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 52-55 Agenda Sub-item “Research and Systematic Observation”, in agenda item “Matters Relating to Science and Review” during COP26.

Japan is pleased to submit following three themes with some possible topics for your consideration. Please note that RD12, EID2020 and RD13 were held as online events, enabling diverse audiences from a wider range of communities to join the events. These participants would welcome an internet-accessible version of the coming EID 2021.

**1. Earth information for the Global Stocktake**

The first Global Stocktake (GST) is planned to take place in 2023. Sharing plans and 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. Under this theme, the Intergovernmental Panel on Climate Change (IPCC) may introduce the Sixth Assessment Report, which was partly published in August 2021.

In this context, Japan can provide the following topic.

*1-a. Estimating and predicting global ocean and terrestrial carbon uptakes in a decadal time scale*

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

Sharing the latest information, such as greenhouse gas emission/concentration changes, states of systematic observation, lessons learned from pandemic-related difficulties, outlooks, future plans 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 three topics.

*2-a. Local and global greenhouse gases (GHG) observation by Japanese satellites*

*2-b. SLCF’s emission tracker: from field observations to data assimilation/inversions assisting inventory methodology development and efficient emission reductions*

*2-c. Climate service on the Data integration and Analysis System (DIAS) in Japan*

**3. Ocean research in the climate system: impacts, effects, and observation**

As mentioned in the IPCC Special Report on the Ocean and Cryosphere in a Changing Climate (SROCC), all people on Earth depend directly or indirectly on the ocean and cryosphere. Also, these 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. 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.

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

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

**1. Earth information for the Global Stocktake**

*1-a. Estimating and predicting global ocean and terrestrial carbon uptakes in a decadal time scale*

Toward the implementation of the Global Stocktake, the need is increasing to estimate and predict variations in atmospheric CO2 concentration over a decadal time scale because such attempts will lead to the visualization of emission-reduction efforts and sophisticated estimates of carbon budgets. CO2 uptake at ocean and land surfaces is a fundamental process in the global carbon cycle, and it fluctuates in response to inherent climate variabilities.

Earth system models are models that can reproduce the global carbon cycle and inherent climate variabilities. By assimilating observed climate data into Earth system models, we can expect to estimate the historical variability of global ocean and terrestrial carbon uptakes and make decadal-scale predictions in the future. In this study, observed climate data are assimilated into an Earth system model, developed under the Japanese climate model development program (TOUGOU), to reproduce the variations in global ocean and terrestrial carbon uptakes. We found that the carbon uptake of the world’s oceans is predictable for about six years into the future.

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

*2-a. Local and global GHG observation by Japanese satellites*

JAXA’s mission is to monitor the global environment from space. GOSAT and GOSAT-2, joint projects of the Ministry of the Environment, the National Institute for Environmental Studies, and JAXA, have been conducting global observations for over a decade to estimate greenhouse gas emissions and anthropogenic emissions. In addition to making these global observations, JAXA developed a new observation method that combines remote sensing technology and passenger aircraft to understand local emissions. At the same time, JAXA has been observing forests, which are sinks of greenhouse gases, for many years and has been working on biomass research and development based on the knowledge acquired. As a space agency, JAXA will contribute to the Paris Agreement by introducing efforts to support an integrated understanding of greenhouse gases and each country‘s reduction efforts using the scientific knowledge on emission sources and sinks obtained through these satellite observations.

*2-b. SLCF’s emission tracker: from field observations to data assimilation/inversions assisting inventory methodology development and efficient emission reductions*

The latest IPCC AR6 WG1 summary for policymakers (SPM) highlighted the roles of short-lived climate forcers (SLCFs) in the future climate change, mainly driven by inevitable reductions in cooling caused by aerosols and a potential counterbalance via stringent methane emission reductions. Depending on future SLCF emission scenarios, a warming of up to 0.9°C in 2100 relative to 2019 could be avoided, and air quality could be improved. Therefore, a globally unified system tracking SLCF emissions and atmospheric changes is highly demanded. Meanwhile, the IPCC Taskforce on Inventories (TFI) initiated expert meetings to develop a methodology for SLCF emission inventories (in addition to GHGs) during the AR7 cycle, and a path to such a system has been approved. However, the planned SLCF bottom-up inventories often encounter extreme uncertainties (up to 200% for black carbon [BC], for example), and thus, constraints on top-down observational systems are essential. Here, our activities relevant to such top-down SLCF tracking systems are presented, consisting of in-situ observations in key regions, satellite observations and data assimilation/inversion based on numerical model simulations, providing best estimates of emissions and their changes. A global synthesis of such initiatives for multiple SLCF species (e.g., NOx, BC and CO) around the world is to be discussed.

*2-c. Climate service on the Data integration and Analysis System (DIAS) in Japan*

Through the Data integration and analysis system (DIAS), we have archived earth observation and climate projection data to provide service and operate applications. These data will help solve various social problems, including climate change adaptation and mitigation. The climate projection data in DIAS cover various scales from global to local area and are open to the public to evaluate the impact of climate change on broader sectors, such as agriculture, disaster reduction and health. In the DIAS project, we are also working on the research and development of end-to-end solutions as advanced usage cases in disaster prevention problems.

**3. Ocean and cryosphere in the climate system: impacts, effects, and observation**

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

The Japan Agency for Marine-Earth Science and Technology (JAMSTEC) is involved in global ocean observation to understand global oceanic changes. High-precision observations using research vessels such as R/V Mirai, 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 allows a global ocean-state estimation. Obtained products are applied not only to oceanic research but also to drift simulations and observation-impact experiments, thereby contributing to the systematic construction of global ocean-observation networks. The actions include obtaining a better understanding of long-term deep-ocean changes in the Pacific Basin and evaluating the impact of BGC Argo data on ocean-state estimation.