Japan welcomes the opportunity to submit its views on possible themes for Earth Information Day in 2021 (EID2021), which takes place in conjunction with SBSTA 57 Agenda Sub-item “Research and Systematic Observation”, in agenda item “Matters Relating to Science and Review” during COP27. Japan is pleased to submit following three themes with some possible topics for your consideration.

1. **Findings from the latest research on the state and observation of the global climate**

As mentioned in the IPCC AR6 WGI Report, there will be a higher likelihood that extreme events with increased intensities, durations and/or spatial extents unprecedented in the observational record will occur. Sharing the latest research outcomes, such as accurate projection of extreme events, outlooks, future plans, tipping point research and relevant studies would be worthwhile. The latest progress and findings based on climate change research that includes local cases will be introduced and discussed in this theme. Japan can provide the following topics.

***1-a. Improve forecast accuracy of stationary linear mesoscale convective systems***

***1-b. Antarctic Ice-shelf basal melting as a possible tipping element***

**2. Ocean and terrestrial surface research in the climate system: status, impacts, effects, and observation**

Ocean and cryosphere components play an important role in the climate system through global exchange of water, energy and carbon. As such, there is no doubt about the importance of ocean not only for human activities but also in the climate system. Also, sharing GHGs’ preliminary information that would contribute to GST among the parties and observation community at this stage would be useful for further preparation and raising awareness. It would be therefore useful to have an opportunity to discuss and share the latest research on this theme. Japan can provide the following topic in this regard.

***2-a. Integrated ocean-observation research by JAMSTEC***

***2-b. Global Imaging of Carbon Dioxide from Space***

***2-c. Global megacity stories: GHG emissions and CO2 uptake by surrounding forests and farmlands measured by satellites***

**3. Supporting the implementation of the Paris Agreement in the agricultural sector through the acquisition of observational information and data on climate change adaptation and mitigation**

Climate action in the agricultural sector is the key to the implementation of the Paris Agreement in terms of mitigation and adaptation, especially in developing countries. On the other hand, given the sector’s features, such actions’ implementation requires distinct methodologies and considerations than for the energy sector, especially in terms of MRV, incentives for famers and the need to ensure productivity and food security. Innovation, data and demonstration are crucial to establishing effective MRV systems for the sector and ultimately achieving sustainability in agriculture.

In this context, Japan can provide the following three topics.

***3-a. Toward the development of a new MRV methodology for multiple drainage in a large paddy area***

***3-b. Evaluating the potential of year-round alternate wetting and drying in the Asia Monsoon region***

***3-c. Toward climate change mitigation and adaption with a stable supply of forest reproductive materials of dipterocarp species***

Further details on the above topics with title are described below.

***1-a. Improve forecast accuracy of stationary linear mesoscale convective systems***

Under climate change, the frequency and intensity of heavy precipitation is already increasing. With additional global warming, it is projected that heavy precipitation will become increasingly frequent and intense, which could lead to increases in the frequency and magnitude of landslides and river floods. In Japan, which is subject to many natural disasters, localized heavy rainfall events, named “stationary linear mesoscale convective systems (SLMCSs),” have been observed and caused landslides and floods often in recent years. However, because the formation mechanism of SLMCSs is unclear and their spatial scale is too small, it is difficult to forecast precisely where and when SLMCSs occur. To better understand the mechanism and improve the forecast accuracy, the Japan Meteorological Agency has strengthened surface observations, satellite observations, weather radar, and ship-borne observations. Furthermore, in collaboration with industry, academia, and government, we have conducted intensive observations in western Japan, and have developed forecast models using the supercomputer “Fugaku.” Based on these campaigns, starting June 1 2022, we have provided an early warning service for extreme rainfall events. Through these activities, we aim to reduce the impact of disasters of extreme rainfall events, which are expected to increase.

***1-b. Antarctic Ice-shelf basal melting as a possible tipping element***

Among the negative impacts of climate change due to ongoing global warming, sea level rise is a social, political, and economic issue because of its considerable impact on lowland and coastal environments. Antarctica stores a massive amount of ice in its bedrock, being an enormous reservoir of earth-surface freshwater and a potentially dominant contributor to future sea level rise. In the Japanese climate-model-development programs, TOUGOU and SENTAN, we conduct numerical experiments using an ocean-sea ice model with an ice shelf component to simulate Antarctic ice-shelf basal melting from the present to a future, warming climate. The model reasonably reproduces the observed amount of ice-shelf basal melting. The model projects a distinct superlinear response of ice-shelf basal melting to future atmospheric warming, demonstrating that future projections of the Antarctic and Southern Ocean climate bifurcate with the level of global warming. We found that in an extreme-warming scenario, a combination of enhanced intrusions of warm deep water and warm summertime surface water can cause the nonlinear response of Antarctic ice-shelf basal melting with a tipping nature, presumably contributing to the negative mass balance of the Antarctic ice sheet and to sea level rise.

***2-a. Integrated ocean-observation research by JAMSTEC***

The oceans cover 70% of the Earth's surface, and the ocean environment in each ocean basin is closely interrelated and varies globally. Understanding the global oceanic properties is the most important piece of basic knowledge for elucidating long-term climate change, including global warming, which has become an international issue in recent years, and the accompanying changes in local weather patterns and frequency of extreme events from a long-term perspective.

JAMSTEC is involved in global ocean observation to understand global changes. High-precision observations using research vessels such as R/V Mirai, the deployment of autonomous observation platforms equipped with physical and biogeochemical sensors (Argo, BGC Argo) and moored buoy monitoring are carried out. Further, integrating available observation data through a data assimilation technique, a global ocean-state estimation emerges. It is applied not only to climate research but also to particle drift simulations and observation-impact experiments. They are contributing to the systematic construction of global ocean-observation networks. This includes discovery of the impact of BGC Argo data on the state estimation.

***2-b. Global Imaging of Carbon Dioxide from Space***

To achieve 1.5°C/2°C temperature targets in the Paris Agreement, it is essential to evaluate national emission reports under the Enhanced Transparency Framework. Such activities are expected to be significantly strengthened by global, long-term, consistent, and validated observation of greenhouse gases from space. The pioneering observations of European ENVISAT, launched in 2002; Japanese GOSAT, launched in 2009; and US OCO-2, launched in 2014, demonstrated that satellites can obtain indispensable greenhouse gas data from space. Based on these early satellites’ achievements, several new satellites, such as Japanese GOSAT-GW, European CO2M, Chinese TanSat-2, and US Geocarb, are being developed.

In the mid-2020s, these new satellites will start providing global CO2 imaging data operationally. Their CO2 imaging capability will enable not only frequent observation of global terrestrial surface but also tracking of plumes from large sources. Inversion systems will digest the huge amounts of data from these satellites. These systems include the Japanese SII-8 system, European Copernicus Atmosphere Monitoring Service, and US Carbon Monitoring System, all of which will be used in estimating carbon fluxes in both global and regional/country scales.

The data that these new satellites will provide in the mid-2020s and beyond and their implication to the Paris Agreement will be introduced.

***2-c. Global megacity stories: GHG emissions and CO2 uptake by surrounding forests and farmlands measured by satellites***

Cities are major sources of GHG emissions, consuming about 75% of the world’s energy and producing 70% of global carbon emissions. Monitoring trends of emissions can support cities identifying emission sources to more effectively achieve their pledges. In this regard, JAXA developed the *space-based surface GHG Emission Indicator (GEI)* for tracking emission changes at key subnational policy-relevant levels, such as cities. JAXA’s GEI is based on the difference between the upper and lower-tropospheric CO2. In addition, reducing the megacity’s GHG emissions and removing the megacity’s GHG emissions are essential toward achieving the net-zero goal. To improve the understanding of the removal, JAXA presents the new observation analysis of the functionality and impact of forests and farmlands surrounding megacities by applying JAXA’s satellite observation data.

In this presentation, JAXA demonstrates how CO2 levels over Cairo, the capital city of Egypt, change over time based on trends in combustion, solar-induced chlorophyll fluorescence (SIF) levels.

***3-a. Toward the development of a new MRV methodology for multiple drainage in a large paddy area***

Methane (CH4) is an important short-lived climate pollutant and the second-most important greenhouse gas after carbon dioxide. The reduction of CH4 emissions strongly contributes to short-term climate change mitigation. Although rice is the staple food in Asia Monsoon countries, its cultivation is one of the major anthropogenic sources of CH4 emission. Multiple drainage is a promising option for reducing CH4 emission from paddy fields. However, their implementation and the monitoring, reporting and verification (MRV) in each field are troublesome; therefore, their application in developing countries is challenging. This poster introduces an ongoing study with the aim of developing an efficient MRV methodology for multiple drainage in an irrigated 60-ha paddy area in Cambodia. To observe CH4 emission from the large paddy area, the researchers simultaneously use a micrometeorological method, a drone-based method and a basic closed-chamber method. This MRV methodology can be applied to other Asia Monsoon countries facing similar challenges. Incentives acquired using this MRV methodology under a carbon-pricing scheme can improve participating farmers’ livelihoods.

***3-b. Evaluating the potential of year-round alternate wetting and drying in the Asia Monsoon region***

The Mekong Delta, located in southern Vietnam, is the country’s largest paddy-rice cropping region, with fertile lowlands and abundant rainfall. In recent years, the area planted with rice has been expanding, and measures to cope with greenhouse gas (GHG) emissions, including methane, and water demand are required. With farmer survey data from A Giang Province in the Mekong Delta region of Vietnam, this poster presents the effects of year-round implementation of alternate wetting and drying (AWD) technology on farmers’ profits and GHG-emission reduction. Here, the researchers calculated the impact on GHG emissions using a life cycle assessment. The results showed that when AWD was implemented throughout the year, farmers’ profits increased by 6% compared to those of farmers who did not implement AWD, and GHG emissions decreased by 38%.

Given the growing concern about methane emissions from paddy-rice cultivation, the results obtained in this study can be used as supporting data for the effectiveness of year-round AWD implementation as an agricultural system that increases farmers’ profits and reduces environmental impacts from agriculture, and it is expected to be a promising mitigation and adaptation measure for climate change in the Asia Monsoon region.

***3-c. Toward climate change mitigation and adaption with a stable supply of forest reproductive materials of dipterocarp species***

Forest trees absorb carbon dioxide from the atmosphere as organic matter and store a large amount of carbon, especially in their woody stems. In addition, harvested wood products can retain carbon for a long time. Harvested wood products’ carbon-storage function contributes to climate change mitigation and adaptation. Dipterocarp is an important timber family in Southeast Asia. However, due to their irregular flowering intervals caused by extreme-climate incidents, such as low temperature and drought, producing a regular supply of reproductive materials is difficult. To enhance the forest carbon stocks to mitigate and adapt to climate change, it is necessary to understand the growth mechanisms involved in leaf production and stem elongation in relation to temperature patterns, which are expected to change as part of the projected climate change. This poster demonstrates an ongoing study aimed at helping to create a stable supply of dipterocarp seedlings for planting by observation of leaf production in Peninsular Malaysia. The results also contribute to climate change mitigation and adaption, specifically regarding how climate change affects dipterocarp seedlings’ reproductive and growth patterns.