Evolution of Science Diplomacy and Its Local-Global Applications*

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The unambiguous reality of human civilization is that we now are globally interconnected. This fact is revealed by 'world wars', which happened for the first time in the history of humankind only in the last century. In context, global human population size has grown more than 1000% since the advent of the nation-state with the Treaty of Westphalia in 1648. During this period, the influence of Science, Technology and Innovation (STI) has been expanding, certainly since the industrial revolution around 1800 when the human population reached 1 billion, accelerating to 8 billion people as we enter the next decade during our digital revolution. The challenges are on a planetary scale, as reflected further by concern about Earth's climate, crossing the spectrum of sub-national to international jurisdictions with the nation-state at the centre. As an example, science diplomacy from the polar regions illustrates how transatlantic science relations are embedded into a global context. With hope and inspiration from the perspective of a practitioner and observer, the evolution of science diplomacy is shared herein with local-global applications as an international, interdisciplinary and inclusive (holistic) process, involving informed decision-making to balance national interests and common interests for the benefit of all on Earth across generations.

1 INTRODUCTION

This article explores the evolution of science diplomacy as a new field with practical intent for present and future generations, recognizing that the challenges we face as a globally interconnected civilization are increasingly influenced by Science, Technology and Innovation (STI). However, to support the development of science diplomacy, this article is much more than documentation and synthesis; it recalls a personal journey with lessons about the integration of science, policy and diplomacy that has been maturing since 1981 with a winter-over in Antarctica. As an early practitioner of science diplomacy, these lessons are introduced herein with the familiarity of a storyteller and 'citizen of the world', who is seeking to inspire capacities of next-generation science diplomats on a global scale.

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My year-long SCUBA diving expedition in McMurdo Sound, Antarctica, at the age of twenty-two was profound, revealing many things, and among the most important was the perspective of our world from a great distance: like looking at the Earth from outer space. It was the year that President Ronald Reagan was shot, interrupting the peaceful isolation of our small outpost to reveal that 'one cannot escape the injustices of mankind'. Impassioned with a sense of global responsibility ever after – with hope and inspiration across generations – I developed a course on *Antarctic Marine Ecology and Ocean Policy*, which the University of California Los Angeles invited me to teach as a Visiting Professor in 1982.

The Antarctic policy course was taught continuously over the next couple of decades, always with the central question about why the United States (US) and Soviet Union cooperated in Antarctica throughout the Cold War, despite the animosity and geopolitics that isolated them elsewhere on Earth. As stated in the *Antarctic Treaty*, which was signed in Washington, DC, on 1 December 1959 with the US and Soviet Union at the height of the Cold War: 'it is in the interest of all mankind that Antarctica shall continue forever to be used exclusively for peaceful purposes and shall not become the scene or object of international discord'.[1] Six of the original twelve Antarctic Treaty signatory nations came from the two sides of the North Atlantic.

Why did the 1959 Antarctic Treaty become the first nuclear arms agreement? What enabled the US and the Soviet Union to establish the region south of 60° south latitude for peaceful purposes only? Answers to these questions underlie the origin of science diplomacy, with its deep roots through history, especially after World War II. The global precedent of the Antarctic Treaty embodied six 'matters of common interest' with science as the keystone,[2] establishing a 'firm foundation for the continuation and development of such cooperation on the basis of freedom of scientific investigation in Antarctica as applied during the International Geophysical Year'.[3] Moreover, the criterion for consultative status in the Antarctic Treaty System is 'conducting substantial scientific research activity',[4] further revealing science as a tool of diplomacy that enabled the US and Soviet Union to negotiate this remarkable treaty with the seven Antarctic claimant and three other non-claimant nations.

Consider the decades after World War II, when human civilization was still reeling from global conflict, with leaders of nations who had witnessed first-hand the horrors of the war.[5] Looking across the centuries, during the 1961 ratification in the US Senate of the Antarctic Treaty, it was argued that this treaty represents: 'a

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1 The Antarctic Treaty (Signed: Washington, D.C., 1 Dec. 1959; Entry into Force: 23 June 1961).
2 P. A. Berkman, *Science into Policy: Global Lessons from Antarctica* (Academic Press 2002).
3 The Antarctic Treaty, *supra* n. 1.
4 *Ibid*., Art. 9.
5 P. A. Berkman, *President Eisenhower, the Antarctic Treaty and Origin of International Space*, in *Science Diplomacy: Antarctica, Science and the Governance of International Spaces* 17–28 (P. A. Berkman, M. A. Lang, D. W. H Walton & O. R. Young eds, Smithsonian Institution Scholarly Press 2011).

document unique in history which may take its place alongside the Magna Carta and other great symbols of man's quest for enlightenment and order'.[6] This is an experiment for the ages, recognizing we can touch the *Magna Carta* with its influence on democracy and constitutional law eight centuries in the future. The lesson from the *Antarctic Treaty* is the path of 'common-interest building' taken by the signatories – as opposed to 'conflict resolution' – underscoring the starting point of the negotiation makes all the difference in the journey.

The 1957–58 International Geophysical Year (IGY), renamed from the 3rd International Polar Year, was part of an international scientific process that started in 1882 to assess relationships between nations and the Earth system on a planetary scale. Fifty years after the IGY, the 4th International Polar Year was being organized[7] and a component of this International Polar Year 2007–2008 would be the Antarctic Treaty Summit (2009), which I co-convened and chaired at the Smithsonian Institution on the 50th anniversary of the 1959 Antarctic Treaty in the city where it was signed.

The Antarctic Treaty Summit involved more than forty sponsoring organizations around the world, including The Royal Society and the American Association for the Advancement of Science (AAAS) as well as the US House of Representatives[8] and US Senate,[9] which adopted a Congressional Resolution with unanimous consent. Participants came from nearly thirty nations, involving keynote addresses by the Secretary General of the United Nations, His Excellency Ban Ki-moon, and His Serene Highness Prince Albert II of Monaco among many others on the 50th anniversary of the signing of the Antarctic Treaty. In addition to generating papers in 'Nature'[10] and 'Science'[11] as well as other journals, the Antarctic Treaty Summit generated the first book on Science Diplomacy,[12] highlighting its international, inter-disciplinary and inclusive (holistic) applications.

During this period, conceptual framing of science diplomacy began to emerge,[13] building on well-established consideration of science and technology relationships with policy.[14] A substantive step in the development of Science Diplomacy as a new field

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6 L. M. Gould, *Testimony to the U.S. Congress, Senate, Committee on Foreign Relations, Regarding the Ratification of the Antarctic Treaty* (14 June 1960).

7 P. A. Berkman, *International Polar Year 2007-08*, 301 Sci. 1669 (2003).

8 United States House of Representatives, *Recognizing the 50th Anniversary of the Signing of the Antarctic Treaty*, House Concurrent Resolution 51, 111th Congress, 1st Session (Washington, DC 2009).

9 United States Senate, *Recognizing the 50th Anniversary of the Signing of the Antarctic Treaty*, Senate Resolution 365, 111th Congress, 1st Session (Washington, DC 2009).

10 P. A. Berkman, *International Spaces Promote Peace*, 462 Nature 412–13 (2009).

11 A. Grimaldi, *Governance of Both Poles*, 326 Sci. 1042 (2009).

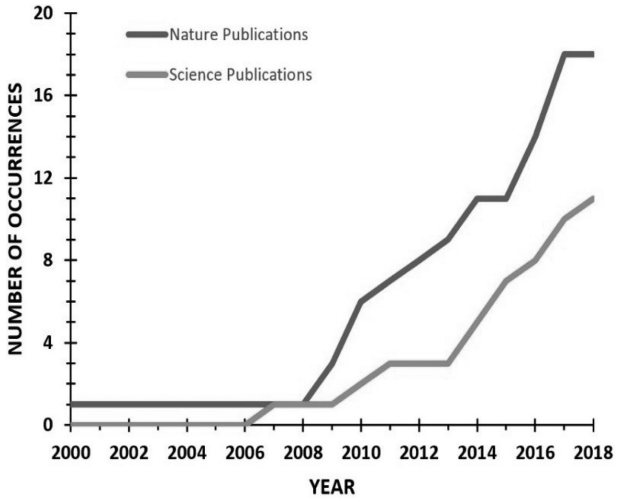
12 *Science Diplomacy: Science, Antarctica and the Governance of International Spaces* (P. A. Berkman, M. A. Lang, D. W. H. Walton & O. R. Young eds, Smithsonian Institution Scholarly Press 2011).

13 K. M. Lord & V. C. Turekian, *Time for a New Era of Science Diplomacy*, 15 Sci. 769–70 (2007); N. V. Fedoroff, *Science Diplomacy in the 21st Century*, 3(1) Cell 9–11 (2009).

14 V. Bush, *Science the Endless Frontier. A Report to the President on a Program for Postwar Scientific Research* (United States Government Printing Office 1945); M. W. Rossiter, *Science and Public Policy Since World*

was the 2008 establishment of the AAAS Center for Science Diplomacy with the creation of 'Science & Diplomacy' as the field's first journal in 2012.[15] Science diplomacy has been accelerating ever since, as illustrated by a rapidly growing number of occurrences of the term among published papers (Figure 1), influenced especially by the 2009 United Kingdom meeting at Wilton Park on the 'New Frontiers in Science Diplomacy'[16], capturing the imagination of the international diplomatic community.

Figure 1 Emergence of 'Science Diplomacy'



Explanation: based on occurrences of the term among published papers in the journals, 'Nature' and 'Science.' Data compiled by J.C. Mauduit.

The Wilton Park meeting and Antarctic Treaty Summit, both in 2009, symbolize intertwined vibrant branches of science diplomacy with a growing number of foreign ministries considering science and technology advice.[17] As a life-long science diplomat, today feels like a renaissance with global dialogues accelerating to co-produce

War II, 1 Osiris 273–94 (1985); J. A. Stein, *Globalisation, Science, Technology and Policy*, 29 Sci. & Pub. Pol'y 402–08 (2002); K. Annan, *Science for All Nations*, 303 Sci. 925 (2004); T. Flink & U. Schreiterer, *Science Diplomacy at the Intersection of S&T Policies and Foreign Affairs: Toward a Typology of National Approaches*, 37 Sci. & Pub. Pol'y 665–77 (2010).

15 V. C. Turekian & N. P. Neureiter, *Science and Diplomacy: The Past as Prologue*, 1(1) Sci. & Dipl. (2012).

16 The Royal Society, *New Frontiers in Science Diplomacy: Navigating the Changing Balance of Power* (The Royal Society 2010).

17 Talloires Dialogue Team, *Science Diplomacy – To 2030 and Beyond*, 2 Sci. Dipl. Action 1–9 (Tufts University, Science Diplomacy Center, 2018); Vienna Dialogue Team, *A Global Network of Science and Technology Advice in Foreign Ministries*, 1 Sci. Dipl. Action 1–20 (Tufts University, Science Diplomacy Center, 2017).

knowledge with STI for the benefit of all on Earth across generations, which is the essence of science diplomacy. Understanding the evolution of science diplomacy[18] and its lasting relevance for our globally interconnected civilization is the primary objective of this article. Appreciating the focus of this special issue is on soft power in transatlantic relations, the example of the Arctic also is considered to illustrate the relevance of science diplomacy with continuous cooperation between North American and European states, including EU Member States, but especially the US and Russian Federation, despite their otherwise troubled relations.[19]

2 INTERTWINED BRANCHES OF SCIENCE DIPLOMACY

Dimensions, elements and applications of science diplomacy are characterized in Table 1 in view of insights generated from the Wilton Park meeting and Antarctic Treaty Summit in 2009. Following the Wilton Park meeting,[20] numerous papers, blogs, lectures and courses have built on the rubric of: 'science in diplomacy;' 'diplomacy for science;' and 'science for diplomacy'. This taxonomy for science diplomacy has been considered widely in view of decision-making by governments.[21]

But, how does science diplomacy operate? As is now being recognized by Science and Technology Advisors to Foreign Ministers,[22] for science diplomacy, the 'traditional taxonomy may be viewed as somewhat academic and of limited practical application'. To be pragmatic, their view from the inside suggests three new categories of science diplomacy with nations:

(1) Actions designed to directly advance a country's national needs;
(2) Actions designed to address cross-border interests; and
(3) Actions primarily designed to meet global needs and challenges.

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18 V. C. Turekian, *Evolution of Science Diplomacy*, 9(3) Global Pol'y 5–7 (2018).

19 This discussion complements the analysis of transatlantic research and science relations from the EU perspective by Prange-Gstöhl: H. Prange-Gstöhl, *The EU's Approach to Transatlantic Science and Research Relations: Between 'Laissez Faire' and 'Science Diplomacy'*, 81–98.

20 The Royal Society, *supra* n. 16.

21 National Research Council, *U.S. and International Perspectives on Global Science Policy and Science Diplomacy: Report of a Workshop* (National Academies Press 2012); TWAS, *The Power of Science Diplomacy. A View from the South*, 26 (3) World Acad. Sci. Newsl. (2014); L. Van Langenhove, *Science Diplomacy: New Global Challenges, New Trend*, 82 RSIS Comment. (2016); L. Van Langenhove, *Tools for an EU Science Diplomacy* (European Commission 2018); A. L. de San Román & S. Schunz, *Understanding European Union Science Diplomacy*, 56(2) J. Com. Mkt. Stud. 247–66 (2018); *Science for Diplomacy: Multi-disciplinary Training Program* (F. Toschi, A. R. Appetito & V. C. Nunziante eds, Consiglio Nazionale delle Ricerche 2017); POST, *Science Diplomacy*, 568 PostNote (Parliamentary Office of Science and Technology, Houses of Parliament 2018); AAAS, *Education and Training*, https://www.aaas.org/program/center-science-diplomacy/training AAAS, Education and Training (2019) (accessed 7 Feb. 2019); *also see* Science & Diplomacy journal (AAAS).

22 P. D. Gluckman, V. C. Turekian, R. W. Grimes & T. Kishi, *Science Diplomacy: A Pragmatic Perspective from the Inside*, 6(4) Sci. & Dipl. (2017).

Such actions are holistic, underscoring the convergence[23] that is happening with science diplomacy, which is reflected by accelerating knowledge co-production. The holistic dimensions of science diplomacy were the focus of the Antarctic Treaty Summit, involving practical applications that also originate as well as operate outside of government with science diplomats contributing to informed decision-making at global-local levels. Based on lessons from the Antarctic Treaty, two basic questions emerged about the role of science in diplomacy (Table 1):

Table 1 Intertwined Branches of Science Diplomacy from Its Seminal Events in 2009

FEATURES	*Seminal Events for the Field of Science Diplomacy*	
	Wilton Park Meeting: *'New Frontiers in Science Diplomacy'*	***Antarctic Treaty Summit*: *'Science Diplomacy: Antarctica, Science and the Governance of International Spaces'***
Dimensions of Science Diplomacy	❖ Science in Diplomacy ❖ Diplomacy for Science ❖ Science for Diplomacy	❖ International ❖ Interdisciplinary ❖Inclusive
Questions, Elements and Applications of Science Diplomacy	• Disengagement • Open channels of communication • Networking • Identify common interests and values • Influencing • Negotiation and mediation • Cooperation	• Essential gauges of changes over time and space • Instruments for Earth system monitoring and assessment • Early warning systems • Determinants of public policy agendas • Provisions of international legal institutions • Sources of invention and commercial enterprise • Sources of continuity in our global society • Tools of diplomacy to build common interests

[23] M. C. Roco, W. S. Bainbridge, B. Tonn & G. Whiteside eds, *Converging Knowledge, Technology and Society: Beyond Convergence of Nano-Bio-Info-Cognitive Technologies* (M. C. Roco, W. S. Bainbridge, B. Tonn & G. Whiteside eds, Springer 2013).

FEATURES	*Seminal Events for the Field of Science Diplomacy*	
	Wilton Park Meeting: *'New Frontiers in Science Diplomacy'*	***Antarctic Treaty Summit*: *'Science Diplomacy: Antarctica, Science and the Governance of International Spaces'***
Nations	20	27
Event Dates	1–2 June 2009	29 November–1 December 2009
Event Website	Unavailable	http://www.atsummit50.aq
Publication	The Royal Society (2010)[24]	Berkman et al. (2011)[25]
Target Audience	Ministries of Foreign Affairs	Global Civil Society

- How does science enable allies and adversaries alike to build common interests?
- How can science promote cooperation and prevent conflict (two sides of the 'coin of peace')?

For our present STI era, these questions underscore the stimulus for science diplomacy as a process to address issues, impacts and resources across time and space.

On Earth, there are areas that fall within the boundaries of nations as well as areas beyond national jurisdictions,[26] established under international law as international spaces to promote peace after World War II.[27] These two generalized categories of jurisdiction reveal our fundamental challenge as a globally-interconnected civilization to balance national interests and common interests for the benefit of all on Earth across generations, recognizing that states will always first and foremost look after their national interests. Such balance highlights a process where 'science diplomacy is the use of scientific collaborations among nations to address the common problems'.[28] On a planetary scale, the importance of this holistic process is eloquently recognized by the European Commissioner for Research, Science and Innovation: 'science diplomacy is

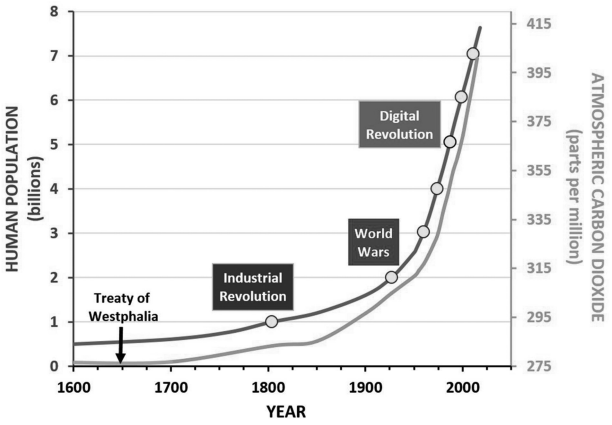
[24] The Royal Society, *supra* n. 16.
[25] Berkman, Lang, Walton & Young, *supra* n. 12.
[26] *Ibid*.
[27] Berkman, *supra* n. 10.
[28] Fedoroff, *supra* n. 13.

the torch that can light the way, where other kinds of politics and diplomacy have failed'.[29]

3 DECISION-MAKING WITH GLOBAL INTERCONNECTIONS

The unambiguous reality of human civilization is that we now are globally interconnected (Figure 2). This fact is revealed simply by the concept of 'world wars', which happened for the first time in the history of humankind only in the

Figure 2 Globally Interconnected Civilization



Explanation: planetary-scale connections with our human population[30] multiplying by billions (dots) are reflected by increasing concentrations of carbon dioxide in the atmosphere globally,[31] enhanced during the industrial revolution[32] –recognizing that 'correlation alone does not mean causation'.[33]

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29 C. Moedas, *EU Approach to Science Diplomacy*, Speech (Washington, DC 1 June 2015), https://ec.europa.eu/commission/commissioners/2014-2019/moedas/announcements/eu-approach-science-diplomacy_en (accessed 8 Feb. 2019).

30 J. D. Durand, *Historical Estimates of World Population: An Evaluation*, 3(3) Population & Dev. 253–96 (1977); Worldometer, Data on the size of the human population on Earth from 1600 to the present, http://www.worldometers.info/world-population/?#table-historical (accessed 8 Feb. 2019), with compilations by the United Nations since 1950, http://www.un.org/en/development/desa/population/ (accessed 8 Feb. 2019).

31 USEPA, *Global Atmospheric Carbon Dioxide Concentration Data. United States Environmental Protection Agency* (2018), https://www.epa.gov/sites/production/files/2016-08/ghg-concentrations_fig-1.csv (accessed 8 Feb. 2019).

32 A. E. Musson & E. Robinson, *Science, Technology and the Industrial Revolution* (Manchester University Press 1969).

33 Adapted from P. A. Berkman, O. R. Young & A. N. Vylegzhanin, *Preface for the Book Series on Informed Decisionmaking for Sustainability*, in *Governing Arctic Seas: Regional Lessons from the Bering Strait and Barents Sea*, Vol. 1 (O. R. Young, P. A. Berkman & A. N. Vylegzhanin eds, Springer 2019).

last century. For perspective, the oldest continuous calendars still in use record nearly 6,000 years – with the past few centuries like years in a lifespan of sixty centuries – demonstrating that we are still in our infancy as a globally- interconnected civilization. Moreover, timing of the past few centuries coincides with exponential increase in global human population size, which is more than 1000% larger than during the advent of the nation-state with the Treaty of Westphalia (1648).

At the scale of the Earth, carbon dioxide levels in the global atmosphere also are accelerating at the same pace as human population size (Figure 1). Without trying to explain this global atmospheric phenomenon, it is clear that there is a symbiosis between our human population and Earth's climate, by definition a planetary process (i.e. Jupiter and other planets in our solar system each have their own unique climates). Underlying all such discussions, is the fact that human population size on Earth is increasing exponentially, which is the root reason for considering climate change 'as a common concern of humankind' since the 1992 United Nations Framework Convention on Climate Change.[34]

The challenge with addressing solutions for humankind is on a planetary scale, across time in a dynamic system measured over decades to millennia,[35] requiring processes that operate in the face of change over generations. In this holistic sense, science is the 'study of change' (symbolized by the Greek letter delta Δ, as in mathematics), including the natural sciences and social sciences as well as Indigenous knowledge. All of these 'sciences' involve rigorous training with inquiry skills to characterize patterns and trends (albeit with different methodologies) that become the bases for decisions. However, as a point of distinction to adjust for change, 'informed decisions operate across a continuum of urgencies'.

For the US, Europe and our globally interconnected civilization (Figure 3), there is a 'continuum of urgencies' that extends from security time scales (mitigating risks of political, economic and cultural instabilities that are immediate) to sustainability time scales (balancing environmental protection, economic prosperity and societal well-being across generations). Importantly, science is a source of continuity in our global society to operate across this continuum.

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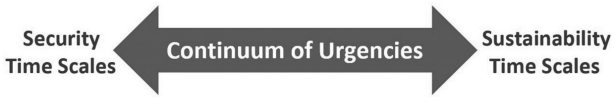
[34] United Nations Framework Convention on Climate Change (Signed: Rio de Janeiro, 4 June 1992: Entry in Force: 21 Mar. 1994).

[35] J. M. Roberts & O. A. Westad, *The History of the World* (6th ed., Oxford University Press 2013).

Figure 3 Theory of Informed Decision-making[36]



Explanation: as a scalable proposition, informed decisions operate across a *'continuum of urgencies,'* like driving on any road, constantly adjusting to the surrounding vehicles and circumstances while being alert to the red lights ahead and traffic behind.

4 SCIENCE DIPLOMACY AS AN HOLISTIC PROCESS FOR HUMANITY

Underlying science diplomacy are the theory, methods and skills of informed decision-making that have emerged over time, evolving from policy as a product into diplomacy as a process with STI. Describing what it is, how it operates and why it is important for our globally- interconnected civilization – putting the puzzle pieces together – science diplomacy is an holistic process, involving informed decision-making to balance national interests and common interests for the benefit of all on Earth across generations.

Recognizing the challenge of humankind forever after World War II is to balance national and common interests on a planetary scale, the first step is to build common interests. Common-interest building is the primary contribution of science diplomacy, starting with questions as the least complicated stage of engagement (Figure 4). Antarctica and outer space illustrate this pathway of negotiation to promote cooperation and prevent conflict, despite the geopolitics that polarized the US and Soviet Union throughout the cold war.[37] The Arctic today is another area of such cooperation propelled by science diplomacy,[38] where transatlantic relations operate with stability across a 'continuum of urgencies' (Figure 3).

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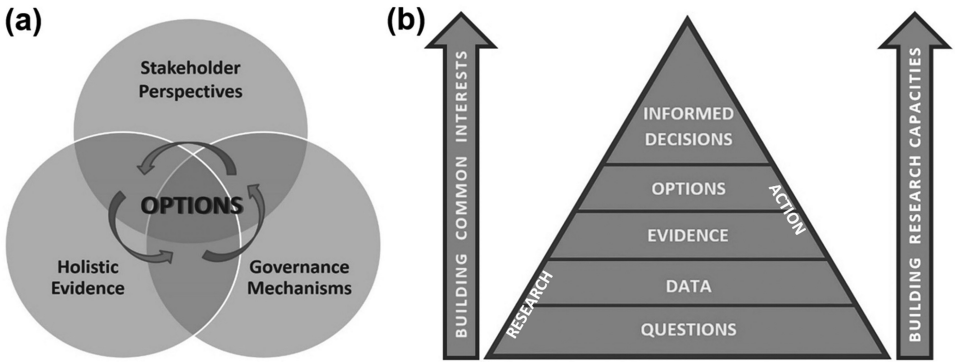
[36] Adapted from the Vienna Dialogue Team, *supra* n. 17.
[37] Berkman, Lang, Walton & Young, *supra* n. 12.
[38] P. A. Berkman, L. Kullerud, A. Pope, A. N. Vylegzhanin & O. R. Young, *The Arctic Science Agreement Propels Science Diplomacy*, 358 Sci. 596–98 (2017).

Figure 4 Science Diplomacy and its Engine of Informed Decision-making



Explanation: **(a) The Decision-Support Process** to reveal options (without advocacy), which can be used or ignored explicitly, for decisions that involve governance mechanisms as well as built infrastructure for sustainability;[39]
(b) Pyramid of Informed Decision-making at global-local scales contributes to implementation of the United Nations Sustainable Development Goals (SDGs).[40]

This holistic process of science diplomacy balances the interests of stakeholders, using evidence in view of governance mechanisms to produce options for decisions (Figure 4a). Moreover, the methods and skills of science diplomacy can be viewed across levels of research and actions from foundational questions to informed decisions at the apex (Figure 4b).

When there are questions of common concern, appropriate methodologies from the natural sciences and social sciences as well as Indigenous knowledge can be identified and applied, building research capacities. The resulting data are iterated with research until the questions are answered. Data to answer questions, however, are fundamentally different than evidence in origin and purpose, representing the threshold between research and action. Evidence is for decisions, synthesizing data and questions in context of the decision-making institutions and decision-makers.[41] Moreover, with practical application, evidence involves

[39] Adapted from the Vienna Dialogue Team, *supra* n. 17.
[40] United Nations, *The 2030 Agenda for Sustainable Development*, Resolution adopted by the General Assembly (New York, 25 Sept. 2015). Adapted from Berkman, Lang, Walton & Young, *supra* n. 12 and Berkman, Young & Vylegzhanin, *supra* n. 33.
[41] The Royal Society, *Evidence Synthesis for Policy: A Statement of Principles* (The Royal Society 2018); C. A. Donnelly, I. Boyd, P. Campbell, C. Craig, P. Vallance, M. Walport, C. J. M. Whitty, E. Woods & C. Wormald, *Four Principles for Synthesizing Evidence*, 558 Nature 361–64 (2018).

two generalized decision arenas, which are coupled to achieve progress with sustainability[42]:

(1) Governance Mechanisms (laws, agreements and policies as well as regulatory strategies, including insurance, at diverse jurisdictional levels); and

(2) Built Infrastructure (fixed, mobile and other built assets, including communication, research, observing, information, transportation, financial and other systems that require technology plus capitalization).

Yet, evidence only compels decision-makers to act, but without specifications about how, when, what or where. In this sense, 'evidence-based' decision-making is incomplete as well as redundant, in that all decisions involve some form of evidence before considering the options. Ultimately, the diplomacy of options is without advocacy to be used or ignored explicitly, respecting the roles and responsibilities of the decision-makers while contributing to informed decisions as the apex goal at global-local levels. To be effective, the holistic process of informed decision-making is guided by the 'continuum of urgencies', seeking to balance economic prosperity, environmental protection and societal well-being that are the essence of sustainability.[43] The innovation with options grows from the underlying questions, data and evidence to produce governance mechanisms as well as built infrastructure, where *2030 Agenda for Sustainable Development* offers a global pedagogy with the granularity of the seventeen SDGs.[44]

5 TRANSATLANTIC DIMENSIONS OF SCIENCE DIPLOMACY ARE GLOBAL

Applying elements of science diplomacy revealed from the *Antarctic Treaty Summit*, and described above, it became possible for two professors to design, co-convene and chair the first formal dialogue between the North Atlantic Treaty Organization (NATO) and the Russian Federation regarding the Arctic. This 2010 NATO Advanced Research Workshop (ARW) on '*Environmental Security in the Arctic Ocean*'[45] was funded by the NATO Science for Peace and Security Programme,[46] which originated with the IGY, celebrating its 60th anniversary in 2018. Moreover, with involvement of the Russian Federation, the NATO-ARW

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42 P. A. Berkman, *Institutional Dimensions of Sustaining Arctic Observing Networks (SAON)*, 68(Suppl. 1) Arctic (2015); Vienna Dialogue Team, *supra* n. 17.

43 WCED, *Our Common Future: From One Earth to One World*, Report Transmitted to the General Assembly as an Annex to Resolution A/RES/42/187 (United Nations, Geneva 1987).

44 United Nations, *supra* n. 40.

45 *Environmental Security in the Arctic Ocean* (P. A. Berkman & A. N. Vylegzhanin eds, Springer 2012).

46 NATO, *NATO Science for Peace and Security Programme*, https://www.nato.int/cps/en/natolive/78209.htm (accessed 8 Feb. 2019).

underwent formal approval by the full NATO-Russia Council of Foreign Ministers, which had adopted a Committee on Science for Peace and Security in 2009.[47]

The NATO-Russia dialogue was convened at the University of Cambridge, involving seventeen nations with all eight Arctic states. Representatives of the NATO Parliamentary Assembly and European Parliament were interacting with experts from four Russian ministries, supported further by a communiqué from a special representative to the President of the Russian Federation. The dialogue also involved the Canadian High Commissioner and representatives of Indigenous peoples organizations as well as an interdisciplinary mix of scientists, supported by engagement from the European Environment Agency, the International Maritime Organization and the North Atlantic Coast Guard Forum, even involving sponsorship from the World Wildlife Fund and Royal Dutch Shell oil company. The holistic engagement of stakeholders in this NATO-Russia event highlights science as a tool of diplomacy, facilitating dialogues among allies and adversaries alike to build common interests. Since 2017, these two professors have been sharing lessons learned as both observers and participants with their '*Science Diplomacy*' video-conferencing course for graduate students at The Fletcher School of Law and Diplomacy in the US and MGIMO University in Russia.[48] A science-diplomacy legacy of their collaboration is the *Baseline of Russian Arctic Laws*,[49] which is the authentic and comprehensive English translation of Russian Arctic laws since the early nineteenth century, providing transparency for all to apply without prior interpretation or bias.

Opportunities for humankind to build common interests are simplified in areas beyond national jurisdictions, as in the high seas of the Central Arctic Ocean,[50] which is surrounded by exclusive economic zones of the 'Arctic 5': US, Canada, Denmark with Greenland and the Faroe Islands, Norway and the Russian Federation. These nations are looking seaward in view of their national interests in contrast to humankind looking landward from the North Pole as a 'pole of peace'.[51]

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47 NATO, *New NRC Committee Structure. NATO-Russia Council of Foreign Ministers* (2011), https://www.nato.int/nrc-website/en/articles/2011-01-10-nrc-statement-09/index.html (accessed 8 Feb. 2019).

48 Science Diplomacy Center, *Science Diplomacy: Environmental Security and Law in the Arctic Ocean*, Video-Conferencing Course between The Fletcher School (United States) and MGIMO University (Russian Federation) (Tufts University 2019), https://sites.tufts.edu/sciencediplomacy/education/science-diplomacy-course/ (accessed 8 Feb. 2019).

49 *Baseline of Russian Arctic Laws* (P. A. Berkman, A. N. Vylegzhanin & O. R. Young eds, Springer 2019).

50 P. A. Berkman & O. R. Young, *Governance and Environmental Change in the Arctic Ocean*, 324 Sci. 339–40 (2009).

51 M. Gorbachev, *Speech in Murmansk at the Ceremonial Meeting on the Occasion of the Presentation of the Order of Lenin and the Gold Star to the City of Murmansk* (Murmansk 1 Oct. 1987), https://www.barentsinfo.fi/docs/Gorbachev_speech.pdf (accessed 8 Feb. 2019).

Considering balance between national interests and common interests with the Arctic High Seas as focus to build common interests, ambassadorial panels were convened with science diplomacy in Reykjavik, Iceland, in 2015 as well as 2016, when high-level representatives contributed from: Canada, China, Finland, France, Germany, Greenland, Iceland, Norway, Russian Federation, Sweden, United Kingdom and US.[52] The Arctic High Seas continues to be an important focus, balancing the interests of Arctic and non-Arctic states, as represented by the Arctic High Seas Fisheries Agreement[53] signed by the 'Arctic 5' along with China, Iceland, Japan, Korea and the European Union.

The lessons of science diplomacy in the Arctic are particularly revealing with continuous cooperation between the US and the Russian Federation, co-chairing task forces to generate three binding Pan-Arctic legal agreements in 2011, 2013 and 2017 with all eight Arctic states (including EU Member States Denmark, Finland and Sweden) that have sovereign jurisdictions north of the Arctic Circle. The Arctic Science Agreement[54] is of special value, propelling dialogues between the science and diplomatic communities[55] with the primary 'importance of maintaining peace, stability, and constructive cooperation in the Arctic'.[56]

Altogether, the Arctic is an important focus for transatlantic relations[57] because it affords opportunities to balance national interests and common interests for the benefit of all on Earth. Such opportunities and interests are represented by the continuous production of communications, resolutions and decisions from the European Commission, Parliament and Council of the European Union about governance mechanisms and built infrastructure in the High North.[58] Moreover, the 2nd Arctic Science Ministerial in Berlin in 2018,[59] building on the first in Washington, DC, in 2016,[60] is a tangible demonstration of transatlantic interests in

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52 Arctic High Seas, *Ambassadorial Panel on Building Common Interests in the Arctic Ocean* (Reykjavik University 2016), https://en.ru.is/news/building-common-interests-in-the-arctic-ocean-1 (accessed 8 Feb. 2019).

53 Agreement to Prevent Unregulated High Seas Fisheries in the Central Arctic Ocean (Ilulissat 3 Oct. 2018).

54 Agreement on Enhancing International Arctic Scientific Cooperation (Fairbanks 11 May 2017).

55 Berkman, Lang, Walton & Young, *supra* n. 12.

56 Arctic Science Agreement Dialogue Panel, *Supporting Implementation of the Arctic Science Agreement*, 3 Sci. Dipl. Action 1–55 (2019), https://sites.tufts.edu/sciencediplomacy/research/science-diplomacy-action/ (accessed 8 Feb. 2019).

57 *Arctic Marine Governance*. Opportunities for Transatlantic Cooperation (E. Tedsen, S. Cavalieri & R. Andreas Kraemer eds, Springer 2014).

58 A. Airoldi, *The European Union and the Arctic. Main developments July 2008–July 2010* (Nordic Council of Ministers 2010); A. Airoldi, *The European Union and the Arctic. Developments and Perspectives. 2010-2014* (Nordic Council of Ministers 2014).

59 European Commission, *Second Arctic Science Ministerial* (Berlin 25–26 Oct. 2018), https://ec.europa.eu/research/index.cfm?pg=events&eventcode=187D5765-E38F-9AFC-958DA987ECDD0613 (accessed 8 Feb. 2019).

60 ARCUS, *Supporting Arctic Science: A Summary of the White House Arctic Science Ministerial Meeting* (Arctic Research Commission of the United States 2016).

the Arctic: 'Be it a frontier or a gateway to Europe, the Arctic is a region of vast importance not only to the 4 million people living there, but also to the European Union and to the rest of the world'.[61]

6 CONCLUSION: THE FUTURE OF SCIENCE DIPLOMACY

Fuelled by questions for our knowledge economy (Fig. 4) - the engine of science diplomacy is informed decision-making with its associated theory, methods and skills that can be applied, trained and refined from global-local levels.[62] The applications of informed decision-making are scalable without boundaries across the seventeen SDGs, which are holistic in the context of our survival as a globally-interconnected civilization.

From the Treaty of Westphalia forward, nation-states have been the basic jurisdictional unit. However, the world wars of the twentieth century created international dimensions on a planetary scale, starting with the League of Nations, established with the *Treaty of Versailles*[63] in France to end World War I. After World War II, establishment of an inclusive international forum emerged with the United Nations Charter,[64] signed among the redwoods of California with symbolism for our world forever after, defining its purposes in the opening words of Article 1: 'to maintain international peace and security'.

With productive consequence, the United Nations has been operating in an holistic manner to maintain international peace and security, as reflected by the evolution of the SDGs. However, maintaining international peace and security now transcends boundaries beyond the capacities of nation-states alone, recognizing that sustainability on a planetary scale operates across a spectrum of jurisdictions, ranging from the international to the national and subnational, in particular cities (Figure 5).

As the global human population continues to accelerate, many cities and sub-national regions already are more powerful economically than many nation-states,[65] recognizing that nations also wield militaries as a distinguishing source of power. However, even this distinction is being minimized with the advent of asymmetric capacities and threats, as in the arena of cybersecurity. Nonetheless, the emergence of 'megacities'[66] with populations over 10 million represents the rise of sub-national

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61 European External Action Service, *European Union Policy for the Arctic* (2017).

62 Vienna Dialogue Team, *supra* n. 17; Berkman, Lang, Walton & Young, *supra* n. 12.

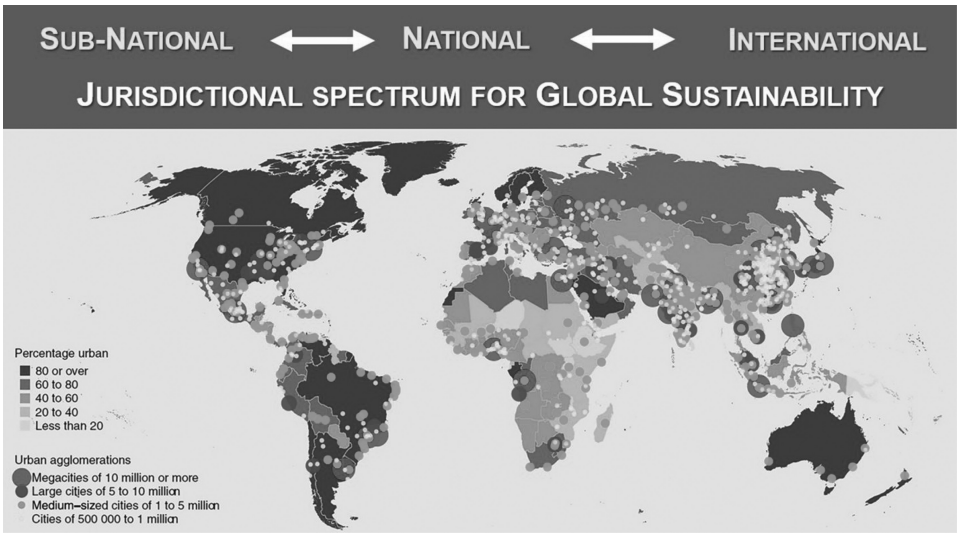
63 Treaty of Versailles. *Traité de Versailles* (Signed: Versailles, 28 June 1919; Entry into Force: 10 Jan. 1920).

64 Charter of the United Nations and Statute of the International Court of Justice (Signed: San Francisco, 26 June 1945; Entry into Force: 24 Oct. 1945).

65 For example, CBS News, *California Now Has the World's 5th Largest Economy* (4 May 2018), https://www.cbsnews.com/news/california-now-has-the-worlds-5th-largest-economy/ (accessed 8 Feb. 2019).

66 United Nations, *World Urbanization Prospects. The 2014 Revision* (United Nations, Department of Economic and Social Affairs 2014).

Figure 5 Jurisdictional Spectrum on Earth



Explanation: 'Megacities'[67] and other large human agglomerations across the Earth with 'urban' defined by nations inclusively,[68] reflecting the spectrum of jurisdictions from sub-national to international with nations as the central jurisdictional unit since the Treaty of Westphalia (Figure 2), when the global human population was less than 1/10 its current size.[69]

jurisdictions, whose capacities are rapidly accelerating with urbanization on a global scale (Figure 5). Simultaneously, STI is more central to the everyday activities of humankind, from smart phones and social media to robotics and artificial intelligence among many other transformations.

With many questions to address, megacities – with those on the two sides of the Atlantic – will have increasingly important roles in the local-global implementation of the SDG, complementing the global-local capacities of nations to operate together across a 'continuum of urgencies' from security to sustainability time scales.[70] The full spectrum of sub-national to international jurisdictions now is

67 *Ibid*.
68 United Nations, *United Nations Demographic Yearbook 2017. ST/ESA/STAT/SER.R/47* (United Nations, Department of Economic and Social Affairs 2018).
69 Adapted from Berkman, Young & Vylegzhanin, *supra* n. 33.
70 Vienna Dialogue Team, *supra* n. 17.

contributing to the progress of our globally-interconnected civilization, when national interests alone are insufficient to build common interests on a planetary scale, forever remembering the consequences of nationalism were global conflict in the twentieth century.[71]

Common-interest building with science diplomacy among allies and adversaries alike after World War II is revealed by the establishment of international spaces.[72] As an holistic process with informed decision-making to achieve sustainability at local-global scales, science diplomacy has relevance to the US, Europe (the EU and its members)[73] and the Russian Federation[74] as well as the rest of our world.[75] The global relevance of diplomacy and sustainability with 'science as a public good' is recognized by the International Science Council (ISC)[76] that emerged from the union of the International Council of Scientific Unions (ICSU) and the International Social Sciences Council (ISSC), championing holistic integration. Within the ISC, global leadership with science diplomacy is being provided especially by the International Network on Government Science Advice (INGSA)[77] with its relationship to the Foreign Ministries Science and Technology Advice Network (FMSTAN).[78] Science diplomacy is maturing as a field globally and across the Atlantic, as reflected by targeted funding from the European Commission during the Horizon 2020 programme.[79] Helping to balance national interests and common interests – promoting cooperation and preventing conflict – science diplomacy is a source of hope and inspiration for the benefit of all on Earth across generations.

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71 R. Haass, *How a World Order Ends and What Comes in Its Wake*, 98(1) Foreign Aff. (2019).

72 Berkman, *supra* n. 10; Berkman, Lang, Walton & Young, *supra* n. 12.

73 J. M. Müller & M. Bona, *Past, Present, and Future of Science Diplomacy in Europe*, 7(3) Sci. & Dipl. (2018).

74 Russian Foundation for Basic Research, *Themed Session: Science Diplomacy* (with 13 articles), 97(1) RFBR J. 1–83 (2018).

75 E. W. Colglazier, *Science Diplomacy and Future Worlds*, 7(3) Sci. & Dipl. (2018).

76 ISC, *Advancing Science as a Global Public Good: High Level Strategy* (International Science Council Paris 2018).

77 INGSA, *International Network for Government Science Advice*, https://www.ingsa.org/ (accessed 8 Feb. 2019).

78 FMSTAN, *Foreign Minister S&T Advice Network*, https://www.ingsa.org/chapters/fmstan/ (accessed 8 Feb. 2019).

79 EL-CSID, *European Leadership in Cultural, Science and Innovation Diplomacy*, https://www.el-csid.eu/; S4D4C (accessed 8 Feb. 2019), *Using Science for/in Diplomacy for Addressing Global Challenges*, https://www.s4d4c.eu/ (accessed 8 Feb. 2019). *See also* Prange-Gstöhl, *supra* n. 19.