

16th International Conference on Harmonisation within Atmospheric
Dispersion Modelling for Regulatory Purposes

8-11 September 2014, Varna, Bulgaria



Experiences in dispersion modelling in the development of air quality management system in Krakow

Agnieszka Bartocha and Marek Rosicki

KRAKOW CITY –

general description of the air pollution problem



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ATMOTERM:

- 10 years experience in Air Quality Action Plan preparation
- Experience in using the models (ADMS Urban and Calmet/Calpuff) for air quality planning and assessment
- We work for local, regional and national authorities in Poland
- We are involved in the whole AQAP preparation process: emission inventories, modelling, public consultation, plans and measures development
- We had this chance to work for the improvement of air quality in Krakow - the very special place in Poland

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Krakow - the 2nd largest city - one of the oldest cities in Poland, with population of approximately 760 000



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general description of the air pollution problem



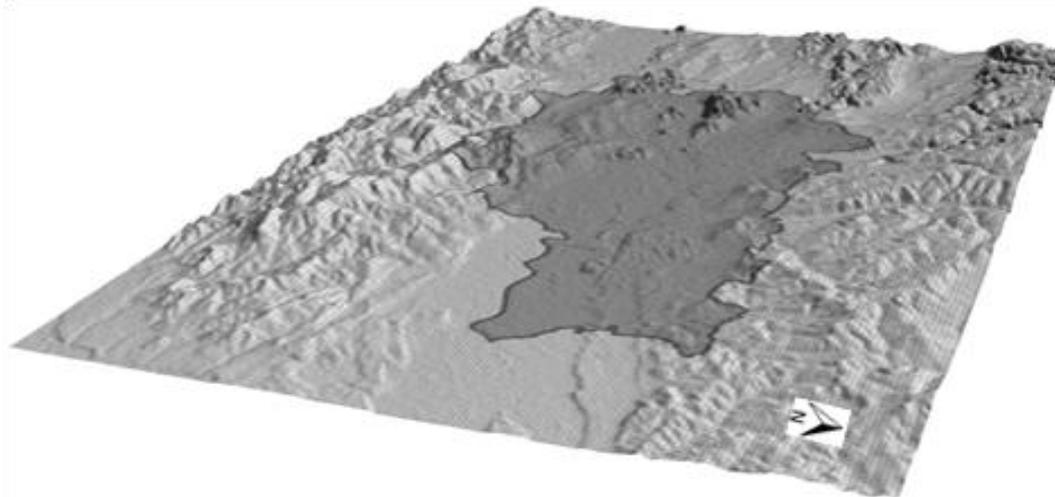
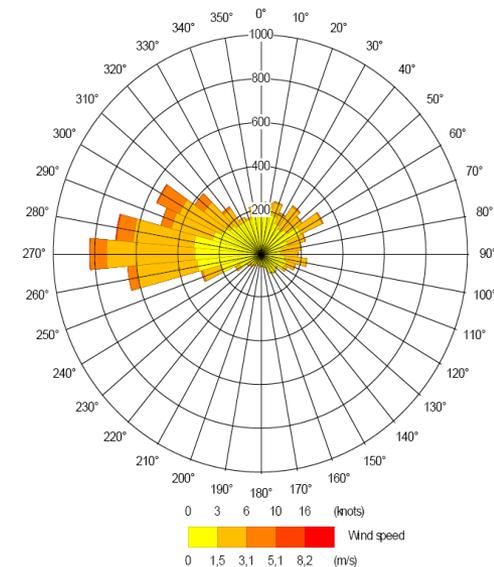
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Difficult orographic conditions:

- location in the Vistula Valley
- low wind speed and thermal inversions observed

(up to 30% of low wind speed during a year)



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general description of the air pollution problem



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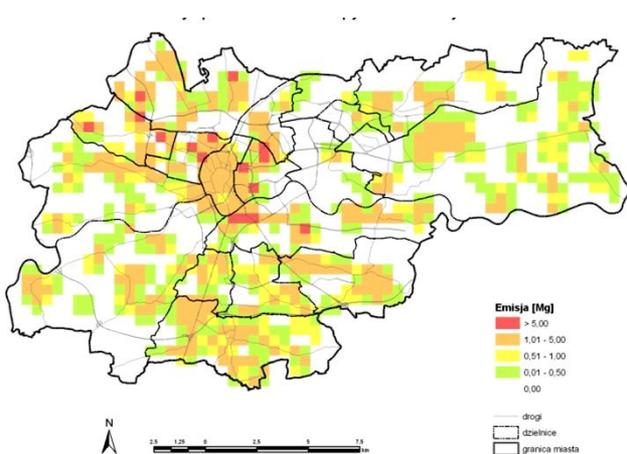
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Emission sources:

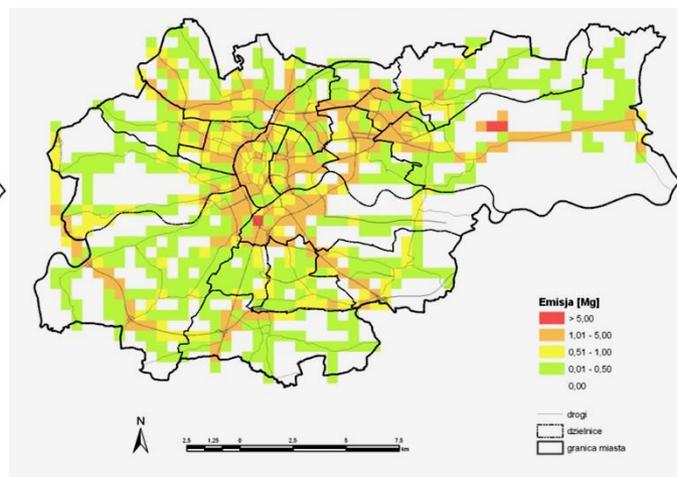
- emissions of pollution from typical urban sources
- location of heavy industry (e.g. steelworks) and two large power plants

PM10 emission distribution in 2009

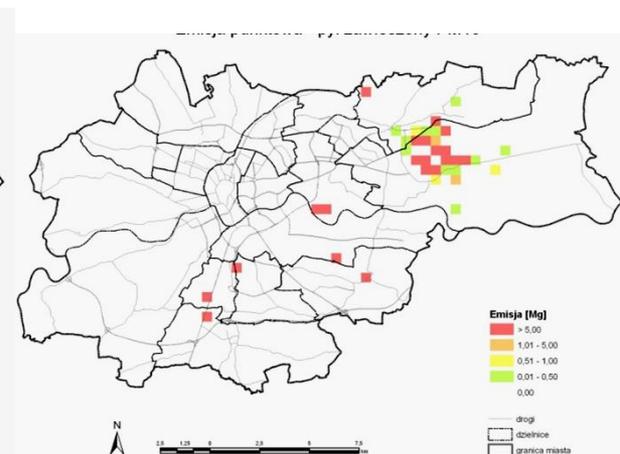
low emission



transport



industry



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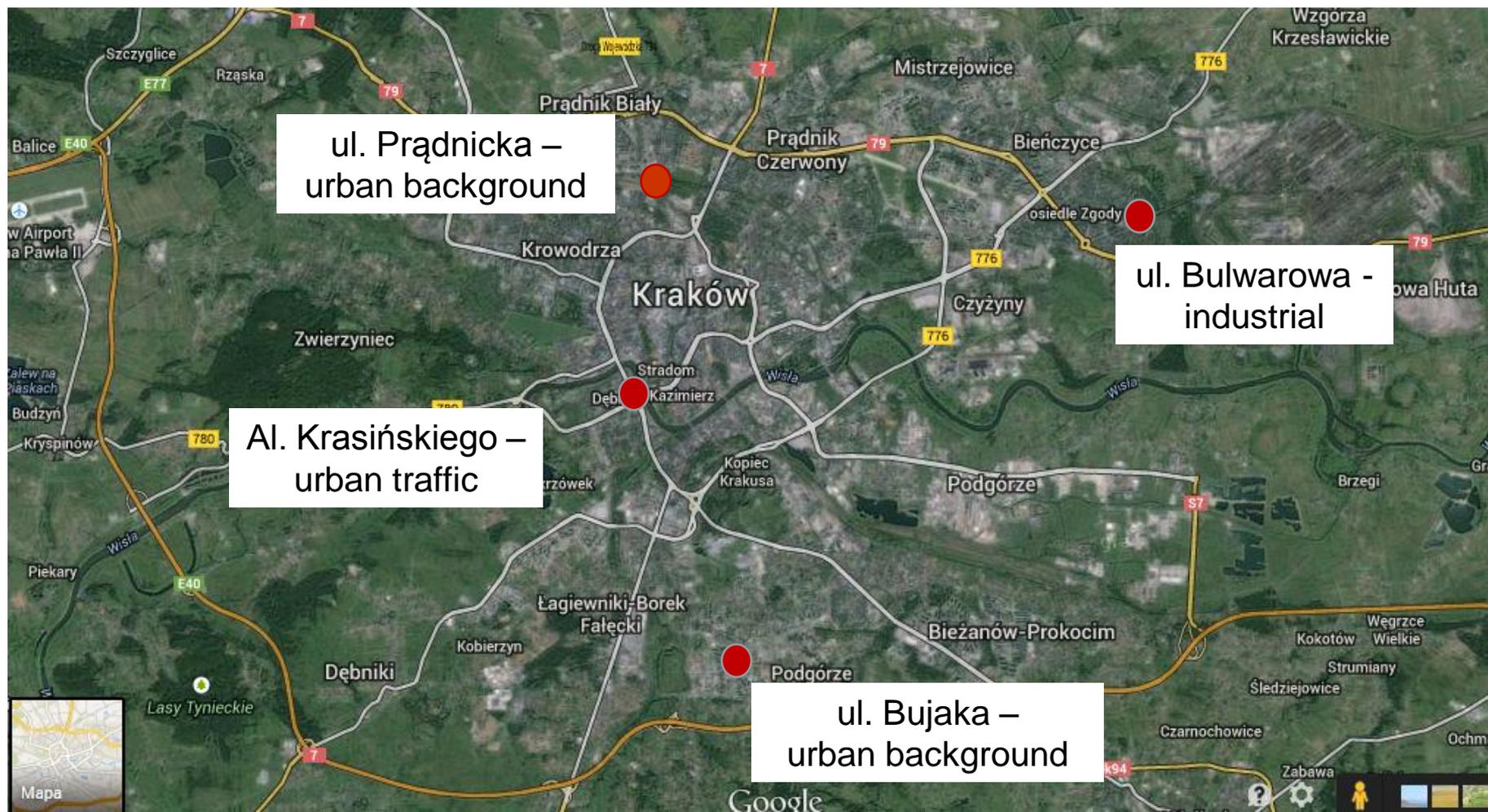
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Location of monitoring stations in Krakow



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general description of the air pollution problem

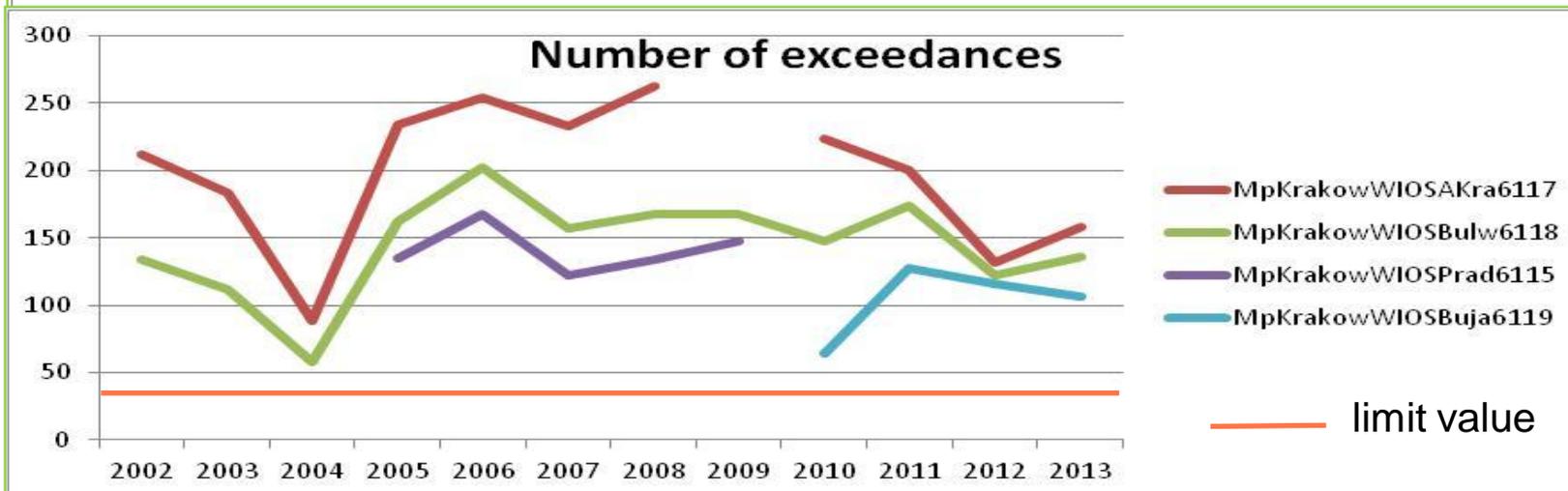
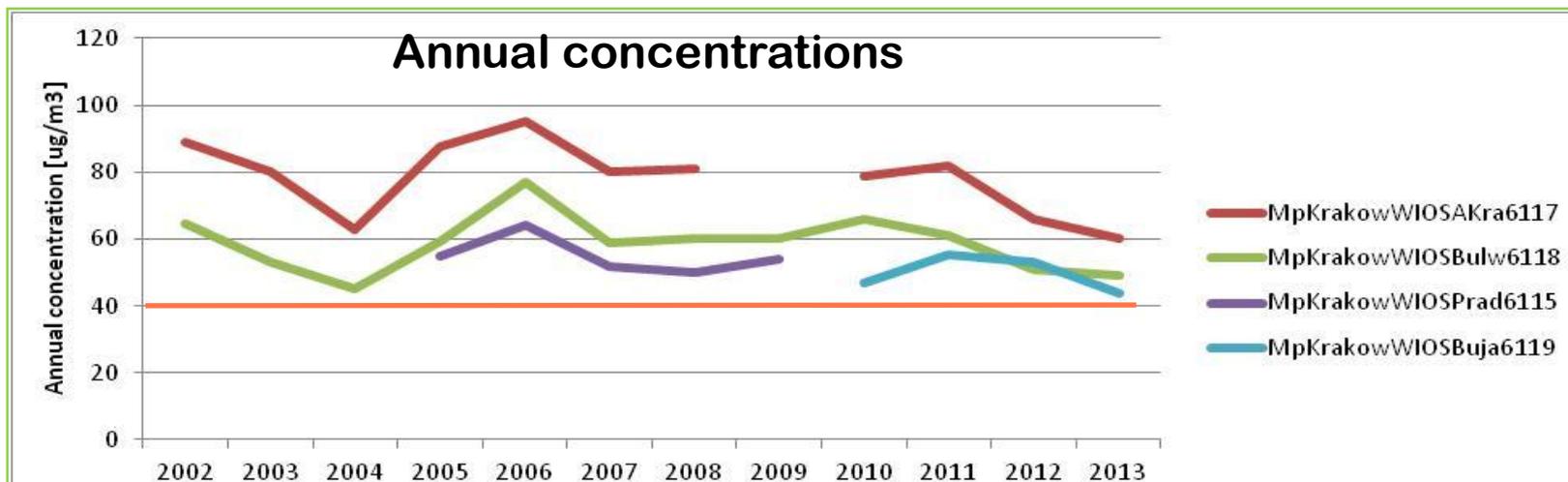


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PM10 pollution in Krakow

(source: National Monitoring of the Environment (PMS) – Regional Inspectorate of Environmental Protection in Krakow (WIOS))



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general description of the air pollution problem



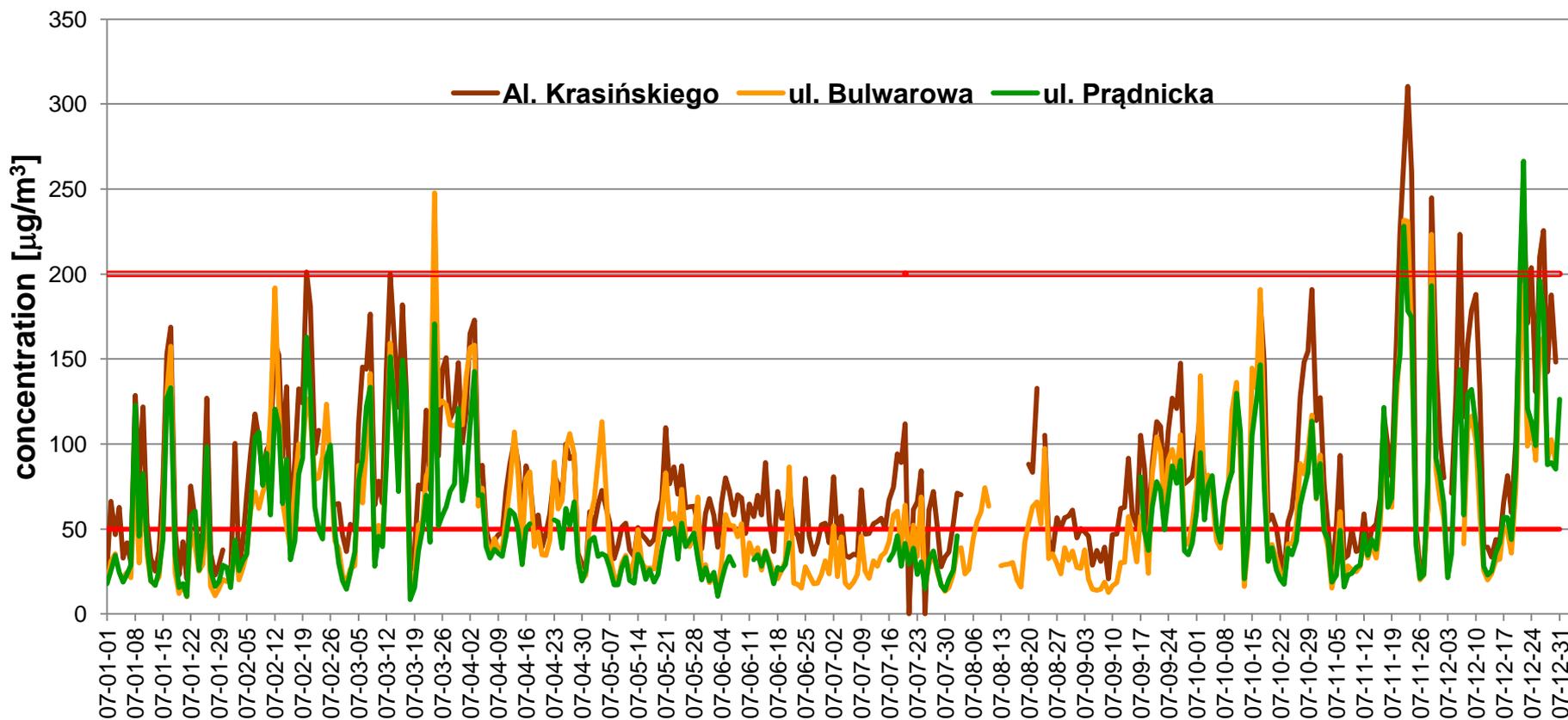
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PM10 pollution in Krakow

(source: National Monitoring of the Environment (PMŚ) – Regional Inspectorate of Environmental Protection in Krakow (WIOŚ))

Time series of 24-hour concentration of PM10 in 2007



KRAKOW CITY –

development of the air quality management system



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1998 Inventory of the industrial emission sources and *air pollution dispersion modelling* using **Calmet/Calpuff**

2009 Second Air Quality Action Plan for PM10, B(a)P and NO₂ using **ADMS Urban**

2010 Implementation of the solid fuel prohibition act
Detailed inventory of emissions from Nowa Huta Industrial Zone using **ADMS Urban**

1992 *Low Emission Reduction Program in Krakow funded by the U.S. Agency for International Development*

2004 First Air Quality Action Plan for PM10, SO₂ and NO₂ using **ADMS Urban**

2005 *JRC project - source apportionment*

2010 *Air pollution forecasts* using **GEM-AQ**

2012 Third Air Quality Action Plan for PM2.5, PM10, B(a)P and NO₂ using **Calmet/Calpuff**

2013 The solid fuel prohibition act

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development of the air quality management system



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What exactly contribution have the domestic heating sources to air quality?

2009 Second Air Quality Action Plan for PM10, B(a)P and NO₂ using **ADMS Urban**

2010 Implementation of the solid fuel prohibition act

Detailed inventory of emissions from Nowa Huta Industrial Zone using **ADMS Urban**

What is the contribution of pollution transport from neighbouring regions?

PM2.5 assessment

What sources are responsible for poor air quality?

2004 First Air Quality Action Plan for PM10, SO₂ and NO₂ using **ADMS Urban**

What strategy for low emission reduction should be implemented to improve air quality in Krakow?

What is the real impact on heavy industry to air quality?

2012 Third Air Quality Action Plan for PM2.5, PM10, B(a)P and NO₂ using **Calmet/Calpuff**

2013 The solid fuel prohibition act

KRAKOW CITY –

results



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Improvement of emission inventories in Krakow for the period 2003-2009 (tonnes)

Type of the sources	2003	2007	2009
Low emission	409	762	839
Transportation	598	540	540
Industry	1112	1716	1248
SUM	2119	2282	2626

source: AQAP for Krakow City 2005, AQAP for Malopolska Region 2009, Implementation of the solid fuel prohibition act 2010, Detailed inventory of emissions from Nowa Huta Industrial Zone 2010

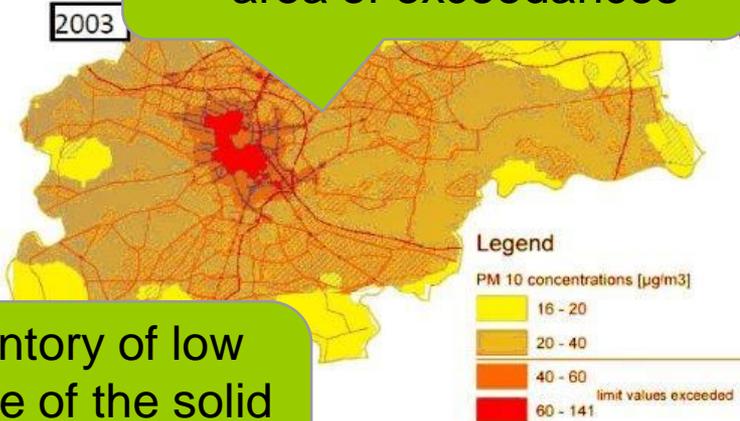
KRAKOW CITY – modelling results



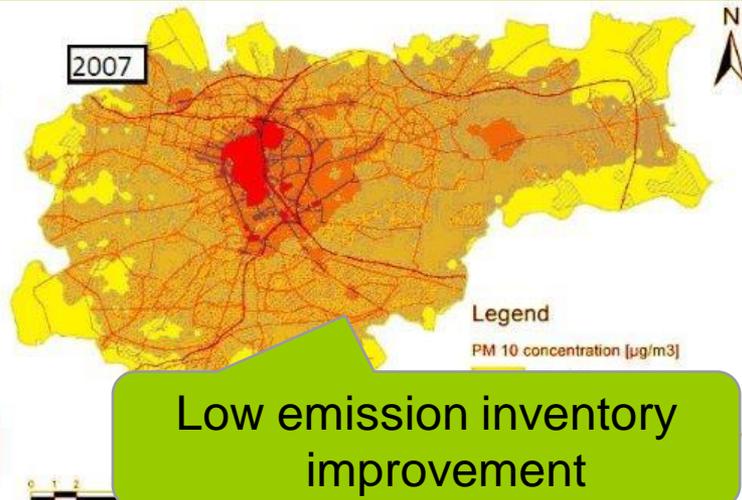
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Modelling
results

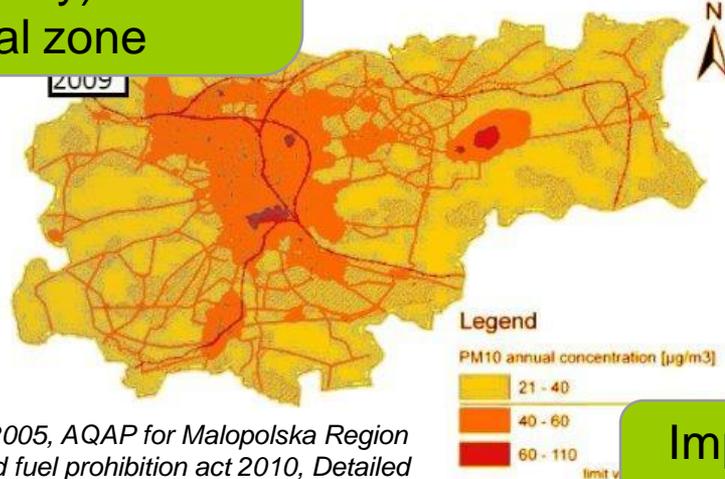
Problem: underestimated
area of exceedances



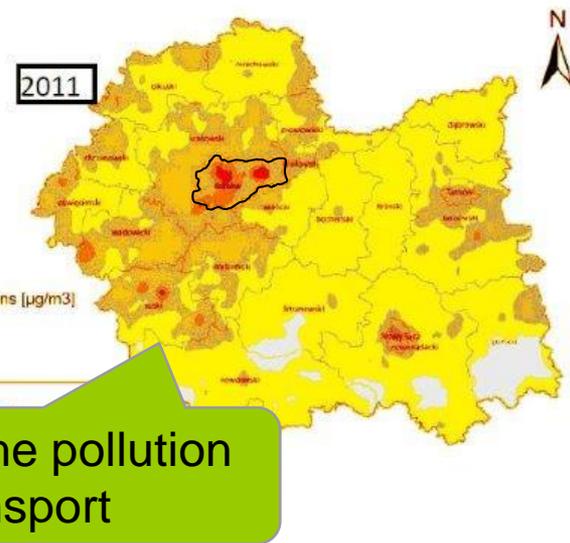
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Detailed inventory of low
emission (use of the solid
fuel inventory) and
industrial zone



Low emission inventory
improvement



Impact of the pollution
transport

source: AQAP for Krakow City 2005, AQAP for Malopolska Region 2009, Implementation of the solid fuel prohibition act 2010, Detailed inventory of emissions from Nowa Huta Industrial Zone 2010, AQAP for Malopolska Region 2012

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Results



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Studies: *Implementation of the solid fuel prohibition act*

Detailed inventory of emissions from Nowa Huta Industrial Zone

Project: *AQAP for Malopolska region 2009*

Model: **ADMS Urban**

Source apportionment:

Annual concentration of PM10 [%] in 2007

Average for the
city (AQAP)

Industry	Transport	Low emission
8	37	55

Annual concentration of PM10 [%] in 2007

Industrial Monitoring
Station – Bulwarowa
(studies)

Industry	Transport	Low emission
22	51	27

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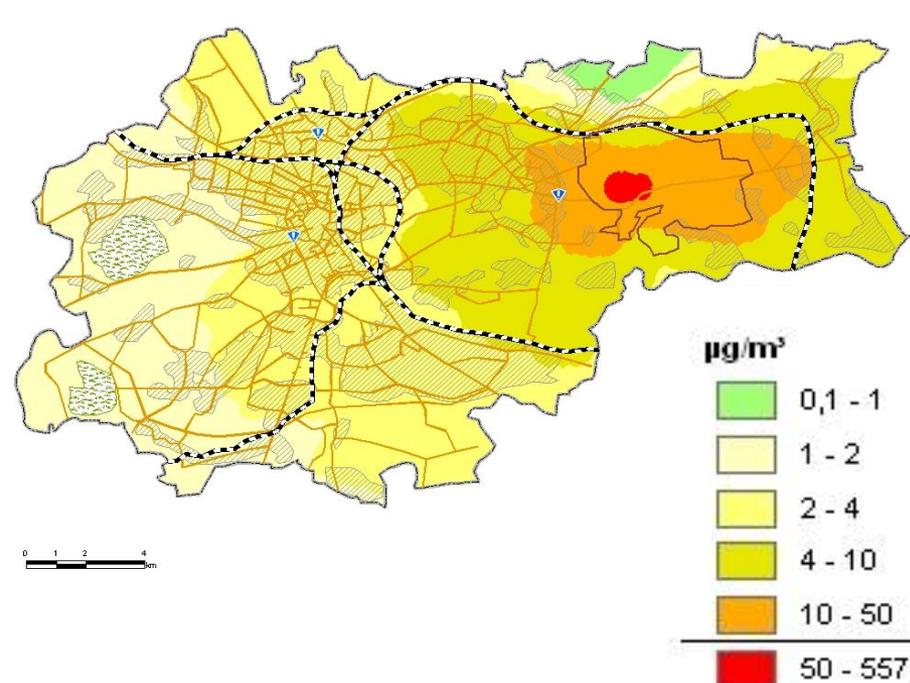
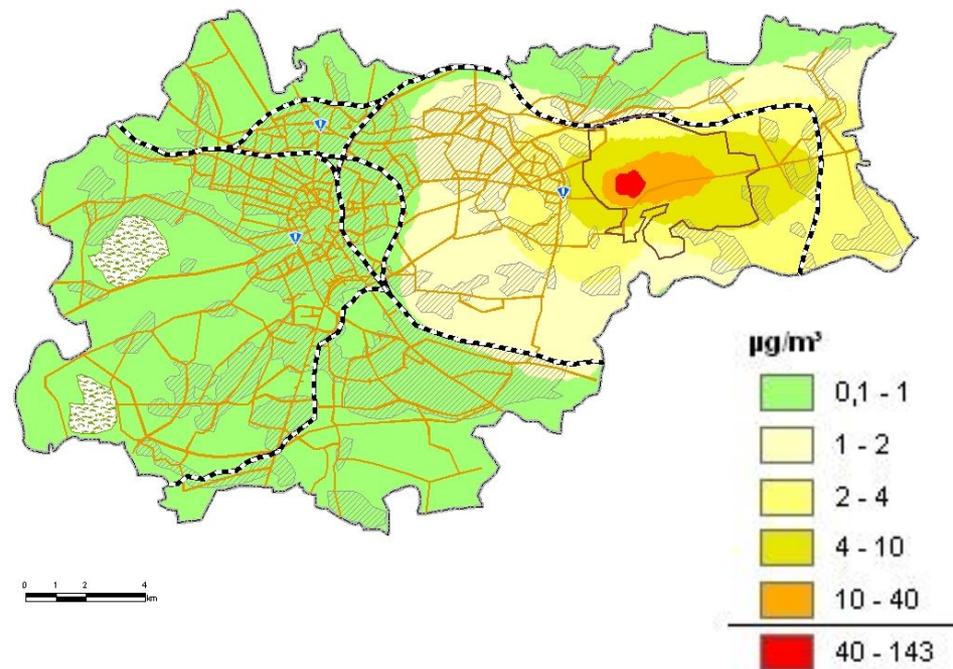
Projects: *Detailed inventory of emissions from Nowa Huta Industrial Zone*

Model: **ADMS Urban**

Impact of the NOWA HUTA Industrial Zone on the city in 2007 year

PM10 annual concentration [$\mu\text{g}/\text{m}^3$]

PM10 percentile of 24-hour concentration [$\mu\text{g}/\text{m}^3$]



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Projects: *Implementation of the solid fuel prohibition act*

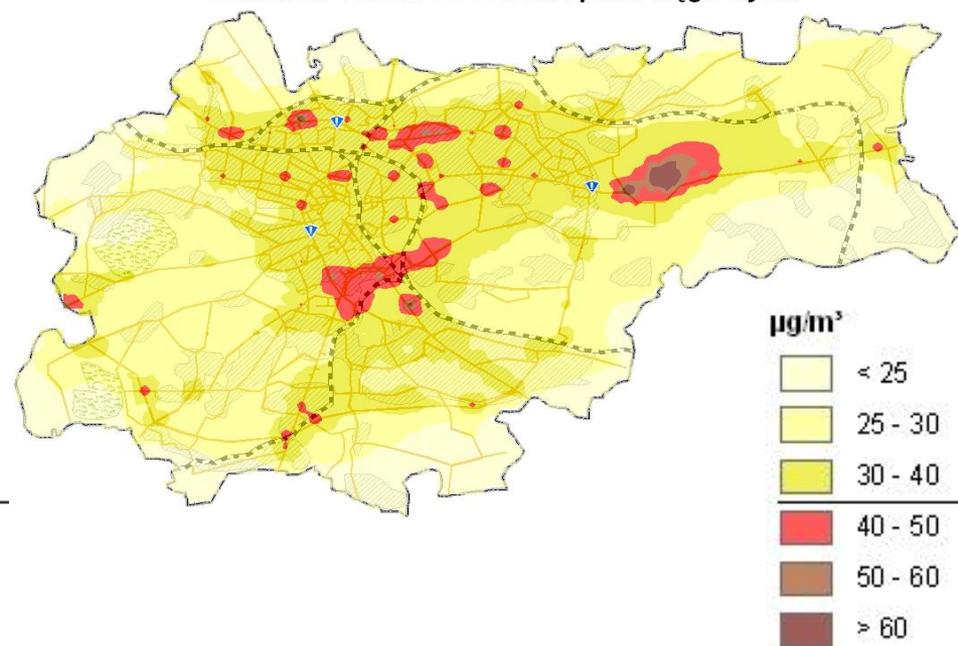
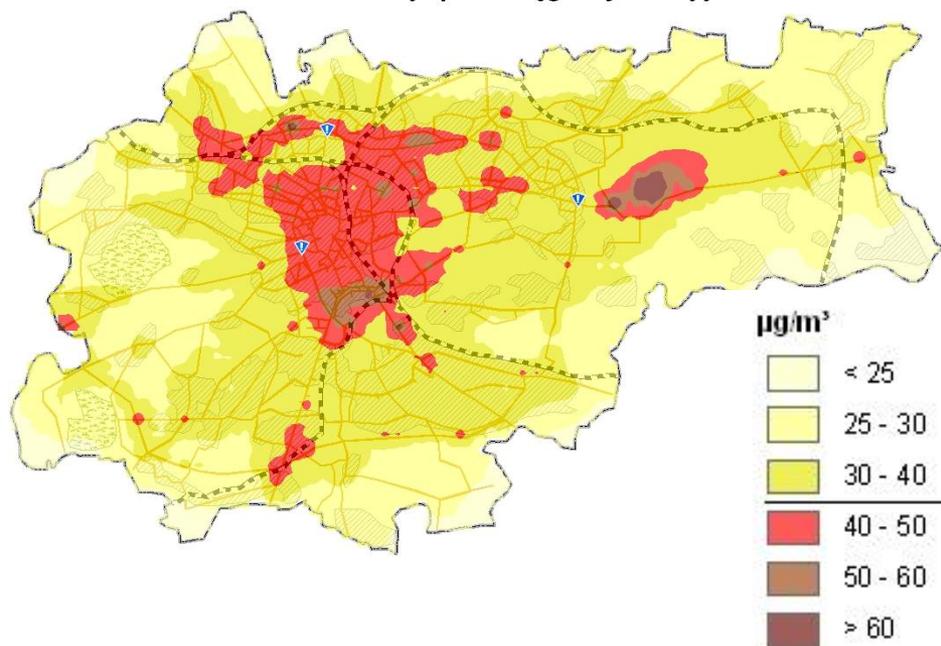
Model: **ADMS Urban**

Influence of solid fuel prohibition scenarios on the air quality in Krakow

„Good quality coal” option

„Full solid fuel prohibition” option

PM10 annual concentration [$\mu\text{g}/\text{m}^3$]



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Projects: *Implementation of the solid fuel prohibition act*

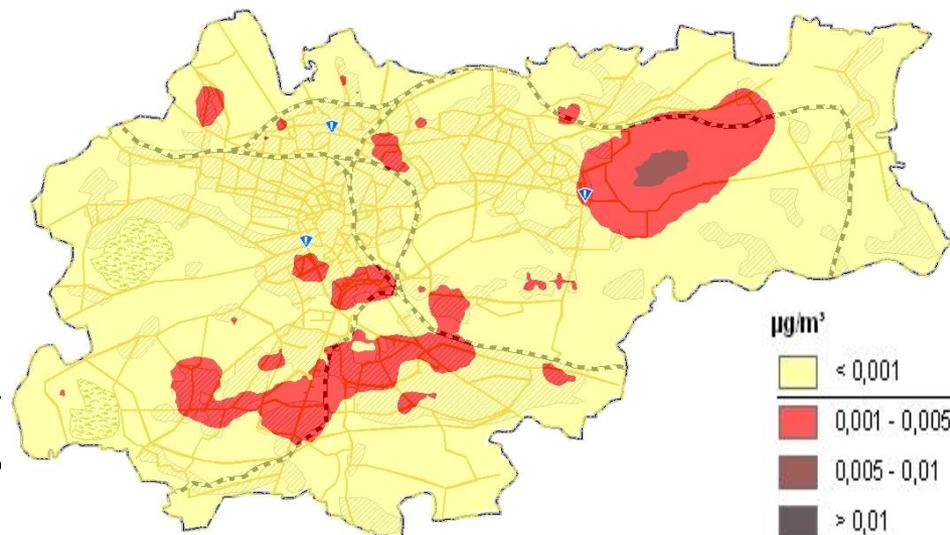
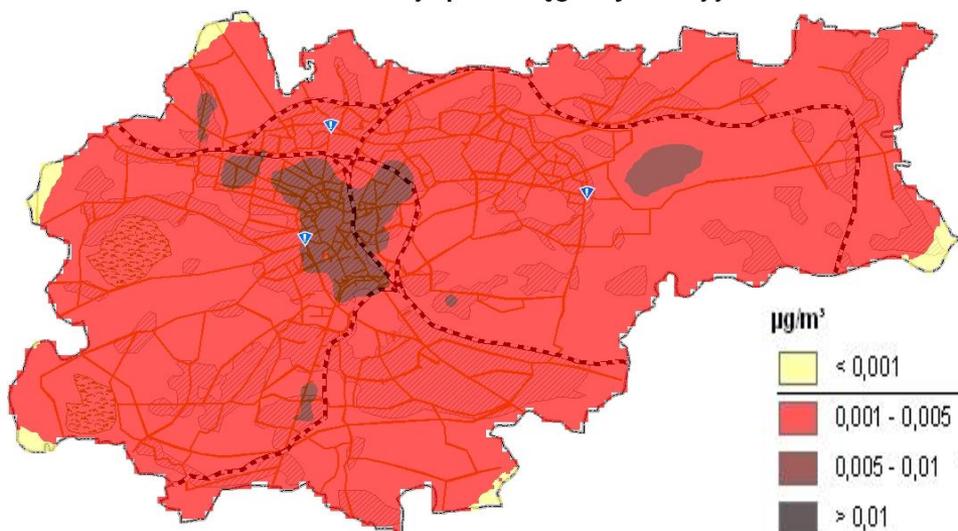
Model: **ADMS Urban**

Influence of solid fuel prohibition scenarios on the air quality in Krakow

„Good quality coal” option

„Full solid fuel prohibition” option

B(a)P annual concentration [$\mu\text{g}/\text{m}^3$]



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Projects: *Implementation of the solid fuel prohibition act*

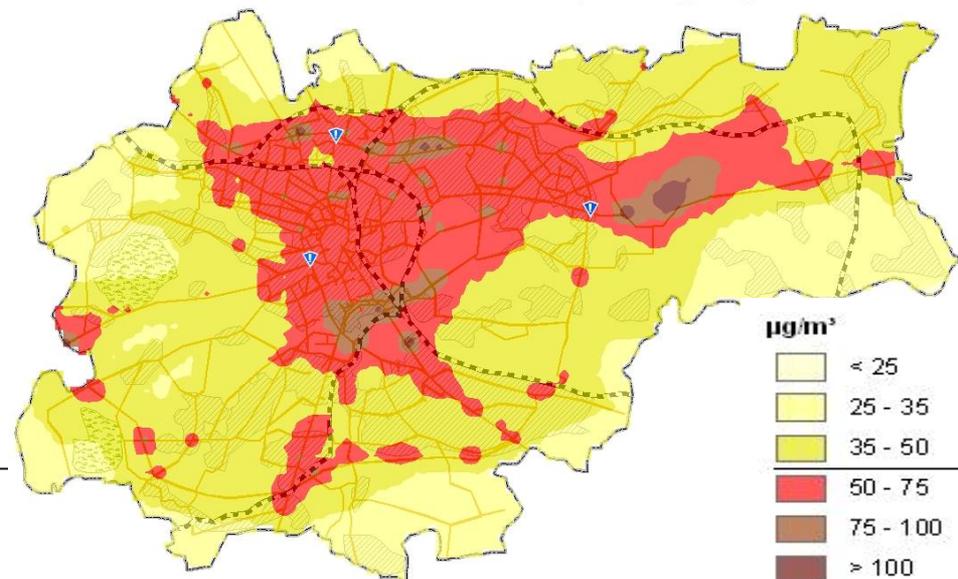
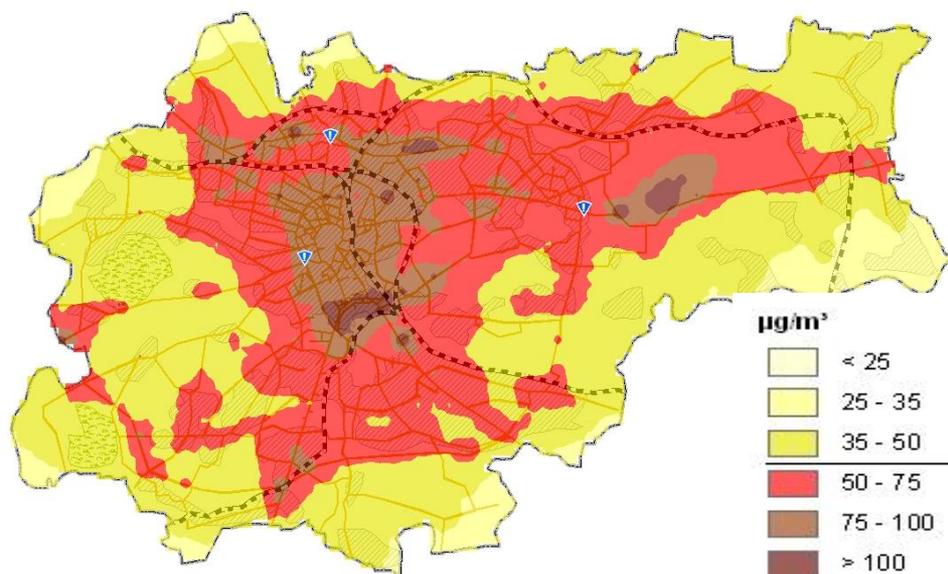
Model: **ADMS Urban**

Influence of solid fuel prohibition scenarios on the air quality in Krakow

„Good quality coal” option

„Full solid fuel prohibition” option

PM10 90,4 percentile [$\mu\text{g}/\text{m}^3$]



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Conclusions



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- Dispersion modelling is a very important tool in air quality management.
- 10 years of analyses and consultations were needed to achieve citizens understanding and participation
- Bottom-up local scale methodology in emission inventory is generally required to achieve good results of modelling.

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Thank you for your attention!

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*Malopolska 2023 – in good air
(AQAP 2012)*