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Simulated changes in the atmospheric "tape recorder" under global warming

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The annual cycle of entry values of water vapour in the tropical lower stratosphere can be followed for over a year from the tropopause up to 10 hPa (33 km), and for this reason has been termed an atmospheric "tape recorder." This observed phenomenon is studied using a recently modified version of the CCCma atmospheric general circulation model (AGCM3+) coupled to a mixed layer ocean. In present-day simulations, the upward propagation of the stratospheric entry values of H2O imply an annual mean vertical upwelling velocity of 0.4-0.5 mm/s between 70 and 20 hPa (19-28 km), 40-50% larger than in HALOE satellite measurements over the last decade. Thus the model's Brewer-Dobson circulation is considerably stronger than observed. A number of simulations of future climate were also performed, in order to gauge the response of the model tape recorder to atmospheric composition and circulation changes associated with increased greenhouse gas concentrations. These simulations show an increase in both the amplitude of the tape recorder signal and in the upwelling velocity of H2O anomalies, consistent with other work suggesting an intensified Brewer-Dobson circulation in a warmer world. Intriguingly, the model also features a corresponding increase in the seasonal H2O anomaly in the troposphere.