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

- 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**

2) Experiment 2

   Improvement experiment for KMA operational model

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

3) Experiment 3

   **LDAPS with new LU data: 2018. 8**
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

Validation data

Wind lidar (6 stations)


Variables: *Vertical profile of wind speed and direction*

Temporal and spatial resolution: *10 min, 50m, Altitude 5~6km*
Seoul Metropolitan Area

Topography

Landuse

Validation (Annual mean temperature) : Experiment 1

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

- 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)

• 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)

- 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)

- Monthly variation of the bias and RMSE
- Bias: Increase of positive bias in winter and decrease of bias in summer
1. Update land-use data

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

Improvement of KMA-LDAPS

International Geosphere and Biosphere Programme (IGBP)

Environmental Geographic Information Service (EGIS)

- 1998
- 1km resolution
2. Urban Canopy Model

(Adapted from Ching et al, 2009. BAMS)
Validation (Summer Temperature): Experiment 2

- **Bias**
  - LDAPS
  - LDAPS-MORUSES

- **RMSE**
  - LDAPS-MORUSES

**Cold**

**Warm**
Validation (Summer Wind speed) : Experiment 2

Bias

LDAPS

RMSE

LDAPS-MORUSES
Validation (Wind profile) : Experiment 1

Buchon

Gwanghwamun

Jungnang

Bias

RMSE
Validation (Wind profile) : Experiment 1

Gwanghwamun

Jungnang
Validation (Wind profile) : Experiment 3

(a) [Graph showing wind speed vs height with curves for IGBP, EGIS, and LIDAR]

(b) [Graph showing correlation coefficient vs height with curves for IGBP and EGIS]

(c) [Graph showing height vs MB (mean bias) with curves for IGBP and EGIS]

(d) [Graph showing height vs RMSE (root mean square error) with curves for IGBP and EGIS]
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!!
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