Asia-Pacific
Economic Cooperation

Monitoring GHG Emissions in APEC: Space-based Solutions

APEC Policy Partnership on Science, Technology and Innovation

July 2025

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EXECUTIVE SUMMARY

In alignment with APEC's shared vision of sustainable and innovative development, a roundtable on "Monitoring GHG Emissions in APEC: Space-based Solutions" was convened on 14 March 2025 under the leadership of the Russian Ministry of Economic Development. The event was held as part of the project PPSTI 01 2022S "APEC Technological Solutions for Monitoring GHG Emissions" endorsed by the Policy Partnership on Science, Technology and Innovation (PPSTI) of the Asia-Pacific Economic Cooperation Forum.

The event focused on exploring the potential of space-based technologies in enhancing greenhouse gas (GHG) emissions monitoring across the Asia-Pacific region. The discussion brought together representatives from governments, international organizations, academic institutions, and private sector stakeholders. It centered on the importance of leveraging satellite Earth observation data to improve the accuracy, transparency, and timeliness of GHG inventories. Participants emphasized the need for regional cooperation in gathering, processing, and interpreting Earth observation data to support science-based policymaking and cross-border environmental accountability.

Key topics included the integration of satellite-derived data into domestic reporting systems, prospects for harmonization of measurement methodologies, and the role of open-access platforms in promoting data democratization. Particular attention was given to capacity-building efforts aimed at supporting developing economies within APEC, ensuring equitable access to advanced monitoring tools and analytical resources.

This report outlines the main contributions, policy recommendations, and technological insights shared during the roundtable. It highlights the growing importance of space-based solutions in addressing climate change and underscores the need for continued multilateral engagement to transform scientific advancements into actionable policies.

OPENING REMARKS

The roundtable commenced with a formal opening session that set the tone for a high-level, policy-driven dialogue on leveraging satellite technologies to enhance climate action across the Asia-Pacific region. The session was moderated by ***Ms. Evgeniia Drozhashchikh****, Deputy Director of the Department of Multilateral Economic Cooperation and Special Projects at the Ministry of Economic Development of the Russian Federation*.

In her welcoming address, Ms. Drozhashchikh emphasized the strategic importance of science, technology, and innovation in addressing global environmental challenges. She underscored Russia's active engagement in advancing the APEC agenda on sustainable development – the economy envisages carbon neutrality by 2060, having elaborated the Strategy of Low Carbon Development as well as the whole new regulation pertaining to mitigation and adaptation to climate change.

Importantly for the roundtable matters, Russia has launched the federal project to create a climate monitoring system. Ultimately, the system will, on the one hand, utilize evidence from ground based, aerial and space-based solutions. On the other hand, it will complement these monitoring methods with bottom-up ones, in particular calculated estimates of emissions.

Ms. Drozhashchikh noted that many APEC economies are exploring methods to improve the way they monitor, report and verify emissions, sources and sinks, hotspots and leaks. Meanwhile international organizations are contributing to these efforts, possessing access to more economies, more trustworthy information sources, and being able to complement one fragment of data with another one to come up with broader recommendations.

The discussion opened the room for exchange of experience of both sides – international organizations and particular economies, representatives of public and private sector, academia. All in all, speakers were invited to test several assumptions. First, that Earth Observation satellites shall be necessarily included in the emissions monitoring contour due to the level of precision and scale they provide. Ranging in spatial, temporal and spectral resolutions, satellites can be effectively applied at the regional, global level, but also point source level. Second, that public and private missions matter equally and could amplify each other rather than move in a competitive mode. Third, that cooperation within APEC and globally will come in handy for all the parties. Transparent exchange of satellite data, open science and open knowledge regarding the models of converting satellite data into user friendly services seem to be a prerequisite for tackling climate change.

Following the moderator's remarks, ***Mr. Marat Berdyev****, Ambassador-at-Large and Senior Official from Russia to APEC*, delivered an official welcome speech on behalf of the Ministry of Foreign Affairs of the Russian Federation. Mr. Berdyev acknowledged the growing importance of space technologies as tools for environmental governance and called for enhanced regional collaboration in developing shared standards, interoperable systems, and accessible data platforms.

He pointed out that while many APEC economies are already investing in domestic GHG monitoring capabilities, there remains a significant gap in harmonizing methodologies and ensuring equitable access to advanced technologies. He urged participants to focus on capacity-building initiatives, particularly for smaller and less technologically developed economies, so they can fully benefit from the potential of space-based solutions.

Mr. Berdyev further emphasized the need for cross-sectoral engagement – bringing together government agencies, research institutions, private industry, and international organizations – to create a comprehensive ecosystem for GHG monitoring. He expressed confidence that the roundtable would serve as a valuable platform for exchanging best practices, identifying policy synergies, and exploring new avenues for public-private partnerships.

In conclusion, he extended his appreciation to all participating delegations, experts, and moderators for their contributions to what he described as a “critical and forward-looking conversation” that aligns with APEC’s overarching mission to promote inclusive economic growth and sustainable development.

INTERNATIONAL PERSPECTIVES

The first thematic session of the roundtable was dedicated to exploring the role of international organizations in advancing satellite-based GHG monitoring. This segment brought together representatives from the APEC Secretariat, the United Nations Office for Outer Space Affairs (UNOOSA), and the United Nations Economic and Social Commission for Asia and the Pacific (UNESCAP). The session focused on bridging global expertise with regional climate governance, emphasizing the need for standardized, accessible, and actionable Earth observation data across the Asia-Pacific. Each presentation combined strategic policy insights with concrete examples of technological implementation, underscoring the growing importance of space-based solutions in addressing climate change at both regional and global scales.

APEC SECRETARIAT

Mr. Eduardo Pedrosa, Executive Director

Mr. Eduardo Pedrosa delivered a compelling and forward-looking presentation that set a clear strategic direction for the Asia-Pacific region's approach to GHG monitoring in the context of climate action. Framing the discussion within the broader mandate of APEC's commitment to sustainable development and economic resilience, Mr. Pedrosa underscored the urgency of modernizing GHG monitoring systems through the integration of satellite-based Earth observation technologies. He emphasized that APEC economies collectively account for over 60% of global CO_2 emissions, positioning the region not only as a major contributor to climate change but also as a critical actor in shaping its mitigation. His remarks positioned space-based monitoring not merely as a technological upgrade but as a policy imperative for enhancing transparency, accountability, and science-driven decision-making across the region.

Mr. Pedrosa outlined five strategic priorities for APEC moving forward:

1. *Data Harmonization:* Establishing unified standards for data collection and processing to ensure consistency across economies.
2. *Capacity-Building:* Supporting developing economies in adopting satellite-based tools through training and knowledge-sharing platforms.
3. *Multi-Stakeholder Engagement:* Encouraging collaboration between governments, academia, private sector actors, and international institutions.
4. *Trade Facilitation:* Promoting liberalization of trade in environmental goods, including remote sensing equipment and software.
5. *Policy Alignment:* Ensuring compatibility of technical and regulatory frameworks to enable seamless cross-border exchange of GHG-related information.

"Climate action is not at odds with economic development but rather a prerequisite for its long-term sustainability"

Mr. Pedrosa concluded by reaffirming the APEC Secretariat's commitment to facilitating dialogue among member economies and promoting the integration of satellite-derived data into economies' climate strategies. He stressed that satellite technologies must not only be accurate but also actionable – accessible to local decision-makers and integrated into broader economic planning processes.

UN Office for Outer Space Affairs (UNOOSA)

Mr. Hamid Mehmood, Head of UN-SPIDER Beijing Office

Mr. Hamid Mehmood presented an overview of the United Nations' efforts to promote the use of space-based technologies for climate resilience and disaster risk reduction. Drawing on extensive experience from over 55 Technical Advisory Missions (TAMs) conducted globally, he highlighted how space-derived data is increasingly being used to support climate strategies, early warning systems, and post-disaster assessments. Mr. Mehmood emphasized that satellite imagery has become an essential tool for real-time GHG tracking, particularly in areas where ground-based monitoring is limited or inconsistent due to logistical or infrastructural constraints.

A central theme of his address was the importance of democratizing access to satellite data to ensure that all economies – especially developing ones – can benefit from accurate and timely environmental intelligence. He noted that open-access platforms are vital for empowering local decision-makers with reliable information that can inform policy, guide adaptation efforts, and support mitigation planning. Mr. Hamid Mehmood also stressed the need for interoperable systems that allow seamless integration of data from multiple sources, including different satellite constellations and in-situ sensor networks. This approach, he argued, enhances the robustness of GHG inventories and builds confidence in the accuracy of emissions reporting.

In addition to technical considerations, Mr. Mehmood addressed the broader institutional and collaborative dimensions of space-based GHG monitoring. He called for stronger partnerships between APEC and the United Nations system to promote the adoption of standardized protocols and enhance transparency in climate reporting. According to him, building trust in satellite-based MRV (Monitoring, Reporting, Verification) systems requires not only technological capacity but also joint validation exercises, and cross-border knowledge exchange. These efforts, he explained, are essential for ensuring that data is not only scientifically sound but also politically credible and socially relevant.

Mr. Hamid Mehmood concluded by reinforcing the idea that satellite technologies must be embedded within broader frameworks of multilateral cooperation and sustainable development. He pointed out the growing synergies between GHG monitoring and green finance mechanisms, noting that verifiable satellite data is increasingly being used to underpin carbon credit schemes and climate-resilient investment decisions. His remarks framed space-based monitoring as more than just a scientific innovation – it is a strategic enabler of climate accountability and a

"Interoperability is key – data from satellites must be integrated with other observational systems to provide a complete and reliable picture of emissions"

cornerstone of global climate governance. In this context, he encouraged APEC economies to embrace satellite Earth observation as a key pillar of their environmental policies and urged continued collaboration with international partners to maximize its impact.

UNITED NATIONS ECONOMIC AND SOCIAL COMMISSION FOR ASIA AND THE PACIFIC (UNESCAP)

Mr. Sanjay Srivastava, Chief of Disaster Risk Reduction Office

Mr. Sanjay Srivastava's presentation offered a strategic and policy-oriented perspective on the integration of space-based GHG monitoring into climate resilience frameworks across the Asia-Pacific region. Speaking on behalf of the United Nations Economic and Social Commission for Asia and the Pacific (UNESCAP), he emphasized that satellite technologies are not only tools for emission tracking but also vital instruments for strengthening adaptation strategies and addressing loss and damage linked to climate change impacts.

He began by situating GHG monitoring within the broader context of Sustainable Development Goal 13 – Climate Action – noting that while mitigation remains a global priority, there is an urgent need to shift towards more inclusive frameworks that incorporate adaptation and resilience-building. He mentioned that the Asia-Pacific faces implications from extreme weather events, sea-level rise, and glacial melting in the Himalayas. In this context, Mr. Srivastava underscored the importance of leveraging satellite data to support proactive risk management rather than reactive disaster response.

A key focus of his address was the Regional Space Applications Programme for Sustainable Development (RESAP) – a flagship initiative led by UNESCAP aimed at integrating Earth observation data into sustainable development planning. RESAP aligns with the outcomes of UNISPACE+50, the global agenda for the peaceful use of outer space for sustainable development. He outlined how RESAP supports multiple SDGs, including climate action (SDG 13), life on land (SDG 15), clean water and sanitation (SDG 6), and sustainable cities (SDG 11), through targeted applications such as land-use mapping, water resource monitoring, and emissions tracking.

One of the most notable examples shared during his presentation was the Pandora Spectrometer Network, deployed across seven economies in the region under the China-UNESCAP Cooperation Programme (CCP). This network measures atmospheric pollutants such as ozone (O_3) and nitrogen dioxide (NO_2) in real time, enabling cross-border identification of air pollution sources. Mr. Srivastava highlighted that this initiative has become a model of South-South cooperation, particularly in terms of capacity-building, joint calibration, and knowledge exchange.

"Satellite technologies offer us the ability to act before disasters strike"

In addition to air quality monitoring, Mr. Srivastava presented findings from pilot projects focused on tracking methane emissions from rice cultivation in the Mekong region, which aim to support low-emission

agricultural practices. He also presented ongoing efforts under the Third Pole Initiative, a collaborative program involving regional partners and scientific institutions to monitor methane release from melting glaciers in the Himalayas. These initiatives, he explained, demonstrate the critical role of satellite data in understanding and responding to both localized and transboundary environmental challenges.

Mr. Srivastava also addressed the growing demand for composite spatial indices, such as the Sustainable Territorial Governance (STG) Index, that integrate satellite-derived environmental data with socio-economic indicators to assess sustainability performance at sub-economy levels. He noted that such indices are increasingly being used by governments and international agencies to guide investment decisions, prioritize adaptation funding, and measure progress toward economy's climate targets.

In conclusion, Mr. Srivastava called for a stronger institutional and technical foundation to support space-based GHG monitoring in the region. He urged APEC economies to:

- Strengthen regional collaboration through shared standards and interoperable systems;
- Invest in capacity-building programs, especially for smaller and less technologically advanced economies;
- Develop open-access platforms that make satellite insights actionable for local decision-makers;
- Promote data localization and integration with domestic climate finance mechanisms.

FROM LOCAL NEEDS TO GLOBAL IMPACT

This session featured presentations by representatives of the APEC member economies, in particular, Indonesia; Russia; and Thailand, offering a comparative view of how APEC economies are applying space-based technologies to monitor GHG emissions and support climate action. The session provided concrete examples of domestic initiatives, technical capabilities, and policy linkages. The session reinforced the diversity of approaches among APEC economies in deploying space technologies for GHG monitoring and demonstrated how these tools can be tailored to local needs while contributing to broader climate goals. Participants stressed the need for capacity-building, and continued technical exchange to strengthen regional resilience and transparency.

THAILAND

Ms. Nuntikorn Kitratporn, Geo-Informatics Scientist, Geo-Informatics and Space Technology Development Agency (GISTDA)

Ms. Nuntikorn Kitratporn, delivered a detailed presentation on the integration of satellite Earth observation data into Thailand's GHG monitoring framework. Her remarks focused on how space-based technologies are being operationalized to support Thailand's Measurement, Reporting, and Verification (MRV) systems, particularly in the agricultural sector, which remains a significant source of methane emissions in the economy.

She began by outlining Thailand's strategic approach to climate governance, emphasizing that satellite technologies are increasingly vital to fulfilling commitments under the Paris Agreement. Given Thailand's reliance on rice cultivation – a major contributor to methane emissions – Ms. Kitratporn highlighted an innovative project that uses satellite imagery to detect flooded rice fields and estimate methane emissions based on inundation frequency and duration.

This initiative combines multiple satellite data sources, including optical and Synthetic Aperture Radar (SAR) imagery, with field-level ground verification conducted in collaboration with the Thailand Rice Department. By integrating these datasets, Thai scientists are able to produce high-resolution maps that track rice crop cycles, water management practices, and emission hotspots across the economy's key agricultural zones.

A core component of her presentation was the development of policy-aligned dashboards which convert complex satellite-derived data into user-friendly formats accessible to government agencies and local stakeholders. These platforms allow decision-makers to visualize emission trends over time, compare performance across provinces, and tailor mitigation strategies at both regional and local levels.

"Satellite data is not just about seeing from above – it's about transforming observations into actionable intelligence for policymakers and farmers alike"

Ms. Kitratporn also described efforts to incorporate additional environmental variables into Thailand's MRV system, such as post-harvest burning detection, phenological monitoring, and land-use change analysis. She noted that open-access satellite data, combined with machine learning algorithms, have significantly enhanced the accuracy and timeliness of GHG inventories, particularly in areas where traditional ground-based monitoring is logistically challenging.

In regard to sectoral priorities beyond agriculture, Ms. Kitratporn confirmed that while rice farming remains a primary focus due to its scale and impact, Thailand is expanding its satellite-based monitoring capabilities to include:

- *Waste management*, particularly landfill methane tracking;
- *Urban emissions*, focusing on transportation and energy use in major cities;
- *Forestry and land cover change*, especially in protected areas and peatlands.

She concluded by underscoring the importance of international cooperation and technology transfer in strengthening Thailand's capacity to implement space-based GHG monitoring. Mr. Kitratporn expressed strong support for regional knowledge-sharing initiatives and called for greater standardization of satellite data protocols across APEC economies to facilitate cross-border comparisons and joint climate action planning.

RUSSIA

Prof. Sergey Bartalev, Principal Researcher at Space Research Institute, the Russian Academy of Sciences

Prof. Sergey Bartalev delivered a comprehensive presentation on Russia's contributions to space-based GHG monitoring, with a particular focus on forest carbon budget estimation, trace gas detection, and land-use change analysis. His remarks highlighted both current capabilities and future directions of Russia's Earth observation program, particularly in the context of international climate reporting obligations under the Paris Agreement.

He began by outlining the growing importance of satellite remote sensing in supporting domestic MRV (Monitoring, Reporting, Verification) systems, especially for economies facing challenges in deploying consistent ground-based measurement networks. Prof. Bartalev emphasized that space-based technologies offer a unique opportunity to improve the accuracy, transparency, and timeliness of GHG inventories – a view echoed throughout the roundtable discussions.

A significant portion of his presentation was dedicated to Russia's forest monitoring initiatives, which play a crucial role in understanding Russia's carbon sequestration potential. He described how satellite imagery is being used to assess forest cover changes, biomass dynamics, and wildfire-induced emissions – all of which are components of Russia's GHG inventory. He also noted that deforestation and degradation trends observed via satellites have prompted stronger policy interventions aimed at preserving boreal ecosystems.

Prof. Bartalev also presented findings from ongoing research into trace gas emissions using high-resolution spectrometers. He introduced a newly developed "green product engine", capable of generating customized outputs such as web maps, dashboards, and mobile applications tailored for diverse end-users including government agencies, academic institutions, and private sector partners. This platform, he explained, allows for real-time tracking of emissions hotspots, particularly in industrial zones, urban areas, and agricultural landscapes.

He outlined several priority applications of remote sensing in GHG monitoring:

- Monitoring GHG emissions from industrial sources, transport corridors, wildfires, and agricultural practices;
- Supporting food security through crop yield forecasting and emissions assessments in the agriculture sector;
- Enhancing disaster risk reduction efforts by analyzing environmental stressors and vulnerability indicators;
- Facilitating urban planning and SDG localization, particularly in collaboration with regional partners like ESCAP and UN-SPIDER.

"We are moving beyond simple mapping toward predictive modeling – enabling assessing not just what happened, but what may happen next in terms of emissions and environmental impact"

In response to questions regarding the integration of dynamic atmospheric models with satellite observations, Prof. Bartalev confirmed that Russia is working on improving the interoperability of observational data with numerical weather prediction models to enhance emission flux estimations. He also mentioned the development of AI-driven analytics tools designed to process large volumes of Earth observation data more efficiently.

One of the most notable aspects of his presentation was the discussion around international cooperation in payload development. He expressed strong support for collaborative projects that allow developing economies to build their own satellite instruments and processing pipelines, thereby enhancing local capacity and reducing dependency on foreign technology. He advocated for:

- *Tailored Data Delivery Systems* aligned with specific sectoral requirements;
- *Integration of Dynamic Atmospheric Models* to improve accuracy in emissions tracking;
- *Long-Term Capacity-Building Programs*, particularly in Southeast Asia, including joint payload development and regional hubs.

He concluded by emphasizing the need for regional hubs for technical exchange across APEC economies to ensure consistency and reliability of satellite-derived GHG data. These centers, he argued, would serve as hubs for technical exchange, training, and validation of remote sensing products – ultimately strengthening trust in space-based monitoring systems.

Ms. Daria Chudnaia, Deputy CEO for Communications, SR Space; Head of Climate Monitoring System (SR CMS)

Ms. Daria Chudnaia represented the Russian private space sector and delivered a detailed presentation on behalf of SR Space, a leading Russian aerospace company developing ultra-light launch vehicles, small satellites, and data-driven services based on Earth observation technologies. She also introduced SR CMS (Climate Monitoring System) – a dedicated branch of the company focused on providing space-based climate analytics to commercial and governmental clients.

Her remarks offered valuable insights into how private industry is contributing to the advancement of satellite-based GHG monitoring, particularly through the development of commercial platforms that support carbon accounting, emissions tracking, and environmental risk assessment.

Ms. Chudnaia began by outlining the core capabilities of SR Space, emphasizing its role in building an end-to-end ecosystem for Earth observation, including satellite manufacturing, launch infrastructure, and data processing. She highlighted recent progress in deploying a constellation of small satellites designed specifically for environmental monitoring, with planned enhancements in methane detection and carbon flux estimation.

She then introduced SR CMS, a new platform developed by the company to deliver high-resolution GHG monitoring services tailored for both public and private stakeholders.

The system integrates:

- *Satellite imagery from multiple sources (including SR Space's own fleet);*
- *Ground-based sensor networks;*
- *AI-driven analytics tools for automatic anomaly detection and trend forecasting*.

This multi-source approach enables near-real-time monitoring of emission hotspots, verification of corporate sustainability claims, and support for domestic MRV (Monitoring, Reporting, Verification) systems.

A central theme of her presentation was the democratization of climate data, especially for smaller economies and private enterprises that may lack access to proprietary remote sensing infrastructure. She noted that SR CMS offers scalable subscription models and API integrations, allowing users to customize data feeds according to their specific needs — whether for regulatory compliance, ESG reporting, or investment planning.

Ms. Chudnaia also discussed the technical challenges and opportunities associated with commercial GHG monitoring. She acknowledged that while satellite data has become more widely available, there remains a need for standardized calibration methods, cross-validation

"Our mission is to make satellite-derived GHG data – not only scientifically accurate – but also commercially accessible and actionable for governments, corporations, and investors"

techniques, and transparent quality assurance protocols to build trust in commercial offerings.

She emphasized the importance of public-private partnerships, noting that SR CMS is actively collaborating with government agencies, research institutions, and international partners to enhance the accuracy and utility of its products. She expressed interest in expanding these collaborations within the APEC framework, particularly in the context of joint capacity-building initiatives.

In response to a question about the integration of crowd-sourced data into satellite observations, Ms. Chudnaia confirmed that the company is exploring hybrid approaches that combine remote sensing with field-level inputs. This includes working with agricultural cooperatives and urban planners to improve data granularity and contextual relevance.

INDONESIA

Mr. Rokhis Komarudin, Head of the Geo-Informatics Research Center, National Research and Innovation Agency (BRIN)

Mr. Rokhis Komarudin delivered a detailed presentation that outlined Indonesia's progress in developing a comprehensive geoinformatics platform for GHG monitoring and environmental management. He provided an in-depth overview of Indonesia's space-based initiatives aimed at enhancing domestic capabilities in climate observation, disaster risk reduction, and sustainable development planning.

He began by outlining Indonesia's broader space activities, which are structured around five pillars:

1. *Space Law and Policy Development*
2. *Space Education and Outreach*
3. *Space Applications (including remote sensing)*
4. *Satellite Development*
5. *Space Industry Development*

Mr. Komarudin emphasized that the third and fourth pillars – space applications and satellite development – are most relevant to GHG monitoring and climate action. He introduced GeoMIMO, a flagship initiative of the Indonesian government that stands for "Geoinformatics Multi-Input Multi-Output." GeoMIMO is designed to integrate diverse data sources – including satellite imagery, field station data, and crowdsourced information – into a unified analytical framework for environmental monitoring and decision-making.

A key focus of his presentation was the application of satellite-based technologies in supporting Indonesia's Nationally Determined Contributions (NDCs) under the Paris Agreement. He highlighted several priority use cases:

- *Forest and peatland monitoring*, particularly in carbon-rich regions such as Kalimantan and Papua;
- *Agricultural emissions tracking*, especially methane from rice paddies;

- *Disaster risk assessment*, including flood mapping and post-disaster recovery analysis.

Mr. Komarudin also discussed the integration of artificial intelligence, machine learning, and deep learning tools into Indonesia's GHG monitoring systems. These technologies, he explained, are being used to automate image classification, detect land-use changes, and predict emission trends based on historical and real-time data.

Then, Mr. Komarudin underscored the importance of localizing satellite data to support sub-economy climate governance. Given Indonesia's archipelagic geography and administrative complexity – comprising 34 provinces and over 500 districts – he stressed the need for tailored monitoring systems that can be utilized by local governments. To this end, Indonesia has developed provincial Earth monitoring systems, enabling regional authorities to access satellite-derived products for land-use planning, forest conservation, and water resource management.

One of the most notable components of his address was the discussion of Indonesia's collaboration with international partners, including UNOOSA through its UN-SPIDER program. He described how Indonesia contributes to global disaster response efforts by analyzing pre- and post-event satellite imagery and sharing findings with regional stakeholders.

He also touched upon Indonesia's involvement in the Crop View Project, a joint initiative with academic institutions and international organizations aimed at promoting crop diversity and sustainable agricultural practices using space-based data. This project uses remote sensing for land use classification, crop type identification, and soil moisture monitoring, offering valuable insights for both mitigation and adaptation strategies.

In addition, he presented experience of collaborations with Japan; Thailand; and Viet Nam. One such effort involves the use of full-polarimetric radar data to monitor water levels, assess land degradation, and support climate-resilient agriculture across the region.

Mr. Komarudin concluded by calling for greater data interoperability and open-access frameworks across APEC economies. He noted that while Indonesia has made significant strides in building domestic capacity for space-based GHG monitoring, continued investment in technology transfer and joint payload development will be essential to sustain progress.

"We see satellite Earth observation as a bridge between science, policy, and people. With better data, we can build more resilient communities and contribute meaningfully to global climate goals"

INSIGHTS AND RECOMMENDATIONS

OPEN FLOOR DISCUSSION

Following the formal presentations by representatives of international organizations and experts from APEC member economies, the APEC roundtable “Monitoring GHG Emissions in APEC: Space-Based Solutions” transitioned into an open-floor discussion. This segment allowed participants to ask clarifying questions, exchange views on technical and policy-related challenges, and propose actionable recommendations for future cooperation.

Participants raised a range of issues, including:

1. Crowdsourcing and Data Validation

A delegate from Indonesia was asked about the use of crowdsourced data in satellite-based GHG monitoring systems and how its quality is ensured. In response, Mr. Rokhis Komarudin (BRIN, Indonesia) emphasized that while satellite imagery provides high-resolution environmental insights, it must be validated with local observations. He noted that Indonesia has developed a system integrating crowdsourced information from farmers, local governments, and NGOs, which is then cross-checked against satellite findings using machine learning algorithms to ensure accuracy.

2. Sectoral Expansion of Monitoring Systems

A question was posed to Ms. Nuntikorn Kitratporn (GISTDA, Thailand) regarding whether Thailand monitors emissions beyond agriculture and waste management. She confirmed that while rice farming and landfill methane remain priority areas due to their scale and impact, the economy is expanding its satellite-based monitoring capabilities to include:

- Urban emissions, particularly from transportation and energy use, in Bangkok and other major cities;
- Forest cover changes, especially in protected zones and peatlands;
- Industrial hotspots, where real-time tracking of emissions can support enforcement of environmental regulations.

She also reiterated the importance of open-access platforms and tailored dashboards for sub-economy policymakers.

3. Technology Transfer and Capacity-Building

One of the most discussed topics during the session was the issue of technology transfer and capacity-building, especially for developing economies within APEC. Prof. Sergey Bartalev (Space Research Institute, Russia) stressed that while many economies have access to satellite data, the challenge lies in building domestic expertise to interpret and apply this data effectively.

He proposed the establishment of regional hubs for data validation and methodological alignment across APEC economies to help smaller economies improve the consistency and reliability of their GHG inventories. These centers would serve as hubs for training, joint payload development, and validation of remote sensing products.

"Technology alone is not enough. We must build partnerships, share knowledge, and empower regional experts to interpret and act on the data we collect from space"

4. Role of Artificial Intelligence and Foundational Models

Several speakers highlighted the growing role of AI, machine learning, and foundational models in processing large volumes of satellite data more efficiently. Mr. Sanjay Srivastava (UNESCAP) pointed out that AI-driven tools are already being used to automate image classification, detect land-use changes, and predict emission trends based on historical data.

However, concerns were raised about the readiness of the remote sensing community to adopt these technologies at scale. One participant noted that while foundational models have evolved rapidly in recent years, the climate monitoring sector has been relatively slow in integrating them into operational workflows.

5. Financing and Public-Private Partnerships

In response to a question about the relative importance of innovation, collaboration, and financing in advancing GHG monitoring, several participants agreed that all three are interdependent. Mr. Hamid Mehmood (UN-SPIDER Beijing) described them as "the three wheels of a tricycle," emphasizing that removing any one would cause the system to collapse.

All in all, participants called for:

- *Increased investment in open-data infrastructure;*
- *Public-private partnerships to accelerate technology adoption;*
- *Green finance mechanisms that recognize satellite-derived data as a credible source for carbon credit verification and climate risk assessment.*

Summary of Key Outcomes and Policy Implications

At the conclusion of the roundtable, several key outcomes and strategic implications emerged from the discussions:

1. Satellite Technologies Matter for Climate Change Monitoring and Policy-Making

There was consensus that Earth observation data offers scalable, transparent, and cost-effective solutions for improving GHG monitoring across diverse economies. The ability to provide near-real-time insights positions satellite monitoring as an auxiliary tool for fulfilling climate change related commitments.

2. Capacity-Building Must Be Prioritized

Developing economies face significant barriers to adopting satellite-based monitoring systems, including limited technical expertise and inadequate infrastructure. All speakers supported calls for targeted investments in training programs, open-access platforms, and institutional partnerships.

3. Interoperability and Data Harmonization to Be Further Examined

Participants emphasized the need for standardized methodologies and shared protocols to ensure comparability of GHG data across borders. Without harmonized frameworks, even cutting-edge technologies risk failing to deliver actionable outcomes.

4. Integration with Green Finance Is Growing in Importance

Satellite-derived data is increasingly being used to underpin carbon credit schemes and climate-resilient investment decisions. This trend opens the room for greater cooperation between science, policy, and business endeavors.

5. Monitoring Should Expand Beyond Mitigation

While much of the focus has been on reducing emissions, there was strong advocacy for extending the scope of satellite monitoring to include adaptation strategies, disaster risk reduction, and loss-and-damage assessments.

6. Regional Partnerships Could Play a Critical Role

Several participants supported the idea of establishing regional collaboration networks and hubs for technology transfer to improve confidence in satellite-derived GHG measurements. These centers could also serve as platforms for joint research, education, and policy dialogue.

7. *Digital Transformation and AI Development Must Be Guided by Policy Frameworks*

As AI and cloud computing become integral to GHG monitoring, considerations around data governance, privacy, and transparency were flagged as important. It was suggested that APEC should explore policy frameworks to guide the responsible use of emerging technologies in tackling climate change.

8. Promote Public-Private Collaboration and Open Data Exchange to Strengthen GHG Monitoring

Private satellite missions are essential for improving the accuracy, timeliness, and scalability of GHG data. Expanding the role of commercial actors complements public efforts and contributes to a more robust and resilient GHG observation system. At the same time, trust-based mechanisms for open data exchange between public and private stakeholders must be established. Transparent sharing of multi-spectral measurements and other datasets enhances analytical quality and enables tailored climate services for governments and businesses alike. Promoting interoperability and collaboration across sectors ensures that satellite-derived GHG data becomes a shared resource for informed decisions, policy implementation, and sustainable development.

"This roundtable has shown that satellite-based GHG monitoring is not only a scientific endeavor but a strategic necessity. Let us continue working together – across borders, sectors, and disciplines – to turn data into meaningful action," –

Moderator, Ms. Evgeniia Drozhaschikh