all Envisat data intended for category 1 use. The price is set at or near the cost of reproduction of the data. Envisat products for category 1 use are disseminated under controlled licensing conditions which stipulate the rights of use and further distribution. If the data are received free, the rights of use will include the obligation to report on and publish the research findings from the use of Envisat data, and the obligation to present such results in symposia organised by ESA. ESA has delegated the responsibility for disseminating data and products for category 2 use to a number of distributing entities. These entities are selected through a tender procedure. For category 2 use, ESA determines the price of Envisat standard products and services which it provides to the distributing entities. The price is set at a level comparable to the price for category 1 use. Distributing entities are allowed to set prices for Envisat standard products and services at or above the price level which ESA charges the distributing entities. For specific purposes, and with the prior agreement of ESA, distributing entities will be allowed to set prices for data products below the price level which ESA charges the distributing entities.
		Council Resolutation of 16 November 2000 on a European space strategy "A European Approach to Global Monitoring For Environment and Security	
EUROPE – GMES www.gmes.info	Cooperation between European Union (27 Member States) and European Space Agency		No official data policy available yet. One of the tasks of the GMES Bureau is to develop a data policy for the different types of data that are involved in GMES. To prepare this policy, a study was made by University College London for the Working Group on Data Policy Assessment. The

		(GMES): Towards Meeting Users' Needs", joint document from ESA and the European Commission Communication from the European Commission to the Council and the European Parliament of 10 November 2005, "Global Monitoring for Environment and Security (GMES): From Concept to Reality" Commission Decision of 8 March 2006 creating a Bureau for Global Monitoring for Environment and Security (GMES)	document can be found at http://www.gmes.info/library/index.php?action=standarddownload&filename=DPAGDFinalReport.pdf&directory=6.%20Cross-Cutting%20Studies%20Documents&
European Union INSPIRE – www.ec-gis.org/inspire	European Union (27Member States)	Directive 2007/2 of the European Parliament and of the Council of 14 March 2007 establishing an Infrastructure for Spatial Information in the European Community (INSPIRE)	The aim of INSPIRE is to create an infrastructure for spatial information in the European Community for the purposes of European Community environmental policies or activities which may have an impact on the environment. The European Directive has entered into force on 15 May 2007 and has to be transposed into national legislation by 15 May 2009. INSPIRE is based on the following data principles: • Data should be collected once and maintained at the level where this can be done most effectively. • It should be possible to combine seamlessly spatial data from different sources and share it between

			many users and applications. • Spatial data should be collected at one level of government and shared between all levels. • Spatial data needed for good governance should be available on conditions that do not restrict its extensive use. • It should be easy to discover which spatial data is available, to evaluate its fitness for purpose and to know which conditions apply for its use. It applies to 34 spatial data themes, including coordinate reference systems, administrative units, hydrography, land cover, orthoimagery, geology, meteorological geographic features, … The INSPIRE directive contains obligations for the Member States and their public authorities regarding the creation of metadata and data specifications. The Member States also have the obligation of providing a network of services for the spatial data themes in the annexes: - discovery services making it possible to search for spatial data sets and services on the basis of and to display the content of the metadata; - view services making it possible, as a minimum, to display, navigate, zoom in/out, pan, or overlay viewable spatial data sets and to display legend information and any relevant content of metadata; - download services, enabling copies of spatial data sets, or parts of such sets, to be downloaded and, where practicable, accessed directly; - transformation services, enabling spatial data sets to be transformed with a view to achieving interoperability; - services allowing spatial data services to be 'invoked'

			Access to these services must be provided through the geo-portal that will be established by the European Commission. Discovery and view services have to be provided free of charge. However, it is possible for a public authority to charge for the use of the view service, where such charges secure the maintenance of spatial data sets and corresponding data services, especially in cases involving very large volumes of frequently updated data. The other services can be charged for by choice of the Member States. The directive also contains obligations concerning data-sharing between the public authorities. The Member States have to adopt measures for the sharing of spatial data sets and services between their public authorities, enabling these public authorities to gain access to spatial data sets and services, and to exchange and use those sets and services, for the purposes of public tasks that may have an impact on the environment. These measures have to preclude any restrictions likely to create practical obstacles, occurring at the point of use, to the sharing of spatial data sets and services. It is allowed for public authorities to licence spatial data sets and services and/or require payment from other public authorities or the institutions and bodies of the European Community. These charges and licenses have to be compatible with the general aim of facilitating the sharing of spatial data sets and services. Where charges are made, these have to be kept to the minimum required to ensure the necessary quality and supply of spatial data sets and services together with a reasonable return on investment, while respecting the self-financing

			requirements of public authorities supplying spatial data sets and services, where applicable. Spatial data that is provided by the Member States to the institutions and bodies of the European Community in order to fulfil their reporting obligations under the environmental Directives are not subject to any charging. The data sharing arrangements that are set up by the Member States under these rules have to be open, on reciprocal and equivalent basis, to bodies established by international agreements to which the European Community and Member States are parties. Member States can limit sharing when it would compromise the course of justice, public security, national defence or international relations. Specific Implementing Rules will be created addressing the dissemination of spatial data by the Member States to the bodies and institutions of the European Community.
Europe – EIONET www.eionet.europa.eu	Members: European Union (27 Member States), 4 EFTA Countries (Iceland, Norway, Liechtenstein and Switzerland), Turkey and European Environment Agency. FYR Macedonia, Croatia, Bosnia &	Council Regulation (EEC) on the establishment of the European Environment Agency and the European environment information and observation network (Eionet) [No.1210/90	Eionet is a partnership network of the European Environment Agency (EEA) and its member and participating countries. It consists of the EEA itself, a number of European Topic Centres (ETCs) and a network of around 900 experts from 37 countries in over 300 national environment agencies and other bodies dealing with environmental information. These are the national focal points (NFPs) and the national reference centres (NRCs). Eionet aims to provide timely and quality-assured

	Herzegovina, Serbia, Montenegro and Albania also participate in the EEA and Eionet work.		data, information and expertise for assessing the state of the environment in Europe and the pressures acting upon it. This enables policy makers to decide on appropriate measures for protecting the environment at national and European level and to monitor the effectiveness of policies and measures implemented. The European Environmental Agency has identified a set of priority annual data flows, in the area of air quality, air emissions, inland waters, marine and coastal waters, contaminated soil, nature conservation and lanc cover. These data are used to update the core set of environmental indicators which form the basis of EEA reports and assessments. As far as possible, data and information which have already been reported by the countries in the framework of EU or international obligations are used within Eionet, entailing that data collected once at a national level can be used for many purposes at national, EU and international level. The data service provides access to most data sets and applications which have been used in EEA's periodical environmental reports and metadata for data that are maintained by other international organisations. In the Data section data sets can be accessed. The data sets contain aggregated data, typically on a country level, with a geographical coverage of at least 15 EU Member States. Graphs and, in the future, maps can be generated from the datasets. Information about the source of each data set and its geographical and temporal coverage is provided. In the Maps and graphs section one can find and

			download maps and graphs used in EEA products.
European Community – Water Framework Directive & WISE (water information system for Europe)	27 Member States + Norway Cooperation with European Commission, European Environment Agency for WISE portal	Directive 2000/60/EC of the European Parliament and of the Council of 23 October 2000 establishing a framework for the Community action in the field of water policy	The Water Framework Directive is a legislative framework to protect and improve the quality of all water resources such as rivers, lakes, groundwater, transitional and coastal water within the European Union. One of the key activities under the joint implementation for the Water Framework Directive is the improvement of the information exchange between Countries, European institutions, the various stakeholders and the interested public. In order to promote an increases information exchange and to facilitate the work in the numerous expert groups, the Commission set up an internet-based platform, the so-called "WFD CIRCA" (see http://ec.europa.eu/environment/water/water-framework/iep/index_en.htm) WISE (the Water Information System for Europe) is being developed since 2006 and should be fully operational by 2010. It will serve as the electronic reporting system for the Member States for reporting on the monitoring frameworks of the Water Framework Directive and for reporting under the Urban Waste Water Treatment Directive (UWWD)[1], Bathing Water Directive (BWD), Nitrate Directive (NID), Drinking Water Directive (DWD) and other mandatory or voluntary reporting to the EU level, in particular submissions to the European Environment Agency (EEA) and ESTAT. All authorised WISE data providers which have the right to upload data into WISE, which are officially

[1] For example, the reporting for Urban Waste Water Treatment Directive on the basis of Articles 15(4), 16, 17 is foreseen via WISE in 2009 at the latest.