An Empirical Approach toward the Reduction Targets of CH4 and O3 as SLCP: For Asia as an example

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Although importance of co-control of SLCPs together with the emission reduction of CO_2, has been well recognized for both of mid- and long-term climate change mitigation, discussion on the implementation into the policymaking process often meet difficulty due to the complexity ascribed to interrelationship between SLCPs and their precursors, particularly for CH_4 and O_3. The chemistry-climate model analysis usually used for presenting future scenarios which can treat such interaction scientifically, tends to give a “black box” for the contribution of each species of SLCPs. In order to deliver a more straightforward message on the effectiveness of the reduction of each SLCP to policymakers, we propose “top-down” method for determining reduction targets of CH_4 and tropospheric O_3 based on the historical levels of their radiative forcing (RF)*.

The increase of RF due to the increase of atmospheric concentration of CO_2 in mid-term future would reach e.g. ~0.80Wm^{-2}in 2040 regardless of the stringent emission control scenarios due to the long atmospheric lifetime more than 100 years. In order to compensate this, if the atmospheric concentrations of CH_4, and O_3 can be decreased to the levels of 1980, 1970, 1960, and 1950 from the 2010 level, RF of CH_4 and O_3 can be reduce to from 0.48 to 0.41, 0.34, 0.27, and 0.22 Wm^{-2}, and from 0.40 to 0.29, 0.23, 0.19, and 0.15 Wm^{-2}, respectively, according to the IPCC 2013 database. Thus, for example, if the atmospheric concentrations of CH_4 and O_3 can be reduced to their levels of 1970, the sum of RF for CH_4 and O_3 will be reduced by 0.31 Wm^{-2}, which can compensate the increase of RF due to CO_2 by 40%.

Here, the global reduction ratios of CH_4, NO_x, and NMVOC necessary to attain the 1970 levels of CH_4 and O_3 have been applied to Asia, and the estimated results were compared by sector with the GAINS model-based cost-beneficial reduction amount proposed by Solution Report (2018) prepared under UN Environment Asia and the Pacific Office. The results show that the emission reduction of CH_4 to the 1970 level is feasible for rice paddies and waste treatment, but for attaining the reduction of livestock emission, new technology/practice would be required. As for NO_x, the possibility of attaining the necessary reduction is high for transport sector. Also, the possibility of attaining the necessary reduction of NMVOC is high for the transport and waste treatment sectors. In contrast, the emission reduction of CH_4 and NMVOC from coal/natural gas/oil production sector, and NO_x from industry/power plant sector is not enough in Solution Report. It can be concluded that in order to attain these targeted reduced emission levels, energy transformation from fossil fuel to renewable energy sources would be highly advantageous.

* H. Akimoto, T. Nagashima, H. Tanimot1, Z. Klimont and M. Amann, An empirical approach toward the SLCP reduction targets in Asia for the mid-term climate change mitigation, Prog. Earth Planet, Sci., 7:73, https://doi.org/10.1186/s40645-020-00385-5, 2020.

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