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Atmospheric Chemistry and Physics Discussions

# *Interactive comment on* "Projecting future HFC-23 emissions" *by* B. R. Miller and L. J. M. Kuijpers

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We thank Reviewer #2 for kind comments regarding the novelty and clarity of our presentation. The helpful suggestions that the reviewer makes regarding improvements to our Introduction and in strengthening of the evidence in support of our conclusions are most welcome, and we have made changes (described below) to incorporate them.

Reviewer #2 suggests that we discuss the contribution of HFC-23 to radiative forcing, relative to the much larger contribution of CO2, in the introduction to put these emissions in perspective. Therefore, we have added text to the Introduction that places HFC-23 in context with other GHGs.

Reviewer #2 asks if we can provide figures regarding the relatively low cost of high temperature incineration in support of our contention that such mitigation measures are economically attractive to policymakers seeking climate protection. Accordingly,



we add the following changes to our introductory text (shown here in []):

"... Unlike many GHG sources that emit to the atmosphere over large spatial and temporal scales (e.g., methane from landfills and nitrous oxide from fertilization of agricultural fields), HFC-23 is produced within the confines of a relatively small number of manufacturing facilities, where it may be destroyed efficiently through high temperature incineration. [The cost of incineration varies regionally, and also depends on whether it is an installation in a new or existing facility. Estimates given by the EPA ("Global Mitigation of Non-CO2 Greenhouse Gases", available at www.epa.gov/climatechange/economics/international.html#Global_Mitigation) indicate that installation costs range $3-4 million, with annual operating costs of order $200-300 thousand per year. Installations capable for all or most of a plant's HFC-23 production have been voluntarily installed already throughout Europe and the US, suggesting that industry is embracing this mitigation strategy.] Thus, the anticipated inseparability of industrial growth and HCFC-22 manufacture suggests that mitigation of HFC-23 co-production will be an important focus for policymakers seeking cost effective means of reducing GHG emissions for some time to come. ..."

Reviewer #2 poses several questions regarding our use of GDP projections in projecting HCFC-22 production for feedstock use. We comply with the reviewer's request to see the regression fit that we used in determining the relationships between GDP and HCFC-22 production by making addition of the Figure S4 to the supplemental section. Reviewer #2 asks, "Is GDP a good proxy for HCFC-22 production?" It is the best proxy that we are aware of, and consequently we follow the practice of other authors ( e.g., Ottinger Schaefer et al. [2006] and Velders et al., [2009]) who use GDP when seeking to project similar industrial production.

Regarding the sensitivity of our projections to the GDP estimates, the EIA offered two additional GDP projections based on their anticipated potential for greater and less economic growth over the period of interest. We summarized the time-integrated differences relative to our choice of their Reference Case:

“The EIA High Economic Growth and Low Economic Growth scenarios for the developed world offer 7.55% greater growth and 7.07% lesser growth, respectively, relative to the GDP Reference Case scenario integrated over the period 2005-2035.”

“The EIA High Economic Growth and Low Economic Growth scenarios for China offer 7.64% greater growth and 7.00% lesser growth, respectively, relative to the GDP Reference Case scenario integrated over the period 2005–2035.”

The corresponding calculated increase or decrease in feedstock use, based on either of these alternate scenarios, follows directly proportionate to these differences.

Referring to Figure 3, Reviewer #2 suggests that a simple regression of historical atmospheric abundance data might yield a projection not too different from our 3-box atmospheric model results using emissions derived from our bottom-up model. This result is intuitively true, for what we observe in the aforementioned historical atmospheric abundance is in fact an accumulation of emissions of a long-lived gas (one that has and is experiencing growth) that includes the influence of atmospheric loss mechanisms and transport. However, such a regression would not yield the main information that we seek, namely, estimates of the contributions of each of the driving forces that govern those emissions. Such a deconvolution is the ultimate goal of this work. We seek to describe an emission function in terms of Developed Countries’ emissions, Developing Countries’ emissions separately from feedstock and dispersive use production, and in terms of Developing Countries’ HFC-23 incineration. With Figure 3 we show the end result, i.e., radiative forcing, that is ultimately of interest in regard to climate change. But it is the knowledge of the driving forces of these emissions that create the atmospheric abundance and radiative forcing that arms policymakers with a tool to make effective change.

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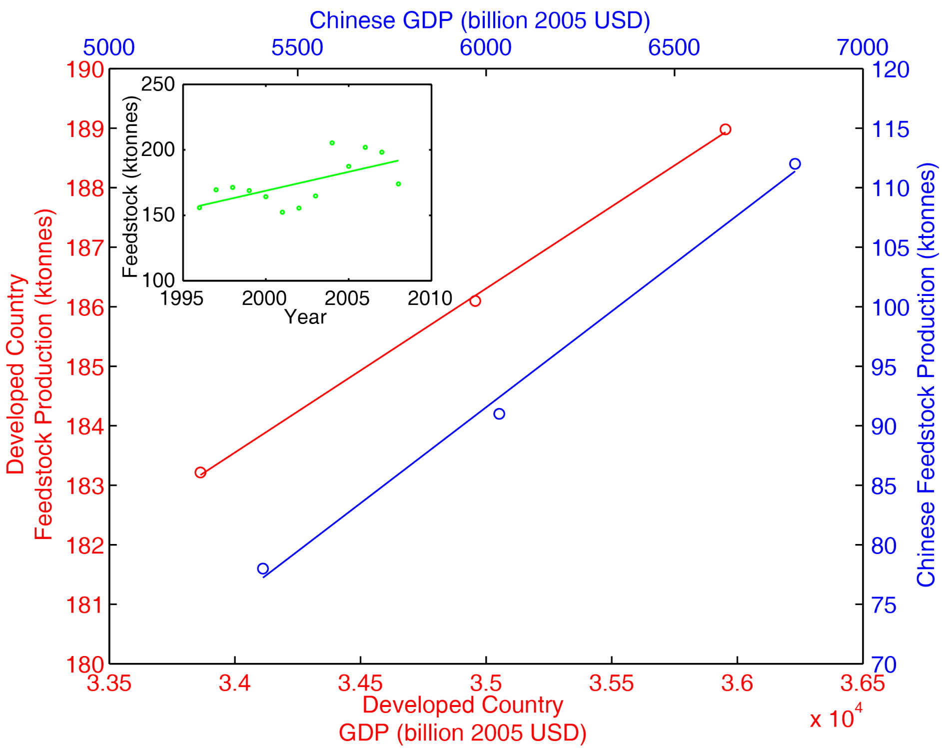


**Fig. 1.** Figure S4. Correlation of Gross Domestic Product (EIA, 2010) for Developed Countries (left and lower axes in red) and China (right and upper axes in blue) with their respective HCFC-22 production fo