

Review of draft paper

“Increasing emissions of HCFC-123 and HCFC-124 may be due to leakage during HFC-125 production”

by Luke M. Western et al.

ACP manuscript egusphere-2025-3000

By:

Kuijpers, Dr. Lambert J.M.

Copernicus Office user ID 192458

(ORCID 0000-0002-0979-9694)

1.

The title “Increasing emissions of HCFC-123 and HCFC-124 may be due to leakage during HFC-125 production” is actually implying too much uncertainty, where it concerns the increase (amount of) emissions, and what the leakage from HFC-125 production could be. I would expect that certain readers would be of the opinion that the paper should not be written now, but once there is more certainty, at a later stage.

2.

One could also consider to change the title slightly, to “Impact of the leakage during HFC-125 production on the increase of HCFC-123 and HCFC-124 emissions”. It does not mean that one has to give exact numbers for the leakage in Gg/yr (see the text of the article).

3.

The sections abstract, introduction, methods, results, discussion and conclusions have been very well written. For the methods and results sections, they consider all sources of emissions available, give background insights and the limits of how various issues should be considered.

There are a few issues that I noted:

- a. 58-62. “Both HCFC-123 and HCFC-124 are known to at least partly degrade in the atmosphere to trifluoroacetic acid (TFA) following their reaction with hydroxy”.... Nice info, but **of less importance to the paper and its considerations**
- b. 113. “NOAA’s Global Monitoring Laboratory in Boulder, CO USA”, **mention Colorado** as in line 122
- c. 225-231. Prior knowledge of the production, $P_{i,t}$, is used to inform the estimation of the parameters of interest, utilising data reported to the United Nations Environment Programme. The production data reported to UNEP are the total production for all end-uses and, separately, as production for feedstock uses. To avoid double counting, we calculated the dispersive production by subtracting the feedstock production from the total production. **Could one please specify which data for which chemicals (feedstock) and for which years have been studied?**
- d. I would be in favour of **phase-down and phase-out, with dashes**
- e. 320. This is a very important sentence, and would deserve all info in all the sentences that follow (*Its emissions have not declined, and possibly increased, over 2018-2023, in line with an increase in HCFC-124 emissions over 2019-2023*). Lines 332-335 could be

elaborated further on what can actually be stated about the relationship between HCFC-123 (-124) and HFC-125 production.

- f. 370 and further down. It starts “Using events where air conditioning units containing HFC-125 had leaked”....”. The air conditioning application deserves more attention (starting with a better introduction, explaining various issues ...). The largest use of HFC-125 in air conditioning is in the form of R-410A, a blend of HFC-125 and HFC-32 (roughly 50% each), and not HFC-125 as a pure HFC. Given the current attention on reducing the use of substances with high GWP, such as R-410A, and the possible replacement by pure HFC-32, a process that is already ongoing in many developed and some developing countries for many years, this may have much more impact on HFC-125 production than the reduction of production (and consumption) compliant with the Kigali schedule. This is also an aspect that needs mentioning in the conclusions.
- g. 385-387. “Both HCFC-123 and HCFC-124 can break down in the atmosphere to form TFA, which can accumulate in aquatic bodies. The harmfulness of TFA is still uncertain. What is certain is that increasing emissions of HCFC-123 and HCFC-124 will lead to more TFA formation, and therefore accumulation in the environment”. These sentences can be deleted here (in 385-387). They are not needed; the issue has been mentioned before.
- h. 389. Given what has been mentioned in paragraph (f), this sentence “Yet production of HFC-125 is projected to increase in the coming years.” needs more thorough analysis, together with references.
- i. 395-406. The conclusions mention a number of issues correctly. The emissions of HCFC-123 are increasing, but it is difficult to say precisely what the source is. The emissions of HCFC-124 are increasing, but one cannot conclude from measurements where they are coming from. So, it leaves little room for hard conclusions, an issue that, together with the possibilities given in the title, may lead to experts giving as their opinion that this paper is, or will be, published at a too early stage.
- j. 405: “An increase in monitoring stations around the world would help to better locate and understand the emission sources of HCFC-124”. As a last conclusion, this is rather weak. The building of measurement stations will cost many years (investment possibilities), so good results will not be available until at some stage in the future, when many other atmospheric conditions may have changed. An IMPORTANT issue to mention here is how the trend of the future HFC-125 production will be, largely concerning future air conditioning trends, i.e., the production numbers for the market.
- k. In summary, the beginning and the end of the paper (title, intro, and conclusions) should be stronger. I.e., the way the title is formulated, and the main issues in the conclusions, specifics regarding the emissions of the two HCFCs, possible impacts on ozone and climate (warming), and future trends on HFC-125 (R-410A) production and consumption trends (maybe also its climate (warming) impact) compared to the two HCFCs the emissions of which are studied.

P.S. The draft needs a spellcheck, some commas can be added or deleted, some verbs should be conjugated in the singular, rather than the plural form, but that is a minor issue

One example (conclusions), where I have done a ~~strikeout~~ underline (conclusions)

Emissions of the hydrochlorofluorocarbons HCFC-123 and HCFC-124 have increased since 2019 despite a phasedown of their production and consumption for dispersive uses under the Montreal Protocol. Any increase in the production of HCFCs should only be for their use to produce other chemicals. Both HCFC-123 and HCFC-124 are intermediates in the production of the ~~non-ozone depleting~~non-ozone-depleting greenhouse gas HFC-125, which has been used to ~~replaced~~replace HCFCs for refrigeration and air conditioning and ~~for~~ fire suppression applications. Our analysis suggests that the increase in global emissions of HCFC-124 can be explained ~~from~~by leakage during the production of HFC-125. We estimate this leakage rate as ~1.0% of HFC-125 production. Other sources of emissions cannot be ruled out. However, emissions of HCFC-123, another intermediate in HFC-125 production, also potentially increased with similar timing to HCFC-124. It is unclear from where the increase in emissions of HCFC-124 since 2019 ~~are~~is originating, as emissions in ~~western~~Western Europe, the USA and East Asia have not increased since 2015, unlike the global emissions. Prior to 2019, emissions from ~~western~~Western Europe, the USA and East Asia ~~are~~were insufficient to explain the global changes over this period. An increase in monitoring stations around the world would help to better locate and understand the emission sources of HCFC-124