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The stratospheric ozone response to the 11-year solar cycle as observed by ground-based NDSC instruments over 1 - 3 decades

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Because it absorbs ultraviolet radiation from the sun, and modulates outgoing infrared radiation from the Earth, atmospheric ozone constitutes a key element of the Earth's climate system. Although measurements of its integrated content and of its vertical distribution have been performed using ground- and satellite-based instruments since several decades, a number of uncertainties still remain as to the response of middle atmospheric ozone to changes in solar irradiance. This paper presents findings recently achieved using long-term measurements of the ozone profile contributed to the Network for the Detection of Stratospheric Change (NDSC). Information as to the 11-year solar signal was extracted using simple time-domain signal analysis from ground-based lidar, microwave, and balloon-borne ozonesonde measurements performed at NyAlesund, Uccle, Hohenpeissenberg, Payerne, Mauna Loa, Lauder, Bern, Observatoire the Haute Provence, and Table Mountain. The results indicate a positive response of middle stratospheric ozone to solar irradiance increases, in contrast to previously reported multiple regression analysis results but in good agreement with numerical model simulations. In the lower stratosphere and the troposphere, a negative solar irradiance-ozone relationship is suggested by 3 of the 4 considered datasets covering this altitude range.