Drivers of Variations in the Vertical Profile of Ozone in the Greenland Sector of the Arctic

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Various chemical and dynamical processes affect Arctic ozone. The effective contributions of these processes to changes in ozone depend on location and altitude. We aim to understand the effect of various parameters on the ozone at different levels of the atmosphere over Arctic stations near Greenland: Alert and Eureka, Nunavut; Ny Alesund, Svalbard; and Summit Station, Greenland. We also investigate the similarities and differences between the different Arctic sites. We first construct vertical profiles of ozone using a combination of *in situ* measurements, balloon-borne ozonesondes from surface to low/middle stratosphere, and satellite retrievals from the Microwave Limb Sounder (MLS) for upper ozone. We focus on the time period between 2005 and 2017 because during this time ozonesondes were launched at all four sites, plus MLS data are available. We then apply stepwise multiple linear regression (MLR) on deseasonalized ozone time series to define the contribution of different parameters at different atmospheric layers: solar flux (SF), the Quasi-Biennial Oscillation (QBO), the El Niño-Southern Oscillation index (ENSO), the Arctic Oscillation (AO), eddy heat flux (EHF), the volume of polar stratospheric clouds (VPSC), equivalent latitude (EL), and the tropopause pressure (TP). The MLR is applied separately to total column ozone (TCO) as well as partial ozone column (PCO) in the troposphere and the lower, middle, and upper stratosphere. We define the most important dynamical drivers of Arctic ozone at each level. These drivers are defined based on mutual selected proxies of stepwise multiple regression analysis using various dynamical parameters on deseasonalized data over these four sites. The final regression model is able to explain more than 80% of the TCO and more than 70% of the PCO in almost all of the layers. The regression model provides the greatest explanatory value in the middle stratosphere.

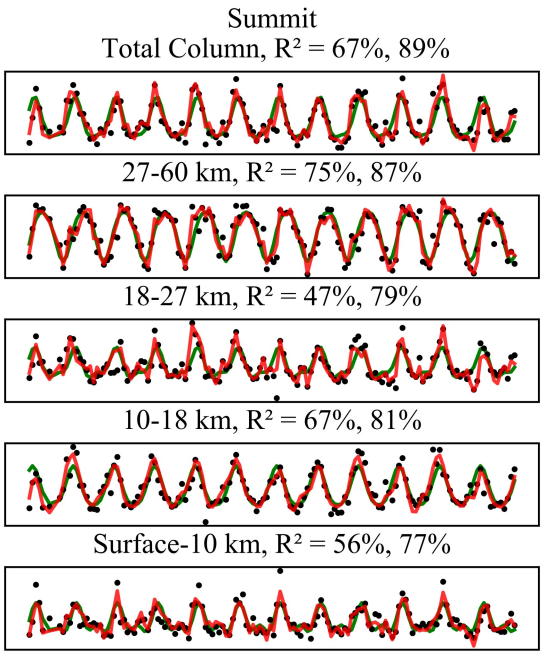

Figure 1. The results of the final model of ozone variations (red curve) for time series of the total column ozone and the partial column ozone (black dots) in four atmospheric layers from Summit. The fitted seasonal cycle is shown as the green curve. The coefficient of determintation (R^2) for each seasonal fit and for the final model are shown in the title.