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Observational evidence of solar activity interaction with chlorine chemistry curbing Antarctic ozone loss

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We present the impact of the so-called energetic particle precipitation (EPP), part of natural solar forcing on the atmosphere, on polar stratospheric NO_x, ozone, and chlorine chemistry in the Antarctic springtime, using multi-satellite observations covering the overall period of 2005–2017. We find consistent ozone increases when high solar activity occurs during years with easterly phase of the quasi biennial oscillation. These ozone enhancements are also present in total O_3 column observations. We find consistent decreases in springtime active chlorine following winters of elevated solar activity. Further analysis shows that this is accompanied by increase of chemically inactive chlorine reservoir species, explaining the observed ozone increase. This provides the first observational evidence supporting the previously proposed mechanism relating to EPP modulating chlorine driven ozone loss. Our findings suggest that solar activity via EPP has played an important role in modulating Antarctic ozone depletion in the last 15 years. As chlorine loading in the polar stratosphere continues to decrease in the future, this buffering mechanism will become less effective and catalytic ozone destruction by EPP produced NO_x will likely become a major contributor to Antarctic ozone loss.