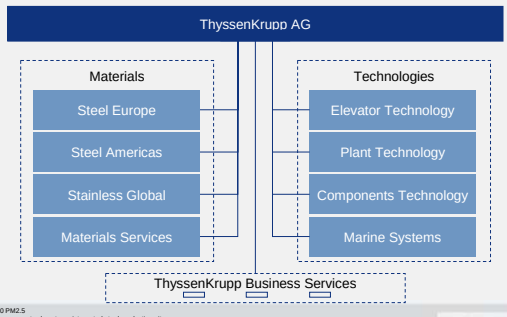
PM2.5 measurements close to an integrated steel production site

Dr. Bastian Bach – RSC, Burlington House, London,
10th December, 2009

ThyssenKrupp Steel Europe

Group structure of ThyssenKrupp
Corporate headquarter, 2 divisions, 8 business areas



Outline

- PM situation in Germany
- PM situation near site of TKSE in Duisburg
- Estimation of source origins
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EU legislation (2008/50/EC) sets limit and target values for PM
Values for PM10 and PM2.5

	PM10	PM2.5
Limit values in µg/m³		
• annual mean	40	25 (2015)
• daily mean	50	
• # exceedances of daily mean	35	
Target value in µg/m³		
• annual mean		25 (2010)

Additionally: National exposure reduction and obligation, indicative limit value 2020

Germany will comply with the PM2.5 target value in 2010
Correlation of PM10 and PM2.5 in 2006 and 2007

- In 2006/2007 PM10 and PM2.5 were measured simultaneously at 82 stations
- The overall PM2.5/PM10 ratio is 0.66

- The PM2.5/PM10 ratio is 0.70 for the background and 0.63 for traffic
- All ratios are highly correlated with an R^2 between 0.81 and 0.92
- A certain probability of concentrations > 25 µg/m³ is only given for a few traffic stations, which can be estimated from the regression functions
- Compliance with the # of exceedances for PM10 implies PM2.5 < 25 µg/m³

Reference: Bruckmann, P., Immissionsschutz 14 (2009), 112…116

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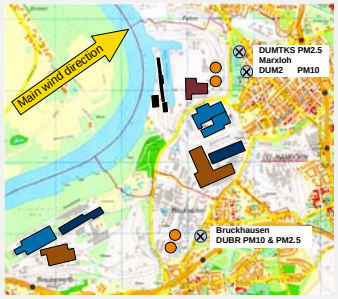
Integrated steel production situated in an urban agglomeration
Site overview of TKSE in Duisburg

- Cokery
- Sinter plant
- Blast furnace
- Steel works
- Hot rolling mill
- Cold rolling mill

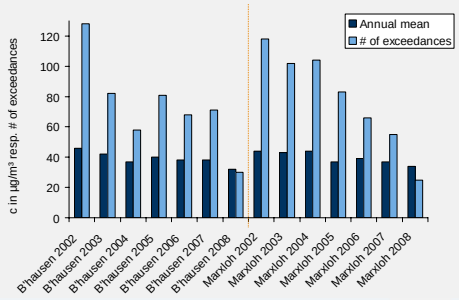
⊗ Sites monitoring PM



Reference for all data of DUM2 and DUBR:
LANUV NRW (not all data yet validated)

Integrated steel production situated in an urban agglomeration
Site overview of TKSE in Duisburg

Successful measures led to improved air quality reg. PM10
Annual mean and number of exceedances near the site in the past



The main subject of the measures has been diffuse sources
Technical and organisational actions were taken

Measures beyond BAT

- Blast furnace 8
- Dedusting of elevated railway carriages

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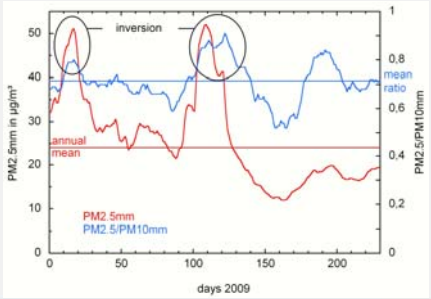
PM values are strongly influenced by weather conditions 2009

Moving mean (20 d) of PM2.5 and PM2.5/PM10 at DUM stations

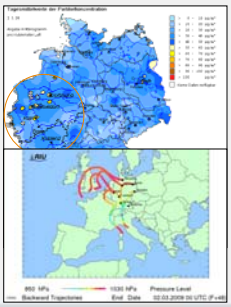
Annual mean of PM2.5 at DUMTKS (Nov08…Nov09): 24 µg/m³



High wind speed from west led to larger scale events

Source origins for 2nd March, 2009

- PM10 at DUM2: 62 µg/m³
- PM2.5/PM10 at DUM stations: 0.67
- Wind speed: 2.5 m/s (av.)
- Wind from the west
- (Re-)suspension (transboundary transport)?

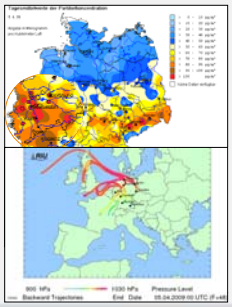


Reference upper figure: UBA, lower figure: RIU - EURAD; both modified

Inversion led to wide range events

Source origins for 5th April, 2009

- PM10 at DUM2: 93 µg/m³
- PM2.5/PM10: 0.86
- Wind speed: 1,2 m/s (av.)
- South-easterly wind direction by trend
- Less than 5 % of PM is Ca, Fe, K, Mg, Na, Zn, C_{tot}
- Secondary particles (transboundary transport)?



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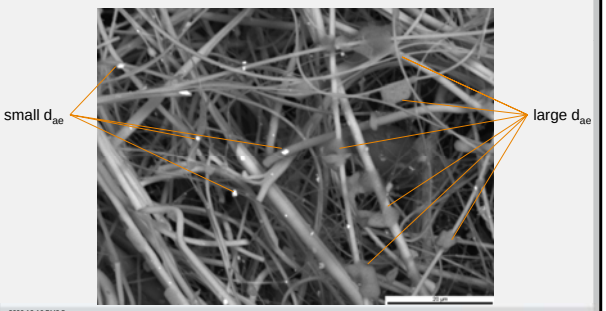
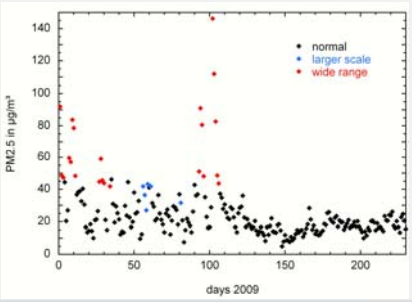


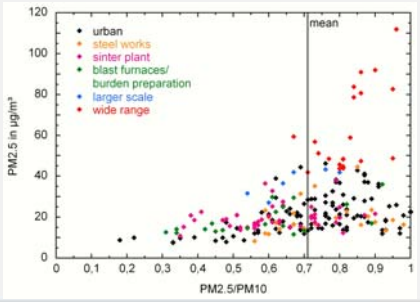
High PM values are correlated with special weather conditions

PM2.5 daily values at DUMTKS in respect to concentrations around



PM2.5/PM10 is an indicator for the wind direction

PM2.5 vs. PM2.5/PM10 at DUM stations



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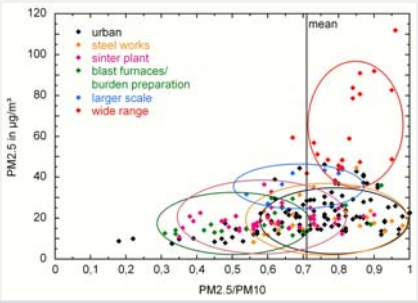

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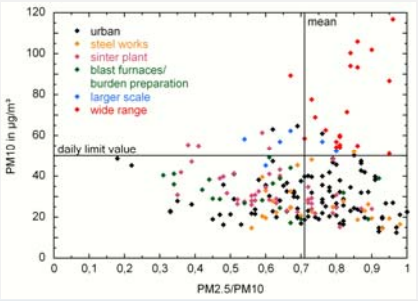
PM10 affected by TKSE is mainly due to the coarse mode
PM10 vs. PM2.5/PM10 at DUM stations



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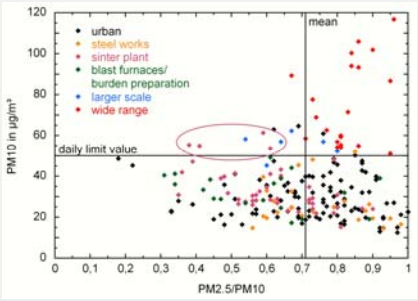

Same outcome in an evaluation programme for PM10 in 2006
Source apportionment by maximum surplus concentrations

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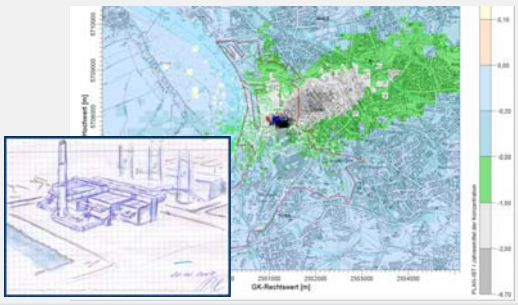
Source apportionment by maximum surplus concentrations

- Burden preparation and stock piling area are very small PM10-sources
- Sinter plant is the most important PM10-source

Reference: Gladtke, D., Volkhausen, W., Bach, B., Atm. Env. 43 (2009) 4655…4665

New sinter plant dedusting will decrease PM10 by up to 3 µg/m³

Effects by improving the primary and secondary dedusting

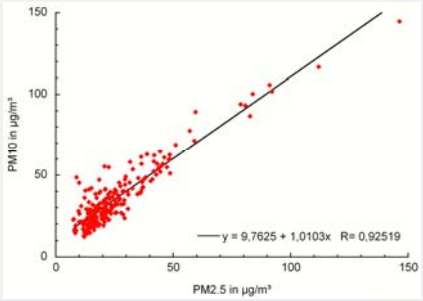


Conclusion

- PM2.5 measurements enhance the state of knowledge regarding PM
- Valuable information about source origins both of PM2.5 and PM10 can be obtained by PM2.5 data
- The PM concentrations are highly affected by meteorological conditions and transboundary transport
- Industrial contribution to PM2.5 is small, urban sector is dominating
- Source apportionment shows that focussing on coarse particles has been and is the right decision to reduce the PM10 surplus burden of the site
- Joint or coordinated air quality plans are necessary

PM10 and PM2.5 are well correlated

PM10 vs. PM2.5 concentrations of DUM stations



Number density distribution of PM2.5/PM10