Global and Regional Emissions Estimates for HCFC-22

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HCFC-22 ($CHClF_2$) is a major greenhouse gas as well as an ozone depleting substance. A low frequency record of HCFC-22 in air since the late 1970s is available through measurements of the Northern Hemisphere Air Samples and the Southern Hemisphere Cape Grim Air Archives. More recently, measurements have been collected using the high-precision high-frequency instruments at the Advanced Global Atmospheric Gases Experiment (AGAGE) stations since the 1990s. NOAA Carbon Cycle Greenhouse Gases Group has also taken measurements from towers since 2006 in addition to the Halocarbon Flask Network measurements since the early 1990s. Using the United Nations Environment Programme data on consumption, as well as an existing bottom-up emissions estimate, we first create gridded a priori HCFC-22 emissions over the 15 years since 1995. We then use the three-dimensional chemical transport model (MOZART v4) and a Bayesian inverse method to estimate global, as well as regional, annual emissions. Our inversion indicates that the global HCFC-22 emissions significantly increased from 1999 to 2001and 2003 to 2006. We further find surge in HCFC-22 emissions in 2009 from Africa and the Middle East. On the other hand, emissions from the Article 5 Asia - the largest emitting region including China and India - show a large decrease in 2008 after the continuous increase from 2005 to 2007, most likely as a result of the Montreal Protocol.

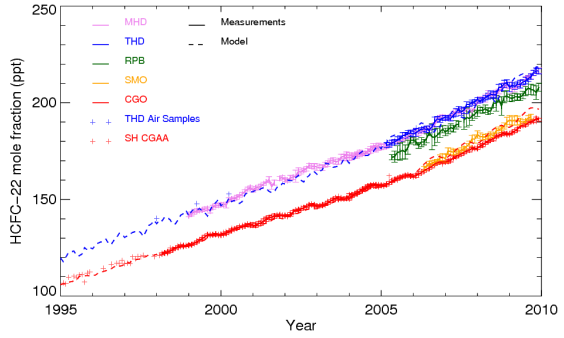

Figure 1. AGAGE archived air samples and model simulations at Cape Grim, Tasmania and Trinidad Head, California, and *in situ* measurements at Cape Grim, Tasmania; Cape Matatula, Samoa; RaggedPoint, Barbados; Trinidad Head, California; and Mace Head, Ireland.

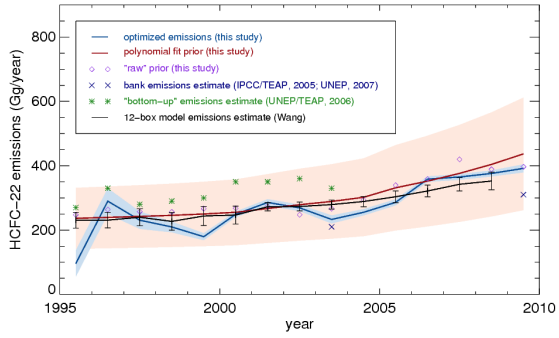

Figure 2. Global total HCFC-22 emissions from this study and published studies. Prior emissions estimates are shown in diamonds. Polynomial fit of these "raw" values that we used in our global inversion are shown in red line with shaded 40% uncertainty range. Optimized emissions from this study are shown in blue with our calculated posterior uncertainty.