Eye on Earth Summit

Special Initiatives Series

Eye On Water Security

3 December 2011

Prepared by

EoE Water Security
Special Initiative Team

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Executive Summary

Problem statement

Water security – the protection of vulnerable water systems, protection against water related hazards such as floods and droughts, sustainable development of water resources and safeguarding access to water functions and services – is an issue commanding serious attention at all levels. Its often trans-boundary in nature, its inter-linkages with domains such as ecosystem management, agricultural and industrial policy, and public well-being, coupled with mounting pressures of population growth, economic affluence, ecosystem degradation and climate change makes for a highly complex domain in which policies must be developed and implemented to address competing requirements.

It is imperative that water-related data, information and knowledge are widely shared and available for the myriad potential uses at multiple levels to support decision and policy making and to help citizens and government in their environmental choices. There is significant interest in the EoE community to explore further the alignment of various existing and planned local, national, regional and global networks.

Information and communication technologies and the social networking and crowd-sourcing capabilities that these facilitate are now making it possible to provide near real-time data and citizen-science contributions, and to link these with other environmental and socio-economic information. These developments are allowing a major step forward in improving the timeliness and effectiveness of water-related decision-making and helping to broaden the involvement of civil society.

There are very many environmental and scientific networks of different types around the world working in each continent according to their own individual needs and localised issues and Individual networks are focused on different parts of the data-information-knowledge chain from, for example, monitoring and statistics through to assessments and good practices. Many of the topics have global relevance but the information is not sufficiently linked or shared. This global relevance may be through the potential for combining local data to explore global and regional impacts, comparison of local conditions, or improved capacity through sharing knowledge and know-how about how to tackle the issues.

Working collaboratively (instead of individually), through a network of networks focused on Water Security provides a realistic mechanism to match supply with demand and thus meet the goals of the Eye on Earth Summit.

How to address

The aim of the Eye on Water Security Special Initiative (EoWSSI) proposes to realise this potential by developing a common vision and by building on and linking current advances using a network-of-networks approach. It does not intend to address anything like the whole gamut of issues surrounding management of data, information and knowledge in the water domain. Rather, it will focus on applying maturing technological capabilities – namely, the semantic web and "cloud computing", to start bridging gaps in the discovery and application of existing data, information and knowledge resources, and in lowering the barriers to publication of those resources, particularly for motivated developing countries.

The EoWSSI will encourage and promote developments which strengthen the networking of water data, information and knowledge at global, regional, sub-regional, national and local levels, including the establishment of strong institutional arrangements and synergies, and help to align relevant existing and planned networking activities. These developments will be guided

by a set of principles and a conceptual framework arising out of the common vision, which will allow the different players to find their place in the overall network of networks to exercise their role, thus enhancing the way in which they will be able to contribute to and benefit from the whole.

EoWSSI will help further three particular aspects of the expected Eye on Earth Summit conclusions (as currently found in the draft declaration):

1. first, concerning the establishment of a forum for cooperation;

2. second, concerning the furthering of Principle 10 of the Rio Declaration;

3. and third, concerning advancing future collaboration on the basis of a set of principles, indicating required functionalities, which will guide the development and operation of the network of networks.

In this manner, EoWSSI is a domain application of the broader Global Network of Network (GNoN) Special Initiative also being proposed to the Summit as a foundational element of the Abu Dhabi outcomes.[1] Most countries of the world now have at their disposal - or could have in the short term - the basic resources needed to establish national environmental networks – including their water-related components - that can be integrated at the regional and global levels.

Institutional cooperation across various levels (local, national, sub-regional, regional, global) as well as partnerships with civil society, facilitated by coordinating entities, is arguably the most important requirement for sustainable networks. This includes close coordination with umbrella bodies within and without the United Nations system. The benefits of institutional cooperation, both within countries and across borders, should not be underestimated as it provides a basis for mutual trust and peer-to-peer capacity building.

Expected accomplishments

Expected overall accomplishments from the EoWSSI will include

- ⚔ enhanced dissemination of data, information and knowledge from the global observing systems and other global initiatives to the regional and national level, thus enhancing sub- national, national and regional capacities

- ⚔ lowering the barriers for relevant data, information, knowledge and services to be collected, stored, discovered and applied across the boundaries that define communities of practice – whether bounded by geography, philosophy, area of expertise or scientific discipline – by refinement and application of semantic web technologies to the water domain

- ⚔ lowering the barriers to publication of water-relevant data, information and knowledge by motivated custodians, particularly in developing countries.

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1 GNoN SI is a concrete response and contribution to the current global debates on international environmental governance (IEG) and on the International Framework for Sustainable Development (IFSD). It will support capacity building and sharing knowledge on managing and using environmental information for decision making activities. A key strategic area for advancing the information exchange agenda is the application of Principle 10 of the Rio Declaration on access to information. The GNoN SI aims to build a Network of Networks around three main components: 1) Institutional cooperation and partnerships; 2) Common content; and 3) Shared infrastructure and tools. While different organisations and networks usually have focus or expertise in one or two of these components, due to their interdependency, all aspects need to be built together to support sustainable processes and effective and efficient outcomes.

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1 Introduction: Water Security: A Globally Scalable Approach To Linking Policy, Science and People.

The Eye on Earth Global Summit provides a unique opportunity to address some of the key issues for human and environmental sustainability. It has a focus on environmental data and information for better informing policy and decision makers, and for increasing levels of engagement and participation of the general public. This comes at a time when advances in technology make it feasible, for the first time, to "keep an eye on the earth" in a way that involves and effects ordinary citizens, and brings together global data gathering capabilities and domain specialists.

For current purposes let us take the definition of water security provided by UNESCO/ Institute for Water Education as that which:

> "...*involves protection of vulnerable water systems, protection against water related hazards such as floods and droughts, sustainable development of water resources and safeguarding access to water functions and services.*"[2]

It is important to note that this definition encompasses 'vulnerability' of systems that includes human-related matters such as potability, industry, agriculture, recreation and sanitation and also environmental dimensions such as ecosystem health.

This Special Initiative proposes a technical basis for improving the creation, sharing and accessing of data, information and knowledge concerning water security, based on the architecture and principles of the network-of-networks approach being advocated elsewhere in the Eye on Earth process.

1.1 Background and Purpose

The Eye On Earth Summit - Abu Dhabi 2011 ("The Summit") is a global intergovernmental and multi-stakeholder event and exhibition to convene the thought and action leaders in the worldwide environmental and societal information networking movement, to converge consensus on key areas of mutual importance, and to collaborate towards strengthening existing initiatives and filling gaps towards more informed policy making and a sustainable future. The Summit is expected to:

a. Identify commonalities in existing environmental and relevant societal information networks in an effort to strengthen, align and synergize these initiatives while collectively filling the gaps through coordinated alignment of common efforts;

b. Strengthen, synergize, and extend global processes for bridging the environmental knowledge gap and provide data, information and tools for decision-making (transformative action);

c. Reinforce multilateral policies and institutional arrangements to leverage investments in environmental data while ensuring the preservation of the investment in this information to improve information infrastructure in countries needed to support more coordinated, effective and sustainable development;

d. Support technical cooperation to accelerate the building of a federated global environmental information infrastructure;

e. Accelerate capacity building and technology support programs around the world to further close the gap between developed and developing nations.

f. Strengthen access to resources to support developing countries

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[2]http://www.unesco-ihe.org/Research/Research-Themes/Water-security

As stated in the original EoE Special Initiatives guideline document, a critical objective of the Eye On Earth Summit is to ensure that there are compelling, specific, achievable outcomes that translate the principles of the Summit to "on the ground" commitments and actions. A target of 4-6 EoE Special Initiatives has been set, each of which is to be defined through the Summit preparation process, and announced during the Closing Plenary. The chosen initiatives are to be those which fundamentally improve the landscape of environmental and societal information networking for the benefit of mankind, and from which compelling, tangible results can be achieved in the medium term. As such they must have the following fundamental characteristics:

Potential to be an agent of change of historical proportions and impact. An EoE Special Initiative must address one or more core objectives and themes of the EoE Summit in a way that will fundamentally change the face of environmental and societal information networking in a substantive, systemic, and sustainable manner;

Identified as a compelling and common need across the EoE stakeholder community. An issue or outcome that is acknowledged as a critical need across a majority of the concerned EoE stakeholder community;

High level support and commitment. The explicit commitment of a constellation of major concerned stakeholders who have the access, influence, commitment and resources to catalyze and implement change. Special initiatives must therefore engage the Donor Community;

Implementable within a reasonable period of time. A viable EoE initiative must be specific and achievable enough to accomplish key, measurable results within 3-5 years;

The crucial need for fresh water of appropriate quality and quantity for maintaining human and ecosystem health is well known and does not need to be belaboured here. Much has been written about water security (or insecurity) as a global, regional, national, local and personal issue, and as a potential source of environmental and social tensions.

The following graphic merely hints at the central complexity of fresh water-related issues. The current initiative does not propose attempting to address the data, information and knowledge management dimensions of this whole spectrum of issues and their inter-relationships. Rather, its focus is on particular aspects for which are broad (if not universal) in application and for which new technologies are now available. The issues to be addressed are:

How can we better discover and apply data, information and knowledge related to water but which are originating or being used in communities of practice as diverse as hydrology, economics, ecosystem management, recreation, and water quality, each with their own ways of describing things?

How can we lower the barriers so that those – especially in developing countries or those negotiating environmental justice issues within developed countries - who have data, information or knowledge about water and are motivated can publish it to the web in ways that can then be discovered and accessed as in 1) above?

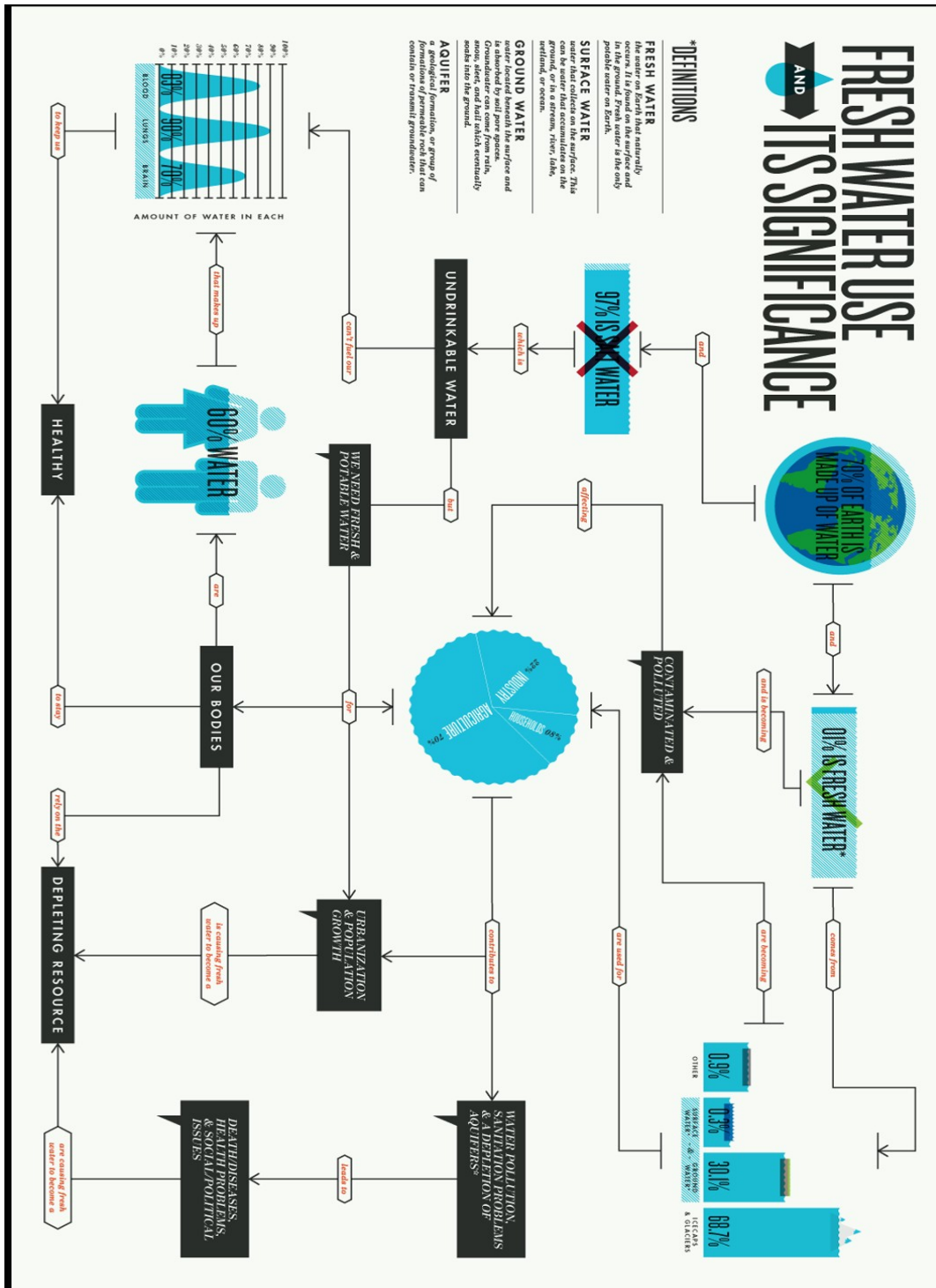The answers that this initiative will demonstrate and evaluate are semantic web services, and cloud computing.

Illustration 1: The Complexity of Water Issues
(from http://3.bp.blogspot.com/-xkOsXof0qkU/TiYRXQCBHBI/AAAAAAAAALI/WIfyoNxRtII/s1600/Concept-Map-Photo.png)

1.1.1 About Eye on Earth Special Initiatives

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4. Support technical cooperation to accelerate the building of a federated global environmental information infrastructure;
5. Accelerate capacity building and technology support programs around the world to further close the gap between developed and developing nations.
6. Strengthen access to resources to support developing countries

As stated in the original EoE Special Initiatives guideline document, a critical objective of the Eye On Earth Summit is to ensure that there are compelling, specific, achievable outcomes that translate the principles of the Summit to "on the ground" commitments and actions. A target of 4-6 EoE Special Initiatives has been set, each of which is to be defined through the Summit preparation process, and announced during the Closing Plenary. The chosen initiatives are to be those which fundamentally improve the landscape of environmental and societal information networking for the benefit of mankind, and from which compelling, tangible results can be achieved in the medium term. As such they must have the following fundamental characteristics:

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- *Identified as a compelling and common need across the EoE stakeholder community*. An issue or outcome that is acknowledged as a critical need across a majority of the concerned EoE stakeholder community;
- *High level support and commitment*. The explicit commitment of a constellation of major concerned stakeholders who have the access, influence, commitment and resources to catalyze and implement change. Special initiatives must therefore engage the Donor Community;
- *Implementable within a reasonable period of time*. A viable EoE initiative must be specific and achievable enough to accomplish key, measurable results within 3-5 years;

1.1.2 Eye on Water Security Special Initiative

The Eye on Water Security Special Initiative (EoWSSI) proposes to implement a water security network of networks (WSNoN) based on the principles and architecture defined on the Global

Network of Networks Special Initiative (GNoNSI) being proposed as one of the four foundation initiatives to emerge from the Summit.

EoWSSI will build partnerships to improve the application of water-related data, information and knowledge for uses such as environmental monitoring and assessment, ecosystem management and water resources management. The WSNoN will apply semantic web technologies (i.e. linked data, resource descriptor frameworks, etc.) and cloud computing to lower the barriers to address the twin issues of getting water-related information resources 'out there' on the web while ensuring that those resources can be found, re-used appropriately, add value, and answer questions.

As a domain-specific instance of GNoN, EoWSSI will be both a testbed for and a pathfinder for it. Through its use of brokering abstraction (being able to use thesauri of terms in different national languages and across different communities of practice) and knowledge abstraction (specifically with governance and sustainability) EoWSSI will implement a transformative vehicle by which the recommendations and guidance emerging from GNoN can be applied, assessed, and the result fed back into GNoN. At the same time, the domain specificity (and reduced complexity) of WSNoN means that it will likely be implemented more quickly than GNoN, and is likely to expose issues and undergo experiences that can alert and inform the GNoN process.

Data, information and knowledge about water - its availability and quality, and projections for supply or over-abundance - are highly fragmented and uncoordinated. Unlike the situation in meteorology, data about water are not currently supported by a consistent global infrastructure. Efforts to create simple overviews of the state of water availability elicit numerous barriers - technical, institutional, even simple awareness.

Efforts to correct this are under way but are far from ubiquitous: for example, standardizing certain observations and measurements of the marine environment and making these data freely computer accessible and open to the public. Meanwhile, the UNEP GEMS/Water network and the Global Run-off Data Centre aggregate terrestrial water information from around the world and to which the public has open and free access.

At the same time, the developed world has invested in gathering data and developing models that create information for planning and crisis/disaster management. What is not clear is how best to re-use the products of research and development, using cost-effective technologies so that developing countries can exploit them using their in-country skills, innovations and indigenous knowledge. Global data provisioning, ICT standards, shared computing facilities and crowd sourcing can assist both developed and developing countries to create better - and better integrated - environmental information systems.

This Special Initiative - Eye on Water Security - aims to pull together at least some of the results of investments already made to deliver greater societal benefit. It will focus on demonstrating the feasibility of coupling current and emerging policies for data and information access, with technologies for data acquisition and modelling, the application of international standards to ensure consistency and the use of communication technologies to overcome cost and skill barriers.

The purpose of this Special Initiative is to deliver enhanced environmental early warning and assessment methods to assist decision-making, by re-purposing and apply emerging technologies and approaches including

- Linked Data,
- Cloud computing,
- Abstracted brokering layer
- citizen science and crowd sourcing

to environmental and societal data, modelling and information. The purpose is to deliver enhanced environmental early warning and assessment methods to assist evidence-based decision-making, Proof of concept will target selected river basins [3] to demonstrate that a global information infrastructure for such a critical resource as surface water can be deployed, building on existing investments while using new and emerging communication and instrumentation techniques. This will be done in a timely and cost-effective manner to support evidence-based decision making, engaging and encouraging participation of the general public.

These steps are presented as the first practical efforts on a longer term path to an improved capability to produce, manage and use most effectively data and information about water, one of Earth's lifelines for humanity and ecosystems.

1.1.3 Scoping considerations

EoWSSI has a limited duration and resources. Its purpose and scope are constrained to explore the potential role of the technical shared infrastructure components noted above applied to targeted water information networks and related water discipline communities

The geographic scope is proposed to address networks of water information networks and to test the above technologies and validate the results through deployment within at least 5 river catchments – the Zambezi, the Gulf Basin (including the Tigris/ Euphrates system), the Ganges, the Murray/Darling, and at least one catchment located in the Americas (to be determined).

The range of feasible tasks and actions during the lifetime of the Initiative will be governed to considerable degree by the programmes and priorities of the networks with which the Initiative will be working. These may be negotiated to a degree but will, in some cases, be locked into existing commitments to which the Initiative will need to adapt.

Most significant, though, is the scope of the domain problem space within which EoWSSI will need to work and prioritize activities. The UN Environment Programme (UNEP) is currently preparing its fifth Global Environment Outlook (GEO5) for publication in June 2012. While this global state of environment report is still in production and its content to be finalized in detail, its consultative preparatory process has identified an impressive (or, perhaps, depressive) compilation of the range of data and information constraints that effect water policy development, implementation and appraisal against agreed international targets. These are likely incomplete but are nonetheless representative of the data and information space that an WSNoN would need to address. They are presented in summary as Appendix 1.

Scoping also includes consideration of how activities for EoWSSI can contribute to the UNEP Programme of Work 2012-2013 and beyond, as well as the work planned for AGEDI Phase 3. Future editions of this document may also provide explicit alignment to other partner agencies such as the EEA.

1.1.4 Alignment with the EoE Objectives and Principles

The scoping considerations described above are designed to meet the objectives for the Eye on Earth Summit - Abu Dhabi 2011, a global intergovernmental and multi-stakeholder event and exhibition to convene the thought and action leaders in the worldwide environmental and societal information networking movement, to converge consensus on key areas of mutual importance, and to collaborate towards strengthening existing initiatives and filling gaps towards more informed policy making and a sustainable future. The Summit is expected to:

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3 The Zambezi, Ganges, the Gulf Basin (including the Tigris/ Euphrates system), the Ganges and Murray/Darling watersheds are initial suggestions. A candidate from the Americas is yet to be proposed

1. Identify commonalities in existing environmental information networks in an effort to strengthen, align and synergize these initiatives while collectively filling the gaps through coordinated alignment of common efforts;
2. Strengthen, synergize, and extend global processes for bridging the environmental knowledge gap and provide data, information and tools for decision-making (transformative action);
3. Reinforce multilateral policies and institutional arrangements to leverage investments in environmental data while ensuring the preservation of the investment in this information to improve information infrastructure in countries needed to support more coordinated, effective and sustainable development;
4. Support technical cooperation to accelerate the building of a federated global environmental information infrastructure;
5. Accelerate capacity building and technology support programs around the world to further close the gap between developed and developing nations.
6. Strengthen access to resources to support developing countries
7. Identify international ICT and other standards which can be adopted by developing countries when developing their water information systems to foster interoperability and enable exchange of information with other networks.

A critical objective of the Eye on Earth Summit is to ensure that there are compelling, specific, achievable outcomes that translate the principles of the Summit to "on the ground" commitments and actions.

Environmental and scientific networks around the world are at work in each continent addressing individual needs and localized issues, many of which in fact have global relevance. This relevance may be through the potential for combining local data to explore global and regional impacts, inter-comparison of local conditions, or improved capacity through sharing knowledge and know-how.

- Draft Eye on Earth Summit declaration para 4 declares: *Agree to work in establishing a forum for cooperation among sub-global and thematic environmental information networks with a view to further enhancing their connectivity and effectiveness in supporting assessments, information exchange and decision-making for sustainable development and work to this end in collaboration with the United Nations.*

- *Draft Eye on Earth Summit declaration para 6: Resolve to support the development of adequate institutional and legislative enabling conditions for furthering principle 10 of the Rio Declaration, inter alia based on the Guidelines for the Development of National Legislation on Access to Information, Public Participation and Access to Justice in Environmental Matters.*

1.1.5 Alignment with international open standards bodies

Open International Standards will be used throughout the Initiative. Where relevant Standards are being developed the Initiative will actively engage with and inform in such processes. Where there are gaps in the standards these will be defined and advice sought through the collaborative and consultative processes of the appropriate standards organisation.

The Water Security SI can leverage work undertaken by a broad stakeholder community through the OGC/WMO Joint Hydrology Domain Working Group and through the technical standardization activities in the field ongoing in ITU.

The Water Security SI has already approached the Open Geospatial Consortium to consider undertaking an Open Web Services interoperability test-bed (OWS) to provide a facility to test the flow of standards compliant data from remote sensors and feeds from simple mobile

phones through processing and modeling applications conducted over a number of locations on the internet for display in a variety of forms on a range of devices including mobile phones and smart phones/tablets. An OWS will enable contributions from OGC Members to be focused onto the automated workflows linking multiple data feeds, data management and processing tools across distributed platforms to answer questions from the data providers and users.

The ITU through the Telecommunication Standardization Bureau (ITU-T) and Radiocommunication Bureau (ITU-R) is working to develop international standards related to water security and climate change. ITU-R standards are used in earth observation satellites that:

- monitor fluctuating land, sea and atmospheric parameters (such as vegetation biomass, ocean salinity, subterranean reserves of fresh water and cloud relief),
- track the progress of hurricanes and typhoons and the effluent from volcanoes and major forest fires,
- weather radars that track tsunamis, tornadoes and thunderstorms,
- radio-based meteorological aid systems that collect and process weather data, and various radio communication systems (satellite and terrestrial) that are used to disseminate information concerning natural and man-made disasters.

ITU-T Study Group 5 is currently working on developing ICT standards related to water security and these can be used by governments and water authorities to implement ICTs which are effective in supporting adaptation to climate change. ITU could play an important role in this area as well as in capacity building initiatives aimed towards implementation of these standards to help countries in taking well informed decisions regarding water security.

The ITU jointly with other stakeholders could play an important role in enhancing developing countries' capability to exploit geospatial technologies, for example through the development of a standardised GeoWeb toolkit for developing countries which would provide the basic elements needed by water stakeholders.

1.2 Process and Results

The planning, design and development of the Summit involves a very diverse range of issues and a large number of simultaneously moving parts. The Working Group and Framework Committee efforts, with the oversight and guidance of the Executive Advisory Board has in large part defined the Special Initiatives that will be the most visible output of the Summit preparation process, and that will define the path forward for some years to come. More detailed descriptions of that process are provided under separate cover.

The technical specialists working in the Eye on Earth working group on Technical Infrastructure believe that existing capabilities can be better integrated by addressing semantic interoperability issues, and best practices can be applied in a global perspective, due to very recent technological developments. The history, scope and sensitivity of water issues is extremely broad, and the number of national and international efforts afoot is very large..

1.3 Intended Outcomes: 3-5 Year Outcome

The Eye on Water Security Special Initiative will:

1. Deliver a defined minimum set of standards, demonstrated against specific use cases in the water domain, for reliably achieving inter-community interoperability at institutional, technical and data levels; in other words to achieve for semantic interoperability what the definition of the Domain Naming System did for the internet.

2. Catalogue and prioritize gaps in data, information and knowledge in the water domain and, where feasible, propose action for closing those gaps

3. Establish a reference clearing house and forum for common technical architecture, principles, model policies, best practices, standards, community linkages, and fora for the ongoing promotion, development and dissemination of information needed to support and sustain local, national, regional and international networking in the water domain.

4. Link major water-related geospatial and statistical information federations around the world and demonstrate stronger alignment and coordination with related initiatives such as the Open Knowledge Foundation and World Summit on the Information Society Forum.

1.4 References

This report includes provisions that are more fully described in other documents and that are included by reference, including:

Eye on Earth Summit Program Design. Original Program Design dated 1 May, 2010. This document is being updated as part of the Summit detailed planning stage, and the provisions there will have bearing on the detailed activities of the GPC Team.

EoE Special Initiatives. This document dated 25 June, 2011 provides an overview of the purpose, process and intended results of the EoE Special Initiatives and other guidelines for their development.

EoE Special Initiatives Formulation. Document dated 8 October, 2011 explaining the synthesis and prioritization of over 50 suggested candidate programs down to several that will be the focus of the 2011 EoE Summit.

2 Existing Situation

Experience in Europe and elsewhere has highlighted three main elements required to sustain networking in an environmental information context: institutional cooperation, common content, shared infrastructure and tools.

1. Institutional cooperation across various levels (local, national, sub-regional, regional, global) as well as partnerships with civil society, facilitated by coordinating entities

2. Agreed shared and common content (data, information, indicators, analyses, assessments, work processes in general) – in order to structure data and information provision and accessibility in an easily understandable way. This desire demands mechanisms that support many such agreements, and promote further adoption of existing and new agreements about common content.

3. Shared infrastructures, standards and tools are the underlying basis for a functioning Network of Networks. A set of principles being agreed in the Draft Eye on Earth Summit declaration (para 3 a) to e) guide the development and operation of these elements

Advancement of the science-policy interface of International Environmental Governance and the Institutional Framework for Sustainable Development: Environment ministers from around the world have acknowledged that the status quo in IEG is no longer a valid option. A political process for IEG reform has been facilitated by UNEP and should align with governance models after Rio+20. The IFSD discussion encompasses the role of institutions comprising the

economic and social pillars as well as the environmental e.g. considering how to step up efforts to bridge the gap between the international financial institutions (IFIs) and the multilateral development banks (MDBs), and the rest of the UN system. An operational Water Security network-of-networks could help bridge some of that gap using emerging semantic interoperability methods to provide means for spanning the widely various linguistic and semantic communities found in these domains.

The science-policy interface for sustainable development needs to be strengthened by incrementally enhancing the sub-global and thematic information networks for environmental sustainability and their global connectivity. The set of mechanisms for a de-facto *multi-scaled, multi-thematic global information network(s) i*s the foundation for enabling widespread, cost-effective and flexible exchange of information. Such a network is also important for facilitating access to information. The network-of-networks could be advanced through *a strategic, systematic and adaptive incremental approach* combined with *adequate capacity building measures*. In order to develop such capacity, it is crucial to provide long term, systemic funding support; the existing networks will not be in a position to fund such synchronization and as further simultaneous "fine tuning" on their own, as the effort would fall outside their current business model. Thus, external funding is vital.

Even within any individual scientific discipline or communities of practice, the 20th century aspiration for single all-encompassing networks has (with some notable exceptions) rarely been achievable or sustainable. Any proposition of networks covering all themes and issues and geographies is even less realistic. Far more tractable will be **networks of water-related networks** centred on select themes, geographies and issues. What is important though is to ensure that these networks of water-related networks can "talk" to each other in a computer language and through electronic forms and formats that they all agree to and understand. This requires that the emphasis must be on the network-of-water-related-networks being able to interoperate successfully using open standards for data access, data formats, metadata and semantics. The work of Working Group 3 on relevant Technical Infrastructure has delivered important contributions by helping to focus on the common data models, service discovery and semantic mediation required.

EoWSSI will apply these insights and principles to the domain of water data and information by:

- Improving interoperability amongst existing water-related networks, not just ones dealing with hydrology and water chemistry including the needed overlap with 'neighbouring' domains like ecosystem health and services, human health and well-being, treaty-based management of shared resources, agriculture, industry and so on.
- Showcasing exemplars of existing technologies and community practices that help achieve (1) but can benefit from increased profile, exposure and stress testing
- Strengthening selected communities of practice either as the developers or users of the exemplars in (2) or as peer communities standing to benefit from improved awareness of and adaptation of the progress being made by their neighbours.

2.1 Landscape of Water Security Issues

WSNoN will facilitate cooperation on acquisition, management and exchange of environmental information, analysis and good practices for use in indicators, early warning, alert services, assessments, the preparation of advice and the development of policy options.

> **Note:** Problem statements are presented from the hypothetical viewpoints of six types of users: high level executives, subject matter experts, educators, trainers and capacity builders and the general public. Refinements will be made and further categories added as further consultation proceed with potential and actual stakeholders.

2.1.1.1 High level Executive:

Consider an executive from government, industry, NGO, academia, education required to know what changes are taking place in the river and/or hydro-geological basin that are, or might become, a serious issue of concern. What are the events or trends that have led to this "alert", which area of the basin is likely to be the source of the issue and what are the downstream risks? It is assumed that the user would be interested in a) being alerted to a problem and b) require a question and answer type of interaction with the option to drill down on items of components of the answer to receive more detail and/or to be able to ask specific questions of others (e.g. advisors, subject matter experts).

An example of downstream questions could include what population is likely to be affected, as well as infrastructure be it existing, under construction or planned.

The outcomes would be better informed users subject to fewer surprises and empowered to ask appropriate questions of the right people.

For some of the high level users the information might indicate where there are gaps in information and present opportunities to address the issue in a proactive fashion. Some high level users might find the answers to such questions important to be aware of potential risks in investment or operational practices and procedures.

2.1.1.2 Subject Matter Experts

Consider subject matter experts who need to be aware of how their data, models or techniques are being applied within workflows to create answers to questions, including questions that arise as a result of mandatory reporting. Also, are their solutions providing "better" results than those that are currently being used with the Water Security SI?

They may want to check for guidelines to improve existing techniques or indicate locations within the processing workflows/value chains where they could intervene to advantage. They need to answer such questions as who else is working in this field and as such, enhance the people networks within and across subject matter areas.

2.1.1.3 Educators, trainers, capacity builders

Consider an educator who needs access to well documented and stable information sources that can be used reliably and consistently over time. This would be for use in developing course/programme materials that they and their students/trainees can readily use or, equally, , for community awareness raising or as background for participatory mapping exercises at community level.

2.1.1.4 General Public

The general public wants to know if the water nearby is good or not to take the kids to swim; if that industrial plant is contaminating the water-table from where my drinking water is pumped; if someone is polluting, how bad is it? And what can be done to rectify the situation?

2.2 Current Institutional Context for Water Security Information and Data

As noted in the introduction, the scope and complexity of water-related issues is extensive and the web of involvement of institutional players at all levels from local and civil to global is

extremely dense. This initiative must be practical and adopt a restricted view. This is, after all, a technical proposal, not a political one.

The constraining filter being applied is to identify institutions already engaged in addressing the question of semantic interoperability, data interoperability and service interoperability in the water domain. As the following graphic suggests, the number is manageable but still impressive, and spans commercial, government, NGO and academic players. Remember, this is only a UNEP-centric view of the Eye on Earth universe, not an attempt at complete taxonomy of all water-related players, even at the technical level.

2.2.1 Landscape of Technical Initiatives:

The following agencies and institutions are known to be active in the substantive space described for WSNoN and are potential contributors of data, services, expertise, best practice guidelines gathering and publishing of water related content. They represent the "push" side of data provision. Many are legally constituted representative bodies but may have only advisory powers. Many are involved in capacity development.

Institution	Capabilities
Consortium of Universities for the Advancement of Hydrologic Science CUAHSI	To be elaborated
CSIRO Land and Water (Australia)	To be elaborated
EAD/AGEDI	To be elaborated
EEA/ WISE	To be elaborated
European Environment Agency/ Water Information System for Europe	To be elaborated
FAO SWALIM Somalia Water and Land Information Management	To be elaborated
GEMS/water	To be elaborated
GEOSS Standards and Interoperability Forum	To be elaborated
Global Run-off Data Centre GRDC	To be elaborated
GeoSUR – transboundary hydrology	To be elaborated
ICIMOD	To be elaborated
International Atomic Energy Agency	To be elaborated
International Centre for Integrated Mountain Development (ICIMOD)	To be elaborated
Joint Research Centre (EC) (INSPIRE and EuroGEOSS project)	To be elaborated
Open Geospatial Consortium OGC (test beds, pilot activities)	To be elaborated
SERVIR	To be elaborated
UNEP	To be elaborated
UNESCO International Hydrology Programme	To be elaborated
UNGIWG and the UNSDI – gazetteer implementation	To be elaborated
US-EPA	To be elaborated

2.2.2 Landscape Institutional Initiatives

The following agencies and institutions are known to be active in the institutional space described for WSNoN and are potential contributors of advocacy, expertise, best practice guidelines on negotiating matters such as data access agreements. Many represent the "pull" side of data usage. Many are legally constituted representative bodies but may have only advisory powers. Some represent potential financial contributors.

Institution	Capabilities
American Association of Geographers	To be elaborated
AUSAID	To be elaborated
EEA Shared Environmental Information System SEIS	To be elaborated
EIS-Africa	To be elaborated
FAO Land and Water	To be elaborated
Ganga River Basin Authority	To be elaborated
GEMS/water	To be elaborated
ICIMOD	To be elaborated
IEEE	The IEEE Committee on Earth Observation (ICEO) is involved in many water initiatives and projects.
Mekong River Commission	To be elaborated
Murray-Darling Basin Authority	To be elaborated
Nile Basin Initiative	To be elaborated
OGC and OGC members including ESRI, Microsoft and Google	To be elaborated
Southern African Development Community (SADC)	To be elaborated
UAE Water Academy	To be elaborated
UNEP/ UNEP-Live	Extend and enable the gathering, dissemination and integration of all environmental data and information for environmental assessment and early warning
UN Water	To be elaborated
UNESCO International Hydrology Programme	To be elaborated
UNESCO Institute for Water Education	To be elaborated
World Health Organization WHO – Water Sanitation and Health Programme	To be elaborated
World Meteorological Organization WMO	To be elaborated
Zambezi River Authority	To be elaborated

As noted earlier, this Initiative will also draw support from other Eye on Earth Special Initiatives, particularly the Global Network of Networks SI from which the architectural principles will derive. The Eye on Education and and the Eye on Disaster Management Sis also seem likely to have elements that will support the EoWSSI.

2.2.3 Landscape for Global Connectivity – Technology Context and Readiness

The following agencies and projects are known to be active in the technology space described for WSNoN and are potential contributors of expertise, standards, services, methodologies or data. Many are engaged already in either this initiative or in the GNoNSI.

Agency/ Project	Capabilities
CSIRO	To be elaborated
EEA	To be elaborated
EuroGEOSS	To be elaborated
ICIMOD	To be elaborated
IEEE	The IEEE Committee on Earth Observation (ICEO) provides technical skills related to registry and catalogue interoperability brokering technology and semantic development
JRC	To be elaborated
OGC	To be elaborated
GRDC	To be elaborated
ITU	To be elaborated

The global collective of all those with interests in delivering – and capabilities to deliver – defining and testing the minimal standards for semantic interoperability, plus demonstrating their effect – are well known and, in many cases, already directly or indirectly engaged in the EoE process.

3 The Eye on Water Security Proposition

3.1 Overview

The key initial players – the institutional architecture of those already dealing with the ICT elements of data, information and knowledge are well known, as are their relationships as the following illustration indicates.

Note that this diagram is incomplete and merely indicative. More importantly, this initiative desperately needs an agreed version of a corresponding digram that portrays the institutional relationships amongst the political coordinating entities in the water security domain – both producers and consumers. This is likely to be a significant undertaking that will require close cooperation with an umbrella body such as UN Water for addressing WSNoN governance and sustainability issues.
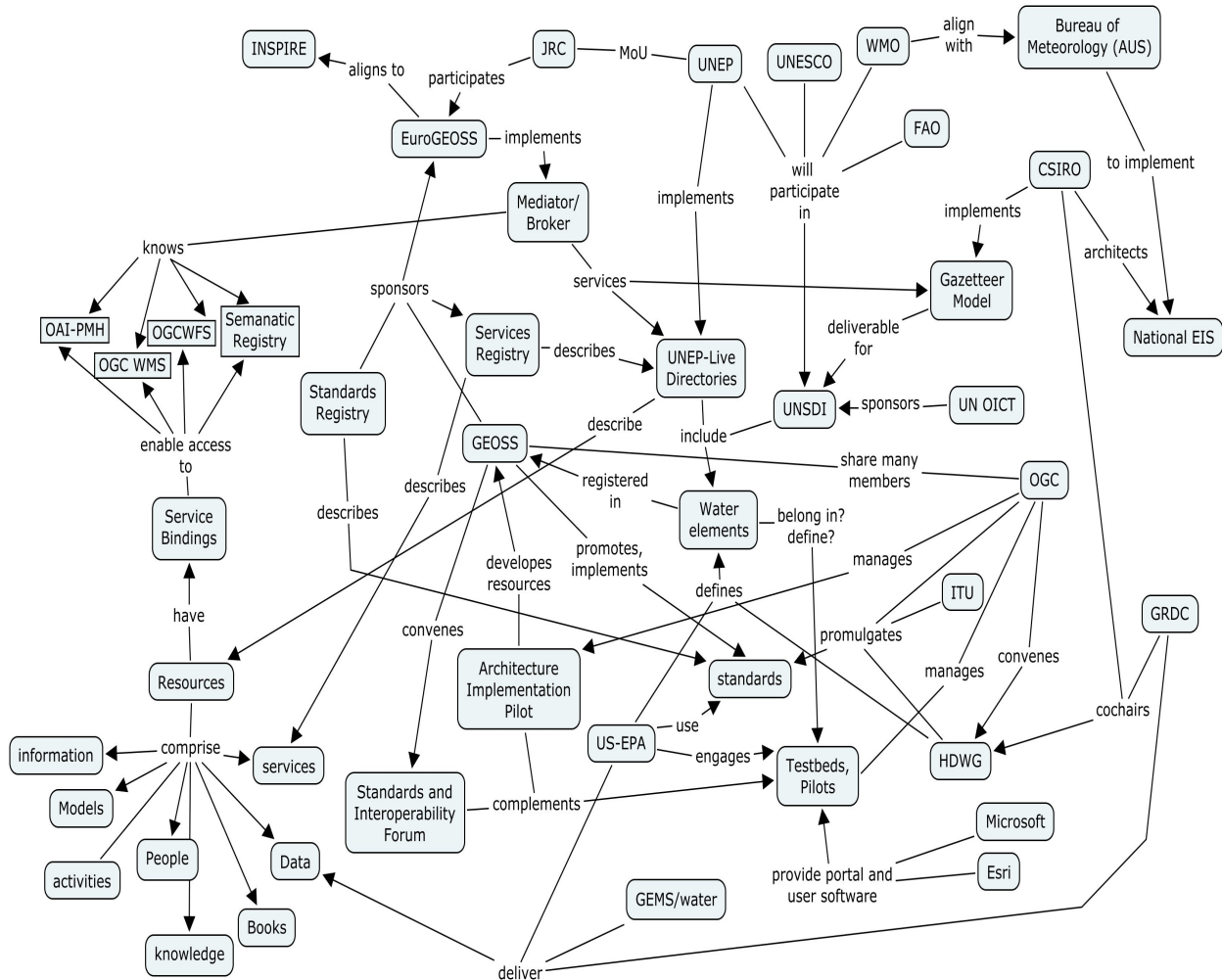
Illustration 2: Key Initial Players - and their relationships - in Implementing the Water SI Initiative

Note that this diagram is incomplete and merely indicative. More importantly, this initiative desperately needs an agreed version of a corresponding digram that portrays the institutional relationships amongst the political coordinating entities in the water security domain – both producers and consumers. This is likely to be a significant undertaking that will require close cooperation with an umbrella body such as UN water if issues of governance and sustainability of the WSNoN.

3.2 Institutional Framework

The Institutional framework for the SI is to create a needs-driven approach to integrating water data, driven by UNEP, and applied using technical capabilities embodied in the OGC Hydrology Domain Working Group, to re-apply and improve best practice in target areas to create comparable data products. The assistance of institutions with experience and capacity in appropriate best practices and international ICT and other standards will be brought to bear in pilot projects with willing institutions in new target areas. The overall architecture, and enabling infrastructure, will be provided under the auspices of UNEP. Global partners including GEO and UNSDI, and regional and commercial solution providers would be involved in order to test emerging technical capabilities for long term provision of suitable services.

3.3 Essential Functionality

The essential functionality the Water Security SI must realise is the delivery of comparable water resources information from multiple regions, exploiting a globally scalable infrastructure whilst allowing local solutions.

There is no perfect set of input data, or model, to characterise a complex and changing environment. Instead, data must be regarded as the end result of a process, which may result in a data archive, or arise from a work flow involving some form of modelling or decision making process. Thus the functionality required includes the ability to adopt and adapt a work flow used in one context (say, a jurisdiction) to deliver a useful water information product, and deploy this work flow in a global context to deliver comparable products from many locales.
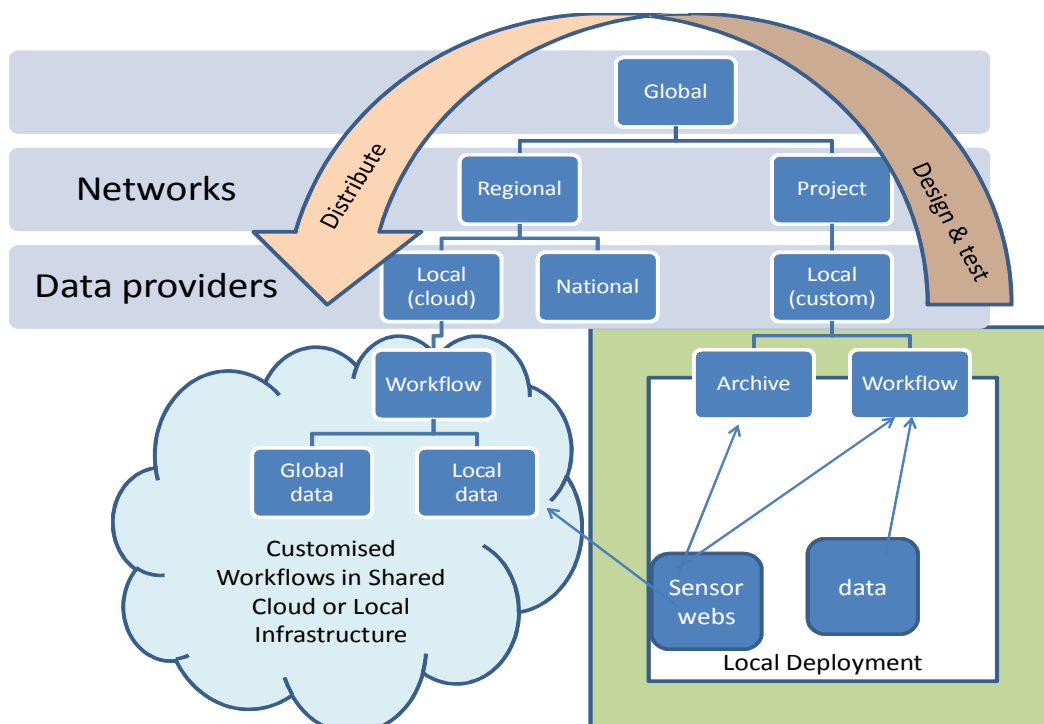
Illustration 3: Delivering local deployment and services and products from the global network of networks

3.4 Technology Framework

The technology framework consists of the following major components:

- Web based connectivity
- Global data sets deployed behind services in "the cloud"
- Linked Data principles to link common semantic information to legacy data representations
- Cloud-provisioned workflows, with localisable templates
- Shared UNSDI spatial referencing framework (UN gazetteer framework)

- Spatial Data Infrastructure (e.g. GEOSS architecture) data access and processing service capabilities
- Geographical 3D modelling
- Integration/mediation brokers (as per GEOSS) for integration and spatio-temporal comparison from multiple sources, probably to be implemented "in the cloud" and abstracted for serving different water security networks and communities
- Result delivery to end users (determined by their needs)

3.5 Data Framework

- Global data sources – ready access
- Local data archives
- In-situ sensors
- Citizen science

3.6 Capacity Building

The capacity development aspects of EoWSSI are described more fully in section 5 "Implementation Approach" following but will have particular focus on for water stakeholders in developing countries in:

- Application of geospatial tools for gathering and managing water -related data
- Spatial data analysis for monitoring and assessment reporting
- Tutorials on the use of open standards for the above tasks
- Use of open standards and "cloud computing" for delivering discoverable water-related data, information and knowledge to the web.

3.7 Partnerships and Program Alignments

The institutions and programmes referred to in section 2.2 will need to be approached individually and collectively to ascertain the most appropriate means of engagement on a case-by-case basis. The methods and guidelines for undertaking this are expected to emerge from GNoNSI activities but are also likely to be informed by the existing engagement with at least some of them throughout the build-up to EoE Summit.

One key set of operational and programmatic partnerships are likely to be with the United Nations Environment Programme (UNEP) through its Water programme and through the implementation of the proposed UNEP-Live.

Since its establishment, the United Nations Environment Programme (UNEP) has worked to promote sustainable water resources management practices through collaborative approaches at the national, regional and global levels. After more than 30 years, water resources management continues as a strong pillar of UNEP's work.

UNEP is actively participating in addressing the water issues together with partner UN agencies, other organizations and donors. We facilitate and catalyse water resource assessments in various developing countries, implement projects that assist countries in developing integrated water resource management plans, create awareness of innovative alternative technologies and assist to develop, implement and enforce water resource management policies, laws and regulations.

Meanwhile, UNEP is embarking on implementing a platform – UNEP-Live – to streamline the development and delivery of its environmental assessment products. UNEP-Live is described at

further length in the Global Network of Network initiative but is pertinent here because of its emphasis on spanning communities' semantic spaces to improve the delivery and discovery of environmental data information and knowledge in all related domains (including social and economic) but including water. It is also an important alignment because of its emphasis on national and regional capacity building to improve the availability and use of environmental data in policy and decision development support.

UNEP-Live and the UNEP water programme are likely to be an important use case and test bed for the principles and practices emerging from GNoN and implementation of the WSNoN.

4 Feasibility Assessment - (Strengths, Weaknesses, Opportunities, Threats)

A SWOT analysis serves the purpose of focusing attention on the key aspects of an initiative, so that most issues can be considered prior to the expense of time and resources. This consideration determines, for the stakeholders, the likelihood of success.

The following table attempts to focus and summarize previous discussion. From this, the development team can decide what metrics to put in place to monitor the development of this special initiative. These metrics and monitors are a by-product of the SWOT analysis.

Strengths	**Weaknesses**
• the large number of stakeholders to support and develop it • agnostic with respect to any specific stakeholder or existing solution • will interoperate globally, not limited to a single component by any participating party • will bring together data, information, and knowledge about the water security in a largely automated way • sharing of resources to emerge more easily, more meaningfully, with less restriction • components developed for the WSNoN can be openly shared • right time to exploit maturing technologies – semantic interoperability, cloud computing, mobile ICT etc.	• small number of active participants so far • institutional and political complexity of the water security issue space • large of number of interfaces required to other science disciplines – life sciences, social sciences, physical sciences etc. • sensitivity of many Governments concerning release and re-use of water-related data
Opportunities	**Threats**
• to strengthen existing water -related networks by facilitating easier integration and interoperability • to support education, research, policy-making, and decision-making to a greater extent than is currently available • to foster stronger institutional cooperation • to further support cooperation and collaboration • to lower the barriers to entry for many	• time it will take to agree upon governance structure including data sharing policies, access policies to data, decision-making procedures for the WSNoN, etc. • politicization and a sense of unfairness through non-transparent acceptance, funding and managing of stakeholders • confusion and misunderstanding of how this initiative fits into the solution landscape vis-à-vis other initiatives, such as GEOSS, UNESCO IHP/IEH etc.

Not every SWOT issue has been determined yet, as many may only be discovered during the initial activities. Therefore, as this proposal evolves then so will the SWOT analysis.

5 Implementation Approach

Implementing WSNoN will be dynamic and iterative. The project schedule will have short term deliverables to ensure that comments and feedback are received in a timely manner based on actual deployable stages.

The EoWSSI partners will collaborate to increase capacity to produce and integrate high quality information about the state of water resources using a network-of-networks approach. It proposes a realistic mechanism to address some of the goals of the Eye on Earth Summit.

WSNoN needs to be viewed as something more like the Internet rather than a web application. It can provide a global infrastructure that supports global sharing and integration of water-related data, information, and knowledge. This can *generically* facilitate easier integration and interoperation of applications and services provided by others, as well as easier mechanisms for discovery, by users, of related data, information, and knowledge.

A three track implementation approach is proposed – technical, institutional and capacity development, cast across the four catchments proposed earlier (Zambezi, Ganges, the Gulf Basin including the Tigris/ Euphrates system, the Ganges and Murray/Darling). The basins are proposed because they cover:

- cross-jurisdiction issues within a single country (Murray/Darling catchment in Australia) where there is intense debate and new policies and regulations being developed by the Australian Government with a highly developed system of observations and measurement for monitoring and to feed into highly sophisticated predictive models. The Murray Darling is an extensive low-relief area with sparse monitoring where new techniques have been developed for hydrologic analysis that are relevant to many water resource poor parts of the world.

- the other basins where transnational boundaries are involved include multiple national languages with widely varied systems for data capture, validation and modeling and where the pathways to policy formulation and the definition of regulations and compliance monitoring vary.

5.1 Activities to be undertaken

The proposed activity streams in each track are summarized in the following table:

Technical Track	Institutional Track	Capacity Building Track
Implement brokerage pilot instance (With JRC/ EuroGEOSS)	Liaison with UN Water and members	Identify and help expose existing assets at country and regional level (cloud computing e.g. Eye on Earth Network)
Develop "DNS for semantic interoperability"	Liaison with international water science community (UNESCO IHP, GEMS/water, CUAHSI etc.)	Demonstrate services integrated with WSNoN and GNoN
Catalogue all known water data networks (with GEOSS Common Infrastructure)	Liaison with regional authorities (SADC, Zambezi, Murray/Darling etc.)	Help to consume global services
Establish reference repository/ clearing house	Canvass about for requirements statements for WSNoN	
Implementing abstracted brokering service*s) "in the cloud"	Integration and Synergy	

The inter-linkages between the implementation tracks and the pilot river basins can be summarized as in the table below, which is to further elaborated as the Initiative progresses.

	Technical Track	Institutional Track	Capacity Building Track
Ganges	Demo consuming of global services	Negotiate data services agreements (ICIMOD, GBA)	Identify and engage technical support for exposing data
Murray/Darling	Supply methodologies, process capabilities		
Tigris/ Euphrates	Demo consuming of global services	Negotiate data services agreements (AGEDI)	Identify and engage technical support for exposing data
Zambezi	Demo consuming of global services	Negotiate data services agreements (SADC, ZBA)	Identify and engage technical support for exposing data
One Basin the Americas	To be determined	To be determined	To be determined

5.1.1 Define and Prove a Minimum Set of Standards for Semantic Interoperability

Integration, or comparability of data from different locales or time periods, requires explicit specification of data semantics. This is not typically easily achieved with technical protocol or structure related interoperability standards. The SI will examine the additional requirements for semantic interoperability and, crucially, the potential role of UNEP and other organisations like WMO or GEO in governance of these standards.

A series of pragmatic technology choices, backed by a strong needs-driven integration agenda and explicit governance will provide new opportunities for improving data integration. One plausible and practical path to implementation will be via the GEOSS Standards Registry, a functioning facility well known in the earth observation community but as yet little-used by any of the water communities. EoWSSI would in a sense "drive business towards" the GEOSS Standards Registry. Meanwhile, IEEE is well positioned as co-lead of the GEOSS Ontology Task to ensure that appropriate standards and guidelines are promoted into the water community

5.1.2 Establish a Reference Repository of Standards for Semantic Interoperability

This will leverage the work being done within the UNSDI to create a web-based Linked Data approach to registering the semantics of named spatial references and the usages within UN information systems. This approach can be extended to include the semantics of water information – controlled vocabularies and cross-walks (ontologies) as used in existing systems. This approach to mapping between different systems is described in the Global Network of Networks SI, and provides a non-invasive means to improve the capacity to integrate existing systems.

5.1.3 Integration and Synergy

A large effort should be expended early on in the study of existing networks, platforms, and solutions, and associated discussions with the people and organizations responsible for them. These can be exemplars for WSNoN (and GNoN) solutions or lessons learned in what not to do. They can also be assets to integrate into the GNoN. For example, there are many water-related communities with existing networks and platforms that can be engaged to participate in the WSNoN. Also, GEOSS has already built certain key components of a global data network that can be leveraged or improved upon via cooperation and coordination in a GNoN initiative.

5.2 Timeline and Resource Requirements

The following represents a rough three-year time line for activities in each of the implementation tracks described earlier.

The assessment of resource requirements requires further analysis but, on rough estimation, stands at US$ 1.5 million, a figure highly dependant on the amount of in-country and regional capacity building considered necessary. Twenty candidates have been assumed.
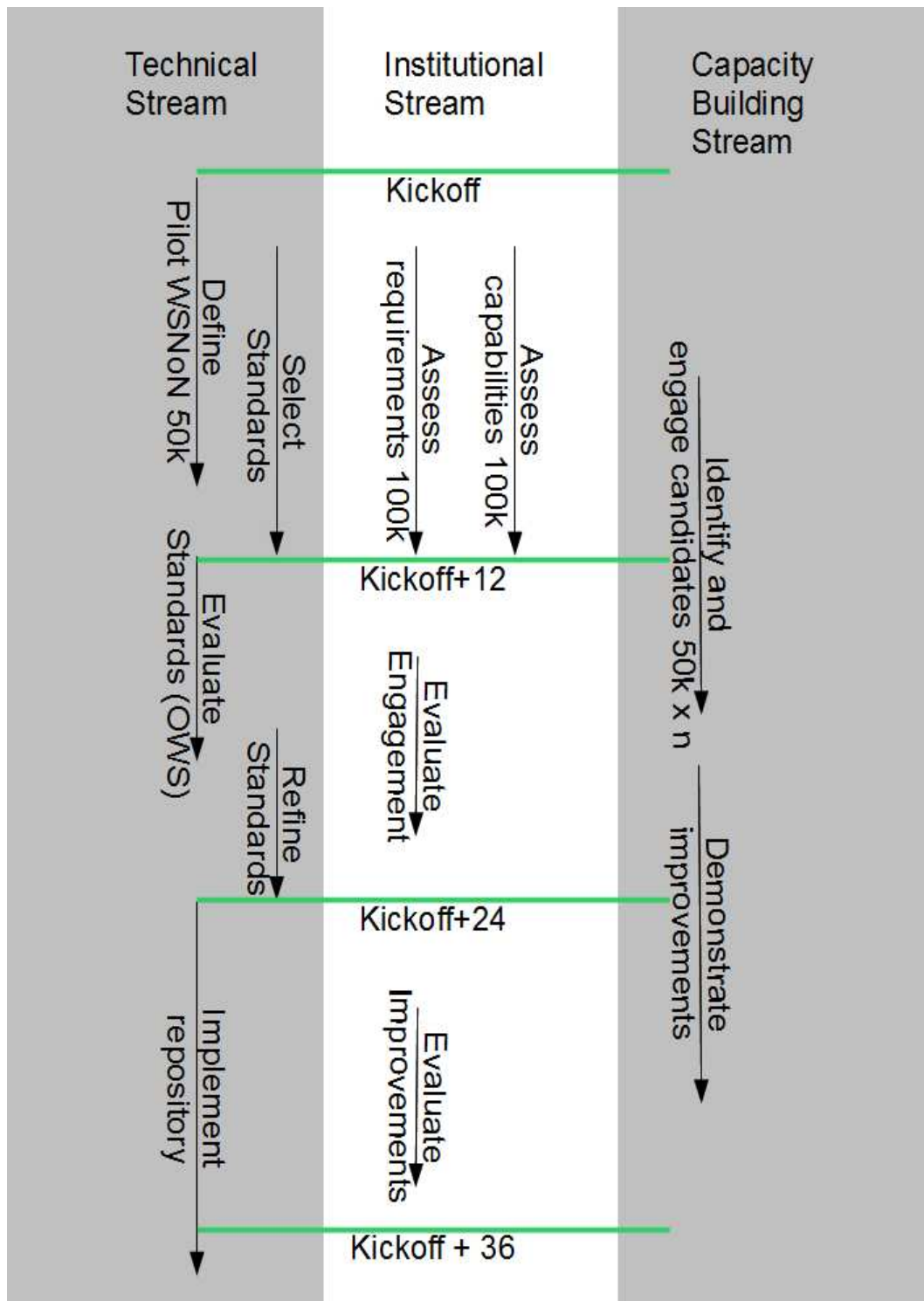
6 Stakeholder Support

The following is a list of current and potential stakeholders for this Special Initiative. The list shows which stakeholders are contributors and which are pending. The list is expected to expand during the Summit. Many of the listed stakeholders have already invested substantial staff and in-kind resources to the development of this SI. During conference calls and emails many of the stakeholders have committed to the process described in this White Paper for progressing the development of this SI, with the expectation of engaging the actions called for in the fully developed Special Initiative.

Stakeholder	Contributor	Pending	Coordinator
Abu Dhabi Global Environment Data Initiative		X	
Abu Dhabi Spatial Data Infrastructure		X	
AfricaEIN		X	
American Association of Association of Geographers	X		
Andean Community, Information Network Infrastructure for the Andean Amazon		X	
Asian Development Bank		X	
AUSAID		X	
CAF - The Latin American Development Bank	X		
The Commonwealth Scientific and Industrial Research Organisation	X		
Consultative Group on International Agricultural Research		X	
EIS-Africa		X	
Esri	X		
European Environment Agency	X		
Food and Agriculture Organization (UN)		X	
Ganga River Basin Authority		X	
Geographic Planning Cooperative	X		
GeoSUR		X	
Google		X	
Group on Earth Observation		X	
Information International Associates	X		
Infrastructure for Spatial Information in Europe	X		
Institute of Electrical and Electronics Engineers	X		
International centre for Integrated Mountain Development		X	
International Telecommunication Union	X		
International Telecommunication Union-World Summit on the Information Society		X	
Joint Research Center (Ispra)	X		
Lawrence Berkeley National Laboratory	X		X
Mekong River Commission		X	
Microsoft	X		
Murray-Darling Basin Authority			
Nile Basin Initiative		X	
Office of Information and Communications Technology, UN Secretariat	X		
Open Geospatial Consortium	X		

7 Appendix 1: Representative statement of data and related gaps concerning Water

Data Gaps	Goal Gaps	Policy Gaps
Poor global data on state of freshwater ecosystems.	Quantifiable targets for ecosystem preservation and restoration from acute and chronic impacts.	Legal recognition of environmental water needs
Updated water-related disease and hazards.	Target to define and ensure minimum environmental water requirements are met at the basin level; Establish basin allocation schemes incorporating environmental water requirements.	Lack of integration of both horizontal (e.g., between sectors) and vertical (e.g., from global to regional to local) policies; Risk management strategies for vulnerable communities.
Safe (not just 'improved') drinking water access by region.	Agreed definition of 'equitable'.	Mechanism for strict implementation of MDG.
Water resource efficiency trend data by sector (including energy sector) and country; virtual water trade trend data. Impacts of virtual water trade.	Agreed definition of 'water security' and related metrics.	Mechanism for strict implementation of MDG.
Global and regional data on sediment, nutrients, marine litter, toxic chemicals, and contaminants of emerging concern.	Quantitative efficiency targets by sector. Water allocation efficiency, including environmental flows.	Inadequate capacity and finances to run sewage treatment facilities in developing countries.
Reporting mechanism and meaningful governance indicators for countries' progress towards integrated water resources management, including the effectiveness of integrated approaches.	Need to ensure adequate treatment and disposal is added to collection targets.	Capacity to effectively assess and regulate environmental impacts beyond national jurisdictions.
Metadata on existing data.	Need for agreed quantitative targets on comprehensive monitoring and reporting systems.	Institutionalized stakeholder participation; systematic gender impact assessment.
Data to assess stakeholder participation, including roles of women and men, and separating data by sex.	Water quality standards and targets for contaminants of emerging concern.	
Monthly flows required to maintain ecosystem services at the basin level.	Goals and targets recognizing, protecting and valuing ecosystem services for human and environmental health and well-being	Lack of global or regional level data sets preclude transboundary management of groundwater resources.

Data Gaps	Goal Gaps	Policy Gaps
Water security metric defined and data developed to allow tracking of trends over time; groundwater recharge; global withdrawals and consumption from energy sector; overlays with water scarcity and and demand from energy (global).		
Holistic cost-benefit analyses of various adaptation and mitigation measures; science-based information on possible consequences of mitigation projects.		
Reporting of mitigation and adaptation outcomes; monitoring and early warning for water-related climate extremes. Long-term hydrologic observatories to monitoring changes to hydrologic cycle as a result of climate change.		
Global and regional data on sediment, nutrients, marine litter, toxic chemicals, and contaminants of emerging concern. Rigorous global and regional water quality index based on comprehensive long-term data.		
Proportion of sewage treated.		
Scope, magnitude, and value of water-related ecosystem services, including the role of wetlands as buffers against extreme events.		
Metrics of coordination effectiveness.		
Global level data sets on groundwater contamination, availability, and abstraction.		

8 Appendix 2: Candidate Showcase Examples

The following are one-page descriptions of candidate Showcase Example projects that demonstrate the possibilities of the Eye on Water Security Special Initiative. These are closely aligned to related activities under the Eye on Global Network Of Networks Special Initiative and reflect the synergy between these two Initiatives.

Further Showcase Example projects are likely to be elaborated in the near future.

Following the descriptions is a listing of a contact person for each project. These are included here as an expression of interest by a broad stakeholder group. The proposed projects are recommended for investment of resources—staff, funds, in-kind—to achieve the objectives of the projects and the EoWSSI.

8.1   A Reference Architecture and Design for Community-Based Data Interoperability Brokers

Originator: IEEE Committee on Earth Observations (ICEO)

Title: A Reference Architecture and Design for Community-Based Data Interoperability Brokers

Stakeholders: IEEE, Earth and Space Science Informatics Lab (ESSI Lab) of the Institute of Atmospheric Pollution Research of the Italian National Research Council (CNR-IIA), Joint Research Centre (JRC) – European Commission.

Summary:

It is well known that much of the Earth observation work taking place today is taking place within communities of practice or communities of interest. These communities are global in reach, but narrow in focus. This is by design. Some of these communities are evolving in conjunction with global initiatives, such as the Global Earth Observing System of Systems (GEOSS), but others are evolving at their own pace and with their own goals in mind.

Some analysis of communities has shown that they are more interested in developing their own internal mechanisms for sharing data amongst the members of the community rather than devoting the effort to ensuring that their work scales to the global, cross-community level. This can be due to many issues, but the one thing that has been voiced many times, and remains consistent, is that after a community has developed an infrastructure that its data providers have adhered to, there is little resolve to change things in order to satisfy an initiative external to the community. A community infrastructure can evolve to varying levels of sophistication in order to achieve intra-community interoperability.

With this in mind, the initiative proposed is to develop a reference architecture and design that will serve as a template or blueprint for the deployment of community or multi-community brokers that can mediate interoperability between the data providers of one or more communities and the data users of other communities. This reference baseline will be abstracted from, and based upon, best practices and exemplar brokers that currently exist. The primary goal is to achieve inter-community interoperability while providing the communities with the freedom to evolve as they see fit and minimizing the impact on community members to share data from across a broad array of disciplines.

One key scenario addressed by this initiative is interoperability taking place between community brokers and not individual data providers and data users. This scenario shields the data providers so that they can just interoperate with their own community broker to share data with others. This scenario requires the community to develop their own broker.

Another key scenario addressed by this initiative is multiple communities working together to provide a multi-community centralized broker to interoperate with other community or multi-community brokers. When multi-community brokers are used, the data providers will interoperate with it via recognized standards, such as OGC web standards, to share data with others. This scenario allows multiple communities to pool resources together to develop the broker.

The solution proposed in this initiative can result in cross-community interoperability and coordination with relevant concurrent activities, such as GEOSS. It also offers an opportunity for Eye-On-Earth to provide a coordination facility for the development and testing of these brokers.

8.2 An Online Collaborative Framework for Community Development of Earth Observation Ontologies

Originator: IEEE Committee on Earth Observations (ICEO)

Title: An Online Collaborative Framework for Community Development of Earth Observation Ontologies

Stakeholders: IEEE, University of Tokyo's Center for Spatial Information Science (CSIS), US Integrated Ocean Observing System (IOOS) Program Office, GEO Air Quality Community of Practice (GEO AQ CoP), Earth and Space Science Informatics Lab (ESSI Lab) of the Institute of Atmospheric Pollution Research of the Italian National Research Council (CNR-IIA).

Summary:

The pressing environmental and societal issues of our time require new approaches to integrating knowledge from the diverse disciplines engaged in studying the Earth's physical systems, and the biological and social systems that depend on them.

The purpose of this initiative is to enhance data interoperability across Earth observation resources, including those available through Eye-on-Earth, the Global Earth Observing System of Systems (GEOSS), INSPIRE, and various data systems. Any system of systems is critically dependent on agreement and adherence to interoperability arrangements that specify how resources interact. Because Earth observing systems are diverse by nature and cover many different domains, the need for semantic interoperability is acute. This is an essential next step beyond the current practices for interoperability, particularly where multi-disciplinary and multi-national activities occur.

Ontologies, as tools for semantic interoperability in a web-based environment, have been in development since the late 1990s, and used in fields such as library science, medicine, and geosciences. However, the full realization of semantic interoperability via ontologies is still uncommon. In many cases the lack of resources prevents the adoption of ontological solutions. Additionally, ontology mapping expertise, which is typically scarce, is required to implement semantic interoperability. These problems are even more challenging when disciplinary, community, and domain boundaries are crossed, as is the case with the Communities of Practice and Societal Benefit areas of the GEOSS. The challenges are compounded by the use of multiple natural languages. We believe that the primary motivation for using ontologies for semantic interoperability – the meaningful sharing of data – is overshadowed by the problem addressed by the proposed work: the lack of a sustainable, usable, cross-community-supported ontological framework.

The proposed special initiative addresses the aforementioned problem via a framework that comprises a suite of integrated ontology tools wrapped in a user-friendly web presence that promotes collaborative ontological development and use within, and across, communities of Earth observation domains. The increased participation of globally diverse Earth observation communities will be realized through this initiative, at least in part, by engaging the intergovernmental Group on Earth Observations (GEO) and similar international initiatives, many of which include worldwide networks of users and contributors on multiple continents. All of the stakeholders involved in this initiative are prime contributors to the development of GEOSS and are well placed to incorporate the proposed activities into the broad international GEOSS framework and other international efforts, as well as facilitating the community engagement and network building that will be an integral part of the initiative.

8.3 UNEP-Live

The proposed UNEP-Live will provide an overarching conceptual framework for understanding and organizing global environmental knowledge activities and capacity building for assessment and reporting. It will benefit countries by providing more flexibility in catering for specific country interests and priorities, in particular supporting their national assessment and reporting obligations by providing common information content, technology infrastructure, standards, guidelines and governance. By organizing assessment knowledge and information, it will also support the proposed goal of governments involved in the debate on international environmental governance. A step-wise and phased approach will be taken to developing a fully functional federated 'UNEP Live' over the next 5 to 6 years.

Governments and their institutions are obviously key elements in meeting UNEP's mandate both as contributors of data and information networks, and practitioners who would be using the tools that UNEP-Live would deliver. Examples of national and regional initiatives include, in West Asia, AGEDI; in Europe, EIONET, SEIS and GMES; in North America the likes of IABIN and, in Latin America, GEOSUR; pan-regional instances such as SERVIR are now operating in Meso-America, East Africa and the Himalaya/ Hindu Kush sub-regions. UNEP-Live will build partnerships between organizations in delivering materials, and identifying and promoting synergies while avoiding duplication.

UNEP's methods of producing environmental assessments draw strongly on collaboration and consultation. UNEP-Live will be required to mediate and streamline the necessary interactions with UNEP's assessment partners. In the case of integrated assessments such as the Global Environment Outlook (UNEP GEO) these partners number in their hundreds and originate in social and economic domains as well as environmental ones. UNEP-Live must integrative – totally dependent on its ability span communities and bring together their added-value resources in novel and informative ways. Key (though not sufficient) to finding and integrating resources will be ability to deal with the agreed semantics by which each community describes their resources.

UNEP, in turn, contributes to large assessment efforts conducted in collaboration with other institutions, such as the Global Integrated Water Assessment. UNEP-Live will need to mediate and streamline UNEP's contribution to these assessment efforts, again requiring the ability to deliver knowledge into those communities using means consistent with their own cultures. Providers to and consumers of data and services through UNEP-Live constitute a wide range of communities, each with their own cultures i.e. ways of describing their resources of interest (semantics) and practices for conducting their business consistent with the very selection of those common interests in the first place.

8.4 GeoSUR

GeoSUR Regional Network Showcase Project
for the Eye on Global Network Of Networks Special Initiative

GeoSUR is a regional program whose aim is to implement an effective inter-institutional mechanism for generating, disseminating, and exploiting environmental and geospatial data useful for decision-making in Latin America and the Caribbean (LAC). The Program has developed and operates five tools/components: i) a Regional Geoportal, ii) a decentralized network of map services, iii) a LAC regional Map Service, iv) a Topographic Processing Service, and v) regional geoprocessing tools for energy assessment and disaster early warning.

The Program is jointly coordinated by CAF - the Development Bank of Latin America and the Pan-American Institute of Geography and History (PAIGH). More than 60 national agencies actively participate in GeoSUR. Participation is open for spatial and environmental data producers from any sector.

Regional networks such as GeoSUR are the missing link between national information networks and global information networks, and are possibly the weakest link in the information chain. Most environmental issues are supranational in nature and need to be looked at from a regional perspective. Think of the Amazon Basin, the Coastal Forests of Eastern Africa or the mountains of Central Asia. How can we track threats and changes to these vulnerable areas without having regional information systems?

GeoSUR, in partnership with the U.S. Geological Survey's Center for Earth Resources Observations and Science (EROS) and the Pan-american Institute of Geography and History (PAIGH). sponsors the development of Shuttle Radar Topography Mission (SRTM) derivative products for South America, and sponsors workshops geared towards South American specialists from national geographic institutes and other national agencies that produce topographic and base maps such as hydrography. Hydrologic flow model are also produced from SRTM data.

GeoSUR has been successful due to several factors including: leadership of respected institutions with a clear mandate surrounding the use and production of geographic information, technical support by international leaders in SDI, funding provided over long periods of time, an inclusive participation policy with low barriers to entry, continuous capacity building, close follow up of partner agencies´ development, data decentralization (keeping data and services close to its producers), and a penchant for developing practical applications in a project with very limited staffing.

Can the GeoSUR model be replicated in other regions of the developing world? With support from UNEP and the Abu Dhabi Global Environmental Data Initiative (AGEDI) we have produced a report to try to answer this question. Based on this research, we do believe regional networks could be started in other areas of the world, and propose strengthening and expanding the GeoSUR model in the LAC region and starting - or reinforcing – regional information networks in Africa and South-East Asia, as part of a four-year showcase project.

9 Appendix 3: List of Acronyms

AEIN	UNEP African Environmental Information Network
AGEDI	Abu Dhabi Global Environment Data Initiative
AUSAID	Australian Government Overseas Aid Program
CAN	Andean Community
CEOS	Committee on Earth Observation Satellites
CSDGM	FGDC Content Standard for Digital Geographic Metadata
CSW	OGC Catalogue Service for the Web
CUAHSI	Consortium of Universities for the Advancement of Hydrologic Science
EEA	European Environment Agency
EIS-Africa	Environmental Information Systems - Africa
EIONET	EuEoEWSropean Environment Information and Observation Network
EoEWSSI	Eye on Earth Water Special Initiative
ESA	European Space Agency
FAO	Food and Agriculture Organization (UN)
FGDC	Federal Geographic Data Committee
GBIF	Global Biodiversity Information Facility
GBO	Global Biodiversity Outlook
GEMS/water	Global Environment Monitoring System /water (UNEP)
GEO	Group On Earth Observations
GEOSS	Global Earth Observation System of Systems
GeoSUR	La Red Geoespacial de America Latina y el Caribe
GGIM	UN Programme on Global Geospatial Information Management (GGIM)
GIS	Geographic Information System
GNoN	Eye on Global Network Of Networks Special Initiative
GNoNSI	GNoN Special Initiative
GRDC	Global Run-off Data Centre
GSDI	Global Spatial Data Infrastructure
IAEA	International Atomic Energy Agency
ICIMOD	International Centre for Integrated Mountain Development
ICT	Information and Communications Technology
IEG	International Environmental Governance
IFIs	international financial institution
IFSD	International Framework for Sustainable Development
INSPIRE	Infrastructure for Spatial Information in Europe
ITU	International Telecommunication Union
MDB	Multilateral Development Bank
MEA	Multilateral Environmental Agreement
NASA/Servir	National Aeronautics and Space Administration/Regional Visualization and Monitoring System (Servir)
NGO	Non-Governmental Organization
NOAA	National Oceanic and Atmospheric Administration
OGC	Open Geospatial Consortium
OKF	Open Knowledge Foundation
SDI	Spatial Data Infrastructure
SEIS	Shared Environmental Information System
SERVIR	Regional Visualization and Monitoring System
SICA	the Central America Integration System
SIR	GEOSS Standards and Interoperability Registry
SWALIM	Somalia Water and Land Information Management (FAO)