GAINS outlook

*Overview of ongoing model developments*

Z. Klimont, K. Kupiainen, Ch. Heyes, J. Borken
Recent and near future GAINS activities - summary

- Global coverage
- Analysis of mitigation potential of near term forcing
- Extension of cost analysis
- Projections extended to 2050
- Gridding of global emissions (0.5 x 0.5 degree)
- Improving BC, OM calculation
- Inclusion of high-emitters
- Improving data and estimates of emissions from flaring in oil and gas industry
- Improving data on diesel generators
- Extension to include Hg
Global analysis of mitigation potential of near term forcing by SLCF
Social vs market costs

- Social planner perspective: investments and savings are discounted over the full technical lifetime of technology with 4% and future prices of fuels assumed.

- Private investor (market) perspective: the rates of return on capital compete with potential gains from alternative investments; shorter lifetime, current prices of fuels, discount rate 10%.
Improving BC and OM estimation in residential sector
Revised methodology (as of March 2012)

$$EF_{OC} = (EF_{PM2.5} \times f_{carb} - EF_{BC}) \div f_{OM}$$

- Equation determines the technology specific OC emission factor for solid fuels in the residential sector based on mass balance
- Fixed parameters (technology specific):
  - Emission factors of PM$_{2.5}$ and BC
  - Fraction of carbonaceous mass in PM$_{2.5}$ ($f_{carb}$)
  - OM/OC ratio ($f_{OM}$)
  - Based on a literature review (e.g. Tissari et al. 2007, Tissari 2008, Todorovic et al. 2007, Boman et al. 2008, Schmidl et al. 2011)

Finland

![Graph showing emission factors for different stove types](graph.png)
1st approach to quantify high emitter emission contribution:

- **Benchmark**: 5% of high emitters in the U.S. (Bond *et al.*, 2004; CRC E-23 study; Ban-Weiss *et al.*, 2000)
- **Definition of emission factors (EF)**: median above (superemitter)/below (normal emitter) 95%;
- **Amplification factor (AF)**: ratio between EF of super and normal emitters

**Problem** of this approach and motivation for further work: A statistical cutoff (e.g. 5%) can be fitted to any kind of distribution and does not necessarily refer to high emitters only. There remains a need for a more technical definition for high emitters.
New data to assess the definition of high emitters

- The challenge: How to define high emitters quantitatively?
  - The normal emitter range indicated by the green arrows?
  - The high emitters in the red circle?

- Approach: Compare two data sets in similar engine/driving situations:
  1. Identify engine/driving situation for European RSD data
  2. Retrieve emission data from Artemis db300 for this engine/driving situation (=normal operation)
  3. Compare 1 and 2 to find the vehicles in RSD that are outside the green arrow range = high emitters
  4. Define amplification factor AF (vs type approval EF, emission standard, fleet average?)
Spatial distribution of emissions

- GAINS BC, OC and SO$_2$ emissions in 2005 and 2030 (baseline scenario) have been spatially distributed based on the proxies created within the Global Energy Assessment GEA (http://www.iiasa.ac.at/Research/ENE/GEA/) (Riahi et al. 2011 forthcoming)

- Published databases used for:
  - Shipping:
    - RCP (Lamarque et al. 2010, based on Eyring),
    - QUANTIFY (Dalsoren et al. 2009)
  - Aviation: QUANTIFY (e.g. Lee et al. 2010)
  - Forest and grassland fires: GFED3 (Van der Werf et al. 2010)
  - Agricultural waste burning: GFED3 spatial distribution in 2005 and multiyear average