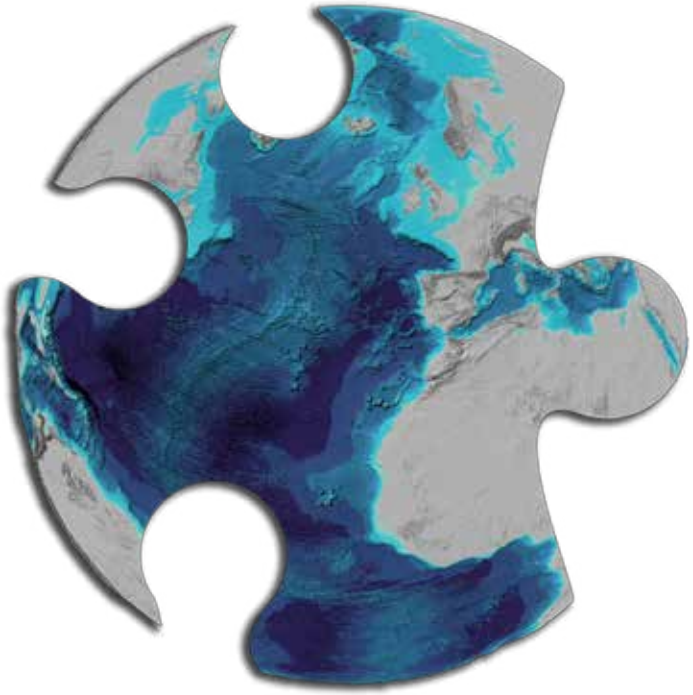
FORUM PROGRAMME AND MATERIALS

The Nippon Foundation-GEBCO

Forum *for* Future Ocean Floor Mapping



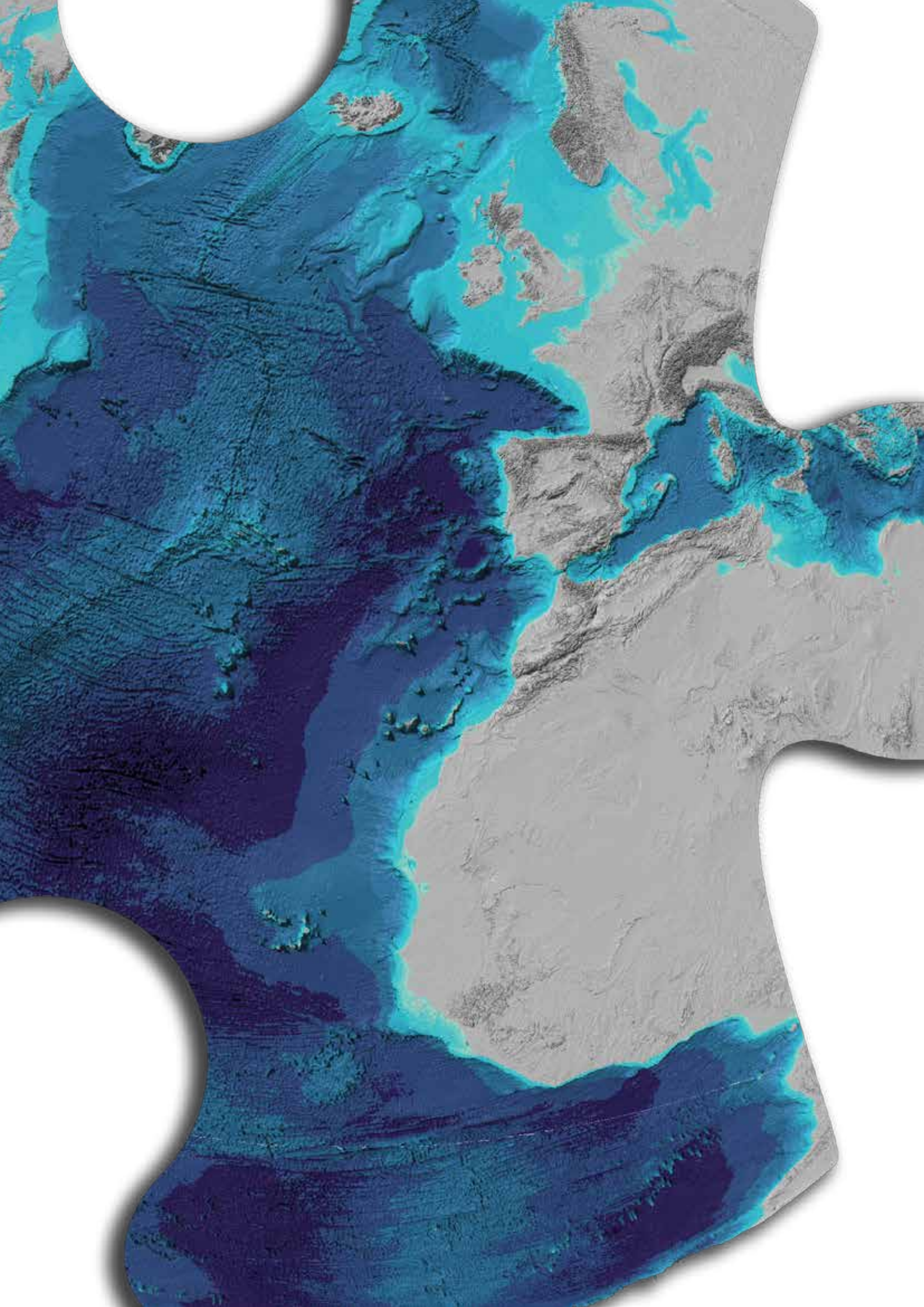
Monaco
15-17 June 2016

THE NIPPON FOUNDATION

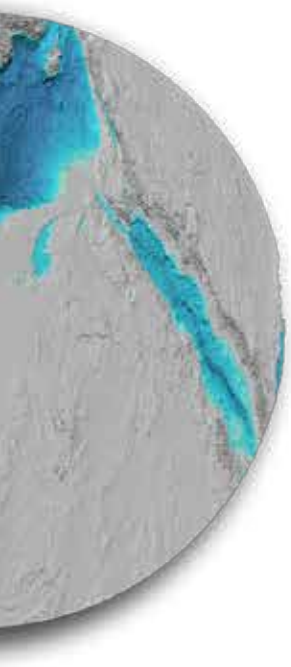
General Bathymetric Chart of the Oceans GEBCO

United Nations Educational, Scientific and Cultural Organization

Intergovernmental Oceanographic Commission



Welcome



Dear Forum for Future Ocean Floor Mapping attendees,

Thank you for your joining us at The Nippon Foundation-GEBCO's Forum for Future Ocean Floor Mapping here in Monaco.

Defining the shape of the world's ocean floor underpins a broad range of human activity associated with the oceans of the world. As we know, bathymetry is the primary instrument for a better understanding of coastal erosion, storm surges, the threat of tsunamis, and ocean currents and tidal flows worldwide. It is the key for assessing the impact of sea-level rises, lies at the heart of safe navigation and is the basis of exploration for oil, gas and mineral resources.

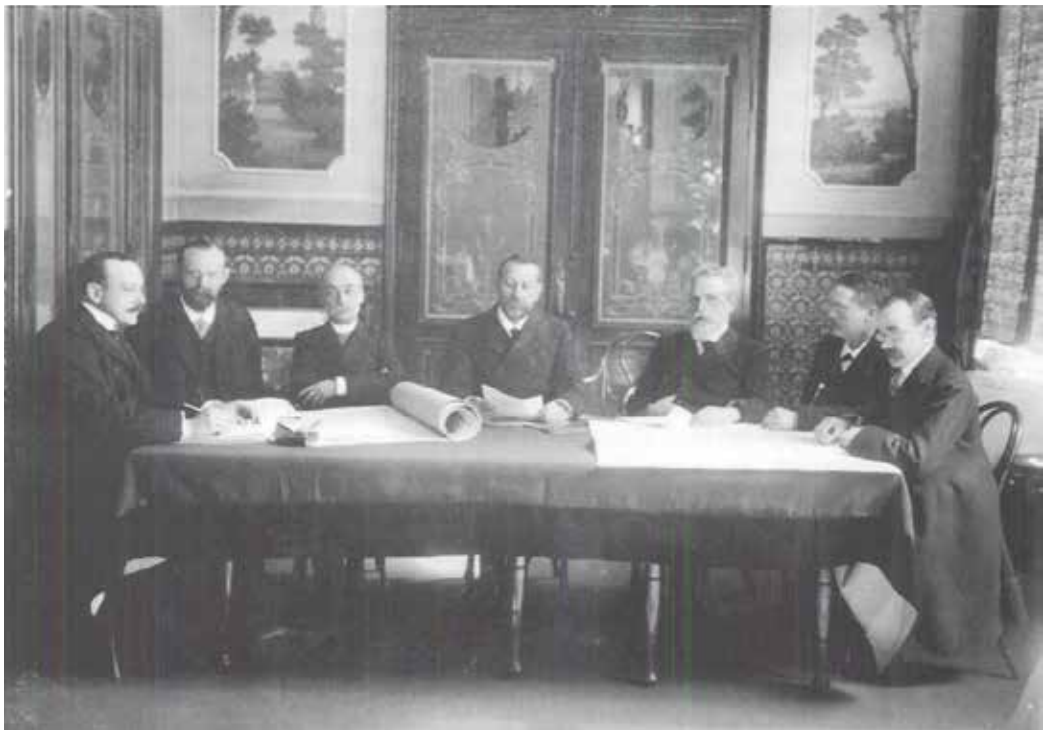
GEBCO's team has been working hard to prepare this programme and I am pleased to bring you this programme and Forum material.

I look forward to working with you over the next few days in Monaco.

Sincerely,

Shin Tani

Shin Tani
Chairman of the GEBCO Guiding Committee



The founding meeting of GEBCO, from 1903, led by HSH Prince Albert I of Monaco

Contents

Agenda and timings

Tuesday, 14 June, 2016	Novotel Monte Carlo Hotel
0900 - 1700	**Registration** – Novotel Monte Carlo Hotel lobby
1800 - 2100	**Icebreaker** – Novotel Monte Carlo Hotel Terrace, 7th floor

Wednesday, 15 June	Monaco Oceanographic Museum	
08:00	**Departure by bus from Novotel Monte Carlo Hotel to Monaco Oceanographic Museum**	
08:15 - 08:45	**Registration Monaco Oceanographic Museum Lobby**	
09:00	**All seated** – await arrival of HSH Prince Albert II	
09:35	**Address by the Chair of the GEBCO Guiding Committee – Shin Tani**	
09:45	**Address by the Chair of The Nippon Foundation – Yohei Sasakawa**	
09:55	**Address and Forum opening by HSH Prince Albert II**	
10:15 - 11:00	Posters. Tea/Coffee Break	
11:00 - 11:10	**IHO opening address**	**Robert Ward,** International Hydrographic Bureau
11:10 - 11:20	**IOC opening address**	**Thorkild Aaurp**, Head of the Tsunami Unit and Technical Secretary of the Global Sea Level Observing System, IOC
11:20 - 11:50	**Keynote speaker 1**	**Robert Ballard,** Center for Ocean Exploration, Graduate School of Oceanography/URI and Ocean Exploration Trust
11:50 - 12:20	**Keynote speaker 2**	**Larry Mayer,** Center for Coastal and Ocean Mapping/ Joint Hydrographic Center, UNH
12:20 - 12:50	**Keynote speaker 3**	**David Heydon,** Deep Sea Mining Expert
13:00 - 14:00	Posters. Lunch, provided by Forum.	
14.00 - 14.30	**Keynote speaker 4**	**Kristina M. Gjerde,** International Union for Conservation of Nature (IUCN)/Wycliffe Management
14.30 - 15:00	**Keynote speaker 5**	**Jyotika Virmani,** XPRIZE Foundation
15:00 - 15:30	Posters. Tea/Coffee Break	
15.30 - 16.00	**Keynote speaker 6**	**Bjorn Jalving,** Kongsberg Maritime, Subsea Division
16:00 - 16:30	**Keynote speaker 7**	**Simon Winchester,** Author
16:45	Departure by bus from Monaco Oceanographic Museum to Novotel Monte Carlo	
19:00	Departure by bus from Novotel Monte Carlo to Monaco Yacht Club	
19:30	Gala Function at Monaco Yacht Club	
22:00	Departure by bus to Novotel Monte Carlo Hotel from Monaco Yacht Club	
22:30	Departure by bus to Novotel Monte Carlo Hotel from Monaco Yacht Club	

Agenda and timings

Thursday, 16 June	Novotel Monte Carlo Hotel, Level 0
09:00 - 10:30	**Panel 1 – Use of bathymetry: The deep ocean perspective** **Moderators:** **Asahiko Taira,** JAMSTEC, Japan **Vicki Ferrini,** GEBCO, USA
10:30 - 11:00	Posters. Tea/Coffee Break
11:00 - 12:30	**Panel 2 – Use of bathymetry: The coastal perspective** **Moderators:** **Larry Mayer,** CCOM/JHC, USA **Marzia Rovere,** GEBCO, Italy
12:30 - 13:30	Posters. Lunch Provided by Forum at Hotel
13:30 - 15:00	**Panel 3 – New tools and techniques in ocean mapping** **Moderators:** **Dawn Wright,** ESRI, USA **Martin Jakobsson,** GEBCO, Sweden
15: 00 - 15:30	Posters. Tea/Coffee Break
15:30 - 17:00	**Panel 4 – Mapping the world ocean floor** **Moderators:** **Craig McLean,** NOAA, USA **Lisa Taylor,** GEBCO, USA
17.00 - 17:15	**Workshop organization session**
19.00	Prearranged Dinner at Novotel Monte Carlo Hotel, provided by Forum

Friday, 17 June	Novotel Monte Carlo Hotel, Level 0 and Level 2
09.00 - 10:00	**Concurrent Workshop Sessions.** Breakout into focus groups with pre-identified leaders from industry and academia. All participants will be assigned to specific focus groups.
10:00 - 10:30	Posters. Tea/Coffee Break
10:30 - 11:30	**Concurrent break-out Sessions.** All participants will rotate to next concurrent Workshop Session.
10:00 - 10:30	Break for transition
11.30 - 12:30	**Concurrent break-out Sessions.** All participants will rotate to next concurrent Workshop Session
12.30 - 14:00	Posters. Lunch, provided by Forum at Hotel.
14:00 - 15:00	**Concurrent break-out Sessions.** All participants will rotate to next concurrent Workshop Session.
15.00 - 15:45	Posters. Tea/Coffee Break
15.45 - 17:00	**Plenary: Way-forward session, draft Forum communiqué. Closing of the Forum**
19:00	Informal Dinner at Novotel Monte Carlo Hotel, provided by Forum

Programme for the Forum

DAY ONE Wednesday, 15 June, 2016

Opening speakers

HSH Prince Albert II

Shin Tani, Chair of the GEBCO Guiding Committee

Yohei Sasakawa, Chair of The Nippon Foundation

Robert Ward, President of the IHB

Thorkild Aaurp, Head of the Tsunami Unit and Technical Secretary of the Global Sea Level Observing System, IOC

Keynote speakers

Robert Ballard, Center for Ocean Exploration, Graduate School of Oceanography/URI and Ocean Exploration Trust

Larry Mayer, Center for Coastal and Ocean Mapping/Joint Hydrographic Center, UNH

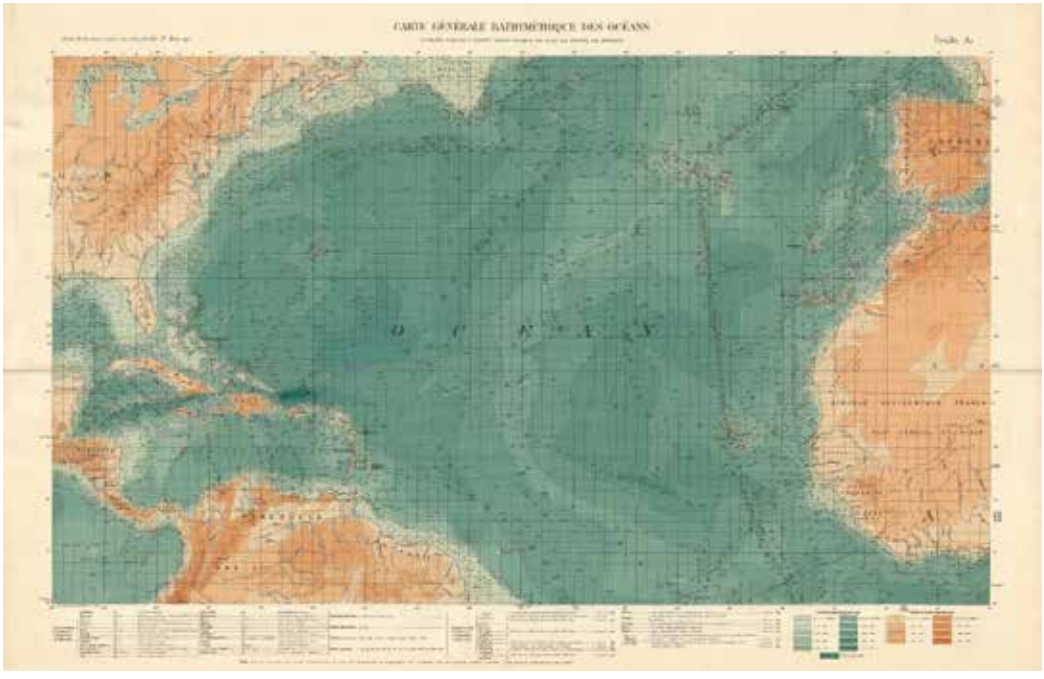
David Heydon, Deep Sea Mining Expert

Kristina M. Gjerde, International Union for Conservation of Nature (IUCN)/Wycliffe Management

Jyotika Virmani, XPRIZE Foundation

Bjorn Jalving, Kongsberg Maritime, Subsea Division

Simon Winchester, Author



From the 1912 second edition the paper General Bathymetric Chart of the Oceans

Programme for the Forum

DAY TWO Thursday, 16 June, 2016

Panel Discussions

The main objective of the panel discussions is to draw from multiple perspectives the use of shallow and deep water bathymetry, new ocean mapping tools and techniques and innovative ways to map the ocean floor. The resulting insights, ideas, recommendations and outstanding questions will feed into the development of a ***"Road Map for Future Ocean Floor Mapping"***, which we will begin drafting during Day Three of the Forum.

The panel sessions will be held sequentially, as they are designed to build on, and complement each other. The panels will consist of five experts, each with broadly different experience, work areas and perspectives. The panelists and moderators will start the sessions by providing a 2-minute introduction and explanation of the unique perspective that they each bring to the discussion. The moderators will then set questions for the panelists starting with those listed below and engage the audience in an open discussion to explore the topics. All Forum attendees will have the opportunity to ask questions and participate in live polls during the panel discussion via a custom smart phone application designed by PowerVote (see back cover). The application will also serve to connect participants and provide Forum information such as profiles and contact information, logistics, documents, agendas, etc.

Panel 1 – Use of bathymetry: The deep ocean perspective

Moderators:

- **Asahiko Taira**, JAMSTEC, Japan
- **Vicki Ferrini,** GEBCO, Lamont–Doherty Earth Observatory, USA

Panel members:

Brian Perratt, Global Marine Systems, United Kingdom
Boris Dorschel, Alfred Wegener Institute, Germany
Juvenal Shiundu, International Maritime Organization, London, United Kingdom
Jennifer Jencks, NOAA (North Atlantic Mapping Program & US ECS Program Office), USA
Razali Ahmad, Petronas Exploration, Malaysia

Questions:

- *Who are the users of deep ocean bathymetry?*
- *What bathymetric products do users want?*
- *At what resolution does the deep ocean need to be mapped?*
- *How much bathymetry is still perceived as necessary in the discovery, study and protection of deep sea extreme ecosystems?*
- *How much bathymetry is essential to environmental management plans that have to be established in areas beyond national jurisdiction?*
- *How can bathymetry be effectively used to identify Marine Protected Areas in areas beyond national jurisdiction?*

Programme for the Forum

Panel 2 – Use of bathymetry: The coastal perspective

Moderators:

- **Larry Mayer,** Center for Coastal and Ocean Mapping/JHC, UNH, USA
- **Marzia Rovere,** GEBCO, Istituto di Scienze Marine/CNR, Italy

Panel members:

Nadia Pinardi, Bologna University, Italy
Thomas Furey, INFOMAR, Ireland
Shep Smith, Office of Coast Survey/NOAA, USA
Peter Harris, GRID-Arendal, Norway
Sjoerd van den Brom, Boskalis, The Netherlands

Questions:

- *Who are the users of shallow water bathymetry?*
- *What bathymetric products do users want?*
- *At what resolution do the coastal areas need to be mapped?*
- *What are the emerging conflicting uses of the coastal areas and how can a better knowledge of bathymetry mitigate these conflicts?*
- *What data resolution is needed for effective hazard and tsunami mitigation programs?*
- *What data resolution is needed for effective oceanographic modelling?*
- *How far are we from an adequate seafloor morphology mapping of the world continental margins?*

Panel 3 – New tools and techniques in ocean mapping

Moderators:

- **Dawn Wright,** ESRI, USA
- **Martin Jakobsson,** GEBCO, Stockholm University, Sweden

Panel members:

Duncan Mallace, QPS, United Kingdom
Paul Cooper, CARIS BV, USA
Bjorn Jalving, Kongsberg Subsea Division, Norway
Hans Öiås, Swedish Maritime Administration, Sweden

Questions:

- *Who are the users of commercial and open source software?*
- *How strong is the demand for innovative software tools in response to the new technology of multibeam systems?*
- *Interferometry vs multibeam?*
- *How can we leverage cloud computing and Big Data?*
- *What are the key developing survey technologies?*
- *How can satellite-derived bathymetry be integrated in the bigger picture?*

Programme for the Forum

Panel 4 – Mapping the world ocean floor

Moderators:

- **Craig McLean,** Office of Oceanic and Atmospheric Research/NOAA, USA
- **Lisa Taylor,** GEBCO, National Centers for Environmental Information/NOAA, USA

Panel members:

Dick Schaap, Mariene Informatie Service, Netherlands
David Millar, Fugro Pelagos, USA
Peter Heffernan, Marine Institute, Ireland
Suzanne Carbotte, Lamont–Doherty Earth Observatory, USA
Thierry Schmidt, Naval Hydrographic and Oceanographic Service/SHOM, France

Questions:

- *How can we best identify current gaps in bathymetric coverage based on geography, depth, and resolution?*
- *How can we engage more mariners to contribute crowdsourced bathymetry?*
- *What is the potential for campaign type efforts to map areas of the ocean floor? Crowdsourced bathymetry?*
- *What are the barriers to sharing bathymetric data and how can we overcome them?*
- *How is industry tackling this challenge?*
- *What processes and practices are working well and how can we build upon them?*
- *How can we leverage satellite-derived bathymetry for mapping sensitive coastal areas?*
- *What partnerships can we foster with governments, industry, NGO's and institutes to get this done?*

DAY THREE Friday, 17 June, 2016

Roadmap Workshop

The primary objective of the Roadmap Workshop is to begin the development of a *"Roadmap for Future Ocean Floor Mapping"* to enable us to realize the vision of achieving 100% ocean floor coverage.

The workshop will begin with four concurrent breakout sessions, each corresponding to one of the four panel subjects from Day Two to start to develop preliminary roadmap sections. Participants will draw on the insights, ideas, recommendations and outstanding questions compiled from the panel discussions as well as their own experience and perspective. In the afternoon, participants will come back together in plenary, when the breakout groups will each present on progress toward the Roadmap. The Draft Roadmap resulting from Day Three will be further developed after the Forum.

Each workshop session will be led by a facilitator and assisted by a rapporteur from the GEBCO community.

Workshop 1 **Use of bathymetry: The deep ocean perspective**
Facilitators: Asahiko Taira, JAMSTEC, Japan; Vicki Ferrini, GEBCO, USA

Workshop 2 **Use of bathymetry: The coastal perspective**
Facilitators: Larry Mayer, CCOM, USA; Marzia Rovere, GEBCO, Italy

Workshop 3 **New tools and techniques in ocean mapping**
Facilitators: Dawn Wright, ESRI, USA; Martin Jakobsson, GEBCO, Sweden

Workshop 4 **Mapping the world ocean floor**
Facilitators: Craig McLean, NOAA, USA; Lisa Taylor, GEBCO, USA

GEBCO – inspiring and coordinating the global effort to map the ocean floor

Scientists' vision of portraying the World Ocean floor on a series of maps inspired the initiation of the General Bathymetric Chart of the Oceans (GEBCO) in 1903. The birth of GEBCO followed from efforts by Prince Albert I of Monaco and Professor Julien Thoulet, University of Nancy, who both shared a strong passion for the ocean. This vision of portraying the depth and shape of the World ocean floor remains at the heart of GEBCO. Over the last 100 years, the ambition has evolved from developing a general bathymetric chart of the deep ocean to producing:

... a high-resolution digital map, from the coast to the deepest trench of the ocean that enables scientists to explore and understand how the ocean works, informs maritime policy and supports the management of natural marine resources for a sustainable Blue Economy.

GEBCO's ideas and vision follow from societal needs, scientific curiosity and technological developments. Knowing the bathymetry, i.e. depth of the ocean floor, is today recognized to be of vital importance not only for navigation and coastal management but also a growing variety of inter-related uses. Bathymetry is a fundamental parameter for studies of deep water circulation, tides, tsunami forecasting, upwelling, fishing resources, wave action, sediment transport, environmental change, slope stability, paleoceanography, site selection for platforms, cables, pipelines and renewables, waste disposal and mineral extraction and much more.

The satellite era has brought the capability to capture a general view of the shape of deep ocean floor. Beyond this general view are the high-resolution bathymetric details required to understand critical ocean processes and to manage our ocean resources. These details must be revealed using modern acoustic mapping technologies requiring coordination beyond individual national boundaries. As a project of both the International Hydrographic Organization (IHO) and Intergovernmental Oceanographic Commission (IOC) of UNESCO, GEBCO is in the best position to undertake a global coordinated effort to map the ocean floor, identify the areas of greatest need so that efforts can be prioritized and to increase the recognition of the importance of bathymetry in intergovernmental forums.

GEBCO recognizes that vast areas of the World ocean floor, especially those at great distances from coastal and national areas of jurisdiction, are far from adequately mapped. Mapping from the coasts to the deepest trench involves reaching beneath the virtually unknown realms of Polar ice shelves and pack ice covered oceans. These environments are less known today than the deep ocean was for Prince Albert I and Professor Julien Thoulet more than 100 years ago.

The journey towards GEBCO realizing our ambition of a global high-resolution digital map involves and requires that:

- *GEBCO, as an IHO and IOC project, being recognized as THE place to go for a wide range of global ocean mapping related information, data, products and expertise.*
- *GEBCO being the home of IHO and IOC ocean mapping expertise with a pool of people who are leaders in all aspects of this field. They include technology experts in industry as well as research organizations who work to develop leading edge technology, practical at-sea surveying experts, data processing experts, database managers, software developers, geologists and geophysicists and other relevant ocean scientists. These experts share a passion for GEBCO's vision, work with ocean mapping projects and advise groups and individuals involved with ocean mapping.*
- *GEBCO being universally respected as an IHO and IOC project, free of any political bias or constraints, enabling it to gather bathymetric data and resources from any nation, industry or governmental, research, academic organization. In return, GEBCO provides information back to all the communities and the public.*

GEBCO is committed to achieving this ambition through building the necessary technical, scientific and management capacity and by engaging with groups involved in the same pursuit. By managing training initiatives such as The Nippon Foundation/GEBCO Training Program at University of New Hampshire and bringing like-minded people together, GEBCO will continue to link individuals and organizations worldwide and enhance existing global networks to drive ocean mapping and a deeper understanding of the current and ancient processes shaping the ocean floor.

The Nippon Foundation / GEBCO Scholars

Since 2004, The Nippon Foundation has provided funding for GEBCO to train a new generation of scientists and hydrographers in ocean bathymetry at the University of New Hampshire in the United States. This is designed to build human capacity in key coastal states by supporting the development of future maritime leaders.

At the present time, 72 scholars from 33 counties have gained their Postgraduate Certificate in Ocean Bathymetry (PCOB). Six more scholars are starting their studies in September.

Students for the PCOB are selected by a competitive application process. Minimum qualifications for acceptance are a four year undergraduate degree in a related science or engineering discipline, and proof of ability to successfully complete a graduate level course in English.

COUNTRY	Up to Year 12
Argentina	1
Australia	1
Bangladesh	3
Barbados	1
Brazil	1
Chile	1
Columbia	1
Ecuador	1
Fiji	1
Ghana	1
India	2
Indonesia	4
Israel	2
Japan	12
Kenya	2
Malaysia	4
Mauritius	1
Mexico	2
Myanmar	2
Nigeria	1
Pakistan	2
Peru	3
Philippines	4
Poland	1
Portugal	1
Russian federation	3
South africa	2
Spain	1
Sri lanka	4
Suriname	1
Thailand	2
Venezuela	1
Vietnam	3

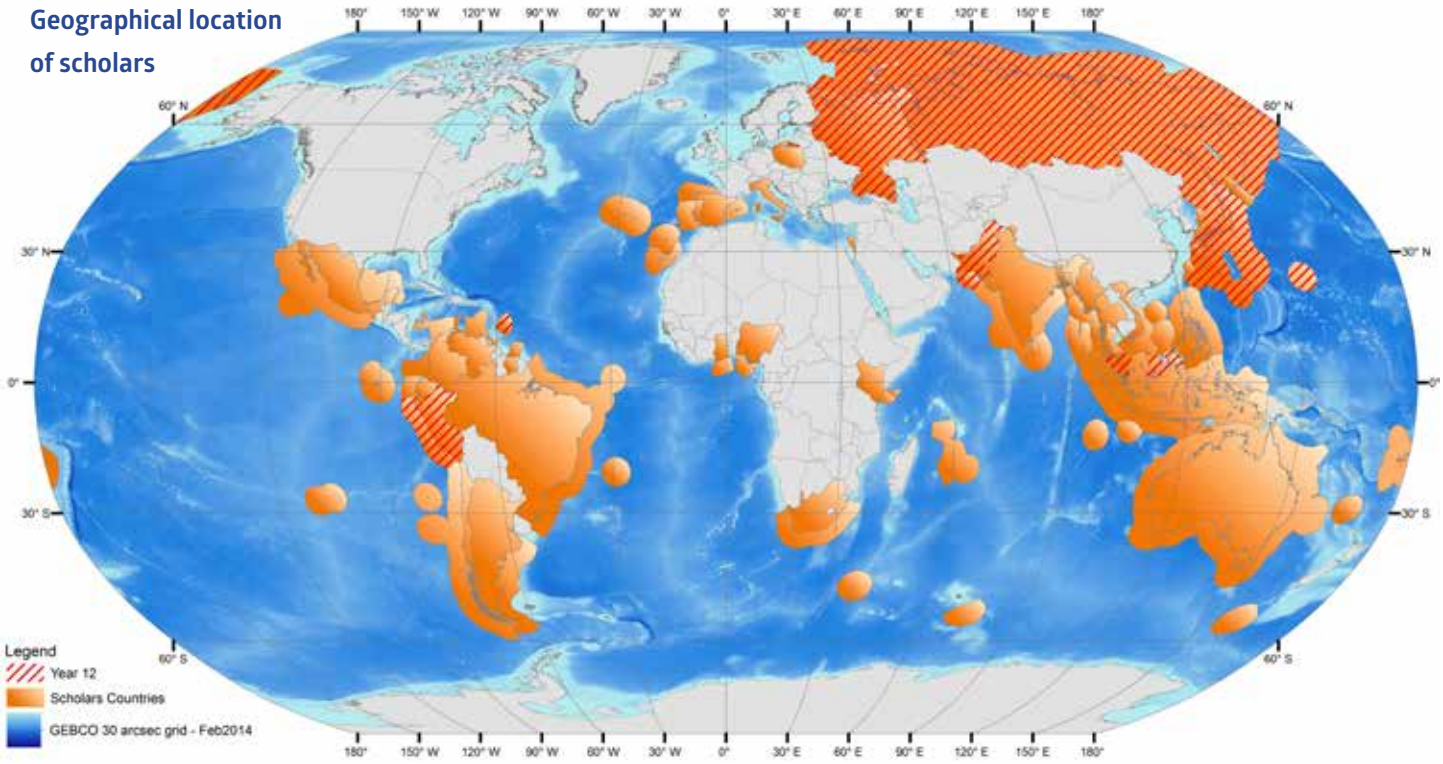
Bernice Mahabier - Year 6

The PCOB course was of great value for my career as a hydrographer, and for my country. Improving data quality, an overview of environmental aspects and being part of a world-wide network of specialist are a few of the benefits of this course. The lab visits gave me the opportunity to make the connection linking science and hydrography with ocean law and policy.

Nguyen Trung Thanh - Year 8

Since my return to Vietnam, I have exchanged and collaborated with Vietnam Navy in applying Multibeam systems. My colleagues in my institute and from Vietnam Navy have deployed a multibeam system and other devices in the South China Sea in the framework of marine projects that are under the management of my institute.

Geographical location of scholars



Profiles

The Principality of Monaco and GEBCO

The GEBCO chart series was initiated in 1903 by Prince Albert I of Monaco. The 7th International Geographic Congress (Berlin, 1899) had in fact nominated a Commission on sub-oceanic nomenclature, which was also responsible for the publication of a general bathymetric chart. The Commission convened in Wiesbaden (April 15-16, 1903), with Prince Albert I of Monaco in the chair, and adopted the characteristics defined in a memorandum by J. Thoulet.

The 24 sheets of *Carte générale bathymétrique des océans* printed in Paris in 1905, hastily prepared, were harshly criticised by E. de Margerie. Immediately Prince Albert decided that a new edition should be made for which a second commission convened in Monaco (1910). The second edition was printed from 1912 to 1931 with contour lines representing the terrestrial relief and a revised nomenclature. The use of sonic and ultrasonic devices increased the amount of data tremendously. The responsibility of the Chart was then transferred to an international organisation: the International Hydrographic Bureau.

For the third and fourth editions there was a major change in organization. Following the death of Prince Albert, his scientific team was disbanded and the International Hydrographic Bureau was invited to take over the project. Again delays were caused by war and, by 1972, only certain sheets of these editions had been published.

Following recommendations by the Scientific Committee on Oceanic Research (SCOR), it was then decided to modernize the whole series and bring in the expertise of the scientific community to meet the needs of present day users. The Intergovernmental Oceanographic Commission (IOC) of UNESCO was invited to cosponsor a 5th Edition, and strong support was provided by the Canadian government. With this structure in hand, the joint IHO-IOC GEBCO Guiding Committee was in a position to offer marine geoscientists in many countries of the world the possibility of publishing their work in a prestigious chart series of high quality. World coverage on the original scale of 1:10 million was completed and published by 1982, followed by a small scale world sheet in 1984.

Since the publication of the 5th Edition GEBCO chart series, and largely because of its success, considerable support has been forthcoming for GEBCO's work, and in 1994 the GEBCO Digital Atlas (GDA) on CD-ROM was published. The first release of the GDA was produced by digitising the bathymetric contours, coastline and shiptracks from the printed sheets of the 5th Edition. It represented the first seamless, high-quality, digital bathymetric contour chart of the world's oceans and now provides the base for the regular updating of GEBCO. A second release was published in 1997.

The latest release of the GDA, the Centenary Edition of the GEBCO Digital Atlas, was published in 2003 and last updated in 2015. It is available from the British Oceanographic Data Centre (BODC). It includes a global set of digital bathymetric contours and coastlines, the latest GEBCO 30 arc-second grid, GEBCO One Minute Grid and the GEBCO gazetteer of geographic names of undersea features. It is accompanied by software for viewing and accessing the data sets.

In 2009, GEBCO released the GEBCO_08 Grid a global grid at 30 arc-second intervals. The grid was generated by combining quality-controlled ship depth soundings with interpolation between sounding points guided by satellite derived gravity data. An updated version of the grid was released in 2010. GEBCO's latest global bathymetric grid at 30 arc-second intervals is the GEBCO_2014 Grid, released in December 2014. It is based on the GEBCO_08 Grid but includes a number of new data sets and regional bathymetric compilations.

In order to widen the GEBCO community and to encourage more younger scientists and hydrographers to become involved in mapping the ocean floor, The Nippon Foundation is sponsoring the training of a new generation of ocean bathymetrists through the Postgraduate Certificate in Ocean Bathymetry (PCOB) at the University of New Hampshire (UNH), USA.

Profiles

The Nippon Foundation

The Nippon Foundation, a private, non-profit foundation was established in 1962 for the purpose of carrying out philanthropic activities, using revenue from motorboat racing. The Foundation's overall objectives include social innovation, assistance for humanitarian activities and global ocean management. Its philanthropic ideals embrace social development and self-sufficiency, and it pursues these principles by working to improve public health and education, alleviate poverty, eliminate hunger and help the disabled.

Since its formation, the Foundation has put a considerable amount of effort into marine capacity building. However, with ocean issues becoming increasingly complex and serious, the Foundation is increasingly becoming concerned that we will be unable to pass on sustainable and healthy oceans to future generations. The Nippon Foundation believes that effective solutions cannot be developed without interdisciplinary and international collaborative efforts, extending beyond the traditional maritime community. Thus, the Foundation aims at building human capacities and creating bonds that transcend national and organizational boundaries. In addition, the Foundation promotes dialogue on global ocean issues and the search for viable solutions.

Such efforts cannot come into effect if the people who can put them into practice are not available around the world. Therefore, one of the Foundation's major commitment is on global capacity building for the world's oceans for nearly 30 years; more specifically, fellowship programmes with various institutes around the world, These programmes cover various fields related to the oceans including global ocean governance, ocean floor mapping, global ocean observation, wellbeing of seafarers, future state of the world's oceans, overfishing and environmental degradation. More than 1,100 fellows and alumni from 132 countries make up The Nippon Foundation fellows' network today.

One example of these fellowship programmes that has, so far, been very successful is the NF-GEBCO Training Programme. Around six students are selected every year to participate in a one-year postgraduate course at the University of New Hampshire on seafloor mapping. The first fellows started the course in 2004 and currently the 12th year group is receiving training.

The Nippon Foundation is currently establishing new platforms that allow fellows/alumni of our fellowship programmes including the NF-GEBCO Programme, not only to collaborate within each programme's fellow network but also to collaborate between each programme's network. The Foundation believes that such platforms are important to enable collaborative efforts to be developed with long-term perspectives for the world's oceans.

For further information on each of our ocean-related fellowship programmes, please go to:

http://www.nippon-foundation.or.jp/en/what/grant/maritime/

Yohei Sasakawa

Yohei Sasakawa is Chairman of The Nippon Foundation, which has been committed to ocean-related issues for over half a century. He was awarded the prestigious International Maritime Prize for 2014 by the International Maritime Organization (IMO) for his contribution to supporting the development of future maritime leaders and to enhancing safety and security in vital shipping lanes.

Mr Sasakawa has long been dedicated to ocean-related human resource development. Through the initiatives of The Nippon Foundation, together with the World Maritime University (WMU), based in Malmo, Sweden, the IMO International Maritime Law Institute (IMLI) in Malta and other organizations, a new generation of ocean professionals has been nurtured.

He has also been instrumental in supporting the establishment of the Cooperative Mechanism in the Straits of Malacca and Singapore, a fund that enables coastal state governments and industry to work together to protect the environment and enhance navigational safety. The Nippon Foundation's support for research and technological projects on maritime safety and marine environment protection have been led by Mr Sasakawa.

Since 2003, he has served as WHO Goodwill Ambassador for Leprosy Elimination. His decades-long commitment to fighting leprosy and the social discrimination it causes is one of his most enduring initiatives. He is also Special Envoy of the Government of Japan for National Reconciliation in Myanmar.

Profiles

The International Hydrographic Organization (IHO)

The International Hydrographic Organization (IHO) was established in 1921 as the International Hydrographic Bureau (IHB). The present name was adopted in 1970 as part of a new international Convention on the IHO adopted by the then member nations. The former name, International Hydrographic Bureau, was retained to describe the IHO Secretariat, which coordinates and promotes the IHO's programmes and provides advice and assistance to Member States. The Secretariat comprises three elected Directors and a small staff at the Organization's headquarters in the Principality of Monaco, the official seat of the organization as a result of the offer of Albert I, Prince of Monaco, to provide suitable accommodations for the bureau. The IHO began its activities with 18 Member States and has now 85 members with 8 others in various stages of applying to join.

The IHO is the inter-governmental organization representing hydrography and its principal role is to ensure that the world's seas, oceans and navigable waters are properly surveyed and charted. The IHO develops hydrographic and nautical charting standards to be adopted and used by the Member States. The IHO coordinates the provision of hydrographic and nautical charting services across the world as well as operating a capacity building programme, aimed primarily at developing countries. The IHO publishes the international standards related to nautical charting and hydrography, including S-57, IHO Transfer Standard for Digital Hydrographic Data, the encoding standard that is used primarily for electronic navigational charts. In 2010 the IHO introduced a new hydrographic geospatial standard for modelling marine data and information, known as S-100. It is based on ISO geographic standard 19100.

The IHO enjoys observer status at the United Nations where it sits as the recognised competent authority on hydrographic surveying and nautical charting.

The IHO has encouraged the formation of 15 Regional Hydrographic Commissions (RHCs) and the IHO Hydrographic Commission on Antarctica (HCA). Each RHC coordinates the national surveying and charting activities of countries within each region and acts as a forum to address other matters of common hydrographic interest.

Most IHO publications, including the standards, guidelines and associated documents such as the *International Hydrographic Review, International Hydrographic Bulletin*, the *Hydrographic Dictionary* and the *Year Book* are available from the IHO website free of charge.

In 2005, the IHO adopted the concept of a World Hydrography Day, which was welcomed by the United Nations General Assembly in resolution A/RES/60/30 Oceans and the Law of the Sea. The date chosen for World Hydrography Day is June 21, the anniversary of the founding of the International Hydrographic Organization. A theme for each World Hydrography Day is chosen by the Member States and is intended to promote the importance of hydrography internationally. The theme for 2016 is "Hydrography - the key to well-managed seas and waterways".

Robert Ward

Robert Ward was elected as the President of the secretariat of the IHO. He assumed the office in September 2012, after serving the previous five years as the secretariat Director responsible for the IHO technical programme.

Ward was born in England and joined the Royal Australian Navy after 13 years service in the British Royal Navy. He retired from the navy in 2007 in the rank of Captain.

During a naval career of 37 years, more than 20 of which were spent in ships, including in command, he developed a wide experience of hydrographic and oceanographic surveying around the world. He also served for a short time as a deck officer in the British Merchant Navy. Ashore, his experience has included the training of hydrographers both in the UK and as the Head of the Royal Australian Navy Hydrographic School. His last position in the Navy was as Deputy Hydrographer of Australia. Robert Ward has a long history of involvement in the implementation and development of the standards and regulations associated with electronic chart navigation and digital hydrographic data both in the IHO and in the IMO.

Profiles

Intergovernmental Oceanographic Commission of UNESCO

The UNESCO's Intergovernmental Oceanographic Commission (IOC) was established by resolution 2.31 adopted by the General Conference of UNESCO in 1960. It first met in Paris at UNESCO Headquarters from 19 to 27 October 1961. Initially, 40 States became members of the Commission and currently there are 148 Member States.

The IOC promotes international cooperation and coordinates programmes in marine research, services, observation systems, hazard mitigation and capacity development in order to understand and effectively manage the resources of the ocean and coastal areas. The IOC assists governments to address their individual and collective ocean and coastal management needs, through the sharing of knowledge, technology and decision-making processes with respect to marine resources, climate variability and sustainable development of the marine environment, in particular in developing countries.

The IOC coordinates ocean observation and monitoring through the Global Ocean Observing System (GOOS), which aims to develop a unified network providing information and data exchange on the physical, chemical, and biological aspects of the ocean. GOOS serves as the ocean component of the Global Climate Observing System (GCOS). IOC sponsors the World Climate Research Programme (WCRP). IOC own work in ocean observation and science and the work of GOOS and WCRP contribute to building the scientific knowledge of climate and its change. UNESCO-IOC is co-convener with the World Meteorological Organization of the World Climate Change Conference.

The IOC also coordinates and fosters the establishment of regional intergovernmental coordinating tsunami warning and mitigation systems in the Pacific and Indian Oceans, in the North East Atlantic, Mediterranean and Caribbean seas. The IOC is in close cooperation also with a number of Member States to strengthen their national Early Warning Services and Preparedness for Coastal Hazards.

The IOC is composed of its Member States, an Assembly, an Executive Council and a Secretariat. The Secretariat is based in Paris. Additionally the IOC has three regional Sub-Commissions: IOC Sub-Commission for Africa and the Adjacent Island States (IOCAFRICA), IOC Sub-Commission for the Caribbean and Adjacent Regions (IOCARIBE), and IOC Sub-Commission for the Western Pacific (WESTPAC). Other outstanding regional body is the Regional Committee for the Central Indian Ocean (IOCINDIO). These regional subsidiary bodies are respectively supported by regional secretariats located in Nairobi, Kenya, Cartagena, Colombia, and Bangkok, Thailand.

There are a number of programme/project offices that complement and reinforce the IOC's field presence: The Perth Regional Programme Office in Australia; Data Buoy Cooperation Panel (DBCP) Argo Project Office (JCOMMOPS) in Brest, France; The IOC Science and Communication Centres on Harmful Algae in Copenhagen, Denmark; the International Oceanographic Data and Information Exchange (IODE) and the Secretariat for the Ocean Biogeographic Information System (OBIS) in Oostende, Belgium.

The IOC has defined its vision and 4 High Level Objectives in the context of its Medium Term Strategy for 2014-2021:

Vision:

"Strong scientific understanding and systematic observations of the changing world ocean climate and ecosystems shall underpin sustainable development and global governance for a healthy ocean, and global, regional and national management of risks and opportunities from the ocean."

High Level Objectives:

1. Healthy ocean ecosystems and sustained ecosystem services.
2. Effective early warning systems and preparedness for tsunamis and other ocean-related hazards.
3. Increased resiliency to climate change and variability and enhanced safety, efficiency and effectiveness of ocean-based activities through scientifically-founded services, adaptation and mitigation strategies.
4. Enhanced knowledge of emerging ocean science issues.

Profiles

Vladimir Ryabinin

Vladimir Ryabinin has been appointed to the post of Executive Secretary of the IOC, at the level of Assistant Director-General of UNESCO, in 2015.

He began his professional career by conducting theoretical studies of the ocean circulation and variability and the role of the ocean in climate. Ryabinin was one of the creators of the first Soviet technology for numerical weather prediction for medium ranges (up to a week) implemented in the mid-1980s. From 1989-1993, he developed a spectral model for the prediction of wind waves on the ocean surface. During that period he lectured at the Moscow State University and participated in a number of offshore engineering projects. Ryabinin obtained the academic degree of a Senior Doctorate in Oceanography and Geophysics in Moscow, in 1995. In 1996-1998, Ryabinin was the Head of the Laboratory for Marine Forecasting Research and Coordinator of national research on marine forecasting. In 1998 he was appointed Principal Scientist at the Euro-Mediterranean Centre on Insular Coastal Dynamics based in Malta. In 2001, Ryabinin joined the International Ocean Institute in Malta, initially as a consultant, and later as its Executive Director. From 2001 to 2015, Ryabinin was a Senior Scientific Officer of the World Climate Research Programme and a staff member of the World Meteorological Organization.

Ryabinin contributed to the design and setup of several important international and national programmes and initiatives, such as GOOS, JCOMM, Global Cryosphere Watch, International Polar Year 2007-2008, Federal Programme "World Ocean" of the Russian Federation, etc. He has authored and/or co-authored a monograph and approximately a hundred articles and publications, mostly in the domains of oceanography, meteorology and climate.

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Petermann Glacier Greenland expedition 2015.

Shin Tani

Shin Tani is the current Chairman of the joint IHO-IOC GEBCO Guiding Committee since October 2013. Before that, he has made a major contribution to GEBCO's work and activities for more than 24 years.

He holds a Master of Science (MSc) in Geophysics from the Post Graduate School of Kyoto University, obtained in 1978, and served the Japan Coast Guard as Vice Admiral. He is the 44th Chief Hydrographer of Japan since 1871.

He is a Member of IHO-IAG ABLOS (Advisory Board on the Law Of the Sea) and served as a member of the UJNR Sea Bottom Surveys Panel from 1979 to 2014. He has been Cabinet Counsellor for the Cabinet Secretariat of the Government of Japan in charge of ocean policy, renewable energy, ocean survey and monitoring, data management, marine cadastre, and UNCLOS Extended Continental Shelf. He was visiting Professor at the Kanazawa University in 2005-2010. He worked at the Japan Oceanographic Data Center (JODC) and the National Geophysical Data Center (NGDC).

© Martin Jakobsso

Mounted high-resolution multibeam sonar on the sailing vessel "Exploder of Sweden" during the expedition VEGA 2013, Northwestern Greenland.

Keynote speaker biographies

Robert D. Ballard

Director of the Center for Ocean Exploration, Graduate School of Oceanography, University of Rhode Island

President of the Ocean Exploration Trust, which owns and operates the E/V NAUTILUS.

Education

- B.S. Physical Science (majoring in Geology and Chemistry), University of California, Santa Barbara, 1965
- Ph.D. in Marine Geology and Geophysics, University of Rhode Island, Graduate School of Oceanography, 1974

While a student at UC Santa Barbara, Ballard completed an officer training program in the US Army and, in 1967, he was called to active duty. Upon his request, Ballard was transferred into the US Navy as an oceanographer and was assigned by the Office of Naval Research to the Woods Hole Oceanographic Institution. After completing his active duty obligation in 1970, Ballard was transferred back to reserve status, where he remained for much of his 30-year military career, being called up only for special assignments. He retired from the Navy as a commander in 1995 after reaching the statutory service limit.

In 1977, Ballard was Co-Chief Scientist of the cruise which first discovered hydrothermal vents along the Galápagos Rift, a spur of the East Pacific Rise, using his remotely towed vehicle ANGUS followed by dives conducted by Alvin, a research submersible from Woods Hole. His research and his scuba diving experiences soon inspired his interest in shipwrecks and he became obsessed with the dream of finding the wreck of the Titanic.

In 1985, Ballard was placed on temporary active duty in the Navy, in charge of investigating the wrecks of two lost nuclear submarines that had sunk nearby the Titanic. Dr. Ballard, on board the R/V Knorr and using Argo, an unmanned deep-towed undersea video camera sled developed by himself, found the thousands of pieces of debris that had littered from the submersibles and sighted the wreck of the Titanic. In 1986, Ballard returned on board Atlantis II to make the first detailed study of the wreck, using the submersible Alvin.

In the following years Ballard found many other shipwrecks around the world, such as the Bismarck in 1989, the Yorktown in 1998 and the wreck of John F. Kennedy's PT-109 off the Solomon Islands in 2002.

A series of expeditions conducted by Ballard in the Black Sea, between late 90's and 2000, identified ancient shorelines, freshwater snail shells, and drowned river valleys supporting the theory that the Black Sea might have been the location for the Biblical Flood. The research team also discovered ancient wrecks close to the town of Sinop at depths of 750 m, radiocarbon dated to the late Roman and Byzantine periods, unveiling that Black Sea maritime trade was most intense between the 2nd and 7th centuries AD. More recently his team discovered a highly preserved shipwreck dating to the early Hellenic period that contained human remains.

In 1989, Ballard founded the JASON Project, a distance education program designed to engage millions of middle school students in science and technology.

In the 1990s Ballard founded the Institute for Exploration which joined forces in 1999 with the Mystic Aquarium part of the non-profit Sea Research Foundation. In 2004, Ballard was appointed professor of oceanography, and currently serves as Director of their Center for Ocean Exploration, at the University of Rhode Island's Graduate School of Oceanography.

In 2008, Ballard secured the E/V Nautilus, which has become his flag-ship for exploration, operated by the Ocean Exploration Trust and funded in part by NOAA's Office of Ocean Exploration. Nautilus is connected by way of a high bandwidth satellite link to the University of Rhode Island's Inner Space Center and from there to the world.

Ballard has been awarded and honored with an impressive range of honorary degrees and prestigious medals. He is currently a National Geographic Explorer-in-Residence. During his long career he has conducted more than 150 deep-sea expeditions.

What the Ocean Exploration Trust is

www.oet.org

The Exploration Vessel (E/V) Nautilus is a 64-meter research vessel currently based in Victoria, British Columbia. E/V Nautilus is on a global mission of exploration, so it has no true home port. The ship is operated by the Ocean Exploration Trust under the direction of Dr. Robert Ballard. Nautilus is equipped with

Keynote speaker biographies

a team of remotely operated vehicles (ROVs) Hercules, and Argus, a multibeam mapping system, and mapping tools Diana and Echo. All of these tools help the Ocean Exploration Trust conduct deep sea exploration of unknown parts of the ocean to a depth of 4,000 meters. E/V Nautilus also has a SeaTel satellite communication system to facilitate live streaming telepresence-enabled outreach and scientific collaboration. Video and data streams are managed through the Inner Space Center (ISC) at the University of Rhode Island's Graduate School of Oceanography. Live footage of exploration at sea can be viewed at www.NautilusLive.org during the expedition season. Around the world, various museums, science centers, after-school programs and schools participate in exploration through live ship-to-shore broadcasts. Audiences online or live at a partner venue can submit questions to the team of explorers, the Corps of Exploration to learn more about the mission and excitement of exploration. Education opportunities exist to bring scientists, students, educators and interns onto the ship to learn with the Corps of Exploration every exploration season.

Selected Publications

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Brennan, M.L. and R.D. Ballard (2014), Archaeological Oceanography. In Encyclopedia of Natural Resources; Wang, Y.Q., Editor; Taylor & Francis, New York,pp. 604-608, doi:10.1081/E-ENRW-120047573.

Larry Mayer

Director of the School of Marine Science and Ocean Engineering

Director of Center for Coastal and Ocean Mapping, University of New Hampshire

Education

- Degree in Geology, magna cum laude, University of Rhode Island, 1973
- Ph.D. in Marine Geophysics, Scripps Institution of Oceanography, 1979

At Scripps, Larry worked with the Marine Physical Laboratory's Deep-Tow Geophysical package, applying this sophisticated acoustic sensor to problems of deep-sea mapping and the history of climate. After being selected as an astronaut candidate finalist for NASA's first class of mission specialists, Larry went on to a postdoctoral position at the School of Oceanography at the University of Rhode Island, where he worked on the early development of the CHIRP sonar system. In 1991, he moved to the University of New Brunswick to take up the NSERC Industrial Research Chair in Ocean Mapping and in 2000, Larry became the founding director of the Center for Coastal and Ocean Mapping at the University of New Hampshire and the co-director of the NOAA/UNH Joint Hydrographic Center, as well as professor of earth science and ocean engineering. In 2014, he became the Director of the newly formed School of Marine Science and Ocean Engineering at UNH.

To date Larry has participated in more than 90 cruises in his professional career, and has been chief or co-chief scientist of numerous expeditions including two legs of the Ocean Drilling Program and eight mapping expeditions in the ice covered regions of the high Arctic. Larry has served on, or chaired, an impressive number of

Keynote speaker biographies

international panels and committees and has published many papers on a variety of topics in marine geology and geophysics.

Larry is the recipient of the Keen Medal for Marine Geology and an Honorary Doctorate from the University of Stockholm. He was a member of the President's Panel on Ocean Exploration, National Science Foundation's Advisory Committee for the Geosciences, and chaired a National Academy of Science Committee on national needs for coastal mapping and charting as well as the recently completed National Academies report on the impact of the Deepwater Horizon Spill on ecosystem services in the Gulf of Mexico. He was co-chair of NOAA's Ocean Exploration Advisory Working Group, and Vice-Chair of the Consortium of Ocean Leadership's Board of Trustees, and a member of the State Department's Extended Continental Shelf Task Force and the Navy's SCICEX Advisory Committee. He has been also scientific advisor of GEBCO in 1993–1998. He is currently the Chair of the National Academies of Science Ocean Studies Board.

Larry's current research deals with sonar imaging and remote characterization of the seafloor as well as advanced applications of 3-D visualization to ocean mapping problems and applications of mapping to Law of the Sea issues, particularly in the Arctic.

What CCOM/JHC is

http://marine.unh.edu/centers-excellence

The Center for Coastal and Ocean Mapping/Joint Hydrographic Center is located in the Chase Ocean Engineering Lab on the University of New Hampshire's Durham campus. The Centers focus on developing leading edge technology (LIDAR, sonar and AUVs) for advancing the ability to map and visualize the seafloor and the water column; training the next generation of hydrographic ocean mappers; advancing in coastal and ocean mapping; supporting safe navigation and coastal management.

CCOM/JHC has 19 teaching and research faculty members whose expertise ranges from marine acoustics and deep-sea photo and video mosaicking to airborne LIDAR and 4D visualization. Facilities feature state-of-the-art technology and two research vessels. The data Visualization Research Lab conducts research into 3D and 4D interactive techniques, multi-resolution rendering, database issues, and virtual reality applied to ocean-related problems. The School of Marine Science and Ocean Engineering, which makes use of the labs, is the University of New Hampshire's first 'interdisciplinary school', designed to address today's highly complex ocean and coastal challenges. Research and development focus on innovative approaches for the representation of uncertainty, complex time- and space-varying oceanographic, biological and geological processes, with a special look at Ocean Engineering and Marine Policy.

In partnership with The Nippon Foundation, GEBCO contracted the CCOM/JHC to develop and offer the Postgraduate Certificate in Ocean Bathymetry training program open to young scientists and hydrographers from around the world, primarily developing countries.

Selected Publications

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Keynote speaker biographies

David Heydon

Founder of DeepGreen Resources & Nautilus Minerals

Education

- University of New South Wales, Australia

David Heydon, is an applied geologist, with innovative technical expertise from over 35 years of experience in the onshore and offshore mining industries.

Recognised as a pioneer of the modern deep sea mining industry, David was the Founder and until 2008 President of Nautilus Minerals Inc., the world leader in commercial development for deepwater minerals.

Metals are demanded worldwide for infrastructure in emerging and developing states (manganese for steel), renewable energy (copper in wind turbines and electric cars) and battery storage (manganese, nickel and cobalt for batteries). Overall, land based copper mines are declining in grade with many new copper projects at a grade of only 0.5% copper requiring more movement of material to obtain copper. Nickel for stainless steel and storage batteries increasingly comes from land based nickel laterite projects such as those in New Caledonia and Madagascar that are impacting rainforests. High grade seafloor deposits could provide an alternative supply of these metals to the world to assist in improving the standard of living and infrastructure of developing states and with the global transition to widespread renewable energy generation and storage.

David personally raised $360M for Nautilus, with funds used to advanced science and knowledge of the ocean floor, its environment and of mineral forming processes together with the development of innovative technologies and techniques. He attracted the backing of leading mining companies such as Placer Dome, Teck Resources, Anglo American and Russia's Metalloinvest.

As CEO of Nautilus, David led numerous successful exploration cruises and was responsible for commissioning equipment design/builds, the world's first deep sea NI 43-101 Resource, a deep sea mining feasibility study as well as an Environmental Impact Assessment.

With a 227 metre long, 31 Mega Watt production support vessel currently being constructed in Fujian China and the three full scale, +200 tonne remote controlled seafloor production tools being 'wet tested', Nautilus has adapted existing technologies from the offshore oil and gas industry, dredging and mining industries to develop a system for the extraction of these high grade deposits on a commercial scale.

As a geoscientist with an engineering 'slant', David has a remarkable history of conceiving and delivering innovative and highly practical options and alternatives in the resources industry. While on a mineral drill ship offshore the western Pacific, he jointly conceived the remote controlled ROVdrill to overcome limitations of conventional drill ships for mineral exploration. Within 12 months from the initial concept, two ROVdrill's were operating commercially at 1,600 metre water depth testing a deep sea copper deposit.

Heydon, is more recently Founder & Deputy Chairman of DeepGreen Resources Inc. which plans to build a processing plant to use a patented 'green' process to treat polymetallic nodules from the deepsea abyssal plains to provide an additional supply of copper, nickel, cobalt and manganese to the world. To obtain the same metals as recovered from a single seafloor polymetallic nodule project would generally require the establishment of three separate mines on land, a copper mine, a nickel-cobalt mine and a manganese mine and related land and social impact. He sees many advantages of the 'new economy' deep sea mining over the 'old economy' traditional land based operations to provide key metals to support global social and economic development.

David received the Moore Medal in 2012 for his role in establishing an industry for the deep-sea mining of seafloor massive sulphides. Recently he was nominated for the 2016 Australian of the Year Awards.

Heydon was a former director of the International Marine Minerals Society and member of the International Society of Offshore and Polar Engineers. He has a practical working knowledge of the International Seabed Authority and UNCLOS and is an invaluable member of work shops, working groups and committees where he can proffer a practical commentary on the management, exploration and commercialisation issues of deep sea resources.

Keynote speaker biographies

Kristina Maria Gjerde

Senior High Seas Advisor, International Union for the Conservation of Nature's (IUCN), Global Marine and Polar Programme

Education

- Juris Doctor, New York University School of Law, 1984
- Bachelor of Arts in History (Summa Cum Laude), University of California, Los Angeles, 1981

Kristina Maria Gjerde is Senior High Seas Policy Advisor to IUCN's Global Marine and Polar Programme. With IUCN, she has focused on promoting reforms to the laws and institutions that govern the high seas and international seabed beyond national jurisdiction, working at the nexus of marine law, science and policy. She is also Adjunct Professor at the Middlebury Institute of International Studies in Monterey, California and the author or co-author of more than 100 publications on law of the sea, fisheries, shipping, deep seabed mining and marine biodiversity conservation issues.

Since establishing a network of policy, scientific, management and legal experts through the IUCN and its World Commission on Protected Areas in 2003, Kristina has co-founded and continues to work with a variety of scientific and NGO collaborative partnerships including the Deep Ocean Stewardship Initiative (2013), the High Seas Alliance (2011), the Sargasso Sea Alliance (now the Sargasso Sea Commission 2010), the Global Ocean Biodiversity Initiative (2008) and the Deep Sea Conservation Coalition (2004).

Kristina initially specialized in admiralty law at the New York City law firm of Lord, Day & Lord. She later transitioned to marine conservation as a research fellow at the Marine Policy Center of the Woods Hole Oceanographic Institution and guest lecturer at the University of Hull Law School in the UK, and represented WWF at the International Maritime Organization in London.

You can watch her talk on: Making Law for the High Seas, from the TED/Mission Blue Voyage to the Galapagos in April 2010:

http://www.ted.com/talks/kristina_gjerde_making_law_on_the_high_seas

What is the International Union for Conservation of Nature?

International Union for Conservation of Nature (IUCN) is the world's oldest and largest global environmental organisation, with almost 1,300 government and NGO Members and more than 15,000 volunteer experts in 185 countries. IUCN supports scientific research, manages field projects all over the world, and brings governments, NGOs, the UN and companies together to develop policy, laws and best practice. IUCN employs almost 1,000 staff in 45 offices and hundreds of partners in public, NGO and private sectors around the world. IUCN helps the world find pragmatic solutions to the most pressing environment and development challenges. IUCN work focuses on valuing and conserving nature, ensuring effective and equitable governance of its use, and deploying nature-based solutions to global challenges in climate, food and development.

Selected Publications

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Druel, E, and Gjerde, K.M. (2014), Sustaining marine life beyond boundaries: the need for and potential content of an UNCLOS Implementing Agreement for marine biodiversity beyond national jurisdiction, 49 Marine Policy 90-97.

Jyotika I. Virmani

Senior Director
Energy and Environment, XPRIZE

Education

- Ph.D. Physical Oceanography, University of South Florida, 2005
- M.S. Atmospheric Science (Marine Environmental Science), State University of New York, 1995
- B.S. (Hons.) Physics, Imperial College of Science, University of London, 1991

JJyotika has been a post-doctoral Research Associate at the University of South Florida, a Research Scientist at the GEC-Marconi Research Centre and a Senior Scientist at the UK Met Office. She was Executive Director of the Florida Coastal Ocean Observing System (FLCOOS) Consortium and has been the Associate Director of the Florida Institute of Oceanography. She served also as Technical Director of the Wendy Schmidt Ocean Health XPRIZE, a $2 M competition to incentivize accurate, robust, and affordable pH sensors to detect Ocean Acidification. She is now the Prize Lead for the Shell Ocean Discovery XPRIZE, a $7 M competition to incentivize deep-sea underwater autonomous robotics to produce high-resolution maps of the sea floor and high-definition imagery. Within this is the NOAA Bonus Prize – a $1 M prize for technology that can trace a biological or chemical signal to its source. She is also engaged in producing science fiction short films and has a blog on tropical storms.

About XPRIZE

For over a decade, the XPRIZE Foundation has been the global leader in incentivized prize competitions. Founded in 1995, XPRIZE is a non-profit organization that solves the world's Grand Challenges by creating and managing large-scale, high-profile competitions that drive innovation and inspire the belief that we can create a better future through breakthrough technological solutions.

About the Shell Ocean Discovery XPRIZE (oceandiscovery.xprize.org)

The $7 million Shell Ocean Discovery XPRIZE, launched on 14th December 2015, is a global, a three-year competition challenging teams to advance breakthrough technologies that, through shore or air deployments, will result in rapid, unmanned and high-resolution deep ocean exploration.

Innovation is vital to reach the scale, depth, speed and resolution necessary to illuminate the mysteries of the deep sea and usher in a new era of ocean exploration. Embedded in this is the National Oceanic and Atmospheric Administration's (NOAA) $1 Million bonus prize, which will incentivize teams to develop underwater sensing technologies that can detect a biological or chemical signal and trace it to its source. Such underwater smart sniffers would be pioneering technology that

Keynote speaker biographies

would allow us to better respond to emergencies, and discover and monitor new marine life and underwater communities in a way that never existed before. By accelerating innovation for the rapid and unmanned exploration of the unchartered deep sea, the XPRIZE will catalyze new markets in deep ocean exploration and sustainable resource development and protection. The technologies needed to win this XPRIZE may span many areas of innovation: engineering, oceanography, robotics, imaging, data visualization, nanotechnology, material science, computing and chemical sensing.

This competition is part of the XPRIZE Ocean Initiative – a commitment to launch five multi-million dollar prizes over 10 years. Collectively, these XPRIZEs address critical ocean challenges and inspire innovation that helps ensure that the world's oceans are healthy, valued and understood. The first two prizes were the Wendy Schmidt Oil Spill Clean-Up XChallenge (awarded in 2012), to develop efficient oil spill cleanup technologies, and the Wendy Schmidt Ocean Health XPRIZE (awarded in 2015), to develop robust, affordable and accurate pH sensors to detect changes in ocean acidification.

Selected Publications

Virmani, J. I. (2015), Discovering a New Planet, Huffington Post, http://huff.to/1ruTcMw

Virmani, J.I., and Bunje, P. M. E. (2015), Incentivizing Innovation for the Oceans and Beyond, MTS Journal, Volume 49, Number 3, May/June 2015,pp. 27-29(3), doi: 10.4031/MTSJ.49.3.5

Virmani, J.I., and R.H. Weisberg (2009), Fish effects on ocean current observations in the Cariaco Basin, J. Geophys. Res., 114, C03028, doi: 10.1029/2008JC004889.

Mayer, D.A., Virmani, J.I., and R.H. Weisberg (2007), Velocity Comparisons from Upward and Downward Acoustic Doppler Current Profilers on the West Florida Shelf. J. Atmos. Oceanic Technol., 24, 1950–1960, doi: 10.1175/JTECH2094.1.

Virmani, J.I., and R.H. Weisberg (2006), The 2005 hurricane season: An echo of the past or a harbinger of the future? Geophys. Res. Lett., 33, L05707, doi: 10.1029/2005GL025517.

Bjørn Jalving

Executive Vice President
Kongsberg Maritime's Subsea division

Education

- M.Sc. in Engineering Cybernetics, University of Science and Technology, Trondheim, 1991

Bjørn Jalving graduated as M.Sc. in Engineering Cybernetics from the Norwegian University of Science and Technology in 1991. He started at FFI, the Norwegian Defence Research Establishment in 1992, on development of autonomous underwater vehicles, working on projects with Kongsberg Maritime, Norwegian Navy, Statoil and NUI. Bjørn developed the HUGIN AUV control and mission management system. He was heavily involved in AUV system design, as well as applying and verifying use of AUVs in new applications as detailed seabed mapping, naval mine hunting (MCM) and marine research. Bjørn was responsible for the team that designed and implemented the HUGIN aided inertial navigation system. In 2000, a HUGIN 3000 from C & C Technologies, the world's first detailed seabed mapping AUV operating on commercial basis in deep waters for the oil and gas industry, provided consistent position accuracies of 2 m and 4 m (1σ) in 1,300 m and 2,200 m of water depths in the Gulf of Mexico. The navigation technology has also been applied in the Kongsberg HAIN system for ROV navigation and dynamic position vessel reference.

In 2006 Bjørn Jalving started in Kongsberg Maritime, in 2007 he became Vice President of the AUV Department. Bjørn was involved in the Kongsberg acquisition of Hydroid, the leading AUV manufacturer of the REMUS product lines.

From 2012 Bjørn has been Executive Vice President for the Subsea Division in Kongsberg. Kongsberg Maritime Subsea provides underwater sensor systems and underwater robotics to offshore energy, naval, marine research, fishery and underwater mapping markets.

During his 14 years at FFI, moving to the position as Principal Scientist, Bjørn Jalving published and co-authored more than 30 publications. In 2014 he has received the Compass Distinguished Achievement Award from the Marine Technology Society for his long career

Keynote speaker biographies

and achievements within AUV technology at the OCEANS 2014 MTS/IEEE conference in St. John 's, Newfoundland, Canada.

What Kongsberg is

Kongsberg Maritime is a wholly owned subsidiary of Kongsberg Gruppen that is an international technology corporation that delivers advanced and reliable solutions that improve safety, security and performance in complex operations and during extreme conditions. The Group is a customer focused organization with a worldwide performance culture. Kongsberg works with customers in the global defence, maritime, oil and gas and aerospace industries. Kongsberg Maritime's Subsea division operates predominantly in the offshore oil and gas markets, surveying (seabed mapping etc), defence, fisheries and oceanography. It develops cutting-edge technology based on hydroacoustics, sensor knowledge, advanced signal processing and underwater engineering, and its products include market leading sonar, multi- and single beam echosounders, positioning and communication systems, autonomous underwater vehicles, cameras, chemical sensors and underwater monitoring systems.

Select Publications

Jalving B (1994): The NDRE-AUV Flight Control System, IEEE Journal of Oceanic Engineering, October 1994.

Jalving B (1999): Depth Accuracy in Seabed Mapping with Underwater Vehicles, Oceans '99, Seattle, Washington, USA, 13 – 16 September 1999.

B Jalving, K Vestgård, N Størkersen (2003): Detailed Seabed Surveys with AUVs. Technology and Applications of Autonomous Underwater Vehicles, edited by Gwyn Griffiths. Taylor & Francis, London and New York, ISBN 0-415-30154-8.

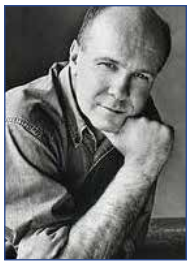
B Jalving, E Bovio, K Gade (2003): "Integrated Inertial Navigation Systems for AUVs for REA Applications", NATO Underwater Research Center Conference Proceedings from MREP 2003, NATO Underwater Research Center May 12 – 15, 2003, La Spezia, Italy

B Jalving, K Gade, O K Hagen and K Vestgård (2003): "A Toolbox of Aiding Techniques for the HUGIN AUV Integrated Inertial Navigation System", Proceedings from Oceans 2003, September 23 – 25, San Diego, CA, USA.

B Jalving, M Mandt, O K Hagen, F Pøhner (2004), "Terrain Referenced Navigation of AUVs and Submarines Using Multibeam Echo Sounders", Proceedings of UDT Europe, June 22 – 25, 2004, Nice, France. Also: Proceedings of UDT Hawaii, October 19 – 21, 2004, Hawaii, USA.

Jalving, B., Gade, K., Svartveit, K., Are Baardsgaard, W. and R. Sørhagen (2004), DVL velocity aiding in the HUGIN 1000 integrated inertial navigation system. Modeling, Identification and Control, 10, 25(4). doi: 10.4173/mic.2004.4.2.

Simon Winchester



Writer, journalist and broadcaster
***New York Times* best-selling author**

Education

- Geology, St. Catherine's College, Oxford, 1966.

In 1965, during his university studies, Simon participated on an expedition in the East Greenland ice-cap. After graduation, he joined a Canadian mining company and worked as field geologist in Uganda, looking for copper deposits. He then made a sudden switch to journalism in 1967, after an inspiring reading of James Morris's artwork "Coronation Everest". After being employed as junior reporter on *The Journal* of Newcastle upon Tyne, in 1969 Winchester succeeded in being appointed to *The Guardian*. He then became its Northern Ireland correspondent, finding himself around several tragic events of the time, like the Bloody Sunday in Londonderry in January 1972 and the British army crackdown during Operation Motorman.

In 1972, Simon was briefly assigned to Calcutta, before becoming correspondent for *The Guardian* in Washington D.C., where he covered the Watergate affair, the resignation of President Nixon and the election to the White House of Jimmy Carter. It was during this period that Simon wrote his first book, *In Holy Terror*, an account of his reporting years in Ireland.

In 1977 he was posted to New Delhi and in 1981 he became Chief Foreign Feature Writer for *The Sunday Times.* One year later, Simon was again on location for an epic event, the invasion of the Falkland Islands by Argentine forces; suspected of being a spy, he was held as a prisoner in Tierra del Fuego for three months.

Keynote speaker biographies

In 1985 Simon decided to working as a freelance writer and move to Hong Kong where he remained for the next twelve years, during which time he rejoined *The Guardian* and accepted an assignment as Asia-Pacific Editor of the newly-established *Conde Nast Traveler* magazine. In the following years, Simon contributed to a number of travel publications including *Traveler, National Geographic* and *Smithsonian magazine*. In June 1997, Simon left Hong Kong and went to live in New York.

Winchester's first truly successful book was *The Professor and the Madman* published in 1998 by Penguin UK as *The Surgeon of Crowthorne*. The book, a *New York Times* Best Seller, is about a forgotten American player in the story of the Oxford English Dictionary. At that point, Simon was ready to be a full time writer and to chalk up one success after another.

In 2001 *The Map that Changed the World* focused on the geologist William Smith and was Winchester's second *New York Times* best seller. The year 2003 saw the publication of *The Meaning of Everything* and of the best-selling *Krakatoa: The Day the World Exploded*, about the infamous legendary volcanic eruption occurred in 1883. In 2005 Simon published *A Crack in the Edge of the World*, a book about San Francisco's 1906 earthquake. The year 2010 was the time for the book *Atlantic: A Vast Ocean of a Million Stories*, about the Atlantic Ocean, from its origins 370 million years ago through the population of its shores by humanity and their interactions with it. In 2015 *Pacific: Silicon Chips and Surfboards, Coral Reefs and Atom Bombs, Brutal Dictators, Fading Empires, and the Coming Collision of the World's Superpowers* focuses on 10 aspects of the Pacific ocean and its inhabitants, including plastic debris, the Pacific Plate, El Niño, surfing and nuclear testing.

Selected Books

Winchester, Simon (1975), In Holy Terror, Faber & Faber, 256pp.

Winchester, Simon (1985), Outposts: Journeys to the Surviving Relics of the British Empire, Harper Perennial, 400pp.

Winchester, Simon (1996), The River at the Center of the World: A Journey up the Yangtze and back in Chinese Time, Picador, 432pp.

Winchester, Simon (1998), The Professor and the Madman. A Tale of Murder, Insanity, and the Making of the Oxford English Dictionary, Harper Perennial, 242pp.

Winchester, Simon (1999), The Fracture Zone: My Return to the Balkans. Harper Perennial, 272pp.

Winchester, Simon (2001), The Map that changed the World: William Smith and the Birth of Modern Geology, Harper Perennial, 368pp.

Winchester, Simon (2003), The Meaning of Everything – the story of the Oxford English Dictionary, Oxford University Press, 288pp.

Winchester, Simon (2003), Krakatoa: The Day the World Exploded – 27 August 1883 eruption of Krakatoa, Harper Perennial, 416pp.

Winchester, Simon (2005), A Crack in the Edge of the World: America and the Great California Earthquake of 1906, Harper Perennial, 512pp.

Winchester, Simon (2008), The Man Who Loved China: The Fantastic Story of the Eccentric Scientist Who Unlocked the Mysteries of the Middle Kingdom, Harper, 336pp.

Winchester, Simon (2010), Atlantic: A Vast Ocean of a Million Stories, Harper Collins, 495pp.

Winchester, Simon (2011), The Alice Behind Wonderland, Oxford University Press, 128pp.

Winchester, Simon (2013), The Men Who United the States: America's Explorers, Inventors, Eccentrics, and Mavericks, and the Creation of One Nation, Indivisible, Harper Perennial, 512pp.

Winchester, Simon (2015), When the Earth Shakes: Earthquakes, Volcanoes, and Tsunamis, Smithsonian, 80pp.

Winchester, Simon (2015), Pacific: Silicon Chips and Surfboards, Coral Reefs and Atom Bombs, Brutal Dictators, Fading Empires, and the Coming Collision of the World's Superpowers, Harper Collins, 512pp

Honours

- Winchester was appointed Officer of the Order of the British Empire for "services to journalism and literature" in Queen Elizabeth II's New Year Honours list of 2006.
- Winchester was named an honorary fellow at St Catherine's College, Oxford in October 2009.
- Winchester received an honorary degree from Dalhousie University in October 2010.

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The German research vessel Polarstern during an expedition into the central Arctic Ocean, 2015.