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Stratospheric HCl increasing again, caused by dynamic variability, driven by increased tropospheric wave activity

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Following the observation of the stratospheric ozone depletion, the CFCs, found to be responsible for the ozone destruction, have been regulated and abandoned by the Montreal protocol. As a consequence, the main stratospheric chlorine reservoir substance, HCl has been found to decrease in its concentration since about 1998. In contrast with the ongoing monotonic decrease of the CFCs in the troposphere, we now observed a recent and significant increase of HCl in the lower stratosphere of the Northern Hemisphere, starting in 2007. Using model simulations, we attribute this trend anomaly to changes in the stratospheric Northern Hemisphere atmospheric circulation, occurring over several consecutive years. As a result of these circulation changes, age of air increases in the Northern Hemisphere above 450 K, allowing a larger relative conversion of the CFCs to HCl. In contrast, age of air decreases in the Southern Hemisphere in the same altitude regime. Both, global satellite observations and modelling studies confirm local effects of residual circulation and horizontal mixing during the last decade as being responsible for the age of air increase in the northern hemisphere.

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