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Continued increase of CFC-113a (CCl_3CF_3) mixing ratios in the global atmosphere: emissions, occurrence and potential sources

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Abstract. Atmospheric measurements of the ozone-depleting substance CFC-113a (CCl_3CF_3) are reported from ground-based stations in Australia, Taiwan, Malaysia and the United Kingdom, together with aircraft-based data for the upper troposphere and lower stratosphere. Building on previous work, we find that, since the gas first appeared in the atmosphere in the 1960s, global CFC-113a mixing ratios have been increasing monotonically to the present day. Mixing ratios of CFC-113a have increased by 40 % from 0.50 to 0.70 ppt in the Southern Hemisphere between the end of the previously published record in December 2012 and February 2017. We derive updated global emissions of 1.7 Gg yr^{-1} on average between 2012 and 2016 using a two-dimensional model. We compare the long-term trends and emissions of CFC-113a to those of its structural isomer, CFC-113 ($CClF_2CCl_2F$), which still has much higher mixing ratios than CFC-113a, despite its mixing ratios and emissions decreasing since the 1990s. The continued presence of northern hemispheric emissions of CFC-113a is confirmed by our measurements of a persistent interhemispheric gradient in its mixing ratios, with higher mixing ratios in the Northern Hemisphere. The sources of CFC-113a are still unclear, but we present evidence that indicates large emissions in East Asia, most likely due to its use as a chemical involved in the production of hydrofluorocarbons. Our aircraft data confirm the interhemispheric gradient as well as showing mixing ratios consistent with ground-based observations and the relatively long atmospheric lifetime of CFC-113a. CFC-113a is the only known CFC for which abundances are still increasing substantially in the atmosphere.

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