Business from technology

Synergy and tradeoff analysis on the reduction strategies for climate and health impacts from particulate matter and greenhouse gases (STARSHIP)

FICCA midway seminar

Research Programme on Climate Change

April 16th, 2013 , Helsinki

Ilkka Savolainen, VTT

Background

Anthropogenic emissions of CO2 (and N2O, CH4)

- Main impact is contribution to Radiative Forcing and Climate Change
- Long-lived in the atmosphere (about 100 a, CH4 about 10 a)
- Main source is the global energy system

Conventional Air Pollution (emissions of SO2, NOx, PM, BC, OC etc.)

- Main impact is Adverse Human Health Effects, but they contribute also to Acidification, Climate Change etc.
- Short-lived in the atmosphere (1- 2 weeks)
- Main source is the energy system

Mitigation of Health Effects and Climate Change – Changes in the energy systems and technologies can have synergy or tradeoffs.

Objectives

- **Analyse mitigation strategies in which the impact of air pollutants on climate and health are taken into account.**

- The main objective of the project is to analyze how the climate change mitigation strategies should be chosen if the impact of conventional air pollutants on radiative forcing and health are taken into account.

- The results will include quantitative analyses on how different technologies will contribute or counteract both the climate and health targets, aiding the setting of robust climate and health policies.

Methods, tools

The calculation models used by the project consortium can be roughly classified in two groups:

Detailed scientific simulation models

- SILAM, ECHAM, SALSA…
- TIMES/TIAM
- ---
- SONETS
- MAC
- REFUGE, MAGICC
- GWP, GTP

Simple operational models for practical policy analysis and support

Work in progress

Published or accepted articles

- Tommi Ekholm, Tomi J. Lindroos and Ilkka Savolainen, 2013. Robustness of climate metrics under climate policy ambiguity. Env.Sci.Pol. (Accepted)
- T. Bergman, V.-M. Kerminen, H. Korhonen, K. E. J. Lehtinen, R. Makkonen, A. Arola, T. Mielonen, S. Romakkaniemi, M. Kulmala, and H. Kokkola (2012) Evaluation of the sectional aerosol microphysics module SALSA implementation in ECHAM5-HAM aerosol-climate model. Geoscientific Model Development 5, 845-868.

Submitted manuscripts

- Kaivosoja, T., Jalava, P.I., Lamberg, H.., Virén, A., Tapanainen, M., Torvela, T., Tapper, U., Sippula, O., Tissari, J., Hillamo, R., Hirvonen, M.-R., Jokiniemi, J., 2013. Comparison of emissions and toxicological properties of fine particles from wood and oil boilers in small (20–25 kW) and medium (5–10 MW) scale. Submitted.
- Tommi Ekholm, 2012. Hedging the climate sensitivity risks of a temperature target. Submitted.
- A.-I. Partanen, A. Laakso, A. Schmidt, H. Kokkola, T. Kuokkanen, J.-P. Pietikäinen, V.-M. Kerminen, K.E.J. Lehtinen, L. Laakso and H. Korhonen (2013) Climate and air quality trade-offs in altering ship fuel sulfur content. Submitted.

Work in progress (2)

Under preparation

- A multi-criteria analysis of climate, air pollution and cost impacts from household-level heating technologies (several authors of VTT, UEF, Syke)
- Lindroos, T.J., Ekholm, T., Savolainen, I. Impact of European Policies on the Climate Effect through the Changes in the Emissions of Short-lived Climate Forcers (SLCF)
- Changes in Radiative Forcing due to European Reductions of Short-lived Climate Forcers (SLFC) and Long-lived Greenhouse Gases (LLGHG) (VTT, FMI)
- Others…

Articles and manuscripts

Comparison of emissions and toxicological properties of fine particles from wood and oil boilers in small (20–25 kW) and medium (5–10 MW) scale

Kaivosoja, T., Jalava, P.I., Lamberg, H.., Virén, A., Tapanainen, M., Torvela, T., Tapper, U., Sippula, O., Tissari, J., Hillamo, R., Hirvonen, M.-R., Jokiniemi, J.

Measured ash species

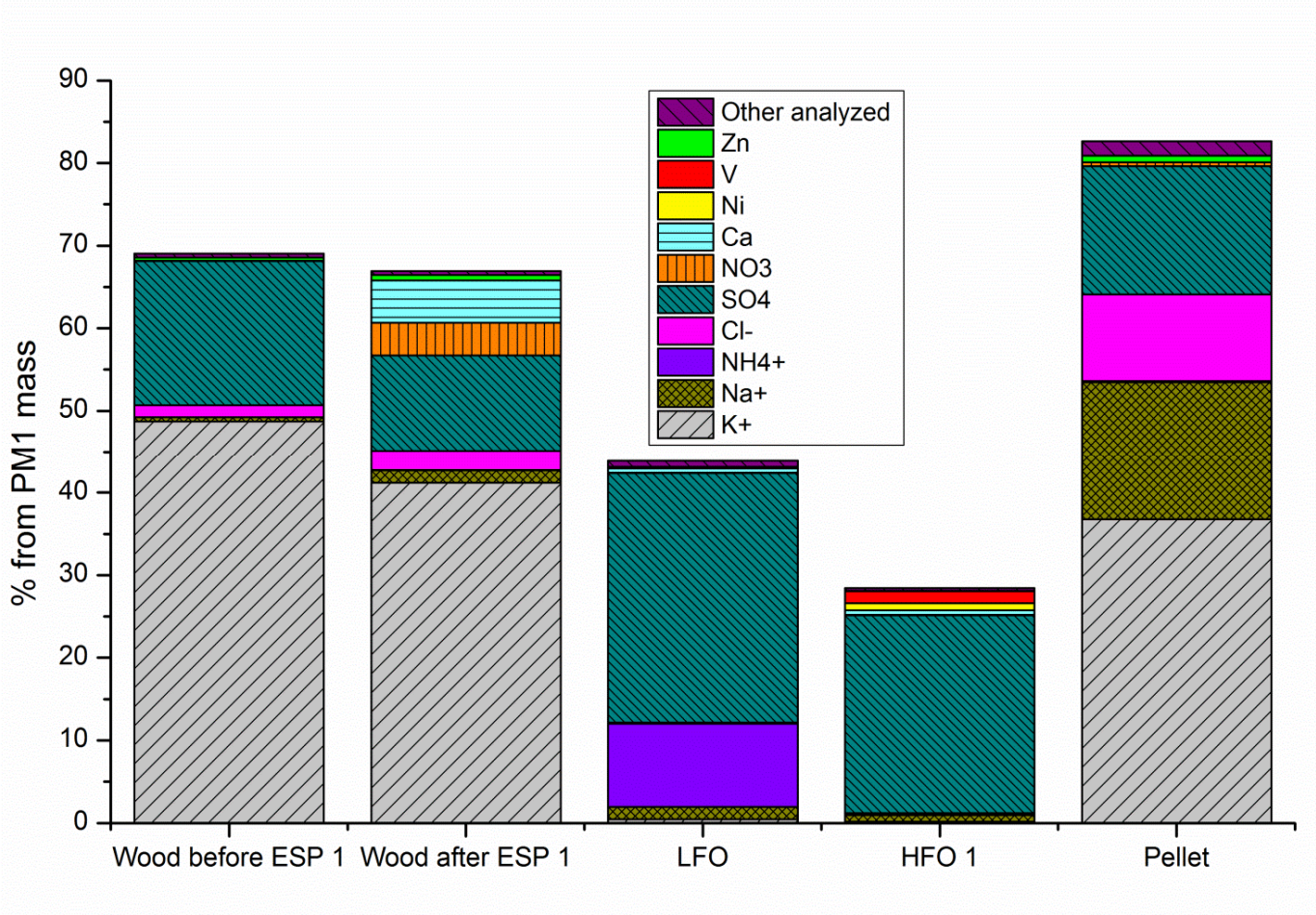


Fig. 2. The main ash species in the PM_1. IC results from pellet combustion are presented also by Lamberg et al. (2011a) and Tapanainen et al. (2011).

PAH content in PM1

Table 3. PAH content in PM_1 (ng mg^{-1}; mg MJ^{-1}), sum of 30 PAHs and sum of genotoxic PAHs. PAH results from pellet combustion are presented by Lamberg et al. and Tapanainen et al.

PAHs in PM1 (ng mg-1)	Wood before ESP 1	Wood after ESP 1	LFO	HFO 1	Pellet
Sum of 30 PAHs	*47*	*1200*	*17060*	*9906*	*6.0*
*Sum of **genotoxic** PAHs*	*23*	*887.64*	*11978*	*9770*	*3.0*
Sum of 30 PAHs (mg/MJ)	*0.013*	*0.0007*	*0.0015*	*0.20*	*0.0001*
PAHs/PM1 (%)	*0.005*	*0.12*	*1.7*	*0.99*	*0.0006*

Conclusions of the paper:

“We suggest that in the long term, besides the emission amounts, also the toxicity of the emissions should be taken into account when regulating the emission limits for the plants.”

<DL = below detection

Robustness of climate metrics under climate policy ambiguity

Tommi Ekholm, Tomi J. Lindroos, Ilkka Savolainen

Conclusions of the article:

“Although ambiguity in current policy might prevent us
from selecting an optimal metric, it can be possible to select robust metric values that perform well with multiple policy targets.”

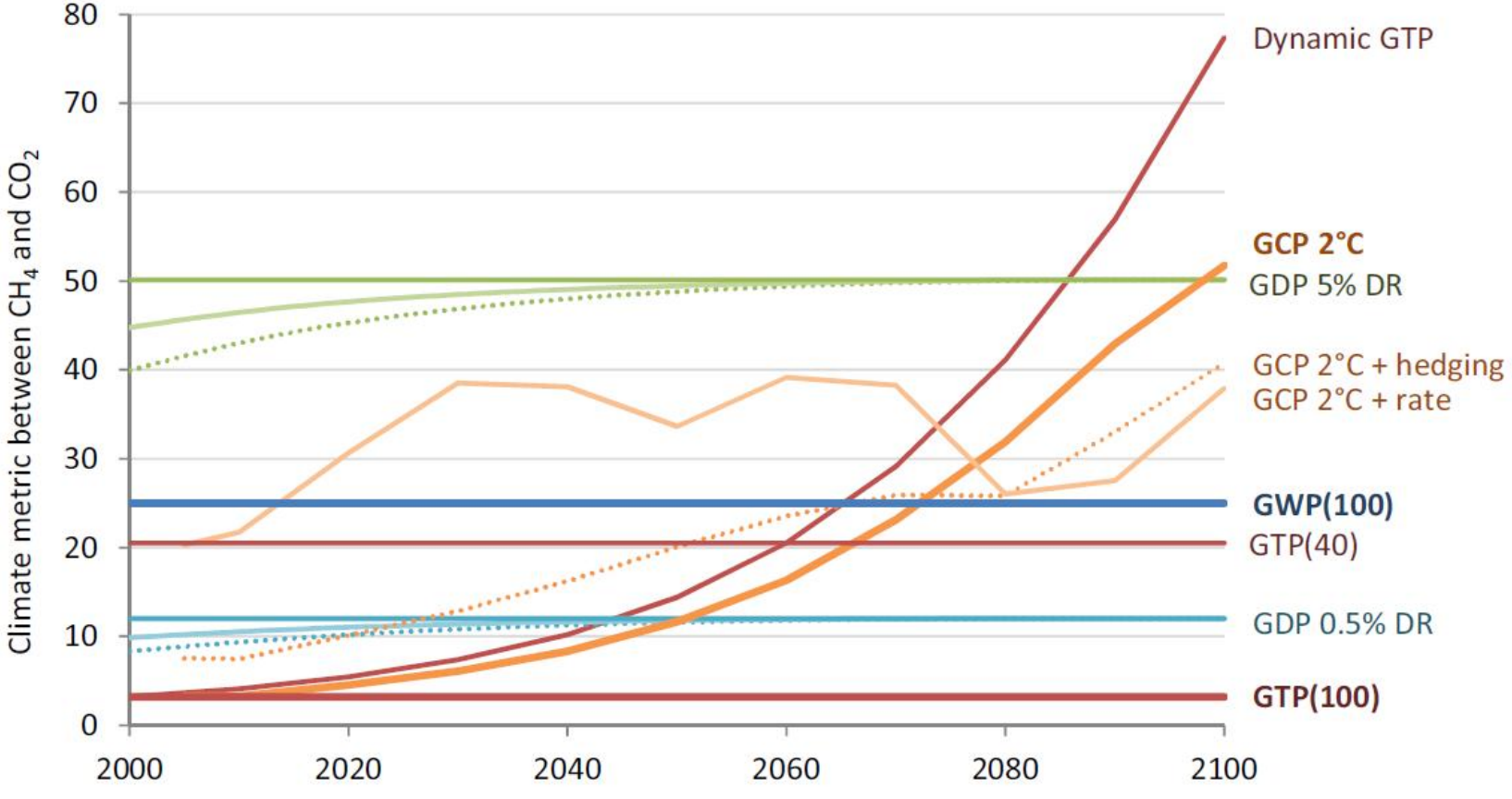


Figure 3: A comparison of different climate metrics for CH_4.

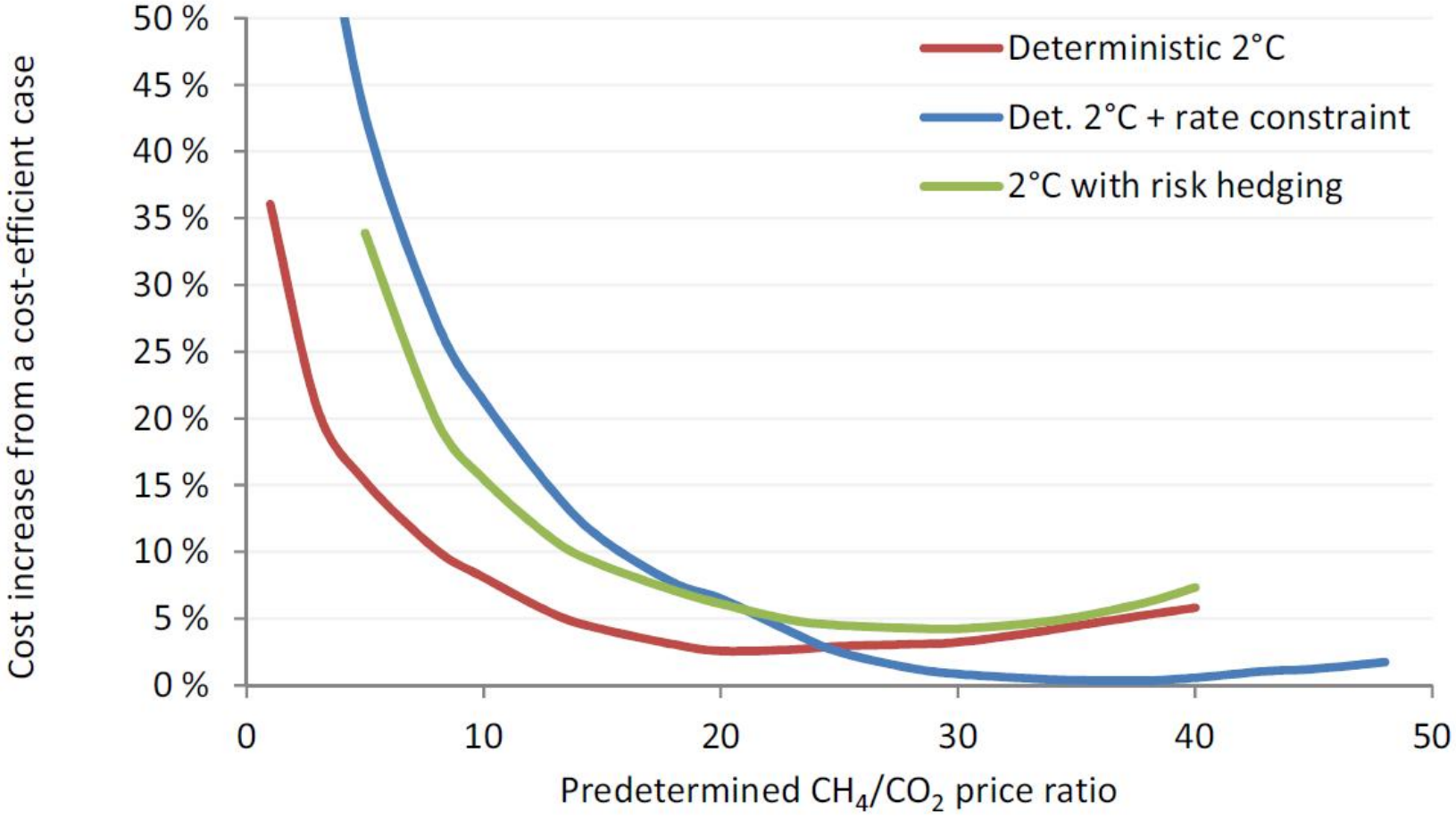
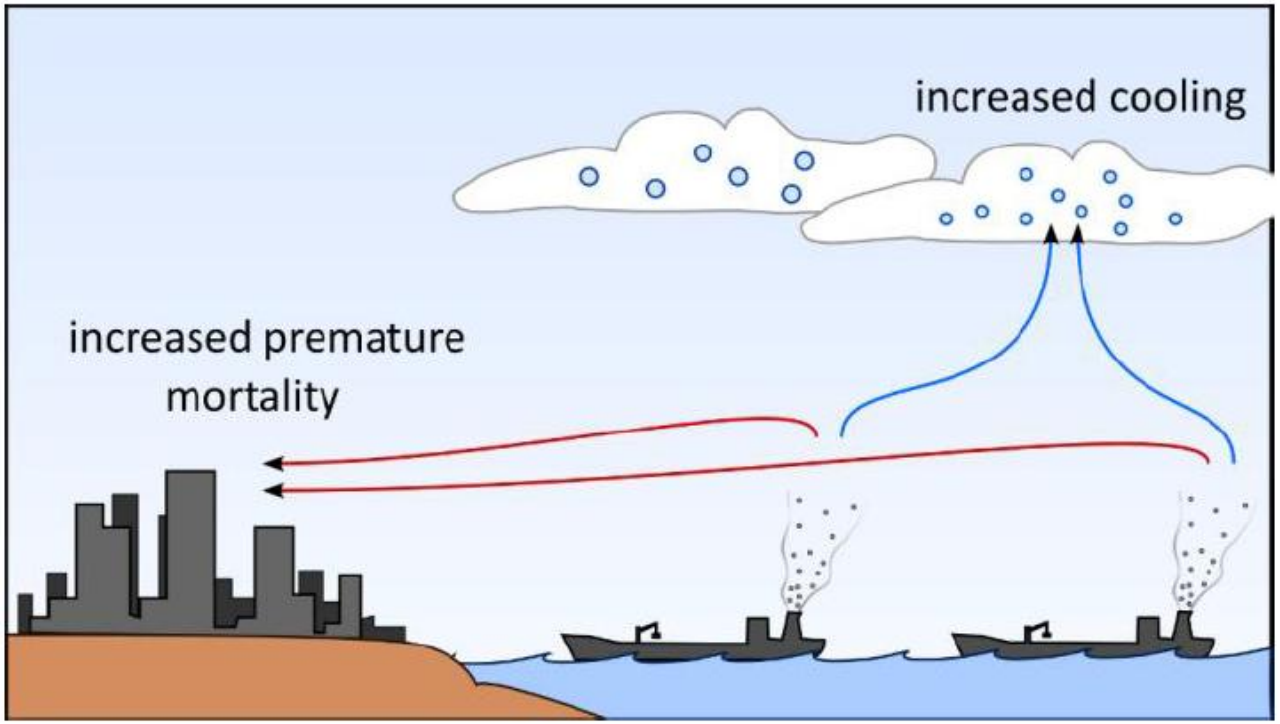


Figure 5: Cost increase from a cost-efficient case to a case with different predetermined price ratios between CH_4 and CO_2, under either a 2°C warming limit, 2°C and a rate-of-change limits, or a 2°C limit with risk hedging against uncertainty on climate sensitivity.

Climate and air quality trade-offs in altering ship fuel sulfur content

Antti-Ilari Partanen, Anton Laakso, Anja Schmidt, Harri Kokkola, Tuomas Kuokkanen, Joni-Pekka Pietikäinen, Veli-Matti Kerminen, Kari E.J. Lehtinen, Lauri Laakso and Hannele Korhonen



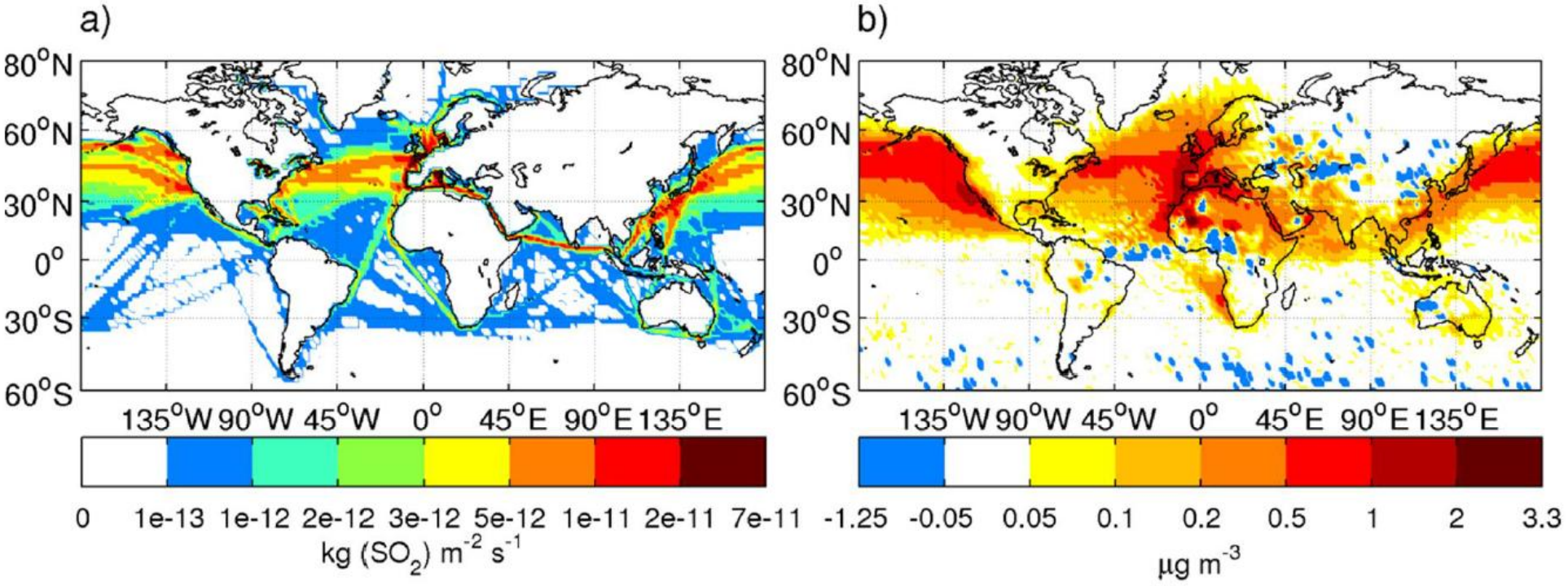
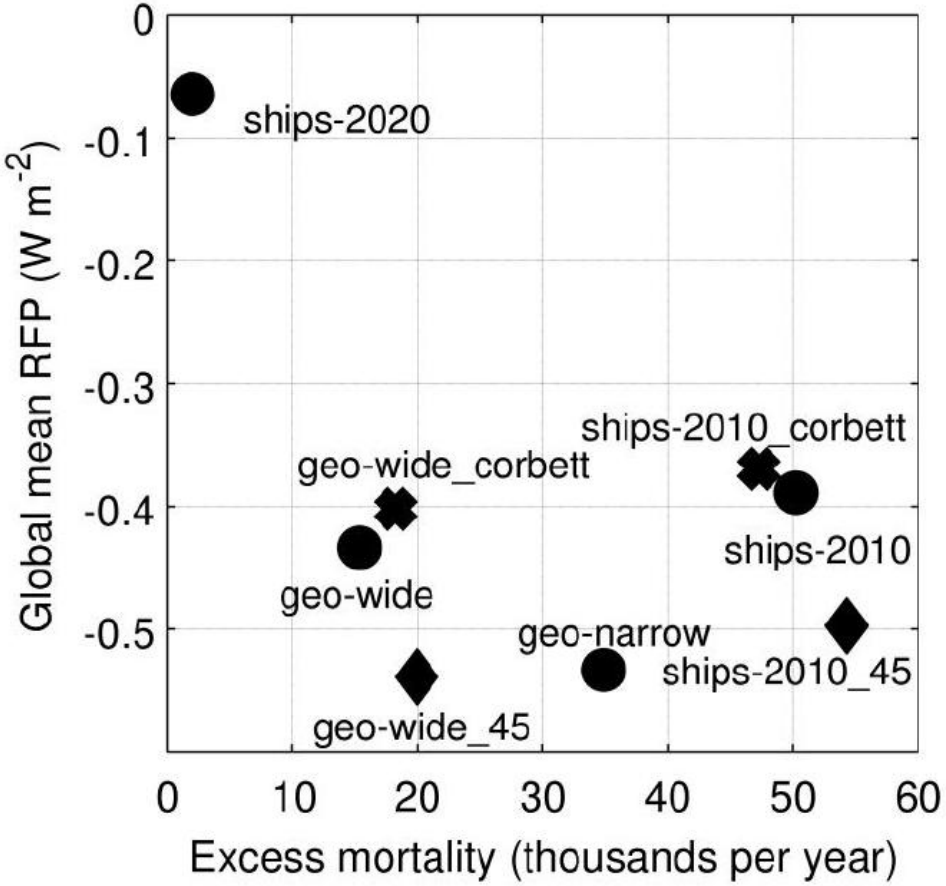


Figure 1. a) SO_2 emissions from ship traffic in the simulation *ships-2010*. The emissions are from the ACCMIP database for the year 2010. b) The contribution of shipping emissions to PM2.5 mass concentrations in the simulation *ships-2010*.

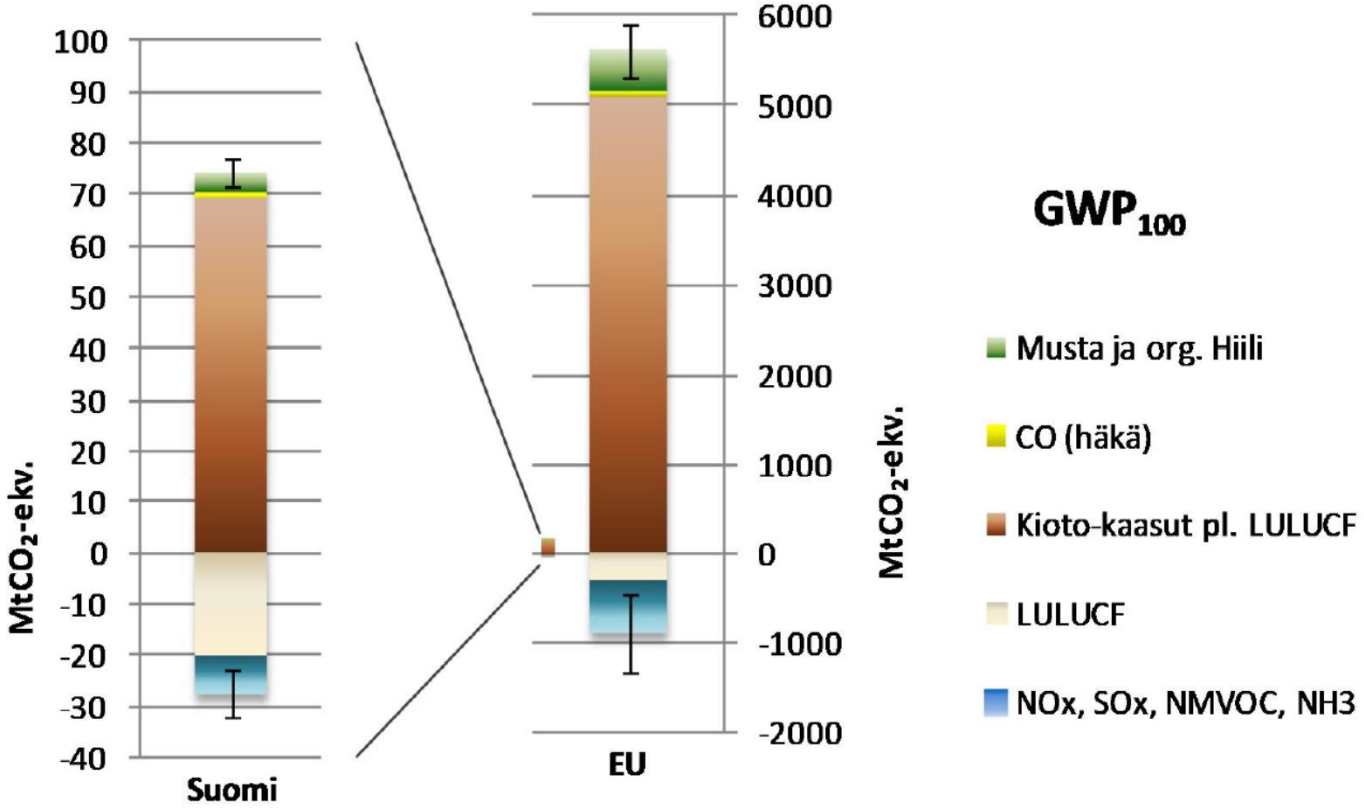


“Our results show that the cooling effect of present-day emissions could be retained with simultaneous notable improvements in air quality,
even if the shipping emissions from the open ocean clearly have a significant effect on continental air quality.”

Manuscript under preparation

Impact of Near-Term Climate Forcers (NTCF) on the Climate Effect of the European Union under Current Policies

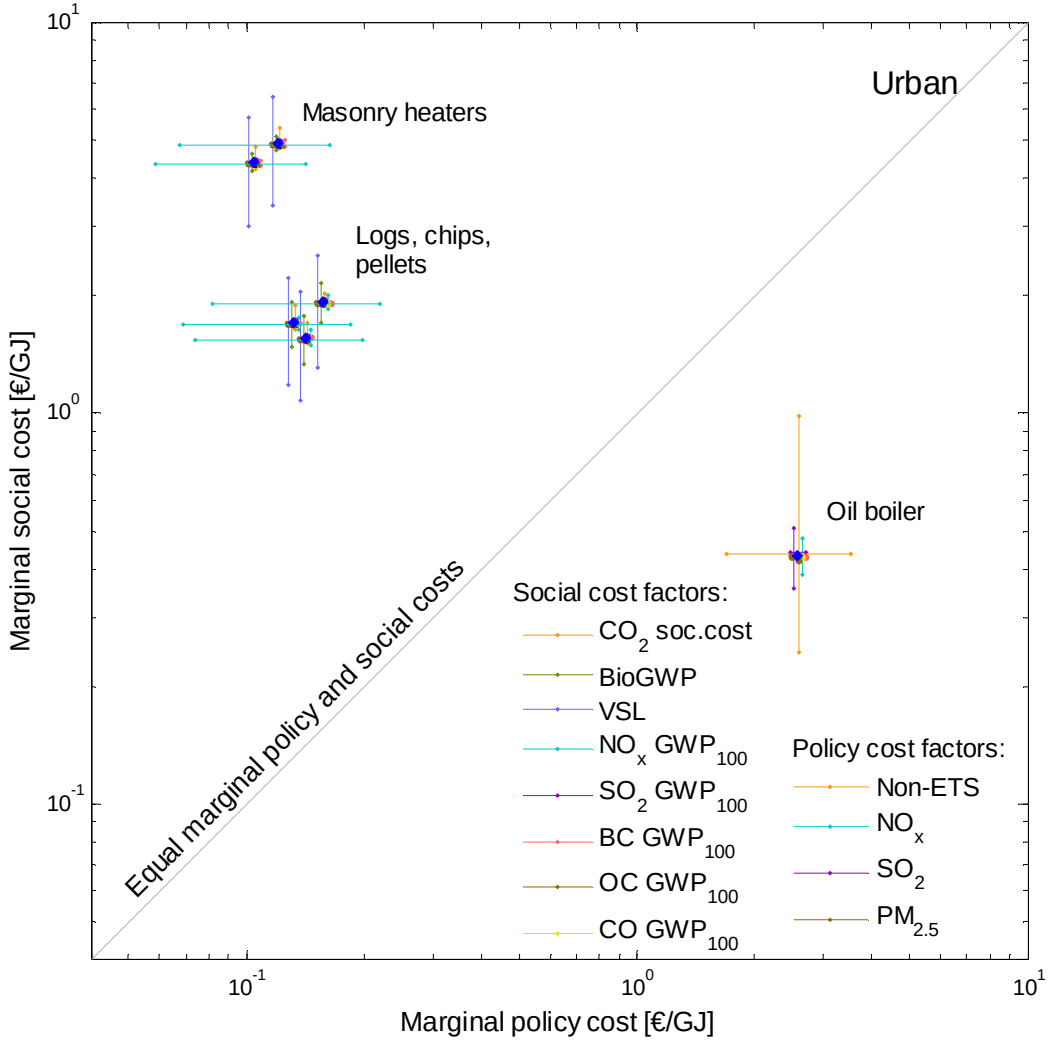
Lindroos, T.J., Ekholm, T., Savolainen, I.



Kuva 5.2. Arvio Suomen ja EU:n vuoden 2000 Kioton-kaasuista ja muista ilmansaasteista CO_2-ekvivalentein. Arvio on tehty GWP_{100}-kertoimilla. Suomen päästöt on esitetty myös suhteessa EU:n kokonaispäästöihin. Tarkemmat laskelmat on esitetty liitteessä 1.

A multi-criteria analysis of climate, health and acidification impacts due to greenhouse gases and air pollution – the case of household-level heating technologies

Authors of VTT, UEF, Syke



Summary

A lot of work underway.

Potentially relevant for policies controlling emission

- to mitigate climate change and
- to minimize health impacts due to air pollution.

Synergies and tradeoffs might require rethinking or reweighting of policies?

Still too early to draw strong suggestions?