

2 30'0"W

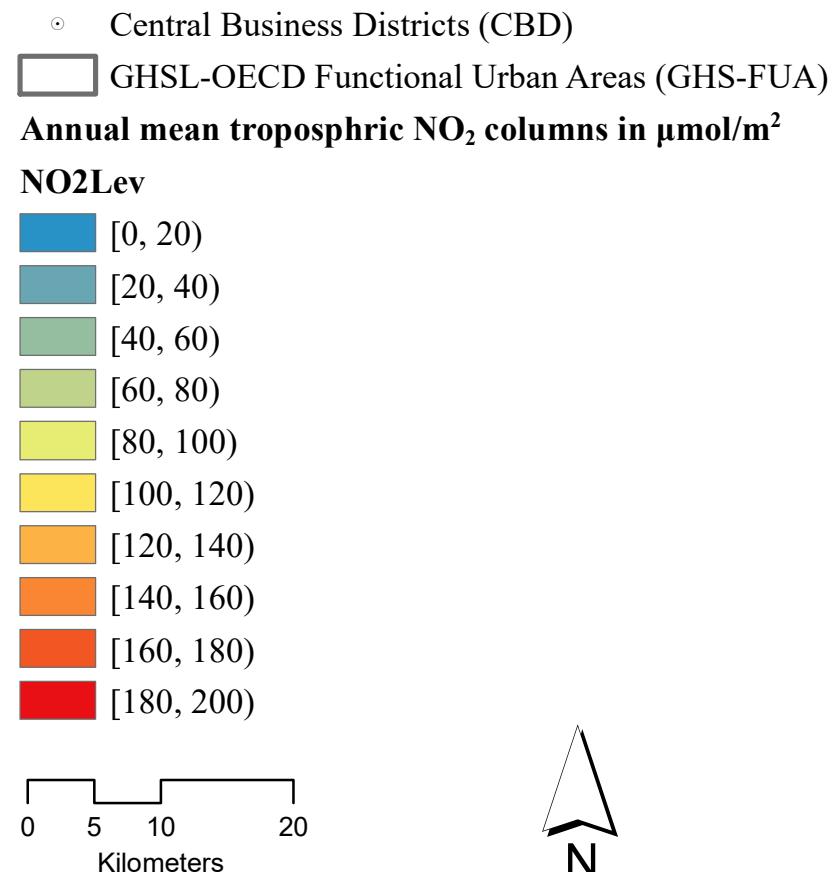
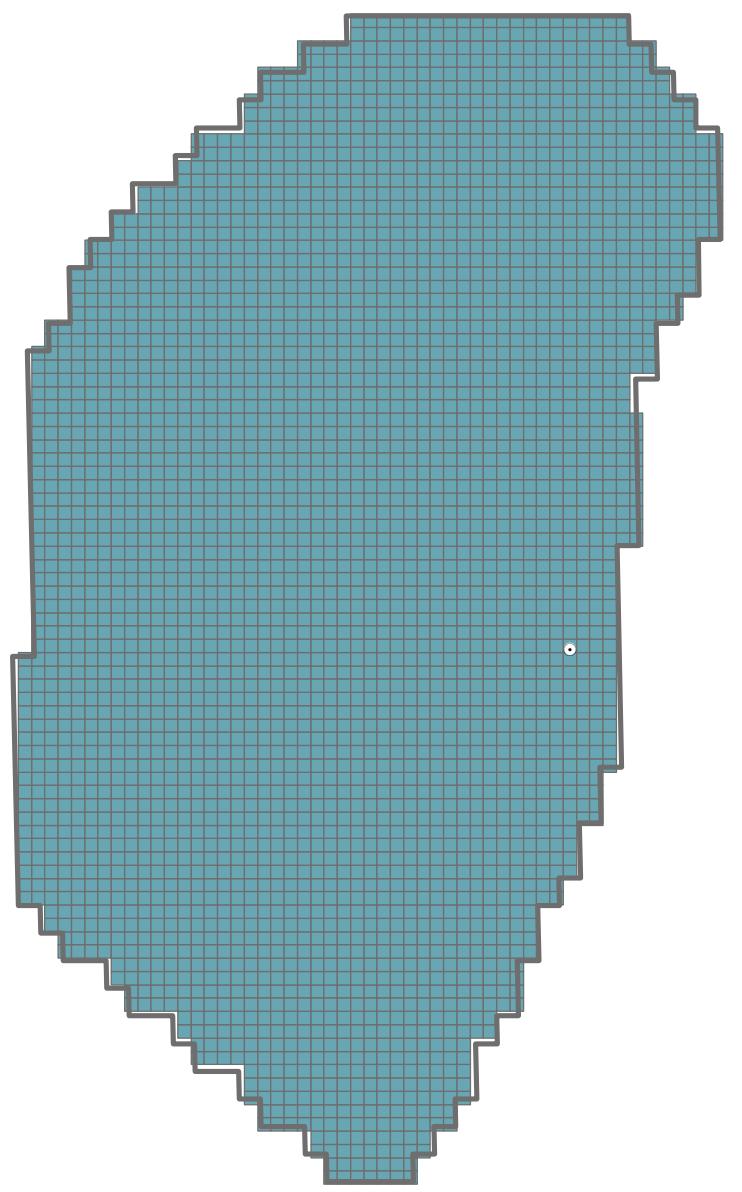
2 20'0"W

2 10'0"W

2 0'0"W

RS-measured tropospheric vertical columns of NO<sub>2</sub> of  
Aberdeen, United Kingdom  
eFUA\_ID: 3949  
at 1 km resolution

57°20'0"N  
57°10'0"N  
57°0'0"N



Locations of CBD in 2006, 2012 by Kilgarriff P., Lemoy R., Mader M.  
GHS-FUA data in 2019 from the European Union. Tropospheric vertical  
columns of NO<sub>2</sub> data in 2018, 2019 from Sentinel-5P,  
the European Space Agency.

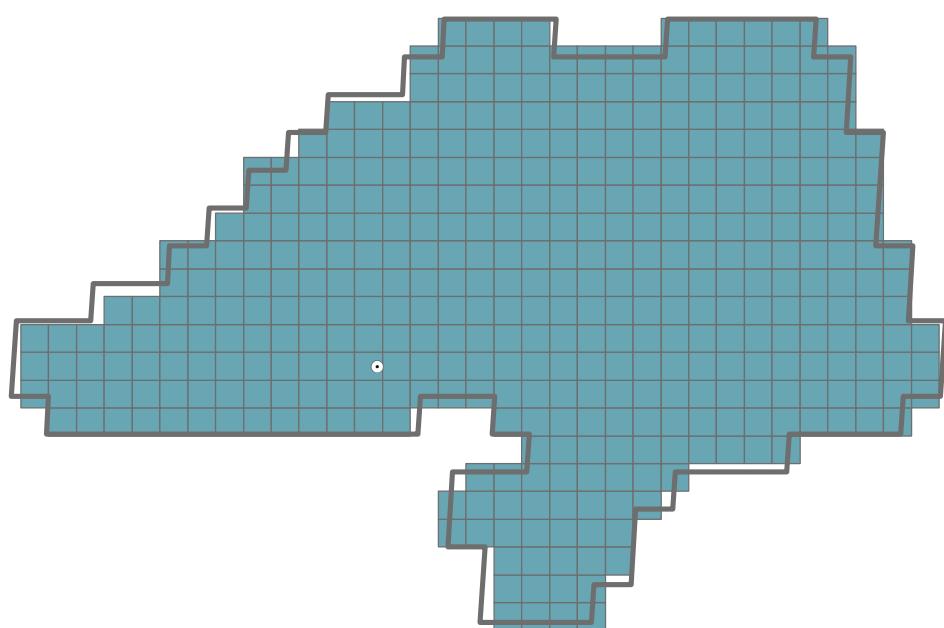
Yufei Wei, 09 March 2022

8 40'0"E

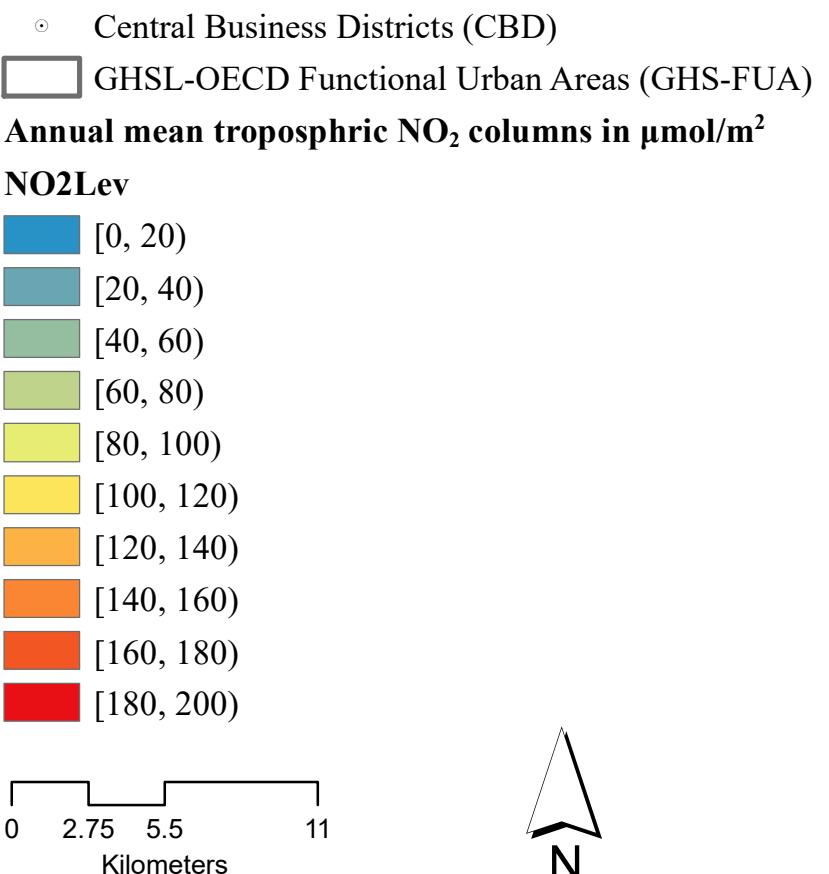
8 50'0"E

RS-measured tropospheric vertical columns of NO<sub>2</sub> of  
Ajaccio, France  
eFUA\_ID: 4653  
at 1 km resolution

42 0'0"N

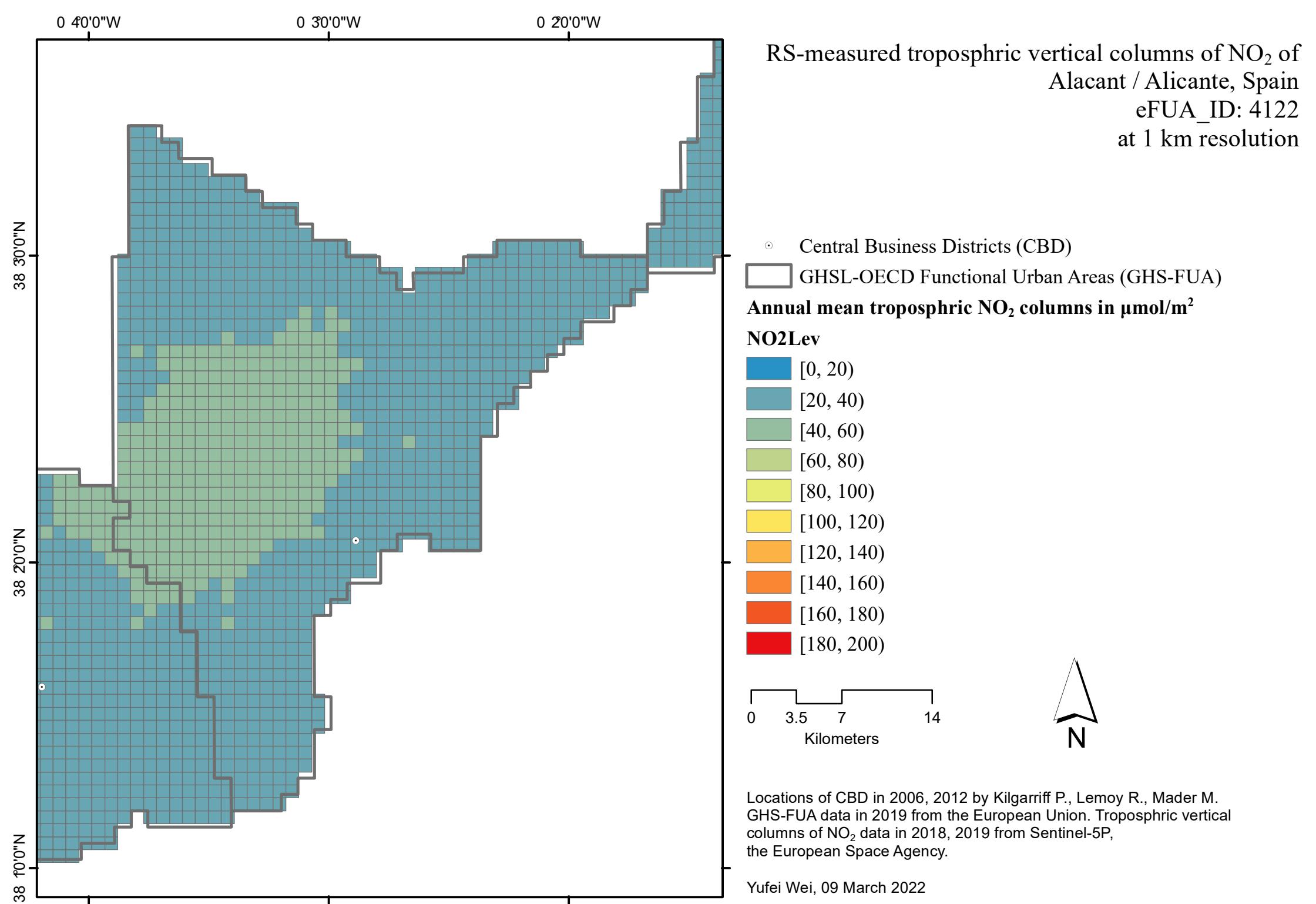


41 50'0"N



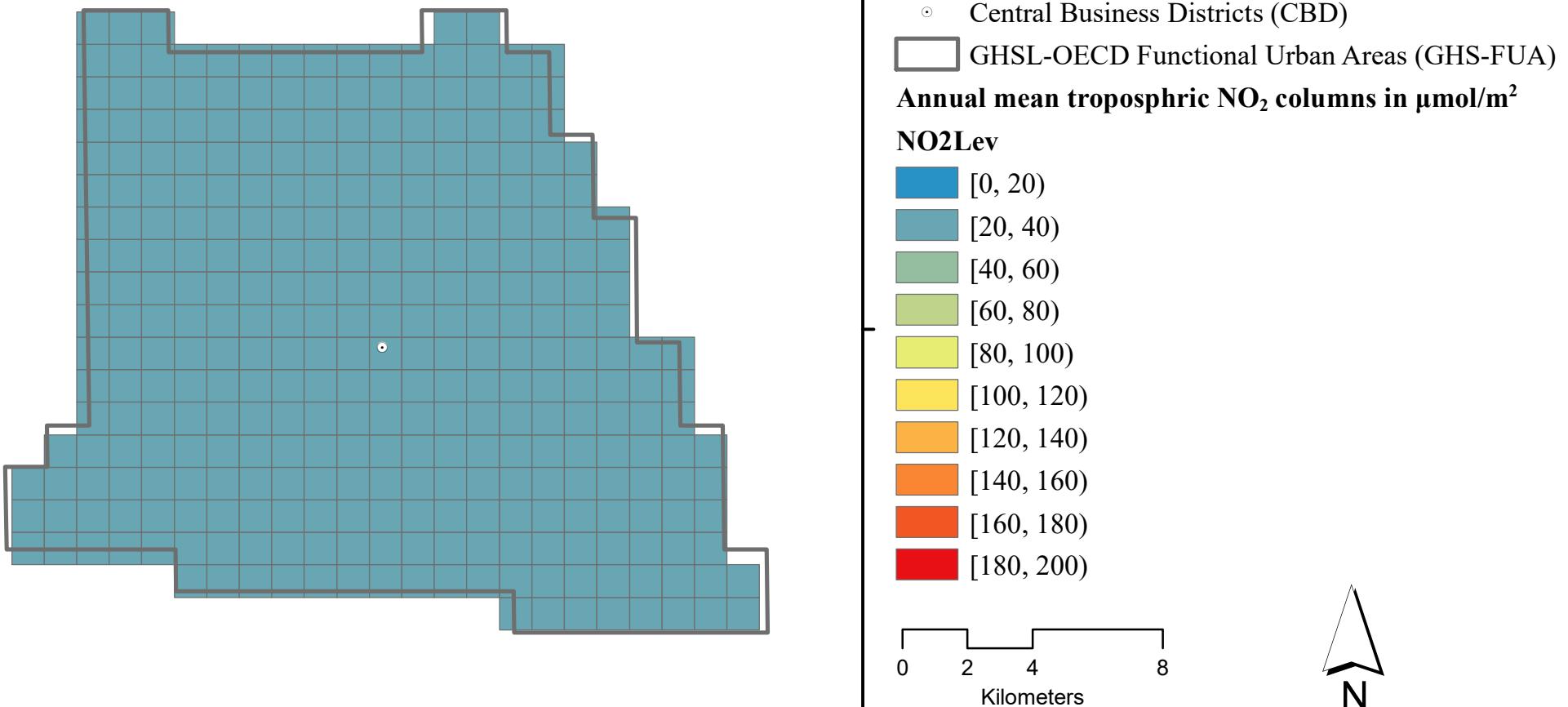
Locations of CBD in 2006, 2012 by Kilgarriff P., Lemoy R., Mader M.  
GHS-FUA data in 2019 from the European Union. Tropospheric vertical  
columns of NO<sub>2</sub> data in 2018, 2019 from Sentinel-5P,  
the European Space Agency.

Yufei Wei, 09 March 2022



1 50'0"W

RS-measured tropospheric vertical columns of NO<sub>2</sub> of  
Albacete, Spain  
eFUA\_ID: 3757  
at 1 km resolution



Locations of CBD in 2006, 2012 by Kilgarriff P., Lemoy R., Mader M.  
GHS-FUA data in 2019 from the European Union. Tropospheric vertical  
columns of NO<sub>2</sub> data in 2018, 2019 from Sentinel-5P,  
the European Space Agency.

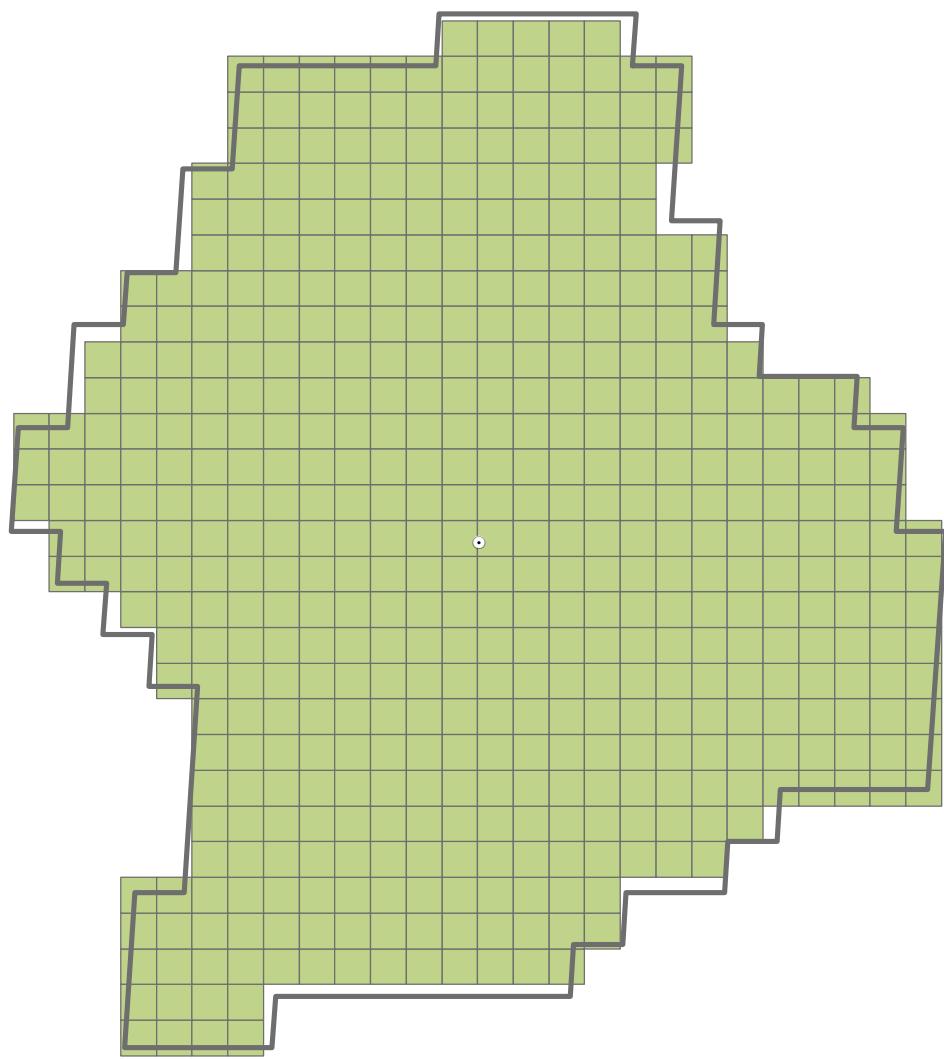
Yufei Wei, 09 March 2022

8 30'0"E

8 40'0"E

RS-measured tropospheric vertical columns of NO<sub>2</sub> of Alessandria, Italy  
eFUA\_ID: 841  
at 1 km resolution

45 00'N



○ Central Business Districts (CBD)

◻ GHSL-OECD Functional Urban Areas (GHS-FUA)

Annual mean tropospheric NO<sub>2</sub> columns in  $\mu\text{mol}/\text{m}^2$

NO2Lev

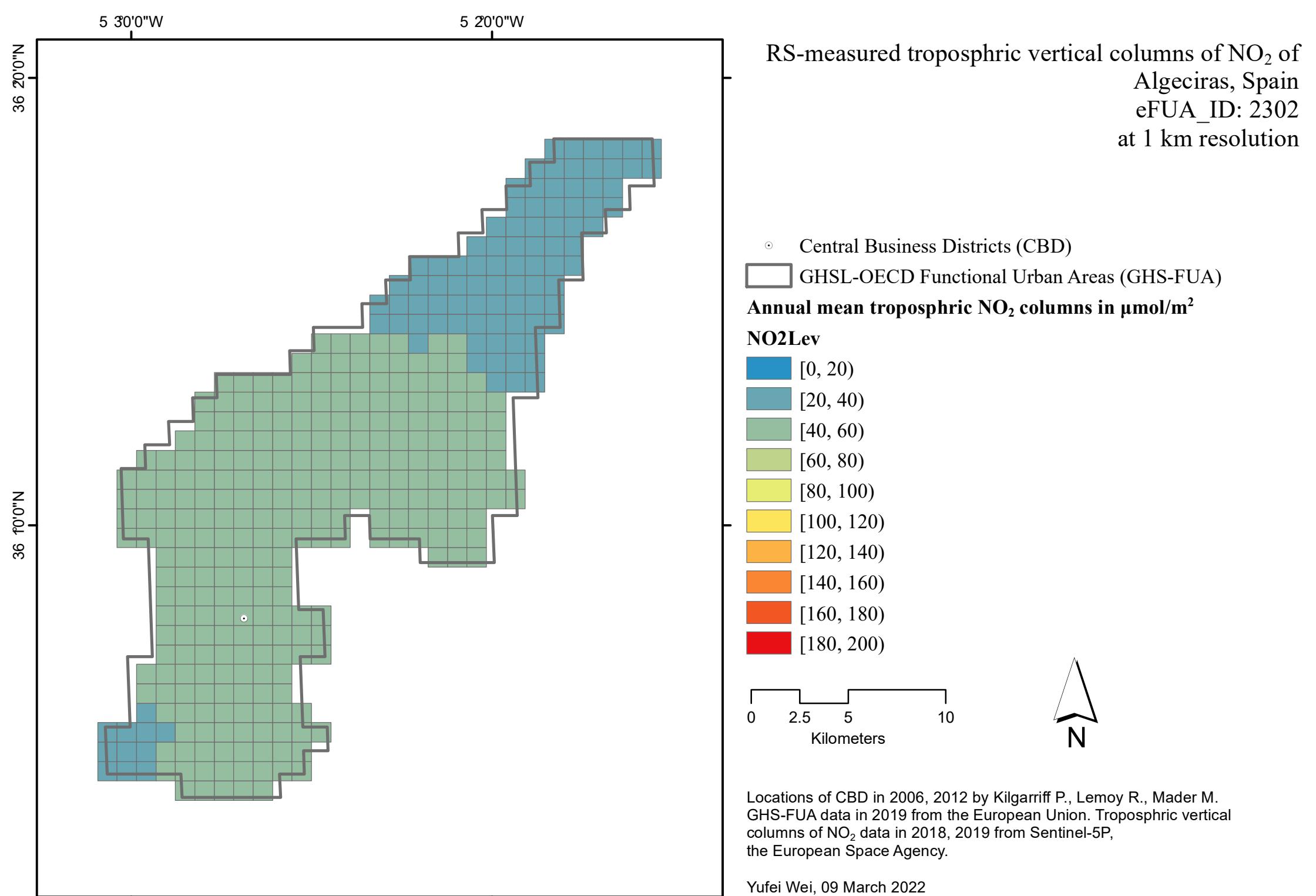
- [0, 20]
- [20, 40]
- [40, 60]
- [60, 80]
- [80, 100]
- [100, 120]
- [120, 140]
- [140, 160]
- [160, 180]
- [180, 200]

0 2.25 4.5 9  
Kilometers



Locations of CBD in 2006, 2012 by Kilgarriff P., Lemoy R., Mader M.  
GHS-FUA data in 2019 from the European Union. Tropospheric vertical  
columns of NO<sub>2</sub> data in 2018, 2019 from Sentinel-5P,  
the European Space Agency.

Yufei Wei, 09 March 2022



2 30'0"W

2 20'0"W

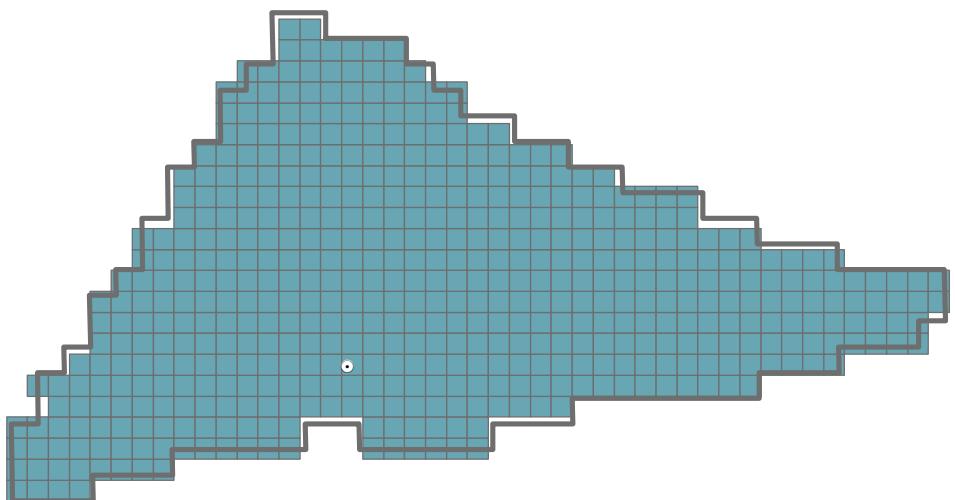
2 10'0"W

RS-measured tropospheric vertical columns of NO<sub>2</sub> of  
Almeria, Spain  
eFUA\_ID: 3626  
at 1 km resolution

37 0'0"N

36 50'0"N

36 40'0"N



○ Central Business Districts (CBD)

◻ GHSL-OECD Functional Urban Areas (GHS-FUA)

Annual mean tropospheric NO<sub>2</sub> columns in  $\mu\text{mol}/\text{m}^2$

NO2Lev

[0, 20)

[20, 40)

[40, 60)

[60, 80)

[80, 100)

[100, 120)

[120, 140)

[140, 160)

[160, 180)

[180, 200)

0 3.75 7.5 15  
Kilometers

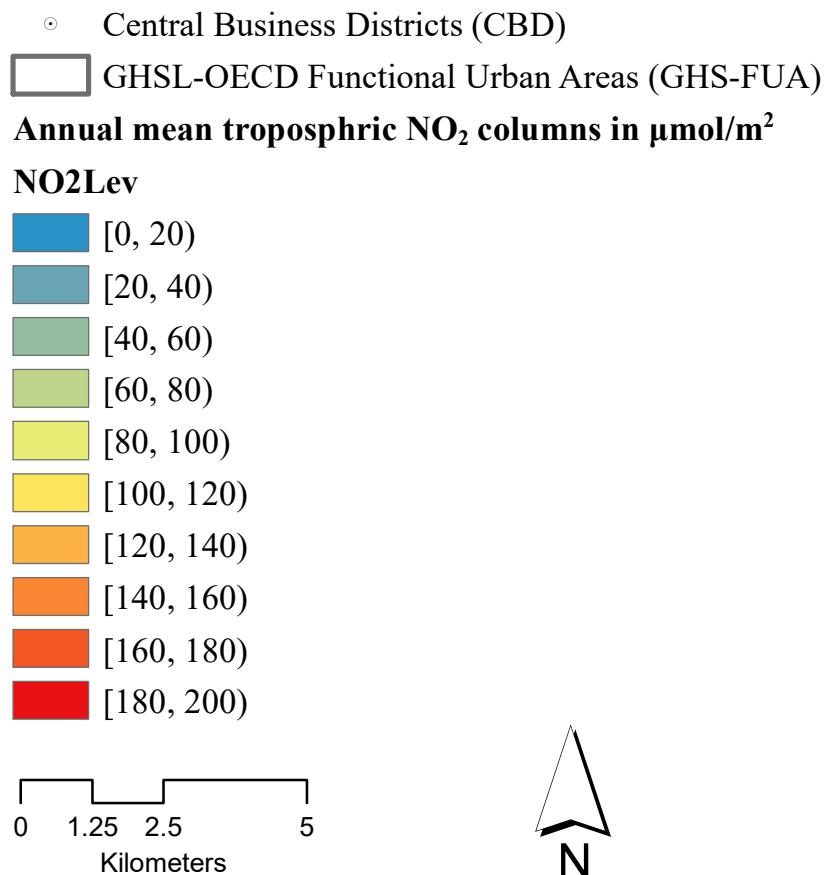
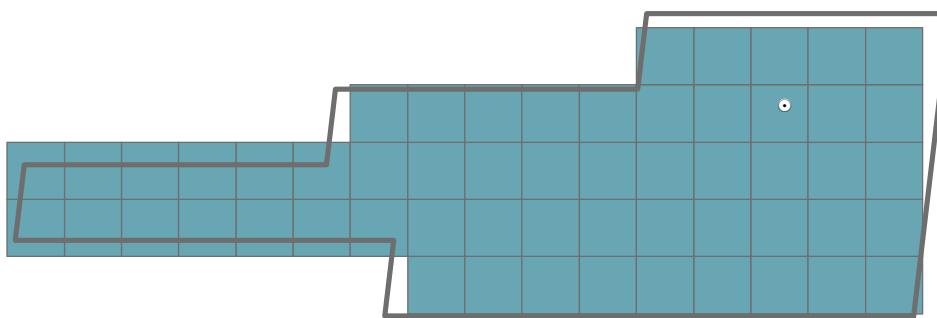


Locations of CBD in 2006, 2012 by Kilgarriff P., Lemoy R., Mader M.  
GHS-FUA data in 2019 from the European Union. Tropospheric vertical  
columns of NO<sub>2</sub> data in 2018, 2019 from Sentinel-5P,  
the European Space Agency.

Yufei Wei, 09 March 2022

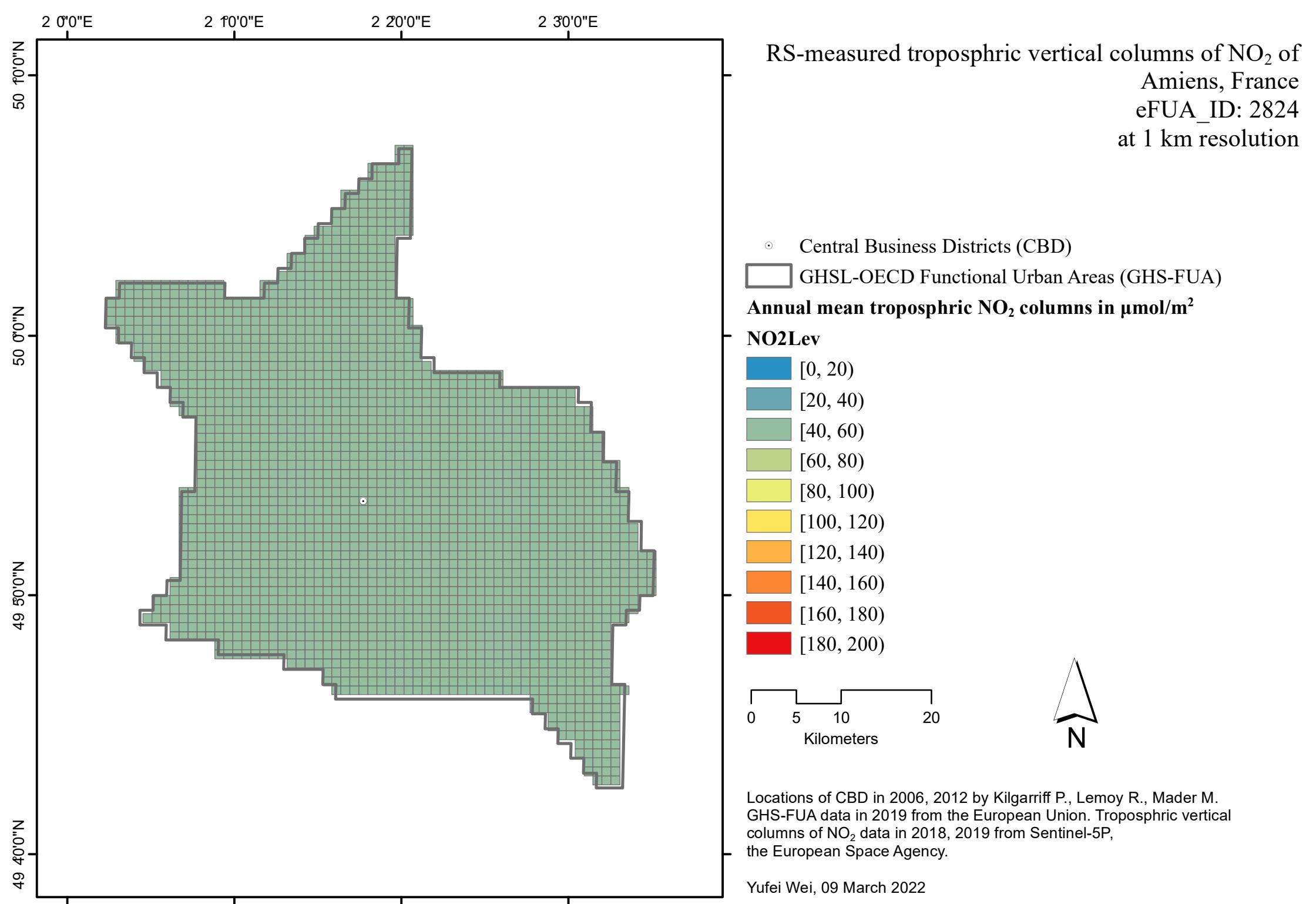
16°30'0"E

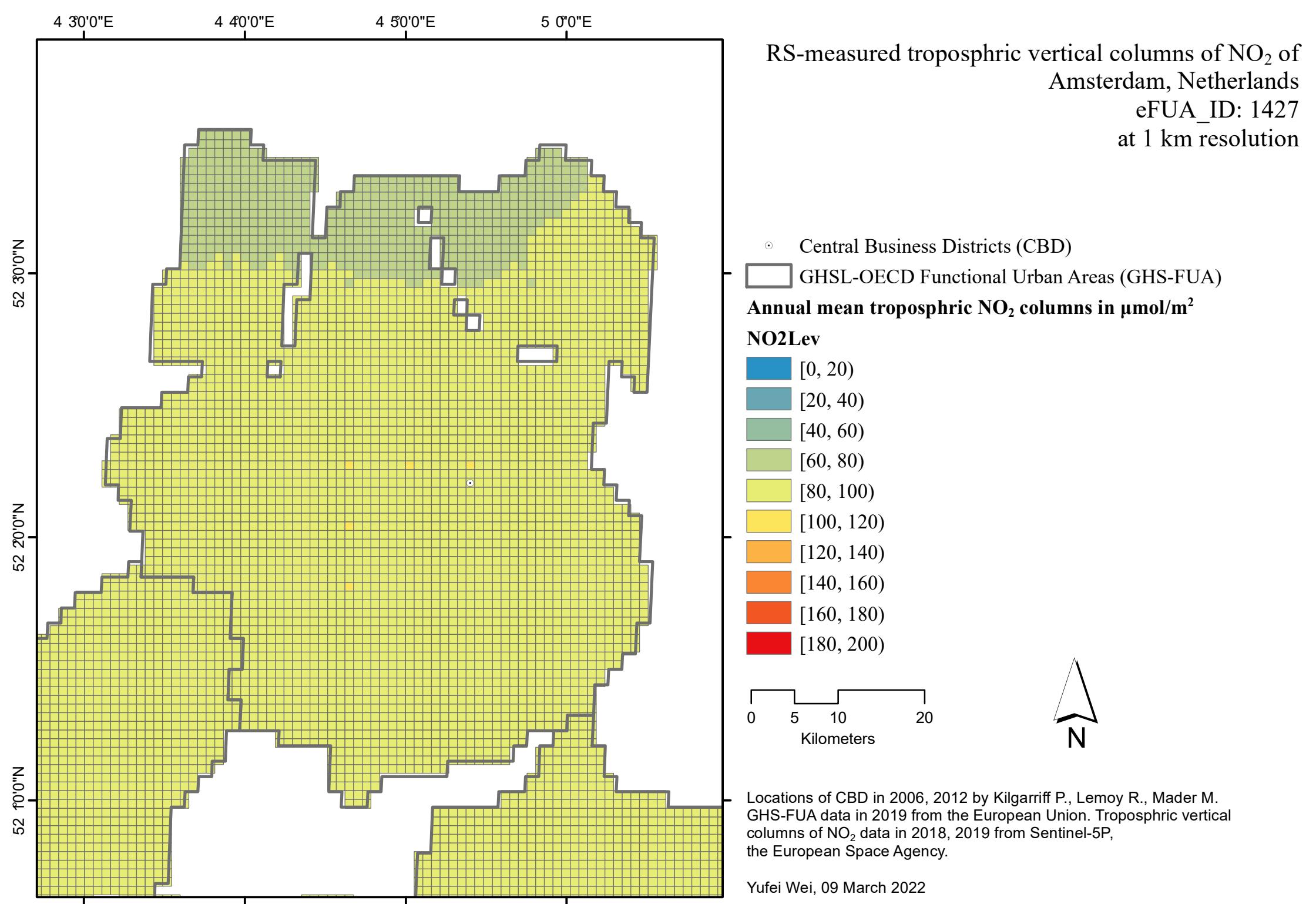
RS-measured tropospheric vertical columns of NO<sub>2</sub> of  
Altamura, Italy  
eFUA\_ID: 4979  
at 1 km resolution

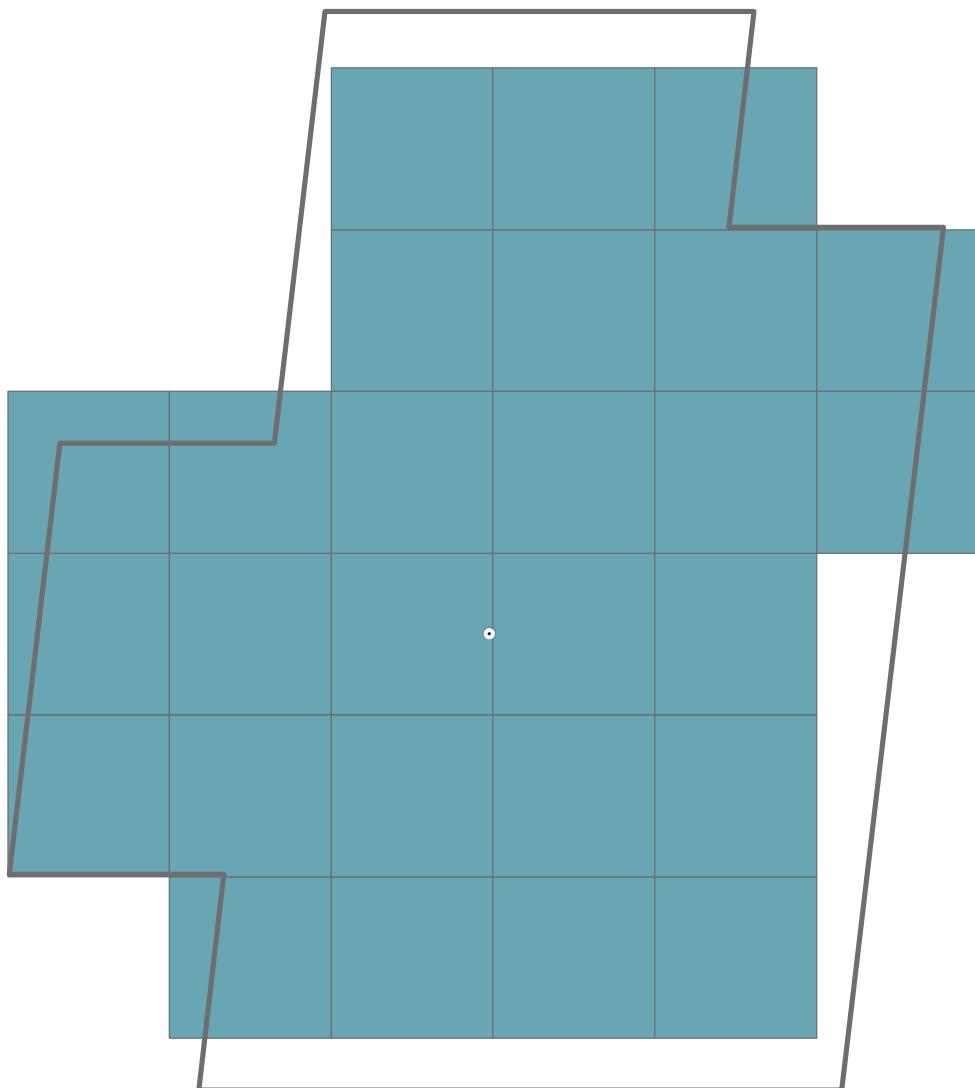


Locations of CBD in 2006, 2012 by Kilgarriff P., Lemoy R., Mader M.  
GHS-FUA data in 2019 from the European Union. Tropospheric vertical  
columns of NO<sub>2</sub> data in 2018, 2019 from Sentinel-5P,  
the European Space Agency.

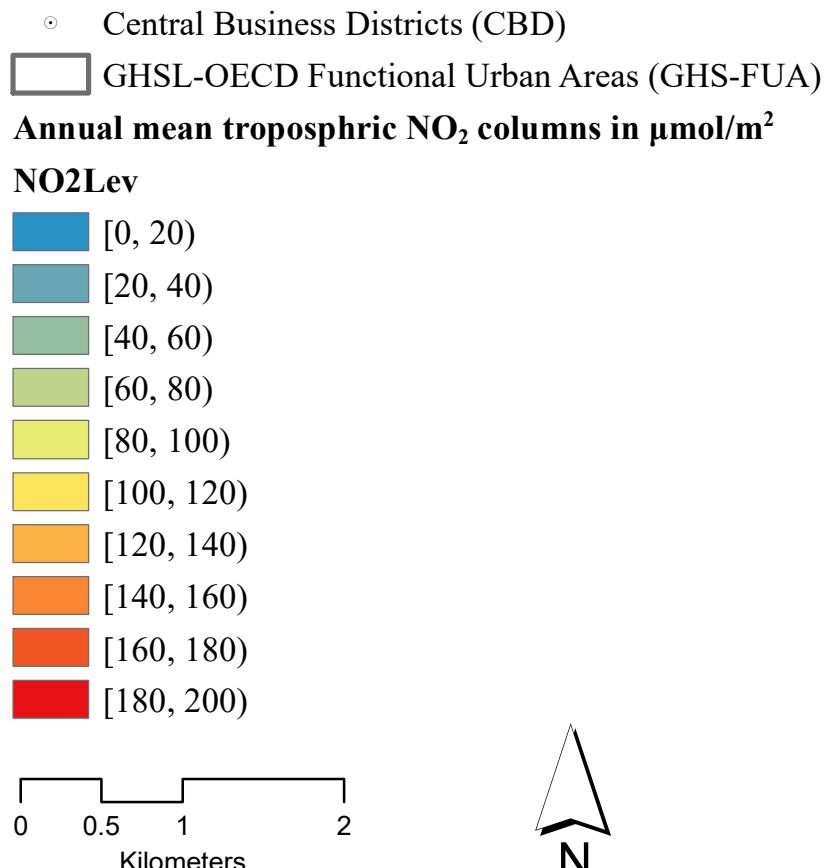
Yufei Wei, 09 March 2022



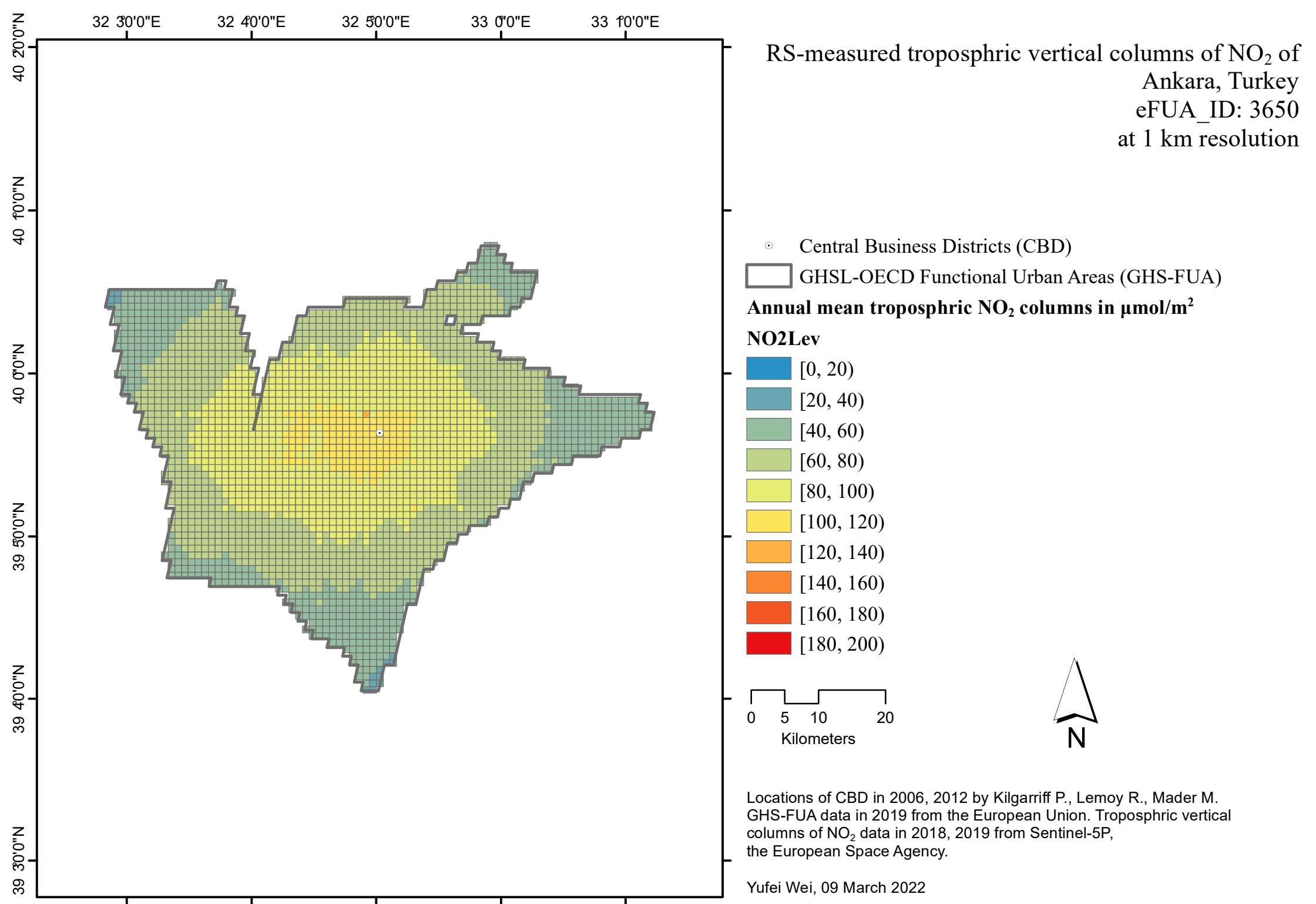


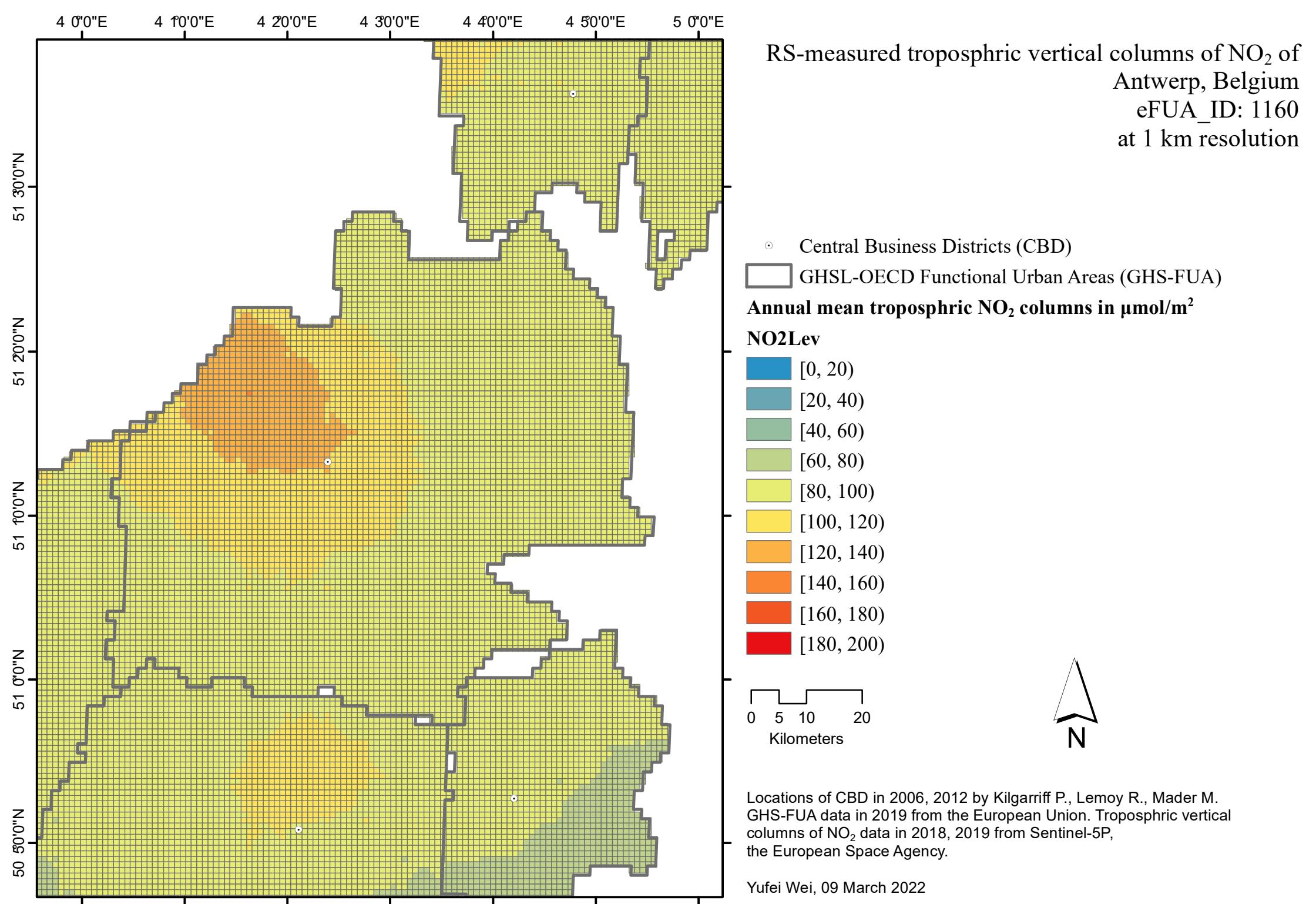


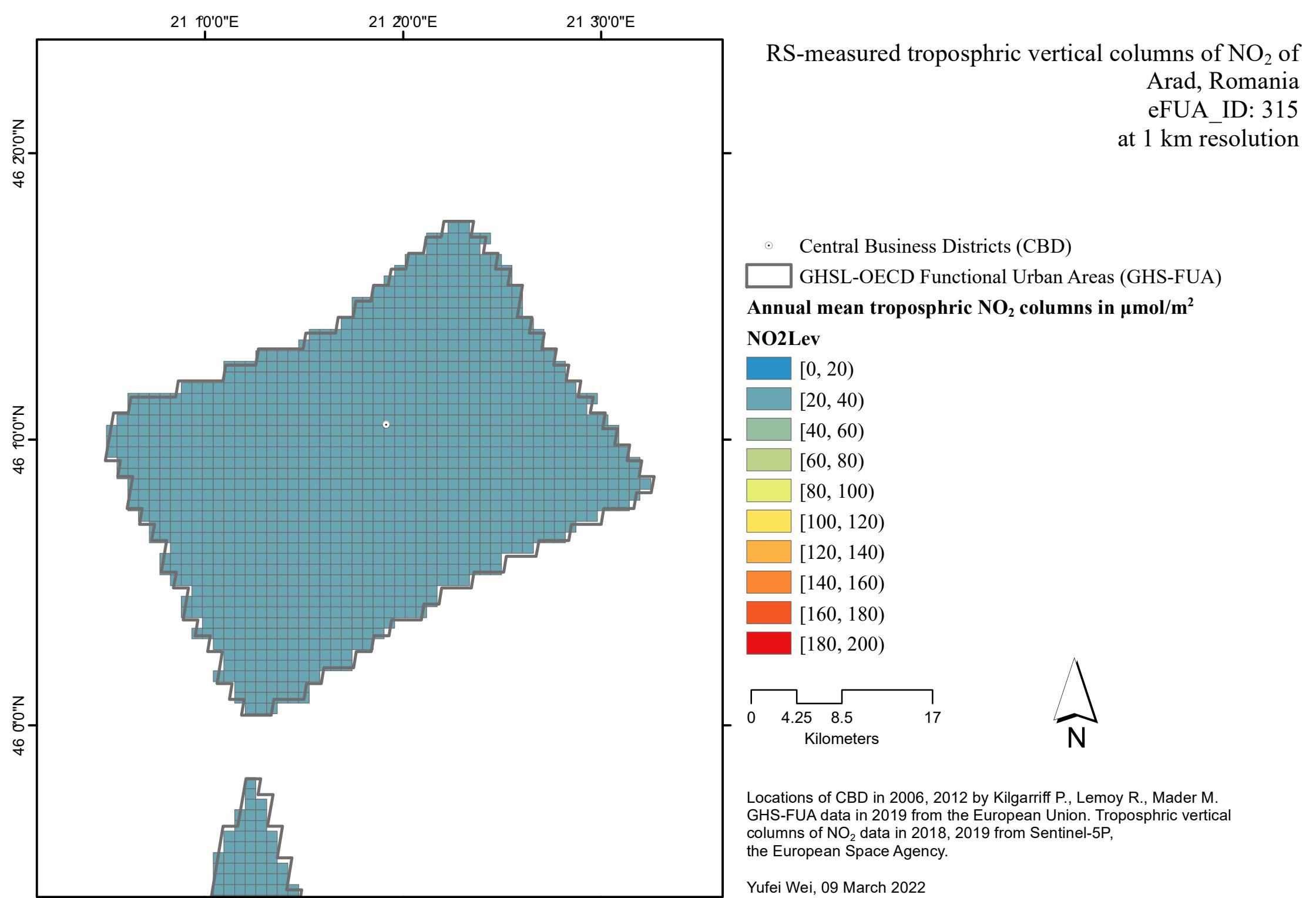
RS-measured tropospheric vertical columns of NO<sub>2</sub> of  
Andria, Italy  
eFUA\_ID: 4846  
at 1 km resolution



Locations of CBD in 2006, 2012 by Kilgarriff P., Lemoy R., Mader M.  
GHS-FUA data in 2019 from the European Union. Tropospheric vertical  
columns of NO<sub>2</sub> data in 2018, 2019 from Sentinel-5P,  
the European Space Agency.





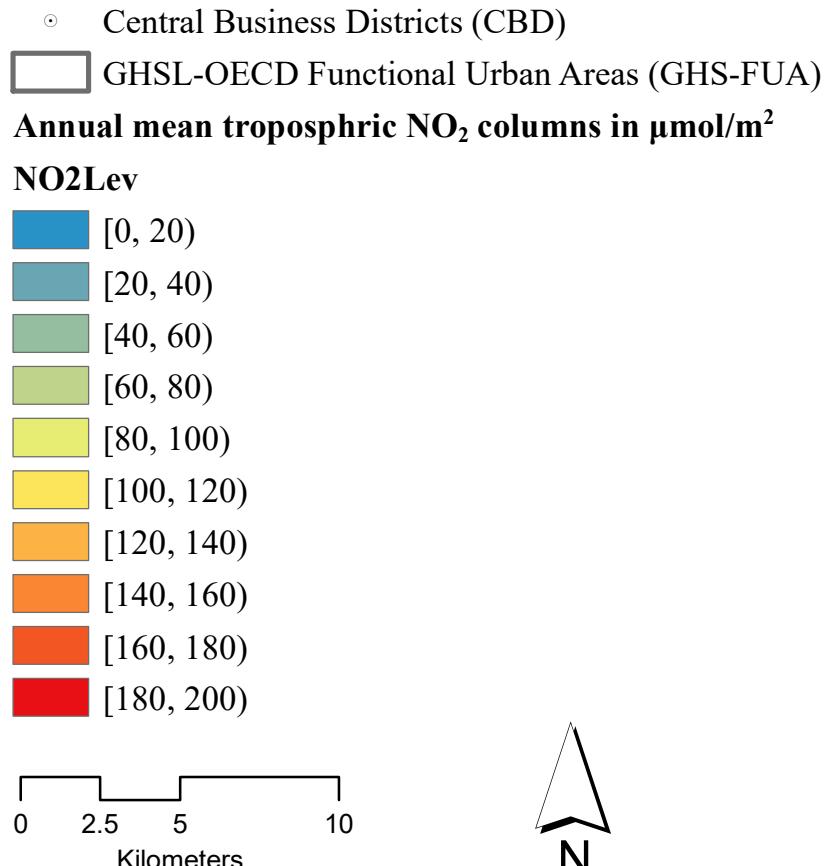
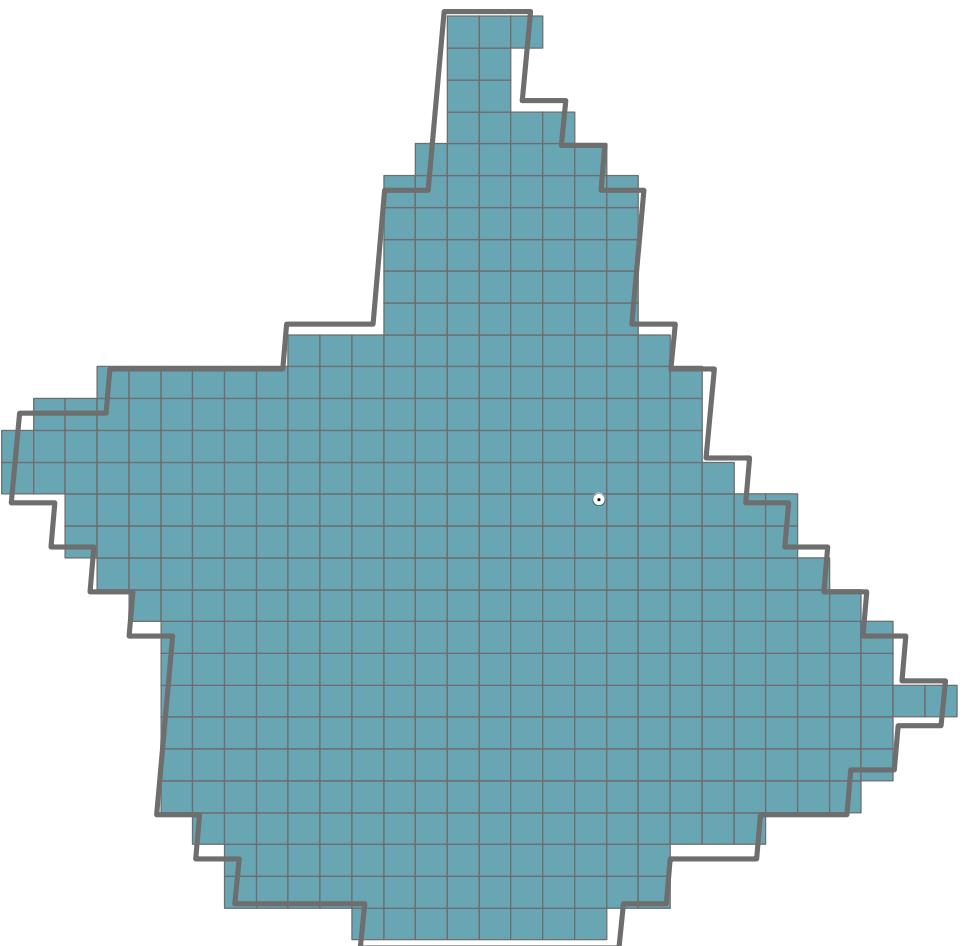


11 50'0"E

12 0'0"E

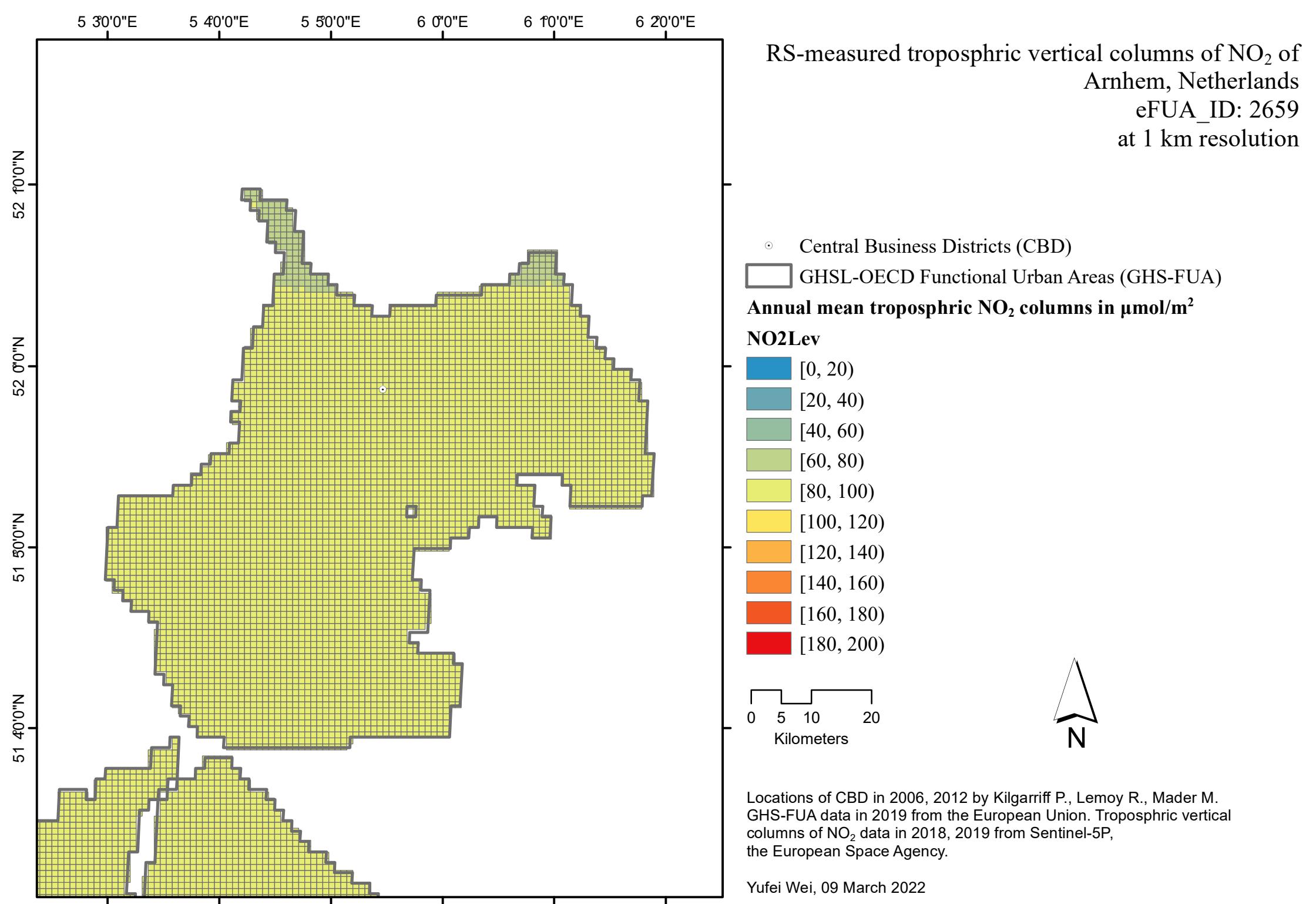
RS-measured tropospheric vertical columns of NO<sub>2</sub> of  
Arezzo, Italy  
eFUA\_ID: 3407  
at 1 km resolution

43 30'0"N  
43 20'0"N



Locations of CBD in 2006, 2012 by Kilgarriff P., Lemoy R., Mader M.  
GHS-FUA data in 2019 from the European Union. Tropospheric vertical  
columns of NO<sub>2</sub> data in 2018, 2019 from Sentinel-5P,  
the European Space Agency.

Yufei Wei, 09 March 2022

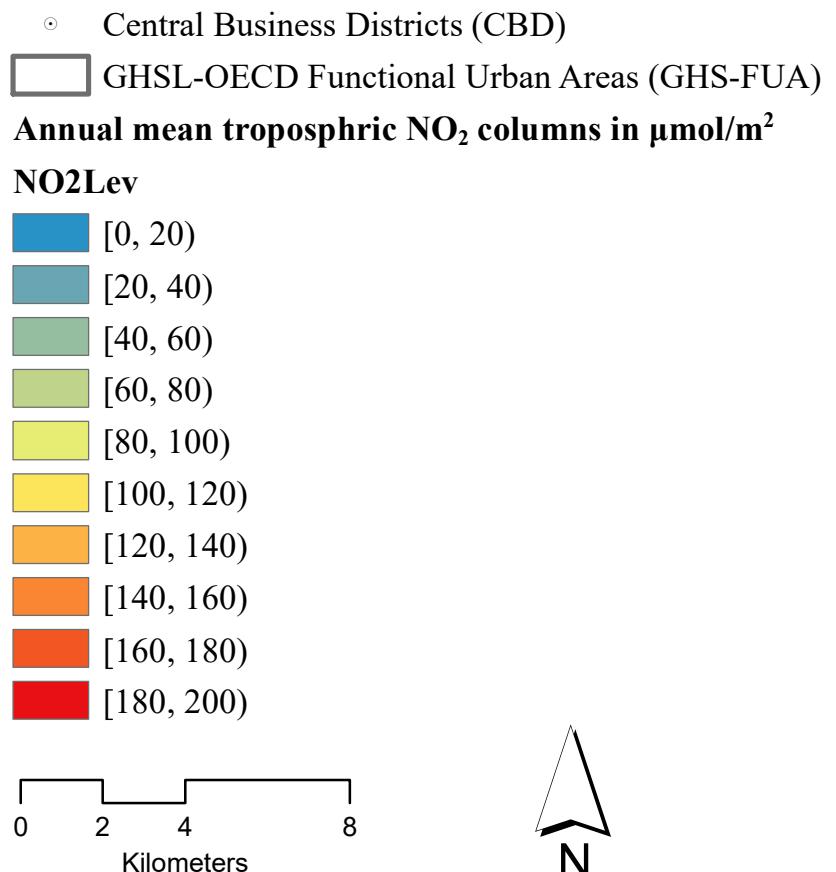
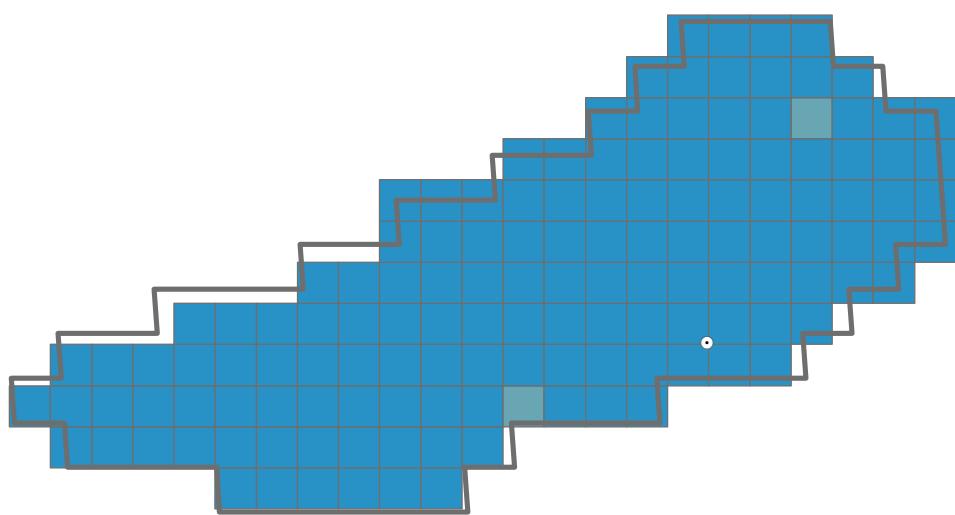


13 40'0"W

13 30'0"W

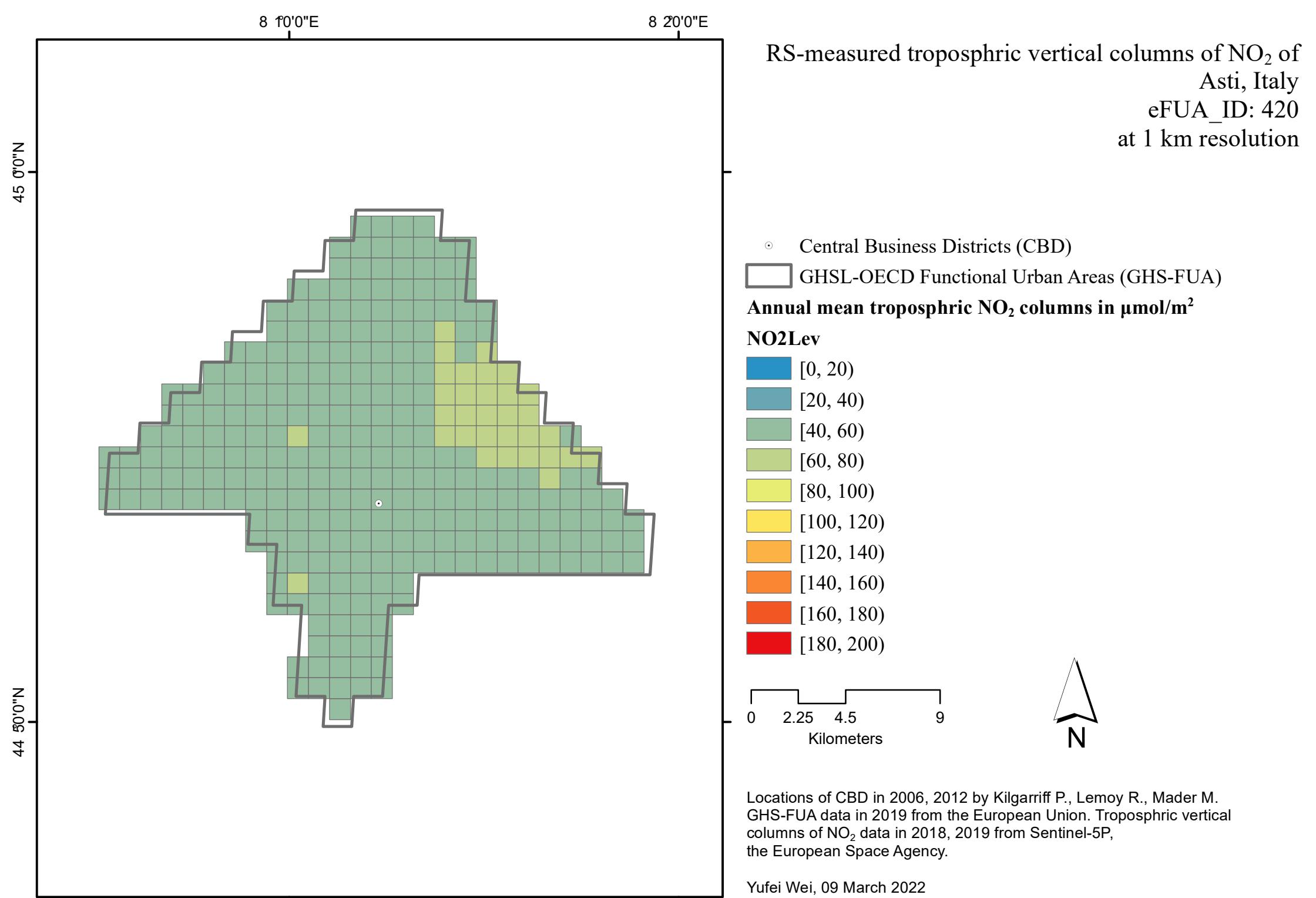
RS-measured tropospheric vertical columns of NO<sub>2</sub> of  
Arrecife, Spain  
eFUA\_ID: 821  
at 1 km resolution

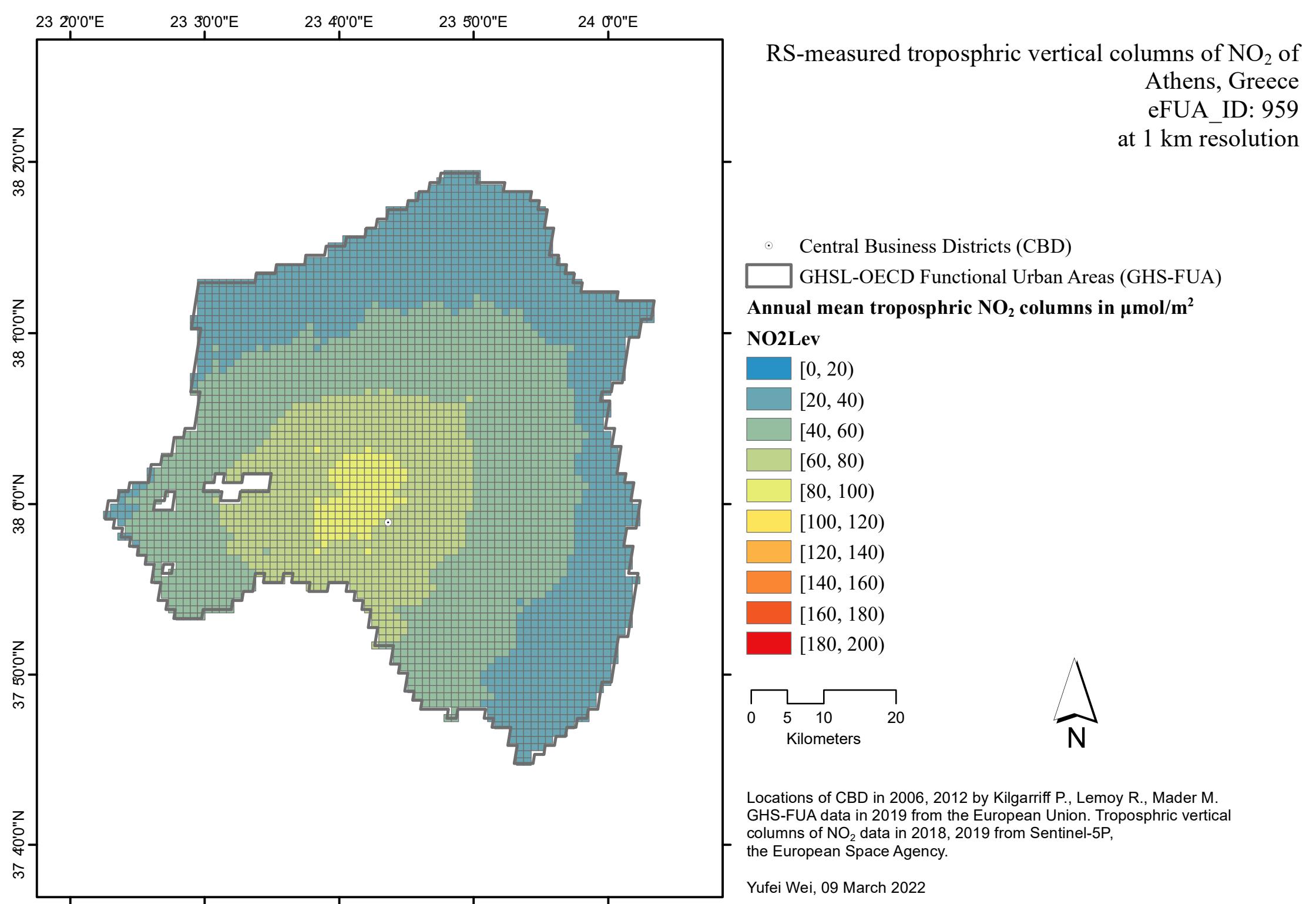
29 0'0"N



Locations of CBD in 2006, 2012 by Kilgarriff P., Lemoy R., Mader M.  
GHS-FUA data in 2019 from the European Union. Tropospheric vertical  
columns of NO<sub>2</sub> data in 2018, 2019 from Sentinel-5P,  
the European Space Agency.

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10 40'0"E

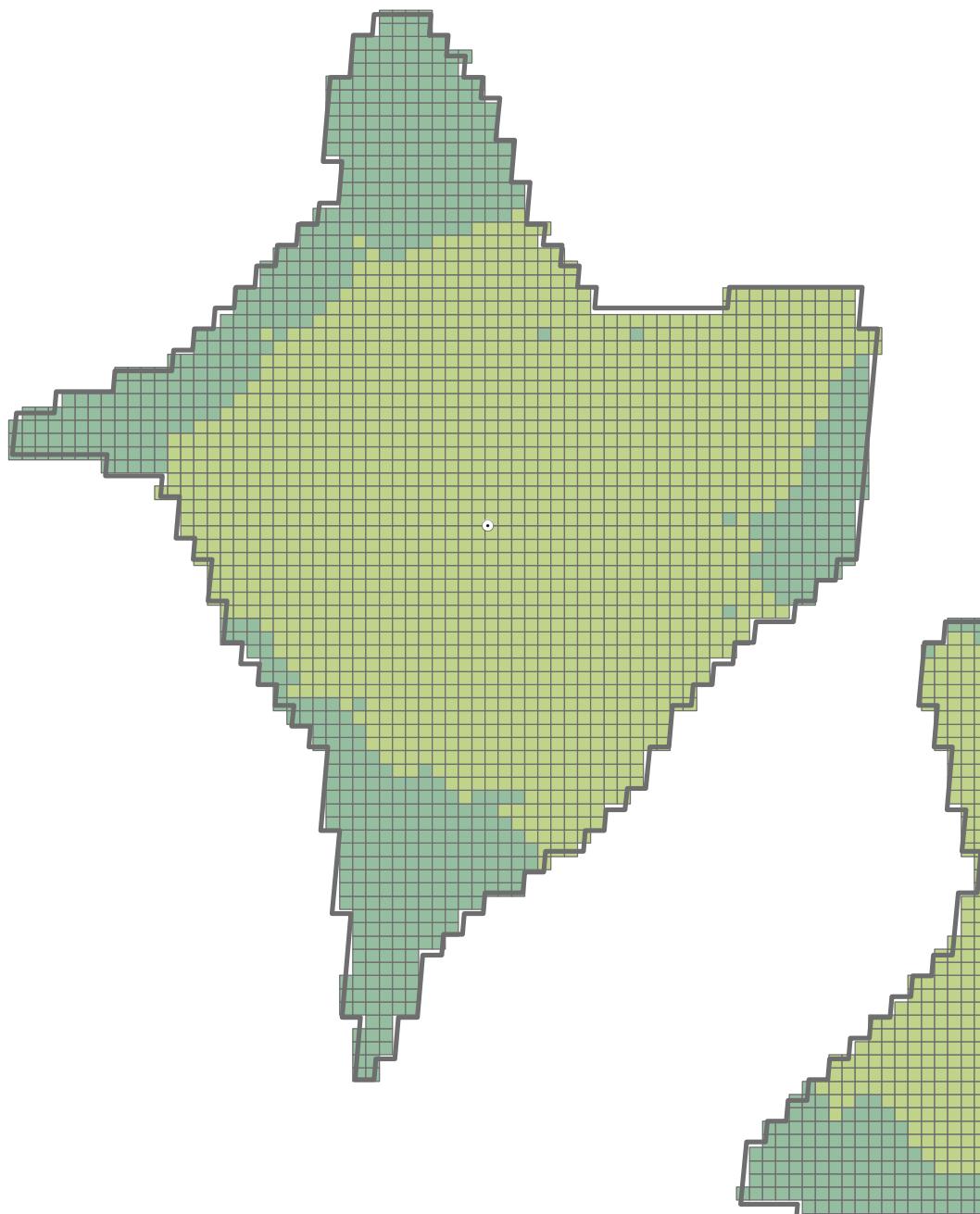
10 50'0"E

11 0'0"E

11 10'0"E

RS-measured tropospheric vertical columns of NO<sub>2</sub> of  
 Augsburg, Germany  
 eFUA\_ID: 4520  
 at 1 km resolution

48 30'0"N  
 48 20'0"N  
 48 10'0"N



○ Central Business Districts (CBD)

◻ GHS-OECD Functional Urban Areas (GHS-FUA)

**Annual mean tropospheric NO<sub>2</sub> columns in  $\mu\text{mol}/\text{m}^2$**

**NO2Lev**

- [0, 20]
- [20, 40]
- [40, 60]
- [60, 80]
- [80, 100]
- [100, 120]
- [120, 140]
- [140, 160]
- [160, 180]
- [180, 200]

0 5 10 20  
 Kilometers



Locations of CBD in 2006, 2012 by Kilgarriff P., Lemoy R., Mader M.  
 GHS-FUA data in 2019 from the European Union. Tropospheric vertical  
 columns of NO<sub>2</sub> data in 2018, 2019 from Sentinel-5P,  
 the European Space Agency.

Yufei Wei, 09 March 2022

14 50'0"E

41 0'0"N

40 50'0"N

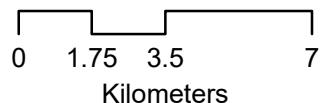
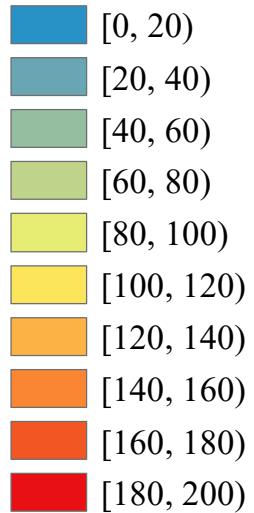
RS-measured tropospheric vertical columns of NO<sub>2</sub> of  
Avellino, Italy  
eFUA\_ID: 4465  
at 1 km resolution

○ Central Business Districts (CBD)

◻ GHSL-OECD Functional Urban Areas (GHS-FUA)

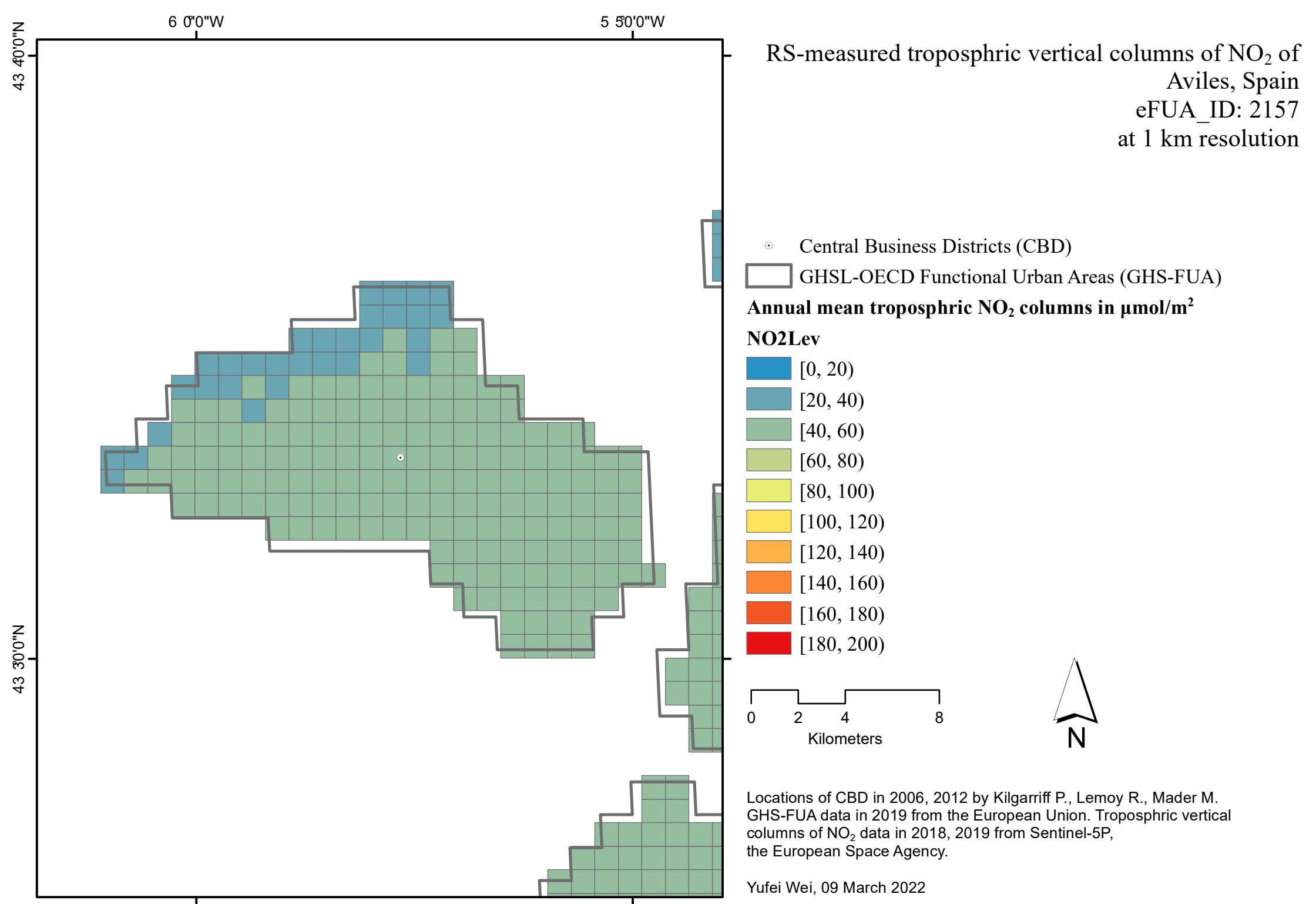
Annual mean tropospheric NO<sub>2</sub> columns in  $\mu\text{mol}/\text{m}^2$

NO2Lev



Locations of CBD in 2006, 2012 by Kilgarriff P., Lemoy R., Mader M.  
GHS-FUA data in 2019 from the European Union. Tropospheric vertical  
columns of NO<sub>2</sub> data in 2018, 2019 from Sentinel-5P,  
the European Space Agency.

Yufei Wei, 09 March 2022



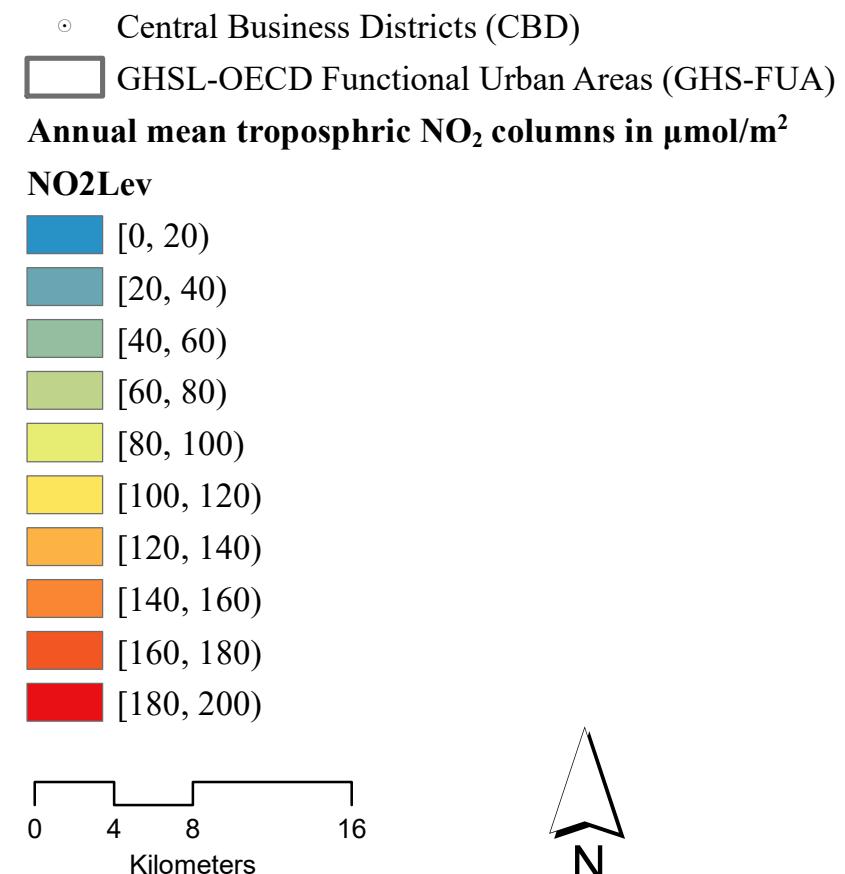
26 40'0"E

26 50'0"E

27 0'0"E

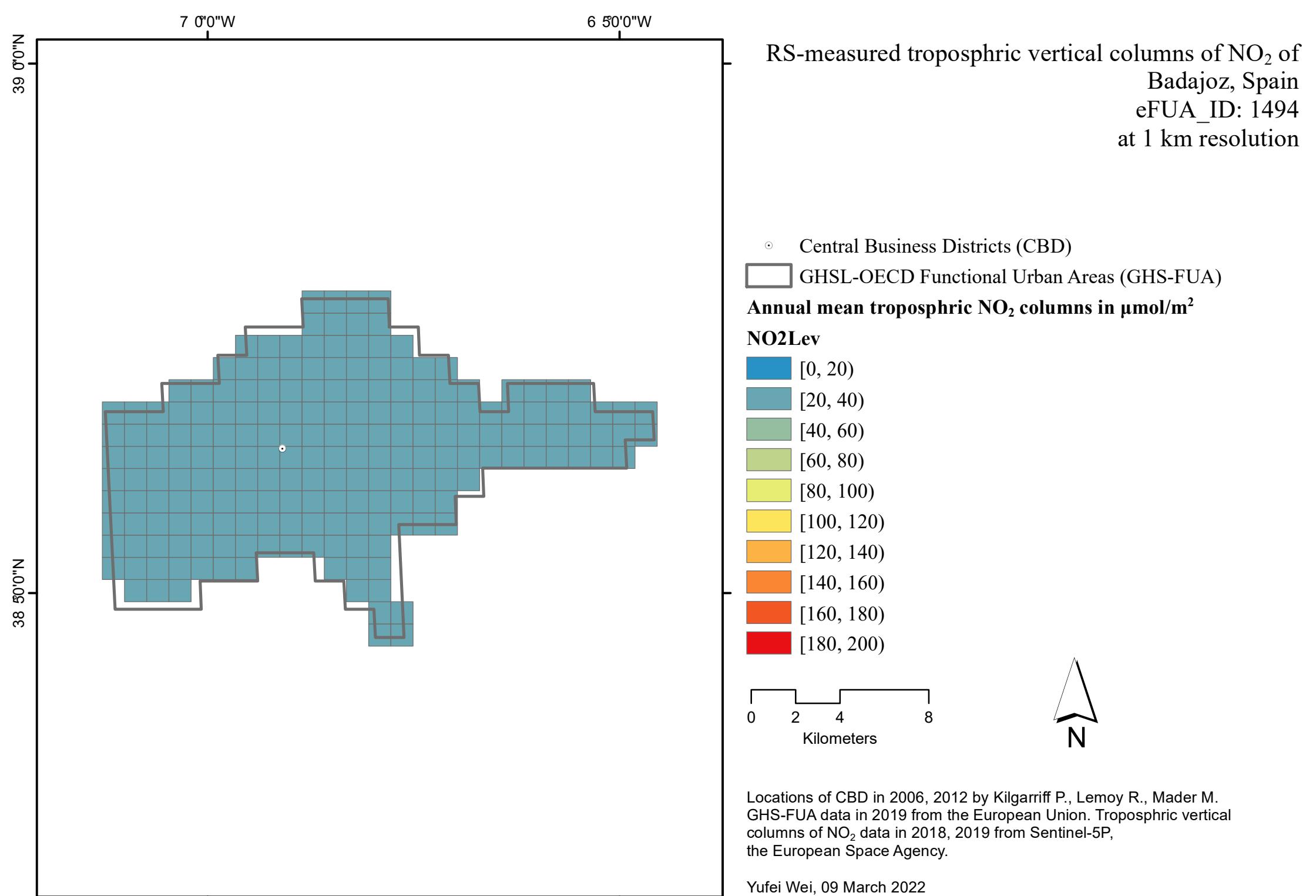
RS-measured tropospheric vertical columns of NO<sub>2</sub> of  
Bacau, Romania  
eFUA\_ID: 2261  
at 1 km resolution

46 40'0"N  
46 30'0"N  
46 20'0"N



Locations of CBD in 2006, 2012 by Kilgarriff P., Lemoy R., Mader M.  
GHS-FUA data in 2019 from the European Union. Tropospheric vertical  
columns of NO<sub>2</sub> data in 2018, 2019 from Sentinel-5P,  
the European Space Agency.

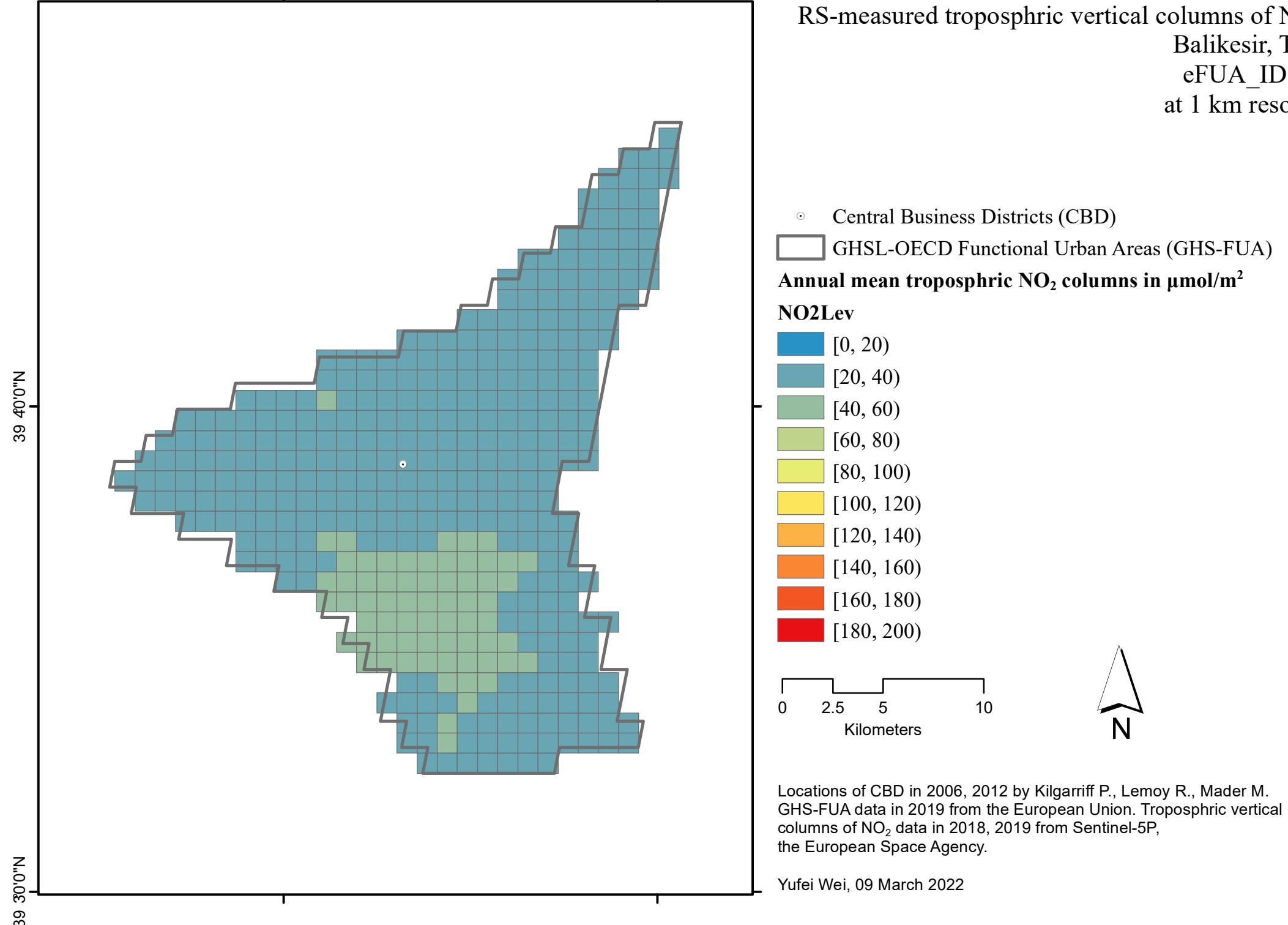
Yufei Wei, 09 March 2022



27 50'0"E

28 0'0"E

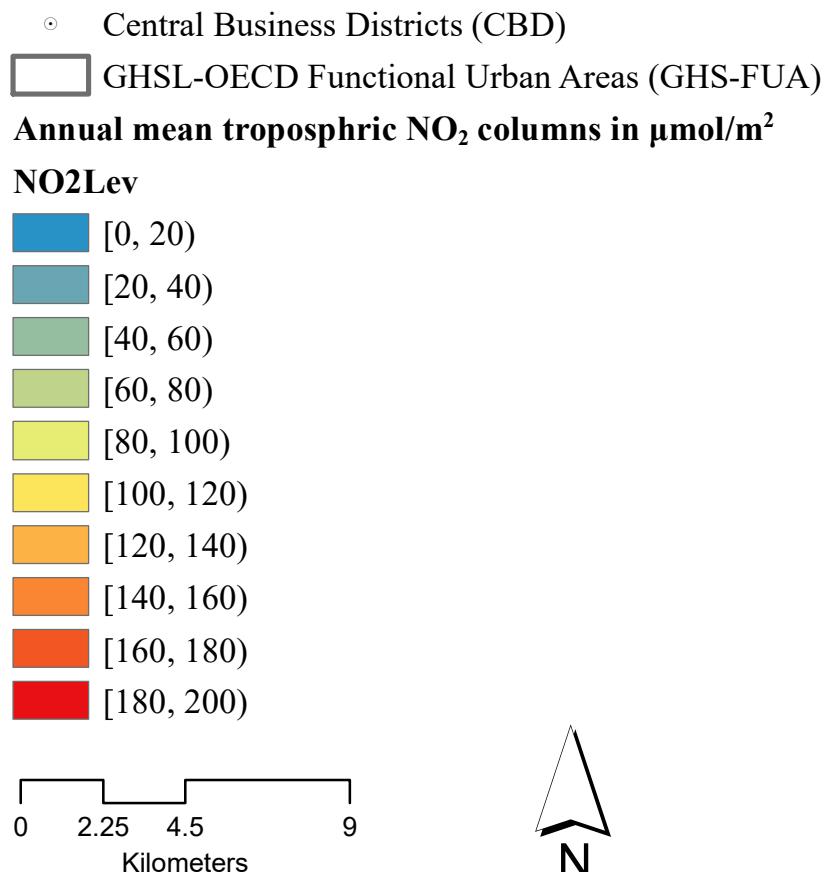
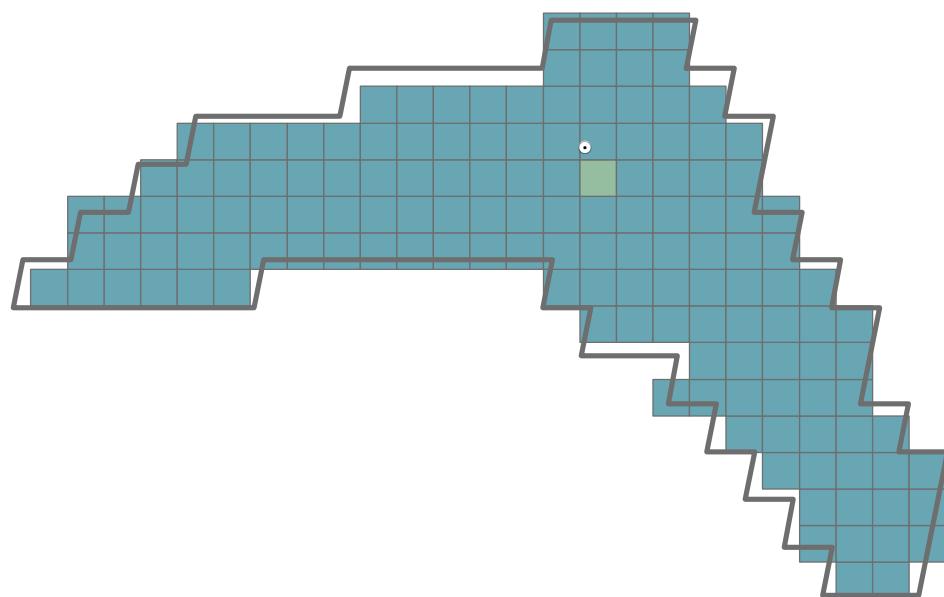
RS-measured tropospheric vertical columns of NO<sub>2</sub> of  
Balikesir, Turkey  
eFUA\_ID: 1353  
at 1 km resolution



27 50'0"E

28 0'0"E

RS-measured tropospheric vertical columns of NO<sub>2</sub> of  
Bandirma, Turkey  
eFUA\_ID: 1140  
at 1 km resolution



Locations of CBD in 2006, 2012 by Kilgarriff P., Lemoy R., Mader M.  
GHS-FUA data in 2019 from the European Union. Tropospheric vertical  
columns of NO<sub>2</sub> data in 2018, 2019 from Sentinel-5P,  
the European Space Agency.

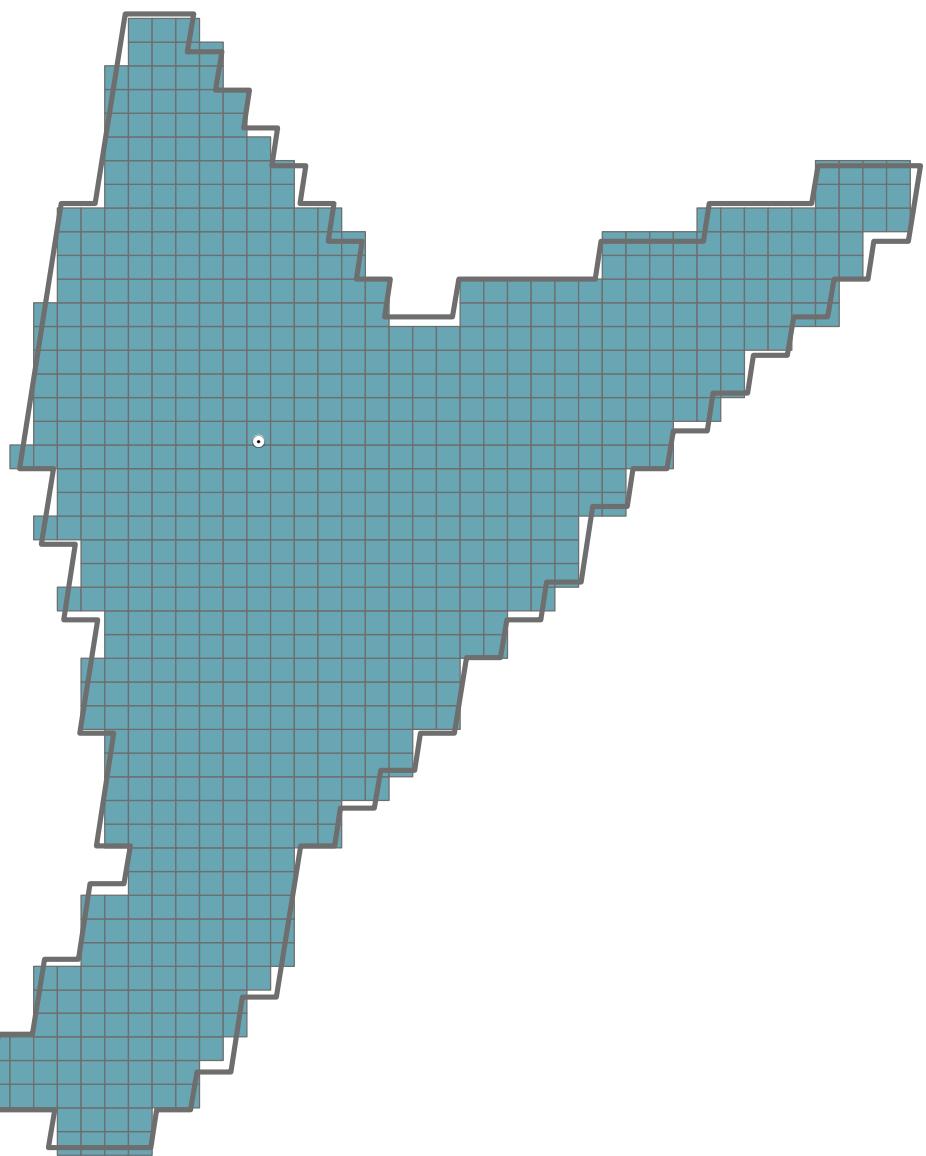
Yufei Wei, 09 March 2022

19 10'0"E

19 20'0"E

RS-measured tropospheric vertical columns of NO<sub>2</sub> of  
Banska Bystrica, Slovakia  
eFUA\_ID: 623  
at 1 km resolution

48 50'0"N



○ Central Business Districts (CBD)

◻ GHSL-OECD Functional Urban Areas (GHS-FUA)

Annual mean tropospheric NO<sub>2</sub> columns in  $\mu\text{mol}/\text{m}^2$

NO2Lev

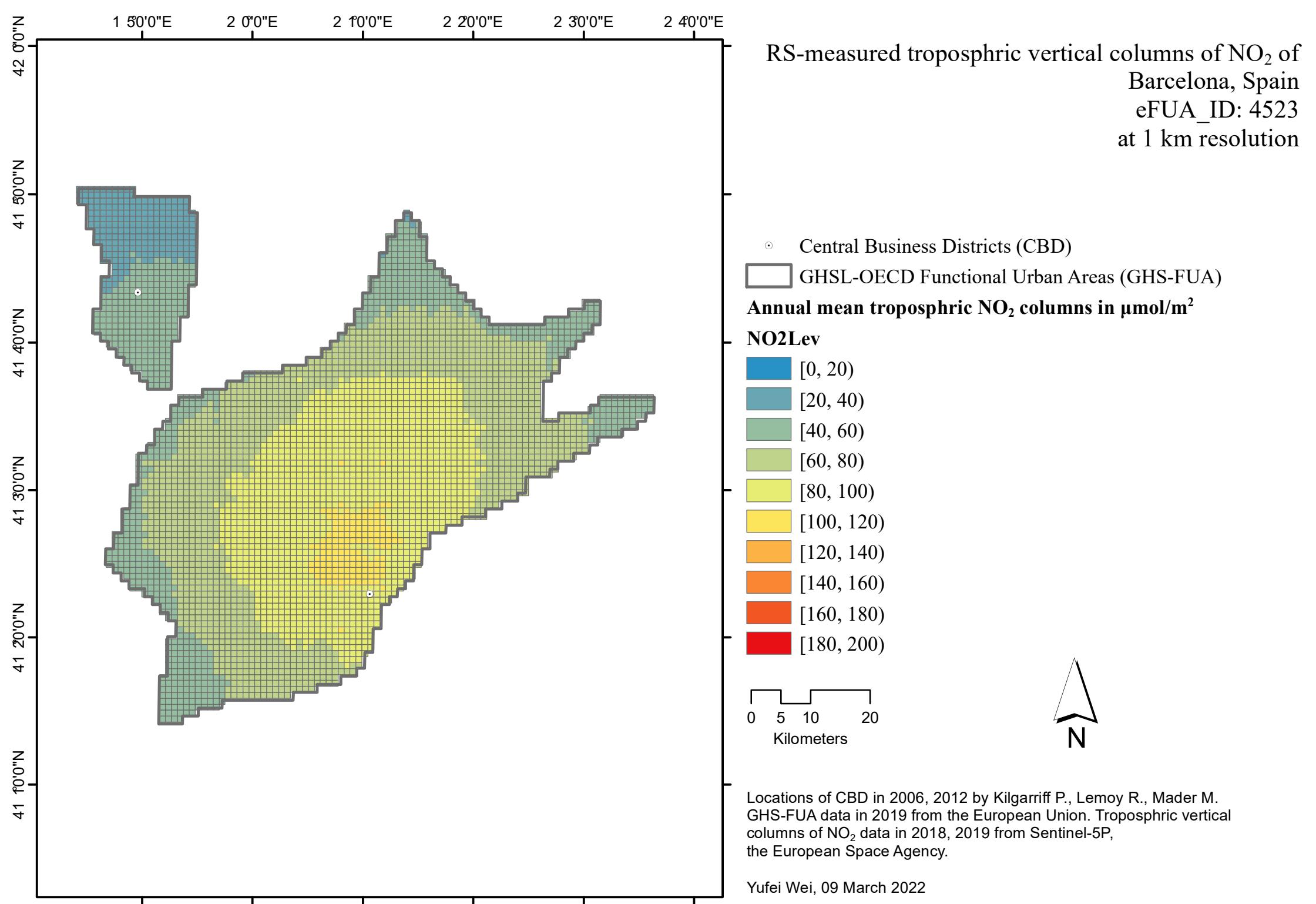
- [0, 20]
- [20, 40]
- [40, 60]
- [60, 80]
- [80, 100]
- [100, 120]
- [120, 140]
- [140, 160]
- [160, 180]
- [180, 200]

0 3.25 6.5 13  
Kilometers



Locations of CBD in 2006, 2012 by Kilgarriff P., Lemoy R., Mader M.  
GHS-FUA data in 2019 from the European Union. Tropospheric vertical  
columns of NO<sub>2</sub> data in 2018, 2019 from Sentinel-5P,  
the European Space Agency.

Yufei Wei, 09 March 2022

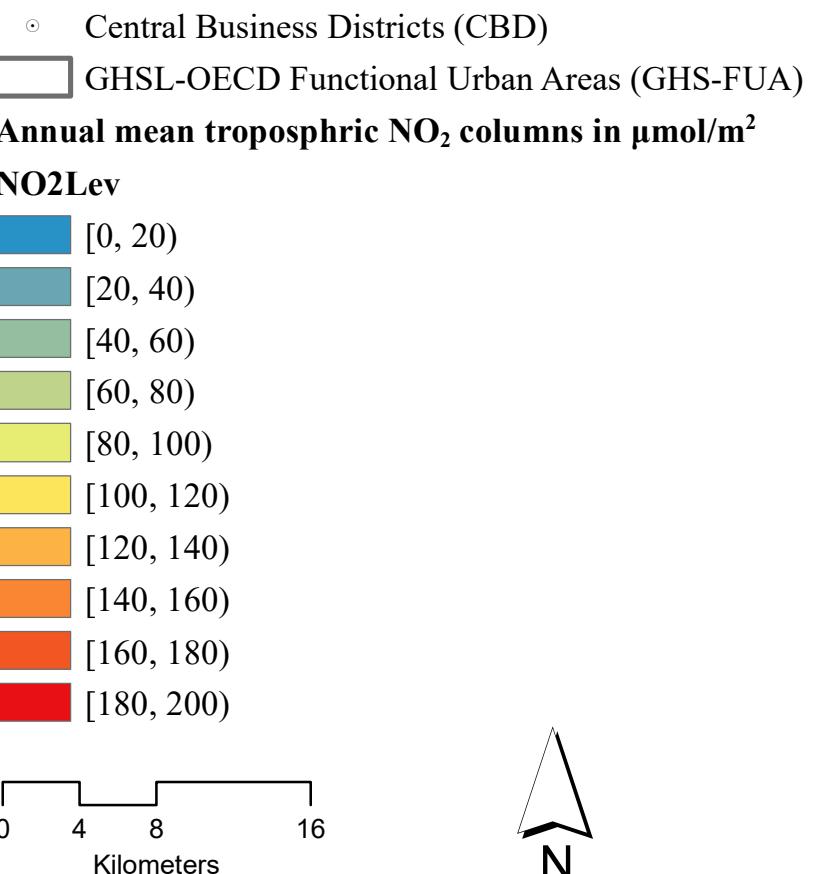
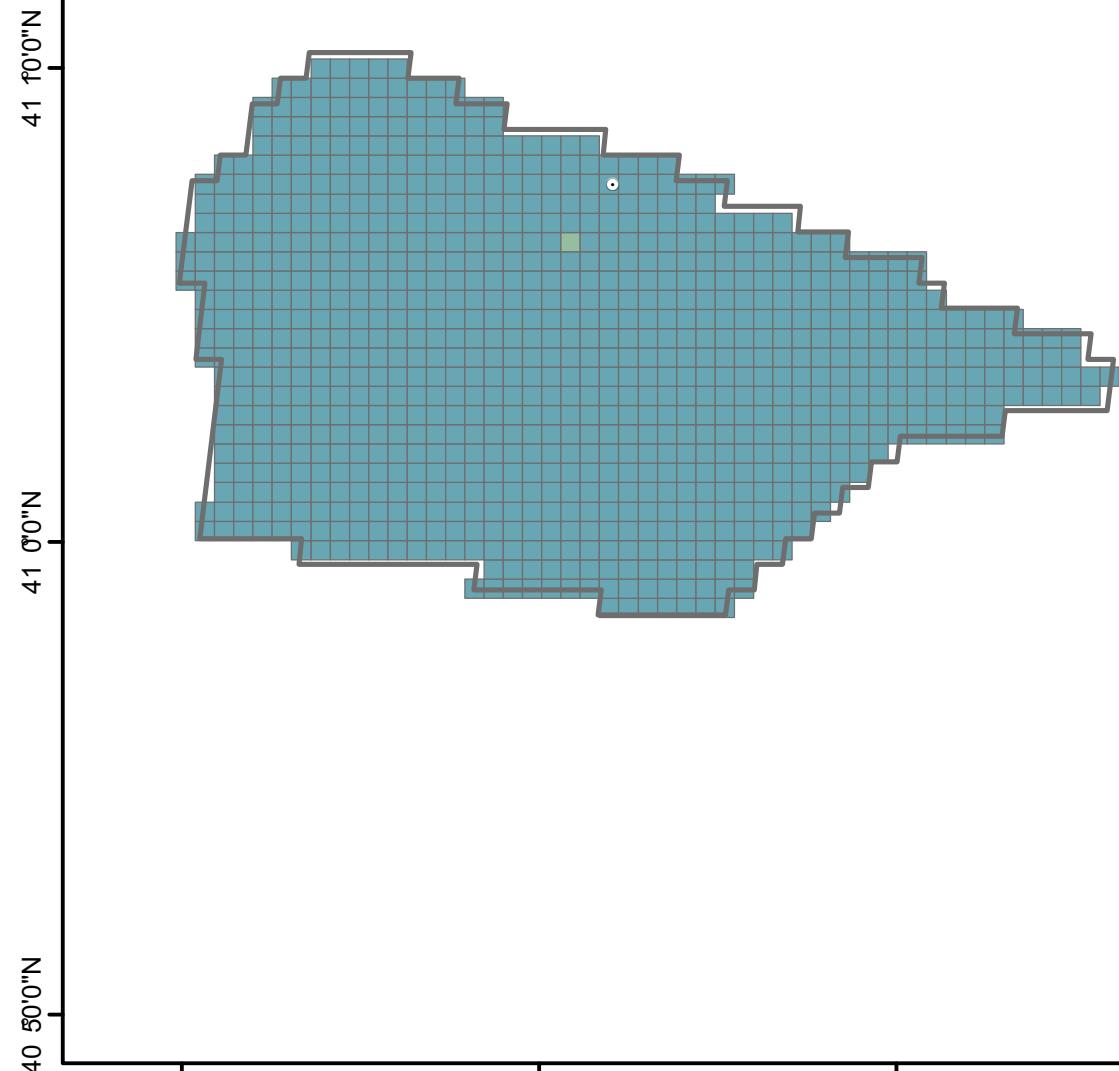


16 40'0"E

16 50'0"E

17 0'0"E

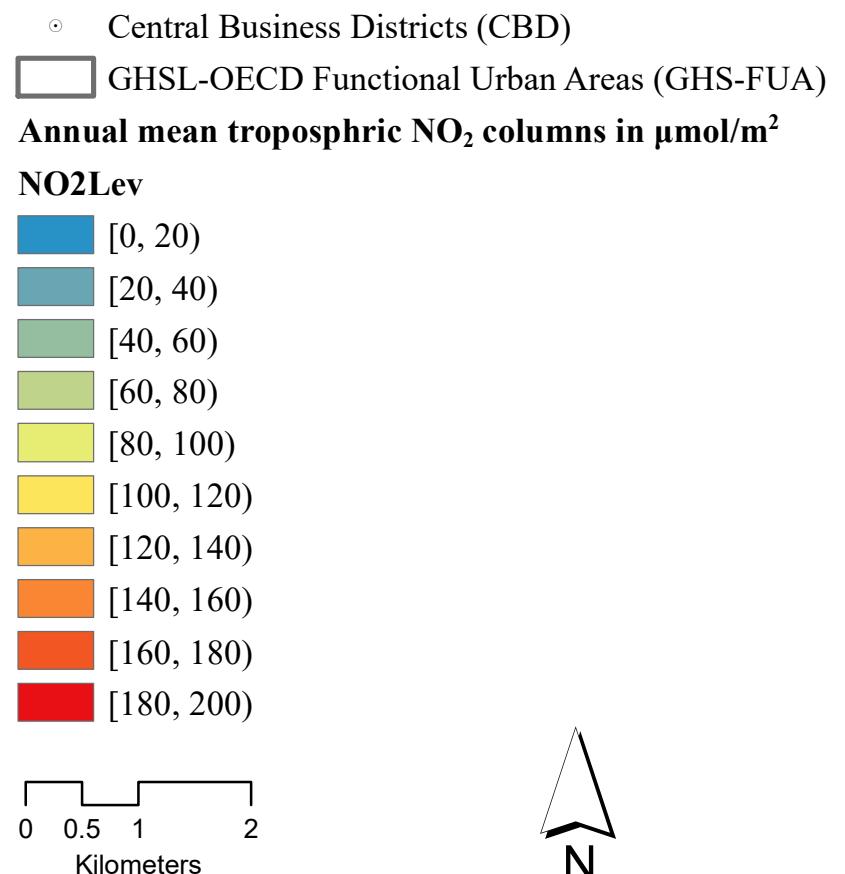
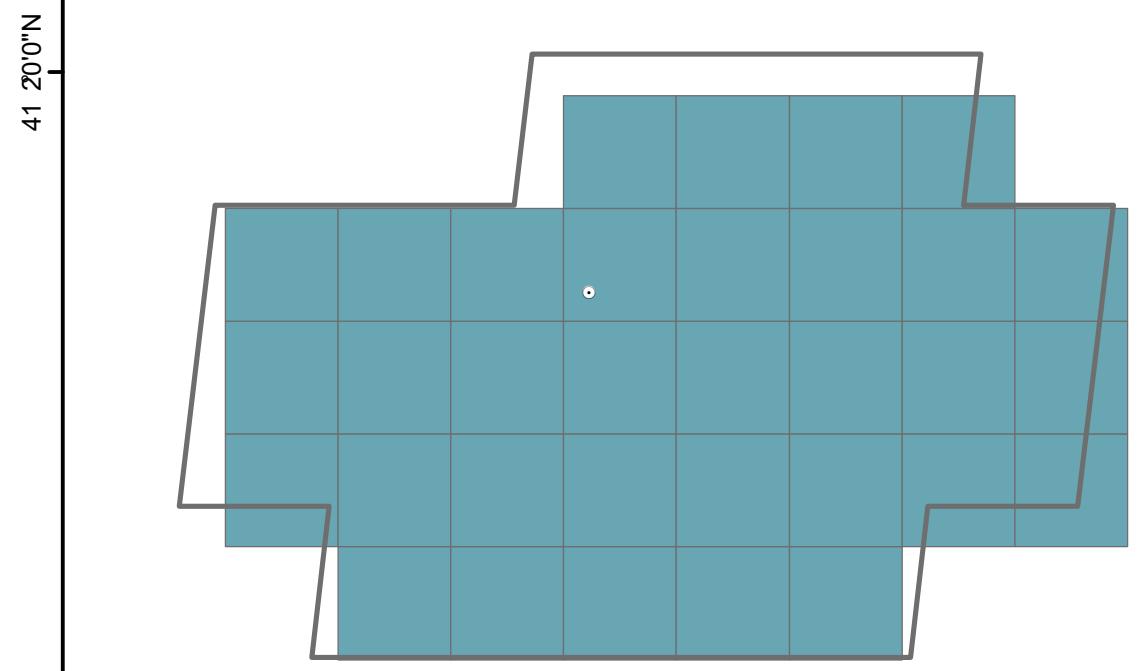
RS-measured tropospheric vertical columns of NO<sub>2</sub> of  
Bari, Italy  
eFUA\_ID: 5004  
at 1 km resolution



Locations of CBD in 2006, 2012 by Kilgarriff P., Lemoy R., Mader M.  
GHS-FUA data in 2019 from the European Union. Tropospheric vertical  
columns of NO<sub>2</sub> data in 2018, 2019 from Sentinel-5P,  
the European Space Agency.

Yufei Wei, 09 March 2022

RS-measured tropospheric vertical columns of NO<sub>2</sub> of  
Barletta, Italy  
eFUA\_ID: 4821  
at 1 km resolution



Locations of CBD in 2006, 2012 by Kilgarriff P., Lemoy R., Mader M.  
GHS-FUA data in 2019 from the European Union. Tropospheric vertical  
columns of NO<sub>2</sub> data in 2018, 2019 from Sentinel-5P,  
the European Space Agency.

7 30'0"E

7 40'0"E

7 50'0"E

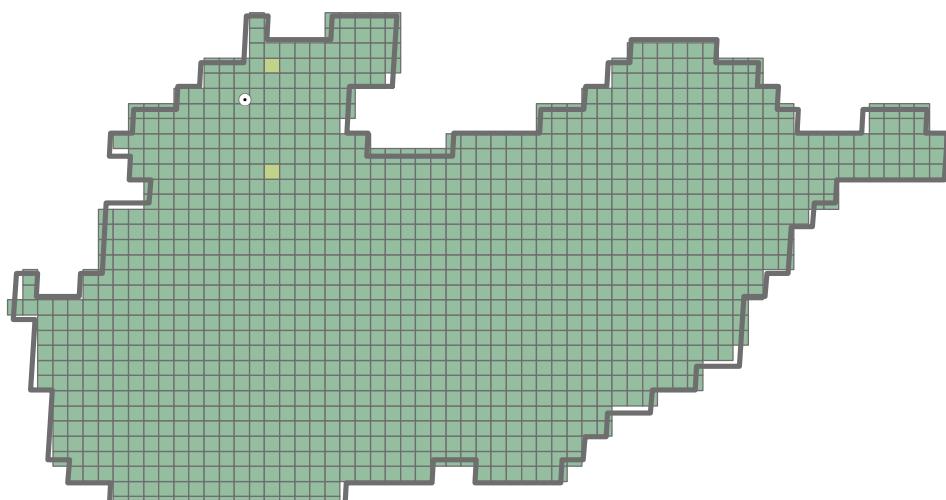
8 0'0"E

47 40'0"N

47 30'0"N

47 20'0"N

RS-measured tropospheric vertical columns of NO<sub>2</sub> of  
Basel, Switzerland  
eFUA\_ID: 935  
at 1 km resolution



○ Central Business Districts (CBD)

◻ GHSL-OECD Functional Urban Areas (GHS-FUA)

Annual mean tropospheric NO<sub>2</sub> columns in  $\mu\text{mol}/\text{m}^2$

NO2Lev

[0, 20)

[20, 40)

[40, 60)

[60, 80)

[80, 100)

[100, 120)

[120, 140)

[140, 160)

[160, 180)

[180, 200)

0 5 10 20  
Kilometers



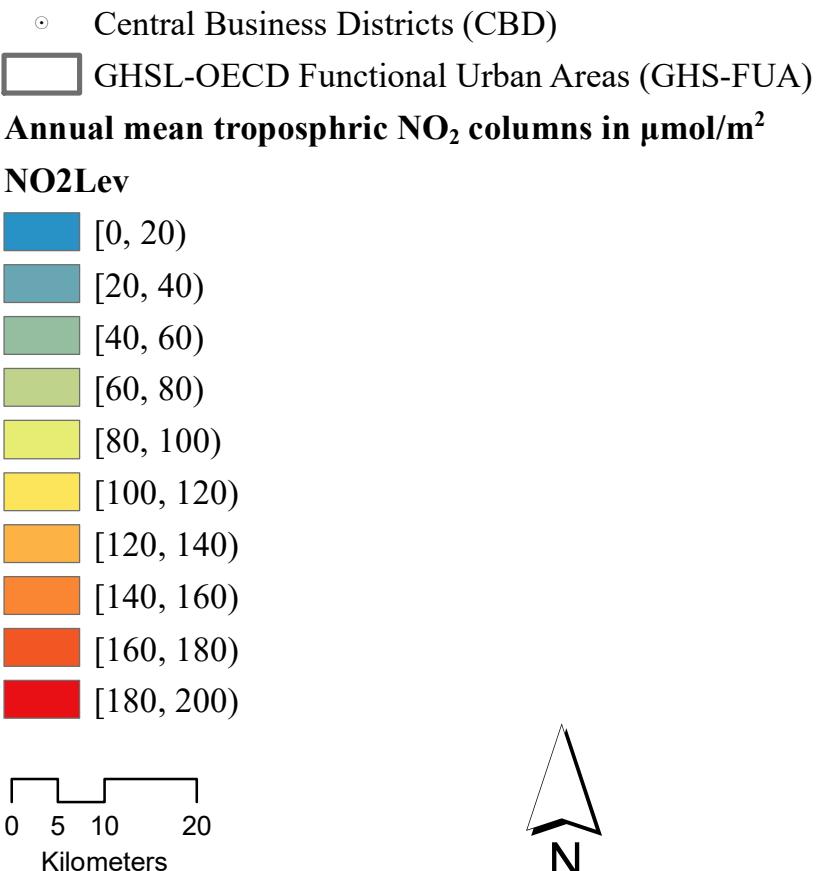
Locations of CBD in 2006, 2012 by Kilgarriff P., Lemoy R., Mader M.  
GHS-FUA data in 2019 from the European Union. Tropospheric vertical  
columns of NO<sub>2</sub> data in 2018, 2019 from Sentinel-5P,  
the European Space Agency.

Yufei Wei, 09 March 2022

6 30'0"W 6 20'0"W 6 10'0"W 6 0'0"W 5 50'0"W 5 40'0"W

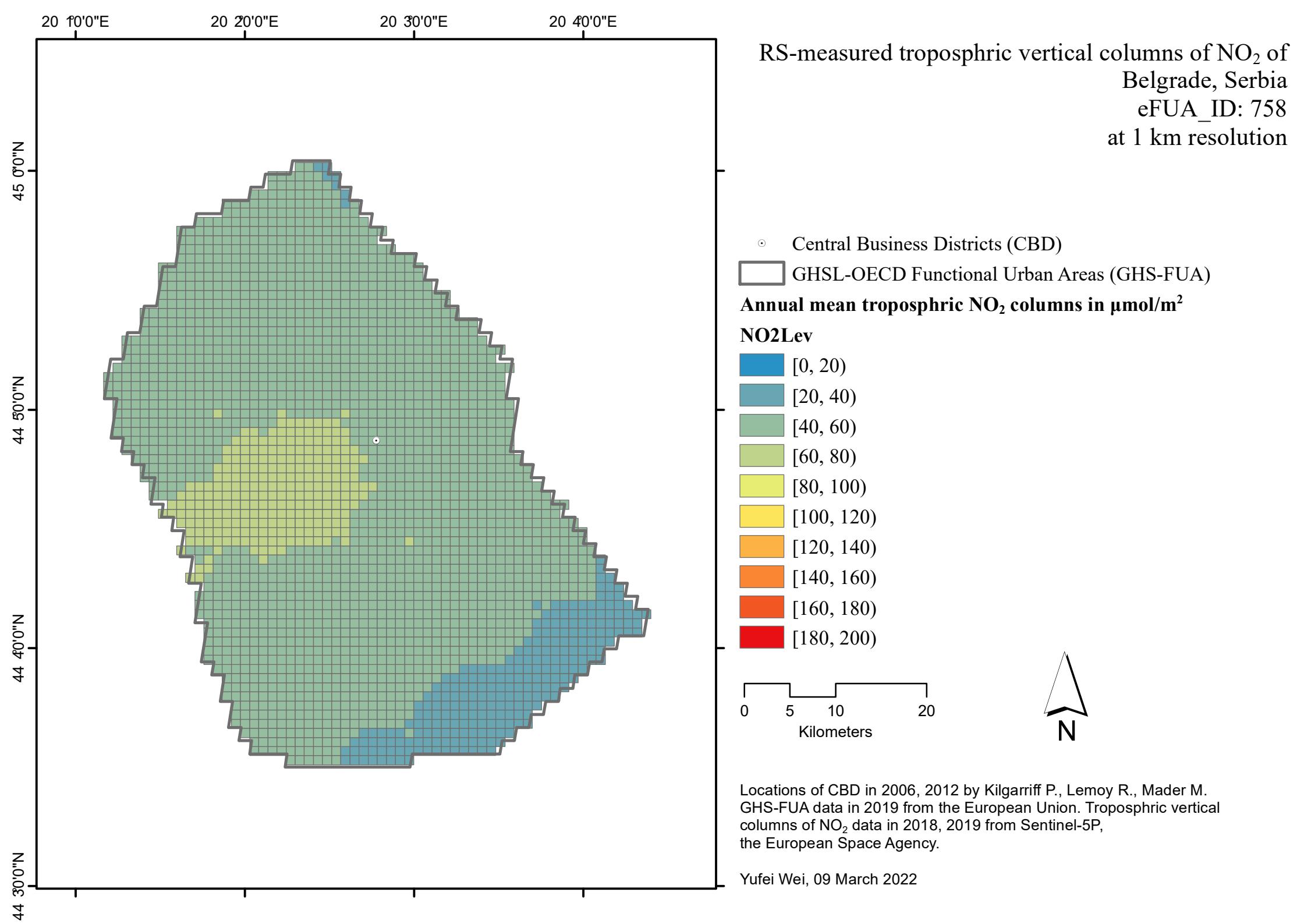
54 50'0"N  
54 40'0"N  
54 30'0"N  
54 20'0"N

RS-measured tropospheric vertical columns of NO<sub>2</sub> of  
Belfast, United Kingdom  
eFUA\_ID: 242  
at 1 km resolution



Locations of CBD in 2006, 2012 by Kilgarriff P., Lemoy R., Mader M.  
GHS-FUA data in 2019 from the European Union. Tropospheric vertical  
columns of NO<sub>2</sub> data in 2018, 2019 from Sentinel-5P,  
the European Space Agency.

Yufei Wei, 09 March 2022



0 10'0"W

0 0'0"

RS-measured tropospheric vertical columns of NO<sub>2</sub> of  
Benidorm, Spain  
eFUA\_ID: 4224  
at 1 km resolution

38 40'0"N

38 30'0"N

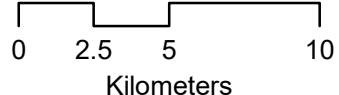
○ Central Business Districts (CBD)

◻ GHSL-OECD Functional Urban Areas (GHS-FUA)

Annual mean tropospheric NO<sub>2</sub> columns in  $\mu\text{mol}/\text{m}^2$

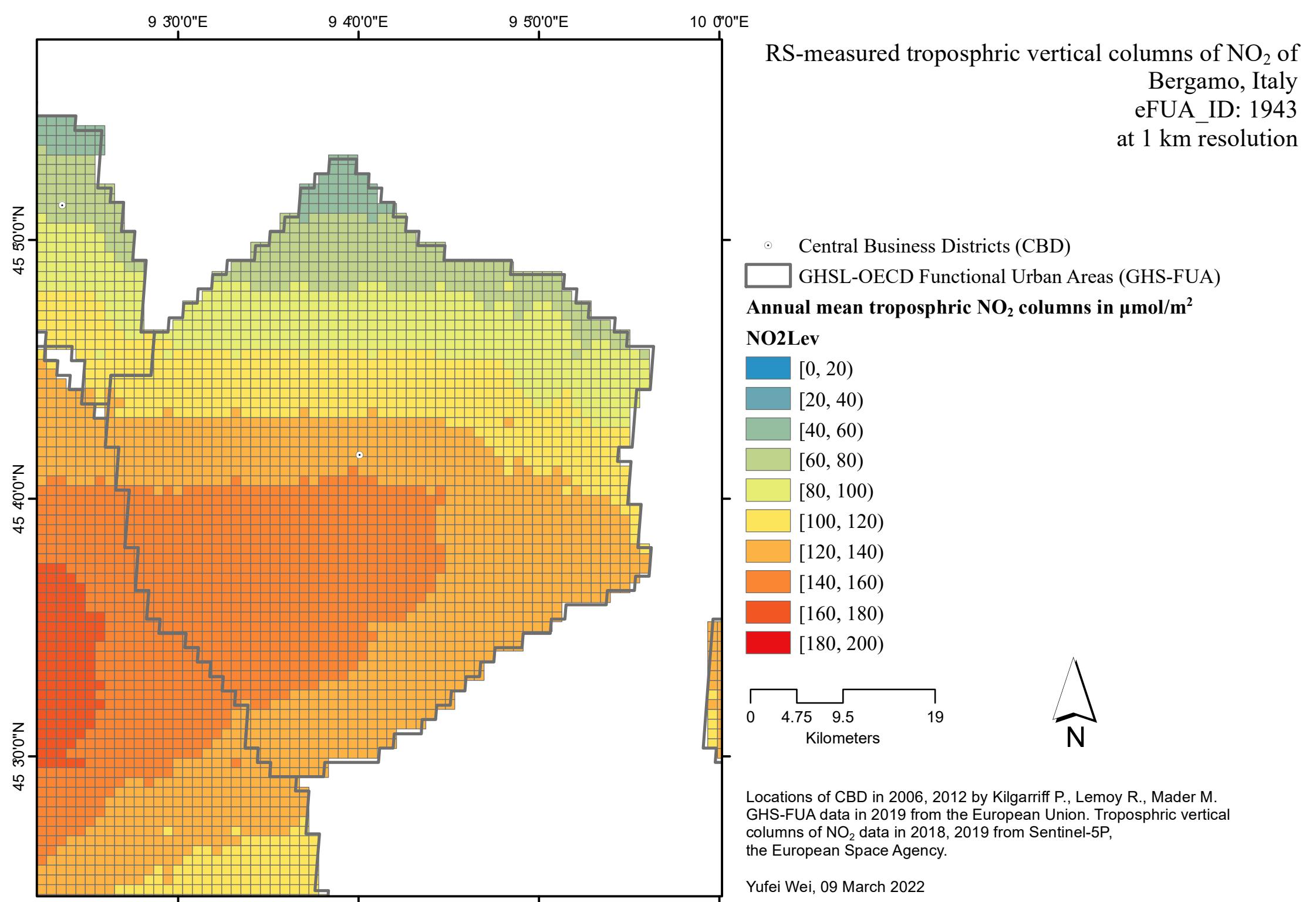
NO2Lev

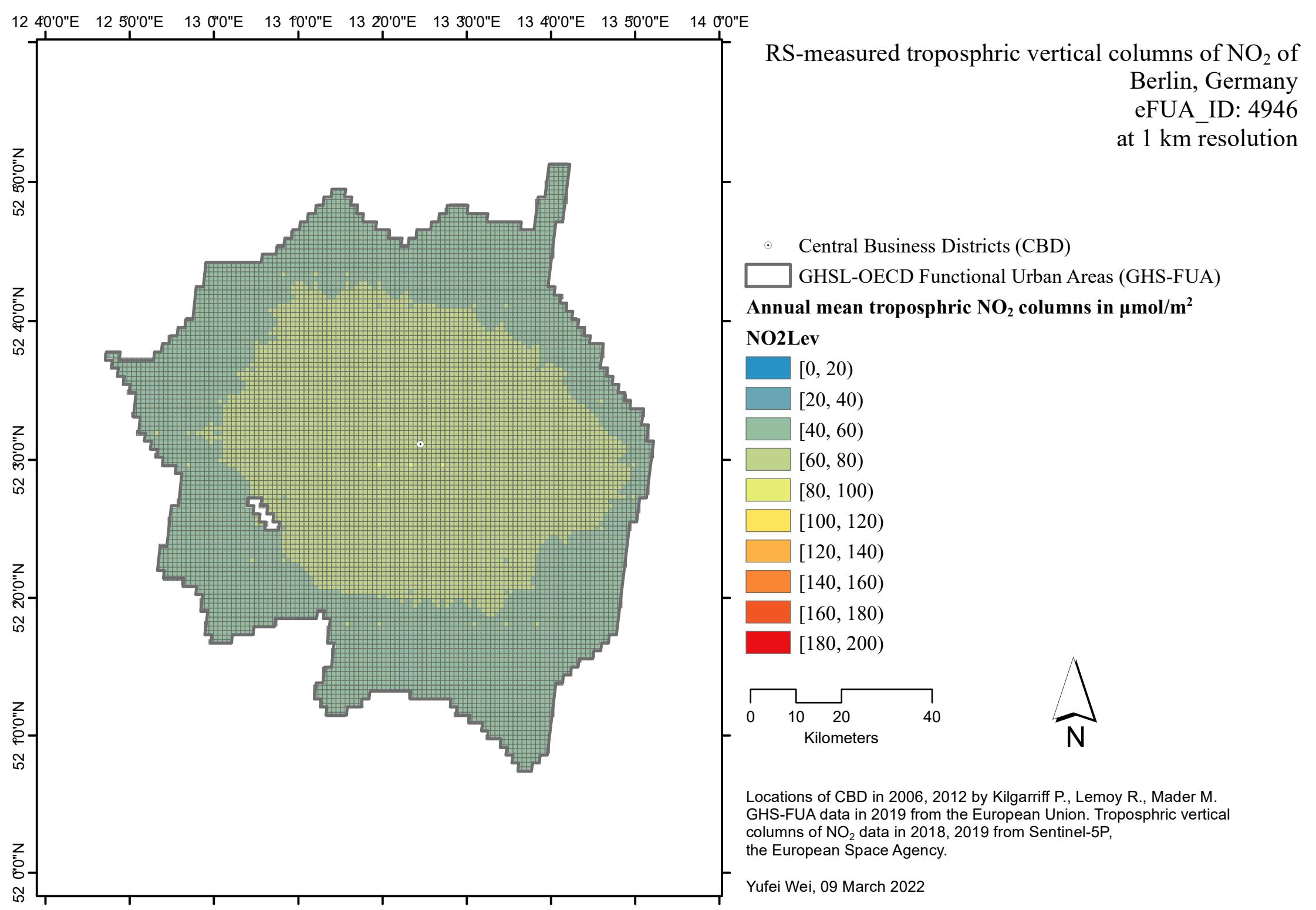
- [0, 20)
- [20, 40)
- [40, 60)
- [60, 80)
- [80, 100)
- [100, 120)
- [120, 140)
- [140, 160)
- [160, 180)
- [180, 200)



Locations of CBD in 2006, 2012 by Kilgarriff P., Lemoy R., Mader M.  
GHS-FUA data in 2019 from the European Union. Tropospheric vertical  
columns of NO<sub>2</sub> data in 2018, 2019 from Sentinel-5P,  
the European Space Agency.

Yufei Wei, 09 March 2022





7 10'0"E

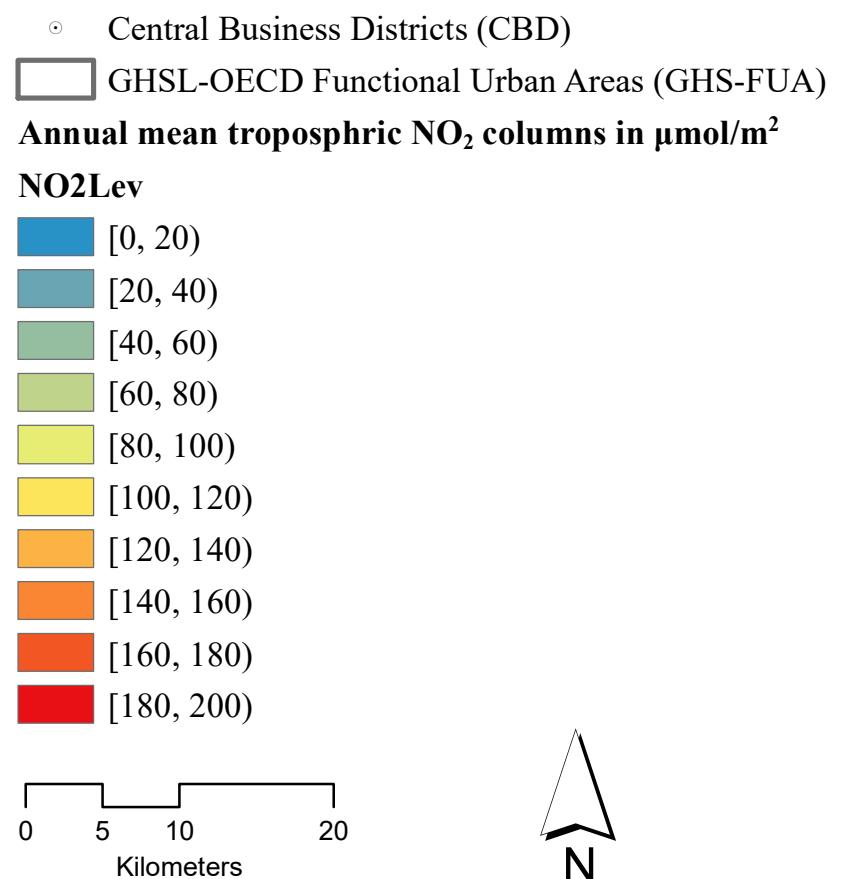
7 20'0"E

7 30'0"E

7 40'0"E

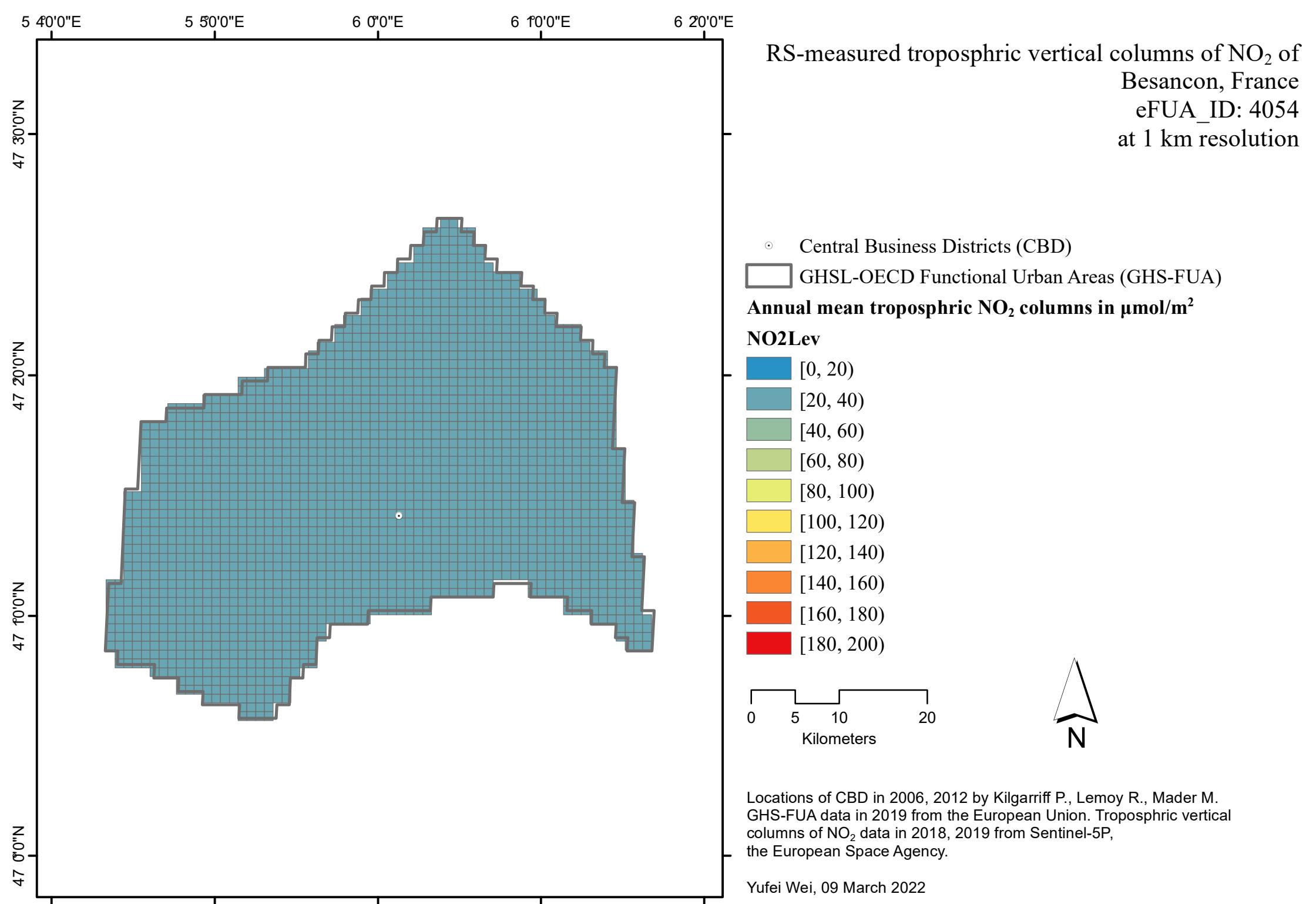
RS-measured tropospheric vertical columns of NO<sub>2</sub> of  
Bern, Switzerland  
eFUA\_ID: 805  
at 1 km resolution

47 10'0"N  
47 00'N  
46 50'0"N



Locations of CBD in 2006, 2012 by Kilgarriff P., Lemoy R., Mader M.  
GHS-FUA data in 2019 from the European Union. Tropospheric vertical  
columns of NO<sub>2</sub> data in 2018, 2019 from Sentinel-5P,  
the European Space Agency.

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22 50'0"E

23 0'0"E

23 10'0"E

23 20'0"E

RS-measured tropospheric vertical columns of NO<sub>2</sub> of  
Bialystok, Poland  
eFUA\_ID: 3601  
at 1 km resolution

53 20'0"N

53 10'0"N

53 0'0"N

○ Central Business Districts (CBD)

◻ GHSL-OECD Functional Urban Areas (GHS-FUA)

**Annual mean tropospheric NO<sub>2</sub> columns in  $\mu\text{mol}/\text{m}^2$** **NO2Lev**

[0, 20)

[20, 40)

[40, 60)

[60, 80)

[80, 100)

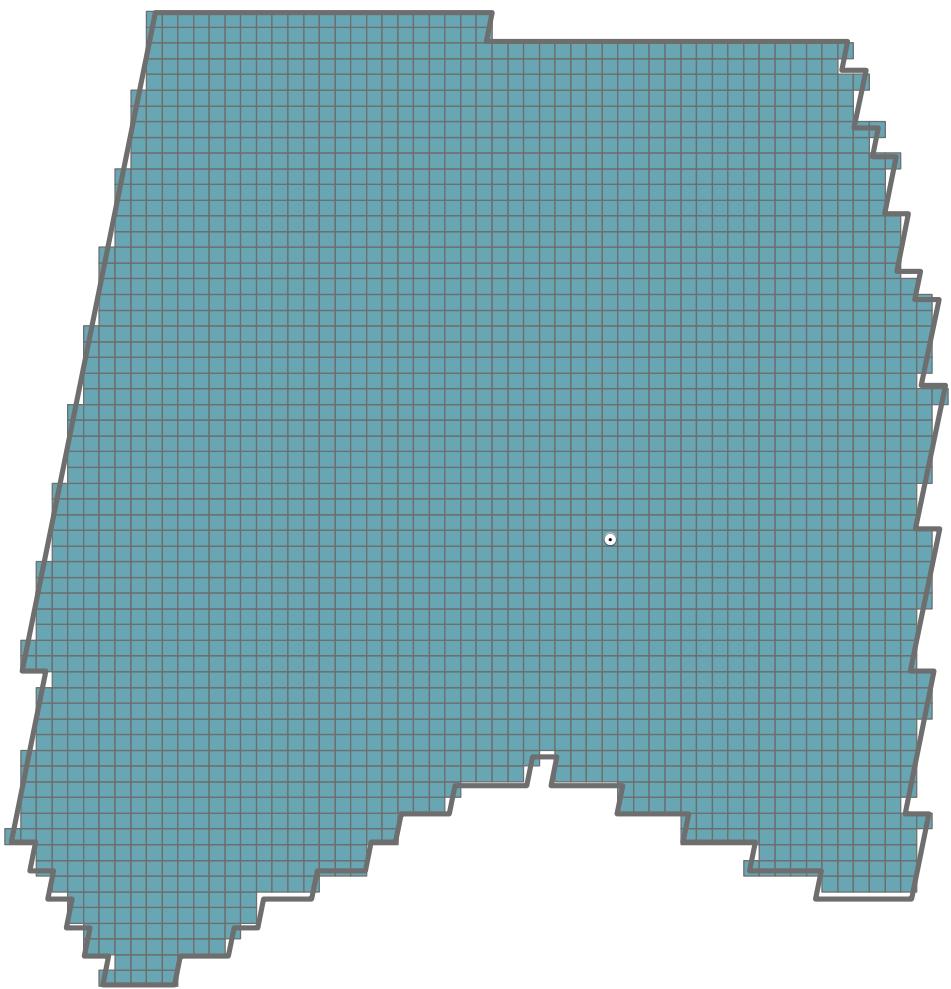
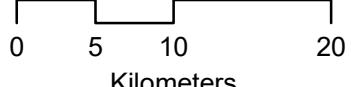
[100, 120)

[120, 140)

[140, 160)

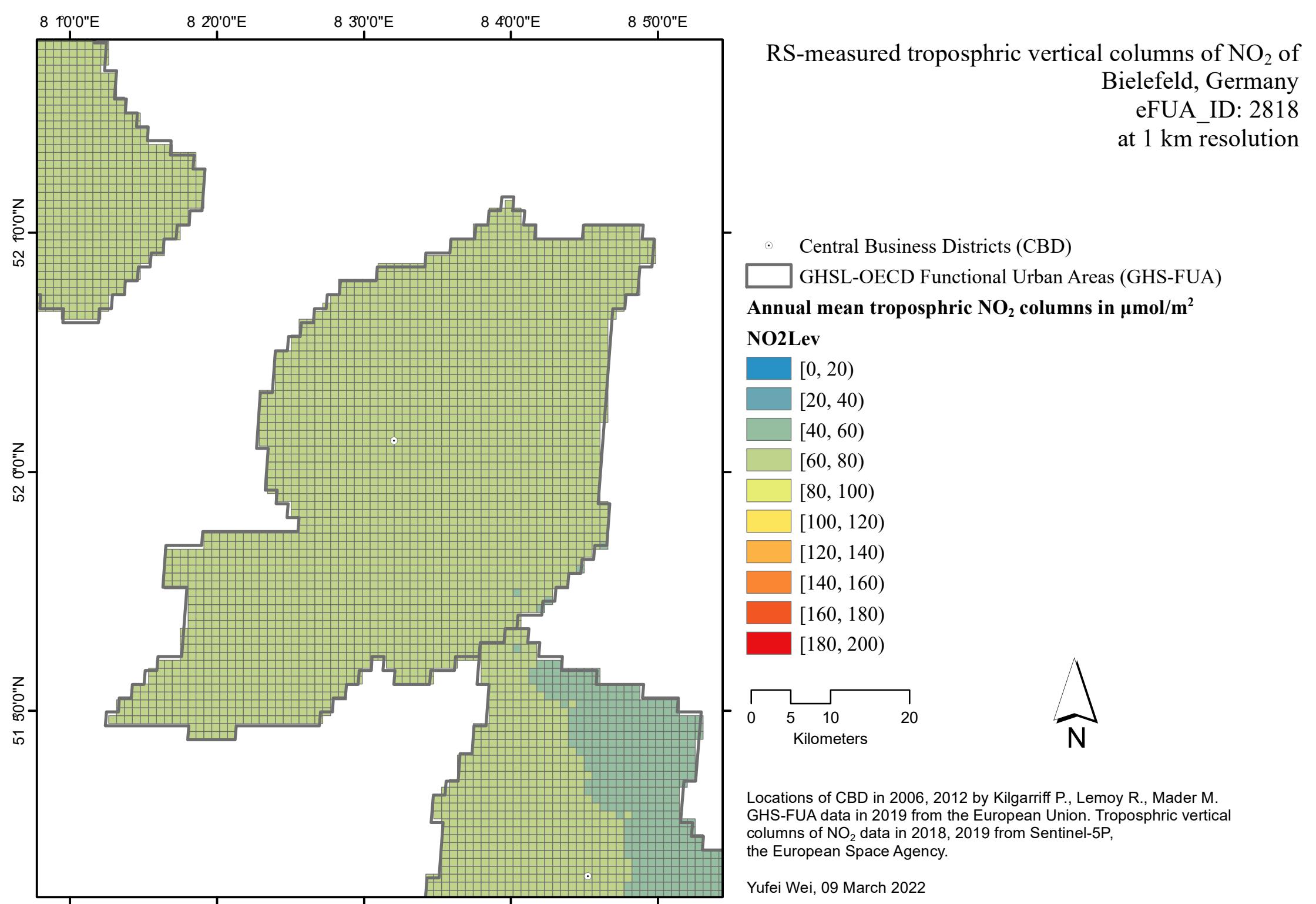
[160, 180)

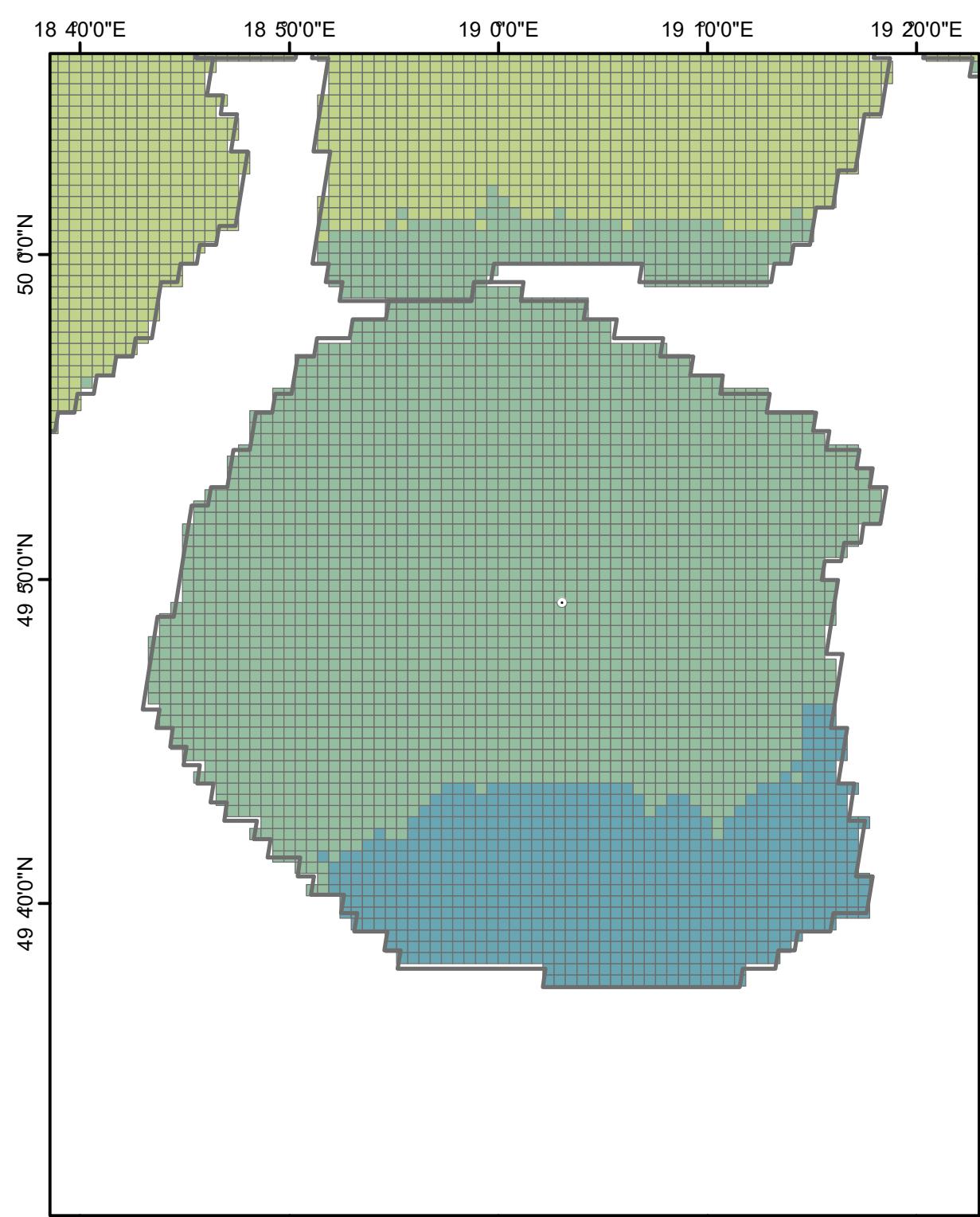
[180, 200)



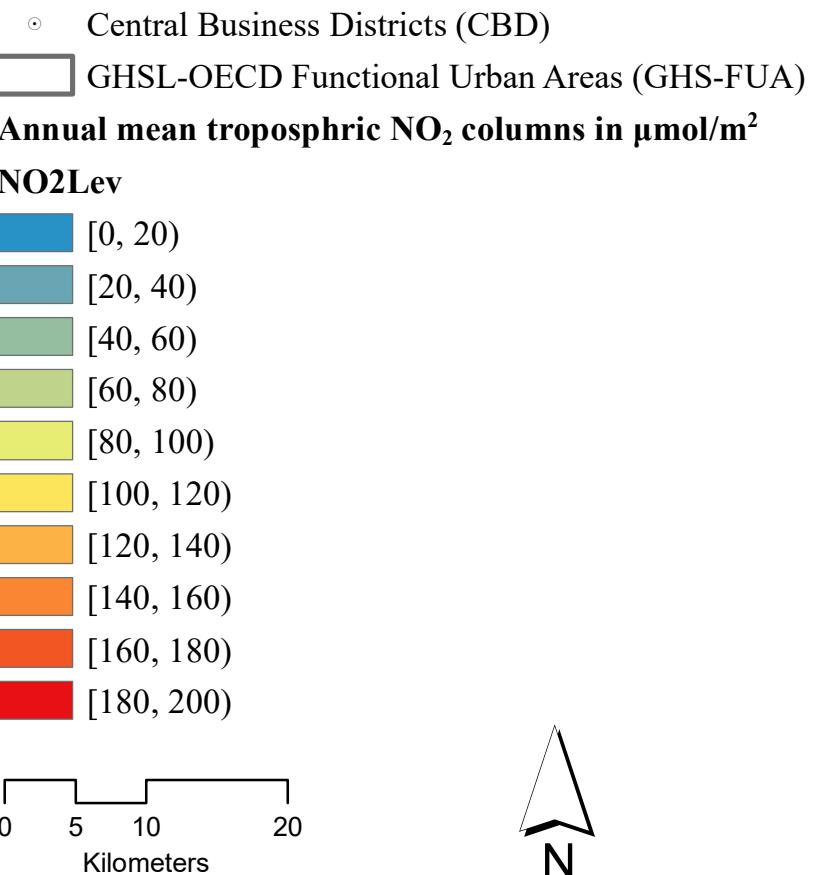
Locations of CBD in 2006, 2012 by Kilgarriff P., Lemoy R., Mader M.  
GHS-FUA data in 2019 from the European Union. Tropospheric vertical  
columns of NO<sub>2</sub> data in 2018, 2019 from Sentinel-5P,  
the European Space Agency.

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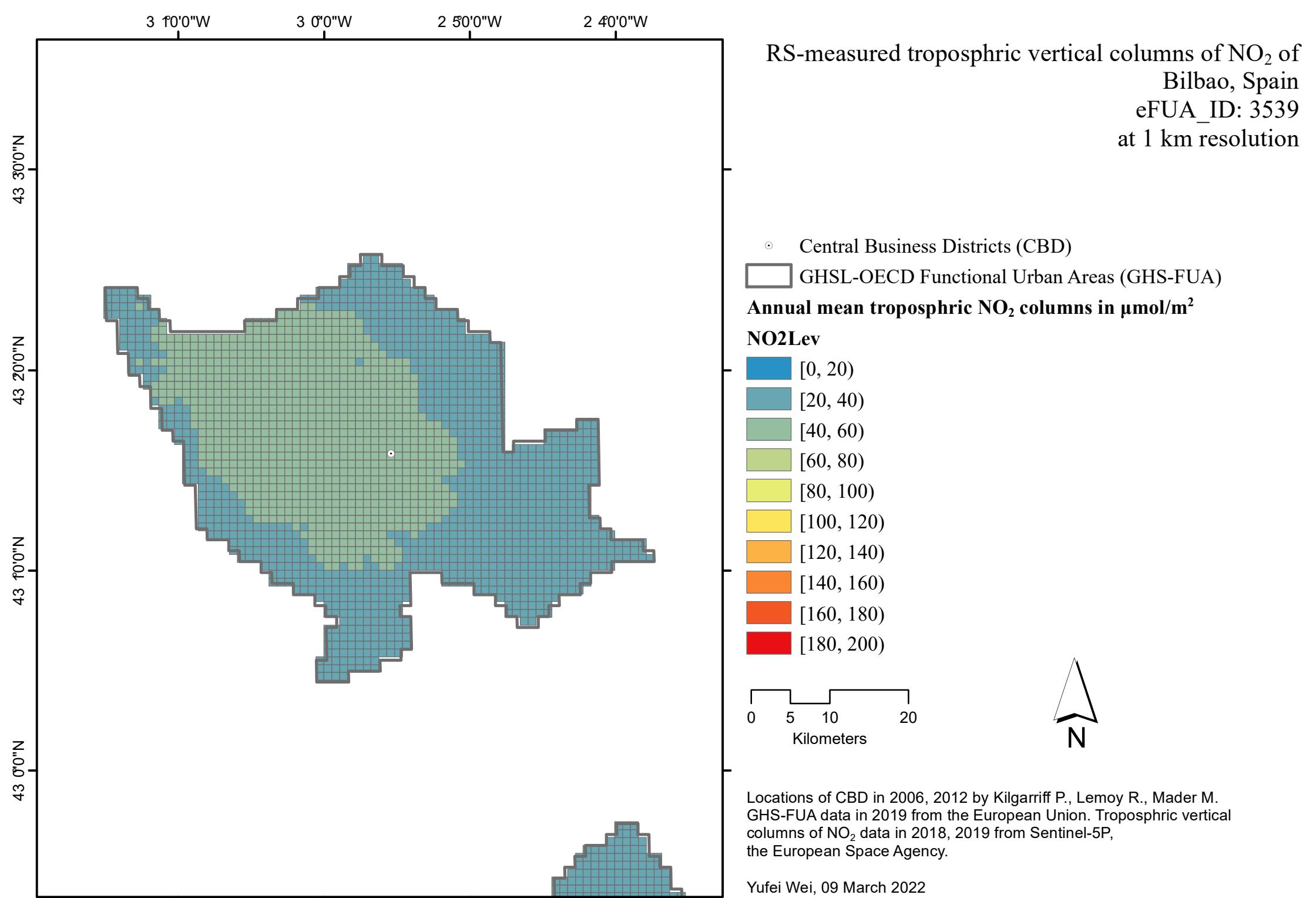


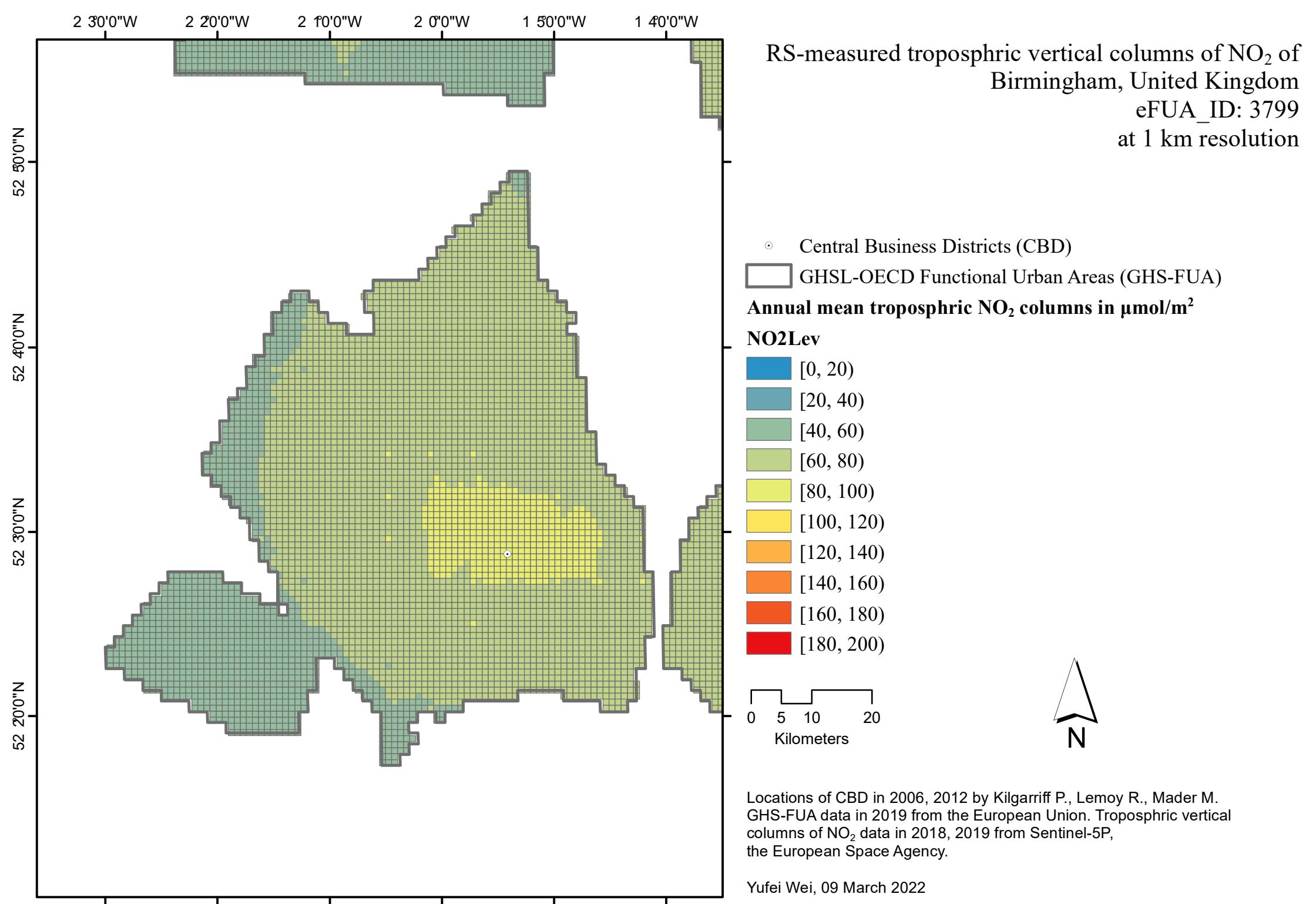
RS-measured tropospheric vertical columns of NO<sub>2</sub> of  
Bielsko-Biala, Poland  
eFUA\_ID: 3016  
at 1 km resolution



Locations of CBD in 2006, 2012 by Kilgarriff P., Lemoy R., Mader M.  
GHS-FUA data in 2019 from the European Union. Tropospheric vertical  
columns of NO<sub>2</sub> data in 2018, 2019 from Sentinel-5P,  
the European Space Agency.

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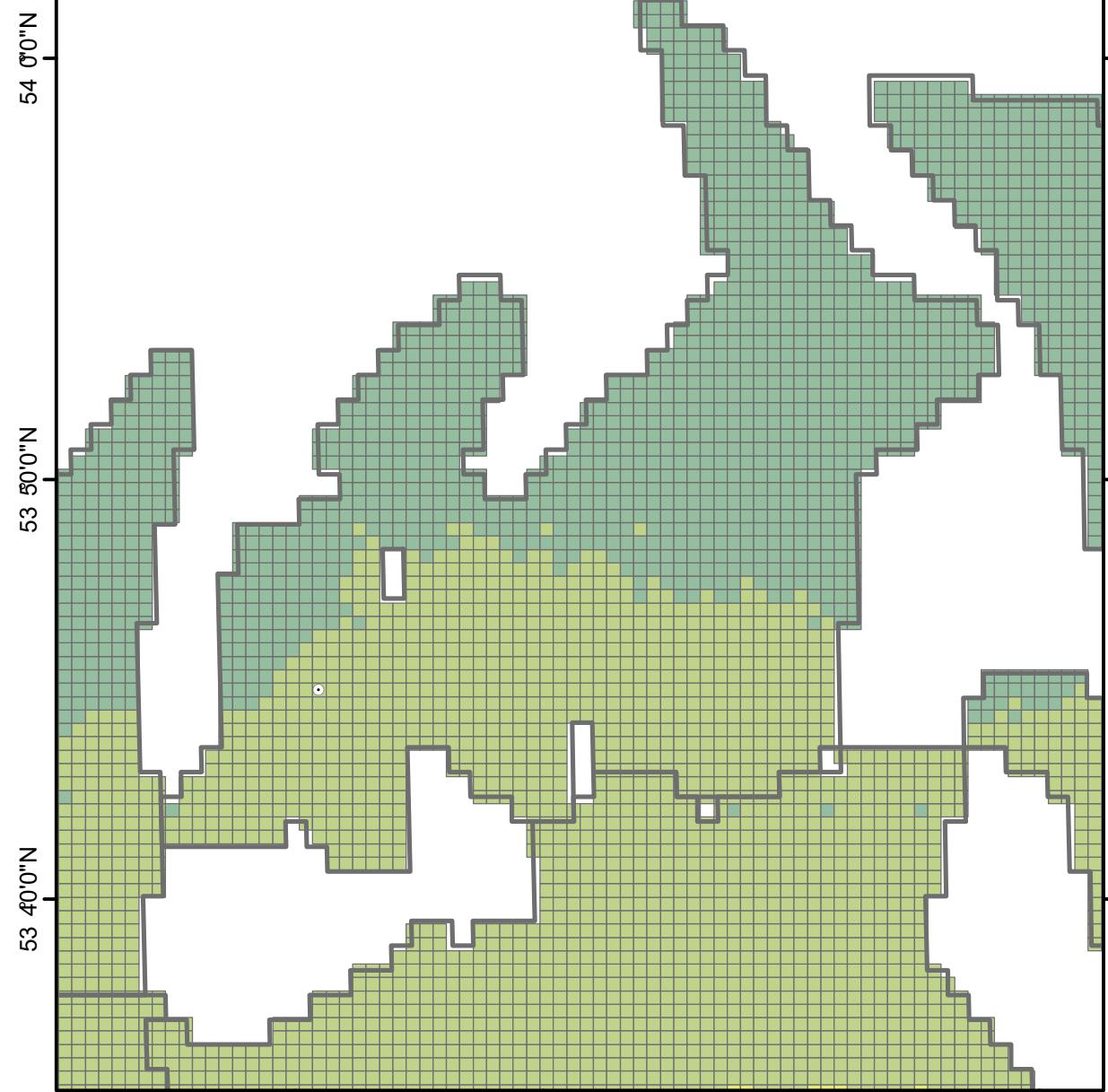
2 30'0"W

2 20'0"W

2 10'0"W

2 0'0"W

RS-measured tropospheric vertical columns of NO<sub>2</sub> of  
 Blackburn, United Kingdom  
 eFUA\_ID: 3401  
 at 1 km resolution



○ Central Business Districts (CBD)

◻ GHS-OECD Functional Urban Areas (GHS-FUA)

**Annual mean tropospheric NO<sub>2</sub> columns in  $\mu\text{mol}/\text{m}^2$**

**NO2Lev**

- [0, 20)
- [20, 40)
- [40, 60)
- [60, 80)
- [80, 100)
- [100, 120)
- [120, 140)
- [140, 160)
- [160, 180)
- [180, 200)

0 5 10 20  
Kilometers



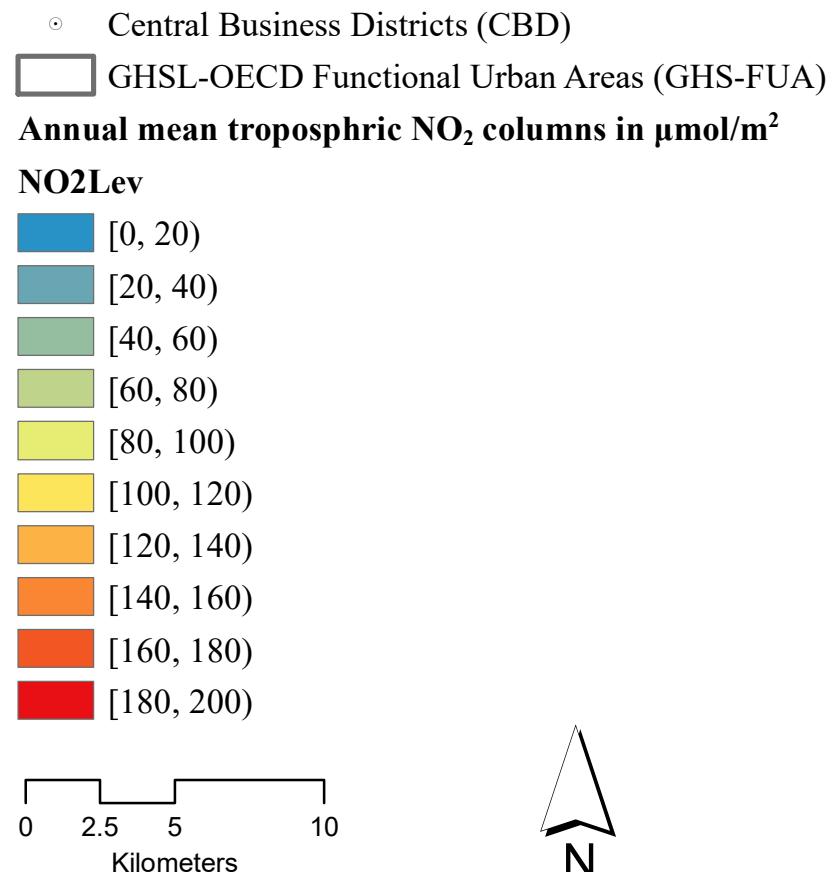
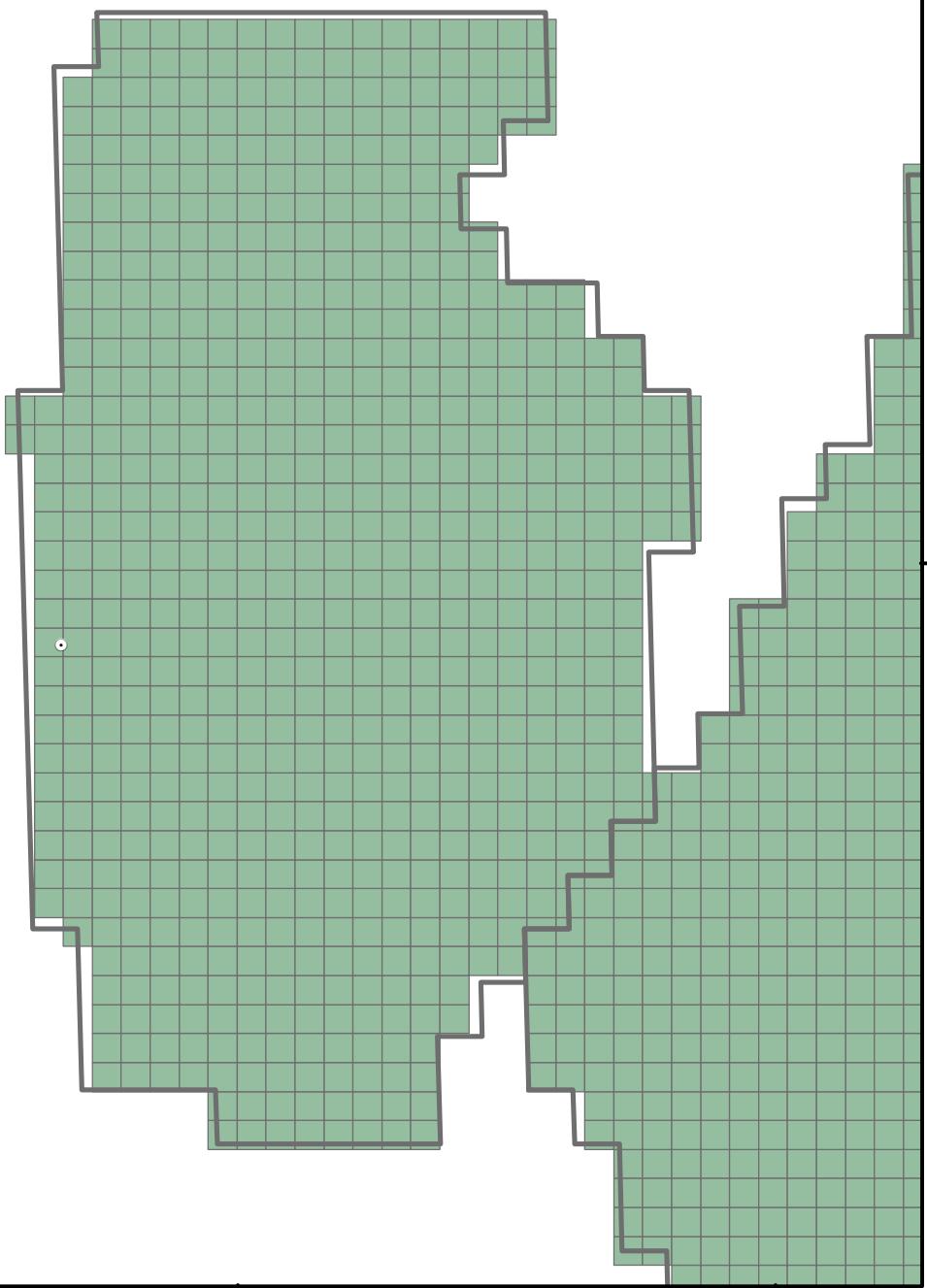
Locations of CBD in 2006, 2012 by Kilgarriff P., Lemoy R., Mader M.  
 GHS-FUA data in 2019 from the European Union. Tropospheric vertical  
 columns of NO<sub>2</sub> data in 2018, 2019 from Sentinel-5P,  
 the European Space Agency.

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3 0'0"W

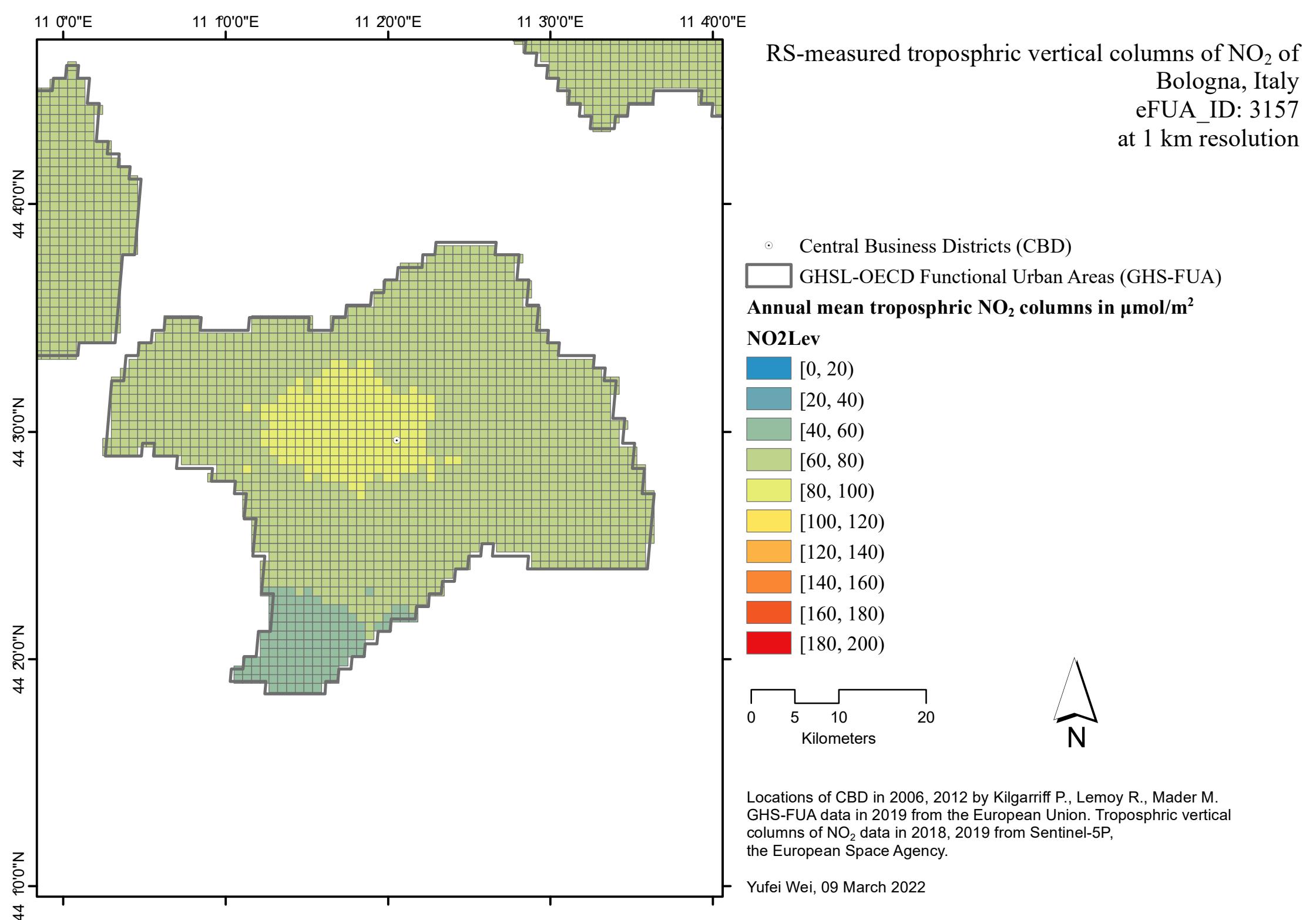
2 50'0"W

RS-measured tropospheric vertical columns of NO<sub>2</sub> of  
Blackpool, United Kingdom  
eFUA\_ID: 2574  
at 1 km resolution



Locations of CBD in 2006, 2012 by Kilgarriff P., Lemoy R., Mader M.  
GHS-FUA data in 2019 from the European Union. Tropospheric vertical  
columns of NO<sub>2</sub> data in 2018, 2019 from Sentinel-5P,  
the European Space Agency.

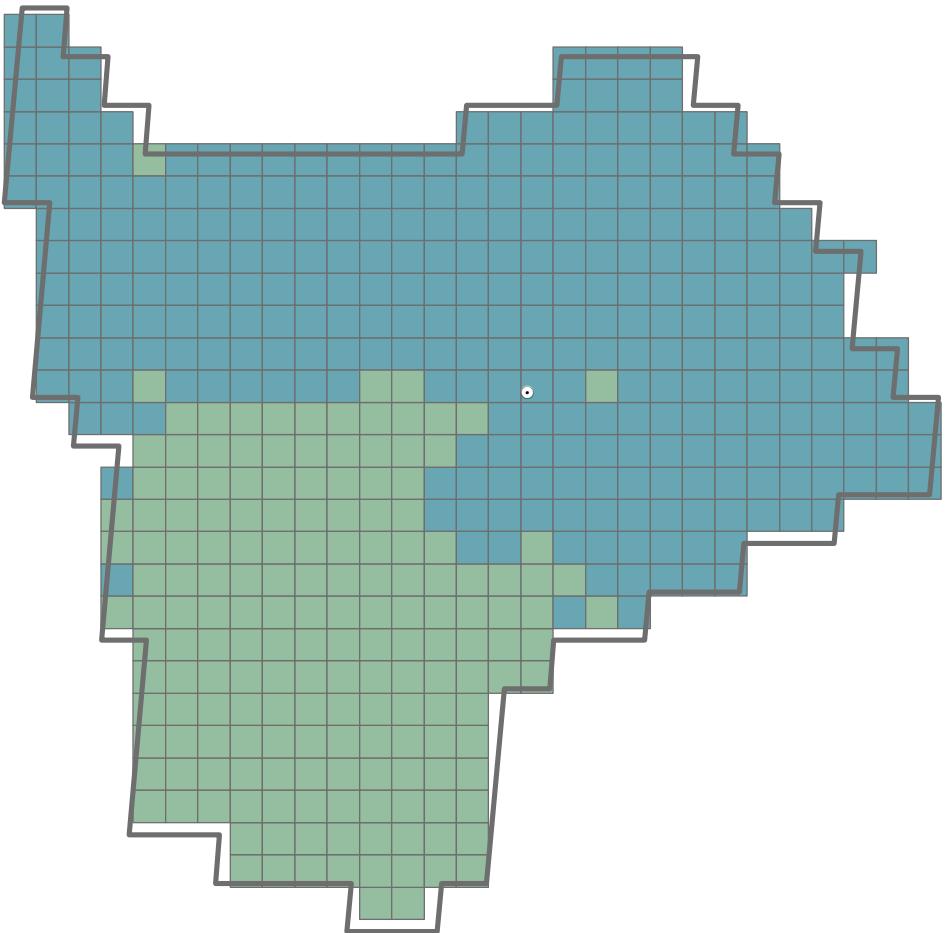
Yufei Wei, 09 March 2022



11 20'0"E

11 30'0"E

RS-measured tropospheric vertical columns of NO<sub>2</sub> of  
Bolzano - Bozen, Italy  
eFUA\_ID: 3002  
at 1 km resolution



○ Central Business Districts (CBD)

◻ GHS-OECD Functional Urban Areas (GHS-FUA)

Annual mean tropospheric NO<sub>2</sub> columns in  $\mu\text{mol}/\text{m}^2$

NO2Lev

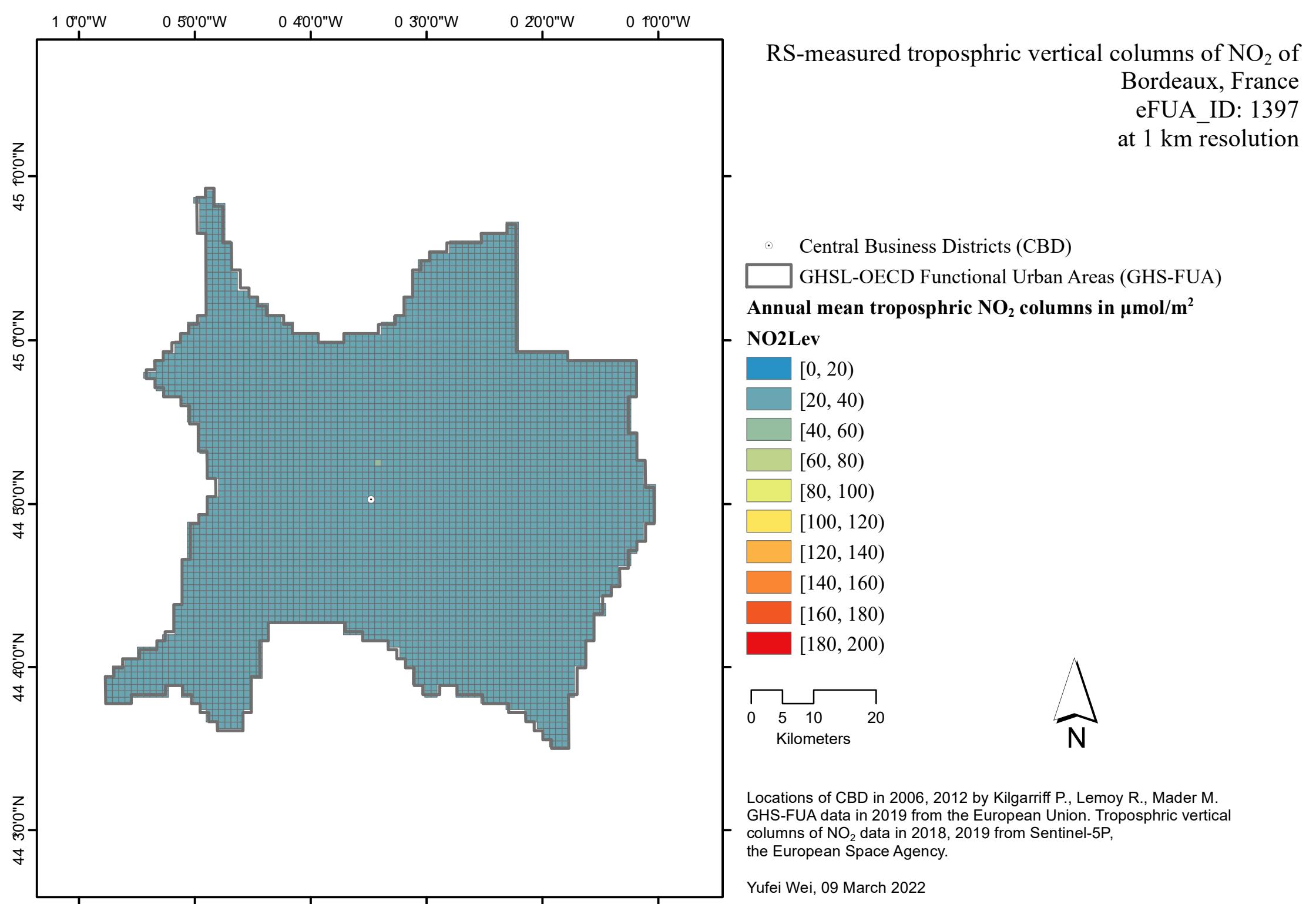
- [0, 20)
- [20, 40)
- [40, 60)
- [60, 80)
- [80, 100)
- [100, 120)
- [120, 140)
- [140, 160)
- [160, 180)
- [180, 200)

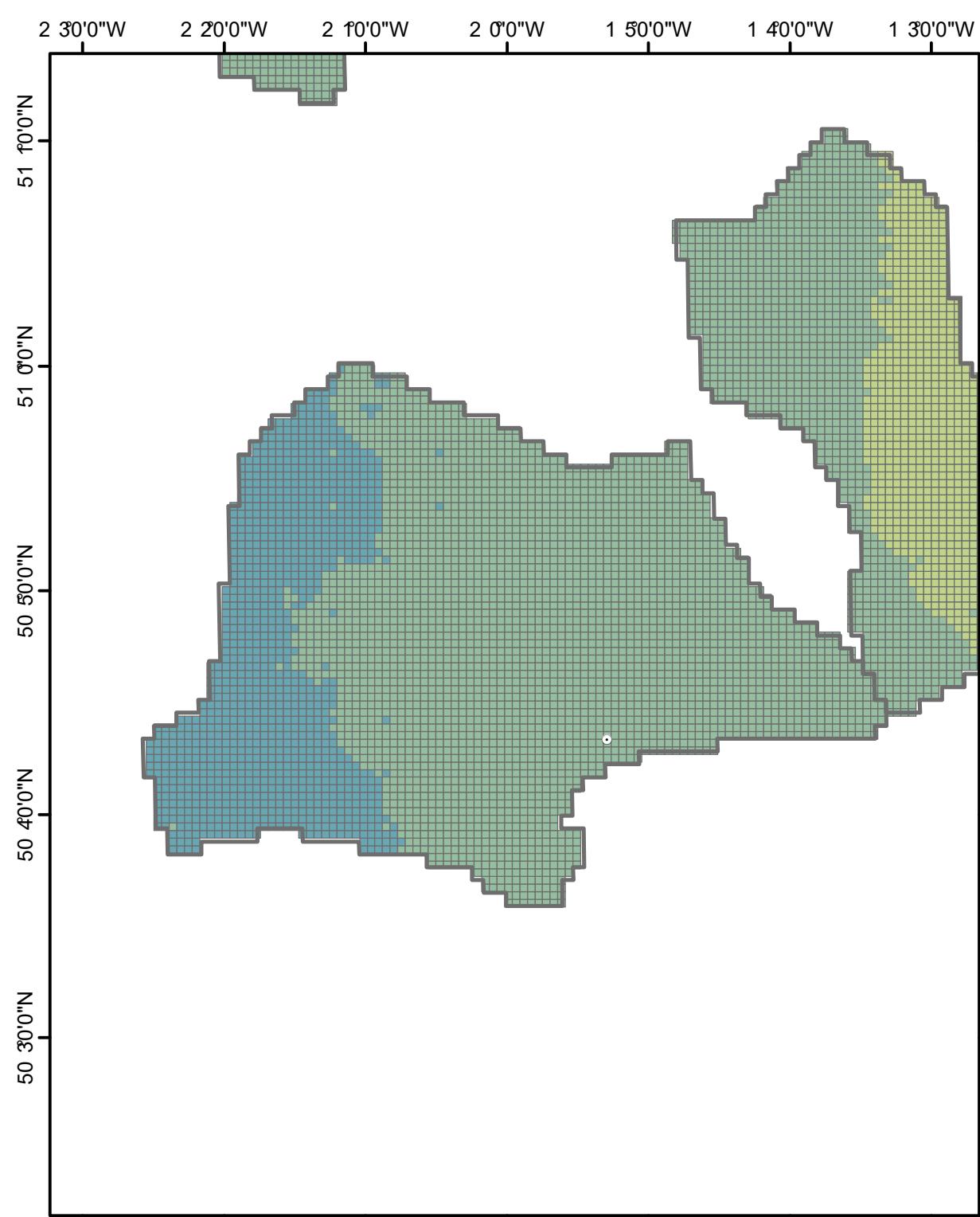
0 2.5 5 10  
Kilometers



Locations of CBD in 2006, 2012 by Kilgarriff P., Lemoy R., Mader M.  
GHS-FUA data in 2019 from the European Union. Tropospheric vertical  
columns of NO<sub>2</sub> data in 2018, 2019 from Sentinel-5P,  
the European Space Agency.

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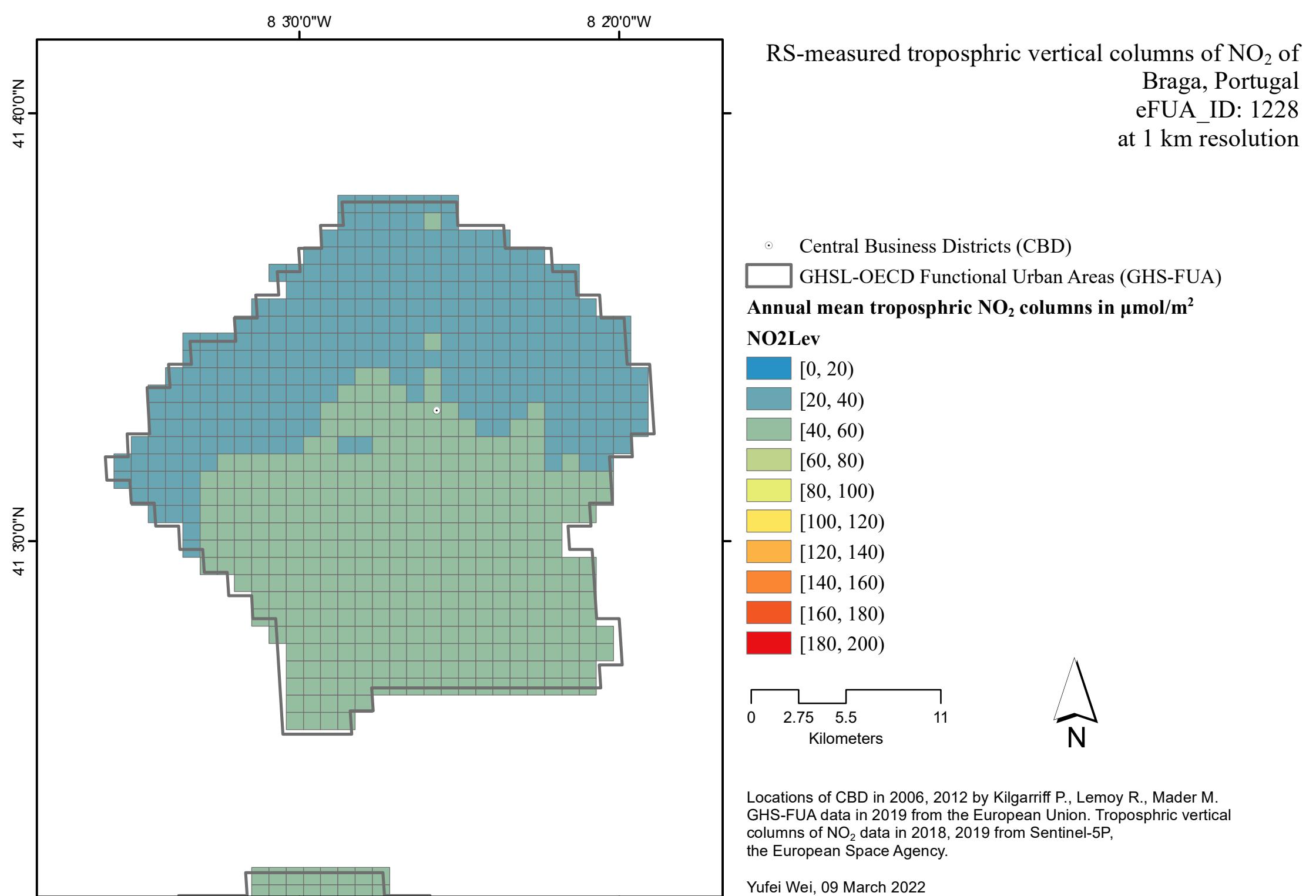




RS-measured tropospheric vertical columns of NO<sub>2</sub> of  
Bournemouth, United Kingdom  
eFUA\_ID: 3912  
at 1 km resolution

Locations of CBD in 2006, 2012 by Kilgarriff P., Lemoy R., Mader M.  
GHS-FUA data in 2019 from the European Union. Tropospheric vertical  
columns of NO<sub>2</sub> data in 2018, 2019 from Sentinel-5P,  
the European Space Agency.

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28 0°0"E

28 10'0"E

RS-measured tropospheric vertical columns of NO<sub>2</sub> of  
Braila, Romania  
eFUA\_ID: 2727  
at 1 km resolution

45 20'0"N

45 10'0"N

○ Central Business Districts (CBD)

◻ GHSL-OECD Functional Urban Areas (GHS-FUA)

Annual mean tropospheric NO<sub>2</sub> columns in  $\mu\text{mol}/\text{m}^2$

NO2Lev

[0, 20)

[20, 40)

[40, 60)

[60, 80)

[80, 100)

[100, 120)

[120, 140)

[140, 160)

[160, 180)

[180, 200)

0 2.75 5.5 11  
Kilometers



Locations of CBD in 2006, 2012 by Kilgarriff P., Lemoy R., Mader M.  
GHS-FUA data in 2019 from the European Union. Tropospheric vertical  
columns of NO<sub>2</sub> data in 2018, 2019 from Sentinel-5P,  
the European Space Agency.

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17 0'0"E

17 10'0"E

17 20'0"E

17 30'0"E

RS-measured tropospheric vertical columns of NO<sub>2</sub> of  
Bratislava, Slovakia  
eFUA\_ID: 163  
at 1 km resolution

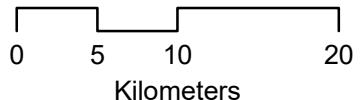
48 20'0"N  
48 10'0"N  
48 0'0"N

○ Central Business Districts (CBD)  
◻ GHS-OECD Functional Urban Areas (GHS-FUA)

**Annual mean tropospheric NO<sub>2</sub> columns in  $\mu\text{mol}/\text{m}^2$**

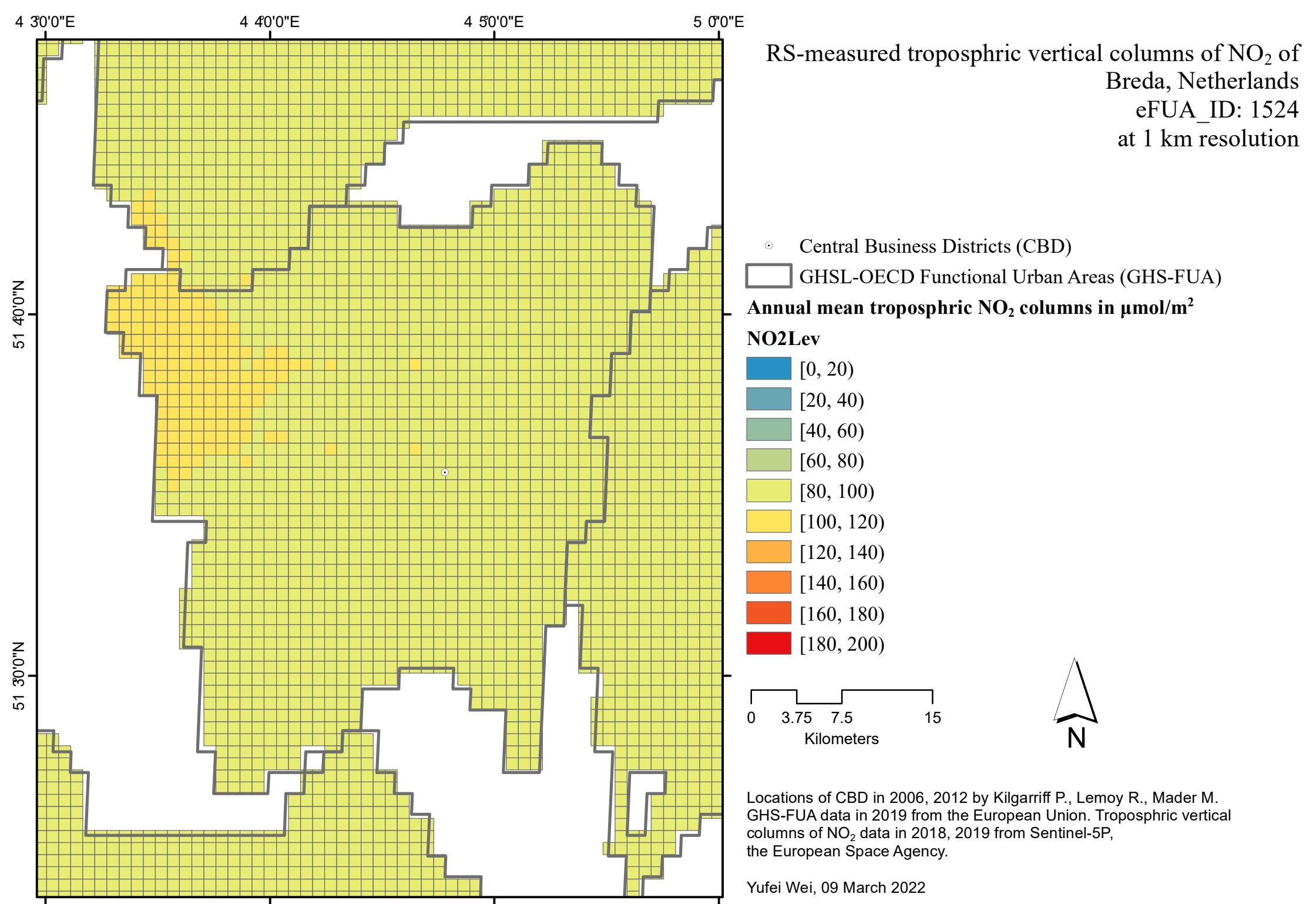
**NO2Lev**

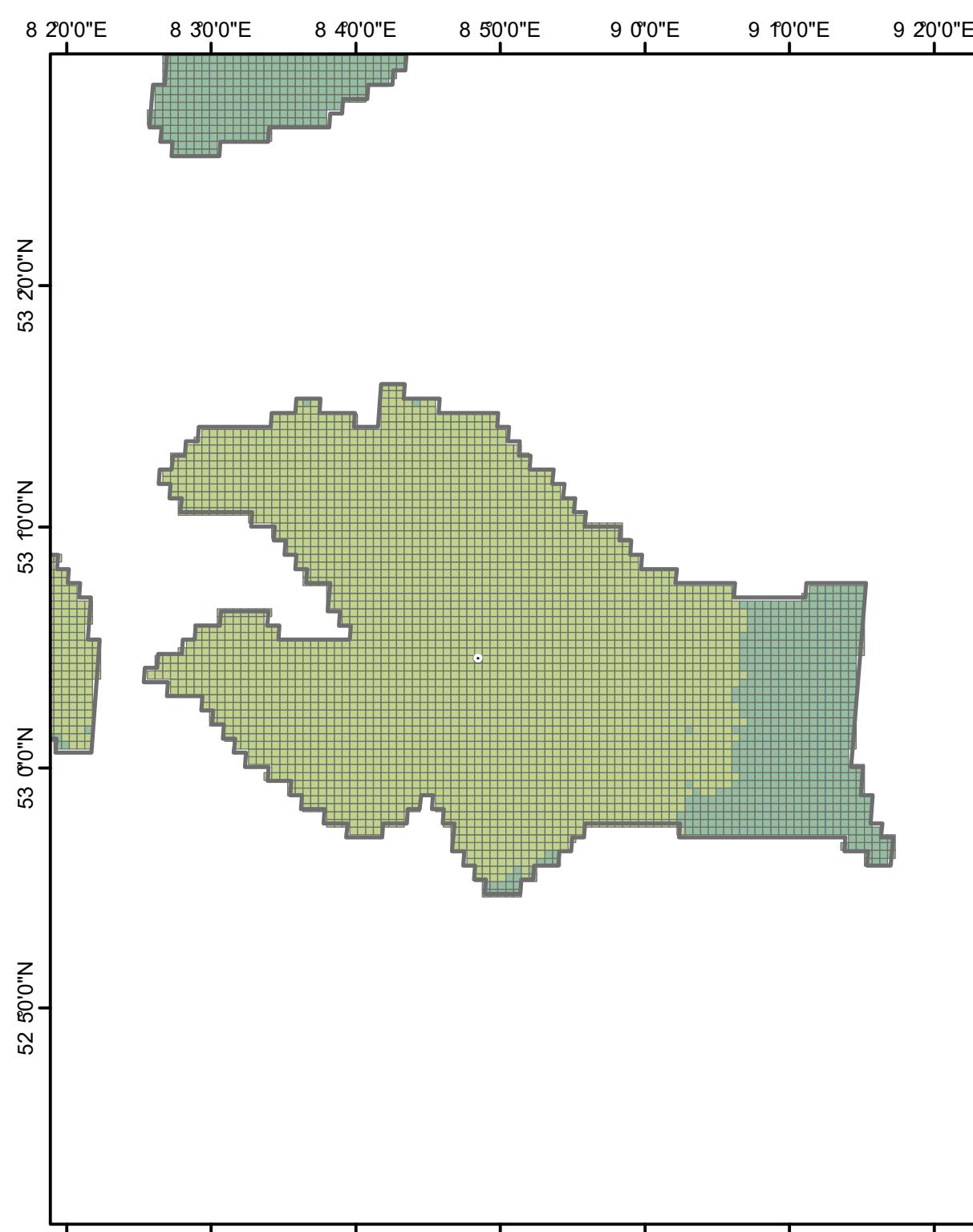
[0, 20)
[20, 40)
[40, 60)
[60, 80)
[80, 100)
[100, 120)
[120, 140)
[140, 160)
[160, 180)
[180, 200)



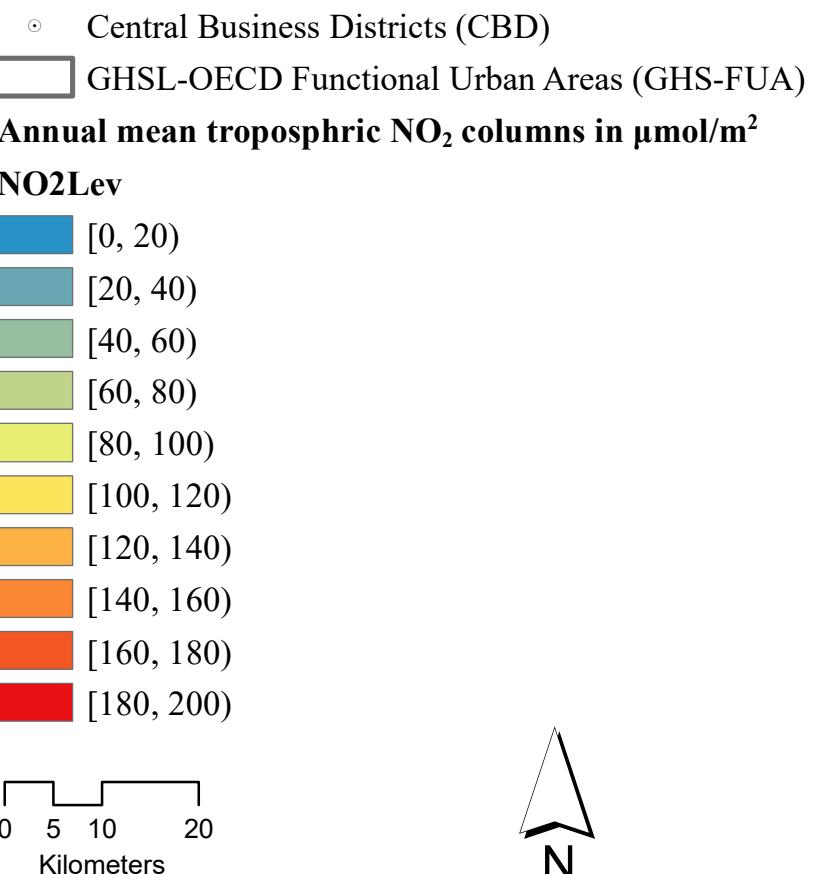
Locations of CBD in 2006, 2012 by Kilgarriff P., Lemoy R., Mader M.  
GHS-FUA data in 2019 from the European Union. Tropospheric vertical  
columns of NO<sub>2</sub> data in 2018, 2019 from Sentinel-5P,  
the European Space Agency.

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RS-measured tropospheric vertical columns of NO<sub>2</sub> of  
Bremen, Germany  
eFUA\_ID: 2877  
at 1 km resolution



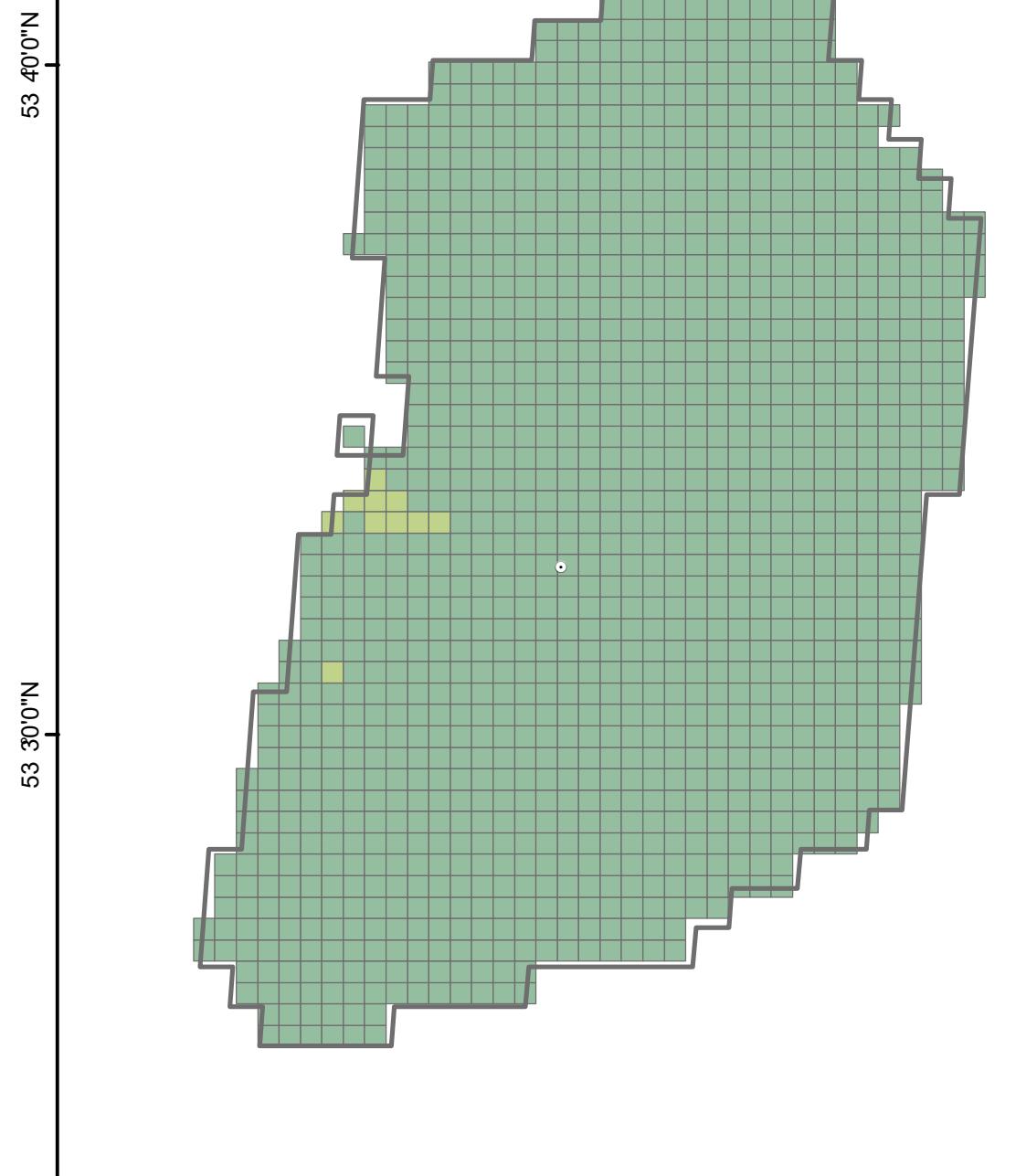
Locations of CBD in 2006, 2012 by Kilgarriff P., Lemoy R., Mader M.  
GHS-FUA data in 2019 from the European Union. Tropospheric vertical  
columns of NO<sub>2</sub> data in 2018, 2019 from Sentinel-5P,  
the European Space Agency.

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8 30'0"E

8 40'0"E

RS-measured tropospheric vertical columns of NO<sub>2</sub> of  
Bremerhaven, Germany  
eFUA\_ID: 2501  
at 1 km resolution



Locations of CBD in 2006, 2012 by Kilgarriff P., Lemoy R., Mader M.  
GHS-FUA data in 2019 from the European Union. Tropospheric vertical  
columns of NO<sub>2</sub> data in 2018, 2019 from Sentinel-5P,  
the European Space Agency.

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10 0'0"E

10 10'0"E

10 20'0"E

45 40'0"N

45 30'0"N

45 20'0"N

RS-measured tropospheric vertical columns of NO<sub>2</sub> of  
Brescia, Italy  
eFUA\_ID: 2312  
at 1 km resolution

○ Central Business Districts (CBD)

◻ GHSL-OECD Functional Urban Areas (GHS-FUA)

Annual mean tropospheric NO<sub>2</sub> columns in  $\mu\text{mol}/\text{m}^2$

NO2Lev

[0, 20)

[20, 40)

[40, 60)

[60, 80)

[80, 100)

[100, 120)

[120, 140)

[140, 160)

[160, 180)

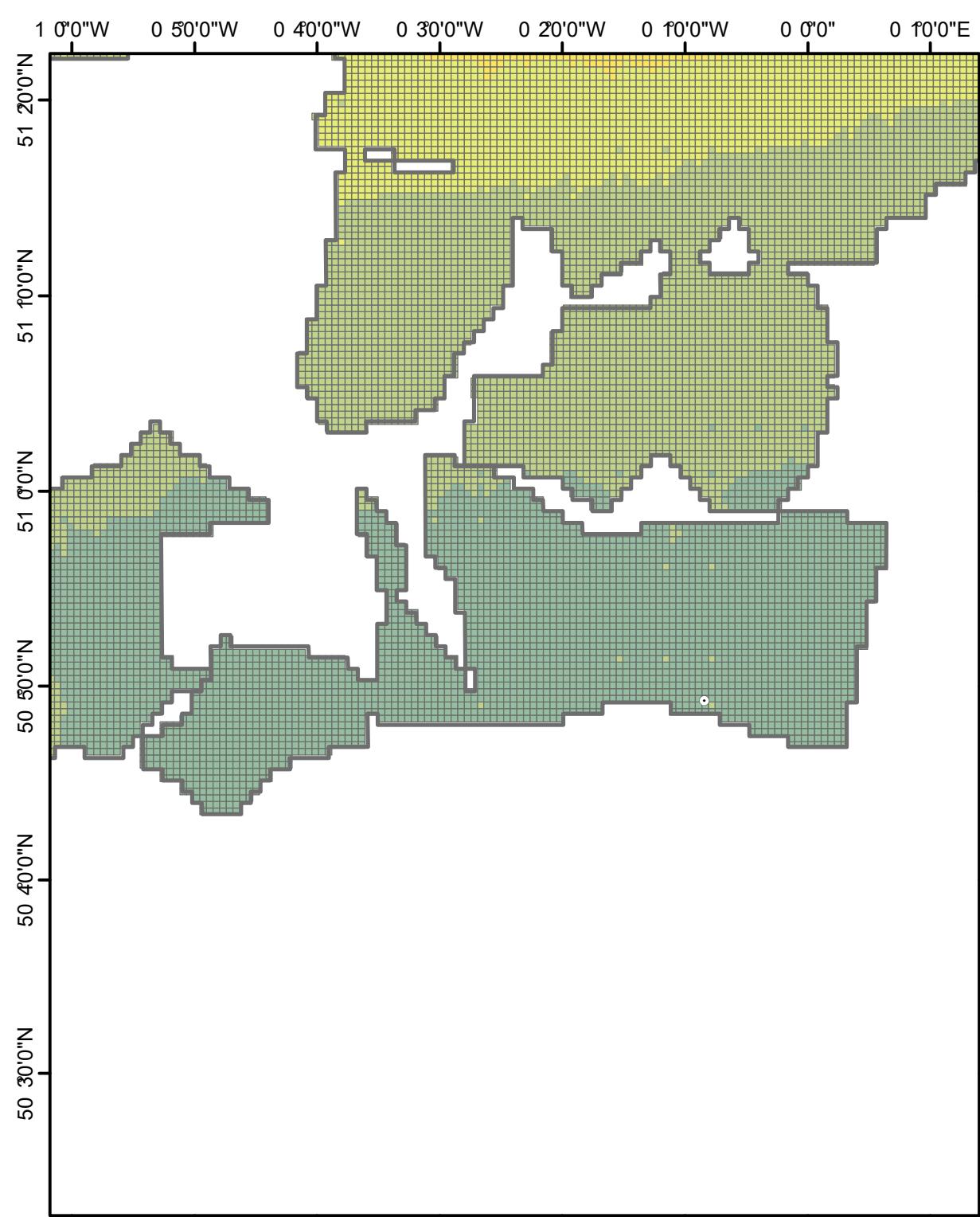
[180, 200)

0 4 8 16  
Kilometers

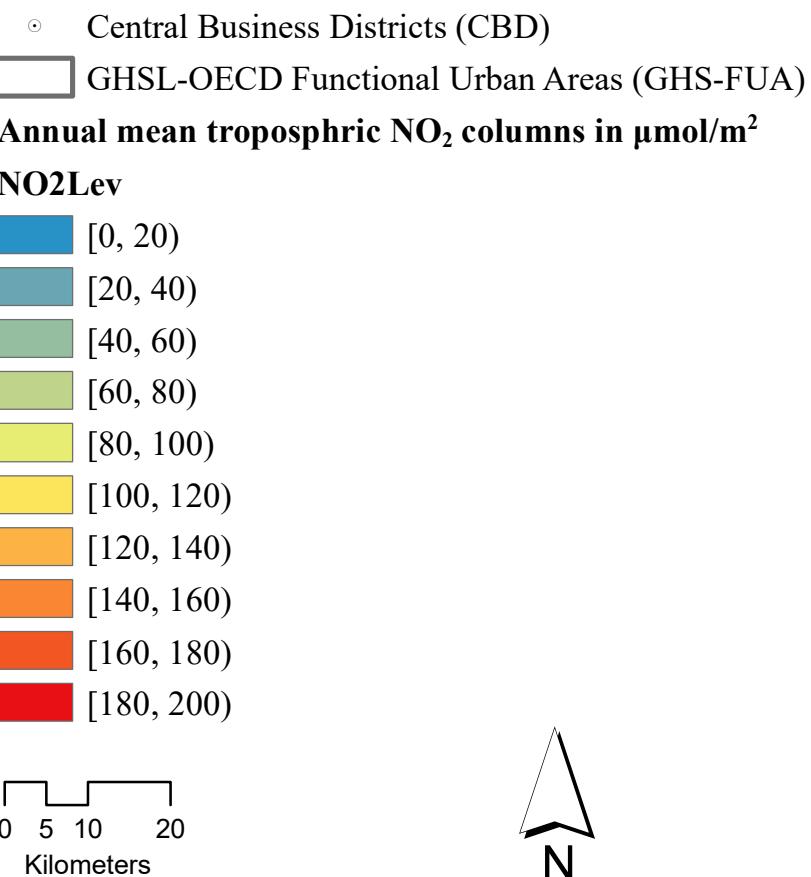


Locations of CBD in 2006, 2012 by Kilgarriff P., Lemoy R., Mader M.  
GHS-FUA data in 2019 from the European Union. Tropospheric vertical  
columns of NO<sub>2</sub> data in 2018, 2019 from Sentinel-5P,  
the European Space Agency.

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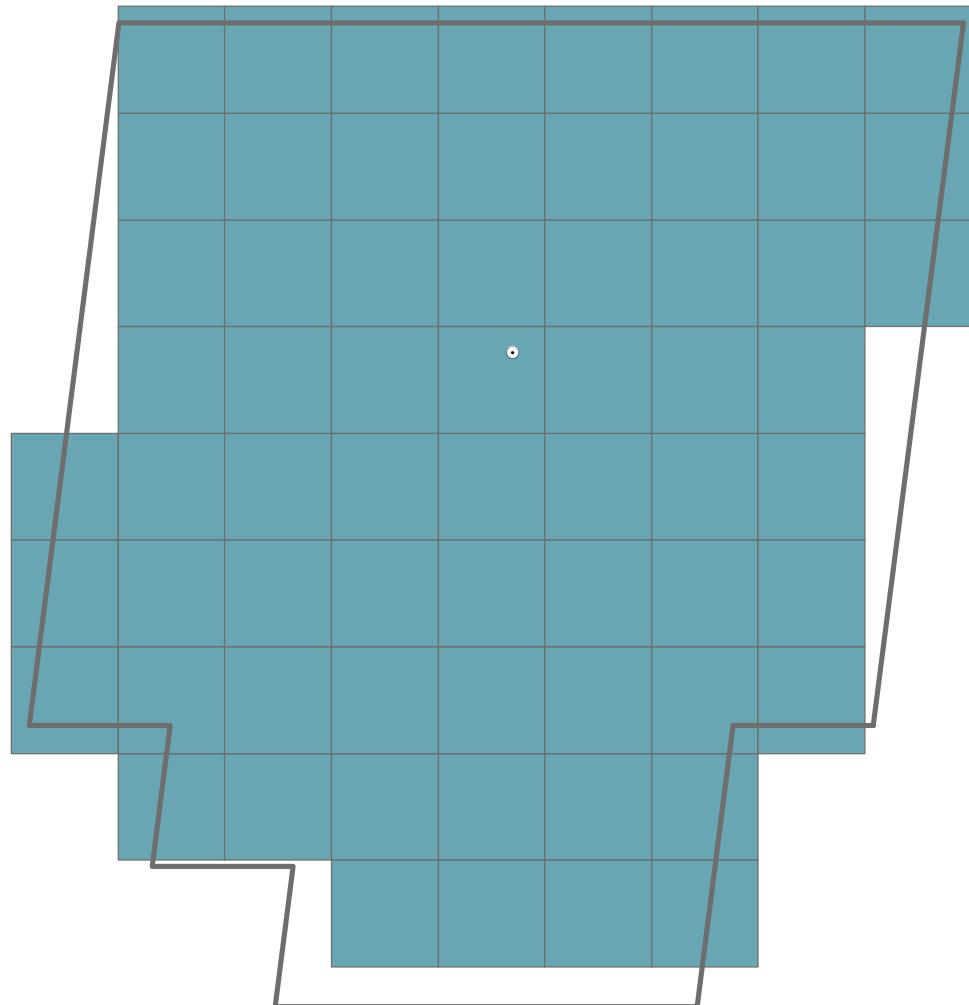


RS-measured tropospheric vertical columns of NO<sub>2</sub> of  
Brighton, United Kingdom  
eFUA\_ID: 5406  
at 1 km resolution

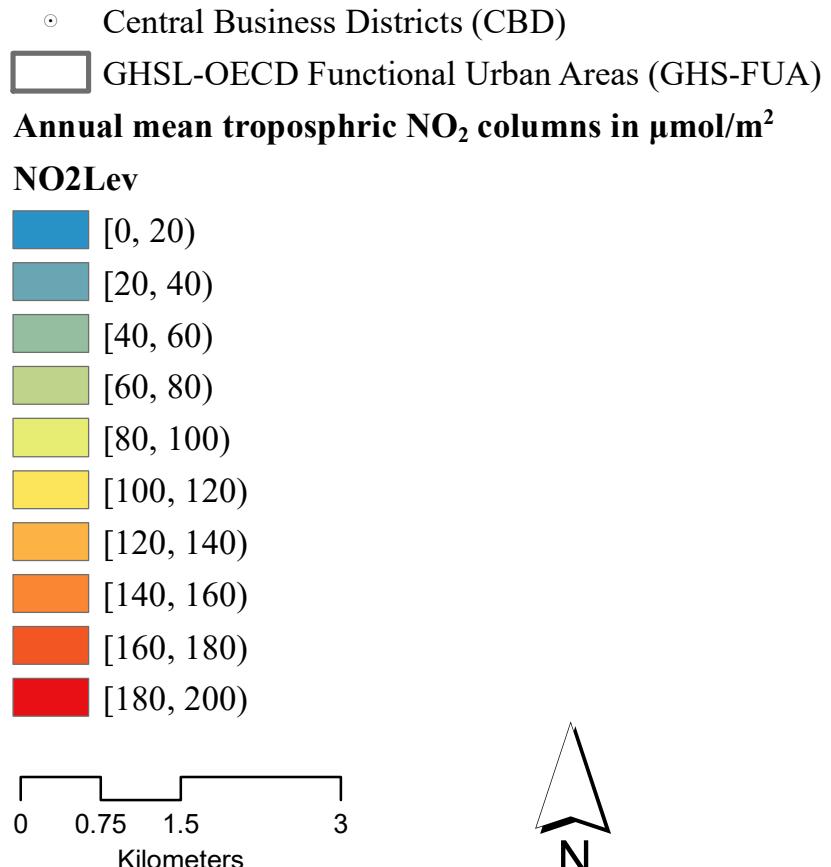


Locations of CBD in 2006, 2012 by Kilgarriff P., Lemoy R., Mader M.  
GHS-FUA data in 2019 from the European Union. Tropospheric vertical  
columns of NO<sub>2</sub> data in 2018, 2019 from Sentinel-5P,  
the European Space Agency.

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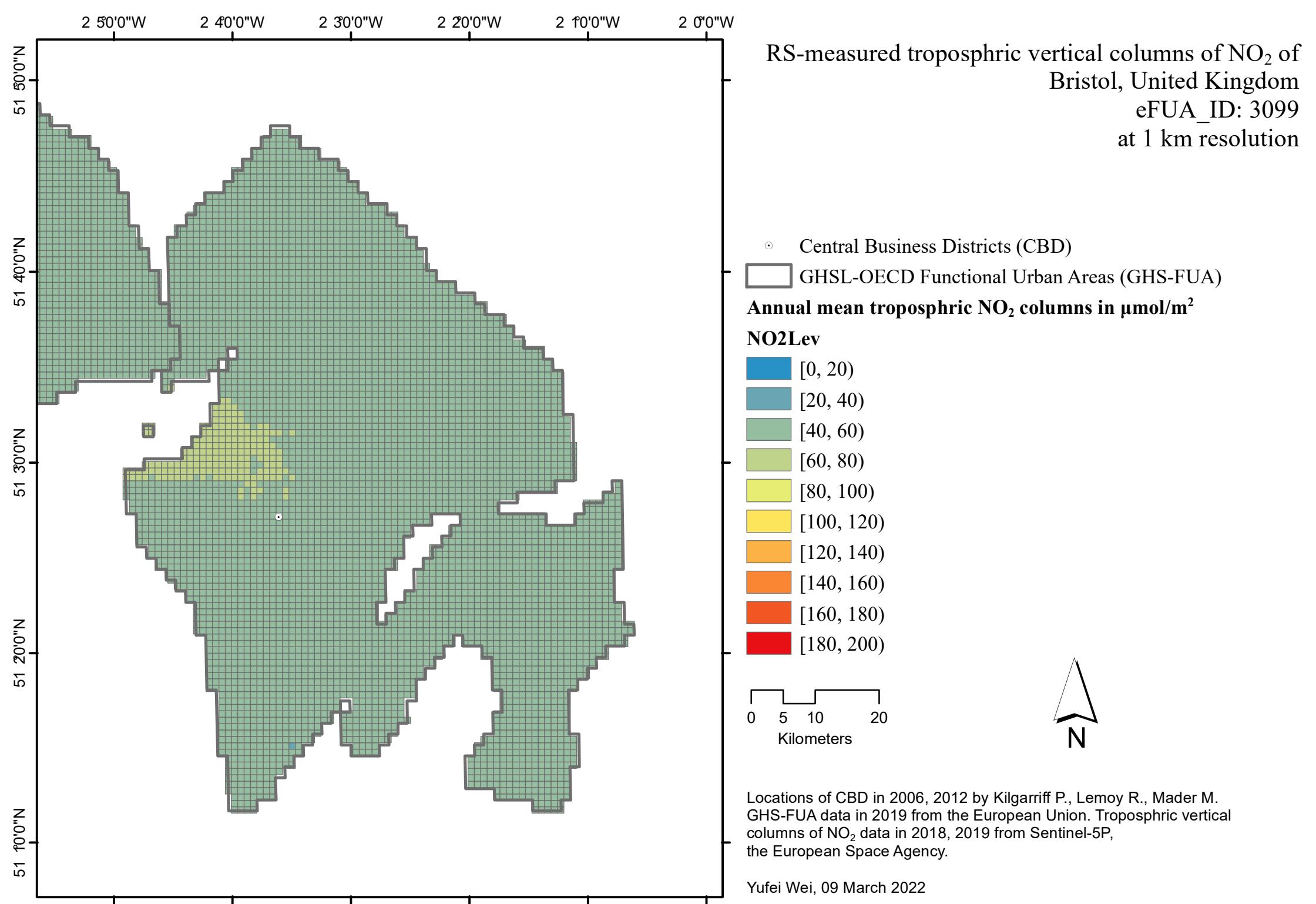


RS-measured tropospheric vertical columns of NO<sub>2</sub> of  
Brindisi, Italy  
eFUA\_ID: 5051  
at 1 km resolution



Locations of CBD in 2006, 2012 by Kilgarriff P., Lemoy R., Mader M.  
GHS-FUA data in 2019 from the European Union. Tropospheric vertical  
columns of NO<sub>2</sub> data in 2018, 2019 from Sentinel-5P,  
the European Space Agency.

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16 20'0"E

16 30'0"E

16 40'0"E

16 50'0"E

17 0'0"E

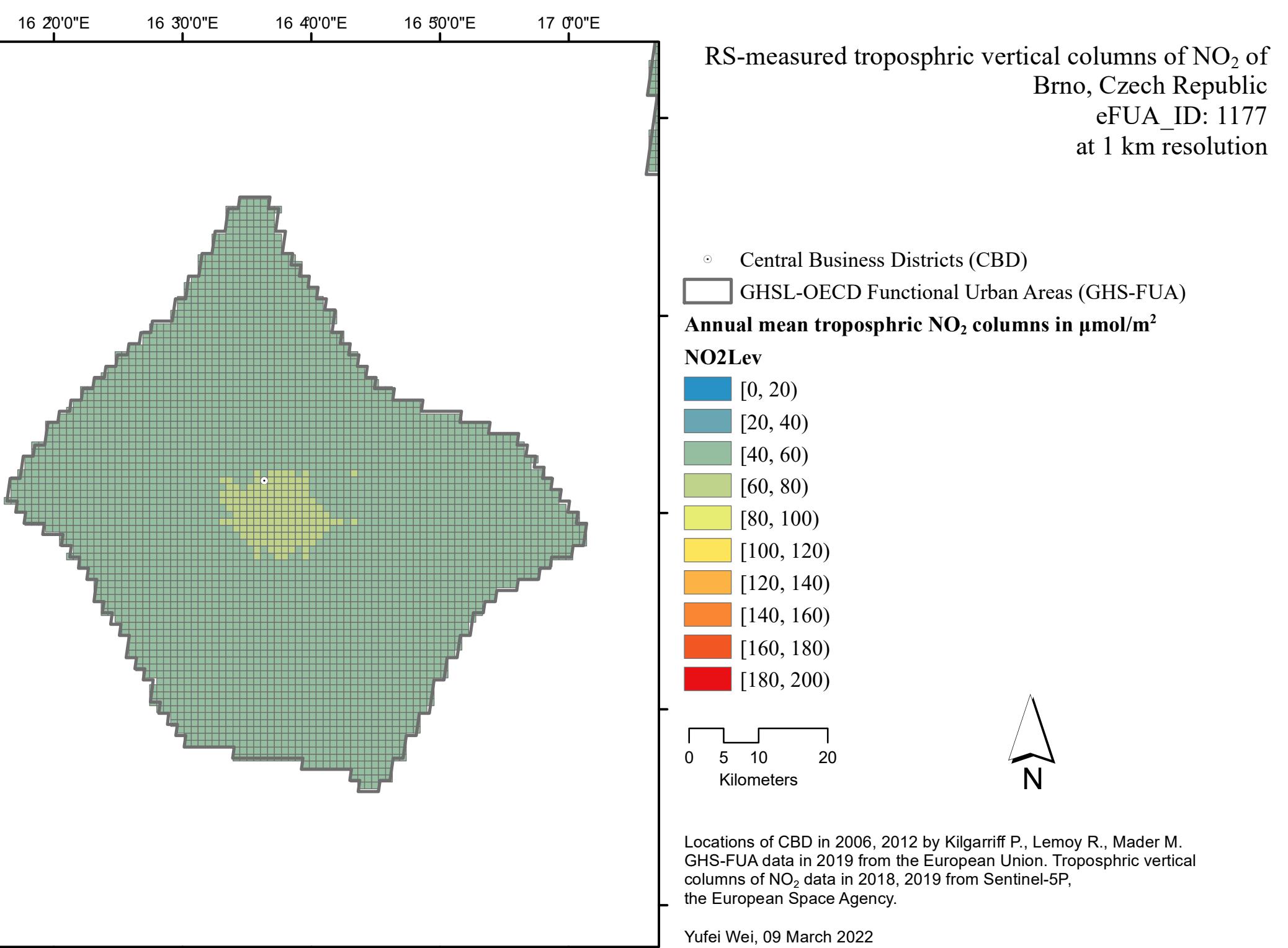
49 30'0"N

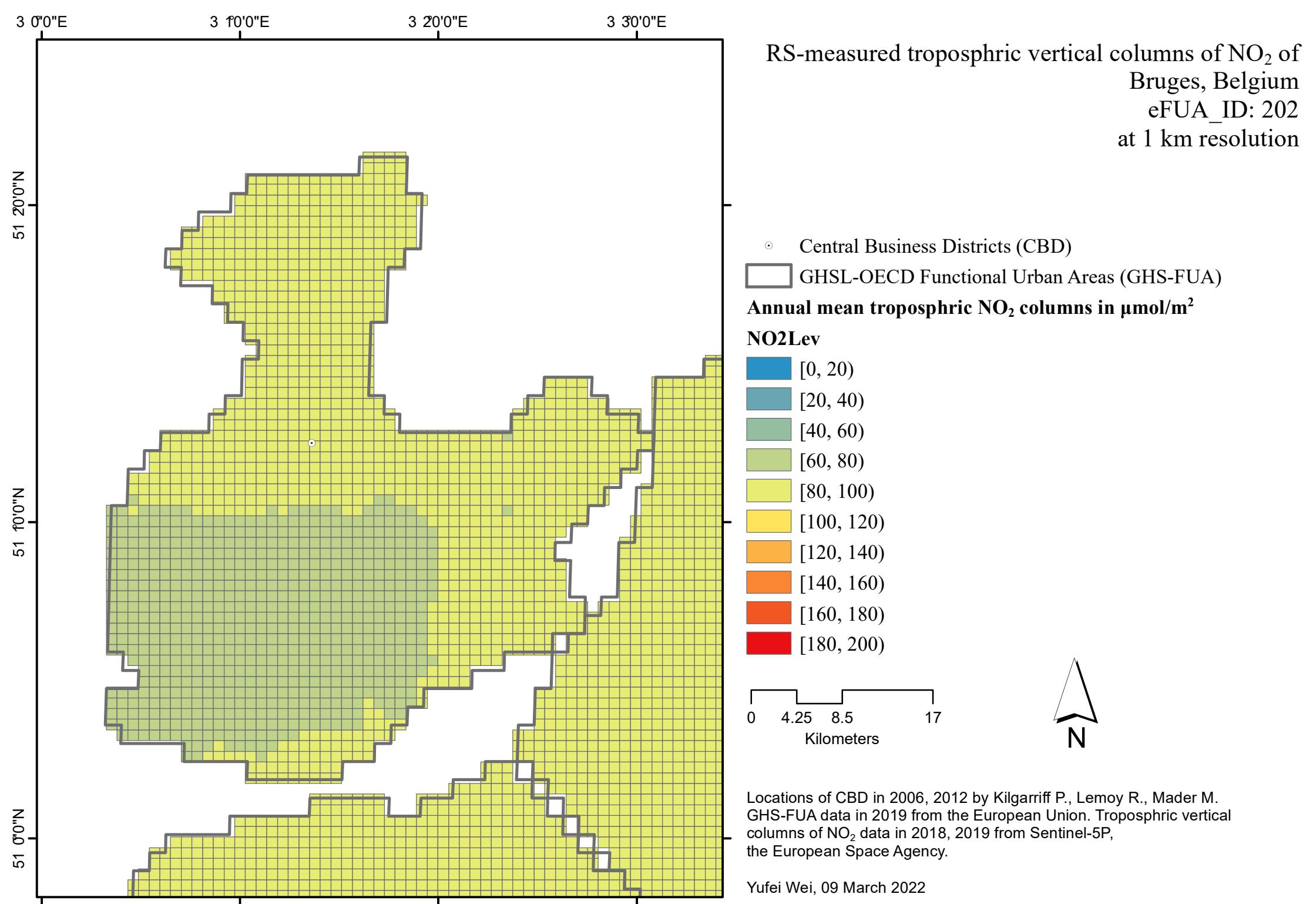
49 20'0"N

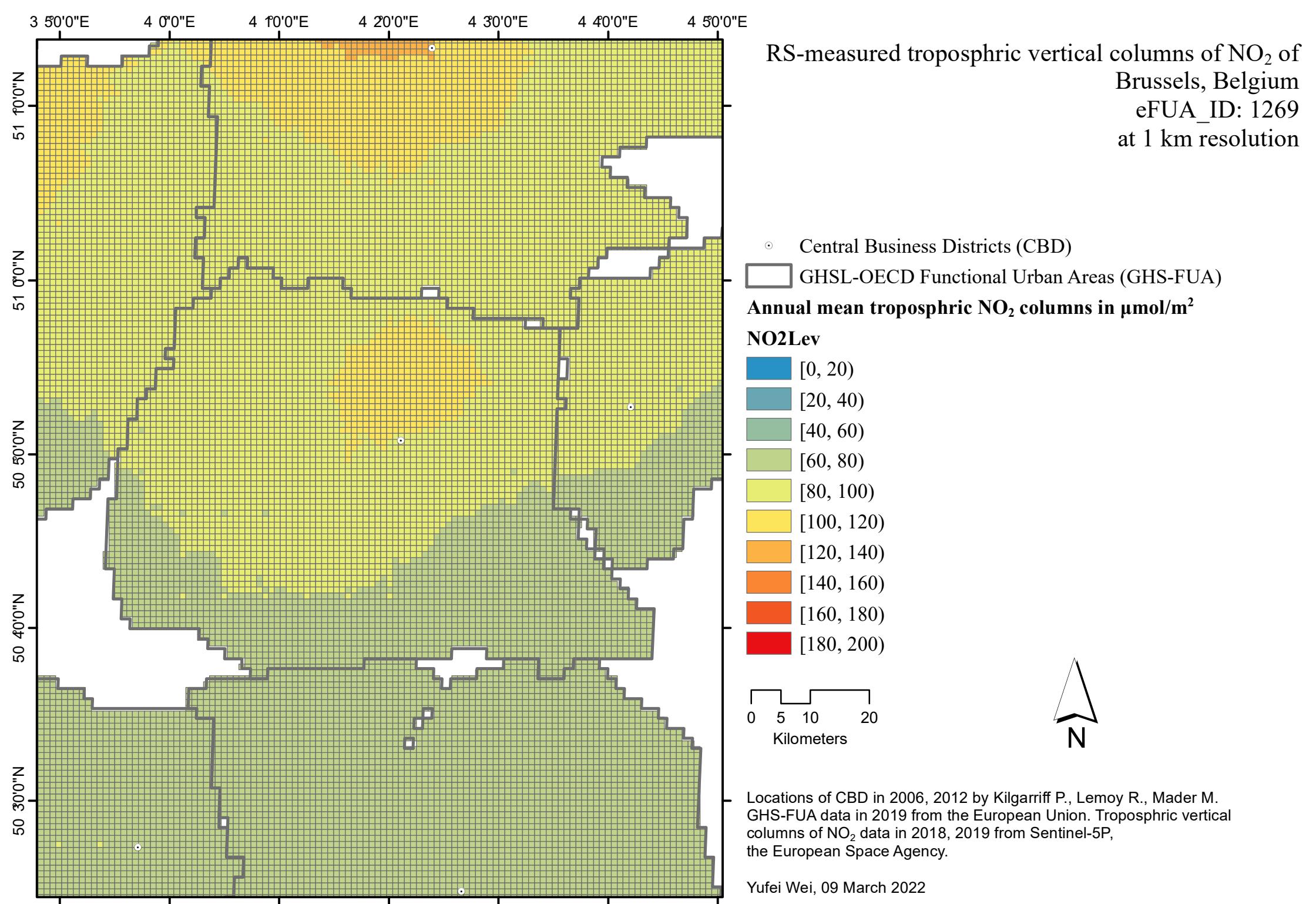
49 10'0"N

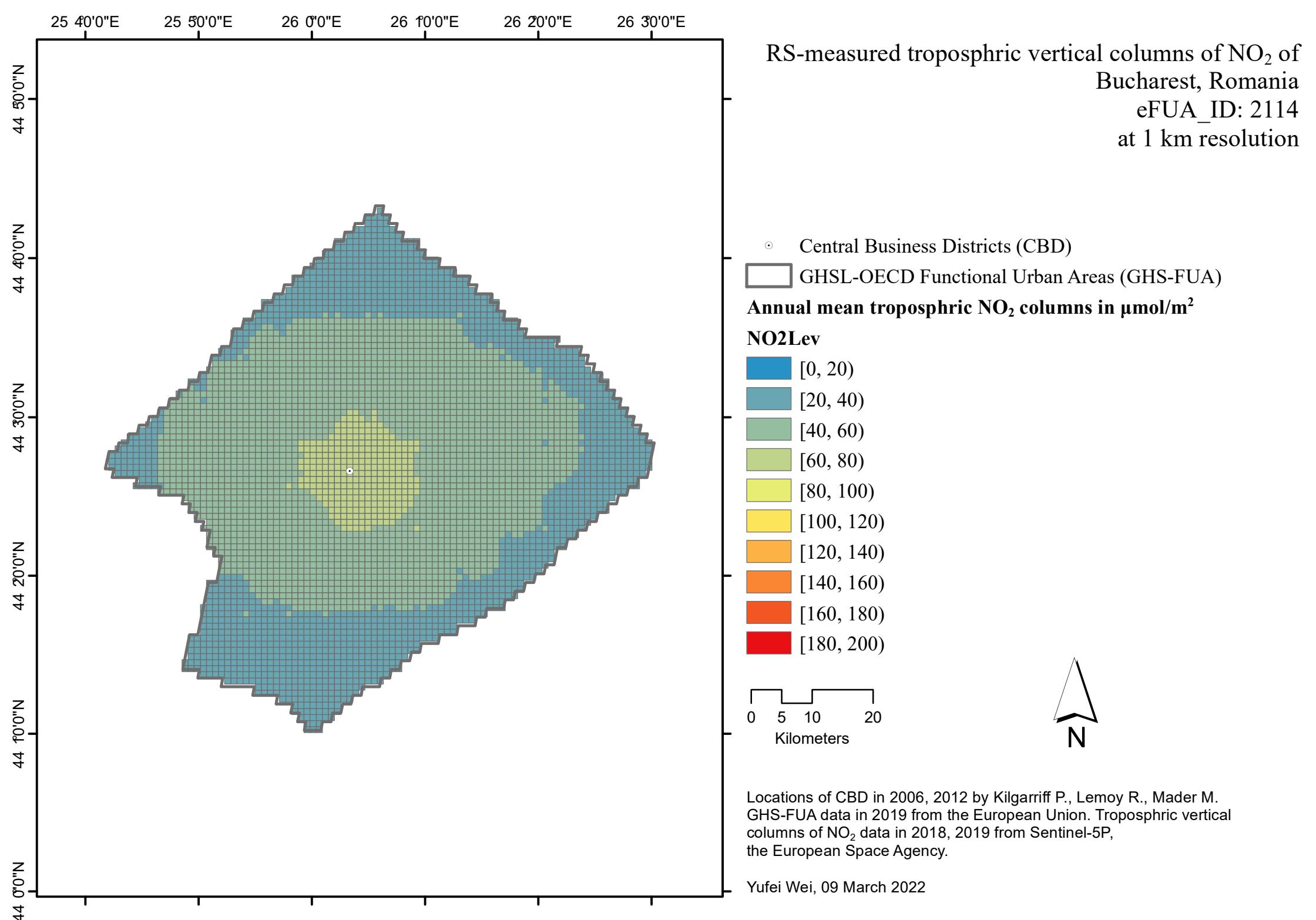
49 0'0"N

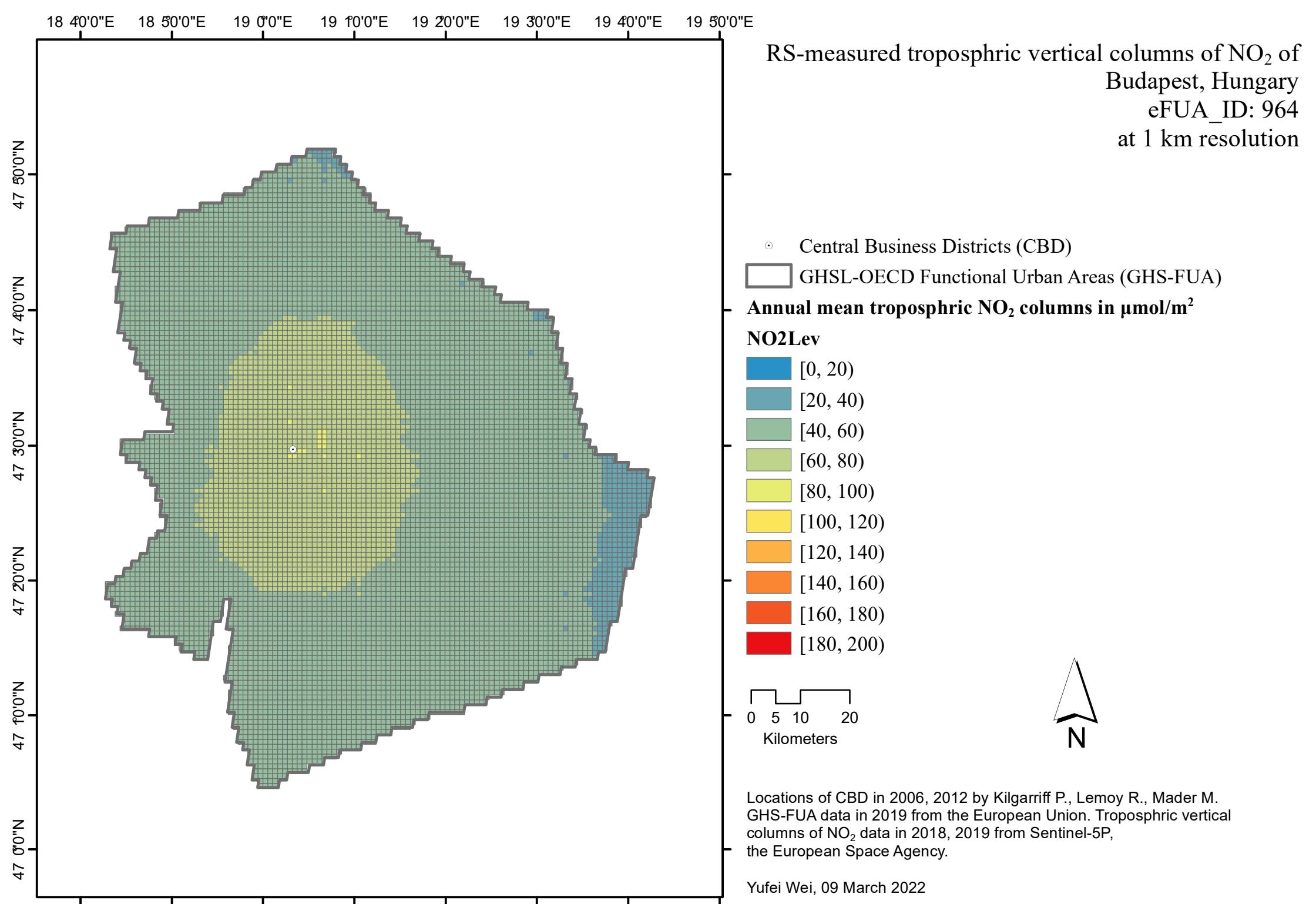
48 50'0"N







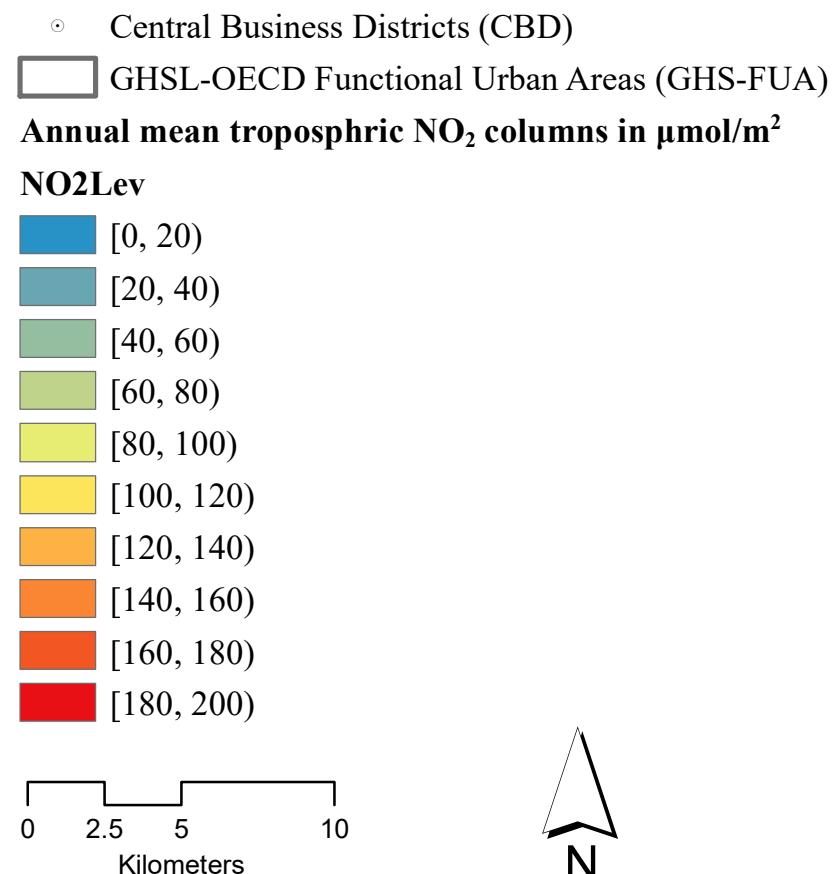
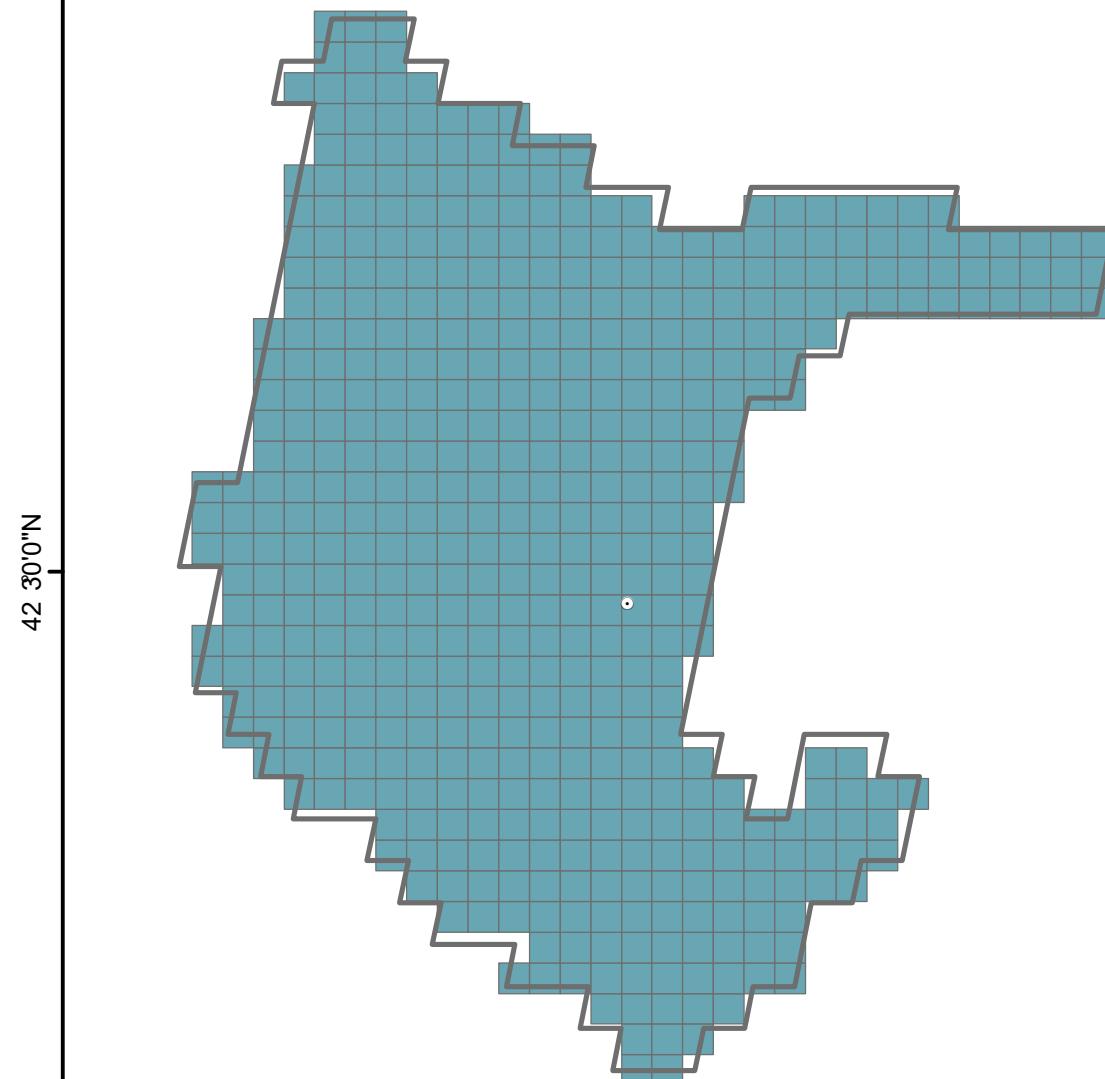




27 20'0"E

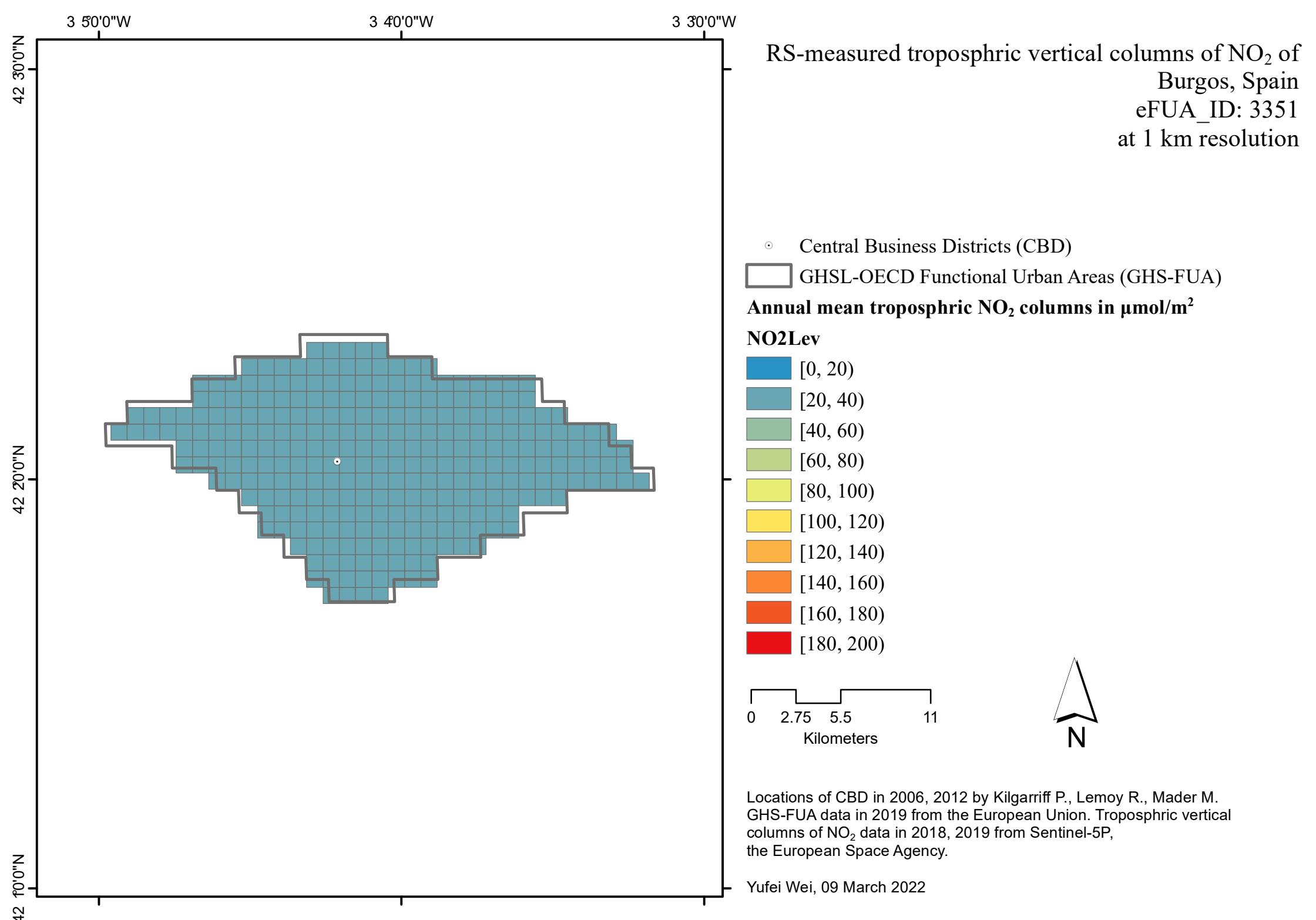
27 30'0"E

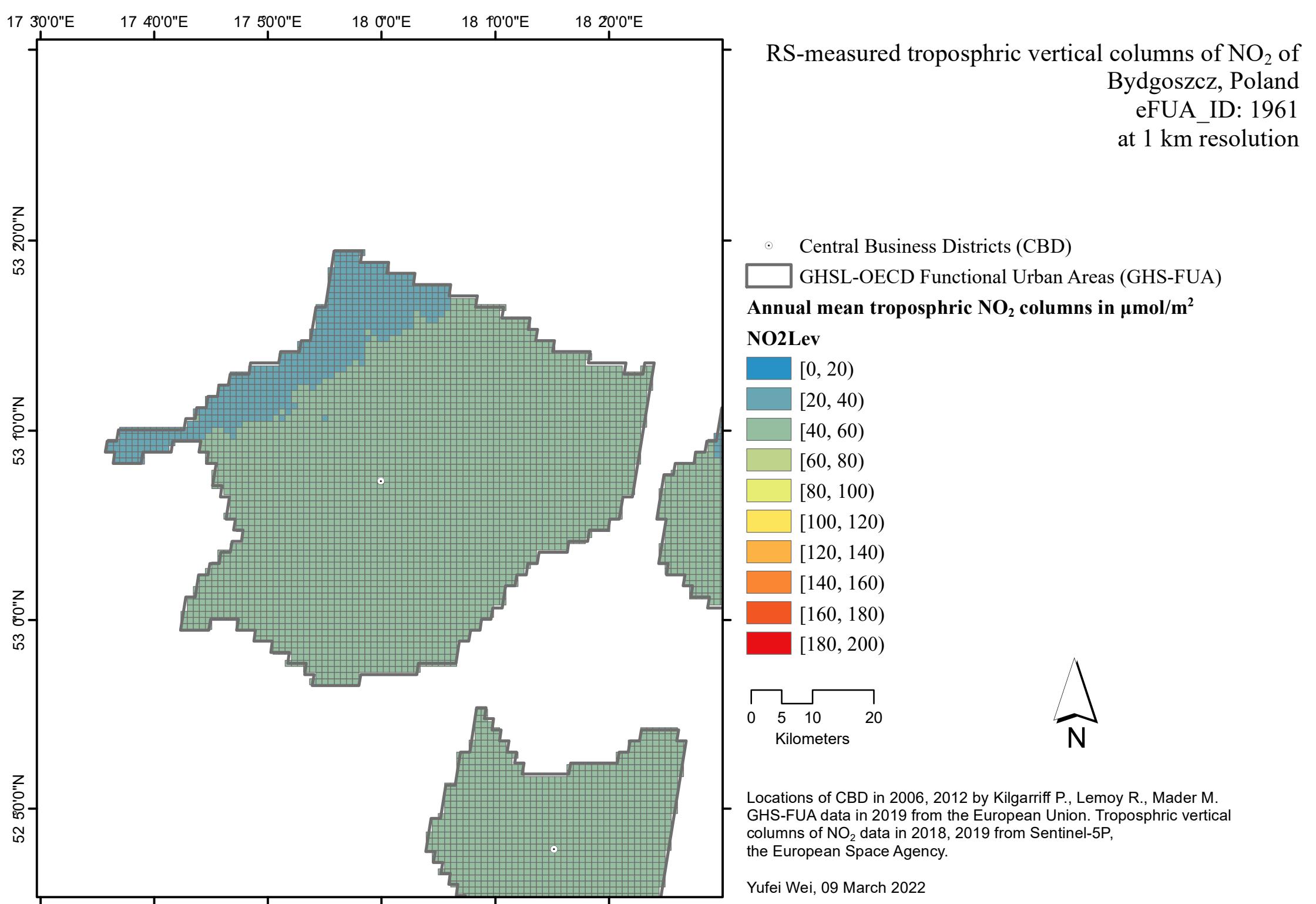
RS-measured tropospheric vertical columns of NO<sub>2</sub> of  
Burgas, Bulgaria  
eFUA\_ID: 797  
at 1 km resolution



Locations of CBD in 2006, 2012 by Kilgarriff P., Lemoy R., Mader M.  
GHS-FUA data in 2019 from the European Union. Tropospheric vertical  
columns of NO<sub>2</sub> data in 2018, 2019 from Sentinel-5P,  
the European Space Agency.

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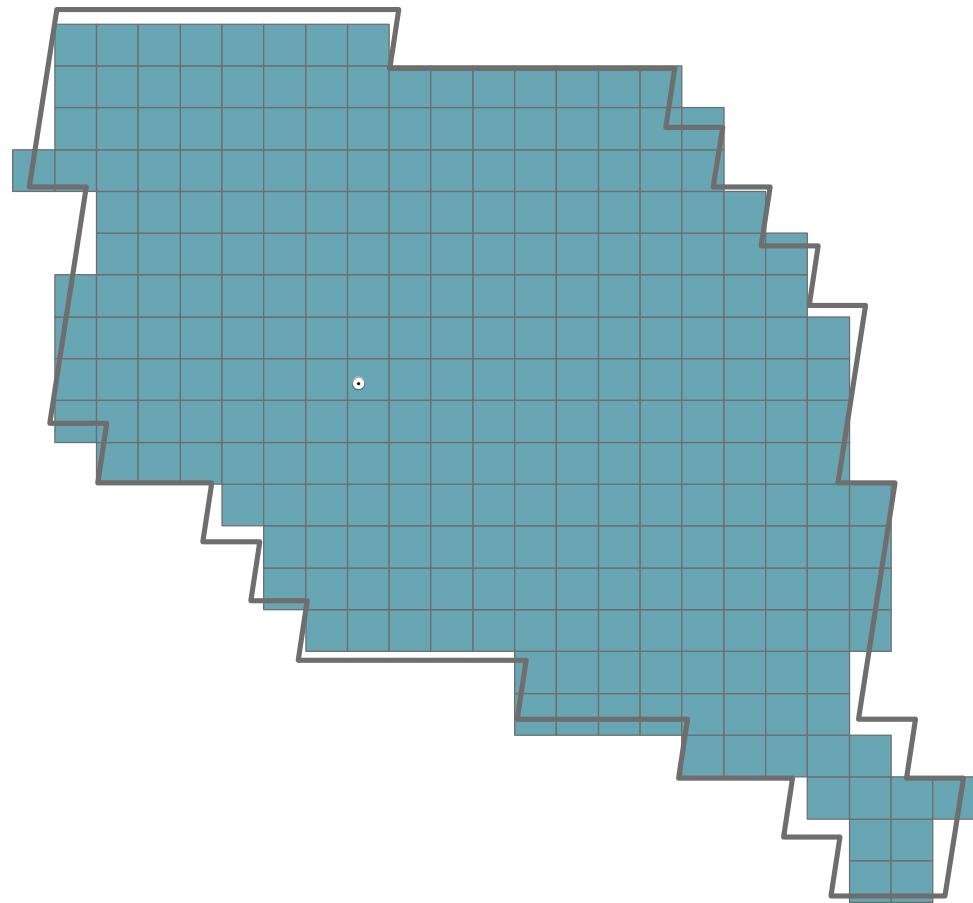




20 20'0"E

20 30'0"E

RS-measured tropospheric vertical columns of NO<sub>2</sub> of  
Cacak, Serbia  
eFUA\_ID: 890  
at 1 km resolution



○ Central Business Districts (CBD)

◻ GHSL-OECD Functional Urban Areas (GHS-FUA)

Annual mean tropospheric NO<sub>2</sub> columns in μmol/m<sup>2</sup>

NO2Lev

- [0, 20]
- [20, 40]
- [40, 60]
- [60, 80]
- [80, 100]
- [100, 120]
- [120, 140]
- [140, 160]
- [160, 180]
- [180, 200]

0 1.75 3.5 7  
Kilometers



Locations of CBD in 2006, 2012 by Kilgarriff P., Lemoy R., Mader M.  
GHS-FUA data in 2019 from the European Union. Tropospheric vertical  
columns of NO<sub>2</sub> data in 2018, 2019 from Sentinel-5P,  
the European Space Agency.

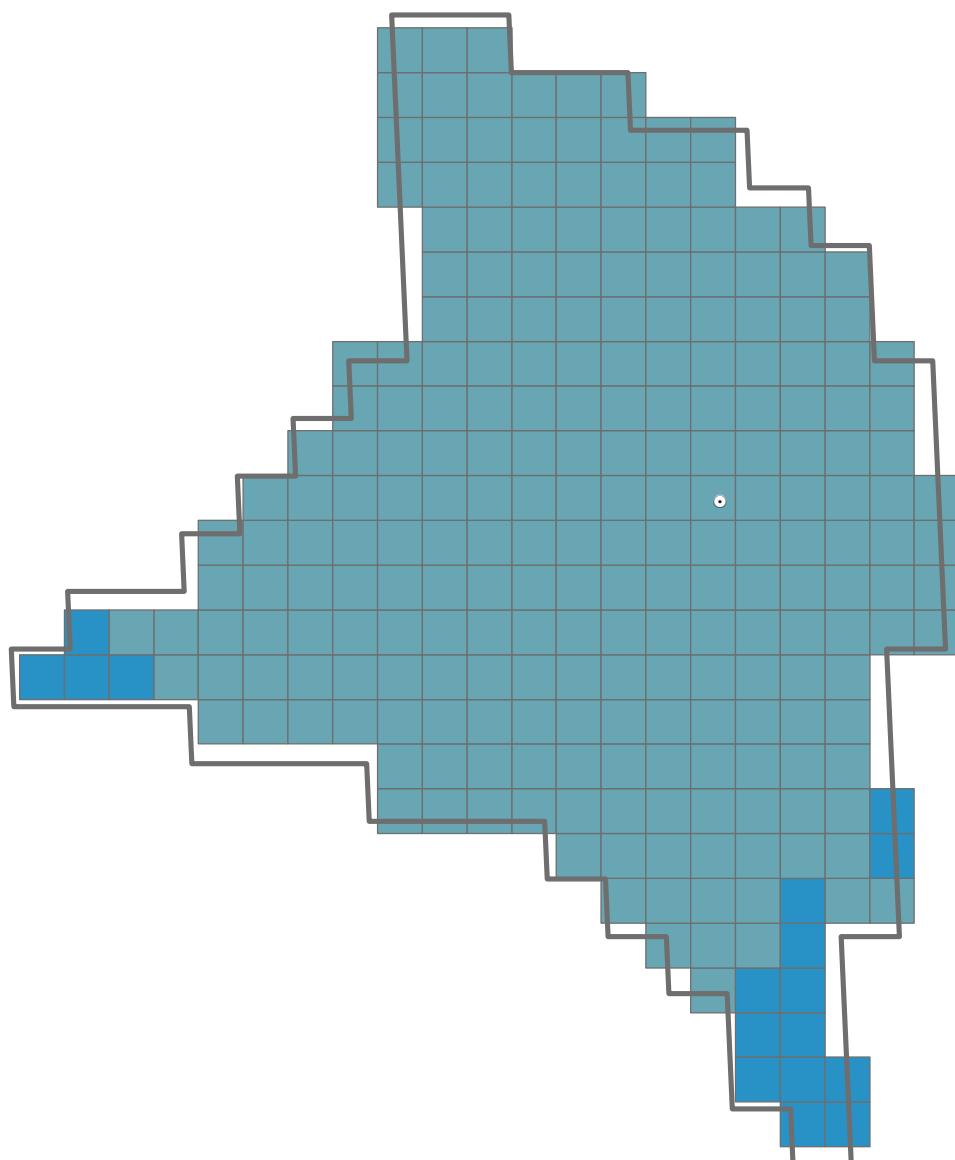
Yufei Wei, 09 March 2022

6 30'0"W

6 20'0"W

RS-measured tropospheric vertical columns of NO<sub>2</sub> of  
Caceres, Spain  
eFUA\_ID: 1766  
at 1 km resolution

39 30'0"N



○ Central Business Districts (CBD)

◻ GHSL-OECD Functional Urban Areas (GHS-FUA)

Annual mean tropospheric NO<sub>2</sub> columns in  $\mu\text{mol}/\text{m}^2$

NO2Lev

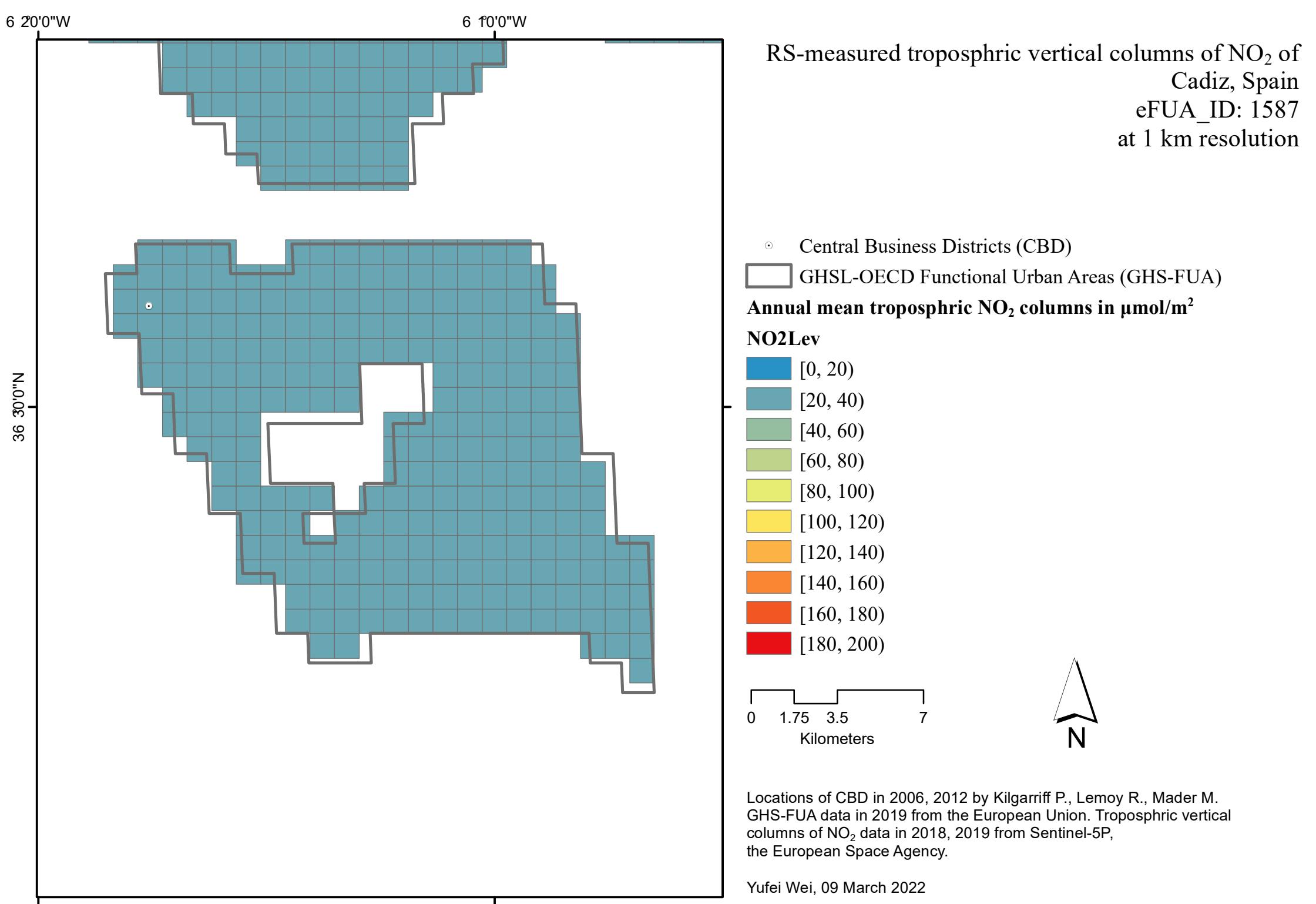
[0, 20)
[20, 40)
[40, 60)
[60, 80)
[80, 100)
[100, 120)
[120, 140)
[140, 160)
[160, 180)
[180, 200)

0 1.75 3.5 7  
Kilometers



Locations of CBD in 2006, 2012 by Kilgarriff P., Lemoy R., Mader M.  
GHS-FUA data in 2019 from the European Union. Tropospheric vertical  
columns of NO<sub>2</sub> data in 2018, 2019 from Sentinel-5P,  
the European Space Agency.

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0 40'0"W

0 30'0"W

0 20'0"W

0 10'0"W

0 0'0"

49 20'0"N

49 10'0"N

49 00'0"N

48 50'0"N

RS-measured tropospheric vertical columns of NO<sub>2</sub> of  
Caen, France  
eFUA\_ID: 1680  
at 1 km resolution

○ Central Business Districts (CBD)

◻ GHSL-OECD Functional Urban Areas (GHS-FUA)

Annual mean tropospheric NO<sub>2</sub> columns in  $\mu\text{mol}/\text{m}^2$

NO2Lev

[0, 20)

[20, 40)

[40, 60)

[60, 80)

[80, 100)

[100, 120)

[120, 140)

[140, 160)

[160, 180)

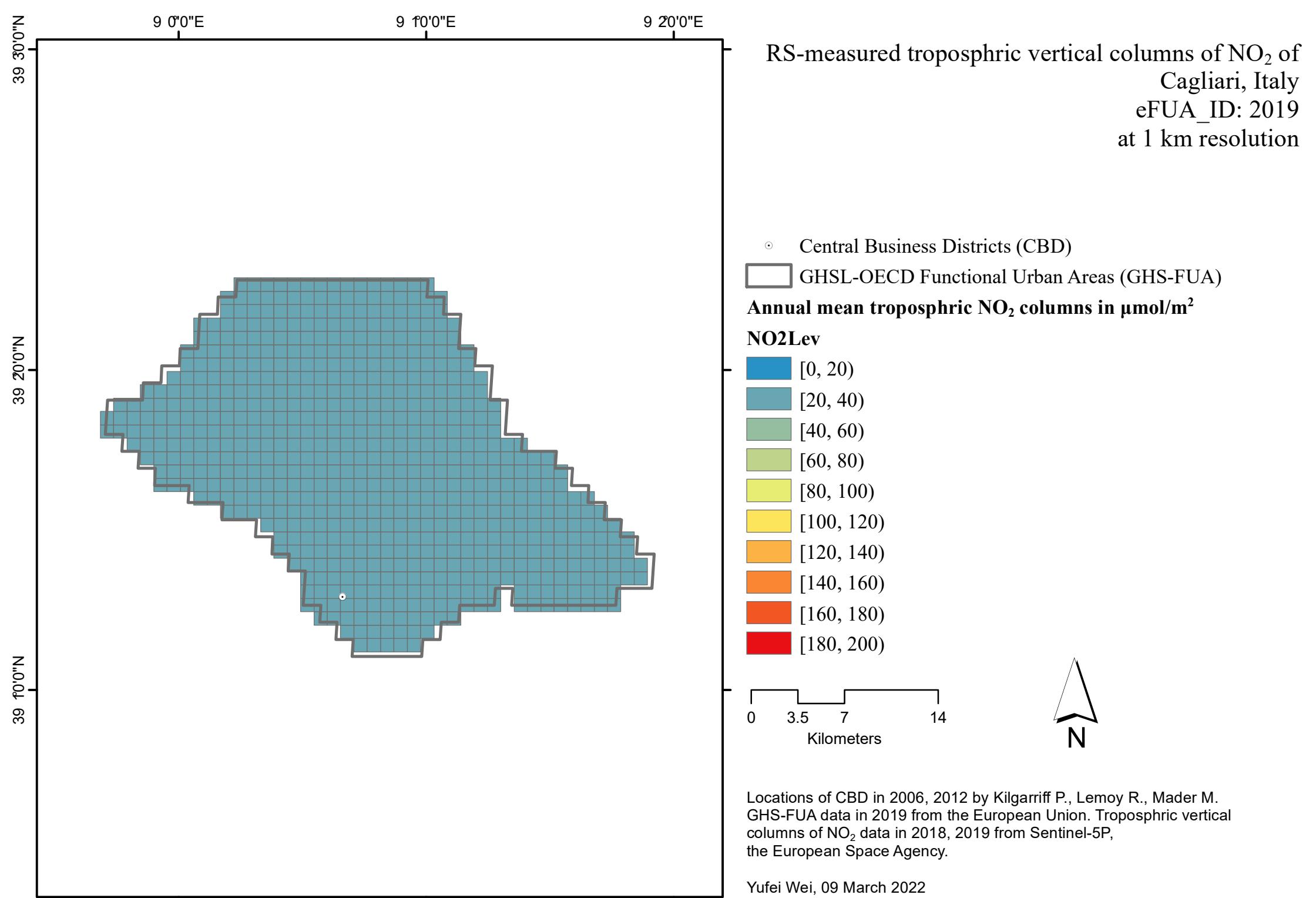
[180, 200)

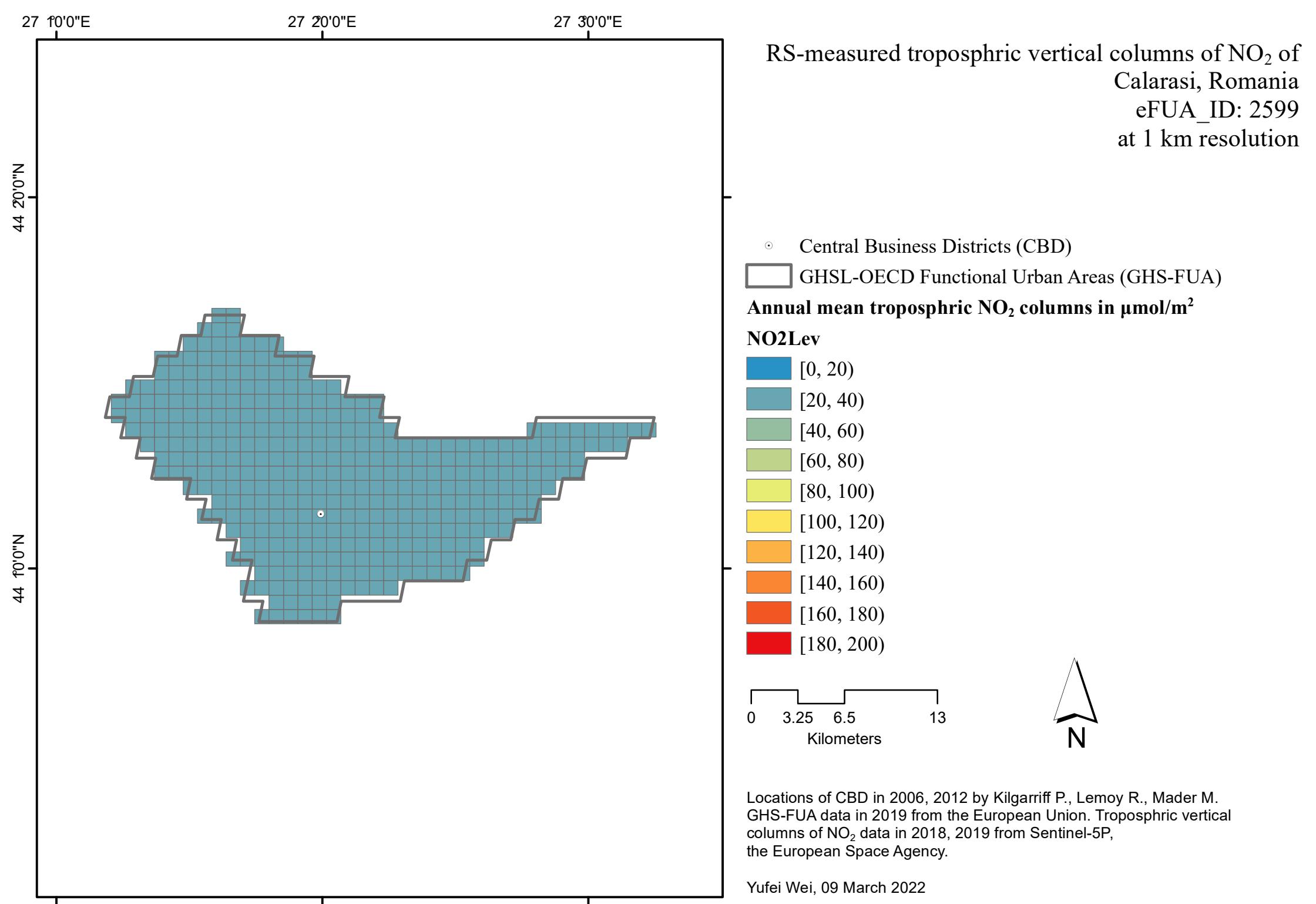
0 5 10 20  
Kilometers



Locations of CBD in 2006, 2012 by Kilgarriff P., Lemoy R., Mader M.  
GHS-FUA data in 2019 from the European Union. Tropospheric vertical  
columns of NO<sub>2</sub> data in 2018, 2019 from Sentinel-5P,  
the European Space Agency.

Yufei Wei, 09 March 2022





0 10'0"W

0 0'0"

0 10'0"E

0 20'0"E

0 30'0"E

52 30'0"N

52 20'0"N

52 10'0"N

52 0'0"N

RS-measured tropospheric vertical columns of NO<sub>2</sub> of  
Cambridge, United Kingdom  
eFUA\_ID: 5550  
at 1 km resolution

○ Central Business Districts (CBD)

◻ GHSL-OECD Functional Urban Areas (GHS-FUA)

Annual mean tropospheric NO<sub>2</sub> columns in  $\mu\text{mol}/\text{m}^2$

NO2Lev

[0, 20)

[20, 40)

[40, 60)

[60, 80)

[80, 100)

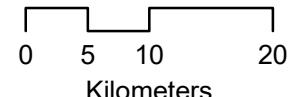
[100, 120)

[120, 140)

[140, 160)

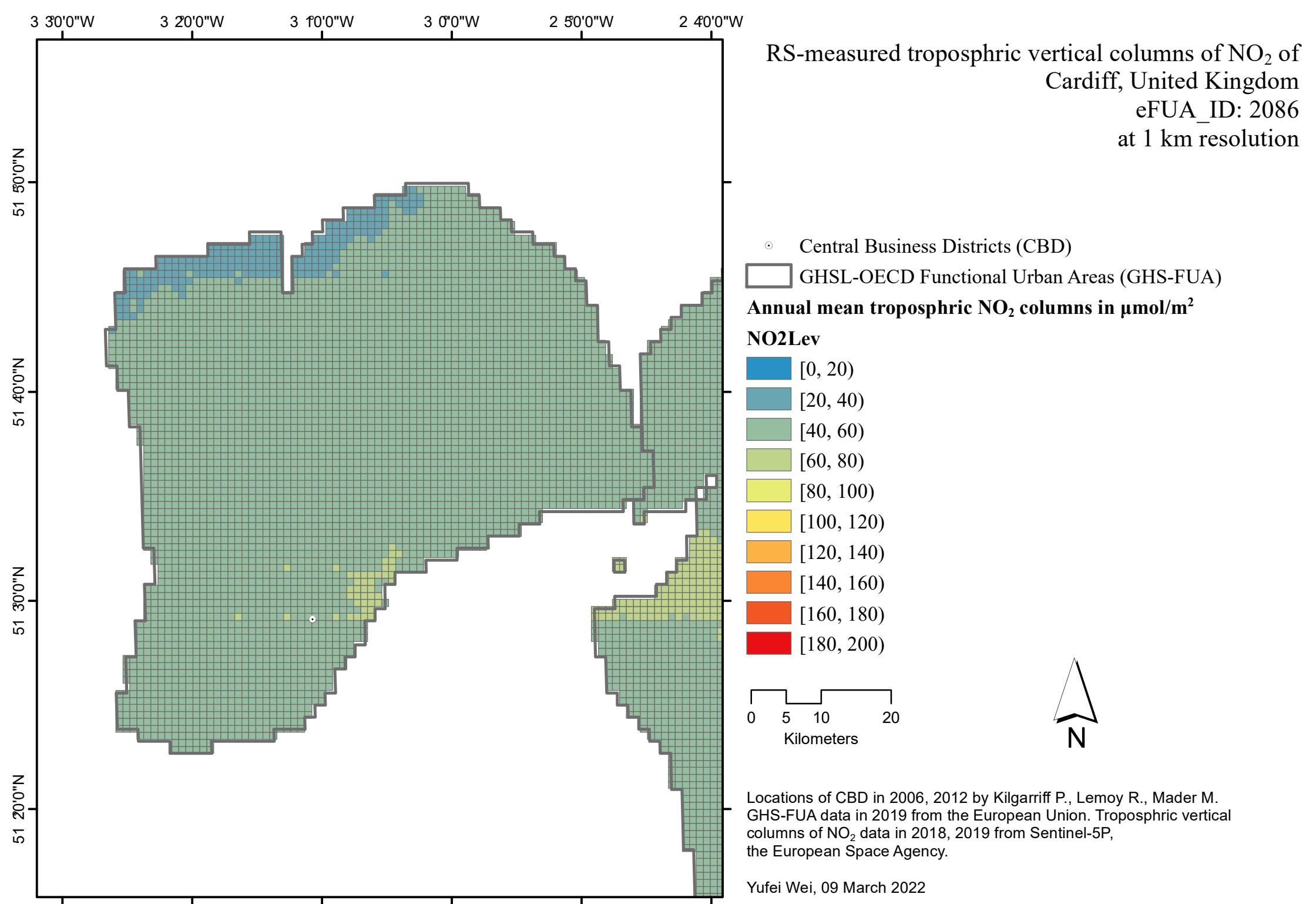
[160, 180)

[180, 200)



Locations of CBD in 2006, 2012 by Kilgarriff P., Lemoy R., Mader M.  
GHS-FUA data in 2019 from the European Union. Tropospheric vertical  
columns of NO<sub>2</sub> data in 2018, 2019 from Sentinel-5P,  
the European Space Agency.

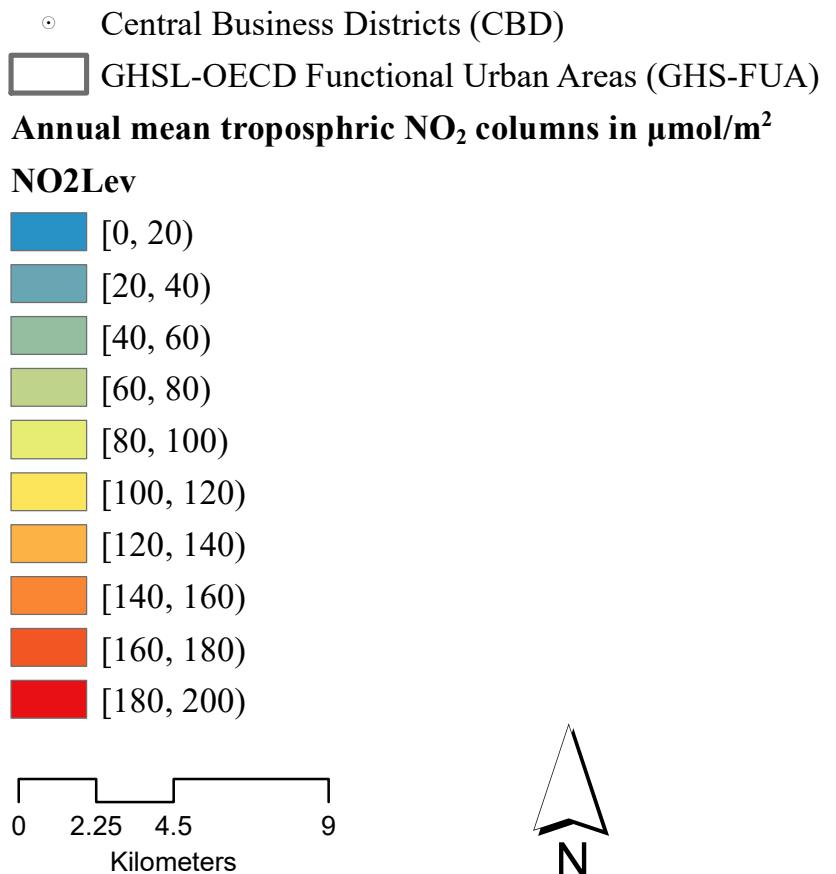
Yufei Wei, 09 March 2022



1 0°0'W

0 50'0"W

RS-measured tropospheric vertical columns of NO<sub>2</sub> of  
Cartagena, Spain  
eFUA\_ID: 3946  
at 1 km resolution



Locations of CBD in 2006, 2012 by Kilgarriff P., Lemoy R., Mader M.  
GHS-FUA data in 2019 from the European Union. Tropospheric vertical  
columns of NO<sub>2</sub> data in 2018, 2019 from Sentinel-5P,  
the European Space Agency.

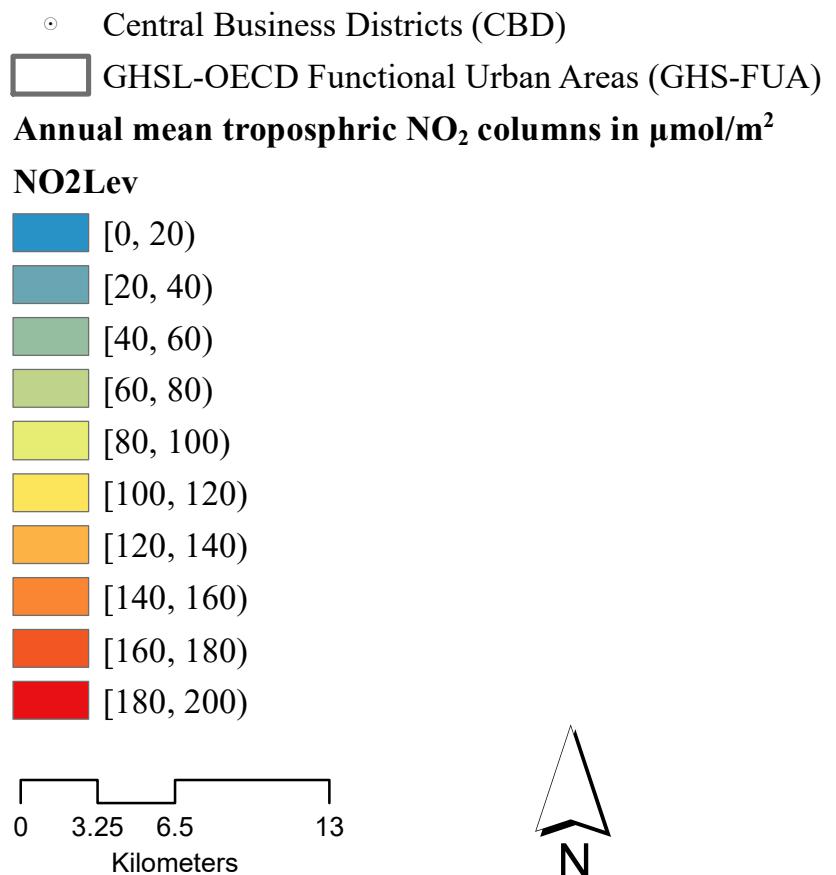
Yufei Wei, 09 March 2022

0 10'0"W

0 0'0"

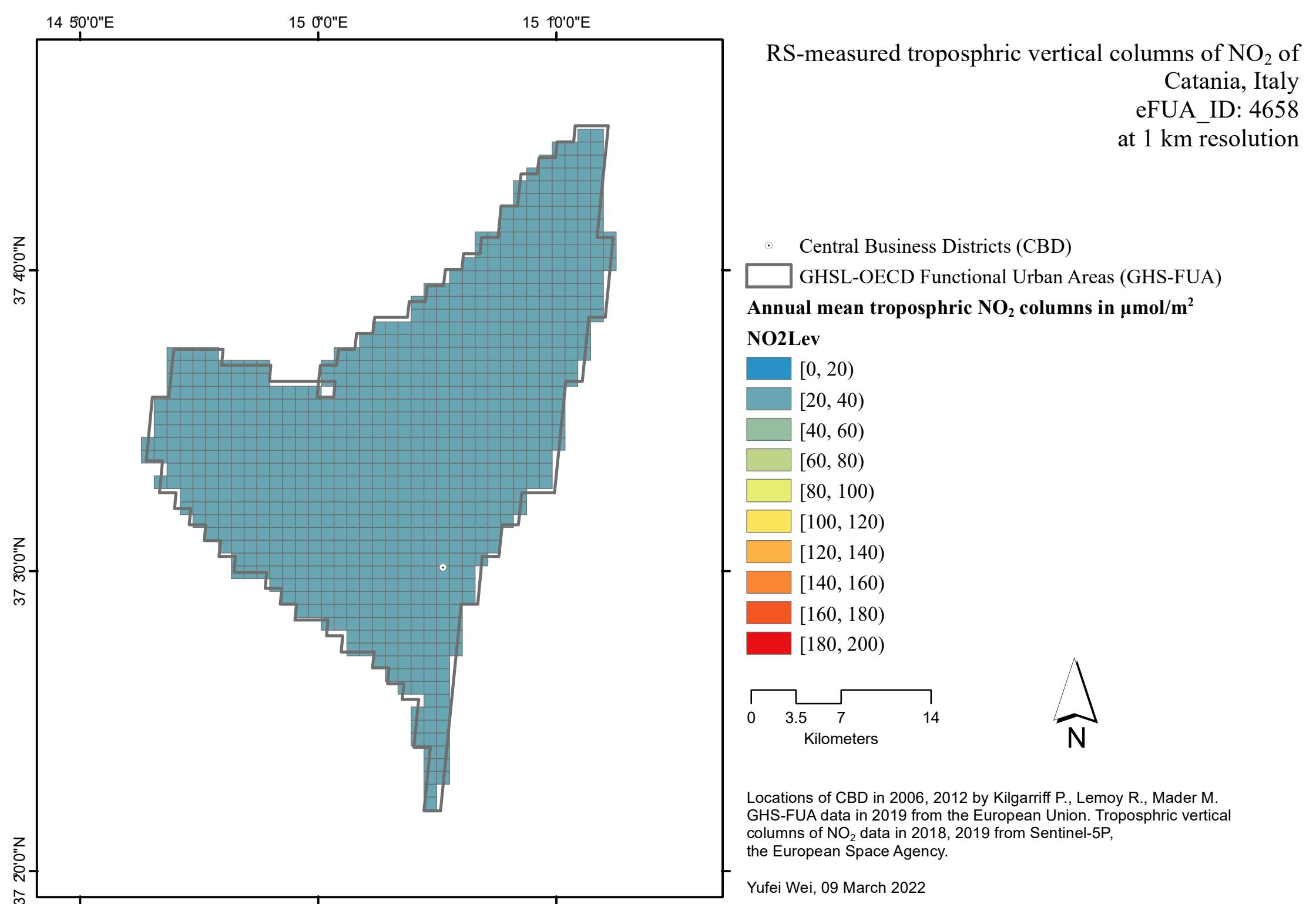
RS-measured tropospheric vertical columns of NO<sub>2</sub> of  
Castellon de la Plana, Spain  
eFUA\_ID: 4258  
at 1 km resolution

40 0'0"N  
39 50'0"N



Locations of CBD in 2006, 2012 by Kilgarriff P., Lemoy R., Mader M.  
GHS-FUA data in 2019 from the European Union. Tropospheric vertical  
columns of NO<sub>2</sub> data in 2018, 2019 from Sentinel-5P,  
the European Space Agency.

Yufei Wei, 09 March 2022

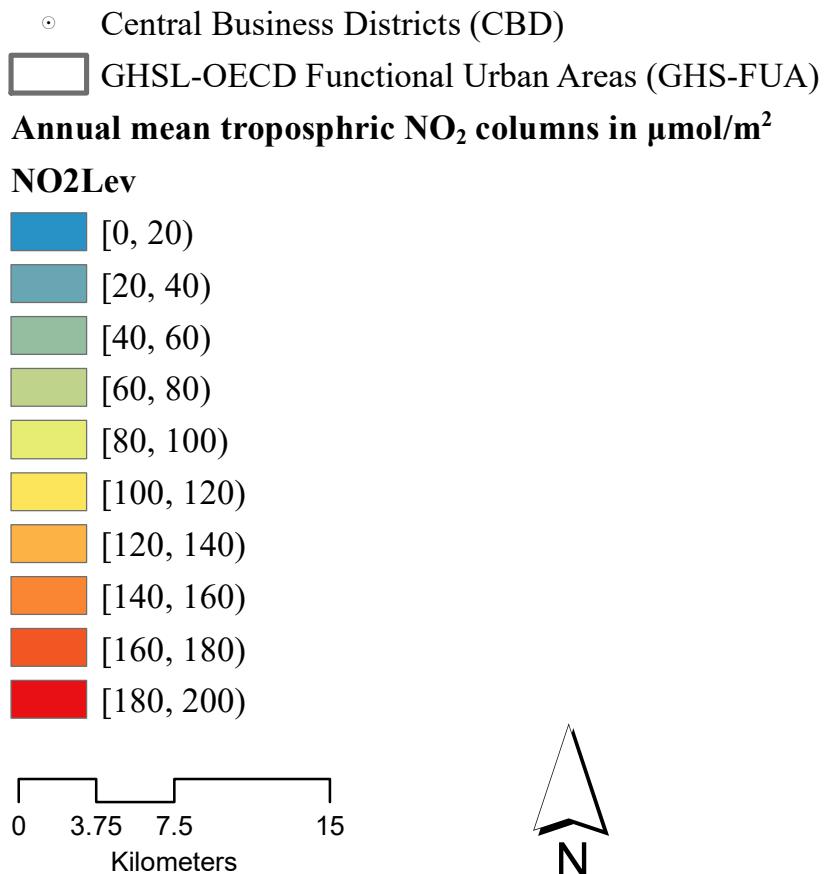
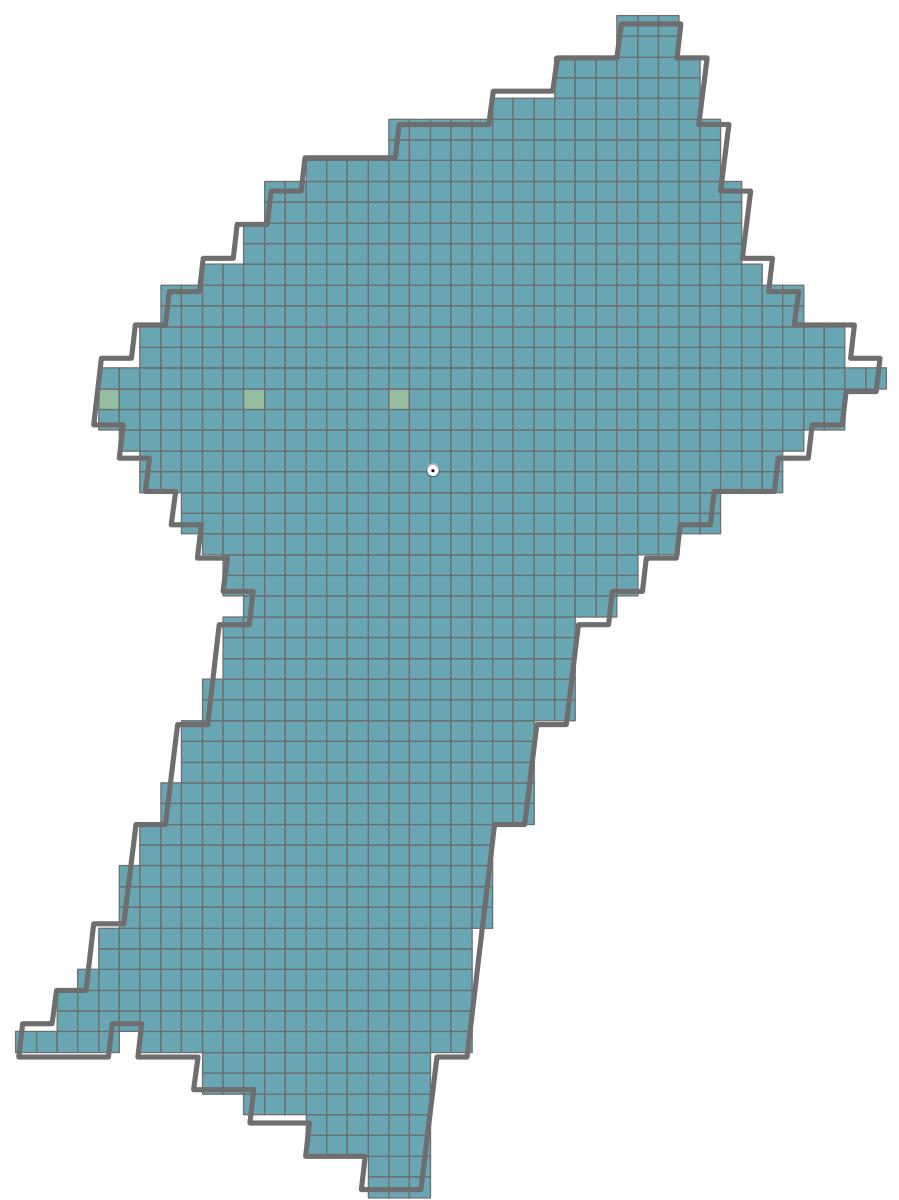


14 20'0"E

14 30'0"E

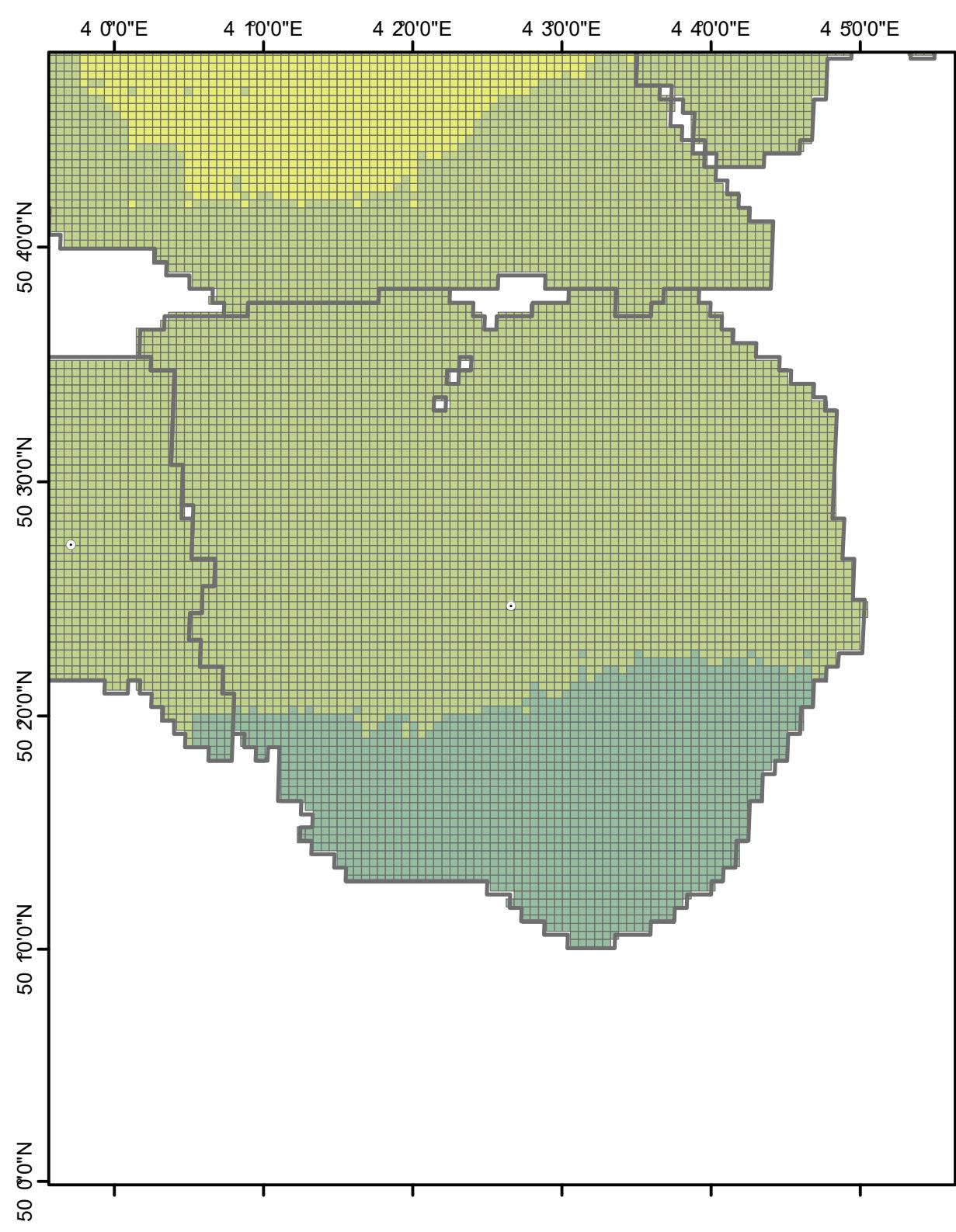
14 40'0"E

RS-measured tropospheric vertical columns of NO<sub>2</sub> of  
Ceske Budejovice, Czech Republic  
eFUA\_ID: 678  
at 1 km resolution

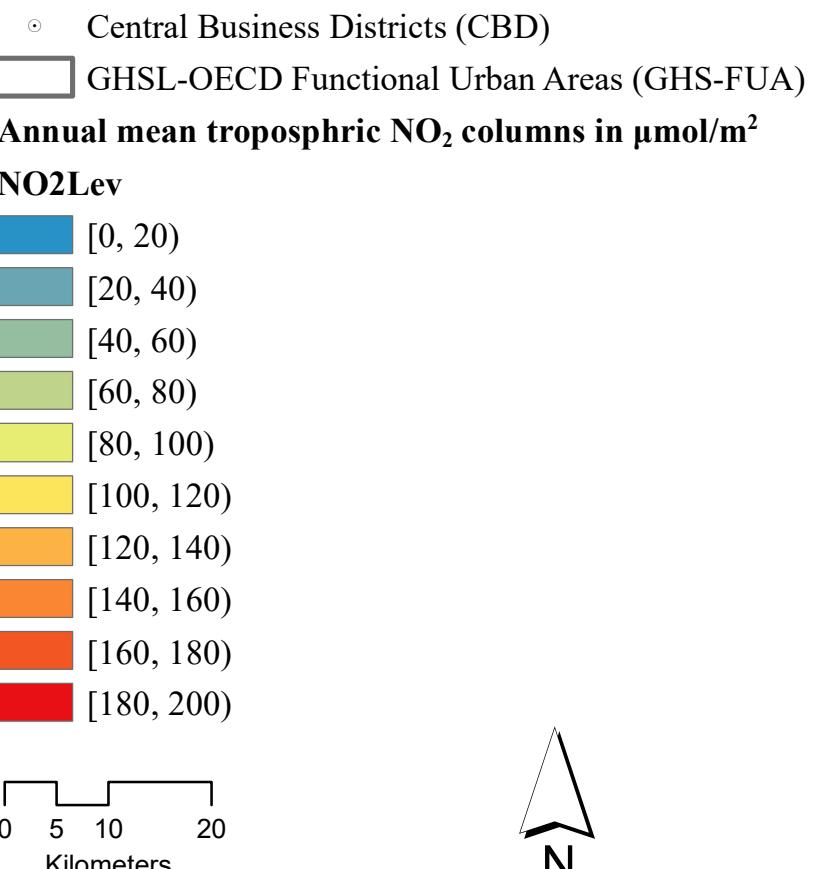
49 0'0"N  
48 50'0"N

Locations of CBD in 2006, 2012 by Kilgarriff P., Lemoy R., Mader M.  
GHS-FUA data in 2019 from the European Union. Tropospheric vertical  
columns of NO<sub>2</sub> data in 2018, 2019 from Sentinel-5P,  
the European Space Agency.

Yufei Wei, 09 March 2022

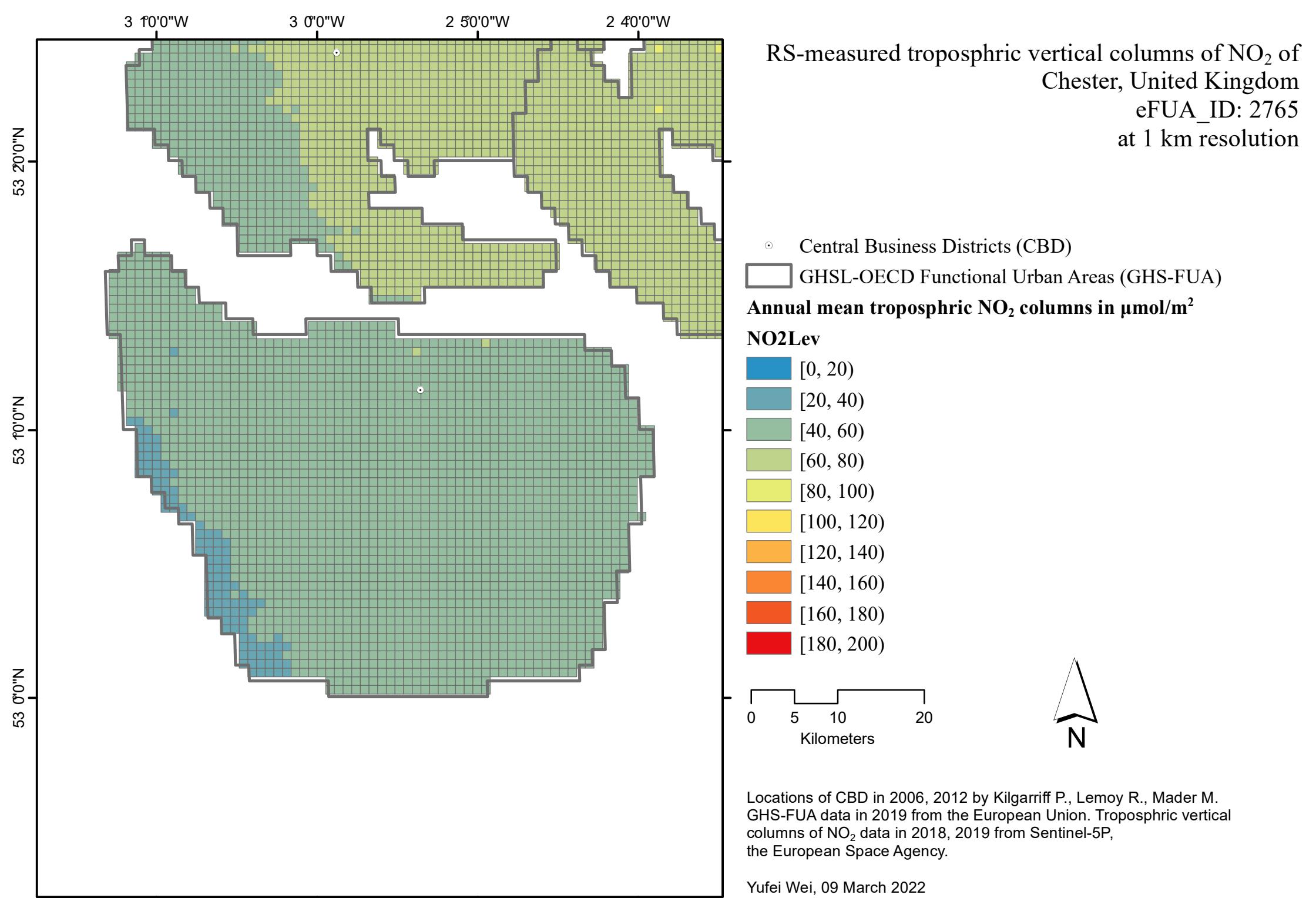


RS-measured tropospheric vertical columns of NO<sub>2</sub> of  
Charleroi, Belgium  
eFUA\_ID: 1372  
at 1 km resolution



Locations of CBD in 2006, 2012 by Kilgarriff P., Lemoy R., Mader M.  
GHS-FUA data in 2019 from the European Union. Tropospheric vertical  
columns of NO<sub>2</sub> data in 2018, 2019 from Sentinel-5P,  
the European Space Agency.

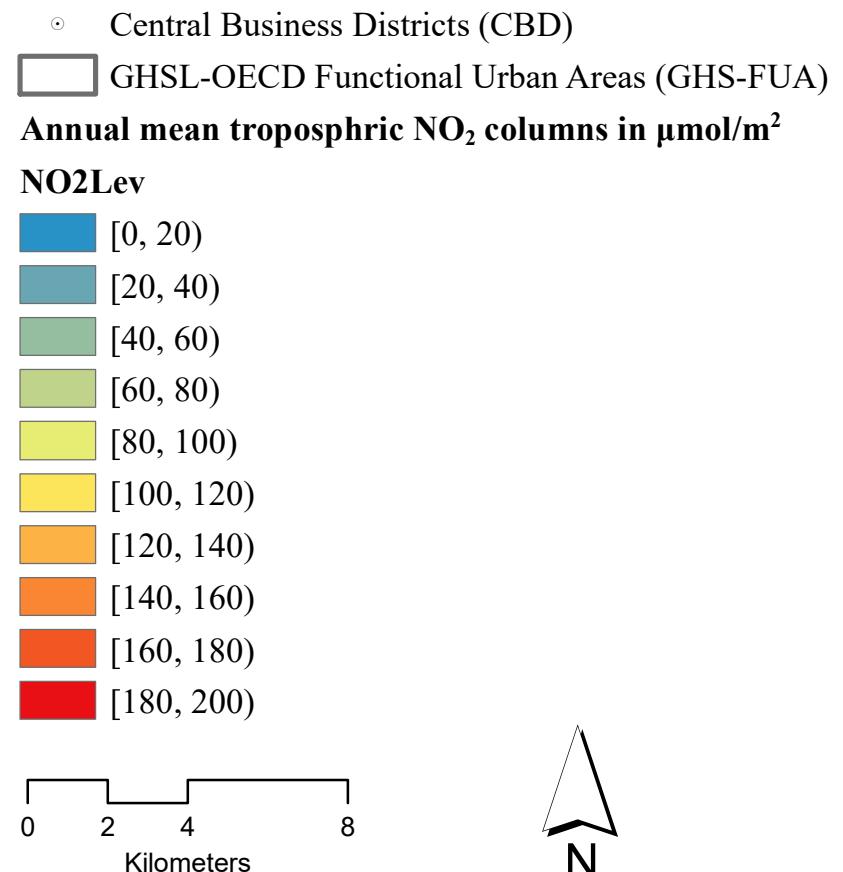
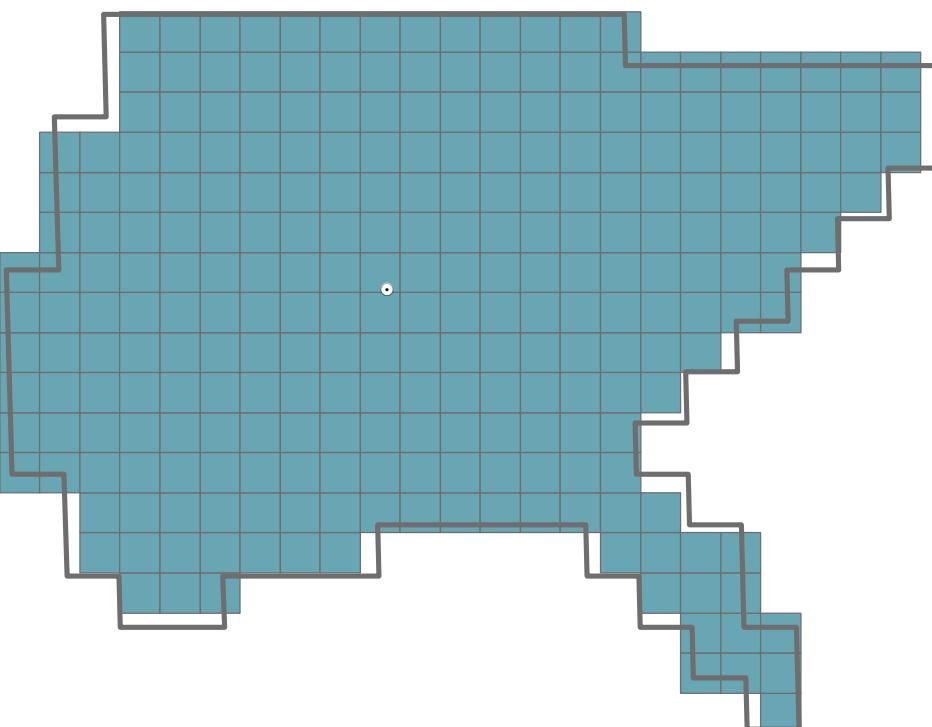
Yufei Wei, 09 March 2022



4°0'W

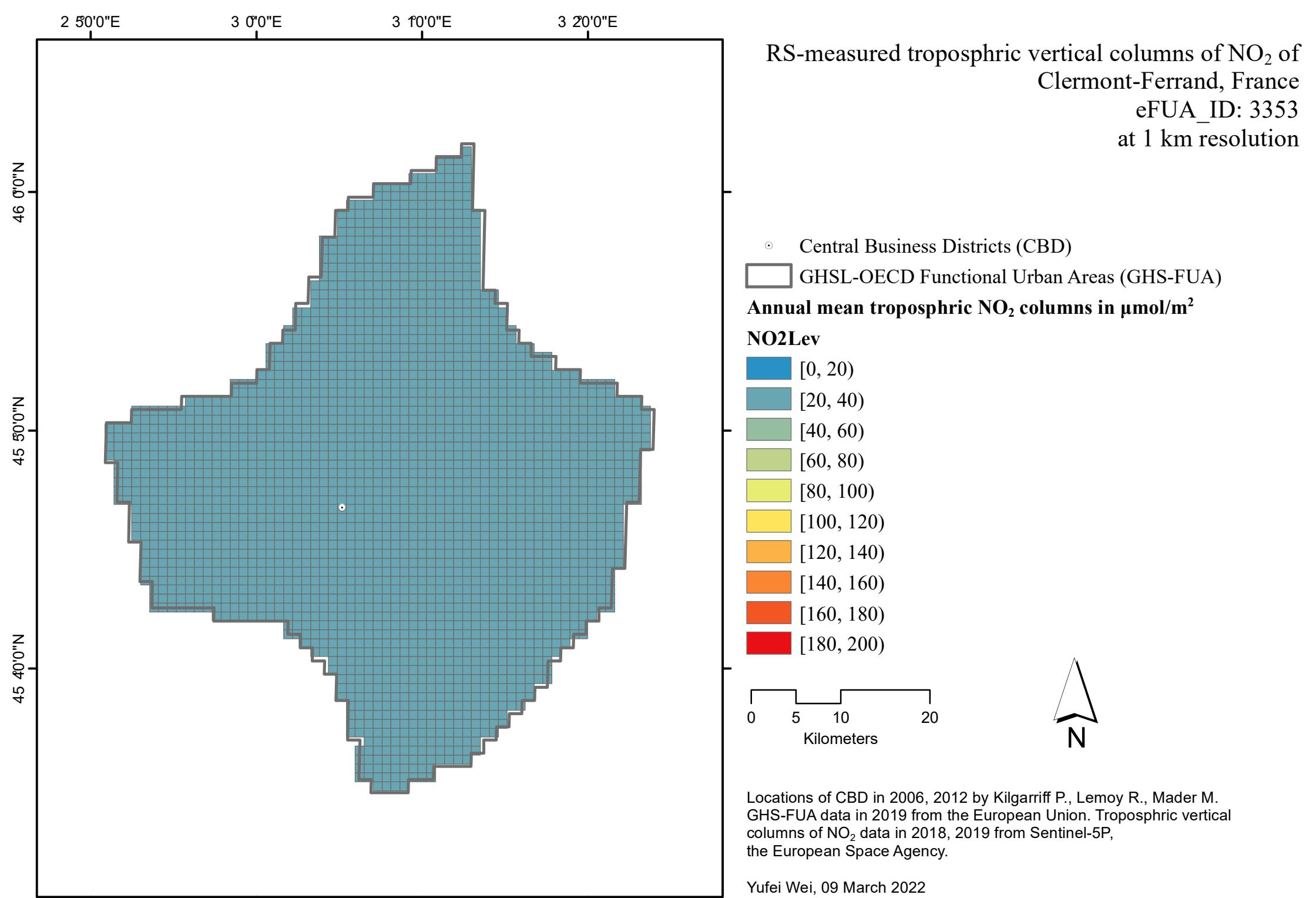
3°50'W

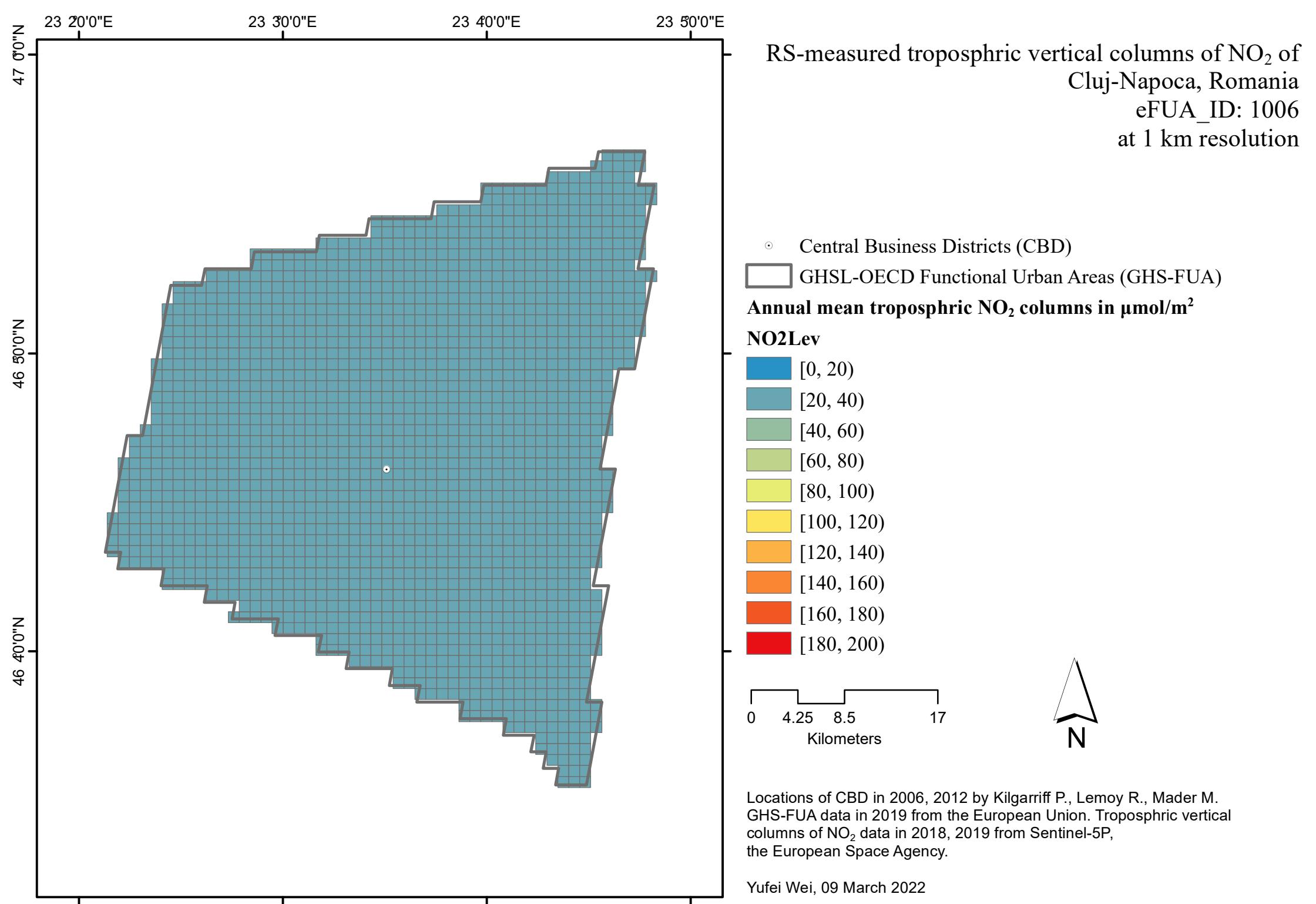
RS-measured tropospheric vertical columns of NO<sub>2</sub> of  
Ciudad Real, Spain  
eFUA\_ID: 3044  
at 1 km resolution



Locations of CBD in 2006, 2012 by Kilgarriff P., Lemoy R., Mader M.  
GHS-FUA data in 2019 from the European Union. Tropospheric vertical  
columns of NO<sub>2</sub> data in 2018, 2019 from Sentinel-5P,  
the European Space Agency.

Yufei Wei, 09 March 2022

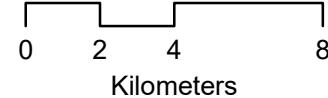
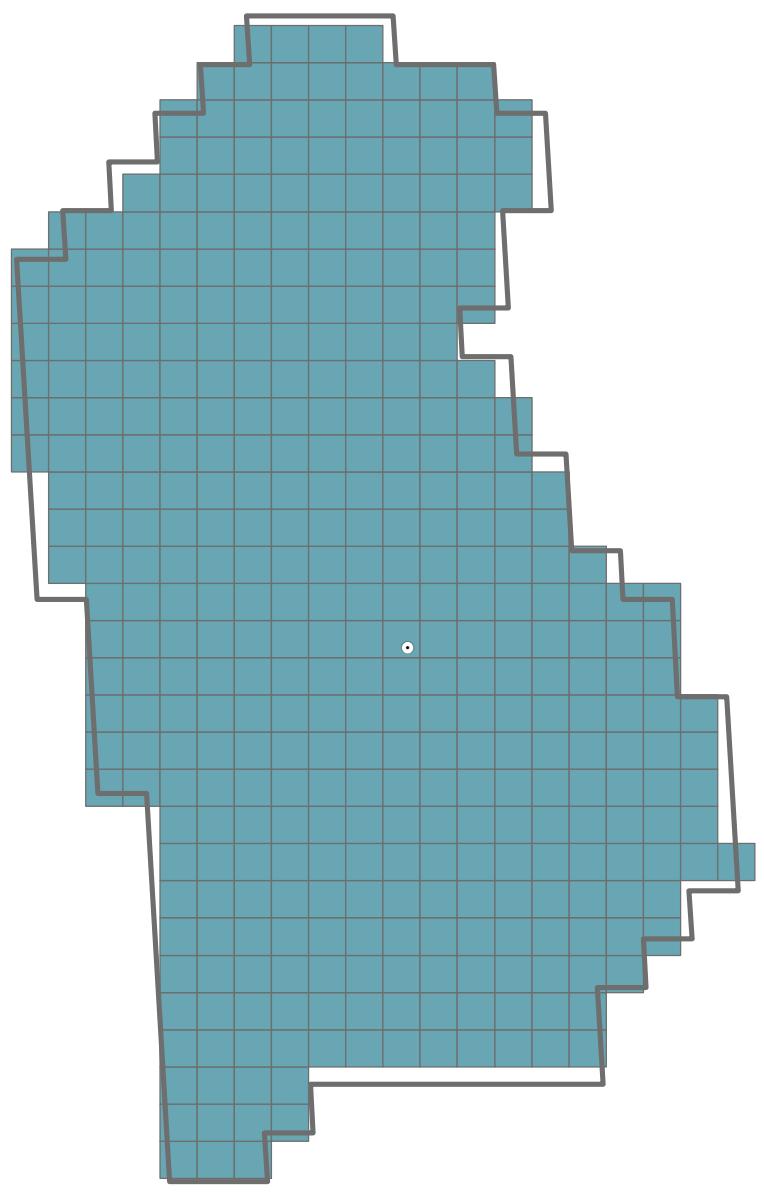




8 30'0"W

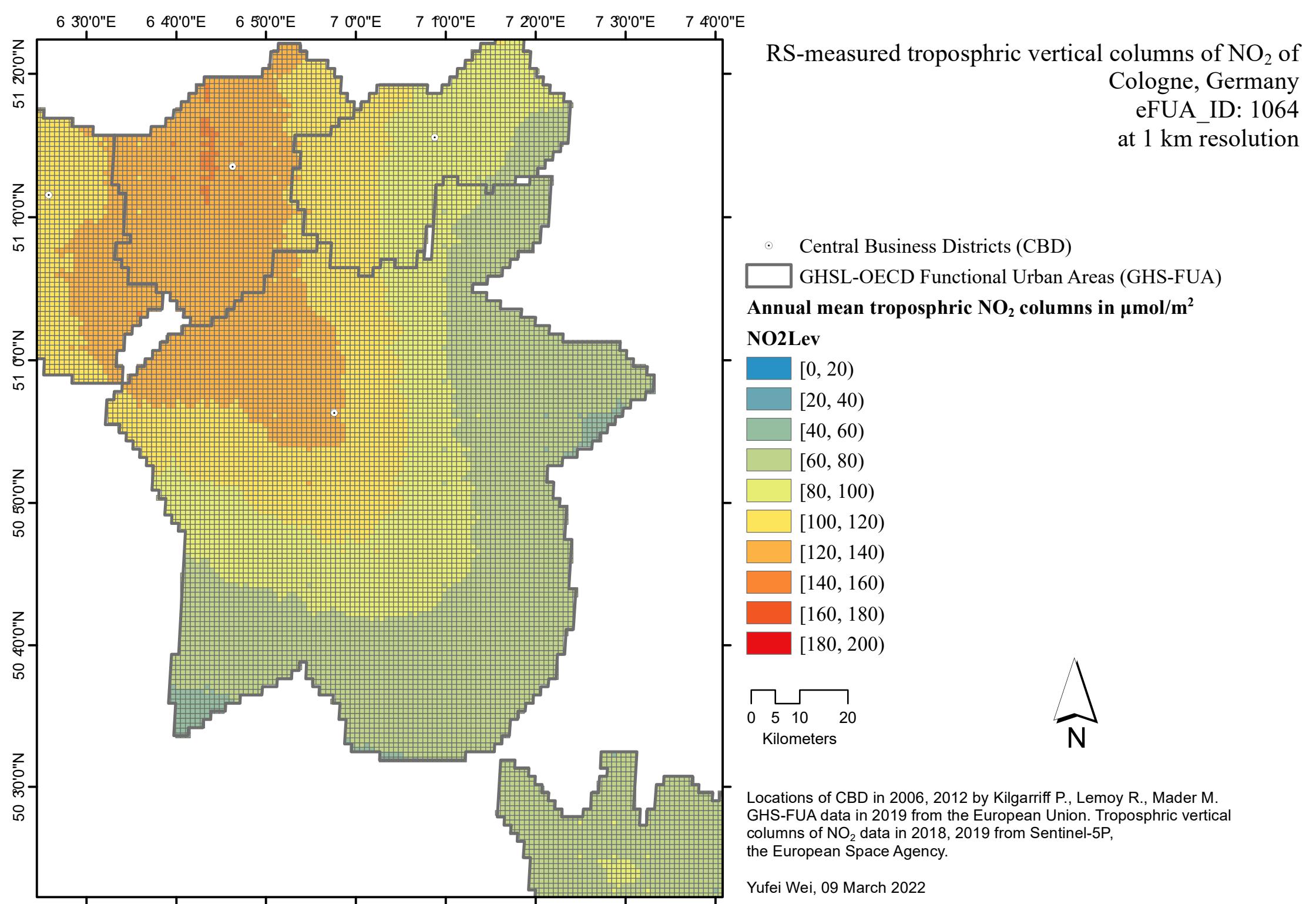
8 20'0"W

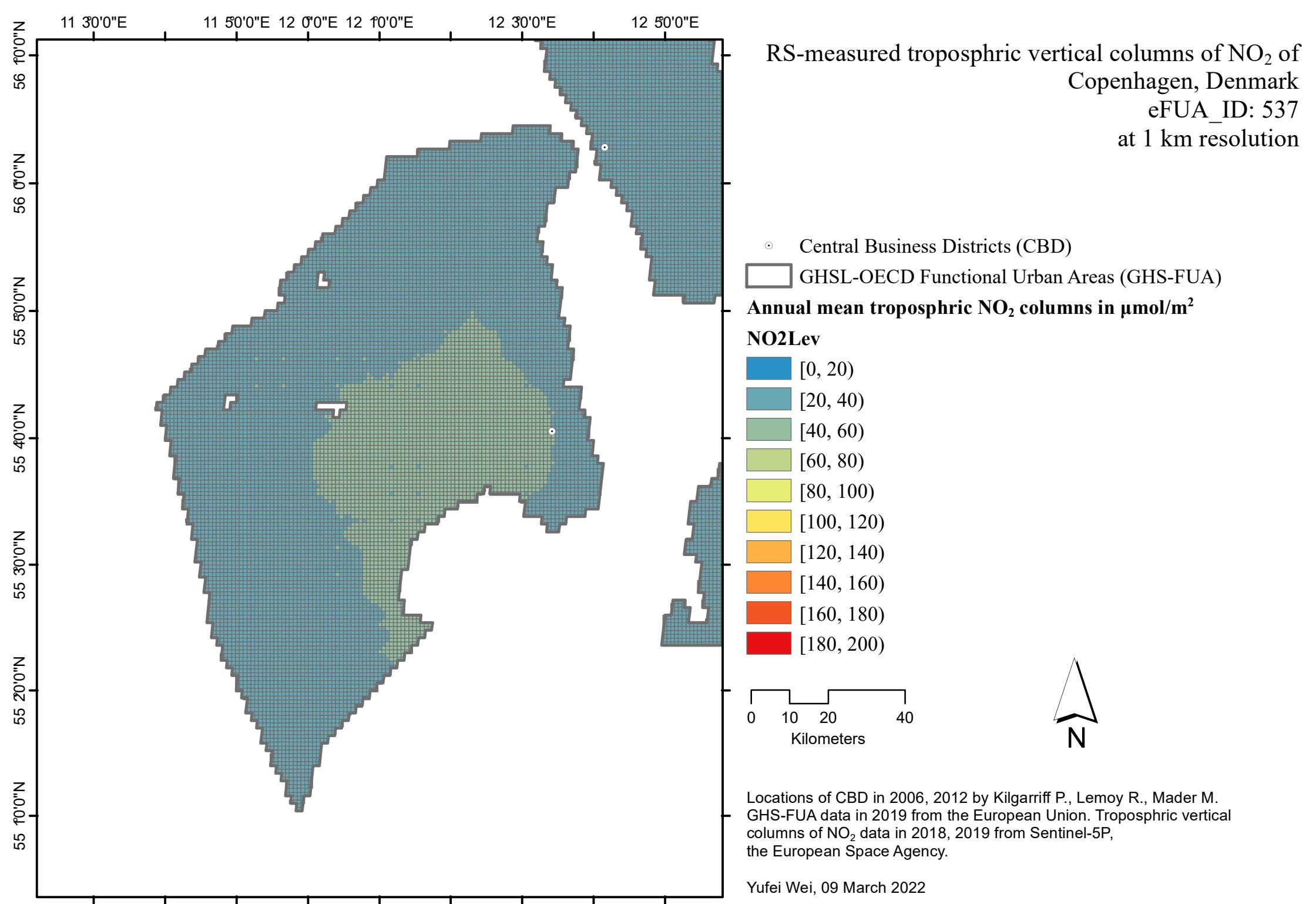
RS-measured tropospheric vertical columns of NO<sub>2</sub> of  
Coimbra, Portugal  
eFUA\_ID: 1118  
at 1 km resolution



Locations of CBD in 2006, 2012 by Kilgarriff P., Lemoy R., Mader M.  
GHS-FUA data in 2019 from the European Union. Tropospheric vertical  
columns of NO<sub>2</sub> data in 2018, 2019 from Sentinel-5P,  
the European Space Agency.

Yufei Wei, 09 March 2022





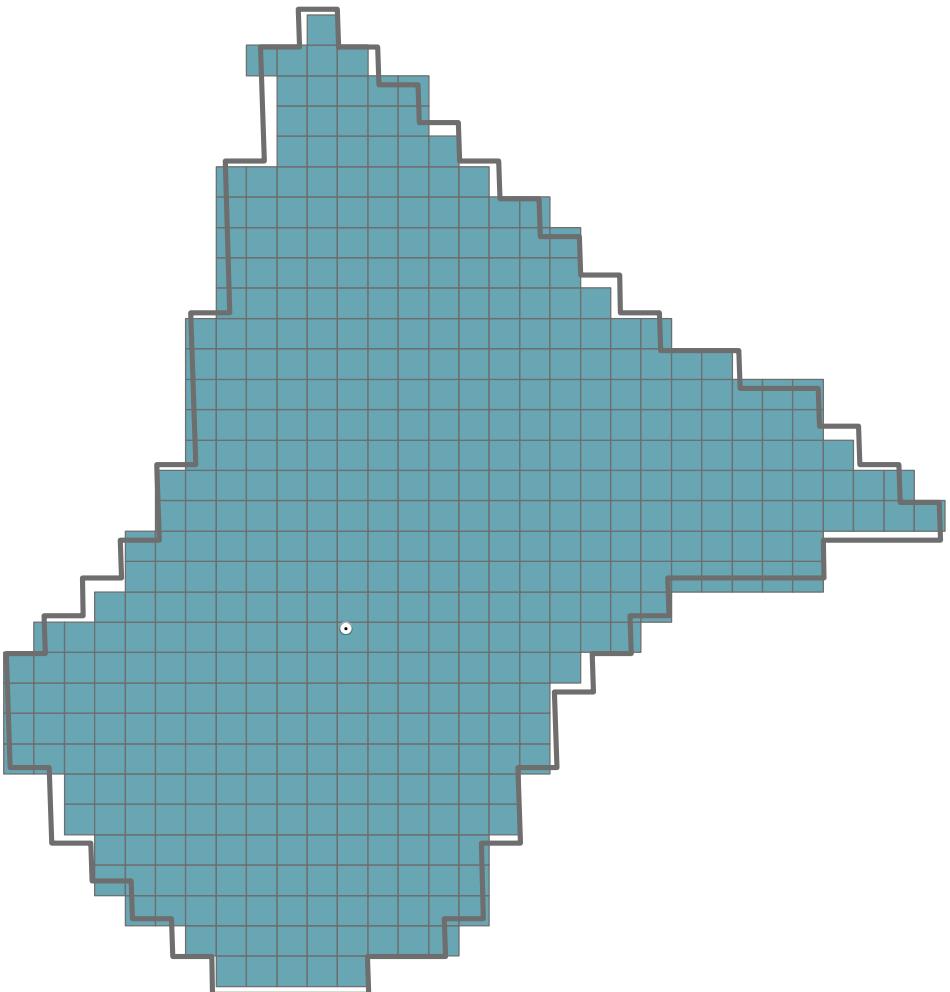
4 50'0"W

4 40'0"W

RS-measured tropospheric vertical columns of NO<sub>2</sub> of  
Cordoba, Spain  
eFUA\_ID: 2700  
at 1 km resolution

38 0'0"N

37 50'0"N



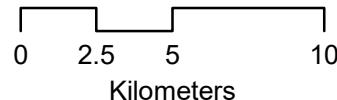
○ Central Business Districts (CBD)

◻ GHS-OECD Functional Urban Areas (GHS-FUA)

Annual mean tropospheric NO<sub>2</sub> columns in  $\mu\text{mol}/\text{m}^2$

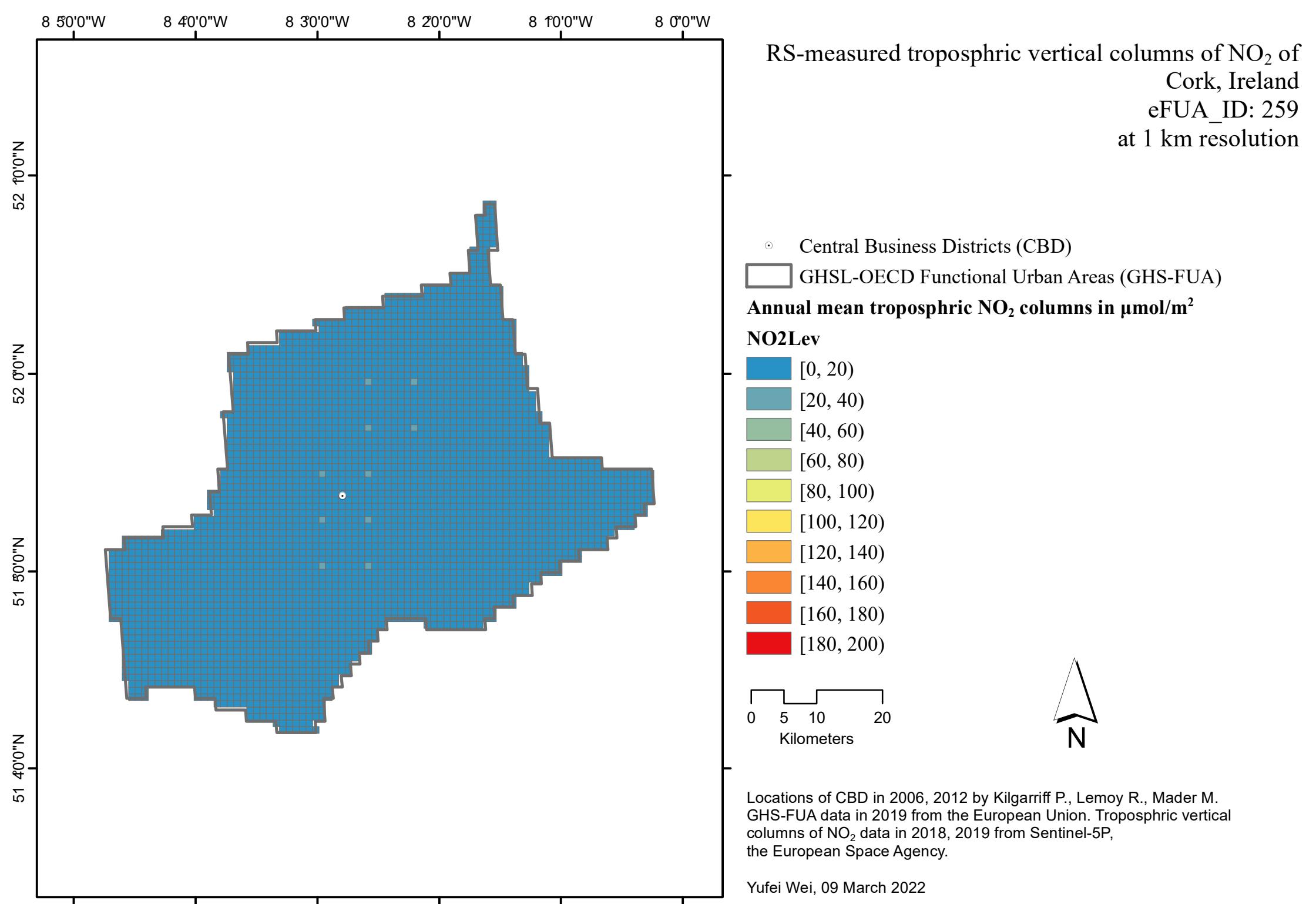
NO2Lev

- [0, 20]
- [20, 40]
- [40, 60]
- [60, 80]
- [80, 100]
- [100, 120]
- [120, 140]
- [140, 160]
- [160, 180]
- [180, 200]



Locations of CBD in 2006, 2012 by Kilgarriff P., Lemoy R., Mader M.  
GHS-FUA data in 2019 from the European Union. Tropospheric vertical  
columns of NO<sub>2</sub> data in 2018, 2019 from Sentinel-5P,  
the European Space Agency.

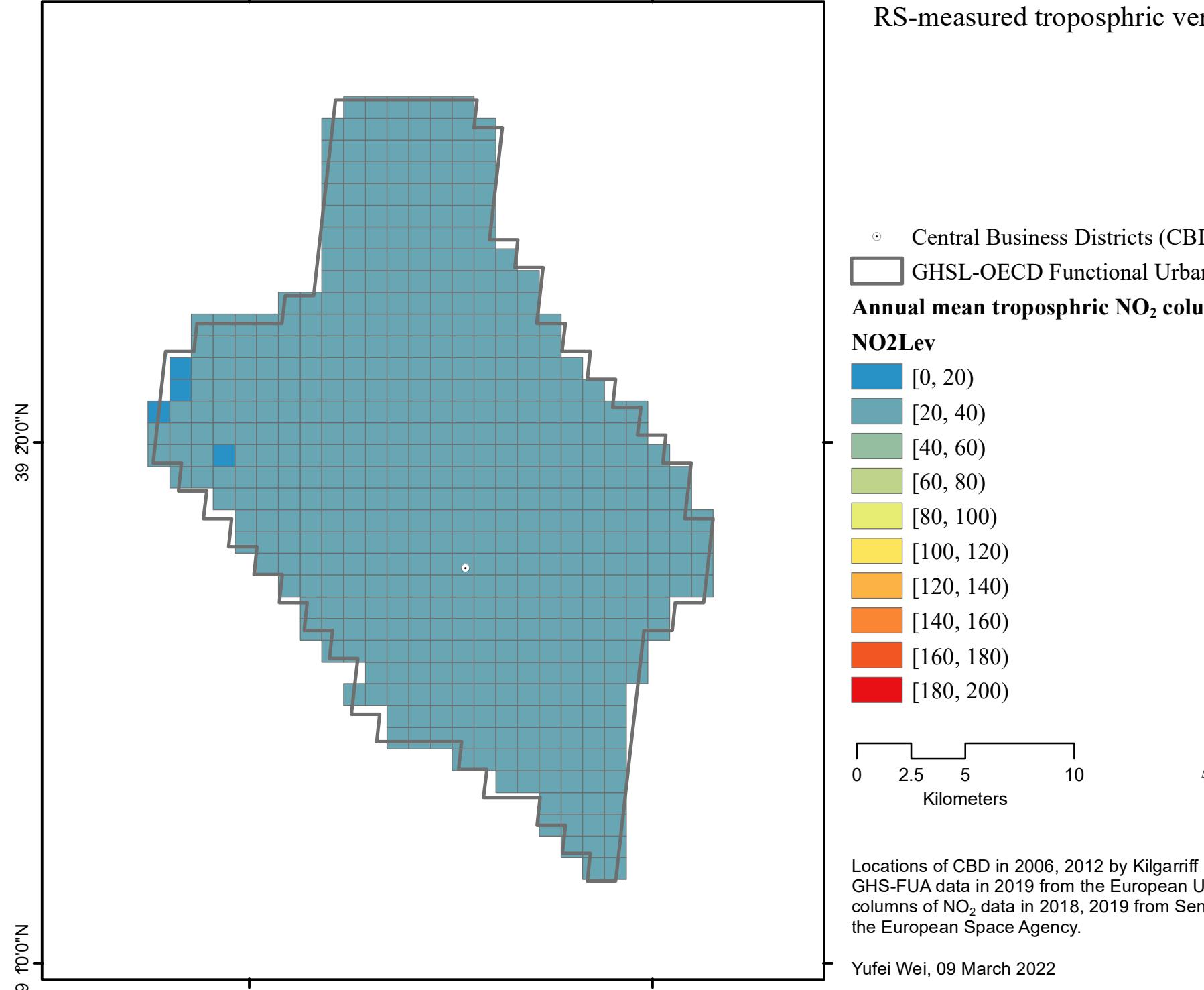
Yufei Wei, 09 March 2022



16 10'0"E

16 20'0"E

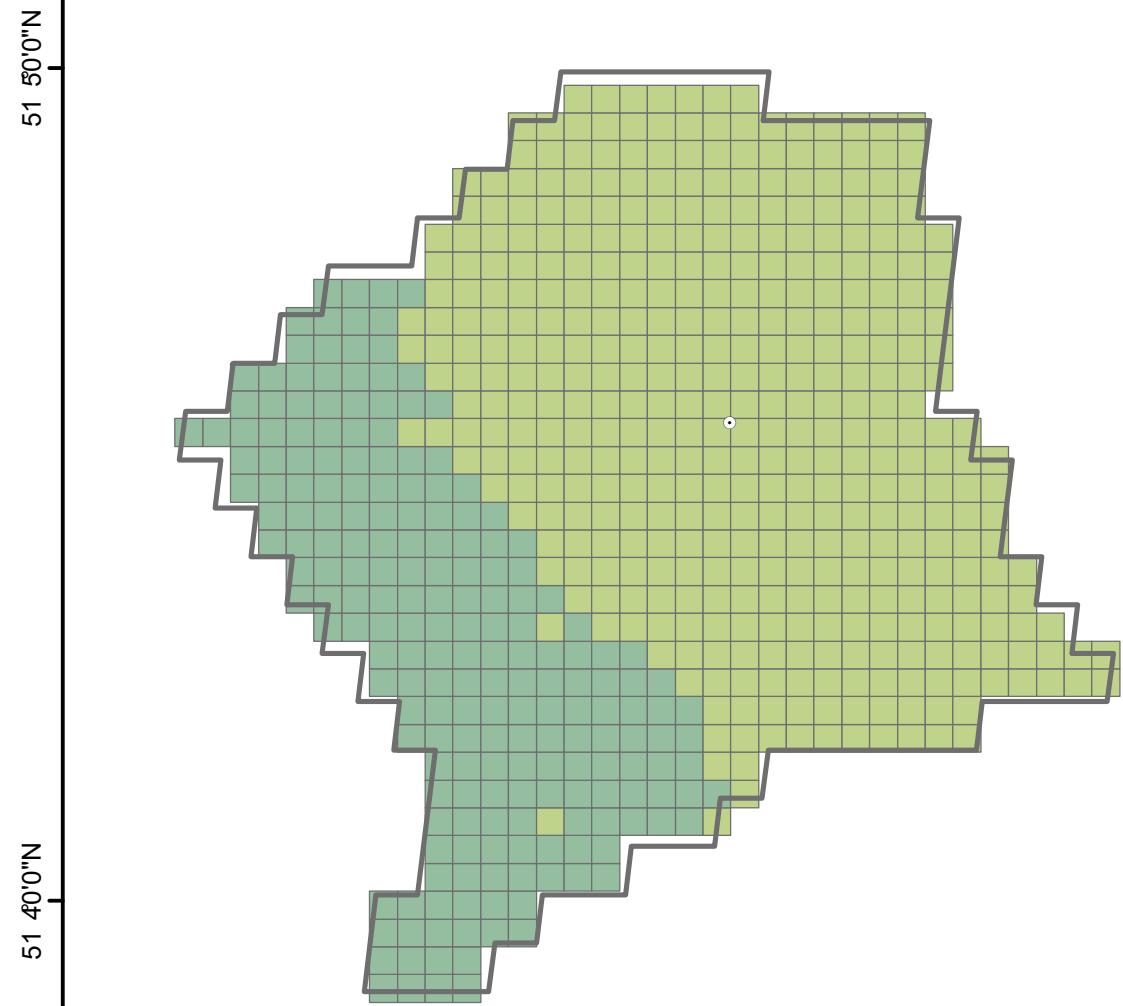
RS-measured tropospheric vertical columns of NO<sub>2</sub> of  
Cosenza, Italy  
eFUA\_ID: 4929  
at 1 km resolution



14 10'0"E

14 20'0"E

RS-measured tropospheric vertical columns of NO<sub>2</sub> of  
Cottbus, Germany  
eFUA\_ID: 5020  
at 1 km resolution



○ Central Business Districts (CBD)

◻ GHSL-OECD Functional Urban Areas (GHS-FUA)

Annual mean tropospheric NO<sub>2</sub> columns in  $\mu\text{mol}/\text{m}^2$

NO2Lev

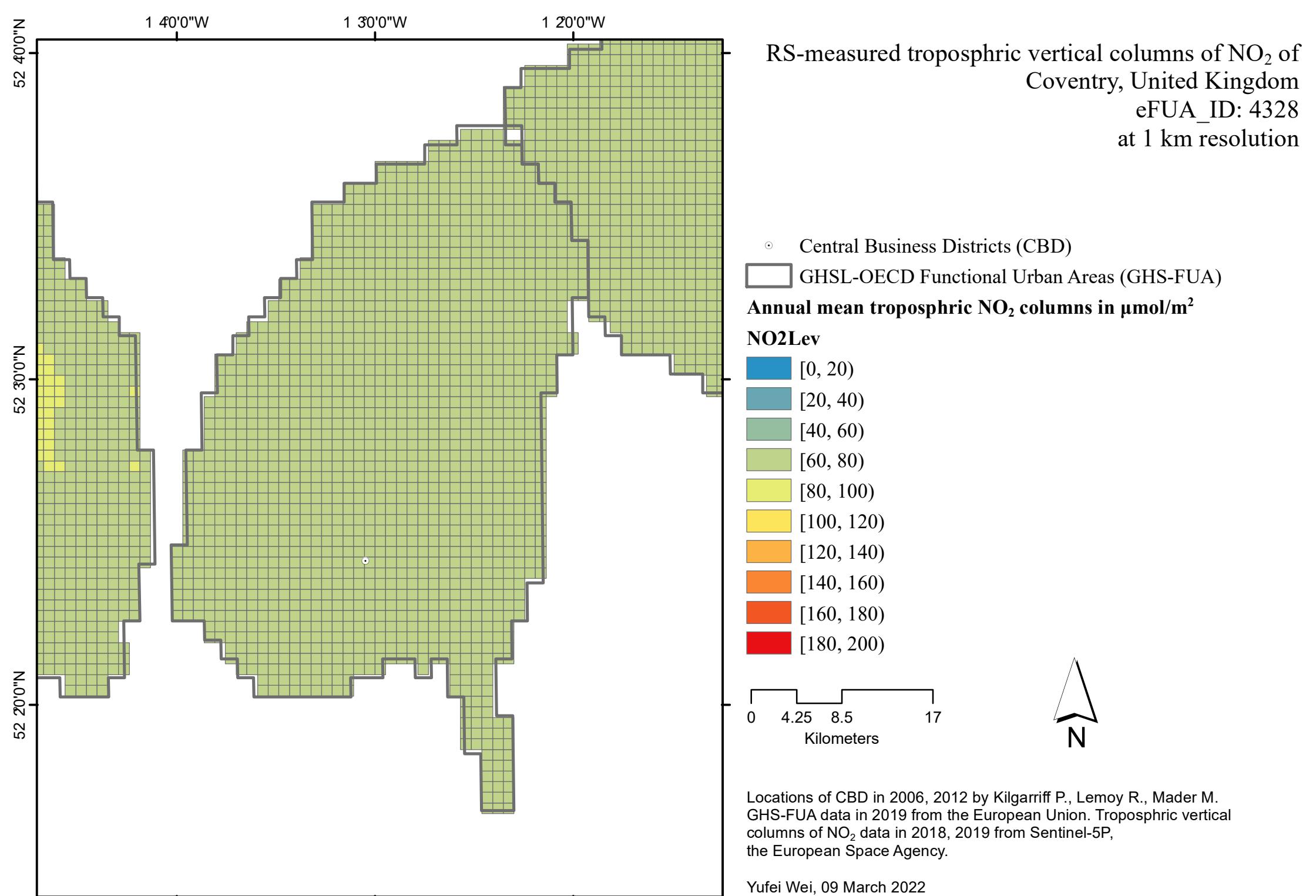
- [0, 20]
- [20, 40]
- [40, 60]
- [60, 80]
- [80, 100]
- [100, 120]
- [120, 140]
- [140, 160]
- [160, 180]
- [180, 200]

0 2.75 5.5 11  
Kilometers



Locations of CBD in 2006, 2012 by Kilgarriff P., Lemoy R., Mader M.  
GHS-FUA data in 2019 from the European Union. Tropospheric vertical  
columns of NO<sub>2</sub> data in 2018, 2019 from Sentinel-5P,  
the European Space Agency.

Yufei Wei, 09 March 2022



23 40'0"E

23 50'0"E

24 0'0"E

RS-measured tropospheric vertical columns of NO<sub>2</sub> of  
Craiova, Romania  
eFUA\_ID: 1231  
at 1 km resolution

44 30'0"N

44 20'0"N

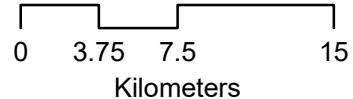
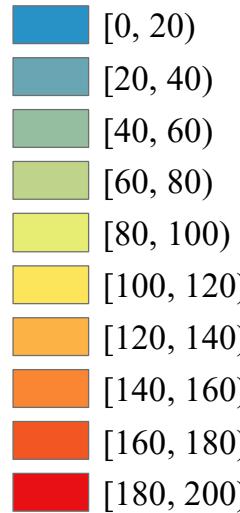
44 10'0"N

○ Central Business Districts (CBD)

◻ GHSL-OECD Functional Urban Areas (GHS-FUA)

Annual mean tropospheric NO<sub>2</sub> columns in  $\mu\text{mol}/\text{m}^2$ 

NO2Lev



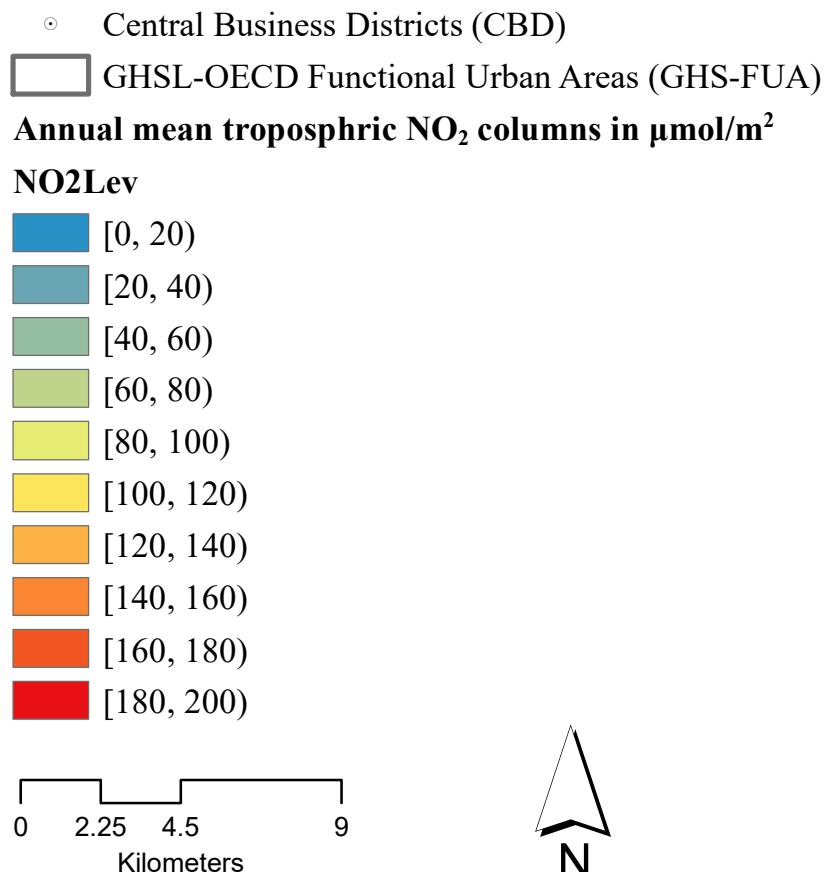
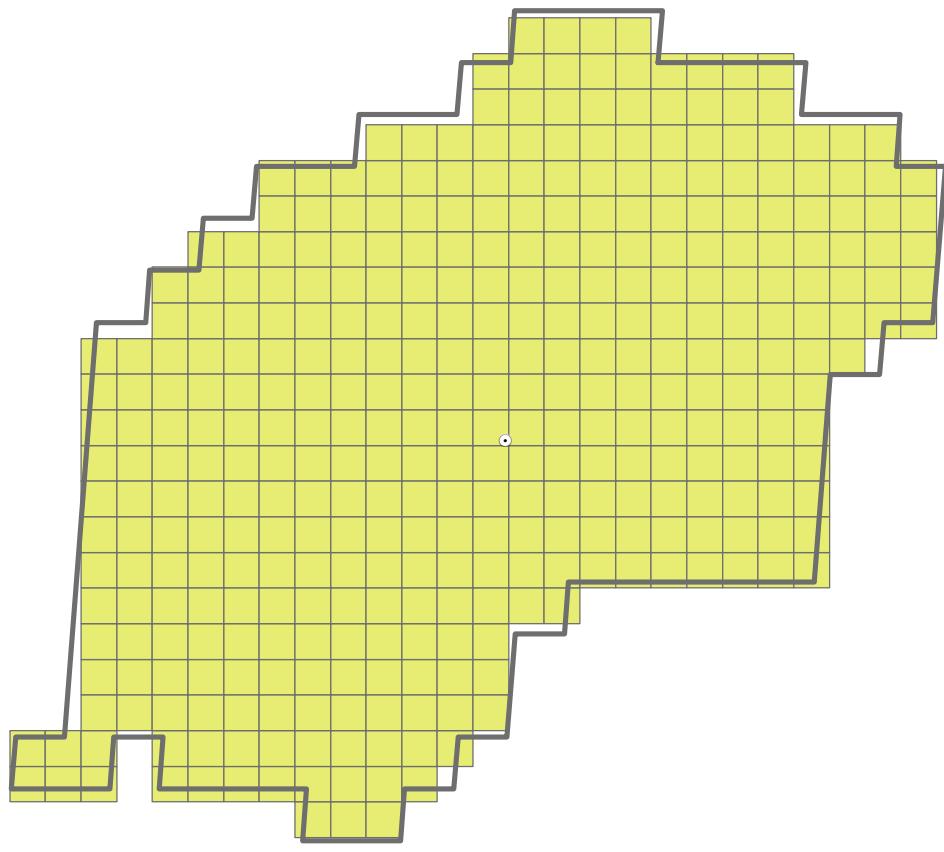
Locations of CBD in 2006, 2012 by Kilgarriff P., Lemoy R., Mader M.  
GHS-FUA data in 2019 from the European Union. Tropospheric vertical  
columns of NO<sub>2</sub> data in 2018, 2019 from Sentinel-5P,  
the European Space Agency.

Yufei Wei, 09 March 2022

10 0'0"E

RS-measured tropospheric vertical columns of NO<sub>2</sub> of  
Cremona, Italy  
eFUA\_ID: 2242  
at 1 km resolution

45 0'0"N



Locations of CBD in 2006, 2012 by Kilgarriff P., Lemoy R., Mader M.  
GHS-FUA data in 2019 from the European Union. Tropospheric vertical  
columns of NO<sub>2</sub> data in 2018, 2019 from Sentinel-5P,  
the European Space Agency.

Yufei Wei, 09 March 2022

18 50'0"E

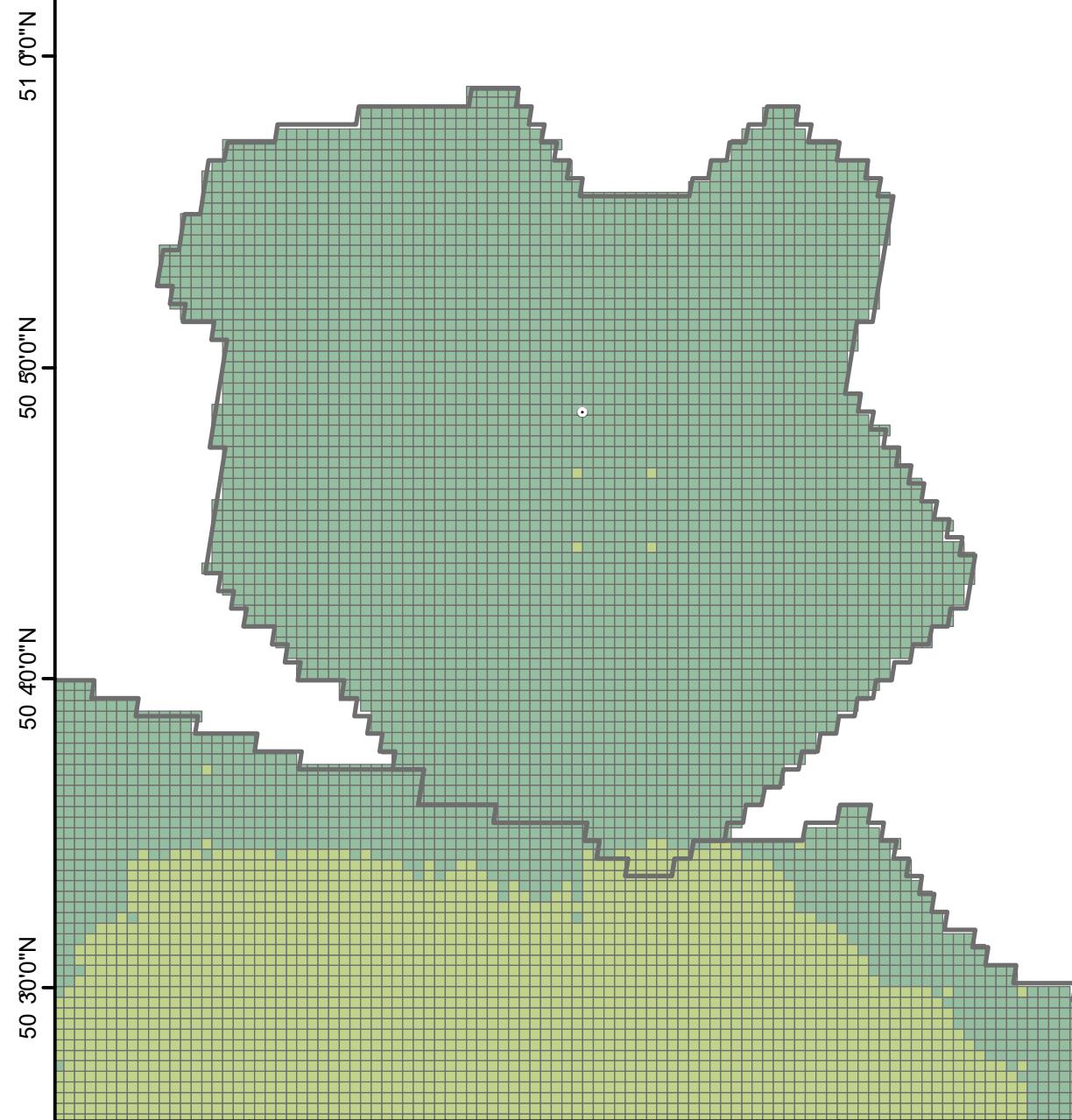
19 0'0"E

19 10'0"E

19 20'0"E

19 30'0"E

RS-measured tropospheric vertical columns of NO<sub>2</sub> of  
Czestochowa, Poland  
eFUA\_ID: 2725  
at 1 km resolution



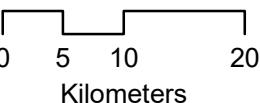
○ Central Business Districts (CBD)

◻ GHSL-OECD Functional Urban Areas (GHS-FUA)

**Annual mean tropospheric NO<sub>2</sub> columns in  $\mu\text{mol}/\text{m}^2$**

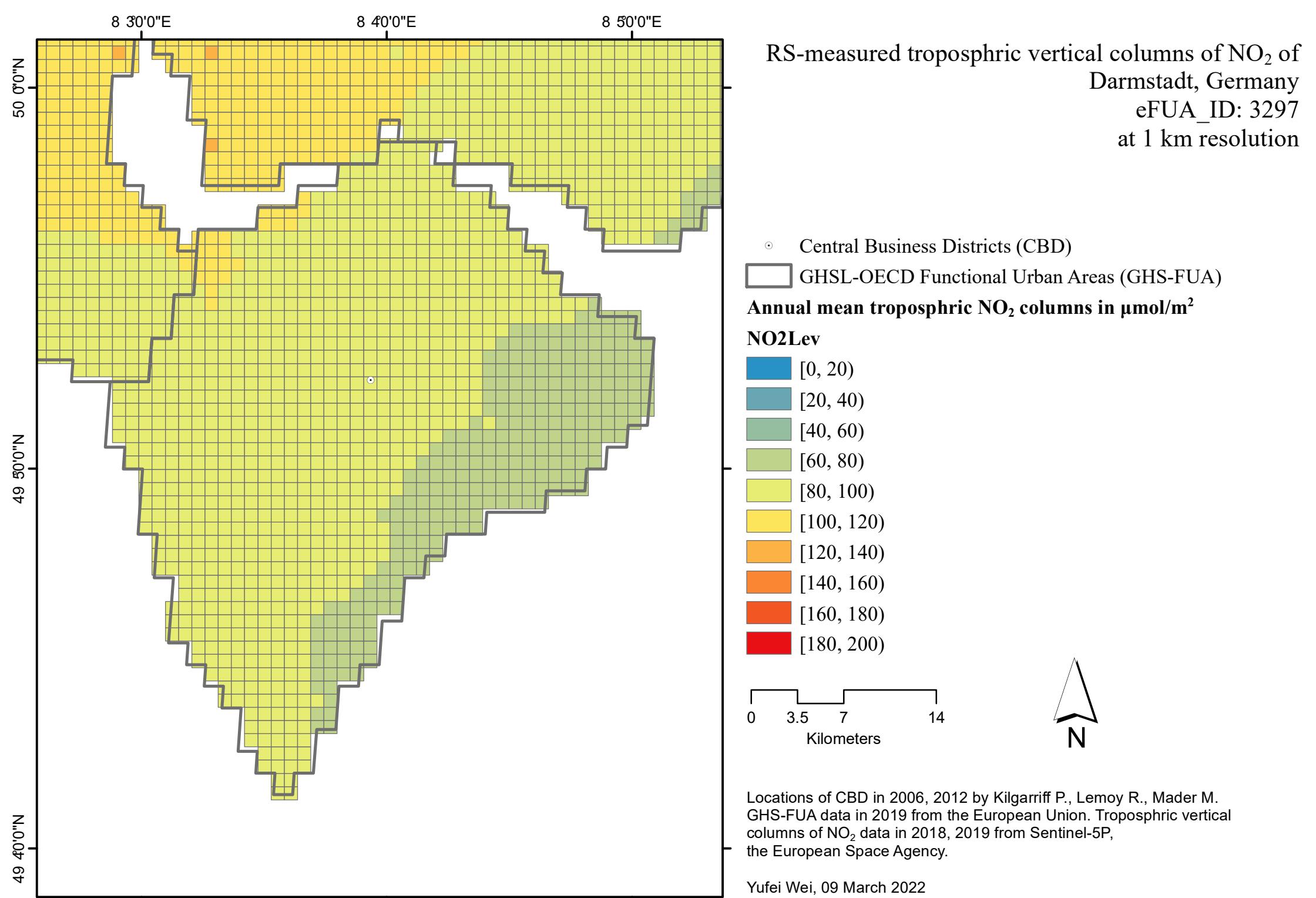
**NO2Lev**

[0, 20)
[20, 40)
[40, 60)
[60, 80)
[80, 100)
[100, 120)
[120, 140)
[140, 160)
[160, 180)
[180, 200)



Locations of CBD in 2006, 2012 by Kilgarriff P., Lemoy R., Mader M.  
GHS-FUA data in 2019 from the European Union. Tropospheric vertical  
columns of NO<sub>2</sub> data in 2018, 2019 from Sentinel-5P,  
the European Space Agency.

Yufei Wei, 09 March 2022



21 30'0"E

21 40'0"E

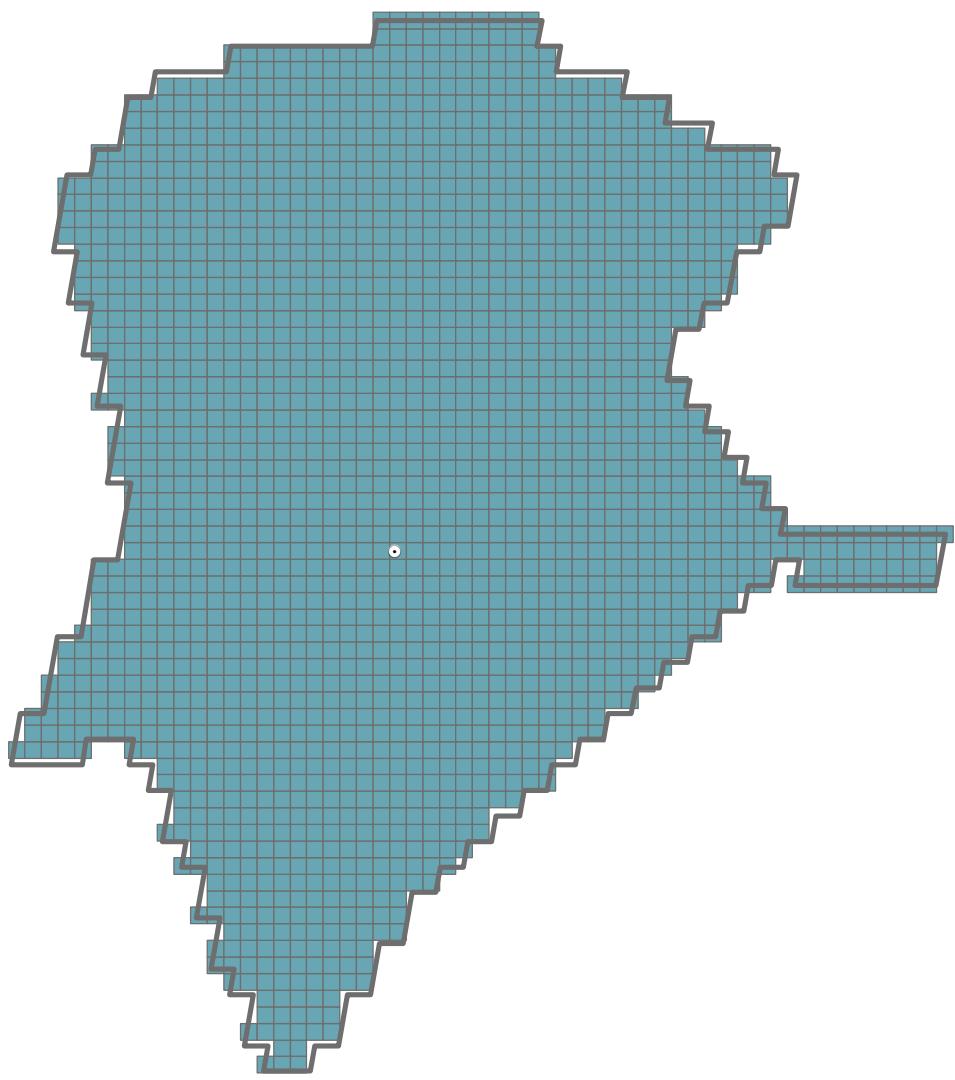
21 50'0"E

RS-measured tropospheric vertical columns of NO<sub>2</sub> of  
Debrecen, Hungary  
eFUA\_ID: 1404  
at 1 km resolution

47 40'0"N

47 30'0"N

47 20'0"N



○ Central Business Districts (CBD)

◻ GHS-OECD Functional Urban Areas (GHS-FUA)

Annual mean tropospheric NO<sub>2</sub> columns in  $\mu\text{mol}/\text{m}^2$

NO2Lev

- [0, 20]
- [20, 40]
- [40, 60]
- [60, 80]
- [80, 100]
- [100, 120]
- [120, 140]
- [140, 160]
- [160, 180]
- [180, 200]

0 4.75 9.5 19  
Kilometers



Locations of CBD in 2006, 2012 by Kilgarriff P., Lemoy R., Mader M.  
GHS-FUA data in 2019 from the European Union. Tropospheric vertical  
columns of NO<sub>2</sub> data in 2018, 2019 from Sentinel-5P,  
the European Space Agency.

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4 50'0"E

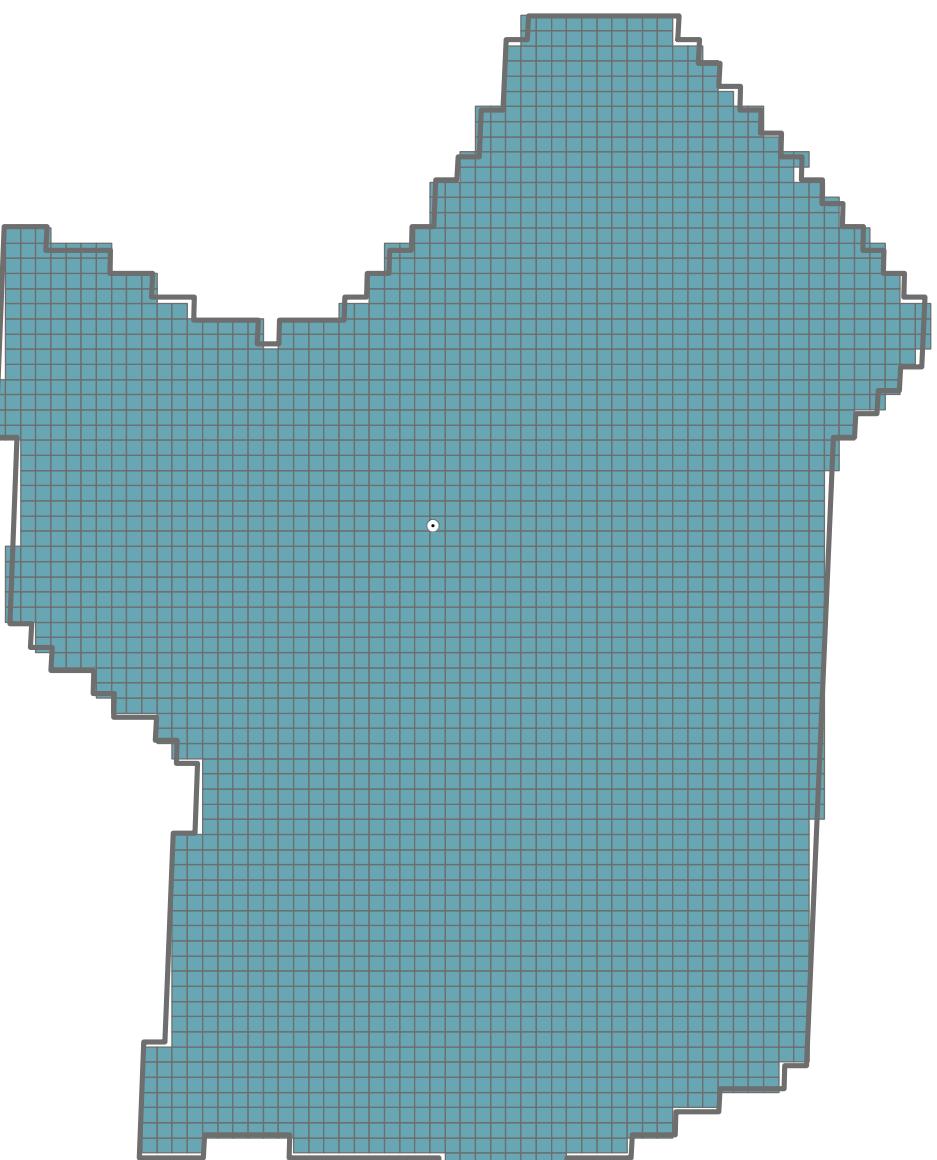
5 0'0"E

5 10'0"E

5 20'0"E

RS-measured tropospheric vertical columns of NO<sub>2</sub> of  
Dijon, France  
eFUA\_ID: 3798  
at 1 km resolution

47 30'0"N  
47 20'0"N  
47 10'0"N  
47 0'0"N



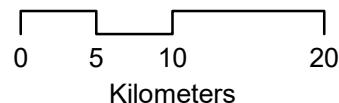
○ Central Business Districts (CBD)

◻ GHS-OECD Functional Urban Areas (GHS-FUA)

Annual mean tropospheric NO<sub>2</sub> columns in  $\mu\text{mol}/\text{m}^2$

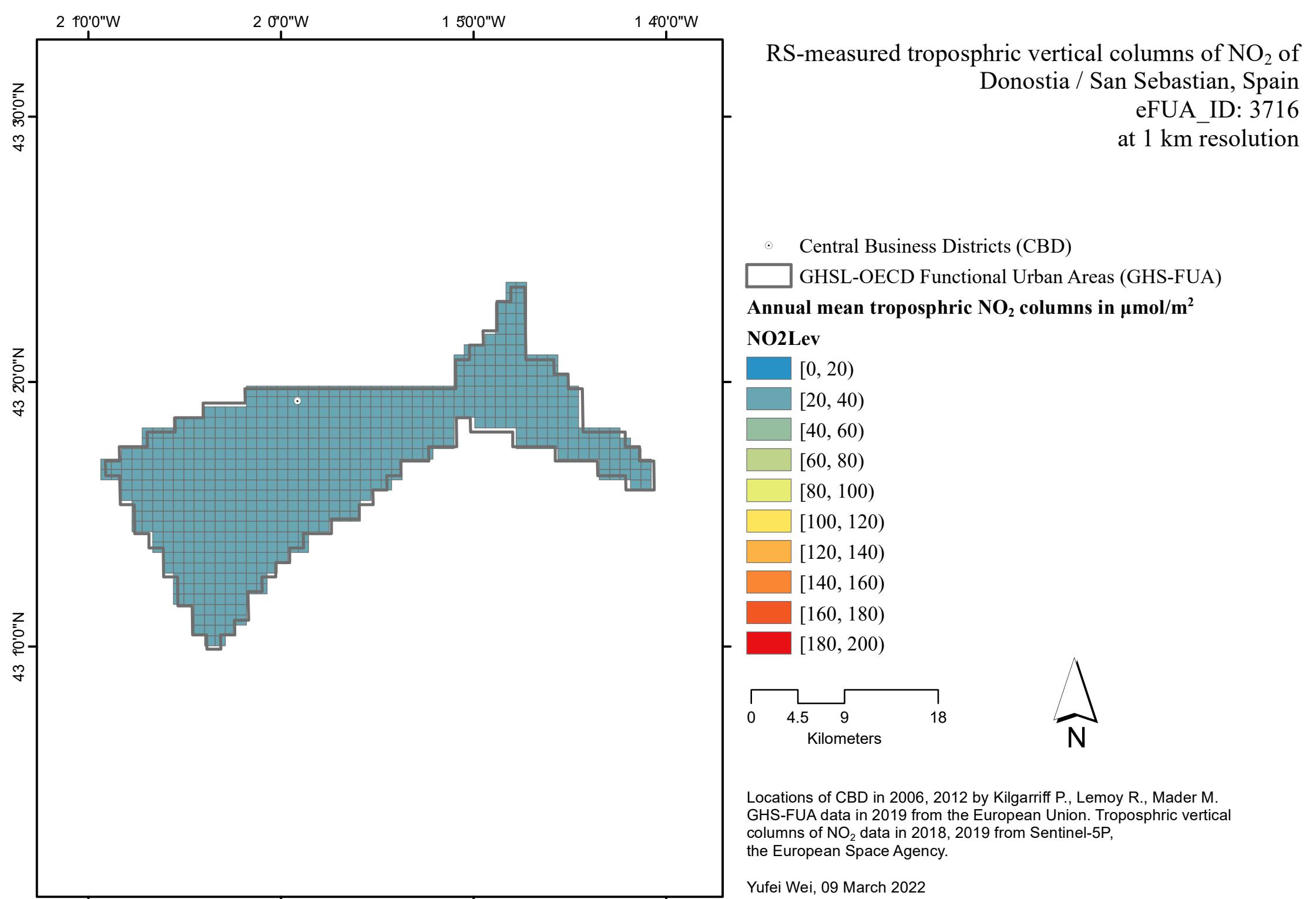
NO2Lev

- [0, 20]
- [20, 40]
- [40, 60]
- [60, 80]
- [80, 100]
- [100, 120]
- [120, 140]
- [140, 160]
- [160, 180]
- [180, 200]



Locations of CBD in 2006, 2012 by Kilgarriff P., Lemoy R., Mader M.  
GHS-FUA data in 2019 from the European Union. Tropospheric vertical  
columns of NO<sub>2</sub> data in 2018, 2019 from Sentinel-5P,  
the European Space Agency.

Yufei Wei, 09 March 2022



13 20'0"E 13 30'0"E 13 40'0"E 13 50'0"E 14 0'0"E

N  
51 20'0"N

N  
51 10'0"N

N  
51 0'0"N

N  
50 50'0"N

RS-measured tropospheric vertical columns of NO<sub>2</sub> of Dresden, Germany  
eFUA\_ID: 4996  
at 1 km resolution

○ Central Business Districts (CBD)

◻ GHSL-OECD Functional Urban Areas (GHS-FUA)

Annual mean tropospheric NO<sub>2</sub> columns in  $\mu\text{mol}/\text{m}^2$

NO2Lev

[0, 20)

[20, 40)

[40, 60)

[60, 80)

[80, 100)

[100, 120)

[120, 140)

[140, 160)

[160, 180)

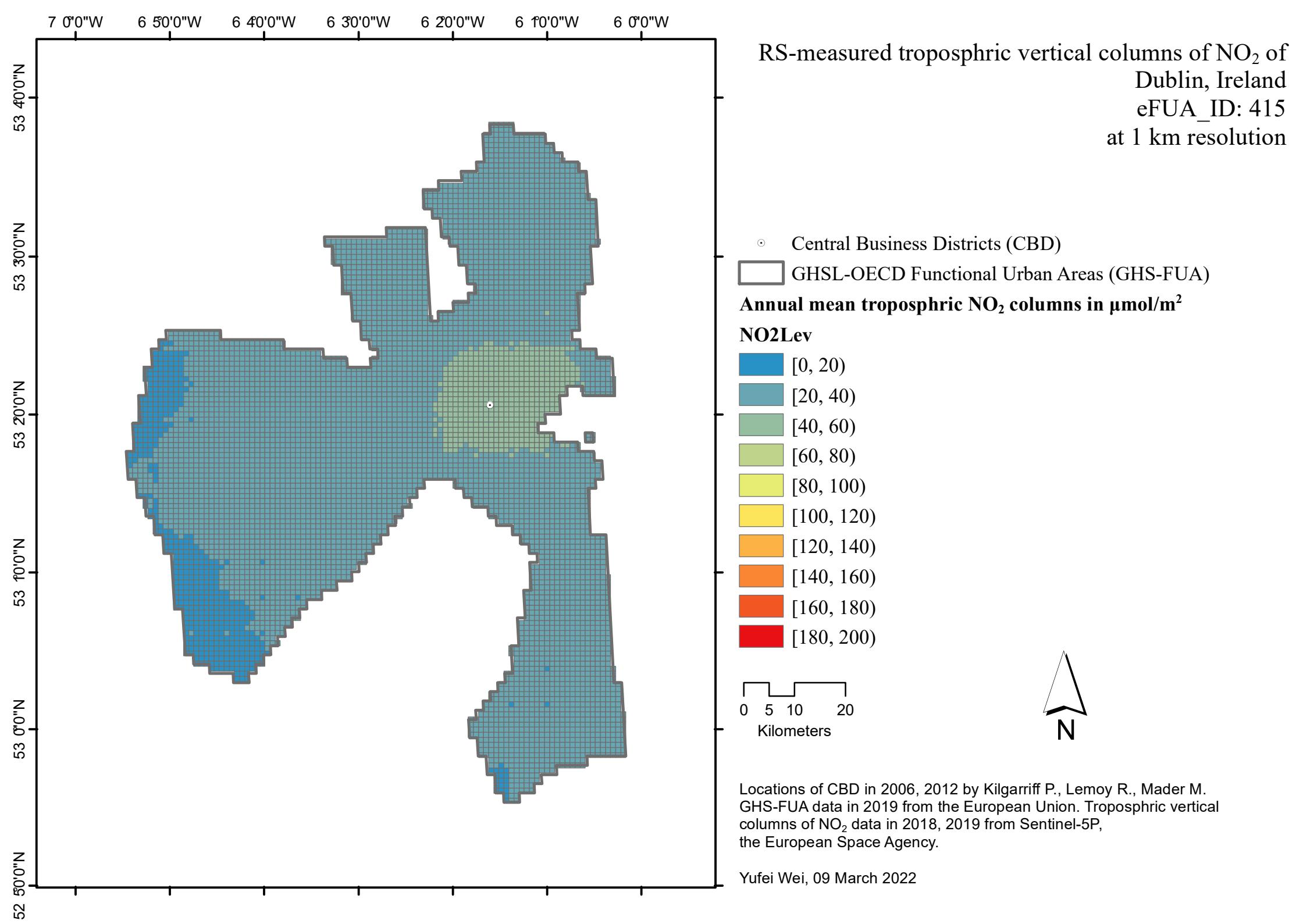
[180, 200)

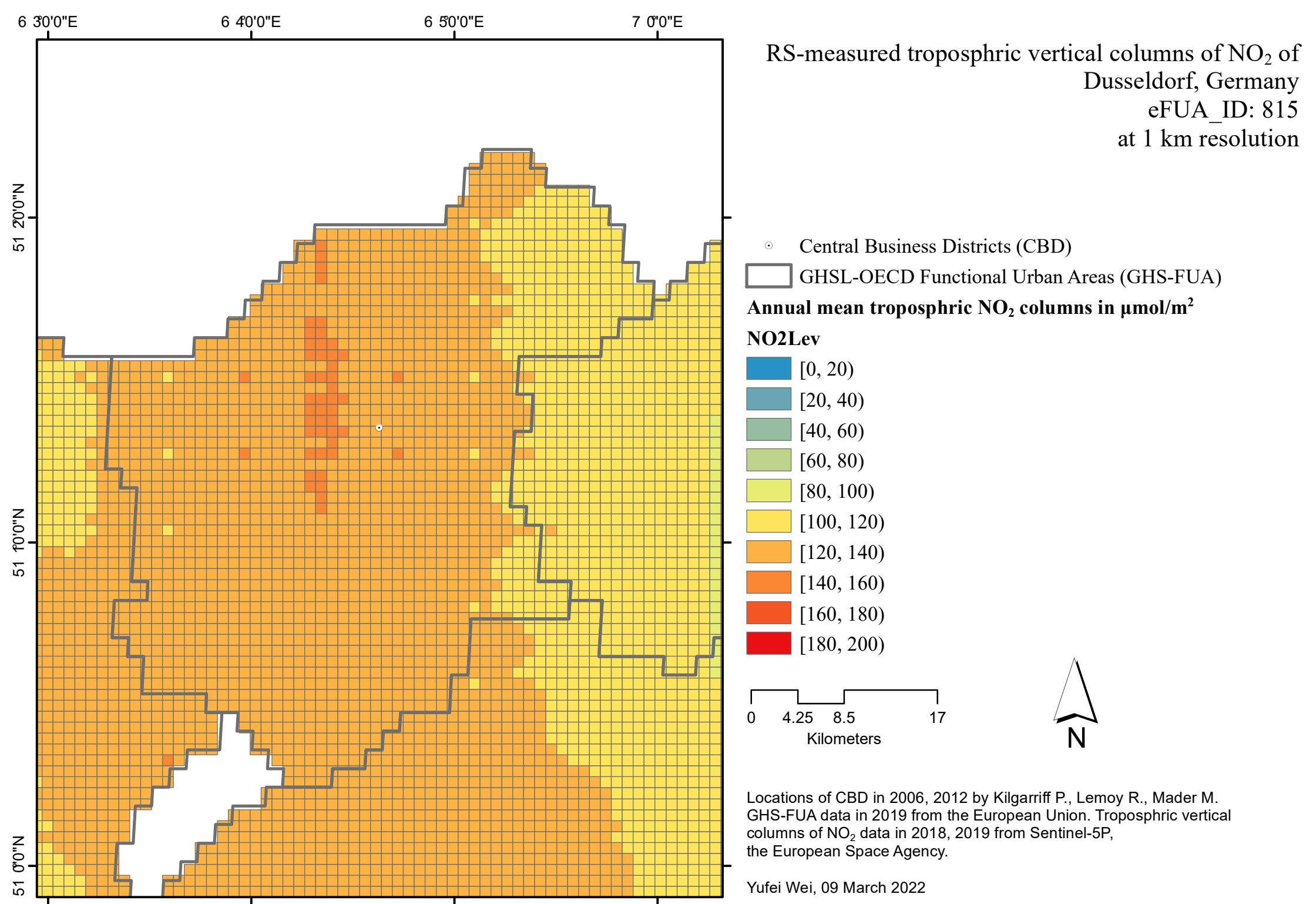
0 5 10 20  
Kilometers

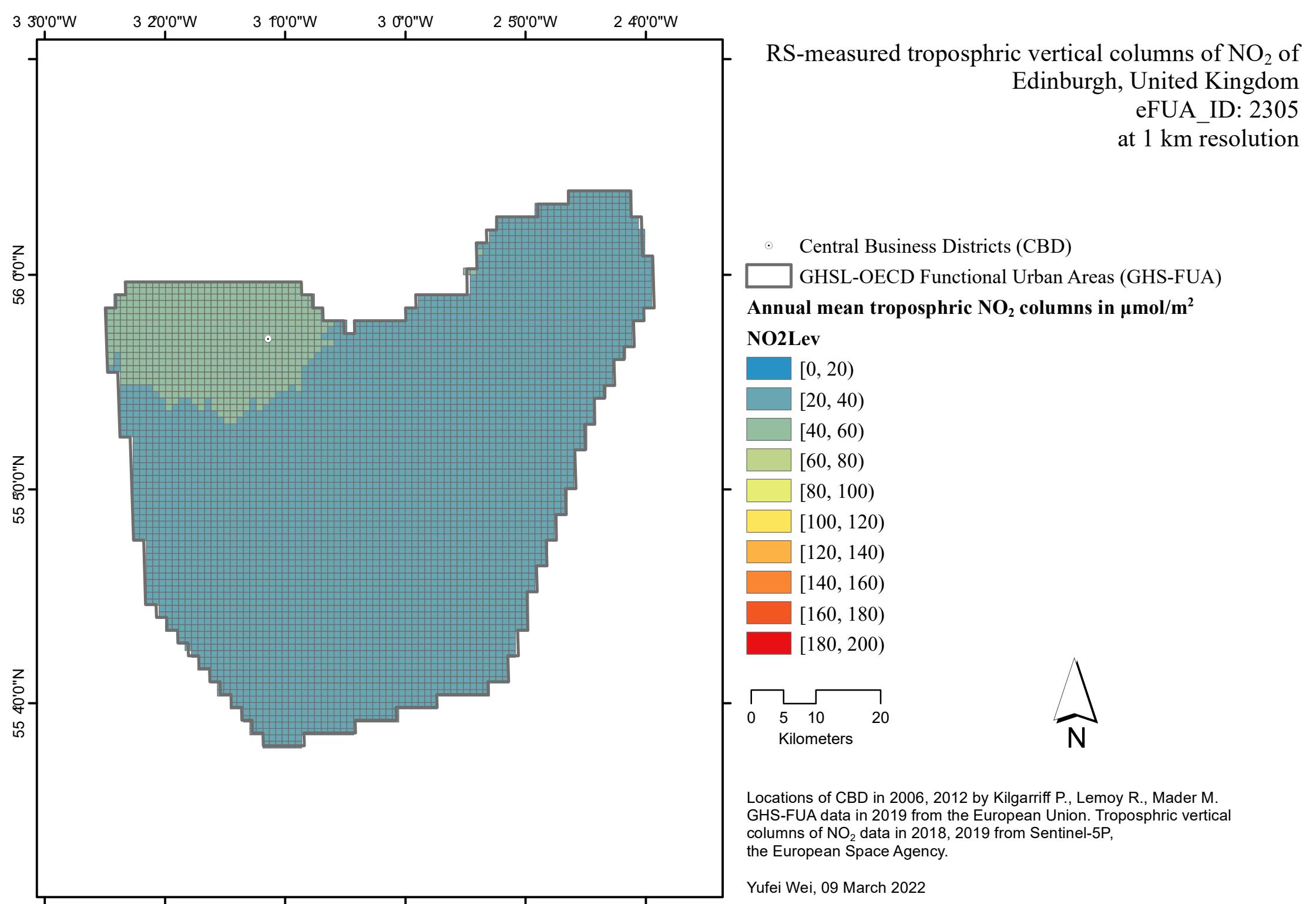


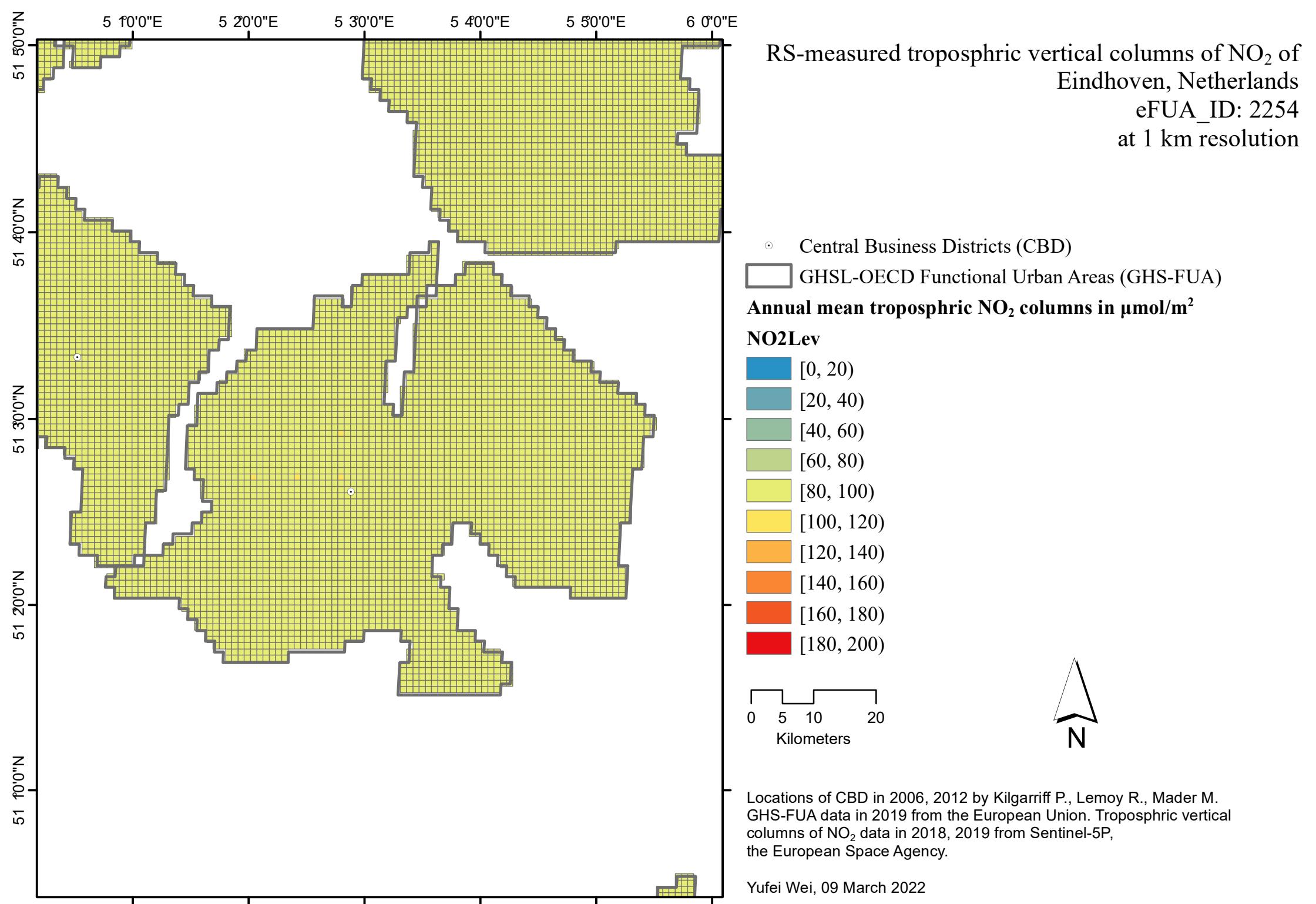
Locations of CBD in 2006, 2012 by Kilgarriff P., Lemoy R., Mader M.  
GHS-FUA data in 2019 from the European Union. Tropospheric vertical  
columns of NO<sub>2</sub> data in 2018, 2019 from Sentinel-5P,  
the European Space Agency.

Yufei Wei, 09 March 2022







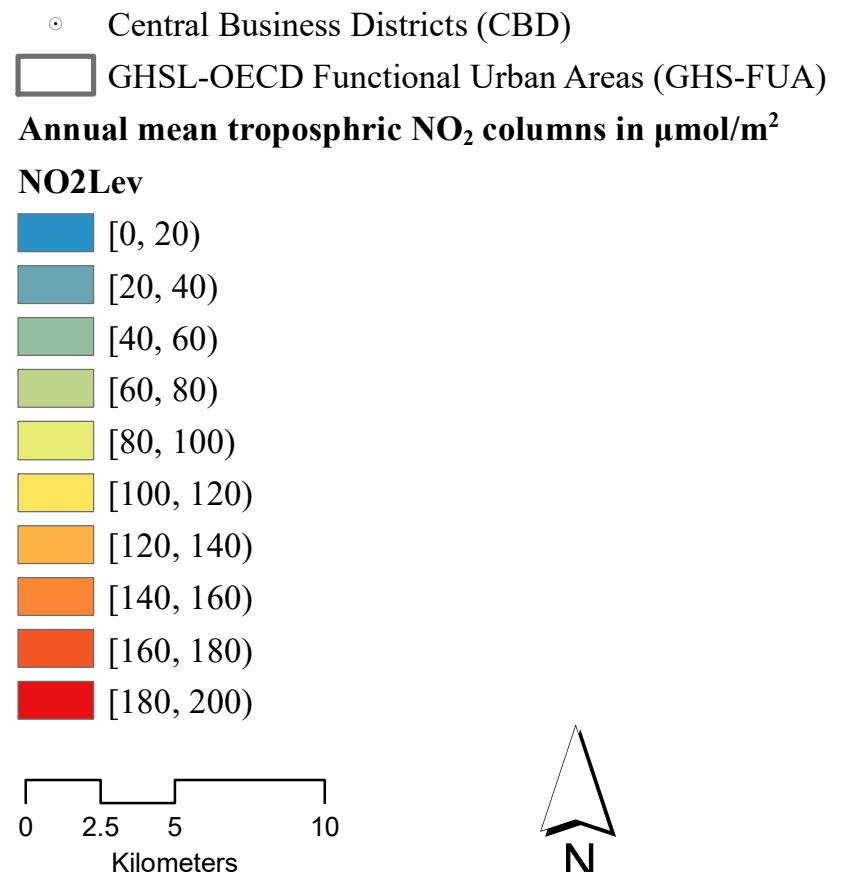
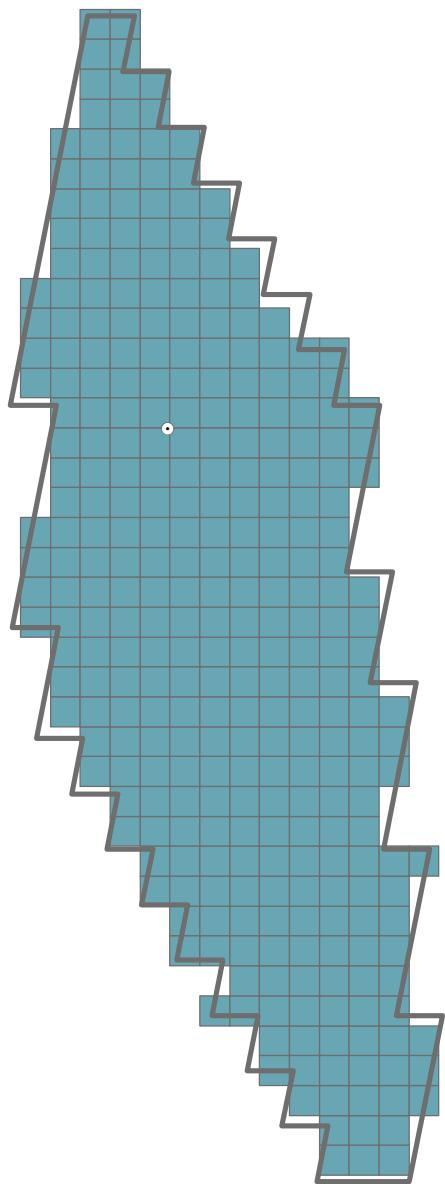


22 20'0"E

22 30'0"E

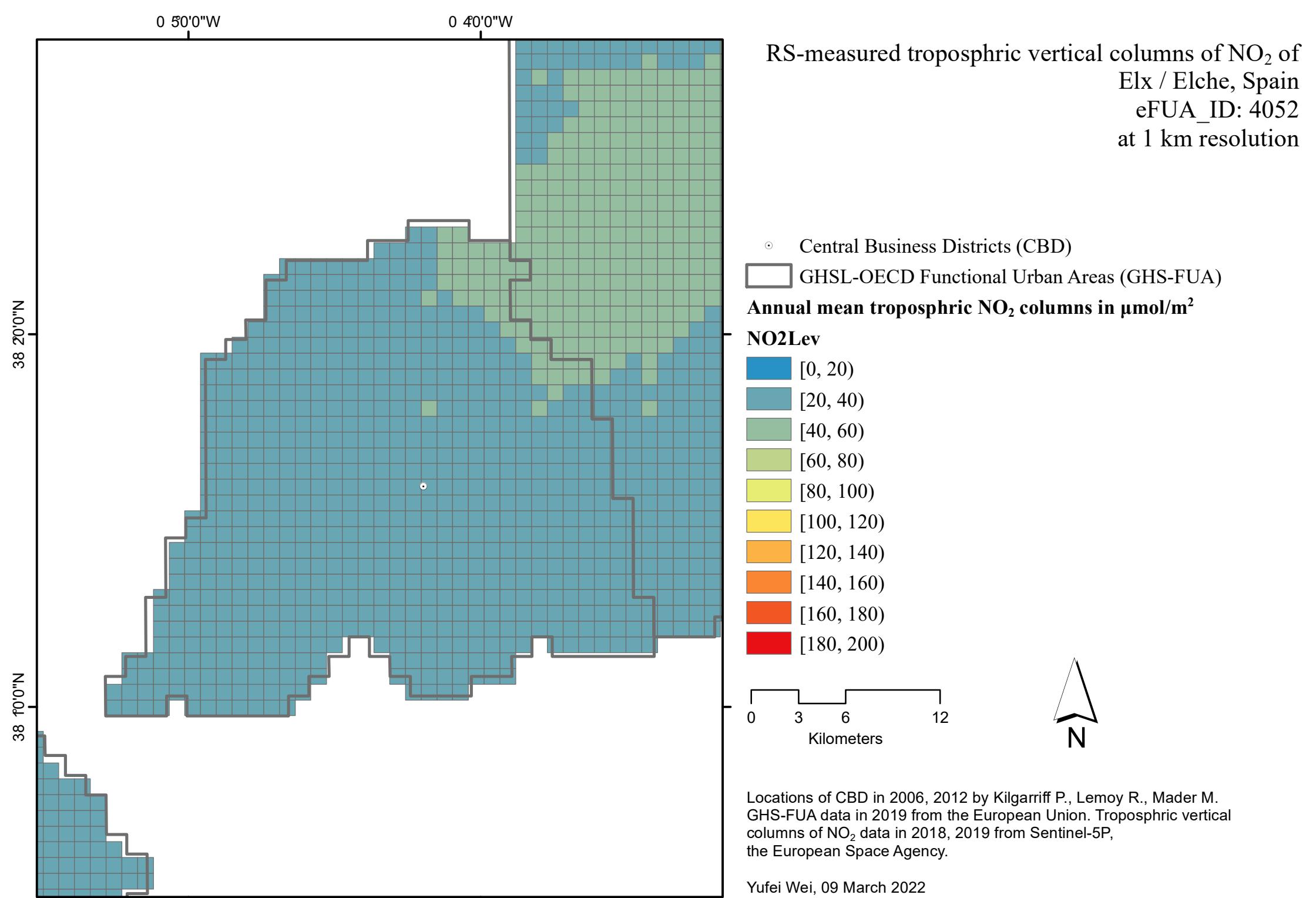
RS-measured tropospheric vertical columns of NO<sub>2</sub> of  
Elk, Poland  
eFUA\_ID: 3513  
at 1 km resolution

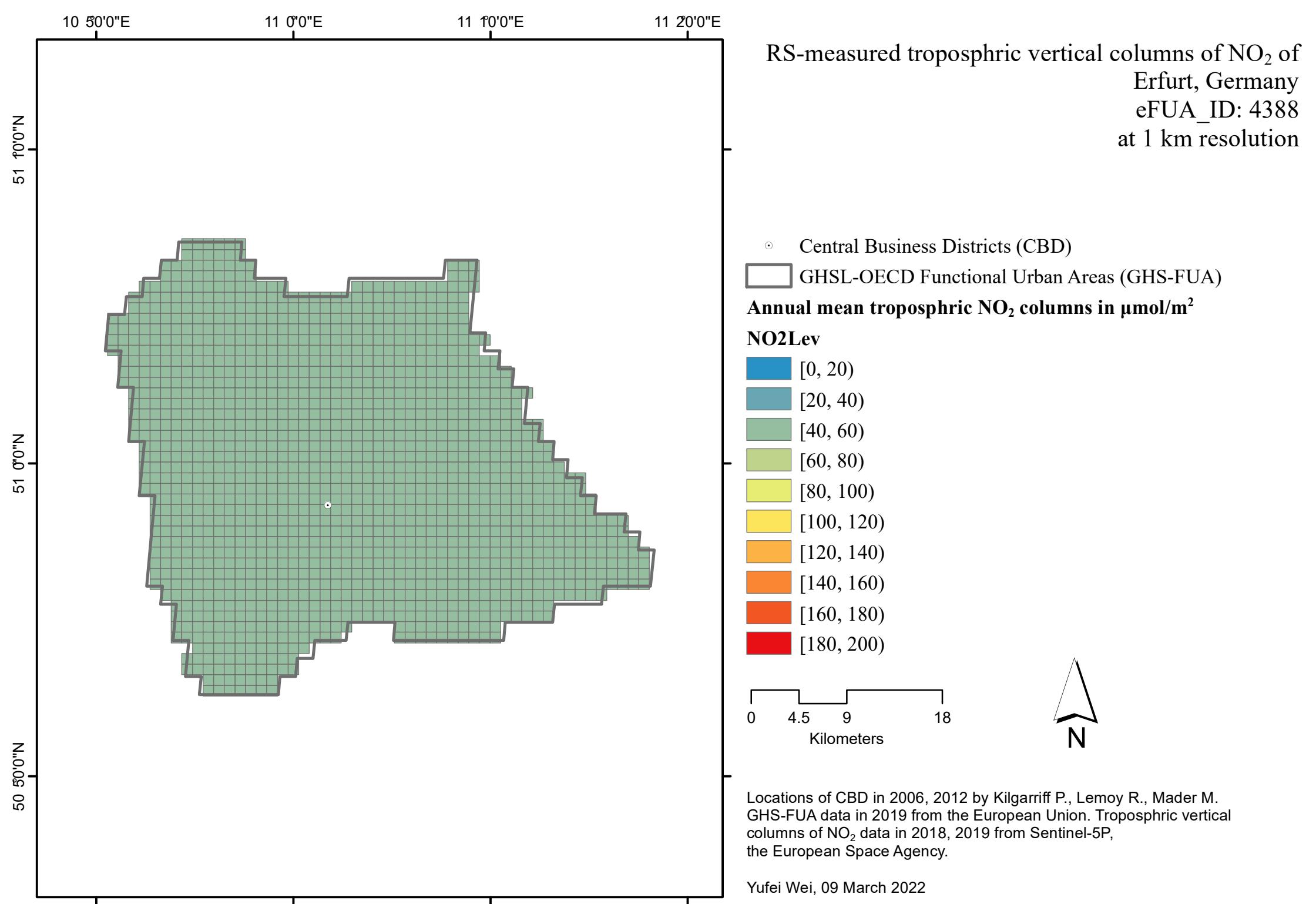
53 50'0"N  
53 40'0"N



Locations of CBD in 2006, 2012 by Kilgarriff P., Lemoy R., Mader M.  
GHS-FUA data in 2019 from the European Union. Tropospheric vertical  
columns of NO<sub>2</sub> data in 2018, 2019 from Sentinel-5P,  
the European Space Agency.

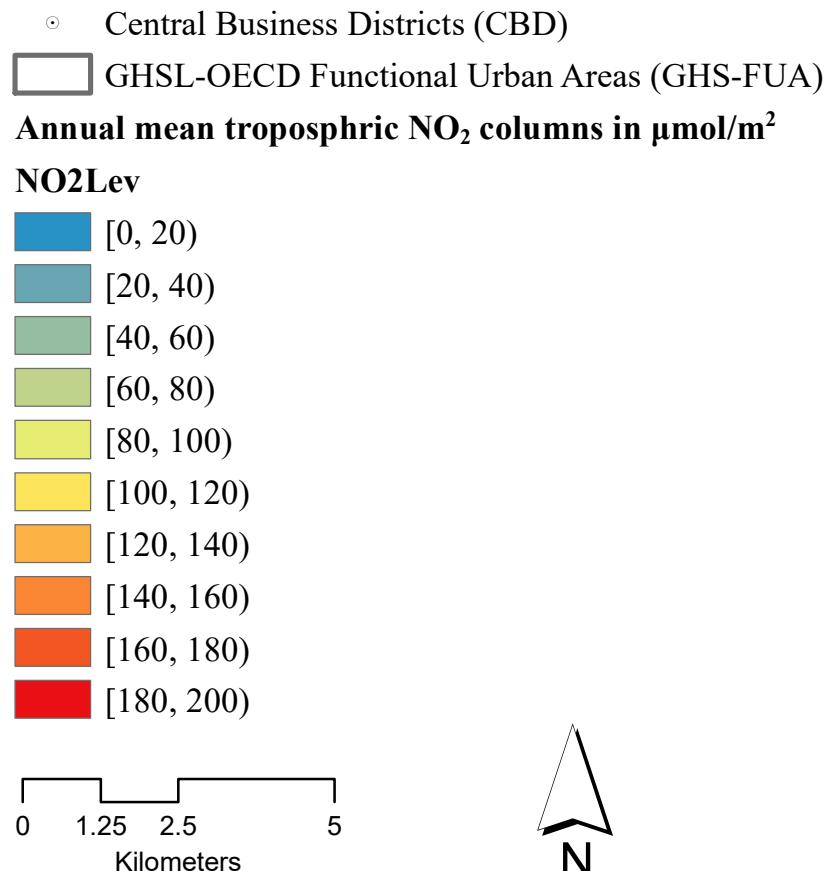
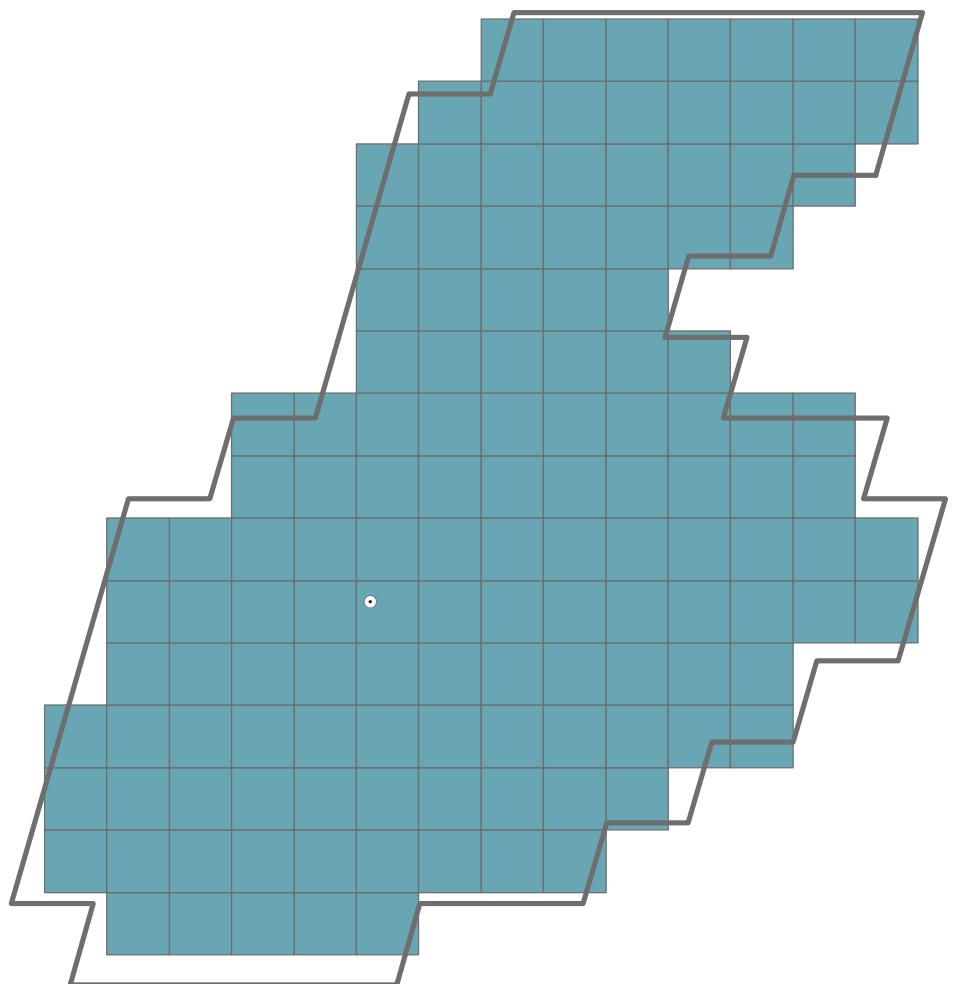
Yufei Wei, 09 March 2022





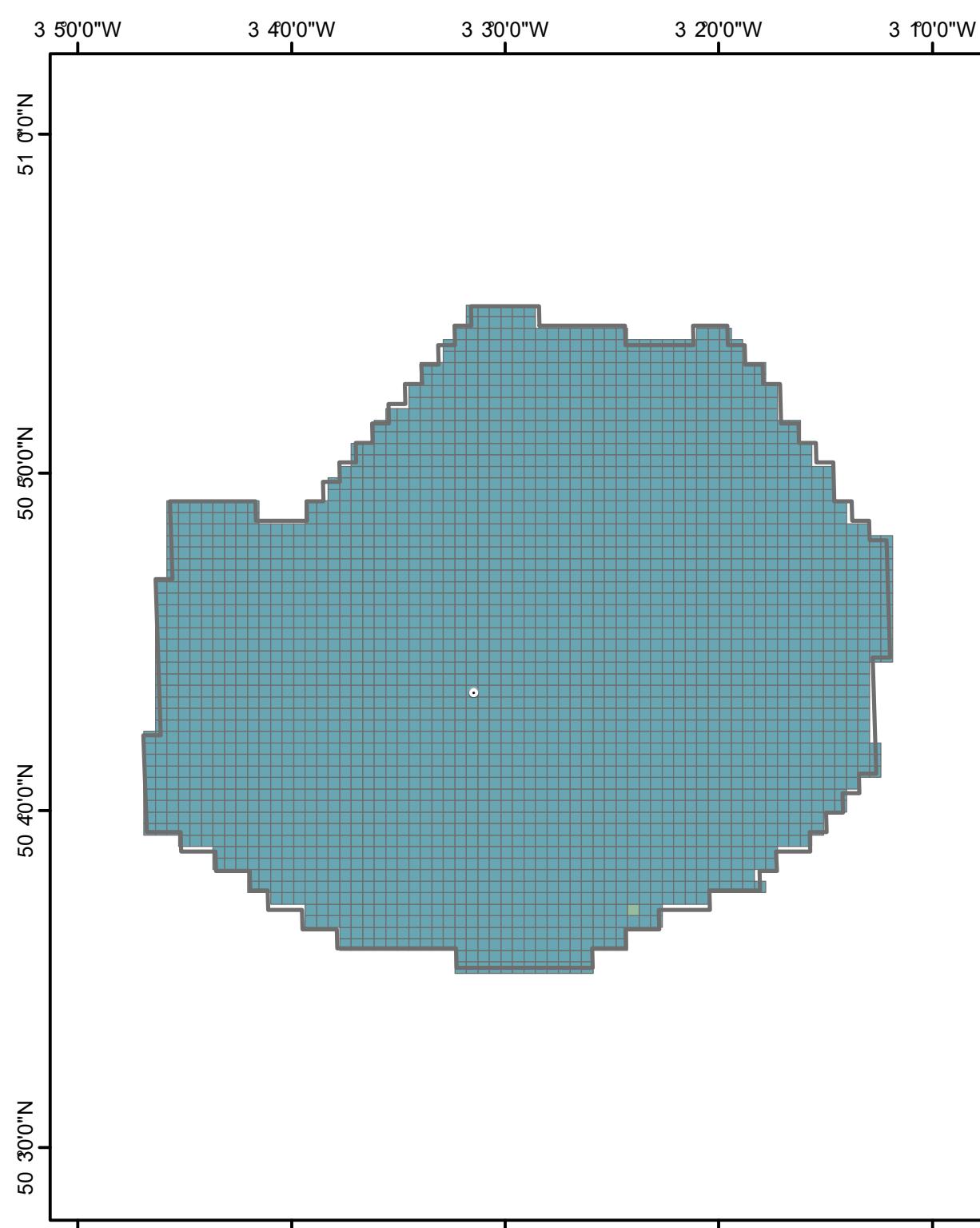
41°20'0"E

RS-measured tropospheric vertical columns of NO<sub>2</sub> of  
Erzurum, Turkey  
eFUA\_ID: 5462  
at 1 km resolution

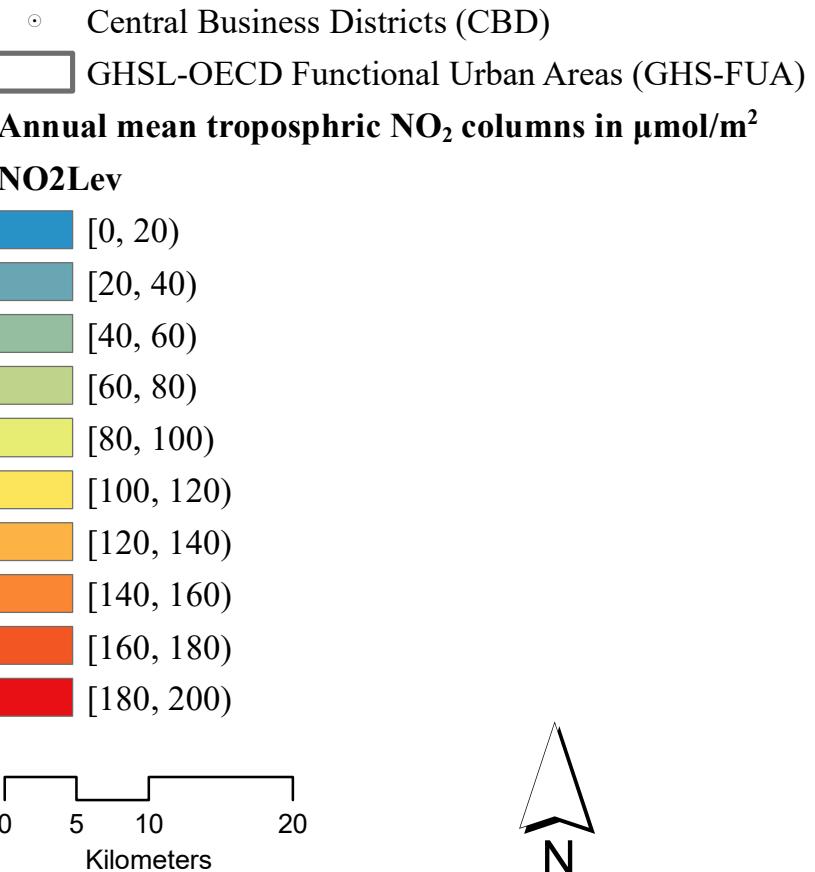


Locations of CBD in 2006, 2012 by Kilgarriff P., Lemoy R., Mader M.  
GHS-FUA data in 2019 from the European Union. Tropospheric vertical  
columns of NO<sub>2</sub> data in 2018, 2019 from Sentinel-5P,  
the European Space Agency.

Yufei Wei, 09 March 2022



RS-measured tropospheric vertical columns of NO<sub>2</sub> of  
Exeter, United Kingdom  
eFUA\_ID: 1854  
at 1 km resolution



Locations of CBD in 2006, 2012 by Kilgarriff P., Lemoy R., Mader M.  
GHS-FUA data in 2019 from the European Union. Tropospheric vertical  
columns of NO<sub>2</sub> data in 2018, 2019 from Sentinel-5P,  
the European Space Agency.

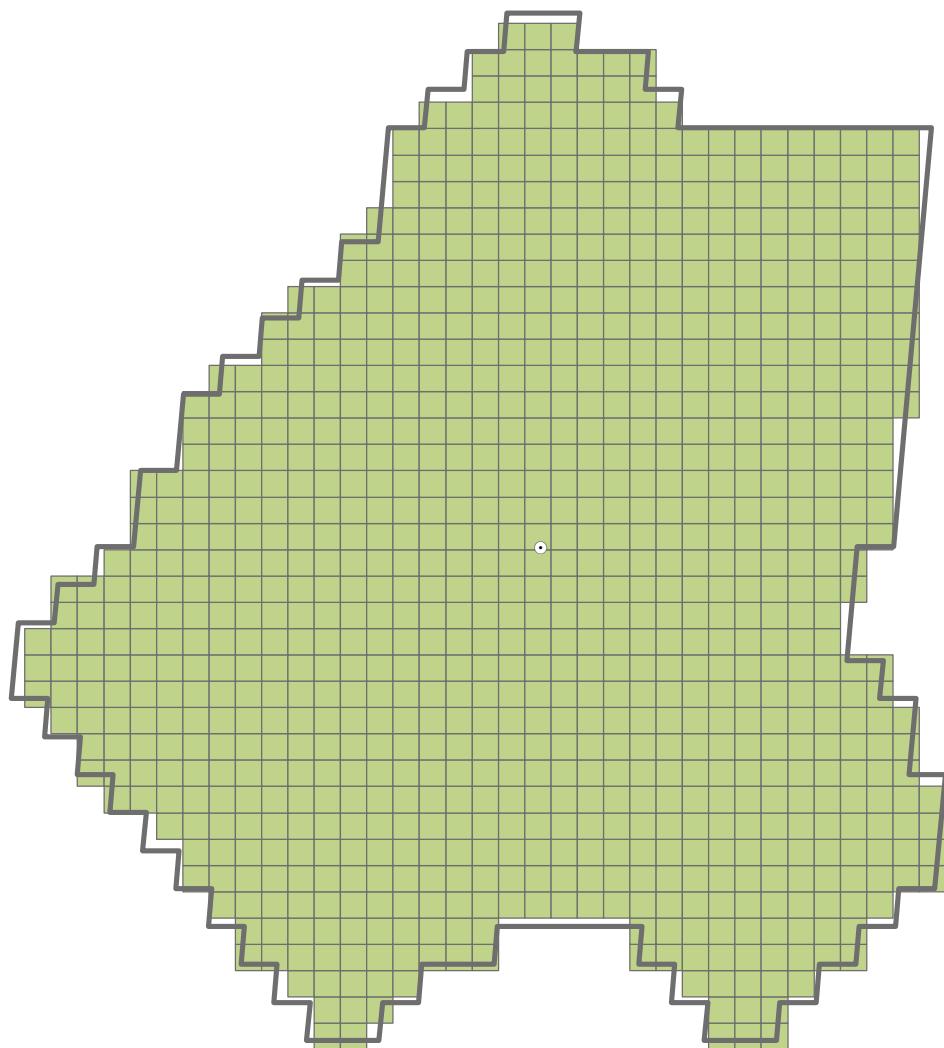
Yufei Wei, 09 March 2022

11 30'0"E

11 40'0"E

45 0'0"N

44 50'0"N



RS-measured tropospheric vertical columns of NO<sub>2</sub> of  
Ferrara, Italy  
eFUA\_ID: 3311  
at 1 km resolution

○ Central Business Districts (CBD)

◻ GHS-OECD Functional Urban Areas (GHS-FUA)

Annual mean tropospheric NO<sub>2</sub> columns in  $\mu\text{mol}/\text{m}^2$

NO2Lev

- [0, 20]
- [20, 40]
- [40, 60]
- [60, 80]
- [80, 100]
- [100, 120]
- [120, 140]
- [140, 160]
- [160, 180]
- [180, 200]

0 3 6 12  
Kilometers



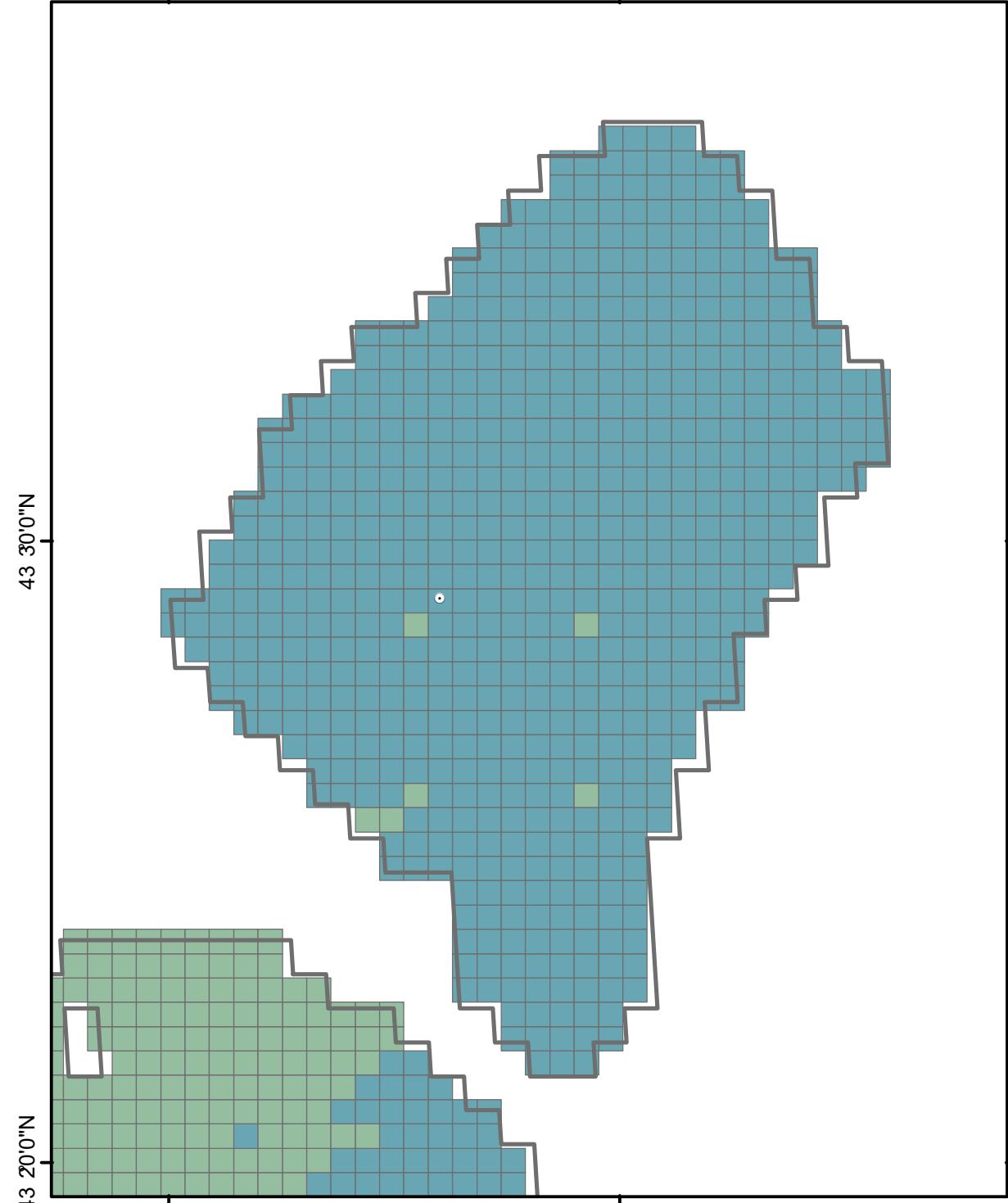
Locations of CBD in 2006, 2012 by Kilgarriff P., Lemoy R., Mader M.  
GHS-FUA data in 2019 from the European Union. Tropospheric vertical  
columns of NO<sub>2</sub> data in 2018, 2019 from Sentinel-5P,  
the European Space Agency.

Yufei Wei, 09 March 2022

8 20'0"W

8 10'0"W

RS-measured tropospheric vertical columns of NO<sub>2</sub> of  
Ferrol, Spain  
eFUA\_ID: 1183  
at 1 km resolution



0 2.75 5.5 11  
Kilometers



Locations of CBD in 2006, 2012 by Kilgarriff P., Lemoy R., Mader M.  
GHS-FUA data in 2019 from the European Union. Tropospheric vertical  
columns of NO<sub>2</sub> data in 2018, 2019 from Sentinel-5P,  
the European Space Agency.

Yufei Wei, 09 March 2022

11 0°0"E

11 10'0"E

11 20'0"E

11 30'0"E

44 0°0"N

43 50'0"N

43 40'0"N

RS-measured tropospheric vertical columns of NO<sub>2</sub> of  
Florence, Italy  
eFUA\_ID: 3106  
at 1 km resolution

○ Central Business Districts (CBD)

◻ GHSL-OECD Functional Urban Areas (GHS-FUA)

Annual mean tropospheric NO<sub>2</sub> columns in  $\mu\text{mol}/\text{m}^2$

NO2Lev

[0, 20)

[20, 40)

[40, 60)

[60, 80)

[80, 100)

[100, 120)

[120, 140)

[140, 160)

[160, 180)

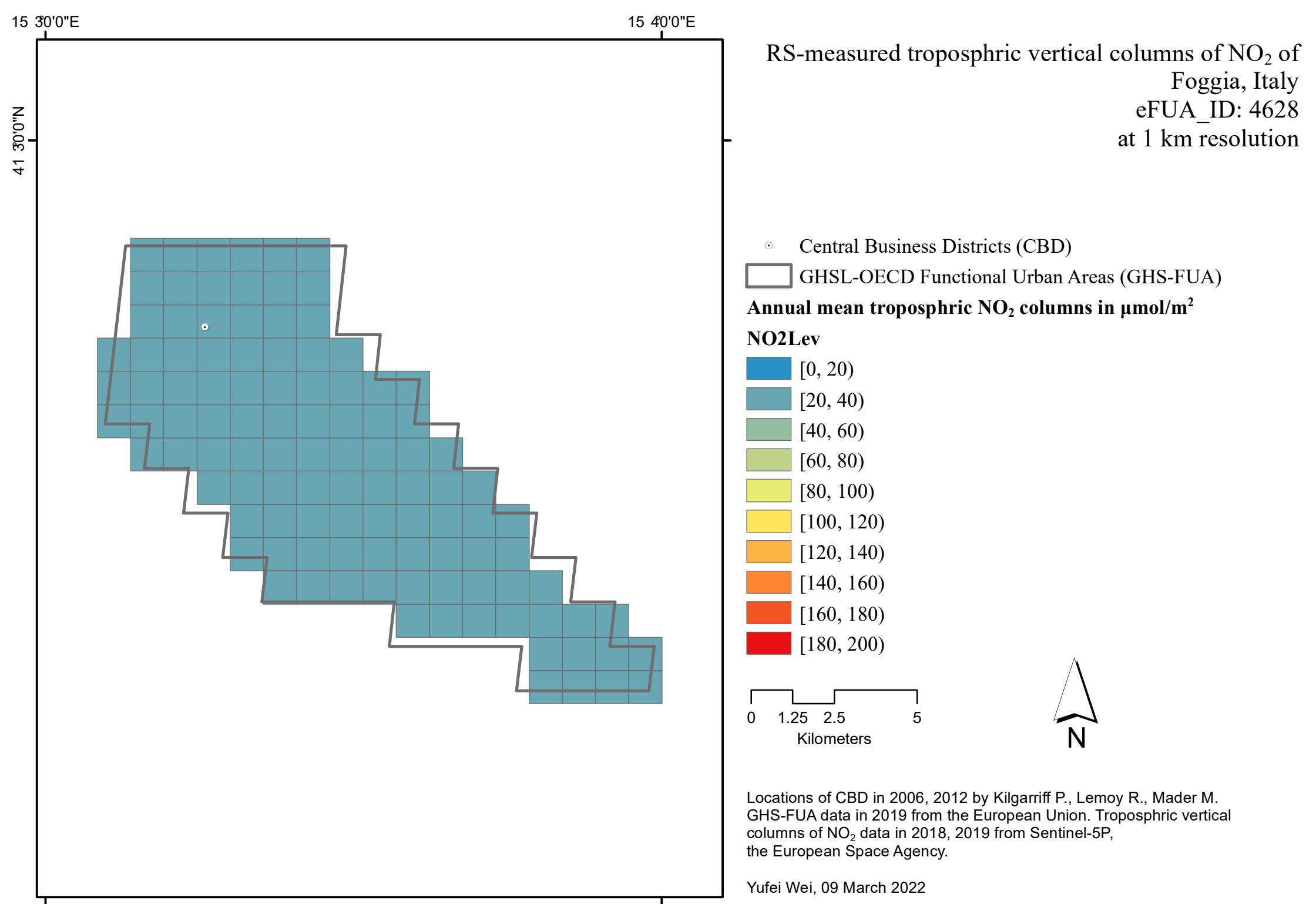
[180, 200)

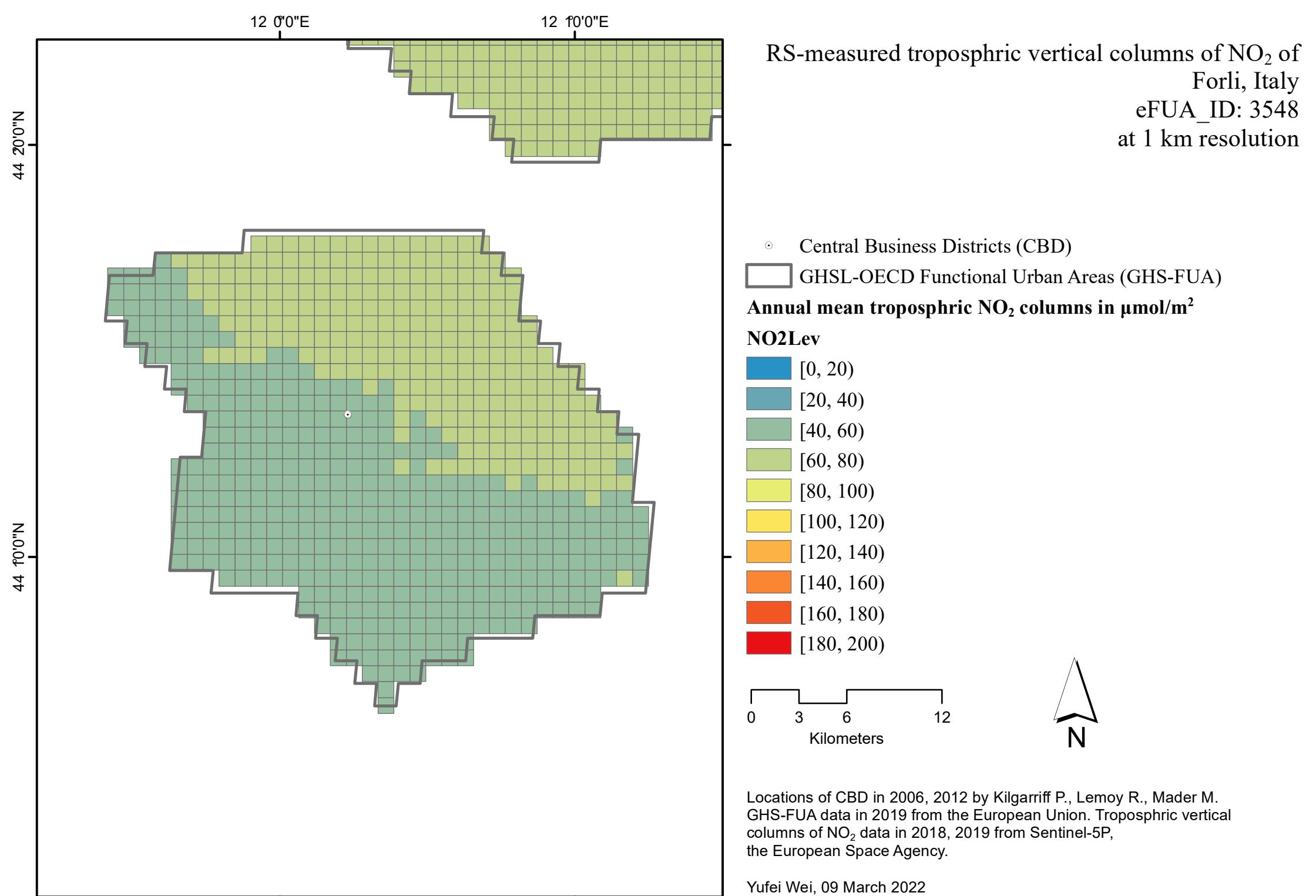
0 5 10 20  
Kilometers

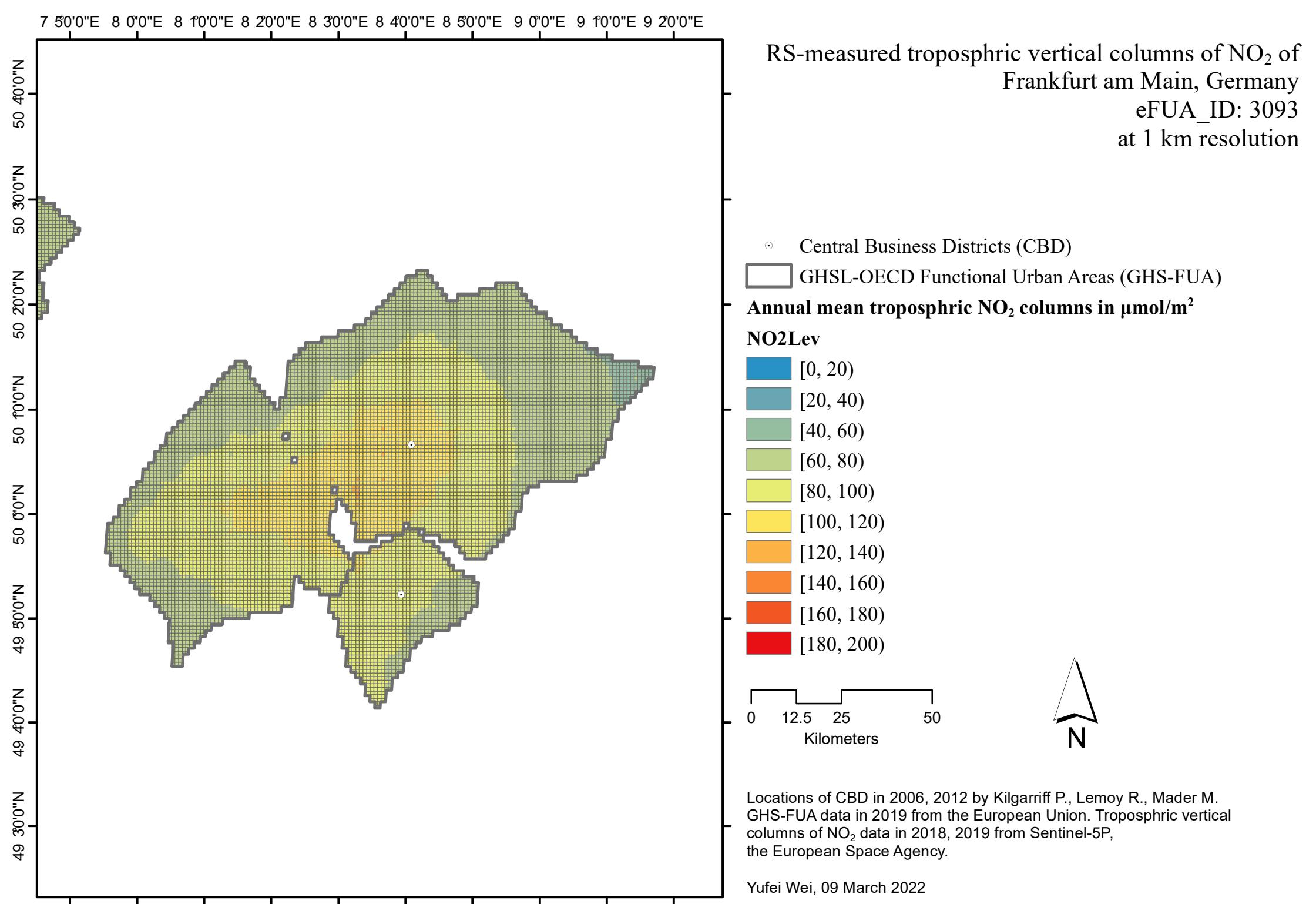


Locations of CBD in 2006, 2012 by Kilgarriff P., Lemoy R., Mader M.  
GHS-FUA data in 2019 from the European Union. Tropospheric vertical  
columns of NO<sub>2</sub> data in 2018, 2019 from Sentinel-5P,  
the European Space Agency.

Yufei Wei, 09 March 2022







7 40'0"E

7 50'0"E

8 0'0"E

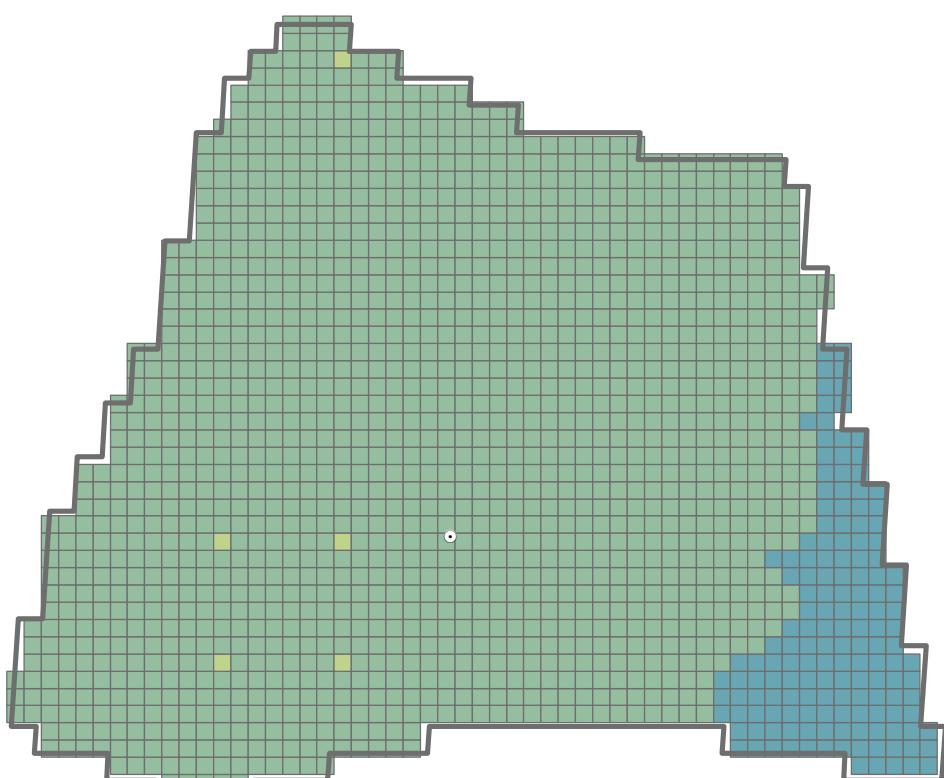
8 10'0"E

RS-measured tropospheric vertical columns of NO<sub>2</sub> of  
 Freiburg im Breisgau, Germany  
 eFUA\_ID: 2435  
 at 1 km resolution

48 10'0"N

48 0'0"N

47 50'0"N



○ Central Business Districts (CBD)

◻ GHS-OECD Functional Urban Areas (GHS-FUA)

**Annual mean tropospheric NO<sub>2</sub> columns in  $\mu\text{mol}/\text{m}^2$**

**NO2Lev**

- [0, 20]
- [20, 40]
- [40, 60]
- [60, 80]
- [80, 100]
- [100, 120]
- [120, 140]
- [140, 160]
- [160, 180]
- [180, 200]

0 4.5 9 18  
Kilometers

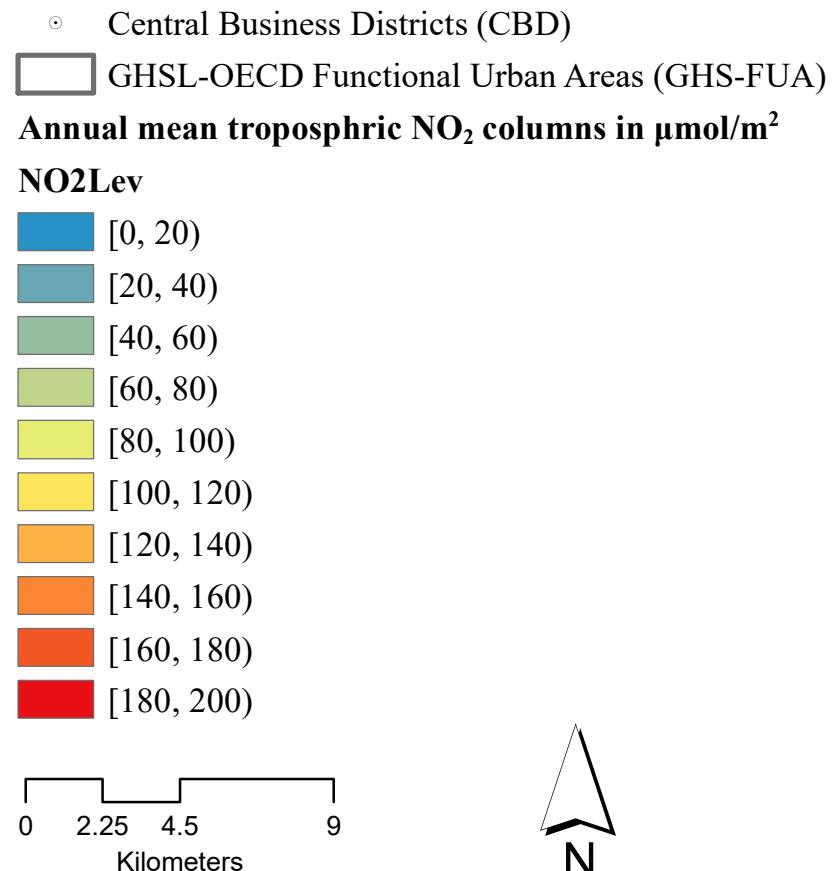
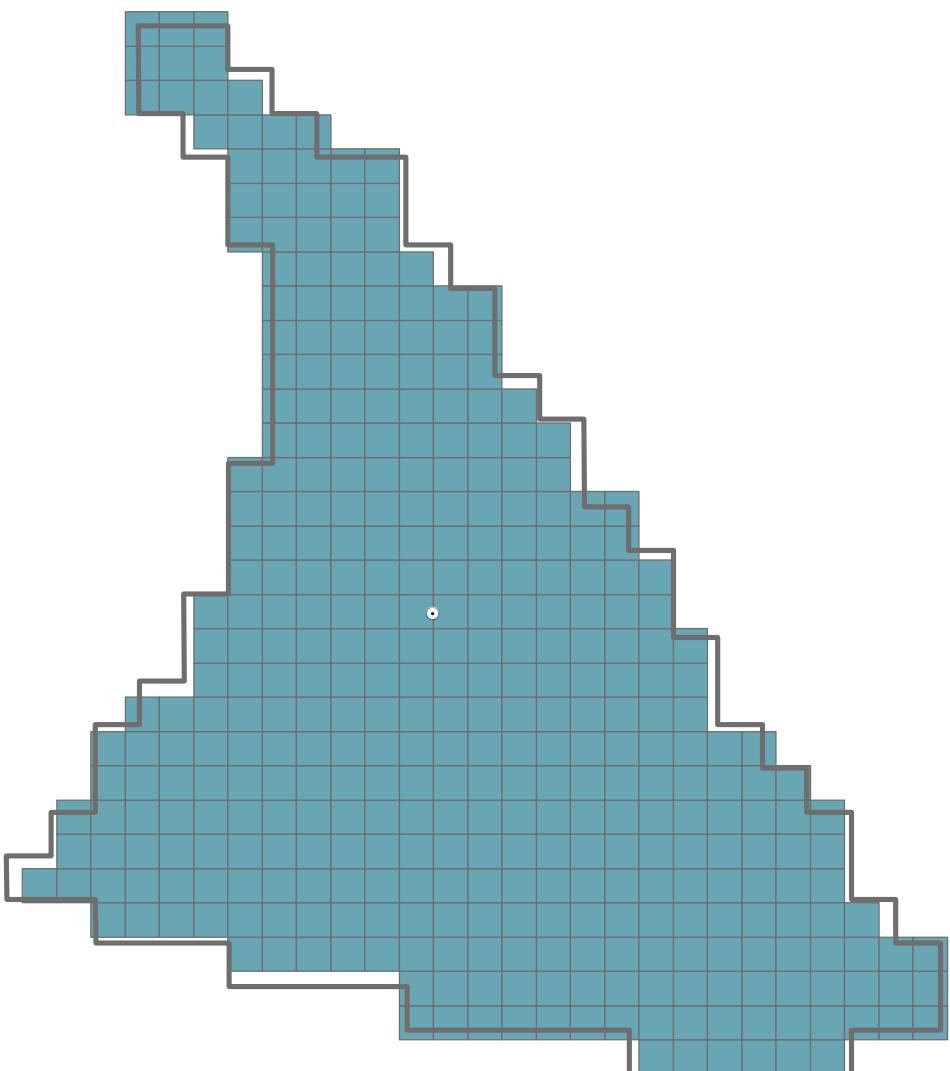


Locations of CBD in 2006, 2012 by Kilgarriff P., Lemoy R., Mader M.  
 GHS-FUA data in 2019 from the European Union. Tropospheric vertical  
 columns of NO<sub>2</sub> data in 2018, 2019 from Sentinel-5P,  
 the European Space Agency.

Yufei Wei, 09 March 2022

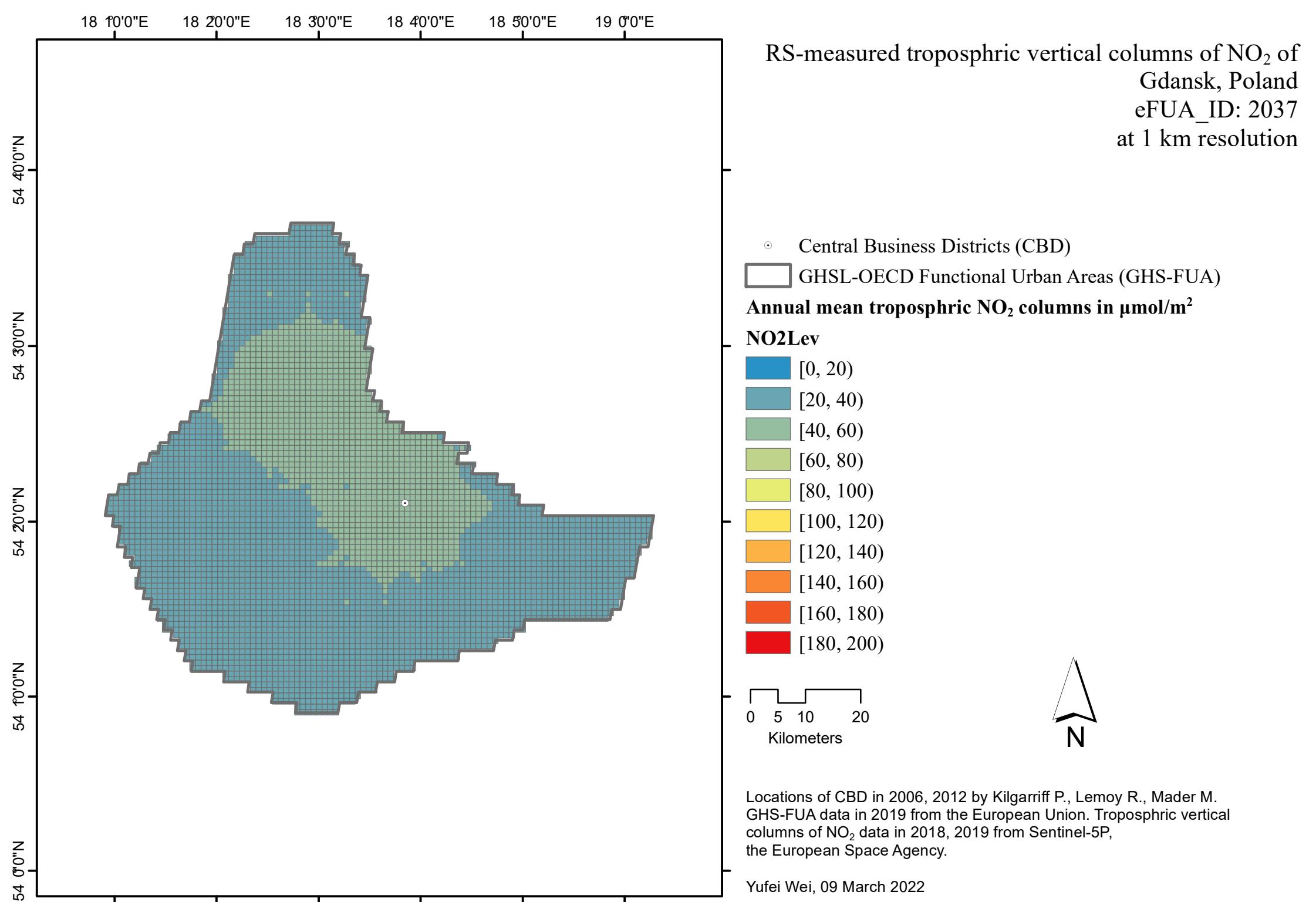
0 10'0"W

RS-measured tropospheric vertical columns of NO<sub>2</sub> of  
Gandia, Spain  
eFUA\_ID: 4190  
at 1 km resolution

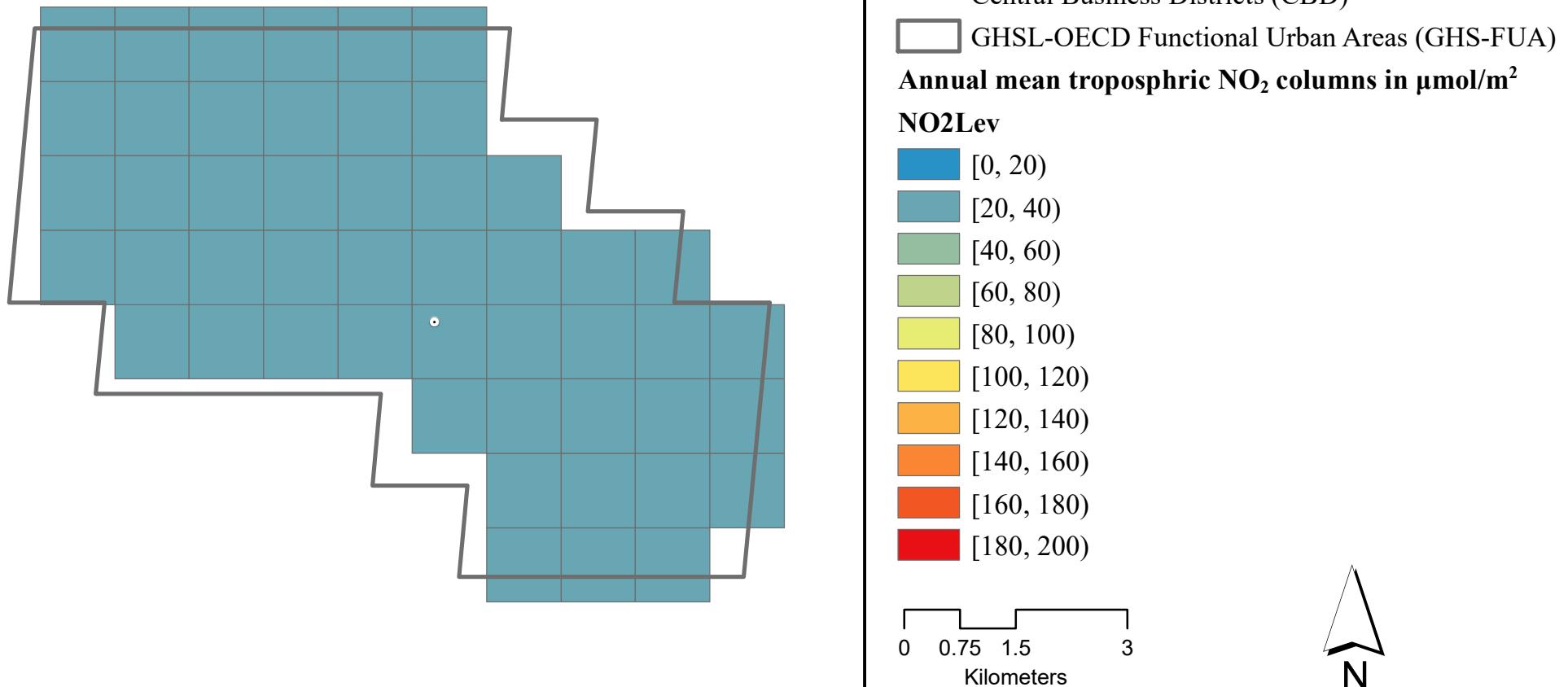


Locations of CBD in 2006, 2012 by Kilgarriff P., Lemoy R., Mader M.  
GHS-FUA data in 2019 from the European Union. Tropospheric vertical  
columns of NO<sub>2</sub> data in 2018, 2019 from Sentinel-5P,  
the European Space Agency.

Yufei Wei, 09 March 2022



RS-measured tropospheric vertical columns of NO<sub>2</sub> of  
Gela, Italy  
eFUA\_ID: 4432  
at 1 km resolution



Locations of CBD in 2006, 2012 by Kilgarriff P., Lemoy R., Mader M.  
GHS-FUA data in 2019 from the European Union. Tropospheric vertical  
columns of NO<sub>2</sub> data in 2018, 2019 from Sentinel-5P,  
the European Space Agency.

Yufei Wei, 09 March 2022

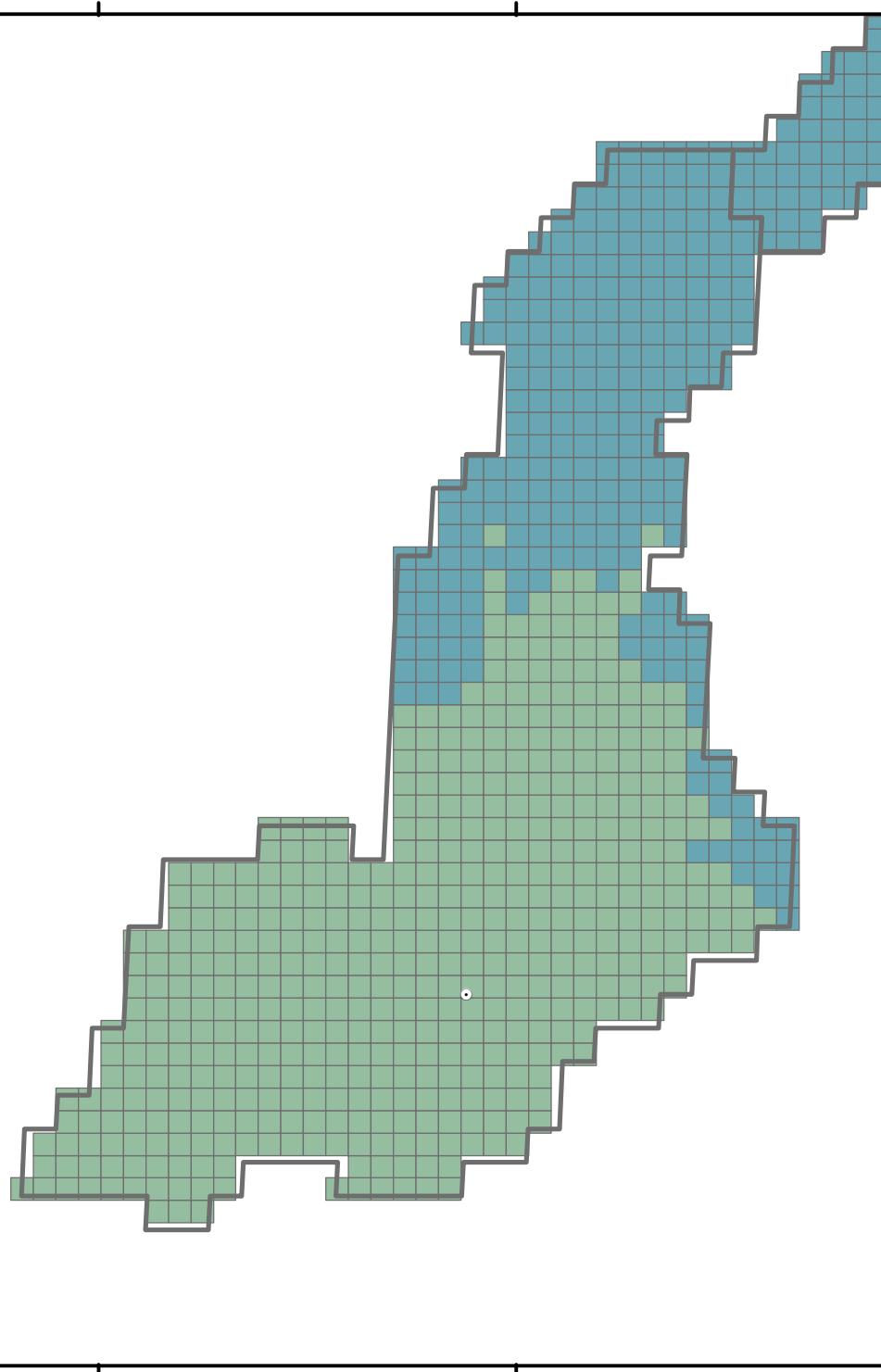
6 0'0"E

6 10'0"E

6 20'0"E

RS-measured tropospheric vertical columns of NO<sub>2</sub> of  
Geneva, Switzerland  
eFUA\_ID: 29  
at 1 km resolution

46 20'0"N  
46 10'0"N



○ Central Business Districts (CBD)

◻ GHS-OECD Functional Urban Areas (GHS-FUA)

Annual mean tropospheric NO<sub>2</sub> columns in  $\mu\text{mol}/\text{m}^2$

NO2Lev

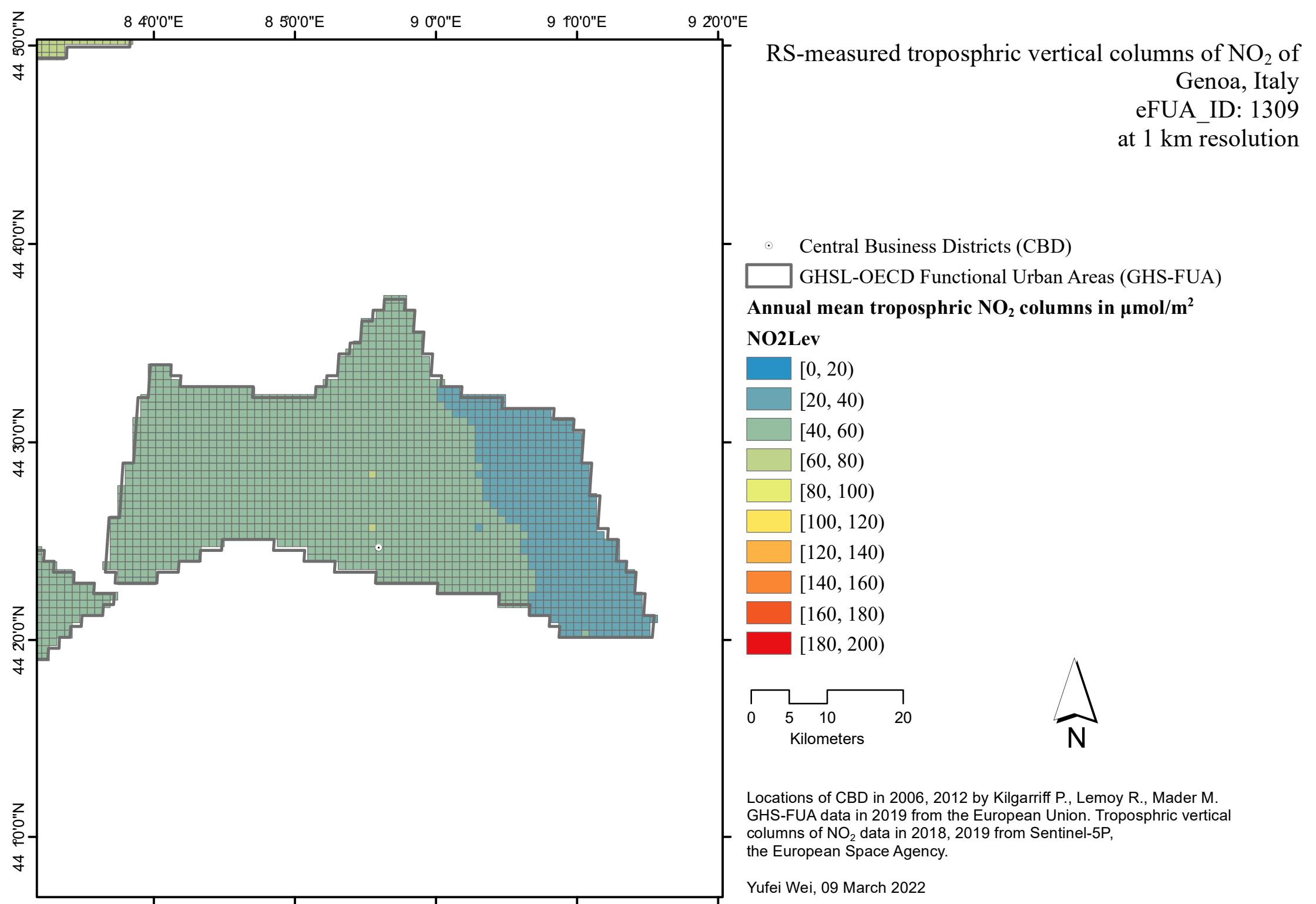
- [0, 20)
- [20, 40)
- [40, 60)
- [60, 80)
- [80, 100)
- [100, 120)
- [120, 140)
- [140, 160)
- [160, 180)
- [180, 200)

0 3.25 6.5 13  
Kilometers



Locations of CBD in 2006, 2012 by Kilgarriff P., Lemoy R., Mader M.  
GHS-FUA data in 2019 from the European Union. Tropospheric vertical  
columns of NO<sub>2</sub> data in 2018, 2019 from Sentinel-5P,  
the European Space Agency.

Yufei Wei, 09 March 2022



11 50'0"E

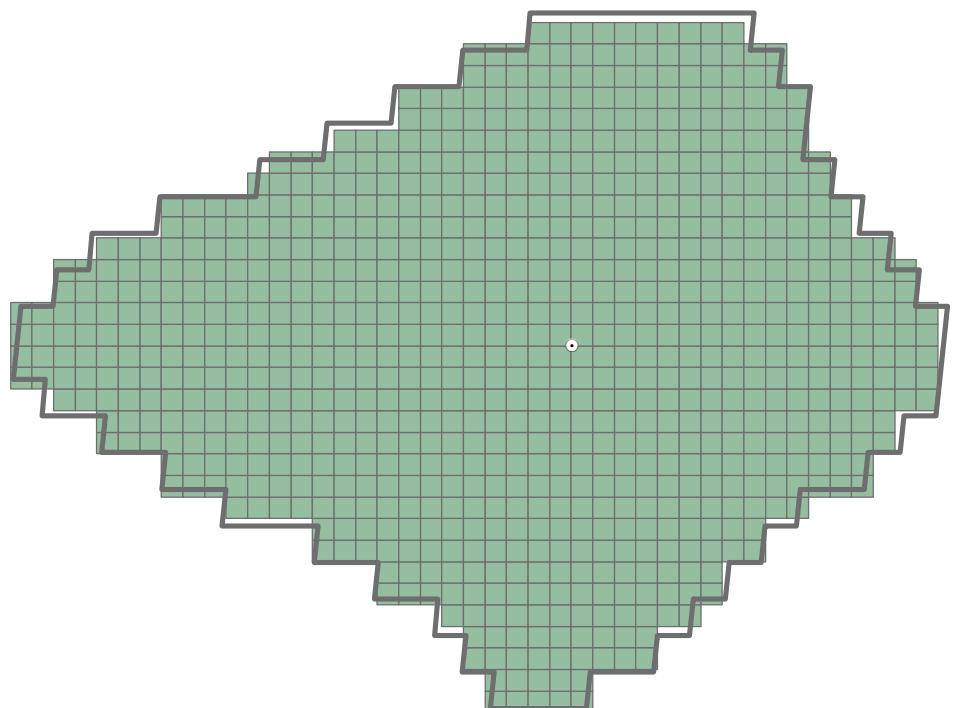
12 0'0"E

12 10'0"E

51 0'0"N

50 50'0"N

RS-measured tropospheric vertical columns of NO<sub>2</sub> of  
Gera, Germany  
eFUA\_ID: 4763  
at 1 km resolution



○ Central Business Districts (CBD)

◻ GHSL-OECD Functional Urban Areas (GHS-FUA)

Annual mean tropospheric NO<sub>2</sub> columns in  $\mu\text{mol}/\text{m}^2$

NO2Lev

[0, 20)

[20, 40)

[40, 60)

[60, 80)

[80, 100)

[100, 120)

[120, 140)

[140, 160)

[160, 180)

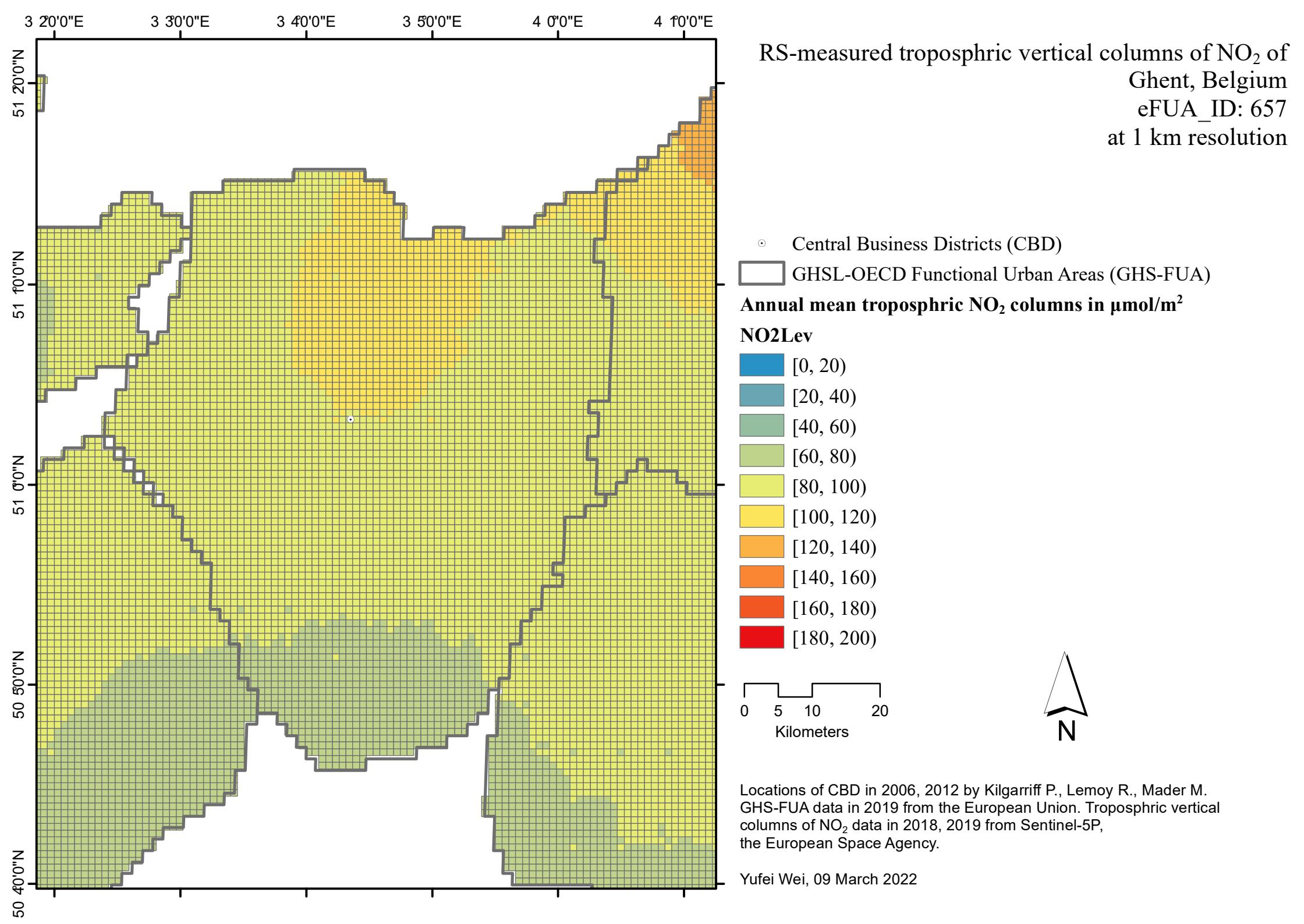
[180, 200)

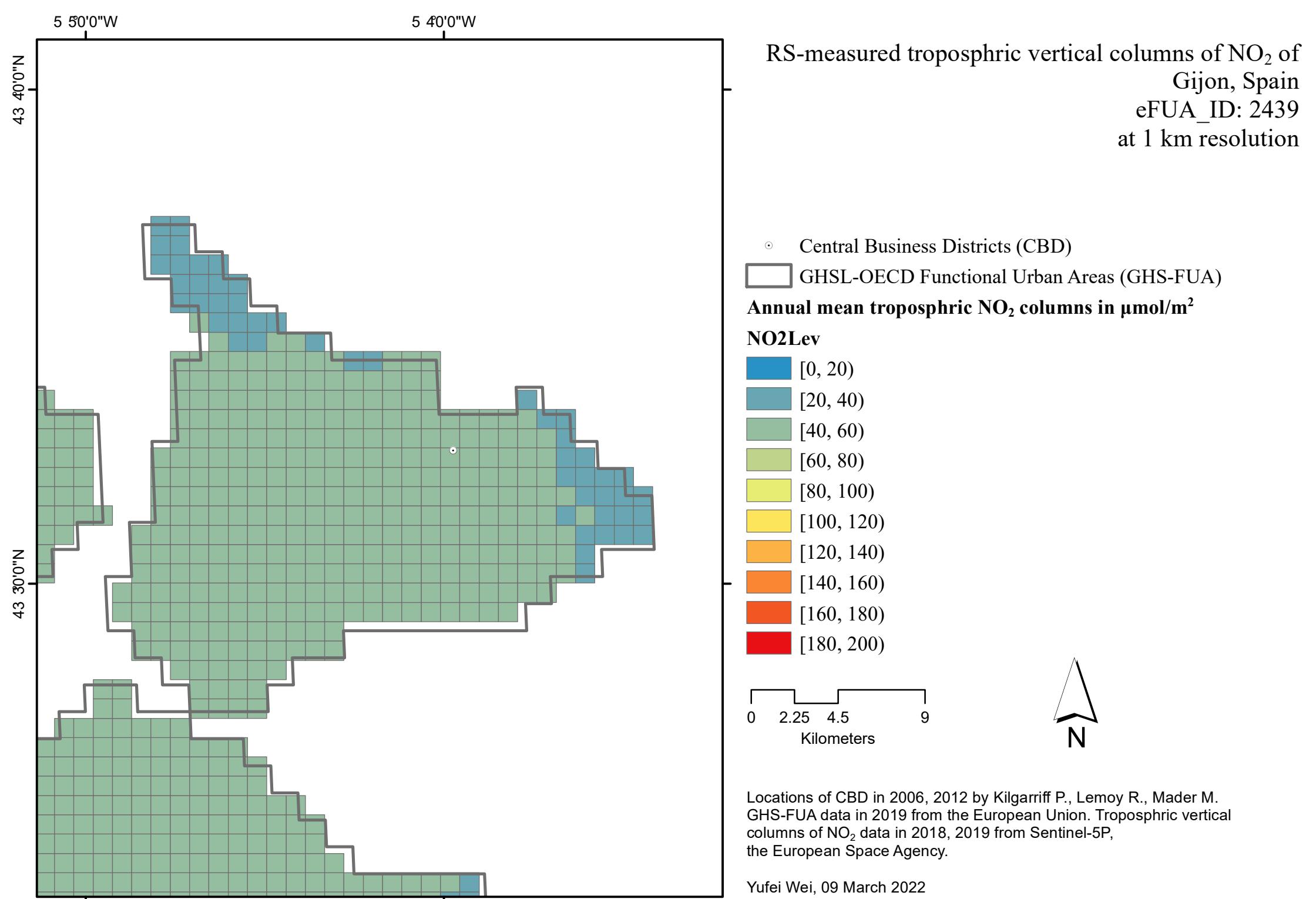
0 3.75 7.5 15  
Kilometers

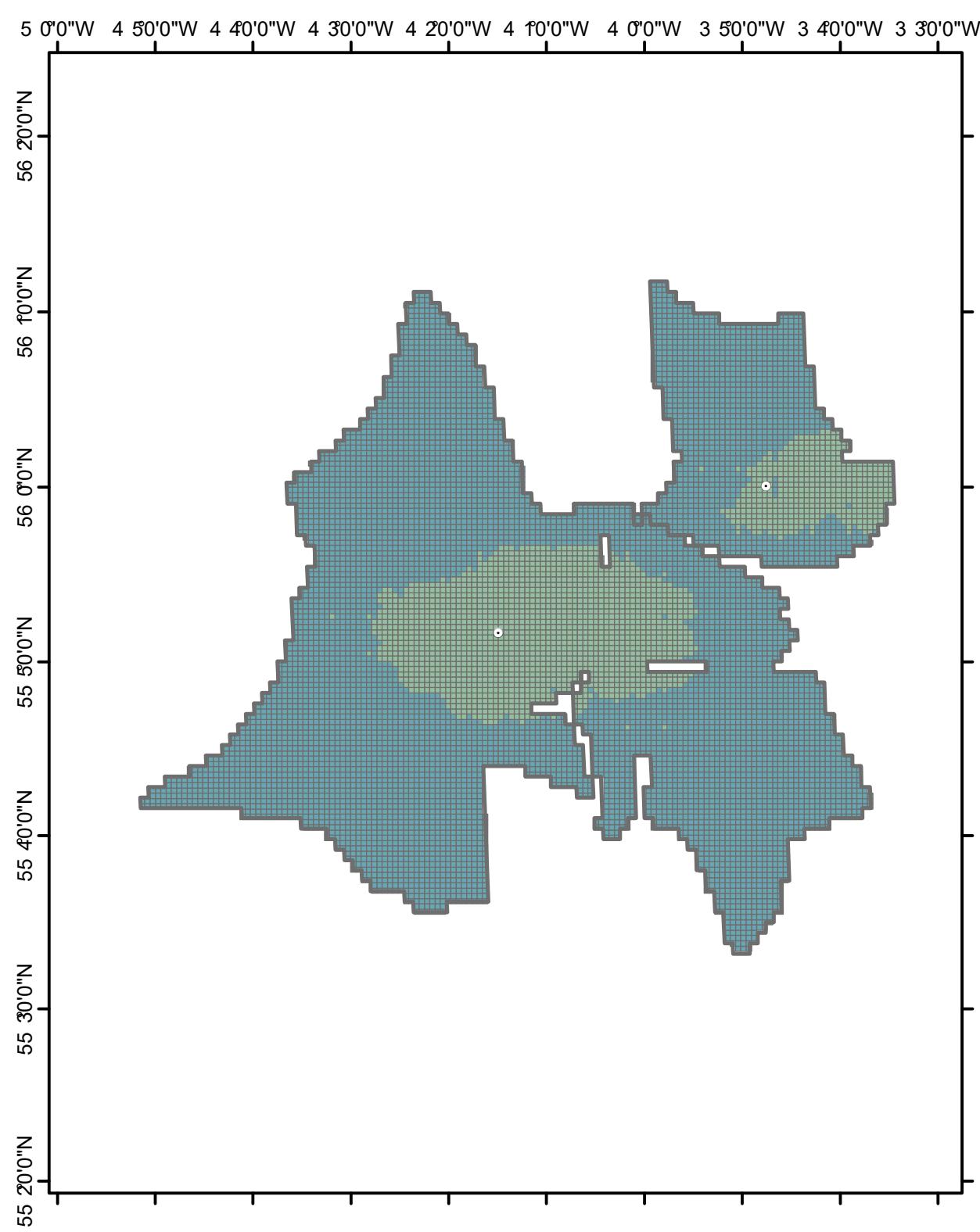


Locations of CBD in 2006, 2012 by Kilgarriff P., Lemoy R., Mader M.  
GHS-FUA data in 2019 from the European Union. Tropospheric vertical  
columns of NO<sub>2</sub> data in 2018, 2019 from Sentinel-5P,  
the European Space Agency.

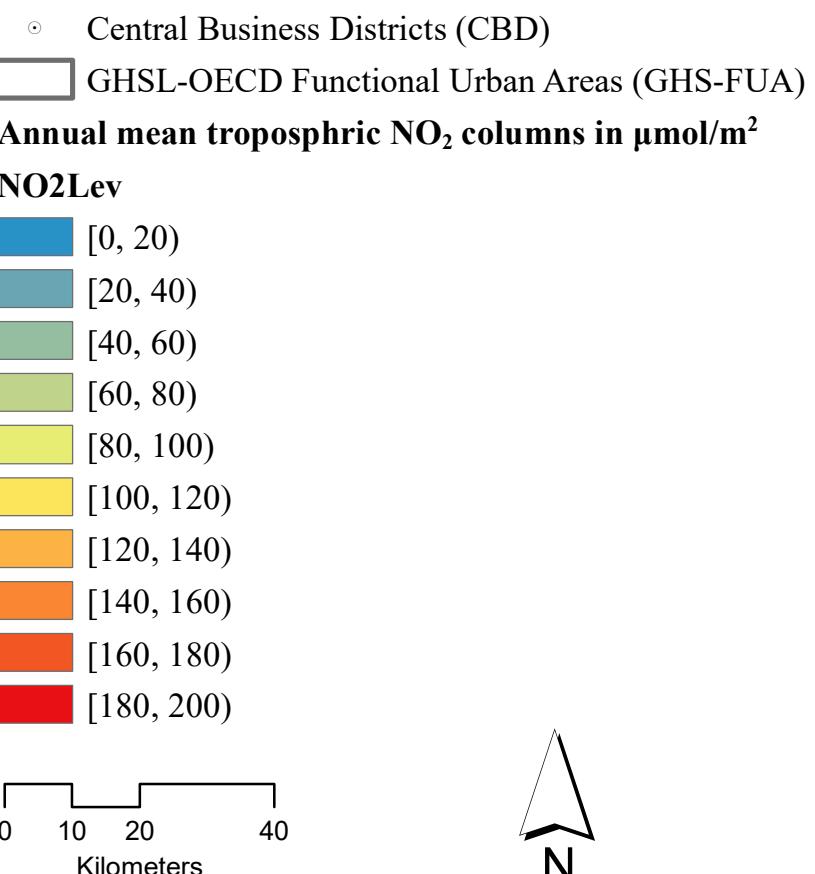
Yufei Wei, 09 March 2022





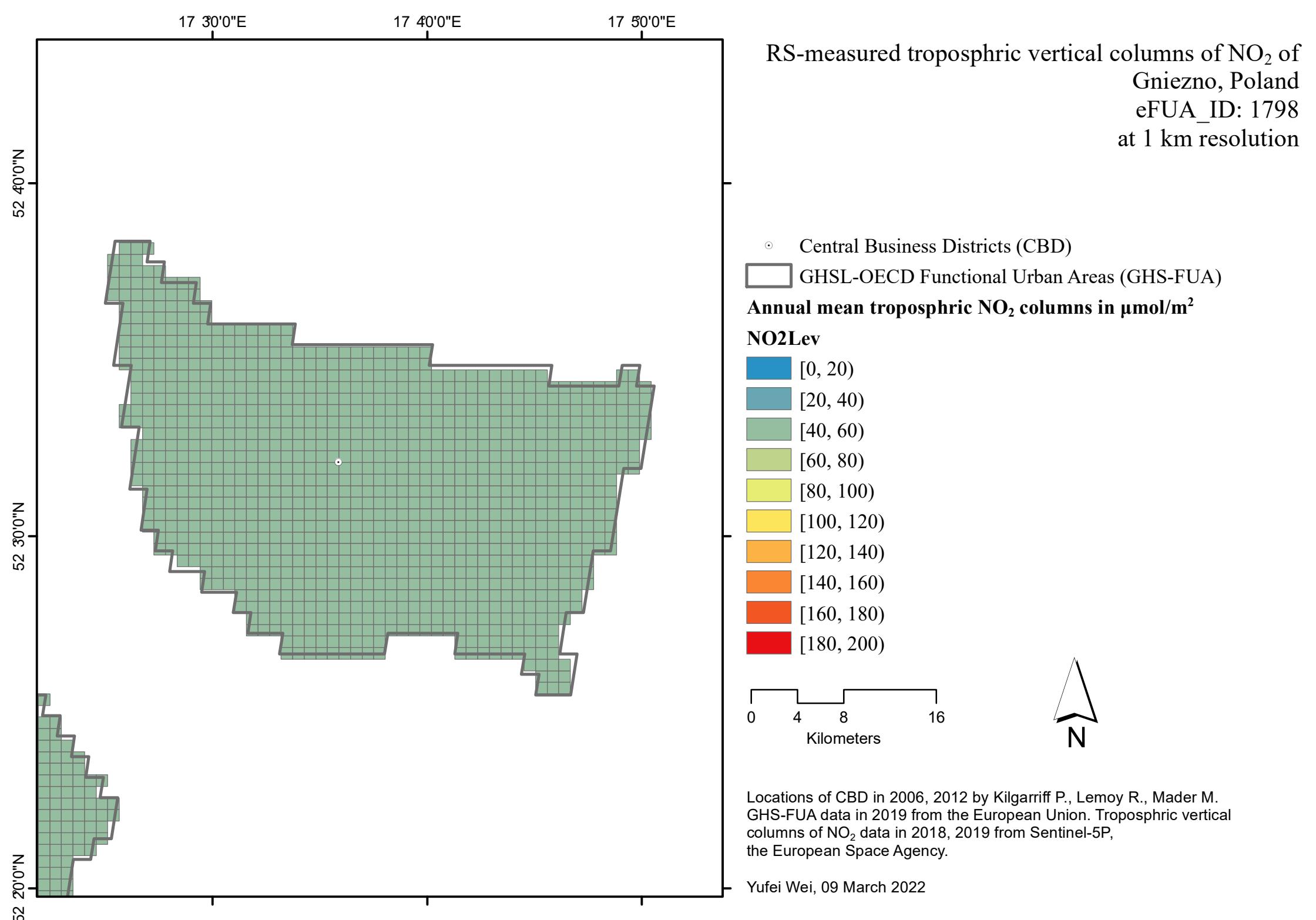


RS-measured tropospheric vertical columns of NO<sub>2</sub> of  
Glasgow, United Kingdom  
eFUA\_ID: 955  
at 1 km resolution



Locations of CBD in 2006, 2012 by Kilgarriff P., Lemoy R., Mader M.  
GHS-FUA data in 2019 from the European Union. Tropospheric vertical  
columns of NO<sub>2</sub> data in 2018, 2019 from Sentinel-5P,  
the European Space Agency.

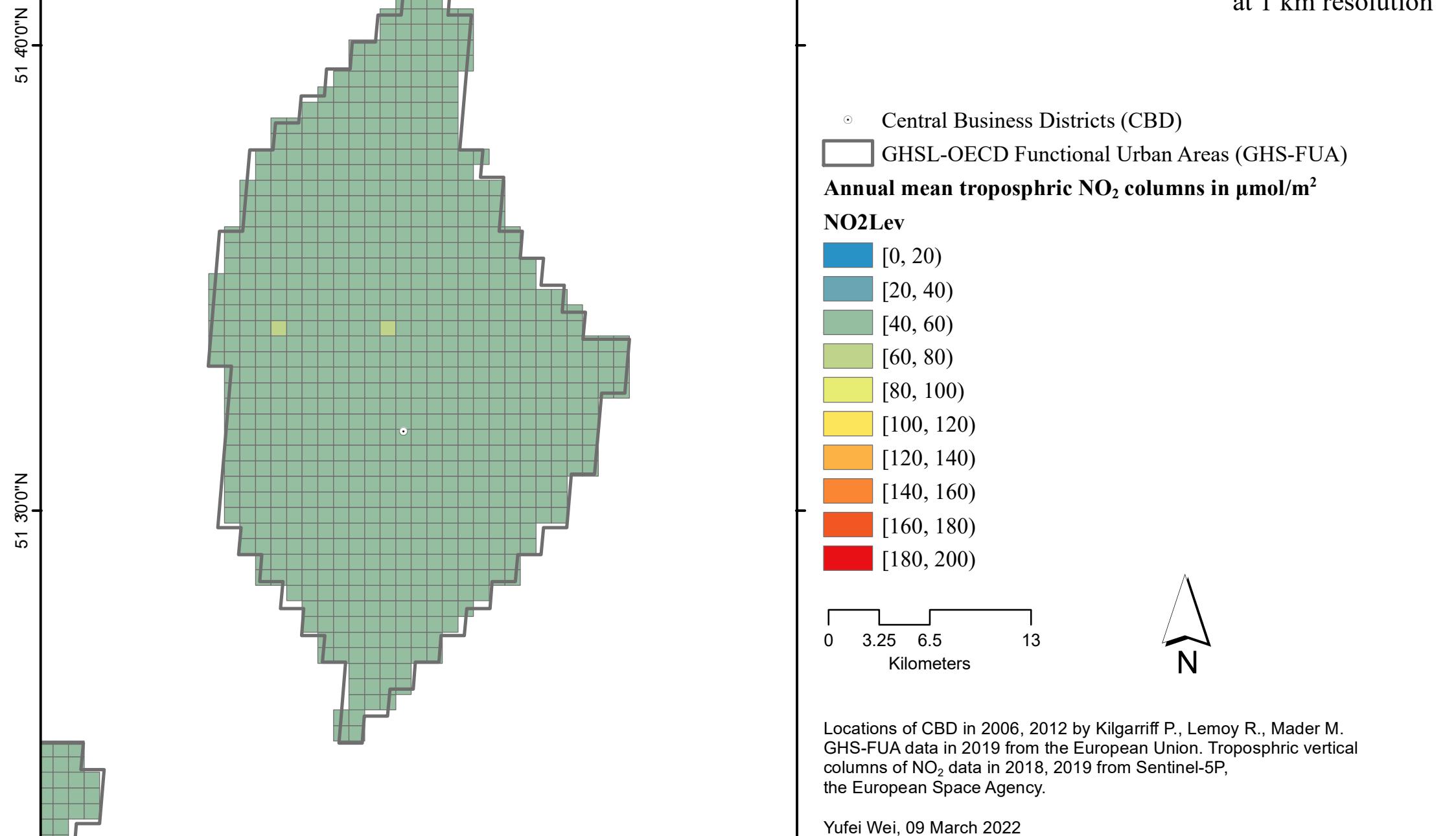
Yufei Wei, 09 March 2022

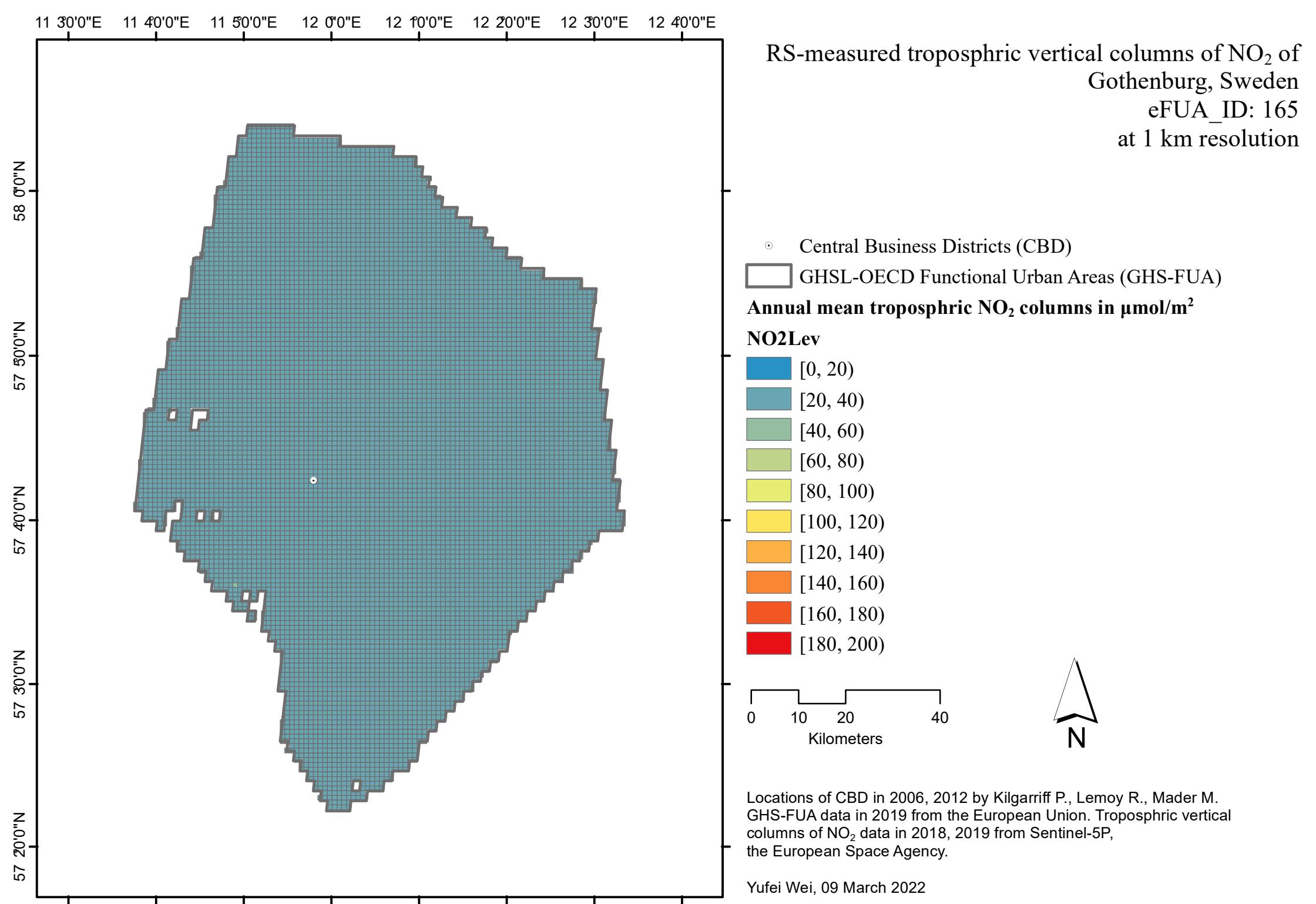


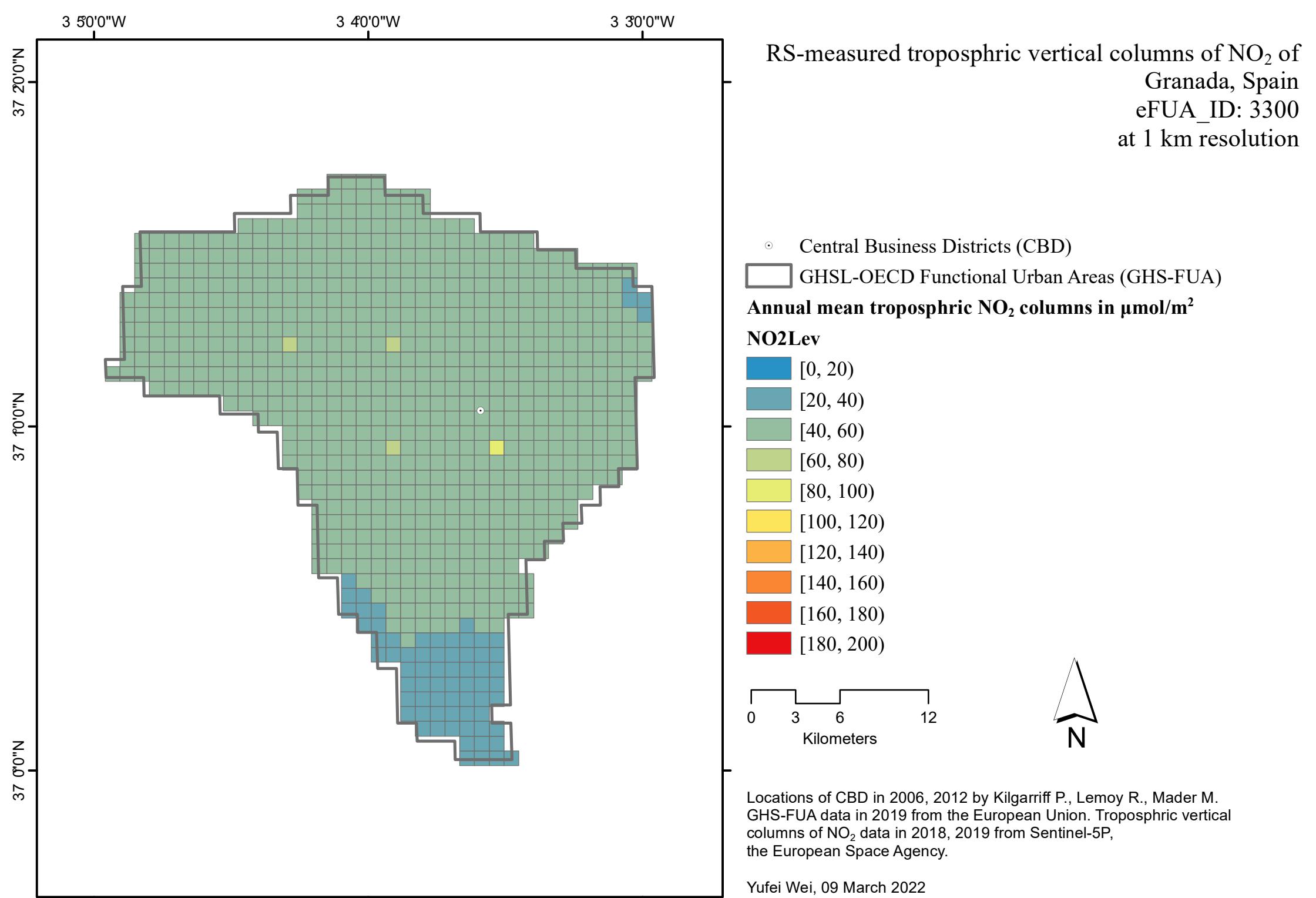
9 50'0"E

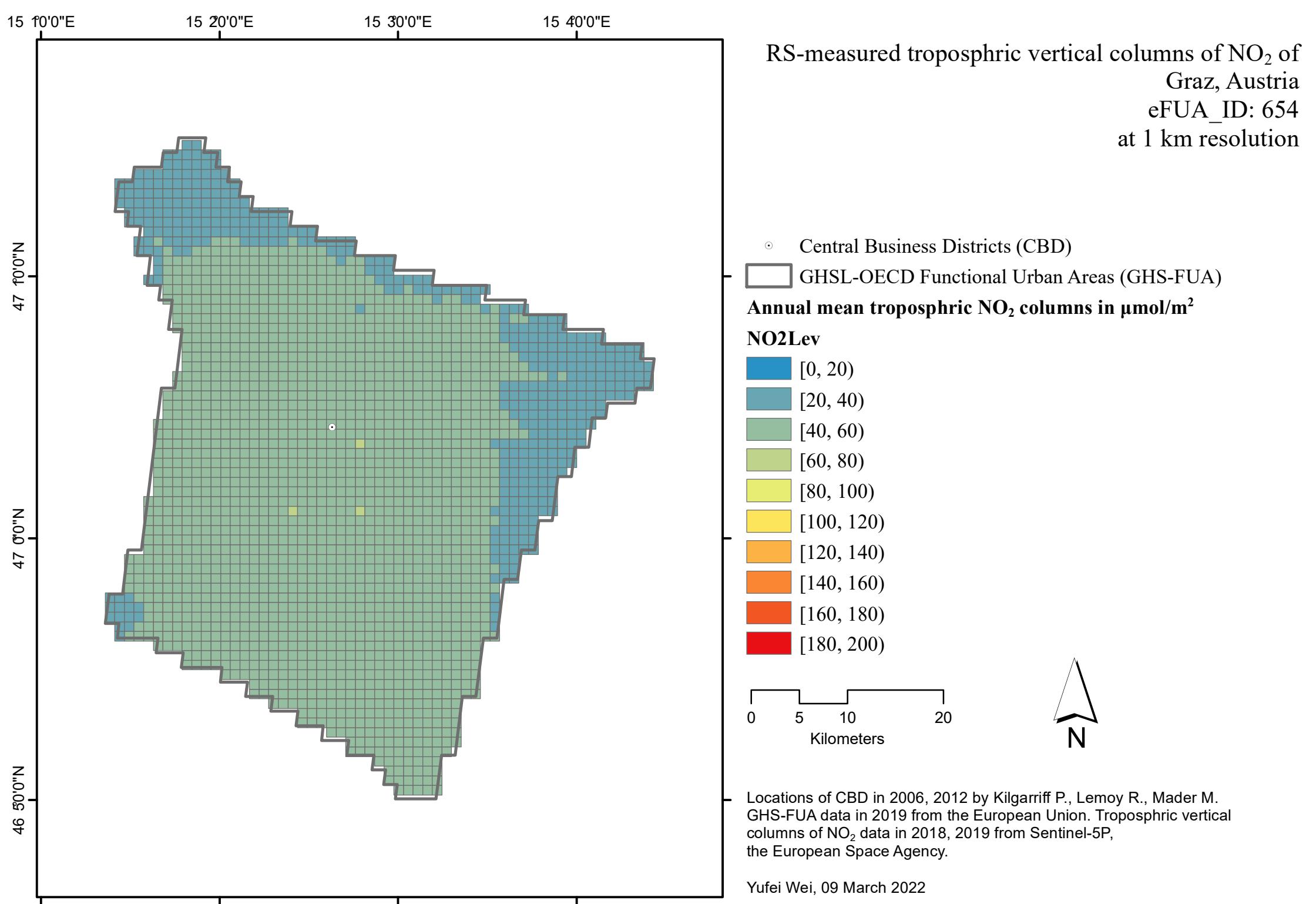
10 0'0"E

RS-measured tropospheric vertical columns of NO<sub>2</sub> of  
Goettingen, Germany  
eFUA\_ID: 4083  
at 1 km resolution









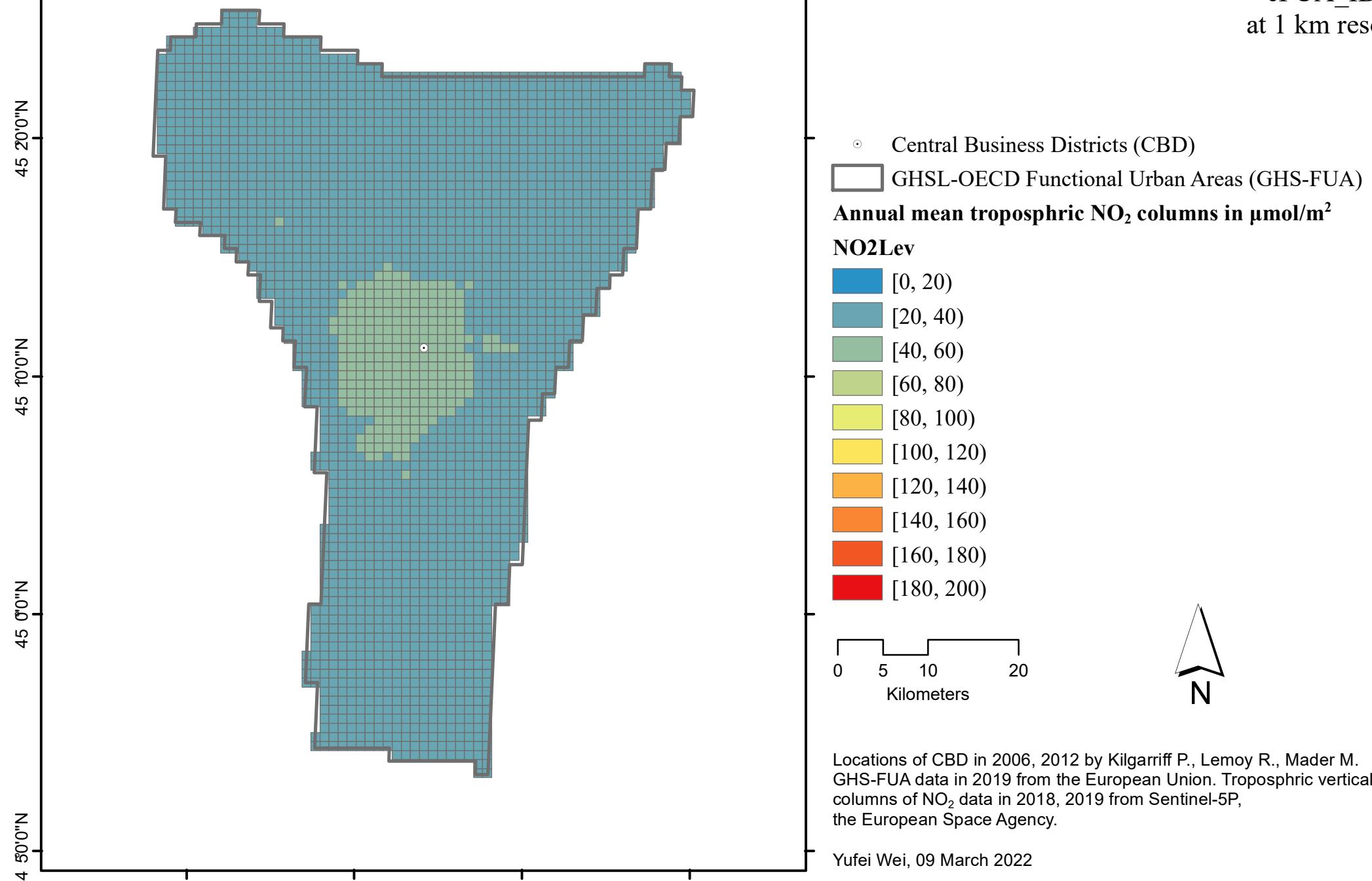
5 30'0"E

5 40'0"E

5 50'0"E

6 0'0"E

RS-measured tropospheric vertical columns of NO<sub>2</sub> of  
Grenoble, France  
eFUA\_ID: 3984  
at 1 km resolution



6 20'0"E

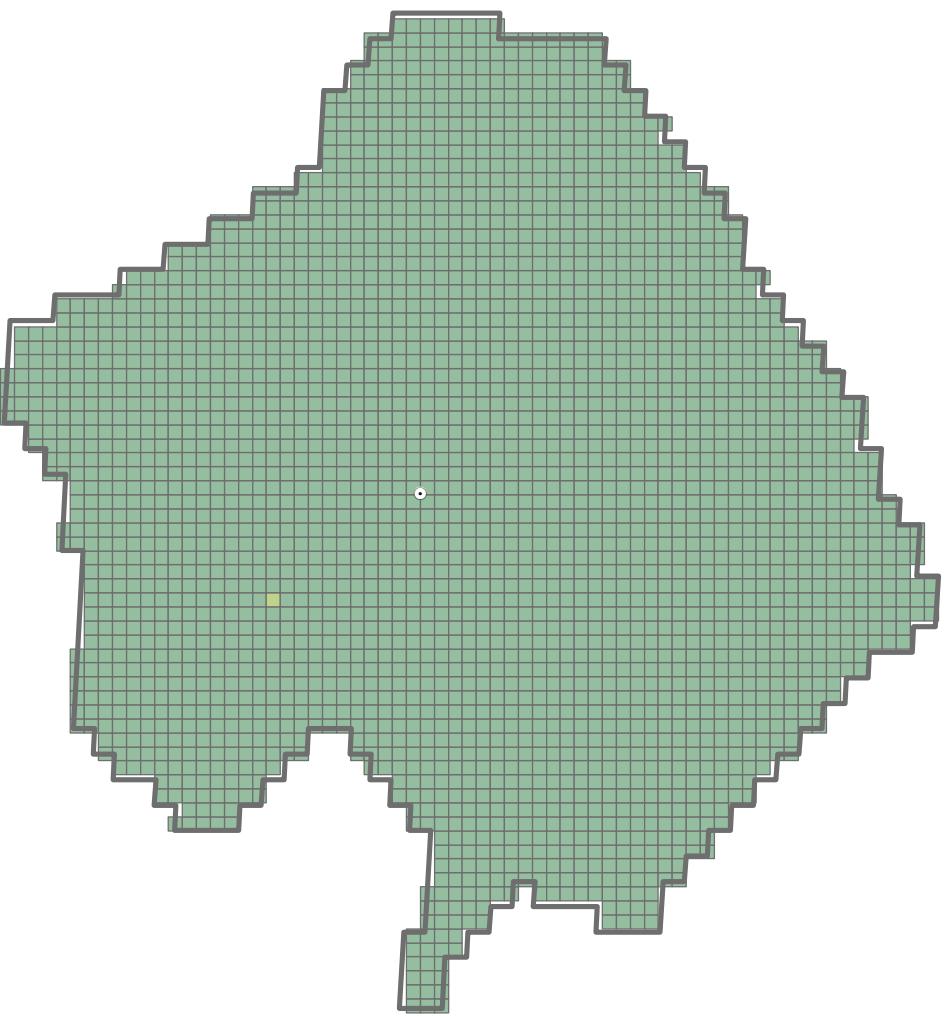
6 30'0"E

6 40'0"E

6 50'0"E

RS-measured tropospheric vertical columns of NO<sub>2</sub> of  
Groningen, Netherlands  
eFUA\_ID: 3116  
at 1 km resolution

53 20'0"N  
53 10'0"N  
53 00'N



○ Central Business Districts (CBD)

◻ GHS-OECD Functional Urban Areas (GHS-FUA)

Annual mean tropospheric NO<sub>2</sub> columns in  $\mu\text{mol}/\text{m}^2$

NO2Lev

- [0, 20]
- [20, 40]
- [40, 60]
- [60, 80]
- [80, 100]
- [100, 120]
- [120, 140]
- [140, 160]
- [160, 180]
- [180, 200]

0 5 10 20  
Kilometers



Locations of CBD in 2006, 2012 by Kilgarriff P., Lemoy R., Mader M.  
GHS-FUA data in 2019 from the European Union. Tropospheric vertical  
columns of NO<sub>2</sub> data in 2018, 2019 from Sentinel-5P,  
the European Space Agency.

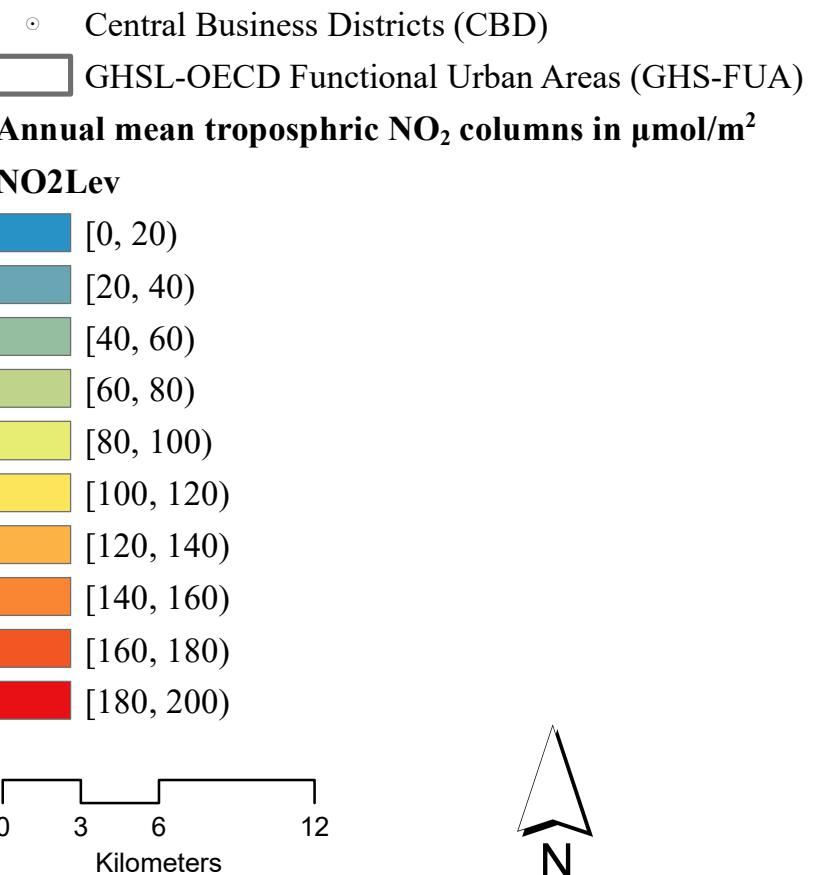
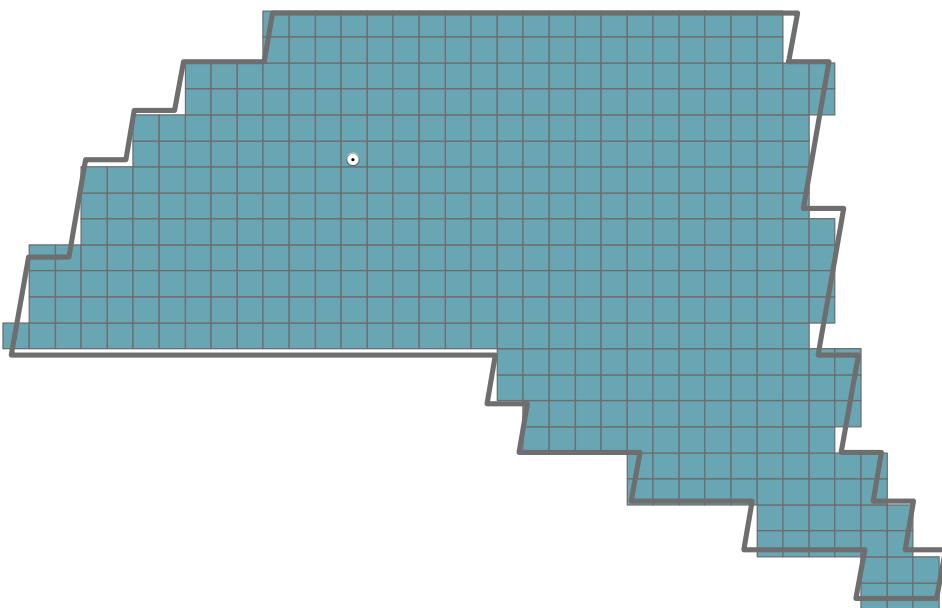
Yufei Wei, 09 March 2022

19 20'0"E

19 30'0"E

RS-measured tropospheric vertical columns of NO<sub>2</sub> of  
Gronowo Gorne, Poland  
eFUA\_ID: 2531  
at 1 km resolution

54 °0'0"N  
54 °0'0"N



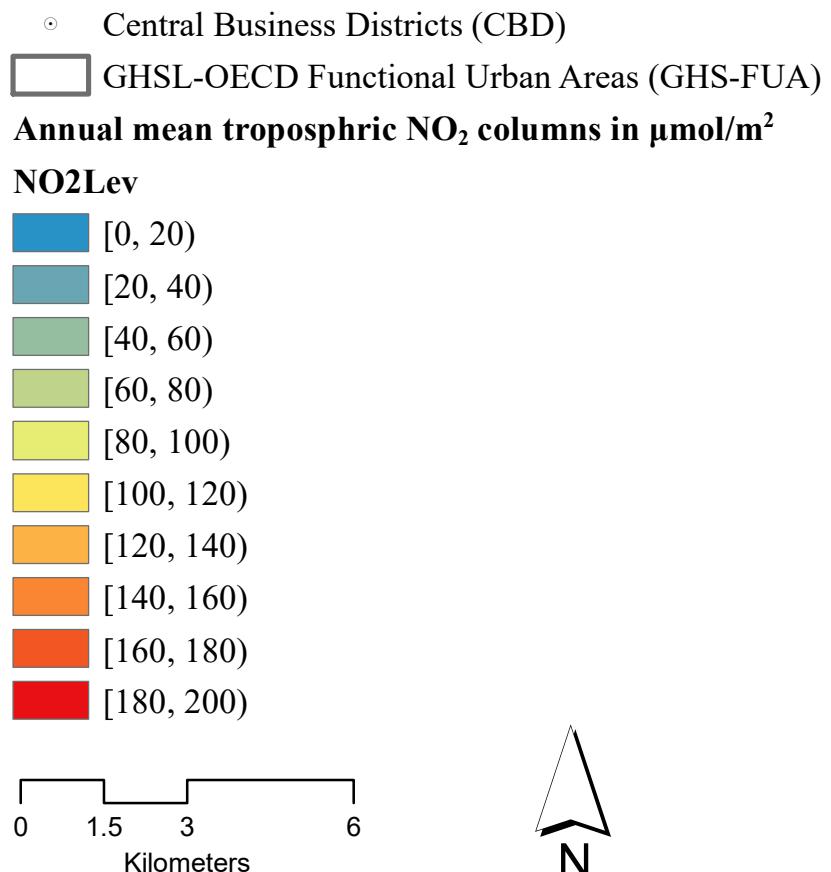
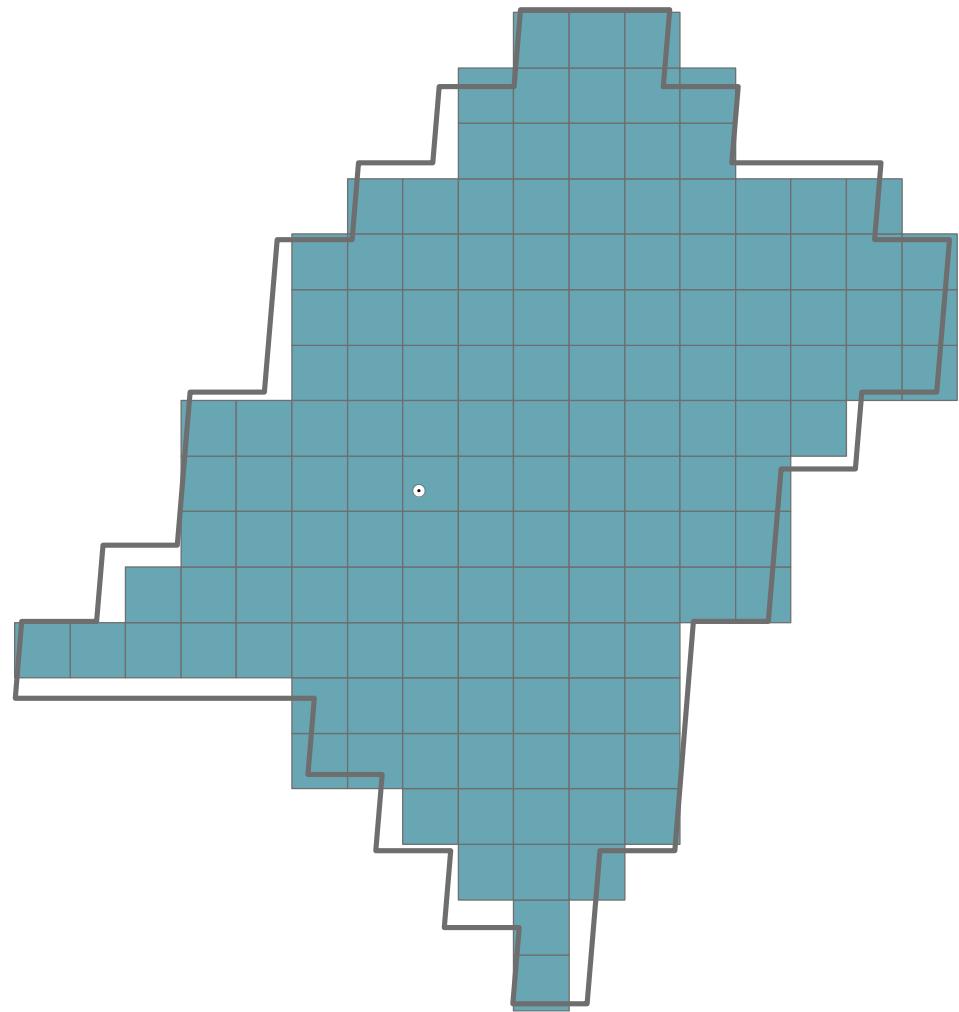
Locations of CBD in 2006, 2012 by Kilgarriff P., Lemoy R., Mader M.  
GHS-FUA data in 2019 from the European Union. Tropospheric vertical  
columns of NO<sub>2</sub> data in 2018, 2019 from Sentinel-5P,  
the European Space Agency.

Yufei Wei, 09 March 2022

11°10'0"E

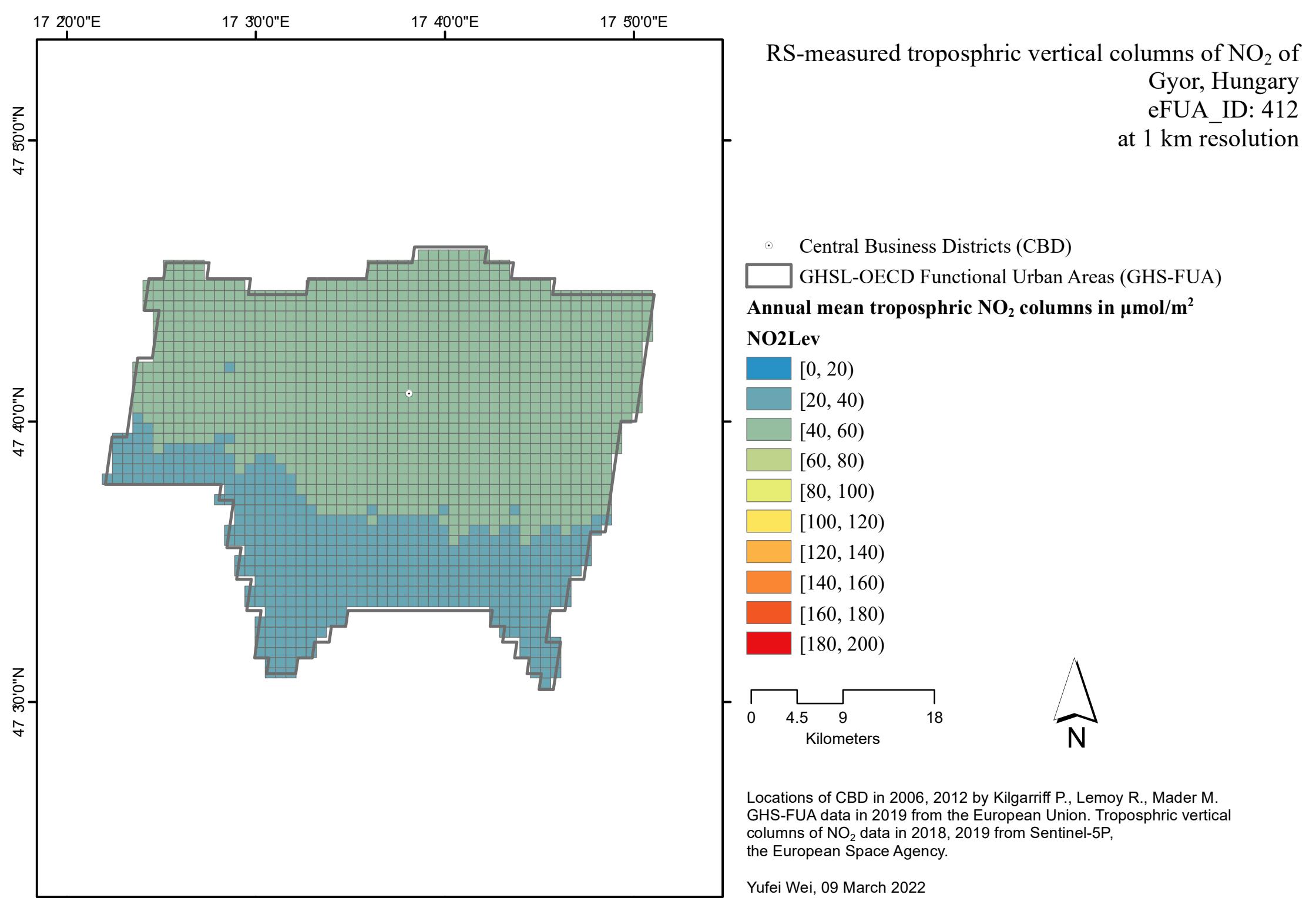
42°50'0"N

RS-measured tropospheric vertical columns of NO<sub>2</sub> of  
Grosseto, Italy  
eFUA\_ID: 3208  
at 1 km resolution



Locations of CBD in 2006, 2012 by Kilgarriff P., Lemoy R., Mader M.  
GHS-FUA data in 2019 from the European Union. Tropospheric vertical  
columns of NO<sub>2</sub> data in 2018, 2019 from Sentinel-5P,  
the European Space Agency.

Yufei Wei, 09 March 2022

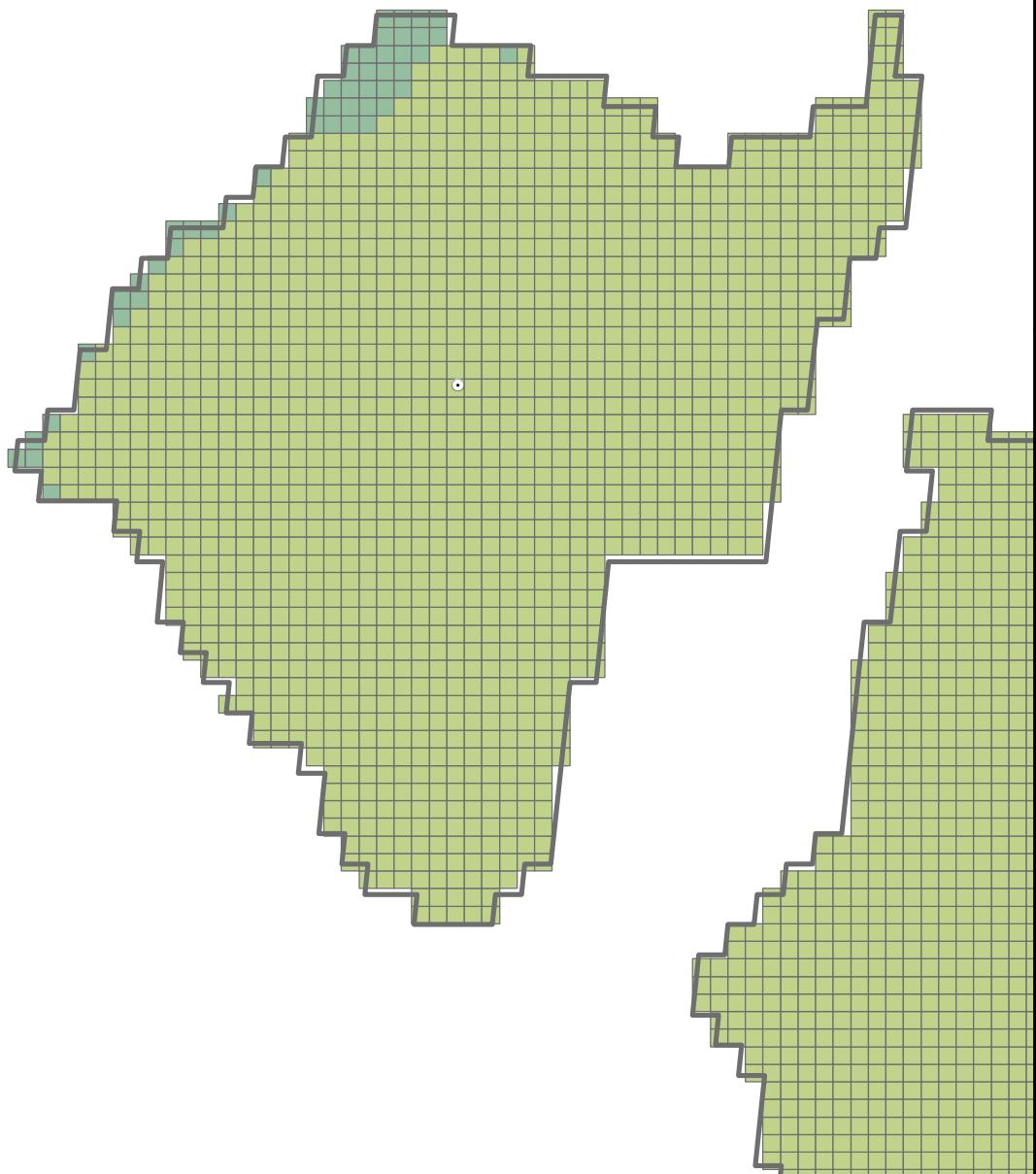


11 50'0"E

12 0'0"E

12 10'0"E

RS-measured tropospheric vertical columns of NO<sub>2</sub> of  
Halle (Saale), Germany  
eFUA\_ID: 4708  
at 1 km resolution



○ Central Business Districts (CBD)

◻ GHSL-OECD Functional Urban Areas (GHS-FUA)

**Annual mean tropospheric NO<sub>2</sub> columns in  $\mu\text{mol}/\text{m}^2$**

**NO2Lev**

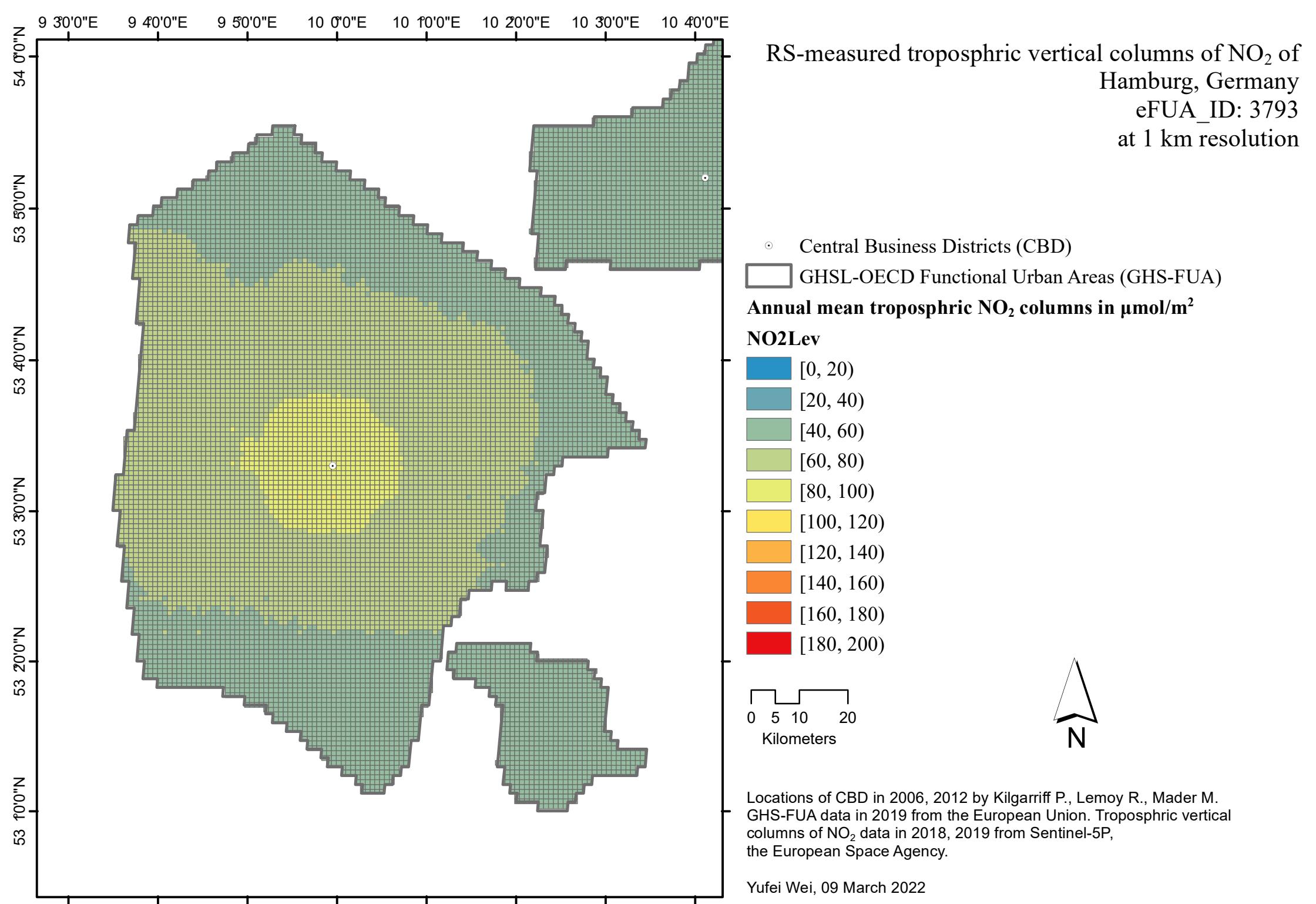
- [0, 20]
- [20, 40]
- [40, 60]
- [60, 80]
- [80, 100]
- [100, 120]
- [120, 140]
- [140, 160]
- [160, 180]
- [180, 200]

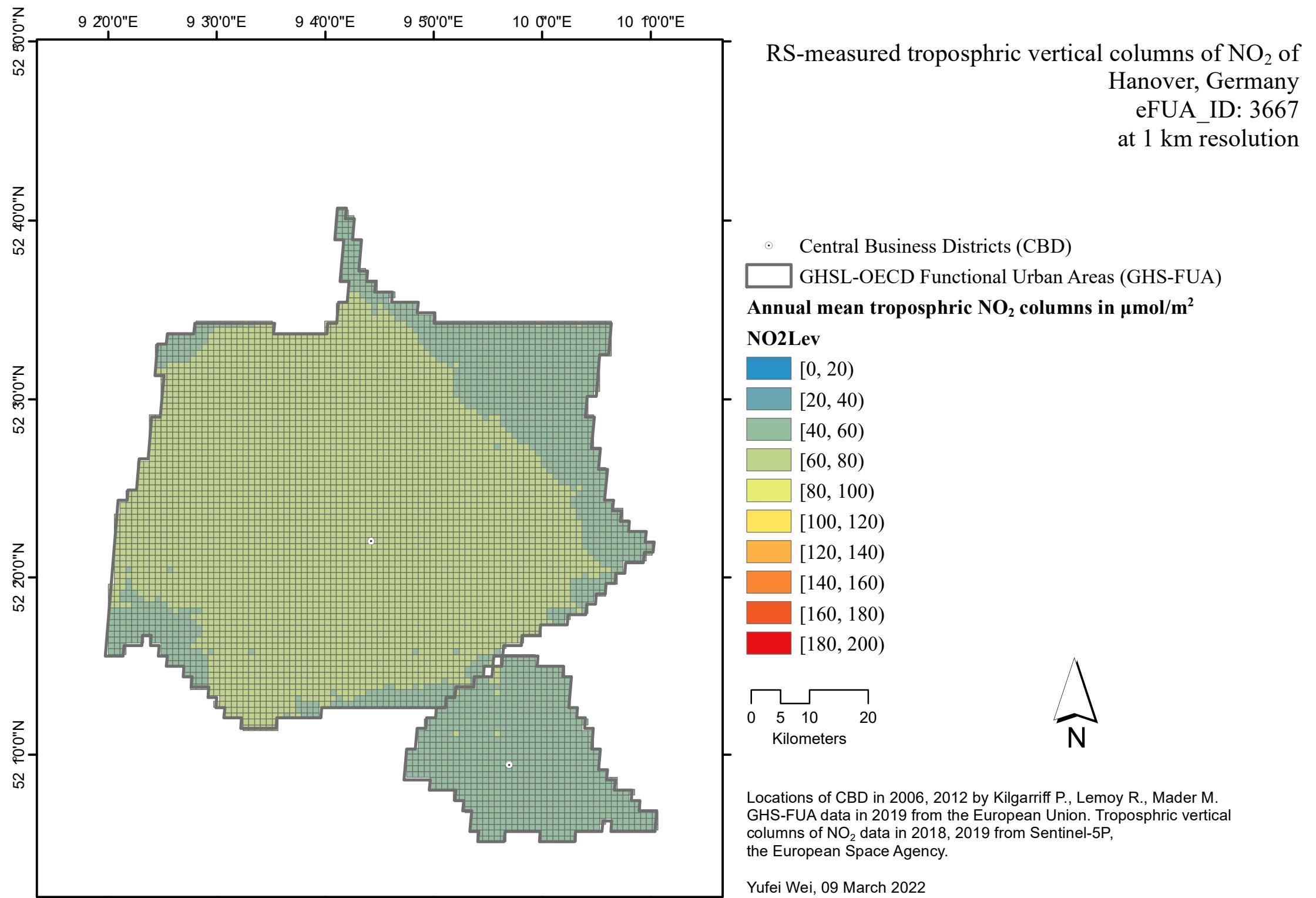
0 4.5 9 18  
Kilometers



Locations of CBD in 2006, 2012 by Kilgarriff P., Lemoy R., Mader M.  
GHS-FUA data in 2019 from the European Union. Tropospheric vertical  
columns of NO<sub>2</sub> data in 2018, 2019 from Sentinel-5P,  
the European Space Agency.

Yufei Wei, 09 March 2022



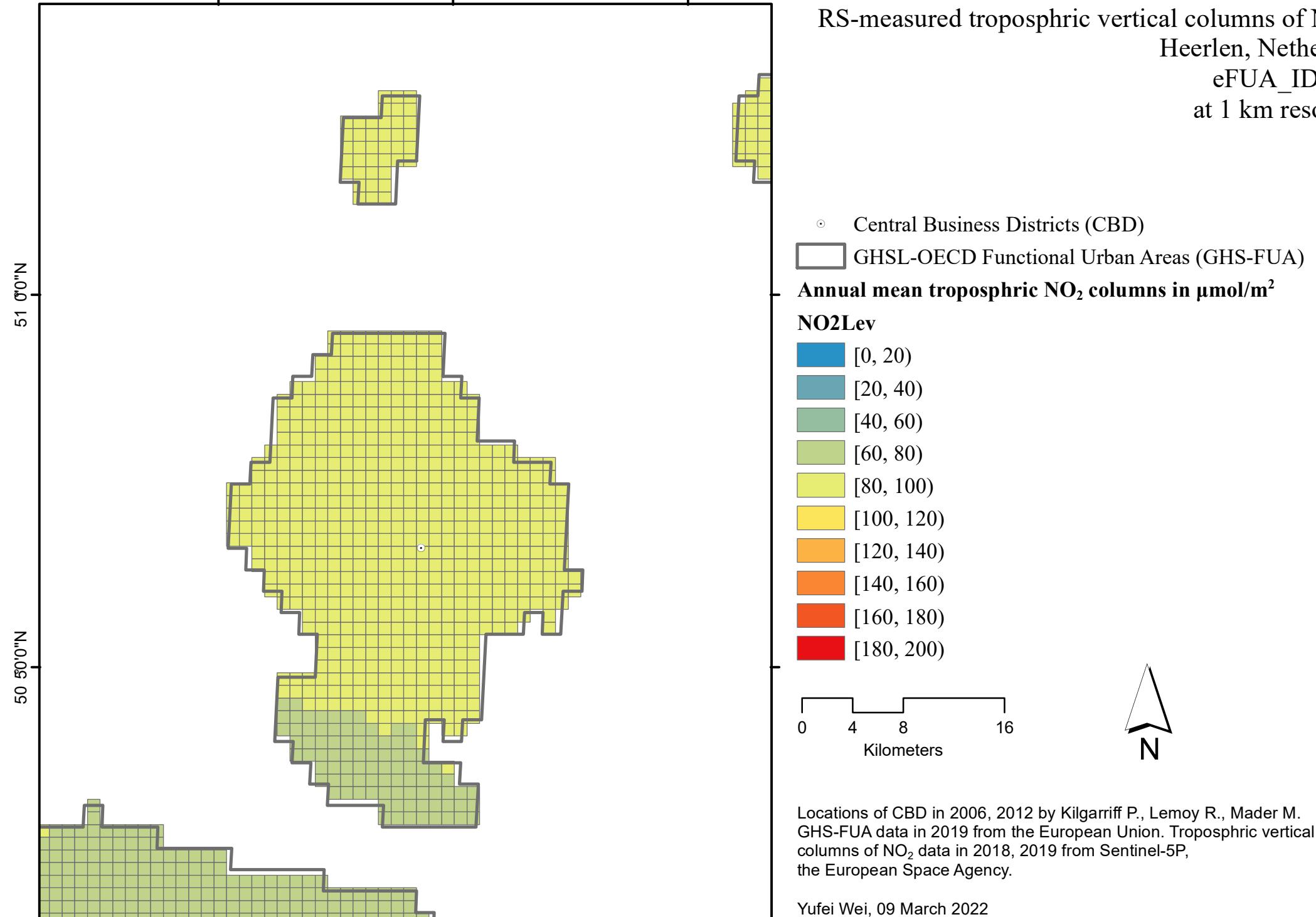


5 50'0"E

6 0'0"E

6 10'0"E

RS-measured tropospheric vertical columns of NO<sub>2</sub> of  
Heerlen, Netherlands  
eFUA\_ID: 2901  
at 1 km resolution



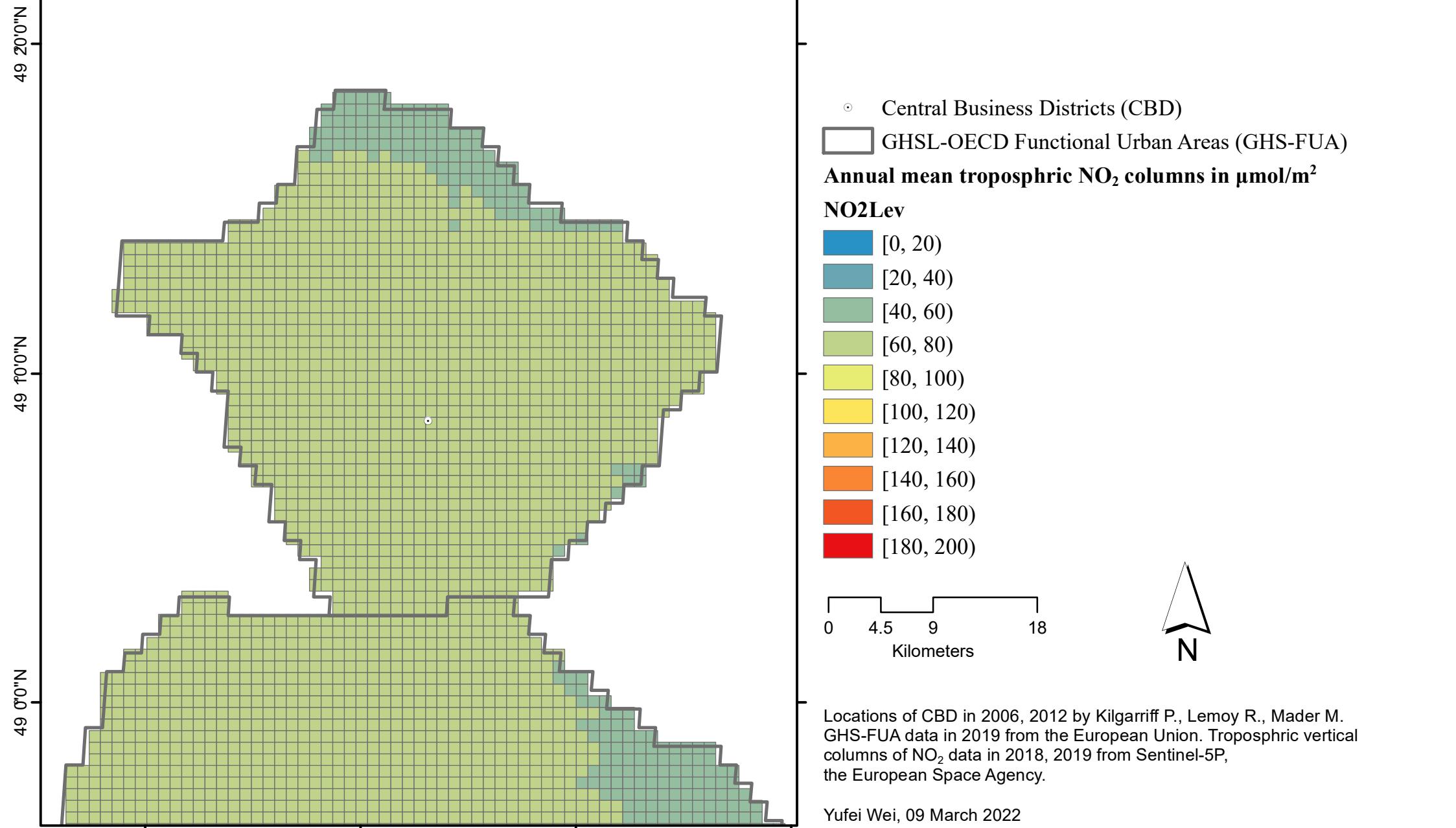
9 0°0"E

9 10°0"E

9 20°0"E

9 30°0"E

RS-measured tropospheric vertical columns of NO<sub>2</sub> of  
Heilbronn, Germany  
eFUA\_ID: 3754  
at 1 km resolution



12 30'0"E

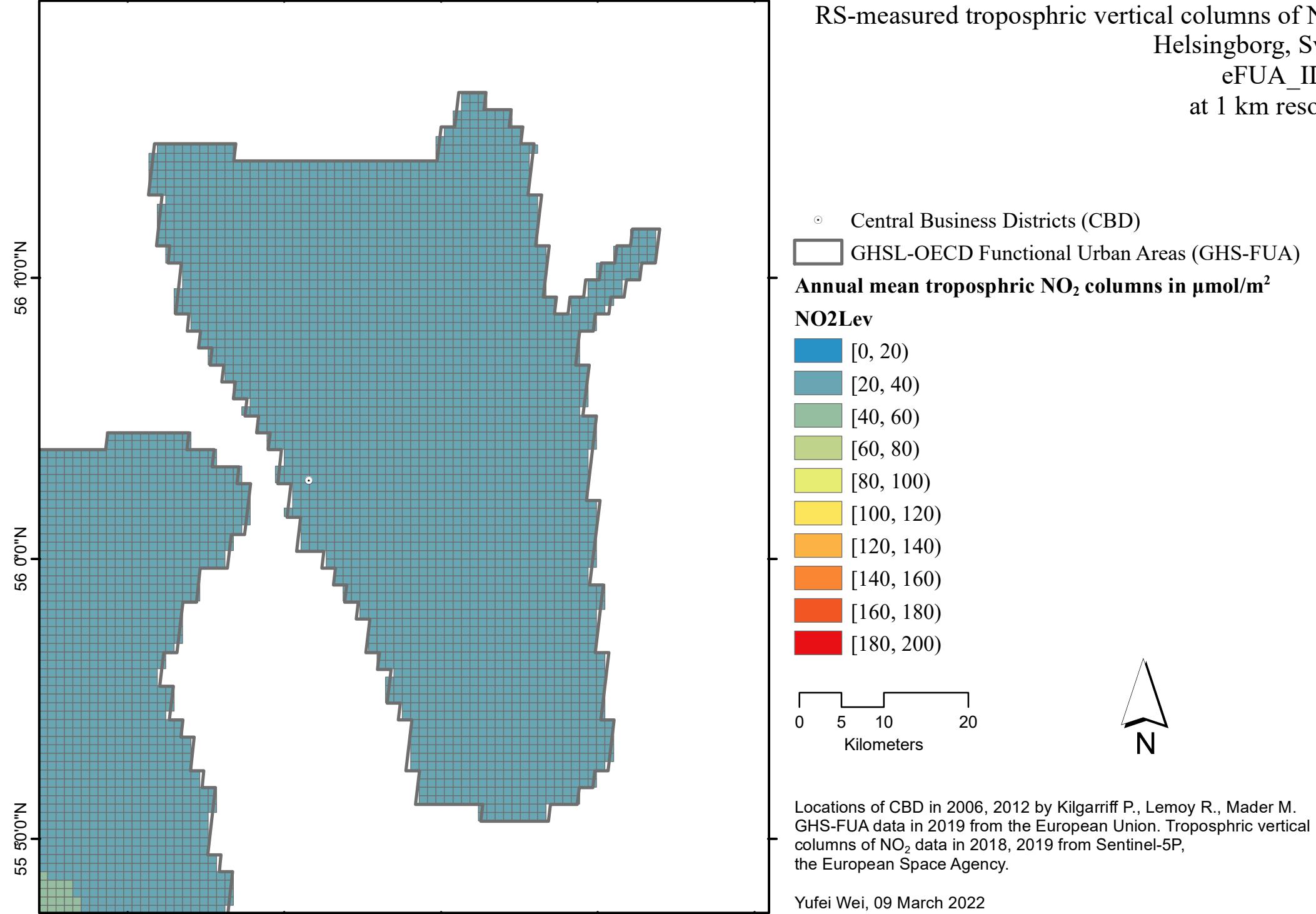
12 40'0"E

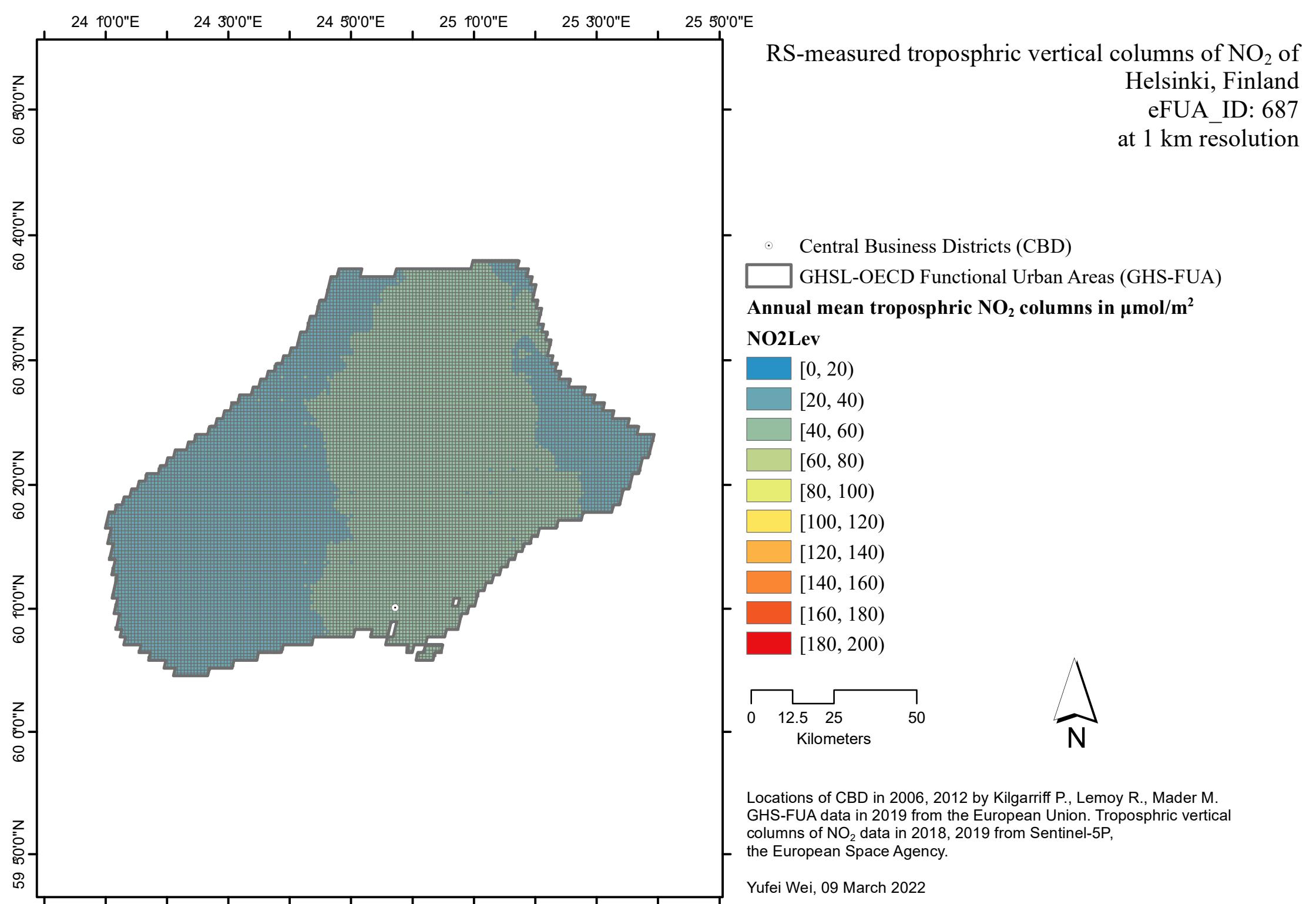
12 50'0"E

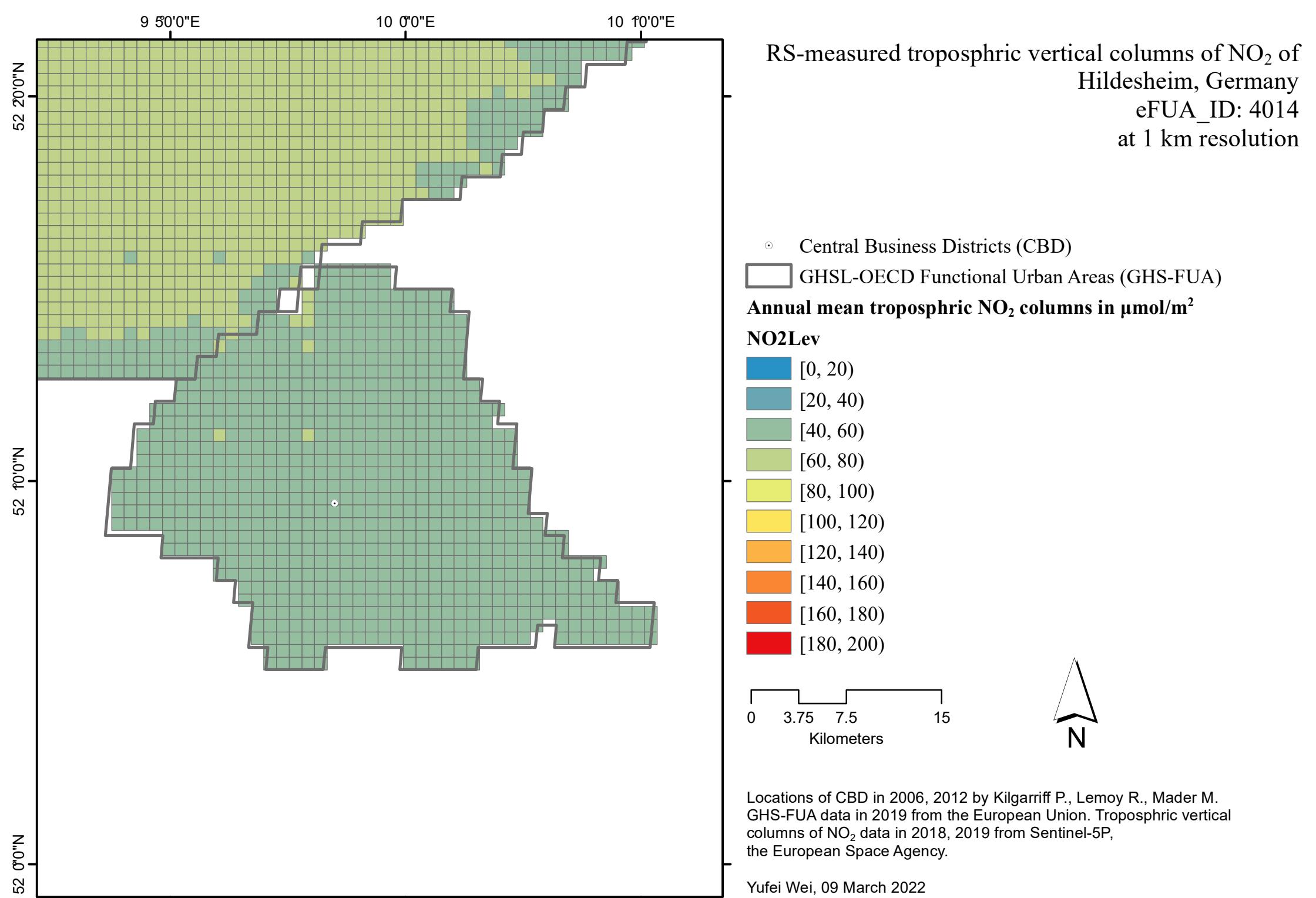
13 0'0"E

13 10'0"E

RS-measured tropospheric vertical columns of NO<sub>2</sub> of  
Helsingborg, Sweden  
eFUA\_ID: 329  
at 1 km resolution





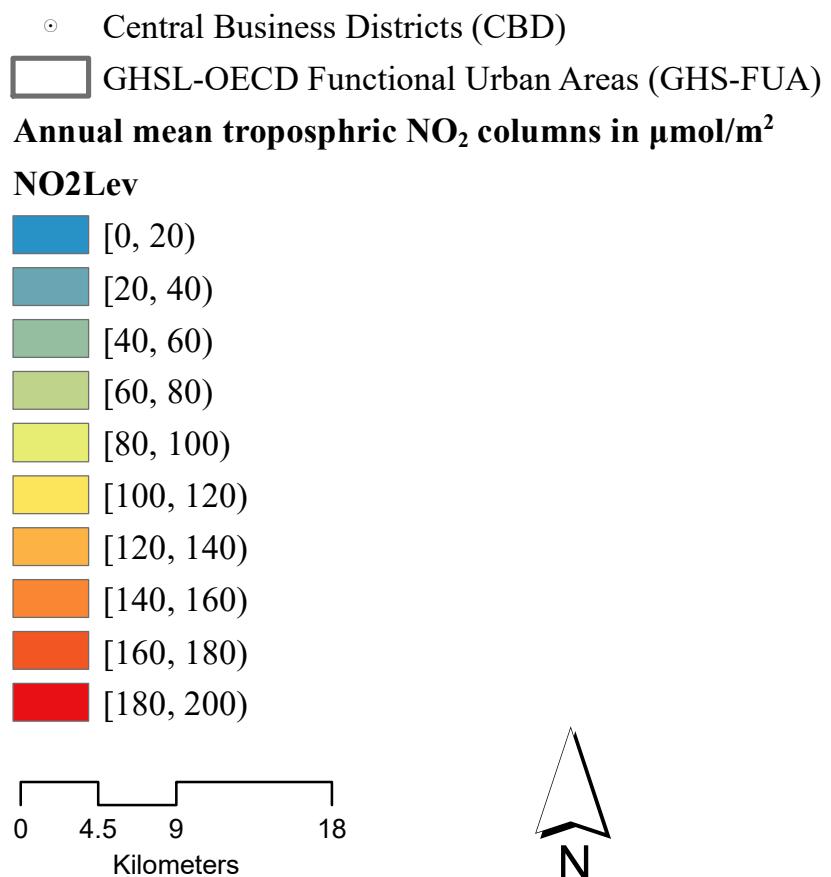
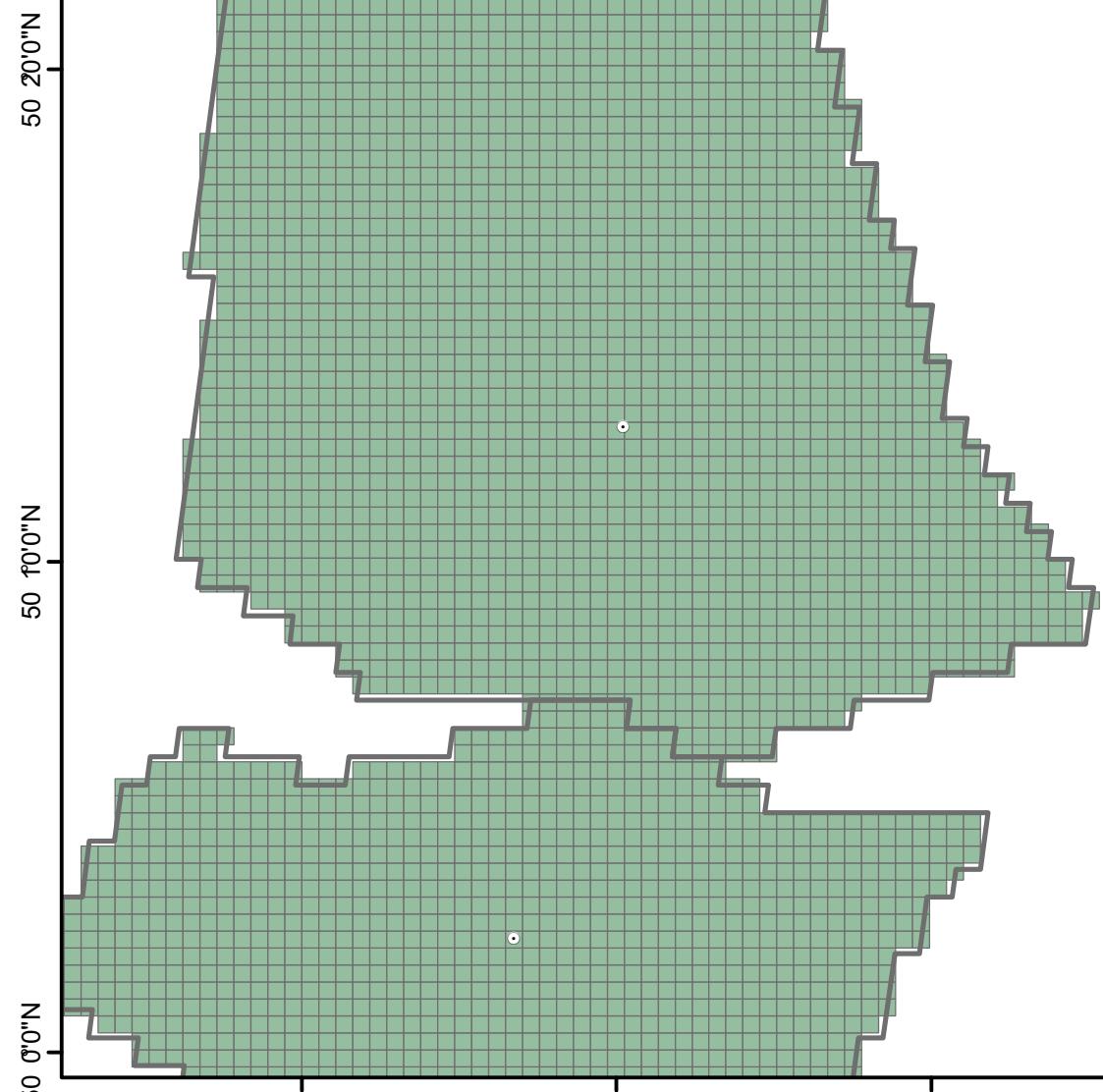


15 40'0"E

15 50'0"E

16 0'0"E

RS-measured tropospheric vertical columns of NO<sub>2</sub> of  
Hradec Kralove, Czech Republic  
eFUA\_ID: 1063  
at 1 km resolution



Locations of CBD in 2006, 2012 by Kilgarriff P., Lemoy R., Mader M.  
GHS-FUA data in 2019 from the European Union. Tropospheric vertical  
columns of NO<sub>2</sub> data in 2018, 2019 from Sentinel-5P,  
the European Space Agency.

Yufei Wei, 09 March 2022

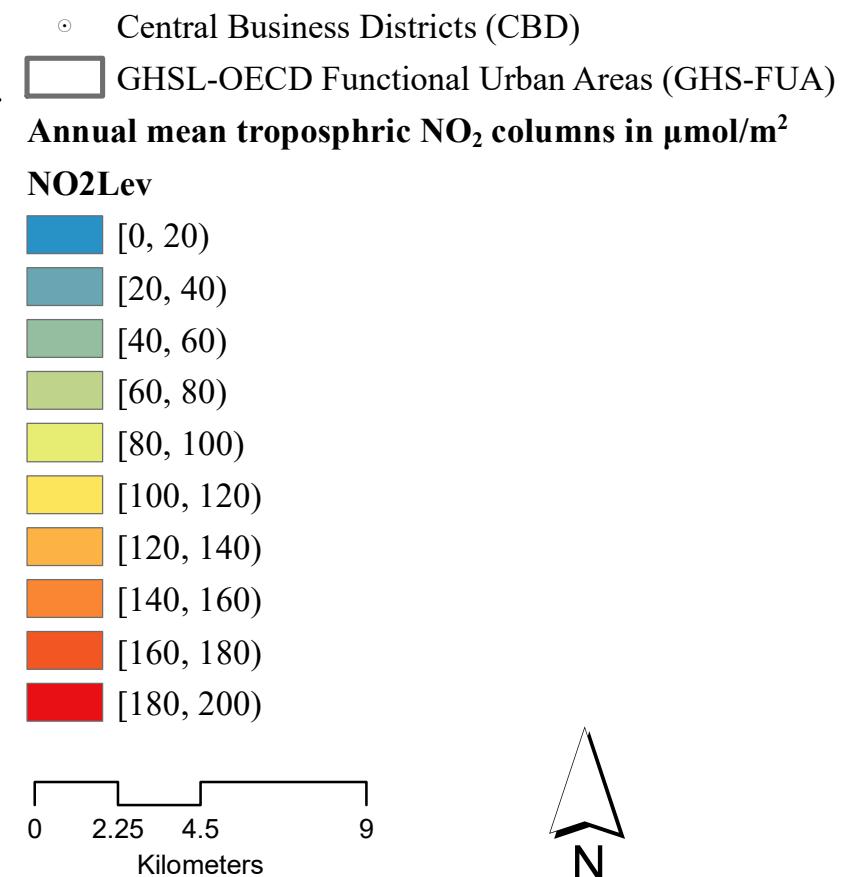
7 0'0"W

6 50'0"W

RS-measured tropospheric vertical columns of NO<sub>2</sub> of  
Huelva, Spain  
eFUA\_ID: 1395  
at 1 km resolution

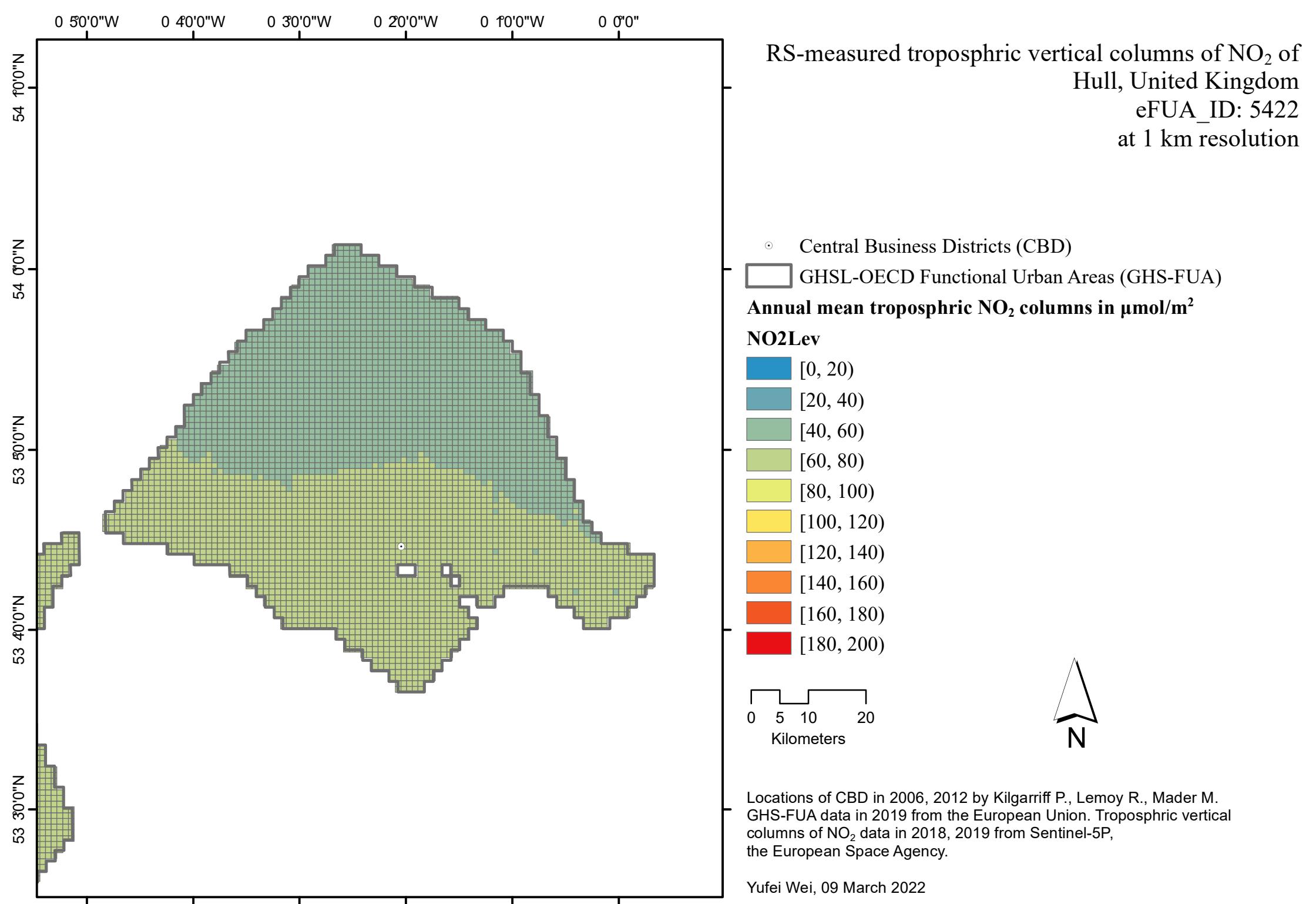
37 20'0"N

37 10'0"N



Locations of CBD in 2006, 2012 by Kilgarriff P., Lemoy R., Mader M.  
GHS-FUA data in 2019 from the European Union. Tropospheric vertical  
columns of NO<sub>2</sub> data in 2018, 2019 from Sentinel-5P,  
the European Space Agency.

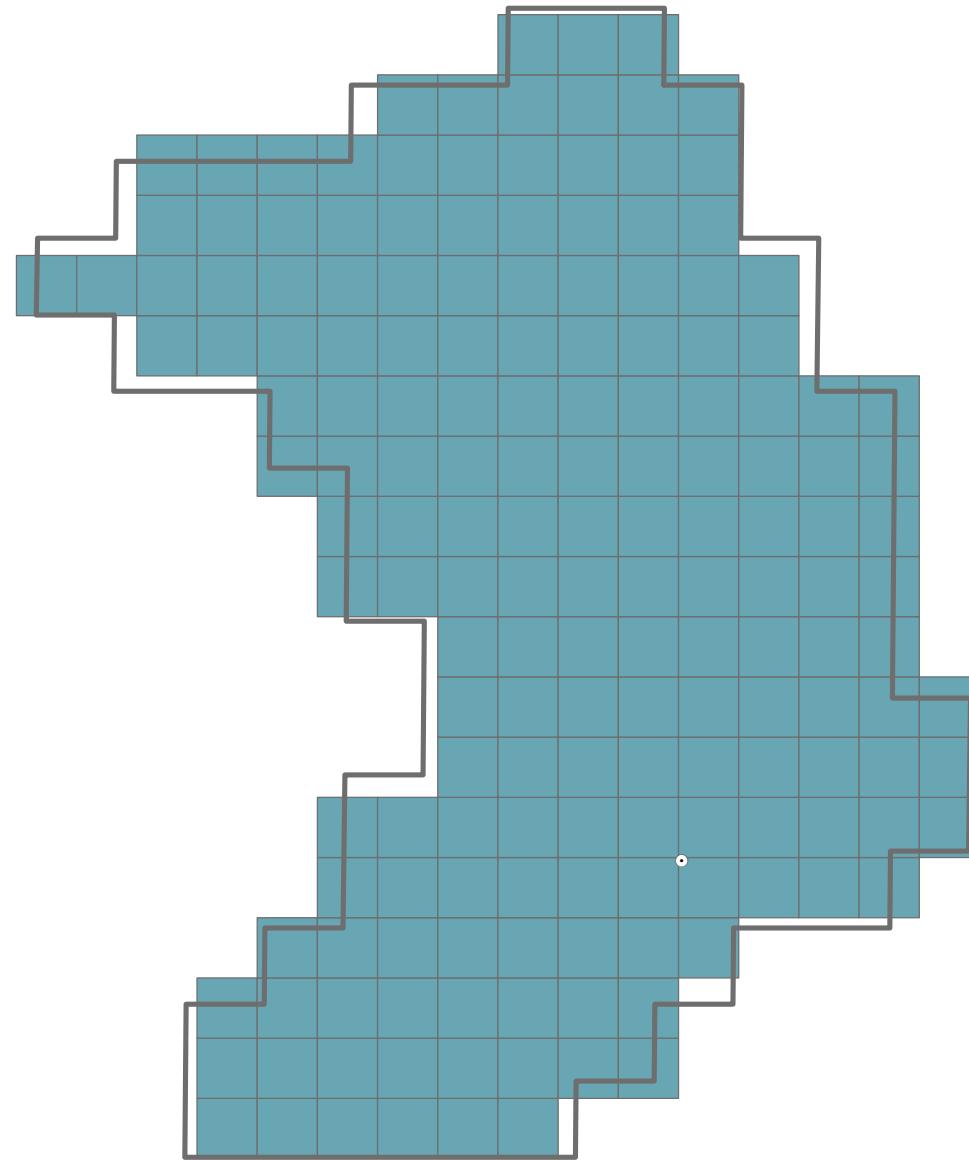
Yufei Wei, 09 March 2022



120°E

39°N

RS-measured tropospheric vertical columns of NO<sub>2</sub> of  
Ibiza, Spain  
eFUA\_ID: 4391  
at 1 km resolution



Locations of CBD in 2006, 2012 by Kilgarriff P., Lemoy R., Mader M.  
GHS-FUA data in 2019 from the European Union. Tropospheric vertical  
columns of NO<sub>2</sub> data in 2018, 2019 from Sentinel-5P,  
the European Space Agency.

Yufei Wei, 09 March 2022



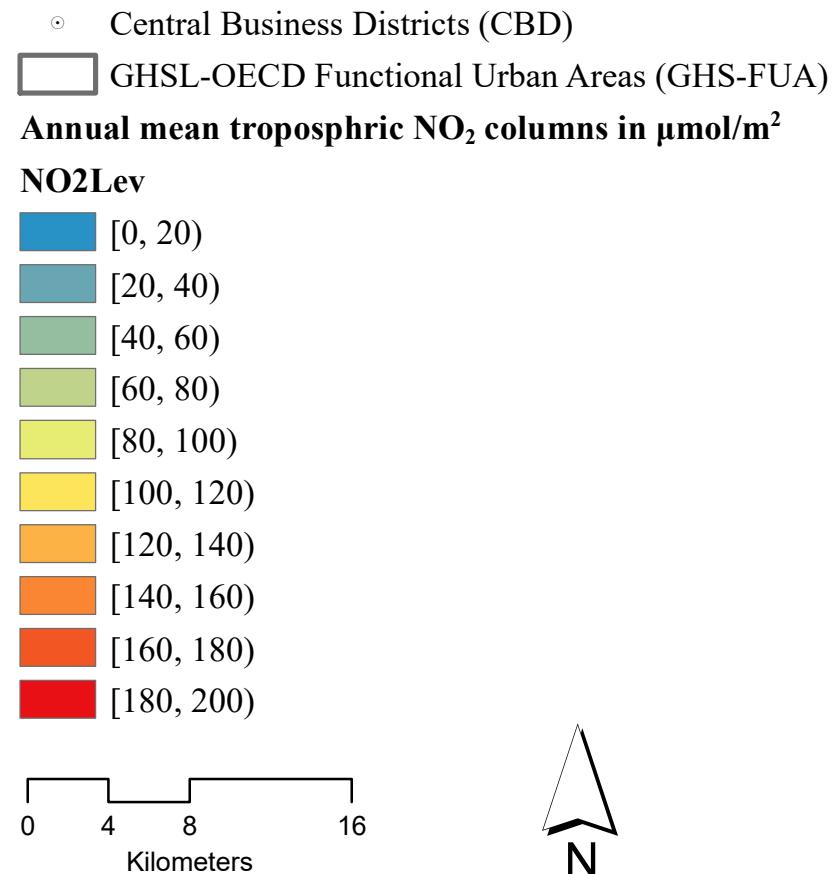
11 20'0"E

11 30'0"E

11 40'0"E

RS-measured tropospheric vertical columns of NO<sub>2</sub> of  
Ingolstadt, Germany  
eFUA\_ID: 4679  
at 1 km resolution

48 50'0"N  
48 40'0"N



Locations of CBD in 2006, 2012 by Kilgarriff P., Lemoy R., Mader M.  
GHS-FUA data in 2019 from the European Union. Tropospheric vertical  
columns of NO<sub>2</sub> data in 2018, 2019 from Sentinel-5P,  
the European Space Agency.

Yufei Wei, 09 March 2022

11 10'0"E

11 20'0"E

11 30'0"E

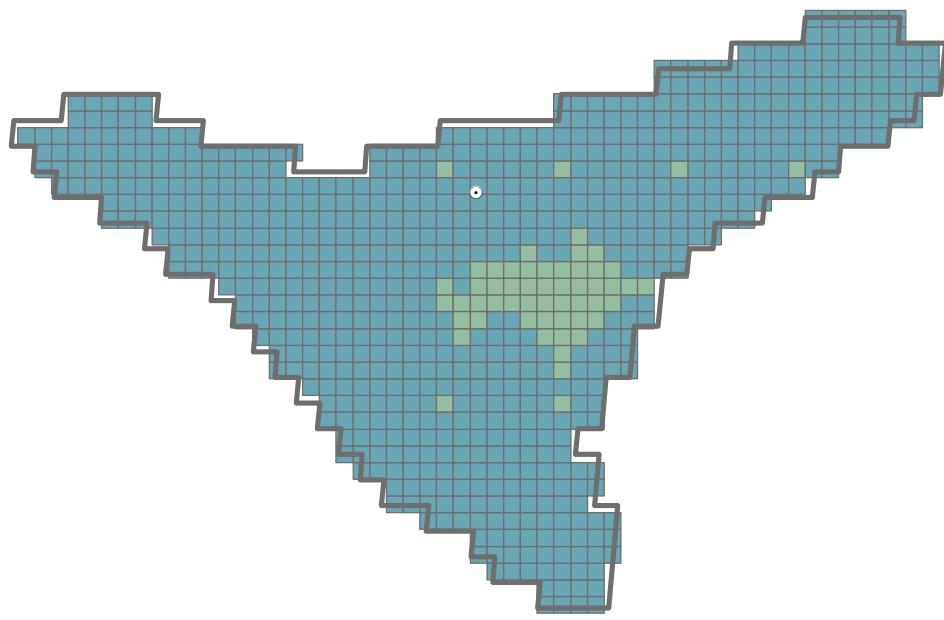
11 40'0"E

RS-measured tropospheric vertical columns of NO<sub>2</sub> of  
Innsbruck, Austria  
eFUA\_ID: 8  
at 1 km resolution

47 20'0"N

47 10'0"N

47 00'0"N



○ Central Business Districts (CBD)

◻ GHS-OECD Functional Urban Areas (GHS-FUA)

Annual mean tropospheric NO<sub>2</sub> columns in  $\mu\text{mol}/\text{m}^2$

NO2Lev

[0, 20)

[20, 40)

[40, 60)

[60, 80)

[80, 100)

[100, 120)

[120, 140)

[140, 160)

[160, 180)

[180, 200)

0 4.75 9.5 19  
Kilometers



Locations of CBD in 2006, 2012 by Kilgarriff P., Lemoy R., Mader M.  
GHS-FUA data in 2019 from the European Union. Tropospheric vertical  
columns of NO<sub>2</sub> data in 2018, 2019 from Sentinel-5P,  
the European Space Agency.

Yufei Wei, 09 March 2022

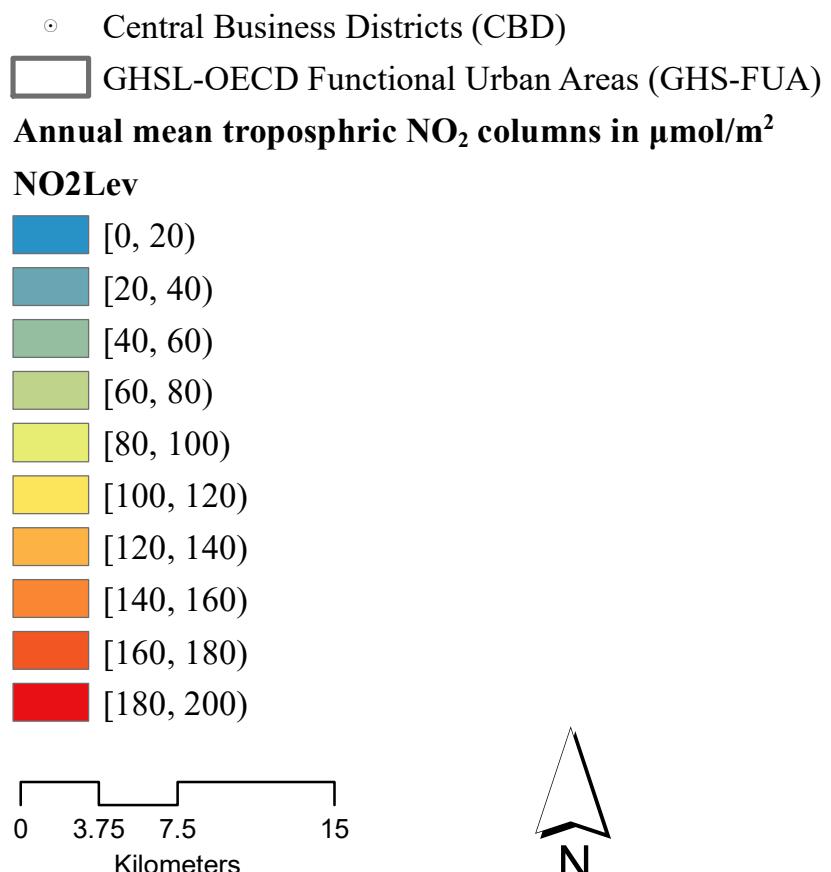
18 10'0"E

18 20'0"E

18 30'0"E

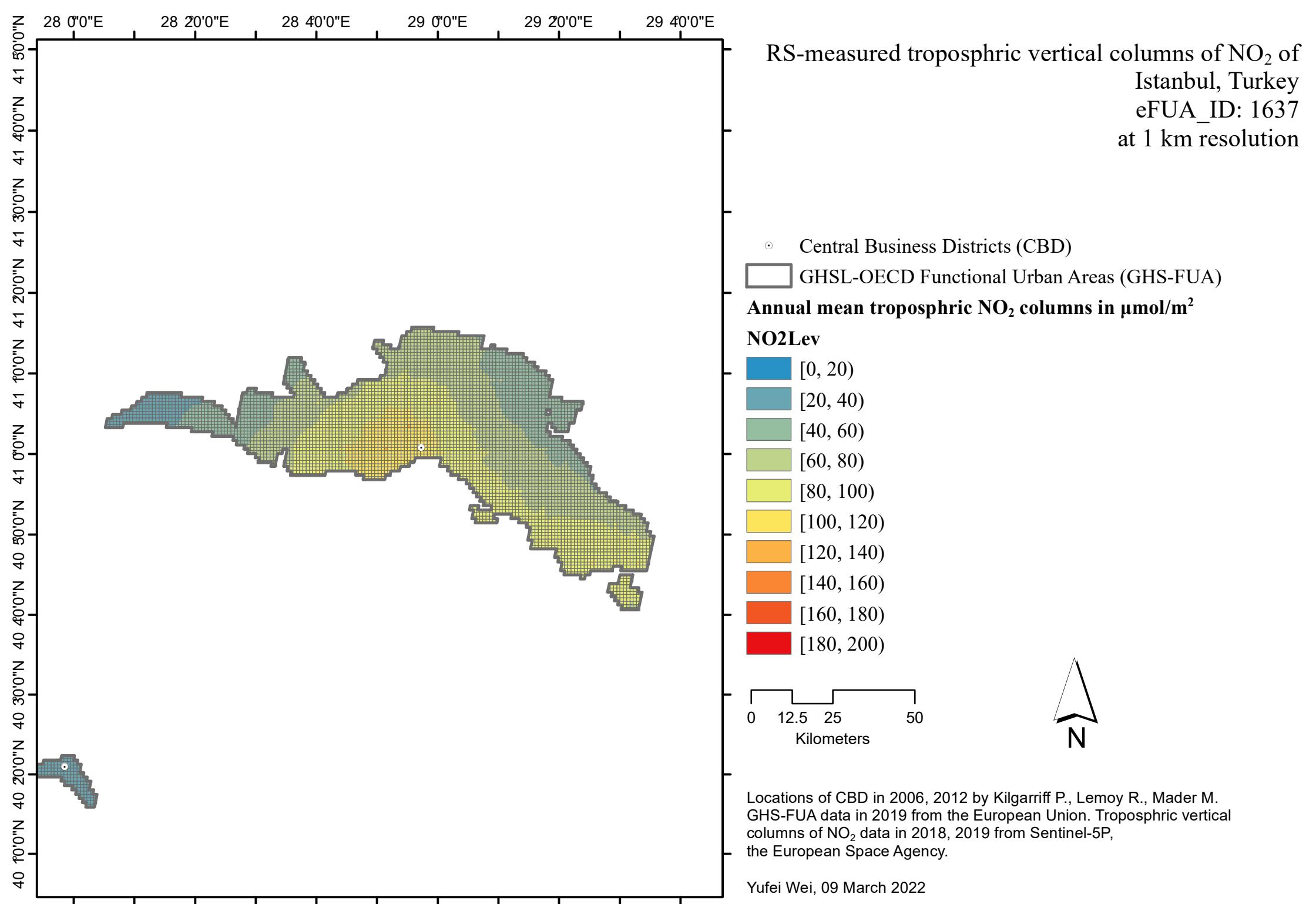
RS-measured tropospheric vertical columns of NO<sub>2</sub> of  
Inowroclaw, Poland  
eFUA\_ID: 2186  
at 1 km resolution

52 50'0"N  
52 40'0"N



Locations of CBD in 2006, 2012 by Kilgarriff P., Lemoy R., Mader M.  
GHS-FUA data in 2019 from the European Union. Tropospheric vertical  
columns of NO<sub>2</sub> data in 2018, 2019 from Sentinel-5P,  
the European Space Agency.

Yufei Wei, 09 March 2022

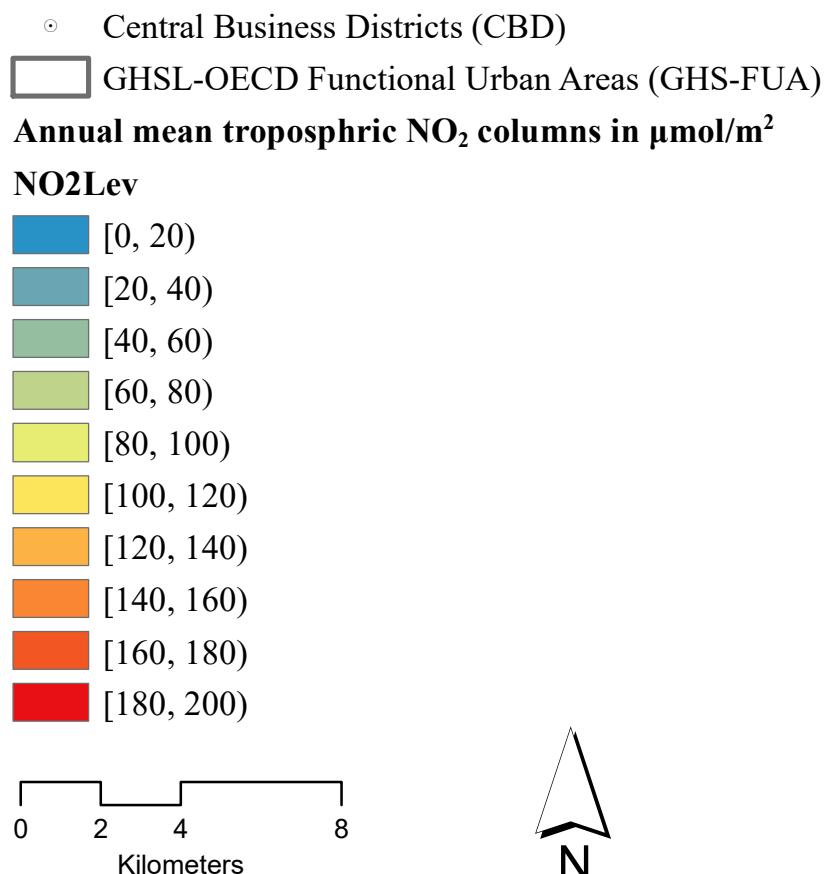
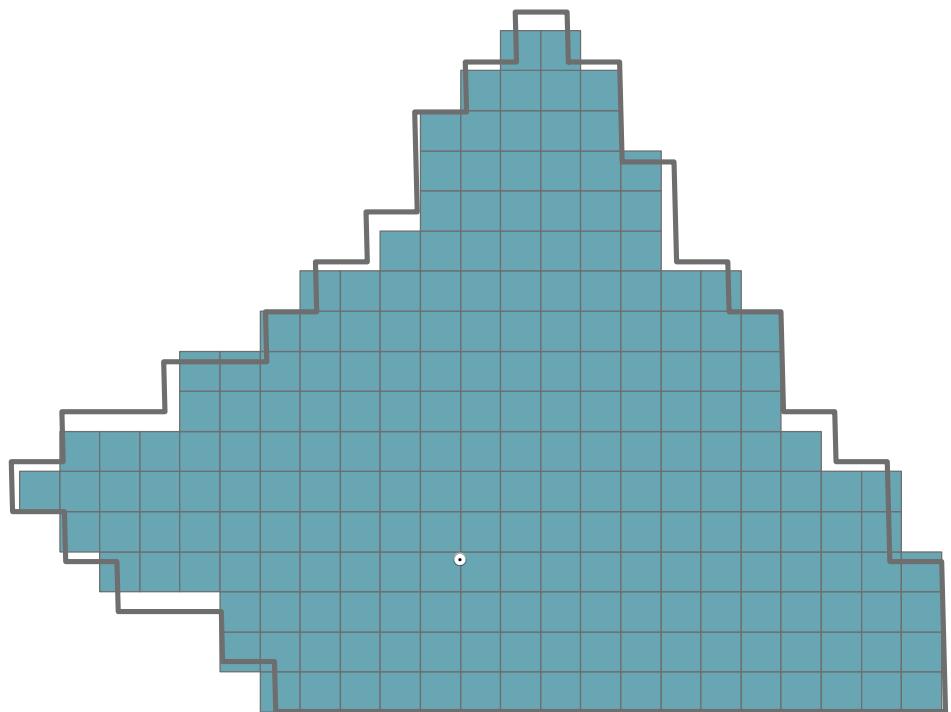


3 50'0"W

3 40'0"W

RS-measured tropospheric vertical columns of NO<sub>2</sub> of  
Jaen, Spain  
eFUA\_ID: 3198  
at 1 km resolution

37 50'0"N



Locations of CBD in 2006, 2012 by Kilgarriff P., Lemoy R., Mader M.  
GHS-FUA data in 2019 from the European Union. Tropospheric vertical  
columns of NO<sub>2</sub> data in 2018, 2019 from Sentinel-5P,  
the European Space Agency.

Yufei Wei, 09 March 2022

15 40'0"E

15 50'0"E

16 0'0"E

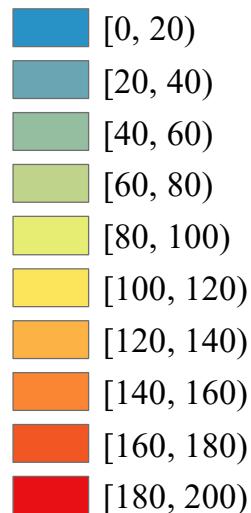
RS-measured tropospheric vertical columns of NO<sub>2</sub> of  
Jelenia Gora, Poland  
eFUA\_ID: 876  
at 1 km resolution

51 0'0"N

50 50'0"N

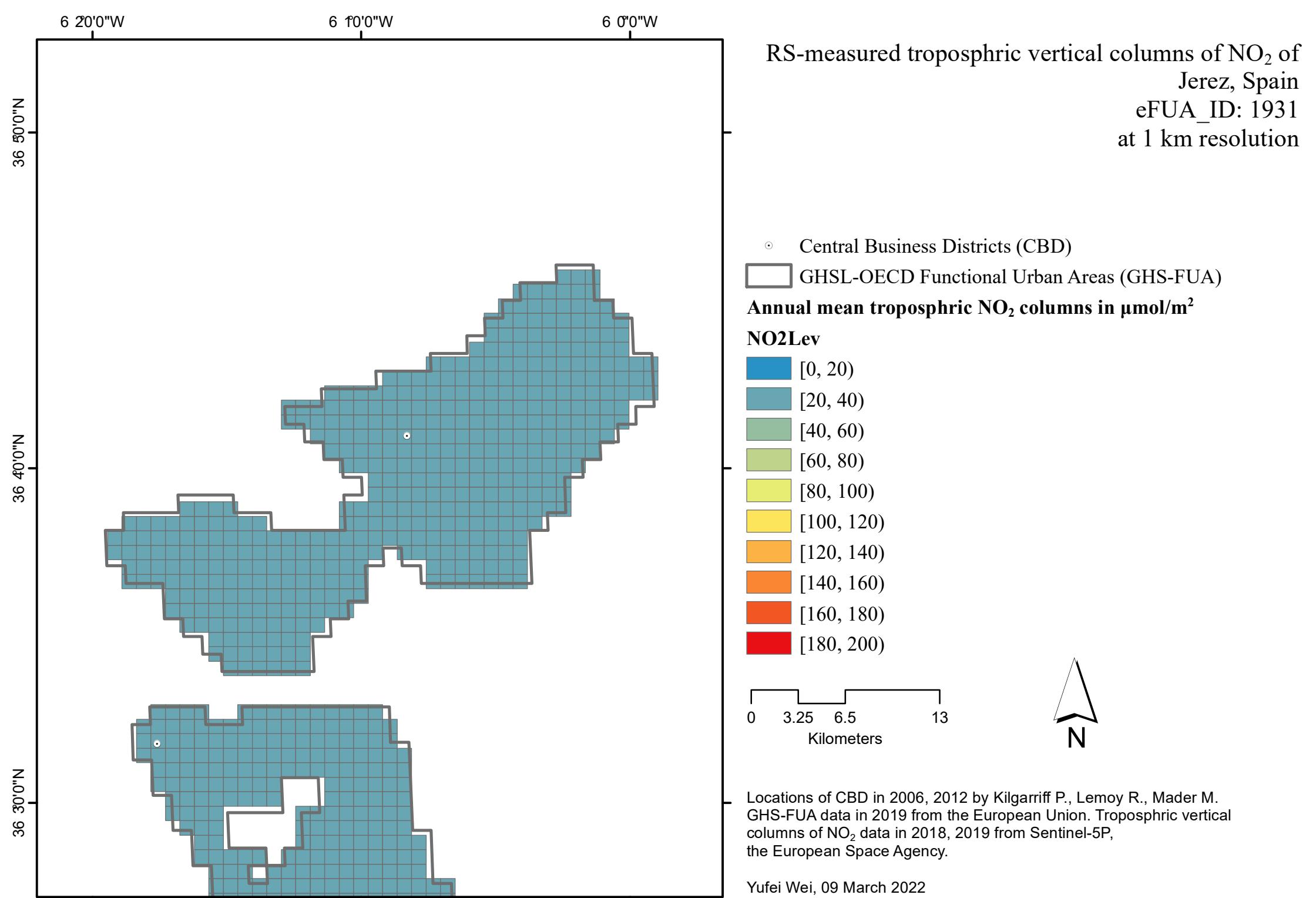
○ Central Business Districts (CBD)

◻ GHSL-OECD Functional Urban Areas (GHS-FUA)

**Annual mean tropospheric NO<sub>2</sub> columns in  $\mu\text{mol}/\text{m}^2$** **NO2Lev**

Locations of CBD in 2006, 2012 by Kilgarriff P., Lemoy R., Mader M.  
GHS-FUA data in 2019 from the European Union. Tropospheric vertical  
columns of NO<sub>2</sub> data in 2018, 2019 from Sentinel-5P,  
the European Space Agency.

Yufei Wei, 09 March 2022

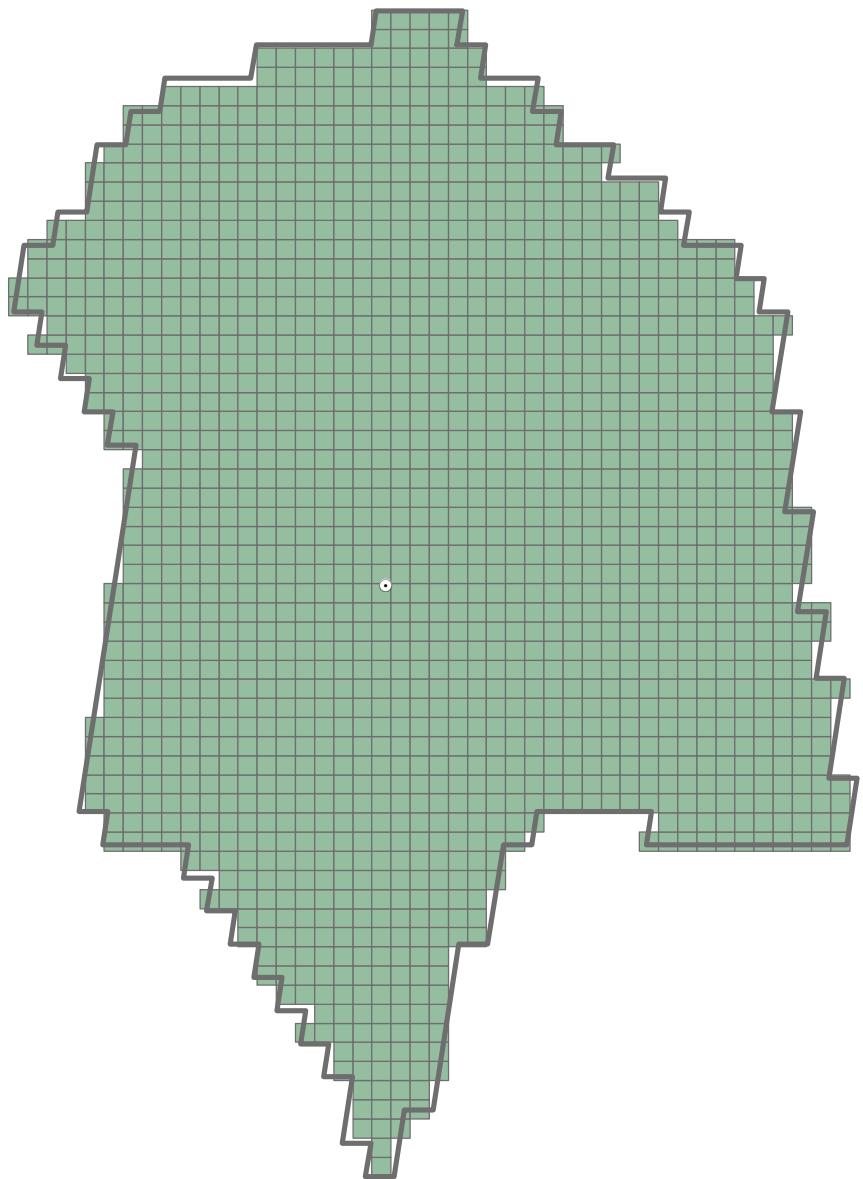


18 0'0"E

18 10'0"E

18 20'0"E

RS-measured tropospheric vertical columns of NO<sub>2</sub> of  
Kalisz, Poland  
eFUA\_ID: 2259  
at 1 km resolution



○ Central Business Districts (CBD)

◻ GHS-OECD Functional Urban Areas (GHS-FUA)

Annual mean tropospheric NO<sub>2</sub> columns in  $\mu\text{mol}/\text{m}^2$

NO2Lev

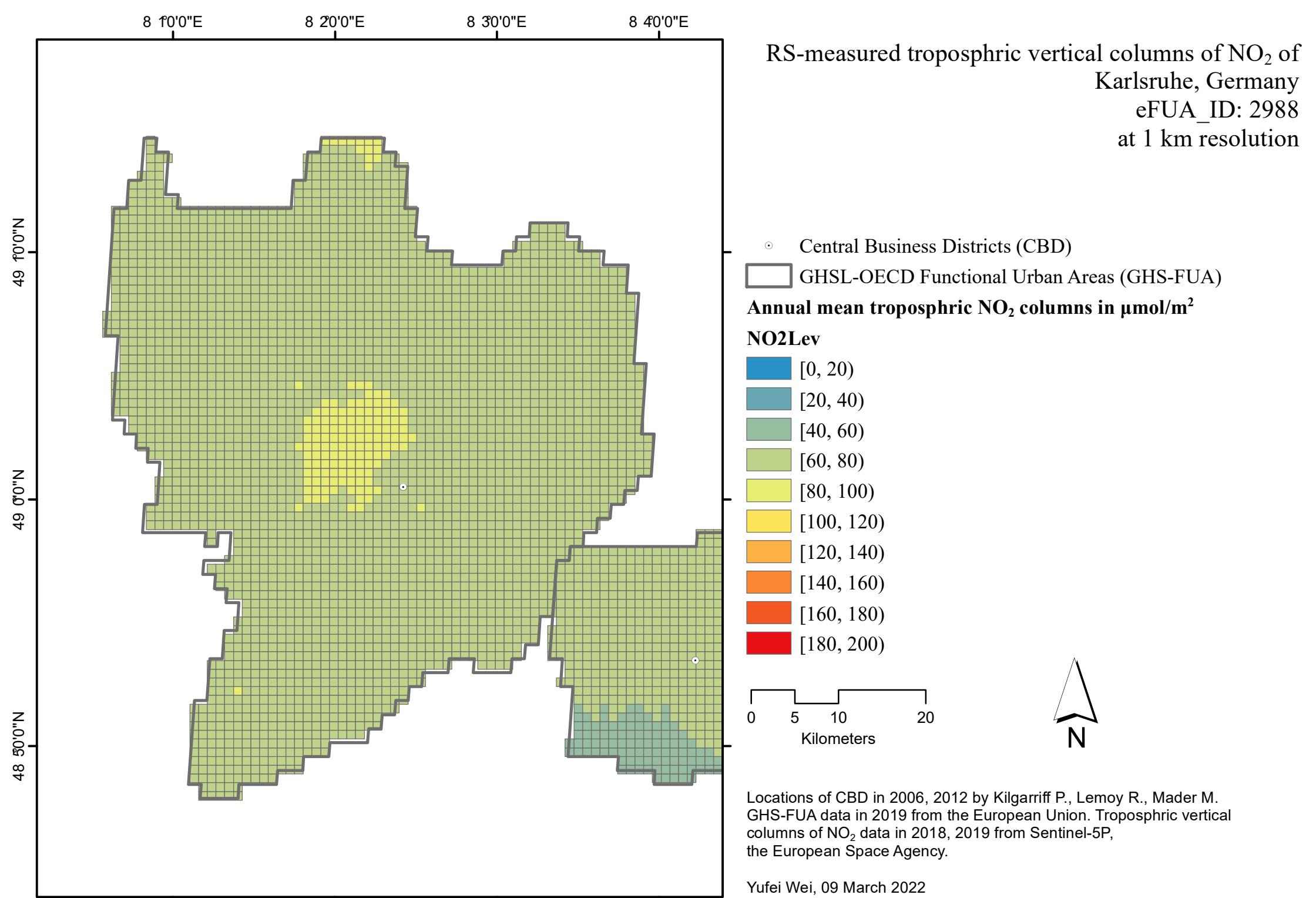
- [0, 20]
- [20, 40]
- [40, 60]
- [60, 80]
- [80, 100]
- [100, 120]
- [120, 140]
- [140, 160]
- [160, 180]
- [180, 200]

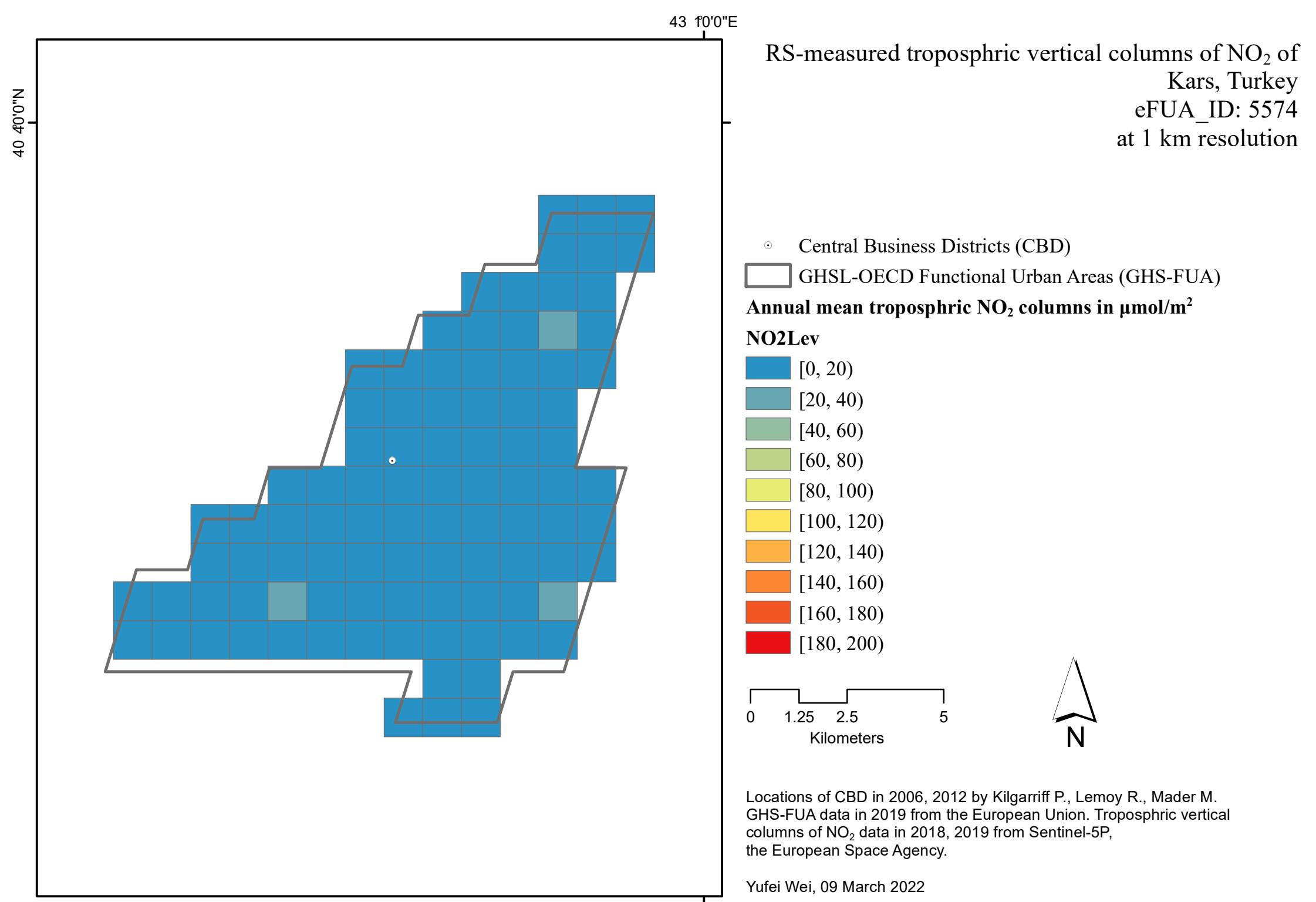
0 4.25 8.5 17  
Kilometers

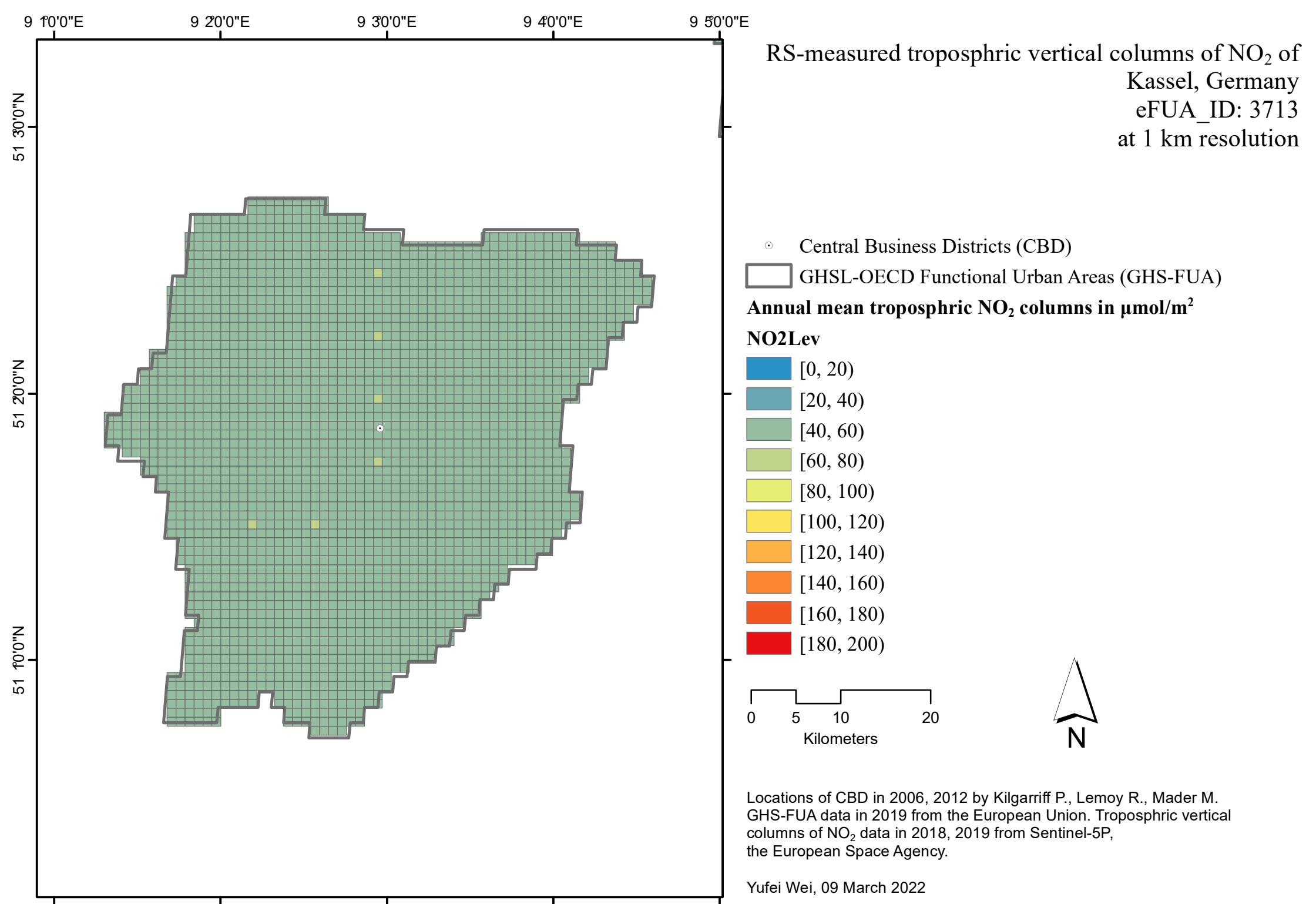


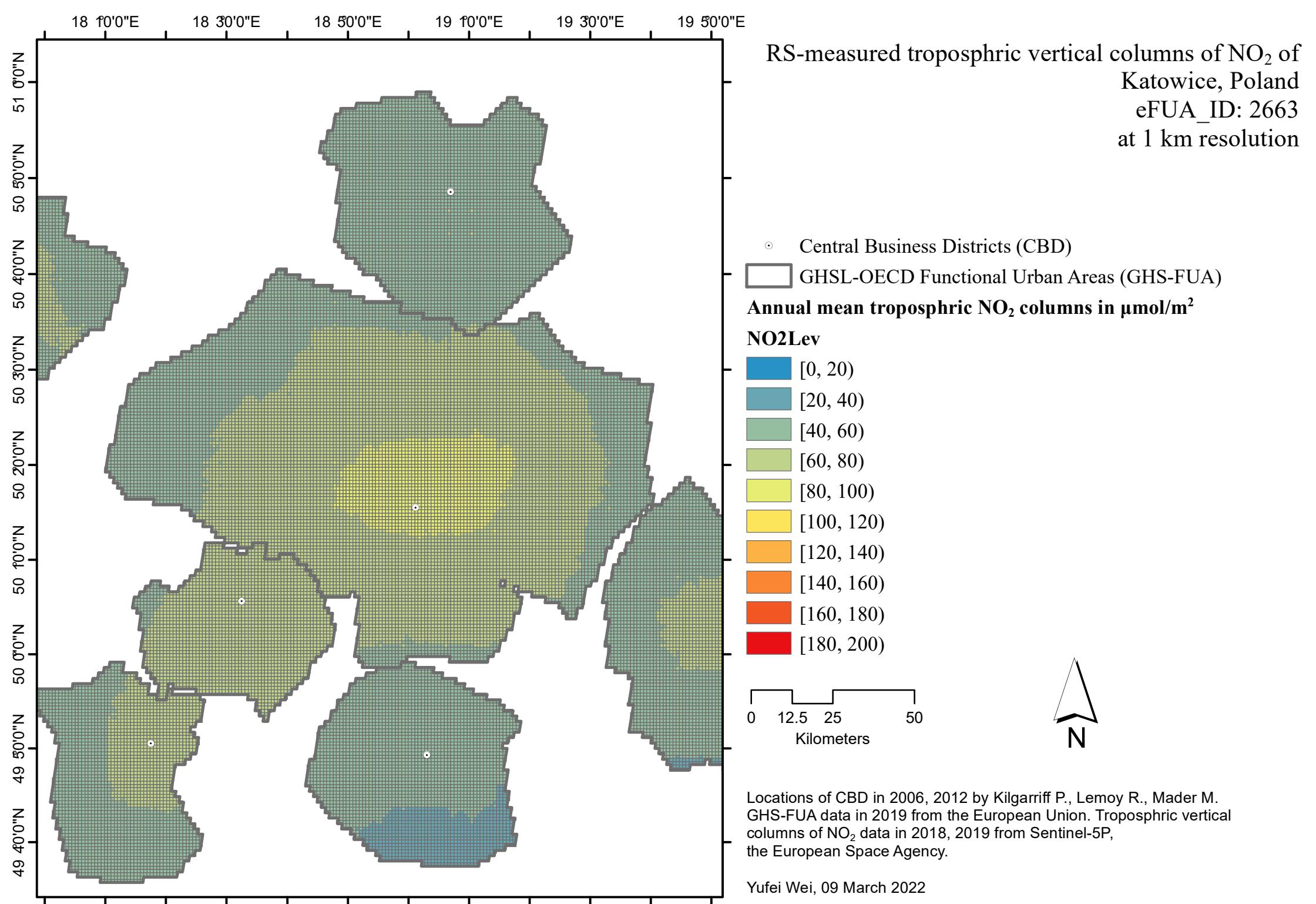
Locations of CBD in 2006, 2012 by Kilgarriff P., Lemoy R., Mader M.  
GHS-FUA data in 2019 from the European Union. Tropospheric vertical  
columns of NO<sub>2</sub> data in 2018, 2019 from Sentinel-5P,  
the European Space Agency.

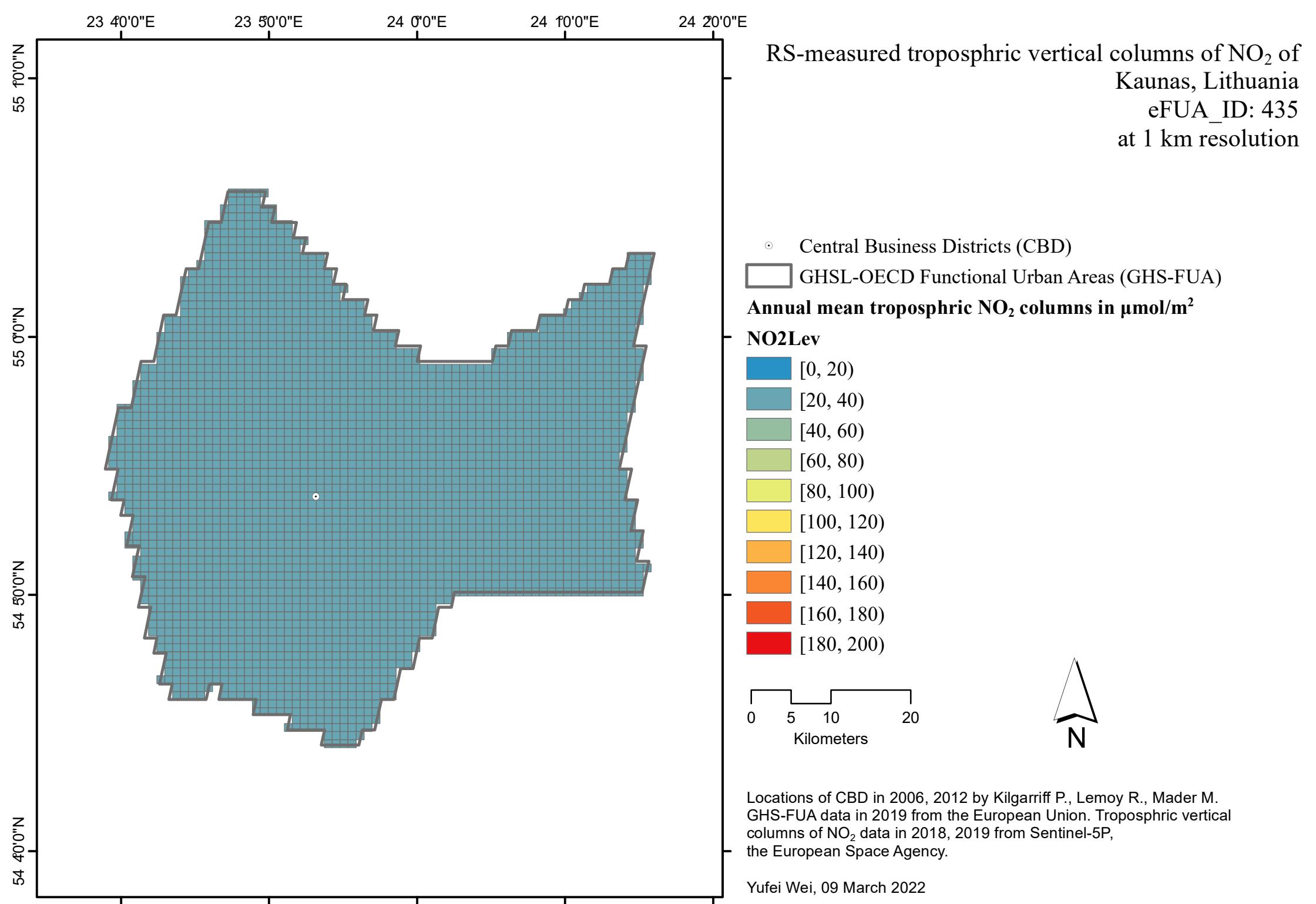
Yufei Wei, 09 March 2022

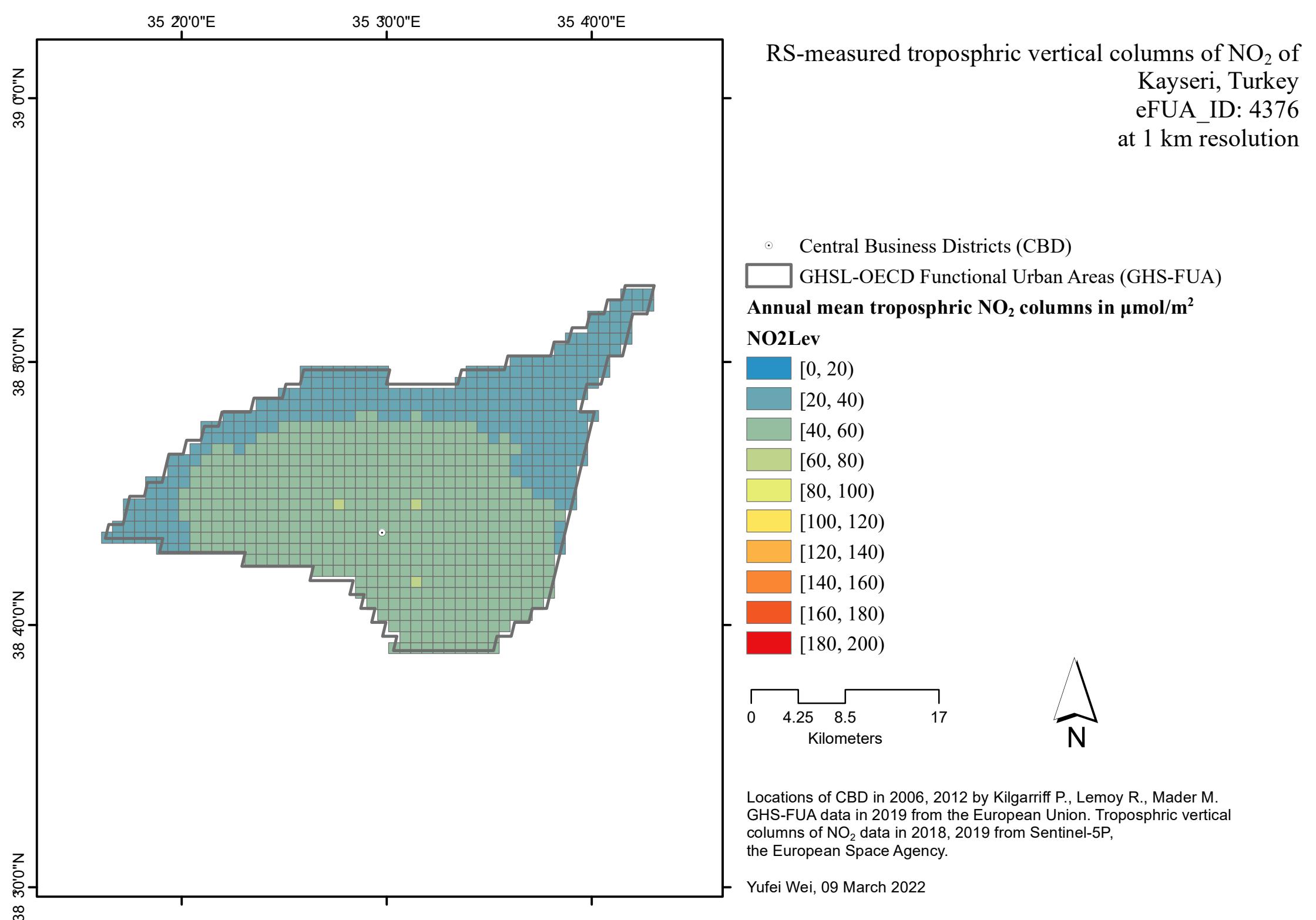


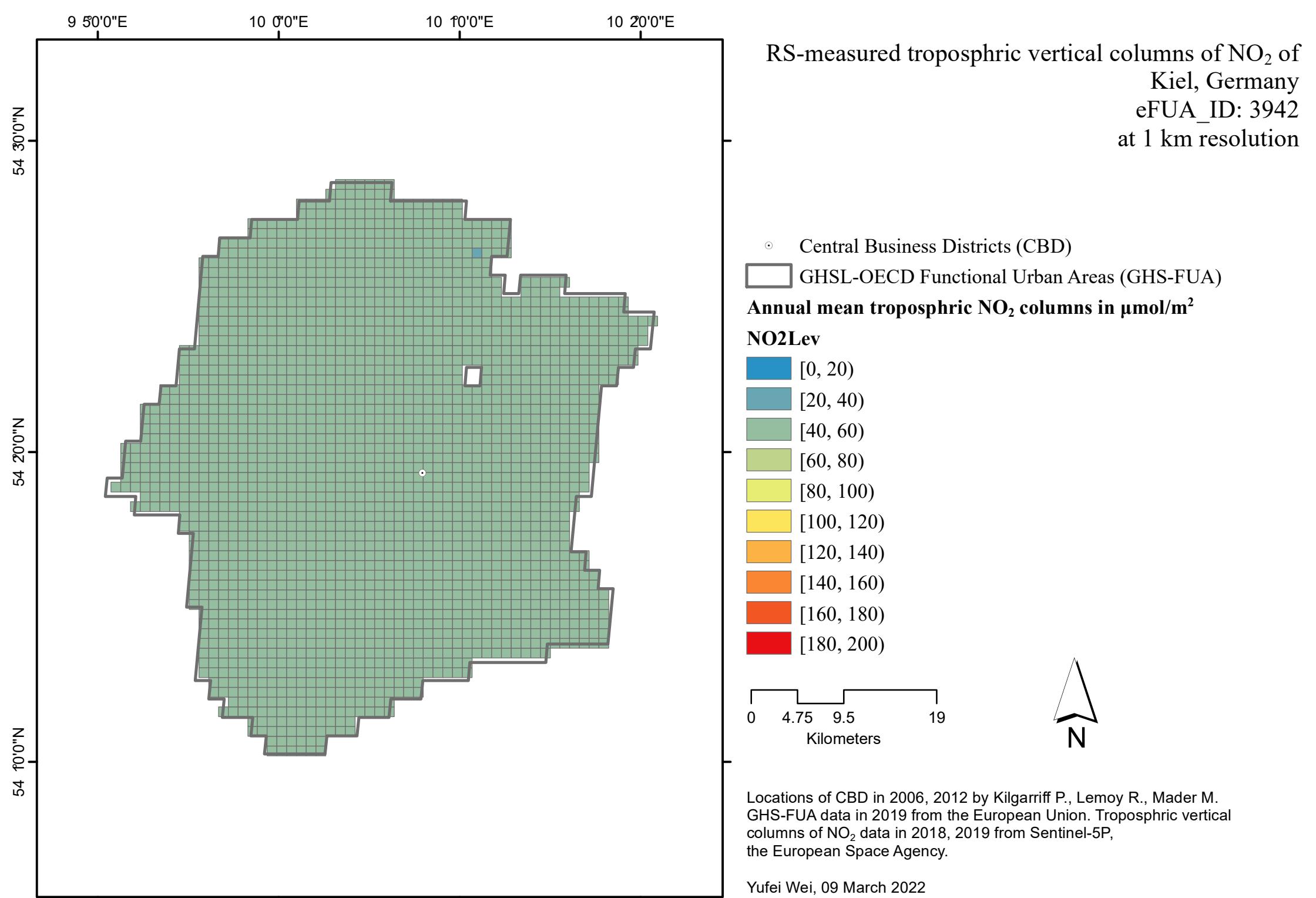












20 30'0"E

20 40'0"E

20 50'0"E

51 0'0"N

50 50'0"N

50 40'0"N

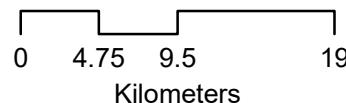
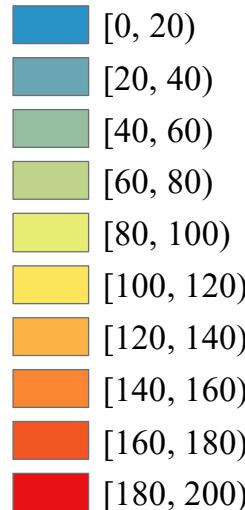
RS-measured tropospheric vertical columns of NO<sub>2</sub> of  
Kielce, Poland  
eFUA\_ID: 3323  
at 1 km resolution

○ Central Business Districts (CBD)

◻ GHSL-OECD Functional Urban Areas (GHS-FUA)

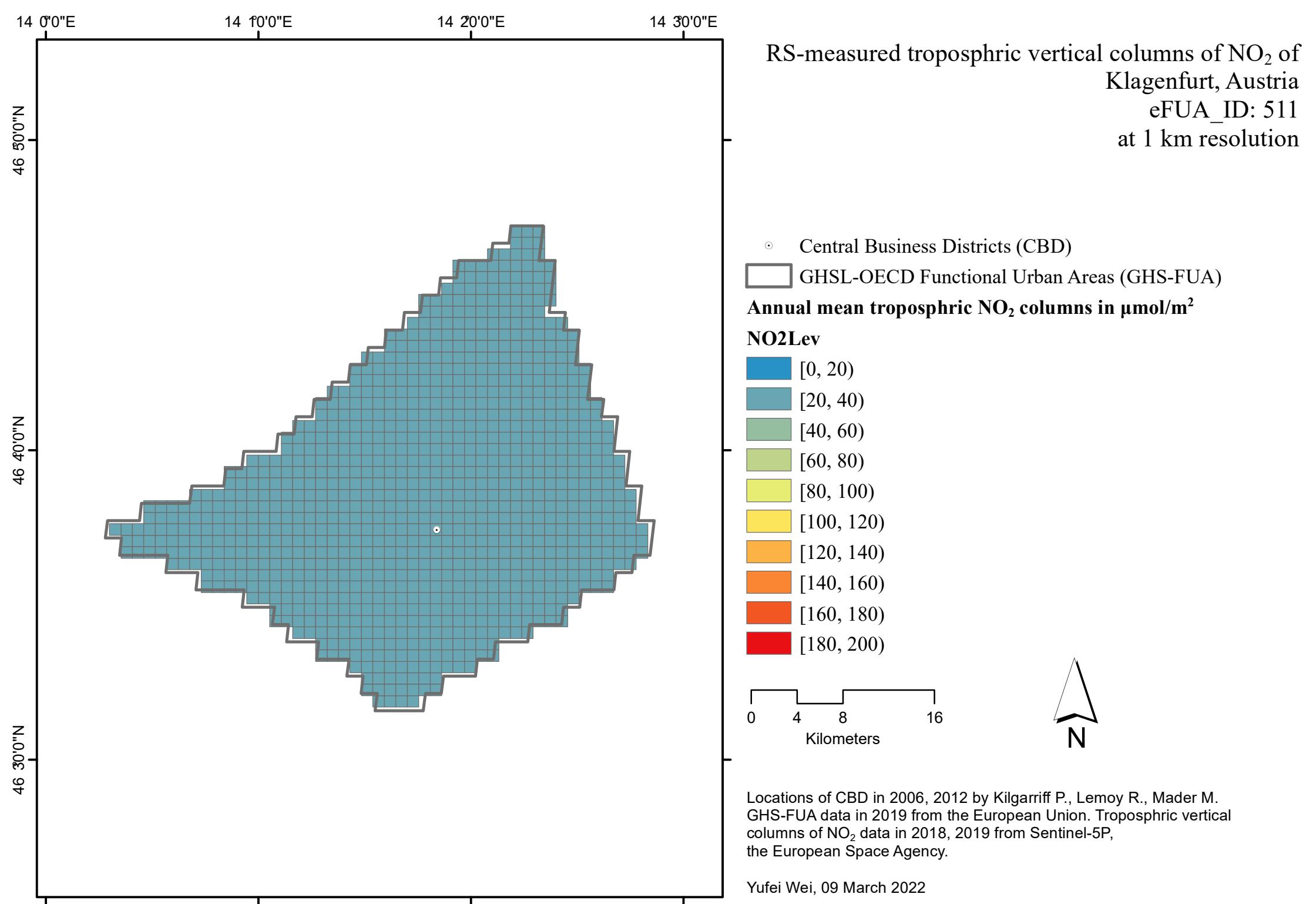
Annual mean tropospheric NO<sub>2</sub> columns in  $\mu\text{mol}/\text{m}^2$

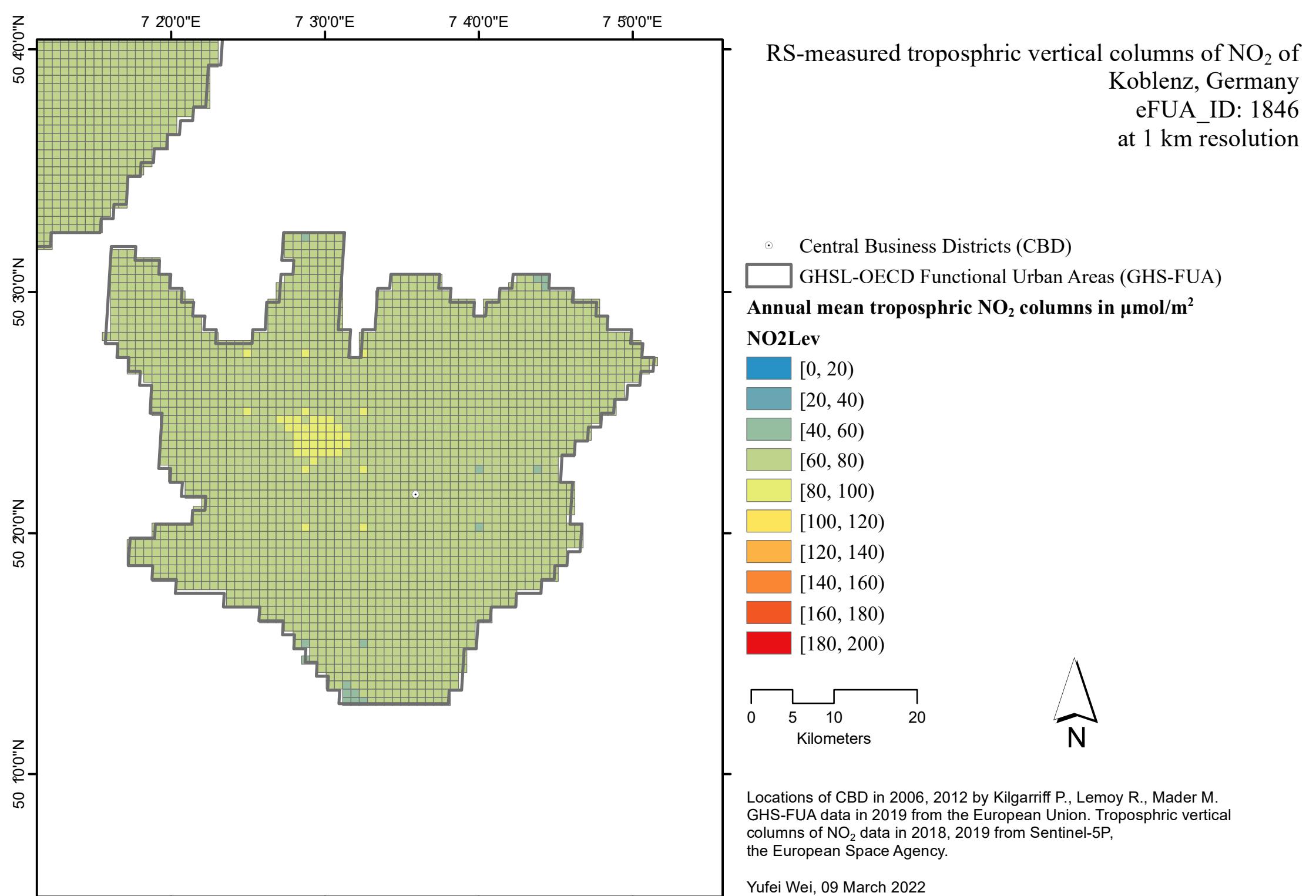
NO2Lev

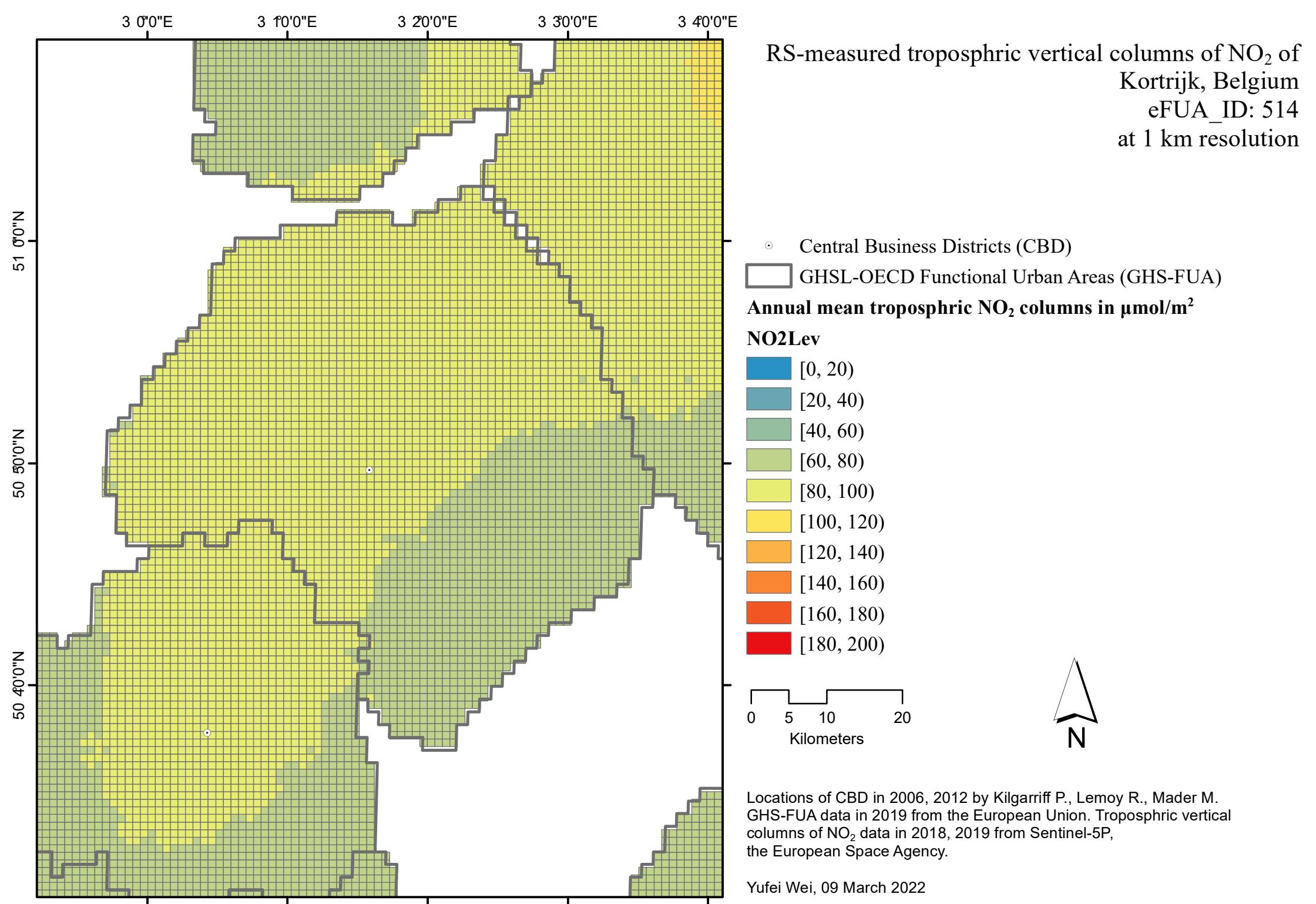


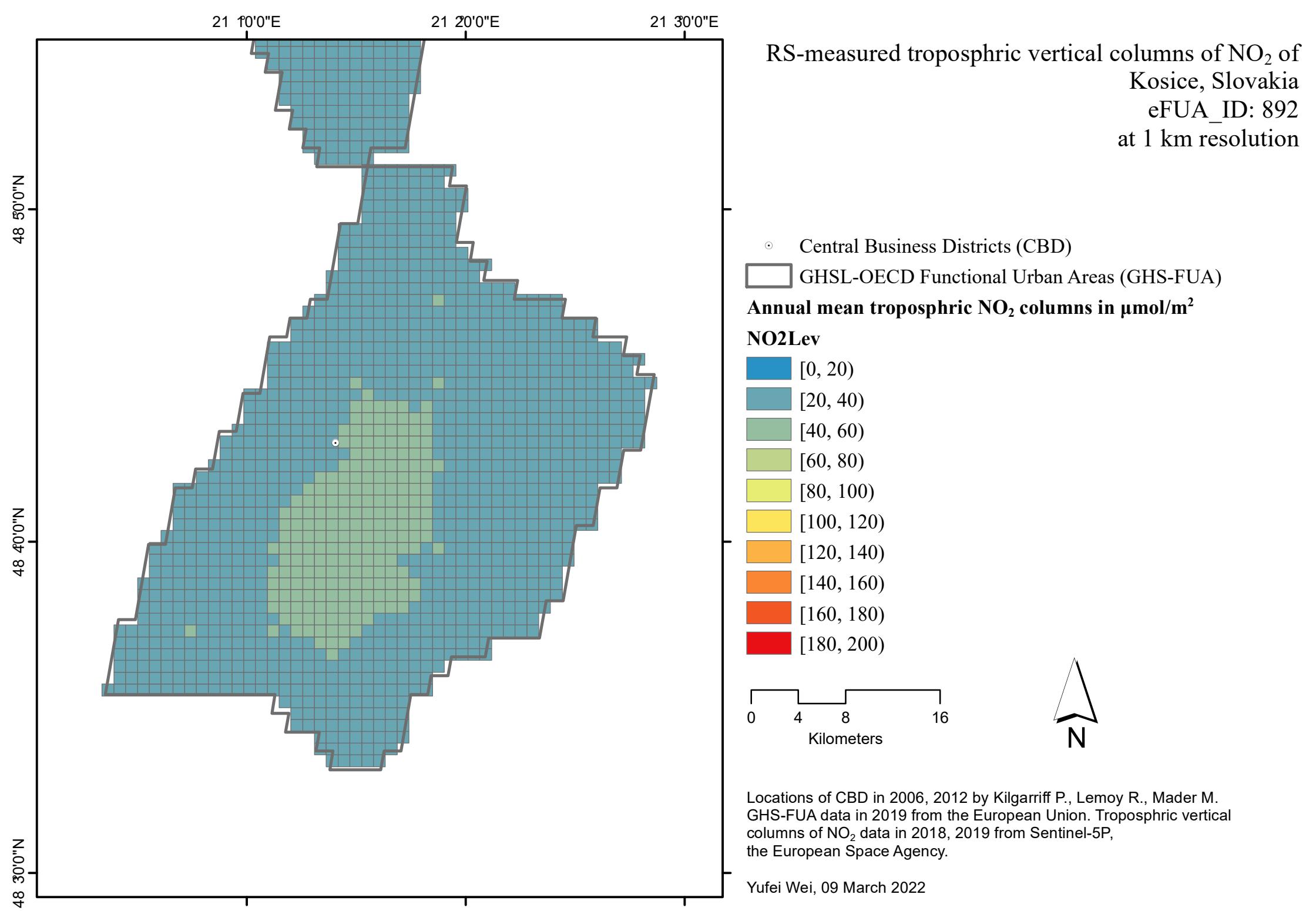
Locations of CBD in 2006, 2012 by Kilgarriff P., Lemoy R., Mader M.  
GHS-FUA data in 2019 from the European Union. Tropospheric vertical  
columns of NO<sub>2</sub> data in 2018, 2019 from Sentinel-5P,  
the European Space Agency.

Yufei Wei, 09 March 2022





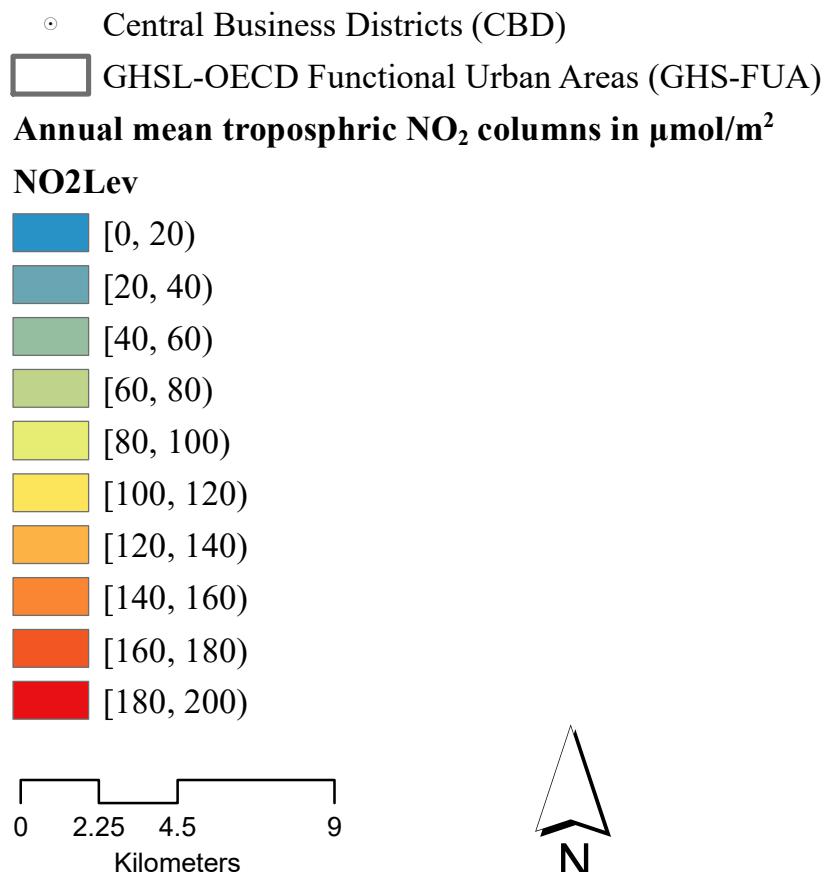
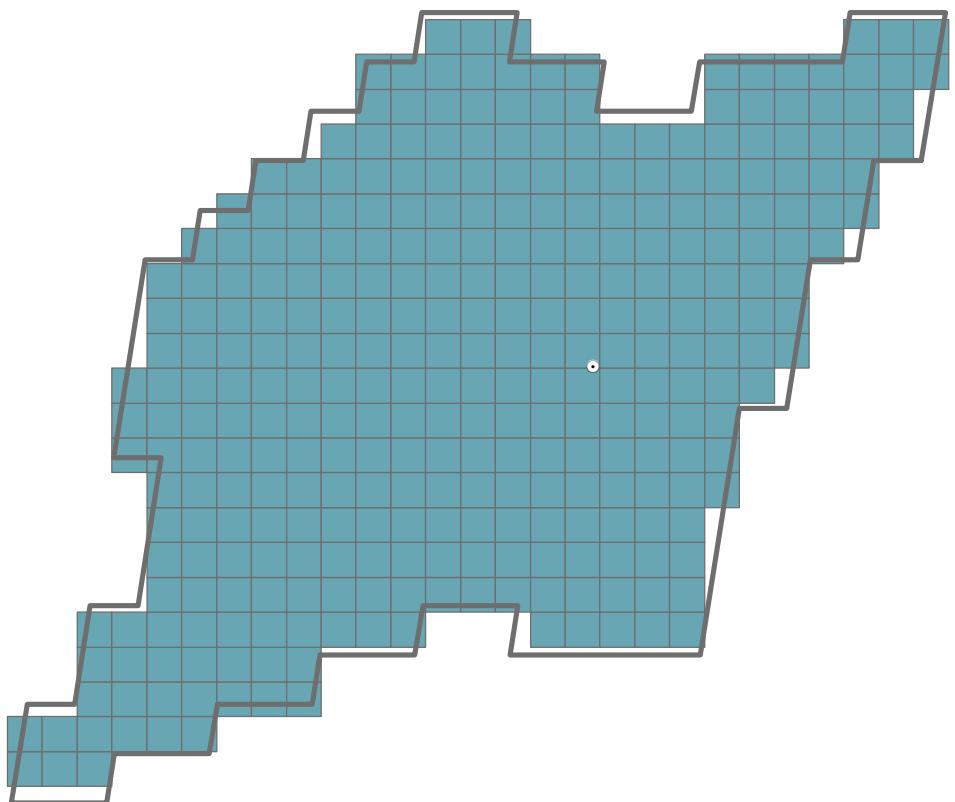




20 50'0"E

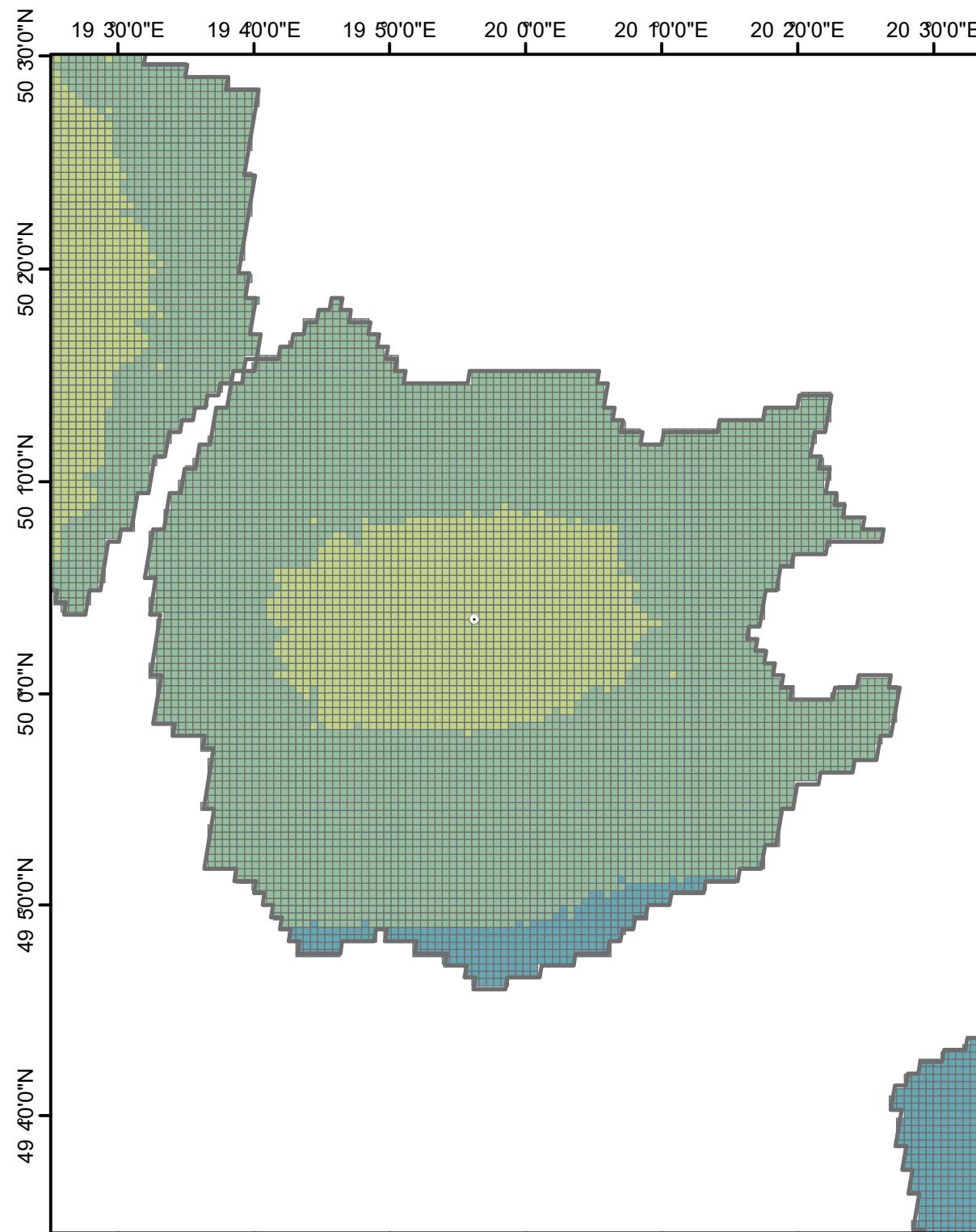
21 0'0"E

RS-measured tropospheric vertical columns of NO<sub>2</sub> of  
Kragujevac, Serbia  
eFUA\_ID: 1343  
at 1 km resolution

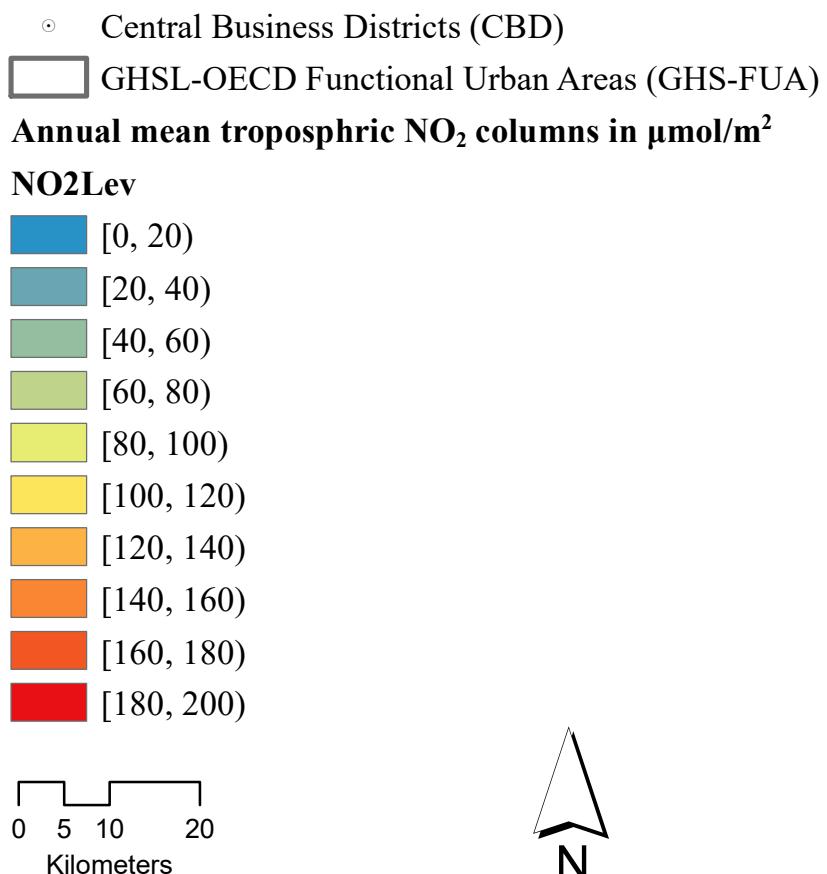


Locations of CBD in 2006, 2012 by Kilgarriff P., Lemoy R., Mader M.  
GHS-FUA data in 2019 from the European Union. Tropospheric vertical  
columns of NO<sub>2</sub> data in 2018, 2019 from Sentinel-5P,  
the European Space Agency.

Yufei Wei, 09 March 2022



RS-measured tropospheric vertical columns of NO<sub>2</sub> of  
Krakow, Poland  
eFUA\_ID: 3171  
at 1 km resolution



Locations of CBD in 2006, 2012 by Kilgarriff P., Lemoy R., Mader M.  
GHS-FUA data in 2019 from the European Union. Tropospheric vertical  
columns of NO<sub>2</sub> data in 2018, 2019 from Sentinel-5P,  
the European Space Agency.

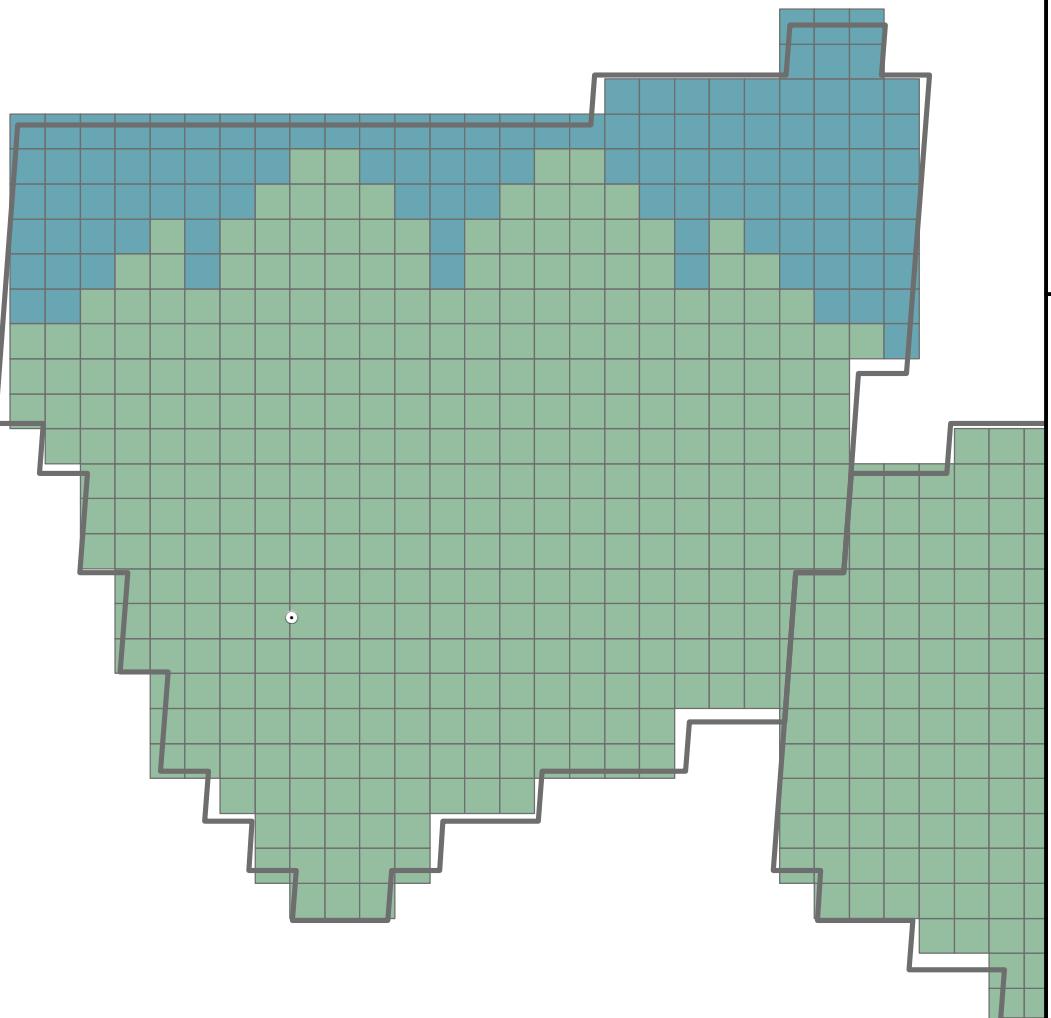
Yufei Wei, 09 March 2022

9 50'0"E

10 0'0"E

RS-measured tropospheric vertical columns of NO<sub>2</sub> of  
La Spezia, Italy  
eFUA\_ID: 2168  
at 1 km resolution

44 10'0"N  
44 0'0"N



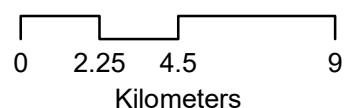
○ Central Business Districts (CBD)

◻ GHS-OECD Functional Urban Areas (GHS-FUA)

Annual mean tropospheric NO<sub>2</sub> columns in  $\mu\text{mol}/\text{m}^2$

NO2Lev

- [0, 20)
- [20, 40)
- [40, 60)
- [60, 80)
- [80, 100)
- [100, 120)
- [120, 140)
- [140, 160)
- [160, 180)
- [180, 200)



Locations of CBD in 2006, 2012 by Kilgarriff P., Lemoy R., Mader M.  
GHS-FUA data in 2019 from the European Union. Tropospheric vertical  
columns of NO<sub>2</sub> data in 2018, 2019 from Sentinel-5P,  
the European Space Agency.

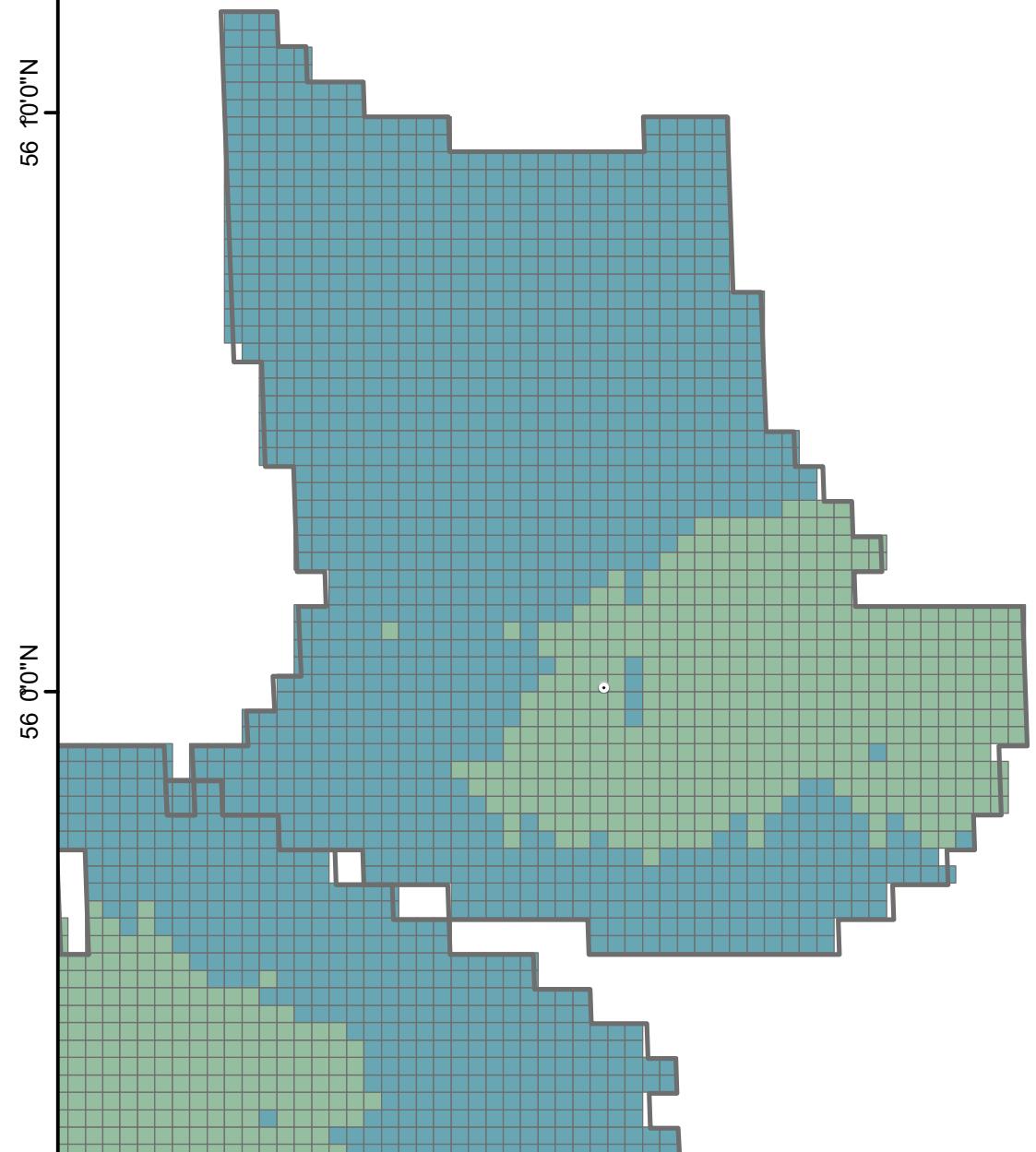
Yufei Wei, 09 March 2022

4 0'0"W

3 50'0"W

3 40'0"W

RS-measured tropospheric vertical columns of NO<sub>2</sub> of  
Larbert, United Kingdom  
eFUA\_ID: 1934  
at 1 km resolution



○ Central Business Districts (CBD)

◻ GHSL-OECD Functional Urban Areas (GHS-FUA)

Annual mean tropospheric NO<sub>2</sub> columns in  $\mu\text{mol}/\text{m}^2$

NO2Lev

- [0, 20]
- [20, 40]
- [40, 60]
- [60, 80]
- [80, 100]
- [100, 120]
- [120, 140]
- [140, 160]
- [160, 180]
- [180, 200]

0 4.25 8.5 17  
Kilometers



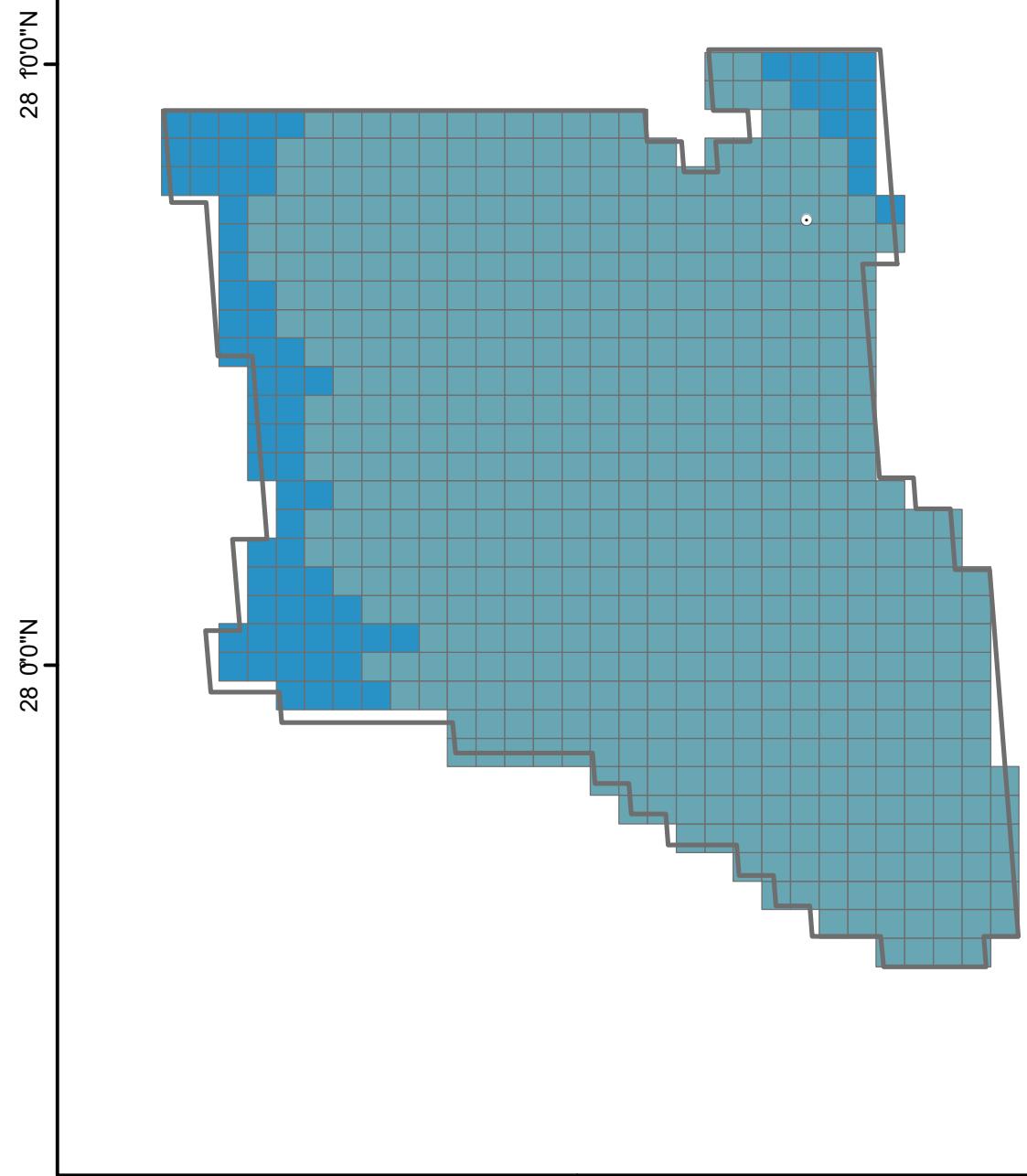
Locations of CBD in 2006, 2012 by Kilgarriff P., Lemoy R., Mader M.  
GHS-FUA data in 2019 from the European Union. Tropospheric vertical  
columns of NO<sub>2</sub> data in 2018, 2019 from Sentinel-5P,  
the European Space Agency.

Yufei Wei, 09 March 2022

15 30'0"W

15 20'0"W

RS-measured tropospheric vertical columns of NO<sub>2</sub> of  
Las Palmas de Gran Canaria, Spain  
eFUA\_ID: 543  
at 1 km resolution



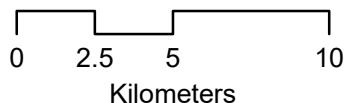
○ Central Business Districts (CBD)

◻ GHS-OECD Functional Urban Areas (GHS-FUA)

Annual mean tropospheric NO<sub>2</sub> columns in  $\mu\text{mol}/\text{m}^2$

NO2Lev

- [0, 20]
- [20, 40]
- [40, 60]
- [60, 80]
- [80, 100]
- [100, 120]
- [120, 140]
- [140, 160]
- [160, 180]
- [180, 200]



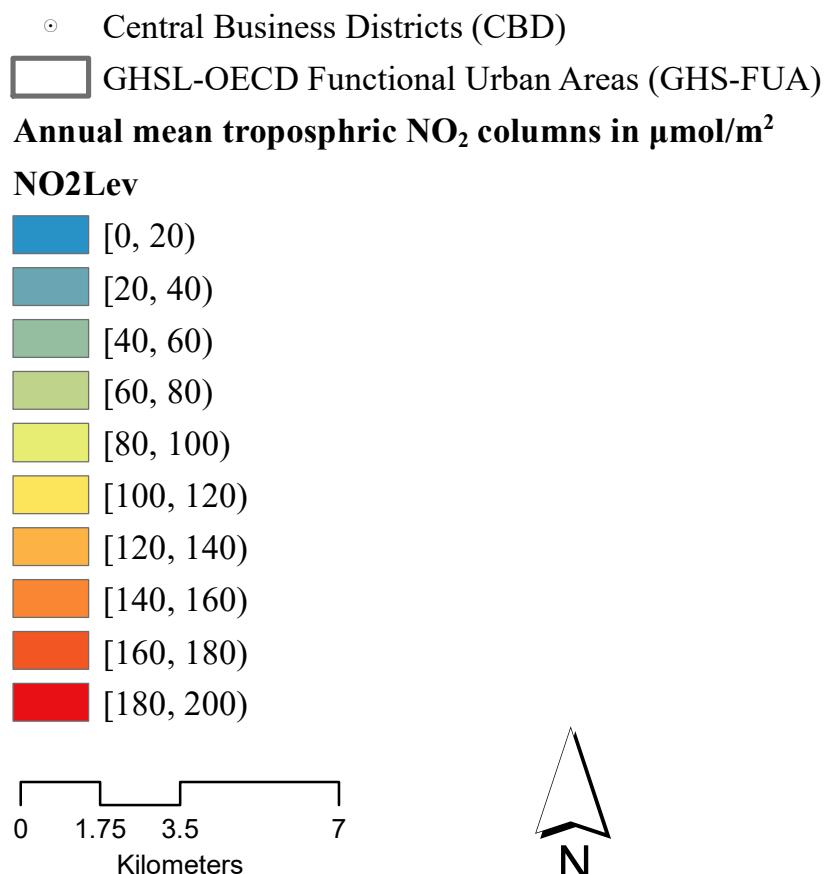
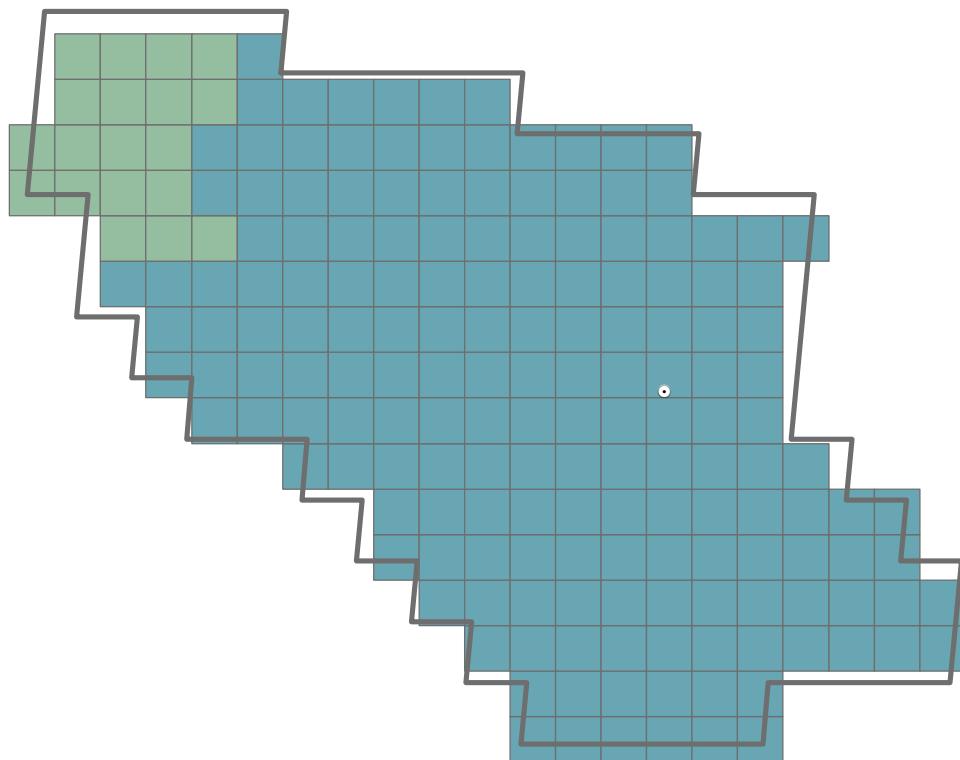
Locations of CBD in 2006, 2012 by Kilgarriff P., Lemoy R., Mader M.  
GHS-FUA data in 2019 from the European Union. Tropospheric vertical  
columns of NO<sub>2</sub> data in 2018, 2019 from Sentinel-5P,  
the European Space Agency.

Yufei Wei, 09 March 2022

12 50'0"E

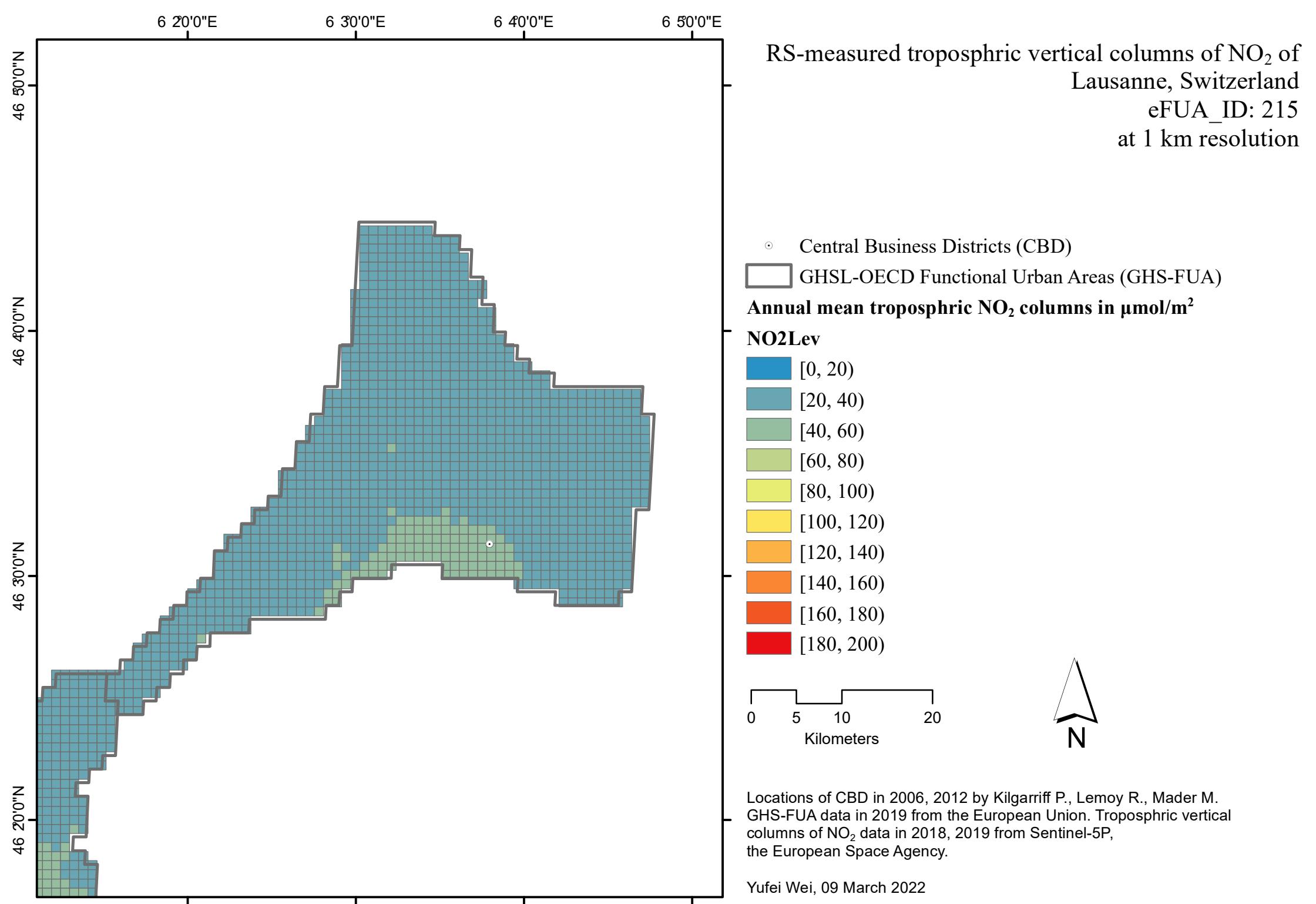
RS-measured tropospheric vertical columns of NO<sub>2</sub> of  
Latina, Italy  
eFUA\_ID: 4094  
at 1 km resolution

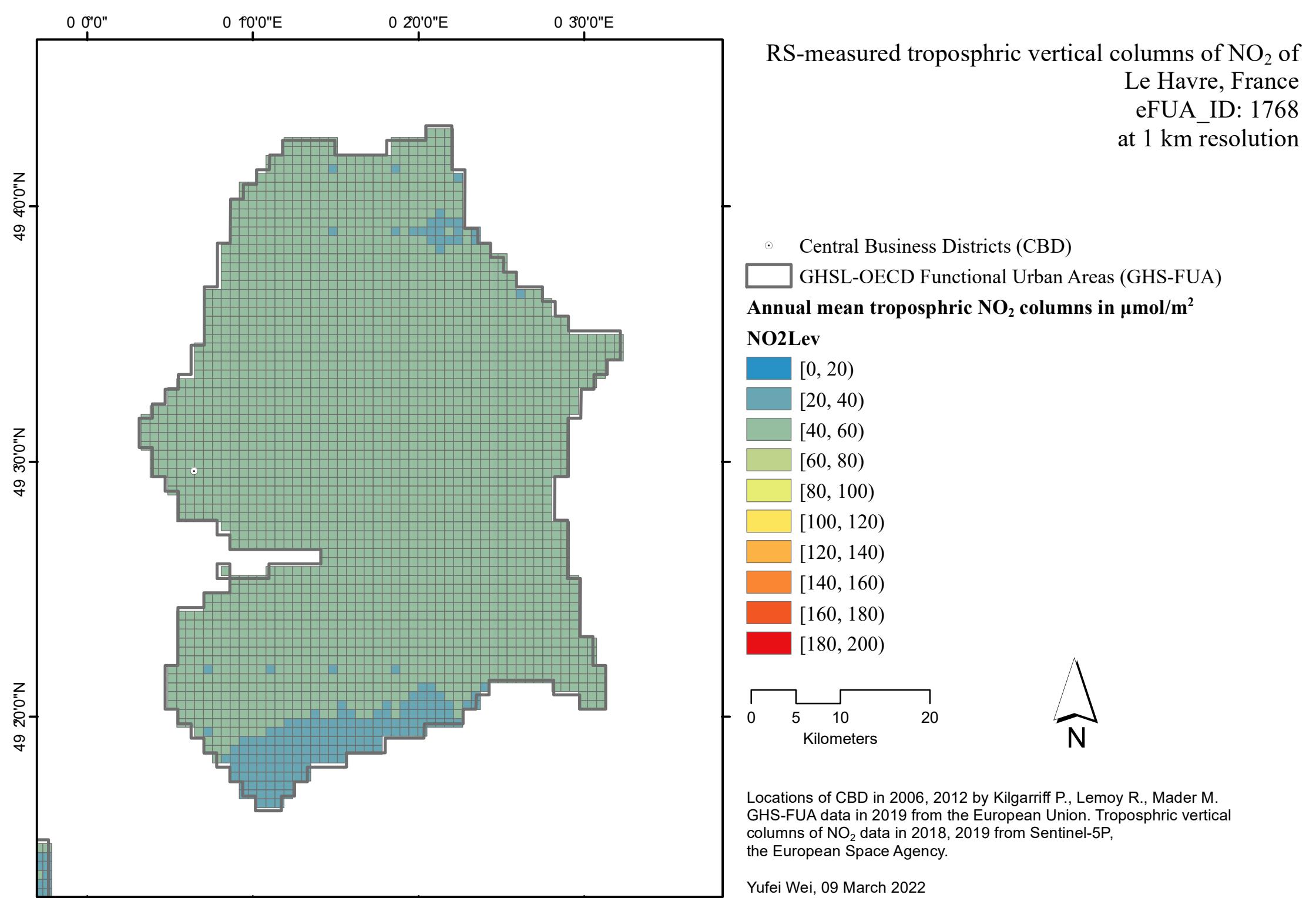
41 30'0"N



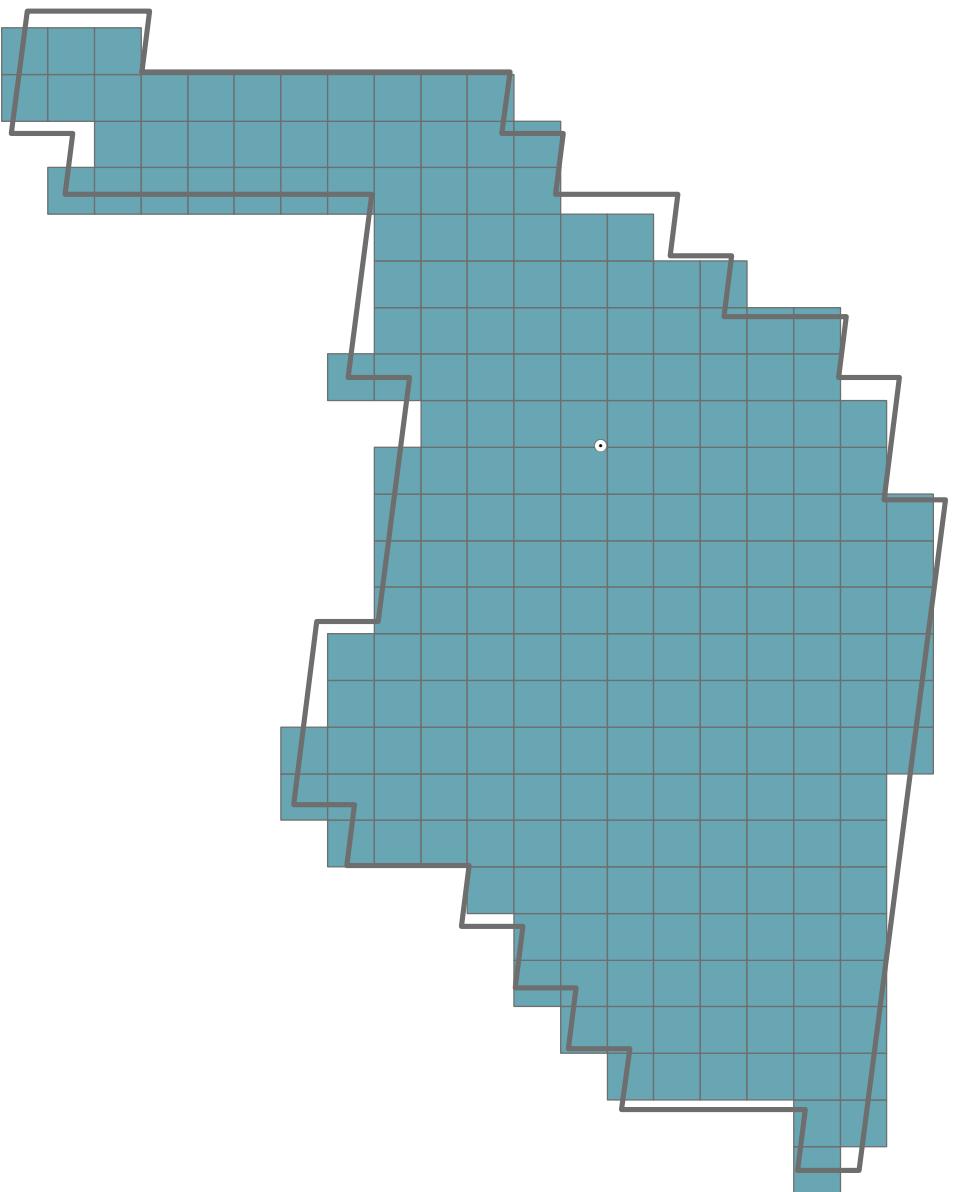
Locations of CBD in 2006, 2012 by Kilgarriff P., Lemoy R., Mader M.  
GHS-FUA data in 2019 from the European Union. Tropospheric vertical  
columns of NO<sub>2</sub> data in 2018, 2019 from Sentinel-5P,  
the European Space Agency.

Yufei Wei, 09 March 2022

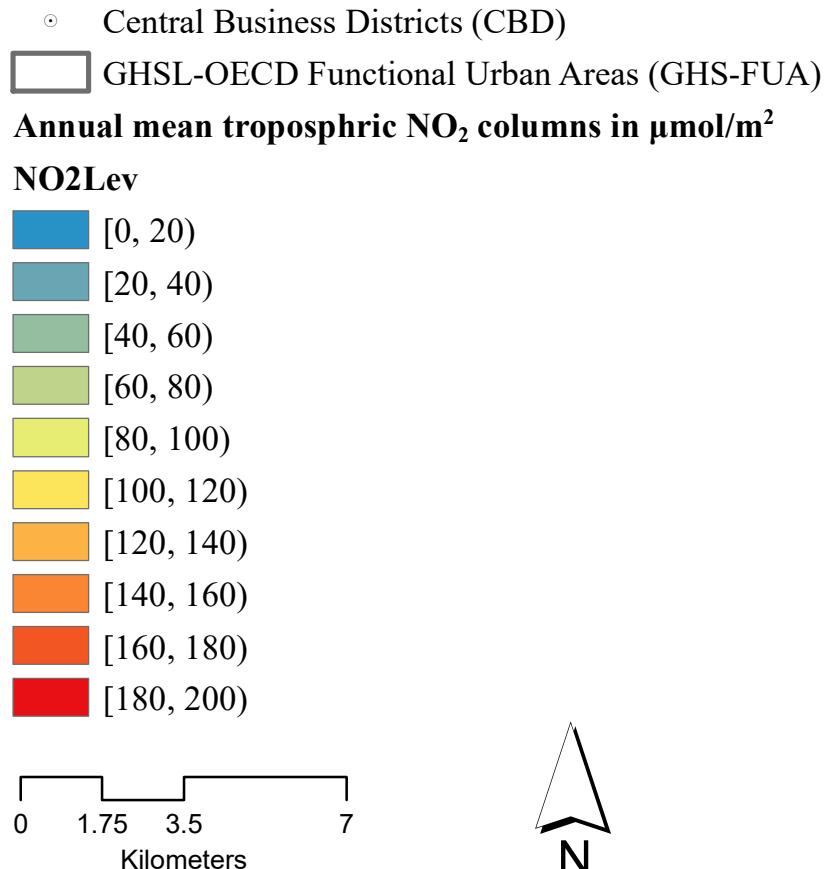




18°10'0"E



RS-measured tropospheric vertical columns of NO<sub>2</sub> of  
Lecce, Italy  
eFUA\_ID: 5071  
at 1 km resolution



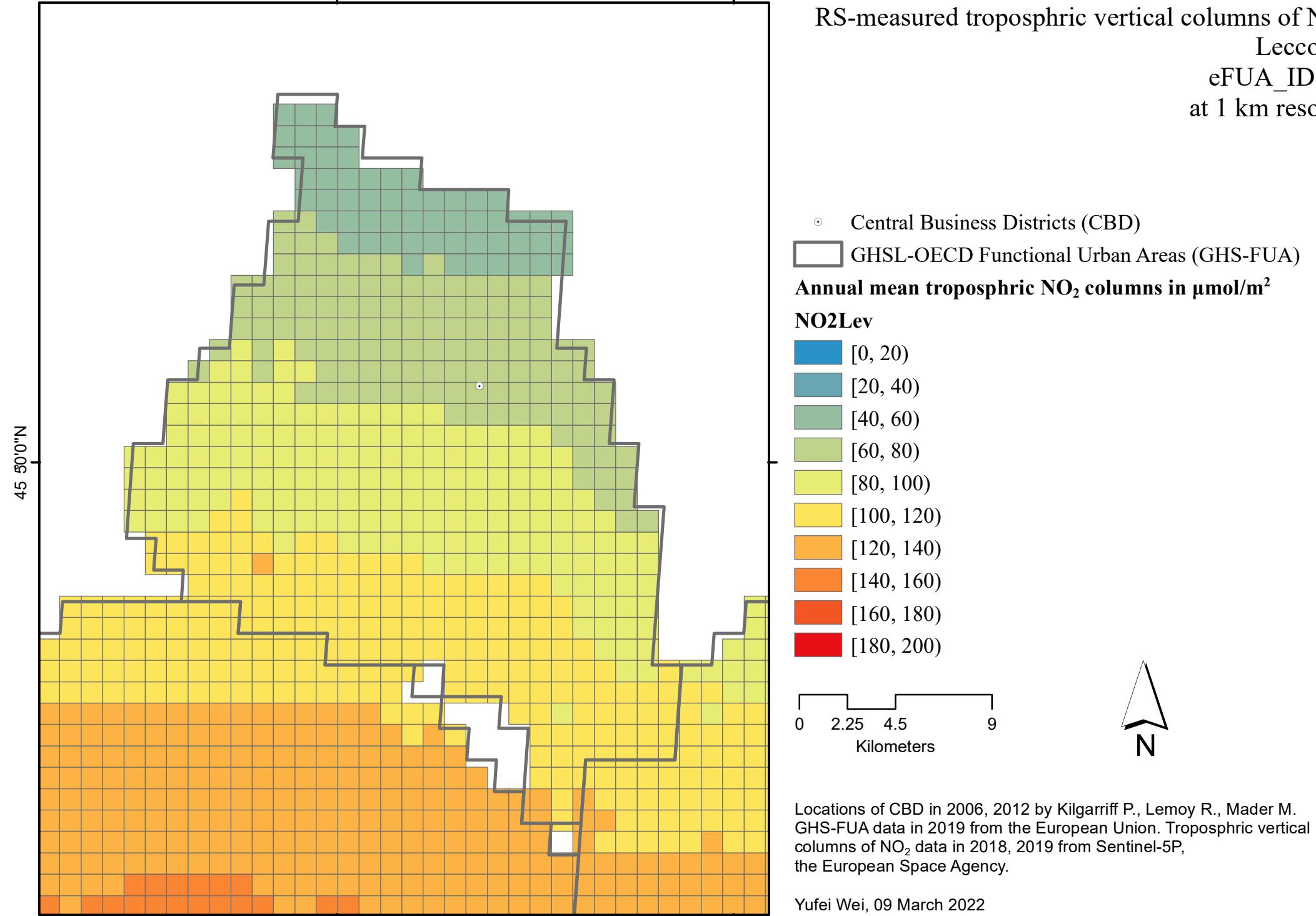
Locations of CBD in 2006, 2012 by Kilgarriff P., Lemoy R., Mader M.  
GHS-FUA data in 2019 from the European Union. Tropospheric vertical  
columns of NO<sub>2</sub> data in 2018, 2019 from Sentinel-5P,  
the European Space Agency.

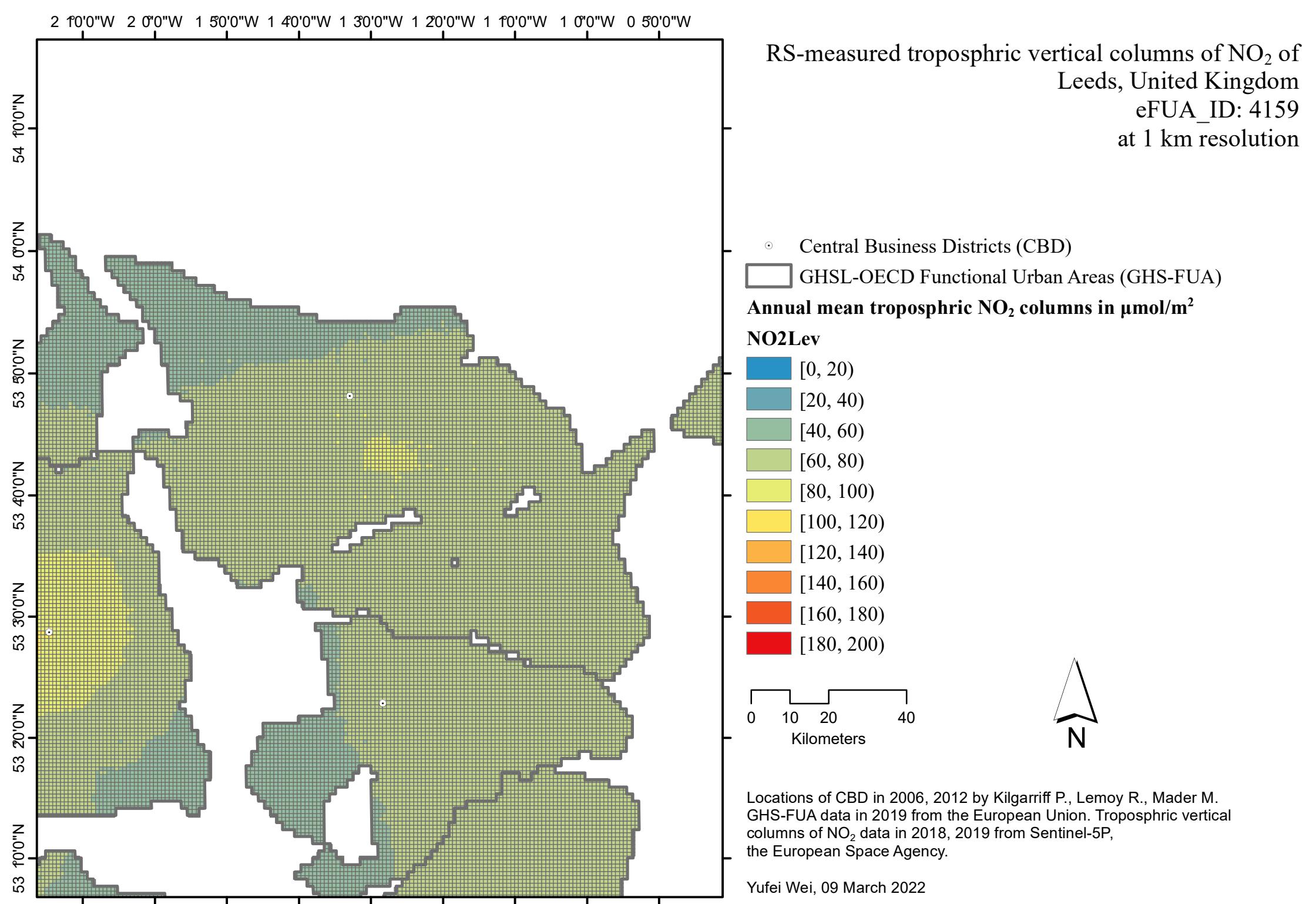
Yufei Wei, 09 March 2022

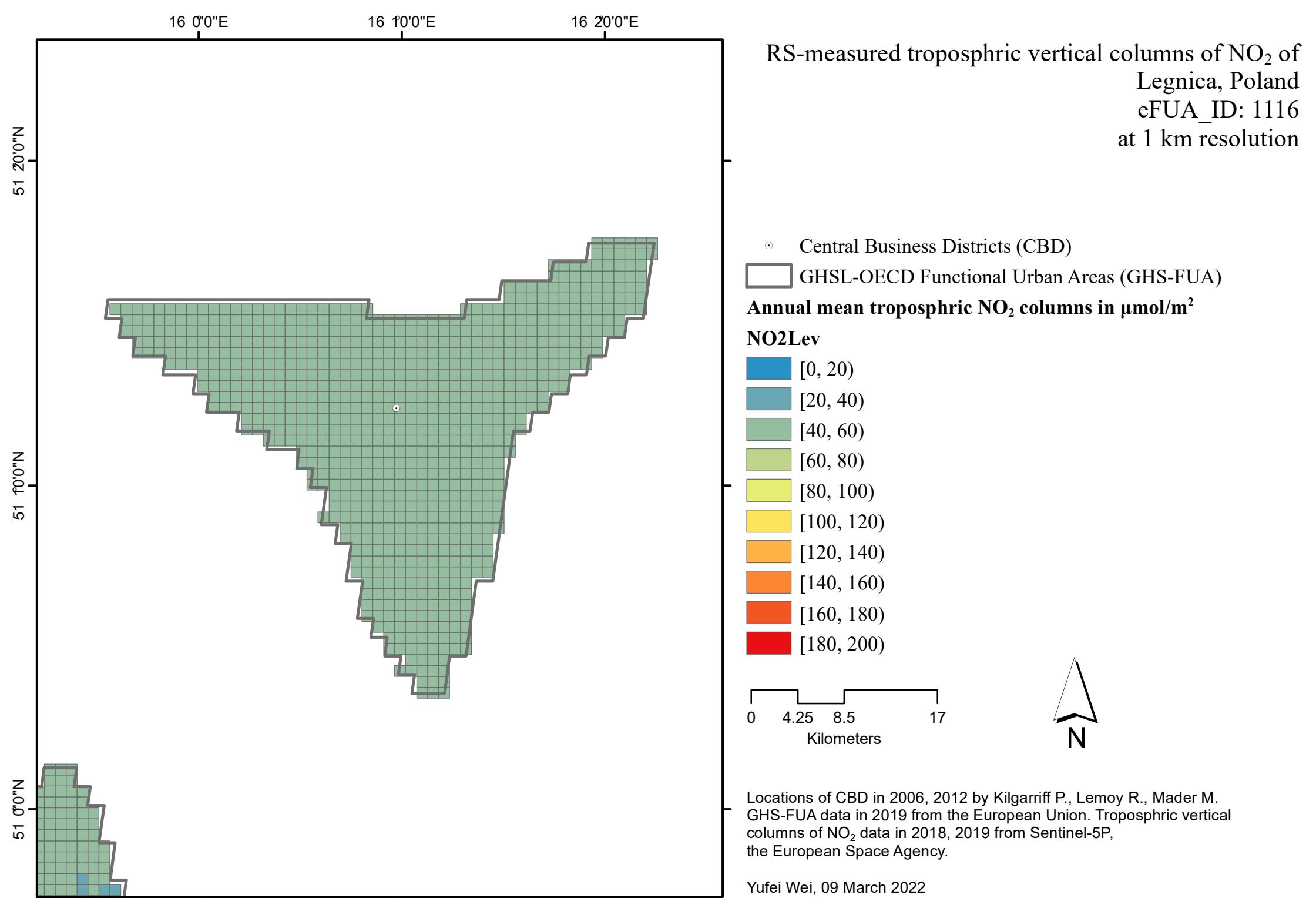
9 20'0"E

9 30'0"E

RS-measured tropospheric vertical columns of NO<sub>2</sub> of  
Lecco, Italy  
eFUA\_ID: 1863  
at 1 km resolution







1 20'0"W

1 10'0"W

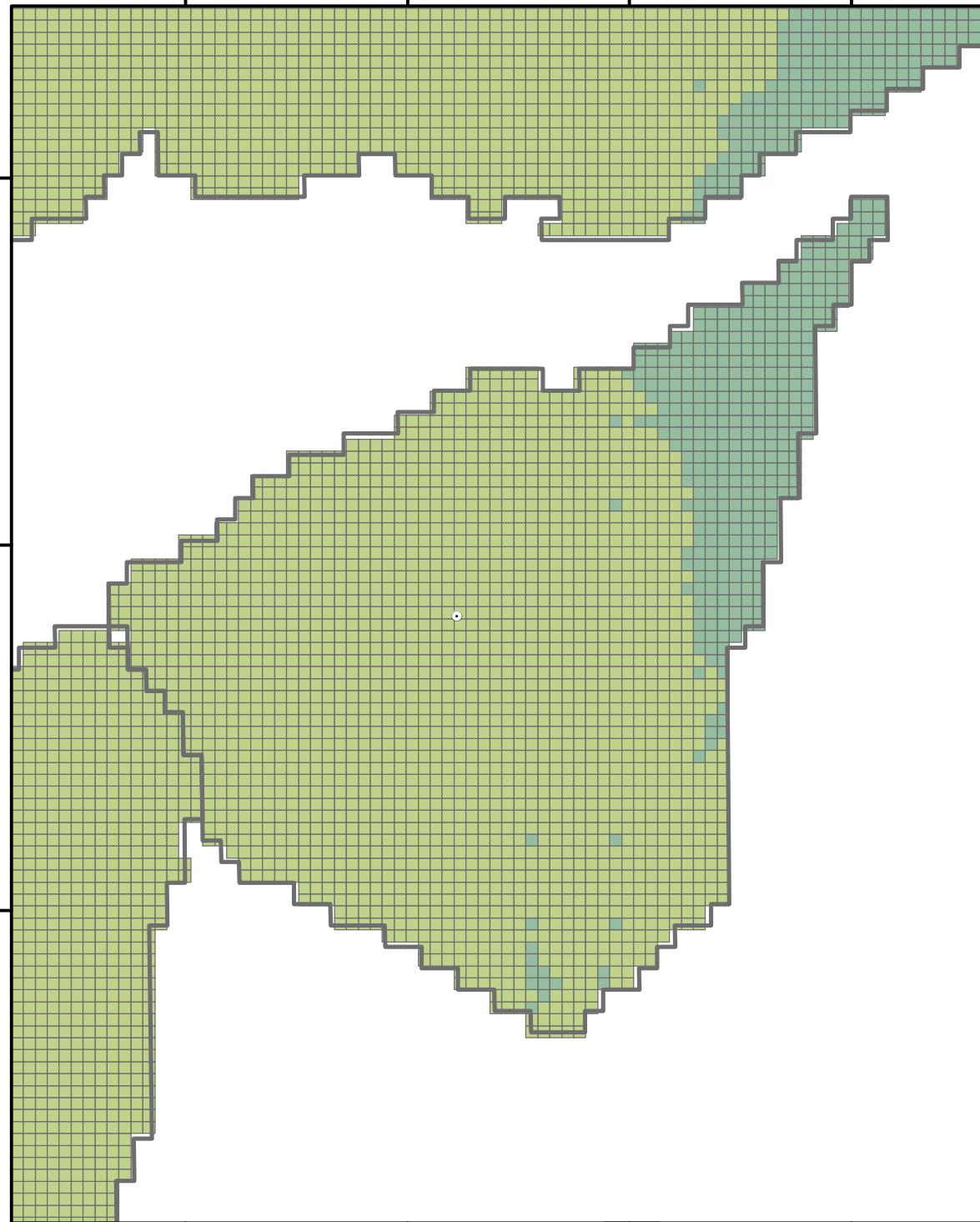
1 0'0"W

0 50'0"W

52 50'0"N

52 40'0"N

52 30'0"N



RS-measured tropospheric vertical columns of NO<sub>2</sub> of  
Leicester, United Kingdom  
eFUA\_ID: 4925  
at 1 km resolution

○ Central Business Districts (CBD)

◻ GHS-OECD Functional Urban Areas (GHS-FUA)

**Annual mean tropospheric NO<sub>2</sub> columns in μmol/m<sup>2</sup>**

**NO2Lev**

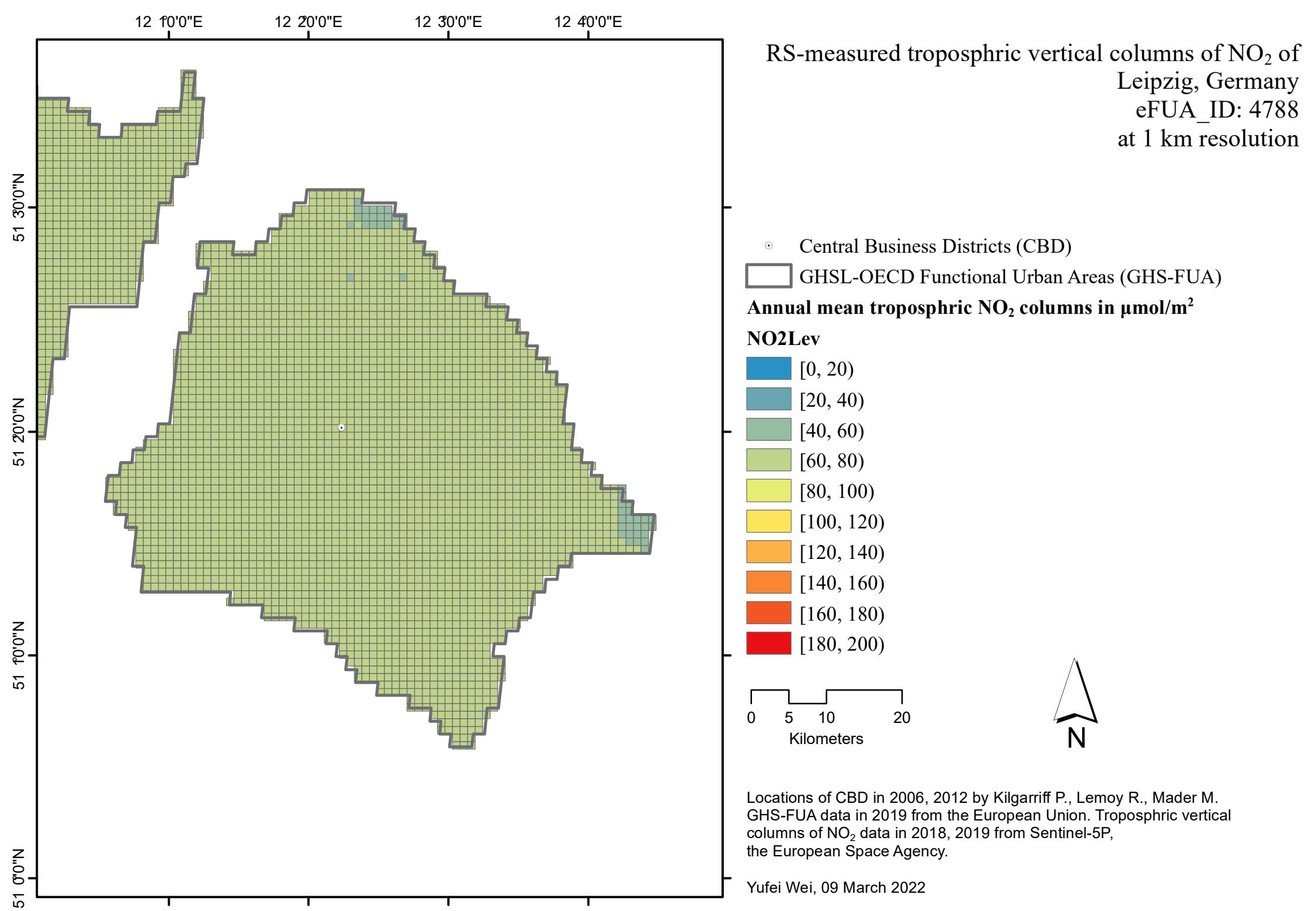
[0, 20)
[20, 40)
[40, 60)
[60, 80)
[80, 100)
[100, 120)
[120, 140)
[140, 160)
[160, 180)
[180, 200)

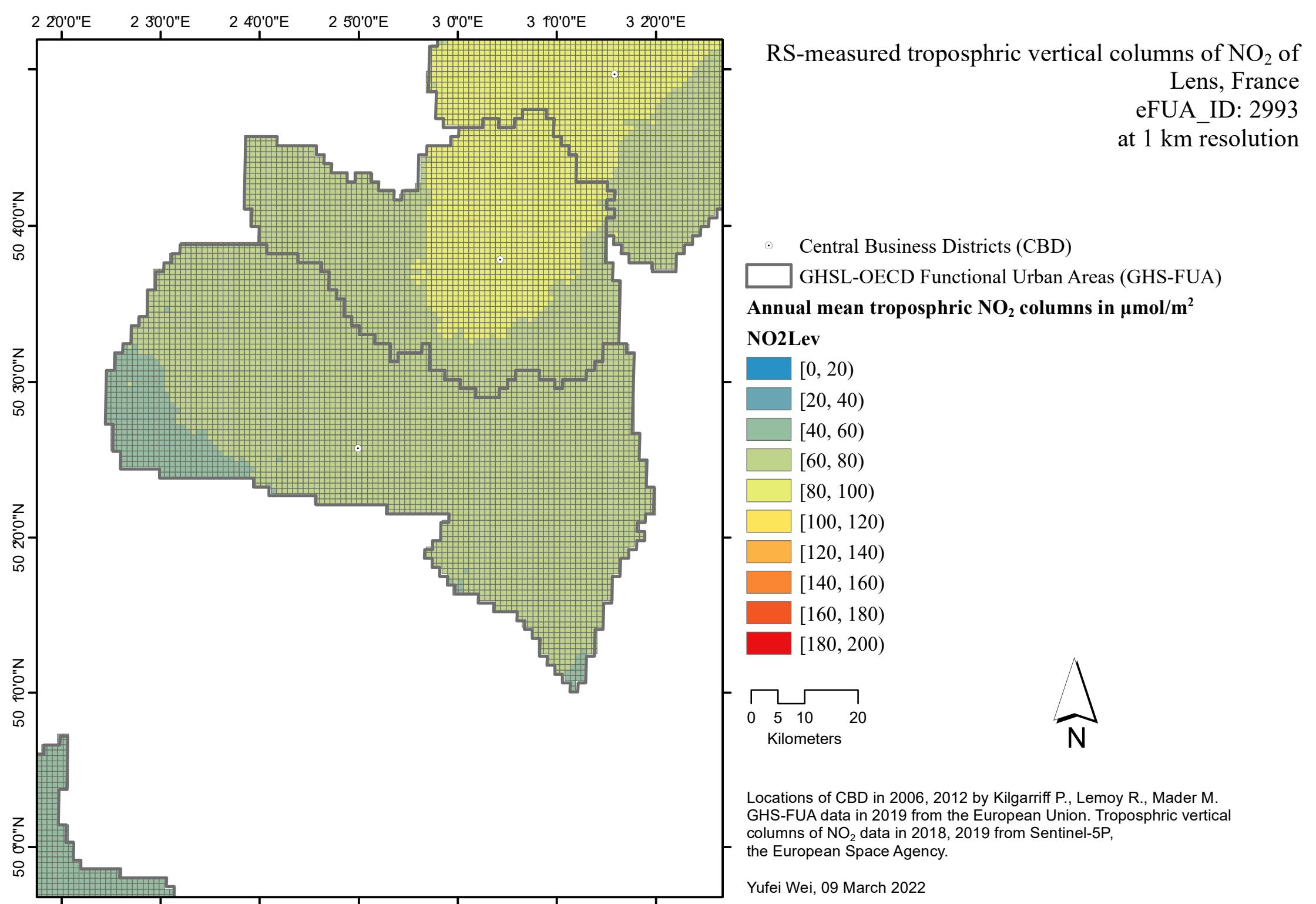
0 5 10 20  
Kilometers



Locations of CBD in 2006, 2012 by Kilgarriff P., Lemoy R., Mader M.  
GHS-FUA data in 2019 from the European Union. Tropospheric vertical  
columns of NO<sub>2</sub> data in 2018, 2019 from Sentinel-5P,  
the European Space Agency.

Yufei Wei, 09 March 2022





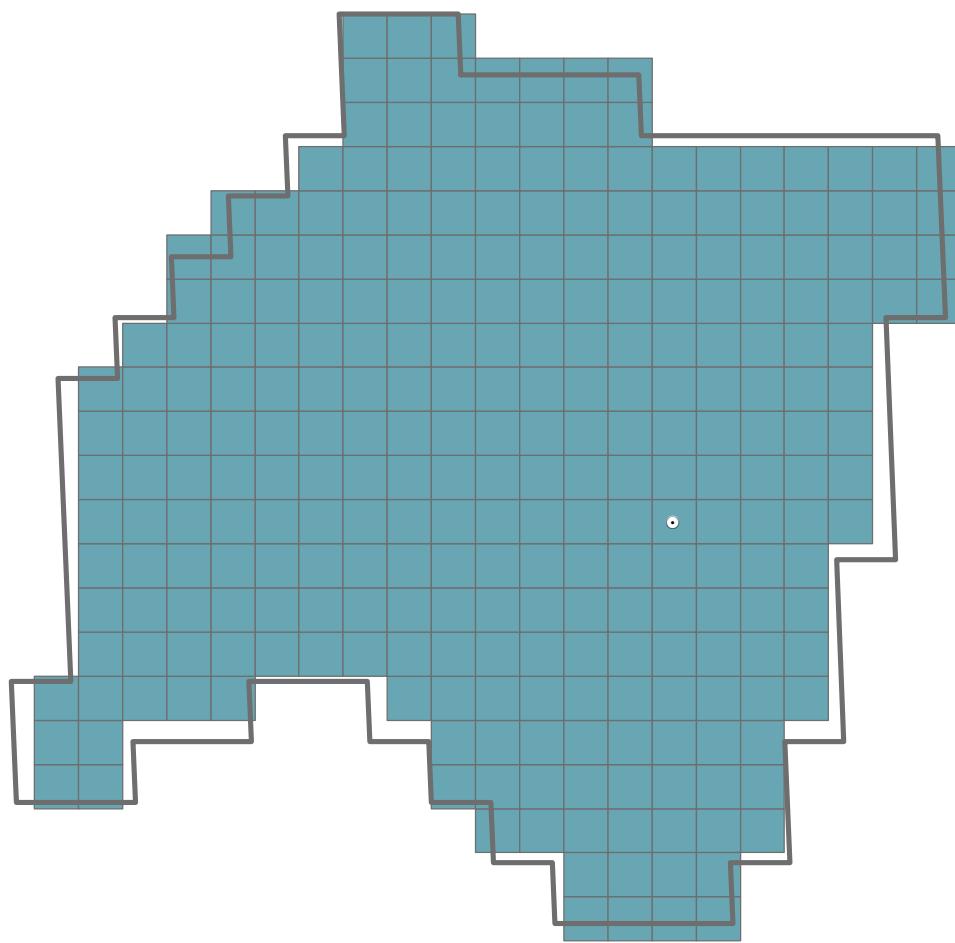
5 40'0"W

5 30'0"W

RS-measured tropospheric vertical columns of NO<sub>2</sub> of  
Leon, Spain  
eFUA\_ID: 2571  
at 1 km resolution

42 40'0"N

42 30'0"N



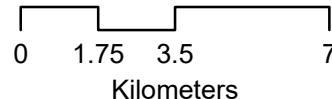
○ Central Business Districts (CBD)

◻ GHSL-OECD Functional Urban Areas (GHS-FUA)

**Annual mean tropospheric NO<sub>2</sub> columns in  $\mu\text{mol}/\text{m}^2$**

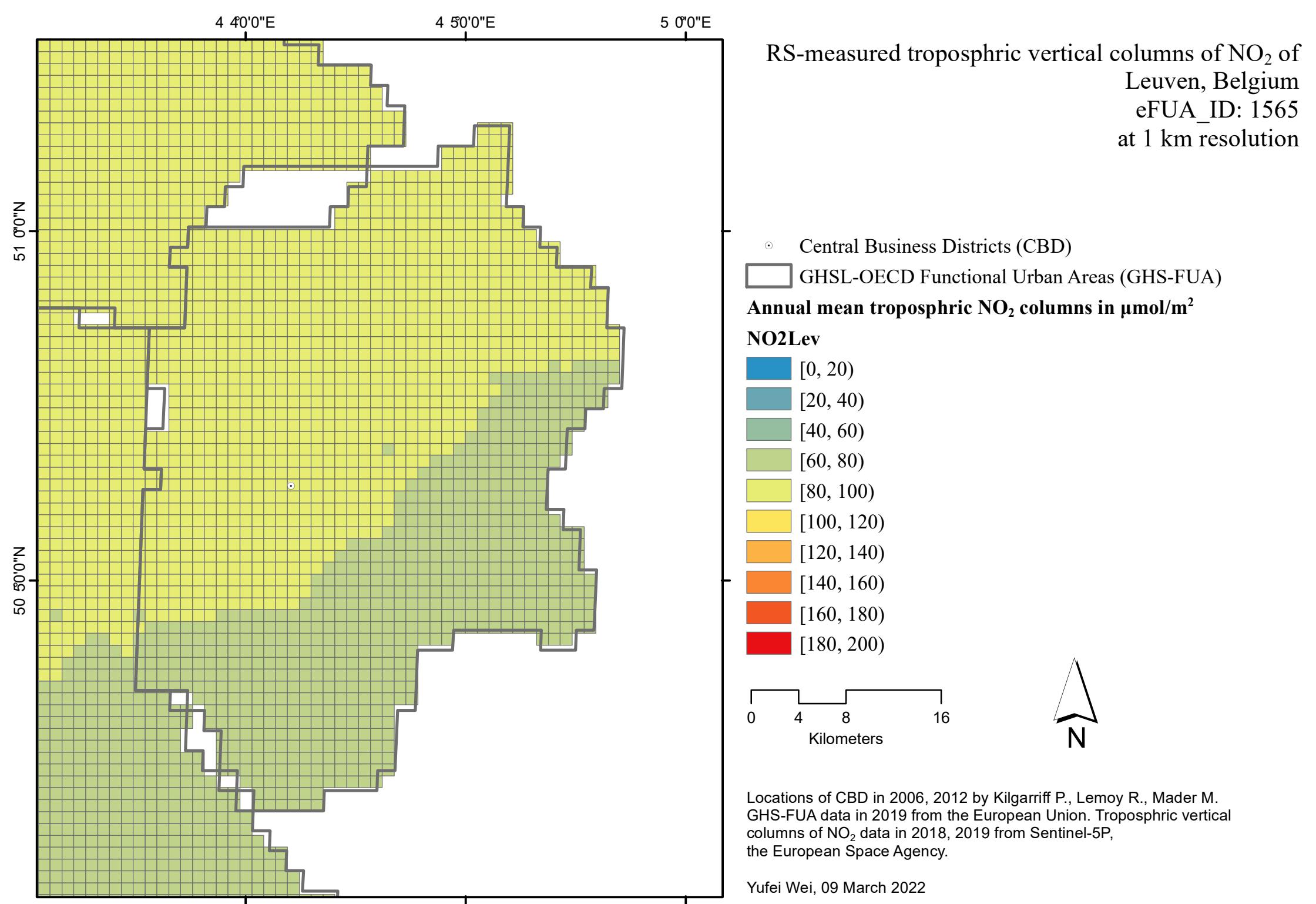
**NO2Lev**

[0, 20)
[20, 40)
[40, 60)
[60, 80)
[80, 100)
[100, 120)
[120, 140)
[140, 160)
[160, 180)
[180, 200)



Locations of CBD in 2006, 2012 by Kilgarriff P., Lemoy R., Mader M.  
GHS-FUA data in 2019 from the European Union. Tropospheric vertical  
columns of NO<sub>2</sub> data in 2018, 2019 from Sentinel-5P,  
the European Space Agency.

Yufei Wei, 09 March 2022



14 50'0"E

15 0'0"E

15 10'0"E

15 20'0"E

51 0'0"N

50 50'0"N

50 40'0"N

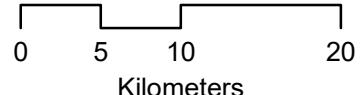
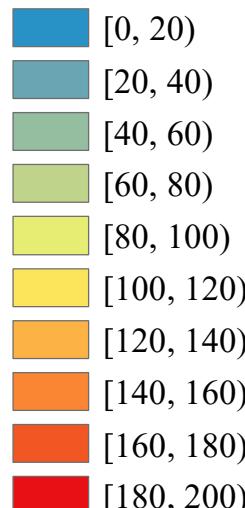
RS-measured tropospheric vertical columns of NO<sub>2</sub> of  
 Liberec, Czech Republic  
 eFUA\_ID: 814  
 at 1 km resolution

○ Central Business Districts (CBD)

◻ GHSL-OECD Functional Urban Areas (GHS-FUA)

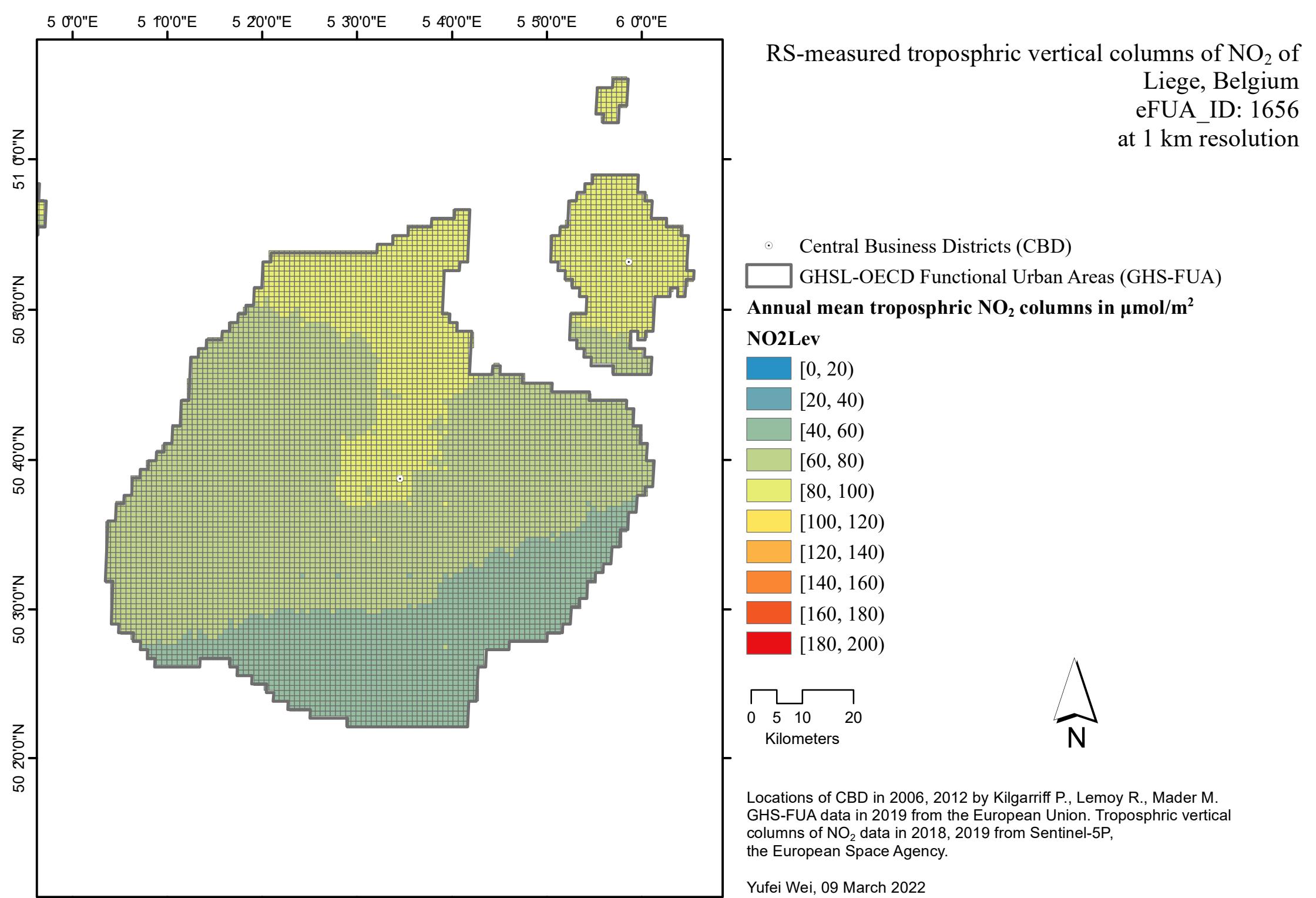
**Annual mean tropospheric NO<sub>2</sub> columns in  $\mu\text{mol}/\text{m}^2$**

**NO2Lev**



Locations of CBD in 2006, 2012 by Kilgarriff P., Lemoy R., Mader M.  
 GHS-FUA data in 2019 from the European Union. Tropospheric vertical  
 columns of NO<sub>2</sub> data in 2018, 2019 from Sentinel-5P,  
 the European Space Agency.

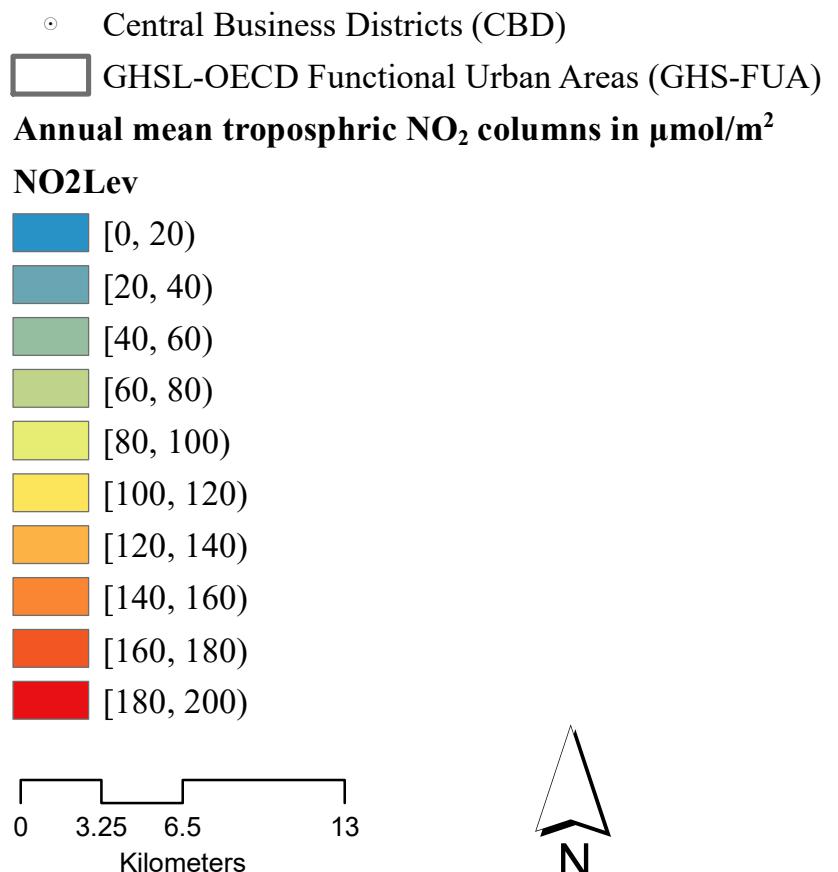
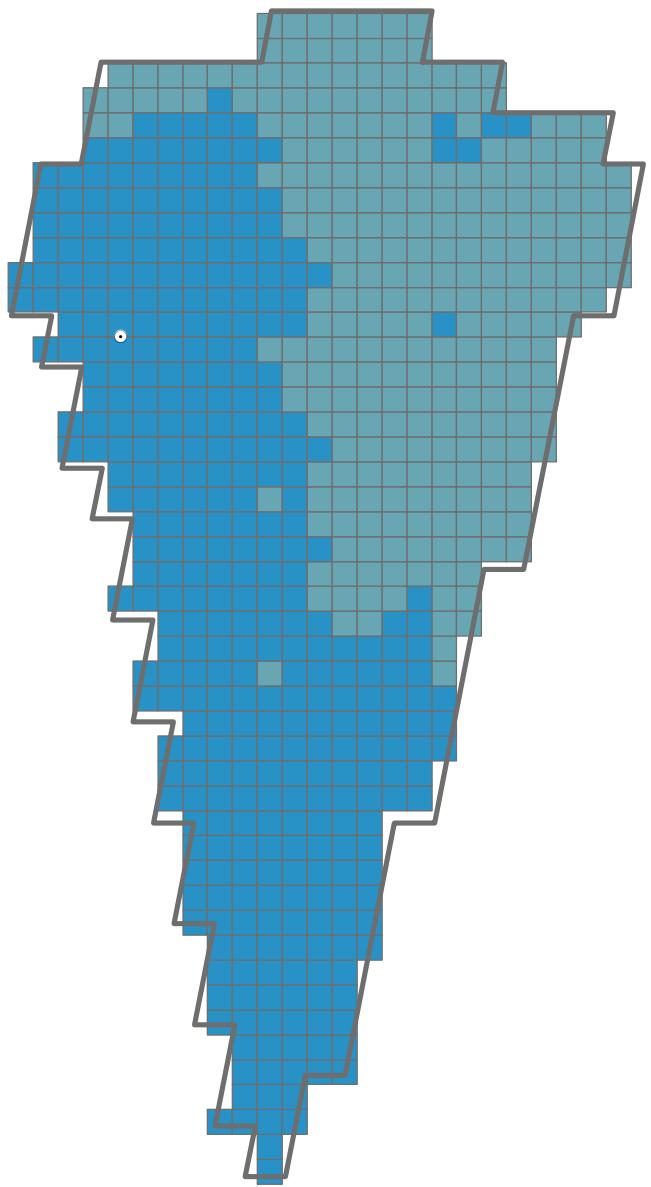
Yufei Wei, 09 March 2022



21 0'0"E

21 10'0"E

RS-measured tropospheric vertical columns of NO<sub>2</sub> of  
Liepaja, Latvia  
eFUA\_ID: 104  
at 1 km resolution



Locations of CBD in 2006, 2012 by Kilgarriff P., Lemoy R., Mader M.  
GHS-FUA data in 2019 from the European Union. Tropospheric vertical  
columns of NO<sub>2</sub> data in 2018, 2019 from Sentinel-5P,  
the European Space Agency.

Yufei Wei, 09 March 2022

2 40'0"E

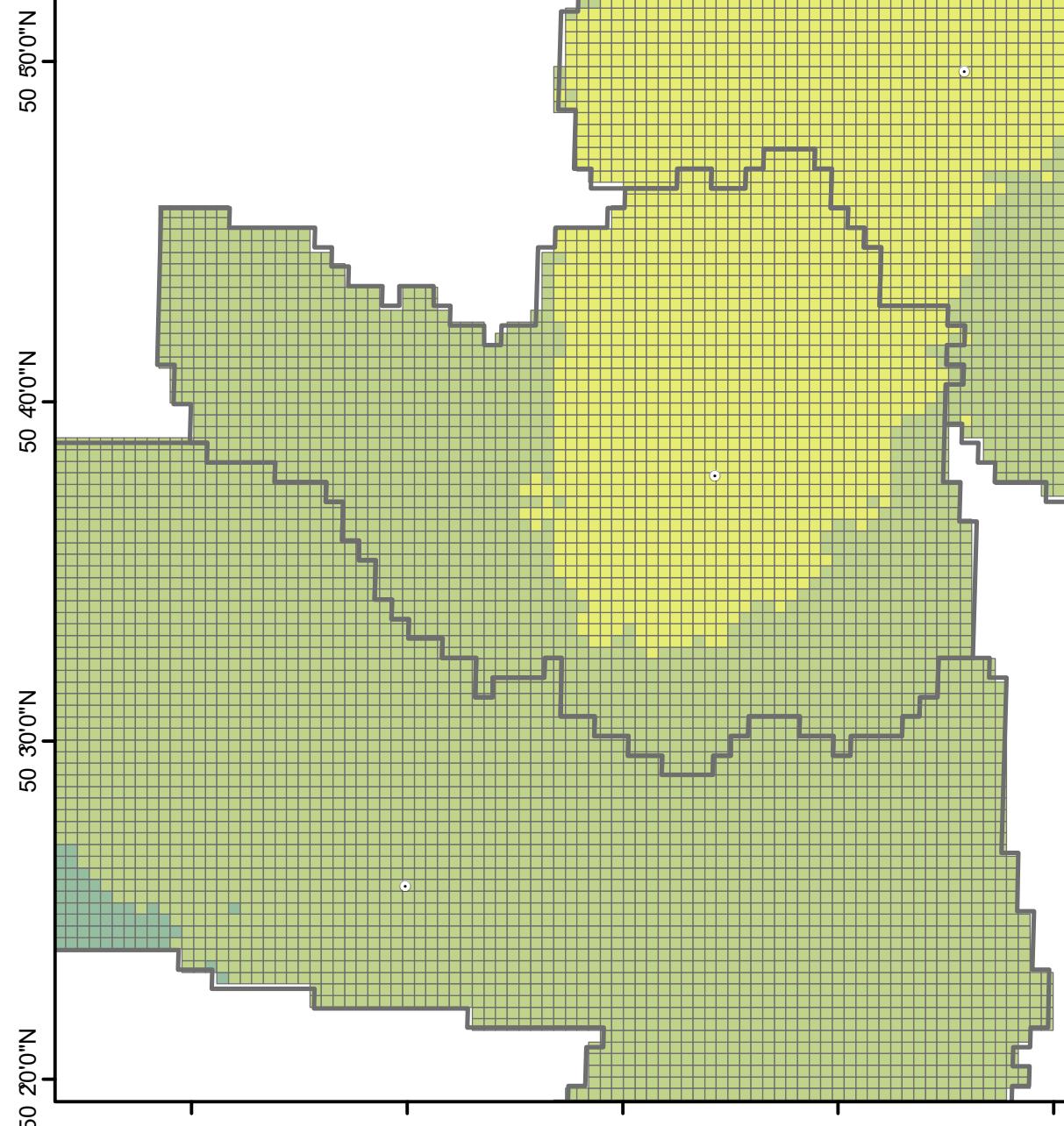
2 50'0"E

3 0'0"E

3 10'0"E

3 20'0"E

RS-measured tropospheric vertical columns of NO<sub>2</sub> of  
 Lille, France  
 eFUA\_ID: 3200  
 at 1 km resolution



○ Central Business Districts (CBD)

◻ GHSL-OECD Functional Urban Areas (GHS-FUA)

**Annual mean tropospheric NO<sub>2</sub> columns in  $\mu\text{mol}/\text{m}^2$**

**NO2Lev**

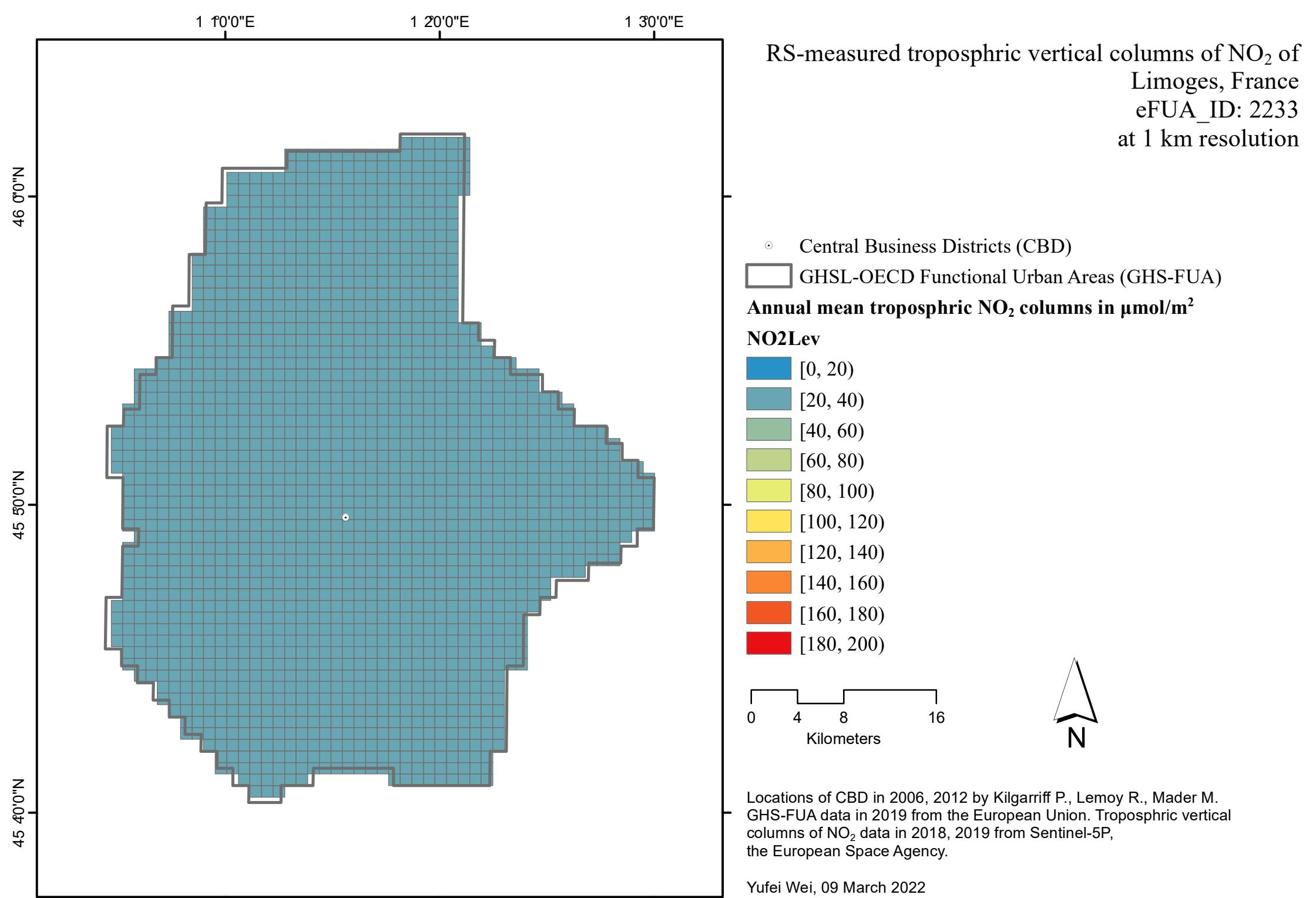
- [0, 20)
- [20, 40)
- [40, 60)
- [60, 80)
- [80, 100)
- [100, 120)
- [120, 140)
- [140, 160)
- [160, 180)
- [180, 200)

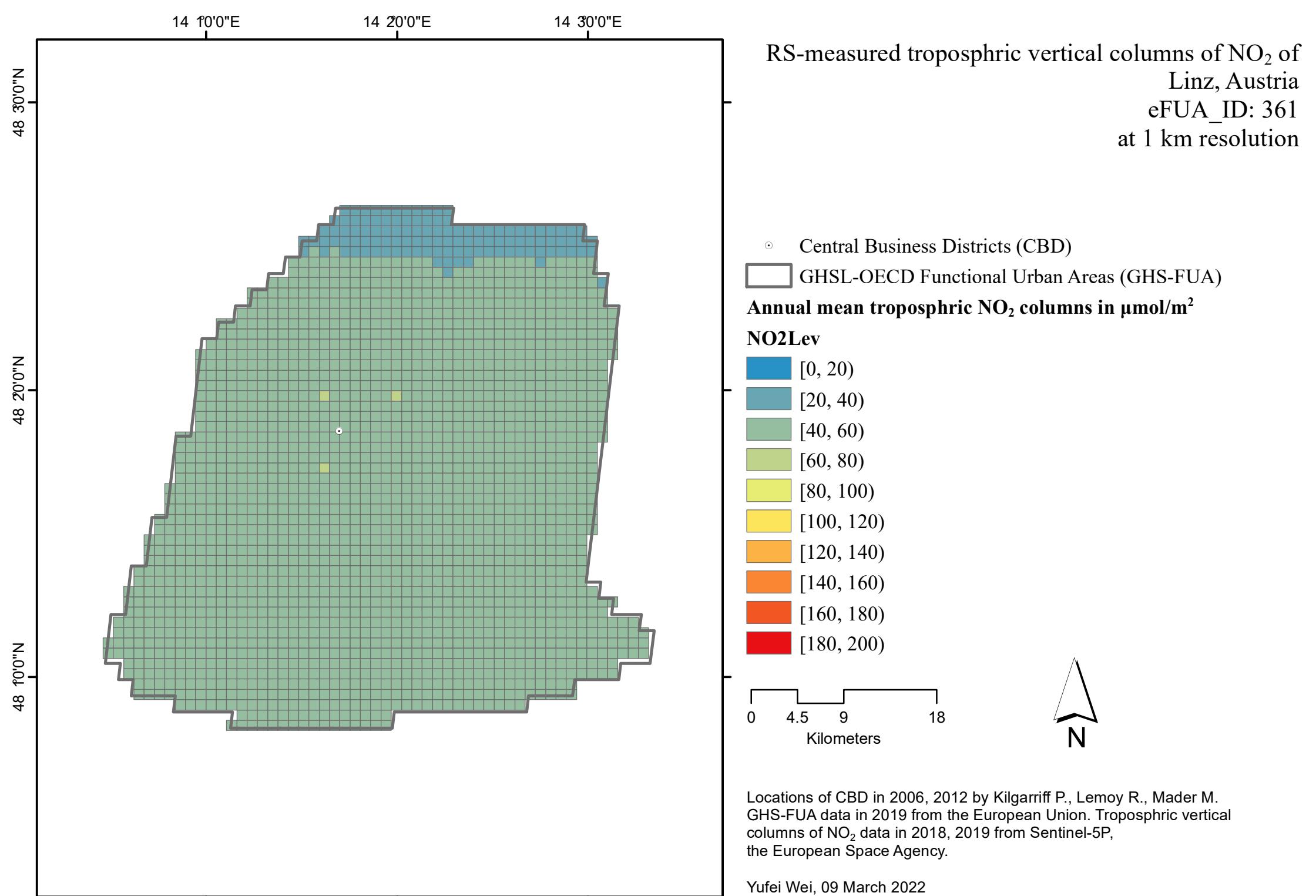
0 5 10 20  
Kilometers

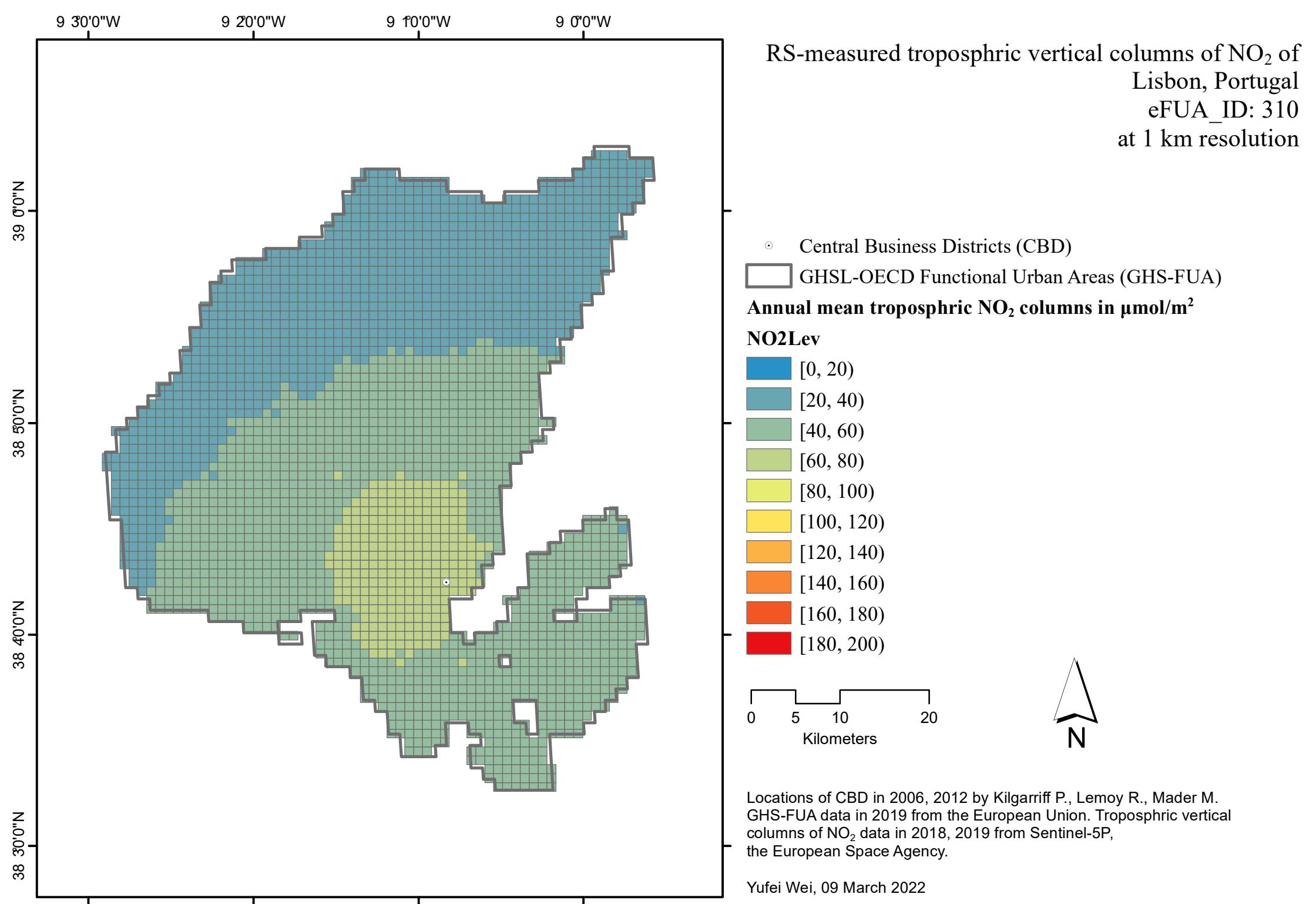


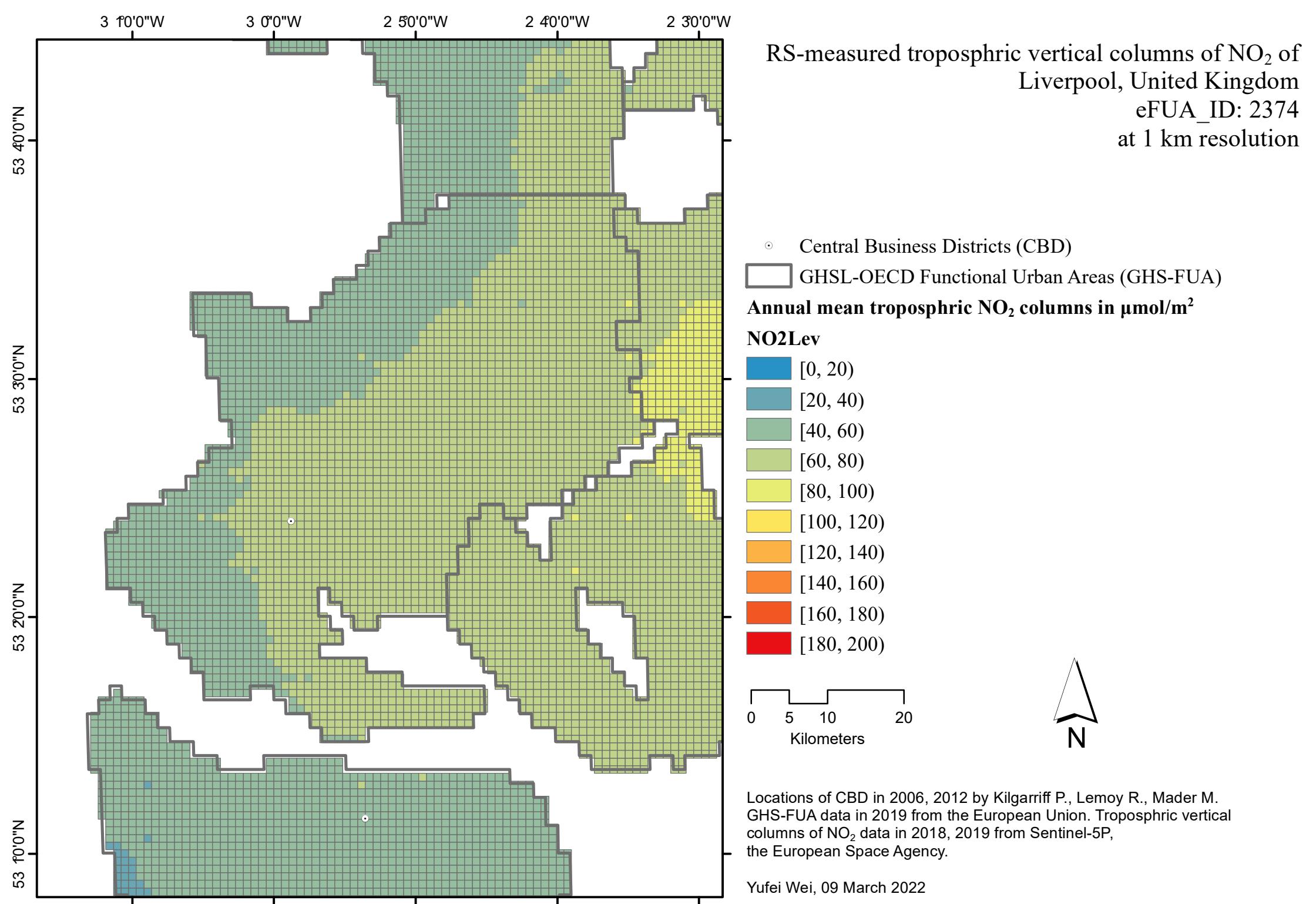
Locations of CBD in 2006, 2012 by Kilgarriff P., Lemoy R., Mader M.  
 GHS-FUA data in 2019 from the European Union. Tropospheric vertical  
 columns of NO<sub>2</sub> data in 2018, 2019 from Sentinel-5P,  
 the European Space Agency.

Yufei Wei, 09 March 2022

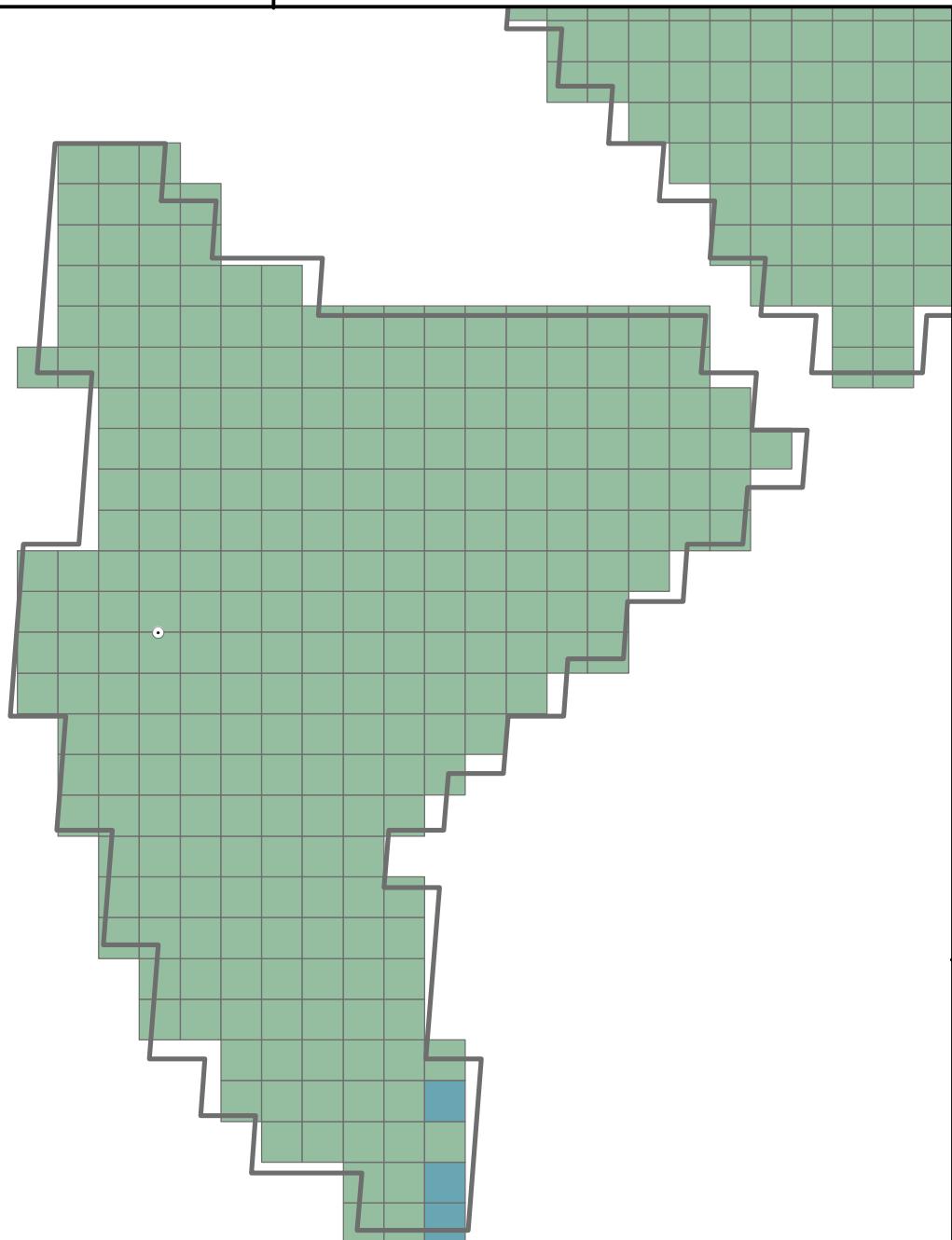








10 20'0"E



RS-measured tropospheric vertical columns of NO<sub>2</sub> of  
Livorno, Italy  
eFUA\_ID: 2581  
at 1 km resolution

○ Central Business Districts (CBD)

◻ GHS-OECD Functional Urban Areas (GHS-FUA)

Annual mean tropospheric NO<sub>2</sub> columns in  $\mu\text{mol}/\text{m}^2$



Locations of CBD in 2006, 2012 by Kilgarriff P., Lemoy R., Mader M.  
GHS-FUA data in 2019 from the European Union. Tropospheric vertical  
columns of NO<sub>2</sub> data in 2018, 2019 from Sentinel-5P,  
the European Space Agency.

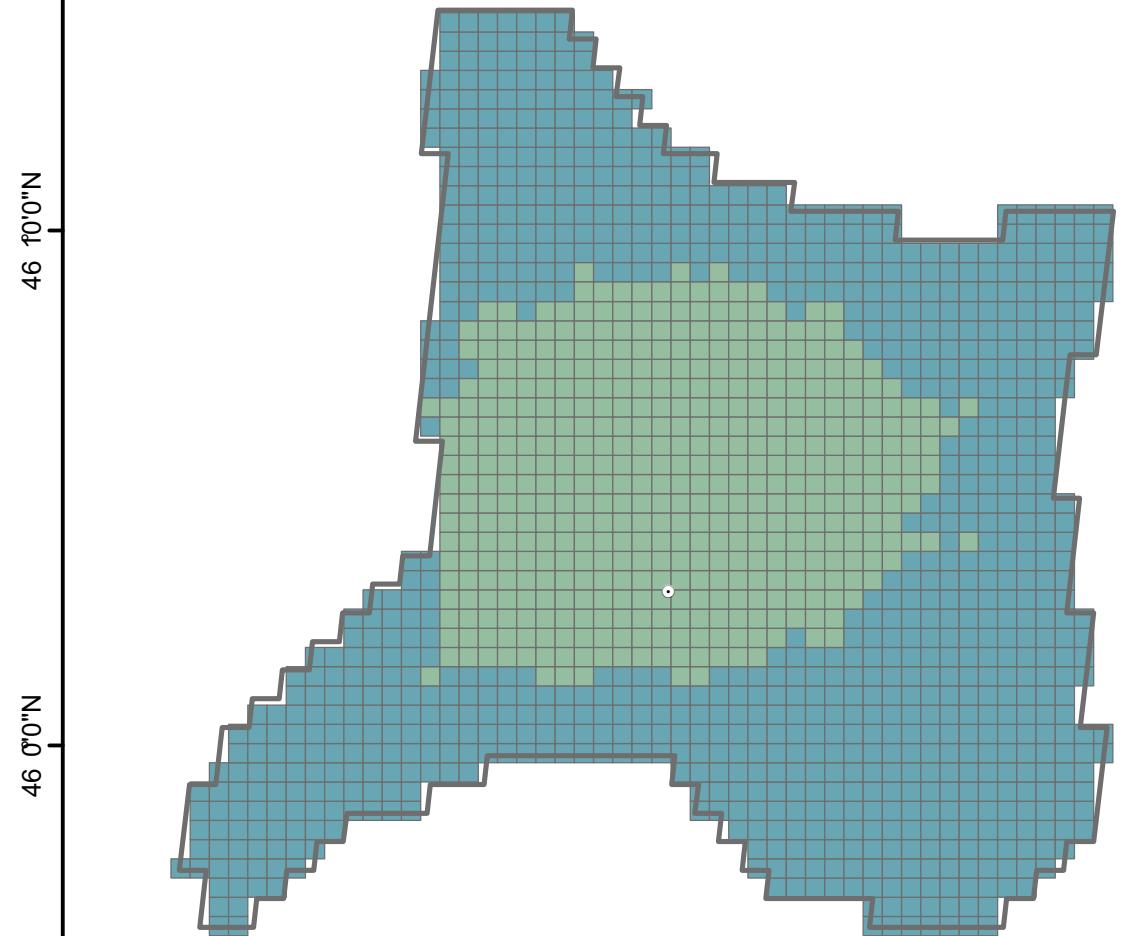
Yufei Wei, 09 March 2022

14 20'0"E

14 30'0"E

14 40'0"E

RS-measured tropospheric vertical columns of NO<sub>2</sub> of  
Ljubljana, Slovenia  
eFUA\_ID: 164  
at 1 km resolution



○ Central Business Districts (CBD)

□ GHS-OECD Functional Urban Areas (GHS-FUA)

Annual mean tropospheric NO<sub>2</sub> columns in  $\mu\text{mol}/\text{m}^2$

NO2Lev

[0, 20)

[20, 40)

[40, 60)

[60, 80)

[80, 100)

[100, 120)

[120, 140)

[140, 160)

[160, 180)

[180, 200)

0 4 8 16  
Kilometers



Locations of CBD in 2006, 2012 by Kilgarriff P., Lemoy R., Mader M.  
GHS-FUA data in 2019 from the European Union. Tropospheric vertical  
columns of NO<sub>2</sub> data in 2018, 2019 from Sentinel-5P,  
the European Space Agency.

Yufei Wei, 09 March 2022

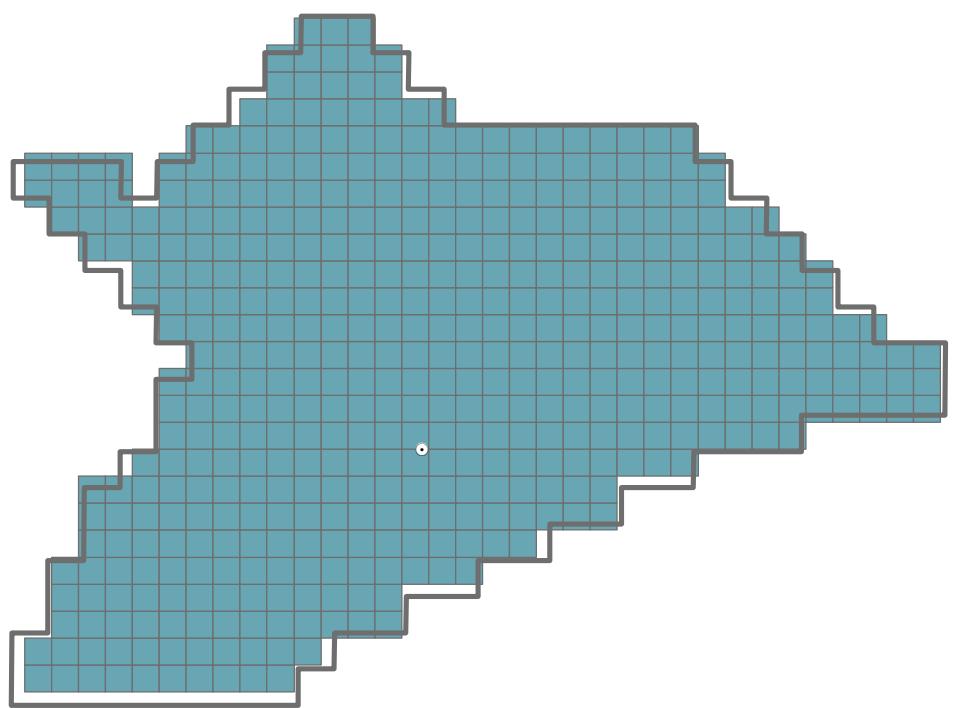
0 30'0"E

0 40'0"E

0 50'0"E

RS-measured tropospheric vertical columns of NO<sub>2</sub> of  
Lleida, Spain  
eFUA\_ID: 4291  
at 1 km resolution

41 40'0"N  
41 30'0"N



○ Central Business Districts (CBD)

◻ GHS-OECD Functional Urban Areas (GHS-FUA)

Annual mean tropospheric NO<sub>2</sub> columns in  $\mu\text{mol}/\text{m}^2$

NO2Lev

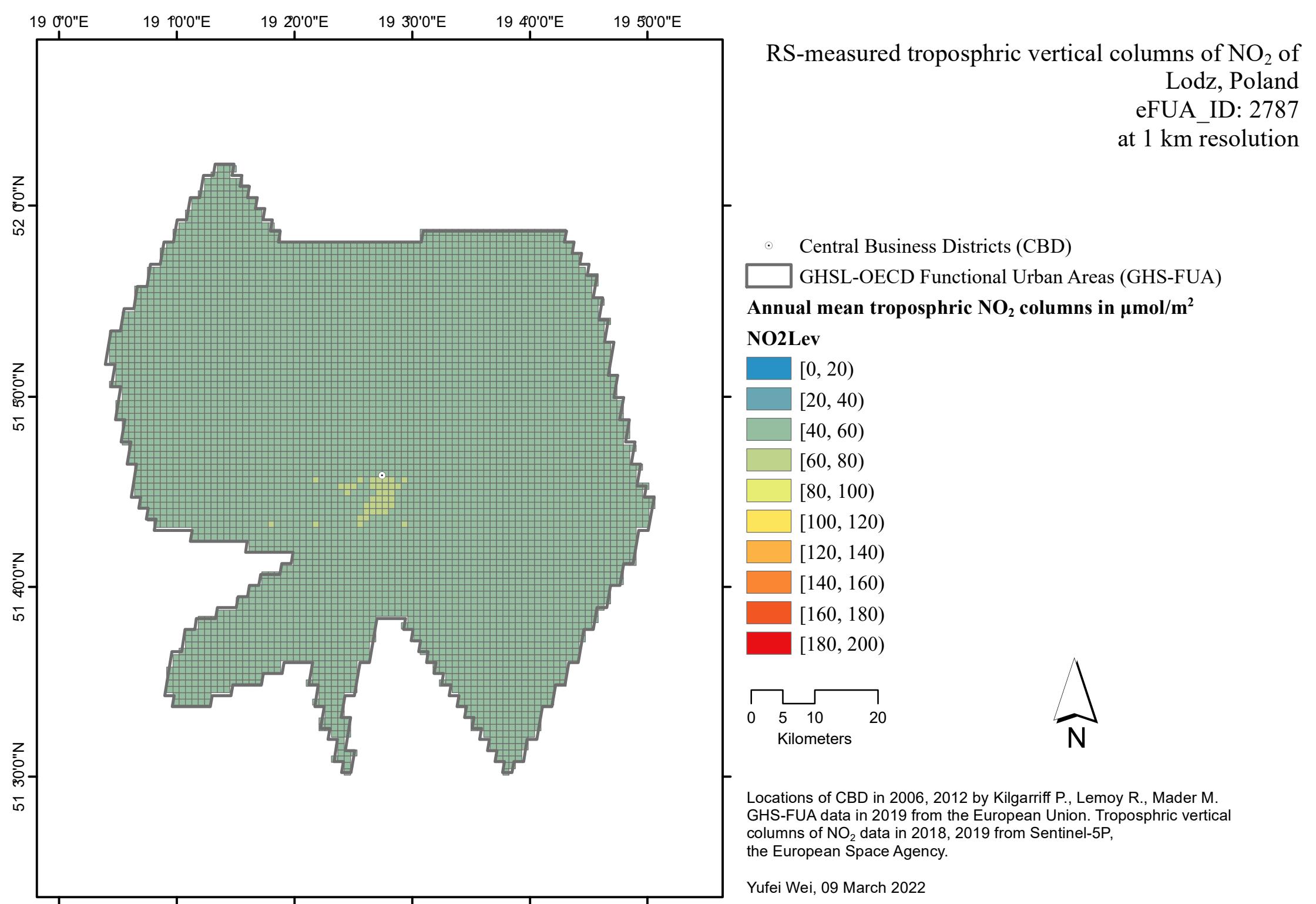
- [0, 20]
- [20, 40]
- [40, 60]
- [60, 80]
- [80, 100]
- [100, 120]
- [120, 140]
- [140, 160]
- [160, 180]
- [180, 200]

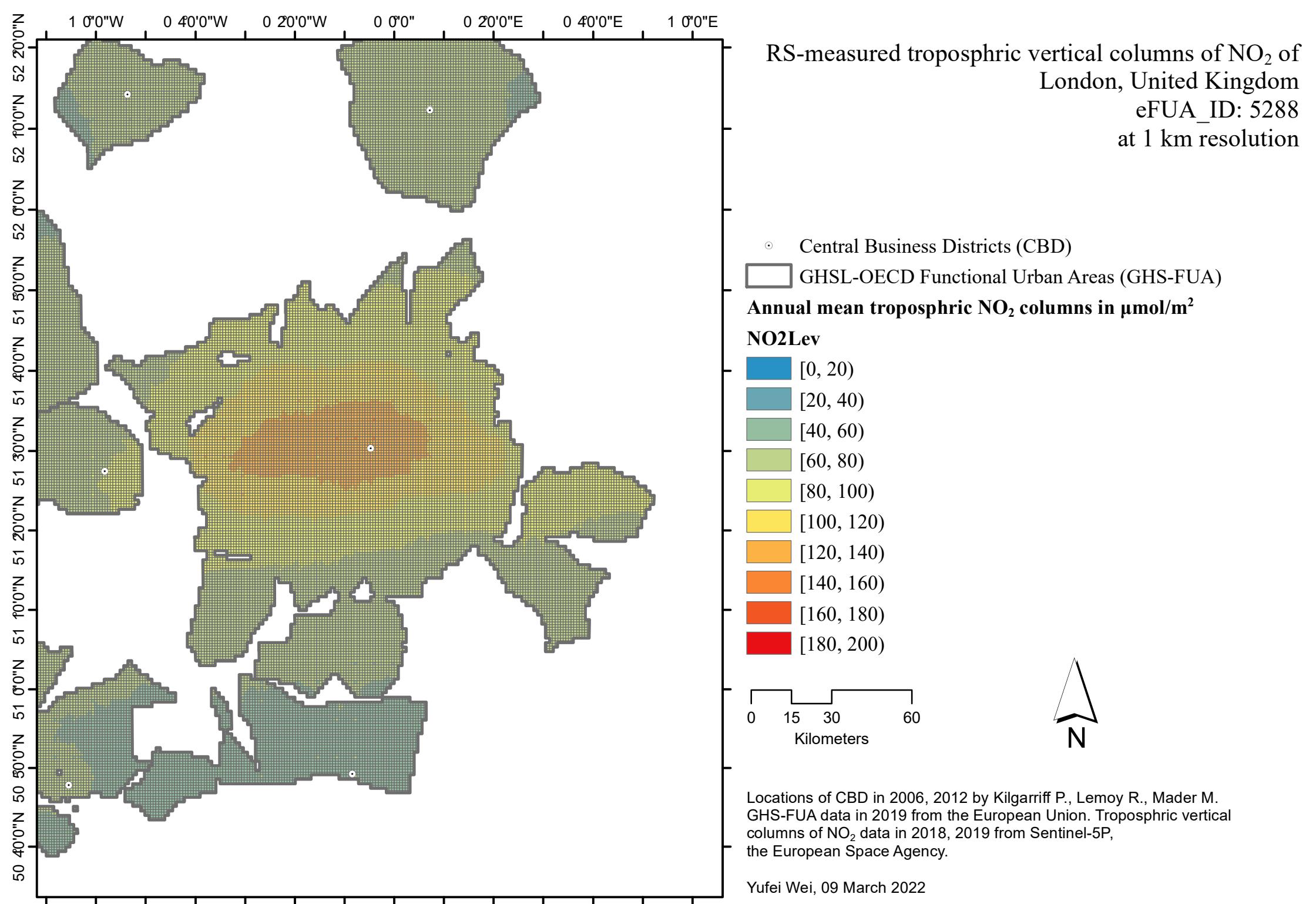
0 3 6 12  
Kilometers

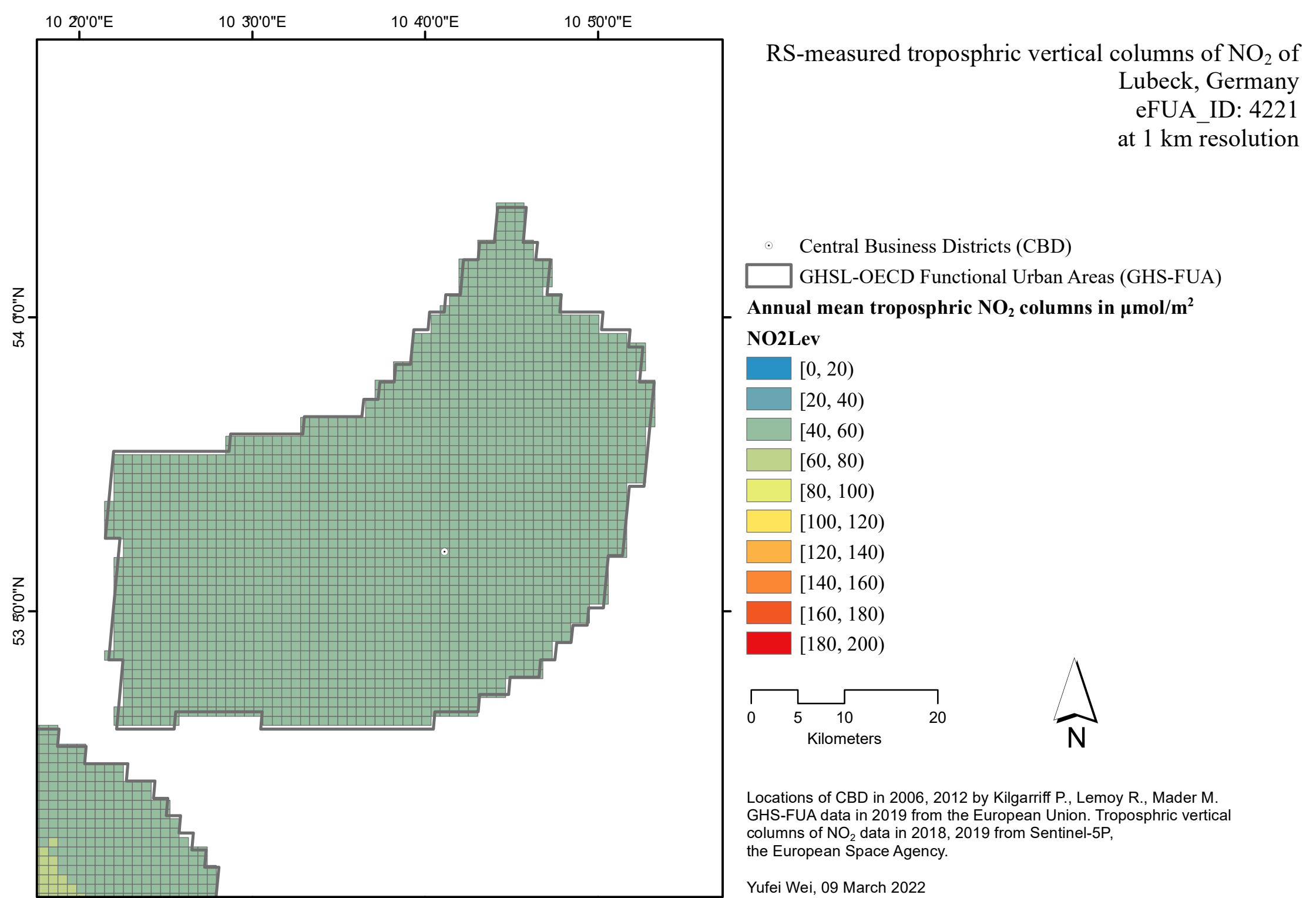


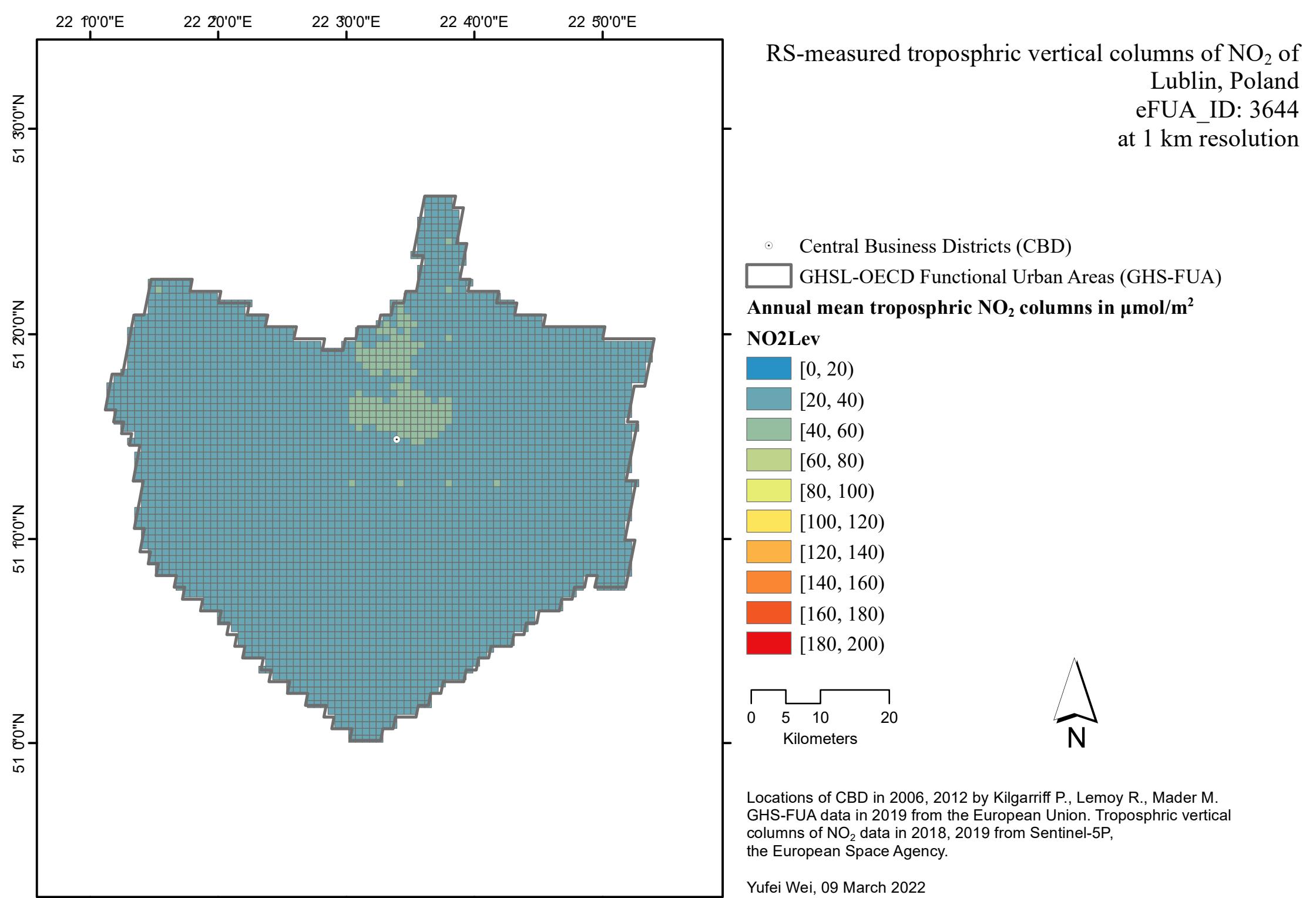
Locations of CBD in 2006, 2012 by Kilgarriff P., Lemoy R., Mader M.  
GHS-FUA data in 2019 from the European Union. Tropospheric vertical  
columns of NO<sub>2</sub> data in 2018, 2019 from Sentinel-5P,  
the European Space Agency.

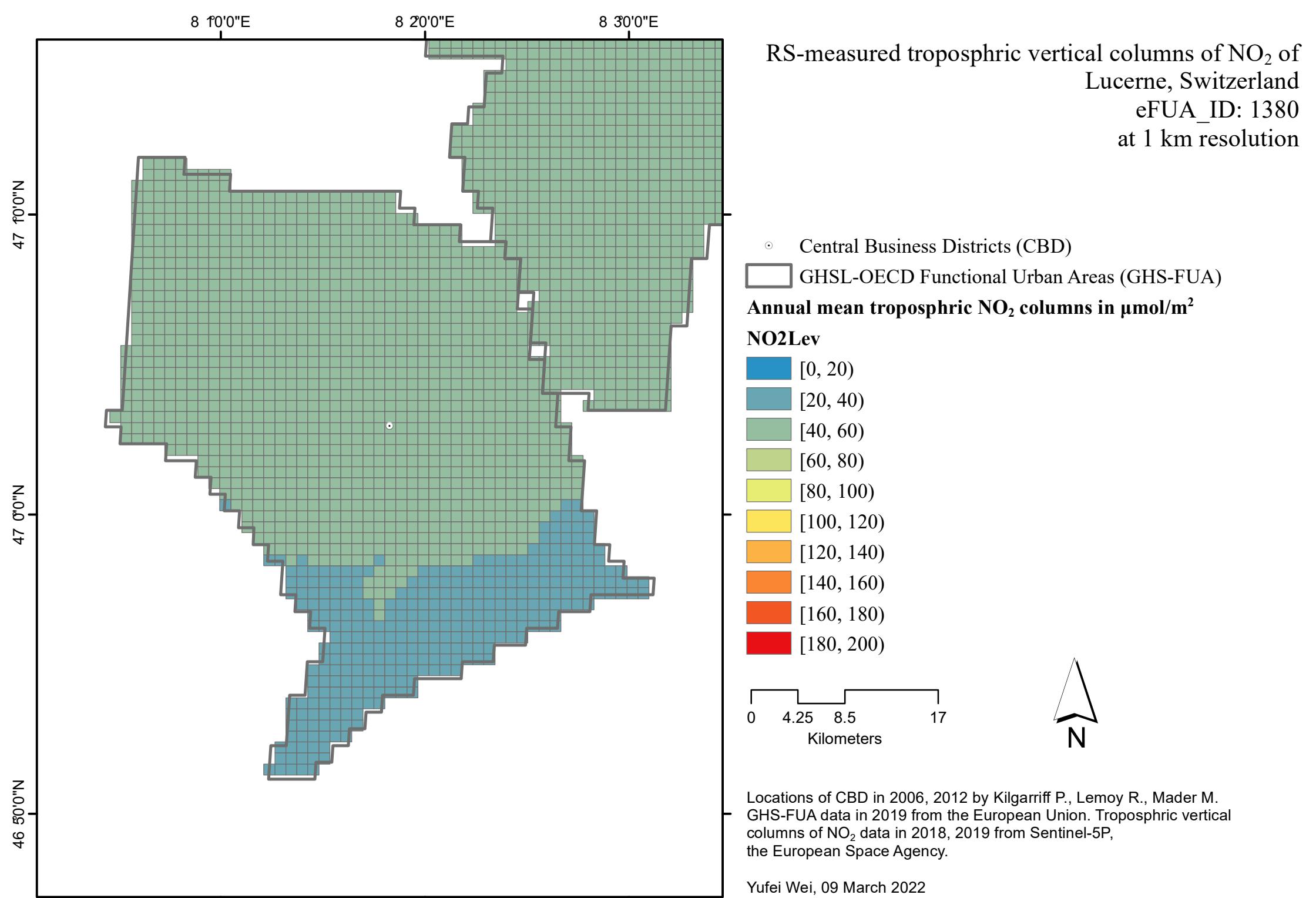
Yufei Wei, 09 March 2022

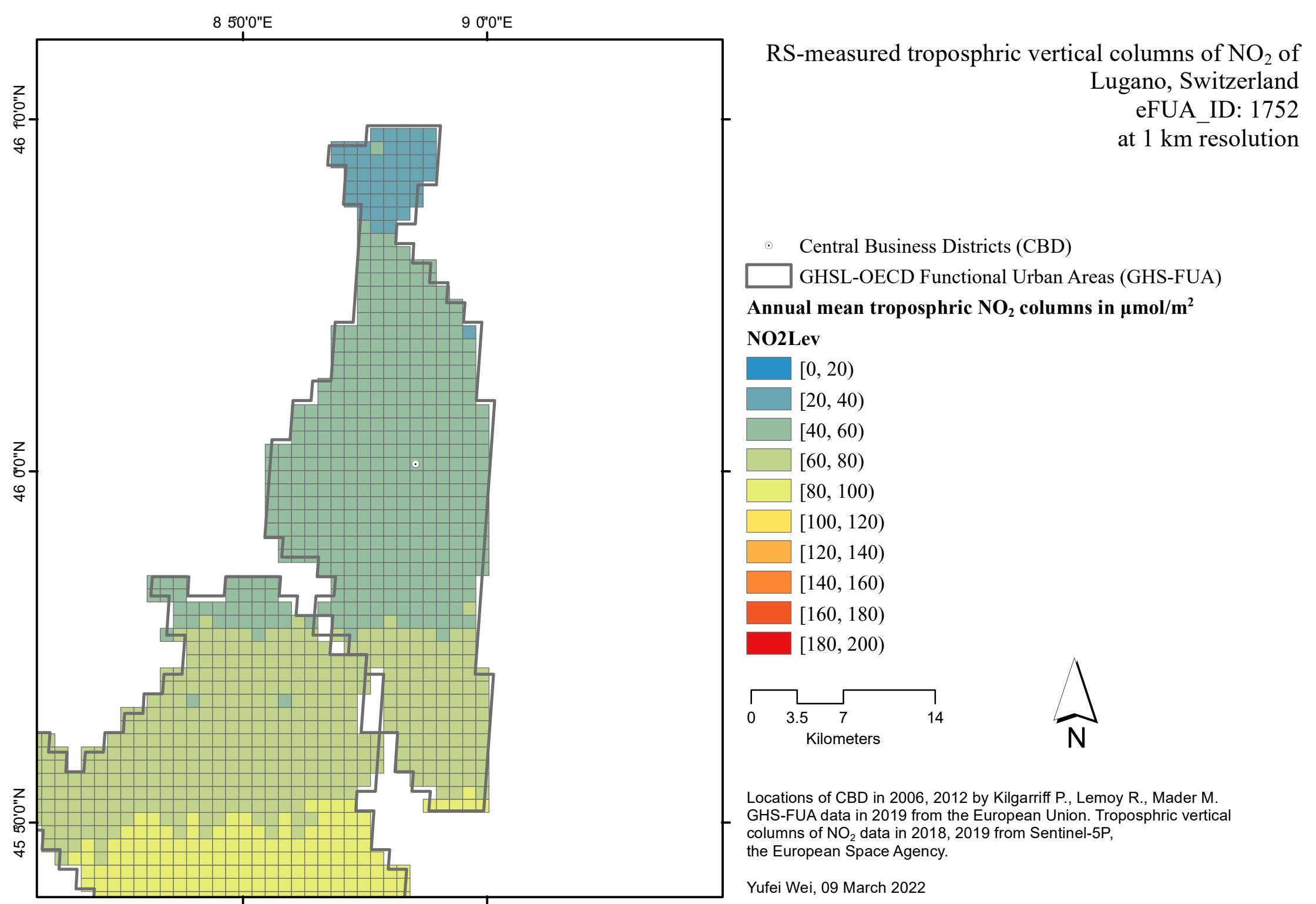


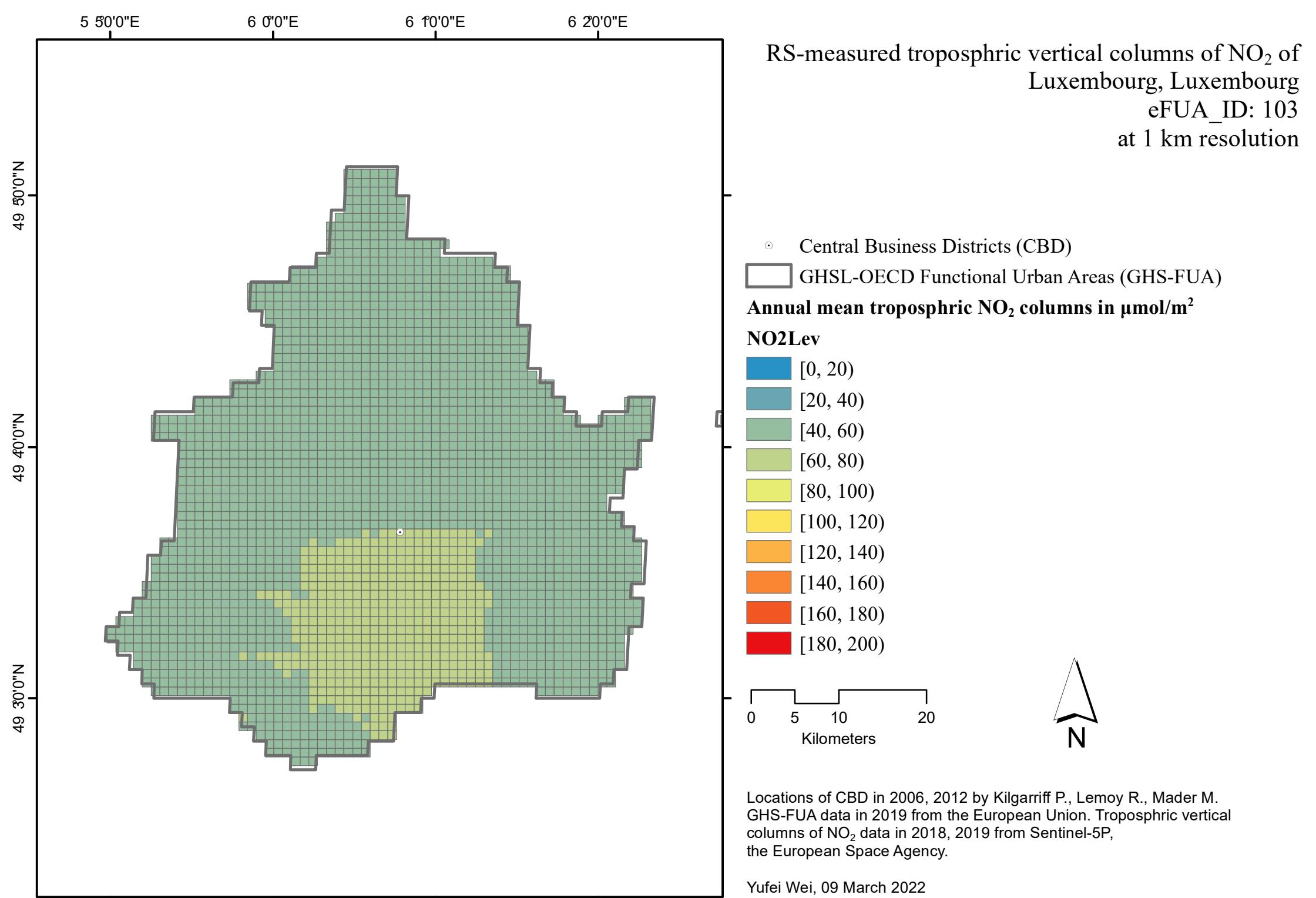


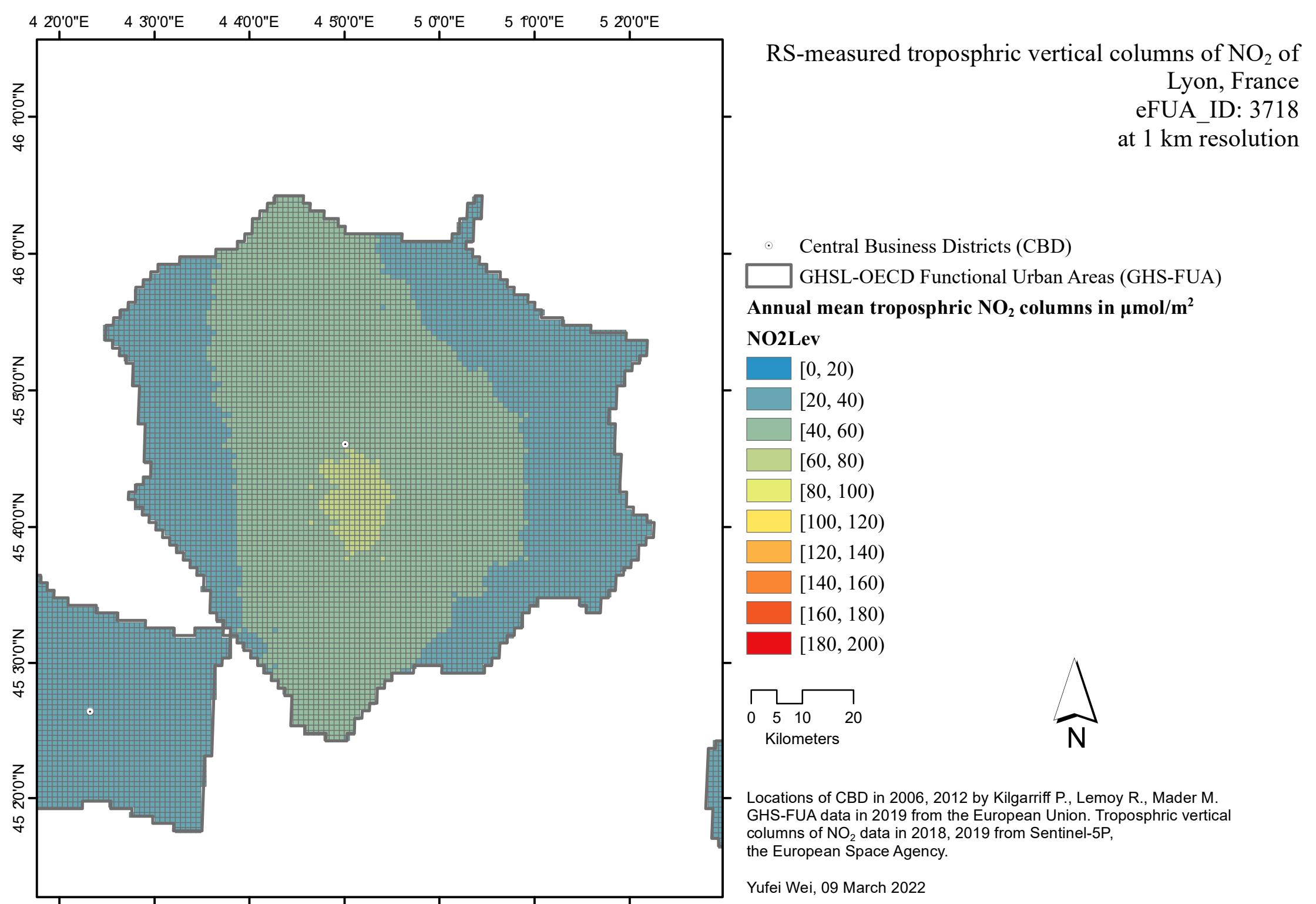


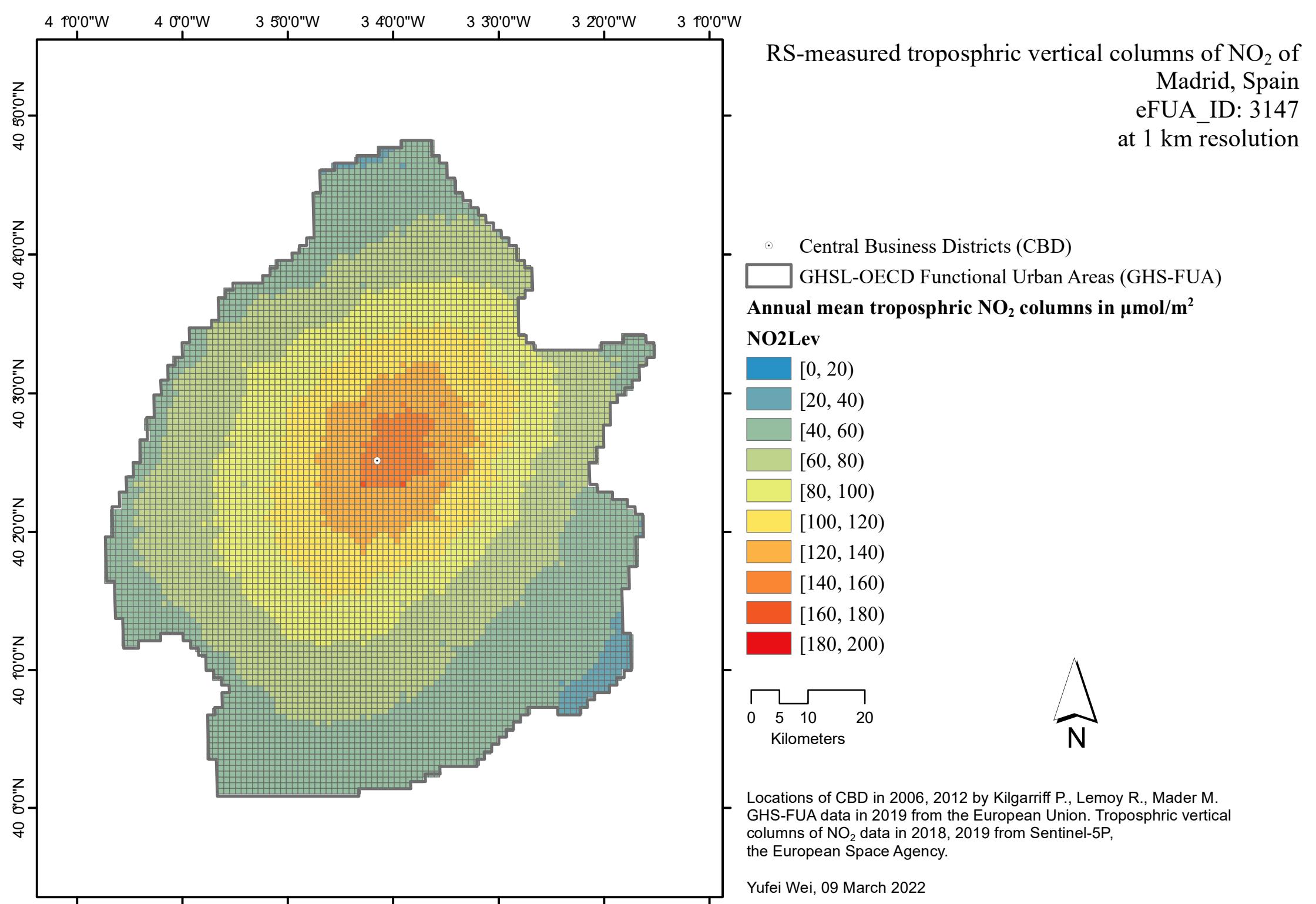


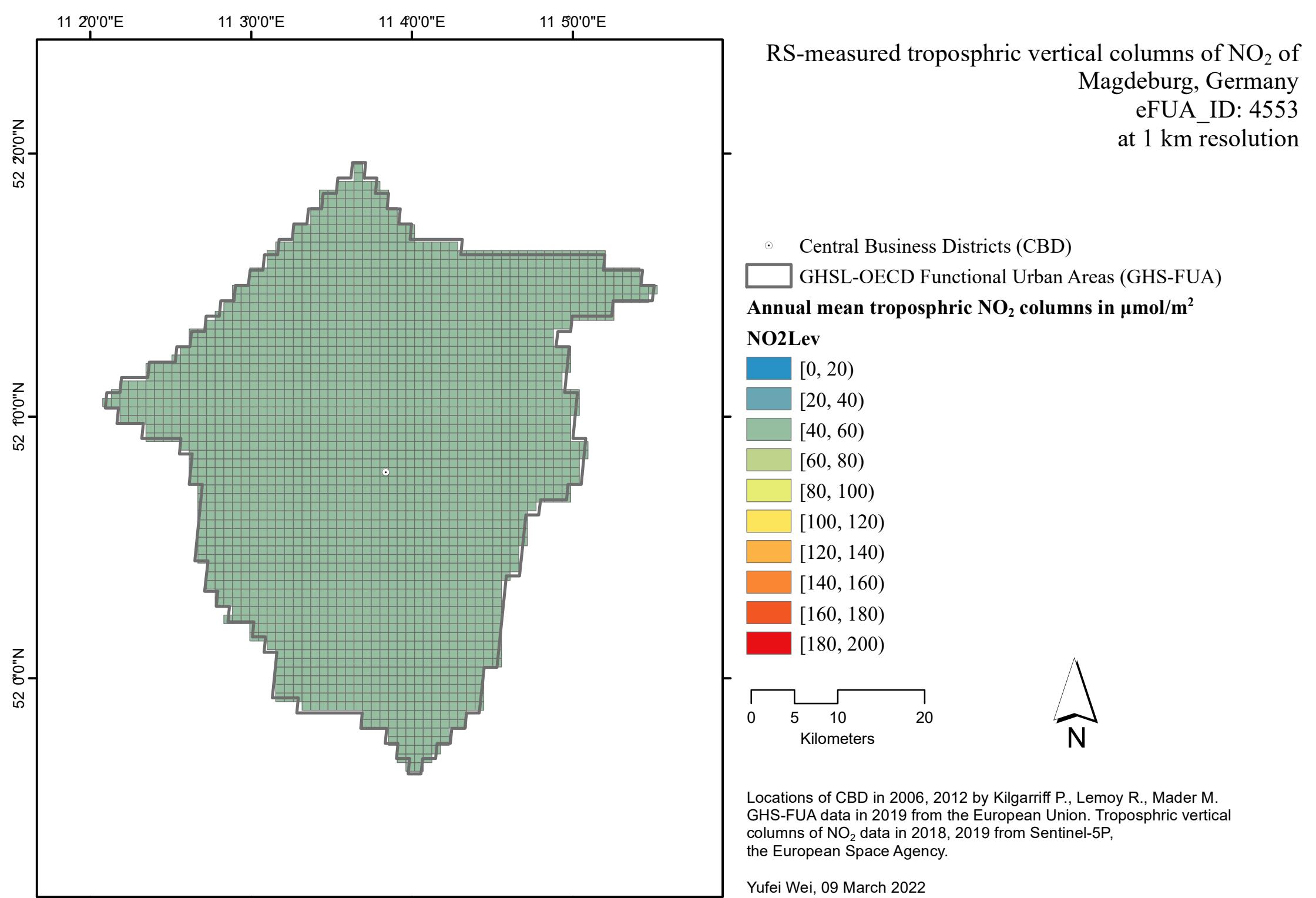


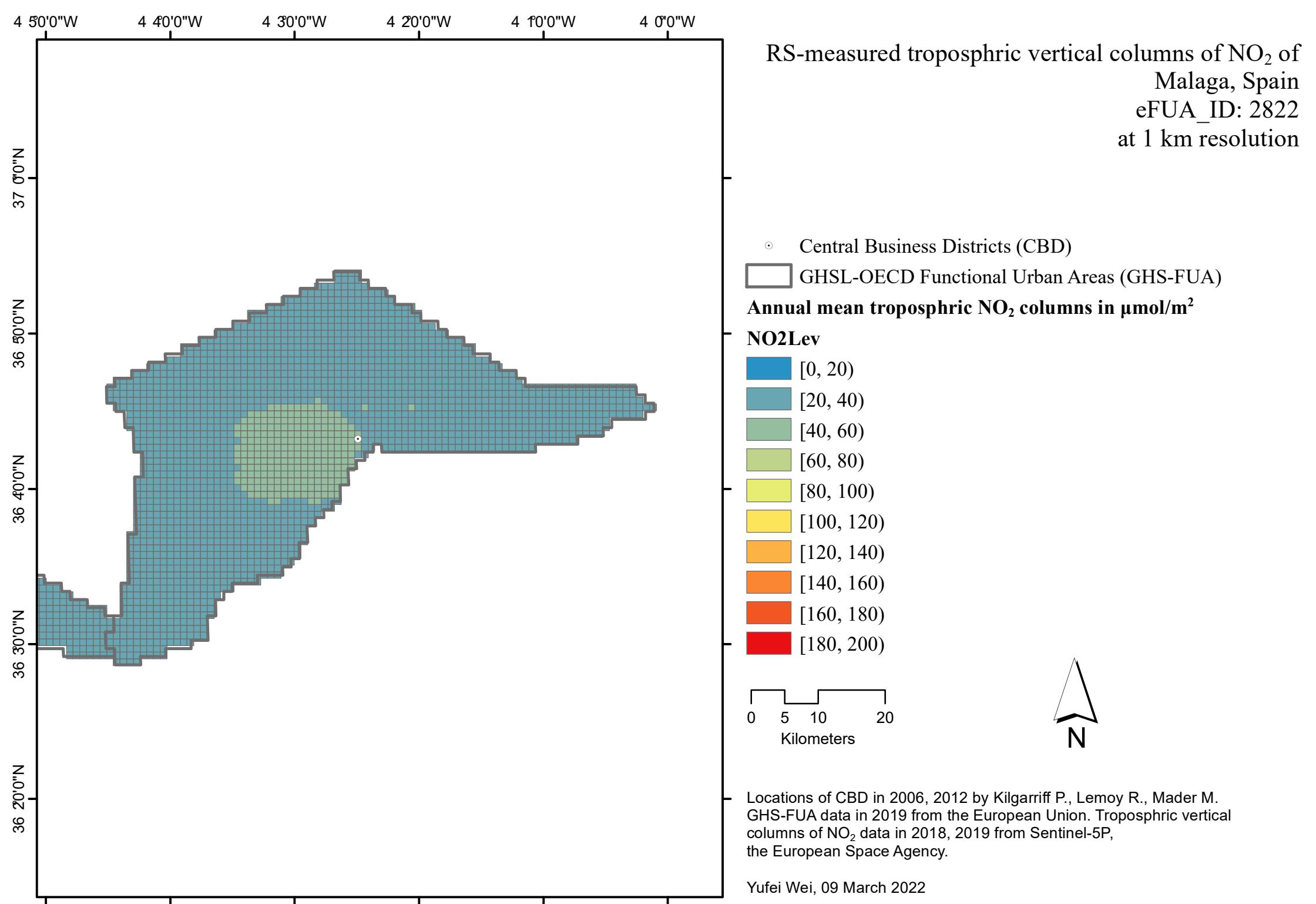












12 50'0"E

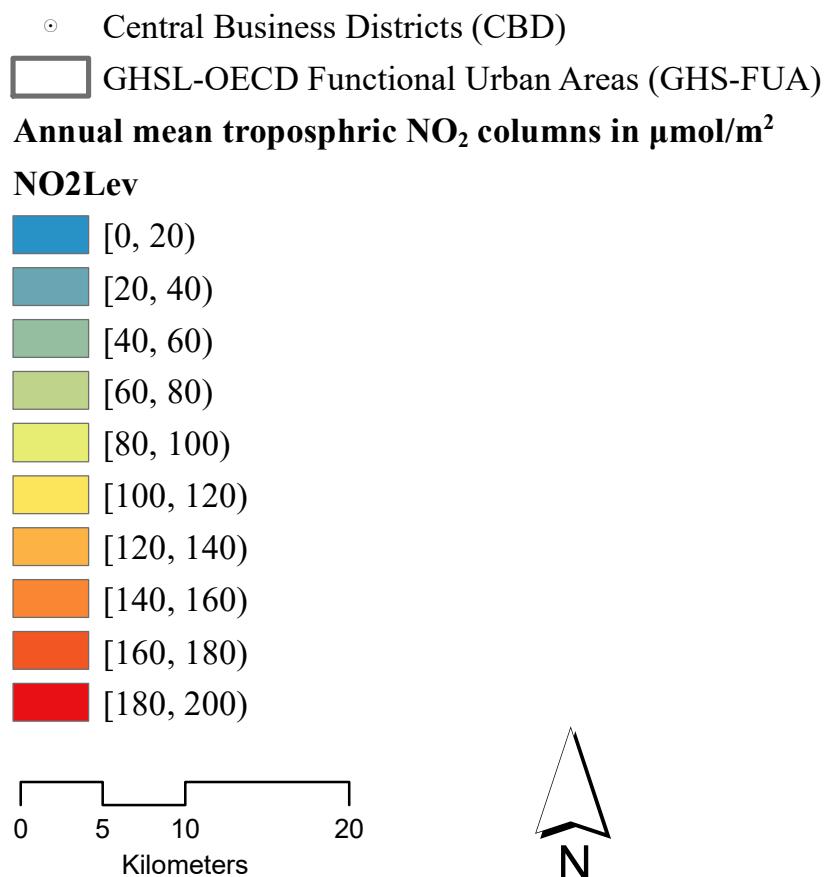
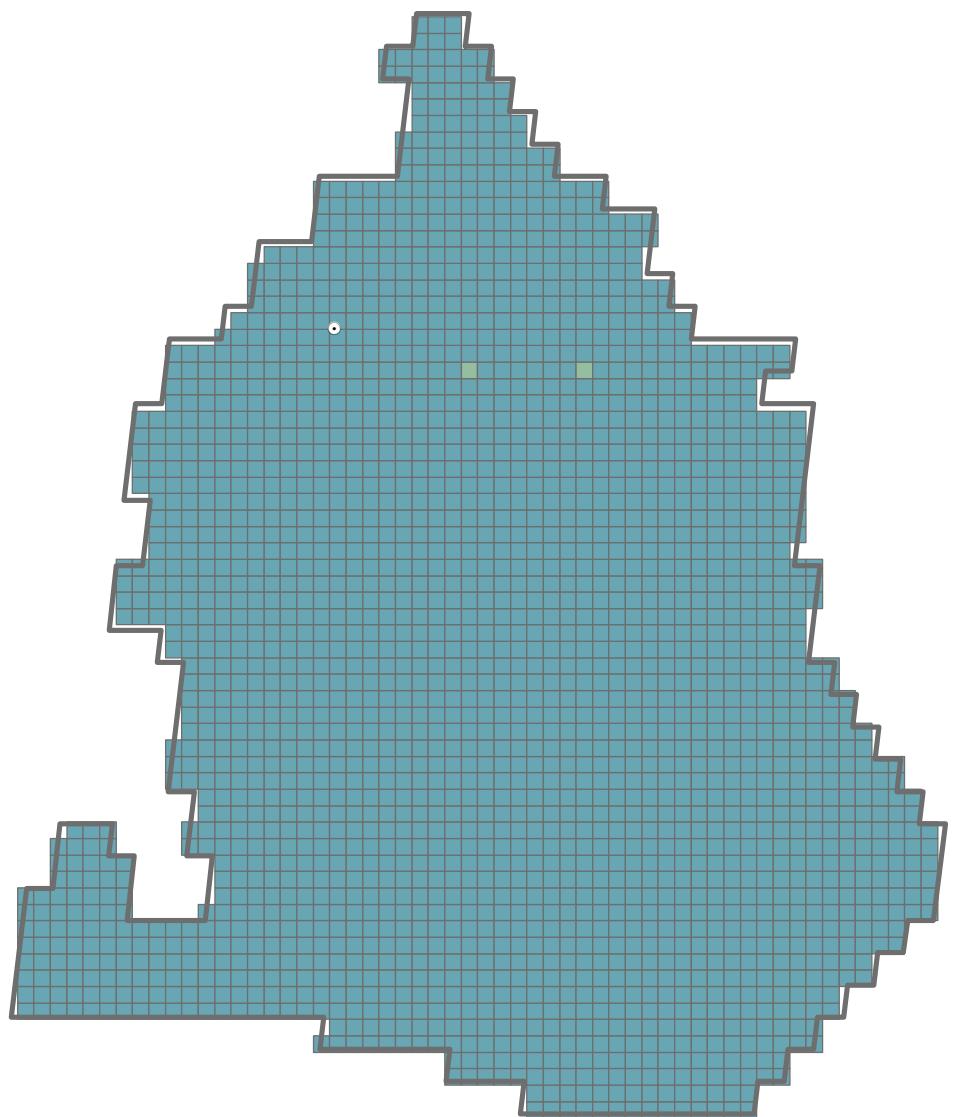
13 0'0"E

13 10'0"E

13 20'0"E

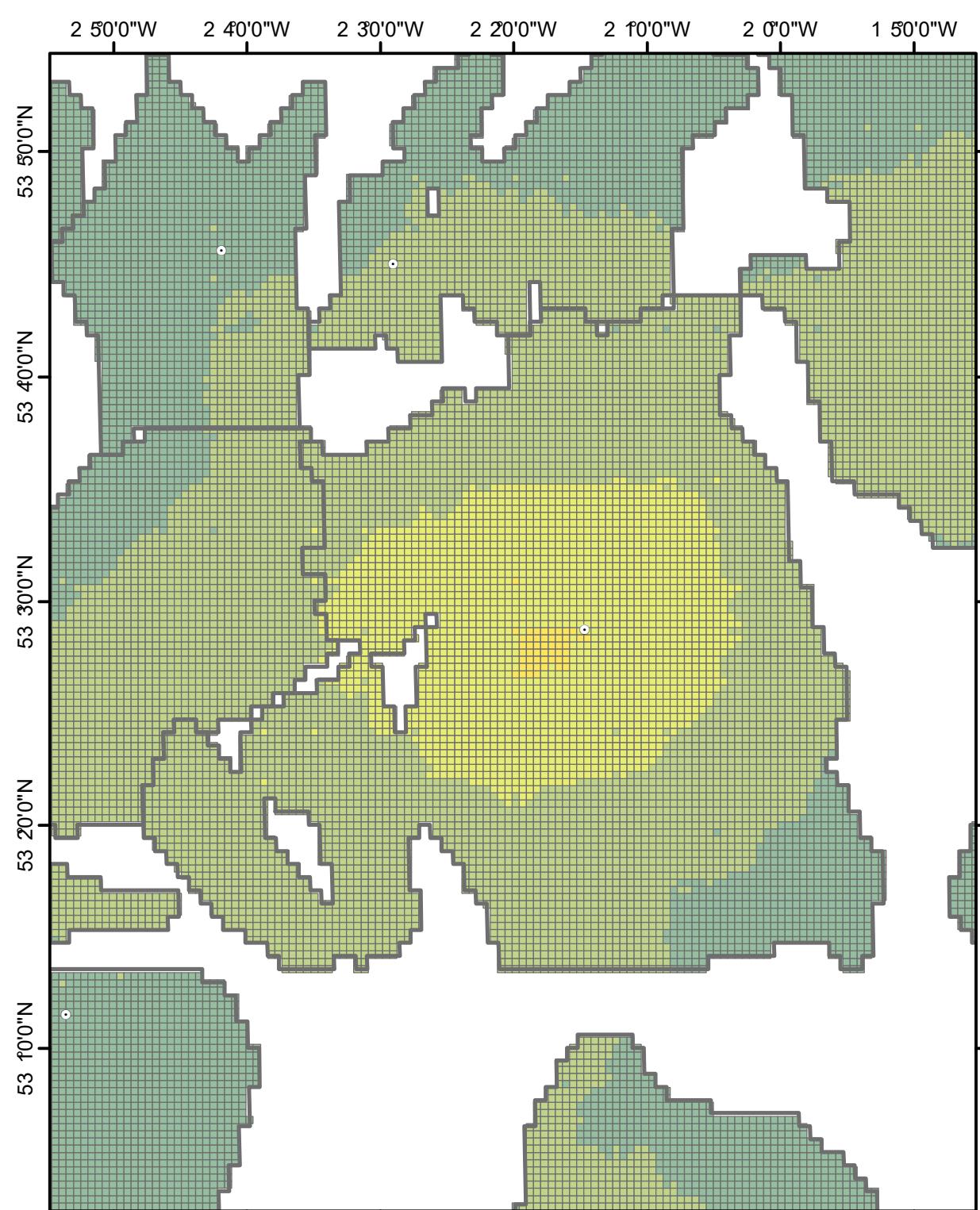
RS-measured tropospheric vertical columns of NO<sub>2</sub> of  
Malmo, Sweden  
eFUA\_ID: 481  
at 1 km resolution

55 40'0"N  
55 30'0"N  
55 20'0"N



Locations of CBD in 2006, 2012 by Kilgarriff P., Lemoy R., Mader M.  
GHS-FUA data in 2019 from the European Union. Tropospheric vertical  
columns of NO<sub>2</sub> data in 2018, 2019 from Sentinel-5P,  
the European Space Agency.

Yufei Wei, 10 March 2022



RS-measured tropospheric vertical columns of NO<sub>2</sub> of  
Manchester, United Kingdom  
eFUA\_ID: 3304  
at 1 km resolution

○ Central Business Districts (CBD)  
◻ GHS-OECD Functional Urban Areas (GHS-FUA)

Annual mean tropospheric NO<sub>2</sub> columns in  $\mu\text{mol}/\text{m}^2$

NO<sub>2</sub>Lev

- [0, 20]
- [20, 40]
- [40, 60]
- [60, 80]
- [80, 100]
- [100, 120]
- [120, 140]
- [140, 160]
- [160, 180]
- [180, 200]

0 5 10 20 Kilometers

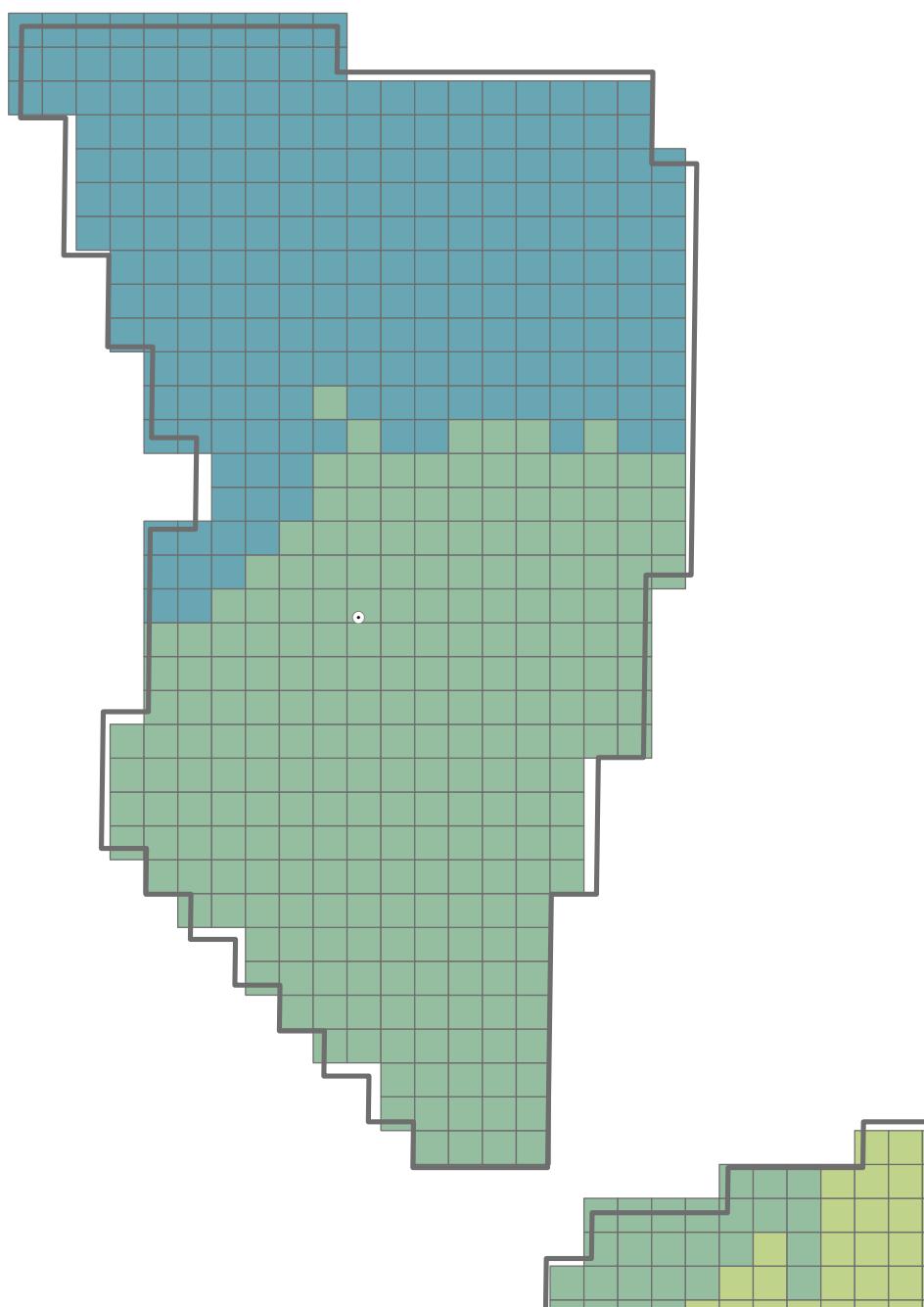


Locations of CBD in 2006, 2012 by Kilgarriff P., Lemoy R., Mader M.  
GHS-FUA data in 2019 from the European Union. Tropospheric vertical  
columns of NO<sub>2</sub> data in 2018, 2019 from Sentinel-5P,  
the European Space Agency.

Yufei Wei, 10 March 2022

1 50'0"E

RS-measured tropospheric vertical columns of NO<sub>2</sub> of  
Manresa, Spain  
eFUA\_ID: 4490  
at 1 km resolution



○ Central Business Districts (CBD)

◻ GHSL-OECD Functional Urban Areas (GHS-FUA)

Annual mean tropospheric NO<sub>2</sub> columns in  $\mu\text{mol}/\text{m}^2$

NO2Lev

- [0, 20]
- [20, 40]
- [40, 60]
- [60, 80]
- [80, 100]
- [100, 120]
- [120, 140]
- [140, 160]
- [160, 180]
- [180, 200]

0 2.25 4.5 9  
Kilometers



Locations of CBD in 2006, 2012 by Kilgarriff P., Lemoy R., Mader M.  
GHS-FUA data in 2019 from the European Union. Tropospheric vertical  
columns of NO<sub>2</sub> data in 2018, 2019 from Sentinel-5P,  
the European Space Agency.

Yufei Wei, 10 March 2022

5°10'0"W

5°0'0"W

4°50'0"W

RS-measured tropospheric vertical columns of NO<sub>2</sub> of  
Marbella, Spain  
eFUA\_ID: 2637  
at 1 km resolution

36°40'0"N

36°30'0"N

36°20'0"N

○ Central Business Districts (CBD)

◻ GHSL-OECD Functional Urban Areas (GHS-FUA)

Annual mean tropospheric NO<sub>2</sub> columns in  $\mu\text{mol}/\text{m}^2$

NO2Lev

[0, 20)

[20, 40)

[40, 60)

[60, 80)

[80, 100)

[100, 120)

[120, 140)

[140, 160)

[160, 180)

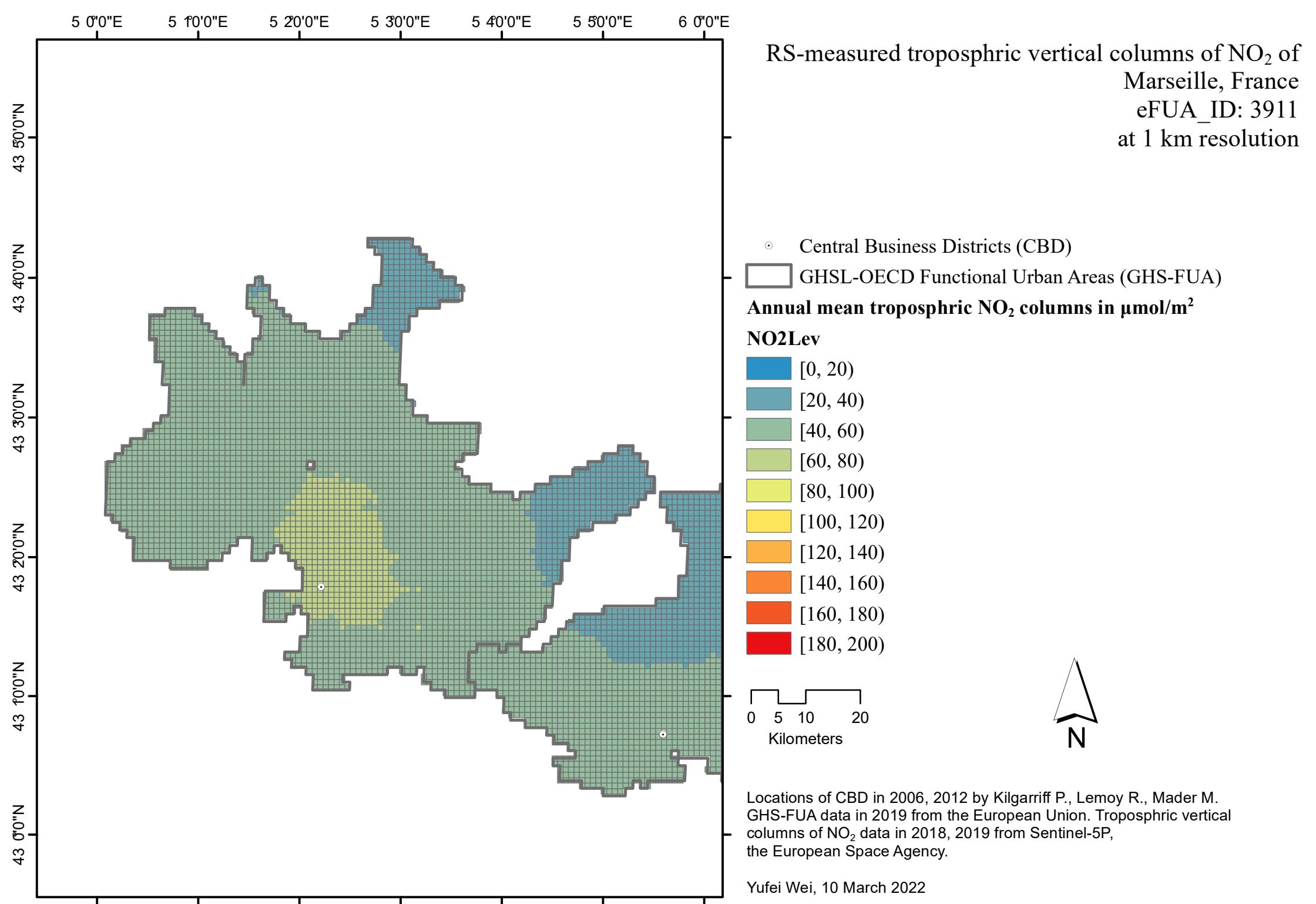
[180, 200)

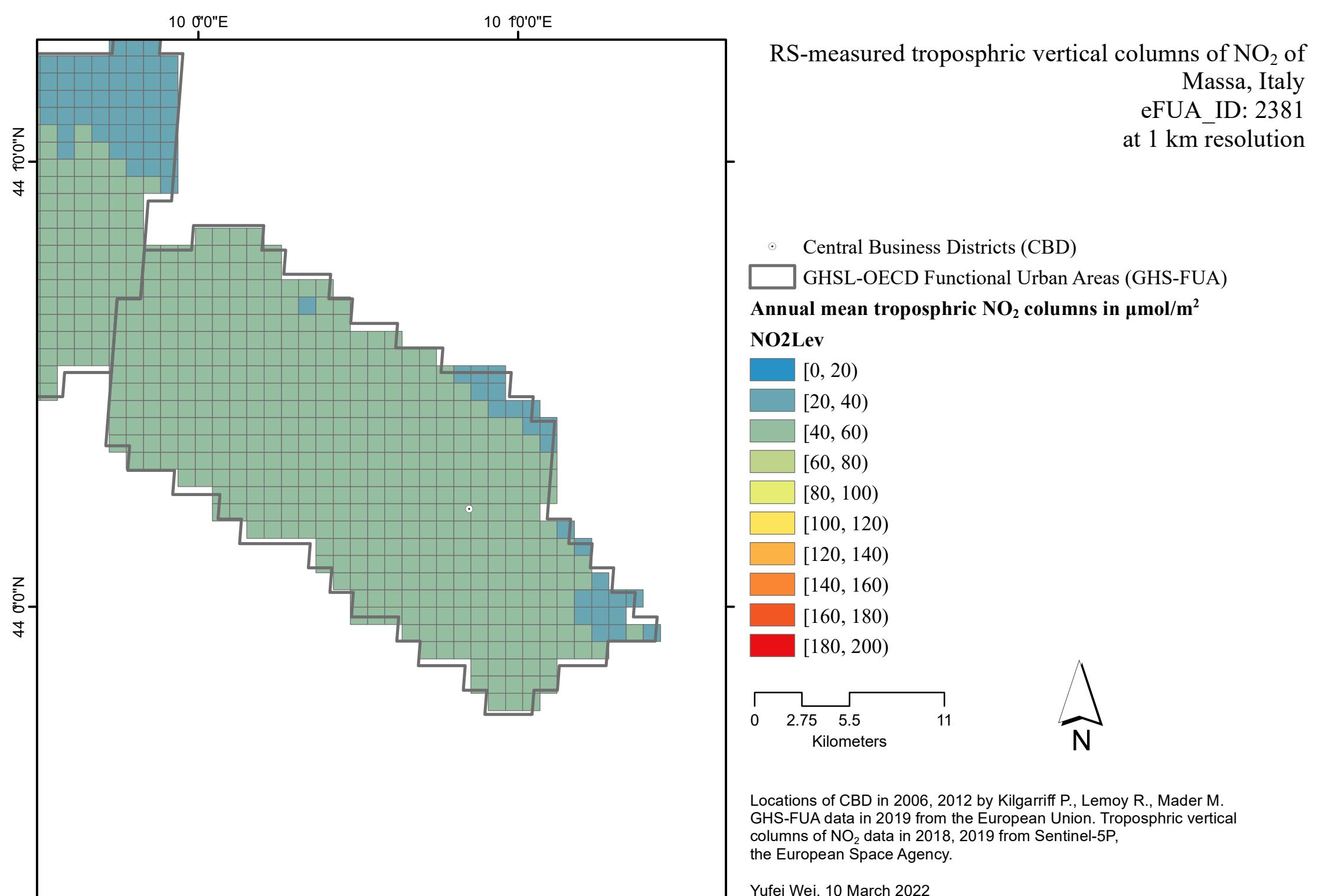
0 4.25 8.5 17  
Kilometers

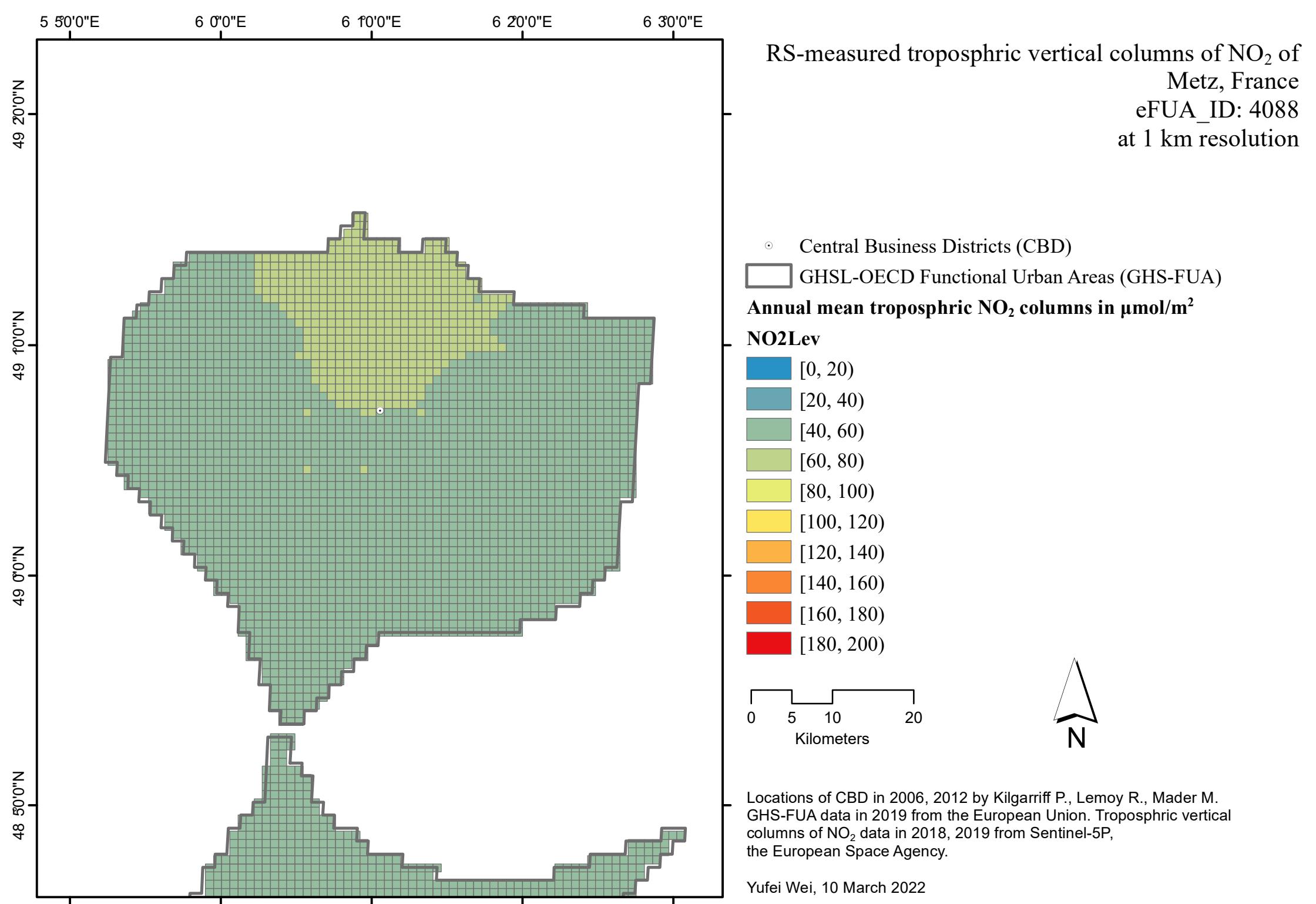


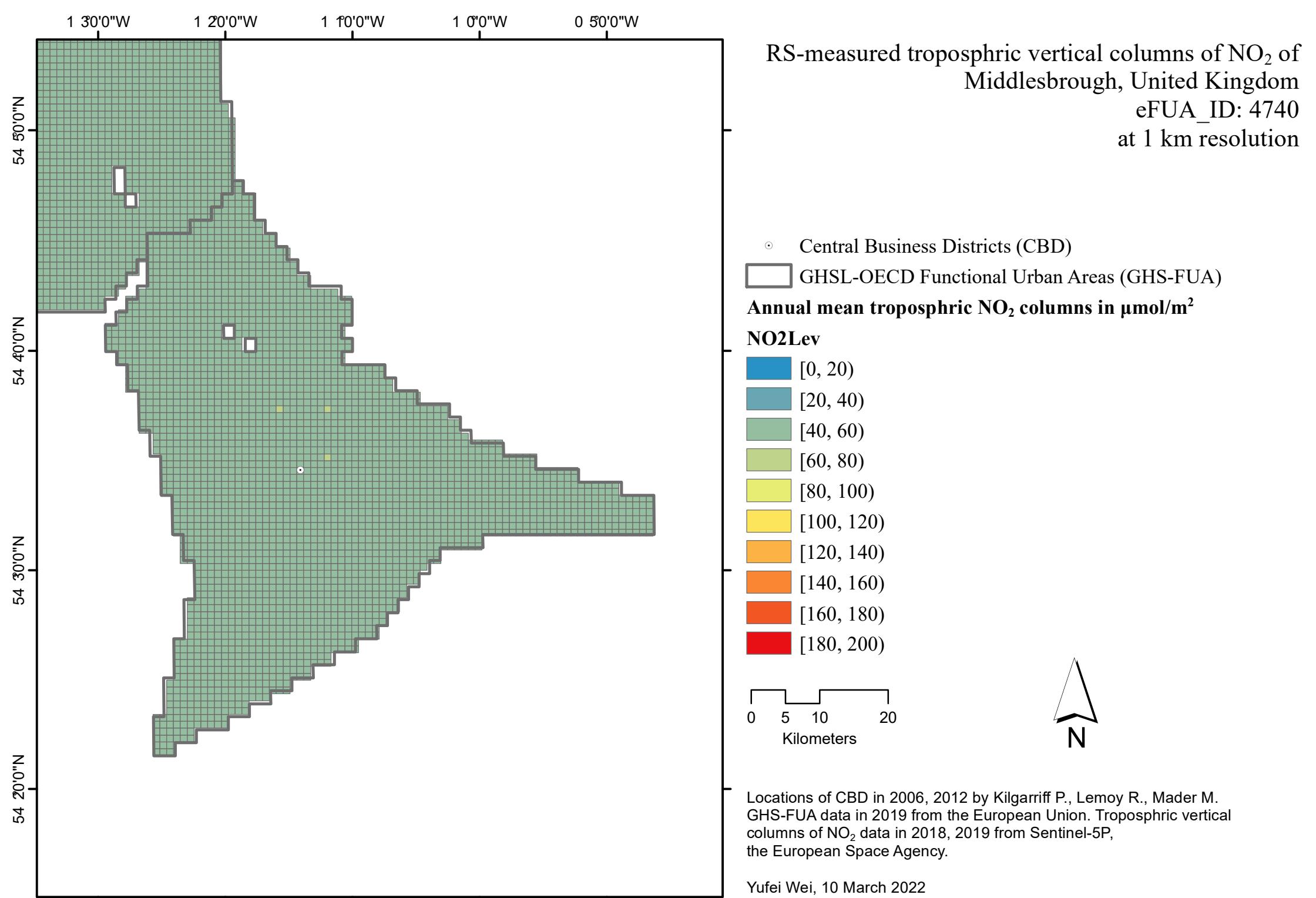
Locations of CBD in 2006, 2012 by Kilgarriff P., Lemoy R., Mader M.  
GHS-FUA data in 2019 from the European Union. Tropospheric vertical  
columns of NO<sub>2</sub> data in 2018, 2019 from Sentinel-5P,  
the European Space Agency.

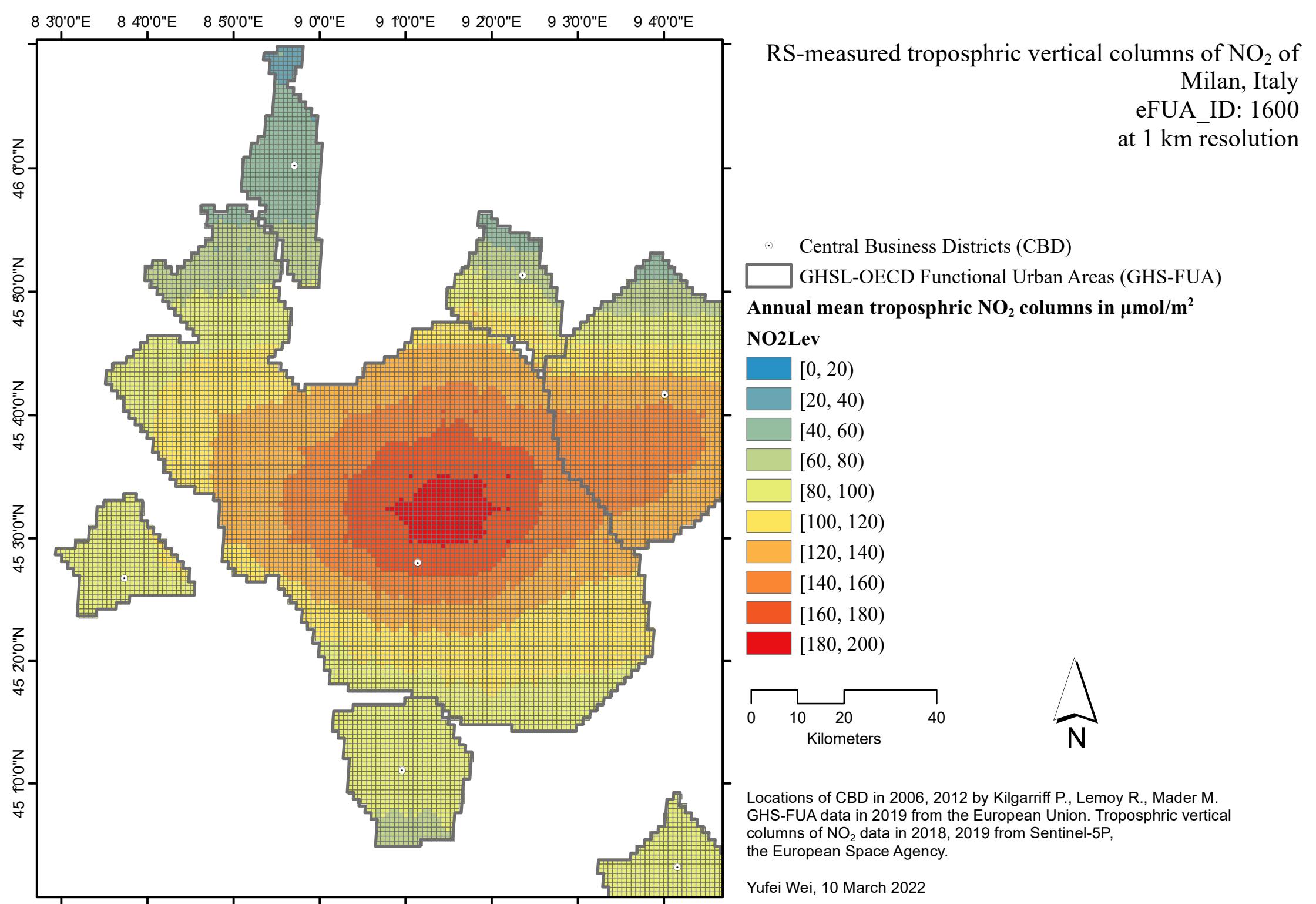
Yufei Wei, 10 March 2022

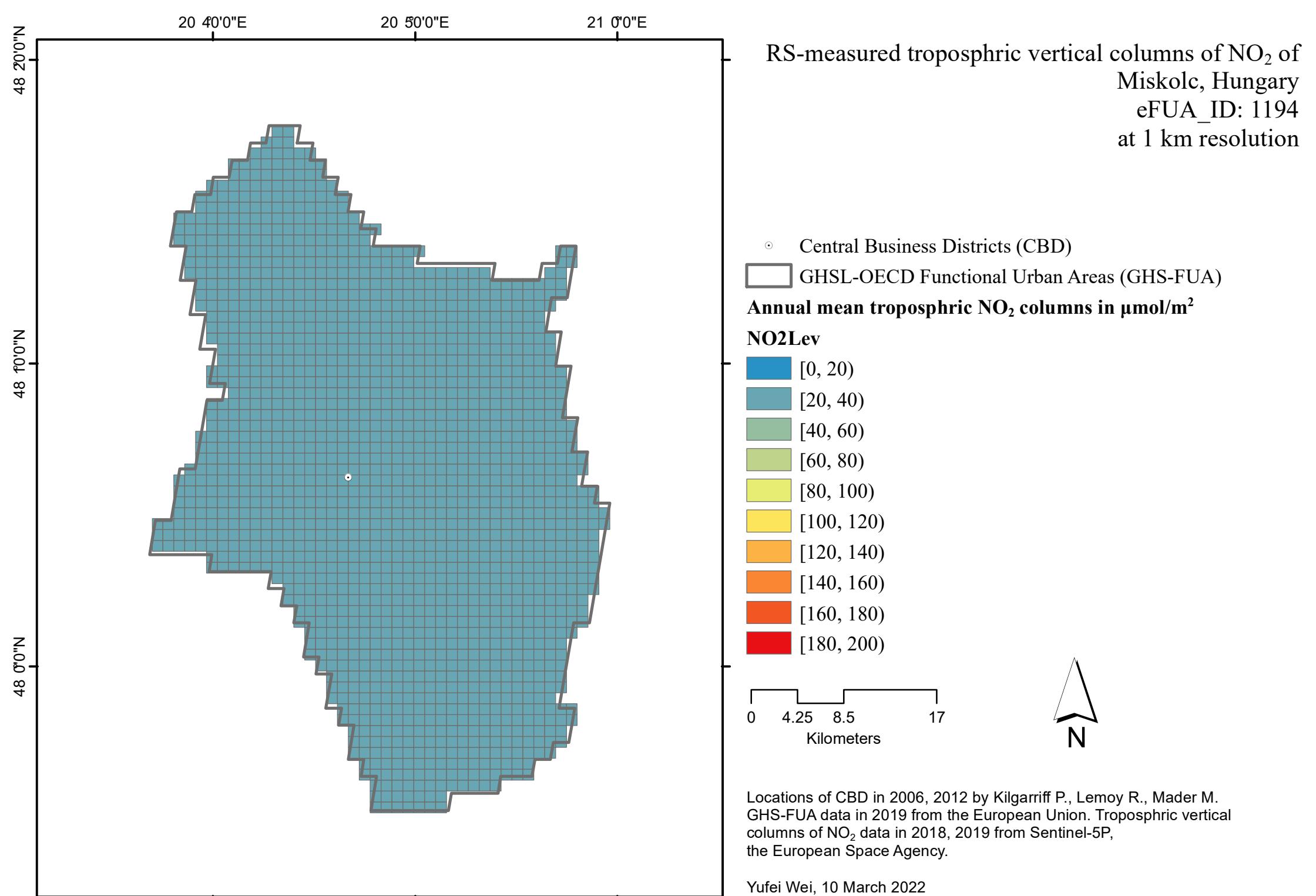








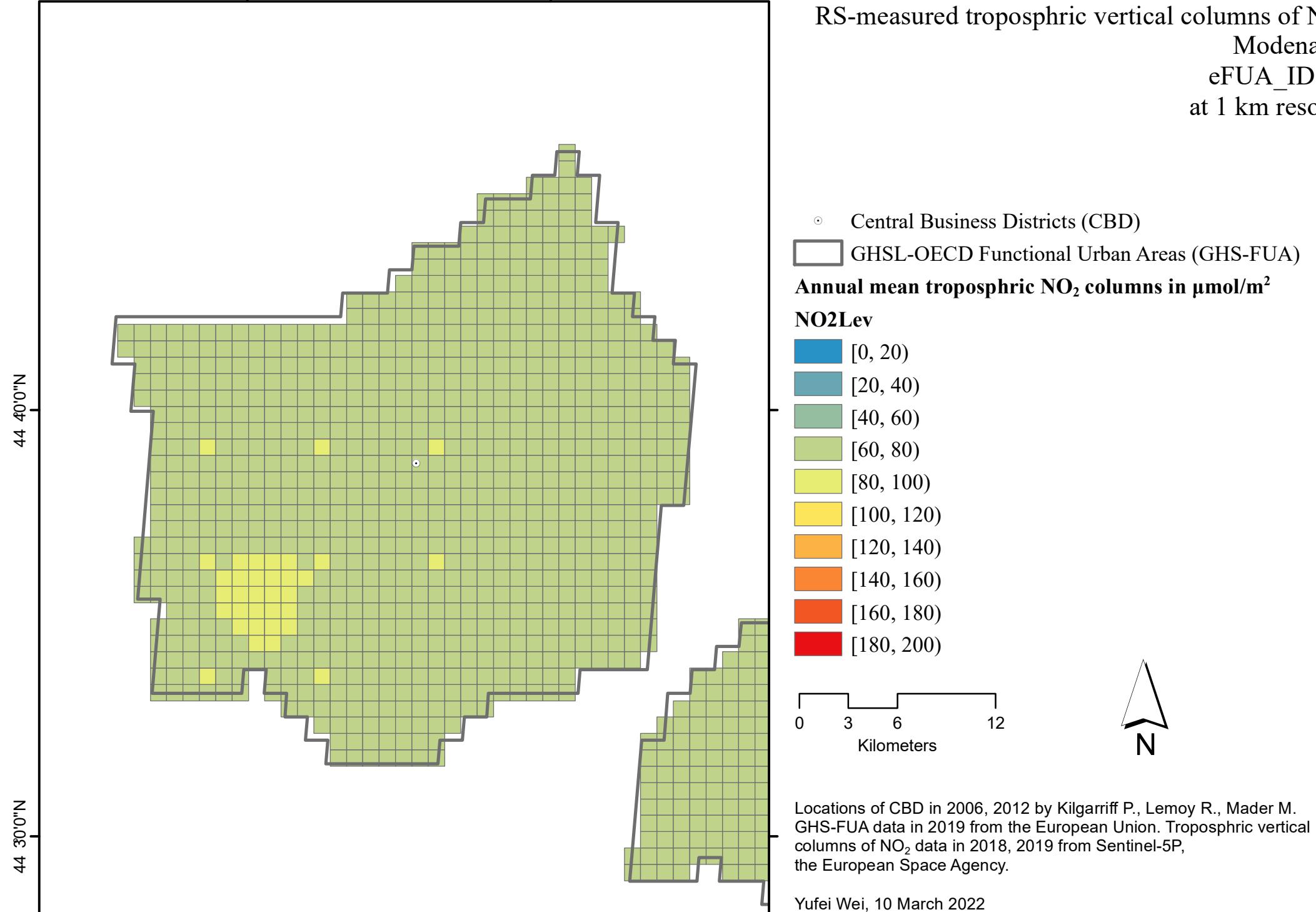


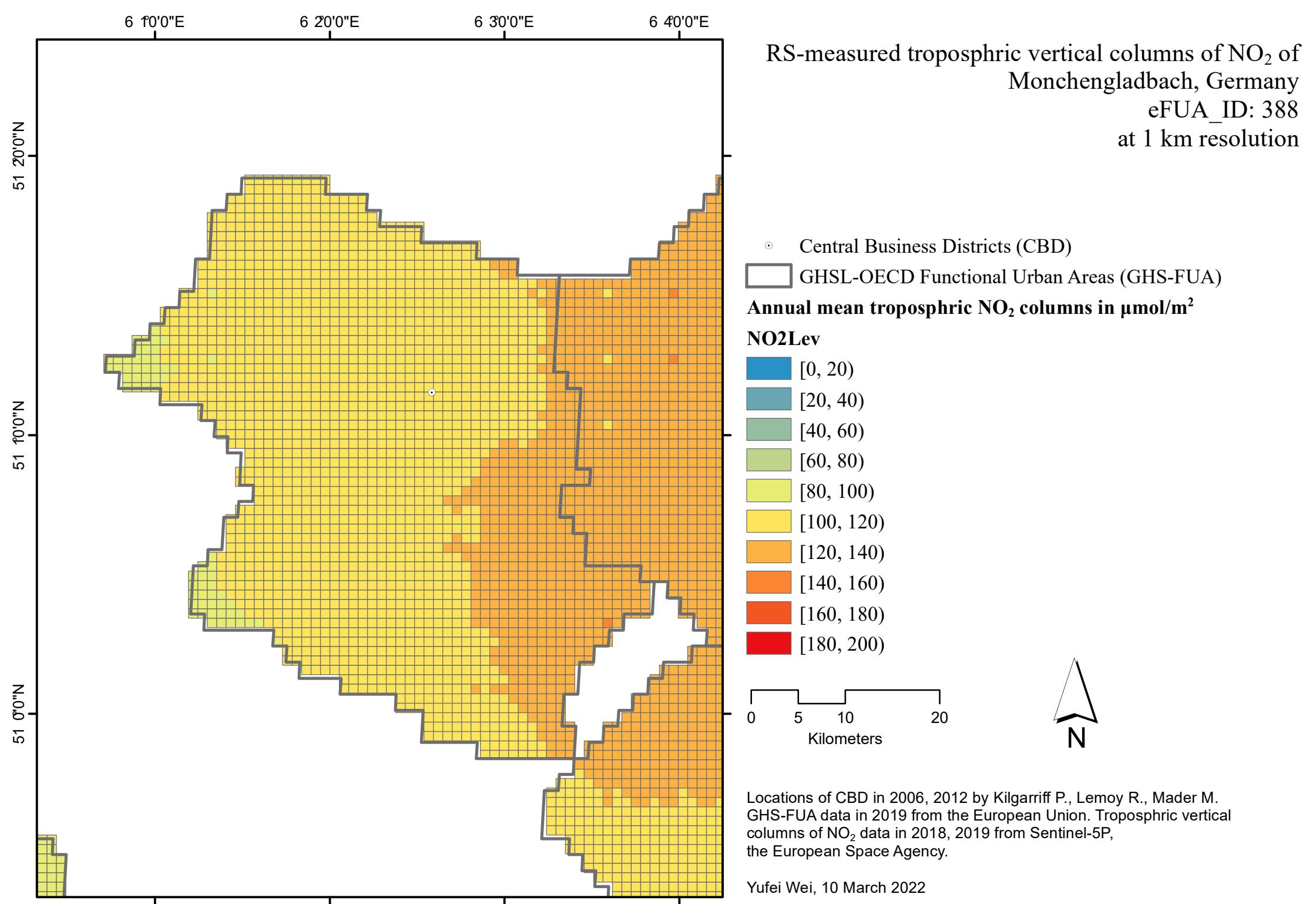


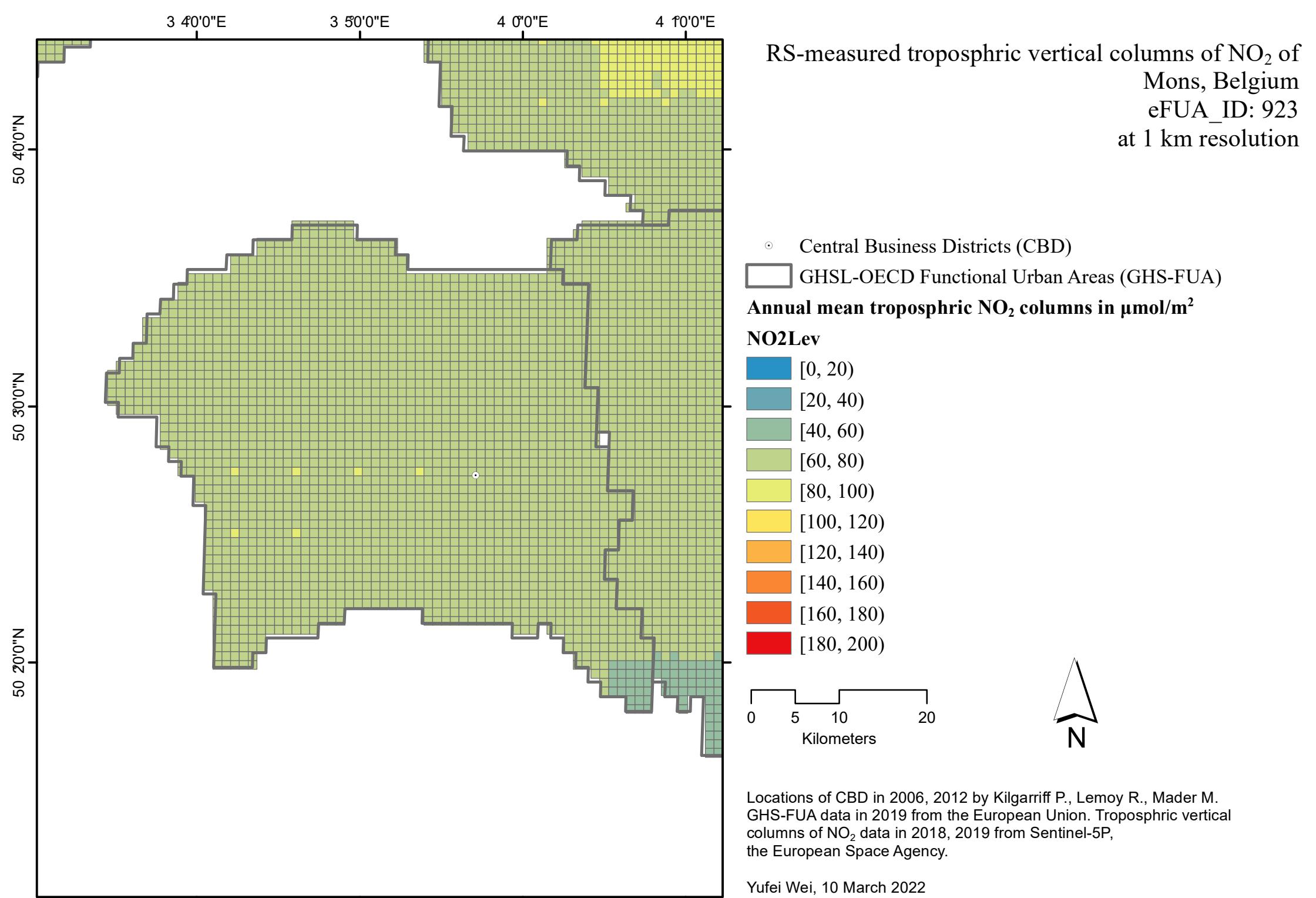
10 50'0"E

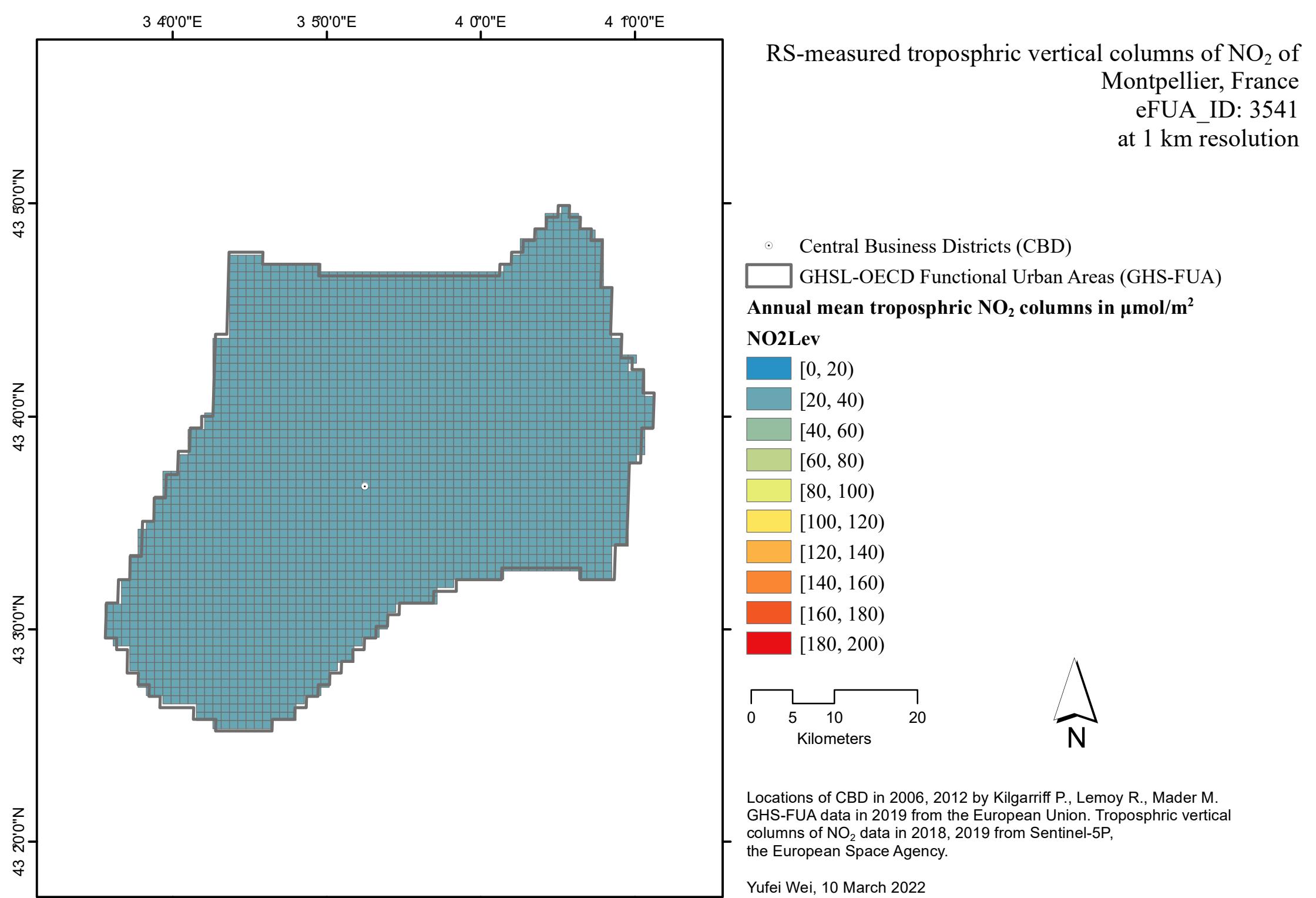
11 0'0"E

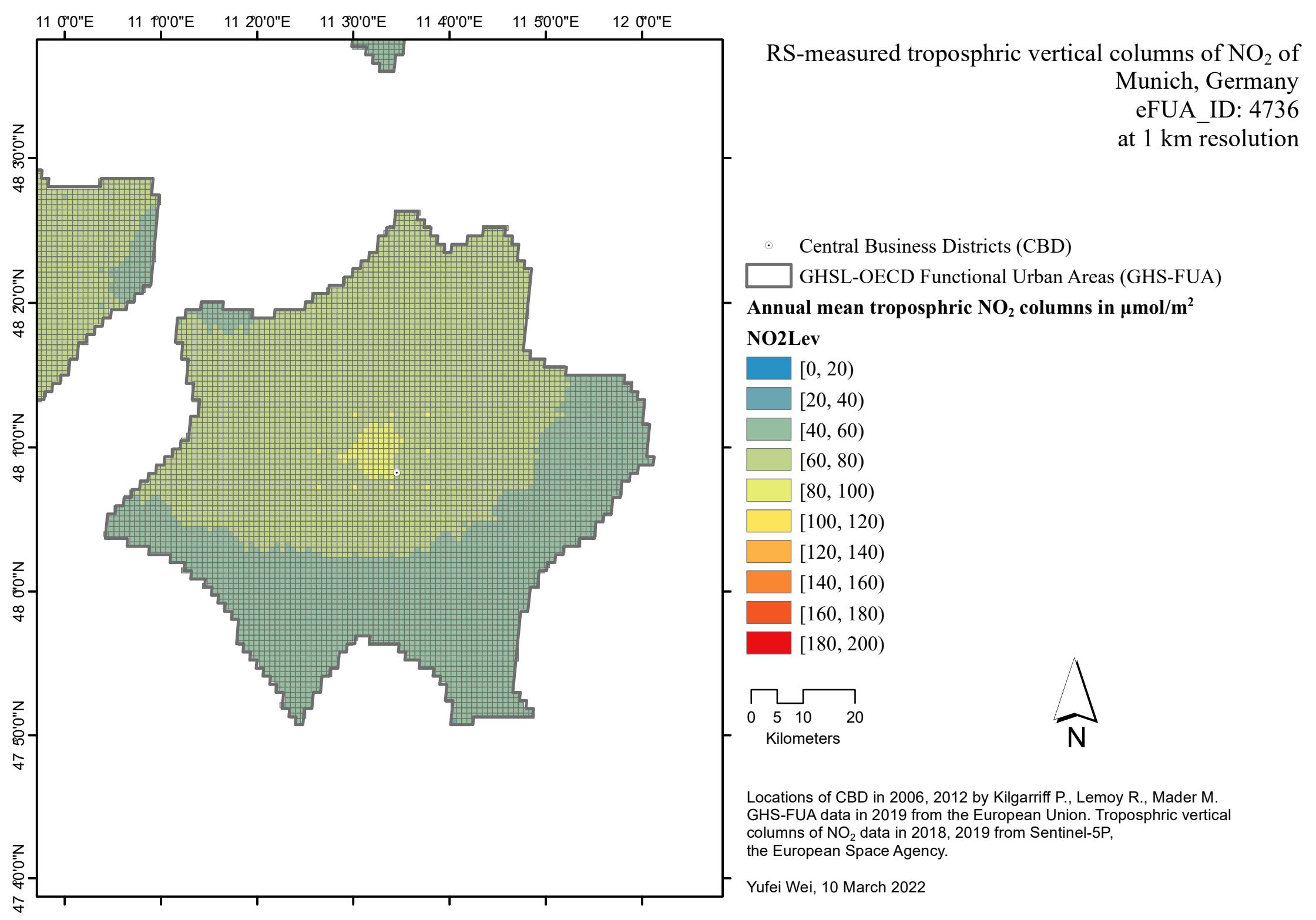
RS-measured tropospheric vertical columns of NO<sub>2</sub> of  
Modena, Italy  
eFUA\_ID: 2832  
at 1 km resolution











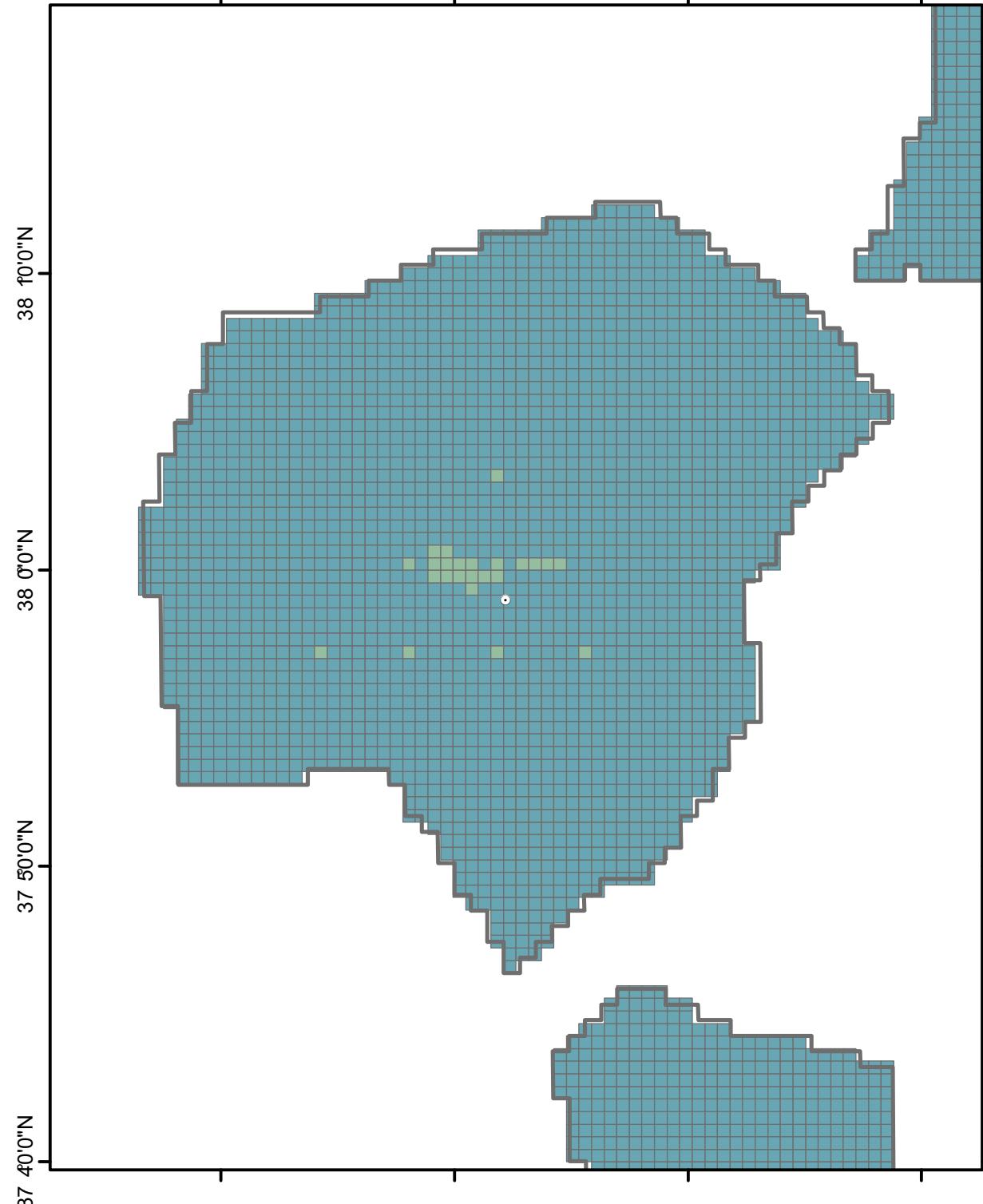
1 20'0"W

1 10'0"W

1 0'0"W

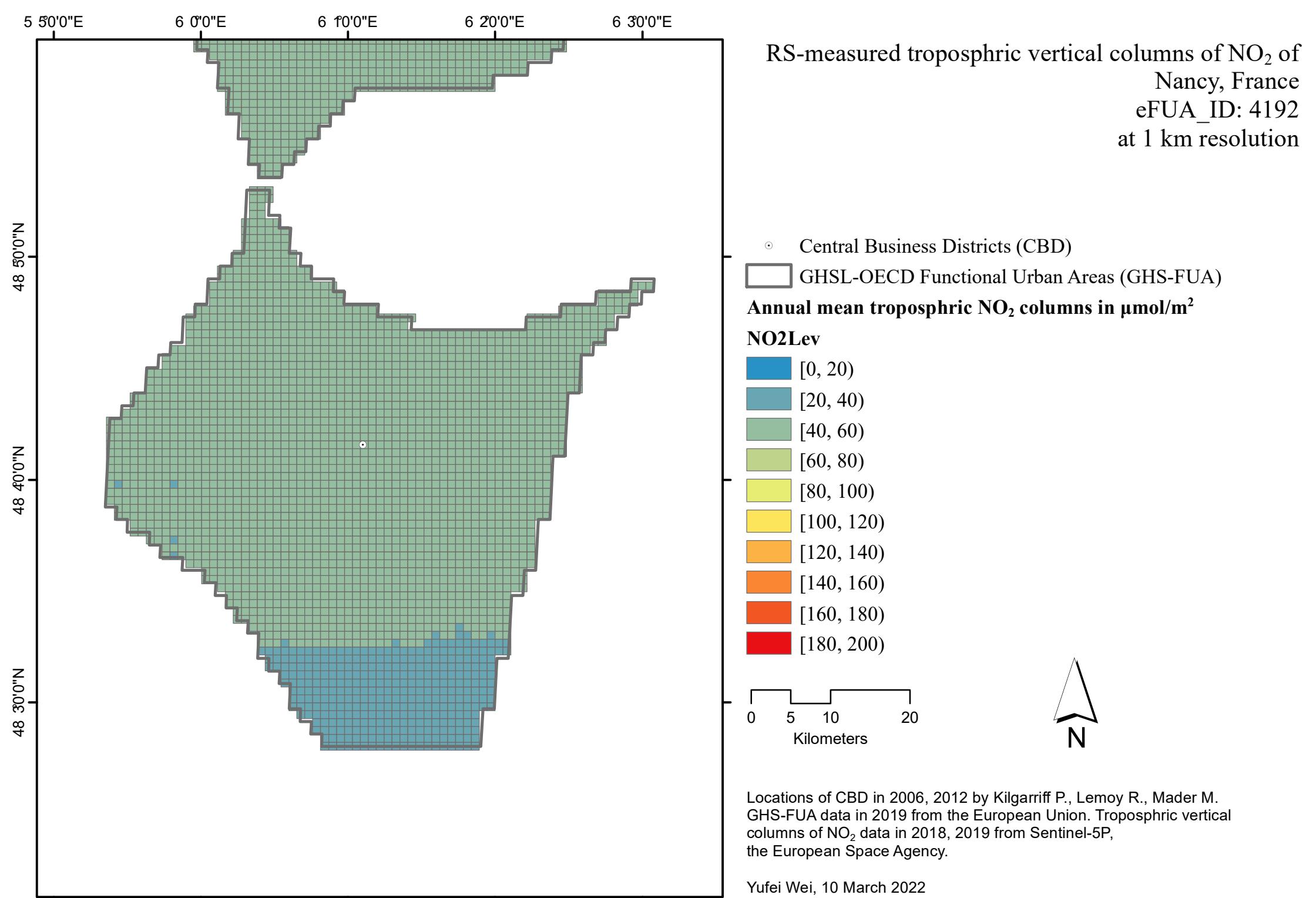
0 50'0"W

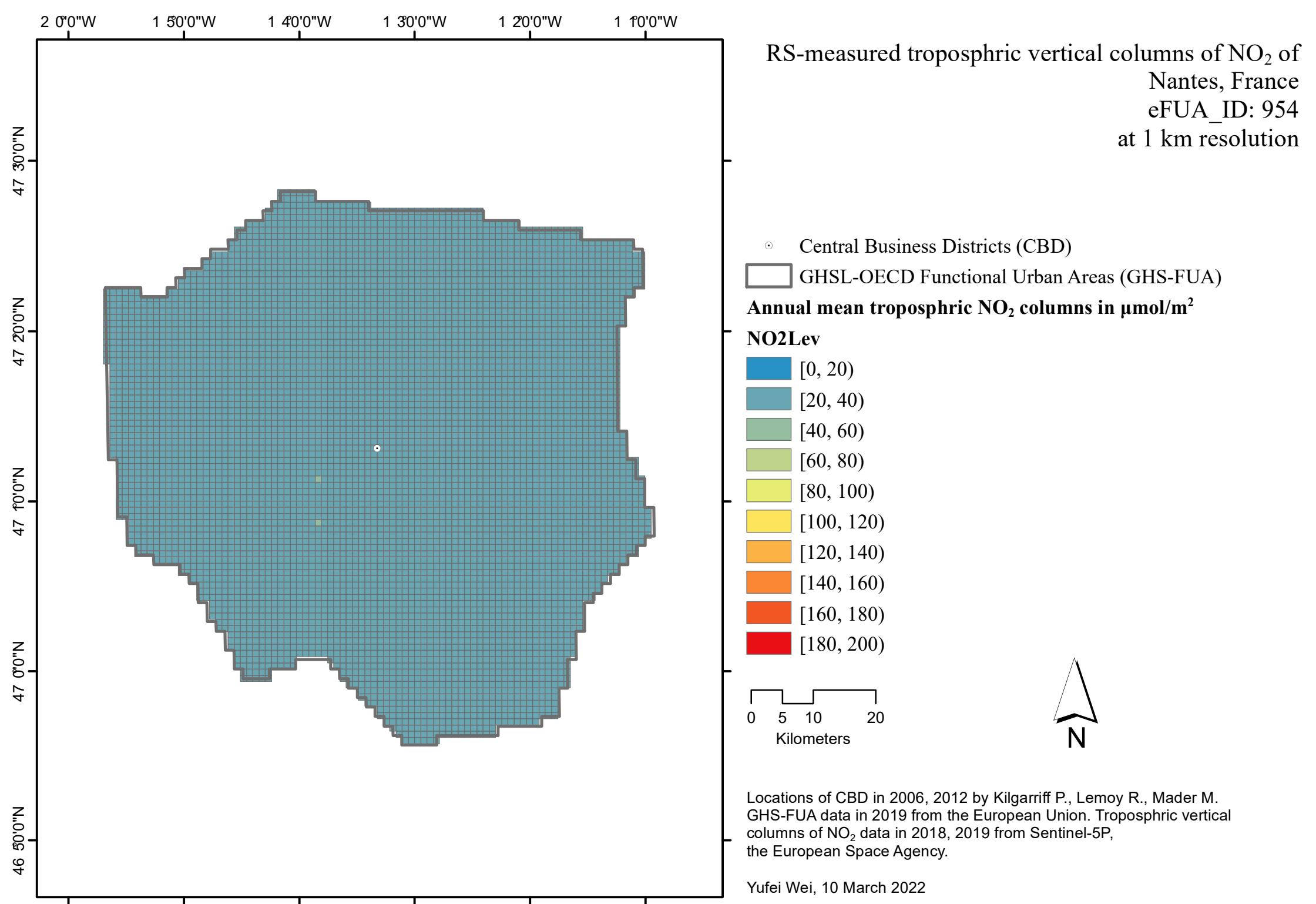
RS-measured tropospheric vertical columns of NO<sub>2</sub> of  
 Murcia, Spain  
 eFUA\_ID: 3909  
 at 1 km resolution

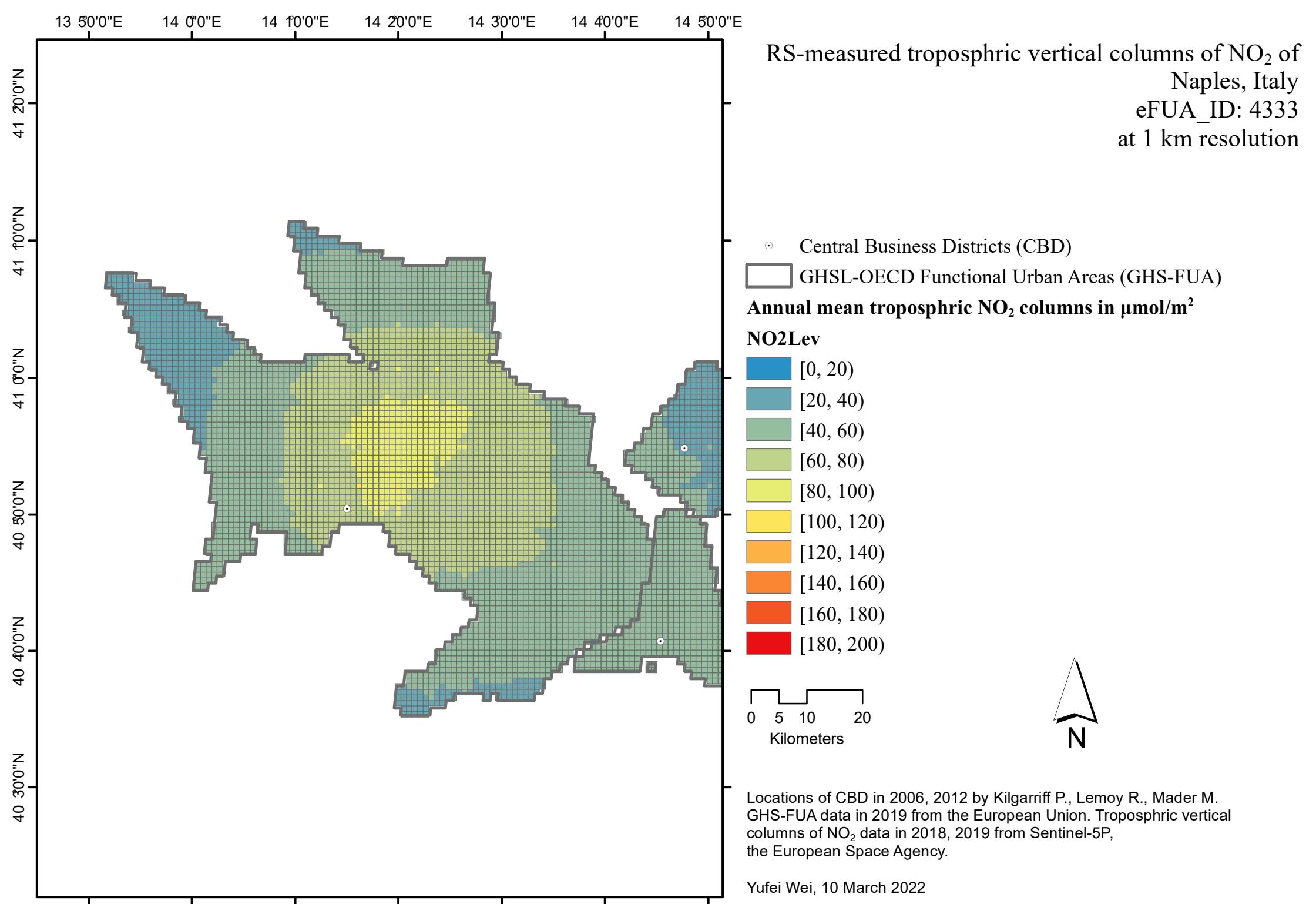


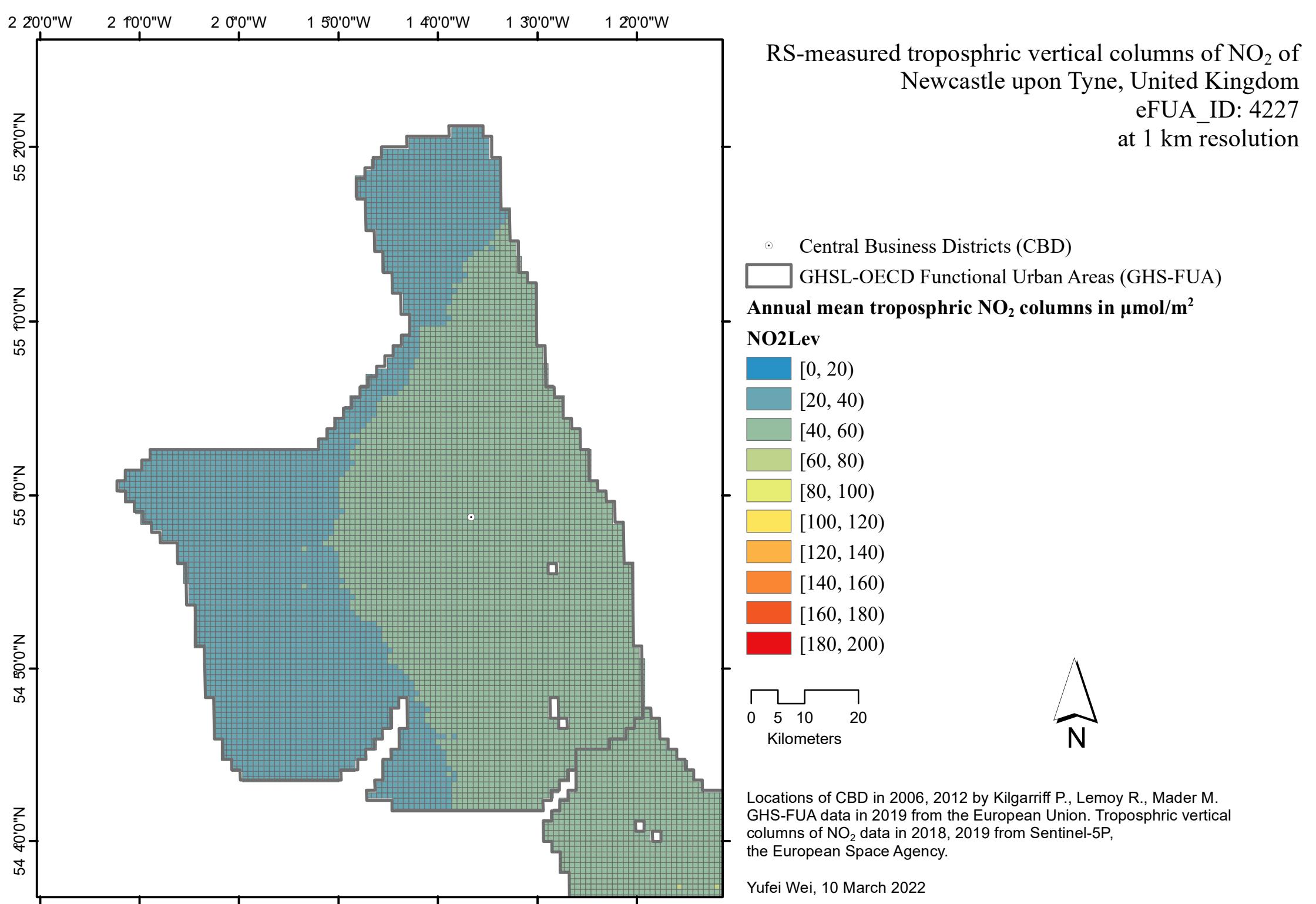
Locations of CBD in 2006, 2012 by Kilgarriff P., Lemoy R., Mader M.  
 GHS-FUA data in 2019 from the European Union. Tropospheric vertical  
 columns of NO<sub>2</sub> data in 2018, 2019 from Sentinel-5P,  
 the European Space Agency.

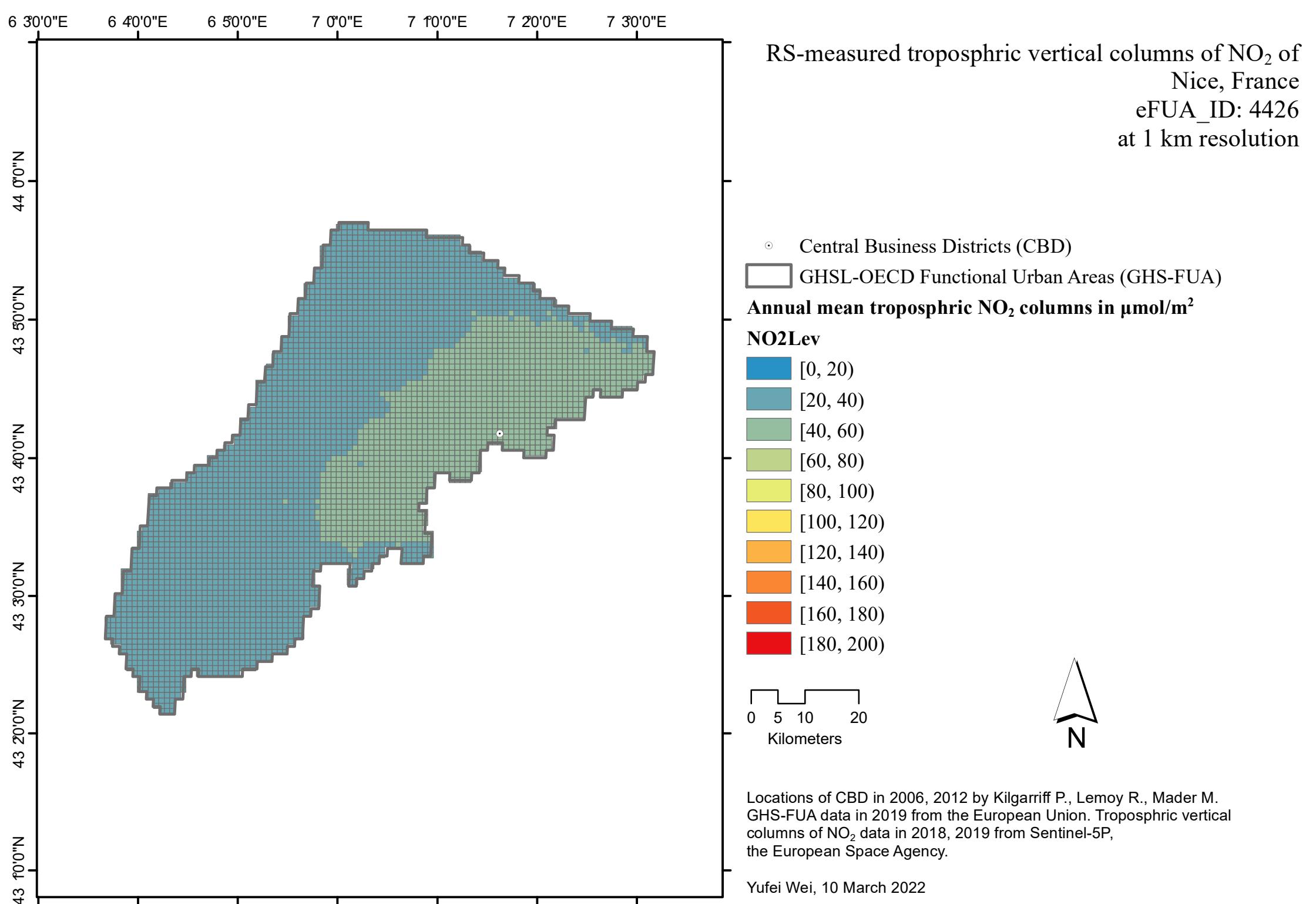
Yufei Wei, 10 March 2022







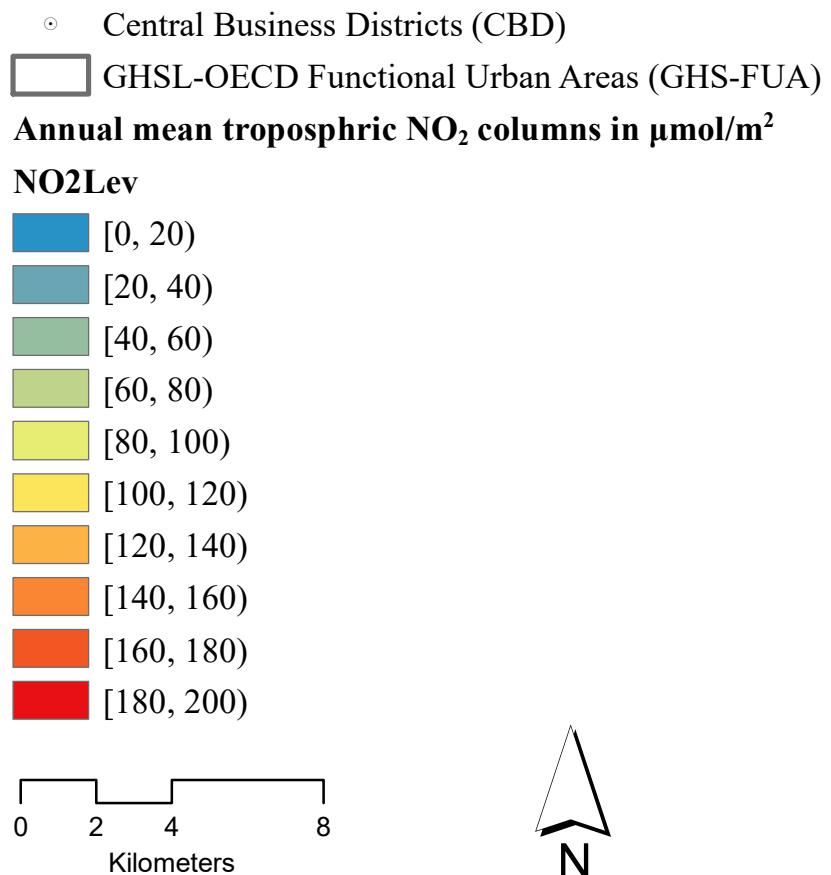
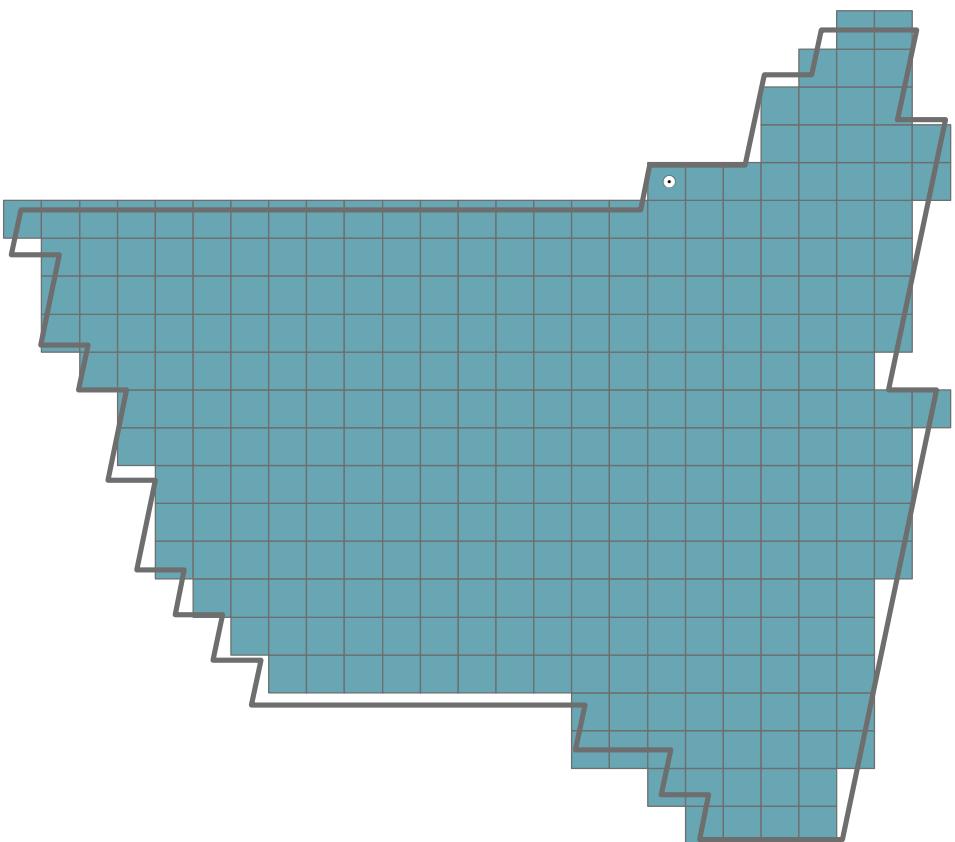




33°20'0"E

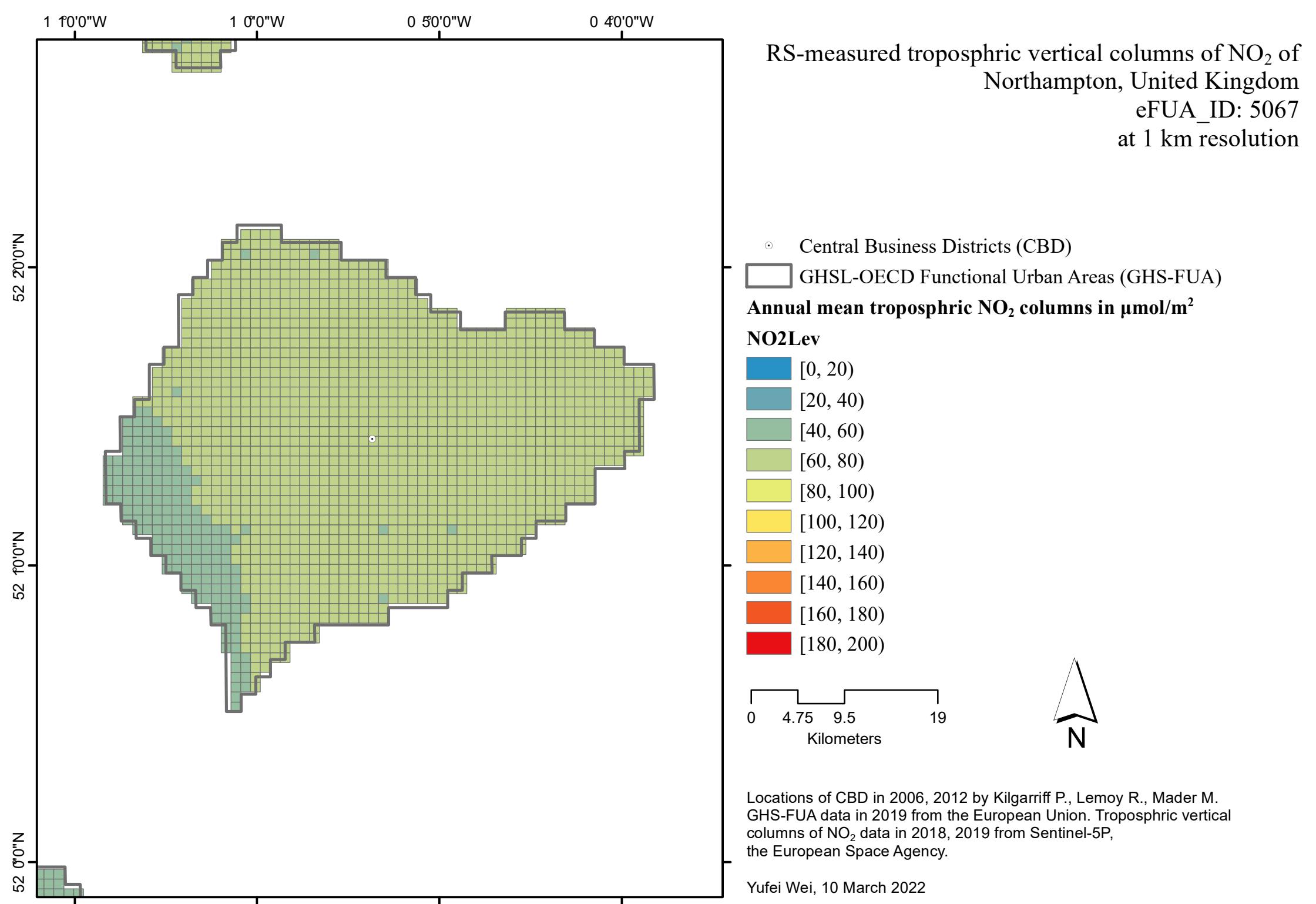
RS-measured tropospheric vertical columns of NO<sub>2</sub> of  
Nicosia, Cyprus  
eFUA\_ID: 226  
at 1 km resolution

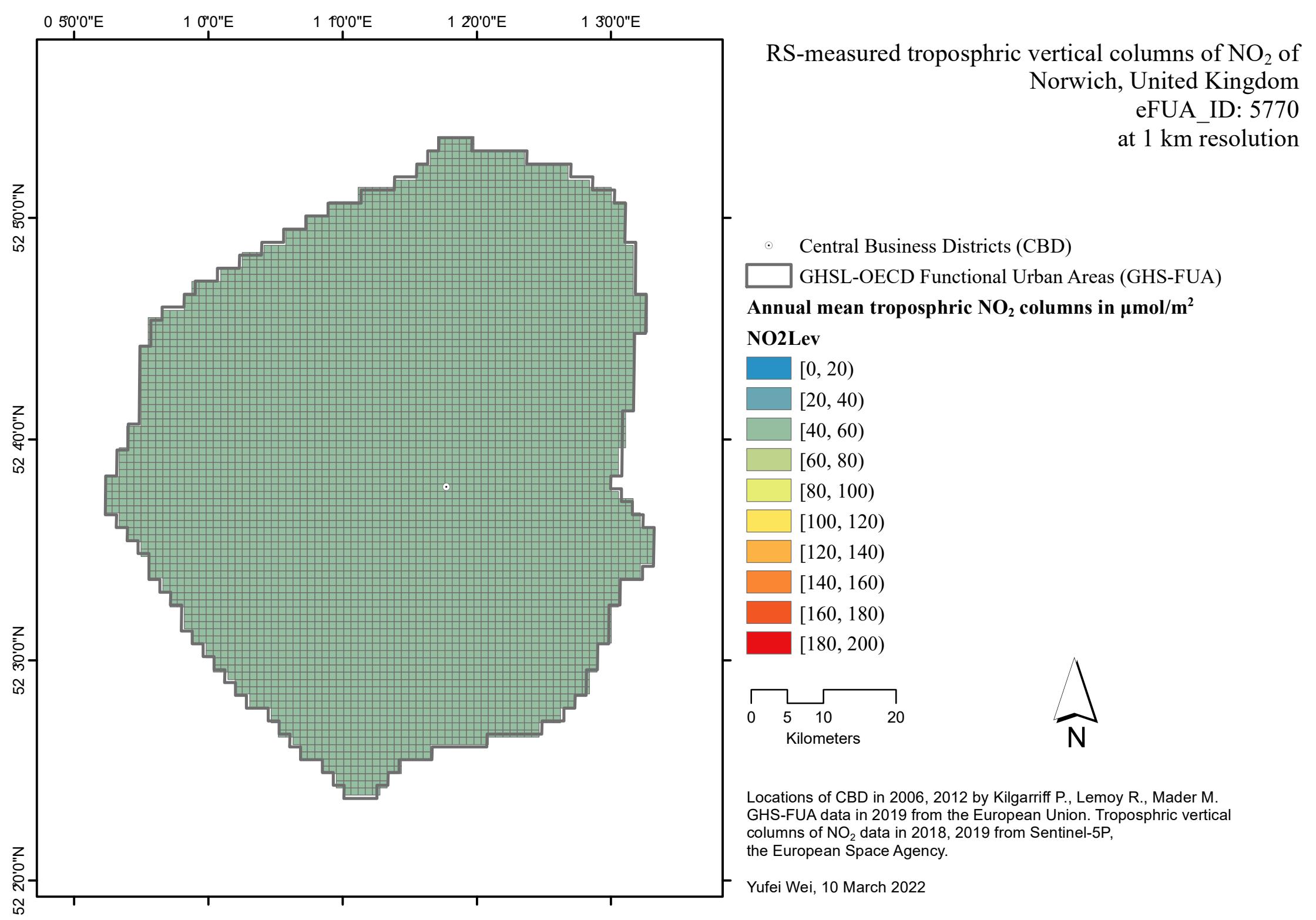
35°10'0"N  
35°0'0"N

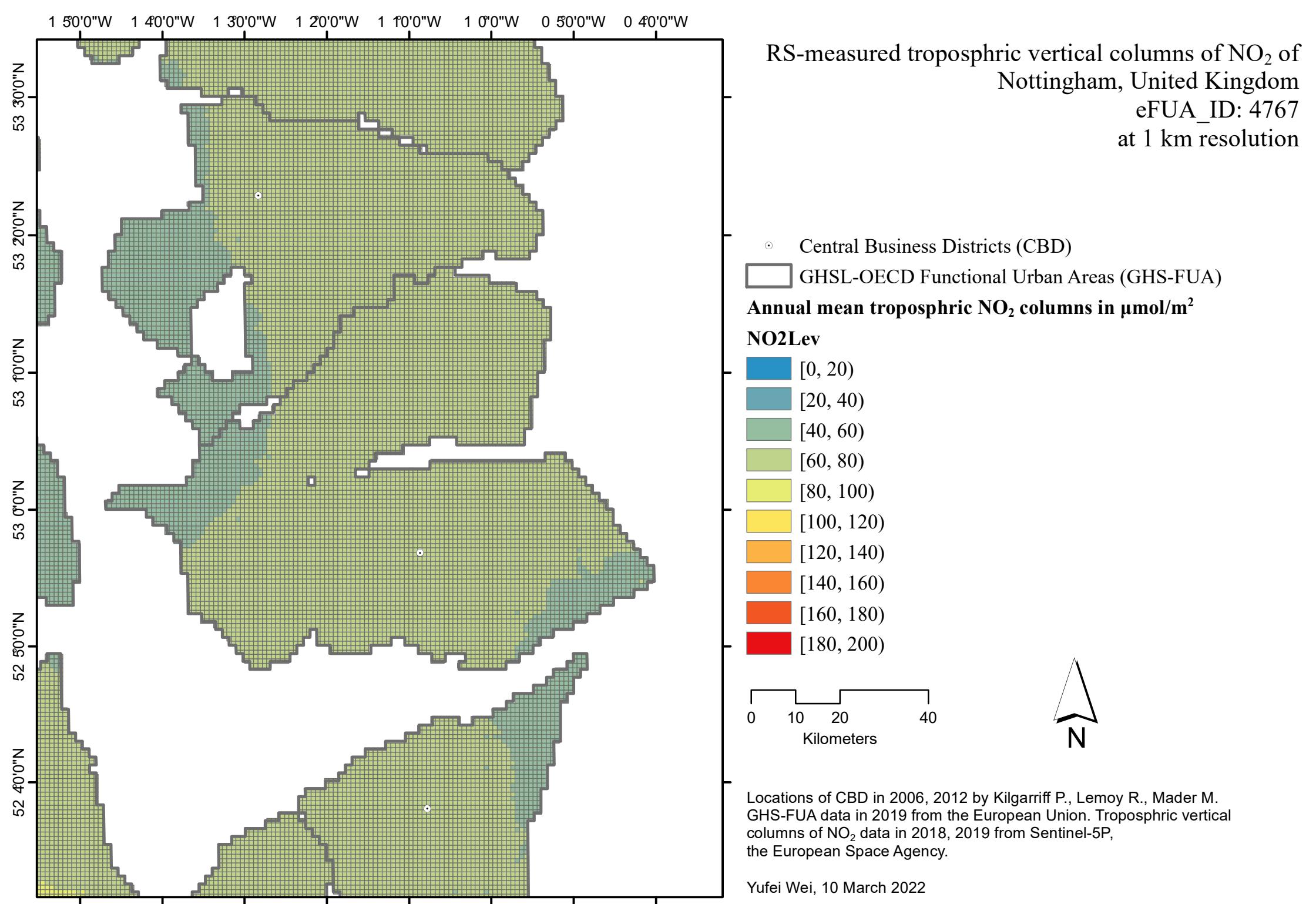


Locations of CBD in 2006, 2012 by Kilgarriff P., Lemoy R., Mader M.  
GHS-FUA data in 2019 from the European Union. Tropospheric vertical  
columns of NO<sub>2</sub> data in 2018, 2019 from Sentinel-5P,  
the European Space Agency.

Yufei Wei, 10 March 2022





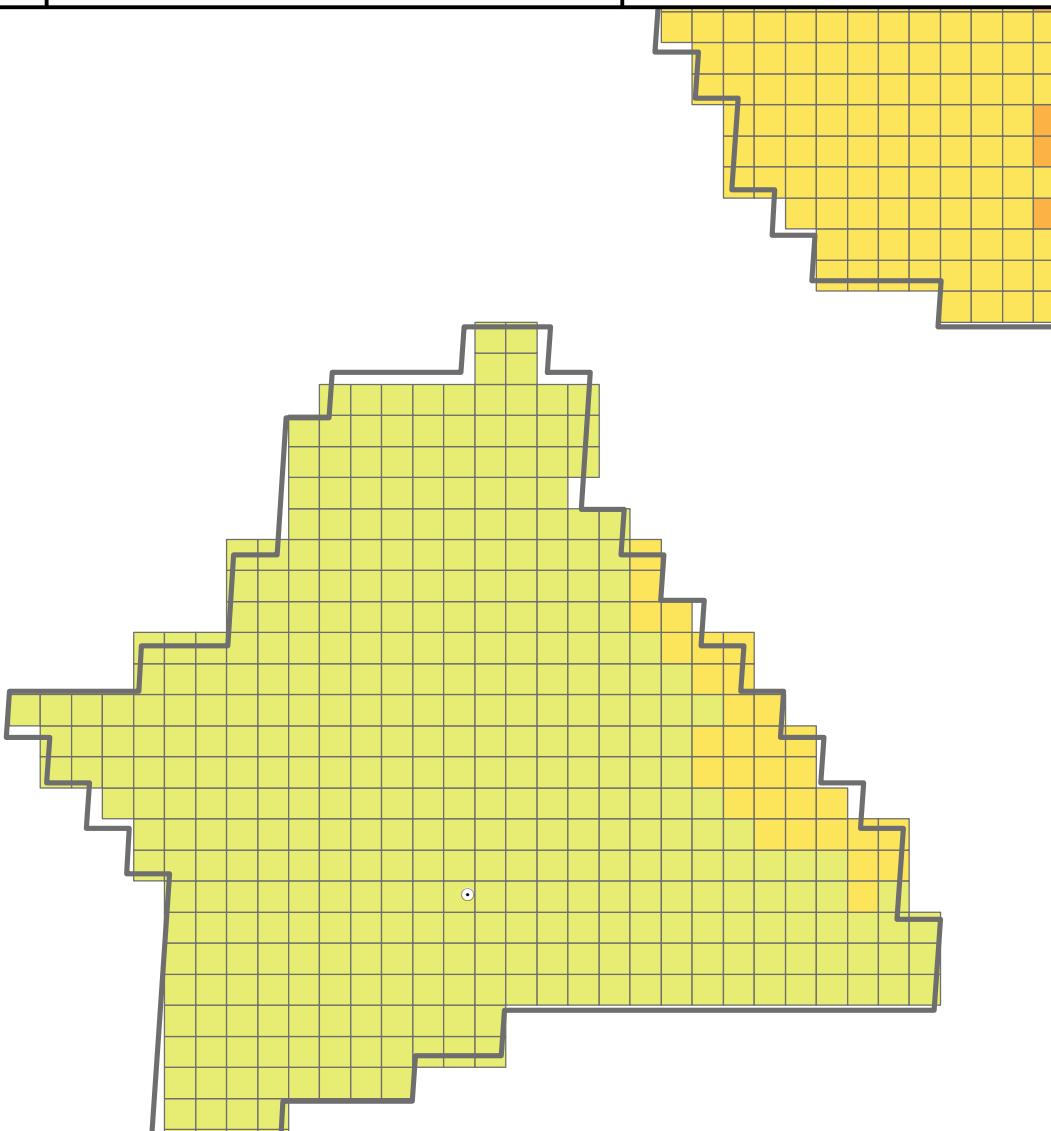


8 30'0"E

8 40'0"E

RS-measured tropospheric vertical columns of NO<sub>2</sub> of  
Novara, Italy  
eFUA\_ID: 706  
at 1 km resolution

45 30'0"N  
45 20'0"N



○ Central Business Districts (CBD)

□ GHS-OECD Functional Urban Areas (GHS-FUA)

Annual mean tropospheric NO<sub>2</sub> columns in  $\mu\text{mol}/\text{m}^2$

NO2Lev

[0, 20)
[20, 40)
[40, 60)
[60, 80)
[80, 100)
[100, 120)
[120, 140)
[140, 160)
[160, 180)
[180, 200)

0 2.5 5 10  
Kilometers



Locations of CBD in 2006, 2012 by Kilgarriff P., Lemoy R., Mader M.  
GHS-FUA data in 2019 from the European Union. Tropospheric vertical  
columns of NO<sub>2</sub> data in 2018, 2019 from Sentinel-5P,  
the European Space Agency.

Yufei Wei, 10 March 2022

20 30'0"E

20 40'0"E

20 50'0"E

21 0'0"E

RS-measured tropospheric vertical columns of NO<sub>2</sub> of  
Nowy Sacz, Poland  
eFUA\_ID: 3418  
at 1 km resolution

○ Central Business Districts (CBD)

◻ GHSL-OECD Functional Urban Areas (GHS-FUA)

Annual mean tropospheric NO<sub>2</sub> columns in  $\mu\text{mol}/\text{m}^2$

NO2Lev

[0, 20)

[20, 40)

[40, 60)

[60, 80)

[80, 100)

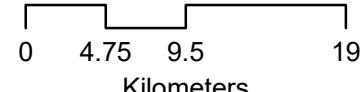
[100, 120)

[120, 140)

[140, 160)

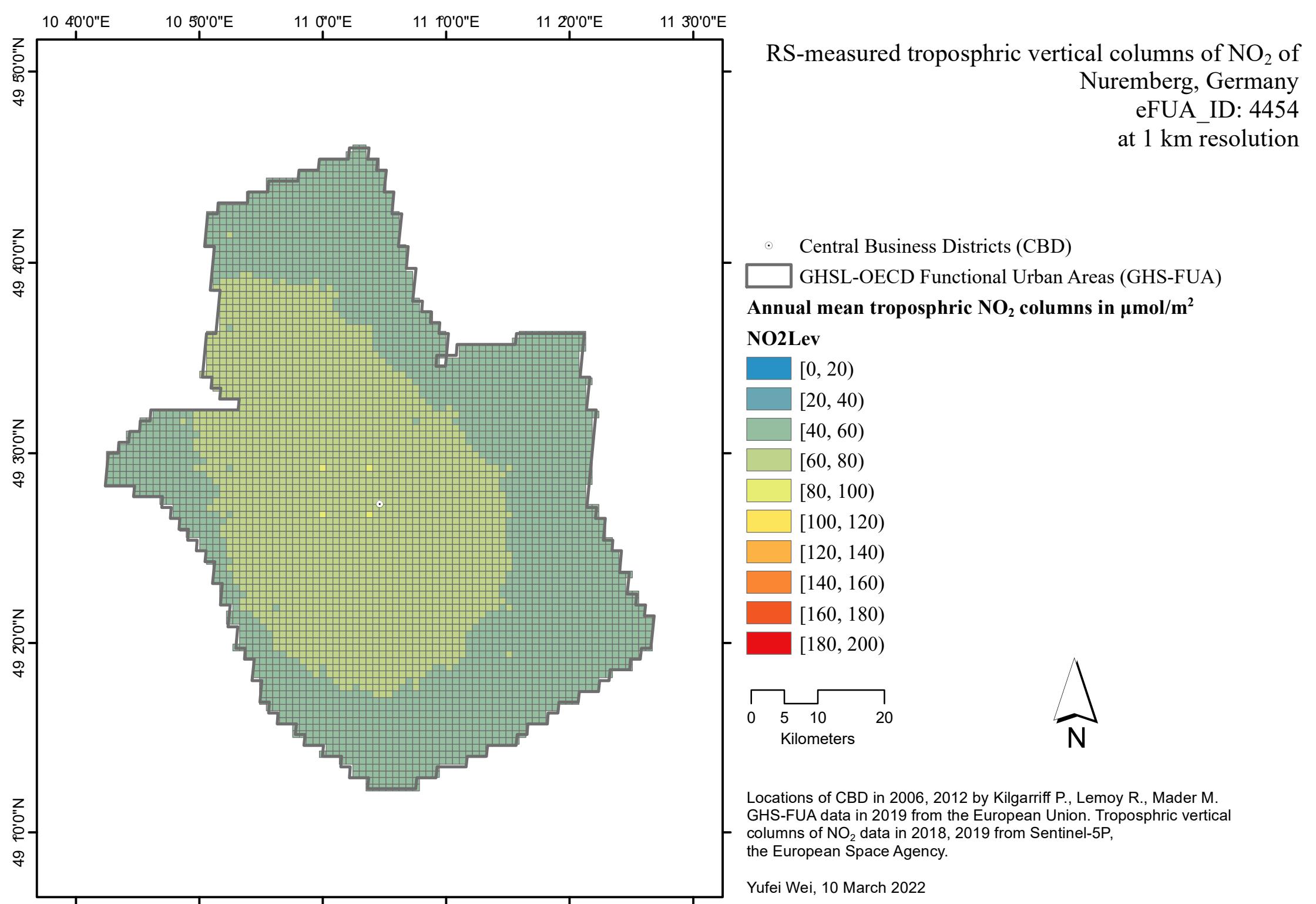
[160, 180)

[180, 200)



Locations of CBD in 2006, 2012 by Kilgarriff P., Lemoy R., Mader M.  
GHS-FUA data in 2019 from the European Union. Tropospheric vertical  
columns of NO<sub>2</sub> data in 2018, 2019 from Sentinel-5P,  
the European Space Agency.

Yufei Wei, 10 March 2022



10 0'0"E 10 10'0"E 10 20'0"E 10 30'0"E 10 40'0"E 10 50'0"E

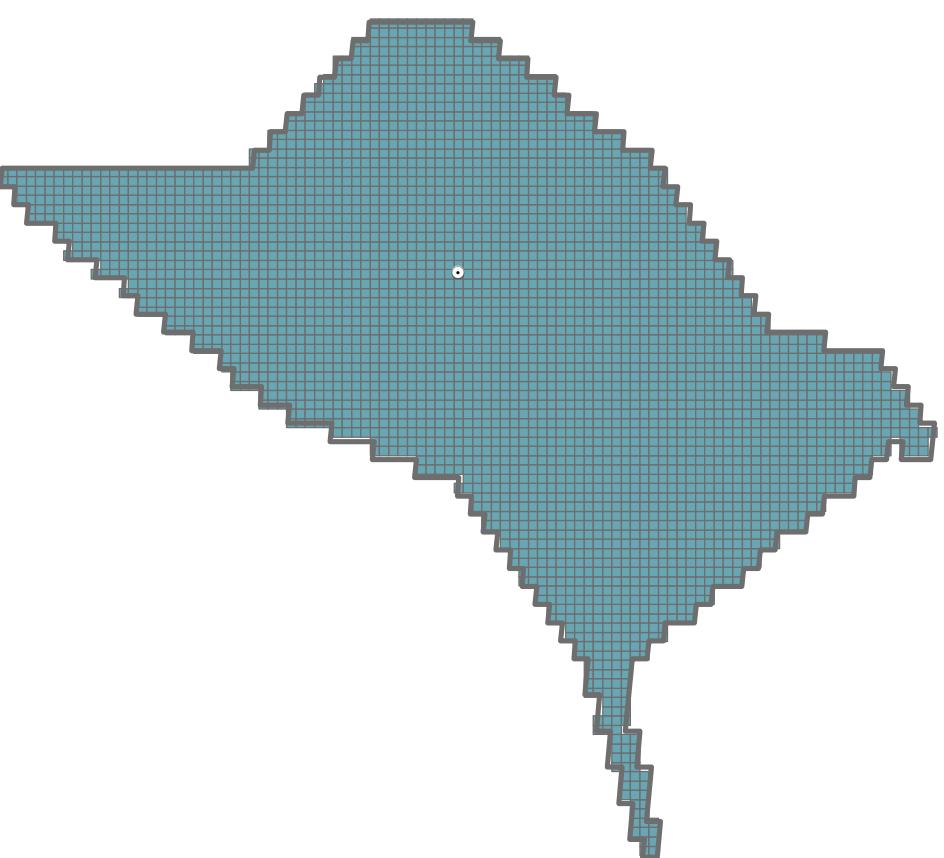
55 40'0"N

55 30'0"N

55 20'0"N

55 10'0"N

55 0'0"N



RS-measured tropospheric vertical columns of NO<sub>2</sub> of  
Odense, Denmark  
eFUA\_ID: 389  
at 1 km resolution

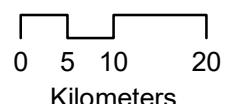
○ Central Business Districts (CBD)

◻ GHS-OECD Functional Urban Areas (GHS-FUA)

Annual mean tropospheric NO<sub>2</sub> columns in μmol/m<sup>2</sup>

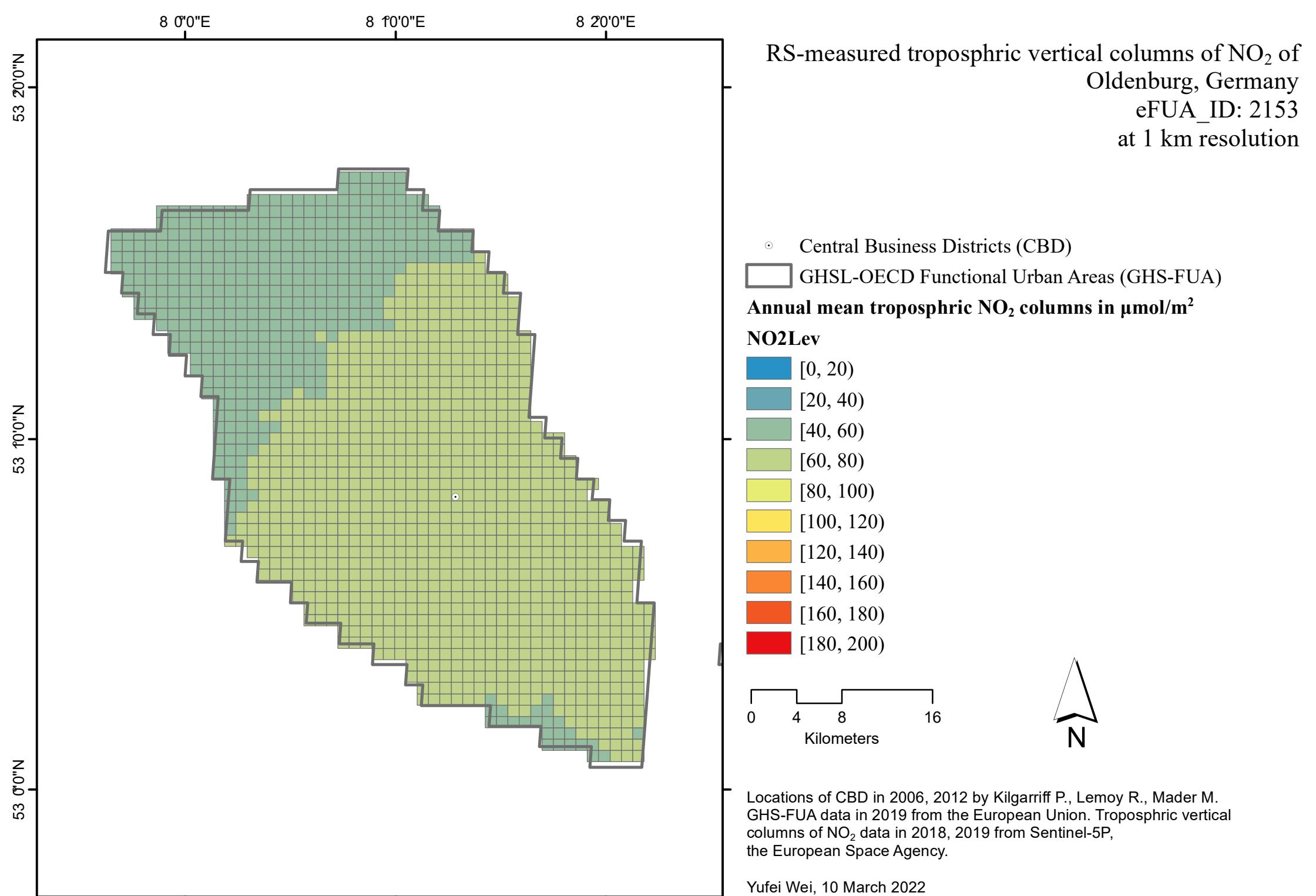
NO2Lev

- [0, 20]
- [20, 40]
- [40, 60]
- [60, 80]
- [80, 100]
- [100, 120]
- [120, 140]
- [140, 160]
- [160, 180]
- [180, 200]



Locations of CBD in 2006, 2012 by Kilgarriff P., Lemoy R., Mader M.  
GHS-FUA data in 2019 from the European Union. Tropospheric vertical  
columns of NO<sub>2</sub> data in 2018, 2019 from Sentinel-5P,  
the European Space Agency.

Yufei Wei, 10 March 2022



17 0°0"E

17 10'0"E

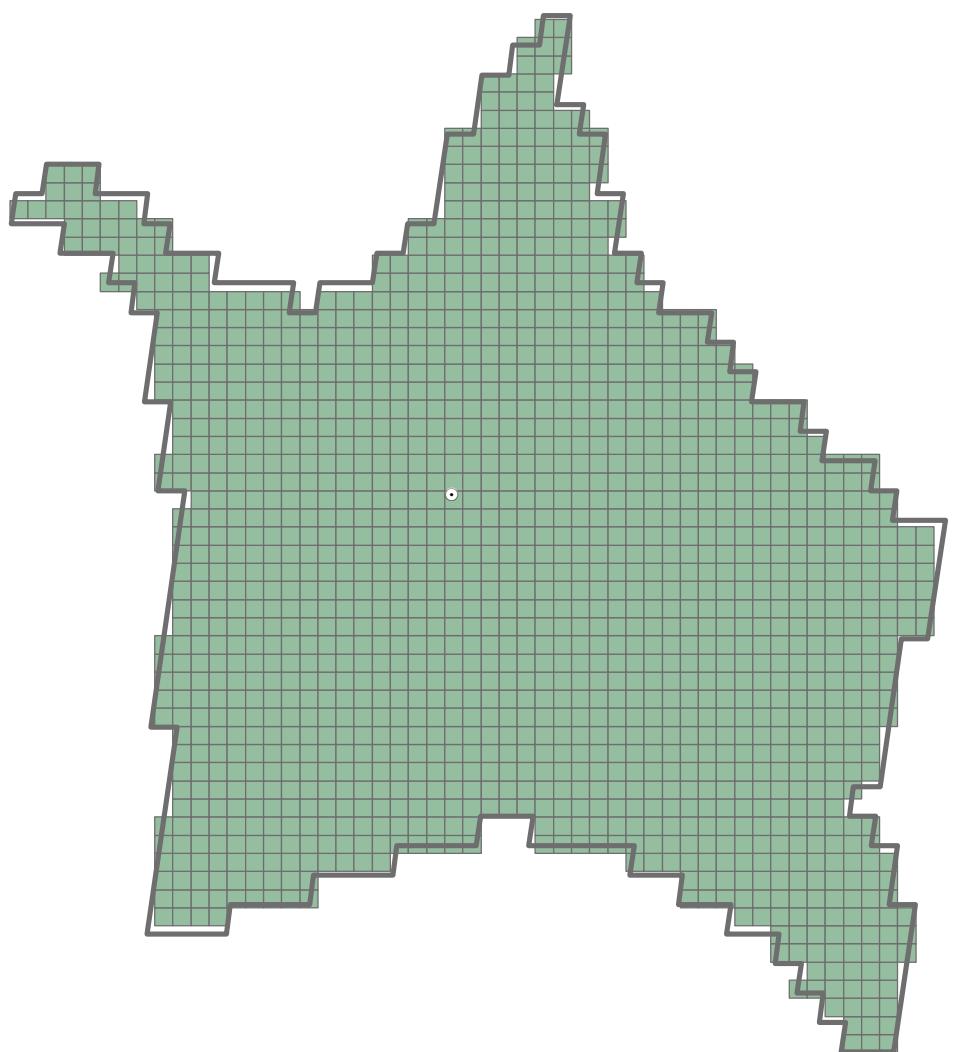
17 20'0"E

17 30'0"E

RS-measured tropospheric vertical columns of NO<sub>2</sub> of  
Olomouc, Czech Republic  
eFUA\_ID: 1286  
at 1 km resolution

49 40'0"N

49 30'0"N



○ Central Business Districts (CBD)

◻ GHSL-OECD Functional Urban Areas (GHS-FUA)

Annual mean tropospheric NO<sub>2</sub> columns in μmol/m<sup>2</sup>

NO2Lev

- [0, 20)
- [20, 40)
- [40, 60)
- [60, 80)
- [80, 100)
- [100, 120)
- [120, 140)
- [140, 160)
- [160, 180)
- [180, 200)

0 4.5 9 18  
Kilometers



Locations of CBD in 2006, 2012 by Kilgarriff P., Lemoy R., Mader M.  
GHS-FUA data in 2019 from the European Union. Tropospheric vertical  
columns of NO<sub>2</sub> data in 2018, 2019 from Sentinel-5P,  
the European Space Agency.

Yufei Wei, 10 March 2022

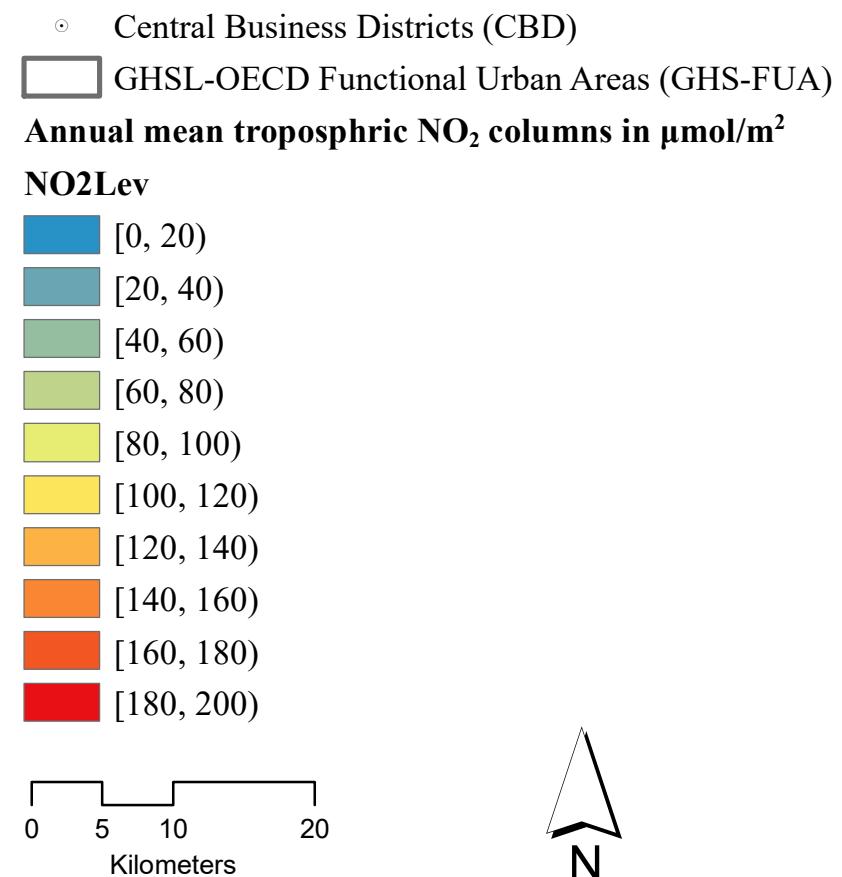
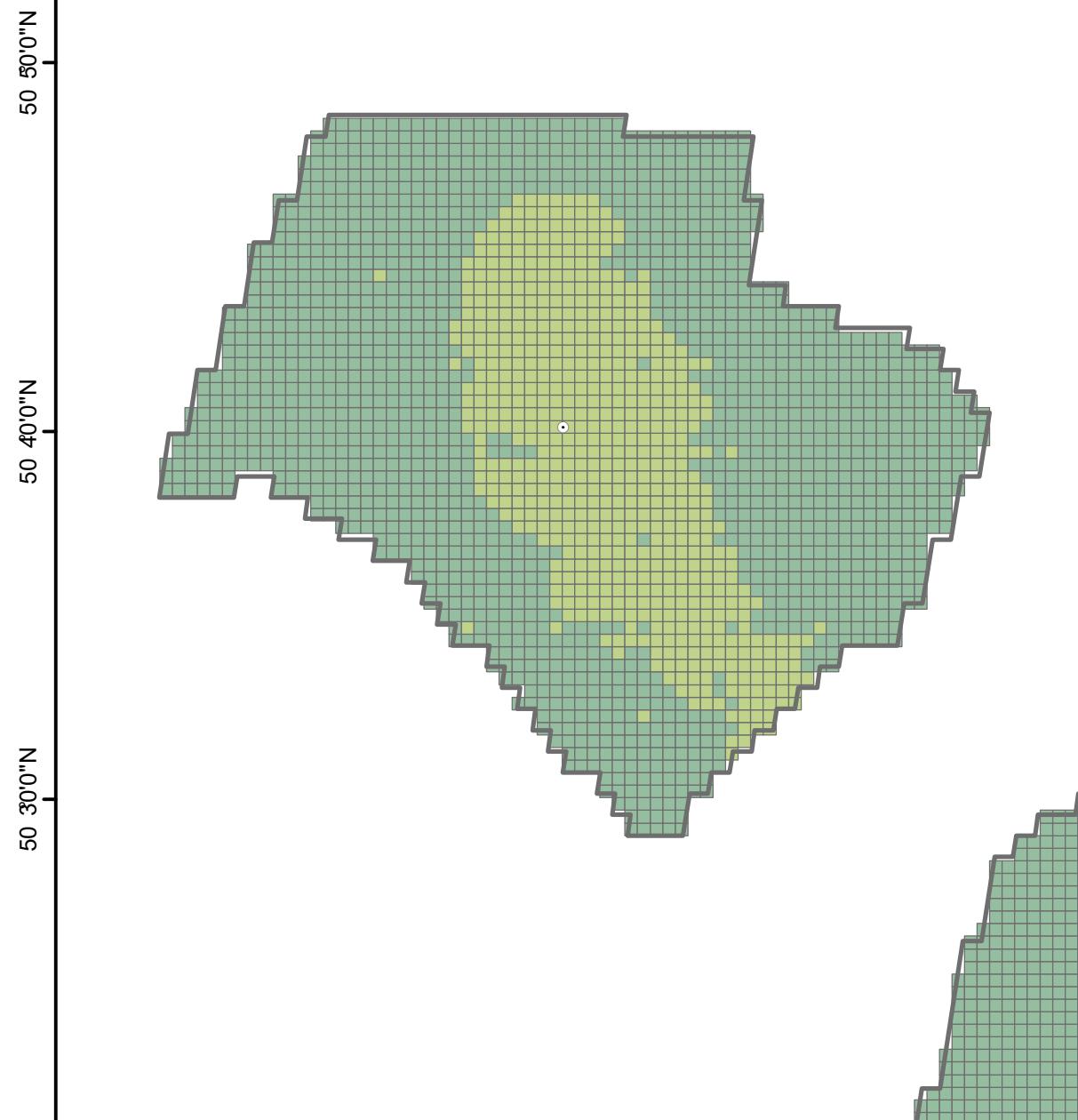
17 40'0"E

17 50'0"E

18 0'0"E

18 10'0"E

RS-measured tropospheric vertical columns of NO<sub>2</sub> of  
Opole, Poland  
eFUA\_ID: 2397  
at 1 km resolution



Locations of CBD in 2006, 2012 by Kilgarriff P., Lemoy R., Mader M.  
GHS-FUA data in 2019 from the European Union. Tropospheric vertical  
columns of NO<sub>2</sub> data in 2018, 2019 from Sentinel-5P,  
the European Space Agency.

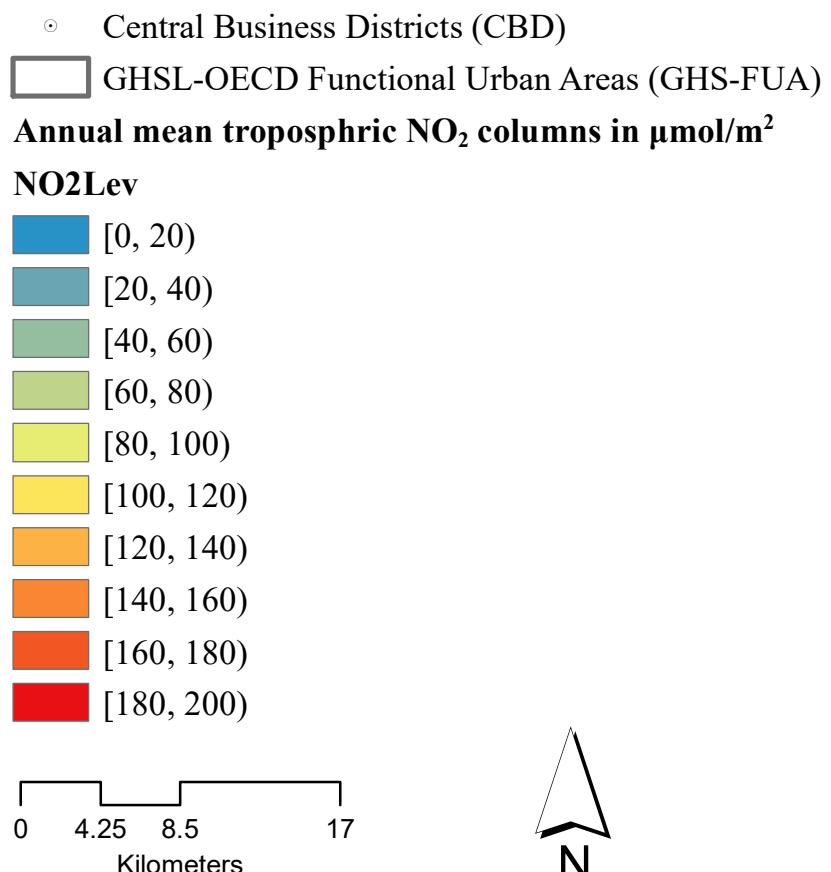
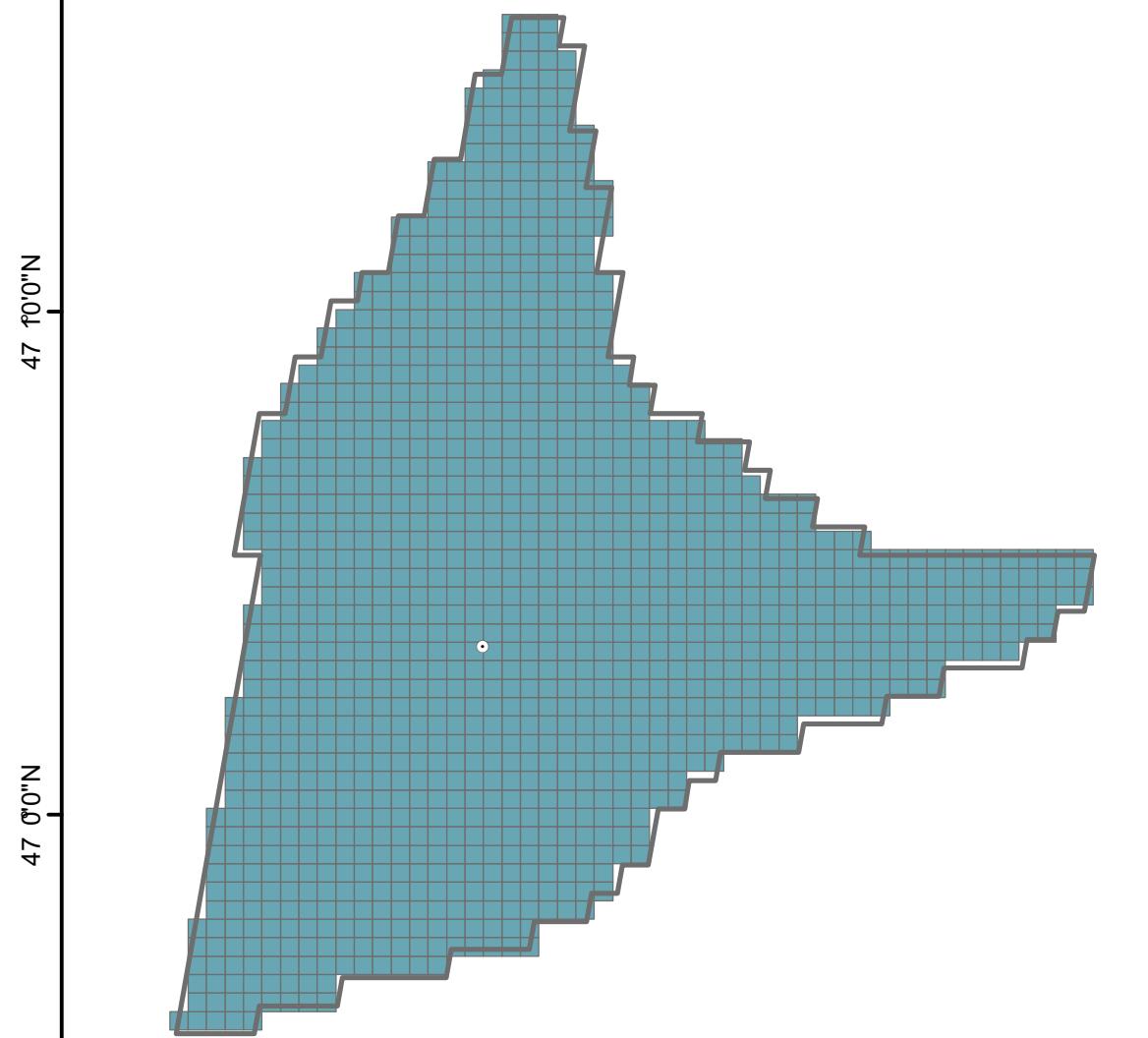
Yufei Wei, 10 March 2022

21 50'0"E

22 0'0"E

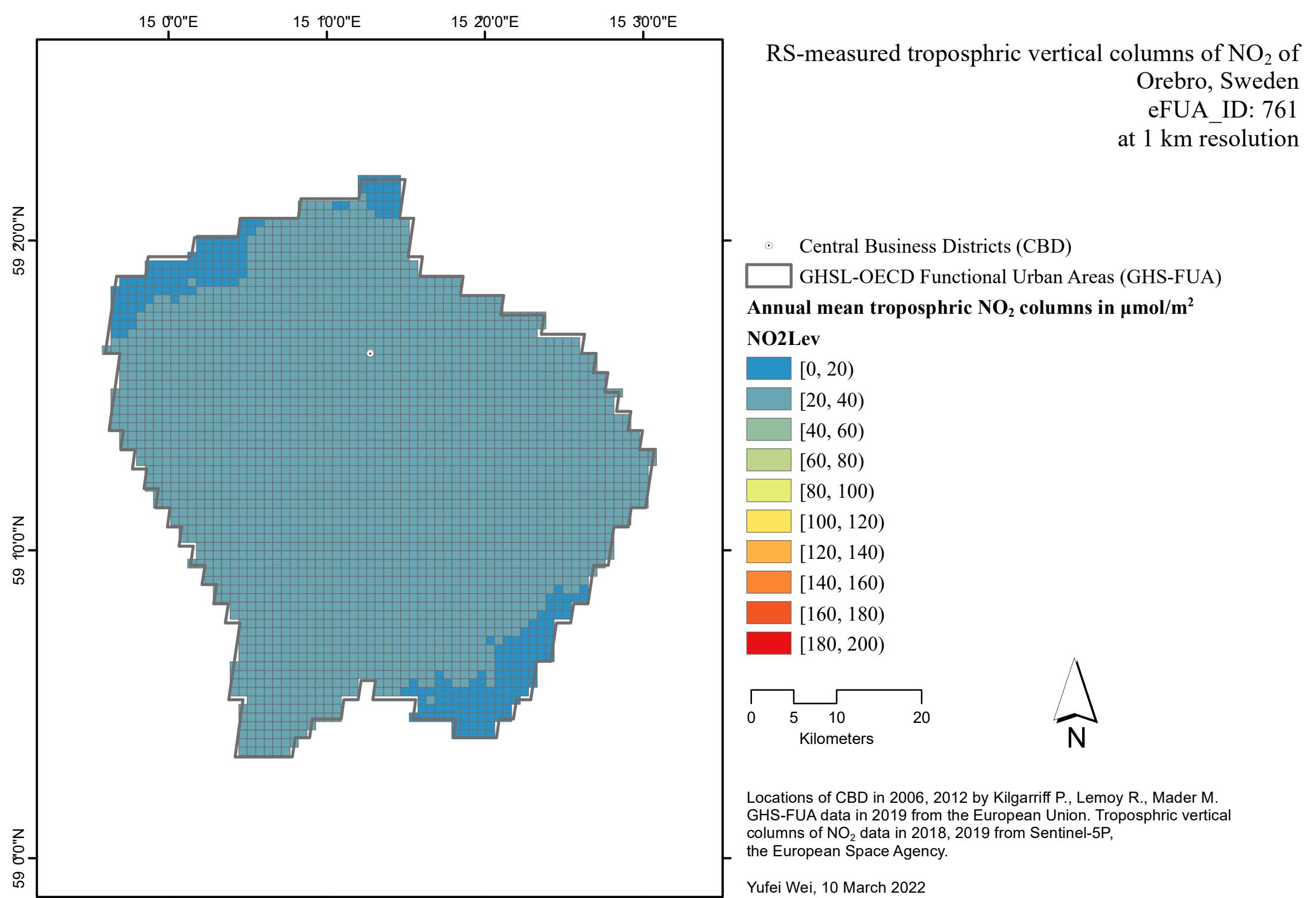
22 10'0"E

RS-measured tropospheric vertical columns of NO<sub>2</sub> of  
Oradea, Romania  
eFUA\_ID: 469  
at 1 km resolution



Locations of CBD in 2006, 2012 by Kilgarriff P., Lemoy R., Mader M.  
GHS-FUA data in 2019 from the European Union. Tropospheric vertical  
columns of NO<sub>2</sub> data in 2018, 2019 from Sentinel-5P,  
the European Space Agency.

Yufei Wei, 10 March 2022



1 40'0"E

1 50'0"E

2 0'0"E

2 10'0"E

2 20'0"E

RS-measured tropospheric vertical columns of NO<sub>2</sub> of  
Orleans, France  
eFUA\_ID: 2639  
at 1 km resolution

48 10'0"N

48 0'0"N

47 50'0"N

47 40'0"N

○ Central Business Districts (CBD)

◻ GHSL-OECD Functional Urban Areas (GHS-FUA)

**Annual mean tropospheric NO<sub>2</sub> columns in  $\mu\text{mol}/\text{m}^2$**

**NO2Lev**

[0, 20)

[20, 40)

[40, 60)

[60, 80)

[80, 100)

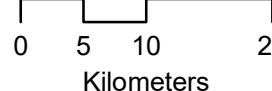
[100, 120)

[120, 140)

[140, 160)

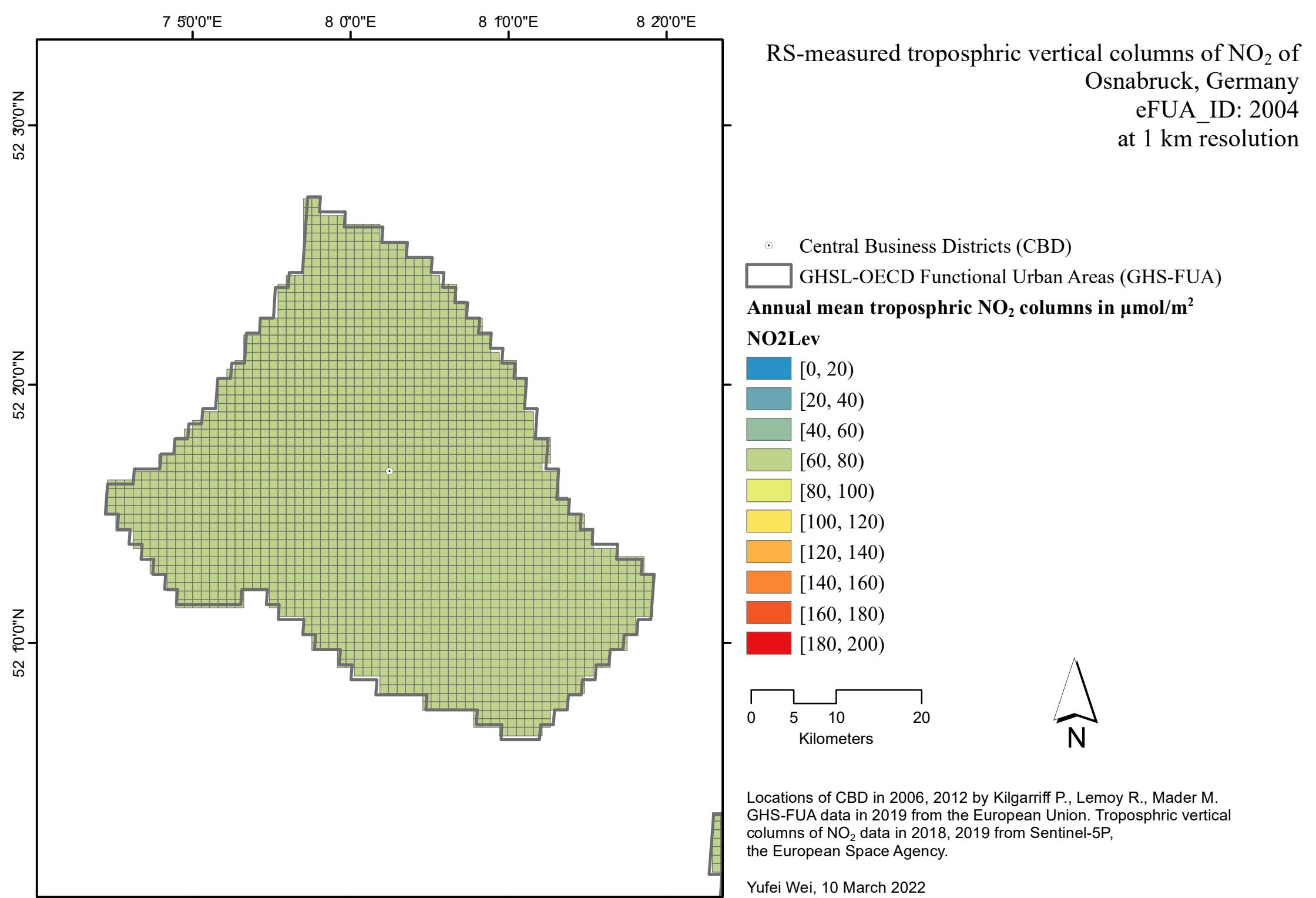
[160, 180)

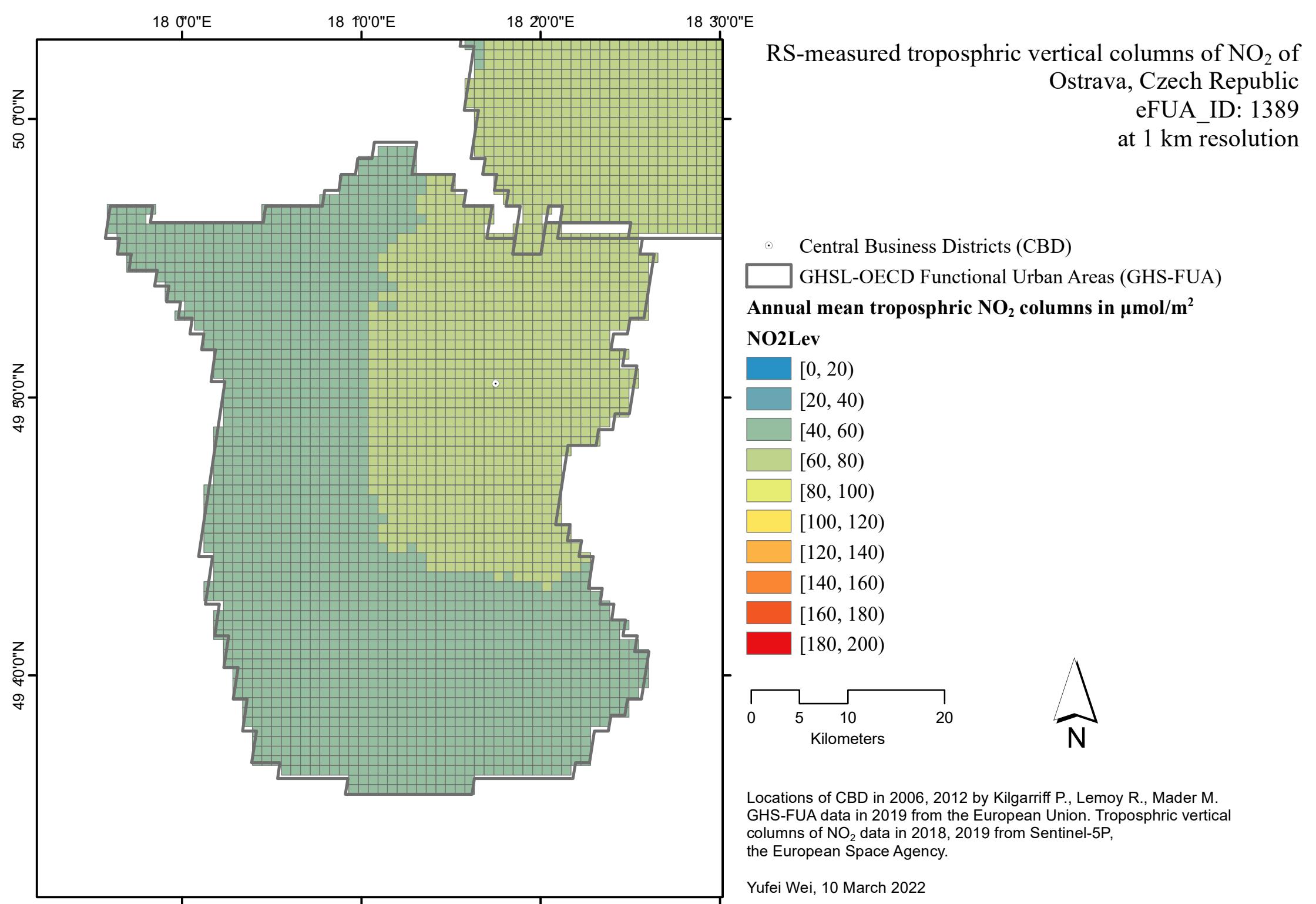
[180, 200)

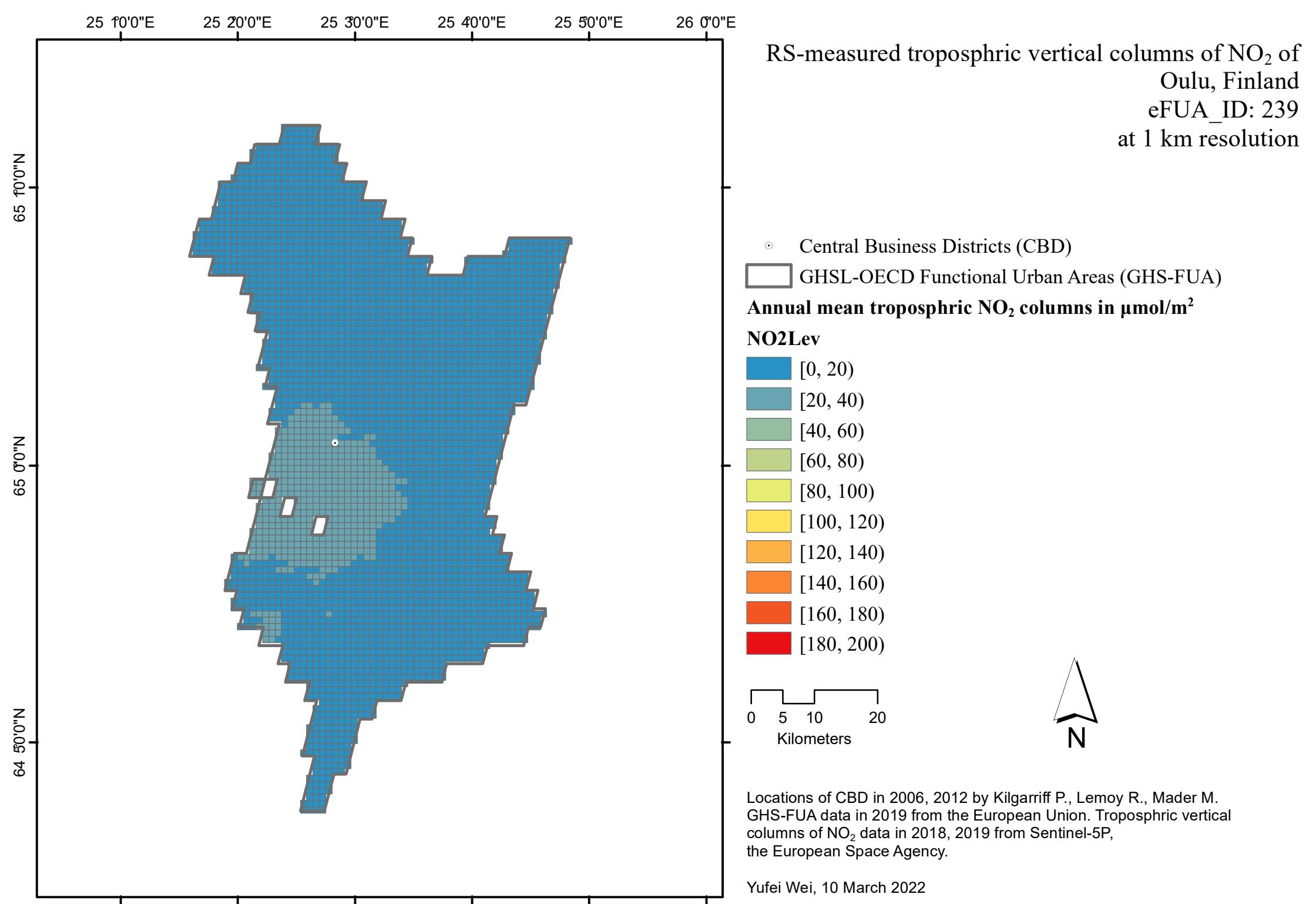


Locations of CBD in 2006, 2012 by Kilgarriff P., Lemoy R., Mader M.  
GHS-FUA data in 2019 from the European Union. Tropospheric vertical  
columns of NO<sub>2</sub> data in 2018, 2019 from Sentinel-5P,  
the European Space Agency.

Yufei Wei, 10 March 2022



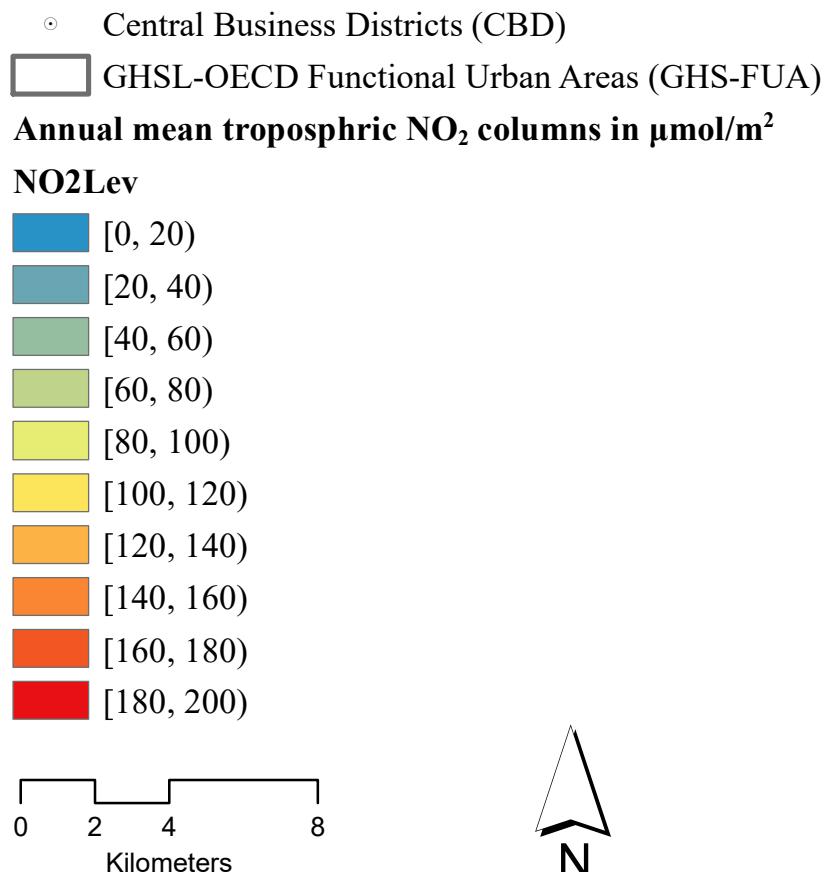
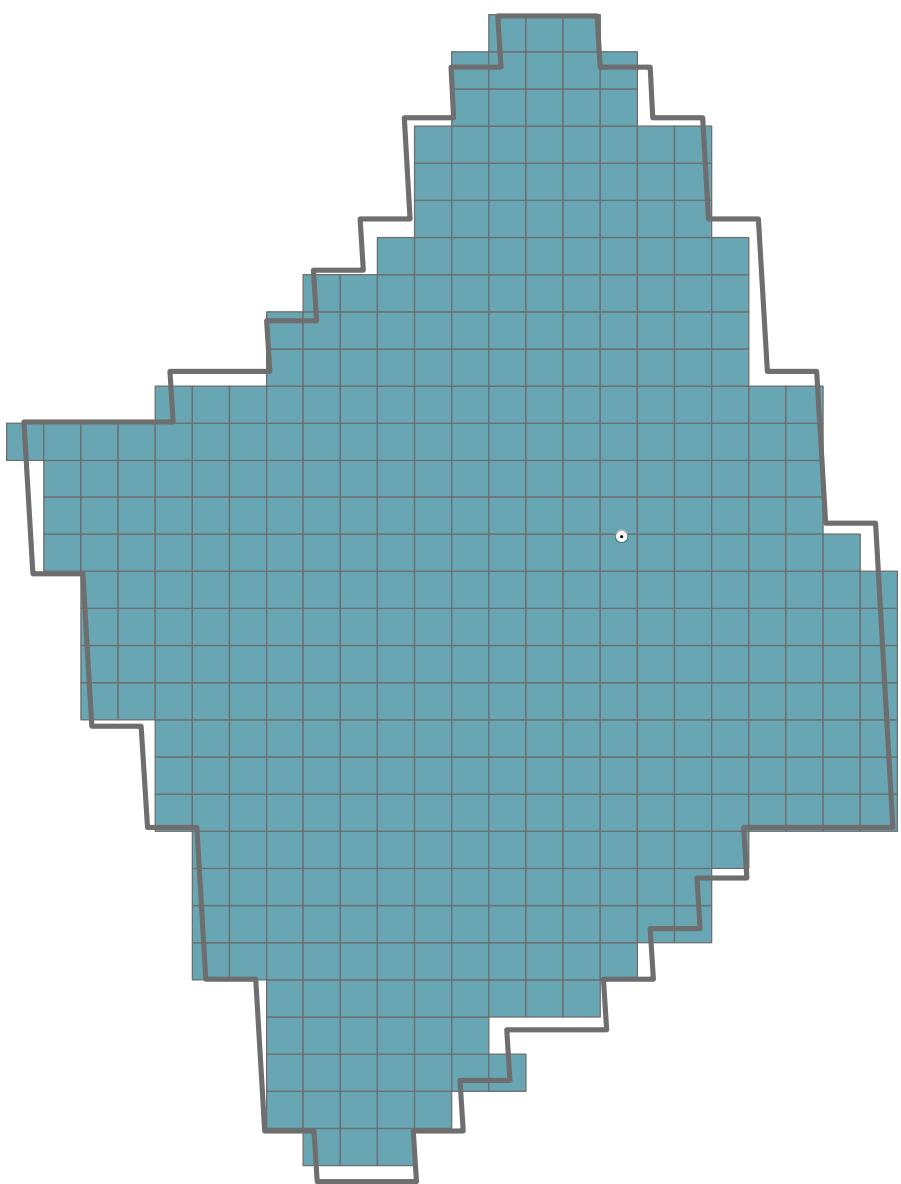




8 0'0"W

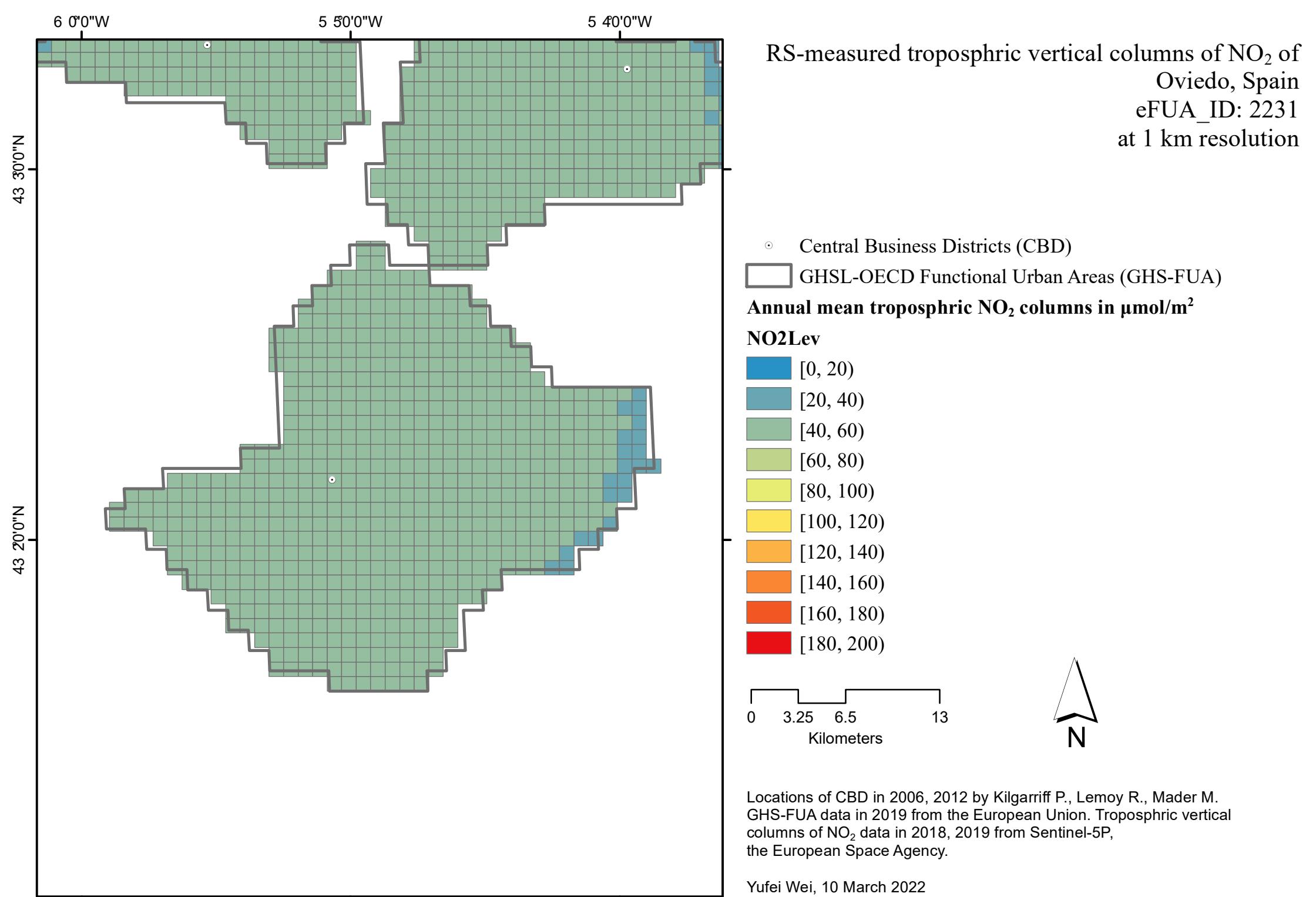
7 50'0"W

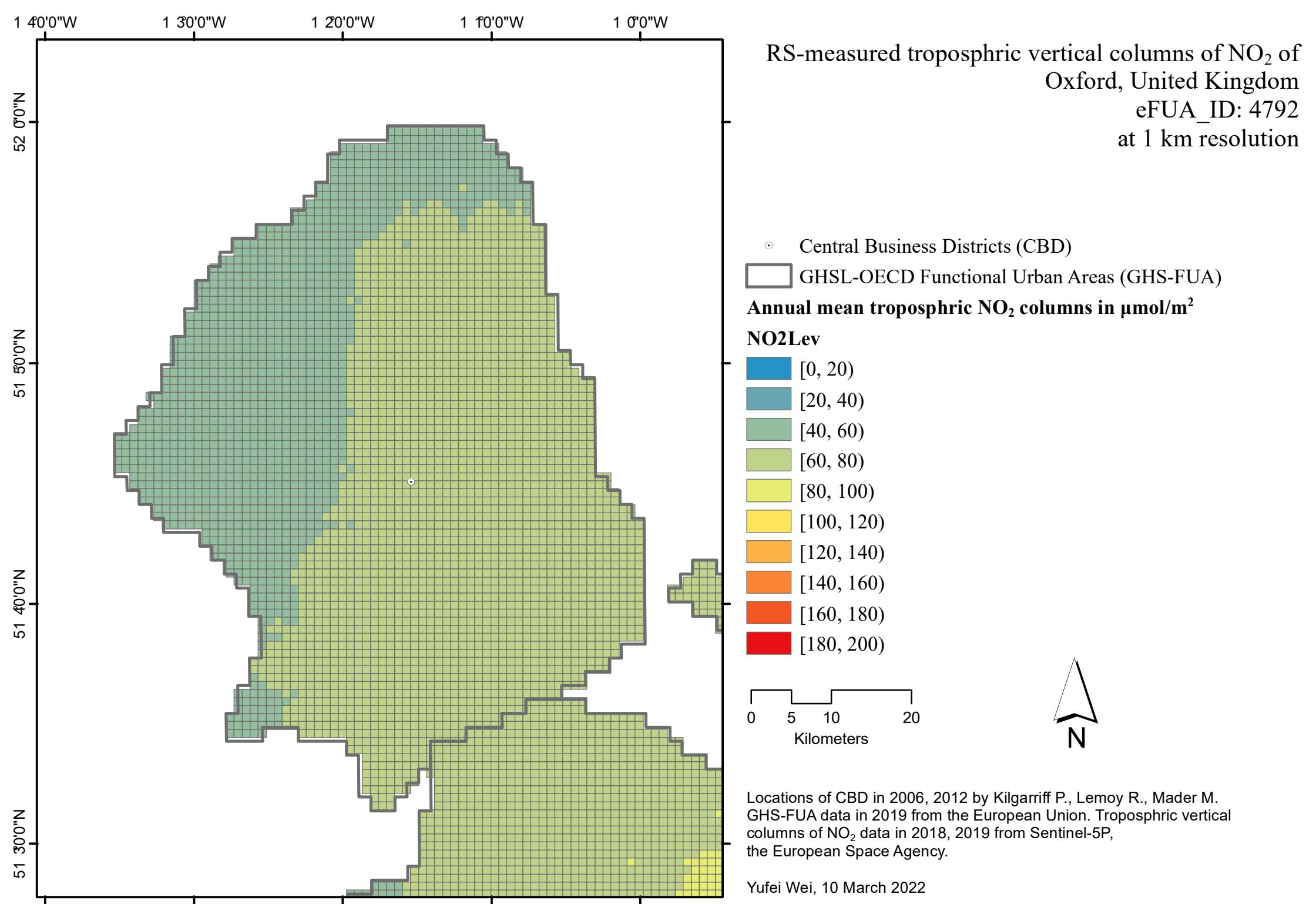
RS-measured tropospheric vertical columns of NO<sub>2</sub> of  
Ourense, Spain  
eFUA\_ID: 1292  
at 1 km resolution

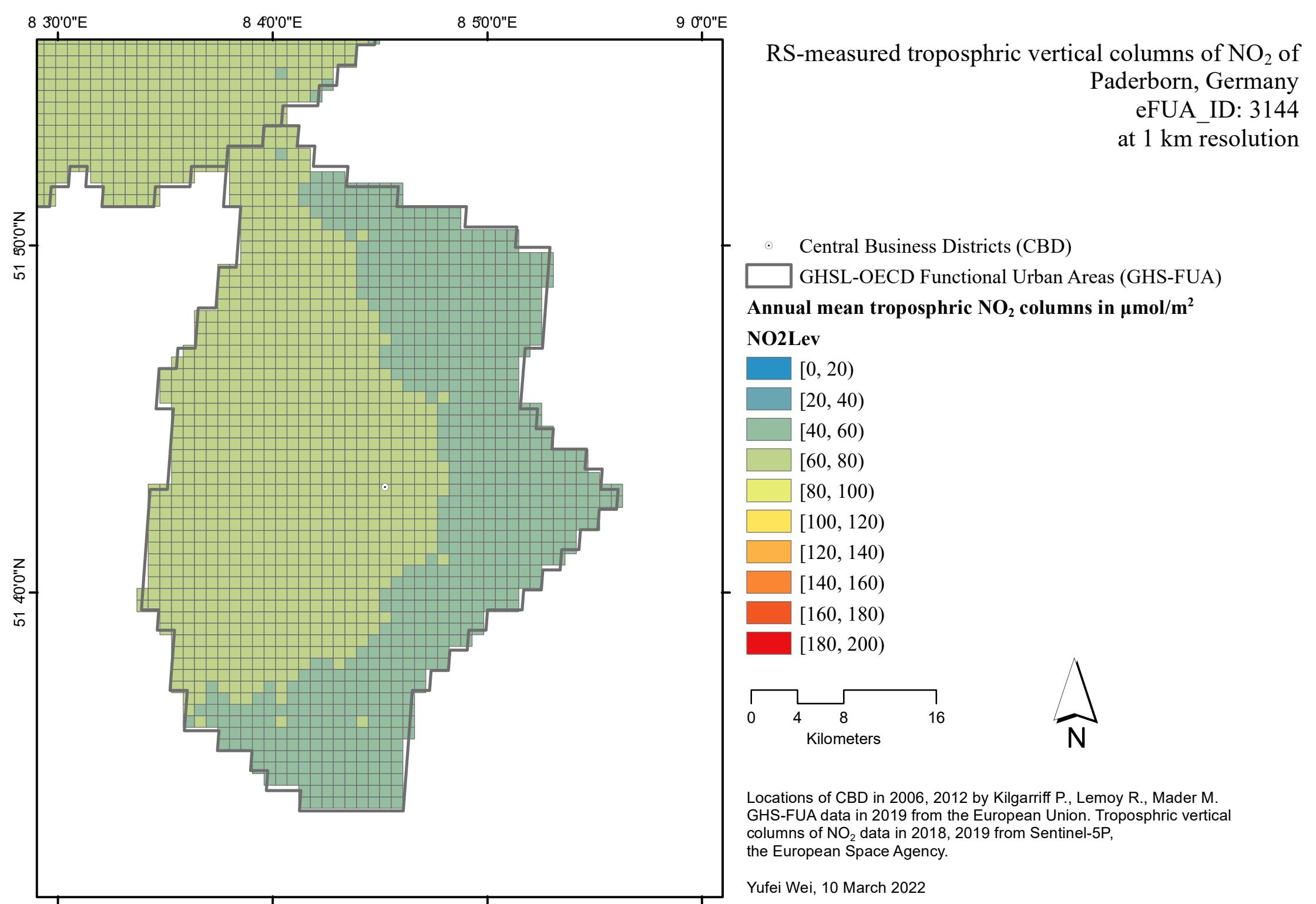


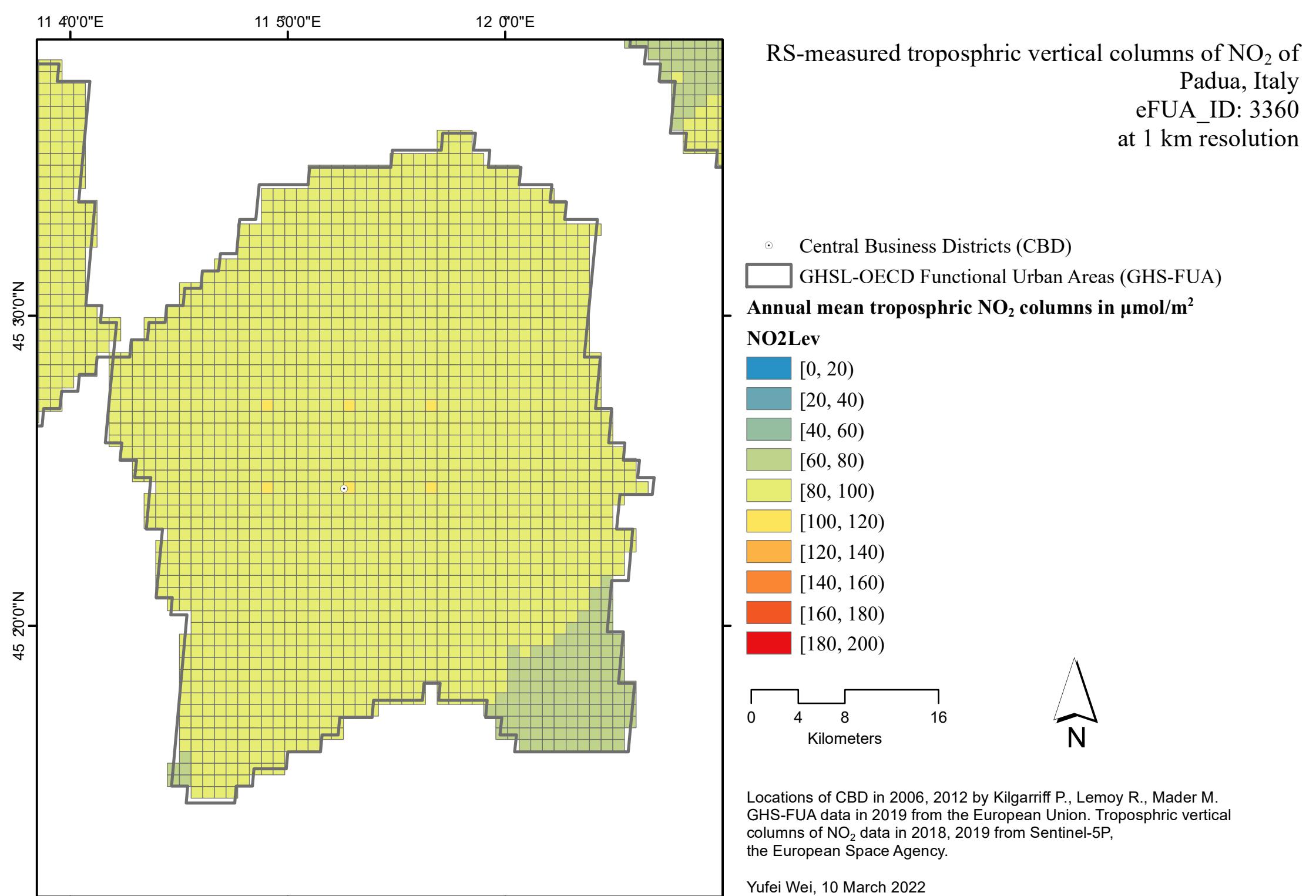
Locations of CBD in 2006, 2012 by Kilgarriff P., Lemoy R., Mader M.  
GHS-FUA data in 2019 from the European Union. Tropospheric vertical  
columns of NO<sub>2</sub> data in 2018, 2019 from Sentinel-5P,  
the European Space Agency.

Yufei Wei, 10 March 2022



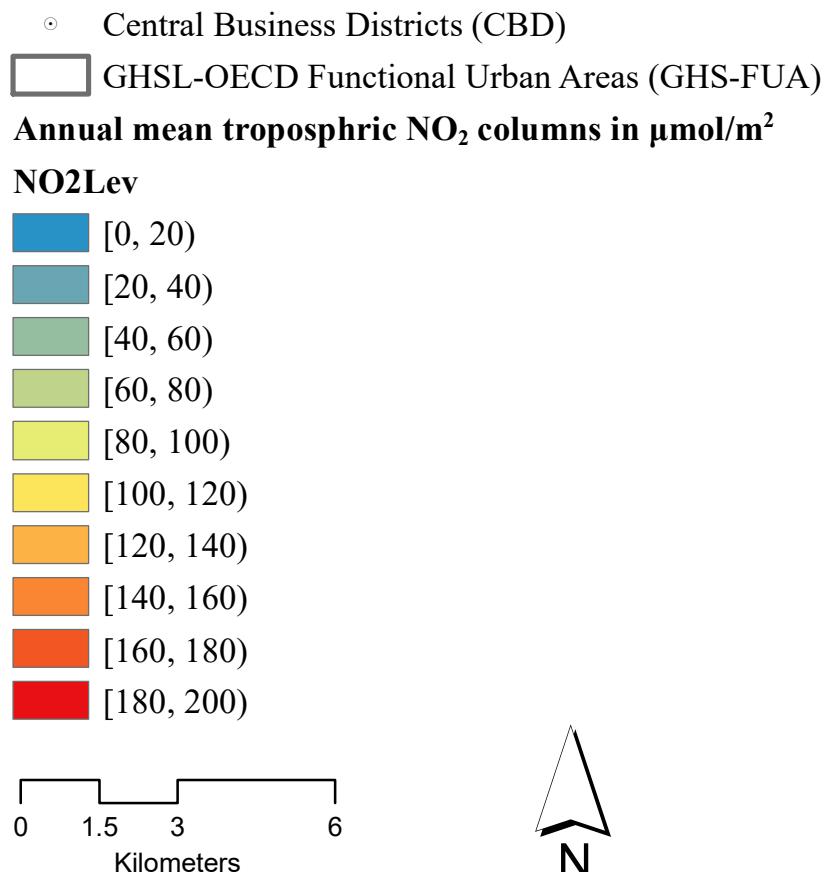
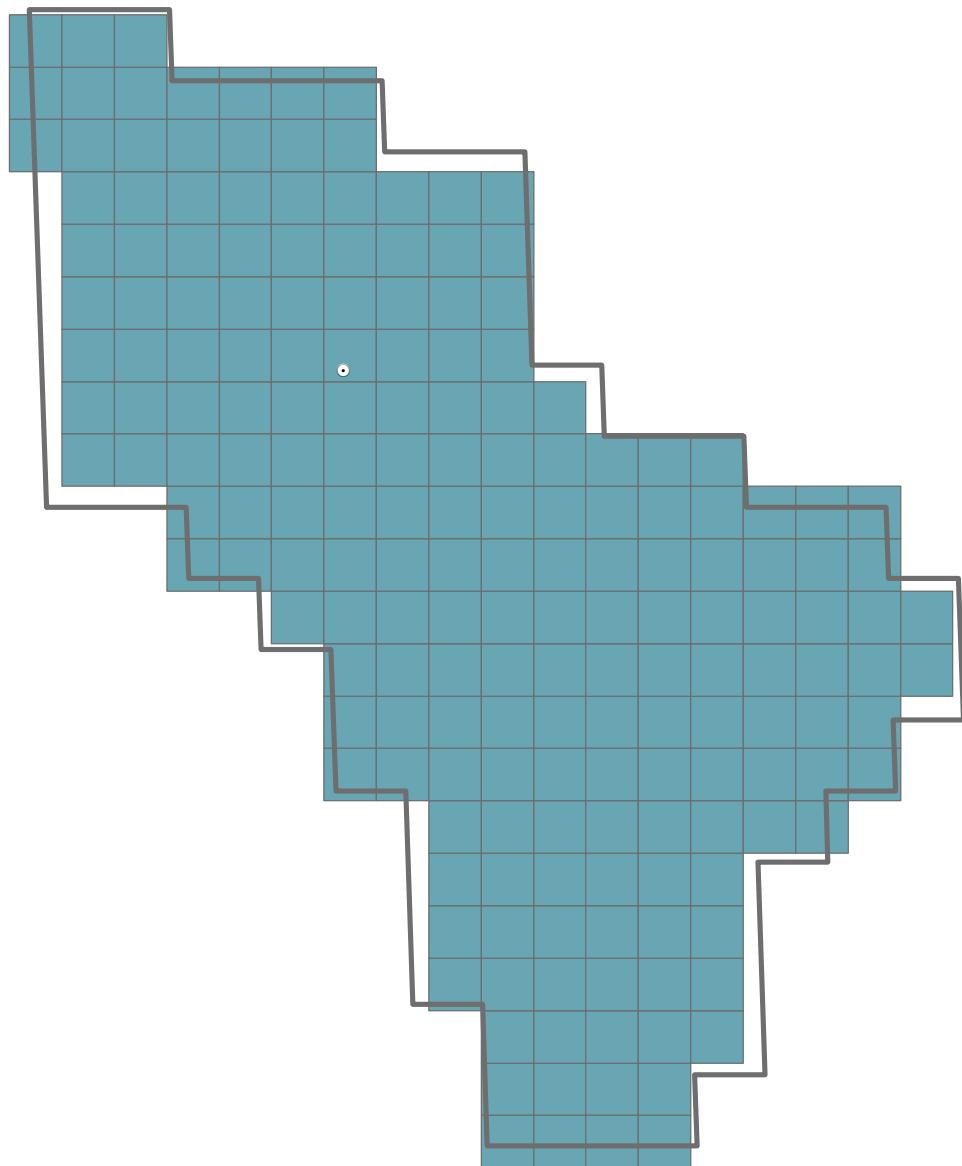






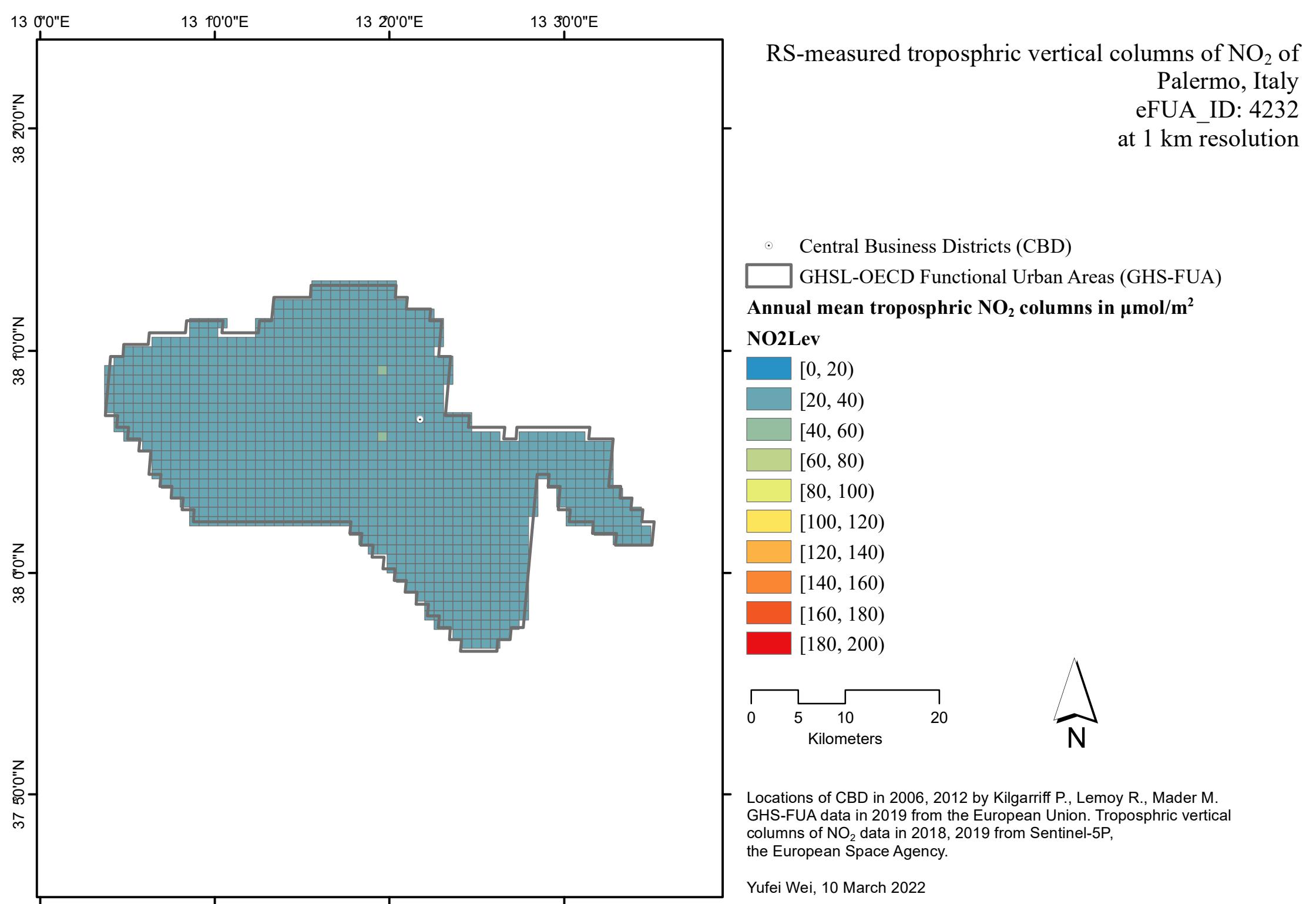
4 30'0"W

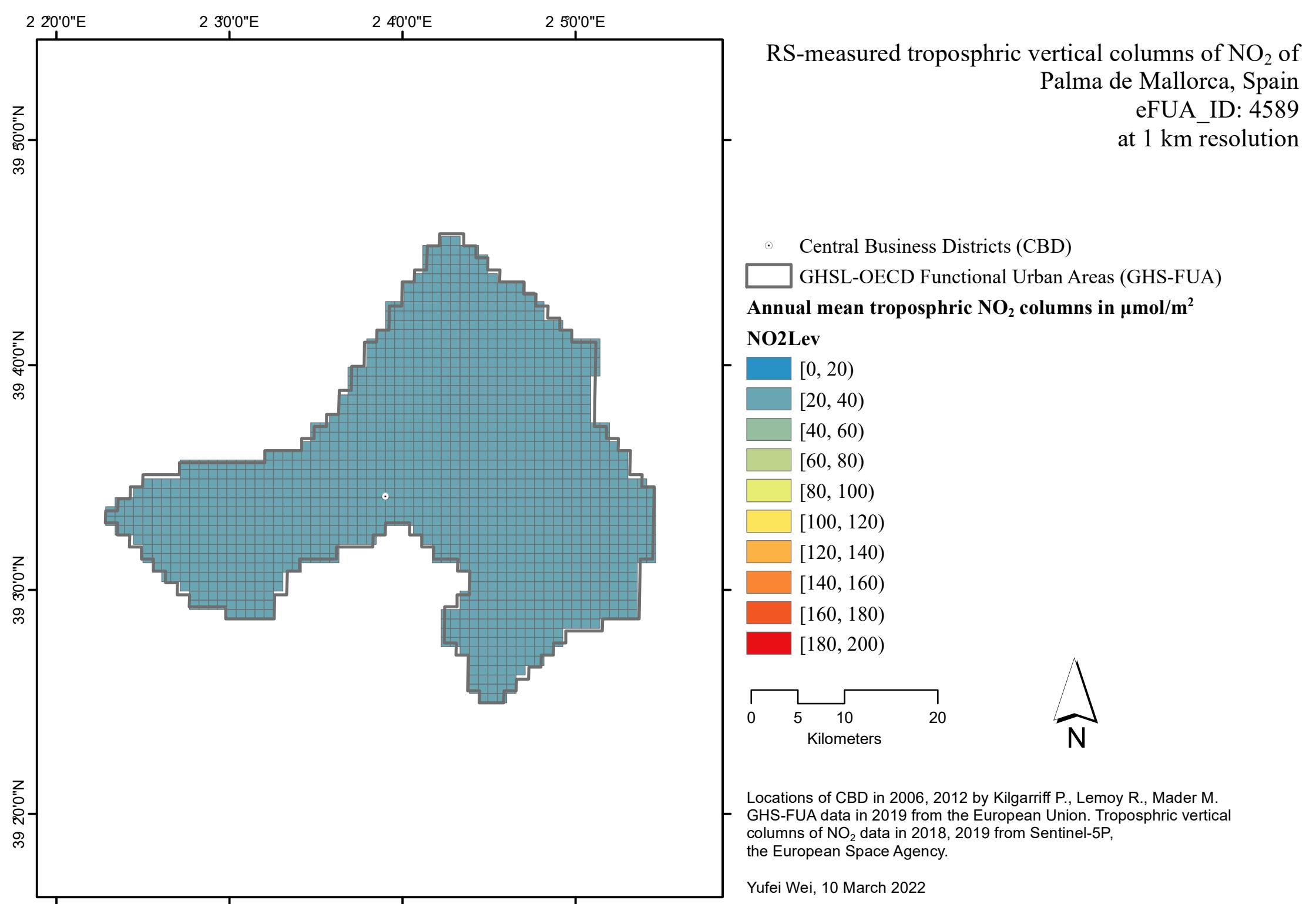
RS-measured tropospheric vertical columns of NO<sub>2</sub> of  
Palencia, Spain  
eFUA\_ID: 2936  
at 1 km resolution



Locations of CBD in 2006, 2012 by Kilgarriff P., Lemoy R., Mader M.  
GHS-FUA data in 2019 from the European Union. Tropospheric vertical  
columns of NO<sub>2</sub> data in 2018, 2019 from Sentinel-5P,  
the European Space Agency.

Yufei Wei, 10 March 2022



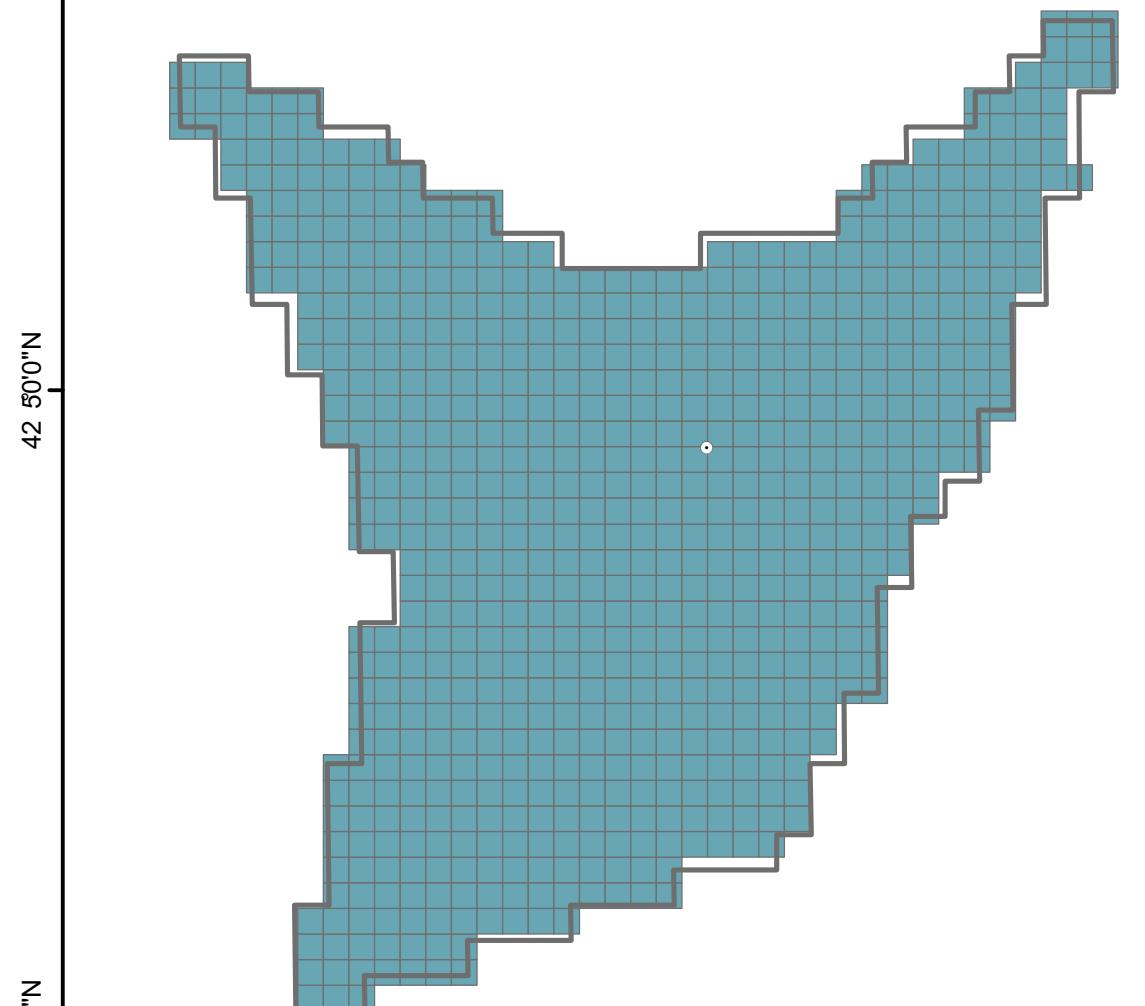


1 50'0"W

1 40'0"W

1 30'0"W

RS-measured tropospheric vertical columns of NO<sub>2</sub> of  
Pamplona, Spain  
eFUA\_ID: 3872  
at 1 km resolution



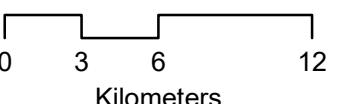
○ Central Business Districts (CBD)

◻ GHS-OECD Functional Urban Areas (GHS-FUA)

**Annual mean tropospheric NO<sub>2</sub> columns in  $\mu\text{mol}/\text{m}^2$**

**NO2Lev**

- [0, 20)
- [20, 40)
- [40, 60)
- [60, 80)
- [80, 100)
- [100, 120)
- [120, 140)
- [140, 160)
- [160, 180)
- [180, 200)



Locations of CBD in 2006, 2012 by Kilgarriff P., Lemoy R., Mader M.  
GHS-FUA data in 2019 from the European Union. Tropospheric vertical  
columns of NO<sub>2</sub> data in 2018, 2019 from Sentinel-5P,  
the European Space Agency.

Yufei Wei, 10 March 2022

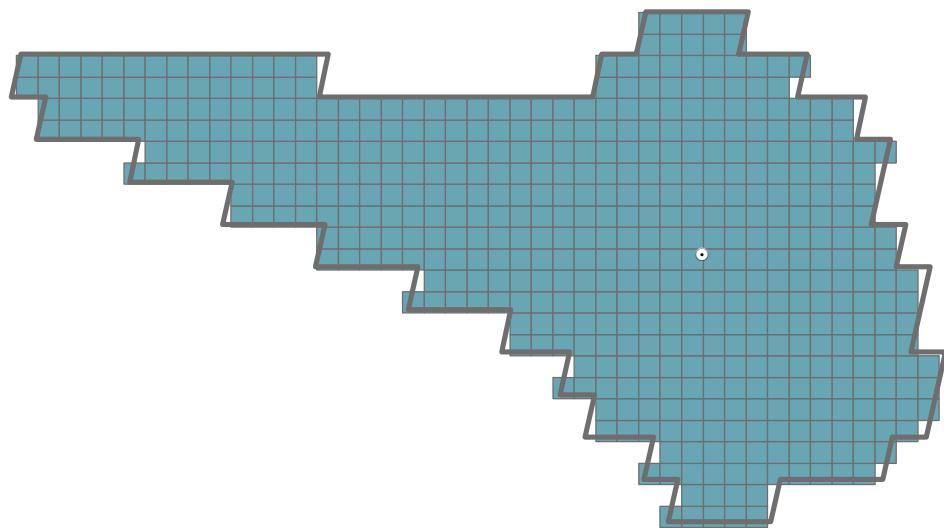
24 10'0"E

24 20'0"E

24 30'0"E

RS-measured tropospheric vertical columns of NO<sub>2</sub> of  
Panevezys, Lithuania  
eFUA\_ID: 580  
at 1 km resolution

55 50'0"N

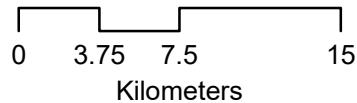
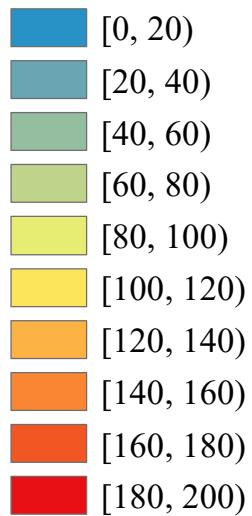


○ Central Business Districts (CBD)

◻ GHS-OECD Functional Urban Areas (GHS-FUA)

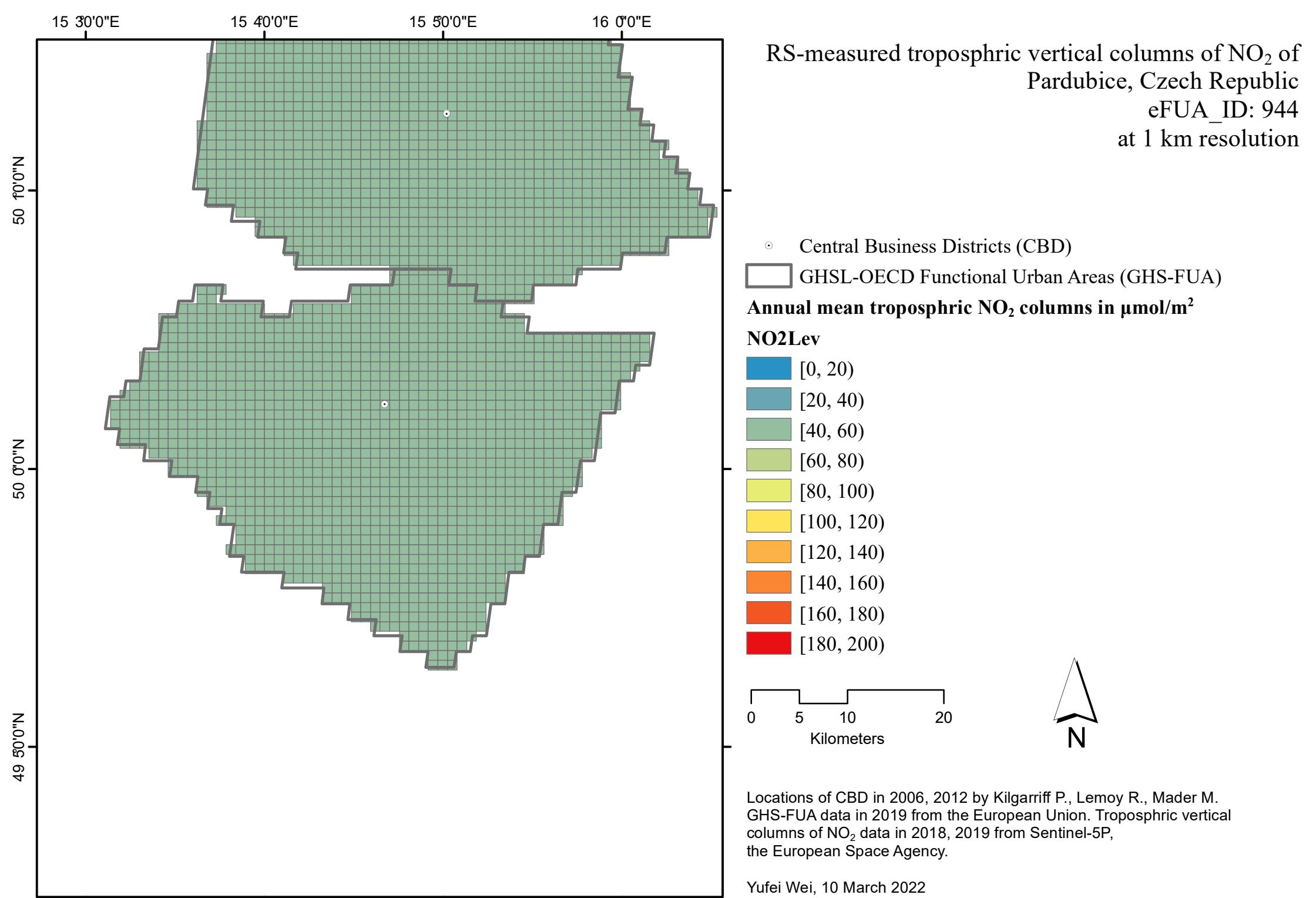
Annual mean tropospheric NO<sub>2</sub> columns in  $\mu\text{mol}/\text{m}^2$

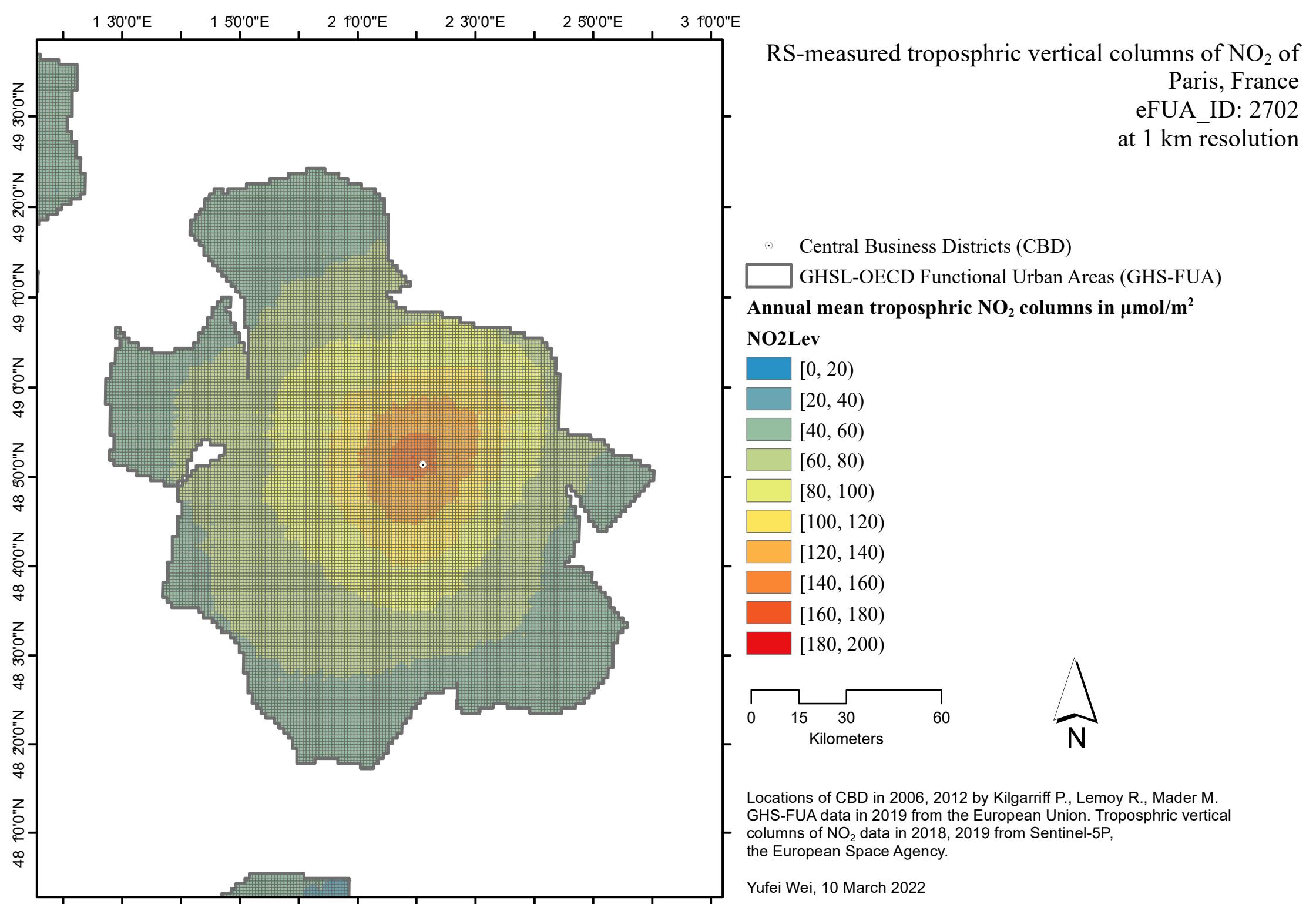
NO2Lev

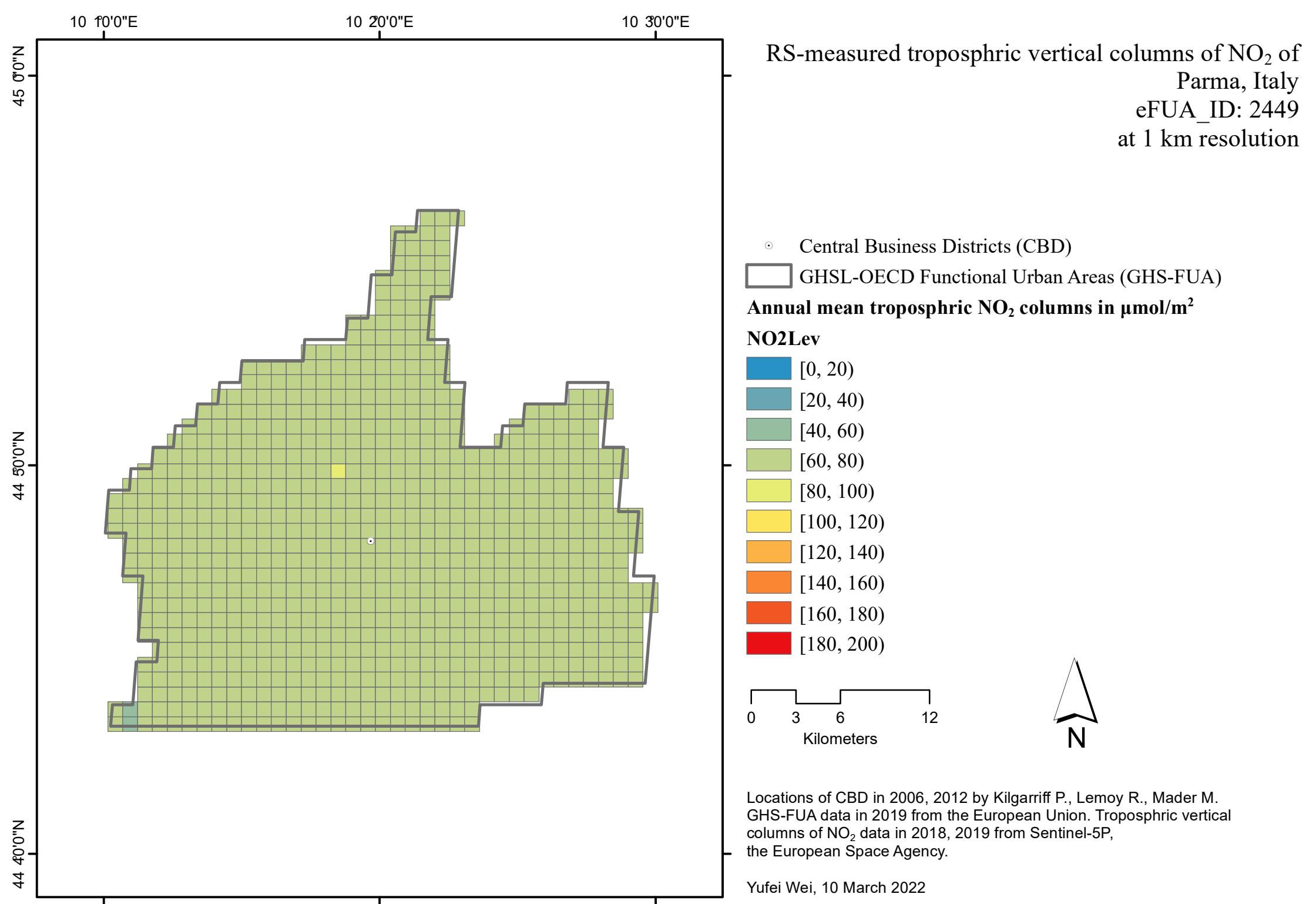


Locations of CBD in 2006, 2012 by Kilgarriff P., Lemoy R., Mader M.  
GHS-FUA data in 2019 from the European Union. Tropospheric vertical  
columns of NO<sub>2</sub> data in 2018, 2019 from Sentinel-5P,  
the European Space Agency.

Yufei Wei, 10 March 2022





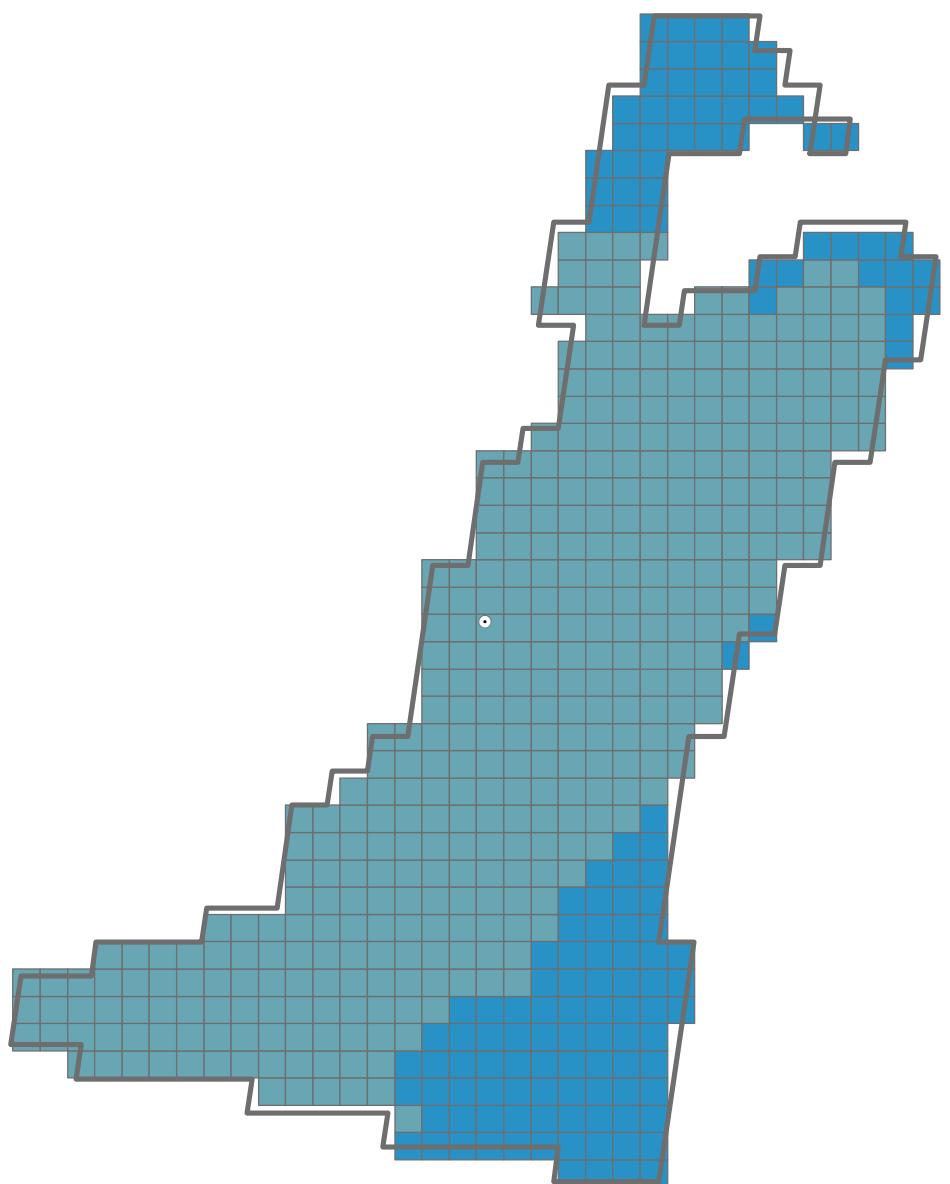


21 40'0"E

21 50'0"E

RS-measured tropospheric vertical columns of NO<sub>2</sub> of  
Patras, Greece  
eFUA\_ID: 249  
at 1 km resolution

38 20'0"N  
38 10'0"N  
38 0'0"N

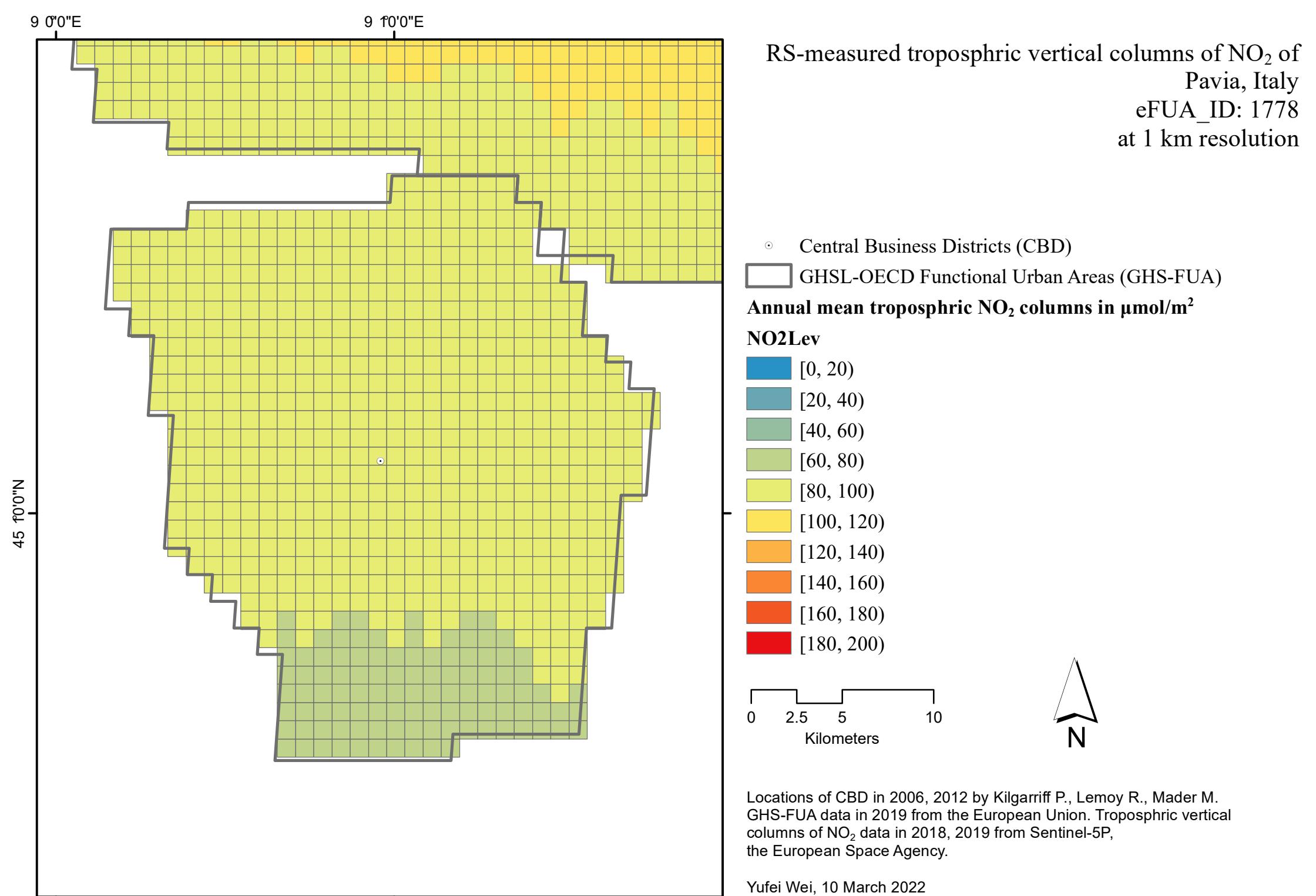


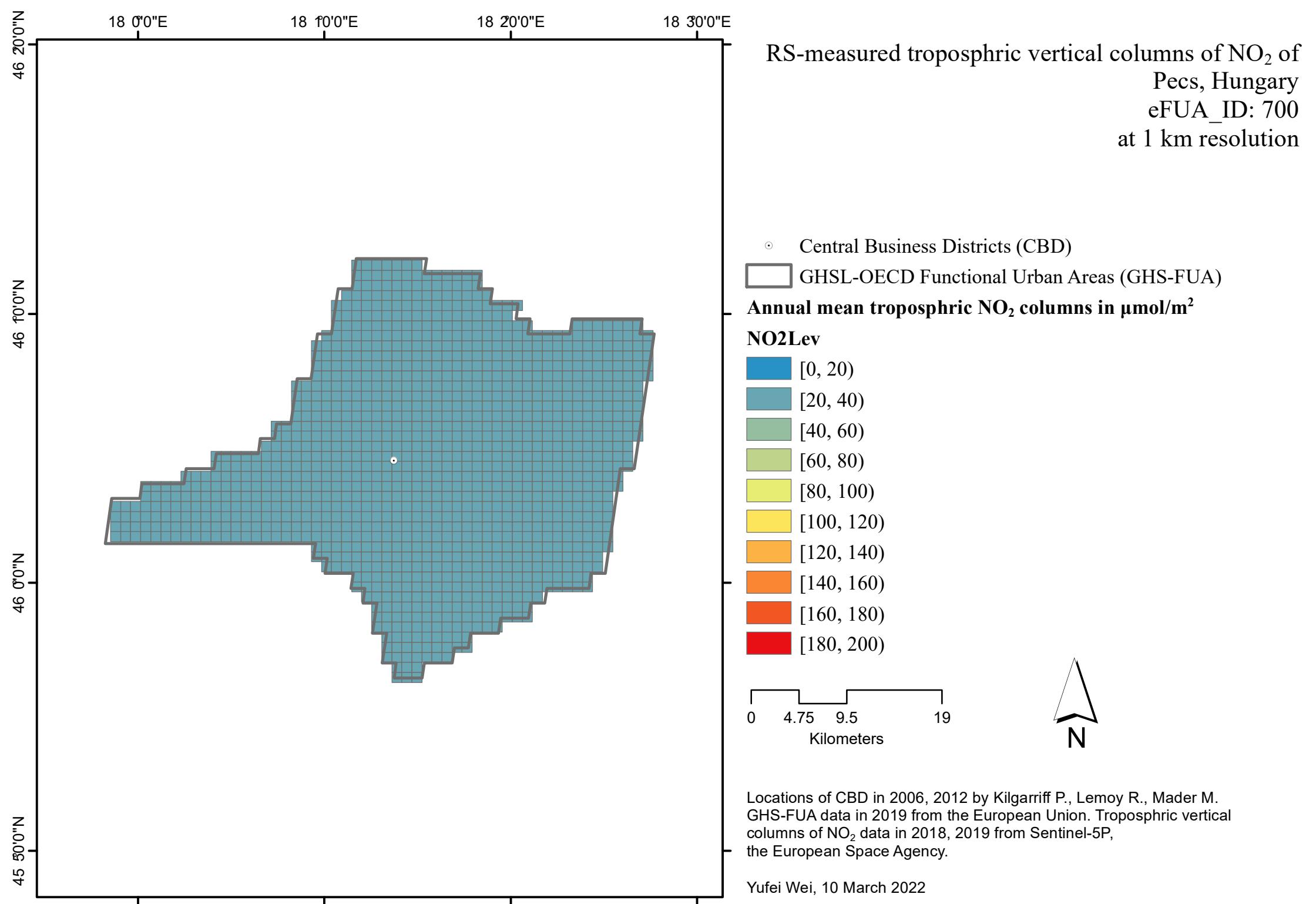
0 2.75 5.5 11  
Kilometers



Locations of CBD in 2006, 2012 by Kilgarriff P., Lemoy R., Mader M.  
GHS-FUA data in 2019 from the European Union. Tropospheric vertical  
columns of NO<sub>2</sub> data in 2018, 2019 from Sentinel-5P,  
the European Space Agency.

Yufei Wei, 10 March 2022



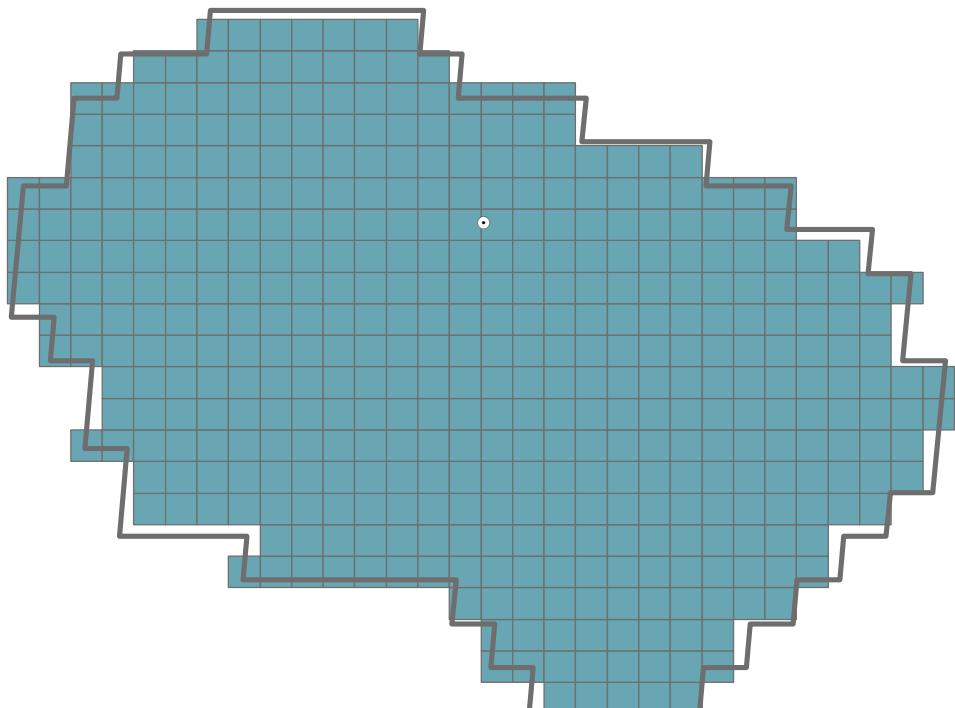


12 20'0"E

12 30'0"E

RS-measured tropospheric vertical columns of NO<sub>2</sub> of  
Perugia, Italy  
eFUA\_ID: 3725  
at 1 km resolution

43 °0'0"N



○ Central Business Districts (CBD)

◻ GHSL-OECD Functional Urban Areas (GHS-FUA)

Annual mean tropospheric NO<sub>2</sub> columns in  $\mu\text{mol}/\text{m}^2$

NO2Lev

- [0, 20]
- [20, 40]
- [40, 60]
- [60, 80]
- [80, 100]
- [100, 120]
- [120, 140]
- [140, 160]
- [160, 180]
- [180, 200]

0 2.5 5 10  
Kilometers



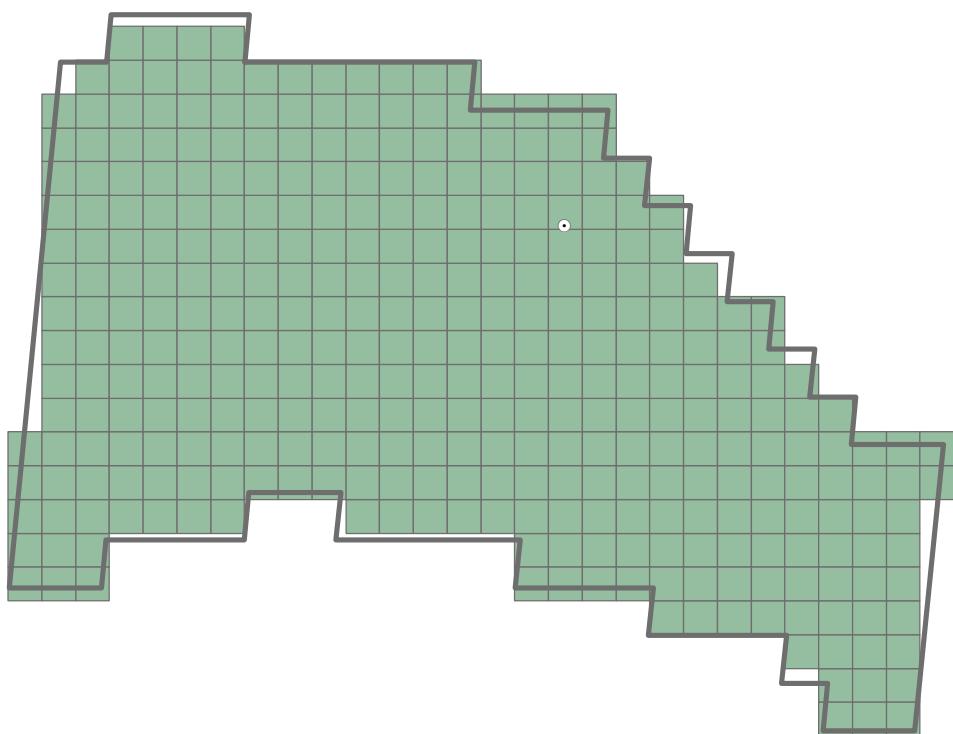
Locations of CBD in 2006, 2012 by Kilgarriff P., Lemoy R., Mader M.  
GHS-FUA data in 2019 from the European Union. Tropospheric vertical  
columns of NO<sub>2</sub> data in 2018, 2019 from Sentinel-5P,  
the European Space Agency.

Yufei Wei, 10 March 2022

12 50'0"E

13 0'0"E

RS-measured tropospheric vertical columns of NO<sub>2</sub> of  
Pesaro, Italy  
eFUA\_ID: 3990  
at 1 km resolution



○ Central Business Districts (CBD)

◻ GHS-OECD Functional Urban Areas (GHS-FUA)

Annual mean tropospheric NO<sub>2</sub> columns in μmol/m<sup>2</sup>

NO2Lev

- [0, 20]
- [20, 40]
- [40, 60]
- [60, 80]
- [80, 100]
- [100, 120]
- [120, 140]
- [140, 160]
- [160, 180]
- [180, 200]

0 2.25 4.5 9  
Kilometers



Locations of CBD in 2006, 2012 by Kilgarriff P., Lemoy R., Mader M.  
GHS-FUA data in 2019 from the European Union. Tropospheric vertical  
columns of NO<sub>2</sub> data in 2018, 2019 from Sentinel-5P,  
the European Space Agency.

Yufei Wei, 10 March 2022

14 0'0"E

14 10'0"E

14 20'0"E

14 30'0"E

42 40'0"N

42 30'0"N

42 20'0"N

RS-measured tropospheric vertical columns of NO<sub>2</sub> of  
Pescara, Italy  
eFUA\_ID: 4299  
at 1 km resolution

○ Central Business Districts (CBD)

◻ GHSL-OECD Functional Urban Areas (GHS-FUA)

Annual mean tropospheric NO<sub>2</sub> columns in  $\mu\text{mol}/\text{m}^2$

NO2Lev

[0, 20)

[20, 40)

[40, 60)

[60, 80)

[80, 100)

[100, 120)

[120, 140)

[140, 160)

[160, 180)

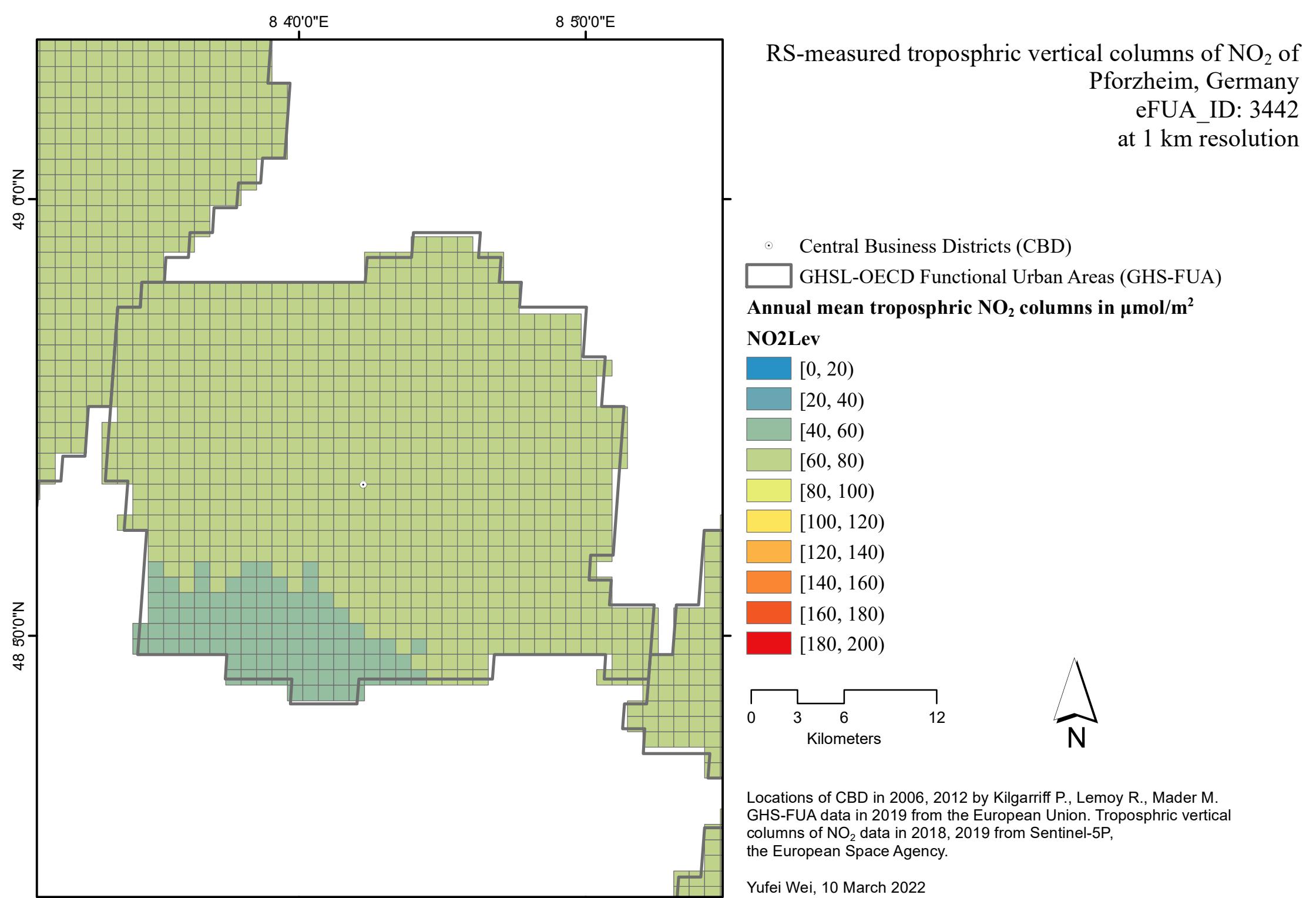
[180, 200)

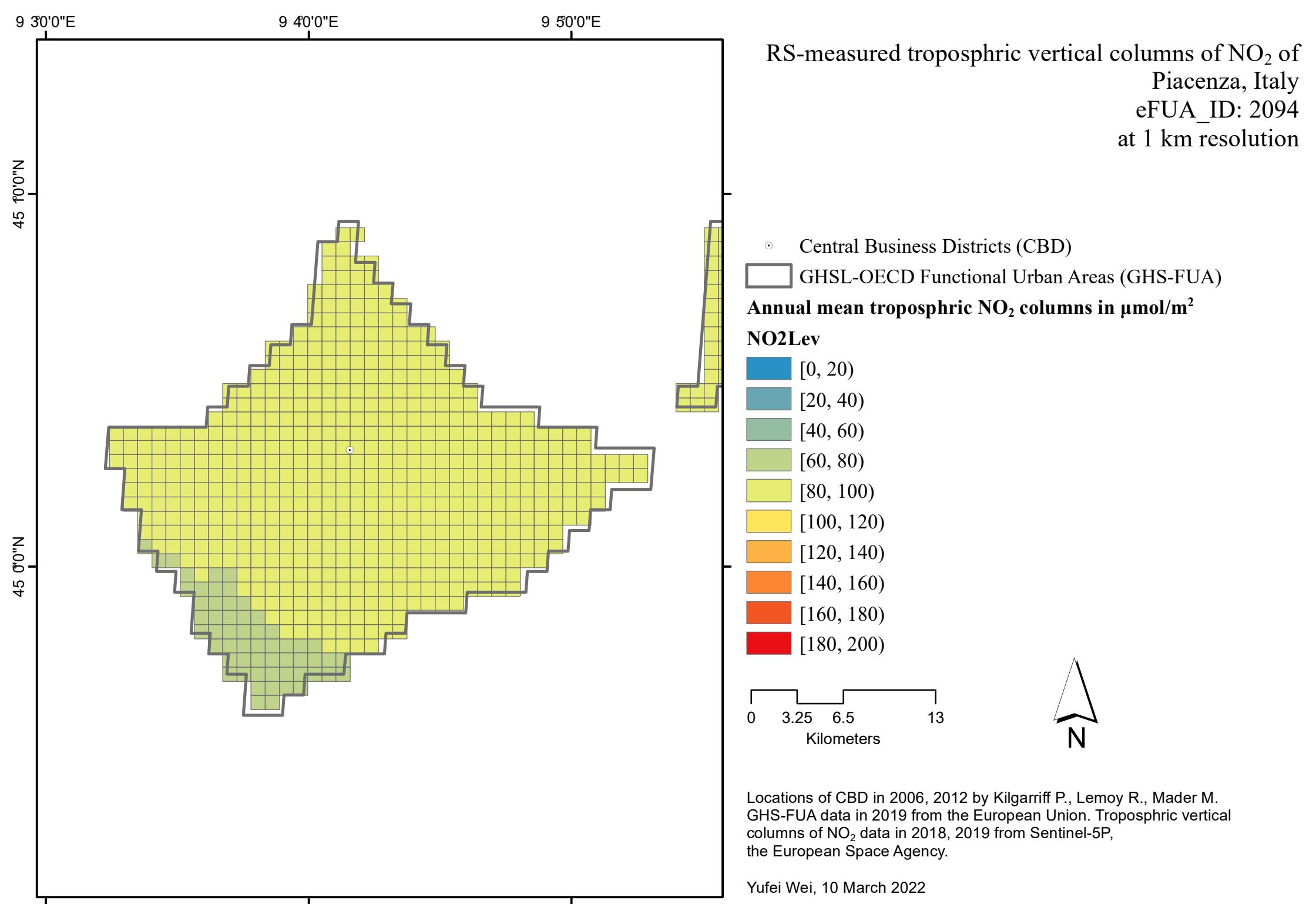
0 4.5 9 18  
Kilometers



Locations of CBD in 2006, 2012 by Kilgarriff P., Lemoy R., Mader M.  
GHS-FUA data in 2019 from the European Union. Tropospheric vertical  
columns of NO<sub>2</sub> data in 2018, 2019 from Sentinel-5P,  
the European Space Agency.

Yufei Wei, 10 March 2022



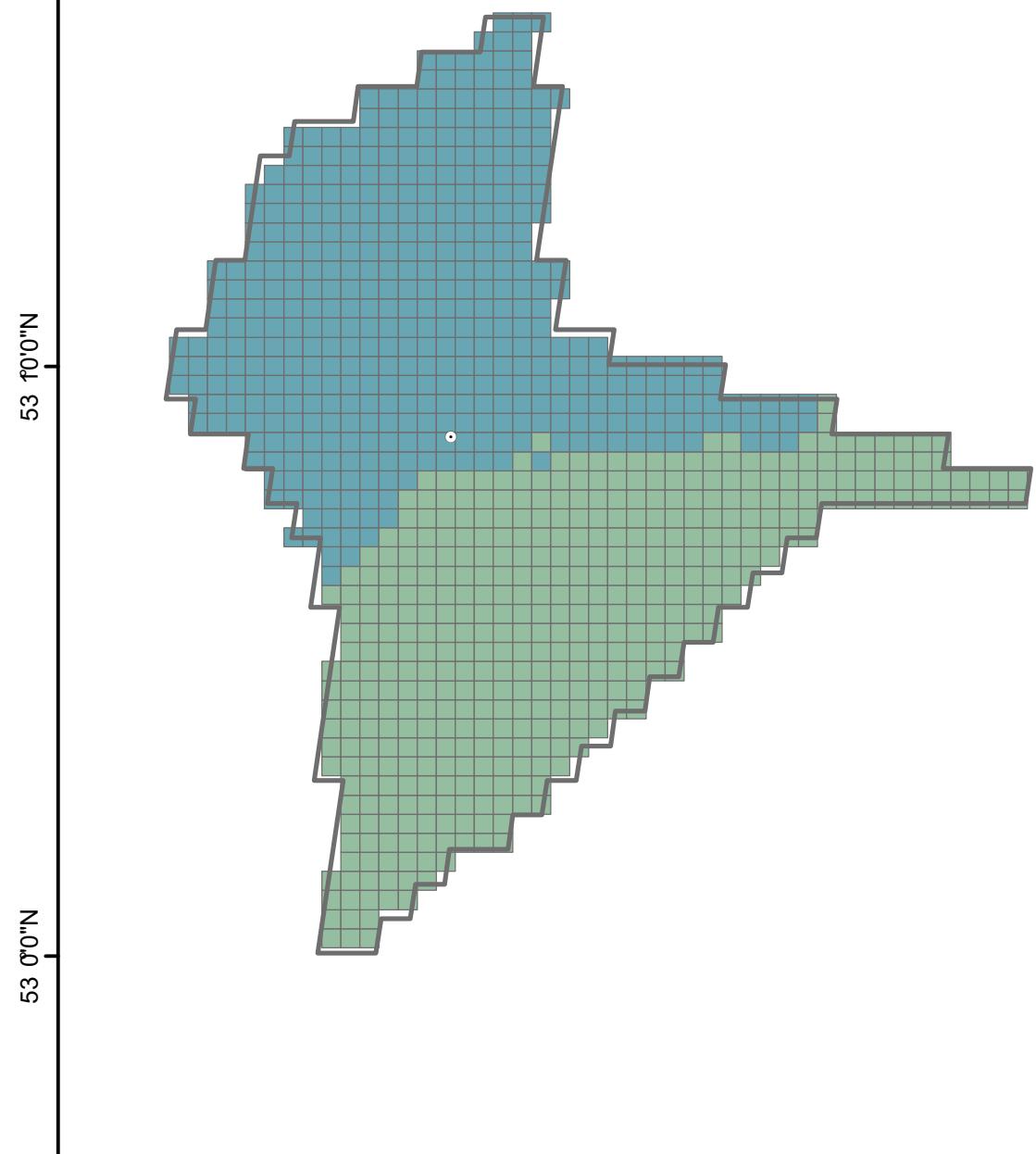


16 40'0"E

16 50'0"E

17 0'0"E

RS-measured tropospheric vertical columns of NO<sub>2</sub> of  
Pila, Poland  
eFUA\_ID: 1226  
at 1 km resolution



○ Central Business Districts (CBD)

◻ GHS-OECD Functional Urban Areas (GHS-FUA)

Annual mean tropospheric NO<sub>2</sub> columns in  $\mu\text{mol}/\text{m}^2$

NO2Lev

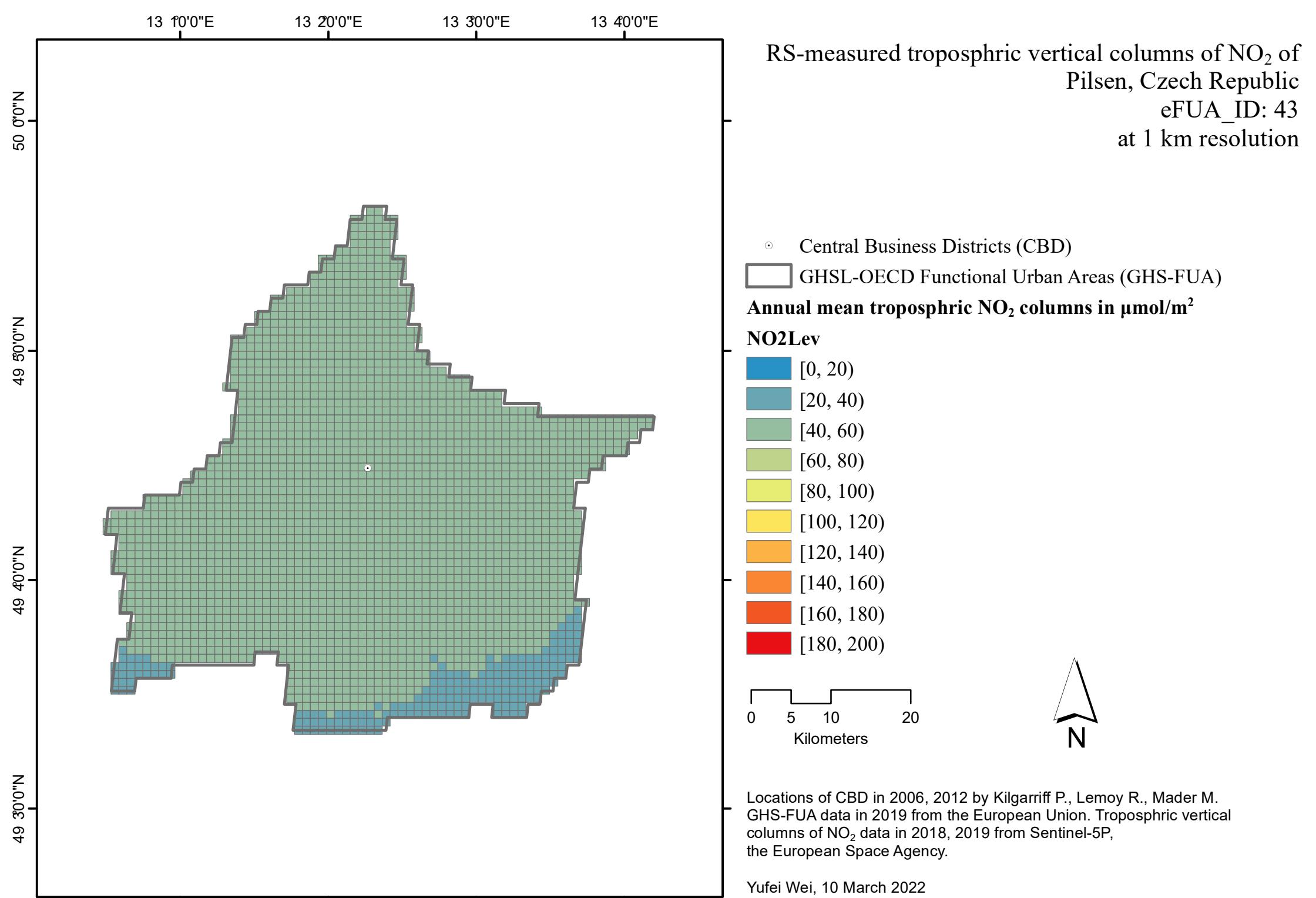
- [0, 20]
- [20, 40]
- [40, 60]
- [60, 80]
- [80, 100]
- [100, 120]
- [120, 140]
- [140, 160]
- [160, 180]
- [180, 200]

0 3.75 7.5 15  
Kilometers



Locations of CBD in 2006, 2012 by Kilgarriff P., Lemoy R., Mader M.  
GHS-FUA data in 2019 from the European Union. Tropospheric vertical  
columns of NO<sub>2</sub> data in 2018, 2019 from Sentinel-5P,  
the European Space Agency.

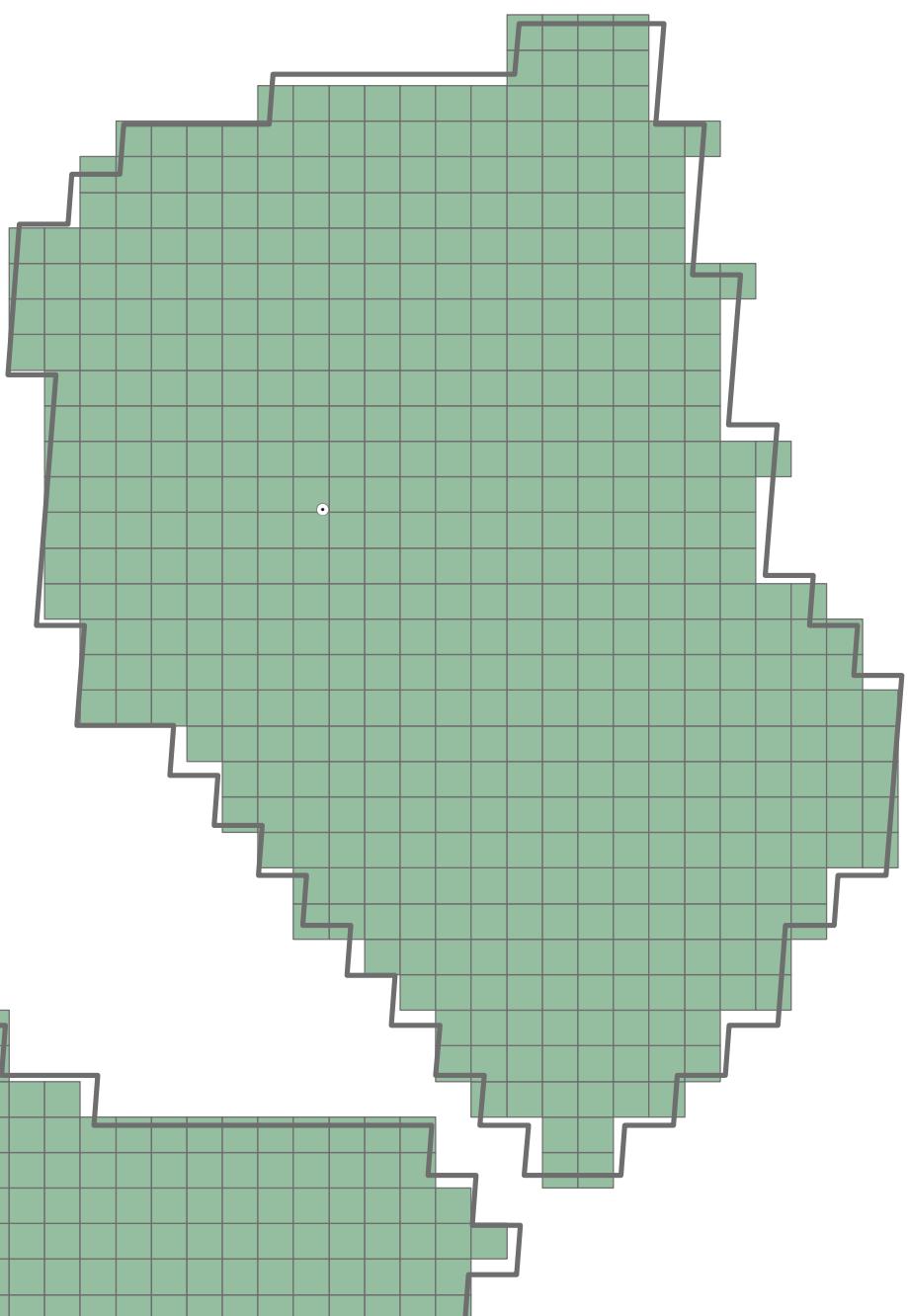
Yufei Wei, 10 March 2022



10 20'0"E

10 30'0"E

RS-measured tropospheric vertical columns of NO<sub>2</sub> of  
Pisa, Italy  
eFUA\_ID: 2647  
at 1 km resolution



○ Central Business Districts (CBD)

◻ GHSL-OECD Functional Urban Areas (GHS-FUA)

Annual mean tropospheric NO<sub>2</sub> columns in  $\mu\text{mol}/\text{m}^2$

NO2Lev

- [0, 20]
- [20, 40]
- [40, 60]
- [60, 80]
- [80, 100]
- [100, 120]
- [120, 140]
- [140, 160]
- [160, 180]
- [180, 200]



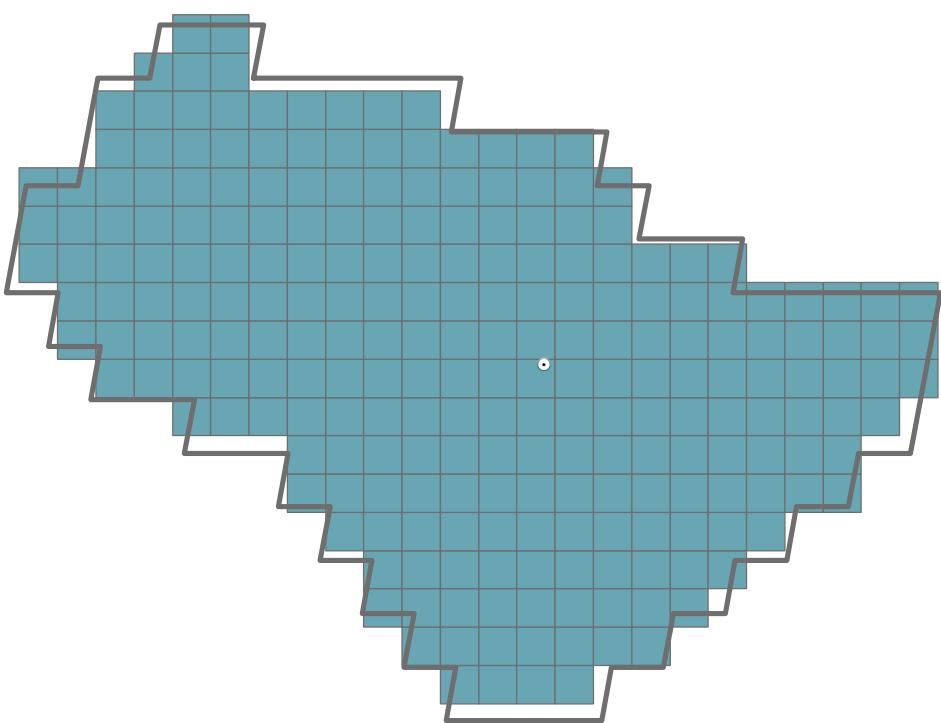
Locations of CBD in 2006, 2012 by Kilgarriff P., Lemoy R., Mader M.  
GHS-FUA data in 2019 from the European Union. Tropospheric vertical  
columns of NO<sub>2</sub> data in 2018, 2019 from Sentinel-5P,  
the European Space Agency.

Yufei Wei, 10 March 2022

24 30'0"E

24 40'0"E

RS-measured tropospheric vertical columns of NO<sub>2</sub> of  
Pleven, Bulgaria  
eFUA\_ID: 206  
at 1 km resolution



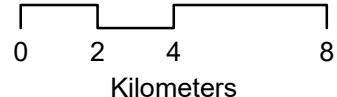
○ Central Business Districts (CBD)

◻ GHSL-OECD Functional Urban Areas (GHS-FUA)

Annual mean tropospheric NO<sub>2</sub> columns in  $\mu\text{mol}/\text{m}^2$

NO2Lev

- [0, 20]
- [20, 40]
- [40, 60]
- [60, 80]
- [80, 100]
- [100, 120]
- [120, 140]
- [140, 160]
- [160, 180]
- [180, 200]



Locations of CBD in 2006, 2012 by Kilgarriff P., Lemoy R., Mader M.  
GHS-FUA data in 2019 from the European Union. Tropospheric vertical  
columns of NO<sub>2</sub> data in 2018, 2019 from Sentinel-5P,  
the European Space Agency.

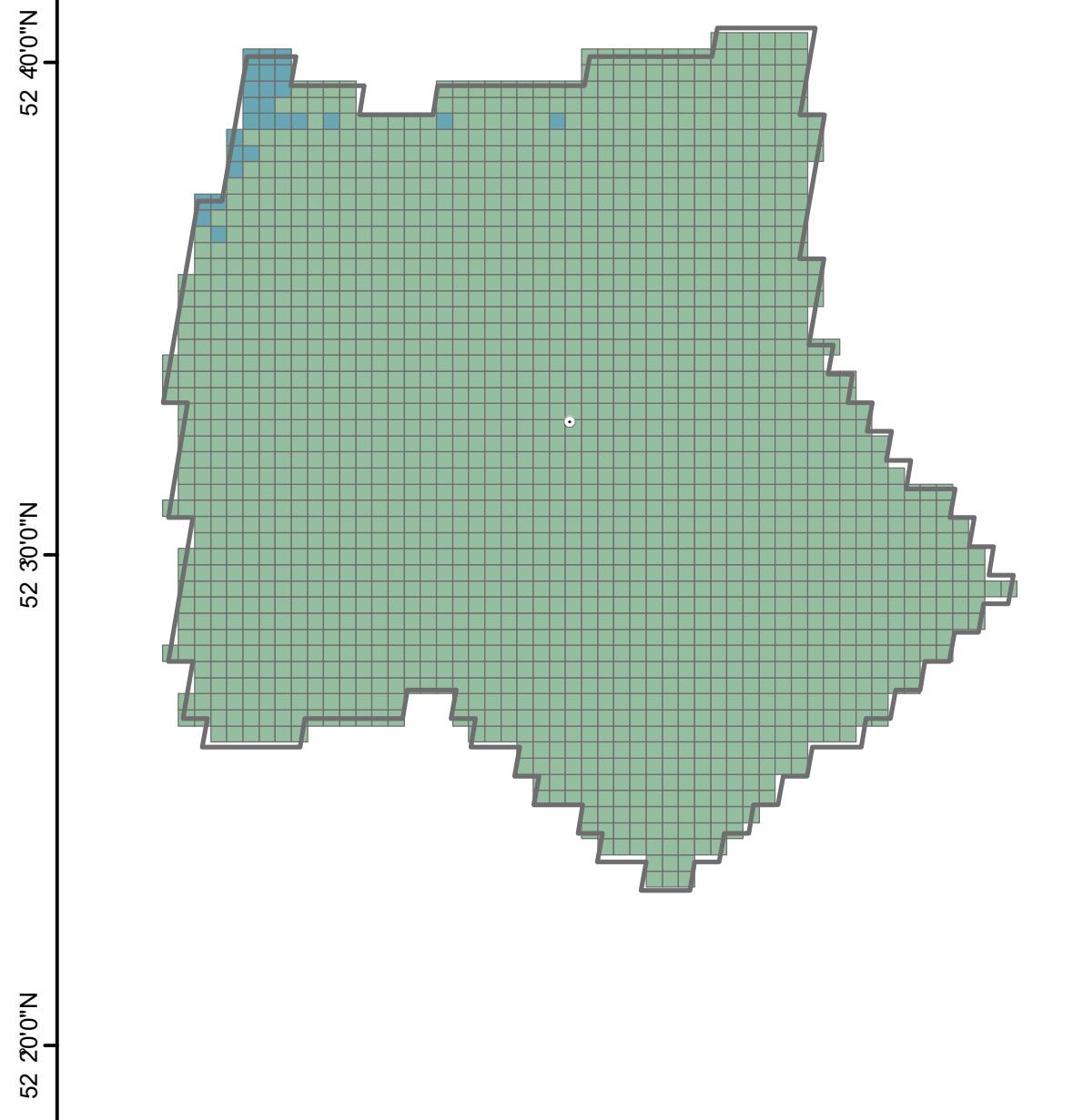
Yufei Wei, 10 March 2022

19 30'0"E

19 40'0"E

19 50'0"E

RS-measured tropospheric vertical columns of NO<sub>2</sub> of  
Plock, Poland  
eFUA\_ID: 2960  
at 1 km resolution



○ Central Business Districts (CBD)

◻ GHSL-OECD Functional Urban Areas (GHS-FUA)

Annual mean tropospheric NO<sub>2</sub> columns in  $\mu\text{mol}/\text{m}^2$

NO2Lev

- [0, 20]
- [20, 40]
- [40, 60]
- [60, 80]
- [80, 100]
- [100, 120]
- [120, 140]
- [140, 160]
- [160, 180]
- [180, 200]

0 4.5 9 18  
Kilometers



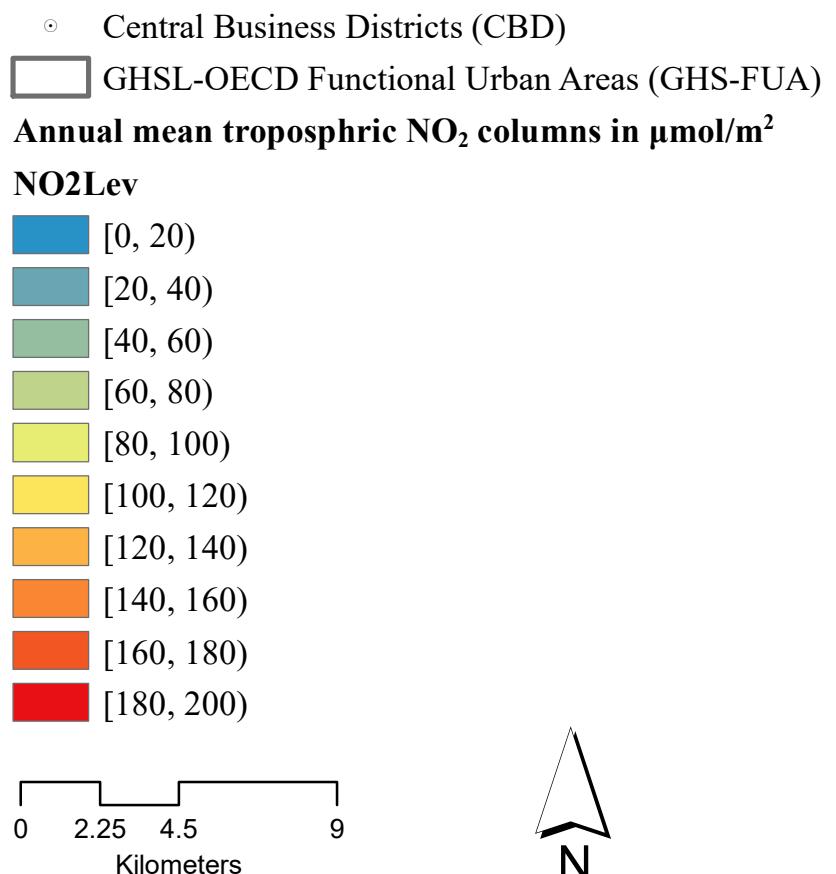
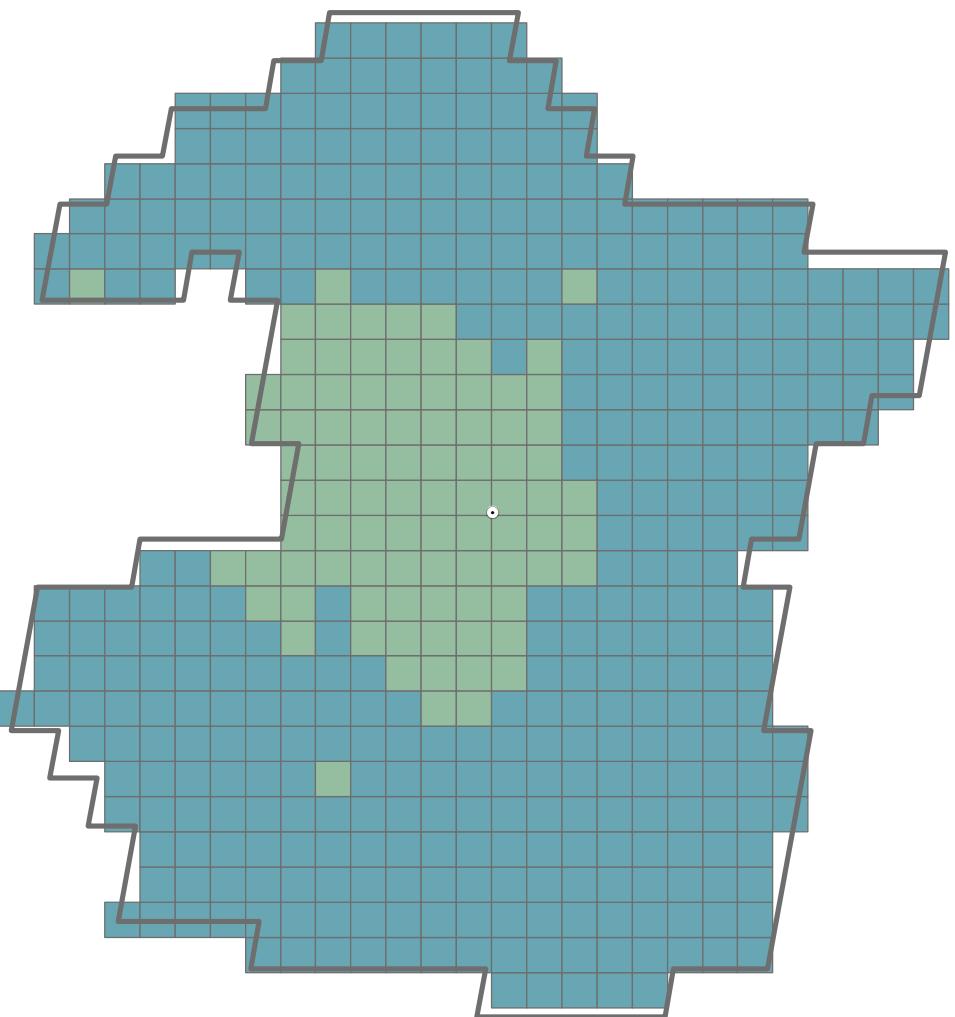
Locations of CBD in 2006, 2012 by Kilgarriff P., Lemoy R., Mader M.  
GHS-FUA data in 2019 from the European Union. Tropospheric vertical  
columns of NO<sub>2</sub> data in 2018, 2019 from Sentinel-5P,  
the European Space Agency.

Yufei Wei, 10 March 2022

24°40'0"E

24°50'0"E

RS-measured tropospheric vertical columns of NO<sub>2</sub> of  
Plovdiv, Bulgaria  
eFUA\_ID: 368  
at 1 km resolution



Locations of CBD in 2006, 2012 by Kilgarriff P., Lemoy R., Mader M.  
GHS-FUA data in 2019 from the European Union. Tropospheric vertical  
columns of NO<sub>2</sub> data in 2018, 2019 from Sentinel-5P,  
the European Space Agency.

Yufei Wei, 10 March 2022

4 30'0"W

4 20'0"W

4 10'0"W

4 0'0"W

3 50'0"W

50 40'0"N

50 30'0"N

50 20'0"N

50 10'0"N

RS-measured tropospheric vertical columns of NO<sub>2</sub> of  
Plymouth, United Kingdom  
eFUA\_ID: 825  
at 1 km resolution

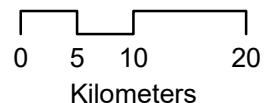
○ Central Business Districts (CBD)

◻ GHSL-OECD Functional Urban Areas (GHS-FUA)

**Annual mean tropospheric NO<sub>2</sub> columns in  $\mu\text{mol}/\text{m}^2$**

**NO2Lev**

- [0, 20]
- [20, 40]
- [40, 60]
- [60, 80]
- [80, 100]
- [100, 120]
- [120, 140]
- [140, 160]
- [160, 180]
- [180, 200]



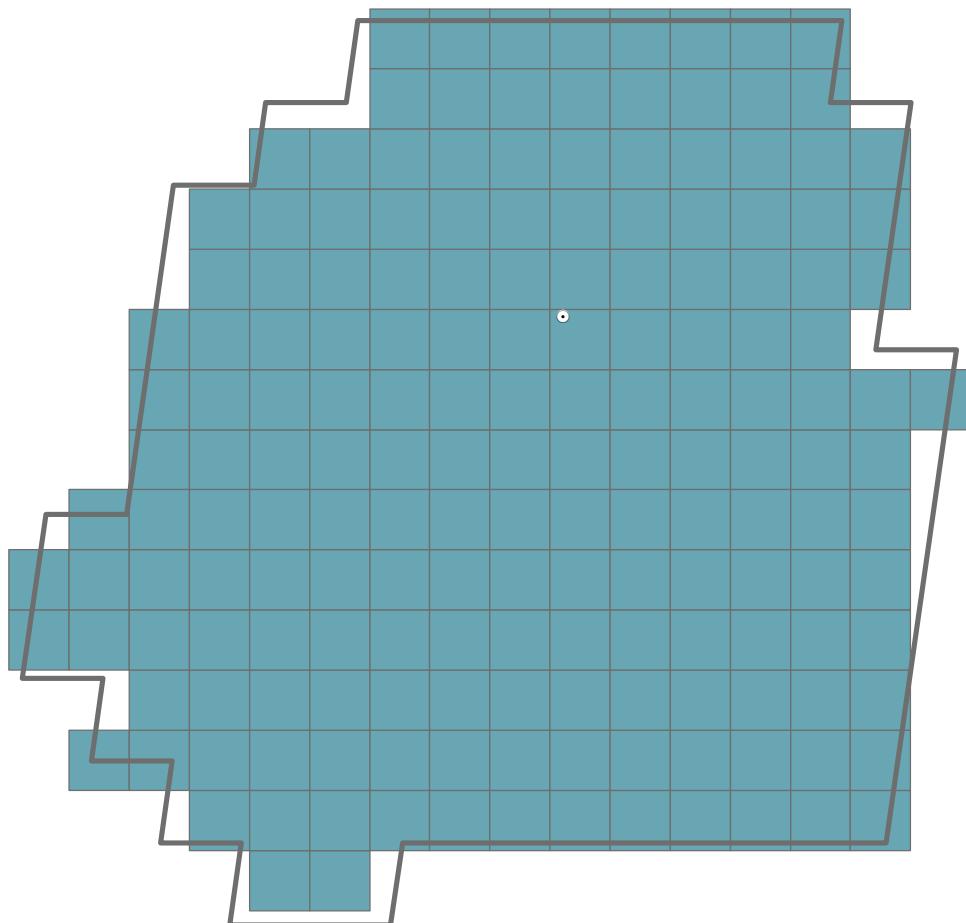
Locations of CBD in 2006, 2012 by Kilgarriff P., Lemoy R., Mader M.  
GHS-FUA data in 2019 from the European Union. Tropospheric vertical  
columns of NO<sub>2</sub> data in 2018, 2019 from Sentinel-5P,  
the European Space Agency.

Yufei Wei, 10 March 2022

19°10'0"E

19°20'0"E

RS-measured tropospheric vertical columns of NO<sub>2</sub> of  
Podgorica, Montenegro  
eFUA\_ID: 116  
at 1 km resolution



○ Central Business Districts (CBD)

◻ GHS-OECD Functional Urban Areas (GHS-FUA)

**Annual mean tropospheric NO<sub>2</sub> columns in  $\mu\text{mol}/\text{m}^2$**

**NO2Lev**

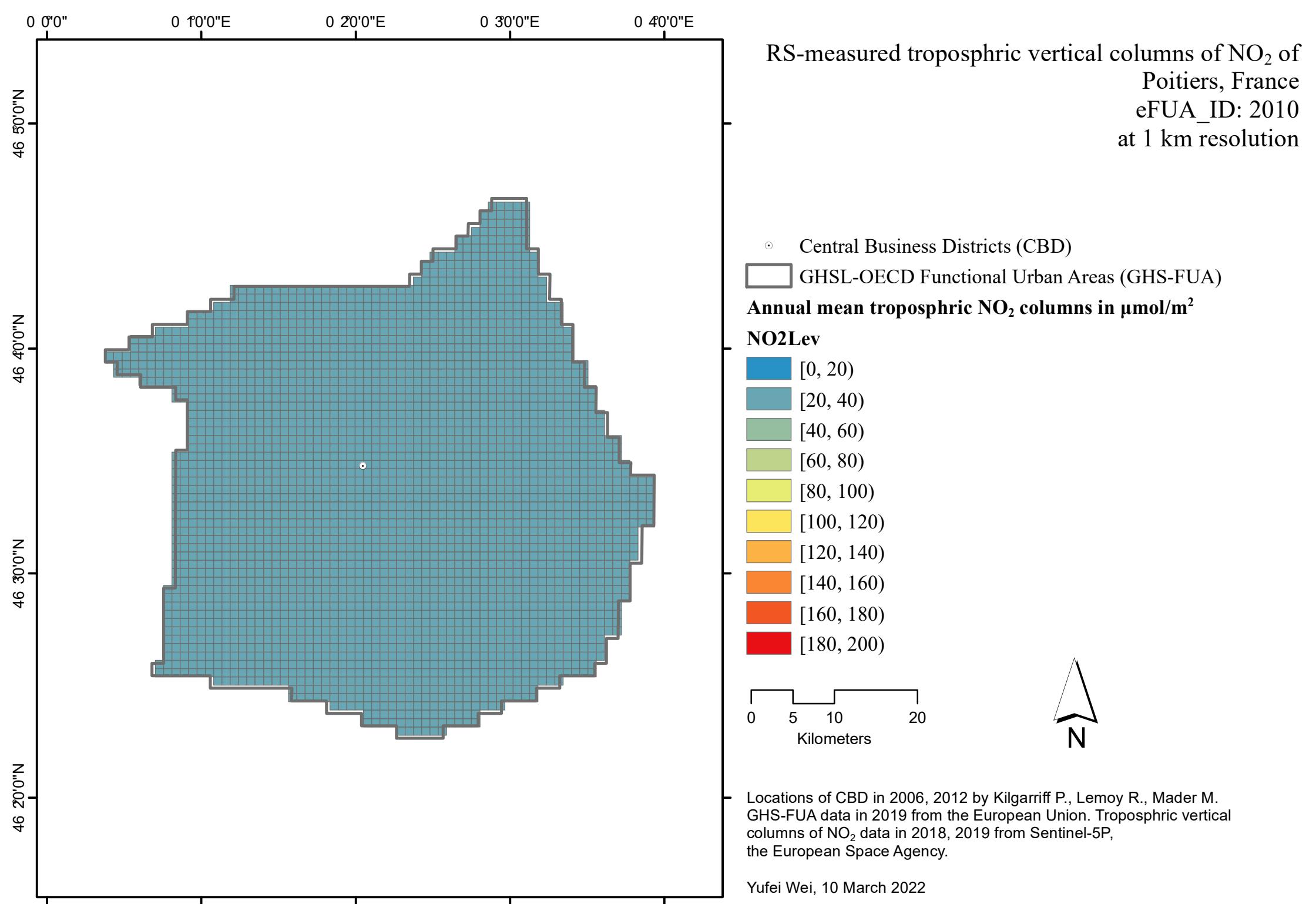
[0, 20)
[20, 40)
[40, 60)
[60, 80)
[80, 100)
[100, 120)
[120, 140)
[140, 160)
[160, 180)
[180, 200)

0 1.25 2.5 5  
Kilometers



Locations of CBD in 2006, 2012 by Kilgarriff P., Lemoy R., Mader M.  
GHS-FUA data in 2019 from the European Union. Tropospheric vertical  
columns of NO<sub>2</sub> data in 2018, 2019 from Sentinel-5P,  
the European Space Agency.

Yufei Wei, 10 March 2022

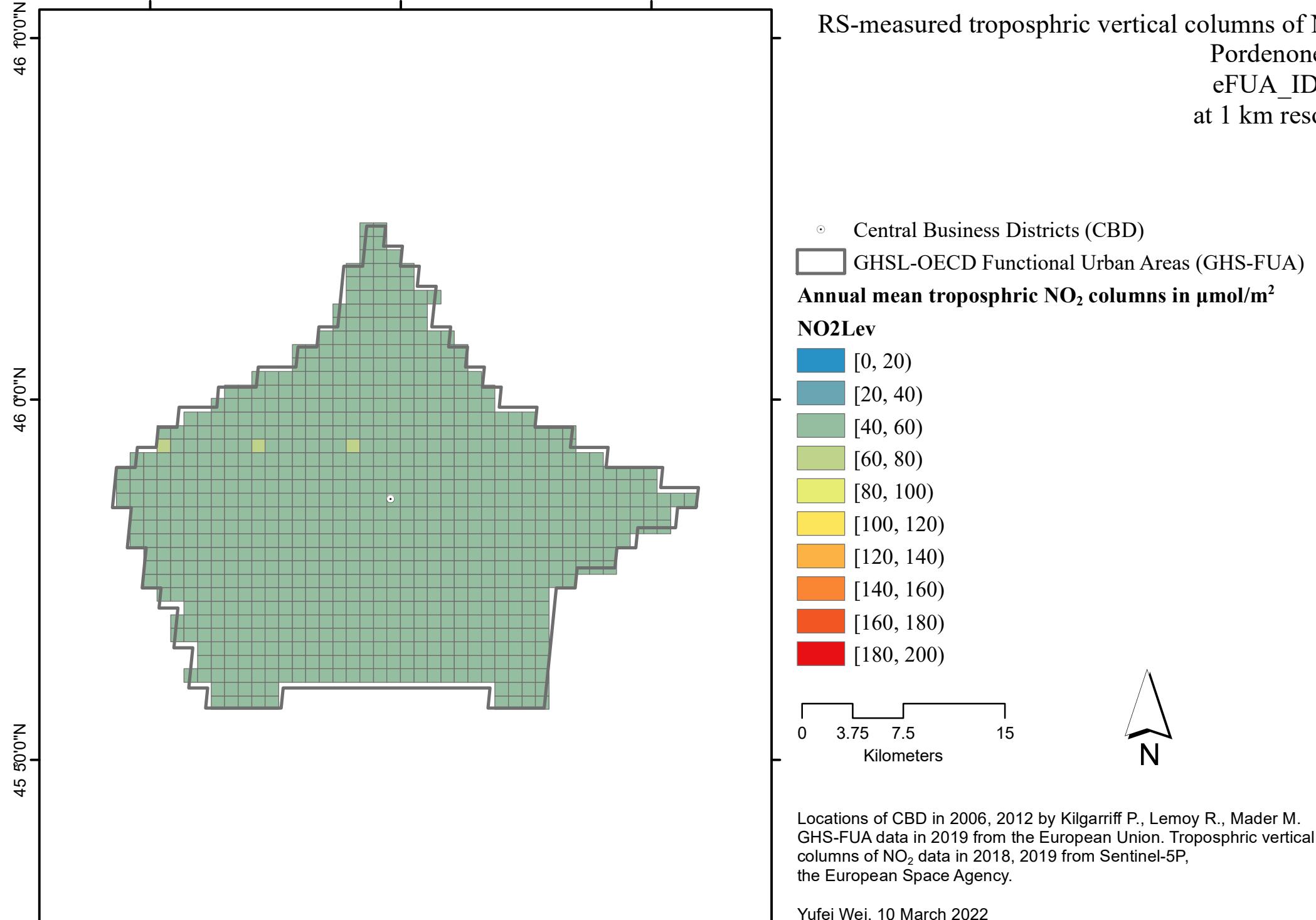


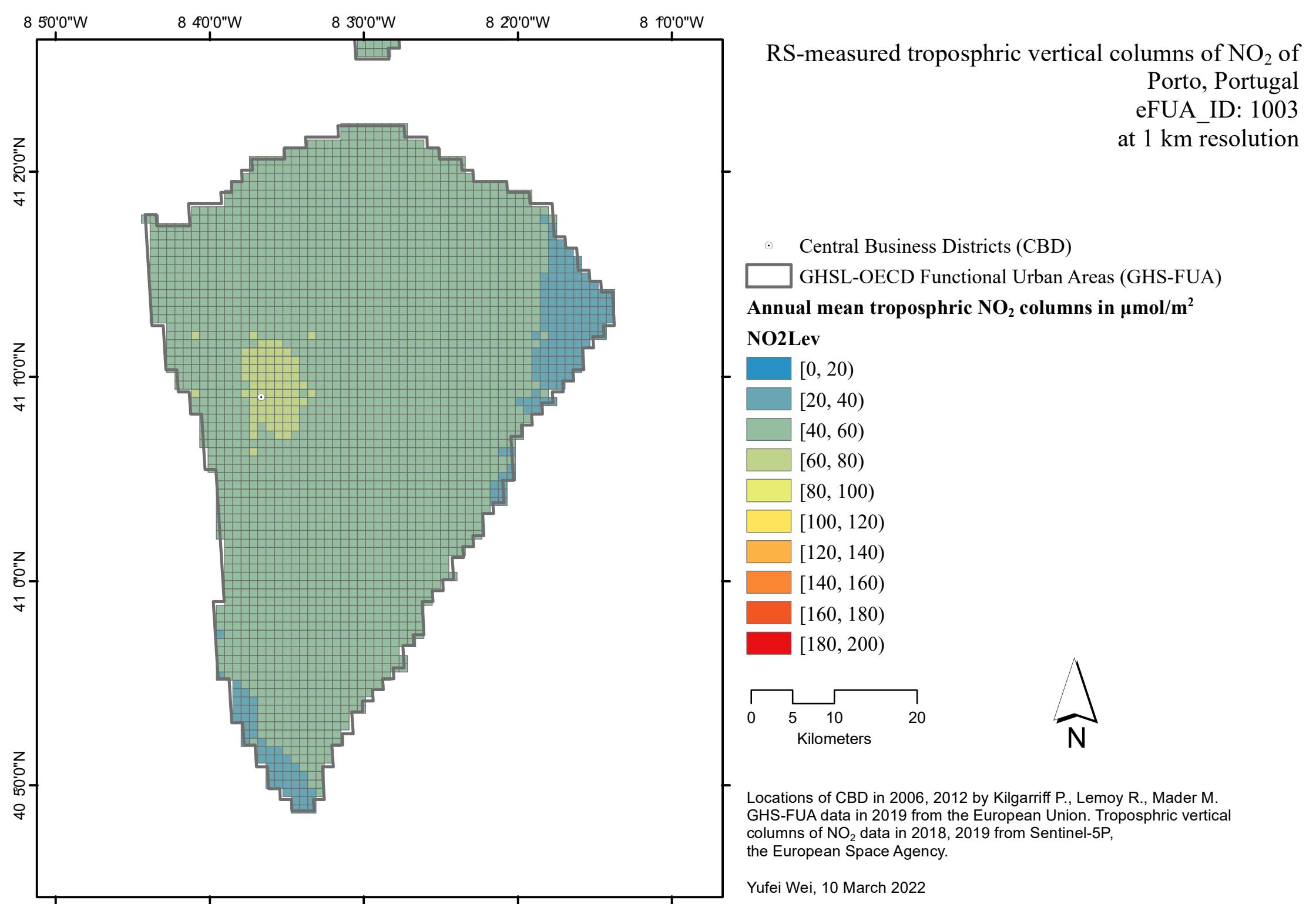
12 30'0"E

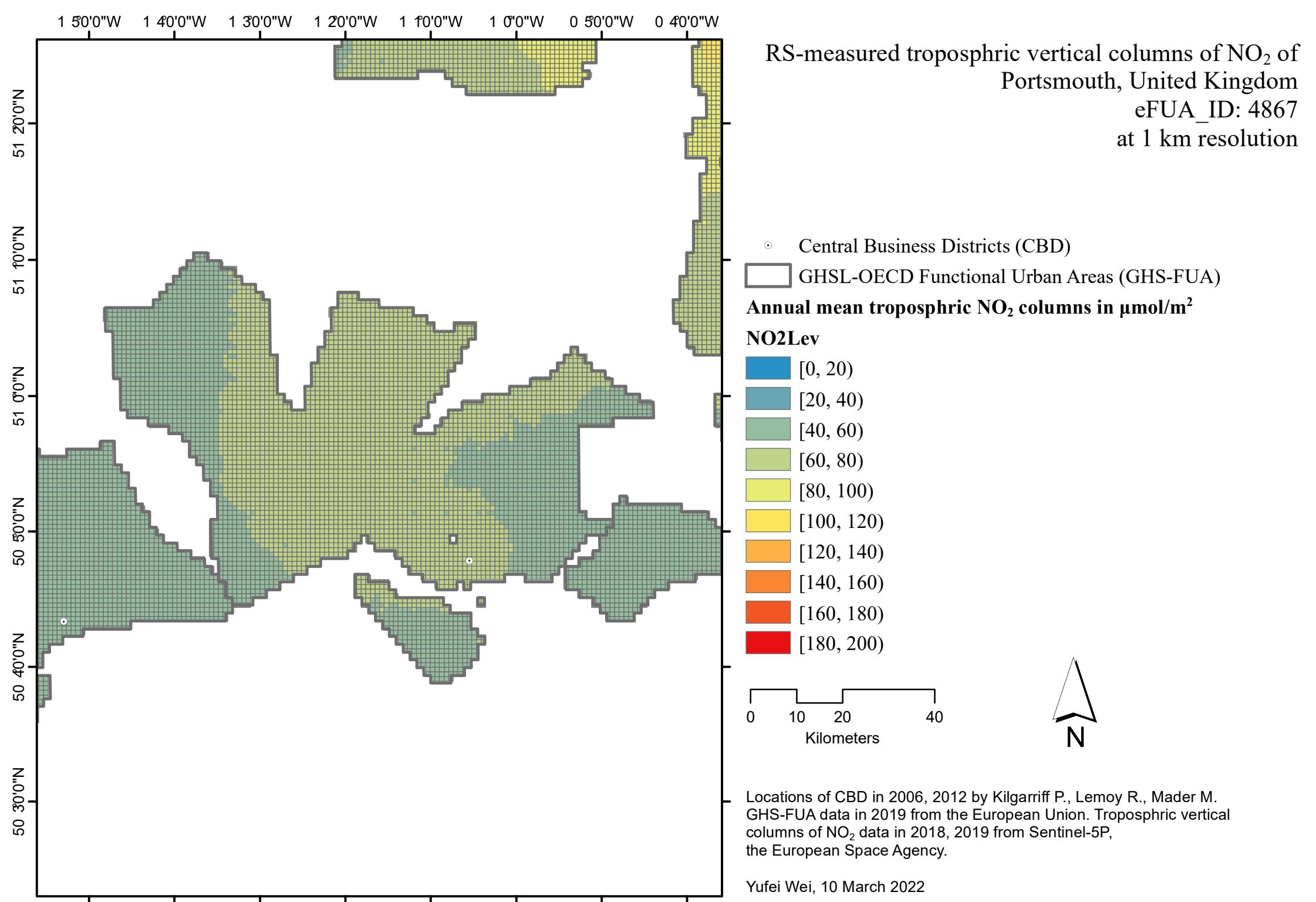
12 40'0"E

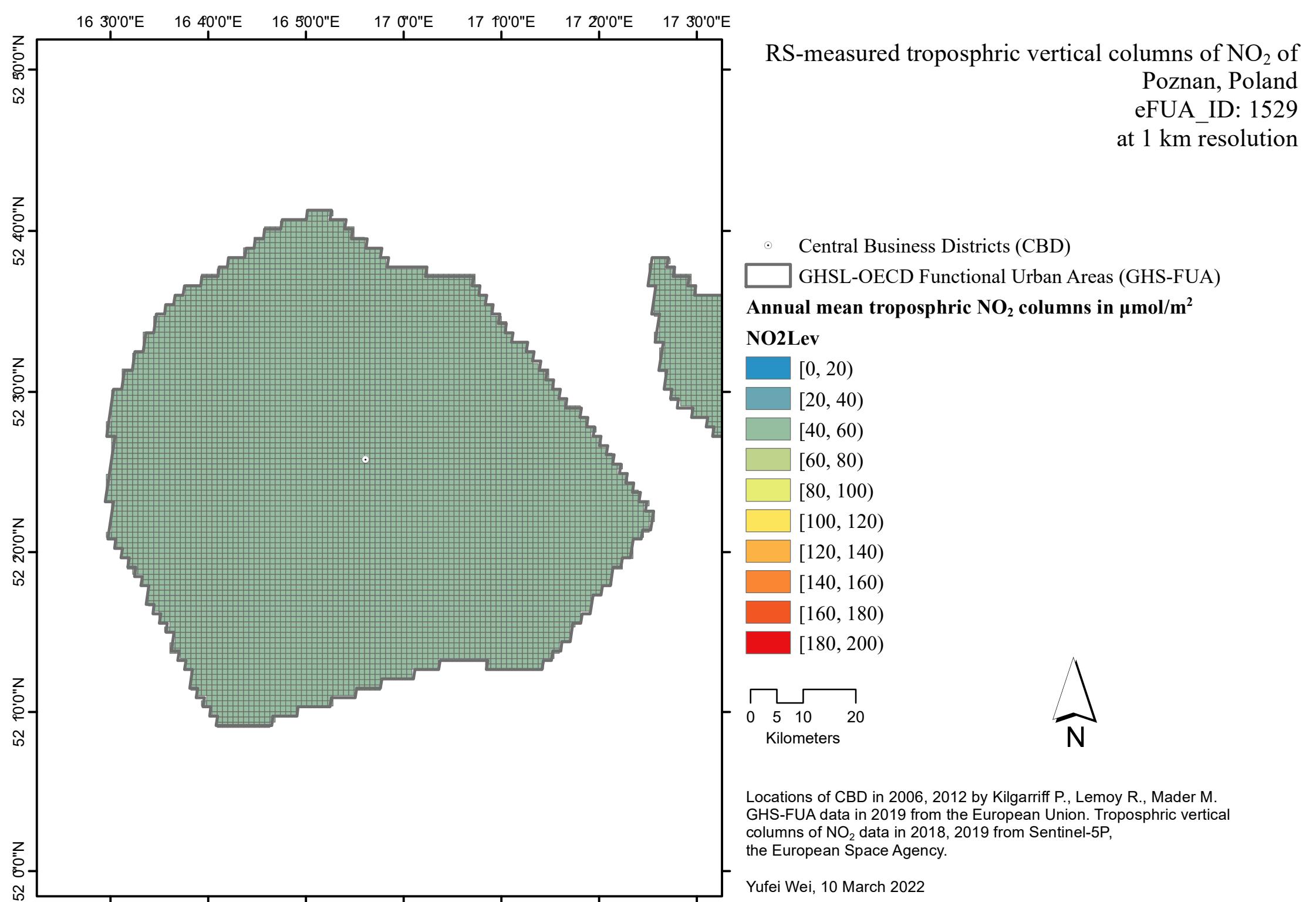
12 50'0"E

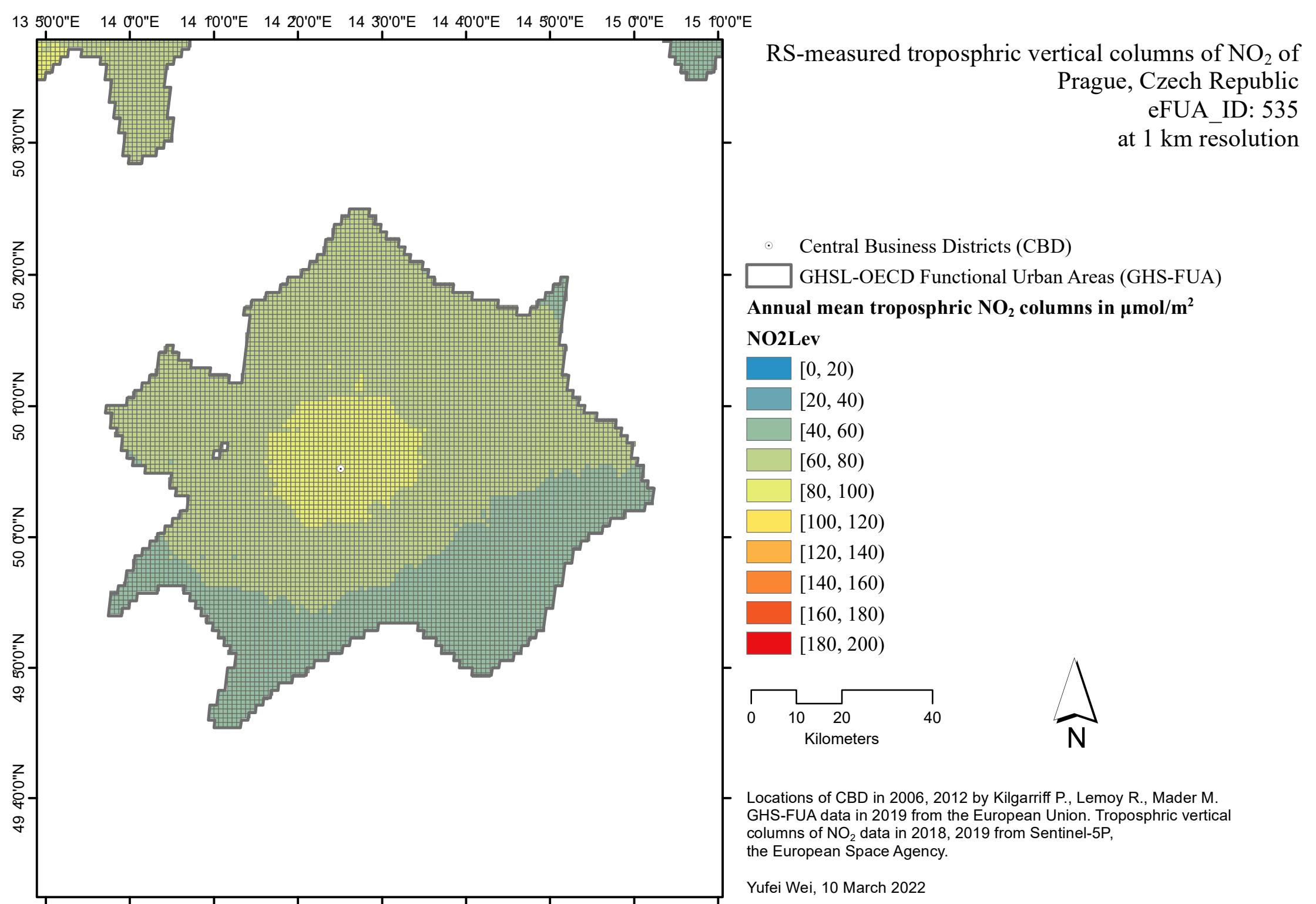
RS-measured tropospheric vertical columns of NO<sub>2</sub> of  
Pordenone, Italy  
eFUA\_ID: 3679  
at 1 km resolution

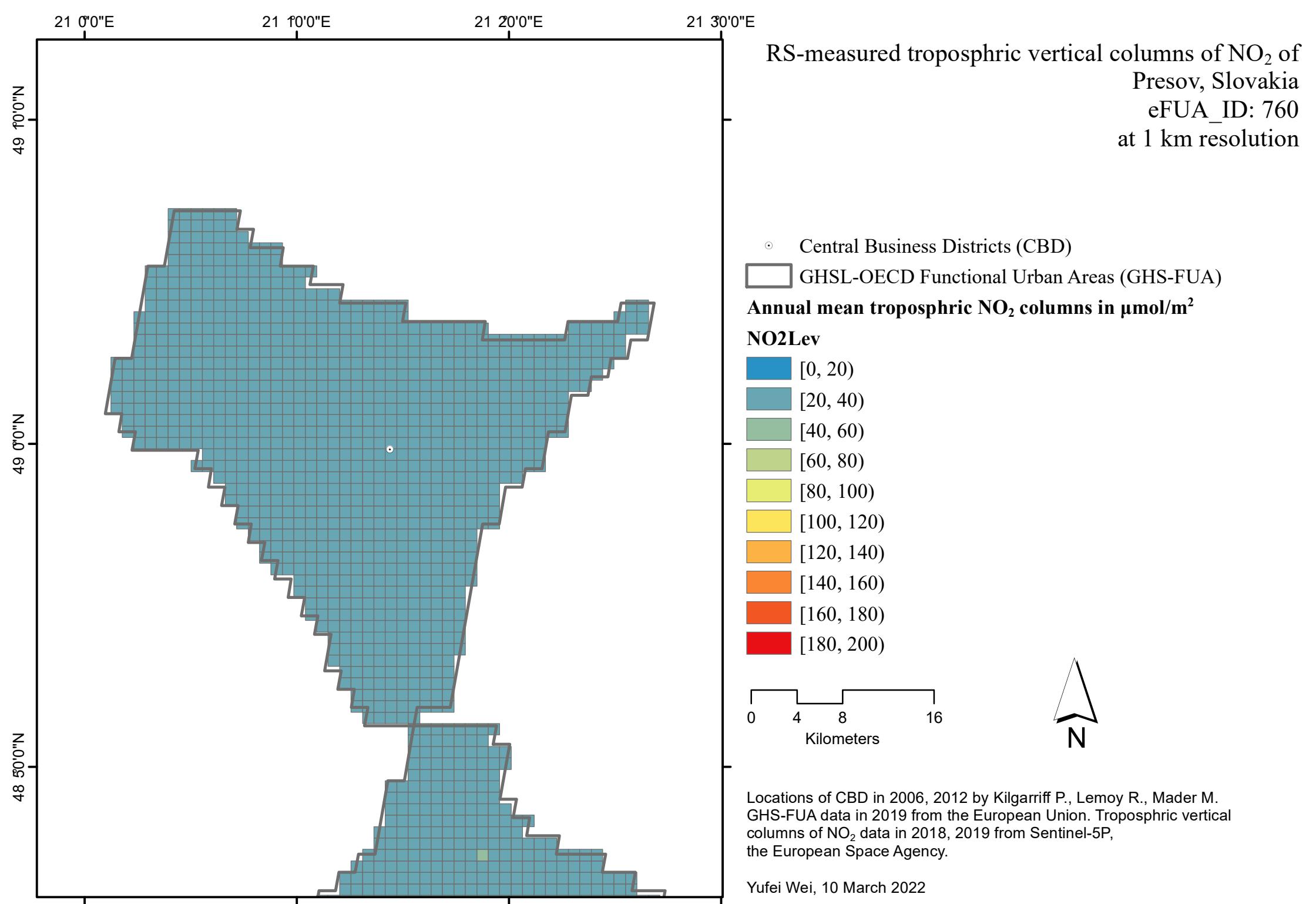












2 50'0"W

2 40'0"W

2 30'0"W

RS-measured tropospheric vertical columns of NO<sub>2</sub> of  
 Preston, United Kingdom  
 eFUA\_ID: 3201  
 at 1 km resolution

53 50'0"N  
 53 40'0"N

○ Central Business Districts (CBD)  
 □ GHSL-OECD Functional Urban Areas (GHS-FUA)

**Annual mean tropospheric NO<sub>2</sub> columns in  $\mu\text{mol}/\text{m}^2$**

**NO2Lev**

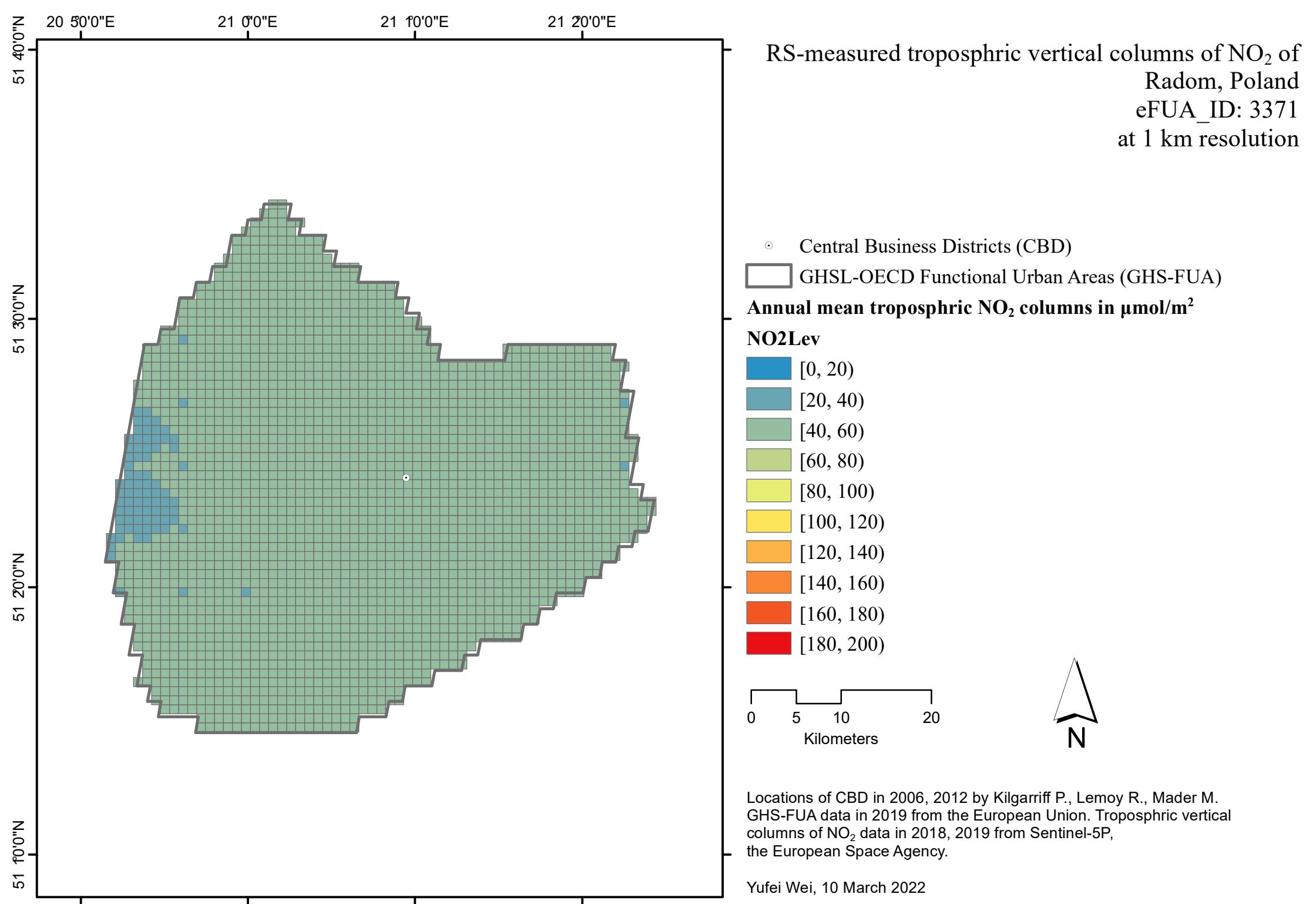
[0, 20)
[20, 40)
[40, 60)
[60, 80)
[80, 100)
[100, 120)
[120, 140)
[140, 160)
[160, 180)
[180, 200)

0 3.75 7.5 15  
 Kilometers



Locations of CBD in 2006, 2012 by Kilgarriff P., Lemoy R., Mader M.  
 GHS-FUA data in 2019 from the European Union. Tropospheric vertical  
 columns of NO<sub>2</sub> data in 2018, 2019 from Sentinel-5P,  
 the European Space Agency.

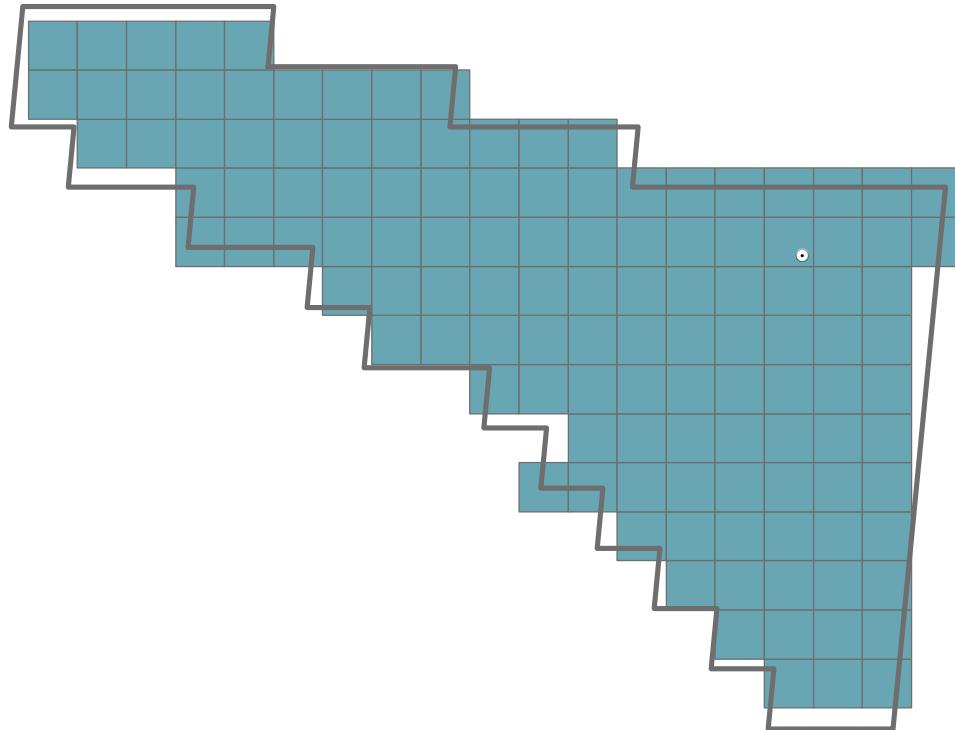
Yufei Wei, 10 March 2022



14°40'0"E

37°0'0"N

36°50'0"N



RS-measured tropospheric vertical columns of NO<sub>2</sub> of  
Ragusa, Italy  
eFUA\_ID: 4564  
at 1 km resolution

○ Central Business Districts (CBD)

◻ GHS-OECD Functional Urban Areas (GHS-FUA)

Annual mean tropospheric NO<sub>2</sub> columns in μmol/m<sup>2</sup>

NO2Lev

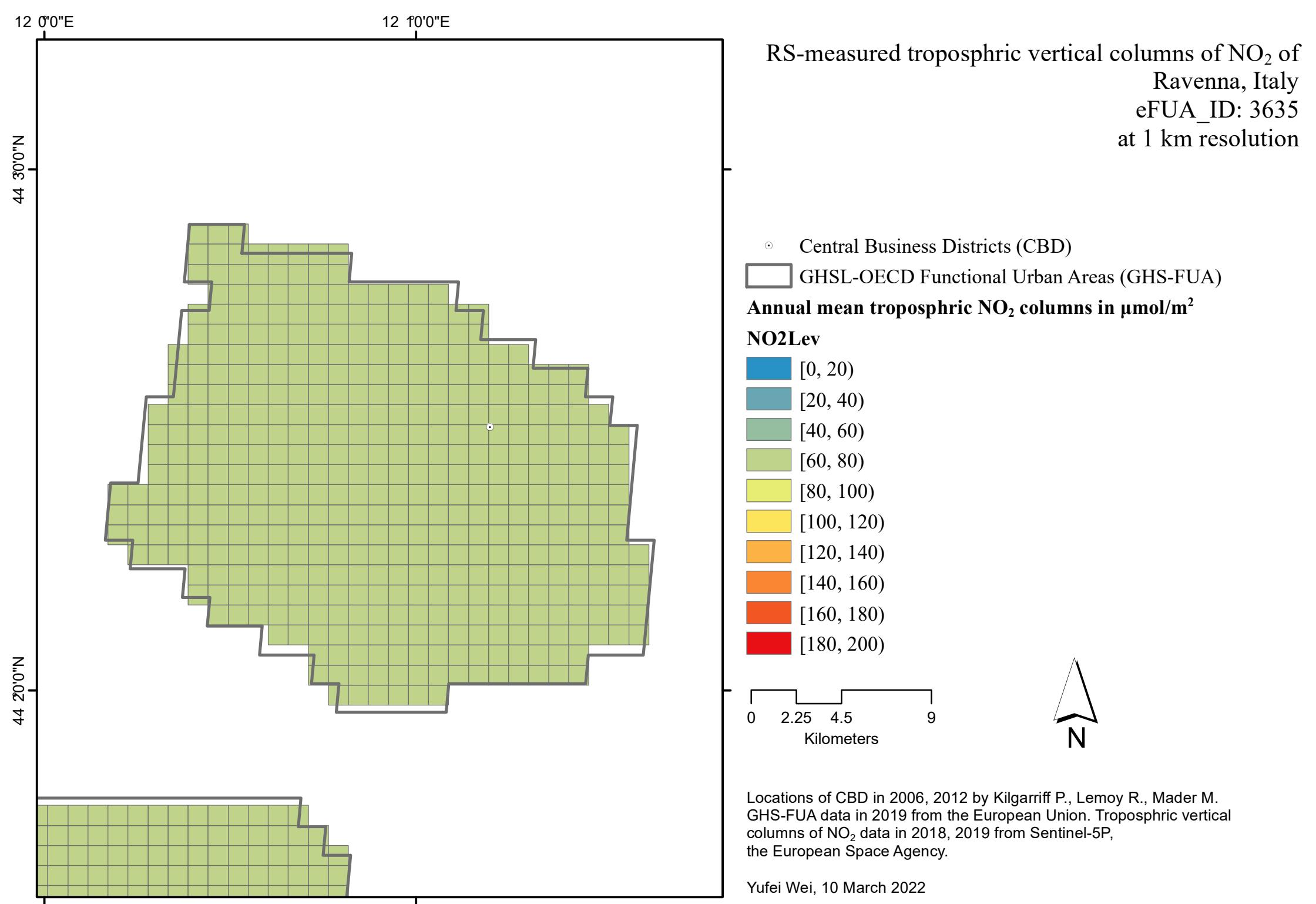
[0, 20)
[20, 40)
[40, 60)
[60, 80)
[80, 100)
[100, 120)
[120, 140)
[140, 160)
[160, 180)
[180, 200)

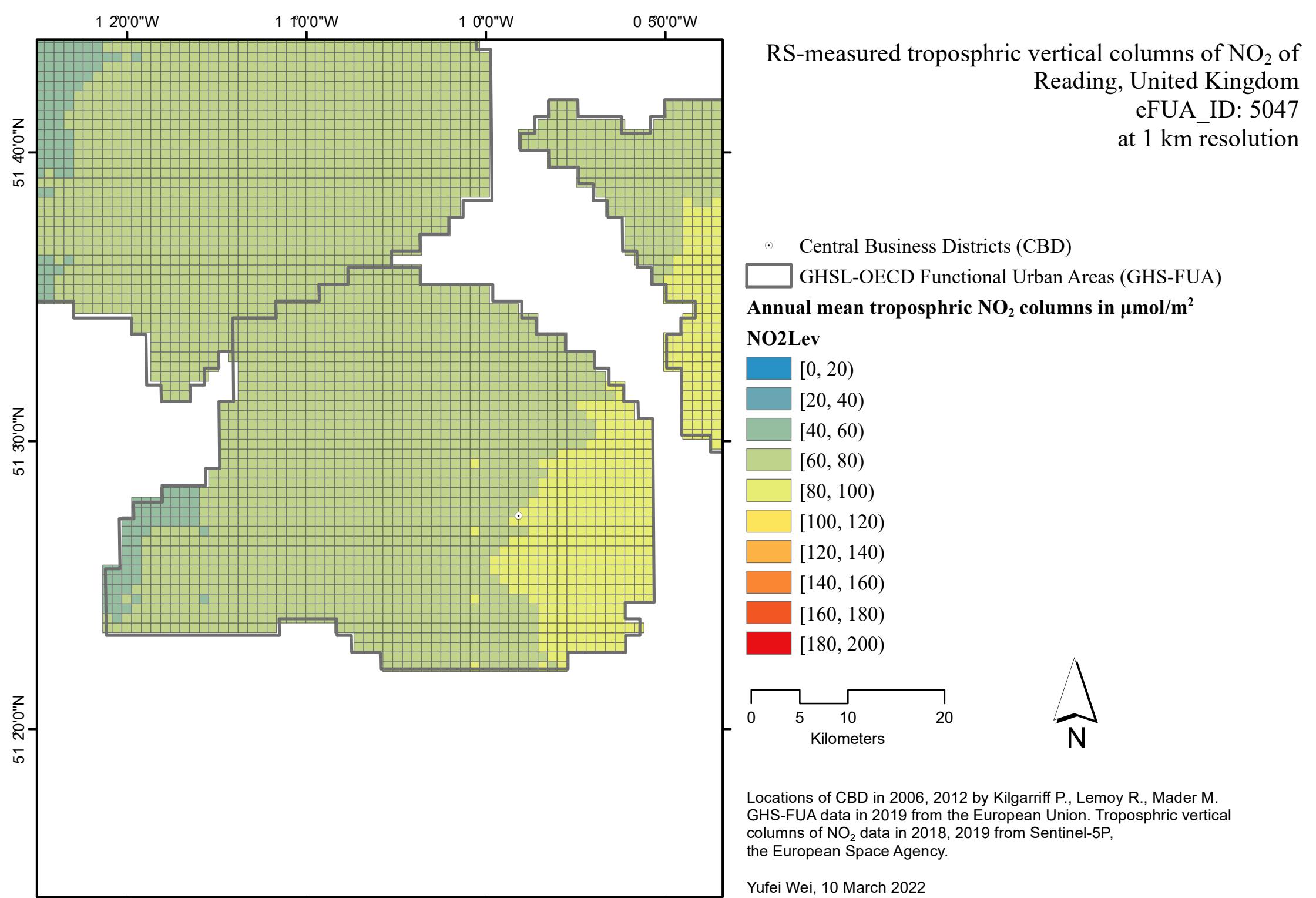
0 1.5 3 6  
Kilometers

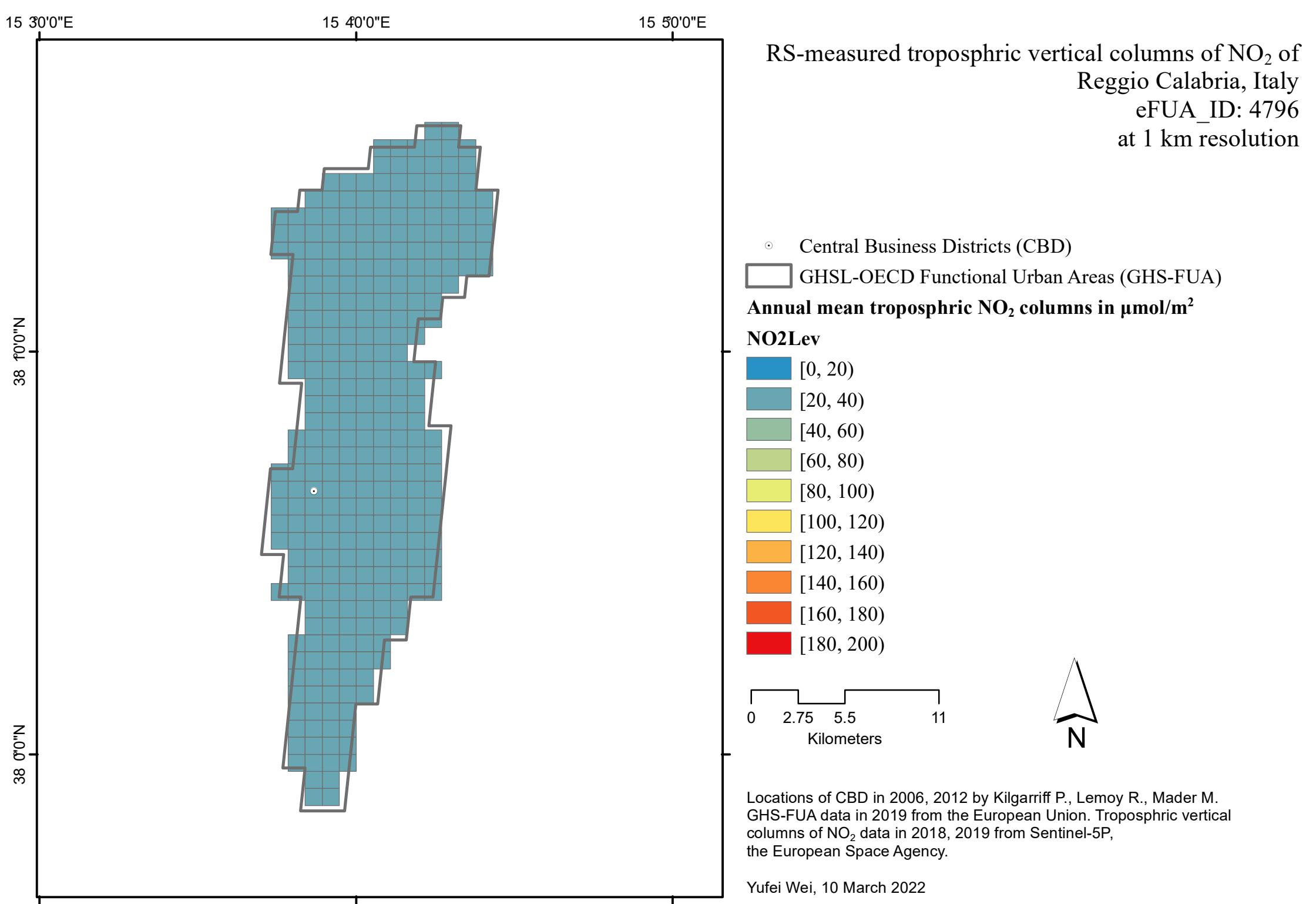


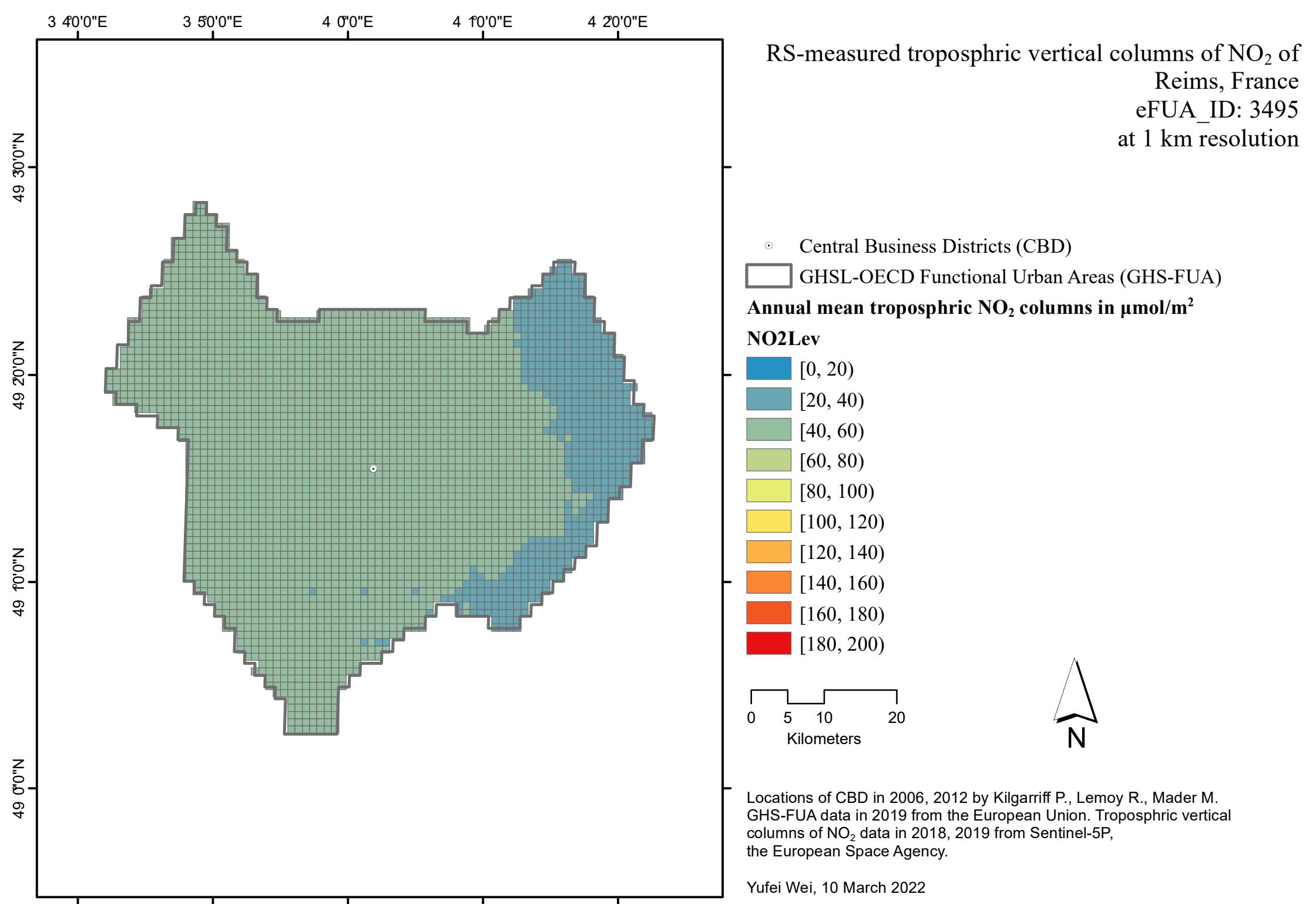
Locations of CBD in 2006, 2012 by Kilgarriff P., Lemoy R., Mader M.  
GHS-FUA data in 2019 from the European Union. Tropospheric vertical  
columns of NO<sub>2</sub> data in 2018, 2019 from Sentinel-5P,  
the European Space Agency.

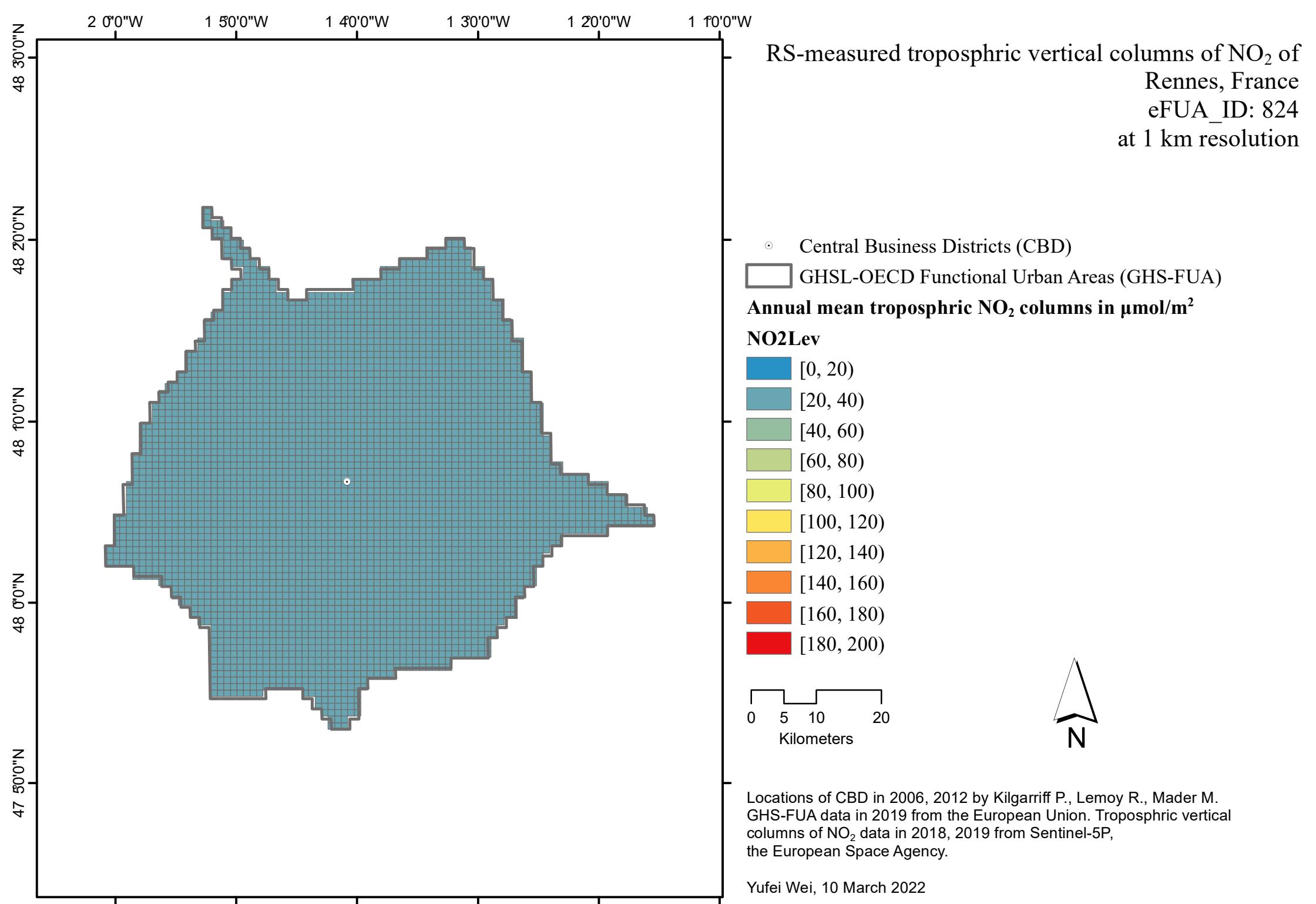
Yufei Wei, 10 March 2022

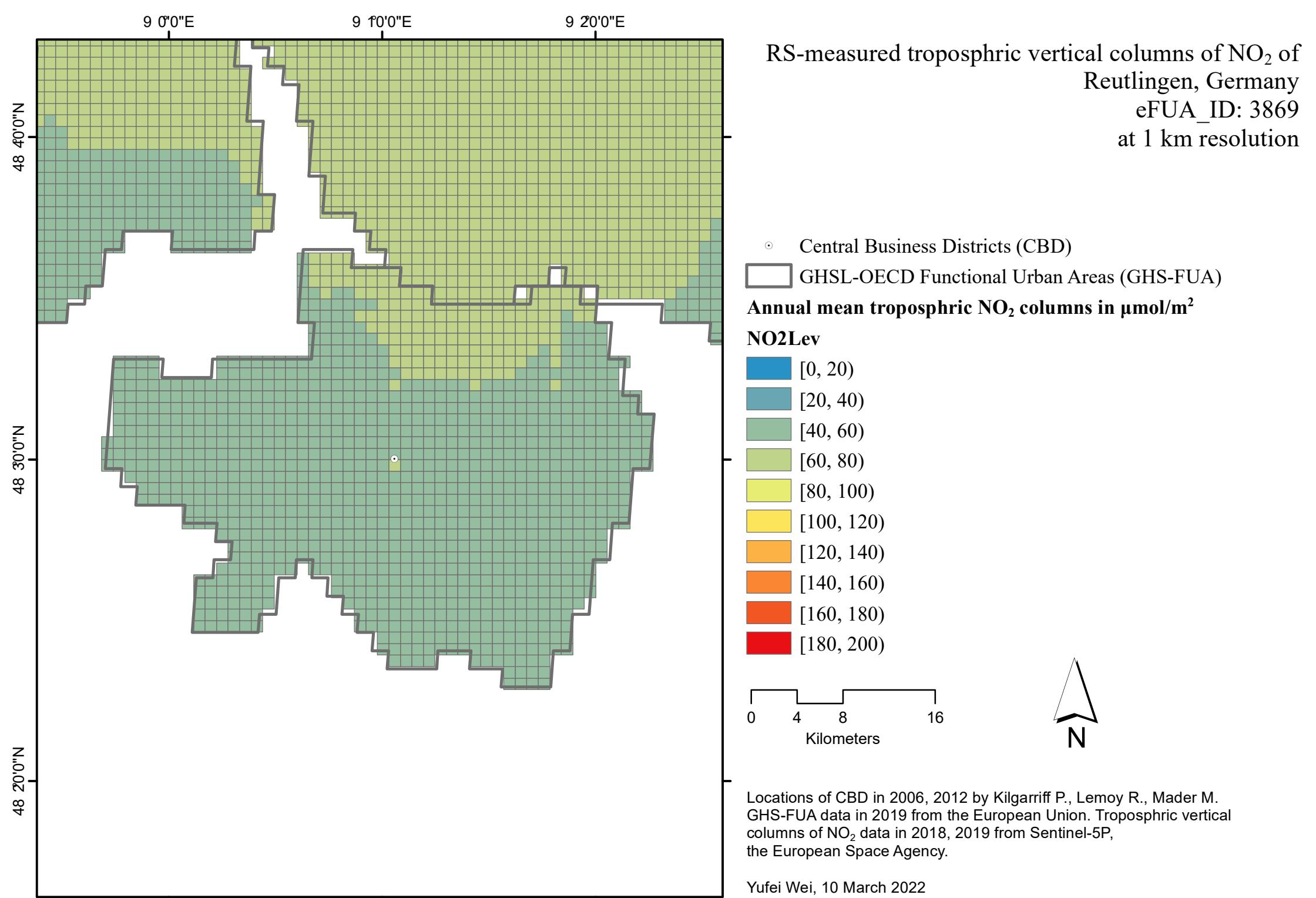










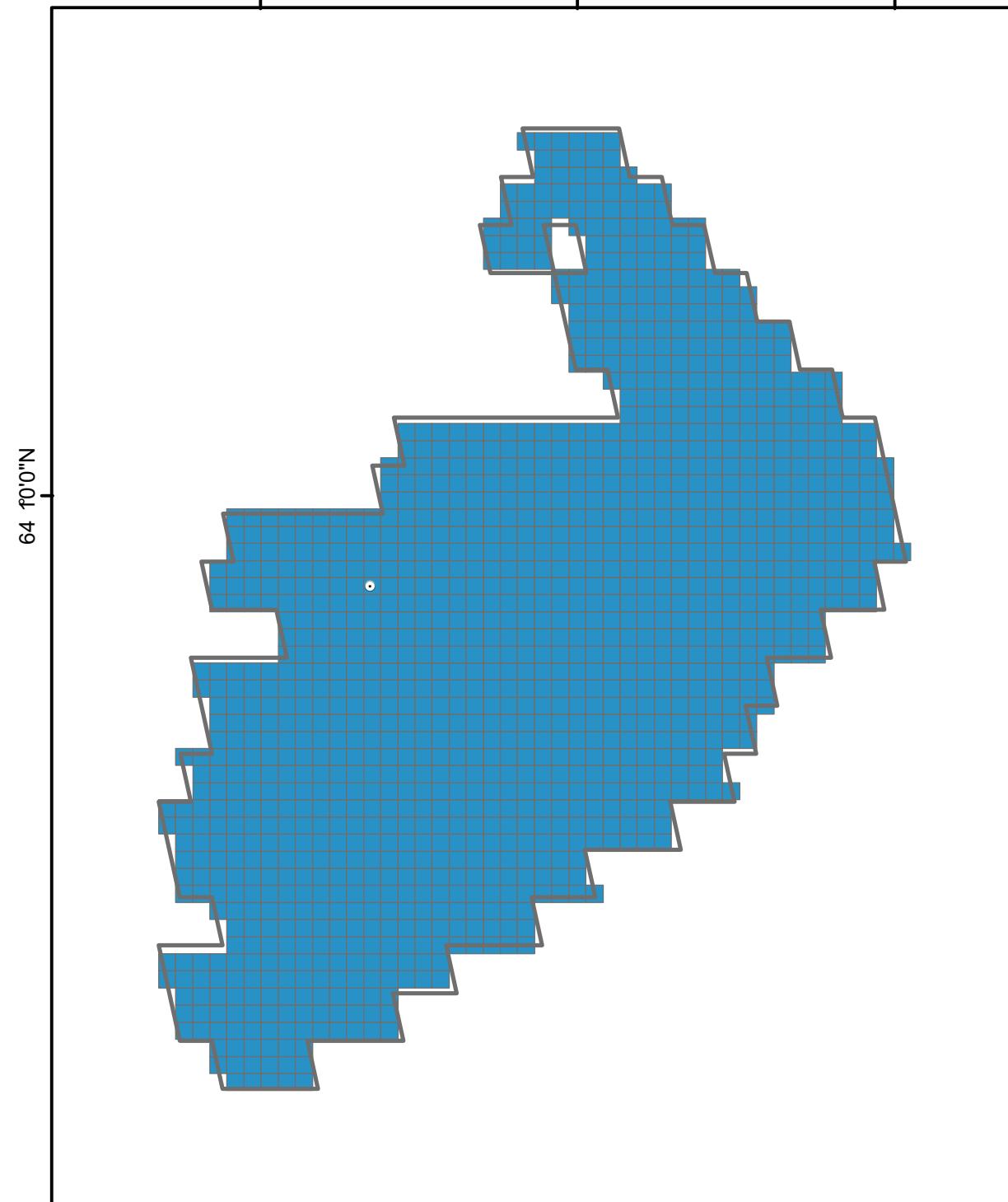


22 0'0"W

21 50'0"W

21 40'0"W

RS-measured tropospheric vertical columns of NO<sub>2</sub> of  
Reykjavik, Iceland  
eFUA\_ID: 83  
at 1 km resolution



○ Central Business Districts (CBD)

◻ GHSL-OECD Functional Urban Areas (GHS-FUA)

Annual mean tropospheric NO<sub>2</sub> columns in μmol/m<sup>2</sup>

NO2Lev

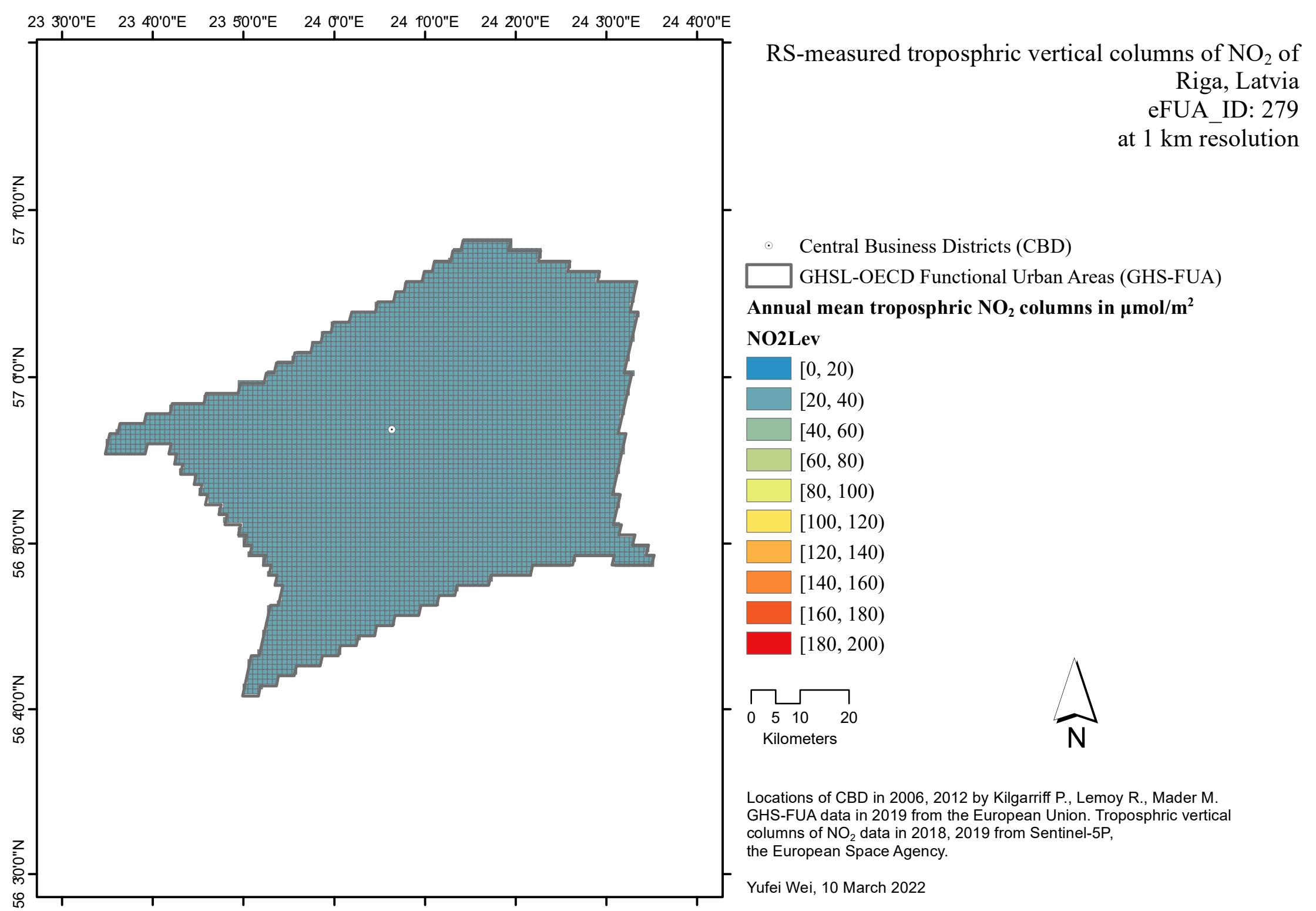
- [0, 20]
- [20, 40]
- [40, 60]
- [60, 80]
- [80, 100]
- [100, 120]
- [120, 140]
- [140, 160]
- [160, 180]
- [180, 200]

0 3.75 7.5 15  
Kilometers



Locations of CBD in 2006, 2012 by Kilgarriff P., Lemoy R., Mader M.  
GHS-FUA data in 2019 from the European Union. Tropospheric vertical  
columns of NO<sub>2</sub> data in 2018, 2019 from Sentinel-5P,  
the European Space Agency.

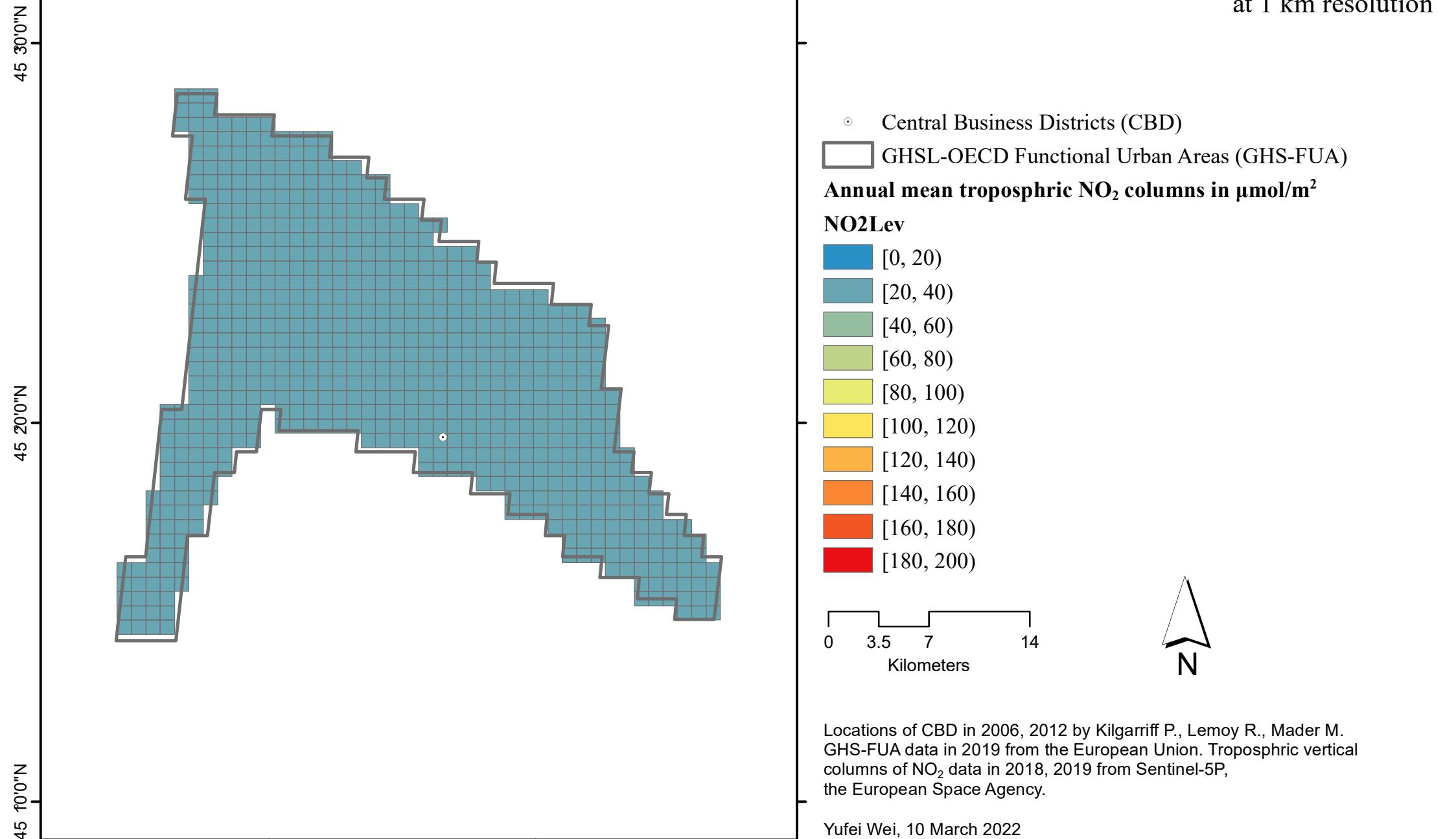
Yufei Wei, 10 March 2022

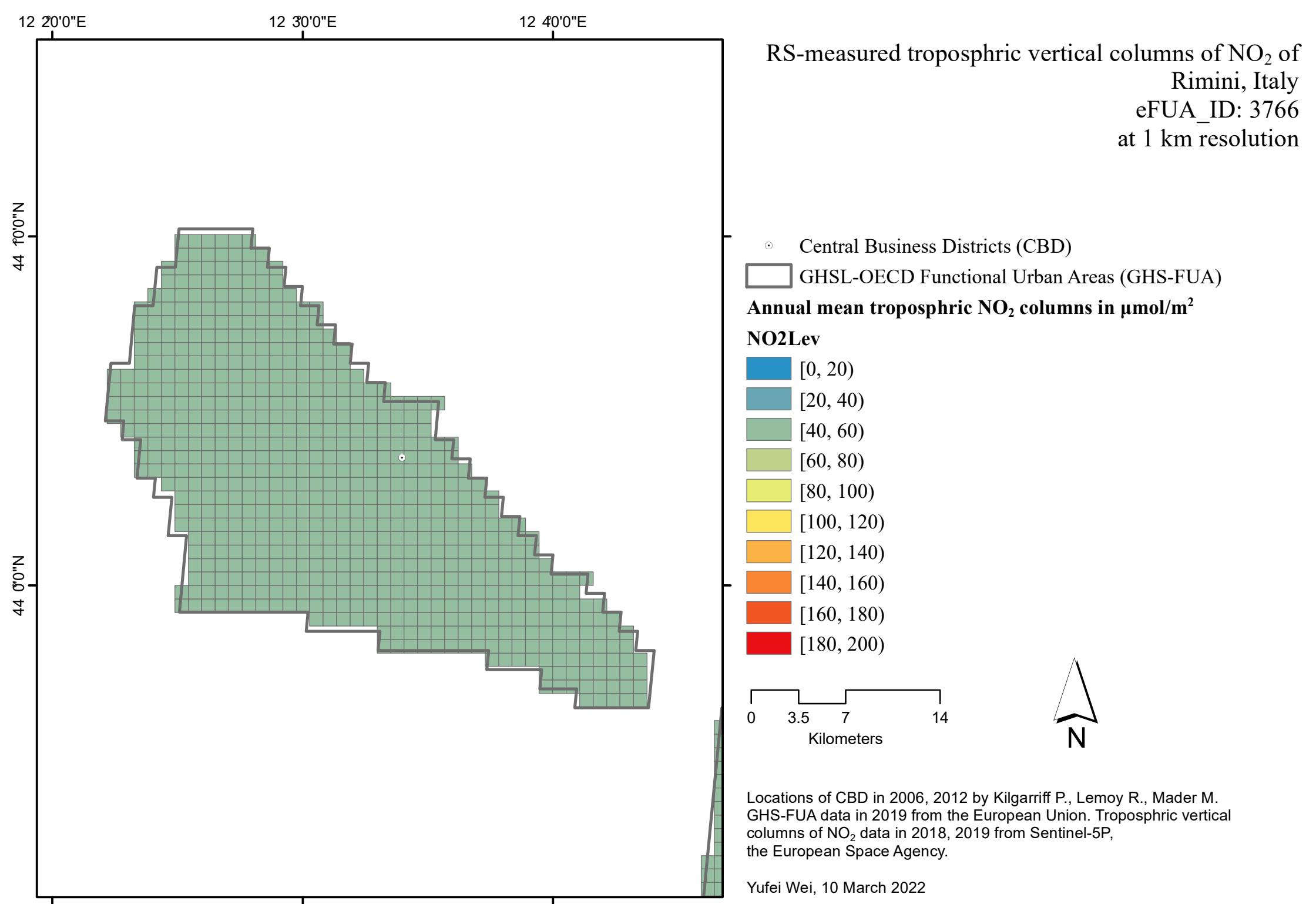


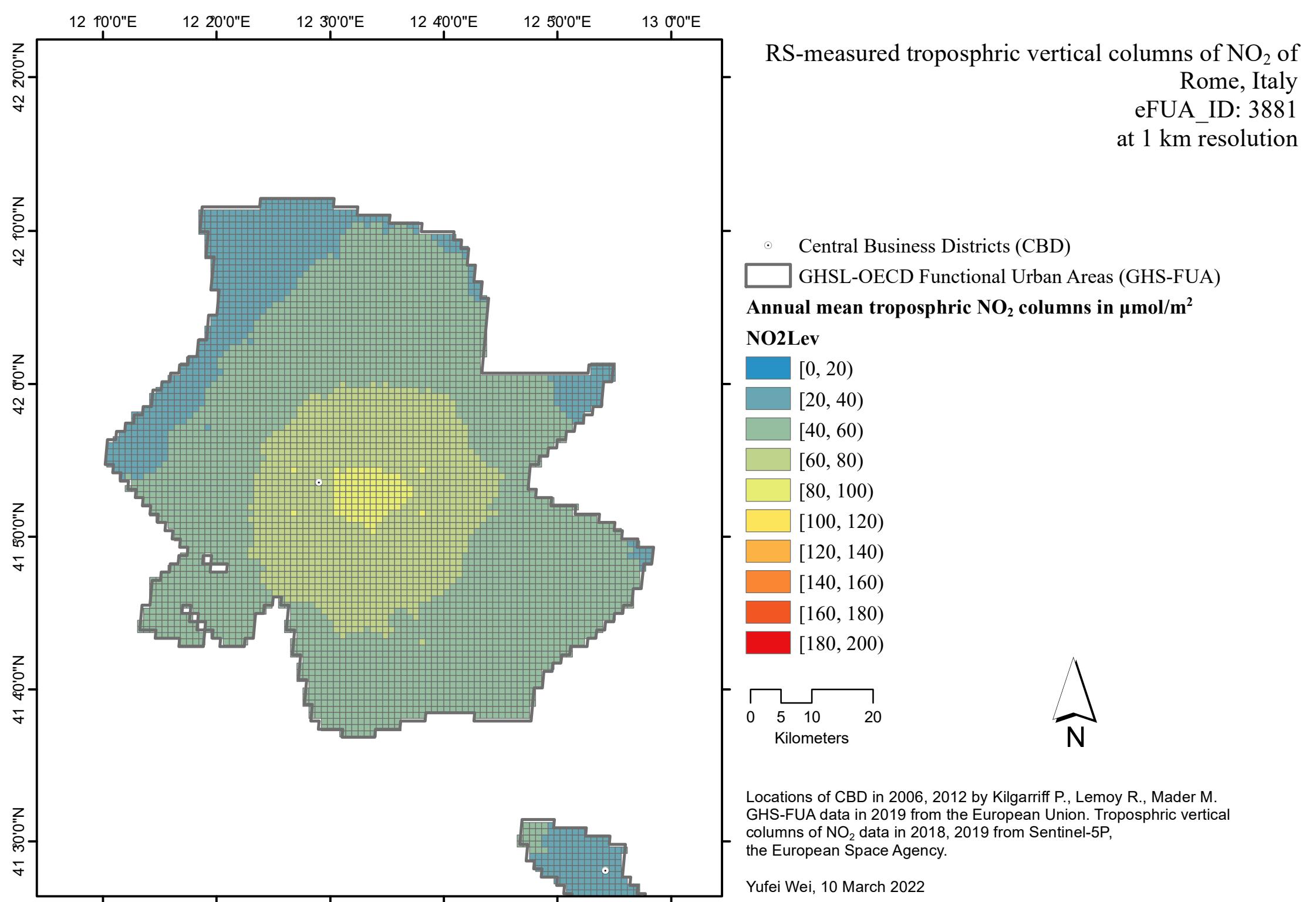
14 20'0"E

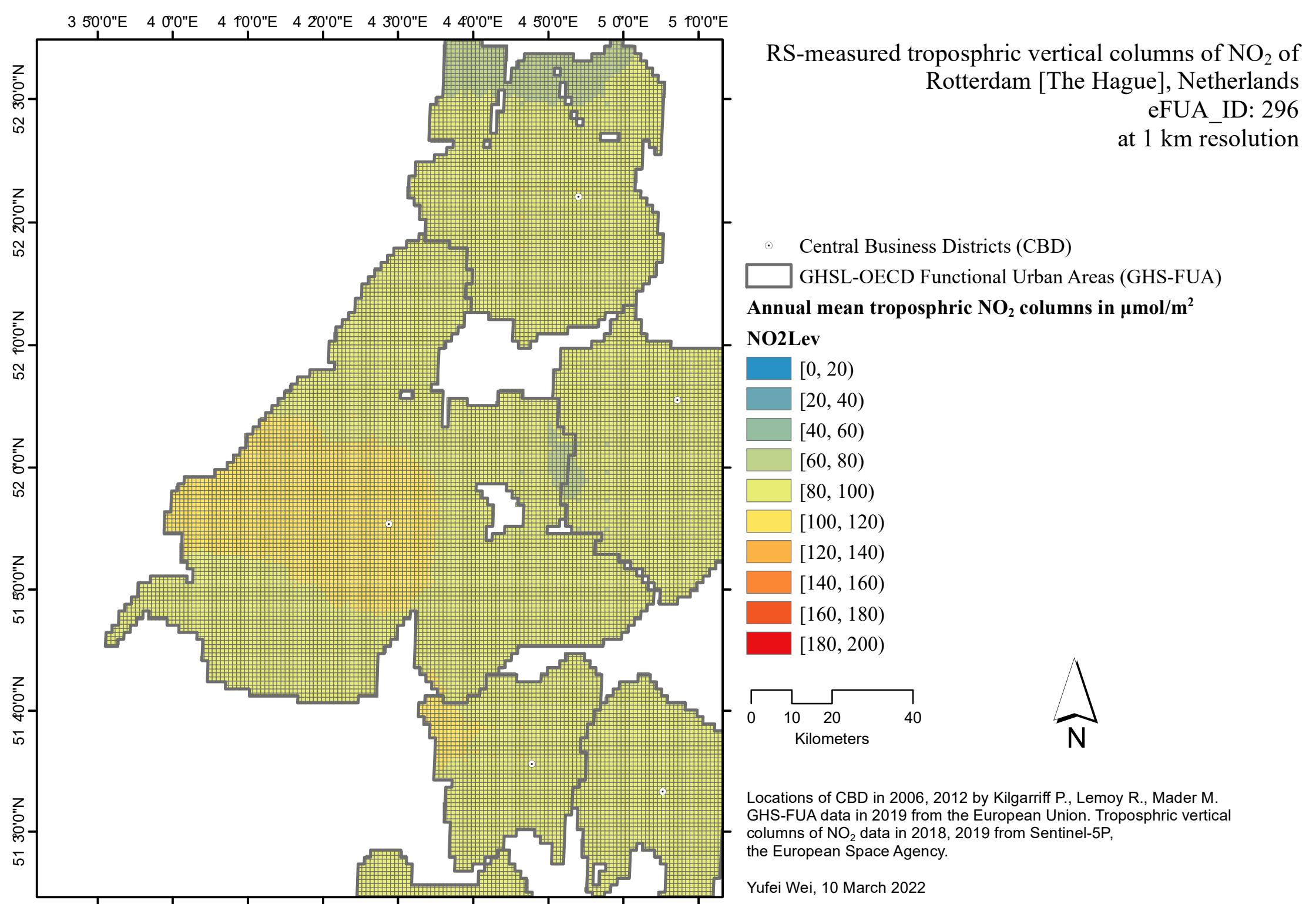
14 30'0"E

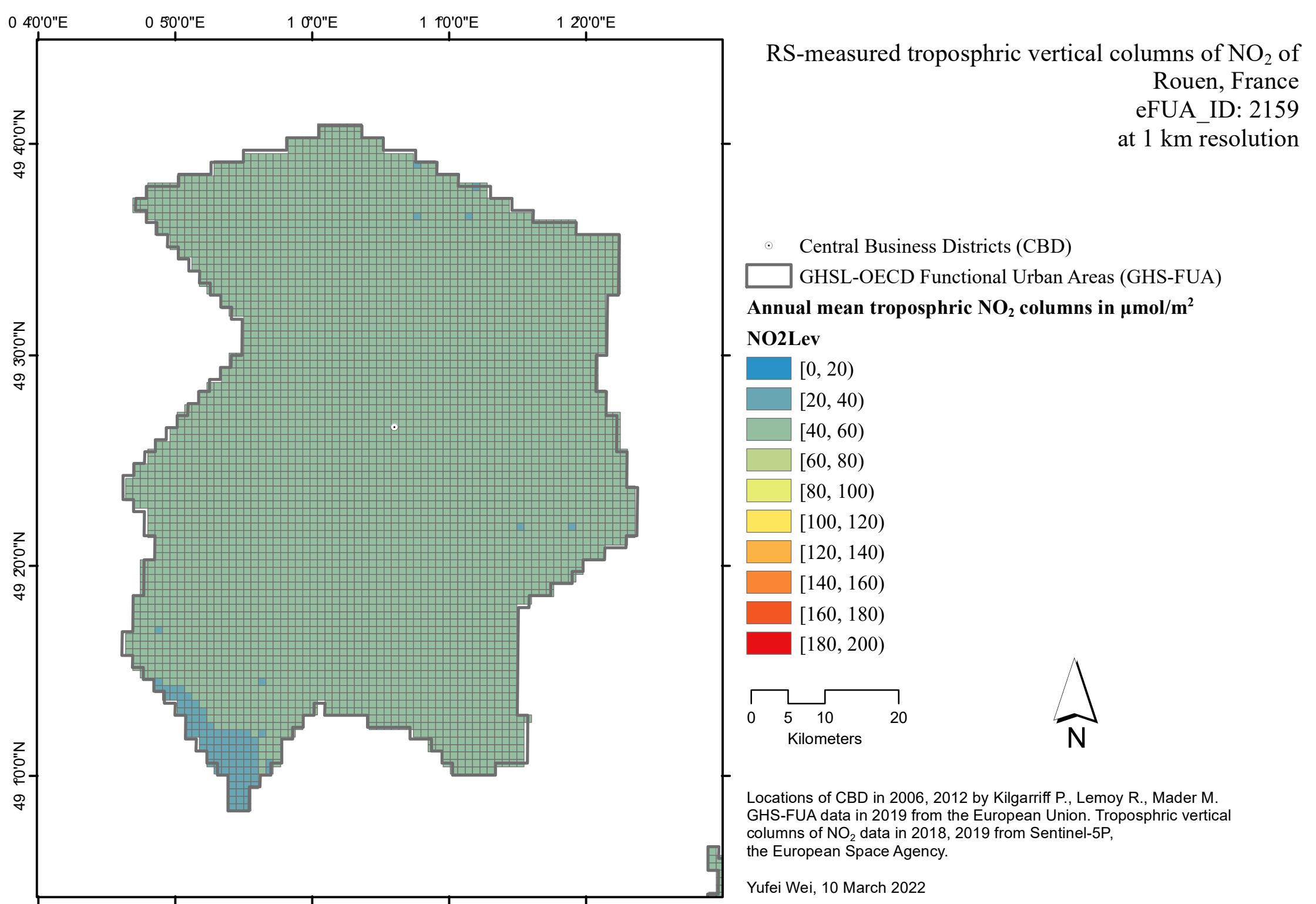
RS-measured tropospheric vertical columns of NO<sub>2</sub> of  
Rijeka, Croatia  
eFUA\_ID: 75  
at 1 km resolution





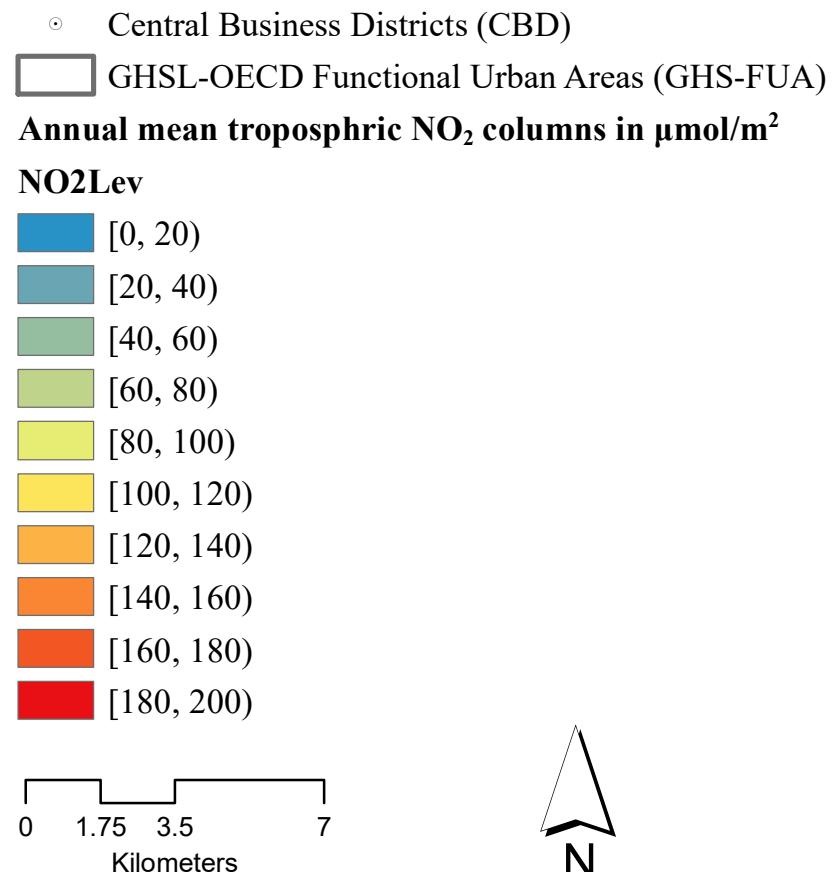
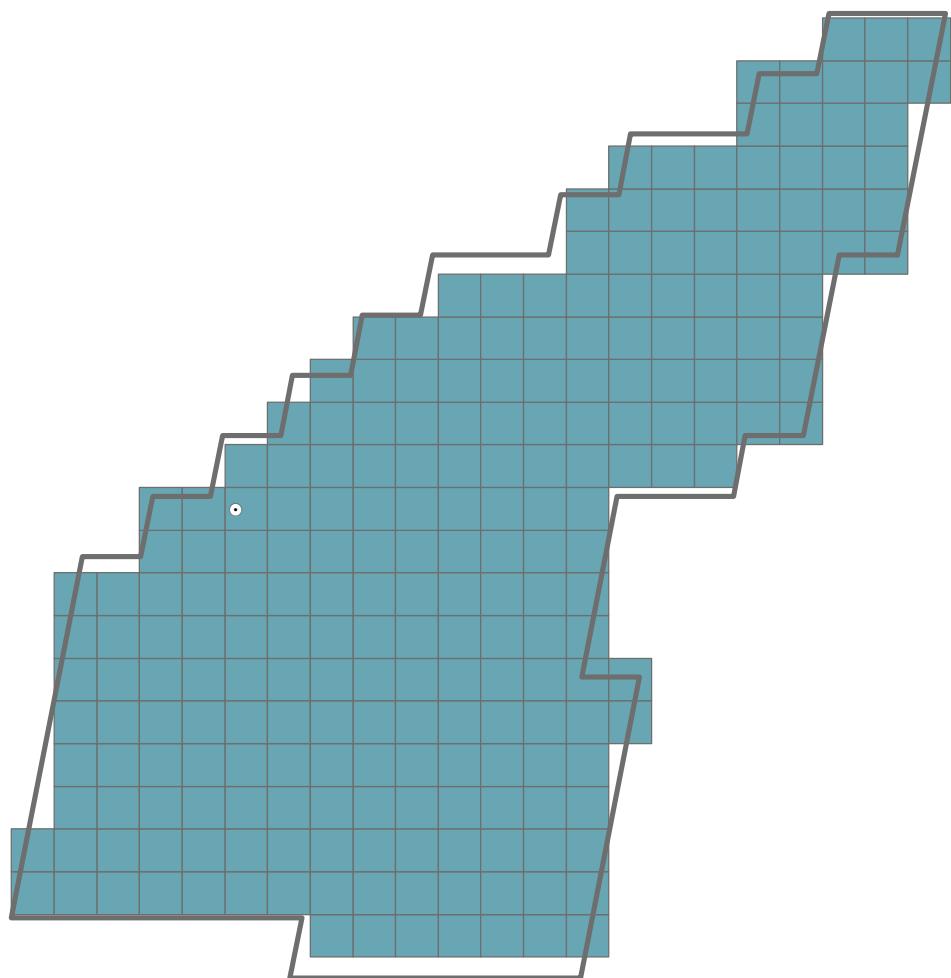






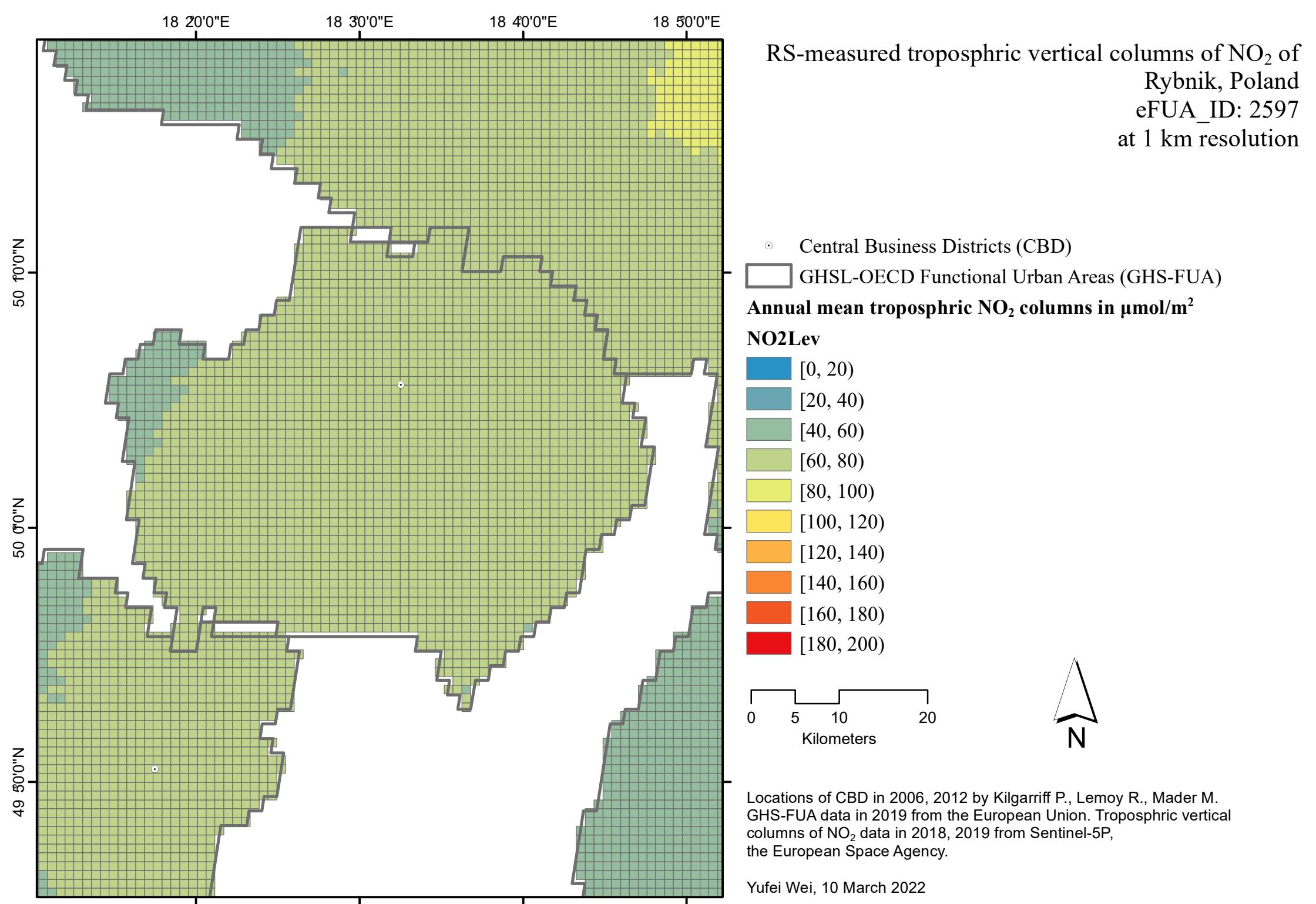
26 0'0"E

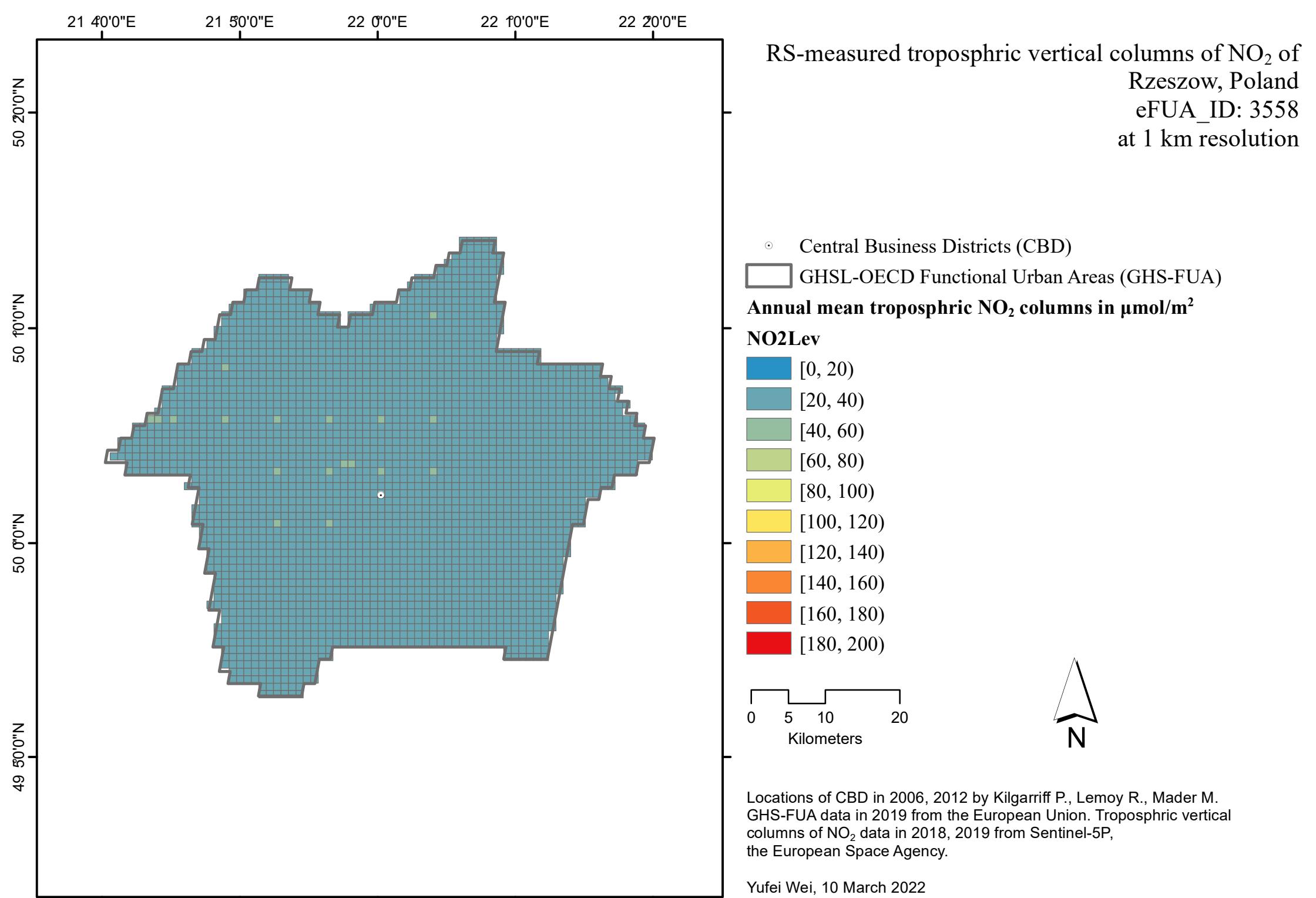
RS-measured tropospheric vertical columns of NO<sub>2</sub> of  
Ruse, Bulgaria  
eFUA\_ID: 518  
at 1 km resolution



Locations of CBD in 2006, 2012 by Kilgarriff P., Lemoy R., Mader M.  
GHS-FUA data in 2019 from the European Union. Tropospheric vertical  
columns of NO<sub>2</sub> data in 2018, 2019 from Sentinel-5P,  
the European Space Agency.

Yufei Wei, 10 March 2022





6 40'0"E

6 50'0"E

7 0'0"E

7 10'0"E

RS-measured tropospheric vertical columns of NO<sub>2</sub> of  
Saarbruecken, Germany  
eFUA\_ID: 1287  
at 1 km resolution

49 30'0"N

49 20'0"N

49 10'0"N

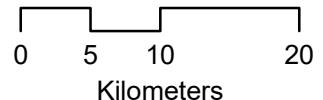
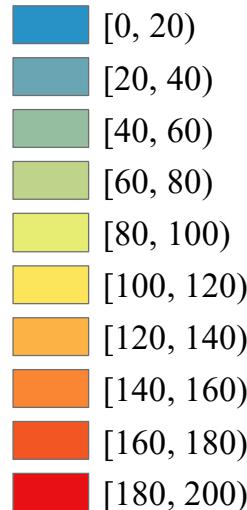
49 0'0"N

○ Central Business Districts (CBD)

◻ GHSL-OECD Functional Urban Areas (GHS-FUA)

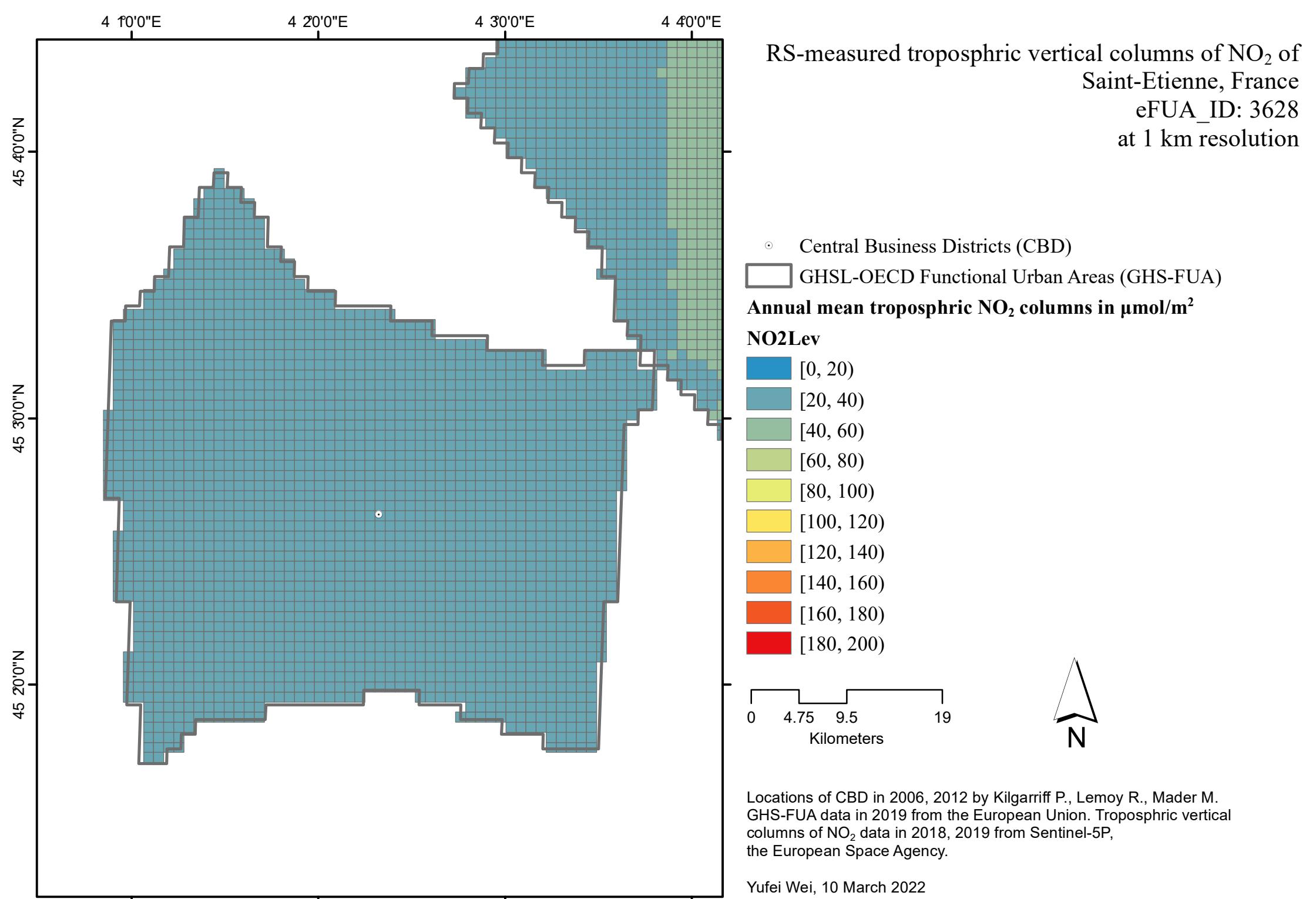
Annual mean tropospheric NO<sub>2</sub> columns in  $\mu\text{mol}/\text{m}^2$

NO2Lev

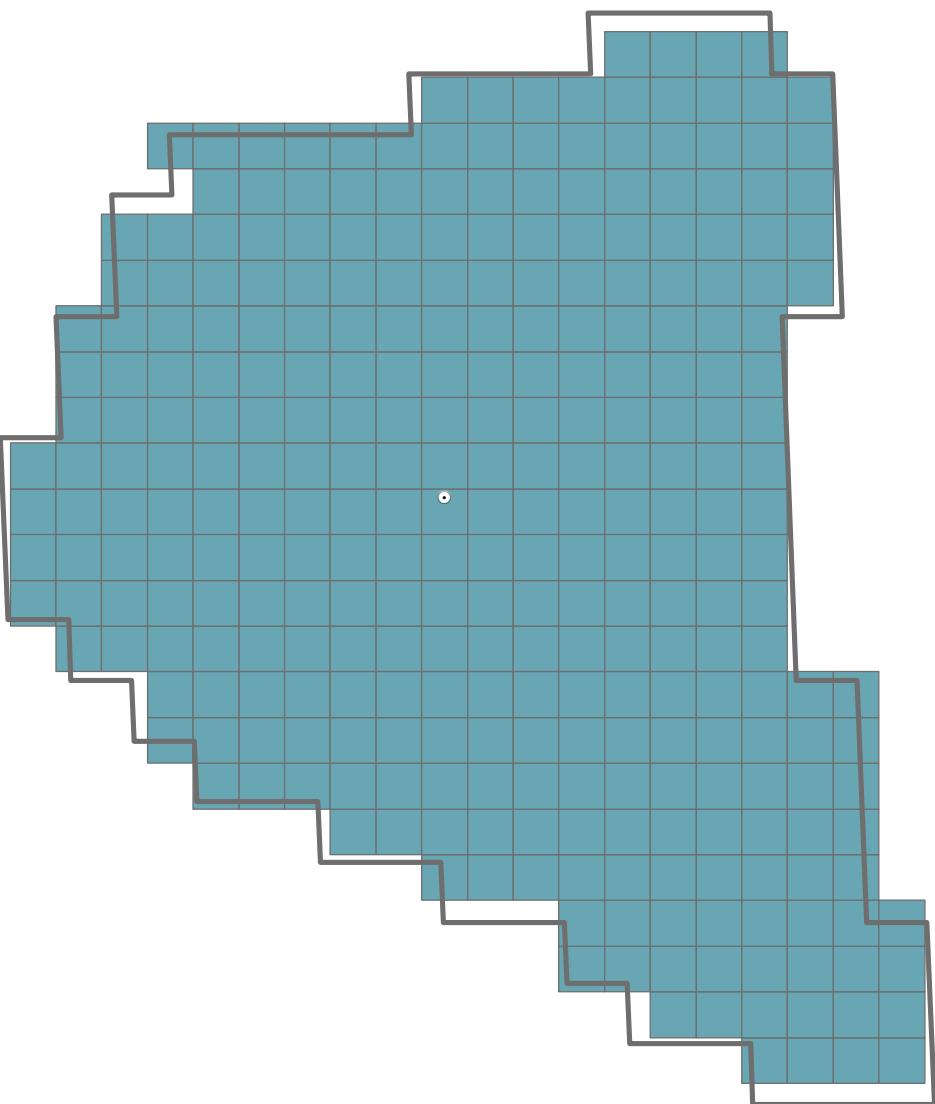


Locations of CBD in 2006, 2012 by Kilgarriff P., Lemoy R., Mader M.  
GHS-FUA data in 2019 from the European Union. Tropospheric vertical  
columns of NO<sub>2</sub> data in 2018, 2019 from Sentinel-5P,  
the European Space Agency.

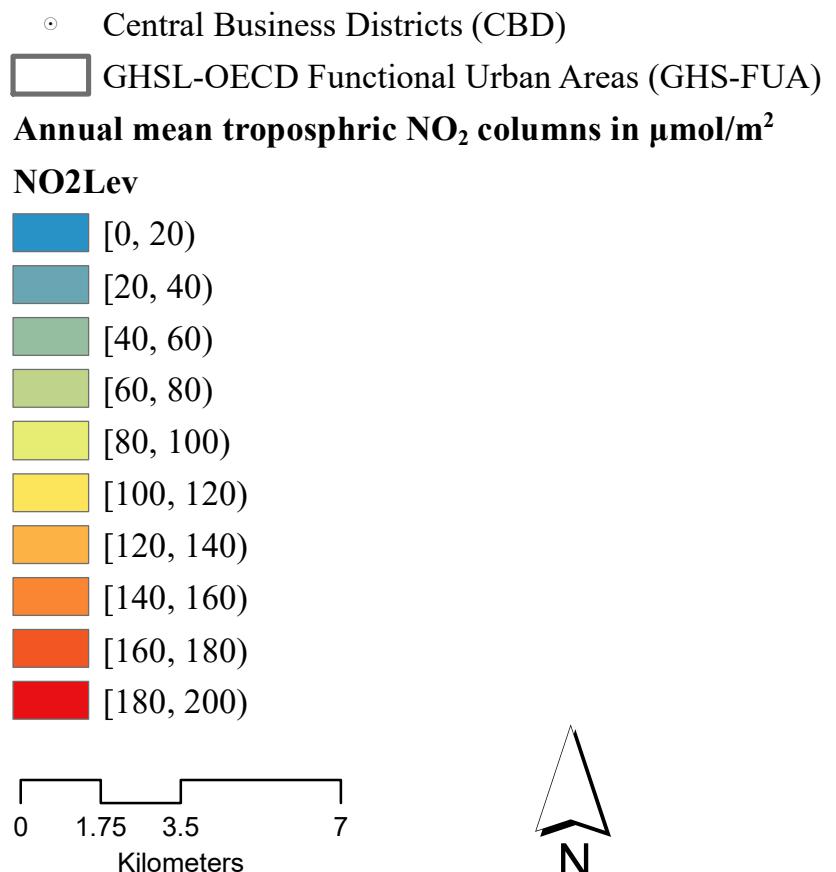
Yufei Wei, 10 March 2022



54°0'W



RS-measured tropospheric vertical columns of NO<sub>2</sub> of  
Salamanca, Spain  
eFUA\_ID: 2371  
at 1 km resolution



Locations of CBD in 2006, 2012 by Kilgarriff P., Lemoy R., Mader M.  
GHS-FUA data in 2019 from the European Union. Tropospheric vertical  
columns of NO<sub>2</sub> data in 2018, 2019 from Sentinel-5P,  
the European Space Agency.

Yufei Wei, 10 March 2022

14 40'0"E

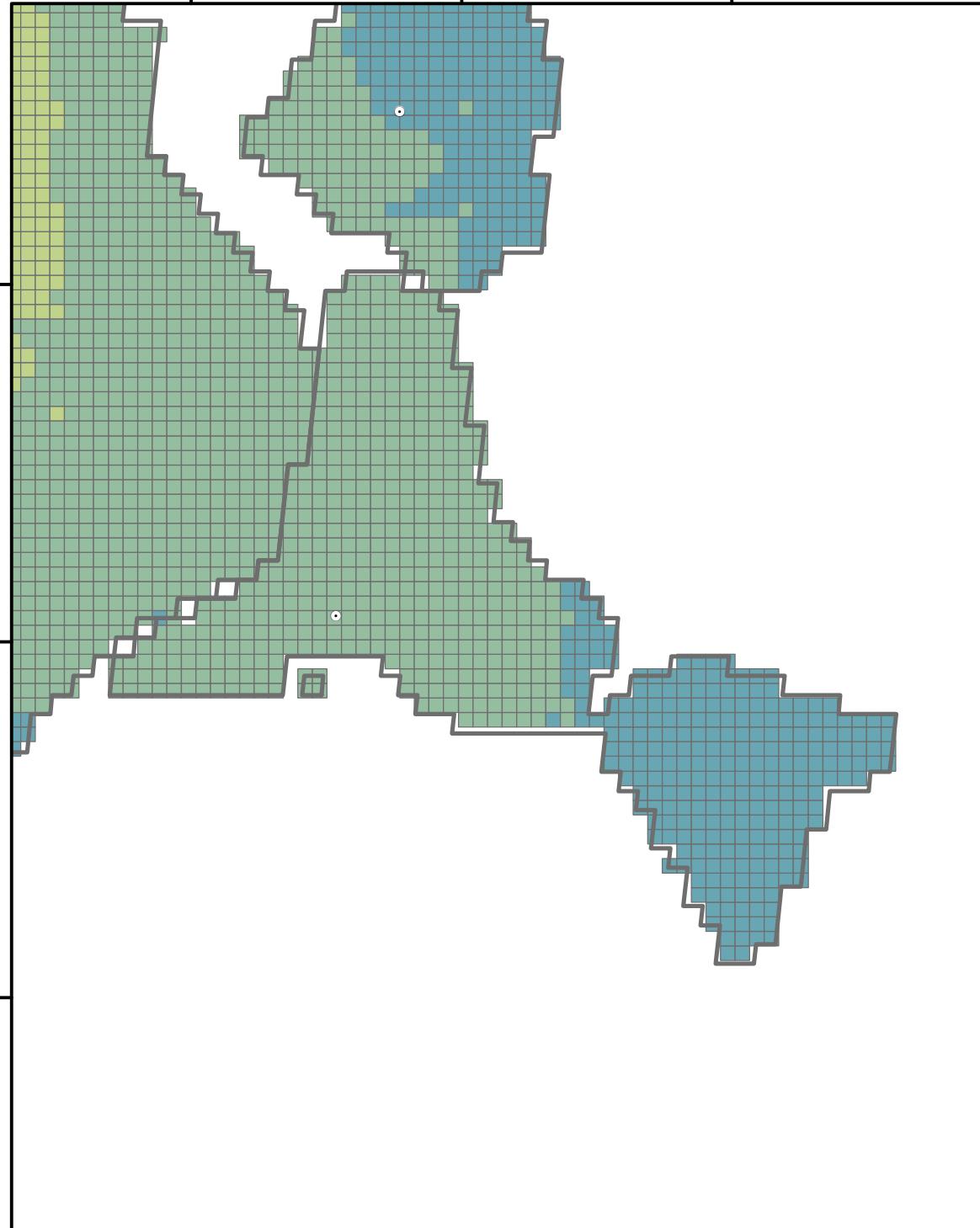
14 50'0"E

15 0'0"E

40 50'0"N

40 40'0"N

40 30'0"N



RS-measured tropospheric vertical columns of NO<sub>2</sub> of  
Salerno, Italy  
eFUA\_ID: 4498  
at 1 km resolution

○ Central Business Districts (CBD)

◻ GHS-OECD Functional Urban Areas (GHS-FUA)

**Annual mean tropospheric NO<sub>2</sub> columns in  $\mu\text{mol}/\text{m}^2$**

**NO2Lev**

- [0, 20)
- [20, 40)
- [40, 60)
- [60, 80)
- [80, 100)
- [100, 120)
- [120, 140)
- [140, 160)
- [160, 180)
- [180, 200)

0 4.5 9 18  
Kilometers



Locations of CBD in 2006, 2012 by Kilgarriff P., Lemoy R., Mader M.  
GHS-FUA data in 2019 from the European Union. Tropospheric vertical  
columns of NO<sub>2</sub> data in 2018, 2019 from Sentinel-5P,  
the European Space Agency.

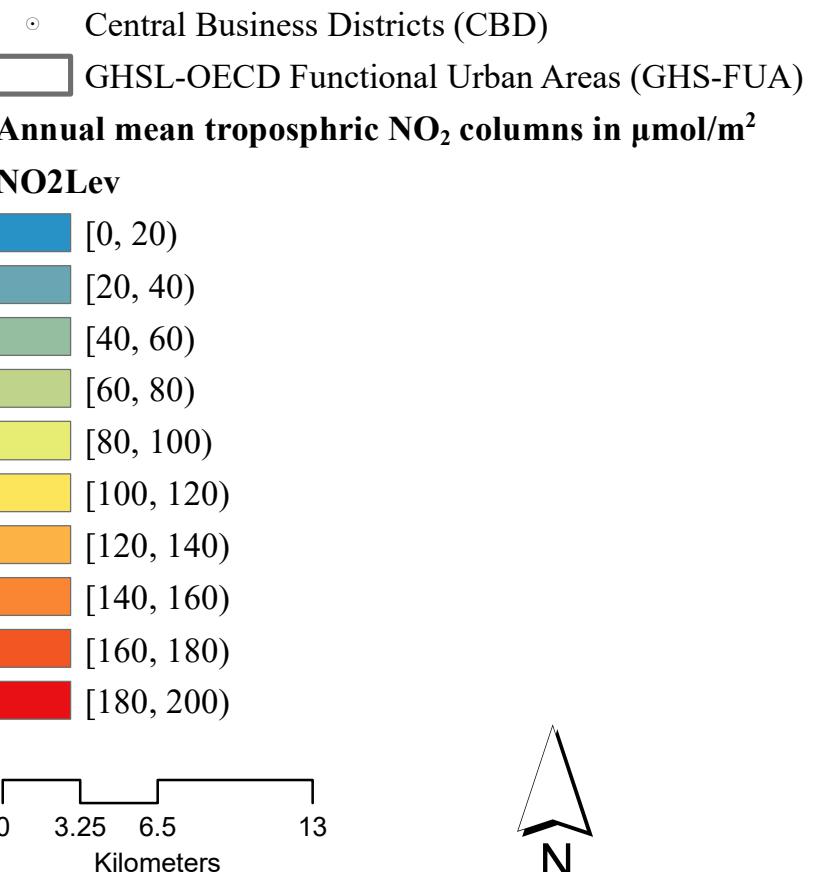
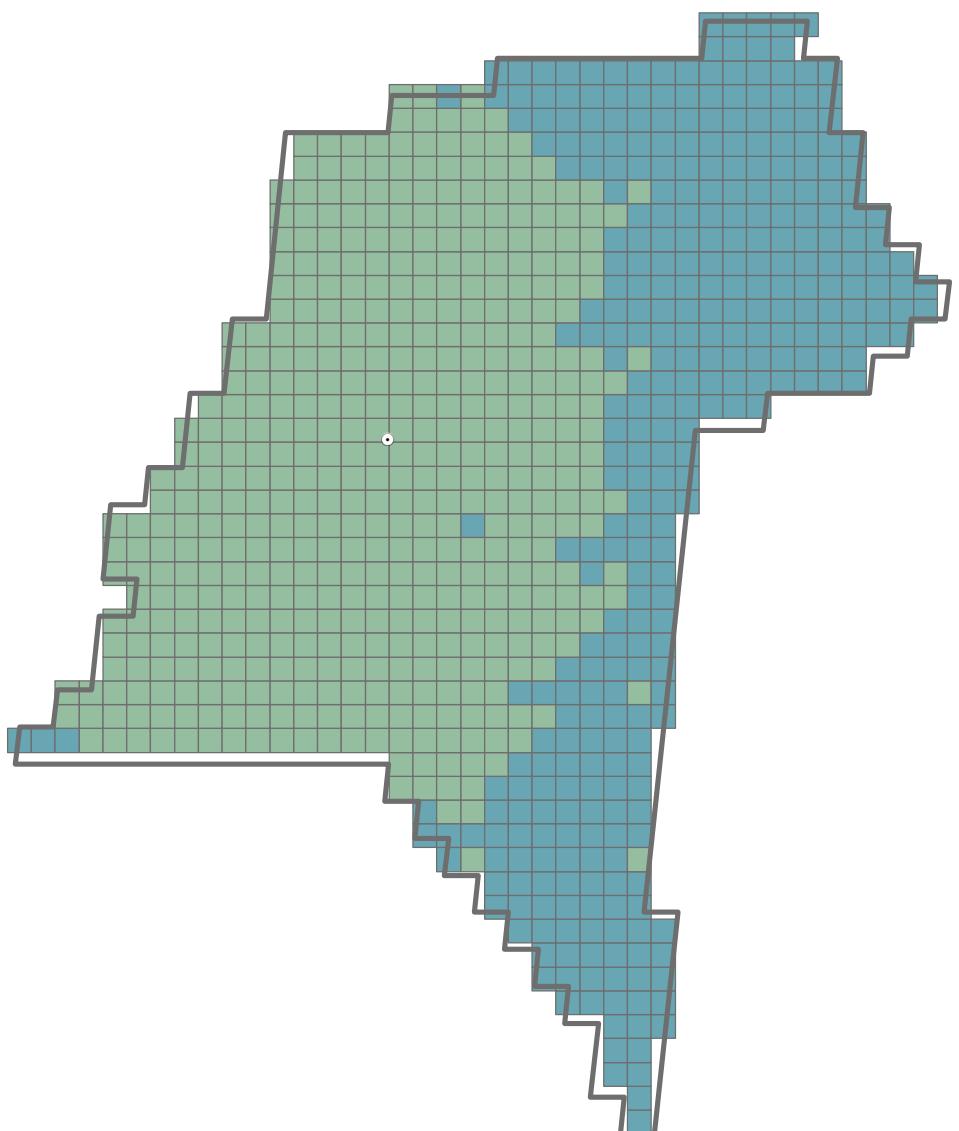
Yufei Wei, 10 March 2022

13 0'0"E

13 10'0"E

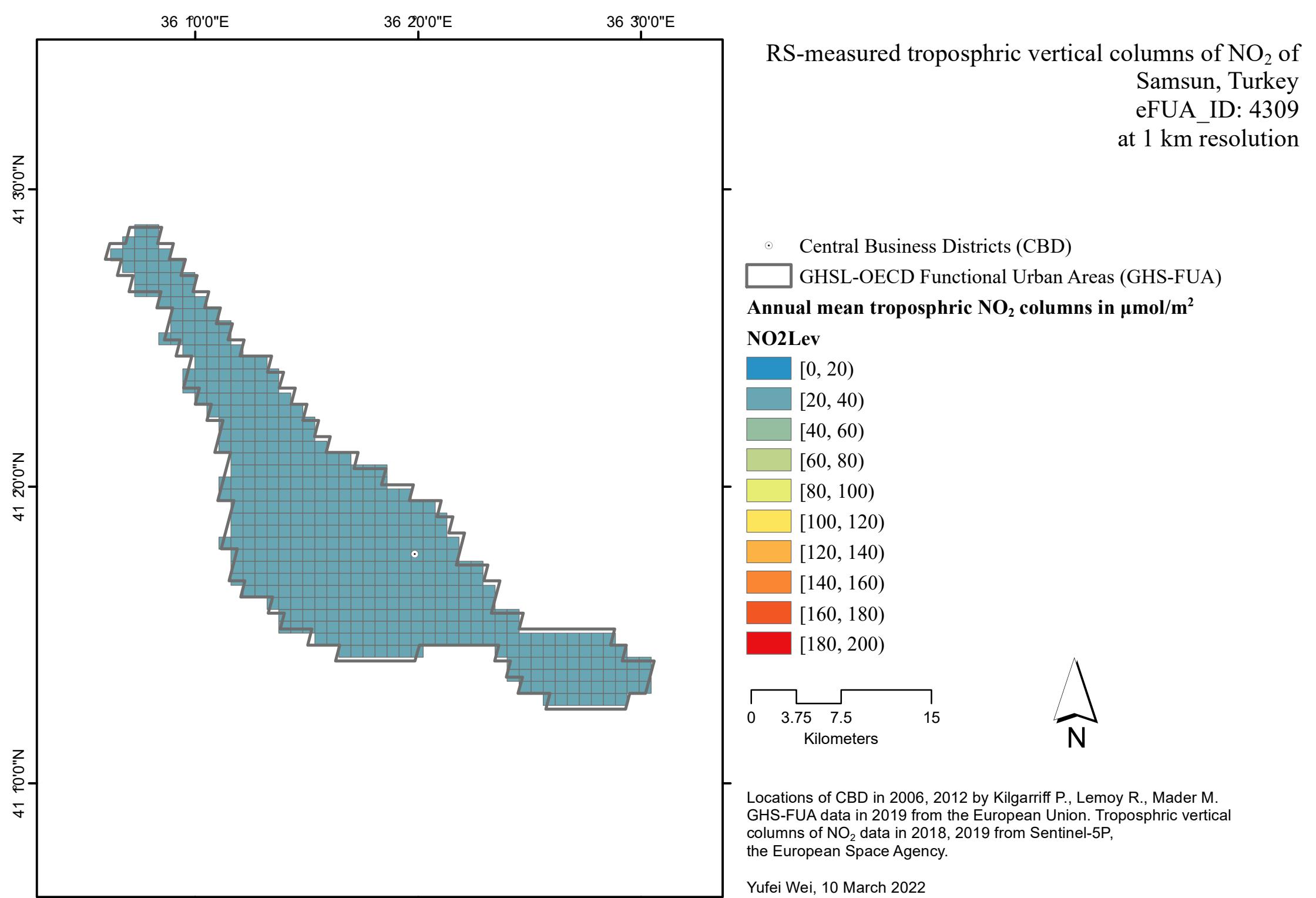
RS-measured tropospheric vertical columns of NO<sub>2</sub> of  
Salzburg, Austria  
eFUA\_ID: 199  
at 1 km resolution

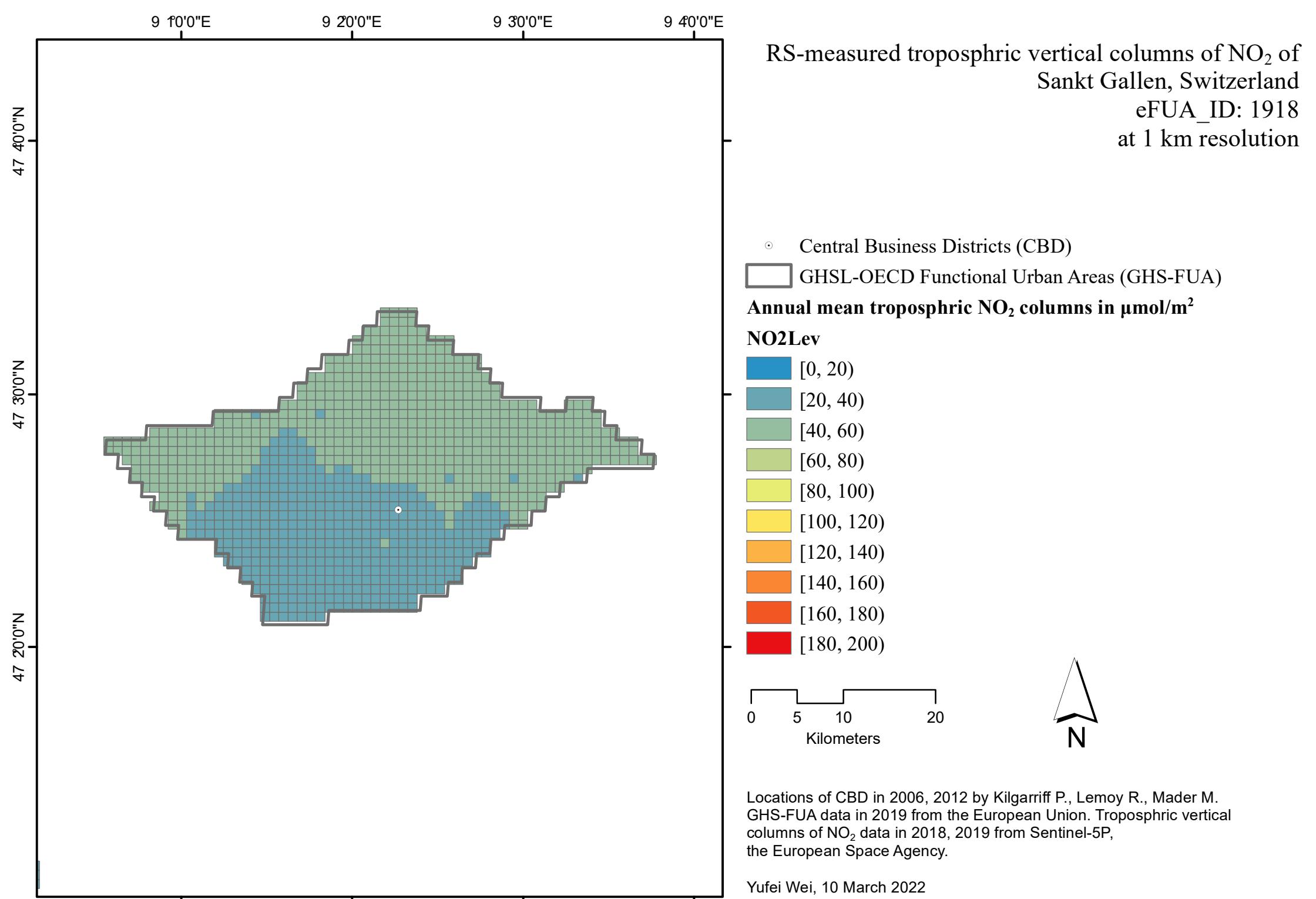
47 50'0"N  
47 40'0"N



Locations of CBD in 2006, 2012 by Kilgarriff P., Lemoy R., Mader M.  
GHS-FUA data in 2019 from the European Union. Tropospheric vertical  
columns of NO<sub>2</sub> data in 2018, 2019 from Sentinel-5P,  
the European Space Agency.

Yufei Wei, 10 March 2022



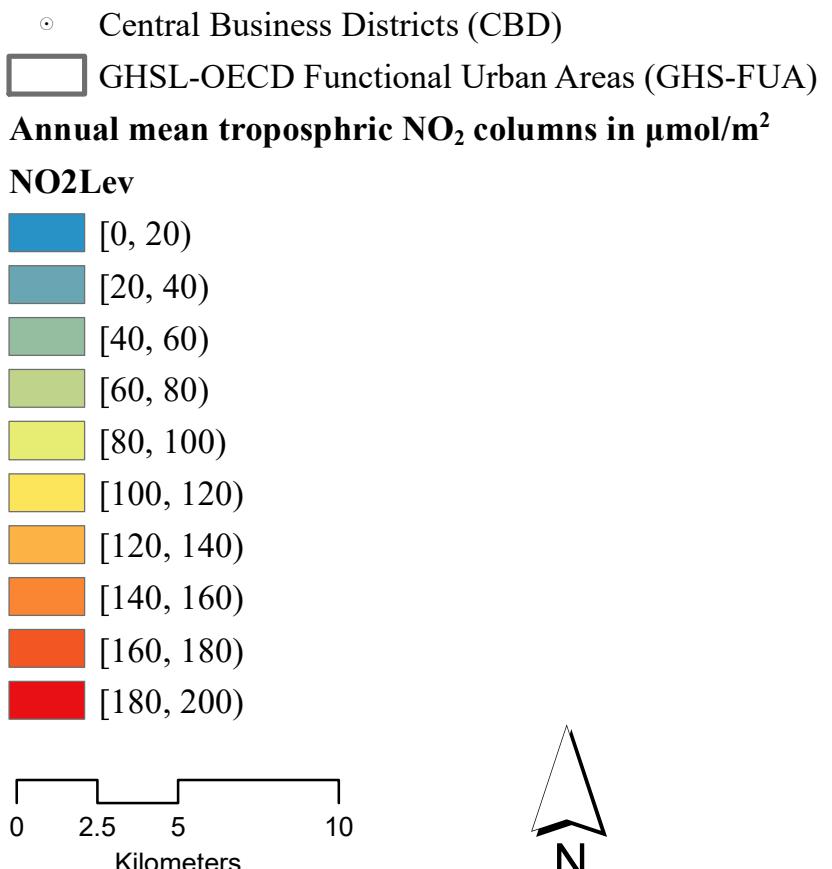


16 20'0"W

16 10'0"W

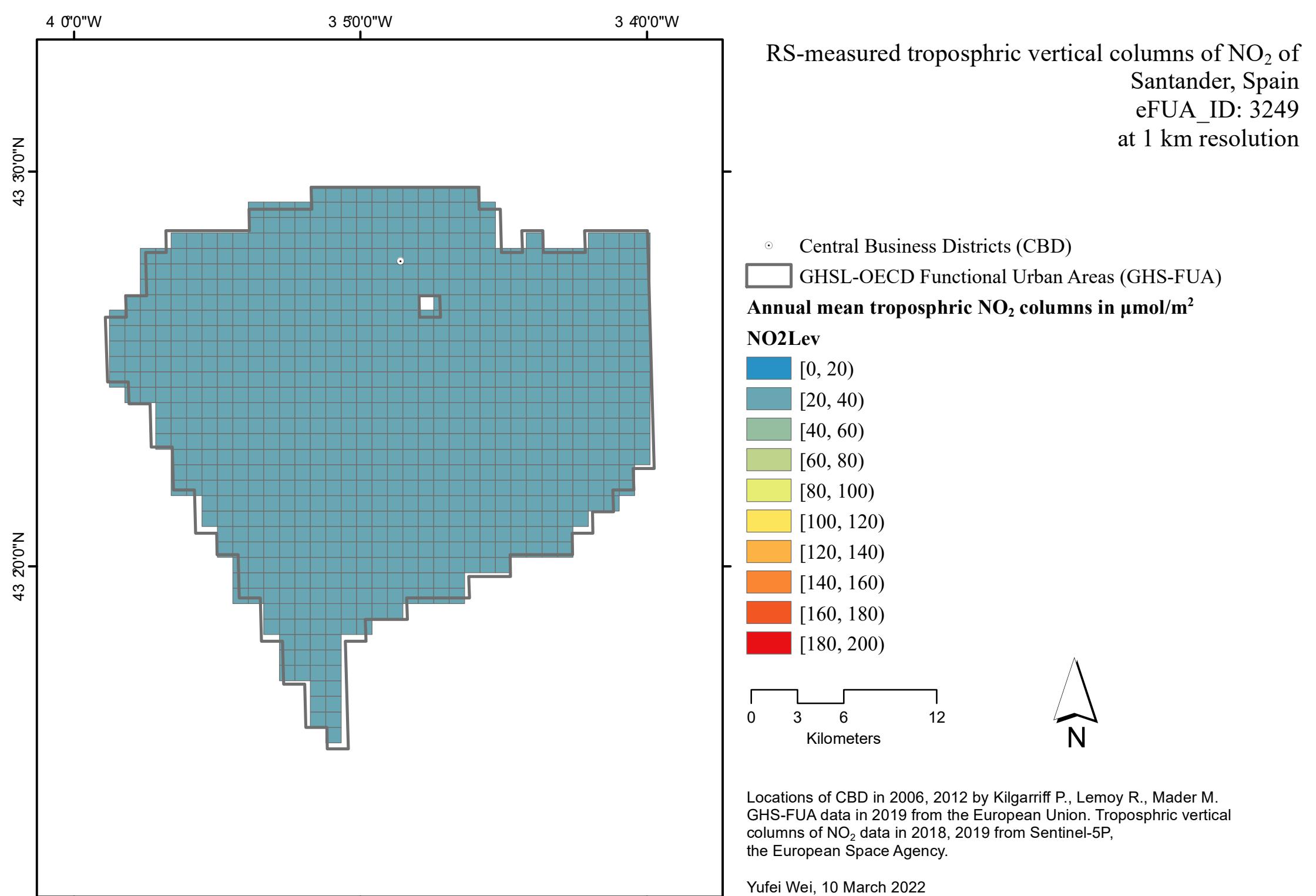
RS-measured tropospheric vertical columns of NO<sub>2</sub> of  
Santa Cruz de Tenerife, Spain  
eFUA\_ID: 395  
at 1 km resolution

28 30'0"N  
28 20'0"N



Locations of CBD in 2006, 2012 by Kilgarriff P., Lemoy R., Mader M.  
GHS-FUA data in 2019 from the European Union. Tropospheric vertical  
columns of NO<sub>2</sub> data in 2018, 2019 from Sentinel-5P,  
the European Space Agency.

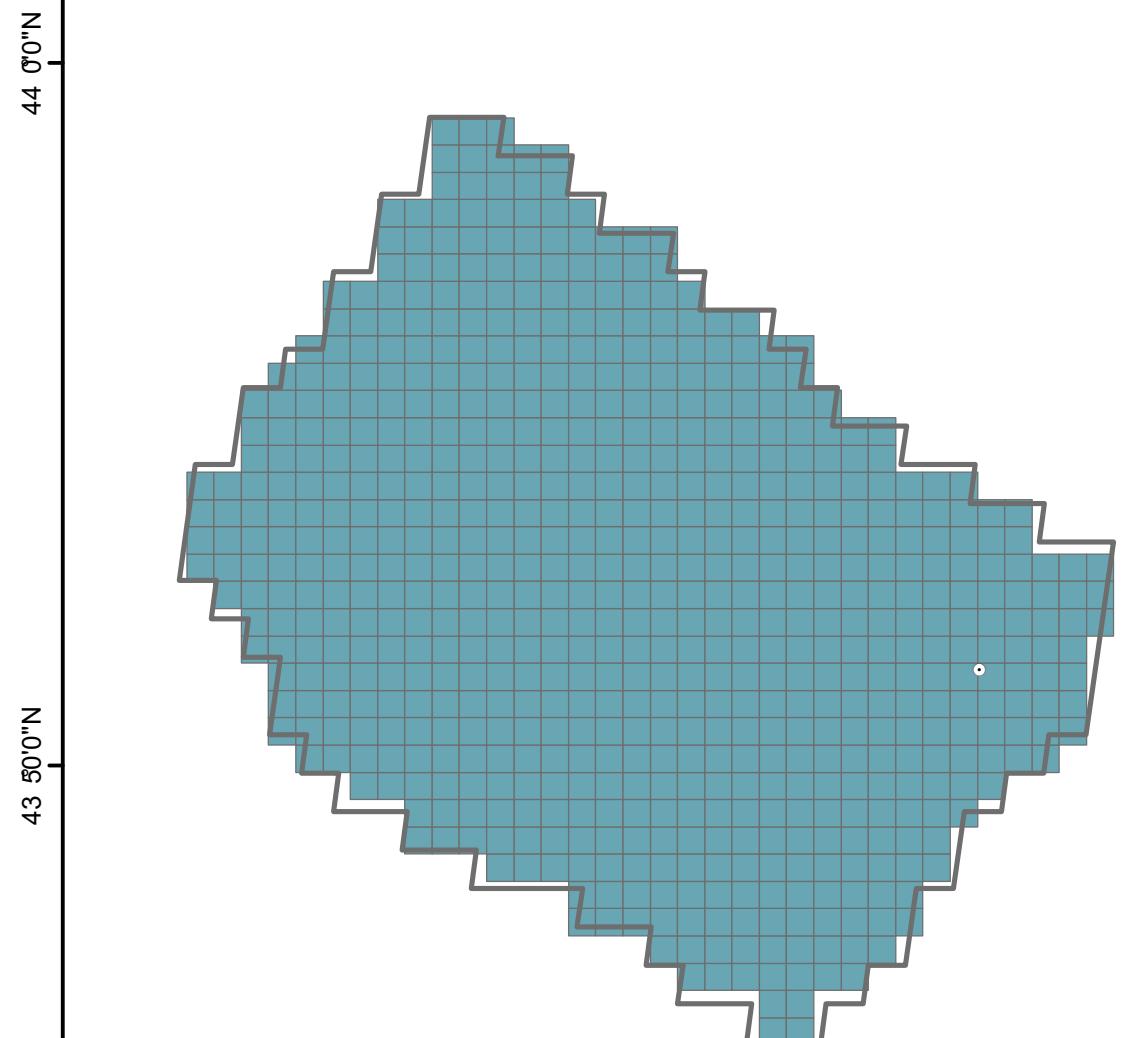
Yufei Wei, 10 March 2022



18 10'0"E

18 20'0"E

RS-measured tropospheric vertical columns of NO<sub>2</sub> of  
Sarajevo, Bosnia and Herzegovina  
eFUA\_ID: 798  
at 1 km resolution



○ Central Business Districts (CBD)

□ GHS-OECD Functional Urban Areas (GHS-FUA)

Annual mean tropospheric NO<sub>2</sub> columns in  $\mu\text{mol}/\text{m}^2$

NO2Lev

- [0, 20]
- [20, 40]
- [40, 60]
- [60, 80]
- [80, 100]
- [100, 120]
- [120, 140]
- [140, 160]
- [160, 180]
- [180, 200]

0 2.75 5.5 11  
Kilometers

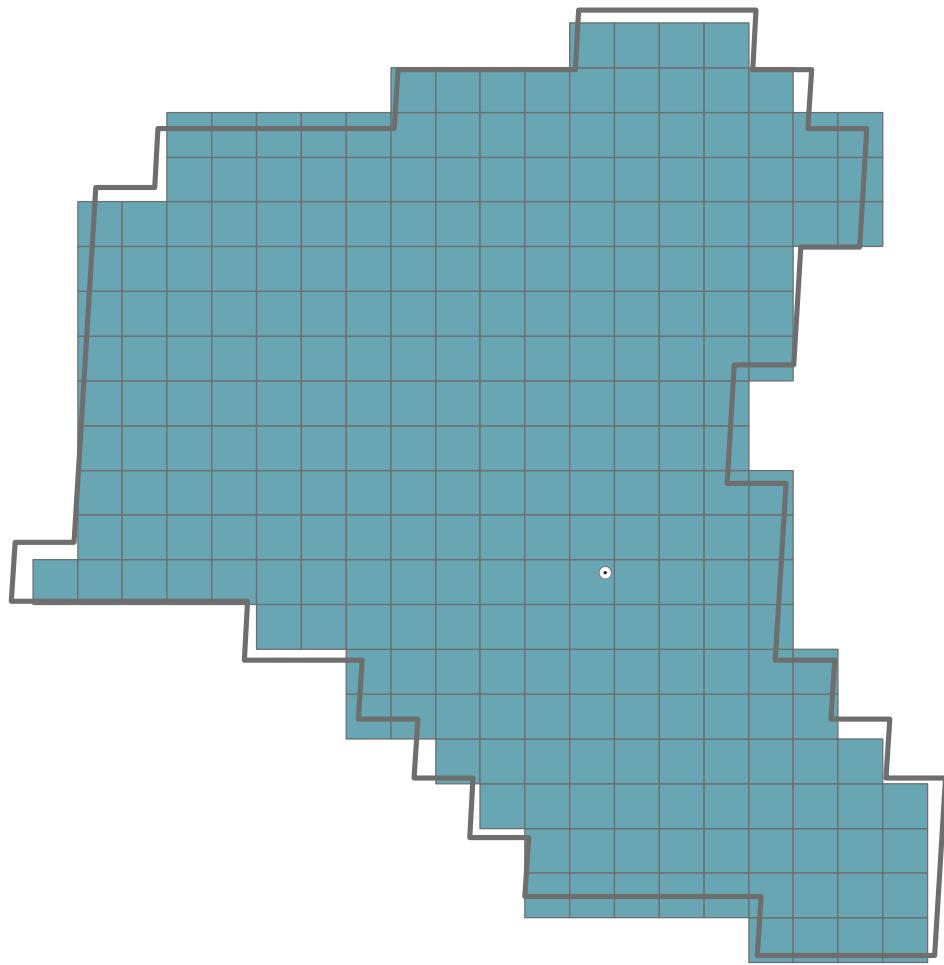


Locations of CBD in 2006, 2012 by Kilgarriff P., Lemoy R., Mader M.  
GHS-FUA data in 2019 from the European Union. Tropospheric vertical  
columns of NO<sub>2</sub> data in 2018, 2019 from Sentinel-5P,  
the European Space Agency.

Yufei Wei, 10 March 2022

8 30'0"E

40 50'0"N



RS-measured tropospheric vertical columns of NO<sub>2</sub> of  
Sassari, Italy  
eFUA\_ID: 1508  
at 1 km resolution

○ Central Business Districts (CBD)

◻ GHS-OECD Functional Urban Areas (GHS-FUA)

Annual mean tropospheric NO<sub>2</sub> columns in  $\mu\text{mol}/\text{m}^2$

NO2Lev

- [0, 20]
- [20, 40]
- [40, 60]
- [60, 80]
- [80, 100]
- [100, 120]
- [120, 140]
- [140, 160]
- [160, 180]
- [180, 200]

0 1.75 3.5 7  
Kilometers



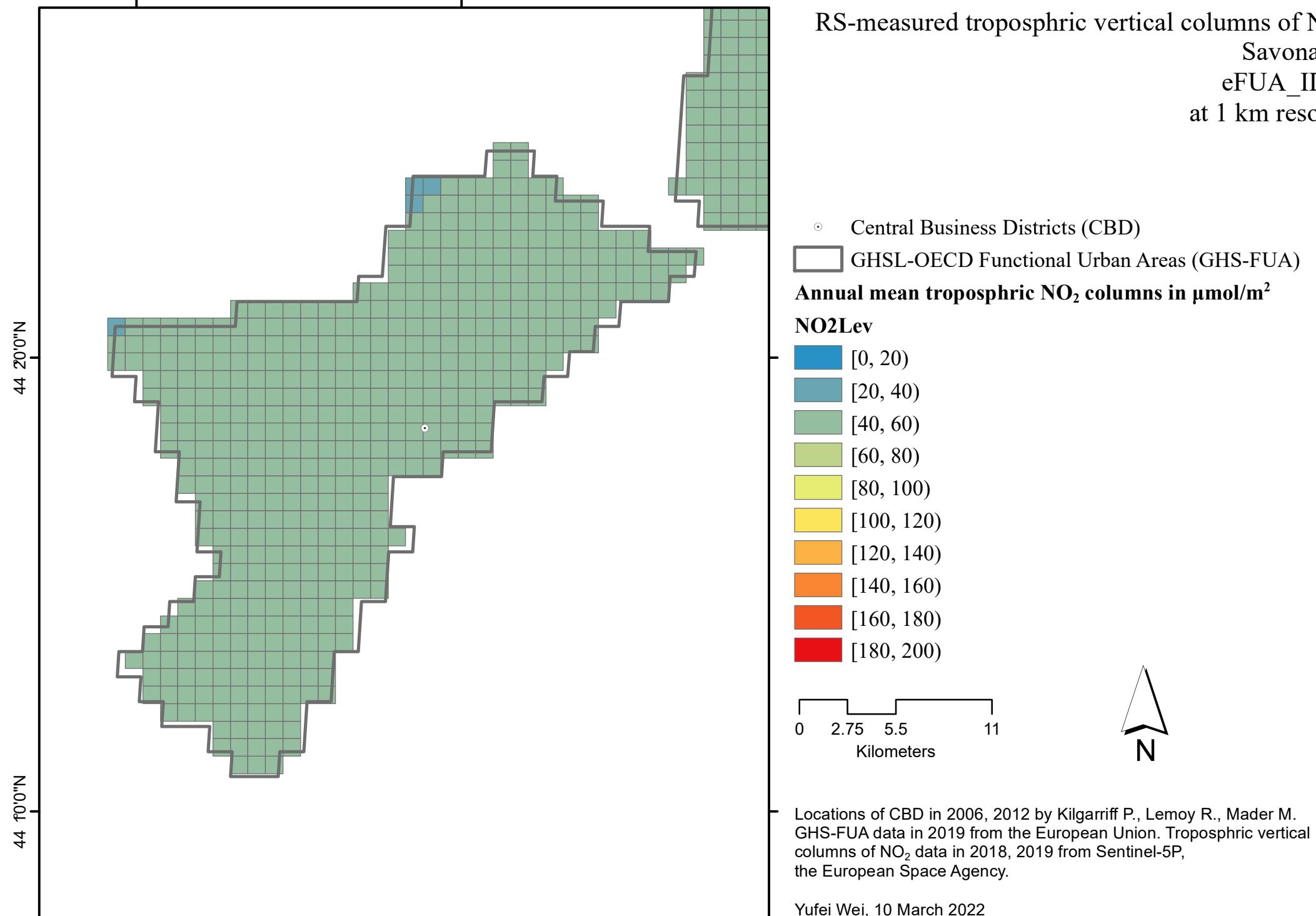
Locations of CBD in 2006, 2012 by Kilgarriff P., Lemoy R., Mader M.  
GHS-FUA data in 2019 from the European Union. Tropospheric vertical  
columns of NO<sub>2</sub> data in 2018, 2019 from Sentinel-5P,  
the European Space Agency.

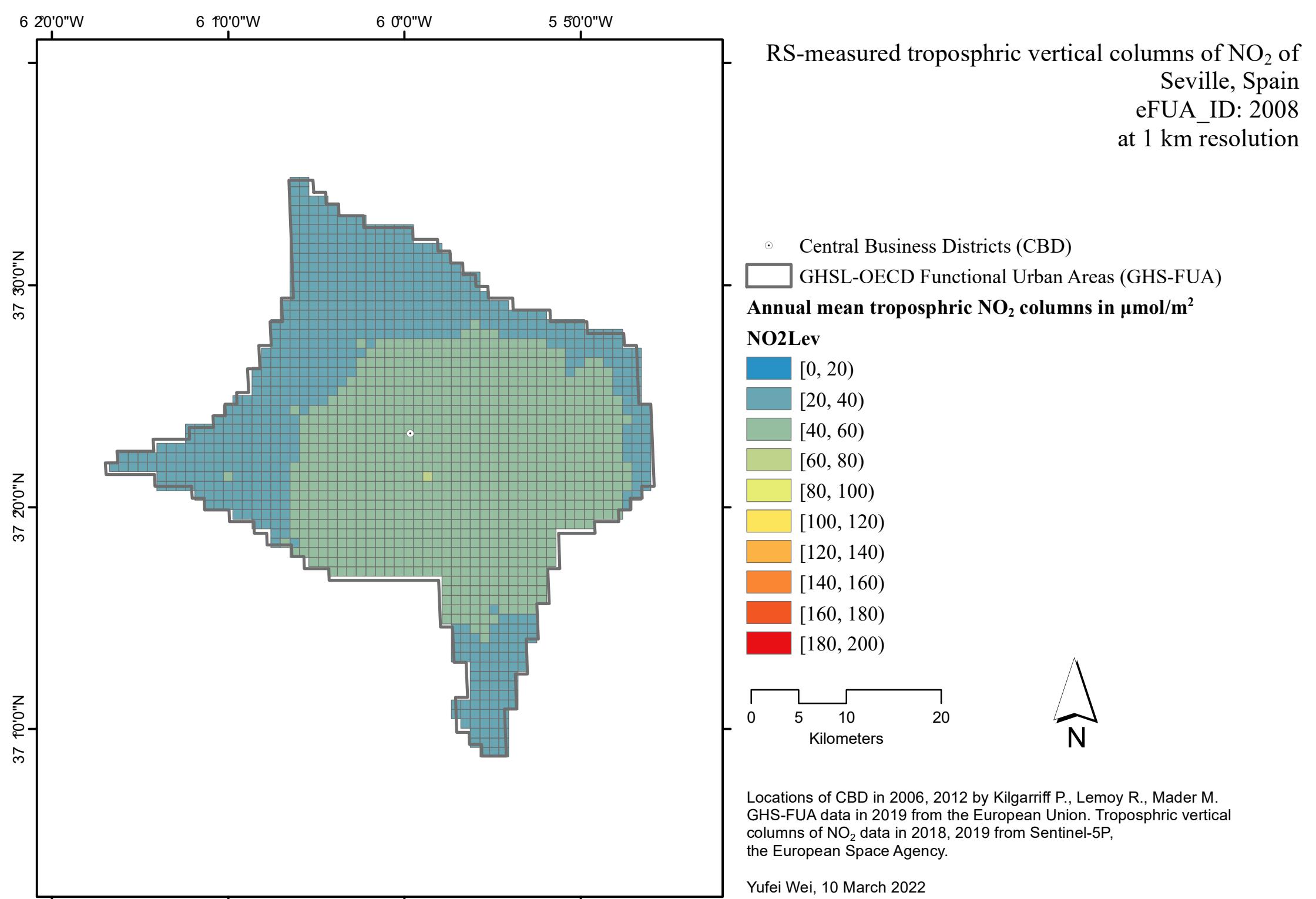
Yufei Wei, 10 March 2022

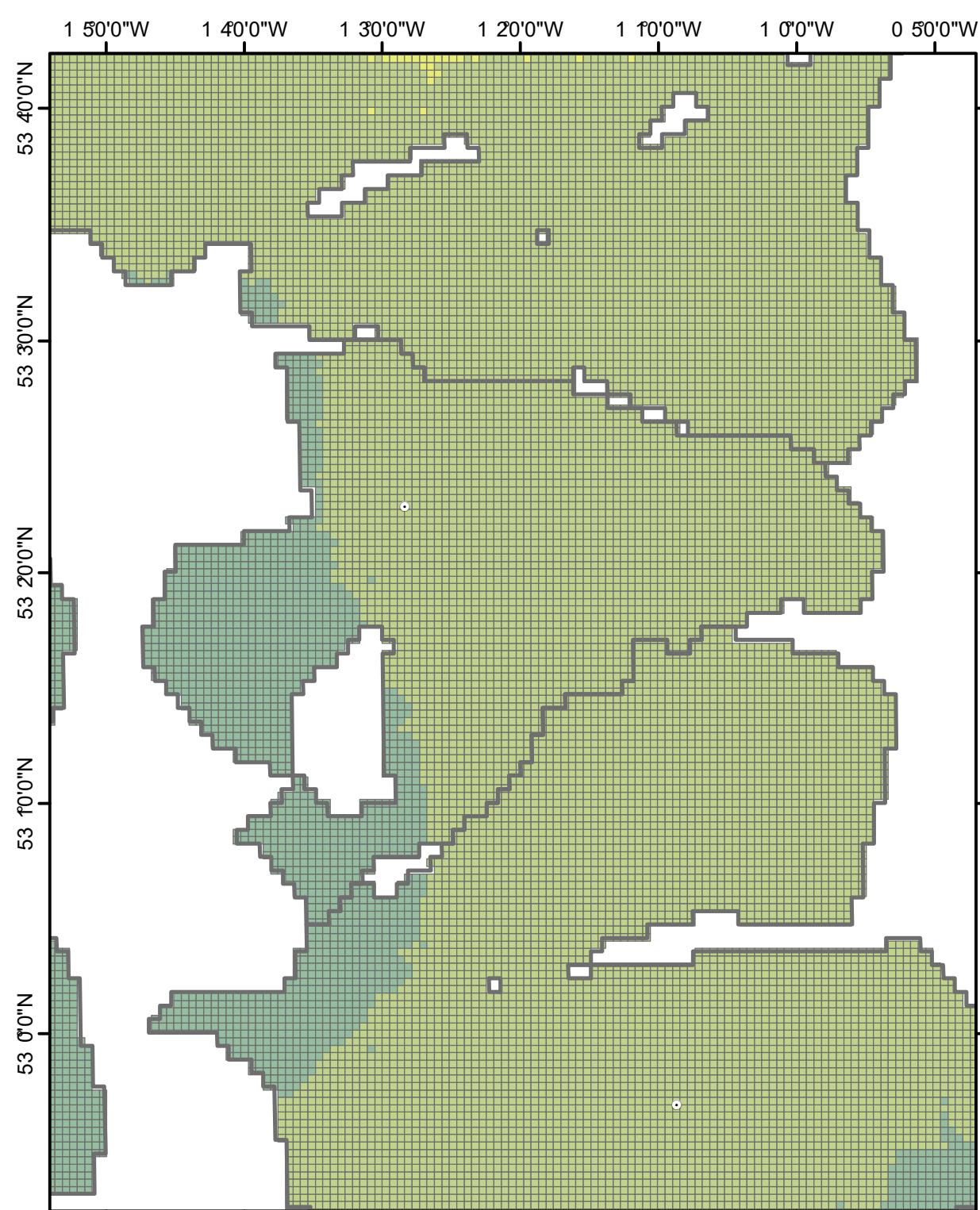
8 20'0"E

8 30'0"E

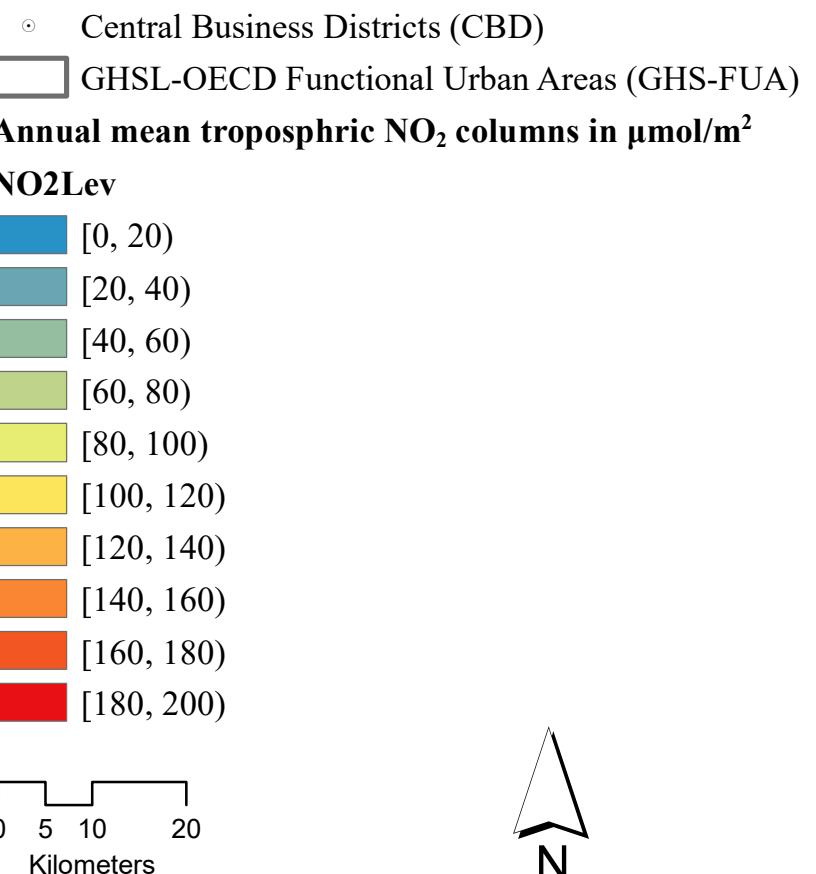
RS-measured tropospheric vertical columns of NO<sub>2</sub> of  
Savona, Italy  
eFUA\_ID: 565  
at 1 km resolution







RS-measured tropospheric vertical columns of NO<sub>2</sub> of  
Sheffield, United Kingdom  
eFUA\_ID: 4460  
at 1 km resolution



Locations of CBD in 2006, 2012 by Kilgarriff P., Lemoy R., Mader M.  
GHS-FUA data in 2019 from the European Union. Tropospheric vertical  
columns of NO<sub>2</sub> data in 2018, 2019 from Sentinel-5P,  
the European Space Agency.

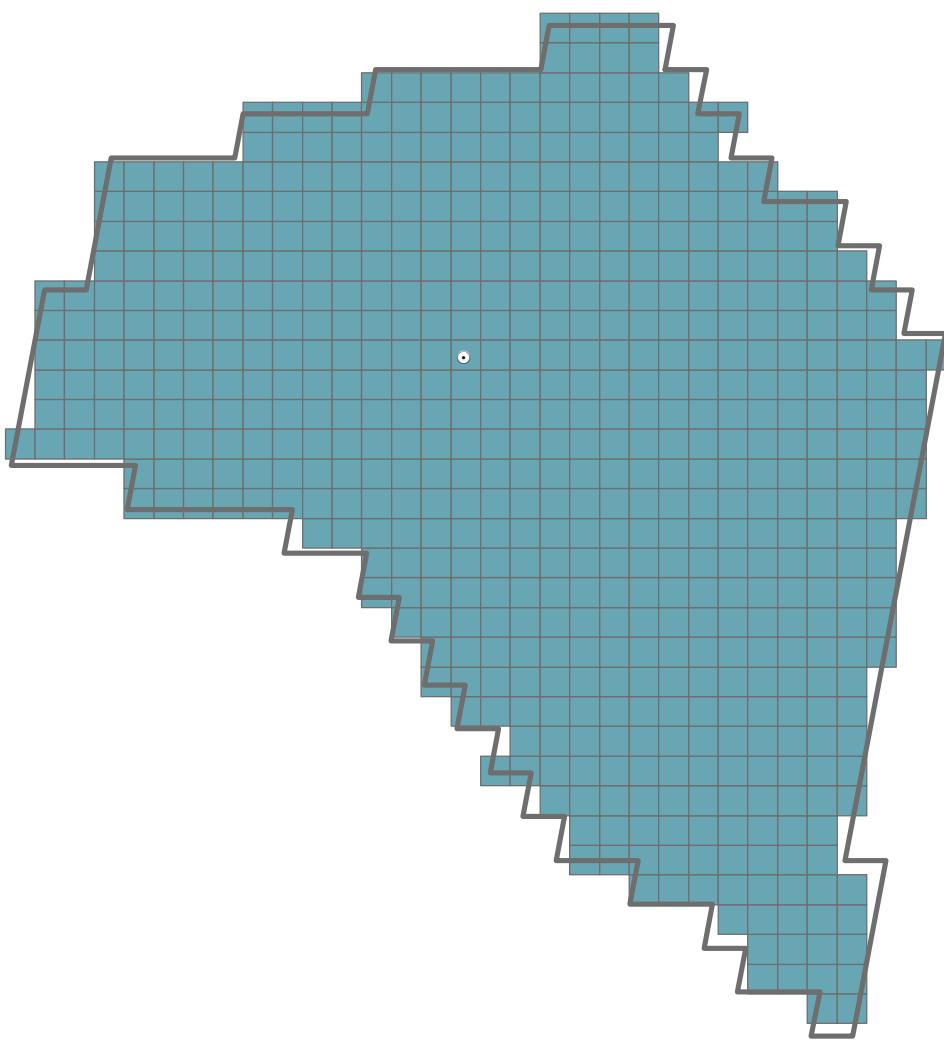
Yufei Wei, 10 March 2022

24 0'0"E

24 10'0"E

RS-measured tropospheric vertical columns of NO<sub>2</sub> of  
Sibiu, Romania  
eFUA\_ID: 1121  
at 1 km resolution

45 50'0"N



○ Central Business Districts (CBD)

◻ GHSL-OECD Functional Urban Areas (GHS-FUA)

Annual mean tropospheric NO<sub>2</sub> columns in  $\mu\text{mol}/\text{m}^2$

NO2Lev

[0, 20)
[20, 40)
[40, 60)
[60, 80)
[80, 100)
[100, 120)
[120, 140)
[140, 160)
[160, 180)
[180, 200)

0 2.75 5.5 11  
Kilometers



Locations of CBD in 2006, 2012 by Kilgarriff P., Lemoy R., Mader M.  
GHS-FUA data in 2019 from the European Union. Tropospheric vertical  
columns of NO<sub>2</sub> data in 2018, 2019 from Sentinel-5P,  
the European Space Agency.

Yufei Wei, 10 March 2022

7 50'0"E

8 0'0"E

8 10'0"E

51 0'0"N

50 50'0"N

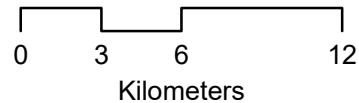
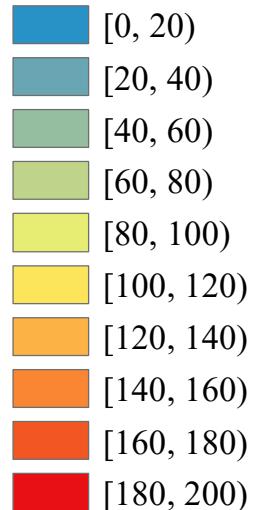
RS-measured tropospheric vertical columns of NO<sub>2</sub> of  
Siegen, Germany  
eFUA\_ID: 2298  
at 1 km resolution

○ Central Business Districts (CBD)

◻ GHSL-OECD Functional Urban Areas (GHS-FUA)

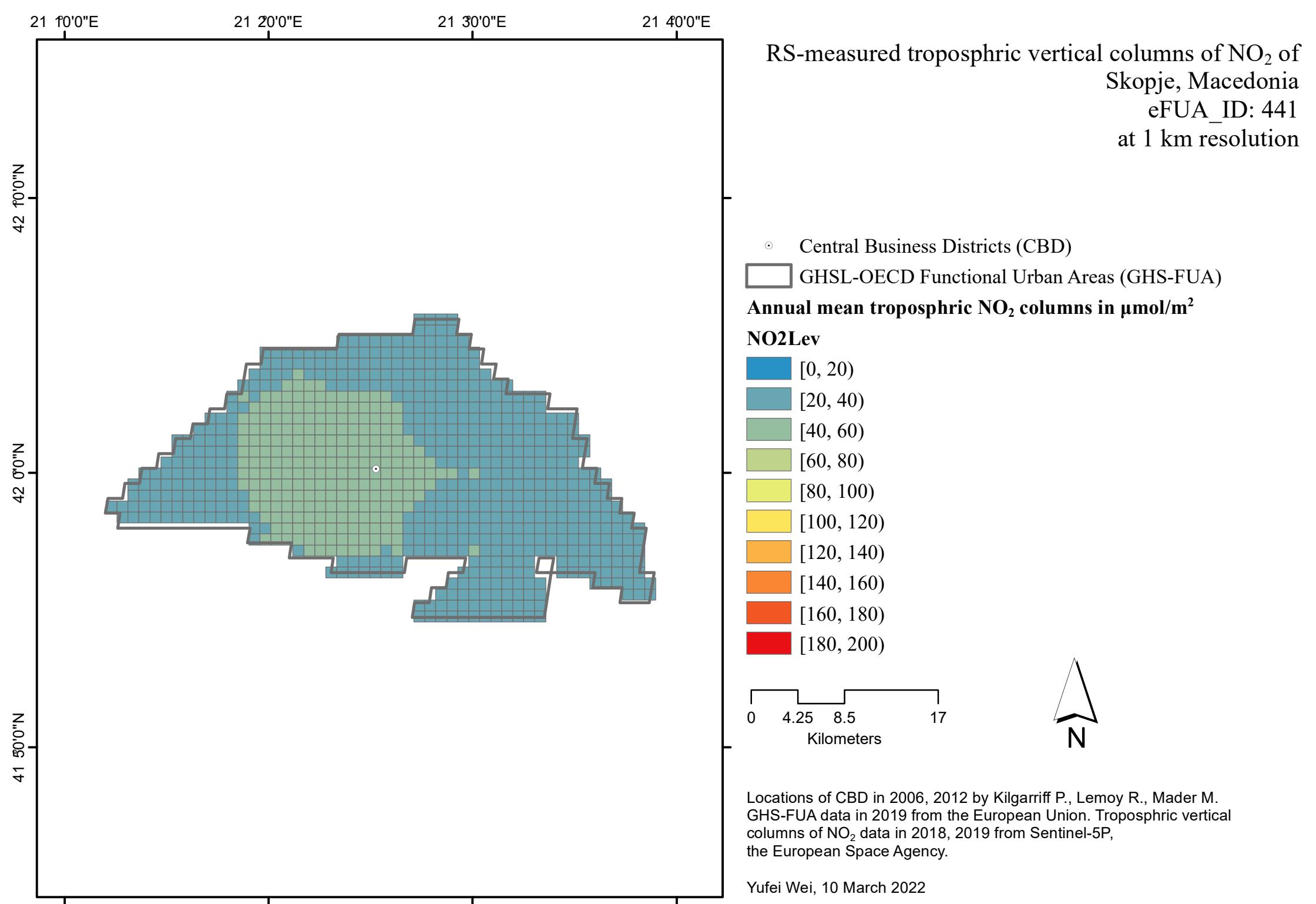
Annual mean tropospheric NO<sub>2</sub> columns in  $\mu\text{mol}/\text{m}^2$

NO2Lev



Locations of CBD in 2006, 2012 by Kilgarriff P., Lemoy R., Mader M.  
GHS-FUA data in 2019 from the European Union. Tropospheric vertical  
columns of NO<sub>2</sub> data in 2018, 2019 from Sentinel-5P,  
the European Space Agency.

Yufei Wei, 10 March 2022



23 0'0"E 23 10'0"E 23 20'0"E 23 30'0"E 23 40'0"E

43 0'0"N

42 50'0"N

42 40'0"N

42 30'0"N

42 20'0"N

RS-measured tropospheric vertical columns of NO<sub>2</sub> of  
Sofia, Bulgaria  
eFUA\_ID: 15  
at 1 km resolution

○ Central Business Districts (CBD)

◻ GHS-OECD Functional Urban Areas (GHS-FUA)

Annual mean tropospheric NO<sub>2</sub> columns in  $\mu\text{mol}/\text{m}^2$

NO2Lev

[0, 20)

[20, 40)

[40, 60)

[60, 80)

[80, 100)

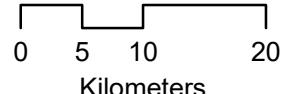
[100, 120)

[120, 140)

[140, 160)

[160, 180)

[180, 200)



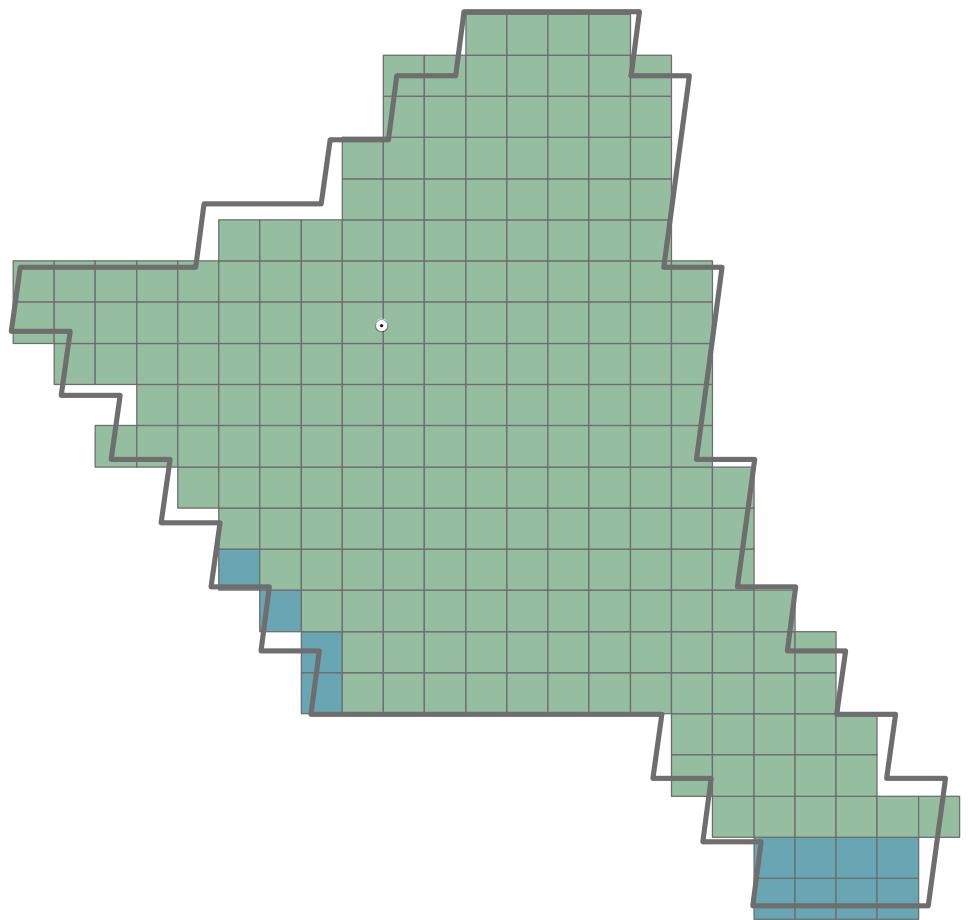
Locations of CBD in 2006, 2012 by Kilgarriff P., Lemoy R., Mader M.  
GHS-FUA data in 2019 from the European Union. Tropospheric vertical  
columns of NO<sub>2</sub> data in 2018, 2019 from Sentinel-5P,  
the European Space Agency.

Yufei Wei, 10 March 2022

16 30'0"E

16 40'0"E

RS-measured tropospheric vertical columns of NO<sub>2</sub> of  
Sopron, Hungary  
eFUA\_ID: 77  
at 1 km resolution



○ Central Business Districts (CBD)

◻ GHSL-OECD Functional Urban Areas (GHS-FUA)

**Annual mean tropospheric NO<sub>2</sub> columns in  $\mu\text{mol}/\text{m}^2$**

**NO2Lev**

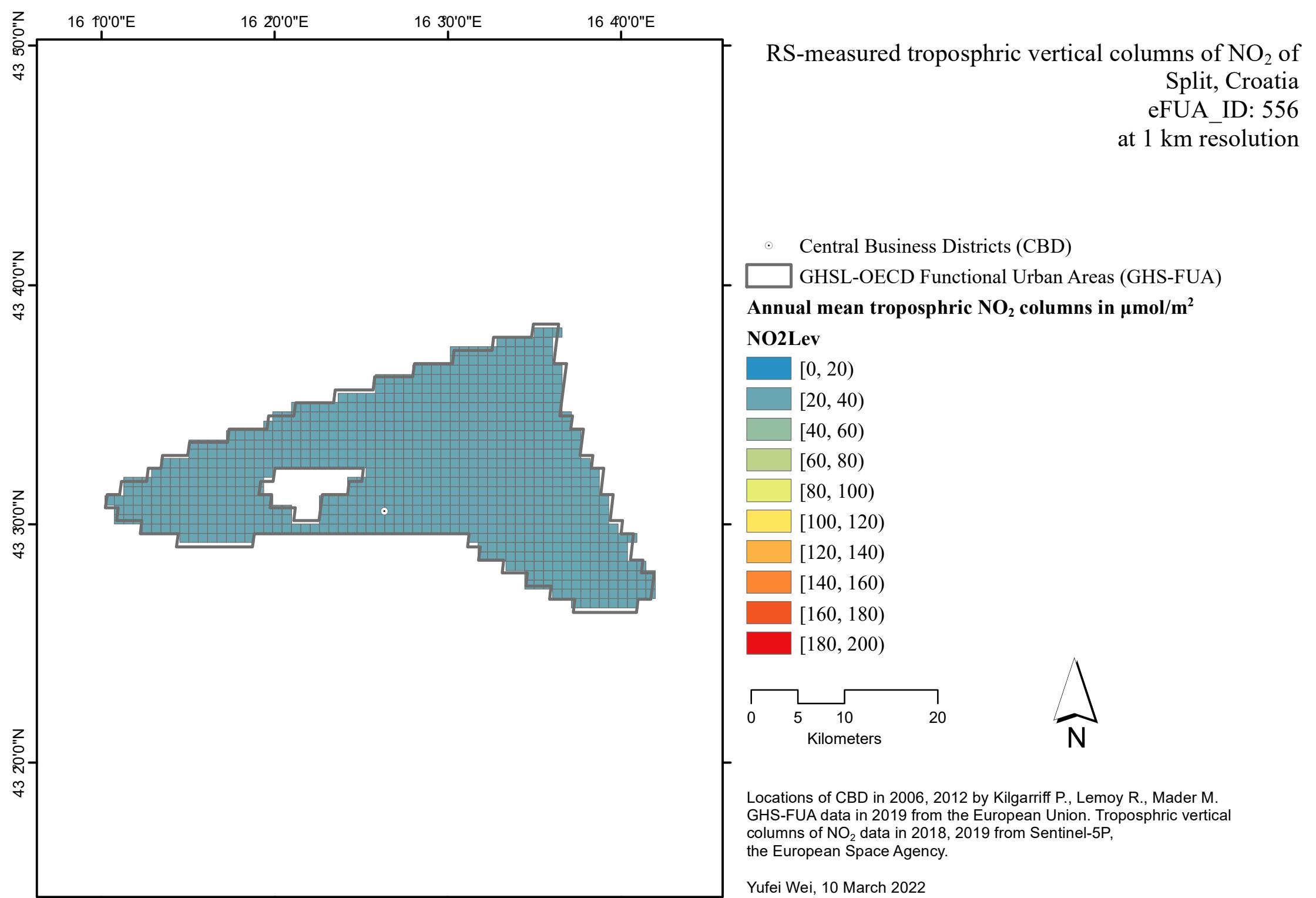
- [0, 20)
- [20, 40)
- [40, 60)
- [60, 80)
- [80, 100)
- [100, 120)
- [120, 140)
- [140, 160)
- [160, 180)
- [180, 200)

0 2 4 8  
Kilometers



Locations of CBD in 2006, 2012 by Kilgarriff P., Lemoy R., Mader M.  
GHS-FUA data in 2019 from the European Union. Tropospheric vertical  
columns of NO<sub>2</sub> data in 2018, 2019 from Sentinel-5P,  
the European Space Agency.

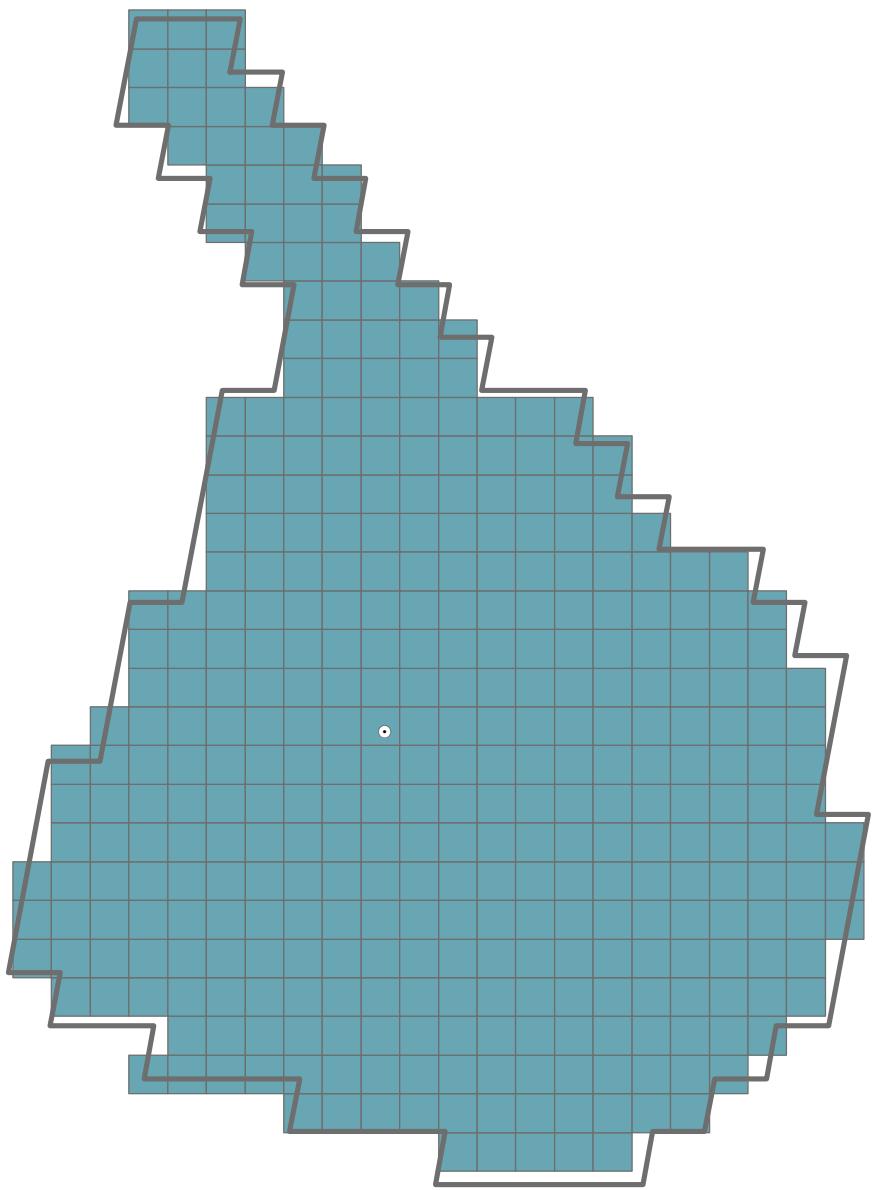
Yufei Wei, 10 March 2022



25 40'0"E

RS-measured tropospheric vertical columns of NO<sub>2</sub> of  
Stara Zagora, Bulgaria  
eFUA\_ID: 661  
at 1 km resolution

42°30'0"N  
42°20'0"N



◦ Central Business Districts (CBD)  
◻ GHSL-OECD Functional Urban Areas (GHS-FUA)

Annual mean tropospheric NO<sub>2</sub> columns in  $\mu\text{mol}/\text{m}^2$

NO2Lev

[0, 20)
[20, 40)
[40, 60)
[60, 80)
[80, 100)
[100, 120)
[120, 140)
[140, 160)
[160, 180)
[180, 200)

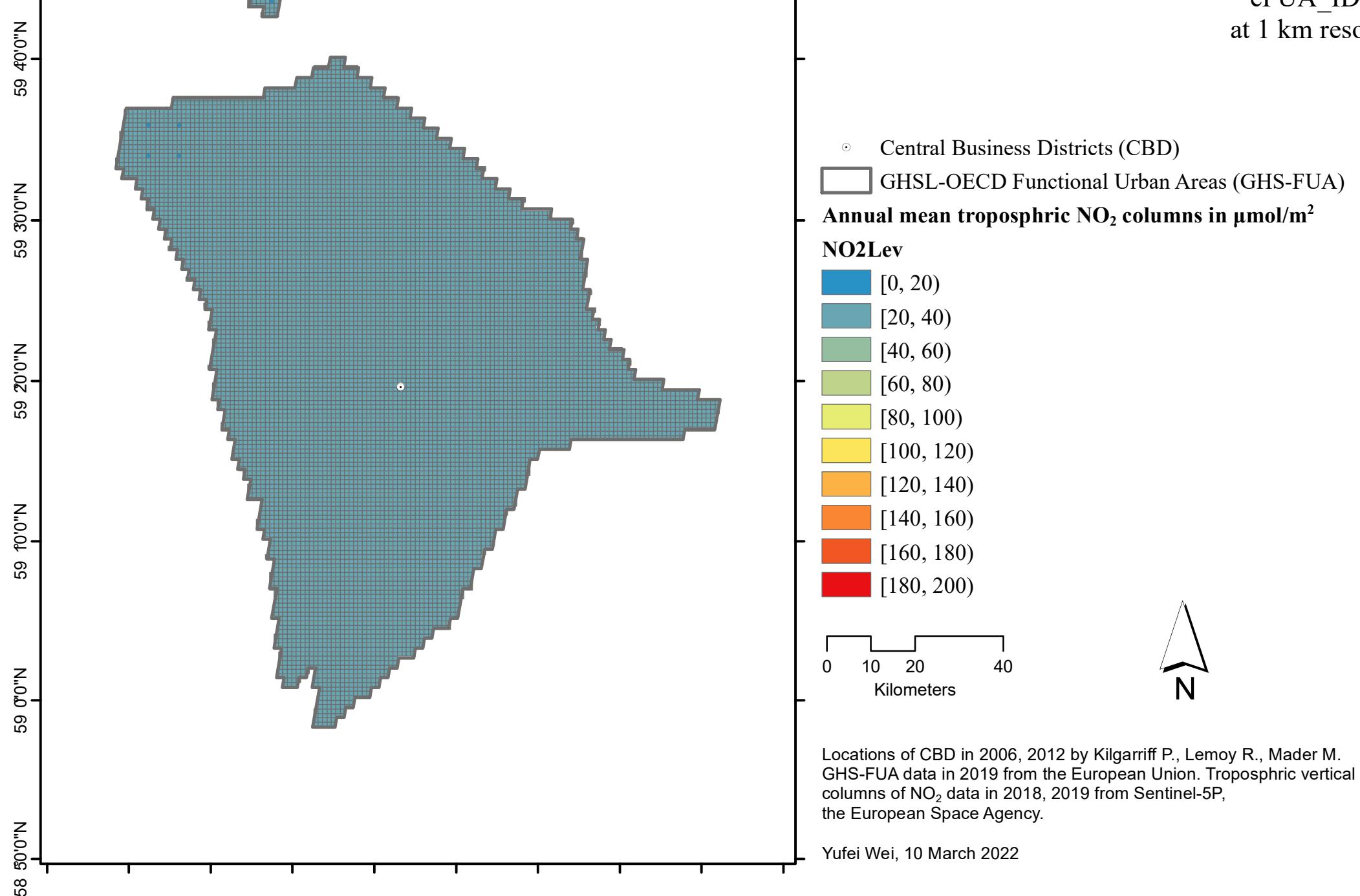
0 2 4 8  
Kilometers



Locations of CBD in 2006, 2012 by Kilgarriff P., Lemoy R., Mader M.  
GHS-FUA data in 2019 from the European Union. Tropospheric vertical  
columns of NO<sub>2</sub> data in 2018, 2019 from Sentinel-5P,  
the European Space Agency.

Yufei Wei, 10 March 2022

17 20'0"E 17 30'0"E 17 40'0"E 17 50'0"E 18 0'0"E 18 10'0"E 18 20'0"E 18 30'0"E 18 40'0"E 18 50'0"E  
RS-measured tropospheric vertical columns of NO<sub>2</sub> of  
Stockholm, Sweden  
eFUA\_ID: 1445  
at 1 km resolution



2 20'0"W 2 10'0"W 2 0'0"W 1 50'0"W

53°0'N

53°0'N

52°50'N

RS-measured tropospheric vertical columns of NO<sub>2</sub> of  
Stoke-on-Trent, United Kingdom  
eFUA\_ID: 3719  
at 1 km resolution

○ Central Business Districts (CBD)

◻ GHSL-OECD Functional Urban Areas (GHS-FUA)

Annual mean tropospheric NO<sub>2</sub> columns in  $\mu\text{mol}/\text{m}^2$

NO2Lev

[0, 20)

[20, 40)

[40, 60)

[60, 80)

[80, 100)

[100, 120)

[120, 140)

[140, 160)

[160, 180)

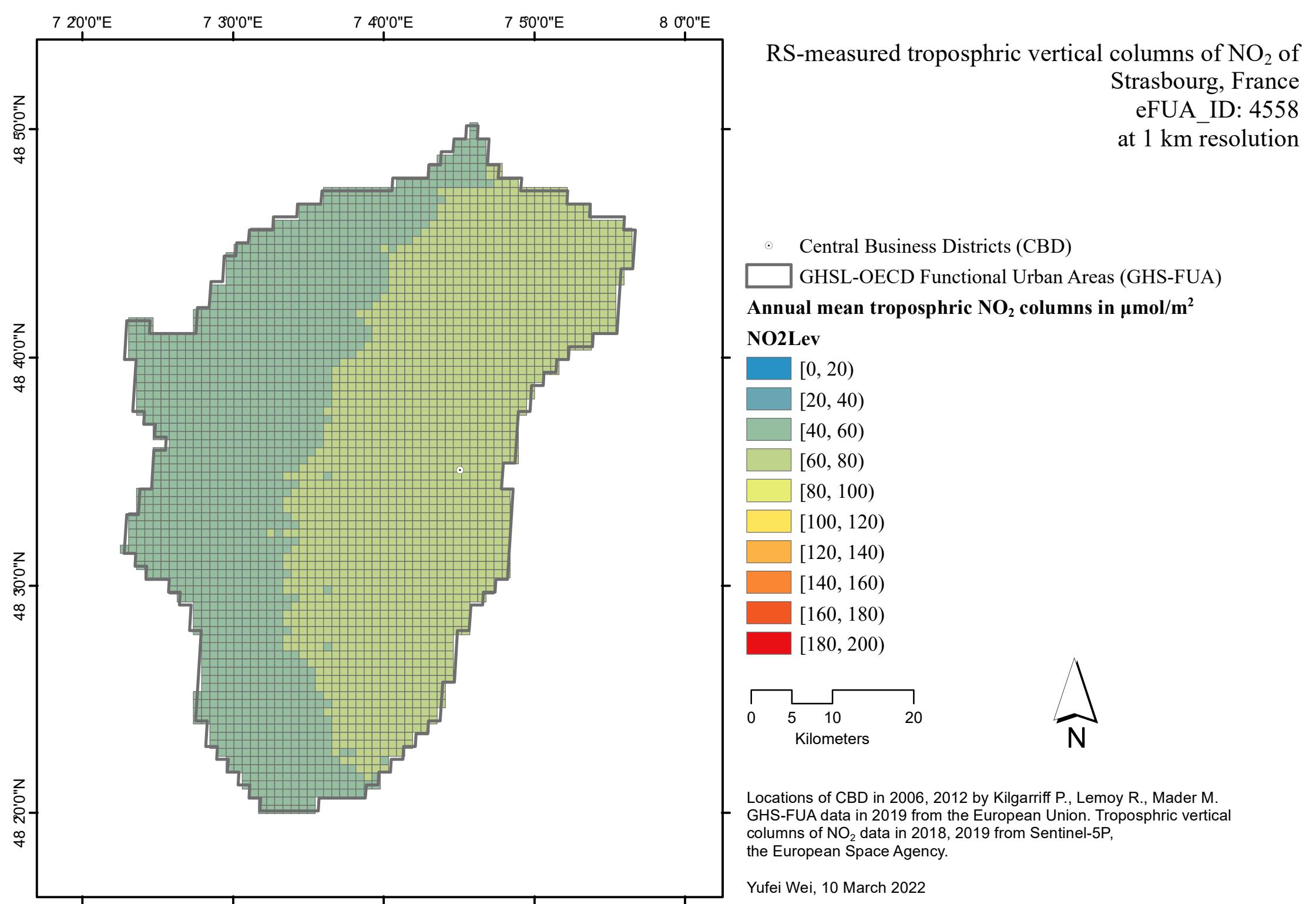
[180, 200)

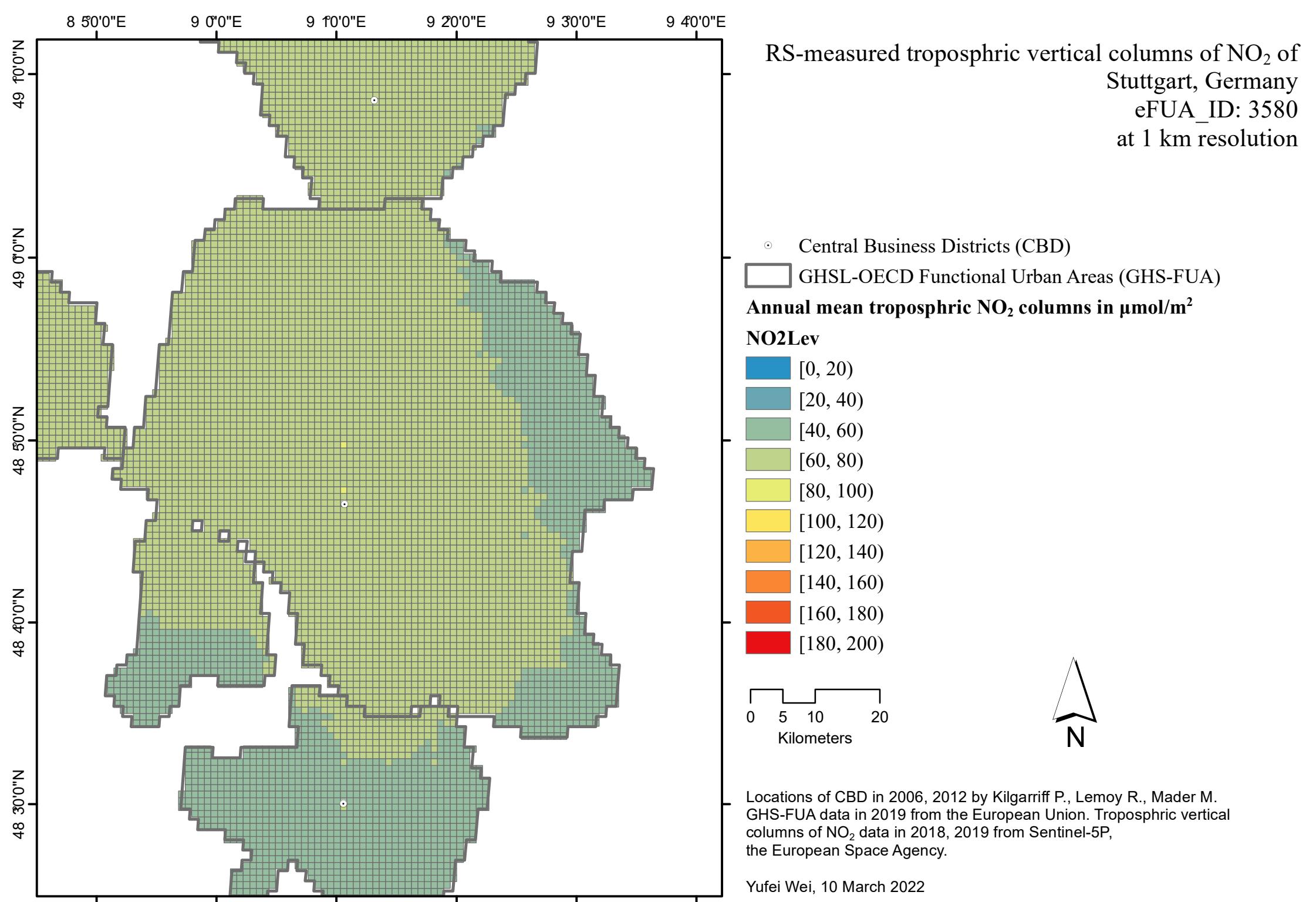
0 5 10 20  
Kilometers

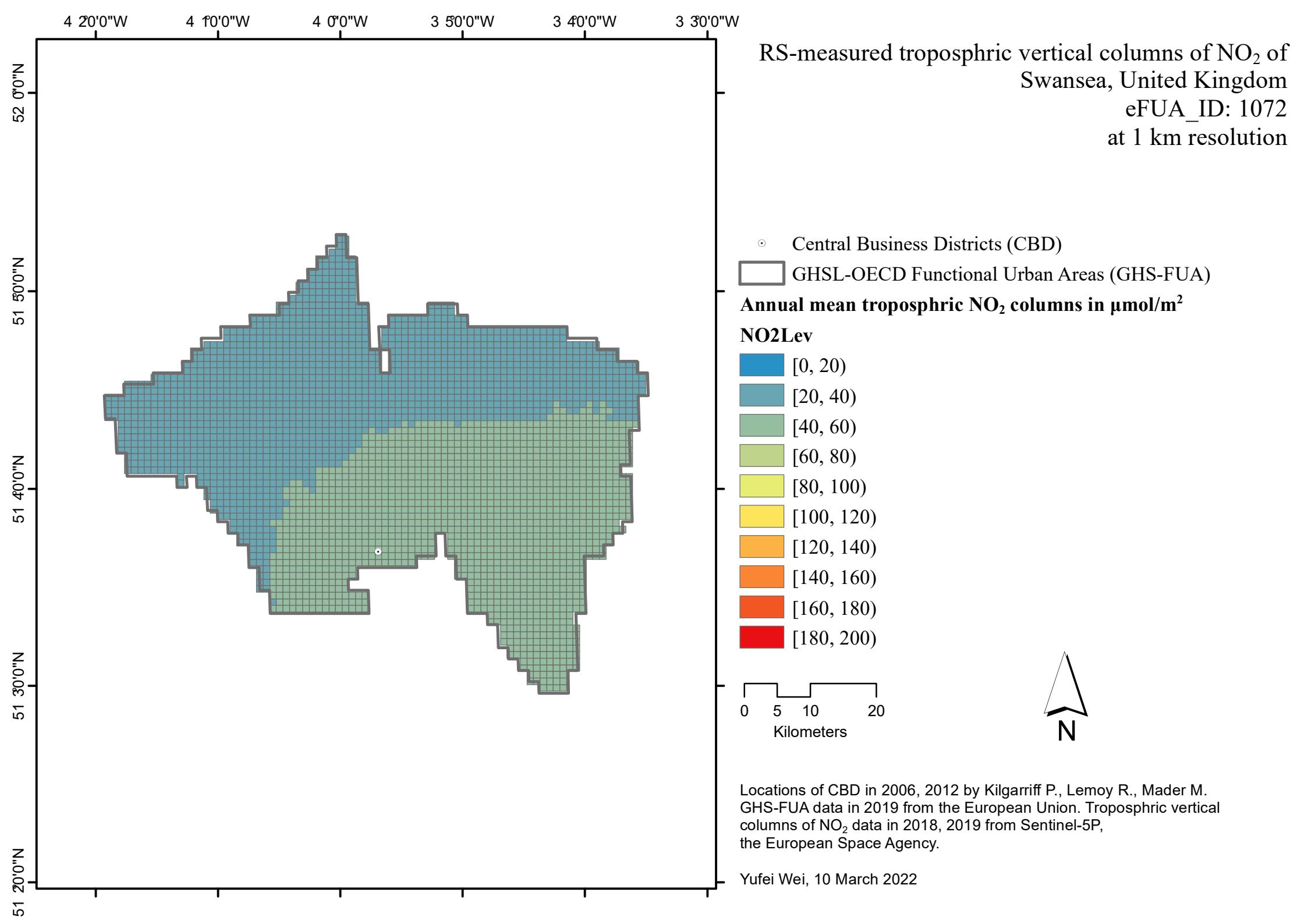


Locations of CBD in 2006, 2012 by Kilgarriff P., Lemoy R., Mader M.  
GHS-FUA data in 2019 from the European Union. Tropospheric vertical  
columns of NO<sub>2</sub> data in 2018, 2019 from Sentinel-5P,  
the European Space Agency.

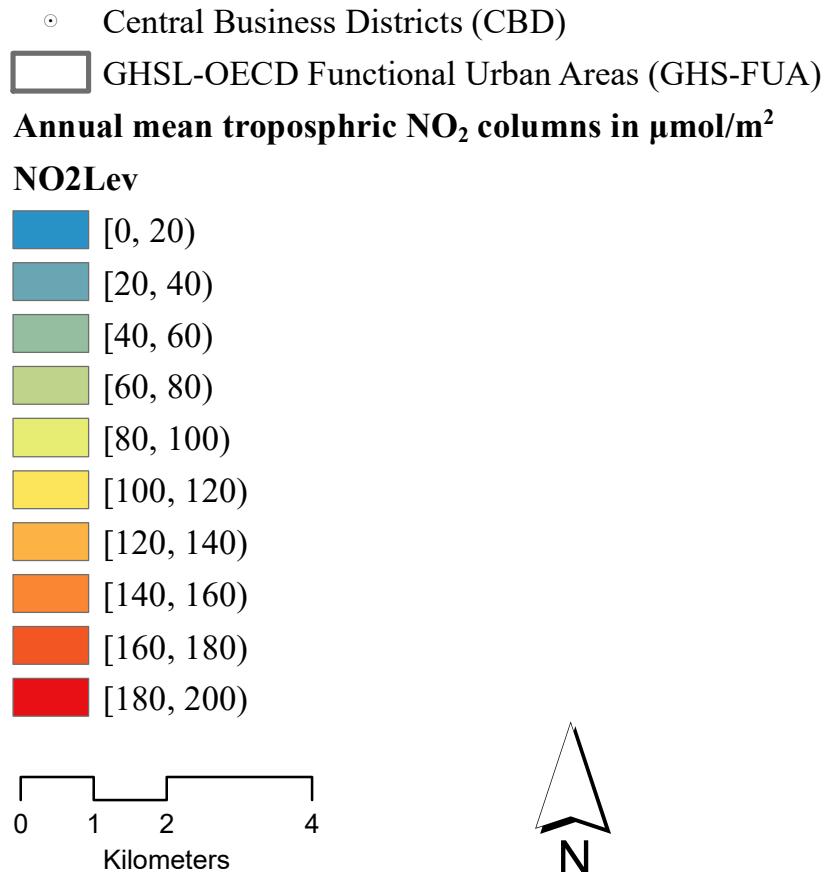
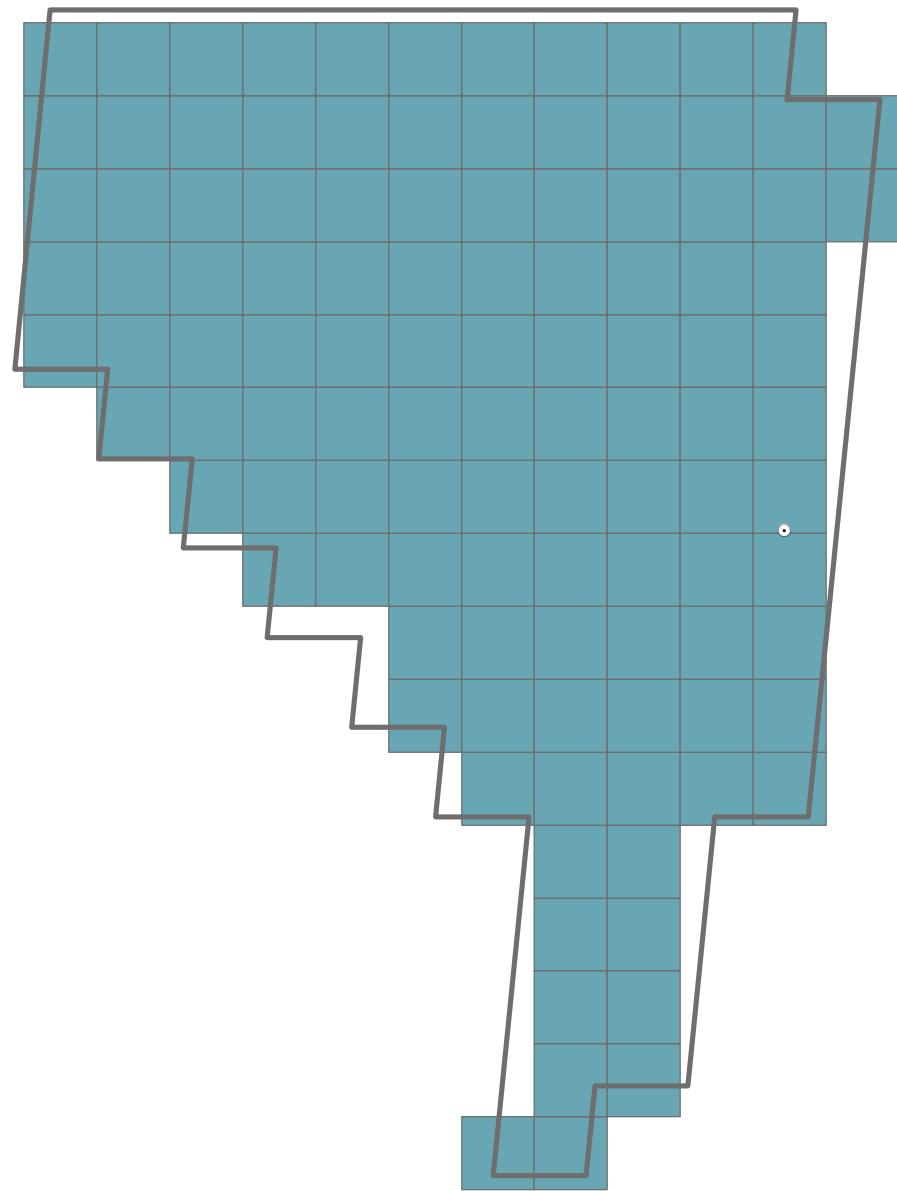
Yufei Wei, 10 March 2022



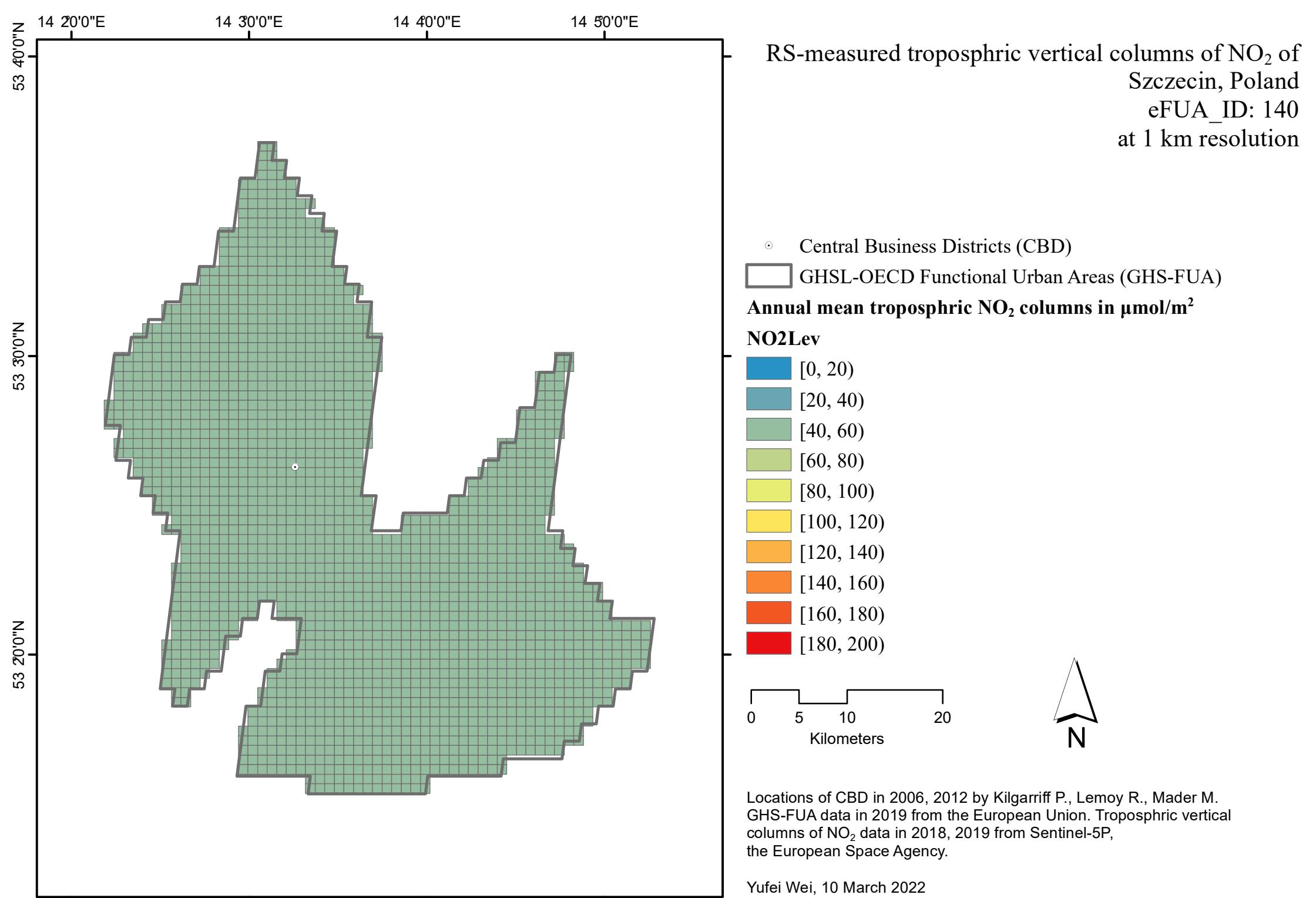


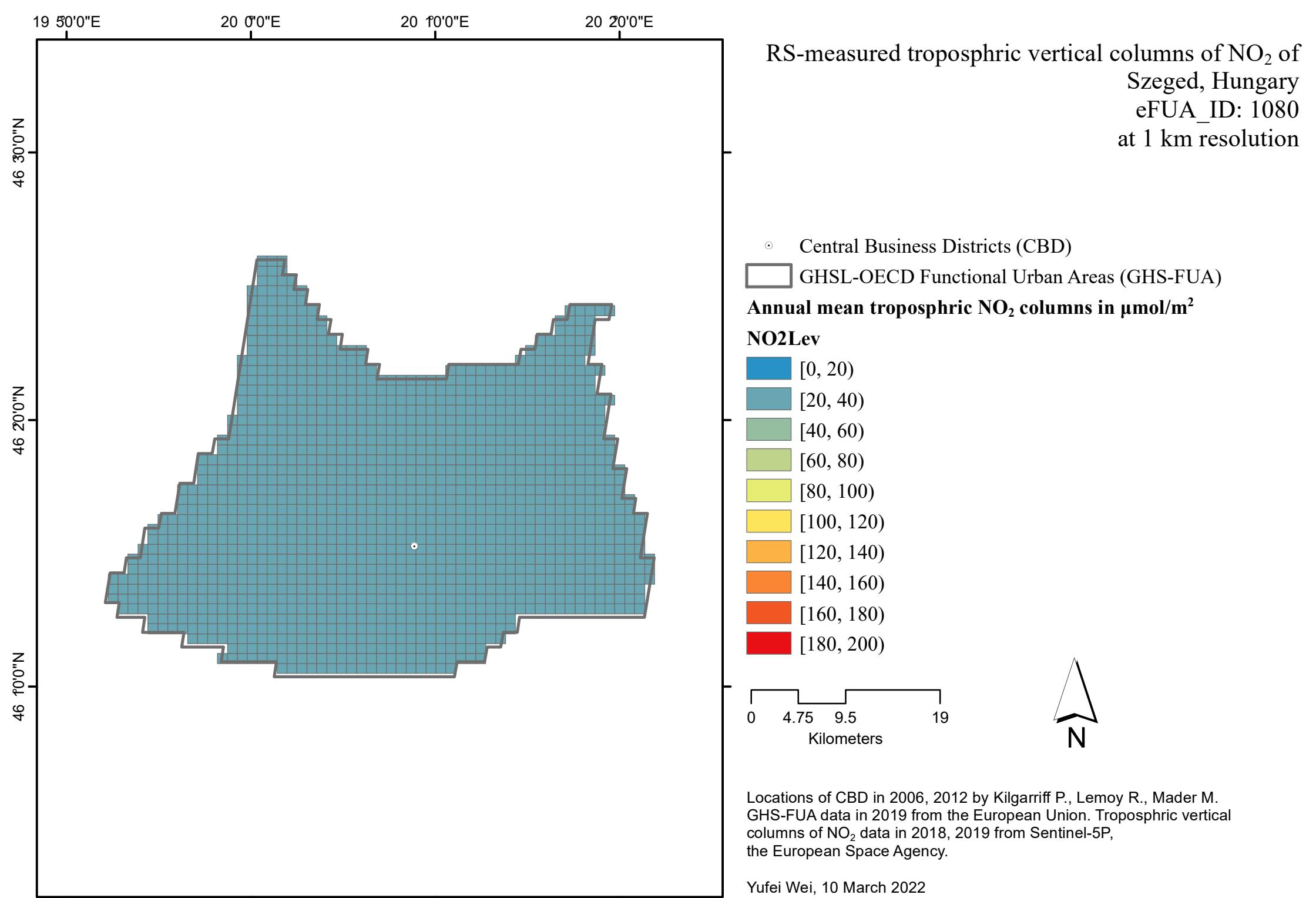


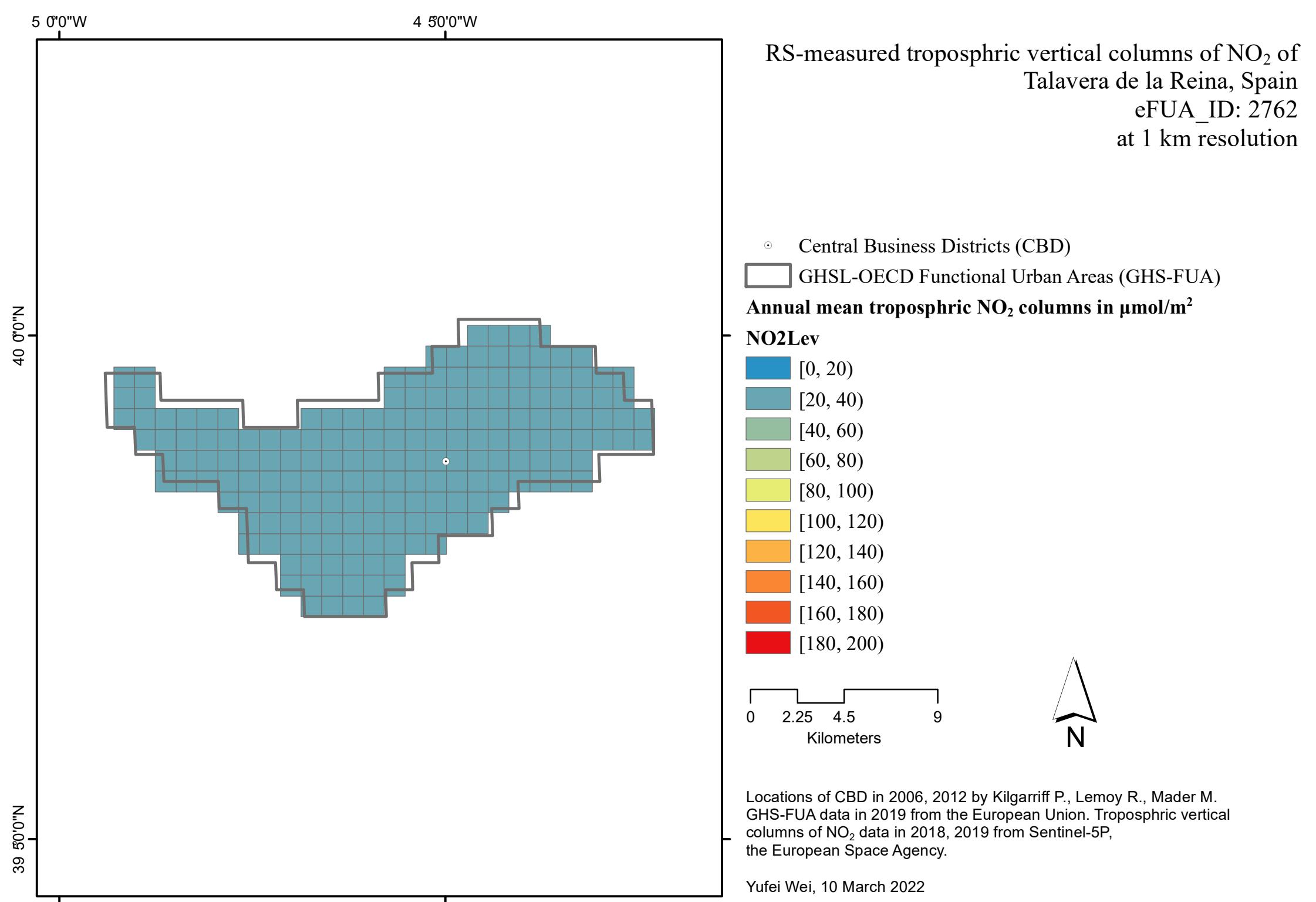
RS-measured tropospheric vertical columns of NO<sub>2</sub> of  
Syracuse, Italy  
eFUA\_ID: 4716  
at 1 km resolution

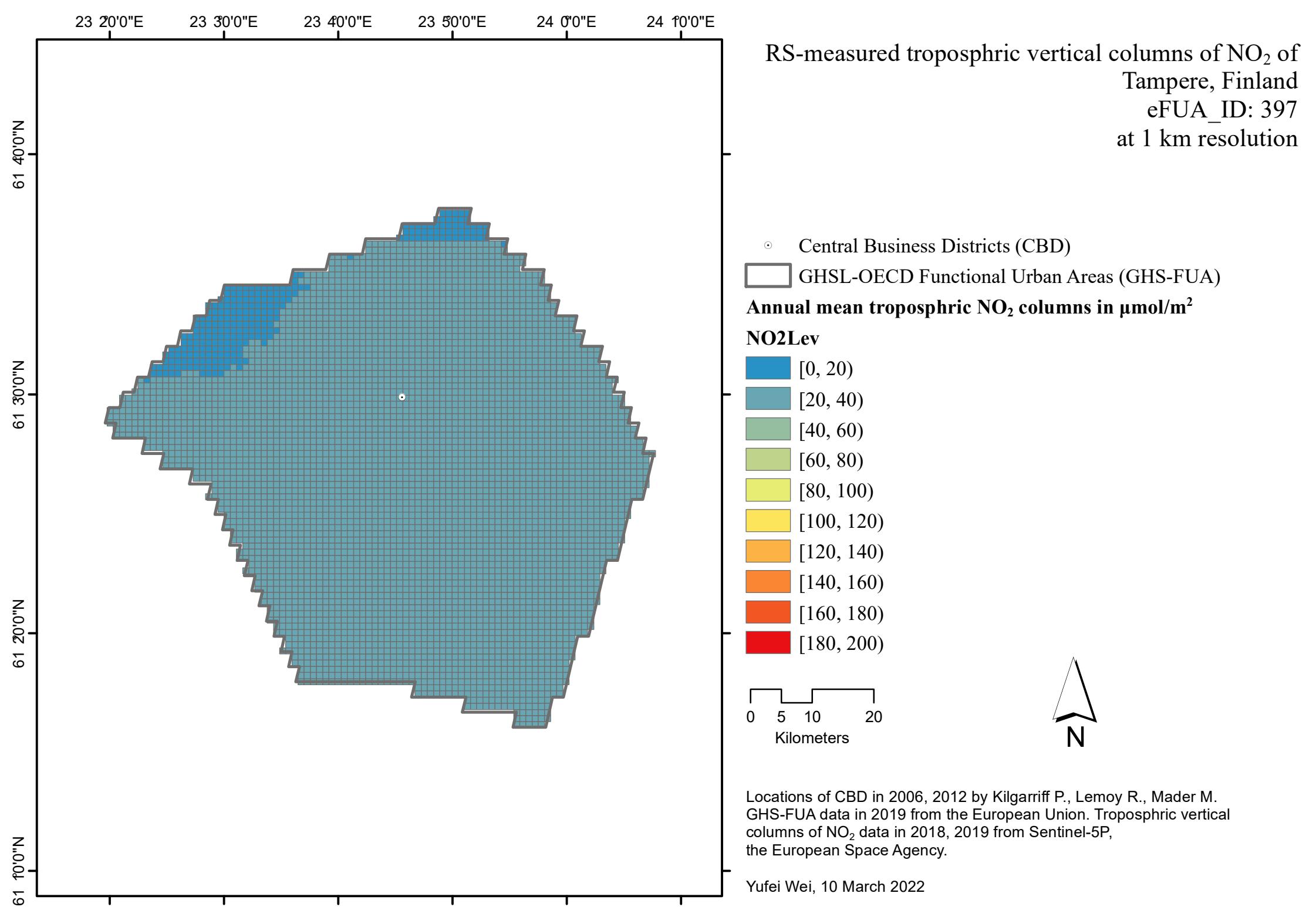


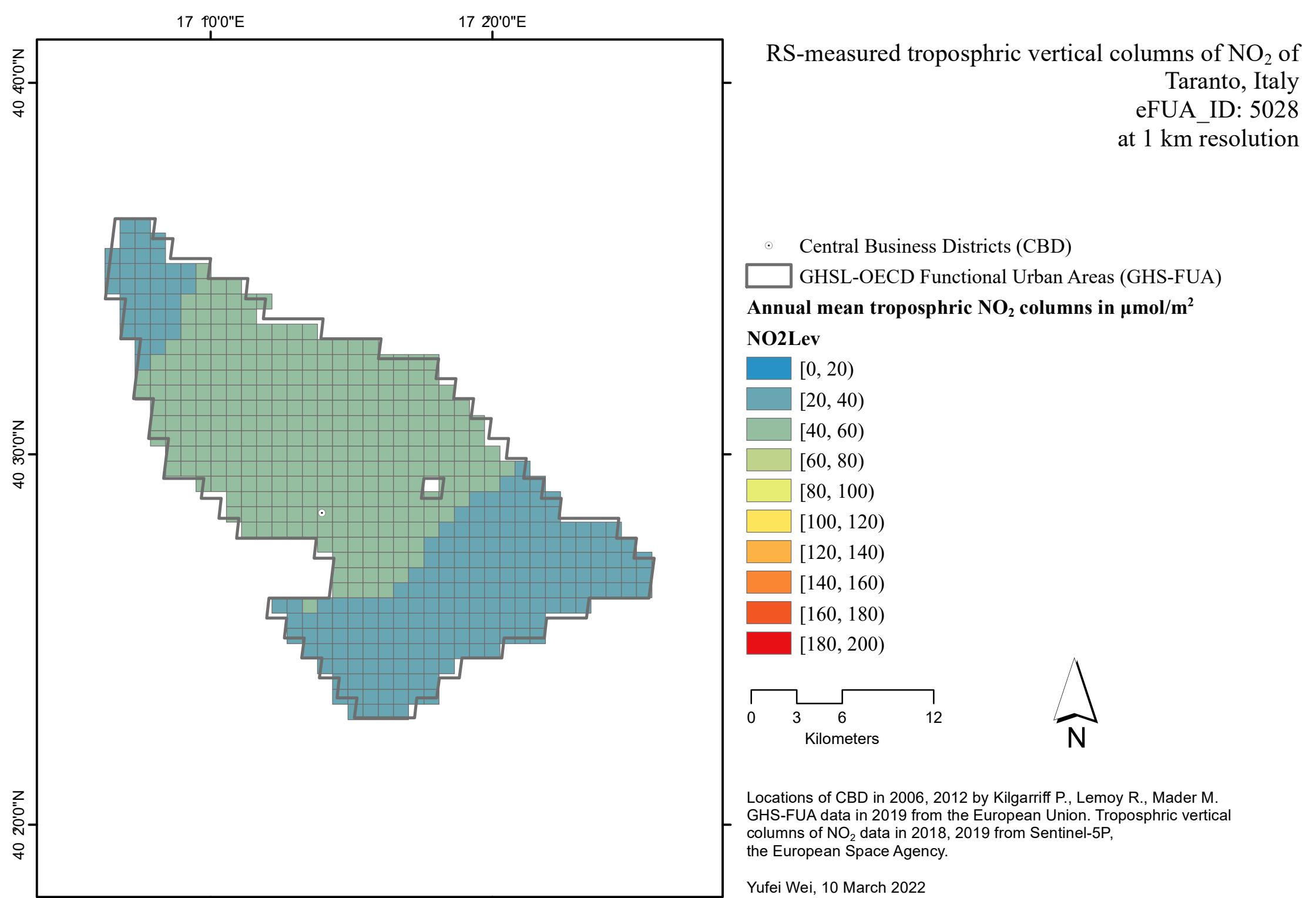
Locations of CBD in 2006, 2012 by Kilgarriff P., Lemoy R., Mader M.  
GHS-FUA data in 2019 from the European Union. Tropospheric vertical  
columns of NO<sub>2</sub> data in 2018, 2019 from Sentinel-5P,  
the European Space Agency.

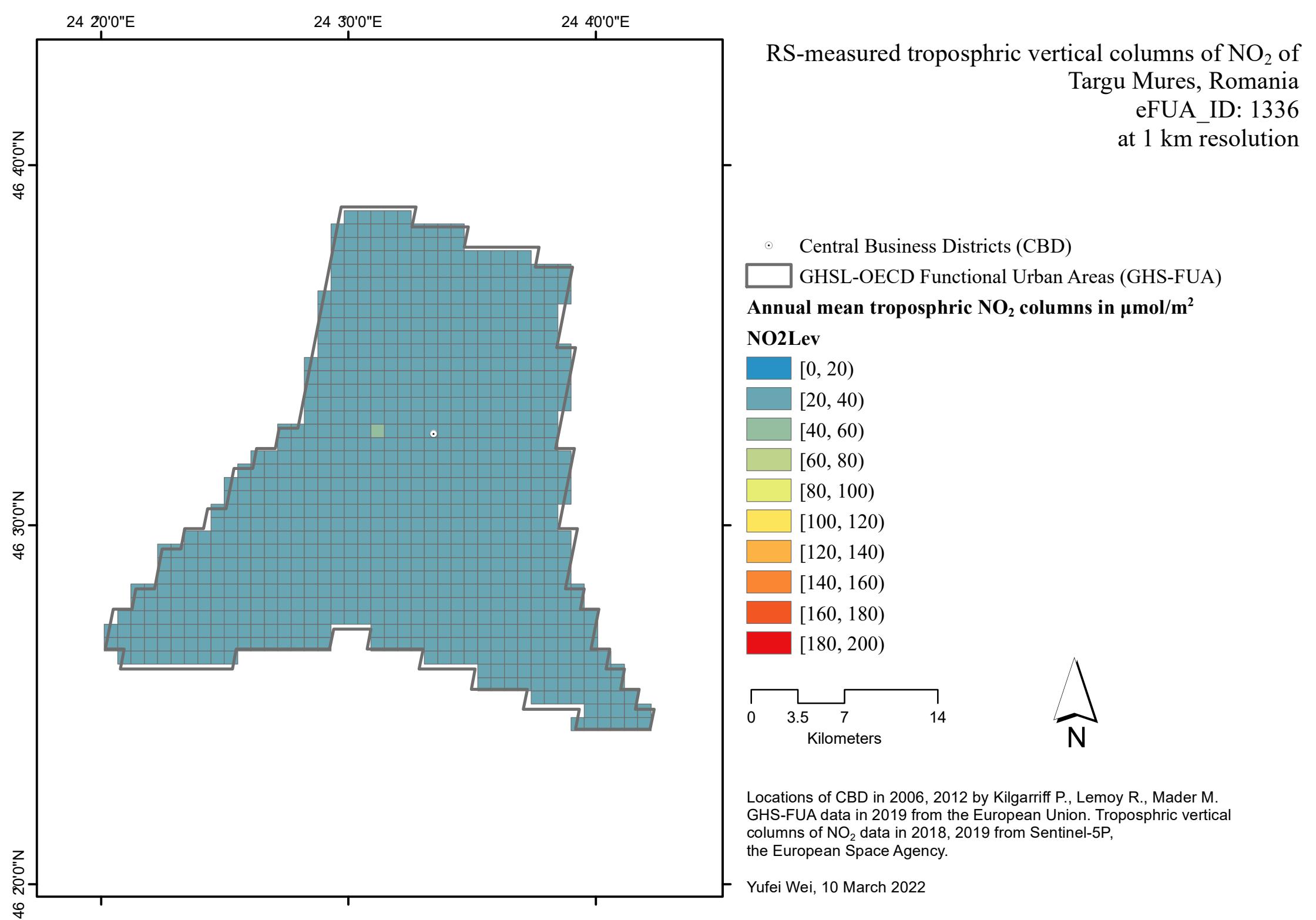












1 0°0"E

1 10'0"E

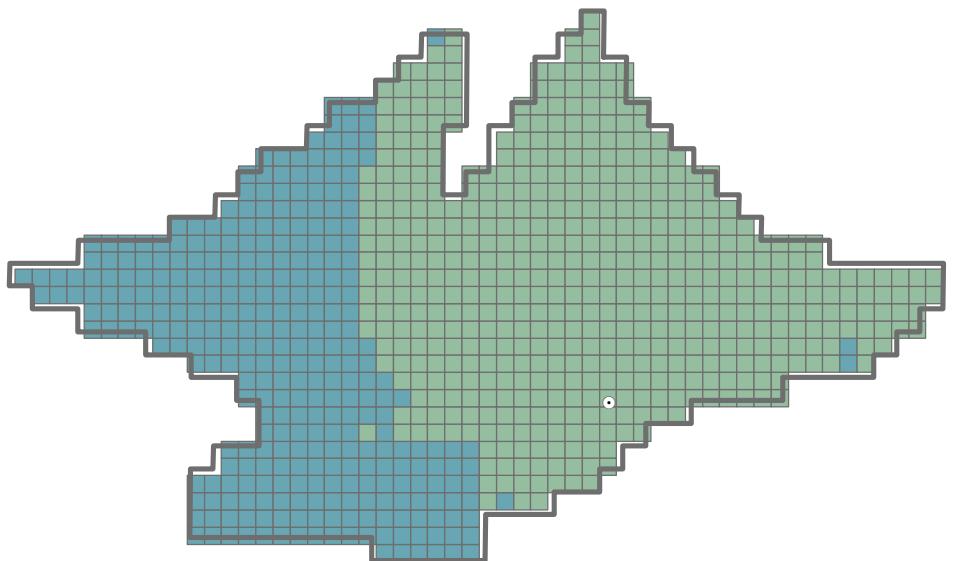
1 20'0"E

RS-measured tropospheric vertical columns of NO<sub>2</sub> of  
Tarragona, Spain  
eFUA\_ID: 4358  
at 1 km resolution

41 20'0"N

41 10'0"N

41 0°0"N



○ Central Business Districts (CBD)

◻ GHSL-OECD Functional Urban Areas (GHS-FUA)

Annual mean tropospheric NO<sub>2</sub> columns in  $\mu\text{mol}/\text{m}^2$

NO2Lev

- [0, 20]
- [20, 40]
- [40, 60]
- [60, 80]
- [80, 100]
- [100, 120]
- [120, 140]
- [140, 160]
- [160, 180]
- [180, 200]

0 4.5 9 18  
Kilometers



Locations of CBD in 2006, 2012 by Kilgarriff P., Lemoy R., Mader M.  
GHS-FUA data in 2019 from the European Union. Tropospheric vertical  
columns of NO<sub>2</sub> data in 2018, 2019 from Sentinel-5P,  
the European Space Agency.

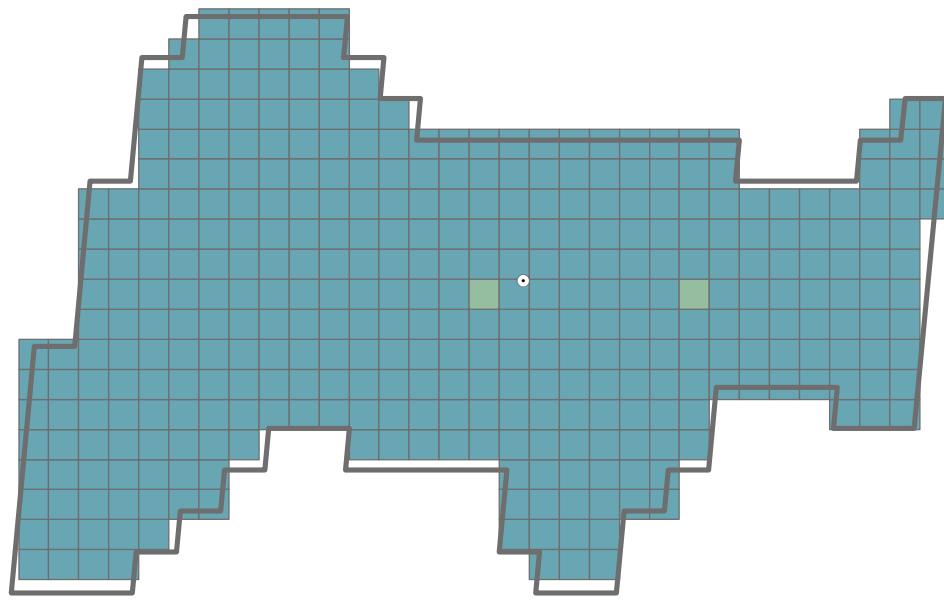
Yufei Wei, 10 March 2022

12 30'0"E

12 40'0"E

RS-measured tropospheric vertical columns of NO<sub>2</sub> of  
Terni, Italy  
eFUA\_ID: 3918  
at 1 km resolution

42 40'0"N



○ Central Business Districts (CBD)

◻ GHS-OECD Functional Urban Areas (GHS-FUA)

Annual mean tropospheric NO<sub>2</sub> columns in μmol/m<sup>2</sup>

NO2Lev

[0, 20)
[20, 40)
[40, 60)
[60, 80)
[80, 100)
[100, 120)
[120, 140)
[140, 160)
[160, 180)
[180, 200)

0 2.5 5 10  
Kilometers

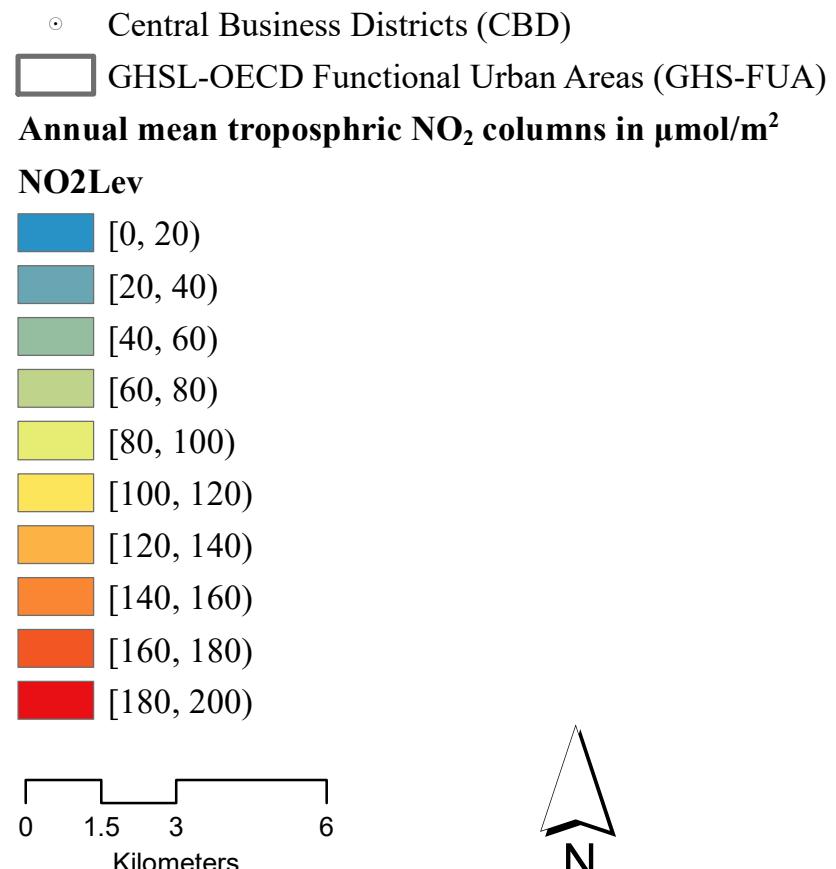
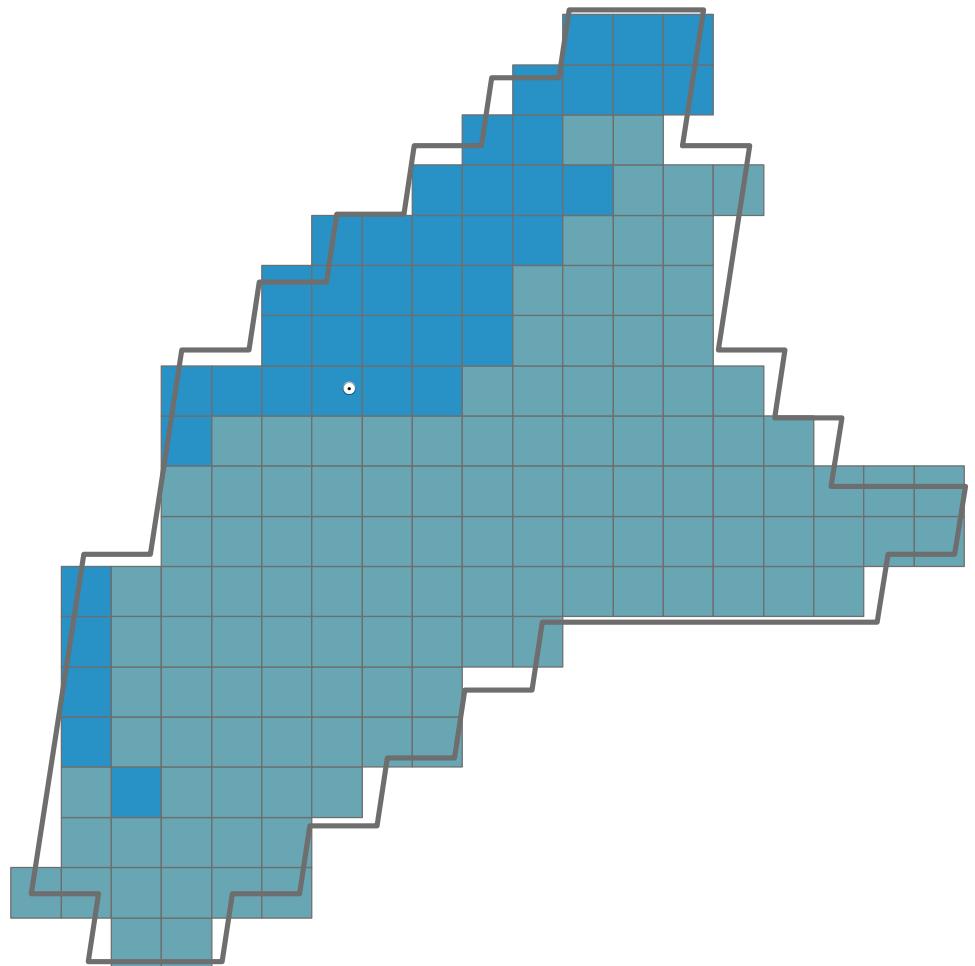


Locations of CBD in 2006, 2012 by Kilgarriff P., Lemoy R., Mader M.  
GHS-FUA data in 2019 from the European Union. Tropospheric vertical  
columns of NO<sub>2</sub> data in 2018, 2019 from Sentinel-5P,  
the European Space Agency.

Yufei Wei, 10 March 2022

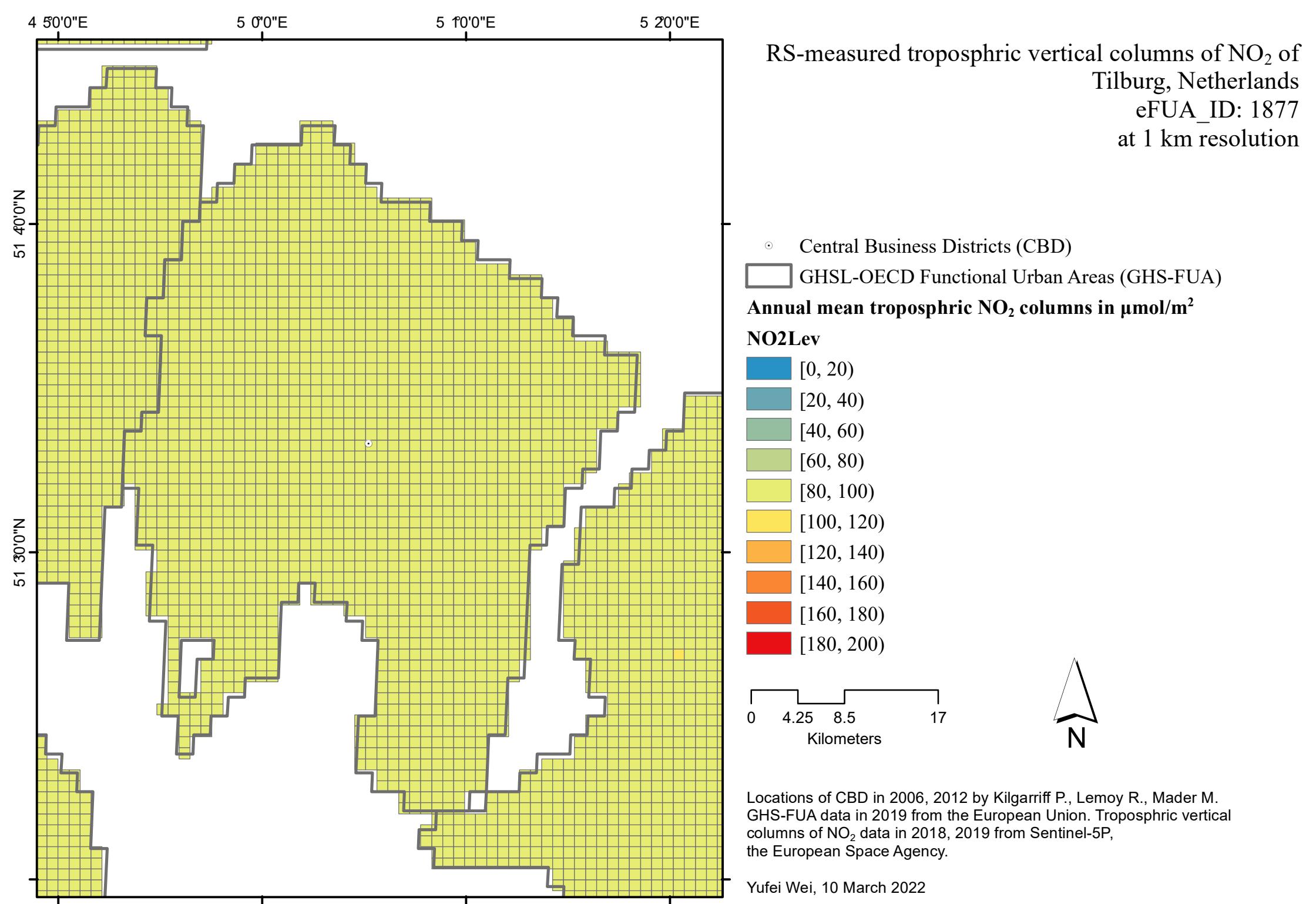
21 0'0"E

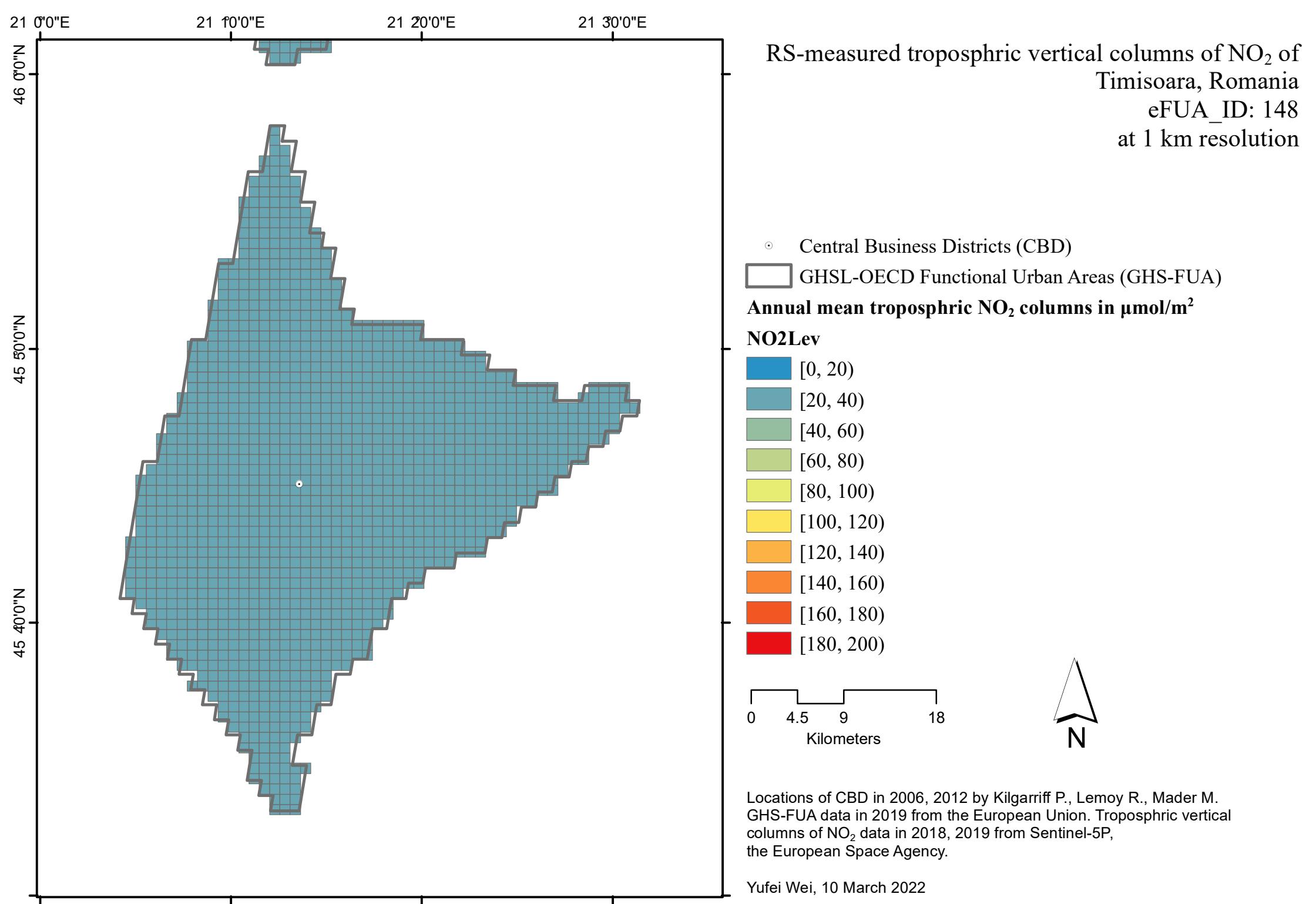
RS-measured tropospheric vertical columns of NO<sub>2</sub> of  
Tetovo, Macedonia  
eFUA\_ID: 285  
at 1 km resolution



Locations of CBD in 2006, 2012 by Kilgarriff P., Lemoy R., Mader M.  
GHS-FUA data in 2019 from the European Union. Tropospheric vertical  
columns of NO<sub>2</sub> data in 2018, 2019 from Sentinel-5P,  
the European Space Agency.

Yufei Wei, 10 March 2022

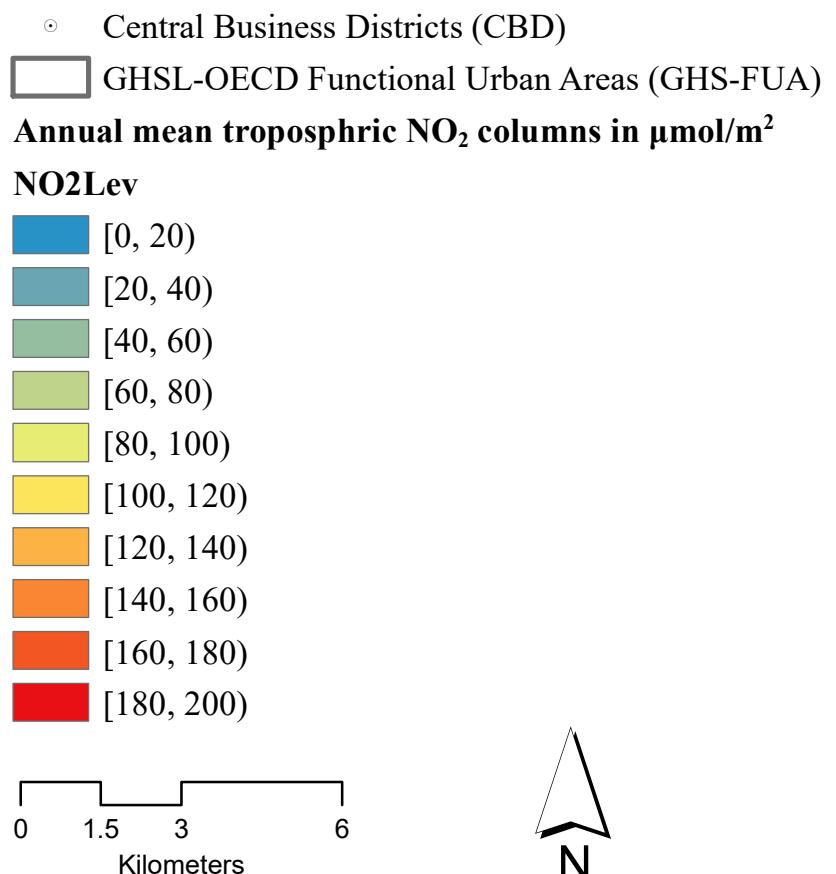
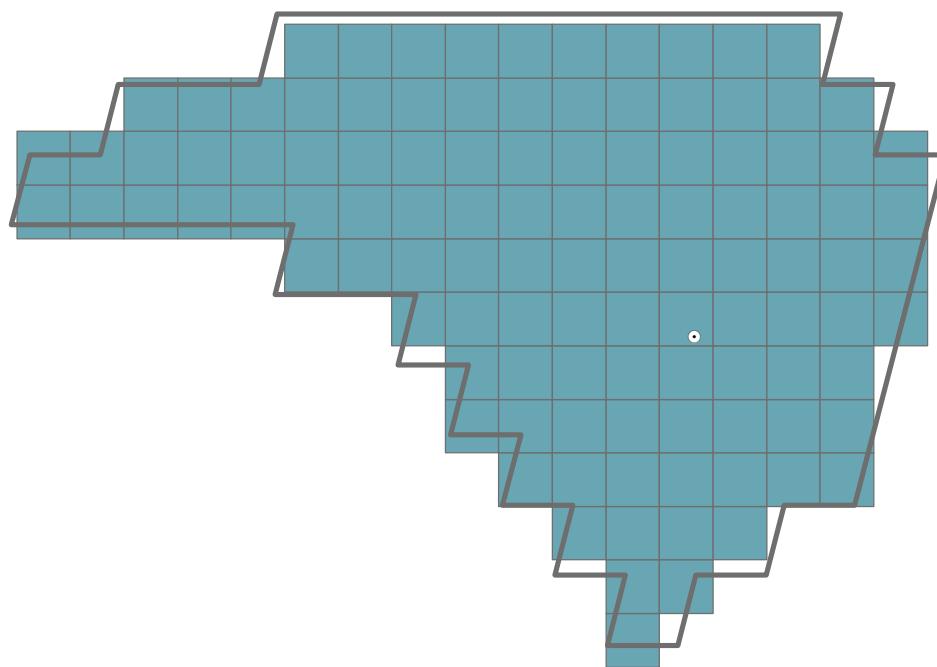




36°30'0"E

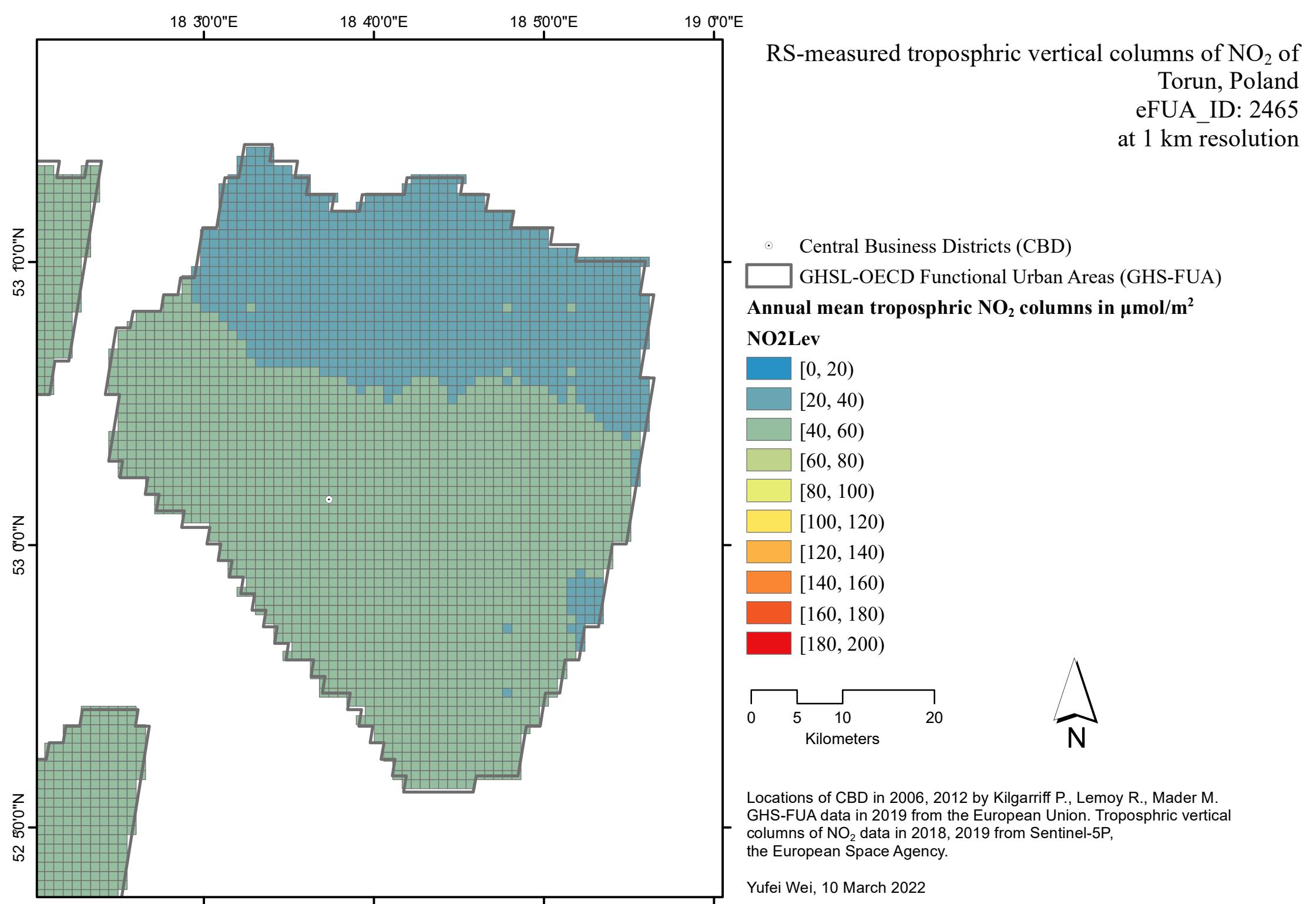
RS-measured tropospheric vertical columns of NO<sub>2</sub> of  
Tokat, Turkey  
eFUA\_ID: 4574  
at 1 km resolution

40°20'0"N



Locations of CBD in 2006, 2012 by Kilgarriff P., Lemoy R., Mader M.  
GHS-FUA data in 2019 from the European Union. Tropospheric vertical  
columns of NO<sub>2</sub> data in 2018, 2019 from Sentinel-5P,  
the European Space Agency.

Yufei Wei, 10 March 2022



5 40'0"E

5 50'0"E

6 0'0"E

6 10'0"E

6 20'0"E

N

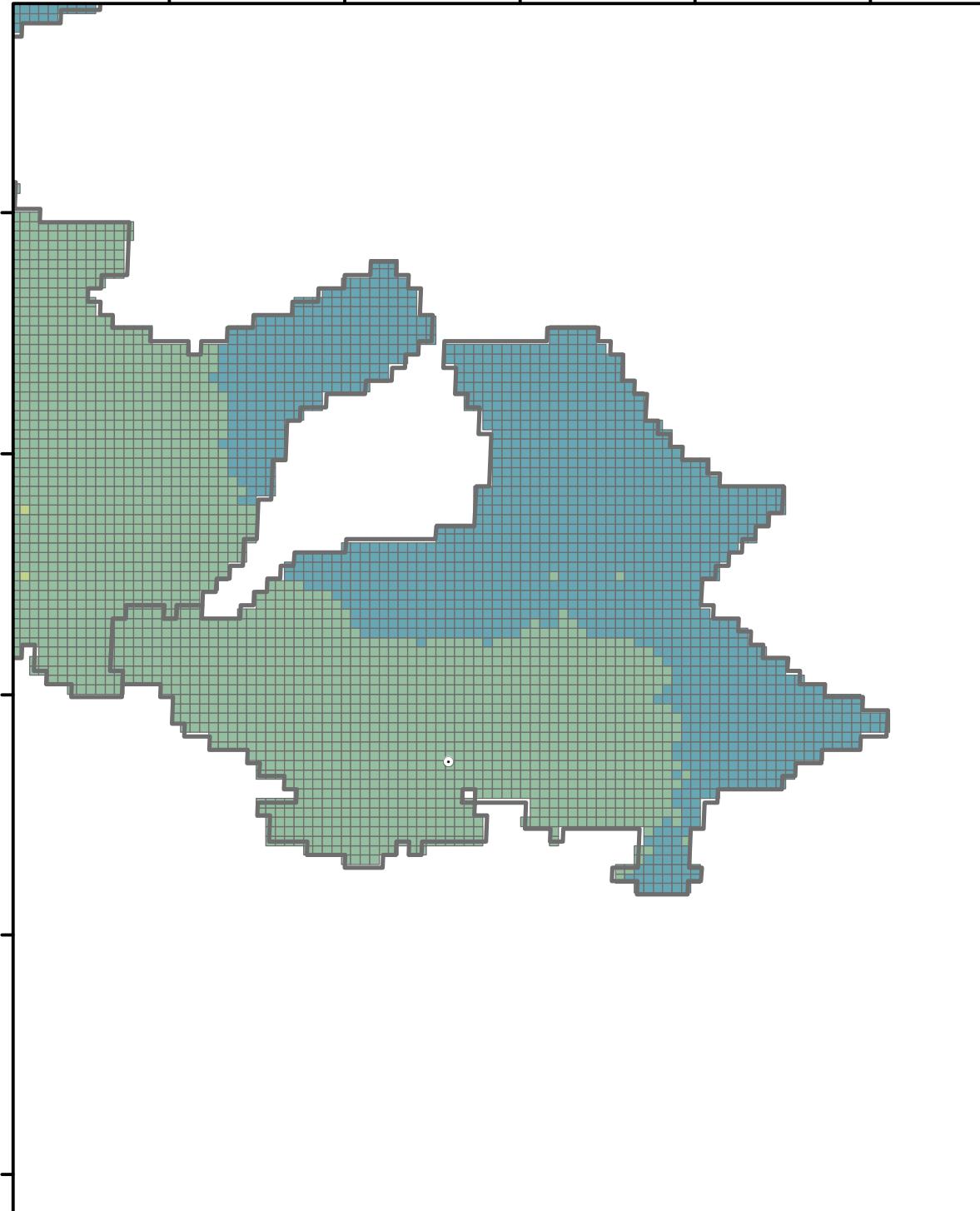
43 30'0"N

43 20'0"N

43 10'0"N

43 0'0"N

42 50'0"N



RS-measured tropospheric vertical columns of NO<sub>2</sub> of  
Toulon, France  
eFUA\_ID: 4158  
at 1 km resolution

○ Central Business Districts (CBD)

◻ GHSL-OECD Functional Urban Areas (GHS-FUA)

Annual mean tropospheric NO<sub>2</sub> columns in  $\mu\text{mol}/\text{m}^2$

NO2Lev

[0, 20)

[20, 40)

[40, 60)

[60, 80)

[80, 100)

[100, 120)

[120, 140)

[140, 160)

[160, 180)

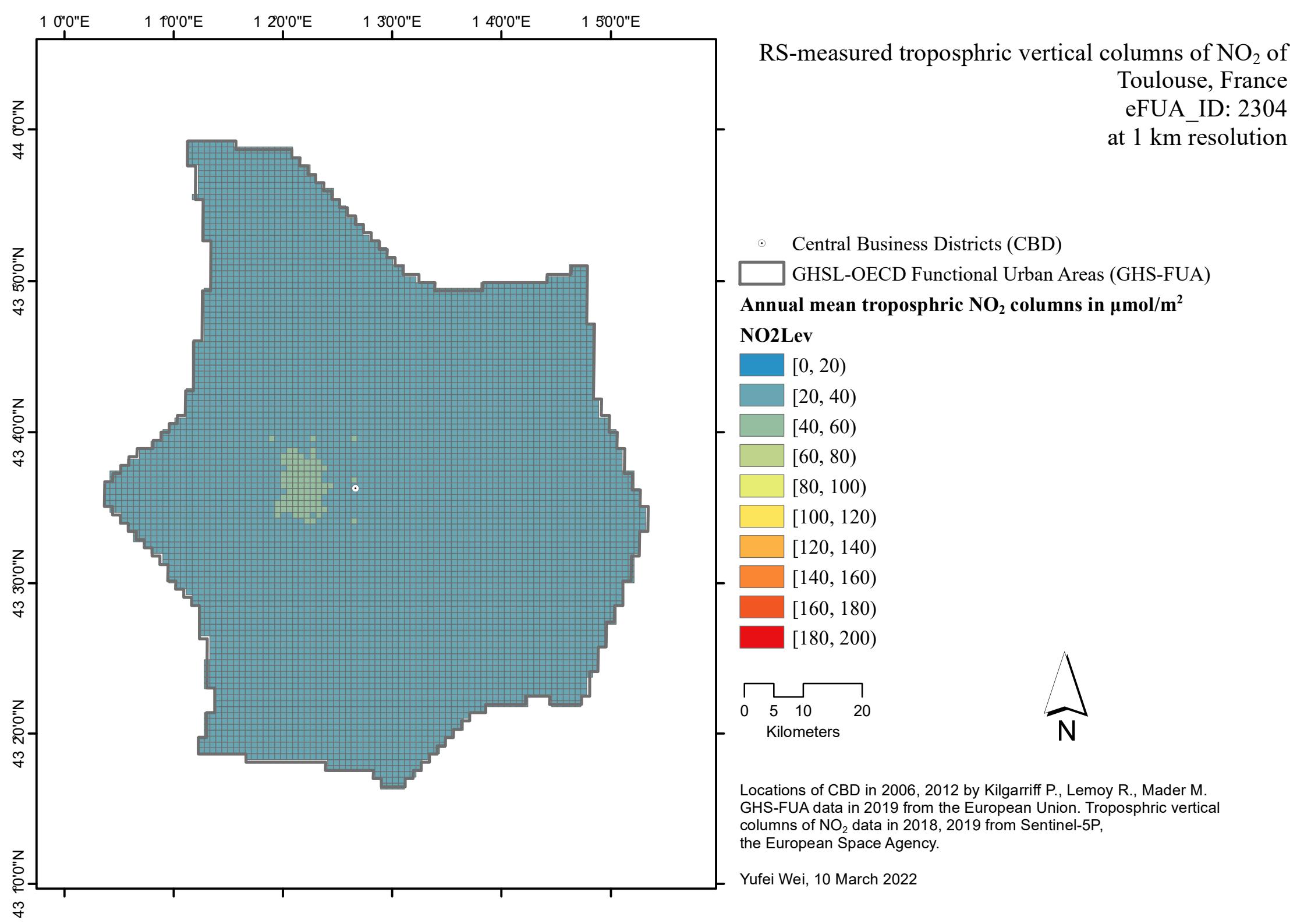
[180, 200)

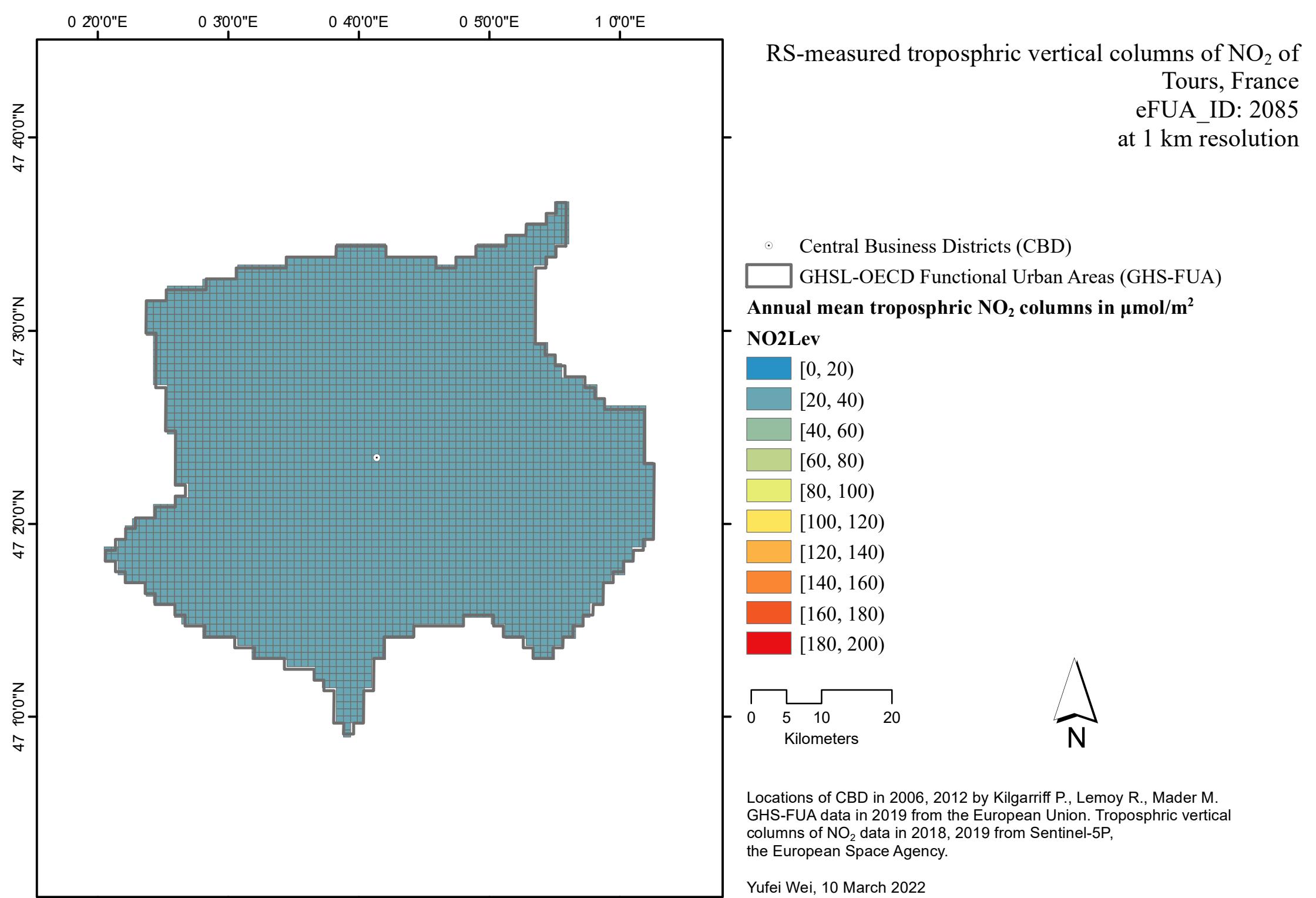
0 5 10 20  
Kilometers



Locations of CBD in 2006, 2012 by Kilgarriff P., Lemoy R., Mader M.  
GHS-FUA data in 2019 from the European Union. Tropospheric vertical  
columns of NO<sub>2</sub> data in 2018, 2019 from Sentinel-5P,  
the European Space Agency.

Yufei Wei, 10 March 2022





39 30'0"E

39 40'0"E

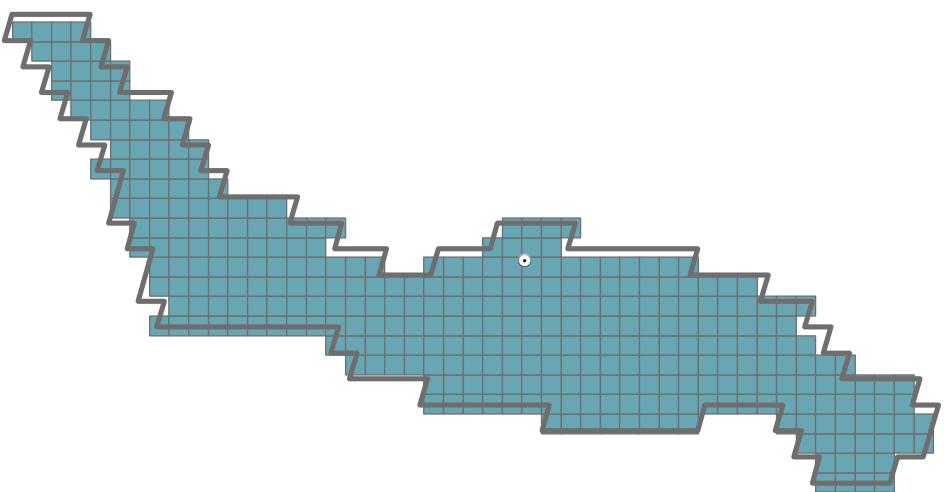
39 50'0"E

RS-measured tropospheric vertical columns of NO<sub>2</sub> of  
Trabzon, Turkey  
eFUA\_ID: 5228  
at 1 km resolution

41 10'0"N

41 00'0"N

40 50'0"N



○ Central Business Districts (CBD)

◻ GHS-OECD Functional Urban Areas (GHS-FUA)

Annual mean tropospheric NO<sub>2</sub> columns in  $\mu\text{mol}/\text{m}^2$

NO2Lev

[0, 20)

[20, 40)

[40, 60)

[60, 80)

[80, 100)

[100, 120)

[120, 140)

[140, 160)

[160, 180)

[180, 200)

0 4 8 16  
Kilometers



Locations of CBD in 2006, 2012 by Kilgarriff P., Lemoy R., Mader M.  
GHS-FUA data in 2019 from the European Union. Tropospheric vertical  
columns of NO<sub>2</sub> data in 2018, 2019 from Sentinel-5P,  
the European Space Agency.

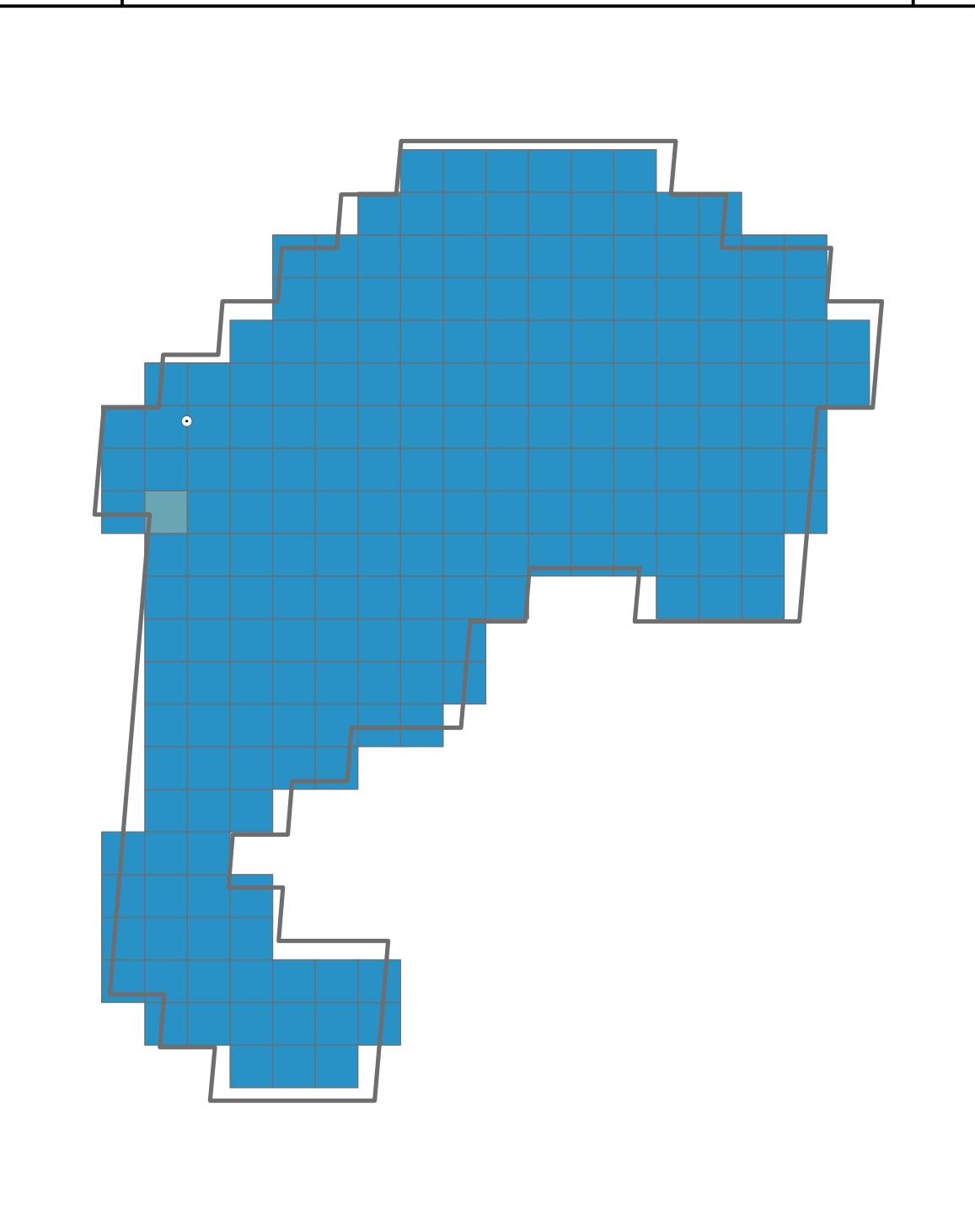
Yufei Wei, 10 March 2022

12 30'0"E

12 40'0"E

RS-measured tropospheric vertical columns of NO<sub>2</sub> of  
Trapani, Italy  
eFUA\_ID: 4130  
at 1 km resolution

38 0'0"N



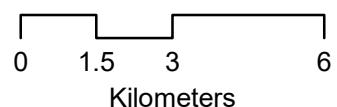
○ Central Business Districts (CBD)

◻ GHSL-OECD Functional Urban Areas (GHS-FUA)

Annual mean tropospheric NO<sub>2</sub> columns in  $\mu\text{mol}/\text{m}^2$

NO2Lev

- [0, 20]
- [20, 40]
- [40, 60]
- [60, 80]
- [80, 100]
- [100, 120]
- [120, 140]
- [140, 160]
- [160, 180]
- [180, 200]



Locations of CBD in 2006, 2012 by Kilgarriff P., Lemoy R., Mader M.  
GHS-FUA data in 2019 from the European Union. Tropospheric vertical  
columns of NO<sub>2</sub> data in 2018, 2019 from Sentinel-5P,  
the European Space Agency.

Yufei Wei, 10 March 2022

11 0'0"E

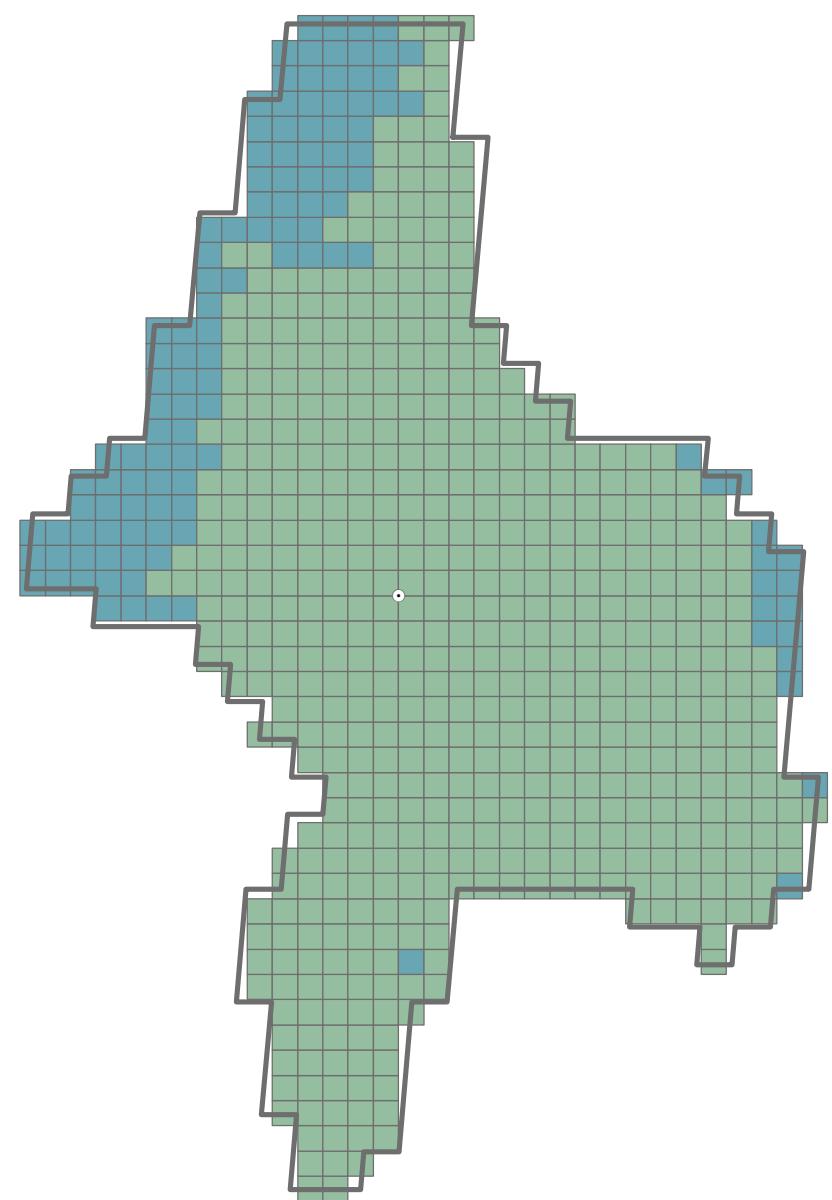
11 10'0"E

11 20'0"E

RS-measured tropospheric vertical columns of NO<sub>2</sub> of  
Trento, Italy  
eFUA\_ID: 2891  
at 1 km resolution

46 0'0"N

46 0'0"N



○ Central Business Districts (CBD)

◻ GHS-OECD Functional Urban Areas (GHS-FUA)

Annual mean tropospheric NO<sub>2</sub> columns in  $\mu\text{mol}/\text{m}^2$

NO2Lev

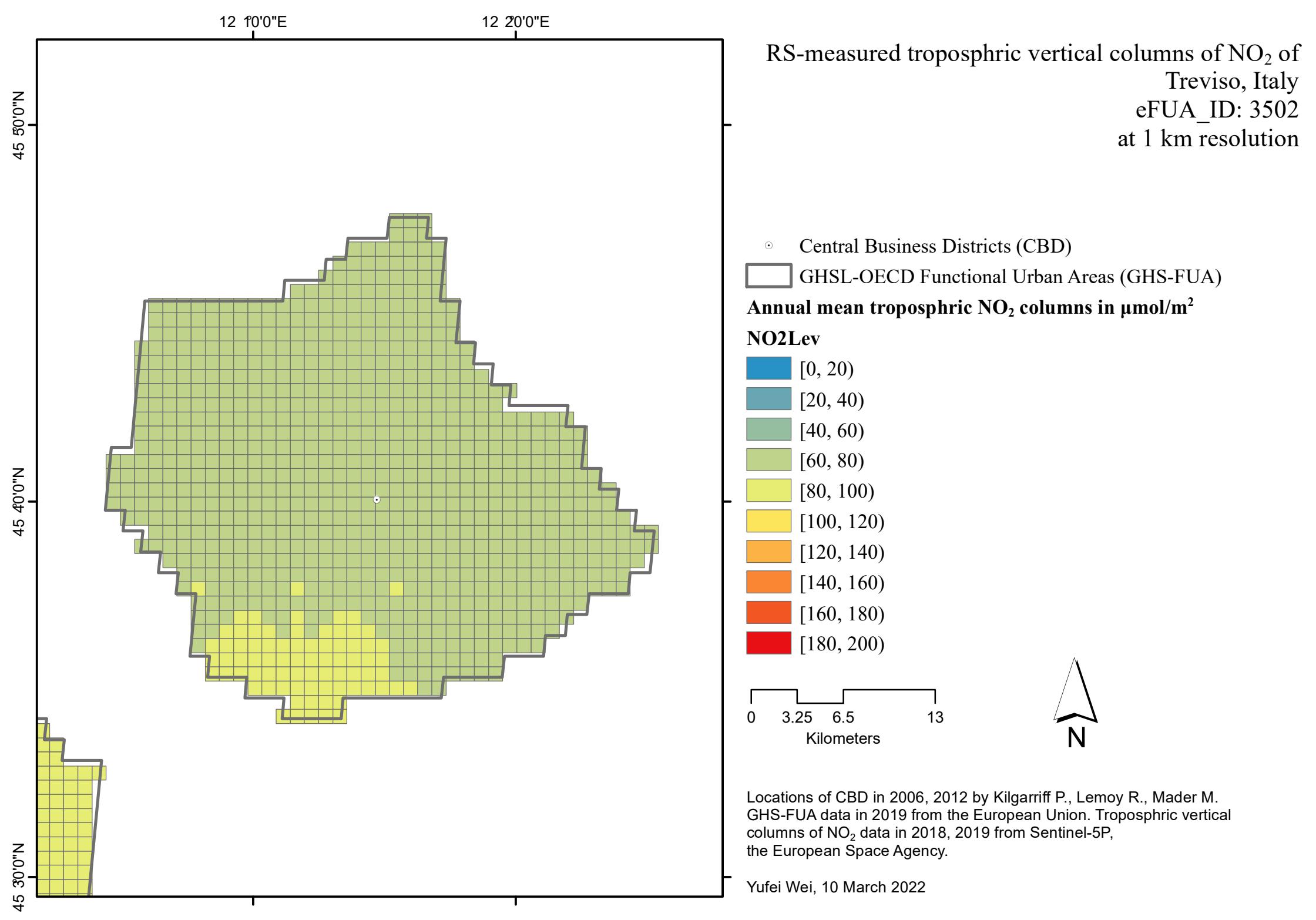
- [0, 20]
- [20, 40]
- [40, 60]
- [60, 80]
- [80, 100]
- [100, 120]
- [120, 140]
- [140, 160]
- [160, 180]
- [180, 200]

0 3 6 12  
Kilometers



Locations of CBD in 2006, 2012 by Kilgarriff P., Lemoy R., Mader M.  
GHS-FUA data in 2019 from the European Union. Tropospheric vertical  
columns of NO<sub>2</sub> data in 2018, 2019 from Sentinel-5P,  
the European Space Agency.

Yufei Wei, 10 March 2022

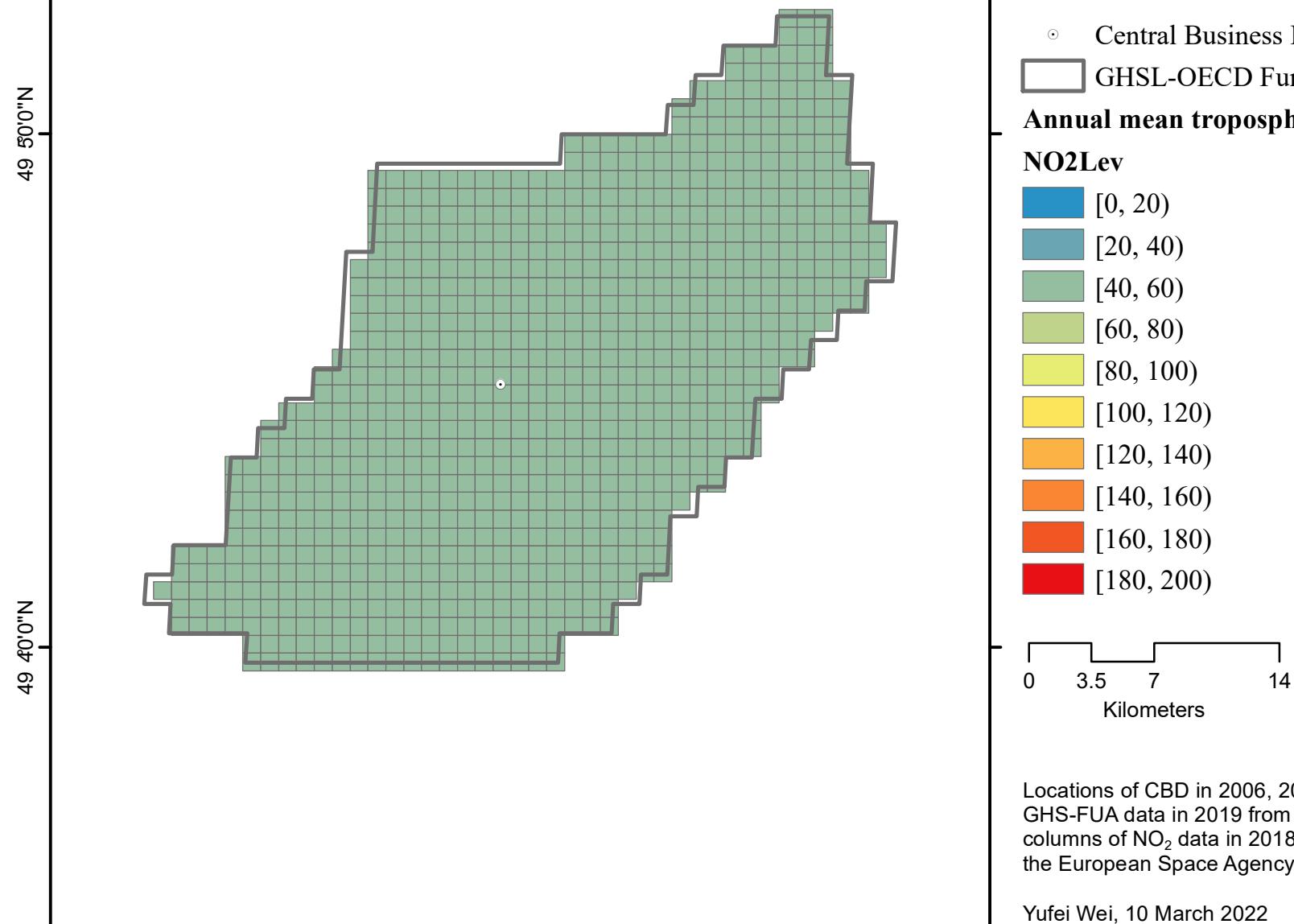


6 30'0"E

6 40'0"E

6 50'0"E

RS-measured tropospheric vertical columns of NO<sub>2</sub> of  
Trier, Germany  
eFUA\_ID: 945  
at 1 km resolution



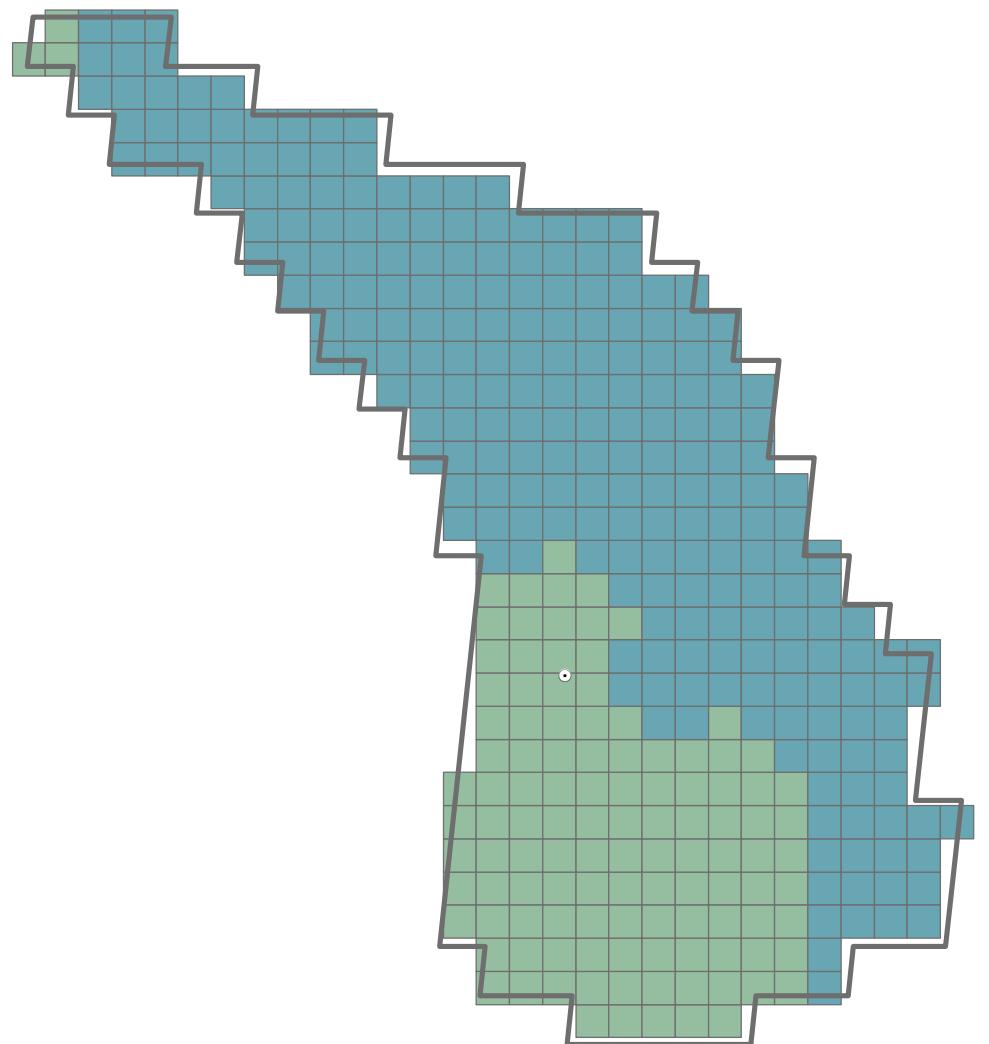
Locations of CBD in 2006, 2012 by Kilgarriff P., Lemoy R., Mader M.  
GHS-FUA data in 2019 from the European Union. Tropospheric vertical  
columns of NO<sub>2</sub> data in 2018, 2019 from Sentinel-5P,  
the European Space Agency.

Yufei Wei, 10 March 2022

13 40'0"E

13 50'0"E

RS-measured tropospheric vertical columns of NO<sub>2</sub> of  
Triest, Italy  
eFUA\_ID: 4164  
at 1 km resolution



○ Central Business Districts (CBD)

◻ GHSL-OECD Functional Urban Areas (GHS-FUA)

Annual mean tropospheric NO<sub>2</sub> columns in  $\mu\text{mol}/\text{m}^2$

NO2Lev

[0, 20)

[20, 40)

[40, 60)

[60, 80)

[80, 100)

[100, 120)

[120, 140)

[140, 160)

[160, 180)

[180, 200)

0 2.5 5 10  
Kilometers



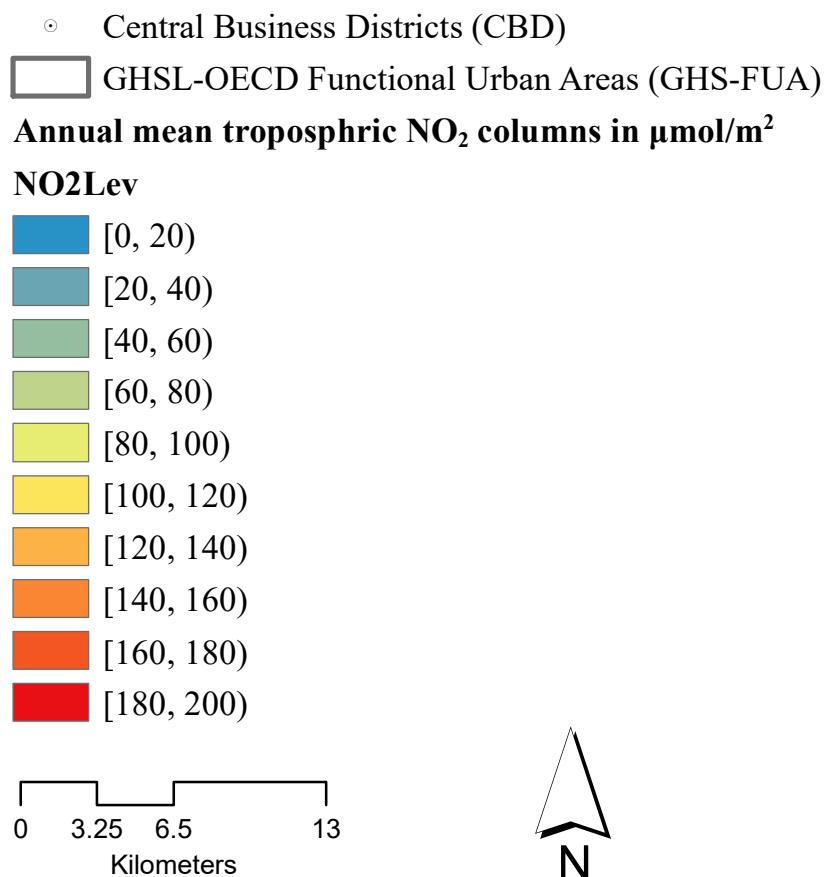
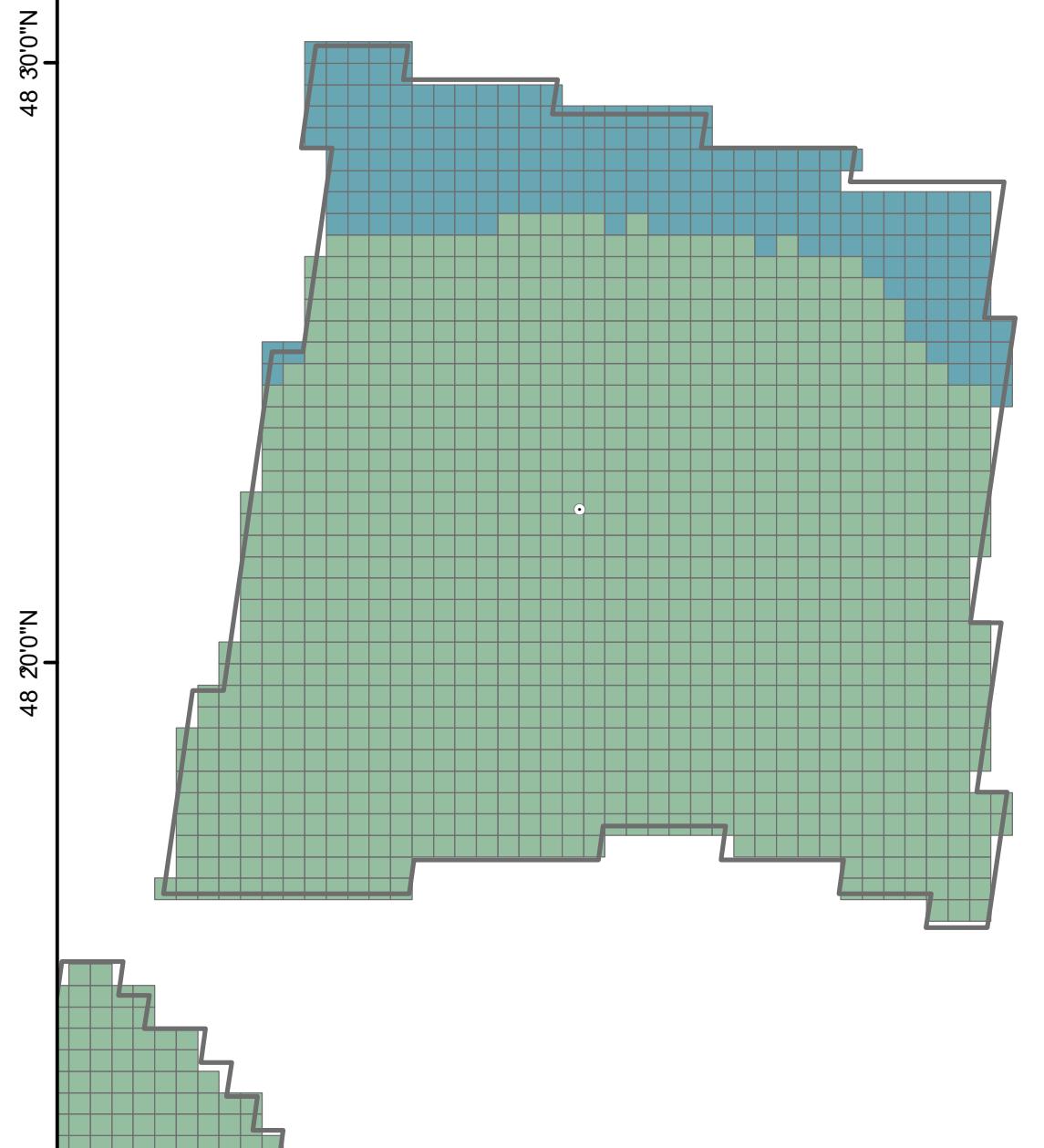
Locations of CBD in 2006, 2012 by Kilgarriff P., Lemoy R., Mader M.  
GHS-FUA data in 2019 from the European Union. Tropospheric vertical  
columns of NO<sub>2</sub> data in 2018, 2019 from Sentinel-5P,  
the European Space Agency.

Yufei Wei, 10 March 2022

17 30'0"E

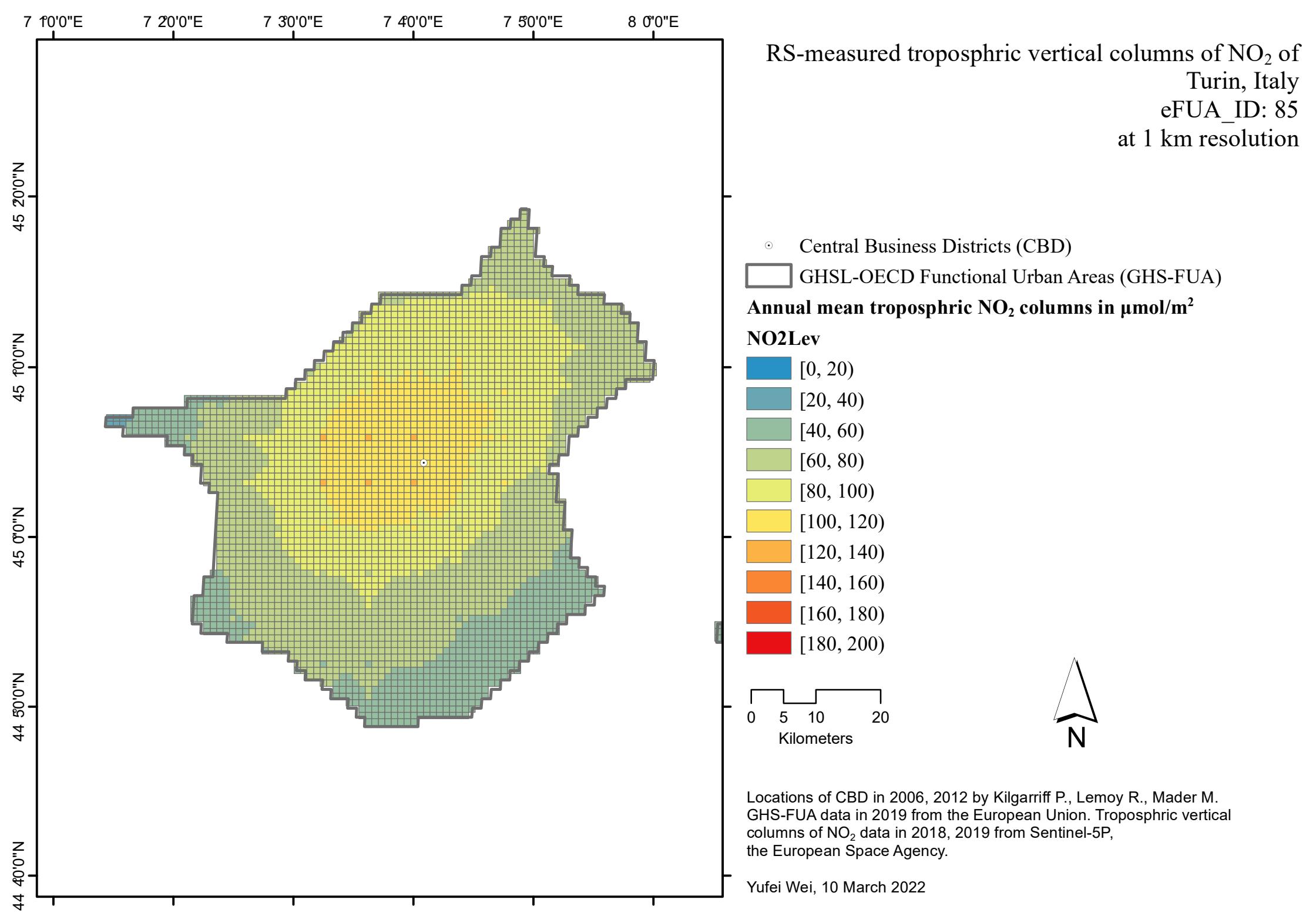
17 40'0"E

RS-measured tropospheric vertical columns of NO<sub>2</sub> of  
Trnava, Slovakia  
eFUA\_ID: 327  
at 1 km resolution



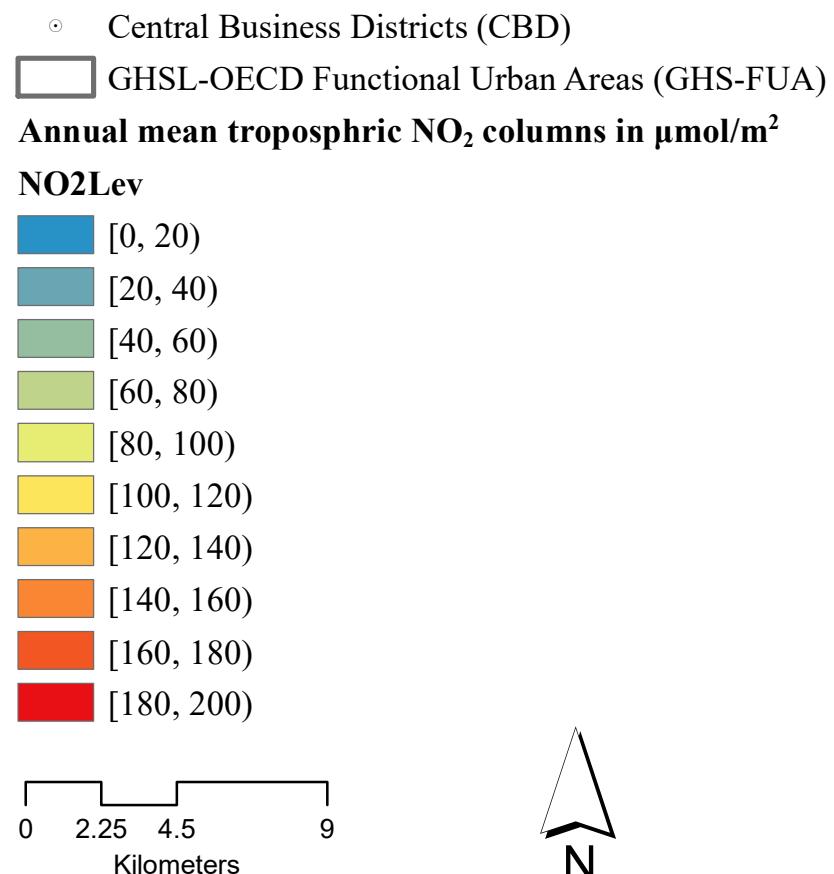
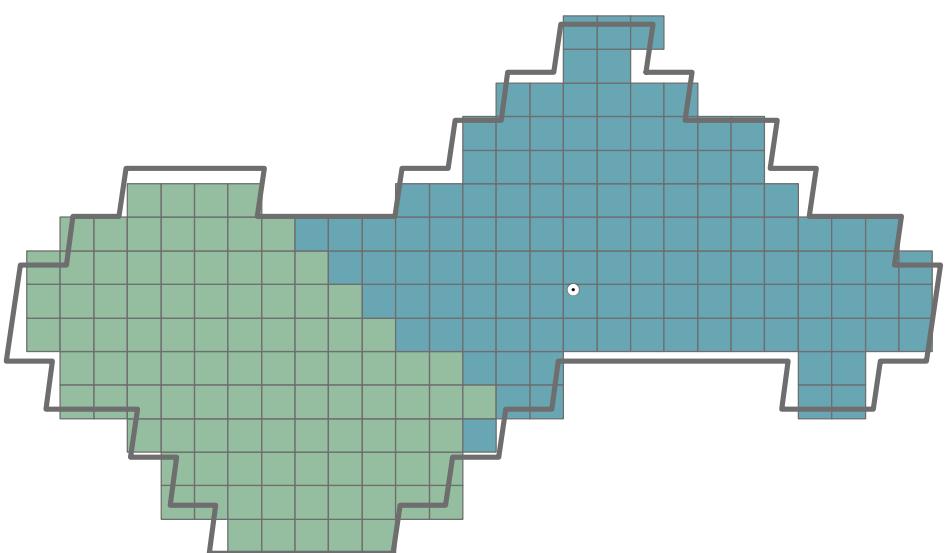
Locations of CBD in 2006, 2012 by Kilgarriff P., Lemoy R., Mader M.  
GHS-FUA data in 2019 from the European Union. Tropospheric vertical  
columns of NO<sub>2</sub> data in 2018, 2019 from Sentinel-5P,  
the European Space Agency.

Yufei Wei, 10 March 2022



18°40'0"E

RS-measured tropospheric vertical columns of NO<sub>2</sub> of  
Tuzla, Bosnia and Herzegovina  
eFUA\_ID: 928  
at 1 km resolution



Locations of CBD in 2006, 2012 by Kilgarriff P., Lemoy R., Mader M.  
GHS-FUA data in 2019 from the European Union. Tropospheric vertical  
columns of NO<sub>2</sub> data in 2018, 2019 from Sentinel-5P,  
the European Space Agency.

Yufei Wei, 10 March 2022

9 50'0"E

10 0'0"E

10 10'0"E

RS-measured tropospheric vertical columns of NO<sub>2</sub> of  
 Ulm, Germany  
 eFUA\_ID: 4255  
 at 1 km resolution

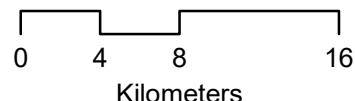
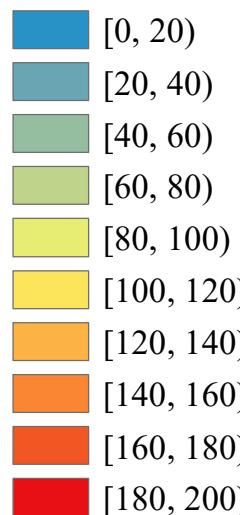
48 30'0"N

48 20'0"N

48 10'0"N

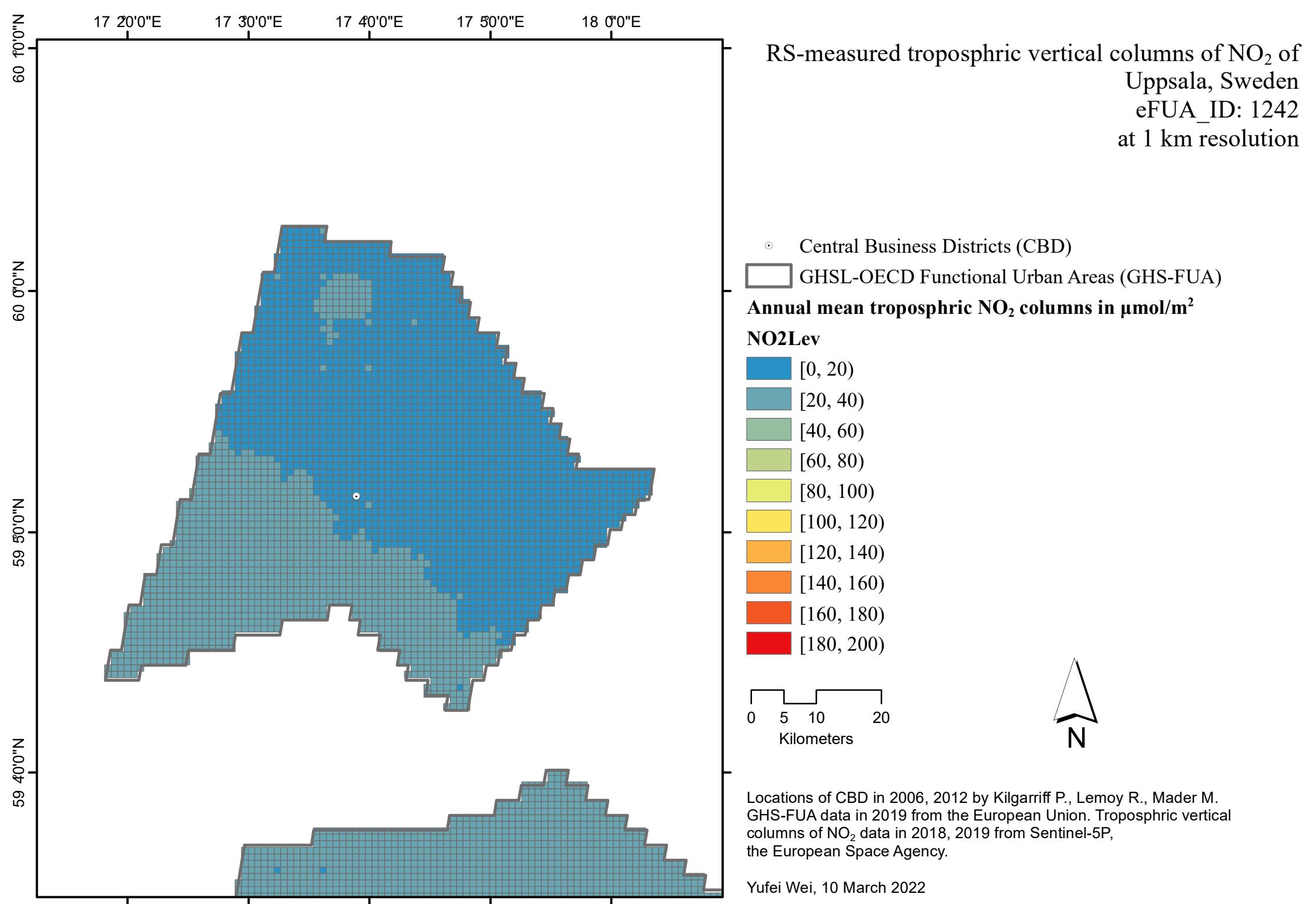
○ Central Business Districts (CBD)

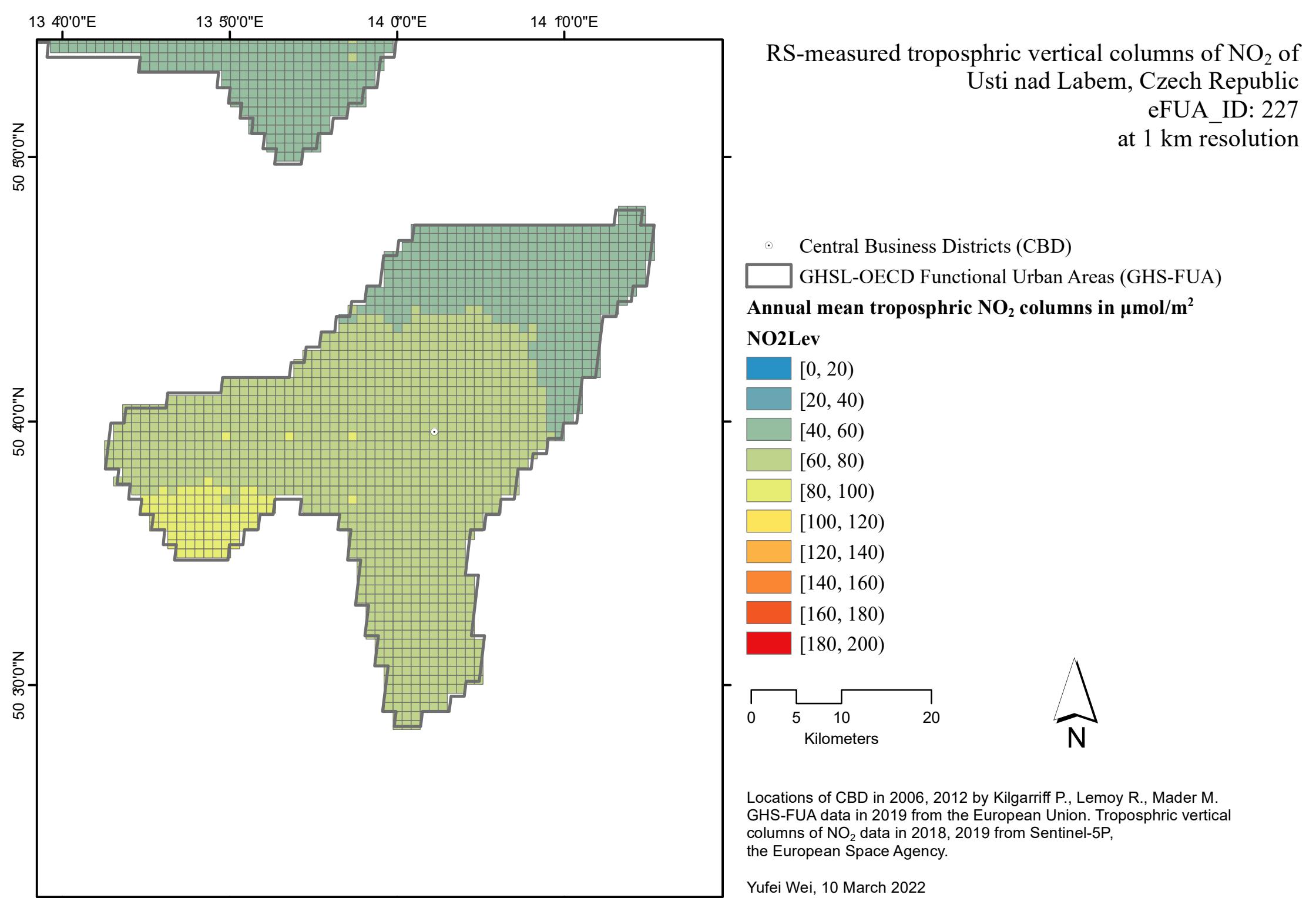
◻ GHSL-OECD Functional Urban Areas (GHS-FUA)

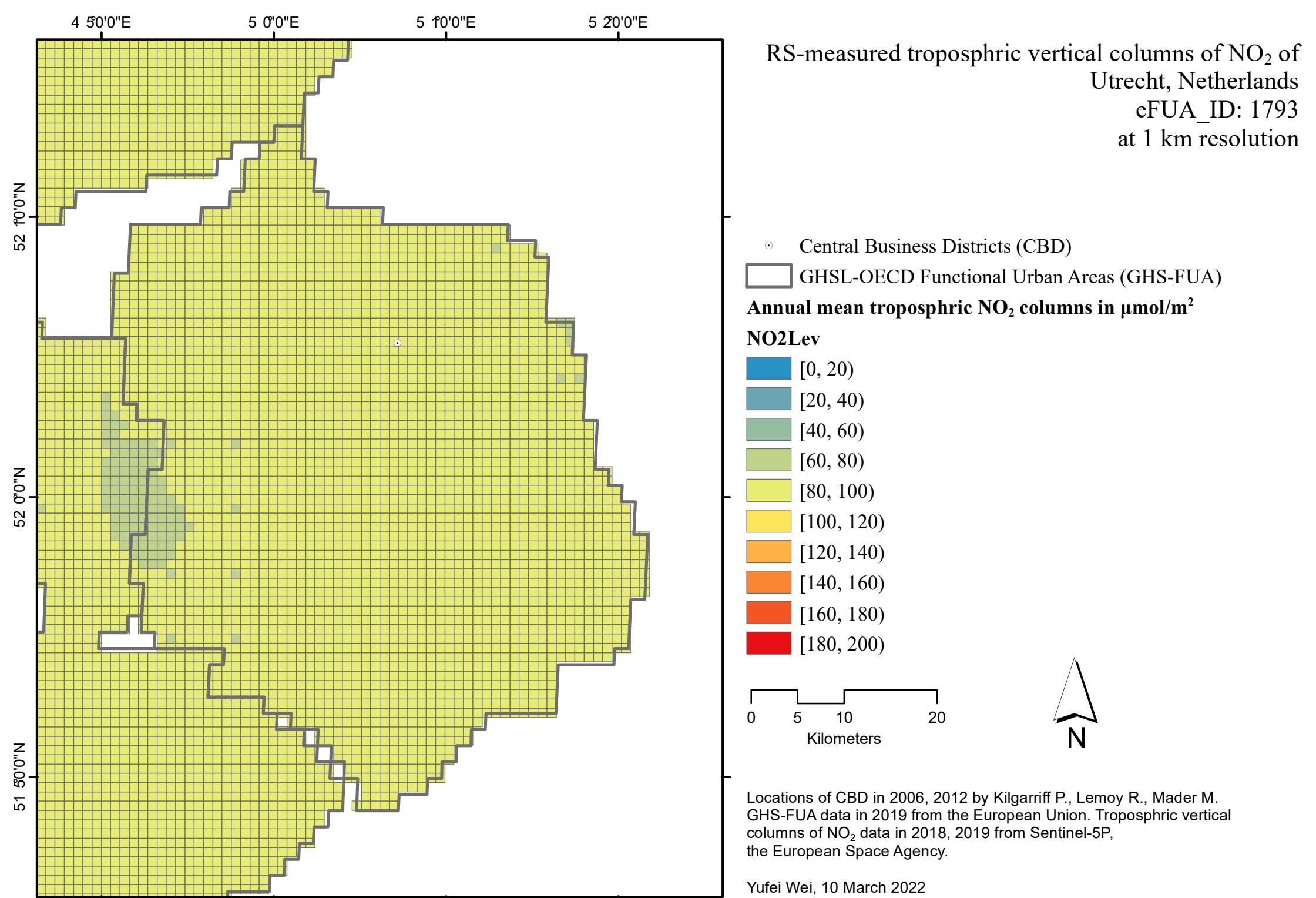
**Annual mean tropospheric NO<sub>2</sub> columns in  $\mu\text{mol}/\text{m}^2$** **NO2Lev**

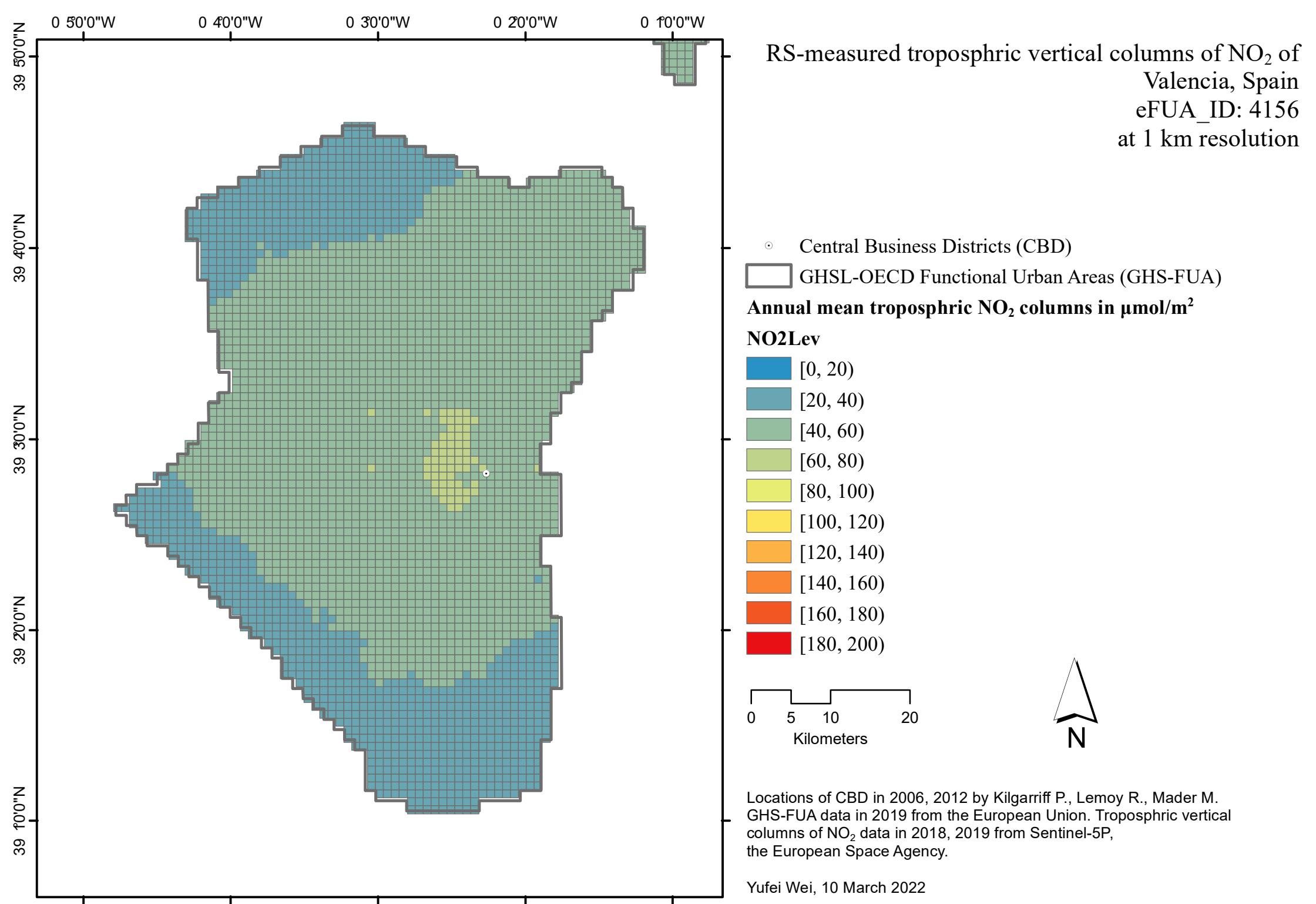
Locations of CBD in 2006, 2012 by Kilgarriff P., Lemoy R., Mader M.  
 GHS-FUA data in 2019 from the European Union. Tropospheric vertical  
 columns of NO<sub>2</sub> data in 2018, 2019 from Sentinel-5P,  
 the European Space Agency.

Yufei Wei, 10 March 2022







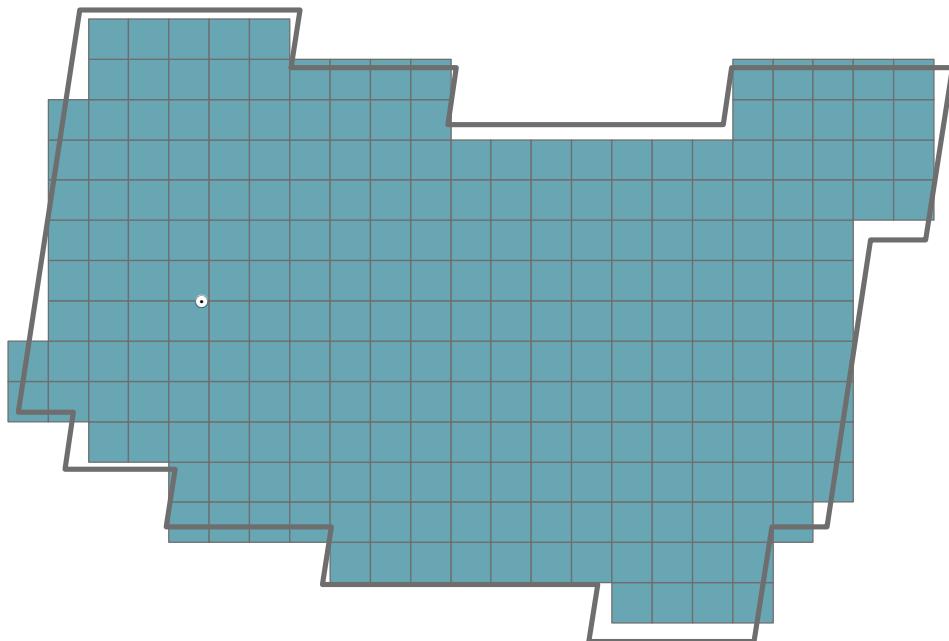


19 50'0"E

20 0'0"E

RS-measured tropospheric vertical columns of NO<sub>2</sub> of  
Valjevo, Serbia  
eFUA\_ID: 478  
at 1 km resolution

44 20'0"N

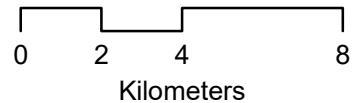
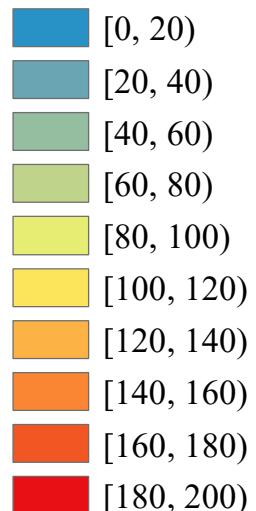


○ Central Business Districts (CBD)

◻ GHSL-OECD Functional Urban Areas (GHS-FUA)

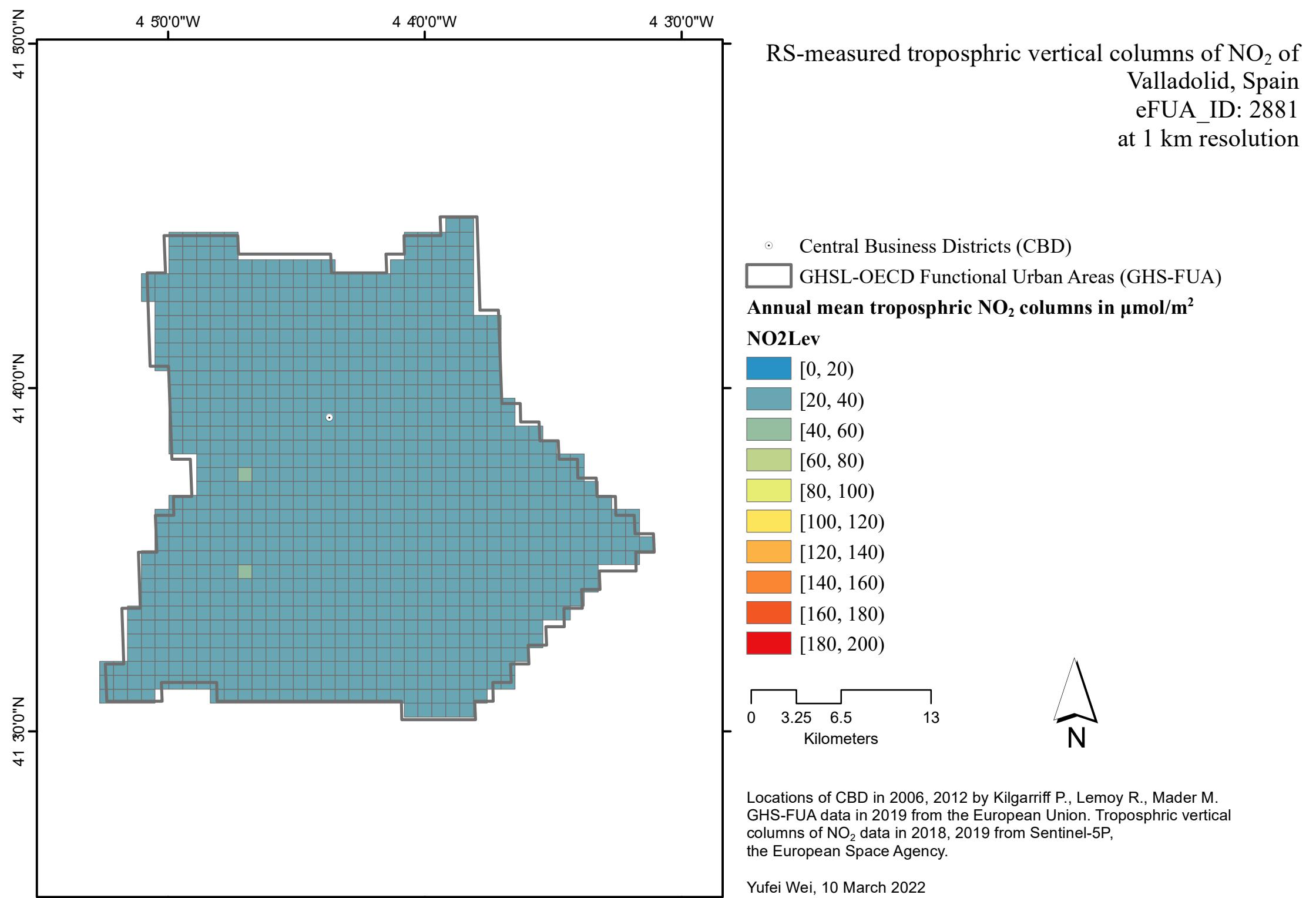
Annual mean tropospheric NO<sub>2</sub> columns in  $\mu\text{mol}/\text{m}^2$

NO2Lev



Locations of CBD in 2006, 2012 by Kilgarriff P., Lemoy R., Mader M.  
GHS-FUA data in 2019 from the European Union. Tropospheric vertical  
columns of NO<sub>2</sub> data in 2018, 2019 from Sentinel-5P,  
the European Space Agency.

Yufei Wei, 10 March 2022



27 40'0"E

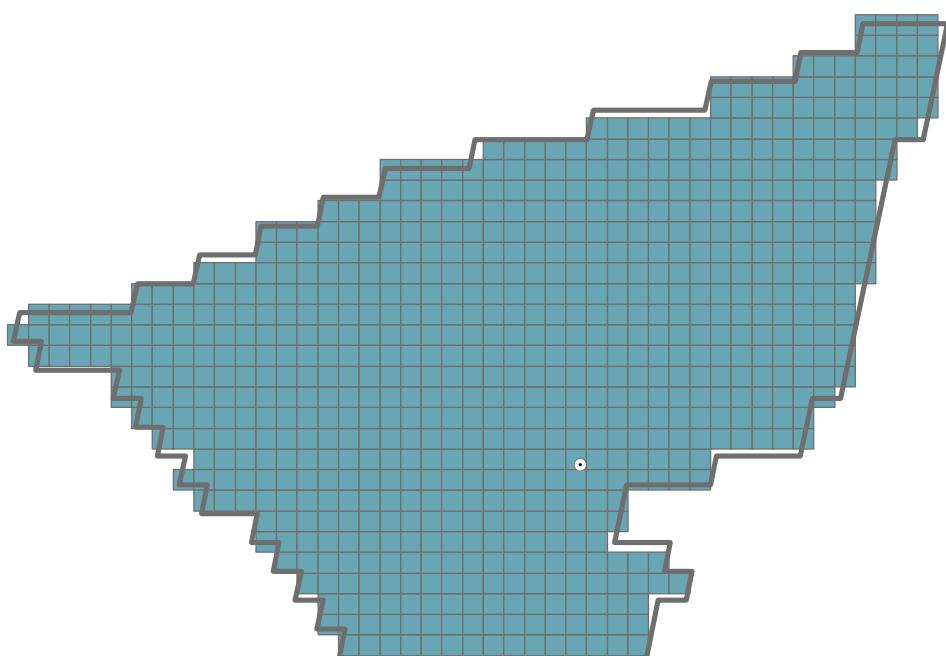
27 50'0"E

28 0'0"E

RS-measured tropospheric vertical columns of NO<sub>2</sub> of  
Varna, Bulgaria  
eFUA\_ID: 927  
at 1 km resolution

43 20'0"N

43 10'0"N



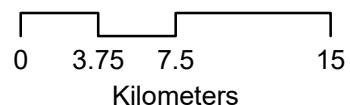
○ Central Business Districts (CBD)

◻ GHS-OECD Functional Urban Areas (GHS-FUA)

**Annual mean tropospheric NO<sub>2</sub> columns in μmol/m<sup>2</sup>**

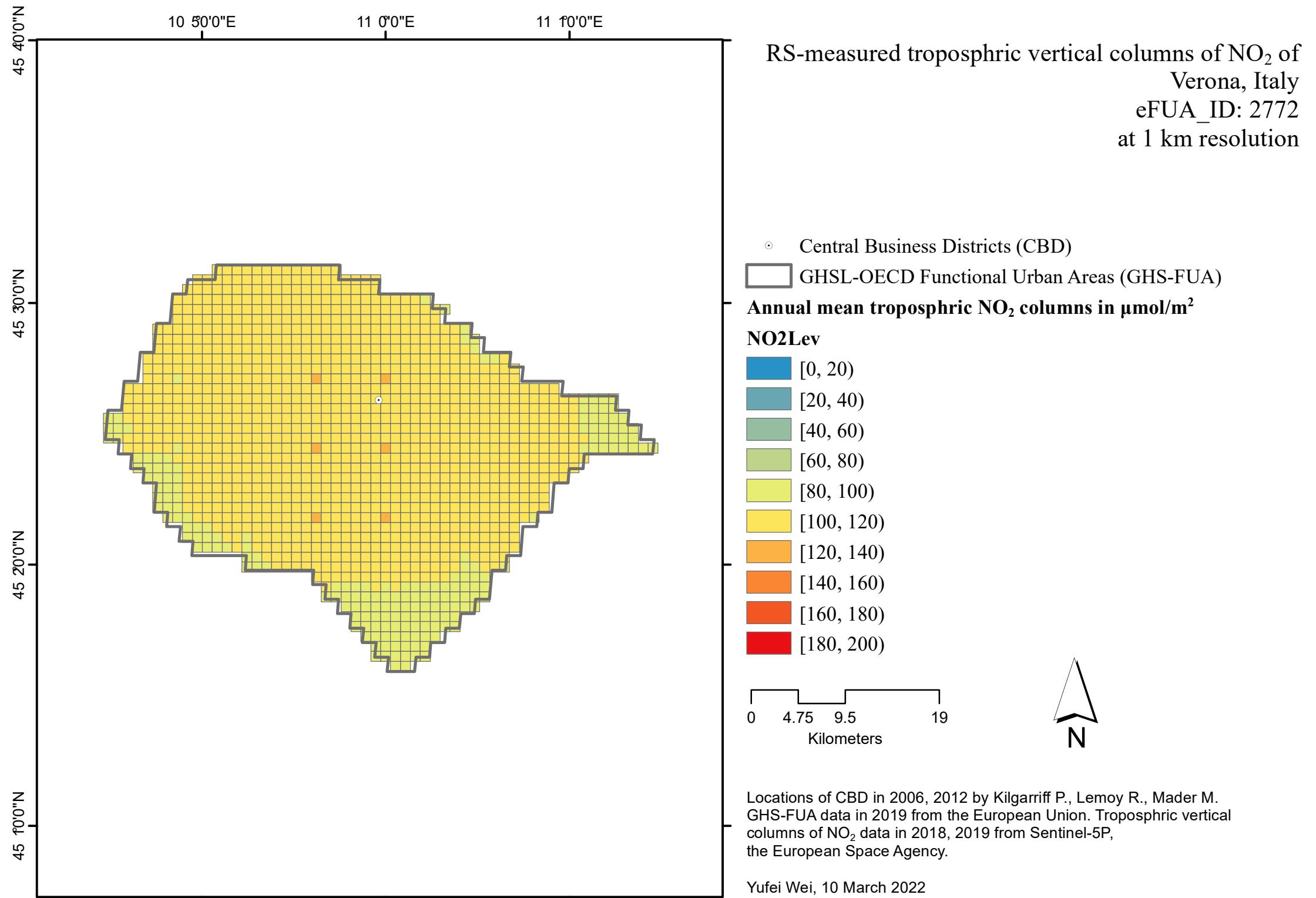
**NO2Lev**

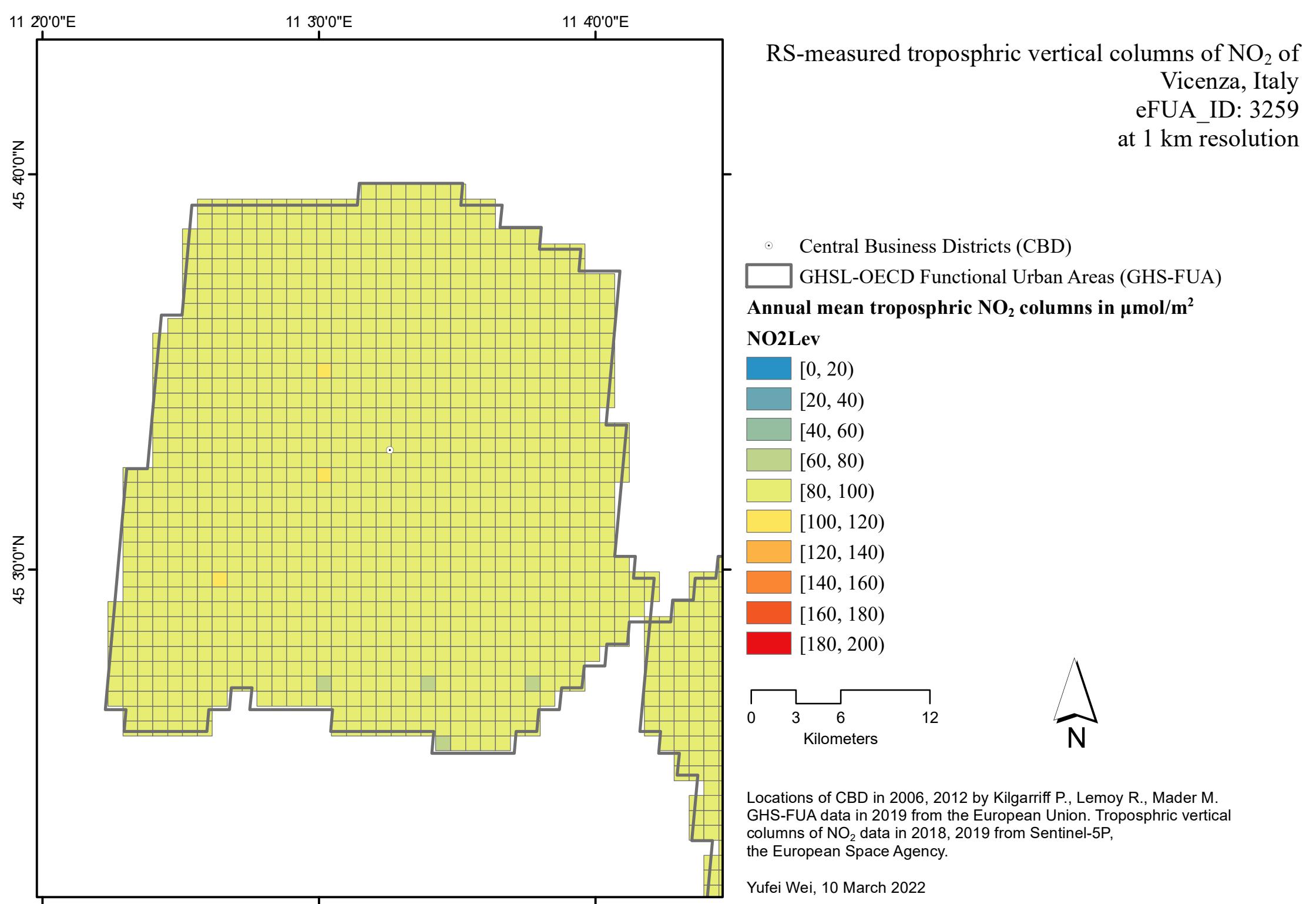
- [0, 20)
- [20, 40)
- [40, 60)
- [60, 80)
- [80, 100)
- [100, 120)
- [120, 140)
- [140, 160)
- [160, 180)
- [180, 200)

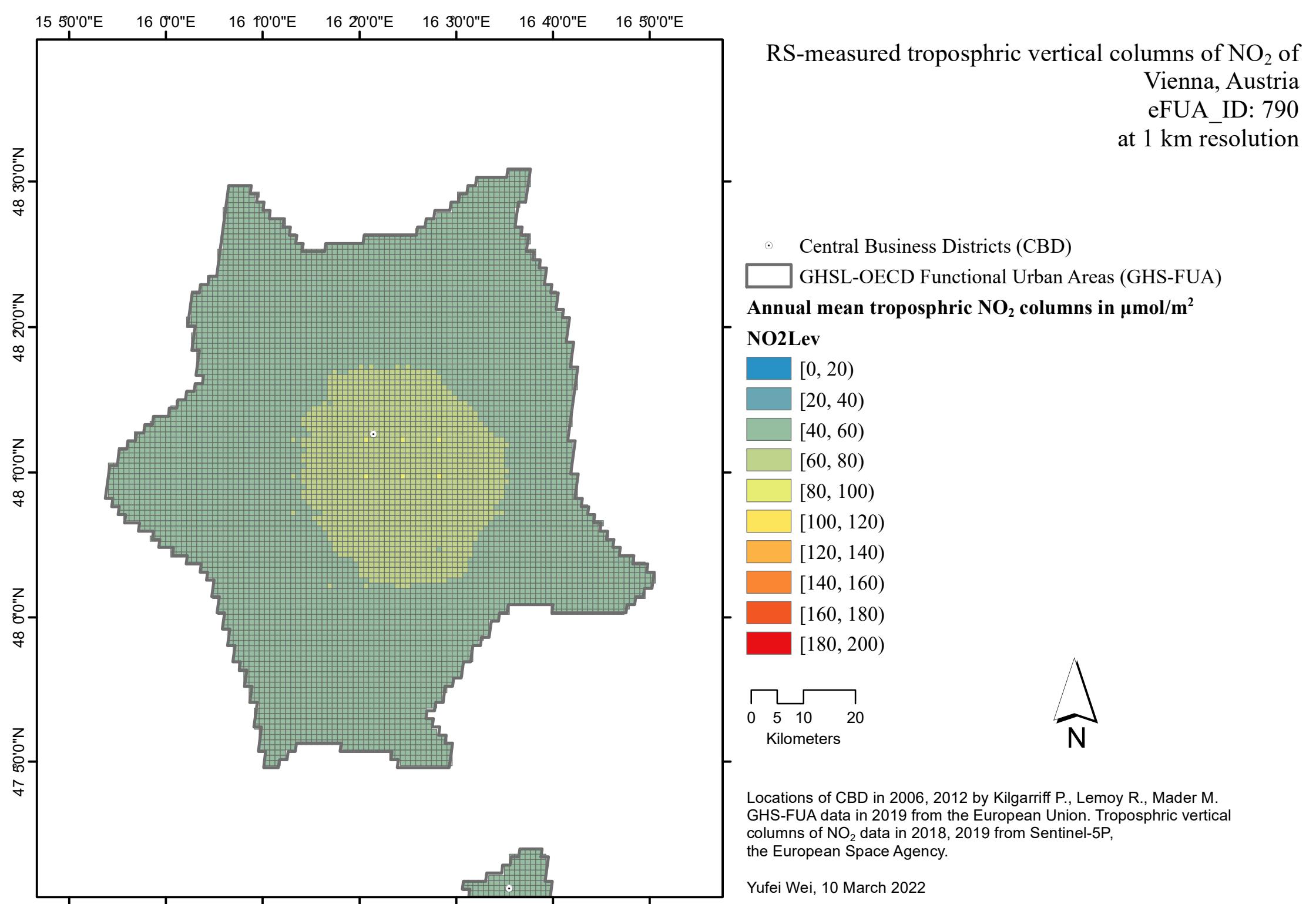


Locations of CBD in 2006, 2012 by Kilgarriff P., Lemoy R., Mader M.  
GHS-FUA data in 2019 from the European Union. Tropospheric vertical  
columns of NO<sub>2</sub> data in 2018, 2019 from Sentinel-5P,  
the European Space Agency.

Yufei Wei, 10 March 2022







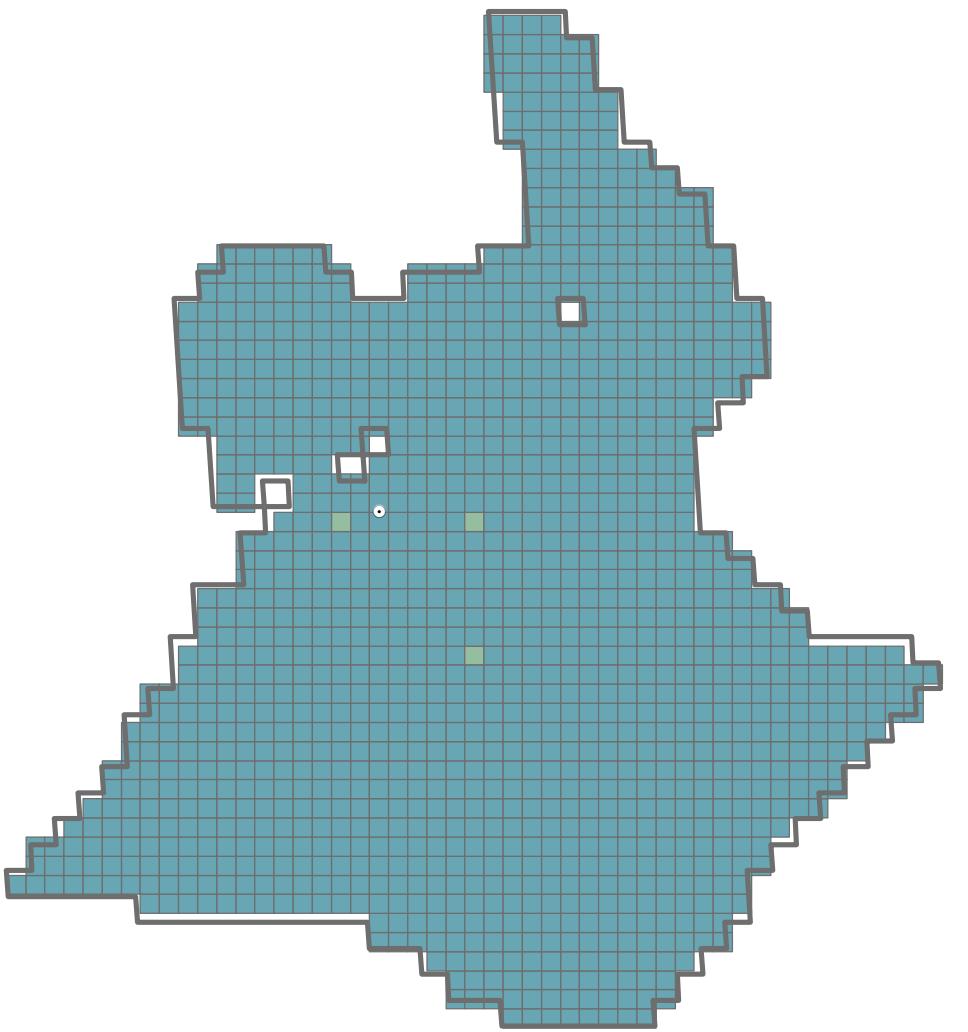
8 50'0"W

8 40'0"W

8 30'0"W

RS-measured tropospheric vertical columns of NO<sub>2</sub> of  
Vigo, Spain  
eFUA\_ID: 952  
at 1 km resolution

42°0'0"N  
42°10'0"N  
42°20'0"N  
42°30'0"N



◦ Central Business Districts (CBD)  
◻ GHS-OECD Functional Urban Areas (GHS-FUA)

Annual mean tropospheric NO<sub>2</sub> columns in  $\mu\text{mol}/\text{m}^2$

NO2Lev

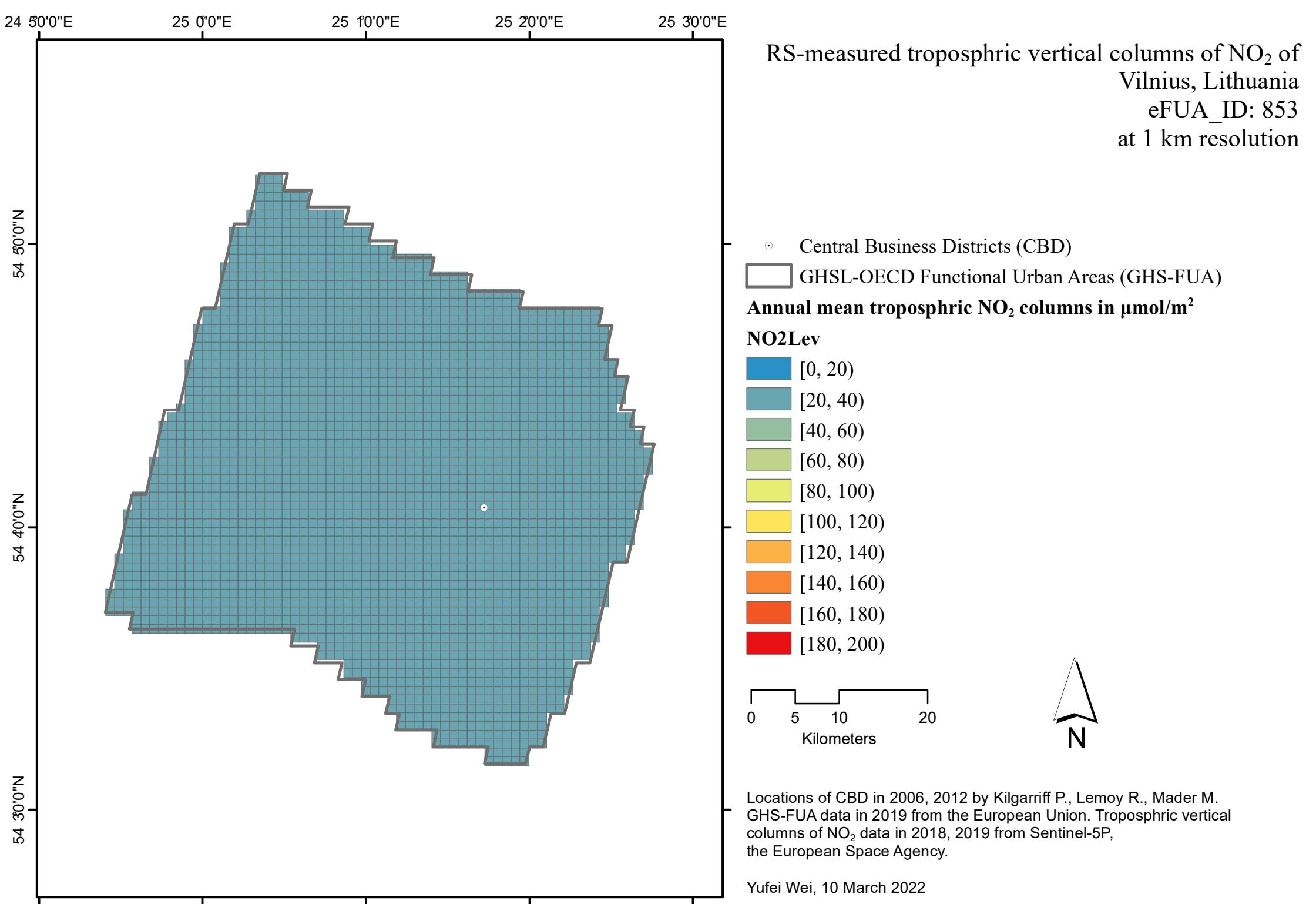
- [0, 20]
- [20, 40]
- [40, 60]
- [60, 80]
- [80, 100]
- [100, 120]
- [120, 140]
- [140, 160]
- [160, 180]
- [180, 200]

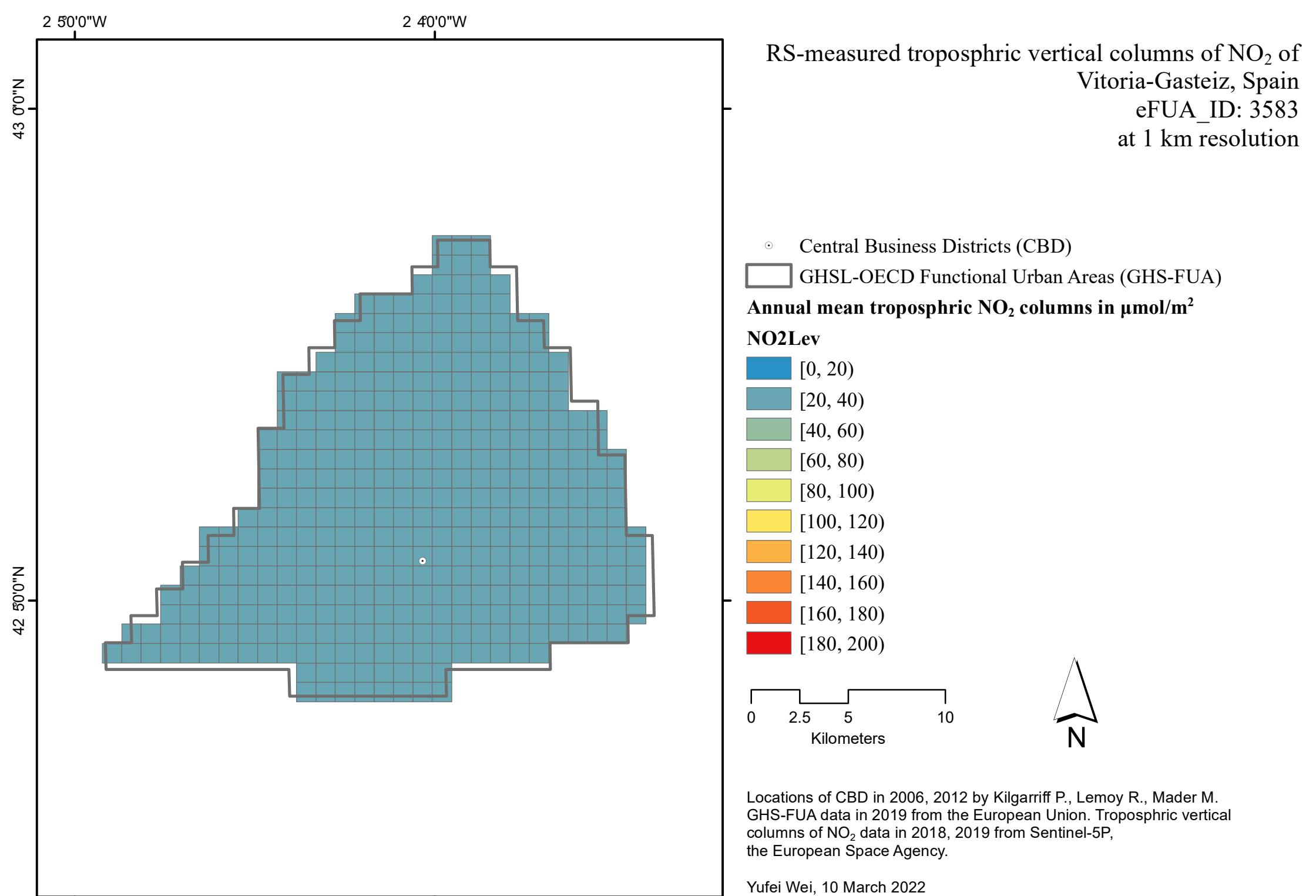
0 4.25 8.5 17  
Kilometers

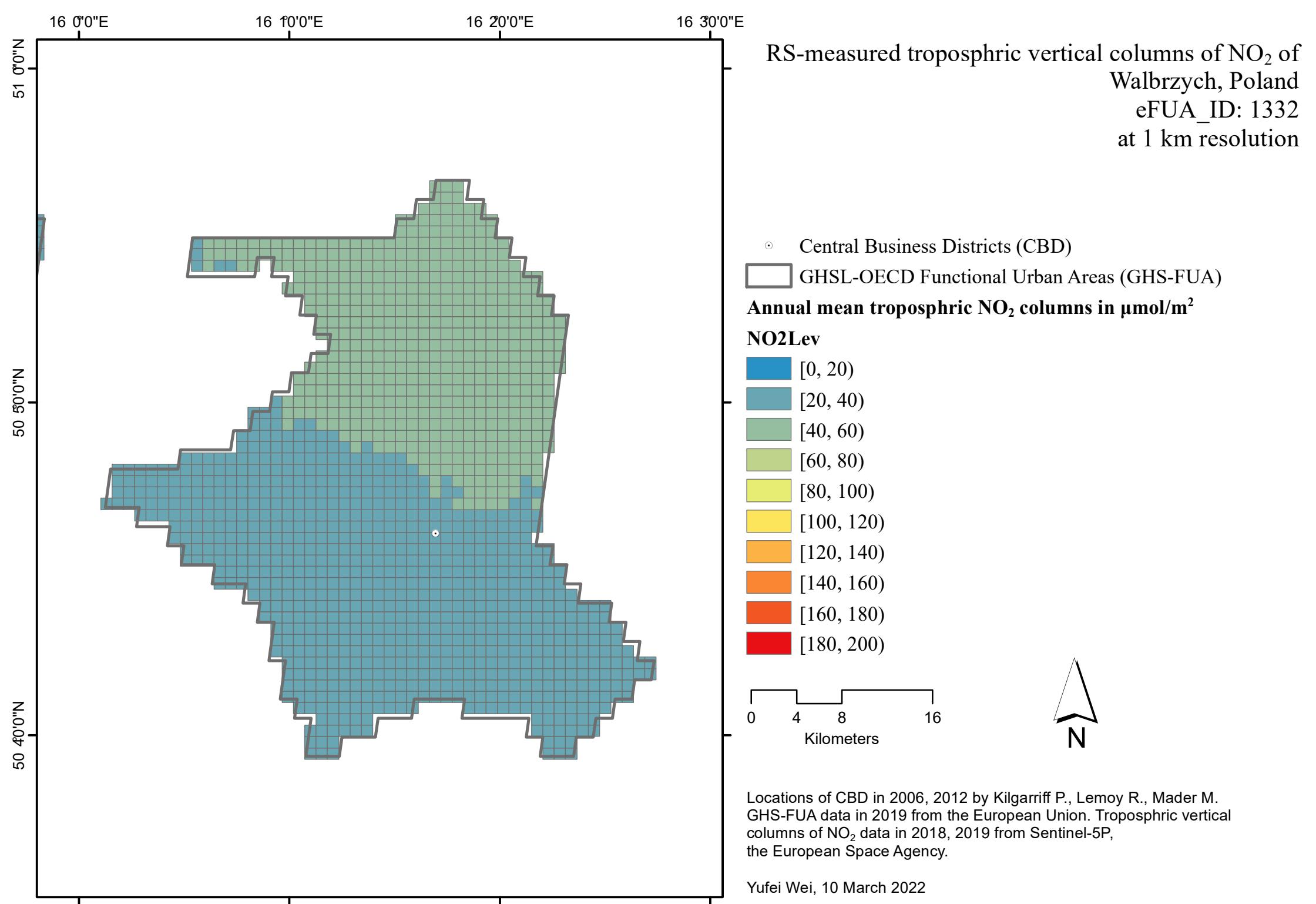


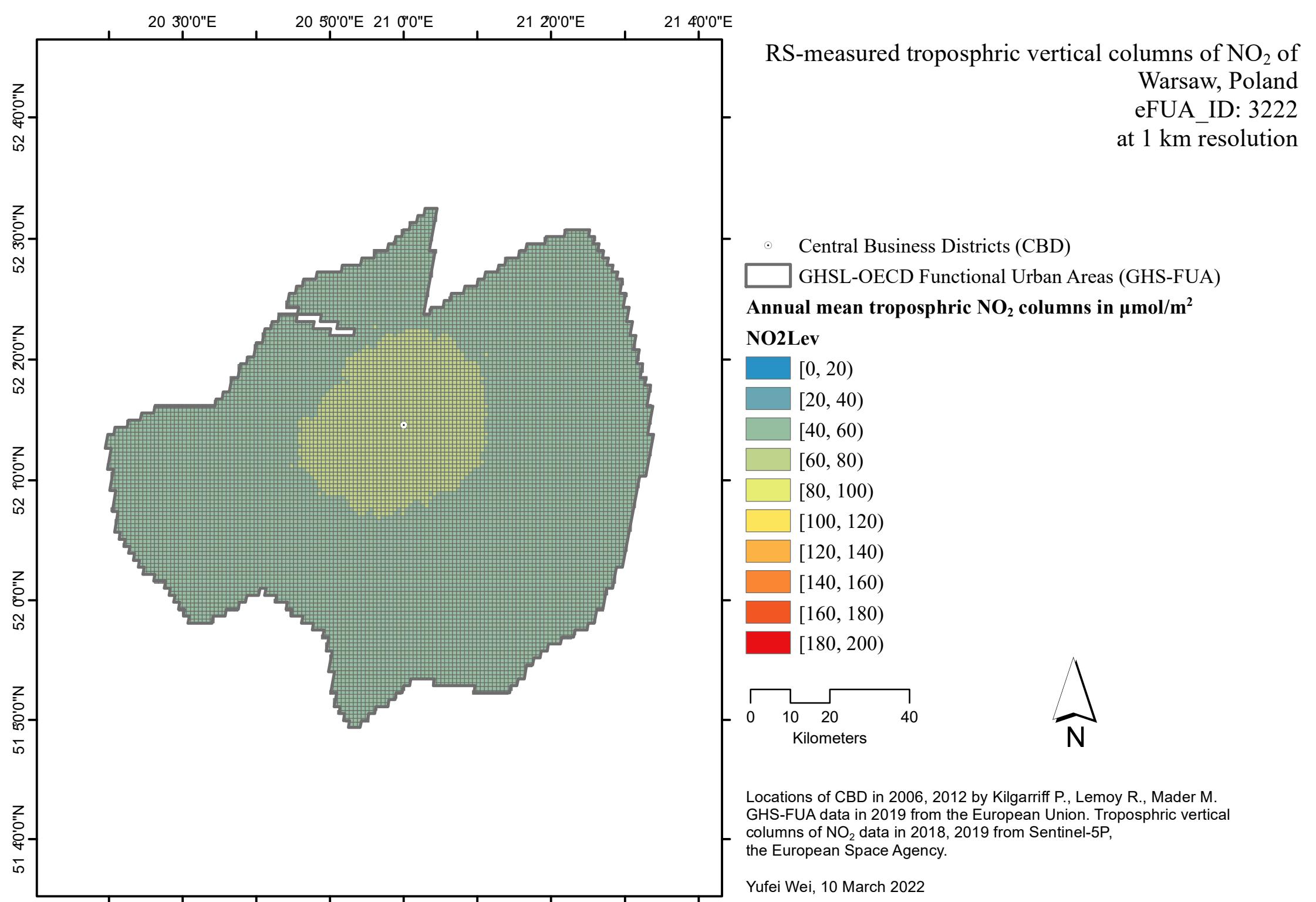
Locations of CBD in 2006, 2012 by Kilgarriff P., Lemoy R., Mader M.  
GHS-FUA data in 2019 from the European Union. Tropospheric vertical  
columns of NO<sub>2</sub> data in 2018, 2019 from Sentinel-5P,  
the European Space Agency.

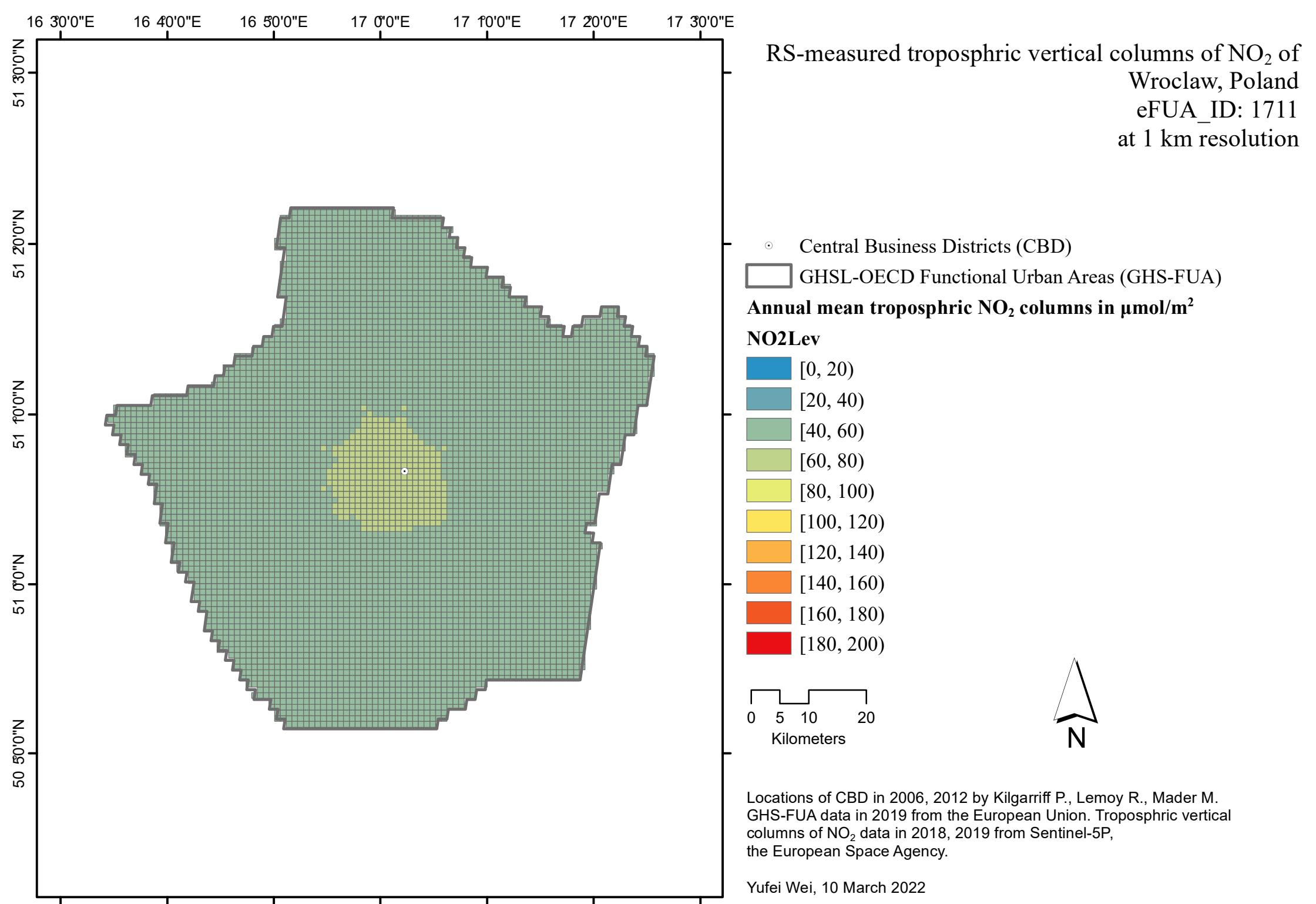
Yufei Wei, 10 March 2022

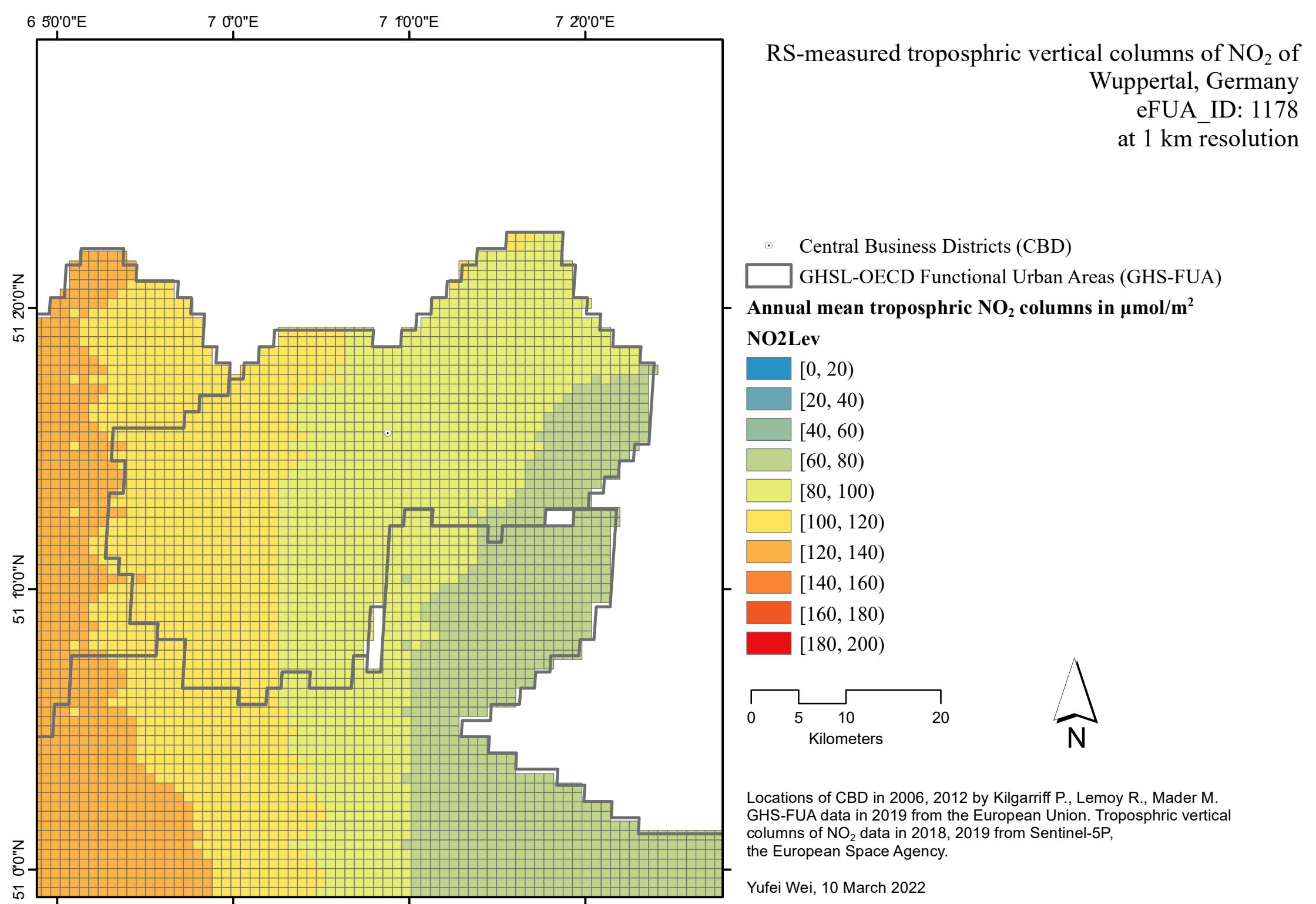


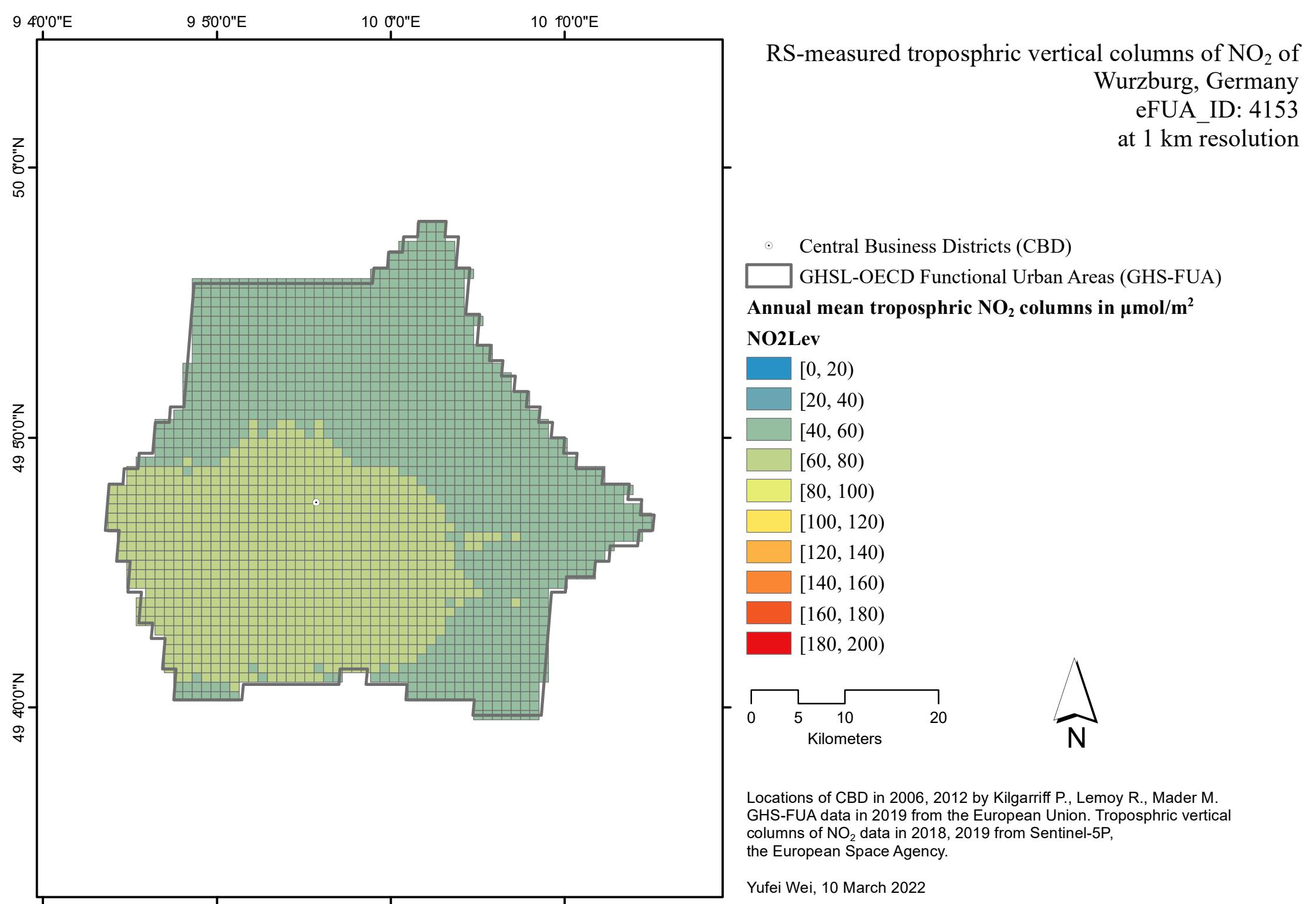


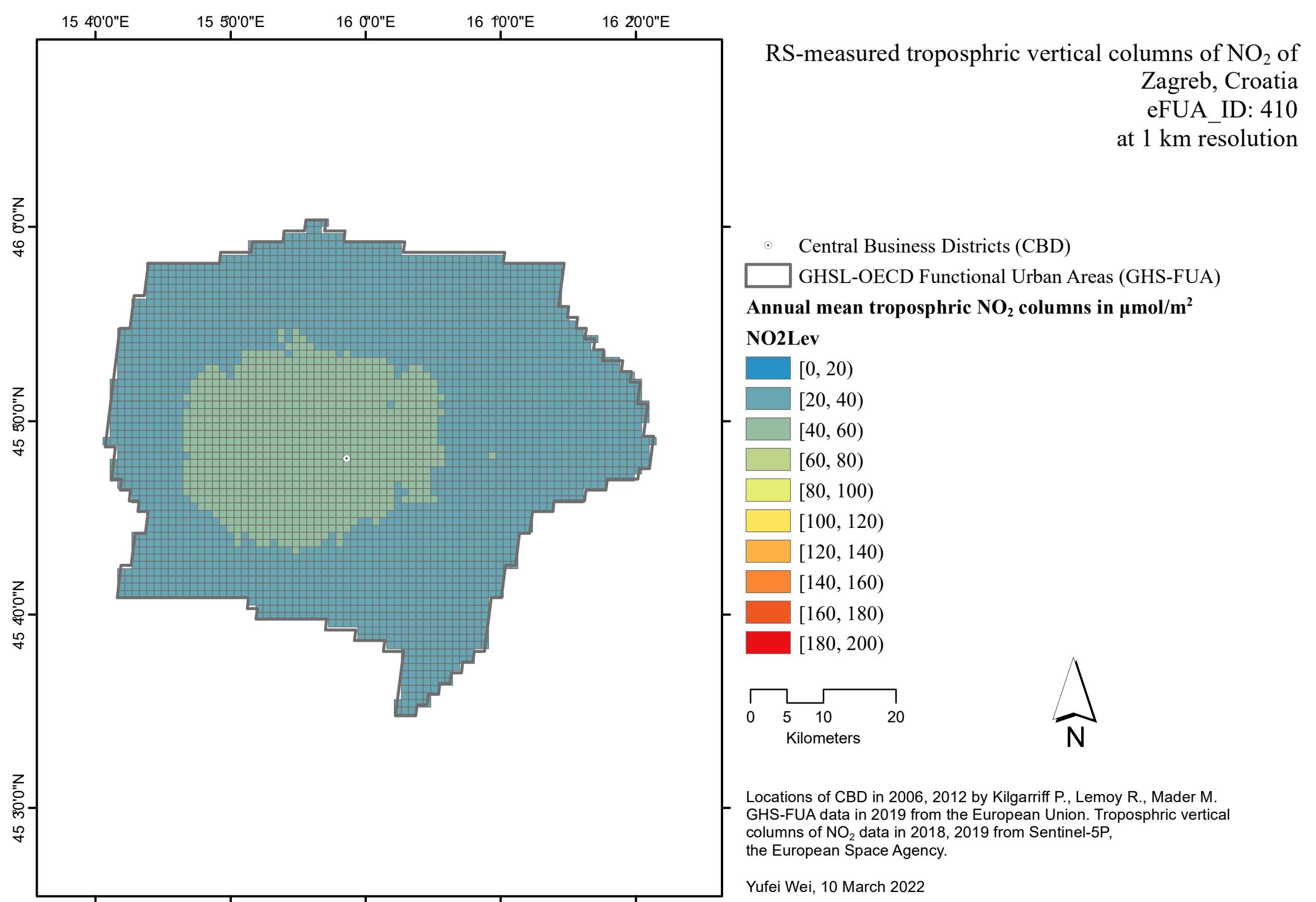


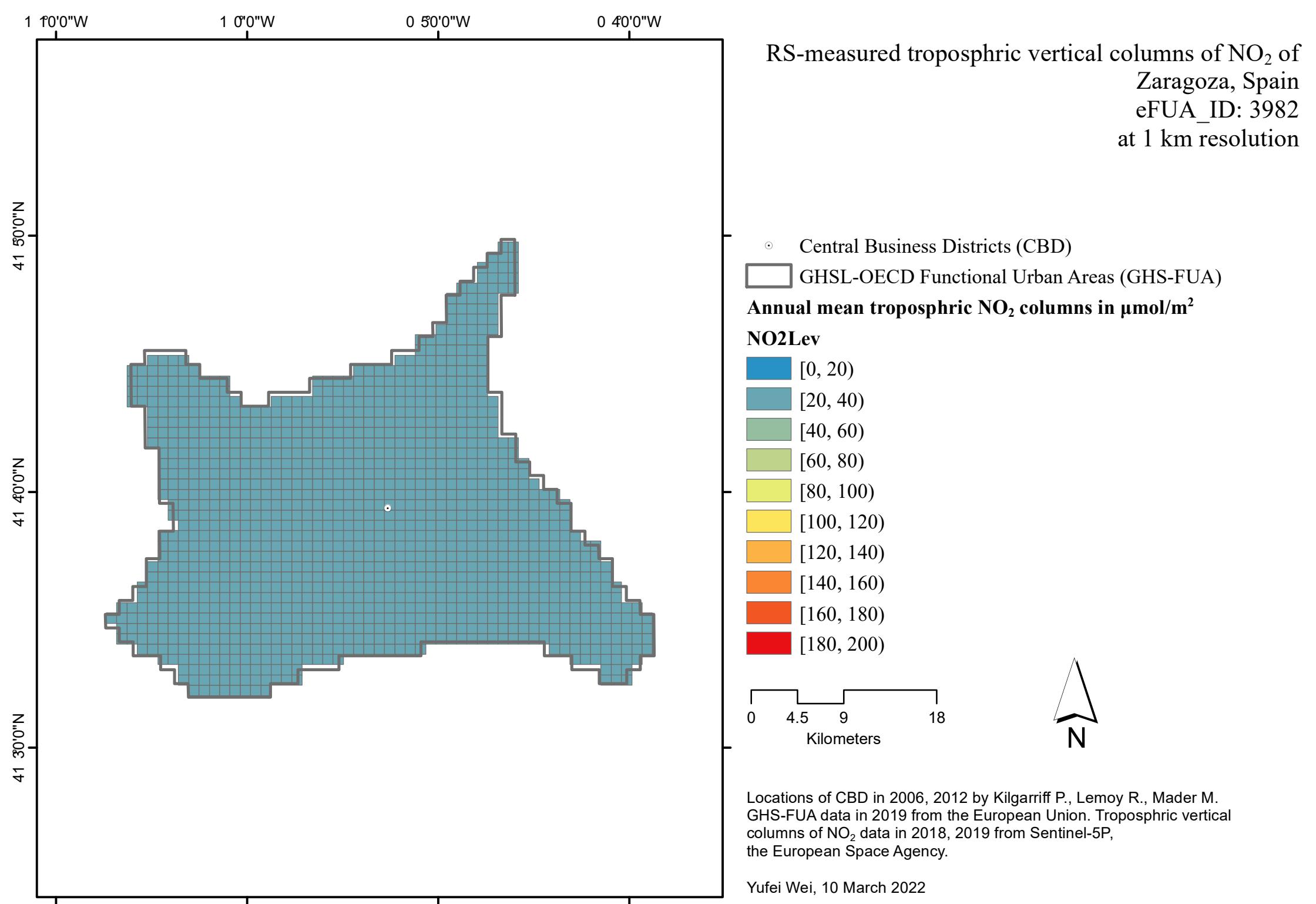






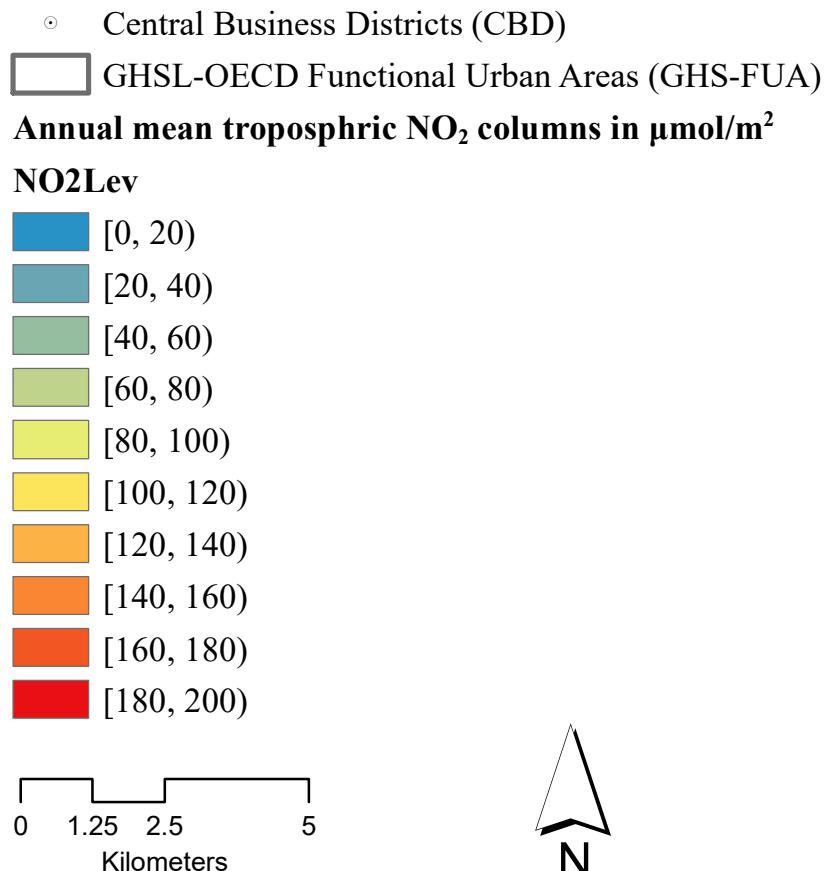
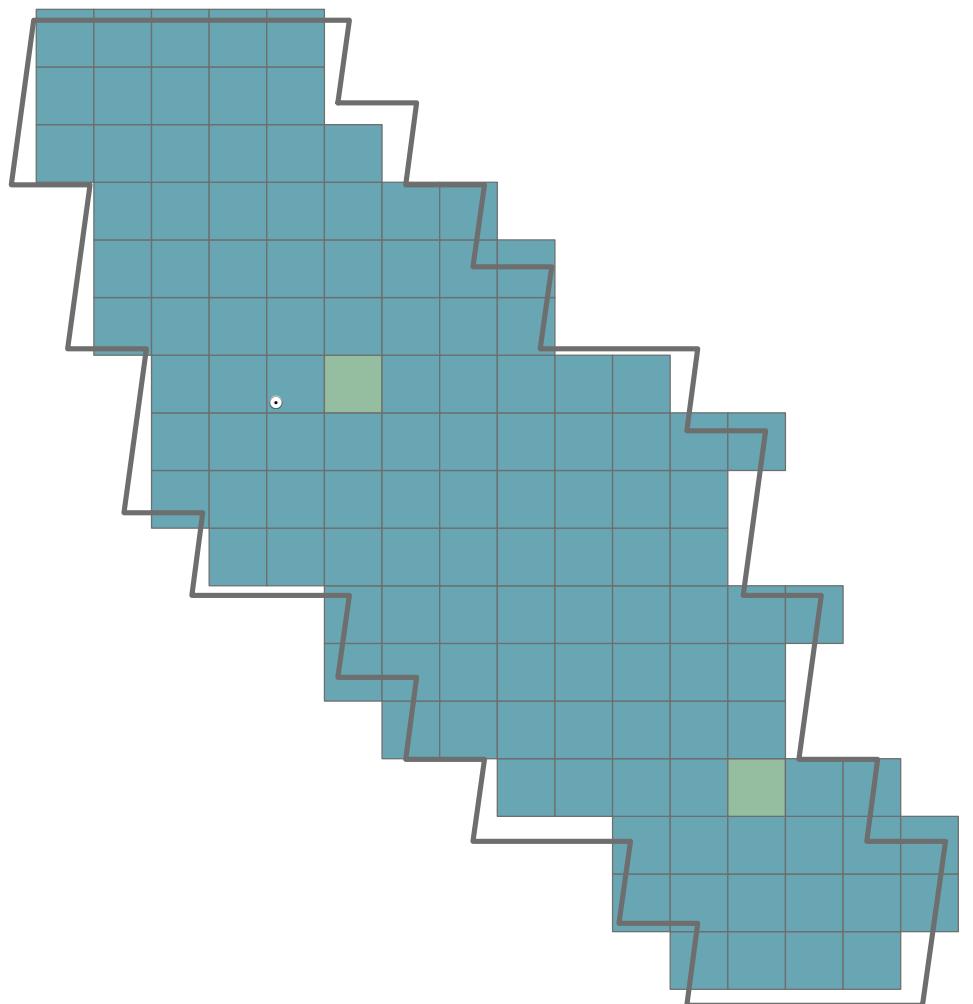






18 0'0"E

RS-measured tropospheric vertical columns of NO<sub>2</sub> of  
Zenica, Bosnia and Herzegovina  
eFUA\_ID: 519  
at 1 km resolution



Locations of CBD in 2006, 2012 by Kilgarriff P., Lemoy R., Mader M.  
GHS-FUA data in 2019 from the European Union. Tropospheric vertical  
columns of NO<sub>2</sub> data in 2018, 2019 from Sentinel-5P,  
the European Space Agency.

Yufei Wei, 10 March 2022

18 30'0"E

18 40'0"E

18 50'0"E

49 20'0"N  
49 10'0"N

RS-measured tropospheric vertical columns of NO<sub>2</sub> of  
Zilina, Slovakia  
eFUA\_ID: 480  
at 1 km resolution

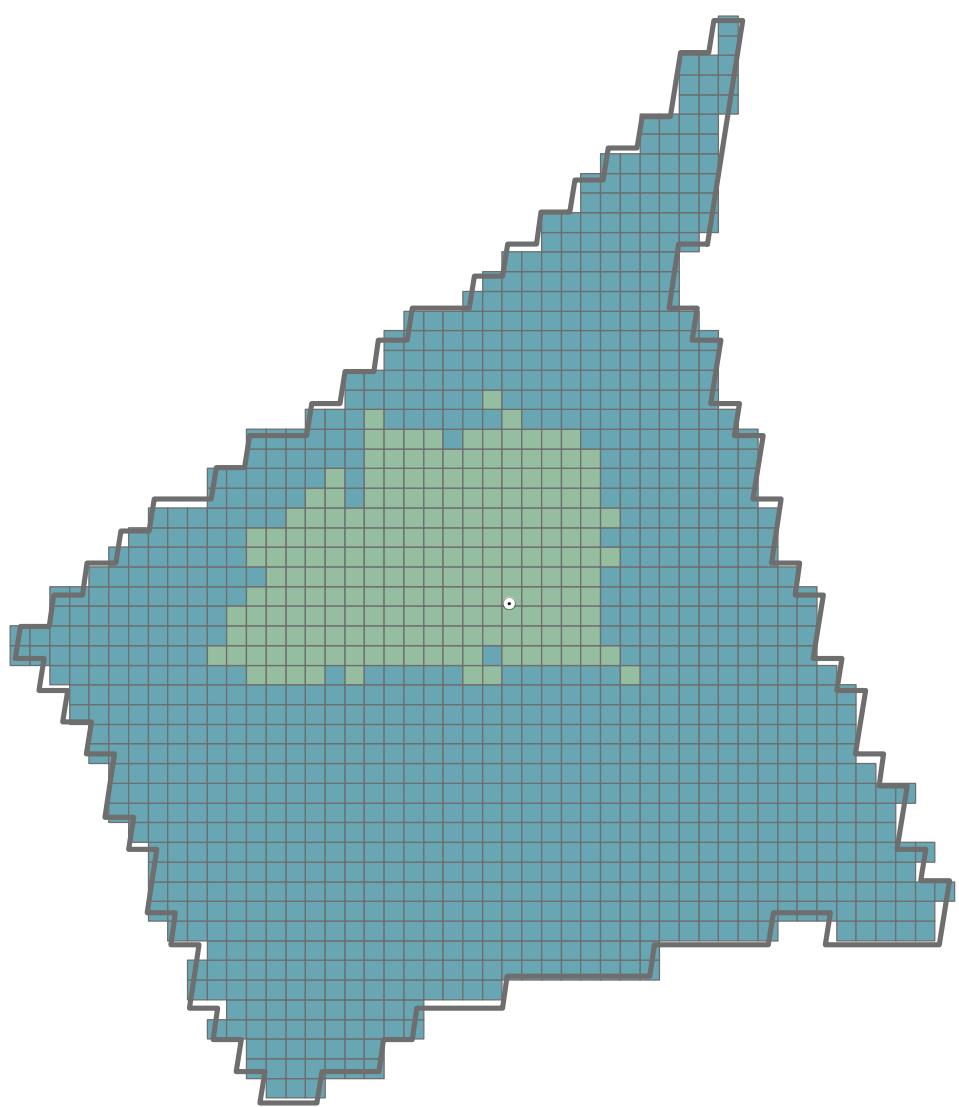
○ Central Business Districts (CBD)  
◻ GHSL-OECD Functional Urban Areas (GHS-FUA)

Annual mean tropospheric NO<sub>2</sub> columns in  $\mu\text{mol}/\text{m}^2$

NO2Lev

[0, 20)  
[20, 40)  
[40, 60)  
[60, 80)  
[80, 100)  
[100, 120)  
[120, 140)  
[140, 160)  
[160, 180)  
[180, 200)

0 4 8 16  
Kilometers



Locations of CBD in 2006, 2012 by Kilgarriff P., Lemoy R., Mader M.  
GHS-FUA data in 2019 from the European Union. Tropospheric vertical  
columns of NO<sub>2</sub> data in 2018, 2019 from Sentinel-5P,  
the European Space Agency.

Yufei Wei, 10 March 2022

