Yale-NUIST Center on Atmospheric Environment

Sensitivity of WRF model to landuse ,with application to Taihu Lake and surrounding areas thermal environment

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Outline

- Introduction
- Model and Data
- Results and Discussions
- Next work

Introduction

- CLM4-LISSS lake model has good performance on simulation of surface temperature, sensible heat and latent heat(Deng ,2013) .However,CLM4-LISSS is an offline model .

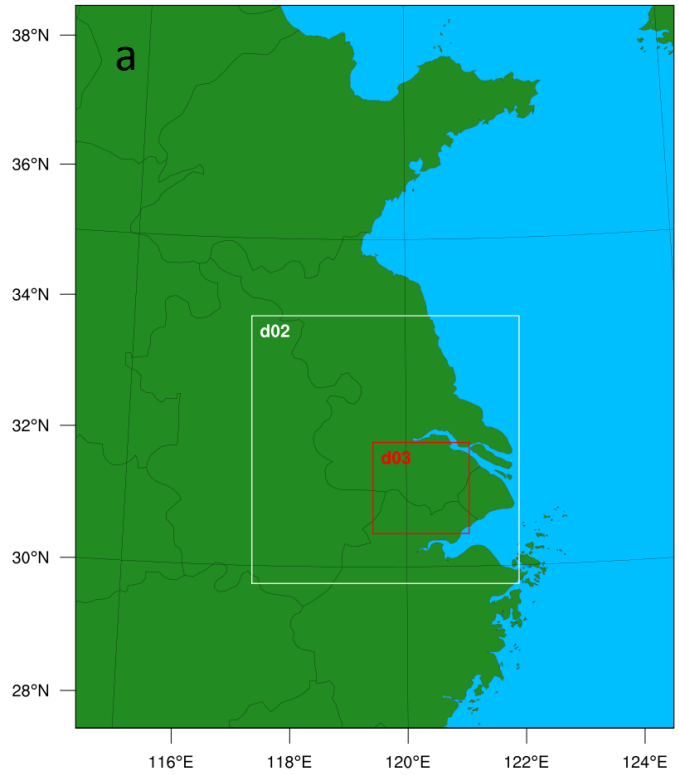
- It is a common approach that analyze lake's impact to local areas' thermal environment using Terrain sensitivity experiment(Yang et al.,2013), however the simulation time domain is one day, which may lack of representative.

Introduction

- We pick up a whole month in Summer to simulate the surrounding areas of Lake Taihu and evaluate suitability of meteorological element simulation by CLM4-LISSS model coupled with WRF which also compared with CLM4.0 and Noah.

- Using Terrain sensitivity experiment to analyze the Lake Taihu's impact to surrounding areas' thermal environment (such as temperature, boundary layer height)

Model and Data



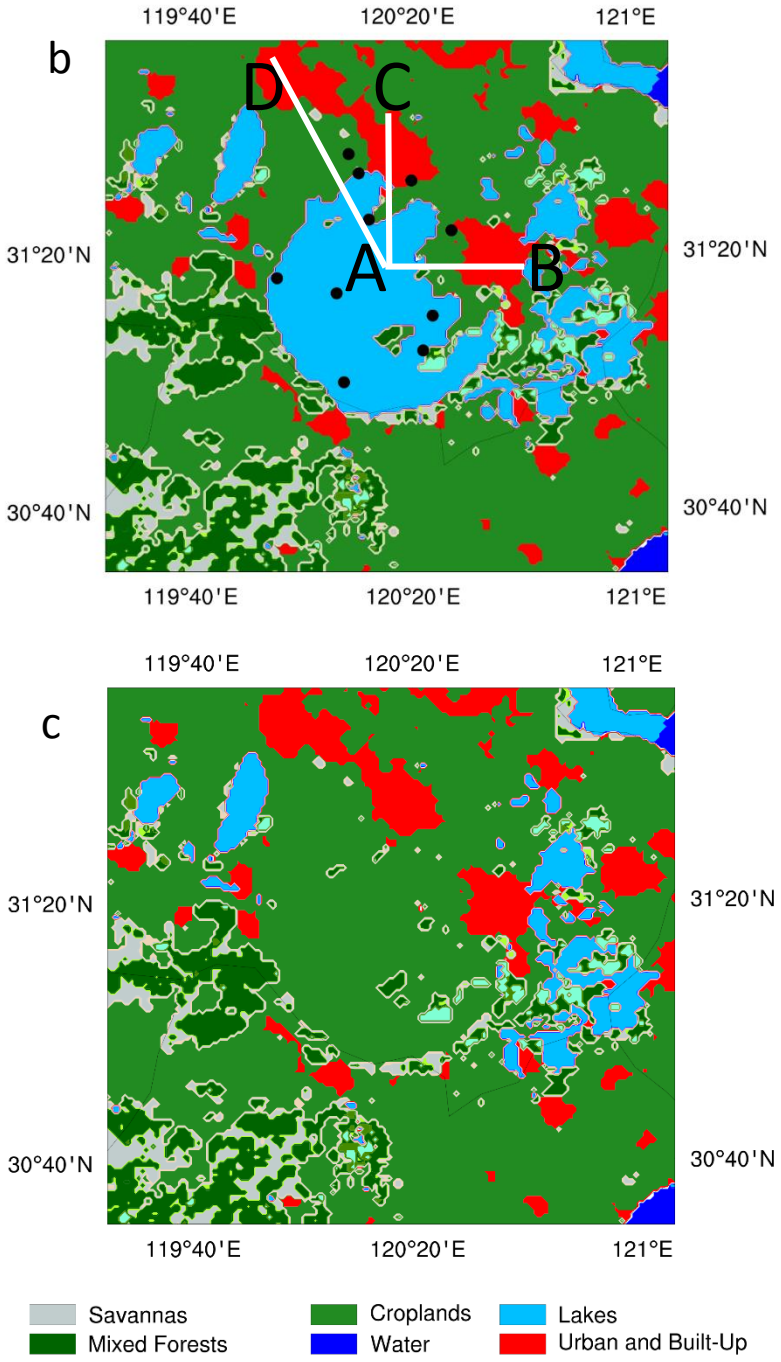


Fig.1 The WRF model domain a. the three nested meshes with horizontal resolution of 9,3,1km; b. the land-use categories over the innermost domain(The line AB,AC,AD denote the location of vertical cross-section in Fig. 8 and the black dots denote the observation stations); c. the land-use categories over the innermost domain without Lake Taihu.

Model and Data

Table. 1 Parameter settings

	1	2	3
Time	Aug 1st,2015 to Aug 31th, 2015		
Initial meteorological field	Fnl(1° ×1°)		
Center	33.0° N, 119.4° E		
Vertical stratification	53 levels		
Horizontal grid point	$113 \times 136, 151 \times 151, 163 \times 154,$		
Horizontal resolution	9km、3km、1km		
sf_surface_physics	Noah	CLM4	CLM4-LISSS(wrf_lake)
bl_pbl_physics	Bougeault and Lacarrere (BouLac) PBL		
sf_urban_physics	Multi-layer, Building Environment Parameterization (BEP) scheme		

Results and discussions

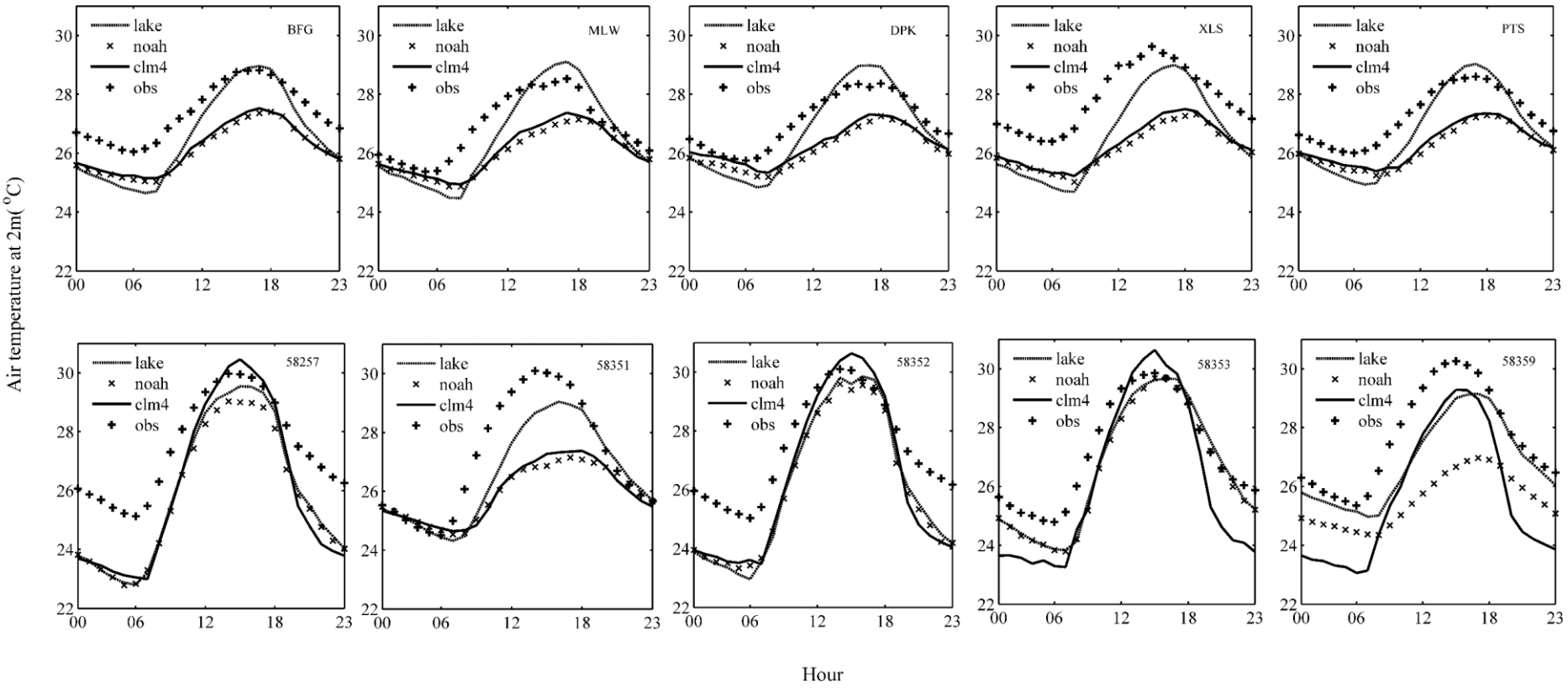


Fig.2 Comparison of simulated (wrflake : dotted line; Noah: ×, CLM4: solid lines) 2m temperature(units:℃) with the observed results(+) at Lake Taihu area(Fig.1b)

Results and discussions

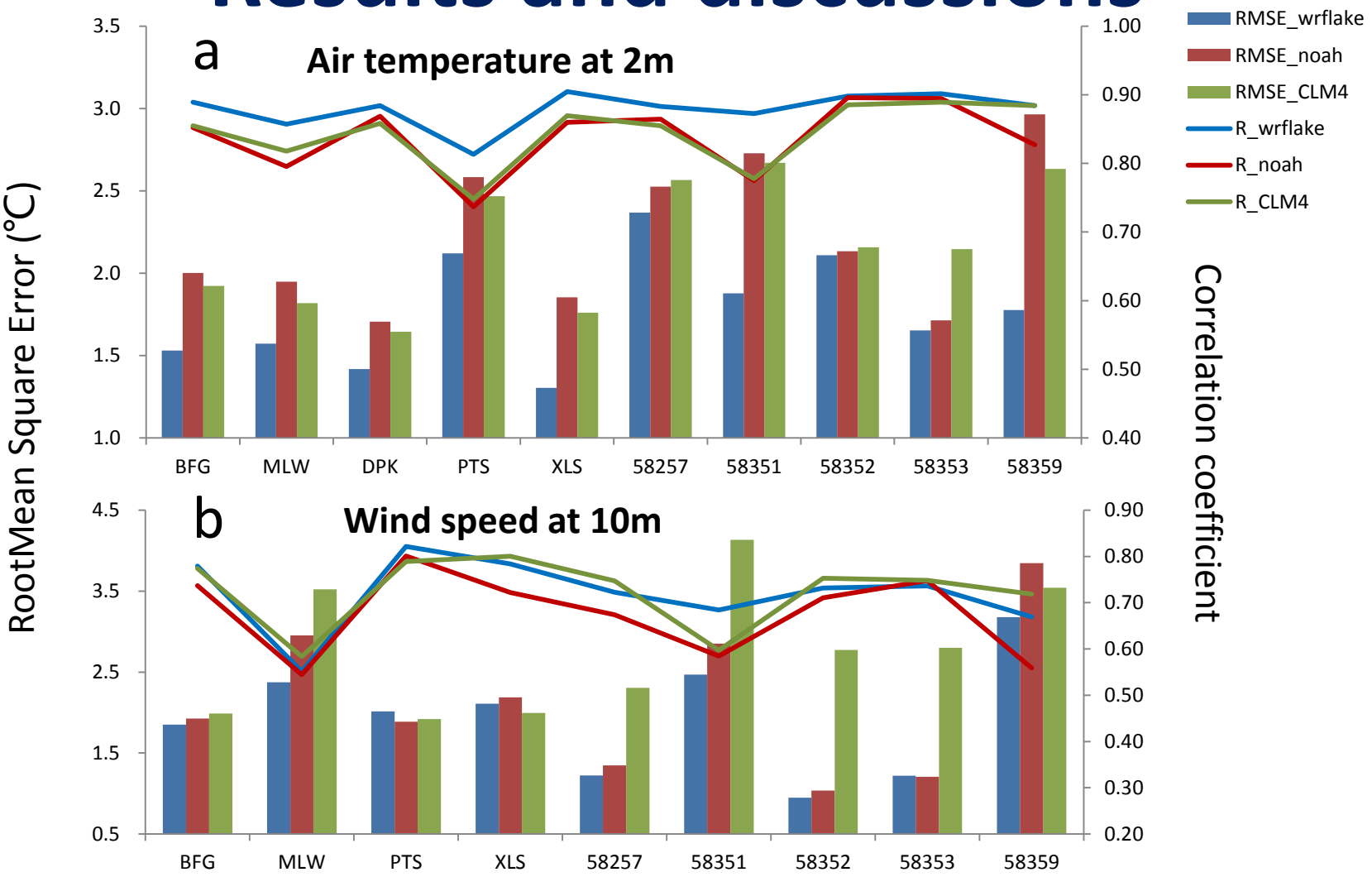


Fig.3 Root mean square(Histogram) and correlation coefficient(solid lines) of the simulated 2m temperature(a) and 10m wind speed (b)with three surface physics schemes(wrf_lake:blue; Noah :red; CLM4: green)

Results and discussions

Case1: Referring to the test （CTL）which using MODIS_LAKE land-use categories（fig.1b）.

Case2: Terrain sensitivity experiment without Lake Taihu（NTL)(fig.1c).

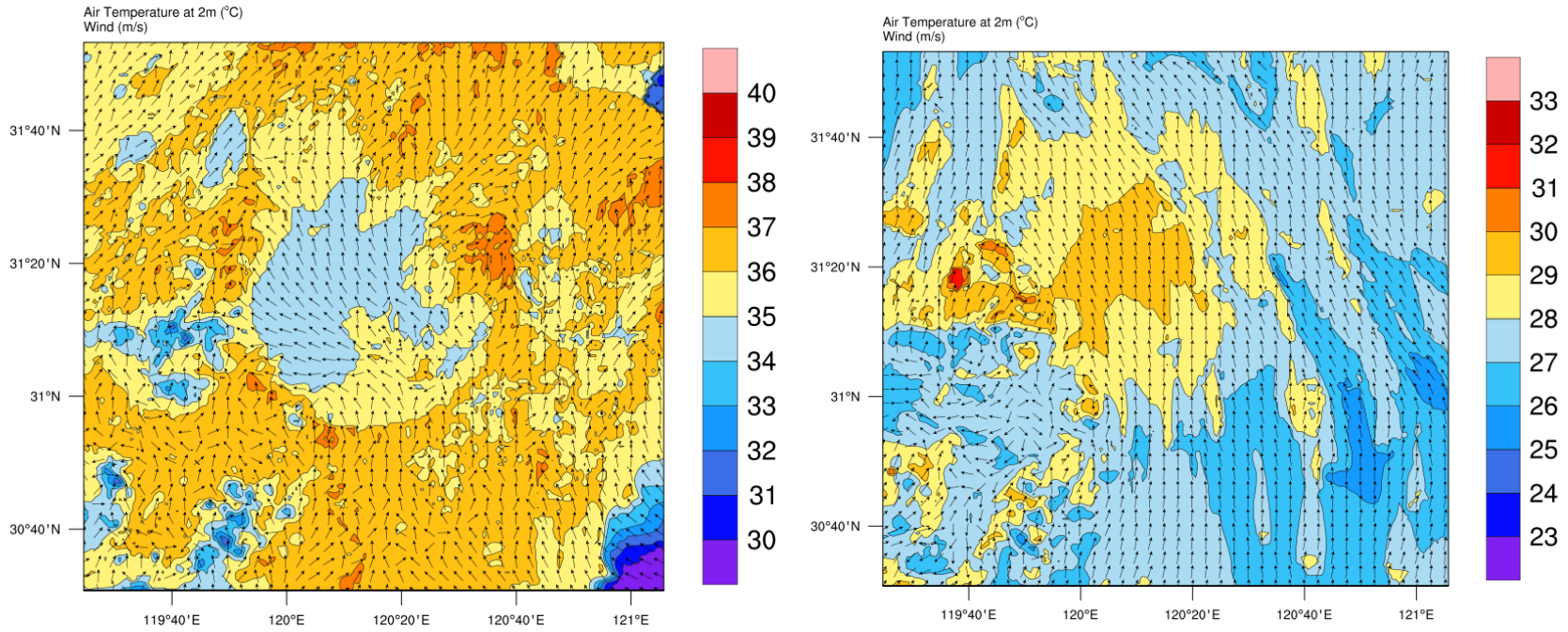


Fig.4 One month averaged 2m temperature (shadows ;units: ℃) and 10m wind speed fields (arrows;m·s^{-1}) from CTL experiments at 15:00 BJT and 06:00 BJT

Results and discussions

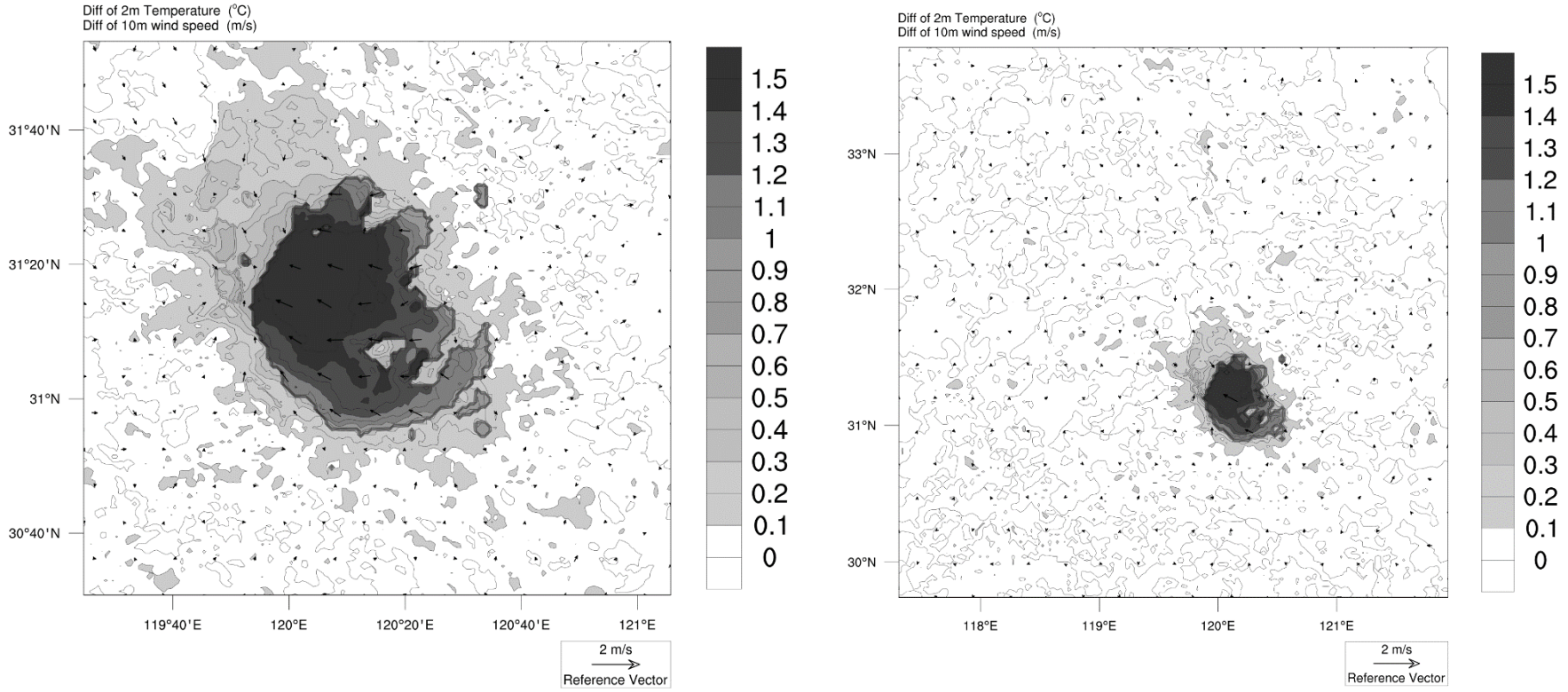


Fig. 5 Differences in averaged 2m temperature(shadows ;units: ℃) and 10m wind field (arrows;$m \cdot s^{-1}$) between CTL and NTL experiments at 06:00 (BJT)

Results and discussions

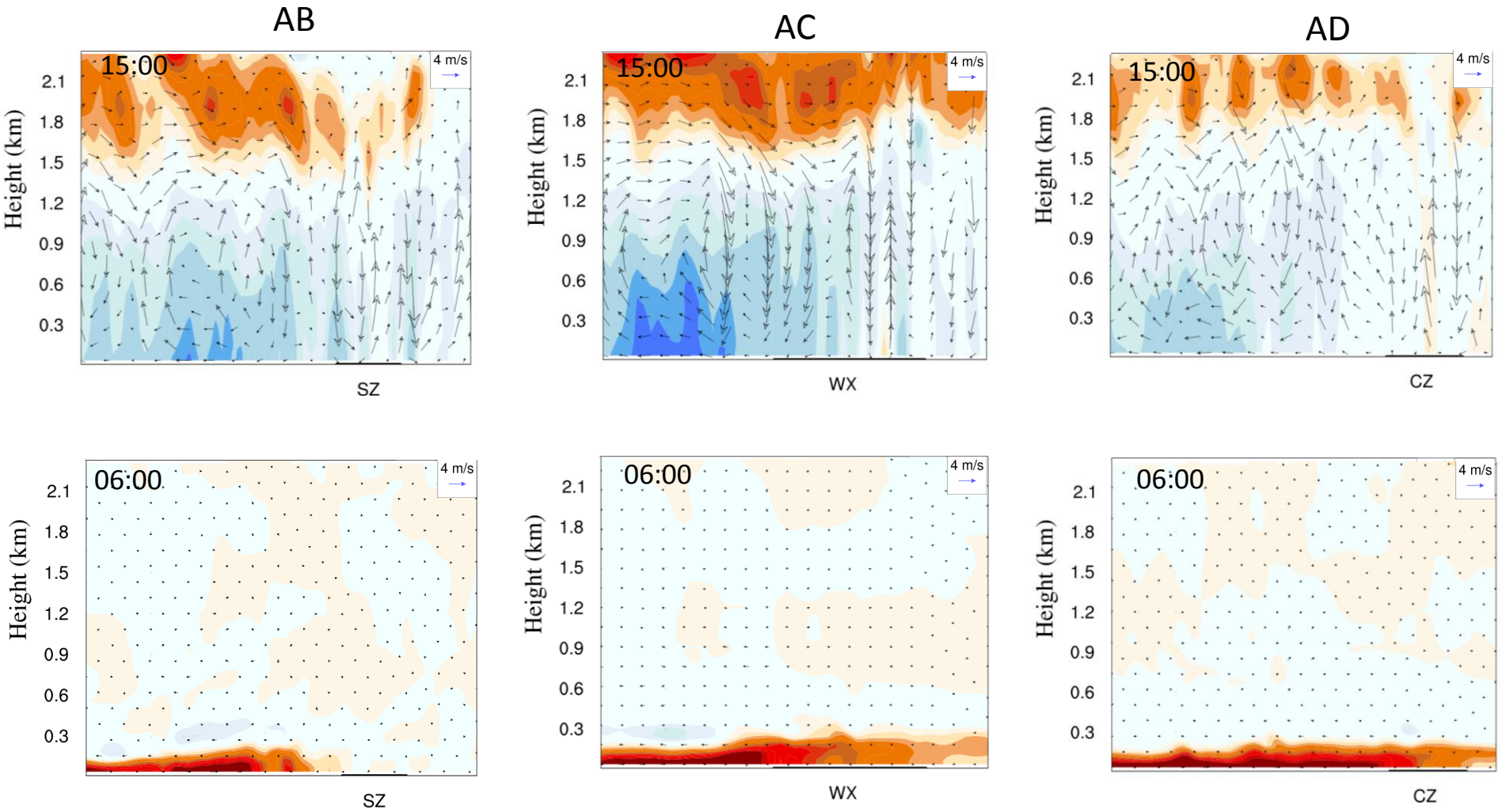


Fig. 6 Vertical cross-sections of differences in averaged temperature(color shadows; units: ℃) and in-plane flow vectors(arrows;units:m·s^{-1}) between CTL and NTL experiments alone line AB(Lake Taihu-Suzhou),AC(Lake Taihu-Wuxi);AD(Lake Taihu-Changzhou) at 06:00 BJT and 15:00 BJT

Primary Conclusions

- During the daytime ,a strong lake breeze between Lake Taihu and land has great impacts on the temperature of the nearby cities. Air temperature over Suzhou, Wuxi and Changzhou is significantly decreased by the cold air from Lake Taihu.
- During the nighttime, near surface temperature over Wuxi and Changzhou is significantly increased by the warm air from Lake Taihu.
- The planetary boundary layer height over Wuxi is more significantly decreased by lake breeze during daytime

Next work

- Pick up one day with typical synoptic condition and find the reason for temperature anomaly at fig.7c.
- Continue simulating the effect of Lake Taihu on the thermal environment of nearby areas in January, April and November
- Combined with CMAQ to analyze Pollutant dispersion and transport

Thank you