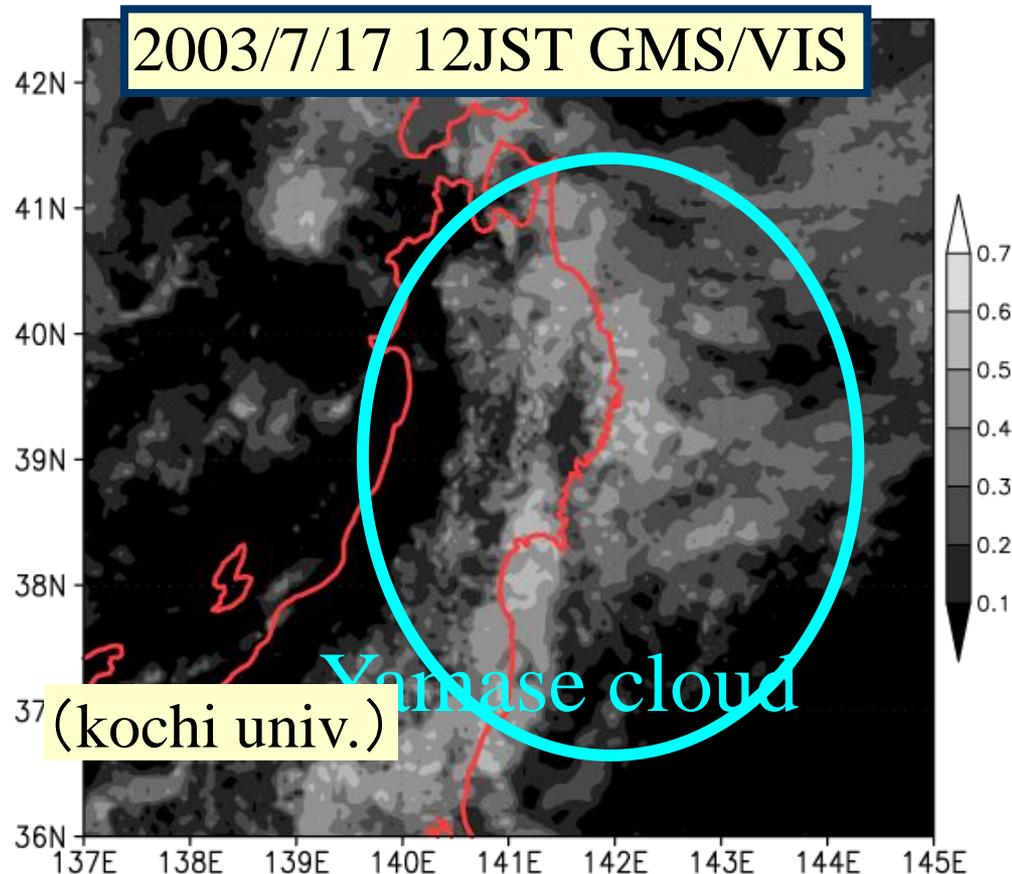
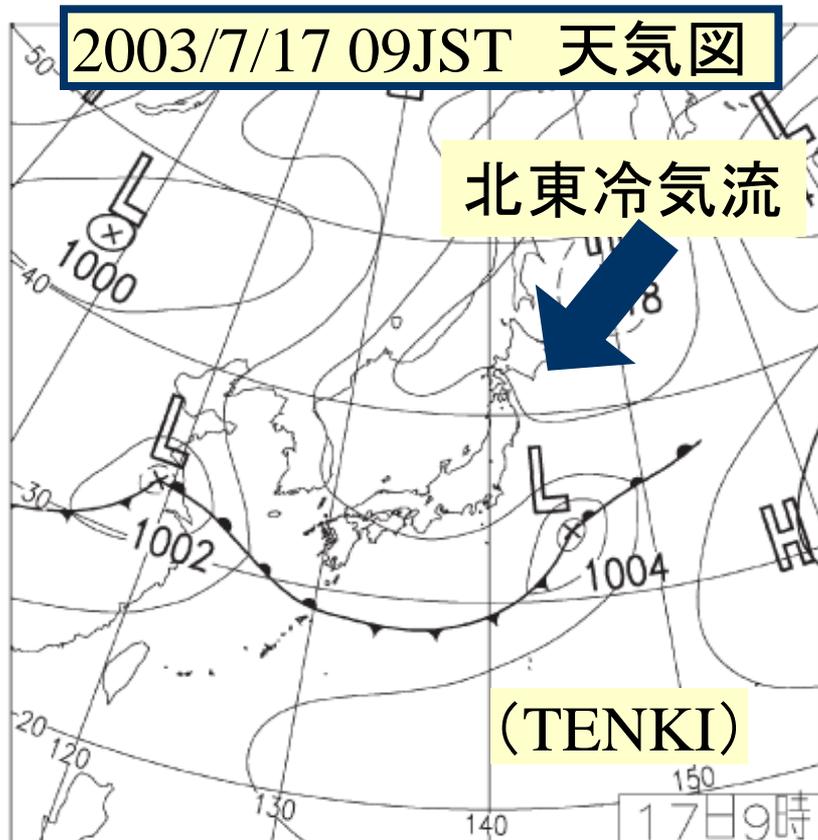


ダウンスケールを用いた2003年の やませの再現実験

沢田雅洋・岩崎俊樹
東北大学理学研究科

やませとは？



- ・ 冷涼な湿潤な北東気流、下層雲を伴う
- ・ 冷夏(1993, 2003)の要因、農被害をもたらす

研究目的

○ ヤマセの詳細な特徴の理解

- 何処で、どの程度、冷える、曇る、湿る？
- 下層雲に雲解像モデルはどの程度有効か？

○ 農業への利用

- 高解像度気象データの利用法

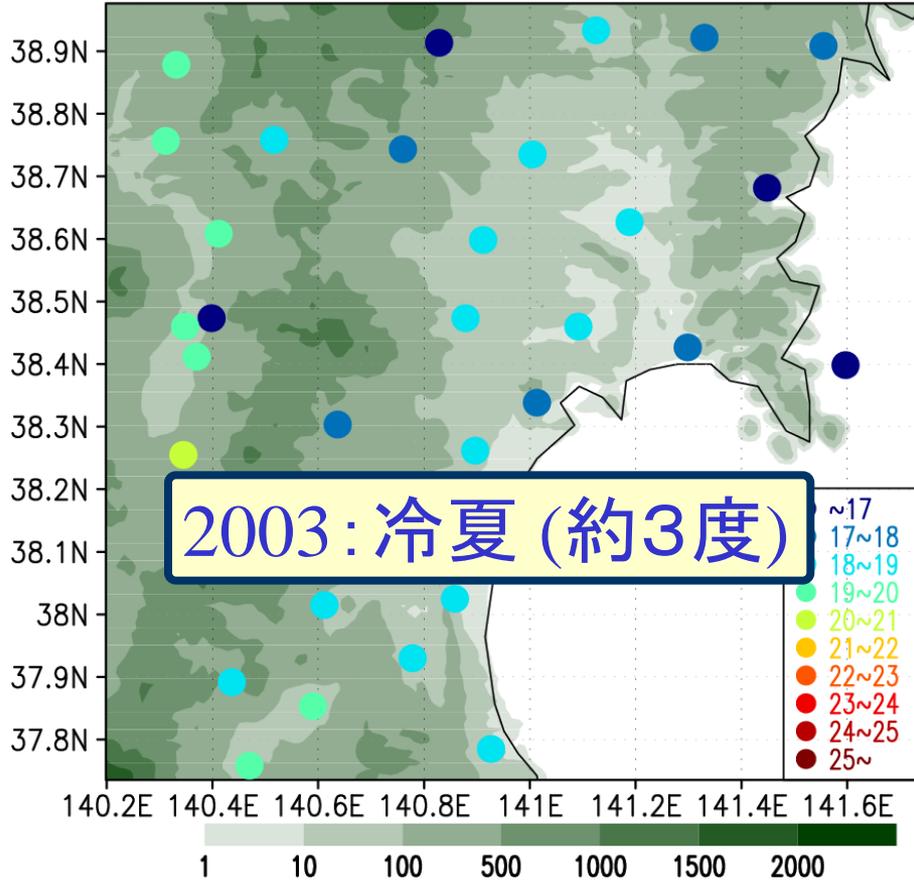
今日のトピック

ダウンスケールのありがたみは？
水平/鉛直解像度の違いは？

2003年のやませ 気温分布

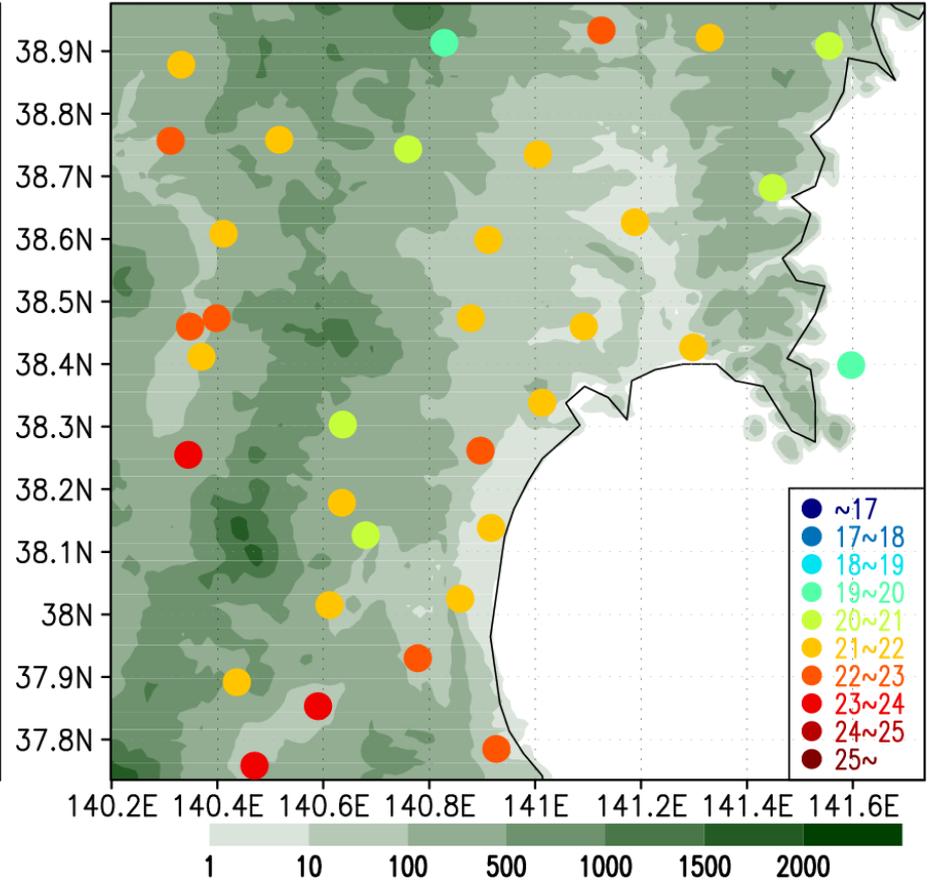
2003/07

TEMP 2003/07



1988-2007/07

88-2007/07

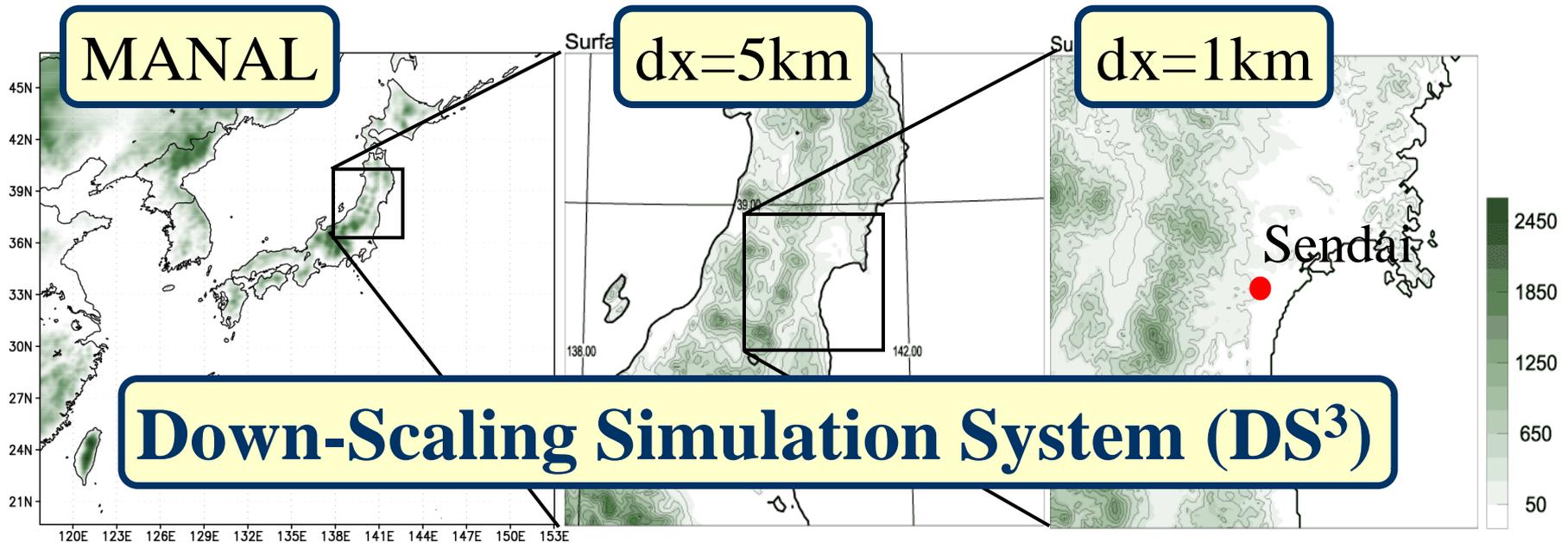


アメダスによる月平均気温
 左: 2003年7月
 右: 20年分の平均

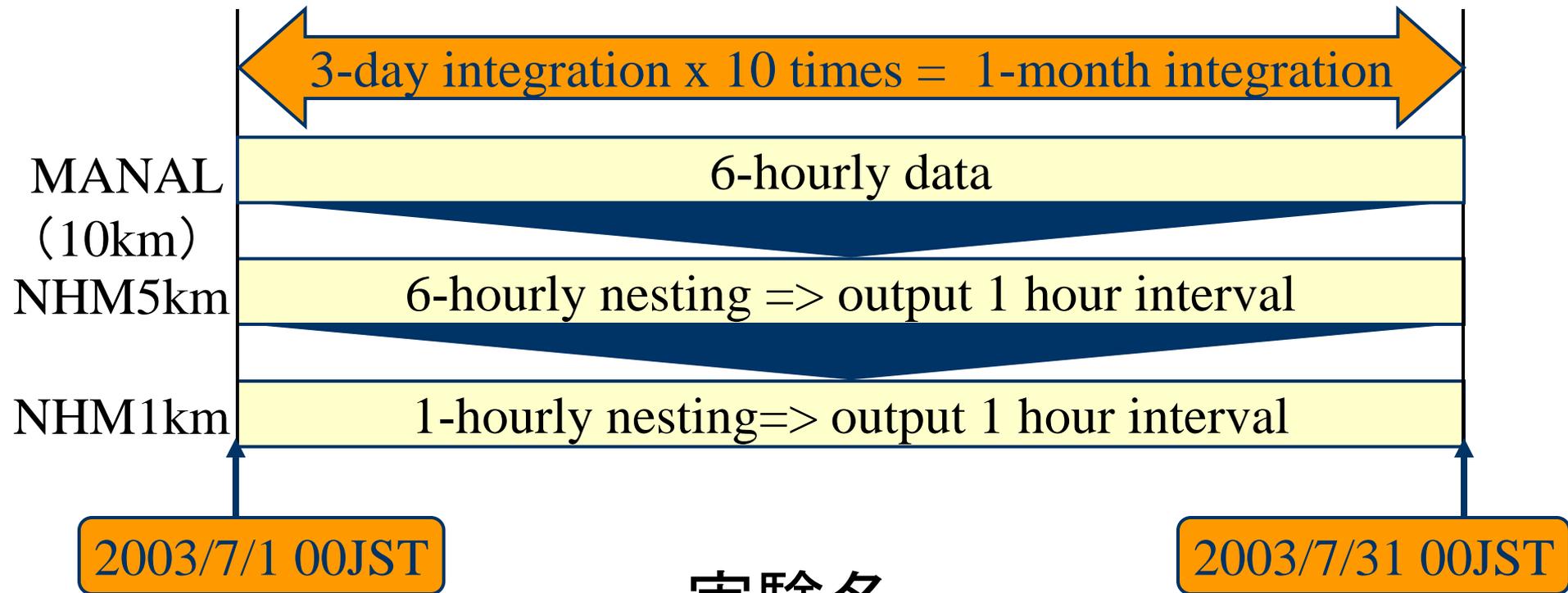
モデルの設定と計算領域

JMA-NHM is used as downscaling simulation system

| | | |
|-------------------------|-----------------------------|----------------------|
| Grid size | 5km / 102x102 | 1km / 151x151 |
| Land surface | Beljaars and Holtslag / SiB | SiB |
| Cloud physics | 5-class bulk | Same as 5km |
| Cloud amount | Partial condensation | Partial condensation |
| umulus parameterization | Kain-Fritsch | none |
| Turbulent closure | Mellor Yamada L3 (MYNN) | Same as 5km |



実験概要



実験名

| | | |
|-----|---------|---------|
| | 38層 | 55層 |
| 5km | 5km-L38 | 5km-L55 |
| 1km | 1km-L38 | 1km-L55 |

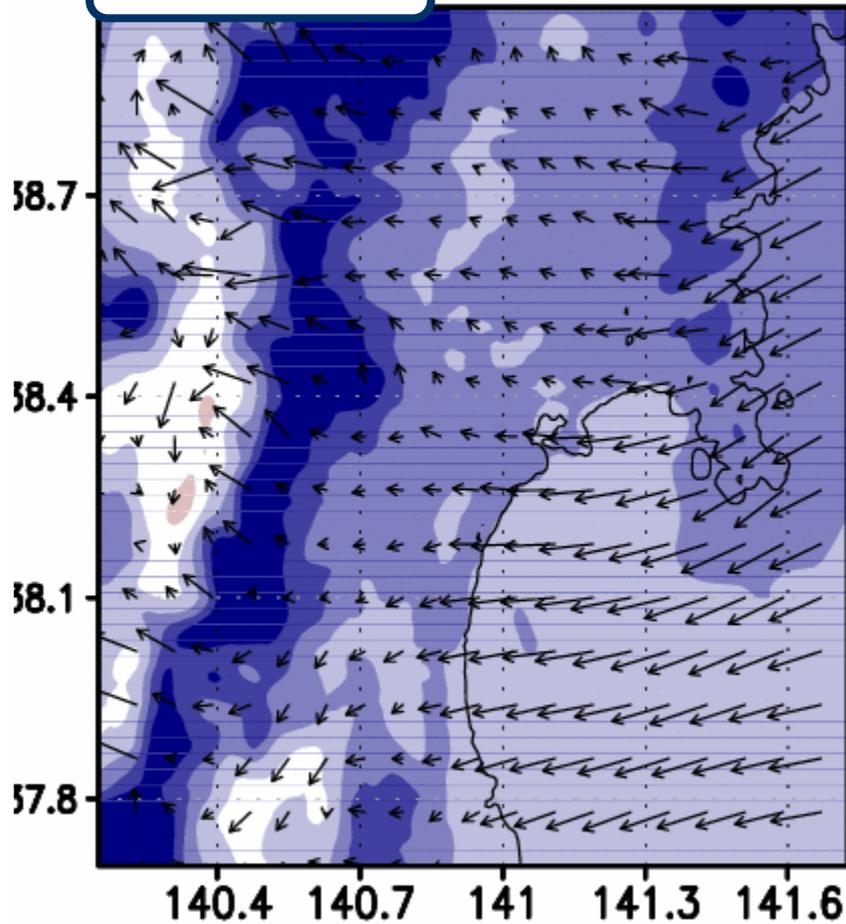
MANAL : mesoscale objective analysis with 10-km mesh by JMA

CTL experiment result

地上気温と下層雲の日変化

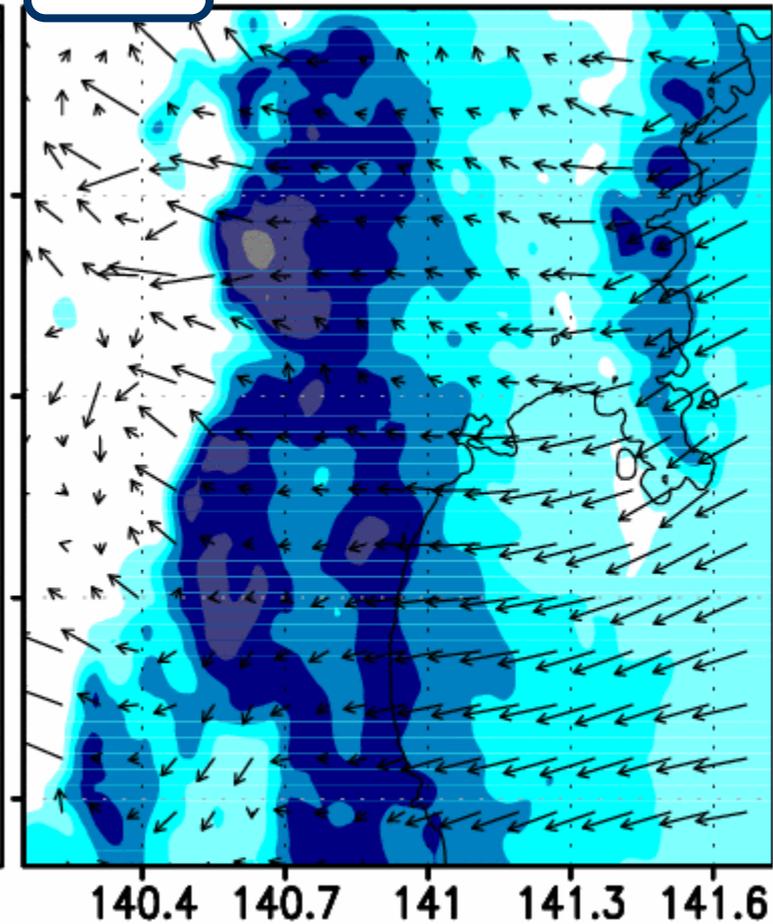
地上気温

07 TS 00JST



LLC

003/07 CLL 00JST



16 17 18 19 20 21 22 23

0.2 0.3 0.4 0.5 0.6 0.7

各時間で月平均した地上気温と下層雲量

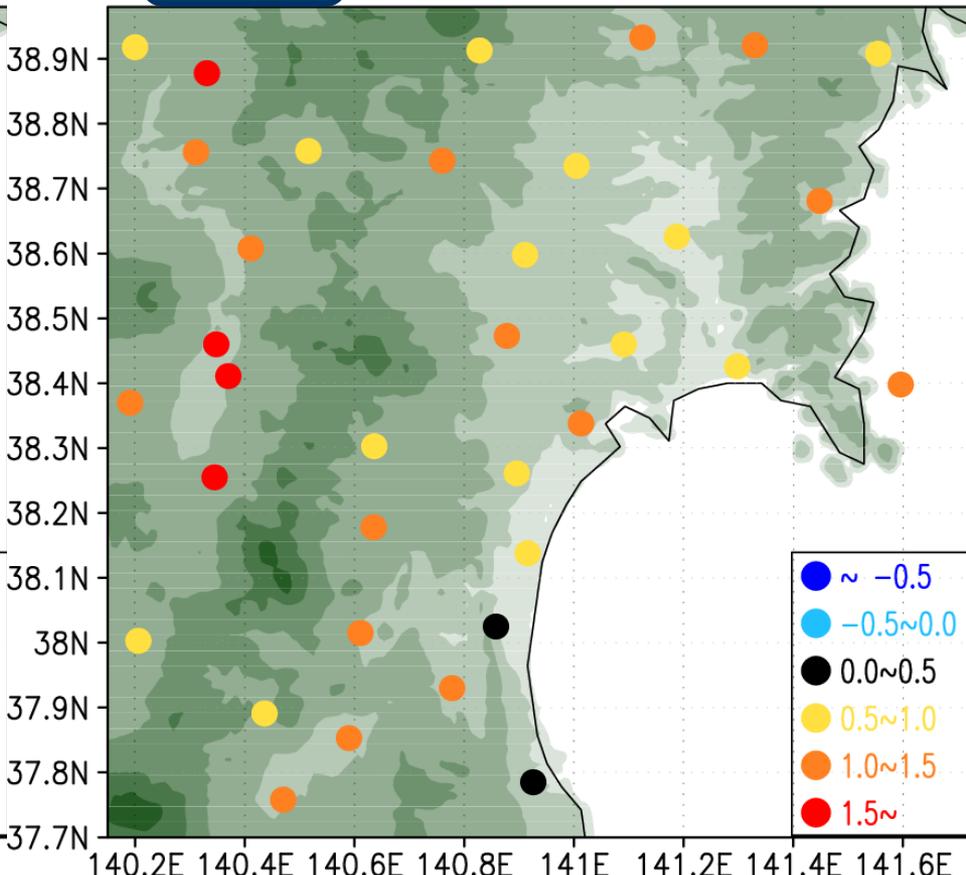
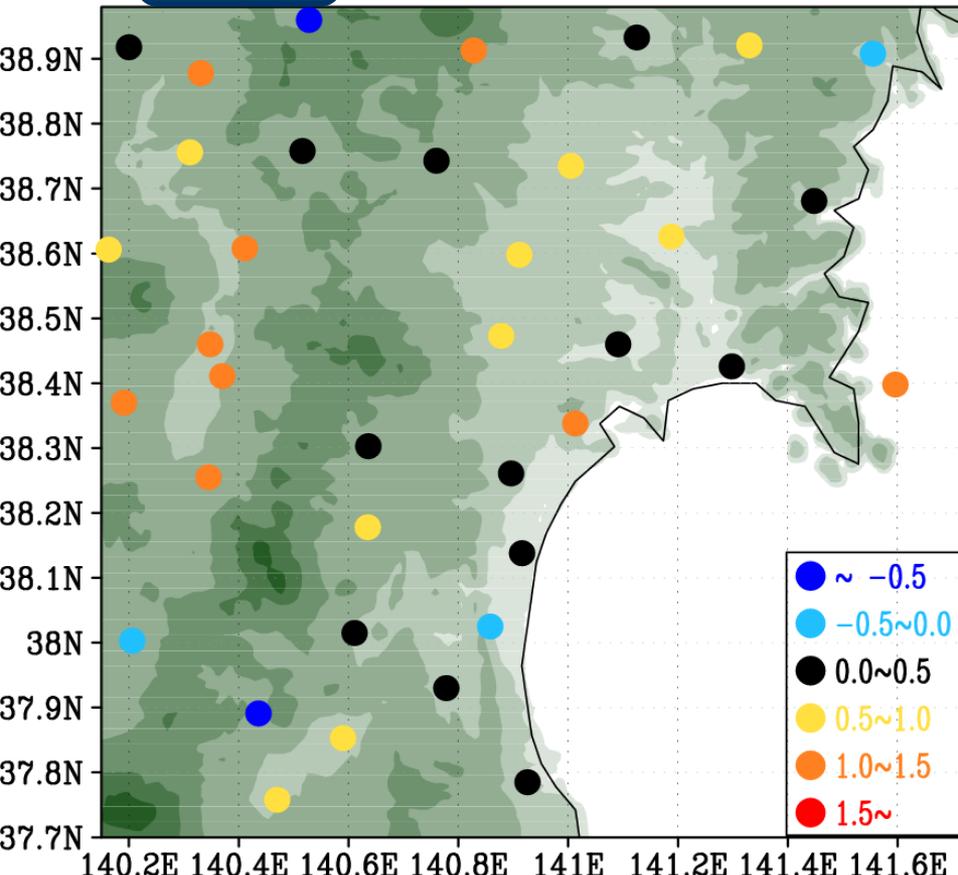
月平均気温の差 水平解像度の違い

5-km

DIFF of TEMP 2003/07

1-km

DIFF of TEMP 2003/07



1 monthly mean ME of air Temp. at each station

1km ex. has larger warm bias than 5km ex.

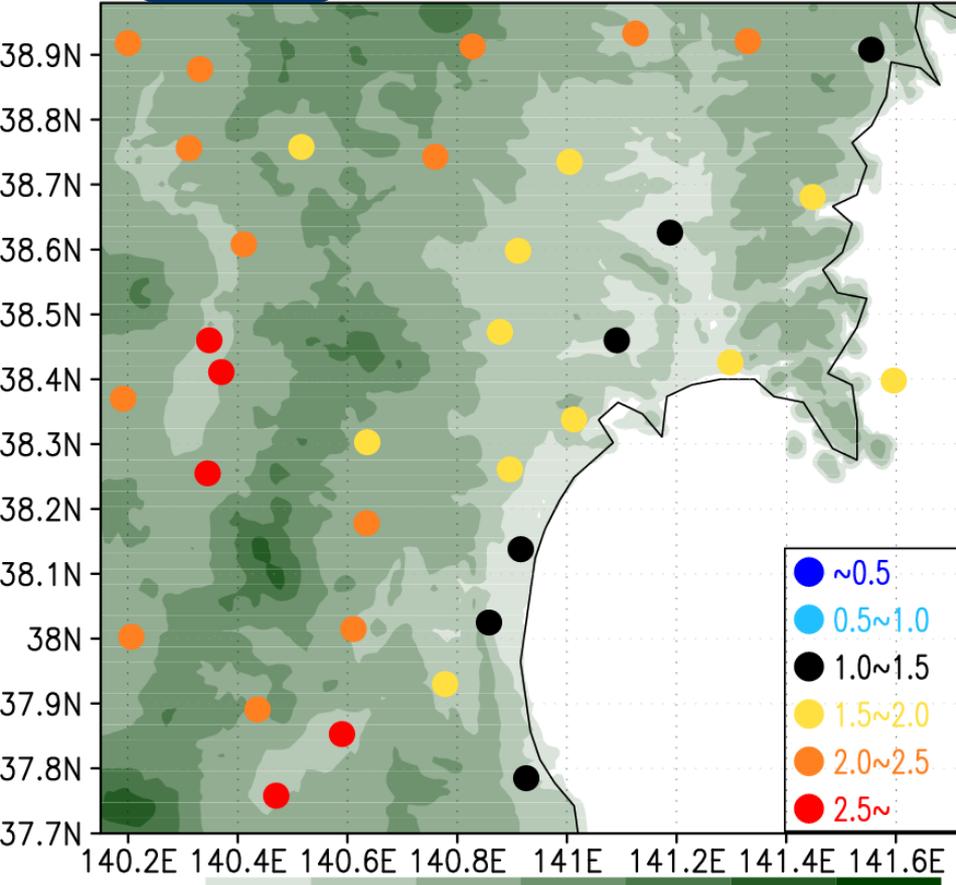
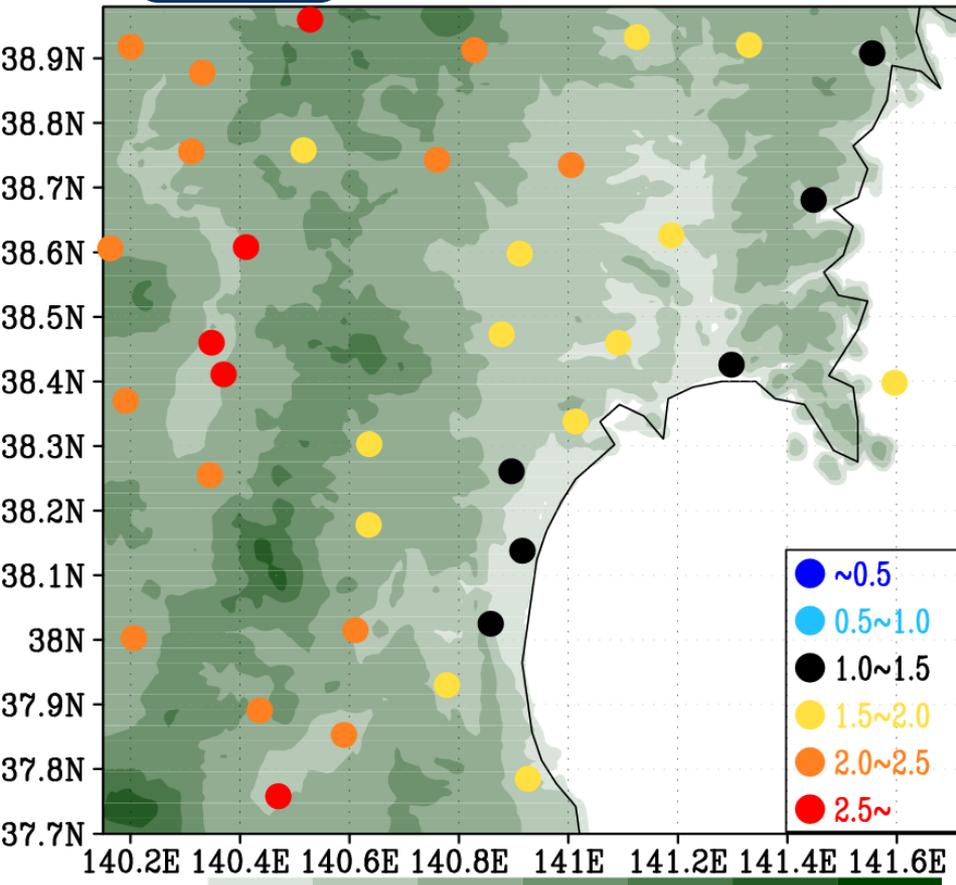
気温のRMSE 水平解像度の違い

5-km

: RMSE of TEMP 2003/07

1-km

RMSE of TEMP 2003/07



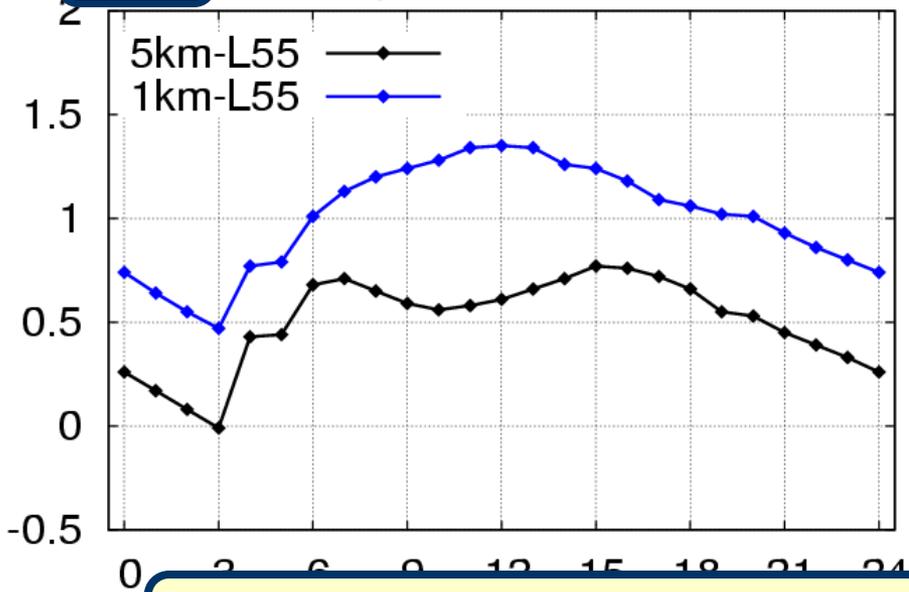
1 monthly mean RMSE of air Temp. at each station

1km ex. has larger warm bias than 5km ex.

気温差とRMSEの日変化 -1km/5km-

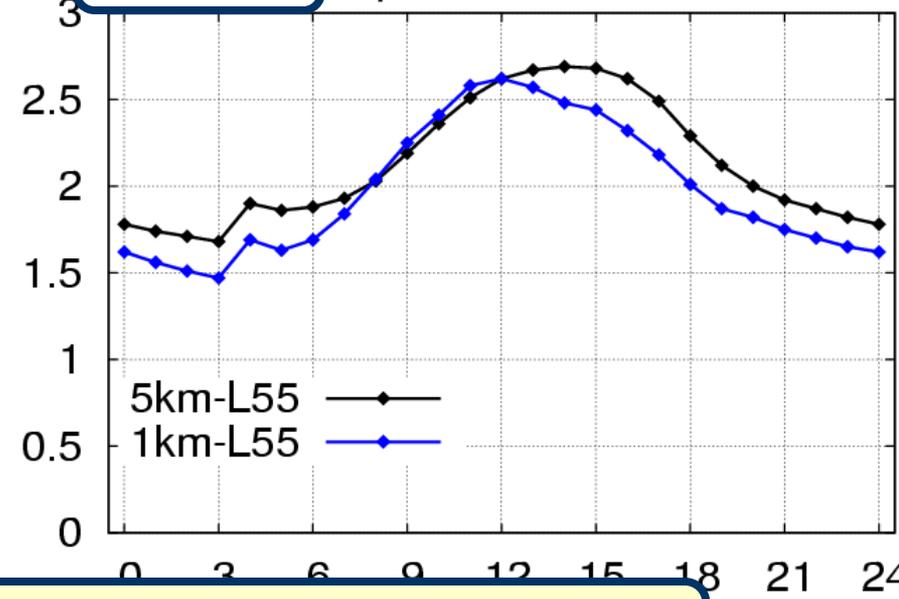
ME

temperature 200307



RMSE

temperature 200307

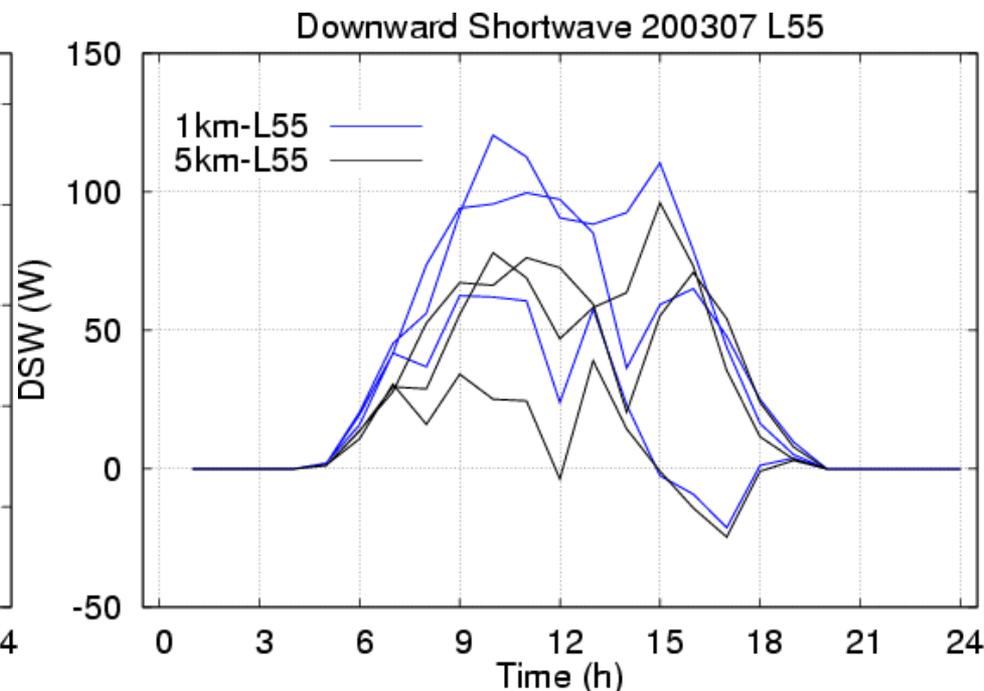
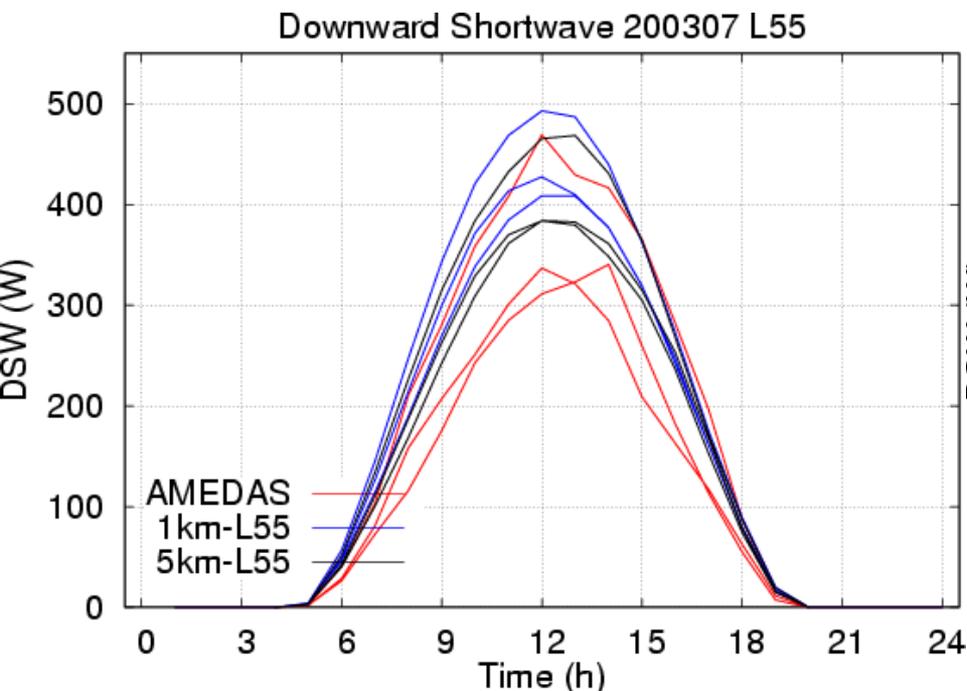


1-km ex. has larger warm bias than 5-km ex.
 RMSE is also larger in 1-km ex. than in 5-km ex.

black line : 5km
 blue line : 1km-ctl

black line : 5km
 blue line : 1km-ctl

短波放射の誤差の日変化



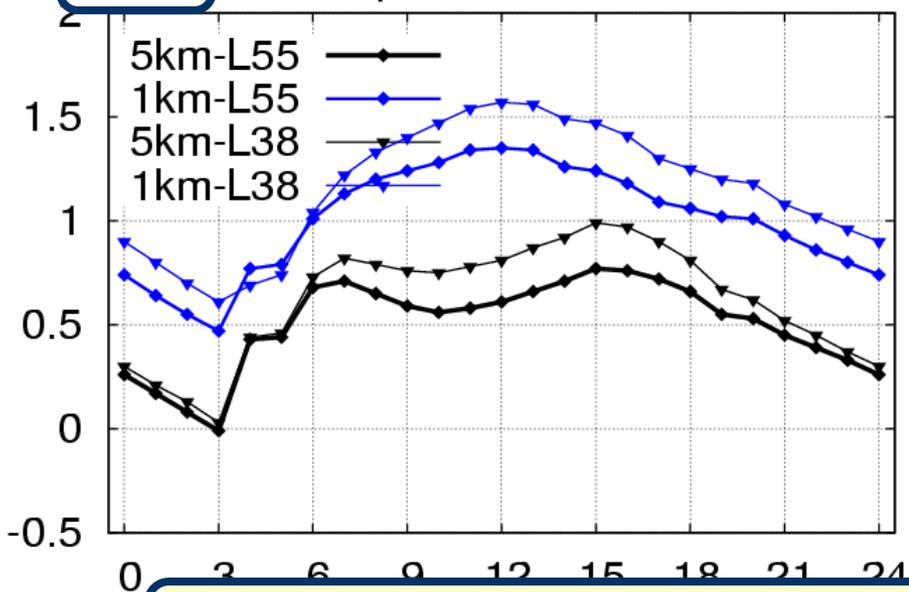
Monthly mean error of SWR
 black line : 5km
 blue line : 1km
 (sendai, yamagata, fukushima)

downward direction
 is positive

気温差とRMSEの日変化 -1km/5km-

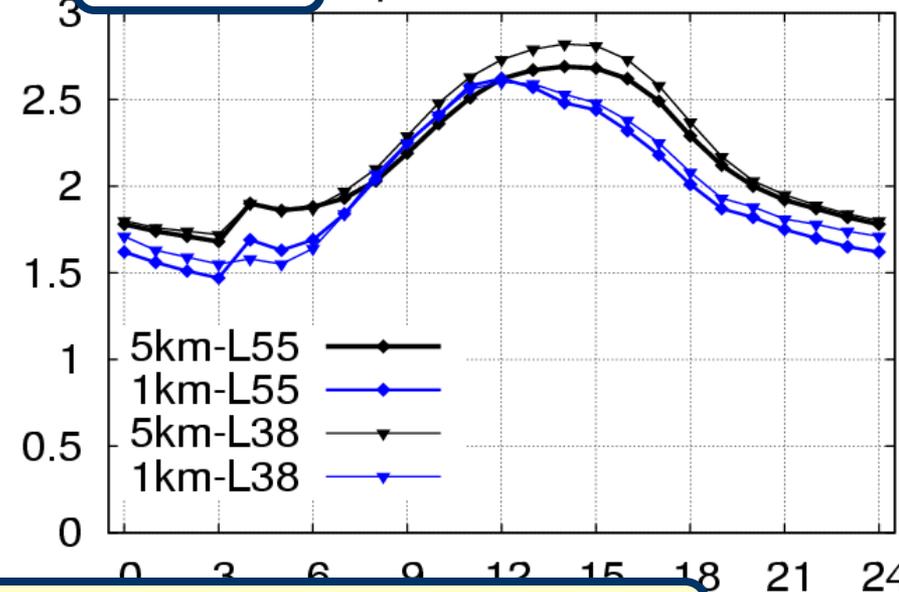
ME

temperature 200307



RMSE

temperature 200307



1-km ex. has larger warm bias than 5-km ex.
 RMSE is also larger in 1-km ex. than in 5-km ex.

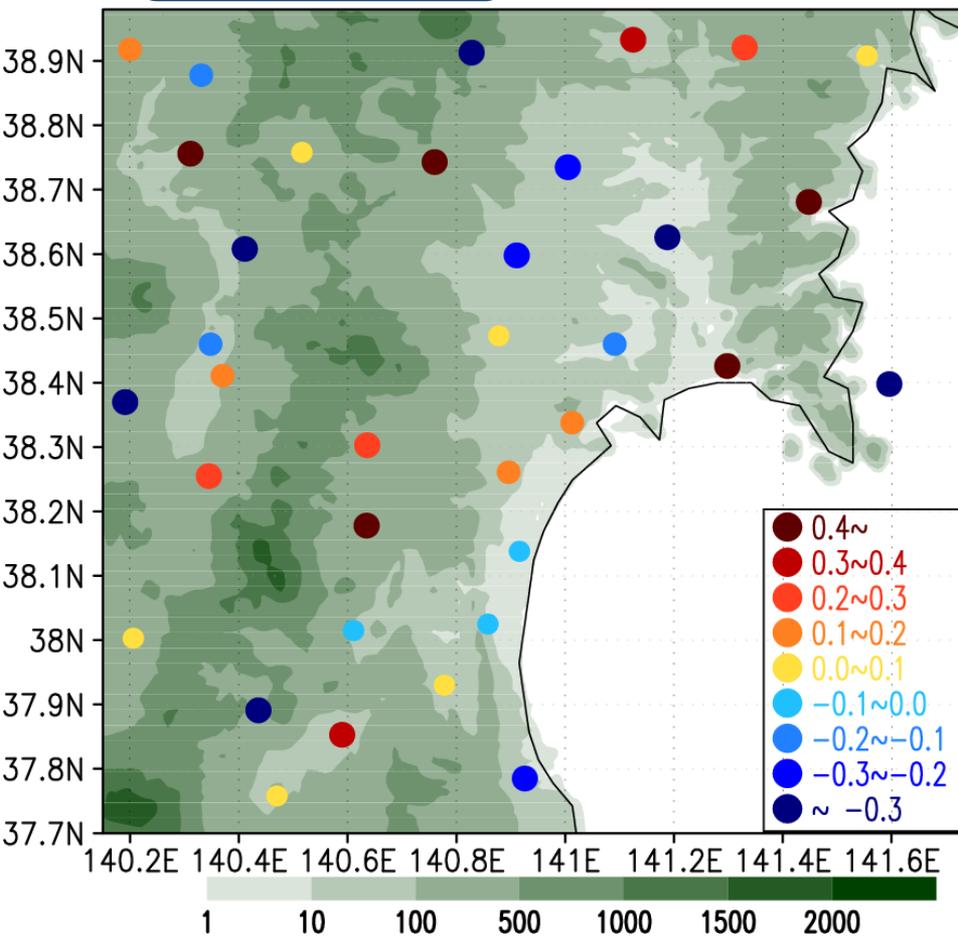
Mon
 black line : 5km-L38
 blue line : 1km-L38
 black line : 5km-L55
 blue line : 1km-L55

temp
 black line : 5km-L38
 blue line : 1km-L38
 black line : 5km-L55
 blue line : 1km-L55

気温のRMSE ~水平/鉛直~

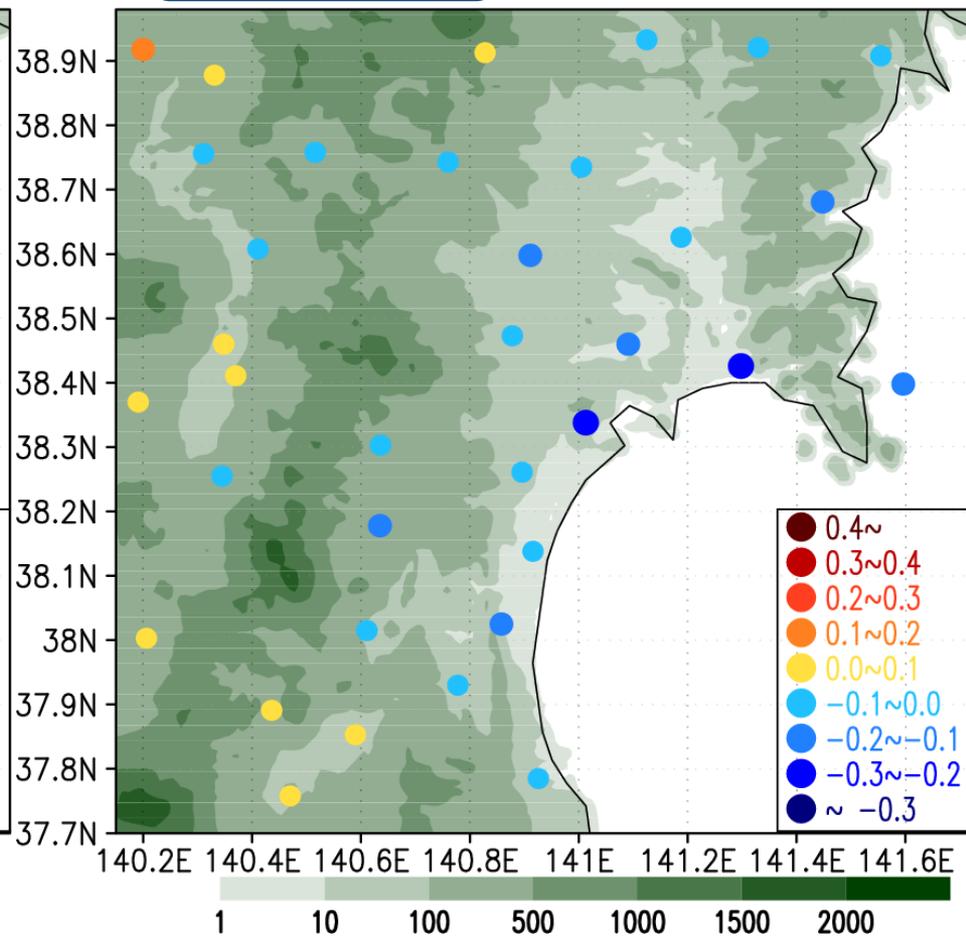
1km - 5km

TEMP 2003/07



L55 - L38

of TEMP 2003/07



monthly mean RMSE of air Temp. at each station

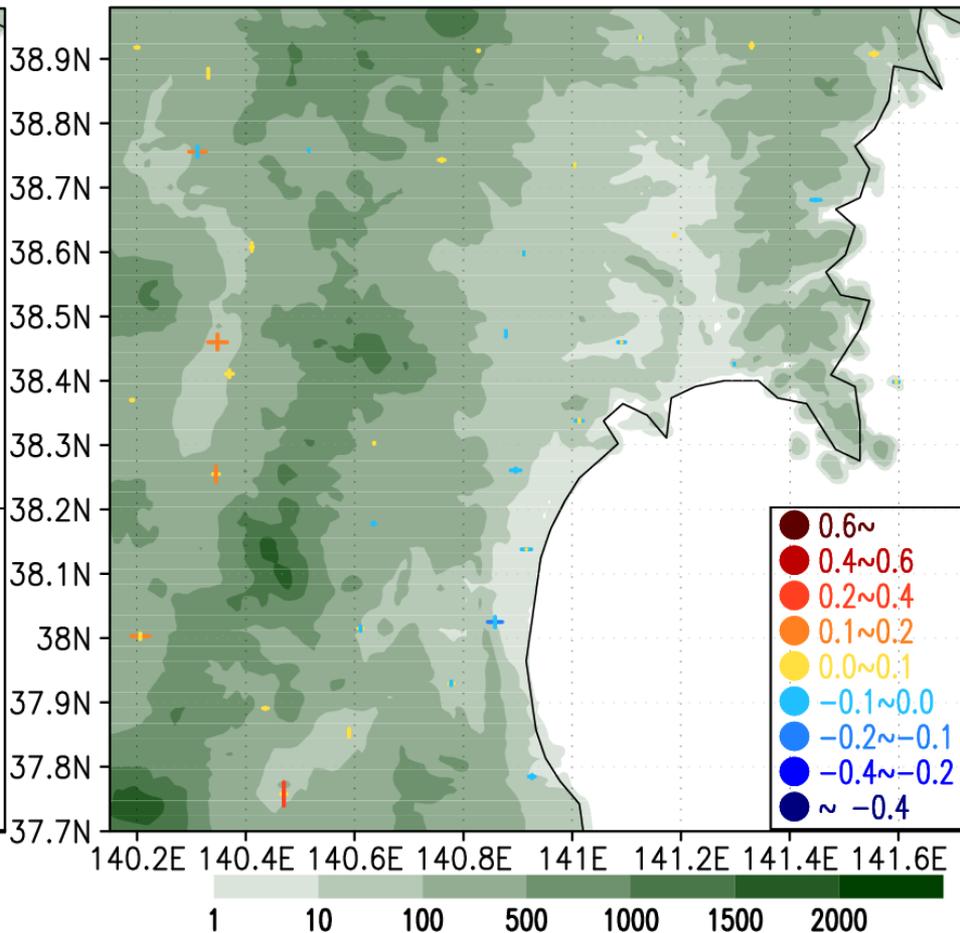
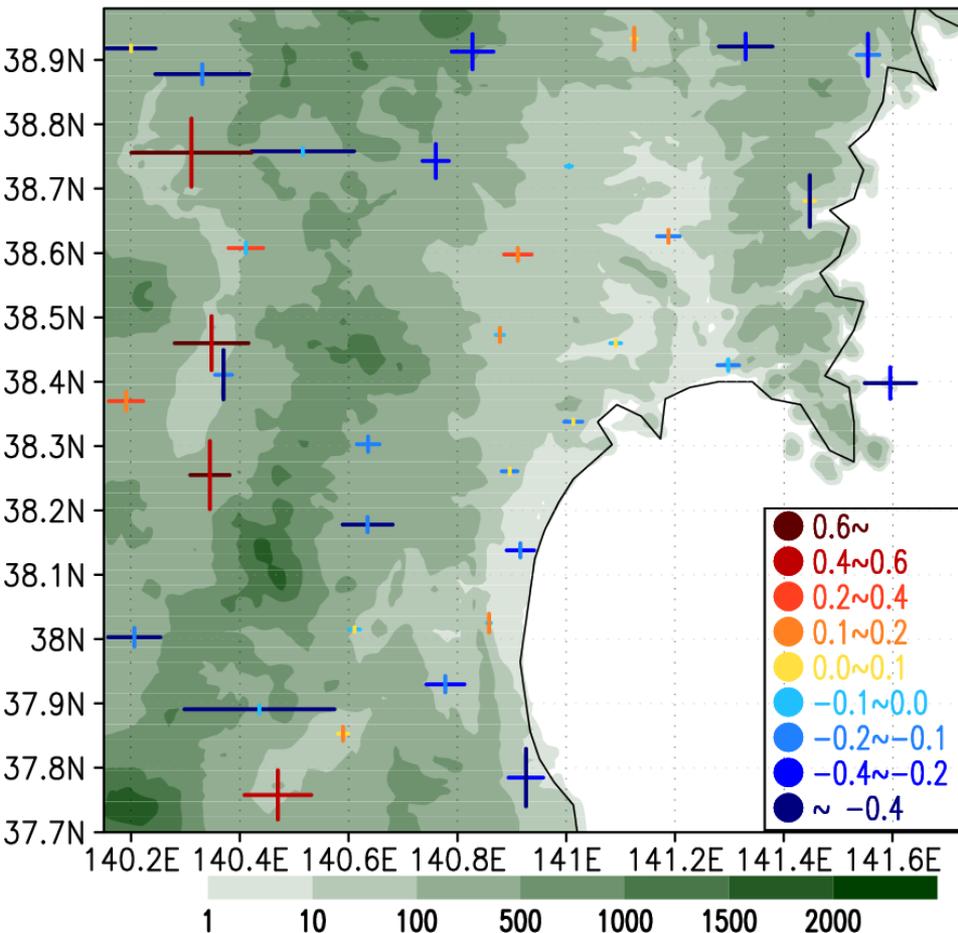
風のRMSE ~水平/鉛直~

1km - 5km

WIND 2003/07

L55 - L38

of WIND 2003/07

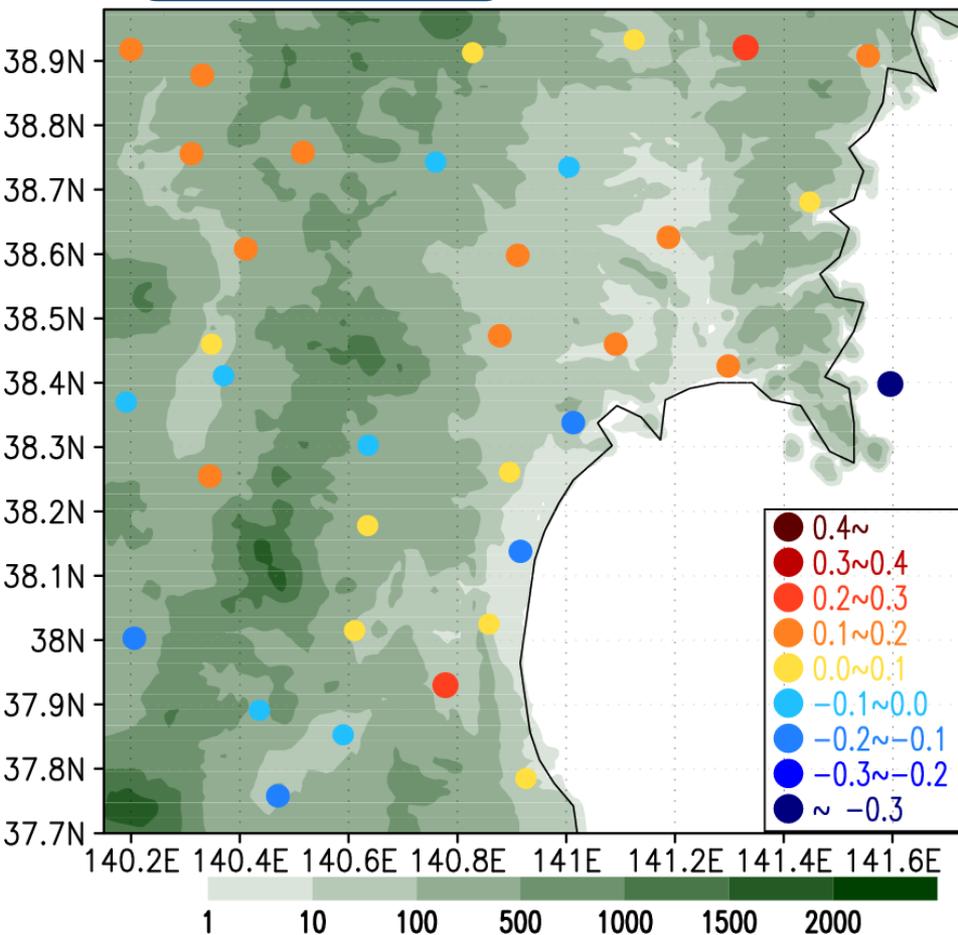


monthly mean RMSE of wind at each station

雨のRMSE ~水平/鉛直~

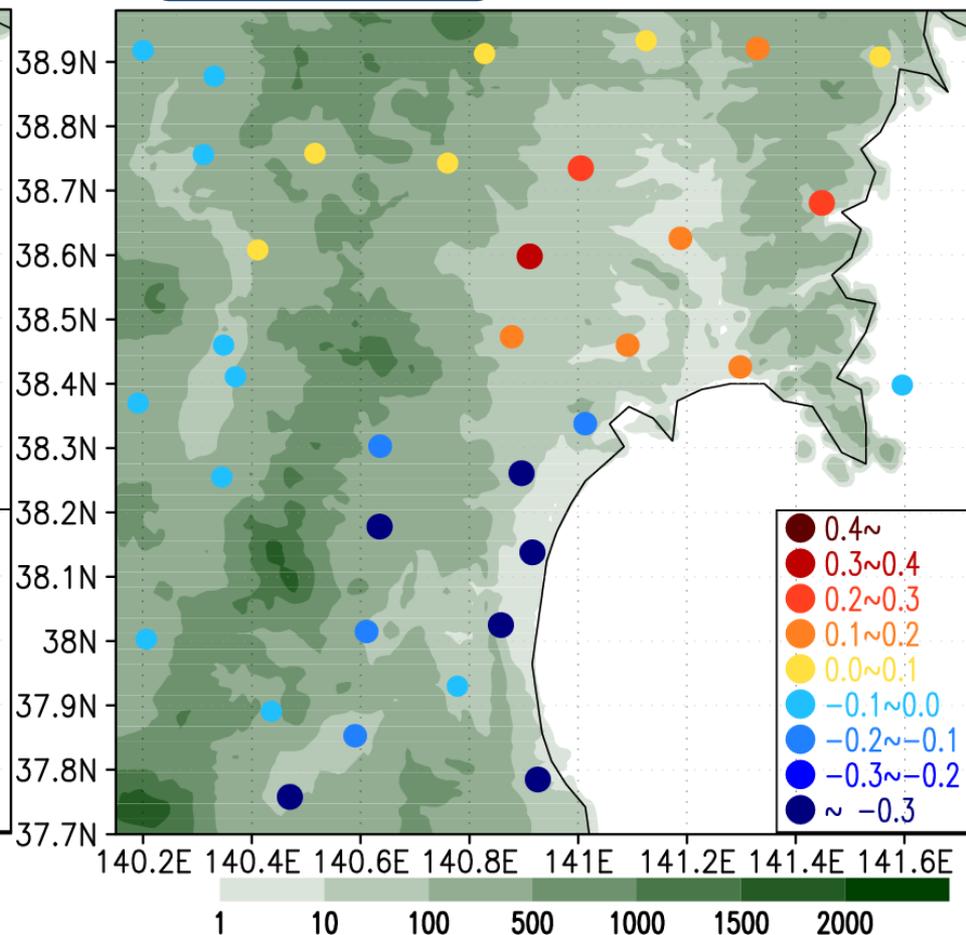
1km - 5km

RAIN 2003/07



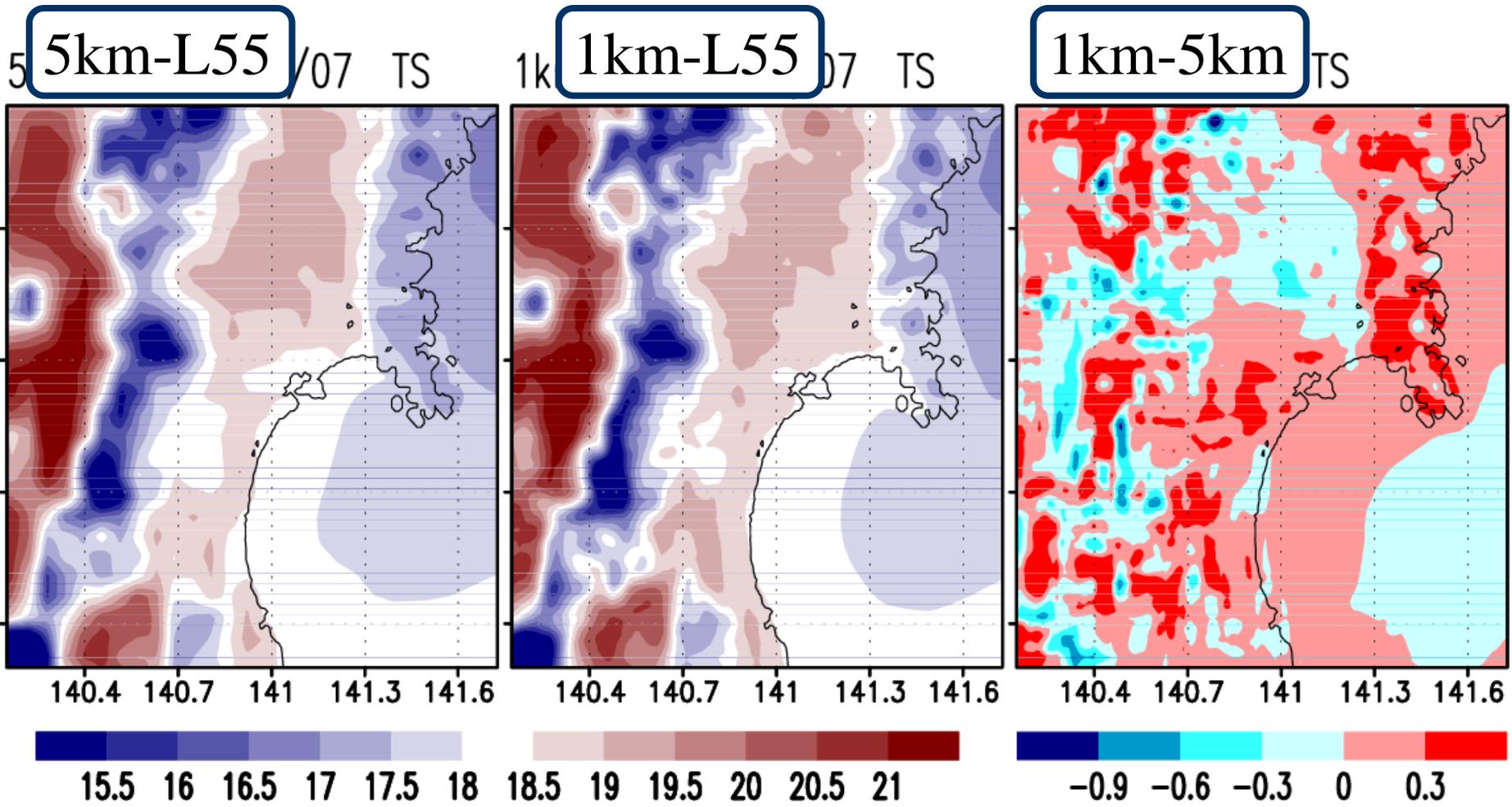
L55 - L38

of RAIN 2003/07



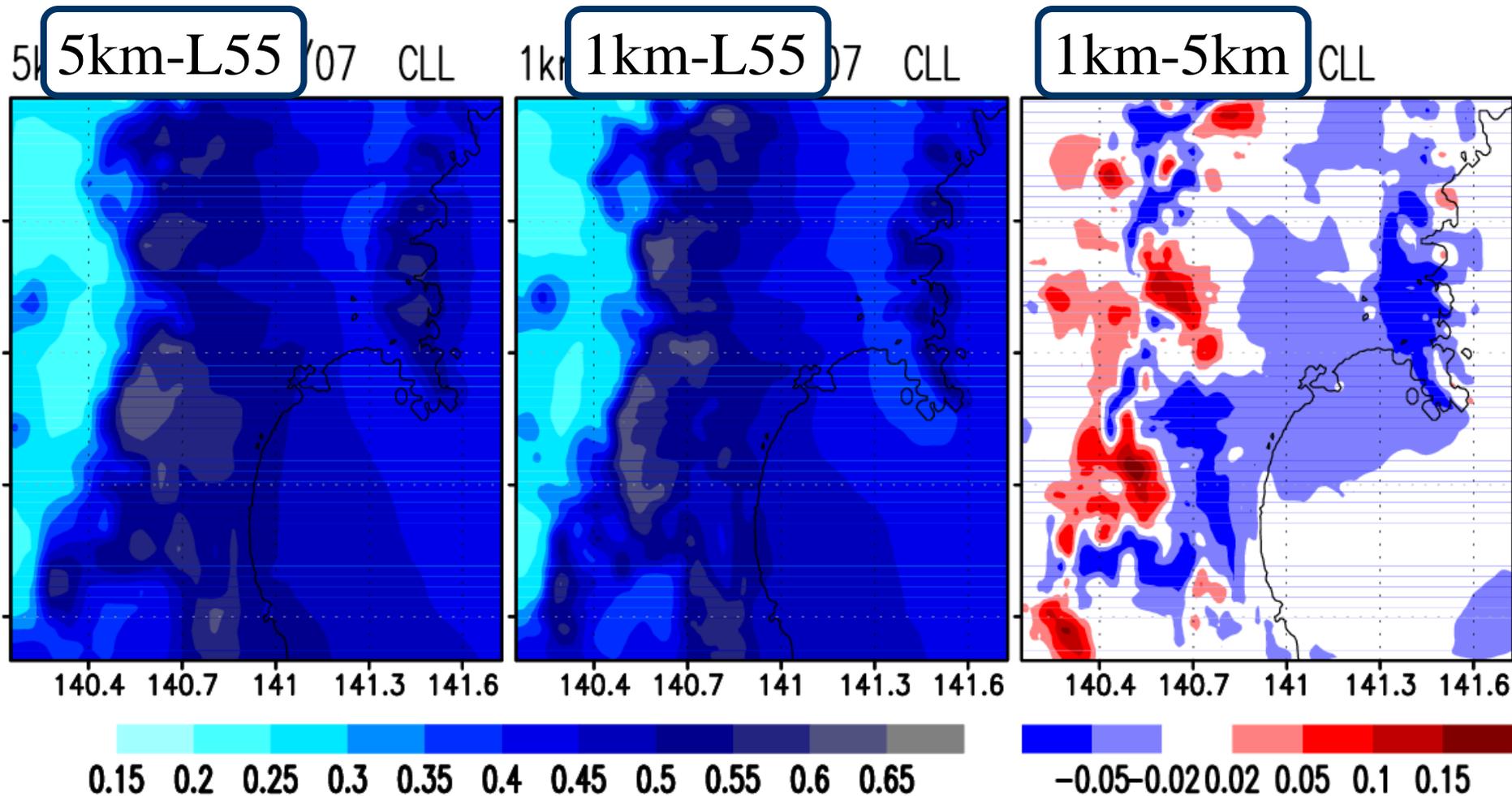
monthly mean RMSE of precipitation at each station

月平均した地上気温の差 -5km/1km-



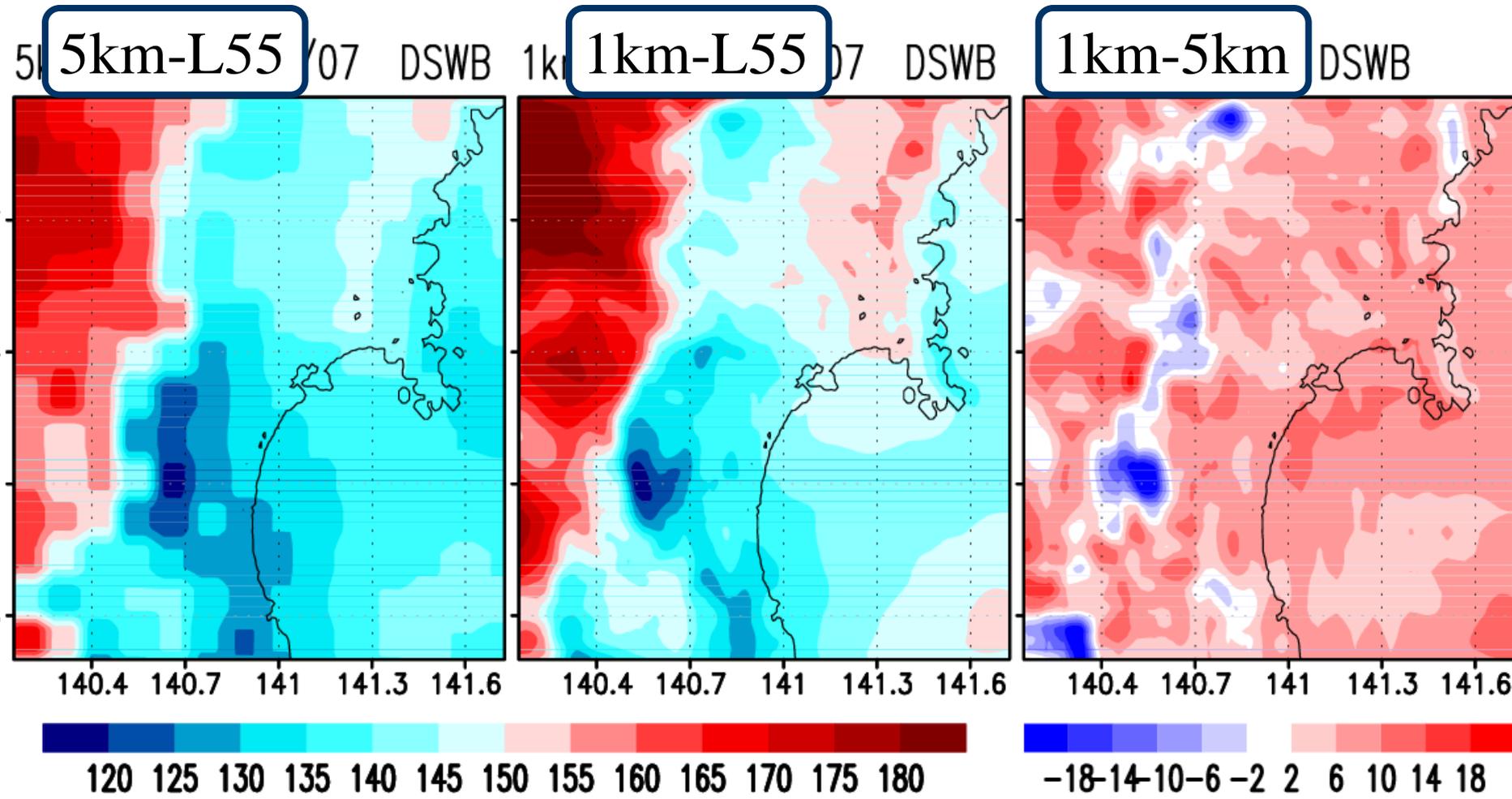
各時間で月平均した地上気温と下層雲量

月平均した下層雲量の差 -5km/1km-



各時間で月平均した地上気温と下層雲量

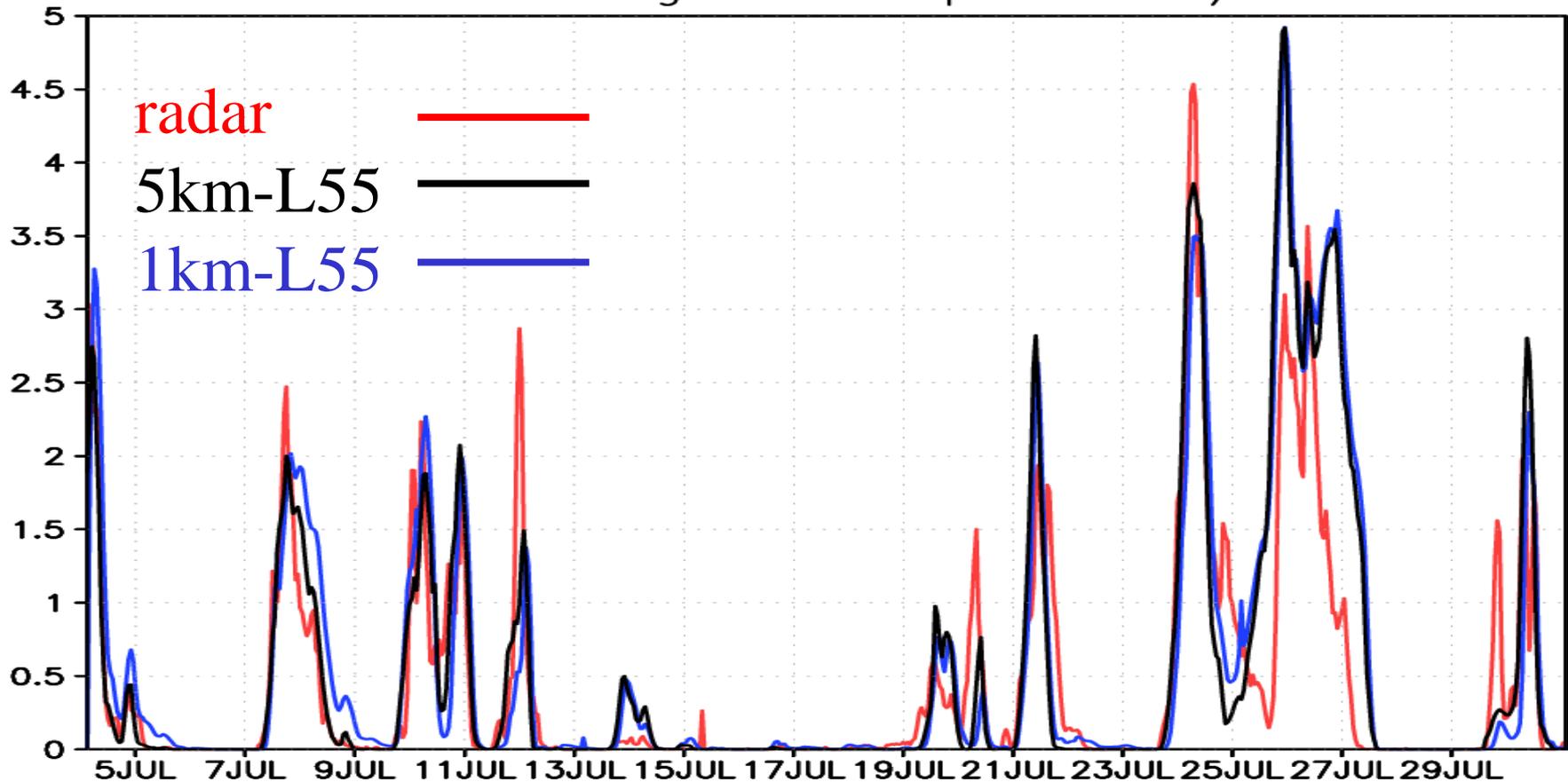
月平均した下向短波放射の差 -5km/1km-



各時間で月平均した地上気温と下層雲量

レーダーアメダスとの比較

area-averaged rain spec 2003/07

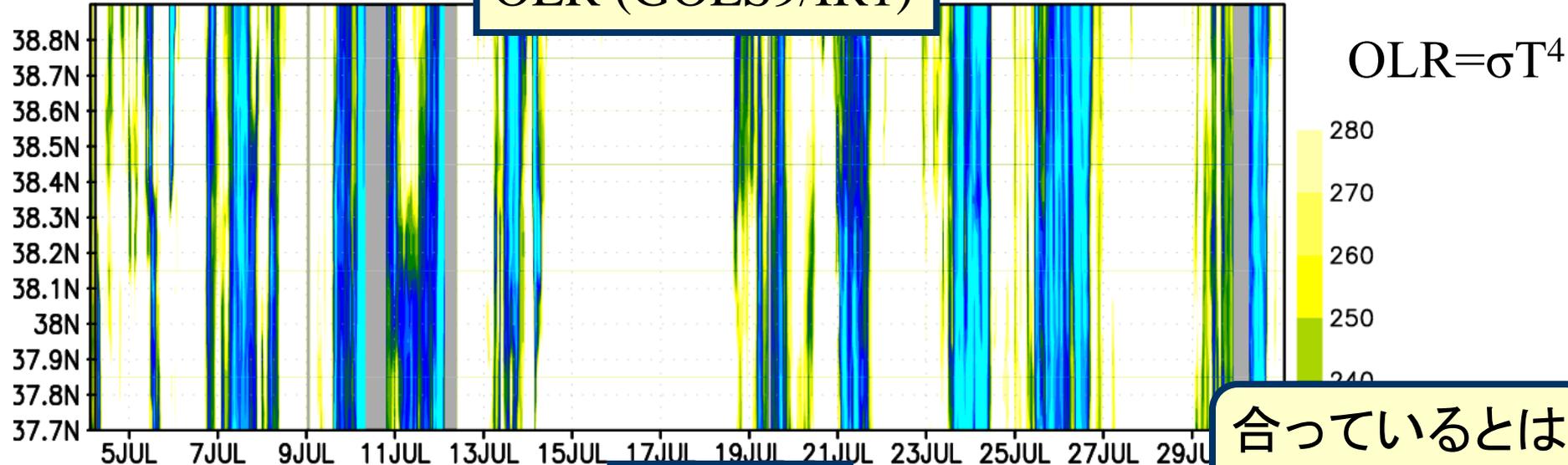


降水量のピークはモデルの方が小さい

領域平均した降水量の時系列

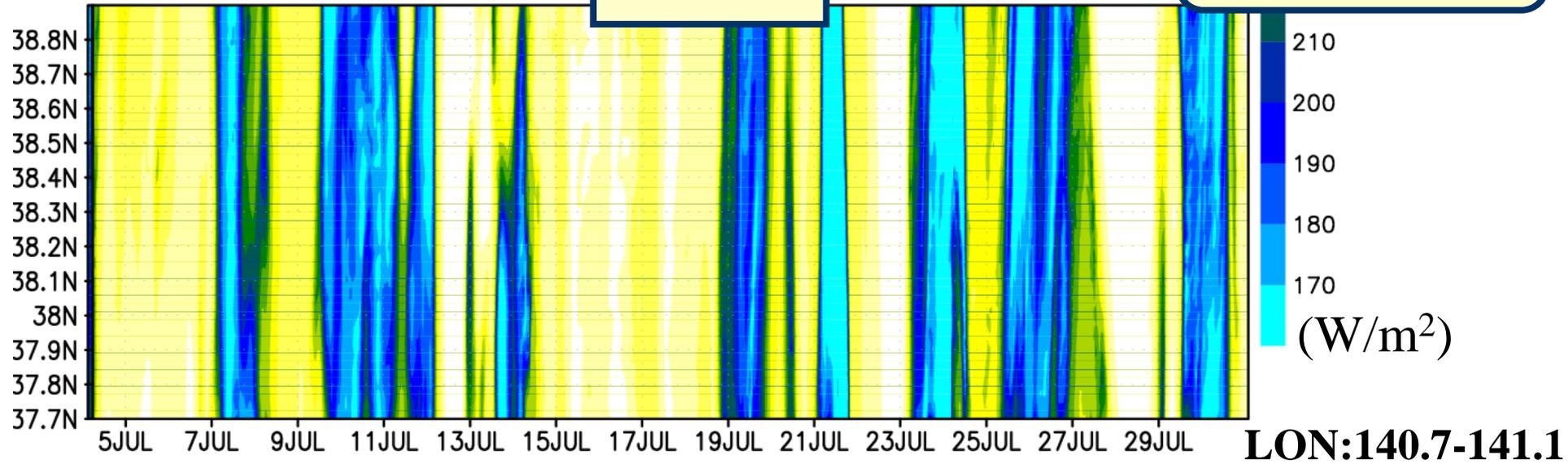
衛星/赤外との比較

OLR (GOES9/IR1)



合っているとは
言い難い...

OLR : 1km-L55 5



まとめ

■ ダウンスケールのありがたみ

- 水平解像度: 1km \leftrightarrow 5km

1kmの方がRMSE(バラツキ)はやや小さい。

※場所に大きく依存。改悪もある。

1kmの方が高温バイアスが大きくなる。

=> 短波放射が多くなるため(下層雲量が少ない?)

- 鉛直解像度: L55 \leftrightarrow L38

L55の方がRMSE(バラツキ)は小さい(太平洋側)。

バイアスはほぼ変わらず。

- レーダーアメダス、衛星データ(IR)との比較
どの解像度でも雲の空間パターンが合わない。

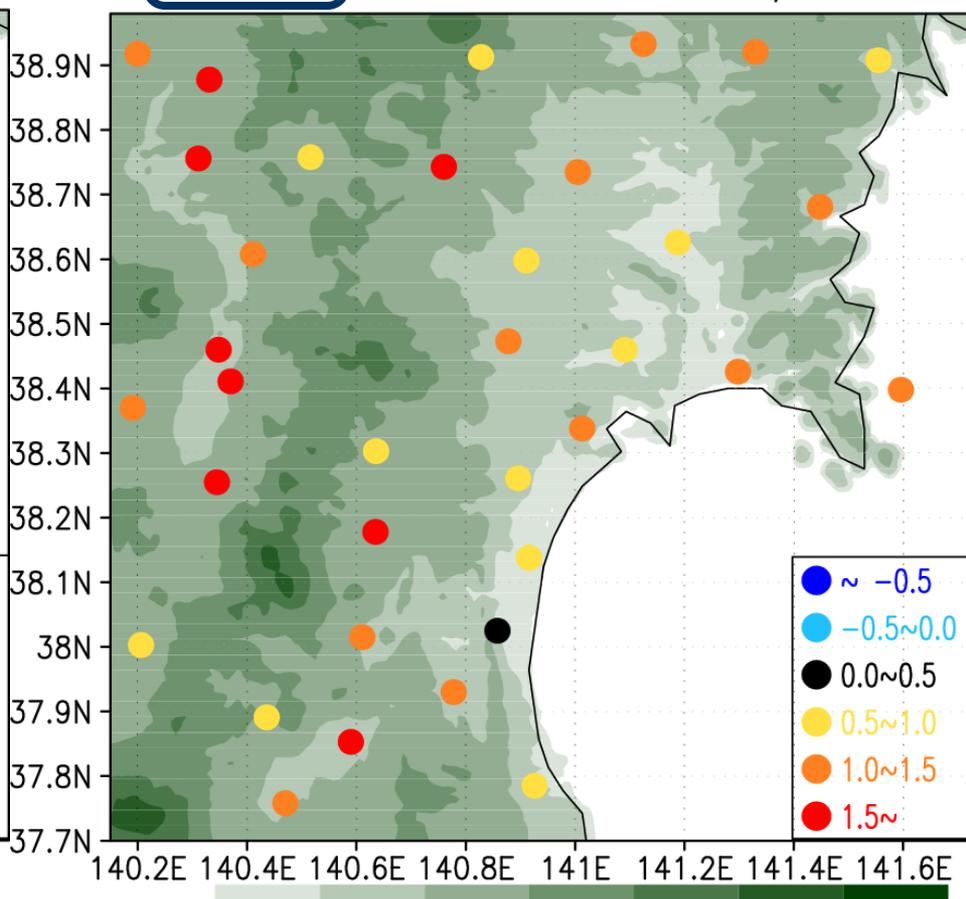
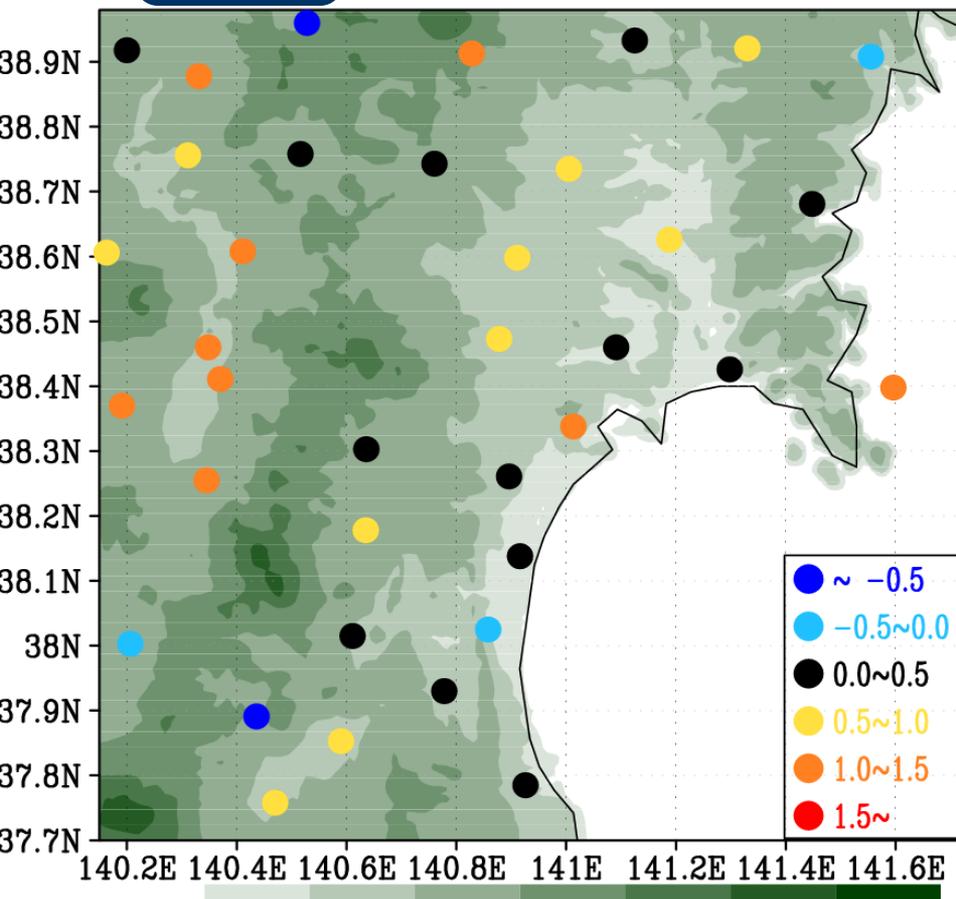
月平均気温の差 水平解像度の違い

5-km

: DIFF of TEMP 2003/07

1-km

: DIFF of TEMP 2003/07



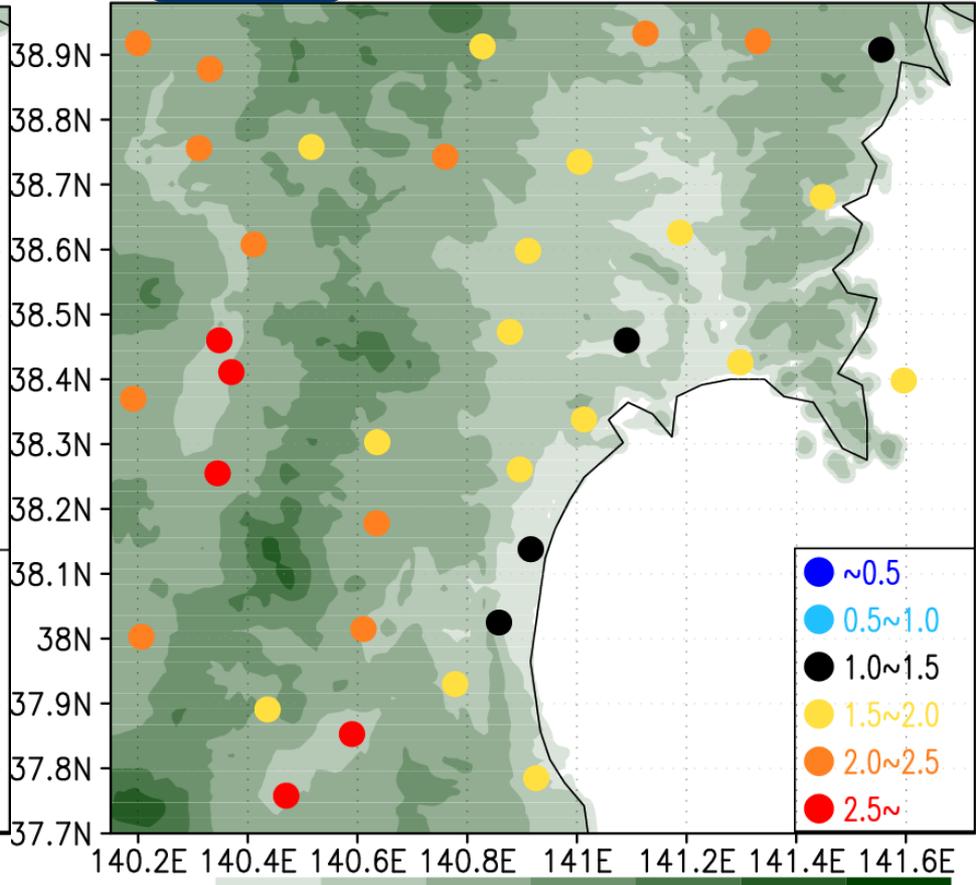
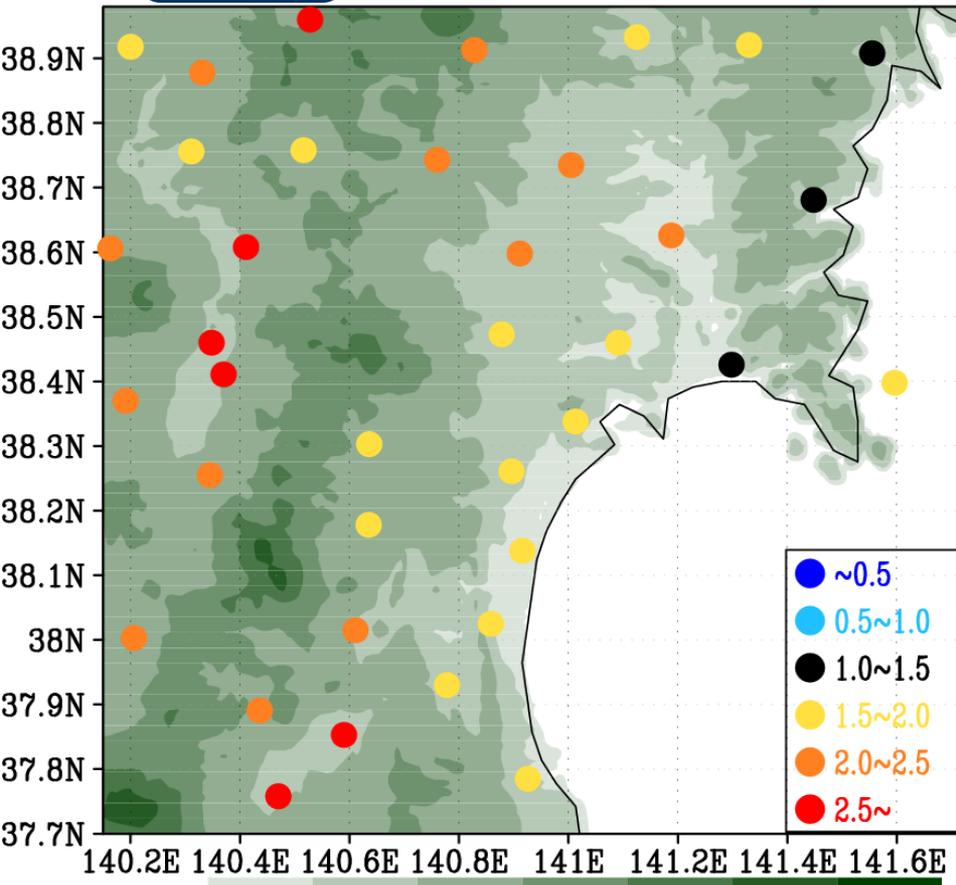
1 monthly mean ME of air Temp. at each station

1km ex. has larger warm bias than 5km ex.

気温のRMSE 水平解像度の違い

5-km : RMSE of TEMP 2003/07

1-km : RMSE of TEMP 2003/07



1 monthly mean RMSE of air Temp. at each station

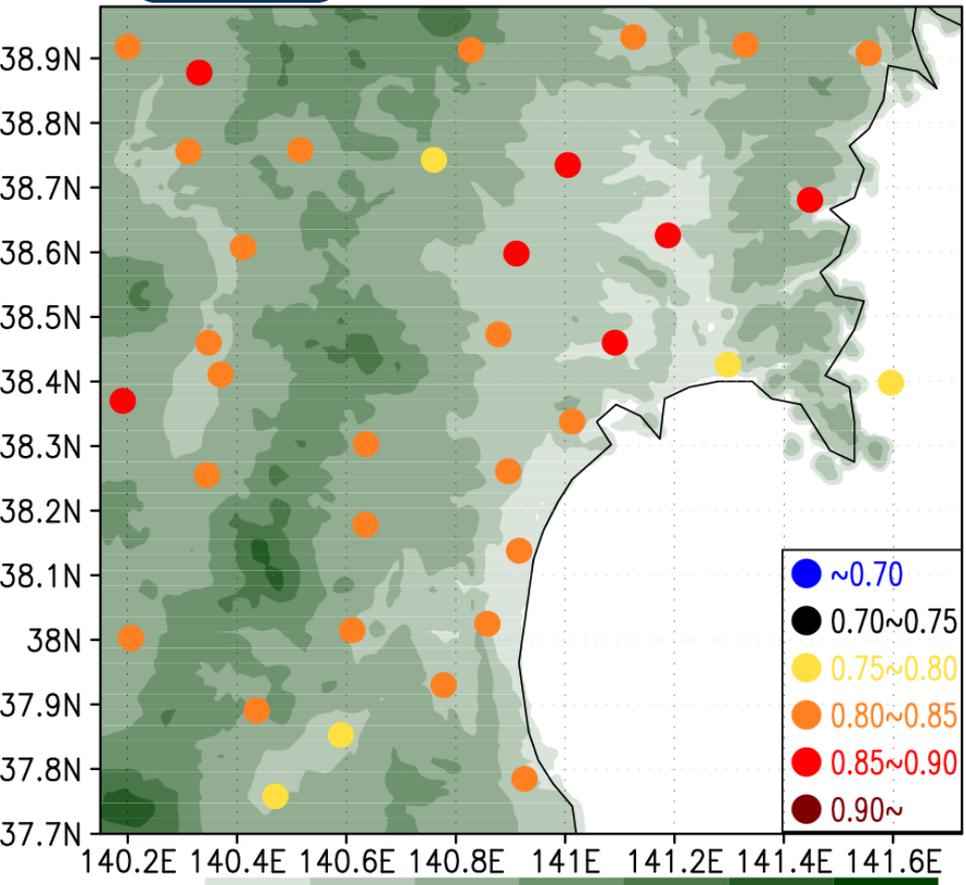
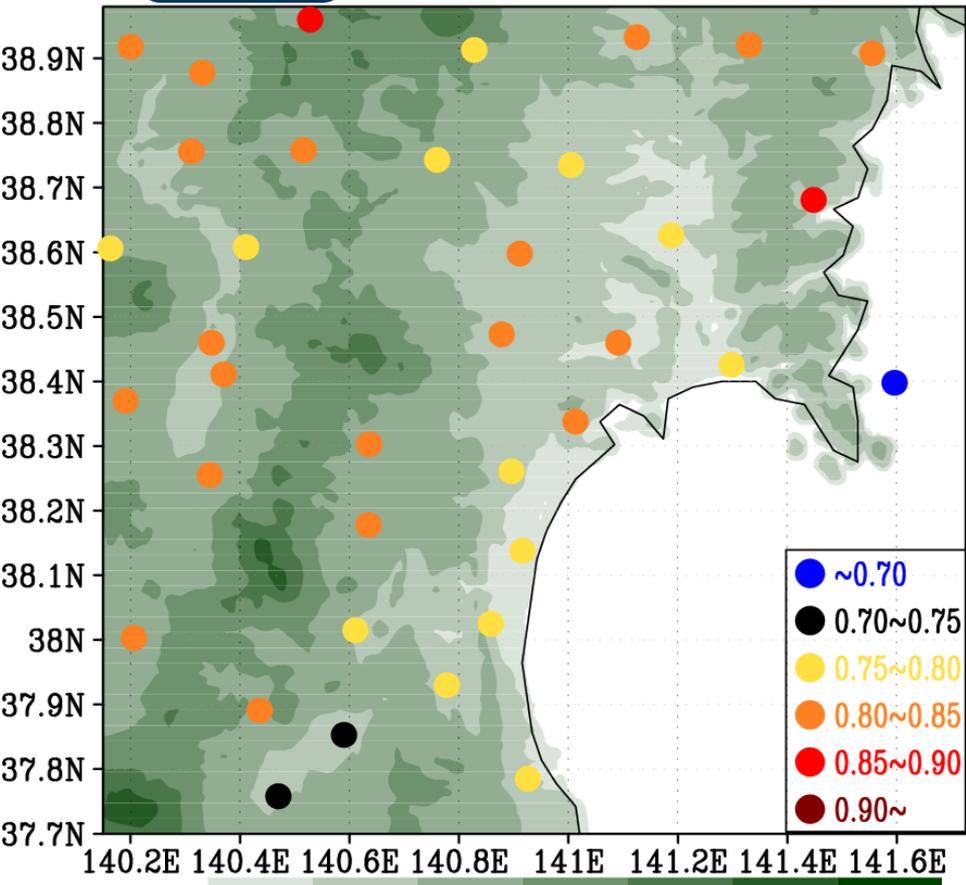
1km ex. has larger warm bias than 5km ex.

2000

気温の相関係数 水平解像度の違い

5-km : COR of TEMP 2003/07

1-km : COR of TEMP 2003/07



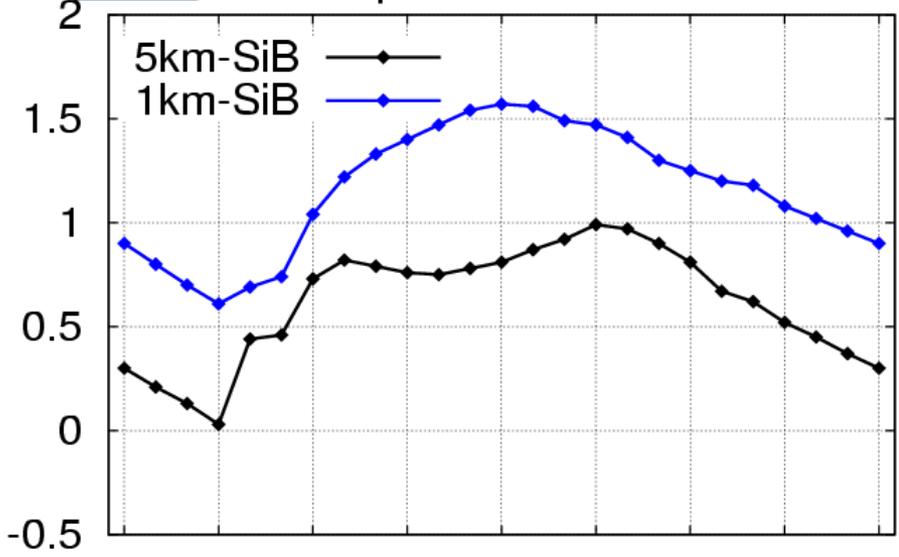
1 monthly mean correlation of air Temp. at each station

1km ex. has larger warm bias than 5km ex.

気温差とRMSEの日変化 -1km/5km-

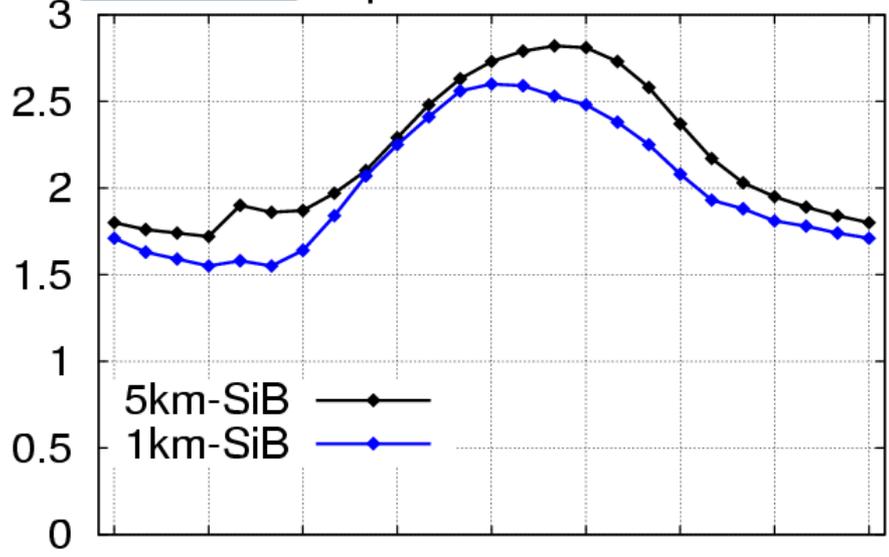
ME

temperature 200307



RMSE

temperature 200307

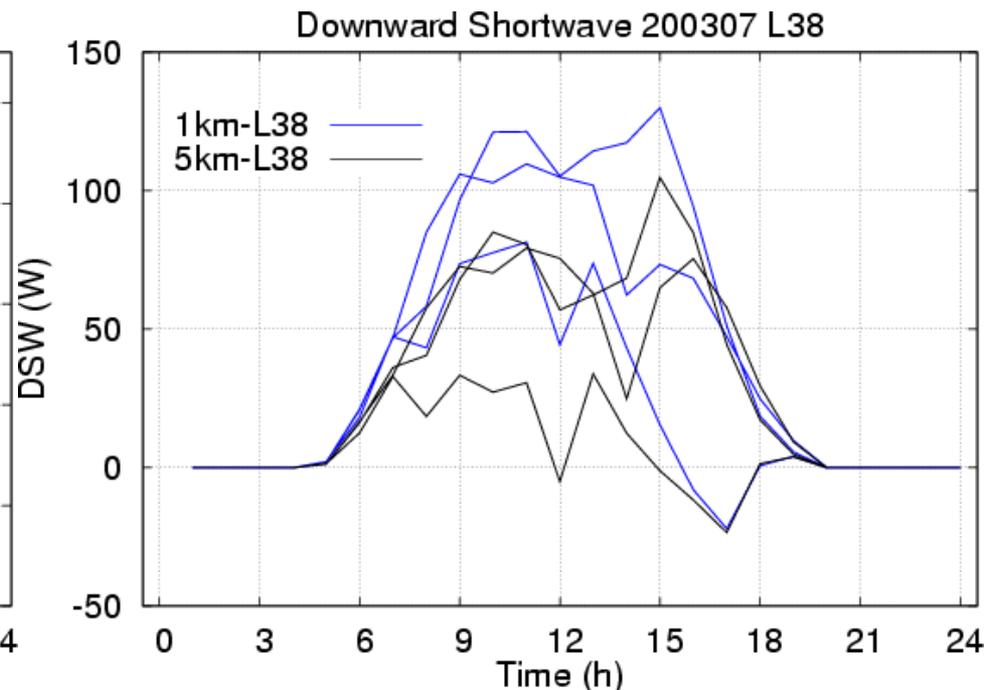
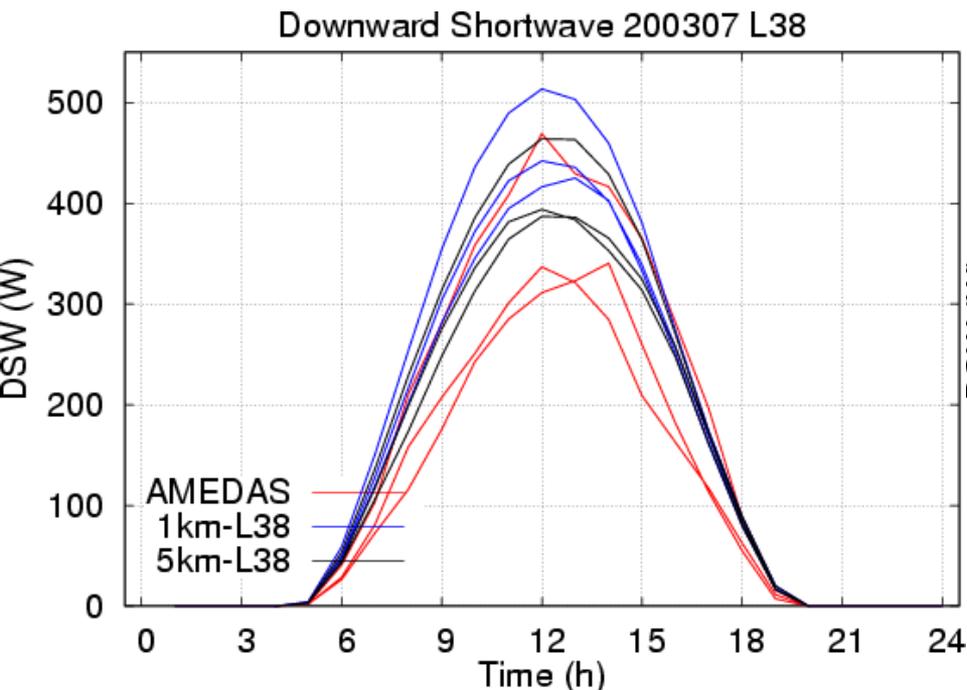


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black line : 5km
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 blue line : 1km-ctl

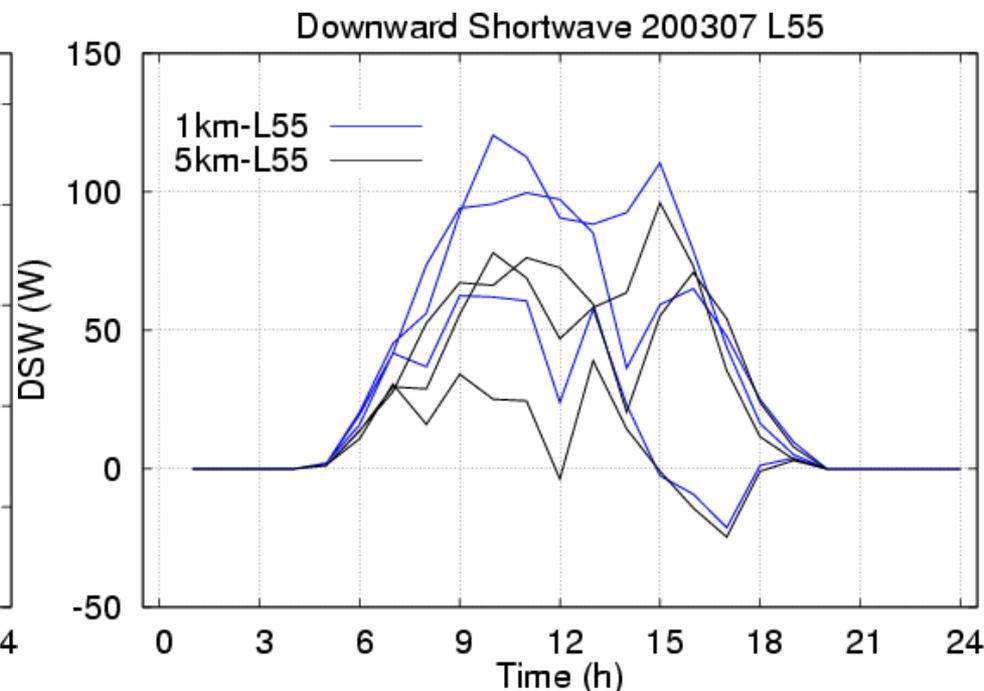
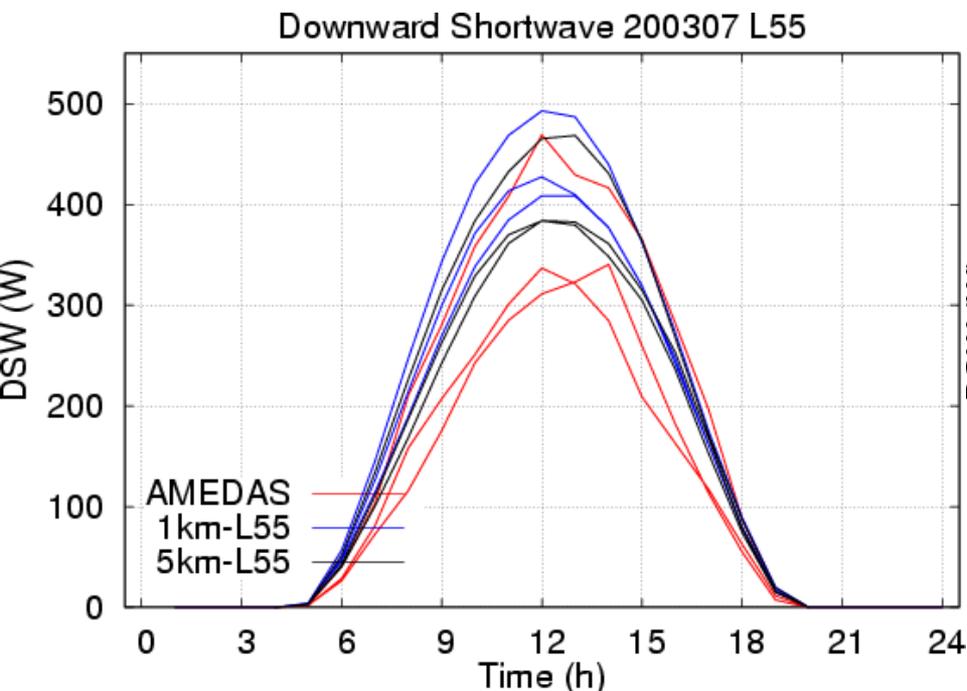
短波放射の誤差の日変化



Monthly mean error of SWR
 black line : 5km
 blue line : 1km
 (sendai, yamagata, fukushima)

downward direction
 is positive L38

短波放射のRMSEの日変化



Monthly RMSE of SWR
 black line : 5km
 blue line : 1km
 (sendai, yamagata, fukushima)

downward direction
 is positive

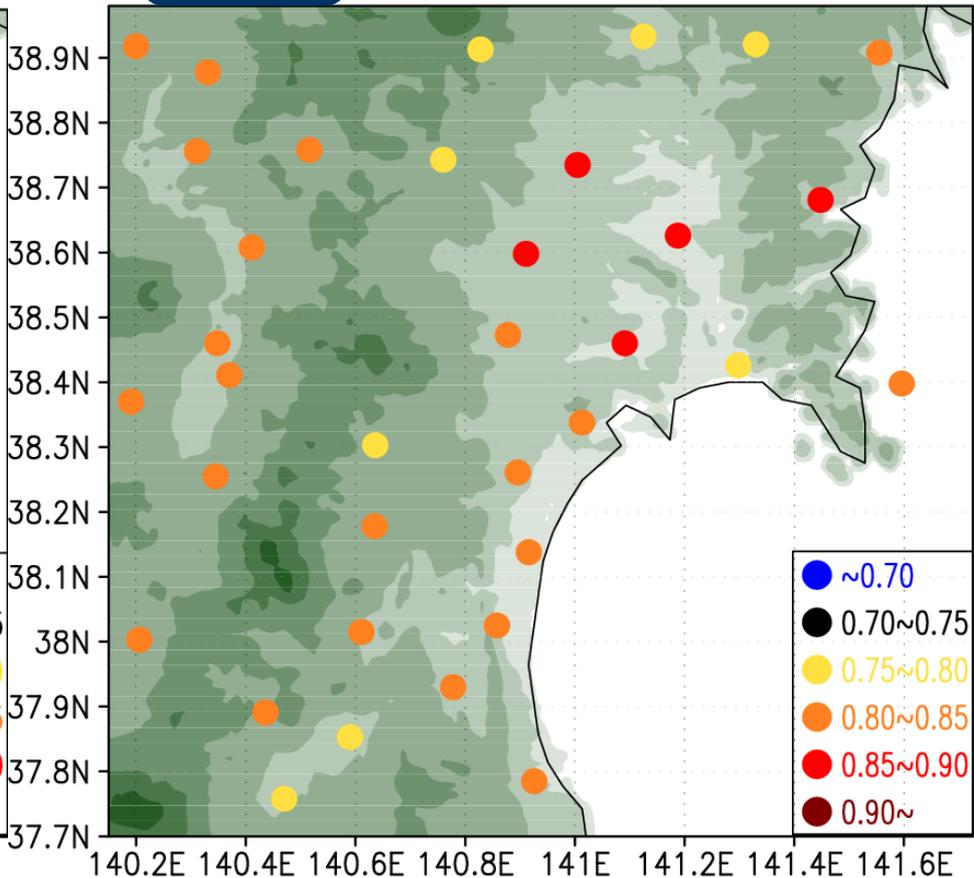
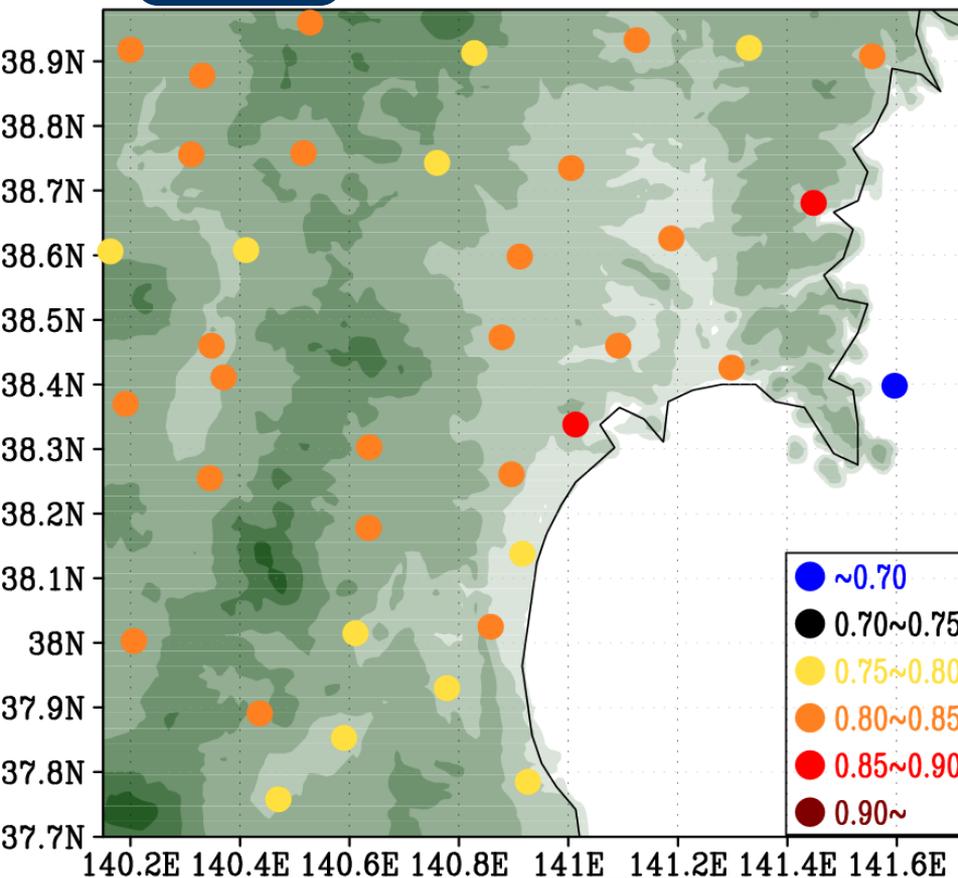
気温の相関係数 水平解像度の違い

5-km

) : COR of TEMP 2003/07

1-km

COR of TEMP 2003/07



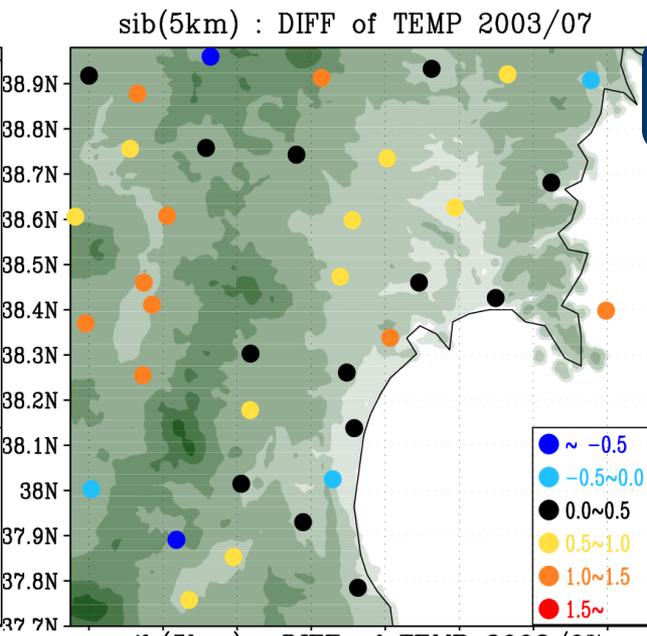
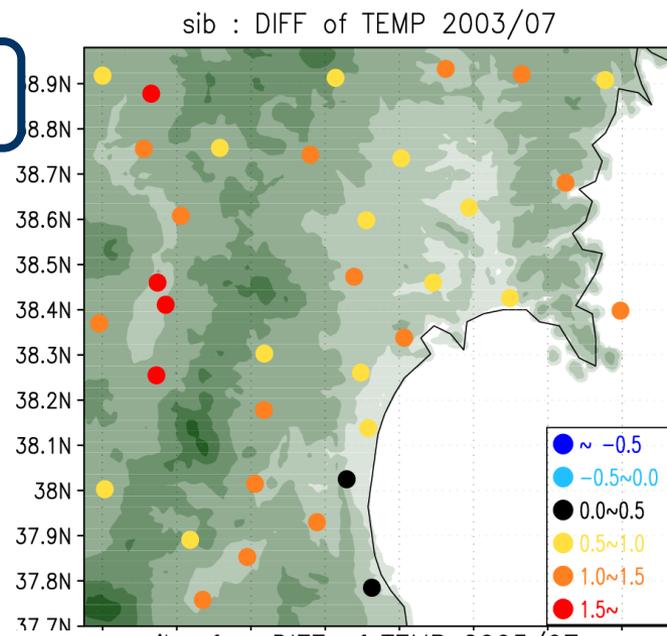
1

monthly mean correlation of air Temp. at each station

1km ex. has larger warm bias than 5km ex.

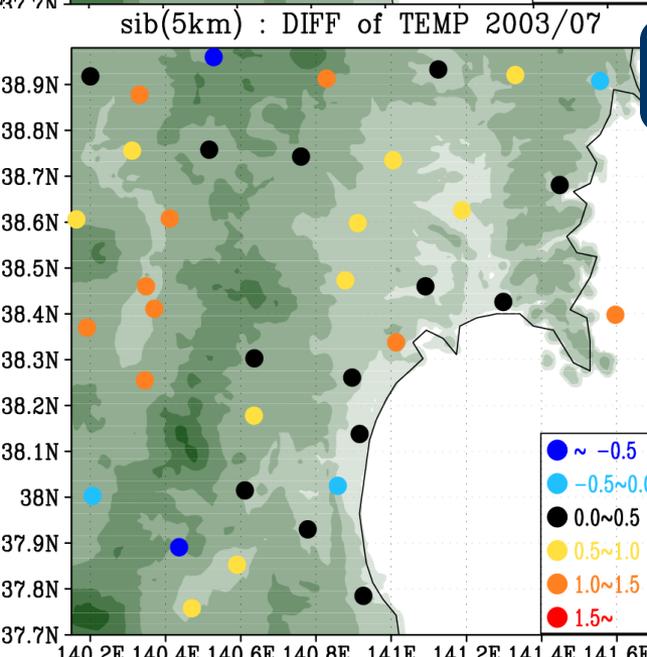
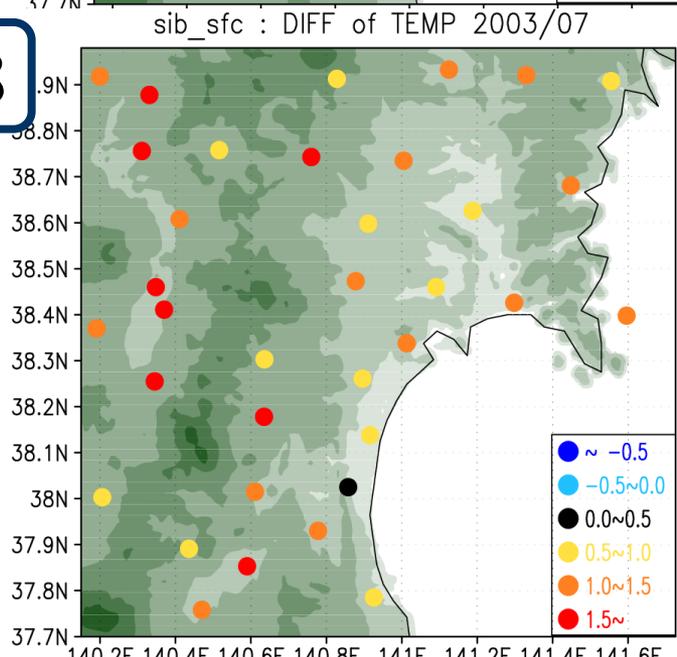
月平均気温の差 鉛直解像度の違い

1km-L55



5km-L55

1km-L38



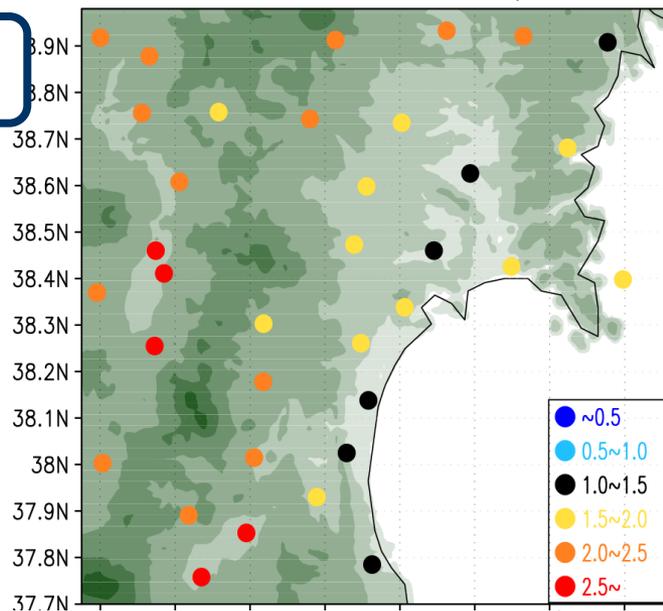
5km-L38

気温のRMSE 鉛直解像度の違い

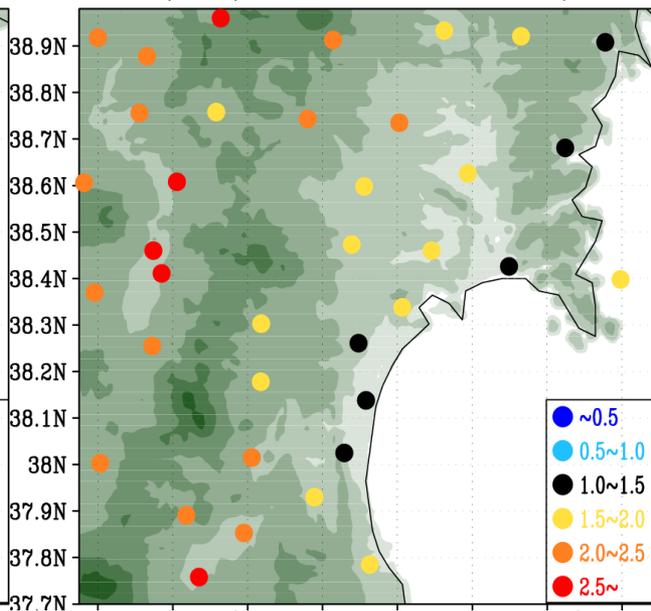
sib : RMSE of TEMP 2003/07

sib(5km) : RMSE of TEMP 2003/07

1km-L55



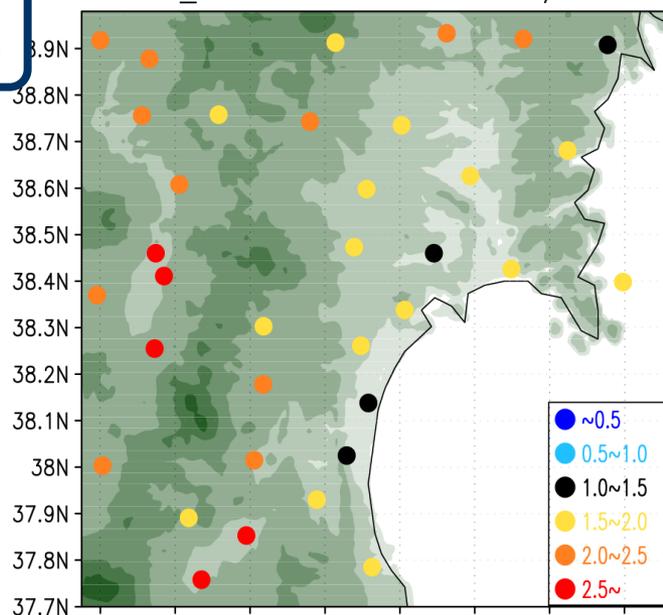
5km-L55



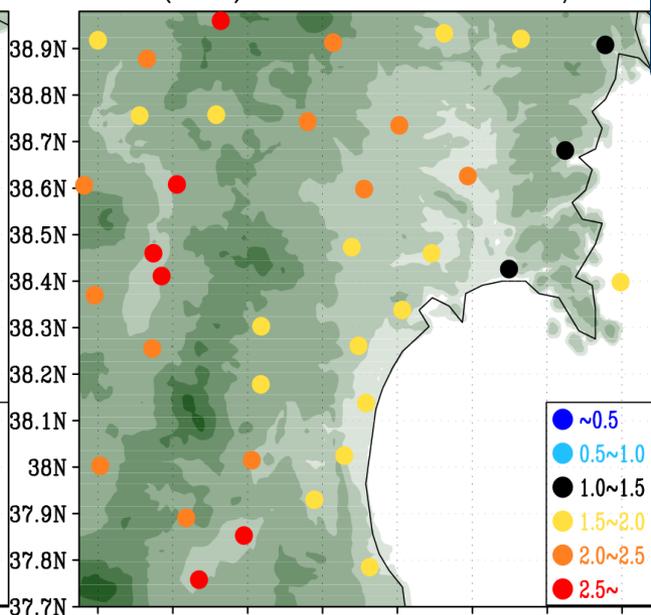
1km-L38

sib_sfc : RMSE of TEMP 2003/07

sib(5km) : RMSE of TEMP 2003/07



5km-L38



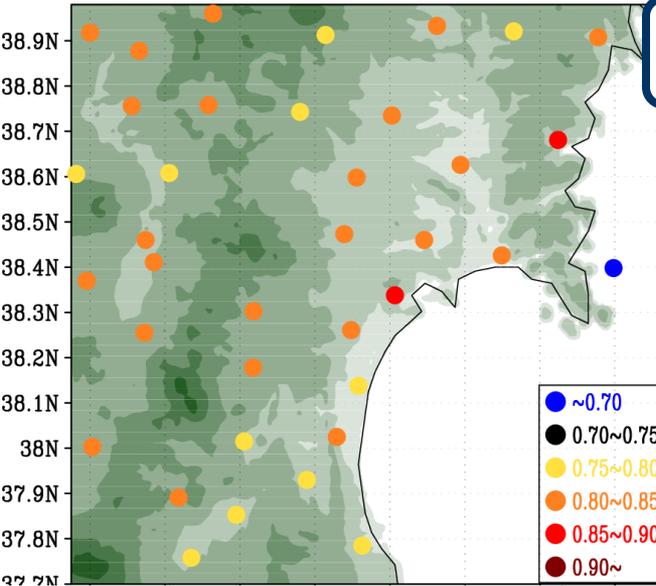
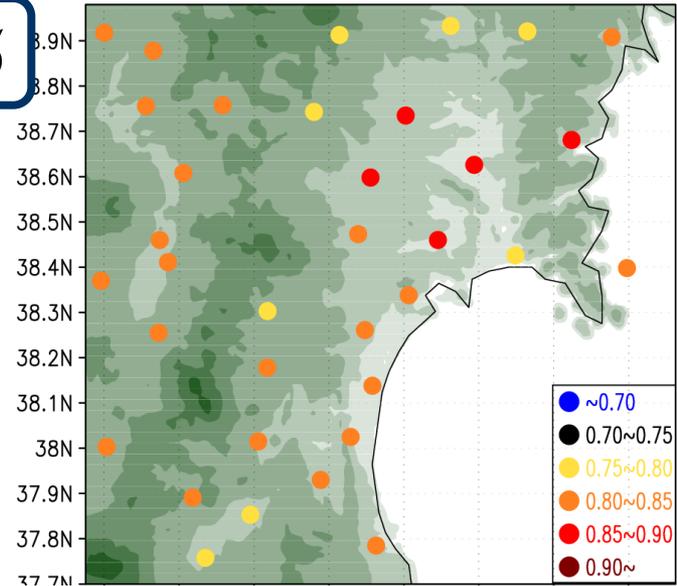
気温の相関係数 鉛直解像度の違い

sib : COR of TEMP 2003/07

sib(5km) : COR of TEMP 2003/07

1km-L55

5km-L55

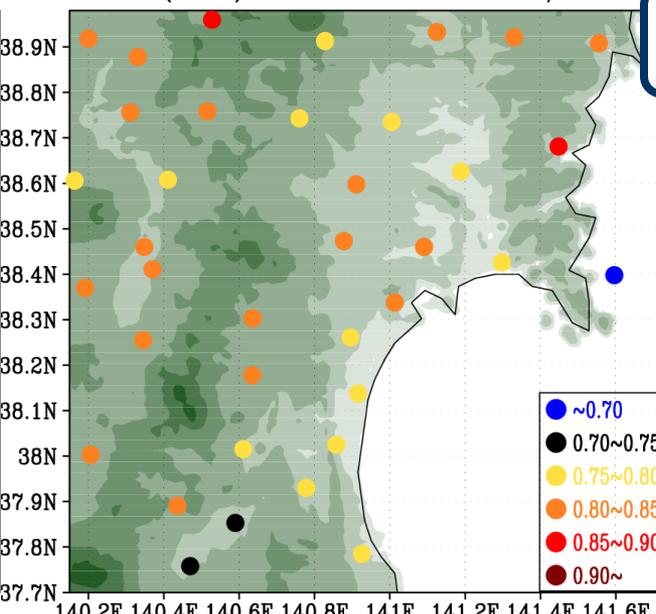
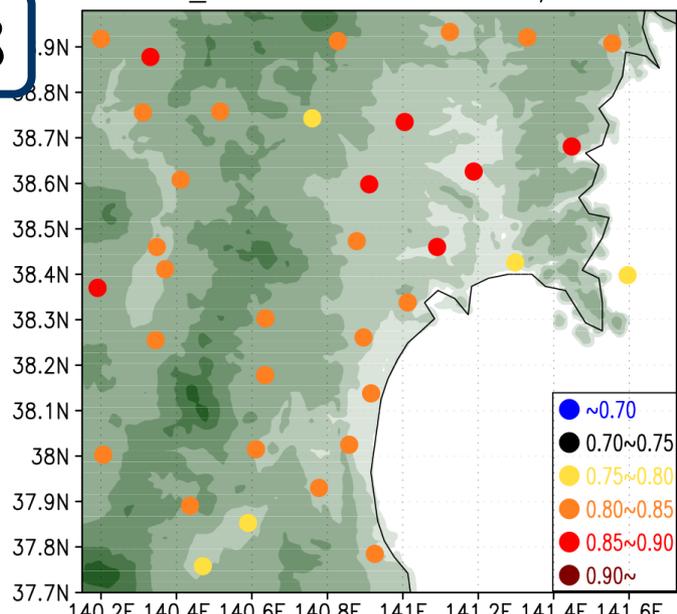


sib_sfc : COR of TEMP 2003/07

sib(5km) : COR of TEMP 2003/07

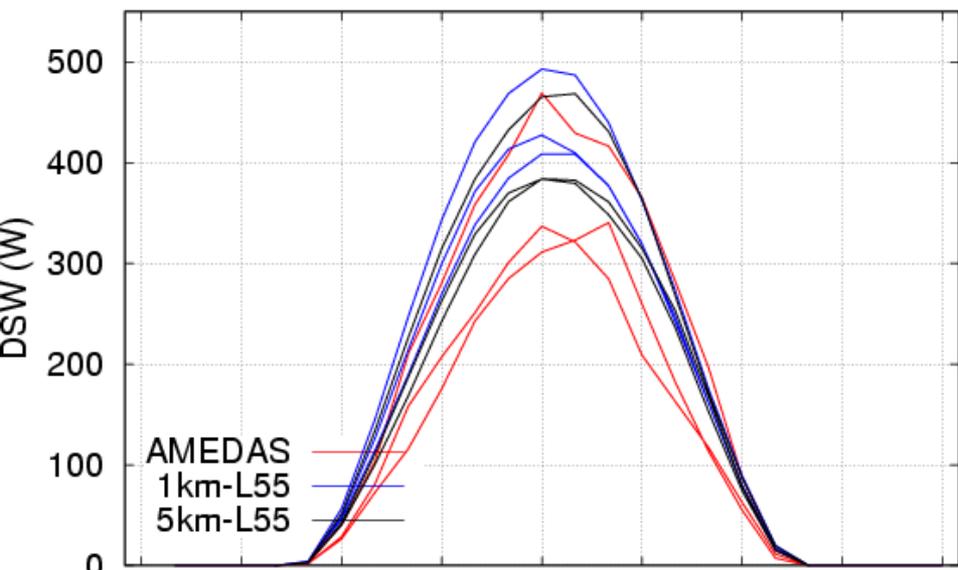
1km-L38

5km-L38

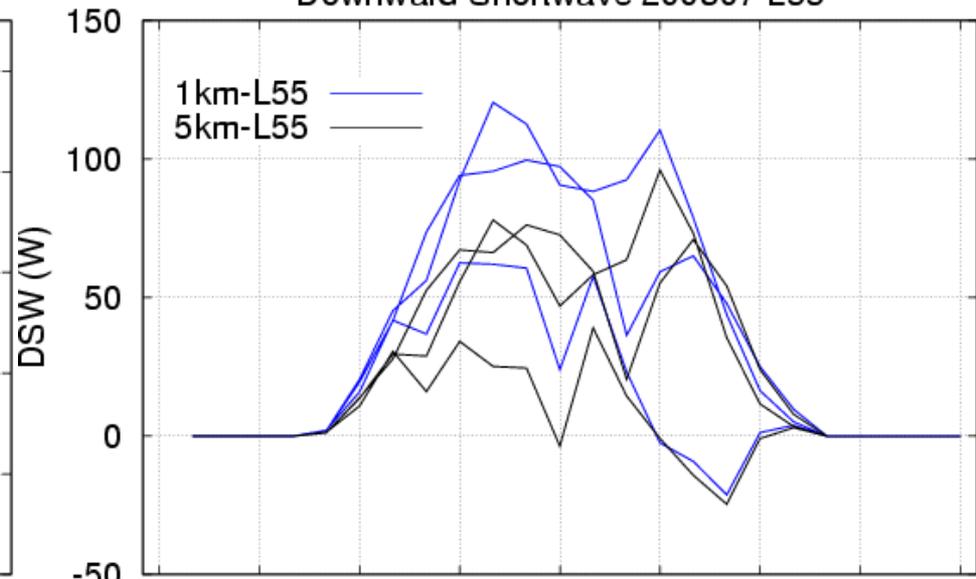


短波放射の誤差の日変化

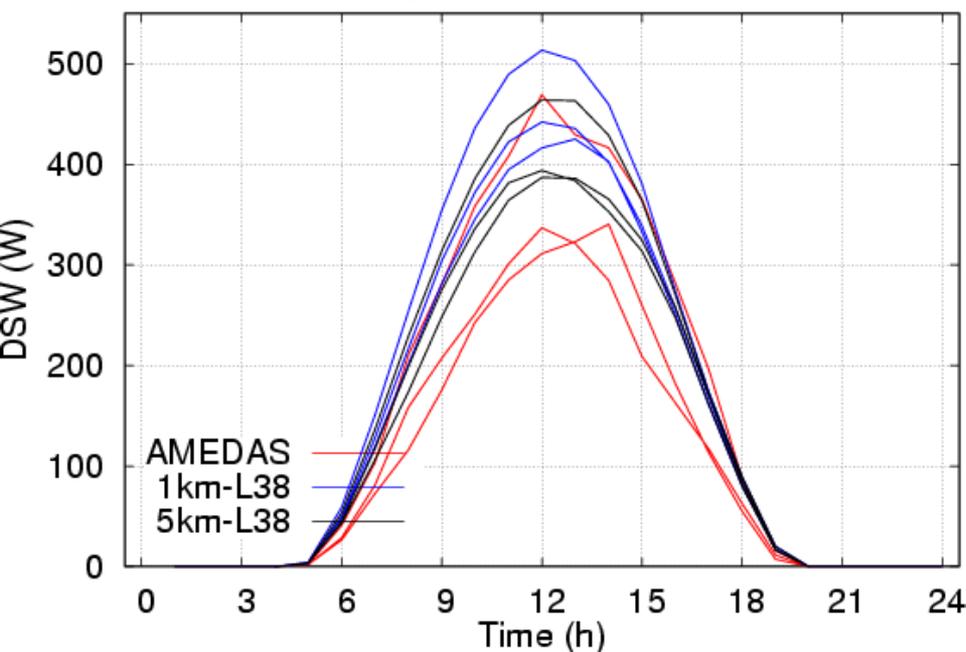
Downward Shortwave 200307 L55



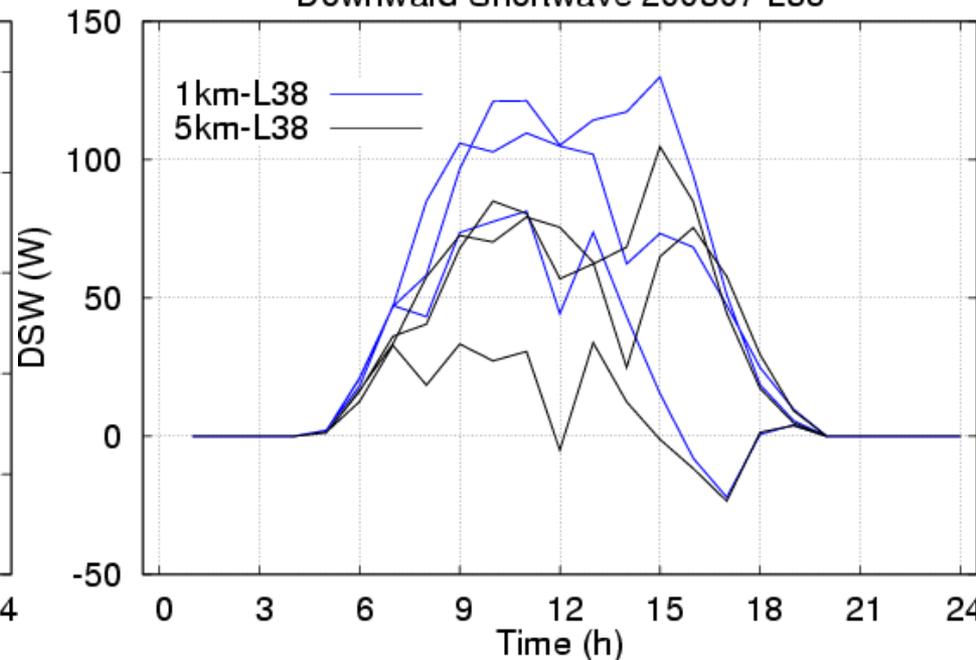
Downward Shortwave 200307 L55



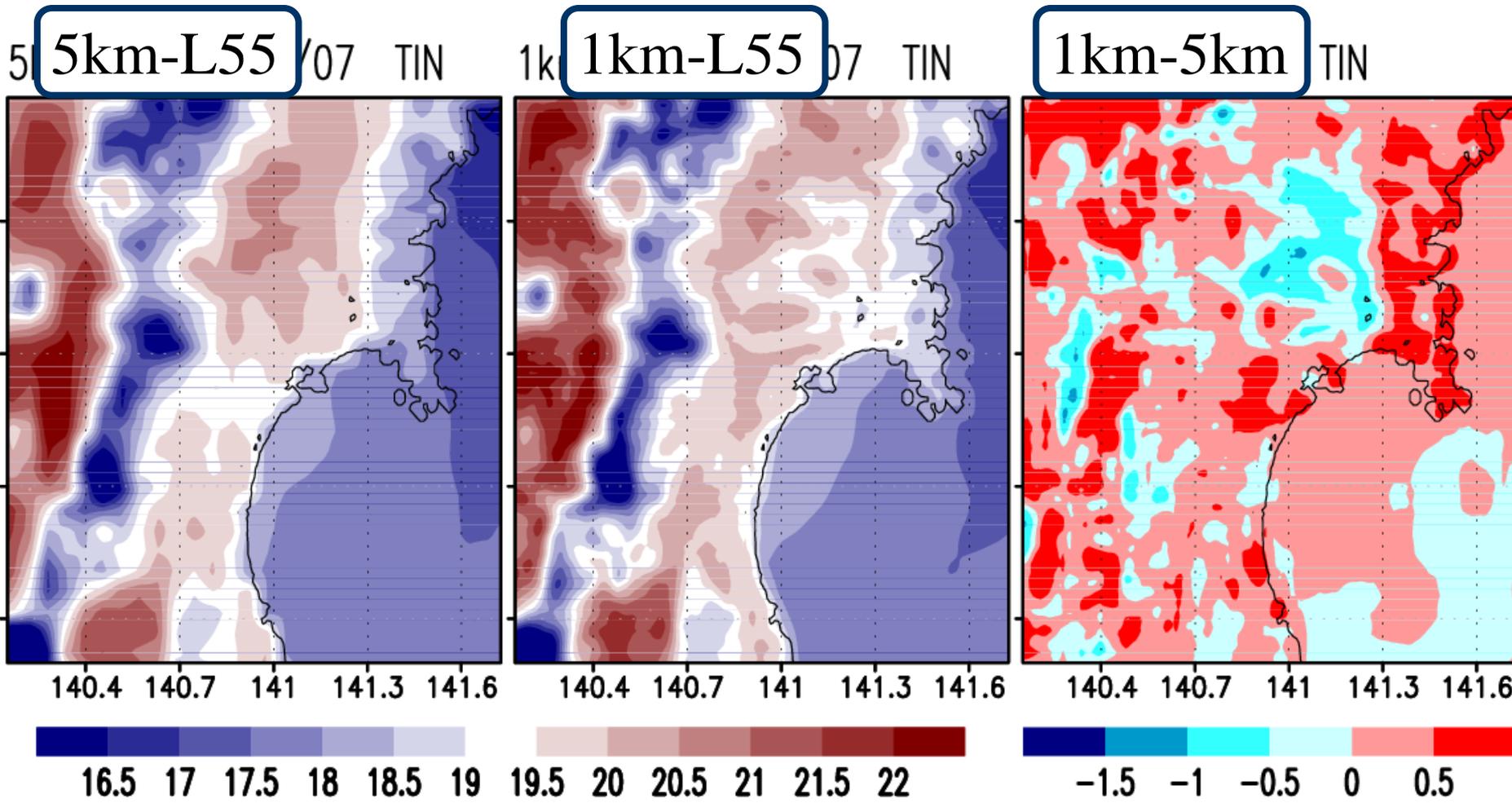
Downward Shortwave 200307 L38



Downward Shortwave 200307 L38

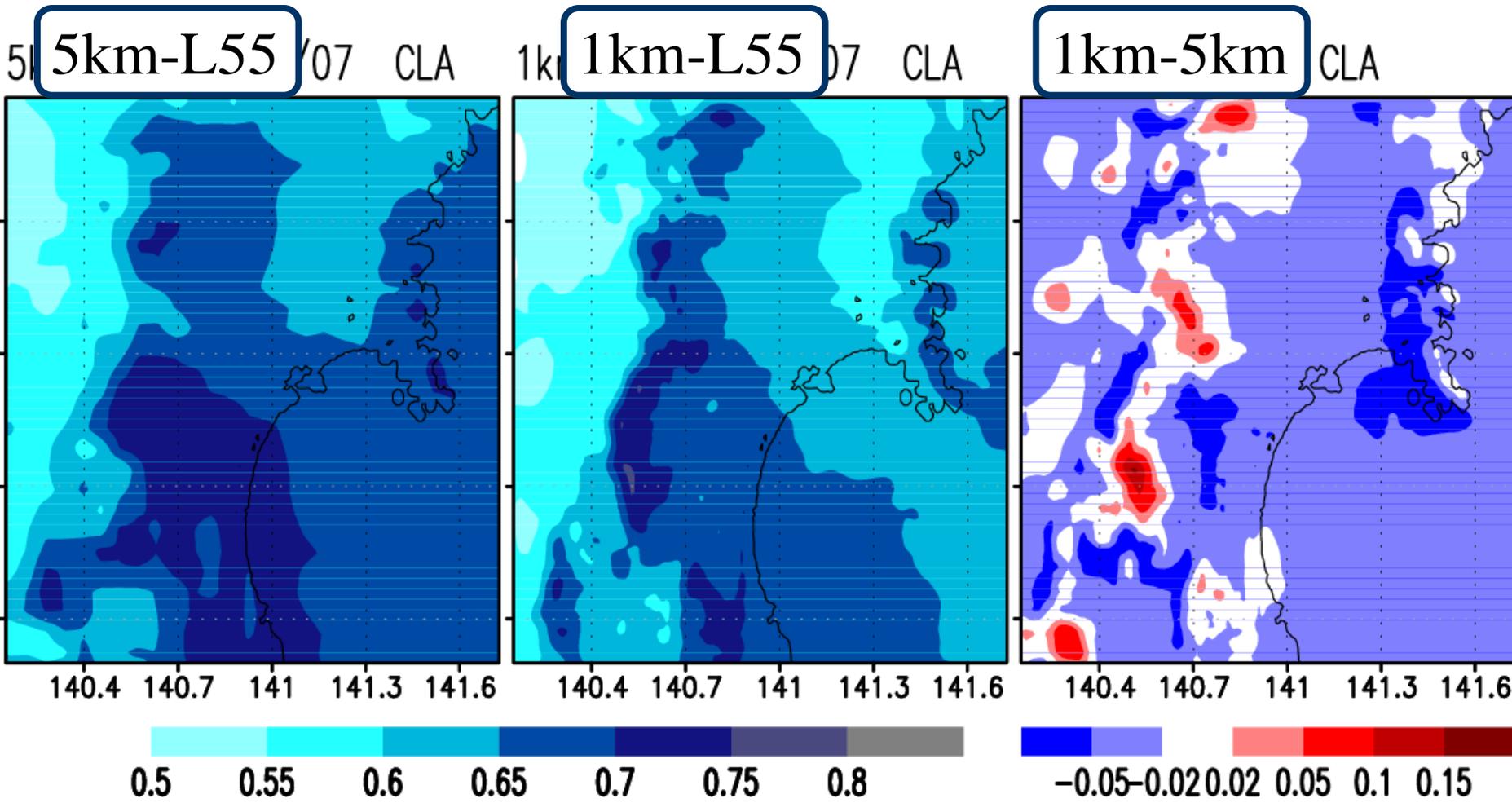


月平均した地面温度の差 -5km/1km-



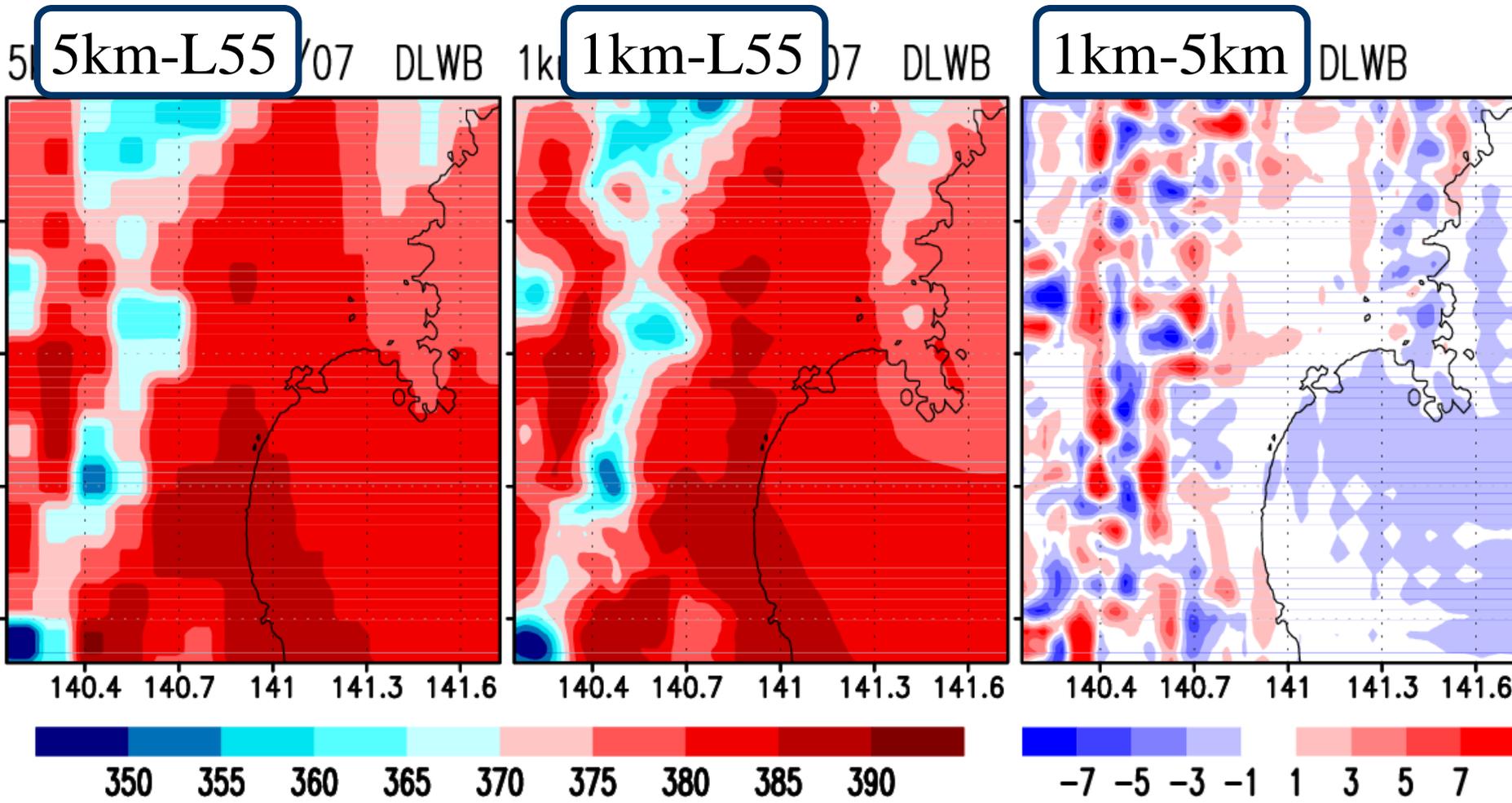
各時間で月平均した地上気温と下層雲量

月平均した全雲量の差 -5km/1km-



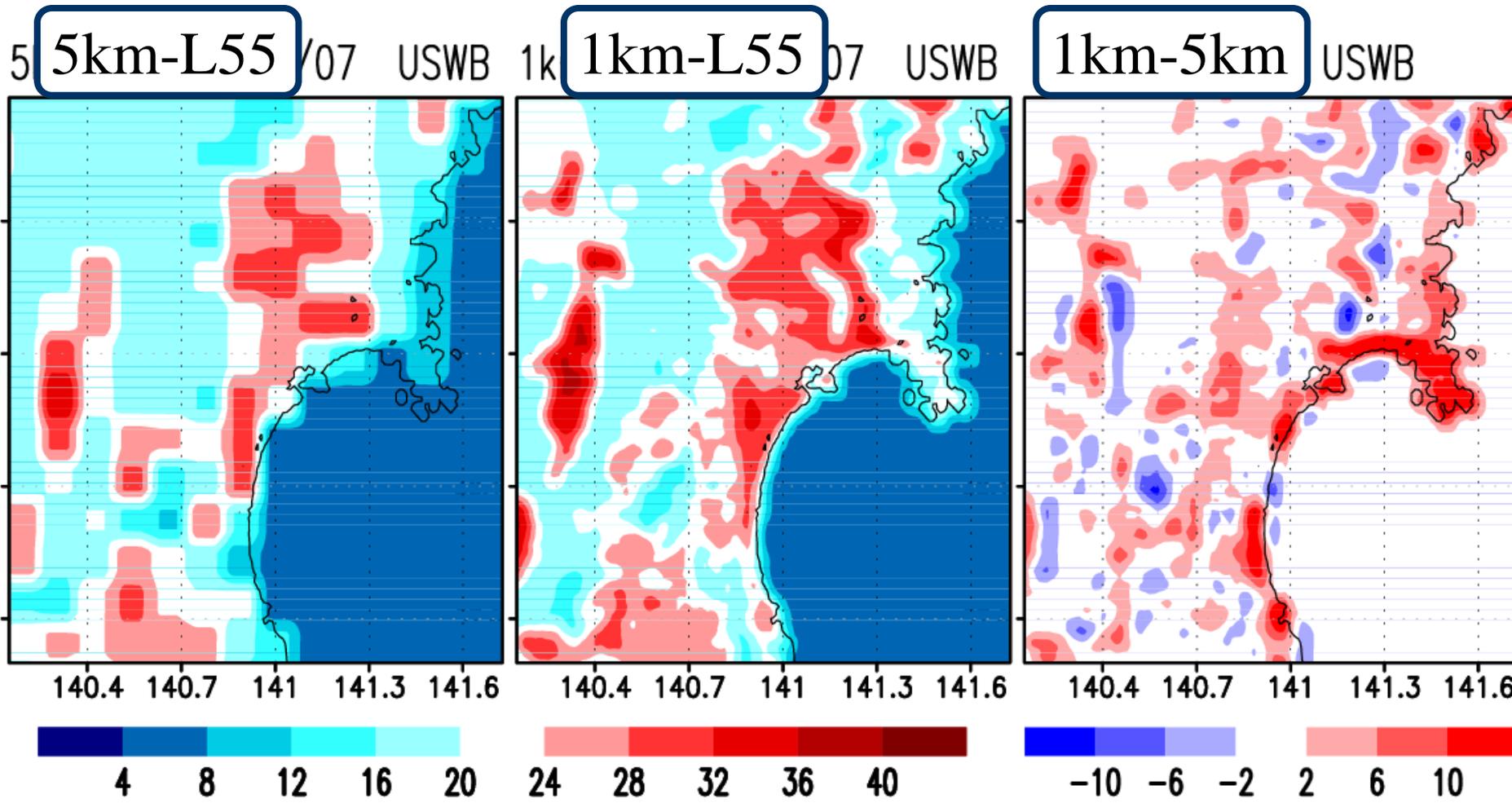
各時間で月平均した地上気温と下層雲量

月平均した下向長波放射の差 -5km/1km-



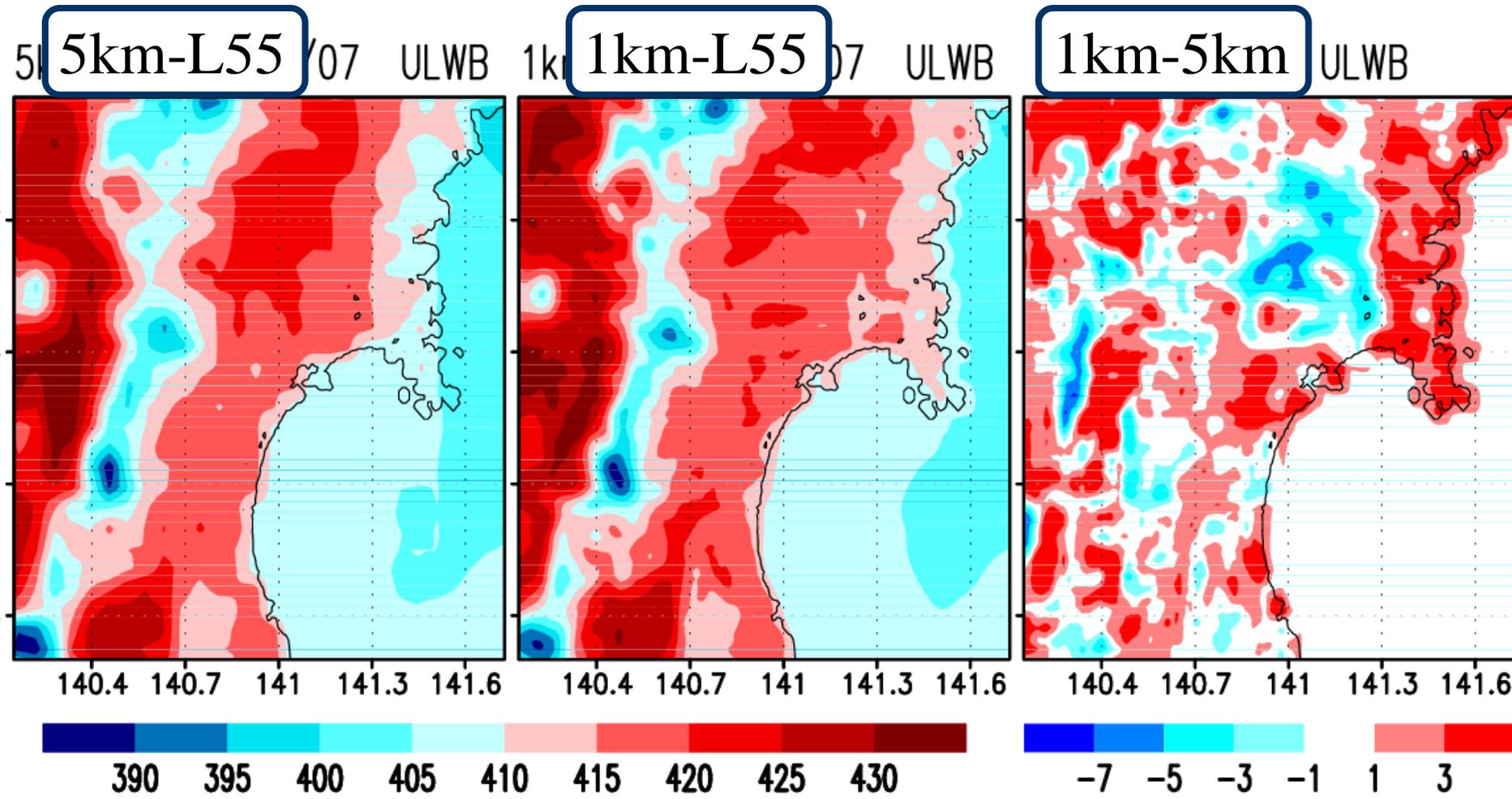
各時間で月平均した地上気温と下層雲量

月平均した上向短波放射の差 -5km/1km-



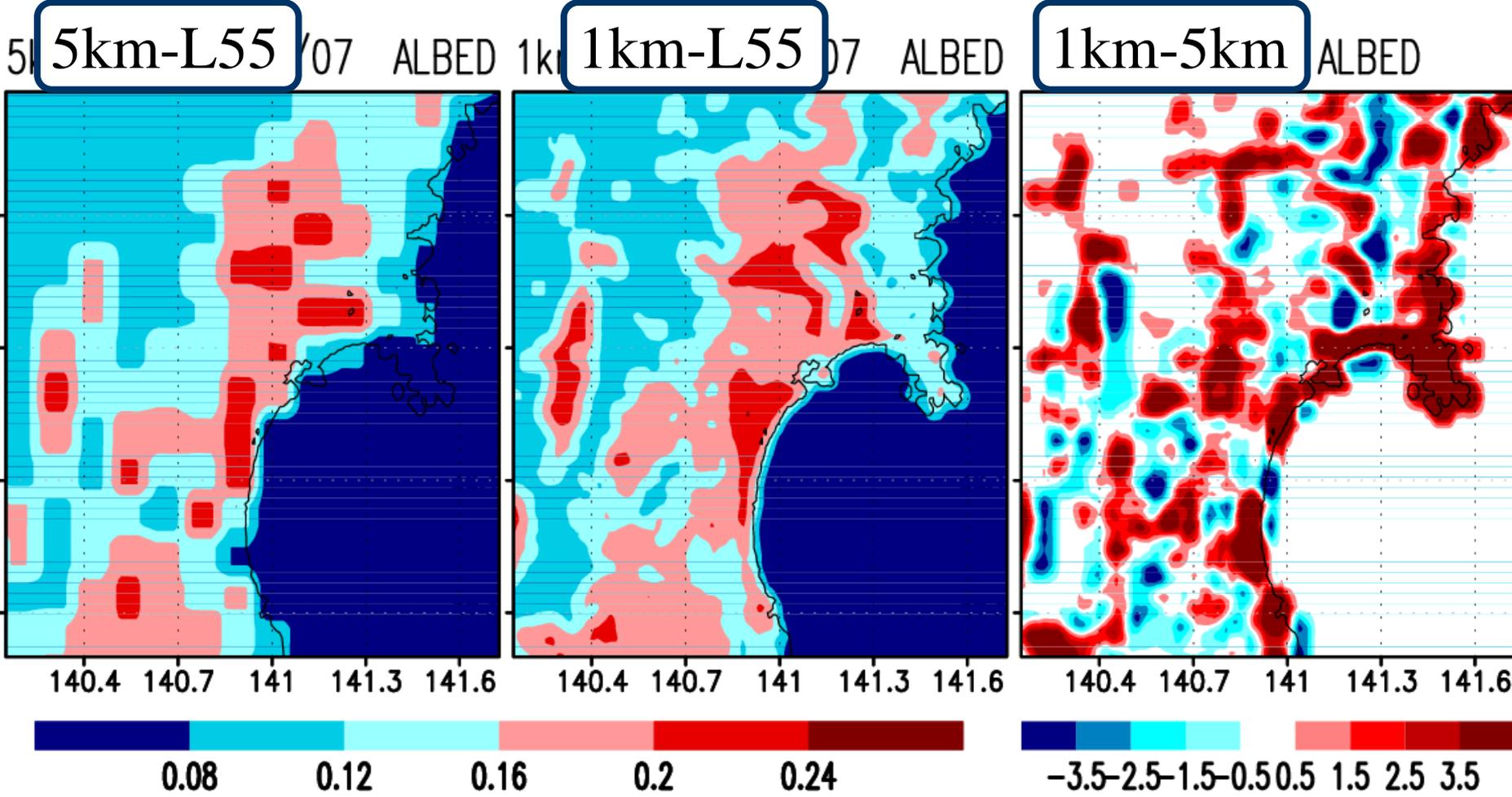
各時間で月平均した地上気温と下層雲量

月平均した上向長波放射の差 -5km/1km-



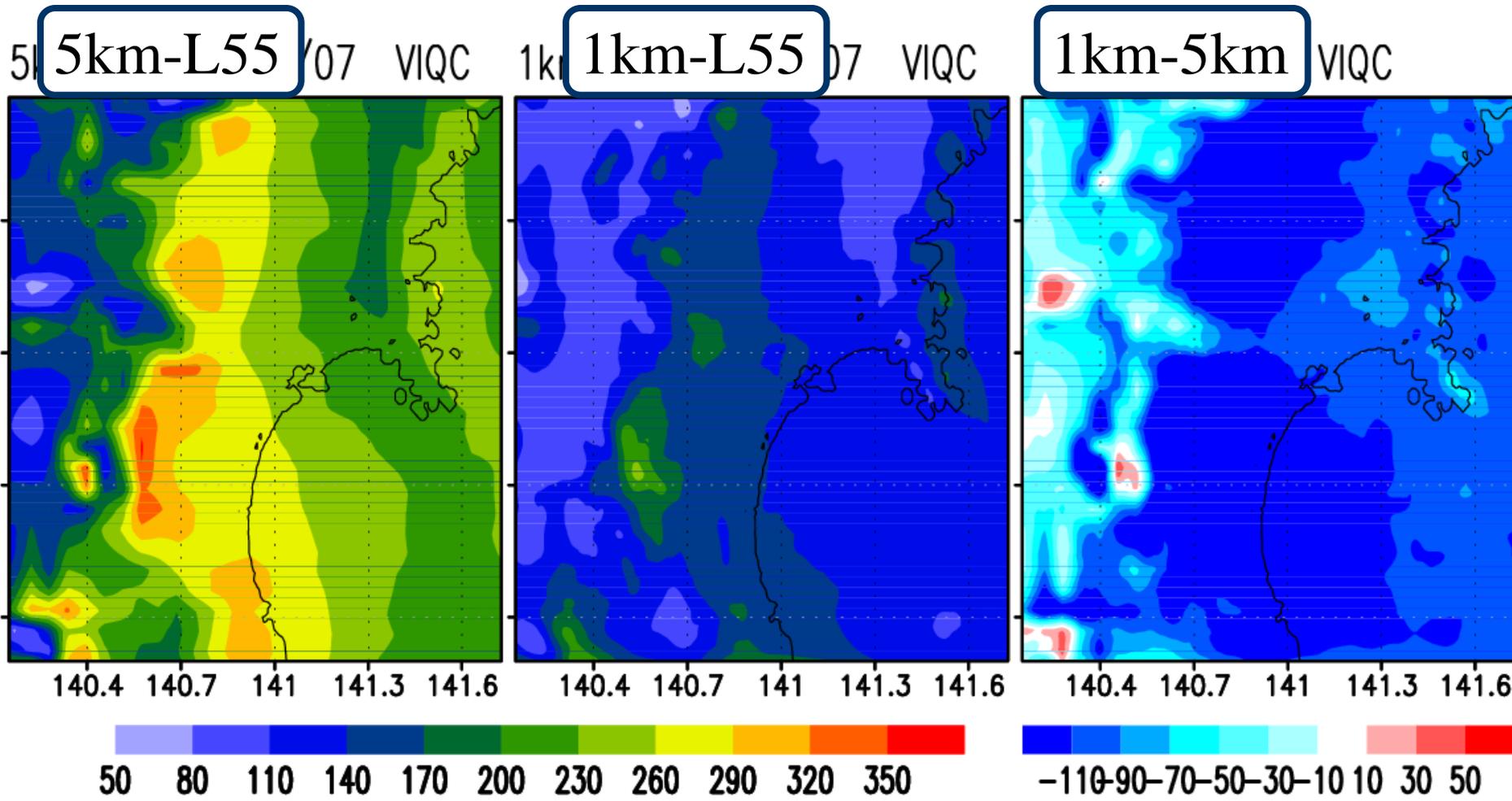
各時間で月平均した地上気温と下層雲量

月平均したアルベドの差 -5km/1km-



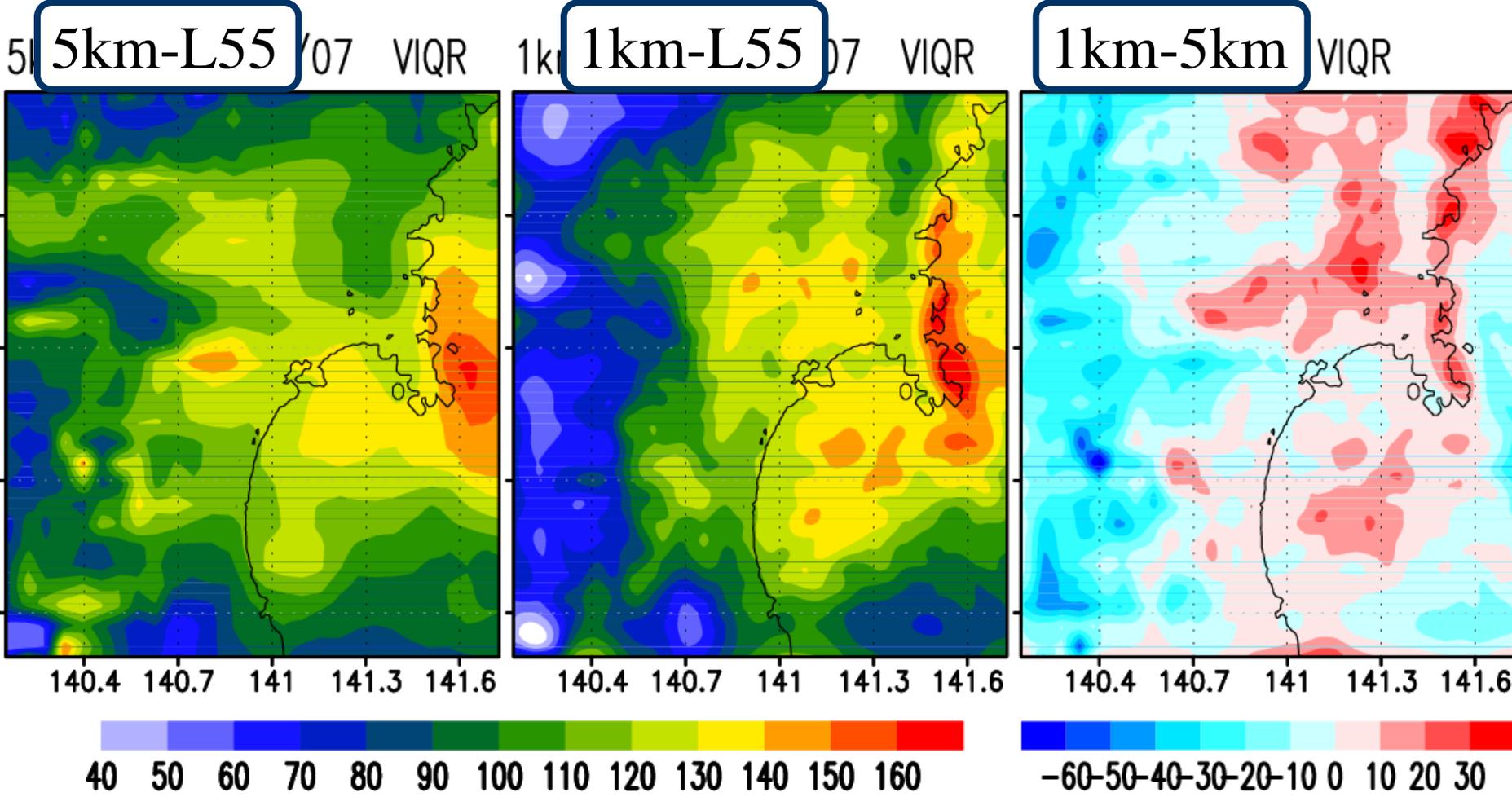
各時間で月平均した地上気温と下層雲量

月平均した鉛直積算雲水量の差 -5km/1km-



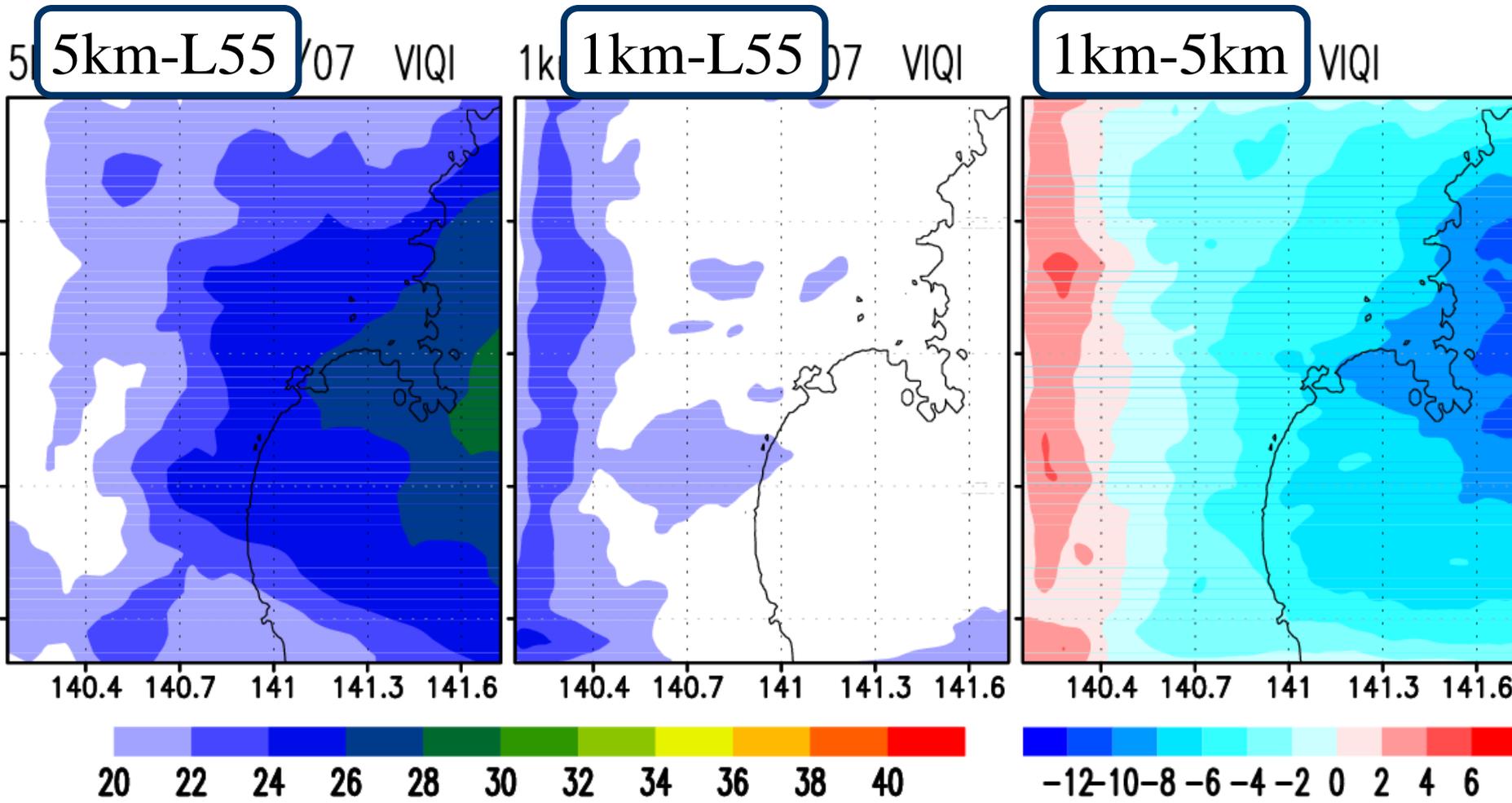
各時間で月平均した地上気温と下層雲量

月平均した鉛直積算雨量の差 -5km/1km-



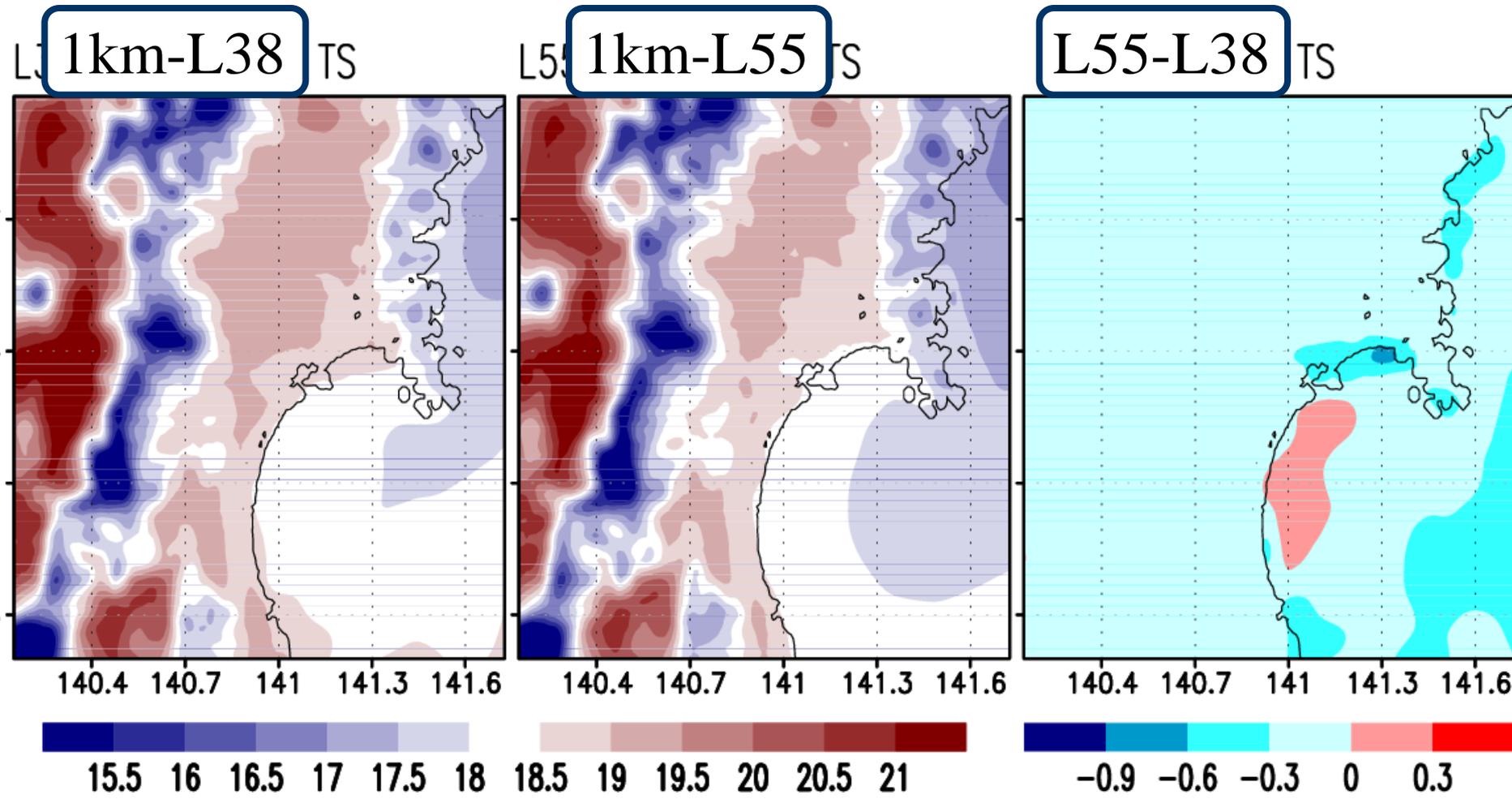
各時間で月平均した地上気温と下層雲量

月平均した鉛直積算雲氷量の差 -5km/1km-



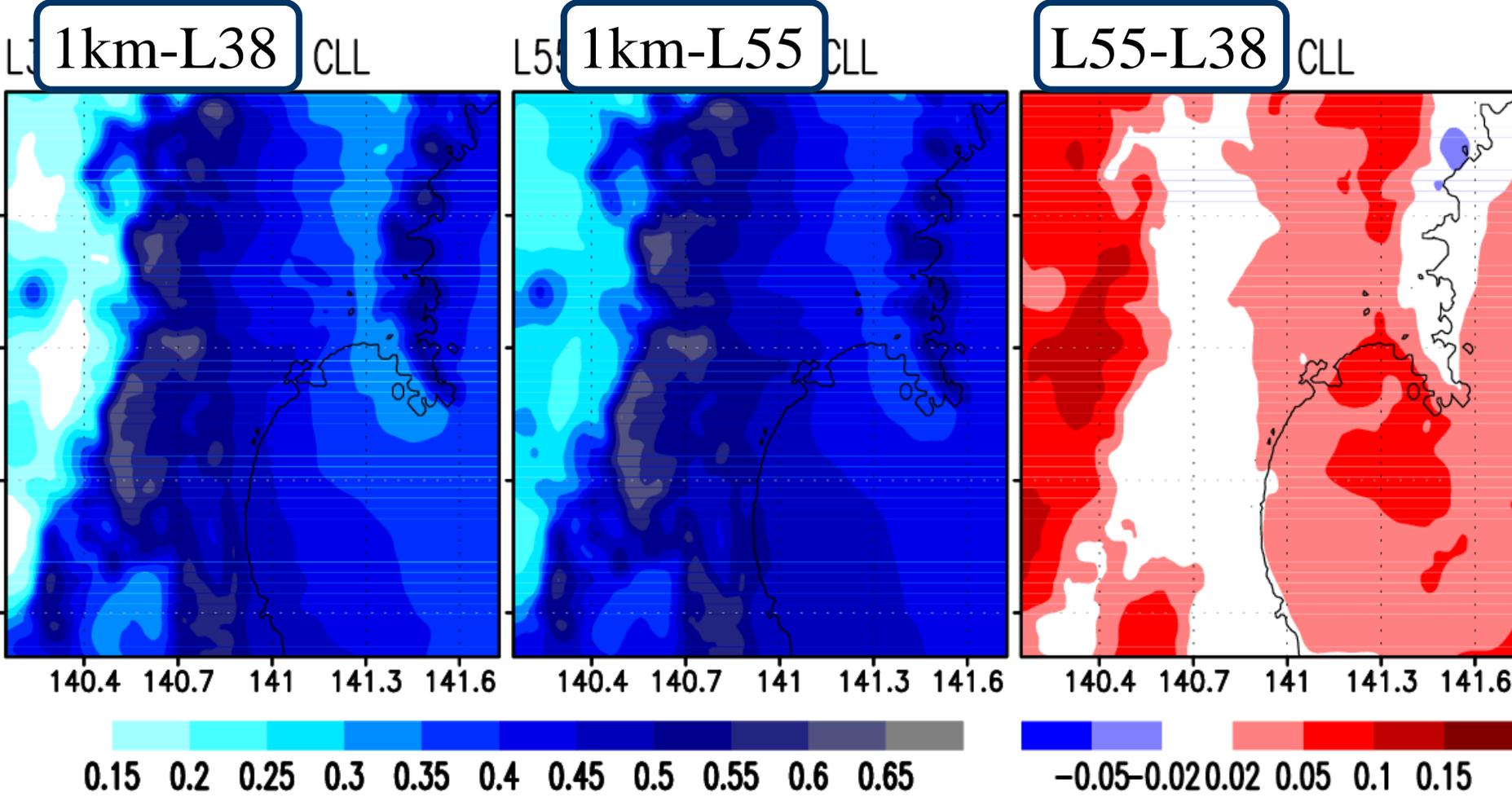
各時間で月平均した地上気温と下層雲量

月平均した地上気温の差 -L38/L55-



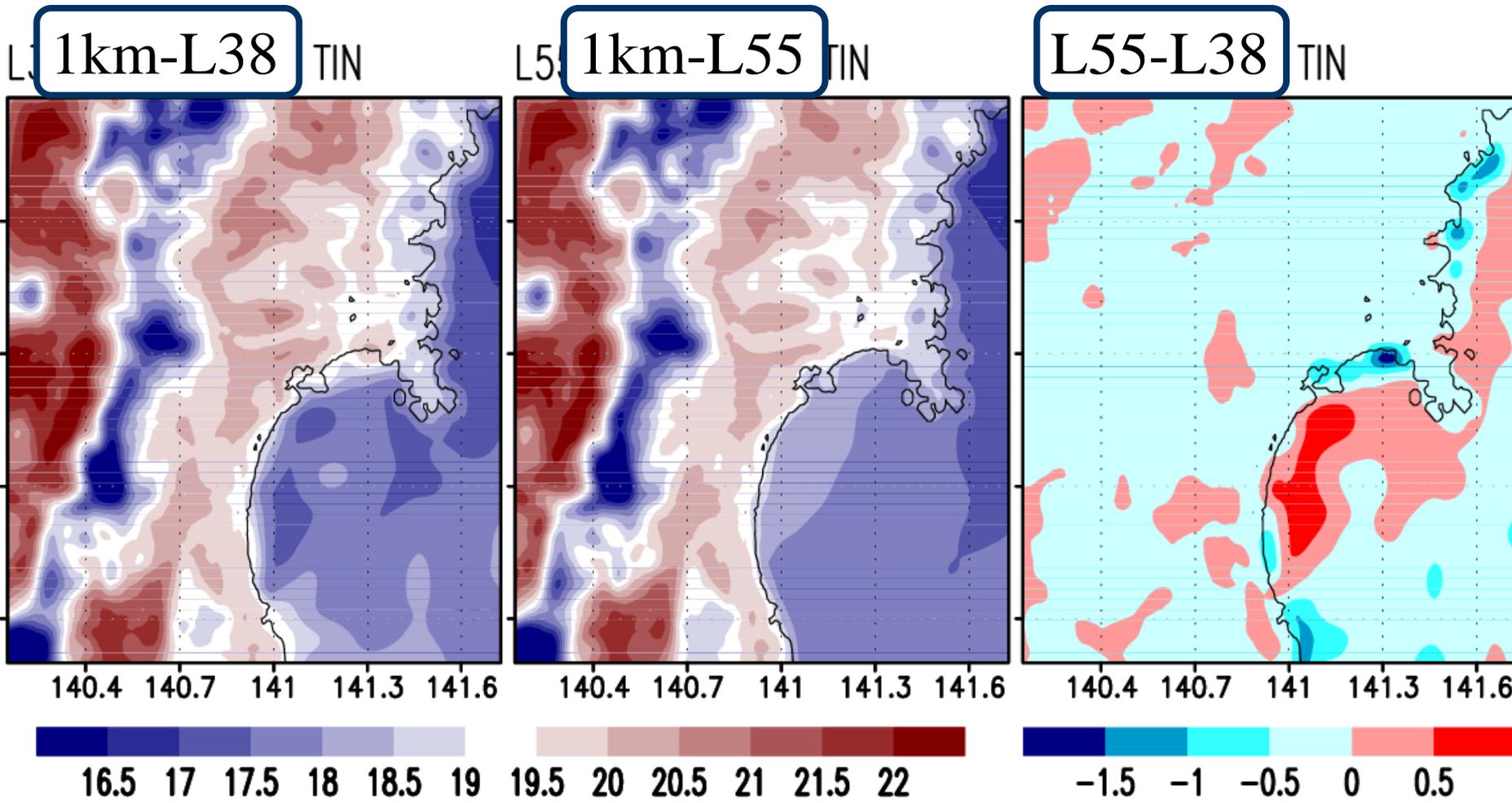
各時間で月平均した地上気温と下層雲量

月平均した下層雲量の差 -L38/L55-



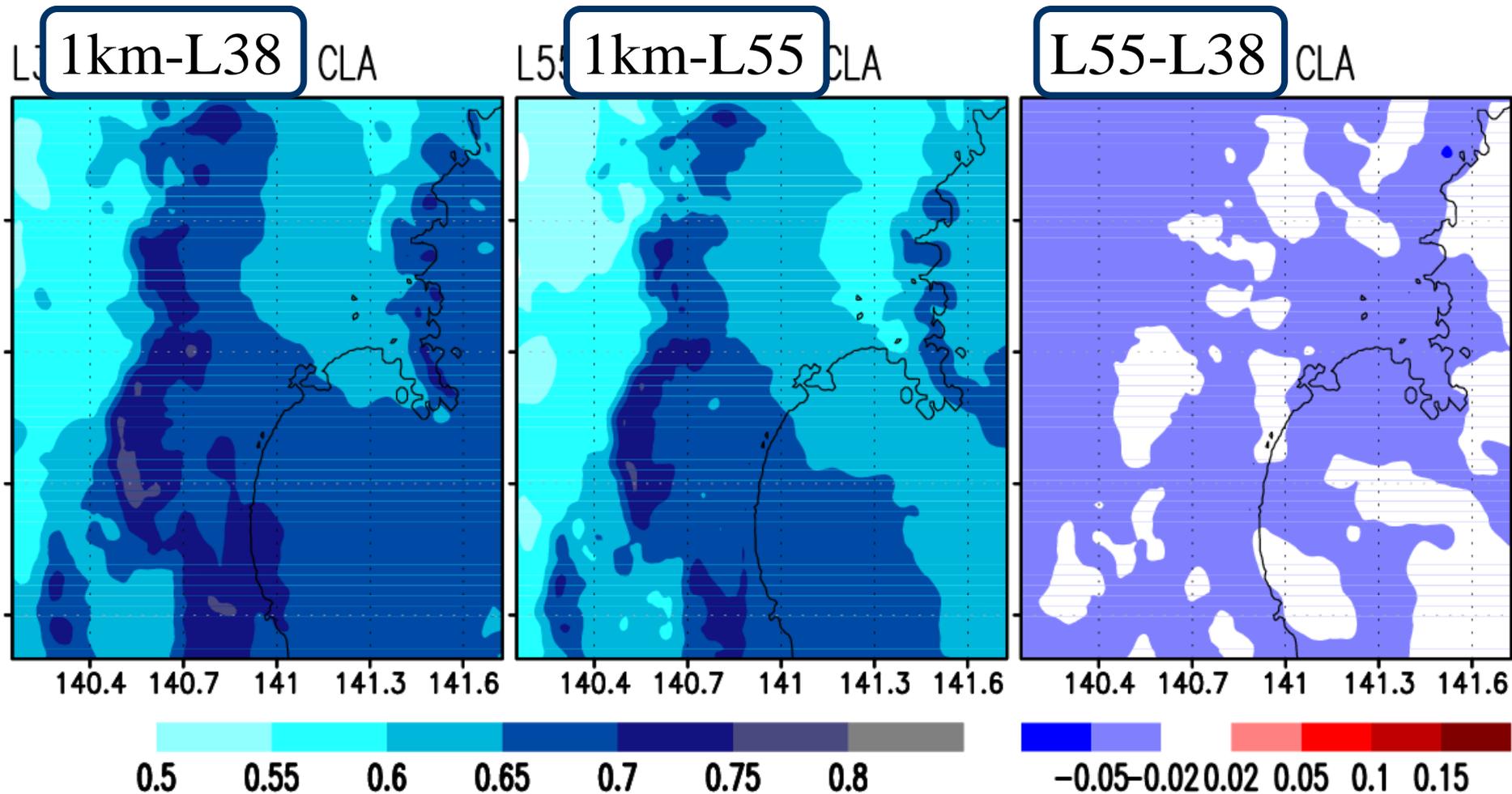
各時間で月平均した地上気温と下層雲量

月平均した地面温度の差 -L38/L55-



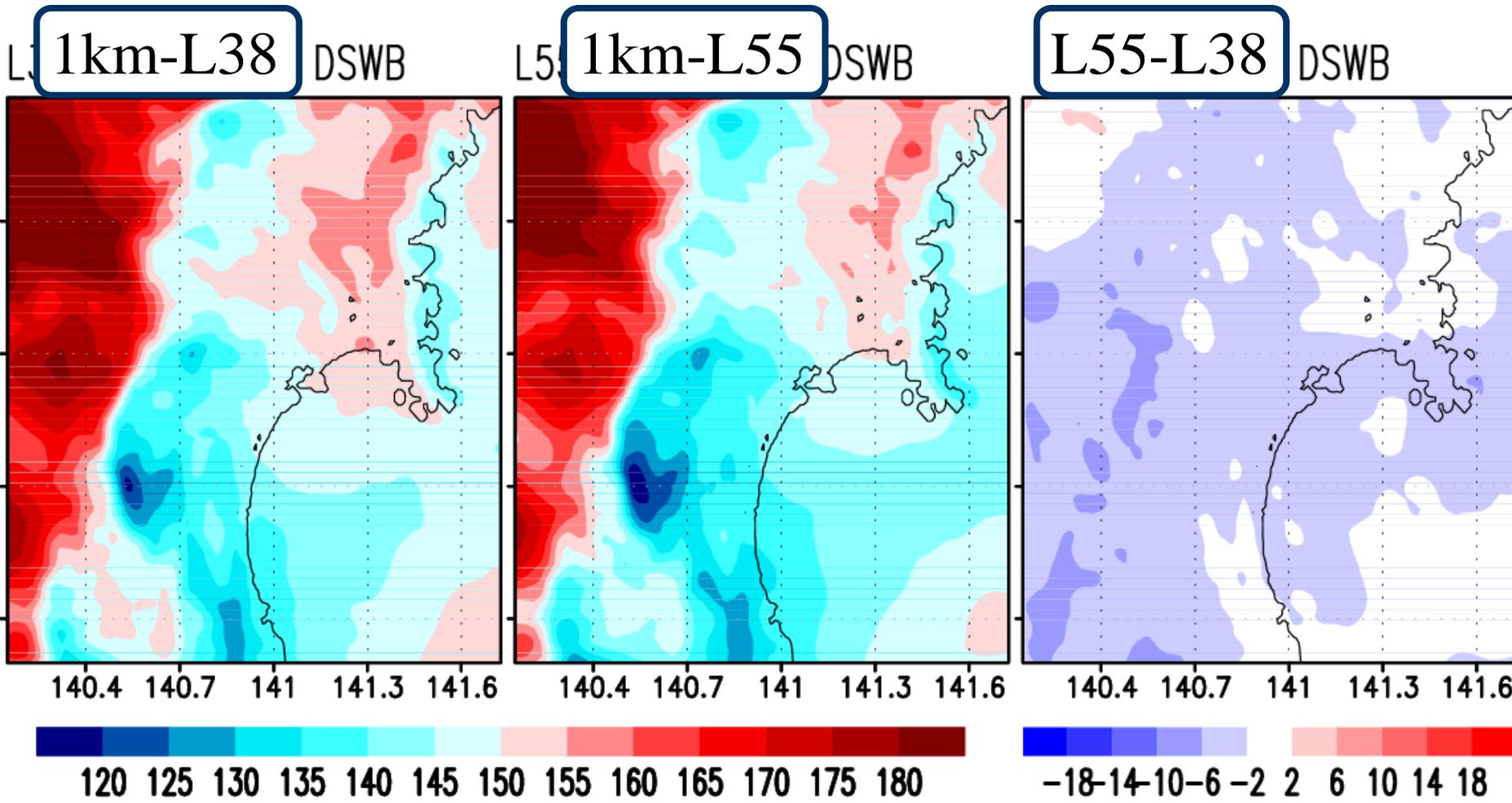
各時間で月平均した地上気温と下層雲量

月平均した全雲量の差-L38/L55-



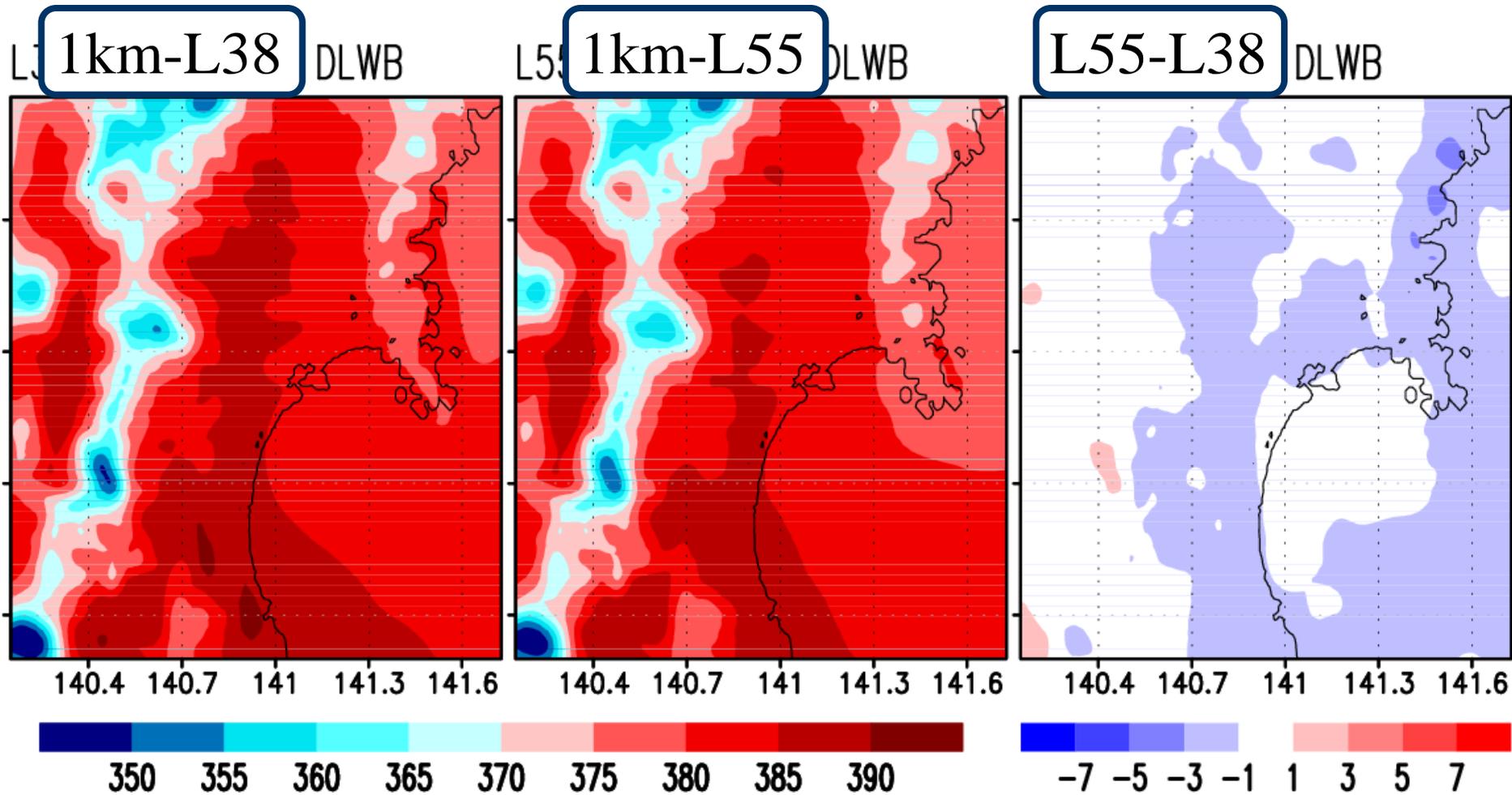
各時間で月平均した地上気温と下層雲量

月平均した下向短波放射の差 -L38/L55-



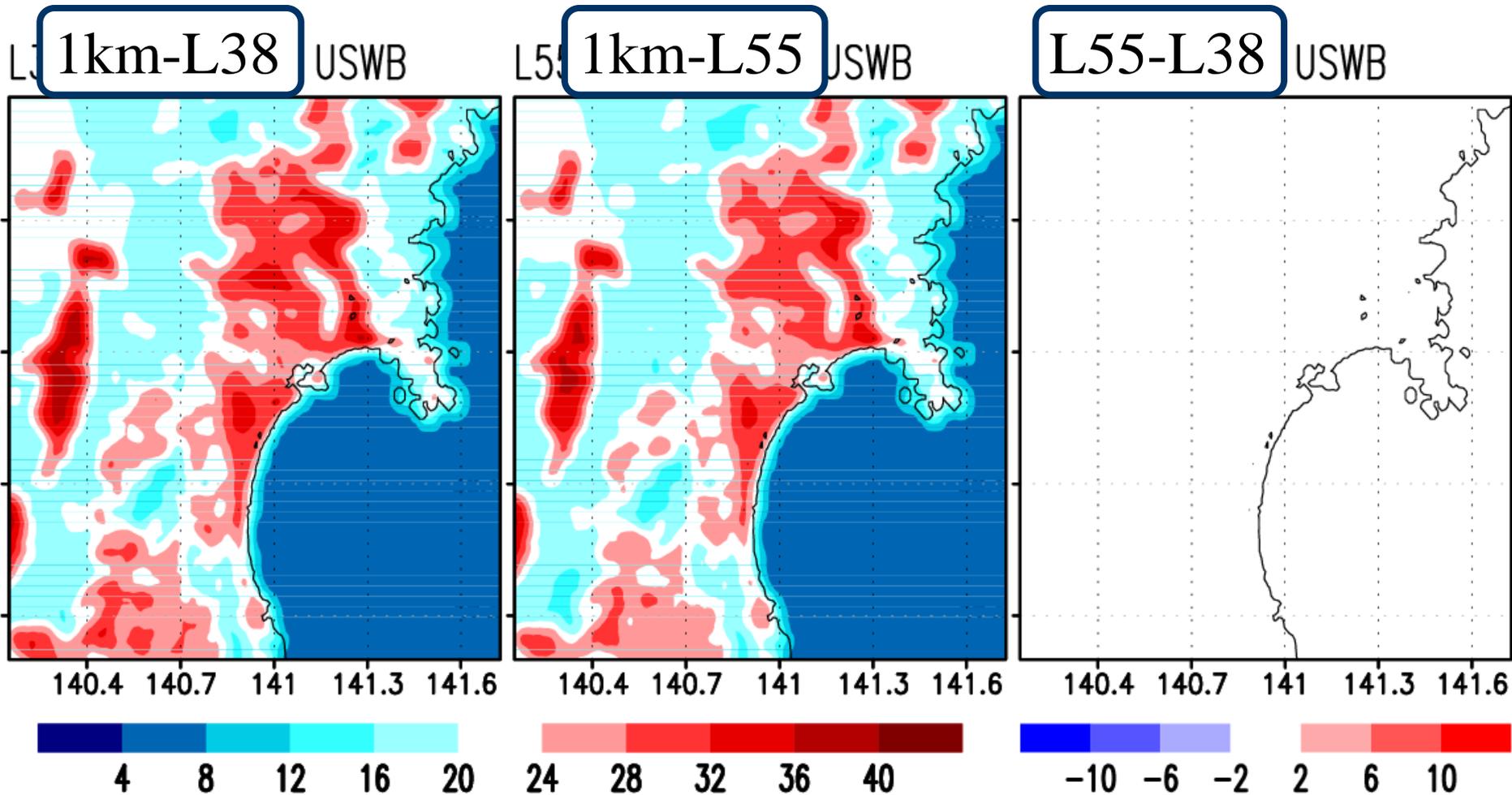
各時間で月平均した地上気温と下層雲量

月平均した下向長波放射の差 -L38/L55-



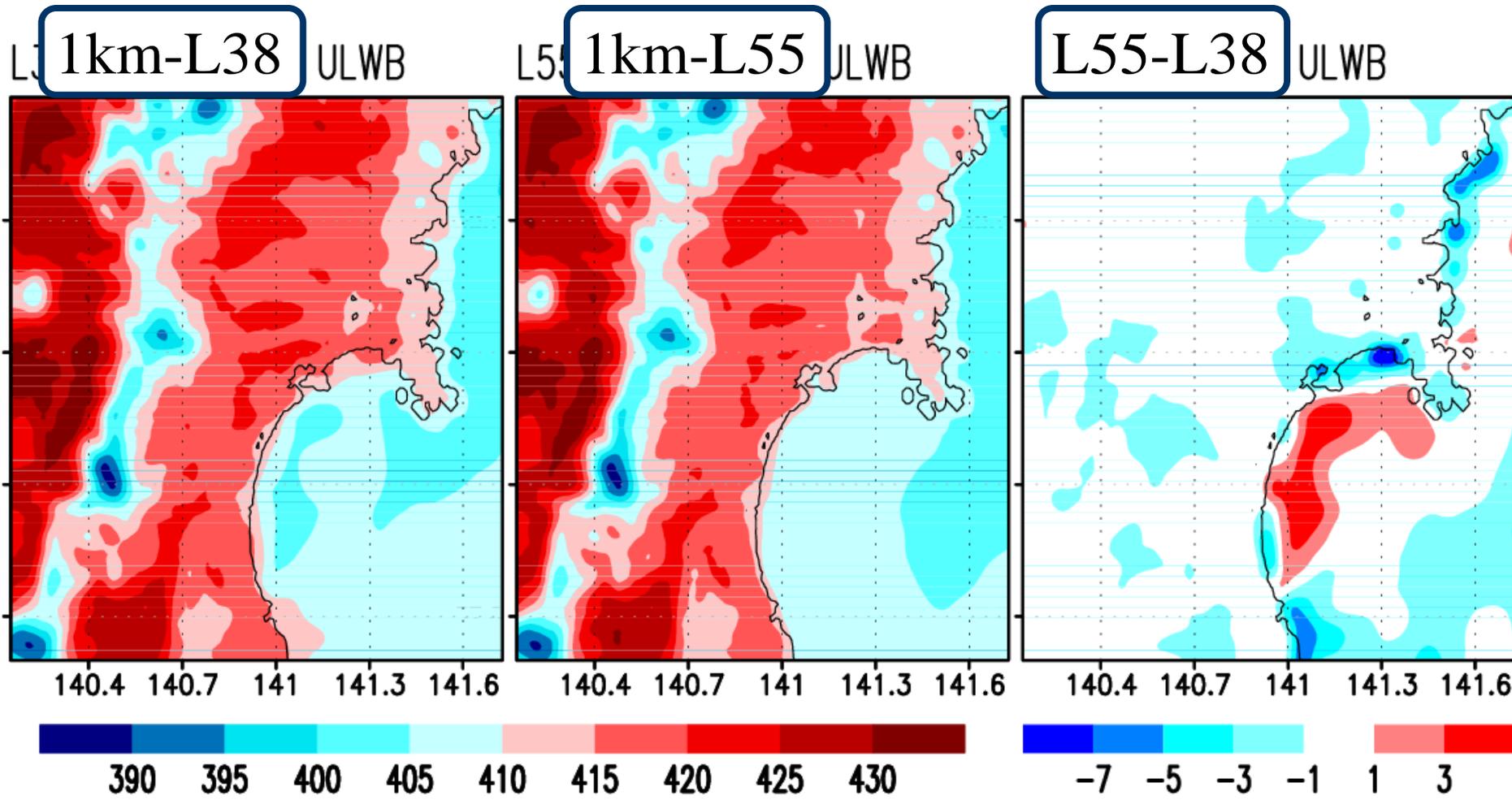
各時間で月平均した地上気温と下層雲量

月平均した上向短波放射の差 -L38/L55-



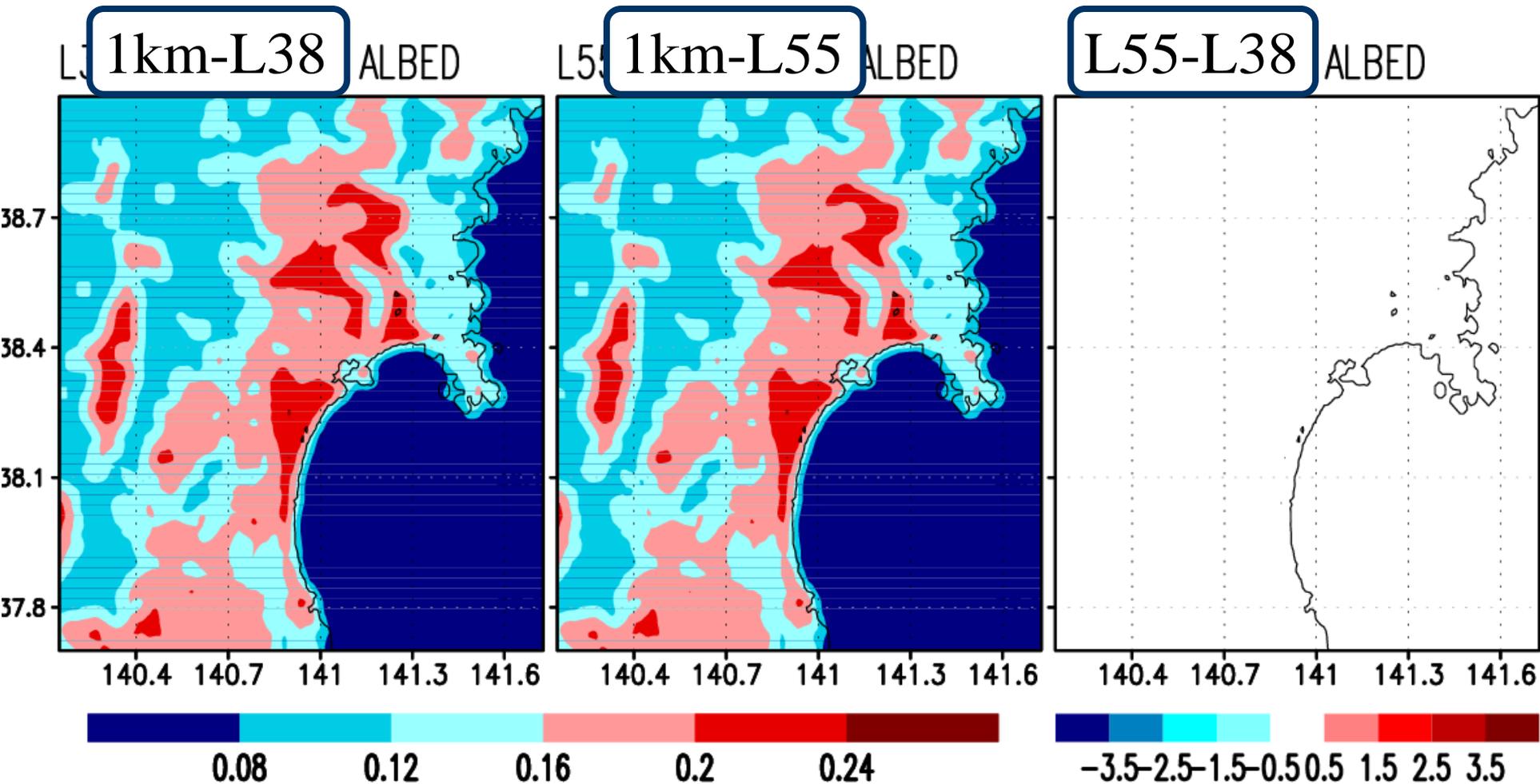
各時間で月平均した地上気温と下層雲量

月平均した上向長波放射の差 -L38/L55-



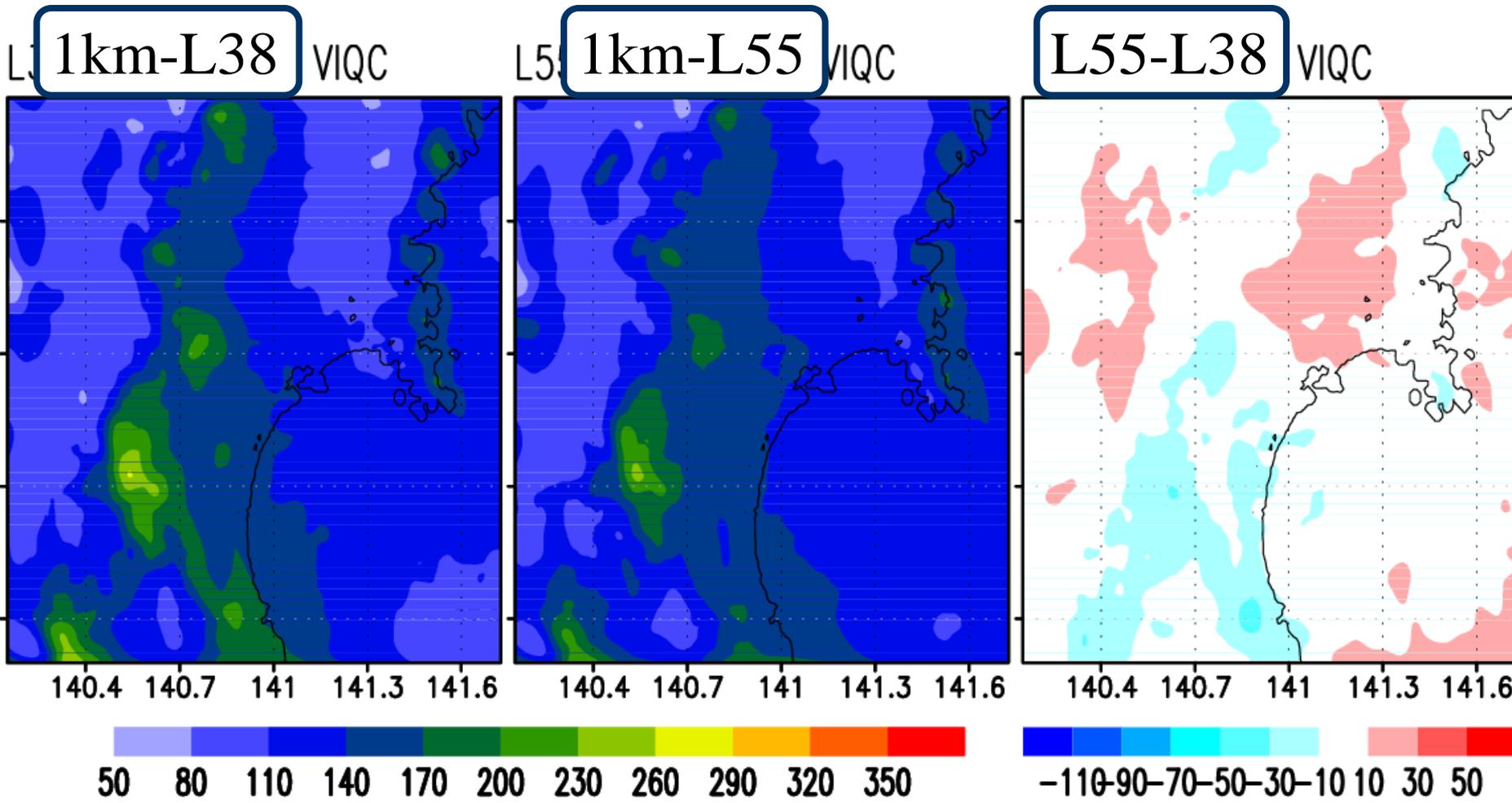
各時間で月平均した地上気温と下層雲量

月平均したアルベドの差 -L38/L55-



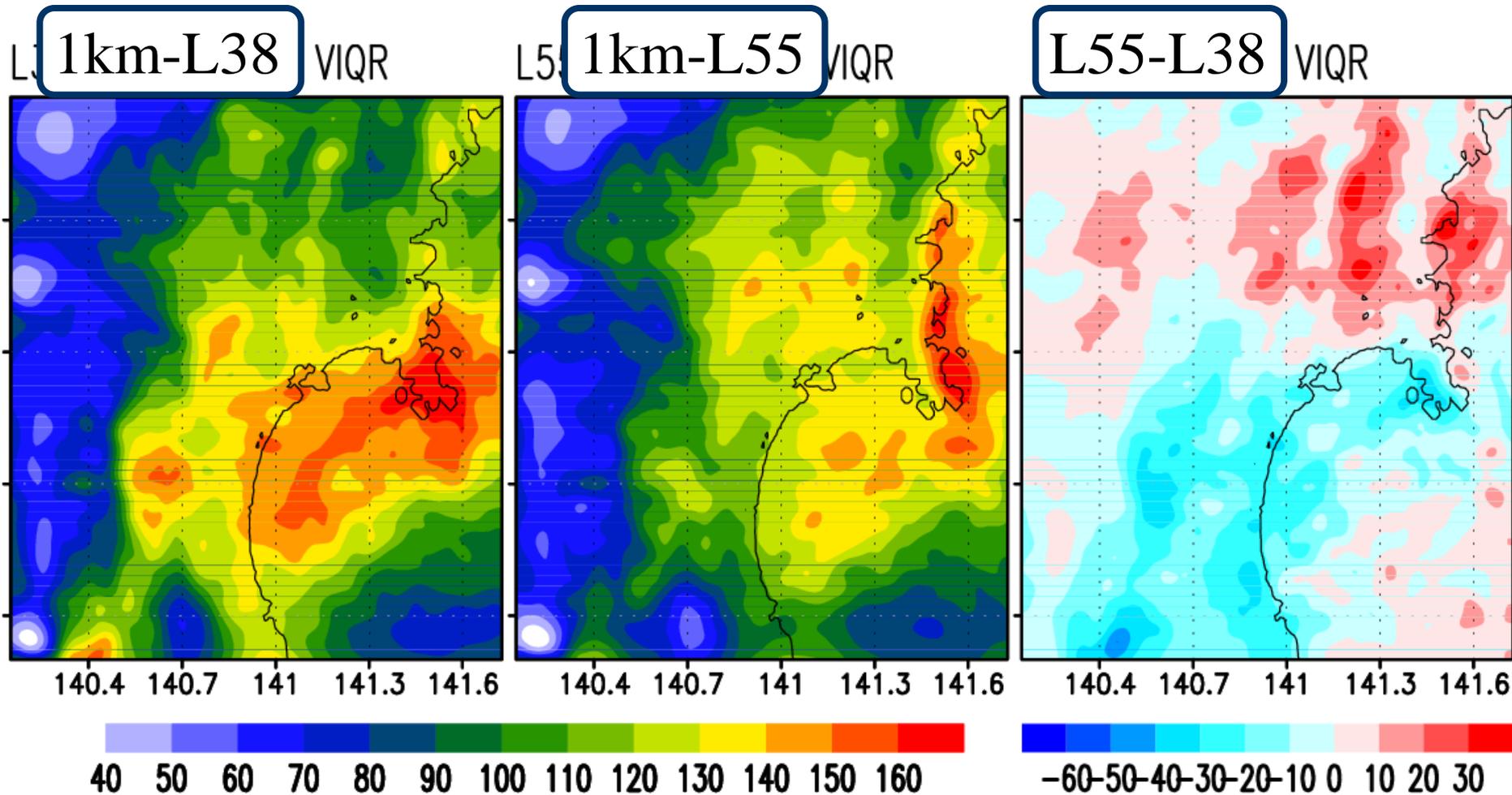
各時間で月平均した地上気温と下層雲量

月平均した鉛直積算雲水量の差 -L38/L55-



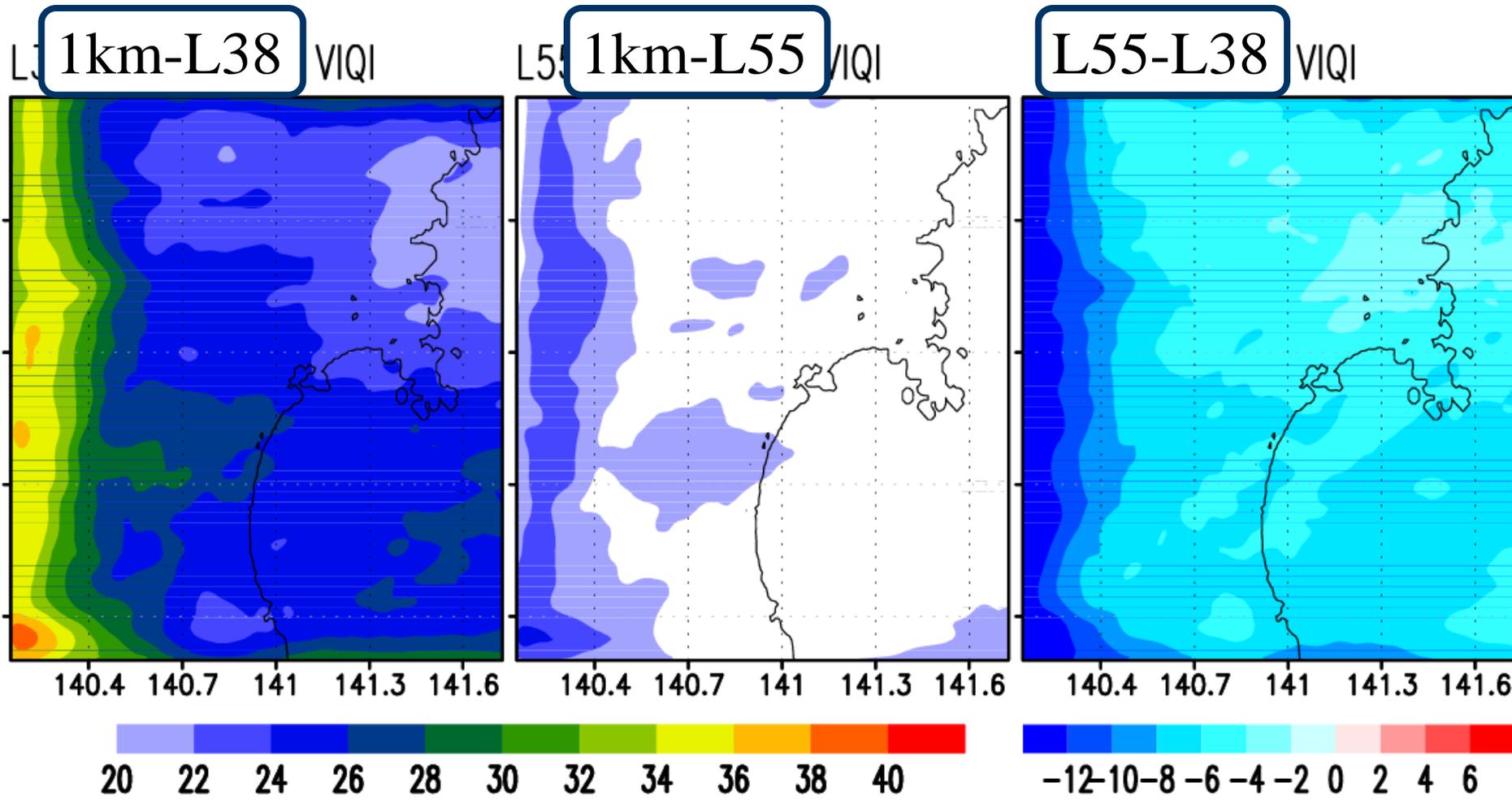
各時間で月平均した地上気温と下層雲量

月平均した鉛直積算雨量の差 -L38/L55-



各時間で月平均した地上気温と下層雲量

月平均した鉛直積算雲氷量の差 -L38/L55-



各時間で月平均した地上気温と下層雲量

地上気温の日変化 -5km/1km-

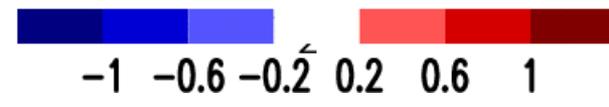
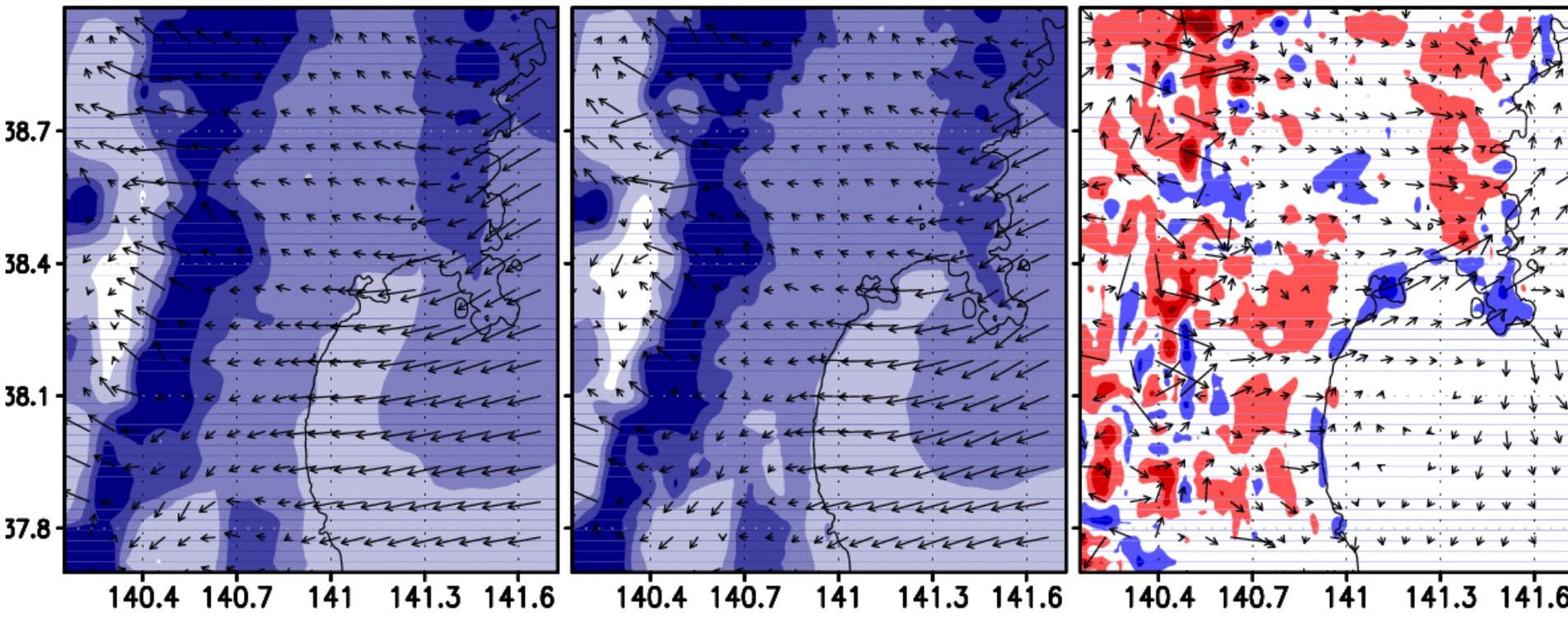
地上気温

LLC

5km-L55 TS 00JST

1km-L55 TS 00JST

Diff. 1km-5km TS 00JST



各時間で月平均した地上気温

下層雲量の日変化 -5km/1km-

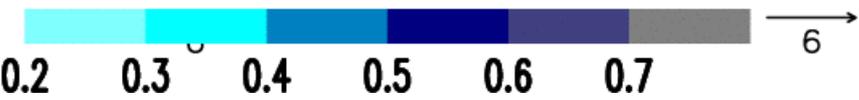
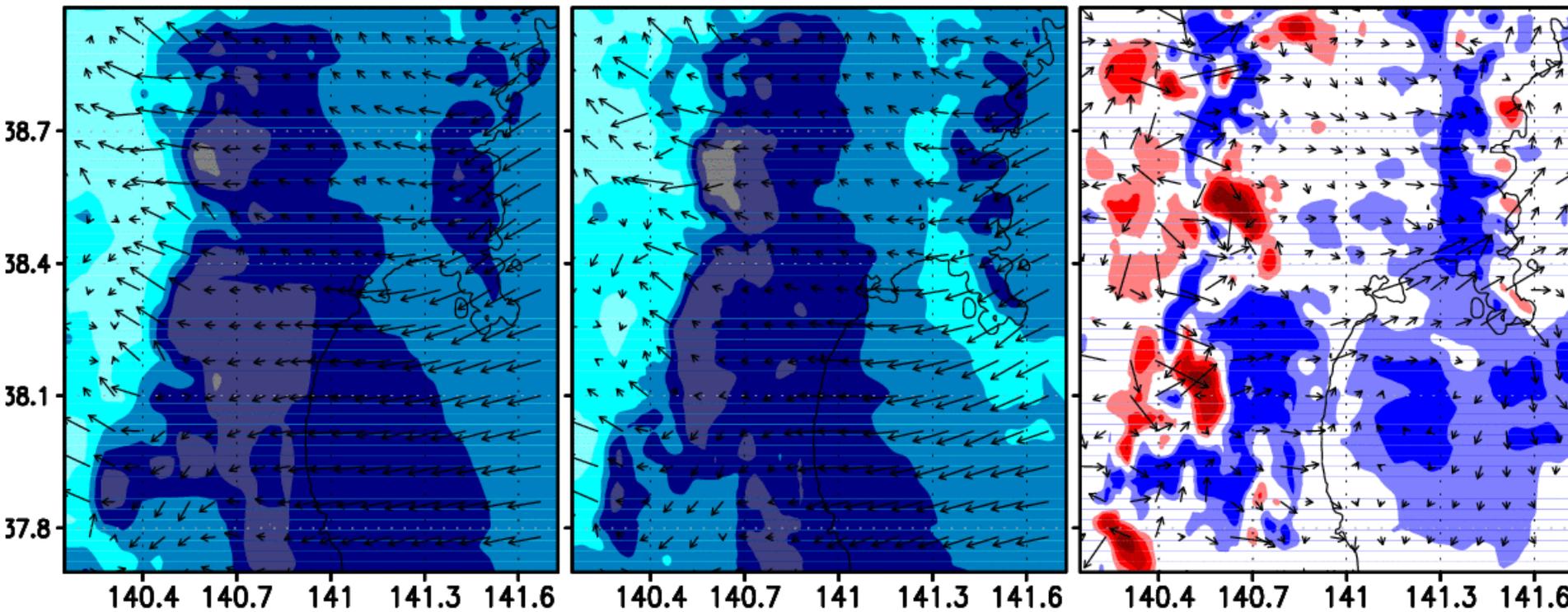
地上気温

LLC

5km-L55 CLL 00JST

1km-L55 CLL 00JST

Diff. 1km-5km CLL 00JST

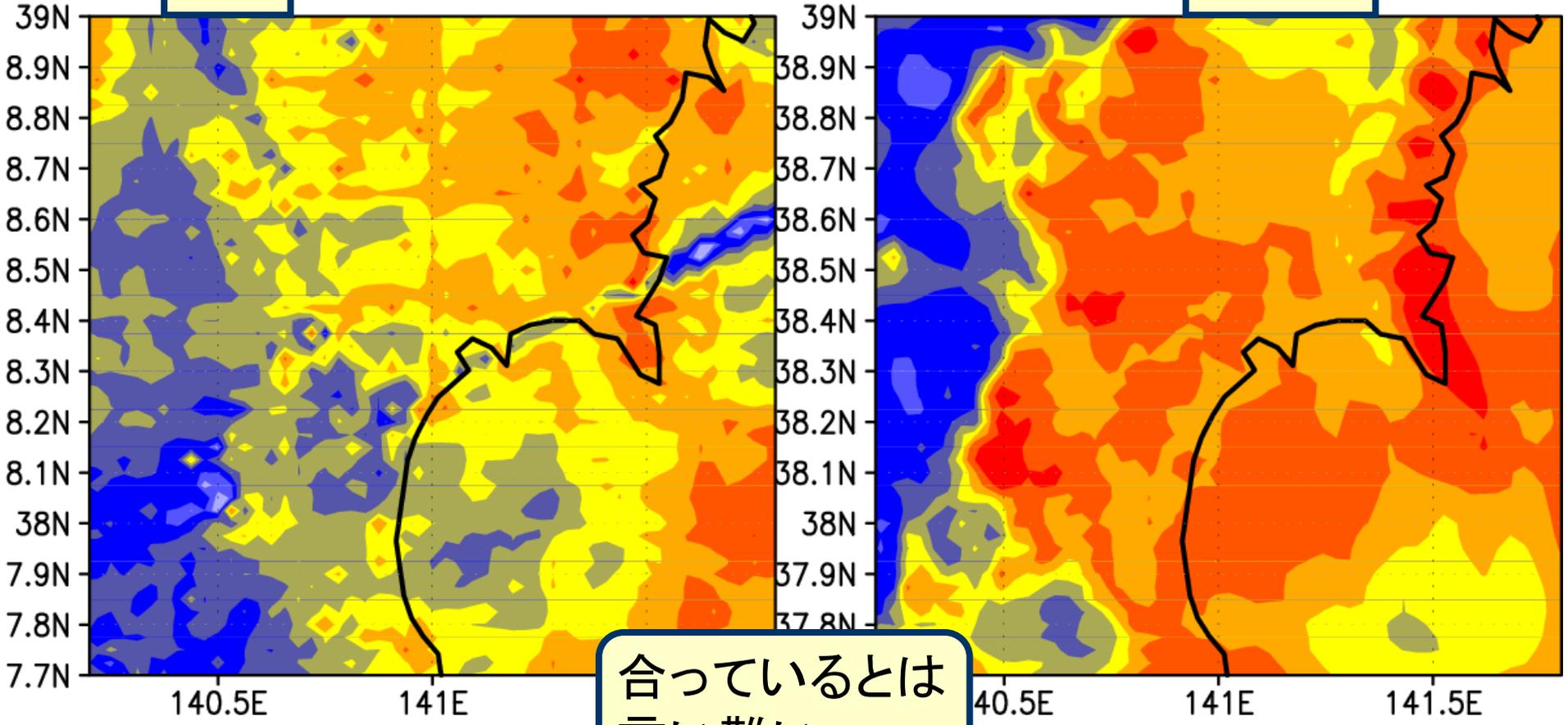


各時間で月平均した下層雲量

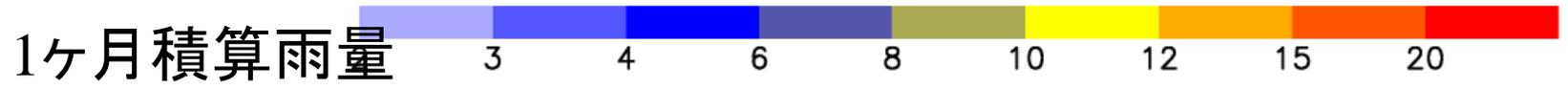
レーダーアメダスとの比較

R/A : RADAR-AMEDAS

RAIN : Nモデル z55



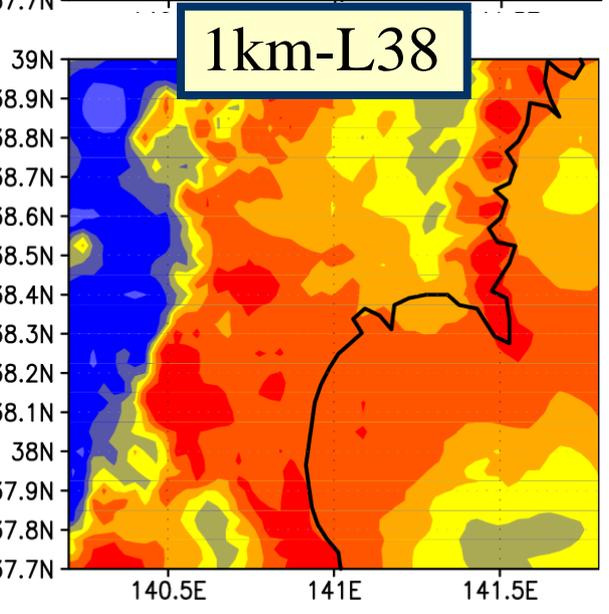
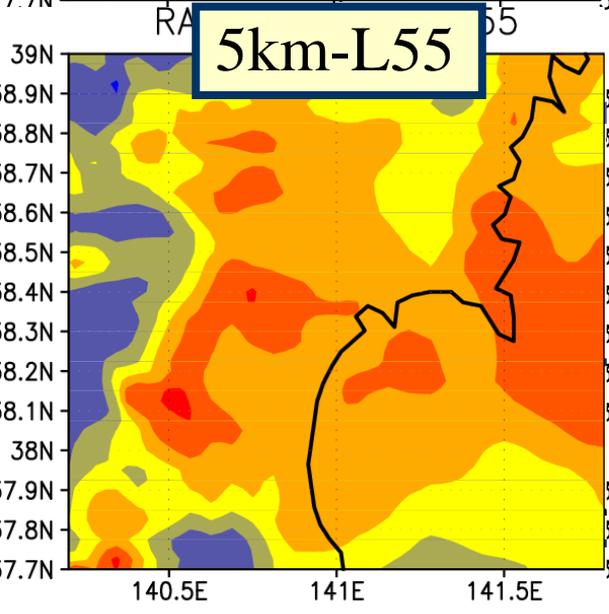
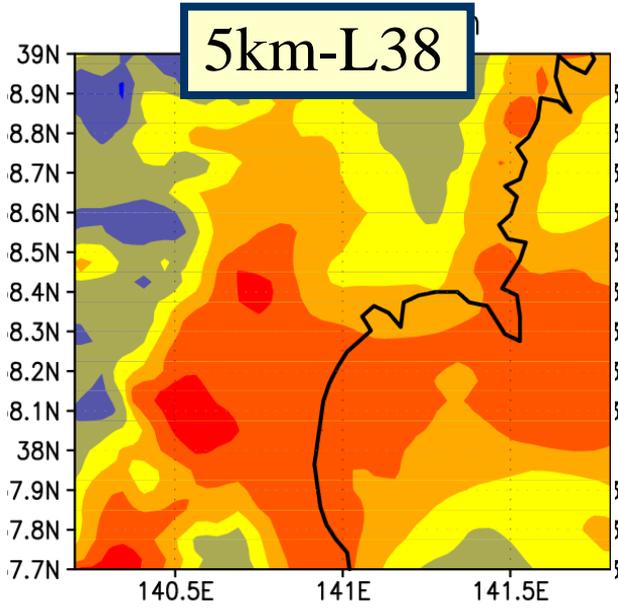
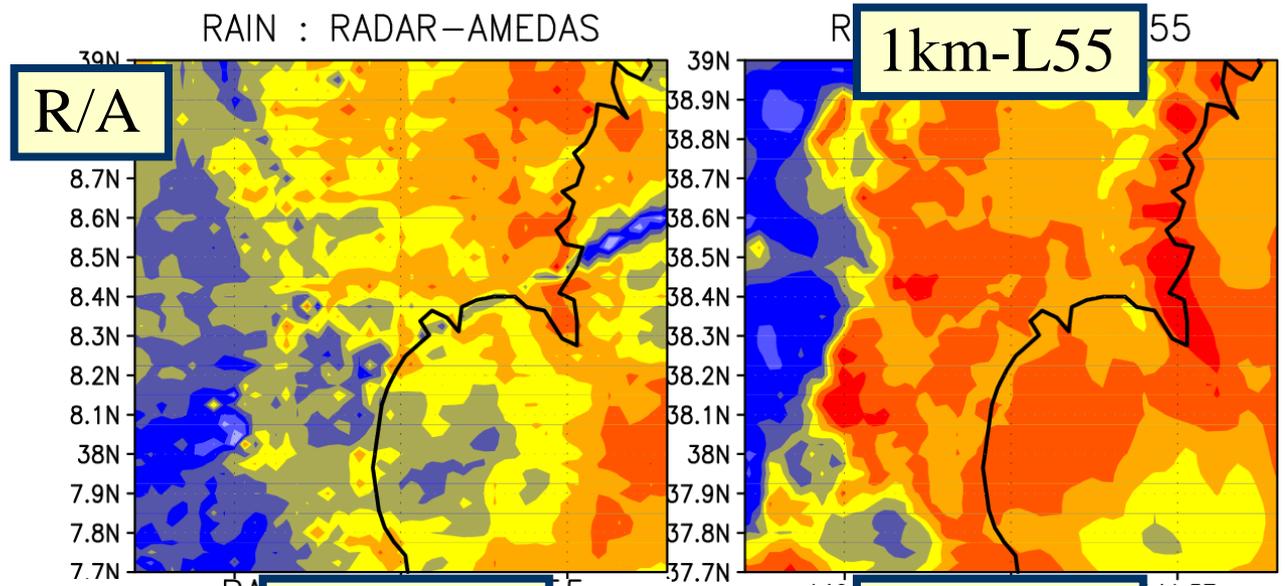
合っているとは
言い難い...



レーダーアメダスとの比較

RAIN : RADAR-AMEDAS

1ヶ月積算雨量

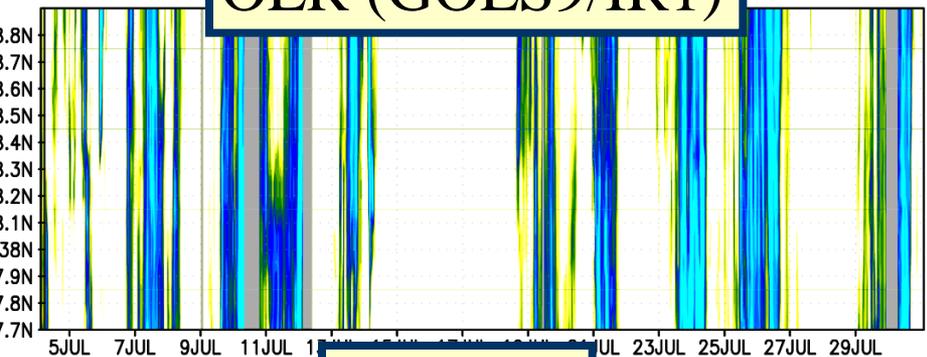


衛星/赤外との比較

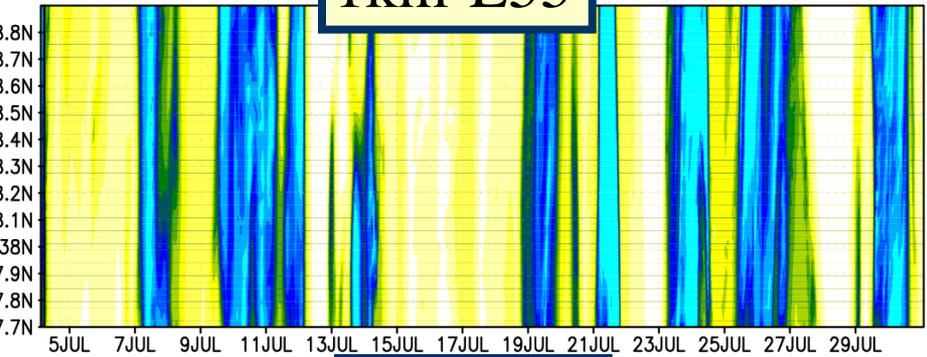
OLR (GOES9/IR1)

$$OLR = \sigma T^4$$

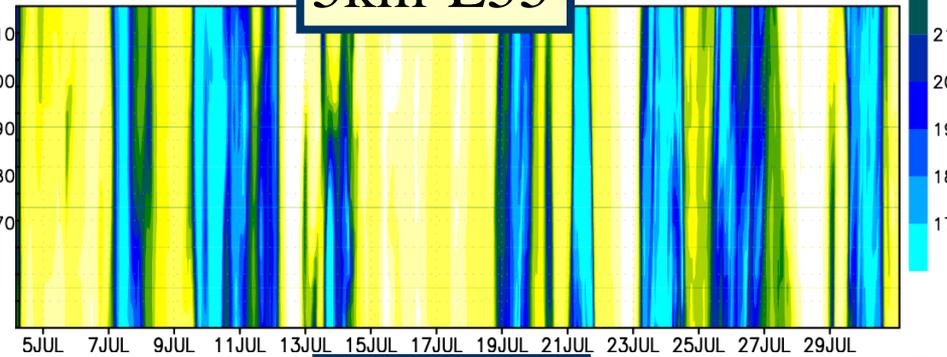
水平解像度：1kmの方が値が小
鉛直解像度：55層の方が値が小



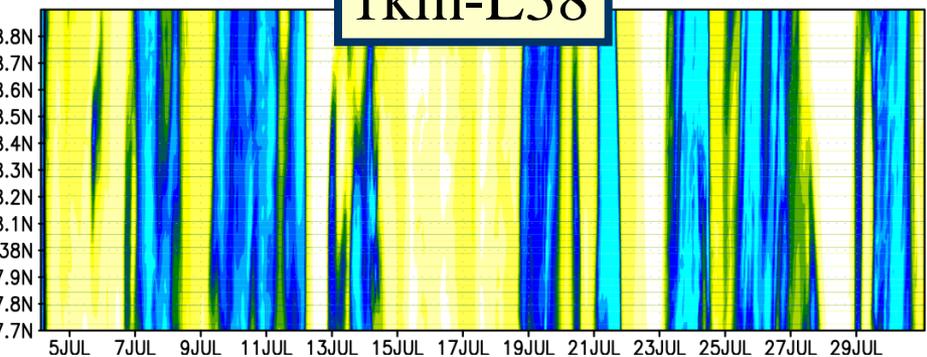
1km-L55



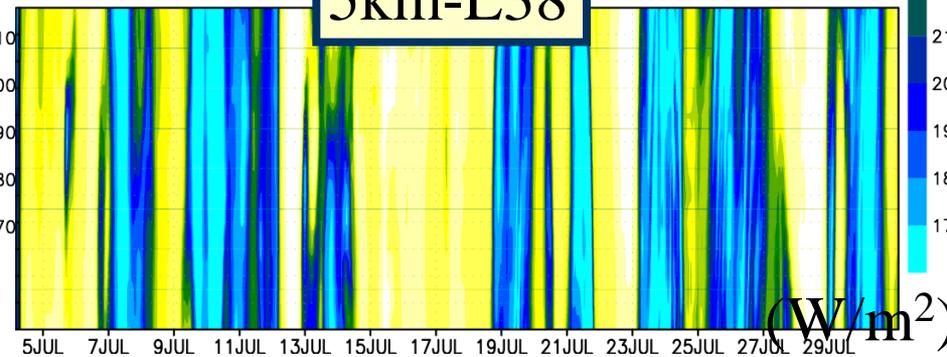
5km-L55



1km-L38



5km-L38



(W/m²)

LON:140.7-141.1