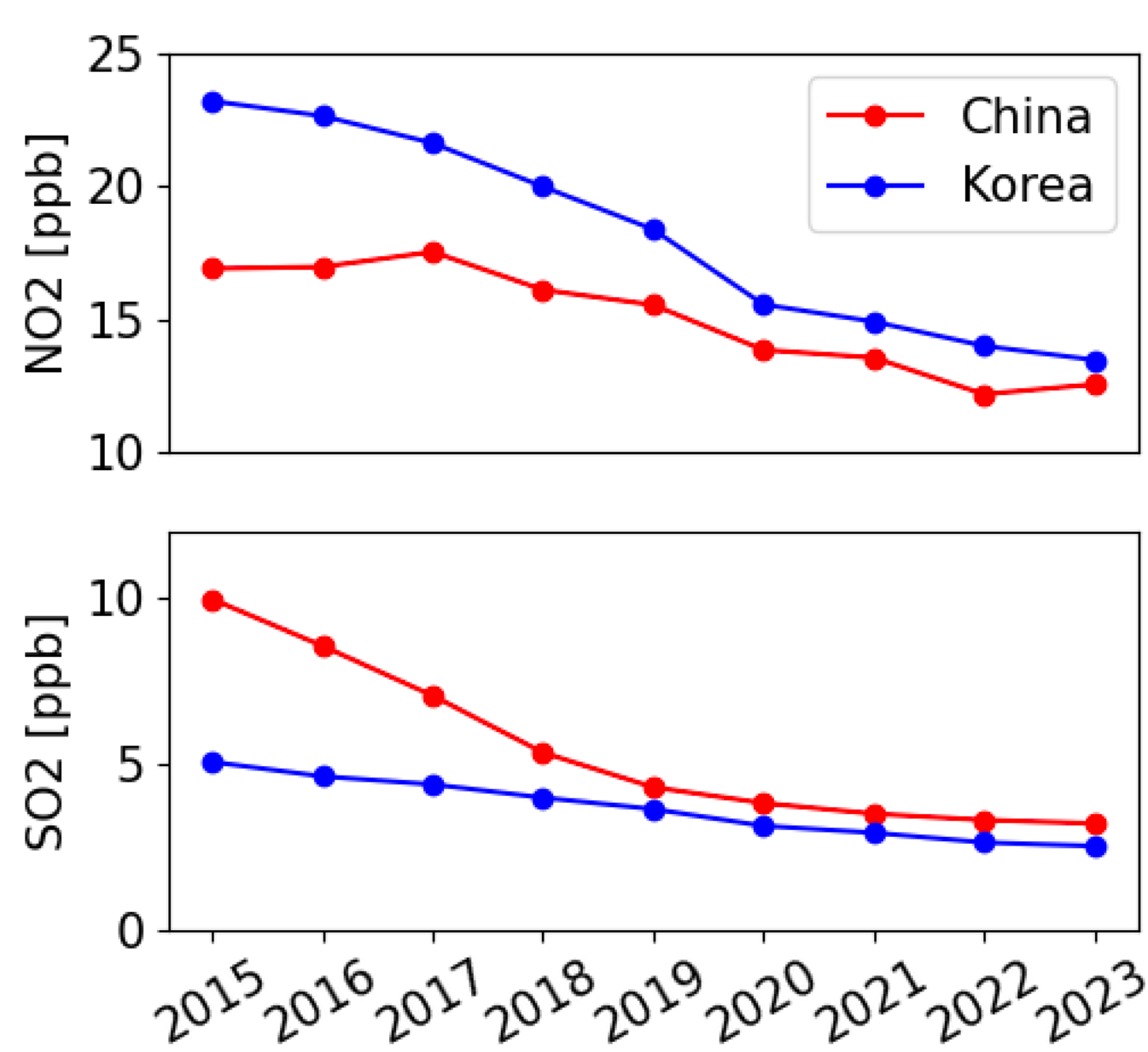


Introduction



- Concentration of air pollutants such as NO₂ and SO₂ follows a decreasing trend in East Asia showing a consistent change in atmospheric composition
- Continuous updates in CTM is needed to keep up with the changing trends in air quality and to produce reliable AMF

Method

GEOS-Chem (Prior) vs GEOS-Chem (Update)

| | GEOS-Chem (Prior) | GEOS-Chem (Update) |
|------------------------|----------------------------|--------------------|
| Resolution | 0.25° x 0.3125°, 47 layers | |
| Meteorological data | GEOSFP 0.25° x 0.3125° | |
| Target period | 2020.08 ~ 2021.07 | 2023.02 |
| Anthropogenic emission | KORUSv5 (2015) | AQNEAv3 (2019) |

- Updated emission inventory AQNEAv3 and up-to-date meteorological data were used as input data for GEOS-Chem version 13.0.0

Result

Evaluation with ground observations

1. Surface Mixing Ratio

- Observation data were collected from the China Air Quality Historical Data Website and Airkorea

AQNEAv3 (2023.02)

| | Mean | | R | RMSE | NMB | NME |
|-------|------|------|------|------|--------|-------|
| | OBS | MOD | | | | |
| Korea | 19.8 | 14.5 | 0.63 | 10.9 | -26.6% | 41.9% |
| China | 15.9 | 14.7 | 0.56 | 8.65 | -7.05% | 42.5% |

KORUSv5 (2021.02)

| | Mean | | R | RMSE | NMB | NME |
|-------|------|------|------|------|-------|-------|
| | OBS | MOD | | | | |
| Korea | 18.8 | 17.6 | 0.69 | 10.1 | -6.7% | 40.3% |
| China | 13.0 | 16.7 | 0.55 | 10.3 | 27.9% | 60.5% |

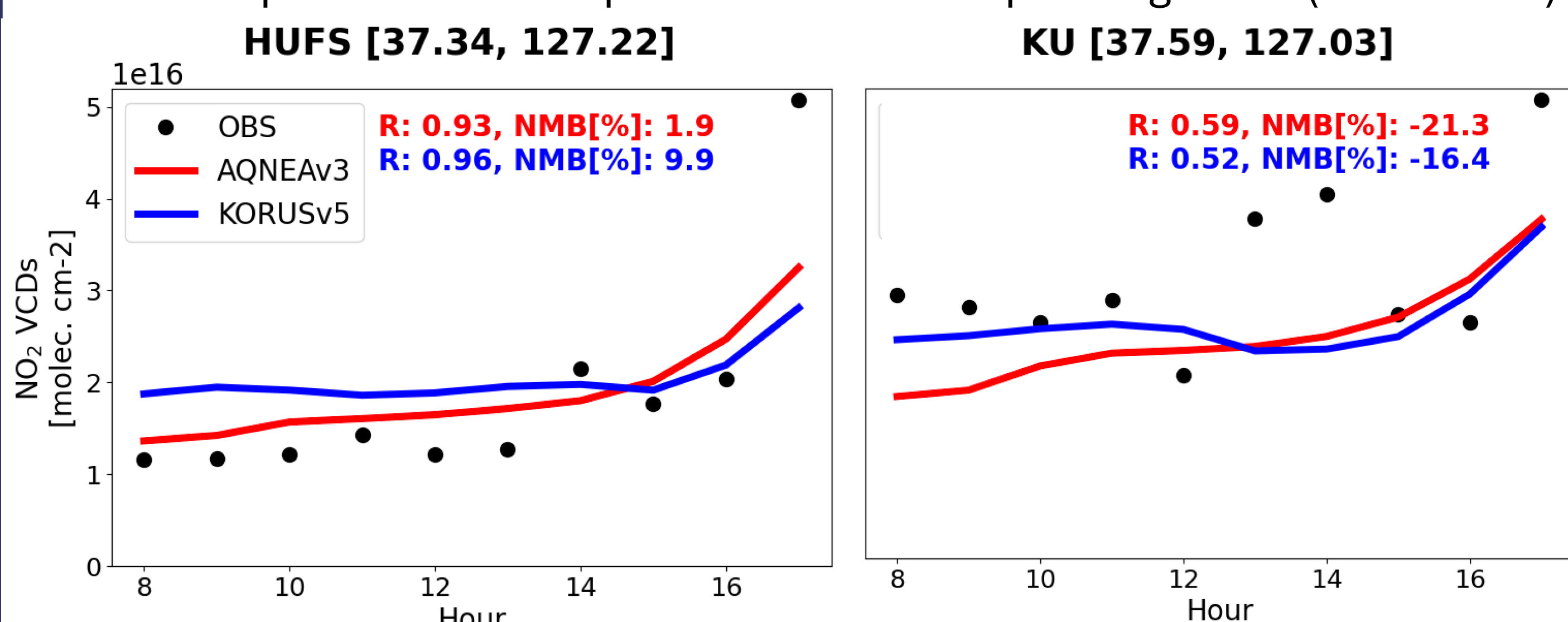
| | Mean | | R | RMSE | NMB | NME |
|-------|------|------|------|------|--------|-------|
| | OBS | MOD | | | | |
| Korea | 2.78 | 2.54 | 0.24 | 3.27 | -8.67% | 74.5% |
| China | 3.63 | 4.22 | 0.17 | 4.30 | 16.4% | 75.7% |

| | Mean | | R | RMSE | NMB | NME |
|-------|------|------|------|------|--------|--------|
| | OBS | MOD | | | | |
| Korea | 3.35 | 3.72 | 0.33 | 4.42 | 11.3% | 72.9% |
| China | 4.11 | 11.2 | 0.19 | 14.6 | 172.0% | 202.3% |

- Prior model results showed overestimation of both SO₂ and NO₂ concentration in China whereas NO₂ concentration in Korea showed underestimation
- With the emission inventory update the NO₂, SO₂ concentration in each regions showed an **overall decrease** leading to improvement from previous overestimation

2. MAX-DOAS observation

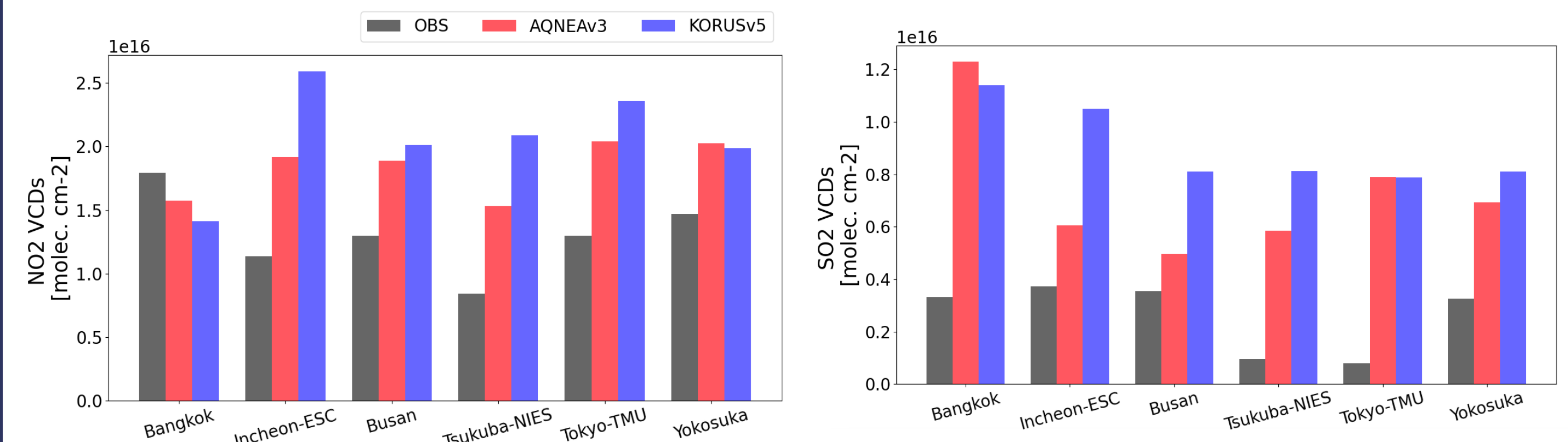
- Observations data was collected from two sites (HUFS, KU) during the ASIA-AQ campaign.
- Diurnal pattern was compared for the corresponding dates (2.14 ~ 2.28)



- Model results showed similar pattern with increase in the afternoon
- Due to reduction in NO_x emission, the NO₂ VCD showed an **overall decrease** leading to smaller value of NMB

3. Pandonia Global Network

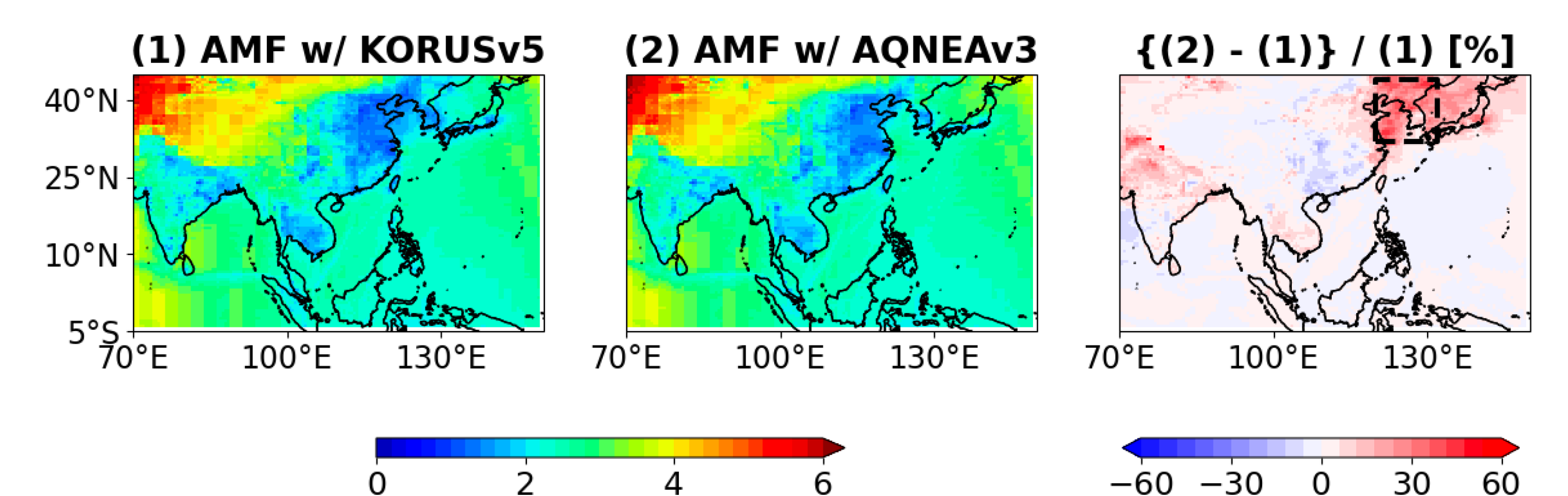
- VCD measurement data of February, 2023 were collected from the Pandonia Global Network (High quality assured quality flag was applied)



- Monthly average VCD for NO₂, SO₂ were evaluated with both model outputs
- In most sites, both NO₂ and SO₂ VCD leaned closer to the observation value showing a decrease

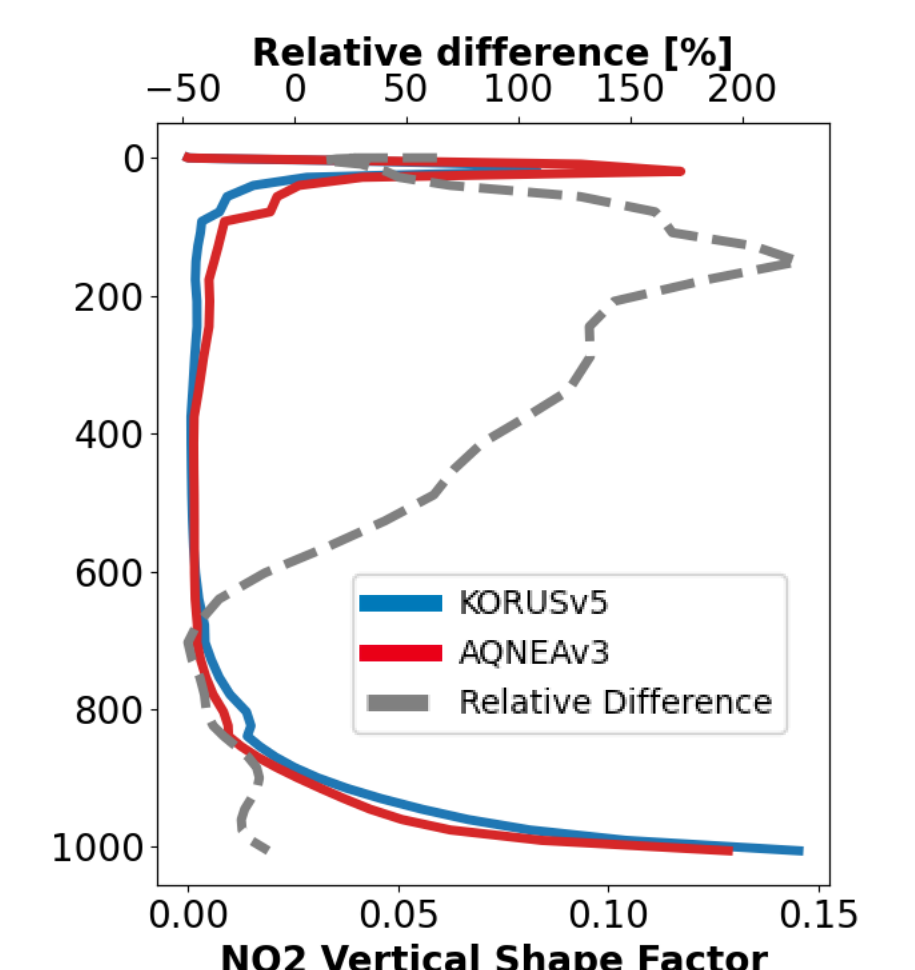
Change in Air Mass Factor

NO₂

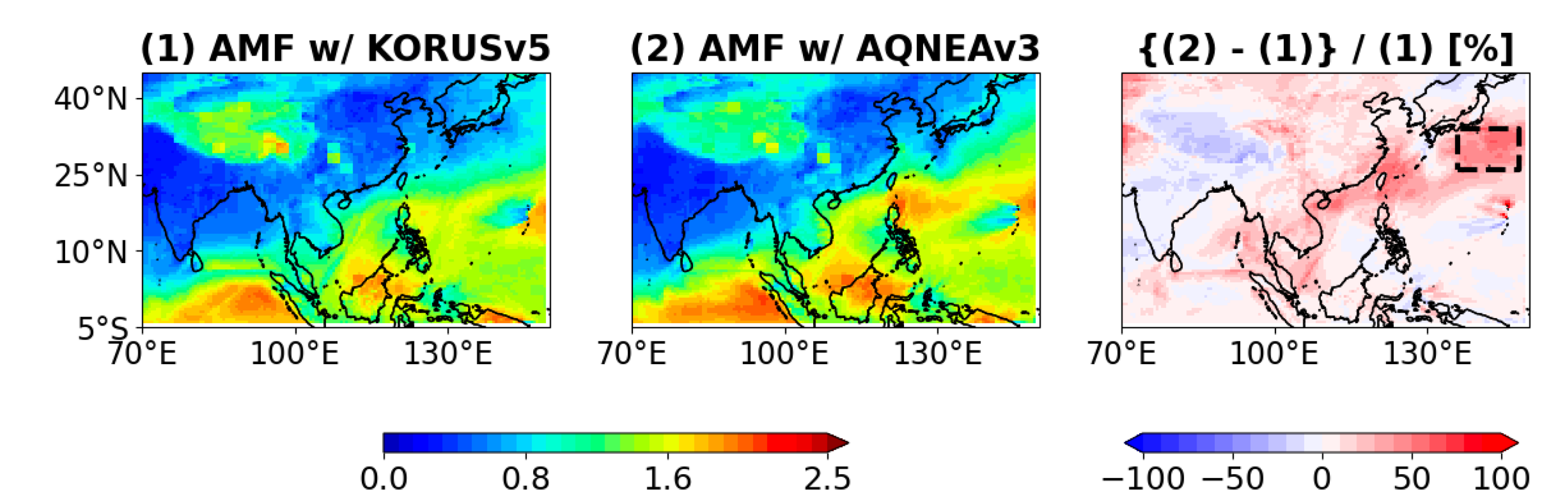


- AMF for NO₂ showed an overall increase of 2.65% across the domain with high change rate around the Korean Peninsula

- VSF was examined in the Korean Peninsula area. While surface concentration has decreased in the area, the upper level showed high relative difference.

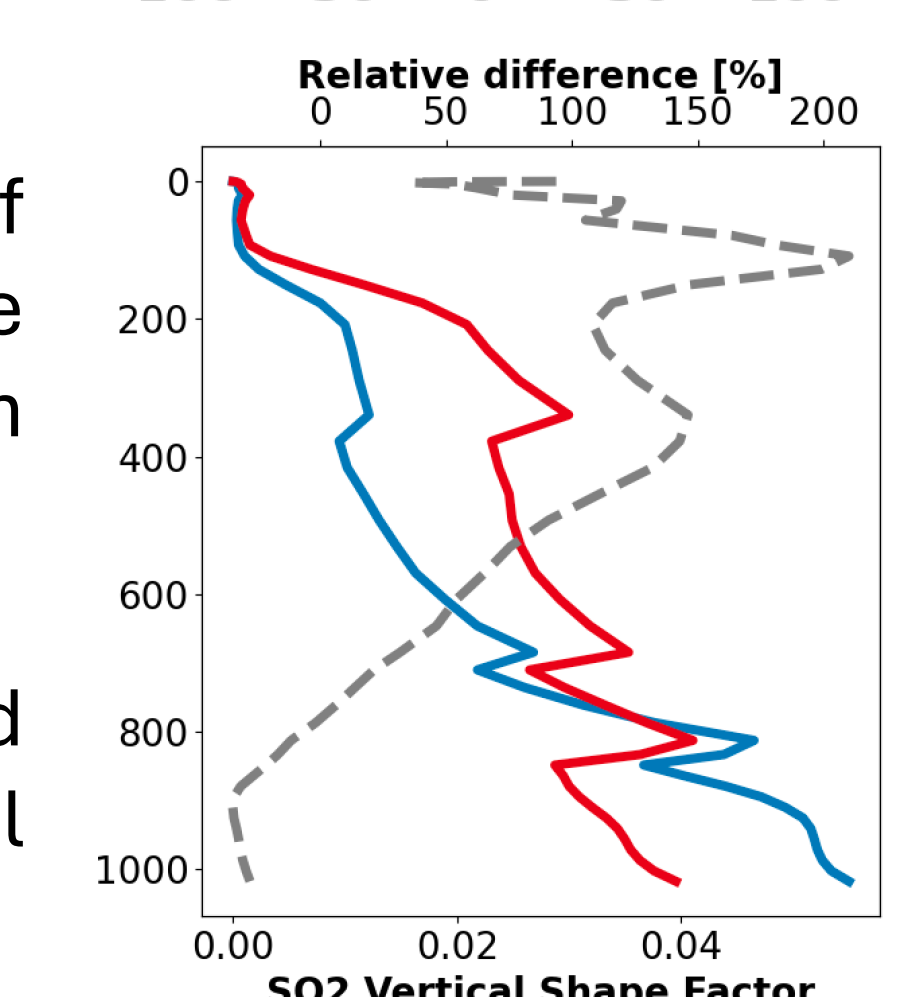


SO₂



- AMF for SO₂ showed an overall increase of 8.63% across the domain with high change rate focused on the Southern China and the Northern Pacific.

- While surface SO₂ concentration has decreased in the Northern Pacific, change in upper level vertical shape factor led to increase in AMF



Conclusion

- This study showed that input updates in CTM model could lead to significant change in AMF for NO₂ and SO₂
- Through updating the CTM results, it is expected to improve its performance as well as providing reliable data for satellite retrievals
- Further evaluation with simulation on different seasons as well as its effect on other gaseous species need to be examined

Acknowledgement

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