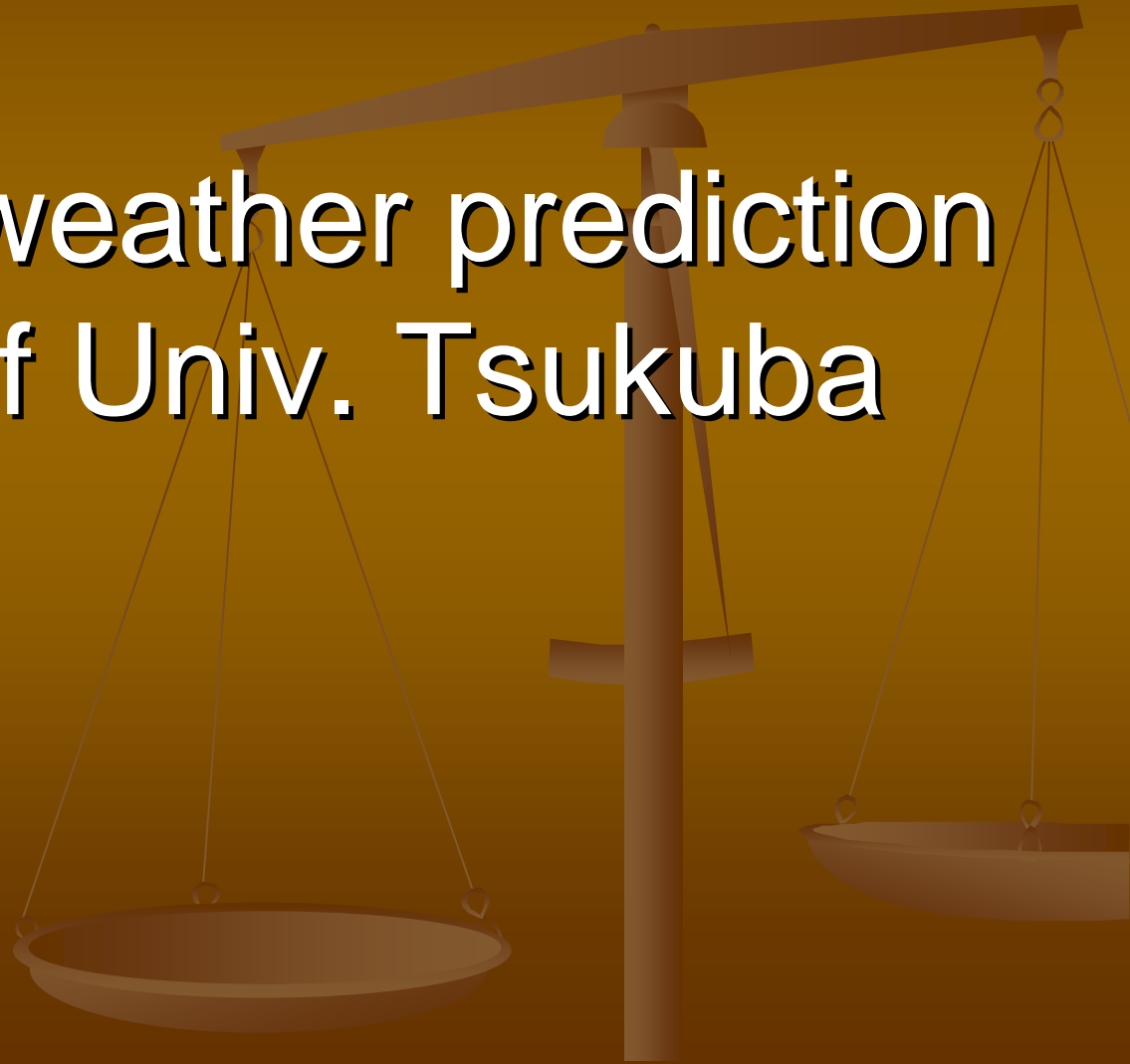


An aerial photograph of a dense urban skyline, likely Tokyo, featuring numerous skyscrapers and high-rise buildings. The image is overlaid with a semi-transparent blue filter. The text is centered over the image.

# Numerical Simulation of Urban Climate using the WRF model

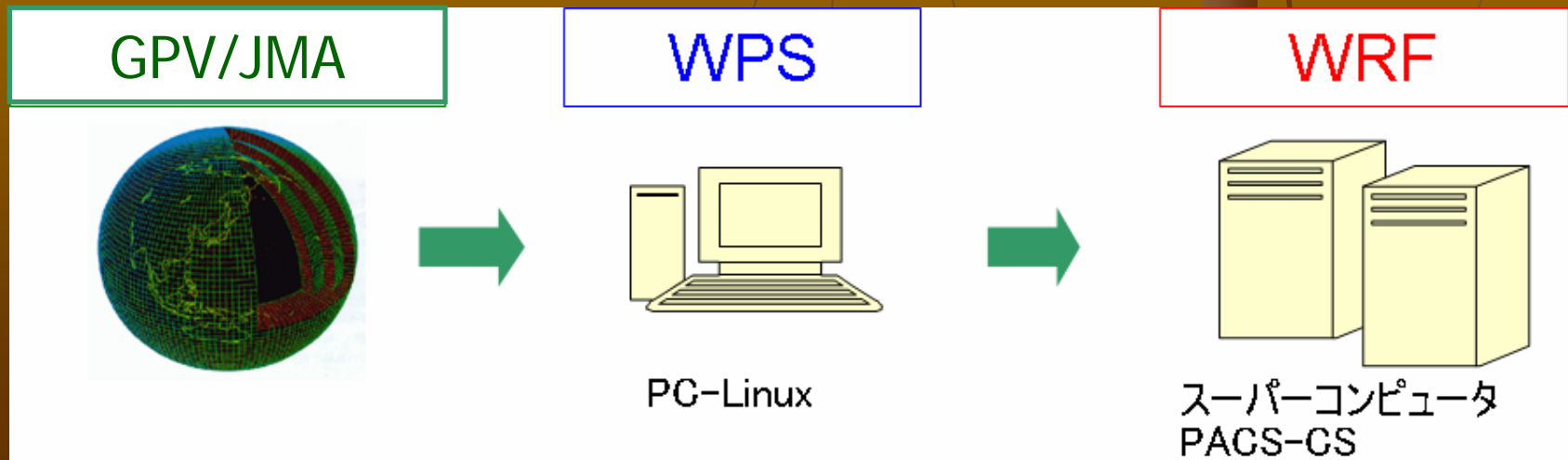
Hiroyuki KUSAKA

# Real-time weather prediction system of Univ. Tsukuba



# Real-time Weather Prediction System

- System is developed based on the WRF model
- The WRF model is new Weather Research and Forecasting model developed by the National Center for Atmospheric Research (NCAR), National Center for Environmental Prediction (NCEP), etc.
- GPV/JMA data is used to create initial and boundary conditions







筑波大学

# リアルタイム気象予測システム



HOME

本日の予測  
(研究室限定)

昨日の予測  
(公開)

リアルタイム予測  
について

開発メンバー

アンケート

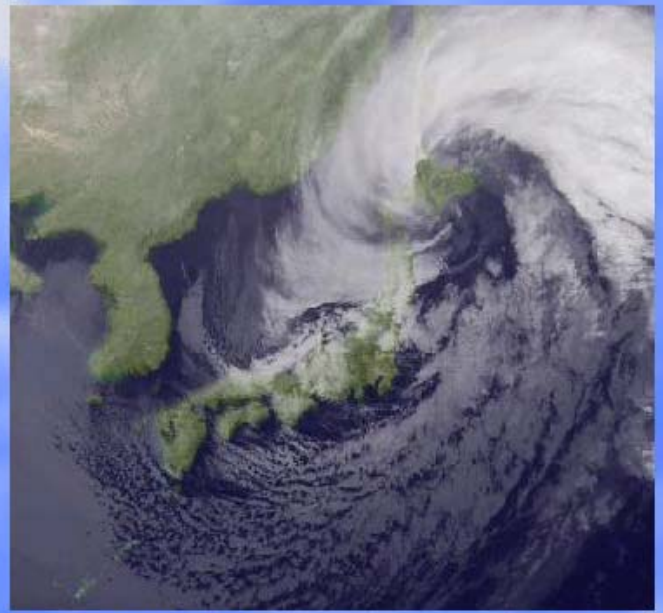
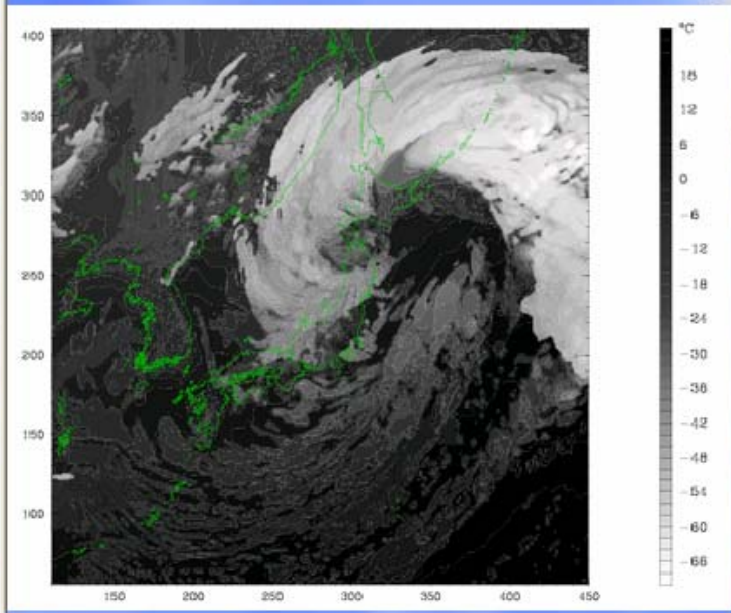
リンク

## 本日の予測 (毎日10時更新!)

WRF予測結果

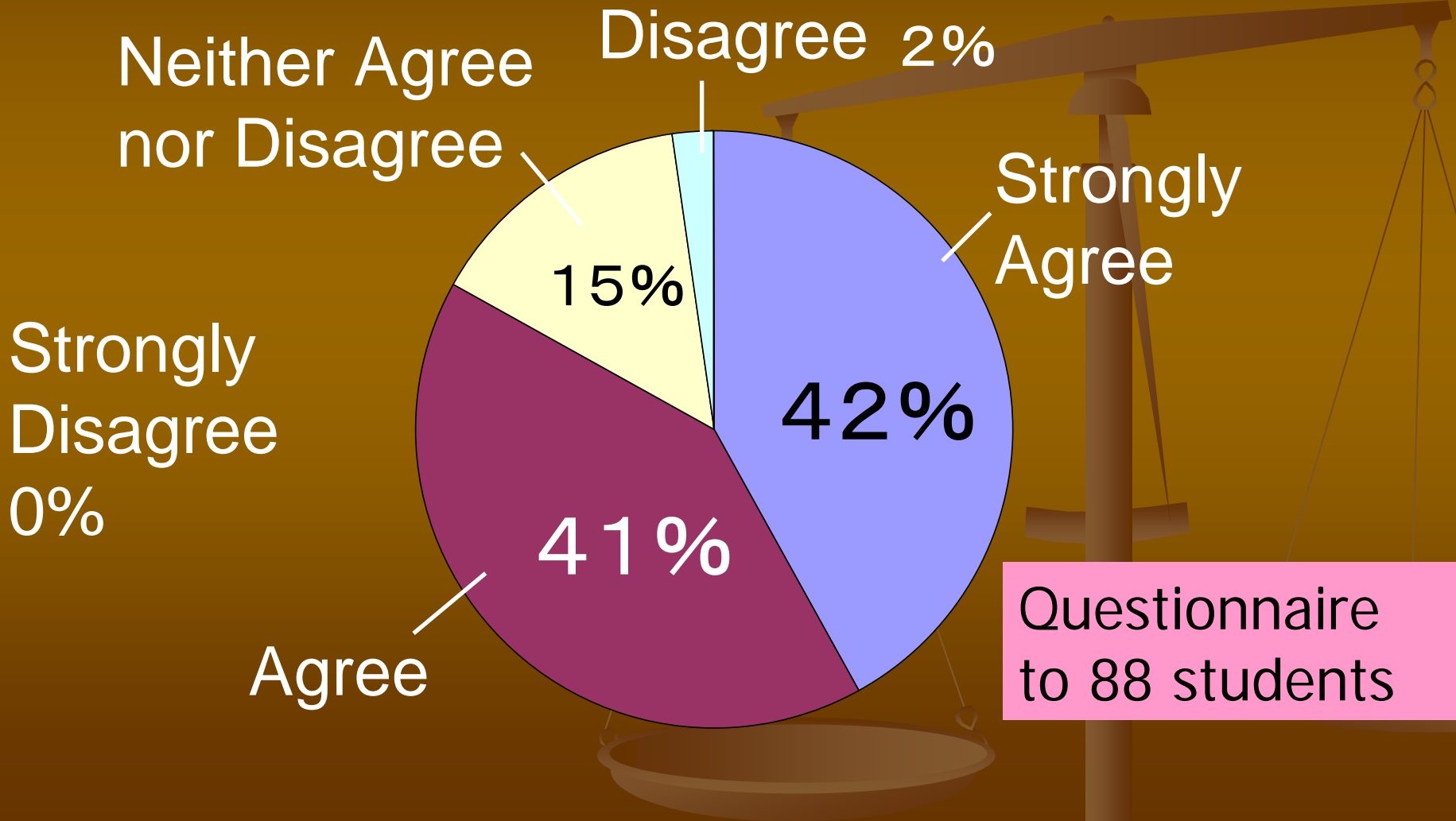
2007年1月7日 9JST

赤外画像



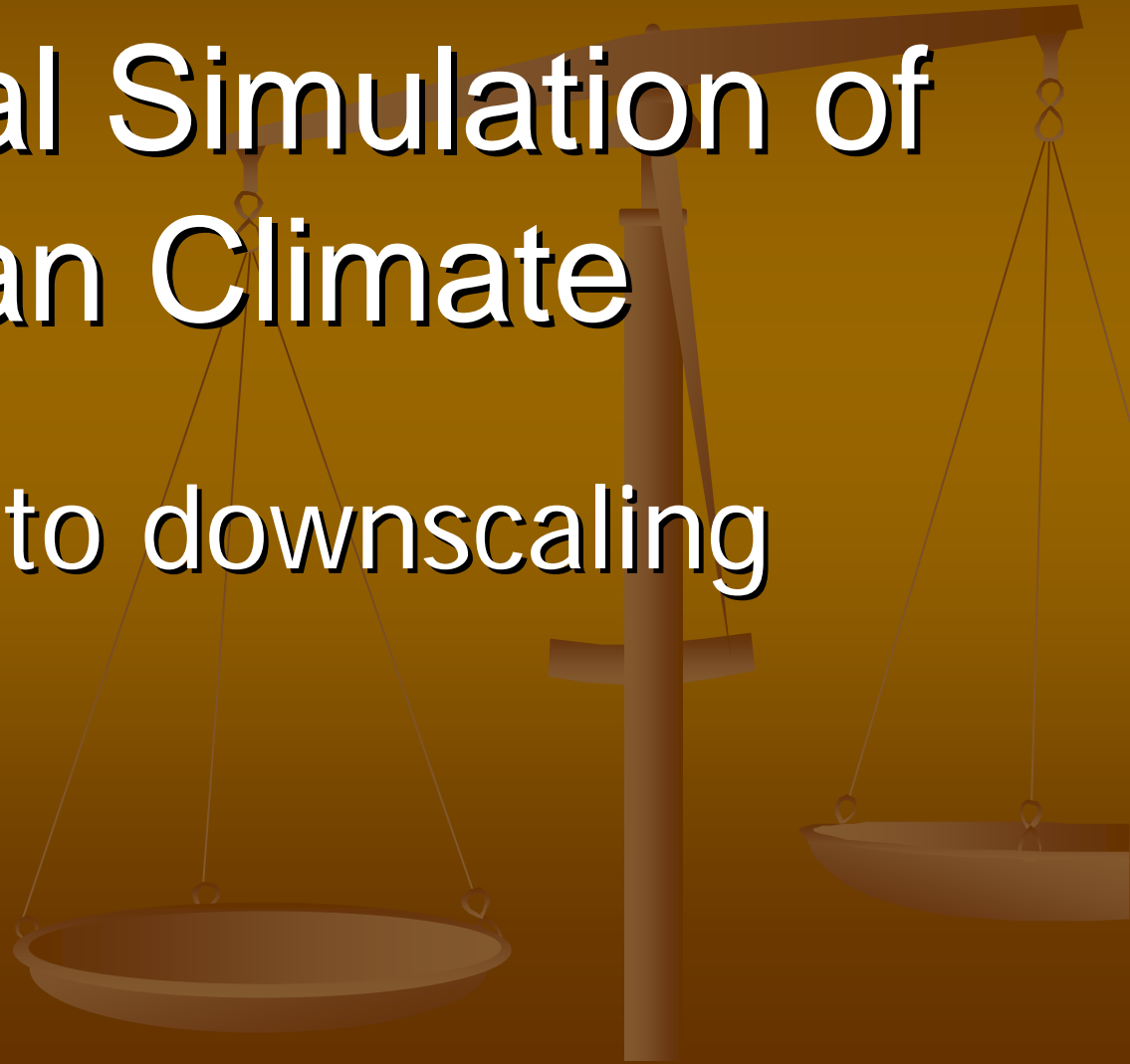
高知大学気象情報頁(<http://weather.is.kochi-u.ac.jp/>) より

(Q) Do you think the system will be useful for your research and/or study?



# Numerical Simulation of Urban Climate

Toward to downscaling



# August 16, 2007 Extremely hot day

extreme temperature 40.9°C at

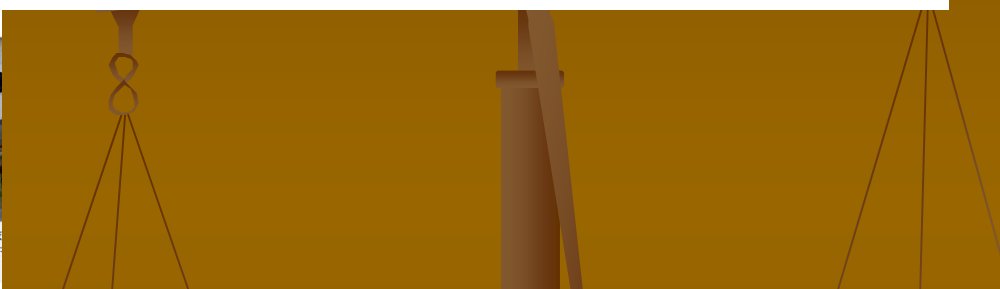
- ▶ 社会
- ▶ スポーツ
- ▶ エンターテインメント
- ▶ 暮らし
- ▶ サイエンス
- ▶ 政治
- ▶ 経済・IT
- ▶ 国際
- ▶ 地域ニュース
- ▶ English
- 記事検索

日本列島は16日も猛暑が続き、岐阜県多治見市で午後2時20分、埼玉県熊谷市で同42分に40.9度の最高気温を観測した。1933年7月25日に山形市で記録した国内最高気温(40.8度)を74年ぶりに更新した。この暑さのため、毎日新聞の集計では同日、埼玉県を中心に6都府県で計12人が新たに熱中症とみられる症状で死亡、水の事故も相次ぎ7府県で7人が亡くなった。



国内最高気温記録した多治見市。駅前の通行人もまばらだー岐阜県多治見市のJR多治見駅で16日午後4時、大竹祐之撮影

ほかに40度を超えたのは▽埼玉県越谷市(40.4度)▽群馬県館林市(40.3度)▽岐阜県美濃市(40.0度)。岐阜市の39.8度など全国25地点で観測史上最高気温とな



Severe heatstroke lead 12 people to death

機密書類回収箱：C.P.S. 準備、溶解処理...西濃運輸が発売

動画ニュース

TBS NEWS BRD

TBSニュースバード (1日4編更新) ニュースビデオを再生

の最低気温も下がり、気温が上がりやすかったといっ。熊谷市など関東地方では上空を北西の風が吹いて山越えの熱風が吹き下ろすフェーン現象が重なった。多治見市など東海地方では太平洋高気圧の中心に近かったことから、最高気温の更新につながったとみられる。

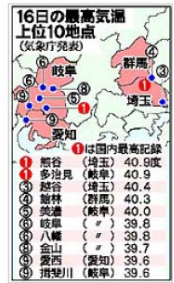


気温40度を超えた埼玉県熊谷市内を暑そうに歩く買い物客らー16日午後1時52分、山本晋撮影

熱中症の死者数は▽埼玉6人▽東京2人▽秋田、群馬、愛知、京都各1人。水の事故の死者数は栃木、群馬、新潟、長野、大阪、広島、鹿児島で各1人となっている。

暑さは17日、やや和らぐが、まだ厳しい残暑が続く。週末には、北海道付近にある前線が南下する影響で太平洋高気圧も勢力を弱め、平年並みの気温に戻る見通し。【古関俊樹】

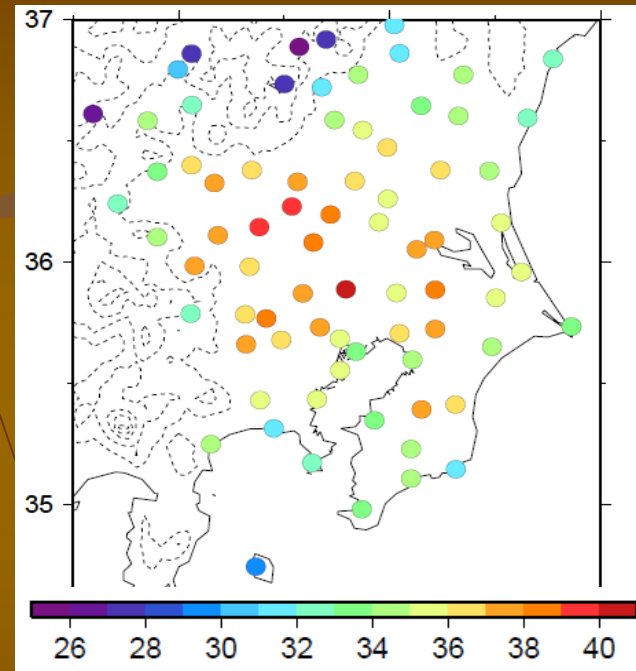
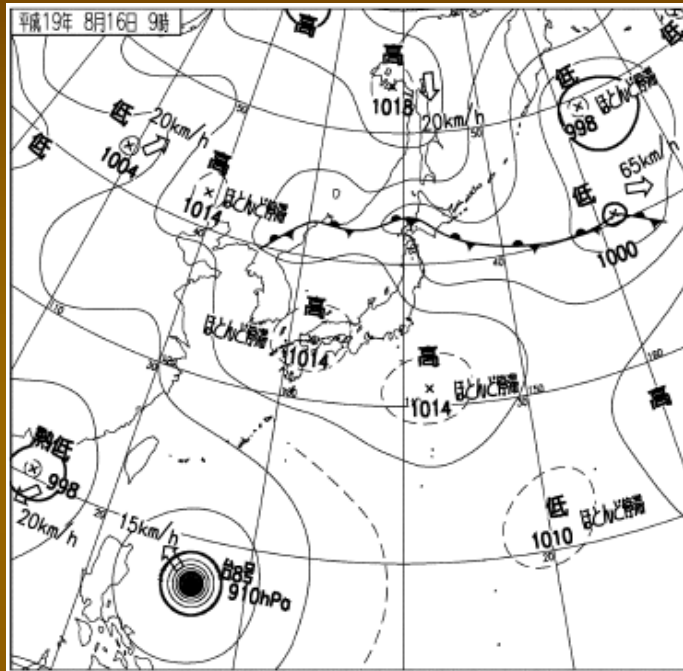
毎日新聞 2007年8月16日 20時38分 (最終更新時間 8月16日 23時41分)



16日の最高気温上位10地点



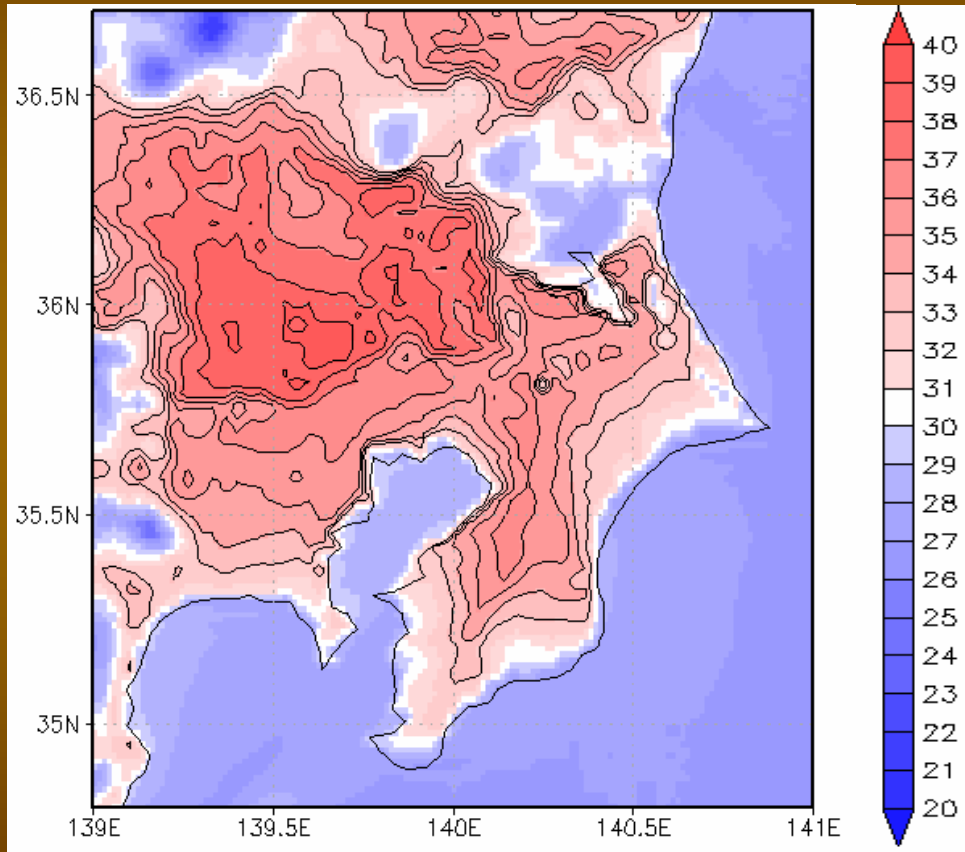
# Surface Weather Chart at 9:00 and 2-m Temperature at 14:00 JST



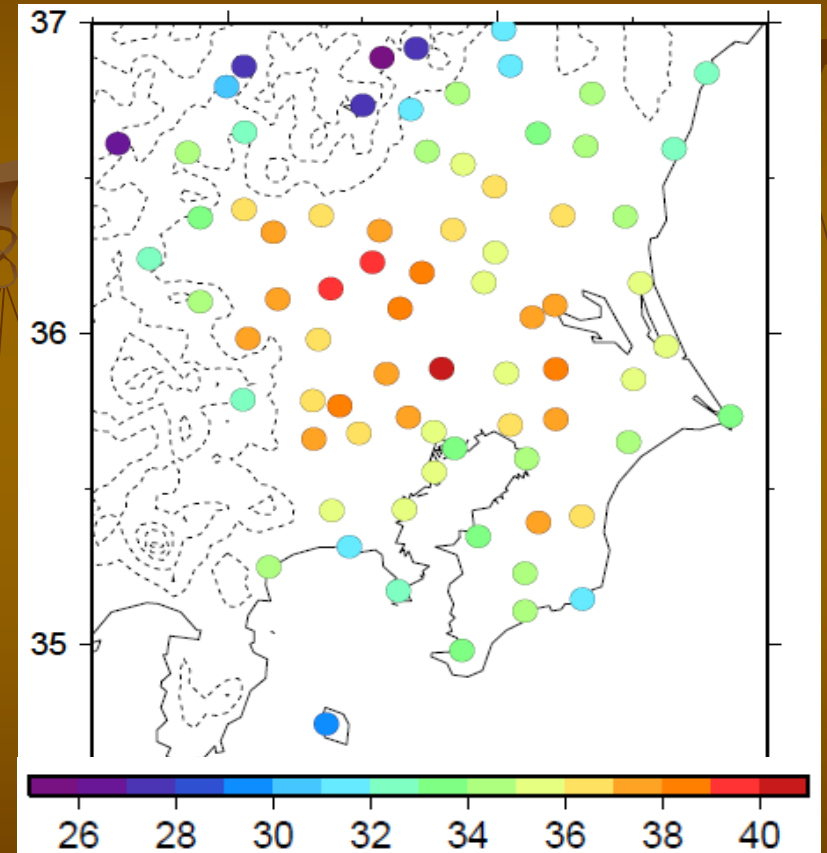
What's happened in the future if such an abnormal weather occurs so often under the global warming situation?



# Surface air temperature at 14:00

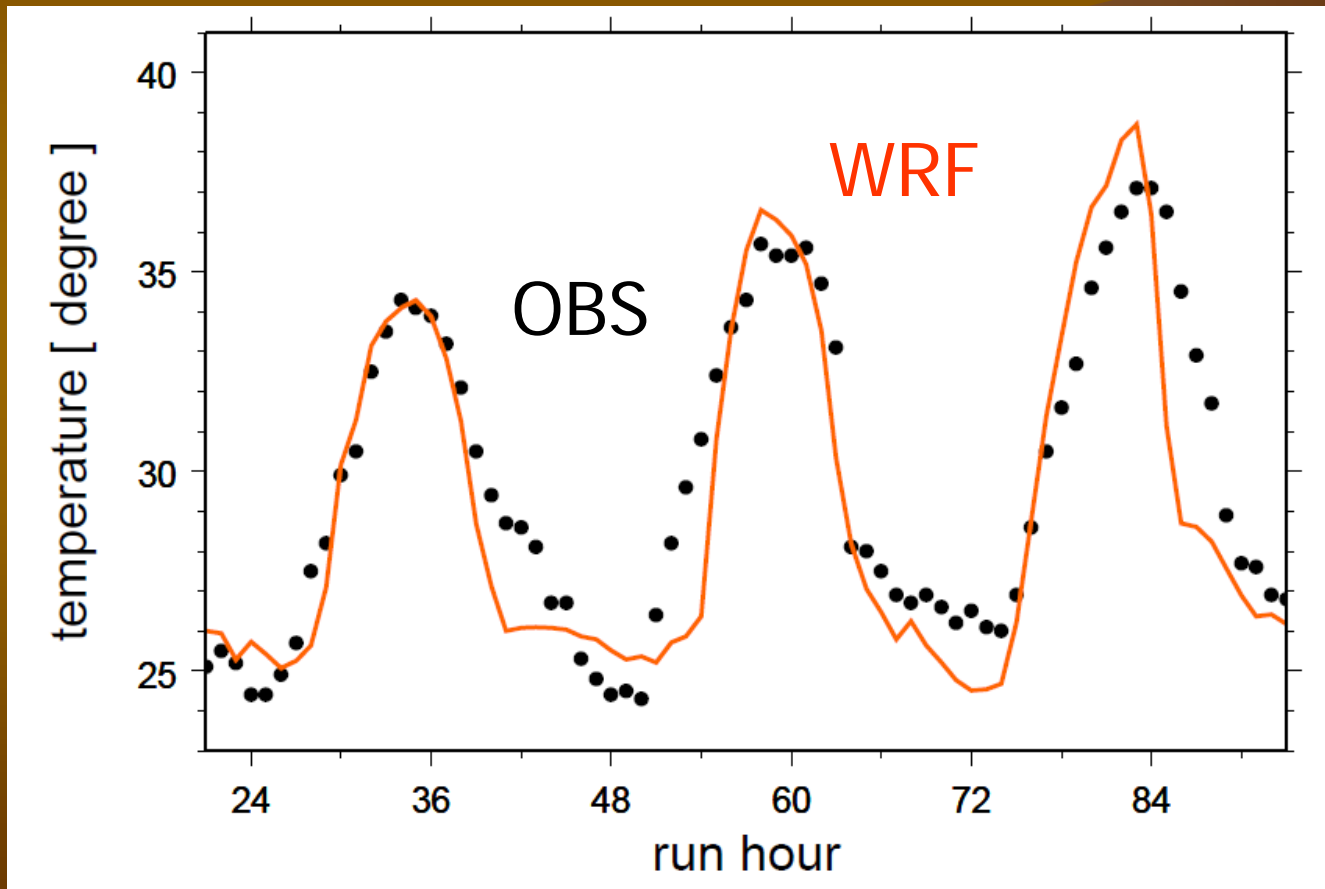


WRF

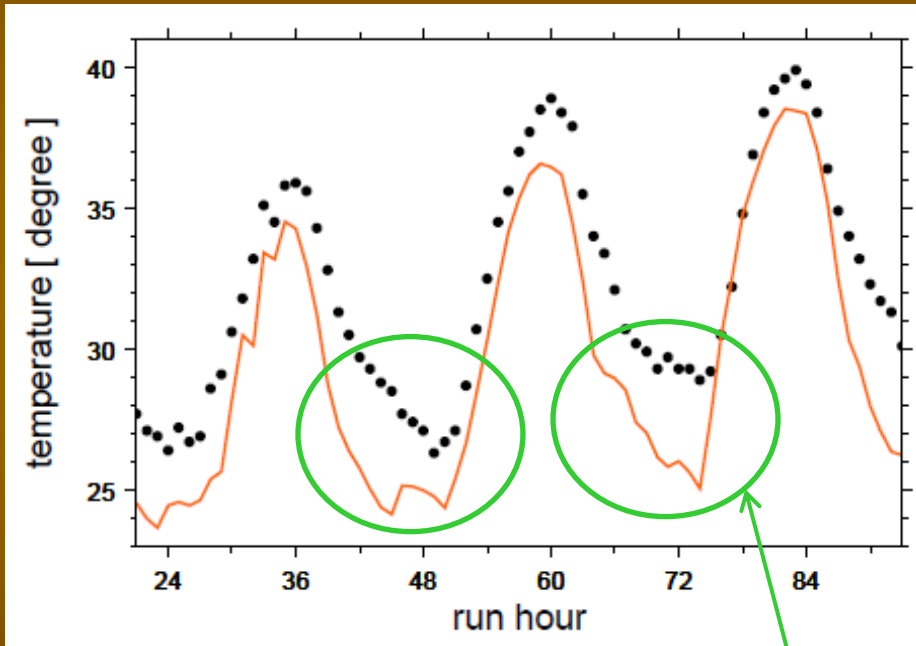


AMeDAS (OBS)

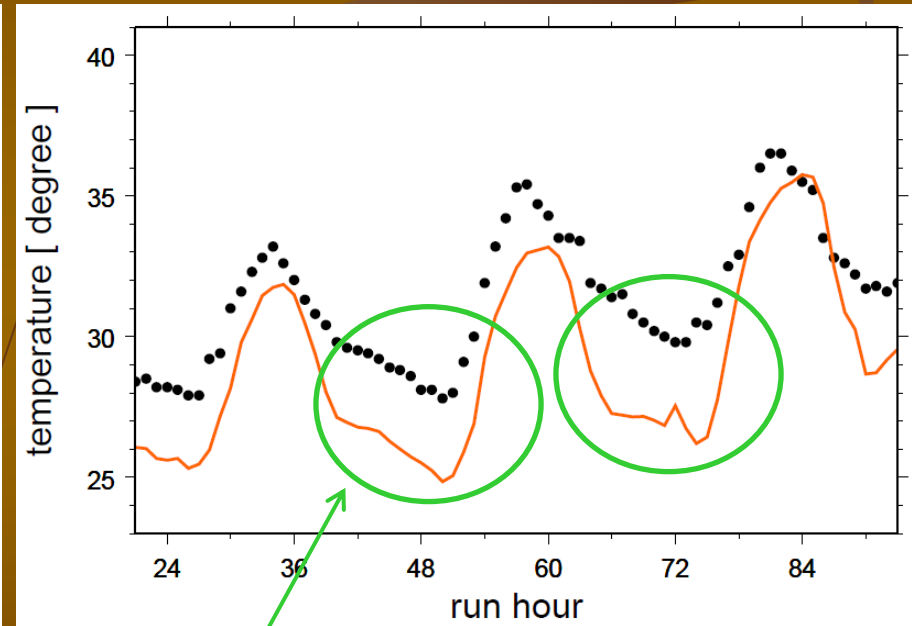
# Surface air temperature at Tsukuba (Aug 14~16)



# Surface air temperature at Kumagaya and Tokyo (Aug 14~16)



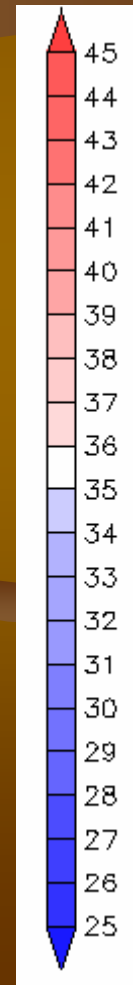
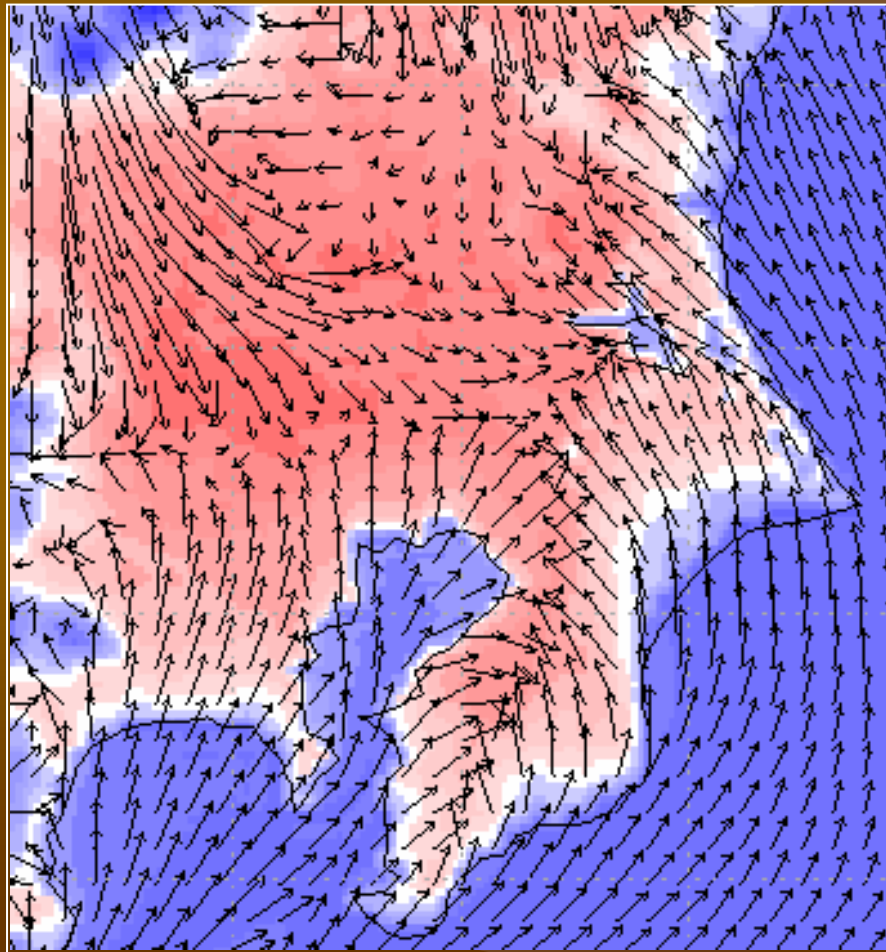
Kumagaya



Tokyo

WRF underestimates the urban temperatures, particularly at night.

# Predicted surface air temperature on the extreme hot day after the global warming (around 2070)





# Summary

- We have developed the real-time local weather prediction system based on the WRF model.
- Local weather on the extreme high temperature event is simulated using our system.
- WRF predicts that daily maximum temperature around 2070 could reach 43°C if such an abnormal weather occurs under the global warming situation.
- However, in the standard WRF model, there are some shortcomings that the nocturnal urban temperature underestimates.

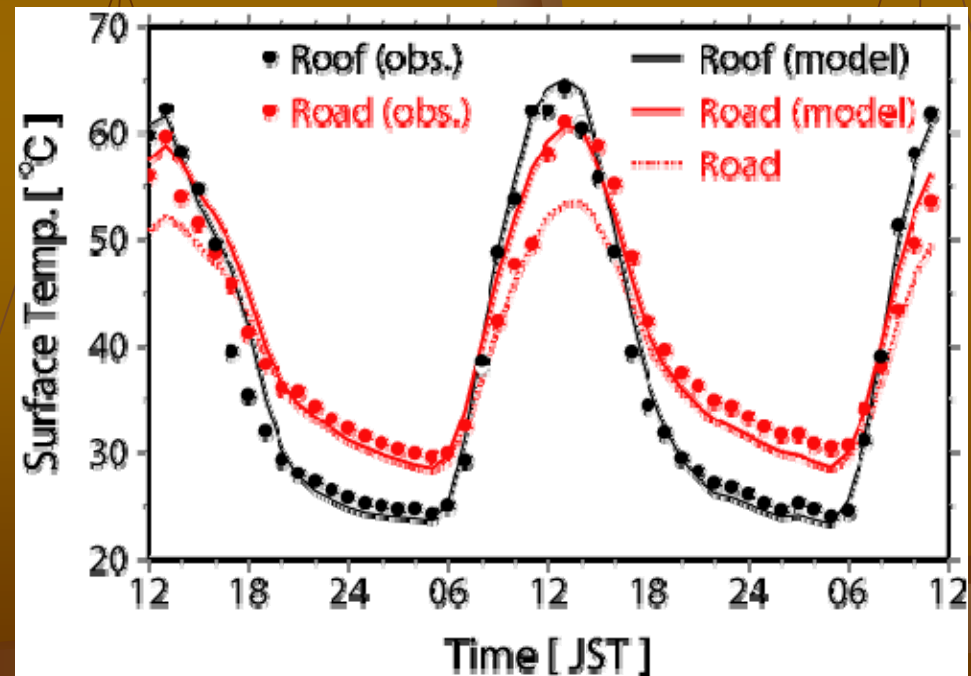
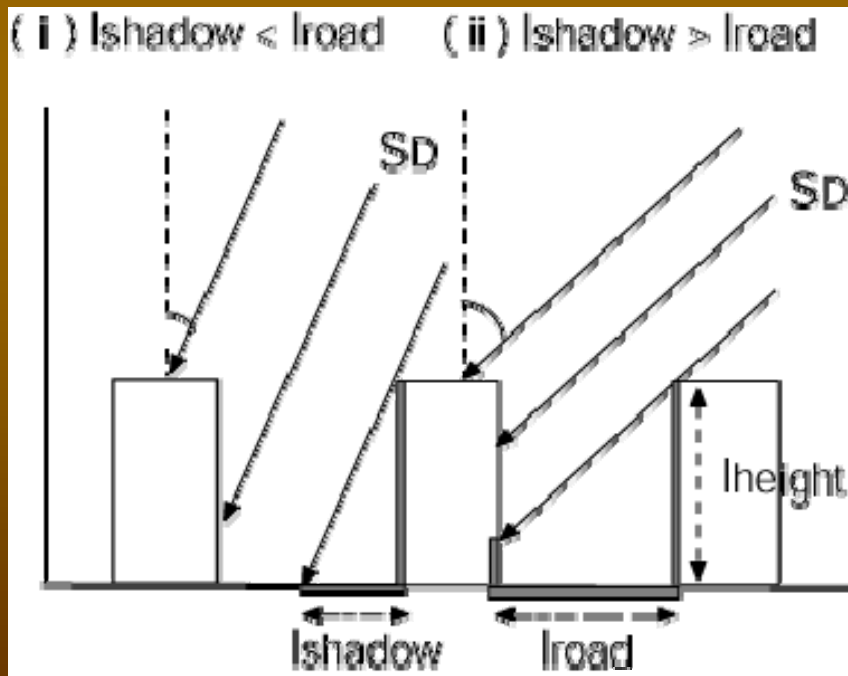


# Ongoing Work

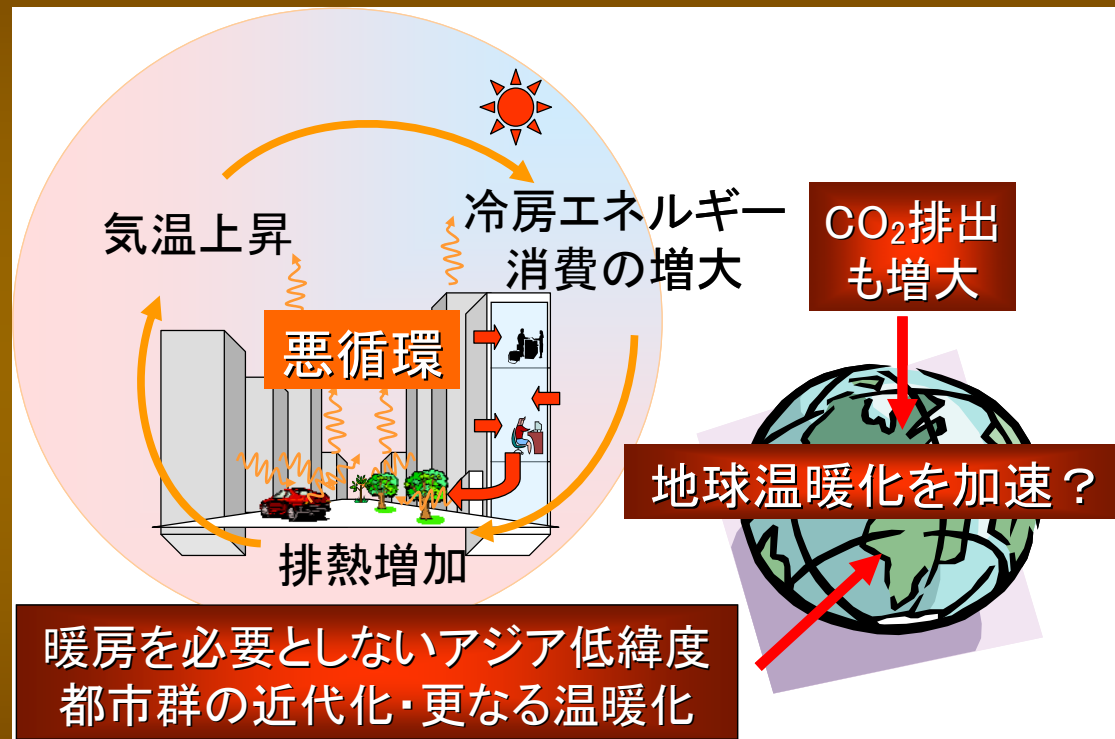
Urban canopy modeling and  
making anthropogenic heat map

# Improving Urban Canopy Model in the WRF

Official Urban Model developed by Kusaka et al. (2001)  
Considering Building and Roof Vegetation Effects



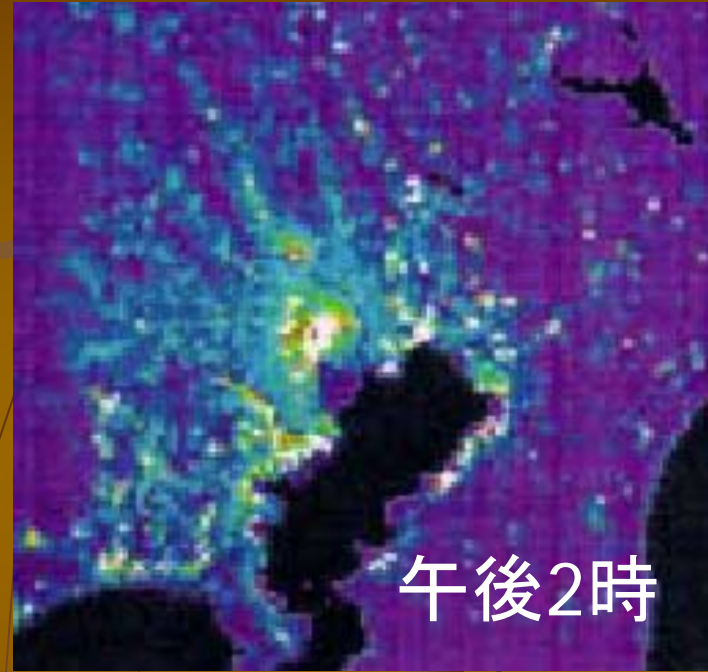
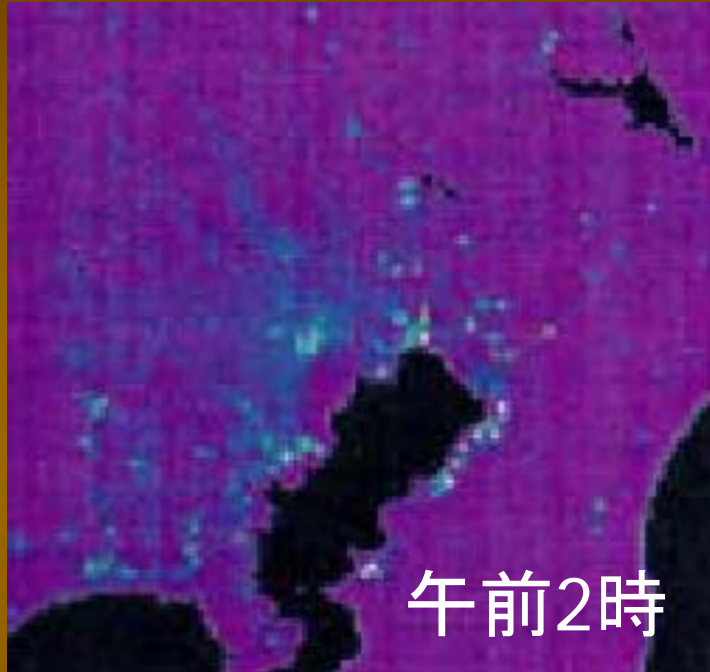
Anthropogenic heat currently increases 5-10% when temperature rises 1°C.



We should predict future local climate, considering anthropogenic heat release.

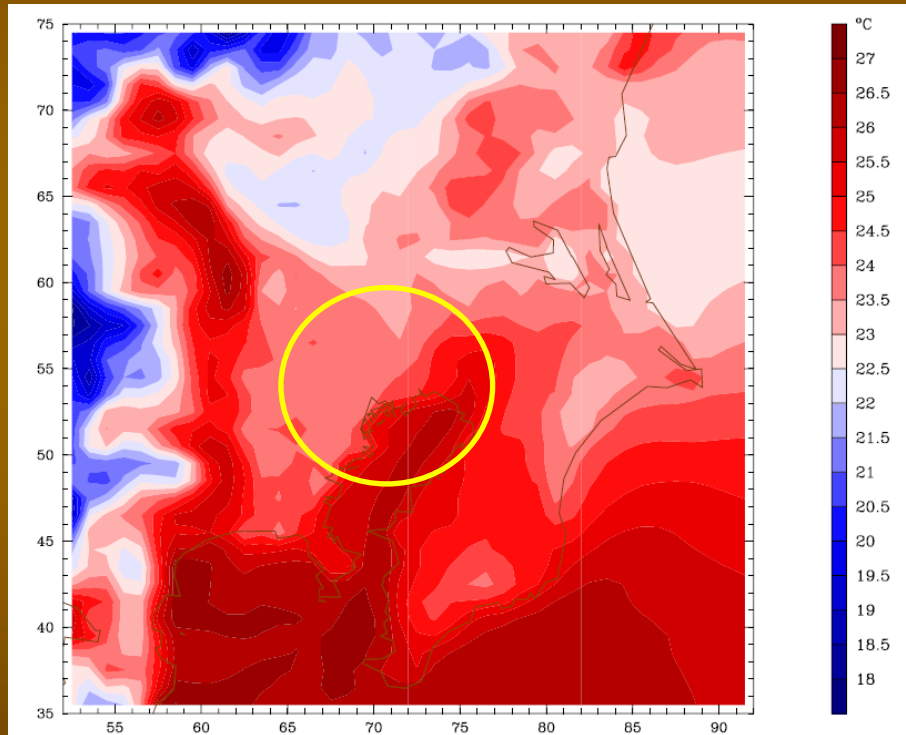


# Anthropogenic Heat Map

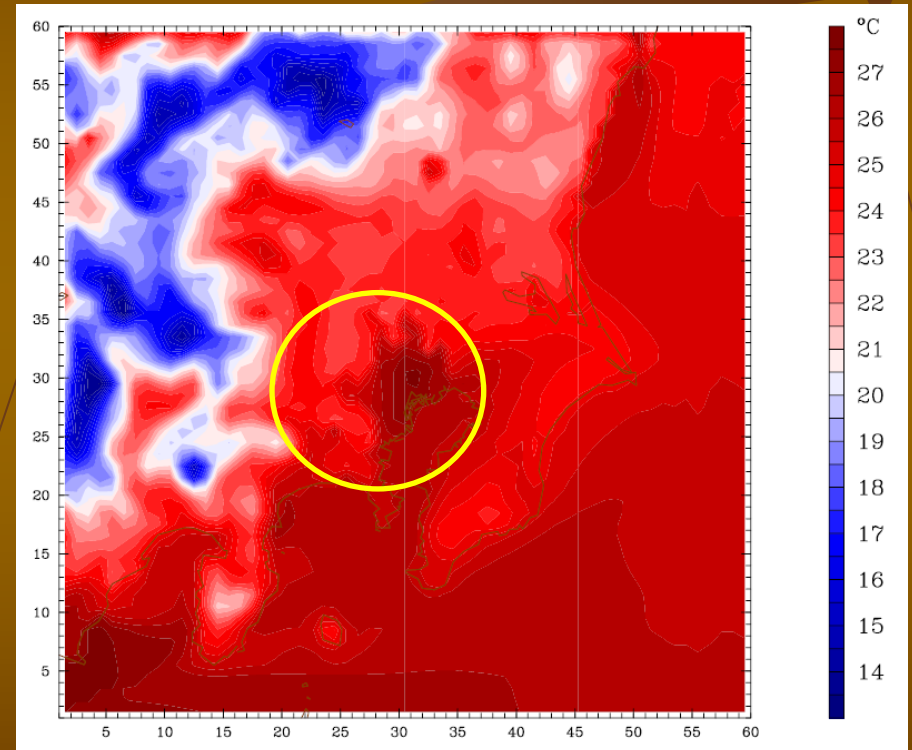


Anthropogenic heat increases nocturnal temperature in the urban area

# Impact of Urban Canopy Model and Anthropogenic Heat Release



Default WRF



WRF + UCM  
+ Anthropogenic heat

# Summary

We are predicting urban-scale local climate under the future global warming using the WRF model running on the PACS-CS.

We will continue to study formation mechanism and prediction of urban climate.

# Acknowledgements

- This work is supported by the global environmental fund (S-5) of the Ministry of Environment Japan and the internal project of the Univ. Tsukuba.
- A part of the work is collaborated with the Frontier Research Center for Global Change (FRCGC).
- We thank Mr. Masayuki Hara of FRCGC, Dr. Yasushi Watarai, Dr. Kumi Kataoka, Ms. Yukako Miya, and Ms. Haruka Kitahata of Univ. Tsukuba.