

MEMBER REPORT

ESCAP/WMO Typhoon Committee
Integrated Workshop

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Nanjing, China

by
Meteorological Service Singapore

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I. Overview of tropical cyclones which have affected/impacted Member's area in 2012

1. Meteorological Assessment (highlighting forecasting issues/impacts)

Singapore is not directly affected by the presence of tropical cyclones in the region, the only exception being Tropical Cyclone "Vamei", which passed within 65 km from Singapore in 2001. However, tropical cyclones which move across the South China Sea may exert some indirect influence on the weather in Singapore. These effects may be in the form of extended rain bands from the cyclones, increased instability leading to enhanced convective activity, and the strengthening and convergence of southwesterly winds resulting in line squalls affecting Singapore, bringing heavy rain and strong surface wind gusts.

The weather in Singapore is largely dominated by monsoons throughout the year. The Northeast Monsoon typically lasts from December to March, bringing with it the traditional wet season during the 1st half of the Monsoon season from December to January. The second half or dry phase of the Northeast Monsoon typically affects Singapore around February and March. The Southwest Monsoon typically lasts from June to September. Separating the 2 distinct monsoon seasons are the Inter-Monsoon periods from April to May and October to November.

The 2011/2012 Northeast Monsoon season set in around mid-November 2011. During a typical Northeast Monsoon, Singapore may be affected by 2-4 surge episodes of prolonged widespread rain, induced by the strengthening of northeasterly winds over the South China Sea. The first surge of the season affected Singapore at the start of December 2011 while the second surge occurred during the second week of the month. Both surges were mild and brought occasional light to moderate rain over Singapore. The surges in second half of the month were more pronounced, bringing intermittent rain throughout the day on 18 December (65 mm), 19 December (79 mm) and 24 December 2011 (60 mm). Around the second week of February, the dry phase of the Northeast Monsoon set in, bringing several days of relatively dry and fair weather conditions to Singapore. The Southwest Monsoon season commenced in second half of May 2012 and lasted till mid October 2012. The rainfall over Singapore during the Southwest Monsoon season was generally below average.

During the 2012 Pacific Typhoon season, there are a few occasions in which tropical storms indirectly affected the weather in Singapore. In July 2012, Tropical Storm Doksuri brought unstable weather conditions over Singapore and the vicinity as it tracked over the northern part of Philippines. Similarly, in September 2012, Typhoon Jelawat also resulted in the passage of a squall line or "Sumatra" squall over Singapore. The "Sumatra" squall was induced by the prevailing southwesterly winds when Jelawat approached Taiwan. Both situations resulted in heavy rainfall over Singapore and the immediate vicinity.

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

It is a challenging task to manage water for both water resource and flood control as these two functions have conflicting interest. Keeping high storage water level is optimal for water resource which may result in increasing the risk of flooding. Accurate, reliable and timely weather forecast will be a good decision support tool to help manage the water resource more efficiently.

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

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

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II. Summary of progress in Key Result Areas (For achievements/results which apply to more than one Key Result Area, please describe them under the most applicable Key Result Area. Then, at the end of the description, place in parentheses () the other applicable Key Result Areas)

1. Progress on Key Result Area 1: Reduced Loss of Life from Typhoon-related Disasters. (List progress on the Strategic Goals and Associated Activities in the Strategic Plan and progress on the 2011 Typhoon Committee Annual Operating Plan goals)
 - a. Meteorological Achievements/Results

To help alleviate the impact of storms such as squalls, or tropical cyclones, the Meteorological Service Singapore (MSS) provides heavy rain and strong winds advisory and warnings to various government agencies to enhance preparedness for expected heavy rain and/or strong wind events. The warnings are also made available to members of the public via the media, internet as well as via smart phone applications.
 - b. Hydrological Achievements/Results

Over the past decades, Singapore has been improving the drainage infrastructure. The flood-prone areas have been reduced from 3200 ha in the 1970s to about 49ha today. Singapore continuously reviews and upgrades her drainage infrastructure to ensure an effective drainage network for flood alleviation and prevention.
 - c. Disaster Prevention and Preparedness Achievements/Results

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 - d. Regional Cooperation Achievements/Results

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 - e. Identified Opportunities/Challenges for Future Achievements/Results

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2. Progress on Key Result Area 2: Minimized Typhoon-related Social and Economic Impacts. (List progress on the Strategic Goals and Associated Activities in the Strategic Plan and progress on the 2008 Typhoon Committee Annual Operating Plan goals)
 - a. Meteorological Achievements/Results

As in KRA 1(a) and KRA 6 (a)
 - b. Hydrological Achievements/Results

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 - c. Disaster Prevention and Preparedness Achievements/Results

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 - d. Research, Training, and Other Achievements/Results

Singapore's Civil Defense Academy provides disaster rescue and mitigation courses to the international community.
 - e. Regional Cooperation Achievements/Results

Singapore's Civil Defense Force provides water rescue and evacuation operations in the event of floods, resulting from typhoons and sustained rainfall and alerts the general public through the Public Warning System on the dangers of an impending flood. In addition, Singapore's Civil Defense Academy conducts disaster rescue and mitigation courses to the international community.

Under the ambit of the United Nations Environment Programme/Office for the Coordination of Humanitarian Affairs (UNEP/OCHA) Joint Environment Unit (JEU)), Singapore provides international assistance for Hazardous Materials emergencies (HazMat) that may arise from typhoon-related incidents.
 - f. Identified Opportunities/Challenges for Future Achievements/Results

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3. Progress on Key Result Area 3: Enhanced Beneficial Typhoon-related Effects for the Betterment of Quality of life. (List progress on the Strategic Goals and Associated Activities in the Strategic Plan and progress on the 2008 Typhoon Committee Annual Operating Plan goals)
 - a. Meteorological Achievements/Results
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 - b. Hydrological Achievements/Results
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 - c. Disaster Prevention and Preparedness Achievements/Results
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 - d. Research, Training, and Other Achievements/Results
 - (i) Singapore participated in several meteorological training workshops/conferences/meetings during the year including those sponsored/organized by the Typhoon Committee. Singapore would like to express her sincere thanks and appreciation to the Typhoon Committee for the opportunity to participate in the workshops. Our officers have found the training workshops/meetings educational and beneficial in their course of work. The list of relevant workshops/conferences attended in 2012 are as follows:
 - The 2nd Meeting of ASIA/PAC Meteorological Advisories and Warnings Implementation Task Force of the CNS/MET Sub-Group of APANPIRG, 19-20 Apr 2012, Bangkok, Thailand
 - 34th Meeting of the SCMG, 24-26 Apr 2012, Siem Reap, Cambodia
 - Training Course on Satellite and Radar Data Interpretation, 21-26 May 2012, Citeko, Indonesia
 - 16th Meeting of Communications/Navigation/Surveillance and Meteorology (CNS/MET) Sub-group of the ASIA/PACIFIC, 23-27 July 2012, Bangkok, Thailand
 - 2nd Meeting of the ICP/PTWS Regional Working Group on Tsunami Warning & Mitigation in the South China Sea Region, 16 -18 Oct 2012, Petaling Jaya, Malaysia
 - (ii) There are on-going efforts to improve the short to medium-range forecasts through the use of NWP models such as the Weather and Research Forecasting (WRF) model. A 2-way nested regional run is currently being used to produce high resolution forecasts over Singapore. Some of the development work in WRF is done jointly with the local universities to improve the forecasts through the use of statistics and weather case studies. There are plans to introduce data assimilation of satellite/radar observations as well as nudging methods to improve the predictions.
 - e. Regional Cooperation Achievements/Results
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 - f. Identified Opportunities/Challenges for Future Achievements/Results
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4. Progress on Key Result Area 4: Improved Typhoon-related Disaster Risk Management in Various Sectors. (List progress on the Strategic Goals and Associated Activities in the Strategic Plan and progress on the 2008 Typhoon Committee Annual Operating Plan goals)
 - a. Meteorological Achievements/Results
As in KRA 1(a) and KRA 6(a)
 - b. Hydrological Achievements/Results
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 - c. Disaster Prevention and Preparedness Achievements/Results
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 - d. Research, Training, and Other Achievements/Results
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 - e. Regional Cooperation Achievements/Results

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As in KRA 2(e)
5. Progress on Key Result Area 5: Strengthened Resilience of Communities to Typhoon-related Disasters. (List progress on the Strategic Goals and Associated Activities in the Strategic Plan and progress on the 2008 Typhoon Committee Annual Operating Plan goals)
- a. Meteorological Achievements/Results
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 - b. Hydrological Achievements/Results
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 - c. Disaster Prevention and Preparedness Achievements/Results
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 - d. Research, Training and Other Achievements/Results
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 - e. Regional Cooperation Achievements/Results
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 - f. Identified Opportunities/Challenges for Future Achievements/Results
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6. Progress on Key Result Area 6: Improved Capacity to Generate and Provide Accurate, Timely, and understandable Information on Typhoon-related Threats. (List progress on the Strategic Goals and Associated Activities in the Strategic Plan and progress on the 2011 Typhoon Committee Annual Operating Plan goals)
- a. Meteorological Achievements/Results
 - (i) Dissemination of weather information via emerging technologies
With the strong penetration of smart phone usage among the Singapore populace, a smart phone application, “myENV” was developed to provide useful information such as air quality and weather information to the general public. Via the app, which is freely available from the app stores, the public is able to obtain an update to the latest weather forecast. More importantly, the app also caters for push alerts to notify end users of rainfall that exceeds certain thresholds, which is useful in warning against flash floods.
 - (ii) Quantitative Precipitation Estimation
Although the network of rain gauges over Singapore is relatively comprehensive, there are still locations which are not covered by rain gauges. In order to capitalize on the advantages of the weather radar in terms of its spatial coverage, the rainfall data from the On-Line Weather Monitoring Network has been integrated into the weather radar system to generate products showing accumulated rainfall amounts. These products are being evaluated over a period to ensure that they provide representative indications of radar-derived rainfall estimations. The evaluation and calibration effort is ongoing.
 - (iii) Launching of Weather Book
MSS launched a weather book, *The Weather and Climate of Singapore*, in March 2012. The book is the first comprehensive publication to focus specifically on Singapore’s weather and climate. The 228-page book covers the weather systems Singapore commonly experience, such as thunderstorms, “Sumatra” squalls and monsoon surges. Written with students, teachers and the general public in mind, the book also explains the science of weather observations and predictions and presents various local climate statistics.
 - (iv) Opening of New Upper Air Observatory Building

The new Upper Air Observatory (UAO) began its operations at the current location in December 2011, following a re-location from its previous site a short distance away due to re-development of the area. The new UAO building is equipped with improved facilities for the launching of weather balloons and green features, such as solar panels and a rain harvesting system that harvests rain water to irrigate the building's landscape. Concurrent with the move to the building, MSS also acquired a new upper air sounding system. The new system is easy to handle and it includes the smallest and lightest synoptic radiosonde available today.

b. Hydrological Achievements/Results

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c. Disaster Prevention and Preparedness Achievements/Results

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d. Research, Training, and Other Achievements/Results

(i) Developing climate science capabilities to support national climate resilience efforts

MSS is establishing the Centre for Climate Research Singapore (CCRS) to undertake research and modeling studies to better understand the climate and weather of Singapore and the wider Southeast Asia region. Through the Centre, MSS is working to address the growing concern of climate change and its impact on Singapore and the region. This includes building capacity in climate modelling, prediction and assessment. Ongoing activities include the production of monthly climate forecasts over Singapore and the region using the US International Research Institute (IRI) for Climate and Society's Climate Prediction Toolkit (CPT) and developing long-term climate assessments using the UK Hadley Centre's PRECIS climate modelling system.

MSS' work will feed into Government strategies for climate resilience/preparedness. One of the areas of concern is the potential changes in Singapore's long term rainfall patterns which could have critical impacts on water resource and flood management.

In May 2011, MSS established a research partnership with the UK Met Office under a Memorandum of Understanding (MOU), for multi-year collaboration in regional climate modeling and research. MSS organized two regional climate modeling workshops in May and September 2011 to foster climate research links with ASEAN Met Services.

e. Regional Cooperation Achievements/Results

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f. Identified Opportunities/Challenges for Future Achievements/Results

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7. Progress on Key Result Area 7: Enhanced Typhoon Committee's Effectiveness and International Collaboration. (List progress on the Strategic Goals and Associated Activities in the Strategic Plan and progress on the 2011 Typhoon Committee Annual Operating Plan goals)

a. Meteorological Achievements/Results

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b. Hydrological Achievements/Results

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c. Disaster Prevention and Preparedness Achievements/Results
As in KRA 2(e)

d. Research, Training, and Other Achievements/Results

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e. Regional Cooperation Achievements/Results

- f. Identified Opportunities/Challenges for Future Achievements/Results
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8 Resource Mobilization Activities

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9. Update of Members' Working Groups representatives

1. Working Group on Meteorology

*Mr Ang Chieng Hai
Senior Meteorological Officer, Weather Services Department
Meteorological Service Singapore
Singapore*

Email: Ang_chieng_hai@nea.gov.sg

2. Working Group on Hydrology

*Mr Mah King Kheong
Senior Meteorological Officer, Weather Services Department
Meteorological Service Singapore
Singapore*

Email: Mah_king_kheong@nea.gov.sg

3. Working Group on Disaster Prevention and Preparedness

*Mr Choo Huat Aik
Senior Meteorological Officer, Weather Services Department
Meteorological Service Singapore
Singapore*

Email: Choo_huat_aik@nea.gov.sg

4. Training and Research Coordinating Group

*Mr Tham Chien Wan
Senior Meteorological Officer, Climate Science Department
Meteorological Service Singapore
Singapore*

Email: Tham_chien_wan@nea.gov.sg

5. Resource Mobilization Group

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