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A Method for Estimating the Evolution of Brewer-Dobson Circulation Upwelling

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Both theory and climate model results suggest that the Brewer-Dobson circulation should strengthen with increasing greenhouse gas concentrations. Can this be confirmed by observations?

Directly measuring the circulation strength is not possible, so verification of this sensitivity has been limited to inferences from observations of long-lived chemicals. These methods, however, are complex and accumulation of the data required for them is difficult. Meanwhile, ozone observations are available from multiple sources spanning decades, but have only been applied to qualitative study of the stratospheric circulation, until now.

In this work, we present a new quantity - effective upwelling - which can be derived from ozone observations by a simple calculation. We then show that effective upwelling anomalies can be an effective proxy for residual circulation (i.e. TEM) upwelling. We present a comparison of TEM upwelling and effective upwelling calculated from CCMI model data to show the validity of the method, and follow this by presenting seasonal cycles, trends, and variability of effective upwelling as calculated by satellite observations.