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Diverse policy implications for future ozone and surface UV in a changing climate

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Due to the success of the Montreal Protocol in limiting emissions of ozone-depleting substances, concentrations of atmospheric carbon dioxide (CO_2), nitrous oxide (N2O), and methane will control the evolution of total column and stratospheric ozone by the latter half of the 21st century. As the world proceeds down the path of reducing climate forcing set forth by the 2015 United Nations Climate Change Conference (COP21), a broad range of ozone changes are possible depending on future policies enacted. Here, we use the Whole Atmosphere Community Climate Model (WACCM) to simulate changes in stratospheric and total column ozone when N2O and methane are varied in future climates with different CO_2 concentrations. While decreases in tropical stratospheric ozone persist regardless of the future emission scenario, extratropical ozone could either remain weakly depleted or even increase well above historical levels, with diverse implications for ultraviolet (UV) radiation. Reducing CO_2 and methane emissions would serve to reduce climate change and to return stratospheric ozone and UV to near historical levels everywhere by the end of the century. Reducing N2O in this scenario would also be beneficial to prevent further ozone depletion. However, if CO_2 and methane continue to increase, the range of policy options to protect the ozone layer would necessarily broaden. One possibility may be allowing continued N2O emissions in order to maintain historical ozone and UV levels in the extratropics.