ISTP-2019
(2019. 5. 20-24, Toulouse)

Evaluation of the urban weather forecast over Seoul metropolitan area from KMA LDAPS

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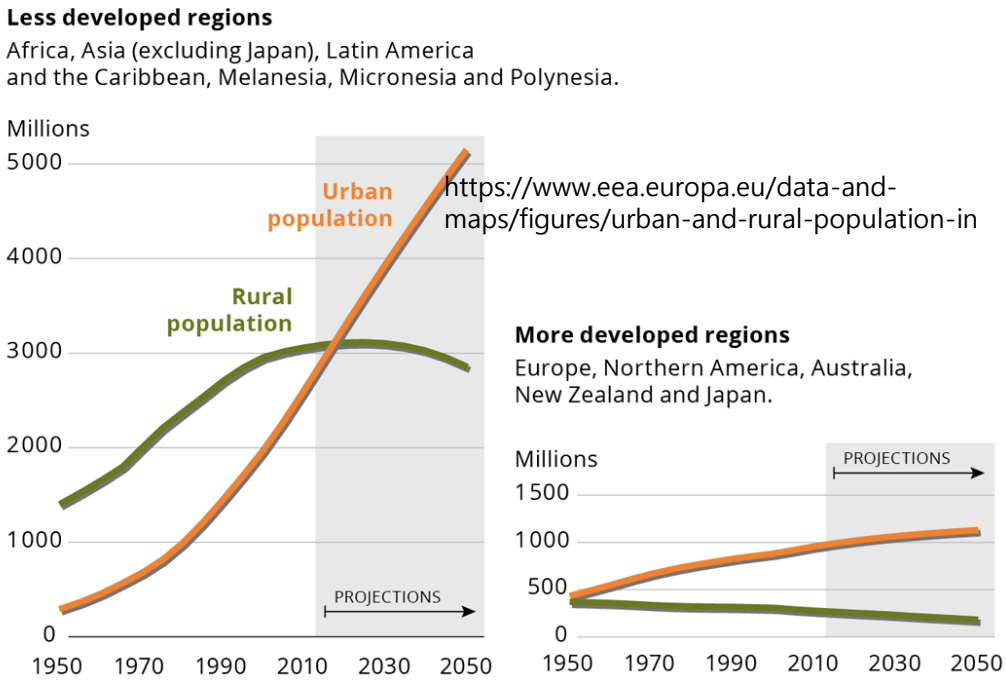
Introduction

- Characteristics of urban
  - High population
  - Building, paved road
  - Local meteorological phenomena
    (UHI, urban flood, rainfall, pollution etc)

- Vulnerability
  - heat stress, high impact weather



https://www.eea.europa.eu/data-and-maps/figures/urban-and-rural-population-in

- Urban forecast, urban planner and decision maker

Importance of urban weather forecast,

Diagnose of operational weather forecast,

Suggestion of improvement method

Model

- Numerical model

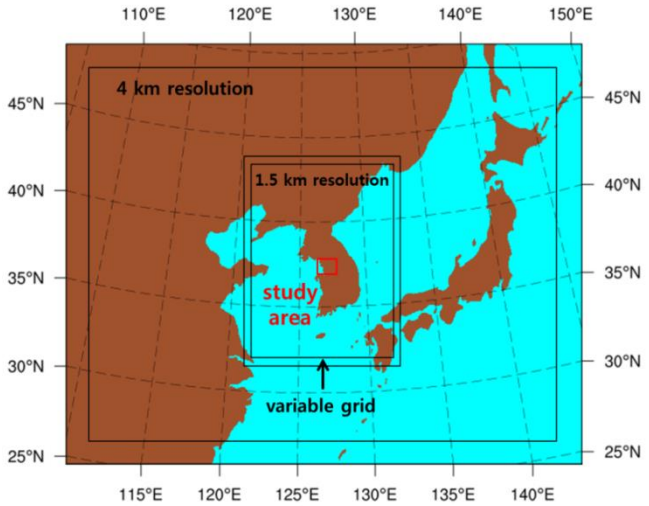
  - UM 10.1, Data assimilation : 3D VAR

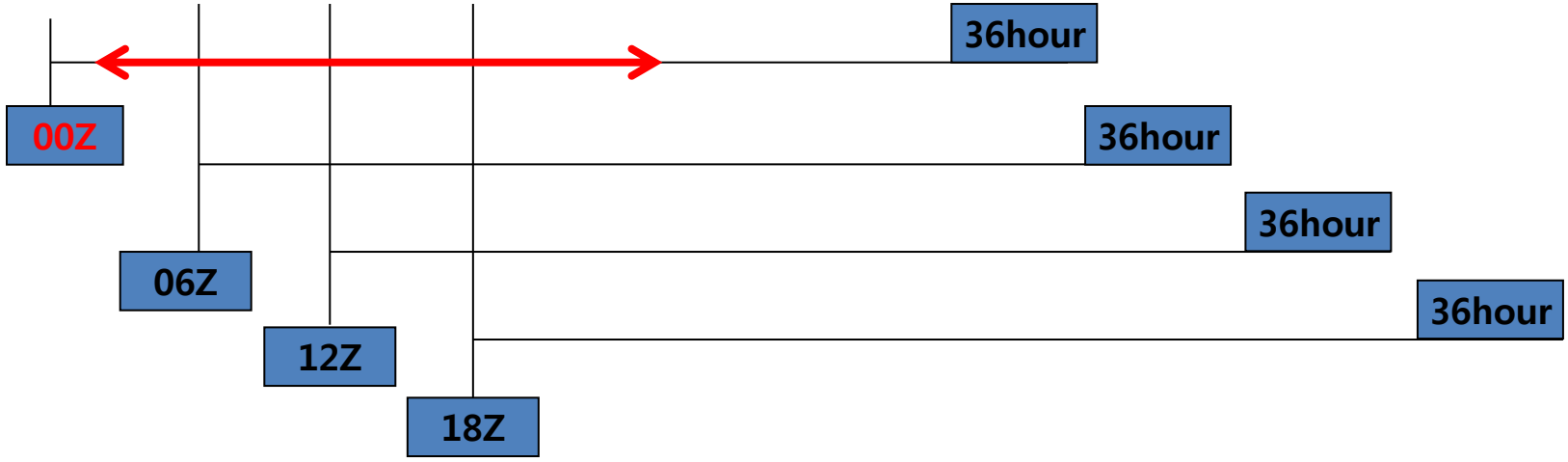
    (Surface observation, Upper air observation,

    Radar, Satellite observation)

  - Horizontal resolution : 1.5 km

  - Runs four times at 00, 06, 12, 18UTC :36-hour forecast





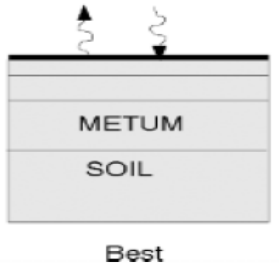
Simulation method

- Experiment and Analysis Period

1) Experiment 1

KMA LDAPS (operational model)

LDAPS-Best: 2016. 6 – 2017. 5

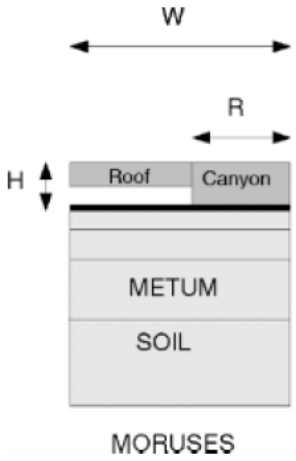


Experiment 1

2) Experiment 2

Improvement experiment for KMA operational model

LDAPS-MORUSES (UCM) : 2017. 6 – 2017. 8



Experiment 2

3) Experiment 3

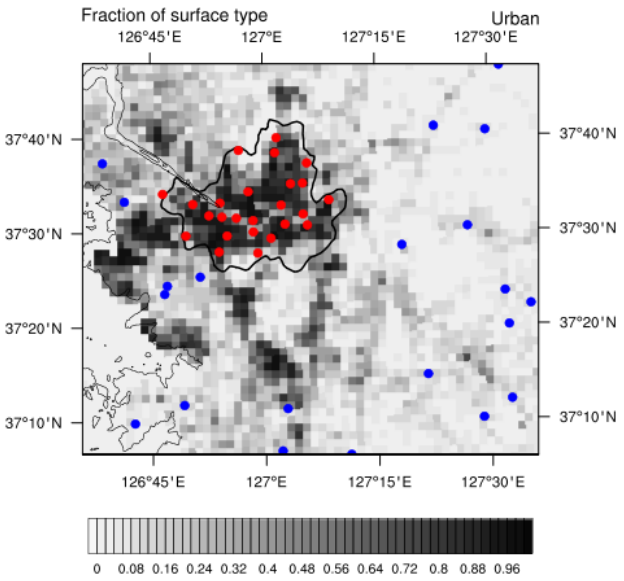
LDAPS with new LU data : 2018. 8

Validation data

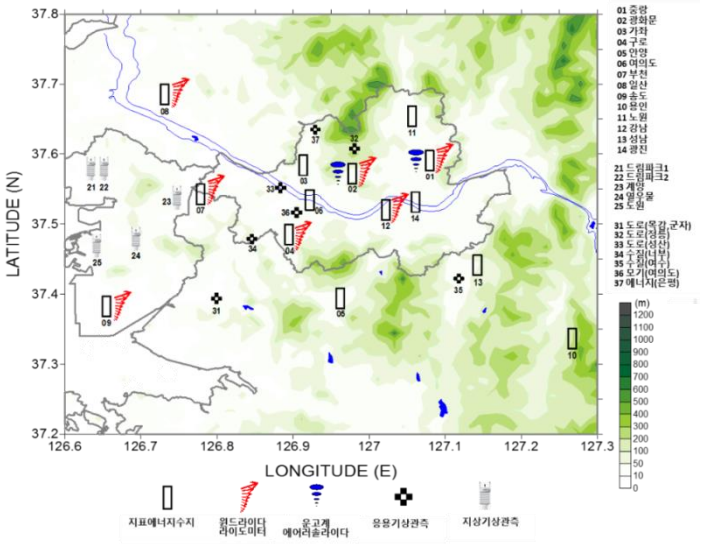
- Validation data

1) KMA AWS data : 25 stations in Seoul (red dot) : Experiment 1 and 2

2) Wind lidar with UMS-Seoul : Experiment 1 and 3



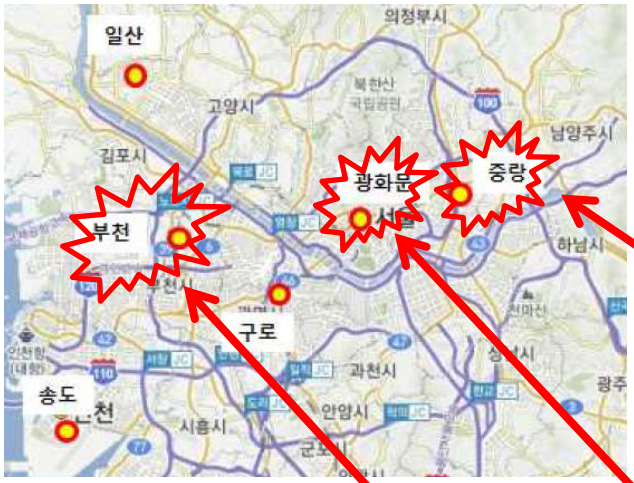
29 stations/
17 stations(Seoul)

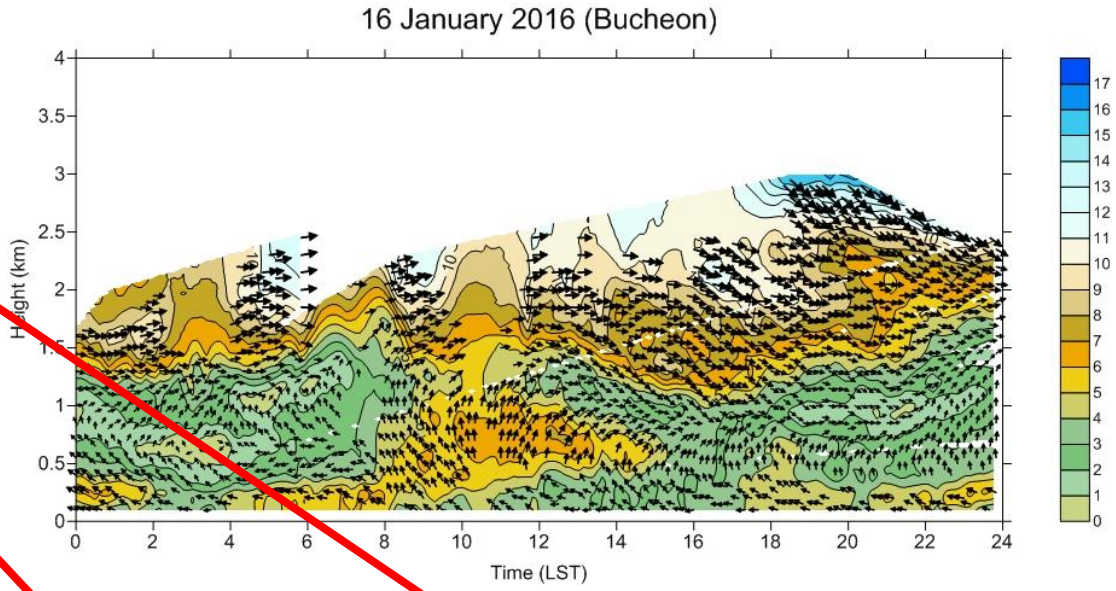


Atmos. Meas. Tech.
(2017, Park. et al)

Validation data

Wind lidar(6 stations)





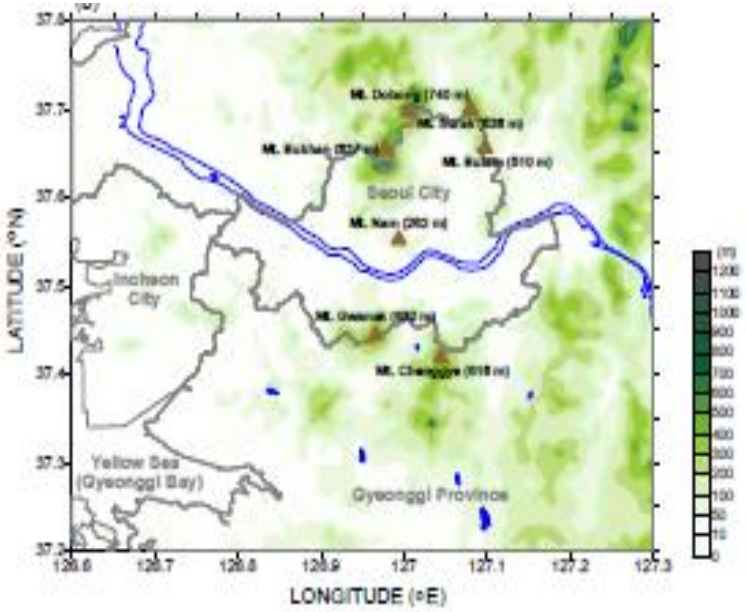
Location & Time : Bucheon, Kwanghwamun, Jungnang(2015), Songdo, Ilsan, Guro(2017)

Variables : Vertical profile of wind speed and direction

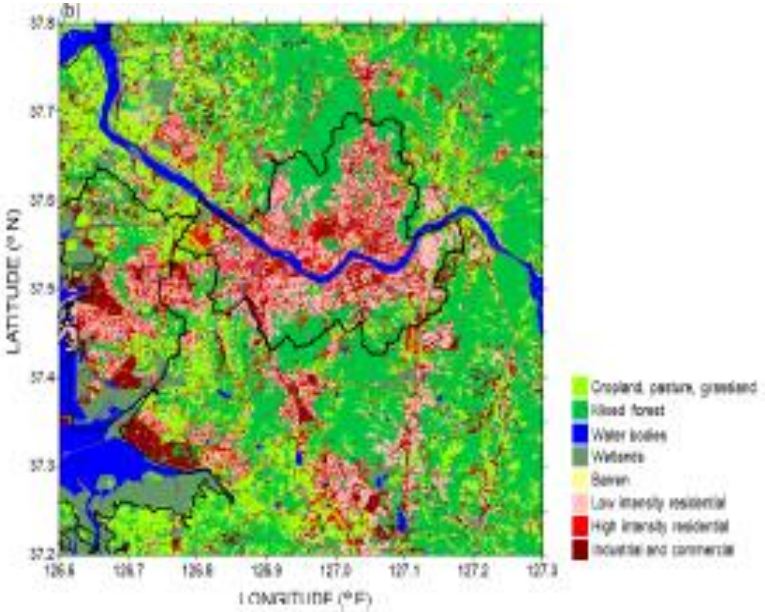
Temporal and spatial resolution : 10 min, 50m, Altitude 5~6km

Seoul Metropolitan Area

Topography

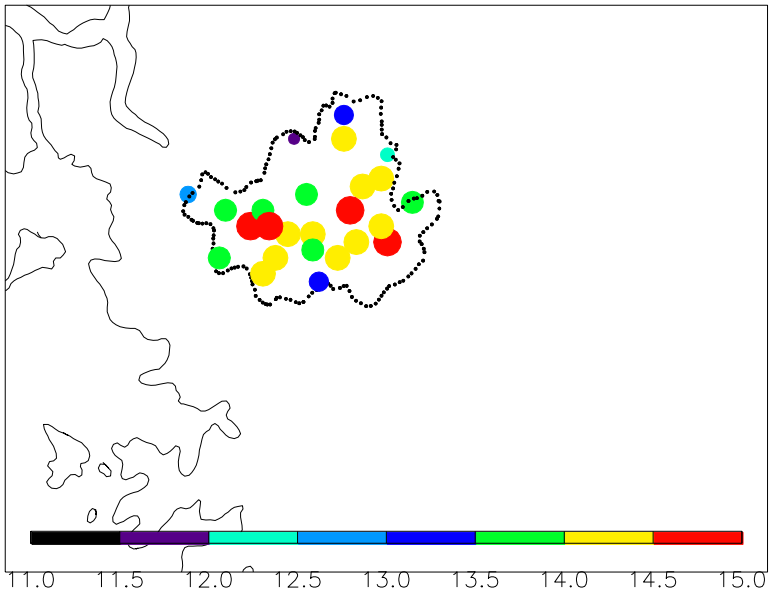


Landuse

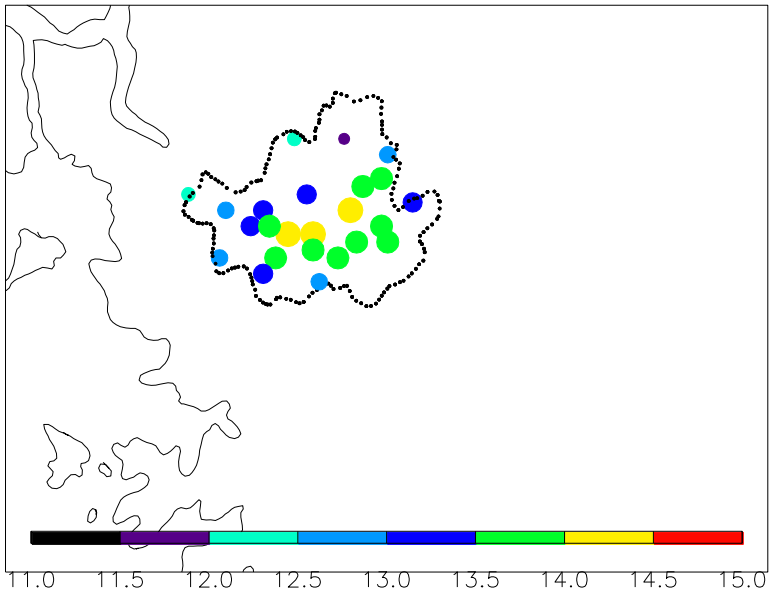


Atmos. Meas. Tech. (2017, Park. et al)

Validation (Annual mean temperature) : Experiment 1



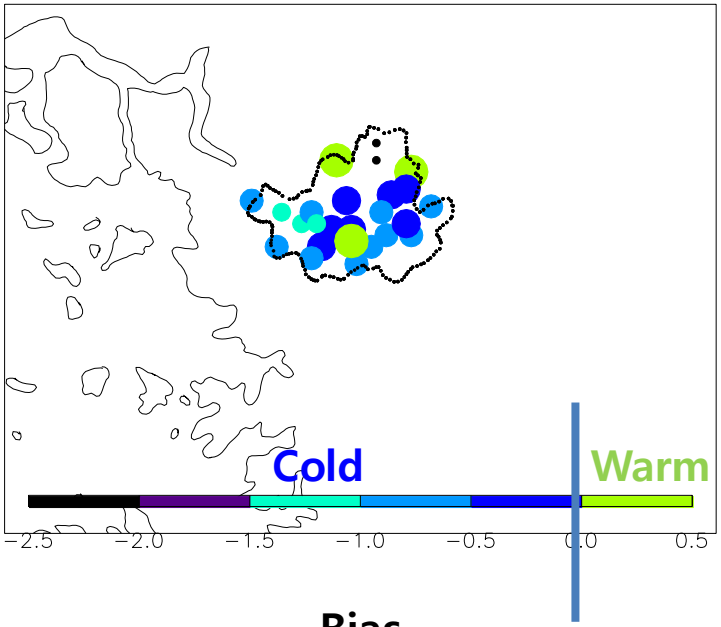
Observation



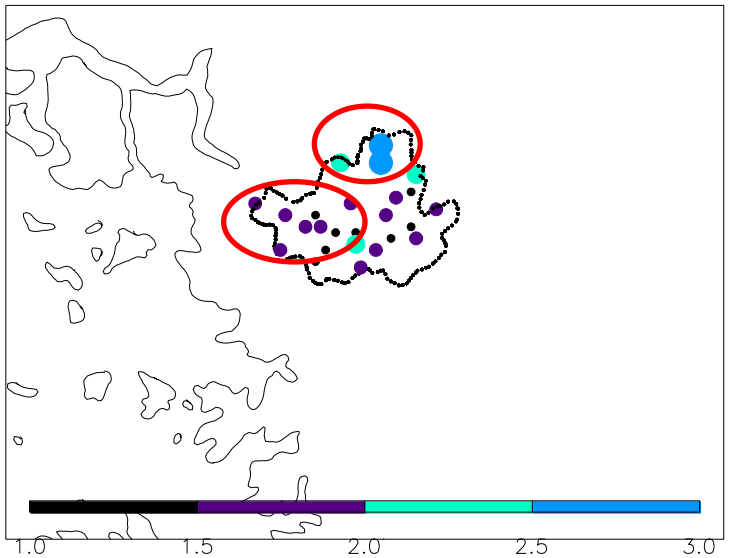
Forecast

- Comparison of the annual averaged temperature
- Seoul temperature is higher in the industrial area than outskirts
- Forecast temperature is lower than observation

Validation (Annual mean temperature)



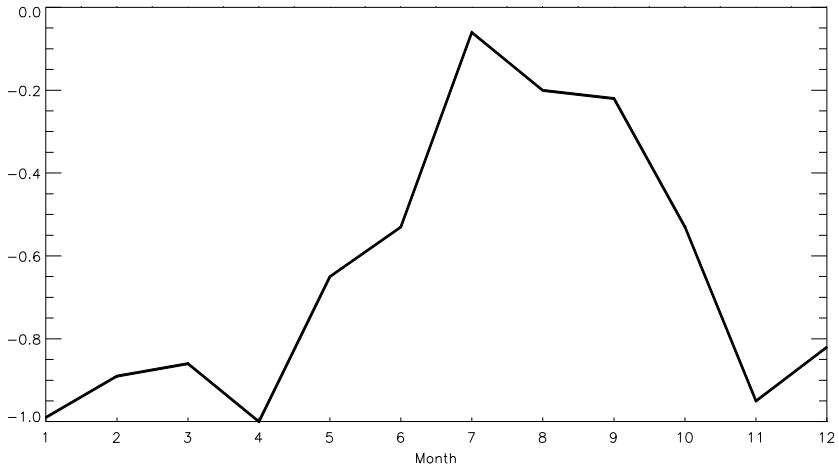
Bias



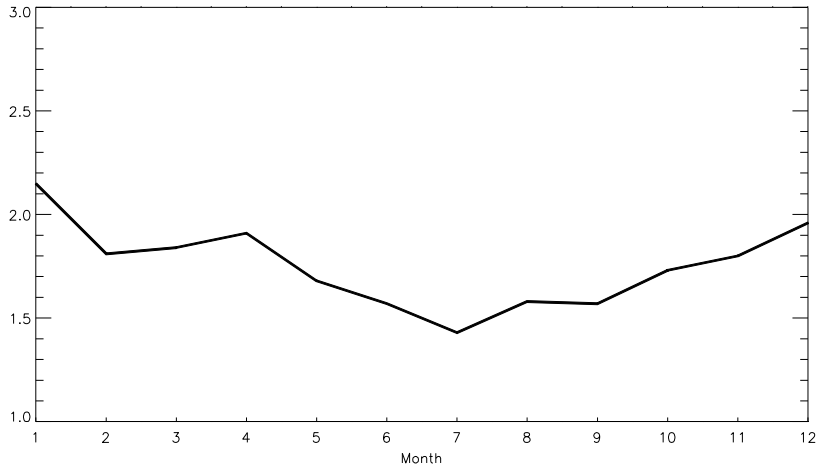
RMSE

- Statistical validation for surface temperature forecast against AWS observation
- Bias : Most of station shows negative bias, model forecast tends to underestimate
- RMSE : Increase of RMSE in the mountain and river area

Validation (Temperature)



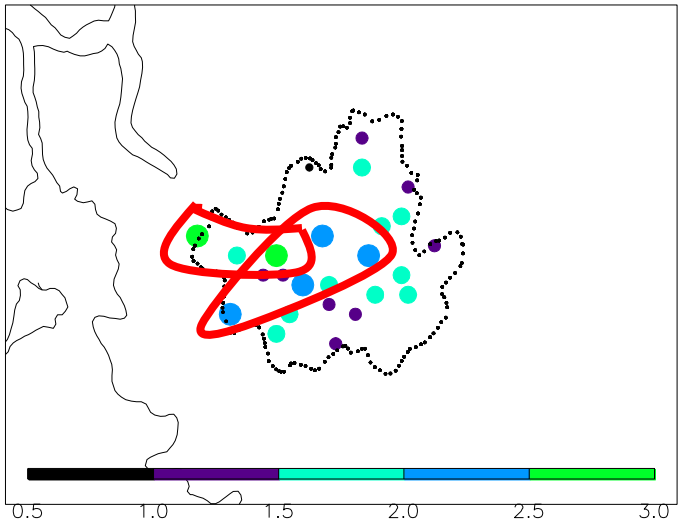
Bias



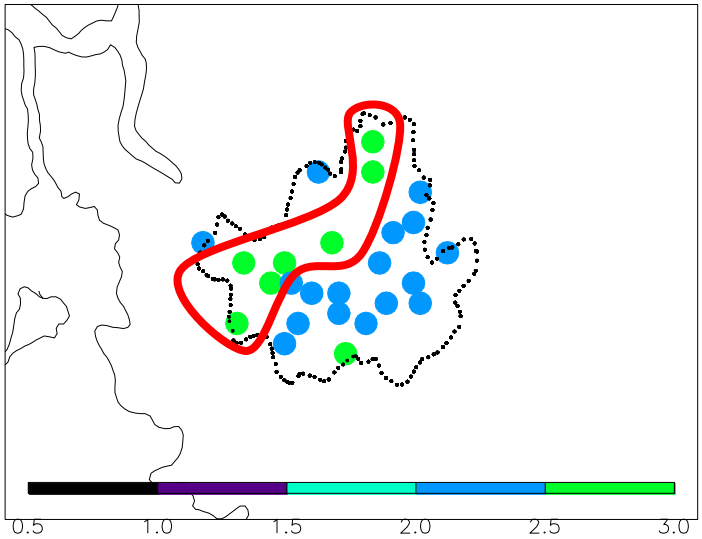
RMSE

- Monthly variation of the bias and RMSE
- Bias: Increase of negative bias in winter and decrease of negative bias in summer
- RMSE: Smaller in the summer than winter

Validation (Annual mean wind speed)



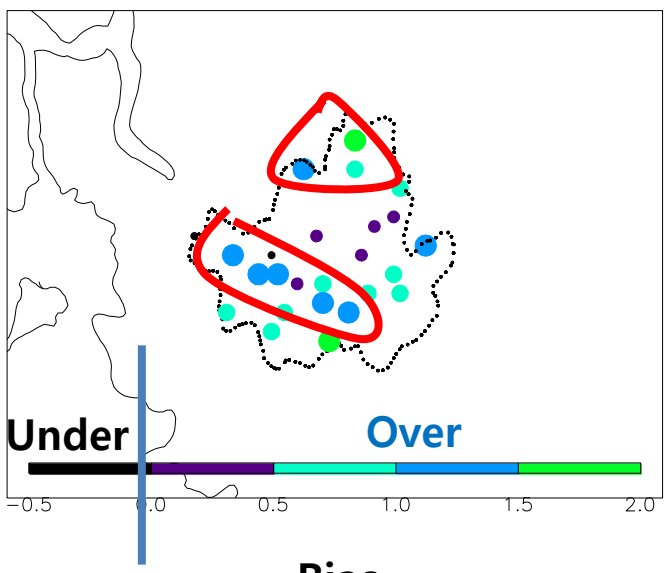
Observation



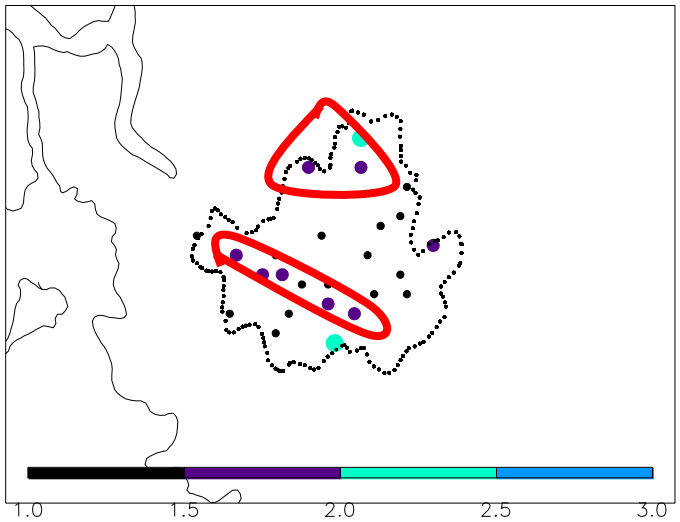
Forecast

- Comparison of the annual averaged surface wind speed
- Wind speed is higher in the west area than east region
- Forecast wind speed overestimates than observation

Validation (Annual mean wind speed)



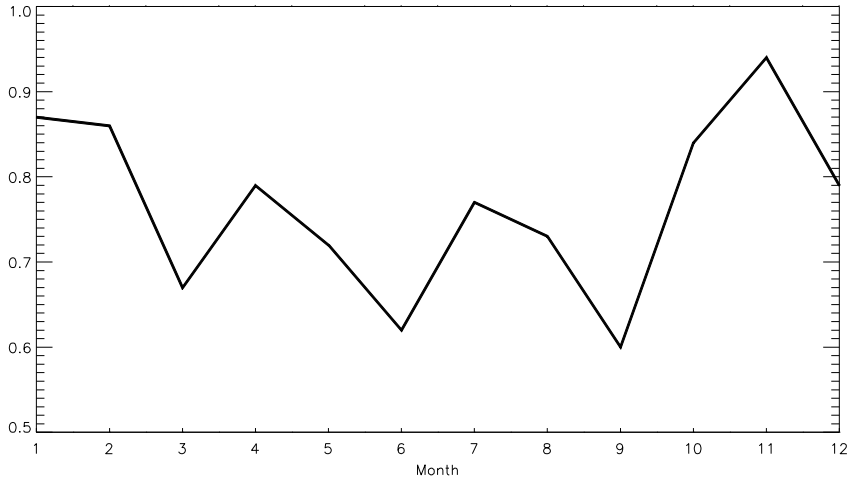
Bias



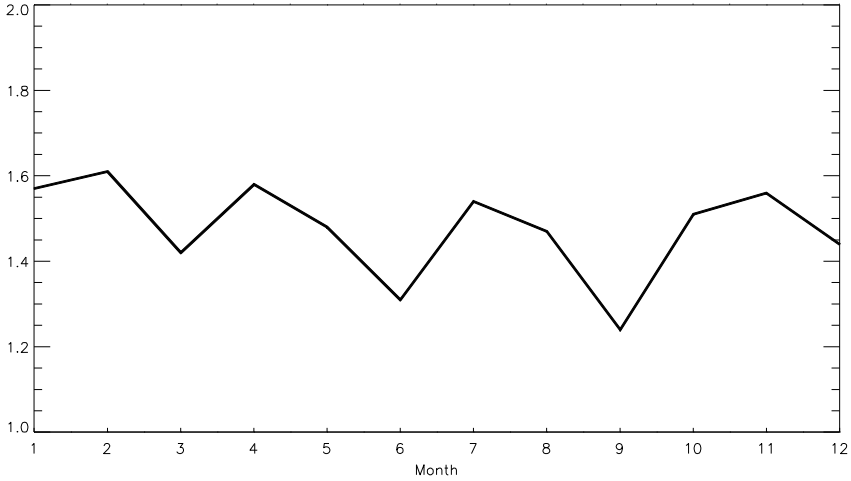
RMSE

- Statistical validation for surface wind speed forecast against AWS observation
- Bias : Most of station shows positive bias, model forecast tends to overestimate
- Increase of Bias and RMSE in the mountain and river area

Validation (Wind speed)



Bias



RMSE

- Monthly variation of the bias and RMSE
- Bias: Increase of positive bias in winter and decrease of bias in summer

Improvement of KMA-LDAPS

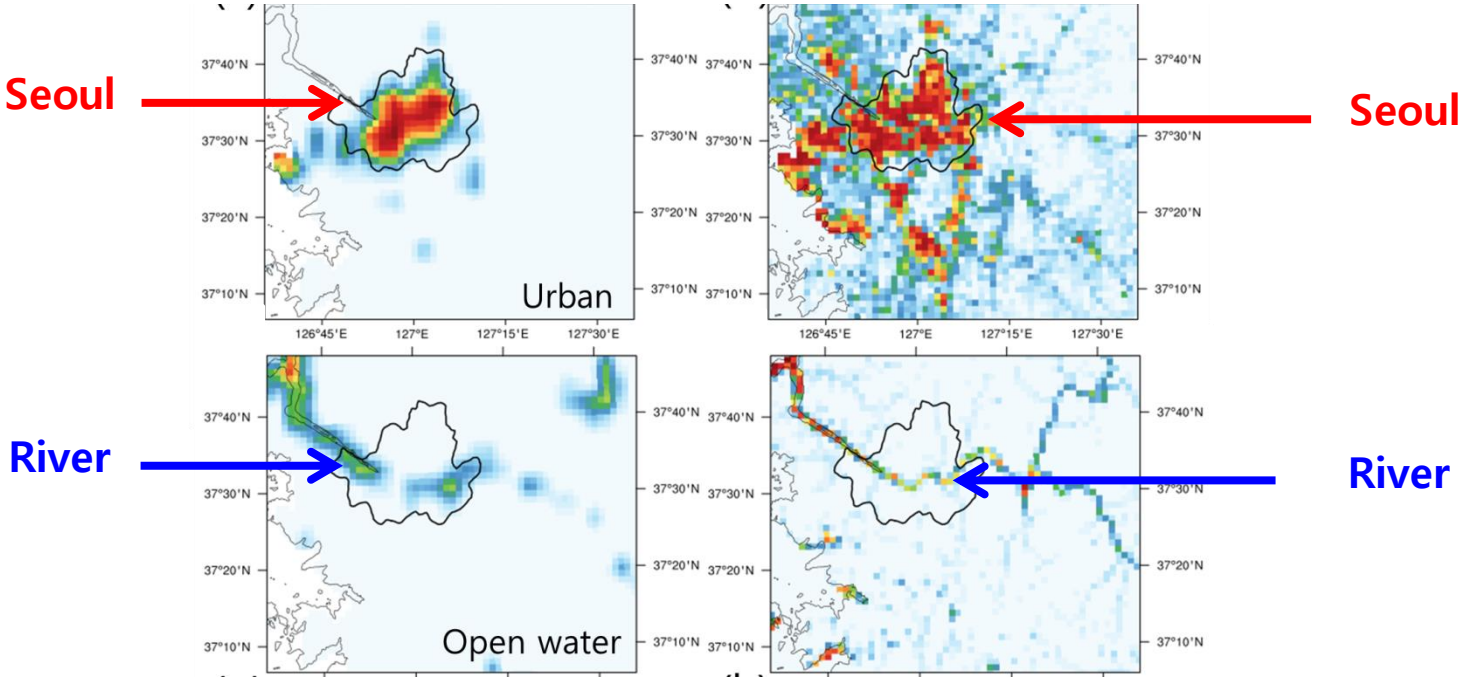
1. Update land-use data

International Geosphere and Biosphere Programme **(IGBP)**

-1998
-1km resolution

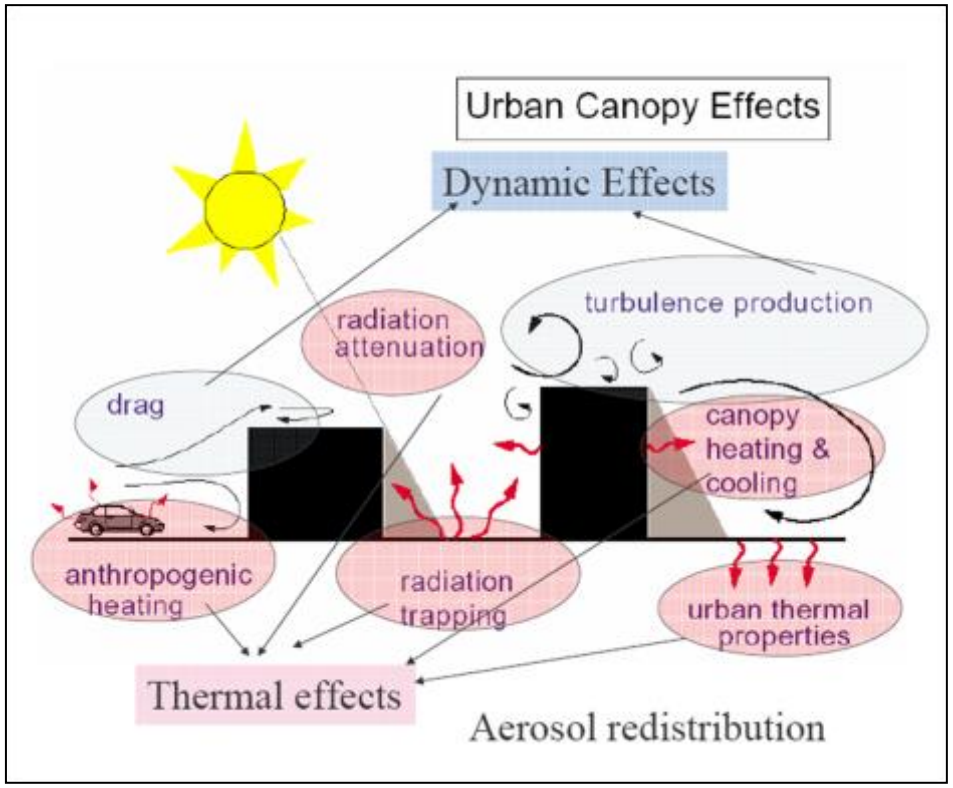
Environmental Geographic Information Service **(EGIS)**

-2007
-5 m resolution (South Korea)
-SPOT-5
-Ministry of Environment, Korea



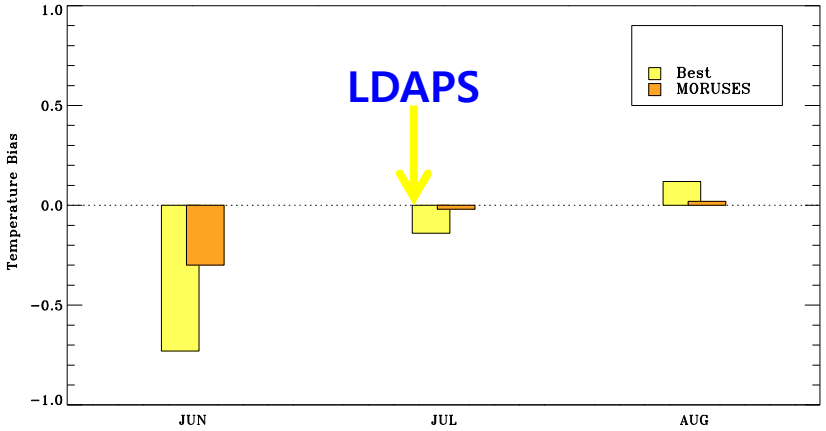
Improvement of KMA-LDAPS

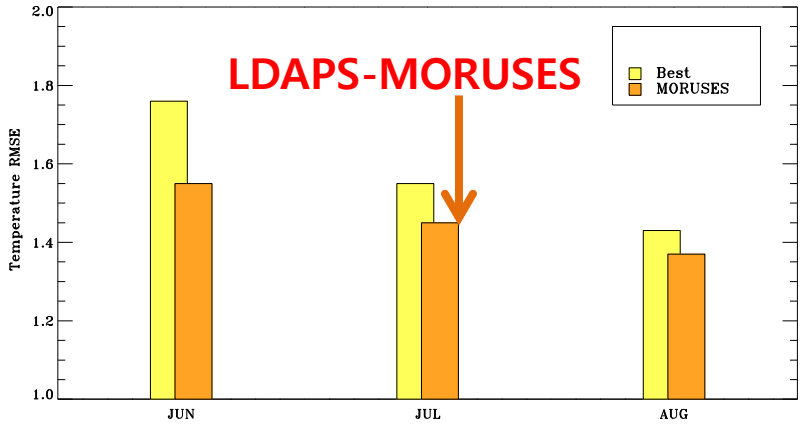
2. Urban Canopy Model



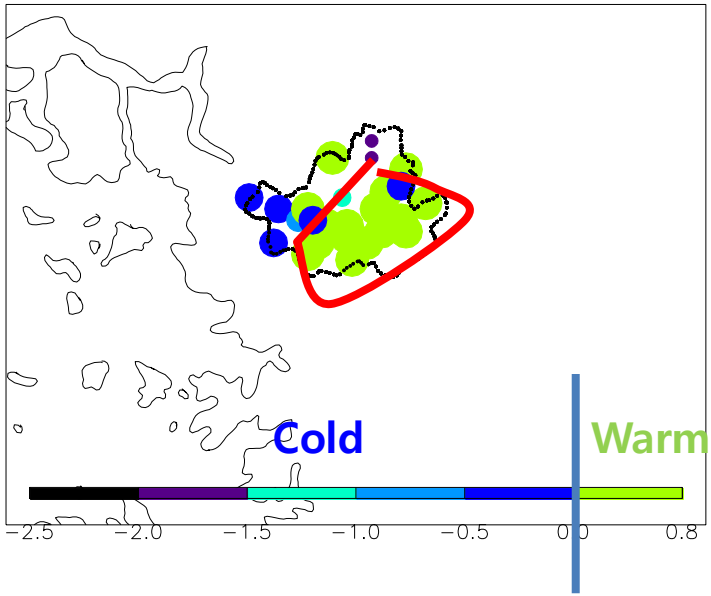
(Adapted from Ching et al, 2009. BAMS)

Validation (Summer Temperature) : Experiment 2

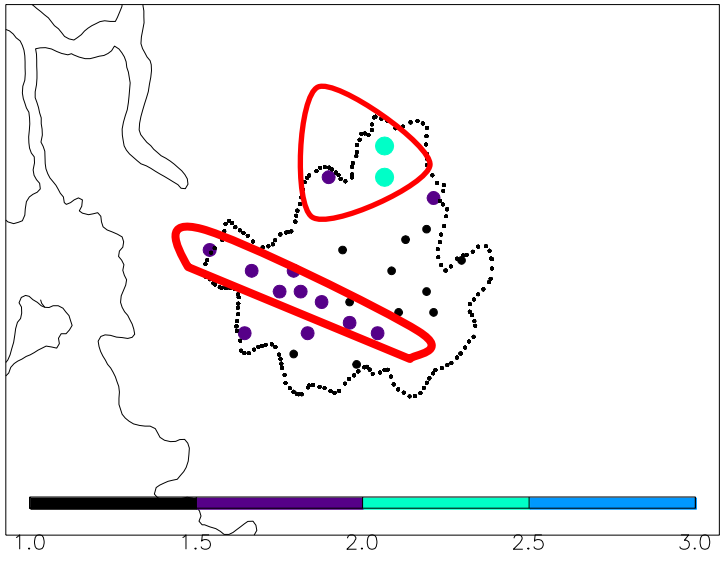




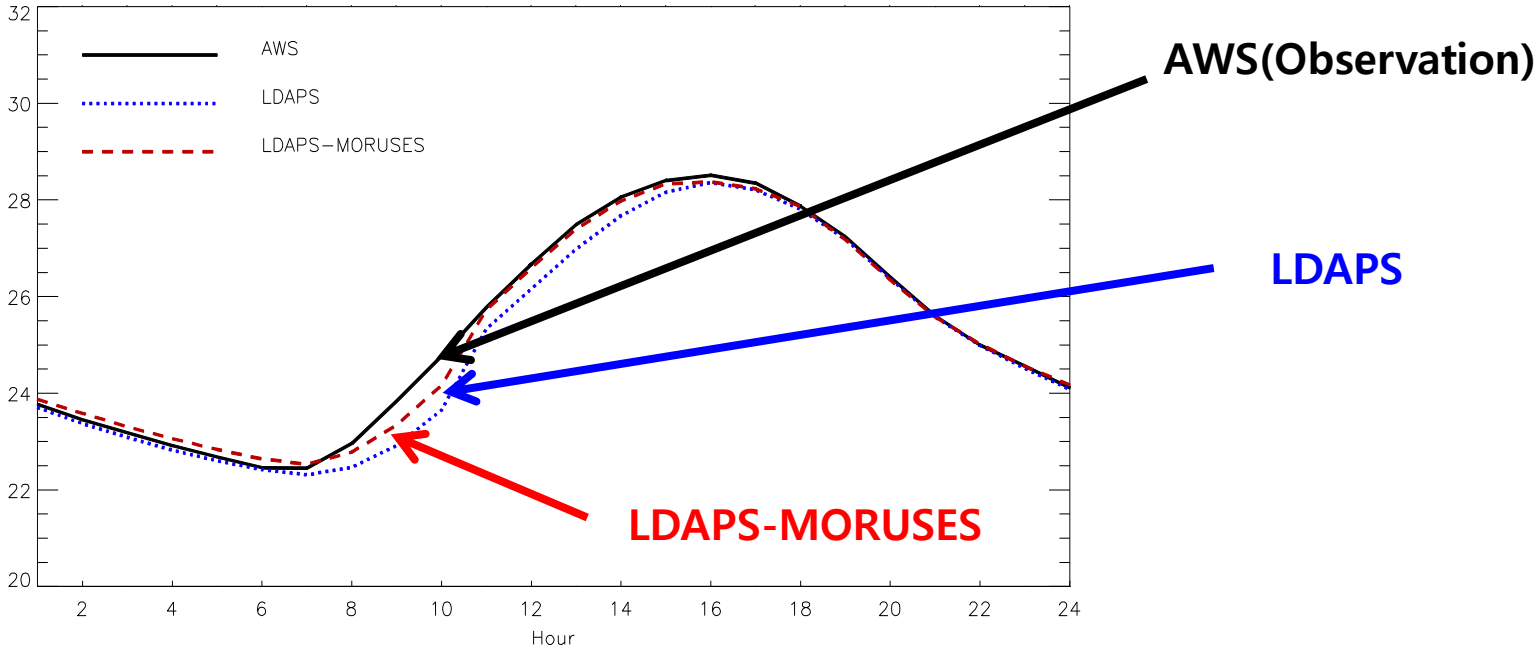
Bias



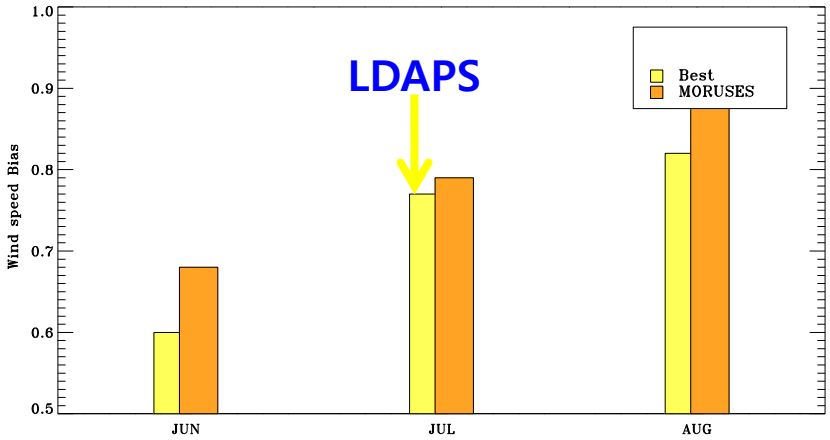
RMSE

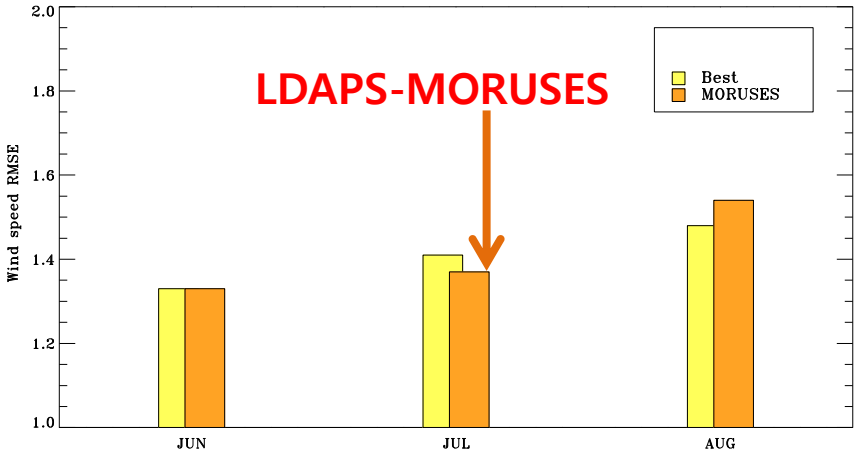


Validation (Summer Temperature) : Experiment 2



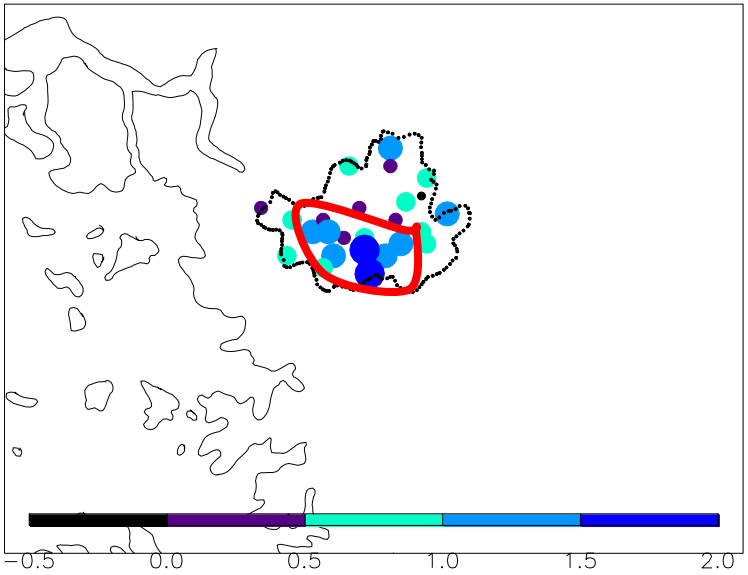
Validation (Summer Wind speed) : Experiment 2

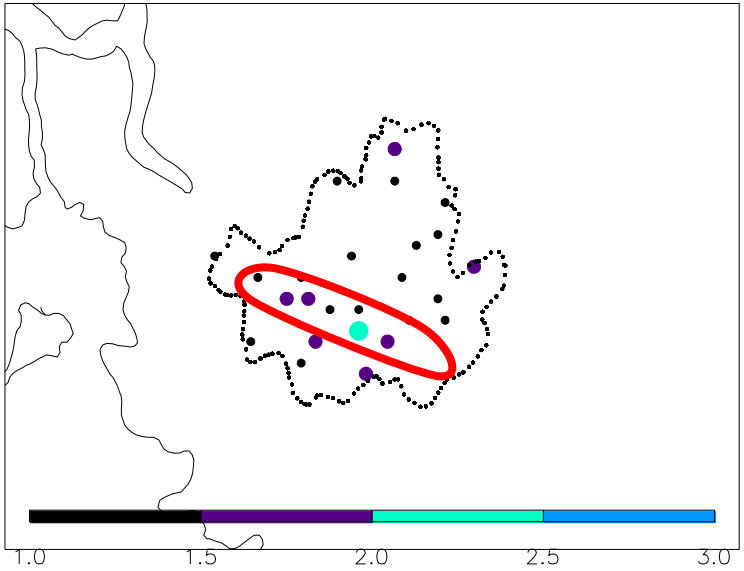




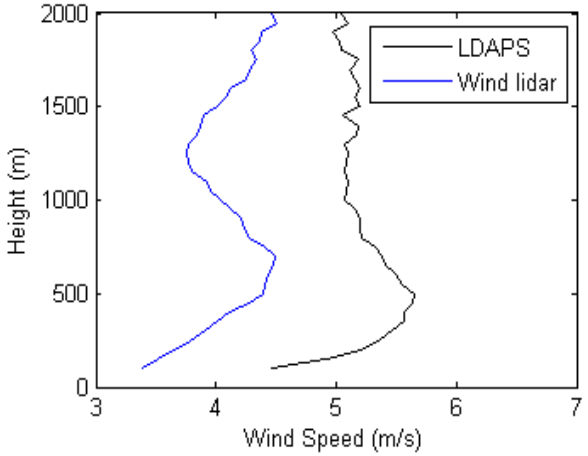
Bias

RMSE

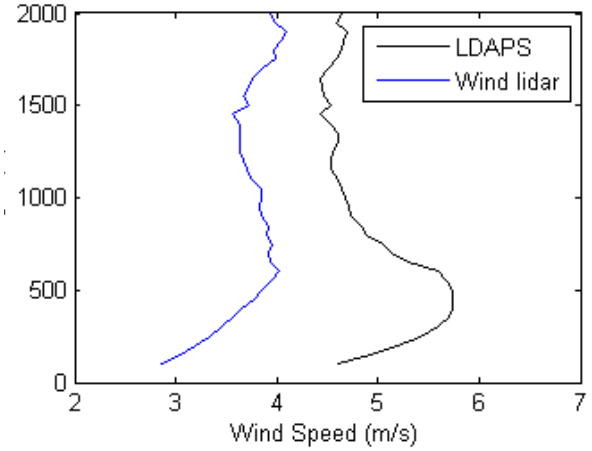




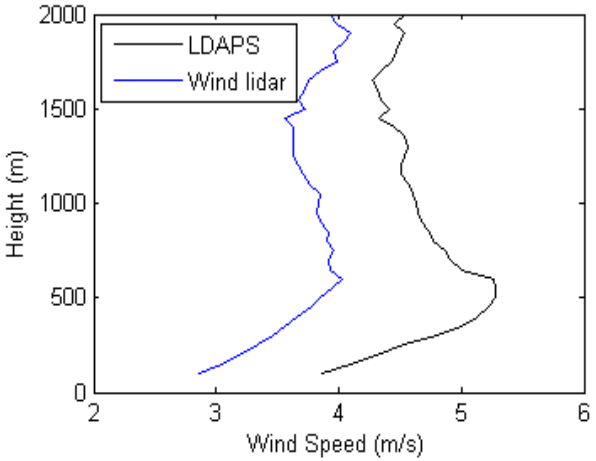
Validation (Wind profile) : Experiment 1



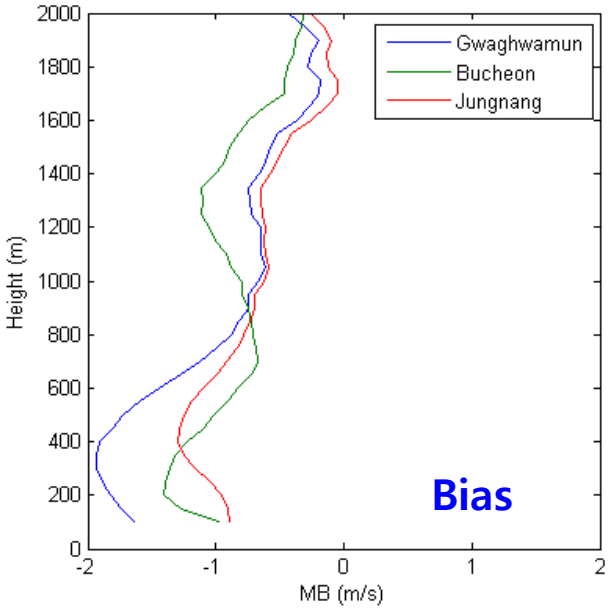
Buchon



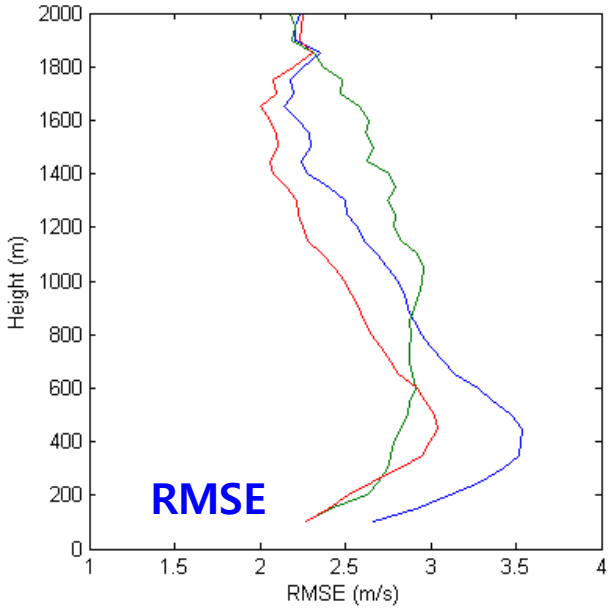
Gwanghwamun



Jungnang

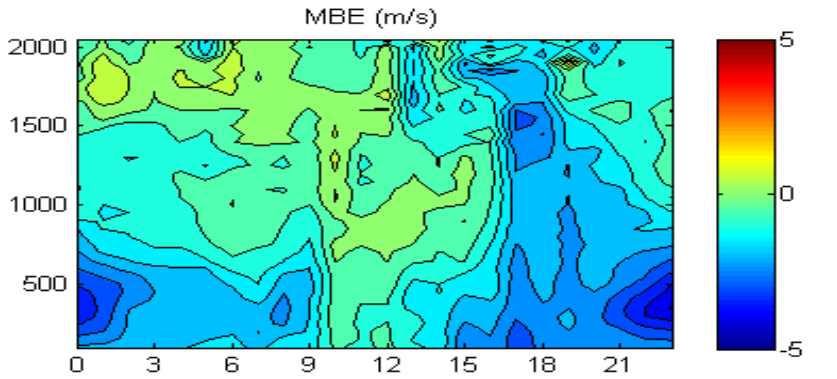


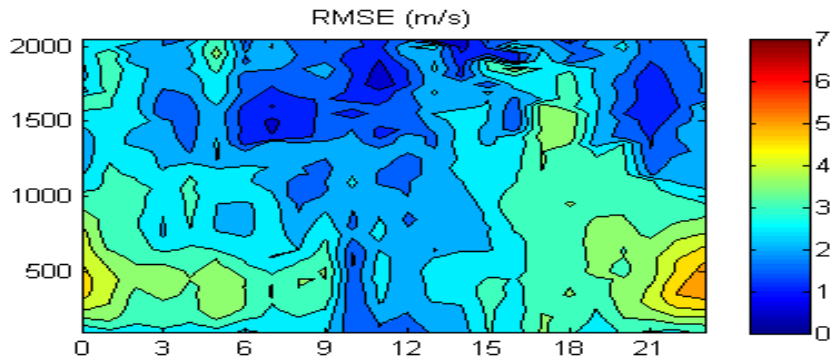
Bias



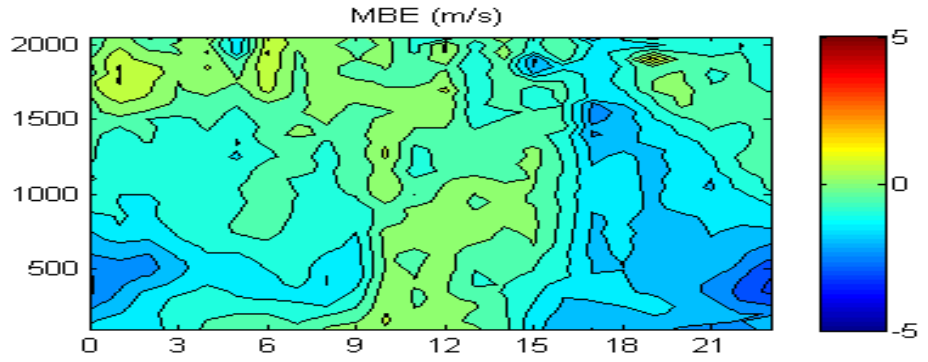
RMSE

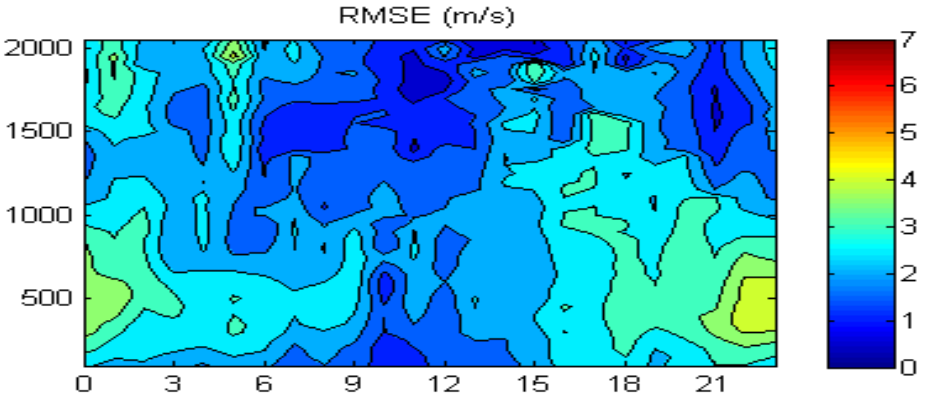
Validation (Wind profile) : Experiment 1





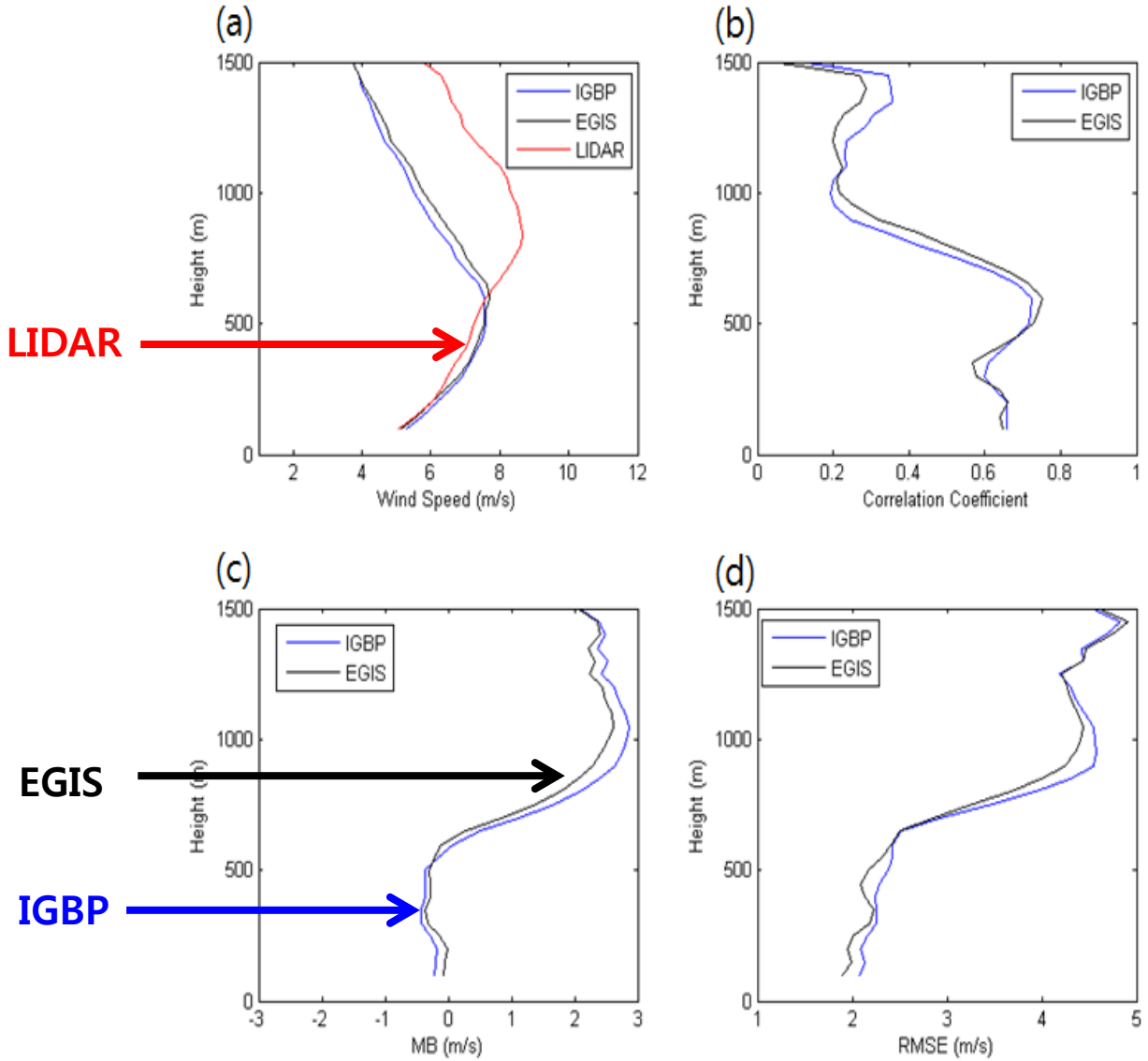
Gwanghwamun





Jungnang

Validation (Wind profile) : Experiment 3



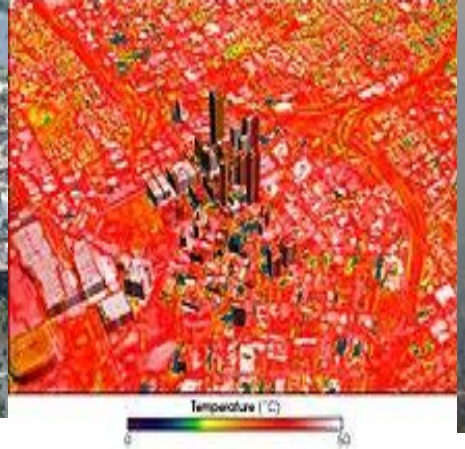
Summary

- Prediction of the urban forecast using Best scheme (LDAPS) in Seoul
  - ✓ Temperature : Underestimation, Warm season RMSE decreases than winter
  - ✓ Wind : Overestimation tendency, error increases in mountain and river region

- Improvement of urban weather forecast using new LU data and urban scheme
  - ✓ Temperature : Improvement of cold bias in the morning time
  - ✓ Wind speed : Surface wind speed is not improved, but wind speed within PBL shows better results in the new LU data simulation

- Future plan
  - ✓ Validation of temperature profile using microwave radiometer
  - ✓ Improvement of urban building information and AH





Thank you !!
(byonjy@kma.go.kr)