**WMO AND ITS CO-SPONSORED BODIES Submission**

**RSO document of SBSTA 50**

**June 2019**

1. **Introduction**

The World Meteorological Organization (WMO) along with its co-sponsored bodies, the Global Climate Observing System (GCOS) and the World Climate Research Programme (WCRP), continues working to increase the relevance of the information they provide to the Parties to the UNFCCC. GCOS provides technical advice on developing the observing system with regard to improving the scientific understanding of climate, and providing clear information to support adaptation. Observations support monitoring and prediction of the climate system, and understanding of future impacts. WCRP plays a unique role in improving the predictability of the climate system and our understanding of the extent of human influence on climate. The Global Framework for Climate Services (GFCS) accelerates and coordinates scientifically sound implementation of measures to improve climate-related outcomes at national, regional and global levels. As a framework with broad participation and reach, GFCS enables the development and application of climate services to assist decision-making at all levels in support of addressing climate-related risks.

1. **State of the global climate report (2018) – State of the climate indicators**

For 25 years, WMO has continued preparing an annual statement on the state of the global climate based on authoritative sources. The statement presents the evolution of key indicators reflecting the state of the global climate system—temperature, greenhouse gas atmospheric concentrations, the state of the oceans and cryosphere. It also contains scientific information that allows for better understanding of the occurrence of extreme weather and climate events and the degree to which they can be attributed to human influences on the climate. WMO is preparing an update for the September 2019 United Nations Climate Action Summit.

The WMO Statement on the State of the Global Climate in 2018, released by the United Nations Secretary General in March 2019, shows a striking record warming recorded from 2015 through 2018, a continuous upward trend in the atmospheric concentrations of the major greenhouse gases, an increasing rate of sea level rise and the loss of sea ice in both northern and southern polar regions. The global temperature in 2018 was 1°C above pre-industrial levels. The period from 2015 to 2018 was the warmest four years on records.

Ocean surface temperatures in a number of ocean areas were unusually warm in 2018 and sea level continues to rise at an accelerated rate. Global mean sea level for 2018 was around 3.7 mm higher than in 2017 and the highest on record. Ocean acidification has continued to increase as well. Glaciers have shrunk, with the cumulative loss of ice since 1970 amounting to 21.1 meter water equivalent(the depth of water that would result from taking the volume of water obtained from melting the snow and ice lost over the past 48 years and distributing it evenly across the area of the glaciers, i.e. a column of water 21.1m deep over every square meter of glacier).

A number of environmental impacts associated with climate change have been tracked. These include coral bleaching and reduced levels of oxygen in the oceans. Others include loss of “Blue Carbon” associated with coastal ecosystems such as Mangroves, Sea grasses and Salt Marshes. Ecosystems across a range of landscapes are important coastal, ocean and terrestrial components of the carbon

cycle. Global warming is expected to contribute to the observed decrease of oxygen in the open and coastal oceans, including estuaries and semi-enclosed seas. Since the middle of the last century, there has been an estimated 1-2 % decrease in the devolved ocean oxygen content.

Hurricane Florence and Michael were two of 14 “billion dollar disasters” in 2018 in the USA. They accounted for around USD 49 billion in damages and over 100 deaths. Super typhoon Mangkhutin in the Pacific affected more than 2.4 million people and resulted in 134 deaths, 127 of them in the Philippines. More than 1,600 deaths associated with intense heat waves and wild fires that occurred in Europe, USA and Japan. Wild fires also were associated to nearly USD 24 billion in USA, highest on record. British Columbia, Canada, broke records for most burned area in a fire season for the second year in a row. WMO has been working with other United Nations organizations on tracking other impacts associated with extreme weather and climate events. After a prolonged decline, the number of undernourished people increased to 821 million in 2017 according to an FAO report. Out of 17.7 million Internally Displaced Persons tracked in 2018 by International Organization on Migration (IOM), over 2 million were displaced due to disasters linked to weather and climate events. Hundreds of thousands of Rohingya refugees were reported by UNHCR and IOM as being affected in 2018 by secondary displacement due to extreme events, heavy rain, flooding and landslides.

According to the latest WMO Bulletin on Greenhouse Gases (GHGs), in 2017 the CO2 concentrations reached new highs, with a global average of 405 parts per million (ppm). Preliminary assessment shows that CO2 continued to increase in 2018. CO2 emissions to date continued to grow at 1.6% in 2017 and at a preliminary 2.7% (1.8% - 3.7%) increase anticipated in 2018, when a new record high of 37.0 ± 1.8 billion tons of CO2 is expected to be reached. The time remaining to achieve commitments under the Paris Agreement is quickly running out.

WMO has initiated a common framework to apply the observations-based approach to improvements of the greenhouse gas emission estimates. This system, the “Integrated Global Greenhouse Gas Information System” (IG3IS) provides robust flux estimates that can be used to support the actions related to implementation the emission reduction strategies. By combining the atmospheric observation and analysis and inverse modelling tools with the spatiotemporally resolved socio-economic information, IG3IS improves estimates of the national emissions and identifies additional emission reduction opportunities on the scales ranging from national to that of individual facilities. IG3IS tools that follow agreed quality assurance protocols can be used to quantify the effects of the actions taken to control emissions and establish reliable emissions trends. IG3IS and associated WMO good practice methodological guidelines for atmospheric measurements and analysis methods have been incorporated into the draft 2019 Refinement of the IPCC Guidelines for National Greenhouse Gas Inventories.

1. **The Green Climate Fund (GCF) and WMO initiative on climate science for adaptation**

In response to the Paris Agreement call for “Strengthening scientific knowledge on climate, including research, systematic observation of the climate system and early warning systems, in a manner that informs climate services and supports decision-making (Article 7, paragraph 7 (c))”, WMO is providing expert services to GCF to facilitate the generation and use of climate information and science in decision-making. This collaboration aims to enhance the climate science basis of GCF funded activities to strengthen the quality, effectiveness, and value of GCF funded projects on the basis of objective, scientific, and climate data-driven conclusions and analysis. The project will facilitate the formulation of technical capacity development at the country and local level(s) to support climate science basis provided for a National Adaptation Plan or a GCF project in the country context and expand understanding and knowledge of climate rationale requirements and preparation within each region. As a next step, GCF and WMO will jointly conduct workshops and consultations with National Meteorological and Hydrological Services (NMHSs), Nationally Designated Authorities and other stakeholders in five countries to test materials prepared under the project for articulating the climate science basis of the climate rationale of the GCF funded activities.

At COP 24, WMO and the GCF signed an MoU that expands their cooperation to include strengthening integrated global-regional-national operational hydrological and meteorological systems and associated climate information services, providing GCF-accredited entities with information and technical support, and aligning and leveraging GCF-funded hydrological and meteorological investments.

1. **Support to adaptation and resilience in climate sensitive sectors**

With regards to supporting adaptation and resilience in climate-sensitive sectors more broadly, Decision 11 adopted by the Conference of the Parties serving as the meeting of the Parties to the Paris Agreement (11/CMA.1) called on the WMO through its GFCS to regularly report on the state of climate services with a view to “facilitating the development and application of methodologies for assessing adaptation needs” and to regularly inform SBSTA about its activities aimed at improving the availability and accessibility of comprehensive climate information, including observational data. In response to this decision, WMO is preparing a “State of Climate Services” report documenting the current status of climate information and associated services in relation to Parties priorities identified in their NDCs and NAPs. Information included in, and underpinning the report will provide WMO and other international organizations and Parties with intelligence for targeting investments in hydro-meteorological systems and associated services for adaptation and resilience.

To support Parties’ institutional capabilities, WMO encourages the establishment of National Frameworks for Climate Services (NFCS) as a key institutional mechanism to coordinate, facilitate and strengthen collaboration among national institutions and other key stakeholders for implementation of the GFCS. So far, around 30 countries have established such frameworks. An NFCS ensures that the entire value chain for the production and application of climate services is addressed systematically with the involvement of all relevant stakeholders in a coordinated manner.

1. **MoU with UNFCCC**

Implementation of a Memorandum of Understanding (MoU) between the UNFCCC Secretariat and WMO in five topical areas is in progress. Each area of work, has a coordinated workplan that includes a number of deliverables. The following actions and achievements took place since June 2018 leading to SBSTA 50:

The WMO annual Statement on the State of the Global Climate and the GHG Bulletin were launched at the press conferences in Geneva and Katowice, during COP 24. They received significant international press coverage and social media outreach (more than 3000 unique citations for each report). On adaptation issues, WMO provided technical contribution to the NAP training workshops on “Appraisal and Prioritization of Options for Adaptation Planning (NAP)” (Fiji, May 2018) and “Adaptation Finance for African countries” (Kigali, Rwanda, September 2018). WMO also contributed to the NAP EXPO 2018 (Egypt, April 2018) and NAP EXPO 2019 (Korea, April 2019).

In 2018, WMO actively participated in two Climate Weeks (Latin America and the Caribbean, and Asia-Pacific) by organizing side events on using IG3IS improvements of national GHG inventories and transformative adaptation. WMO also organized a Carbon Forum at COP-24 in Katowice, Poland to deliver country case studies. WMO’s contribution has enhanced cooperation between the UNFCCC Regional Collaboration Centres (RCCs) with the WMO Regional Climate Centers (RCCs).

In the context of annex 5 of the MoU which was signed at COP 24, focused on loss and damage, the WMO initiative on cataloguing high-impact hydro-meteorological events and associated impacts has been launched as a test phase in Europe and South-East Asia. Results from these tests will assist Parties in associating losses and damages with the corresponding hydro-meteorological phenomena. Further results will be reported to SBSTA 51.

1. **Cataloguing extreme events**

Related to annex 5 of the MoU between WMO and UNFCCC, in response to the calls for reducing the losses associated with extreme events in the Sendai Framework for Disaster Risk Reduction 2015−2030, the Paris Agreement, and UNFCCC Warsaw International Mechanism for Loss and Damage associated with climate change impacts (WIM), and the 2030 Agenda for Sustainable Development with its 17 Development Goals (SDGs), WMO in collaboration with international experts from domains such as weather, climatology, hydrology, oceanography, agriculture meteorology and disaster risk reduction has developed a methodology for cataloguing weather, water, climate and space weather events. The cataloguing initiative is based on assigning a Universal Unique Identifier (UUID) of each individual event and a standard definition of events and their recording. A standard methodology for cataloguing hazardous hydro-meteorological events is essential for many disaster risk management (DRM) applications. The methodology provides means of unambiguous linking such events with the associated loss and damage, by characterization in terms of location, duration, magnitude and timing. It is expected that the eighteenth World Meteorological Congress (Cg-18) in June 2019 will adopt the cataloguing methodology referred to as “WMO Cataloguing of Hazardous Events”.

1. **GCOS activities and support to “Systematic observation”**

GCOS task teams have been discussing a list of activities that can foster development of the observing system with regard that helps to improve understanding of the climate system. A GCOS task team on terrestrial observations of the impacts of climate variability and change has met and is finalizing a report. Observations can both support prediction of and response to, future impacts and also monitor implementation of associated actions. Initial discussions considered a range of topics including:

* One response to urban heatwaves causing mortality and morbidity is through increasing green space and so cooling neighborhoods: this can be remotely sensed;
* Some changes in irrigation are observable from space but attribution to specific drivers, such as limited water resources, droughts and changing rainfall, is difficult;
* Changes in the distribution and phenology of the terrestrial biosphere are being observed. Monitoring land cover not only shows loss of particular habitats (e.g. forests) but also can point to the drivers behind these changes. This may also support a climate indicator for the biosphere.

The GCOS Steering Committee will consider the outcomes of this Task Team meeting and propose a way forward.

The series of GCOS regional workshops is continuing. This year a 3rd workshop is planned in Belize with a focus on implementing the WMO Global Basic Observing Network (GBON). GBON will provide the minimum data needed, not just for numerical weather prediction, but also global climate models and reanalysis. The report from the 2nd regional workshop held last year in Uganda, which focuses on the challenges in planning sustainable networks, has been finalized.

A meeting of GCOS experts across atmosphere, ocean and land domains, took place in March 2019 to consider observations of the carbon and water cycles and the earth’s energy balance as input into the revision of the GCOS implementation plan due in 2022. The meeting identified three key themes of sustainability, traceability and data access for the update.

Lastly, GCOS considers the Earth Information Day initiative as an important opportunity to enhance dialogue between the science communities and the Parties to the UNFCCC based on the latest scientific information.

1. **WCRP supporting “Research” activities**

For 40 years the World Climate Research Programme (WCRP) has played a unique role in addressing frontier scientific questions related to the coupled climate system, to determine to what extent climate can be predicted and the extent of human influence on climate. In the last decades, climate science has evolved substantially, through advances in fundamental science, innovation in observations and simulations and a more interdisciplinary and integrated Earth system approach.

WCRP is presenting the vision and pathway for the world’s climate research for the coming decade (2019-2028), bringing together the scientific research community, partner programmes, research funders, and governments. WCRP strengthens efforts to advocate fundamental climate science; to maintain a vibrant research portfolio to enthuse the next generation of science leaders; and to ensure that society has access to the best possible science that underpins the implementation of the Paris Agreement of 2015 and multilateral environmental conventions.

Some of the key progress and outstanding issues in pursuing global coordination of climate research are summarized as follows:

* The WCRP and its Coupled Model Intercomparison Project (CMIP) continues to provide valuable multi-model climate simulations and projections that serve as the foundation for the Intergovernmental Panel on Climate Change (IPCC) assessments, the policy deliberations by the distinguished delegation of all Parties, and climate services and products disseminated world-wide. For example, the Carbon Dioxide Removal Model Intercomparison Project (CDR-MIP) brings together models of the Earth system in a common framework to explore the potential, impacts, and challenges of CO2 removal, addressing the very question of “Climate Reversibility”. The growing dependency on CMIP is a demonstrated success of science-to-decision channel, yet requires substantial and continuous support of the Parties.
* The Earth Energy Imbalance (EEI) is the recognized core subject of the climate research; it is the unique quantities defining the status of global climate change and expectations for continued global warming. The WCRP is proud to advise on the significant progress in converged approach for an EEI uncertainty assessment, to improve and quantify the absolute value of the EEI; to perform an inventory of the EEI in the Earth system; and, to further increase knowledge on the implications of EEI particularly in regions and for the benefit of societies. WCRP respectively calls for the attention of Parties to support this important initiative, that will provide the firm foundation to setting and improving various climate indicators.
* There has been significant advance in understanding human influence on individual extreme events that have resulted in significant loss and damage in the recent past. Yet numerous challenges lie ahead to understand the causes of the changes and possible future, and to meet the society’s adaptation needs: science shows that we need to enhance the current monitoring capabilities for extremes, and to improve prediction of extremes in different spatial and temporal scales. There is an urgent need to develop innovative communication solutions between climate research and its user communities, toward the decision-relevant, actionable information and knowledge.
* WCRP looks forward to the proactive support of the presenting Parties to improve observational technologies and sophisticated computing infrastructure, and in connecting global scales to the scales where people live. By tackling the scale barriers and developing fine scale climate projection and prediction, climate research can empower and refine risk management, emergency planning and preparedness, adaptation and mitigation strategies.
* Strengthening the link between research and action is a critical element in successful measures to thrive in changing climate. To this end, continuous support of fundamental climate science is essential to better understand and bridge scientific gaps, and furthermore, to ensure sound decisions for our future. The compelling need for open access and interoperability of climate information, capacity development in climate science and allied fields, and collaboration across institutions and programmes is essential.