MEMBER REPORT (SINGAPORE)

ESCAP/WMO Typhoon Committee
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I. Overview of tropical cyclones which have affected/impacted Member's area since the last Committee Session

1. Meteorological Assessment (highlighting forecasting issues/impacts)

The development of tropical cyclones/storms over the Indian or western Pacific Oceans can at times influence the winds over Singapore. This in turn can have an impact on the island's weather depending on the position of the storm as it tracks over the large bodies of water of the South China Sea and the western Pacific Ocean. The weather impact can also be from extensions of the tropical storm's rain bands over the southern South China Sea close to the Equator. The presence of these tropical storms could either bring fair and dry weather conditions or heavy thundery showers to the Island State. In the case of the latter, lines of thunderstorm or squalls accompanied by occasional strong gusty winds are often induced under the influence of the storm, resulting in widespread heavy rainfall over Singapore.

During the Pacific Typhoon season in 2019, the tropical storms in the South China Sea and the western Pacific Ocean did not have much influence on the weather in Singapore.

2. Hydrological Assessment (highlighting water-related issues/impact)

Nil.

3. Socio-Economic Assessment (highlighting socio-economic and DRR issues/impacts)

Nil.

4. Regional Cooperation Assessment (highlighting regional cooperation success and challenges)

Nil.

II. Summary of Progress in Priorities supporting Key Result Areas

1. ENHANCEMENT OF WEATHER OBSERVING NETWORK

Meteorological Service Singapore (MSS) operates a comprehensive suite of weather observing systems. It comprises a network of manned and automatic weather stations, an upper air station, a lightning detection network, 2 dual-polarization Doppler weather radars, a wind profiler, wind and aerosol LIDARs and various weather and environmental satellite reception and processing systems. MSS' observing systems are continually being improved and enhanced to support operational needs and services.

During the period of review, the spatial coverage of the automatic weather stations (AWS) across the island was further enhanced. There are to-date about 104 stations within the network. All the stations measure rainfall, with a number of the stations measuring other parameters, such as wind, pressure and temperature.

Information from the weather observation network is provided in near-real time to the public and to government agencies, and supports the provision of reliable and timely forecast and warnings of heavy rain events.

Identified opportunities/challenges, if any, for further development or collaboration:
Nil.

Priority Areas Addressed:
Improved capacity to generate and provide accurate, timely and understandable weather information including typhoon-related threats.

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2. ASEAN CLIMATE OUTLOOK FORUM (ASEANCOF) AND SOUTHEAST ASIA REGIONAL CLIMATE CENTRE NETWORK (SEA RCC-NETWORK)

(i) ASEANCOF

Background

The ASEAN Climate Outlook Forum (ASEANCOF) was established in 2013, following the support at the 35th Meeting of the ASEAN Sub-Committee on Meteorology and Geophysics (ASCMG, July 2013). ASEANCOF provides collaboratively developed and consensus-based seasonal climate outlooks and related information on a regional scale, including risk assessment of heightened tropical cyclone activities and the associated atmospheric circulation anomalies. These activities support decision-making to manage climate-related risks and support sustainable development. The hosting of ASEANCOF sessions is rotated among ASEAN Member States and supported by the Meteorological Service Singapore (MSS), as host of the ASEAN Specialised Meteorological Centre (ASMC).

Recent Developments

The last meeting, ASEANCOF-11, was held in Kuala Lumpur, Malaysia, from 29 October – 2 November 2018. The Malaysian Meteorological Department (MMD) hosted the meeting in collaboration with the ASEAN Specialised Meteorological Centre (ASMC). The event was co-sponsored by the ASEAN Science, Technology and Innovation Fund (ASTIF), the Malaysian government, and the World Meteorological Organization (WMO). ASEANCOF-11 was held back-to-back with the WMO Space-based Weather and Climate Extremes Monitoring Demonstration Project (SEMDP) Workshop for East Asia and the Western Pacific.

Apart from the customary process of issuing regional consensus outlooks for temperature and rainfall for the upcoming boreal winter monsoon season (December 2018 – February 2019), a two-day workshop for the SEMDP involved relevant WMO Regional Climate Centres (RCCs) and NMHSs in designing space-based rainfall monitoring products provided by the satellite operators. The purpose is to evaluate and recommend the use of the products to monitor extreme events such as persistent heavy rainfall and droughts at the regional and national levels.

During the two-day SEMDP workshop, participants discussed their requirements for monitoring extreme weather and climate events using satellite remote sensing, which will help to supplement ground observation data. End-users were also invited to present their requirements for the monitoring and assessment of extreme weather and climate events. The participating end-users included the Hydro and Agro Informatics Institute (HAII, Thailand), International Rice Research Institute (IRRI) and the Mekong River Commission (MRC). A breakout group discussion was organised involving the NMHSs, satellite providers, GPCs, RCCs, and end-users to ensure the satellite products to be developed under the SEMDP would be relevant to the various sectors in coping with present climate variability and extremes.

The most recent ASEANCOF-12 meeting was conducted via email correspondence and online meeting, and was coordinated by the Thai Meteorological Department (TMD) in collaboration with ASMC for the June-August (JJA) summer monsoon season of 2019. The Consensus Outlook from ASEANCOF-12 for the region was published in early June 2019.

The next session, ASEANCOF-13, is planned to be hosted by the TMD in November 2019 in Bangkok.

Detailed meeting reports are available at http://asmc.asean.org/asmc_asean_conf_about/.

(ii) SEA RCC-Network

The Southeast Asia Regional Climate Centre Network (SEA RCC-Network) is an operational platform for delivery of climate services. The Network complements the ASEANCOF, which is primarily a platform for sharing best practices and improving the process of consensus-building for climate outlooks. An RCC-Network for the region was first proposed at the WMO RA V 16th Session (Jakarta, May 2014), and covers ten Southeast Asian countries in two WMO Regional Associations (RA), RA II and RA V. The SEA RCC-Network entered the demonstration phase in November 2017.

As a group of centres (nodes), the SEA RCC-Network collectively fulfils the four mandatory functions of an RCC, namely long-range forecasting led by Singapore (MSS), climate monitoring led by the Philippines (PAGASA), operational data services led by Indonesia (BMKG), and training led by all three partners. Singapore is the coordinator of the Network. Within the monitoring and long-range forecasting functions, assessments of tropical cyclone activities are included as deliverables by either the lead node or a contributing consortium member.

Recent Developments

Following the start of the demonstration phase for the SEA RCC-Network, the 3 nodes have since provided pilot products for long-range forecast, climate data services, and monitoring through their respective portals. These sites can be accessed from the main page of the SEA RCC-Network (http://ccrs.weather.gov.sg/sea-rcc-network). During the demonstration phase, monitoring and outlook products for tropical cyclone activity will be explored by the responsible node or consortium member of the node. The SEA RCC-Network will discuss with WMO at a planned physical meeting in November 2019 on further development of the Network, including a proposed Climate Watch System, delivering advisories to NMHSs of heightened risk of TC development, among other extreme events.

Identified opportunities/challenges, if any, for further development or collaboration:
ASEANCOF is mainly focused on seasonal predictions while the SEA RCC-Network serves as complementary platforms to deliver both seasonal (long-range) and sub-seasonal (shorter range) monitoring and outlook products, particularly for *risk* of tropical cyclone related activities. These products will be contributed by its Climate Monitoring Node led by PAGASA, the Philippines and its Long-Range Forecast (LRF) Node led by MSS, Singapore, with contributions from PAGASA as a consortium member of the LRF Node.

Priority Areas Addressed:
Improved capacity to generate and provide accurate, timely and understandable information on typhoon-related threats.

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3. **CAPABILITY-BUILDING PROGRAMME IN SUBSEASONAL-TO-SEASONAL PREDICTIONS FOR SOUTHEAST ASIA (S2S-SEA)**

MSS, as host of the ASEAN Specialised Meteorological Centre (ASMC), conducts Capability-Building Programme in Subseasonal-to-Seasonal Predictions for Southeast Asia (S2S-SEA). S2S-SEA is a multi-year series of workshops to equip the NMHSs with the knowledge and skills to deliver S2S predictions to end-users. The S2S predictions typically span timescales of 2 weeks to 2 months and has the potential to provide warnings for extreme rainfall events, caused by tropical storms or otherwise, but requires further studies.

The first two workshops, held in March 2017 and August 2018, focused on building the technical capability of the National Meteorological and Hydrological Services (NMHSs) in S2S predictions. For the third workshop in July 2019 (http://asmc.asean.org/publication-asmc-bulletin-issue-4-sep-2019/), ASMC collaborated with ESCAP and RIMES to shift the focus to prediction product development with involvement from end-user agencies and the disaster risk reduction community. During the workshop, NMHSs and end-user representatives examined case studies of extreme rainfall events to assess the viability of using S2S predictions. To tighten and continue the collaboration with end-user agencies towards product development, the S2S-SEA will embark on a Pilot Project involving targeted end-users and specific areas in the next two years. Details on the planned Pilot Project is described in this primer co-authored with ESCAP (https://www.unescap.org/resources/applying-subseasonal-seasonal-predictions-improve-disaster-risk-reduction-south-east-asia).

Identified opportunities/challenges, if any, for further development or collaboration:
Extreme rainfall anomalies from typhoon related activities are often more predictable within one week lead time based on preliminary assessment. While S2S prediction is intended only for two-weeks lead time onwards, it can potentially be used to signal increased risk of rainfall extremes arising from typhoon-induced atmospheric circulation anomalies in the region.

Priority Areas Addressed:
Strengthen typhoon-related disaster risk reduction activities in various sectors, including increased community-based resiliency with better response, communication, and information sharing capability.

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4. COLLABORATIONS WITH THE NATIONAL WATER AGENCY TO MANAGE AND MAINTAIN ADEQUATE WATER SUPPLY

The National Water Agency of Singapore manages the water supply, water catchment and used water in Singapore. Intense thunderstorms, prolonged rainfall and dry spell events can have an impact on the water levels in the water catchment areas. Therefore, it is crucial for the National Water Agency to receive reliable and as accurate as possible extended- and long-range forecasts on the timescale of weeks to months ahead so as to make informed decisions to manage the level of water in the reservoirs. Rainfall patterns on this timescale are influenced by planetary- and synoptic-scale climate drivers and processes, including tropical cyclones that change the atmospheric circulation patterns over Singapore and the nearby region.

MSS provides a 7-Day quantitative precipitation forecast to the National Water Agency. It is an outlook of the total rainfall amount expected for critical water catchment areas for the next several days. This enables the National Water Agency in their manpower management to prepare for heavy rainfall events, and to maintain adequate water supply for the nation. MSS has also been providing a 3-month probabilistic rainfall outlook to the Agency and are exploring ways to improve these services, including providing quantitative estimates of rainfall and its linkages to reservoir water levels and streamflow.

Identified opportunities/challenges, if any, for further development or collaboration:
Nil.

Priority Areas Addressed:
Minimize and mitigate the potential negative impact of heavy rainfall and extended dry period events.

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5. HYDROLOGICAL ACHIEVEMENTS AND RESULTS

Over the past decades, Singapore has been improving the drainage infrastructure. The flood-prone areas have been reduced from 3200 hectares in the 1970s to about 29.0 hectares today. Singapore continuously reviews and upgrades her drainage infrastructure to ensure an effective drainage network for flood alleviation and prevention.

Identified opportunities/challenges, if any, for further development or collaboration:
Nil.

Priority Areas Addressed:
The rain band associated with typhoons occasionally induce intense thunderstorms over Singapore. The constant effort to review and upgrade the drainage infrastructure can help to minimize the impact of flash floods on business and everyday life.

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6. PARTICIPATION IN TRAINING WORKSHOPS, CONFERENCES AND MEETINGS

Singapore participates in several meteorological training workshops, conferences and meetings each year. Our officers found the training workshops/meetings educational and beneficial in their course of work. The list of relevant workshops, conferences and meetings attended in 2018/2019 are as follows:

- ESCAP/WMO Typhoon Committee 13th Integrated Workshop, 5–9 Nov 2018, Chiang Mai, Thailand
- ESCAP/WMO TC Roving Seminar on 'Apps of Remote Sensing Technologies', 20-22 Nov 2018, Singapore
- 3rd Meeting Workshop on Subseasonal-to-Seasonal Predictions for Southeast Asia, 22-26 Jun 2019, Singapore
- 2nd Meeting of the Steering Group for Space-Based Weather and Climate Extremes Monitoring (SWCEM) Demonstration Project (SEMDP), 21-23 Aug 2019, Tokyo, Japan
- Implementation Coordination Meeting of SEA-RCC Network, 19-20 Sep 2019, Singapore

Identified opportunities/challenges, if any, for further development or collaboration:
The workshops provided opportunities for officers to expand their knowledge and develop projects within the Service to better improve our services to users.

Priority Areas Addressed:
Attending meetings and workshops can help to ensure that Singapore as with other Members are working towards the improving international and regional collaboration.

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