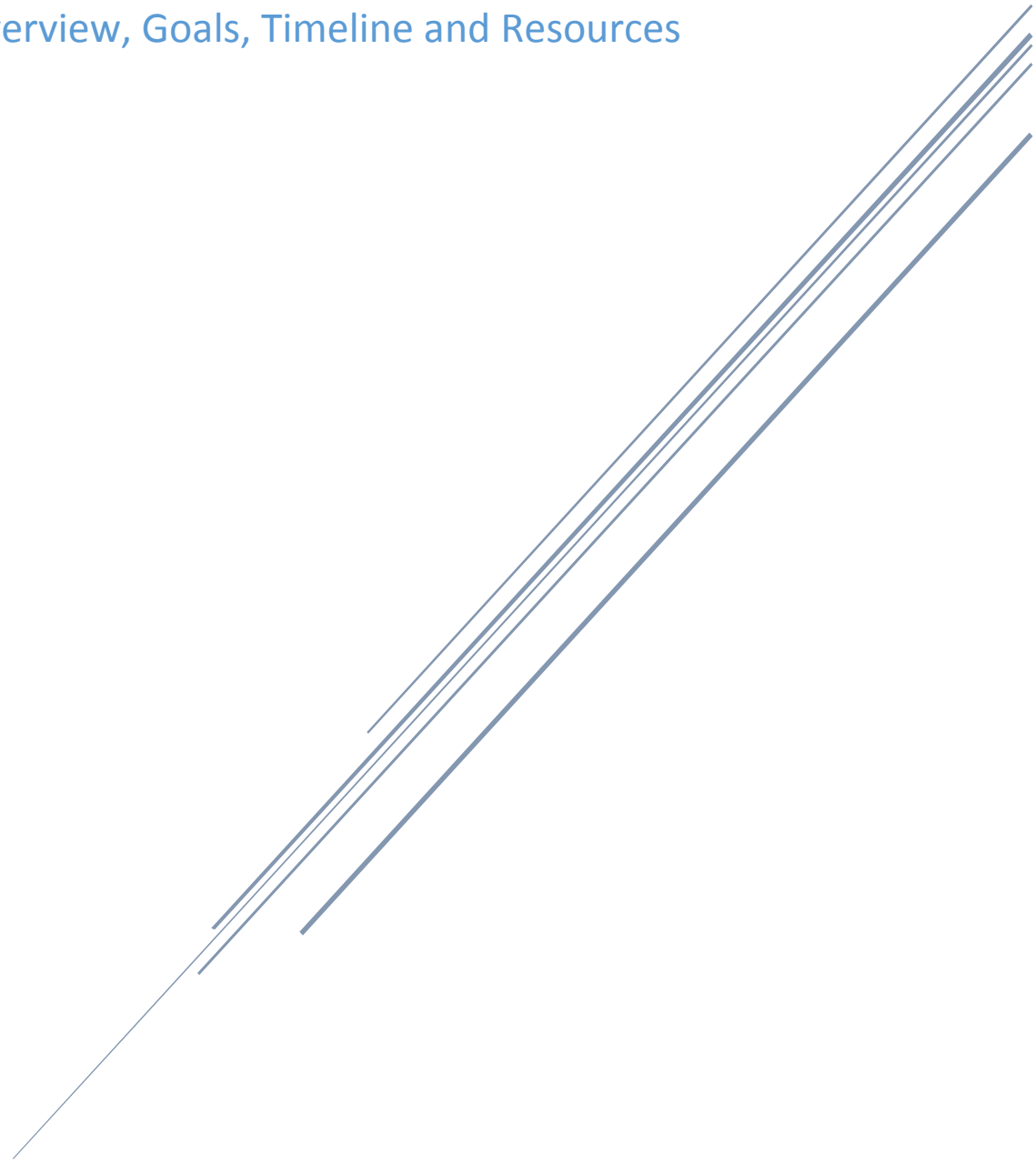
BELMONT FORUM: E-INFRASTRUCTURE AND DATA MANAGEMENT KNOWLEDGE HUB

Project Overview, Goals, Timeline and Resources



Prepared by the UK-US Secretariat

Co-Led by Lee Allison - Arizona Geological Survey (US) & Robert Gurney – University of Reading (UK)

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BELMONT FORUM OVERVIEW

The Belmont Forum is a group of 14 of the world's major funders[1] of global environmental change research and international science councils that was established in 2009. It aims to (i) remove critical barriers to sustainability by (ii) aligning and mobilising international resources in order to (iii) accelerate delivery of international environmental research.

The Belmont Forum vision:

1. "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
2. Seeks to **add value** to strategies that are currently evolving within the environmental change research and operational service provider communities."[2]

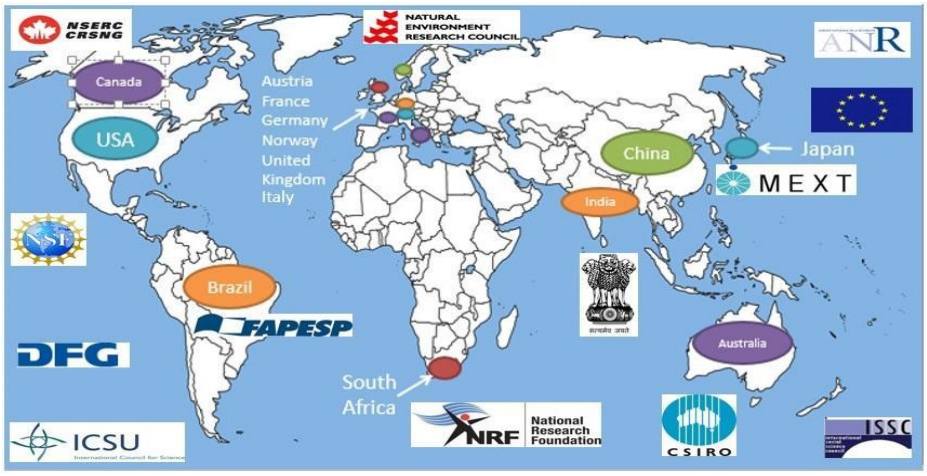

Figure 1: Belmont Forum Members.

The Belmont Challenge

The Belmont Forum is guided by the charge embodied in the Belmont Challenge, which is a "funders' vision for the priority knowledge and capabilities derived from environmental research that society needs, and the underpinning research challenges over the next decade to deliver them."[3] The Belmont Challenge aims:

> **"To deliver knowledge needed for action to avoid and adapt to detrimental environmental change including 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
> - Interaction of natural and social sciences
> - Enhanced environmental information service providers to users

[1] See http://igfagcr.org/index.php/bf-members for a complete list of Belmont Forum members.
[2] Belmont Forum, "The Belmont Challenge: A Global, Environmental Research Mission for Sustainability," March 2011, http://igfagcr.org/images/documents/belmont_challenge_white_paper.pdf.
[3] Belmont Forum, "The Belmont Challenge," accessed February 11, 2014, http://igfagcr.org/index.php/challenge.

- Effective international coordination mechanisms

With priority foci being:

- Coastal vulnerability
- Freshwater Security
- Ecosystem Services
- Carbon Budgets
- Most vulnerable societies"[4]

Goals are for "these challenges [to] be integrated into a seamless, global Earth System Analysis and Prediction System (ESAPS),[5] which will provide decision-makers with a holistic decision support system."[6]

E-Infrastructure & Data Management Knowledge Hub

The Belmont Forum has recognised that abilities to develop end-to-end environmental decision support systems are impaired by a lack of coordinated research strategies and objectives between individual infrastructures and across disciplines and scales and by the growth of "big and complex data" to scales well beyond the capabilities of traditional data handling tools. In particular it has identified a need for international collaboration on practical research that can pilot 'real-world' exemplars to improve interoperability of technical architecture and governance for data, e-infrastructure and data analytics.

As a first step, the Belmont Forum has initiated the *E-Infrastructure and Data Management* Cooperative Research Agreement (CRA) 18 month scoping programme, to take place between September 2013 and April 2015, that aims to develop capable e-infrastructures to meet the Belmont Challenge:

1. More **integrated communities**, that are better able to collaborate on e-infrastructure challenges by building international teams and partnerships that can effectively partner with civil society to co-design e-infrastructures, data management and data-analytical challenges, set standards in interoperability of data, models and tools and in governance, such as in security, legal and ownership models AND
2. Provide a community-owned *Global E-Infrastructure and Data Management Strategy and Implementation Plan*, which will **inform** stakeholders, **prioritise** action to address the interoperability challenges, and **integrate** existing national and international research in order to promote more holistic environmental support systems

The project is community-owned and will be collaboratively co-designed and co-delivered by participating Belmont Forum countries. Wherever possible, existing collaborative activities will be used, with a principle of subsidiarity so that only new activities which need to be done in common internationally and which fall outside existing mechanisms will be recommended for further work.

The E-Infrastructure and Data Management CRA was crafted with input from Belmont Forum and IGFA members, and from recommendations received at a Belmont Forum scoping workshop in December 2012,[7] two town hall sessions at the American Geophysical Union

[4] Ibid.
[5] Belmont Forum, "The Belmont Challenge: A Global, Environmental Research Mission for Sustainability."
[6] Belmont Forum, "The Belmont Challenge."
[7] "Working together, NSF and NERC facilitated a workshop involving many Belmont Forum program officers and

Meeting and the Geological Society of America Meeting, and many informal discussions with international researchers. In February 2013, the Belmont Forum met in New Delhi, India, and made the decision to initially support a series of collaborative scoping activities instead of a competitive call for small grants:

> "Recognising that there are existing national and international integration efforts, and that several countries have recently formed programmes and consortia in the area of e-infrastructure interoperability and governance, it may be more productive for the Belmont Forum to put its resources into creating the 'space' to bring communities together for further integration and to build a community strategy rather than to focus these resources on a competitive call for several small grants and a single strategic consortia. The latter approach risks fragmenting these existing communities and potentially excluding important players, while supporting a collaborative approach has a high potential to deliver an international, integrated strategy that is 'owned' by the community."[8]

A majority of the Belmont Forum countries and member agencies are participating in the E-Infrastructure and Data Management CRA. Participating countries and agencies include:

1. Australia: Commonwealth Scientific and Industrial Research Organisation (CSIRO)
2. Brazil: Sao Paulo Research Foundation (FAPESP)
3. European Commission (EC)
4. Germany: 1) Federal Ministry of Education and Research (BMBF); 2) Deutsche Forschungsgemeinschaft (DFG)
5. France: National Research Agency (ANR)
6. International Council for Science (ICSU)
7. Italy: National Research Council (CNR)[9]
8. Japan: Science and Technology Agency (JST)
9. South Africa: National Research Foundation (NRF)
10. United Kingdom: Natural Environmental Research Council (NERC)[10]
11. United States of America: National Science Foundation (NSF)[11]

Timeline

In contrast to previous CRAs that the Belmont Forum has funded,[12] the e-Infrastructures and Data Management CRA is envisioned as a multi-step, multi-funding cycle program, in order to use feedback and knowledge created from early phases to better address community needs, priorities, and future directions in later phases. The CRA is envisioned to occur in two phases:

1. **Phase One: Building Communities and Developing a Community Strategy and Implementation Plan: 18-month "Knowledge Hub" programme over 2013 – 2014**

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members of the international scientific community on 10-11 December 2012 in San Francisco, California, USA. The purpose of this workshop was to narrow the scope of a potential call and to develop an implementation strategy for delivering this CRA opportunity." Belmont Forum, "Proposed Collaborative Research Action (CRA) e-Infrastructures and Data Management Summary and Implementation Strategy," BF13-7, February 20, 2013.

[8] Ibid.

[9] Italy is a new member of the Belmont Forum as of December 2013.

[10] NERC is co-funding the Belmont Forum E-Infrastructure and Data Management CRA Secretariat (UK Team at the University of Reading).

[11] NSF is co-funding the Belmont Forum E-Infrastructure and Data Management CRA Secretariat (US Team at the Arizona Geological Survey).

[12] These include Coastal Vulnerability and Freshwater Security. For more information, please see www.belmontforum.org.

to "bring together the leading national natural and social scientists and users that are utilizing cloud computing for environmental data management, modeling and services to form an
international "Knowledge Hub". Researchers will share information on challenges and best practices regarding the technical and governance challenges of data management and infrastructure interoperability and architecture. They will develop a Community Implementation Plan for integrating research into a holistic environmental decision-support system, and make recommendations for future Belmont Forum calls that can develop pilot 'end-to-end' exemplars."[13]

2. **Phase Two: Delivering the future of data and e-infrastructures– potential call in 2015 or later.** The nature of Phase Two will depend on outcomes and products from Phase One and funding agency participation, but may include a call for medium to large sized grants to implement the strategies and vision from Phase One. It would support development of complete end-to-end, practical exemplars of environmental information services that utilize the cloud to integrate observational data, modeling and services that can help deliver on the goals of the Future Earth initiative and other global initiatives such as GEO-GEOSS."[14]

Current activities are part of Phase One; Phase Two activities will be determined by the outcomes of Phase One.

Phase One

Phase I activities are organized around a virtual Knowledge Hub (www.bfe-inf.org) to scope out the *Community Strategy and Implementation Plan* for the research needed to deal with issues such as architecture and interoperability, and governance in the context of better utilising environmental data to address the challenges presented by global environmental change.

Milestones and Deliverables

Key milestones and deliverables for Phase One include the following:

- **July 2013 – November 2014**: Program of international community building and strategy development activities, including mapping exercises, workshops, exchanges, summer-schools (Phase I).
    - **October 2013**: First Steering Committee In-Person Meeting (Windsor, UK)
    - **November 2013 – January 2014:** National Delegations are selected; Work Packages are refined
    - **February –November 2014:** Work Packages scoping activities
    - **April 2014:** Second Steering Committee Meeting (Vienna, Austria)
    - **April – September 2014:** Work Package In-Person Meetings
    - **October – December 2014:** Steering Committee and Secretariat compile material from WPs for Draft *Community Strategy and Implementation Plan*
- **December 2014:** Draft *Community Strategy and Implementation Plan* produced, with recommendations for Phase Two Belmont Forum Call to develop 'Exemplars'
- **Early 2015:**Final *Community Strategy and Implementation Plan* produced

Phase One Implementation

The project is guided by an international **Steering Committee**, consisting of experts from Belmont Forum members' research and user communities, and from international organisations

[13] Belmont Forum, "Proposed Collaborative Research Action (CRA)," BF13-7, February 20, 2013.
[14] Ibid.

such as Future Earth and the Global Earth Observation System of Systems (GEOSS). The Steering Committee will also oversee production of the resulting *Plan*. Each Steering committee member is responsible for leading one or more **Work Packages** to collectively assess existing international e-infrastructure capabilities, gaps and overlaps, prioritize challenges, and provide recommendations on how to best address the Belmont Challenge.

A National Delegation **Assembly** is composed of approximately 10-12 researchers and users sponsored by each Belmont Forum partner, each of whom participate in scoping activities via the Work Packages. Assembly members are spread across the six Work Packages, and are expected to participate in a series of scoping activities, which will consist primarily of virtual meetings, webinars and associated working groups activities. These activities will contribute to the development of the *Community Strategy and Implementation Plan.* Assembly members are expected to attend one Work Package in-person meeting in early 2014, date and location TBD but likely international. We anticipate an average of one virtual meeting per month, supplemented by additional activities as needed, which will likely include reviewing and providing input on assessments and documents, and participating in discussion forums.

The Knowledge Hub, Secretariat, and Assembly are supported by a 10-member **Secretariat,** jointly led by the US and UK (Dr. Lee Allison at the Arizona Geological Survey, USA and Prof. Robert Gurney at the University of Reading, UK).

Work Packages

A 3-day Steering Committee Meeting[15] was held in Windsor, United Kingdom, October 15-17, 2013, to identify and determine leadership of WPs in the areas of Governance, Architecture, and Interoperability. Steering Committee members identified the following areas of focus for the WPs:

1. Standards
2. Improved interface between the computation and data infrastructures
3. Harmonisation of global data infrastructure for sharing environmental data
4. Data Sharing
5. Open Data
6. Capacity-Building (cross-cutting)

Each of the WPs is led by one or more Steering Committee (SC) members, and supported by two Secretariat support staff, (one person each from the US and UK Secretariat teams). Steering Committee members agreed that coordination and collaboration between established bodies is essential to avoid duplication of effort, and facilitating research through improved access to relevant data and partners was of first importance. Enthusiasm for ongoing participation, collaboration and action was strong, and several near-term action items were identified to jumpstart the work package scoping activities.

Work Package Methodology

While specific activities will vary across WPs, according to WP areas of focus and goals, Steering Committee members agreed on a general work methodology be used as a starting point for each WP to begin activities:

1. Establish current **Best Practice Use Cases** (including solutions to problems, decision

[15] For more information, please see the Steering Committee Meeting Summary

making processes and regional coordination) as advisory exemplars for on-going study.
2. Use these exemplars to identify **Barriers** to integration and collaboration (What is hindering coordination/collaboration at the moment? Possible factors include cultural, cross-disciplinary and international/national/regional issues, externalities, constraints, dependencies by funding agencies and government) and;
3. Identify **Gaps** in current knowledge and activities (What has yet to be solved in terms of effective governance? What have people not found a solution to yet?), leading to the creation and/or development of;
4. Develop **Guidelines and Recommendations** (Codes of conduct, solutions to overcome barriers) in areas where the Belmont Forum could make a significant contribution through its involvement and intervention.

The Guidelines and Recommendations produced by each work package will be the primary deliverable to the Belmont Forum Group of Programme Coordinators (GPC[16]). This deliverable has the potential to serve as the foundation of a future Belmont Forum Collaborative Research Action (CRA) on enhancing international e-infrastructures and data management practices for global environmental change research.

WP 1: Standards

Steering Committee (SC) Leads: Roberto Cossu (European Space Agency) and Mustapha Mokrane (ICSU WDS)
SC Participants: Jean-Pierre Vilotte (France), Christoph Waldmann (CoopEUS), Toshio Koike (Japan), and Stefano Nativi (Italy)
Secretariat Support Staff: Kathie Bowden (UK)**,** Rachael Black (US)

Areas of Focus:

- Discoverability and annotation
- Ontologies and semantics
- Brokering
- Access to models
- Data provenance identifiers
- Minimal standards to be identified for maximum participation
- Identifying ways to facilitate cooperation between existing groups
- Identifying and bringing together domain experts from existing bodies (e.g. RDA, GEOSS) to address key community identified requirements in a holistic way

WP 2: Improved Interface between computation and data infrastructures

SC Leads: Jean-Pierre Vilotte (France) and Toshio Koike (Japan)
SC Participants: Roberto Cesar (Brazil) and Andrew Treloar (Australia)
Secretariat Support Staff: Jane Lewis (UK), Kate Kretschmann (US)

Areas of Focus

- Identification of the interface and existing gaps in synergy between data and computing infrastructure from a user perspective
- Security Models and Access
- Bringing together experts on infrastructure and computing to advise on current best practice and identify exemplars
- Identification of the most immediate barriers to improving interfaces and potential funding to support lowering of these barriers
- Measurement of performance and how the difference has been made

[16] See Appendix III: contact points for participating Belmont Forum agencies.

- User community-driven and coming from the data community

WP 3: Harmonisation of global data infrastructure for sharing environmental data

SC Leads: Christoph Waldmann (CoopEUS)
SC Participants: Andrew Treloar (Australia) and Toshio Koike (Japan)
Secretariat Support Staff: Jane Lewis (UK), Anna Katz (US)

Areas of Focus

- Defining minimal interface for cooperation on environmental harmonisation
- Identifying general requirements of the ecosystem, using user scenarios as the springboard
- Building on experiences of the COOPEUS project, adding experiences of other work done internationally
- Use Japan's experience as a key knowledge source
- Findings from this Work Group to provide guidance to other Work Packages

WP 4: Data Sharing

SC Lead: Dale Peters (South Africa)
SC Participants: Andrew Treloar (Australia), Bob Samors (GEOSS)
Secretariat Support Staff: Genevieve Pearthree (US), Kim Oakley (UK), Kate Kretschmann (US)

Areas of Focus

- Investigating data authenticity and quality
- Investigating data provenance (certification, standards)
- Investigating incentives to share data
- Cultural Issues - different disciplines, national/regional
- Developing trust across spectrum of sources
- Preservation of data context
- Legal issues, within and across national jurisdictions, liability (subcommittee)*
- Long term sustainability and organisational continuity
- Community approach to standards (community implementation of standards)

WP 5: Open Data

SC Leads: Andrew Treloar (Australia) and Birgit Gemeinholzer (Germany)
SC Participants: Toshio Koike (Japan), Stefano Nativi (Italy), Robert Samors (GEOSS), Jean-Pierre Vilotte (France)
Secretariat Support Staff: Kim Oakley (UK), Genevieve Pearthree (US)

Areas of Focus

- Open access
- Integration with civil society (Citizen science, crowd-sourcing, policy and the role of appropriate hardware/software)**
- Development of a strategy to promote/implement open data across groups with an interest in environmental data who are at various stages of technical maturity
- Development of match-making services linking data providers with suitable repositories to support open data
- Uses of open data, liability/uncertainty in decision making

WP 6: Capacity Building (cross-cutting)

SC Leads: Lee Allison (US) and Robert Gurney (UK)
Secretariat Support Staff: Kathie Bowden (UK), Genevieve Pearthree (US)

Areas of Focus

- Investigation into IT resource gaps, including Data Infrastructure

- Cross-disciplinary education and training
- Sustainable human resources, including communities of practice, social/cultural/organizational capacity building
- Security
- Legal Issues, including Intellectual Property issues (beyond data sharing [focus in WP 4])

WP 6 members are initially assigned to other WPs and will be identified to also serve in WP 6 at a later date. WP 6 members will be brought together for an in-person meeting, anticipated to take place in the UK in August/September 2014. This meeting will serve to bring together cross-cutting issues related to capacity building identified in the other WPs.

Resources Available to You

A suite of resources is available to carry out the activities called for in the E-Infrastructure and Data Management CRA. The 10-member UK-US Secretariat collaborates closely to provide technical, administrative, and coordination to the Steering Committee, National Assembly, and Work Packages. The Secretariat also manages the Knowledge Hub.

Knowledge Hub

The Belmont Forum initiative calls for a space in which project participants can communicate and collaborate virtually at www.bfe-inf.org. This virtual portion of the Knowledge Hub is more than an online web-based asset as it also serves to facilitate the flow of ideas and knowledge of the whole community, including the 140-member Assembly. Broadly, this Knowledge Hub is:

1. The community of researchers, practitioners, and end-users who are participating in this program
2. The online community hub for digital, dynamic content that is frequently updated
3. A space that provides communications among project participants (content creators and users)
4. An open space – both in terms of transparency as well as inclusiveness to project participants
5. Searchable – a crucial component to help people easily find content within the platform

Groups and Workspaces

Users will connect with each other via working group spaces in the general Knowledge Hub. The structure of these online group spaces is designed to mimic the structure of the groups actively carrying out work on the Belmont Forum project.

1. *Steering Committee*
2. *Secretariat*
3. *Assembly*
4. *Work Packages*
    a. Standards
    b. Improved interface between the computer and data infrastructures
    c. Harmonisation of global infrastructure for sharing environmental data
    d. Data Sharing
    e. Open Data
    f. Capacity Building

Workspaces are designed to provide individual groups within the Knowledge Hub the ability to have their own virtual workspace, which then pushes drafts or completed documents, specifications, requests for participation, or calendar events to the larger Belmont Forum community. Transparency of the projects is key; however, we also recognize that products in development may require some sensitivity to minimize misinterpretation during the development phase; thus the need for semi-private workspaces.

Workspace Functionality

Functionality for these groups includes:

1. **Group-level calendars**, - intended for groups to have a centralized project planning calendar where they can track internal calls and deadlines.
2. **Events** – intended for groups to have a location for planning project specific events, like project kick-off meetings, virtual meetings, etc.
3. **Assigned tasks** – the ability to assign and track tasks within the group
4. **Forums** – the ability to have discussion forums for the project groups as well as a general forum for Belmont Forum-wide participation
5. **Document upload and editing** (basic file extensions—DOC, PPT, XLS, PDF, JPG, FLV, etc.) – for documents currently in process. Also included will be a location for linking to editable Google Docs that the group is currently working on
6. **Photos** – for sharing group photos

The base functionalities of each group workspace can be customized by the workspace administrator (assigned).

User-Created Groups

Should the need for new groups arise in order to facilitate work on new areas of focus or cross-group collaboration, users will be able to create new group workspaces via a simple series of steps. This workspace and its functionality will be modeled after the established group spaces (outlined above). Creation of the group will require a moderator approval.

Login Capabilities

To simplify user login, minimize password fatigue, and minimize the need for help-desk situations for password/username updates, we are implementing a Single Sign-On (SSO) capability on the Knowledge Hub. This means that users with an existing account at one of the popular user accounts such as Google, Yahoo, Facebook, etc. can use that sign-on to access their profile on the Knowledge Hub.

User Profiles

A critical component to the Knowledge Hub is the ability of the participants to have user profiles, which will include personal and professional information as attributes (see list below). The users include all members of the Belmont Forum who are participating in this project; as people join the Belmont Forum initiative they will be able to create a user profile on the Knowledge Hub. Users will have to ability to find other users by searching under certain profile attributes such as location, domain, affiliation, etc. This will allow the Belmont Forum community to collaborate more effectively and efficiently, leveraging existing expertise and geographic connections.

Communication Capabilities

All users will be able to send and receive messages and participate in forums. All forums will exist at three levels:

1. Group level workspace forums (e.g. Standards Working Group, Open Data Working Group)
2. Space-level forums (e.g. Work Packages, Secretariat, Steering Committee)
3. A general, Knowledge Hub-wide forum. All participants in the Knowledge Hub will receive these communications.

Events/Calendars

Calendars are available at the group level (e.g. Standards Working Group, Open Data Working Group), the space level (e.g. Work Packages, Secretariat), and in the form of a single, Knowledge Hub-wide general calendar. Users adding an event at the group level have the option to extend it to the larger calendars with admin approval. Event listings include an iCal feature allowing the user to easily sync any event with a personal calendar (e.g. Google, Outlook).

Documents

Users can create and upload new documents, edit and comment on drafts, and search a central, Knowledge Hub-wide repository of finalized documents.

New documents are added by users to a group workspace via upload or text field. Those users will have the option of designating a document as a draft, editable by other group members, or as a finalized version that is not editable but will remain open to comments. Once finalized, the document can be uploaded to the Belmont Forum-wide file repository.

The Belmont Forum Data Management and e-Infrastructures Google Drive will remain available and active for any persons or groups that would like to continue using it. The document upload and collaboration system outlined above is not meant to fully replace the Google Drive system, but make it more flexible and easy to access from related Knowledge Hub activity. If a user/group wishes, a link to the group's Google Drive or Google Doc can be placed on the group's workspace in order to quickly link users to a document collaboration.

File Repository

A central file repository will be publicly accessible and will support a range of common file types. Users will be able to search by descriptive keywords, date, group, file type, and document type (e.g. work plan, meeting minutes, etc.). Initially a Drupal based file repository with Dublin Core metadata will be implemented. However, in maintaining and continuing the vision of Belmont Forum and to enable long-term preservation of digital assets, we are researching a more robust data management platform for the Knowledge Hub such as a Fedora Repository or DSpace Repository; both are free and open source software installations.

Appendix I: Steering Committee Biographies

Steering Committee Co-Chairs and Secretariat Leads

M. Lee Allison, US Co-Chair, WP 6
State Geologist & Director, Arizona Geological Survey
+1 520 209 4121
lee.allison@azgs.az.gov
www.arizonageology.blogspot.com

Lee Allison was appointed State Geologist and Director of the Arizona Geological Survey in December, 2005. Previously, he served as State Geologist in Utah (1989-1999) and Kansas (1999-2004). During 2004-2005, he was Policy Advisor for Science and Energy to Gov. Kathleen Sebelius of Kansas, and chaired the Kansas Energy Council from its inception in 2002 to 2005. Research Interests: Geoscience policy: hazards, energy, minerals; Geoinformatics/cyberinfrastructure; Community engagement. Lee is the Principal Investigator of the Test Enterprise Governance Project, part of the National Science Foundation's EarthCube initiative.

Lee is a co-chair of the Steering Committee and leads the U.S. Secretariat team at the Arizona Geological Survey.

Robert Gurney, UK Co-Chair, WP 6
Professor and Academic Lead for Space/Earth Observation Research
NERC Coordinator of Environmental Information, Professor of Earth Observation Science
r.j.gurney@reading.ac.uk
http://www.nceo.ac.uk/

Robert Gurney is Professor of Earth Observation Science in the School of Maths, Meteorology and Physics at the University of Reading in the UK. He is also Director of the Environmental Systems Science Centre, and one of the Heads of the Department of Meteorology within the School. He is interested in land-atmosphere interactions and the use of Earth Observation to improve our knowledge of how processes at the land surface scale in time and space. He is also interested in using novel cloud computing for organising observations and model output and allowing these to be compared and visualised. He has been a member of numerous science advisory bodies. Before coming to Reading in 1990, he was Head of the NASA GSFC Hydrological Sciences Branch.
Robert is a co-chair of the Steering Committee and leads the U.K. Secretariat team at the University of Reading.

Steering Committee Members

Roberto M. Cesar Jr, WP 2
University of São Paulo - USP
Institute of Mathematics and Statistics - IME
Computer Science Department
cesar@ime.usp.br
http://escience.ime.usp.br

Roberto has been a full-Professor of the University of São Paulo (USP) since 2008. Graduated in Computer Science from Universidade Estadual Paulista Julio de Mesquita Filho (IBILCE - UNESP - 1992), MS in Electrical Engineering from Universidade Estadual de Campinas (UNICAMP - 1993) and Ph.D. in Physics from the University of São Paulo (USP - 1997). He is currently a Full-Professor in the Department of Computer Science - IME - USP. He served as a member of the Coordination Area of Computer Science of FAPESP and of the Evaluation Committee Capes (Computer Science). He is currently special advisor for Physical Sciences and Engineering at FAPESP. He is Director of the eScience Research Center at USP and head of the Computer Science Department. He has experience in computer science, with emphasis on computer vision, pattern recognition, image processing, bioinformatics and eScience.

Roberto Cossu, WP 1 (Co-Lead)
Ec and 3nd Party RTD Engineer, European Space Agency
Roberto.cossu@esa.int

Roberto began his scientific activity was started in the areas of signal and image analysis and pattern applied to Earth Observation, with special focus on multi-temporal remote-sensing data analysis for land-cover monitoring and damage assessment. Since his arrival at ESA, his interests include the utilization of Grid and Cloud, Open GIS, OpenSearch, and emerging Web-based technologies for Earth observation and environmental applications, focusing on innovative technology for accelerating the access and exploitation of Earth observation data.

His interests also include cloud computing and virtualization concepts for enabling scientists to derive new environmental indicators, scaling up on the dimension of the input data set whenever needed. These activities are carried out in the context of large collaborative projects and with the support of an industrial team he coordinates and manages, which entails interfacing with other partners and the European Commission, and disseminating the results in international scientific events.

Birgit Gemeinholzer, WP 5 (Co-Lead)
Researcher/Faculty member at the Botanic Garden and Botanical Museum Berlin-Dahlem
http://www.bgbm.org/bgbm/staff/wiss/Gemeinholzer/

Birgit is involved in the following barcoding initiatives: TreeBOL, DNA Barcoding Initiative for Conservation, Plant Working Group, Leading Labs

Network, and the following iBOL Working Groups: WG1.2 Land Plants, WG1.7 Freshwater Bio-Surveillance, WG2.2 Museum Life. She is also involved in the following aspects of barcoding: fieldwork/specimen collecting, Museum work/specimen curation, Labwork/generating barcode sequences, Management of barcode data, Using barcode data in taxonomy/systematic biology, Using barcode data for other applications. Her current projects include Barcoding of diatoms and TreeBol.

Toshio Koike, WP 1, WP 2 (Co-Lead), WP 3
Professor at the Department of Civil Engineering, The University of Tokyo
tkoike@hydra.t.u-tokyo.ac.jp

Toshio is also the Executive Director, Earth Observation Data and Information Fusion Research Initiative (EDITORIA) at The University of Tokyo, and is a Special Adviser to Minister of Education, Culture, Sports, Science and Technology of Japan. Toshio's research interests include hydro-meteorological variability and its impacts on water resources, remote sensing and satellite hydrology, and hydrological processes in the Asian monsoon and their predictability.

Mustapha Mokrane, WP 1 (Co-Lead)
Executive Director of the ICSU-WDS International Programme Offices
mustapha.mokrane@icsu-wds.org

Mustapha Mokrane is the first Executive Director of the ICSU-WDS International Programme Offices Since March 2012. He worked previously at the International Council for Science (ICSU) as Science and Information Technology Officer coordinating ICSU's Scientific Data and Information activities and liaising with its partners. He was also responsible for the information technology related activities. After moving from Algeria, his home country, he trained as molecular biologist in France. His scientific background covers genetics and bioinformatics and he developed a strong interest for scientific data and information. He holds a Ph.D. in Molecular Biology from the Aix-Marseille University.

Stefano Nativi, WP 1, WP 5
Italian Natural Resource Council – Institute of Atmospheric Pollution Research
stefano.nativi@cnr.it

Stefano is head of the Earth and Space Science Informatics Laboratory (ESSI-lab) belonging to the Institute of Atmospheric Pollution Research (IIA) of the National Research Council of Italy (CNR). He is an expert on multi-disciplinary interoperability and cyber (e)-infrastructures for Earth Sciences. Research and operational experience in the fields of Geospatial Information, Earth Observation, and international standardization. He is co-chair of the GEO Science & Technology Committee and lead of the European Team of the GEO Standard and Interoperability Forum (EuroSIF). He is president of the Earth and Space Sciences Informatics (ESSI) division of the European Geosciences Union (EGU). He is member of the INSPIRE Drafting Teams for Metadata

and Data Specification: Atmospheric Conditions & Meteorological geographical features.He is also an adjunct Professor of "Systems for land management" at the University of Padua.

Dale Peters, WP 4 (Lead)
South Africa - University of Cape Town
Dale.peters@uct.ac.za

Dale serves as the Deputy Director of Technical Services in the Library Directorate at the University of Cape Town. Dale has also served as a member on the Data Intensive Research Initiatives of South Africa (DIRISA) working group, National Integrated Cyber Infrastructure, and a Project Manager of The Digital Imaging Project of South Africa (DISA), developing tools for capacity building to support international standards for the capture and storage of digital data.

Robert Samors, WP 5
GEO/GEOSS[17]
rsamors@geosec.org

Bob is the Senior External Relations Manager at Group on Earth Observations (GEO). He also serves as the Senior Consultant of the Association of Public and Land-Grant Universities (APLU), where he manages the APLU initiative to develop national measures of university contributions to regional economies. Bob has a long history and expertise in government, receiving his PhD from Harvard University Kennedy School of Government and working for various state governments, senators, and Universities throughout his impressive career. His research interests include public policy and advocacy for federal research funding, formulation of national science and research programs, and federal technologies policy issues. As Associate Vice President and Director for Federal Relations at University of North Carolina, he secured more than $50M in earmarks and grants and assisted the President on national initiative on learning innovation and other national policy issues.

Andrew Treloar, WP 3, WP 4 & WP 5 (Co-Lead)
Australian National Data Service
andrew.treloar@ands.org.au
http://andrew.treloar.net/

Dr. Andrew Treloar is the Director of Technology for the Australian National Data Service (ANDS) with particular responsibility for demonstrating the value of bringing together data from different disciplines to answer new questions, and international engagement. In 2008 he led the project to establish ANDS. He is also a co-chair of the Research Data Alliance Technical Advisory Board and was a Visiting Fellow at the DANS organisation in the Netherlands in 2013/14. His research interests include data management and scholarly communication. He never seems to be able to

[17] GEO/GEOSS is not supporting a National Assembly Delegation as part of this effort.

make enough time for practising his cello, or reading, but does try to prioritise talking to his chickens and working in his vegetable garden and orchard.

Jean-Pierre Vilotte, WP 1, WP 2 (Co-Lead)
Institut de Physique du Globe de Paris
jeanpierre.violette@gmail.com

Jean-Pierre is a professor at the Institut de Physique du Globe de Paris and Director of the Seismology Department. His research interests include mechanics and dynamics of earthquake sources, full wave field propagation in complex geological media and site effects, dynamics of frictional granular-type media with implications for gravitational debris flows. He is also involved in the development of a plate boundary observatory in Northern Chile, a collaborative project between the French CNRS, the University of Chile (Santiago) and the GFZ Potsdam.

Martin Visbeck
GEOMAR
mvisbeck@geomar.de

Martin is Head of the Physical Oceanography Research Unit at GEOMAR. His research interests include the role of the ocean in climate variability, variability of ocean circulation, deep water formation in sub polar regions, and much more. Throughout his career Martin has served as a professor of at Columbia University and Deputy Director at Leibniz Institute of Marine Sciences. He is currently a Senior Research Scientist at Lamont-Doherty Earth Observatory, a professor of Ocean Circulation and Climate Dynamics at Helmholtz Center Ocean Research Kiel, and is a member of AGU Ocean Science Executive Committee and the ICSU Transition Team (the interim governing body of the "Future Earth" initiative).

Christoph Waldmann, WP 3 (Lead)
COOPEUS – University of Bremen
waldmann@marum.de

Christoph is a Coordinator of the COOPEUS Project "Connecting Research Infrastructures" as well as the Senior Scientist at the University of Bremen, Center for Marine Environmental Sciences (MARUM). His research projects refer to the development of new methods of the efficient, long-term observation of processes in the sea. The work covers the range starting from hydro-acoustic methods and instruments, e.g., to the quantification of bubble streams, about optical methods for measuring basic parameters in the water column up to mobile and stationary observation platforms.

Appendix II: Secretariat Biographies

Secretariat: UK-US Project Managers

Kathie Bowden: UK Secretariat Lead, WP 1 & WP 6 Lead
University of Reading
Centre Manager for Space@Reading, School of Mathematical & Physical Sciences
k.e.bowden@reading.ac.uk
Tel: +44 (0) 118 378 7763

Kathie is currently the Centre Manager for Space@Reading, supporting space activities across the University. She has over 25 years' experience of the application of space data within industry and academia. Kathie is a geologist with a degree from UCL and postgraduate diploma from the University of Northern Arizona where she specialised in remote sensing applications. More recently Kathie has been instrumental in the skills agenda for the space sector. She is working in collaboration with the UKSA, Space Leadership Council, Satellite Applications Catapult and industry to address the skills gap. One of the initiatives she has led is the National Space Internship Network which has attracted over 45 high quality undergraduates in its first year. Kathie is a member of the Geological Remote Sensing Group, of which she was the founding Chair. She is also a Fellow and past Chair of the Remote Sensing and Photogrammetry Society and was awarded the Founder's Medal for Services to the Society in 2008.

Genevieve Pearthree: US Secretariat Lead, WP 4 Lead, WP 5 & WP 6 Support
Project Manager, Arizona Geological Survey
+1 520-209-4164
genevieve.pearthree@azgs.az.gov

Genevieve's work focuses on long-term sustainability and governance issues related to distributed networks and cyberinfrastructure. She has been researching governance issues for the past two years as part of the NSF EarthCube initiative. She is the Lead Project Coordinator for the EarthCube Test Enterprise Governance Project and the US Secretariat Node of the Belmont Forum E-Infrastructure and Data Management Cooperative Research Action initiative. Prior to her current work, Genevieve was a Spanish/English bilingual Montessori science and social studies teacher in Cochabamba, Bolivia. Her interests outside of work include travel and foreign languages, skiing, hiking, and biking.

US Secretariat: Arizona Geological Survey

Rachael Black
WP 1 Support
Project Coordinator
+1 520-209-4168
Rachael.black@azgs.az.gov

Rachael has worked in libraries, museums, and archives for many years, and recently earned her Masters of Library and Information Science from the University of Washington. Professionally, she is interested in understanding how people search for, use, and share information, and is an advocate for the development of tools and systems that facilitate open and equitable access to all types of information. Outside of work, she enjoys visiting, and volunteering at, museums and botanical gardens, and is an avid cyclist. She will be embarking on her third long distance bike tour this summer. Rachael is also a Project Coordinator for the EarthCube Test Enterprise Governance Project.

Anna Katz
WP 3 Support
Project Coordinator
+1 520-209-4166
anna.katz@azgs.az.gov

Anna recently received her Bachelor of Science in Environmental Policy from Trinity University. Her research interests include environmental science and activism, and public policy (environmental, international, sustainable communities). She is a project coordinator at Arizona Geological Survey working on community engagement and governance for issues of open data/interoperability in the geosciences as part of the EarthCube Test Enterprise Governance Project. Her activities/interests outside of work include hiking, running, soccer (really, any sort of outdoor recreation), and yoga.

Kate Kretschmann
WP 2 Support
Project Coordinator
+1 520-209-4169
kate.kretschmann@azgs.az.gov

Kate is a Project Coordinator working on community building and project development for the Belmont Forum e-Infrastructure and EarthCube Test Enterprise Governance initiatives. Based at the Arizona Geological Survey, Kate comes from an editorial background in science reference publishing and online media.

Kim Patten: **Additional Secretariat Support**
Associate Director for Planning & Development
+1 520-209-4125
kim.patten@azgs.az.gov

Kim is the Project Manager for the U.S. Department of Energy funded State Geological Survey Contributions to the National Geothermal Data System and for the U.S. National Science Foundation funded EarthCube Test Enterprise Governance Project. She holds an M.S. in Environmental Planning and a B.A. in Political Science, both from the University of Arizona and completed studies in Irish History at University College, Cork. Her current work interests and activities include: public policy related to open data, clean-energy development, and workforce training. Outside of work, Kim's hobbies include equestrian (Eventing & Dressage), downhill skiing, travel, historic preservation, and gardening.

UK Secretariat: University of Reading

Jane Lewis
WP 2 & WP 3 Lead
Deputy Technical Director, Reading e-Science Centre
j.p.lewis@reading.ac.uk
Tel: +44 (0) 118 378 5173

Following an MSc in computing science at Imperial College, London, Jane has worked in software and systems engineering in the telecomms and defence industry sectors, gaining experience in system design & architecture, documentation, code & testing, team and engineering management, and latterly with a strong emphasis on quality process improvement whilst running the technical team delivering an urgent complex defence project. After a short break in 2011/12 to do an MSc in meteorology at Reading University, Jane now works at ReSC in the role of deputy technical director which requires the application of engineering skills to the software work packages in research projects undertaken in the department, and where she is able to combine industrial experience in mapping systems and in the software delivery process with meteorological subjects such as environmental data.

Kim Oakley
WP 5 Lead & WP 4 Support
F/T PA & Administrator, P/T MRes Student, Dept. of Meteorology (Harry Pitt)
k.oakley@reading.ac.uk
Tel: +44 (0) 118 378 7765

Kim is the full time Administrator and PA for Meteorology (Harry Pitt) academics at the University of Reading. In addition to PA work for 3 Professors (including Professor R. Gurney OBE) Kim also provides administrative support to 50 research scientists & PhD students, and assists with the Space Internship Network (SpIN). Kim is a Philosopher with a degree from Kent University and postgraduate qualifications in Psychology and Horticulture. More recently Kim has obtained funding to complete a Research Masters (MRes) in Informatics part-time, where she is focusing on citizen science crowdsourcing and its potential use for international collaborative research projects of the future.

Appendix III: Group of Programme Coordinators

Below is information for each of the contact points for participating Belmont Forum agencies.

Partner Country	**Contributing Partner Organizations**	**Group of Programme Coordinators Member**
Australia	The Commonwealth Scientific and Industrial Research Organization (CSIRO)	Jenny Baxter Jenny.Baxter@csiro.au
Brazil (Sao Paulo)	São Paulo Research Foundation (FAPESP)	Diego Felipe Muñoz dmunoz@fapesp.br
European Union	European Commission	Michel Schouppe Michel.Schouppe@ec.europa.eu
France	Agence Nationale de la Recherche (ANR)	Jean-Yves Berthou Jean-yves.BERTHOU@agencerecherche.fr Mathieu Girerd Mathieu.GIRERD@agencerecherche.fr
Germany	Bundesministerium für Bildung und Forschung (BMBF)	Svetlana Thaller-Honold Thaller-honold@vdi.de Kristin May[KCR2] kristin.may@bmbf.bund.de Volkmar Dietz Volkmar.Dietz@bmbf.bund.de
Germany	Deutsche Forschungsgemeinschaft (DFG)	Johannes Karte Johannes.Karte@dfg.de
ICSU	International Council for Science (ICSU)	Steven Wilson steven.wilson@icsu.org
Italy	CNR	Dr. Enrico Brugnoli enrico.brugnoli@cnr.it
Japan	Japan Society and Technology Agency (JST)	Geng Tu tu@jst.go.jp

South Africa	National Research Foundation (NRF)	Achu Enow a.enow@nrf.ac.za
United Kingdom	Natural Environment Research Council and Economic and Social Research Council (NERC)	Sophie Hodgson slh601@nerc.ac.uk Michelle Manning mcman@nerc.ac.uk
United States of America	National Science Foundation (NSF)	Maria Uhle muhle@nsf.gov Kevin Rose krose@nsf.gov Kelly Watson kewatson@nsf.gov

Support for Programme Secretariat: Theme Programme Office (TPO):
National Science Foundation (NSF), USA
Natural Environment Research Council (NERC), United Kingdom

Maria Uhle muhle@nsf.gov; Kevin Rose krose@nsf.gov; Kelly Watson kewatson@nsf.gov
Gina Adams gadams@nerc.ac.uk Sophie Hodgson slh601@nerc.ac.uk