GWSP
Global Water System Project

Earth System Science Partnership

GLOBAL WATER NEWS

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EDITORIAL

This Global Water News heralds a new phase of the GWSP, and introduces three new members of the Scientific Steering Committee, and newly appointed staff of the International Project office (IPO). We greatly appreciate the renewed support of the German Ministry of Research and Education (BMBF), and the intellectual and logistical base provided by the Center for Development Research (ZEF) at the University of Bonn. Presenting our future vision, my opening article gives an outline of future challenges and plans for the Project, building on the progress made since its inception five years ago. That progress has been made within the framework provided for joint projects by the four programs of the Earth System Science Partnership, which itself has been evolving. The various articles reporting details of recent GWSP progress illustrate the inter-disciplinary nature of the GWSP and the extent and value of collaboration with institutions and ESSP partner projects around the world. The GWSP is very much a global project, and led by its international Scientific Steering Committee (SSC) will continue to build on past strengths and chart new directions in response to accelerating global environmental change. We will need all the support we can get from the scientific community to achieve our goals, and as incoming Executive Officer, I welcome feedback and proposals for collaboration from readers.

Janos Bogardi
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THE 3RD PHASE OF GWSP

Global environmental change and its components: climate change, land degradation, the consequences of unsustainable resource use, population pressure and the inherent needs and impacts are more and more dominating the hydrological cycle. Consequently these challenges are the focus of scientific concerns and international debate.

As far as water is concerned climate change is causing a significant increase of floods and droughts. In recent decades the acceleration of the hydrological cycle can be observed worldwide. More frequent and larger extremes do not augur well for the future. The demand for the resource to grow food, to generate energy, to use as process water and transport medium, to drink it and to deploy it as the main agent of sanitation is steadily increasing. Here we face an unpleasant dilemma. While on one hand we aim to preserve and even to rehabilitate aquatic ecosystems, the reality of environmental changes, prolonged droughts would force us to restart building reservoirs, to use increasingly inter-basin transfers. This dilemma could be highlighted by juxtaposing the daunting political options: either we bring water to people or people would migrate to water. In recent years the environmentally or disaster displaced people outnumbered those seeking refuge due to wars or violence as reported by several humanitarian agencies.

On the lake shore, China.

The observed and expected increase in water demand means more water withdrawal for human purposes from natural water bodies. This would further emphasize the competition between socioeconomic uses and ecosystem needs. Water is likely to become *the* security issue of the 21st century.

Already the 2nd World Water Forum in 2000 in The Hague identified these challenges and called for "Walter Security in the 21st century".

While the conflict potential of increasing uses of scarce (and dwindling) resources is obvious, we do not mean "water wars". Humanity has only the option of cooperation in using and protecting shared resources. Irrespective of its compartments—catchments, basins, aquifers—through the atmospheric and ocean links there is ultimately only one global hydrocycle in the world.

Owing to the central role that water plays in ecological integrity, biogeochemical cycling, climate dynamics, and human development and well-being, a new science perspective is today considering fresh water resources as a multi-faceted *system* and, more specifically, as a *global system*. A founding principle of the *Global Water System Project*, and one that distinguishes it from other water science efforts, is the notion that physical, biological, chemical, and social factors all shape the character of the water cycle and hence the world's global freshwater resource base.

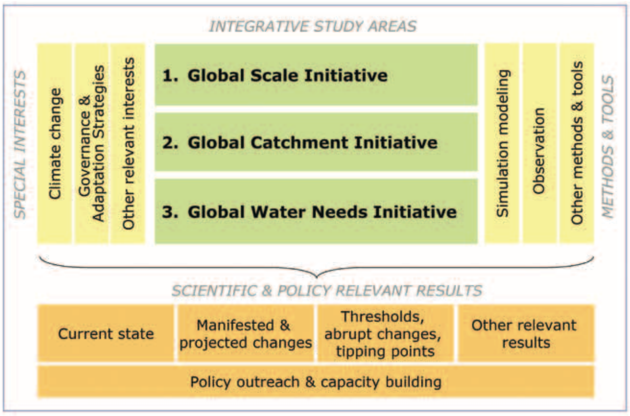
There are four motivating factors to address the water challenges in the global context: (i) the need for resource assessment in light of rapid climate and environmental change, (ii) the absence of a systematic framework for evaluating the physical, biogeochemical, biological, and social dimensions of the world's freshwater resource base, (iii) ongoing frustration in developing trackable, policy-relevant indicators to monitor this important strategic resource, and (iv) global-scale challenges to govern water systems wisely, which are exacerbated by the uncertainty and risks of climate change. A quantitative underpinning to address this policy imperative has yet to be developed. The GWSP is uniquely suited to addressing these important strategic development issues.

At its inception the GWSP identified three intellectual challenge areas:

1. To capture the magnitudes, mechanisms and triggers of anthropogenic and environmental change
2. To identify the main links and feedbacks of these changes in and upon the global water system
3. To measure resilience and adaptability of the global water system and to derive sustainable governance studies and strategies towards integrated water resource management.

Within this context the emerging phase 3 of the GWSP will focus on three core integrative study areas as shown in the following figure:

Figure 1: *Structure of GWSP activities in its 3rd phase*



The **Global Scale Initiative (GSI)** is fundamentally science-driven but highly policy oriented. Its products are designed to ensure relevance to a broad community of users.

The principal **goal** of the *Global Scale Initiative* is:

> *to provide scientists and policymakers with high quality, quantitative, and timely information on the condition of* the Global Water System, *both now and into the future, reflecting sound biogeophysical and human dimension perspectives.*

The initial focus of the *GSI* will be on producing the world's first operational, "near real-time", and authoritative picture of the fresh water system of the planet. This will provide the benchmark against which *GWSP* assessments of future change can be measured.

The overall goal of the *State-of-the-GWS* effort can be stated as its central science question:

> *What is the* "State-of-the-Global Water System" *defined by physical, biological, chemical, and social perspectives as well as through their combination?*

A rich variety of supporting questions can also be posed and will be used to guide the exercise:

- Where are the regions of emerging water scarcity—due to different stresses?
- How much of the world's population is at any one time facing substantial levels of water stress?
- What is the global freshwater resource base, limited not only in physical terms but by pollution and in-stream flow requirements for navigation and the maintenance of aquatic ecosystem services?
- What is the collective, systematic, and global-scale significance of changes unfolding within the GWS?
- How "operations-ready" are current Earth system & social science models, data sets, and indicators for depicting the contemporary, and forecasting the future, state of water resource stress?

Table: *GWSP Global Catchment Initiative Research Questions; agreed upon by the GCI Expert Group at its first meeting on 7–8 February 2008 in Bonn, Germany.*

GWSP Core Themes	GCI Research Questions
Theme 1. What are the magnitudes of anthropogenic and environmental changes in the global water system and what are the key mechanisms by which they are induced?	How is global change manifested in particular catchments (at the decadal to century time scales)? How do changes in climate, land cover/use, demography, institutions and consumption patterns, driven by external factors, affect the characteristics of particular catchments? Which other external factors are important? What are the expected impacts of these changes on society and ecosystems?
Theme 2. What are the main linkages and feedbacks within the earth system arising from changes in the global water system?	What meteorological, hydrological or biogeochemical connections from beyond the catchment are observed in specific catchments, why do they occur and which feedbacks do they induce? What are the determining factors and the consequences of virtual water trade? How do international power relations affect the use of water and other natural resources in catchments?
Theme 3. How resilient and adaptable is the global water system to change, and what are sustainable water management strategies?	What is an appropriate framework to address vulnerability, resilience and adaptive capacity of water systems in river basins from a global perspective and to integrate across scales to identify and rank factors, and their interactions, which influence sustainability? How did and do water governance regimes compare between catchments in their ability to achieve sustainable (environment, social, economic) management of the water resource and to adapt to global change? What was and is the influence of international institutions (e.g. binding conventions, global norms) and global actors on the resilience of river basins and how can such influence be improved? How can sustainable water management that takes into account uncertainties introduced by global change improve the balancing of water needs for ecosystems and human activities?

- What are the levels of uncertainty associated with a contemporary view of water system stress and how can these be conveyed to policy-makers?

The **Global Catchment Initiative (GCI)** is a GWSP-supported research program and network which encourages the use of large catchment throughout the world as "living laboratories" for better understanding the functioning of the global water system (especially in its terrestrial phase).

The over-arching goal of the GCI is to expand the viewpoint of river basin research and management to include the global perspective.

As a rule of thumb, the GCI will focus on basins approximately 100,000 square km and above in size. As an illustration of how the new integrative study areas respond to the original GWSP themes, the table above summarizes the core research questions of GCI.

The **Global Water Needs Initiative (GWNI)** recognizes that against the background of drastically changing human demands and impacts of global change on water resources, it will be important to quantify the amount and characteristics of that part of the river flow that sustains ecosystem health.

GWNI will in particular seek to find scientific answers to the following key questions:

1. Can a scientific rationale and process be developed for credible and defensible environmental flow standards (EFS) at the country and regional scales?
2. What is the global distribution of the economical and social values of freshwater goods and services at river basin, country and regional scales?
3. What are the human water consumption patterns (by water use sector) for specific river basins, countries and regions?
4. How can we meet human needs for water and at the same time protect important assets and values that freshwater ecosystems provide?

These integrative study areas define the three main thrusts and synergies of the GWSP in its third phase. The expected scientific results will be presented as reports and papers in science fora and media, which represent the traditional mode of outputs. Across the spectrum of capacity building, education of the future generation of scientists needs to move towards stronger integration and providing the knowledge base for raising public awareness. Within this scope, policy dialogues with decision makers towards knowledge-based solutions that safeguard and develop the GWS can be perceived as focal activities.

The ESSP framework provides the possibility of further synergies—health and water, food security and water, and carbon and water, while the GWSP could prove its usefulness for the four 'parent programs'—DIVERSITAS, IGBP, IHDP, and WCRP. As adaptation emerges as an inevitable strategy to face global change, the GWSP will gain in importance. If mitigation was an 'energy question' adaptation would be predominantly 'water' and land use.

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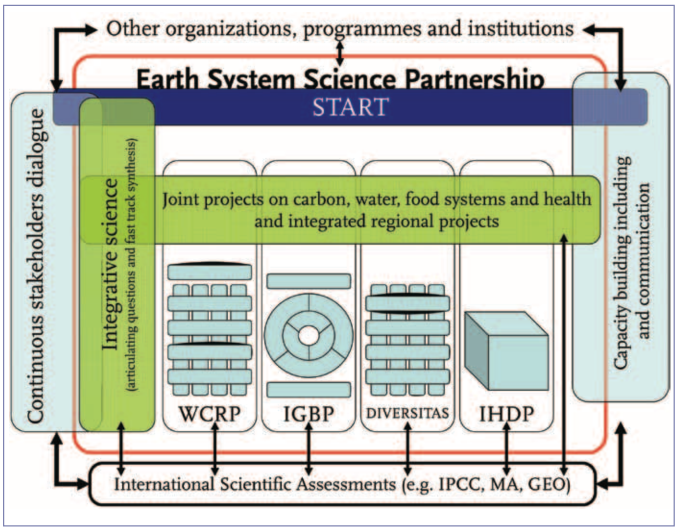
EARTH SYSTEM SCIENCE PARTNERSHIP (ESSP)—COMMUNITY BUILDING FOR NEW SCIENCE INSIGHTS

What is ESSP?

The ESSP is a science partnership of the four international global environmental change research programmes—an international programme of biodiversity science (DIVERSITAS), International Geosphere-Biosphere Programme (IGBP), International Human Dimensions Programme on Global Environmental Change (IHDP), and the World Climate Research Programme (WCRP)—for the integrated study of the Earth system, the ways that it is changing, and the implications for global and regional sustainability. ESSP's vision is "to address complex Earth system questions that are important to society and that require problem solving skills from a range of natural and social sciences". (ESSP Scientific Committee, March 2009).

Figure 1: *The integrative structure and activities of ESSP*



ESSP Joint Projects and Integrative Science

ESSP activities aim to develop a global environmental change (GEC)-oriented research agenda of direct relevance for societies. It does this by building upon and further integrating the disciplinary and interdisciplinary results from the four international global environmental change research programmes through joint projects, capacity building, contributing to the science assessments, involvement in science-policy fora and capacity building through START (Figure 1). The ESSP Joint Projects aim to address the challenges caused by GEC with innovative integrative approaches, to elucidate interactions between natural and social systems and to understand the implications of human-driven changes for the functioning of the Earth system. The current suite of Joint Projects focus on carbon dynamics, food systems, health and water (GWSP).

ESSP Joint Projects bridge global, regional and local levels. These elements actually are the first elements of a system of GEC science and construct the essential knowledge base needed to respond effectively and quickly to the great challenge of GEC. Moreover, ESSP and its Joint Projects (including GWSP) offer a genuine home base for the new type of interdisciplinary (and transdiciplinary) researcher, who is so urgently needed to tackle today's global change and sustainability challenges. In the short time that they have been in operation, the Global Carbon Project (GCP), the Global Environmental Change and Food Systems (GECAFS) and the GWSP have each in their own way and with their own different methodologies and approaches gone about building the scientific infrastructure that allows us to take a more integrated approach to global environmental change science. The annual updates on the carbon cycle, for example, have attracted impressive media coverage. We now also have established the new Global Environmental Change and Human Health (GECHH) project that will tackle global environmental change from a different approach.

As an international facilitator, the GEC research programmes and their partnership in Earth system science assisted the development of the African network for Earth system science (AfricanNESS) science plan, http://www.igbp.net/documents/AfricanNess-2008.pdf. Here you will see that the science plan focuses on four top-level issues, water resources being one of them with input from the GWSP.

Communications and Outreach

In response to a recent International Council for Science (ICSU) commissioned review of ESSP that stated that the ESSP needs to engage with the wider community, the ESSP has been developing a series of communications and outreach tools, namely:

Knowledge Products

The ESSP will provide a mechanism to help promote and deliver knowledge products. As the experience with the carbon budgets (http://www.globalcarbonproject.org/carbonbudget/index.htm) released by the GCP has shown, integrative and synthetic science products that are released and updated regularly, and have a direct connection with the policy process can generate a lot of visibility and excitement. Several other examples of such knowledge products within the different projects of the ESSP and the research programmes already exist, including the GWSP digital water atlas (http://atlas.gwsp.org).

Forum

The ESSP will co-convene an Earth system science forum with strategic partners. The first one being the Tallberg Forum, 25–28 June 2009 with the Stockholm Resilience Centre and the Stockholm Environment Institute on "Making the Planetary Boundaries Relevant for Policy and Practice". This kind of forum will serve as a vehicle for a high-level dialogue with stakeholders, including opinion leaders from civil society, business and government. The forum can also help highlight and communicate key insights from science, raise awareness and build support for interventions to support all partner GEC research programmes and their projects (including GWSP), and identify key issues and areas of relevance for the Earth system science agendas of ESSP and its partners.

Journal

The ESSP will launch a high quality, interdisciplinary, peer-reviewed journal entitled *Current Opinion in Environmental Sustainability* (published by Elsevier) in October 2009. This journal will provide a valuable outlet for the science of the GEC research community, including water-related research. It will appeal to a wide audience through policy briefs, short assessments or issue summaries. This journal will be open access to developing country scientists.

Collaborative Research

Not only is the GWSP a key ESSP research project / integrative science endeavour, the GWSP also provides strategic oversight as a member of the ESSP Scientific Committee. Vice versa, the ESSP SC serves as a key platform to ensure that GEC water-related research is encompassed in community wide research efforts. One example is the ESSP bioenergy initiative that takes an Earth system view of bioenergy, its opportunities and constraints in contributing to stabilizing atmospheric CO_2. Another community-wide endeavour that GWSP provides input to is the new CGIAR Challenge Programme on "Climate Change, Agriculture and Food Security" (CCAFS), which is a major collaborative endeavour between the Consultative Group on International Agricultural Research (CGIAR) and their partners, and the ESSP. It is aimed at overcoming the additional threats posed by a changing climate to achieving food security, enhancing livelihoods and improving environmental management in the developing world. An international launch conference is anticipated in early 2010. Opportunities for GWSP and GEC researchers to declare intent to be involved in this exciting new program can be found on the ESSP website (http://www.essp.org/index.php?id=76).

Both these research initiatives were spearheaded by GWSP sister projects—bioenergy and sustainability safeguards (Global Carbon Project, GCP) and the CGIAR program on climate change, agriculture and food security (Global Environmental Change and Food System, GECAFS). Considering the fundamental importance of water resources and the millennium development goals, now might be the time for the GWSP scientific community and its leadership to think about a GWSP led ESSP community-wide research initiative?

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THE GWSP GLOBAL SCALE INITIATIVE (GSI)

The *Global Scale Initiative* is designed to promote a fully global-scale perspective within the *GWSP*—one of its key founding principles. Why the global-scale? Owing to the central role that water plays in ecological integrity, biogeochemical cycling, climate dynamics, and human well-being, a new science perspective is today recognized as essential, considering freshwater-related aspects being part of a multi-faceted *system* and, more specifically, part of a *global system*. This principle distinguishes the *Global Water System Project* from other water-science efforts, that is, the notion that physical, biological, chemical, and social factors all shape the character of the water cycle and hence the world's freshwater resource base.

The *GSI* is built around a pragmatic approach toward addressing this principle and on achieving near-term progress. It is guided, as all *GWSP* activities, by (i) continental-to-global perspectives, (ii) interdisciplinarity, and (iii) making best use of high quality scientific and technical resources. The effort is fundamentally science-driven but highly policy-informing, and planning is underway to ensure relevance to a broad community of users. The principal goal of the *Global Scale Initiative* is:

> *To provide scientists and policymakers with high quality, quantitative, and timely information on the condition of* the Global Water System*, both now and into the future, reflecting sound biogeophysical and human dimension perspectives.*

The overarching goal is being realized through development of a set concrete outputs. Several have already been developed as part of the original set of Fast-Track Activities of the Project: **The GWSP Atlas, GWSP Water Balance Intercomparison** led by co-Chair J. Alcamo, **GWSP Dams and Reservoirs, GWSP-LOICZ Deltas-at-Risk**, and **GWSP Water Indicators.** Two team-based efforts have been consolidated under the Indicators activity over the last 18 months.

State-of-the-Global Water System

The first effort is "The State-of-the-Global Water System" product, an integrated data compendium representing a definitive, comprehensive, and up-to-date picture of the state of the hydrologic system and affiliated world water resources currently made possible by the conjunction of in situ observations and Earth system science modeling and data assimilation outputs. There are four motivating factors for developing the *State* product: (i) a well-recognized need for up-to-date global water resource assessment in light of rapid climate and environmental change, (ii) the absence of a systematic framework for evaluating the physical, biogeochemical, biological, and social dimensions of the world's freshwater resource base, (iii) ongoing frustration in developing trackable, policy-relevant indicators depicting this important strategic resource, and (iv) global governance challenges for climate change also pass into the realm of water systems, but a quantitative underpinning to address this policy imperative has yet to be developed. The GWSP is uniquely suited to addressing these important strategic development issues.

The initial focus of the *GSI* will be on producing the world's first operational, "near real-time", and as definitive as possible a picture of the fresh water system of the planet, currently being presented as monthly updates and covering the period 2000-to-present.

Figure 1: *Part of a prototype system developed in conjunction with World Water Assessment Program (WWAP) and its Expert Group on Indicators.*

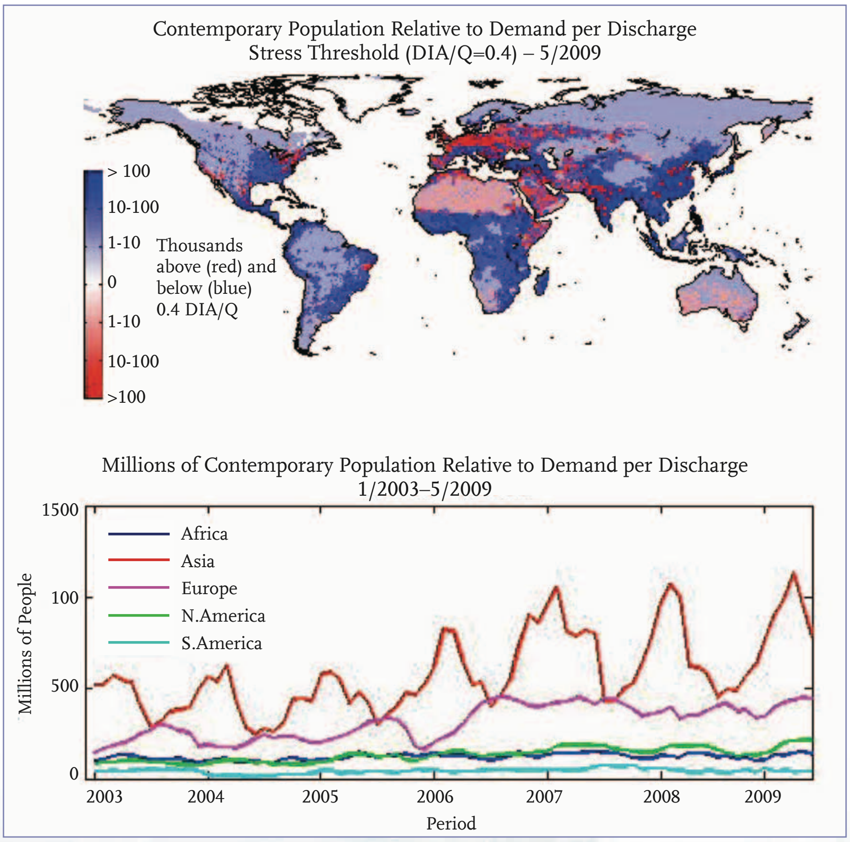
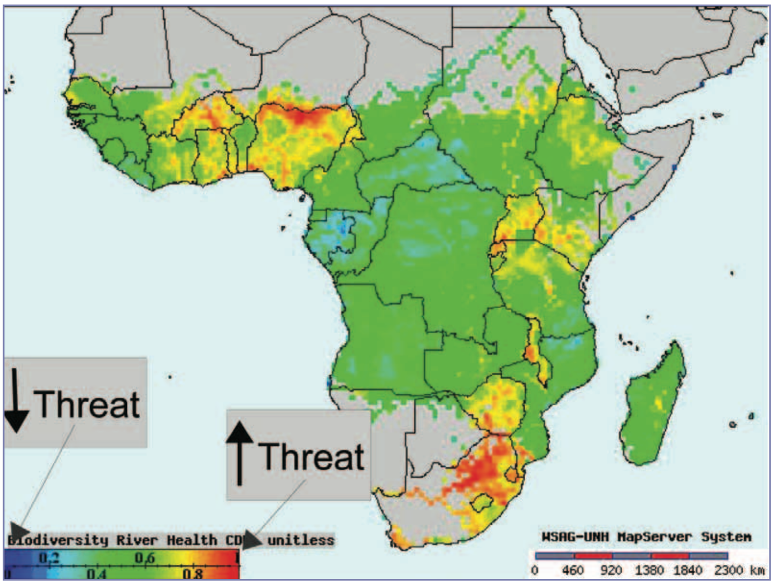


Figure 2: *A preliminary results computed as part of the RiverHealth analysis. The image shown is an attempt to map threats to inland biodiversity. A parallel mapping is being prepared for human water security.*



This will provide an important benchmark against which *GWSP* assessments of future change can be measured. The effort requires close collaboration with numerous international partners. Chief among these is the World Water Assessment Programme and its Pilot Study on Indicators on which the GSI is collaborating directly (Figure 1). There are four broad supporting objectives of the *State* product:

- Mapping*: To create a coherent geography—a set of electronic maps—on the* State of the Global Water System *and world water resources with focus on contemporary and future time horizons.*
- Database Use and Data Integration*: To demonstrate the use of sufficiently mature "off-the-shelf", operational data bases that can assess the state of, and variability in, the contemporary GWS; the Global-Rapid Indicator Mapping System (Global-RIMS) software product is currently being applied for RiverHealth project integration.*
- Change Detection*: To develop models, data sets, and other necessary tools to identify hot spots of recent and ongoing change with respect to the physical, biological, biogeochemical, and human dimension aspects of the GWS.*
- Priority Setting*: To translate the global-scale outputs into research, education, and policy priorities.*

RiverHealth

The second effort consolidated under the GSI indicators activity is an assessment of threats to the global system of rivers. Although work by a number of blue ribbon panels (e.g. Pew Foundation; Millennium Ecosystem Assessment) has articulated threats to coastal and marine ecosystems, a recent paper (2008) in *Science* by Halpern et al. has gained particularly broad attention, perhaps fueled by a now well-conditioned public interest in the environment catalyzed by climate change, thinking "green", and an increasing awareness that the Earth's resource base may indeed have limits.

At the same time, and despite relatively high profile outputs and events like the two existing *World Water Development Reports*, a *UN Decade for Water*, and several *World Water Forums*, a similar notoriety has evaded the freshwater resource and ecosystem services question.

Work executed over the last several years in two concurrent ESSP efforts, the *Global Water System Project* and *DIVERSITAS*, has positioned us to jointly execute an analysis of emerging threats to fresh water on the continental land mass, an inland aquatic systems "response" to the Halpern et al. paper, which arguably used GIS-based data sets which were equally, if not less, mature than those that have already been assembled under ESSP auspices (e.g. *GWSP Global-RIMS indicator compendium* and GWSP *Water Atlas)*.

RiverHealth will report two primary output map products, which are effectively global-scale geographies of:

- Threats to the freshwater resource base for human use, which would necessarily consider water for the domestic, industrial, and agricultural sectors; and,
- Threats to freshwater required and made available to natural ecosystems.

Either of the two potential outcomes—concordance or contrast between the two maps—yields an important message. In the case of the former, we would then be able to articulate that stewardship of both human and natural water resources must go hand-in-hand and that solutions must be locally integrated, supporting the principles of *Integrated Water Resources Management* (*IWRM*). Concordant spatial patterns would also yield the first identification of "hotspots" of multidimensional vulnerabilities at the global scale, thereby facilitating prioritization of investments in threat abatement. If instead the results conflict between the biodiversity and human-oriented maps, then the problem is more daunting and filled with contrasting objectives, upstream-downstream conflict, and human-nature dichotomies, which must be reconciled--nonetheless a compelling result.

Fishing boats, Mexico.

It is anticipated that follow-on studies will build upon the outcome of the workshop to develop a more in-depth and longer-term analysis. Two branches of inquiry will move forward, one involving human water resource perspectives and another focusing on biodiversity and ecosystem health. It will be critical to maintain an ongoing cross-fertilization of ideas across these two follow-ons, in order to explore all possible synergies. The GSI stand ready to support the ongoing dialogue. As part of this support, GWSP is co-sponsoring a symposium entitled *"The Freshwater Biodiversity Crisis: a global threat to ecosystems and people"*, organized by Klement Tockner (Germany), Charles J. Vörösmarty (USA) at the DIVERSITAS OSC-2, 13–16 October 2009, Cape Town, South Africa.

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GLOBAL WATER GOVERNANCE: QUO VADIS?

How can and should water resources be 'governed' at a global scale? Whereas some years ago the relevance of such a question was highly contested, the need for global coordination in water governance is not disputed any longer. However, the judgements diverge considerably on the current state and desirable future developments of global coordination efforts. Some see a promising base for sustainable water governance in the present institutional diversity of global water initiatives embedded in large networks. Others argue that with proliferation large international water meetings such as the World Water Forum have become non-effective and inefficient. Others go even further and argue that the World Water Forum has become an arena to promote economic interests of the powerful. Indeed, whereas the size of the industrial exhibition is growing from year to year, the final declaration of the Forum's informal ministerial process has remained quite inconsequential in policy terms. This year no agreement was possible to support 'water as a human right', but could be reached on a rather weak statement to declare 'water as a basic need'. Father Miguel d'Escoto, President of the UN General Assembly, an outspoken critique of water privatization, was denied a public audience at the Forum. Maude Barlow, senior advisor to Father d'Escoto, read his statement to the People's Water Forum criticizing the World Water Council and the World Water Forum. He called upon the UN member states to implement a process leading to a legitimate global water forum under UN auspices. Such discussions show that time has come for a more serious reflection on the question "How can and should water resources be 'governed' at a global scale?".

The issue of water governance should be differentiated from the question of water management. Management is about achieving goals, with given means and resources, within given constraints and preferably in a 'cost-effective way'. Governance is about setting the stage for management, the processes of selecting policy options among competing values, translating them into goals, means and processes to be 'managed', evaluating outcomes and accounting externally, and taking responsibility for choices made along the way. Water management is about effectiveness and efficiency. Water governance is about legitimacy.

Experiences at the various emerging levels of water governance have contributed to an increasing awareness of the need to fill the institutional gap. The debate on global warming and Climate Change has acted as a catalyst. Pasquale Steduto—current Chair of UN Water—and Johan Kuylenstierna—his Chief Technical Advisor—eloquently distilled the essence: "Climate change, energy, food security, economic development—in the end, it all trickles down to water'.[1] World water forums of professionals, experts

1 Climate-L.ORG Bulletin, January, 2009

and field administrators have gradually developed into social movements to fill the institutional void, generating shared norms, ideas and understanding. However, by their very institutional nature these movements, despite increasing mass participation and wholesale turn out at peak-events and summit meetings, are incapable of generating a collective and mutually binding policy agenda. The mechanisms for generating legitimate and binding collective decisions on future agendas are lacking. Worse even: the Classical 'Iron Law of Oligarchy' from organisational sociology would predict that when left unstructured and unorganised, specific interest—those that can reap the selective benefits from the global movement—inevitably will capture and come to dominate the process. This will eventually exhaust the energy and erode the legitimacy of these social, functional and professional movements.

Water is the common good among various political and social discourses: 'Water frequently functions as the link between the climate system and human society. Strategies related to climate change adaptation must increasingly focus on water resources management.'[2] A consequence of lacking an institutional organisation will most likely be that water ends up with the worst end of the stick, rather than becoming the guiding principle in the international climate, energy or economic development debate. Organisation of the governance process is important. Legitimacy is the question to be addressed, given the current condition of global water governance. Organisation should not be confused with centralisation. Decentralised 'Free Markets' are notoriously one of the most structured, organised and regulated social institutions. However, the world is in the process of witnessing what happens if these complex organisations, in certain critical domains, are left unchecked and unbalanced by civic, social or public sector institutions. Like 'marketable goods', also 'governable goods' require complex, multi-layered and multi-scaled institutional structures effectively to govern and link local to global concerns, and *vice versa*.

2 Steduto, Kuylenstierna, op. Cit.

The multi-faceted nature of water.

The multi-faceted nature of water

Much of the debate on global and adaptive governance is about networks and the importance of non-governmental processes. However important the development form government to governance as an analytical orientation has been, one should not overlook that governance without government in the end is most likely to be futile. An analysis of the current state of global water governance shows the diffuse and fragmented character of today's Global Water Governance, with heterogeneous players without indications of emerging global leadership. A combination of a global, formal, centralized approach in combination with global informal networks and markets may have the potential to meet present and future challenges for global water governance, since it combines legitimate global coordination with flexibility and adaptive negotiation spaces. UN Water is thus far comprised of functional and nongovernmental agents of various water-related 'partners', not organisations representing governmental units, or the water governance system in and of itself. The missing link in the current global water governance structure is the 'vertical' cross-layer, cross-scale dimension of the water governance system.

In order to become a useful and effective countervailing power in the various global debates associated with water, the prevailing system of *multi-governance of water*, is to be complemented and embedded in a system of *multi-level water governance*. To this end much primary and particularly comparative institutional research still needs to be done. Every governance system consists of functional and territorial units and arenas of action, which are the relevant territorial units within the emerging global water governance structure: catchment areas, river basins, deltas, coastal zones, islands, or a combination of all of these? And how are the various functional and territorial units institutionalised within various cultural contexts and administrative traditions? What do we know about the performance of the agents of international water governance: the 'water-bureaucracies' within various national systems, which are most likely to provide the administrative backbone and implementation structure of 'global water governance'? How can one on a mutually accepted basis, and without having to refer to panacea-models or standards, measure, monitor and account for the performance of these units of water governance, which are most likely operating within and beyond national governmental borders? Some basic questions in global water governance need to be addressed urgently in order properly to support and sustain an inevitable institutionalisation process. Required is a research and policy agenda that combines functional global governance scenarios with a thorough, systemic and empirical comparative analysis of water governance regimes, in order to avoid panaceas or one-sided institutional models dominating the debate on the design and institutional development of a governing system which is '...multi-faceted and (where) there is no single actor that can claim to have the full mandate".[3]

Acknowledgements:

The authors would like to thank all participants of the session 'Governance and the global water system' organized by the GWSP during the recent IHDP Open Meeting for stimulating discussions and commitment to engage in building up a global water governance research and practitioners' network.

Further reading:

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3 Steduto, Kuylenstierna, op. Cit.

GREEN AND BLUE WATER IN THE GLOBAL WATER SYSTEM—A MODEL SYNTHESIS

The global Green-Blue Water Initiative (GBI), which we presented initially in the December 2007 GWSP newsletter, is about to deliver its first product: a forthcoming special issue of the Journal of Hydrology, with nine papers presenting a synthesis of green and blue water simulations from 8 global models, ranging from (eco-) hydrological and agronomic models all the way to economic partial and general equilibrium models. Despite their very different origin, objectives, structure and process parameterization, the models converge on a number of key messages:

1) **Green water dominates food production and virtual water trade** globally, totalling about 5000–5500 $km^3\ yr^{-1}$ for crops, whereas the total for blue water for crops is estimated as 1000–1500 $km^3\ yr^{-1}$. Even regions that depend strongly on irrigation, such as Middle East–North Africa, meet about half of their total crop water demand from green water.

When all meat and dairy production is included, total green water consumption reaches about 14.000 $km^3\ yr^{-1}$ (assuming that 1/3 of the total evapotranspiration from permanent grazing land is actually going into livestock production). Food production for export is mostly rainfed and accordingly virtual water trade is also dominated by green water.

However, the synthesis also demonstrates considerable differences between models in the spatio-temporal patterns of green and blue water fluxes, e.g. the amounts of green water supporting rainfed versus irrigated cropland, the fractions of water consumed in the cropping and fallow period respectively, and also the fractions of productive transpiration versus unproductive evaporation in total crop water use.

GBI scenarios project a faster future growth of green rather than blue water use, considering also that many countries are reaching the limit of sustainable blue water extraction.

2) **Blue water resources are being critically overexploited** in an increasing number of basins and regions. The GBI model synthesis confirms this trend from a new perspective: irrigation water demand to support currently observed crop production cannot be met from renewable lo-

cal water resources in a large number of model grid cells (0.5° resolution). Accordingly up to 50% of the total irrigation water demand has to come from non-renewable or overexploited (groundwater) resources or from transfers from other grid cells.

Climate change scenarios indicate increasing water scarcity in several regions, but the synthesis also points out the moderating effect of increasing crop/vegetation water use efficiency under higher atmospheric CO_2 concentration.

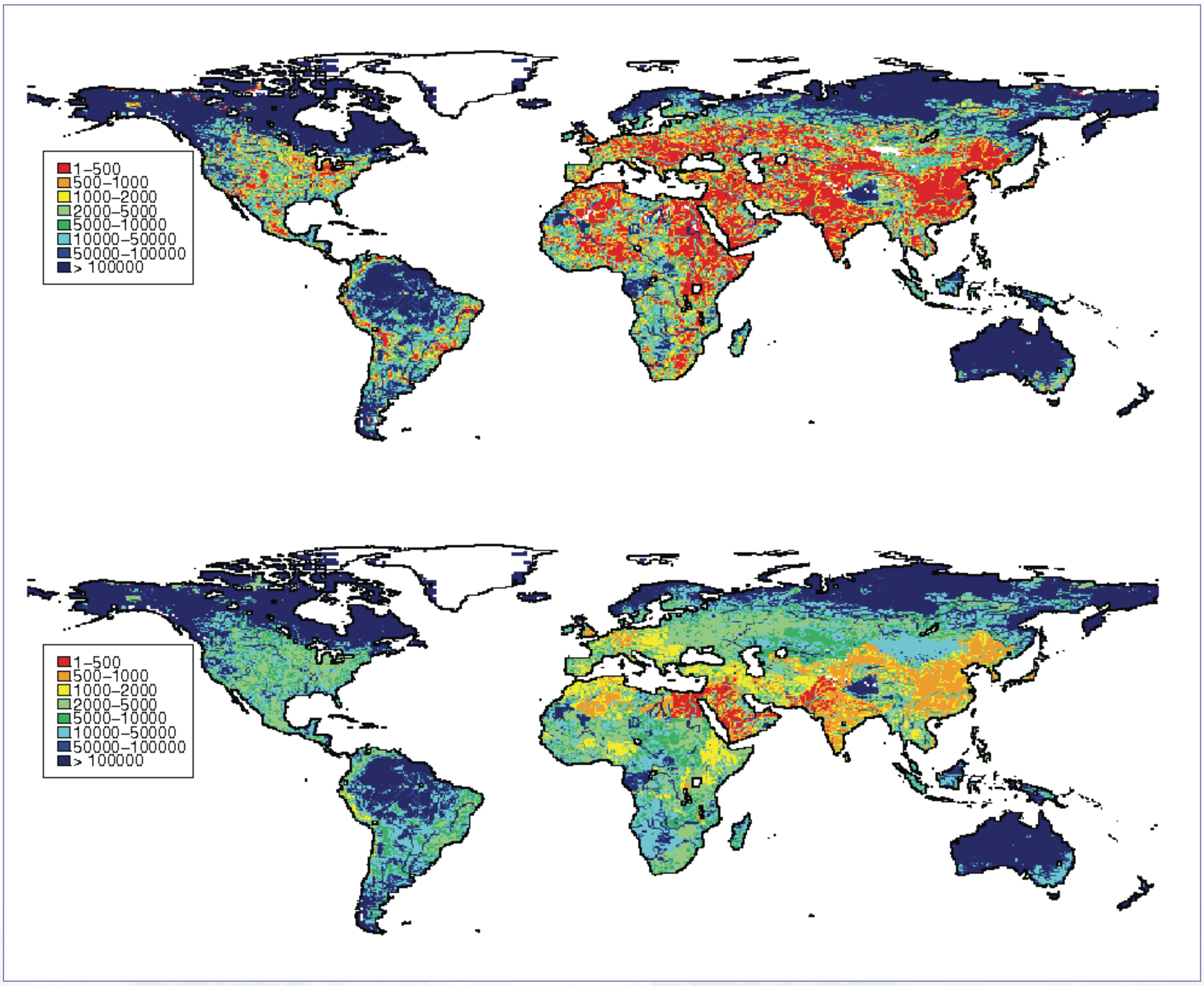
3) **There is significant potential for improving green and blue crop water productivity** (CWP) and hence for producing more food with less water. Since higher CWP is generally correlated with higher yields, there is enormous potential to increase productivity, in particular in the low-yield hunger hot-spots of the world. GBI models confirm very low CWP in so-called "drylands" of Africa or Asia, where improved management practices for not only water but also land could significantly reduce water demand per unit of crop production.

GBI models indicate that adding irrigation water by itself has no marked effect on CWP, given that crop water use and yield increase simultaneously under irrigation. Hence, comparisons between irrigated and rainfed CWP, for regions with similar climate, soil and crop types, show no large differences.

However, the amount of water required per unit of biomass produced increases in warmer and drier climates, so that food/virtual water trade from cold and humid to warm and dry countries can improve overall CWP, resulting in significant water savings as a result of international food trade.

4) **A wide range of management options exists along the green to blue water continuum** for achieving significant increases in water productivity and food production. The conventional approaches of adding new irrigation

Figure: *Different water scarcity indices: average values of 1971–2000 of blue water (top) versus blue plus green water (bottom) in $m^3 capita^{-1} year^{-1}$.*



Box: Definition of green and blue water

Green water is defined as the soil water held in the unsaturated zone, formed by precipitation and available to plants, while blue water refers to water in rivers, lakes, wetlands and aquifers, which can be withdrawn for irrigation and other human uses. Consistent with this definition, irrigated agriculture receives blue water (from irrigation) as well as green water (from precipitation), while rainfed agriculture only receives green water. Land use decisions drive the partitioning of rainfall into green and blue water and hence become part of water management.

schemes and/or expansion of agricultural land need to be integrated with—and in some cases be replaced by—management options such as rainwater harvesting and storage, supplementary irrigation, conservation agriculture, or crop selection and breeding. The GBI models have begun to assess the global potential for some of these measures:

- current irrigation has increased biomass or food production by about 20% globally (and much more in severely water limited regions).
- rainwater harvesting could increase crop production by up to 20% globally and up to 100% in sub-Saharan Africa.
- when providing the required amount of fertilizer, water productivity and yields could double in some of the most critical regions.
- economic analysis showed that targeted investments in agricultural research and market access can significantly increase productivity and production, while simultaneously reducing water and land demand, e.g. in the Nile basin.

5) **A combined top-down and bottom-up approach will be required** to assess fully the potentials and tradeoffs for these and other management options in different eco-hydrological and socio-economic contexts. Some tradeoffs have been identified as part of this synthesis, such as reductions in downstream water availability from increasing upstream rainwater harvesting, or the effects of continued overexploitation of groundwater. But full quantifications and also the identification of critical thresholds are still lacking. These will require the integration of global-scale assessments with local information, e.g. on livelihoods, farming systems, adoption potentials etc. The GWSP Global Catchment Initiative could provide an appropriate framework for this integration.

As a basis for further integrated assessments, a new combined green-blue water scarcity index has been developed, with runoff plus groundwater recharge representing the blue water resource and evapotranspiration (ET) over cropland plus 1/3 of ET over grazing land representing the green water resource.

At the recent WATCH-GWSP workshop in Wallingford, close coordination between GBI and the WaterMIP model inter-comparison was agreed, addressing issues such as:

- more realistic quantification of consumptive blue and green water uses and productivities, based on separate simulations with and without irrigation
- improved simulation of yield losses from dryspells and droughts, as well as yield and productivity gains from (supplementary) irrigation and other water management options
- better definition of the different sources of irrigation water, including not only fossil and renewable groundwater, and wastewater reuse but also water storage, reservoir management and water transfer options
- integration of environmental water requirements
- harmonization of land and water uses, economic and technological development scenarios
- tradeoffs between different water uses

These steps will foster improvements of green and blue water parameterizations across models. Improved simulations of different interventions and their region-specific potential can better inform investment in agricultural water and land management. Also, more realistic assessments of water-related carrying capacities in terms of food production and other ecosystem services will become possible.

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CONFERENCES AND WORKSHOPS

Kyoto conference on hydrological changes

An international conference dubbed as "Hydro-Change 2008 in Kyoto: Hydrological Changes and Management from Headwater to the Ocean" was held from 1–3 October 2008 at Kyoto Garden Palace, Kyoto, Japan. The scientific conference was organized jointly by the Research Institute for Humanity and Nature (RIHN, Japan), the International Association of Hydrological Sciences (IAHS), and the Global Water System Project (GWSP), and co-sponsored by International Association for Headwater Control (IAHC) and European Observation of Mountain Forests (EOMF). Attended by 149 scientists from 22 countries, the event provided a forum for sharing interdisciplinary knowledge and current awareness on integrated water management under pressures from changing climate and anthropogenic activities. A total of 110 papers in 11 sessions, and 50 posters were presented

The scientific sessions of the conference covered topics which included land-atmosphere interaction, land-ocean interaction, groundwater - surface water interaction, headwater studies under climate changes and human impacts, coastal zone and estuary studies, socio-ecological analyses and monitoring of vulnerable water resource, integrated models and management for sustainable uses of water resources, reconstruction of human impacts on the surface and subsurface environments, and other water issues in regions with vulnerable water resources.

The conference provided an opportunity for the scientific community to have a better appreciation and a deeper understanding of the priorities, scales, and skills and even a good indicator of what may be achieved through an international and interdisciplinary research network. Moreover, the forum revealed that there is an urgent need to further promote the integration of environmental and anthropogenic issues in hydrological change studies inasmuch as the climate change and human impact signals are still being addressed separately in large scale and rapid environmental change research. However, the conference also noted that progress had been made towards building greater appreciation of the role of groundwater in surface hydrology from headwaters to the ocean. The integration of socio-economic concerns, the role of various stakeholders from developers, to land and water users, planners and policy makers remains to be enhanced. There is a greater need to better understand the causes and effects of human activities and for hydrologists to appreciate the consequences of their good advice to society and the environment.

The proceedings of the conference featuring 102 selected papers presented covering a wide range of topics have been published in the book edited by M. Taniguchi, W.C. Burnett, Y. Fukushima, M. Haigh and Y. Umezawa, 2009. *From Headwaters to the Ocean: Hydrological Change and Watershed Management* (Taylor & Francis, London, U.K.; 679 pages). The detailed information for each session and session conveners are also described in the official web site of the conference: http://www.chikyu.ac.jp/HC_2008/index.htm.

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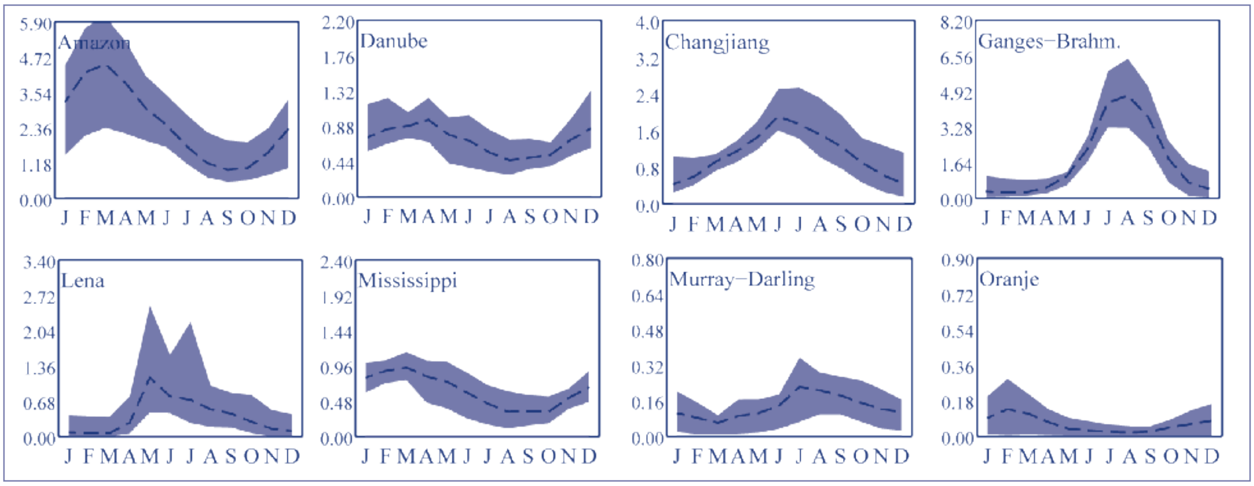
WaterMIP: A multi-model estimate of the global water balance

The Water Model Intercomparison Project (WaterMIP) aims to compare a variety of models of the terrestrial hydrological cycle, and to produce multi-model ensemble estimates of the state of the world's water resources for the 20th and 21st centuries. WaterMIP is a joint activity between the EU FP6 project Water and Global Change (WATCH) and the Global Water System Project (GWSP), and the first workshop was held in Kassel in 2007. WaterMIP now includes both Global Hydrological Models (GHMs) and Land Surface Schemes (LSSs) within Global Climate Models for an enhanced analysis of the global water balance. The main focus is on water resources, and hence the effects of human interventions, e.g. dams and irrigation, will also be included in model simulations.

A WATCH-GWSP workshop was held at the Centre for Ecology and Hydrology (CEH) in Wallingford, United Kingdom, May 27–28, 2009. Around 30 researchers were gathered to discuss the status of the WaterMIP model-

Figure 1: *Mean monthly (1985–1999) basin averaged runoff (mm day⁻¹) for eight river basins. Dashed line shows the mean values of the ten models, while the shaded area shows the range between the models.*



ling effort so far, and how to proceed further. Currently 10 models have submitted results for naturalised runs, i.e. without human impacts, using historical forcing data. The results show a large spread in the resulting water fluxes between the models—see examples in Figure 1—but little systematic differences in the resulting water balance terms between GHMs and LSSs have been found. However, features of individual models can be related to differences in behaviour. Upcoming runs will consider human interventions (e.g. irrigation) and scenarios for the 21st century.

During the workshop, close coordination between WaterMIP and the GWSP global Green-Blue Water Initiative (GBI) was agreed on; see also report on GBI elsewhere in this newsletter. More information and progress on WaterMIP can be found at our website: http://www.eu-watch.org/modelintercomparison.

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Parched soil by the White Nile, Khartoum, Sudan.

Global Environmental Change in the Coastal Zone: a Socio-Ecological Integration

15–19 June 2009, Skjetten, Norway

LOICZ, the Land Ocean Interactions in the Coastal Zone, a joint core project of IHDP and IGBP organized this Dahlem type workshop. An invited group of 41 scientists (among them Janos Bogardi, the new executive officer of the International Project Office (IPO) of GWSP) from different disciplines, representing all continents—and hence coasts— gathered for an intensive meeting without formal presentations but with the firm aim to review the state of the art and identify for the next biennium or so the challenges and scientific priorities for the coasts. Laurence Mee's umbrella paper *Between the Devil and the Deep Blue Sea: the Coastal Zone in an Era of Globalization* and dozens of background papers were distributed among the participants prior the meeting. Following the model of the Dahlem workshops 4 working groups reviewed:

1. Coastal Innovation: New Methods and Solutions that Integrate Positive Adaptation
2. Fractal Coastal Futures: Emerging Global Trends
3. Scales of Critical Change in the Coastal Zone
4. The Role of Governance in the Coastal Zone

Members of the different working groups could migrate and participate in other sessions. Discussions and problem mapping sessions were skillfully steered gradually to become real workshops where senior scientists sat side by side and started to write in awesome silence the "mosaics" of an emerging compendium and science policy book. Among possible future governance needs a gamut of proposals was considered at different scales. As to effective communication and transfer of science results, the idea of an Intergovernmental Panel on Coastal Zone Security (IPCZS) was floated. Motivated by the success of IPCC, IPCZS could explore how to raise awareness for a landform/seascape and its manifold threats.

LOICZ, like GWSP, is challenged to communicate knowledge-based information about their respective areas of scientific mandate to policy makers and to politicians. Adaptation research is a crucial issue for both of us. Given that the terrestrial part of the hydrological system is probably the most efficient agent to link the coastal zone with faraway places, and transport the consequences of unsustainable practices upstream to the coasts, we have a "natural mandate" of cooperation. The new joint publication on the Dynamics and Vulnerability of Delta Systems (see news on the publication and recent LOICZ-GWSP collaboration below) is an important milestone along the long way the two projects have to pass together.

Janos Bogardi
Executive Officer of the International Project Office (IPO) of GWSP

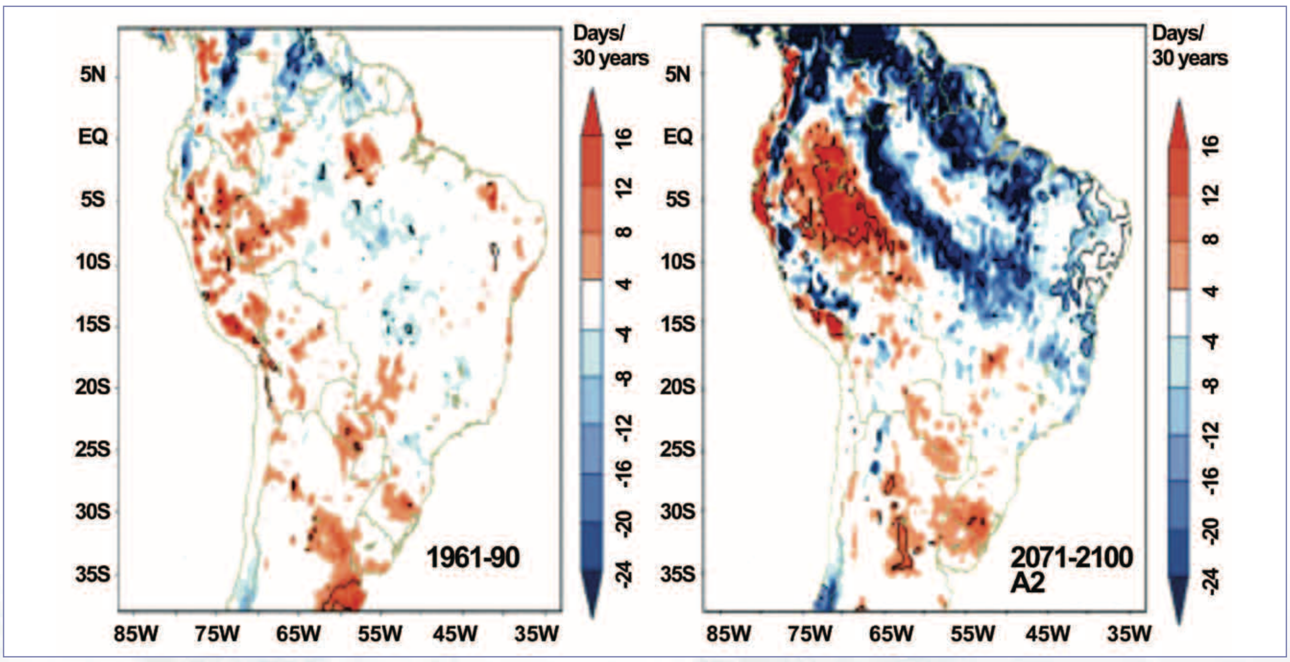
NEWS FROM THE REGIONS

Long term variability and change of rainfall extremes in Southeastern South America

Heavy or extreme precipitation events have important effects on society, since flash floods associated with intense, but often brief, rainfall events may be the most destructive of extreme events. Over many areas the frequency of heavy precipitation events has increased, and extreme rainfall events have affected large cities such as Sao Paulo, Rio de Janeiro and Buenos Aires, resulting in an increase in flooding events during the last 50 years. Such changes in extremes have impacts on human activities: agriculture, human health, urban development and planning and water resources management. Almost 120 people died as a consequence of intense rainfall and land slides that affected the city of Blumenau, in southern Brazil, and economical losses were of the order of US $ 350 million dollars. An expected consequence of global warming is an intensification of the hydrological cycle. In very broad terms, this would be expected to increase the frequency and intensity of extreme rainfall events. If no adaptation measures are taken, this increase in extremes may imply in huge economical losses.

Dynamical downscaling for climate change scenarios in South America has been developed and indices of rainfall extremes have been used in projections for 2071-2100, using the HadRM3P regional model. For the present, the broad spatial pattern of observed trends in indices of ex-

Figure 1: *Simulated trends of extreme rainfall index R10 for 1961–1990 (left). The trend is assumed as linear and represents the values of 1990 minus 1961, in days/30 years. Projections for the A2 scenario (right side) for 2071–2100. Color scale is shown on the right side of the simulated indices maps. Black line delineates areas where the linear trend is statistically significant at 5% level using the Student's t-test. This figure is available in color online at www.interscience.wiley.com/ijoc*



tremes, such as R10mm (number of days with rainfall above 10 mm) is well simulated by the model, with positive trends in large regions of Southeastern South America and negative trends around 40°S in Chile. The trends are consistent between observations and simulations in northern Argentina, Uruguay and parts of Paraguay where they are generally increasing.

In the climate response to global warming projected by the HadRM3P model, the R10mm projections suggest increases in the frequency and intensity of extreme rainfall events in western Amazonia, the northern coast of Peru and Ecuador and in southeastern South America, being higher for the A2 high emission scenario. The projected trends in Southeastern South America show basically a continuation and intensification of the positive rainfall extreme trends detected during the second half of the XX Century.

A major objective of analyzing HadRM3P simulations of extreme climate events under past and possible future emissions is to provide projections of future regional extreme climate events that could be used in impact studies in South American countries. The HadRM3P model was run under the Project MMA/BIRD/GEF/CNPq (PROBIO Project), the Brazilian National Climate Change Program from the Ministry of Science and Technology MCT, the UK Global Opportunity Fund-GOF Project Using Regional Climate Change Scenarios for Studies on Vulnerability, endorsed by the GWSP.

Further reading

Marengo, J, A, Jones, R., Alves, L., Valverde, M., 2009: Future change of temperature and precipitation extremes in South America as derived from the PRECIS regional climate modeling system, *Int. J. Climatol*. Published online in Wiley InterScience (www.interscience.wiley.com) DOI: 10.1002/joc.1863

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GWSP-ANSO Research Work and Activities

For the Asian Network Science Office in Beijing, evaluating climate change impacts on water resource projects and water resource planning are key issues, as are the new challenges posed by investing for planning and managing water resources. Recent research activities include a project—*Screening for Climate Change Adaptation: Managing the potential impacts of climate change on the water sector in China"* supported by cooperation between the Climate Change Coordination Committee Office of the NDRC and DFID China, the Institute of Geographic Science and Natural Resources Research (IGSNRR), Chinese Academy of Sciences and Institute of Development Studies, University of Sussex. This project utilised case studies to test a framework for screening projects for climate change impacts and adaptation options. The four case studies included: flood control and land drainage management in the Huai river basin; water management of Miyun Reservoir; integrated water and environment management in the Haihe river basin; and an integrated restoration plan for the Shi Yang river basin.

Climate change impacts on the water resources of main rivers in China is also the topic of a book, supported by Chinese Academy of Sciences—*Water Resources Vision in China*—that reports research results on the most sensitive and vulnerable regions and on calamities of flood and drought, food safety, South-to-North Water Transfer, glacier shrinking, effects on society and economy development and adaptation Regions covered include the North China plain, Yellow River Basin and Cold & arid regions.

Other research activities in China include a project from national MoST designed to answer important scientific questions on adaptation to climate change in the context of national needs for water resources. International cooperation continues in the form of activities such as the China-Australia water resources workshop, and a China-Dutch water workshop which has been held for discussing cooperation on common water resources problems and themes of research projects.

The head of GWSP-ANSO, Prof. Xia Jun, participated in work on climate change in Yellow River Basin (YRB) as part of the EU-China River Basin Management Program. A field trip and investigation of head water area was completed. Major emerging issues include:

1. While air temperature increase in the past and future is certain, the impact of climate change on hydrological processes (such as precipitation, evapo-transpiration, surface water and ground water), particular on water resources in YRB, will be uncertain. This issue needs special attention in relation to sustainable water use, water resources re-planning, water project design and operation in middle and long term, and social and economic sustainable development.
2. The YRB is the 2nd largest river basin in China, and the impact of climate change on its water resources will be very complex. The EU-China project selected key representative areas for research focus: the water sources areas in upstream areas, the so-called "Yellow River water tower' which is the source of almost 40 % total runoff in whole basin: the middle stream

which are prone to erosion and heavy rain; and the downstream with its wetland eco-system at the river mouth and susceptible to sea level rise.

3. The project is initiating a rapid assessment analysis of climate change scenarios, for which downscaling is important because GCMs have too low resolution to be directly used in the YRB water impact assessment. The scenarios will be integrated scenarios: that include both climate variables and scenarios for relevant socio-economic development.

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ANNOUNCEMENTS

IPO News

New GWSP Executive Officer

Prof. Janos J. Bogardi took up the position of Executive Officer on 1 June 2009. His first degree was in Civil Engineering at the Technical University of Budapest, Hungary, with special emphasis on water resources and agricultural water resources development. After obtaining a post graduate Diploma on Hydrology from the University of Padua, Italy, he earned his PhD in Civil Engineering at the University of Karlsruhe, Germany. Early in his career he worked as a consulting engineer in Africa and was seconded by the German Agency for Technical Co-operation (GTZ) to the Asian Institute of Technology (AIT) in Bangkok, Thailand for several years.

He was Professor for Hydraulics, and quantitative Water Resource Management Hydrology at the Agricultural University of Wageningen, the Netherlands, then worked with the United Nations Educational Scientific and Cultural Organization (UNESCO) in Paris, France, ultimately as the Chief of the Section on Sustainable Water Resources and Management. He was then appointed Director of the United Nations University–Institute for Environment and Human Security (UNU-EHS) in Bonn, Germany and has been Vice-Rector a.i. of the Vice Rectorate of UNU in Europe (UNU-ViE) since May 2007.

Prof. Bogardi has authored, co-authored, and edited more than 170 publications. He has been awarded honorary doctorates by universities in Hungary, Poland and Russia. In June 2008, he was honored by the International Cannes Water Prize "Grand Prix des Lumières de l'Eau de Cannes".

Janos brings to the GWSP a wealth of international experience and a wide knowledge of water issues.

Janos Bogardi
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New Scientific Officer

We are pleased to announce the appointment of Dr. Konrad Vielhauer as Science Officer at the International Project Office of GWSP in Bonn. Dr. Vielhauer is a tropical agronomist by training and has obtained his doctorate degree from the University of Göttingen, Germany. He specialized in soil microbiology then later worked on the soil physical problems of fallow management systems in southern Nigeria, where he worked at the IITA. Subsequently he moved to the Eastern Amazon region, Brazil to work in a collaborative project with the Brazilian Agricultural Research Corporation (Embrapa) on fallow management systems replacing slash-and-burn by a chop-and-mulch technology. Before joining the GWSP he occupied the position of research center manager and scientific coordinator of the GLOWA-Volta project in Burkina Faso as which was hosted at the Center for Development Research (ZEF) of the University of Bonn in collaboration with the newly founded Volta Basin Authority (VBA). After establishing a small reservoir agricultural irrigation scheme in the southwest of Burkina Faso his most recent work was designed to help build up the VBA Observatory with research results and products developed by the GLOWA-Volta project in order to enhance transboundary integrated water resources management in the Volta basin.

Konrad has substantial experience in coordinating scientific projects and in organizing international conferences. His main task at the IPO will be to coordinate GWSP's activities in support of the executive director.

Konrad Vielhauer
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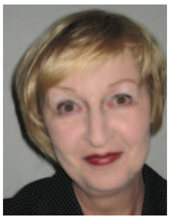
New Administrative and Finance Officer



Gisela Ritter-Pilger joined the GWSP IPO on June 1, 2009 after working at the ZEFb secretariat since 1998. Before that she worked in the German Foreign Office in Hanoi and at the OECD in Paris. Gisela looks after our general administration, including our financial matters. In particular she will apply her extensive international experience in administration to handle logistic and organizational matters at conferences and workshops.

Gisela Ritter-Pilger
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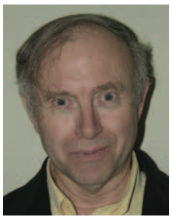
New SSC members

David Dudgeon has worked at the University of Hong Kong for over 25 years, and was awarded the Biwako Prize in Ecology (2000). He is the author of over 150 articles in international journals and numerous book chapters dealing with the ecology of streams and rivers in tropical Asia, and the conservation of freshwater biodiversity. His books include *Tropical Asian Streams* (1999), *The Ecology and Biodiversity of Hong Kong*, and an edited collection, *Tropical Stream Ecology* (2008). Dudgeon sits on the editorial board of several international journals, and is a member of the Freshwater Cross-cutting Network of DIVERSITAS.



Rick Lawford, the former Director of the International GEWEX Project Office, currently is based at the University of Manitoba in Winnipeg, Manitoba, where he serves as the Network Manager for the Canadian Drought Research Initiative, an adviser to GEWEX (through the University of Maryland, Baltimore County) and a GEO Consultant on water cycle activities. Previously, he worked in NOAA as a manager for the GEWEX Americas Prediction Project (GAPP) and other GEWEX activities. He also occupied a number of positions in the Canadian government, primarily with Environment Canada in program management and research in the fields of hydrology, hydroclimatology and meteorology.

Johan Rockström is the Executive Director of the Stockholm Environment Institute (SEI) and the Stockholm Resilience Centre, is a Professor in Natural Resource Management at Stockholm University, and a guest Professor at the Beijing Normal University. He works on global environmental change, resilience and sustainability, agricultural water management, watershed hydrology, global water resources and food production, and eco-hydrology, and is a frequent key-note speaker in several international research, policy and development arenas. He is on the scientific advisory board of the Potsdam Institute for Climate Impact research, the scientific overview committee of ICSU, the executive board of the Resilience Alliance, and the board of WaterAid Sweden.

Other news from the GWSP Scientific Steering Committee

We are pleased to advise readers that **Joseph Alcamo**, Co-Chair of the GWSP SSC has been appointed Chief Scientist for the United Nations Environment Program., and responsible for the scientific direction of the organization. We are expecting that this will be a good chance for the GWSP to boost its connections to the policy community. In order to bring some of his GWSP initiatives to fruition, Joseph plans to remain Co-Chair for the time being.

Co-Chair **Charles Vörösmarty**, after more than 30 years as a researcher at the University of New Hampshire, has accepted a Professorship in the Civil Engineering Department at The City College of New York in September 2008. City College is a part of the larger City University of New York, for which he will serve as founding Director of the CUNY Environmental Cross-Roads Initiative. He has also been named NOAA-CREST Distinguished Scientist. Vörösmarty and his group at The City University of New York will serve as a node in a U.S. contribution to UNESCO's International Hydrological Programme through the International Center for Integrated Water Resources Management (ICIWaRM) led by the US Army Corps of Engineers' Institute for Water Resources.

SSC member, **Stuart Bunn** was recently appointed as a National Water Commissioner (www.nwc.gov.au). He also has recently become the convener of the "Water resources and freshwater biodiversity network" for the Australian National Climate Change Adaptation Facility (www.nccarf.edu.au). The network brings together scientists (from over 20 Australian universities and research organizations) and stakeholders with an interest in the impacts of climate change on surface water and groundwater inland aquatic and semi-aquatic ecosystems, the associated social and economic impacts of changed water regimes due to climate change, and potential adaptation strategies.

Other News

Publication on Deltas at Risk

A joint collaboration of LOICZ and GWSP (led by SSC co-chair Charles Vörösmarty) has continued its work started in 2007, resulting in a publication (see below) from the major science and technical workshop held in Boulder, Colorado (USA) in September of that year. The overall theme explores the scope and degree to which the world's coastal delta systems are made vulnerable and placed under risk as a consequence of global change. The effort has been unique in that it has united both freshwater upland and coastal/ocean perspectives. The publication documents evidence that the world's coastal zone is increasingly being placed into risk, surprisingly as a consequence of multiple upstream (as opposed to ocean sea level rise) impacts. Decisions made with regard to water resource management, often 100s if not 1000s of km upstream, such as irrigation and dam construction, trap or divert the riverine sediments needed to maintain the integrity of these coastal systems. Many of the mega-cities of Asia, for example, are growing rapidly in these environments and many are already suffering an acceleration in the apparent rate of sea level rise well in excess of the global average---these deltas are sinking.

Overeem, I. & Syvitski, J.P.M. (eds) (2009): *Dynamics and Vulnerability of Delta Systems. LOICZ Reports & Studies No. 35*. GKSS Research Center, Geesthacht, Germany

CALENDAR

World Water Week 2009—Responding to Global Changes: Accessing Water for the Common Good with Special Focus on Transboundary Waters

16–22 August 2009

Venue: Stockholm International Fairs (Stockholmsmässan) in Älvsjö, Stockholm, Sweden

http://www.worldwaterweek.org/

6th International Scientific Conference on the Global Energy and Water Cycle—Water in a Changing Climate: Progress in Land-Atmosphere Interactions and Energy / Water Cycle Research

24–28 August 2009

Venue: Sofitel Melbourne hotel, Melbourne, Australia

http://gewex.org/2009gewex_ileaps_conf.html

22nd IGBP-SC Officers Meeting

21–23 September 2009

Stockholm, Sweden

Type of conference: By invitation

IGBP and Royal Swedish Academy of Sciences Symposium, Planet under pressure: global changes, regional challenges

24–24 September 2009

Stockholm, Sweden

Type of conference: Open

DIVERSITAS projects and networks SC meetings

11–12 October 2009

Capetown, South Africa

Type of conference: By invitation

GLOWA—National conference of GLOWA Danube and GLOWA Elbe

12–14 October 2009

Potsdam, Germany

http://www.glowa.org/de/konferenz_potsdam/konferenz_potsdam.php

DIVERSITAS OSC2—Second DIVERSITAS Open Science Conference—Biodiversity and society: understanding connections, adapting to change

13–16 October 2009

Venue: CTICC, Cape Town, South Africa

Following up on the First DIVERSITAS Open Science Conference "Integrating biodiversity science for human well-being" (9-12 November 2005, Oaxaca, Mexico), and in order to provide in-depth overviews of a broad range of topics in biodiversity research and initiate biodiversity research projects around the world, DIVERSITAS announces its Second Open Science Conference: Biodiversity and society: Understanding connections, adapting to change. The conference will be held shoulder to shoulder with the Science Steering Committee meeting of the Global Water System Project (GWSP-SSC).

http://www.diversitas-osc.org/

Type of conference: Open

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The Global Water System Project (GWSP) is a Joint Project of the Earth System Science Partnership (ESSP) consisting of four Global Environmental Change Programmes: the International Geosphere-Biosphere Programme (IGBP), the International Human Dimensions Programme on Global Environmental Change (IHDP), the World Climate Research Programme (WCRP) and DIVERSITAS, an international programme of biodiversity science. The *overarching question* of the GWSP is how human actions are changing the global water system and what are the environmental and socio-economic feedbacks arising from the anthropogenic changes in the global water system.

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Earth System Science Partnership

DIVERSITAS an international programme of biodiversity science

GLOBAL IGBP CHANGE

WCRP World Climate Research Programme

IHDP International Human Dimensions Programme on Global Environmental Change