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**IMPLEMENTATION GUIDELINES
FOR THE GEOSS DATA SHARING PRINCIPLES**

27 September 2008 Draft

[Revisions to 17 May 2008 Draft]

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11 According to the Global Earth Observation System of Systems (GEOSS) *10-Year Implementation*
12 *Plan*, the purpose of GEOSS is “to realize a future wherein decisions and actions for the benefit
13 of humankind are informed via coordinated, comprehensive and sustained Earth observations and
14 information.” GEOSS is seen by its participants as an important contribution to meeting the
15 United Nations Millennium Development Goals and to furthering the implementation of
16 international treaty obligations. The system will encompass all areas of the Earth, with a
17 particular emphasis on addressing the needs of developing country users. GEOSS will incorporate
18 *in situ*, seaborne, airborne, and space-based observations and address the integration of
19 observations and models to support nine societal benefit areas.

20 The GEOSS *10-Year Implementation Plan* explicitly acknowledges the importance of data
21 sharing in achieving the GEOSS vision and anticipated societal benefits. The Plan, endorsed by
22 nearly 60 governments and the European Commission at the 2005 Third Earth Observation
23 Summit in Brussels, highlights the following GEOSS Data Sharing Principles:

- 24 **1. There will be full and open exchange of data, metadata, and products shared within**
25 **GEOSS, recognizing relevant international instruments and national policies and**
26 **legislation.**
- 27 **2. All shared data, metadata, and products will be made available with minimum time**
28 **delay and at minimum cost.**
- 29 **3. All shared data, metadata, and products being free of charge or no more than cost of**
30 **reproduction will be encouraged for research and education.**

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32 All members of GEO—whether existing ones or new—are required to endorse the Plan and
33 therefore these Principles. At the same time, it is important to underscore the fact that GEOSS is
34 composed of voluntarily contributed systems and data, which are governed by pre-existing laws
35 and policies that may not be fully compatible with the Principles. Both the association of GEO
36 Members and Participating Organizations and their adherence to the Data Sharing Principles are
37 thus not legally binding. The Principles will gain acceptance and importance through good-faith
38 voluntary adherence, which may also be accompanied by legal and policy changes at the national
39 or international levels.

40 In 2006, the GEO Secretariat requested the Committee on Data for Science and Technology
41 (CODATA), an interdisciplinary committee of the International Council for Science (ICSU), to
42 recommend implementation guidelines for the GEOSS data sharing principles and to draft an
43 accompanying background white paper that helps to explain and substantiate these
44 *Implementation Guidelines*. Based on the CODATA Task Group’s analysis of the relevant
45 GEOSS documents, applicable international agreements and practice, and extensive consultation
46 with experts on data policy from around the world, these *Implementation Guidelines* are proposed
47 for further consideration by GEO Members and Participating Organizations in implementing the
48 GEOSS Data Sharing Principles.

49 It is important to emphasize that the successful implementation of the Data Sharing Principles
50 will depend upon successfully promoting the benefits of full and open access to GEOSS data
51 through a process that engages directly both data providers and data users. Moreover, it should be
52 recognized that GEOSS is a dynamic system in a continual state of development and evolution.
53 Therefore, as new observing systems and data types are deployed and the world in which they are
54 operating changes, it may become necessary to revise these *Implementation Guidelines* on a
55 periodic basis and not view them as immutable.

56 ***Promoting the implementation of the principle of full and open exchange of data in***
57 ***accordance with the GEOSS Data Sharing Principles.***

58 **1) For GEOSS to realize its vision and potential, it is essential to promote the full and open**
59 **exchange of metadata, data and products in accordance with the Data Sharing Principles.**

60 GEOSS is envisioned as a system of systems that can deliver integrated data and information
61 as rapidly as possible to meet important user needs. Therefore, it is important that the
62 component systems of GEOSS interoperate seamlessly with each other and with that the
63 fewest possible constraints on the sharing and integration of needed data and information (i.e.,
64 metadata and data products). To achieve this, it is vital for data and information providers who
65 share the goals of GEOSS to participate actively in the system and to implement at least the
66 minimum set of technical and policy requirements that have been identified by GEO for data
67 and system interoperability. The GEOSS Data Sharing Principles use the term “full and open
68 exchange” of data as the guiding policy, which has been used in various public international
69 and national environmental projects and research over the past two decades. In this context,
70 full and open exchange means that data and information derived from publicly funded
71 activities are made available with as few restrictions as possible, on a nondiscriminatory basis,
72 for no more than the cost of reproduction and distribution. By adhering to the GEOSS Data

73 Sharing Principles, system operators and other providers allow those data, metadata, and
74 products that they contribute to GEOSS to be shared under clear, predefined terms, consistent
75 with these Principles and Implementation Guidelines. The emphasis should be on promoting
76 the benefits of full and open access to GEOSS data through a process that engages directly
77 both data providers and data users.

78

79 *Encouraging GEOSS users to reuse and re-disseminate shared data, metadata, and*
80 *products.*

81 **2) The full and open exchange of data called for in the Data Sharing Principles should**
82 **apply to GEOSS data, metadata, and products even after such shared information is**
83 **disseminated to users. Users need to be able to integrate, reuse, and re-disseminate the**
84 **shared information with minimal restrictions in order to achieve maximum results in the**
85 **GEOSS societal benefit areas.** A literal reading of the GEOSS Data Sharing Principles could
86 lead to the interpretation that the “full and open exchange of data” applies only to data when
87 they exist “within GEOSS” itself, i.e., prior to delivery to all other potential users. This
88 interpretation might allow GEOSS providers to impose constraints on the integration, reuse,
89 and re-dissemination of data and information generated by GEOSS. Such constraints, however,
90 would drastically reduce the utility of GEOSS to users and therefore significantly diminish the
91 societal benefits intended to be realized by GEOSS. Because the value of data lies in their use,
92 the users of GEOSS data need the flexibility to reuse and re-disseminate the resulting shared
93 information in order to maximize their own uses, as well as the relevant secondary applications
94 of such data and information for the broad societal benefits. For example, data, metadata, and
95 products needed for immediate humanitarian assistance after a natural disaster may also be
96 vital to recovery and reconstruction efforts that are undertaken by a wide variety of both
97 governmental and nongovernmental organizations.

98 **a. GEO should encourage all GEOSS components that are developed and operated by**
99 **governmental, public-sector organizations to provide most, if not all, of their data,**
100 **metadata, and products without any reuse or re-dissemination restrictions.** Many
101 countries already have made commitments through their national laws and policies and in
102 international agreements to provide open and unrestricted availability for data, metadata,
103 and products from various government-operated systems. By encouraging all publicly
104 funded contributors of GEOSS elements to provide full and open access to their data,
105 metadata, and products without reuse or re-dissemination restrictions, GEO will ensure the

- 106 critical mass of digital resources needed to make GEOSS an invaluable resource to the
107 world.
- 108 **b. To meet the full range of user needs identified as priorities by GEO, private-sector or**
109 **hybrid public-private systems should be encouraged to contribute at least a useful**
110 **subset of their data and products on a full and open basis, without any reuse or re-**
111 **dissemination restrictions.** It is in the interest of all GEOSS components and participants
112 to ensure that the range and use of GEOSS data continues to expand, especially in
113 developing countries. Providing usable subsets of shared information without reuse or re-
114 dissemination restrictions from private or public-private data systems will not only help
115 demonstrate the value of those digital resources to existing and potential users, but could
116 also provide incentives for governments or other organizations to contribute new elements
117 to GEOSS.
- 118 **c. Attribution requirements should include recognition of all significant data sources**
119 **or authors, as well as the GEOSS component that enabled access to and delivery of**
120 **the data.** Recognition is needed not only for the GEOSS participants that delivered data,
121 metadata, and products to a user, but also to the original data sources or authors, in order
122 to provide greater incentives for such contributions. Recognition of contributions through
123 attribution will help provide incentives to participate in GEOSS, in accordance with the
124 Data Sharing Principles.

125 *Ensuring consistency in the implementation of the GEOSS Data Sharing Principles*
126 *with relevant international instruments and national policies and legislation.*

- 127 **3) All GEO Member States and Participating Organizations are expected abide by various**
128 **specific restrictions on the dissemination and use of data, metadata, and products based**
129 **on international instruments and national policies and legislation. Such restrictions**
130 **pertain mainly to concerns regarding the protection of: national security, proprietary**
131 **interests, privacy, confidentiality, indigenous rights, and conservation of sensitive**
132 **ecological, natural, archaeological, or cultural resources.** All participants in GEOSS are
133 expected to respect national laws and policies and international agreements in providing
134 access to all of their data, metadata, and products, recognizing that some data, metadata, and
135 products can be used in both beneficial and potentially harmful ways.
- 136 **a. In order to promote these goals and to help provide greater knowledge about these**
137 **issues within the GEOSS community, GEO should establish an online compendium**

138 **of the relevant international instruments and national policies and legislation.** Such a
139 compilation would provide a major service to both GEOSS providers and users alike.

140 **b. GEO should establish an overall focal point for coordinating the application of these**
141 **restrictions to avoid the development of a confusing array of vague and inconsistent**
142 **use policies and approval procedures.** Uncertainties in jurisdiction, legal interpretation,
143 applicability, and other aspects of national and international policies and laws could make
144 certain types of data (e.g., high resolution data) difficult to access and use, even if they are
145 readily available through automated, interoperable systems. It is therefore necessary for
146 GEO to coordinate the access and approval policies, working to standardize definitions
147 and procedures, clarify restrictions and allowable uses in advance, and address areas where
148 there are conflicting or vague policies.

149 **c. Consistent with sections 3.a and b. above, each GEO Member State and Participating**
150 **Organization also should consider establishing a focal point to coordinate**
151 **information on and interpretation of any restrictions applicable to its GEOSS**
152 **elements.** There may be a range of different policies, laws, and responsible agencies even
153 within a single country that can make determination of data rights and restrictions difficult.
154 The establishment by each GEO Member of an authoritative online focal point for data
155 policy issues would help GEO to work out more clearly what restrictions may apply to
156 GEOSS elements provided by that Member. Such a mechanism could maintain an
157 inventory of applicable and legitimate restrictions, develop a contact list of experts, and
158 act as a clearinghouse for inquiries about these issues, in particular, and the nation's
159 GEOSS activities, in general.

160 **d. GEO should consider utilizing machine-readable, common-use licensing approaches**
161 **for copyrighted data products that place primary responsibility for compliance on**
162 **the users rather than enforcing compliance through technical controls on data access.**
163 New methods for automated, flexible digital rights management and common-use
164 licensing (such as Creative Commons licenses) for otherwise copyrighted data products
165 provide the capability to manage a reasonable range of data restrictions in a rapid and
166 seamless manner online. These methods can also help educate users about their rights,
167 responsibilities, and restrictions regarding the shared information they obtain from GEOSS.
168 Such approaches offer greater flexibility and the potential to promote both planned and
169 unforeseen societal benefits than more traditional approaches that rely on technical
170 controls, while reducing transaction costs.

171 *Implementing pricing policies consistent with the GEOSS Data Sharing Principles.*

172 4) **The pricing of GEOSS data, metadata, and products should be based on the premise**
173 **that the data and information within GEOSS is a public good for public-interest use in**
174 **the nine societal benefit areas. GEO, together with its GEOSS data providers, should set**
175 **standards for “minimum cost” based on this premise.** For GEOSS to achieve its desired
176 vision, the costs of access to and the information shared through the system needs to be free
177 or as low as possible for the widest possible range of users.

178 a. **The costs of data collection and system development and integration into GEOSS**
179 **should be considered a previously incurred cost and an unallowable part of cost**
180 **recovery.** The default price for data under the principle of full and open exchange is the
181 cost of reproduction and distribution to the user, or the marginal cost of fulfilling the user
182 request. Member States and other Participating Organizations should be willing to
183 develop, implement, and integrate their GEOSS components using their own resources.
184 All organizations contributing to GEOSS should recognize that they receive direct and
185 indirect benefits from participating in the system, such as the ability to seamlessly
186 integrate their own data with data provided by a range of other sources.

187 b. **Although the Data Sharing Principles in theory allow for recovery of minimum costs**
188 **for access to metadata, in practice, metadata generally should be made available**
189 **openly at no cost, to enable users to discover sources of data and information**
190 **without restriction.** Metadata (descriptive documentation of the primary data set) are
191 essential to making GEOSS function effectively as a system of systems and to ensuring
192 that all GEOSS data and information are fully accessible on a non-discriminatory basis to
193 all users. Charging for access to metadata would constrain many potential users from
194 discovering useful data and information that might be of significant value to them.
195 Implementing a system that identifies users for charging purposes also increases the
196 complexity of development and will likely increase the costs to GEOSS.

197 c. **GEO should encourage development of flexible, online cost recovery mechanisms**
198 **that allow different types of users to understand their access costs.** As the diversity
199 and volume of resources and services offered by GEOSS increase, users will have more
200 choices of types and sources of shared information to address their needs. For example,
201 they may need to choose between access to cost-free data, which they may need to
202 process themselves, or to value-added information or services, for which charges may
203 apply, but which can save them time or effort. They may face tradeoffs between the
204 higher costs of high resolution data vs. cost-free or low-cost low resolution data, between

205 more processed quality-controlled data vs. raw data, or between real-time vs. near real-
206 time or historic data. Some users may need to obtain data without re-dissemination or
207 reuse restrictions, whereas others may be willing to live with restrictions in return for
208 lower costs. To facilitate these decisions, it is important for GEO to explore
209 implementation of online cost recovery mechanisms similar to those now common on the
210 Internet in industry. Such systems should greatly reduce the transaction costs for cost
211 recovery and provide users with much more detailed and accurate information on the
212 costs of accessing alternative data, metadata, and products available through GEOSS.

213 **d. GEO should encourage cost recovery models that waive or minimize costs for**
214 **developing country applications and users not covered by the research and**
215 **education Data Sharing Principle.** The existing infrastructure for data delivery over the
216 Internet favors users in developed countries who typically have ready access to relatively
217 low-cost and high-bandwidth connections over those in developing countries, who have
218 limited or expensive connectivity and who are therefore faced with higher costs of access
219 to or delivery of data. GEO needs to work at a technical level to equalize the accessibility
220 of shared information to users in developing and developed countries, as well as
221 structuring cost recovery models that facilitate and promote uses of GEOSS data that
222 specifically address developing country problems, or users based in developing countries.
223 For example, since the cost of fulfilling a user order is more likely to be driven by the
224 complexity of the order rather than the volume of data delivered, cost-recovery charges
225 should be based on the characteristics of an order rather than the volume of data (number
226 of bytes) delivered. Moreover, where possible, GEO members should explore ways to
227 waive or minimize costs for developing country uses and users, e.g., through direct
228 subsidies or recognition of in-kind contributions to GEOSS. The transfer of appropriate
229 technology also should be strongly encouraged to facilitate access of developing
230 countries to data, metadata, and products, and for them to benefit fully from GEOSS.

231 **e. Cost recovery approaches and licensing arrangements for data and products**
232 **contributed to GEOSS that require payments for reuse of data and products**
233 **already acquired by users are not consistent with the GEOSS Data Sharing**
234 **Principles.** One approach to cost recovery outside GEOSS is to reduce the payment for
235 delivery and initial use of data, and then restrict further use unless additional payments
236 are made. Although this approach may make initial use of data outside the GEOSS
237 framework more economical for some users, it restricts broader reuse of data by the
238 initial user and secondary users. It also discourages collaborative arrangements by users

239 to purchase and share data flexibly, contrary to the purpose and intent of the GEOSS Data
240 Sharing Principles. For these reasons such restrictions should not be allowed for data
241 made available through GEOSS.

242 *Reducing the time delays for making data available through GEOSS.*

- 243 **5) GEO should promote “minimal time delay” to data within GEOSS, depending on the**
244 **type of data and application and the need for appropriate quality control, and data**
245 **should be transmitted on a real-time basis whenever necessary or practicable.** Some
246 types of GEOSS data applications, such as disaster warnings, will depend on rapid access to
247 data, metadata, and products. Maximizing the potential societal benefits of GEOSS in many
248 cases will require minimizing the time delays in providing data and information through
249 GEOSS to users.
- 250 **a. For operational systems, time delays should be minimized through automated**
251 **quality control procedures.** In general, operational systems deliver relatively well
252 defined and understood data on key environmental or other parameters. In most cases,
253 automated quality control procedures can minimize time delays in data delivery.
- 254 **b. For research data, time delays may need to include a limited period of quality**
255 **control and exclusive use by the data provider. These should reflect the norms of the**
256 **relevant scientific communities or data processing centers.** Research data systems
257 tend to deal with instruments or parameters that may be less well understood than those
258 supported by operational systems and that may be subject to more frequent or serious
259 quality control problems. Some delay may therefore be necessary for the preparation of
260 metadata and quality control procedures. In the case of the introduction of new research
261 data (e.g., from a new instrument) into an existing GEOSS component, a period of
262 restricted access on the part of the research or instrument team may be needed. Such
263 periods should be kept to the shortest reasonable level, reflecting the normal practices of
264 scientists and data managers responsible for similar systems or data production activities.

265 *Promoting research and education uses of GEOSS data, metadata, and products.*

- 266 **6) GEO should develop and adopt clear definitions of “research” and “education.”**
- 267 Ideally, such definitions would be focused on the planned use of the information shared
268 through GEOSS, rather than the status of the user. Many different types of organizations are
269 increasingly involved in research and education in both developed and developing countries,
270 including various commercial, for-profit organizations, nongovernmental organizations, and

271 governmental and intergovernmental agencies. Not-for-profit academic institutions may
272 conduct research for for-profit firms that do not release the results for public use, whereas
273 many for-profit organizations perform research and educational activities on behalf of
274 governments for the public good. Thus, the institutional affiliation of the user is not
275 necessarily a good indicator of the use of GEOSS data, metadata, and products (and related
276 services) by the user. Instead, GEO, together with its Member States and Participating
277 Organizations, should define the types of research and education that are to be given
278 preferential treatment in GEOSS, e.g., publicly funded research or research that leads to
279 openly available results. Education should at least encompass all classroom and online
280 educational activities, but whether or not the GEO principle on research and education should
281 apply to educational and scientific publishing is an important policy issue that the GEO
282 community should explicitly consider.

283 **a. Cost reductions provided for research and educational activities (and for support of**
284 **developing country applications, consistent with section 4.d) should be documented,**
285 **if possible.** GEO should as much as possible inform users about the costs of the data and
286 information they obtain, including any cost reductions provided for research and
287 educational activities or for developing country applications. This will educate users
288 about the costs they should expect when they move from educational and research
289 applications to other operational applications. Tracking aggregate cost reductions for
290 research, education, and developing country applications is also one important element in
291 demonstrating to governments and other sponsors the continuing value of GEOSS in
292 terms of its impact on capacity building.

293 **b. Users receiving data at reduced or no cost should be strongly encouraged to provide**
294 **impact metrics and information regarding their use of the GEOSS data, metadata,**
295 **and products.** A second element in demonstrating the continuing value of GEOSS is to
296 document the impacts of GEOSS data, metadata, and products in diverse arenas,
297 including science, education, and development. Users who utilize GEOSS at reduced or
298 no cost should be expected to provide in-kind assistance in the form of help in
299 documenting the use and impact of data, metadata, and products received. GEO should
300 take steps to make submission of qualitative or quantitative impact metrics simple, but
301 also desirable, from a user viewpoint (e.g., as part of setting up a data subscription or
302 notification service, or obtaining a common-use license for downloaded products). See
303 also Implementation Guideline 7, below.

304 *Developing metrics and indicators for GEOSS data sharing activities.*

305 **7) GEO should develop minimum standards for data usage metrics and indicators to**
306 **ensure that the overall utility and impact of GEOSS data, metadata, and products can**
307 **be objectively documented.** Since a key objective of GEOSS is to provide integrated
308 GEOSS data, metadata, and products (and related services) from multiple sources to users as
309 quickly and seamlessly as possible, it is vital that GEOSS develop straightforward methods
310 for assessing usage and the results of that use. This will enable GEOSS to report on usage and
311 impact to GEOSS components, which in turn can use these metrics to justify continued
312 operations, system improvements, and/or specific subsidies for research, education, and
313 developing country applications.

314 **a. Usage metrics should capture the quantitative and qualitative results of GEOSS data,**
315 **products, and services across the nine societal benefit areas and in other important**
316 **realms, as well as the “throughput” of data, metadata, and products enabled by**
317 **GEOSS.** GEO Members and other sponsors and participants in GEOSS will need
318 statistical information on the volume and diversity of shared information delivered by
319 GEOSS, on the services rendered for users, and on the user community itself. But equally
320 important will be metrics and indicators, both quantitative and qualitative, that
321 characterize the impact of GEOSS across, at a minimum, the nine societal benefit areas.

322 **b. GEO should devote significant effort toward making the collection, analysis, and**
323 **interpretation of impact metrics and indicators an integral part of the system of**
324 **systems.** Planning for assessments that use metrics and indicators in a systematic manner
325 at an early stage, rather than as an afterthought, will help GEOSS evolve more quickly and
326 effectively.

327

328 **8. *Developing effective coordination and outreach mechanisms for implementing***
329 ***the GEOSS Data Sharing Principles***

330 **a. In order to implement the GEOSS Data Sharing Principles successfully, GEO needs**
331 **to establish an internal organizational structure for promoting the established**
332 **principles vis-à-vis the data providers and users.** The success of GEOSS depends to a
333 large extent on establishing and maintaining data dissemination process and activities
334 founded on the Data Sharing Principles that have been adopted by consensus. The Members
335 and Participating Organizations, supported by the GEO Secretariat, therefore need to develop
336 a comprehensive implementation plan that is consistent with the Principles and

337 Implementation Guidelines. This will require consultation with all major GEOSS stakeholder
338 groups and continuing outreach efforts.

339 **b. GEO should consider developing procedures to encourage the adherence of GEOSS**
340 **elements to the GEOSS Data Sharing Principles.** For any data sharing system to be
341 successful, user expectations regarding data accessibility and usability need to be met on a
342 consistent basis. Users—and the GEO purpose—will become frustrated if the exceptions start
343 to become more prevalent than the rule. Since the GEOSS Data Sharing Principles set a high
344 standard for data access, it is important for GEO to develop effective mechanisms and
345 procedures to encourage GEOSS elements to adhere to the Data Sharing Principles. When
346 GEO establishes the policy and technical criteria for systems as formal elements of GEOSS,
347 GEO also needs to have a way to monitor and encourage the Member States and Participating
348 Organizations in GEOSS to continue to meet those criteria; otherwise, the overall “system of
349 systems” is unlikely to attain its full potential.

350