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Implementation of near-term climate impacts into GAINS

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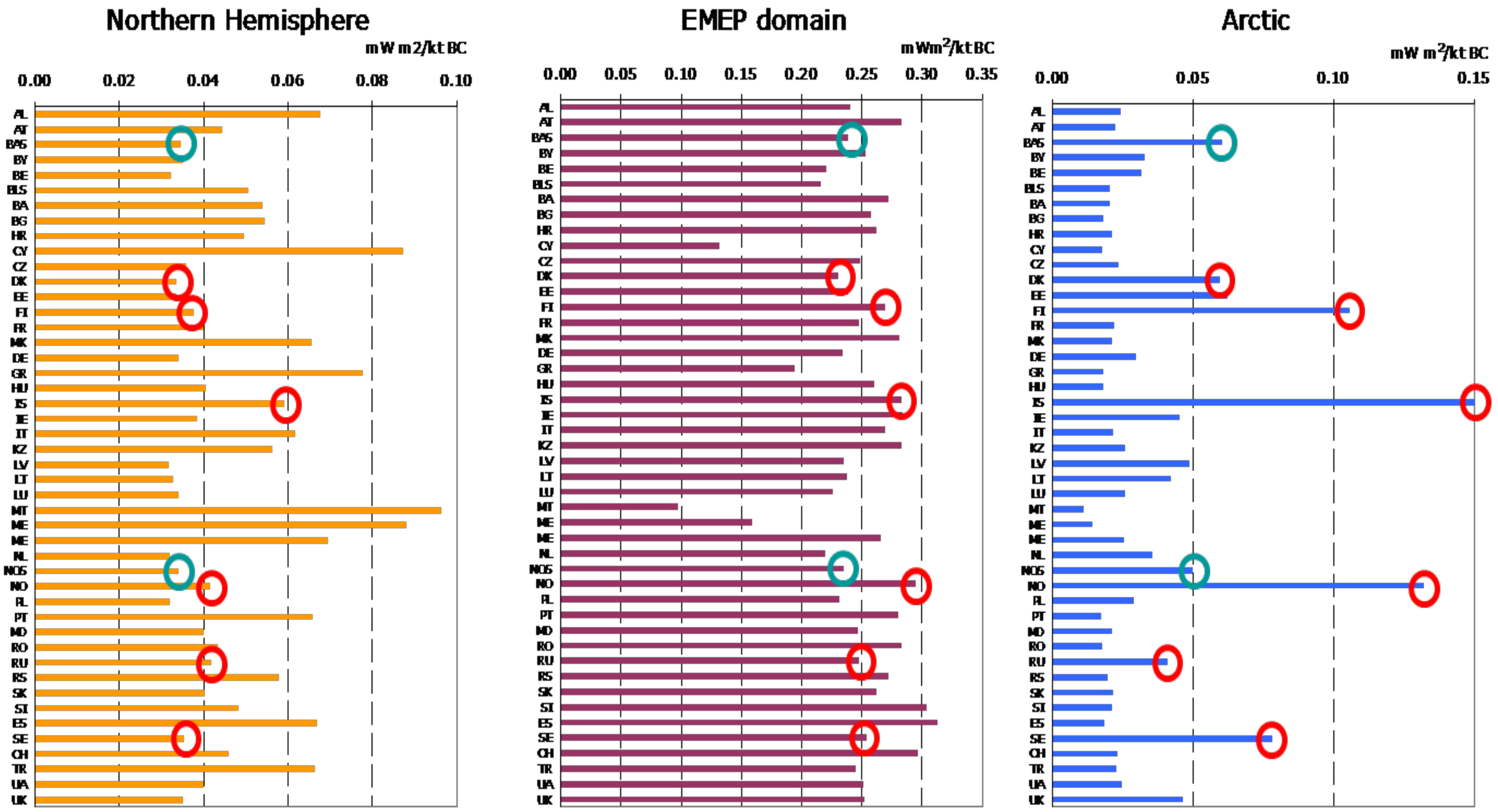
emep Co-operative programme for monitoring and evaluation of the long-range transmissions of air pollutants in Europe

Extension of GAINS to estimate radiative forcing for the EMEP domain

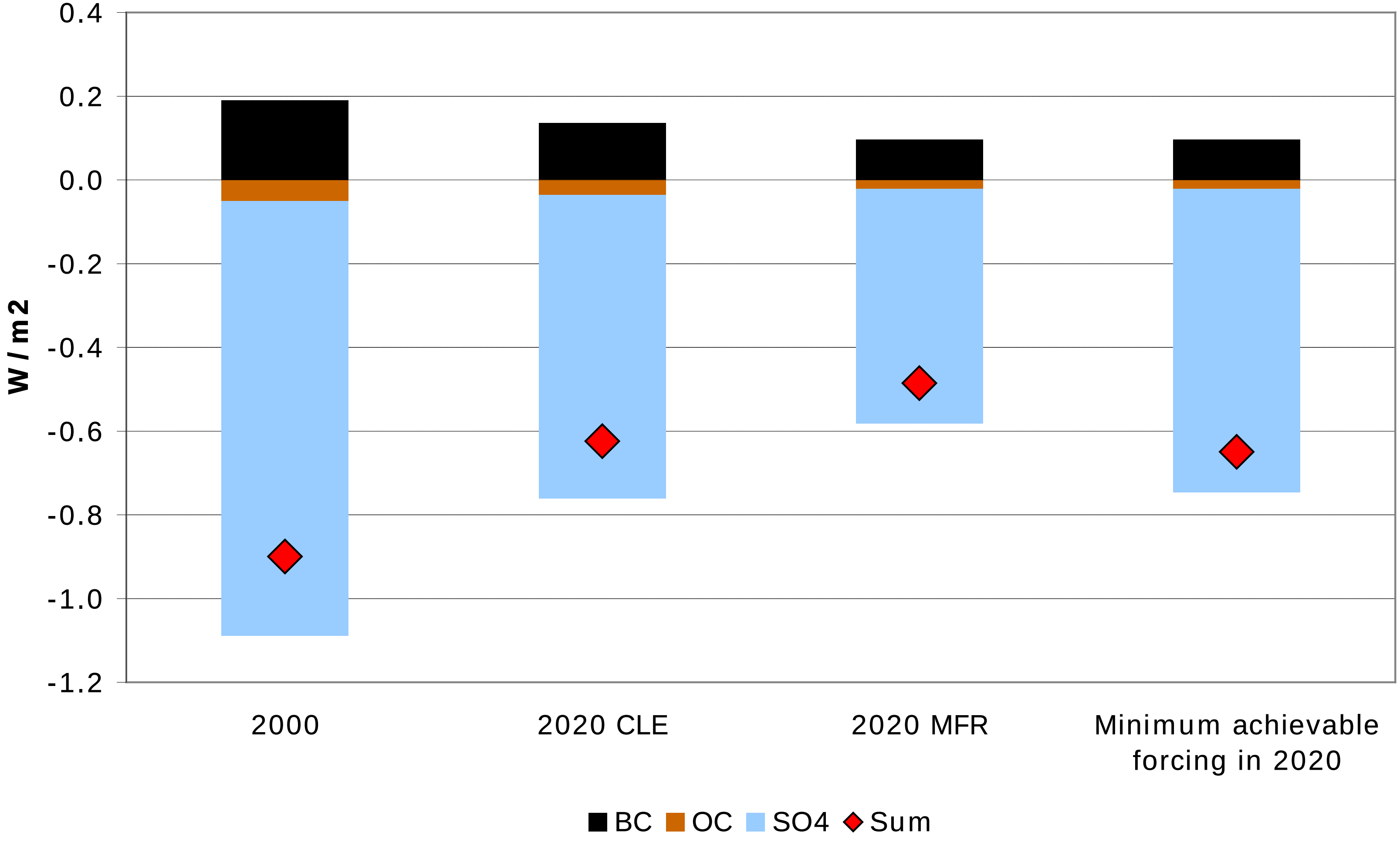
- Source-receptor relationships (country emissions to grid column concentrations) calculated by MSC-W, for SO2, NOx (aerosol), BC, OC)
- Normalized radiative forcing from column concentrations provided by Uni Oslo/CICERO, based on AEROCOM project
- Source-receptor relationships implemented in GAINS optimization
- Currently, only for aerosols. Ozone is still under development
- Similar approach for carbon deposition to Arctic and Alpine glaciers
- GAINS emission estimates for black carbon and organic carbon, consistent with the PM2.5 calculations

Impacts of country BC emissions on instantaneous radiative forcing

Source: EMEP/MSC-W



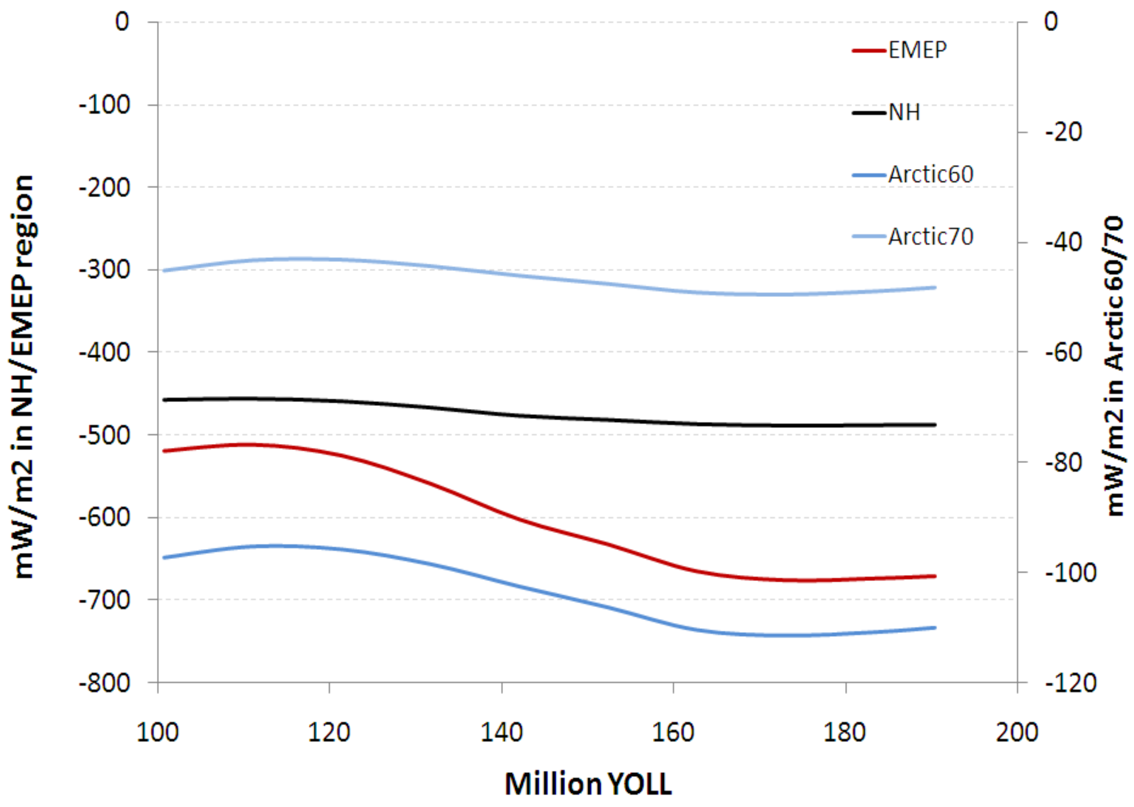
Radiative forcing over the EMEP domain from the emissions of the countries in the EMEP domain



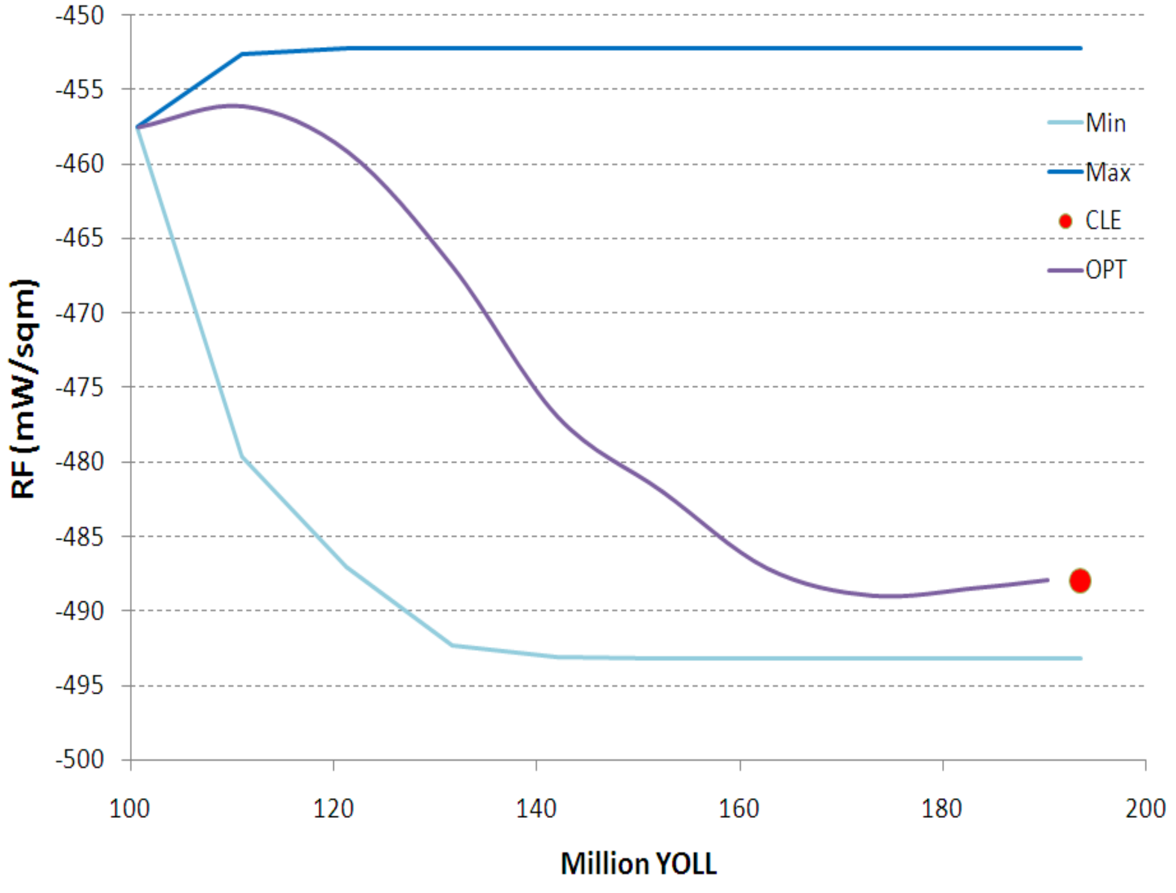
RF and carbon deposition for the policy scenarios

	Baseline	LOW	Low*	Middle	High*	HIGH	MTFR	Lowest RF
Radiative forcing from emissions in the EMEP domain [mW/m^2]								
Northern Hemisphere	-488	-487	-487	-482	-473	-474	-472	-493
EMEP domain	-671	-662	-664	-631	-577	-583	-569	-696
Arctic > 60°	-110	-109	-109	-106	-99	-100	-100	-115
Arctic > 70°	-48	-49	-49	-47	-45	-45	-46	-53
Radiative Forcing - for the EMEP domain, by component [mW/m^2]								
Total	-671	-662	-664	-631	-577	-583	-569	-696
BC	134	121	123	121	120	119	96	97
OC	-35	-29	-30	-29	-29	-28	-22	-24
SO_4	-723	-709	-713	-680	-626	-634	-604	-723
NO_3	-46	-44	-44	-43	-42	-40	-39	-46
Total carbon deposition (BC and OC, dry and wet) [mg/m^2.yr]								
Arctic > 60°	4.9	4.3	4.4	4.3	4.3	4.2	3.5	3.7
Arctic > 70°	1.3	1.2	1.2	1.2	1.2	1.2	1.0	1.0
Alps	59.6	55.5	55.6	55.3	54.3	53.0	39.0	43.5

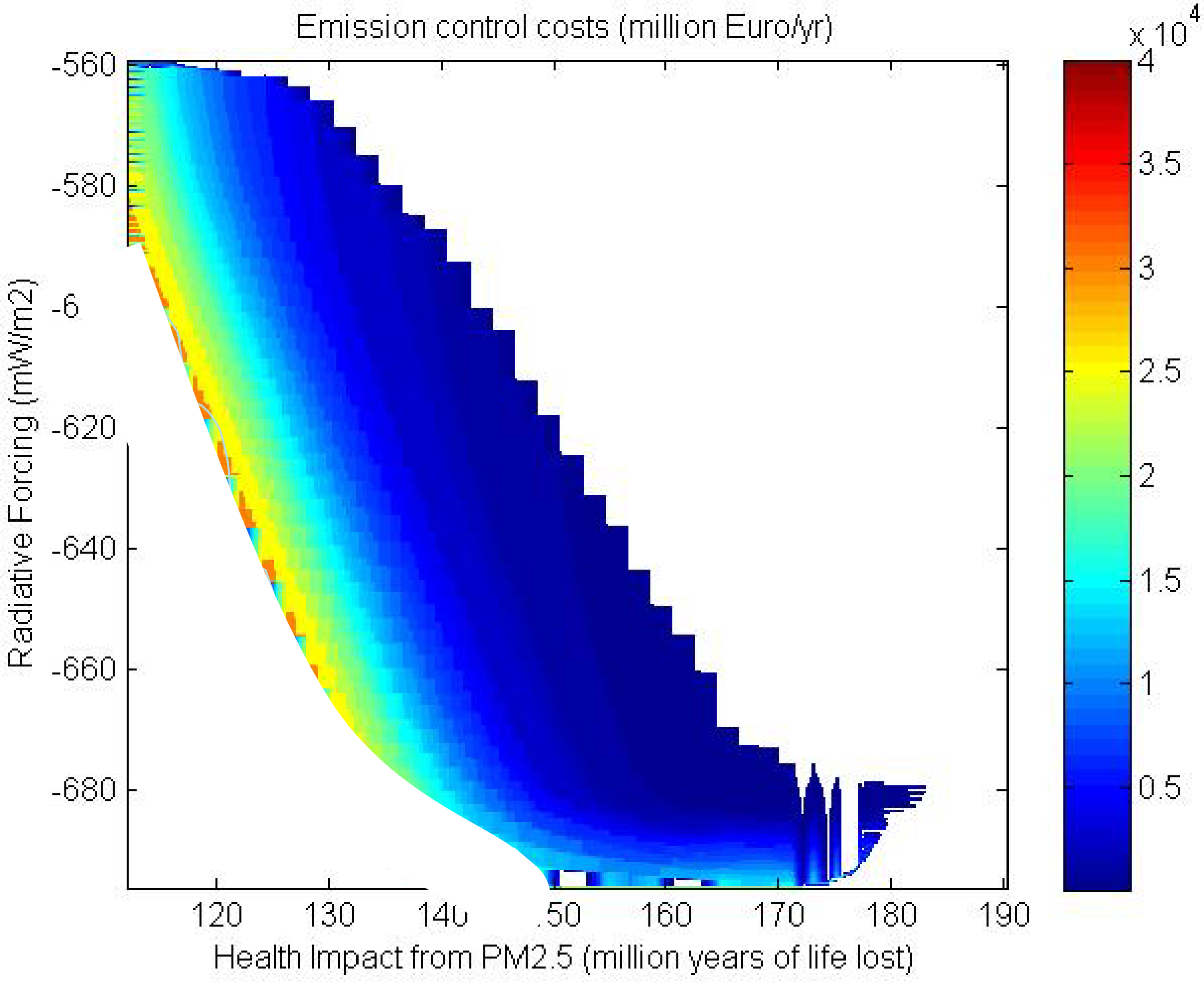
Radiative forcing in four regions, resulting from a cost-effective Europe-wide reduction in the YOLL health indicator



Feasible range for changes in RF



Emission control costs to reduce YOLLs and RF



Conclusions
on the RF implementation in GAINS

- Instantaneous radiative forcing from aerosols and carbon deposition have been implemented in GAINS as an additional impact of air pollutants.
- For aerosols emitted in the EMEP region, radiative forcing is currently estimated at about -0.7 W/m^2,
  compared to about 2.7 W/m^2 from long-lived greenhouse gases.
- The current emission control scenario could reduce negative forcing (i.e., warm) by about 0.1 W/m^2.
- Low cost options are available to reduce these negative impacts of air pollution control on short-term forcing to some extent. This will require implementation of a few measures targeted specifically at BC.
- Radiative forcing from ozone is still under development.