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VMM
VLAAMSE MILIEUMAATSCHAPPIJ

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The effect of wood burning on particulate matter concentrations in Flanders, Belgium

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Wood consumption

Emissions = Activity Data x Emission Factor

(grammes) (GJ) (g/GJ)

Wood burning emissions:

E_{pol}= Wood consumption x EF_{pol}

Calculation based on data collected by survey

New survey's in 2010 : underestimation of wood consumption

Update of wood consumption based on results of the Energy Consumption Survey (ECS, 2010)

4.6 PJ → 15.6 PJ

x 3.4

Emission Factors

- Currently used by the Belgian Regions :
  - based on FPS (Belgian Federal Public Service) study

Mean EF (ton/PJ)	2000	2005	2006	2007	2008	2009	2010
PM2,5	121	122	121	121	121	122	122
PM10	128	128	128	128	128	128	128
TSP	135	135	135	135	135	135	135
NOx	100	79	79	79	79	79	79
PAH (kg/PJ)	16695	16697	16695	16698	16695	16696	16696

Mean EF = Total emissions/total wood consumption

Emission Factors

- New emission factors:
  - Based on literature study, expert estimation
  - Priority to use recently published EF, international consensus, consistency between pollutants
  - (Mean EF) variable in time due to changes in stove park and legislation

Mean EF (ton/PJ)	2000	2005	2006	2007	2008	2009	2010
PM2,5	665	583	575	553	550	513	509
PM10	666	584	576	554	551	514	510
TSP	699	612	604	580	578	539	534
NOx	62	68	69	70	70	73	73
PAH (kg/PJ)	12995	12995	12995	12995	12995	12995	12995

Mean EF = Total emissions/total wood consumption

Source: Emissies door houtverbranding – sectoren gebouwenverwarming en landbouw (VITO, november 2011)

Emission Factors

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x4

- New proposal:

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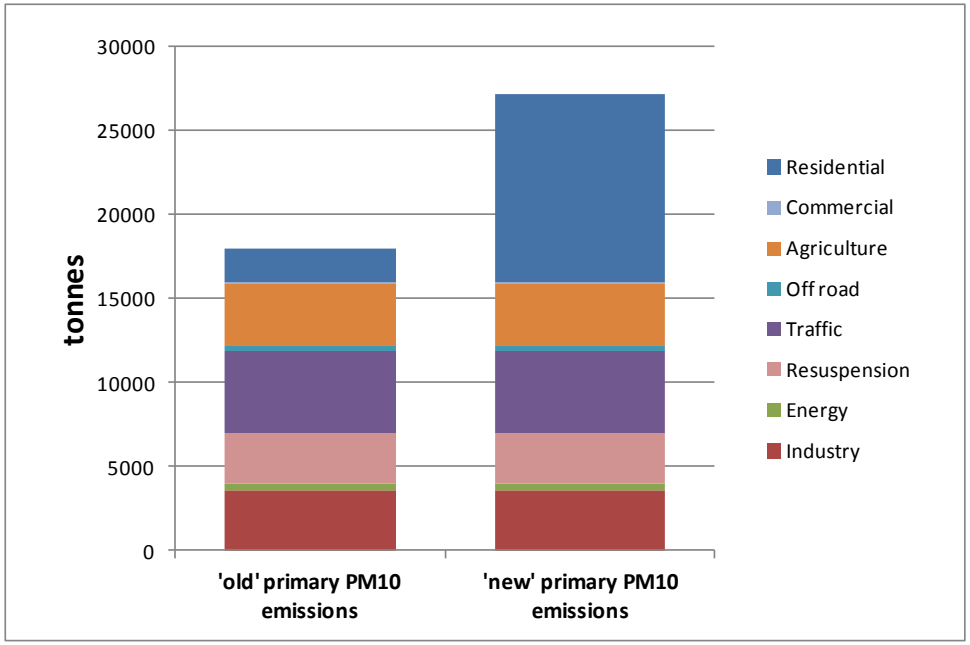
Effect of new EF's and wood consumption

- Total PM10 emissions of residential wood burning will increase with a factor 13.5 in 2010 (x 3.4 due to wood consumption, x 4 due to EF)
- Share residential sector in the total primary PM10 emissions will increase from 11% to 41% (and becomes the most important source)



Is this realistic ?

- Are these new calculated PM emission totals for residential wood burning realistic ?
- To answer this question :
  - Perform a model excercise and use the current (old) and new emissions
  - Compare model results with measurements

Emissions ↔ Immissions

Measurements

- 2 'Chemkar' campaigns with *measurements* of levoglucosan (= scientifically accepted tracer for wood burning emissions)

$$\mathbf{PM_{10,wood} = 10.7 \times levoglucosan}$$

- Feb 2010 - Feb 2011
- Jun 2011 - Jul 2012

Source: VMM (2011), Chemkar PM10, Chemische karakterisering van fijn stof in Vlaanderen - 2010

VMM (2013), Chemkar PM10, Chemische karakterisering van fijn stof in Vlaanderen, 2011-2012

Model Setup

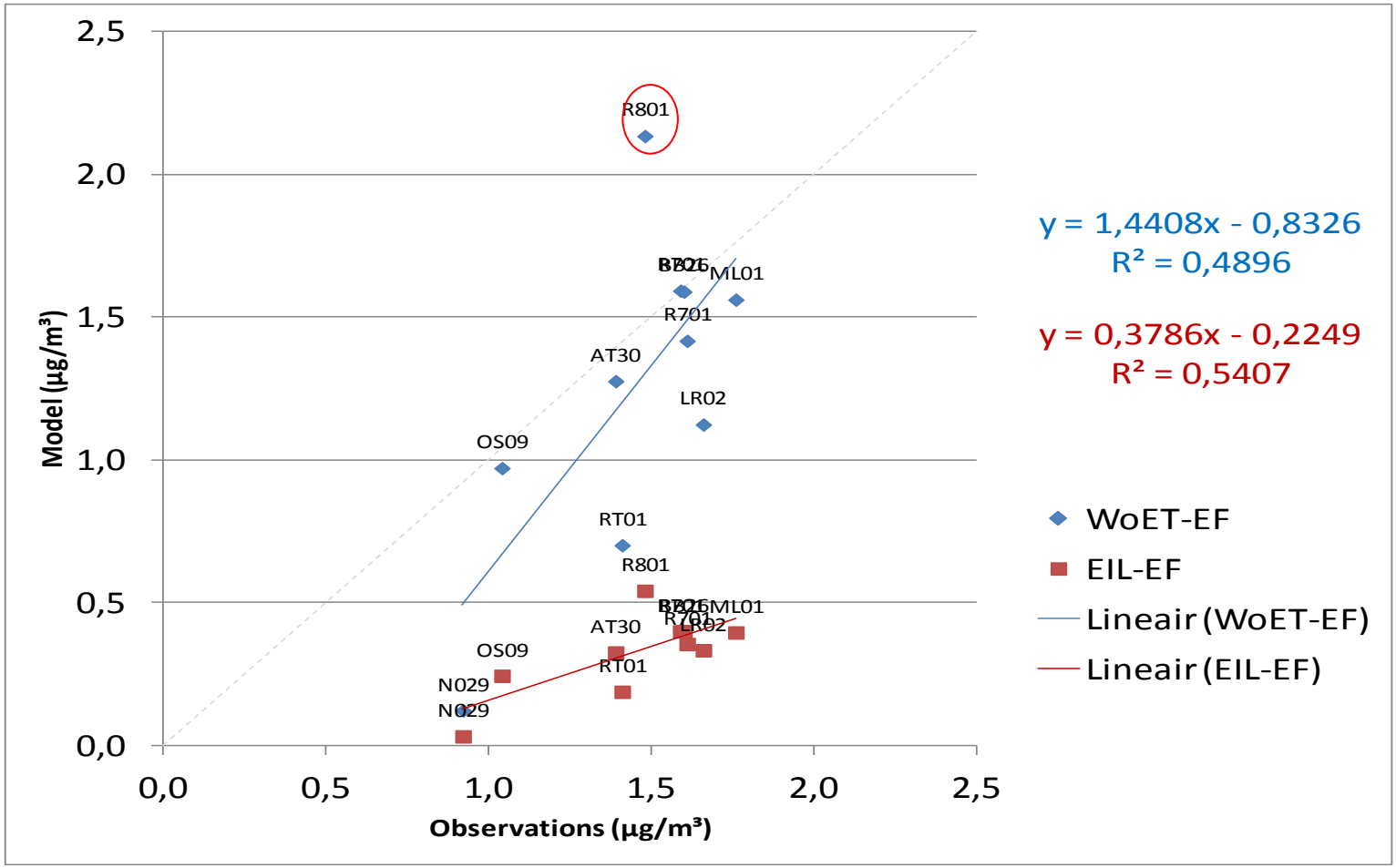
- Use of IFDM, a bi-gaussian dispersion model
  - Flemish spatial distribution map of wood consumption
  - Total wood consumption from Flemish Energy Balance (based on Eurostat survey)
  - Currently used emission factors: EF_{EIL}= 128 ton/PJ
  - New emission factors: EF_{woet}= 510 ton/PJ
- Model calculation of the PM10 concentrations (due to wood burning emissions) at the monitoring locations
- No sources outside Flanders (background = 0)

Source: Deeltaak houtverbrandingsemissies uit Referentietaak Luchtkwaliteitsmodellering (VITO, 2013)

Model results

Very close to source

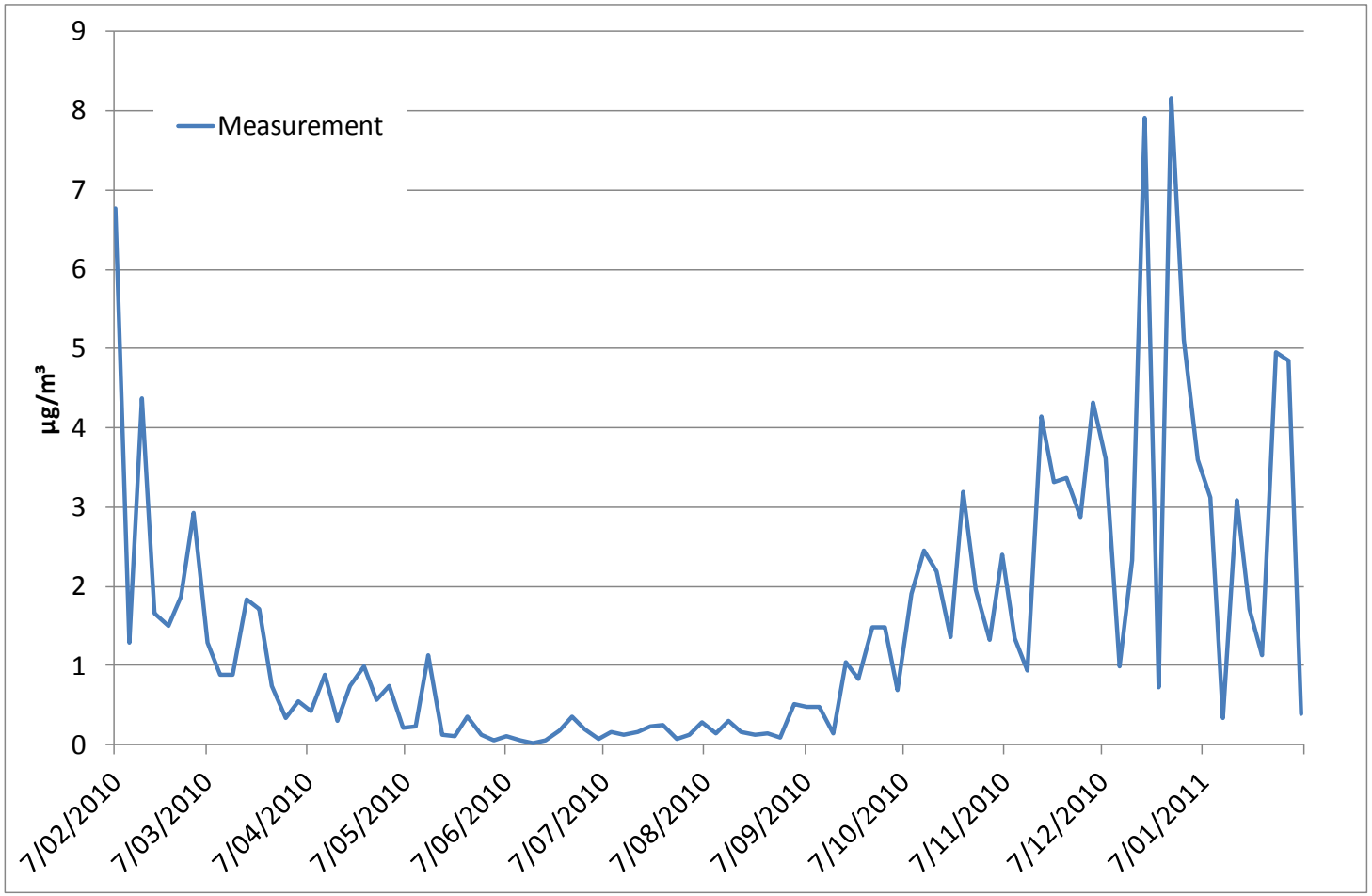
» Spatial validation without Hamme (HA02)



Model results

Temporal validation:

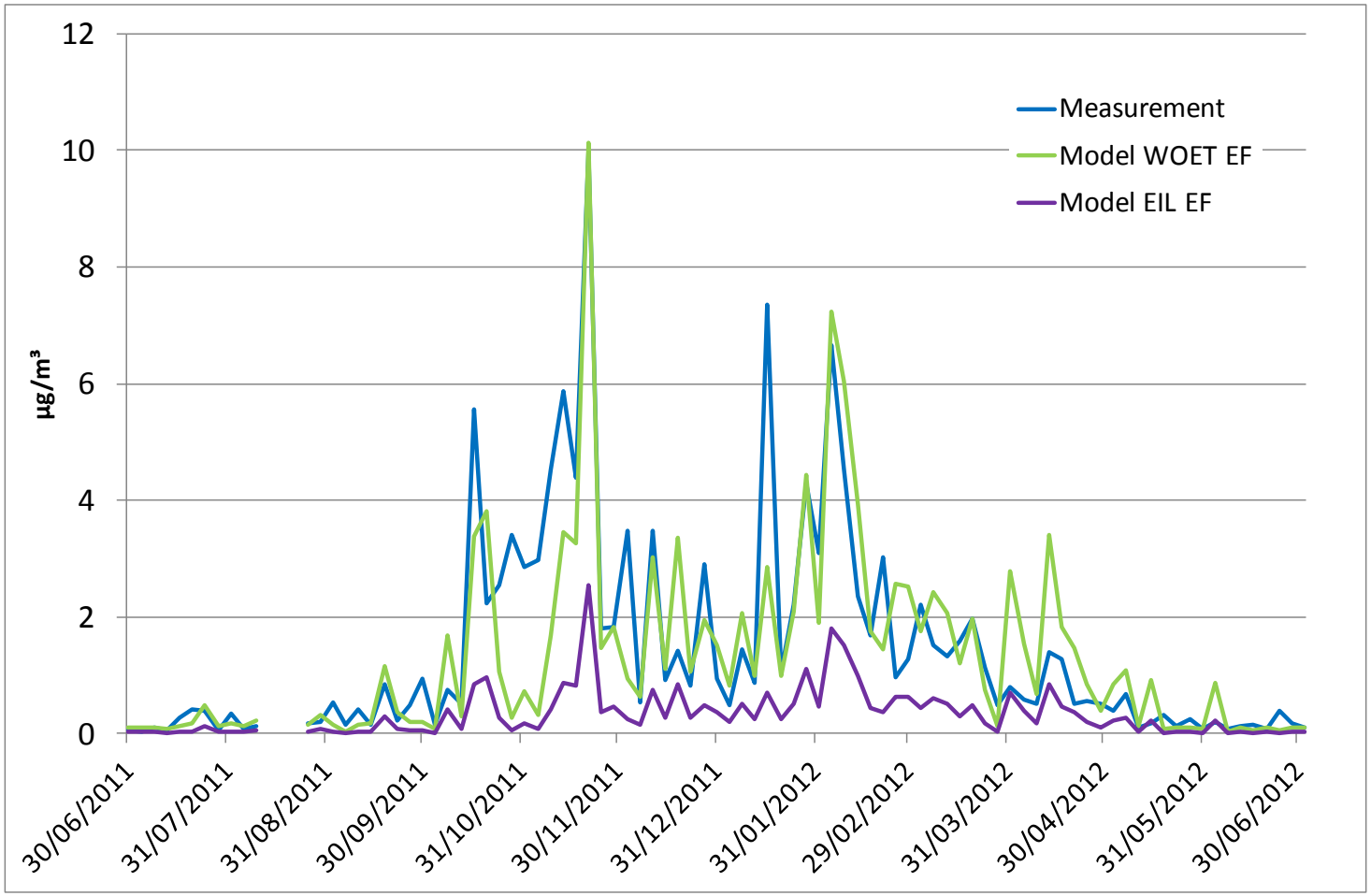
average of daily averages (all locations) - period 1



Model results

Temporal validation:

average of daily averages (all locations) - period 2



Missing sources

- Biomass power plants
  - Emissions from fuel mix
  - % wood burning not known
  - Total PM10 emissions from biomass power plants in 2010:

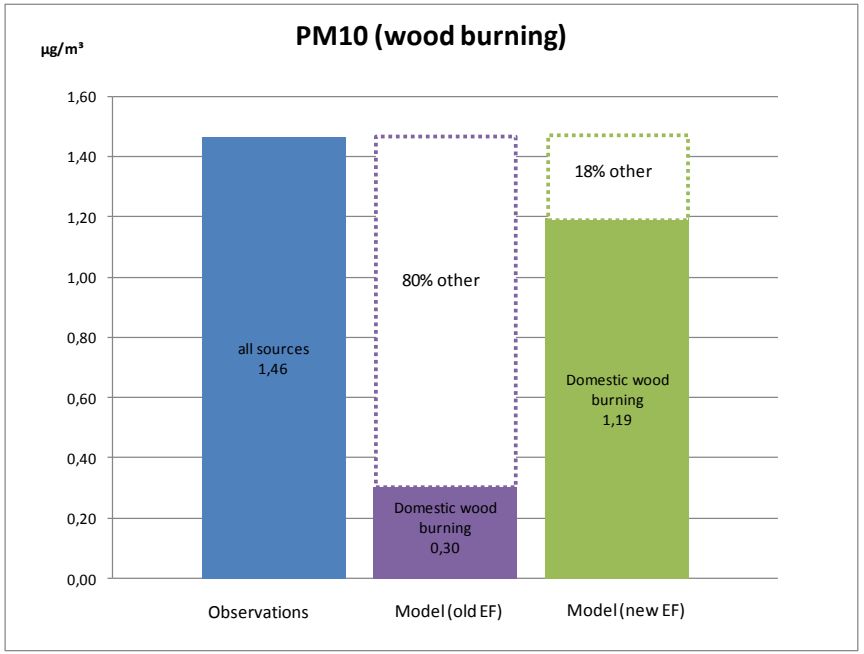
    162 tonnes
  - Total domestic wood burning emissions in 2010 (tonnes):

    new wood consumption, old EF: 2005 tonnes

    new wood consumption, new EF: 7991 tonnes

  → Contribution of *biomass power plant emissions* is *very small* compared to the total domestic wood burning emissions.
- Unknown sources (?)
- Background (incl. Brussels, Wallonia)
  - Emissions from local sources are probably more important than the contribution due to long range transport
  - Hard to estimate the impact of foreign sources
  - "expert estimation" : 0.2 – 0.4 µg/m³ (annual mean)

Missing sources



- Model calculations with current EIL EF :
  80% of PM10 due to wood burn in Flanders has sources outside Flanders?
  → (*very*) unlikely

Conclusions

- Model calculations using the old PM10 emissions due to wood burning can only explain 20% of the measured PM10 concentrations from wood burning
- This underestimation cannot be explained by missing/unknown emission sources and/or import from long range transport
- Model results with the new PM10 emissions from wood burning are much more inline with measurements
- More information on the background concentrations however is needed