The Belmont Challenge: A Global, Environmental Research Mission for Sustainability

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1. EXECUTIVE SUMMARY

In 2009, the world's main funders of environmental change research formed a new, high-level group called the Belmont Forum. Its aim is to mobilise international resources at a scale that matches the challenge from global environmental change, in order to catalyse delivery of the environmental science-derived solutions that society needs.

This paper sets out the Belmont Forum's vision, at this time, for the priority knowledge, capabilities, underpinning research and organisational mechanism needed to deliver effective solutions to the challenges of global environmental change. Our vision provides a basis for research funders to broker new partnerships with international stakeholders from the science community, operational service providers and users, to align and mobilise our collective resources and expertise toward a global environmental research mission for sustainability.

Our vision seeks to add value to strategies that are currently evolving within the environmental change research and operational service provider communities. As public sector funders of research we can offer a perspective from the nexus of research and government, from which it is clear to us that: (i) the priority research challenges should be those that deliver welfare and economic benefits to society both today and tomorrow, and (ii) that true and effective partnerships between funders, researchers, operational service providers and users will be essential for success.

The Challenge

In recent decades Earth System science has provided society with a valuable, basic understanding of the environment and human society as interconnected systems; namely, how humans are changing the global environment, and how these changes may affect human well-being. If society is to address environmental change in the 21st century, our current knowledge must be built upon now, to improve our understanding of the impacts, vulnerabilities and risks of environmental change, in order to enable us to develop adaptation and mitigation strategies as well as to benefit from opportunities in an environmentally sustainable manner. To be most valuable, this knowledge must be provided on time and space scales that enable effective decision-making and support equitable economic and social development. To describe this need, The Belmont Forum has established the following 'Belmont Challenge':

> ***To deliver knowledge needed for action to mitigate and adapt to detrimental environmental change and extreme hazardous events.***
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> *This requires:*
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> - *Information on the state of the environment, through advanced observing systems;*

- *Assessments of risks, impacts and vulnerabilities, through regional and decadal analysis and prediction;*
- *Enhanced environmental information service providers to users;*
- *Inter- and transdisciplinary research which takes account of coupled natural, social and economic systems;*
- *Effective integration and coordination mechanisms, to address interdependencies and marshal the necessary resources.*

With priority foci being:

- *Coastal Vulnerability;*
- *Freshwater Security;*
- *Ecosystem Services;*
- *Carbon Budgets;*
- *Most vulnerable societies.*

The Response

Meeting the 'Belmont Challenge' requires a profound change to the way we support and undertake global environmental change research. With this document, the Belmont Forum seeks to provide, from the research funders' point of view, the priorities for knowledge and capabilities, and associated research and observations, around which international resources for research must urgently be coordinated. We outline an overarching framework, *Earth System Analysis and Prediction System (ESAPS)*, to integrate and catalyze these priorities into a seamless, holistic environmental decision-support system.

The proposed framework is comprised of ideas for:

- Systematic targeting and integration of observations and research to overcome critical limits to predictions
- Overarching strategic governance to establish key priorities among competing demands and promote cooperation;
- A greater voice for users in informing the research priorities;
- A step-change increase in collaboration across scientific disciplines, especially those between the natural and the social sciences and geographical areas;
- A profound increase in collaboration across geographical regions with a special emphasis on enhancing scientific capacity in developing countries; and
- Improved mechanisms for major transnational funding that overcome current constraints to cross-border support while respecting national requirements and statutes.

Recently, in addition to the to the Belmont Forum effort, several other initiatives to generate potential mechanisms to effectively address these crucial challenges and catalyse organisational change have been embarked upon by the international operational service provider and research communities. We propose that these initiatives programmes be drawn together into a high-level joint strategic task force. This task force would, over the next 1-2 years, design and secure the necessary partners and support for a 10 year research mission that would address the Belmont Challenge.

2. INTRODUCTION

This White Paper sets out the perspective of many of the world's major environmental research funding agencies, at this point in time, on the 'grand challenges' for global change research that need to be delivered over the next 10-20 years, to achieve sustainability. The scale of the challenges requires a profound change in the way research is organised, with a partnership approach across international funders, researchers, operational service providers (including meteorological services and development agencies) and users from government, business and civil society, to mobilise and coordinate the resources necessary for an environmental research mission for sustainability. The perspectives set out in this paper will provide the basis for funders to engage with partners to catalyse a collaborative response to these challenges.

The paper considers:

The Challenge:

- The critical environmental and socio-economic-science derived knowledge and capabilities that society needs to respond appropriately to the threats and opportunities precipitated by environmental change in the 21st century, which we articulate as the 'Belmont Challenge'

The Response:

- The pivotal research challenges that need be met to provide this knowledge and capability. The focus is explicitly on interventions that require global-scale international cooperation, are solutions-focused, and integrate observations, prediction and knowledge platforms, and
- The key requirements of a Roadmap to deliver this transformative international research agenda, focusing on stronger partnerships between funders, providers and users of research, coupled with appropriate prioritisation.

3. THE CHALLENGE

The 21st century need for science-based solutions

In recent decades, Earth System science has provided society with a basic understanding of the environment and human society as interconnected systems. It has started to generate understanding of how human actions are changing the global environment and predictions of how these changes may affect future human well-being. We know that humankind is pushing important environmental variables on which we depend (climate, freshwater, biodiversity, and elemental cycles) outside the stable boundaries that they have exhibited over the last 10,000 years. This period, the 'holocene' is the one during which human society has evolved and prospered[1]. There is no doubt that our current path is unsustainable. Evidence is emerging that the rate and magnitude of anthropogenic environmental change is moving towards states beyond our ability to control or adapt to it [2]. The Global Environmental Change programmes (IGBP, WCRP; IHDP, DIVERSITAS and their partnership programme

ESSP[a]) coordinated under the auspices of ICSU, and international observational programmes (such as GCOS, GEO/GEOSS) have played an important role in directing, synthesizing and communicating research to promote this improved understanding of global environmental change.

The information that society needs now, in the 21st Century, to respond to the challenges of global environmental change, must build on this basic and global-scale understanding to provide science-based solutions for adaptation and mitigation. Society needs critical information about interconnected environmental and societal risks and how to manage them, including how to protect life and property, make decisions about trade-offs between different socio-environmental management options, and transition to sustainable economies. This will require science-based knowledge about the impacts of global environmental change at the scales at which decision-makers operate – a particular priority is to provide assessments of global environmental change impacts, at regional and decadal scales. To maximise benefit to policy and business, provision of this information will need to be co-designed in partnership with influential societal decision-making systems, internationally and at regional scales. The UN Intergovernmental Panel on Climate Change (IPCC), Global Energy Assessment (GEA) and Intergovernmental Platform on Biodiversity and Ecosystem Services (IPBES) provide models for such engagement.

By providing the foresight and insight to enable innovative technical and societal solutions to environmental change, research will drive opportunities for equitable economic and social development. These will include:

- Enabling effective transitions to low-carbon, resource-efficient economies, through assessing whole-system impacts and trade-offs for innovation options in sectors such as energy, agriculture, water and waste,
- Providing an evidence base for development, auditing and regulation of new markets for trading ecosystem services, such as carbon sequestration, nitrogen fixation, water purification, etc.,
- Monitoring and forecasting to protect property and infrastructure, reducing economic losses from damage and degradation and providing confidence for investment,
- Improving health and well-being through reduced vulnerability to natural hazards and pollution, and
- Lifting people out of poverty through supporting innovative sustainable development pathways towards Millennium Development Goals

Providing the knowledge, predictions and decision-support tools, with the required urgency, is an enormous intellectual and technical challenge. Understanding the interconnectedness of the 'Earth System' across its physical-chemical-biological- -societal dimensions and across spatial and temporal scales, and leveraging this understanding to predict changes and inform behaviours and decisions, will require

[a] IGBP = International Geosphere-Biosphere Programme; WCRP = World Climate Research Programme; IHDP = International Human Dimensions Programme: DIVERSITAS = an international programme of biodiversity science; ESSP = Earth System Science Partnership; GEOSS = Global Earth Observing System of Systems; GEO = Group on Earth Observations; GCOS = Global Carbon Observing System; ICSU = International Council for Science).

interdisciplinary conceptual frameworks of enormous complexity. Understanding what environmental information is most crucial to know, and what measurements, technologies, and models are needed for this, is a significant challenge in its own right. Delivering the required data collection and provision, modelling and stakeholder engagement will require a step-change in technical capabilities (particularly in high-performance computing, data management, sensor technologies, and interactive communication tools). It will also require investing in the process of translating and communicating new scientific knowledge; creating a "safe, authorized space" for routine dialogue between stakeholders and researchers. These are 'Grand Challenges' and their scale will require a profound change in our approach to prioritising, funding and conducting research. Specifically a step change in collaboration will be required: Collaboration across national funding agencies to co-ordinate resources and conduct research of the scale and complexity that no single nation can achieve alone; Transdisciplinary collaboration to address the coupled environmental and socio-economic solutions to environmental change; and collaboration between research and operational service providers to deploy resources efficiently and accelerate pull-through of research to users.

International research and meteorological service communities have recently described their priorities for 'grand challenge' research for sustainability. For example:

- Grand Challenges in Earth System Science for sustainability, a report by ICSU as part of its ongoing visioning process[2]
- "Regional Environmental Change: Human Action and Adaptation – What does it take to meet the Belmont Challenge"[3] – a report of an ICSU Panel commissioned by the Belmont Forum of Environmental Change Funding Agencies,
- Developing a common strategy for integrative global environmental change research and outreach: the Earth System Science Partnership[4] – a strategy paper of the ESSP,
- A Safe operating space for humanity[1] – coordinated by the Stockholm Resilience Centre,
- WMO Third World Climate Conference – Declaration to Establish a Global Framework for Climate Services (September 2009), and
- Special Issue of the Bulletin of the American Meteorological Association: Putting it All Together – An Earth System Prediction Initiative (October 2010). [5],
- Lessons Learned from IPCC AR4: Scientific Developments Needed to Understand, Predict and Respond to Climate Change [6]

There is considerable alignment among these analyses and visions. In particular around the need for:

- Improved forecasts of regional and decadal scale changes that fully take into account coupled socio-environmental systems – requiring a suite of integrated Earth System Models,
- Observations of the Earth system that can validate models, provide early warning of change and support decision making - requiring advanced observing systems that integrate environmental and socio-economic data, quantitative and qualitative data, and historical and contemporary data and are

at a high-enough resolution to detect systematic change and capture extreme events,

- Knowledge of 'tipping points' (critical thresholds at which rapid, non-linear environmental change will occur that will disrupt wellbeing of society), our proximity and vulnerability to them, and strategies for avoiding, adapting and enhancing our resilience to them – requiring integration of environmental and complexity science, and of 'impact' and 'response' research,
- Knowledge of technical and socio-economic innovations that can overcome barriers to sustainability, likely to include options for international trade in the Earth System – requiring highly integrative and synthetic science, and comparative assessments of whole-system and whole-life-cycle environmental impacts and trade-offs for different options, and
- Knowledge platforms – two-way information and communication tools that support the needs of sectors such as agriculture, energy, insurance, health, transport, etc. for information on forecasts, impacts, vulnerability and adaptation – will require a step-change in science-society bridging activities and capabilities, including mechanisms to enable science to be directed in response to user-identified needs.
- Co-design of research agendas among stakeholders - connecting scientific, economic and social development agendas in directing and benefiting from research.

The existing Global Environmental Change Programmes, each undertake research relating to these needs, and frequently do so in partnership with users, especially from intergovernmental bodies, such as the Intergovernmental Panel on Climate Change (IPCC), United Nations Environment Programme (UNEP), and World Meteorological Organisation (WMO). However, it is recognised by research providers and funders alike that the impact of the programmes may be limited by their current organisation, which has evolved in an opportunistic and fragmented way. Intervention to promote strategic overarching direction and prioritisation, and integration across structural borders, is needed, if we are to target the available resources more effectively to meet the 'grand challenges'.

The Funders' perspective: 'The Belmont Challenge'

Funders of environmental research are part of the equation for realising a research mission for sustainability and are keen to see the enhanced level of coordination needed. In July 2009, the world's major funders of environmental change research, and major international science councils, met at Belmont House, Maryland USA, to consider how best to align financial and human capital towards delivering the environmental science knowledge base that society will need in the 21st century. The group decided to continue as a high-level but informal body that can take decisive action about allocation of significant resources for environmental change research. It has become known as the 'Belmont Forum[b],[c]' .

[b] The Belmont Forum members include principals of the following organisations: Department of Climate Change (Australia); Ministry for Education Science and Research (Austria); São Paulo Research Foundation (FAPESP) (Brazil); Natural Sciences and Engineering Council (Canada); Canadian Foundation for Climate and

As funders, the Belmont Forum, does not seek to introduce an additional or alternative vision into the mix of strategies emerging from the global environmental change research community, described above. We seek to add value to them by contributing a funders' perspective on how emergent 'grand challenge' research might be prioritised and organised, to maximise the impact of, and potential for, sustainable, international support of the magnitude required. We offer this perspective as agencies that, operating at the nexus of research and government, are responsible for prioritising investment of public money towards research approaches that can deliver the greatest welfare and economic benefits to society both today and tomorrow. It is clear to us that: (i) the priority research challenges should be those that deliver welfare and economic benefits to society, and (ii) real partnership between funders, researchers, operational service providers and users will be essential for success. In other words, the international global change research community must 'seal' the contract with society, first proposed by Jane Lubchenco[6] in 1998.

The Belmont Forum has set out in the 'Belmont Challenge' its view of priorities for knowledge and capability in the 21st century, around which international resources for research must most urgently be coordinated. The Belmont Challenge takes account of the strategic visions set out by international research communities described above, as well as our organisations' own strategic priorities, as informed by our research communities, our governments and our stakeholders in business and civil society. Our priorities are in broad agreement with the analyses of the world's major scientific programmes and councils.

The Belmont Challenge is:

> ***To deliver knowledge needed for action to avoid and adapt to detrimental environmental change and extreme hazardous events.***
>
> *This requires:*
>
> - *Assessments of risks, impacts and vulnerabilities, through regional and decadal-scale analysis and prediction,*
> - *Information on the state of the environment, through advanced observing systems,*
> - *Enhanced environmental information service provision to users*

Atmospheric Science; National Natural Science Foundation of China; Agence Nationale de la Recherche (France); Agence Nationale de la Recherche (France); Centre National de la Recherche Scientifique (France); European Commission; Deutch Forschungsgemeinshaft (Germany); Federal Ministry of Education and Research (BMBF) (Germany); Ministry of Education, Culture, Sports, Science and Technology (MEXT) (Japan); Ministry of Earth Sciences (India); Rsearch Council of Norway; National Research Foundation (South Africa); Natural Environment Research Council (UK); National Science Foundation (USA); International Council for Science; International Social Science Council).

[c] The Belmont Forum operates as the Council of Principals for the ongoing, and broader, International Group of Funding Agencies for Environmental Change Research (IGFA).

- *Inter- and transdisciplinary research which takes account of coupled natural, social and economic systems*
- *Effective integration and coordination mechanisms, to address interdependencies and marshal global resources*

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With priority foci being:

- *Coastal Vulnerability*
- *Freshwater Security*
- *Ecosystem Services*
- *Carbon Budgets*
- *Most vulnerable societies*

4. THE RESPONSE

Critical Interventions

In the following discussion, (a) – (d) below, we suggest priorities for predictions, observations, information services and integrating capabilities needed to meet the Belmont Challenge, and some of the pivotal research and capacity-building challenges needed to get us there. The priorities listed are not exhaustive. Conspicuously, for example, details of the socio-environmental research dimensions are lacking, as is information on the extent to which the priorities can be met through improved coordination of existing capability or where investment in new capability is required. Further development and prioritisation should take place as part of the Roadmap described at the end of this paper, where we will fully encourage the participation of the international science community, operational service providers (including meteorological services and development agencies) and users from government, business and civil society.

a) <u>Information on the state of the environment through advanced observing systems</u>: to verify the accuracy of predictions, assess proximity to disruptive change and monitor the effectiveness of adaptation and mitigation strategies.

Priorities will include observing systems that provide:

i. Data and knowledge to improve, verify and refine model predictions at regional and decadal scales,

ii. Data and knowledge to assess proximity to disruptive tipping points to identify vulnerable regions/societies, provide early warning of disruptive change (e.g. Extreme hydro-meteorological events, disruption of ecosystem services, etc.), and inform avoidance/adaptation strategies, and

iii. Monitoring of stocks and fluxes of key environmental change variables (e.g. carbon, nitrogen, water, deforestation, groundwater) for long-term survey, and to support markets and regulation.

<u>Underpinning Research Challenges</u>

There is a need for linked sensors, data preservation and information systems prioritised on environmental and socio-economic variables that characterise dynamics and vulnerabilities of regions and systems.

Data/information systems must be accessible, with a range of data products and visualisation tools for non-specialists and linked with decision-making systems.

To maximise efficiency of existing capability, there is a need to improve coordination between existing observational and data systems, and between academic and operational systems. Major international programmes aimed at improving effectiveness and coordination of global and regional monitoring systems (e.g. GEOSS; ICSU World Data Systems, WMO) will be important partners.

b) <u>Predictions of risks, impacts and vulnerabilities through regional and decadal analysis and prediction</u>: To provide foresight about changes in the Earth System, which takes full account of societal interactions and focus on changes that may cause abrupt and potentially irreversible and disastrous changes

Priorities will include developing predictive capabilities for:

i. The likelihood and severity of extreme hydro-meteorological events and related geohazards, and their impacts on human socio-economic systems in a given geographical region, from seasons to decades, under different greenhouse gas emission and land-use scenarios,

ii. Likelihood of biodiversity loss that will compromise provision of essential ecosystem services for a given terrestrial, freshwater or marine region, under given climate and management scenarios, and

iii. Predictions of the environmental and health impact of changes to other biogeochemical cycles (e.g. nitrogen, phosphorous) or to increased loadings of toxic pollutants

<u>Underpinning Research Challenges:</u>

We agree with the consensus view of the international science communities, that there is the need for convergence around limited number of Earth System models (whilst also recognising the need for maintaining an appropriate level of model diversity), which can then be developed into a hierarchy of models with regional capability. To evaluate impacts the models (and associated observations) must have the capability to analyse and predict the coupled meteorological, biological, biogeochemical, hydrological, geological, and socio-economic processes. Developing the capability to 'zoom in' and 'zoom-out' between global- to regional-scale assessments will also be critical. To maximise pull through to users, model development and outputs should be linked to decision-making systems.

The modelling studies should focus on the probability of occurrence of future extreme events, the impacts of these on human societies, and consequences (including costs) of different adaptation and mitigation strategies. This will require understanding of

non-linear dynamics and thresholds beyond which systems tip into alternate states. Predictions of impacts and risks that compare and integrate 'bottom-up' approaches (i.e. critical thresholds) and 'top-down' approaches (e.g. downscaling) will be important for providing maximum insight and benefit to users.

c) Enhanced environmental information service provision to users through knowledge platforms: Delivering applied knowledge to support innovative adaptation and mitigation solutions, based on the observations and predictive knowledge outlined in (a) and (b).

These must enable:

i. Interaction with end users to identify what predictive and observational capabilities will bring most effective knowledge for adaptation and mitigation solutions,

ii. Products developed on a regular schedule, tailored to user needs,

iii. Identification of strategies needed to reduce vulnerability to change (mitigation or adaptation),

iv. Comparative analyses (costs and benefits) of different mitigation and adaptation strategies, based on whole-system, whole-lifecycle impacts, vulnerability and risks. Include assessments of the trade-offs and strategies to mange the tradeoffs, and

v. A regular focum for dialogue between researchers and stakeholders: a "safe, authorized space" in which the science and stakeholder communities can interact to better deal with today's problems and better anticipate the issues of tomorrow".

ICSU[2] has identified some priority needs for information on strategies and tradeoffs including: How can global energy security be provided entirely by sources that are renewable and have neutral impacts on other aspects of global sustainability; How can competing demands for scarce land and water be met over the next half-century – while dramatically reducing land use greenhouse gas emissions, protecting biodiversity and maintaining or enhancing other ecosystem services; How can ecosystem services meet the needs for improving the lives of the world's poorest peoples and those of developing regions (such as safe drinking water and waste disposal, food security, and increased energy use) within a framework of global sustainability? What are the potentials and risks of geo-engineering strategies to address climate change?

<u>Underpinning Research Challenges</u>

New information systems and tools to support communication and participatory research approaches between research providers and users are needed. These platforms will need to provide information and services beyond those traditionally provided by national meteorological and environmental services – e.g. to sectors

including agriculture, insurance, investment, health, transport, commerce and manufacturing. The systems will also need to transcend national perspectives and serve global users.

Comparative analysis of different approaches towards risk reduction will require development of risk models, and multi-disciplinary quantitative analysis of their outputs. It will be important to identify any potential unintended consequences of changes. The risk models will need to be able to integrate quantitative and qualitative information.

(d) Development of Integration Mechanisms

The research challenges in (a) – (c) are highly interdependent. Meeting the Belmont Challenge will require much more effective coordination and integration across them than has been achieved to date. Priorities include:

An integrating conceptual framework: This is essential to drive effective coordination and integration of the diverse disciplinary, institutional and financial resources needed to deliver the Belmont Challenge. We suggest an *Earth System Analysis and Prediction System* (ESAPS) as an integrating Framework. A focus on aligning resources towards an holistic environmental change decision-support system would provide a framework for:

- A systematic approach to improving observations, prioritising resources to describe as many components of the Earth System as possible, subject to the constraints of technical (including computational) and human resources available
- Utilising the improved observations and data to overcome critical limits to model predictive capability, in particular through fully-coupled data assimilation system, and re-analysis of the last 50 years as a vital test of the system
- Developing prediction capability with clearly defined scenarios to account for the unknowable (typically human behaviour) elements

together with:

- Identifying key partners (researchers, funders, users, operational service providers) to be engaged,
- Prioritising research challenges within the Belmont Challenge
- Focusing on research, observation systems and knowledge that require global cooperation. (The priority for the Belmont Challenge is to develop the 'zoom capability' to move between global and regional scale assessments. Application of this capability for regionally-focused research is best undertaken by national, regional or local organisations).
- Development of the 'Climate Services' concept into a holistic decision-support system that considers multiple environmental stressors

- **Governance** – An authoritative, international, multi-sectoral partnership, with effective representation from the major stakeholder groups will be critical for

- **Collaborative Research** – a step change in collaboration across disciplinary and geographical boundaries. Interdisciplinary and trans-disciplinary research should couple natural sciences with the full range of socio-economic, humanities, health and engineering sciences. It will require framing environmental change issues in ways that encourage and enable participation of groups other than environmental scientists. Networking existing centres of excellence across regions and disciplines will be important. Such a network would build a focus on interdisciplinary Earth System science, while incorporating regional initiatives. It would provide access to state-of-the-art facilities and training to scientists around the world,

- **Building and Enhancing Capacity in Developing Countries** – to assess regional aspects of global environmental change, impacts and vulnerabilities, and provide information to public and private sector decision-makers there is an enormous need for capacity building in developing countries. Regional networks of partnerships between scientists and institutions from developed and developing countries to conduct research are important and could facilitated through the network of centres of excellence, described above

- **Next Generation Sustainability scholars** - a major and transformative effort will be required to train graduate, doctoral and post-doctoral researchers with the interdisciplinary, cross-sectoral skills needed to address context-specific problems of sustainability. Academic careers need to be restructured so that the reward and progression systems support such grand-challenge oriented research.

- **Enhanced mechanisms for transnational funding** – a suite of collaborative tools is needed that overcome current constraints to transnational funding while adhering to national requirements and statutes. These should, span the spectrum of cooperation, from alignment and sharing of national programmes and capabilities to co-design and co-funding of joint programmes and capabilities. The' toolkit' should also benefit from previous experience of 'what works' and 'what doesn't', by taking into account existing models for international cooperation between funding agencies, such as the G8HORCS Joint Calls, the European Joint Programming Initiative and collaborative mechanisms of the European Commission. To take immediate action to accelerate transnational support for the 'priority foci' areas of the Belmont Challenge, the Belmont Forum has identified a limited number of Collaborative Research Actions (Annex I) to improve collaboration between national funding agencies, piloting approaches that could be applied more broadly. We anticipate being able to progress these areas on a 'fast track' because they are closely linked to existing priorities for a critical mass of Belmont Forum funding agencies.

The organisational changes needed to develop the capability for this integration will necessitate a profound change to the current way environmental science is organized and supported. However, a number of initiatives, linked to the strategic visioning activities described above, are beginning to consider and stimulate the appropriate organisational changes needed to achieve the goals of the Belmont Challenge. These include: Strategic alignment of funding agencies through establishment of the Belmont Forum; The Global Environmental Change Programme's analysis of new institutional frameworks required for global sustainability research, led by ICSU [(2)]; and the WMO High Level Task Force that is developing an Implementation Plan for a Global Framework for Climate Services[(7).]

5. ROADMAP

The Belmont Forum proposes that a high-level, **joint strategic task force**, with representation from across the major stakeholder groups (research providers, research funders, government, business and civil society) is established as an over-arching governance mechanism to drive forwards the integrated, global research mission for sustainability set out under the Belmont Challenge. Such a task-force is consistent with a proposal discussed by global environmental change programmes and funders as part of the ICSU Visioning process in June 2010 [(2)]. We consider it essential that only one such group is established, and that it is developed jointly by the global Environmental Change funding, research, and operational service provider communities, in partnership with other users of global change research. Organisations that represent each of these communities (e.g. The Belmont Forum, ICSU, ISSC and WMO) would be represented in the overarching task force, and play a vital role in informing priorities and facilitating action.

Over the next 1-2 years, this task force would develop a comprehensive, strategic **Roadmap** for supporting and delivering the 'grand challenge' research needed over the next 10-20 years. The strategic task force would draw the stakeholder communities together to: establish the research priorities; secure political and financial support, including restructuring the international funding landscape to better support an integrated research system; promote the integration of existing research programme structures into more streamlined systems; commission the most appropriate research structures to deliver the research; and build the necessary linkages with decision-making systems to facilitate uptake of the research outputs by users.

The Roadmap should:

(a) **Refine and prioritise** the needs for environmental-science derived knowledge and capability set out above and in the visions and strategies of the international scientific organisations and other stakeholders from government, business and civil society. A priority will be more strongly engaging socio-economic and socio-environmental science and user voices in determining these priorities.

It should agree the **outcomes** required (knowledge, capability and services needed by society and corresponding underpinning research challenges) and a **strategy** (key players (funders, providers, users), timetable and budget) for delivering them. The

outcomes and strategy should be clearly **prioritised.** The prioritisation should have at its core the critical research and integration needs and mechanisms to provide environmental information services to governments, business and society at large, which can be guided by the ESAPS integrating framework. It should also reflect the urgency with which the information is needed, and the tractability of the research providing that information. This prioritisation should include identification of 'quick wins' where there is significant existing capability to deliver an outcome, as well as areas in which more strategic planning and investment is required.

(b) Ensure that wherever possible, implementation focuses on **increasing the effectiveness of existing capability, through improved prioritisation and coordination**.

Specify which outcomes of the roadmap can be delivered by more focused and coordinated use of existing research national and international research programmes, infrastructure and training. Set out a strategy for organising the existing capability and delivering the resulting outcomes, to include:

- coordination and integration of existing observations, datasets, programmes, training and knowledge exchange platforms, and
- reallocation of resources from capability that is not a priority, to enhance capability that is

(c) Identify which outcomes require **investment in new capabilities** (i.e. cannot be delivered by more efficient use of existing capability). Set out a strategy for delivering the new investments and the resulting outcomes.

Over the next few months, the Belmont Forum, in partnership with ICSU and ISSC, will discuss with stakeholders from research, operational service providers, government, business and civil society, our proposal for a Joint Strategic Task Force to develop a Roadmap for the global environmental science mission set out in the Belmont Challenge and ESAPS. The objective of these discussions will be to identify how the funders' vision set out in this paper may be best aligned and taken forward with similar emerging high-level strategies of our stakeholders.

References:

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(2) Reid et al. (2010). Earth System Science for Global Sustainability: Grand Challenges. Science 330: 916-917.

(3) ICSU Panel (2010) "Regional Environmental Change: Human Action and Adaptation – What does it take to meet the Belmont Challenge"

(4) Leemans et al. (2009) Developing a common strategy for integrative global environmental change research and outreach: the Earth System Science Partnership. Current Opinion in Environmental Sustainability 1: 4-13.

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(6) Doherty, S.J., et al. (2009), Lessons learned from IPCC AR4: Scientific developments needed to understand, predict and respond to climate change. Bull. Amer. Meteor, Soc., 90(4): 497-513.
(7) Lubchenco (1998). Entering the Century of the Environment: A new social contract for Science. Science 279: 4911 – 497
(8) WMO High Level Task Force towards a Global Framework for Climate Services (http://www.wmo.int/hlt-gfcs/)

Annex I

Pilot Collaborative Research Actions in 'priority foci' areas of the Belmont Challenges to accelerate collaboration between national funders of research in support of transnational research

Title	Focus
Coastal Zone Vulnerability	Scoping opportunities to plan a new international research activity to improve information for regional decision-making
Water Security	Scoping opportunities to bring together national and regional observations and modelling of water availability and extreme events to develop a global picture
Food Security	Engaging with the ESSP Challenge Programme on Climate Change, Agriculture and Food Security (CCAFS) to explore opportunities to accelerate earth system science contributions to regional-scale food security challenges, with a potential focus on Sub-Saharan Africa.
Securing the Biodiversity-Ecosystem Services Baseline	Scoping opportunities to align and coordinate existing national biodiversity and ecosystem functioning observation and monitoring sites to develop an international observation network.
Ocean Acidification	Assessing the existing coverage of Southern Ocean Observatories supported by Belmont Forum members, and the critical gaps.
Forests and Agriculture	Scoping opportunities to align and co-design measurements and modelling of carbon stocks and forests, to assess the contribution of tropical forests world-wide in the global carbon sink.

Annex II

Complementarity between the Belmont Challenge and the ICSU Grand Challenges for Earth System Science for Sustainability.