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Unlocking the puzzle of tropical ozone changes

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Tropical total column ozone has shown basically no sign of ozone depletion over the period 1980-1998, when stratospheric ozone depletion due to anthropogenic ozone depleting substances (ODSs) was clearly evident at mid- to high latitudes. In contrast, vertically resolved long-term measurements in the tropical stratosphere obtained from the SAGE instrument series indicated ozone depletion from the tropical lower to upper stratosphere. The apparent mismatch between the information obtained from the two measurement systems (which employ differing measurement principles) was a long-standing puzzle, and concerns about the reliability of the observational timeseries were raised. This study, based on a combined model-measurement approach using SPARC/IGAC Chemistry-Climate Model Initiative simulations and observations from both the SPARC Data Initiative and GOME, presents new evidence that the mismatch between total and vertically resolved observations can be explained by increases in tropospheric column ozone. We also quantify how much of the decline in lower to upper stratospheric ozone in the tropics was induced chemically, rather than dynamically from a strengthening Brewer-Dobson circulation. Finally, we discuss whether signs of tropical ozone recovery can be detected over the most recent time period 1998-2015.