## **MEMBER REPORT**

ESCAP/WMO Typhoon Committee 9<sup>th</sup> Integrated Workshop

# Singapore

20 – 24 October 2014 ESCAP – UN Conference Center, Bangkok, Thailand

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### I. Overview of tropical cyclones which have affected/impacted Member's area in 2014

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 1<sup>st</sup> 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, and is typically the drier period of the year. Separating the 2 distinct monsoon seasons are the Inter-Monsoon periods from April to May and October to November.

During the 2014 Pacific Typhoon season, the tropical storms did not have much influence over the weather in Singapore.

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 DRR issues/impacts)
- 4. Regional Cooperation Assessment (highlighting regional cooperation successes and challenges)

#### II. Summary of progress in Key Result Areas

### TC Members' Report Summary of Progress in KRAs

Title of item 1: Heavy Rain and Strong Winds Advisory and Warnings

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.

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

KRA =	1	2	3	4	5	6	7
Meteorology	$\checkmark$	$\checkmark$		$\checkmark$			
Hydrology							
DRR							
Training and research							
Resource mobilization or regional collaboration							

Member:	Singapore	Name of contact for this item:	Li Ka Wing			
Telephone:		Email:	Li_Ka_Wing@nea.gov.sg			

Title of item 2: Research in Enhancement of Heavy Rain Warning Services

In provision of heavy rain warnings, the percentage of detection (POD), false alarms ratio (FAR) and lead time are important parameters in determining the accuracy of the forecast.

A research in enhancing MSS' heavy rain warning services is currently being conducted. The study aims to improve the lead time of heavy rain warnings for convective weather to 30 minutes or more, with a POD of  $\sim$ 80% and FAR of  $\sim$ 50%.

A set of atmospheric sounding and rainfall data is used in the research to develop a Heavy Rain Index (HRI). Verification of the heavy rain warnings with the observed heavy rain events' database is being conducted. With average yearly issuances of 185 warnings, the POD and FAR is around 80% and 70% respectively with the average lead time of more than an hour.

More studies are being conducted to reduce the FAR while maintaining the POD.

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

KRA =	1	2	3	4	5	6	7
Meteorology						$\checkmark$	
Hydrology							
DRR							
Training and research							
Resource mobilization or regional collaboration							

Member:	Singapore	Name of contact for this item:	Li Ka Wing
Telephone:		Email:	Li_Ka_Wing@nea.gov.sg

Title of item 3: Hydrological Achievements and 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 35 ha 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

KRA =	1	2	3	4	5	6	7
Meteorology							
Hydrology	~						
DRR							
Training and research							
Resource mobilization or regional collaboration							

Member:	Singapore	Name of contact for this item:	Li Ka Wing
Telephone:		Email:	Li_Ka_Wing@nea.gov.sg

#### Title of item 4:

Implementation of the High Performance Computing System for Numerical Modelling in MSS

The Centre for Climate Research Singapore (CCRS) of MSS is working closely with the UK Met Office to develop its capability in numerical weather and climate modelling.

In January 2014, CCRS acquired a CRAY XC-30 High Performance Computing System (HPC) to support its numerical weather prediction activities. This new computer comprises of 8-core 2.6 Ghz Intel Sandy Bridge processors, with 168 compute nodes providing a total of 2688 cores. Each compute node has a 64GB 1600 MHz DDR3 memory, giving a total system memory of about 1TB. The HPC has a theoretical peak performance of 55.9 TFLOPS and a Lustre file system providing 745 TB of useable file storage space.

The HPC is currently being employed at full capacity to complete a set of high resolution regional climate simulations for the Southeast Asian region. The output from these model simulations will form the central component within Singapore's Second National Climate Change Study. The new HPC is also being used to develop a high resolution weather prediction system that will become operational in 2016.

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

Nil

<u>Summary Table</u> of relevant KRAs and components (please tick boxes, can be more than one, as appropriate):

KRA =	1	2	3	4	5	6	7
Meteorology		$\checkmark$		$\checkmark$		$\checkmark$	
Hydrology							
DRR							
Training and research							
Resource mobilization or regional collaboration							

Member:	Singapore	Name of contact for this item:	Li Ka Wing
Telephone:		Email:	Li Ka Wing@nea.gov.sg

Email:

Li Ka Wing@nea.gov.sg

Title of item 5: ASEAN Climate Outlook Forum (ASEANCOF)

Following the establishment of the ASEAN Climate Outlook Forum (ASEANCOF) and the successful conclusion of ASEANCOF-1 meeting in December 2013, the Meteorological Service Singapore (MSS) organised the second meeting (ASEANCOF-2) on 29 May 2014 from 0600 – 0830 UTC via video conferencing. It was attended by representatives from the ASEAN countries of Brunei, Malaysia, Myanmar, Philippines, Singapore, Thailand and Vietnam.

ASEANCOF-2 started with a review of the previous consensus seasonal outlook for DJF 2013-2014 issued during ASEANCOF-1. The temperature and precipitation outlooks issued for DJF 2013-2014 were generally representative of observational climate data. This was followed by individual presentations from ASEAN countries on their national climate outlooks for JJA 2014 and the bases for such predictions. The Forum then reviewed the current state and predictions of large-scale circulation features such as the El Niño Southern Oscillation (ENSO) and the Indian Ocean Dipole (IOD). There were also discussions on the potency of the tropical storm system in the upcoming season. The Global Producing Centres' (GPCs) forecasts for JJA 2014 from the WMO-LC-LRMME (WMO Lead Centre) website were then considered as inputs to the expert assessment leading to the final consensus outlook.

Going forward, with the support of WMO, MSS is organising the third meeting (ASEANCOF-3) on 17-19 November 2014. Apart from the normal activities of the forum assessing large-scale climate processes (e.g. ENSO and IOD), GPCs' predictions and national outlooks, this meeting will also have a session on the use of seasonal climate predictions in the water resources management sector. Identified water representatives from the region will be invited to contribute to this session. This meeting will also comprise of a training workshop on the third day, to train NMS participants on making better operational use of available GPC predictions and other seasonal products.

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

Nil

KRA =	1	2	3	4	5	6	7
Meteorology							
Hydrology							
DRR							
Training and research						$\checkmark$	
Resource mobilization or regional collaboration							

Member:	Singapore	Name of contact for this item:	Li Ka Wing
Telephone:		Email:	Li_Ka_Wing@nea.gov.sg

#### Title of item 6:

Southeast Asia Climate Analysis and Modelling (SEACAM) Workshop

The Southeast Asia Climate Analysis and Modelling (SEACAM) framework was initiated by the Centre for CCRS in 2011 in collaboration with the UK Met Office Hadley Centre (MOHC). SEACAM's objectives are to enhance regional scientific cooperation and increase scientific capacity among climate researchers in the Southeast Asia region through workshops and collaborative projects in the areas of regional climate analysis and modelling.

The 4<sup>th</sup> SEACAM workshop held at CCRS from 25-27 February 2014. A total of 32 participants - including representatives from the ASEAN countries of Brunei, Cambodia, Indonesia, Malaysia, Myanmar, Philippines, Singapore, Thailand and Vietnam - came together to analyse a set of climate modelling data from six 25 km resolution 150-year PRECIS Regional Climate Model (RCM) experiments over Southeast Asia.

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

KRA =	1	2	3	4	5	6	7
Meteorology							
Hydrology							
DRR							
Training and research						$\checkmark$	
Resource mobilization or regional collaboration							

Member:	Singapore	Name of contact for this item:	Li Ka Wing
Telephone:		Email:	Li_Ka_Wing@nea.gov.sg

Title of item 7:

Hosting of Training Workshops, Conferences and Meetings

Singapore hosted/organised several meteorological training workshops / conferences/meetings during the year. The list of relevant workshops/conferences hosted/organised by MSS in 2014 are as follows:

- 3rd Climate Science Expert Network (CSEN) of IPCC AR5 findings for Southeast Asia, 13 15 Jan 2014
- 4th Southeast Asia Climate Analysis and Modelling (SEACAM) Workshop, 25 27 Feb 2014
- V2 Study: Technical Engagement Session on Coastal Protection & Ocean Modelling, 3 7 Mar 2014
- CSEN on Sea Level Rise Workshop , 5 Mar 2014
- CSEN on Urban Heat Island Workshop , 6 Mar 2014

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

KRA =	1	2	3	4	5	6	7
Meteorology							
Hydrology							
DRR							
Training and research			$\checkmark$				
Resource mobilization or regional collaboration							

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Telephone:		Email:	Li_Ka_Wing@nea.gov.sg

Title of item 8:

Participations in Training Workshops, Conferences and Meetings

Singapore participated in several meteorological training workshops/conferences/meetings during the year. Our officers have found the training workshops/meetings educational and beneficial in their course of work. The list of relevant workshops/conferences attended in 2014 are as follows:

- 46<sup>th</sup> Session of the ESCAP/WMO Typhoon Committee, 10 13 Feb 2014, Bangkok, Thailand
- Regional Training Workshop on Weather Radar Basis & Routine Maintenance and Real-Time Radar Rainfall Estimation & Forecasting, 24 Feb - 7 Mar 2014, Bangkok, Thailand
- European Geosciences Union (EGU) General Assembly 2014, 27 Apr 2 May 2014, Vienna, Austria
- 6<sup>th</sup> Conference on Management of National Meteorological and Hydrological Services (NMHSs) in RA V (South-West Pacific), 30 Apr - 1 May 2014, Jakarta, Indonesia
- The 16<sup>th</sup> Session of Regional Association V (South-West Pacific) , 2 8 May 2014, Jakarta, Indonesia
- International ASEAN South East Asia Climate Assessment & Dataset (SACA&D) Conference & Workshop 2014 (IASCW), 20 - 23 May 2014, Bogor, Indonesia
- Atmospheric Circulation Reconstructions over the Earth SE Asia (ACRE SE Asia) Workshop, 27 28 May 2014, Kuala Lumpur, Malaysia
- ASEAN Task Force Meeting To Review Alert Levels and Trigger Points on Fire Suppression, 11 12 Jun 2014, Petaling Jaya, Malaysia
- Scientific visit and UK Met Office Unified Model (UM) User workshop and Tutorial, 1 Jun 6 Jul 2014, Exeter, UK
- Technical Conference on "Climate Services Building on CLIPS Legacy", 30 Jun 2 Jul 2014, Heidelberg, Germany
- 11<sup>th</sup> Asia Oceania Geosciences Society (AOGS) Annual Meeting, 27 Jul 1 Aug 2014, Sapporo, Japan
- 36<sup>th</sup> Meeting of the ASEAN Sub-Committee on Meteorology and Geophysics (SCMG), 1 – 3 Sep 2014, Vientiane, Laos PDR

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

Nil

KRA =	1	2	3	4	5	6	7
Meteorology							
Hydrology							
DRR							
Training and research			$\checkmark$				
Resource mobilization or regional collaboration							

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