European Network on New Sensing Technologies for Air Pollution Control and Environmental Sustainability - *EuNetAir*

COST Action TD1105

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New Sensing Technologies for Indoor Air Quality Monitoring: Trends and Challenges

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Using WRF-AERMOD System for Urban Traffic Air Pollution Short-Range Forecasting

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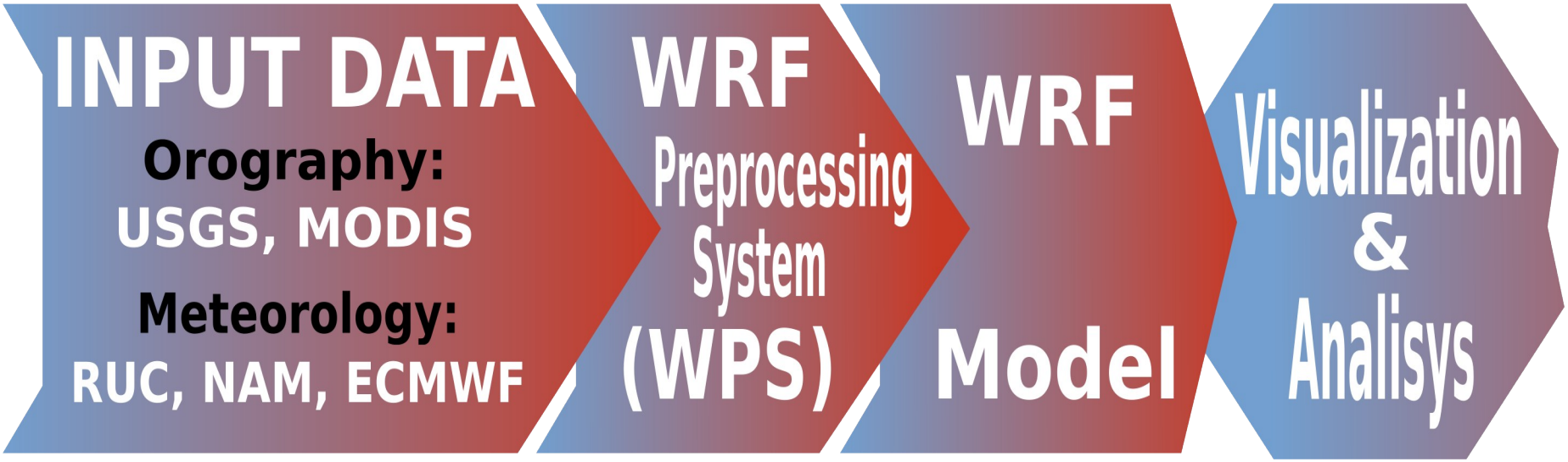
Aims for building an urban air pollution forecasting system

- Inform the population for possible pollution that exceeds a given concentration threshold
- Plug-in WRF-AERMOD to an automated traffic control system (possible future project)
- Improvement of the dispersion model AERMOD through assessment by means of statistical, operational and scientific methods
- To achieve better knowledge about the behavior of different pollutants in urban areas under various meteorological conditions

WRF system

WRF (**W**eather **R**esearch **F**orecasting Model) – a numerical weather prediction system designed to serve both atmospheric research and operational forecasting needs. In this system WRF serves as a meteorological preprocessor for AERMOD.



AERMOD (Atmospheric Dispersion Modeling System)

.sfc file

1.YY/MM/DD/JD/HH
2.Sensible heat flux H(W/m2)
3.Surface friction velocity U*(m/s)
4.Convective velocity scale W*(m/s)
5.dθ/dz in the 500m above PBL(deg/m)
6.Height of convectively generated BL Zic(m)
7.Height of mechanicaly generated BL Zim(m)
8.Monin-Obukhov length L (m)
9.Surface roughness z0(m)
10.Bowen ratio B
11.Albedo
12.Wind speed U(m/s)
13.Wind direction(deg)
14.Height of measurement of wind Hw(m)
15.Ambient temperature T(K)
16.Height of temperature is measured Ht(m)
17.Precipitation code (0-45)
18.Precipitation amount (mm)
19.Relative humidity(%)
20.Surface pressure p(mb, Hpa)
21.Cloud cover (tenths)

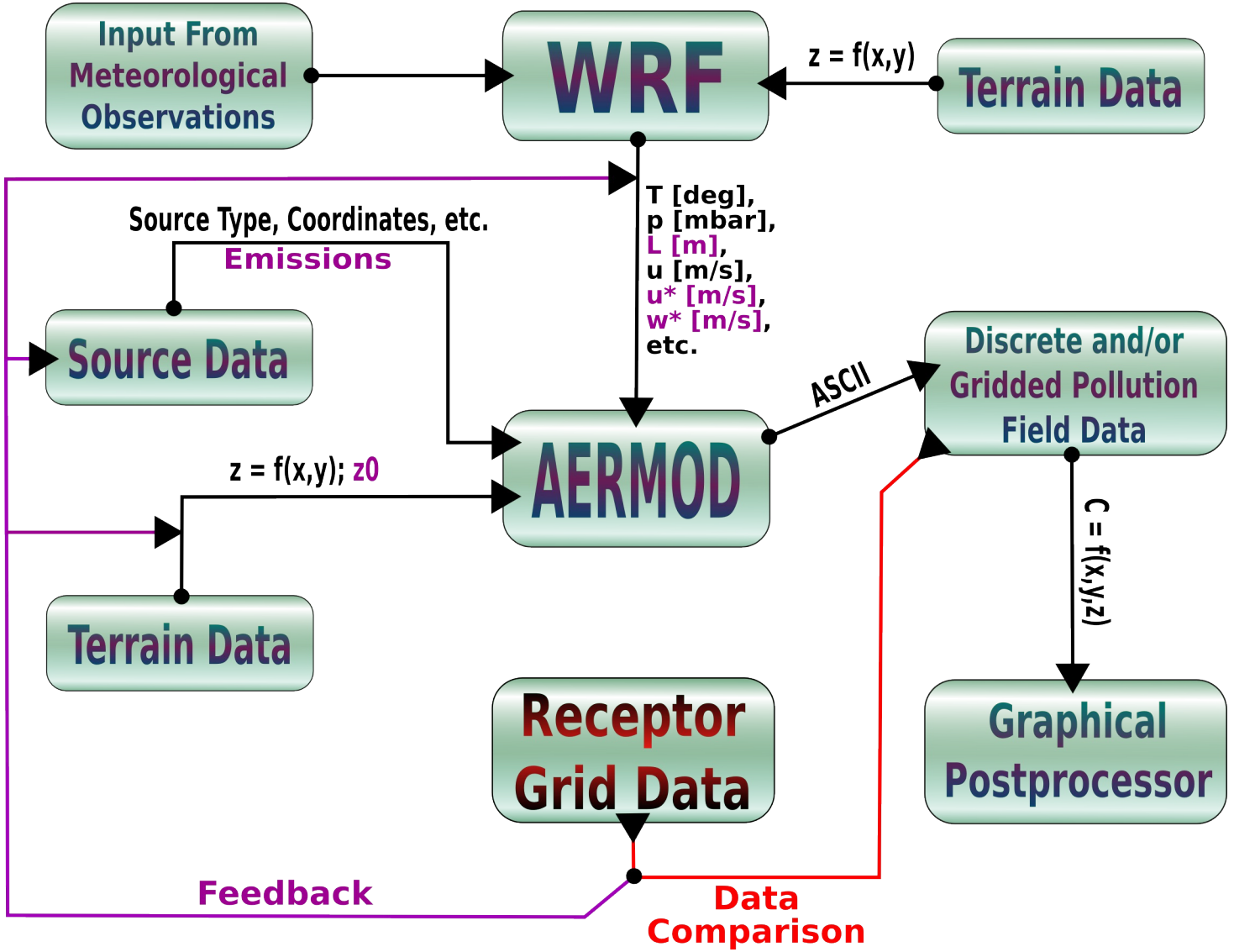
.pfl file (vertical wind and temperature profiles)

1.YY/MM/DD/HH
2.Measurement height h(m)
3.Top flag (1 or 0)
4.Wind direction
5.Wind speed
6.Temperature T(oC)
7.STDDEV of wind dir (deg)
8.STDDEV of wind speed (m/s)

aermod.inp file

1.Control options: URBAN/ RURAL, FLAT etc.
2.Source data: Emission rate, Source type, location etc.
3.Terrain data (x,y,z)
4.Receptor data (x,y,z) – cartesian grid, polar grid, discrete receptors
5.Output options (.dat file with (x, y, concentration) array chosen in this case).

WRF-AERMOD system structure



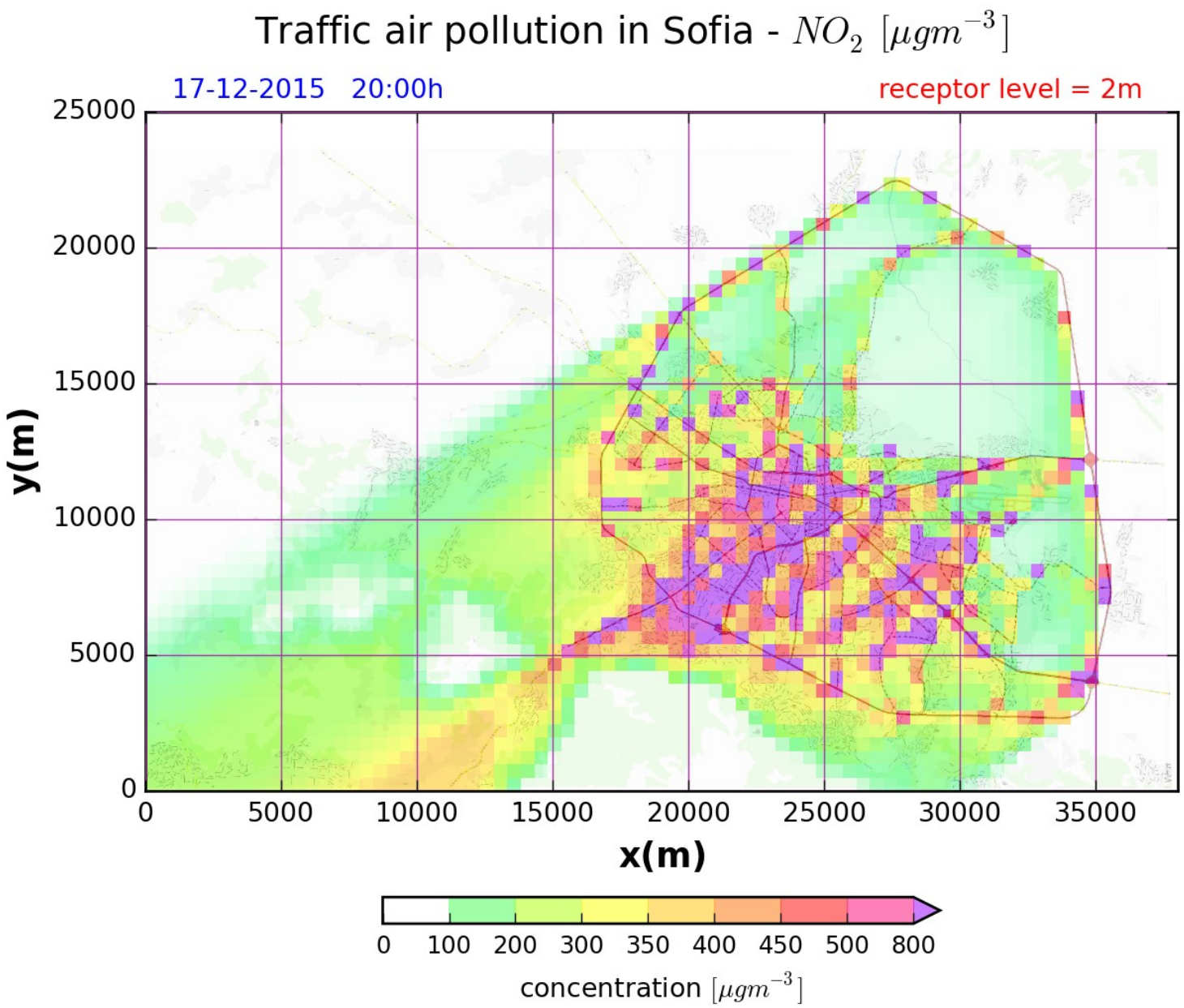
Sources

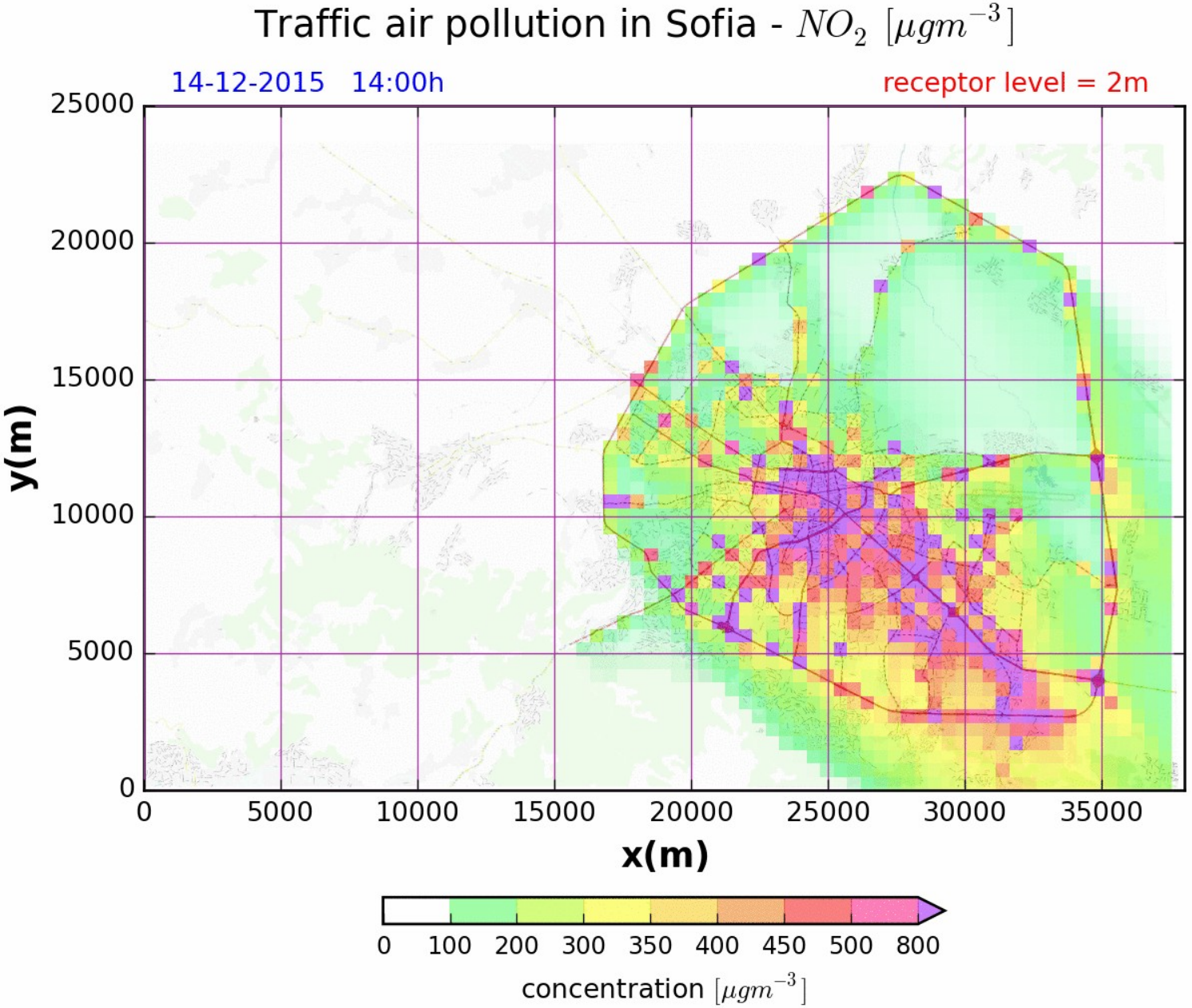
- The larger streets and the boulevards with the moving vehicles together are presented as line sources
- The squares and parking lots are presented as area sources

- Every source group has its own emission rate timetable corresponding to the traffic intensity at a specific hour of the day.

Table 1. *Emission rate timetable as required by AERMOD*

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24
Mon	0.1	0.1	0.1	0.1	0.3	0.6	0.9	1	1	0.9	0.8	0.9	0.7	0.7	0.7	0.8	1	0.9	0.8	0.6	0.2	0.2	0.1	0.1
Tue	0.1	0.1	0.1	0.1	0.3	0.6	0.9	1	1	0.9	0.8	0.9	0.7	0.7	0.7	0.8	1	0.9	0.8	0.6	0.2	0.2	0.1	0.1
Wed	0.1	0.1	0.1	0.1	0.3	0.6	0.9	1	1	0.9	0.8	0.9	0.7	0.7	0.7	0.8	1	0.9	0.8	0.6	0.2	0.2	0.1	0.1
Thu	0.1	0.1	0.1	0.1	0.3	0.6	0.9	1	1	0.9	0.8	0.9	0.7	0.7	0.7	0.8	1	0.9	0.8	0.6	0.2	0.2	0.1	0.1
Fri	0.1	0.1	0.1	0.1	0.3	0.6	0.9	1	1	0.9	0.8	0.9	0.7	0.7	0.7	0.8	1	0.9	0.8	0.6	0.2	0.2	0.1	0.1
Sat	0.1	0.1	0.1	0.1	0.1	0.3	0.5	0.7	0.7	0.7	0.8	0.8	0.7	0.4	0.4	0.6	0.7	0.7	0.6	0.6	0.5	0.3	0.1	0.1


Traffic air pollution in Sofia - NO_2 $[\mu gm^{-3}]$
17-12-2015 20:00h
receptor level = 2m
25000
20000
15000
10000
5000
0
y(m)
0
5000
10000
15000
20000
25000
30000
35000
x(m)
0
100
200
300
350
400
450
500
800
concentration $[\mu gm^{-3}]$


Traffic air pollution in Sofia - NO_2 $[\mu gm^{-3}]$
14-12-2015 14:00h
receptor level = 2m
25000
20000
15000
10000
5000
0
y(m)
0
5000
10000
15000
20000
25000
30000
35000
x(m)
0
100
200
300
350
400
450
500
800
concentration $[\mu gm^{-3}]$

Known problems and possible ways to solve them

- **SOURCE RELATED**
  - **Q: How to get close to the actual emission rates for each source and their contribution to the whole pollution process?**
- **A: Denser receptor net, precise remote sensing, vehicle traffic counters**

Known problems and possible ways to solve them

RELATED TO METEOROLOGY

- **Data availability – measurements with higher space/time resolution**
- **Specific weather conditions – still weather, thunderstorms etc.**
- **Model performance, forecast uncertainties – closely related to data availability, and to computational resources as well**

AERMOD utilizes meteorological data from just one point which is considered to be representative for the whole modeled domain.


THANK YOU!