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Temperature increase of 21st century mitigation scenarios

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The study's objectives: Estimates of 21st Century global-mean surface temperature increase have generally been based on scenarios that do not include climate policies. For instance, IPCC's 4th Assessment Report recently projected that by 2100, global mean surface temperature would increase by 1.1–6.4°C over the 1990 level. This range, however, is based solely on scenarios without climate policy – leaving the question on how climate policy could influence this range completely unanswered. A recently published paper by us has now extended these estimates by assessing the possible impacts of climate policies on projected warming ranges using newly developed multigas mitigation scenarios, based on a wide range of modeling approaches (van Vuuren et al. 2008). The article assesses the atmospheric CO2 concentrations, radiative forcing, and temperature increase for these new scenarios using two reduced complexity climate models. This allows us to say something on the degree of temperature increase that might be avoided by introducing climate policy, but also on committed climate change. Earlier, assessments have been made of warming that would occur if concentrations were kept at the year 2000 levels. However, based on inertia in socio-economic systems, estimates based on credible and feasible mitigation scenarios are arguably more relevant for policy making. The study's methods: For this article, a set of baseline and associated mitigation scenarios was compiled from a group of Integrated Assessment Models (IAM) with results for the most relevant greenhouse gases and air pollutants (although these model also calculate greenhouse gas concentration and climate change, here, we use only their emission outputs). These models are AIM, EPPA, IMAGE, IPAC, MESSAGE and MiniCAM (22–30). The IAMs include all major greenhouse gases (CO2, CH4, N2O, and halocarbons) and consistent representations of air pollutants, i.e., aerosols (SO2) and tropospheric ozone precursors (CO, NOx, VOCs). The set of baseline and mitigation scenarios covers almost the full range of scenarios published since 2001 (Fisher et al. 2007). The radiative forcing and climate implications of the emissions projections were simulated by using two climate models: a relatively simple climate model (MAGICC) and an earth system model of intermediate complexity (Bern2.5CC). Both models were run accounting for uncertainty in the climate sensitivity and carbon cycle dynamics. These models were also used by IPCC in the 4th Assessment Report. The study's results: The study shows that without climate policy forcing in 2100 for central parameters ranges from 6 to 10 W/m2 compared with preindustrial over the range of emissions scenarios. Forcing in mitigation cases is stabilized or declining by 2100, with values reduced to 2.4–5.1 W/m2. Projected temperature changes by year 2100 (relative to 1990) are 2.6–4.6°C for the baseline scenarios and central (best-estimate) model parameters. Uncertainties in the carbon cycle and climate sensitivity more than double the ranges associated with emissions to 2.1–6.1°C in MAGICC and results in

an even wider range of possible outcomes in the Bern2.5CC model of 1.4–7.7°C. For the 4.5 W/m2 target, climate model simulations result in a 2100 temperature increase of 0.8–4.4°C (full Bern2.5CC range). The temperature increase is 1.1–1.7°C for the central model parameter settings for the lowest emissions scenarios, with a full range of 0.5–2.8°C in the Bern2.5CC model. Conclusions: The study find that even the most stringent of climate policies will not be able to prevent global warming entirely. Therefore, in addition to efforts to reduce anthropogenic greenhouse gas emissions, societies should also consider strategies for adapting to higher global temperatures. The analysis reports an average minimum warming by the year 2100 of 1.4 degrees Celsius from baseline levels in 1990, for the most stringent emission reduction scenarios. While the minimum temperature rise is significantly less than that projected without emission mitigation policies, it is higher than previous reports that focused on climate inertia alone. At the same time, the study also shows that climate policies can effective decrease the range of climate projections – and thus adds to the IPCC projections that only include no-policy cases. The total set of mitigation scenarios result in temperature increase of 0.5–4.4°C over 1990 levels or 0.3–3.4°C less than the no-policy cases.

References

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