WGTMR – WG on Tropical Meteorology Research

Yihong DUAN

With thanks to the members of the WG

World Meteorological Organization
Organisation météorologique mondiale
Outline

- Highlights (2017/18)
- Priority AAs
- General matters
The 2018 field campaign by the Southern China Monsoon Rainfall Experiment (SCMREX)

http://scmrex.cma.gov.cn

Period: 1 April to 30 June 2018

**Major Instruments**

- Dual-Polarization Radar (1 X-POL, 2 C-POLs, 5 fixed S-POLs)
- C-band frequency-modulated continuous-wave radar (C-FMCW)
- Ka-band Cloud Radars (CRs)
- Micro Rain Radar (MRR)
- Microwave Radiometer (MR)
- 2-D Video Disdrometers (2DVD)
- Laser-optical Disdrometer
- Laser Ceilometer (Ceilometer)
- X-band Phased-array Radar (X-PAR)
- Total-sky Cloud Imager (TCI)
- Precipitation Particle Imager (PPI)
- Cloud Condensation Nuclei Counter (CCNC)
- Aerodynamic Particle Sizer (APS)
- Lightning Low-frequency E-field Detection Array (LFEDA)
The Years of the Maritime Continent (YMC)-Sumatra Campaign 2017
http://www.jamstec.go.jp/ymc/

- **Period:** November 2017 - January 2018
- To study the interaction between diurnal cycle of rain and the MJO near the coast line
- **Participants:** Japan - JAMSTEC, Univ of Tokyo, Univ of Toyama, Kyoto Univ, Yamaguchi Univ, NME Ltd., MWJ Ltd.; Indonesia - BMKG, BPPT, Univ of Bengkulu, etc.; US - Univ of Hawaii/IPRC
- **Observations:** C/X-band Doppler radars, Radiosonde, GNSS-derived water vapor, Surface meteorology, Sky camera, CFH/Ozone sonde, Videoonde, m-TRITON buoy, Sub-surface ADCP mooring, etc.
The YMC-BSM (Boreal Summer Monsoon study) Campaign 2018

- **Period**: July 1 - August 31, 2018

- To study the atmospheric convection associated with northward propagating Boreal Summer Intraseasonal Oscillation (BSISO) and interaction between upper troposphere - lower stratosphere

- **Participants**: Indonesia – LAPAN and BMKG, Japan - JAMSTEC, Kyoto University, and NME Ltd, Palau - Koror Weather Service, Philippines – PAGASA and University of the Philippines, Vietnam - National Hydro-Meteorological Service

- **Observations**: PAGASA Laoag site, X-band Doppler radar, radiosonde, GNSS-derived water vapor, lidar, disdrometer, equatorial atmosphere radar, CFH-Ozone-CPS sonde, ozone sonde
The field campaign 2018 by the Understanding and PreDiction of Rainfall Associated with landFalling Tropical cyclones (UPDRAFT) project

Total 12 target TCs since 2015
Http://10.228.2.54/973Share/index.html
Total 25 tropical cyclones in 2018 over northwest Pacific
The Sixth International Workshop on Monsoons (IWM-6)

THEME of IWM-6: The Global Monsoon System – Research and Forecast of Severe Monsoon Weather and Climate Impacts

- Singapore, 13-17 Nov 2017
  - 169 oral and poster papers presented, including 38 invited reviews
- Organized by the WGTMR in cooperation with the CLIVAR/GEWEX Monsoon Panel, the MJO Task Force, the S2S Steering Group, the YMC Scientific Steering Committee, Meteorological Service Singapore, and Chinese University of Hong Kong
- Topics: Regional Monsoon, High-Impact Weather, Intraseasonal & S2S, Modeling & Climate Change

- An article entitled “The multi-scale global monsoon system: Research and prediction challenges in weather” by C.-P. Chang and co-authors summarizing IWM-6 is currently in press in the Bulletin of the American Meteorological Society
- Work is underway on a book entitled The Global Monsoon System: Research and Forecast (C.-P. Chang, ed.) that is based on invited lectures at IWM-6
The 4\textsuperscript{th} International Workshop on Tropical Cyclone Landfall Processes (IWTCLP-4)

https://www.wmo.int/pages/prog/arep/wwrp/new/iwtclp-4.html

- ** THEME of IWTCLP-4:** Tropical cyclone landfall impacts - Transitioning from observations and modeling to greater understanding and better forecasts
- Macau, China, 5-8 December 2017
  - Invited lead speakers, contributed papers and posters
- Organized by the in partnership with WMO’s Tropical Cyclone Programme
- A special issue of *Tropical Cyclone Research and Review* published in 2018 from a compilation of selected papers presented at the IWTCLP-4
The EXOTICCA/TLFDP/UPDRAFT Joint Meeting

- Shanghai, 10-11 July 2018

- **Organized** by the WGTMR in cooperation with the Chinese Academy of Meteorological Sciences and Shanghai Typhoon Institute of CMA

- **Objective**
  - Enhance cooperation between the three projects, coordinate and discuss the schedule of 2018-2019 observation periods

- **Outcomes**
  - Establish a super scientific steering committee
  - TLFDP: verify advanced forecast techniques and forecast products and set up a data sharing website for all the three projects
  - EXOTICCA: Further the research on typhoon intensity change of tropical cyclones approaching the coasts and conduct field campaigns
  - UPDRAFT: understanding and prediction of rainfall distribution of the landfalling tropical cyclones and conduct field campaigns
  - Integrate social science and verifications in all the three projects
  - Organize a training course and a workshop
Workshop on Advancing the Tropical Cyclone Total Warning System Concept

- **Background:** organized by the WGTMR in response to a recommendation of the IWTC-8 to conduct a scientific meeting *between tropical cyclone experts of the WGTMR and social scientists for the purpose of advancing the Total Warning System concept*

- Auckland, New Zealand, 13 September 2018
- **Organized** by the WGTMR in cooperation with the SERA WG and Tonkin + Taylor

- **Topics**
  - Technology advancement leading to forecast improvement
  - Communication of tropical cyclone warnings
  - Utilization of warning information
For ALL - Priority AAs (10 min)

• Report on each of the Action Areas you have identified as priority.

• Tell us about the concrete results from your Working Group in the past year and the plans for the next 2 years.
Action Areas with priorities

Key priority 1: AA 1 - ADDRESS LIMITATIONS

- Improved prediction of high impact weather events such as tropical cyclones and monsoon heavy rainfall is essential for protecting both life and property.
- Enhanced understanding of the factors underlying these events is critical to improving these predictions as well the dissemination of these forecasts to relevant stakeholders.
- Improved predictions facilitates a more resilient society.
- These works are closely related to the objectives of Action Area 1—Address Limitations.

Main Outcomes (2017/18)

- Targeted field campaigns designed to observe, simulate, and understand key physical processes underlying these phenomena will be conducted. These include TLFDP (Typhoon Landfall Forecast Demonstration Project) and UPDRAFT (Understanding and Predicting Rainfall from Landfalling Tropical Cyclones) for tropical cyclones, and SCMREX (Southern China Monsoon Rainfall Experiment) for monsoon heavy rainfall, and YMC (Years of the Maritime Continent) for maritime continent weather-climate systems.
- Vast quantities of observed tropical cyclone and monsoon heavy rainfall data were collected, along with dynamical model output.
- We anticipate that improved predictions and understanding will result from these various field campaigns.

Also related to AA5, AA14, and AA15.
TLFDP

- Development of TC forecast verification techniques
  - Collection of real-time forecast products from 15 typhoon forecast product providers and observational data
  - Verifications of track, intensity, and precipitation forecasts of NWP models and official guidance

- Report
  - Realtime: http://tlfdp.typhoon.gov.cn
  - Post-season: annually session of ESCAP/WMO TC (2013- now)
  - Papers: published in peer-reviewed journals

- New forecast techniques
- Tropical cyclone forecast and observation data exchanges
Improved understanding of the development of heavy-rain-producing storms in Southern China during the early summer rainy season
- The Relationship between Anomalous Presummer Extreme Rainfall over South China and Synoptic Disturbances. *J. Geophys. Res.*, 2018
- Sensitivity of a Simulated Squall Line during SCMREX to Parameterization of Microphysics. *J. Geophys. Res.*, 2018

Established a convection-permitting ensemble prediction system (MSEPS)

Rainfall observation data exchanges
The integrated observations by SCMREX are used to improve cloud microphysics schemes, which leads to better simulations of heavy-rain-producing MCS.

• Storm morphology
• Storm development & movement

Qian et al. (2018; JGR)
YMC

- YMC-Sumatra Campaign 2017
- YMC-BSM (Boreal Summer Monsoon study) 2018 Campaign
- Publications
  - Coastal upwelling events along the southern coast of Java during the 2008 positive Indian Ocean Dipole. *J. Oceanogr.*, 2018
  - Drastic thickening of the barrier layer off the western coast of Sumatra due to the Madden Julian Oscillation passage during the Pre-Years of the Maritime Continent campaign. *Prog. Earth Planet. Sci.*, 2018
  - Land-sea surface air temperature contrast on the western coast of Sumatra Island during an active phase of the Madden-Julian oscillation. *Prog. Earth Planet. Sci.*, 2018
  - Maritime continent coastlines controlling Earth's climate. *Prog. Earth Planet. Sci.*, 2018
- Observation data exchanges
Key priority 1: AA 1 - ADDRESS LIMITATIONS (cont’d)

Near Future

– TLFDP (phase IV, 2019 to 2021)
  ● Data collection and sharing
  ● TC intensity analysis technique evaluation
  ● TC track, intensity, and precipitation forecast verification

– UPDRAFT (continued)
  ● Field campaign
  ● Research on the role of various physical processes in governing tropical cyclone rainfall

– SCMREX (extend to phase III, 2019-2021)
  ● Field campaign
  ● Enhanced observations with focuses on pre-storm air-aerosol-Cloud microphysics and surface fluxes
  ● Research on physical mechanisms - urban, topography, and sea/land contrast effects, and aerosol-convection-precipitation interaction
  ● NWP studies - convective-scale predictability, data assimilation, development of model physics schemes, and ensembles

– YMC
  ■ YMC-Banda Sea
  US-Indonesia Joint Research in Jan 2019
Near Future (cont’d)

Workshops and training sessions will be held to communicate the results from these field experiments and develop recommendations for both the operational and research community.

- The 4th Workshop on Monsoon Heavy Rainfall in conjunction with the SCMREX workshop (Beijing, China, 2019)

- The TLFDP/UPDRAFT/EXOTICCA joint meeting will be held in Hangzhou, China in 2019

- A TLFDP training course in cooperated with SERA will be held in Nanjing, China in 2019.
Key priority 2: AA 6 - ATTRIBUTION

• Climate change and specifically its impacts on tropical cyclones and monsoon rainfall is one of the most critical environmental problems facing society today.
• Understanding of the attribution of climate changes on monsoons and tropical cyclones is critical to improve forecasts of future events.

Main Outcomes (2017/18)

• Maintain an Atlantic basin seasonal hurricane forecast compilation website (http://www.seasonalhurricanepredictions.org)
• Maintain a global real-time tropical cyclone activity tracker (http://tropical.atmos.colostate.edu/Realtime).
• Frontier workshops including tropical cyclone and monsoon climatology sections, such as IWM-VI and IWTCLP-4, were successfully organized.
• An article entitled “The multi-scale global monsoon system: Research and prediction challenges in weather” by C.-P. Chang and co-authors summarizing IWM-VI is currently in press in the Bulletin of the American Meteorological Society.
• Work is underway on a book entitled The Multi-Scale Global Monsoon System (C.-P. Chang, ed.).
Expansion of Atlantic basin seasonal hurricane forecast website compilation

- http://www.seasonalhurricanepredictions.org
- Now with 26 different contributing agencies
Redesign of Global Real-Time Tropical Cyclone Activity Tracker

- Provides six-hourly updates of global TC statistics to date using NHC/CPHC/JTWC operational best tracks
- Also included are comparisons with daily climatologies to date
- Historical TC statistics available as far back as data allows
- Utilized as real-time “to date” numbers for Atlantic seasonal hurricane forecast website

http://tropical.atmos.colostate.edu/Realtime
Key priority 2: AA 6 – ATTRIBUTION (cont’d)

Near Future

• Propose to hold a workshop to discuss various approaches to attribution. The literature reviews could be used as a basis for the discussions of this workshop.
• A literature review of the current state of monsoon rainfall attribution will be conducted.
• Conduct a review of tropical cyclone attribution studies of recent high-impact tropical cyclones (e.g., Harvey-2017).
• Hold a workshop on the impact of climate change on the tropical cyclone and update the WMO statement (issued in 2010)
Key priority 3: **AA 9 - PRECIPITATION PROCESSES**

- The prediction of both tropical cyclones and monsoon heavy rainfall depends on the understanding of aerosol and cloud processes and their representation in numerical models.
- We intend to use the results from various field campaigns to inform the techniques used to represent these processes.

**Main Outcomes (2017/18)**

- Targeted field campaigns designed to observe, simulate and understand aerosol and cloud processes underlying these phenomena were conducted. These include UPDRAFT for tropical cyclones and SCMREX for monsoon heavy rainfall.
  
  Total 12 target TCs since 2015
  
  http://10.228.2.54\973Share\index.html

- We anticipate that improved rainfall prediction will result from these various field campaigns.
The ice-phase microphysical processes are important pathways of particle growth in the outer rainbands where riming contributes significantly to heavy rain.
Publications related to UPDRAFT


Near Future

- The field campaigns in UPDRAFT and SCMREX will be continued.
- The planned PRECIP project will span both tropical cyclone and monsoon heavy rainfall regimes.
- Workshops and training sessions will be held to communicate the results from the field experiments and develop recommendations for both the operational and research community.
General matters

Cross-cutting activity highlights

- Establish a super scientific steering committee for EXOTICCA/TLFDP/UPDRAFT and integrate social science (SERA) and verifications (WGFVR) in the projects.

- Organized the IWM-6 in cooperation with the CLIVAR/GEWEX Monsoon Panel, the MJO Task Force, and the S2S Steering Group.

- Organized the Workshop on Advancing the Total Warning System Concept with SERA and Tokin + Taylor in Auckland, New Zealand, 13 September 2018.

- EXOTICCA: in collaboration with the ESCAP/WMO Typhoon Committee.
IWTC-9 : MAIN TOPICS

1. Cyclogenesis
2. TC Track
3. TC Intensity Change
4. TC Structure Analysis & Change
5. Communication of Forecast Uncertainty & Warnings using probabilistic hazard information
6. TC Variability beyond the Synoptic Scale
7. TC Analysis & Remote Sensing
IWTC-9: SPECIAL FOCUS SESSIONS

1. Seamless GDPFS
2. Improving skill of TC Forecasts and the S2S database
3. HIWeather Project and TCs
4. Next generation meteorological satellite systems
5. Significant Tropical Cyclones in 2017
6. Improving storm surge forecast skill on S2S time scales
7. New Observation Strategies
8. New Uses of UAVs in TC Research
9. Basic set of TC verification metrics for NMHSs
10. Global Multi-Hazard Alert Systems
11. Automated TC Forecast Systems
Invitation List – 140
  75 Researchers
  65 Forecasters
Early Career Scientists - 18
Venue: Honolulu, Hawaii, USA
Dates: 3-7 Dec 2018

Hyatt Regency Waikiki Beach Resort and Spa
Thank you
Merci
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