

# The Urban Theme in the MAIRS Program



Ailikun – IPO of MAIRS, Beijing, China

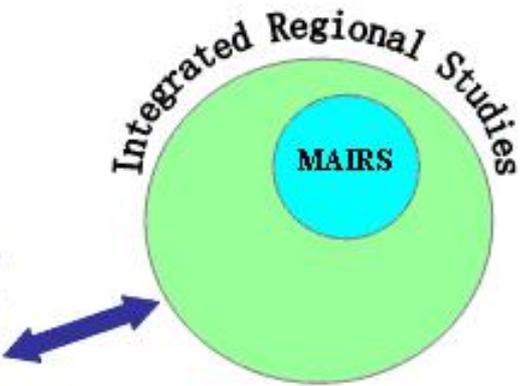
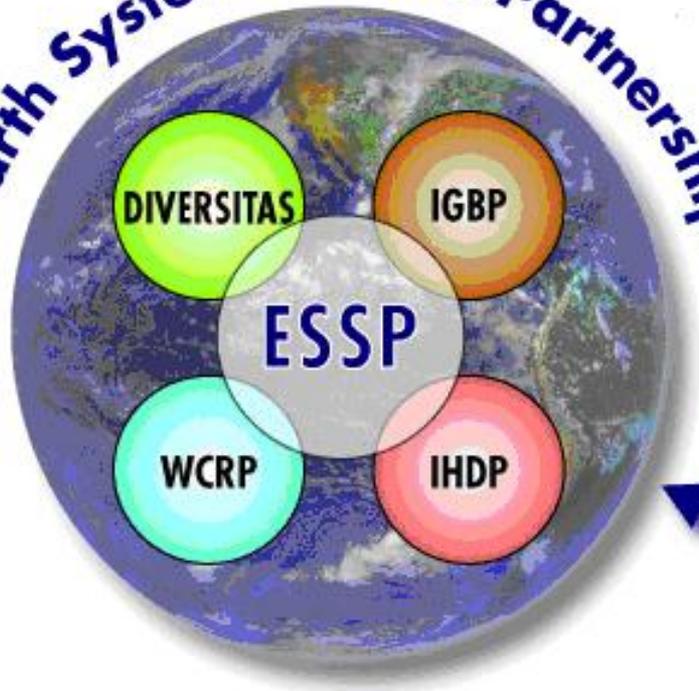
Jiaguo Qi – Michigan State University

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## OUTLINE:

- Brief Intro. MAIRS Program
- Urban Theme in the MAIRS
- Discussion

# Earth System Science Partnership



Initiated in 2005  
Funded by CAS  
Under ESSP



# MAIRS and Its Missions

## The Program

- MAIRS is an international research program, implemented by START, the START TEA-RC and Chinese donors under the ESSP, focusing on human monsoon system interactions.
- Geographic Region: Monsoon Asia.
- Established in 2005
- Funding: Chinese Academy of Sciences
- <http://mairs-essp.org>

## Missions

- To better understand how **human** activities in the region are interacting with and altering natural variability of atmospheric, terrestrial and marine components of the monsoon system;
- To contribute to the provision of a sound scientific basis for sustainable development of monsoon Asia;
- To develop a predictive capacity of estimating changes in global-regional linkages in the earth system and to project the future consequences of such changes.

# MAIRS and Its Approaches

- Address interdisciplinary science questions focusing on the *interactions* between environment and human systems
  - LCLUC
  - Socioeconomics
  - Climate and
  - Hydrology

- Four Zones:
  1. Coastal Zone
  2. Mountain Zone
  3. Semi arid Zone
  4. *Urban Zone*

# MAIRS Working Groups

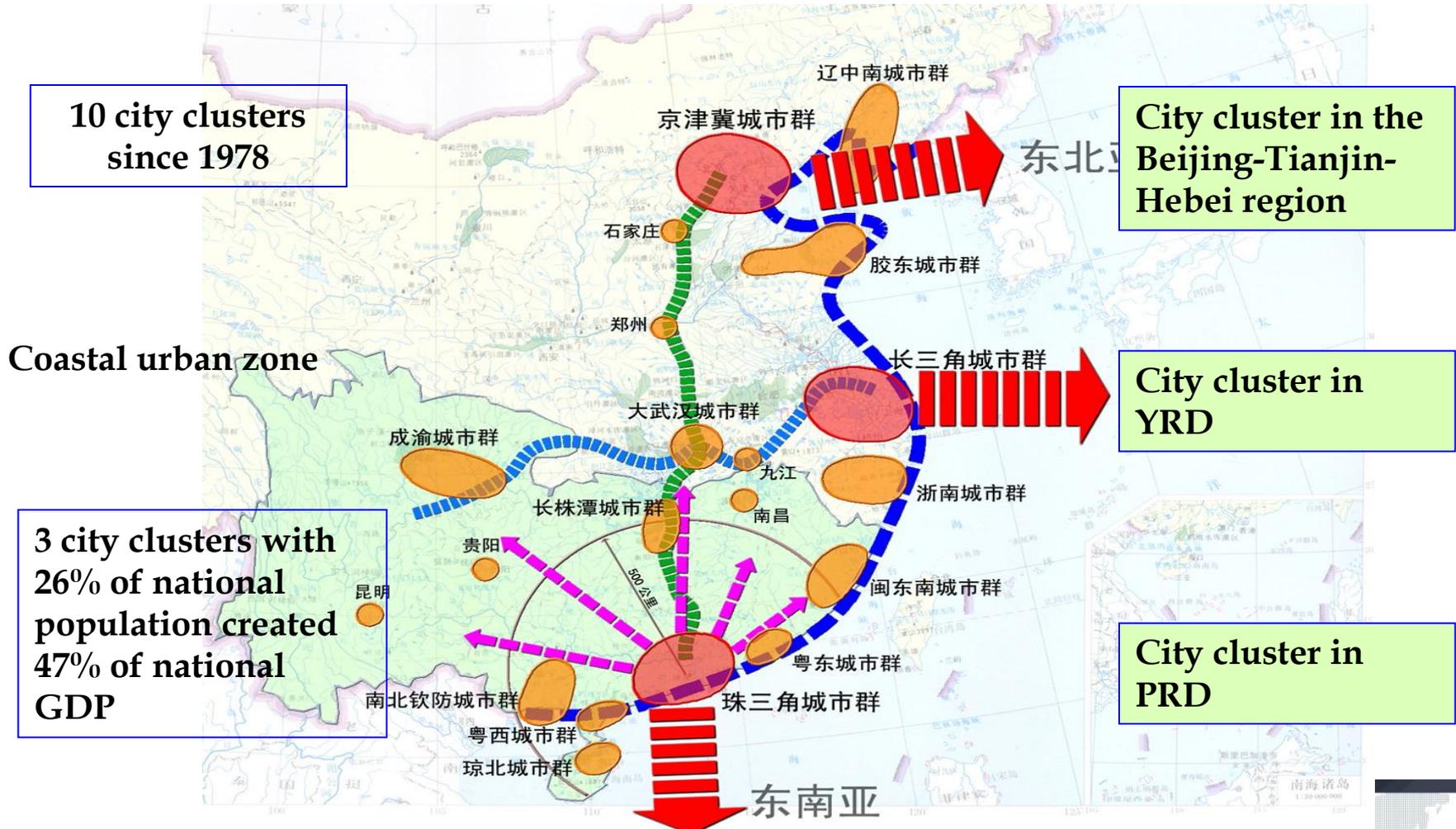
- *Megacity Study* (coastal & urban)
- Dryland Study (semiarid & arid)
- Mountain Study
- Regional Modeling and cross cutting

# Megacity Study Agenda

- ✚ Aerosol-climate interaction
- ✚ Urbanization, Land cover change and local/regional water cycle
- ✚ Risk assessment and disaster management (flood, drought, heat wave impacts etc.)

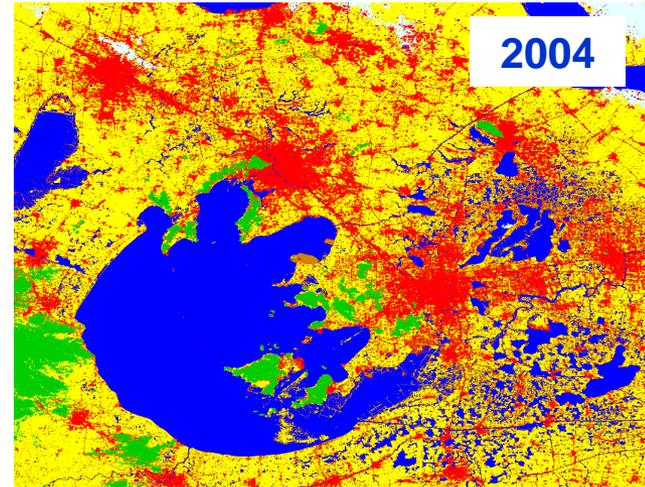
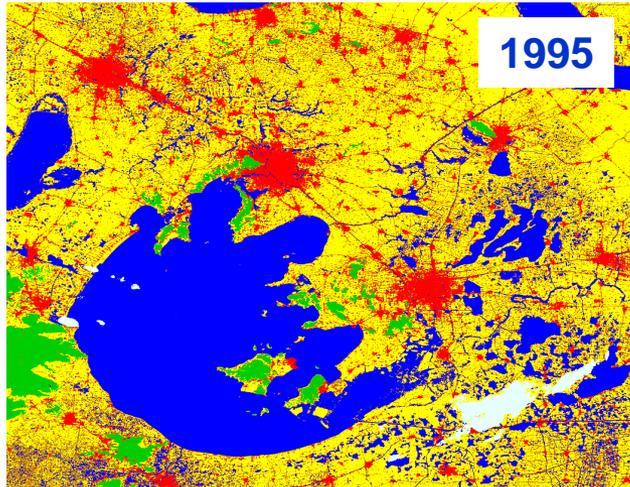
# Motivation

Rapid urbanization characterized by mega-city cluster is a driving force and a strategy of China's socio-economic development

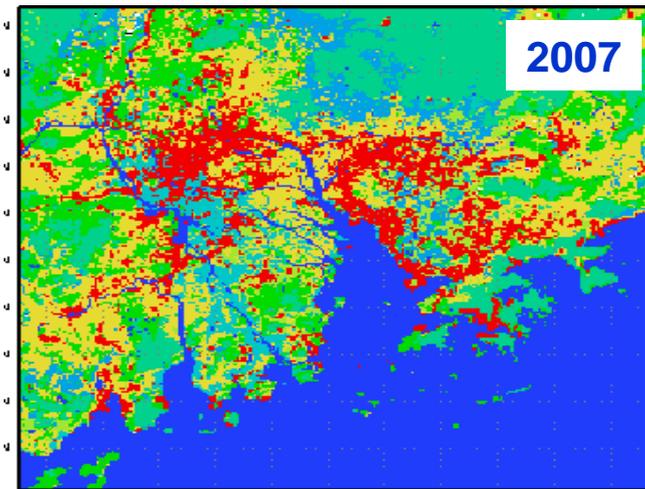
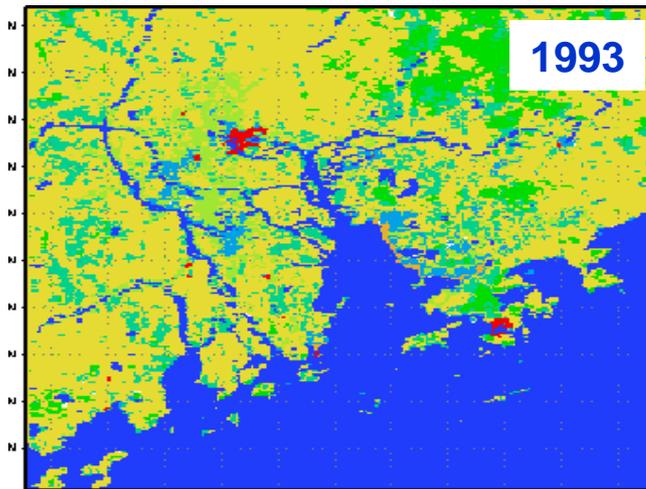


# Rapid Urbanization in China

Yangtze  
River Delta

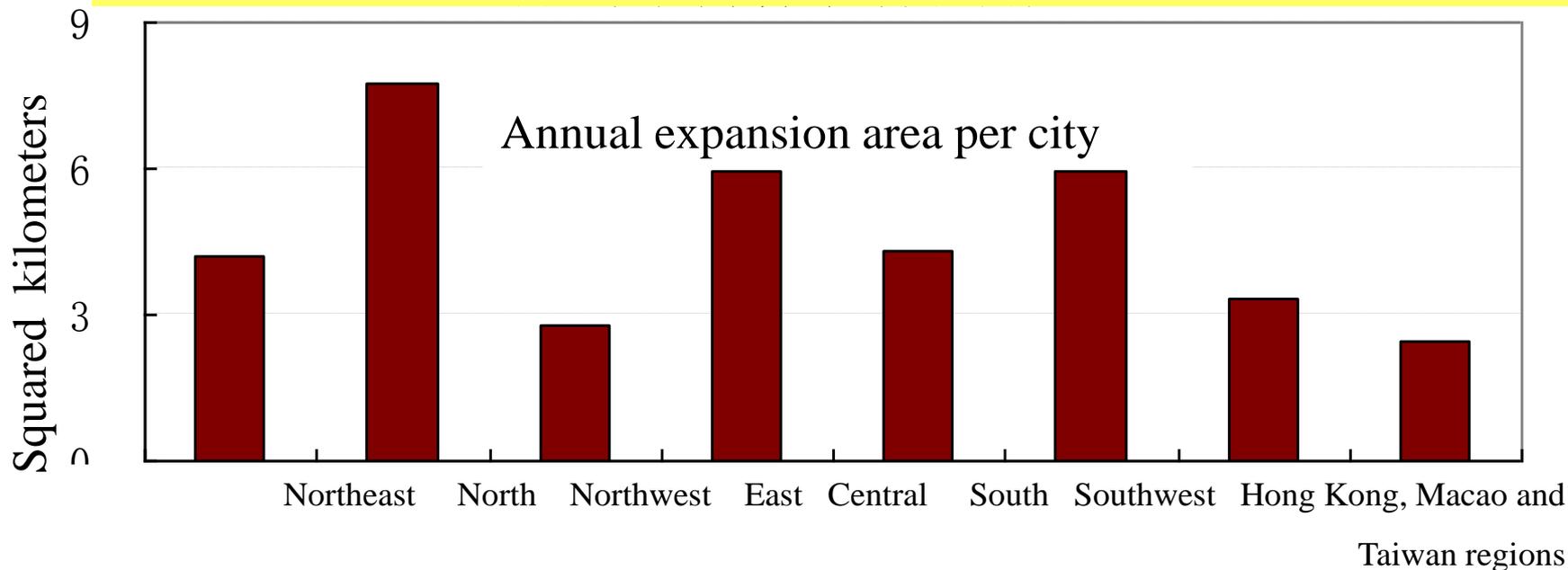


Pearl River  
Delta



Source: Xiu-Qun YANG, Nanjing University, China  
NASA LCLUC Annual Meeting, Rockville, MD, April 3-5, 2012

## Urban Annual Expansion Rate in Different Regions in China (~2008)



North China (Beijing-Tianjin), east central (Yangtze River Delta) and southwest (Pearl River Delta) were most rapid urbanized, by Wen 2011

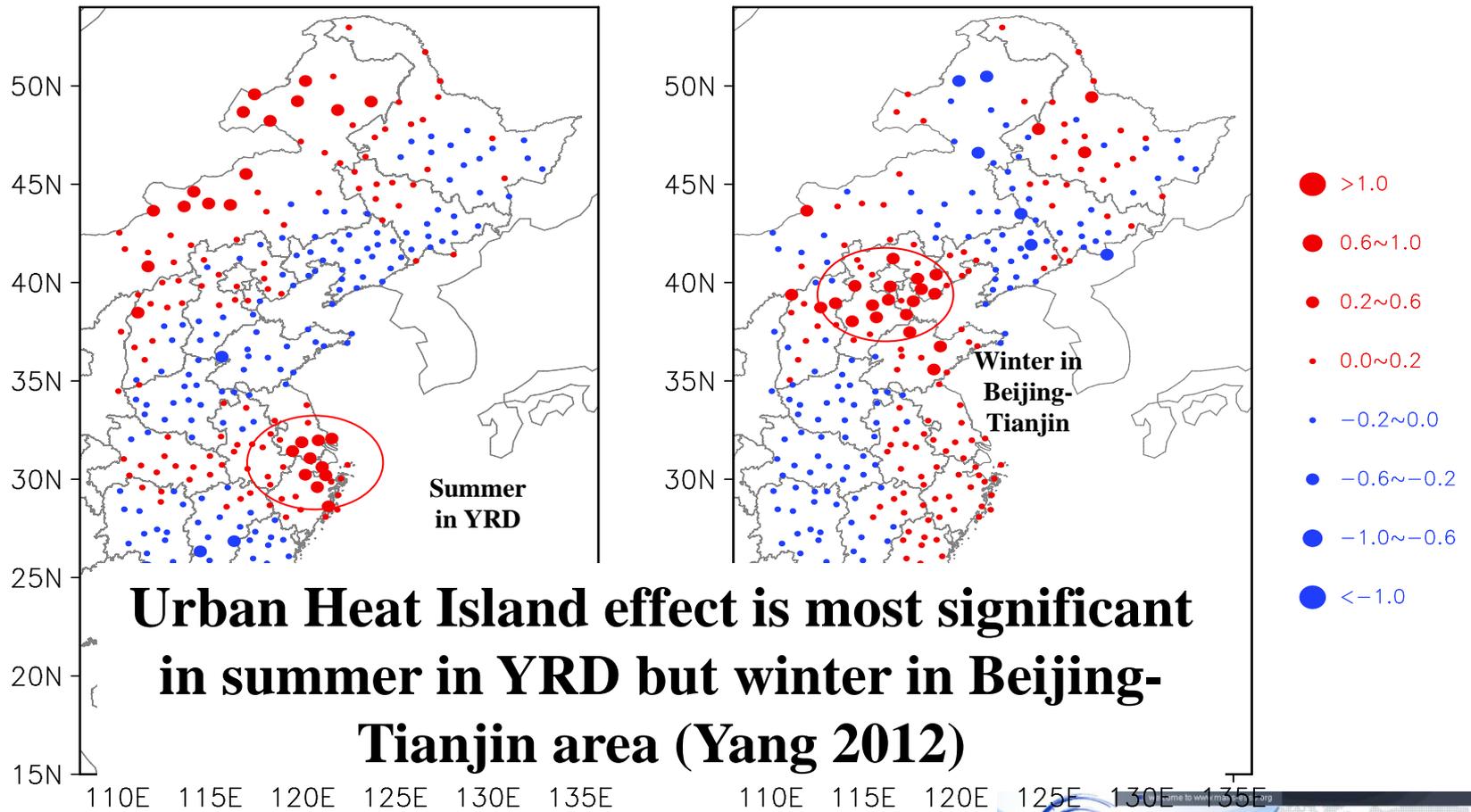
# Urbanization-caused SAT trend detected with **Spatial Anomaly** method

The **SA** at a station is defined as a departure from the regional average

over an  $8^{\circ} \times 8^{\circ}$  domain centered at the station

(1979-2008)

## Spatial Anomaly of Trend in east China



**Urban Heat Island effect is most significant  
in summer in YRD but winter in Beijing-  
Tianjin area (Yang 2012)**

110E 115E 120E 125E 130E 135E

110E 115E 120E 125E 130E 135E

JJA MEAN TEM

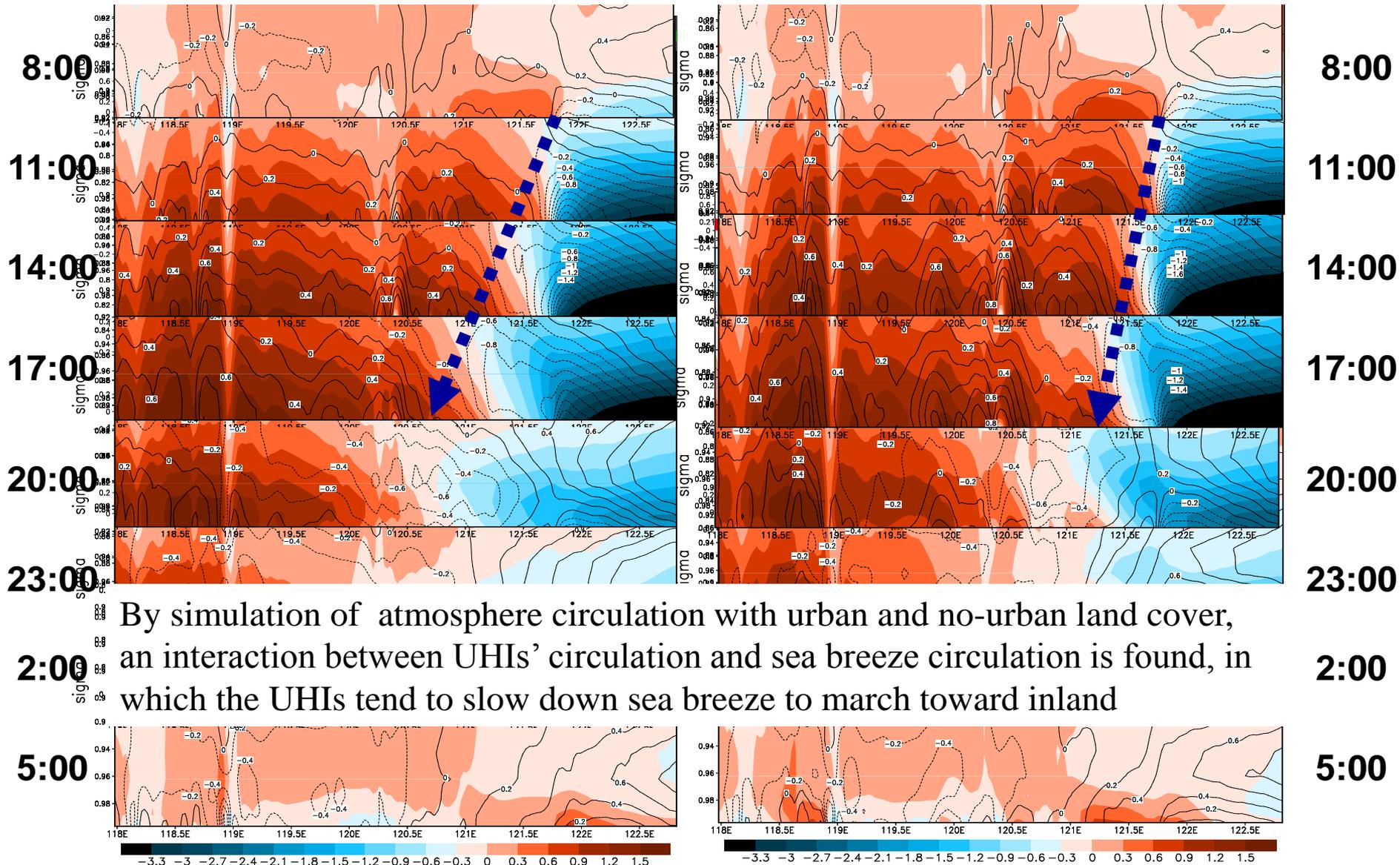
DJF MEAN TEM

# Interaction between UHI circulation & Sea Breeze

## (JJA, 2001-2004)

NoUrban

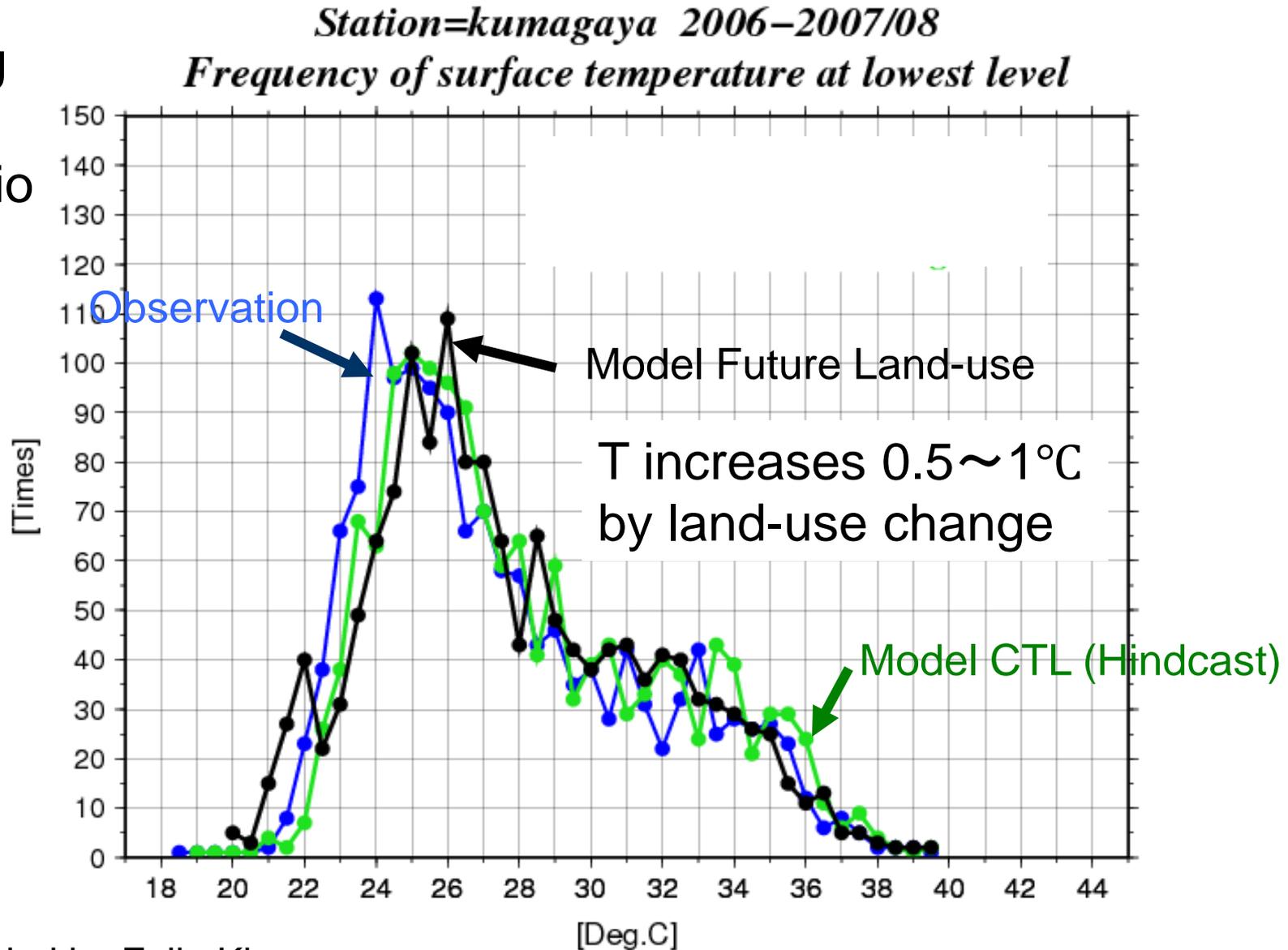
Urban



By simulation of atmosphere circulation with urban and no-urban land cover, an interaction between UHIs' circulation and sea breeze circulation is found, in which the UHIs tend to slow down sea breeze to march toward inland

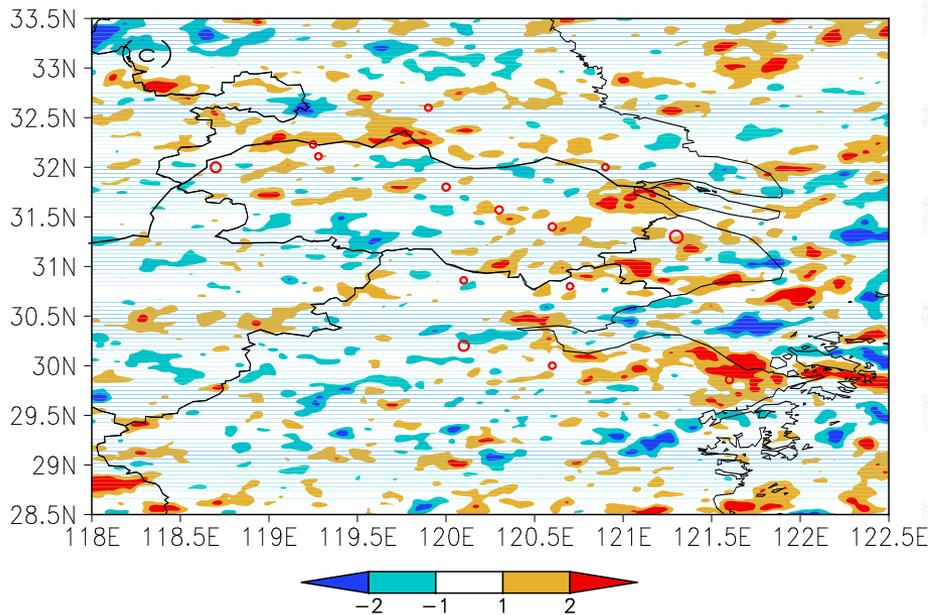
# Probability of Hourly Temperature during August

Changing  
only by  
urban ratio

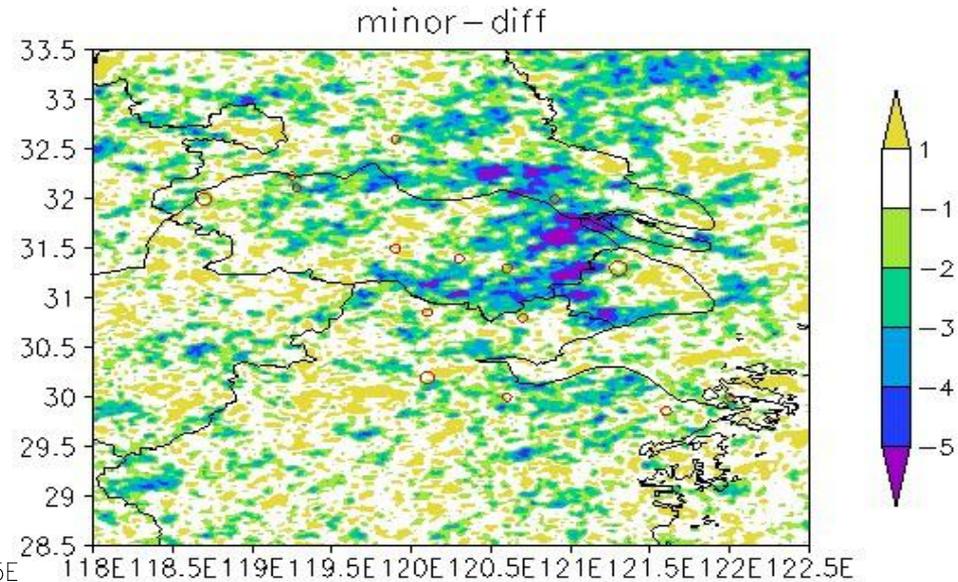


# Precipitation change: Urban vs. Non-Urban (JJA)

## Precipitation intensity

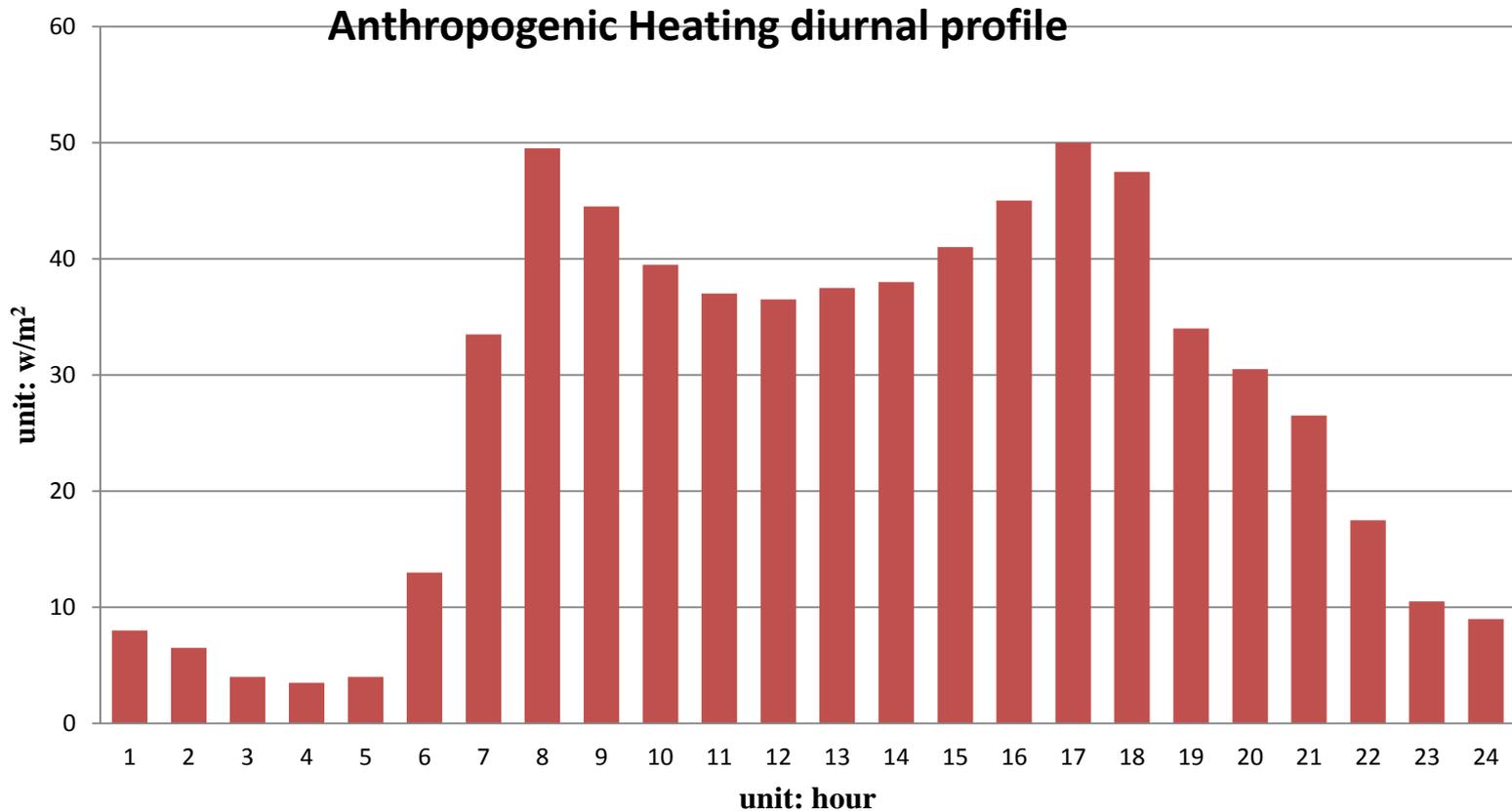


## Days of light rain (0.1-10mm/d)

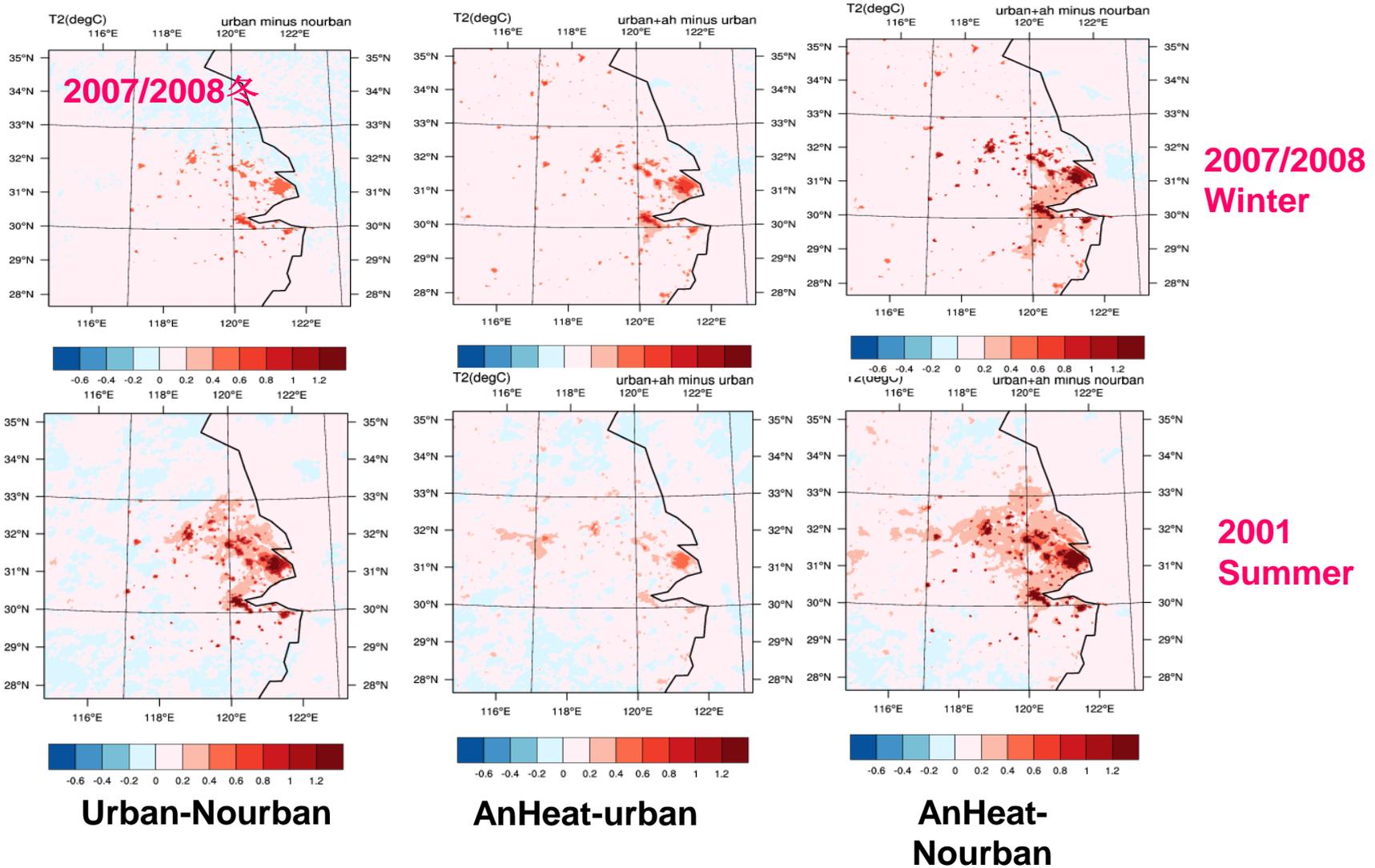


The urbanization in Yangtze River Delta region tends to increase the daily rainfall intensity and heavy rainfall days (frequency) but decrease the days of light rain (Tang 2012)

# Effect of Anthropogenic Heating



# Effect of Anthropogenic Heating



# Conclusions

- ◆ Large scale expansion in the monsoon region over the past two decades
- ◆ Urbanization has significant impacts on local and regional climate
- ◆ Models are capable of capturing the interactive nature of urbanization and regional climate change
- ◆ Anthropogenic activities have regional consequences

# Coming up Next

- ✦ 21-22 Dec 2011, JST-MOST joint workshop in Suzhou (*passed*)
- ✦ 25-27 April 2012, Asian megacity workshop
- ✦ 27-28 Sep 2012, JST-MOST joint workshop in Tokyo
- ✦ The modeling effort is to continue at high resolution
- ✦ Various projects are assessing societal risk of continued urbanization.

Changes in the  
**Human-Monsoon System**  
of East Asia in the  
Context of Global Change



editors  
**Congbin Fu**  
**J R Freney**  
**J W B Stewart**

*Monsoon Asia Integrated Regional Study on Global Change - Vol 1*

 **World Scientific**

# Changes In The Human-Monsoon System Of East Asia In The Context Of Global Change (Monsoon Asia Integrated Regional Study on Global Change)

edited by **Congbin Fu, J. R. Freney**  
and **J W B Stewart (2008)**

**Thank you!**

# MAIRS



For questions, contact

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or visit <http://mairs-essp.org>