The Southern China Monsoon Rainfall Experiment (SCMREX)

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**Background:** Climatological Annual Precipitation of China (1971-2012)
Background: Distribution of Excessively Heavy Rain (1971-2012)

<table>
<thead>
<tr>
<th>24 h max. rainfall (mm)</th>
<th>Total Occur. (times)</th>
<th>South of 28°</th>
</tr>
</thead>
<tbody>
<tr>
<td>X 300 – 450</td>
<td>320</td>
<td>68%</td>
</tr>
<tr>
<td>▲ 450 – 600</td>
<td>19</td>
<td>63%</td>
</tr>
<tr>
<td>■ &gt; 600</td>
<td>13</td>
<td>69%</td>
</tr>
<tr>
<td>&gt; 300</td>
<td>352</td>
<td>68%</td>
</tr>
</tbody>
</table>
**Background:** Distribution of Monthly Rainfall Amount over South China (1971-2012)

Early summer is the major rainy season for South China.
Background: Need to Improve Forecast Skill

TS scores of accumulative rainfall forecast over southern China (Guangdong, Guangxi and Hainan) in (a) May and (b) June of 2010.

Colors represent forecaster, global models (T639, Japan and Germany), mesoscale models (MM5 and GRAPES), respectively.

(Data source: CMA Numerical Prediction Center)
Quantitative Precipitation Forecast

Scientific understanding & technique development

Numerical model
- Cloud microphysics
- Planetary boundary layer
- Land surface

Initial condition
- Observation
- Data assimilation

Ensemble generation
- Predictability
- Perturbation method

Scientific understanding & technique development
Southern China Monsoon Rainfall Experiment (SCMREX, 2013-20) - A WMO/WWRP RDP

Scientific Objectives
With new, integrated data collected during the IOPs,

- **To better understand development of the heavy-rain-producing storms in Southern China during the pre-summer rainy season**
  - Processes governing convective initiation & development
  - Storm-internal processes

- **To improve QPF skill by**
  - better understanding multi-scale precipitation processes
  - DA impact study, model physics scheme improvement, and ensemble experiments at convection-permitting scale

- [http://scmrex.cma.gov.cn](http://scmrex.cma.gov.cn)
SCMREX Field Campaigns

Distribution of major Facilities

IOPs:
1 May to mid-Jun, 2013-18

Field Campaign Participants
- State Key Laboratory of Severe Weather (LaSW), Chinese Academy of Meteorological Sciences (CAMS)
- Institute of Tropical and Marine Meteorology, CMA, Guangzhou (ITMM)
- Institute of Heavy Rain, CMA, Wuhan (IHR)
- Nanjing University (NJU)
- Chengdu University of Information Technology (CUIT)
- Hong Kong Observatory (HKO)
- Guangdong Meteorological Bureau (5 operational S-POLs)
- Guangxi Meteorological Bureau
- Hainan Meteorological Bureau

- About 2700 extra soundings
- 8 radiosonde stations
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)

Three super sites:
- Cloud & precipitation (Longmen)
- Fast-evolving storms (Nanhai)
- Lightning (Conghua)
SCMREX Working Groups

- Observation
- Data Processing
- Data Management
- Physical mechanism studies
- NWP studies
- Data assimilation
- Model physics
- Ensemble forecast
International Collaboration
SCMREX Progress

Physical mechanisms:
• Extreme rainfall events
• Regional persistent rainfall
• Diurnal variations

Numerical weather prediction (NWP):
• Data assimilation for better initial conditions
  Wind profiler network
  Weather radar radial velocity
• Improving cloud microphysics scheme
• Evaluation of quantitative precipitation forecast (QPF)
• Convection-permitting ensemble forecast

Retrieval technique and data analysis:
• Dual-polarimetric radar
  Quantitative precipitation estimation (QPE)
  Hydrometeor classification
• Frequency-modulated continuous-wave radar (FMCW)
  Rain drop size distribution (DSD)
• Vertically-pointing radars with various wavelengths
  Cloud-precipitation interior structure


Publication List (II)

Future Plan (I)

Enhanced observations
- Pre-storm air + Aerosol + Cloud Microphysics
- Surface fluxes & PBL

King Air aircraft
- Cloud (FCDP, 2D-S, CPI, CCP, HVPS)
- Aerosol (Iso Inlet, CVI, SMPS, PCASP, SP2, CCN-200)
- Meteorology (dropsonde, AIMMS-20 with PMS Canister)
Future Plan (II)

Physical mechanism study
• Urban, topography, sea/land contrast effects
• Aerosol-conv.-precipitation interaction

NWP study
• Convective-scale Predictability
• DA impact:
  – FY-4 satellite
  – polarimetric radar
• Improving Model Physics Schemes
  – PBL + Microphysics
• Ensemble generation methods

An International Workshop
• Spring 2019, Beijing
• Host: State Key Laboratory of Severe Weather, CAMS

The South China Sea Monsoon Experiment
• In preparation
Thank you for your attention!