Fireplaces: Good for your CO$_2$ footprint, bad for air quality

Ulrich Pfeffer, Tanja Schuck, Ludger Breuer

Air Quality in Europe: Particulate Matter

23 November 2011

- EU limit values for PM$_{10}$ are exceeded in many European cities
- Episodes with high PM$_{10}$ levels – e.g. winter 2011 / 2012
- To reduce the PM burden we need to know the sources
Background

• Combustion releases a number of substances into the air e. g. carbon monoxide, aerosol particles, hydrocarbons, PAH, ...

• Each type of combustion process bears a characteristic signature

• Wood burning emissions can be identified by specific tracers such as certain
  – hydrocarbons
  – isotopic carbon “fingerprint”
  – a class of sugars: anhydrosugars, one of them is levoglucosan
Number of Stoves and Fireplaces sold in Germany

Sales of Single Stoves and Fireplaces in Germany

- Chimneys + Slow-burning Stoves
- Heating/Chimney Inserts
- Ovens/Ranges
- Pellet Stoves
- Total Number
Air Quality Network in NRW

We use **Levoglucosan** to get a grasp of how strongly wood burning influences local and regional air quality.

North Rhine-Westphalia (NRW):
- 34,000 km²
- 18 million people
- a dense air quality monitoring network
PM$_{10}$ Concentration in NRW

EU daily limit value
Absolute and Relative Concentrations of Levoglucosan in PM$_{10}$
Project „Smoke in my Garden …“

In the past ....

Source 1

Source 2

2 x LVS

Determination of conversion factor: $PM_{10} = F \cdot levogluocosan \approx 13$
Contribution of Wood Burning to $\text{PM}_{10}$

**PM$_{10}$ at Station DUM2**

- **PM$_{10}$ wood burning**
- **PM$_{10}$ other sources**

**EU daily limit value**

PM$_{10}$ [µg/m$^3$]

- PM$_{10}$ at Station DUM2
- PM$_{10}$ wood burning
- PM$_{10}$ other sources

*01/11/2011, 01/12/2011, 01/01/2012, 01/02/2012, 01/03/2012, 01/04/2012*

Green Week, 4-7 June 2013, Brussels

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PM$_{10}$ Limit Value Exceedances

PM10 Exceedances caused by wood burning (Nov 2011 - April 2012)

# days > 50 µg/m³

Station

BIEL, BORG, BOTT, BUCH, DDCS, DMD2, DUBR, DUM2, EIFE, GELS, GRGG, KRES, MHHS, STYR, VACW, VKTU, VMGR, VWEL, WALS, WAST

EU limit value: 35 days per year

wood burning
PM10 other sources
Sensitivity Analysis of Conversion Factor F

Percentage of days > 50 µg/m³ PM10 caused by wood burning calculated as LG * F (with F = 6 ..... 15)

21 sites in NRW

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Some Examples across Europe

**Maenhaut 2012:**

In Flanders, 10–15% of winterly PM$_{10}$ are from wood burning.

**Borrego 2010:**

PM$_{10}$ burden in Lisbon due to residential wood combustion—up to 60 exceedance days total could be avoided all over Portugal by usage of certified appliances.

**Caseiro 2010:**

10% of PM$_{10}$ load in autumn and winter in Vienna are related to wood smoke.
Summary and Conclusions

- Potential for significant reduction of exceedance days

- Quality of combustion process plays a crucial role
  - Use stoves rather than open fire places
  - Replace or upgrade old installations for domestic heating
  - Use stoves with optimal combustion and filter techniques

- Regulation of use of single stoves during episodes with high PM concentrations?

- Transport of air masses plays also an important role
  - a European Issue
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Accepted for publication in „Gefahrstoffe – Reinhaltung der Luft“

Contribution of wood burning to the exceedance of PM₁₀ limit values in North Rhine-Westphalia

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