- European Network on New Sensing Technologies for Air Pollution Control and Environmental Sustainability - *EuNetAir*
- COST Action TD1105
- <u>Special Session</u>: *Environmental Case Studies from Mediterranean, Central and Eastern Europe*
- Duisburg, Germany, 4 - 6 March 2013
- <u>Action Start date</u>: 01/07/2012 - <u>Action End date</u>: 30/06/2016
- Year: 2012-2013 (*Starting Action*)

LATVIJAS UNIVERSITATE
ANNO 1919
UNIVERSITY OF LATVIA

Dr. Iveta Steinberga (Latvia)

Function in the Action (WG3 member, SIG4, Gender Balace)

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Air Quality Modelling in Latvia: Challenges and Failures

Overwiev

- Air quality models usage
- Types of used AQ models
- Some practical examples
- Future needs

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Air quality models usage (1)

Historical background

- until 1998 – models from former Soviet Union (e.g. Ecolog)

- from 1998 – mainly dispersion models (e.g. AIRMOD)

Air quality models usage (2)

Legislation

- at operator level (for regulatory purposes) – officially allowed models published in legislation rules
- at municipality level – the same as for operators

NB!

There is possibility to use own model if I can prove high uncertainty with measurements.

Types of used AQ models (1)

The most popular – Gaussian dispersion model

- offered by company AB OPSIS, EnviMan
- AERMOD (USA, EPA)

- ADMS Urban
- OSPM

Types of used AQ models (2)

The general equation to calculate the steady state concentration:

$$C(x,y,z)=\frac{Q}{2\pi U\,\sigma_y\sigma_z}\left[\exp-\left(\frac{y^2}{2\sigma_y{}^2}\right)\right]\left\{\exp\left[\frac{-(z-H)^2}{2\sigma_z{}^2}\right]+\exp\left[\frac{-(z+H)^2}{2\sigma_z{}^2}\right]\right\}$$

c(x,y,z) = mean concentration of diffusing substance at a point (x,y,z) [kg/m^3],

x = downwind distance [m],

y = crosswind distance [m],

z = vertical distance above ground [m],

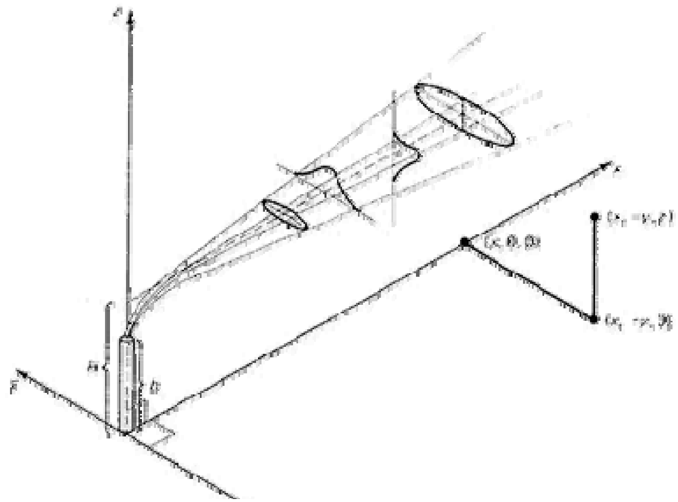
Q = contaminant emission rate [mass/s],

σ_y = lateral dispersion coefficient function [m],

σ_z = vertical dispersion coefficient function [m],

U = mean wind velocity in downwind direction [m/s],

H = effective stack height [m].



Plume Dispersion by Gaussian Distribution and Coordinate System

Types of used AQ models (3)

The lateral dispersion coefficient function and, the vertical dispersion coefficient functions depend on the downwind distance and the atmospheric stability class.

These coefficients in meters can be obtained using Pasquill-Gifford-Turner estimates

$$\sigma_{PGTy}(s,x) = (k_{s,1}x)\left[1+\left(\frac{x}{k_{s,2}}\right)\right]^{-k_{s,3}}$$

$$\sigma_{PGTz}(s,x) = (k_{s,4}x)\left[1+\left(\frac{x}{k_{s,2}}\right)\right]^{-k_{s,5}}$$

Surface wind speed at 10 m (m/s)	**Day**			**Night**	
	Incoming Solar radiation			Cloud Cover	
	Strong	Moder.	Slight	Thinly Overcast	Mostly Cloudy
< 2	A (s = 1)	A-B	B (s = 2)		
2-3	A-B	B	C (s = 3)	E (s = 5)	F (s = 6)
3-5	B	B-C	C	D	E
5-6	C	C-D	D (s = 4)	D	D
>6	C	D	D	D	D

s = an integer [1-6] representing the atmospheric stability;
$k_{x,x}$ = empirical constants, values for each of the stability class

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Atmospheric stability

Plays the most important role in the transport and dispersion of air pollutants.

Can either encourage or suppress vertical air motion.

Frequently varies through a wide range in different layers of the atmosphere for several reasons.

Most important factors in atmospheric stability – diurnal changes, impact of topography, seasonal variation.

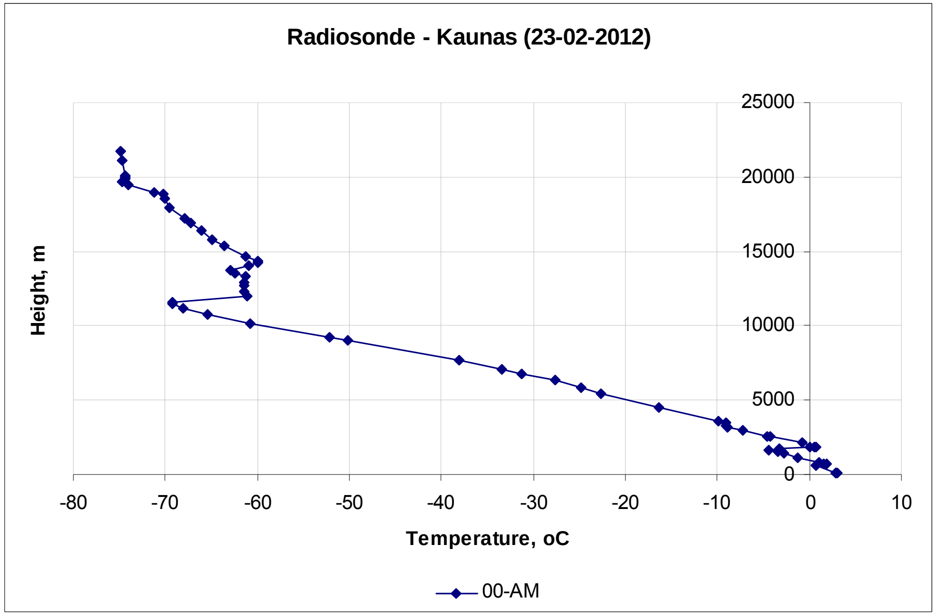
Meteorology (1)

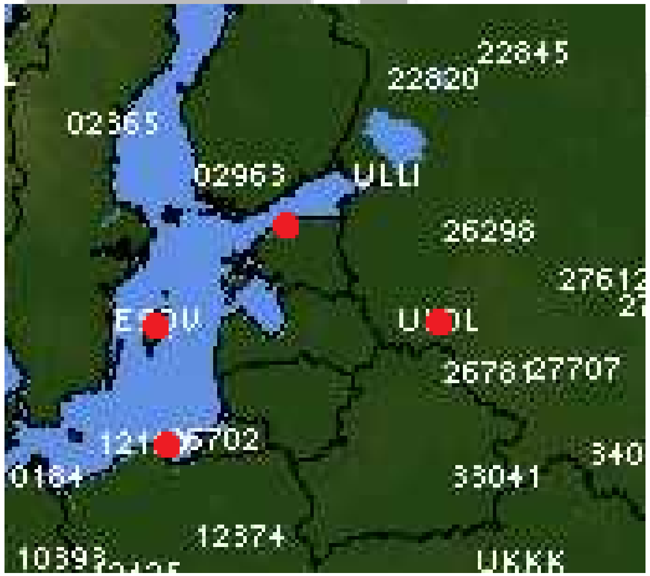
Atmospheric stability classification methods:

- P- G Method
- P-G / NWS Method
- The STAR Method
- BNL Scheme
- Sigma Phi Method
- Sigma Omega Method
- Modified Sigma Theta Method
- NRC Temperature Difference Method
- Wind Speed ratio (U_R) Method
- Radiation Index Method
- AERMOD Method (Stable and Convective cases)

Meteorology (2)

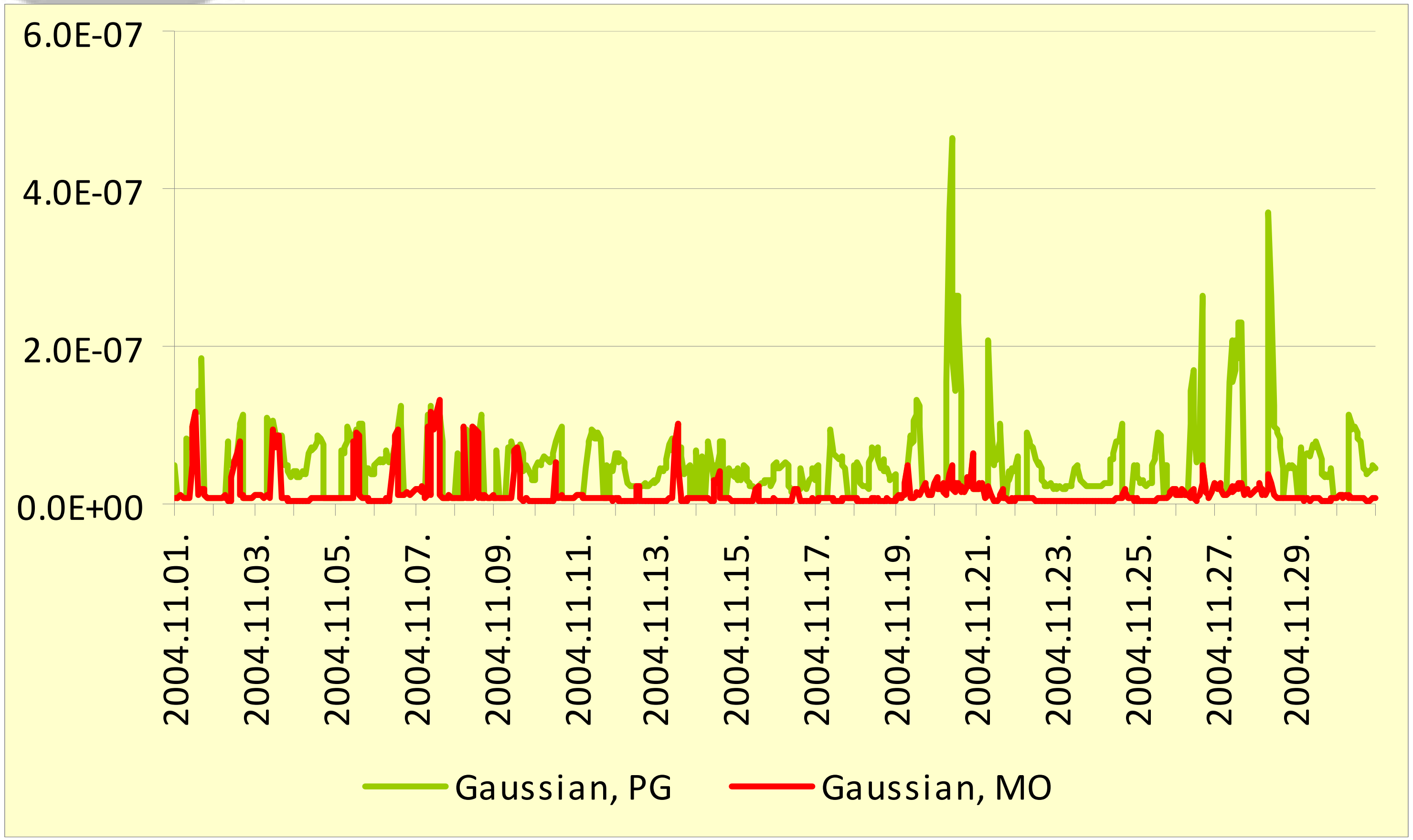
Radiosonde data:





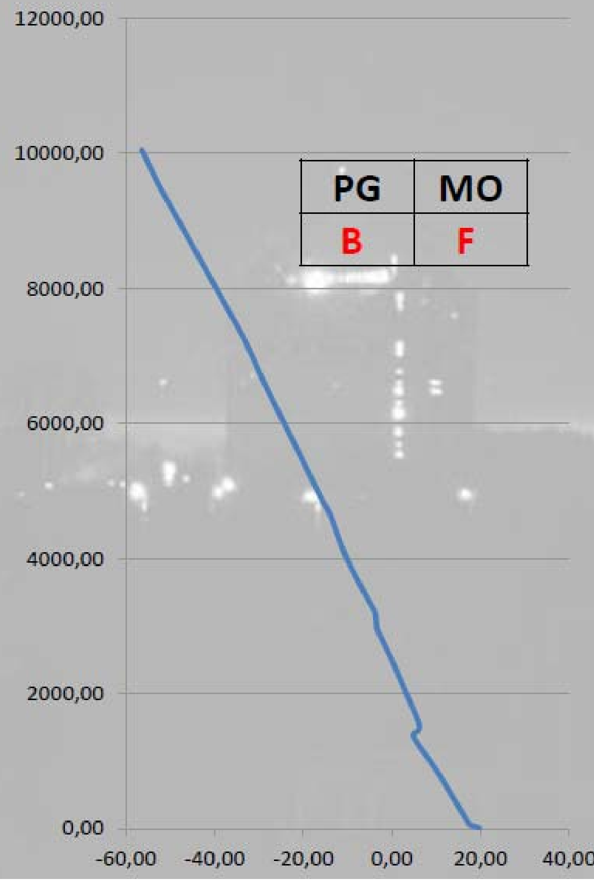
Łeba (PL) – **S**
Visby (SE) – **W**
Tallinn (EE) – **N**
Velikie Luki (RU) - **E**

http://weather.uwyo.edu/upperair/sounding.html

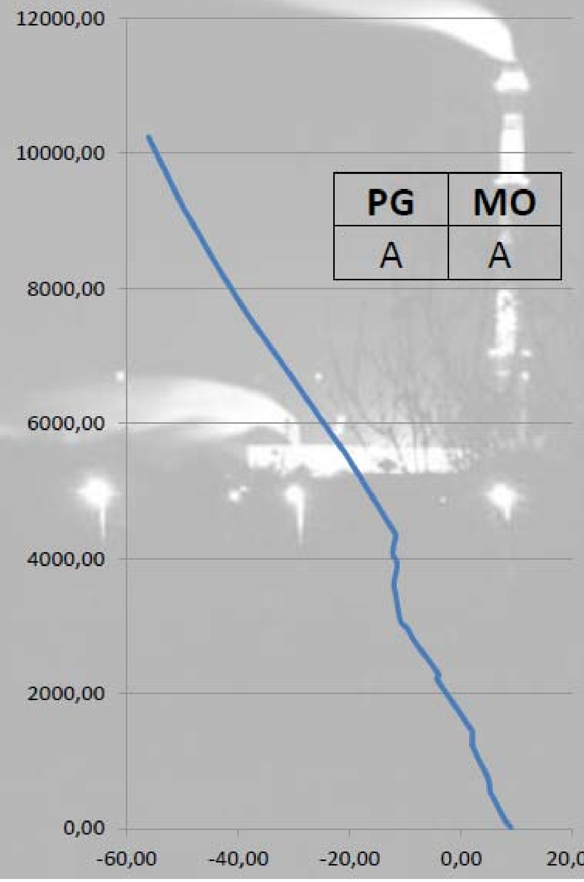

6.0E-07
4.0E-07
2.0E-07
0.0E+00
2004.11.01.
2004.11.03.
2004.11.05.
2004.11.07.
2004.11.09.
2004.11.11.
2004.11.13.
2004.11.15.
2004.11.17.
2004.11.19.
2004.11.21.
2004.11.23.
2004.11.25.
2004.11.27.
2004.11.29.
Gaussian, PG
Gaussian, MO

Radiosounding check

01.05.2004.



15.05.2004.



Practical examples

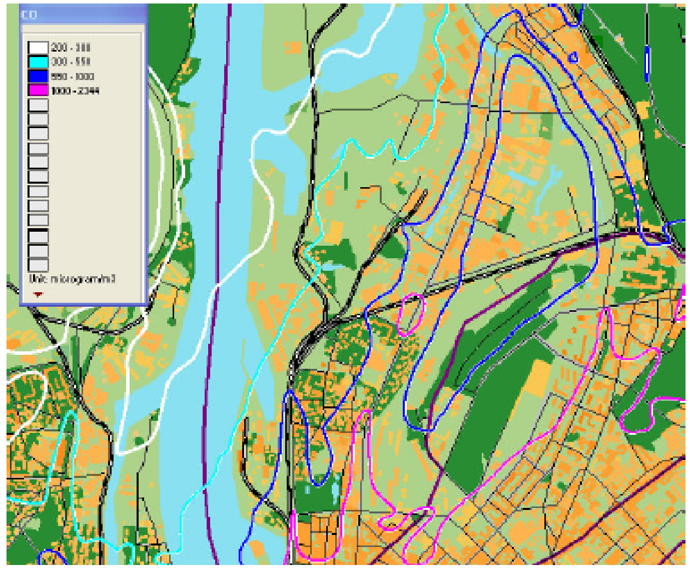
- Air quality zoning for Riga city
- Future scenaroius
  - Future fuels
  - Future cars
- City planning
  - New enterprises
  - Traffic flows

OGLEKĻA OKSĪDA
8 STUNDU 98-PROCENTĪLO KONCENTRĀCIJU NOVĒRTĒJUMS
RĪGĀ, ANDREJOSTAS RAJONĀ

BEZ UZŅĒMUMIEM:

1. *A/S RĪGAS OSTAS ELEVATORS (RĪGĀ, ANDREJOSTAS IELĀ 14);*
2. *SIA "RĪGAS CENTRĀLAIS TERMINĀLS FILIĀLE "ANDREJOSTA" (RĪGĀ, EKSPORTA IELĀ 15);*
3. *SIA "RĪGAS CENTRĀLAIS TERMINĀLS" (RĪGĀ, EKSPORTA IELĀ 15);*
4. *SIA "STREK" (RĪGĀ, URIEKSTES IELĀ 9)*

M 1:25 000

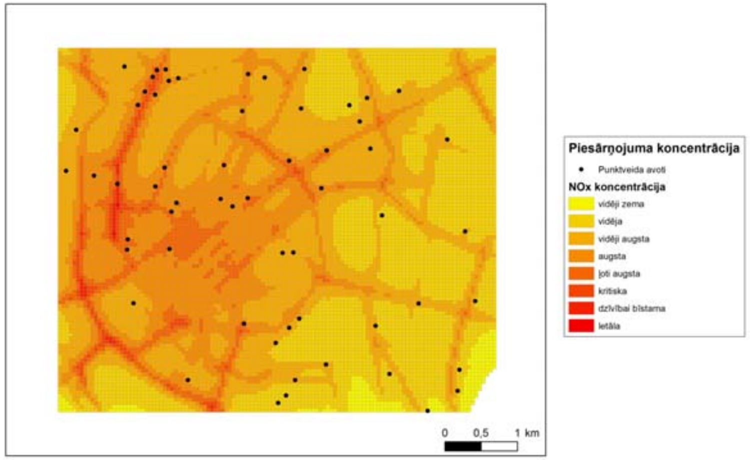


Izkliežu aprēķini veikti analizējot gaisa piesārņojuma līmeni Andrejostas rajonā. Aprēķinos iekļauti:

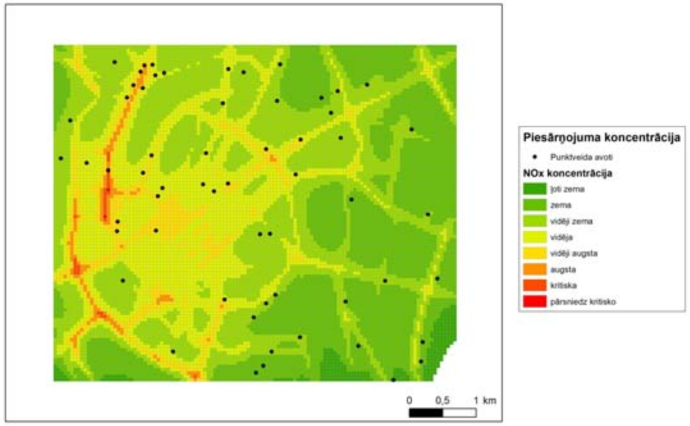
- stacionārie piesārņojuma avoti (datu bāze 2-Gaiss);
- mobilie piesārņojuma avoti (transporta plūsmu intensitātes mērījumu dati).

Režģa šūnas izmēri - 50×50 m.

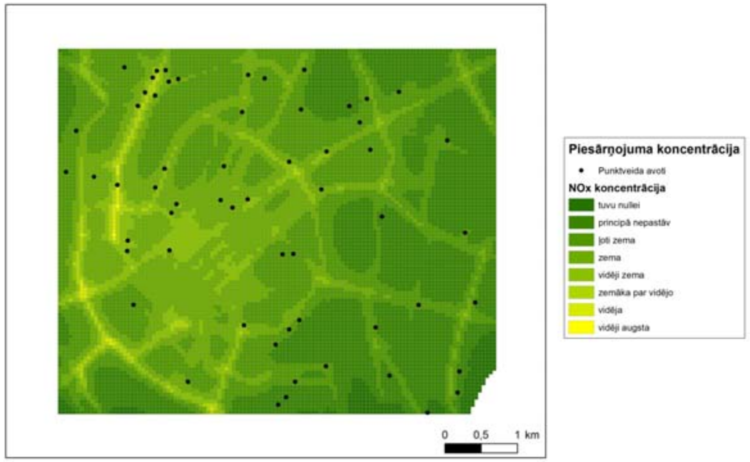
NOx koncentrācija Rīgas centra rajonā



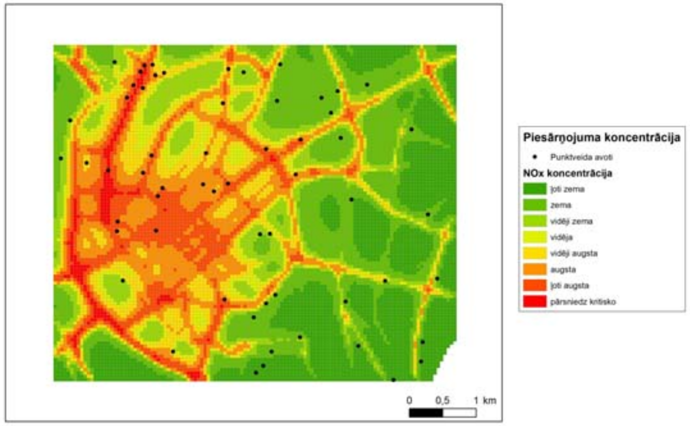
NOx koncentrācija Rīgas centra rajonā



NOx koncentrācija Rīgas centra rajonā



NOx koncentrācija Rīgas centra rajonā



Problems

Uncertainties in emissions (due to avoid monopoly)

- point sources
- traffic

PBL calculations (different parameterization methods - P-G or Monin-Obukhov?);

Odour dispersion

Spatial resolution problem (manipulation with results)

PM modelling

Air pollution-mortality linkage

Future interests/needs

1. aerosol and odour models,
2. secondary aerosols,
3. aerosol abrasion (tire wear, brake wear, diff. types of pavements, etc.),
4. aerosol resuspension (sanding, washing effects, etc.)
5. air quality forecasts,
6. validation of models (at late and early stages).

Thank you!

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