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Weekly Cycles in Tropospheric NO_2 Over Largest Urban Agglomerations Inferred From OMI Data

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Gregory G. Leptoukh
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Motivation ·

NO_2 in the troposphere

- Toxic gas (direct influence on human health)
- Plays a key role in tropospheric photochemistry
  - Removes VOCs
  - NO_x ($NO+NO_2$) are precursors of
    - tropospheric O_3 (toxic)
    - nitric acid ⇨ acid rains ⇨ damage biosphere
    - nitrate aerosols ⇨ radiative and temperature effects
- Radiative active gas (absorbs visible radiation λ=0.4-0.6 nm)

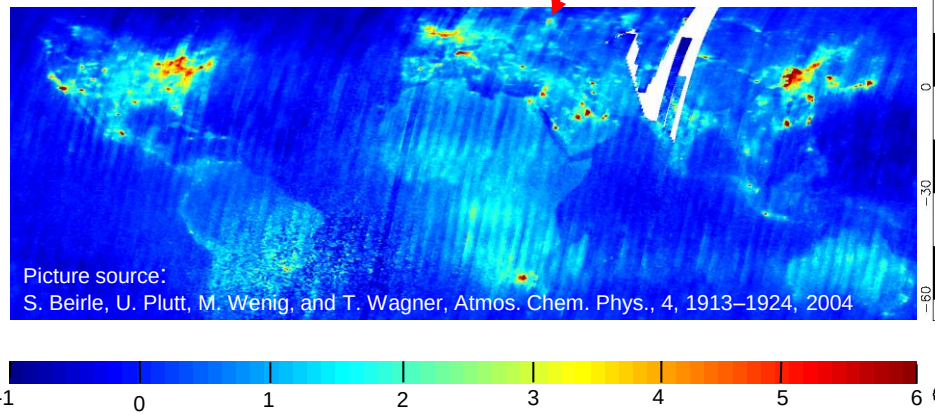
Weekly cycle in tropospheric NO_2

- is one of manifestations of anthropogenic influence
- is important for short-period forecast of urban air pollution
- through radiative and temperature effects of NO_2 and nitrate aerosol may induce weekly variability in meteorological parameters

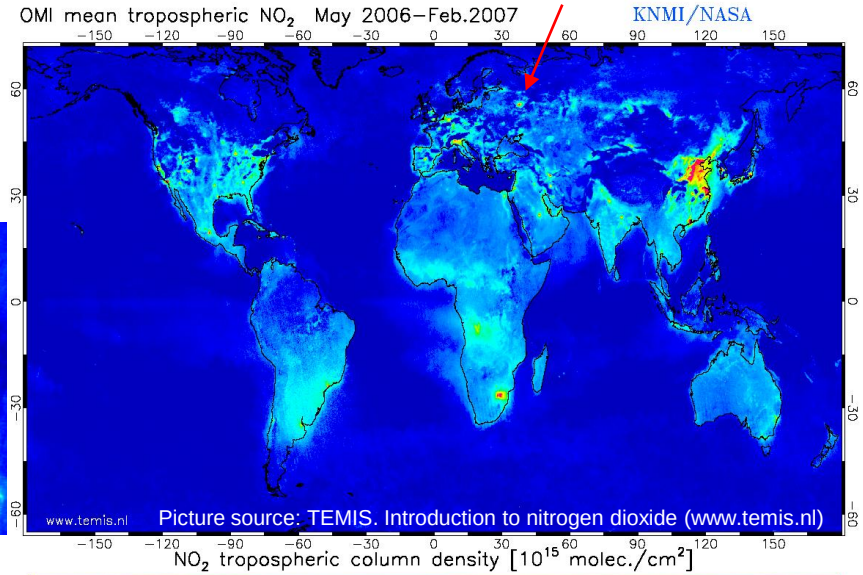
Motivation · ·

GOME mean tropospheric NO_2 VCD (1997-2001). Narrow swath mode (80 x 40 km²)

Moscow

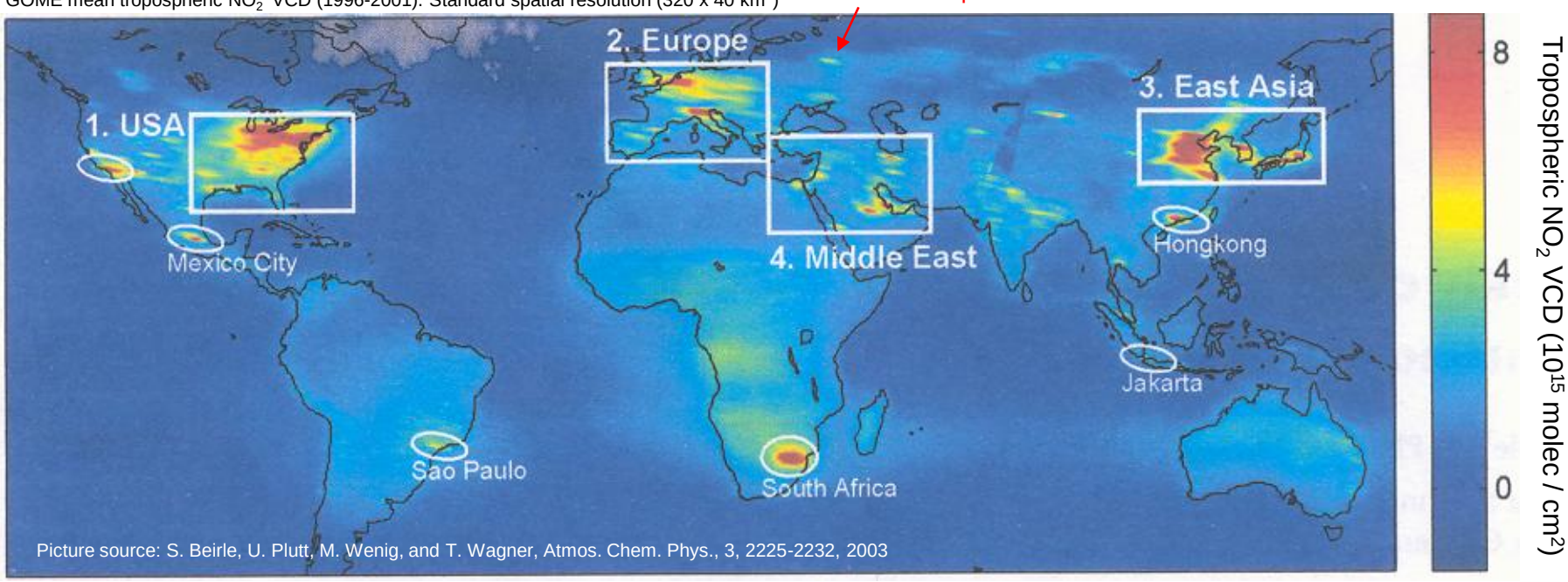


Moscow

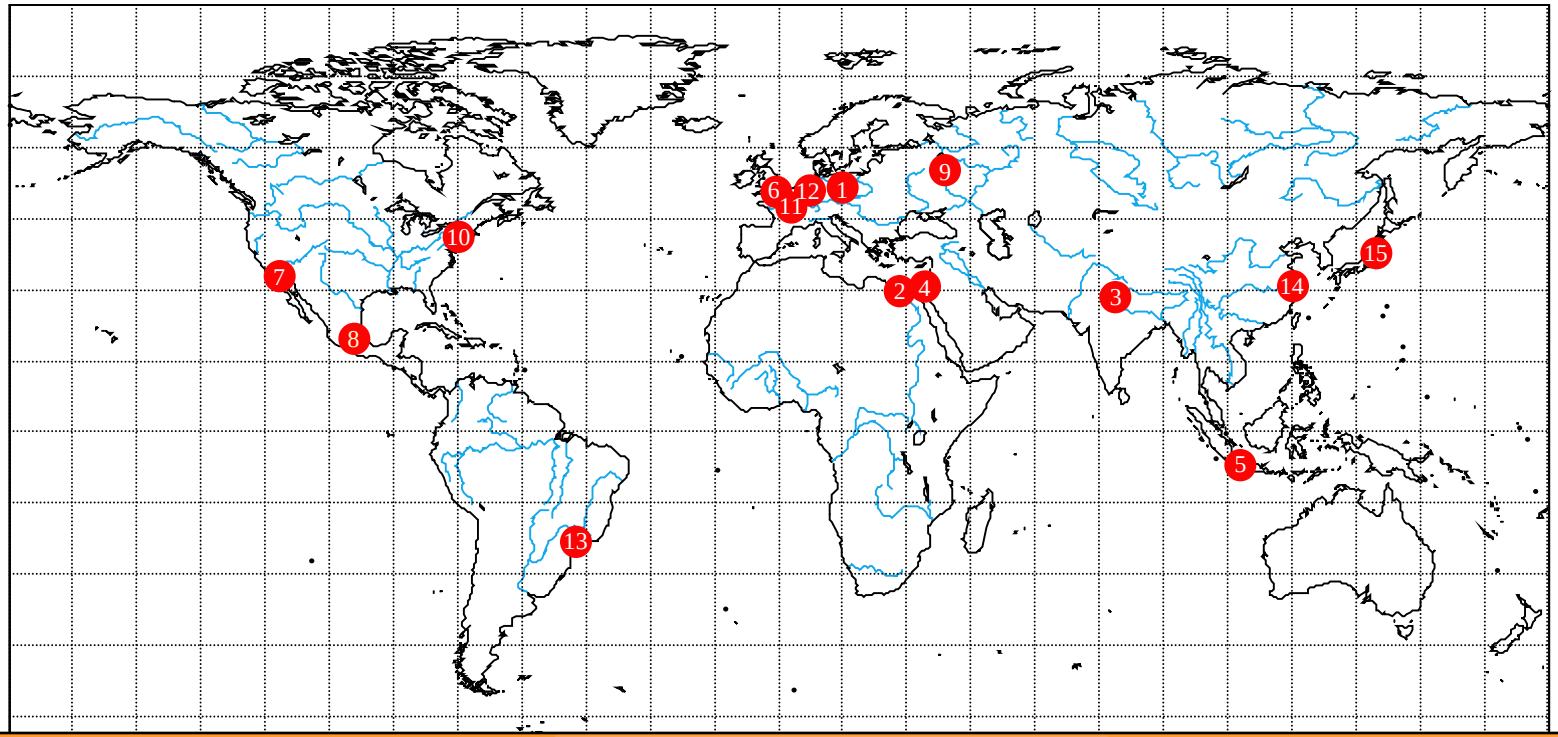


GOME mean tropospheric NO_2 VCD (1996-2001). Standard spatial resolution (320 x 40 km²)

Moscow drops out from consideration



Urban agglomerations used in this work

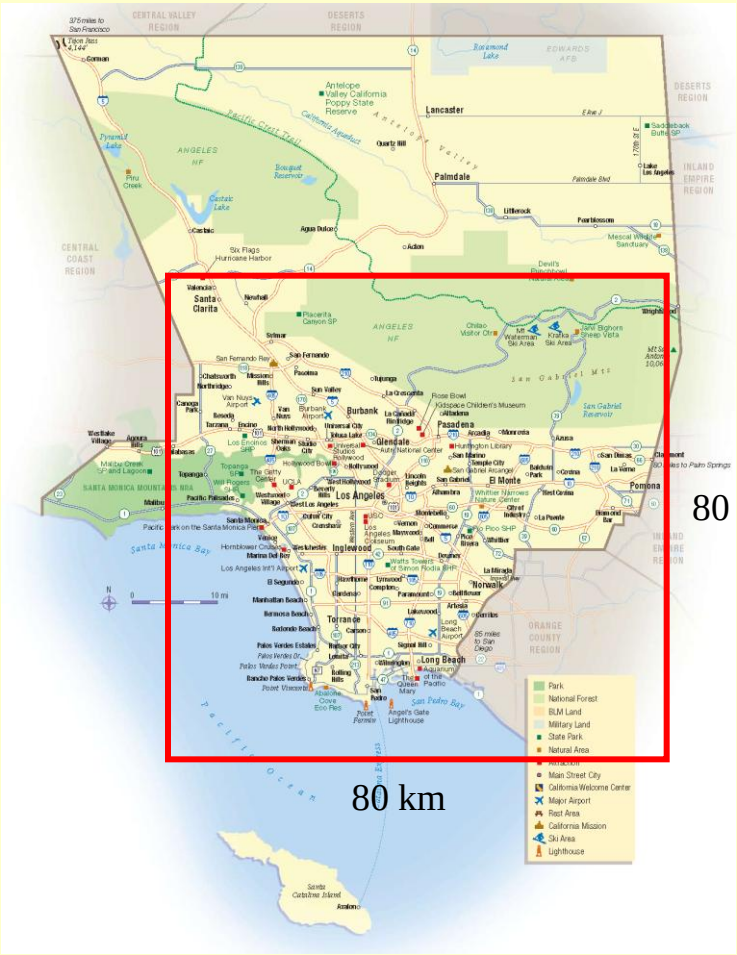


No	Agglomeration (region)	Population (million people) *	OMI NO_2 data collecting area		Days of observations	NO_2 (10^{15}), molec cm^{-2}
			Latitude, deg	Longitude, deg		
1	Berlin	3.7	52.3-52.7 N	13.1-13.8 E	944	5.24±0.10
2	Cairo	17.0	29-31.7 N	31.2-32.2 E	1765	2.94±0.02
3	Delhi	19.8	28-29.5 N	76-78 E	1713	3.78±0.03
4	Israel	7.5	34.5-35.5 N	31-33.2 E	1658	3.98±0.04
5	Jakarta	23.3	5.9-7.7 S	106-108 E	1682	1.65±0.01
6	London	8.6	51.2-51.7N	0.5 W-0.3 E	900	9.36±0.18
7	Los Angeles	14.9	33.6-34.4 N	117.7-118.7 W	1652	13.06±0.17
8	Mexico	18.6	19-20 N	98-100 W	1504	2.69±0.04
9	Moscow	13.7	55.5-55.9 N	37.4-37.9 E	940	10.4±0.24
10	New York	21.3	39.5-41.5 N	73-75.7 W	1527	7.93±0.11
11	Paris	10.5	48.7-49.1 N	2.1-2.6 E	996	8.50±0.16
12	Ruhr	7.3	50.7-51.8 N	6.8-7.8 E	1155	11.09±0.18
13	São Paulo	19.5	23-24 S	46-47 W	1237	3.96±0.07
14	Shanghai	14.7	30-32 N	120-122 E	1350	13.62±0.18
15	Tokyo	34.7	35-36.2 N	139-140.2 E	1283	11.67±0.18

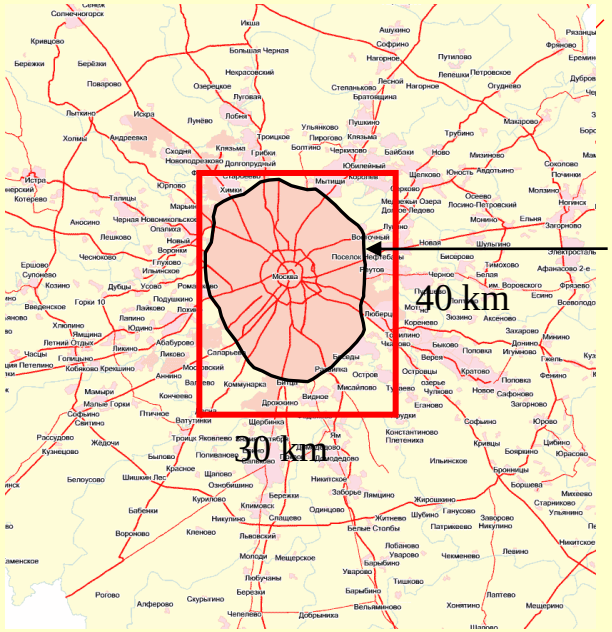
* www.demographia.com (2009)

The areas of OMI data collecting (two examples)

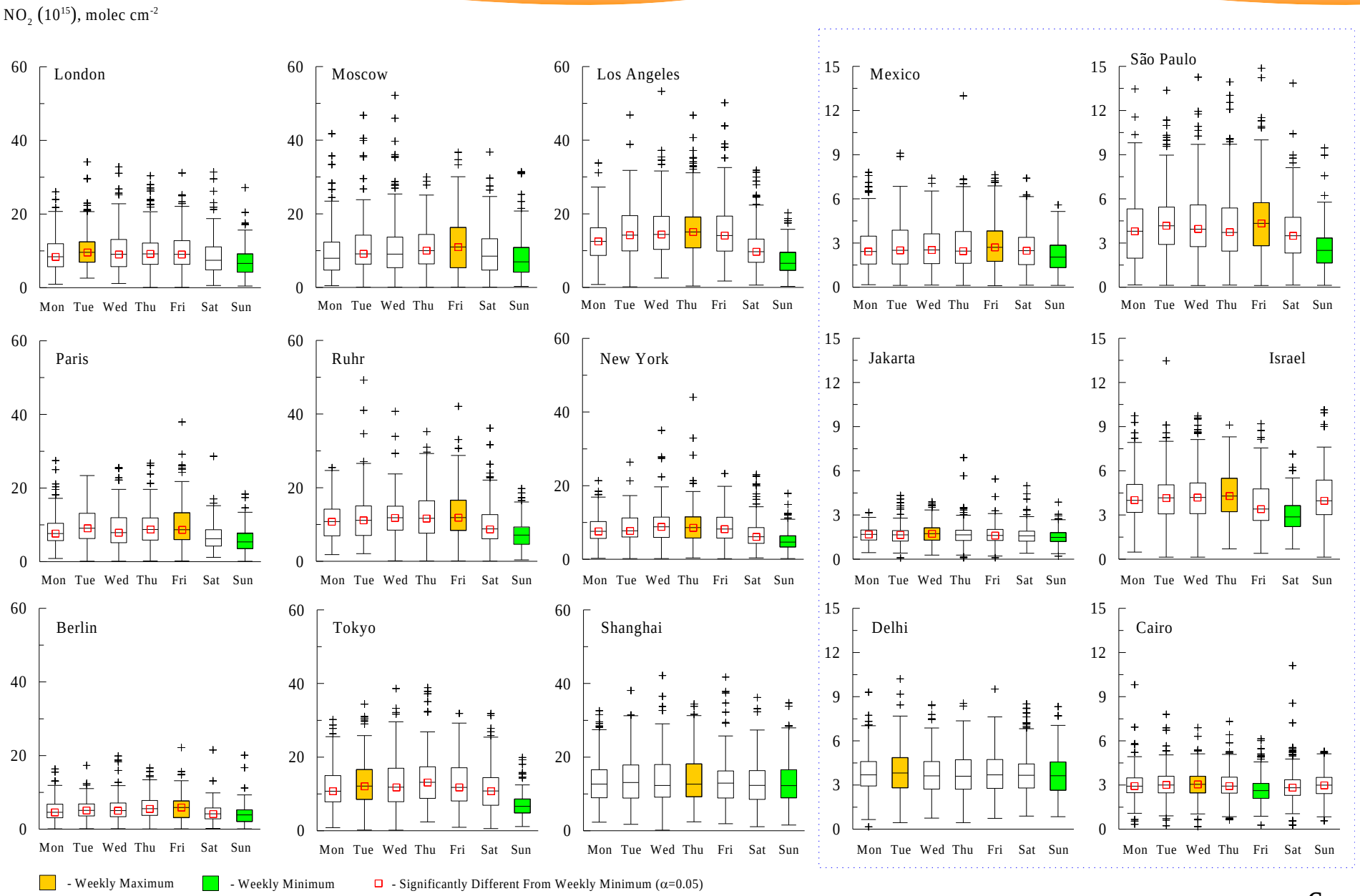
Los Angeles



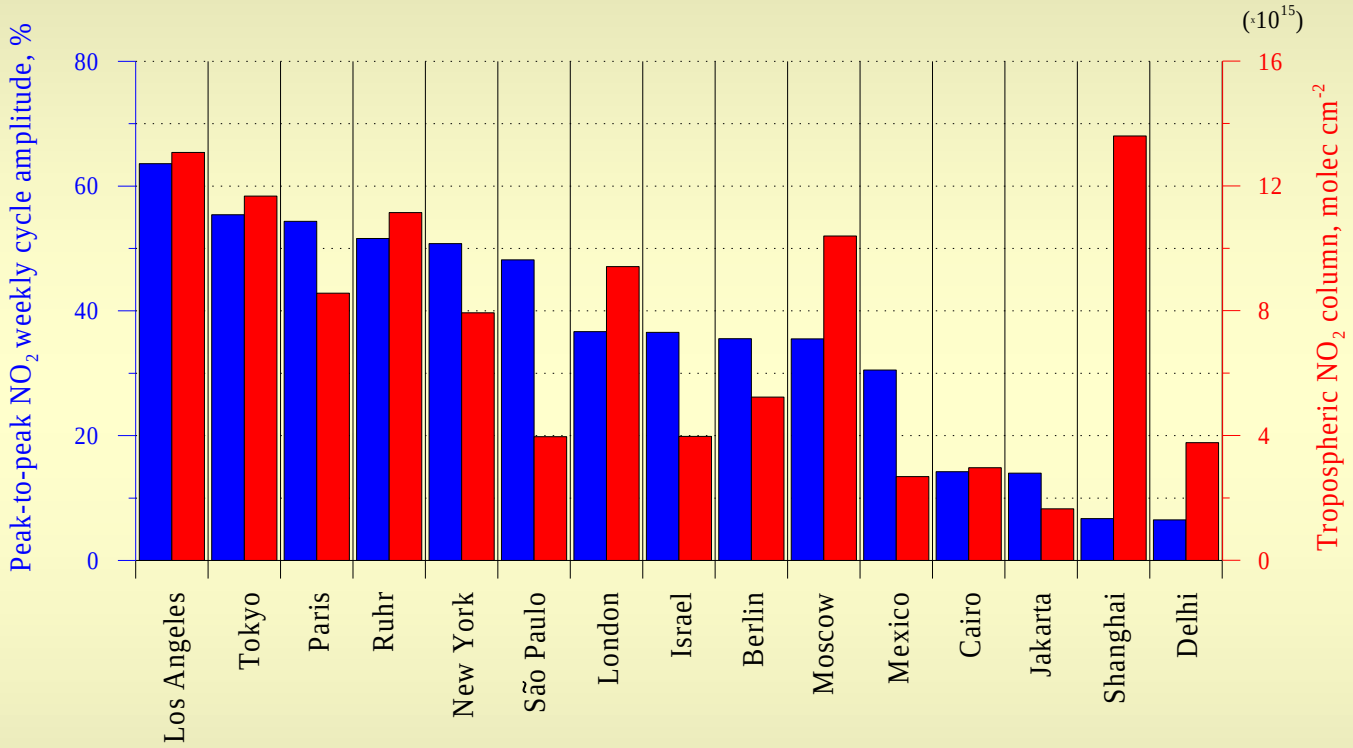
Moscow



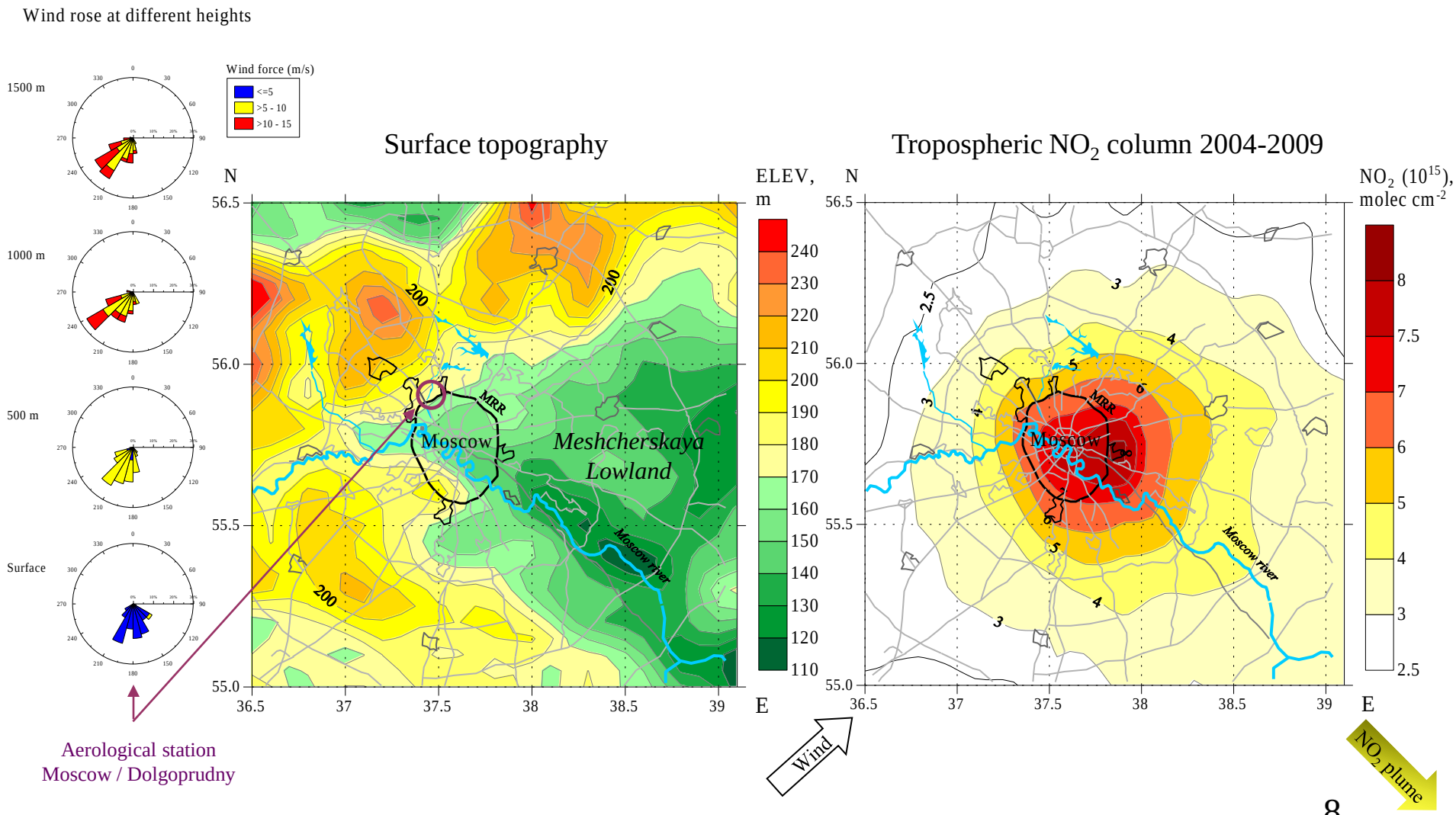
Box-Whisker plots of tropospheric NO2 data observed in different days of the week



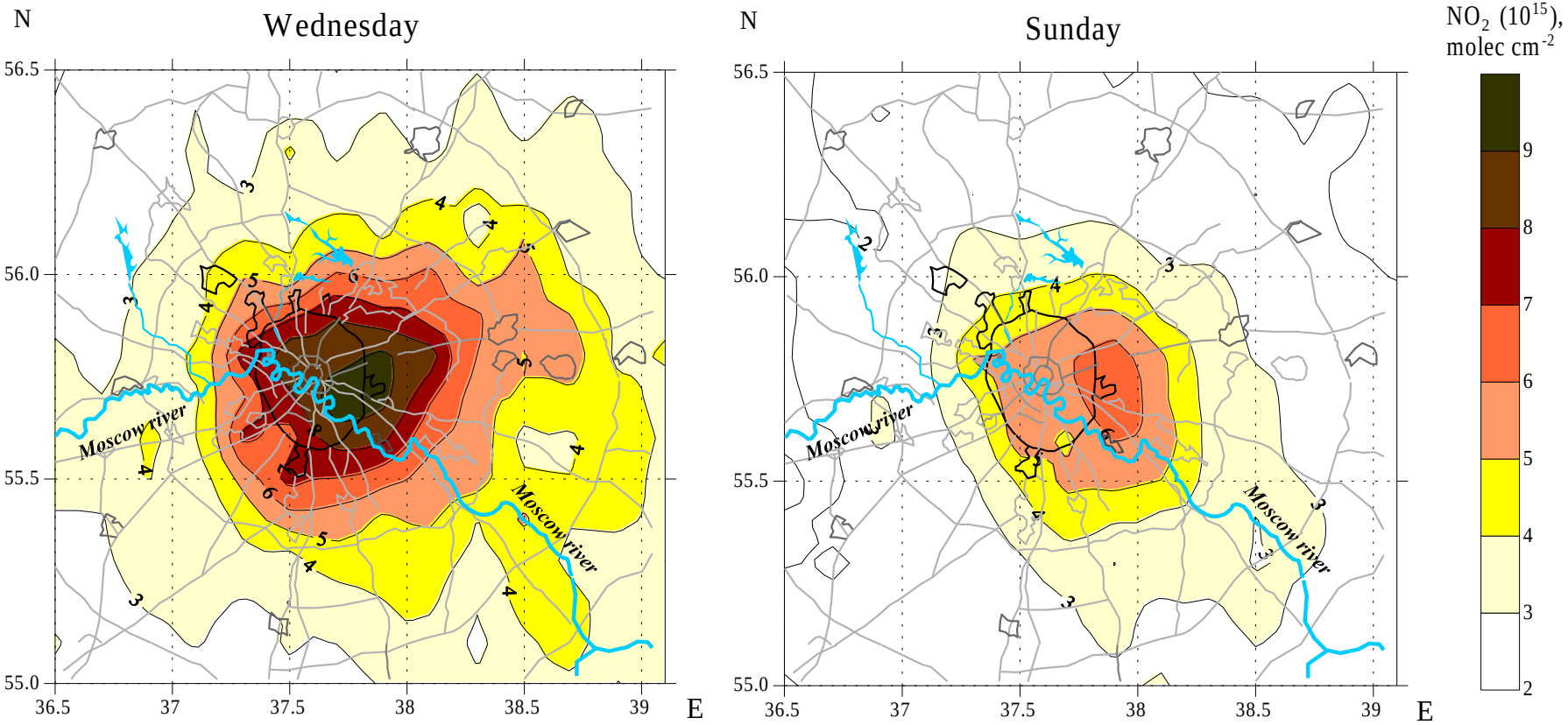
Weekly cycle amplitudes vs mean tropospheric columns



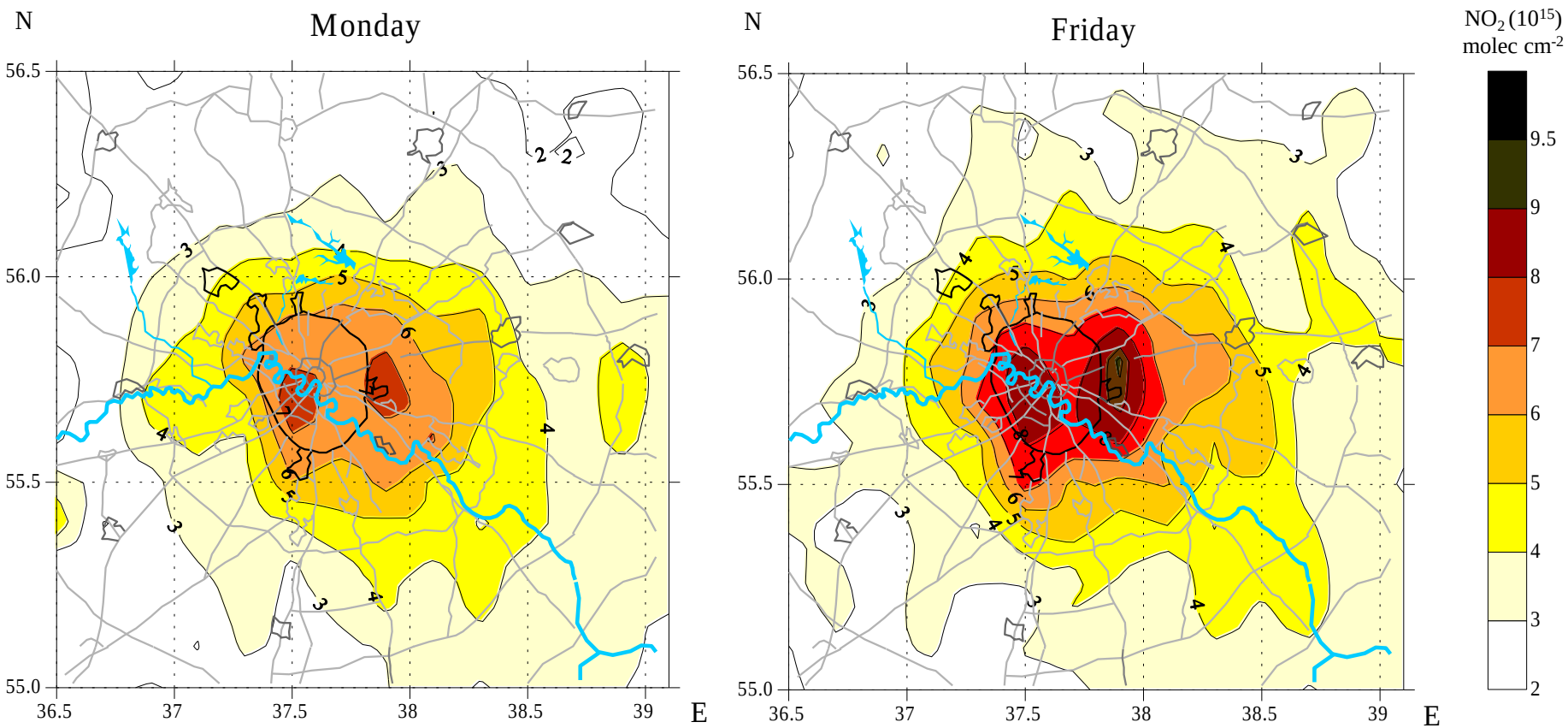
Spatial distribution of tropospheric NO_2 over Moscow region

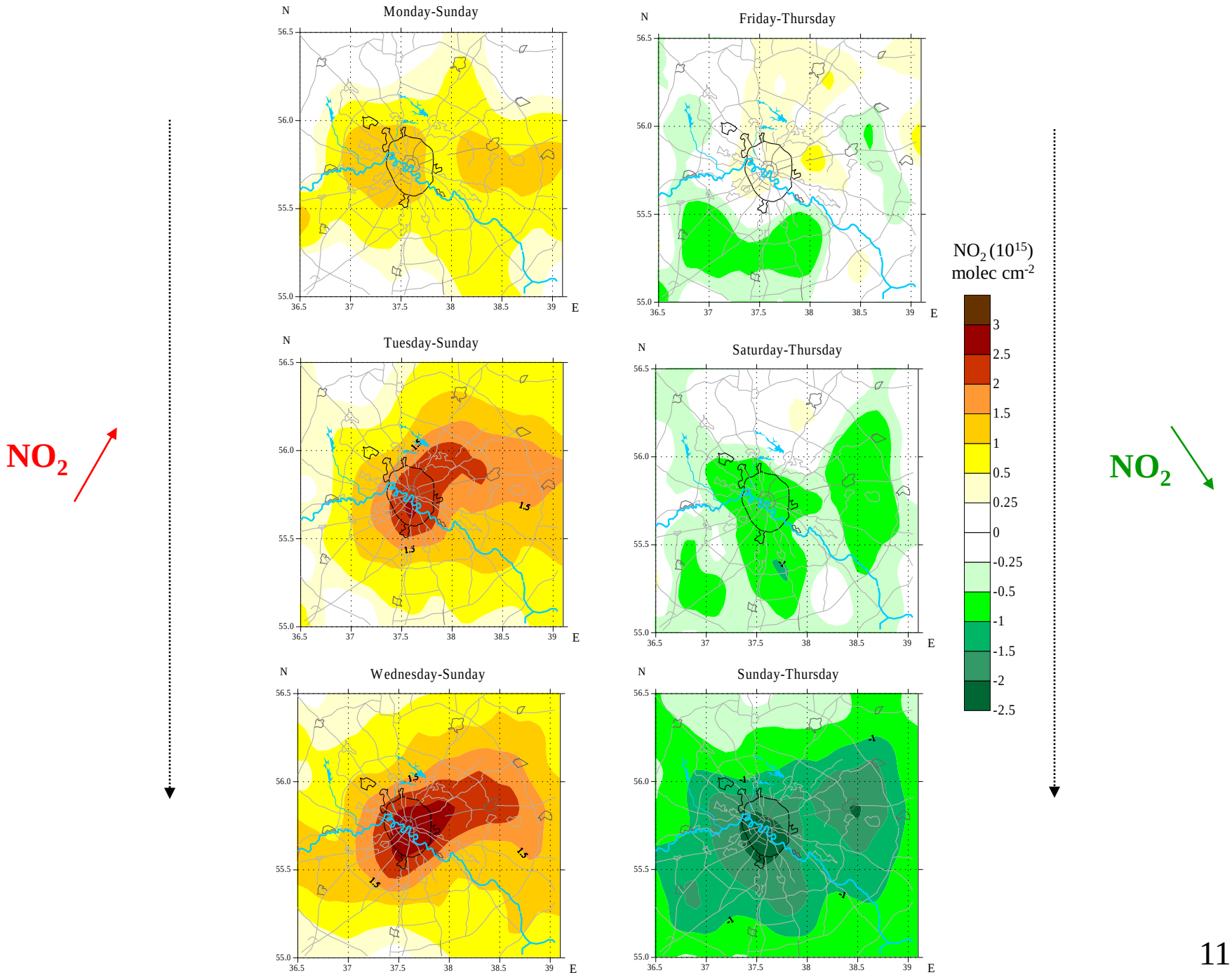


Spatial distributions of tropospheric NO_2 on weekday and weekend



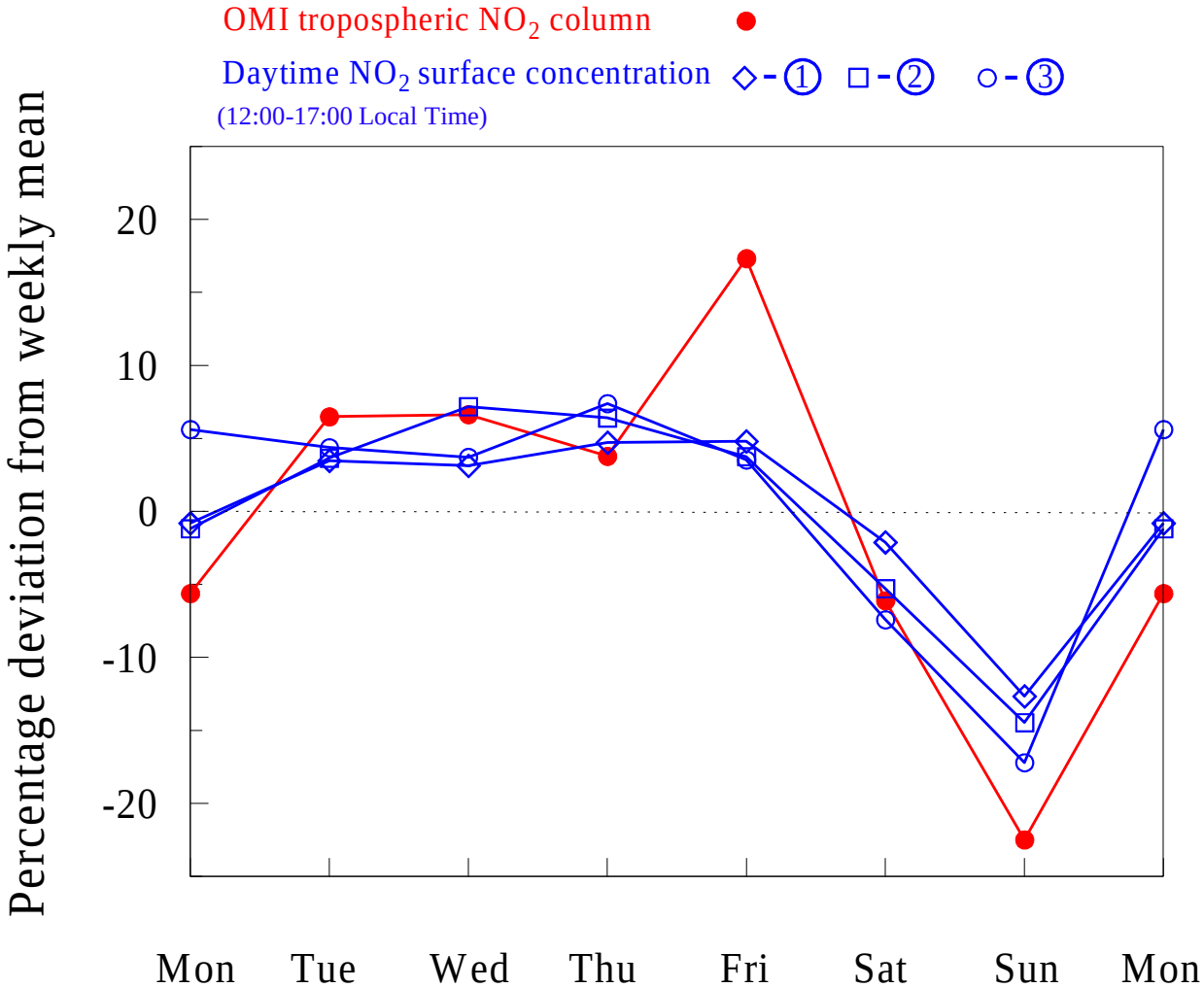
Spatial distributions of tropospheric NO2 in transitional days




Monday-Sunday
Friday-Thursday
Tuesday-Sunday
Saturday-Thursday
Wednesday-Sunday
Sunday-Thursday
N
E
56.5
56.0
55.5
55.0
36.5
37
37.5
38
38.5
39
NO2 (10^15) molec cm^-2
3
2.5
2
1.5
1
0.5
0.25
0
-0.25
-0.5
-1
-1.5
-2
-2.5
NO2
NO2

Weekly cycle in nitrogen dioxide in Moscow

as seen in OMI tropospheric NO_2 columns and ground-level NO_2 concentrations

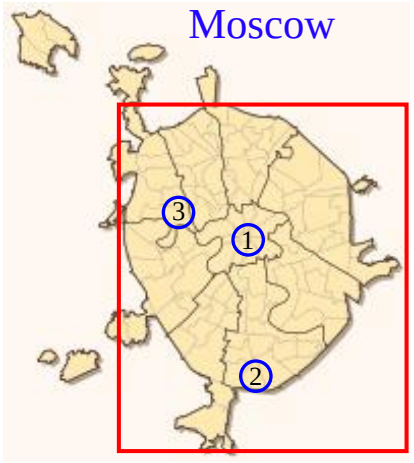


Ground-Based Stations:

① Balchug (Moscow's downtown)

② Biryulyvo

③ Narodnoe Opolchenie



OMI data collecting area

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- We acknowledge the scientists of the OMI mission and associated NASA personnel for the production of the data used in this research effort. Analyses and visualizations used in this presentation were produced with the help of Giovanni online data system (http://disc.sci.gsfc.nasa.gov/giovanni), developed and maintained by the NASA GES DISC

- We thank Moscow Ecological Service "Mosecomonitoring" (http://mosecomon.ru) for providing us NO_2 surface concentration observations at the Moscow' stations Balchug, Biryulyovo, and Narodnoe Opolchenie

- We thank the staff of the University of Wyoming for free access to the archive of the upper-air observations (http://weather.uwyo.edu)

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Thanks for your attention!
Moscow, Bitsa Park, Wednesday