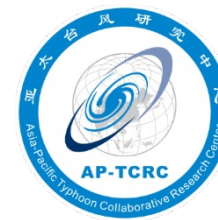


Progress of **EX**periment **On T**yphoon **I**ntensity **C**hange in **C**oastal **A**rea (EXOTICCA)-II -- a Lidar Observational Study in the DownTown of Shanghai During Typhoon Muifa(2211)

TANG Jie

- 1. Shanghai Typhoon Institute, China Meteorological Administration, Shanghai, China*
- 2. Hongkong Observatory, Hongkong, China*
- 3. Asia-Pacific Typhoon Collaborative Research Center*





Background: Footprints of EXOTICCA





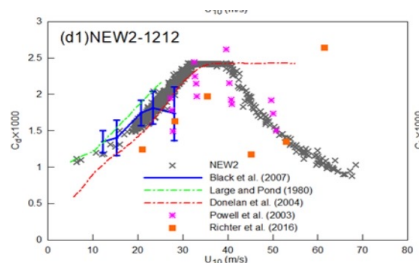
Background: Differences between EXOTICCA I and II

	EXOTICCA(2014-2018)	EXOTICCA II(2019-2023)
PLATFORMS	Mobile Van and few aircraft observation	Satellite-Aircraft-Land-Ocean Multi-platforms
INSTRUMENTS	radiosonde,tower,surface operation observation	Lidar,dropsondes,SFMR,High- resolution radar,orbit satellite
UNITS	STI,HKO	STI,HKO+NJU,IAP,NSSC,NMC,SIO ...
TEAMS	field team (<10 people)	field team+ model team+data team international advisor and visiting scientists
DATA	Collection	Target Collection + Research + Operation + Model + Datasets



Background: TEAMS of EXOTICCA-II

**Air-Space-Surface--Ocean
Typhoon Experiment TEAM**
STI/CMA; HKO; SIO; NSSC/CMA;
BUAA; NUA; TENG DUN; Airda...

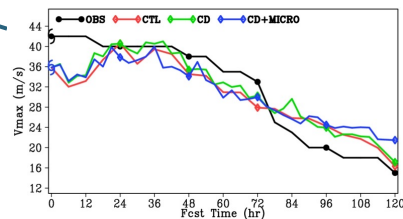
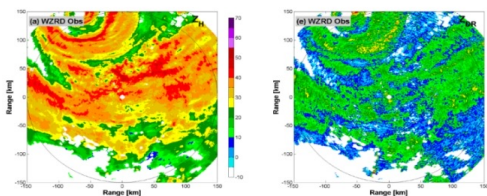


Boundary Layer Scheme

Nuist; HRD/AOML/NOAA;
STI/CMA

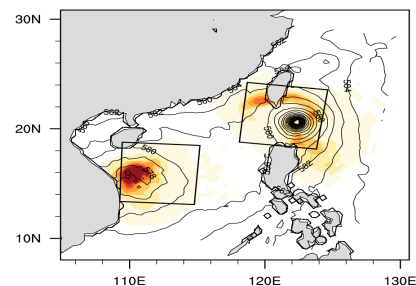
Microphysics TEAM

with Updraft
NJU; STI/CMA



Adaptive observation and data assimilation TEAM

IAP/CAS; STI/CMA



Forecast and Data sharing TEAM with TLFDP

NMC/CMA; STI/CMA



Operation Goals of EXOTICCA II

- **1-3 cases every year**
- **A set of typhoon field scheme based on surface-ocean-aero-satellite unified platform**
- **Observation study based on experiment data**



Scientific Goals of EXOTICCA II

- **Offshore typhoon identification technique**
- **Fine scale structure characters in the boundary layer**
- **Cloud and precipitation microphysics cooperated with**
- **The exchange of mass, energy and momentum between stratosphere and troposphere**
- **Typhoon dataset based on website**

Typhoon threatens to coacitiess cities:



Typhoon Hato 2018



Hurricane Michael 2018



Typhoon Mangkhut 2018

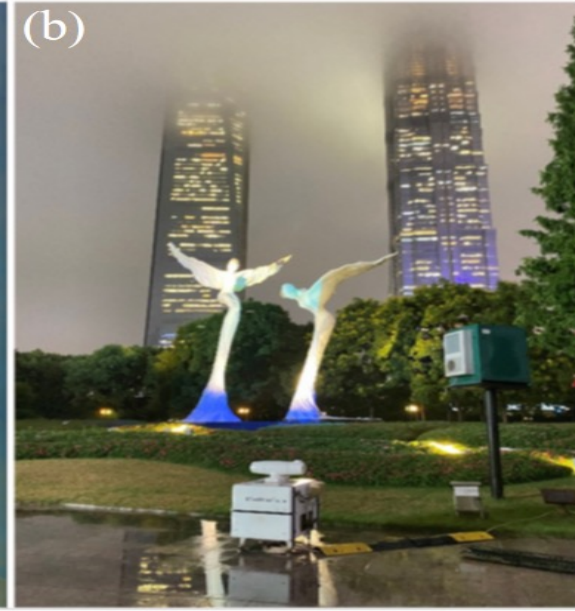
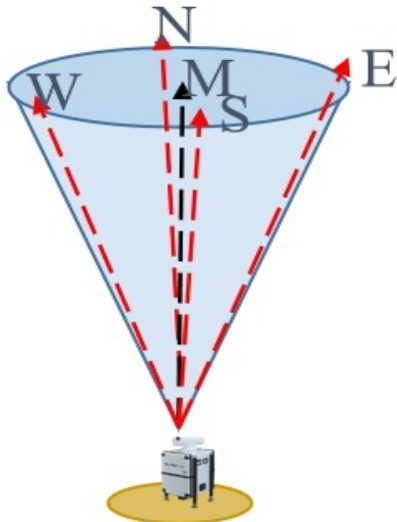
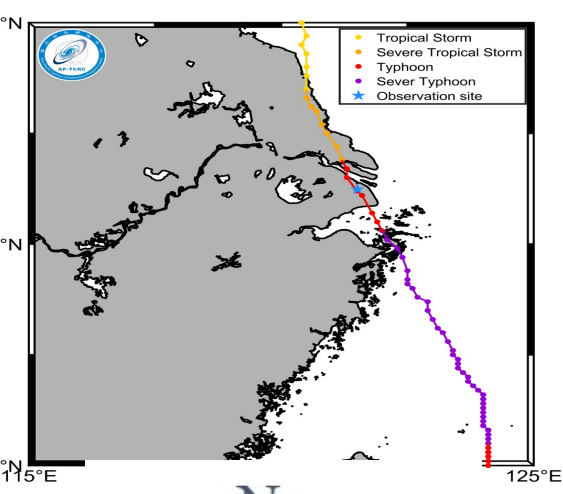


Typhoon Meranit 2016

If we do something for gale wind disaster warning ?

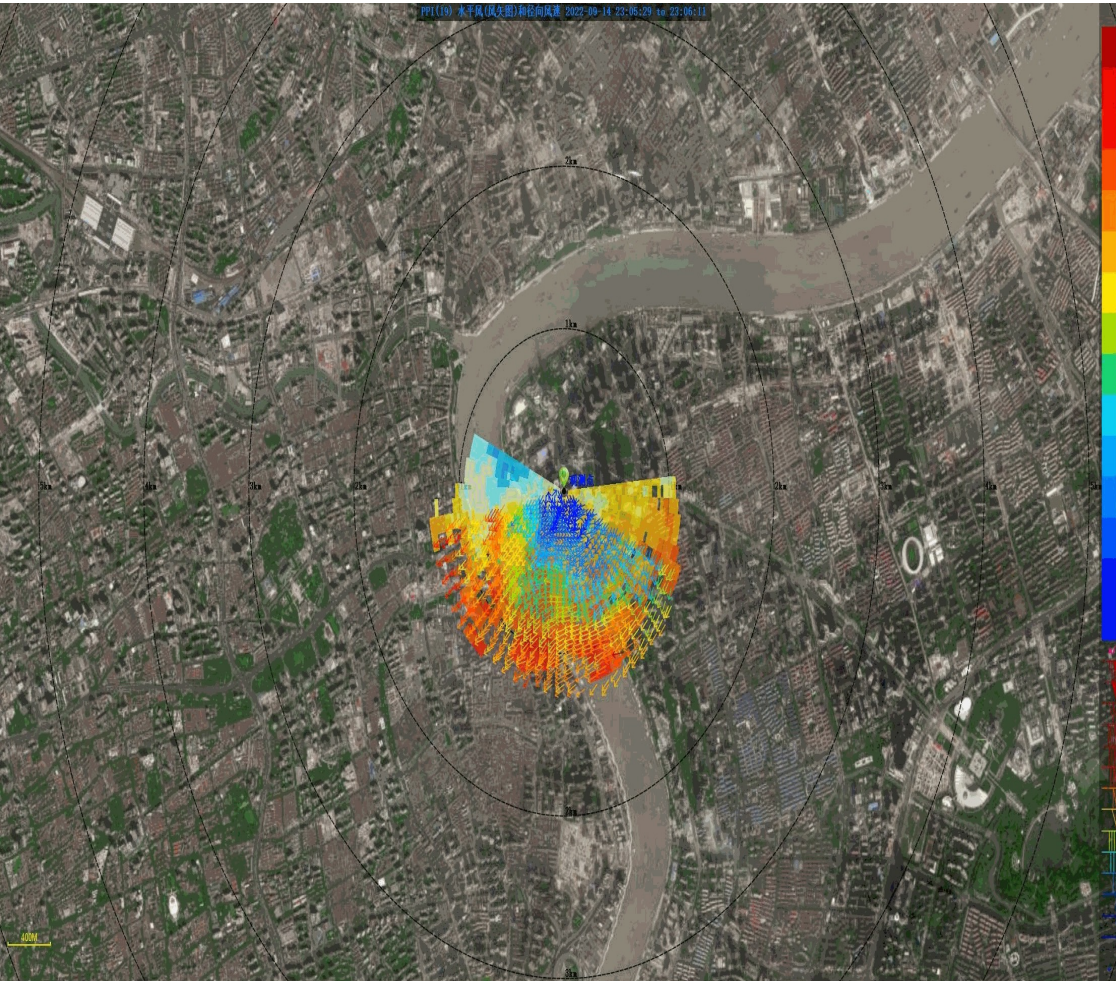


Typhoon Muifa(2212) Wind Observation in Downtown (Lujiazui) of Shanghai

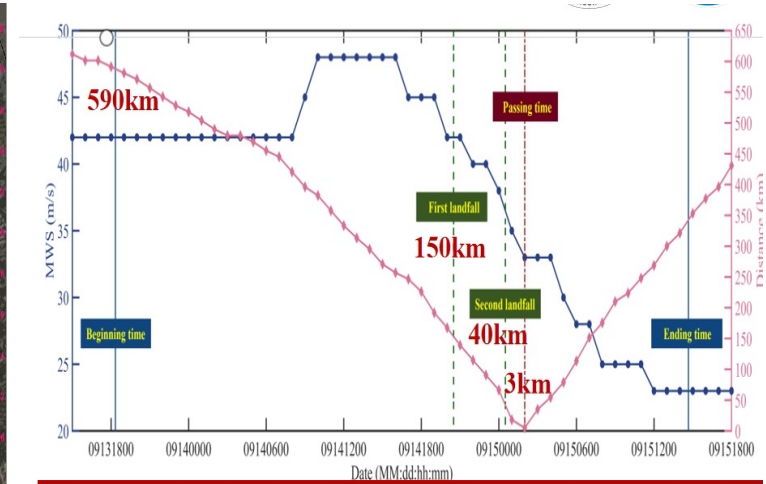




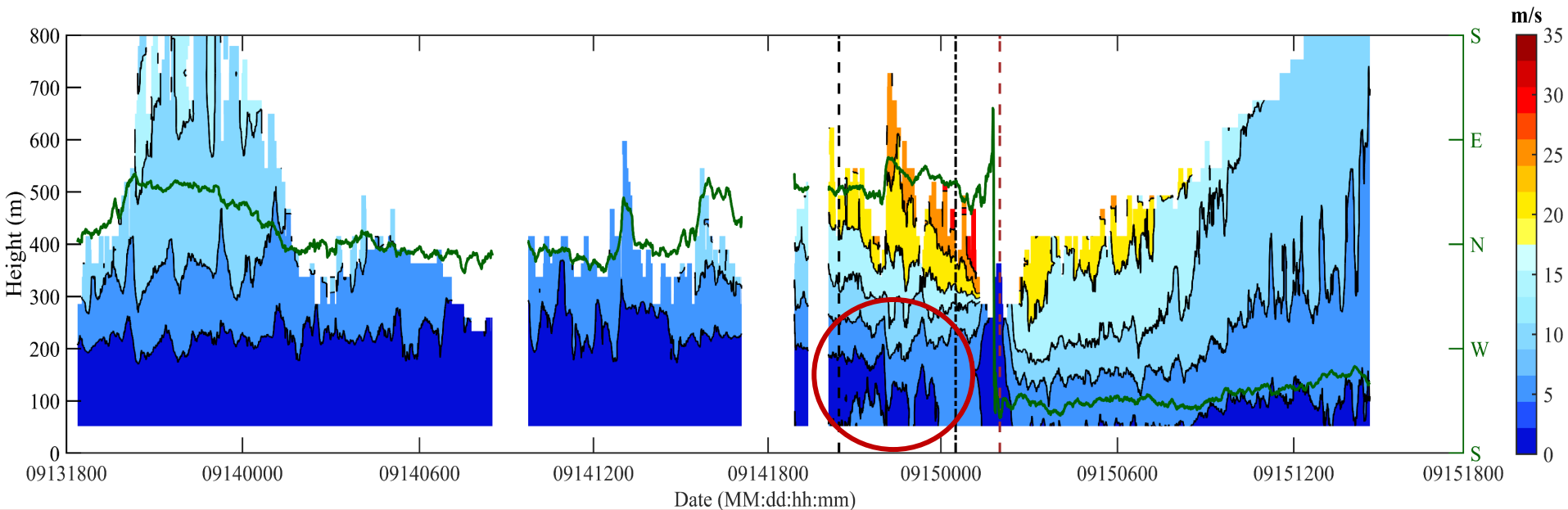
Typhoon Muifa Observation in Downtown(Lujiazui) of Shanghai



Resolution: about 25meters;2 minutes



Horizontal wind in different stage



09131819-09141700, Distance to typhoon center (590-250km), outer region, maximum wind 17.9m/s,

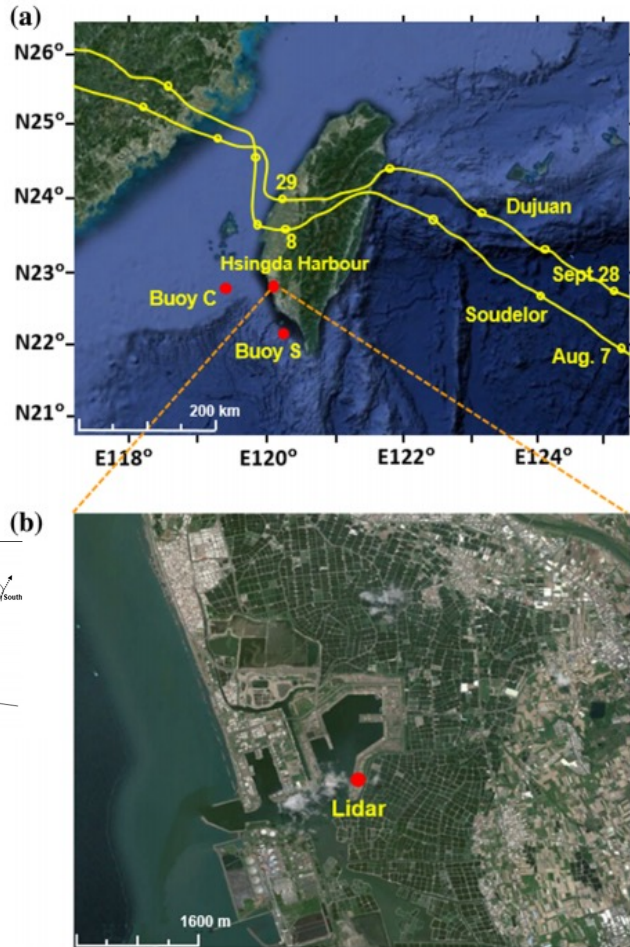
09141700-09142030, Distance to typhoon center (250-150km), outer region, maximum wind 23.9m/s

09142030-09150030, Distance to typhoon center (150-40km), inner core, maximum wind 32.7m/s

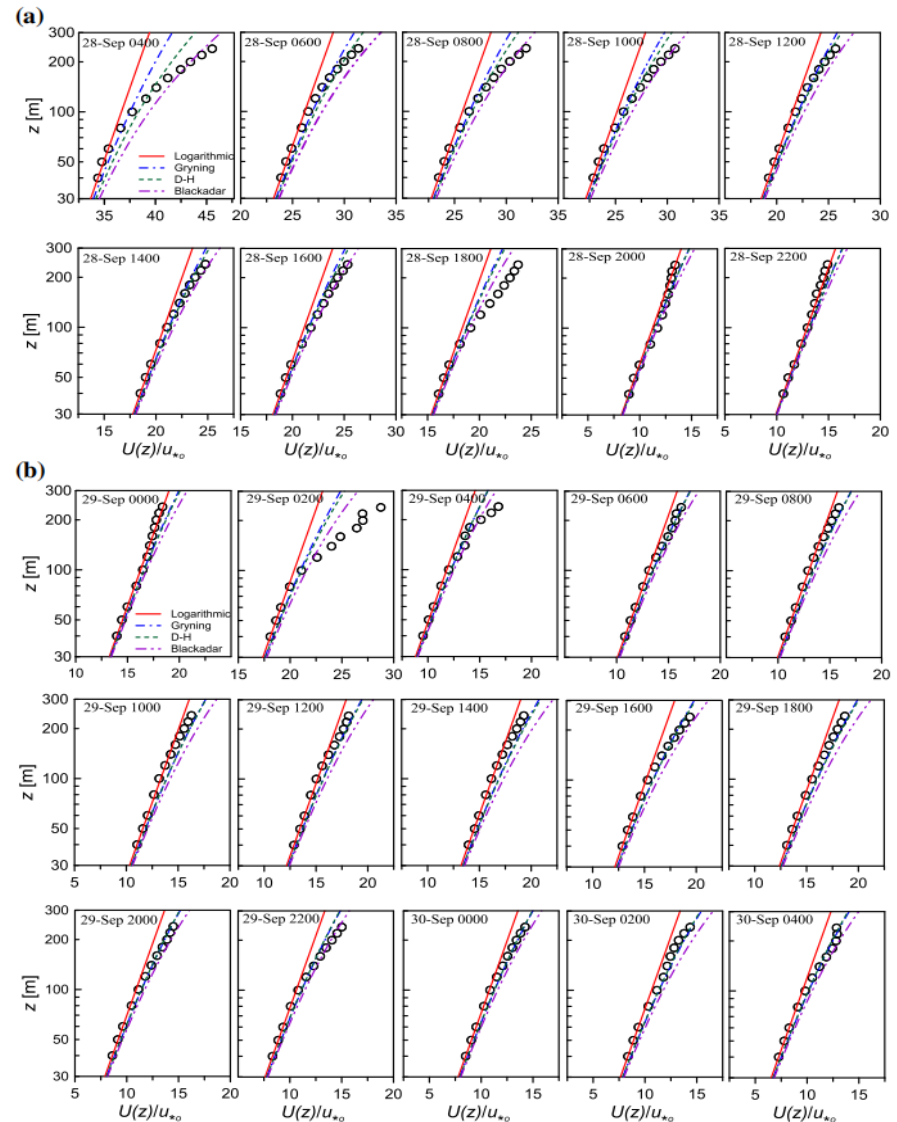
09150030-09150200, Distance to typhoon center(40-3km), eye region, maximum wind 34.9m/s

09150200-09151441, Distance to typhoon center(30-200km, outer region, maximum wind 22.1m/s

Previous Lidar observation in typhoon environment



Tsai et al. 2019 BLM

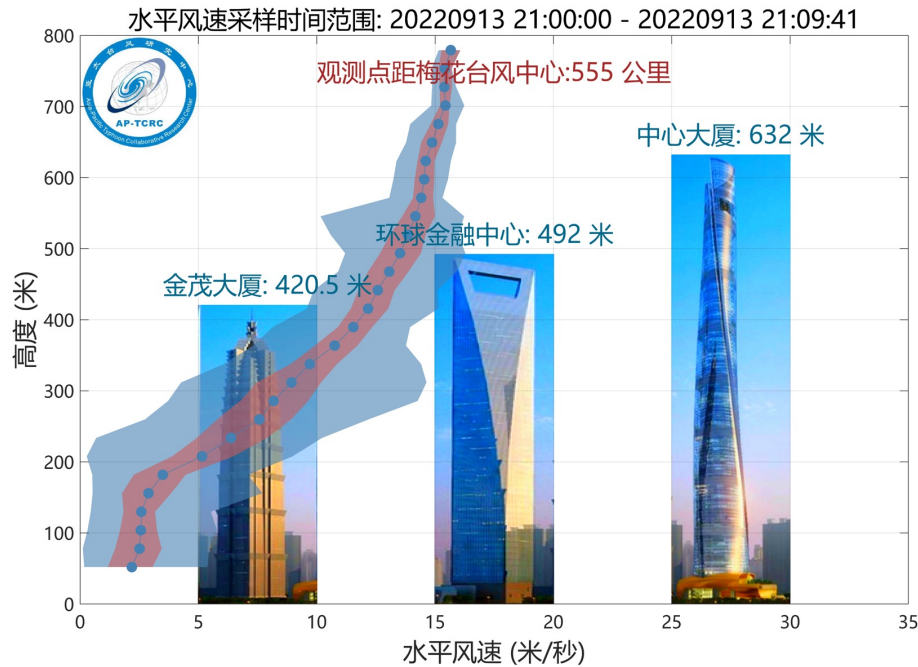


wind will increase with height monotonically at log rate



Typhoon Muifa(2212) Wind Observation in Downtown(Lujiazui) of Shanghai

Distance to typhoon center: 555KM



Distance to typhoon center: 262 KM

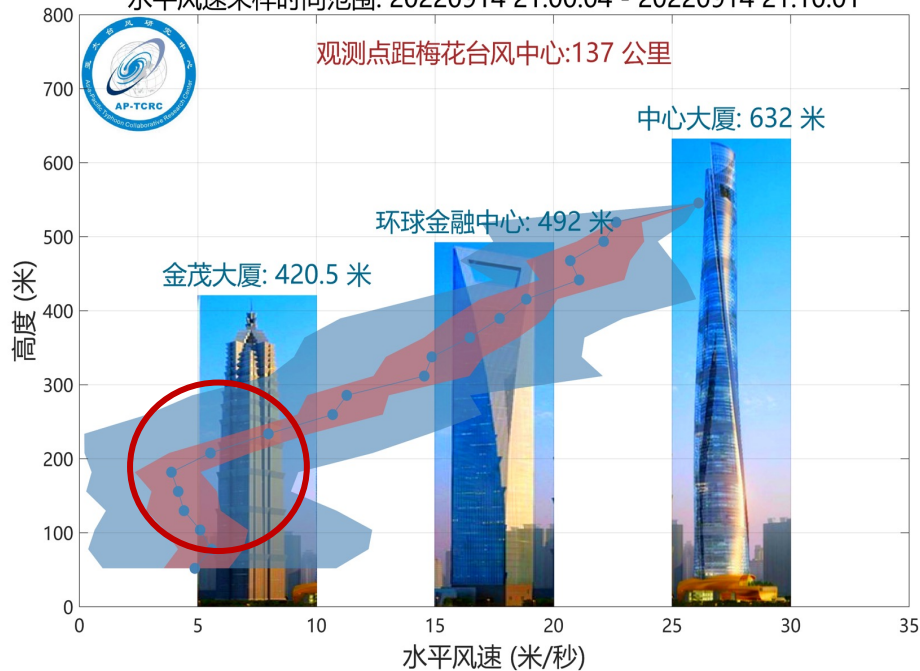




Typhoon Muifa(2212) Wind Observation in Downtown(Lujiazui) of Shanghai

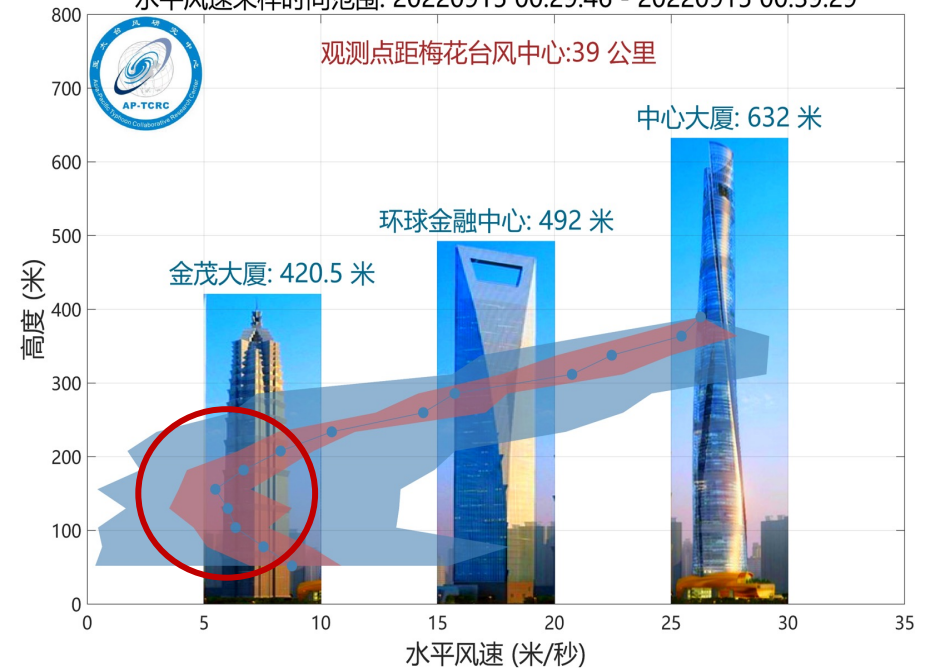
Distance to typhoon center: 137KM

水平风速采样时间范围: 20220914 21:00:04 - 20220914 21:10:01



Distance to typhoon center: 39KM

水平风速采样时间范围: 20220915 00:29:46 - 20220915 00:39:29



Possible danger height region between 100-200 meters



Typhoon Muifa(2212)Wind Observation in Downtown(Lujiazui) of Shanghai

Distance to typhoon center: 7KM



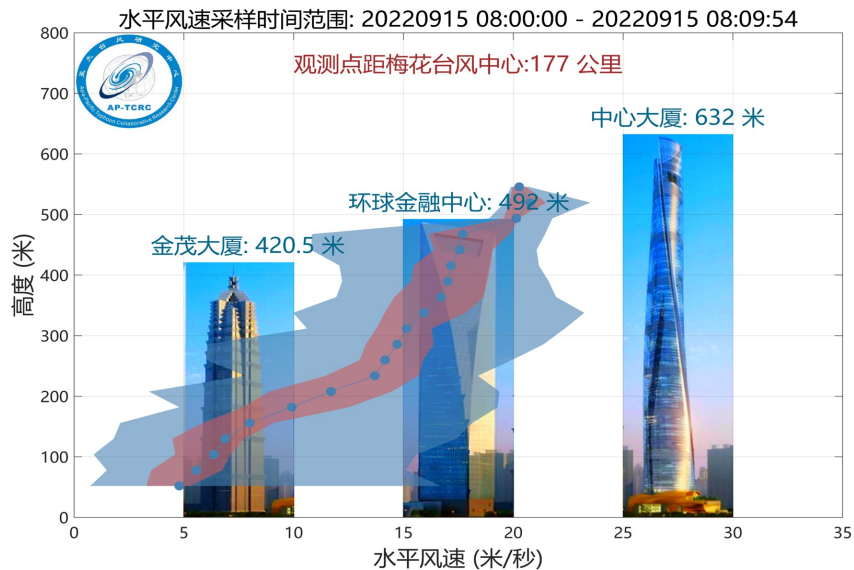
Distance to typhoon center: 115KM



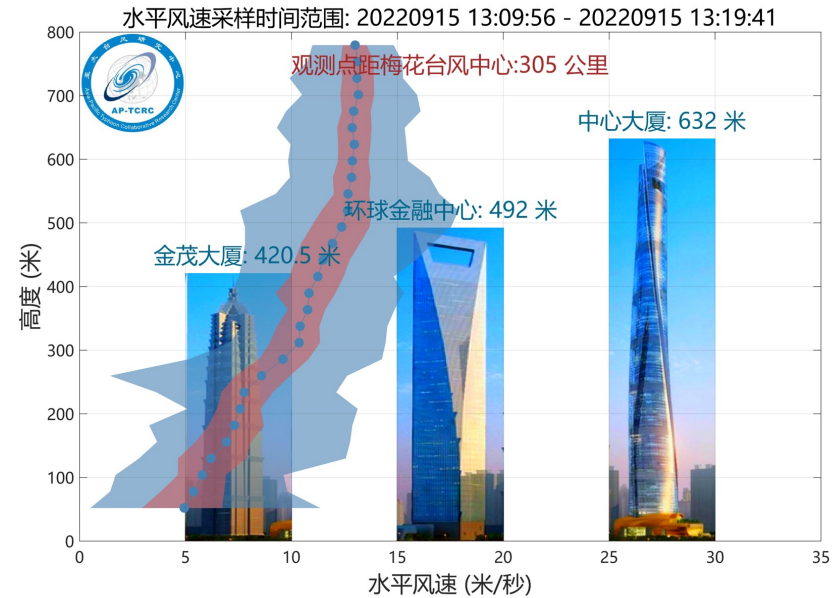


Typhoon Muifa(2212)Wind Observation in Downtown(Lujiazui) of Shanghai

Distance to typhoon center: 177 KM



Distance to typhoon center: 305 KM



TKE with height

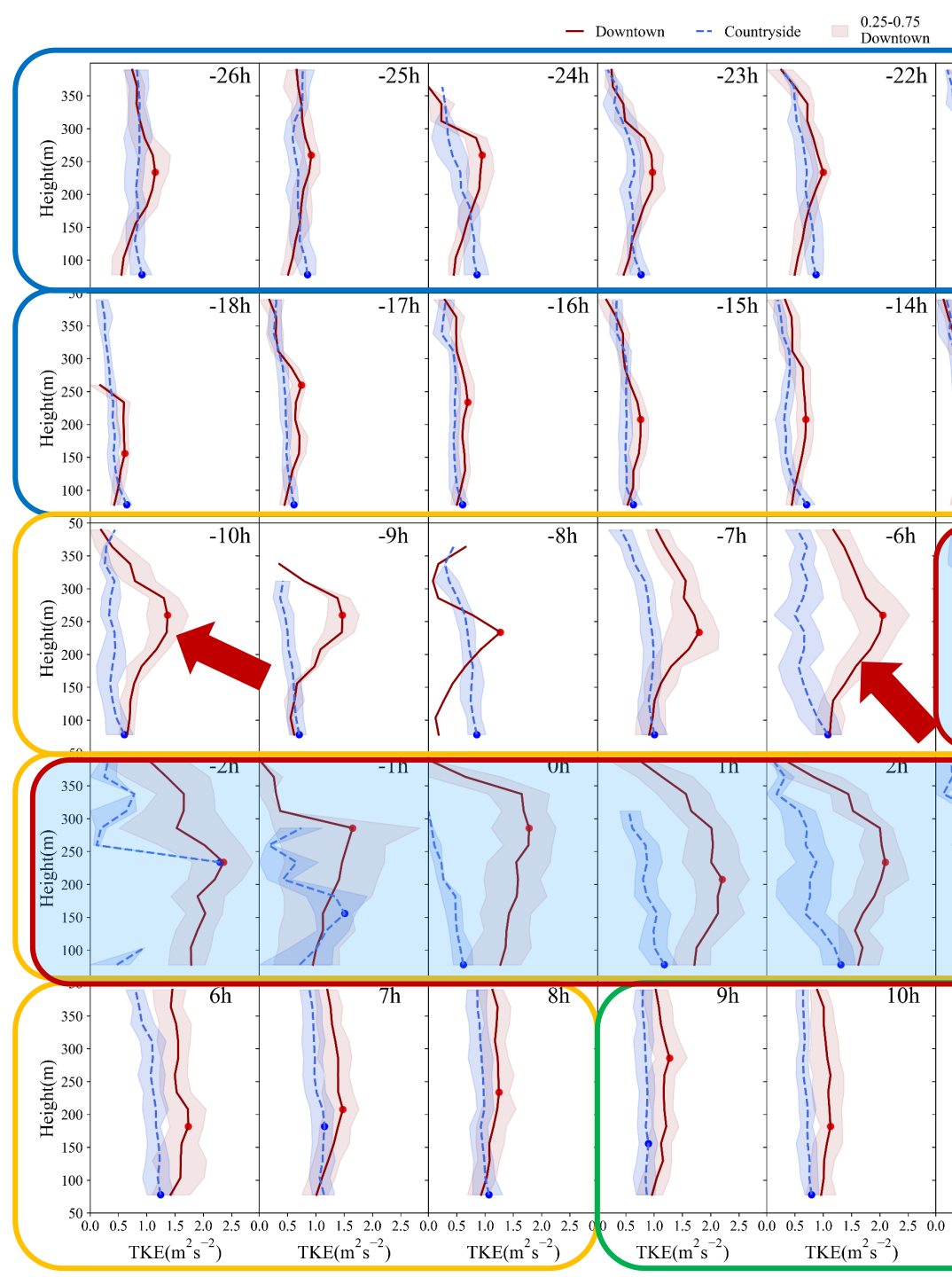
— Downtown

- - - Countryside

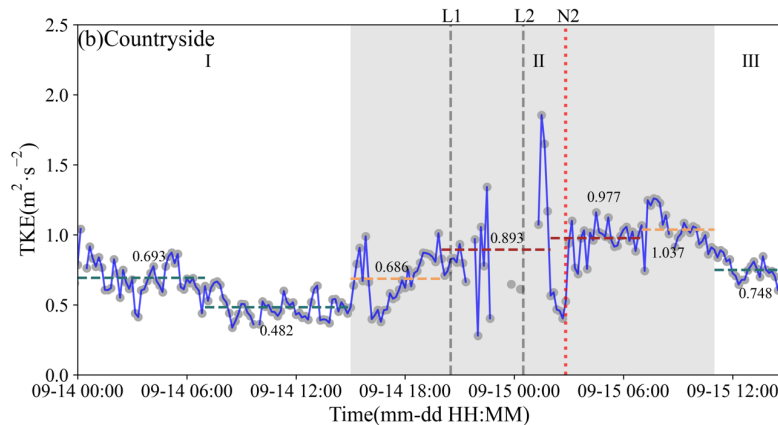
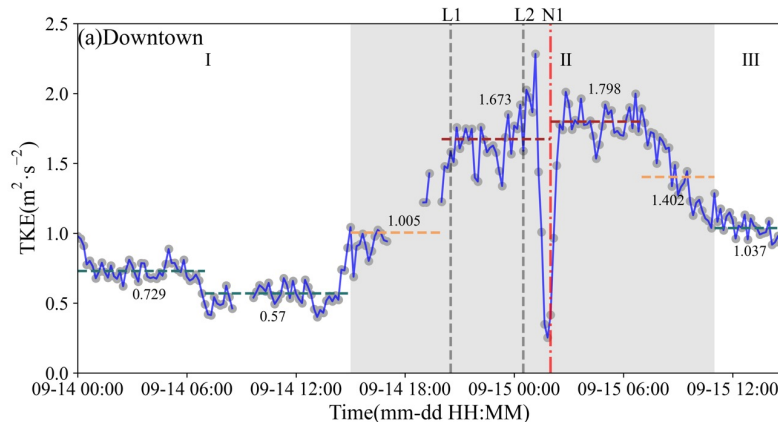
- different tendency
- TKE in Downtown will increase and then decreases with height
- TKE in Countryside will decrease with height.

- In the outregion(-26h to -12 h), Downtown and countryside are similar in TKE

- In the inner core region, TKE in downtown increased more remarkably.
- The maximum differences lay in the 150-300 meters which may imply potential dangerous.



TKE With time



	I		II				III
Time	1(-26h ~20h)	2(-19h ~12h)	3(-11h ~7h)	4(-6h ~1h)	5(0h ~4h)	6(5h ~8h)	7(9h ~12h)
Downtown	0.729	0.57	1.005	1.673	1.76	1.402	1.037
Countryside	0.693	0.482	0.686	0.893	0.977	1.037	0.748
Difference	0.036	0.09	0.32	0.78	0.78	0.37	0.29
Ratio	1.143	1.18	1.47	1.87	1.8	1.35	1.39

- In outer region, TKE in Downtown is about 1.1 to 1.4 TKE in the Countryside
- In the inner core region, TKE in Downtown is about 1.8 TKE in Countryside

In the downtown region, TKE in the inner core region increased too much than that in the countryside.



Summary

- ❑ Lidar can be used in the typhoon boundary layer observation even in severe precipitation and gale wind environment .
- ❑ In the inner core region of typhoon circulation, there is a **dangerous-potential wind region** in the Shanghai downtown.
- ❑ Shyscripers and high buildings in the megacity would induce the low-level local gale wind and more turbulences were generated by these buildings.
- ❑ More lidar-based typhoon-wind experiment in urban and port environment are highly encouraged! The low-level (100-300 meters) of urban boundary layer has highly concerned !



EXOTICCA II in 2024-2025

- **more scientific experiment in different scene structure and influences in urban environment (City) and air-sea interaction under typhoon environment (offshore)**
- **Experiment Dataset under support of AP-TCRC**
more open , more scientists will be invited to join EXOTICCA-II
e.g. Lidar observation, Satellite observation...
- **Improvement Forecast skills based Experiment data together**
Target observation related with CNOP ..



EXOTICCA-II Plans in 2024-2025

- An aircraft Kingair350 has been finished in upgrade and installation with SFMR,KPR and GVR ,AIMMS-30
- Supplemental type certificate of the aircraft has been granted by Air traffic controllers and ready to fly into typhoon in this year
- The aircraft has stand by in Hainan
- Kingair-350 ,Yilong-10 of CMA,together with HKO three aircrafts in EXOTICCA-II



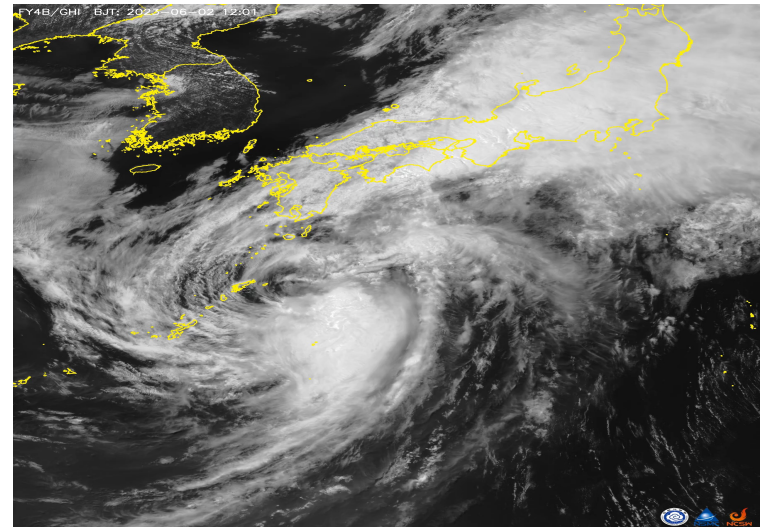
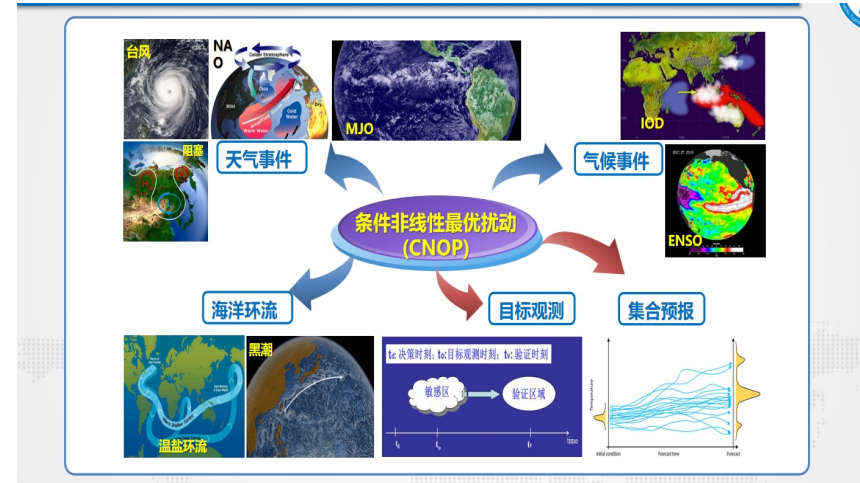
YiLong-10 UAV: Sanya region
HKO aircraft: Hongkong region
Kingair-350: Sanya-Hongkong region





EXOTICCA-II Plans in 2024-2025

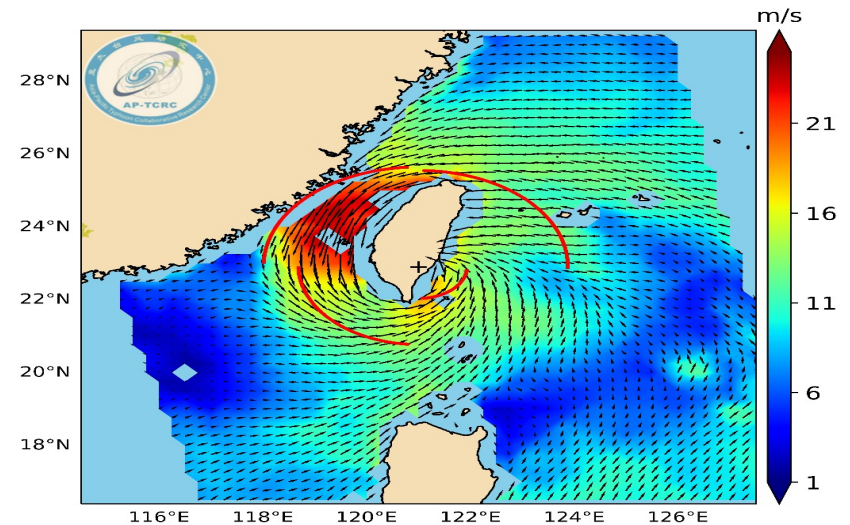
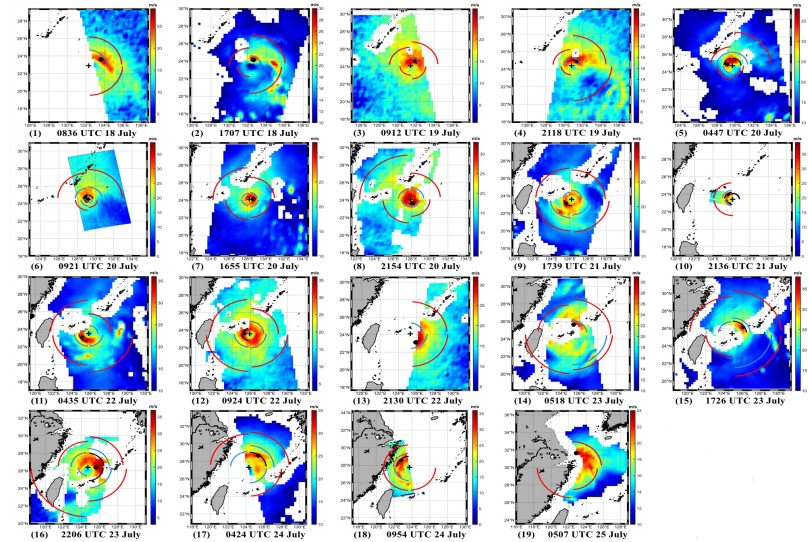
- **CNOP(Conditional nonlinear optimal perturbations) target observation: Decide where and when and how to excute field campaign**
- **Invite Satellite special observation support from NSMC/CMA in EXOTICCA in ultra-high resolution**
- **NWP Typhoon Structure Watching by orbit-satellites**





EXOTICCA-II Plans in 2024

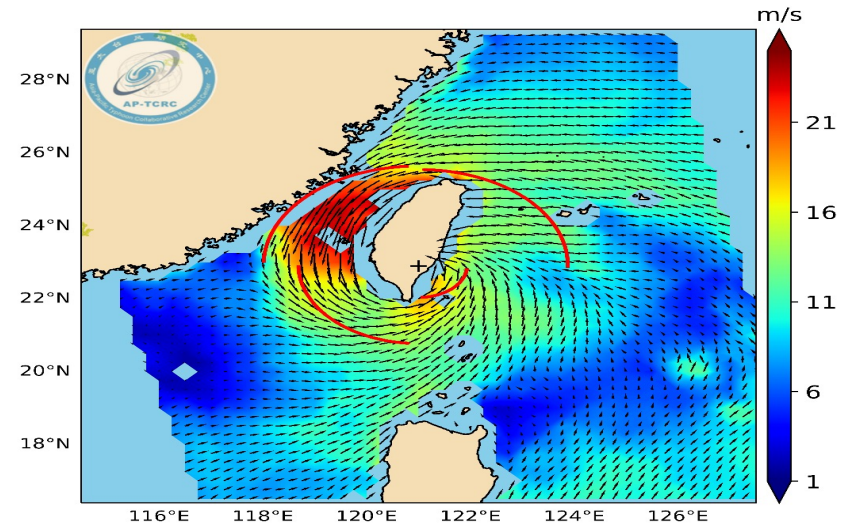
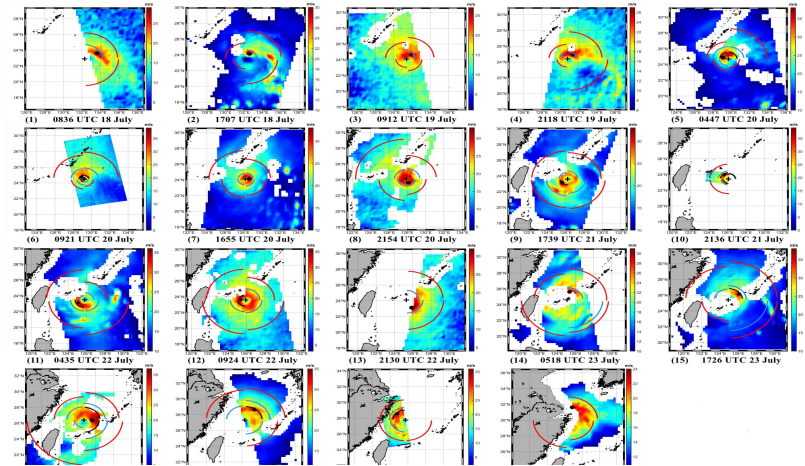
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EXOTICCA-II Plans in 2024

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- **NWP Typhoon Structure Watching by orbit-satellites**



the images and data will be opened in ap-tcrc website

Thank You!

more information ,please visit
<https://ap-tcrc.org>



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Asia-Pacific Typhoon Collaborative Research Center

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Establishment of the First International Scientific Steering Committee of the Asia-Pacific Typhoon Collaborative Research Center (AP-TCRC)

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About Us



Introduction

The Asia-Pacific Typhoon Collaborative Research Center (AP-TCRC) is a newly established international joint typhoon research unit, located in the Lingang Special Area of Shanghai, China. It is supported by the ESCAP/WMO Typhoon Committee (the Committee) and hosted by the

Shanghai Municipal Government of China and the China Meteorological Administration. The AP-TCRC aims to strengthen scientific and technical cooperation with the Committee and other related international organizations. It provides a sustainable platform for conducting collaborative research on advanced sciences and key techniques in typhoon monitoring, typhoon forecasting and modelling, and typhoon associated disaster prevention and mitigation.

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Members

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News

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A blue-tinted background image of the Shanghai skyline, featuring the Oriental Pearl Tower and other skyscrapers along the Huangpu River.

Thank You!

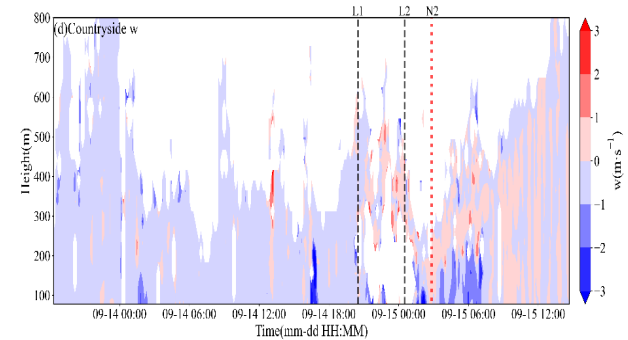
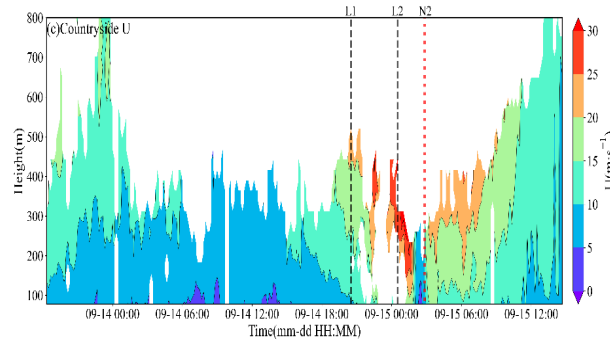
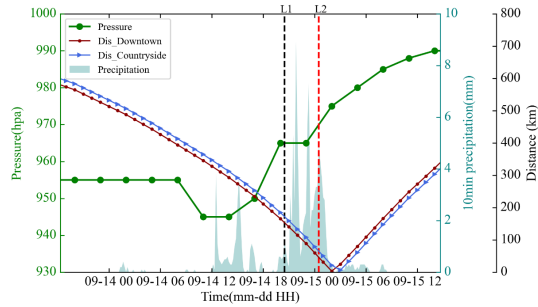
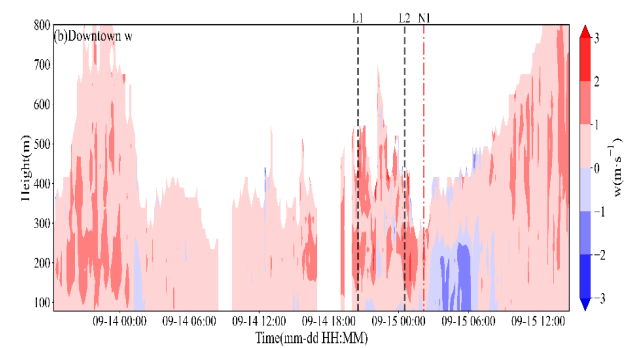
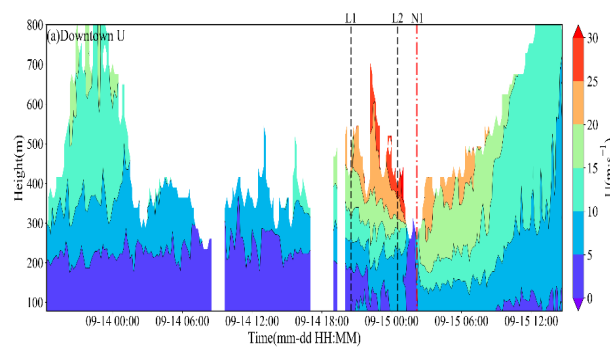
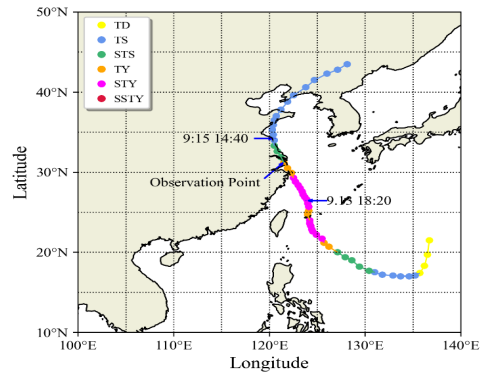
Jie TANG

Shanghai Typhoon Institute, China Meteorological Administration

E-mail: tangj@typhoon.org.cn



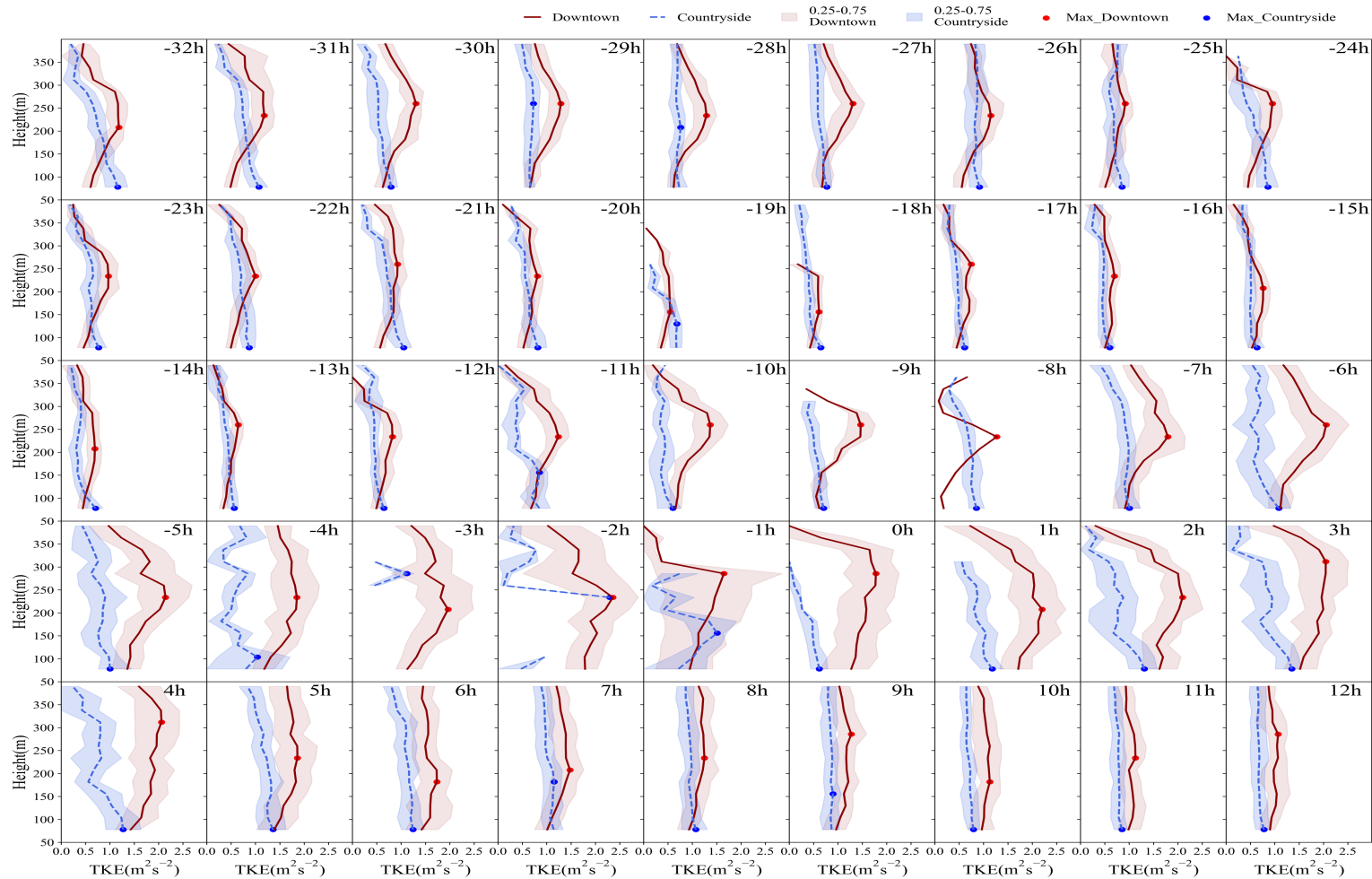
Typhoon Muifa(2212) Wind Observation in Downtown (Lujiazui) of Shanghai



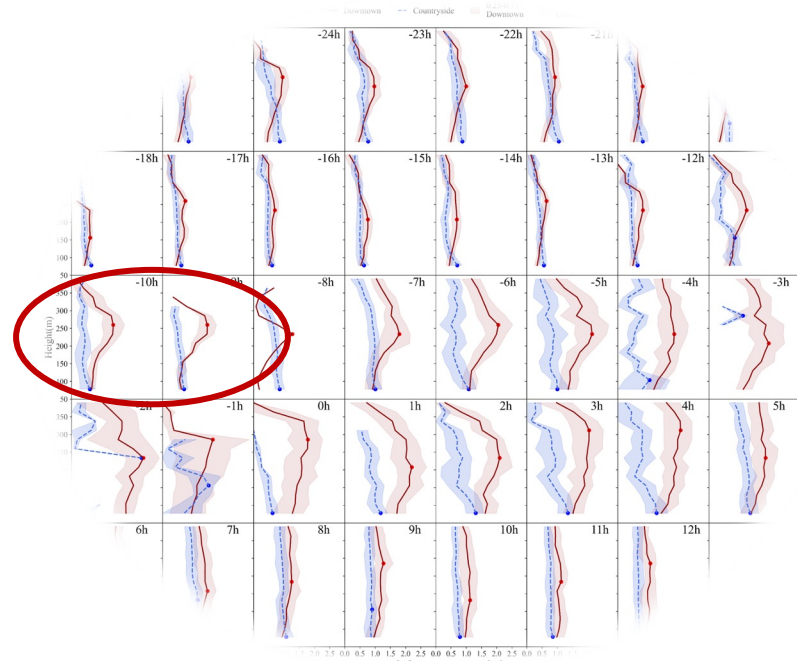
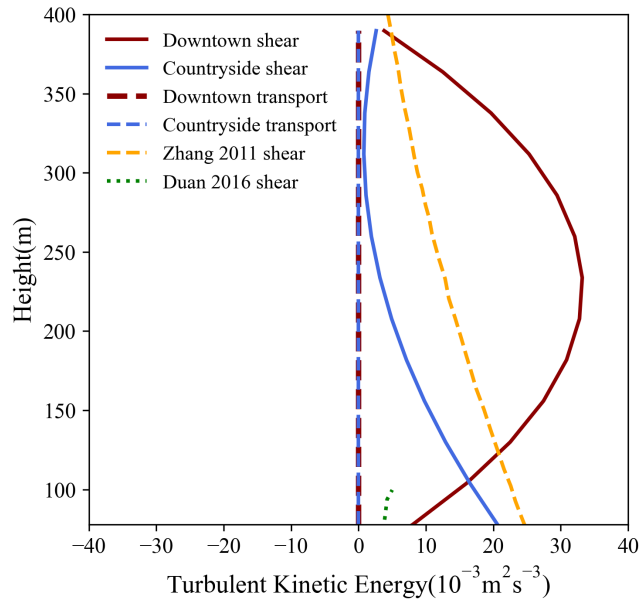


Typhoon Muifa(2212)

TKE Observation in Downtown and countryside of Shanghai



TKE shear and transportation



- 二者切变项的变化趋势相差较大。传输项一致。
- Countryside的切变项随着高先减小后增大，其值的大小居于Zhang 2009 and Duan 2016之间，在250米以下和zhang2009的趋势一致。
- Downtown的切变项随着高度的增高先增大后减小，和台风本体区域的TKE廓线变化一致(Fig.5)。
- 推断Downtown的TKE在250米附近出现凸起的现象是风切变导致的。