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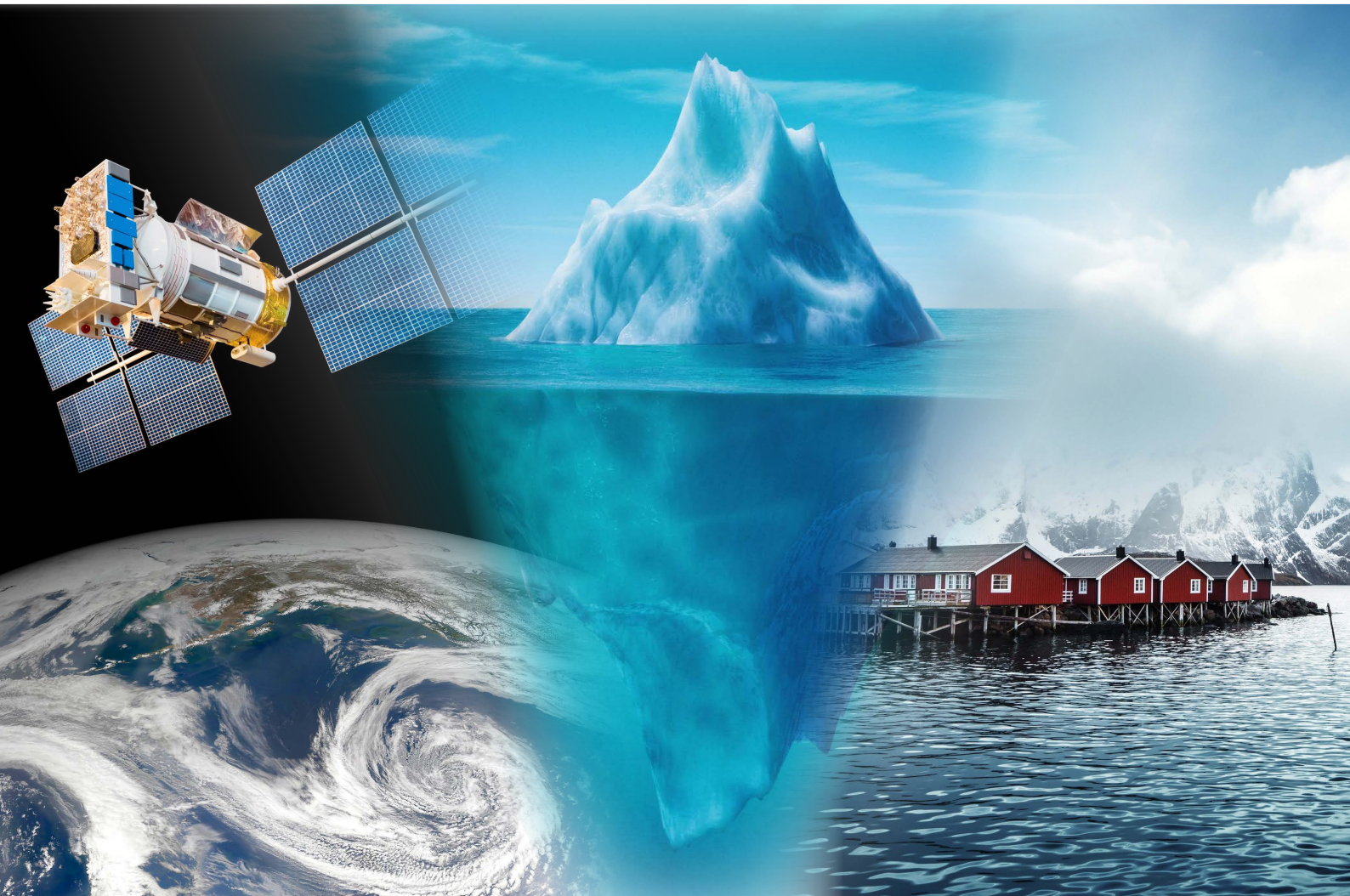
GLOC 2023

IAF GLOBAL SPACE CONFERENCE ON CLIMATE CHANGE

23 - 25 MAY 2023 | OSLO, NORWAY

Fire and Ice – Space for Climate Action

HIGH-LEVEL SUMMARY



GLOC 2023
HIGH-LEVEL SUMMARY

A COMPREHENSIVE SYNOPSIS OF THE FIRST IAF GLOBAL SPACE CONFERENCE ON CLIMATE CHANGE

Fire and Ice – Space for Climate Action

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Abstract:

The International Astronautical Federation (IAF) Global Space Conference on Climate Change (GLOC) 2023, convened in Oslo, Norway, 23–25 May 2023, was specifically formulated to address how the space community can be an accelerator for climate action. Humankind is having a profound impact on the Earth's climate. A prominent example is greenhouse gas emissions, which are at a peak since the pre-industrial era. This growth is contributing to a continually changing climate and is increasing severe weather and other environmental extremes. The space community has been instrumental in creating today's scientific understanding of Earth's system and in enabling applications that assess and address the many aspects of climate change. However, the space community and space technologies can go further than present plans to accelerate action to address climate challenges. The first step is to educate policymakers, media, and the public on what and how the space community has contributed to date, what its plans are for the future, and what additional actions are possible if bold initiatives are undertaken.

GLOC 2023 brought together more than 500 participants — space agencies, end users of space-based products and services, policy makers, commercial industry, philanthropic organizations, and the media — to explore the topic and synthesize findings and recommendations to increase the use of space-based products and services for climate action. This paper documents key findings for advancing the use of Earth observations and space technologies for climate action and urges all parties to increase their efforts for more effective communication, integration, and greater collaboration globally.

Findings Context

Scientific and engineering evidence shows the value of space-based observations for assessing Earth's environmental state, facilitating carbon emissions reductions, and adapting to climate change. In many cases, space-based observations constitute the only means to obtain important climate variables on a global basis. Yet, challenges remain. The Earth's climate is still warming. The community must tackle uncertainties on extent and impacts due to 1) how effective human mitigation actions will be and 2) what gaps in knowledge and services need to be filled to improve science, predictions, mitigations, and adaptations.

Improved modelling is one major challenge. Severe environmental phenomena like floods can no longer be predicted based on historical data. New methods must be developed to predict extremes in the future. Mitigation is another major challenge. Ultimately, the growth of greenhouse gases in the atmosphere must be addressed through several means and the space community has the potential to support this action.

Recognizing the importance of climate change, matched with the current limited understanding of the space sector's potential to do far more to address the environmental crisis, the International Astronautical Federation (IAF) realized that *Space for Climate Change* had to be a focal point of discussion in the IAF Global Conferences Programme. The objective was to signal to national governments and international organizations that the space community has the right tools to

contribute much more than planned to the global efforts to better understand and battle climate change.

The IAF, along with the Conference host, the Norwegian Space Agency (NOSA), designed GLOC 2023 as a *non-conventional Conference* aimed at bringing together the space community and influencers outside the space community including scientists, engineers, policy makers, media, government, commercial, and Non-Governmental Organizations (NGOs). GLOC 2023 has been shaped as an all-together platform to create cross-sector dialogue, understanding, and elicit findings and observations to address increasing the use of products and services derived from space-based observations as a tool for climate action.

The Conference resulted in recommendations to guide the space community's future priorities and actions. Those judged to be the most impactful are captured in this paper. We have organized them as

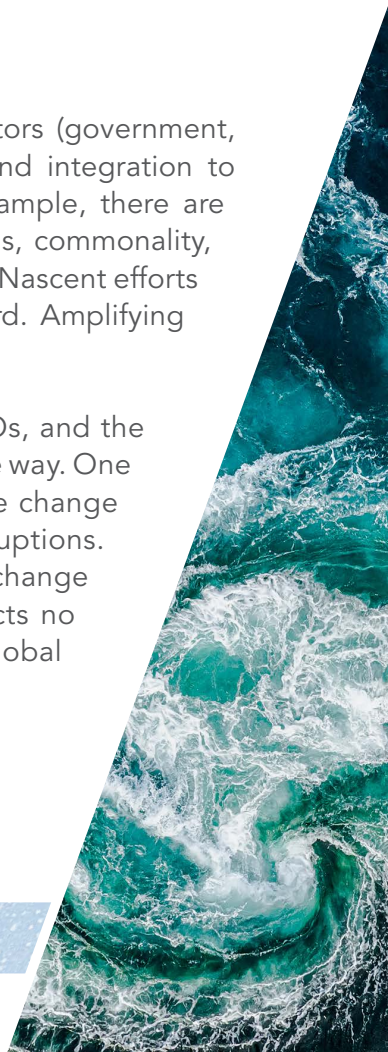
- **Collaboration:** Recommendations and a call for greater collaboration among organizations and countries, especially with the emerging new space entities.
- **Communication:** Identified and called for more effective space community communication strategies with policymakers and the public, at large.
- **Gaps, last mile and more:** Ensuring that 'the last mile is not forgotten, e.g., reaching everyone regardless of where they live on the Earth needs attention.
- **Demonstration to action:** Scaling up successful demonstration projects for global long-term implementation is essential.
- **Additional major points:** Other overarching points which did not group with the other recommendations but were judged highly impactful.

Discussions at the GLOC touched on each of these and many more.

Collaboration

While much collaboration is occurring across borders, organizations, and sectors (government, industry, academia), there is still a need for more enhanced collaboration and integration to achieve maximum application of space capabilities to climate action. For example, there are many data portals, yet enhanced collaboration is necessary to create standards, commonality, and integration to make major improvements in discoverability and accessibility. Nascent efforts have started — for example, the NASA-ESA-JAXA Earth Observing Dashboard. Amplifying and building on such collaborations is necessary to accelerate the process.

Participants voiced that transparency is necessary to align governments, NGOs, and the private sector with common goals in a globally comprehensive and collaborative way. One impactful insight introduced was the notion of a polycrisis, which links climate change to interconnected challenges from food shortages to socioeconomic disruptions. This underscored the transnationality and interconnectedness of climate change and its global impact. One speaker emphasized that "climate change respects no borders". Therefore, sustained, integrated action will be required at both global and local levels.



Speakers noted that national space agencies have been the mainstay of space-based observations for decades, and financial and political support for their efforts must be continued. Their observation and technology programs have been the workhorses of this sector. Over the last few decades, a robust commercial sector has emerged with capabilities for increased spatial, spectral, and temporal resolution, as well as enhanced applications and services tailored to many needs. Used together, these public- and private-sector capabilities can accelerate climate action.

The pace of technology improvement has substantially accelerated the space sector's ability to address climate action. This is projected to continue to increase the affordability and capability to expand and accelerate both the ability of *traditional space* and *new space* community–delivered applications for climate change mitigation and adaptation.

As a result of general and space-specific technology advances that have dramatically reduced barriers to entry, there is a wide variety of opportunities for space community private enterprises, especially startup companies, to address climate change for the benefit of society. This can be in the form of observations or applications. The abundance of publicly available climate-related datasets is an enabler for the latter. New business models that can foster strong commercial and public-private partnerships have the demonstrated potential to make critical contributions, but there needs to be long-term implementation action to harvest that potential.

Communication

Space continues to fascinate most people, and yet, communicating the value of space-based observations to humanity remains elusive. Several outstanding sessions at GLOC focused on communications and articulated that scientists absolutely love to talk about "what" they are doing and "how" they are doing it. One prominent speaker exclaimed that the space community is in its own communications "bubble." Going the extra step and communicating "why" something is being done and what it means in an easily understood manner for politicians, citizens, and end-users was identified as a big challenge that must be overcome!

The space community, reflecting on its capability to communicate its value to addressing climate change, needs to go beyond a focus on data, technology, and numbers to be effective. This includes engagement with the public, media, policy makers, and especially the younger generations on their own terms. It must recognize today's media landscape and engage through alternate means that are more effective than the traditional press release to traditional media.

Speakers recommended several methods to engage and create connection such as human-interest storytelling. They indicated that the space community must recognize that the business model of social media, and to some extent all media, is dependent on grabbing attention through "clickbait" headlines and events and that it is hard to get the value of Earth Observations through this media cacophony. Speakers noted, "It's not about the satellite or where data comes from" and recommended that the space community tells its story by how it contributes to something bigger and more important to give meaning and relevancy to audiences.

Many speakers noted that the messaging of authors in the Conference science sessions should

be communicated outside the science and space communities to the public through engagement that fosters appropriate and meaningful understanding and response. They also stated that there is a gap across different sectors in knowledge and awareness of how satellite data can help address climate change mitigation and adaptation.

Gaps — last mile and more

Major attention was raised on gaps in the availability of climate information useful for application at the local level and for non-space industries/sectors (finance, social sciences etc.). Speakers termed this the "last mile" problem analogous to the challenge and expense of connecting individual users to networks and grids like communications and power.

When it comes to optimizing space for climate action, contributors to this "last mile" issue include gaps in local-scale observational coverage; shortage of applications that inform local mitigation and adaptation; knowledge of information availability, affordability, ease of access, discoverability, and searchability; and the ability, training, and adaptation of applications for non-experts to make appropriate use of the information for climate action. A notable quote reflecting these gaps was, "Our end users are very often drowning in data and starving for information."

Even within the science world, many who could benefit are not aware or have insufficient resources to take advantage of space capabilities. Such gaps, if addressed, create a very large opportunity to accelerate climate action. To address "last mile" gaps, recommended measures include substantially more emphasis on linking monitoring to practical solutions and interpreting data in a meaningful way for policymakers and the public to use for their own informed climate action.

Speakers noted that there is a lack of access in areas of the world where the effects of climate change are more severe (e.g., the Pacific Islands), often with low wealth and poor infrastructure, which if addressed can enable major gains for large portions of the planet and its people. The value of integrating native knowledge for local action was raised. Open science and data improve science return by providing more people with access to information, and the return increases over time with long time series data sets. It was also noted that open science, especially if communicated in ways media, the public, and policy makers can relate to, also builds trust.

Experience reported at the Conference recommended that local communities must be involved in gathering requirements for the development and usage of space data for their needs. Improved standardization was also emphasized as critical to improve access and efficiency.

Successful Demonstration to Long Term Global Action

Many examples of new technologies and business models are being experimented with by both traditional and new space. The challenge for them is how to translate demonstrated success into sustained capability and enable global impact.

One example proposed was to develop a "climate action framework" of policy-based incentives and penalties (whether economic or regulatory) at the individual actor level, taking advantage of space-based information to cultivate action.

A notable demonstration of this reported at the Conference was Norway's International Climate and Forest Initiative (NICFI). It demonstrates how such action could play a globally pivotal role in combatting climate change and preserving biodiversity by supporting tropical forest countries in protecting rainforests. Through the provision of free access to high-resolution satellite imagery, NICFI has enabled improved monitoring of these forests, empowering users from 158 countries to analyze the data and contribute to the global effort against deforestation. However, it is a demonstration project which requires long-term funding for sustainment.

Another not widely recognized potential lies with using satellite data to address fugitive methane emissions, which is a very powerful greenhouse gas. Space-based methane observations available today are already actionable and can be used to identify local sources that could be reduced or eliminated. The capacity of the methane observing system will be greatly enhanced in the upcoming years through new satellite missions from commercial to philanthropic and government missions. These developments provide new sources of information to inform action. However, speakers recommended that an enhanced policy framework is required to maximize payoff.

Many other examples were also presented for applying powerful new space capabilities to problems such as the potential to make major improvements in addressing wildfires and reduce illegal, unreported, and unregulated fishing, which is a parallel pressure that adds to what climate change is already doing to aquatic life. These all represent demonstrated, scalable capabilities that could provide dramatic acceleration to climate action under the right framework, resources, and priorities.

Additional major points:

GLOC included a session devoted to the younger generation of space professionals and students. Participants in that session voiced that it is vital to include younger generations to help raise awareness that young people are not only more severely impacted by climate change but are also valuable contributors to climate action. That session recommended a more prominent role, along with more leadership attention to the younger generation.

Participants also pointed out the need for continued long-term support of factors for success that may not be well recognized. For example, availability and joint use of non-space and space data is necessary for better understanding and modelling climate. Individual missions implemented to answer specific questions often "contribute to our understanding in unexpected and highly impactful ways, so these should be continued." Data continuity is deemed exceedingly important as climate change is a long-term decades and centuries challenge.

There are unique measurements that can only be acquired from space-based platforms. Those data sets are critical to enable a global understanding of how interconnected Earth system phenomena operate. Such understanding is critically important to better predict the climate as it warms. One example highlighted at the conference was the water cycle. We need to understand how its change is impacting lives and livelihoods around the world and what measures are most

effective to address those changes. The work to understand Earth's water cycle from space can only be done through international collaboration — no single nation or continent can do the job alone.

Summary and conclusions

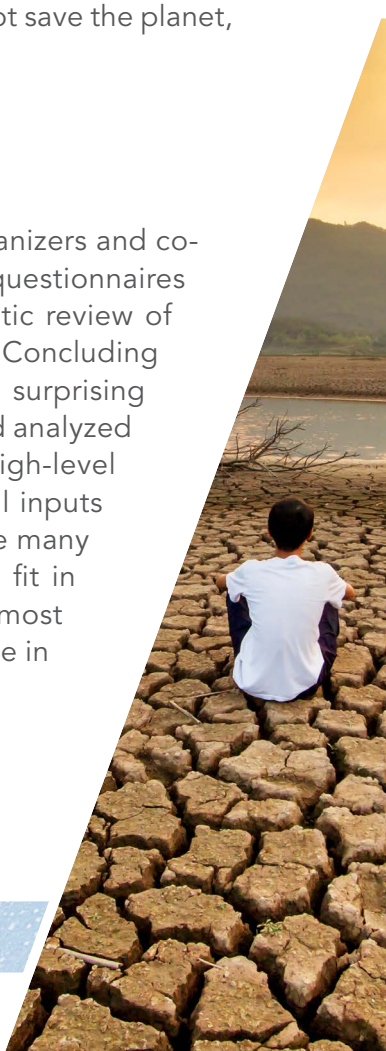
The announcement of GLOC created strong interest and energetic participation. The post-conference survey confirmed the value to participants. Summarizing the conference´s most important points and conveying them to broader audiences beginning with this paper, along with an IAF commitment to initiate a regular sequence of GLOCs, is part of the plan to carry the value beyond the direct participants.

Immediate plans beyond this paper are to address the global space community at the International Astronautical Congress, Baku Azerbaijan in early October 2023, the Group on Earth Observations Ministerial Summit, Cape Town, South Africa in early November 2023, and COP 28, early December 2023, Dubai, United Arab Emirates, then further branch to other venues. The IAF will also begin planning for the next GLOC to continue the dialogue to advance space for climate action.

What did we hope to achieve — In short, get higher visibility external to the space community of the contributions space is making versus how much more it could do to address the climate challenges. This leads ultimately to maximizing the potential of the space community to contribute to climate action for mitigation and adaptation. *How well did we do* — satisfaction scores indicated a rating of greater than 8 out of 10 on satisfaction. Directions for improvement included better representation from the next generation, end users, and non-western participants. Individuals from 45 countries participated. From one prominent speaker: "I think that space will not save the planet, but the planet will not be saved without space."

Disclaimer:

This document is the product of the expert judgement of the GLOC 2023 Organizers and co-chairs based on observations during participation in the Conference, input to questionnaires provided by session organizers, provided abstracts and papers, and systematic review of recorded sessions (all Plenaries, Lectures, Global Networking, Opening and Concluding sessions) to extract highlights. From these, most important points, most surprising information, summary gaps, and summary recommendations were captured and analyzed to be synthesized by the authors with administrative support into this high-level summary. In the interest of time and cost, we did not formally trace individual inputs to this summary but have retained intermediate synthesis products. There were many more important points that came from the conference than could practically fit in this paper, so judgment was applied to include what was considered to be the most important. The abstracts, papers, and recordings will be archived and accessible in the IAF Information System for future utilization.



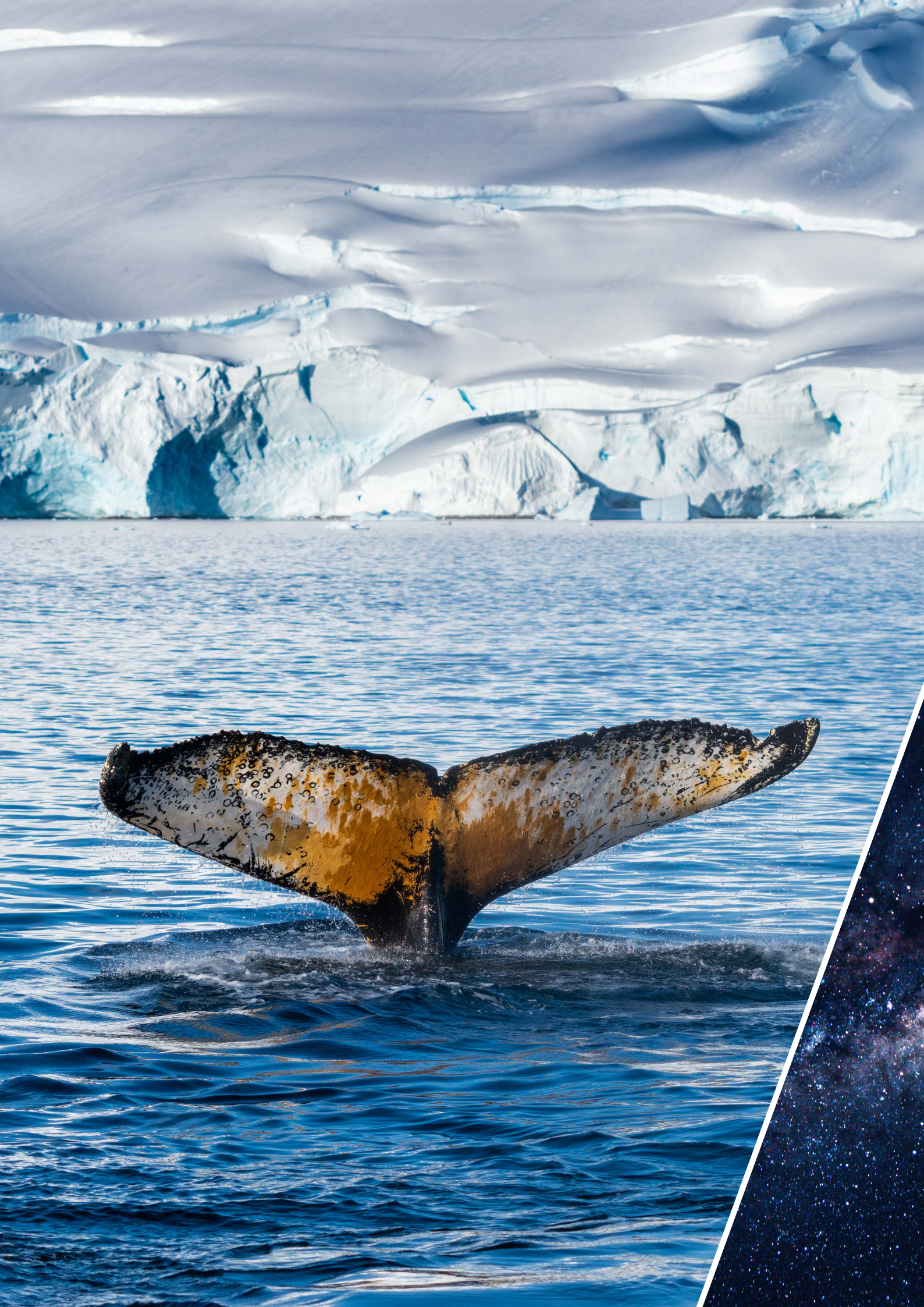
Terminology:

Open Science: Free and open access to methodology, data, and results along with sufficient documentation, metadata, and use information to enable both scientific and non-specialist personnel to discover, access, and utilize the science results.

Climate action: Making observations and measurements, developing models and understanding based on observations, continuously monitoring climate change over long time periods, mitigating climate change, and adapting to the impacts of climate change.

Traditional space: Through most of its history, space has been the province of Governments, primarily from major economically advanced countries, although often with many private companies, academic organizations, and other types of organizations supporting the national programs. These long-time spacefaring entities are termed in this paper, *traditional space*. This also includes long-time commercial activities such as satellite communications and broadcast.

New space: General and space specific technology advances have dramatically reduced barriers to entry and enabled viability of an explosion of new business model feasibility over the past decade to address societal needs that were previously prohibitive. This has unleashed a vast wave of investment and new space ventures, large and small, with many having world-changing success.



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